CHAPTER

34

NAVIGATION

MD-80
AIRCRAFT MAINTENANCE MANUAL

CHAPTER 34
NAVIGATION

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

34-EFFECTIVE PAGES

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

34-EFFECTIVE PAGES

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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34-EFFECTIVE PAGES

Subject/Page	Date	COC
34-22-00 Config 12 (cont)		
4	Feb 01/2015	
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34-22-00 Config 13		
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34-22-00 Config 13 (cont)		
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34-22-00 Config 15		
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34-22-00 Config 16		
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14	Feb 01/2015	

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Subject/Page	Date	COC
34-22-00 Config 16 (cont)		
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Subject/Page	Date	COC
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36	Feb 01/2015	

Subject/Page	Date	COC
34-22-00 Config 18 (cont)		
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34-22-00 Config 2		
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34-22-00 Config 5		
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34-22-00 Config 6		
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111	Feb 01/2016	

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Subject/Page	Date	COC
34-22-00 Config 6 (cont)		
112	Feb 01/2016	
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34-22-00 Config 9		
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34-22-00 Config 9 (cont)		
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34-22-00 Config 1		
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233	Feb 01/2016	
34-22-00 Config 1 (cont)		
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34-22-00 Config 2		
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217	Feb 01/2015	
218	Feb 01/2015	

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Subject/Page	Date	COC
34-22-00 Config 2 (cont)		
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34-22-00 Config 4 (cont)		
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34-22-00 Config 7		
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34-22-00 Config 8		
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203	Feb 01/2016	
34-22-00 Config 8 (cont)		
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34-22-03 Config 1		
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212	Feb 01/2016	

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Subject/Page	Date	COC
34-24-00	(cont)	
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34-25-00		
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34-28-00	(cont)	
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34-29-01		
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34-30-00		
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Subject/Page	Date	COC
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34-43-00		
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34-43-01		
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34-43-02		
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34-43-02		
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34-43-02		
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34-43-03		
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34-45-00 Config 3		
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34-45-00 Config 1		
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208	Feb 01/2016	
209	Feb 01/2016	
210	Feb 01/2016	C
34-45-00 Config 12		
R 201	Aug 01/2016	C
O 202	Aug 01/2016	C
O 203	Aug 01/2016	C
O 204	Aug 01/2016	C

Subject/Page	Date	COC
34-45-00 Config 12 (cont)		
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O 206	Aug 01/2016	C
34-45-00		
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34-45-01 Config 3		
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202	Feb 01/2015	C
34-45-02 Config 1		
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202	Feb 01/2015	
34-45-03 Config 2		
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203	Feb 01/2015	C
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34-45-04		
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202	Feb 01/2015	C
203	Feb 01/2015	C
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34-46-00 Config 1		
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5	Feb 01/2015	C

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34-EFFECTIVE PAGES

Subject/Page	Date	COC
34-47-00 (cont)		
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34-47-01		
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34-50-00 Config 2		
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Subject/Page	Date	COC
34-51-00 Config 2		
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34-51-00 Config 3		
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34-51-00 Config 6		
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34-51-00 Config 8		
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34-51-00 Config 9		
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34-51-00 Config 10		
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34-51-00 Config 11		
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3	Feb 01/2016	
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Subject/Page	Date	COC
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110	Feb 01/2016	
34-51-00 Config 4		
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105	Feb 01/2015	
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34-51-00 Config 9		
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103	Feb 01/2015	
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105	Feb 01/2015	
106	BLANK	
34-51-00 Config 10		
101	Feb 01/2016	
102	Feb 01/2016	
103	Feb 01/2015	
104	Feb 01/2016	

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34-EFFECTIVE PAGES

Subject/Page	Date	COC
34-58-02 Config 1 (cont)		
405	Feb 01/2015	
406	Feb 01/2015	
34-58-02 Config 4		
401	Feb 01/2015	C
402	Feb 01/2015	C
403	Feb 01/2015	C
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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

34-EFFECTIVE PAGES

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

34-EFFECTIVE PAGES

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Subject/Page	Date	COC

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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

34-EFFECTIVE PAGES

CHAPTER 34
NAVIGATION

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CHAPTER 34
NAVIGATION

NAVIGATION - GENERAL - DESCRIPTION AND OPERATION

1. General

A. The aircraft navigation system provides visual and aural information to the flight crew to safely maneuver and navigate the aircraft. This information is in operation during pre-takeoff, takeoff, enroute flight, approach, and landing. When the airplane is in an air traffic controlled area it also transmits information to ground control personnel to determine airplane identity, location, and altitude.

B. The airplane navigation systems operate independently or interfaces with other systems to provide this information (Figure 1). The pitot/static system provides raw data for the air data computers operation (Figure 3).

WJE 415-427, 429, 861-866, 868, 869, 871-874, 891-893

C. The navigation systems displays and systems controls are located in the flight compartment (Figure 1 and Figure 5). The line replaceable units (LRUs), transceivers, gyros, computers, and etc. which transmit information to the displays are primarily located in the electrical/electronics compartment and forward accessory compartment (Figure 2). The antennas are located on the upper and lower fuselage, vertical stabilizer, and nose radome area (Figure 4). Detail locations of the system components are provided in the Description and Operation or Maintenance Practices sections of the Maintenance Manual.

WJE 886, 887

D. The navigation systems displays and systems controls are located in the flight compartment. The line replaceable units (LRUs), transceivers, attitude heading reference units, computers, and etc. which transmit information to the displays are primarily located in the electrical/electronics compartment and forward accessory compartment. The antennas are located on the upper and lower fuselage, vertical stabilizer, and nose radome area. Detail locations of the system components are provided in the Description and Operation or Maintenance Practices sections of the Maintenance Manual.

WJE 415-427, 429, 861-866, 868, 869, 871-874, 886, 887, 891-893

E. The Navigation Maintenance Manual is divided into seven major section headings, each section containing the specific types of Navigation systems applicable. These major section headings are as follows:

Table 1

Heading	Section Designation
Navigation - General	NAVIGATION - GENERAL, SECTION 34-00
Flight Environmental Data	FLIGHT ENVIRONMENT DATA, SECTION 34-10
Attitude and Direction	ATTITUDE AND DIRECTION, SECTION 34-20
Landing and Taxiing Aids	LANDING AND TAXIING AIDS, SECTION 34-30
Independent Position Determining	INDEPENDENT POSITION DETERMINING, SECTION 34-40
Dependent Position Determining	DEPENDENT POSITION DETERMINING, SECTION 34-50
Performance Management	PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SECTION 34-63

F. Flight Environment Data

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

(1) That portion of equipment which senses environmental conditions and uses the data to influence navigation of the airplane. This section includes systems and components as follows: Air Data Computing System, Altitude System, Mach Airspeed and Overspeed Warning System, Pitot Static System, True Airspeed and Air Temperature System, Vertical Speed Indicator, Altitude Advisory, and TAT/Thrust Rating.

WJE 873, 874, 892, 893

(2) That portion of equipment which senses environmental conditions and uses the data to influence navigation of the airplane. This section includes systems and components as follows: Air Data Computing System, Altitude System, Mach Airspeed and Overspeed Warning System, Pitot Static System, Vertical Speed Indicator, Altitude Advisory, and TAT/Thrust Rating.

WJE 886, 887

(3) That portion of equipment which senses environmental conditions and uses the data to influence navigation of the aircraft. This section includes systems and components as follows: Air Data Computing System, Altitude and Altitude Advisory Systems, Mach Airspeed and Overspeed Warning System, Pitot Static System, Vertical Speed Indication, RAT/Thrust Rating System, and Stall Protection System.

WJE 415-427, 429, 861-866, 868, 869, 871-874, 886, 887, 891-893

G. Attitude and Direction

WJE 415-427, 429, 861-866, 868, 869, 871-874, 891-893

(1) That portion of equipment which uses magnetic and gyroscopic forces. This section includes systems and components as follows: Compass System, Navigation Displays, Attitude System, Flight Director Displays, and Instrument Monitor System.

WJE 886, 887

(2) That portion of equipment which uses magnetic and gyroscopic forces. This section includes systems and components as follows: Heading System, Navigation Displays, Attitude System, Flight Director Displays, and Instrument Monitor System.

WJE 415-427, 429, 861-866, 868, 869, 871-874, 886, 887, 891-893

H. Landing and Taxiing Aids

(1) That portion of equipment which provides guidance during approach, landing and taxiing. This section describes the Marker Beacon System, and ILS System.

I. Independent Position Determining

(1) That portion of equipment which provides data to determine position and is mainly independent of ground installations. This section includes systems and components as follows: Weather Radar System, Radio Altimeter System, and Ground Proximity Warning System.

J. Dependent Position Determining

WJE 415-427, 429, 861-866, 868, 869, 871-874, 891-893

(1) That portion of equipment which provides data to determine position and is mainly dependent on ground installations. This section includes systems and components as follows: VHF Navigation System, Distance Measuring Equipment System, Automatic Direction Finding System, and Air Traffic Control Transponder System.

WJE 886, 887

(2) That portion of equipment which provides data to determine position and is mainly dependent on ground installations. This section includes systems and components as follows: VHF Navigation System, Distance Measuring Equipment System, Automatic Direction Finding System, Air Traffic Control Transponder System and Omega Navigation System.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 886, 887, 891-893

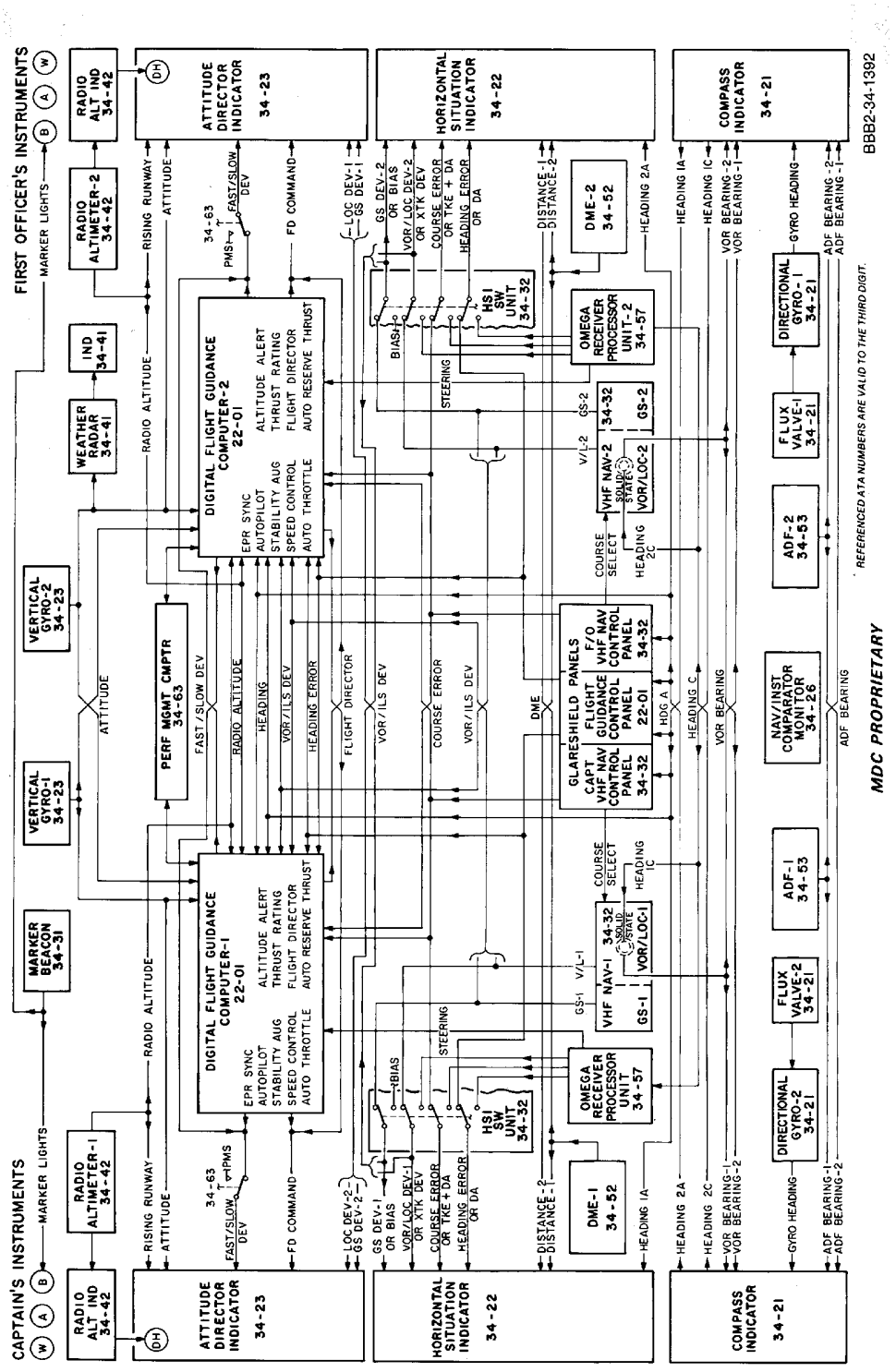
K. Performance Management

(1) That portion of equipment which provides coordinated control of pitch and thrust for flight performance optimization. This section includes systems and components as follows: Performance Management System (Performance Management Computer and Performance Management Control Display Unit).

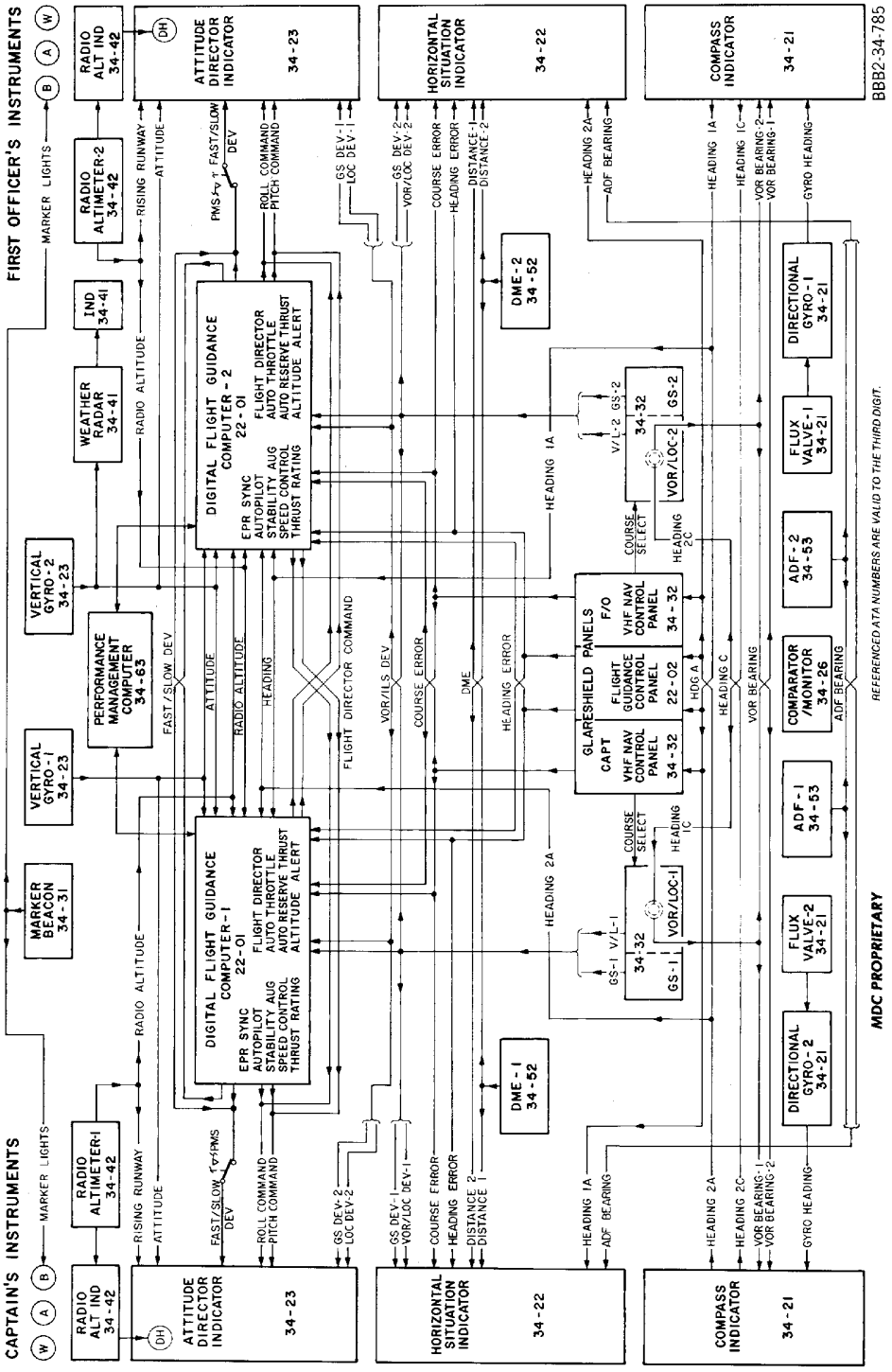
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

L. Flight Management (109-130, 159, 161-165, 201-999)

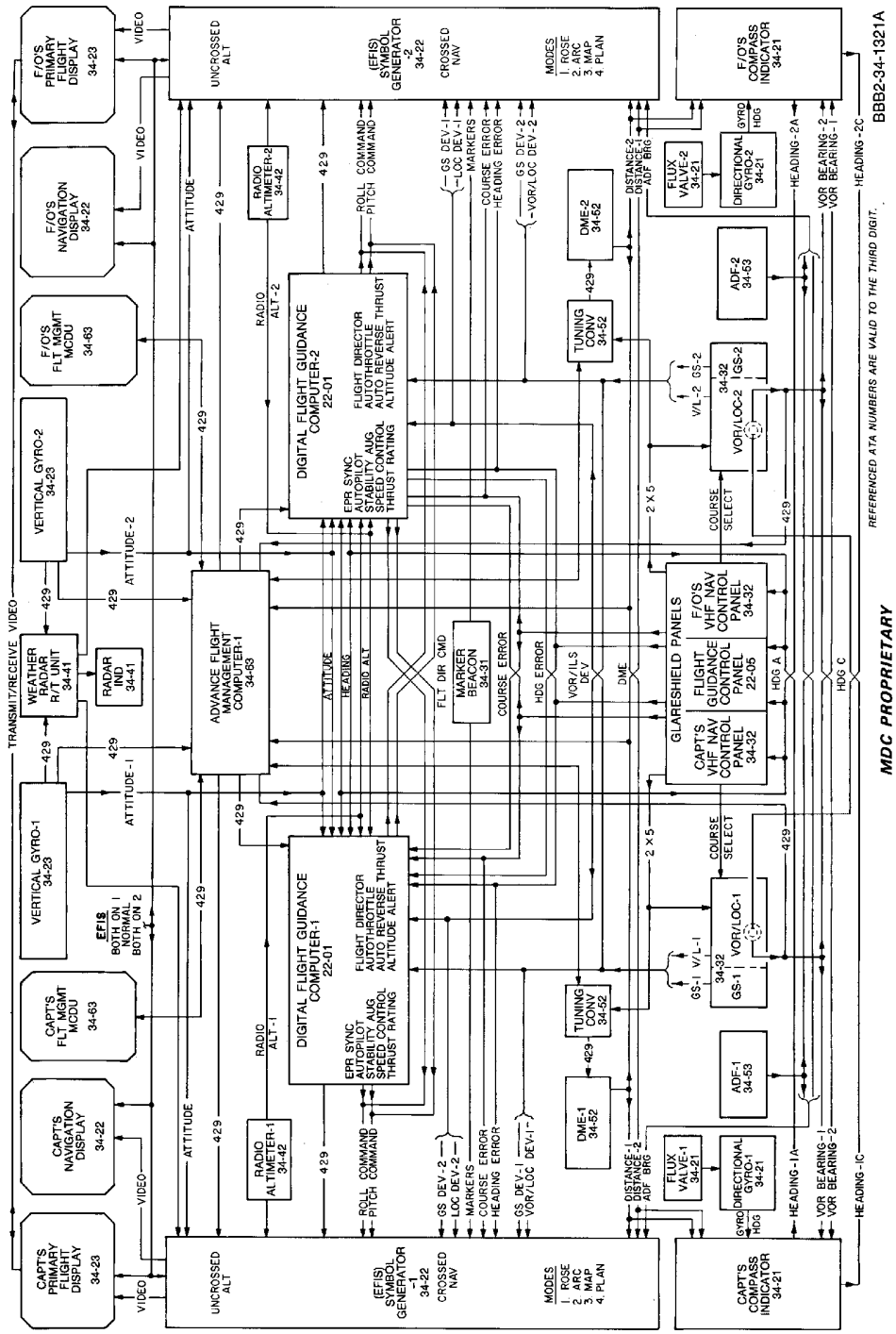
(1) The Flight Management System (FMS) provides the means for the Captain or First Officer to initiate aircraft control in automatic navigation, lateral and vertical guidance commands, Electronic Flight Instrument System (EFIS) MAP OR PLAN display information and the most advantageous airplane flight performance.



Navigation System - Block Diagram
Figure 1/34-00-00-990-862 (Sheet 1 of 4)

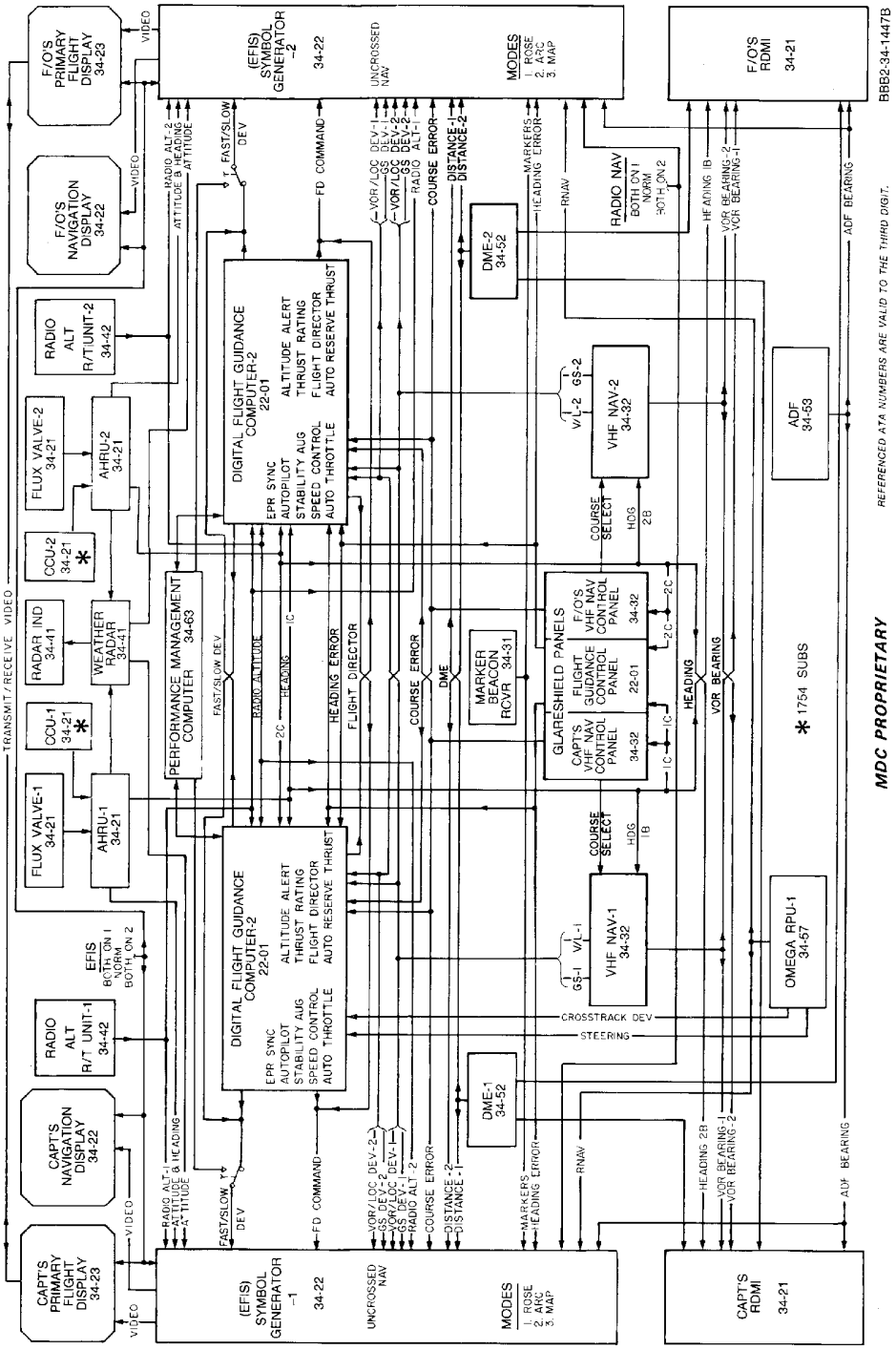


Navigation System - Block Diagram
Figure 1/34-00-00-990-862 (Sheet 2 of 4)



Navigation System - Block Diagram
Figure 1/34-00-00-990-862 (Sheet 3 of 4)

EFFECTIVITY
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



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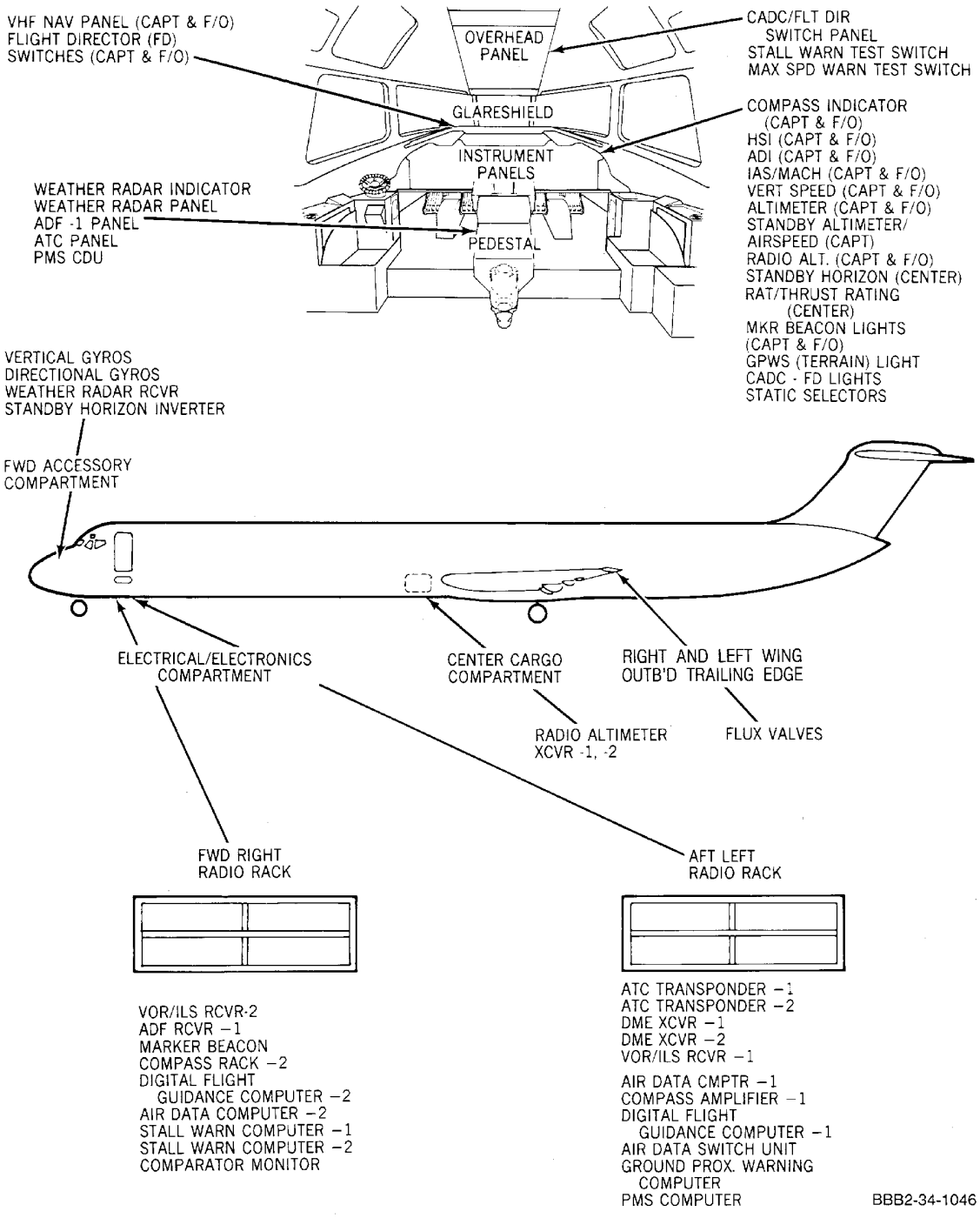
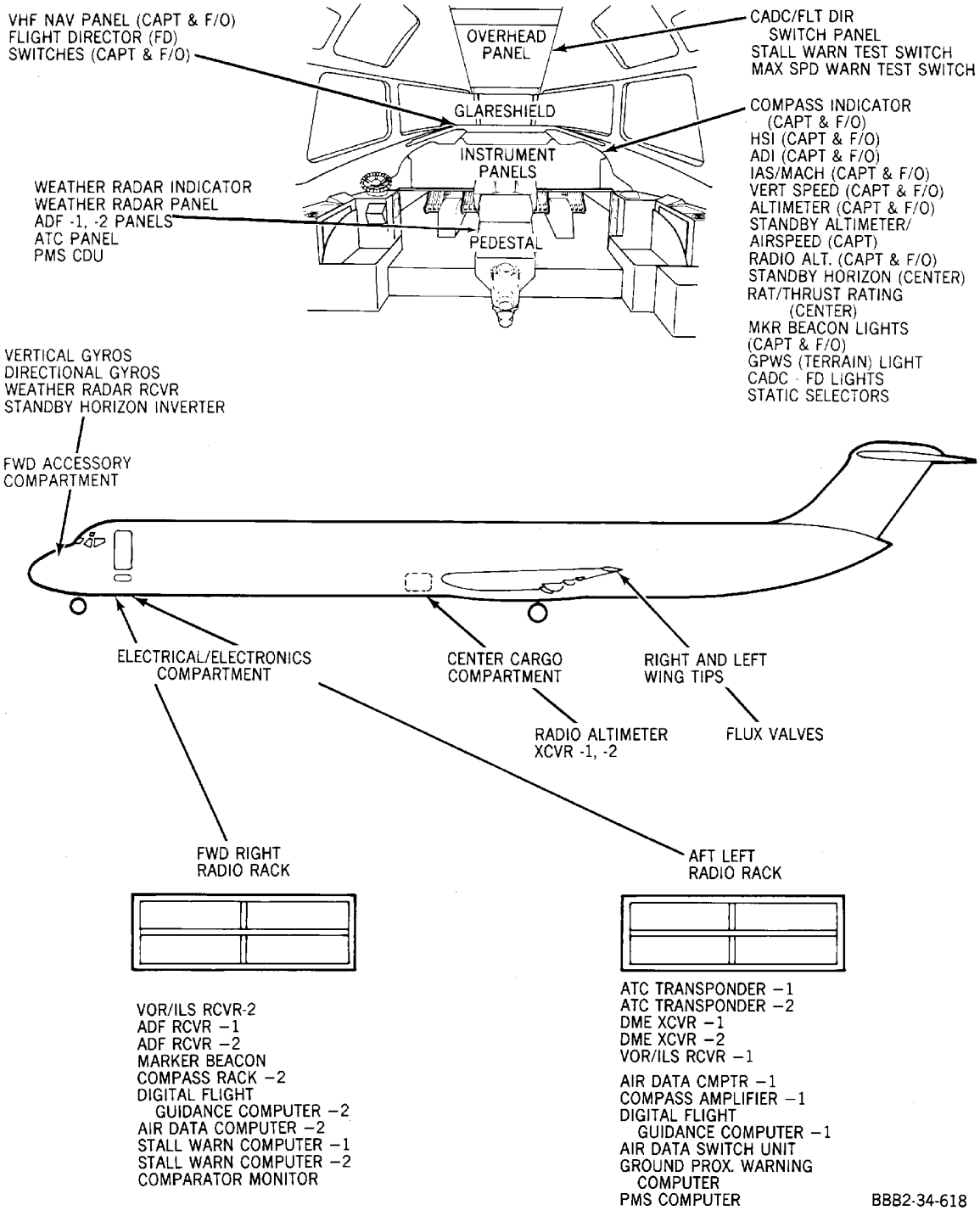
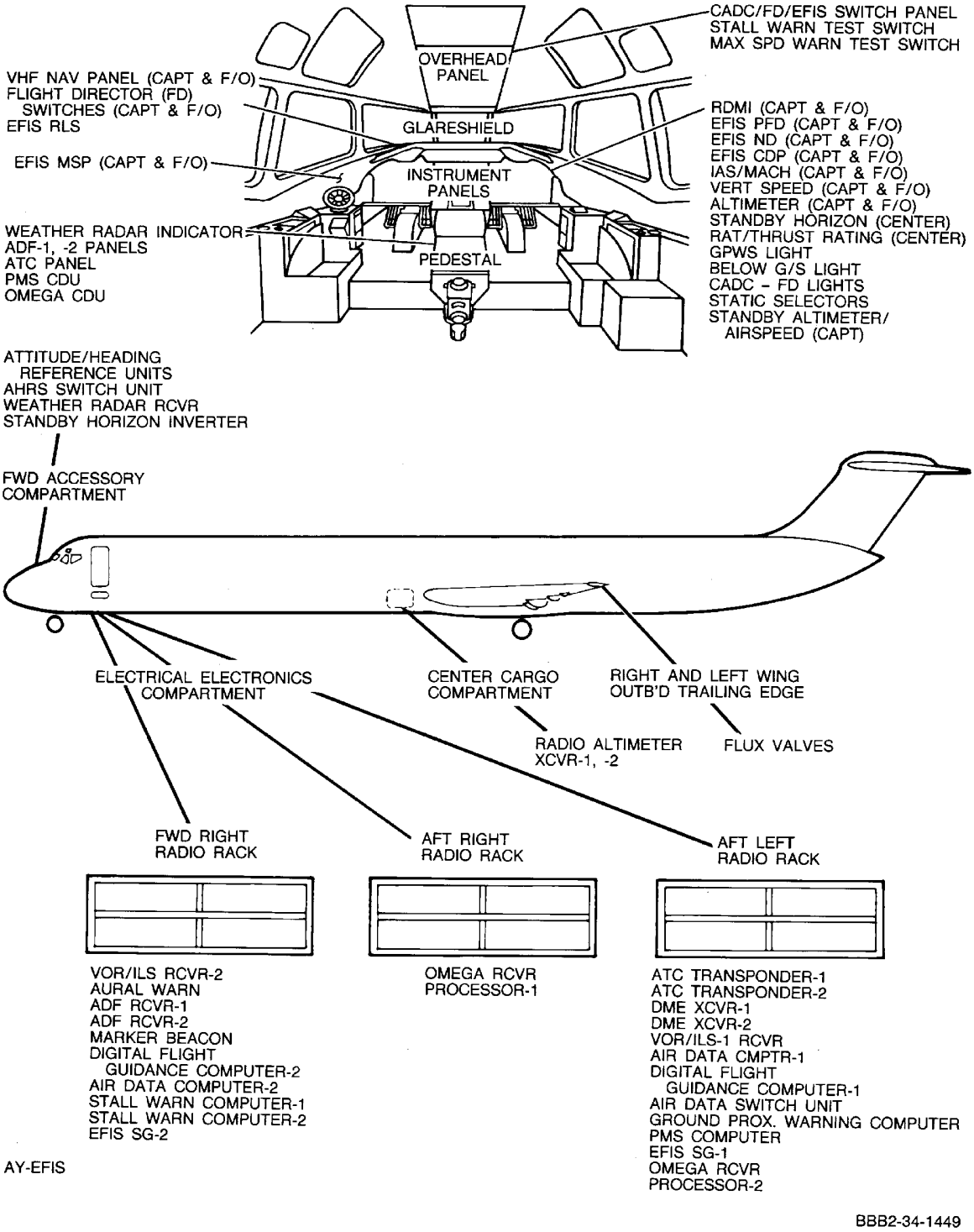


Navigation System Replaceable Components Location
Figure 2/34-00-00-990-863 (Sheet 1 of 3)

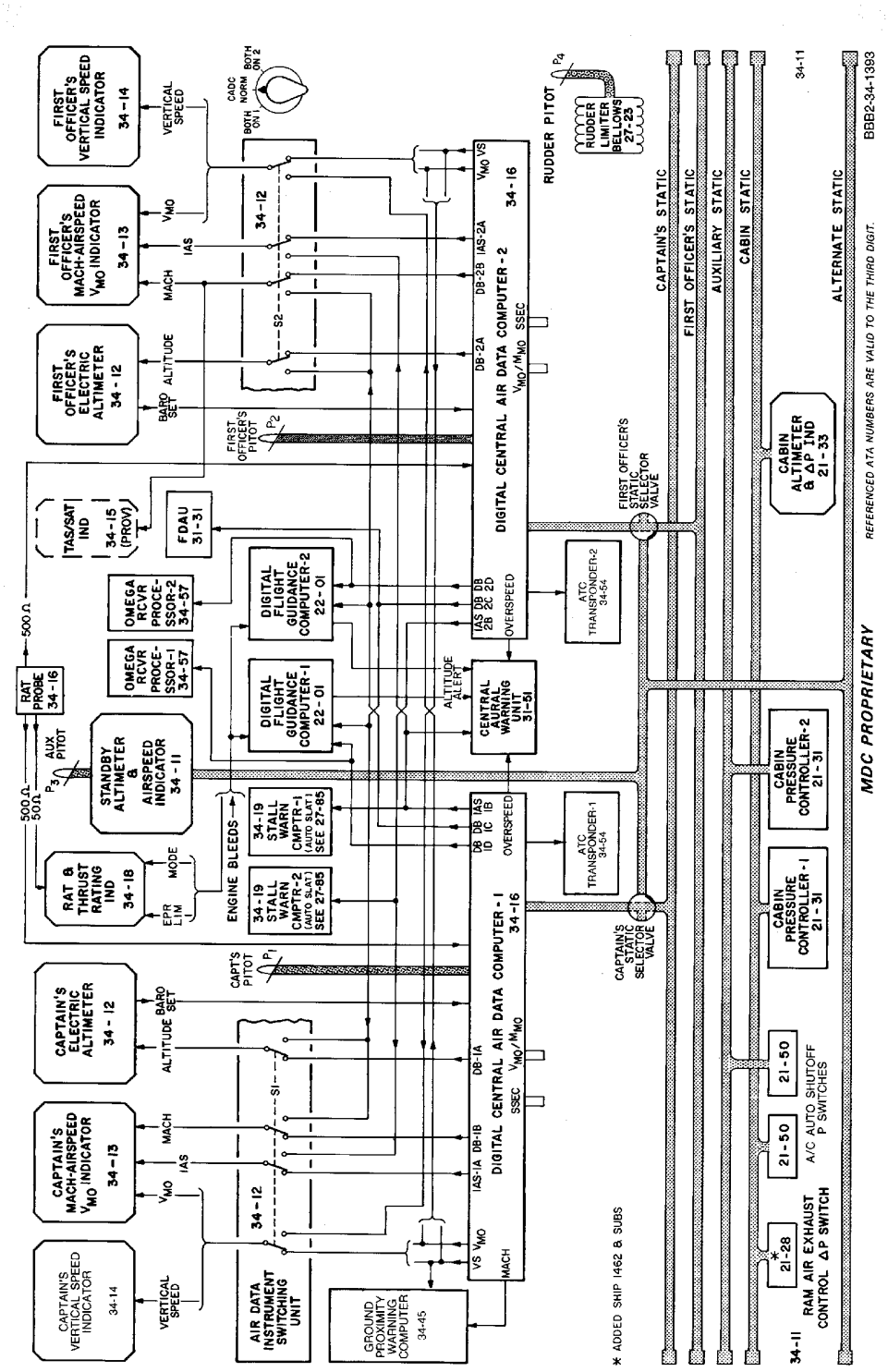


Navigation System Replaceable Components Location
Figure 2/34-00-00-990-863 (Sheet 2 of 3)

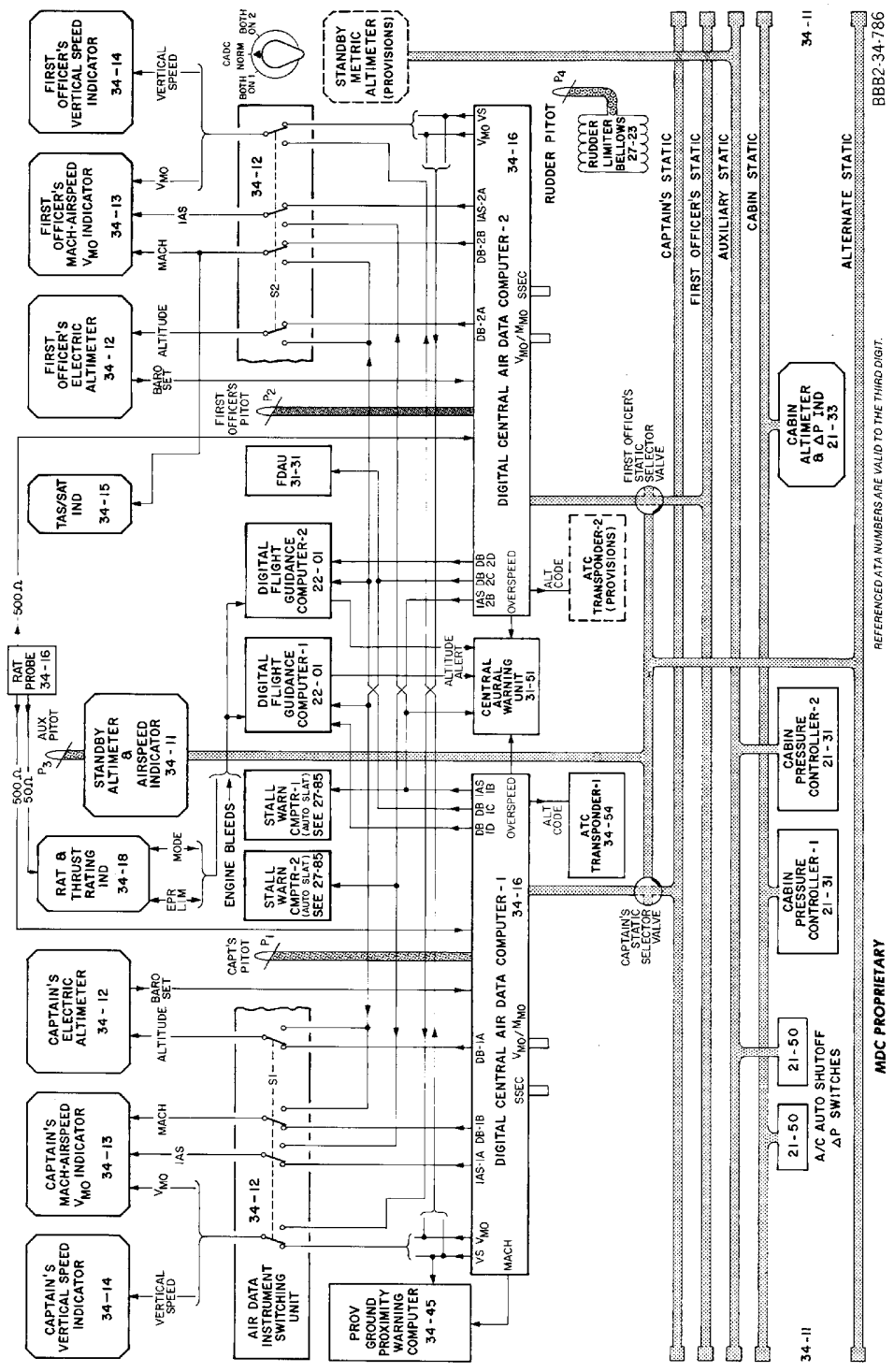
EFFECTIVITY
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891



Navigation System Replaceable Components Location
Figure 2/34-00-00-990-863 (Sheet 3 of 3)

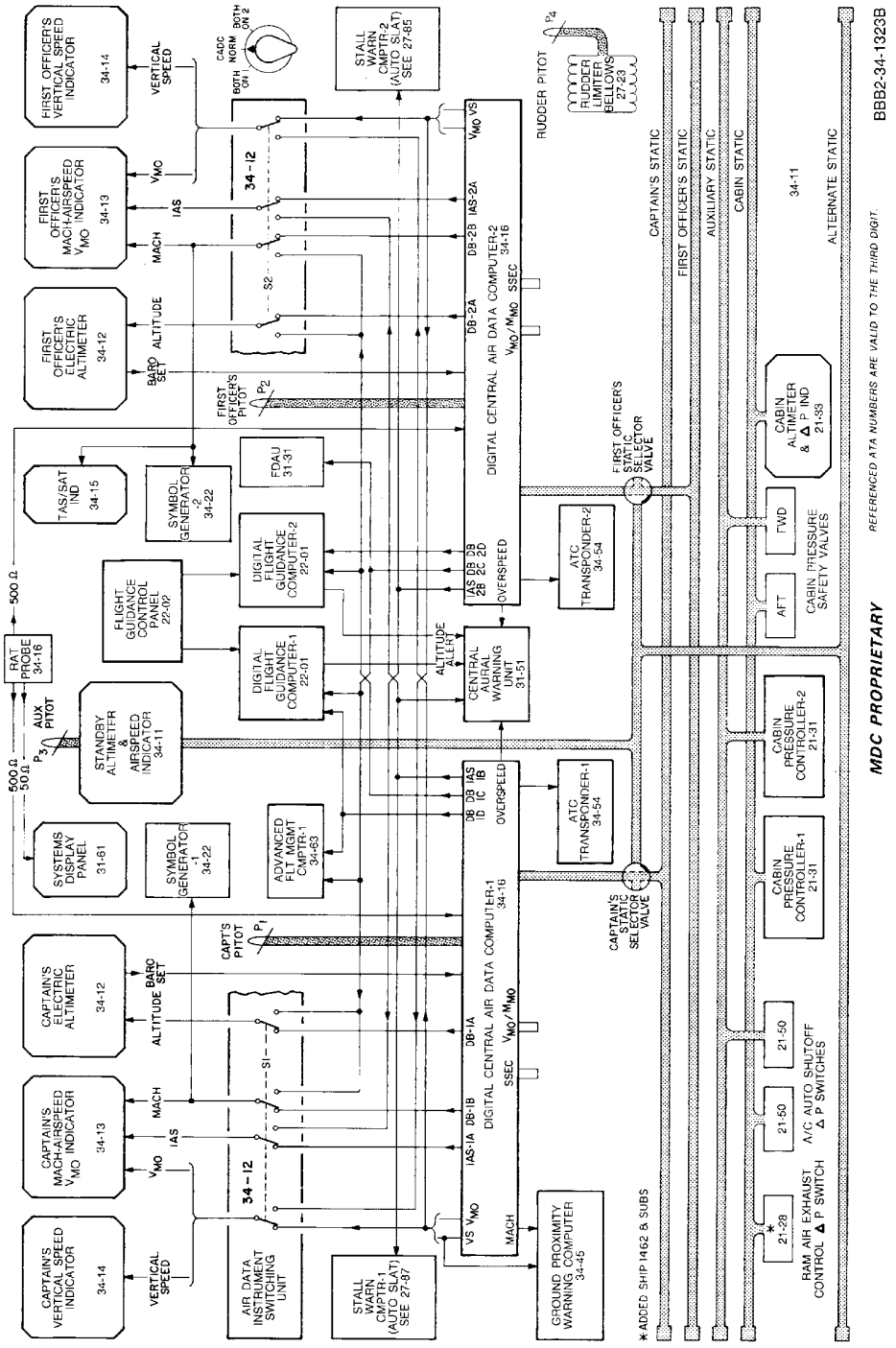


Air Data System - Block Diagram
Figure 3/34-00-00-990-864 (Sheet 1 of 4)



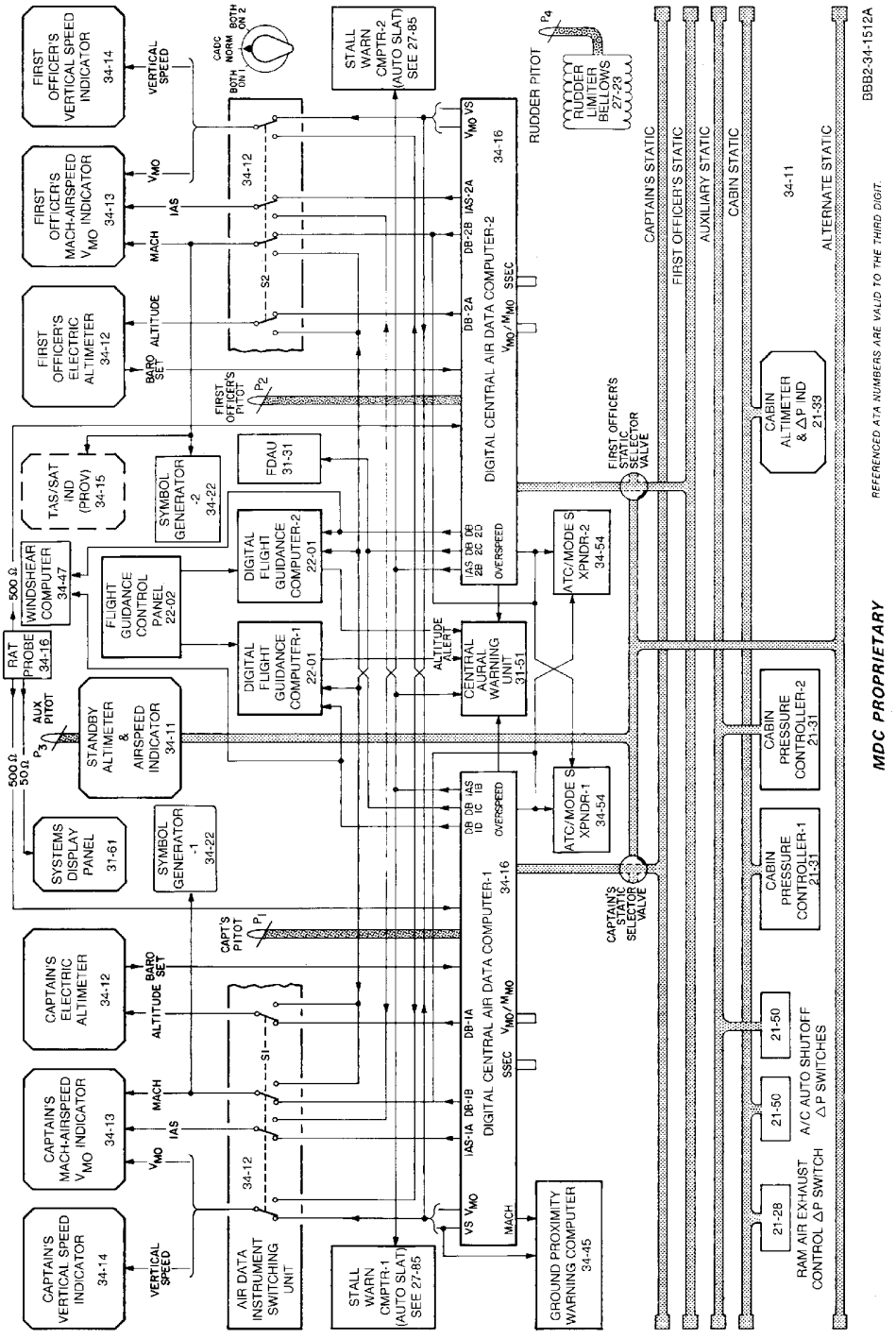
Air Data System - Block Diagram
Figure 3/34-00-00-990-864 (Sheet 2 of 4)

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

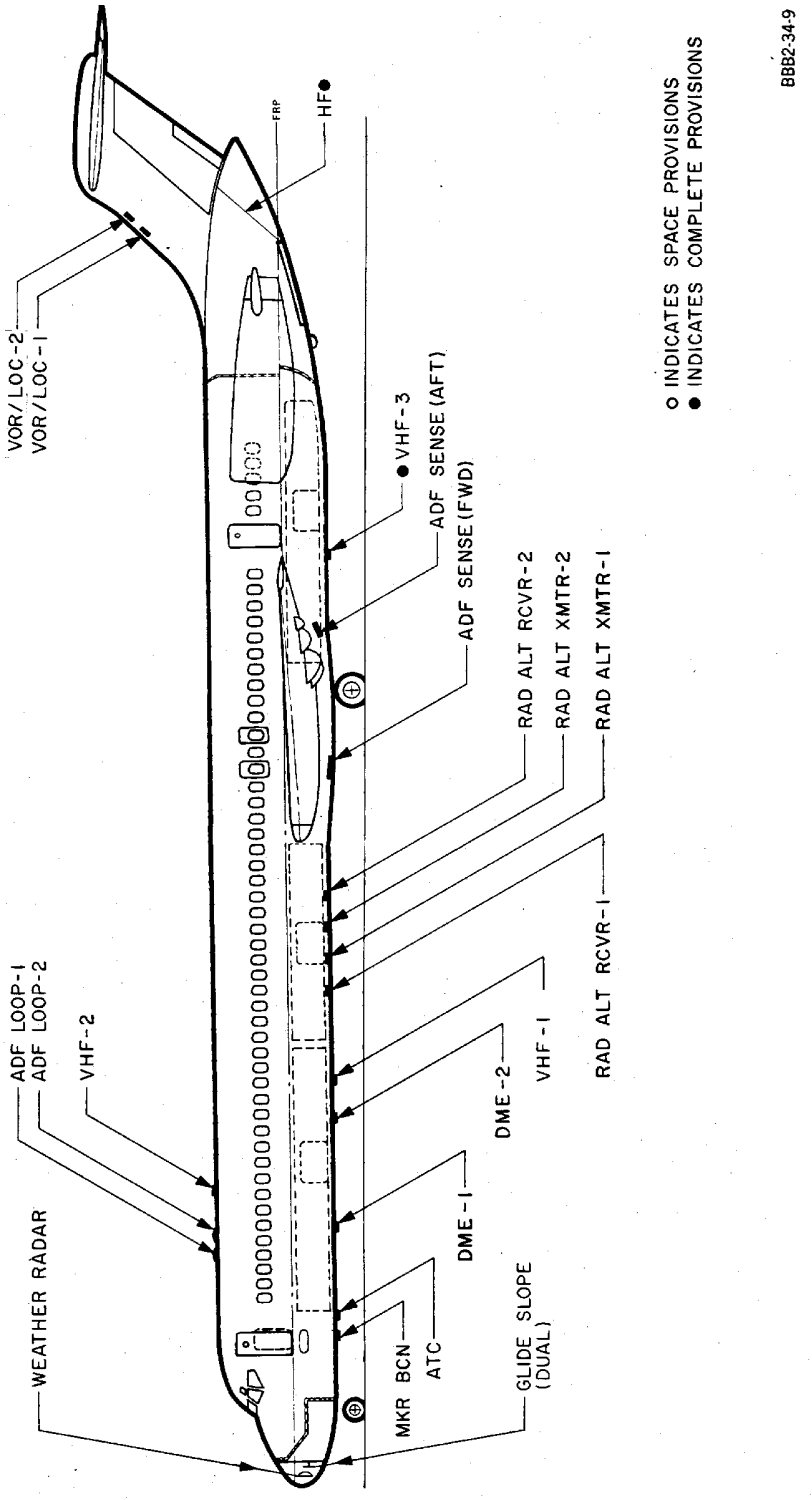


Air Data System - Block Diagram
Figure 3/34-00-00-990-864 (Sheet 3 of 4)

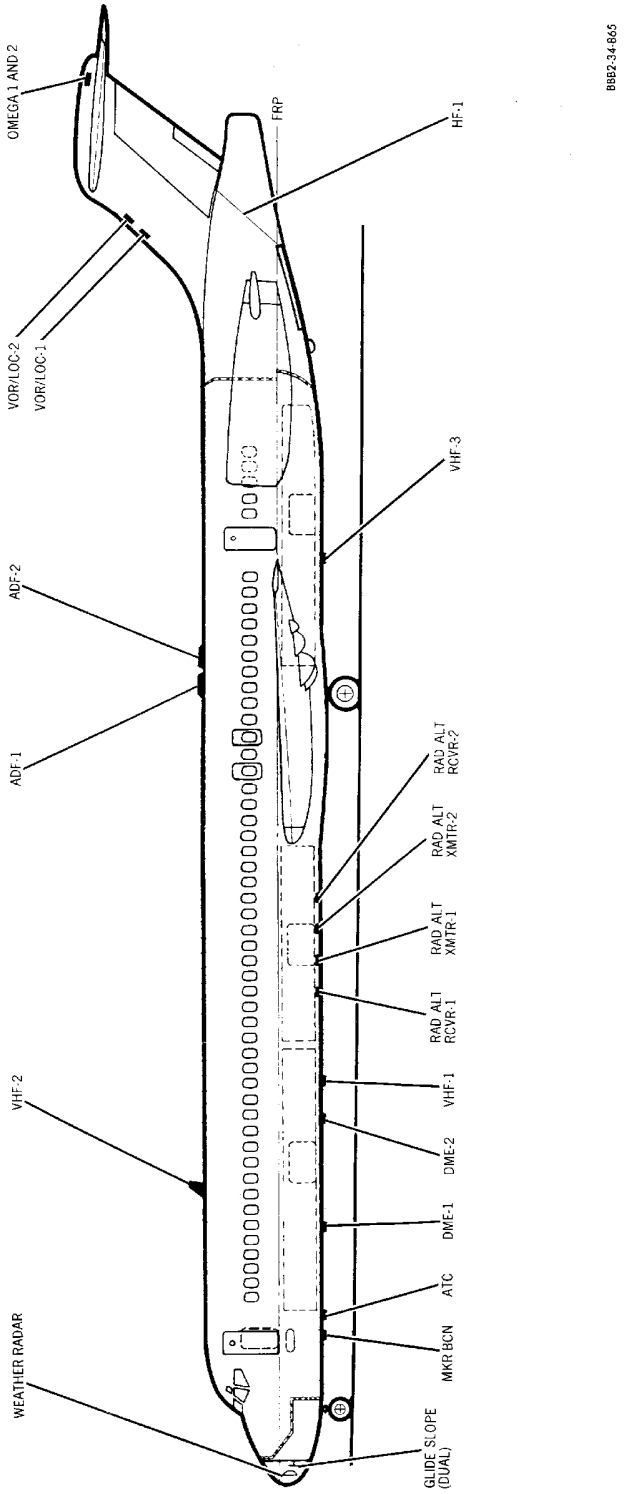
EFFECTIVITY
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



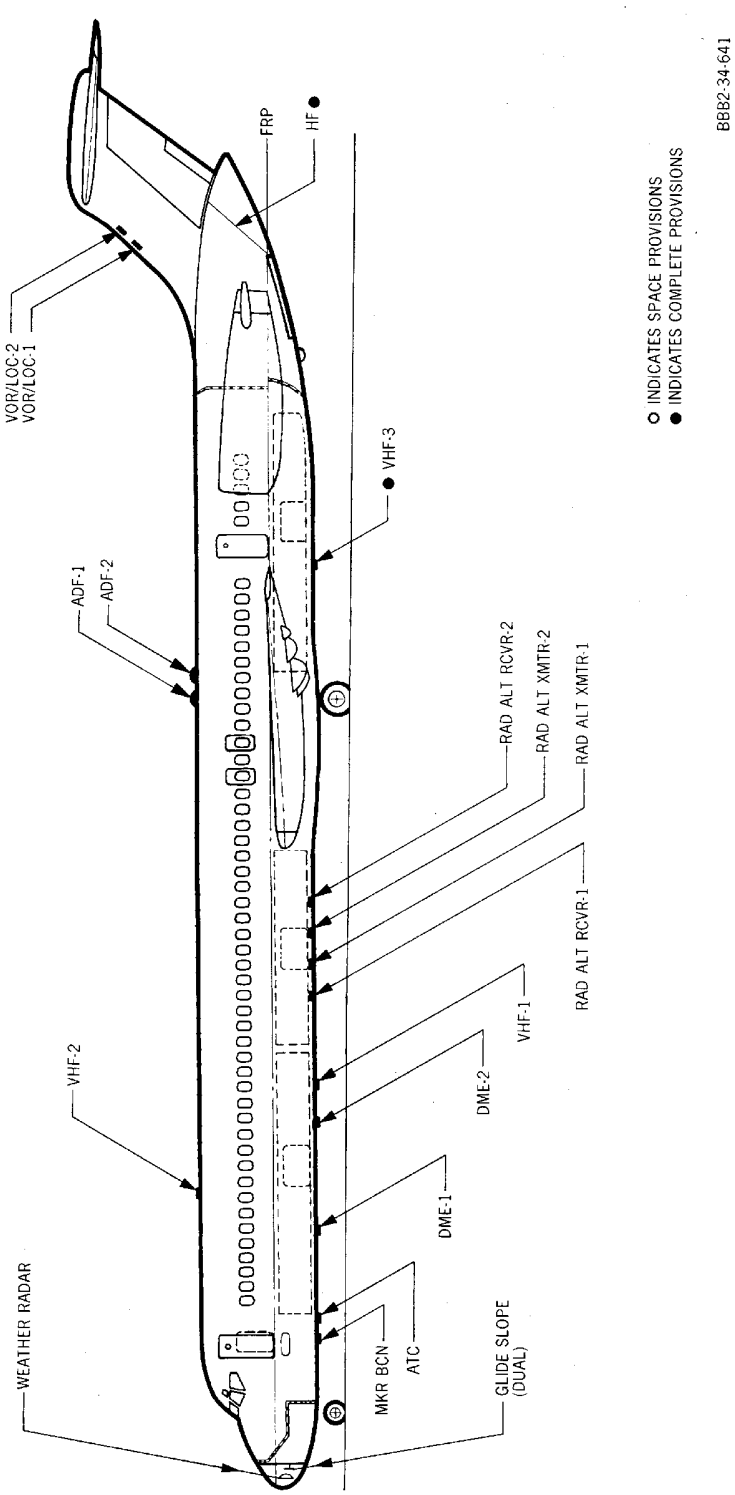
Air Data System - Block Diagram
Figure 3/34-00-00-990-864 (Sheet 4 of 4)



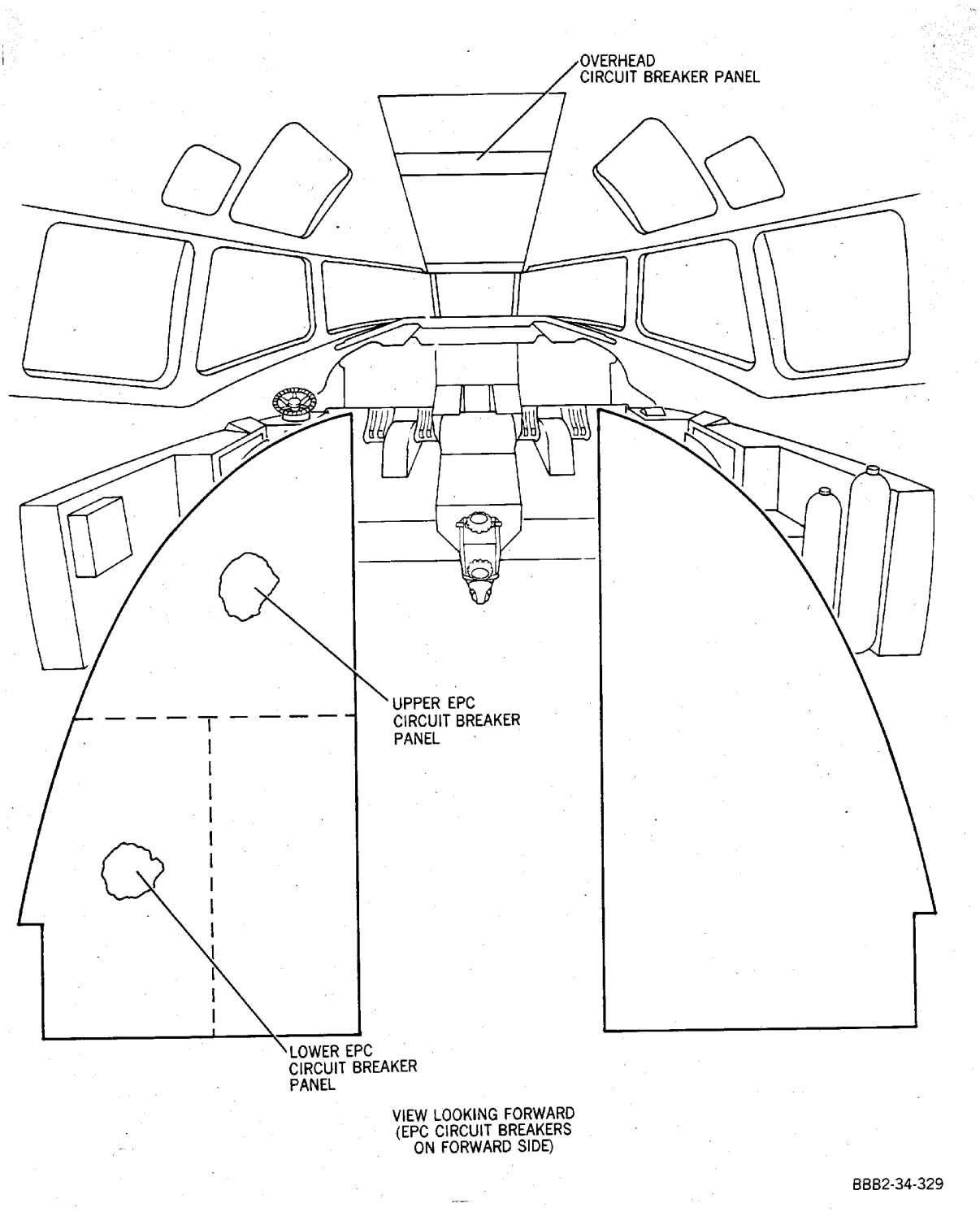
Antenna Locations
Figure 4/34-00-00-990-865 (Sheet 1 of 3)



Antenna Locations
Figure 4/34-00-00-990-865 (Sheet 2 of 3)



Antenna Locations
Figure 4/34-00-00-990-865 (Sheet 3 of 3)



Navigation System Circuit Breaker Panels
Figure 5/34-00-00-990-866

NAVIGATION - GENERAL -DESCRIPTION AND OPERATION

1. General

A. The aircraft navigation system provides visual and aural information to the flight crew to safely maneuver and navigate the aircraft. This information is in operation during pre-takeoff, takeoff, enroute flight, approach, and landing. When the airplane is in an air traffic controlled area it also transmits information to ground control personnel to determine airplane identity, location, and altitude.

B. The aircraft navigation systems operate independently or interface with other systems to provide this information. The pitot/static system provides raw data for the air data computers operation.

C. The navigation systems displays and systems controls are located in the flight compartment. The line replaceable units (LRUs), transceivers, gyros or attitude heading reference units, inertial instruments, computers, and etc. which transmit information to the displays are primarily located in the electrical/electronics compartment and forward accessory compartment. The antennas are located on the upper and lower fuselage, vertical stabilizer, and nose radome area. Detail locations of the system components are provided in the Description and Operation or Maintenance Practices sections of the Maintenance Manual.

D. The Navigation Maintenance Manual is divided into seven major section headings, each section containing the specific types of Navigation systems applicable. These major section headings are as follows:

Table 1

Heading	Section Designation
Navigation - General	NAVIGATION - GENERAL, SECTION 34-00
Flight Environmental Data	FLIGHT ENVIRONMENT DATA, SECTION 34-10
Attitude and Direction	ATTITUDE AND DIRECTION, SECTION 34-20
Landing and Taxiing Aids	LANDING AND TAXIING AIDS, SECTION 34-30
Independent Position Determining	INDEPENDENT POSITION DETERMINING, SECTION 34-40
Dependent Position Determining	DEPENDENT POSITION DETERMINING, SECTION 34-50
Performance Management/Flight Management	PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SECTION 34-63

E. Flight Environment Data

WJE 405-411, 880, 881, 883, 884; AIRCRAFT BEFORE AVIONICS UPGRADE MODIFICATION

(1) That portion of equipment which senses environmental conditions and uses the data to influence navigation of the airplane. This section includes systems and components as follows: Air Data Computing System, Altitude System, Mach Airspeed and Overspeed Warning System, Pitot Static System, True Airspeed and Air Temperature System, Vertical Speed Indicator, Altitude Advisory, and TAT or RAT/Thrust Rating.

WJE 401-404, 412, 414, 875-879

(2) That portion of equipment which senses environmental conditions which influence navigation of the aircraft. This section includes: Air Data Computing System, Altitude System, Mach Airspeed and Overspeed Warning System, Pitot Static System, True Airspeed and Air Temperature System (if installed), Vertical Speed Indicator, Altitude Advisory, and TAT/Thrust Rating.

WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION

(3) That portion of equipment which senses environmental conditions which influence navigation of the aircraft. This section includes: Air Data Computing System, Altitude System, Mach Airspeed and Overspeed Warning System, Pitot Static System, True Airspeed and Air Temperature System (if installed), Vertical Speed Indicator, Altitude Advisory, and TAT/Thrust Rating.

WJE 401-412, 414, 875-881, 883, 884

F. Attitude and Direction

WJE 405-411, 880, 881, 883, 884

(1) That portion of equipment which uses magnetic and gyroscopic forces. This section includes systems and components as follows: Compass System (on aircraft with VG/DG), Heading System (on aircraft with AHRS), Navigation Displays, Attitude System, Flight Director Displays, and Instrument Monitor System, and Heads Up Display (HUD) if installed.

WJE 401-404, 412, 414, 875-879

(2) That portion of equipment which uses magnetic and inertial forces to determine aircraft heading and attitude. This section includes: Compass System, Navigation Displays, Attitude System, Flight Director Displays, and Standby Horizon System.

WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION

(3) That portion of equipment which uses magnetic and inertial forces to determine aircraft heading and attitude. This section includes: Compass System, Navigation Displays, Attitude System, Flight Director Displays, and Standby Horizon System.

WJE 401-412, 414, 875-881, 883, 884

G. Landing and Taxiing Aids

(1) That portion of equipment used during approach, landing and taxiing. This section includes: Marker Beacon System, and ILS System.

H. Independent Position Determining

WJE 405-411, 880, 881, 883, 884; AIRCRAFT BEFORE AVIONICS UPGRADE MODIFICATION

(1) That portion of equipment which provides data to determine position and is mainly independent of ground installations. This section includes systems and components as follows: Weather Radar System, Radio Altimeter System, and Ground Proximity Warning System.

WJE 401-404, 412, 414, 875-879

(2) That portion of equipment used to determine aircraft position, independently of ground installations. This section includes: Weather Radar System, Radio Altimeter System, Inertial Reference System, Ground Proximity Warning System, and Windshear Alert and Guidance System.

WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION

(3) That portion of equipment used to determine aircraft position, independently of ground installations. This section includes: Weather Radar System, Radio Altimeter System, Inertial Reference System, Ground Proximity Warning System, and Windshear Alert and Guidance System.

WJE 401-412, 414, 875-881, 883, 884

I. Dependent Position Determining

WJE 405-411, 880, 881, 883, 884; AIRCRAFT BEFORE AVIONICS UPGRADE MODIFICATION

(1) That portion of equipment which provides data to determine position and is mainly dependent on ground installations. This section includes systems and components as follows: VHF Navigation System, Distance Measuring Equipment System, Automatic Direction Finding System, and Air Traffic Control Transponder System.

WJE 401-404, 412, 414, 875-879

(2) That portion of equipment used to determine aircraft position which is mainly dependent on ground installations. This section includes: VHF Navigation System, Distance Measuring Equipment System, Automatic Direction Finding System, and Air Traffic Control Transponder System.

WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION

(3) That portion of equipment used to determine aircraft position which is mainly dependent on ground installations. This section includes: VHF Navigation System, Distance Measuring Equipment System, Automatic Direction Finding System, and Air Traffic Control Transponder System.

WJE 405-411, 880, 881, 883, 884

J. Performance Management (Airplanes 104-999)

(1) That portion of equipment which provides coordinated control of pitch and thrust for flight performance optimization. This section includes systems and components as follows: Performance Management System (Performance Management Computer and Performance Management Control Display Unit).

WJE 401-404, 412, 414, 875-879

K. Flight Management

(1) The Flight Management System (FMS) provides the means for the Captain or First Officer to initiate aircraft control in automatic navigation, lateral and vertical guidance commands, Electronic Flight Instrument System (EFIS) MAP OR PLAN display information and the most advantageous airplane flight performance.

WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION

L. Flight Management

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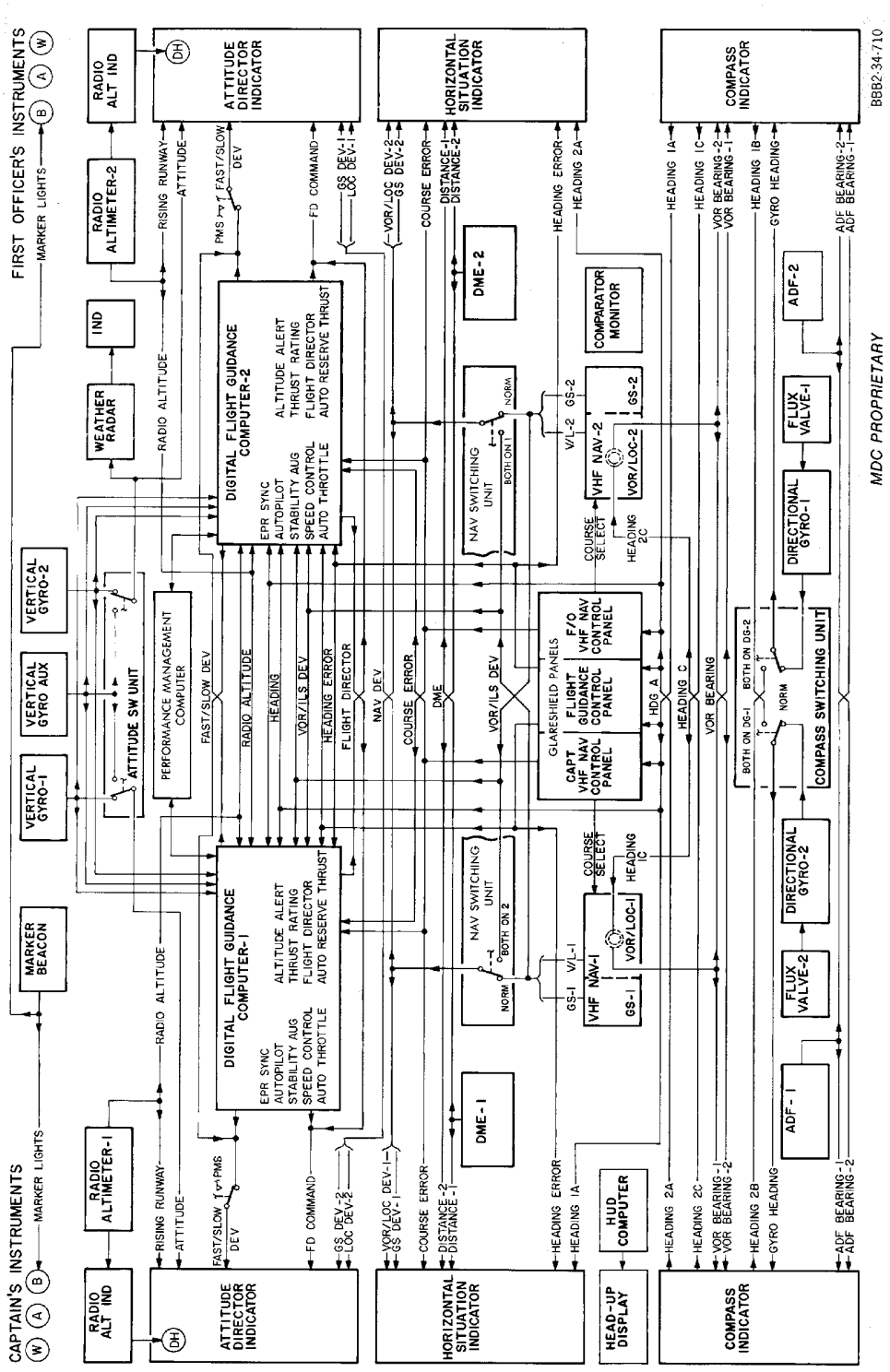
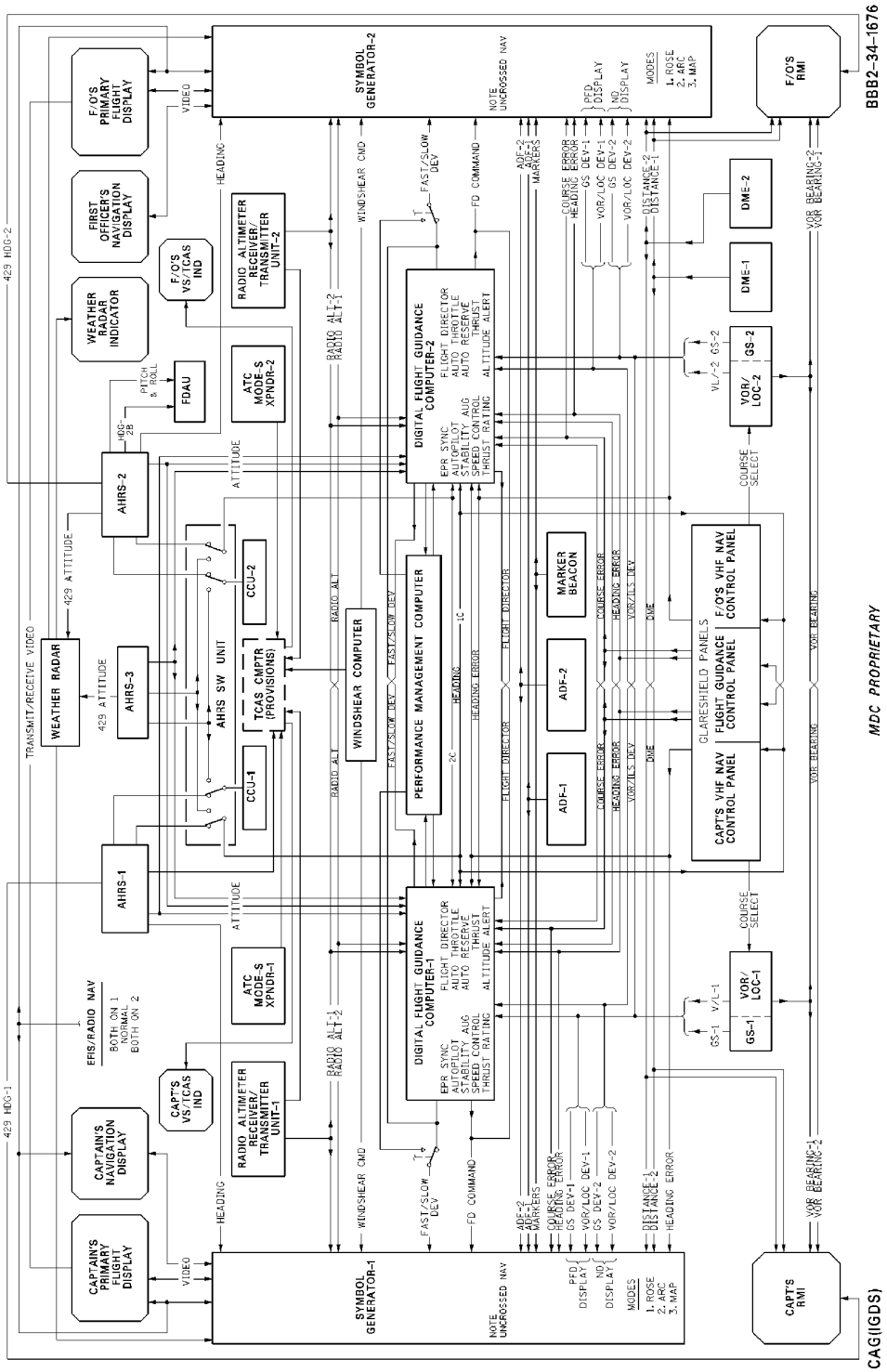
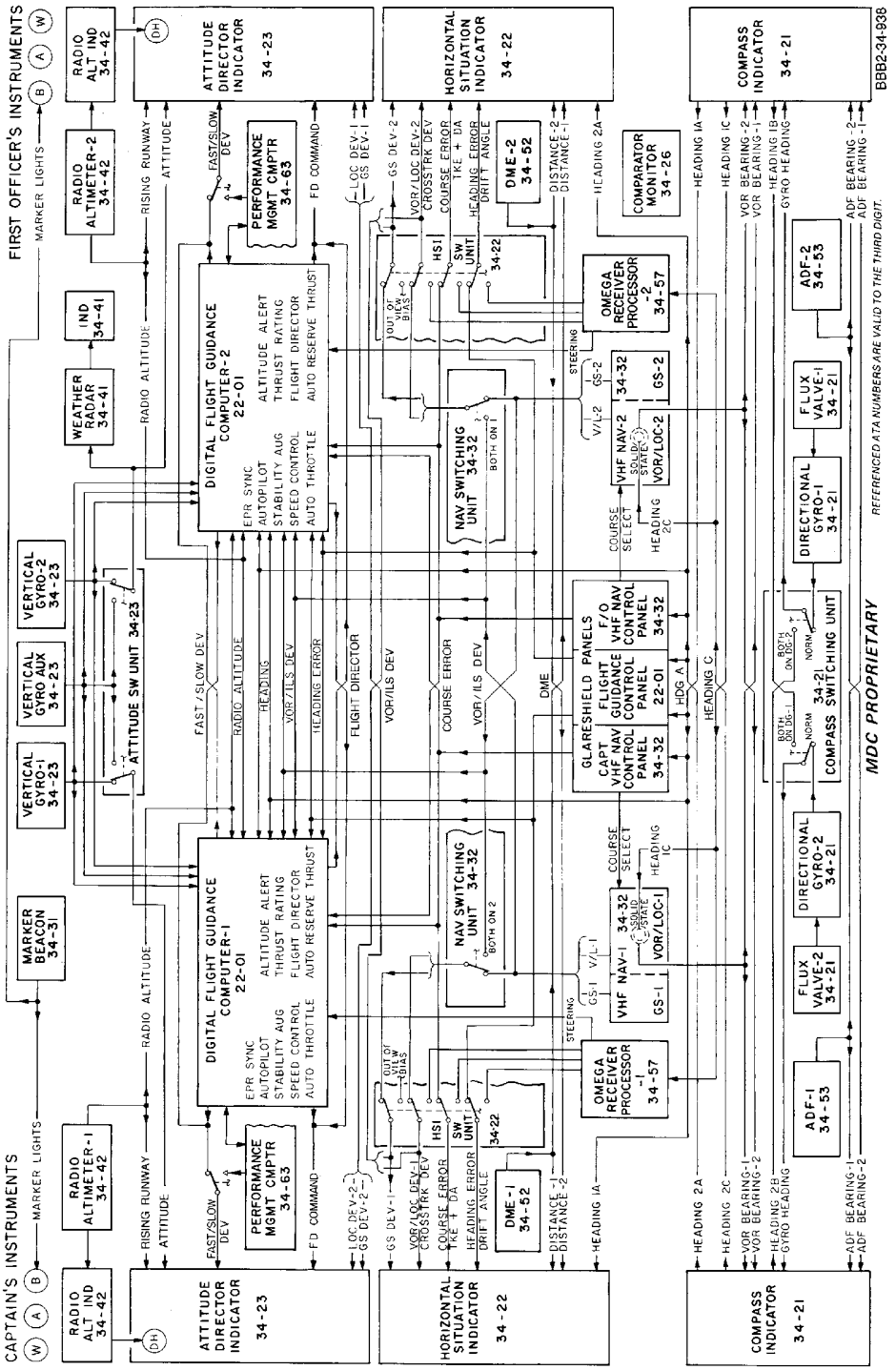


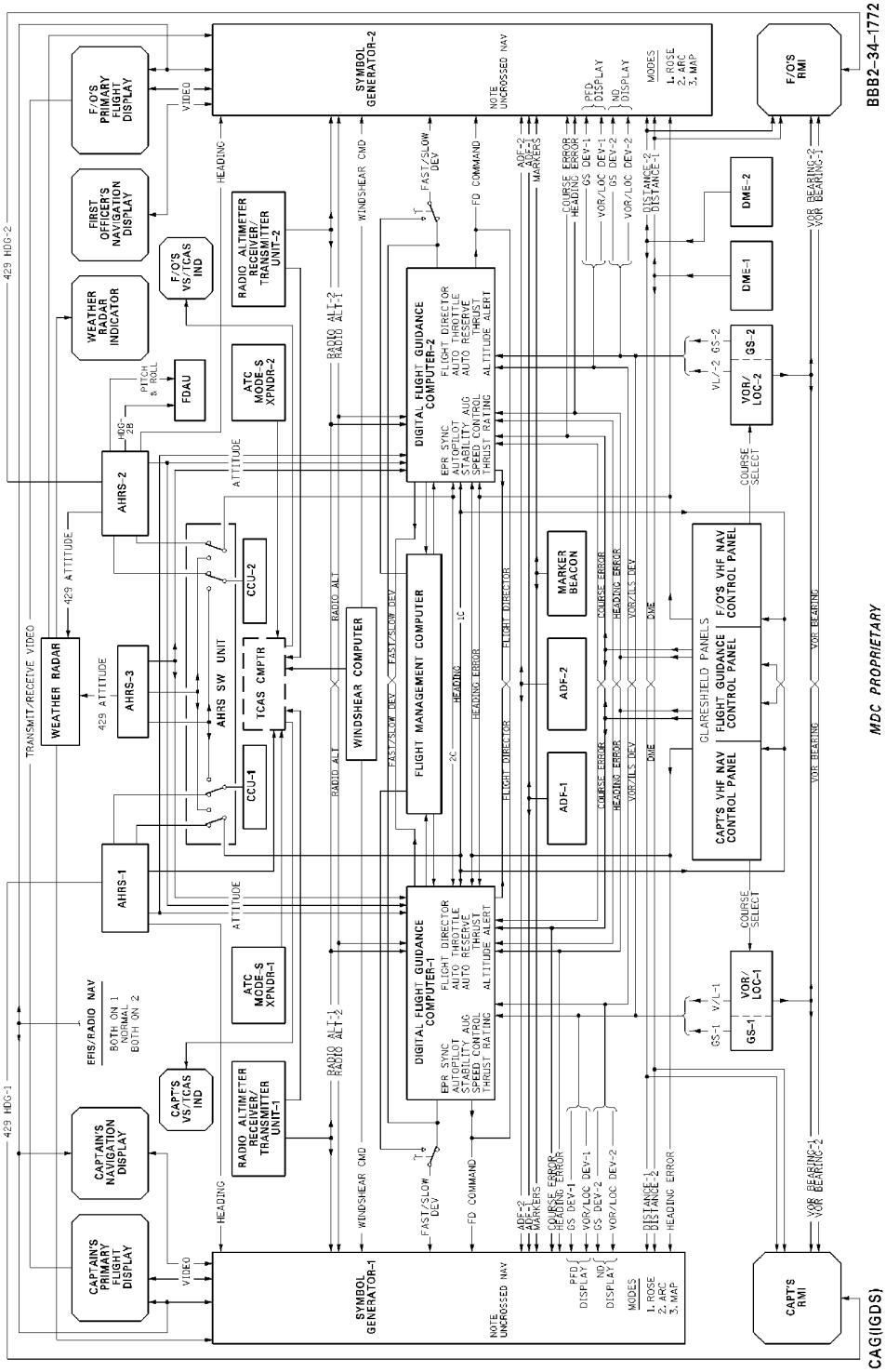
Navigation System - Block Diagram
Figure 1/34-00-00-990-806 (Sheet 1 of 5)



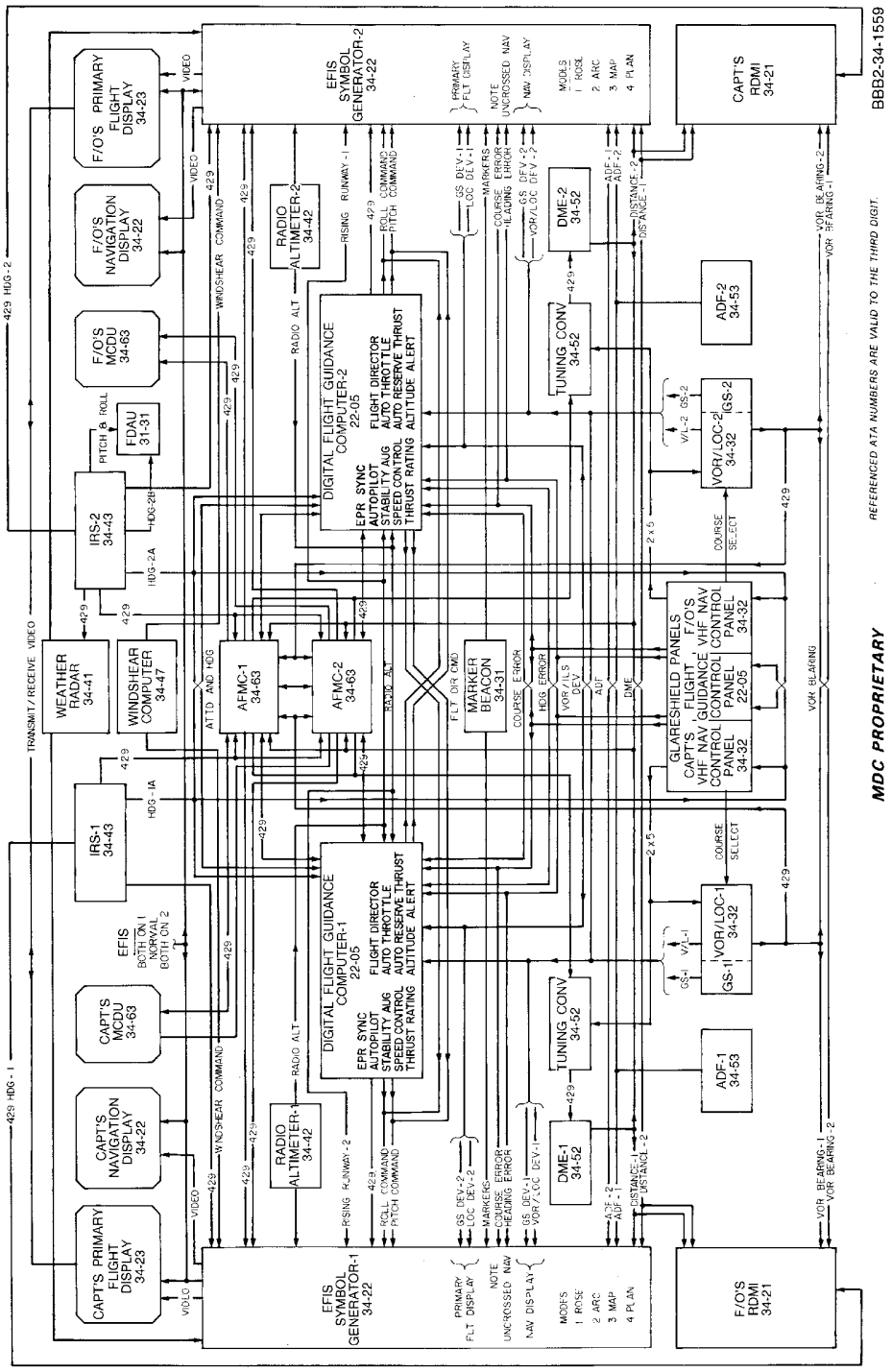
Navigation System - Block Diagram
Figure 1/34-00-00-990-806 (Sheet 2 of 5)



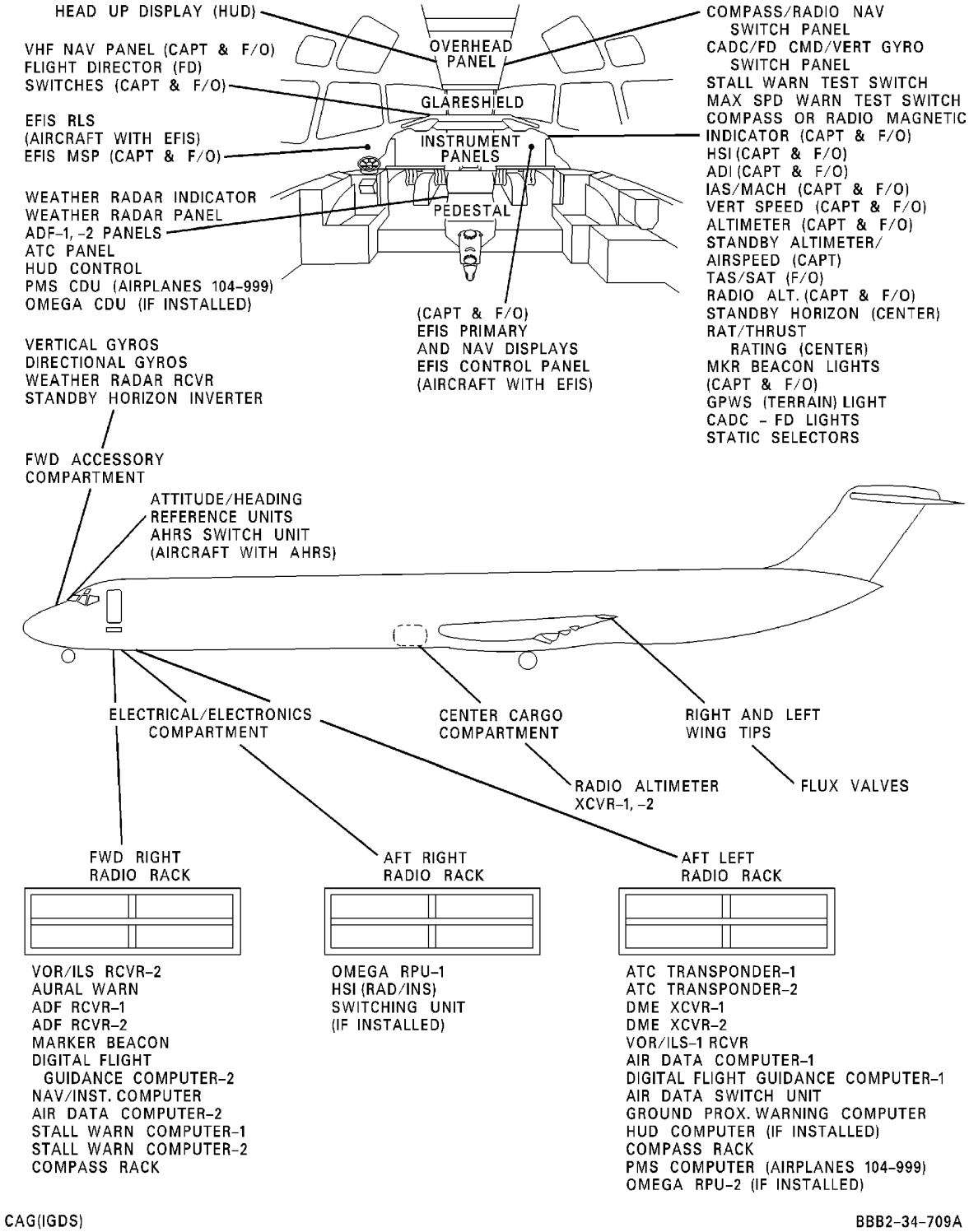
Navigation System - Block Diagram
Figure 1/34-00-00-990-806 (Sheet 3 of 5)



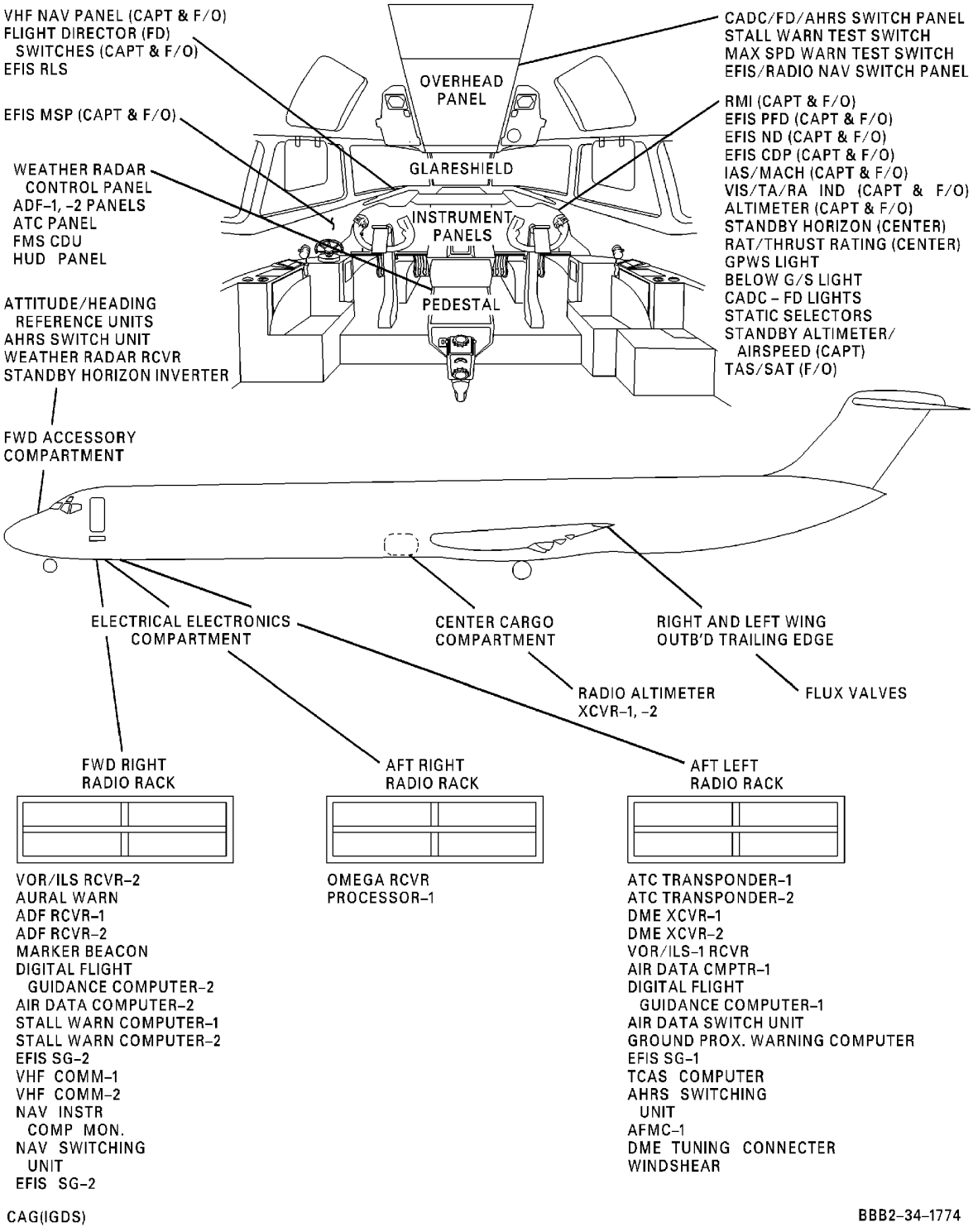
Navigation System - Block Diagram
Figure 1/34-00-00-990-806 (Sheet 4 of 5)



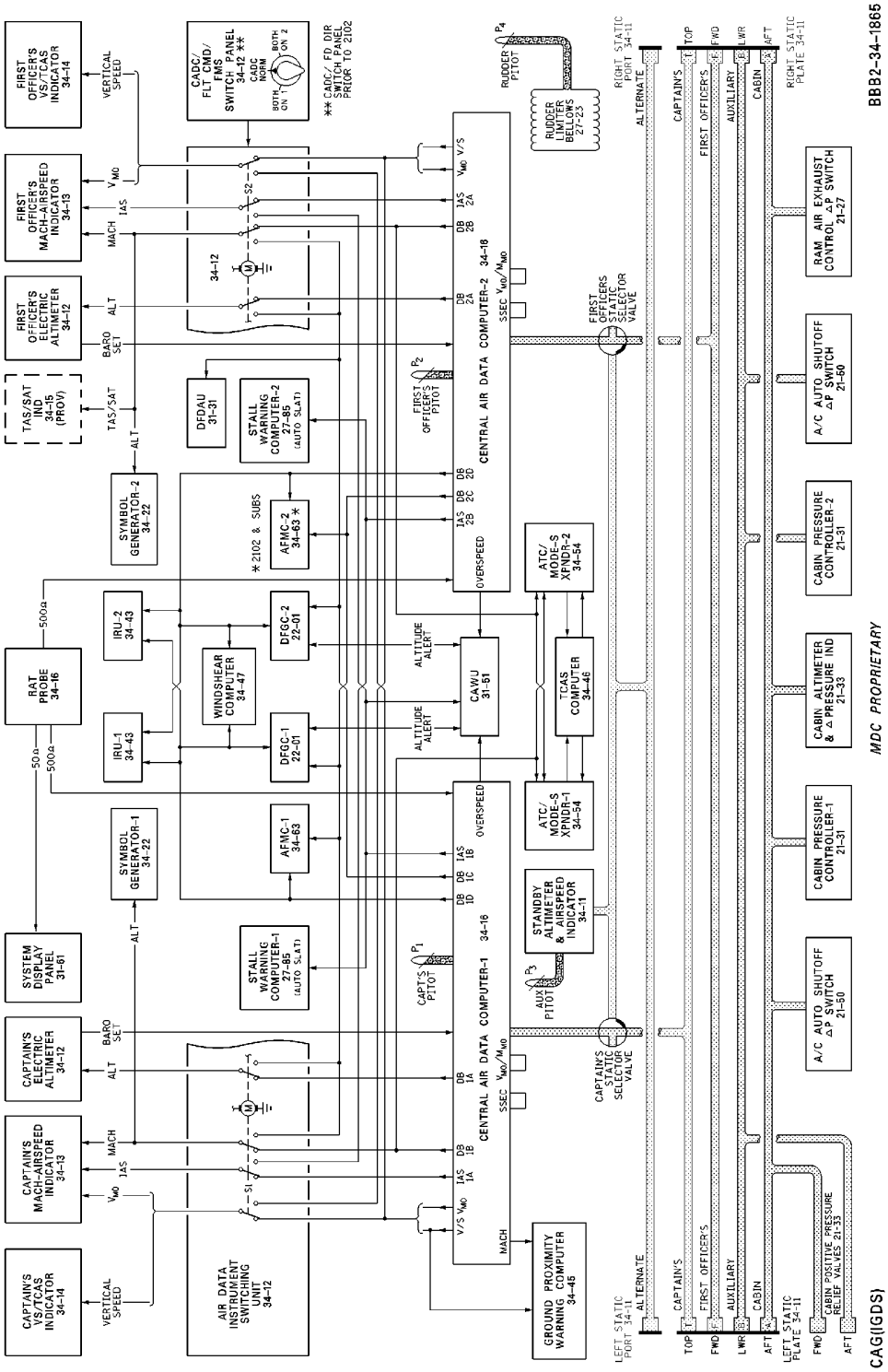
Navigation System - Block Diagram
Figure 1/34-00-00-990-806 (Sheet 5 of 5)



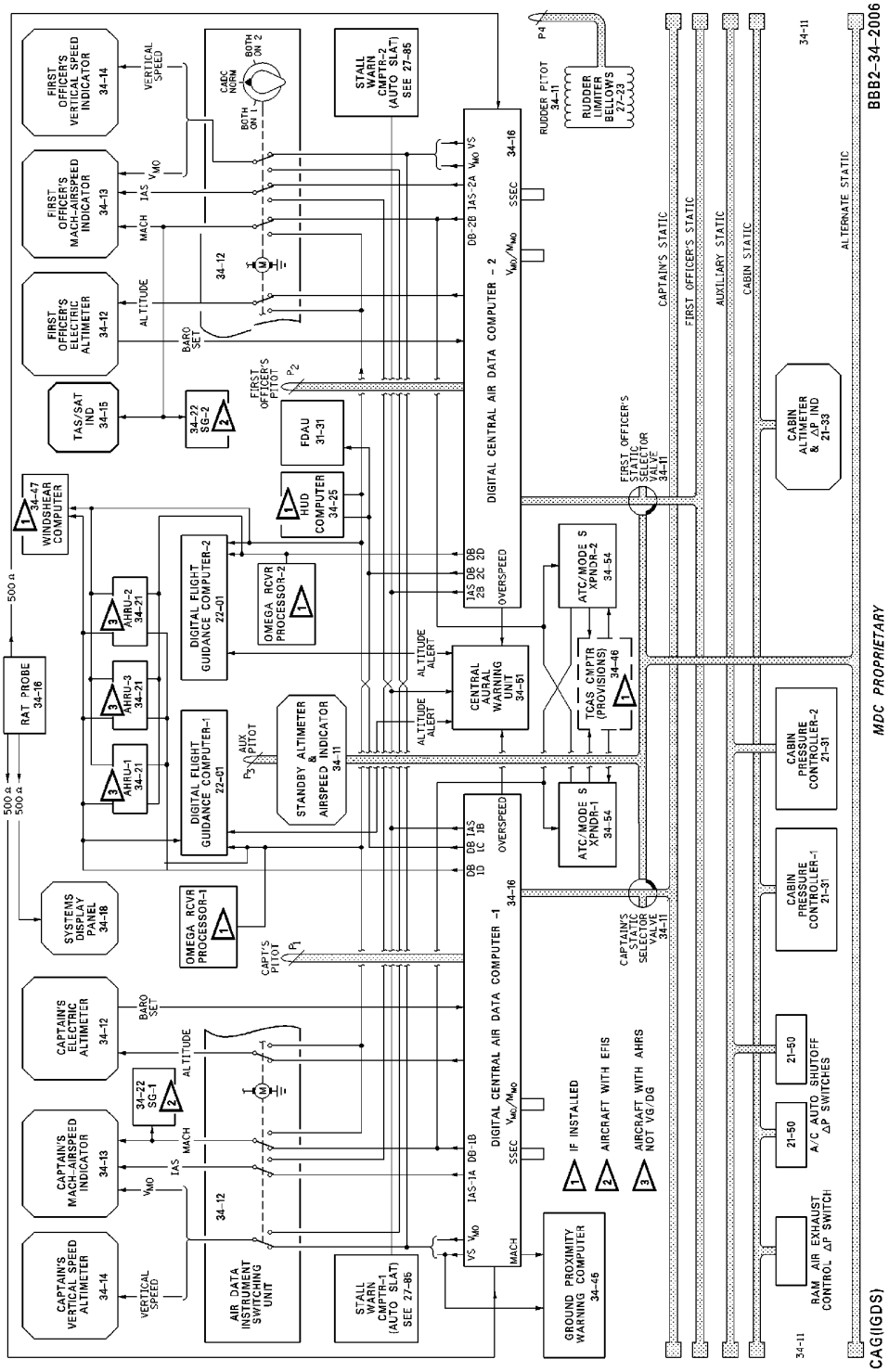
Navigation System Replaceable Components Location
Figure 2/34-00-00-990-827 (Sheet 1 of 2)



Navigation System Replaceable Components Location
Figure 2/34-00-00-990-827 (Sheet 2 of 2)

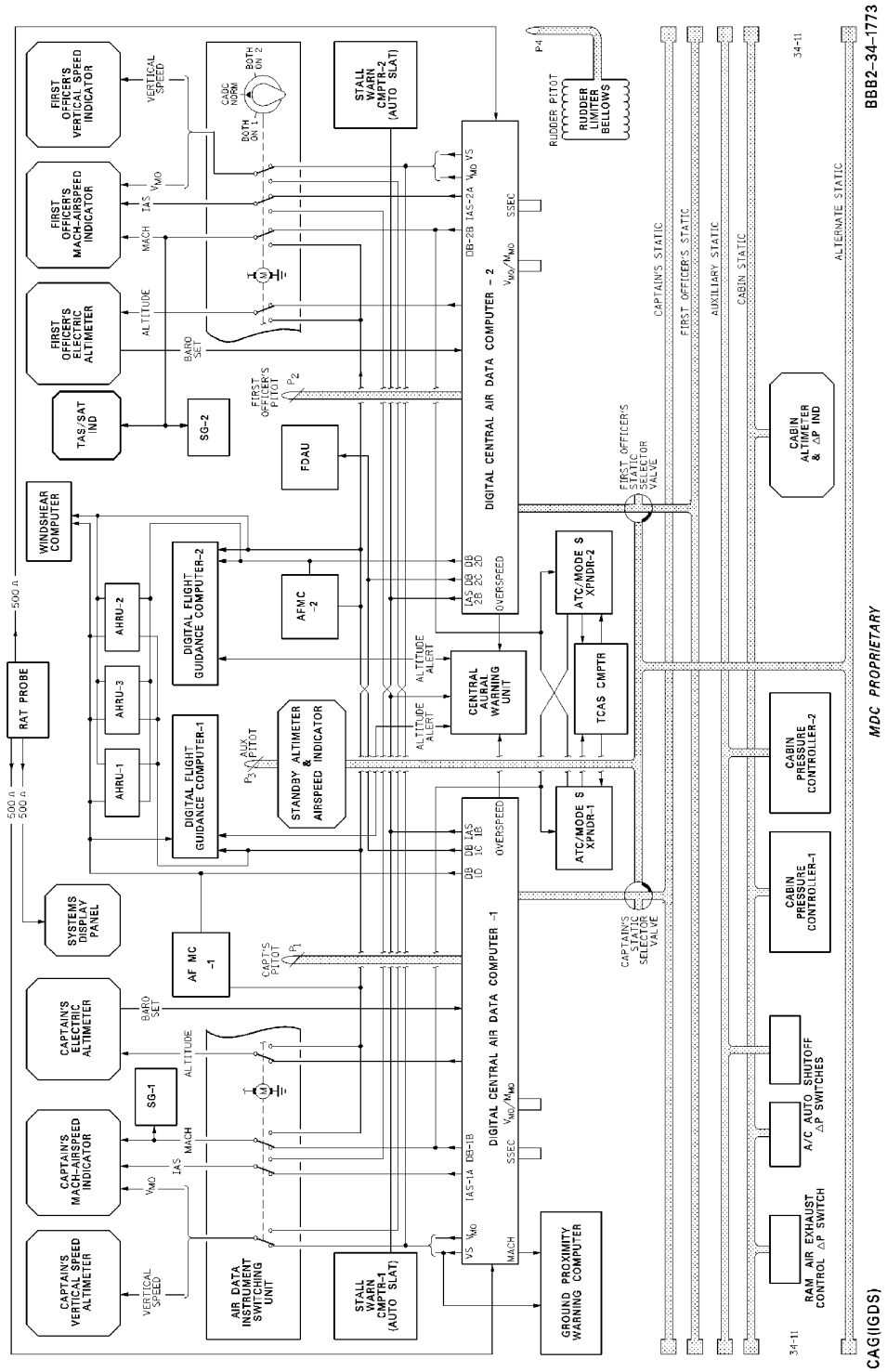


Air Data System - Block Diagram
Figure 3/34-00-00-990-839 (Sheet 1 of 4)



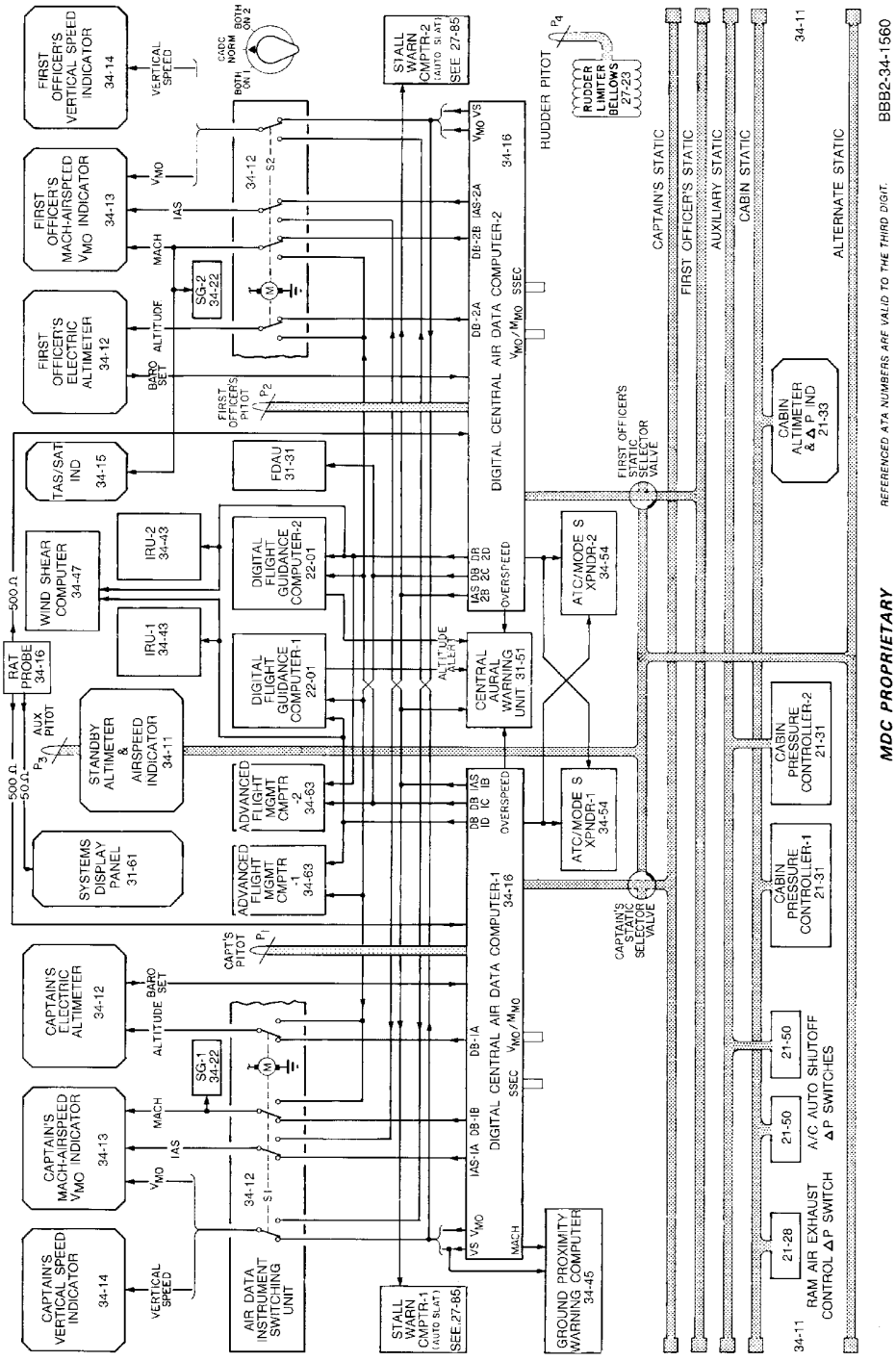
Air Data System - Block Diagram
Figure 3/34-00-00-990-839 (Sheet 2 of 4)

EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AIRCRAFT BEFORE AVIONICS UPGRADE MODIFICATION

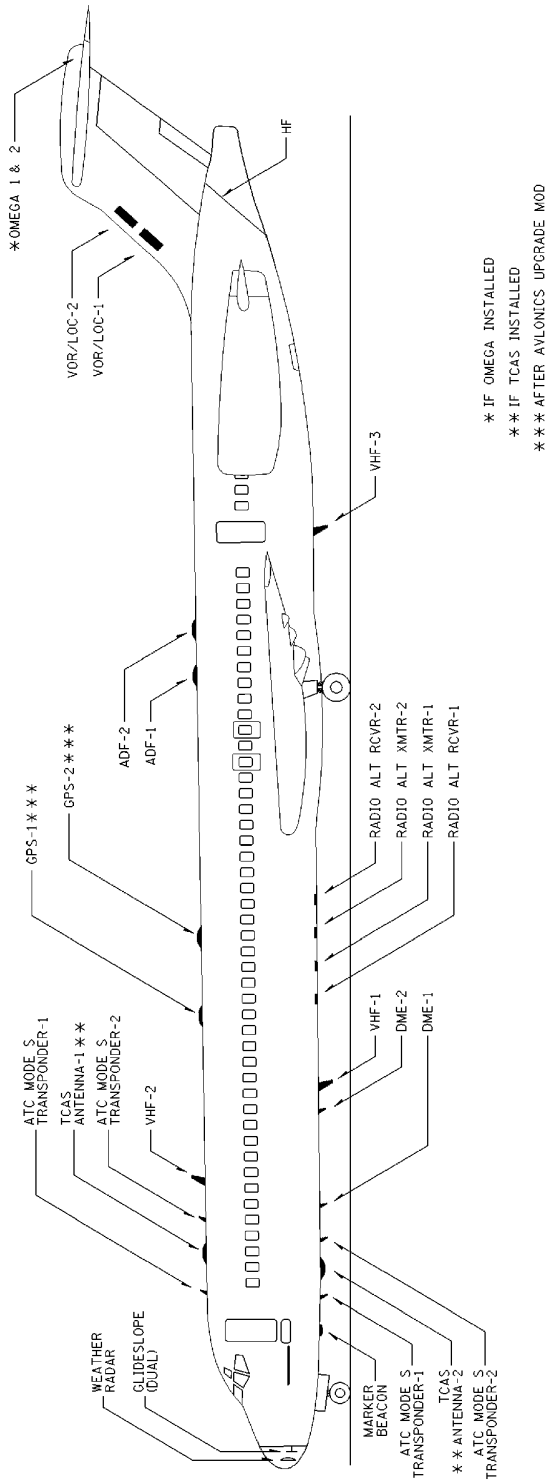


Air Data System - Block Diagram
Figure 3/34-00-00-990-839 (Sheet 3 of 4)

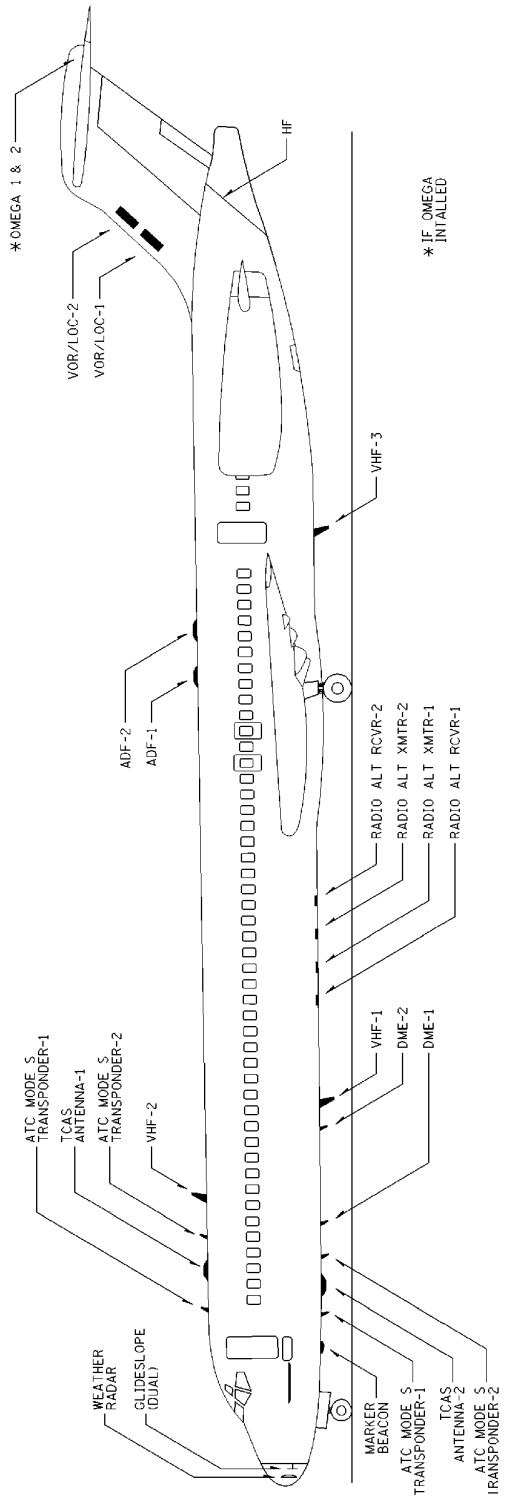
EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AIRCRAFT AFTER AVIONICS UPGRADE MODIFICATION



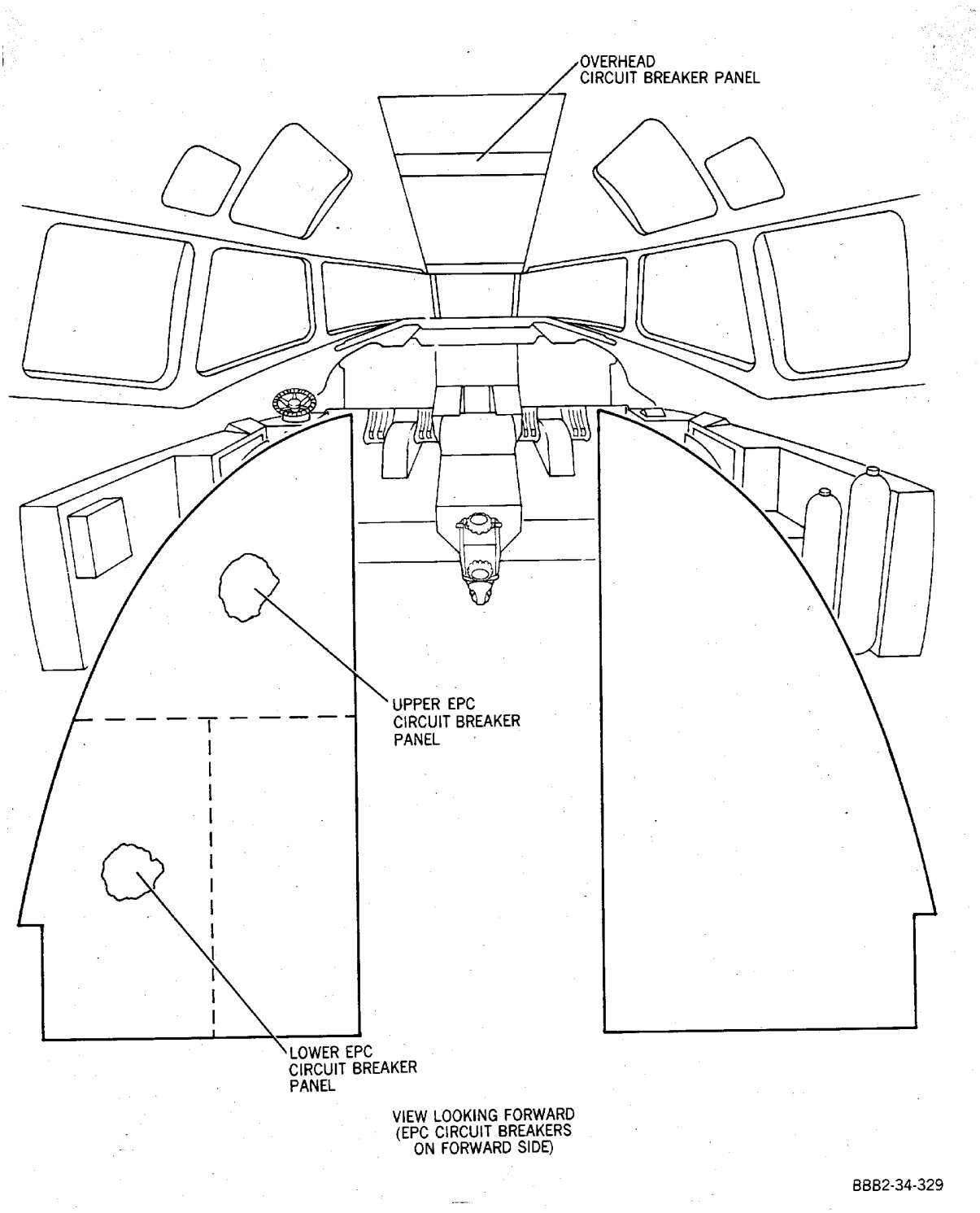
Air Data System - Block Diagram
Figure 3/34-00-00-990-839 (Sheet 4 of 4)



Antenna Locations
Figure 4/34-00-00-990-858 (Sheet 1 of 2)



Antenna Locations
Figure 4/34-00-00-990-858 (Sheet 2 of 2)



Navigation System Circuit Breaker Panels
Figure 5/34-00-00-990-859

GENERAL - MAINTENANCE PRACTICES

1. General

A. General Maintenance Practices provides certain common practices applicable to most maintenance procedures performed on the airplane. The general common practices pertain to safety procedures, typical removal/installations of rack mounted units, control panels, and instruments, handling of replaced units which are repairable, observant inspection of system components during maintenance procedures, cleaning, and corrosion treatment.

2. Safety Precautions

A. Prior to removal/installation of any electrically operated component, the applicable circuit breakers should be opened, then tagged and safetied per customers procedures.

B. Before any procedure that will cause to operate a movable aircraft component, make certain of the following:

(1) Any obstructions, such as workstands, should be free of the field of operation of the component to prevent damage to the aircraft.

(2) All personnel working in or about the aircraft should be cognizant of the operation to prevent injury to personnel.

CAUTION: WHEN AIRCRAFT IS ON JACKS, ELECTRICAL CIRCUITS TO INSTRUMENT COOLING FAN ARE DE-ENERGIZED THROUGH GROUND CONTROL RELAY. DAMAGE TO ELECTRONIC EQUIPMENT ON INSTRUMENT PANEL CAN OCCUR WHEN INSTRUMENT COOLING FAN IS INOPERATIVE AND CONDITIONED AIR IS NOT AVAILABLE. CHAPTER 21 PROVIDES PROCEDURES FOR OPERATION OF INSTRUMENT COOLING FAN WITH AIRCRAFT ON JACKS.

C. Before ground operation of avionics system components, make certain adequate cooling air is provided to components to prevent overheating of components.

D. The National Transportation Safety Board (NTSB) and the Federal Aviation Administration (FAA) recommend that adequate safeguards and/or instruction are available for the proper removal of any covers installed on pitot static ports or other aircraft sensory probes exposed to cleaning and maintenance prior to flight. Also the FAA and NTSB want the static port covers to be highly conspicuous for maintenance inspection and removal. To maintenance personnel when completing maintenance on aircraft pitot static systems, remove all tape and covers with warning flags. This will prevent death and injury to persons and damage to the aircraft.

NOTE: This paragraph applies to all sections of the manual that are not covered by warnings.

E. Make certain the area around pitot static ports are clean with no residue from tape used. The residue when left can cause erroneous instrument readings. This could cause injury and death to persons and damage to the aircraft.

3. Observant Inspection

A. During maintenance procedures involving instruments, check for cracked or broken glass faces, obscured face or instrument markings, looseness of instrument mounting.

B. During removal/installation of rack mounted units, check electrical connectors on rack and unit for bent/broken or contaminated pins, check for cracked, loose or corrosion in or about plugs, check for damaged wiring, check for dust accumulation on LRU, the LRU mount and any mount filters that may be installed.

C. During removal/installation of plugs or coaxial connectors from components, check for bent/broken and contaminated connector pins, damaged wiring or corrosion.

4. **Component Handling**

   A. When repairable component is removed and replaced, component removed should be properly packaged or handled for transport to repair depot or shop.

5. **Electrical Connectors and Lines**

   A. After disconnection of electrical connectors, hoses or lines, open connection points of connectors, hoses, or lines should be protected from damage and contamination by suitable caps or coverings.

6. **Cleaning**

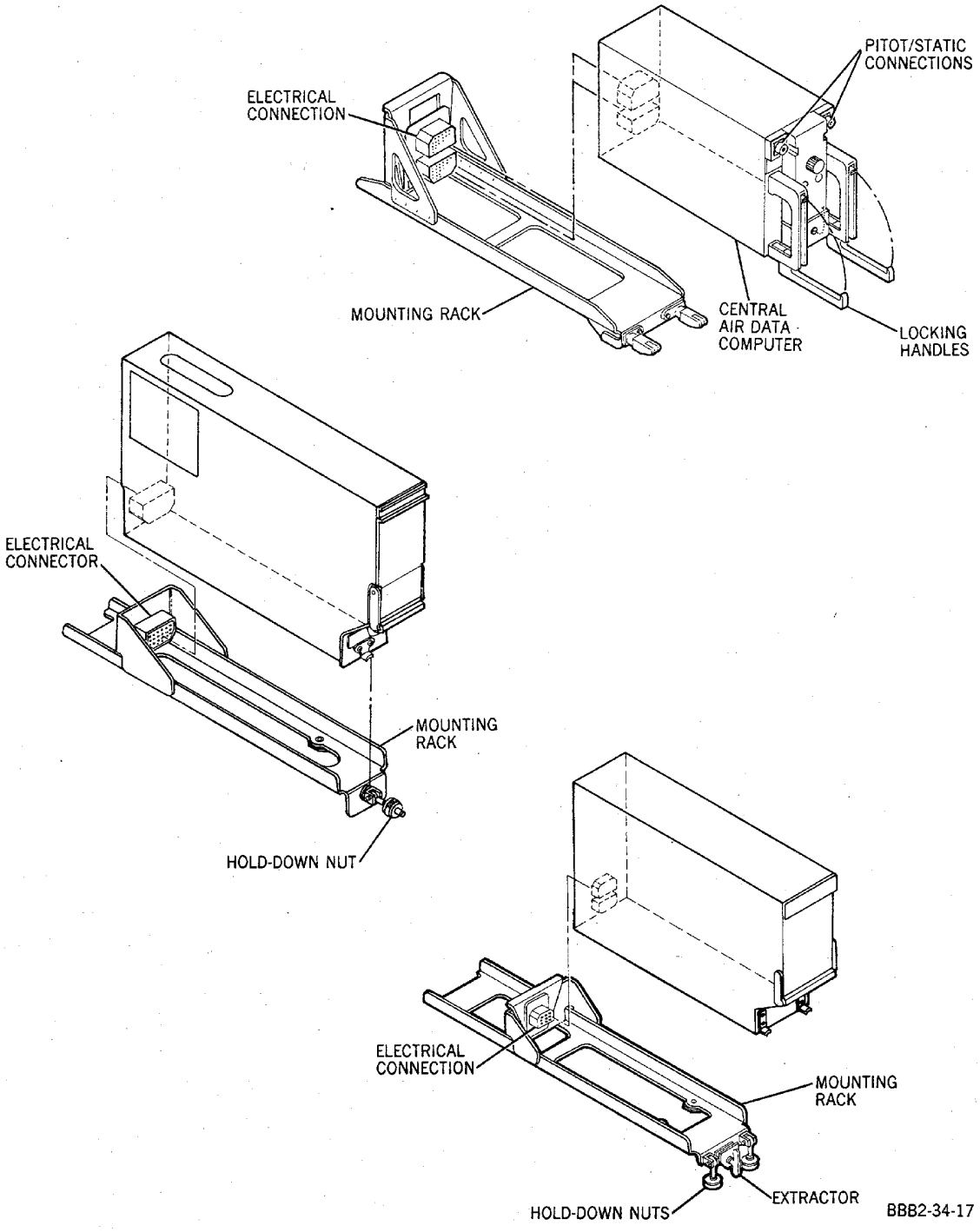
   A. When toxic materials such as cleaning solvents are used in enclosed areas, area should be well ventilated to prevent personnel from inhaling fumes.

   B. Removal of sealants from aircraft surfaces should be removed with non-metallic scraper to prevent damage to aircraft surface covering.

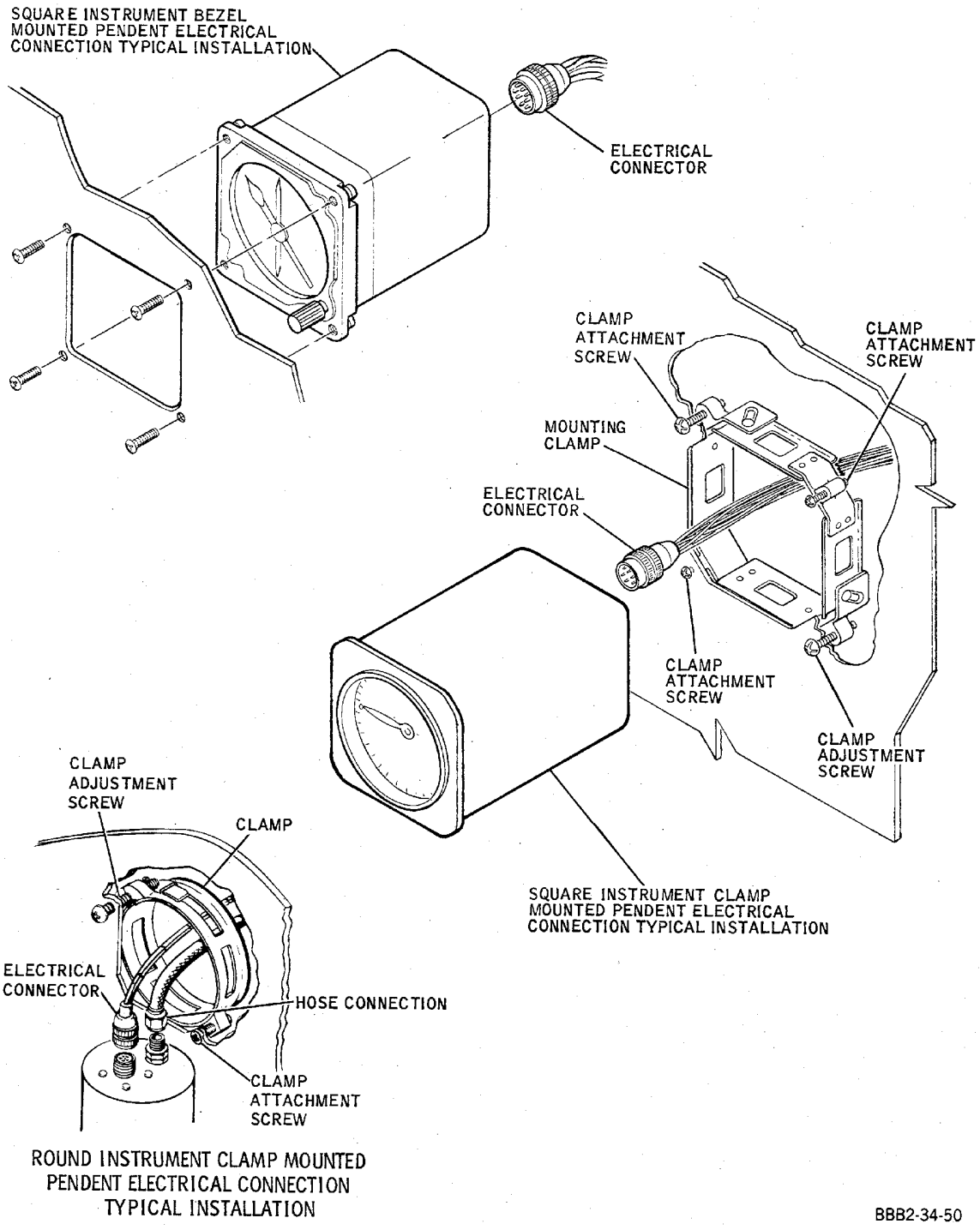
   C. Aircraft surfaces stripped and cleaned for bonding purposes should not be extensively cleaned beyond bonding area. Exposed surfaces are subject to corrosion. Exposed areas beyond bonding should be treated to match adjoining surface.

   D. Static port areas should be cleaned with lint-free cloth and alcohol. All orifices should be checked for being clean and clear of any obstruction.

   E. Upon removal and installation of rack mounted units, vacuum away any accumulated dust on the unit, the unit mounting tray and any filters that may be installed. This will help prevent overheat problems to the LRU's.



Rack Mounted Units -- Removal/Installation - Typical
Figure 201/34-00-00-990-860



Instrument Installations -- Typical
Figure 202/34-00-00-990-861

7. Corrosion

NOTE: Any procedure for corrosion removal from components or surfaces should be analyzed for possible damage to component or surface. The component or surface should be properly checked after corrosion treatment to make certain it is structurally or operably acceptable.

A. Corrosion can be removed with nylon abrasive pad, surface should be thoroughly cleaned of residue, dried and treated with a corrosive inhibitive compound. After sufficient drying, surface should be treated to correspond to surrounding surface.

B. The following is recommended when any antenna is replaced, or moisture accumulation is suspected:

(1) Remove any existing corrosion from antenna connector plug and receptacle with stainless steel wire brush or nylon abrasive pad.

(2) Remove residue with clean cloth dampened with dry cleaning solvent.

(3) Connect coax cable to antenna receptacle.

(4) After mating connectors, coat all metal surfaces of entire assembly (antenna receptacle and coax connectors, as applicable) with a corrosion inhibiting compound.

(5) Allow applied compound to air dry for four (4) hours with adequate ventilation before installing antenna.

8. General Maintenance Procedure for Overhead Instrument Switching Panels

A. Remove Instrument Switching Panel (Figure 203)

(1) Loosen four fasteners on switching panel.

(2) Slide panel out of mount on overhead panel untill connector is exposed.

(3) Disconnect electrical connector from receptacle and remove panel.

B. Install Instrument Switching Panel (Figure 203)

(1) Position panel and connect electrical connector to panel receptacle.

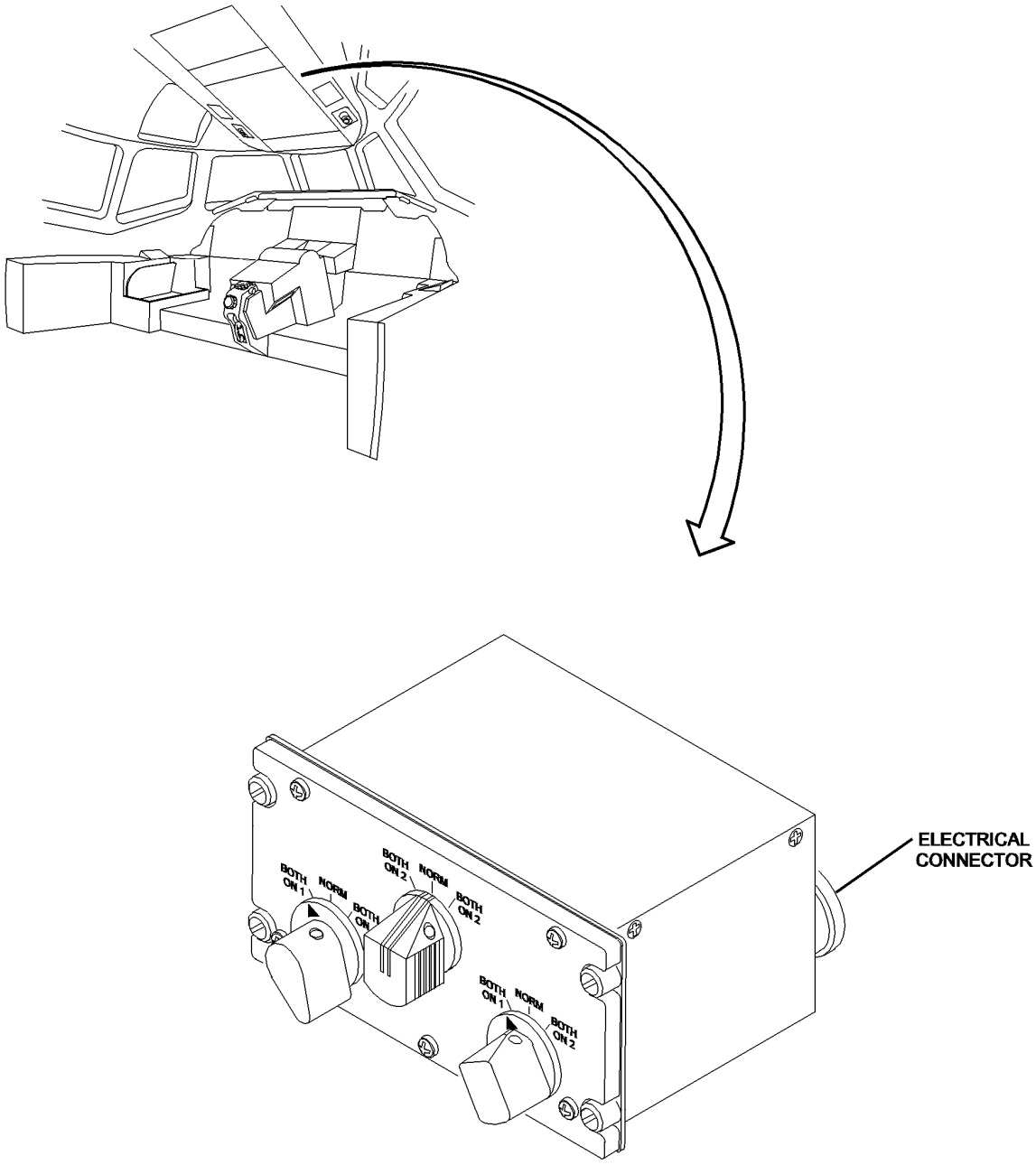
(2) Slide panel into mount and tighten fasteners.

(3) Perform test of instrument switching panel. (Paragraph 8.C.)

C. Test Instrument Switching Panel

(1) Place all switches to the NORM position.

(2) Perform Return To Service (RTS) BIT (DFGS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, page 201)



Instrument Switching Panel - Maintenance Practices
Figure 203/34-00-00-990-867

FLIGHT ENVIRONMENT DATA - DESCRIPTION AND OPERATION

1. General

A. This section describes that portion of equipment which senses environmental conditions and uses the data to influence navigation. The various systems provide, through air sensing equipment, navigation and flight safety information to the pilots to indicate minimum and maximum limits of operation while the airplane is airborne.

2. Pitot-Static

A. The pitot-static system consists of pitot tubes and static ports and the associated piping. The system supplies environmental pressures necessary for operation of the air data computing system, standby altimeter/airspeed indicator, cabin altimeter, and cabin pressure control.

3. Altitude

A. The altitude system consists of the captain's and first officer's primary altimeter driven from the digital air data computer, and the standby altimeter/airspeed indicator driven from the static and pitot system.

4. Mach Airspeed and Overspeed Warning

A. The captain's and first officer's mach airspeed indicators are driven from the applicable digital air data computer to display mach, maximum airspeed, and indicated airspeed. An output from the air data computing system is fed to the central aural warning unit, which annunciates an overspeed condition. A standby, altimeter/airspeed indicator is driven by pitot static input.

5. Vertical Speed Indicator

A. The captain's and first officer's vertical speed indicators use an analog, input from the applicable air data computer to provide a display of the ascent or descent speed of the airplane.

WJE 401-404, 406-408, 411, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 886, 887, 891

6. True Airspeed and Static Air Temperature

A. The SAT/TAS indicator uses a digital input from air data computer-2 to provide a display of static air temperature and true airspeed. The total air temperature (TAT) sensor furnishes an input to both digital air data computers.

WJE ALL

7. Air Data Computing

A. The digital air data computers use inputs from the pitot-static system and total air temperature sensor to furnish indications of environmental conditions necessary for navigation. The system also furnishes inputs to the digital flight guidance computer.

8. Total Air Temperature and Thrust Rating

A. The total air temperature and thrust rating system provides numeric displays of RAM air temperature (RAT) and thrust rating parameter, mode selection, and failure indication. The outputs of thrust rating computations from the Digital Flight Guidance Computers are a function of RAT, pressure altitude, thrust information, bleed air conditions, and selected flight mode.

PITOT STATIC SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The pitot static system provides pitot (impact) pressure and static (outside air) pressure for operation of the air data computers, standby altimeter airspeed indicator, cabin pressure controllers, cabin altimeter differential indicator and engine transducers. Static air is also provided for the metric altimeter when installed.

B. The pitot static system consists of four pitot tubes, two static plates and two static ports interconnected to form five separate static source systems, two manifolds, two static selector valves, and the associated interconnecting stainless steel tubing.

C. Pitot System - Three pitot heads are located on the upper fuselage nose, one on left side (Captains), one on right side (First Officers), and one in the center (auxiliary). The Captain's supplies pitot pressure to air data computer-1, First Officer's supplies pitot pressure to air data computer-2, and the auxiliary supplies pitot pressure to the standby altimeter/airspeed indicator. The pitot heads have integral heaters and drain holes to prevent icing and moisture accumulation. The fourth pitot tube is located on the vertical stabilizer leading edge and supplies pitot pressure to the rudder limiter bellows.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

D. Static System - The two static sources are located symetrically, on each side of the forward fuselage area. The corresponding ports on left and right sides are connected together to form five static systems as follows: Captains, First Officers, auxiliary, cabin, and alternate. The Captains, First Officers, auxiliary, and cabin static ports are located in a cluster on the same compensating plate on the upper part of the fuselage. The alternate is a single port located more forward and on the lower part of the fuselage. The Captain's static system supplies static air to CADC-1, First Officer's to CADC-2, Auxiliary to Cabin Pressure Controller-2, Cabin to Cabin Pressure Controller-1 and Cabin Altimeter, and alternate to Standby Altimeter/Airspeed Indicator and Captain's or First Officer's system as applicable to static selector valve position. Electrically heated blankets are installed at the static plates and ports to prevent icing of the ports. Control for the heater circuits is located on the overhead panel in the flight compartment. Condensation drain caps are installed in the static lines and located in the nosewheel well and electrical/electronics compartment.

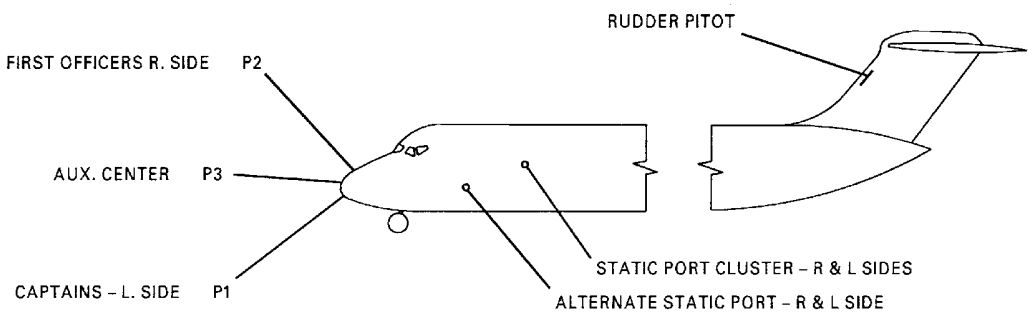
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

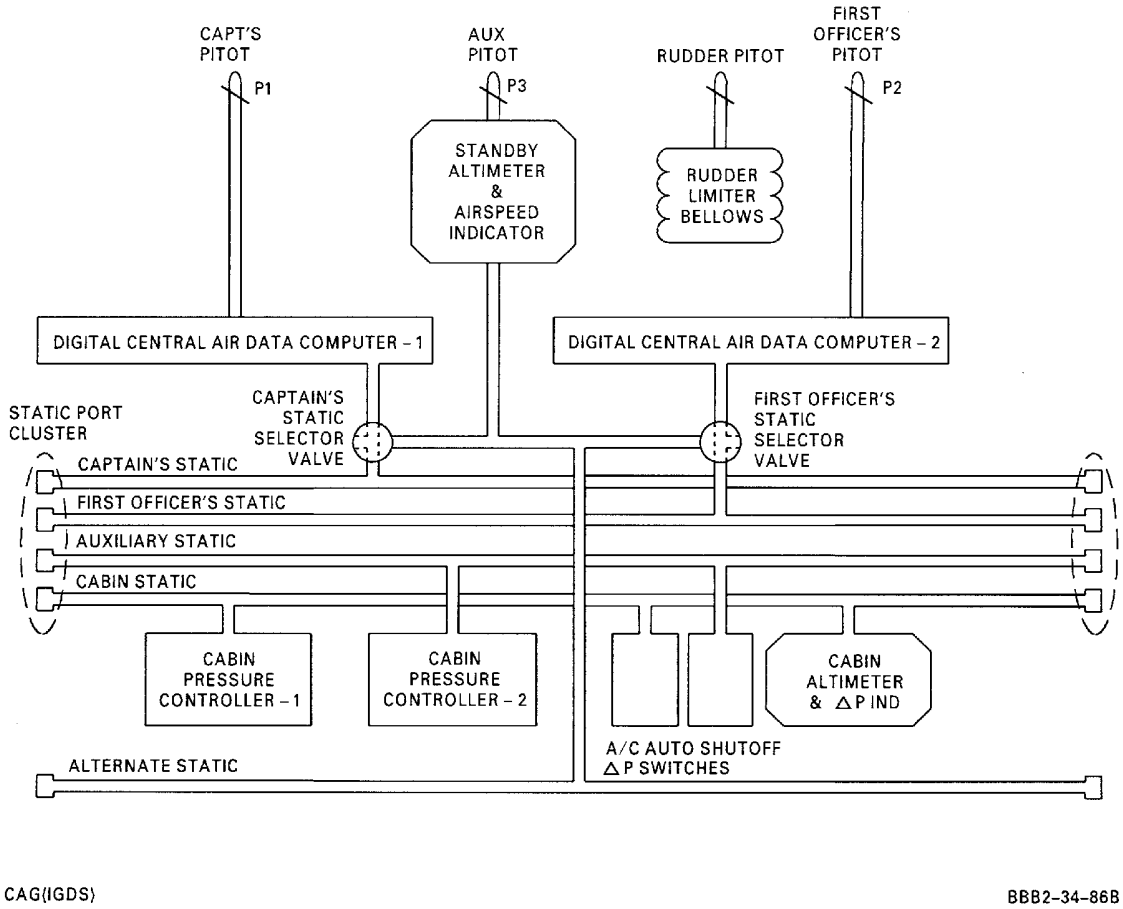
E. Static System - The two static sources are located symetrically, on each side of the forward fuselage area. The corresponding ports on left and right sides are connected together to form five static systems as follows: Captains, First Officers, auxiliary, cabin, and alternate. The Captains, First Officers, auxiliary, and cabin static ports are located in a cluster on the same compensating plate on the upper part of the fuselage. The alternate is a single port located more forward and on the lower part of the fuselage. The Captain's static system supplies static air to CADC-1; First Officer's to CADC-2; Auxiliary to Cabin Pressure Controller-2, Fwd Cabin Pressure Safety Valve and Standby Metric Altimeter; Cabin to Cabin Pressure Controller-1, Aft Cabin Pressure Safety Valve and Cabin Altimeter; and alternate to Captain's or First Officer's system as applicable to static selector valve position. Electrically heated blankets are installed at the static plates and ports to prevent icing of the ports. Control for the heater circuits is located on the overhead panel in the flight compartment. Condensation drain caps are installed in the static lines and located in the nosewheel well and electrical/electronics compartment.

WJE ALL

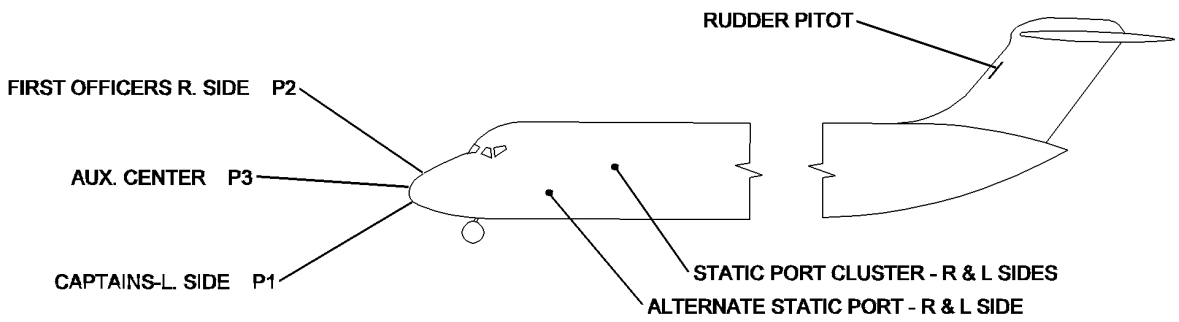
F. Two static selector valves are located, one on the Captain's instrument panel, and one on the First Officer's instrument panel. The valves are a two position valve and are placarded, NORM and ALT. The valves are utilized in the ALT position to supply static air from the alternate static system to either the Captain's, First Officer's system or both at the same time. In the NORM position, static air is supplied as noted on paragraph begins with Static System.

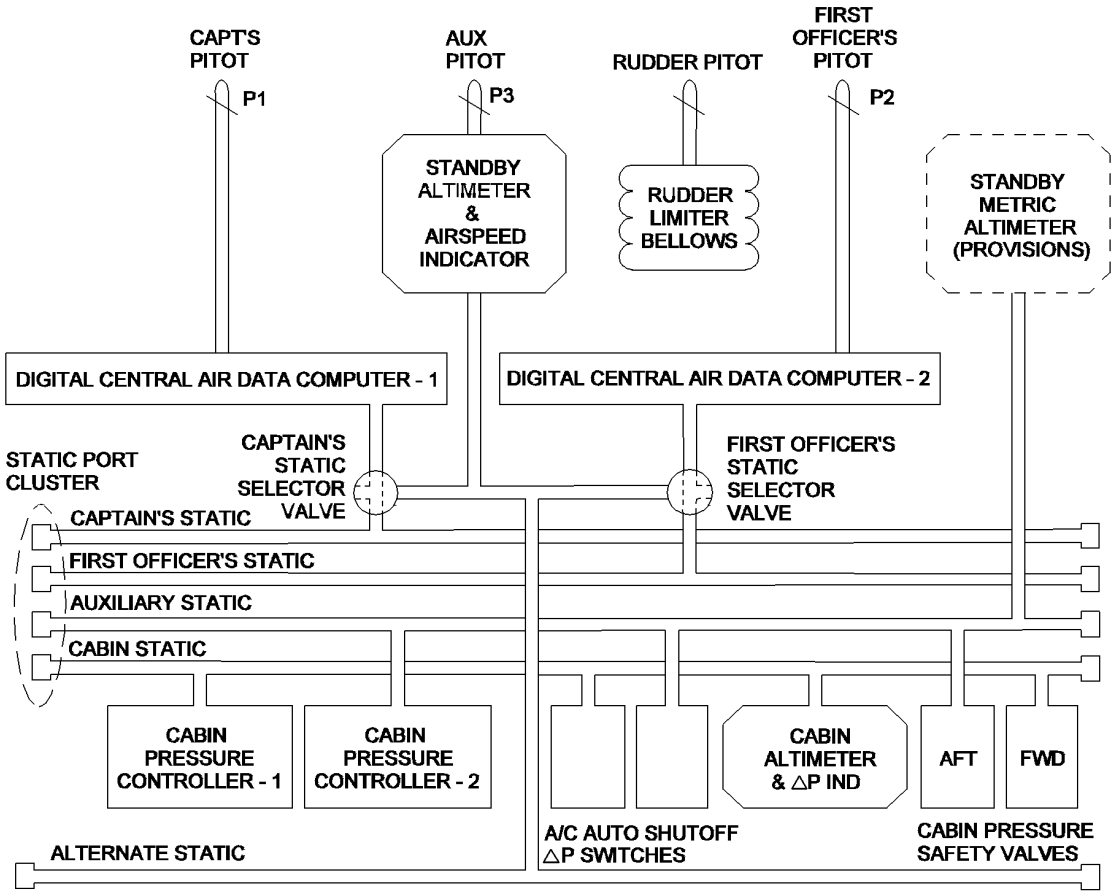
G. The pitot static systems are in operation at all times.





Pitot Static Lines
Figure 1/34-11-00-990-801 (Sheet 1 of 2)





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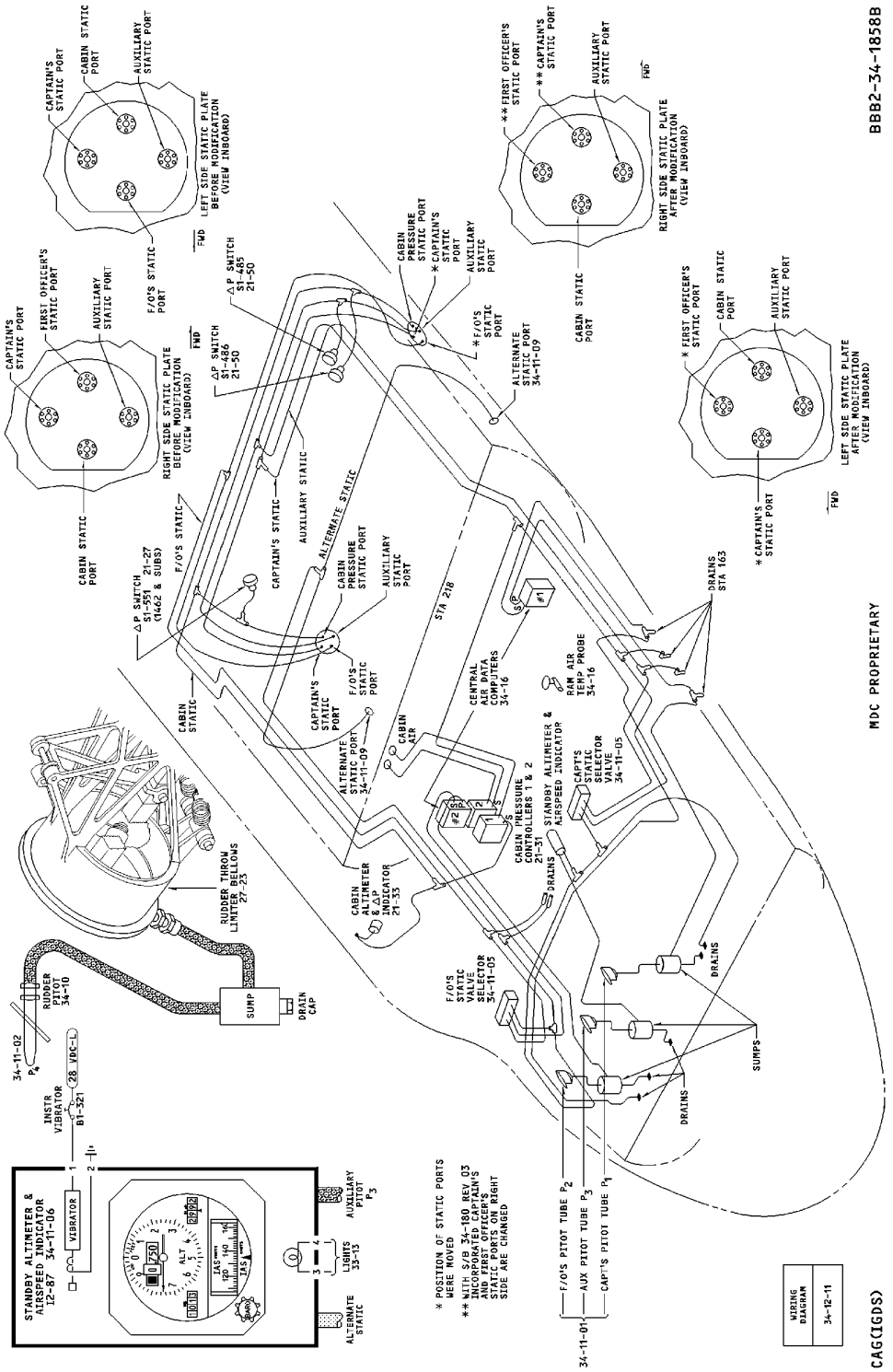
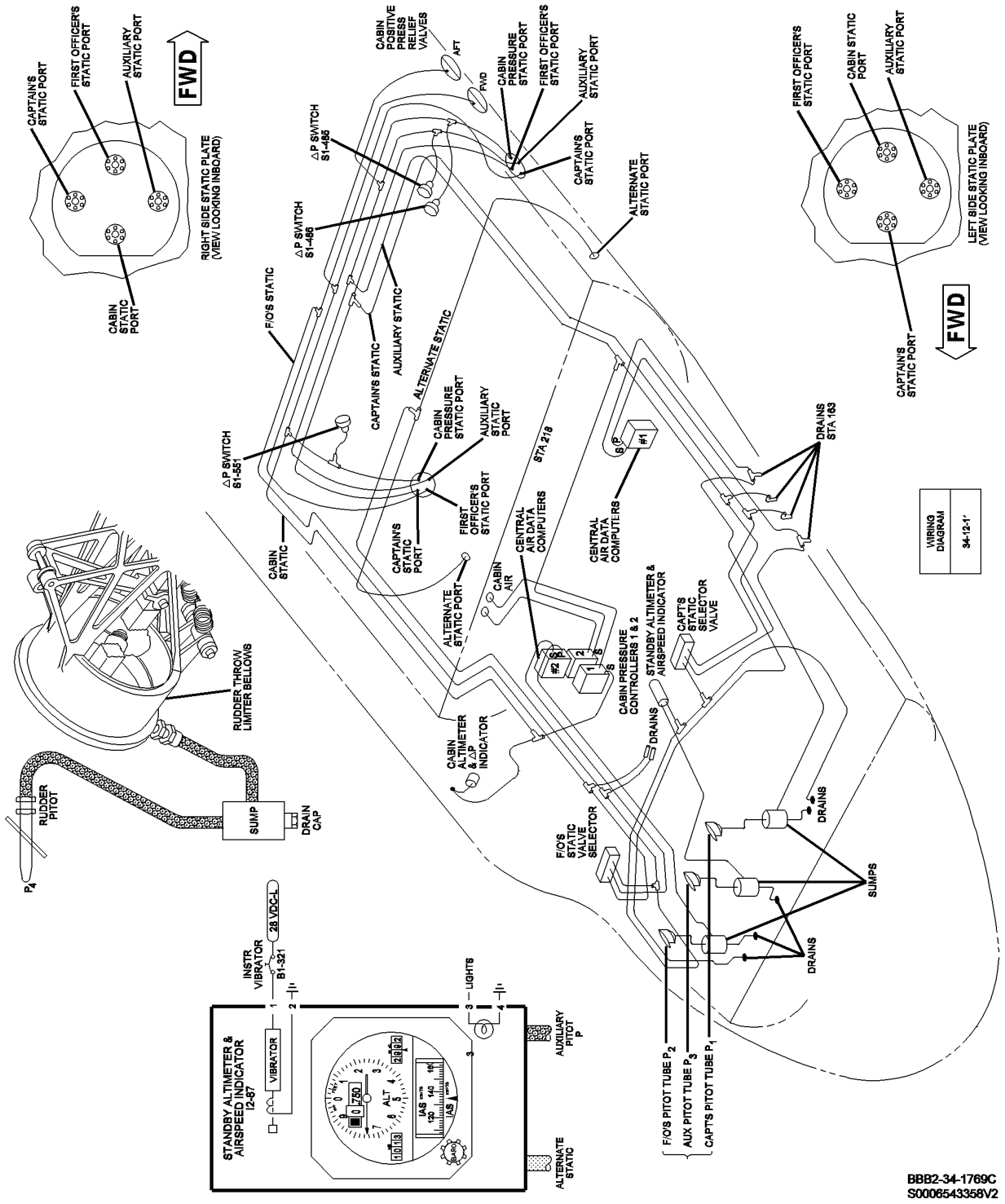
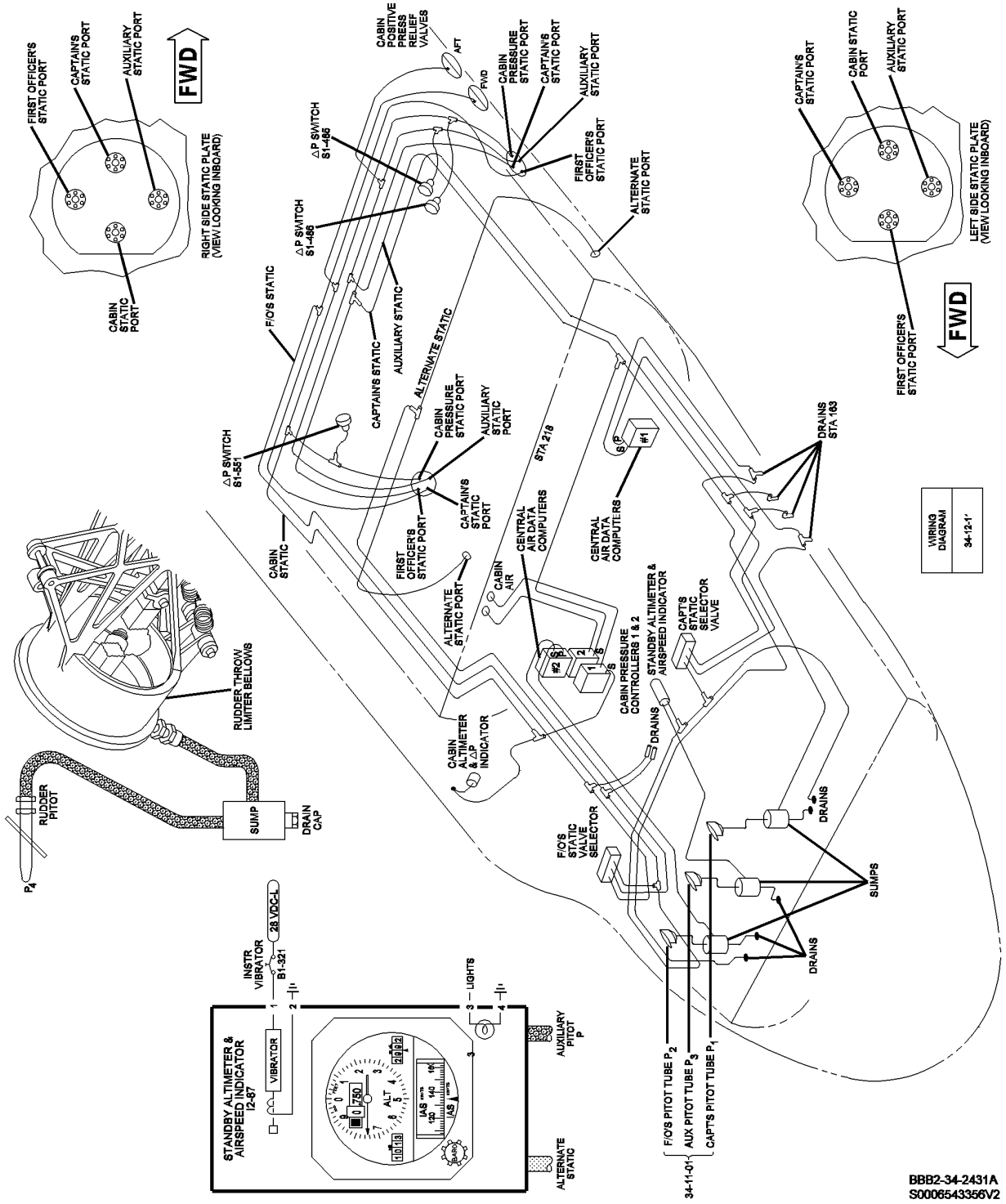
Pitot Static Lines
Figure 1/34-11-00-990-801 (Sheet 2 of 2)



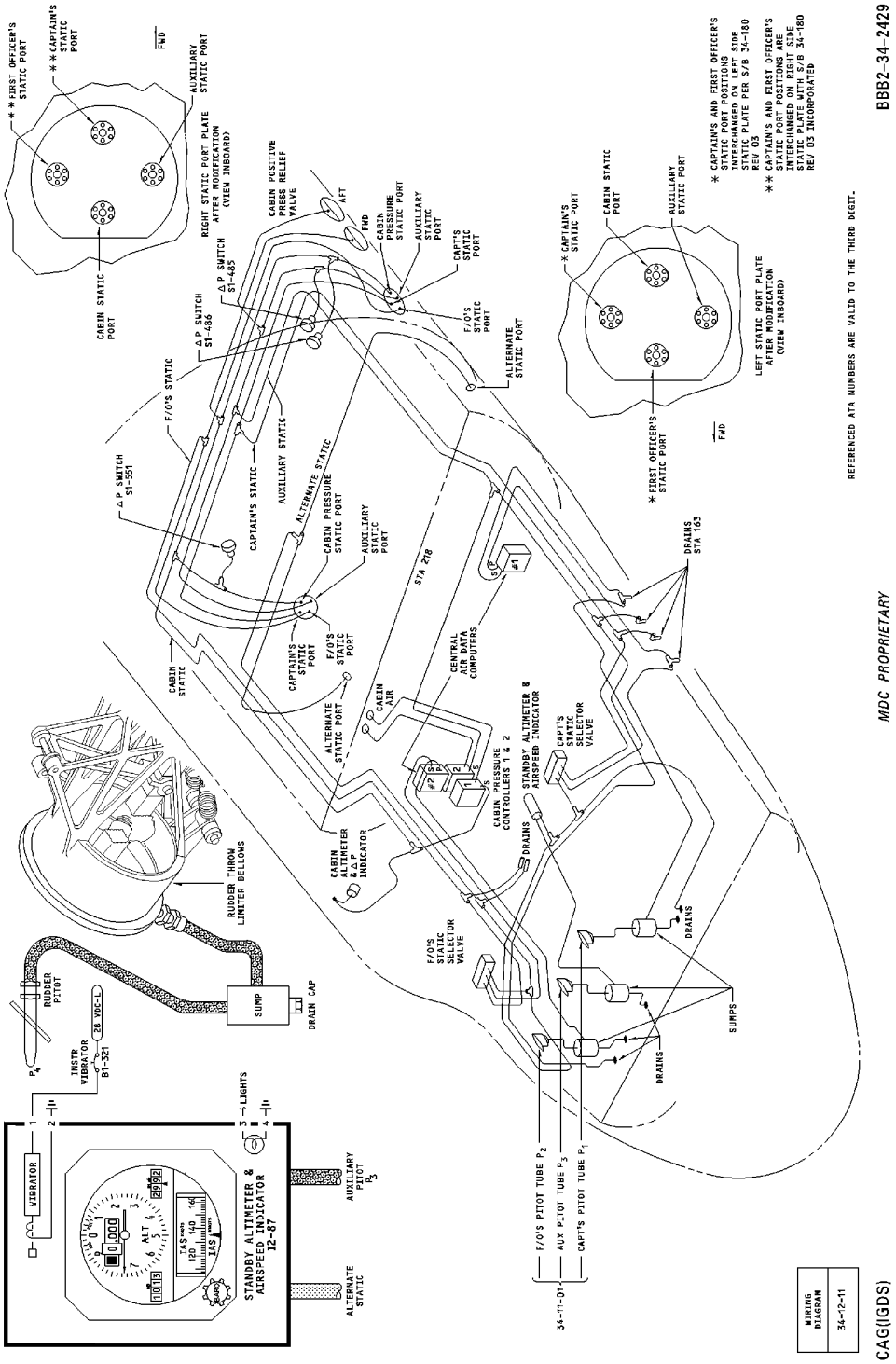
Pitot Static System
Figure 2/34-11-00-990-802 (Sheet 1 of 4)



Pitot Static System
Figure 2/34-11-00-990-802 (Sheet 2 of 4)



Pitot Static System
Figure 2/34-11-00-990-802 (Sheet 3 of 4)



Pitot Static System
Figure 2/34-11-00-990-802 (Sheet 4 of 4)

PITOT STATIC - MAINTENANCE PRACTICES

1. General

A. The pitot and static systems pitot tubes, static ports, and pneumatic piping, function to connect the airplane instrumentation with the atmosphere. The air information is primarily required for the computation of the airplane airspeed and altitude. The sampled air pressures are sensed at the equipment and converted to equivalent electrical or mechanical values to facilitate operation. The pitot and static systems installed consist of a captain's, first officer's, auxiliary, cabin and an alternate. The following procedures provide for testing each installed system.

B. Only the applicable systems need be leak tested as required. When individual system is tested, refer to paragraph Paragraph 6. after test.

C. Procedures are provided for purging the pitot and static system lines.

NOTE: Refer to (GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 34-00-00/201) for NTSB and FAA requirements for covering pitot and static ports.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Air Data Tester model No. 127-1M	Edcliff Instruments
Air Data Tester 189109200000	Kollsman, Inc.
Air Data Tester DPS1000, DPS350, DPS450, DPS500	Barfield, Inc.
Air Data Tester MPS31C, MPS34C	PMC Engineering, LLC
Tape - Polyester, Red, Silicone Adhesive DPM 850-24	Valley Industrial Products
Dry Nitrogen(DPM 154–2) (Purge Pitot and Static Lines)	Commercial
Lacing and tying tape (DPM 731–6)	Breyden Products, Inc
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893 PRE DC9-AOL-2111	
Adapter, static port 33410LH-90-5	Nav-Aids, LTD
Adapter, static port 33410SAS-90-4	Nav-Aids, LTD

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893 PRE DC9-AOL-2111 (Continued)

Table 201 (Continued)

Name and Number	Manufacturer
WJE ALL	
Pitot head adapter 7131A-1	Edcliff Instruments
Pitot head adapter P15589M1-3 (Optional)	Nav-Aids, LTD.
Adapter, Rudder limiter pitot tube P62261M-3	Nav-Aids, LTD.
WJE ALL POST DC9-AOL-2111	
Adapter, static port 33410LH-125-4	Nav-Aids, LTD

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

3. **Pitot-Static System Leak Check Requirements**

A. No Pitot-Static System Leak Check Is Required For The Following Conditions:

(1) Following disconnection/reconnection of any pitot-static hoses that have quick disconnect fittings, including those on the CADC's, Standby Altimeter/Airspeed Indicator, and Cabin Pressure Controllers, but the following checks of the quick disconnect fittings must be made:

(a) When the quick disconnect fittings are reconnected, verify proper connection by visually inspecting the bayonet interlock through the inspection holes on the side of the locking collar.

(b) Gently pull on the back of the disconnect fitting to verify they are properly secured.

(2) Following the removal and reinstallation of any electrically operated air data instruments, including: primary altimeters, primary mach-airspeed indicators, and vertical speed indicators.

B. A 26,000 Foot Pitot-Static System Leak Check Must Be Performed Under The Following Conditions:

(1) At Base Overhaul.

(2) When a pitot-static system leak check is called for by a phase check item.

(3) When a leak is suspected, but is not revealed by a 3,000 foot leak check.

(4) For any pilot discrepancy report which cannot be fault isolated and corrected by a pressure unit (LRU) replacement or 3,000 foot leak check.

(5) After any major repair or modification to the pitot-static system tubing.

(6) After removal/replacement of a static port or pitot tube.

(7) After full purging of the pitot-static system.

C. A 3,000 Foot Pitot-Static System Leak Check Must Be Performed Under The Following Conditions:

(1) Any time a pitot-static line, cabin static line, or auxiliary static line, is opened at a B-nut fitting.

(2) Any time standby altimeter/airspeed indicators without quick disconnect pitot-static fittings and cabin altimeter/delta-P indicator hoses are disconnected and reconnected to a B-nut fitting.

(3) For initial troubleshooting of a suspected pitot-static system leak; if no leak is identified, the 26,000 foot leak check must be accomplished.

WJE 875-879

4. Pitot-Static System Test Requirements

A. General

(1) Whenever maintenance has been performed on a pitot or static system resulting in connectors being opened, a check for leakage must be performed. The conditions that determine whether a 3,000 foot or 26,000 foot leak test is required are listed below.

B. A 26,000 foot pitot-static system leak test must be performed under the following conditions. (See Paragraph 4.C. for 3,000 foot check requirements.)

(1) At Base Overhaul.

(2) When a pitot-static system check is called for by a phase check item.

(3) When a leak is suspected that is not revealed by a 3,000 foot check.

(4) For any flight discrepancy report which cannot be corrected by a pressure unit change or a 3,000 foot check.

(5) After any major repair or modification to the pitot-static system tubing.

(6) After removal or replacement of a static port or pitot tube.

(7) After purging the pitot-static system.

C. A 3,000 foot minimum check of the pitot-static system must be performed under the following conditions: (See Paragraph 4.B. for 26,000 foot check requirements.)

(1) Any time a static or pressure instrument is changed, or a line is opened during routine maintenance and a 26,000 foot check is not required.

(2) Check the static system only (3,000 foot check) when air data instruments or central air data computers are changed, and pitot lines and instruments have not been disturbed.

(3) On aircraft with quick disconnects attaching the pitot and static lines to the units in the air data system, a 3000 foot leak check is not required when the following steps are performed:

(a) When the quick disconnects are reconnected, verify proper connection by visually inspecting the bayonet interlock through the inspection holes on the side of the locking collars.

(b) Gently pull on the back of the quick disconnects to verify the pitot and static line connectors are secured to the unit.

(4) On aircraft with quick disconnects, changing the cabin pressure controllers does not require a check for leakage in the cabin static or auxiliary static systems. All other aircraft require leak check.

WJE ALL

5. Adjustment/Test Pitot Static Systems

A. Safety and Operating Precautions

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(1) Line maintenance personnel must be alert to the fact that under certain conditions, central air data computer (CADC) operation can result in sudden movement of powered control surfaces. This condition is only present when the Flight Guidance system is in operation. Under these conditions, actuation of the self-test or application of pitot static pressures, provides CADC outputs that can cause a FLIGHT Guidance corrective response and result in movement of the control surfaces. Therefore, prior to applying pitot static pressure or depressing the PUSH TO TEST switch on the CADC front panel, it is necessary to open, tag, and safety Flight Guidance system circuit breakers.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

B. Leak Test Captain's Pitot and Static Systems (26,000 foot)

Table 202

Step	Operation	Desired Result
(1)	Place central air data computer switching unit selector switch and CAPT's and F/O, static air selector switches on gusset panels to NORM position.	
(2)	Seal captain's pitot tube drain holes utilizing tape or other suitable device.	
(3)	Connect Air Data Tester to captain's pitot tube utilizing suitable adapter.	
(4)	Connect Air Data Tester to captain's static port utilizing suitable adapter.	
(5)	Seal opposite captain's static port utilizing tape or other suitable device.	
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
WJE ALL		
(6)	Adjust Air Data Tester for 29.92 inches Hg. (as applicable)*	*Adjusting air data tester may not be applicable for different testers.
(7)	On captain's Altimeter, adjust BARO knob for Altimeter display that agrees with Air Data Tester display.	

Table 202 (Continued)

Step	Operation	Desired Result
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
(8)	Set Air Data Tester airspeed for 335(±5) knots.	Applies air pressure to pitot system.
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(8)	Set Air Data Tester airspeed for 350(±5) knots.	Applies air pressure to pitot system.
WJE ALL		
(9)	Set Air Data Tester altitude for 26,000 feet.	Applies vacuum to static system.
(10)	Record altitude indicated on Altimeter.	
(11)	Record airspeed indicated on Mach Airspeed Indicator.	
(12)	Actuate Air Data Tester pitot and static leak test switches.	Seals source from pitot and static systems.
(13)	After 1 minute, compare indications with recorded values from steps (10) and (11).	Changes should not exceed following:
		Altitude 100 feet
		Airspeed 5 knots
(14)	Release Air Data Tester pitot and static leak test switches.	
(15)	Slowly return Air Data Tester and pitot, static systems pressure to atmospheric pressure.	Rate not to exceed 6000 feet per minute.
WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.		
(16)	Remove tape and disconnect Air Data Tester.	
(17)	Captain's system test complete.	

C. Leak Test First Officer's Pitot and Static Systems (26,000 foot)

Table 203

Step	Operation	Desired Result
(1)	Place central air data computer switching unit selector switch and CAPT'S and F/O's static selector switches on gusset panels to NORM position.	
(2)	Seal first officer's pitot tube drain hole utilizing tape or other suitable device.	
(3)	Connect Air Data Tester to first officer's pitot tube utilizing suitable adapter.	
(4)	Connect Air Data Tester to first officer's static port utilizing suitable adapter.	

Table 203 (Continued)

Step	Operation	Desired Result
(5)	Seal opposite first officer's static port utilizing tape or other suitable device.	
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
WJE ALL		
(6)	Adjust Air Data Tester for 29.92 inches Hg.	
(7)	On first officer's Altimeter, adjust BARO knob for altimeter display that agrees with Air Data Tester display.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(8)	Set Air Data Tester airspeed for 350(±5) knots.	Applies air pressure to pitot system.
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
(8)	Set Air Data Tester airspeed for 335(±5) knots.	Applies air pressure to pitot system.
WJE ALL		
(9)	Set Air Data Tester altitude for 26,000 feet.	Applies vacuum to static system.
(10)	Record altitude indicated on Altimeter.	
(11)	Record airspeed indicated on Mach Airspeed Indicator.	
(12)	Actuate Air Data Tester pitot and static leak test switches.	Seals source from pitot and static systems.
(13)	After 1 minute, compare indications with recorded values from steps (10) and (11).	Changes should not exceed following:
		Altitude 100 feet

Table 203 (Continued)

Step	Operation	Desired Result
		Airspeed 5 knots
(14)	Release Air Data Tester pitot and static leak test switches.	
(15)	Slowly return Air Data Tester and pitot, static systems pressure to atmospheric pressure.	Rate not to exceed 6000 feet per minute.
WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.		
(16)	Remove tape and disconnect Air Data Tester.	
(17)	First Officer's system test complete.	

D. Leak Test Auxiliary Pitot and Alternate Static Systems (26,000 foot)

(1) Place static air selector switch on CAPT and F/O, gusset panels to ALT position.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
U	31	B1-831	CAWS OVERSPEED ENG FIRE HORIZ STAB

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR

Table 204

Step	Operation	Desired Result
(1)	Seal AUX pitot tube drain hole utilizing tape or other suitable device.	
(2)	Connect Air Data Tester to AUX pitot tube utilizing suitable adapter.	

Table 204 (Continued)

Step	Operation	Desired Result
(3)	Connect Air Data Tester to alternate static port utilizing suitable adapter.	
(4)	Seal opposite alternate static port utilizing tape or other suitable device.	
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
WJE ALL		
(5)	Adjust Air Data Tester for 29.92 inches Hg.	
(6)	On standby altimeter/airspeed and Captain's and First Officer's Altimeter indicators, adjust BARO knob for altimeter display that agrees with Air Data Tester display.	

NOTE: During accomplishment of the auxiliary pitot and alternate static leak test, the overspeed aural warning may be heard and may be ignored. This is a nuisance output of CADC-1 and caused by the lack of pitot pressure into CADC-1 via the captain's pitot tube when the static source to CADC-1 is pressurized. The following circuit breakers may be opened to shut off the OVERSPEED AURAL WARNING for the duration of this test:

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(3) Open this circuit breaker and install safety tag:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
U	31	B1-831	CAWS OVERSPEED ENG FIRE HORIZ STAB

Table 205

Step	Operation	Desired Result
(7)	Set Air Data Tester airspeed for 335(±5) knots.	Applies air pressure to pitot system.
(8)	Set Air Data Tester altitude for 26,000 feet.	Applies vacuum to static system.
(9)	Record altitude and airspeed indicated on standby Altimeter/airspeed indicator.	
(10)	Record altitude indicated on Captain's and First Officer's altimeter.	
(11)	Actuate Air Data Tester pitot and static leak test switches.	Seals source from pitot and static systems.
(12)	After 1 minute, compare indications with recorded values from step (9) and (10).	Changes should not exceed following:
		Altitude 100 feet
		Airspeed 5 knots
(13)	Release Air Data Tester pitot and static leak test switches.	
(14)	Slowly return Air Data Tester and pitot, static systems pressure to atmospheric pressure.	
WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.		
(15)	Remove tape and disconnect Air Data Tester.	
(16)	Alternate system test complete. Return airplane to required configuration.	

E. Leak Test Auxiliary Static System (26,000 foot)

Table 206

Step	Operation	Desired Result
(1)	Connect Air Data Tester to auxiliary static port utilizing suitable adapter.	
(2)	Seal opposite auxiliary static port utilizing tape or other suitable device.	
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		

Table 206 (Continued)

Step	Operation	Desired Result
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
WJE ALL		
(3)	Adjust Air Data Tester for 29.92 inches Hg.	
(4)	Set Air Data Tester altitude for 26,000 feet.	Applies vacuum to static
(5)	Actuate Air Data Tester static leak test switch.	Seals source from static system.
(6)	After 1 minute check altitude display on Air Data Tester.	Air Data Tester altitude display should not change by more than 100 feet.
(7)	Release Air Data Tester static leak test switch.	
(8)	Slowly return Air Data Tester static system pressure to atmospheric pressure.	Rate not to exceed 6000 feet per minute.
WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.		
(9)	Remove tape and disconnect Air Data Tester.	
(10)	Auxiliary static system test complete.	

F. 3,000 Foot Pitot-Static System Leak Test

NOTE: Only the pitot and/or static system(s) on which lines have been disconnected need to be checked.

Table 207

Step	Operation	Desired Result
(1)	Place central air data computer switching unit selector switch and CAPT's and F/O, static air selector switches on gusset panels to NORM or ALT as applicable.	No Test.

Table 207 (Continued)

Step	Operation	Desired Result
(2)	Seal applicable pitot tube drain holes utilizing tape or other suitable device.	No Test.
(3)	Connect Air Data Tester to applicable pitot tube utilizing suitable adapter.	No Test.
(4)	Connect Air Data Tester to applicable static port utilizing suitable adapter.	No Test.
(5)	Seal applicable opposite static port utilizing tape or other suitable device.	No Test.
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
WJE ALL		
(6)	Adjust Air Data Tester for 29.92 inches Hg. (as applicable)	Adjusting air data tester may not be applicable for different testers.
(7)	On applicable Altimeter, adjust BARO knob for Altimeter display that agrees with Air Data Tester display.	Altimeter display agrees with Air Data Tester display.
(8)	Set Air Data Tester airspeed for 250 knots.	Applies air pressure to pitot system.
(9)	Set Air Data Tester to 3,000 feet above ramp altitude.	Applies vacuum to static system.
(10)	Record altitude indicated on Altimeter.	Altitude recorded.
(11)	Record airspeed indicated on Mach Airspeed Indicator.	Airspeed recorded.
(12)	Actuate Air Data Tester pitot and static leak test switches.	Seals source from pitot and static systems.
(13)	After 1 minute, compare indications with recorded values from steps (10) and (11).	Changes should not exceed the following:

Table 207 (Continued)

Step	Operation	Desired Result
		Altitude 60 feet
		Airspeed 2.5 knots
(14)	Release Air Data Tester pitot and static leak test switches.	Source to pitot and static systems unsealed.
(15)	Slowly return Air Data Tester and pitot-static systems pressure to atmospheric pressure.	Rate not to exceed 6,000 feet per minute.
WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.		
(16)	Remove tape and disconnect Air Data Tester.	No test.

G. Leak Test Cabin Static System

Table 208

Step	Operation	Desired Result
(1)	Connect Air Data Tester to Cabin static port.	
NOTE: When Air Data Tester is connected to only one static port, only corresponding port on opposite side of aircraft should be sealed.		
(2)	Adjust test apparatus altimeter to 29.92 in. Hg.	
(3)	Adjust Air Data Tester altitude to 20,000 feet.	
(4)	Seal off vacuum source to static ports for one minute.	
(5)	Air Data Tester altitude display should not change by more than 100 feet.	100 ft. Altitude change
WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893		
NOTE: When changing altitude do not exceed 6,000 feet/minute.		
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
NOTE: When changing altitude do not exceed 15,000 feet/minute.		
WJE ALL		
(6)	Slowly return static pressure to atmospheric pressure.	

H. Test Vertical Stabilizer Pitot Line

(1) Connect pitot line from test set to vertical stabilizer pitot tube.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893 (Continued)

CAUTION: DO NOT EXCEED 100 KNOTS PER MINUTE INDICATED RATE OF CHANGE ON PITOT TUBES.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

CAUTION: DO NOT EXCEED 250 KNOTS PER MINUTE INDICATED RATE OF CHANGE ON PITOT TUBES.

(2) Slowly apply pitot pressure to increase airspeed to 300 knots as indicated by test set airspeed indicator.

WJE ALL

(3) Observe test set airspeed indicator for one minute. Airspeed should not decrease more than 10 knots.

(4) Slowly return pitot pressure to zero.

(5) Remove test line from vertical stabilizer pitot tube.

I. Air Data Indicator Tolerance Checks

NOTE: This procedure checks the air data indicators to a calibrated source (Air Data Tester).

Table 209 MD-81, 82, 83, 88 Air Data Indicator Tolerance

MD-81, 82, 83, 88 Series Aircraft					
ALTITUDE		1,000	5,000	25,000	35,000
AIRSPEED		150	250	340	280
ALTIMETER	MIN. MAX.	980 1,020	4,960 5,040	24,860 24,980	34,860 35,010
AIRSPEED POINTER	MIN. MAX.	145 155	245 255	334 344	274 284
VMO POINTER	MIN. MAX.	340 346	340 346	340 346	286 293
MACH	MIN. MAX.	- -	.402 .422	.796 .806	.812 .822
STANDBY ALTIMETER	MIN. MAX.	950 1,050	4,900 5,100	24,800 25,200	34,750 35,250
STANDBY AIRSPEED	MIN. MAX.	140 160	240 260	330 350	270 290

(1) Set air data tester to values as shown. (Table 209)

(2) Check that air data indicators on aircraft are within tolerances specified in Table 209.

6. Leak Test Termination

A. Terminate

(1) Remove air data tester.

(2) Make certain sealing tape has been removed from all static ports and pitot head drain holes.

(3) Remove the safety tags and close these circuit breakers:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
U	31	B1-831	CAWS OVERSPEED ENG FIRE HORIZ STAB

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE ALL			

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(4) Return aircraft to required configuration.

7. Purge Pitot and Static Systems

A. Full Purge

CAUTION: CONTROL DRY NITROGEN GAS PRESSURES WHEN YOU REMOVE THE GAS. DO NOT LET THE PRESSURE RATE BE MORE THAN 12 POUNDS PER SQUARE INCH.

(1) Disconnect pitot and static terminating lines from all pressure operated air data instruments, air data computers, cabin differential pressure indicator, cabin pressure controllers, differential pressure switches and cabin pressure safety valves, if installed.

(a) Disconnect fittings from all pitot/static lines.

(b) Remove drain caps as required.

CAUTION: SECURE THE FLEXIBLE PRESSURE LINES TO PREVENT WHIPPING MOVEMENT WHEN PRESSURE IS APPLIED.

(2) Connect purging nitrogen source to pitot or static line at the forward and highest point of the system.

(3) Apply dry nitrogen purge for a period of three minutes, regulate flow rate and do not exceed 12 psi (83 kPa).

(4) Conclude purging operation, return system to normal configuration.

(5) Do a visual inspection of pitot/static ports and lines and verify no debris is present.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

(6) Perform system leak test as applicable (Paragraph 3.).

WJE 875-879

(7) Perform system leak test as applicable (Paragraph 4.).

WJE ALL

B. Quick Purge of the CADC Static System using the Quick Disconnect Fitting

(1) General:

(a) This procedure applies only to the CAPT (Captain) and First Officer (F/O) with quick-disconnect fittings that attach the static system lines. This procedure uses the quick-disconnect fittings on the aircraft-side static system lines to purge the lines without the need to do a system leak check. When troubleshooting has identified the one defective system, this procedure can be used to purge the defective system without the requirement to do a subsequent leak check.

NOTE: This quick purge procedure can be done on only one static system at a time. If the CAPT and F/O static systems are purged with this procedure during one maintenance interval, a low level leak check is necessary for the two systems to be validated before the subsequent flight.

(b) A suspected static system blockage may be identified by comparing the baro-corrected altimeter indications of the Captain's and First Officer's altimeters, while the aircraft is on the ground. The altimeter readings should closely match the actual local field altitude. If one altimeter indication is significantly higher than the local field altitude, that system may be considered suspect for a static line blockage.

This may be accomplished by adjusting the local barometric setting using the BARO knob on the Captain's and First Officer's altimeters. The barometric setting should be the same for both systems. The resultant altimeter indication on both altimeters should be within 50 feet of the local field altitude. If one altimeter is significantly different from the local field altitude and the other altimeter, then the discrepant reading may indicate a static line blockage, and that system may be quick purged per the following procedure.

(2) Job-Setup

CAUTION: MAKE SURE THAT THE STATIC AIR SELECTOR SWITCH FOUND ON THE CAPTAIN'S AND FIRST OFFICER'S GUSSET PANELS ARE IN THE NORM POSITION BEFORE YOU APPLY NITROGEN GAS PRESSURE TO THE STATIC SYSTEM LINE. THIS WILL CAUSE DAMAGE TO THE STANDBY INSTRUMENTS.

(a) Put the STATIC AIR selector switches on the CAPT and F/O gusset panels in the NORM position.

(b) Disconnect the static system line from the applicable Central Air Data Computer (CADC)

1) Secure the flexible pressure lines with lacing and tying tape to prevent whipping movement when pressure is applied.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1347, GAS/NITROGEN/DRY (DPM 154-2)

HAZMAT 1000, REFER TO MSDS

(c) Connect a regulated source of dry nitrogen to the static line with an adapter with a quick-disconnect half from the static system line removed from the CADC

NOTE: The adapter can be made locally to give a connection of the regulated nitrogen source line to the quick-disconnect fitting half on the end of the aircraft-side static system line removed from the CADC

(3) Quick Purge Of The CADC Static System:

CAUTION: DO NOT APPLY MORE THAN 12 PSI (83KPA) TO THE LINES. THIS CAN CAUSE DAMAGE TO THE STATIC LINES.

(a) Adjust the dry nitrogen pressure to a maximum of 12 psi (83 kPa).

1) Apply the pressure for 2 minutes.

2) Make sure that you can feel dry nitrogen leaving the applicable left and right external static ports when pressure is applied.

(b) Decrease the dry nitrogen pressure 0 psi (0 kPa).

(c) Disconnect the dry nitrogen source from the static system line.

(d) Visually examine the static port openings for all unwanted material .

(e) Release the static system line and connect to the CADC.

1) When the quick-disconnect fittings are connected, visually examine the bayonet interlock through the inspection holes on the side of the locking collar.

2) Lightly pull on the rear of the quick disconnect fitting to make sure that they are correctly connected.

(4) Job Close-Up

(a) Remove all the tools and equipment from the work area. Make sure the area is clean.

C. Purge Rudder Limiter Pitot Line

CAUTION: CONTROL DRY NITROGEN GAS PRESSURES WHEN YOU REMOVE THE GAS. DO NOT LET THE PRESSURE RATE BE MORE THAN 12 POUNDS PER SQUARE INCH.

(1) Drain rudder limiter pitot line sump (Paragraph 8.B.).

(2) Disconnect pitot line from fitting on rudder throw limiter actuator cover.

CAUTION: SECURE THE FLEXIBLE PRESSURE LINES TO PREVENT WHIPPING MOVEMENT WHEN PRESSURE IS APPLIED.

(3) Connect purging nitrogen source to pitot tube, using pitot head adapter.

(4) Apply dry nitrogen purge for a period of three minutes, regulate flow rate and do not exceed 12 psi (83 kPa).

(5) Conclude purging operation, return system to normal configuration.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

(6) Perform system leak test as applicable. (Paragraph 3.)

WJE 875-879

(7) Perform system leak test as applicable. (Paragraph 4.)

WJE ALL

8. Pitot/Static System Lines Drain Check

A. Check Drains

NOTE: The Captain's indicator/drain is located on the left side of the E/E compartment and First Officer's on the right side. The drains are a plastic hose assembly with a visible ball float that indicates level of moisture in the line. A cap on the end of the hose can be removed for moisture drainage.

(1) Gain access to E/E compartment.

(2) Check pitot and static line moisture indicator floats for indication of moisture; if indicator denotes moisture, remove cap and drain.

(a) If moisture is found, check pitot heads (probes) drains for blockage (PAGEBLOCK 34-11-02/201).

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

(3) If line required opening, install cap and leak check as required. (Paragraph 3.)

WJE 875-879

(4) If line required opening, install cap and leak check respective system as required. (Paragraph 4.)

WJE ALL

(5) Return airplane to required configuration.

B. Drain Rudder Limiter Pitot Line Sump

(1) Remove drain cap from rudder limiter pitot line sump, located in upper tail section of fuselage, and drain sump.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

(2) Install drain cap, and leak check as required. (Paragraph 3.)

WJE 875-879

(3) Install drain cap, and leak check as required. (Paragraph 4.)

WJE ALL

(4) Return airplane to required configuration.

PITOT STATIC - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG -3 task card data.

TASK 34-11-00-720-801

2. Functional Check of the Pitot and Static System for Leakage (High Altitude)

NOTE: This procedure is a scheduled maintenance task.

A. Safety and Operating Precautions

(1) Line maintenance personnel must be alert to the fact that under certain conditions, Central Air Data Computer (CADC) operation can result in sudden movement of powered control surfaces. This condition is only present when the Flight Guidance system is in operation. Under these conditions, actuation of the self-test or application of pitot static pressures, provides CADC outputs that can cause a FLIGHT Guidance corrective response and result in movement of the control surfaces. Therefore, prior to applying pitot static pressure or depressing the PUSH TO TEST switch on the CADC front panel, it is necessary to open, tag, and safety Flight Guidance system circuit breakers.

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1914	Test Set - Air Data Model FLMTS (Flight Line Maintenance) **MD80-81, -82, -83, -88** Part #: 18910920000 Supplier: 89944 Part #: DPS1000 Supplier: 21844 Part #: DPS350 Supplier: 21844 Part #: DPS450 Supplier: 21844 Part #: MPS34C Supplier: 48RQ2 Part #: MPS43 Supplier: A0197 Part #: MPS45 Supplier: 48RQ2 Part #: MPS49 Supplier: 48RQ2 Opt Part #: 18910480000 Supplier: 89944 Opt Part #: DPS500 Supplier: 21844 Opt Part #: MPS-24-E Supplier: A0197 Opt Part #: MPS-26 Supplier: A0197 Opt Part #: MPS-28 Supplier: A0197 Opt Part #: MPS-30 Supplier: 41364 Opt Part #: MPS31C Supplier: 48RQ2 Opt Part #: PV-100 Supplier: 1CE49
COM-13438	Adapter - Pitot Test **MD80-81, -82, -83, -88** Part #: P15589M1-3 Supplier: 38002
COM-13441	Adapter - Static Test **MD80-81, -82, -83, -88** Part #: 33410SAS-90-4 Supplier: 38002
COM-13442	Adaptor - Static Test **MD80-81, -82, -83, -88** Part #: 33410SAS-125-4 Supplier: 38002

(Continued)

Reference	Description
COM-14369	Adapter, Rudder Throw Limiter, Pitot Tube **MD80-81, -82, -83, -88** Part #: P62261M-3 Supplier: 38002

C. Consumable Materials

NOTE: Equivalent replacements are permitted for the items that follow.

NOTE: It is possible that some materials in the Consumable Materials chart cannot be used for some or all of the necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Reference	Description	Specification
G60355	Tape - Polyester, Red, Silicone Adhesive	DPM 850-24

D. Prepare for the Functional Check of the Pitot and Static Systems for Leakage (High Altitude)

SUBTASK 34-11-00-865-001

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A

(Continued)

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

E. Functional Check of the Pitot and Static System for Leakage (High Altitude)

SUBTASK 34-11-00-720-001

(1) Do a functional check of the CAPT (Captain) pitot and static system for leakage.

(a) Place CADC switching unit selector switch, CAPT, First Officer (F/O) and static air selector switches on gusset panels to NORM position.

(b) Seal CAPT pitot tube drain holes utilizing red polyester tape, G60355 or other suitable device.

(c) Connect air data model test set, COM-1914 to CAPT pitot tube utilizing pitot test adapter, COM-13438.

WJE ALL POST DC9-AOL-2111; Pre AOL No MD80-AOL-2111

(d) Connect air data model test set, COM-1914 to CAPT static port utilizing static test adapter, COM-13441.

WJE ALL POST DC9-AOL-2111; Post AOL No MD80-AOL-2111

(e) Connect air data model test set, COM-1914 to CAPT static port utilizing static test adaptor, COM-13442.

WJE ALL

(f) Seal opposite CAPT static port utilizing red polyester tape, G60355 or other suitable device.

NOTE: When air data model test set, COM-1914 is connected to only one static port, only corresponding port on opposite side of aircraft must be sealed.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.

WJE ALL

(g) Adjust air data model test set, COM-1914 for 29.92 inches Hg. (as applicable).

NOTE: Adjusting air data model test set, COM-1914 may not be applicable for different testers.

(h) On CAPT altimeter, adjust BARO knob for altimeter display that agrees with air data model test set, COM-1914 display.

(i) Set air data model test set, COM-1914 altitude for 26,000 feet.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

(j) Set air data model test set, COM-1914 airspeed for 335(±5) knots.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

(k) Set air data model test set, COM-1914 airspeed for 350(±5) knots.

WJE ALL

(l) Record altitude indicated on altimeter.

(m) Record airspeed indicated on Mach Airspeed Indicator.

(n) Actuate air data model test set, COM-1914 pitot and static leak test switches.

(o) After 1 minute, compare indications with recorded values.

1) Altitude change should not exceed 100 ft.

2) Airspeed change should not exceed 5 knots.

(p) Release air data model test set, COM-1914 pitot and static leak test switches.

(q) Slowly return air data model test set, COM-1914 and pitot, static systems pressure to atmospheric pressure.

NOTE: Rate not to exceed 6000 feet per minute.

(r) Remove red polyester tape, G60355 and disconnect air data model test set, COM-1914.

SUBTASK 34-11-00-720-002

(2) Do a functional check of the F/O pitot and static system for leakage.

(a) Place CADC switching unit selector switch, CAPT, F/O and static air selector switches on gusset panels to NORM position.

(b) Seal pitot tube drain holes utilizing red polyester tape, G60355 or other suitable device.

(c) Connect air data model test set, COM-1914 to F/O pitot tube utilizing pitot test adapter, COM-13438.

WJE ALL POST DC9-AOL-2111; Pre AOL No MD80-AOL-2111

(d) Connect air data model test set, COM-1914 to F/O static port utilizing Static test adapter, COM-13441.

WJE ALL POST DC9-AOL-2111; Post AOL No MD80-AOL-2111

(e) Connect air data model test set, COM-1914 to F/O static port utilizing Static test adapter, COM-13442.

WJE ALL

(f) Seal opposite F/O static port utilizing red polyester tape, G60355 or other suitable device.

NOTE: When air data model test set, COM-1914 is connected to only one static port, only corresponding port on opposite side of aircraft must be sealed.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.

WJE ALL

(g) Adjust air data model test set, COM-1914 for 29.92 inches Hg. (as applicable)

NOTE: Adjusting air data model test set, COM-1914 may not be applicable for different testers.

(h) On F/O altimeter, adjust BARO knob for altimeter display that agrees with air data model test set, COM-1914 display.

(i) Set air data model test set, COM-1914 altitude for 26,000 feet.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

(j) Set air data model test set, COM-1914 for 335(±5) knots.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

(k) Set air data model test set, COM-1914 airspeed for 350(±5) knots.

WJE ALL

(l) Record altitude indicated on altimeter.

(m) Record airspeed indicated on Mach Airspeed Indicator.

(n) Actuate air data model test set, COM-1914 pitot and static leak test switches.

(o) After 1 minute, compare indications with recorded values.

1) Altitude change should not exceed 100 ft.

2) Airspeed change should not exceed 5 knots.

(p) Release air data model test set, COM-1914 pitot and static leak test switches.

(q) Slowly return air data model test set, COM-1914 and pitot, static systems pressure to atmospheric pressure.

(r) Remove red polyester tape, G60355 and disconnect air data model test set, COM-1914.

SUBTASK 34-11-00-865-002

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(3) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR

NOTE: During accomplishment of the auxiliary pitot and alternate static leak test, the overspeed aural warning may be heard and may be ignored. This is a nuisance output of CADC-1 and caused by the lack of pitot pressure into CADC-1 via the CAPT pitot tube when the static source to CADC-1 is pressurized. The following circuit breakers may be opened to shut off the OVERSPEED AURAL WARNING for the duration of this test:

Open this circuit breaker and install safety tag:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
U	31	B1-831	CAWS OVERSPEED ENG FIRE HORIZ STAB

SUBTASK 34-11-00-720-003

(4) Do a functional check of the auxiliary pitot and alternate static systems for leakage.

(a) Place static air selector switch on CAPT and F/O, gusset panels to ALT position.

(b) Seal AUX pitot tube drain hole utilizing red polyester tape, G60355 or other suitable device.

(c) Connect air data model test set, COM-1914 to AUX pitot tube utilizing pitot test adapter, COM-13438.

WJE ALL POST DC9-AOL-2111; Pre AOL No MD80-AOL-2111

(d) Connect air data model test set, COM-1914 to alternate static port utilizing Static test adapter, COM-13441.

WJE ALL POST DC9-AOL-2111; Post AOL No MD80-AOL-2111

(e) Connect air data model test set, COM-1914 to alternate static port utilizing Static test adapter, COM-13442.

WJE ALL

(f) Seal opposite alternate static port utilizing red polyester tape, G60355 or other suitable device.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

CAUTION: DO NOT EXCEED 15,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES. DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.

(g) Adjust air data model test set, COM-1914 for 29.92 inches Hg.

WJE ALL

(h) On standby altimeter/airspeed, CAPT and F/O altimeter indicators, adjust BARO knob for altimeter display that agrees with air data model test set, COM-1914 display.

(i) Set air data model test set, COM-1914 airspeed for 335(±5) knots.

(j) Set air data model test set, COM-1914 altitude for 26,000 feet.

(k) Record altitude and airspeed indicated on standby altimeter/airspeed indicator.

(l) Record altitude indicated on CAPT and F/O altimeter.

(m) Actuate air data model test set, COM-1914 pitot and static leak test switches.

(n) After 1 minute, compare indications with airspeed and altitude values recorded above.

1) Altitude change should not exceed 100 ft.

2) Airspeed change should not exceed 5 knots.

(o) Release air data model test set, COM-1914 pitot and static leak test switches.

(p) Slowly return air data model test set, COM-1914 and pitot, static systems pressure to atmospheric pressure.

(q) Remove red polyester tape, G60355 and disconnect air data model test set, COM-1914.

SUBTASK 34-11-00-720-005

(5) Do a functional check of the auxiliary static system for leakage.

WJE ALL POST DC9-AOL-2111; Pre AOL No MD80-AOL-2111

(a) Connect the air data model test set, COM-1914 to the auxiliary static port utilizing Static test adapter, COM-13441.

WJE ALL POST DC9-AOL-2111; Post AOL No MD80-AOL-2111

(b) Connect the air data model test set, COM-1914 to the auxiliary static port utilizing Static test adapter, COM-13442.

WJE ALL

(c) Seal opposite auxiliary static port utilizing red polyester tape, G60355 or other suitable device.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

(d) Adjust air data model test set, COM-1914 for 29.92 inches Hg.

(e) Set air data model test set, COM-1914 altitude for 26,000 feet.

(f) Actuate air data model test set, COM-1914 static leak test switch.

(g) After 1 minute check altitude display on air data model test set, COM-1914.

1) Air data model test set, COM-1914 altitude display should not change by more than 100 feet.

(h) Release air data model test set, COM-1914 static leak test switch.

(i) Slowly return air data model test set, COM-1914 static system pressure to atmospheric pressure.

1) Rate not to exceed 6000 feet per minute.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(j) Remove red polyester tape, G60355 and disconnect air data model test set, COM-1914.

SUBTASK 34-11-00-720-006

(6) Do a functional check of the Cabin Static System.

(a) Connect air data model test set, COM-1914 to the cabin static port.

NOTE: When air data model test set, COM-1914 is connected to only one static port, only corresponding port on opposite side of aircraft should be sealed.

(b) Adjust test apparatus altimeter to 29.92 inches Hg.

(c) Adjust air data model test set, COM-1914 altitude to 20,000 feet.

(d) Seal off vacuum source to static ports for one minute.

(e) Air data model test set, COM-1914 altitude display should not change by more than 100 feet.

(f) Slowly return static pressure to atmospheric pressure.

NOTE: When changing altitude do not exceed 6,000 feet/minute.

SUBTASK 34-11-00-720-007

(7) Do a functional check of the Rudder Throw Limiter Pitot System.

CAUTION: DO NOT EXCEED 100 KNOTS PER MINUTE INDICATED RATE OF CHANGE ON PITOT TUBES.

(a) Connect pitot line from test set to vertical stabilizer pitot tube utilizing Rudder Throw Limiter, Pitot Tube Adapter, COM-14369.

(b) Slowly apply pitot pressure to increase airspeed to 300 knots as indicated by test set airspeed indicator.

(c) Observe test set airspeed indicator for one minute. Airspeed should not decrease more than 10 knots.

(d) Slowly return pitot pressure to zero.

(e) Remove test line from vertical stabilizer pitot tube.

F. Job Close Up

SUBTASK 34-11-00-080-001

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(1) Make sure that all red polyester tape, G60355 is removed from static ports and drains.

SUBTASK 34-11-00-865-003

(2) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
U	31	B1-831	CAWS OVERSPEED ENG FIRE HORIZ STAB

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE ALL			

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	13	B10-346	YAW DAMPER-2

——— END OF TASK ———

TASK 34-11-00-720-802

3. Functional Check of the Standby Altimeter/Airspeed System

A. Functional Check of the Standby Altimeter/Airspeed System

SUBTASK 34-11-00-720-008

(1) Do a functional check of the standby altimeter/airspeed system.

NOTE: This task is performed as part of the Functional Check of the Pitot Static system for Leakage (High Altitude). Refer to Task Card 34-010-03-01 (AMM Task 34-11-00-720-801).

——— END OF TASK ———

TASK 34-11-00-720-803

4. Functional Test of the Captain and First Officer's Altimeter

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
24-40-00 P/B 001	EXTERNAL POWER - DESCRIPTION AND OPERATION

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1914	Test Set - Air Data Model FLMTS (Flight Line Maintenance) **MD80-81, -82, -83, -88** Part #: 18910920000 Supplier: 89944 Part #: DPS1000 Supplier: 21844 Part #: DPS350 Supplier: 21844 Part #: DPS450 Supplier: 21844 Part #: MPS34C Supplier: 48RQ2 Part #: MPS43 Supplier: A0197 Part #: MPS45 Supplier: 48RQ2 Part #: MPS49 Supplier: 48RQ2 Opt Part #: 18910480000 Supplier: 89944 Opt Part #: DPS500 Supplier: 21844 Opt Part #: MPS-24-E Supplier: A0197 Opt Part #: MPS-26 Supplier: A0197 Opt Part #: MPS-28 Supplier: A0197 Opt Part #: MPS-30 Supplier: 41364 Opt Part #: MPS31C Supplier: 48RQ2 Opt Part #: PV-100 Supplier: 1CE49

(Continued)

Reference	Description
COM-13438	Adapter - Pitot Test **MD80-81, -82, -83, -88** Part #: P15589M1-3 Supplier: 38002
COM-13441	Adapter - Static Test **MD80-81, -82, -83, -88** Part #: 33410SAS-90-4 Supplier: 38002

C. Consumable Materials

NOTE: Equivalent replacements are permitted for the items that follow.

NOTE: It is possible that some materials in the Consumable Materials chart cannot be used for some or all of the necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Reference	Description	Specification
G60355	Tape - Polyester, Red, Silicone Adhesive	DPM 850-24

D. Job Set-up - Functional Test of the Captain and First Officer's Altimeters

SUBTASK 34-11-00-865-005

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

SUBTASK 34-11-00-861-001

(2) Apply aircraft electrical power. (EXTERNAL POWER - DESCRIPTION AND OPERATION, PAGEBLOCK 24-40-00/001)

SUBTASK 34-11-00-480-002

(3) Connect the air data model test set, COM-1914 using static test adapter, COM-13441 and pitot test adapter, COM-13438 test equipment as follows:

(a) On the overhead panel, place the CADC switch to NORM. On the captain's and first officer's gusset panels, make sure the STATIC AIR switches in the NORM position.

(b) On the ATC control panel, put the mode select knob to the STBY position.

(c) To connect the air data test set to the aircraft static ports and pitot tubes, do the steps that follow:

WARNING: USE ONLY RED POLYESTER TAPE G60355 TO SEAL THE STATIC PORTS. IF THE HOLES BECOME CLOGGED WITH TAPE RESIDUE, INCORRECT AIRSPEED-SENSING AND ALTITUDE-SENSING SIGNALS CAN OCCUR. THIS CAN CAUSE DANGEROUS FLIGHT CONDITIONS.

1) Seal the captain's and first officer's pitot tube drain holes with red polyester tape, G60355 or other suitable device.

2) Connect the air data model test set, COM-1914 to the captain's and first officer's pitot tube and static ports.

3) Seal the opposite side static ports using red polyester tape, G60355 or other suitable device.

E. Procedure - Functional Test of the Captain and First Officer's Altimeters

SUBTASK 34-11-00-720-009

(1) In the flight compartment:

(a) On the captain's and first officer's altimeters, adjust the BARO knob to 29.92 in/Hg (1013.21 mBar).

WARNING: MAKE SURE ALL PERSONS AND EQUIPMENT ARE CLEAR OF THE AREAS AROUND THE CONTROL SURFACES. THE PITOT/STATIC TESTS CAN CAUSE THE AIRCRAFT CONTROL SURFACES TO MOVE. SUDDEN MOVEMENT OF THE CONTROL SURFACES CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

(2) On the air data test set:

(a) Adjust the altitude to 41,000 ft (12,497 m).

(b) Adjust the airspeed to 105 knots.

(3) On the captain's instrument panel:

(a) Compare the altitude shown on the captain's altimeter display with that shown on the air data test set. The difference between the altimeter and the test set must not be more than ±75 (±23 m).

(b) Compare the airspeed shown on the captain's airspeed indicator with that shown on the air data test set. The difference between the airspeed indicator and the test set must not be more than ±4 knots.

(4) On the first officer's instrument panel:

(a) Compare the altitude shown on the first officer's altimeter with that shown on the air data test set. The difference between the altimeter and the test set must not be more than ±75 (±23 m).

(b) Compare the airspeed shown on the first officer's airspeed indicator with that shown on the air data test set. The difference between the airspeed indicator and the test set must not be more than ±4 knots.

(5) On the air data tester:

(a) Slowly return the pitot and static pressure to the atmospheric pressure.

F. Job Close-up - Functional Test of the Captain and First Officer's Altimeters

SUBTASK 34-11-00-080-002

(1) Remove the test equipment as follows:

(a) Disconnect the air data tester from the captain's and first officer's pitot tube and static ports.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(b) Remove tape from the captain's and first officer's pitot tube drain holes and static ports.

SUBTASK 34-11-00-942-001

(2) Remove all the tools and equipment from the work area. Make sure the area is clean.

SUBTASK 34-11-00-865-004

(3) Remove the safety tags and close these circuit breakers:

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

SUBTASK 34-11-00-862-001

(4) Remove external power from the aircraft, if no longer needed. (EXTERNAL POWER - DESCRIPTION AND OPERATION, PAGEBLOCK 24-40-00/001)

——— END OF TASK ———

PITOT STATIC - INSPECTION/CHECK

1. General

A. This procedure contains MSG -3 task card data.

TASK 34-11-00-212-801

2. Inspect Pitot Static System Drains for Moisture

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
34-11-00 P/B 201 Config 1	PITOT STATIC - MAINTENANCE PRACTICES
34-11-02 P/B 201	PITOT TUBES - MAINTENANCE PRACTICES

B. Inspect Pitot Static System Drains for Moisture

NOTE: The Captain's indicator/drain is located on the left side of the E/E compartment and First Officer's on the right side. The drains are a plastic hose assembly with a visible ball float that indicates level of moisture in the line. A cap on the end of the hose can be removed for moisture drainage.

SUBTASK 34-11-00-010-001

(1) Gain access to E/E compartment.

SUBTASK 34-11-00-212-001

(2) Check pitot and static line moisture indicator floats for indication of moisture; if indicator denotes moisture, remove cap and drain.

(a) If moisture is found, check pitot heads (probes) drains for blockage. (PITOT TUBES - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-02/201)

SUBTASK 34-11-00-010-002

(3) Gain access to the tail compartment.

SUBTASK 34-11-00-212-002

(4) Check rudder limiter pitot system for moisture.

(a) Remove drain cap from rudder limiter pitot line sump, located in the upper tail section of fuselage, and drain sump.

SUBTASK 34-11-00-790-001

(5) If any pitot static lines required opening, leak check as required. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

C. Job Close-up

SUBTASK 34-11-00-410-001

(1) Close the E/E compartment door.

END OF TASK

STATIC PORTS - MAINTENANCE PRACTICES

1. General

A. The primary static ports are arranged in clusters of four, integrally fastened to a static port plate, and mounted on the right and left sides of the aircraft fuselage skin adjacent to the forward cargo compartments. The static port cluster is factory-mounted on the static port plate and should not be removed from the plate. The plate provides the orifices for the static lines and corrects any airflow-induced errors by means of its aerodynamic surface. Removal and installation is accomplished with the plate assembly (clusters attached). (Figure 201 and Figure 202)

B. The alternate port is a separate and distinct assembly consisting of a single port mounted through the fuselage skin at a location forward of the primary static ports. For removal and installation of alternate static ports, refer to Figure 205 and Paragraph 4..

C. Access to piping and connector sides of ports is gained through the forward and mid cargo compartment access doors.

D. For static port heater checks, refer to Paragraph 9..

E. The aerodynamic cleanliness inspections of Paragraph 6. and Paragraph 7. should be performed whenever removal/installation or repair to static port area has occurred.

F. The accuracy of the altitude and airspeed system is dependent on the aerodynamic cleanliness of the fuselage skin in the vicinity of the static ports, becoming critical in the region immediately surrounding the static ports. In order to maintain acceptable accuracy in determining altitude and airspeed, the specified limitations or tolerances are required in the vicinity of the static ports.

G. Prior to starting any removal/installation or repair in the alternate static port area, it is recommended to prepare a mylar overlay in graphic form. Indicate on the overlay detailed areas and amount of deviation in existing surface area. (Figure 220)

H. After completion of removal/installation or repair in the alternate static port area, again use mylar overlay to plot detailed areas and amount of deviation. Compare deviation plotting and assure that current airframe condition is within the allowable tolerances outlined in Paragraph 7..

NOTE: Inspection with mylar overlay is required for the alternate static port, but only when waviness of the fuselage skin may be affected (i.e., doubler replacement, skin repair). Replacement of the alternate static port assembly alone will usually not require mylar overlay inspection.

I. The primary static ports on MD-80 series aircraft are incorporated into an externally mounted compensating plate that aerodynamically adjusts the pressure at the static ports to provide an accurate input to the air data system. Because there is no semicritical area surrounding the compensating plate around the primary static ports, inspection with mylar overlay is not required after removal/installation of static port pressure plate. However, the area 18 inches (457.2 mm) from the center of the plate must conform to class II area aerodynamic requirements, as called out in Paragraph 6.J., controlled area. (Figure 221)

J. For Reduced Vertical Separation Minimum (RVSM) certified aircraft, the aerodynamic cleanliness requirements of Paragraph 8. must be met in addition to those of Paragraph 6. and Paragraph 7..

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Mold release, fluorocarbon MS-122 DPM 3494	Miller-Stephenson Chemical Co.
Compound, silicone heat sink, AP-280 DPM 5979	ANDPAK/Zip-Chem Products, Inc.
Compound, sealing/locking, Anaerobic; Loctite #222 DPM 6082	Loctite Corp.
Sealant, low adhesion (MIL-S-8784) PR-1428 or 1773 B-2 DMS 2410	PRC-DeSoto International Darlington Road, Shildon CO Durham DL4 2QP, England
Piano wire, fine	
Torque-wrench (0-50 inch-pounds range)	
One inch (25.4 mm) circular rivet shaver	Commercial
Bonding jig, Static Port Plug, T&E 34-12-1	Locally manufactured
PR-1422 sealant B-1/2 or B-2 DMS 2082	Courtaulds Aerospace Inc.
PR -1828 sealant B1/2 and B1/4	PRC-DeSoto International, Inc.
Cleaner, handwipe Brulin-MP1793 CPN 4188374 or any DPM 6380-X or Satwipe Isopropyl Alcohol CPN 4151447	Brulin & Company, Inc.
Fixture - Static Port Contour and Mismatch 5916784-1	The Boeing Company
Mylar	Commercial
Fiberglass cloth AMS9084 TYPE XI, CLASS 1 (0.035 - 0.055) DPM 5545-84	BGF Industries, Inc.

Table 201 (Continued)

Name and Number	Manufacturer
Gauge, Fixture Compensating Plate, DZZ7352-1	The Boeing Company
Adhesive, epoxy #Lefkoweld 109NA DPM 6047 or	Courtaulds Aerospace Inc.
Adhesive, Epoxy EY-4014-A/B DPM 1132 or	Fiber Resin Corp. Burbank, CA
Adhesive, Epoxy EC2216 B/A Gray DPM 3279 CPN 5996516 CPN 4041354 or	Minn Mining & Mfg. Co.
Adhesive, Epoxy Epibond 1337-A/9615A DPM 3412	PRC-DeSoto, International Glendale, CA

3. **Removal/Installation Static Port Plates**

A. Remove Static Port Plate

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(2) Disconnect static piping from all ports of plate to be removed; cap static ports and lines.

(3) Disconnect electrical connector from heater; remove wiring clamps as necessary.

NOTE: The rub plate is bonded to the outside of the fuselage skin and is of slightly larger diameter than the static port plate. Normal removal or replacement of the static port plate or static port heater should not require removal of the rub strip.

(4) Remove the nuts washers or spacer (if installed) from the static port plate. (Figure 201 and Figure 202)

NOTE: On some aircraft either a washer or spacer is installed under the nut at the 6 o'clock and 12 o'clock position only.

CAUTION: PERMANENT WARPING OF OUTER FUSELAGE SKIN AREA OR DAMAGE TO PLATE, MAY BE CAUSED BY USE OF EXCESSIVE FORCE OR ALLOWING PLATE TO FALL TO GROUND.

(5) Use thin spatula-type blade to loosen existing bond between plate and surface of thin rub plate. Use care not to damage edge of static port plate.

NOTE: A thin aluminum rub plate is bonded to the fuselage. Do not remove the rub plate, when removing the static port plate assembly.

(6) If the use of spatula does not break the bond between the static port plate and the rub plate without damage, use a suitable length of fine piano wire in a saw action between the static port plate and the rub plate to cut through the bond around the periphery.

(7) Use rubber mallet to gently tap plate free for removal.

(8) If necessary, remove heater blanket from static port plate. (STATIC PORT HEATERS - MAINTENANCE PRACTICES, PAGEBLOCK 30-30-01/201).

B. Install Static Port Plate

(1) Before installation of plate assembly, the Total Indicator Reading (TIR) should not be greater than 0.012 in. (0.305 mm). (This is calculated by adding the largest negative reading, taken as positive, to the largest positive reading (example: -0.006 in. (0.152 mm)/+0.004 in. (0.102 mm), -0.006 in. (0.152 mm) + 0.004 in. (0.102 mm) = 0.010 in. (0.254 mm) TIR (Paragraph 6.).

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

WARNING: HANDWIPE CLEANER IS AN AGENT THAT IS FLAMMABLE, A SENSITIZER, AN ASPHYXIANT, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN HANDWIPE CLEANER IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET HANDWIPE CLEANER IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(3) Clean all metal faying surfaces: Use cloth dampened with handwipe cleaner.

(4) Visually check rub plate on fuselage. Any burring or dimpling around mounting holes or around cutout must be removed. Careful filing is acceptable. Check for peeling around periphery of rub plate; any peeling requires rework of rub plate.

(5) If rub plate must be replaced, perform the following:

(a) Remove rub plate with very thin spatula blade to loosen existing bond.

(b) Using cleaning solvent, remove all sealants from fuselage surface. FR primer need not be removed.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1079, METHYL ETHYL KETONE (DPM 535)

HAZMAT 1000, REFER TO MSDS

(c) Wipe faying surfaces with a clean cloth dampened with Methyl Ethyl Ketone (MEK) solvent.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1117, COMPOUND/INTEGRAL FUEL TANKS SEALING (DMS QPL 2082 B1/2 AND B2)

HAZMAT 1000, REFER TO MSDS

(d) In using PR 1422, B-1/2 or B-2 or PR 1828 B1/2 or B1/4, follow directions in Paragraph 3.B.(5)(e) through Paragraph 3.B.(5)(h).

NOTE: Pot life of PR 1422, B-1/2 is 1/2 hour. Pot life of PR 1422, B-2 is 2 hours.

Pot life of PR 1828 B1/2 is 30 minutes and cure time is 3 hours.

Pot life of PR 1828 B1/4 is 15 minutes and cure time is 1.5 hours.

(e) Apply approximately 0.005 in. (0.127 mm) to 0.010 in. (0.254 mm) of mixed adhesive/sealant to rub plate and aircraft faying surface with spatula.

(f) Immediately position rub plate on aircraft, and apply only sufficient pressure to allow intimate contact and maintain approximately 0.003 in. (0.076 mm) to 0.010 in. (0.254 mm) adhesive/sealant around periphery. Do not apply high pressure.

(g) Clean away excessive adhesive/sealant with clean cloth dampened with methyl ethyl ketone (MEK) solvent.

(h) Allow to cure at 70°F (21°C) to 85°F (29°C) until firm. Adequate bond strength is attained in 24 hours (minimum temperature 70°F (21°C)).

NOTE: The cure time of the sealant can be accelerated by the application of a heat lamp at 145°F (62.8°C) maximum temperature, to the sealed surface for one (1) hour.

(6) If necessary, install static port heater blanket. (STATIC PORT HEATERS - MAINTENANCE PRACTICES, PAGEBLOCK 30-30-01/201)

(7) Temporarily fit static port plate to fuselage side. Do not use nuts. Note gap between edge of static port plate and rub plate. If hand pressure will not press plate down such that estimated gap will be no greater than 0.020 in. (0.508 mm) after installation, use another plate.

WARNING: FLUOROCARBON MOLD RELEASE IS AN AGENT THAT IS POISONOUS, AN ASPHYXIANT, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN FLUOROCARBON MOLD RELEASE IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET FLUOROCARBON MOLD RELEASE IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THESE HAZARDOUS AGENTS.

(8) Remove plate and spray outer edge of inside of plate with MS-122 Fluorocarbon Mold Release as shown on Figure 202 and allow to dry for 15 minutes.

(9) Cut fiberglass insulator (AMS9084) to shape of heater blanket, providing cutout for thermostat and thermal fuse. Place in compensating plate recess.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1726, WINDSHIELD AND WINDOW SEALANT - PR-1425 (DPM 2410)

HAZMAT 1000, REFER TO MSDS

(10) Apply faying surface seal, of low adhesion DMS 2410 sealant, approximately 1 in. (25 mm) wide around outer edge of compensating plate. (Figure 201)

(11) Fit static port plate, including heater blanket and insulator, to fuselage side such that studs protrude approximately half way into their respective holes.

WARNING: ANAEROBIC SEALING/LOCKING COMPOUND IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN ANAEROBIC SEALING/LOCKING COMPOUND IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES. USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET ANAEROBIC SEALING/LOCKING COMPOUND IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THESE HAZARDOUS AGENTS.

(12) From inside fuselage, start nuts and washers on four studs underneath longeron flanges using Loctite #222 compound. Nuts cannot be put on these studs if plate is pulled up to fuselage side.

(13) Start nuts with washers or spacers on two studs through longerons using Loctite #222 compound.

NOTE: On some aircraft the two studs through longerons either have a washer or spacer installed under the nut.

CAUTION: OVERTORQUING OF COMPENSATING PLATE FASTENERS CAN CAUSE DIMPLES ON OUTER SURFACE AND CAN BE CAUSE FOR PLATE REJECTION.

(14) Start nuts and washers on remaining six screws, using Loctite #222 compound. Firmly press plate against fuselage side and carefully and evenly torque all nuts to 13 ±1 in-lb (1 ±1 N·m). (Figure 202)

CAUTION: OVERTORQUING OF COMPENSATING PLATE FASTENERS CAN CAUSE DIMPLES ON OUTER SURFACE AND CAN BE CAUSE FOR PLATE REJECTION.

(15) Retorque all nuts 13 ±1 in-lb (1 ±1 N·m) at approximately 10 minute intervals, until no further tightening is observed. (Figure 202)

WARNING: SEALANT REMOVER SOLVENT IS AN AGENT THAT IS AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN SEALANT REMOVER SOLVENT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET SEALANT REMOVER SOLVENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(WARNING PRECEDES)

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THESE HAZARDOUS AGENTS.

(16) Remove all sealant squeeze-out from exterior surfaces and inner periphery of cutout, with a cloth dampened with handwipe cleaner, work remaining sealant into any void areas under plate lip.

(17) Check that gap between plate and aluminum or titanium rub strip does not exceed dimensions shown in Figure 204.

NOTE: To prevent induced error in flight instruments, plate assembly fit with surface skin tolerance is critical.

(18) Connect static port piping.

(19) Connect heater electrical connector; install any wiring clamps removed.

(20) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(21) After installation of plate assembly, the TIR should not be greater than 0.018 in. (0.457 mm). (This is calculated by adding the largest negative reading, taken as positive, to the largest positive reading (example: -0.006 in. (0.152 mm)/+0.004 in. (0.102 mm), 0.006 in. (0.152 mm) + 0.004 in. (0.102 mm) = 0.010 in. (0.254 mm) TIR.) If the readings are ± 0.006 in. (0.152 mm) or less, it is not necessary to accomplish Paragraph 6.H. and Paragraph 6.I., except that Paragraph 6.I.(3) is still required.

WJE 412, 414

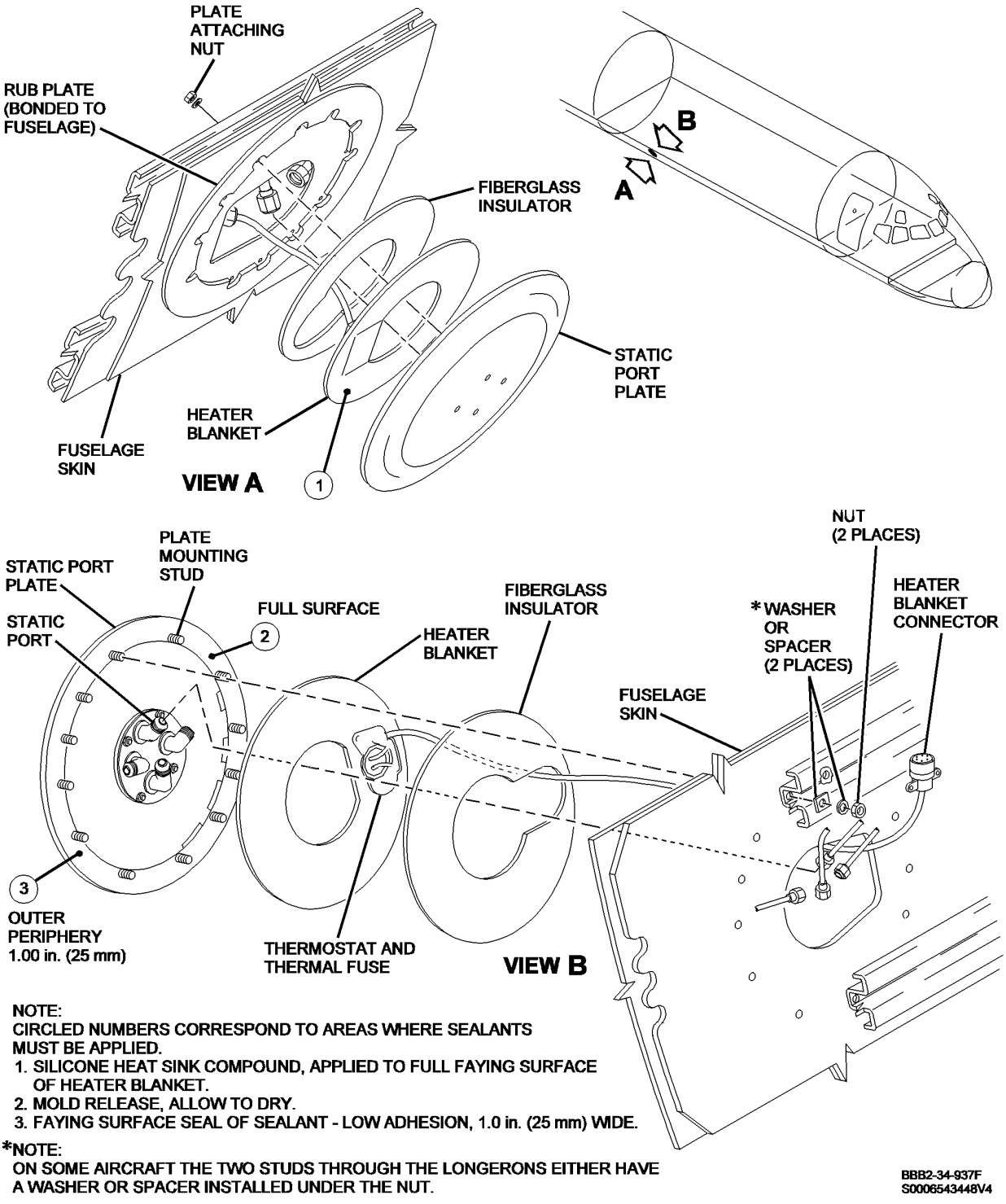
WJE (22) After installation of plate assembly, the TIR should not be greater than 0.018 in. (0.457 mm). (This is calculated by adding the largest negative reading, taken as positive, to the largest positive reading (example: -0.006 in. (0.152 mm)/+0.004 in. (0.102 mm), 0.006 in. (0.152 mm) + 0.004 in. (0.102 mm) = 0.010 in. (0.254 mm) TIR.) If the readings are ±0.006 in. (0.152 mm) or less, it is not necessary to accomplish Paragraph 6.H. and Paragraph 6.I., except that Paragraph 6.I.(4) is still required.

WJE **WJE ALL**

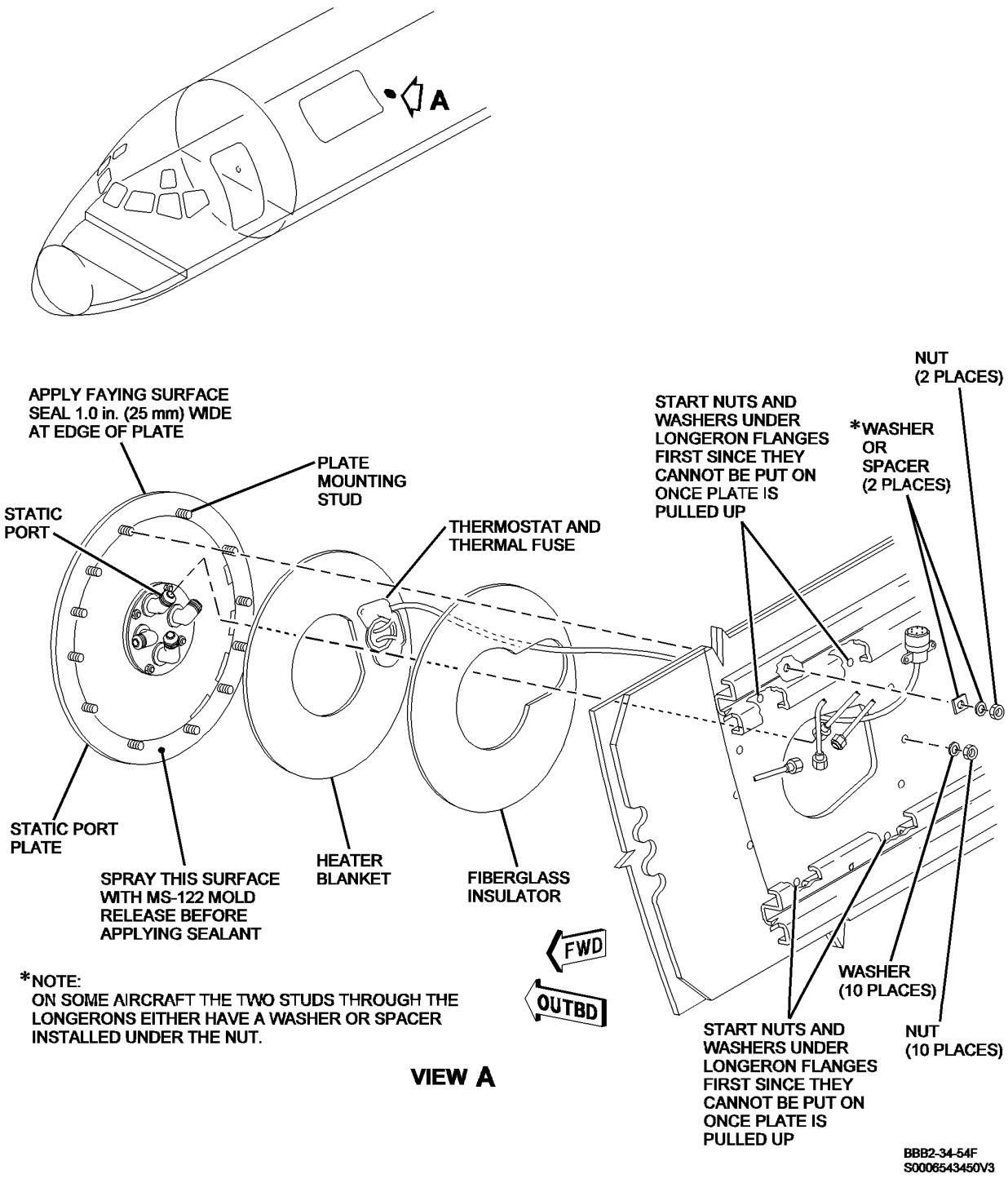
(23) Functionally test static port heater. (PAGEBLOCK 30-30-00/201)

(24) Perform applicable static system leak test. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

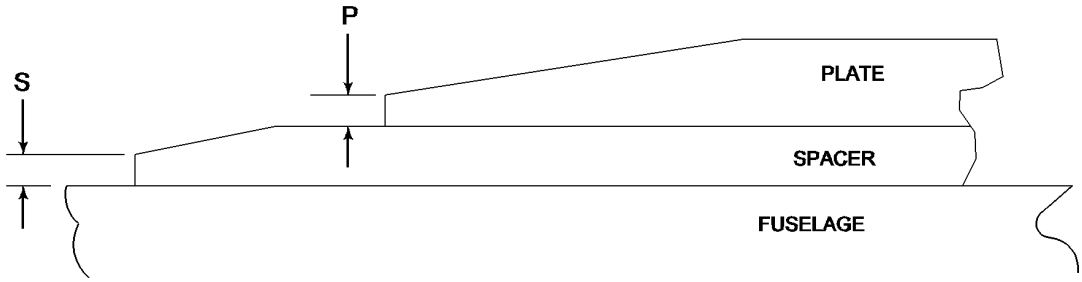
(25) Perform static port aerodynamic cleanliness inspection. (Paragraph 6.)



Static Port Plate and Heater
Figure 201/34-11-01-990-801



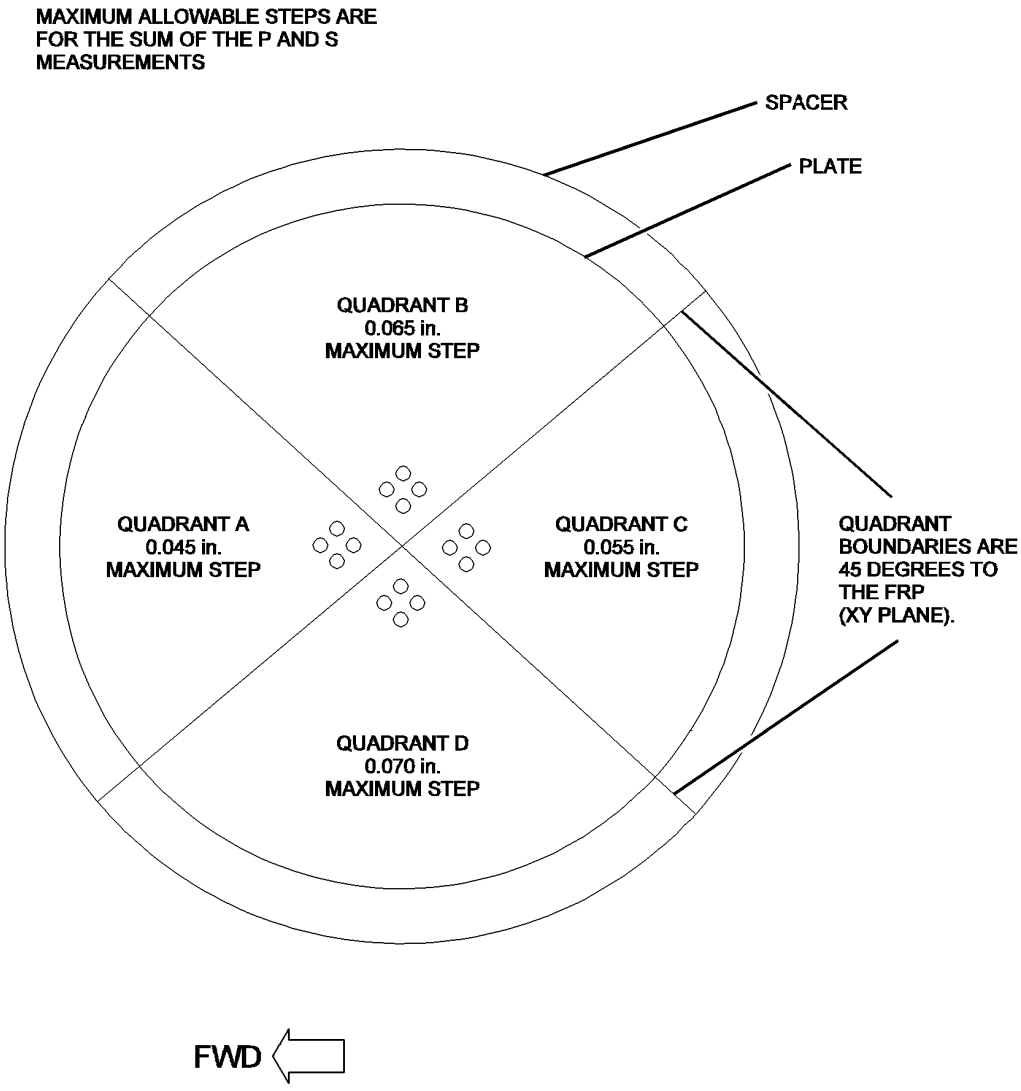
Static Port Plate -- Removal/Installation
Figure 202/34-11-01-990-802



NOTE: THE ALLOWABLE STEP IS DEFINED AS THE COMBINATION OF THE P (PLATE) AND THE S (SPACER), EDGE THICKNESS.

BBB2-34-2739
S0000211590V1

Step Measurement
Figure 203/34-11-01-990-838



Static Plate Step Inspection
Figure 204/34-11-01-990-837

4. Removal/Installation Alternate Static Ports

A. Remove Alternate Static Port

(1) Installed static ports (alternate only) may be any combination of three manufacturing designs, which effects the manner of removal/installation. Figure 206 shows the three types of ports that may be installed, or used as replacement units.

(2) Prior to starting removal, and upon completion of installation, perform Paragraph 7., Alternate Static Port Aerodynamic Cleanliness Inspection, for required recording of surface deviation on mylar plotting chart.

NOTE: Removal/installation procedures are the same for the alternate static ports. The following procedures apply when replacing a complete alternate port assembly.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(a) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(b) Disconnect static piping from port. Protect piping and connector from damage or contamination; seal opening with protective tape.

(c) Remove three attaching screws holding flange to internal surface.

(d) Use thin spatula type blade to loosen existing bond between triangular mounting flange and internal skin surface. Use blade to gently loosen bond around rim and sides of port.

CAUTION: EXCESSIVE FORCE WILL DAMAGE FUSELAGE SKIN.

(e) Using dowel 0.063 in. (1.600 mm) smaller than port diameter, gently tap against external face of port with mallet to free port for removal.

B. Install Alternate Static Port

NOTE: Static ports are manufactured to a standard length that is suitable to all mounting locations. However, in some locations the internal doubler, jamb, or skin build-up will vary in thickness and the port adapter length will exceed the aerodynamic contour tolerances. To determine the proper fit prior to final installation, perform the following preliminary fit check:

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

(WARNING PRECEDES)

Hazardous Material Warnings

HAZMAT 1079, METHYL ETHYL KETONE (DPM 535)

HAZMAT 1000, REFER TO MSDS

(2) Clean surrounding metal faying surfaces with Methyl Ethyl Ketone (MEK) or solution of water alcohol. Check that all old adhesive epoxy residue is removed.

(3) Locate and mark triangular flange hole alignment; insert static port assembly (Configurations A and B) or static port adapter (Configuration C) into hole. Check port and fuselage skin for flush fit. Final static port installation must fit flush with skin ±0.001 inch (±0.025 mm). If port extends outward from surface skin greater than 0.005 inch (0.127 mm) scribe point at 0.005 inch (0.127 mm) beyond flush fit, remove port from hole and machine mill off excess to scribe point. Use extreme care during milling operation to assure that excessive heat does not cause distortion or loss of part integrity.

NOTE: When installing the Configuration C static port adapter, the barrel of the static port must be milled to accept the thickness of the plug insert at 0.005 inch (0.127 mm) beyond flush fit. Refer to Figure 207 and Figure 208.

(4) After completing preliminary fit check, thoroughly clean surrounding metal faying surfaces.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1726, WINDSHIELD AND WINDOW SEALANT - PR-1425 (DPM 2410)

HAZMAT 1000, REFER TO MSDS

(5) Lightly but thoroughly coat static port and adjoining surfaces with MIL-S-8784 sealant. Sealant should fill butt gap around fitting.

(6) Orient static port alignment in identical manner as previously installed and insert into place.

CAUTION: THE USE OF SCREW LENGTHS OTHER THAN THOSE SPECIFIED IS NOT PERMITTED. USE OF DIFFERENT SCREW LENGTH WOULD RESULT IN EITHER INADEQUATE THREAD GRIP OR DISTORTION OF EXTERNAL SKIN SURFACE.

(7) Insert attaching screws in flange and tighten.

WARNING: USE THE HAZARDOUS MATERIAL WARNINGS GIVEN BELOW FOR THE STEPS THAT FOLLOW.

THE HAZARDOUS MATERIAL WARNINGS ARE LISTED AFTER THE INTRODUCTION SECTION IN THE FRONT OF THE AMM.

Hazardous Material Warnings

HAZMAT 1079, METHYL ETHYL KETONE (DPM 535)

HAZMAT 1000, REFER TO MSDS

(8) Use soft cloth dampened with Methyl Ethyl Ketone (MEK) to wipe excess adhesive sealant from area.

(9) Allow sufficient time for bonding cure.

NOTE: When installing a new port with larger diameter holes (Configuration "C"), the orifice port must be set into the installed adapter, checked for 0.005 inch (0.127 mm) maximum beyond flush fit, and bonded in place using adhesive, DPM 1132, or DPM 3279 or DPM 3412, or DPM 3484-1. Set up bonding jig as shown in Figure 208 and allow sufficient time for proper cure.

CAUTION: APPLY RIVET SHAVER IN 1-SECOND INTERVALS AND ALLOW TO COOL. THIS WILL PREVENT EXCESSIVE BUILDUP OF HEAT THAT CAN DESTROY THE BOND BETWEEN STATIC PORT PLUG AND BARREL. THIS CAUTION IS ESPECIALLY IMPORTANT WHEN SHAVING CONFIGURATION “C”.

(10) Final flush fitting is accomplished by shaving installed port assembly to reestablish required surface deviation. Use 5/8 to1 inch (16 to 25.4 mm) circular rivet shaver for final contour matching flush within ±0.001 inch (±0.03 mm).

NOTE: An alternate method of flush filing static port can be achieved by using a Scotch Brite or equivalent disc. Ensure static line is disconnected and taped off to eliminate debris contamination.

(11) Test bond strength of installed static port plug by applying force of from 20 to 30 pounds (9.072 to 13.607 kg) along central axis of port. Force should be applied in both an inward and outward direction. Any displacement of insert must be cause for rejection and rework.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(12) Remove protective covering from static piping and connect piping to port.

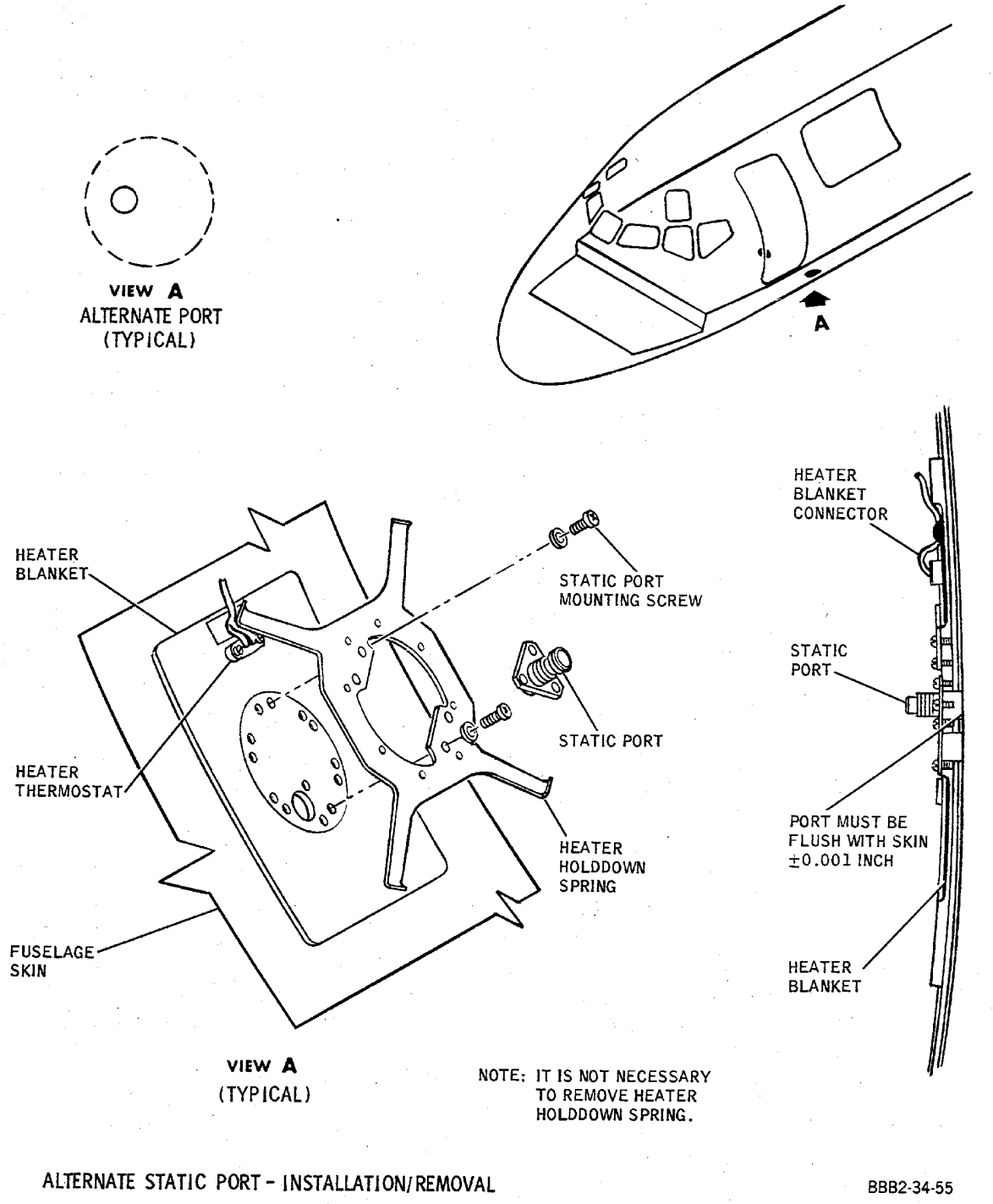
(13) Perform leak test on affected static system. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

(14) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(15) Perform alternate static port aerodynamic cleanliness inspection. (Paragraph 7.)



Alternate Static Ports -- Removal/Installation
Figure 205/34-11-01-990-803

5. **Removal/Installation Static Port Plug (Configurations B and C)**

A. Remove Static Port Plug

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(2) Disconnect static piping from port. Protect piping and connector from damage or contamination; seal opening with protective tape.

CAUTION: EXCESSIVE FORCE WILL DAMAGE FUSELAGE SKIN.

(3) Working from inside forward lower cargo compartment, use 0.234 inch (5.944 mm) diameter wood dowel and rubber mallet and gently tap plug from port.

B. Install Static Port Plug

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(2) Thoroughly clean mating surfaces of internal port and insert.

WARNING: EPOXY ADHESIVE IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN EPOXY ADHESIVE IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET EPOXY ADHESIVE IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(WARNING PRECEDES)

(3) Lightly coat static port insert faying surface areas with adhesive (DPM 1132, or DPM 3279, or DPM 3412, or DPM 3484-1), use care not to apply an excess of adhesive which would occlude orifice openings.

CAUTION: EXCESS HEAT DURING MILLING OPERATION WILL CAUSE A DEGRADATION OF THE EPOXY ADHESIVE. THEREFORE CONDUCT MILLING OPERATION IN SHORT ONE SECOND CYCLES AND ALLOW TO COOL BETWEEN CYCLES.

(4) Press fit insert into static port, wipe excess adhesive from area, and check fuselage skin area for flush fit. Secure insert using static port plug bonding jig T&E 34-12-1. When static port with insert installed protrudes outward from fuselage skin surface greater than 0.005 inch (0.127 mm), scribe part at 0.005 inch (0.127 mm), remove static port and insert, mill down to scribe line, refit and reinstall. When installed port and insert mismatch with skin is less than minus 0.001 (0.025 mm) and plus 0.005 inch (0.127 mm), final flush fitting is accomplished by milling with a standard "Micro Stop" one-inch diameter rivet shaver.

(5) Allow sufficient time for appropriate bonding cure prior to performing pull test and final contour shaving.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(6) Remove protective covering from static piping and connect piping to port.

(7) Test bond strength of installed part by applying force of from 20 to 30 pounds (9.072 to 13.607 kg) along central axis of port. Force shall be applied in both pushing and pulling movement. Any displacement of port or insert is cause for rejection and rework.

(8) Perform alternate static port aerodynamic cleanliness inspection. (Paragraph 7.)

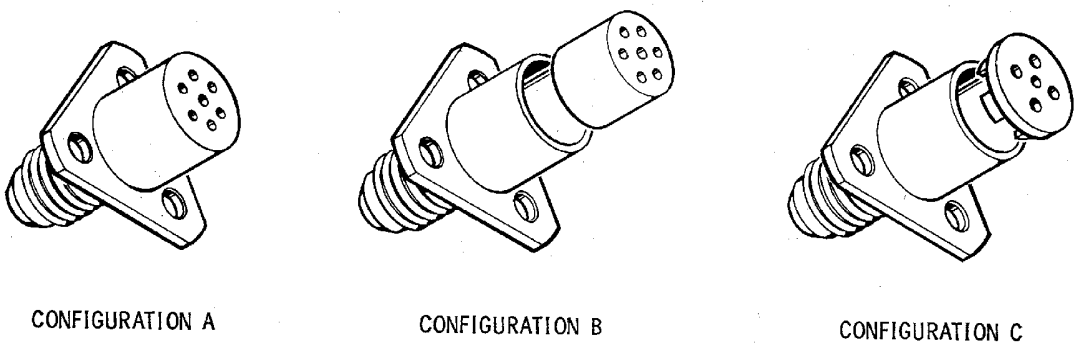
(9) Perform Air Data System leak test. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

(10) Remove the safety tags and close these circuit breakers:

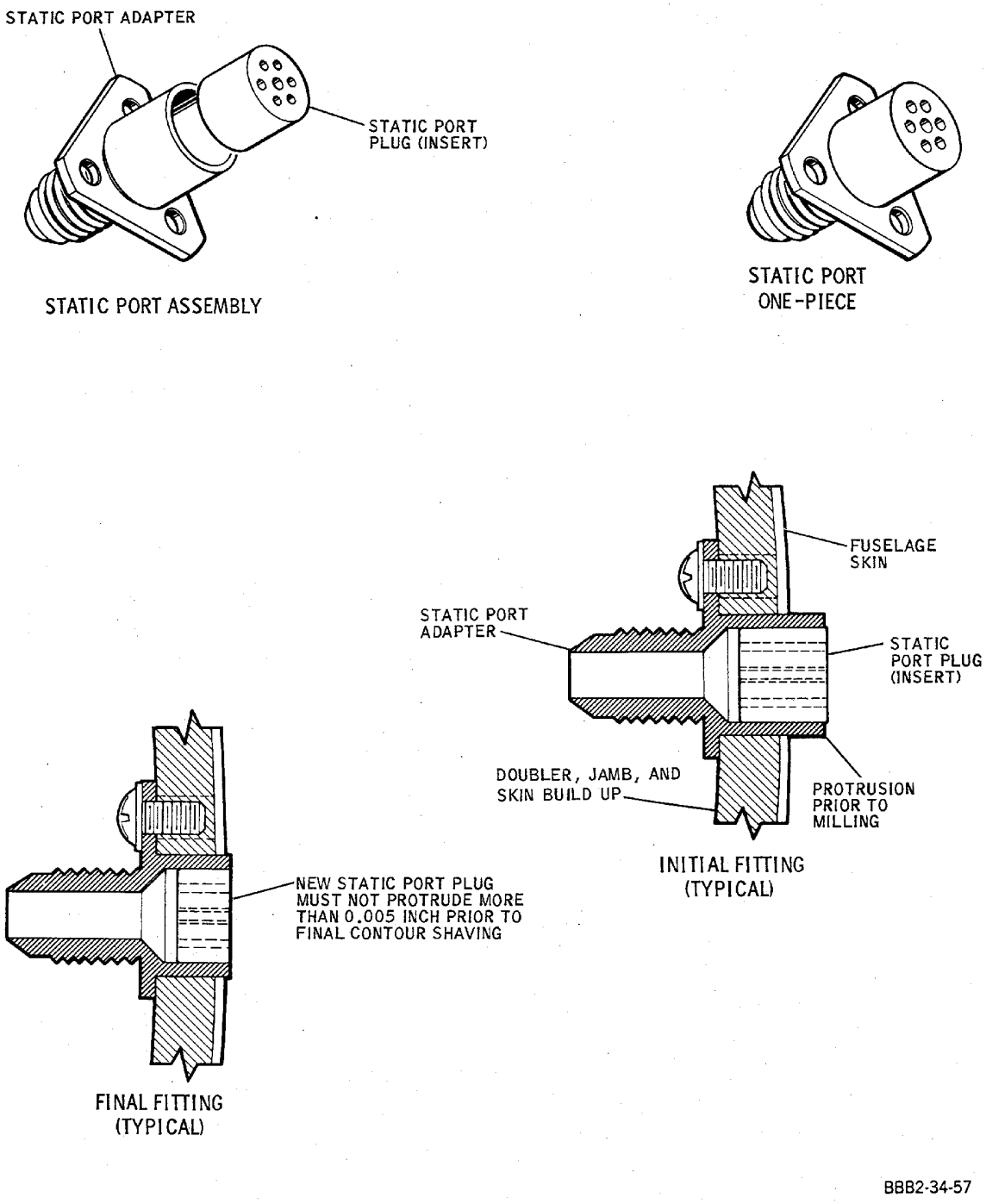
LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

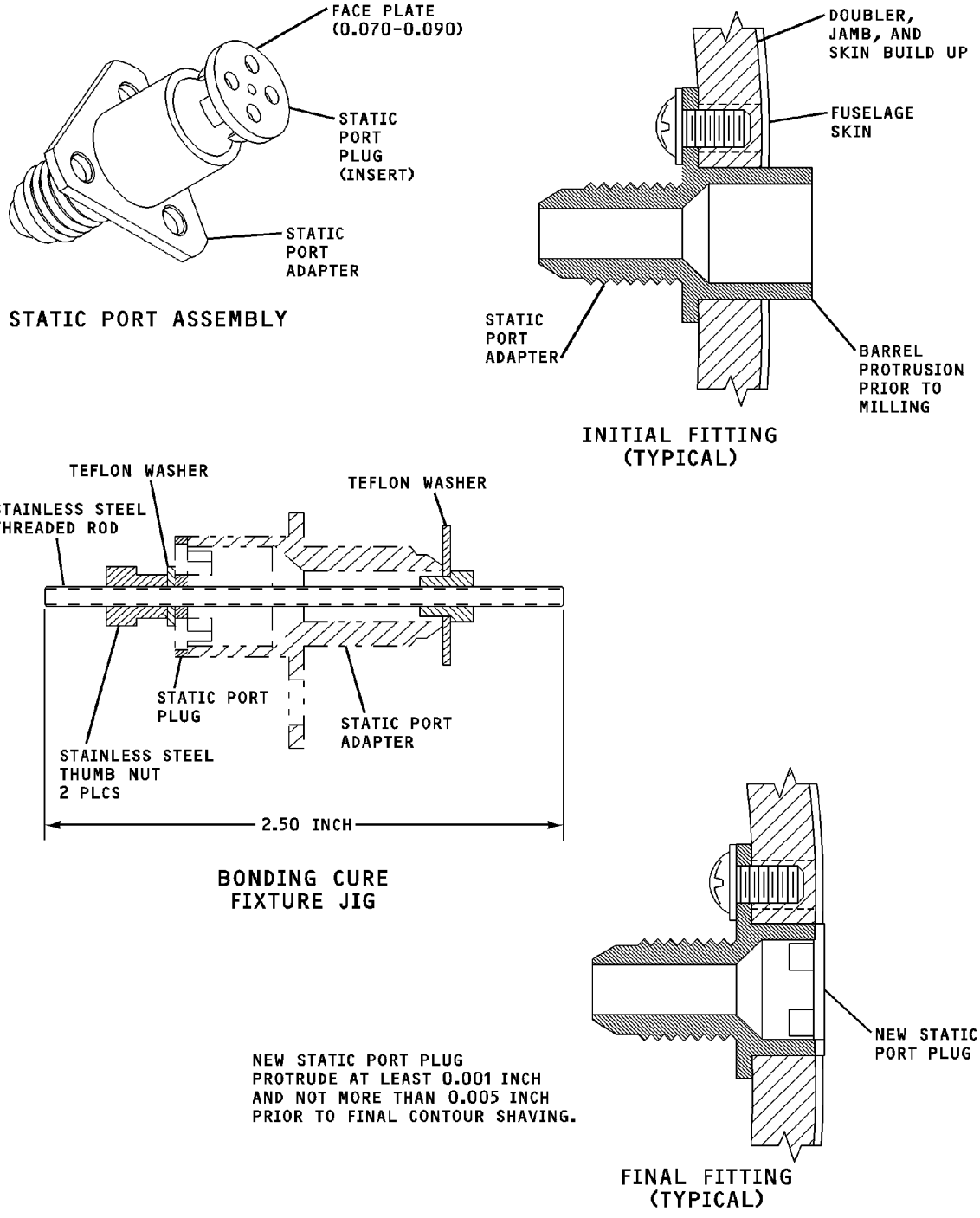
(11) Return aircraft to required configuration.



Alternate Static Port Assemblies
Figure 206/34-11-01-990-804



Static Port Plug -- Removal/Installation (Configurations A and B)
Figure 207/34-11-01-990-805



Static Port Plug -- Removal/Installation (Configuration C)
Figure 208/34-11-01-990-806

6. **Primary Static Port Aerodynamic Cleanliness Inspection**

A. Compensating Plate Inspection:

Table 202 Test Equipment Required

DZZ7352-1	(Compensating Plate Inspection Fixture)
0.094 x 6" (2 ea.)	(Drill Rods)
5916784-1	(Inspection Fixture)
DMS 1861-2-1000 or Equiv.	(Masking Tape)
COL-ERASE 1277 Carmine RED Pencil	

B. Lay Out Plane Lines

(1) Lay out plane lines on the STATIC PORT COMPENSATING plate with COL-ERASE 1277, or equivalent, RED pencil. Draw the lines parallel to the horizontal center line of the aircraft. (Figure 209)

(2) Lay out plane line (A). Provide spaces of 0.12 inch between the line and the port holes. The space is to prevent pencil lead from being introduced into the port holes and a reference where to lift the dial indicator point over the port holes.

(3) Lay out two lines 0.69 inch (17.53 mm) from the plane line (A). Draw one above and below the center plane line (Plane Lines D and E).

(4) Lay out two lines 1.5 inches (38 mm) from the plane line (A). Draw one above and one below the center plane line (A) (Plane Lines B and C).

C. Zero the Indicator

(1) Place drill rod sections on a calibration block and set fixture DZZ7352-1 on rods with sensor between rods. Unlock the bezel (loosen the lock knob). Adjust the bezel so that the dial indicator reads zero. Lock bezel (tighten lock knob) but do not disturb the reading. (Figure 210)

D. Attach Drill Rods to the Port Plate

(1) Place drill rods onto the plate perpendicular to the horizontal center line and 0.75 inches (19.05 mm) from each edge. Secure the rods with tape (DMS 1861-2-1000). (Figure 209)

E. Measure the Convexity and Concavity

WJE **WJE 412, 414**

WJE NOTE: The COMPENSATION PLATE INSPECTION MEASUREMENT FORM, (Figure 214) is
WJE included for the operator's convenience. It is not necessary for the operator to use a form to
WJE record the different dimensions as long as the calculations to determine if the primary static
WJE port plate is serviceable are done correctly.

WJE **WJE ALL**

(1) Place fixture (DZZ7352-1) onto the drill rods. Position the fixture so that its longest edge is parallel to the plane lines. (Figure 210)

(2) Move the fixture so that its dial indicator point is on plane line (A). Position the dial indicator point to the inside edge of one of the drill rods.

(3) Move (slide on the drill rods) the fixture along the plane line while observing the indicator's readings. Avoid the port holes. Look for the most negative and most positive readings. Record the most negative and most positive reading. Do not take a reading if the dial indicator's point is in a port hole.

(4) Repeat Paragraph 6.E.(2) and Paragraph 6.E.(3) for plane lines B and C.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

F. Specifications

(1) Before plate installation, Total Indicator Reading (TIR) should not be greater than 0.012 in. (0.305 mm).

(2) After installation of plate assembly, the TIR should not be greater than 0.018 of an inch (0.457 mm). (This is calculated by adding the largest negative reading, taken as positive, to the largest positive reading (example: -0.006/+0.004, 0.006 + 0.004 = 0.010 inch TIR) (-0.15/+0.10, 0.15 + 0.10 = 0.25 mm TIR).) If the readings are ±0.006 or less, it is not necessary to accomplish Paragraph 6.H. and Paragraph 6.I., except that Paragraph 6.I.(3) is still required.

WJE 412, 414

WJE G. Specifications (Figure 213)

WJE (1) Before plate installation, Total Indicator Reading (TIR) should not be greater than 0.012 in. (0.305 mm).

WJE (2) After installation of plate assembly, the TIR should not be greater than 0.018 of an inch (0.457 mm). (This is calculated by adding the largest negative reading, taken as positive, to the largest positive reading (example: -0.006/+0.004, 0.006 + 0.004 = 0.010 inch TIR) (-0.15/+0.10, 0.15 + 0.10 = 0.25 mm TIR).) If the readings are ±0.006 or less, it is not necessary to accomplish Paragraph 6.H. and Paragraph 6.I., except that Paragraph 6.I.(4) is still required.

WJE **WJE ALL**

H. Measure the Waviness

WJE **WJE 412, 414**

WJE NOTE: The COMPENSATION PLATE INSPECTION MEASUREMENT FORM, (Figure 214) is included for the operator's convenience. It is not necessary for the operator to use a form to record the different dimensions as long as the calculations to determine if the primary static port plate is serviceable are done correctly.

WJE **WJE ALL**

(1) Remove the drill rods.

(2) Check zero setting of inspection fixture 5916784-1, or similar, and adjust as necessary by placing fixture on a calibration block and rotating bezel until indicator reads zero. (Figure 211)

NOTE: Inspection fixture should be adjusted so that indicator reads approximately half the full-scale range when fixture is on calibration block.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(3) Place the inspection fixture (5916784-1) onto the port plate. The center line that passes through the two legs with the dial indicator tip between them must be parallel with the horizontal plane line "A" for all measurements. (Figure 211)

WJE 412, 414

WJE (4) Put the static port contour check fixture (5916784-1) on the primary static port compensating plate plane line C.

WJE (a) Make sure that the plane line you measure goes through the two legs with the indicator point between them.

WJE (b) Do not measure the incorrect horizontal plane line.

WJE (5) Start at the center of the static port plate on plane line C and move the static port contour check fixture (5916784-1) to the left in 0.5 in. (12.7 mm) increments along plane line C and record the dimensions.

WJE (a) Do not record a dimension if the dial indicator point or one of the tripod legs is in a static port hole.

WJE (b) Do not record a dimension if one of the tripod leds is off the static port surface and onto the plate chamfer.

WJE (c) Record all necessary dimensions.

WJE (6) Do the above steps again for the right side of plane line C. Start at the center of the static port plate surface and move the static port contour check fixture (5916784-1) to the right.

WJE (7) Do the above steps again for plane lines B, E and D.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(8) Position the inspection fixture on plane line "C". Move the fixture so that one of the tripod legs is at the edge of the plate surface.

(9) Move the fixture along the line to the opposite edge of the surface while observing the indicator's reading. Record the most negative and the most positive readings. Do not take a reading if one of the tripod legs is off the plate surface, one of the tripod legs in a plate hole, or the dial indicator point is in a plate hole.

(10) Repeat Paragraph 6.H.(8) and Paragraph 6.H.(9) for plane lines B, E, and D.

WJE ALL

I. Specifications

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(1) The maximum allowable reading is + or - 0.006 of an inch (±0.15 mm) over the defined plane lines.

WJE 412, 414

WJE (2) The maximum permitted waviness dimension must not be more than ± 0.006 in. (0.152 mm) over the defined plane lines.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(3) Assure that the dimple depth of compensating plate at weld stud locations caused by over torquing or external loads is no more than 0.015 in. (0.38 mm).

WJE 412, 414

WJE (4) The maximum dimple depth of a welded stud location caused by over torque or external loads is 0.015 in. (0381 mm).

WJE **WJE ALL**

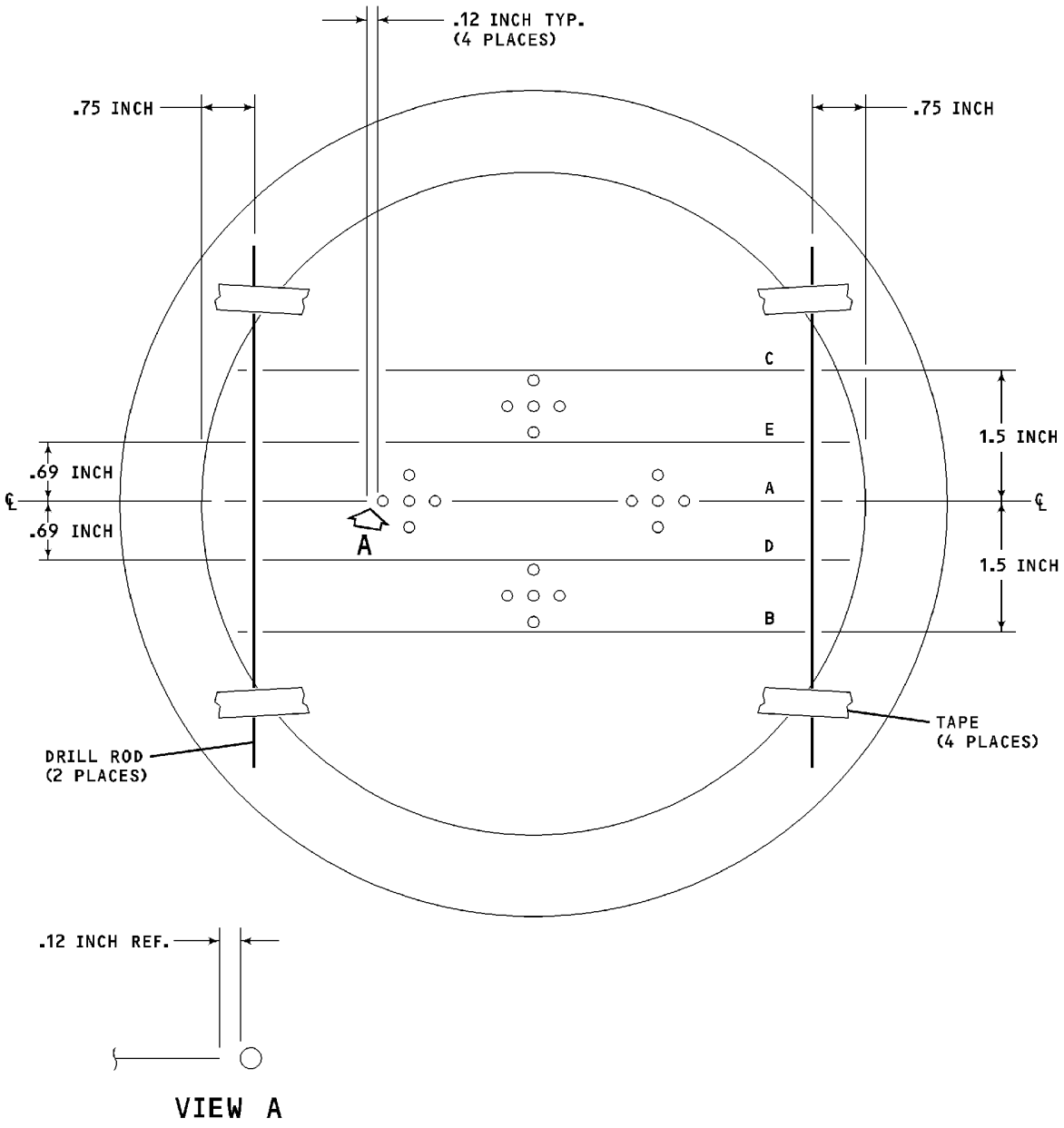
J. Controlled Area Inspection:

The primary static port compensating plate controlled area is defined as the area between the outer edge of the compensating plate and a circle with an 18 inch (457.2 mm) radius measured from the center of the plate. (Figure 212)

(1) Class II waviness and rivet flushness requirements must be met in the controlled area.

NOTE: Refer to SRM 51-50-0, paragraph 6.A.(5) and 6.B.(1)(a) Class II Waviness and Rivet Flushness Requirements, 0.090 inch maximum.

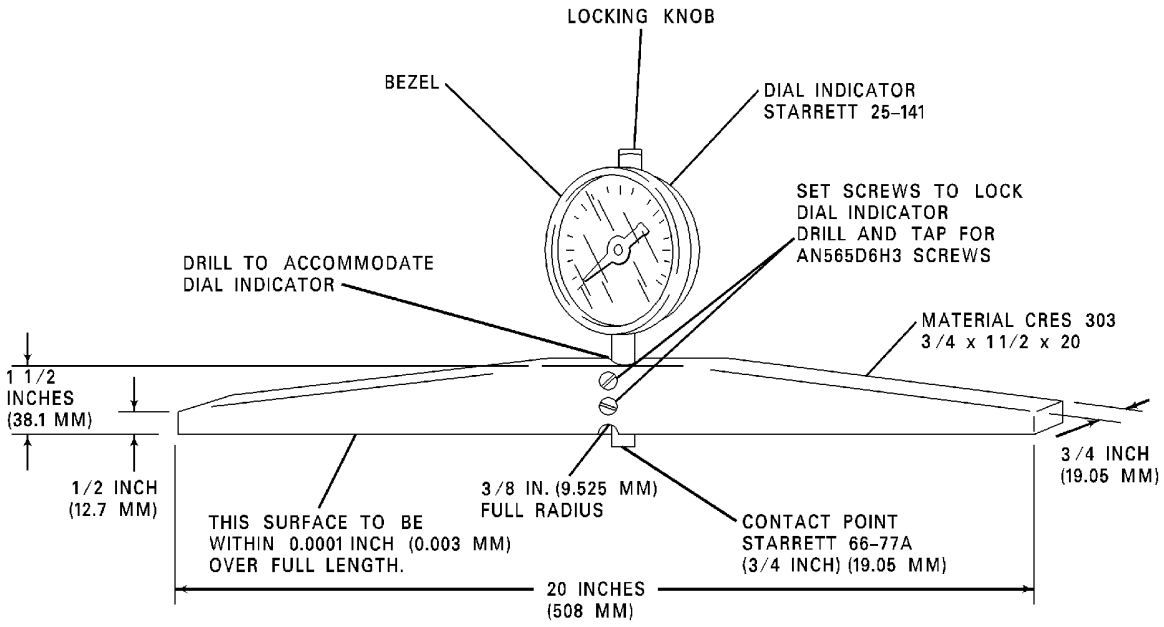
(2) The controlled area of the primary static port compensating plate should not have any portion of a skin patch mismatched greater than + or - 0.015 inch (+/-0.38 mm), with the exception that any design mismatches within the controlled area must be maintained in any subsequent repair.



Primary Ports Layouts Critical Waviness Check
Figure 209/34-11-01-990-807

NOTE:

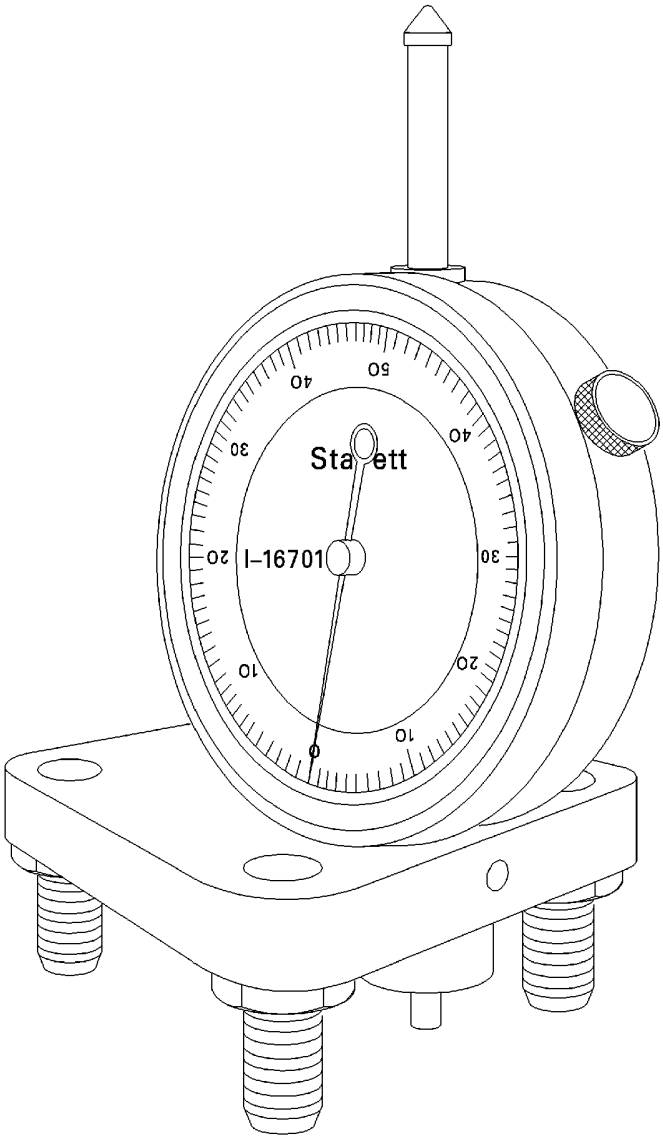
COMPENSATING PLATE INSPECTION FIXTURE IS TYPICAL EXAMPLE ONLY SUBSTITUTE MATERIAL DIAL INDICATOR, AND HARDWARE CAN BE USED, OR ALTERNATE DESIGN FOR ACCOMPLISHING COMPENSATING PLATE INSPECTION.



CAG(IGDS)

BBB2-34-2009B

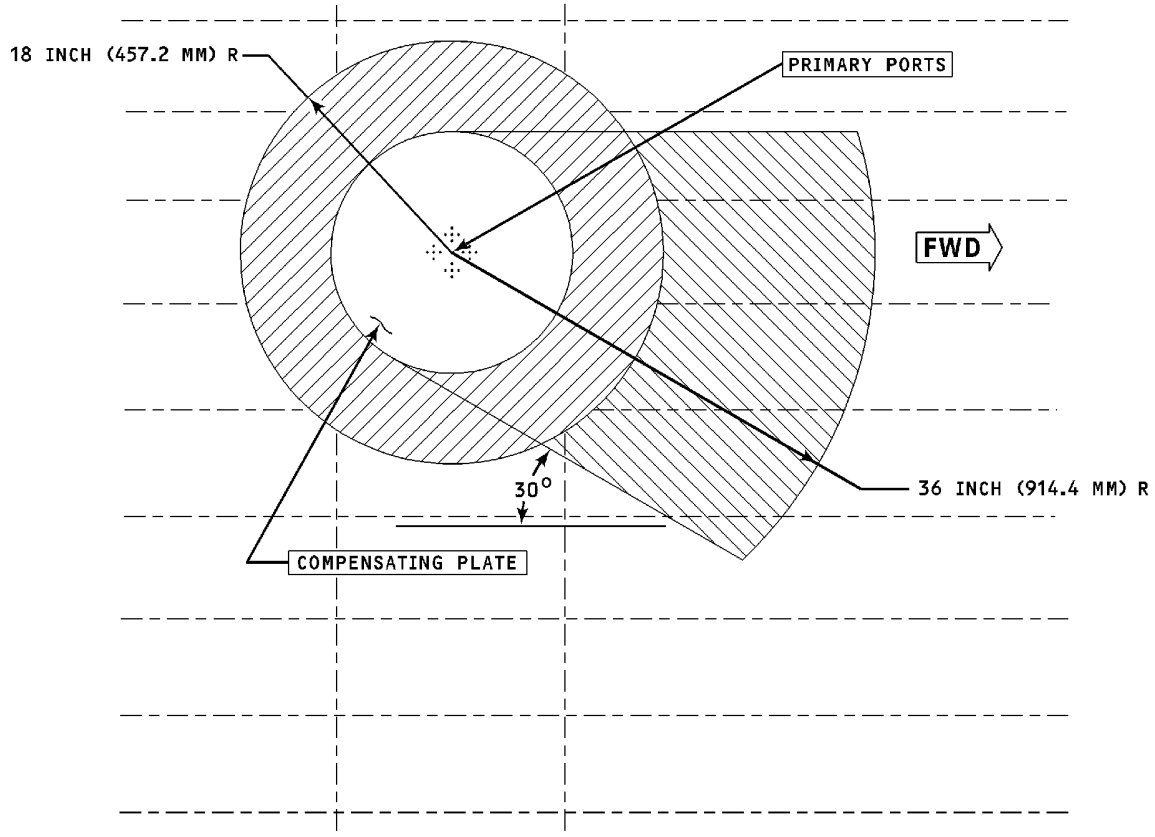
Compensating Plate Inspection Fixture DZZ7352-1 -- Example
Figure 210/34-11-01-990-808



CAG(IGDS)

BBB2–34–2010

Inspection Fixture 5916784-1
Figure 211/34-11-01-990-809



LEGEND:

- CRITICAL AREA
- CONTROLLED AREA
- RVSM CONTROLLED AREA (SEE PARAGRAPH 8.)

CAG(IGDS)

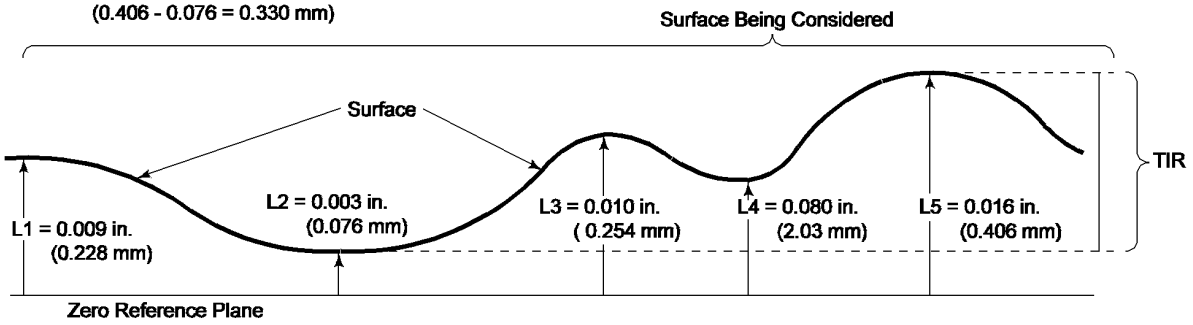
BBB2-34-2011A

Static Port Class Areas (Primary)
Figure 212/34-11-01-990-810

EXAMPLE 1 - All readings Positive or Zero

Subtract Absolute Value of Minimum Positive Reading (or Zero) from Absolute Value of Maximum Positive Reading.

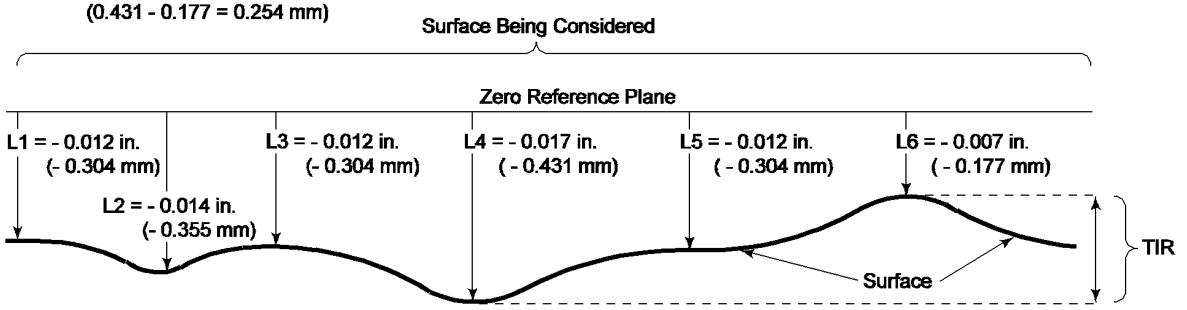
Total Indicated Reading (TIR) = Difference between maximum positive reading and minimum positive reading
= L5 - L2 = 0.016 - 0.003 = 0.013 in.
(0.406 - 0.076 = 0.330 mm)



EXAMPLE 2 - All readings Negative or Zero

Subtract Absolute Value of Minimum Negative Reading (or Zero) from Absolute Value of Maximum Negative Reading.

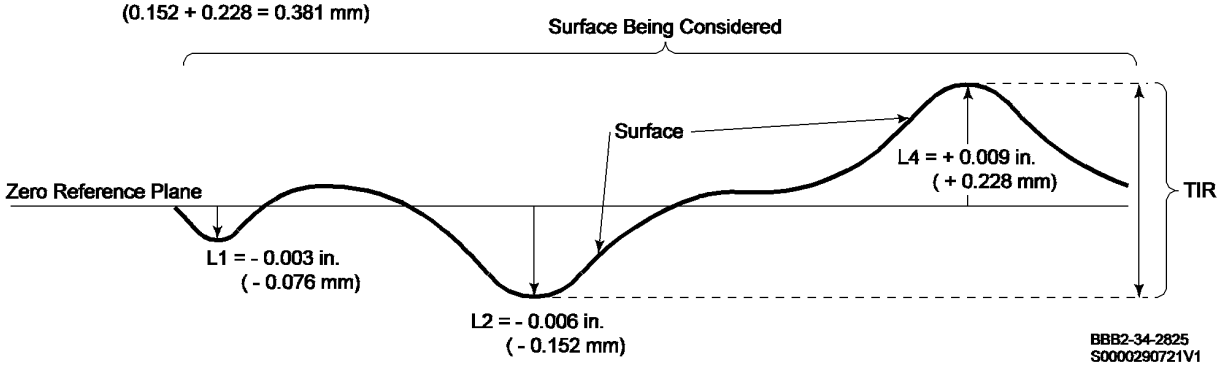
Total Indicated Reading (TIR) = Difference between maximum negative reading and minimum negative reading
= L4 - L6 = 0.017 - 0.007 = 0.010 in.
(0.431 - 0.177 = 0.254 mm)



EXAMPLE 3 - All readings Positive and Negative

Add Absolute Value of Maximum Negative Reading to Absolute Value of Maximum Positive Reading.

Total Indicated Reading (TIR) = Difference between maximum negative reading and maximum positive reading
= L2 + L4 = 0.006 + 0.009 = 0.015 in.
(0.152 + 0.228 = 0.381 mm)



WJE
WJE

Compensating Plate - Convexity Concavity Check
Figure 213/34-11-01-990-842

LEFT STATIC PORT PLATE CONVEXITY & CONCAVITY MEASUREMENTS

	Left of Center Line							Right of Center Line						
	3.0 in. (76mm)	2.5 in. (63.5mm)	2.0 in. (51mm)	1.5 in. (38.1mm)	1.0 in. (25.4mm)	0.5 in. (12.7mm)	CL	0.5 in. (12.7mm)	1.0 in. (25.4mm)	1.5 in. (38.1mm)	2.0 in. (51mm)	2.5 in. (63.5mm)	3.0 in. (76mm)	TIR*
Line C														
Line A														
Line B														

RIGHT STATIC PORT PLATE CONVEXITY & CONCAVITY MEASUREMENTS

	Left of Center Line							Right of Center Line						
	3.0 in. (76mm)	2.5 in. (63.5mm)	2.0 in. (51mm)	1.5 in. (38.1mm)	1.0 in. (25.4mm)	0.5 in. (12.7mm)	CL	0.5 in. (12.7mm)	1.0 in. (25.4mm)	1.5 in. (38.1mm)	2.0 in. (51mm)	2.5 in. (63.5mm)	3.0 in. (76mm)	TIR*
Line C														
Line A														
Line B														

*TIR IS DETERMINED BY THE EXAMPLES IN THE FIGURE FOR THE COMPENSATING PLATE CONVEXITY AND CONCAVITY CHECK.

TIR MUST BE ≤ 0.018 in. (0.457mm) (PLATE INSTALLED ON AIRCRAFT)

NOTE:
DO NOT RECORD PRIMARY STATIC PORT COMPENSATING PLATE INSPECTION FIXTURE INDICATIONS WHEN THE INDICATOR POINT IS IN A STATIC PORT HOLE. IF AN INDICATION IS OVER A STATIC PORT HOLE, PUT N/A IN THE APPLICABLE CELL.

LEFT STATIC PORT PLATE WAVINESS MEASUREMENTS

	Left of Center Line						Right of Center Line				
	2.5 in. (63.5mm)	2.0 in. (51mm)	1.5 in. (38.1mm)	1.0 in. (25.4mm)	0.5 in. (12.7mm)	CL	0.5 in. (12.7mm)	1.0 in. (25.4mm)	1.5 in. (38.1mm)	2.0 in. (51mm)	2.5 in. (63.5mm)
Line C											
Line E											
Line D											
Line B											

RIGHT STATIC PORT PLATE WAVINESS MEASUREMENTS

	Left of Center Line						Right of Center Line				
	2.5 in. (63.5mm)	2.0 in. (51mm)	1.5 in. (38.1mm)	1.0 in. (25.4mm)	0.5 in. (12.7mm)	CL	0.5 in. (12.7mm)	1.0 in. (25.4mm)	1.5 in. (38.1mm)	2.0 in. (51mm)	2.5 in. (63.5mm)
Line C											
Line E											
Line D											
Line B											

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Compensating Plate - Inspection Measurement Form
Figure 214/34-11-01-990-843

7. Alternate Static Port Aerodynamic Cleanliness Inspection

A. Definition of Special Class Areas for Alternate Static Ports (Figure 215)

(1) Critical Area - The region bounded by a circle with a 4 inch (101.6 mm) radius measured from the center of the port.

(2) Semi-Critical Area - The region between two concentric circles having 4 inch (101.6 mm) and 6 inch (152.4 mm) radii, respectively, when measured from the center of the port.

(3) Controlled Area - The region between two concentric circles having 6 inch (152.4 mm) and 18 inch (457.2 mm) radii, respectively, when measured from the center of the port.

NOTE: 1. Prior to starting any removal/installation or repair in the alternate static port area, it is recommended to prepare a mylar overlay in graphic form. Indicate on the overlay detailed areas and the amount of deviation in the existing surface area. (Figure 216)

2. After completion of removal/installation or repair in the alternate static port area, again use the mylar overlay to plot detailed areas and the amount of deviation. Compare the deviation plotting and assure the current surface condition is within allowable tolerances outlined in Paragraph 8.D..

3. The use of a mylar overlay for inspecting the alternate static port area when no removal/installation or repair has been accomplished is at the operator's option. Replacement of the alternate static port alone will usually not require the use of the mylar overlay. Alternate static port area inspection may be more convenient using the mylar overlay since it provides radials at 15 degree increments and inch rings for the critical and semi-critical areas.

B. Alternate Port: Waviness Inspection Procedure

(1) Any skin damage within 6-inch (152.4 mm) radius from center of port cluster shall be submitted to Material Review for disposition.

(2) Required equipment and supplies are as follows:

(a) Inspection check fixture 5916784-1. (Figure 211)

(b) Red masking tape (used with mylar overlay only).

(c) Inspection aid - mylar overlay (optional, if no repair in alternate static port area) (expendable). (Figure 216)

(d) Straight edge, 7 inches (177.8 mm) long.

(e) Straight edge, 20 inches (508 mm) long.

(f) Carmine red pencil COL-ERASE 1277.

(3) Prior to inspection:

(a) Check that dial indicator on inspection fixture 5916784-1 has valid calibration decal.

(b) Check zero setting and adjust as necessary, by placing inspection fixture 5916784-1 on a calibration block and adjusting bezel until indicator reads zero.

NOTE: The inspection check fixture should be adjusted so that the indicator reads approximately half of the full scale range when the fixture is on the calibration block. (Figure 211)

(c) Thoroughly clean area to be inspected.

(4) Waviness Inspection (With Mylar Overlay)

(a) Attach inspection aid (mylar overlay) snugly to side of fuselage using red masking tape.

(b) Horizontal centerline marked on mylar overlay shall be parallel to horizontal centerline of aircraft. Center mylar overlay over alternate static port.

(c) Place inspection check fixture against mylar overlay. Two legs with dial indicator tip between them shall be parallel to horizontal centerline on mylar overlay and shall not rest on static port when taking readings.

(d) Place the dial indicator tip on every intersecting line having a letter or number designator on the mylar overlay, and record the deviation at each of these intersections.

(e) Verify all deviations observed are within the waviness tolerances specified in Paragraph 7.C. below.

(5) Waviness Inspection (Without Mylar Overlay)

(a) Mark alternate static port area per Figure 216 using carmine red pencil (COL-ERASE 1277 or equivalent).

(b) Place inspection check fixture against the aircraft surface next to the alternate static port. Two legs with the dial indicator tip between them shall be parallel to the horizontal centerline of the aircraft and shall not rest directly on the static port when taking all readings.

(c) Place the dial indicator tip on every intersecting line having a letter or number designator, and record the deviation at each of these intersections.

(d) Verify all deviations are within the waviness tolerances specified in Paragraph 7.C. below.

C. Waviness Tolerances

(1) Critical area: All readings should be within +/-0.006 inch (±0.15 mm).

(2) Semicritical area: All readings should be within +/-0.012 inch (±0.31 mm).

(3) Controlled area: Class II waviness tolerances must be met. See SRM 51-50-0, paragraph 6.

D. Fore and Aft Contour Check

Perform the fore and aft contour checks shown in Figure 217. This procedure is for forward and aft measurements of depressions and protrusions over dimensions shown.

E. Port Mismatch Inspection Procedure:

(1) Make inspection without inspection aid - mylar overlay.

(2) Check mismatch at four places on each port - top, bottom, fore, and aft. (Figure 218, View A)

(a) Place inspection check fixture over static port being checked, with fixture's three legs resting on the fuselage skin.

(b) Slide inspection check fixture toward edge of port and note indicator reading.

(c) Continue moving inspection check fixture until indicator tip rests on fuselage skin, immediately adjacent to port. Note this reading.

NOTE: The difference between a reading taken on the port and a reading taken on the adjacent fuselage skin is the port mismatch at that point.

(d) Record mismatch to nearest 0.001 inch (0.025 mm), indicating if port is high (+) or low (-). See mismatch requirements in Paragraph 7.F.(1) that follows: (Figure 218,View B and C)

F. Mismatch Tolerance - Critical Area

(1) Ports must not exceed ±0.001 inch (±0.025 mm) at forward and aft edges (on horizontal centerline) or +0.002 inch to -0.001 inch (+0.051 to -0.025 mm) at top and bottom edges (on vertical centerline).

(2) Rivets must not exceed ±0.001 inch (±0.025 mm).

(3) Skin patches must not exceed ±0.003 inch (±0.076 mm), except that 15 percent of patch edge within critical area, may have a maximum mismatch not exceeding ±0.006 inch (±0.152 mm).

(4) Skin patch edge must be at least 1.50 inches (38 mm) from center of nearest static port.

(5) Any design mismatch within critical area must be maintained in any later repair.

(6) Maximum permissible gap between the alternate port and fuselage skin is 0.030 inch (0.762 mm).

G. Mismatch Tolerance - Semi-Critical Area

NOTE: Remove mylar for these measurements.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(1) Rivets must be flush to +0.003 inch (+0.076 mm) (Class II).

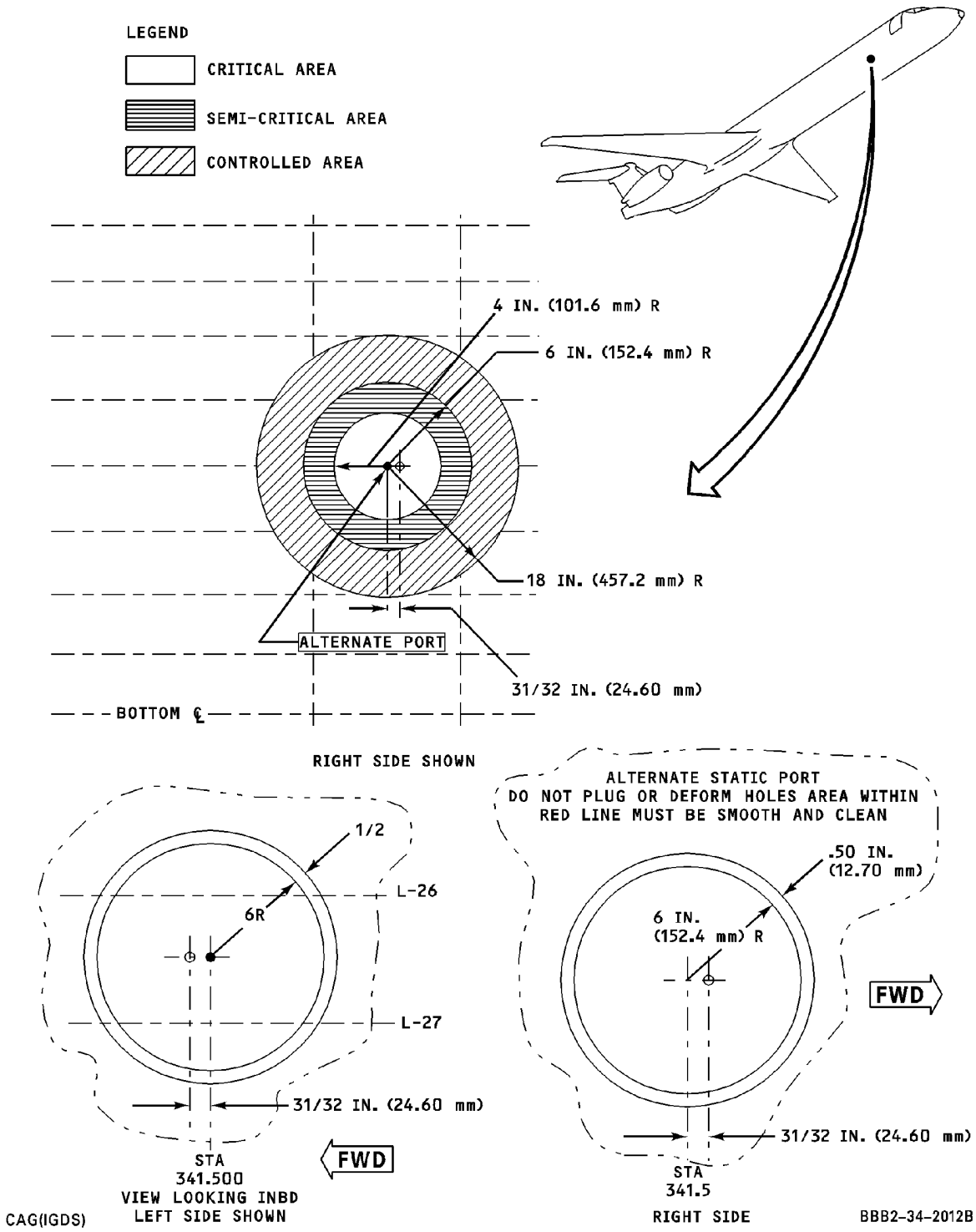
(2) Skin patches must not exceed ±0.010 inch (±0.25 mm), except that 15 percent of patch edge within semi-critical area, may have a maximum mismatch not exceeding ±0.015 inch (±0.38 mm).

(3) Any design mismatch within semi-critical area must be maintained in any later repair.

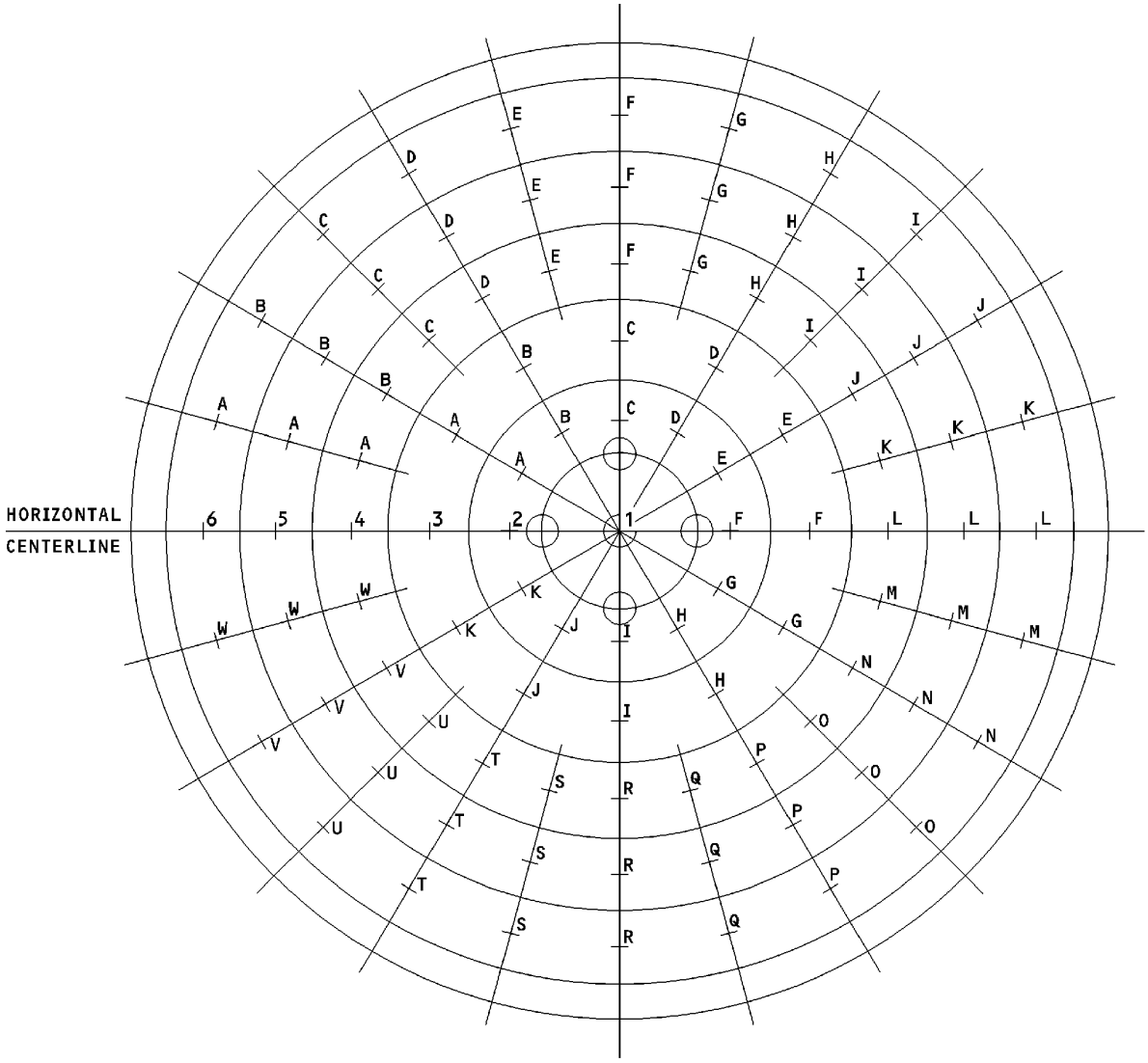
H. Mismatch Tolerance - Controlled Area

(1) Controlled area should conform to the following tolerances:

(a) Region surrounding critical and semi-critical areas should not have any portion of skin patch mismatched greater than ±0.015 inch (±0.38 mm), except that design mismatches within controlled area must be maintained in later repair.

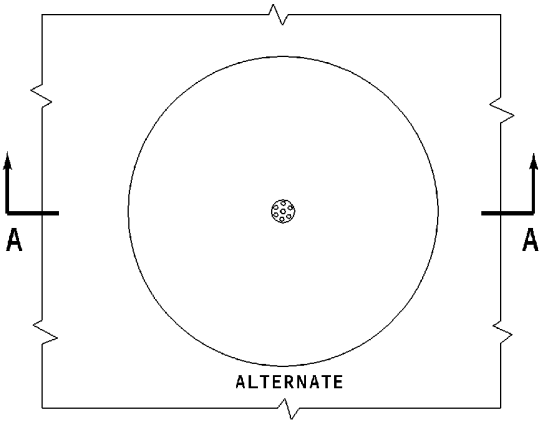


Static Port Class Areas (Alternate)
Figure 215/34-11-01-990-811

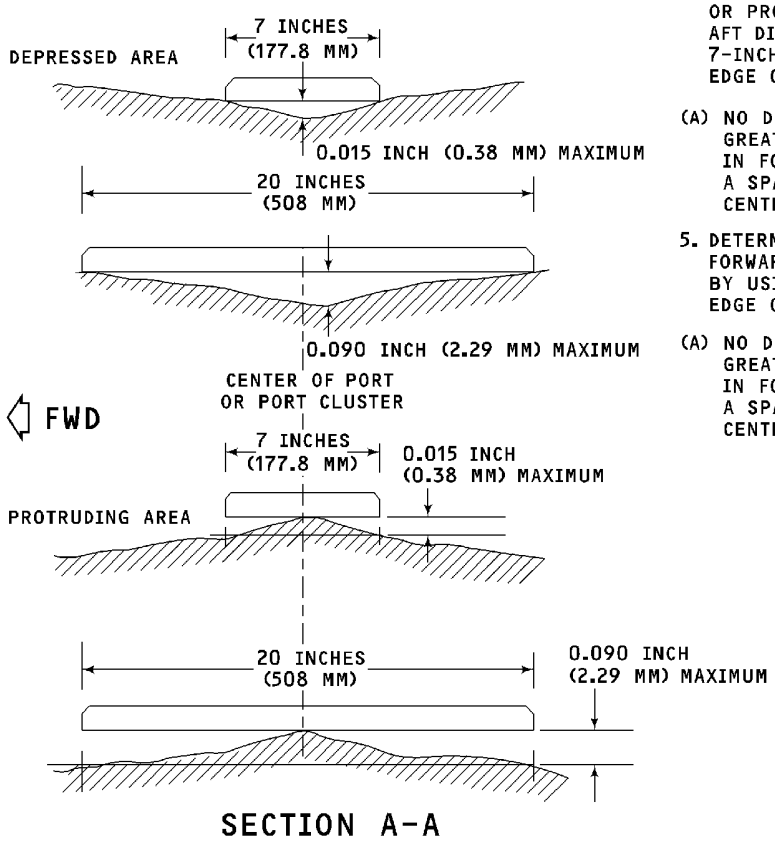


Facsimile of Mylar Overlay Inspection Aid DZZ7354
Figure 216/34-11-01-990-812

SUPPLEMENTAL WAVINESS TOLERANCES
MD-80 ALTERNATE STATIC PORTS



VIEW LOOKING INBOARD
AT ALTERNATE STATIC PORT



SECTION A-A

INSTRUCTION: ALTERNATE PORTS ONLY

PROCEDURE:

1. THE TOLERANCES WITHIN CRITICAL AREA OF THE PORTS ARE SHOWN IN SECTION A-A.
2. EQUIPMENT REQUIRED.

(A) PRECISION STRAIGHT EDGE, 7 INCHES (177.8 MM) LONG.

(B) PRECISION STRAIGHT EDGE, 20 INCHES (508 MM) LONG.

3. IN ADDITION TO THE WAVINESS INSPECTION REQUIREMENTS OF PARAGRAPHS 7.B AND 7.C., INSPECT PORTS AS SHOWN IN SECTION A-A.
4. DETERMINE GREATEST DEPRESSION OR PROTRUSION IN FORWARD AND AFT DIRECTION BY USING THE 7-INCH (177.8 MM) STRAIGHT EDGE CENTERED OVER THE PORTS.

(A) NO DEPRESSION OR PROTRUSION GREATER THAN 0.015 INCH (0.38 MM) IN FORWARD OR AFT DIRECTION WITHIN A SPAN OF 7 INCHES (177.8 MM) CENTERED OVER THE PORTS IS ALLOWED.

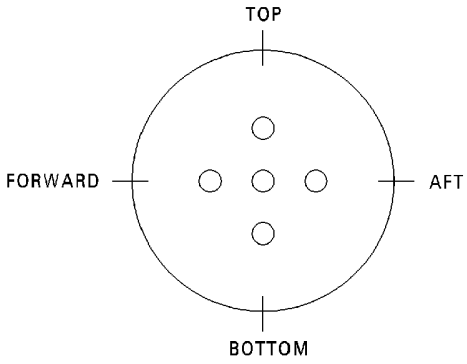
5. DETERMINE GREATEST DEPRESSION IN FORWARD AND AFT DIRECTION BY USING 20.00 INCH (508 MM) STRAIGHT EDGE CENTERED OVER THE PORTS.

(A) NO DEPRESSION OR PROTRUSION GREATER THAN 0.090 INCH (2.29 MM) IN FORWARD OR AFT DIRECTION WITHIN A SPAN OF 20.00 INCHES (508 MM) CENTERED OVER PORT IS ALLOWED.

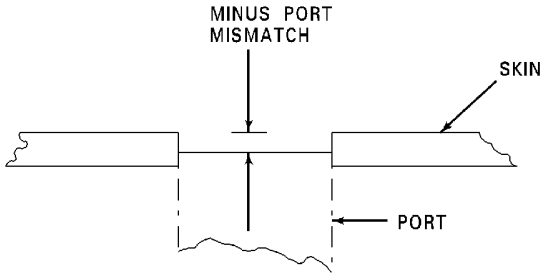
CAG(IGDS)

BBB2-34-2015B

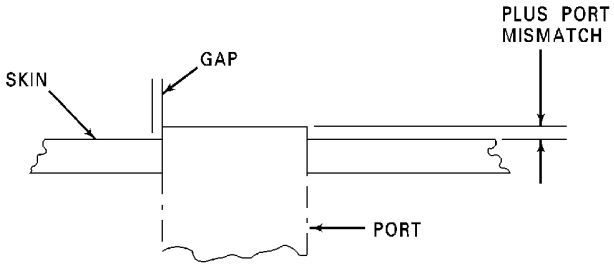
Alternate Static Ports Fore and Aft Critical Area Contour Check
Figure 217/34-11-01-990-813



A. MISMATCH CHECK POINTS



B. LOW PORT MISMATCH



C. HIGH PORT MISMATCH

CAG(IGDS)

BBB2-34-2016

Mismatch Check Points for High and Low Ports
Figure 218/34-11-01-990-814

8. **Requirements for Aircraft Operating in RVSM Airspace**

NOTE: This paragraph applies only to MD-80 aircraft to be certified for RVSM (Reduced Vertical Separation Minimums) operation as well as for maintenance of MD-80 aircraft that continue to operate in the RVSM environment.

NOTE: While the alternate static port may not be used during RVSM flight, the alternate static port is required to be inspected. The alternate static port is a part of the aircraft altimetry system that may be used for altitude cross checking in the event of an altitude split between primary systems.

A. Perform inspections of Paragraph 6. and Paragraph 7. and make certain that waviness and mismatch requirements therein are met.

B. Perform inspections of Paragraph 6. and Paragraph 7. and make certain that waviness and mismatch requirements therein are met. Reference Paragraph 8.F. for contour changes that exceed limits.

C. RVSM Aerodynamic Cleanness Tolerances and RVSM Controlled Area Definition:

(1) The RVSM controlled area is the region forward of the primary static ports only, bounded by the 18-inch (457.2 mm) controlled area radius, tangents to the edge of the static plate, and a 36-inch (914.4 mm) radius, as shown in Figure 212 and Figure 221.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(2) Waviness and mismatch requirements for the RVSM controlled area are the same as for the controlled areas and are given in Paragraph 6.J..

WJE ALL

D. External doubler repairs within the special class areas of the normal and alternate static ports.

(1) External doubler repairs are not permissible in the alternate port critical area. Repairs must be flush. (Paragraph 7.F. for requirements)

(2) External doubler repairs are acceptable in the controlled and RVSM controlled areas if the requirement of Paragraph 8.F., Dents, Bulges, and External Doubler Repairs are met.

(3) In the alternate port semi-critical area, a portion of a repair that extends from the controlled area is acceptable if the requirements of Paragraph 8.F., Dents, Bulges, and External Doubler Repairs are met.

(4) External doubler repairs within the special class areas must have 10 to 1 minimum chamfers on all edges down to an edge height of 0.020-inch maximum.

E. External doubler repairs in the vicinity of the primary and alternate static ports which lie outside the controlled and RVSM controlled areas are permissible provided that the thickness and chamfer are in accordance with SRM 53-04, Figure 12B.

F. Dents, Bulges, and External Doubler Repairs

(1) For the purposes of this sub-paragraph, dents, bulges, and (approved) external doubler repairs will be referred to as contour changes.

(2) For the normal static ports, a single contour change within the controlled and RVSM controlled areas and beyond must not exceed the limits given in Figure 219.

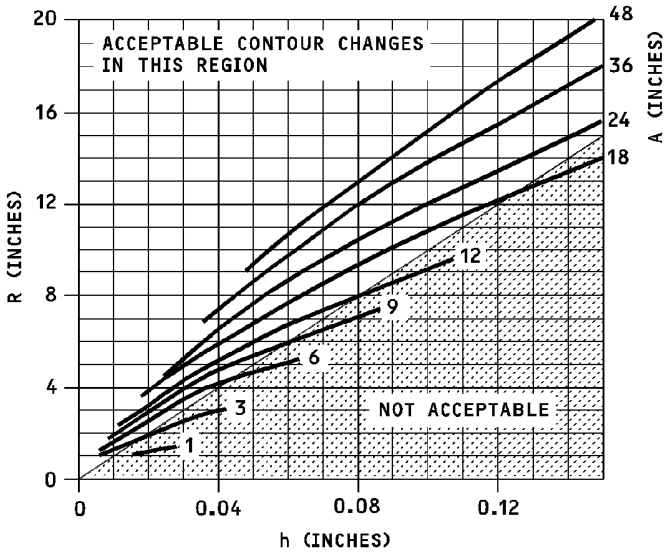
(3) For the alternate static ports, a single contour change within the critical, semi-critical, and controlled areas and beyond must not exceed the limits given in Figure 219.

(4) For a single contour change beyond the range of Figure 219, the requirement is that R/h be greater than or equal to 100, with "A" equal to or less than 21 inches. If "A" is greater than 21 inches, contact Boeing. As shown in Figure 219, "R" is the distance from the static port to the nearest edge of the contour change, "h" is the maximum height or depth of the contour change, and "A" is the largest dimension of the contour change.

(5) Not more than two contour changes per airspeed system are allowed within the controlled and RVSM controlled area outer boundaries. For example, the primary ports could have two on one side, or one on each side. The same applies to the alternate ports. The two contour changes must each have R/h greater than or equal to 200 and "A" less than or equal to R/2.

(6) For acceptability of any contour changes on the primary static port compensating plates, contact Boeing.

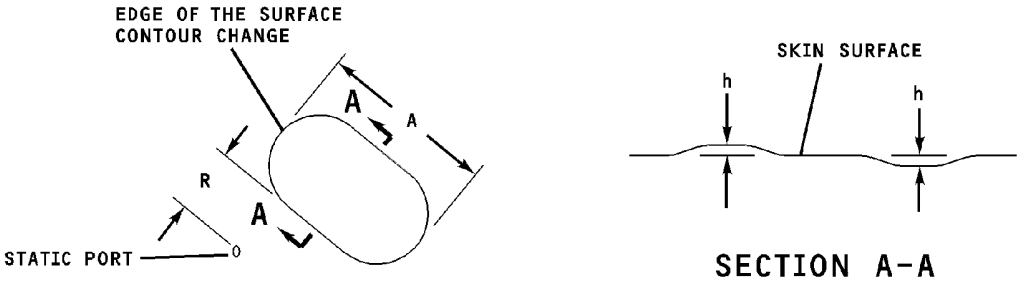
(7) For contour changes that exceed the above limits, contact Boeing.



A = THE LARGEST DIMENSION OF CONTOUR CHANGE

h = THE MAXIMUM DEPTH OR HEIGHT OF THE CONTOUR CHANGE

R = THE MINIMUM DISTANCE FROM THE STATIC PRESSURE PORT TO THE NEAREST EDGE OF THE CONTOUR CHANGE (I.E, TO THE LOCATION WHERE THE CHANGE FROM CONTOUR STARTS)



LIMITS ON SURFACE CONTOUR CHANGE NEAR STATIC PORTS

CAG(IGDS)

BBB2-34-2432

Aerodynamic Smoothness - Static Ports
Figure 219/34-11-01-990-815

9. Check Static Port Heaters

A. Check Static Port Heaters

NOTE: The following circuit breakers are opened to prevent the pitot tube and stall warning transducers from heating operation during the static port heating checks.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(2) Make sure that these circuit breakers are closed:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

(3) Place meter SEL & HEAT switch to positions noted below. Readings after one minute should agree with those below:

(a) RIGHT STATIC (one minute only) - Meter - 5.75-10.0.

(b) LEFT STATIC (one minute only) - Meter - 5.75-10.0.

(4) Place the meter SEL & HEAT switch to the OFF position.

(5) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR

(Continued)

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

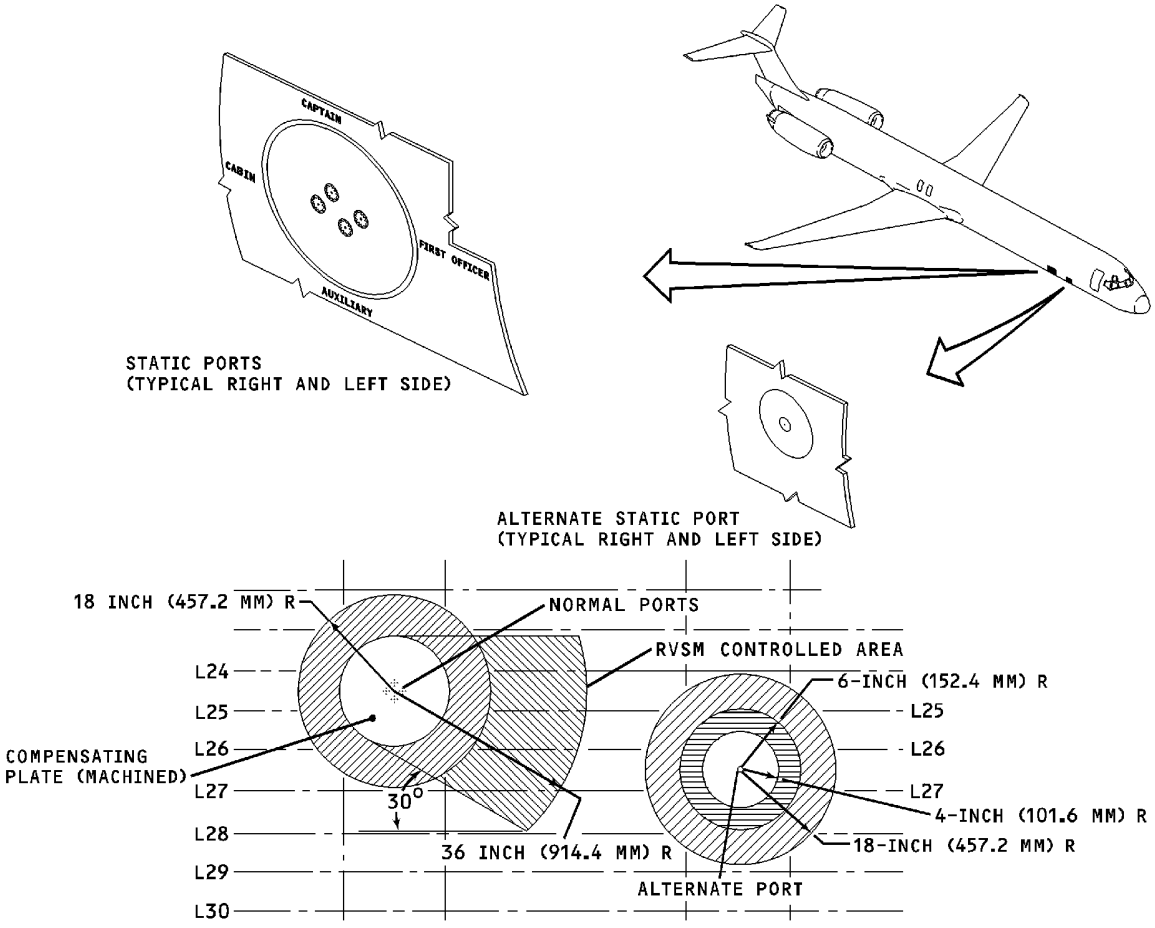
Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(6) Return aircraft to required configuration.

Aerodynamic Contour Check -- Alternate Static Ports
Figure 220/34-11-01-990-816



DEFINITIONS OF SPECIAL CLASS AREAS

1. CRITICAL AREA
   a. NORMAL PORTS - THE EXTERNALLY MOUNTED COMPENSATING PLATE
   b. ALTERNATE PORTS - THE REGION BOUNDED BY A CIRCLE WITH A 4 INCH (101.6 MM) RADIUS MEASURED FROM THE CENTER OF A PORT CLUSTER.
2. SEMI-CRITICAL AREA (ALTERNATE PORTS ONLY)
   THE REGION BETWEEN TWO CONCENTRIC CIRCLES HAVING A 4 INCH (101.6 MM) AND 6 INCH (152.4 MM) RADII RESPECTIVELY, MEASURED FROM THE CENTER OF THE PORT.
3. CONTROLLED AREA
   a. NORMAL PORTS - THE REGION BETWEEN THE OUTER EDGE OF THE COMPENSATING PLATE AND A CIRCLE WITH AN 18 INCH (457.2 MM) RADIUS MEASURED FROM THE CENTER OF A PORT CLUSTER.
   b. ALTERNATE PORTS - THE REGION BETWEEN TWO CONCENTRIC CIRCLES HAVING 6 INCH (152.4 MM) AND 18 INCH (457.2 MM) RADII RESPECTIVELY, MEASURED FROM THE CENTER OF THE PORT.
4. RVSM CONTROLLED AREA
   THE REGION FORWARD OF THE NORMAL STATIC PORTS ONLY, BOUNDED BY THE 18 INCH (457.2 MM) CONTROLLED AREA RADIUS, TANGENTS TO EDGE OF STATIC PLATE, AND A 36 INCH (914.4 MM) RADIUS, AS SHOWN.

LEGEND:

- CRITICAL AREA
- SEMI-CRITICAL AREA
- CONTROLLED AREA
- RVSM CONTROLLED AREA (SEE PARAGRAPH 8.)

CAG(IGDS)

BBB2-34-907A

Aerodynamic Areas -- Static Ports
Figure 221/34-11-01-990-817

STATIC PORTS - INSPECTION/CHECK

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-11-01-211-801

2. Detailed Inspection of the Primary and Alternate Static Ports for Critical Waviness (RVSM Operation Only)

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
34-11-01 P/B 201 Config 1	STATIC PORTS - MAINTENANCE PRACTICES

B. Detailed Inspection for Critical Waviness of the Primary and Alternate Static Ports

SUBTASK 34-11-01-211-001

(1) Perform a detailed inspection for critical waviness of the primary and alternate static ports per AMM Requirements for Aircraft Operating in RVSM Airspace. (STATIC PORTS - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-01/201 Config 1)

——— END OF TASK ———

PITOT TUBES - MAINTENANCE PRACTICES

1. General

A. The removal and installation procedures for the captain's, first officer's, and auxiliary pitot tubes are identical. Looking forward, on the upper fuselage nose section, the captain's, first officer's, and auxiliary pitot tubes are installed on the left, right, and center positions, respectively. A rudder limiter pitot tube is also located in the leading edge of the vertical stabilizer.

B. Access to the captain's, first officer's and AUX pitot tube assemblies is through access door in the nosewheel well.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
O-ring 2-26-S418-6	Parker Seal Company
Sealant, Silicone (Kit - 90-006 with catalyst 90-006-2) DMS 1799	Dow Corning Corp.
Solvent, cleaning 1,1,1 trichloroethane (stabilized vapor degreasing) DPM 5792	Canadian Industries, Ltd.
Air data tester model No. 127-1M	Edcliff Instruments
Dry nitrogen (purge pitot and static lines)	Commercial
Compound, high temperature antiseize MIL-A-907 DPM 377	FEL-PRO, Inc.
Insulation Class "AA" DMS 1966	Owens-Corning Fiberglass Corp.
Cloth, silicone rubber coated glass SRG0408 1/C-2 DMS 1953-1	Minnesota Mining and Manufacturing Co.

Table 201 (Continued)

Name and Number	Manufacturer
Tape, silicone adhesive DMS 1983	CHR Industries, Inc.
Thread, beta glass, coated DPM 2907-2	Allied-Signal Inc. Fluorglas
Solvent, P-D-680 Type 1 DPM 518	Stoddard

3. **Removal/Installation Pitot Tubes**

A. Remove Pitot Tubes (Capts, F/O, AUX)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(2) Remove bolts, lockwashers, and flat washers securing pitot tube assembly to airplane structure.

(3) Disconnect and cap electrical connector attached to pitot tube assembly.

(4) Disconnect and cap pressure line coupling attached to pitot tube assembly.

(5) Remove pitot tube and O-ring from airplane structure. Discard the O-ring.

NOTE: The O-ring is located in the groove in the pitot tube base and forms the pressure seal for the hole in the fuselage accommodating the electrical connector and pressure line.

B. Install Pitot Tubes (Capts, F/O, AUX)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

CAUTION: BEFORE INSTALLING PITOT TUBE, MAKE CERTAIN PITOT TUBE ASSEMBLY AND FAYING SURFACES OF TUBE AND AIRPLANE ARE ABSOLUTELY CLEAN AND FREE OF FOREIGN OBJECTS. PRIOR TO CLEANING OR ANY OTHER OPERATION WHEREIN THE MOUNTING SURFACE OF THE PITOT TUBE MAY COME IN CONTACT WITH A CLEANING SOLUTION, THE TWO MOUNTING HOLES SHALL BE TEMPORARILY SEALED WITH APPROVED TAPE TO PREVENT MOISTURE FROM ENTERING THE MOUNTING HOLES. REMOVE TAPE BEFORE INSTALLING.

(2) Clean airplane mounting surface for pitot tube assembly (Solvent - MIL-T-81533).

(3) Apply an even light coat of silicone sealant to faying surfaces of pitot tube and mounting surface of airplane.

(4) Place O-ring and pitot tube on airplane structure, apply sealant under head of attaching screws and install screws.

CAUTION: TO ENSURE PROPER SEATING, TIGHTEN BOLTS ALTERNATELY TO APPLY UNIFORM LOAD TO PITOT TUBE ASSEMBLY.

(5) Tighten bolts to torque of 25 inch-pounds.

(6) Remove cap from pressure line coupling and attach line to pitot tube assembly.

NOTE: Whenever a pitot tube is opened, a pitot static leak test should be performed (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1).

(7) Connect electrical connector.

(8) Clean any excess sealant around pitot head and attaching screws.

(9) Remove the safety tags and close these circuit breakers:

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(10) Perform Leak Test (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1).

C. Capt., F/O, and Aux Pitot Heater Checks

NOTE: The following circuit breakers are opened to prevent heating operation of the static ports and stall warning transducers during pitot tube heater checks.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	21	B1-416	RIGHT STATIC PORT HEATER
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

CAUTION: MAKE CERTAIN PITOT TUBE PROTECTIVE COVERS ARE REMOVED BEFORE STARTING HEATING CHECKS.

(2) Place METER SEL & HEAT switch to OFF position.

(3) Make sure that these circuit breakers are closed:

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893 (Continued)

(Continued)

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(4) Place METER SEL & HEAT switch to noted positions and record readings after one minute and verify with noted readings.

(a) CAPT PITOT (one minute only) Meter - 2.0 - 10.0

(b) AUX PITOT - Meter - 2.0 - 10.0

(c) F/O PITOT - Meter - 2.0 - 10.0

NOTE: Capt, Aux and F/O readings may be as low as 1.0 if heaters were operated prior to this test.

(5) Place meter SEL & HEAT switch to OFF position.

(6) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	21	B1-416	RIGHT STATIC PORT HEATER
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

(7) Return airplane to required configuration.

D. Remove Pitot Tube (Rudder Limiter)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

(2) Remove mount screws in rudder limiter pitot tube mount assembly and carefully pull unit from stabilizer until hose fitting is clear from stabilizer.

(3) Remove insulation and disconnect hose fitting and electrical connector from pitot tube, and remove pitot assembly.

E. Install Pitot Tube (Rudder Limiter)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

(2) Apply antiseize compound to pitot tube threads.

(3) Connect pitot hose and electrical connector to pitot tube.

(4) Wrap pressure hose and electrical harness for a distance of approximately 8 inches with fibrous glass insulation. Secure insulation tightly with beta glass thread.

(5) Wrap insulation for a distance of approximately 10 inches with silicon rubber coated fibre glass cover. Secure covering with silicon tape.

NOTE: Insulation should fit tightly against mount assembly, and maximum diameter of compressed wrapping not to exceed 2 inches.

(6) Clean mounting surface of mount assembly and vertical stabilizer.

(7) Apply faying sealant to vertical stabilizer mounting surface. Insert pitot tube with mount assembly in vertical stabilizer with drain hole down, and install mounting screws.

(8) Remove the safety tag and close this circuit breaker:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

(9) Check for operation of pitot tube heater.

(10) Leak test per PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1, Test Vertical Stabilizer Pitot Line.

F. Rudder Q Limiter Pitot Heater Check

NOTE: The following circuit breakers are opened to prevent heating operation of the static ports and stall warning transducers during pitot heater check.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

CAUTION: MAKE CERTAIN PITOT TUBE PROTECTIVE COVERS ARE REMOVED BEFORE STARTING HEATING CHECKS.

(2) Place METER SEL & HEAT switch to OFF position.

(3) Make sure that these circuit breakers are closed:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	21	B1-416	RIGHT STATIC PORT HEATER
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

(4) Place METER SEL & HEAT switch to noted position and record reading after one minute and verify with noted reading.

(a) RUD LIM PITOT - Meter - 7.0 - 10.0

NOTE: Rud Lim reading may be as low as 6.0 if heater was operating prior to this test.

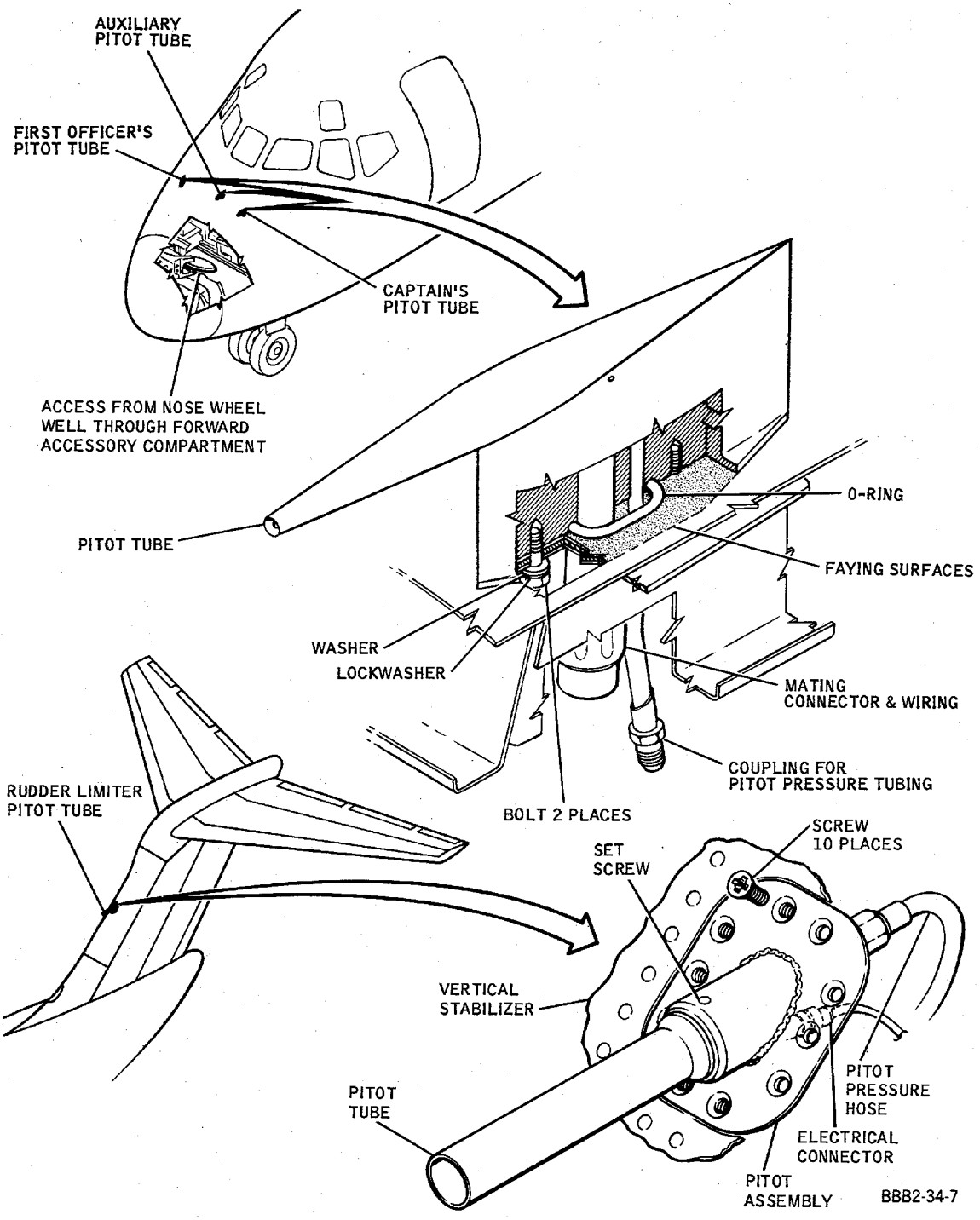
(5) Place METER SEL & HEAT switch to OFF position.

(6) Remove the safety tags and close these circuit breakers:

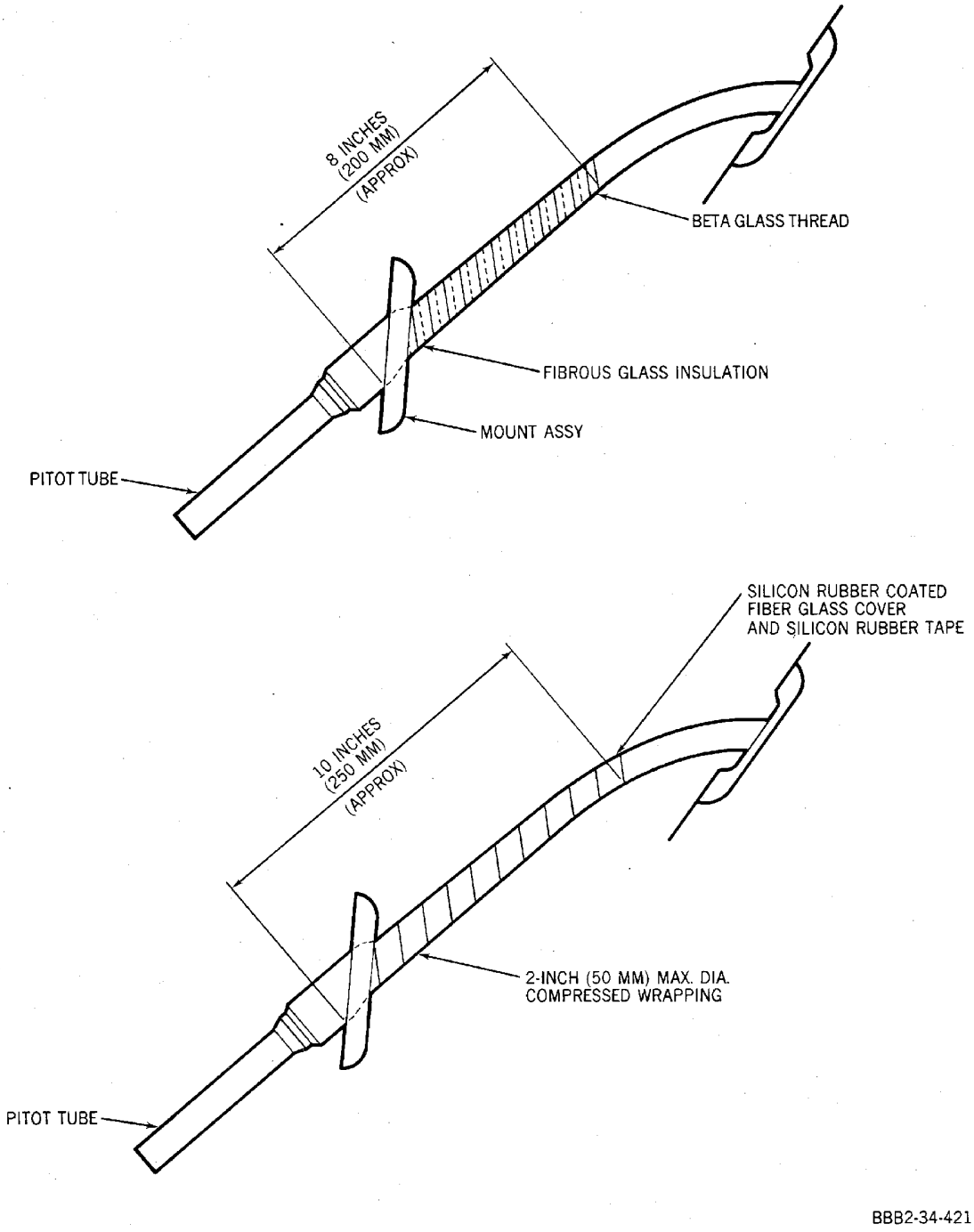
LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

(7) Return aircraft to required configuration.

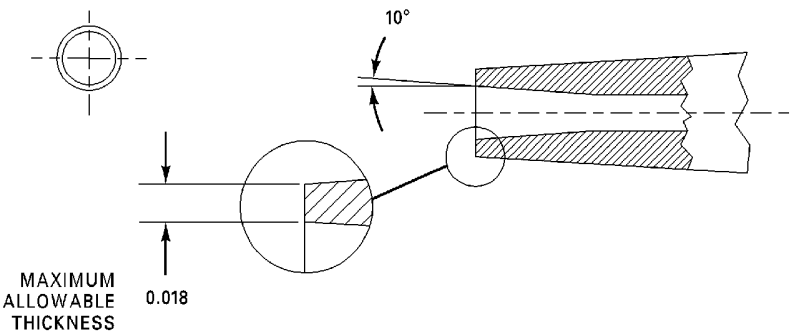


Pitot Tube -- Installation
Figure 201/34-11-02-990-801

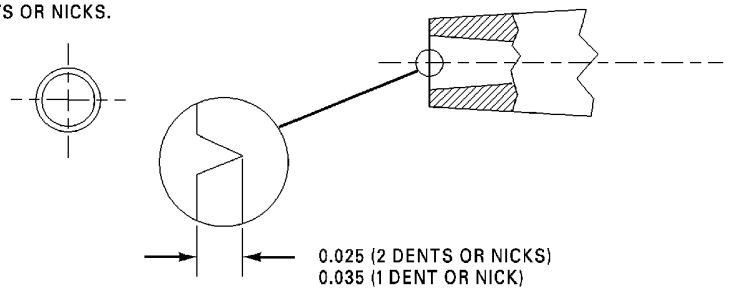


Pitot System -- Rudder Throw Limiter
Figure 202/34-11-02-990-802

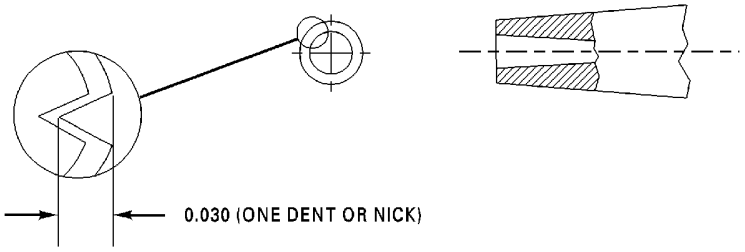
(1) MAXIMUM ALLOWABLE FLATNESS ON NOSE CIRCULAR SURFACE.



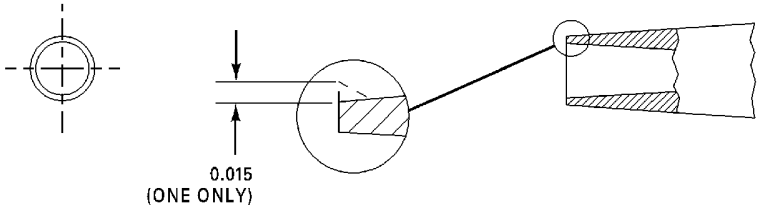
(2) LONGITUDINAL DENTS OR NICKS.



(3) RADIAL DENTS OR NICKS (INSIDE OR OUTSIDE) OR FLATNESS.



(4) FLARED LEADING EDGE, INSIDE OR OUTSIDE.



(5) SUPERFICIAL CRACKS, CORROSION, AND PITTING 1/8 INCH OR MORE AFT OF THE NOSE DO NOT AFFECT OPERATION OF THE TUBE AND SHOULD BE DISREGARDED.

CAG(IGDS) BBB2-34-1656

Nose Pitot Tube Damage Tolerances
Figure 203/34-11-02-990-803

4. Pitot Tube Drain Hole Check

NOTE: The procedures in paragraph Paragraph 4.A. must be performed prior to those in paragraph Paragraph 4.B. and/or Paragraph 5.A. following any reported airspeed discrepancy.

A. Visual Check - Pitot Tube Drain Holes

CAUTION: EXERCISE CARE IN CHECKING PITOT TUBE TO PREVENT SEVERE BURN TO HANDS.

(1) Make certain METER SEL & HEAT switch on overhead panel is OFF and pitot tubes are not hot.

(2) Attempt to sight through left and right drain holes of each pitot tube.

(3) Observe that ambient light (or flashlight) is visible through both drain holes of each pitot tube.

(a) If light is visible, continue procedure at Paragraph 4.B..

(b) If light is not visible through drain, proceed with next item.

(4) If drain hole blockage is evident, report findings, then perform cleaning procedures specified in paragraph Paragraph 5.A..

B. Forced Air Check-Pitot Tube Drain Holes

CAUTION: EXERCISE CARE IN CHECKING PITOT TUBE TO PREVENT SEVERE BURN TO HANDS.

(1) Make certain METER SEL & HEAT switch on overhead panel is OFF and pitot tubes are not hot.

(2) Connect air pressure source (Dry nitrogen) or air data tester to pitot tube (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1).

(3) Adjust air pressure source to 5 PSI maximum or air data tester to 450 knots maximum.

(4) Check for air flow out of each drain hole by placing finger alternately over each hole.

CAUTION: EXCESSIVE PRESSURE APPLIED TO PITOT TUBE BY EITHER METHOD PROVIDED CAN CAUSE DAMAGE TO INSTRUMENTS.

(5) An alternative method can be used by placing a 9/16 inch inside diameter hose approximately three feet long to end of pitot tube and blowing lightly into opposite end of hose. Check for airflow from drain holes as in step Paragraph 4.B.(4).

(6) If air flows through both holes, terminate procedure.

(7) If pitot tube drain holes are blocked, clean drain holes per paragraph Paragraph 5.A..

5. Cleaning Blocked Pitot Tube Drain Holes

A. Clean Pitot Drain Hole

(1) Clear obstructions from pitot tube drain hole by inserting a number 30 gauge wire carefully into drain hole.

(2) Purge affected pitot system as follows:

(a) Disconnect pitot terminating lines from affected CADC, EPR transducer, and/or airspeed indicator and cap fittings.

(b) Connect purging nitrogen source at corresponding CADC or airspeed indicator line of affected pitot head system.

NOTE: Secure flexible pressure hoses to prevent any whipping movement when pressure is applied.

(c) Regulate dry nitrogen pressure to 25 PSI (maximum 30 PSI) and purge system lines by applying pressure for a period of 3 minutes.

(d) During purging period, check for unrestricted flow of air out of drain holes.

(e) If it is determined blockage is cleared, terminate purging operation and return system to normal configuration.

(f) If drain hole blockage is not cleared, remove and replace pitot tube.

NOTE: Removed pitot tubes that show evidence of blockage by oil or grime residue can be soaked in Stoddard solvent (P-D-680) and then purged with air pressure at 45 PSI maximum to drain holes and outlet strut to clear blockage.

WARNING: MIL-PRF-680 TYPE 1 SOLVENT IS AN AGENT THAT IS FLAMMABLE AND POISONOUS. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN MIL-PRF-680 TYPE 1 SOLVENT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET MIL-PRF-680 TYPE 1 SOLVENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

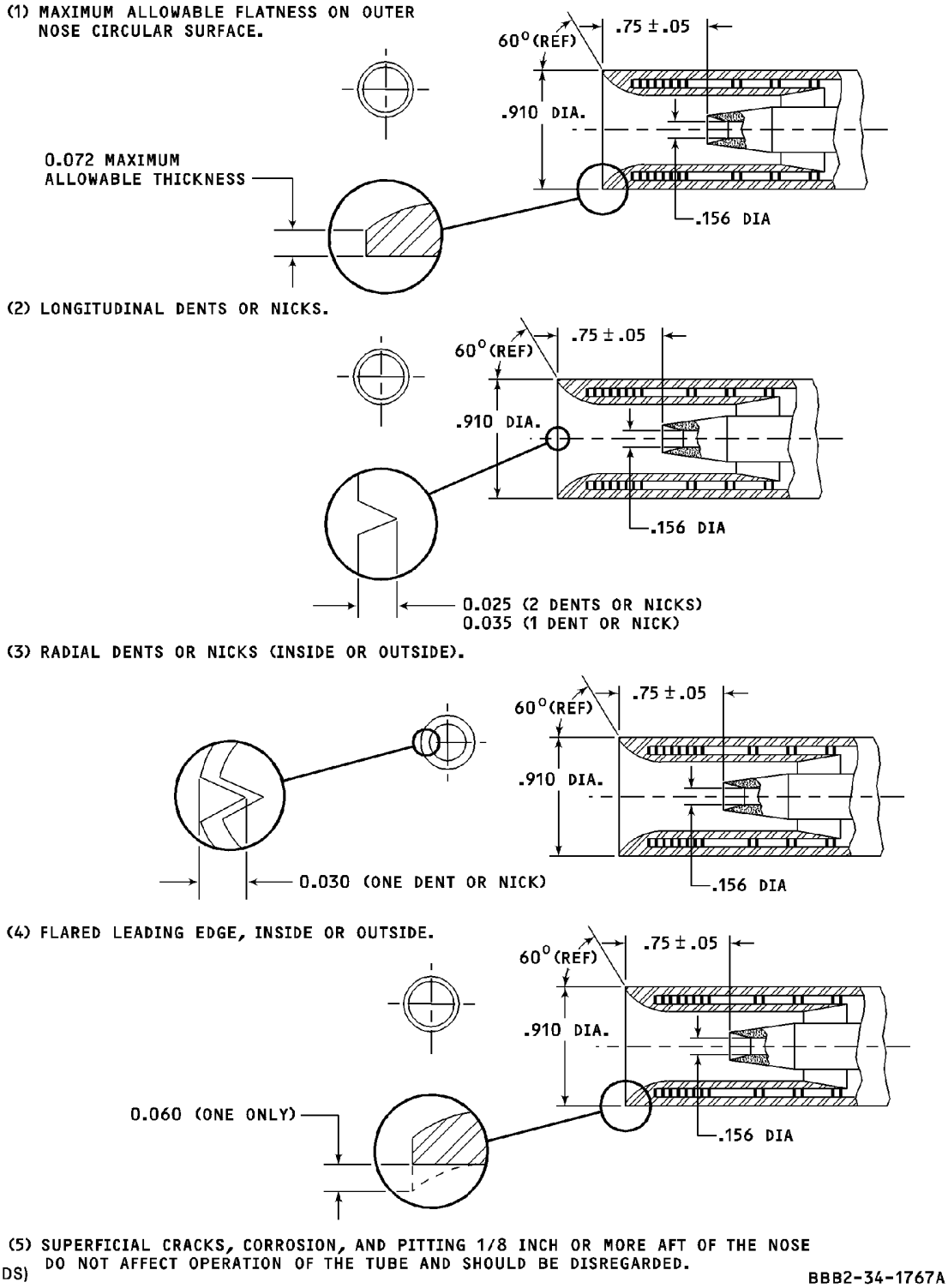
- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(3) Perform leak test on applicable pitot system (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1).

6. Pitot Tube Damage Tolerances

A. Refer to Figure 203 for nose pitot tube damage tolerances; refer to Figure 204 for rudder pitot tube damage tolerances.



Rudder Pitot Tube Damage Tolerances
Figure 204/34-11-02-990-804

PITOT TUBES - INSPECTION/CHECK

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-11-02-210-801

2. General Visual Inspection of the Rudder Limiter Pitot Tube

A. Inspect the Rudder Limiter Pitot Tube

SUBTASK 34-11-02-840-001

(1) Gain access to the leading edge of the vertical stabilizer.

SUBTASK 34-11-02-210-001

(2) Inspect the rudder limiter pitot tube for cracks, corrosion, condition, and security.

——— END OF TASK ———

STATIC SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the static selector valve. The static selector valves are mounted on the captain's and first officer's gusset section of the instrument panel. Access to the selector valves is gained by opening the captain's or first officer's instrument panel. Removal/installation procedures for both selector valves are identical.

2. Removal/Installation Static Selector Valve

NOTE: Some static selector valves are equipped with micro switches and a Cannon plug disconnect. Removal/ installation procedures are identical for both types of valves.

A. Remove Static Selector Valve

(1) Open applicable captain's or first officer's instrument panel INSTRUMENT PANELS - GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 31-00-02/201 to gain access to side and rear of gusset panel.

CAUTION: NOTE RELATIVE POSITION AND MARKING OF STATIC PIPING PRIOR-TO DISCONNECT. USE EXTREME CARE WHEN MOVING OR ADJUSTING PIPING LINES-TO AVOID KINKING.

(2) Disconnect and cap static piping (3 places) from rear of selector valve.

(3) On face of gusset section, remove valve handle.

(4) Remove light plate.

(5) Remove valve attaching screws, grasp back side of selector valve and remove by gently sliding out of gusset section.

B. Install Static Selector Valve

(1) Gain access to gusset panel by opening adjacent instrument panel INSTRUMENT PANELS - GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 31-00-02/201.

(2) Carefully place selector valve into position (No 1 port outboard) from rear of gusset panel and install attaching screws.

CAUTION: USE EXTREME CARE WHEN MOVING, ALIGNING, OR TIGHTENING STATIC PIPING-TO STATIC SELECTOR VALVE. OBSERVE RELATIVE POSITION AND MARKING OF STATIC PIPING-TO ENSURE CONNECTION-TO APPROPRIATE FITTING.

(3) Remove caps and connect static piping to selector valve.

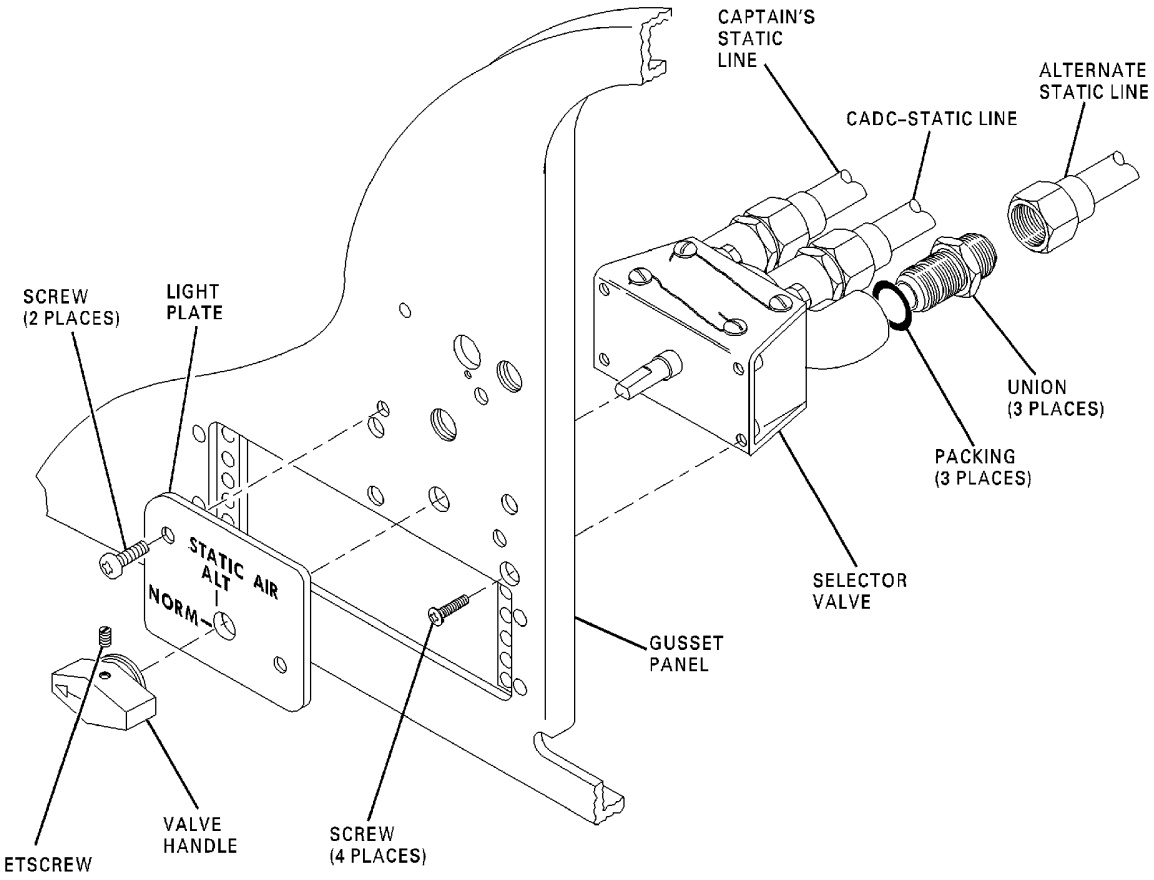
(4) Install light plate on gusset panel.

(5) Install valve handle.

(6) Close and secure instrument panel.

C. Functional Check

(1) Perform leak test of applicable captain's or first officer's, and alternate static systems. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)



CAPTAIN'S SIDE SHOWN –
FIRST OFFICER'S TYPICAL

CAG(IGDS)

BBB2-34-76B

Static Selector Valve -- Removal/Installation
Figure 201/34-11-03-990-801

STATIC SELECTOR VALVE - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-11-03-710-801

2. Operational Check of the Static Selector System

A. Operational Check of the Static Selector System

SUBTASK 34-11-03-710-001

(1) Do an operational check of the static selector system.

NOTE: This task is performed as part of the Functional Check of the Pitot Static System for Leakage (High Altitude). Refer to Task Card 34-010-03-01 (AMM Task 34-11-00-720-801).

——— END OF TASK ———

ALTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Altitude System is composed of two Primary Altimeter Indicators and a Pneumatic Standby Altimeter/Airspeed Indicator. The primary indicator operations are dependent upon signal information supplied by the Central Air Data Computers. The standby indicator is a pneumatically operated instrument fed directly by the environment pressure of the Static System. The primary and secondary indicators are capable of displaying barometrically corrected altitude. The altitude correction is obtained by manually selecting the appropriate barometric pressure with the individual indicators BARO set knob.

B. Primary Altimeter Indicators. The Captain's Primary Altimeter Indicator is mounted on the Captain's instrument panel and displays information received from the Central Air Data Computer -1. The First Officer's Primary Altimeter Indicator is mounted on the First Officer's instrument panel and displays information received from the Central Air Data Computer -2. The air data information to the Captain's and First Officer's displays is routed from their respective CADC's through the air data instrument switching unit. Captain's and First Officer's indicators display information received from Central Air Data Computer -1 or -2, as selected by the overhead panel CADC selector switch and routed through the air data instrument switching unit. The indicator BARO set knob adjusts a correction voltage provided to the Central Air Data Computer in order to obtain the computer barometrically corrected altitude output. The indicators function operation includes an internal failure monitor to assure the validity of the displayed information. In addition, the indicator operation is verified during line maintenance procedures by employing the self-test function features of the Central Air Data Computer.

C. Pneumatic Standby Altimeter/Airspeed Indicator. The Pneumatic Standby Altimeter/Airspeed Indicator is mounted on the captain's instrument panel and displays information received from the Alternate Static System. The pressure altitude mechanism is compensated by adjustments of the BARO set knob to provide a barometrically corrected altitude indication.

2. Operation

A. Primary Altimeter Indicators. The Primary Altimeter Indicator decodes and displays digital barometric corrected altitude data received from the Central Data Computer. The indicators receive serial digital information, process the information utilizing integrated circuits, and display the information by means of servo operated numerical wheels. Internal failure monitoring circuits annunciate failed displays and facilitate checkout and maintenance procedures. The altimeter displays and functional operation are as follows (Figure 1):

(1) Pointer (Altitude). The pointer, in conjunction with the calibrated dial, displays altitude between thousand foot levels. The pointer is positioned by a servo system as determined by the binary counter and logic control circuits. The 360 degree dial periphery is equal to 1000 feet. The dial scale has minor calibrations at each 50 foot increment and major calibrations each 100 feet. Pointer rotation is clockwise for increasing altitudes above sea level. Below sea level (negative altitude) increases are indicated by a counterclockwise pointer rotation.

(2) Counter (Altitude). The counter displays altitude hundreds, thousands, and ten thousands of feet on numeric indicator wheels. The numeric wheels are positioned by the servo system with signals provided by the binary counter and logic control circuits. The altitude counter display has a range of -1000 to +50,000 feet, with an accuracy of ±7 feet independent of barometric setting. The ten thousand foot digit (left most wheel) of the counter shows alternate diagonal white lines for altitudes between sea level and 10,000 feet, a numeral for 10,000 feet and above, and a negative (NEG) altitude shutter to obscure the counter dis-played to annunciate altitude below sea level. Negative altitudes (altitudes below sea level) are determined by interpretation of the pointer rather than by direct pointer or counter readings. As an example, the altitude depicted in the Figure 1 Below Sea Level illustration is 260 feet below sea level. This is determined by reading the pointer position counterclockwise from the "0" position to the 740 foot position.

(3) Barometric Pressure Setting. The indicator BARO set knob is mechanically linked and controls the counter wheels positioning for the two barometric pressure displays. The left counter provides a reading of the set barometric pressure in millibars and the right counter in units of inches of mercury. Each counter may be obscured by an internally adjusted mask. The BARO set knob also positions the wiper of the baro potentiometer. The potentiometer receives a dc voltage from the Central Air Data Computer and the wiper voltage is returned to the computer. The voltage ratio provides the BARO SET input signal.

(4) Altitude Advisory Light. The amber altitude advisory light is located in the upper left corner of the indicator. Operation of the light is controlled by selection and settings of the Altitude Advisory System. The light comes on approaching preselected altitude or when the airplane deviates from a preset altitude.

(5) Altitude Bug. The altitude bug is positioned on the periphery of the altitude pointer dial through mechanical linkage with the altitude bug knob. The knob is located in the lower right corner of the altimeter indicator. The bug provides a mechanical device that may be utilized by the pilot as a memory aid. Turning the knob, rotates the bug position on the dial, this is the only function of the device.

(6) Failure Warning (OFF) Flag. The Failure Warning Flag indicates valid or invalid operation of the altimeter. The flag annunciates normal altimeter operation by remaining in an out of view position and annunciates failures affecting the altitude display in the in view (OFF) position. The operation of the flag is controlled by the altimeter failure monitor circuits. In the OFF position the flag covers all altitude counters. The failure warning indication results from the following conditions: loss of input power; invalid computer input; no computed data received for 2(±0.5) seconds; no input received for 2(±0.5) seconds; internal power supply failure; loss of internal coarse or fine synchro excitation; or persistent excessive servo null.

B. Pneumatic Standby Altimeter/Airspeed Indicator. The Pneumatic Standby Altimeter/Airspeed Indicator displays the altitude as derived from a pressure input from the Alternate Static System.

(1) The indicator provides the following displays (Ref. Figure 1):

(a) Altitude pointer display of altitude between thousand foot levels.

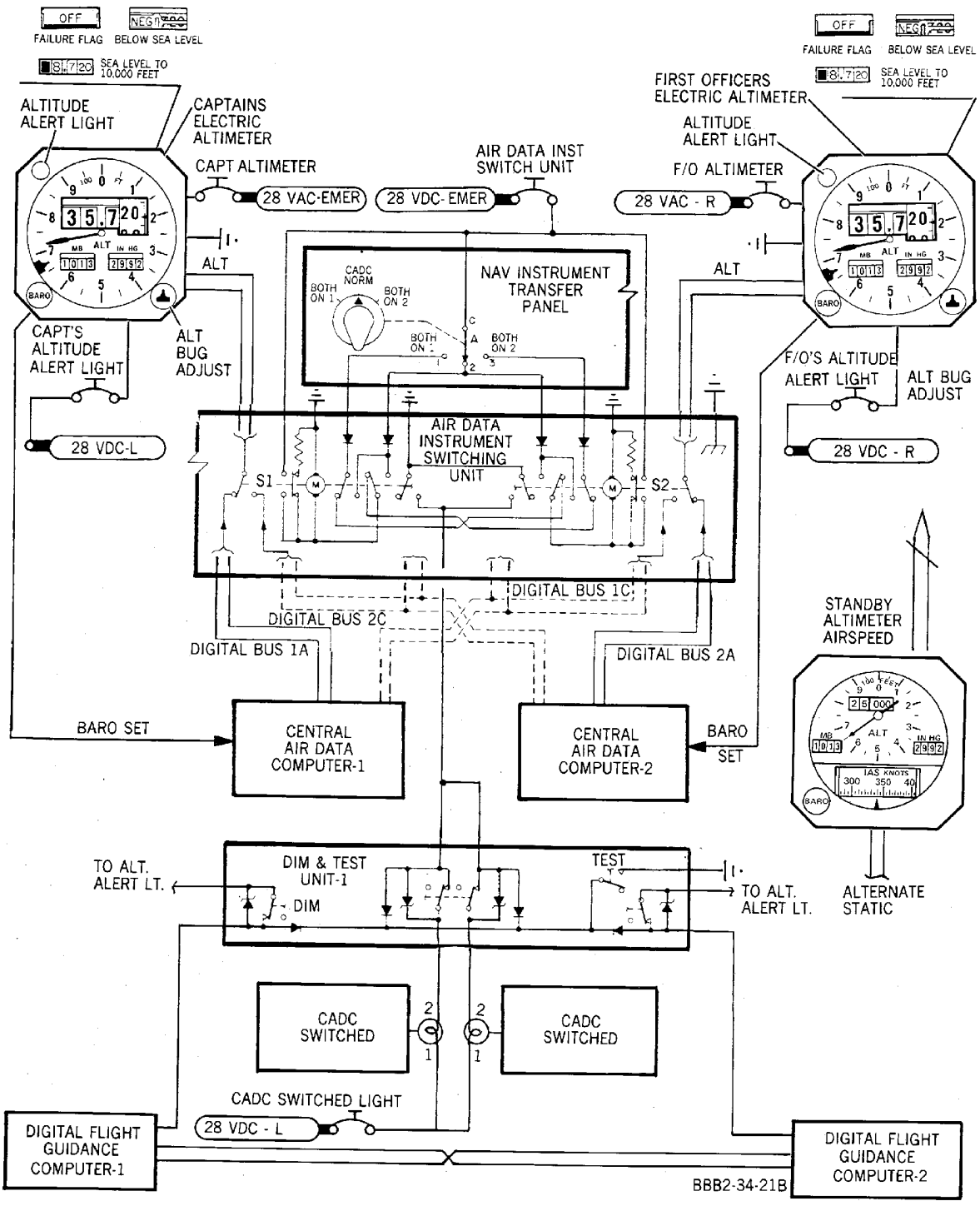
(b) Altitude numeral display of altitude thousand foot levels.

(c) Barometric pressure counter, set by means of the BARO set knob, displays barometric pressure in units of millibars and inches of mercury.

(2) The indicator mechanism is contained within an airtight case into which the Alternate Static System feeds the environment pressure. The environment pressure is sensed by two diaphragms that are mechanically linked to the altitude indicators. Compensation is provided for eliminating erroneous indications resulting from mechanism temperature, backlash, and oscillation.

(3) Adjustments for local barometric pressure conditions is made manually by rotation of the BARO set knob. The BARO knob rotates the barometric counter and repositions the altitude mechanism. The result of setting the barometric counter for the local landing field elevation is that the altitude dis-play will be the actual altitude above the field.

(4) Electrical interface with the indicator provides for internal indicator lighting and vibration circuitry.



Altitude System
Figure 1/34-12-00-990-801

3. To Operate System

A. Primary Altimeter Indicator

NOTE: When electrical buses are energized 28 volts ac power is applied to the altimeter unless CAPT'S ALTIMETER or FO'S ALTIMETER circuit breakers are open.

B. Pneumatic Standby Altimeter/Airspeed Indicator

NOTE: Standby Altimeter/Airspeed Indicator is in operation at all times. The indicator vibrator is controlled by the STANDBY ALTIMETER VIBRATOR circuit breaker.

ALTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty altitude system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the altitude system operation are:

electric altimeters, and standby altimeter/airspeed indicator.

E. The altitude components are located as follows:

Table 101

Component	Location
Electric Altimeters	Captain's and First Officer's Instrument Panels
Standby Altimeter/Airspeed Indicator	Captain's Instrument Panel
First Officer's Altimeter Circuit Breakers	Upper EPC Circuit Breaker Panel
Captain's Altimeter Circuit Breakers	Overhead Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Altitude System

A. Trouble Shoot

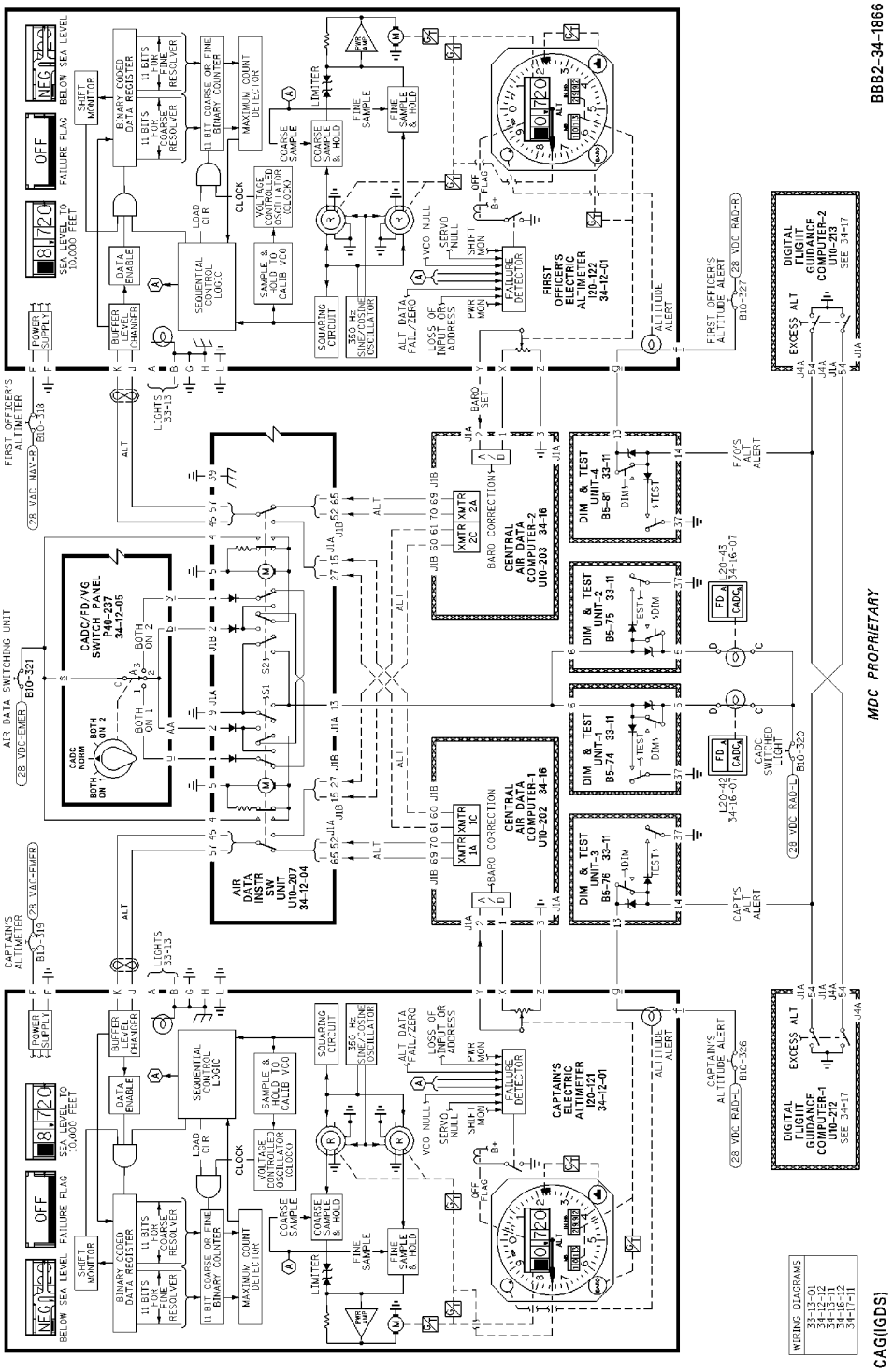
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are electric altimeters and standby altimeter/airspeed indicator.

Table 103

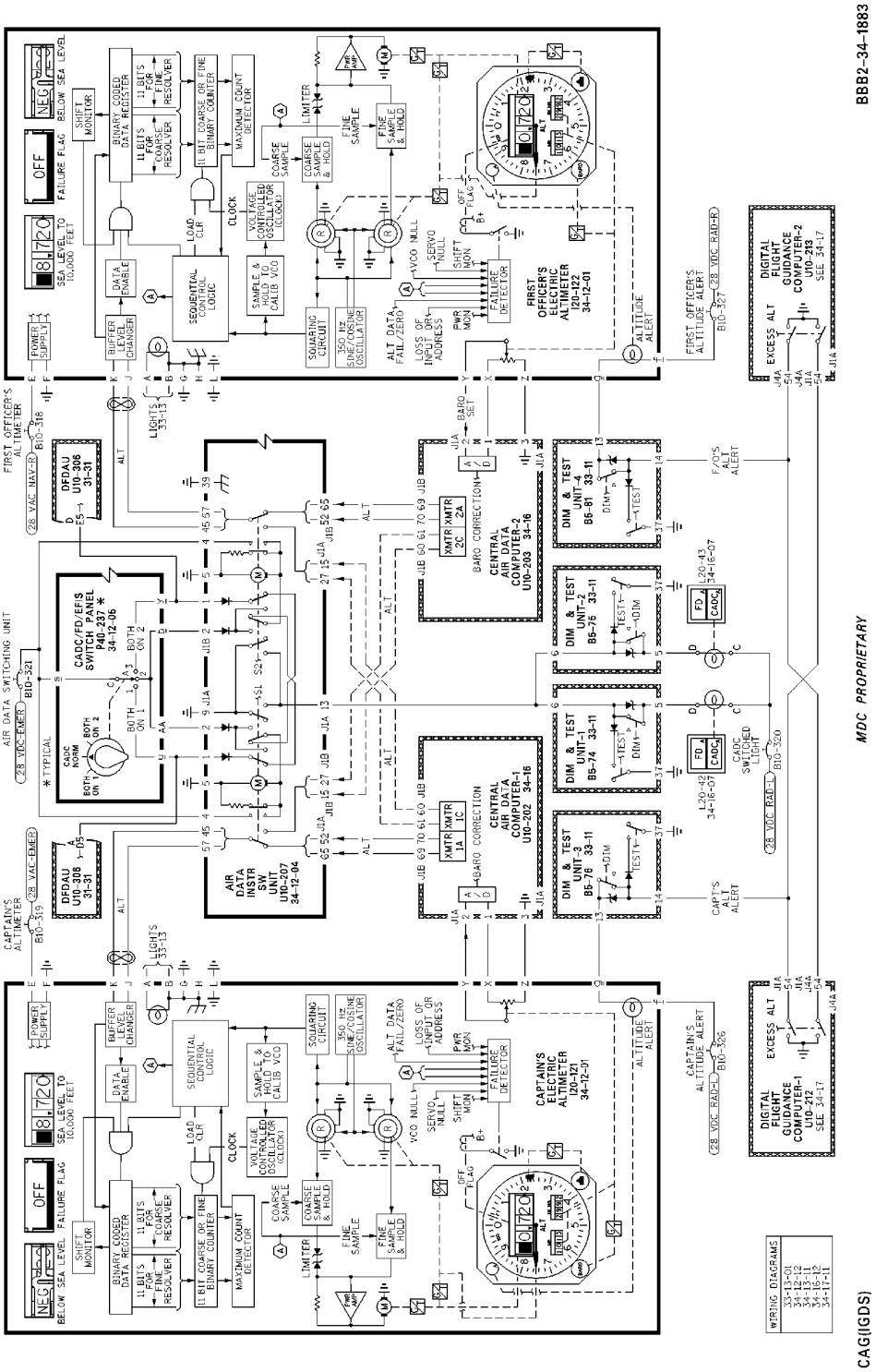
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	Switch CADC switch to CADC-1 or -2 to isolate faulty CADC input.	Replace faulty LRUs.

Table 103 (Continued)

Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Leak check pitot or static lines to standby altimeter airspeed indicator.	Correct any known leakage.



Electric Altimeters -- Schematic
Figure 101/34-12-00-990-803 (Sheet 1 of 2)



Electric Altimeters -- Schematic
Figure 101/34-12-00-990-803 (Sheet 2 of 2)

ALTITUDE - MAINTENANCE PRACTICES

1. General

A. The altimeter indicators display the airplane barometrically corrected altitude. The altitude correction is obtained by manually selecting the appropriate barometric pressure with the individual indicator BARO set knob. The captain's and first officer's indicators receive data inputs from their respective Central Air Data Computer (CADC), when the CADC selector switch is in the NORM position. Captain's and first officer's indicator displays information received from CADC -1 or -2 as selected through the air data instrument switching unit. The CADC self test function is utilized to provide information for the captain's and first officer's altimeter indicator tests. The pneumatic altimeter indicator is utilized as a standby display of altitude, as derived from the static system pneumatic input to the indicator. The Air Data Tester is utilized to provide information for the standby/altimeter/airspeed indicator tests.

NOTE: Use of a CADC Remote Test Adapter cable will allow CADC test switch actuation from the flight compartment (PAGEBLOCK 34-16-00/201). Care must be exercised to prevent multiple test selection execution which can cause incorrect self test outputs. When remote test adapter is used, step in procedures to depress and hold CADC PUSH TO TEST switch is not required.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Air data tester Model No. 127-1M	Edcliff Instruments
Test Adapter, CADC Remote (5963440-1)	
Red tape VIP 7331 DPM 850-24	Valley Industrial Products
33410 LH 90-5 Static Port Adapter	Canadian Aero Inst. Co.

3. Adjustment/Test

A. Preliminary

(1) Line maintenance personnel must be alert to the fact that under certain conditions the CADC self test function can result in sudden movement of powered control surfaces. This condition is only present when a Flight Guidance system is in operation. Under these conditions, actuation of the self test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of the control surfaces. Therefore, prior to depressing the PUSH TO TEST switch, it is necessary to open, tag and safety Flight Guidance system circuit breakers.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(3) Connect CADC remote test adapter cable to air data computer -1 and -2 as required.

NOTE: If remote test adapter used, air data computer circuit breakers must be opened during connecting and disconnecting of adapter cable.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(5) On the Overhead Switch Panel, place central air data computer switching unit selector switch to NORM position and check that failure warning flags are out of view on the captain's and first officer's altimeter.

B. Test Altimeters

NOTE: Captain's system tests are described, first officer's system is identical unless parenthetically noted.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891, 892

Table 202

Step	Operation	Desired Result
(1)	Rotate Captain's (First Officer's) Altimeter BARO knob clockwise.	Altitude display increases.
(2)	Rotate Captain's (First Officer's) Altimeter BARO knob counterclockwise.	Altitude display decreases.
(3)	Adjust Captain's (First Officer's) Altimeter BARO knob for 29.92 in. hg. display.	Altitude display indicates 29.92 in. hg.
(4)	Place CADC 1 (2) MODE SELECTOR switch in FUNCTION TEST position.	
WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891		
(5)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator displays altitude of 9915(±15) feet. (Model 87 aircraft 9830(±15) feet).
WJE 873-879, 892		
(5)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator displays altitude of 9915(±15) feet.
WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891, 892		
(6)	Release PUSH TO TEST switch.	
(7)	Place CADC 1 (2) MODE SELECT switch in the FAILURE WARNING position.	
(8)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator displays following failure warning: Flag in view.
(9)	Release PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator test complete.

WJE 401-404, 412, 414, 893

Table 203

Step	Operation	Desired Result
(1)	Rotate Captain's (First Officer's) Altimeter BARO knob clockwise.	Altitude display increases.
(2)	Rotate Captain's (First Officer's) Altimeter BARO knob counterclockwise.	Altitude display decreases.
(3)	Adjust Captain's (First Officer's) Altimeter BARO knob for 29.92 in. hg. display.	Altitude display indicates 29.92 in. hg.
(4)	Place CADC 1 (2) MODE SELECTOR switch in FUNCTION TEST position.	
(5)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator displays altitude of 9915(±15) feet.
(6)	Release PUSH TO TEST switch.	
(7)	Place CADC 1 (2) MODE SELECT switch in the FAILURE WARNING position.	
(8)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator displays following failure warning: Flag in view.
(9)	Release PUSH TO TEST switch.	Captain's (First Officer's) Altimeter Indicator test complete.

WJE ALL

C. Test Standby Altimeter/Airspeed Indicator

NOTE: Standby Altimeter/Airspeed indicator is also checked in STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-02/201.

Table 204

Step	Operation	Desired Result
(1)	Close STANDBY ALTIMETER VIBRATOR circuit breaker.	Standby Altimeter/Airspeed Indicator vibrator comes on.
(2)	Set Captain's and First Officer's Static Selector Valves to normal position.	Static Selector Valves at normal position.
(3)	Connect Air Data Tester to Alternate Static Port and AUX pitot tube utilizing suitable adapter.	Air Data Tester connected to alternate static port and AUX pitot tube.
(4)	Seal opposite Alternate Static Port and pitot head drain hole, utilizing tape or other suitable device.	Opposite Alternate Static and pitot head drain hole are sealed.
(5)	Adjust Air Data Tester Standby Altimeter/Airspeed Indicator for 29.92 inches Hg.	Air Data Tester Standby Altimeter/Airspeed Indicator is at 29.92 inches Hg.
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		

Table 204 (Continued)

Step	Operation	Desired Result
CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.		
(6)	Set air data tester to values shown below.	Standby Altimeter/Airspeed should indicate within maximum range.

Table 205

	Set Tester		Standby Altimeter/Airspeed	
(a)	Altitude Airspeed	1,000 N/A	Min. 900 Min. -	Max. 1,100 Max. -
(b)	Altitude Airspeed	2,000 N/A	Min. 1,900 Min. -	Max. 2,100 Max. -
(c)	Altitude Airspeed	3,000 N/A	Min. 2,900 Min. -	Max. 3,100 Max. -
(d)	Altitude Airspeed	5,000 250	Min. 4,900 Min. 240	Max. 5,100 Max. 260
(e)	Altitude Airspeed	10,000 N/A	Min. 9,875 Min. -	Max. 10,125 Max. -
(f)	Altitude Airspeed	15,000 N/A	Min. 14,850 Min. -	Max. 15,150 Max. -
(g)	Altitude Airspeed	25,000 340	Min. 24,800 Min. 330	Max. 25,200 Max. 350
(h)	Altitude Airspeed	30,000 N/A	Min. 29,775 Min. -	Max. 30,225 Max. -
(i)	Altitude Airspeed	35,000 280	Min. 34,750 Min. 270	Max. 35,250 Max. 290
(j)	Altitude Airspeed	40,000 N/A	Min. 39,725 Min. -	Max. 40,275 Max. -

Step	Operation	Desired Result
(7)	Slowly return Air Data Tester and Alternate Static system pressure to atmospheric pressure.	Rate not to exceed 6000 feet per minute.
(8)	Remove tape and disconnect Air Data Tester.	Standby Altimeter/Airspeed Indicator test complete.

D. Test Termination

(1) Remove test equipment.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(2) Make certain sealing tape is removed from alternate static port and auxiliary pitot head drain hole.

(3) Remove the safety tags and close these circuit breakers:

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(4) Return aircraft to required configuration.

E. Altimeter Tolerances

NOTE: The true field elevation or altitude is the reference to which all three altimeters must be measured against.

NOTE: The altimeters must read within 60 feet of each other.

(1) In service altimeter tolerances are as follows:

Table 206

Step	Altimeter(s)	Elevation	Tolerance
(a)	Standby, Captain's, and First Officer's	Ramp or field elevation. Add 5 feet to field elevation for altimeter location	±30 feet.
(b)	Captain's to First Officer's	At 25,000 feet	100 feet max.
(c)	Captain's to First Officer's	At 35,000 feet	120 feet max.
(d)	Captain's to First Officer's to Standby	At Field Elevation	60 feet max.
(e)	Captain and First Officer to Standby	At 25,000 feet	250 feet max.
(f)	Captain's and First Officer's to Standby	At 35,000 feet	320 feet max.

ALTIMETER (ELECTRIC) - MAINTENANCE PRACTICES

1. General

A. This maintenance practices provides removal/installation procedures for the altimeter. There are two altimeter indicators located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel. Each altimeter displays barometric corrected altitude data received from the applicable -1 or -2 central air data computer as selected from the air data switching unit.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring.

2. Removal/Installation Altimeter

A. Remove Altimeter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open following circuit breakers, as applicable to Altimeter being removed.

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	3	B10-319	CAPTAIN'S ALTIMETER 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	15	B10-326	CAPTAIN'S ALTITUDE ALERT

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	1	B10-318	FIRST OFFICER'S ALTIMETER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	2	B10-327	FIRST OFFICER'S ALTITUDE ALERT

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install Altimeter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Ensure following applicable circuit breakers are opened, tagged, and safetied.

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	3	B10-319	CAPTAIN'S ALTIMETER 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	15	B10-326	CAPTAIN'S ALTITUDE ALERT

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	1	B10-318	FIRST OFFICER'S ALTIMETER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	2	B10-327	FIRST OFFICER'S ALTITUDE ALERT

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	3	B10-319	CAPTAIN'S ALTIMETER 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	15	B10-326	CAPTAIN'S ALTITUDE ALERT

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	1	B10-318	FIRST OFFICER'S ALTIMETER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	2	B10-327	FIRST OFFICER'S ALTITUDE ALERT

WARNING: WHEN FLIGHT GUIDANCE SYSTEM IS ENERGIZED, UNDER CERTAIN CONDITIONS, CADC SELF TEST FUNCTION CAN CAUSE MOVEMENT OF FLIGHT CONTROL SURFACES.

(6) Open digital flight guidance circuit breakers located on upper EPC circuit breaker panel.

(7) Adjust BARO knob on Captains/First Officers altimeter to 29.92 Hg.

(8) Place selector switch on CADC to FUNCTION TEST position.

WJE 401-404, 412, 414, 873-879, 892, 893

(9) Press PUSH TO TEST switch on CADC, altimeter should display 9915(±15) feet.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 886, 887, 891

(10) Press PUSH TO TEST switch on CADC, altimeter should display 9915(±15) feet (9830(±15) feet on Model 87 aircraft).

WJE ALL

(11) Close circuit breakers opened in step (Paragraph 2.B.(6)).

WJE 886, 887

(12) Return aircraft to required configuration.

MACH, AIRSPEED AND OVERSPEED WARNING - DESCRIPTION AND OPERATION

1. General

A. Mach Airspeed Indicator. The Mach Airspeed Indicator is installed in the Captain's and First Officer's instrument panels and displays mach number, computed airspeed, maximum allowable airspeed, and command airspeed. Dual installation is utilized to provide annunciation for information developed within a Captain's and a First Officer's system. The Captain's and First Officer's indicators primary inputs, computed airspeed, maximum allowable airspeed, and a digital mach number, are received from their respective Central Air Data Computer. Captain's and First Officer's indicator displays information received from the Central Air Data Computer -1 when CADC selector switch is in BOTH ON 1 and from -2 computer when CADC switch is in BOTH ON 2 position. In addition, command airspeed inputs are received from the Digital Flight Guidance computer.

B. A Standby Altimeter and Airspeed Indicator, installed in the Captain's instrument panel, is utilized as a standby annunciation of airspeeds and altitude. The indicated airspeed and altitude is derived from pitot and static system pneumatic inputs to the indicator (PAGEBLOCK 34-13-02/201).

C. Overspeed Warning - The Overspeed Warning signal is a dc discrete voltage developed within the Central Air Data Computer and its overspeed warning signal provided to the Central Aural Warning Unit, to annunciate an overspeed condition.

2. Operation

A. Mach Airspeed Indicator - The Mach Airspeed Indicator provides numeral annunciation of the mach number; pointer display of the computed airspeed and maximum allowable airspeed; and bug display of commanded airspeed. The indicator operational functions are as follows:

(1) Mach number digital annunciation is provided by a three digit (tenths, hundredths, and thousandths) magnetic wheel type indicator. The digital input signal is received from the Central Air Data Computer (CADC), processed by indicator circuitry, and utilized to position the magnetic indicator wheels. Display failures are indicated as follows:

(a) An invalid input signal results in the counters being driven to .000 and the OFF flag in view.

(b) A loss of the input signal for 2 seconds results in the counters being driven to .054 and the OFF flag in view.

(2) Computed airspeed (CAS) annunciation is provided by pointer rotation in conjunction with the 0 to 450 knot dial range. The pointer is positioned by mechanical linkage with the CAS drive motor. The motor is operated by the amplified CAS input signal from the CADC. Malfunction of the CAS display causes the failure flag, placarded A/S, to be in view.

(3) Maximum allowable airspeed (Vmo) annunciation is provided by pointer rotation through a dial range of 257.5 to 450 knots. The pointer is positioned by mechanical linkage with the Vmo drive motor and mechanically stopped at a 257.5 knot minimum. The motor is operated by the amplified Vmo input signal from the CADC. Failure of the Vmo display results in the pointer returning to a 257.5 knot indication.

(4) Command airspeed annunciation is provided by bug rotation around the periphery of the dial range from 0 to 450 knots. The bug is positioned by mechanical linkage with the command airspeed drive motor. The motor is operated by the amplified command airspeed input signal from the Digital Flight Guidance computer.

(5) The airspeed failure (A/S) flag mechanism is a rotary solenoid actuated by the internal control monitor. Normal operation is annunciated by biasing the flag out of view as a result of solenoid current. A failure is annunciated by returning the flag to the in view position as a result of reduced solenoid current.

(6) The Computed Airspeed Internal Control Monitor initiates the failure annunciations of the airspeed failure flag. A three-input AND gate circuit functions as a switch to control the operation of the flag rotary solenoid. Inputs to the AND gate consist of the amplified computed airspeed input signal; the airspeed dc reference input voltage; and the dc computed airspeed valid input voltage. The Mach Airspeed Indicator power supply provides dc excitation to the rotary solenoid. Operation of the solenoid is interrupted, resulting in the flag in view annunciation, under any one of the following conditions:

(a) An invalid computed airspeed input signal.

(b) Loss of the computed airspeed dc reference input voltage for 2 seconds.

(c) Loss of primary power.

(d) A high servo null.

(e) An invalid computed airspeed valid input voltage.

(7) The mach failure (OFF) flag mechanism is a magnetic device actuated by an internal control monitor. Normal operation is annunciated by biasing the flag out of view. A failure is annunciated by return of the flag to the in view position as a result of a reduced bias.

(8) The Mach Internal Control Monitor initiates failure annunciations of the mach number display and the mach failure flag. Input signal conditions resulting in a failure annunciation are summarized as follows:

(a) Invalid input signal

Mach number displays .000

Mach failure flag in view.

(b) Loss of input signal for 2 seconds

Mach number displays .054

Mach failure flag in view.

(c) Loss of primary power

Mach number displays last valid annunciation

Mach failure flag in view.

(9) The Maximum Allowable Airspeed (Vmo) Internal Control Monitor initiates the failure annunciation of the Vmo display, resulting in the Vmo pointer minimum indication, under any one of the following conditions:

(a) Loss of the Vmo dc reference input voltage.

(b) Loss of primary power.

(c) An invalid altitude valid input voltage.

B. Tolerances exist between the FGCP and the airspeed command bugs. These tolerances are a maximum of 4 knots split between the Captain, First Officer, stand-by and FGCP in the speed range of 80 to 149 KIAS. These tolerances increase to a maximum of 6 knots in the speed range of 150 to 249 KIAS. The tolerances increase to a maximum of 10 knots in the speed range of 250 to 350 KIAS. The maximum for a mach selected speed is .02 mach at 0.8 mach.

NOTE: When using the autopilot, the autopilot shall control to ± 5 knots of the FGCP selected speed.

C. Standby Altimeter/Airspeed Indicator - The Standby Altimeter/ Airspeed Indicator displays the indicated airspeed and altitude as derived from pneumatic inputs. The only electrical wiring required, provides internal instrument lighting and vibrator power. The indicator receives an impact pressure input from the AUX Pitot system and an environment pressure input from the Alternate Static system. The pitot-static system input pressure (a combination of altitude pressure and airspeed pressure) provides a numerical readout of airspeed by the use of a moving drum read against the fixed lubber line. The static system input pressure operates to counteract the pitot pressure input by an amount equivalent to the altitude pressure and results in the readout corresponding to increases and decreases of the airspeed pressure portion of the pitot system input. Altitude pressure to the indicator operates a diaphram mechanically linked to the altitude pointer which is geared to a quick transfer 6000's and 10,000's foot counters followed by three fixed zero's to indicate altitude.

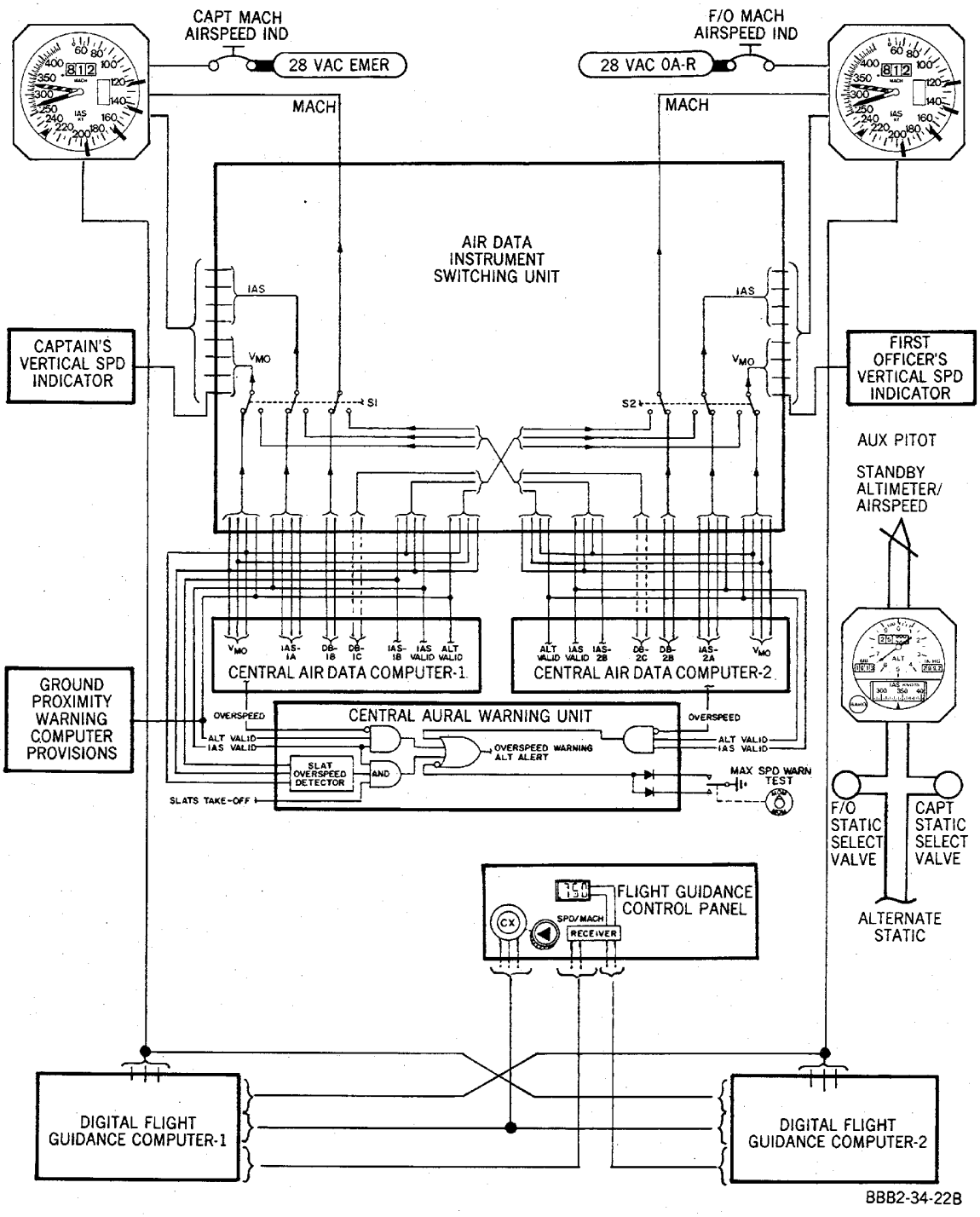
3. To Operate System

A. Mach - Airspeed Indicator

(1) When electrical buses are energized, 28 vac power is applied to the Mach - Airspeed Indicator unless CAPT's MACH A/S or FO's MACH A/S circuit breakers are open.

B. Standby Altimeter/Airspeed Indicator

(1) The Standby Altimeter/Airspeed Indicator is in operation at all times.



Mach - Airspeed and Overspeed Warning System
Figure 1/34-13-00-990-801

MACH AIRSPEED AND OVERSPEED WARNING SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble shooting provided in this section are basic procedures for isolating and correcting a faulty mach airspeed and overspeed warning system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable Units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major component of the system is: The Mach Airspeed Indicator. The system interfaces with the air data system, vertical speed indicator, digital flight guidance computer and central aural warning unit. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The components are located as follows:

Table 101

Component	Location
Mach-Airspeed Indicators	Captain's and First Officer's Instrument Panels
Capt Mach Airspeed Ind Circuit Breaker	Overhead Circuit Breaker Panel
First Officer's Mach Airspeed Ind Circuit Breaker	Upper EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Mach Airspeed and Overspeed Warning System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are mach airspeed indicators, air data computers, digital flight guidance computers, vertical speed indicators, and central aural warning unit.

Table 103

Step	Procedures	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.

Table 103 (Continued)

Step	Procedures	Correction
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

B. Trouble Shooting (Fault Conditions)

(1) Fault Condition - Prior to takeoff, the flight crew reports, Captain's or First Officer's airspeed indicator shows 60 - 70 knots while the opposite indicator shows 0 knots after a heavy and/or freezing rain.

(a) Possible cause:

1) Pitot tube or lines blocked (water or other contamination).

2) Static port or lines blocked (water or other contamination).

(b) Recommendation:

1) Identify the blocked pitot line by the airspeed indicator that is at 60 - 70 knots.

a) If the Captain's airspeed indicator is at 60 - 70 knots, the lines in left air data system (pitot static system 1) are probably blocked.

b) If the First Officer's airspeed indicator is at 60 - 70 knots, the lines in right air data system (pitot static system 2) are probably blocked.

2) If a pitot static system is blocked, do the quick purge of that pitot and static system only. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

NOTE: A quick purge of only the pitot static system 1 or pitot static system 2 can be done in one maintenance interval with no additional maintenance required.

3) If the left and right pitot static systems are purged in the same maintenance interval, a full system check of the two pitot and static systems is required. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

(2) Fault Condition - An erratic or suspect airspeed indication (i.e., a difference of 80 knots between the Captain's and First Officer's airspeed indicators) during takeoff roll caused the flight crew to reject the takeoff and return to the gate.

(a) Possible cause:

1) Pitot tube or lines blocked (water or other contamination).

2) Static port or lines blocked (water or other contamination).

(b) Recommendation:

1) Identify the blocked pitot line by reviewing the log book entry.

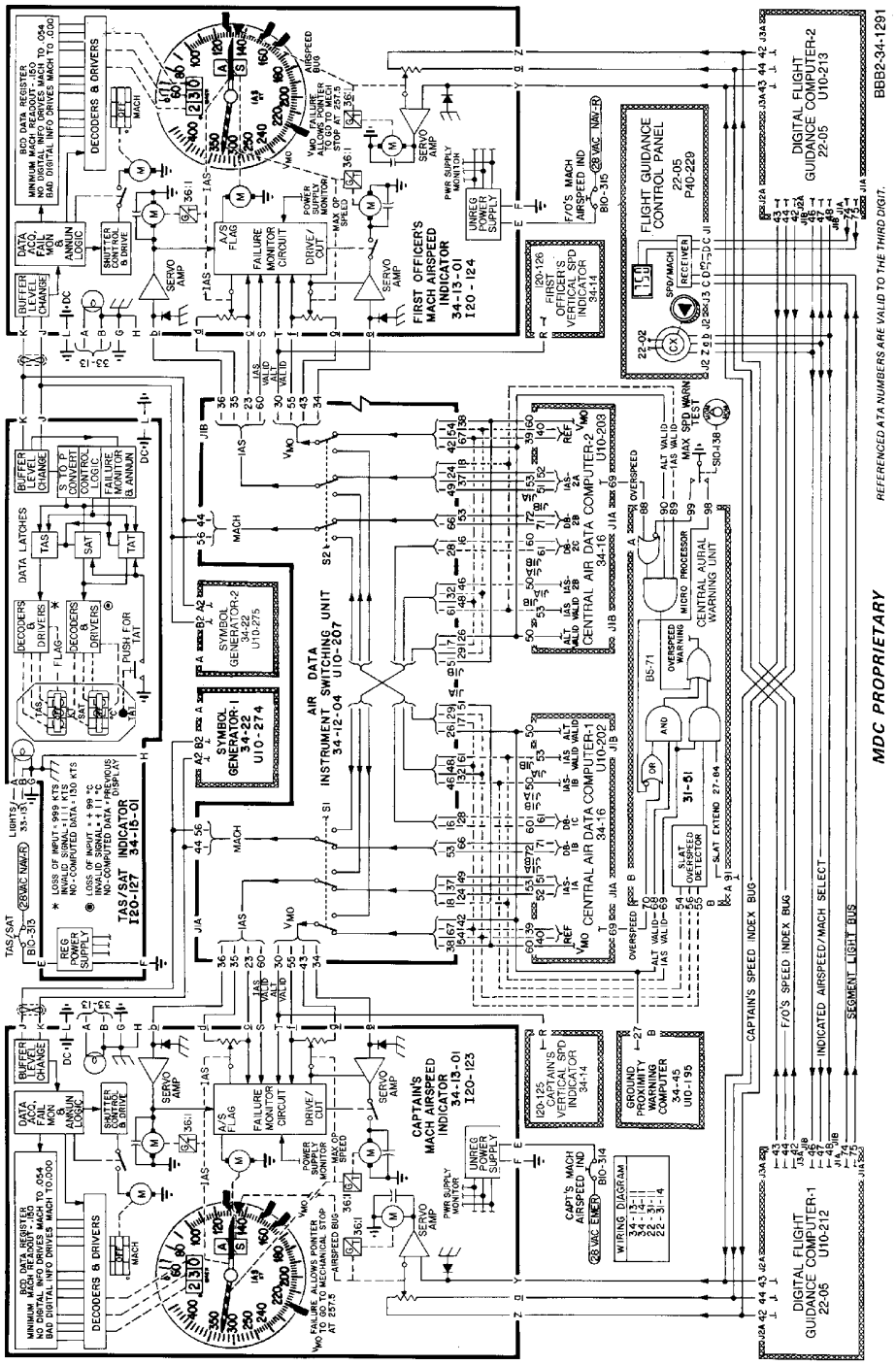
a) If the Captain's airspeed indicator is suspected, the lines in left air data system (pitot static system 1) are probably blocked.

b) If the First Officer's airspeed indicator is suspected, the lines in right air data system (pitot static system 2) are probably blocked.

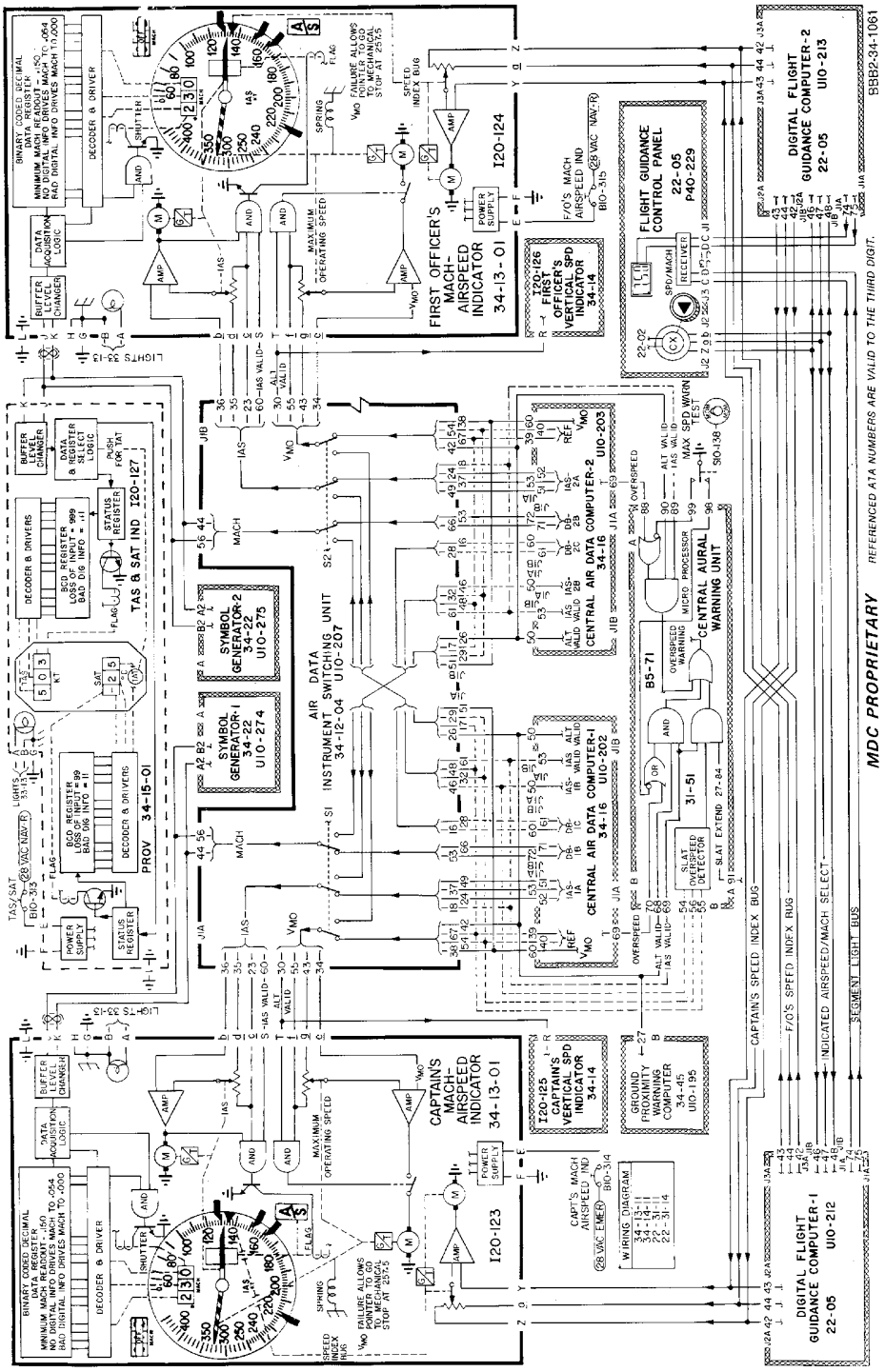
2) If a pitot static system is blocked, do the quick purge of that pitot and static system only. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)

NOTE: A quick purge of only the pitot static system 1 or pitot static system 2 can be done in one maintenance interval with no additional maintenance required.

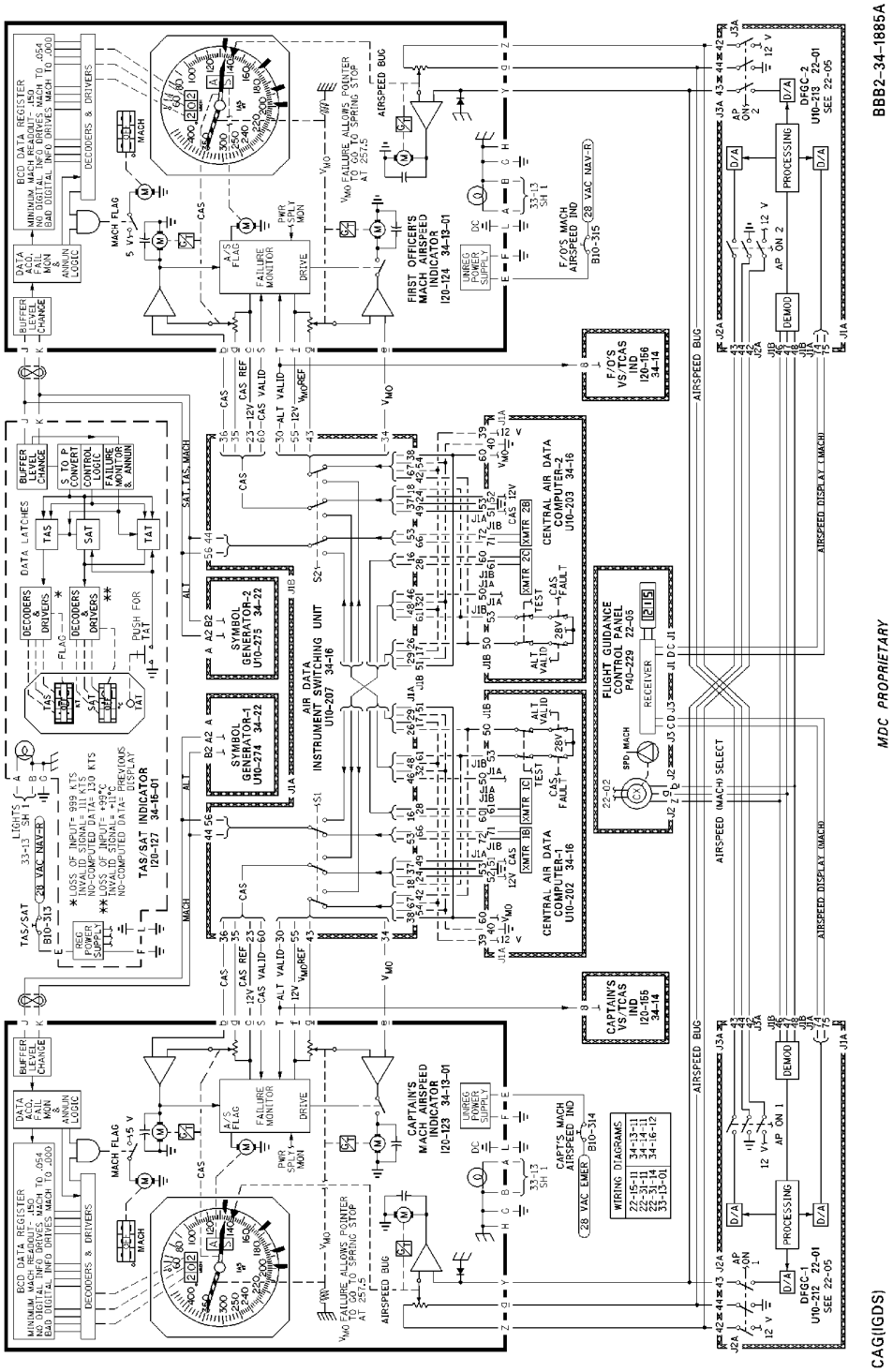
3) If the left and right pitot static systems are purged in the same maintenance interval, a full system check of the two pitot and static systems is required. (PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1)



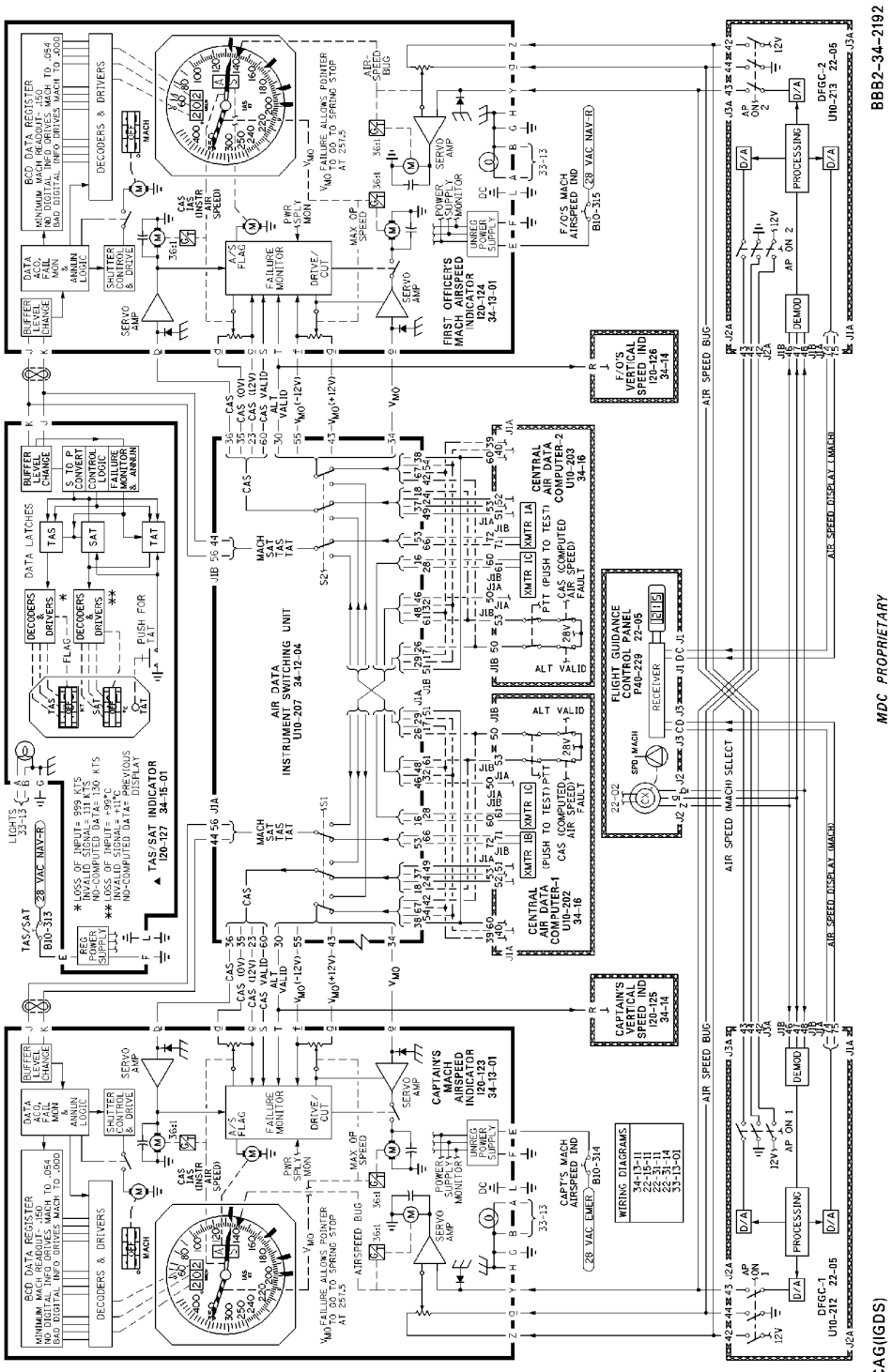
MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 1 of 7)



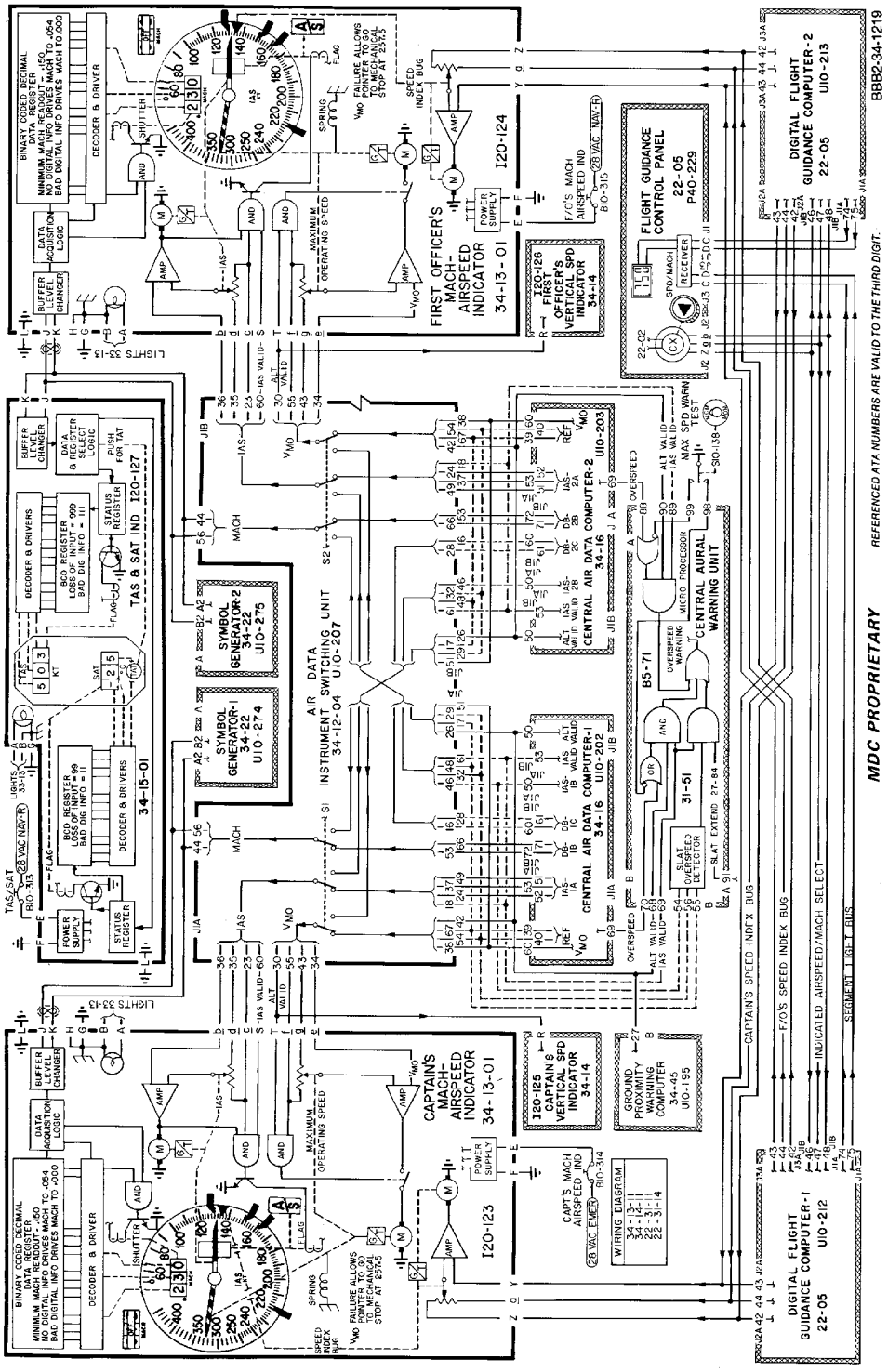
MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 2 of 7)



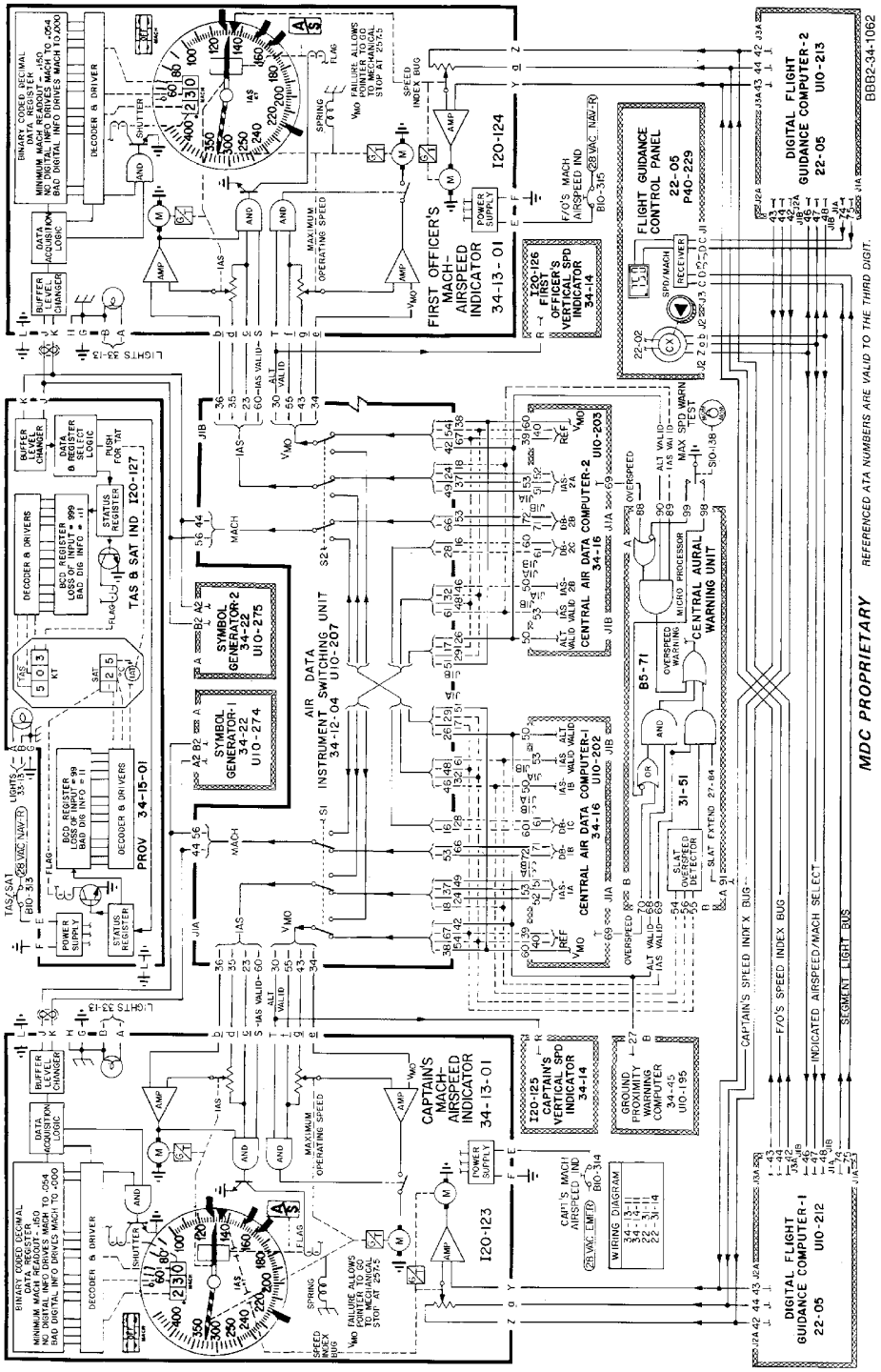
MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 3 of 7)



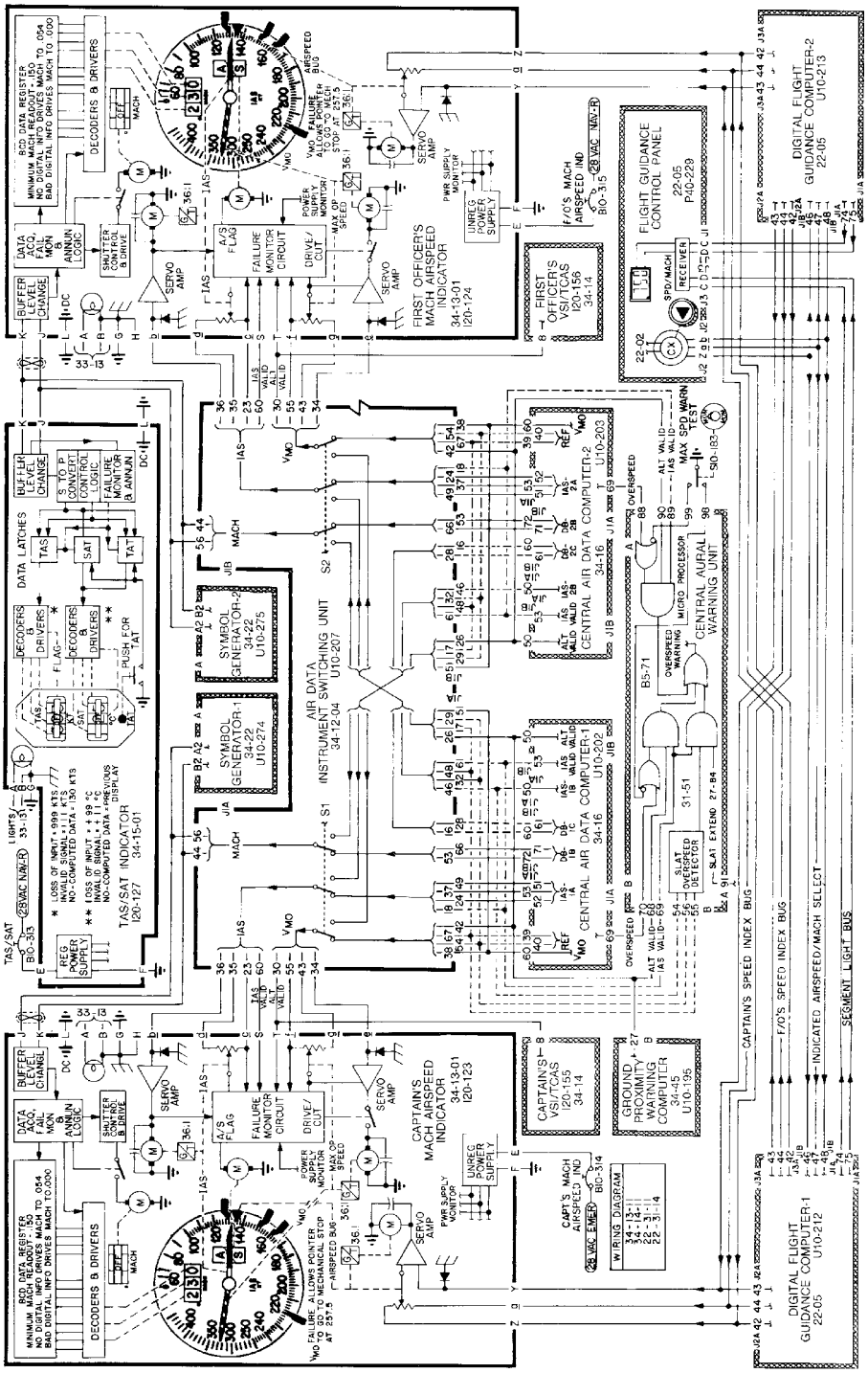
MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 4 of 7)



MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 5 of 7)



MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 6 of 7)



MACH-Airspeed and Overspeed Warning System -- Schematic
Figure 101/34-13-00-990-802 (Sheet 7 of 7)

MACH, AIRSPEED AND OVERSPEED WARNING - MAINTENANCE PRACTICES

1. General

A. The Mach Airspeed Indicators display Mach number, computed airspeed, maximum allowable airspeed, and command airspeed. The Captain's and First Officer's indicators primary inputs are received from their respective Central Air Data Computer (CADC). Captain's and First Officer's indicator displays information received from CADC-1 when CADC selector switch is in BOTH ON 1 and from CADC-2 when CADC switch is in BOTH ON 2 position. The CADC self-test function is utilized to provide information for the Mach Airspeed Indicator tests.

B. The Standby Altimeter/Airspeed Indicator is utilized as a standby annunciation of airspeed. The indicated airspeed is derived from pitot and static system pneumatic inputs to the indicator. The Air Data Tester is utilized to provide information for the Airspeed tests.

NOTE: Use of a CADC Remote Test Adapter cable will allow CADC test switch actuation from the flight compartment (PAGEBLOCK 34-16-00/201). Care should be exercised to prevent multiple test selection execution which can cause incorrect self test outputs. When CADC Remote Test Adapter cable is used, the step in procedures stating to depress the PUSH TO TEST switch on CADC is not required.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Air data tester model No. 127-1M	Edcliff Instruments
Red tape VIP 7331 DPM 850-24	Valley Industrial Product

3. Adjustment/Test Mach Airspeed Indicator

A. Preliminary

(1) Line maintenance personnel must be alert to the fact that under certain conditions the CADC self-test function can result in sudden movement of powered control surfaces. This condition is only present when a Flight Guidance system is in operation. Under these conditions, actuation of the self-test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of the control surfaces. Therefore, prior to depressing the PUSH TO TEST switch, it is necessary to open, tag, and safety Flight Guidance system circuit breakers.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(3) Connect CADC remote test adapter cable to air data computer-1 and -2 as required.

NOTE: If remote test adapter used, air data computer circuit breakers should be opened during connecting and disconnecting of adapter cable. FUNCTION TEST on CADC is on position on adapter. On position actuates PUSH TO TEST operation.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(5) Place central air data computer switching unit selector switch to NORM position and check that failure warning flags are out of view on following indicators.

Table 202

Indicator	Location
Captain's Mach Airspeed	Captain's Instrument Panel
First Officer's Mach Airspeed	First Officer's Instrument Panel

B. Test Mach Airspeed Indicator

NOTE: Captain's system tests are described, First Officer's system is identical unless parenthetically noted.

Table 203

Step	Operation	Desired Result	
(1)	Place CADC 1 (2) MODE SELECT switch in the FUNCTION TEST position.		
(2)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Mach Airspeed Indicator for the following displays:	
WJE 401-404, 873-879, 892, 893			
		Mach	0.746(±.006) M
		Airspeed	419(±3) knots
		Maximum Allowable Airspeed	343(±3) knots (overspeed warning sounds)
WJE 405-412, 414-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891			
	*Model 87 aircraft	Mach	0.746(±.000) M *0.744(±.000) M
		Airspeed	419(±3) knots *417(±3) knots
		Maximum Allowable Airspeed	343(±3) knots (overspeed warning sounds)
WJE 886, 887			
		Mach	0.744(±.000) M
		Airspeed	417(±3) knots
		Maximum Allowable Airspeed	343(±3) knots (overspeed warning sounds)
WJE ALL			
(3)	Release PUSH TO TEST switch.	Overspeed warning goes off, instruments return to normal indication.	
(4)	Place CADC 1 (2) MODE SELECT switch in FAILURE WARNING position.		
(5)	Depress and hold CADC 1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Mach Airspeed Indicator for following failure warning displays:	
		OFF flag in view, Mach flag in view, and Vmo pointer 257(±10) knots.	
(6)	Release PUSH TO TEST switch.		
(7)	Mach Airspeed Indicator test complete.		

C. Test Standby Airspeed (Standby Altimeter/Airspeed Indicator)

NOTE: Standby Airspeed is also checked in ALTITUDE - MAINTENANCE PRACTICES, PAGEBLOCK 34-12-00/201 Config 1 and STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-02/201.

Table 204

Step	Operation	Desired Result
(1)	Set Captain's and First Officer's Static Selector Valves to normal position.	
(2)	Seal Auxiliary Pitot Tube drain hold utilizing tape or other suitable device.	
(3)	Connect Air Data Tester to Auxiliary Pitot Tube utilizing suitable adapter.	
(4)	Connect Air Data Tester to Alternate Static Port utilizing suitable adapter.	
(5)	Seal opposite Alternate Static Port utilizing tape or other suitable device.	
CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.		
CAUTION: DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 250 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED. DO NOT EXCEED 400 KNOTS AIRSPEED, AND DO NOT PERMIT INPUT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
(6)	Adjust Air Data Tester for 29.92 inches Hg.	
(7)	Set Air Data Tester altitude to 5000 and airspeed to 250 knots.	Airspeed on standby altimeter/ airspeed displays 240-260 knots.
(8)	Set Air Data Tester altitude to 25000 and airspeed to 340 knots.	Airspeed displays 330-350 knots.
(9)	Set Air Data Tester altitude to 35000 and airspeed to 280 knots.	Airspeed displays 270-290 knots.
(10)	Slowly return Air Data Tester and pitot, static systems pressure to atmospheric pressure.	Rate not to exceed 6000 feet per minute.
(11)	Remove tape and disconnect Air Data Tester.	Standby Airspeed test complete.

D. Self Test Overspeed Warning

(1) Press and hold MAX SPD WARN TEST switch on overhead panel to SYS-1 position; aural warning should sound.

(2) Release test switch, aural warning should cease.

(3) Press and hold MAX SPD TEST switch to SYS-2 position; aural warning should sound.

(4) Release test switch, aural warning should cease.

E. Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

F. Test Termination

(1) Remove test equipment.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(2) Make certain tape has been removed from static ports and pitot head.

(3) Return aircraft to required configuration.

4. Mach Airspeed Indicator Tolerances

A. In-service Mach Airspeed Indicator tolerances are as follows:

Table 205

Airspeed	Max Difference Between Pilot, Copilot, and Standby Indicators
80 to 149 Kts	4 Kts
150 to 249 Kts	6 Kts

Table 205 (Continued)

Airspeed	Max Difference Between Pilot, Copilot, and Standby Indicators
250 to 350 Kts	10 Kts
Mach 0.8	.02 Mach

MACH AIRSPEED INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the mach-airspeed indicator. There are two mach-airspeed indicators located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel. Each indicator provides digital annunciation of mach number, and pointer and dial display of computed air-speed, maximum allowable airspeed, and command airspeed.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring.

2. Removal/Installation Mach Airspeed Indicator

A. Remove Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open and tag following circuit breakers, as applicable to indicator being removed.

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	5	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 410			
A	6	B10-314	CAPTAIN'S MACH AIRSPEED IND 28 VAC
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	3	B10-315	FIRST OFFICER'S MACH AIRSPEED INDICATOR

WARNING: WHEN FLIGHT GUIDANCE SYSTEM IS ENERGIZED, UNDER CERTAIN CONDITIONS, CADC SELF TEST FUNCTION CAN CAUSE MOVEMENT OF FLIGHT CONTROL SURFACES.

(6) Open digital flight guidance system circuit breakers located on upper EPC.

(7) Place selector switch on CADC in FUNCTION TEST position.

WJE 401-404, 412, 414, 873-879, 892, 893

(8) Press PUSH TO TEST switch on CADC, MACH/AIRSPEED indicator should display 0.746(±.006) MACH, 419(±3) knots and maximum allowable airspeed 343(±3) knots.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 886, 887, 891

(9) Press PUSH TO TEST switch on CADC, MACH/AIRSPEED indicator should display 0.746(±.000) MACH, 419(±3) knots and maximum allowable airspeed 343(±3) knots. On Model 87 aircraft, MACH indication should display 0.744(±.000) MACH, and airspeed 417(±3) knots.

WJE ALL

(10) Close circuit breakers opened in Paragraph 2.B.(6).

NOTE: Mach Airspeed and Overspeed Warning system test is also tested in MACH, AIRSPEED AND OVERSPEED WARNING - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-00/201.

(11) Return aircraft to required configuration.

WJE 412, 414

WJE 412, 414 (Continued)

3. Removal Installation Set Airspeed Pointers

A. Remove Set Airspeed Pointers

(1) Rotate set airspeed pointers counter-clockwise one at a time, to the 11:00 o'clock position.

(2) Using a straightened #1 paper clip (0.040 dia) or similar tool, insert into the hole located at the top of indicator and pushing down on the inside of the pointer while rotating counter-clockwise.

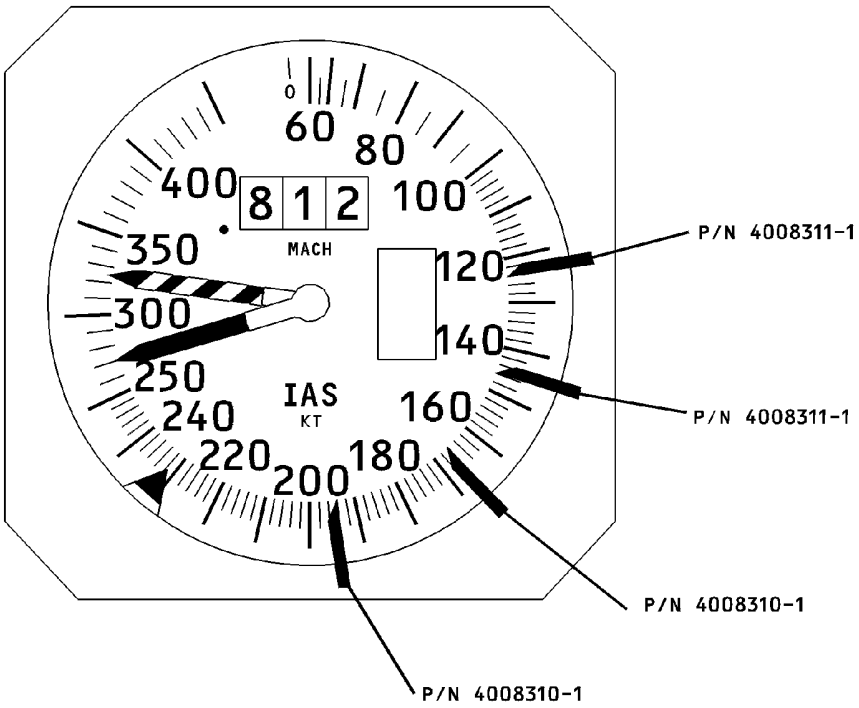
WARNING: PIECES OF A BROKEN POINTER THAT MAY BE LEFT IN THE RETAINING GROOVE AND MUST BE REMOVED PER STEPS (1) AND (2).

(3) To remove the remaining pointers, repeat (Paragraph 3.A.(1) and Paragraph 3.A.(2)).

B. Install Set Airspeed Pointers

(1) Install set airspeed pointers with part numbers and bevels matching Figure 201.

(2) Insert pointers into groove at the 11:00 o'clock position and rotate clockwise.



CAG(IGDS)

BBB2-34-2459

WJE
WJE

MACH - Airspeed Indicator MEA
Figure 201/34-13-01-990-801

STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the standby altimeter/airspeed indicator. The indicator is located in the flight compartment on the Captains instrument panel. The indicator displays altitude in feet and indicated airspeed (IAS) in knots, as derived from inputs from the alternate pitot and alternate static systems. The only electrical input required is for instrument lighting and for the instrument vibrator.

NOTE: If necessary, the instrument panel can be opened for access to the pitot/static connections, and the indicator wiring (INSTRUMENT PANELS - GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 31-00-02/201).

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
Air data tester, Model No. 127-1M	Edcliff Instruments
Red tape VIP 7331, DPM 850-24	Valley Industrial Products
33410LH90-5, Static port adapters	Canadian Aero Inst Co.

3. Removal/Installation Standby Altimeter/Airspeed Indicator

A. Remove Standby Altimeter/Airspeed Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	31	B1-321	INSTR VIBRATOR

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap pitot hose connector, static hose connector, and electrical connector.

(6) Verify flex hoses have not been kinked.

B. Install Standby Altimeter/Airspeed Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	31	B1-321	INSTR VIBRATOR

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

CAUTION: ENSURE HOSES ARE NOT KINKED.

(2) Remove caps from connect electrical connector, pitot hose connector, static hose connector and the three indicator connections.

(3) Examine electrical connector for damage and unwanted material. (ELECTRICAL CONNECTORS - MAINTENANCE PRACTICES, SWPM 20-31-00)

(4) Connect electrical connector, pitot hose connector and static hose connector to their applicable connections on the indicator.

(5) If quick disconnect connectors are installed on the indicators, do the steps that follow:

(a) Visually check the bayonet interlock of each quick disconnect through the inspection holes on the side of the locking collar.

(b) Gently pull on the back of each quick disconnect to make sure each connect is correctly installed.

(6) Insert indicator through panel face and mounting clamp.

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(7) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(8) Remove the safety tags and close these circuit breakers:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	31	B1-321	INSTR VIBRATOR

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

(9) On aircraft without quick disconnect fittings, perform leak test on alternate pitot/static system if required per PITOT STATIC - MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1, Pitot-Static System Test Requirements.

(10) Do a check of the indicator internal light as follows:

(a) At the captain's INSTR PANEL LTS control panel. turn the PANEL switch clockwise from OFF position.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893 (Continued)

1) Make sure that the internal light comes on and gets brighter as the switch is turned clockwise.

2) Turn the switch back to OFF position. Make sure that the internal light goes dim then off.

WJE 415-427, 429

WJE (11) Perform leak test on alternate pitot/static system if required per PITOT STATIC - WJE MAINTENANCE PRACTICES, PAGEBLOCK 34-11-00/201 Config 1, Pitot-Static System Test WJE Requirements. Leak test per PITOT STATIC - MAINTENANCE PRACTICES, WJE PAGEBLOCK 34-11-00/201 Config 1, Adjustment/Test Pitot Static Systems, as applicable.

WJE ALL

C. Test Standby Altimeter/Airspeed Indicator

(1) Verify STANDBY ALTIMETER VIBRATOR circuit breaker is closed.

(a) Make sure that the vibrator operates by sound or feel.

(2) Set Captain's and First Officer's Static Selector Valves to normal position.

(3) Connect a Milhard Model 127-1M Air Data Tester (or equivalent) to Alternate Static Port utilizing suitable adapter and AUX pitot tube.

(4) Seal opposite Alternate Static Port and pitot head drain hole, utilizing tape or other suitable device. Maintain 100 knots minimum during testing to prevent negative pressure from being applied to airspeed indicator bellows.

CAUTION: MAKE SURE THE AIR-DATA-TESTER OPERATES CORRECTLY. IF IT DOES NOT OPERATE CORRECTLY, IT CAN CAUSE DAMAGE TO THE INSTRUMENTATION SENSOR DEVICES.

CAUTION: WHEN YOU CHANGE ALTITUDE, DO NOT LET THE RATE OF CHANGE BE MORE THAN 6,000 FEET PER MINUTE. WHEN YOU CHANGE AIRSPEED, DO NOT LET THE RATE OF CHANGE BE MORE THAN 100 KNOTS PER MINUTE. DO NOT SUDDENLY RELEASE PRESSURE TO THE ATMOSPHERE FROM THE PITOT/STATIC LINES WHILE THE AIR DATA TESTER IS CONNECTED. DO NOT LET THE STATIC PRESSURE BE MORE THAN THE PITOT PRESSURE. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

(5) Adjust Air Data Tester and Standby Altimeter/Airspeed indicator for 29.92 inches Hg.

(6) Vary air data tester to values noted below. Standby Altimeter/Airspeed should indicate within values noted.

Table 202

Step	Set Tester		Standby Altimeter/Airspeed	
(a)	Altitude	5000	Min. Max.	5100 4900
	Airspeed	250	Min. Max.	240 260
(b)	Altitude	25000	Min. Max.	24800 25200

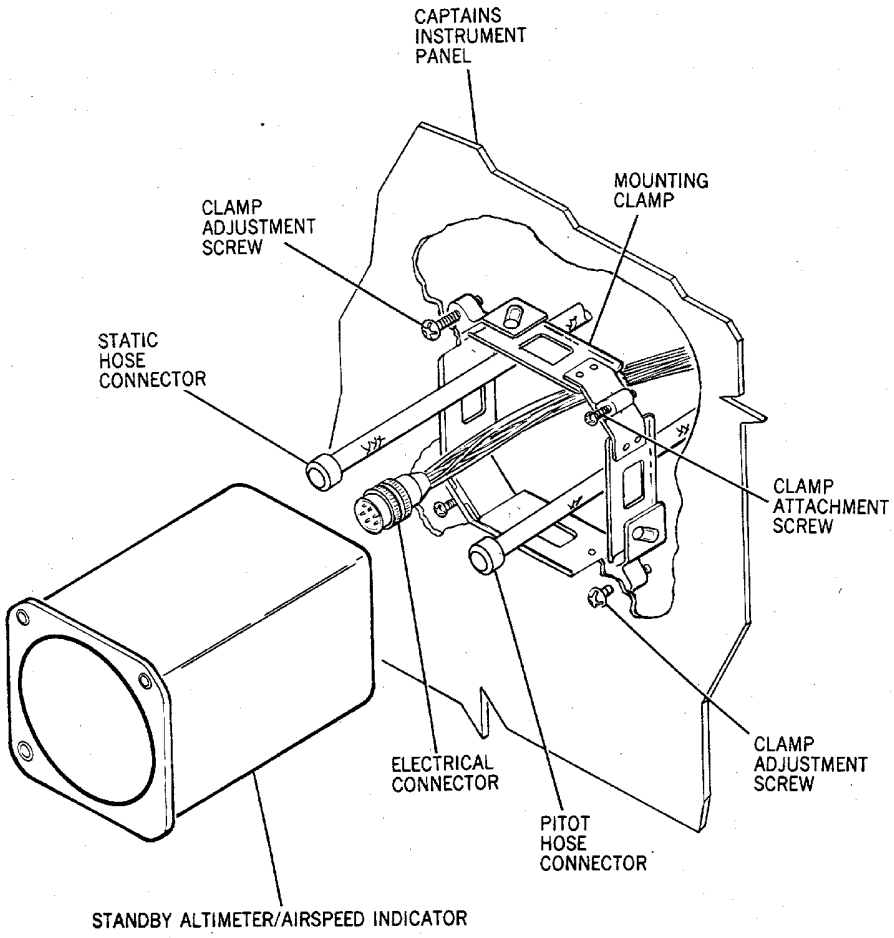
Table 202 (Continued)

Step	Set Tester		Standby Altimeter/Airspeed	
	Airspeed	340	Min. Max.	330 350
(c)	Altitude	35000	Min. Max.	34750 35250
	Airspeed	280	Min. Max.	270 290

(7) Slowly return Air Data Tester pressure to atmospheric pressure.

WARNING: MAKE SURE THAT ALL TAPE IS REMOVED FROM STATIC PORTS BEFORE FLIGHT. IF YOU DO NOT REMOVE THE TAPE, IT CAN CAUSE A MALFUNCTION OF THE AIRCRAFT IN FLIGHT. THIS CAN KILL PERSONS AND CAN CAUSE DAMAGE TO THE AIRCRAFT.

(8) Remove tape and disconnect Air Data Tester.



Standby Altimeter/Airspeed Indicator -- Removal/Installation
Figure 201/34-13-02-990-801

VERTICAL SPEED SYSTEM - DESCRIPTION AND OPERATION

1. General

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

A. Vertical Speed is derived from the Central Air Data Computer and displayed by the Vertical Speed Indicator. A Captain's indicator is mounted on the Captain's instrument panel and displays information received from the Central Air Data Computer -1 (CADC switch in NORM). A First Officer's indicator is mounted on the First Officer's instrument panel and displays information received from the Central Air Data Computer -2 (CADC switch in NORM). When CADC switch is in BOTH ON 1 or BOTH ON 2, both vertical speed indicators receive information from selected CADC.

WJE ALL

B. The vertical speed is displayed by means of a pointer in conjunction with a calibrated dial. The pointer displays the up and down (vertical) speed of the airplane in feet per minute (fpm). The pointer travel is electrically limited to ±170° of travel. The accuracy of the pointer display during proper operation is ±40 fpm at 0 fpm to ±60 fpm at 6000 fpm.

2. Operation

A. The Vertical Speed Indicator receives input information in the form of a dc voltage ratio signal (ALT RATE). The indicator processes the information and displays the results by means of a dc servo loop driven pointer. The vertical speed pointer operation is as follows:

(1) The Central Air Data Computer Altitude Rate signal is a dc voltage proportional to the desired vertical speed indication. The Altitude Rate signal varies between +10 and -10 volts dc (approximately 500 millivolts per 1000 feet/minute).

(2) The Central Air Data Computer also furnishes reference voltages (+12 and -12 volts dc) that are utilized within the dc servo loop to accurately control the pointer idication.

(3) The vertical speed pointer is mechanically positioned by the pointer drive motor. The motor operates when the dc control amplifier inputs (Altitude Rate and dc servo loop) are not at a null condition.

(4) The dc servo loop and the altitude rate filter provide for damping and oscillation elimination of the vertical speed pointer.

B. The failure warning (OFF) flag is a two position display controlled by the failure monitor four input AND gate. The flag is out of view during normal operation of the indicator and in view to annunciate a failure.

(1) The failure monitor AND gate receives inputs from the following:

(a) Null monitor circuit

(b) Voltage (reference) level detector circuit

(c) Power supply output

(d) Uncorrected Altitude Flag (ALT FLAG) signal from the Central Air Data Computer.

(2) The failure warning (OFF) flag will come into view when one or more of the following conditions occur:

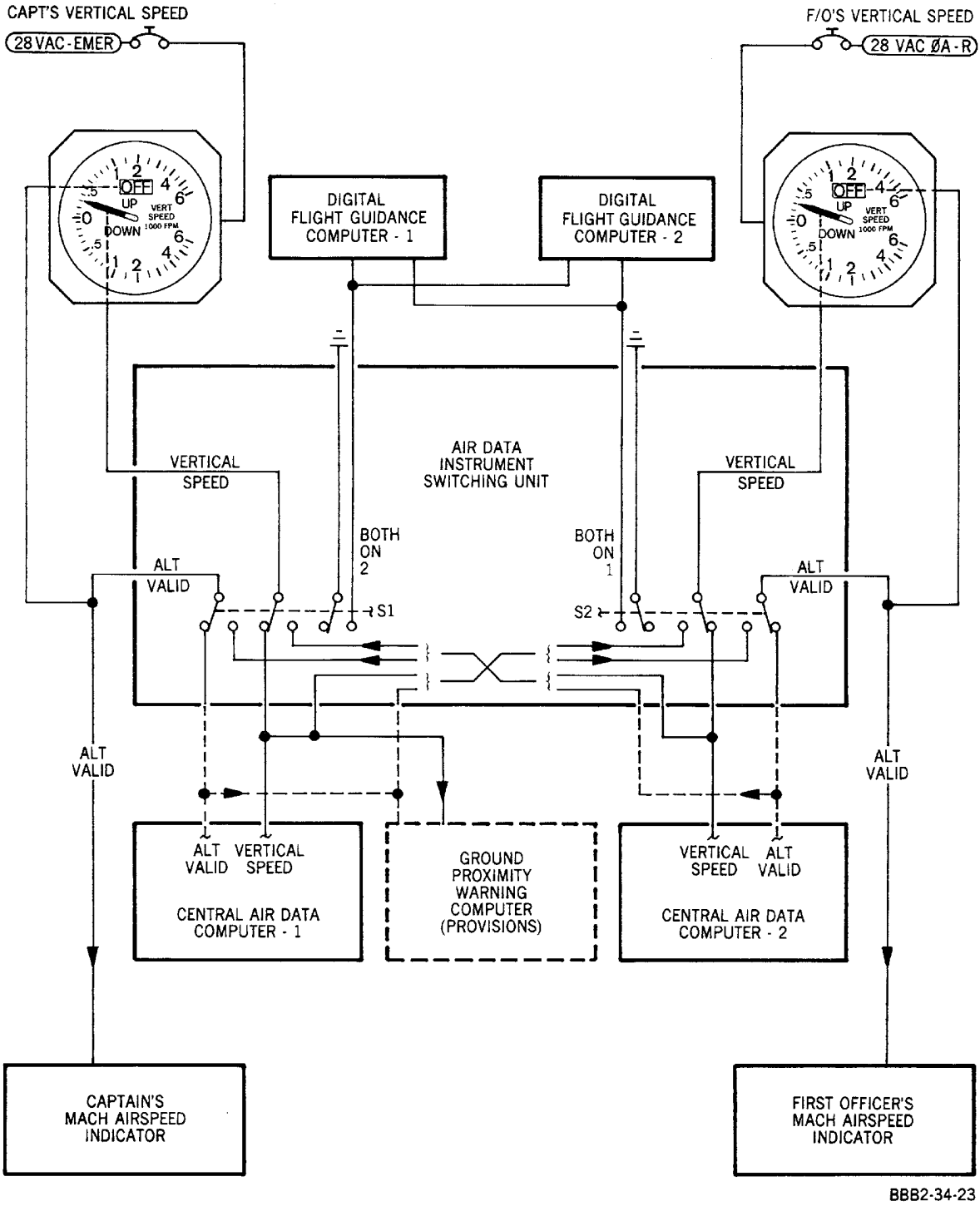
(a) Loss of 28 volt dc input data valid signal (ALT FLAG)

(b) Over range input (more than + or -10 volts) (ALT RATE)

(c) Failure of pointer to follow input

(d) Loss of power

(e) Loss of input reference voltage (+12 or -12 volt dc).



Vertical Speed System
Figure 1/34-14-00-990-801

3. To Operate System

A. When electrical buses are energized 28 vac power is applied to the Vertical Speed Indicator unless CAPT'S VERTICAL SPEED or FO'S VERTICAL SPEED circuit breakers on left and right emergency buses of overhead circuit breaker panel are open.

VERTICAL SPEED - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty vertical speed system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the Vertical Speed system are: Vertical Speed Indicators. The system interfaces with Air Data Computers, Digital Flight Guidance Computers, and Mach Airspeed Indicators. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The Vertical Speed components are located as follows:

Table 101

Component	Location
Vertical Speed Indicators	Captain's and First Officer's Instrument Panels
Capt's and F/O's Vertical Speed Circuit Breakers	EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Vertical Speed System

A. Trouble Shoot

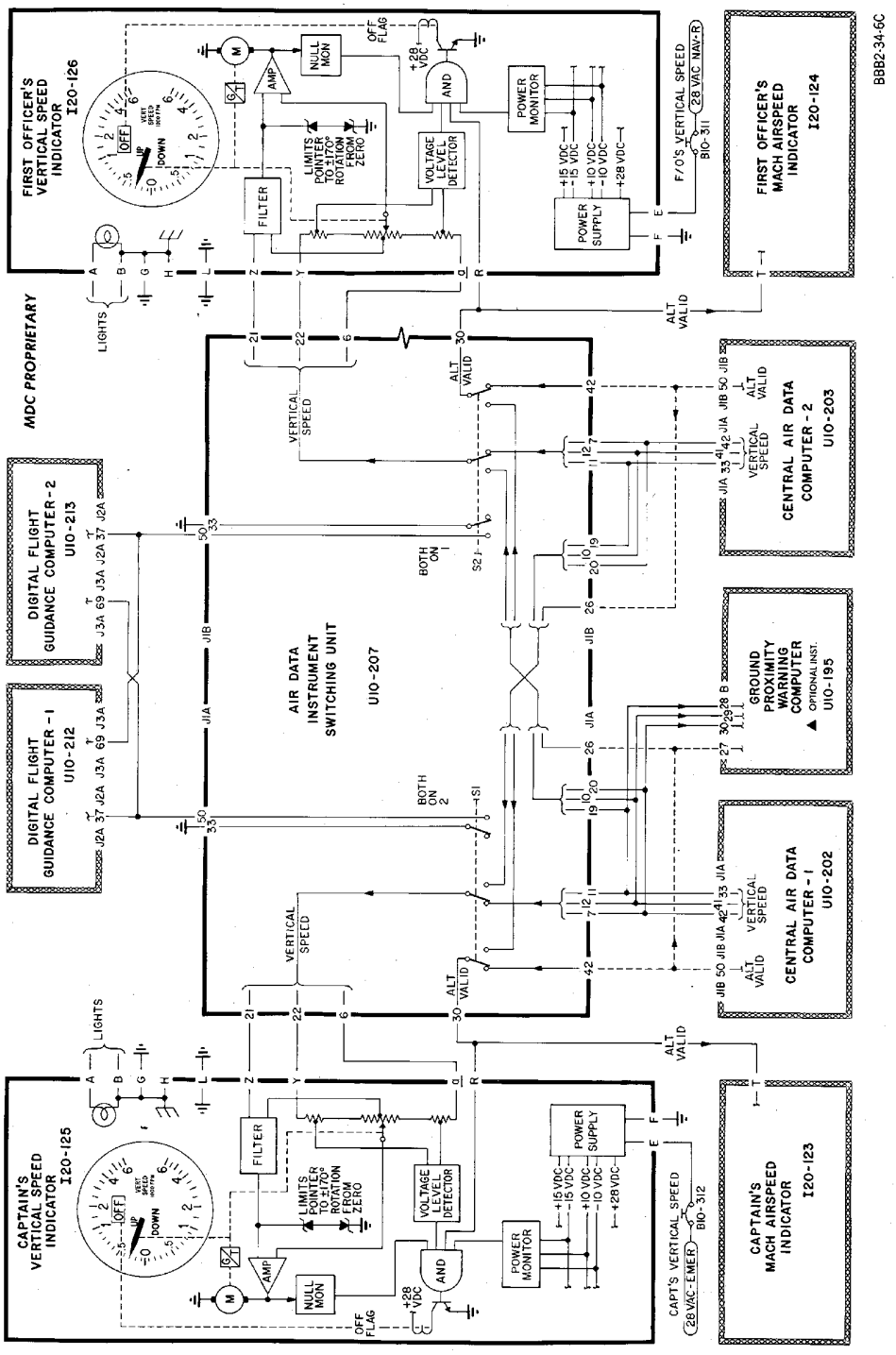
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Vertical Speed Indicators, Air Data Computers, Digital Flight Guidance Computers, and Mach Airspeed Indicators.

Table 103

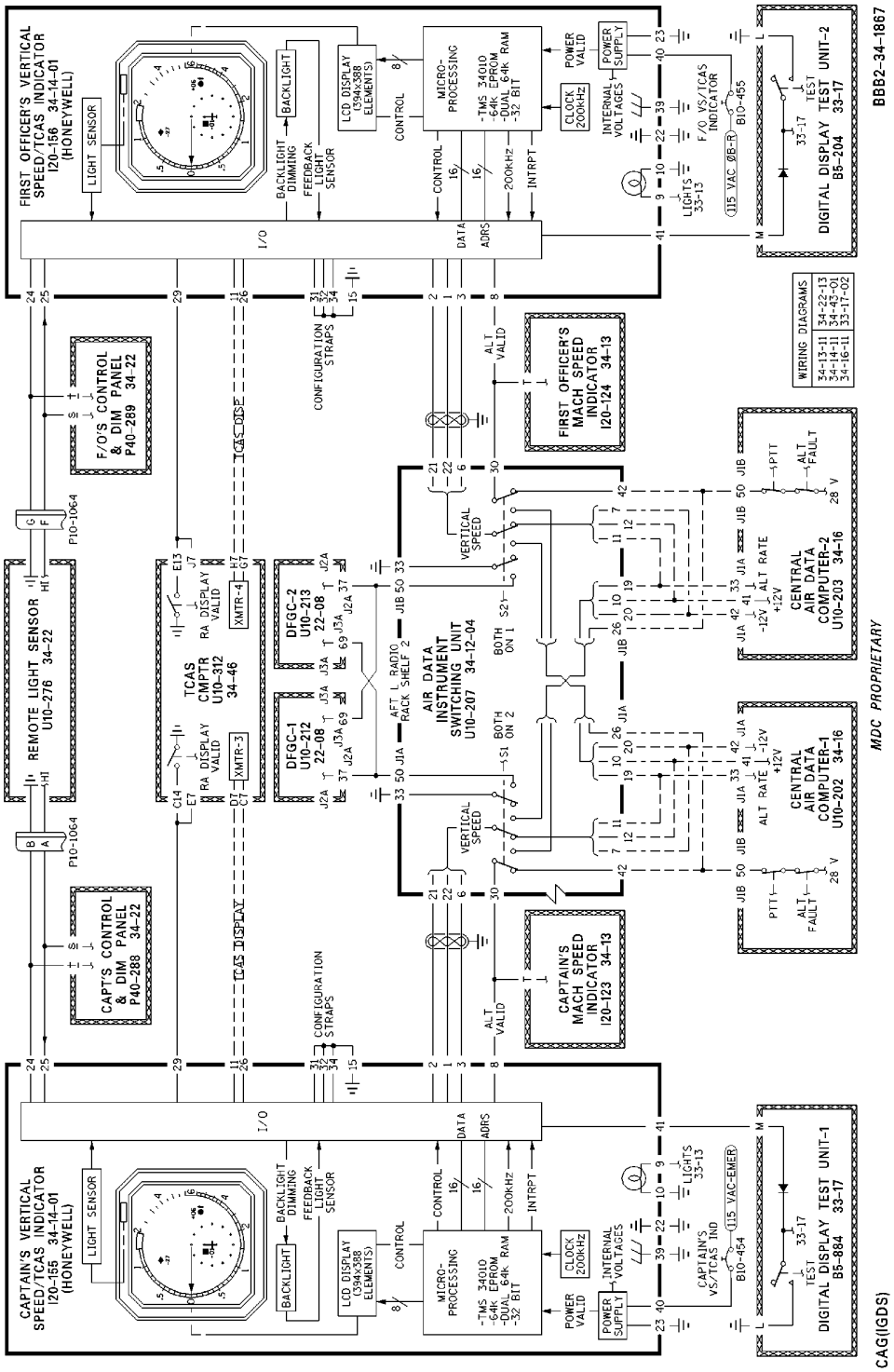
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

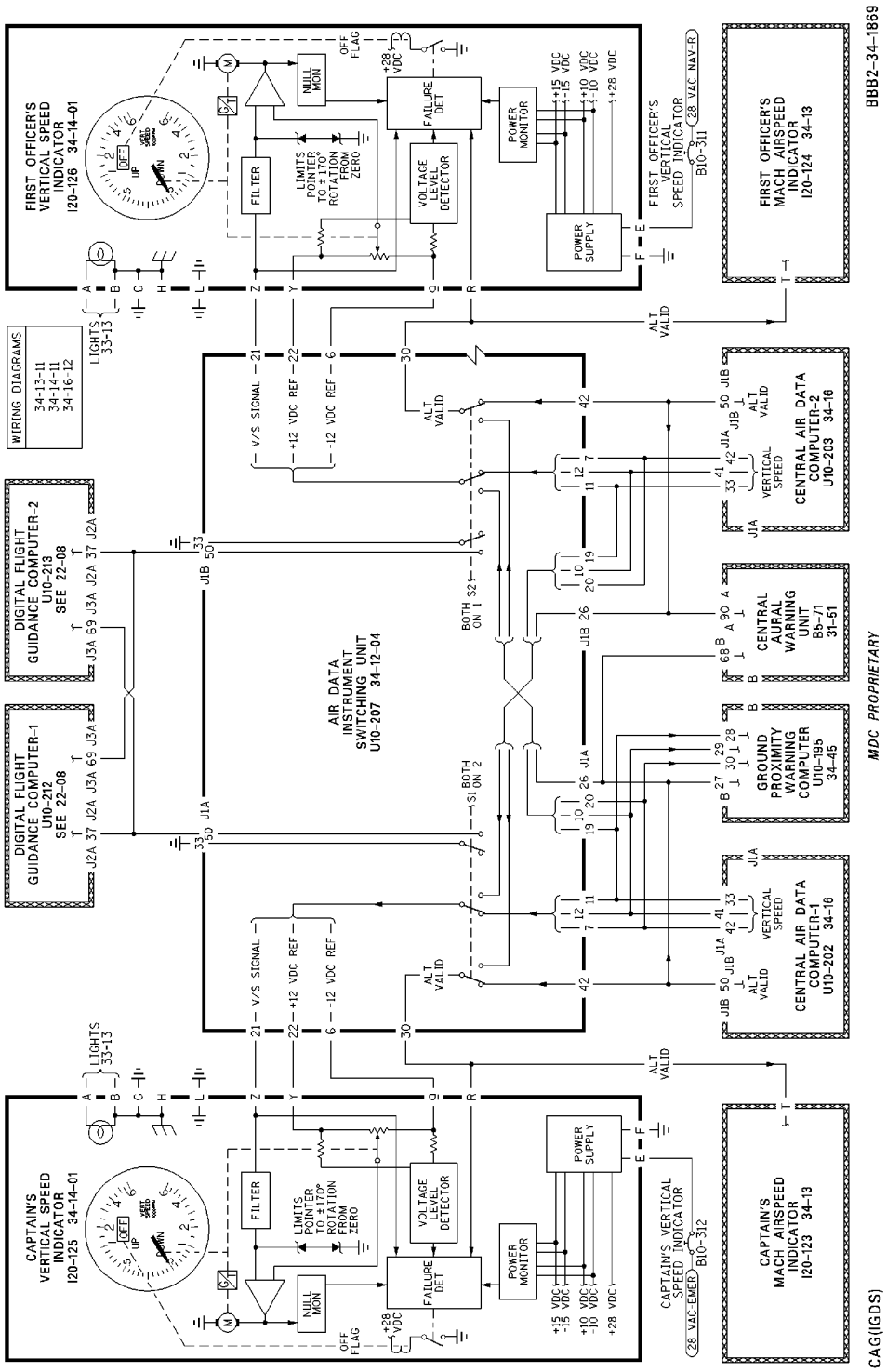
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



Vertical Speed System - Schematic
Figure 101/34-14-00-990-804 (Sheet 1 of 3)



Vertical Speed System - Schematic
Figure 101/34-14-00-990-804 (Sheet 2 of 3)



Vertical Speed System - Schematic
Figure 101/34-14-00-990-804 (Sheet 3 of 3)

VERTICAL SPEED - MAINTENANCE PRACTICES

1. General

A. The Vertical Speed Indicator is utilized to display vertical speed to the pilot as derived from the Central Air Data Computer (CADC). Normally, the Captain's indicator displays information received from CADC -1 and the First Officer's indicator displays information received from CADC -2. Instrument switching and annunciation, allows either CAPT or F/O vertical speed indicators to be driven from either CADC -1 or CADC -2. The indicator pointer displays the up and down (vertical) speed of the airplane in feet per minute and the failure warning (OFF) flag annunciates proper operation of the indicator display. The CADC self-test functions are utilized to provide fixed information for the indicator tests.

2. Adjustment/Test Vertical Speed Indicator

A. Safety and Operating Precautions

(1) Line maintenance personnel must be alert to the fact that under certain conditions the CADC self-test function can result in sudden movement of powered control surfaces. This condition is only present when a Flight Guidance system is in operation and the hydraulic power is energized. Under these conditions, actuation of the self test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of the control surfaces. Therefore, prior to depressing the PUSH TO TEST switch, it is necessary to open, tag, and safety Flight Guidance system circuit breakers.

(2) There is no mechanical adjustment for the vertical speed indicator.

B. Test Vertical Speed Indicator

NOTE: Captain's system tests are described, First Officer's system is identical unless parenthetically noted.

(1) Place central air data computer switching unit selector switch to NORM position and ensure that failure warning flags are out of view on the captain's and first officer's vertical speed indicators.

Table 201

Step	Operation	Desired Result
(1)	Place CADC -1 (2) front panel MODE SELECT switch in FUNCTION TEST position.	
(2)	Depress and hold CADC -1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Vertical Speed Indicator for following display:
		1000(±100) feet per minute
(3)	Release PUSH TO TEST switch.	
(4)	Place CADC -1 (2) front panel MODE SELECT switch in FAILURE WARNING position.	
(5)	Depress and hold CADC -1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Vertical Speed Indicator for following display:
		OFF flag in view
(6)	Release PUSH TO TEST switch.	Vertical Speed Indicator test complete.
(7)	Return aircraft to required configuration.	

C. In-service Tolerances

Table 202

Indicators	Altitude	Vertical Speed	Tolerance
Pilots and Copilots V/S Indicators	On Ground	Static	0±200 FPM
Pilots and Copilots V/S Indicators	<4000 Ft.	±500 FPM	V/S±200 FPM
Pilots and Copilots V/S Indicators	<4000 Ft.	±2000 FPM	V/S±600 FPM

VERTICAL SPEED INDICATOR - MAINTENANCE PRACTICES

1. General

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

A. There are two vertical speed indicators (VSI) located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel. Each indicator displays vertical speed data received from the applicable -1 or -2 central air data computer (CADC).

WJE 410, 875-879

B. There are two vertical speed indicators (VSI)/TCAS located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel. Each indicator displays vertical speed data received from the applicable -1 or -2 central air data computer (CADC). The VSI's also display information from the Traffic Alert and Collision Avoidance System (TCAS).

Refer to SUBJECT 34-46-00 for TCAS operation.

WJE ALL

C. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring (INSTRUMENT PANELS - GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 31-00-02/201).

2. Removal/Installation Indicator

A. Remove VSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open following circuit breakers, as applicable to VSI being removed.

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-407, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 891-893			
A	6	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 861			
A	7	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 401-408, 412, 414, 864, 875-880, 886, 887			
A	7	B10-454	CAPTAIN'S VS/TCAS IND
WJE 410			
A	8	B10-454	CAPTAIN'S VS/TCAS IND
WJE **WJE 412, 414**			
WJE C	2	B10-454	CAPTAIN'S VERTICAL SPEED
WJE **WJE ALL**			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

	Row	Col	Number	Name
WJE	L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

WJE
WJE **UPPER EPC, RIGHT RADIO AC BUS**

	Row	Col	Number	Name
WJE				
WJE	**WJE 412, 414**			
WJE	F	2	B10-455	F/O'S VERTICAL SPEED INDICATOR

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 401-406, 409, 412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893			
B	2	B10-311	FIRST OFFICER'S VERTICAL SPEED INDICATOR

UPPER EPC, RT AC

Row	Col	Number	Name
WJE 407, 408, 410, 411, 875-879			
J	16	B10-455	F/O VS/TCAS INDICATOR

WJE ALL

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

WJE ALL

B. Install VSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-407, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 891-893			
A	6	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 861			
A	7	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 401-408, 412, 414, 864, 875-880, 886, 887			
A	7	B10-454	CAPTAIN'S VS/TCAS IND

WJE 401-408, 412, 414, 864, 875-880, 886, 887 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 410			
A	8	B10-454	CAPTAIN'S VS/TCAS IND
WJE 412, 414			
C	2	B10-454	CAPTAIN'S VERTICAL SPEED

WJE ALL

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 412, 414			
F	2	B10-455	F/O'S VERTICAL SPEED INDICATOR

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 401-406, 409, 412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893			
B	2	B10-311	FIRST OFFICER'S VERTICAL SPEED INDICATOR

UPPER EPC, RT AC

Row	Col	Number	Name
WJE 407, 408, 410, 411, 875-879			
J	16	B10-455	F/O VS/TCAS INDICATOR

WJE ALL

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

WJE ALL

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-407, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 891-893			
A	6	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 861			
A	7	B10-312	CAPTAIN'S VERTICAL SPEED IND 28 VAC
WJE 401-408, 412, 414, 864, 875-880, 886, 887			
A	7	B10-454	CAPTAIN'S VS/TCAS IND
WJE 410			
A	8	B10-454	CAPTAIN'S VS/TCAS IND
WJE **WJE 412, 414**			
WJE C	2	B10-454	CAPTAIN'S VERTICAL SPEED
WJE **WJE ALL**			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
WJE L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

WJE
WJE **UPPER EPC, RIGHT RADIO AC BUS**

WJE Row	Col	Number	Name
WJE **WJE 412, 414**			
WJE F	2	B10-455	F/O'S VERTICAL SPEED INDICATOR

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 401-406, 409, 412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893			
B	2	B10-311	FIRST OFFICER'S VERTICAL SPEED INDICATOR

UPPER EPC, RT AC

Row	Col	Number	Name
WJE 407, 408, 410, 411, 875-879			
J	16	B10-455	F/O VS/TCAS INDICATOR

WJE ALL

C. Test Vertical Speed Indicator

NOTE: Captain's system tests are described, First Officer's system is identical unless parenthetically noted. Line maintenance personnel must be alert to the fact that under certain conditions the CADC self-test function can result in sudden movement of powered control surfaces. This condition is only present when a Flight Guidance system is in operation and the hydraulic power is energized. Under these conditions, actuation of the self test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of the control surfaces. Therefore, prior to depressing the PUSH TO TEST switch, it is necessary to open, tag, and safety Flight Guidance system circuit breakers.

WJE 412, 414

Table 201

	Operation	Desired Result
(1)	With CADC select switch (overhead panel flight compartment) in NORM position.	Vertical speed flag out of view.
		1000(±100) feet per minute
(4)	Release PUSH TO TEST switch.	
		OFF flag in view
(7)	Release PUSH TO TEST switch.	Vertical Speed Indicator test complete.
(8)	Return aircraft to required configuration.	

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

Table 202

	Operation	Desired Result
(1)	With CADC select switch (overhead panel flight compartment) in NORM position.	Vertical speed flag out of view.
(2)	Place CADC -1 (2) front panel MODE SELECT switch in FUNCTION TEST position.	
(3)	Depress and hold CADC -1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Vertical Speed Indicator for following display:
		1000(±100) feet per minute
(4)	Release PUSH TO TEST switch.	
(5)	Place CADC -1 (2) front panel MODE SELECT switch in FAILURE WARNING position.	
(6)	Depress and hold CADC -1 (2) PUSH TO TEST switch.	Check Captain's (First Officer's) Vertical Speed Indicator for following display:
		OFF flag in view
(7)	Release PUSH TO TEST switch.	Vertical Speed Indicator test complete.
WJE 401-409, 411, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893		
(8)	Return aircraft to required configuration.	

Table 202 (Continued)

	Operation	Desired Result
WJE 410, 875-879		
(8)	On aircraft with TCAS, perform TCAS self-test. (34-46-00, page 201)	
(9)	Return aircraft to required configuration.	

TRUE AIRSPEED AND STATIC AIR TEMPERATURE - DESCRIPTION AND OPERATION

1. General

A. The True Airspeed and Static Air Temperature (TAS/SAT) Indicator (Figure 1) is utilized to display the airplane true airspeed, static air temperature, and total air temperature to the pilot as derived from the Central Air Data Computer. The indicator is mounted on the First Officer's instrument panel and receives input data from the Central Air Data Computer -1 or -2 through the air data switching unit. The indicator receives digital input information, processes this information in integrated circuits, and displays the results by means of magnetic wheels.

B. The indicator operation includes an internal failure monitoring function to readily assure the validity of the displayed information. Failure warning (OFF) flags annunciate invalid operation of the true airspeed and static air temperature displays. In addition, the indicator operation is quickly and accurately verified during line maintenance procedures by employing the self-test functions feature of the Central Air Data Computer.

2. Operation

A. The indicator inputs consist of an indicator lighting voltage, a 28 volts ac power supply voltage, and the Central Air Data Computer digital signal. The serial digital input signal is obtained from the Central Air Data Computer -1 or -2 through the air data switching unit. The indicator buffer level changer, data acquisition and register select logic circuits receive, process, and provide the information to the pertinent binary coded decimal data register circuit. The output of the data register circuits is fed to the respective decoder and driver circuits for application to the appropriate magnetic wheel.

B. True Airspeed (TAS) display. The digital annunciation of airplane true airspeed is provided by a three-digit magnetic wheel type display. The display range is from 130 to 599 knots, displayed to the nearest knot, with an accuracy of ±1 knot. The threshold sensitivity due to an electrical signal is one knot and the response rate of the counter is less than 300 milliseconds for adjacent characters.

C. Static Air Temperature (SAT) display. The digital annunciation of static air temperature is provided by a three-digit magnetic wheel type display. The display range is from -99°C to +50°C and consists of the sign (+ or -) with two digits. The display is accurate to the nearest degree centigrade ±1 degree and the threshold sensitivity due to an electrical signal is 1 degree centigrade.

D. Total Air Temperature (TAT) display. The digital annunciation of total air temperature is provided on the static air temperature display when the indicator TAT pushbutton switch is depressed. The display range, accuracy and threshold sensitivity are -50° to +99°C.

E. True Airspeed failure indications are as follows:

(1) An invalid signal results in a display of 111 knots with the failure warning (OFF) flag in view.

(2) A loss of input signal for 2(±0.5) seconds results in a display of 999 knots with the failure warning (OFF) flag in view.

(3) No computed data for two seconds results in a display of 130 knots with the failure warning (OFF) flag out of view.

(4) An internal power supply failure results in the failure warning (OFF) flag in view.

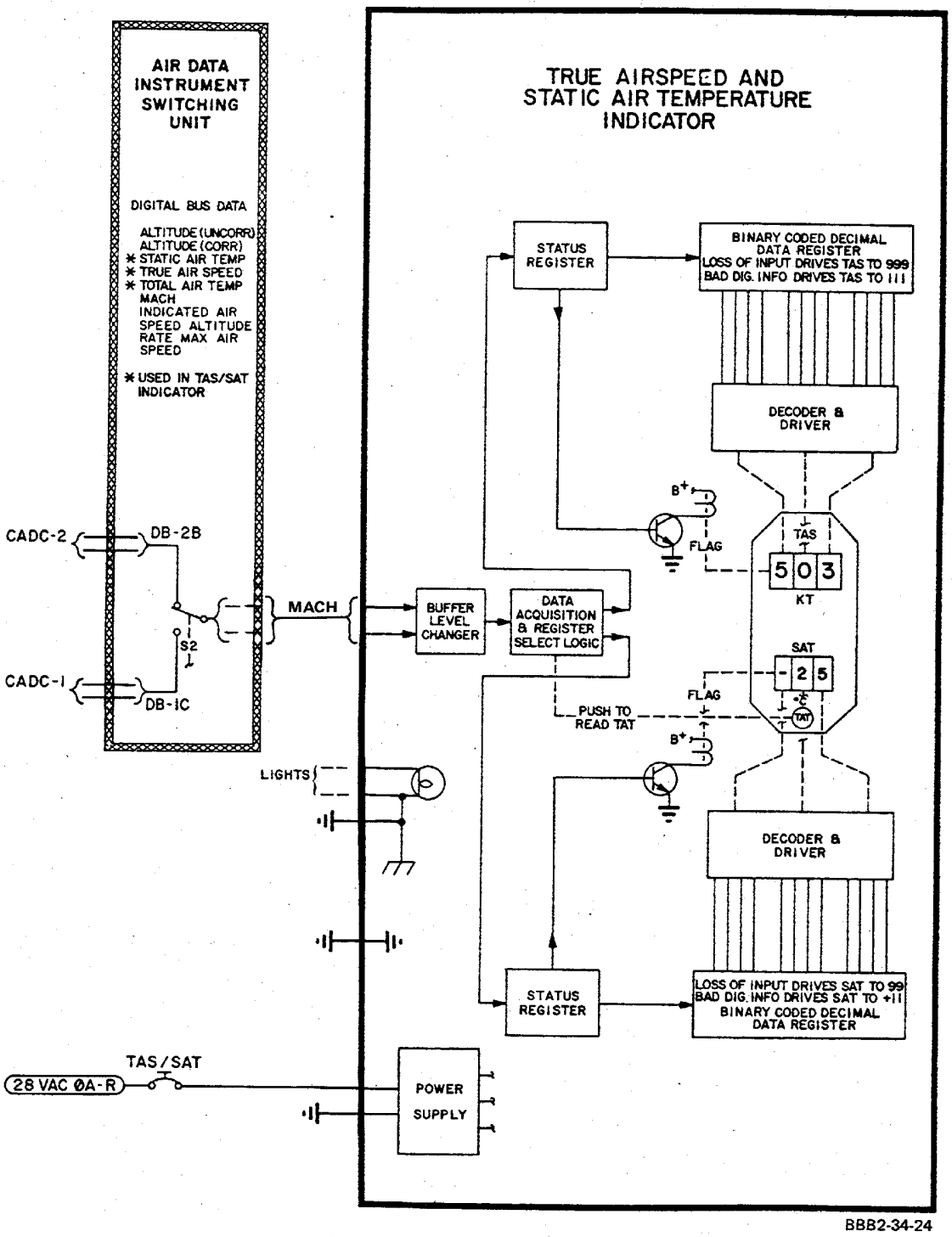
F. Static air temperature failure indications are as follows:

(1) An invalid signal for 2(±0.5) seconds results in a display of +11 degrees centigrade with the failure warning (OFF) flag in view.

(2) A loss of input signal for 2(±0.5) seconds results in a display of +99 degrees centigrade with the failure warning (OFF) flag in view.

(3) An internal power supply failure results in the failure warning (OFF) flag in view.

NOTE: When electrical buses are energized 28 vac power is applied to the indicator unless the TAS/SAT circuit breaker is open.



True Airspeed and Static Air Temperature System
Figure 1/34-15-00-990-801

TRUE AIRSPEED AND STATIC AIR TEMPERATURE - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty True Airspeed (TAS)/Static Air Temperature (SAT) Indicator system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable Unit (LRU).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major component of the TAS/SAT system is the TAS/SAT Indicator. The system interfaces with Air Data Computers. In trouble shooting some checks may have to be made to Air Data systems. See applicable trouble shooting sections.

E. The TAS/SATindicator is located as follows:

Table 101

Component		Location		
TAS/SAT Indicator		First Officer's Instrument Panel		
REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10–313	TRUE AIRSPEED STATIC AIR TEMP	Upper EPC	RIGHT RADIO BUS	B/6

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 630A	Triplett

3. Trouble Shooting TAS/SAT Indicator System

A. Trouble Shoot

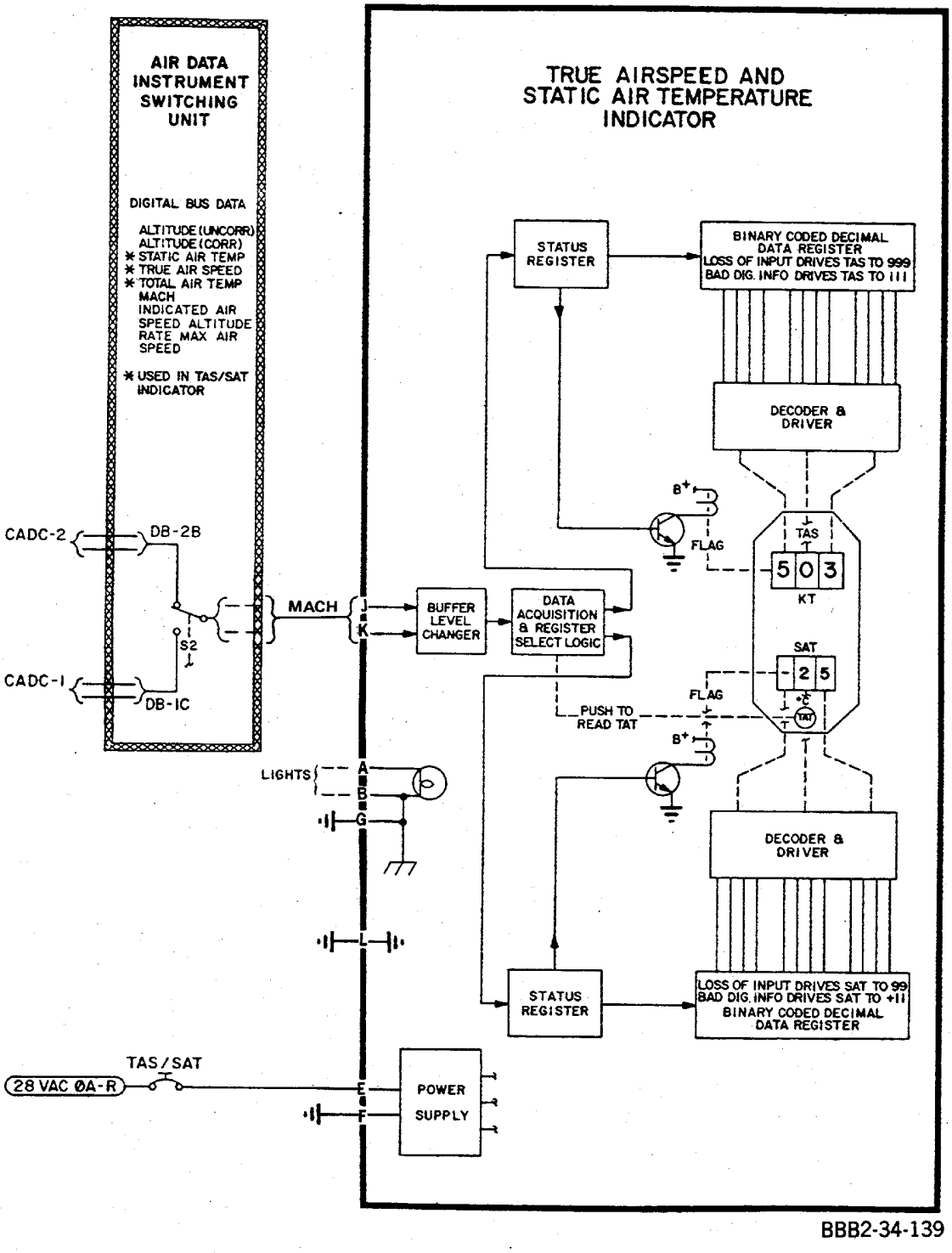
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are TAS/SATIndicator and Air Data Computers.

Table 103

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

Step	Procedure	Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



TAS/SAT Indicator System - Schematic
Figure 101/34-15-00-990-802

TRUE AIRSPEED AND STATIC AIR TEMPERATURE - MAINTENANCE PRACTICES

1. General

A. The TAS/SAT Indicator is utilized to display the airplane true airspeed, static air temperature, and total air temperature to the pilot as derived from the Central Air Data Computer (CADC). Normally the indicator receives digital input information from CADC-2, processes this information in integrated circuits, and displays the results by means of magnetic wheels. Instrument switching and annunciation allows either Captain's or First Officer's airspeed to be driven from either CADC-1 or CADC-2. The indicator operation includes an internal failure monitoring function and failure warning (OFF) flags annunciate invalid operation of the true airspeed and static air temperature displays. The CADC-2 self-test function is utilized to provide information for the indicator tests.

2. Adjustment/Test True Airspeed and Static Air Temperature Indicator

A. Preliminary

NOTE: Use of a CADC Remote Test Adapter cable will allow CADC test switch actuation from the flight compartment (AIR DATA COMPUTING - MAINTENANCE PRACTICES, PAGEBLOCK 34-16-00/201, Figure 201). Care should be exercised to prevent multiple test selection execution which can cause incorrect self test outputs. When CADC Remote Test Adapter cable is used, and selector switch is in ON position, the step in procedures stating to depress and hold the PUSH TO TEST switch on CADC is not required.

(1) Line maintenance personnel must be alert to the fact that under certain conditions the CADC self-test function can result in sudden movement of powered control surfaces. This condition is only present when a Flight Guidance system is in operation. Under these conditions, actuation of the self test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of the control surfaces. Therefore, prior to depressing the PUSH TO TEST switch, it is necessary to open, tag, and safety Digital Flight Guidance system circuit breakers.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

B. Test TAS/SAT Indicator

Table 201

Step	Operation	Desired Result
(1)	Check that failure warning flags are out of view on the TAS/SAT Indicator.	
(2)	Place CADC-2 front panel MODE SELECT switch in FUNCTION TEST position.	
(3)	Depress and hold CADC-2 PUSH TO TEST switch.	Check TAS/SAT indicator for following displays:
WJE 401-404, 412, 414, 873, 874		
		True Airspeed 456(±1) knots
WJE 406-408, 411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 891		
		True Airspeed 456(±00) knots *454(±00) knots
NOTE: *Model 87 aircraft		
WJE 401-404, 406-408, 411, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 891		
		Static Air Temperature -27(±2)°C
NOTE: VALID WHEN ON lights come ON when manual activated self-test is initiated by pressing PUSH TO TEST switch and remains lit (if there is no failure) until PUSH TO TEST switch is released.		
(4)	While CADC-2 PUSH TO TEST switch is pressed, depress TAT switch on TAS/SAT indicator.	Static Air Temperature display shows 0(±2)°C.
(5)	Release PUSH TO TEST and TAT switches.	
(6)	Place CADC-2 front panel MODE SELECT switch in FAILURE WARNING position.	

Table 201 (Continued)

Step	Operation	Desired Result
(7)	Depress and hold CADC-2 PUSH TO TEST switch.	Check TAS/SAT indicator for following displays:
		True Airspeed OFF flag in view. Static Air Temperature OFF flag in view.
(8)	Release PUSH TO TEST switch.	True Airspeed OFF flag out of view.
		Static Air Temperature view. OFF flag out of

(1) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(2) Return airplane to required configuration.

TAS/SAT INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the TAS/SAT indicator. The TAS/SAT indicator is located in the flight compartment, on the first officer's instrument panel (Figure 201). The indicator displays true airspeed (TAS) in knots, and static air temperature (SAT) in degrees centigrade. When the TAT pushbutton is depressed, the SAT display is replaced by a digital display of total air temperature. Input data is in BCD form from central air data computer-1 and from computer -2, as selected through the air data switching unit.

NOTE: If necessary, the first officer's instrument panel can be opened for access to the indicator wiring.

2. Removal/Installation TAS/SAT Indicator

A. Remove Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	6	B10-313	TRUE AIRSPEED & STATIC AIR TEMP

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	6	B10-313	TRUE AIRSPEED & STATIC AIR TEMP

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	6	B10-313	TRUE AIRSPEED & STATIC AIR TEMP

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(6) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

NOTE: Use of a CADC Remote Test Adapter cable will allow CADC test switch actuation from the flight compartment (AIR DATA COMPUTING - MAINTENANCE PRACTICES, PAGEBLOCK 34-16-00/201, Figure 201). Care should be exercised to prevent multiple test selection execution which can cause incorrect self test outputs. When CADC Remote Test Adapter cable is used, and selector switch is in ON position, the step in procedures stating to depress and hold the PUSH TO TEST switch on CADC is not required.

(7) Place CADC-2 mode select switch in FUNCTION TEST position and press PUSH-TO-TEST switch; true airspeed display should show 456(±1) knots and static air temperature should show -27(±2) degrees centigrade.

(8) While holding CADC-2 PUSH TO TEST button, press TAT switch on TAS/SAT indicator static air temperature display should show 0(±2)° centigrade.

NOTE: TAS/SAT indicator is also tested in AIR DATA COMPUTING - MAINTENANCE PRACTICES, PAGEBLOCK 34-16-00/201.

(9) Return airplane to required configuration.

(10) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

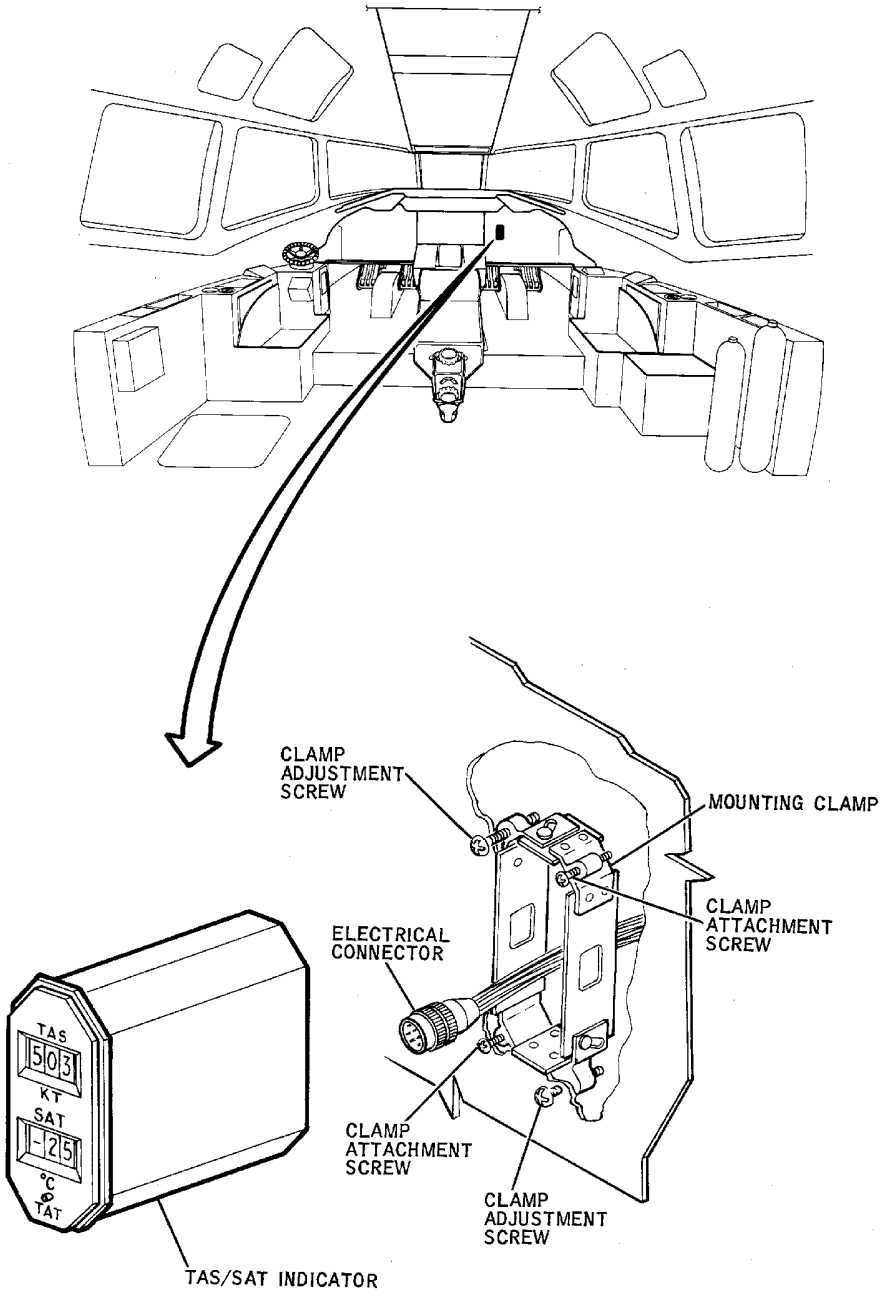
UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

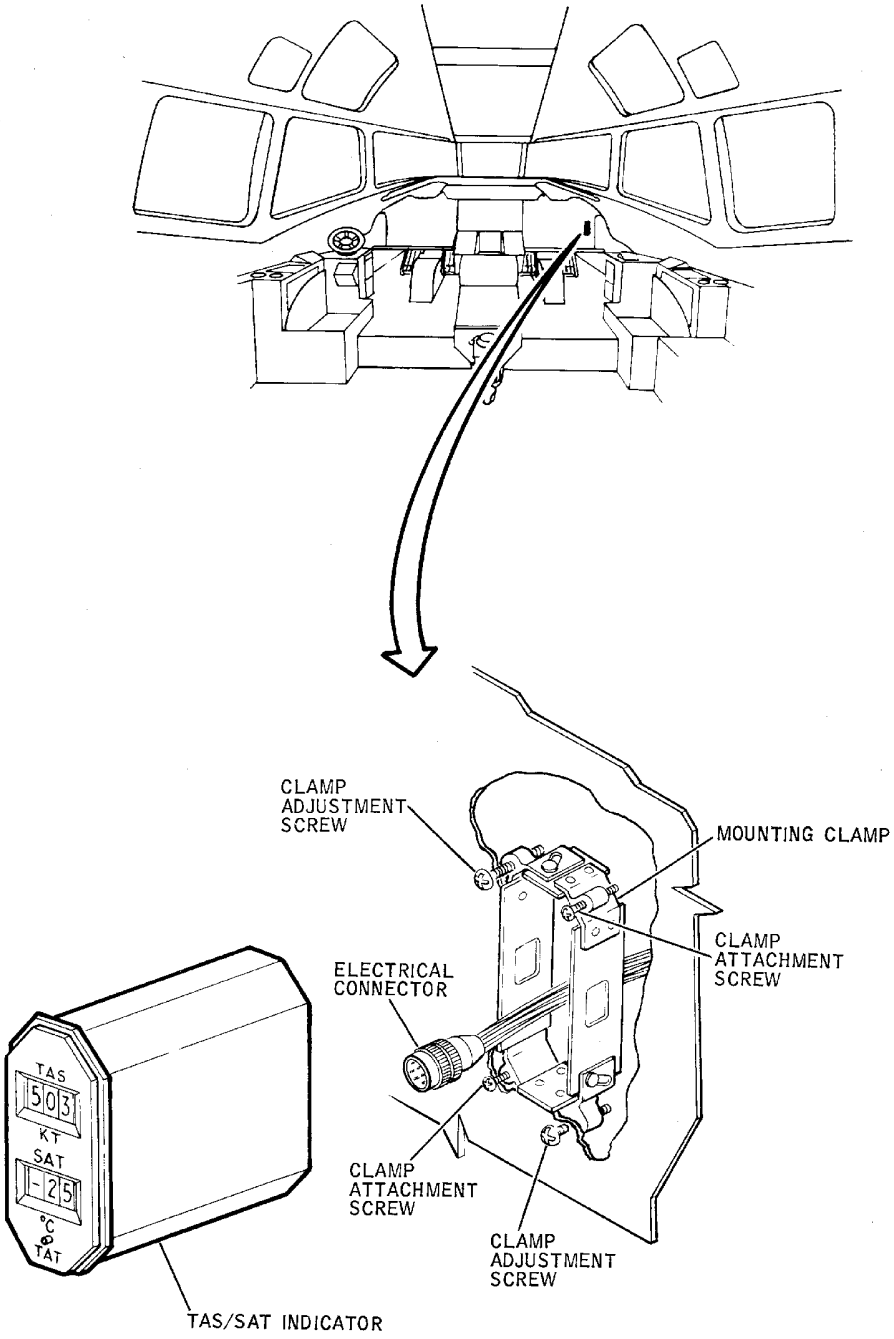
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(11) Return airplane to required configuration.



TAS/SAT Indicator -- Removal/Installation
Figure 201/34-15-01-990-801 (Sheet 1 of 2)



TAS/SAT Indicator -- Removal/Installation
Figure 201/34-15-01-990-801 (Sheet 2 of 2)

AIR DATA COMPUTING - DESCRIPTION AND OPERATION

1. Description

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 886, 887, 891

A. Air Data Computing is accomplished by two Central Air Data Computers. The computers receive dynamic inputs from the Pitot systems, Static systems, and the Ram Air Temperature Probe. Computed air data is provided to the following using equipment: Primary Mach/Airspeed Indicators, Vertical Speed Indicators, Altimeters, Ram Air Temperature/Thrust Rating Indicator, True Airspeed/ Static Air Temperature Indicator, Central Aural Warning system, ATC Transponders, Flight Data Acquisition Unit, and the Digital Flight Guidance Computers. The mathematical computations necessary to obtain the desired air data are performed by the computer software. The computed output information is presented as analog discrete and digital voltages representing altitude, airspeed, altitude rate temperature, mach and validity signals. Built-in test provides continuous monitoring of the computer during in-flight operation and initiates failure output signals for invalid test results. In addition, self-test capability is provided. The self tests are actuated during line maintenance by CADC front panel controls or remote self test tool.

WJE 405, 407-411, 884

NOTE: On aircraft 131-132, the computed air data is provided to the Omega/VLF navigation system.

WJE 873, 874, 892, 893

B. Air Data Computing is accomplished by two Central Air Data Computers. The computers receive dynamic inputs from the Pitot systems, Static systems, and the Ram Air Temperature Probe. Computed air data is provided to the following using equipment: Primary Mach/Airspeed Indicators, Vertical Speed Indicators, Altimeters, Ram Air Temperature/Thrust Rating Indicator, Central Aural Warning system, ATC Transponders, Flight Data Acquisition Unit, and the Digital Flight Guidance Computers. The mathematical computations necessary to obtain the desired air data are performed by the computer software. The computed output information is presented as analog discrete and digital voltages representing altitude, airspeed, altitude rate temperature, mach and validity signals. Built-in test provides continuous monitoring of the computer during in-flight operation and initiates failure output signals for invalid test results. In addition, self-test capability is provided. The self tests are actuated during line maintenance by CADC front panel controls or remote self test tool.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893

C. Central Air Data Computer (CADC). The CADC is a solid state device of modular construction, consisting of two pressure sensitive transducer modules, plug-in printed circuit cards, a power supply module, and a chassis assembly. The front panel contains a fault isolation test connector for off-airplane trouble shooting, air fittings for static and pitot pressure connectors, a function selector switch, press to test switch, a VALID WHEN ON light, and FAILURE HISTORY lights. Three electrical connectors mounted in the back of the chassis provide interconnections with the airplane wiring.

D. The dual CADC installation utilizes two line replaceable CADC units installed on the radio rack in the electrical/electronics compartment. The units are mounted on sliding racks by means of camlocking handles and rear hold-down alignment pins.

E. CADC instrument switching is provided by a CADC Selector switch located on the overhead panel. With the switch in NORM, CADC-1 outputs are to Captain's air data instruments and CADC-2 to First Officer's. With the switch in BOTH ON 1, outputs to both Captain's and First Officer's instrument systems are on CADC-1. With switch in BOTH ON 2, Captain's and First Officer's instrument systems are on CADC-2.

F. Central Air Data Computer inputs are as follows:

(1) Static pressure (Ps) is applied via pneumatic lines from the airplane static ports.

(2) Total pressure (Pt) is applied via pneumatic lines from the airplane pitot tubes.

(3) Total air temperature (RAT) voltage is applied as a resistance bridge input from the Ram air temperature sensor.

(4) Barometer setting (BARO SET) voltage is applied from the wiper of a three wire potentiometer connection with the altimeter.

(5) Altitude hold, mach hold, computed air speed hold, enable voltages are applied in one of two electrical states for computer circuitry selection. ATC enable ground is supplied through airplane wiring.

(6) Airplane SSEC and VMO data inputs are set into the computer by connecting certain computer electrical connector pins together through airplane wiring.

(a) Desired maximum operating airspeed (Vmo) characteristics are provided by programmed inputs selected by jumper wire connections.

(b) Static source error correction (SSEC), to correct for static source errors, is provided by programmed inputs selected by jumper wire connections.

G. Central Air Data Computer outputs are as follows:

(1) Serial Digital outputs from four digital buses.

(a) Uncorrected pressure altitude (Hpu).

(b) Barometric corrected pressure altitude (Hpc).

(c) Pressure altitude (Hp) rate.

(d) Computed airspeed (CAS).

(e) Maximum allowable airspeed (Vmo).

NOTE: Maximum allowable airspeed is a function of altitude and airplane configuration. In order to provide fully interchangeable Central Air Data Computers the airspeed envelope is programmed by utilizing jumpers installed in the airplane wiring.

(f) Mach (M).

(g) True airspeed (TAS).

(h) Static air temperature (SAT).

(i) Ram air temperature (RAT).

(2) Parallel digital output, air traffic control altitude (Hatc), from a ten-bit encoding circuit (ten wires plus one common) is provided to the Air Traffic Control (ATC) transponders.

(3) Analog outputs.

NOTE: The computer analog output circuits interface with equipment and indicators of an analog nature. The output circuits utilize electrical components in a manner to simulate a voltage ratio electro-mechanical device.

(a) Computed airspeed outputs are 3 wire DC amplified signals and receive information up-date eight times per second.

(b) Maximum airspeed output is 2 wire DC amplified signals and receives information up-date two times per second.

(c) Mach output is a 3 wire DC amplified output signals and receives information up-date eight times per second.

(d) Altitude rate output is a 3 wire DC amplified output signals and receives information up-date 16 times per second.

(e) Computed airspeed, altitude, and mach hold outputs are provided as dc ± voltage ratio.

(4) Failure warning voltages for the operation of mach, computed airspeed, and uncorrected pressure altitude flags and maximum allowable airspeed aural warning are provided as dc discrete outputs.

H. Built-in Self Test. The built-in test capability of the CADC also provides for ground crew initiated self tests which effectively verify the operational status of the computer during line maintenance. The CADC self-test feature is also utilized as a test signal source when verifying the operation of using systems and indicators. The three self tests consist of a function test, a delta (change) test, and a failure warning test. The self tests are controlled by the MODE SELECT switch and the PUSH TO TEST switch located on the CADC front panel (Figure 1). The MODE SELECT switch is rotated to the desired test position and the PUSH TO TEST switch is pushed and held to operate. The tests operation and indications are as follows:

(1) Function TEST. The function test verifies the Analog/Digital and Digital/Analog converter, central processor, digital output section, Input/Output control, analog output, clock, power supply, and portions of the Maximum Allowable Airspeed and Static Source Error Correction circuitry. During the function test the central processor receives a zero degree centigrade signal from the Analog/Digital converter and receives fixed Ps and Pt values from the memory, computes, and transmits the air data outputs.

(2) Function TEST. With the MODE SELECT SWITCH in FUNCTION TEST, BARO Set to 29.92 HG and pressing the CADC PUSH TO TEST Switch, Value indications on the applicable instruments will denote the following correct operations of the CADC:

(a) Uncorrected Pressure Altitude

(b) Mach

(c) Total (RAM) Air Temperature

(d) Baro Corrected Pressure Altitude (No Correction of 29.92" Hg)

(e) Knots, Computed Airspeed

(f) Static Air Temperature

(g) Knots, True Airspeed

(h) Feet per minute Pressure Altitude Rate

(i) Knots, Maximum Allowable Airspeed

(j) Zero delta (ratio = 0.5) Delta Pressure Altitude, Delta Mach, and Delta Computed Airspeed

(k) Failure warning flags do not show for Analog Uncorrected Altitude, Computed Airspeed, and Mach

(l) Overspeed aural warning sounds (CAS 7 VMO)

(3) Delta TEST. Delta test output indications are:

(a) Ambient altitude +100 feet Uncorrected Pressure Altitude

(b) Ambient Mach (+0.05)

(c) Ambient air temperature for Total (Ram) Air Temperature

(d) Ambient altitude + baro set input correction +100 feet Baro Corrected Altitude

(e) Ambient Computed Airspeed +30 knots for Computed Airspeed

(f) Ambient air temperature for Static Air Temperature

(g) Ambient rate (plus a transient) for Pressure Altitude Rate

(h) Ambient true airspeed

(i) Sea level value of maximum allowable airspeed program extrapolated to ambient altitude for Maximum Allowable Airspeed

(j) Failure monitor flags not showing for analog Uncorrected Pressure Altitude, Computed Airspeed, and Mach

(k) Overspeed warning horn silent (unless ambient computed airspeed +16 knots delta value exceeds VMO value.

(4) Failure Warning TEST. The failure warning test verifies the failure warning (discrete) circuits, digital line driver circuits, and portions of the central processor. During the failure warning test the failure warning (discrete) bits in the digital words outputs are set and the failure warning designations are transmitted. The failure warning test output indications are as follows for an operational CADC:

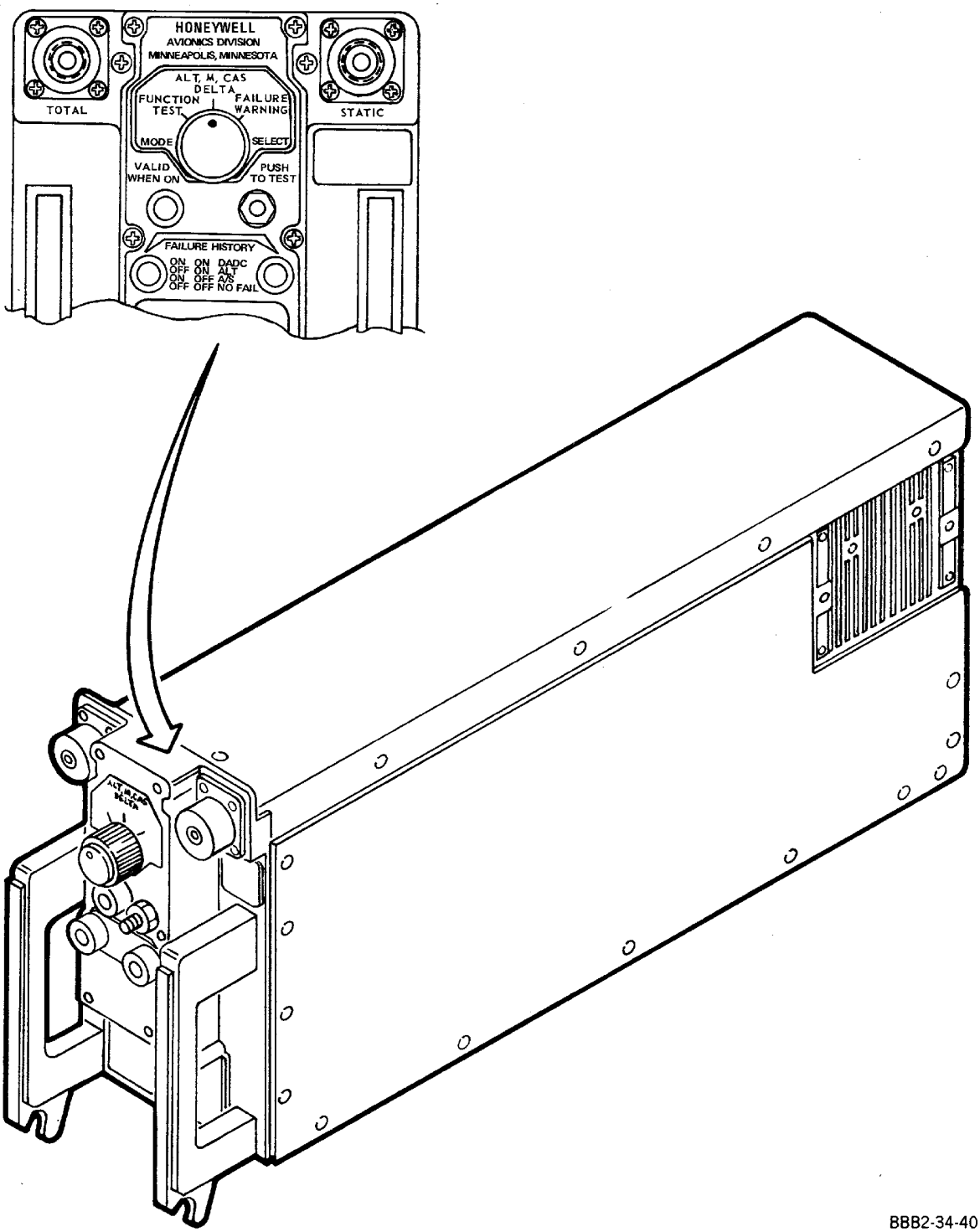
(a) A fail signal is transmitted to all analog and digital output subscribers.

(b) VALID WHEN ON light comes on.

(c) FAILURE HISTORY lights should not come on.

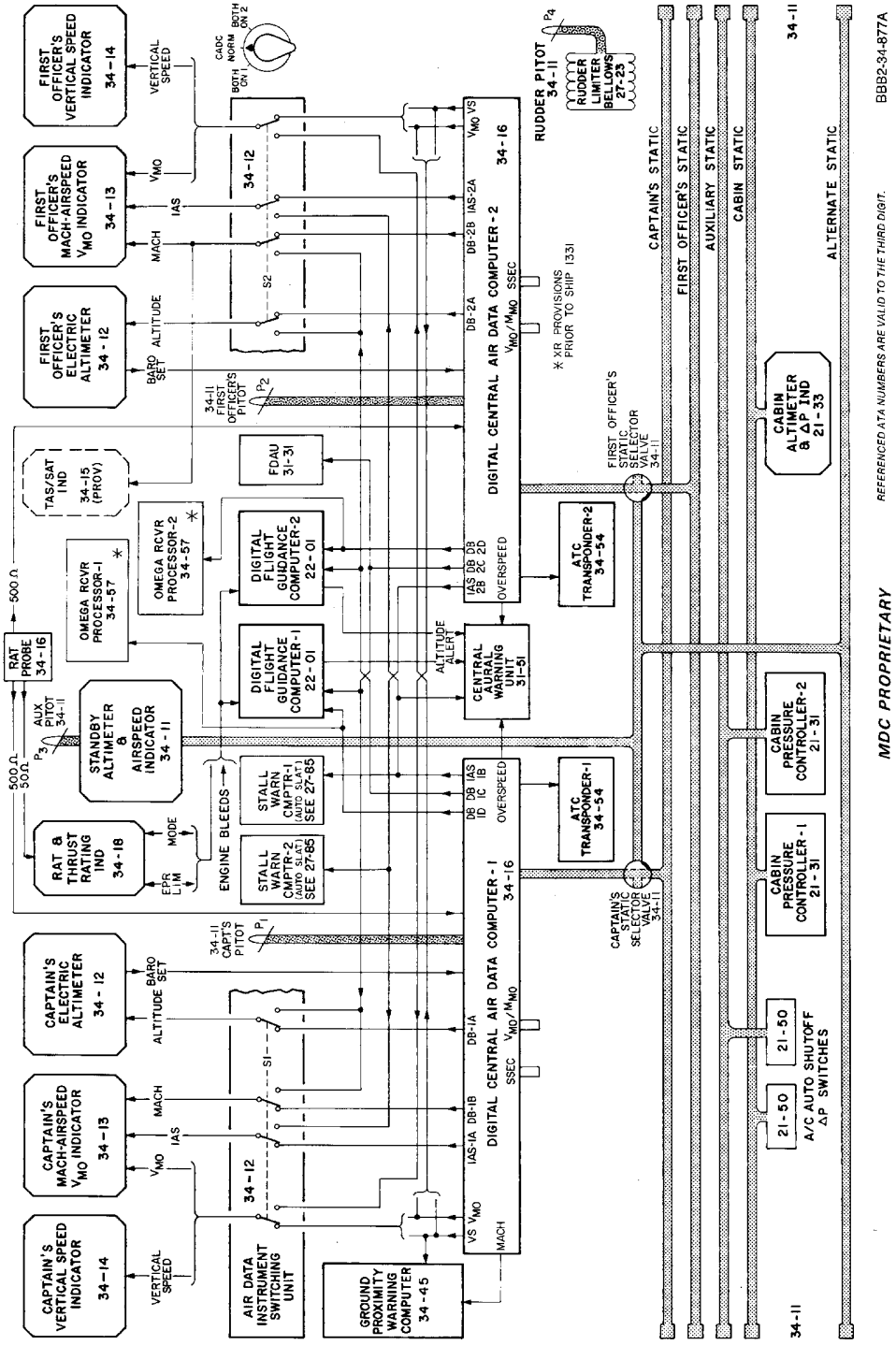
I. To Operate System

(1) With airplane buses energized and circuit breakers closed, the air data computers are operational.

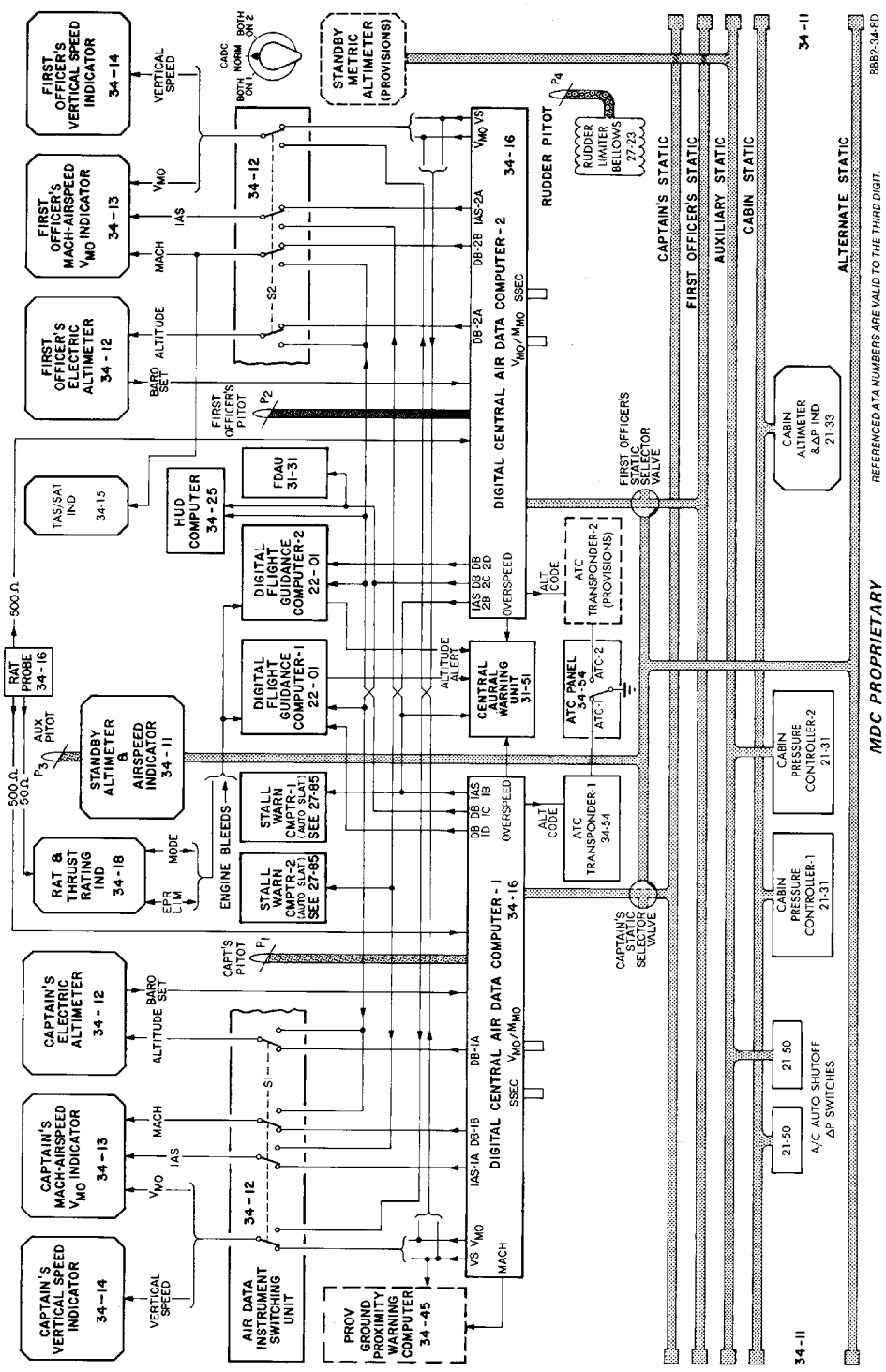


Central Air Data Computer
Figure 1/34-16-00-990-805

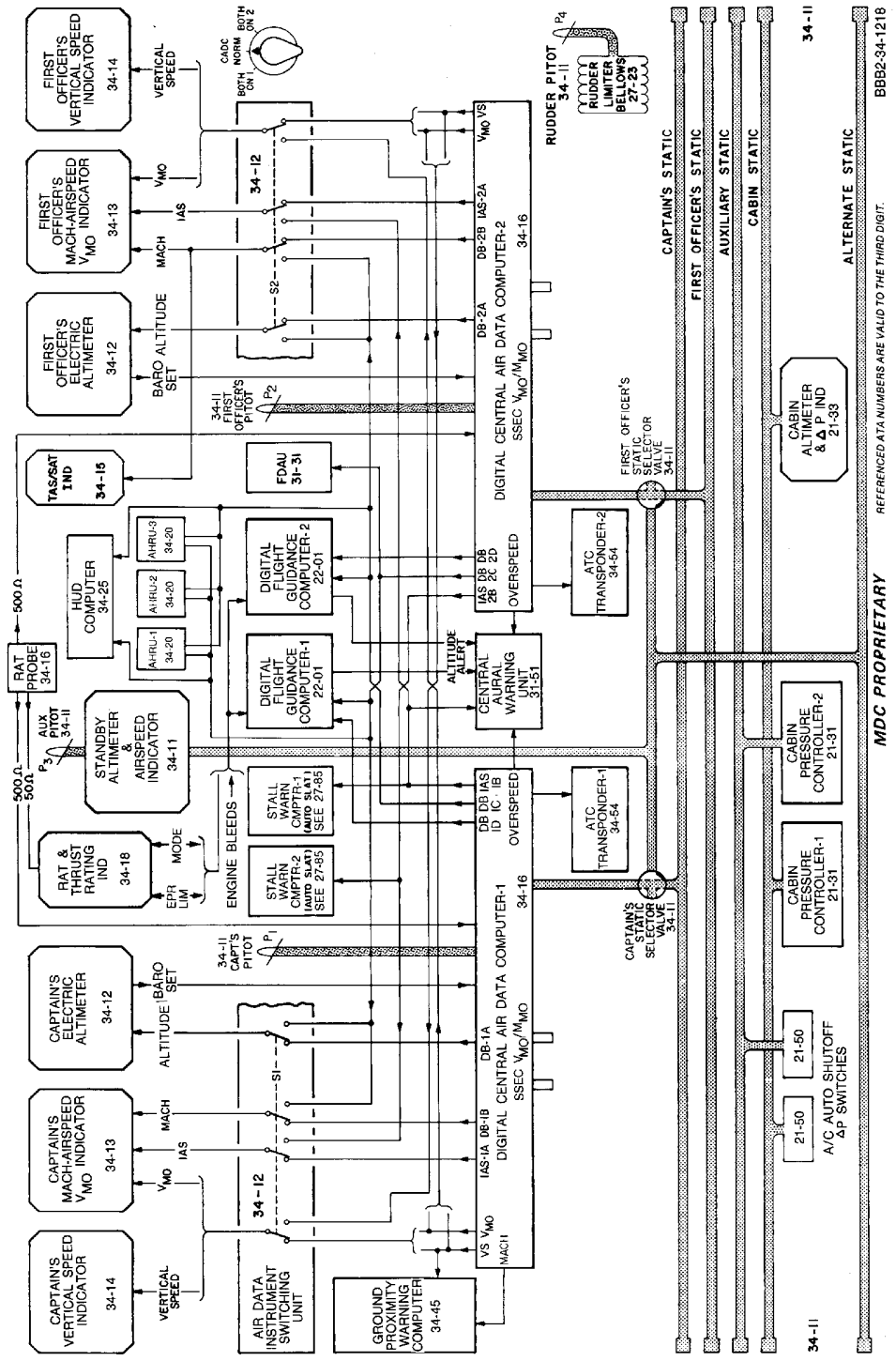
EFFECTIVITY
WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893



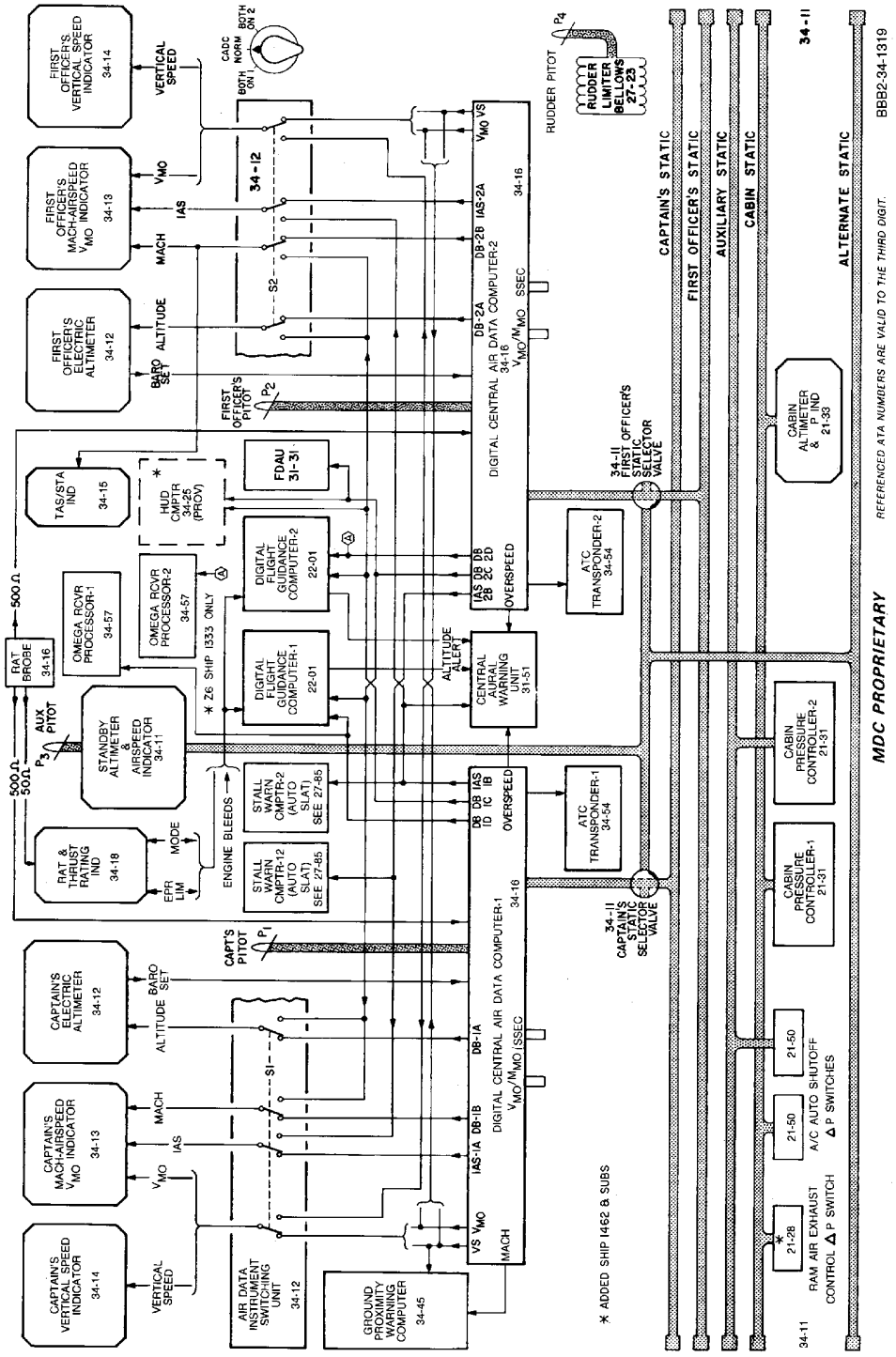
Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 1 of 7)



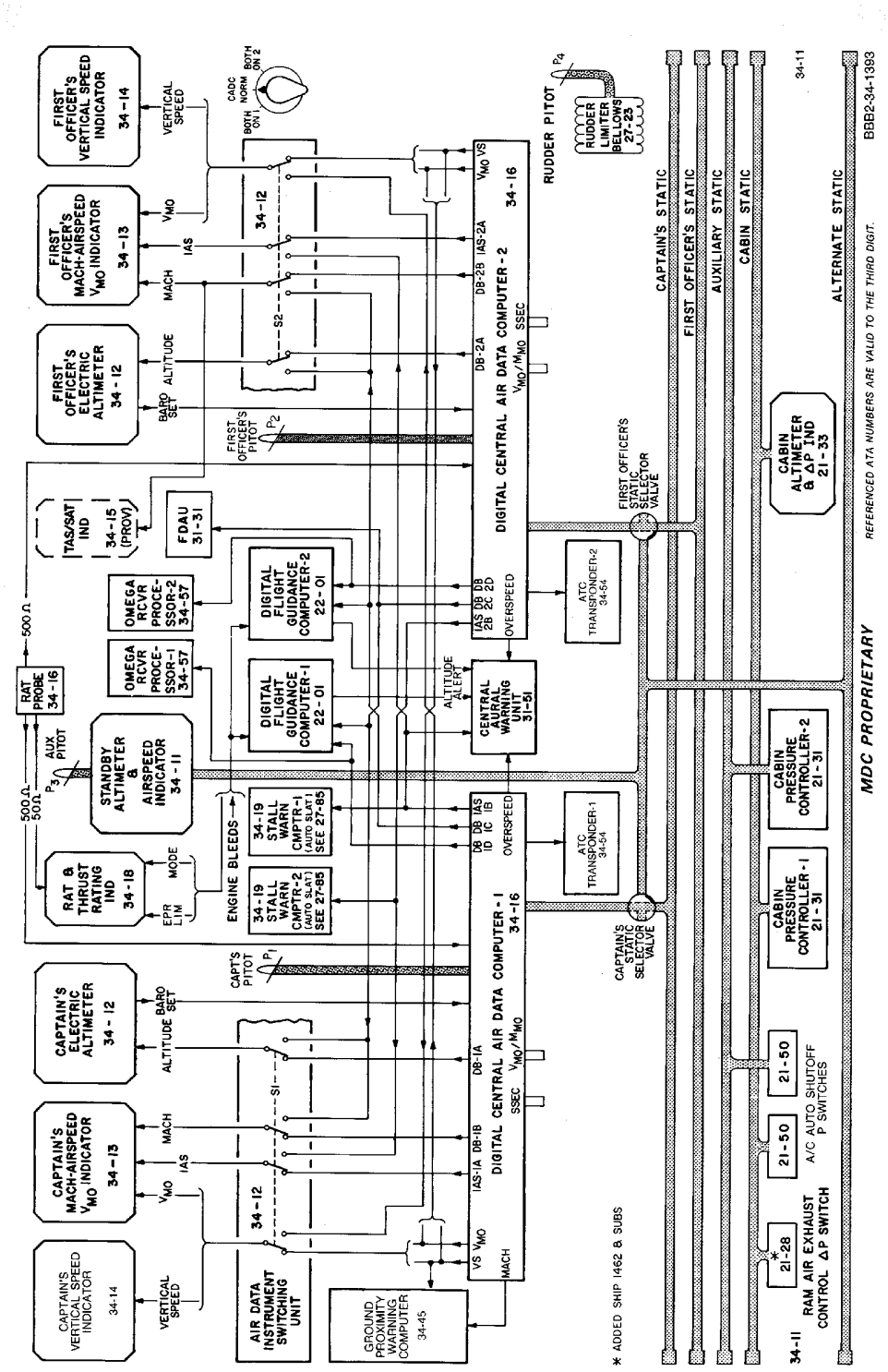
Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 2 of 7)



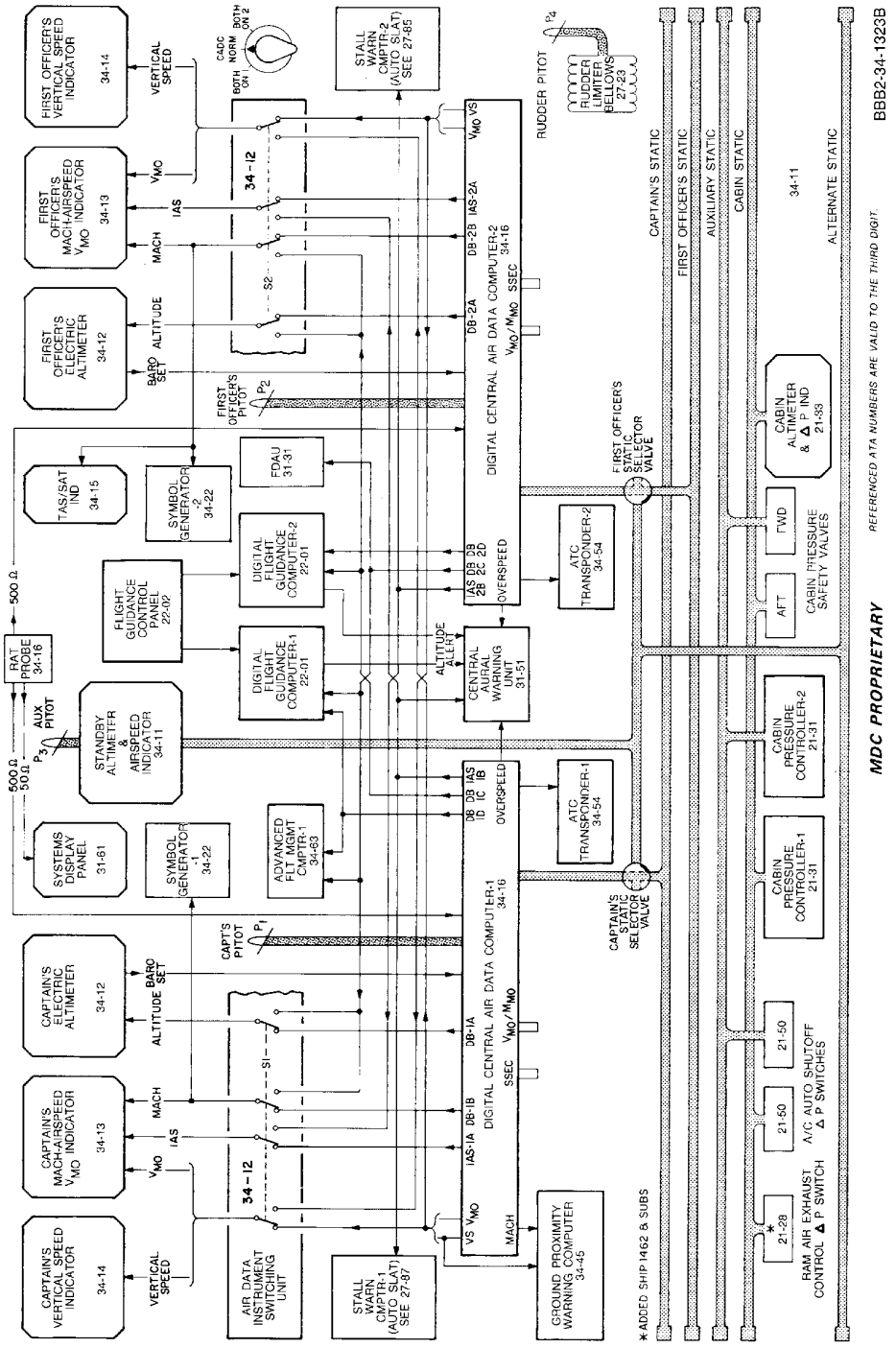
Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 3 of 7)



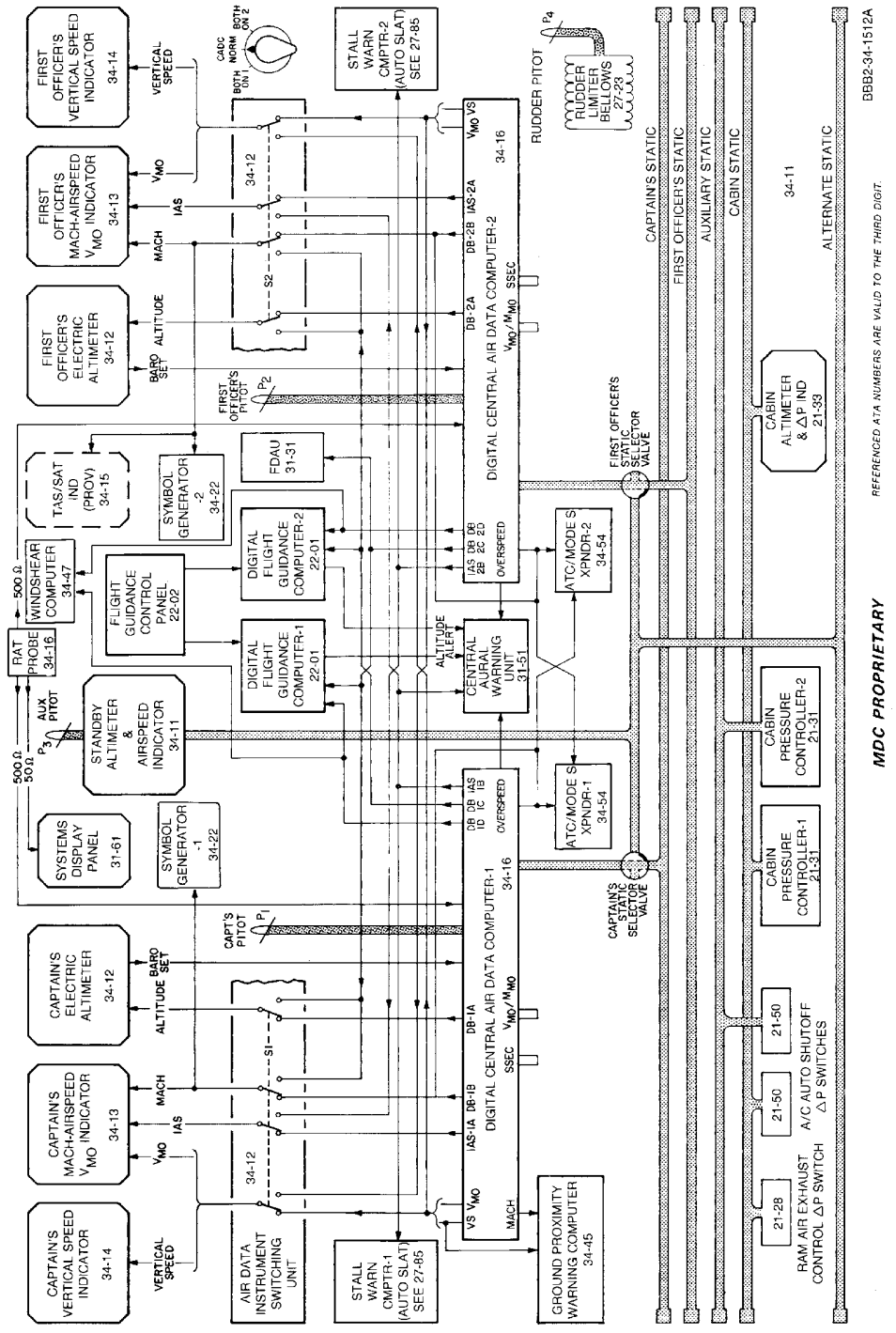
Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 4 of 7)



Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 5 of 7)



Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 6 of 7)



Air Data System - Block Diagram
Figure 2/34-16-00-990-806 (Sheet 7 of 7)

AIR DATA COMPUTING - DESCRIPTION AND OPERATION

1. Description

WJE 406

A. Air Data Computing is accomplished by two Central Air Data Computers. The computers receive dynamic inputs from the Pitot systems, Static systems, and the Ram Air Temperature Probe. Computed air data is provided to the following using equipment: Primary Mach/Airspeed Indicators, Vertical Speed Indicators, Altimeters, Ram Air Temperature/Thrust Rating Indicator, True Airspeed/ Static Air Temperature Indicator, Attitude and Heading Reference Units, Central Aural Warning system, ATC Trans-ponders, Flight Data Acquisition Unit, and the Digital Flight Guidance Computers. The mathematical computations necessary to obtain the desired air data are performed by the computer software. The computed output information is presented as analog discrete and digital voltages representing altitude, airspeed, altitude rate temperature, mach and validity signals. Built-in test provides continuous monitoring of the computer during in-flight operation and initiates failure output signals for invalid test results. In addition, self-test capability is provided. The self tests are actuated during line maintenance by CADC front panel controls or remote self test tool.

WJE 401-404, 412, 414, 875-879

B. Air Data Computing is accomplished by two Central Air Data Computers. The computers receive dynamic inputs from the Pitot systems, Static systems, and the Ram Air Temperature Probe. Computed air data is provided to the following using equipment: Primary Mach/Airspeed Indicators, Vertical Speed Indicators, Altimeters, True Airspeed/Static Air Temperature Indicator, Inertial Reference Units, Central Aural Warning system, ATC Transponders, Flight Data Acquisition Unit, and the Digital Flight Guidance Computers. The mathematical computations necessary to obtain the desired air data are performed by the computer software. The computed output information is presented as analog discrete and digital voltages representing altitude, airspeed, altitude rate temperature, mach and validity signals. Built-in test provides continuous monitoring of the computer during in-flight operation and initiates failure output signals for invalid test results. In addition, self-test capability is provided. The self tests are actuated during line maintenance by CADC front panel controls or remote self test tool.

WJE 401-404, 406, 412, 414, 875-879

C. Central Air Data Computer (CADC). The CADC is a solid state device of modular construction, consisting of two pressure sensitive transducer modules, plug-in printed circuit cards, a power supply module, and a chassis assembly. The front panel contains a fault isolation test connector for off-airplane trouble shooting, air fittings for static and pitot pressure connectors, a function selector switch, press to test switch, a VALID WHEN ON light, and FAILURE HISTORY lights. Three electrical connectors mounted in the back of the chassis provide interconnections with the airplane wiring.

D. The dual CADC installation utilizes two line replaceable CADC units installed on the radio rack in the electrical/electronics compartment. The units are mounted on sliding racks by means of camlocking handles and rear hold-down alignment pins.

E. CADC instrument switching is provided by a CADC Selector switch located on the overhead panel. With the switch in NORM, CADC-1 outputs are to Captain's air data instruments and CADC-2 to First Officer's. With the switch in BOTH ON 1, outputs to both Captain's and First Officer's instrument systems are on CADC-1. With switch in BOTH ON 2, Captain's and First Officer's instrument systems are on CADC-2.

F. Central Air Data Computer inputs are as follows:

(1) Static pressure (Ps) is applied via pneumatic lines from the airplane static ports.

(2) Total pressure (Pt) is applied via pneumatic lines from the aircraft pitot tubes.

(3) Total air temperature (RAT) voltage is applied as a resistance bridge input from the Ram air temperature sensor.

(4) Barometer setting (BARO SET) voltage is applied from the wiper of a three wire potentiometer connection with the altimeter.

(5) Altitude hold, mach hold, computed air speed hold, enable voltages are applied in one of two electrical states for computer circuitry selection. ATC enable ground is supplied through airplane wiring.

(6) Airplane SSEC and VMO data inputs are set into the computer by connecting certain computer electrical connector pins together through airplane wiring.

(a) Desired maximum operating airspeed (Vmo) characteristics are provided by programmed inputs selected by jumper wire connections.

(b) Static source error correction (SSEC), to correct for static source errors, is provided by programmed inputs selected by jumper wire connections.

G. Central Air Data Computer outputs are as follows:

(1) Serial Digital outputs from four digital buses.

(a) Uncorrected pressure altitude (Hpu).

(b) Barometric corrected pressure altitude (Hpc).

(c) Pressure altitude (Hp) rate.

(d) Computed airspeed (CAS).

(e) Maximum allowable airspeed (Vmo).

NOTE: Maximum allowable airspeed is a function of altitude and airplane configuration. In order to provide fully interchangeable Central Air Data Computers the airspeed envelope is programmed by utilizing jumpers installed in the airplane wiring.

(f) Mach (M).

(g) True airspeed (TAS).

(h) Static air temperature (SAT).

(i) Ram air temperature (RAT).

(2) Parallel digital output, air traffic control altitude (Hatc), from a ten-bit encoding circuit (ten wires plus one common) is provided to the Air Traffic Control (ATC) transponders.

(3) Analog outputs.

NOTE: The computer analog output circuits interface with equipment and indicators of an analog nature. The output circuits utilize electrical components in a manner to simulate a voltage ratio electro-mechanical device.

(a) Computed airspeed outputs are 3 wire DC amplified signals and receive information up-date eight times per second.

(b) Maximum airspeed output is 2 wire DC amplified signals and receives information up-date two times per second.

(c) Mach output is a 3 wire DC amplified output signals and receives information up-date eight times per second.

(d) Altitude rate output is a 3 wire DC amplified output signals and receives information up-date 16 times per second.

(e) Computed airspeed, altitude, and mach hold outputs are provided as dc ± voltage ratio.

(4) Failure warning voltages for the operation of mach, computed airspeed, and uncorrected pressure altitude flags and maximum allowable airspeed aural warning are provided as dc discrete outputs.

H. Built-in Self Test. The built-in test capability of the CADC also provides for ground crew initiated self tests which effectively verify the operational status of the computer during line maintenance. The CADC self-test feature is also utilized as a test signal source when verifying the operation of using systems and indicators. The three self tests consist of a function test, a delta (change) test, and a failure warning test. The self tests are controlled by the MODE SELECT switch and the PUSH TO TEST switch located on the CADC front panel (Figure 1). The MODE SELECT switch is rotated to the desired test position and the PUSH TO TEST switch is pushed and held to operate. The tests operation and indications are as follows:

(1) Function TEST. The function test verifies the Analog/ Digital and Digital/Analog converter, central processor, digital output section, Input/Output control, analog output, clock, power supply, and portions of the Maximum Allowable Airspeed and Static Source Error Correction circuitry. During the function test the central processor receives a zero degree centigrade signal from the Analog/Digital converter and receives fixed Ps and Pt values from the memory, computes, and transmits the air data outputs.

(2) Function TEST. With the MODE SELECT SWITCH in FUNCTION TEST, BARO Set to 29.92 HG and pressing the CADC PUSH TO TEST Switch, Value indications on the applicable instruments will denote the following correct operations of the CADC:

(a) Uncorrected Pressure Altitude

(b) Mach

(c) Total (RAM) Air Temperature

(d) Baro Corrected Pressure Altitude (No Correction of 29.92" Hg)

(e) Knots, Computed Airspeed

(f) Static Air Temperature

(g) Knots, True Airspeed

(h) Feet per minute Pressure Altitude Rate

(i) Knots, Maximum Allowable Airspeed

(j) Zero delta (ratio = 0.5) Delta Pressure Altitude, Delta Mach, and Delta Computed Airspeed

(k) Failure warning flags do not show for Analog Uncorrected Altitude, Computed Airspeed, and Mach

(l) Overspeed aural warning sounds (CAS 7 VMO)

(3) Delta TEST. Delta test output indications are:

(a) Ambient altitude +100 feet Uncorrected Pressure Altitude

(b) Ambient Mach (+0.05)

(c) Ambient air temperature for Total (Ram) Air Temperature

(d) Ambient altitude + baro set input correction +100 feet Baro Corrected Altitude

(e) Ambient Computed Airspeed +30 knots for Computed Airspeed

(f) Ambient air temperature for Static Air Temperature

(g) Ambient rate (plus a transient) for Pressure Altitude Rate

(h) Ambient true airspeed

(i) Sea level value of maximum allowable airspeed program extrapolated to ambient altitude for Maximum Allowable Airspeed

(j) Failure monitor flags not showing for analog Uncorrected Pressure Altitude, Computed Airspeed, and Mach

(k) Overspeed warning horn silent (unless ambient computed airspeed +16 knots delta value exceeds VMO value).

(4) Failure Warning TEST. The failure warning test verifies the failure warning (discrete) circuits, digital line driver circuits, and portions of the central processor. During the failure warning test the failure warning (discrete) bits in the digital words outputs are set and the failure warning designations are transmitted. The failure warning test output indications are as follows for an operational CADC:

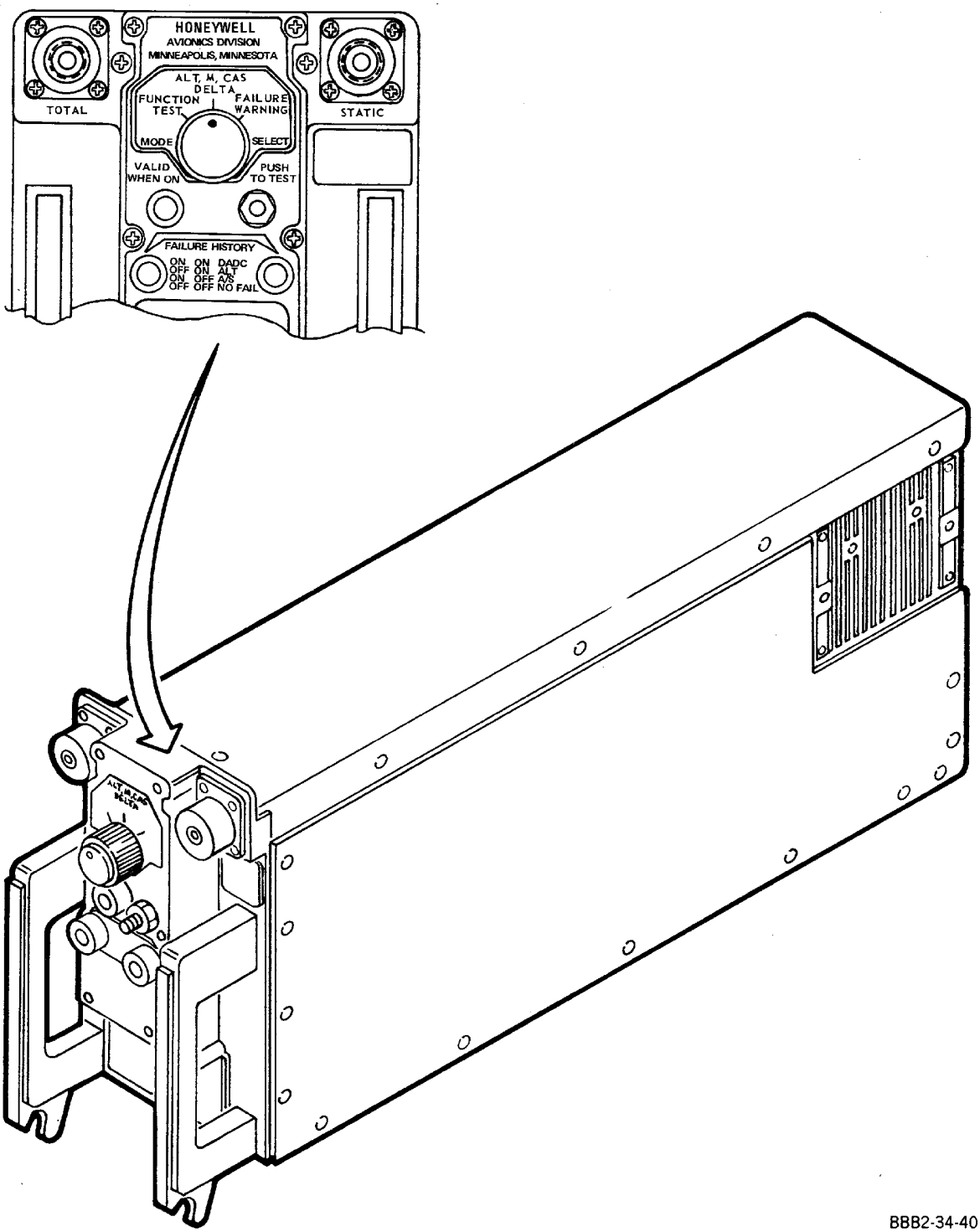
(a) A fail signal is transmitted to all analog and digital output subscribers.

(b) VALID WHEN ON light comes on.

(c) FAILURE HISTORY lights should not come on.

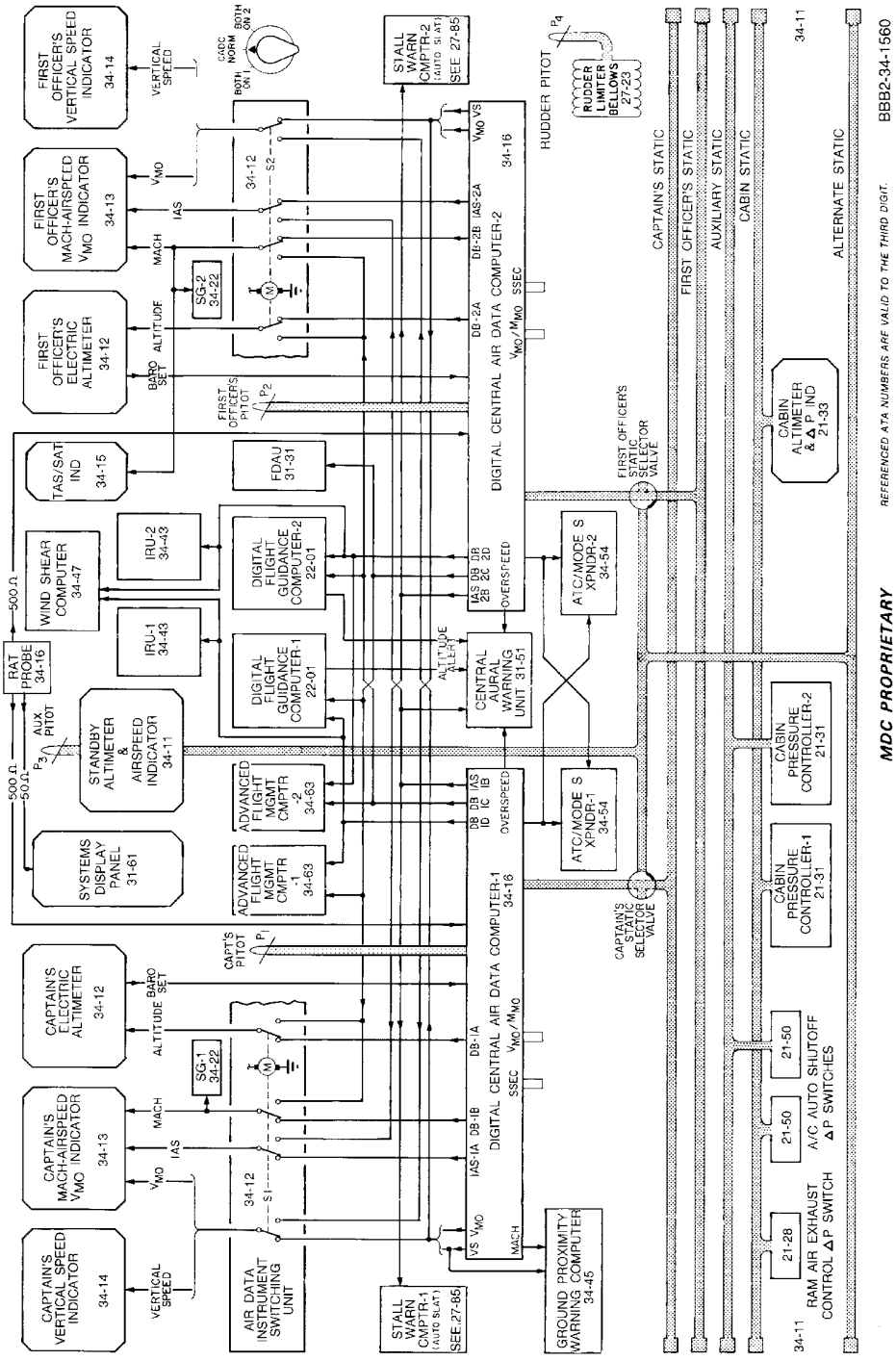
I. To Operate System

(1) With aircraft buses energized and circuit breakers closed, the air data computers are operational.

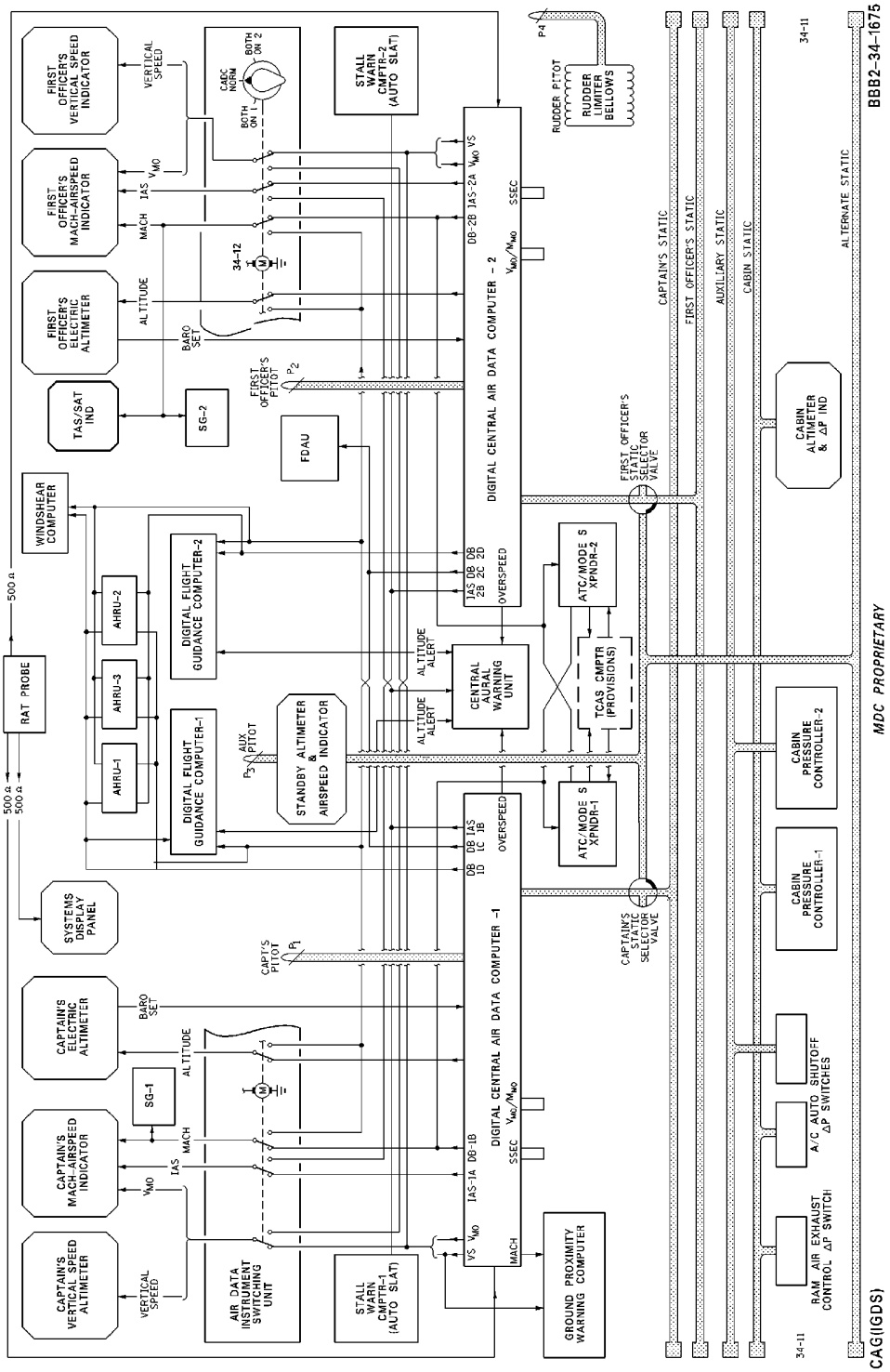


Central Air Data Computer
Figure 1/34-16-00-990-803

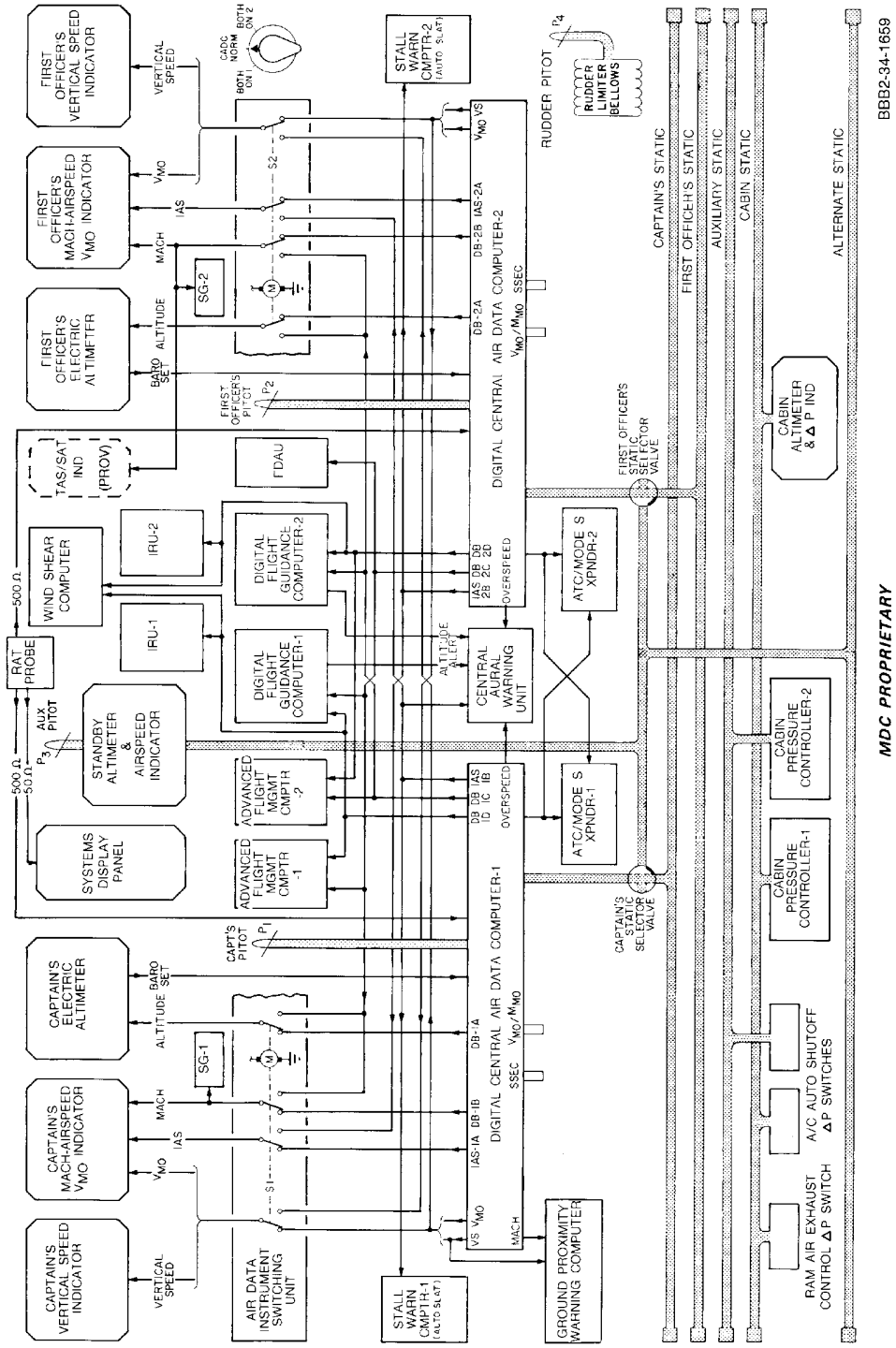
EFFECTIVITY
WJE 401-404, 406, 412, 414, 875-879



Air Data System - Block Diagram
Figure 2/34-16-00-990-804 (Sheet 1 of 3)



Air Data System - Block Diagram
Figure 2/34-16-00-990-804 (Sheet 2 of 3)



Air Data System - Block Diagram
Figure 2/34-16-00-990-804 (Sheet 3 of 3)

AIR DATA COMPUTING - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty air data system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the Air Data Computing system are: Air data computer and ram air temperature probe. The system interfaces with the pitot static system. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The Air Data components are located as follows:

Table 101

Component	Location
Air Data Computers	Radio Racks in Electrical/ Electronics Compartment
Air Data Computer - 1	Overhead Circuit Breaker Panel
Air Data Computer - 2	Upper EPC Circuit Breaker Panel
Ram Air Temperature and Probe Heater	Lower EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Air Data System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

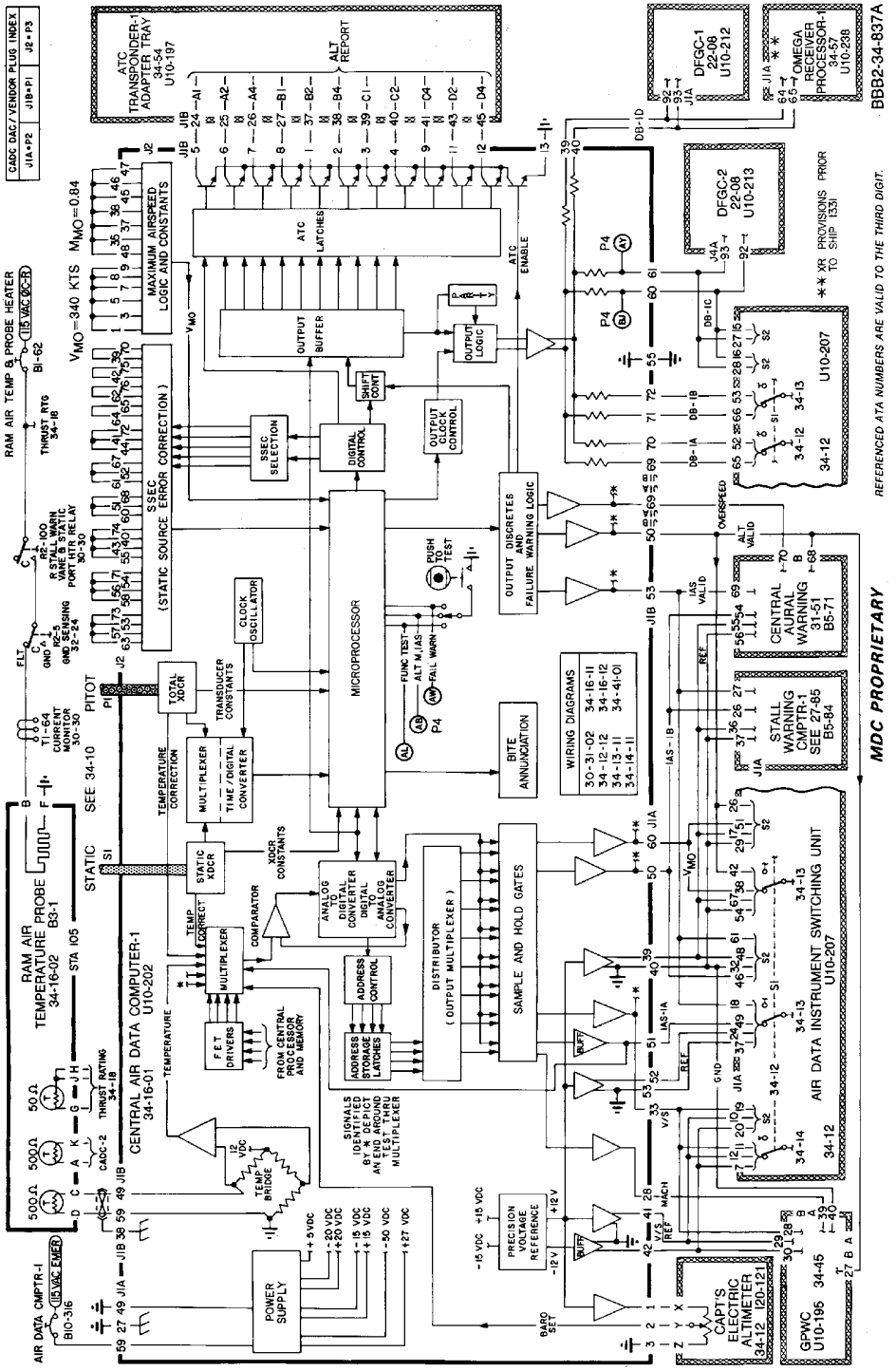
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

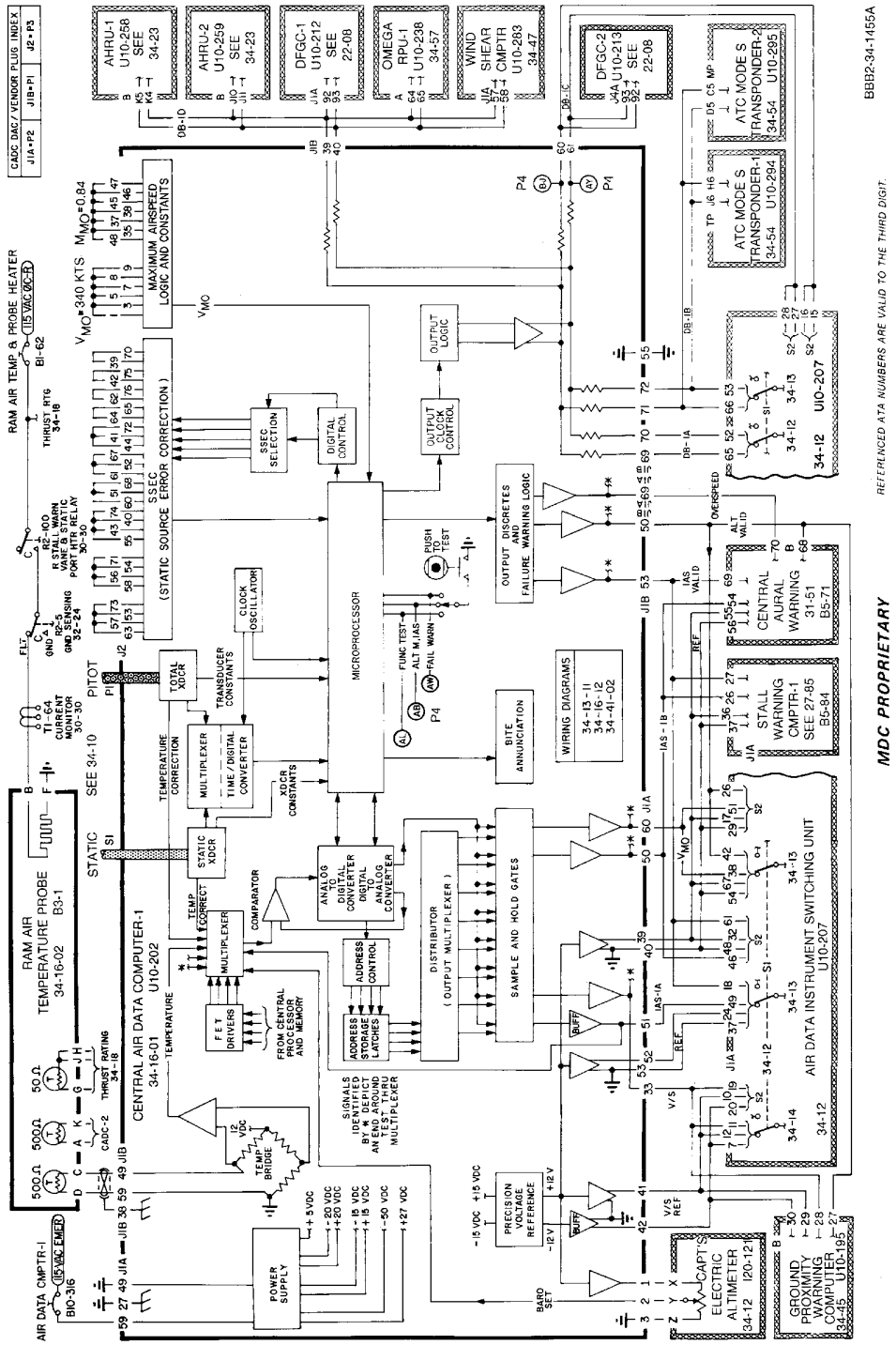
WJE ALL

Table 103

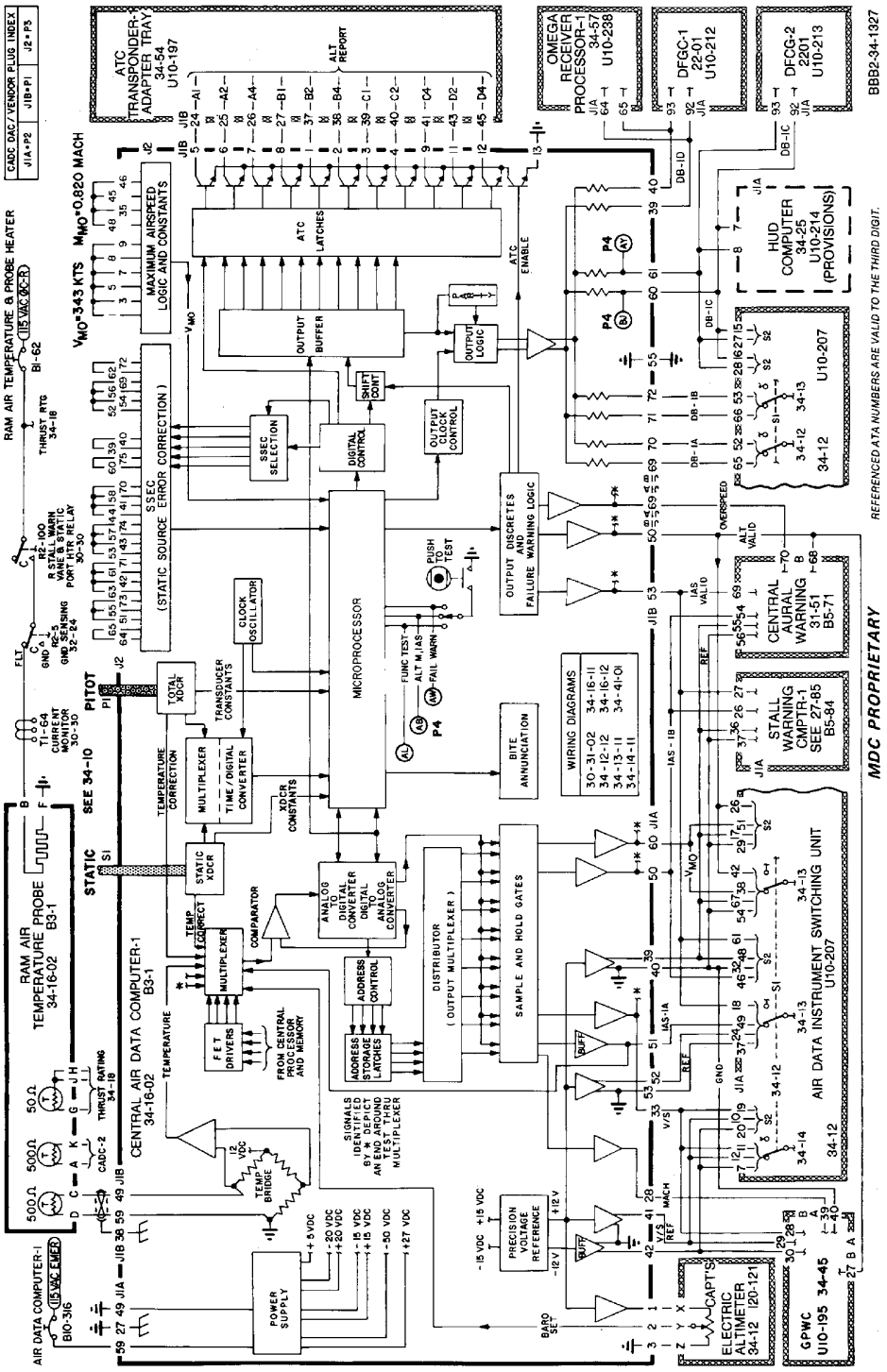
Procedure		Correction
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893		
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at air data computers. (ADC)	Correct main power supply to buses, replace faulty circuit breakers, wires, or ADC.
WJE ALL		
(2)	Check for proper grounds at ADC.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded.
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893		
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
WJE ALL		
(4)	In a dual system, interchange ADCs to establish isolation of faulty LRUs.	Replace faulty ADC.
(5)	Replace suspected faulty ADC or component with a known operational unit.	Replace faulty ADC or components.
(6)	Check for leaks in pitot static system. PITOT STATIC, SUBJECT 34-11-00, Page 201	Replace faulty lines, parts or connections in lines.
(7)	Perform check on ram air temperature probe. PAGEBLOCK 34-16-02/201	Replace faulty ram air temperature probe.
(8)	Perform Return to Service (RTS) test (SUBJECT 22-01-05, Page 201).	



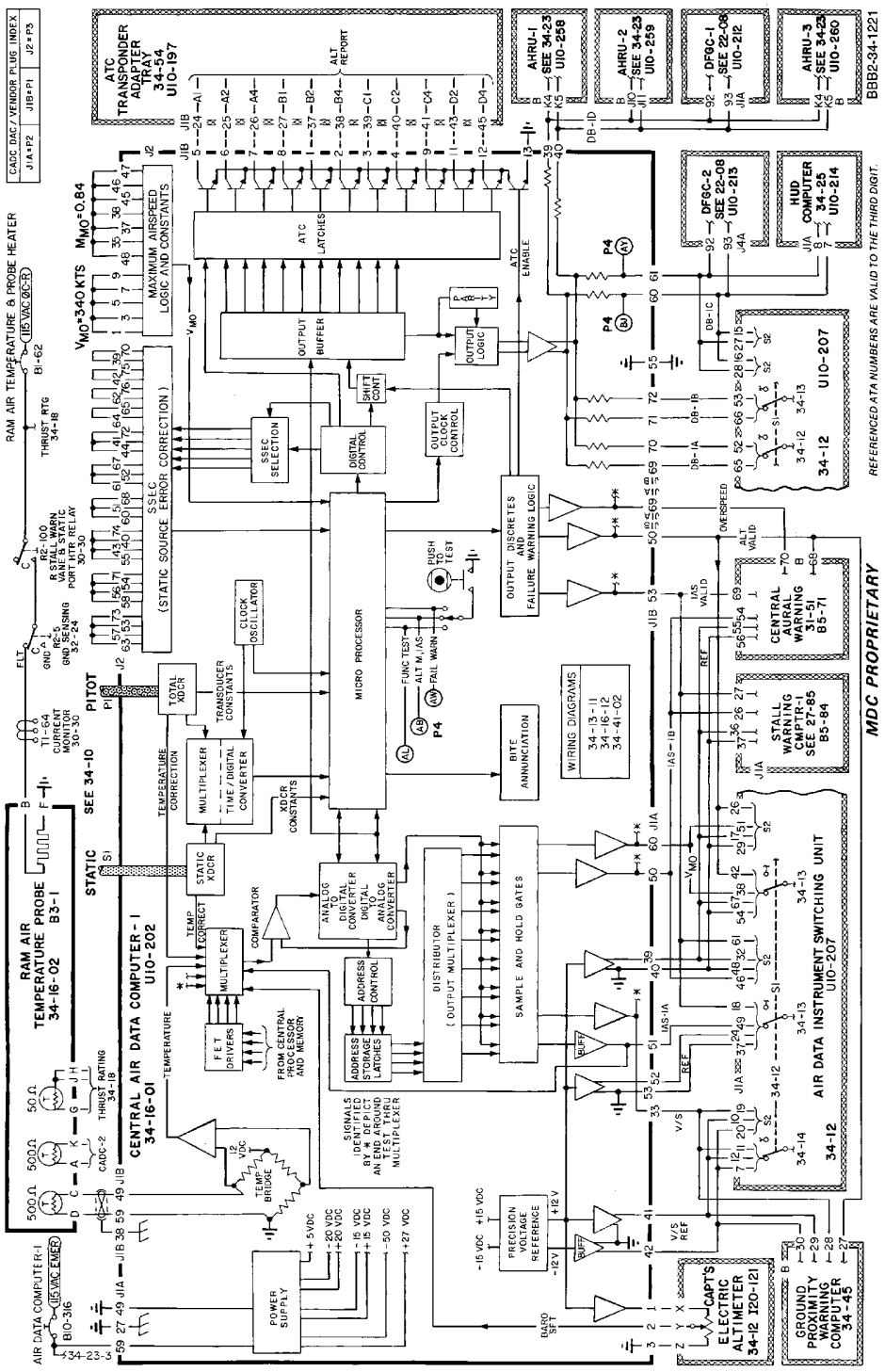
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 1 of 11)



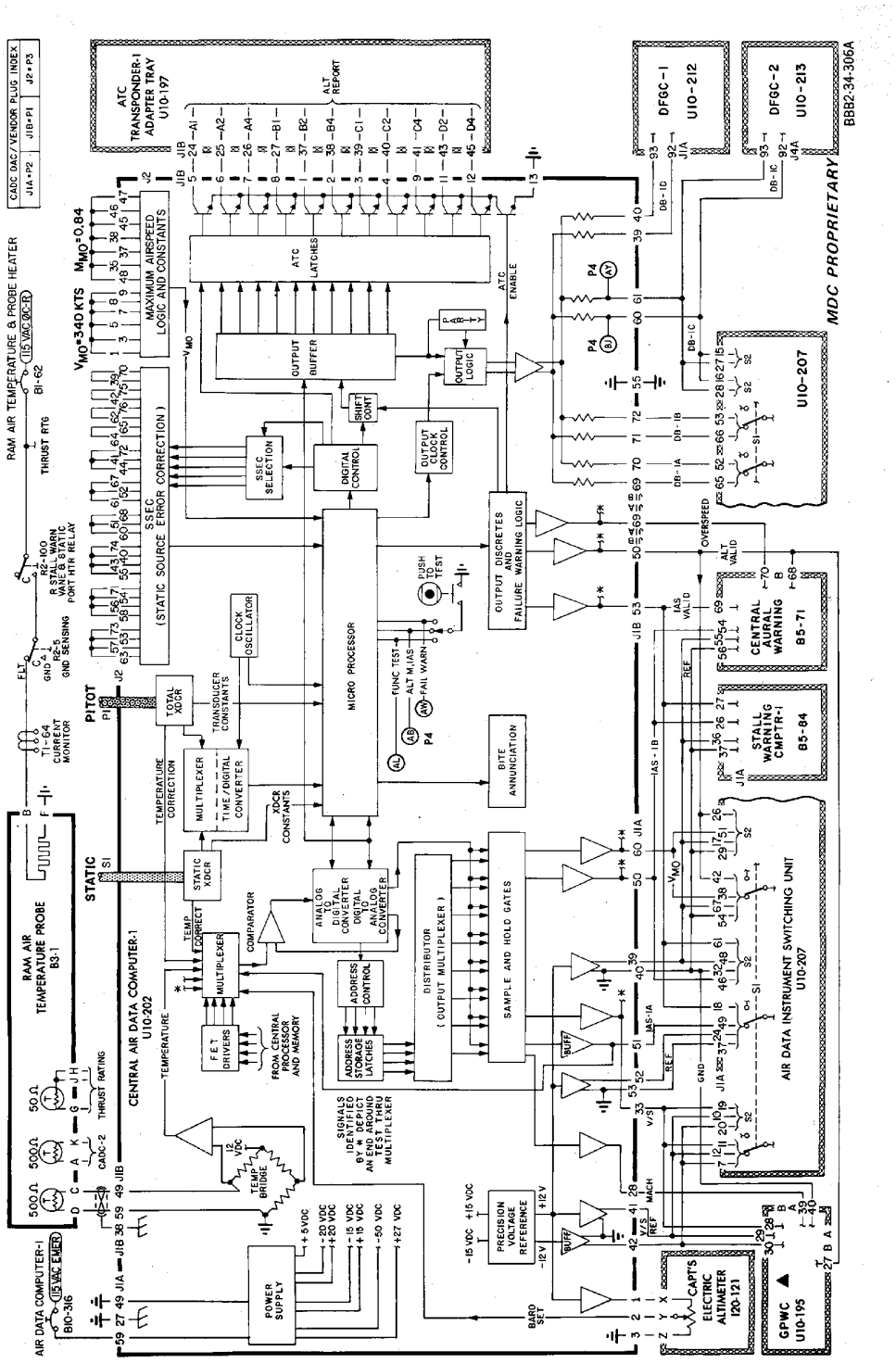
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 2 of 11)



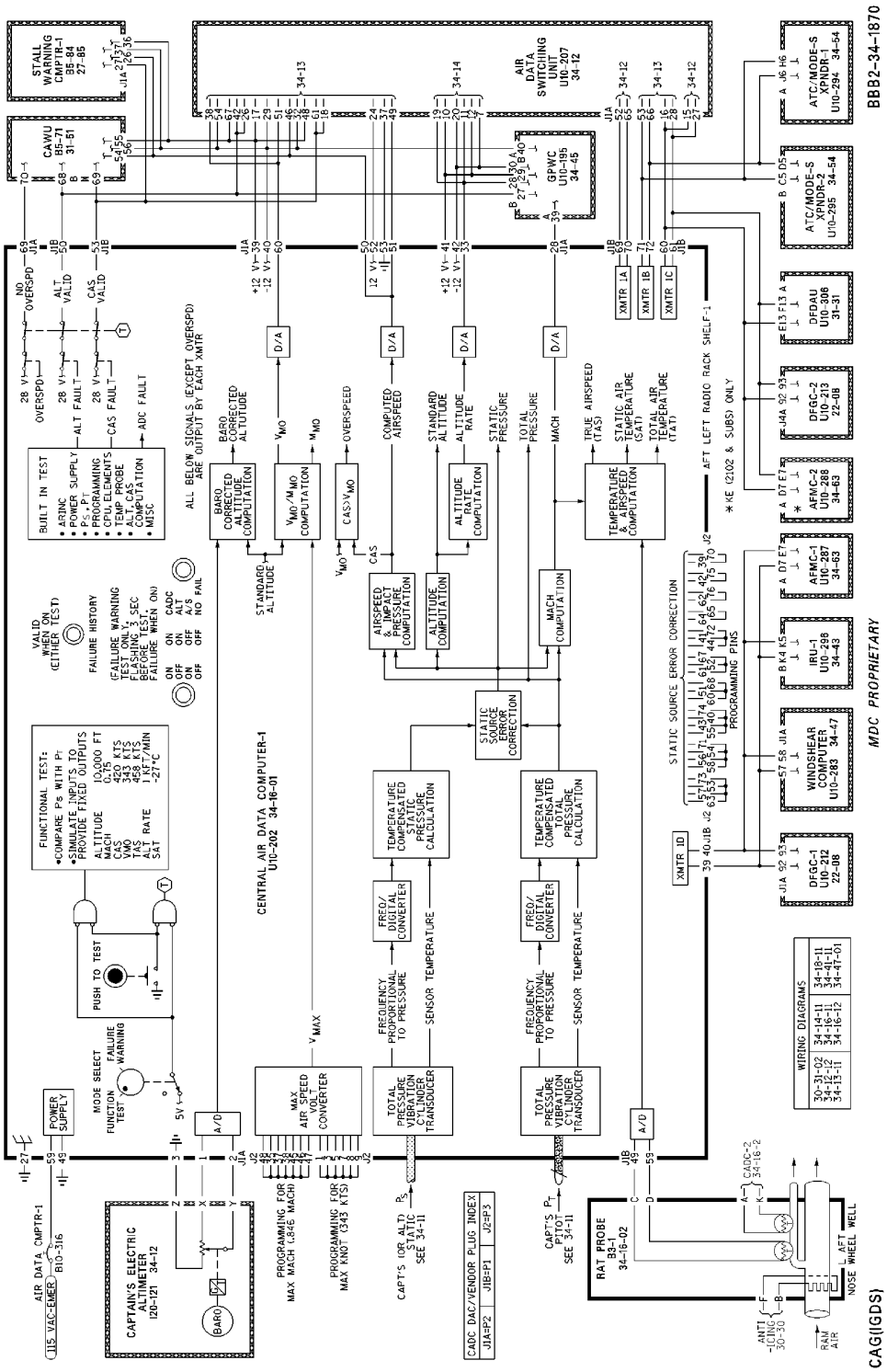
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 3 of 11)



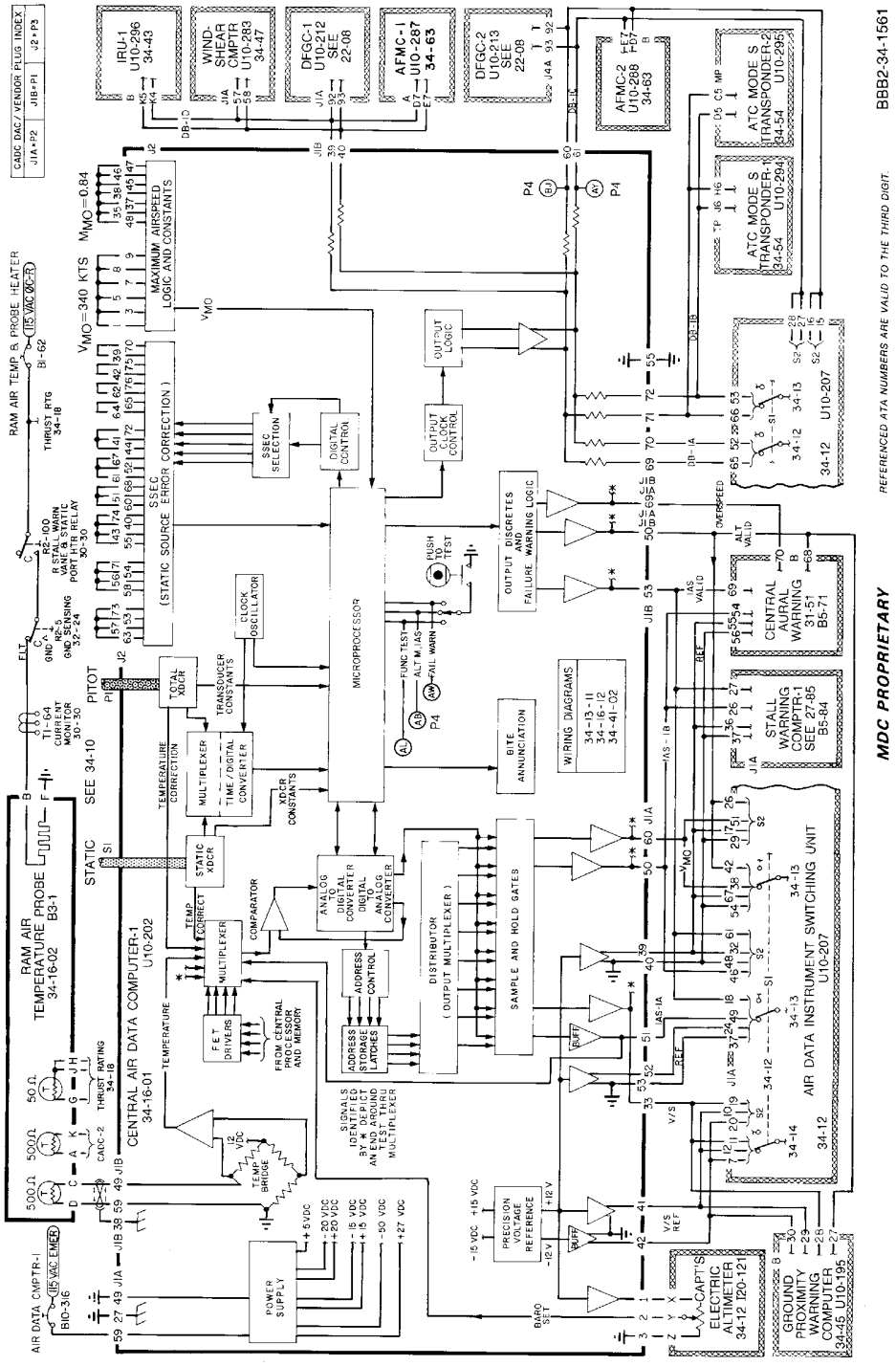
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 4 of 11)



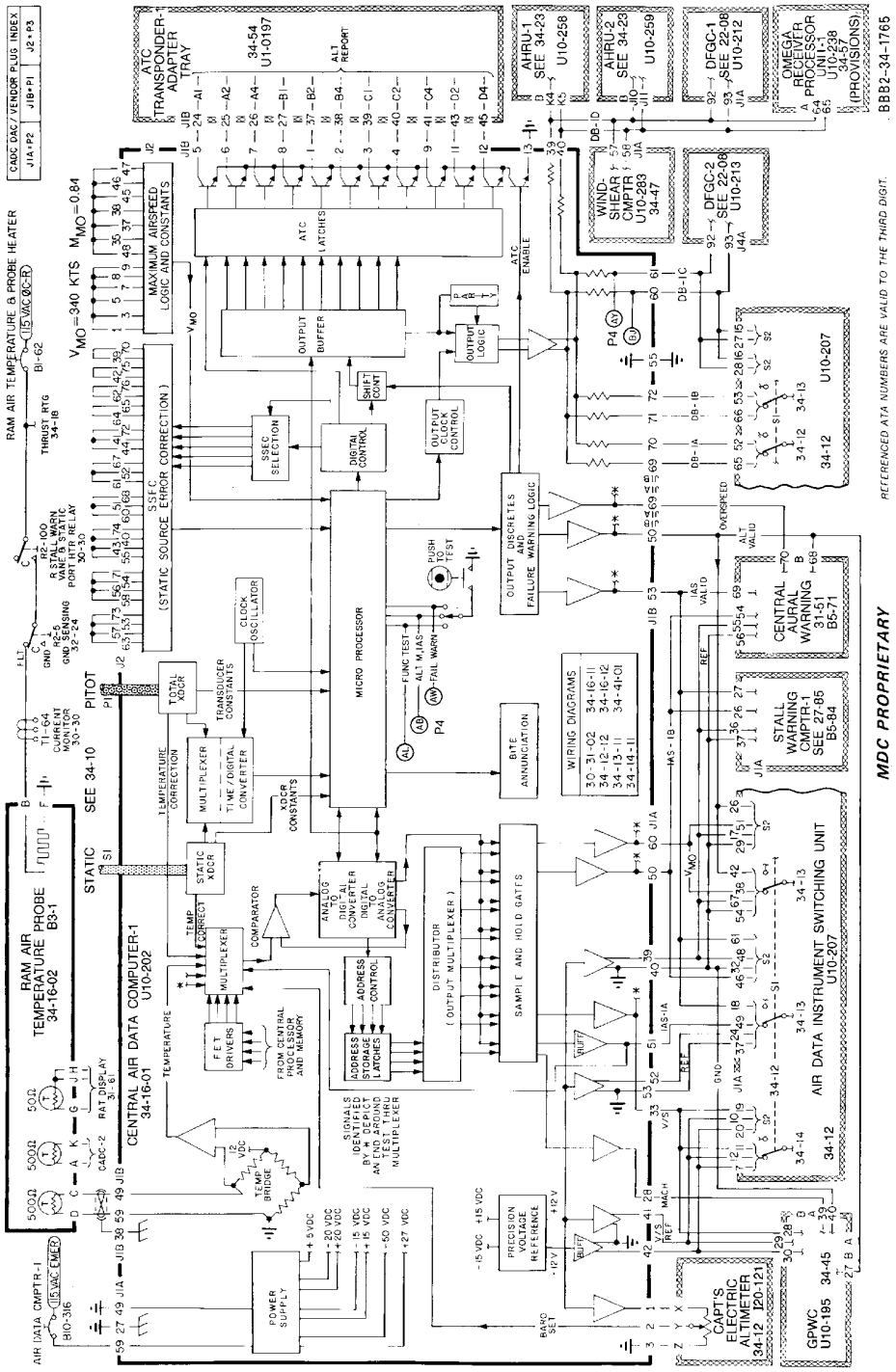
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 5 of 11)



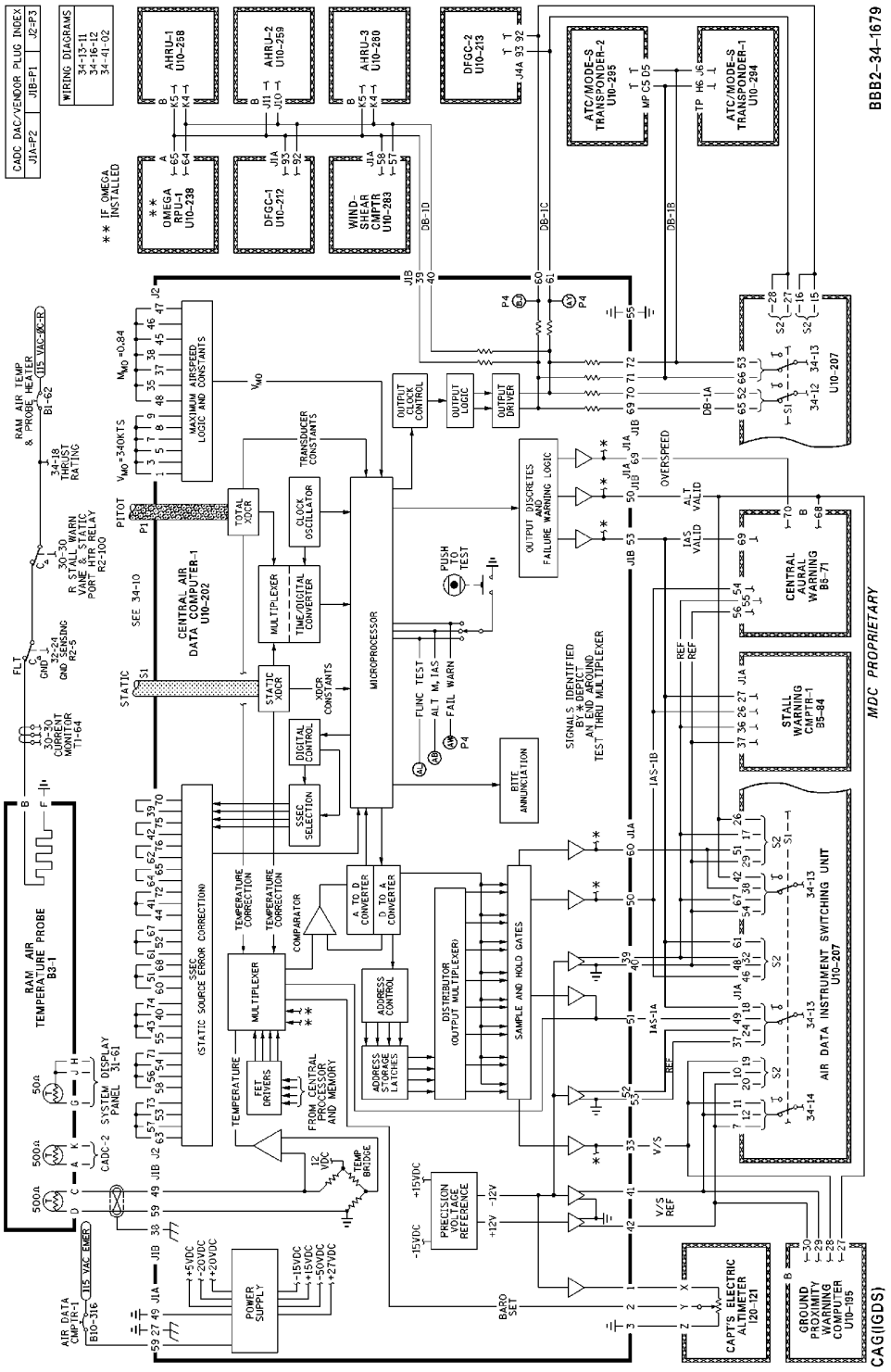
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 6 of 11)



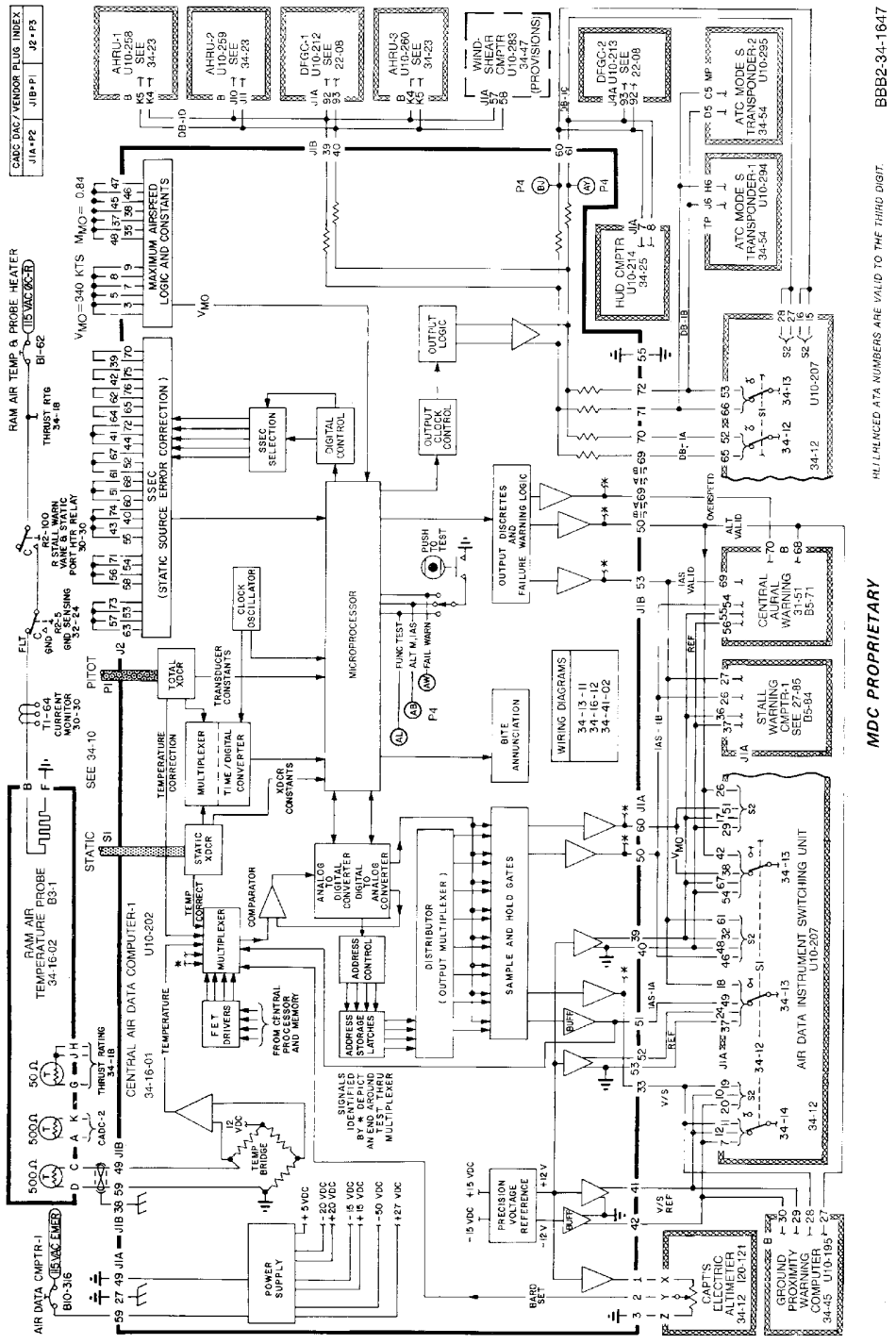
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 7 of 11)



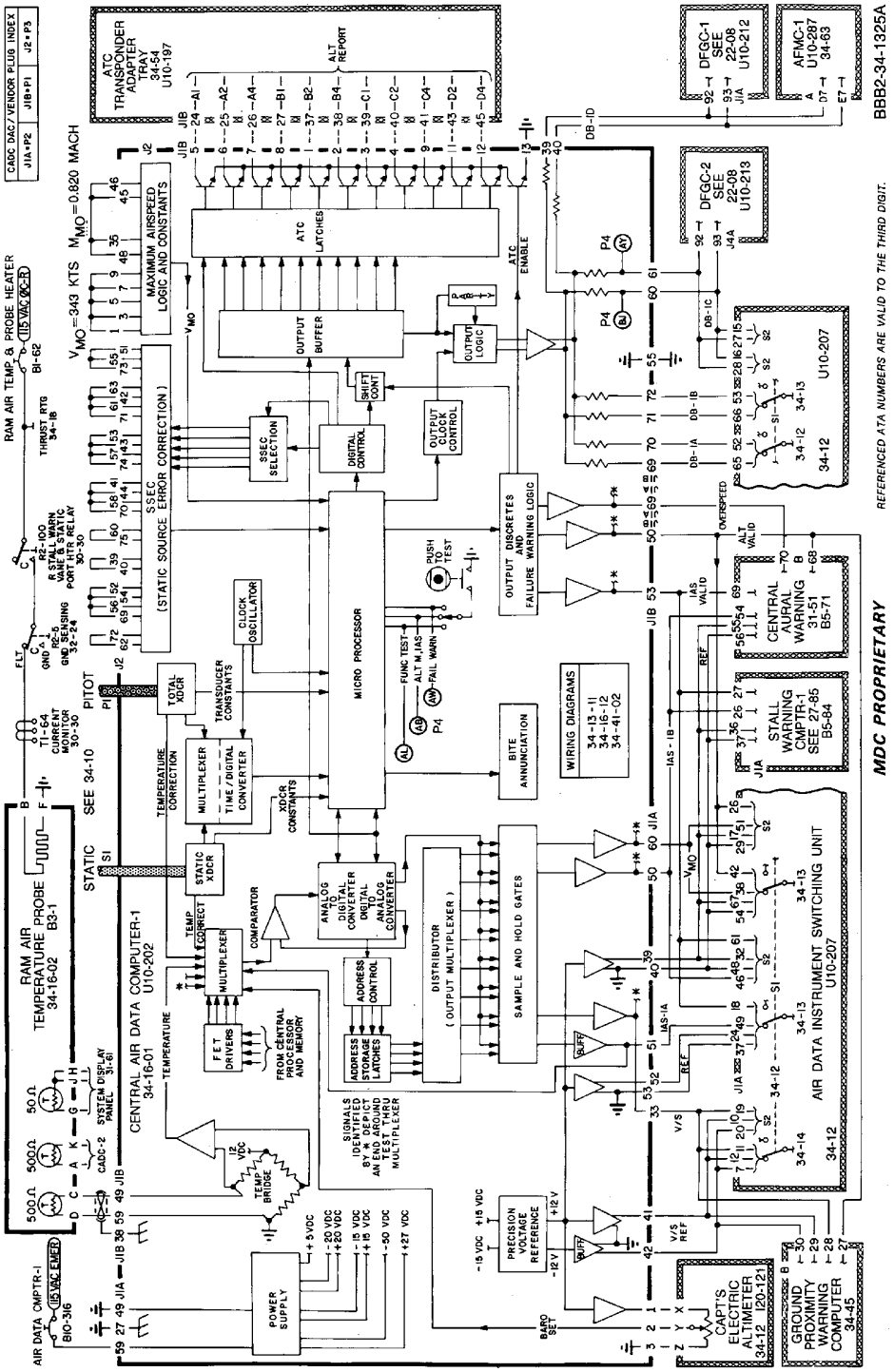
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 8 of 11)



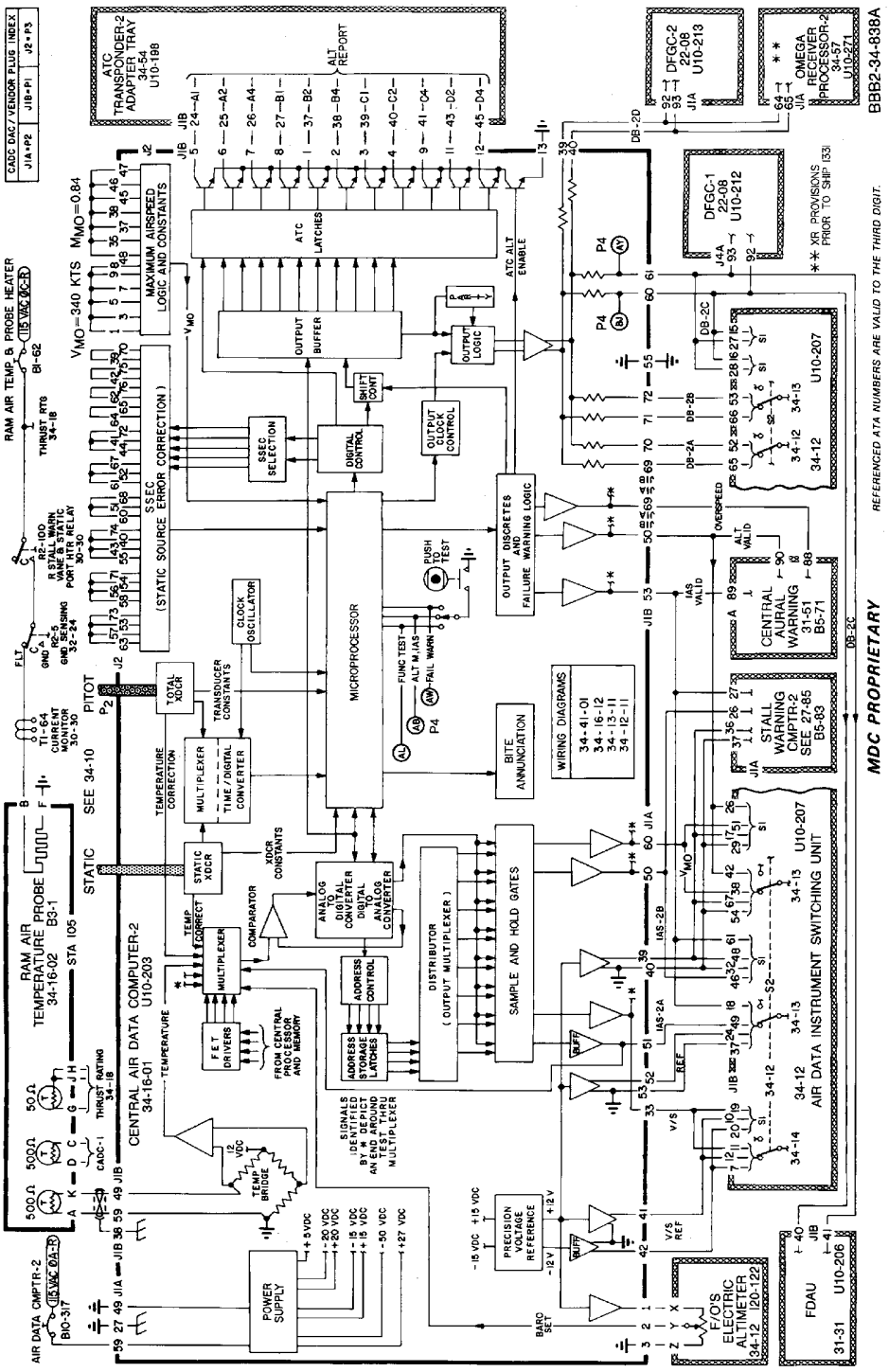
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 9 of 11)



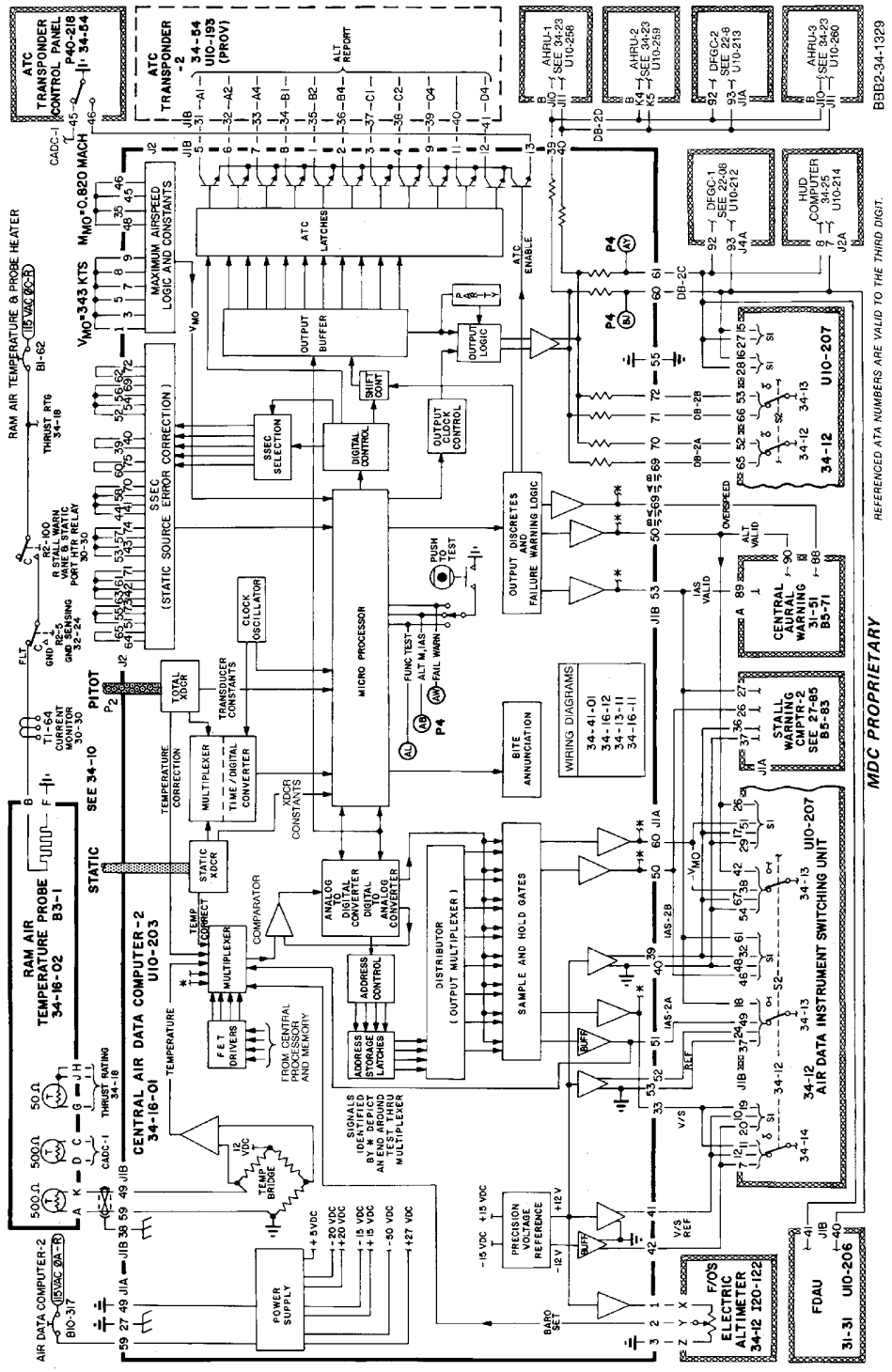
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 10 of 11)



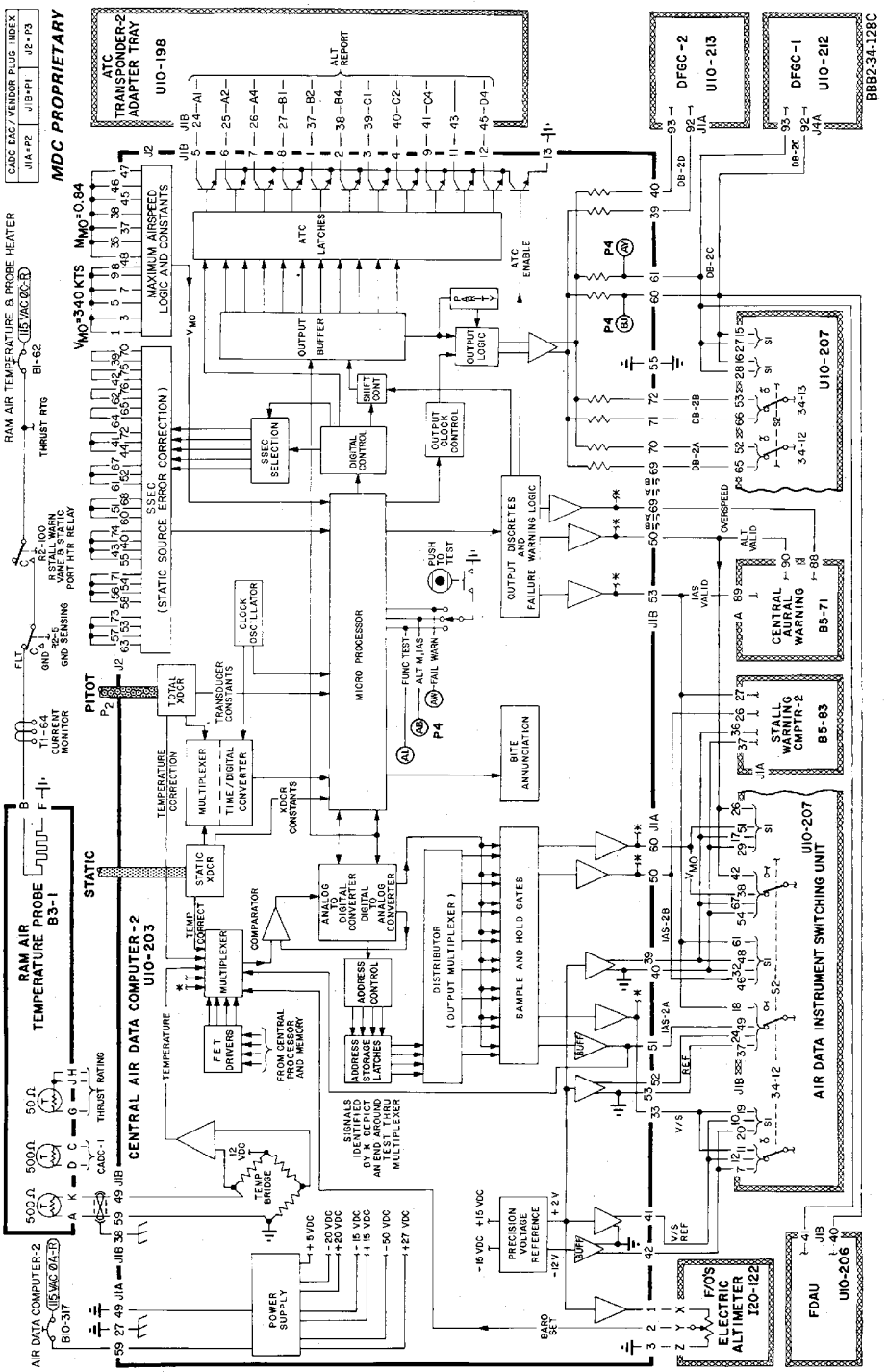
Air Data Computer-1 - Schematic
Figure 101/34-16-00-990-807 (Sheet 11 of 11)



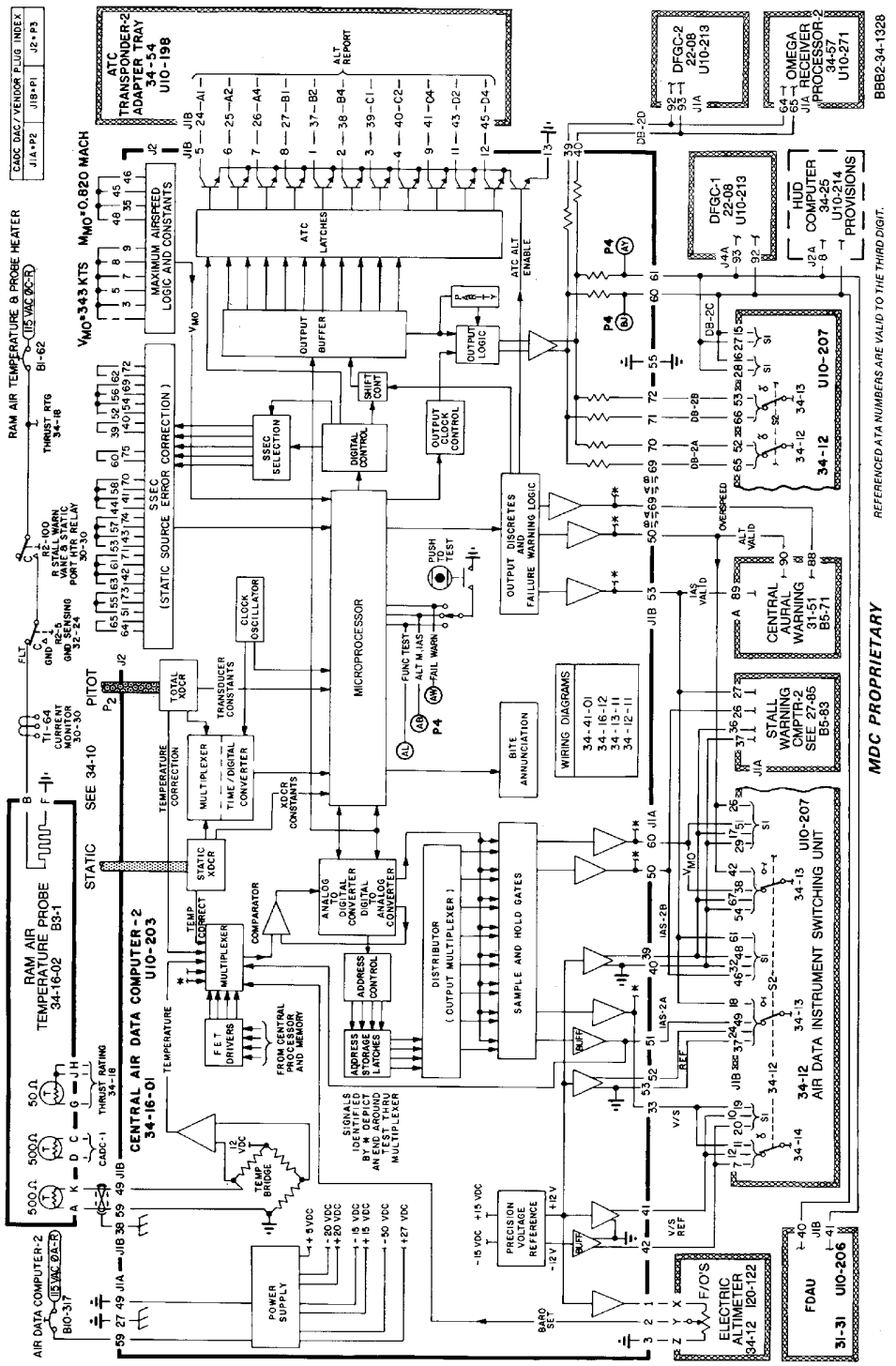
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 1 of 11)



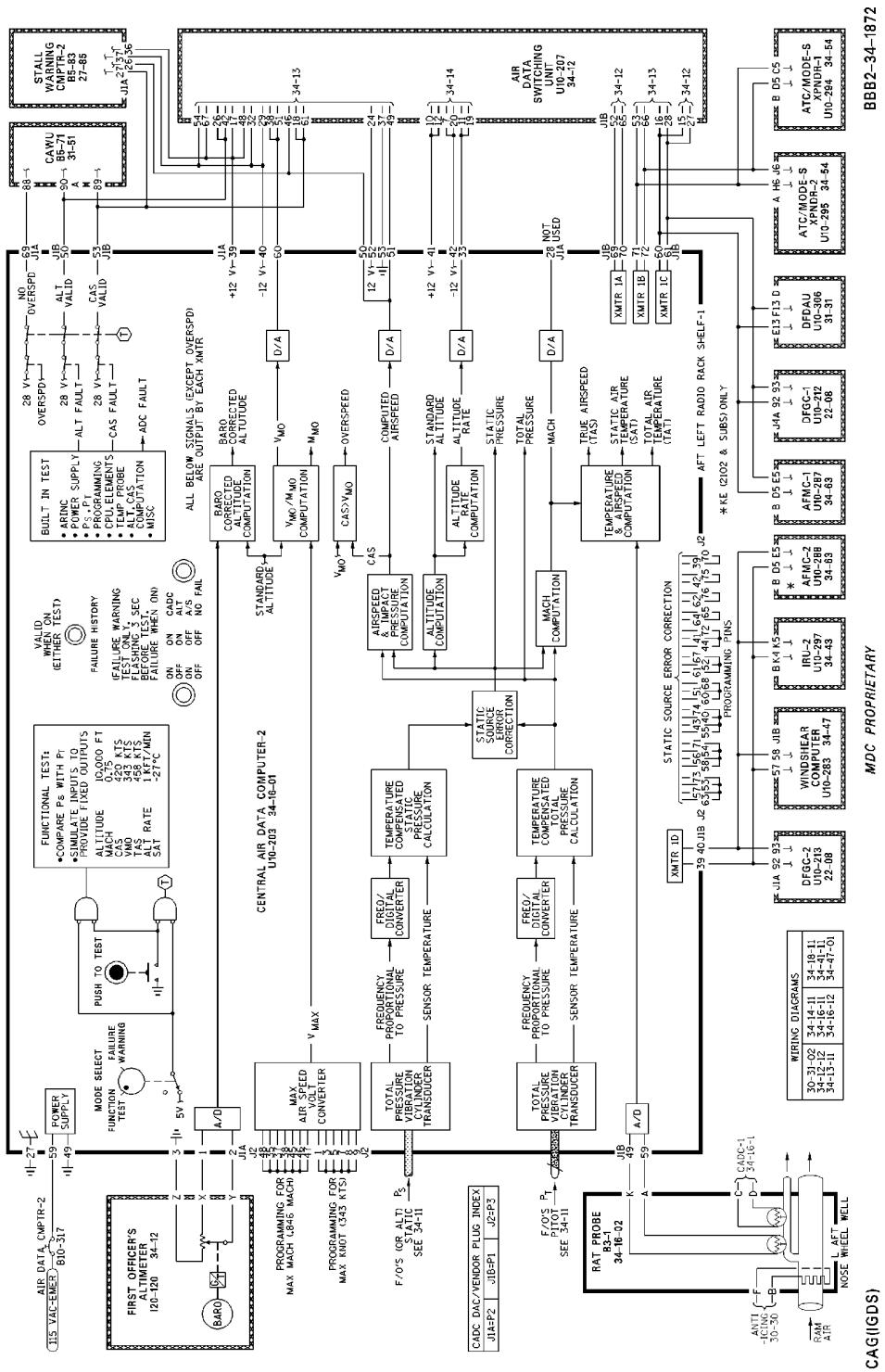
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 2 of 11)



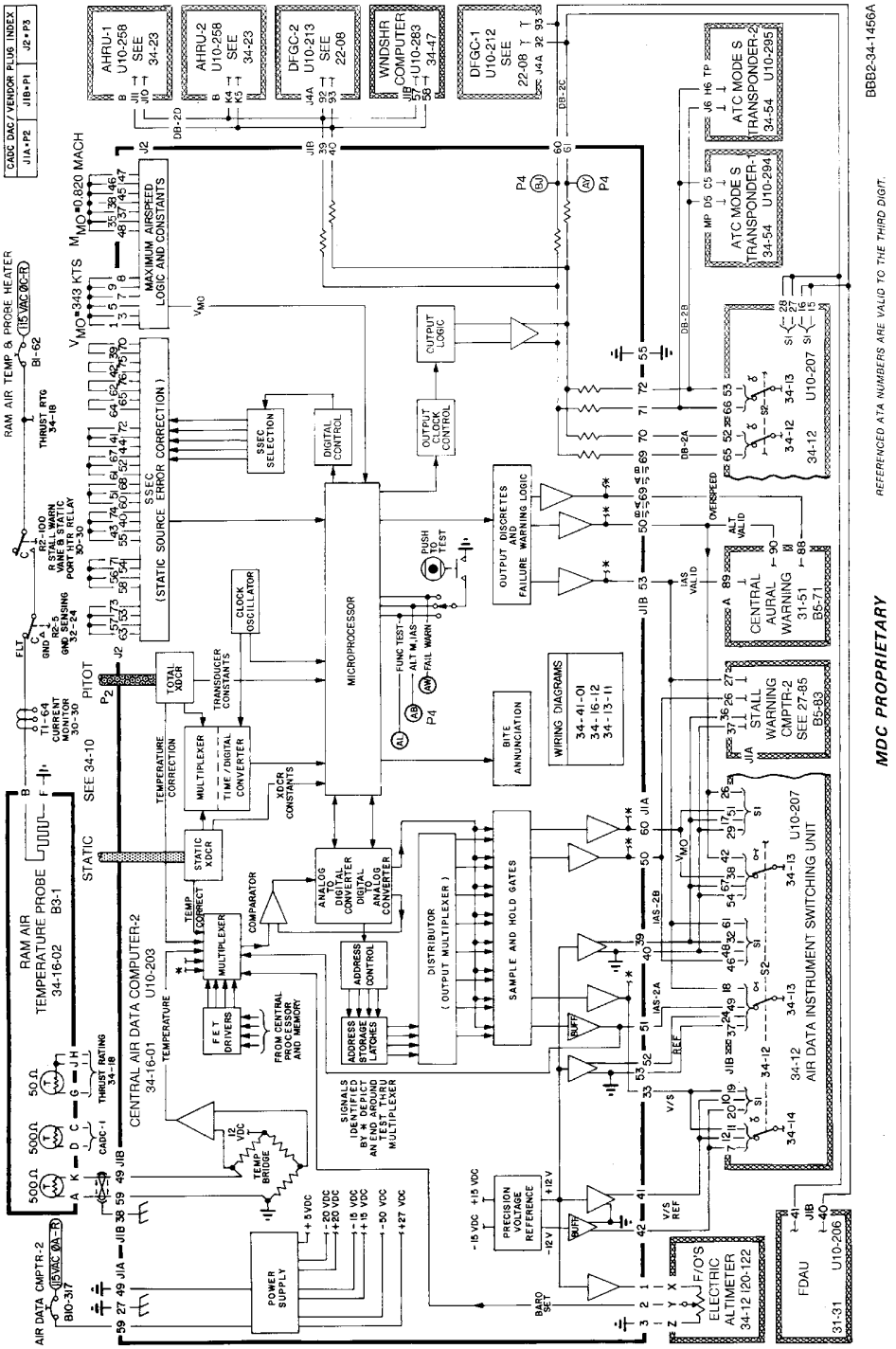
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 3 of 11)



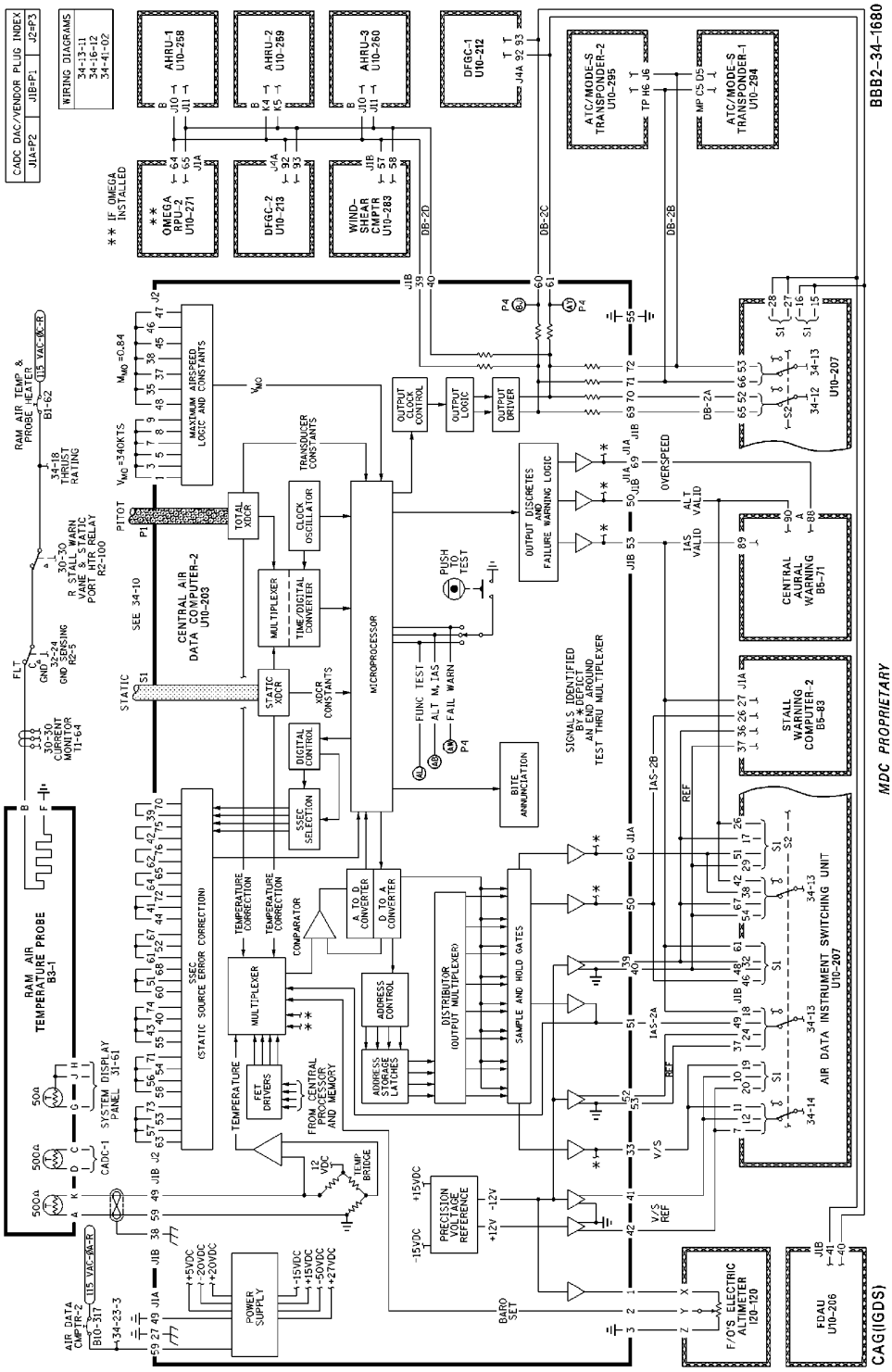
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 4 of 11)



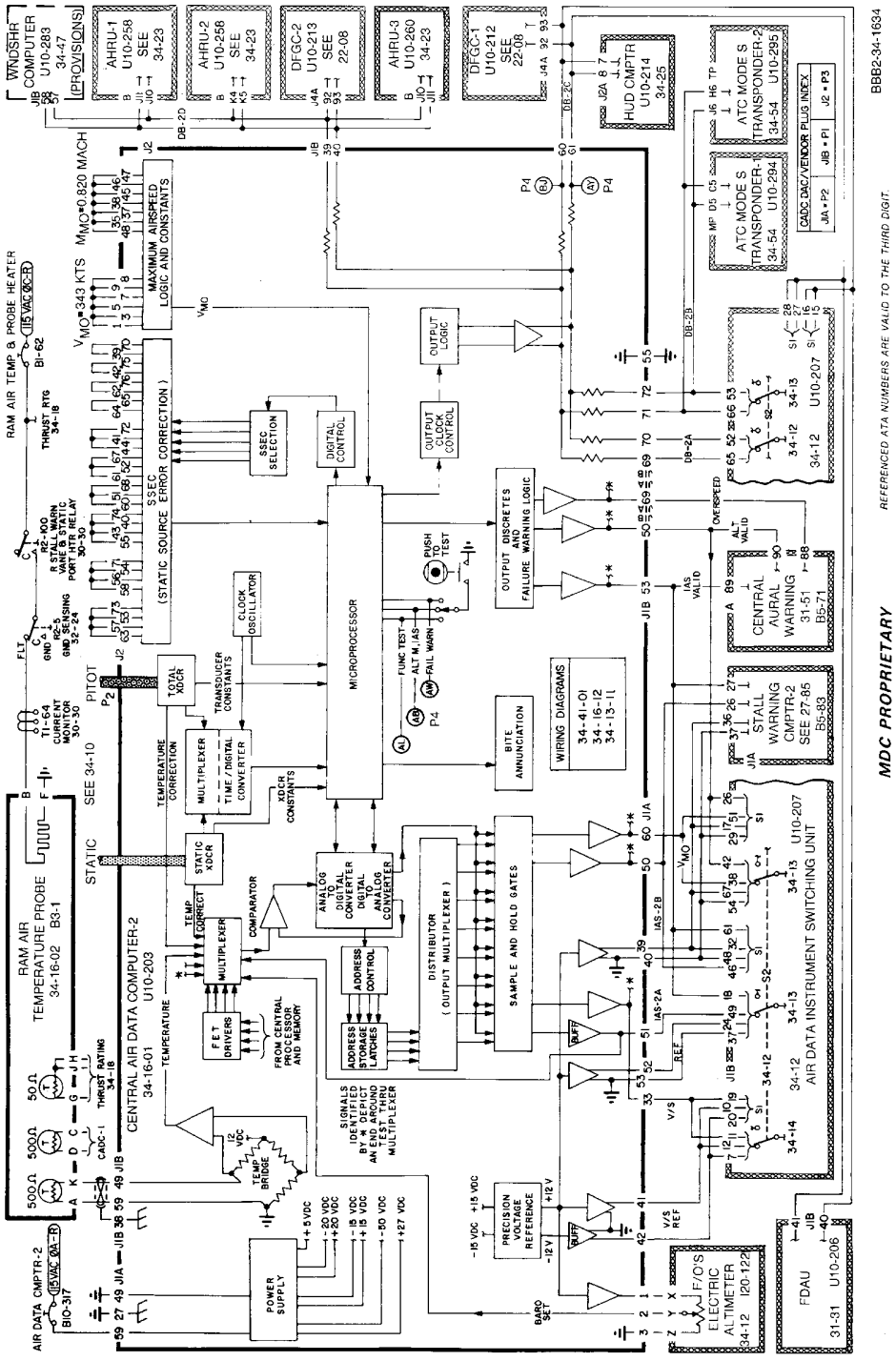
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 5 of 11)



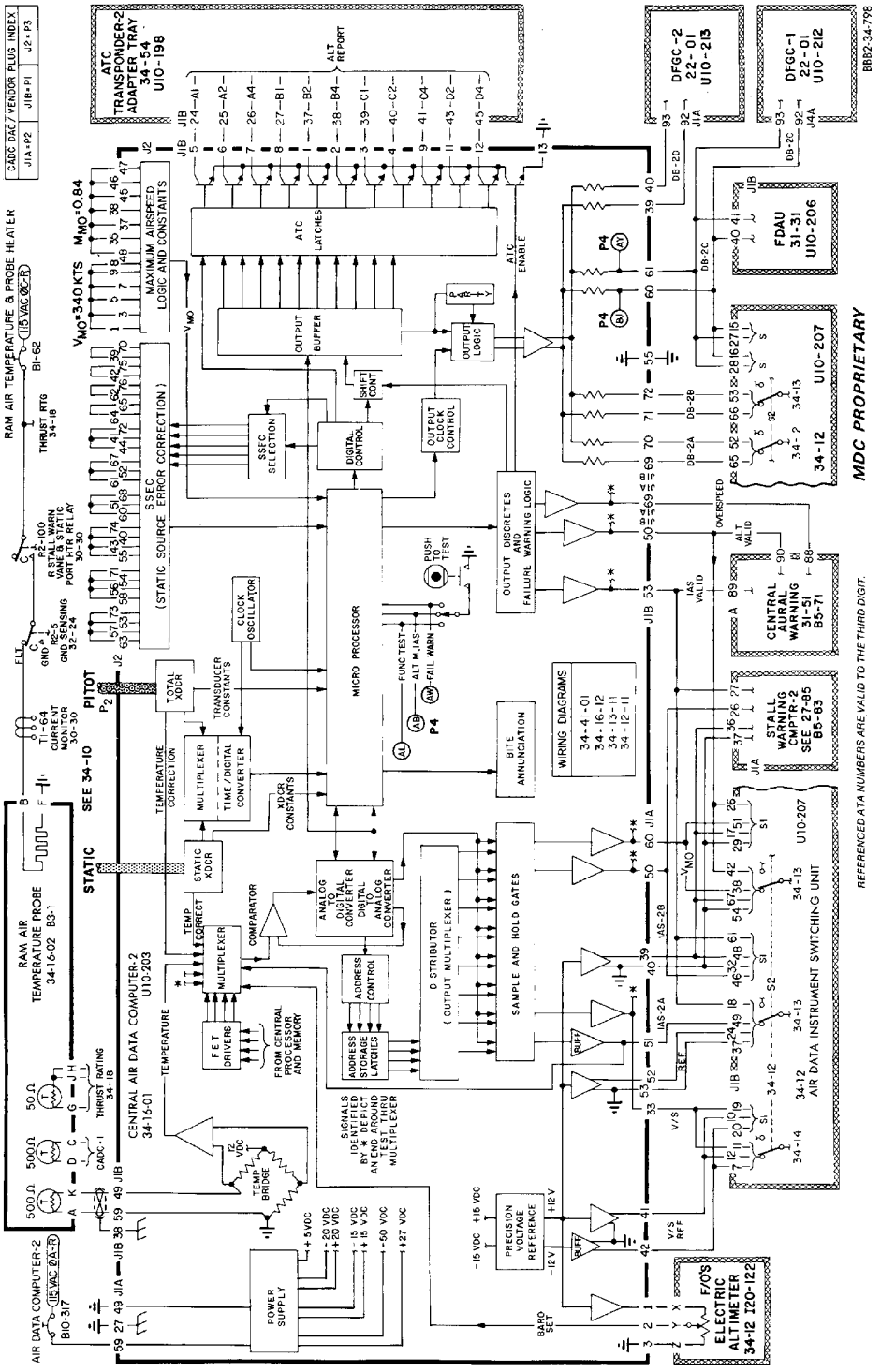
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 6 of 11)



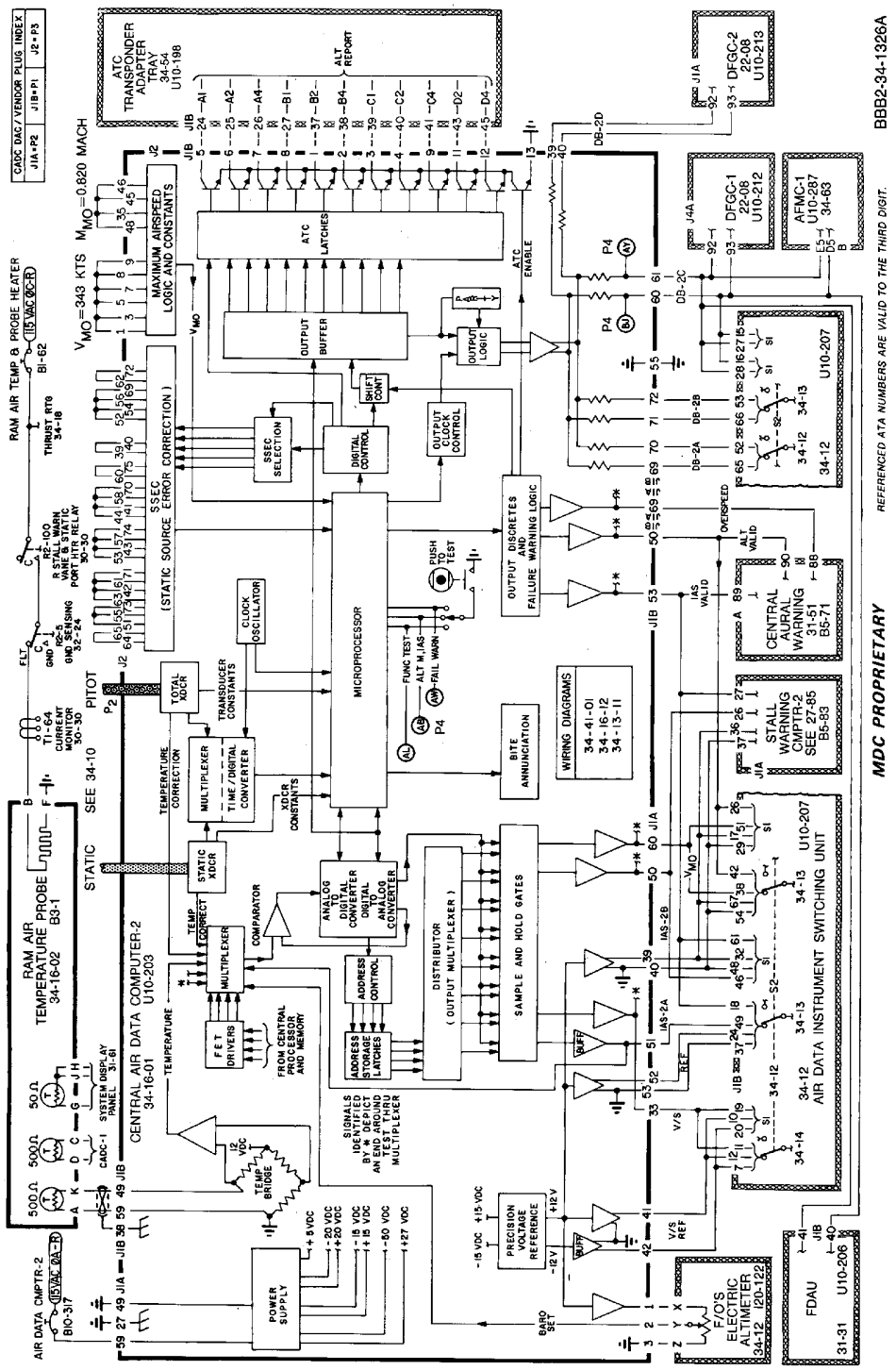
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 7 of 11)



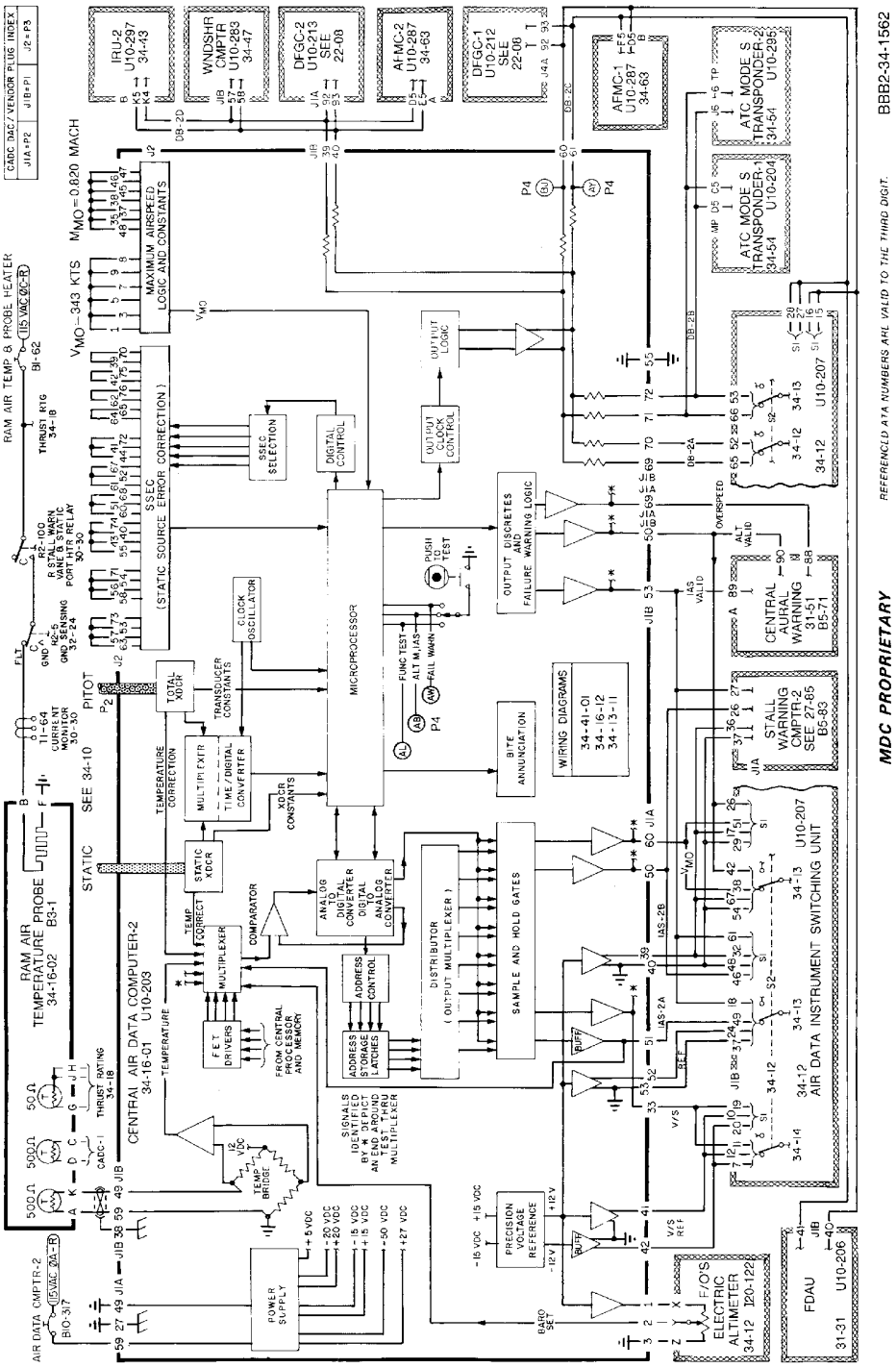
Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 8 of 11)



Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 9 of 11)



Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 10 of 11)



Air Data Computer-2 - Schematic
Figure 102/34-16-00-990-808 (Sheet 11 of 11)

AIR DATA COMPUTING - MAINTENANCE PRACTICES

1. General Maintenance Features

A. Air Data Computing is accomplished by CADC. CADC is designed as an interchangeable unit and includes Built-In-Test Equipment (BITE). BITEBITE self-test is actuated during line maintenance by front panel controls. Self-test provision expedites maintenance procedures since no additional test equipment is required.

B. CADC front panel switches select and initiate separate self tests. Tests in these procedures consist of a Function Test, and a Failure Warning Test. Function test utilizes fixed values, stored within computer memory, to simulate computer input data. CADC performs normal computations upon simulated inputs and transmits results as test outputs. Failure warning test actuates computer failure warning circuitry and transmits a fail signal to all analog and digital output subscribers. Respective operations are verified by noting results displayed by respective indicators. (Figure 201)

NOTE: Use of a CADCCADC Remote Test Adapter cable will allow CADC test switch actuation from the flight compartment. Care should be exercised to prevent multiple test selection execution which can cause incorrect self test outputs. When CADC Remote Test Adapter cable is used, the step in procedures stating to depress the PUSH TO TEST switch on CADC is not required.

C. Non-Volatile Maintenance Indication - Built-In-Test (BIT) failure memory shall have capacity to log failure history of a minimum of five individual flights with a capacity of at least two failures per flight. Failure history lights will illuminate only when front panel Push-To-Test button is depressed and Function Test switch is in Failure Warning Test position. Lights will illuminate if there are any failures in memory for any of last five flights only.

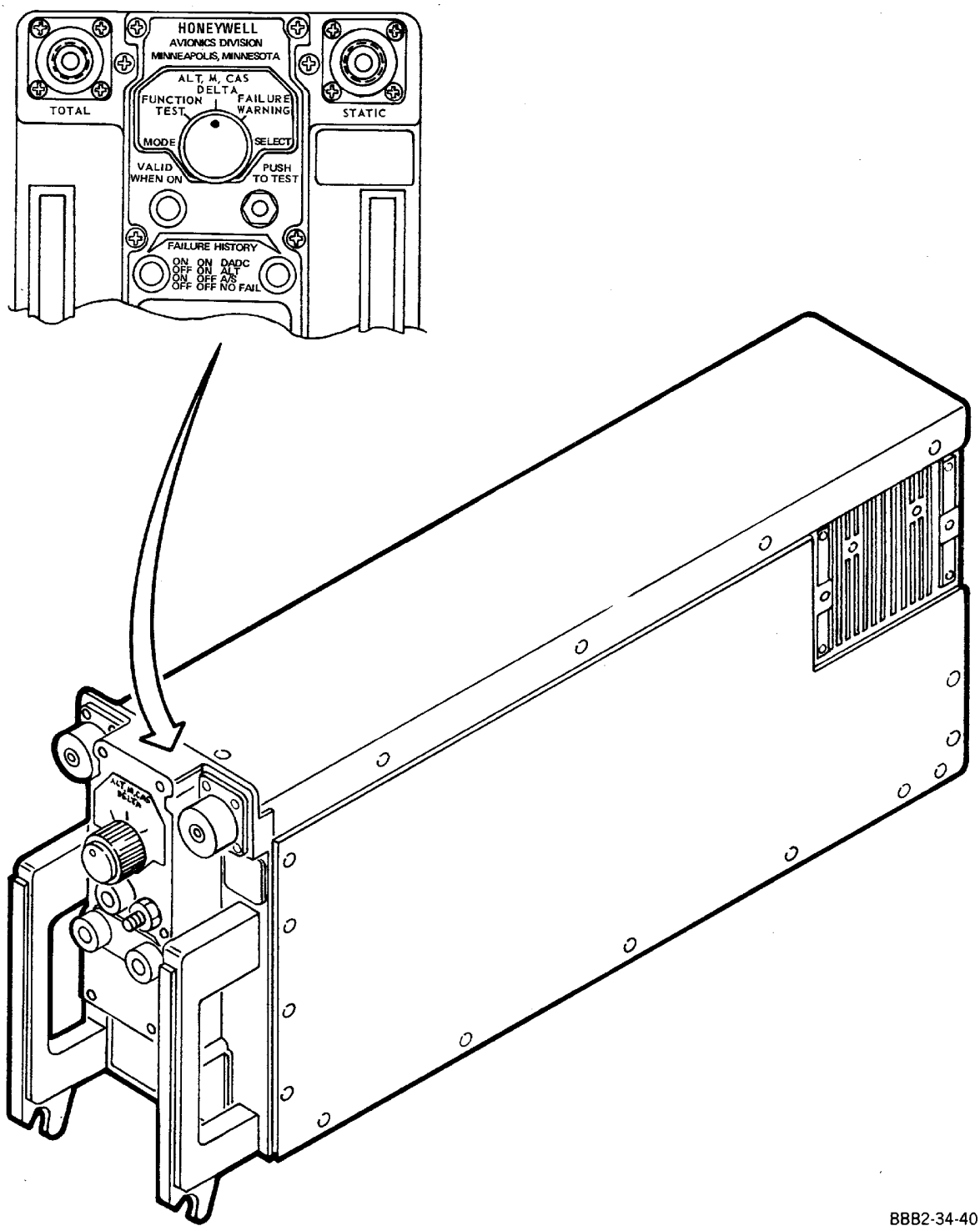
D. Light pattern of two failure history lights is as follows:

Table 201

Light ON	Indication
ON - ON	"CADC INOP"
OFF - ON	"ALT INOP"
ON - OFF	"AIRSPEED INOP"
OFF - OFF	No failures recorded

E. In addition, light pattern will be ON-ON if both an altitude and airspeed function failure has occurred within last five flights.

F. Non-volatile maintenance memory may be reset only during shop maintenance.



Central Air Data Computer -- Front Panel
Figure 201/34-16-00-990-809

2. Safety and Operating Precautions

A. Line maintenance personnel must be alert to fact that under certain conditions CADC self-test function can result in sudden movement of powered control surfaces. This condition is only present when Flight Guidance system is in operation. Under these circumstances, actuation of self test provides CADC outputs that can cause a Flight Guidance corrective response and result in movement of control surfaces. Therefore, prior to depressing PUSH TO TEST switch, open, tag, and safety Flight Guidance system circuit breakers.

3. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 202

Name and Number	Manufacturer
Test Adapter, CADC Remote (5963440-1)	Douglas Aircraft Co.

4. Adjustment/Test

A. Preliminary

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

(2) Connect CADC remote test adapter cable to air data computer-1 and -2 as required.

NOTE: If remote test adapter used, air data computer circuit breakers should be opened during connecting and disconnecting of adapter cable.

(3) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(4) Check that failure warning flags are out of view on following indicators.

Table 203

Indicator	Location
Captain's Mach Airspeed	Captain's Instrument Panel
First Officer's Mach Airspeed	First Officer's Instrument Panel
Captain's Altimeter	Captain's Instrument Panel
First Officer's Altimeter	First Officer's Instrument Panel
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893	
Captain's Vertical Speed	Captain's Instrument Panel
WJE ALL	
First Officer's Vertical Speed	First Officer's Instrument Panel
*[1]True Airspeed Static Air Temperature	First Officer's Instrument Panel

*[1] When TAS/SAT indicator installed.

B. Test Altimeter BARO Setting

Table 204

Step	Operation	Desired Result
(1)	Rotate Captain's Altimeter BARO knob clockwise.	Altitude display increases.
(2)	Rotate Captain's Altimeter BARO knob counterclockwise.	Altitude display decreased.
(3)	Adjust Captain's Altimeter BARO knob for 29.92 in. Hg. display.	Altitude display adjusted at 29.92 in. Hg.
(4)	Rotate First Officer's Altimeter BARO knob clockwise.	Altitude display increases.
(5)	Rotate First Officer's Altimeter BARO knob counterclockwise.	Altitude display decreases.
(6)	Adjust First Officer's Altimeter BARO knob for 29.92 in. Hg. display.	Altitude display adjusted at 29.92 in. Hg.

C. CADC Self Test

Table 205

Step	Operation	Desired Result	
(1)	Place CADC -1 MODE SELECT switch in FUNCTION TEST position.		
(2)	Depress and hold CADC -1 PUSH TO TEST switch.	Check Captain's indicators for following displays:	
		Altitude	9915(±15) feet
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
		Mach	0.746(±.006)
WJE ALL			
		Airspeed	419(±3) knots
		Maximum Allowable Airspeed	343(±3) knots
		Vertical Speed	1000(±100) fpm
(3)	Release PUSH TO TEST switch.		
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
(4)	Place CADC switch on overhead panel to BOTH ON 1 position.	Captain's CADC light comes on, First Officer's CADC light comes on.	
(5)	Place CADC switch In NORM position.	Captain's and First Officer's CADC lights go off.	
WJE ALL			
(6)	Place CADC -2 MODE SELECT switch in FUNCTION TEST position.		
(7)	Depress and hold CADC -2 PUSH TO TEST switch.	Check First Officer's indicators for following displays:	
		Altitude	9915(±15) feet
		Mach	0.746(±.006)
		Airspeed	419(±3) knots

Table 205 (Continued)

Step	Operation	Desired Result	
		Maximum Allowable Airspeed	343(±3) knots
		Vertical Speed	1000(±100) fpm
		True Airspeed (TAS)	456(±1) knots
		*[1]Static Air Temperature	-27(±2)°C
(8)	Place CADC switch on overhead panel in BOTH ON 2 position.	First Officer's CADC light comes on, Captain's CADC light comes on.	
(9)	Return CADC switch to NORM position.	Captain's and First Officer's CADC lights go off.	
(10)	*[1]Depress TAT switch on TAS/SAT indicator.	*[1]Static Air Temperature display shows 0(±2)°C.	
(11)	Release PUSH TO TEST and TAT switches.		
(12)	Place CADC -1 MODE SELECT switch in FAILURE WARNING position.		
(13)	Depress and hold CADC -1 PUSH TO TEST switch.	Check Captain's indicators for following failure warning displays:	
		Altitude	Flag in view.
		Mach Airspeed	MACH flag in view, airspeed flag in view, Max Airspeed Vmo pointer 257(±10) knots.
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
		Vertical Speed	OFF flag in view.
WJE ALL			
(14)	Release PUSH TO TEST switch.		
(15)	Place CADC -2 MODE SELECT switch in FAILURE WARNING position.		
(16)	Depress and hold CADC -2 PUSH TO TEST switch.	Check First Officer's indicators for following failure warning displays:	
		Altitude	Flag in view.
		Mach Airspeed	MACH flag in view, airspeed flag in view, Max Airspeed Vmo pointer 257(±10) knots.
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
		Vertical Speed	OFF flag in view.
WJE ALL			
		*[1]True Airspeed	TAS flag in view.
		*[1]Static Air Temperature	SAT flag in view.
(17)	Release PUSH TO TEST switch.		

*[1] If TAS/SAT indicator installed.

(1) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	12	B10-317	AIR DATA CMPTR -2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	13	B10-346	YAW DAMPER-2

D. Test Termination

(1) Remove CADC remote self test cable from CADC if used.

(2) Return aircraft to required configuration.

5. In-Service Instrument Tolerances

A. In-service Mach Airspeed tolerances are as follows:

Table 206

Airspeed	Max Difference Between Pilot, Copilot, and Standby Indicators
80 to 149 Kts	4 Kts
150 to 249 Kts	6 Kts

Table 206 (Continued)

Airspeed	Max Difference Between Pilot, Copilot, and Standby Indicators
250 to 350 Kts	10 Kts
Mach 0.8	.02 Mach

B. Altimeters Tolerances

NOTE: The true field elevation or altitude is the reference to which all three altimeters must be measured against.

NOTE: The altimeters must read within 60 feet of each other.

(1) In-service Altimeter tolerances are as follows:

Table 207

Altimeter(s)	Elevation	Tolerance
Standby, Captain's, and First Officer's	Ramp or field elevation. Add 5 feet to field elevation for altimeter location.	±30 feet
Captain's to First Officer's	At 25,000 feet	100 feet max.
Captain's to First Officer's	At 35,000 feet	120 feet max.
Captain's to First Officer's to Standby	At Field Elevation	60 feet max.
Captain's and First Officer's to Standby	At 25,000 feet	250 feet max.
Captain's and First Officer's to Standby	At 35,000 feet	320 feet max.

C. Vertical Speed Tolerances

(1) In-service Vertical Speed tolerances are as follows:

Table 208

Indicators	Altitude	Vertical Speed	Tolerance
Captain's and First Officer's V/S Indicators	On Ground	Static	0±200 FPM
Captain's and First Officer's V/S Indicators	<4000 Ft.	±500 FPM	V/S ±200 FPM
Captain's and First Officer's V/S Indicators	<4000 Ft.	±2000 FPM	V/S ±600 FPM

CENTRAL AIR DATA COMPUTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the central air data computer. Two central air data computers (CADC) are installed on the radio racks in the electrical/electronics compartment. Each CADC receives dynamic inputs from the pitot and static system, and the RAT probe.

NOTE: Removal/installation procedures for both units are identical except for circuit breaker placarding.

2. Removal/Installation CADC

A. Remove CADC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(2) On front panel of CADC, disconnect self sealing quick disconnect pitot and static fittings.

(3) Press release button at top of handles; pull inner portion of handles out and down to release locking pins.

(4) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install CADC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that connectors are properly aligned, and that latch handles engage on keeper pins.

(4) Close locking handles and press firmly until securely locked in place.

NOTE: Handles should lock in place with a firm snap with-out excessive force. Computer should not have any looseness. Refer to Figure 201 for dimension noted on mounting rack.

(5) Connect pitot and static quick disconnect fittings to connectors on front panel of CADC.

NOTE: Torque value for connecting quick disconnect coupling halves to CADC and hose side is 50 inch-pounds (5.65 N·m).

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(7) Place MODE SELECT switch, on front panel of CADC, to FAILURE WARNING position, press PUSH TO TEST switch button and verify VALID WHEN ON light comes on and FAILURE HISTORY lights are OFF.

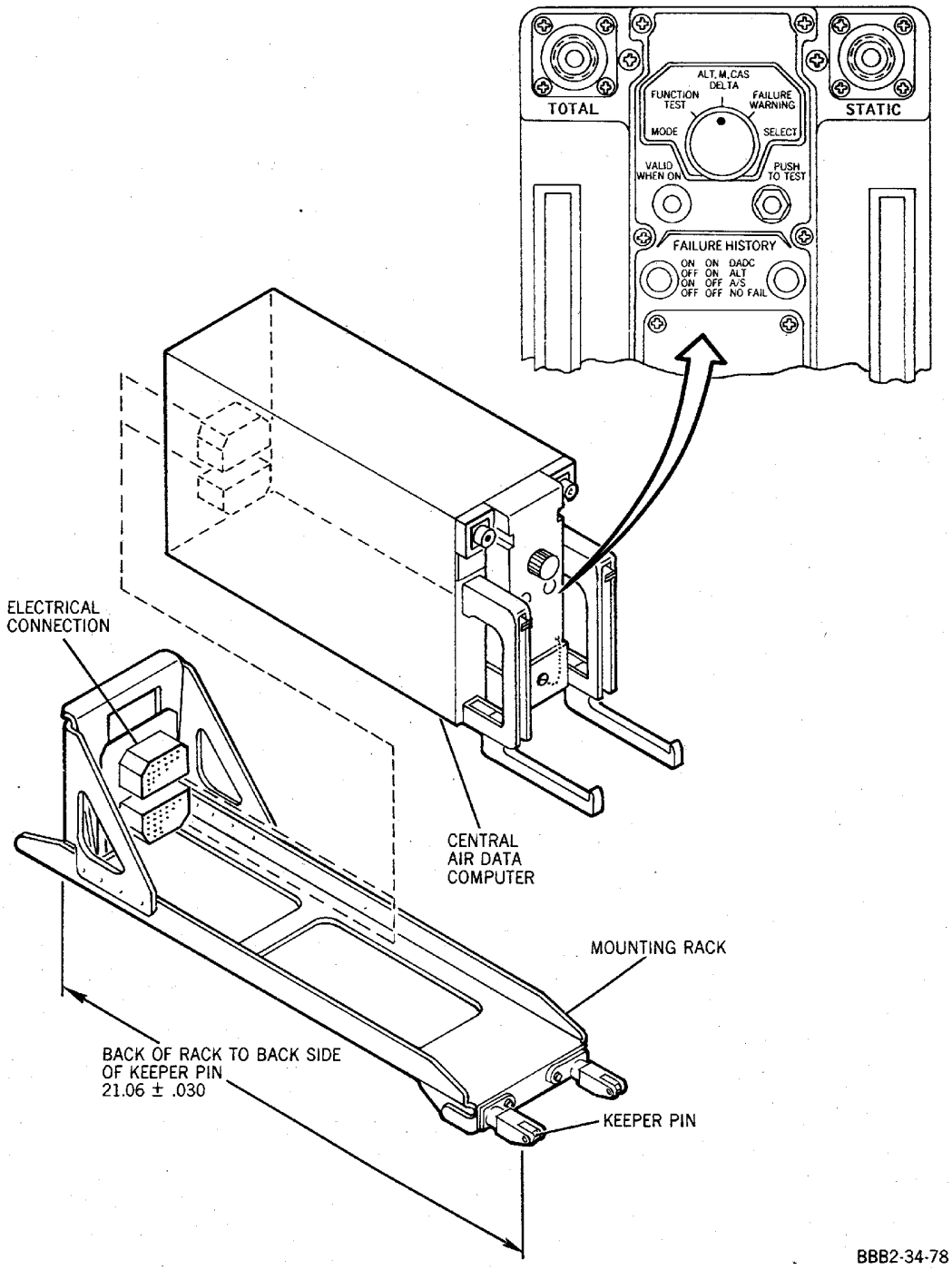
(8) Perform leak test on applicable pitot-static system. (PITOT STATIC, SUBJECT 34-11-00, page 201)

NOTE: If necessary, refer to PAGEBLOCK 34-16-00/201, for complete system test.

NOTE: A leak test is not required when a single CADC is replaced. A leak test must be performed when both CADCs are replaced at the same time.

(9) Perform Return-to-Service (RTS) test. (SUBJECT 22-01-05, Page 201)

(10) Return aircraft to required configuration.



Air Data Computer - Removal/Installation
Figure 201/34-16-01-990-801

RAM AIR TEMPERATURE (RAT) PROBE - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the RAM Air Temperature (RAT) Probe. The probe provides total air temperature outputs to the central air data computers and the ram air temperature/thrust rating indicator. The probe is installed on the lower forward right side of the fuselage nose section. Access is gained from the outside of the fuselage.

NOTE: The heating element and temperature sensing elements are an integral part of the RAM air temperature probe and cannot be removed or repaired separately.

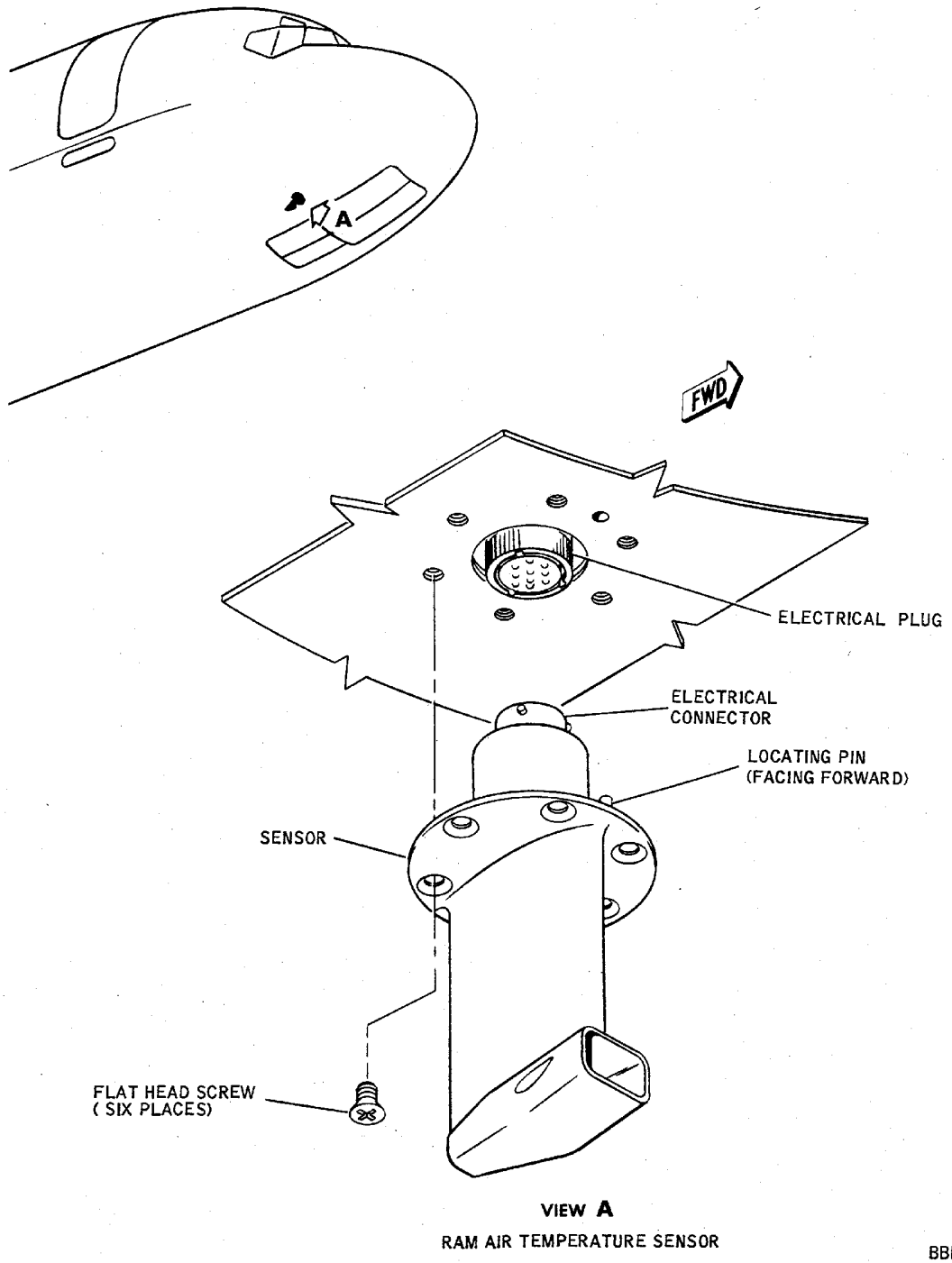
2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Sealant, silicone (kit - 90-006 with catalyst 90-006-2) DMS 1799	Dow Corning Corp.
Solvent, cleaning 1,1,1 trichloroethane (stabilized vapor degreasing) DPM 5792	Canadian Industries, Ltd.
Sealant, faying PR 1431G DMS 2013	Courtaulds Aerospace, Inc.
Precision thermometer, -40 to +60 degrees centigrade scale	



RAM Air Temperature Probe -- Removal/Installation
Figure 201/34-16-02-990-801

3. **Removal/Installation - RAT PROBE**

A. Remove RAT PROBE

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

(2) Remove six screws which hold the temperature probe to the fuselage.

(3) Gently ease the temperature probe outward from the mounting hole and disconnect and cap the electrical mating connector.

B. Install RAT PROBE

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

WARNING: 1,1,1-TRICHLOROETHANE IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN 1,1,1-TRICHLOROETHANE IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET 1,1,1-TRICHLOROETHANE IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

CAUTION: BEFORE INSTALLING RAT PROBE, MAKE SURE RAT PROBE ASSEMBLY AND FAYING SURFACES OF PROBE AND AIRCRAFT ARE ABSOLUTELY CLEAN AND FREE OF FOREIGN OBJECTS.

(2) Clean RAT probe and aircraft mounting surfaces with solvent (1,1,1 trichloroethane or equivalent (DPM 5792)).

WARNING: SILICONE SEALANT IS AN AGENT THAT IS POISONOUS, CARCINOGENIC, CORROSIVE, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN SILICONE SEALANT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET SILICONE SEALANT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(3) Apply an even light coat of silicone sealant (DMS 1799) to faying surfaces of RAT probe and mounting surfaces of aircraft.

(4) Remove cap from electrical connector. Align temperature probe with air inlet facing forward; connect electrical connector to temperature probe receptacle in proper keyway.

WARNING: FAYING SURFACE SEALANT IS AN AGENT THAT IS FLAMMABLE, POISONOUS, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN FAYING SURFACE SEALANT IS USED.

- GAS/AIR MIXTURES MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET FAYING SURFACE SEALANT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(5) Position temperature probe for final mounting. Apply sealant (DMS 2013) under head of attaching screws, then insert and tighten six screws.

(6) Clean excess sealant from around RAT probe and attaching screws.

(7) Ensure that METER SEL & HEAT selector switch (located on overhead switch panel) is in OFF position.

(8) Remove the safety tag and close this circuit breaker:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

(9) Place standard centigrade thermometer within or adjacent to RAM air temperature probe air inlet. Allow sufficient time (3 to 5 minutes) for thermometer reading to stabilize, note final stabilized ambient air temperature at probe.

(10) Temperature reading of RAT on Ram air and thrust rating indicator should agree with thermometer reading within ±2.0 degrees centigrade. On aircraft with electronic engine display panel, RAT is displayed on the electronic engine display panel.

(11) On aircraft with True Airspeed and Static Air Temperature (TAS/SAT) Indicator installed, press TAT pushbutton switch on TAS/SAT indicator. Note digital annunciation shown on Static Air Temperature (SAT) display, and compare with ambient air temperature measured at probe air inlet. Two readings should agree within ±2.0 degrees centigrade.

(12) Place CADC selector switch to BOTH ON 1 position, repeat step (Paragraph 3.B.(11)).

(13) Place CADC switch to NORM.

4. Adjustment/Test RAT Probe

CAUTION: MAKE CERTAIN THAT RAM AIR TEMPERATURE PROBE HEATER OPERATION IS LIMITED TO TWO MINUTES MAXIMUM, TO PREVENT DAMAGE.

A. RAT Probe Heater Check

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	33	B1-23	LEFT GROUND CONTROL RELAY

WJE ALL

NOTE: Circuit breakers are opened to prevent other heaters from operating during test.

CAUTION: MAKE CERTAIN RAT PROBE PROTECTIVE COVER IS REMOVED.

(2) Verify RAM AIR TEMP & PROBE HEAT circuit breaker and RIGHT STATIC PORT HEATER circuit breaker on lower EPC circuit breaker panel are closed.

(3) Place METER SEL & HEAT switch on overhead panel to RAT probe position.

(4) Current reading on meter should read 6.5 to 8.5.

(5) Close LEFT GROUND CONTROL RELAY circuit breaker.

(6) Current reading on meter should read 0.0 to 0.5.

(7) Place METER SEL & HEAT switch to OFF position.

(8) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	33	B1-23	LEFT GROUND CONTROL RELAY

WJE ALL

(9) Return airplane to required configuration.

AIR DATA SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for air data instrument switching unit. The air data instrument switching unit is installed on the radio rack in the electrical/electronics compartment. Operation of the switching unit is controlled by the CADC switch on the overhead switch panel.

2. Removal/Installation Air Data Switching Unit

A. Remove Air Data Switching Unit

WARNING: TAG AND SAFETY CIRCUIT BREAKERS.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
C	8	B10-321	AIR DATA SWITCHING UNIT
WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	9	B10-321	AIR DATA SWITCHING UNIT

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE ALL			
G	17	B10-320	CADC SWITCHED LIGHT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(2) Unscrew knurled holddown nuts at front of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle ccw until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Air Data Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
C	8	B10-321	AIR DATA SWITCHING UNIT
WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	9	B10-321	AIR DATA SWITCHING UNIT

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE ALL			
G	17	B10-320	CADC SWITCHED LIGHT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(2) Visually check switching unit connector plugs, on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide switching unit straight into rack, ensuring that electrical connectors are properly aligned with mounting rack connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle cw until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on switching unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
C	8	B10-321	AIR DATA SWITCHING UNIT
WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	9	B10-321	AIR DATA SWITCHING UNIT

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE ALL			
G	17	B10-320	CADC SWITCHED LIGHT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(7) On overhead switch panel, place air data switching unit selector switch alternately to NORM, BOTH ON 1, and BOTH ON 2 Position, and verify warning flags in captain's and first officer's Altimeter, vertical speed indicator, and MACH air-speed indicator are out of view.

(8) Place selector to NORM position.

NOTE: If necessary, refer to AIR DATA COMPUTING - MAINTENANCE PRACTICES, PAGEBLOCK 34-16-00/201 for complete system test.

(9) Return airplane to required configuration.

AIR DATA SWITCHING UNIT - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-16-03-710-801

2. Operational Check of the Air Data Switching

A. Prepare to do an Operational Check of the Air Data Switching

SUBTASK 34-16-03-865-001

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
C	8	B10-321	AIR DATA SWITCHING UNIT
WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	9	B10-321	AIR DATA SWITCHING UNIT

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE ALL			
G	17	B10-320	CADC SWITCHED LIGHT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

B. Operational Check of the Air Data Switching

SUBTASK 34-16-03-710-001

(1) On the overhead panel, place the CADC switch to BOTH ON 1,

(a) Make sure the captain's and first officer's CADC lights come on,

(b) Make sure the first officer's indicators show the same as the captain's.

SUBTASK 34-16-03-710-002

(2) Open this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

(a) Make sure the captain's and first officer's displays do not change.

(3) Close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

SUBTASK 34-16-03-710-003

(4) Place the CADC switch to NORM,

(a) Make sure the captain's and first officer's CADC lights go off.

SUBTASK 34-16-03-710-004

(5) Place the CADC switch to BOTH ON 2,

(a) Make sure the captain's and first officer's CADC lights come on,

(b) Make sure the captain's indicators show the same as the first officer's.

SUBTASK 34-16-03-710-005

(6) Open this circuit breaker:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

(a) Make sure the captain's and first officer's displays do not change.

(7) Close this circuit breaker:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

SUBTASK 34-16-03-710-006

(8) Place the CADC switch to NORM,

(a) Make sure the captain's and first officer's CADC lights go off.

END OF TASK

ALTITUDE ADVISORY - DESCRIPTION AND OPERATION

1. Description

A. The altitude advisory system will advise the flight crew that the airplane is approaching a preselected altitude, and provide an alert signal when the airplane deviates from a selected altitude.

B. Digital altitude information from the central air data computers is utilized, by the digital flight guidance computers, to provide computations for the two separate but inter-related functions of altitude preselect, and altitude advisory. The altitude preselect function provides a means to program selected altitude into the autopilot and flight director systems for automatic or commanded level-off when a desired altitude is reached. The flight guidance control panel contains an altitude preselect knob and a digital display of the selected altitude. The altitude advisory function provides visual indication by an altitude alert light on the captain's and first officer's primary altimeters, and aural annunciation from speakers activated by signals from a central aural warning unit.

C. Altitude preselect operates only through autopilot, or flight director guidance. However, altitude advisory is available even with both autopilots disengaged and both flight directors turned off. The advisory function will operate whenever the digital flight guidance computer is energized, and is receiving valid altitude signals from the air data computer and flight guidance control panel.

D. The digital selected altitude readout is controlled by the altitude preselect knob. The three-position control is spring-loaded to center position. Pushing in and turning the knob provides fast altitude adjustment. Center position provides fine altitude adjustment. Momentary pull-out position arms the flight guidance system for preselected altitude capture. Momentary push-in position resets the altitude preselect system.

E. Selection of existing altitude input from the applicable central air data computer. Air data information to the captain's system is from the CADC-1, and to the first officer's system from the CADC-2. Placing the DFGS system selector switch to position 1, selects the captain's system and when set to position 2, selects the first officer's system. The CADC SWITCHED annunciator light, on the captain's instrument panel, comes on when the CADC switch is in other than NORM position. During this condition, only the "ON" CADC/ALTITUDE advisory system can be utilized.

F. When the aircraft is approximately 750 feet from a preselected altitude, the altitude alert light comes on. Approximately 250 feet before preselected altitude is reached, the light goes out. If for any reason, the aircraft is maneuvered beyond the 250 foot range of selected altitude, a 2 second tone is heard and the alert light flashes on and off followed by the word ALTITUDE. A flashing alert light can be turned off by selecting a new altitude which is more than 750 feet from existing altitude, or by maneuvering the aircraft to within 250 feet of selected altitude. A steady light can only be turned off by selecting a new altitude.

NOTE: As noted in paragraph Paragraph 1.B. the altitude advisory is interrelated with the altitude preselect system. The altitude preselect system is contained in Chapter 22 Maintenance Manual. For checkout of the altitude advisory system, refer to the Altitude Preselect and Advisory system in AUTO FLIGHT, CHAPTER 22.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 886, 887, 891-893

NOTE: On some aircraft, at 750 feet from the preselected altitude or an altitude greater than 750 feet that is proportional to the aircraft vertical speed, a one second aural warning shall sound and the amber lights shall illuminate and remain on until the aircraft is 250 feet from the preselected altitude.

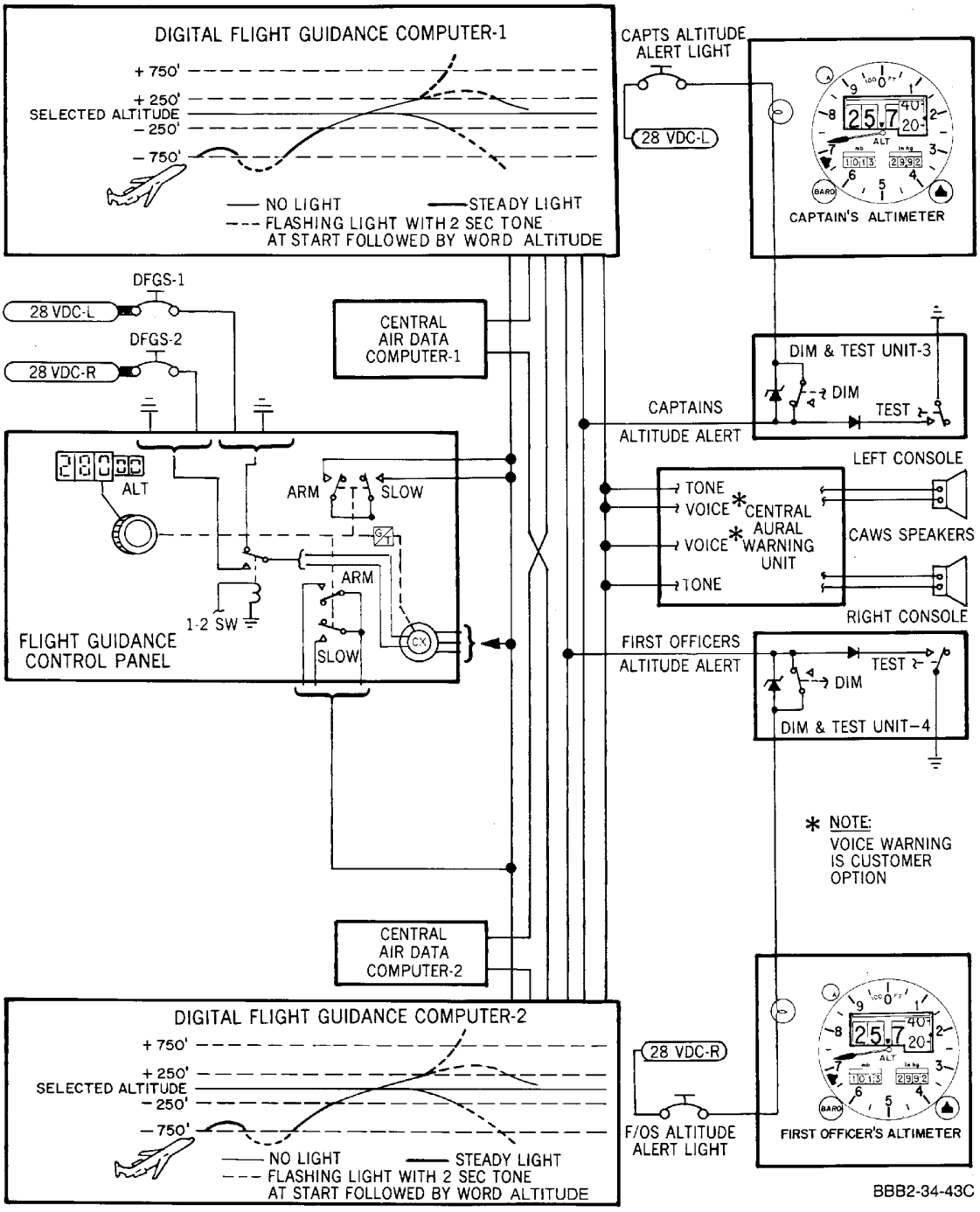
WJE 405-411, 884

G. When the aircraft is approximately 750 feet from a preselected altitude, the altitude alert light comes on. Approximately 150 feet before preselected altitude is reached, the light goes out. If for any reason, the aircraft is maneuvered beyond the 150 foot range of selected altitude, a 2 second tone is heard and the alert light flashes on and off followed by the word ALTITUDE. A flashing alert light can be turned off by selecting a new altitude which is more than 750 feet from existing altitude, or by maneuvering the aircraft to within 150 feet of selected altitude. A steady light can only be turned off by selecting a new altitude.

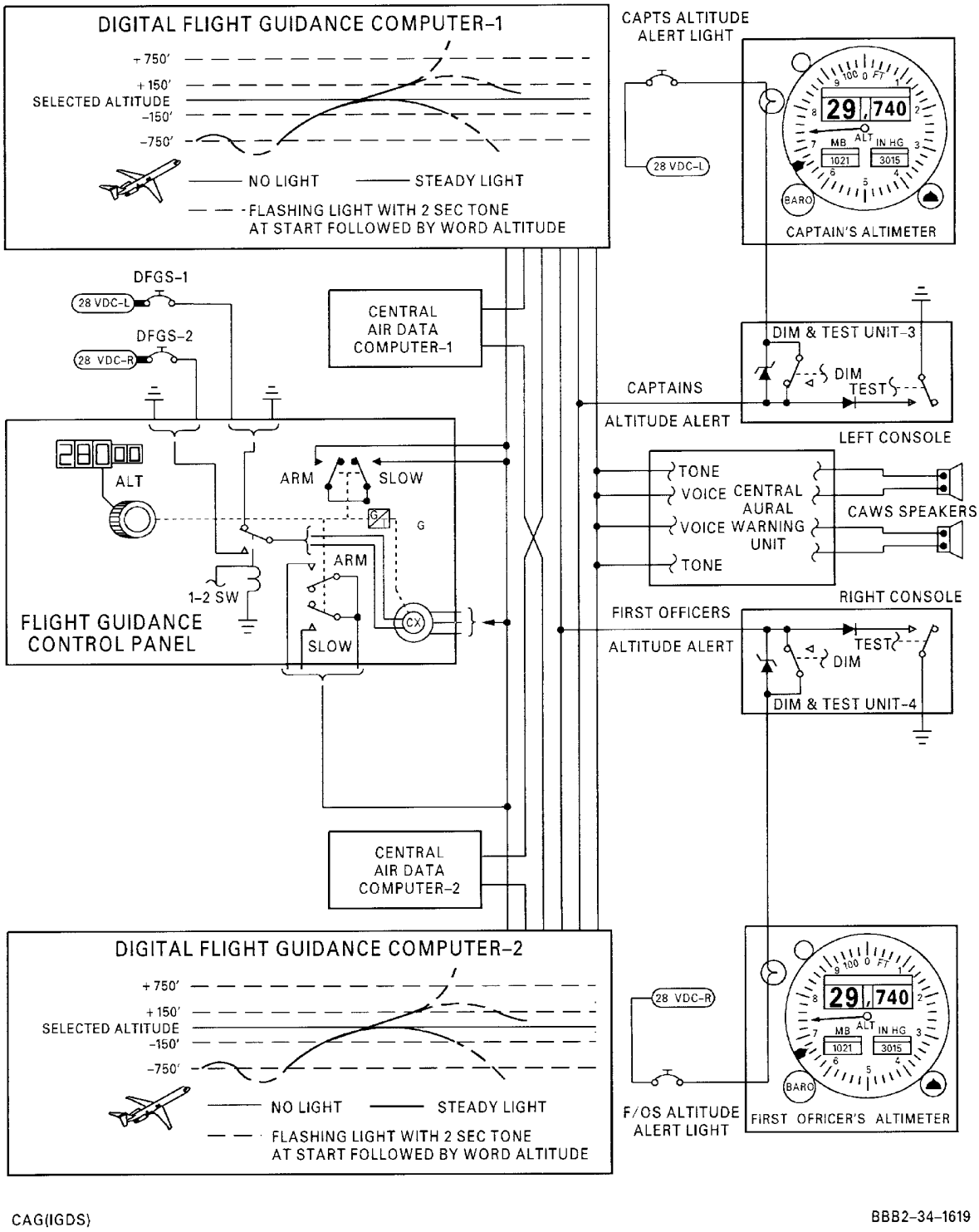
WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 886, 887, 891-893

H. When the aircraft is approximately 750 feet from a preselected altitude, the altitude alert light comes on. Approximately 250 feet before preselected altitude is reached, the light goes out. If for any reason, the aircraft is maneuvered beyond the 250 foot range of selected altitude, a 2 second tone is heard and the alert light flashes on and off followed by the word ALTITUDE. A flashing alert light can be turned off by selecting a new altitude which is more than 750 feet from existing altitude, or by maneuvering the aircraft to within 250 feet of selected altitude. A steady light can only be turned off by selecting a new altitude.

WJE ALL



Altitude Advisory System
Figure 1/34-17-00-990-801 (Sheet 1 of 2)



Altitude Advisory System
Figure 1/34-17-00-990-801 (Sheet 2 of 2)

ALTITUDE ADVISORY - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Altitude Advisory system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The altitude advisory system consists of altitude alert lights on the captains and first officers altimeters, altitude setting control on the flight guidance control panel and audio recognition through the central aural warning system speakers. The system interfaces with the digital flight guidance computers which processes information from the central air data computers to provide the information for altitude alerting operations. In trouble shooting checks may have to be made to these interfacing components. See applicable trouble shooting sections.

E. The Altitude Advisory components are located as follows:

Table 101

Component	Location
Alert Lights	Captains and First Officers Altimeters
Altitude Setting Control	Flight Guidance Control Panel
CAPT's ALTITUDE ALERT circuit breaker	LEFT RADIO DC BUS
F/O's ALTITUDE ALERT circuit breaker	RIGHT RADIO DC BUS

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Altitude Advisory

A. Trouble Shoot

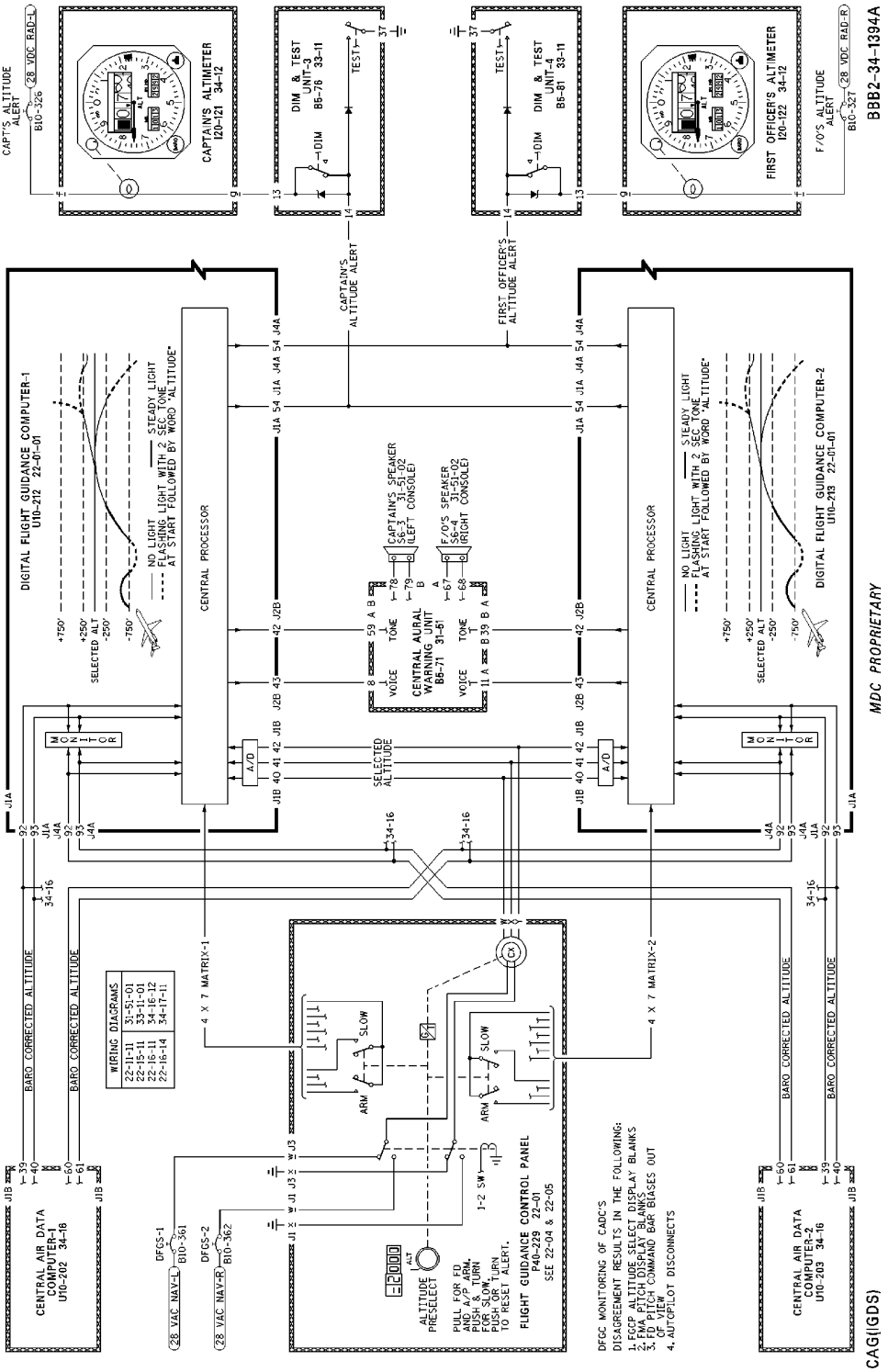
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Air Data Computers, Digital Flight Guidance Computers, Altimeters, and Central Aural Warning Unit.

Table 103

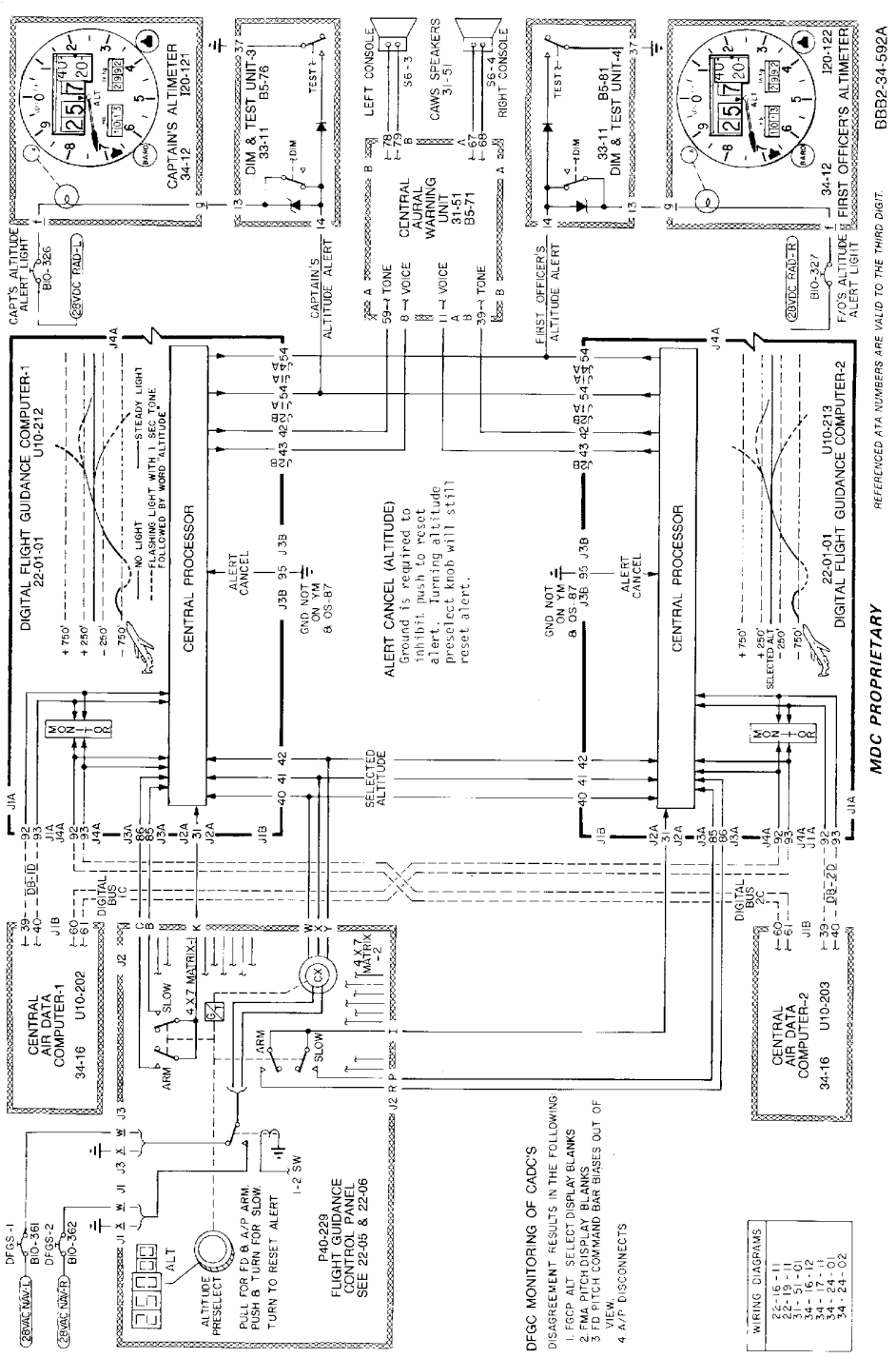
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs and components. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.

Table 103 (Continued)

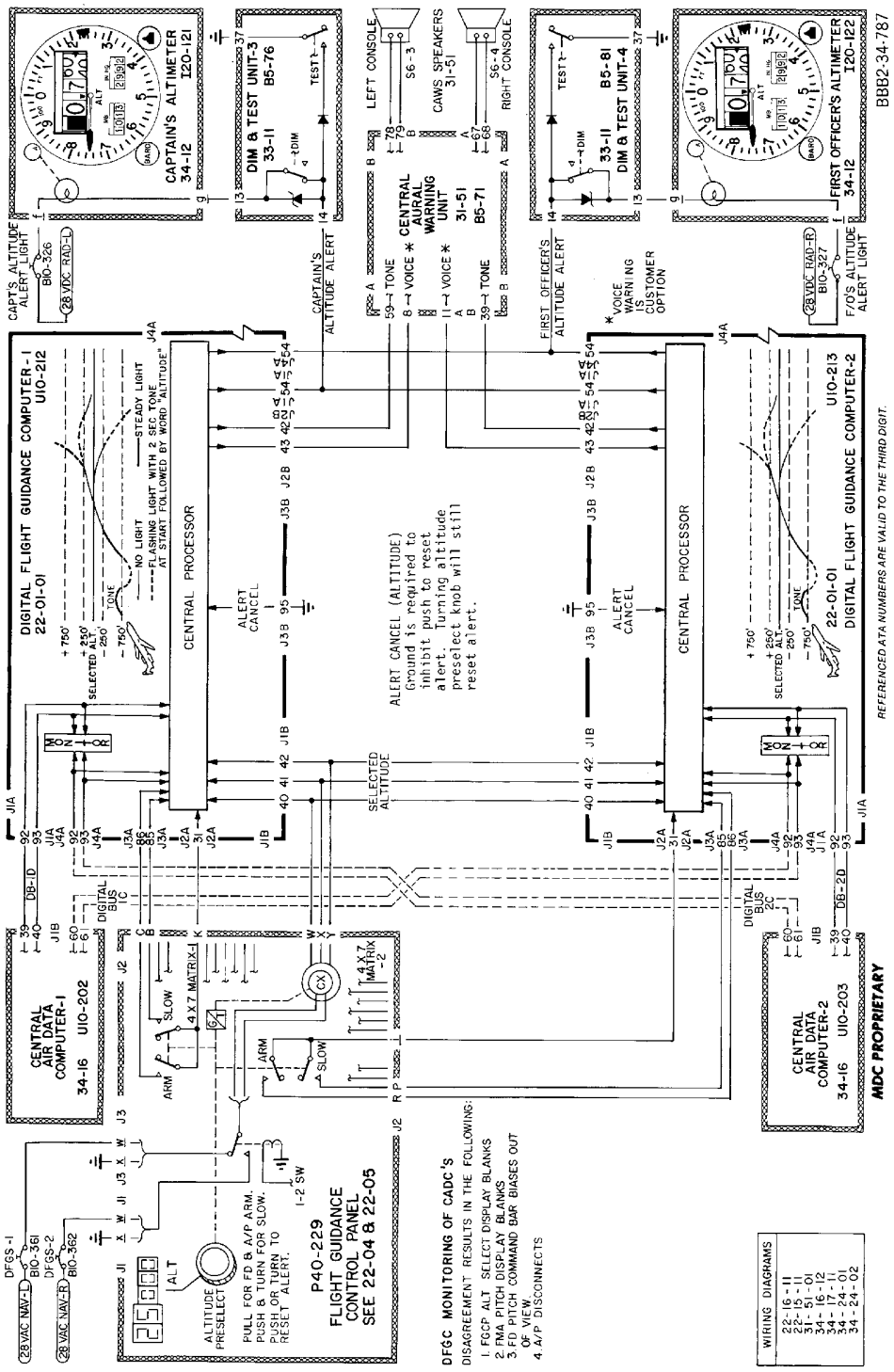
Step	Procedure	Correction
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs or components to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test SUBJECT 22-01-05, Page 201.	



Altitude Alert System -- Schematic
Figure 101/34-17-00-990-802 (Sheet 1 of 3)



Altitude Alert System -- Schematic
Figure 101/34-17-00-990-802 (Sheet 2 of 3)



Altitude Alert System -- Schematic
Figure 101/34-17-00-990-802 (Sheet 3 of 3)

RAM AIR TEMPERATURE AND THRUST RATING - DESCRIPTION AND OPERATION

1. General

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

A. The ram air temperature and thrust rating system provides numeric display of ram air temperature (RAT) and thrust rating parameters (EPR LIM) of the following modes as selected on the ram air temperature/thrust rating indicator (RAT/TRI):

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

The thrust rating system provides numeric display of thrust rating parameters (EPR LIM) of the following modes as selected on the thrust rating indicator (TRI):

WJE ALL

- TO -- TAKEOFF
- TO FLX -- TAKEOFF FLEXIBLE
- GA -- GO AROUND
- MCT -- MAXIMUM CONTINUOUS THRUST
- CL -- CLIMB
- CR -- CRUISE

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

B. The ram air temperature and thrust rating system consists of the RAT/Thrust Rating Indicator (RAT/TRI), the Digital Flight Guidance Computer (DFGC), a Ram Air Temperature probe, and an assumed temperature select panel. The system interfaces with the Central Air Data Computer (CADC) and engine bleed air components to determine the proper EPR limit. Figure 1 is a block diagram of the thrust rating system.

C. The RAT/TRI is mounted on the center instrument panel. It displays EPR LIM and RAT, and provides flight mode selection to the DFGC. RAT is displayed in degrees centigrade using a two digit display (units and tens), with a "PLUS" and "MINUS" shutter. Thrust rating parameter (EPR LIM) is displayed using a three digit counter. MODE selection is displayed by illumination of the selected pushbutton switch. The mode select switches are placarded as follows: TO (takeoff), TO FLX (takeoff flexible), GA (go-around), MCT (maximum continuous thrust), CL (climb), and CR (cruise). In case of failure in the system, solenoid operated flags will partially obscure the applicable RAT or EPR LIM display. The indicator receives RAT data from the ram air probe, and analog thrust rating parameters from the digital flight guidance computer. A back lighted NO MODE is annunciated following application of power until a mode is selected; following completion of system test; when mode selected on TRI mismatches the mode received from the DFGC; and in the event a non-normal bleed air logic configuration is selected.

D. The temperature select panel is located on the left upper instrument panel. It provides the ability to compute and position the EPR limit indexes for variable derated thrust values over a range of assumed temperatures. The assumed temperature is dialed in as determined from the takeoff analysis for the applicable airport and runway, and is equal to the maximum temperature which a takeoff would be possible at the actual takeoff gross weight.

E. The digital flight guidance computer receives digital uncorrected altitude, total air temperature, and computed air speed from the CADC. Flight mode commands are received from mode selection circuits in the RAT/TRI. Bleed air logic inputs are fed into the bleed air correction circuit of the DFGC. The CAS input from the CADC is used to clamp the computation of the thrust rating parameter in the TAKEOFF mode above 60 knots.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

ALL inputs to the computer are electronically processed to provide a computed thrust rating parameter and sent as an analog output to the RAT/TRI.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

F. The thrust rating system consists of the Thrust Rating Indicator (TRI) and interfaces with the Digital Flight Guidance Computer (DFGC), Central Air Data Computer (CADC) and engine bleed air components to determine the proper EPR limit.

G. The TRI is mounted on the center instrument panel. It displays EPR LIM at the top of the electronic engine display panel and provides flight mode selection to the DFGC. Thrust rating parameter (EPR LIM) is displayed using a three digit display. MODE selection is displayed by illumination of the selected pushbutton switch. The mode select switches are placarded as follows: TO (takeoff), TO FLX (takeoff flexible), GA (go-around), MCT (maximum continuous thrust), CL (climb), and CR (cruise). The indicator receives analog thrust rating parameters from the digital flight guidance computer. A back lighted NO MODE is annunciated following application of power until a mode is selected; following completion of system test; when mode selected on TRI mismatches the mode received from the DFGC; and in the event a non-normal bleed air logic configuration is selected (Table 2).

H. A temperature select knob is located on the TRI. It provides the ability to compute and position the EPR limit indexes for variable derated thrust values over a range of assumed temperatures. The assumed temperature is dialed in as determined from the takeoff analysis for the applicable airport and run-way, and is equal to the maximum temperature which a takeoff would be possible at the actual takeoff gross weight. The assumed temperature selected is displayed on the lower portion of the flight mode annunciator (FMA) autothrottle section.

I. The digital flight guidance computer receives digital uncorrected altitude, total air temperature, and computed air speed from the CADC. Flight mode commands are received from mode selection circuits in the TRI. Bleed air logic inputs are fed into the bleed air correction circuit of the DFGC. The CAS input from the CADC is used to clamp the computation of the thrust rating parameter in the TAKEOFF mode above 60 knots.

ALL inputs to the computer are electronically processed to provide a computed thrust rating parameter and sent as an analog output to the TRI.

J. The ram air temperature (RAT) is displayed on the lower portion of the flight mode annunciators (FMA) autothrottle section.

WJE ALL

2. Operation

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

A. The Ram air temperature and thrust rating system is operable when the airplane electrical buses are energized. Individual electrical power is supplied by the RAM AIR TEMP and PROBE HEATER circuit breaker and applicable circuit breakers for the interfacing systems.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

B. The thrust rating system is operable when the airplane electrical buses are energized. Individual electrical power is supplied by the RAM AIR TEMP and PROBE HEATER circuit breaker and applicable circuit breakers for the interfacing systems.

WJE ALL

C. The Digital Flight Guidance Computer (DFGC) performs the following functions:

(1) Accepts digital pressure altitude, computed air speed, and total air temperature from the CADC and computes EPR limit with normal or non-normal bleed air extraction.

(2) Accepts discrete inputs from various bleed air switches and determines the corrected bleed extraction schedule from the normal or non-normal bleed.

(3) Accepts a discrete ground input for activating the system self test mode of operation and provides a fixed EPR limit (based on engine type) to the TRI.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(4) Provides a DC analog voltage output to the RAT/TRI for the computed EPR limit.

(5) Accepts four discrete input voltages from the RAT/TRI as the coded selected mode of operation.

(6) Provides four discrete output voltages to the RAT/TRI as the coded computer operating mode.

(7) Accepts a discrete input voltage from the RAT/TRI as an EPR function valid.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(8) Provides a DC analog voltage output to the TRI for the computed EPR limit.

(9) Accepts four discrete input voltages from the TRI as the coded selected mode of operation.

(10) Provides four discrete output voltages to the TRI as the coded computer operating mode.

(11) Accepts a discrete input voltage from the TRI as an EPR function valid.

WJE ALL

(12) Provides an EPR LIM valid output discrete to the TRI.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(13) Provides a discrete output voltage to the RAT/TRI to annunciate NO MODE operation.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(14) Provides a discrete output voltage to the TRI to annunciate NO MODE operation.

WJE ALL

(15) Accepts and codes five option pin discrete inputs to identify the proper engine curve program to be utilized.

(16) Provides monitoring of the following:

(a) Altitude signal and valid from the CADC.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(b) Total air temperature signal and valid from the CADC.

WJE ALL

(c) Computed airspeed signal and valid from the CADC (50 to 450 knots).

(d) Program and clock timing.

(e) Computation.

(f) TRC memory sum check.

(g) Bleed air input circuits.

(h) System self test (fixed outputs).

(i) Computer power supply.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(j) Display valid discrete from the RAT/TRI.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(k) Display valid discrete from the TRI.

WJE ALL

D. The Ram Air Temperature/Thrust Rating Indicator (RAT/TRI) performs the following functions:

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(1) Accepts RAT probe resistance input and computes and displays RAT.

WJE ALL

(2) Accepts a DC analog voltage from the DFGC and displays EPR limit.

(3) Accepts a discrete input from the DFGC for annunciating the NO MODE when a non-normal bleed logic is selected or system power is applied.

(4) Provides means of manually selecting an operational flight mode and means for annunciating each active mode.

(5) Provides means for manually selecting system self test mode.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(6) Provides a discrete self test output to the DFGC (and displays a +12°C fixed RAT).

WJE ALL

(7) Provides four discrete output voltages to the DFGC as the codes selected mode of operation.

(8) Accepts four discrete input voltages from the DFGC as the coded computer operating mode and compares it to the TRI-selected mode code.

(9) Provides a discrete voltage output to the DFGC as the EPR function valid.

(10) Accepts a discrete input from the DFGC to indicate DFGC EPR LIM command validity.

(11) Accepts inputs for remotely selecting GA mode directly from throttle palm switches, or from the DFGC when on the ground for less than 20 seconds.

(12) Provides monitoring of the following:

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(a) RAT probe resistance range.

(b) RAT servo null.

WJE ALL

(c) EPR LIM servo null and validity.

(d) System self test.

(e) Indicator power supply.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(f) Flight Mode Match (RAT/TRI & DFGC in same mode).

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(g) Flight Mode Match (TRI & DFGC in same mode).

WJE ALL

(13) Provides failure display annunciations as follows:

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(a) Trips flags over display of RAT and/or EPR LIM for indicator failures of critical power supplies, primary power, mode mismatch and lack of servo null.

(b) Trips RAT flag for RAT probe failures out of range.

(c) Trips EPR flag for DFGC failures and non-normal bleed air system logic inputs.

(d) Trips EPR flag and annunciates NO MODE for certain assumed temperature select failures.

(e) Trips EPR flag, displays EPR 1.30 Limit, and annunciates for CADC NO MODE failures detected by the DFGC.

(f) Trips EPR flag, displays EPR 2.00 limit, and annunciates NO MODE for uncertified engine pin logic inputs.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(g) EPR LIM will blank for indicator failures of critical power supplies, primary power, mode mismatch and lack of servo null.

(h) EPR blanks for DFGC failures and non-normal bleed air system logic inputs.

(i) EPR blanks and annunciates NO MODE for certain assumed temperature select failures.

(j) EPR displays EPR 1.30 Limit, and annunciates for CADC NO MODE failures detected by the DFGC.

(k) EPR displays EPR 2.00 limit, and annunciates NO MODE for uncertified engine pin logic inputs.

WJE ALL

(14) During initial application of power, reapplication of interrupted power, or following release of the self test pushbutton, the indicator latches to the NO MODE state. Selection of the desired flight mode is required to acquire a valid EPR LIM display and flight mode.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

E. The RAT/TRI supplies the DFGC with flight mode information output from the mode selector switches mounted on the face of the indicator. The indicator will compare the selected mode with the mode the computer is operating in. If mode agreement is not reached NO MODE will be annunciated and the EPR LIM flag will come into view. If the mode is in agreement, the mode pushbutton will illuminate blue. The external go-around signal overrides all other modes when the airplane is airborne, so that when the palm switches on the throttles are pressed, the GA mode is annunciated and autothrottle will operate to GA thrust if previously engaged.

F. Failure warning inputs from the DFGC are processed by the RAT/TRI and displayed by operation of the EPR LIM flag and "NO MODE" light.

G. System test is actuated by pressing and holding the test button located on the indicator bezel. Upon activation of system test, the RAT/TRI will display +12 degrees C RAT and EPR limit based on engine type installed.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

H. The TRI supplies the DFGC with flight mode information output from the mode selector switches mounted on the face of the indicator. The indicator will compare the selected mode with the mode the computer is operating in. If mode agreement is not reached NO MODE will be annunciated and EPR LIM will blank. If the mode is in agreement, the mode pushbutton will illuminate blue. The external go-around signal overrides all other modes when the airplane is airborne, so that when the palm switches on the throttles are pressed, the GA mode is annunciated and autothrottle will operate to GA thrust if previously engaged.

I. Failure warning inputs from the DFGC are processed by the TRI and the EPR LIM will blank and "NO MODE" light will come on.

J. System test is actuated by pressing and holding the test button located on the indicator bezel. Upon activation of system test, the TRI will display EPR limit based on engine type installed.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

K. System test is actuated by pressing and holding the test button located on the indicator bezel. Upon activation of system test, the RTI will display +12 degrees C RAT and EPR limit based on engine type installed.

L. The temperature select panel provides the means to manually transmit an assumed temperature to the digital flight guidance computer for EPR limit for variable derated thrust values over a range of assumed temperatures. The temperature select panel is armed only when TO FLEX mode has been selected on the RAT/ Thrust rating indicator.

Table 1 VALID TRI Modes

PACKS	ENGINE ANTI-ICE	AIRFOIL ANTI-ICE	CROSS FEED VALVE	THRUST RATING INDICATOR MODE					
				TO	TO FLX	GA	MCT	CL	CR
OFF	OFF	OFF	ANY POSIT	X_1	X	X	NM	NM	NM
OFF	ONE or BOTH	OFF	ANY POSIT	X_1	X_1	X_2	NM	NM	NM
OFF	ONE or BOTH	ONE or BOTH	ANY OPEN	X_1	X_1	X_2	NM	NM	NM
OFF	ONE or BOTH	ONE or BOTH	BOTH OPEN	X_1	X_1	X_2	NM	NM	NM
ONE or BOTH	OFF	OFF	ANY POSIT	X	X	X	X	X	X
ONE or BOTH	ONE or BOTH	OFF	ANY POSIT	X_1	X_1	X_2	X	X	X
ONE or BOTH	ONE or BOTH	ONE or BOTH	ONE OPEN	X_1	X_1	X_2	X	NM	X
ONE or BOTH	ONE or BOTH	ONE or BOTH	BOTH OPEN	X_1	X_1	X_2	NM	X	X
OFF	OFF	ONE or BOTH	ANY POSIT	NM	NM	NM	NM	NM	NM
ONE or BOTH	OFF	ONE or BOTH	ANY POSIT	NM	NM	NM	NM	NM	NM
NM = Indicates NO MODE in that configuration (non-normal bleed air configuration).									
X = VALID - EPR indication and NO MODE light de-energized and mode pushbutton illuminated for mode selected.									
X_1 = RAT below 10°C									

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

Table 1 VALID TRI Modes (Continued)

PACKS	ENGINE ANTI-ICE	AIRFOIL ANTI-ICE	CROSS FEED VALVE	THRUST RATING INDICATOR MODE					
				TO	TO FLX	GA	MCT	CL	CR
X_2 = RAT below 14°C									

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

M. The assumed temperature select provides the means to manually transmit an assumed temperature to the digital flight guidance computer for EPR limit for variable derated thrust values over a range of assumed temperatures. The temperature select is armed only when TO FLEX mode has been selected on the Thrust rating indicator.

Table 2 VALID TRI Modes

PACKS	ENGINE ANTI-ICE	AIRFOIL ANTI-ICE	CROSS FEED VALVE	THRUST RATING INDICATOR MODE					
				TO	TO FLX	GA	MCT	CL	CR
OFF	OFF	OFF	ANY POSIT	X_1	X	X	NM	NM	NM
OFF	ONE or BOTH	OFF	ANY POSIT	X_1	X_1	X_2	NM	NM	NM
OFF	ONE or BOTH	ONE or BOTH	ANY OPEN	X_1	X_1	X_2	NM	NM	NM
OFF	ONE or BOTH	ONE or BOTH	BOTH OPEN	X_1	X_1	X_2	NM	NM	NM
ONE or BOTH	OFF	OFF	ANY POSIT	X	X	X	X	X	X
ONE or BOTH	ONE or BOTH	OFF	ANY POSIT	X_1	X_1	X_2	X	X	X
ONE or BOTH	ONE or BOTH	ONE or BOTH	ONE OPEN	X_1	X_1	X_2	X	NM	X
ONE or BOTH	ONE or BOTH	ONE or BOTH	BOTH OPEN	X_1	X_1	X_2	NM	X	X
OFF	OFF	ONE or BOTH	ANY POSIT	NM	NM	NM	NM	NM	NM
ONE or BOTH	OFF	ONE or BOTH	ANY POSIT	NM	NM	NM	NM	NM	NM
NM = Indicates NO MODE in that configuration (non-normal bleed air configuration).									
X = VALID - EPR indication and NO MODE light de-energized and mode pushbutton illuminated for mode selected.									
X_1 = RAT below 10°C									
X_2 = RAT below 14°C									

WJE ALL

N. The Valid TRI Mode notes are as follows:

(1) The thrust rating indicator (TRI) provides valid EPR values for the modes and temperature limitations listed above.

(2) The TRI corrections for ice protection are determined by both the airfoil anti-ice switch and the crossfeed valve positions. A crossfeed valve must be opened when airfoil anti-ice is selected in order to obtain airfoil anti-ice EPR correction. However, corresponding switch and valve, i.e., right crossfeed valve with right airfoil anti-ice switch selected, is not required to be activated simultaneously for TRI ice protection correction.

(3) MCT is a single engine mode and the TRI requires one crossfeed valve closed when airfoil ice protection is selected.

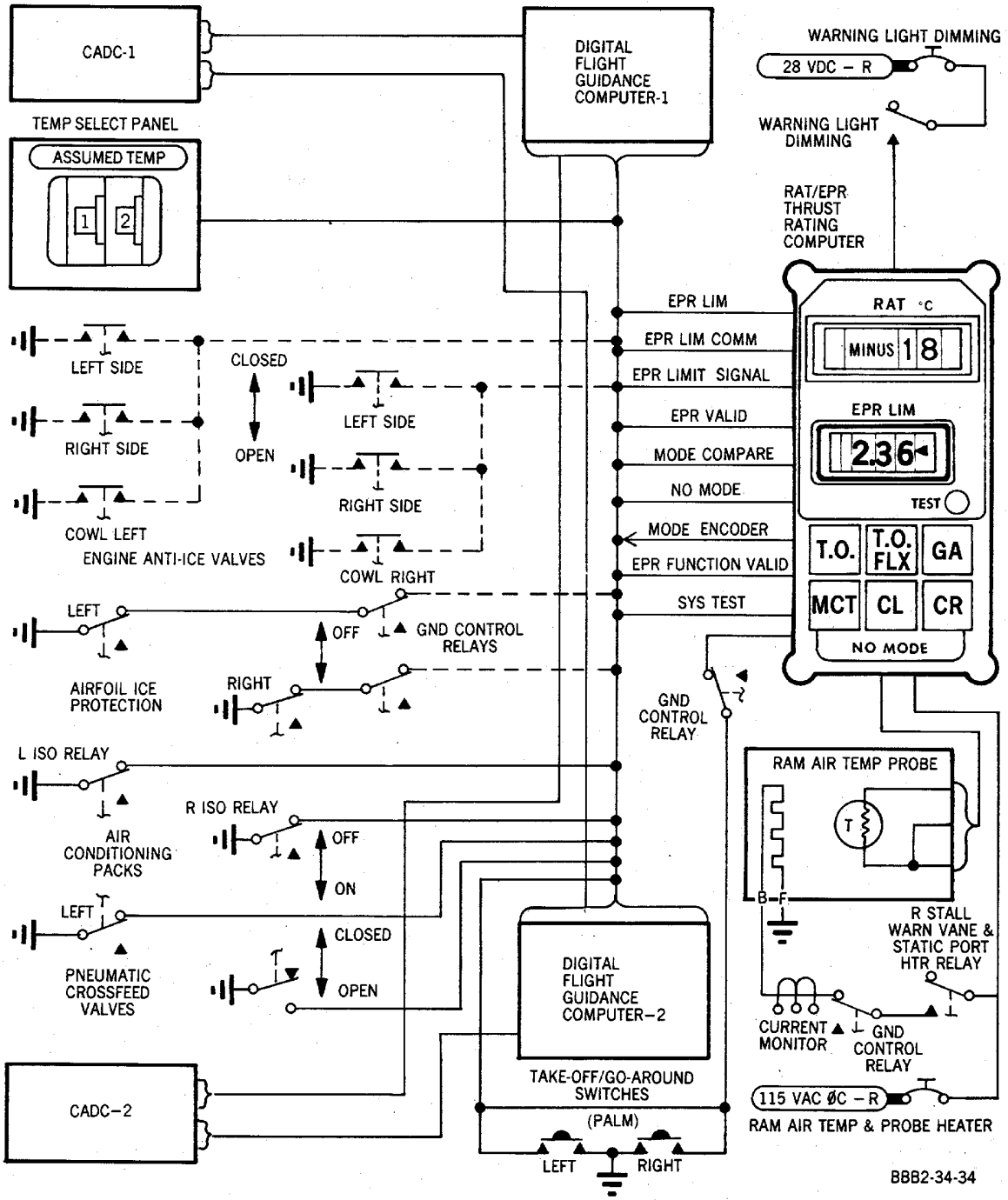
WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(4) The airfoil anti-ice and RAT probe heater are wired through the ground control relay and cannot be normally selected while the aircraft is on the ground. The remote selection of the TRI GA mode is also wired through the ground control relay; therefore remote GA mode selection is possible only when the aircraft is airborne.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(5) The airfoil anti-ice is wired through the ground control relay and cannot be normally selected while the aircraft is on the ground. The remote selection of the TRI GA mode is also wired through the ground control relay; therefore remote GA mode selection is possible only when the aircraft is airborne.

WJE ALL



Ram Air Temperature and Thrust Rating System
Figure 1/34-18-00-990-801

RAM AIR TEMPERATURE AND THRUST RATING SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ram air temperature and thrust rating system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the system are: RAT/Thrust Rating Indicator and Temperature Select Panel. The system interfaces with Central Air Data Computers, Digital Flight Guidance Computers, and Ram Air Temperature Probe. In trouble shooting checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The RAT/Thrust Rating components are located as follows:

Table 101

Component	Location
RAT/Thrust Rating Indicator	Center Instrument Panel
Ram Air Temp & Probe Heater Circuit Breakers	Lower EPC Circuit Breaker Panel
Temperature Select Panel	Left Upper Instrument Panel

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting RAT/Thrust Rating System

A. Trouble Shoot

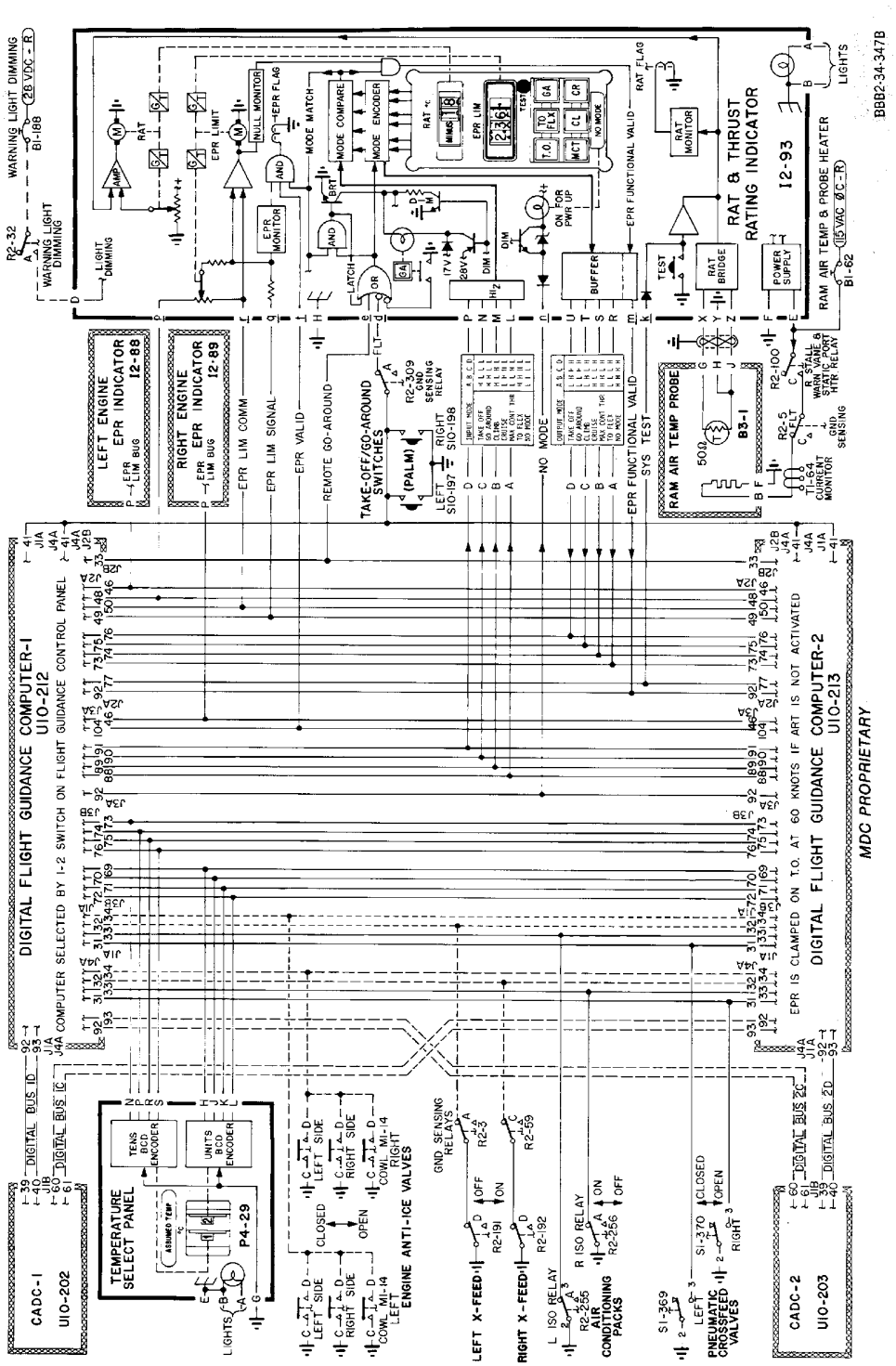
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are RAT/Thrust Rating Indicator, Central Air Data Computers, Digital Flight Guidance Computers, Temperature Select Panel, and RAT Probe.

Table 103

Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

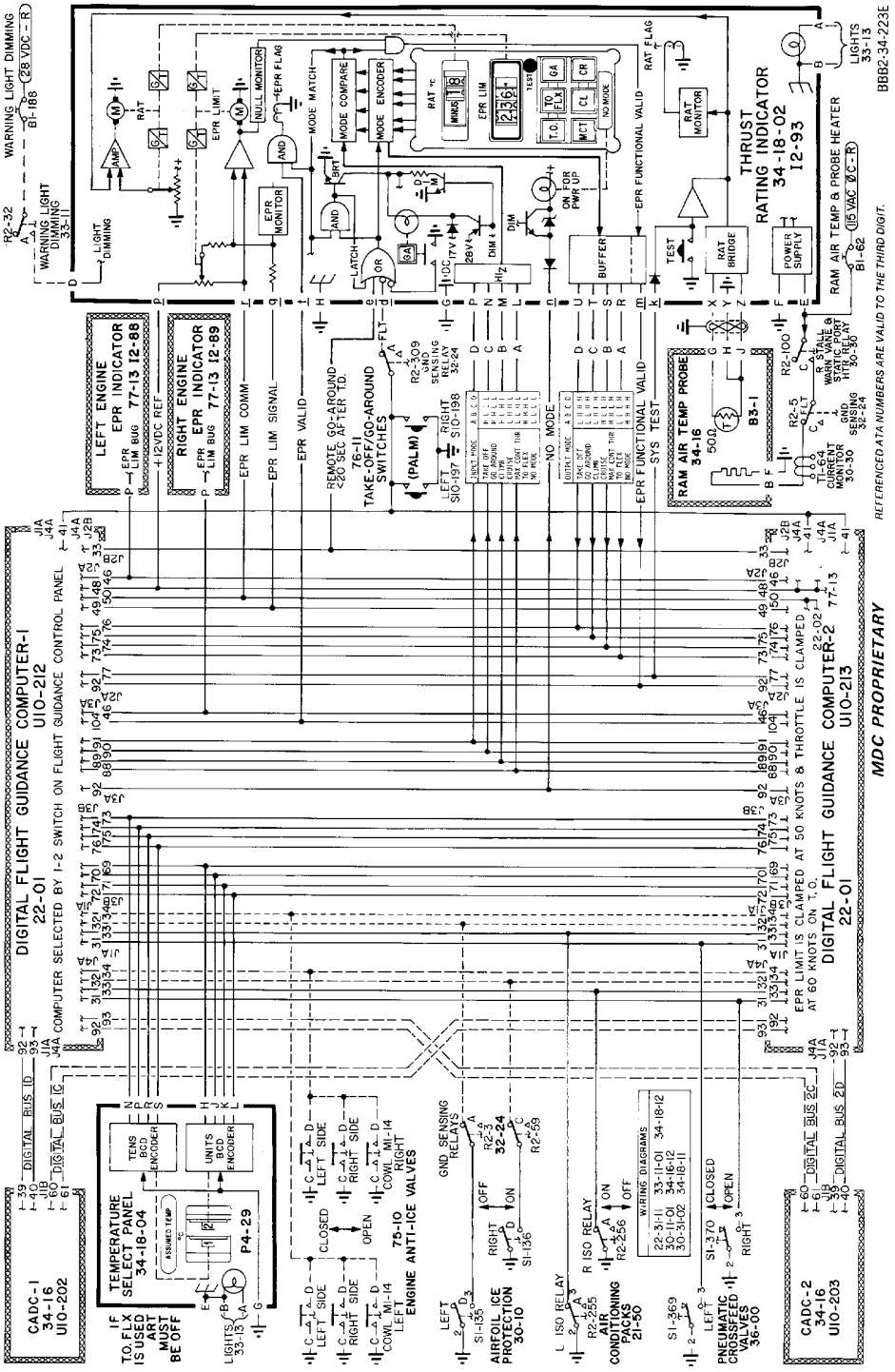
Table 103 (Continued)

Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	

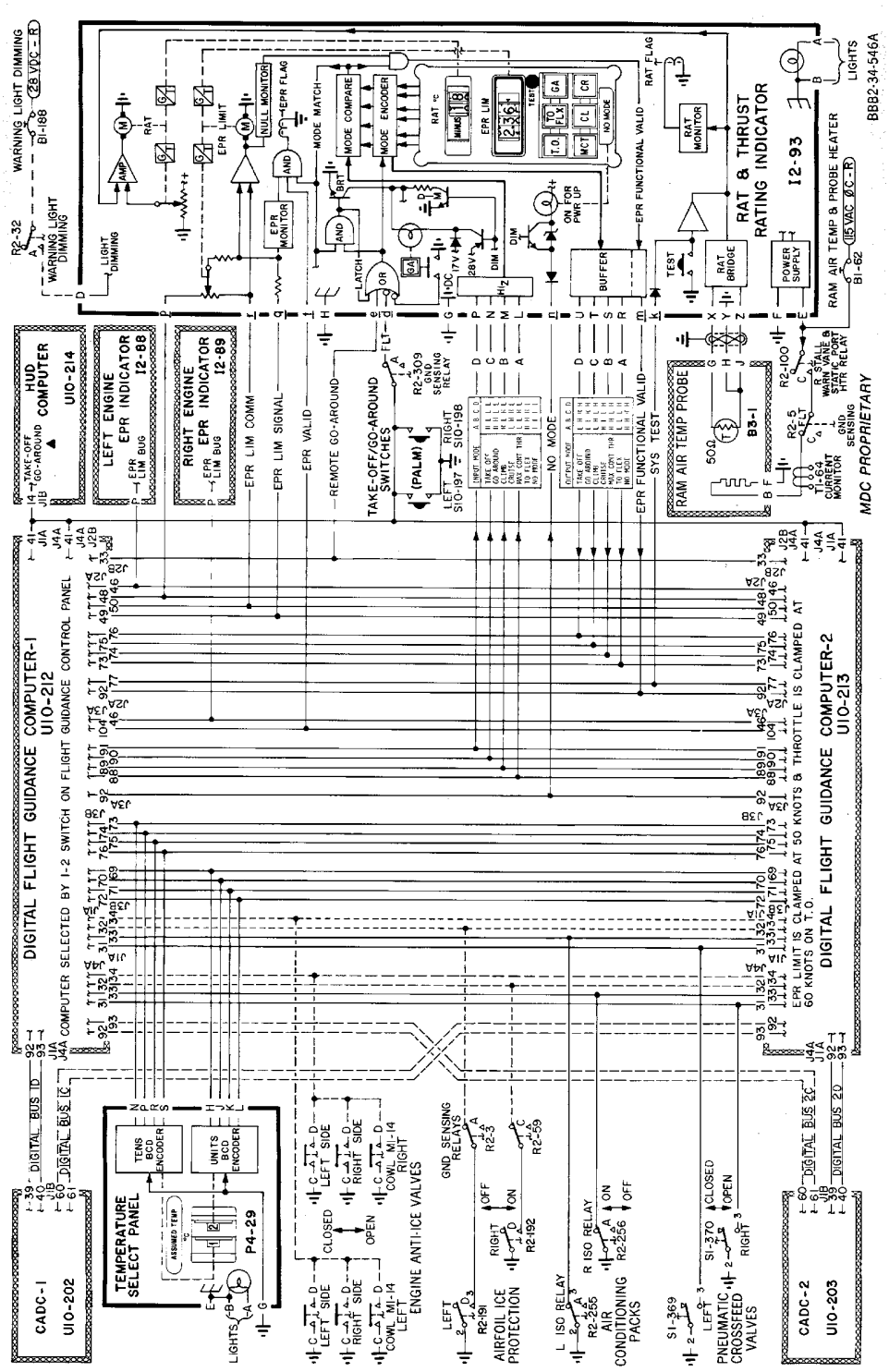


Ram Air Temperature and Thrust Rating System -- Schematic
Figure 101/34-18-00-990-802 (Sheet 1 of 3)

EFFECTIVITY
WJE 405, 409, 881, 883, 884



Ram Air Temperature and Thrust Rating System -- Schematic
Figure 101/34-18-00-990-802 (Sheet 2 of 3)



Ram Air Temperature and Thrust Rating System -- Schematic
Figure 101/34-18-00-990-802 (Sheet 3 of 3)

THRUST RATING SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty thrust rating system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the system are: Thrust Rating Panel. The system interfaces with Central Air Data Computers, Digital Flight Guidance Computers, Engine Display Panel and System Display Panel. In trouble shooting checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The Thrust Rating components are located as follows:

Table 101

Component	Location
Thrust Rating Panel	Center Instrument Panel
Ram Air Temp & Probe Heater Circuit Breakers	Lower EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting RAT/Thrust Rating System

A. Trouble Shoot

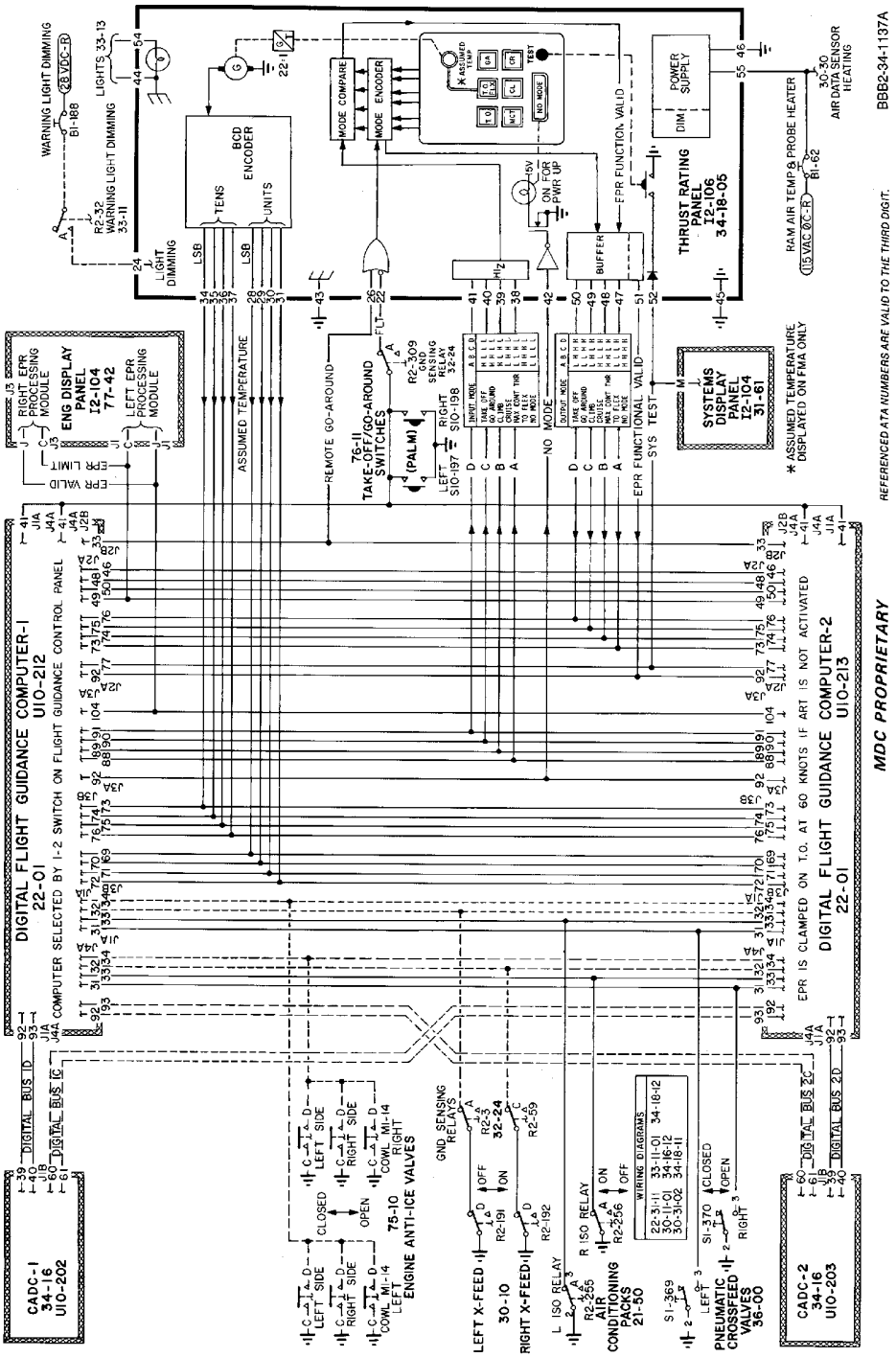
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Thrust Rating, Central Air Data Computers, Digital Flight Guidance Computers, Engine Display Panel and System Display Panel.

Table 103

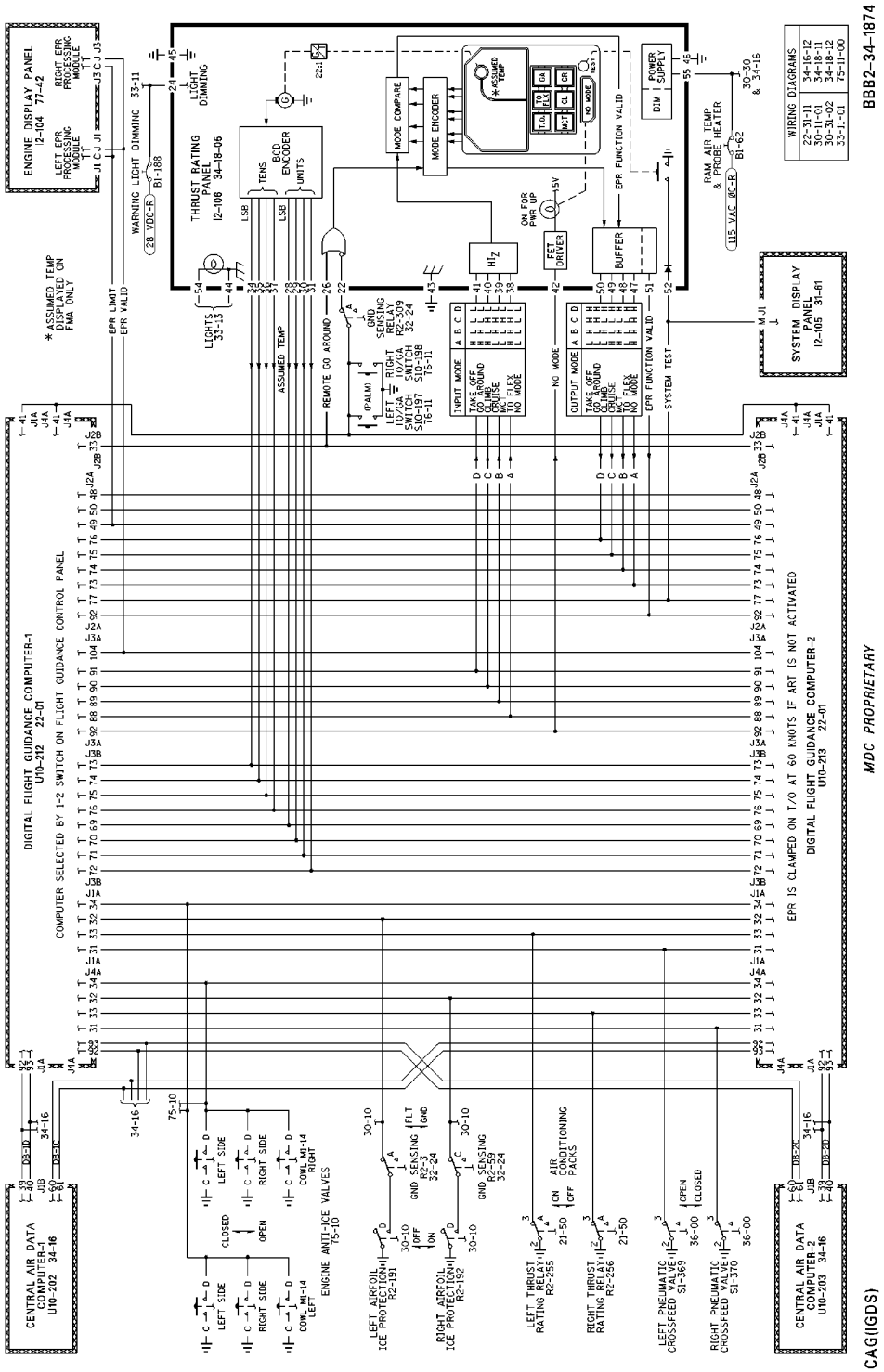
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

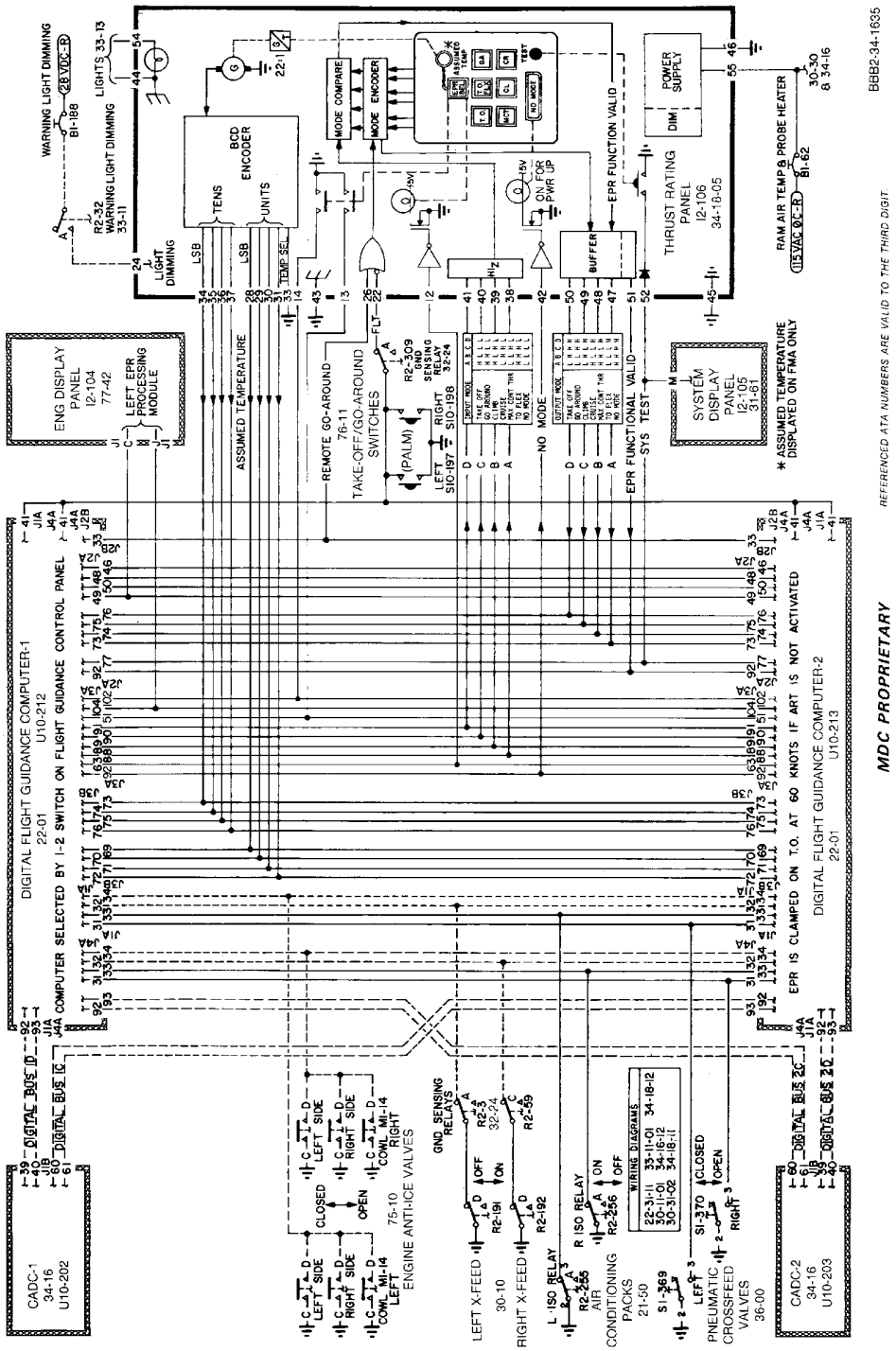
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201).	



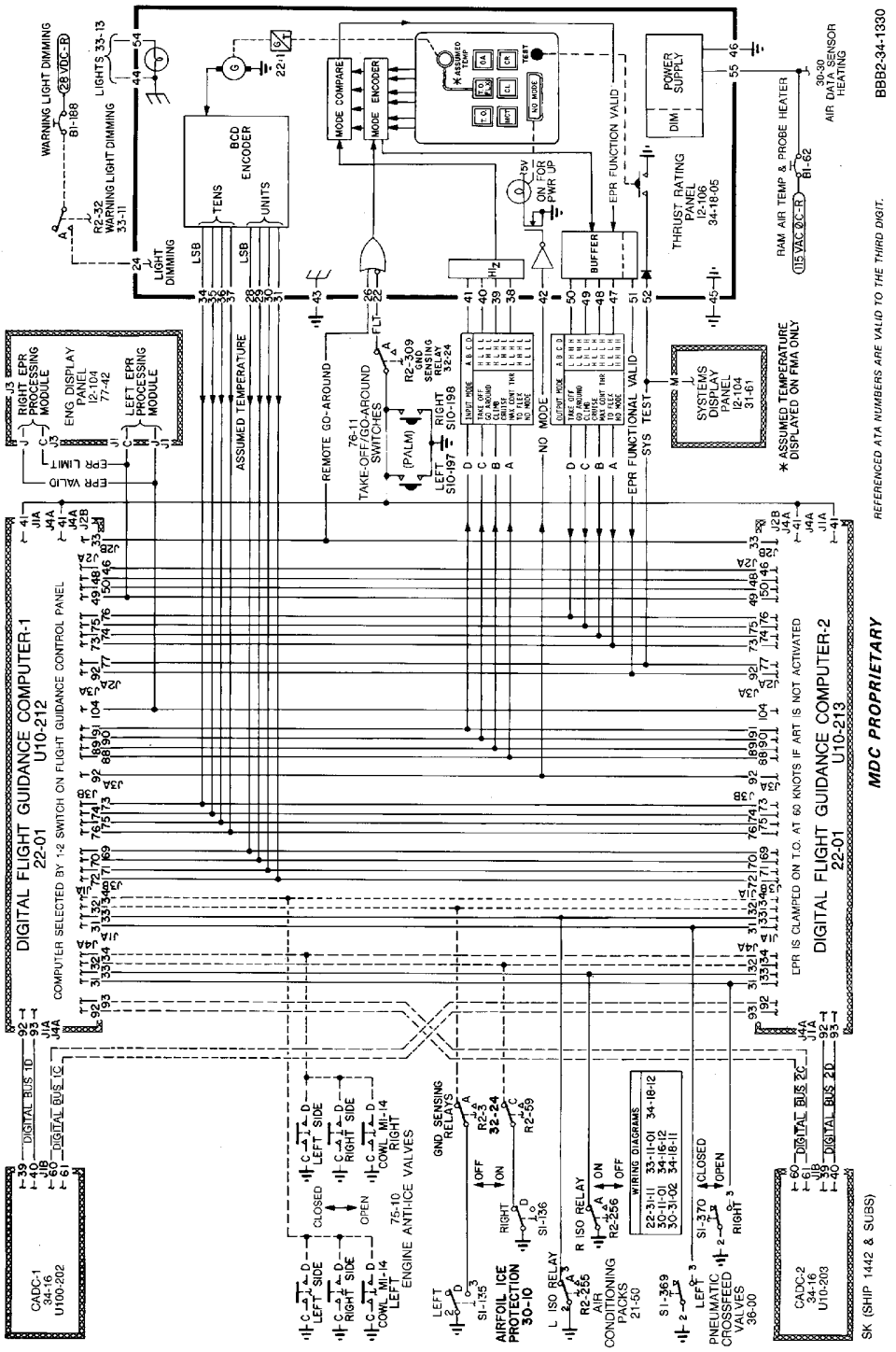
Thrust Rating System -- Schematic
Figure 101/34-18-00-990-803 (Sheet 1 of 4)



Thrust Rating System -- Schematic
Figure 101/34-18-00-990-803 (Sheet 2 of 4)



Thrust Rating System -- Schematic
Figure 101/34-18-00-990-803 (Sheet 3 of 4)



Thrust Rating System -- Schematic
Figure 101/34-18-00-990-803 (Sheet 4 of 4)

RAM AIR TEMPERATURE AND THRUST RATING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The ram air temperature and thrust rating system consists of the ram air temperature/thrust rating indicator and a temperature select panel. The system interfaces with the digital flight guidance computer, ram air temperature probe and various engine bleed configurations to provide numeric display of ram air temperature and thrust rating parameters (EPR) on the ram air temperature/thrust rating indicator.

NOTE: The following Maintenance Practices are applicable for airplanes with JT8D-217, 217A or 219 engines. Refer to (SUBJECT 71-02-00, Page 201) for instructions if intermix installation of JT8D-217 and JT8D-217A engines is accomplished on the airplane.

2. Adjustment Test

NOTE: The following tests are made with AP-ON switch in the No. 1 A/P position. To test A/P-2, place switch in -2 position and repeat test.

NOTE: During the following tests make certain the ANTI ICE HEATER AND AMMETER SELECTOR switch on the overhead panel is in the OFF position.

A. System Test

Table 201 Table I

Engines	RAT	LIM
JT8D-209	+12°C(±1°)	1.86(±0.01)
JT8D-217	+12°C(±1°)	1.94(±0.01)
JT8D-217A	+12°C(±1°)	2.04(±0.01)
JT8D-217C	+12°C(±1°)	2.04(±0.01)
JT8D-219	+12°C(±1°)	2.08(±0.01)

Table 202

Step	Operation	Desired Result
(1)	Place autopilot DFGC switch to 1.	
(2)	Verify that Ram Air Temperature/Thrust Rating indicator (RTI) on Center Instrument Panel displays following:	
	RAT FLAG	OUT OF VIEW
	RAT	AMBIENT (±5°C)
	EPR LIM FLAG	IN VIEW
	NO MODE Annunciation	Amber light ON
(3)	Depress TEST pushbutton located on RTI front panel and verify following:	
	RAT FLAG	OUT OF VIEW
	RAT	+12°C (±1°C)
	EPR LIM FLAG	OUT OF VIEW
	EPR LIM	SEE Table 201
(4)	Release TEST pushbutton and verify following display:	
	RAT FLAG	OUT OF VIEW
	RAT	AMBIENT (±5°C)

Table 202 (Continued)

Step	Operation	Desired Result
	EPR LIM FLAG	IN VIEW
	EPR LIM	2.00 (±.01)
	NO MODE Annunciation	Amber light ON
(5)	Depress TO mode pushbutton on front panel of RTI.	Only TO mode annunciated bright blue.
WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.		
(6)	Open these circuit breakers and install safety tags:	
	REF DES: B1-23 — CIRCUIT BREAKERS: LEFT GROUND CONTROL RELAY — LOCATION AND PANEL AREA: UPPER EPC BUS — ROW/COL: K/33	
	REF DES: B1-24 — CIRCUIT BREAKERS: RIGHT GROUND CONTROL RELAY — LOCATION AND PANEL AREA: UPPER EPC BUS — ROW/COL: L/33	
(7)	Depress left palm switch located on left throttle lever.	Only GA mode annunciated bright blue.
(8)	Depress TO mode pushbutton.	Only TO mode annunciated bright blue.
(9)	Depress right palm switch located on right throttle lever.	Only GA mode annunciated bright blue.
(10)	Pull 'Pull to Dim' switch located on Overhead Switch Panel.	Intensity level of only GA mode decreases.
(11)	Depress Pull to Dim switch.	Intensity level of only GA Mode increases to original level.
(12)	Depress CL mode pushbutton.	Only CL mode annunciated bright blue.
(13)	Depress CR mode pushbutton.	Only CR mode annunciated bright blue.
(14)	Depress MCT mode pushbutton.	Only MCT mode annunciated bright blue.
(15)	Depress GA mode pushbutton.	Only GA mode annunciated bright blue.
(16)	Depress TO FLEX mode pushbutton.	Only TO FLEX mode annunciated amber.
(17)	On Temperature Select Panel, set assumed temperature to 00°C.	Lower portion of FMA auto throttle window is 00.
(18)	Set temperature select panel to 55°C.	Lower portion of FMA auto throttle window is 55.
(19)	Place DFGC switch to position 2 and repeat test.	Results should be same as DFGC in position 1.
(20)	Remove the safety tags and close these circuit breakers:	

Table 202 (Continued)

Step	Operation		Desired Result	
	REF DES	CIRCUIT BREAKERS	LOCATION/AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	UPPER BUS EPC	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	UPPER BUS EPC	L/33
(21)	Return airplane to required configuration.			

RAM AIR TEMPERATURE AND THRUST RATING SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 884, 891

A. The ram air temperature and thrust rating system consists of the ram air temperature/thrust rating indicator and a temperature select panel. The system interfaces with the digital flight guidance computer, ram air temperature probe and various engine bleed configurations to provide numeric display of ram air temperature and thrust rating parameters (EPR) on the ram air temperature/thrust rating indicator.

B. On later aircraft with electronic engine display panel, EPR and RAT indications will be displayed on top portion of the electronic engine display panel. EPR and RAT indications are electronic generated digital displays. Failure indications are displayed by blanking of EPR and RAT and replaced by a dash on the electronic engine display panel. The assumed temperature select is located on the thrust rating indicator. In following test procedures, substitute procedure callouts as applicable for the thrust rating indicator and electronic engine display panel.

WJE 405, 406, 409, 410, 875-879, 881, 883, 884

NOTE: The following Maintenance Practices are applicable for aircraft with JT8D-217A, 217C or 219 engines.

Refer to ENGINE INTERMIX, SUBJECT 71-02-00, Page 201 for instructions if intermix installation of JT8D-217A, -217C and JT8D-219 engines is accomplished on the aircraft.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

NOTE: The following Maintenance Practices are applicable for aircraft with JT8D-209, 217, 217A or 219 engines. Refer to ENGINE INTERMIX, SUBJECT 71-02-00, Page 201 for instructions if intermix installation of engines is accomplished on the aircraft.

WJE 873, 874, 892, 893

C. The ram air temperature and thrust rating system consists of the ram air temperature/thrust rating indicator, the digital flight guidance computer, a ram air temperature probe, and a temperature select panel. The system interfaces with the central air data computer and various engine bleed configurations to provide numeric display of ram air temperature and thrust rating parameters (EPR) on the ram air temperature/thrust rating indicator.

NOTE: The following Maintenance Practices are applicable for aircraft with JT8D-219 engines.

WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 891-893

2. Adjustment Test

NOTE: The following tests are made with AP-ON switch in the No. 1 A/P position. To test A/P-2, place switch in -2 position and repeat test.

NOTE: During the following tests make certain the ANTI ICE HEATER AND AMMETER SELECTOR switch on the overhead panel is in the OFF position.

A. System Test

Table 201 Table I

Engines	RAT	LIM
JT8D-209	+12°C(±1°)	1.86(±0.01)
JT8D-217	+12°C(±1°)	1.94(±0.01)
JT8D-217A	+12°C(±1°)	2.04(±0.01)

Table 201 Table I (Continued)

Engines	RAT	LIM
JT8D-217C	+12°C(±1°)	2.04(±0.01)
JT8D-219	+12°C(±1°)	2.08(±0.01)

Table 202

Operation		Desired Result
(1)	Place Autopilot DFGC switch to 1.	
WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 884, 891		
(2)	Verify that ram air temperature (RAT) and thrust rating indications (EPR) are as follows:	
WJE 873, 874, 892, 893		
(2)	Verify that Ram Air Temperature/Thrust Rating Indicator (RAT/TRI) on Center Instrument Panel displays the following:	
WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 891-893		
	RAT FLAG	OUT OF VIEW
	RAT	AMBIENT (±5°C)
	EPR LIM FLAG	IN VIEW
	NO MODE Annunciation	Amber light ON
WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 884, 891		
(3)	Depress TEST pushbutton located on RTI front panel and verify following:	
WJE 873, 874, 892, 893		
3	Depress TEST pushbutton located on RAT/TRI front panel and verify following:	
WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 891-893		
	RAT FLAG	OUT OF VIEW
	RAT	+12°C(±1°C)
	EPR LIM FLAG	OUT OF VIEW
	EPR LIM	SEE Table 201
(4)	Release TEST pushbutton and verify following display:	
	RAT FLAG	OUT OF VIEW
	RAT	AMBIENT (±5°C)
	EPR LIM FLAG	IN VIEW
WJE 415-427, 429, 861-866, 868, 869, 871-874, 891-893		
	EPR LIM	2.00(±.01)

WJE 415-427, 429, 861-866, 868, 869, 871-874, 891-893 (Continued)

Table 202 (Continued)

Operation		Desired Result
WJE 405, 406, 409, 410, 875-879, 881, 883, 884		
	EPR LIM	SEE Table 201
WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 891-893		
	NO MODE Annunciation	Amber light ON
WJE 405, 406, 409, 410, 875-879, 881, 883, 884		
(5)	Depress TO mode pushbutton on front panel of RTI.	Only TO mode annunciated bright blue.
WJE 873, 874, 892, 893		
(5)	Depress TO mode pushbutton on front panel of RAT/TRI.	Only TO mode annunciated bright blue.
WJE 405, 406, 409, 410, 873-879, 881, 883, 884, 892, 893		
WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.		
(6)	Open these circuit breakers and install safety tags:	

REF DES	CIRCUIT BREAKERS	LOCATION	PANEL AREA	ROW/COL
B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33

(7)	Depress left palm switch located on left throttle lever.	Only GA mode annunciated bright blue.
(8)	Depress TO mode pushbutton.	Only TO mode annunciated bright blue.
(9)	Depress right palm switch located on right throttle lever.	Only GA mode annunciated bright blue.
(10)	Pull 'Pull to Dim' switch located on Overhead Switch Panel.	Intensity level of only GA mode decreases.
(11)	Depress Pull to Dim switch.	Intensity level of only GA Mode increases to original level.
(12)	Depress CL mode pushbutton.	Only CL mode annunciated bright blue.
(13)	Depress CR mode pushbutton.	Only CR mode annunciated bright blue.

WJE 405, 406, 409, 410, 873-879, 881, 883, 884, 892, 893 (Continued)

Table 202 (Continued)

Operation		Desired Result
(14)	Depress MCT mode pushbutton.	Only MCT mode annunciated bright blue.
(15)	Depress GA mode pushbutton.	Only GA mode annunciated bright blue.
(16)	Depress TO FLEX mode pushbutton.	Only TO FLEX mode annunciated amber.
(17)	On Temperature Select Panel, set assumed temperature to 00°C.	Lower portion of FMA auto-throttle window is 00.
(18)	Set assumed temperature to 55°C.	Lower portion of FMA auto throttle window is 55.
(19)	Place DFGC switch to position 2 and repeat test.	Results should be same as DFGC in position 1.
(20)	Return aircraft to required configuration.	
(21)	Remove the safety tags and close these circuit breakers:	

REF DES	CIRCUIT BREAKERS	LOCATION	PANEL AREA	ROW/COL
B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(5)	Depress GA mode pushbutton.	Only GA mode annunciated bright blue.
(6)	Depress TO FLEX mode pushbutton.	Only TO FLEX mode annunciated amber.
(7)	On Temperature Select Panel, set assumed temperature to 00°C.	Lower portion of FMA auto-throttle window is 00.
(8)	Set assumed temperature to 55°C.	Lower portion of FMA auto throttle window is 55.
(9)	Place DFGC switch to position 2 and repeat test.	Results should be same as DFGC in position 1.
(10)	Return aircraft to required configuration.	

RAM AIR TEMPERATURE AND THRUST RATING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The ram air temperature and thrust rating system consists of the thrust rating indicator and interfaces with the digital flight guidance computer, a ram air temperature probe, central air data computer and various engine bleed configurations to provide numeric display of ram air temperature and thrust rating parameters (EPR) on the electronic engine display panel. An assumed temperature select adjustment control is located on the thrust rating indicator. The assumed temperature is displayed on the lower portion of the flight mode annunciator.

NOTE: The following Maintenance Practices are applicable for aircraft with JT8D-217A or -217C engines and with JT8D-219 engines.

2. Adjustment Test

NOTE: The following tests are made with AP-ON switch in the No. 1 A/P position. To test A/P-2, place switch in -2 position and repeat test.

NOTE: During the following tests make certain the ANTI ICE HEATER AND AMMETER SELECTOR switch on the overhead panel is in the OFF position.

A. System Test

Table 201 Table I

Engines	RAT	LIM
JT8D-209	+12°C(±1°)	1.86(±0.01)
JT8D-217	+12°C(±1°)	1.94(±0.01)
JT8D-217A	+12°C(±1°)	2.04(±0.01)
JT8D-217C	+12°C(±1°)	2.04(±0.01)
JT8D-219	+12°C(±1°)	2.08(±0.01)

Table 202

Operation		Desired Result
(1)	Place Autopilot DFGC switch to 1.	
(2)	Verify that Ram Air Temperature (RAT) and Thrust Rating indications (EPR) are displayed on electronic engine display panel as follows:	
	RAT	AMBIENT (±5°C)
	EPR	No display
	NO MODE Annunciation	Light ON
(3)	Depress TEST pushbutton located on TRI front panel and verify following:	
	RAT	+12°C (±1°C)
	EPR LIM	SEE Table 201
(4)	Release TEST pushbutton and verify following display:	
	RAT	AMBIENT (±5°C)
	EPR LIM	No Display
	NO MODE Annunciation	Amber light ON

Table 202 (Continued)

Operation		Desired Result
(5)	Depress "TO" mode pushbutton on front panel of TRI.	Only TO mode annunciated bright blue.

WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(6) Open these circuit breakers and install safety tags:

REF DES	CIRCUIT BREAKERS	LOCATION	PANEL AREA	ROW/COL
B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33

(7)	Depress left palm switch located on left throttle lever.	Only GA mode annunciated bright blue.
(8)	Depress TO mode pushbutton.	Only TO mode annunciated bright blue.
(9)	Depress right palm switch located on right throttle lever.	Only GA mode annunciated bright blue.
(10)	Pull pull to dim switch located on overhead switch panel.	Intensity level of only GA mode decreases.
(11)	Depress pull to dim switch.	Intensity level of only GA Mode increases to original level.
(12)	Depress CL mode pushbutton.	Only CL mode annunciated bright blue.
(13)	Depress CR mode pushbutton.	Only CR mode annunciated bright blue.
(14)	Depress MCT mode pushbutton.	Only MCT mode annunciated bright blue.
(15)	Depress GA mode pushbutton.	Only GA mode annunciated bright blue.
(16)	Depress (FLEX TO) mode pushbutton.	Only (FLEX TO) mode annunciated bright amber.
(17)	On thrust rating indicator, set assumed temperature to 00°C.	Lower portion of FMA auto throttle window is 00.
(18)	Set temperature select to 55°C.	Lower portion of FMA auto throttle window is 55.
(19)	Place DFGC switch to position 2 and repeat test.	Results should be same as DFGC in position 1.

(20) Remove the safety tags and close these circuit breakers:

REF DES	CIRCUIT BREAKERS	LOCATION	PANEL AREA	ROW/COL
B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33

Table 202 (Continued)

Operation			Desired Result		
	B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33
(21)	Return aircraft to required configuration.				

RAT/THRUST RATING INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the RAT/Thrust Rating Indicator. The RAT/Thrust Rating Indicator is located in the flight compartment, on the center instrument panel. (Figure 201) The indicator operates in conjunction with the digital flight guidance computer to display total air temperature (RAT), and N_1/EPR limit for existing temperature and altitude consistent with operating condition selected.

NOTE: If necessary, the center instrument panel can be opened for access to the indicator wiring. (INSTRUMENTS, CHAPTER 31)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Lamp, NO MODE annunicator, P/N CM7-7839	Chicago Miniature/Drake
Filter, lamp, P/N D231-100-4	Master Dynamics Corp.

3. Removal/Installation RAT/Thrust Rating Indicator

A. Remove Indicator

NOTE: Indicator light failure is not cause for unit removal. Before removing indicator, check/replace non-functioning mode indicator lamps. To do this, pull out mode switch light lens to gain access to lamp. To replace NO MODE annunciator, refer to Section Paragraph 4., NO MODE Annunciator Lamp Replacement.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	25	B1-188	WARNING LIGHT DIMMING

(2) Remove mounting screws from front of RAT/Thrust Rating Indicator.

(3) Carefully remove indicator from instrument panel and disconnect electrical connector from instrument.

(4) If indicator is not to be installed for a period of time, it is recommended to place dust cover on electrical connector and stow wiring to prevent damage to connector and wiring.

B. Install Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	25	B1-188	WARNING LIGHT DIMMING

(2) Check indicator and aircraft wiring connector for residue or bent pins in connector.

(3) Connect electrical connector to indicator.

(4) Carefully insert indicator into instrument panel mounting hole and install mounting screws in indicator.

NOTE: If instrument panel is open, the electrical connector may be installed after indicator is mounted in panel.

(5) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	25	B1-188	WARNING LIGHT DIMMING

(6) Press and hold TEST button on front of indicator/panel and check RAT and EPR LIM indications as follows:

Table 202

Engines	RAT	LIM
JT8D-209	+12°C(±1°)	1.86(±0.01)
JT8D-217	+12°C(±1°)	1.94(±0.01)
JT8D-217A	+12°C(±1°)	2.04(±0.01)
JT8D-217C	+12°C(±1°)	2.04(±0.01)
JT8D-219	+12°C(±1°)	2.08(±0.01)

(7) Perform Return to Service (RTS) test. (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 1 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 3 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 6 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 4 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 5 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 10 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 11)

(8) Return aircraft to required configuration.

4. NO MODE Annunciator Lamp Replacement

A. Replace Lamp (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	25	B1-188	WARNING LIGHT DIMMING

(2) Remove socket head screws and washers from NO MODE lens.

CAUTION: DO NOT PRY LENS FROM SIDES. LENS IS EASILY SCRATCHED. SCRATCHES MAKE LEGEND ILLEGIBLE TO FLIGHT CREW.

(3) Remove NO MODE lens by placing small, flat screwdriver in screw holes and carefully lift out lens.

CAUTION: DO NOT RIP OR TEAR GASKET. GASKET WILL NOT PREVENT LIGHT LEAKS IF RIPPED OR TORN.

(4) Remove panel gasket.

(5) Remove defective lamp using small, tweezer-type device. Pull lamp straight out.

(6) Install new lamp.

(7) Discard and replace amber filter.

NOTE: Amber filter should be trimmed so that filter material does not cover lamp electrical contacts.

(8) Install gasket and NO MODE lens.

(9) Remove the safety tags and close these circuit breakers:

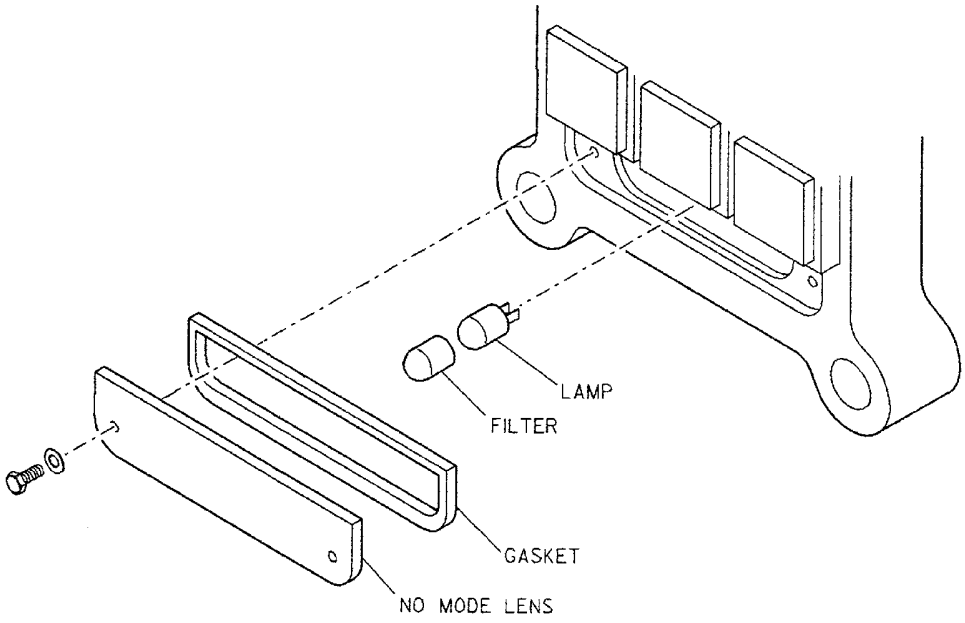
LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	25	B1-188	WARNING LIGHT DIMMING

(10) Verify NO MODE light comes on.



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NO MODE Annunciator Lamp -- Removal/Installation
Figure 201/34-18-02-990-801

STALL WARNING SYSTEM - DESCRIPTION AND OPERATION

1. General

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

A. The stall warning system continuously monitors the aircraft wing-lift loading and automatically initiates a control column shaking action by energizing a control column shaker and visual and aural indications when the airplane approaches a stall condition. A Post Stall Recovery System (PSRS) is activated if the aircraft local alpha angle increases to a post stall condition. The PSRS, when activated, causes a servo in the elevator control system to push the control column yoke forward causing an aircraft nose down attitude. The stall warning system is a dual installation with each system possessing the capability to activate all stall warning signals.

WJE 412, 414

B. The stall warning system continuously monitors the aircraft wing-lift loading and automatically initiates a control column shaking action by energizing a control column shaker and visual and aural indications when the aircraft approaches a stall condition. A Post Stall Recovery System (PSRS) is activated if the aircraft local alpha angle increases to a post stall condition. The PSRS, when activated, causes a servo in the elevator control system to push the control column yoke forward causing an aircraft nose down attitude. The stall warning system is a dual installation with each system possessing the capability to activate all stall warning signals.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

C. The aircraft stall warning system has sufficient monitoring to check the angle of attack (AOA) sensor for tolerance exceedence. If system tolerances are exceeded, a Stall Indication Failure (SIF) light on overhead annunciator panel (OAP) will alert the crew to the need for maintenance action. If the previous flight has reported no abnormalities, the AOA vanes should be considered serviceable and safe for flight.

2. Description

A. The system consists of two AOA transducers, two stall warning computers, dual control column shakers, audio recognition, signal annunciators and the PSRS (Stick Pusher Servo Actuator). A stall warning test switch is located on the overhead switch panel.

B. The AOA transducers are installed on the left and right sides of the lower fuselage nose at approximately station 80. The transducers provide a synchro signal proportional to the AOA of the aircraft. Upward motion of the trailing edge of the vane produces an increasing angle.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

C. The stall warning computers are located in the forward right radio rack of the electrical/electronic compartment. Each computer receives and combines signals from one AOA transducer, one flap position transmitter, both wing slat proximity unit outputs and one horizontal stabilizer sensor. The computer initiates a pre-stall signal that is rate and CG compensated to provide both pre-stall warning and stall recognition signals when stall conditions are approached. The front panel of the Stall Warning Computer contains Sensor Failure annunciators light emitting diodes (LEDS), System Difference annunciators (LEDS), a Computer Output annunciator (LED), SIF, Computer Failure and Auto Slat Failure annunciators (LEDS), a Memory Reset button switch and a Toggle Test switch. Five LED maintenance annunciators on the front of each computer will indicate VANE, FLAP, SLATS, COMPUTER, or STAB FAULTS. Five Difference LED indicators will indicate VANE, FLAPS, STAB, SLAT or COMPUTER differences in the absence of detected faults. COMPUTER difference is indicated only if there are no VANE, STAB, FLAP or SLAT differences. Fault or difference LEDS light only when the TEST switch on box panel is in a test position. Their status is retained up to 7 hours with power off and they will be automatically re-set at the next takeoff or by the manual re-set button on front panel. Front panel self test has two positions, NORMAL test and MAINT test. NORMAL test is in parallel with pilots self test switch and may be performed in any flap/slat position. The MAINT test requires that flaps be set to FULL UP, slats retracted STAB to 5° aircraft nose up (ANU) and vanes should be set to mid range. The alpha vanes have scribe marks which allow the mechanic to set vane to mid point (±0.5) degrees without tooling. During MAINT test the LED indicators will indicate vane, flap, stab computer or slat errors and isolate these errors to the side causing the error. In more than 95% of failures the mechanic will be directed to the line replaceable unit (LRU) causing the fault. An SIF LED on the front panel is in parallel with the cockpit SIF light. The COMPUTER OUTPUT LED on front panel comes on when self test is successful.

D. Both control column shakers are energized by the pre-stall signal from either one or both of the computers. If both systems recognize a STALL warning for a predetermined period, the stick pusher will be activated when slats are not retracted.

E. At stall conditions, a warning horn (klaxon), or an oscillating sound, or the word "STALL" is relayed to the cockpit through speakers located in the captain's and first officer's consoles.

F. Both stall recognition lights are energized and the lights flash in synchronization with the oscillating sound. The stall recognition lights are located on the glare shield.

G. Any channel malfunction or mismatch of input signals causes the stall indicator failure light to come on.

H. Stall warning activation is also affected by flap and slat information. This information is input to the stall warning computers from the flap position transmitters and the slat retracted or extended signals.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

3. Operation

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

A. Dual computers and sensors provide independent detection of stall while the outputs are "OR'ed" so that either system may trigger both shakers, horns, and lights. If both systems recognize a STALL warning for a predetermined period, the stick pusher will be activated. Alpha and flap inputs are provided by synchro transducers for added reliability. The proximity switch unit provides independent left and right slat discretes to each system corresponding to the 3 slat positions RET, MID and EXT. Each system is enabled by main gear discrete from the proximity unit and the nose oleo input initiates the pre-rotation alpha check. With weight on wheels the auto slat function is automatically tested if the FLAP/SLAT handle is moved from the UP/RET position.

WJE 412, 414

B. Dual computers and sensors provide independent detection of stall while the outputs are "OR'ed" so that either system may trigger both shakers, horns, and lights. If both systems recognize a STALL warning for a predetermined period, the stick pusher will be activated. Alpha and flap inputs are provided by synchro transducers for added reliability. The proximity switch unit provides independent left and right slat discretes to each system corresponding to the three (3) slat positions RET, MID and EXT. Each system is enabled by main gear discrete from the proximity unit and the nose oleo input initiates the pre-rotation alpha check. With weight on wheels the auto slat function is automatically tested if the FLAP/SLAT handle is moved from the UP/RET position.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

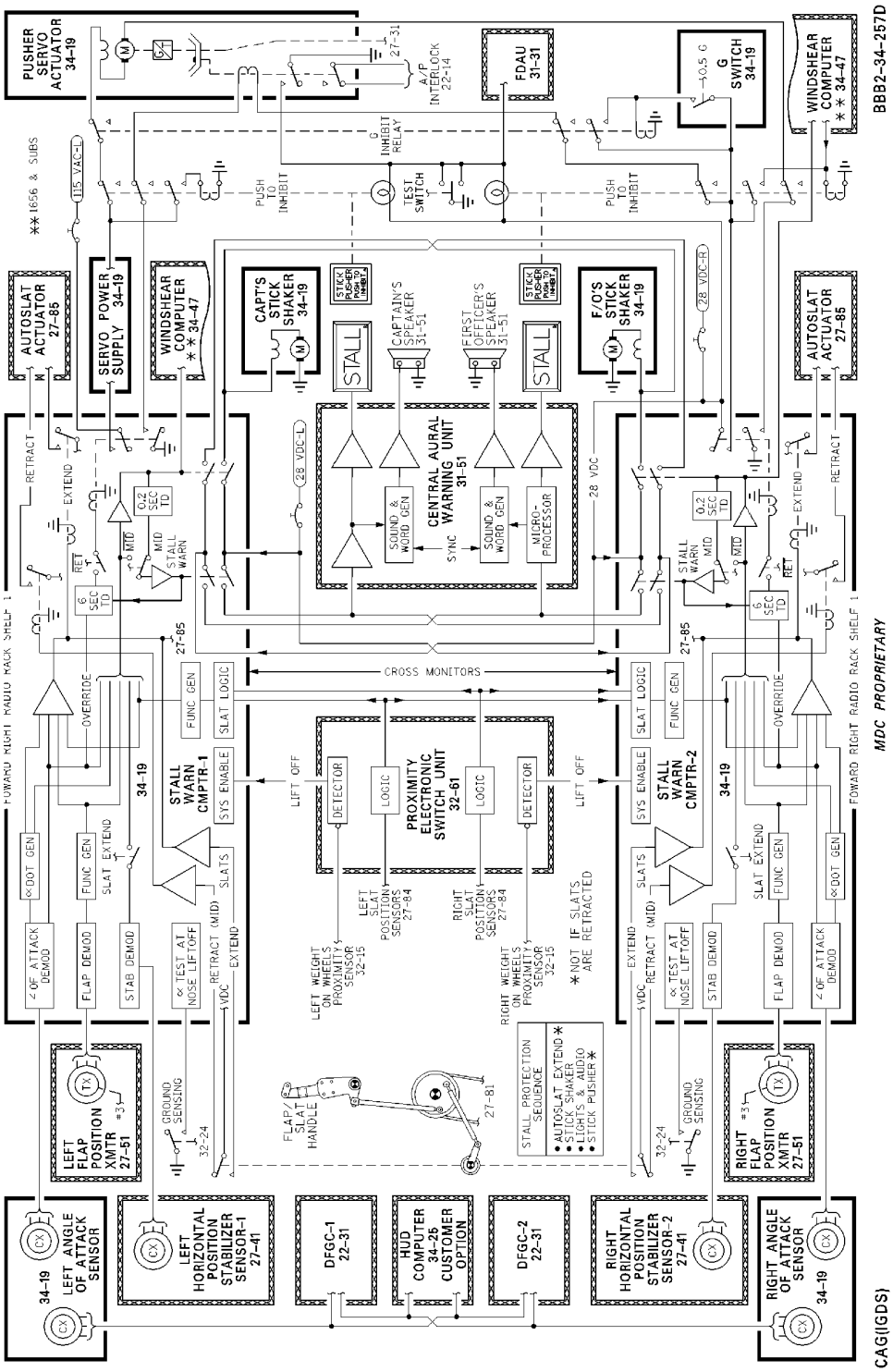
C. Outputs from each computer drive both shakers directly and drive the stall warning lights and warning horn indirectly through the Central Aural Warning system. Failures or disagreement between left and right systems are indicated to the pilot by the SIF light on the OAP. When the SIF light is on, the warning horn or aural warning is usually inhibited. The flight crew may self test each system on the ground or in flight at any flap/slat position. Some detected failures will inhibit self test.

D. The stall warning computer monitors flap and alpha synchros for opens, shorts, loss of excitation and improper voltage ratios. Monitoring is simplified by using center tapped synchros. Angle of attack is also checked just prior to rotation and if not between -3 degrees and -10 degrees of alpha local, a vane failure is indicated. Left and right slat discretes enter each box but the left box uses only left information when both are valid and switches automatically to right slat info if the left should fail. The slat valid failure from the proximity unit represents improper slat sensor sequence and certain other slat sensor faults. The stall warning computer compares left and right slat signals and will detect opens, shorts and improper signals and annunciate the failures. The computer also compares left and right vanes and flap angles as well as the computers themselves.

WARNING: IF STICK PUSHER SERVO DRIVE IS DISABLED, JUMPER PLUG (P1-2003) STOWED ADJACENT TO SERVO DRIVE PLUG TO RECEPTACLE CONNECTION (R5-520) MUST BE INSTALLED IN AIRCRAFT ELECTRICAL RECEPTACLE. AUTO PILOT WILL NOT OPERATE WHEN SERVO DRIVE PLUG IS DISCONNECTED.

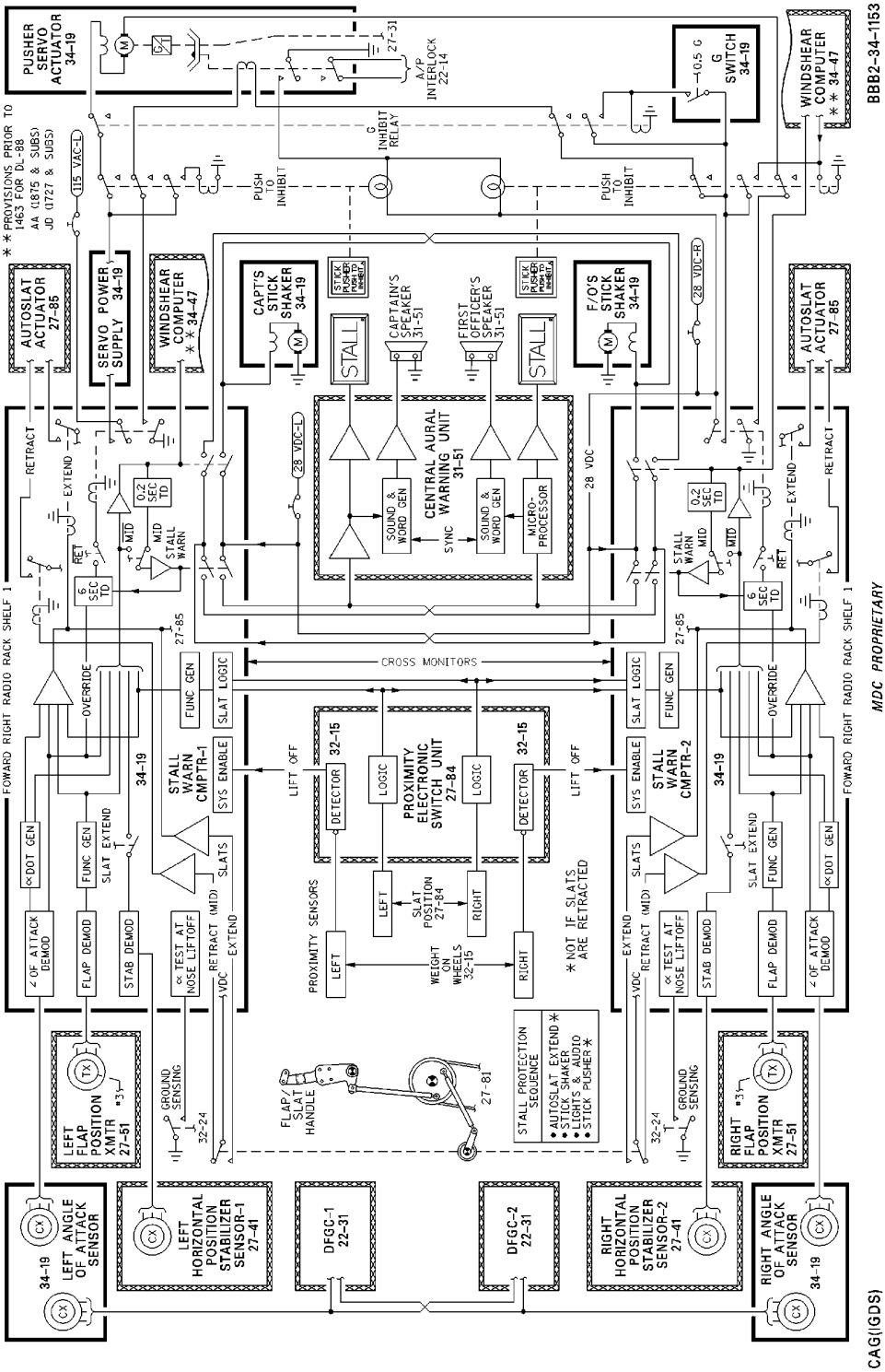
WARNING: IF STICK PUSHER SERVO DRIVE IS DISABLED, JUMPER PLUG (P2-2003) STOWED ADJACENT TO SERVO DRIVE PLUG TO RECEPTACLE CONNECTION (R5-520) MUST BE INSTALLED IN AIRCRAFT ELECTRICAL RECEPTACLE. AUTO PILOT WILL NOT OPERATE WHEN SERVO DRIVE PLUG IS DISCONNECTED.

E. A stall avoidance system (stick pusher) disconnect electrical plug stowage panel is located adjacent to the stick pusher servo. The panel contains stowage receptacles for the servo electrical plugs. If disabling of the stick pusher system is required, the system is disabled by stowing the servo electrical plugs at the stowage receptacles (STICK PUSHER SERVO DRIVE AND BRACKET ASSEMBLY - MAINTENANCE PRACTICES, PAGEBLOCK 34-19-03/201).

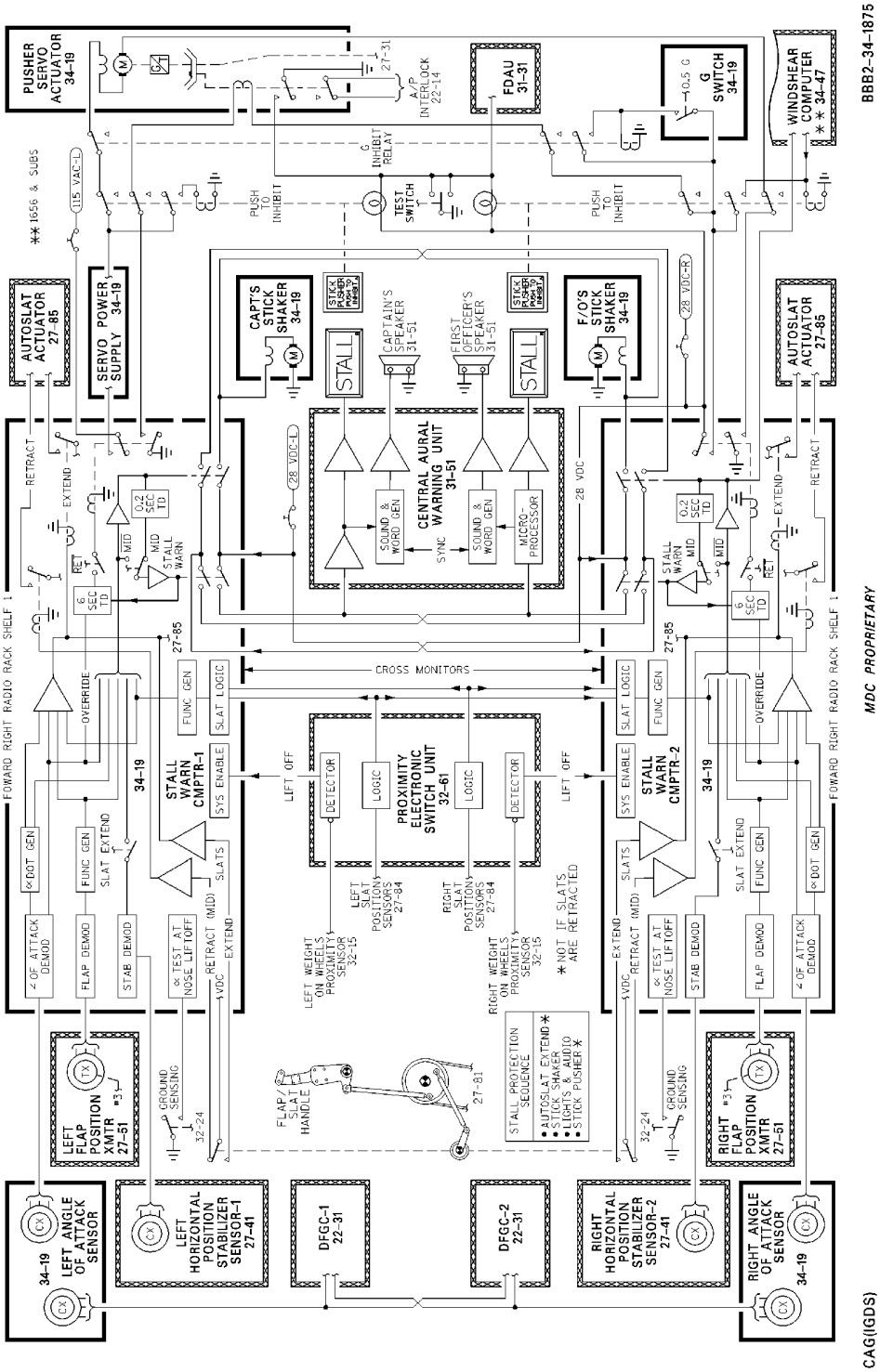


Stall Warning System
Figure 1/34-19-00-990-803 (Sheet 1 of 4)

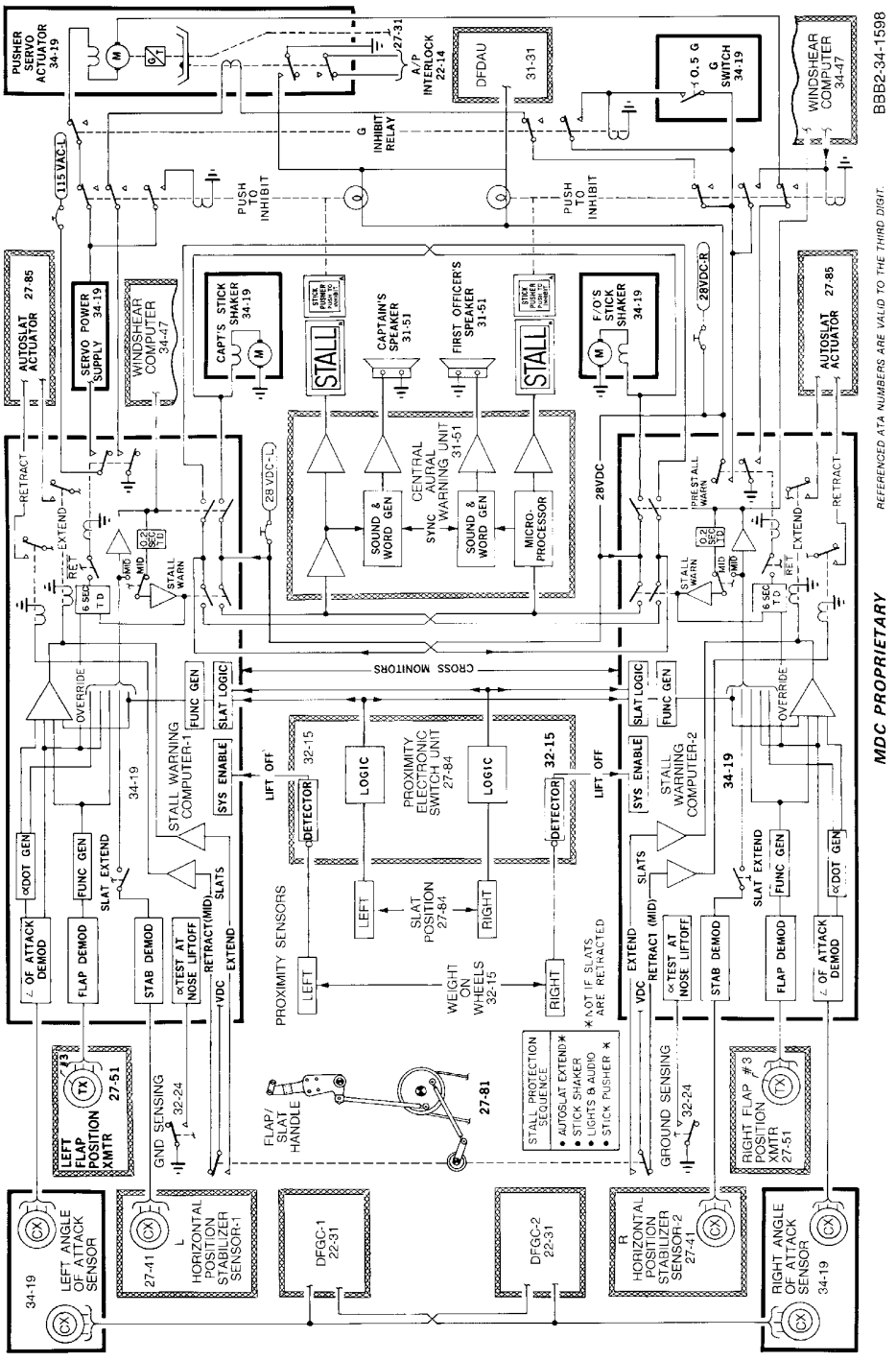
EFFECTIVITY
WJE 407, 408, 411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 891



Stall Warning System
Figure 1/34-19-00-990-803 (Sheet 2 of 4)



Stall Warning System
Figure 1/34-19-00-990-803 (Sheet 3 of 4)



Stall Warning System
Figure 1/34-19-00-990-803 (Sheet 4 of 4)

STALL WARNING SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The stall warning system (Stall Warning/Auto Slat System) continuously monitors the aircraft wing-lift loading and automatically initiates a control column shaking action by energizing a control column shaker and visual and aural indications when the aircraft approaches a stall condition. A Stick Pusher System is activated if the aircraft local alpha angle increases to a Supplementary Stall Recognition (SSRS) condition. The stick pusher, when activated, causes a servo in the elevator control system to push the control column yoke forward, causing an aircraft nose-down attitude. The stall warning system is a dual system installation; each system can independently activate all stall warning signals. Both computers are required to activate the stick pusher system.

B. The aircraft stall warning system has sufficient monitoring to check the angle of attack AOA Sensor for tolerance exceedence. If system tolerances are exceeded, a Stall Indication Failure (SIF) light on the overhead annunciator panel (OAP) will alert the crew to the need for maintenance action. If the previous flight has reported no abnormalities, the AOA vanes should be considered serviceable and safe for flight.

2. Description

A. The system consists of two angle-of-attack transducers, two stall warning computers, dual control column shakers, audio recognition, signal annunciators and the Stick Pusher System (Stick Pusher Servo Actuator). A stall warning self test switch for each system is located on the emergency overhead circuit breaker panel.

B. The angle-of-attack transducers are installed on the left and right sides of the lower fuselage nose at approximately station 80. The transducers provide a synchro signal proportional to the angle-of-attack of the aircraft. Upward motion of the trailing edge of the vane produces an increasing angle.

C. The stall warning computers are located in the forward right radio rack of the electrical/electronics compartment. Each computer receives and combines signals from one angle-of-attack transducer, one flap position transmitter, both wing slat proximity unit outputs and one horizontal stabilizer sensor. The computer initiates a pre-stall signal that is rate-and CG-compensated to provide both pre-stall warning and stall recognition signals when stall conditions are approached. The front panel of the Stall Warning Computer contains Sensor Failure annunciators (LEDS), System Difference annunciators (LEDS), a Computer Output annunciator (LED), Stall Indication Failure, Computer Failure and Auto Slat Failure annunciators (LEDS), a Memory Reset button switch and a Toggle Test switch. Five LED maintenance annunciators on the front of each computer will indicate VANE, FLAPS, SLATS, COMPUTER, or STAB FAULTS. Five Difference LED indicators will indicate VANE, FLAPS, STAB, SLATS or COMPUTER differences in the absence of detected faults. COMPUTER difference is indicated only if there are no VANE, STAB, FLAP or SLAT differences. Fault or difference LEDS light only when the test switch on box panel is in a TEST position. Their status is retained up to 7 hours with power off and they will be automatically re-set at the next takeoff or by the manual re-set button on front panel. Front panel self test has two positions, NORMAL TEST and MAINT TEST. NORMAL TEST is in parallel with pilots' self test switches, and may be performed in any flap/slat position. The MAINT TEST requires flaps set to FULL UP, slats retracted, STAB to 5° ANU, and vanes set to mid-range. The alpha vanes have scribe marks which allow the mechanic to set vane to mid-point (±0.5) degrees without tooling. During MAINT TEST, the LED indicators will indicate vane, flap, stab, computer or slat errors and isolate these errors to the side causing the error. In more than 95% of failures, the mechanic will be directed to the LRU causing the fault. A Stall Indication Failure (SIF) LED on the front panel of the computer functions in parallel with the cockpit SIF light. The COMPUTER OUTPUT LED on front panel lights when self test is successful.

D. Both control column shakers are energized by the pre-stall signal from either one or both of the computers.

E. At stall conditions, an oscillating sound and the word "STALL" are relayed to the cockpit through speakers located in the captain's and first officer's consoles. The red STALL lights on the glareshield come on, and flash in synchronization with the oscillating sound.

F. Any channel malfunction or mismatch of input signals causes the STALL INDICATION FAILURE (SIF) light, located on the overhead annunciator panel, to come on.

G. The pusher will operate simultaneously with SSRS in all slat configurations (RET, MID and EXT).

H. Stall warning activation is also affected by flap and slat information. This information is input to the stall warning computers from the flap position transmitters and the slat retracted or extended signals.

3. Operation

A. Each system receives angle-of-attack (alpha), stabilizer position and flap information from its respective sensors. The proximity switch unit provides independent left and right slat discretes to each system, corresponding to the three slat positions RET, MID and EXT. Each system is enabled by a main gear discrete from the proximity switch unit and a nose oleo relay input initiates a pre-rotation alpha check. Either computer provides pre-stall warning by actuating both stick shakers. Stall recognition output of either computer actuates the stall horns and lights through the Central Aural Warning System (CAWS). Ground Proximity Warning is inhibited whenever stick shakers are on.

(1) System failures will cause the Stall Indication Failure (SIF) light on the overhead panel to come on. Alpha faults, flap faults, power loss faults and computer faults will inhibit shaker and recognition outputs. Either system may be tested by using the Stall Self Test switches on the overhead panel. Continuous cross comparison is made of alpha, flaps, stabilizer, slats and the computers. The Stall Warning Horn is inhibited when the difference of the alpha signals, flap signals, or stabilizer signals is greater than the predetermined value (2.7° for alpha, 5° for flap, and 1.5° for stabilizer).

B. Auto Slat System - The purpose of the Auto Slat System is to extend the slats from MID only to EXT just prior to stick shaker actuation. Each computer receives airspeed information from its respective air data computer for auto slat inhibit at high speeds. Each computer may extend the slats by driving either or both actuators. Flap handle switch inputs provide the command to extend the slats when the handle is positioned beyond 14°. They also provide the logic to automatically retract the slats. A second flap handle switch provides a RET Flap Handle input for Auto Slat Test reset. Actuator position is monitored by potentiometers located in each actuator. Auto Slat operation is indicated by an AUTO SLAT EXTEND light on the center instrument panel and failures are indicated by a master caution light and an AUTO SLAT FAIL light on the overhead annunciator panel.

(1) System self-test occurs automatically when the slats are first positioned to MID on the ground.

C. Auto Slat Actuators - Two independent electro-mechanical actuators are summed through a mechanical linkage so that either may extend the slats. Actuator number one extends to extend the slats and actuator number two must retract to extend the slats. Each actuator contains internal extend and retract limit switches and a position feedback potentiometer.

D. Stick Pusher System - The system consists of a servo clutch, actuator and G switch located in the forward E/E compartment, a power supply in the avionics radio rack, G switch relay, two dump relays, a "PUSHER DUMPED/RESET" switch in the E/E compartment, two pilot operated "PUSH 1/PUSH 2" lights/switches in the glareshield, and a dump switch in the after center pedestal. Two independent Stall Self Test switches allow simultaneous test of SW computer-1 and -2, in order to ground test the stick pusher.

(1) Outputs from both computers are required to actuate the servo clutch and servo actuator which provides the force to drive the control column rapidly forward. (Control column is pushed forward with 80 pounds of force above existing elevator forces.) Once activated, each pusher output will remain latched until the stick shaker turns off. The "PUSH 1/PUSH 2" annunciators will illuminate and latch to indicate that the pusher has been actuated. The pilots can turn off the "PUSH 1/PUSH 2" lights by pressing either of the "PUSH 1/PUSH 2" lights. Alpha rate is inhibited for 6 seconds after main gear lift-off. This minimizes the chance of nuisance pusher, shaker or stall warning at takeoff.

(2) Either pilot may disable the pusher by pressing the manual dump switch. This causes two magnetic latching relays to change state and remove power from the servo and clutch and illuminate the "PUSHER DUMPED" lights. These relays can only be reset by pressing the "PUSHER DUMPED/RESET" switch located in the E/E compartment. Excessive reduction of g forces following pusher operation will actuate the G switch and disable the pusher and turn on the "PUSHER DUMPED" lights until a recovery is made. A pusher fail condition lasting more than 1 second will turn on and latch a "PUSHER FAIL" and the "MASTER CAUTION" lights and will inhibit the stick pusher. The fail may be reset by pressing either "PUSH 1/PUSH 2" switch.

WARNING: IF STICK PUSHER SERVO DRIVE IS DISABLED, JUMPER PLUG (P1-2003) STOWED ADJACENT TO SERVO DRIVE PLUG TO RECEPTACLE CONNECTION (R5-520) MUST BE INSTALLED IN AIRCRAFT ELECTRICAL RECEPTACLE. AUTO PILOT WILL NOT OPERATE WHEN SERVO DRIVE PLUG IS DISCONNECTED.

(3) A stall avoidance system (stick pusher) disconnect electrical plug stowage panel is located adjacent to the stick pusher servo. The panel contains stowage receptacles for the servo electrical plugs. If disabling of the stick pusher system is required, the system is disabled by stowing the servo electrical plugs at the stowage receptacles (STICK PUSHER SERVO DRIVE AND BRACKET ASSEMBLY - MAINTENANCE PRACTICES, PAGEBLOCK 34-19-03/201).

STALL WARNING SYSTEM - TROUBLE SHOOTING

1. General

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

A. Trouble Shooting provided in this section contain basic and detail procedures for isolating and correcting a faulty stall warning system in the airplane.

WJE 892

B. Trouble Shooting provided in this section contain basic and detail procedures for isolating and correcting a faulty stall warning system (Stall Warning/Auto Slat System) in the aircraft.

WJE ALL

C. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

D. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

E. If during a NORMAL or Maintenance self test, faults are designated by the Lights on front panel of the Stall Warning Computers then refer to paragraph Paragraph 4. Computer Designated Faults Trouble Shooting.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

F. The basic components of the stall warning system operation are: stall warning computers, angle-of-attack (AOA) sensors, stick shakers, stall warning lights, stick pusher servo, stick pusher servo power supply, and G switch. Interfacing units are flap transmitters, stabilizer position transmitters, proximity switch, aural warning unit, ground proximity warning computer, auto slat actuators, air data computer, and flap/slat handle.

WJE 892

G. If, during a Normal or Maintenance self test, any of the fault LED's on front panel of the Stall Warning Computers come on, refer to paragraph Paragraph 4. Computer Designated Faults Trouble Shooting.

H. The basic components of the stall warning system operation are: stall warning computers, angle-of-attack sensors, stick shakers, stall warning lights, stick pusher servo, stick pusher servo power supply, dump switch, dumped/reset switch, and G switch. Interfacing units are flap transmitters, stabilizer position transmitters, proximity switch, aural warning unit, ground proximity warning computer, auto slat actuators, air data computer, and flap/slat handle.

WJE ALL

WARNING: DURING ANY PART OF TESTS, WHEN HYDRAULIC POWER IS IN USE, MAKE CERTAIN ALL PERSONNEL AND EQUIPMENT ARE CLEAR OF HYDRAULIC POWERED SURFACES, CABLES, OR LINKAGE IN MOTION.

I. The stall warning system components are located as follows:

Table 101

Component	Location
WJE 892	
Stall Lights	Captain's and First Officer's Glareshields
STALL SELF TEST-1 and -2 Switches	Overhead Switch Panel
PUSHER DUMPED and FAIL Lights	Overhead Annunciator Panel
PUSHER DUMP Switch	Aft Center Panel
PUSHER DUMPED/RESET Switch	Electrical/Electronics Compartment
Stall Indication Fail Light	Emergency Circuit Breaker Panel
PUSH 1/PUSH 2 Lights/Switches	Capt's and F/O's Glareshield
Auto Slat Fail Light	Overhead Annunciator Panel
Auto Slat Extend Light	Center Instrument Panel
WJE ALL	
Stall Warning Lights	Captain's and First Officer's Glareshields
Stall Warning Computers	Electrical/Electronics Compartment
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893	
Angle-of-Attack (AOA) Transducers	Left and Right Side Forward Fuselage
WJE 892	
Angle-of-Attack Transducers	Left and Right Side Forward Fuselage
WJE ALL	
Stick Shakers	Left and Right Control Columns
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893	
Stall Indication Fail (SIF) Light	Overhead Annunciator Panel (OAP)
WJE ALL	
Stick Pusher Servo	Electrical/Electronics Compartment
Stick Pusher Servo Power Supply	Electrical/Electronics Compartment
G Switch	Electrical/Electronics Compartment
Stall Warning Circuit Breakers	Lower EPC C/B Panel
Stall Warning Alpha Flap Circuit Breakers	Upper C/B Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 630A	Triplett

3. Trouble Shooting Stall Warning System (BASIC Procedures)

A. Trouble Shoot

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are stall warning computers, stick shakers, AOA transducers, stick pusher servo, servo power supply and G switch.

NOTE: Flap or AOA transmitter failure, loss of 115 vac power to the computer, or failure of the computer itself will cause a SIF warning and, in addition, inhibit self-test by the cockpit overhead self-test switch.

WJE 892

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are stall warning computers, stick shakers, AOA transducers, stick pusher servo, servo power supply and G switch.

NOTE: Flap or angle-of-attack transmitter failure, loss of 115 vac power to the computer, or failure of the computer itself will cause a SIF warning and, in addition, inhibit self-test at the stall SELF TEST switches located on the overhead switch panel.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

Table 103

Step	Procedure	Correction
(1)	Perform NORMAL and Maintenance Self Test at Stall Warning Computers.	Refer to Paragraph 4. for computer designated faults trouble shooting.
(2)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(3)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(4)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(5)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(6)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

WJE 412, 414

Table 104

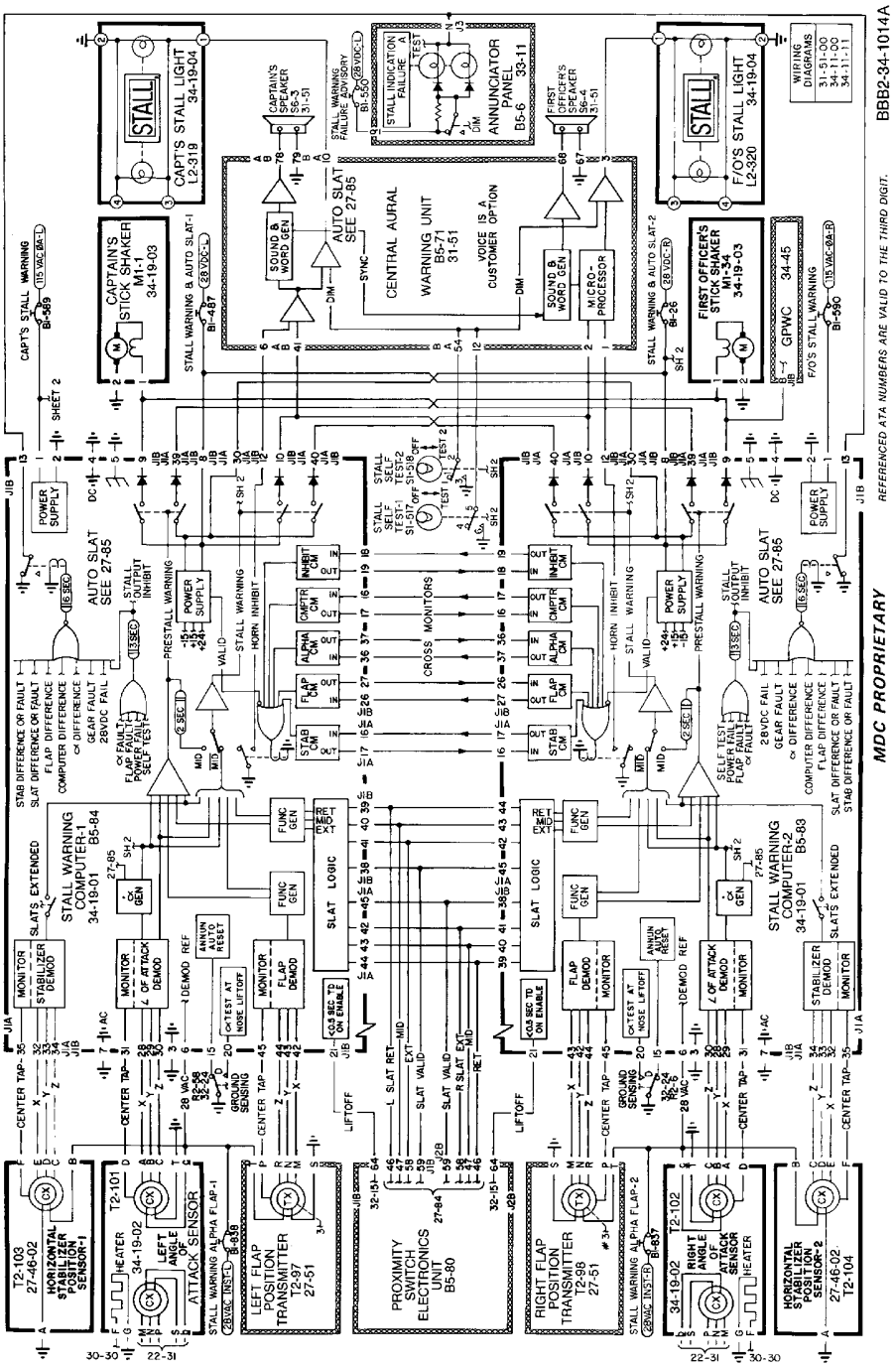
Step	Procedure	Correction
(1)	Perform NORMAL and Maintenance Self Test at Stall Warning Computers.	Refer to Paragraph 4. for computer designated faults trouble shooting.
(2)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(5)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

WJE 412, 414 (Continued)

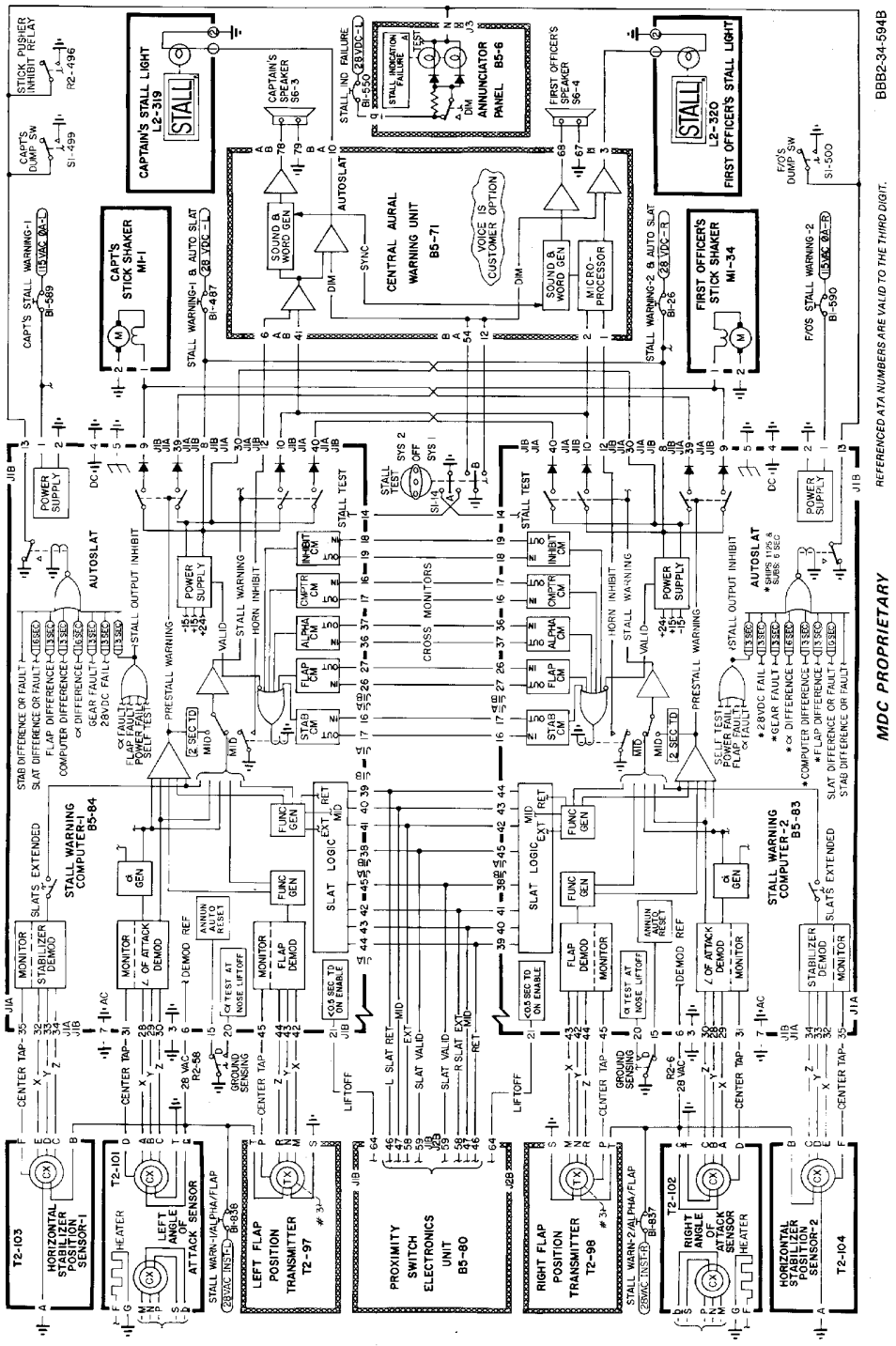
Table 104 (Continued)

Step	Procedure	Correction
(6)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

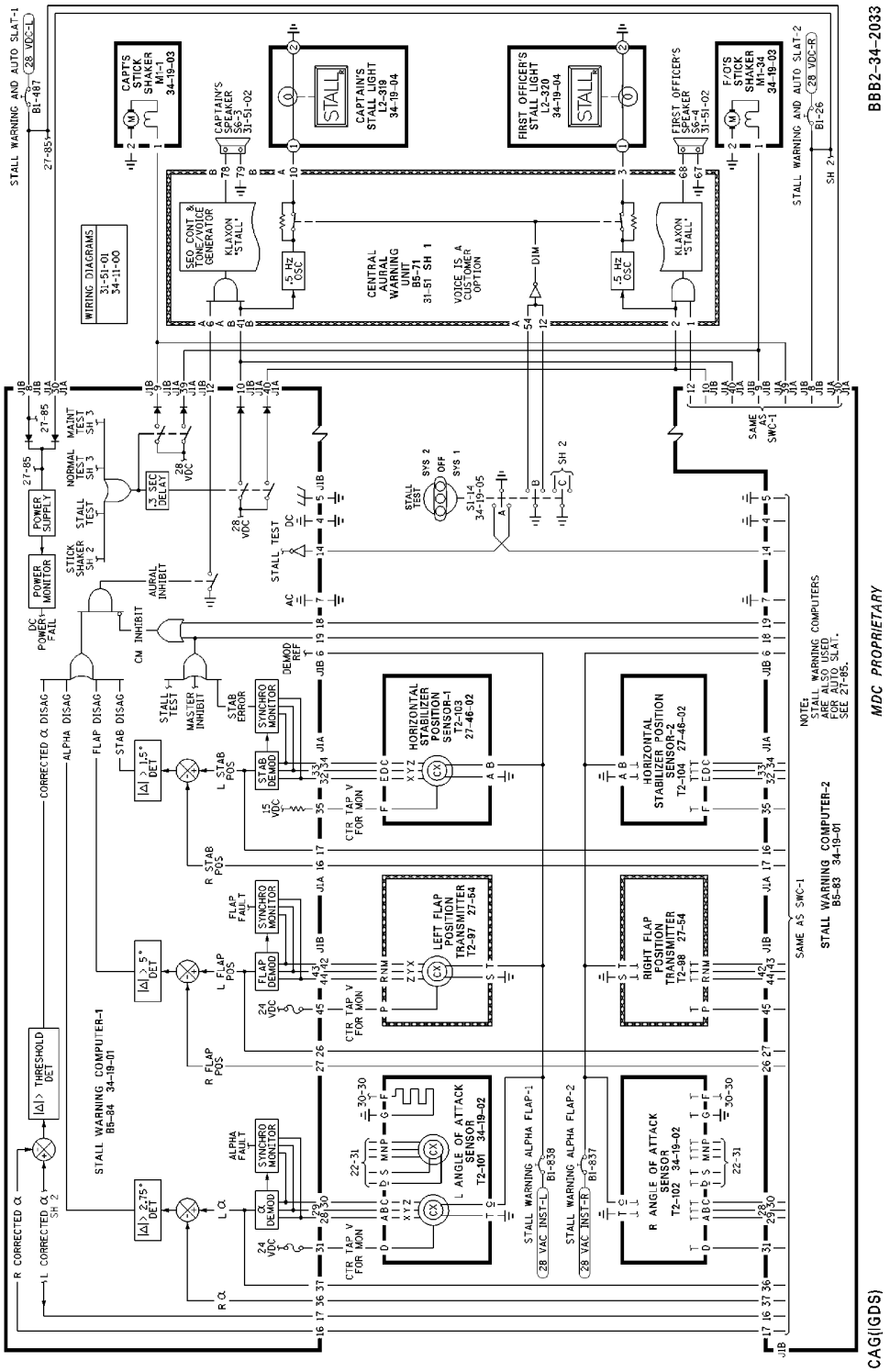
WJE ALL



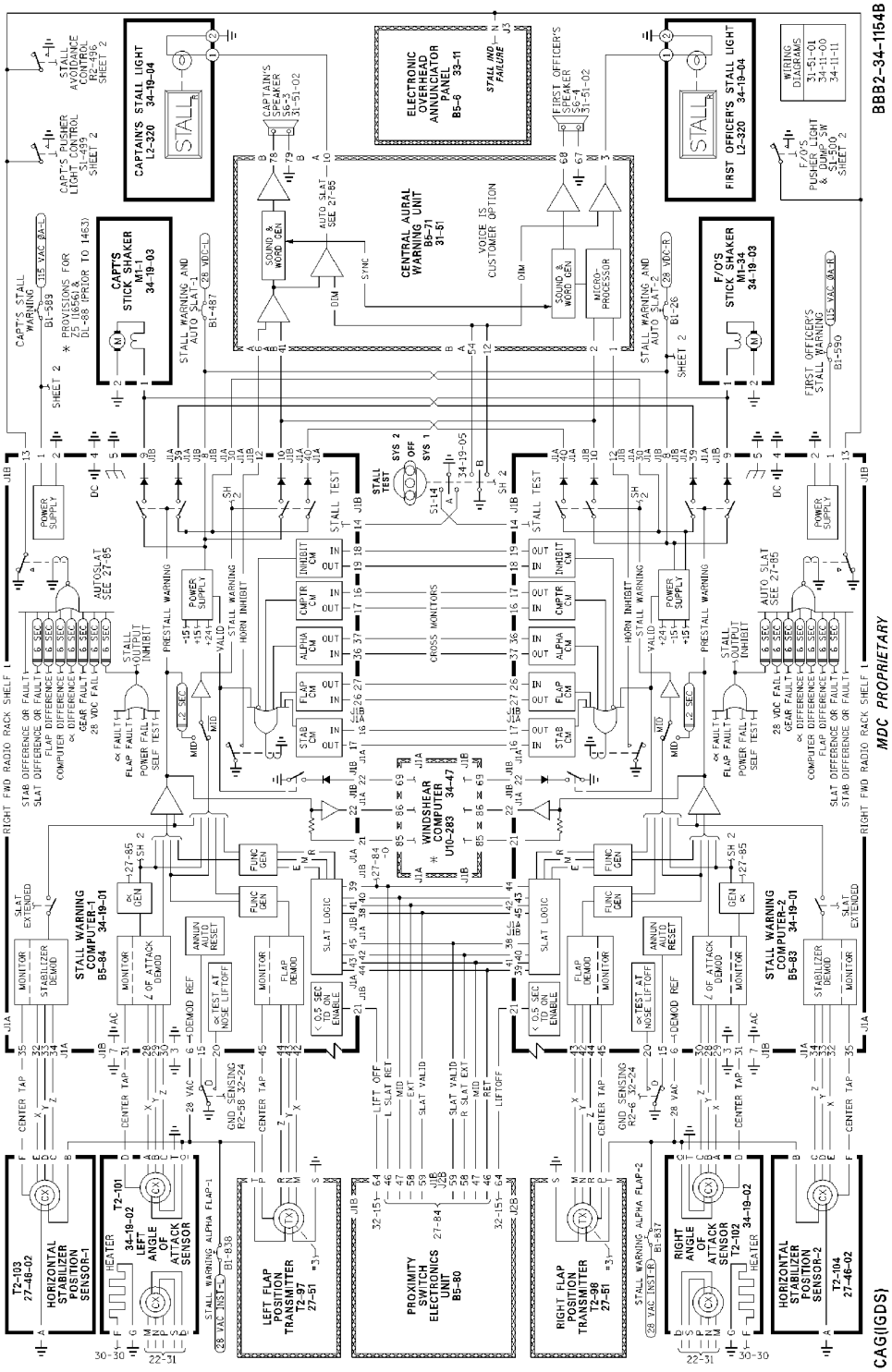
Stall Warning System -- Schematic
Figure 101/34-19-00-990-810 (Sheet 1 of 4)



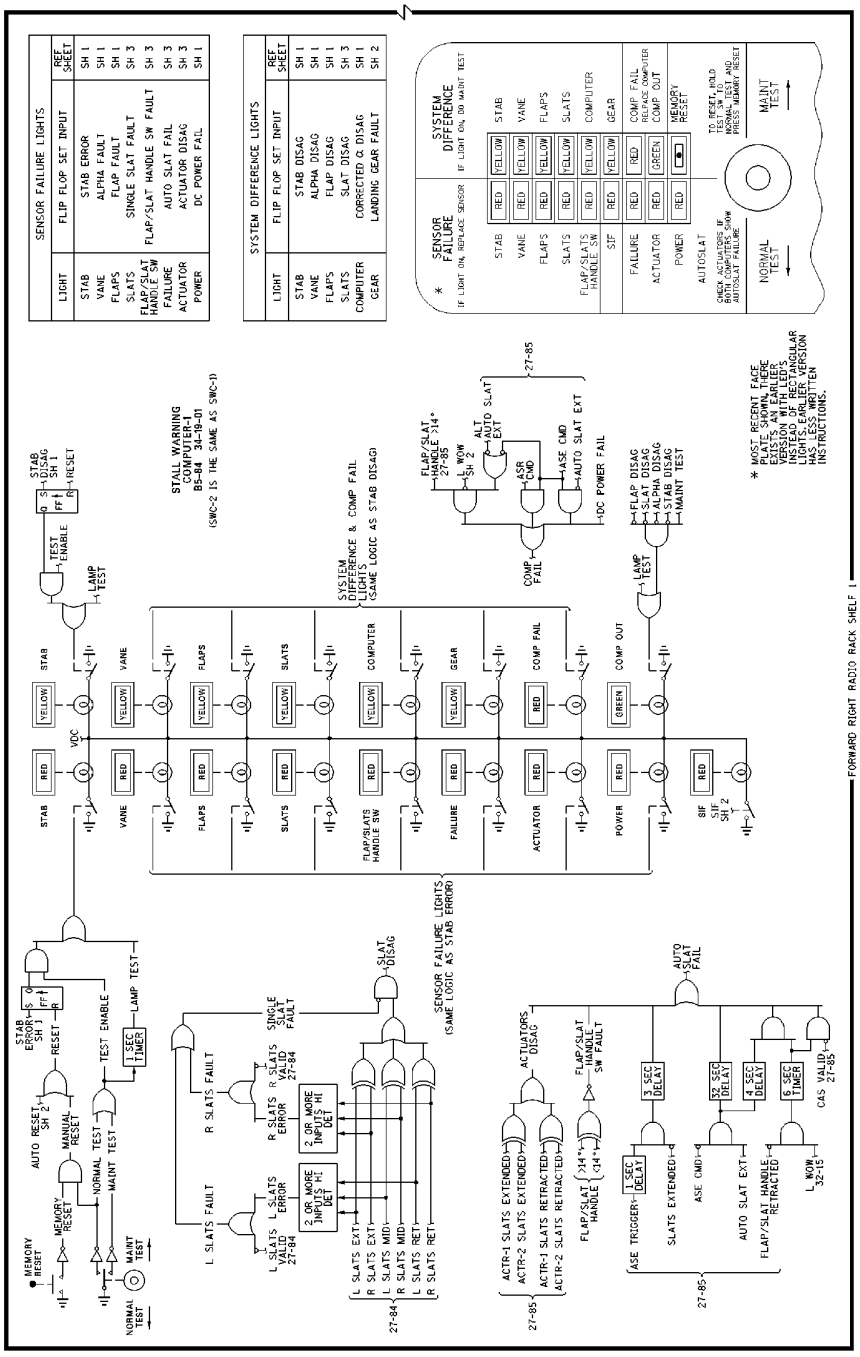
Stall Warning System -- Schematic
Figure 101/34-19-00-990-810 (Sheet 2 of 4)



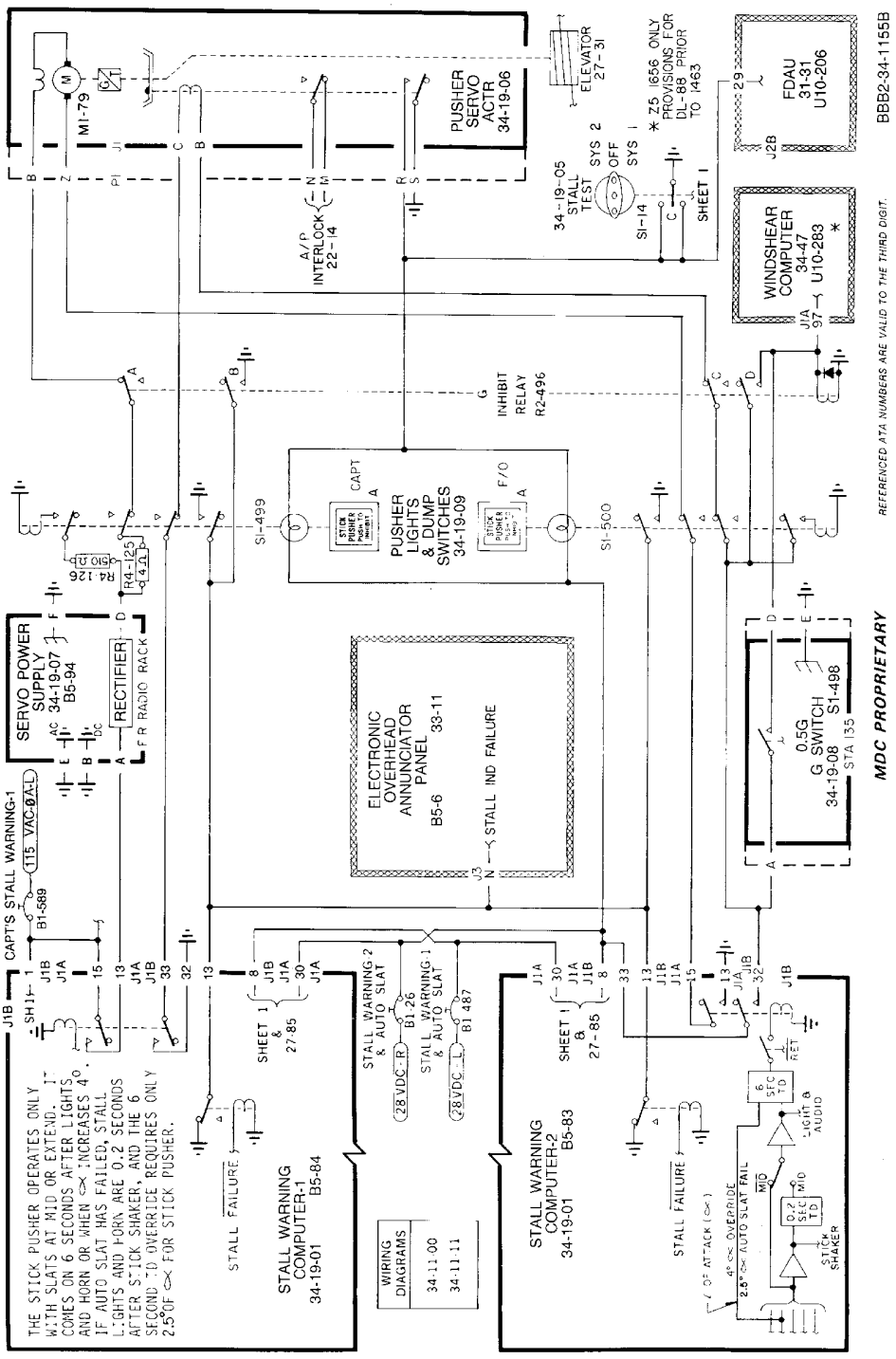
Stall Warning System -- Schematic
Figure 101/34-19-00-990-810 (Sheet 3 of 4)



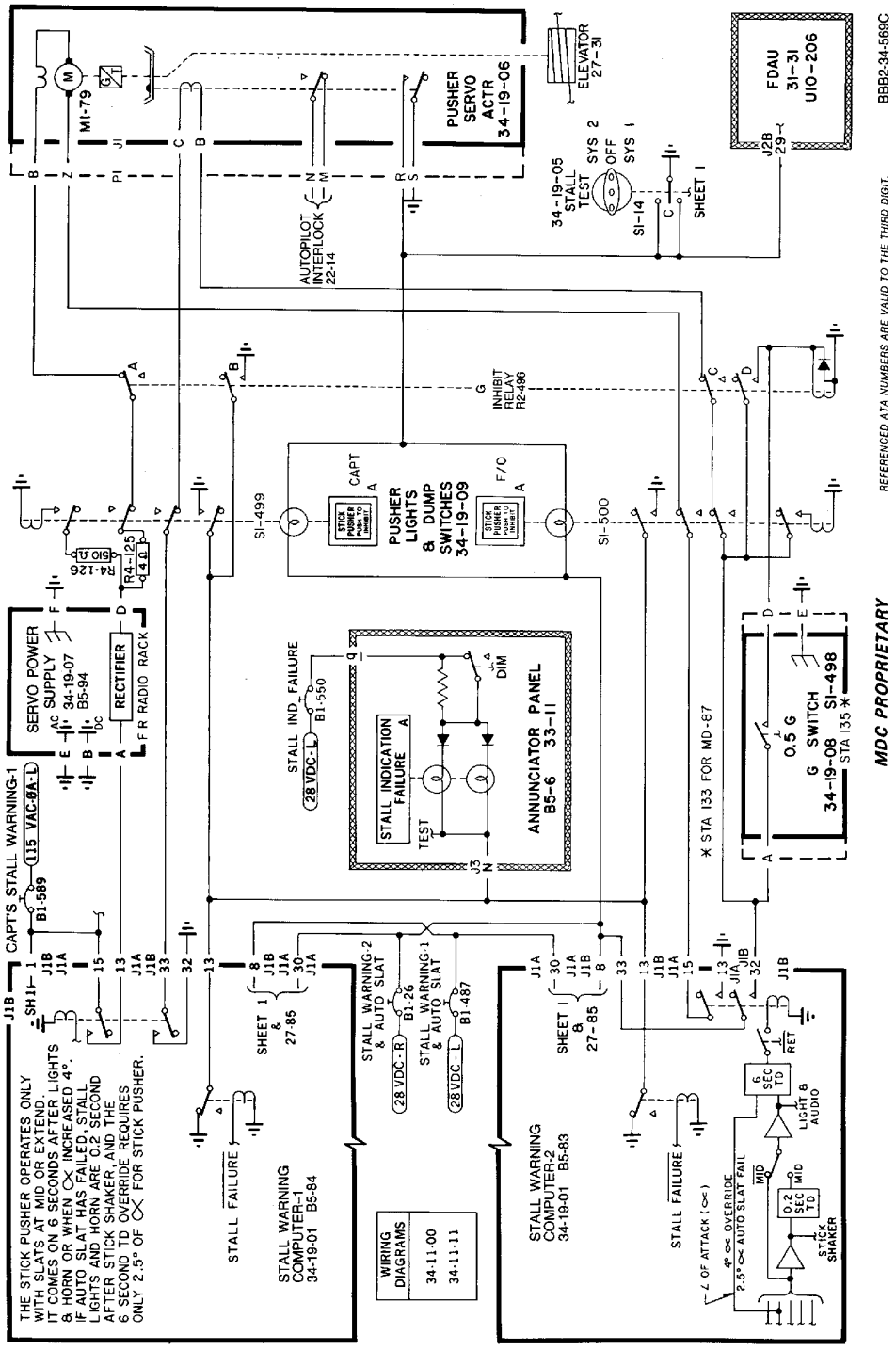
Stall Warning System -- Schematic
Figure 101/34-19-00-990-810 (Sheet 4 of 4)



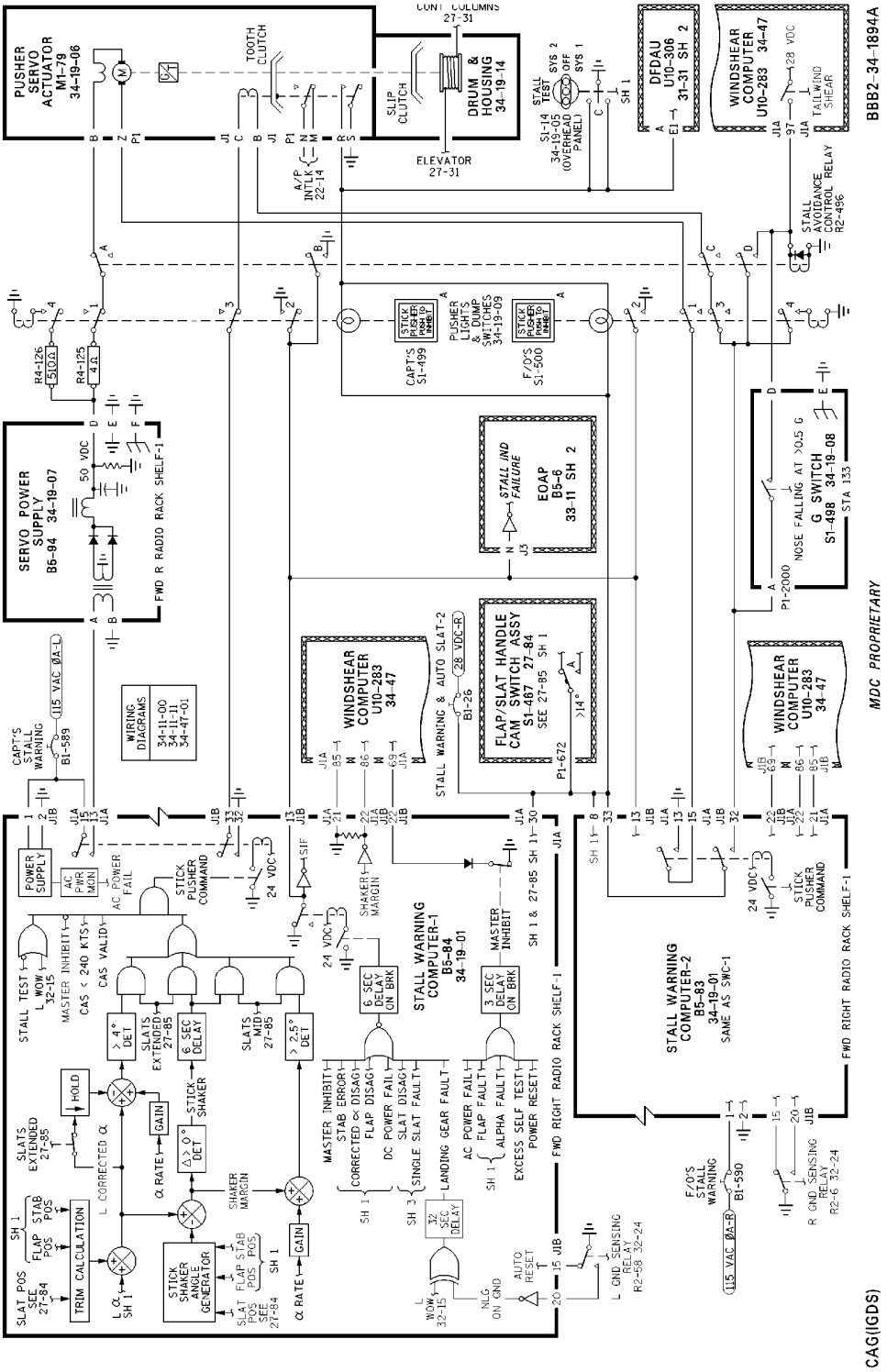
Stall Warning Computers
Figure 102/34-19-00-990-811



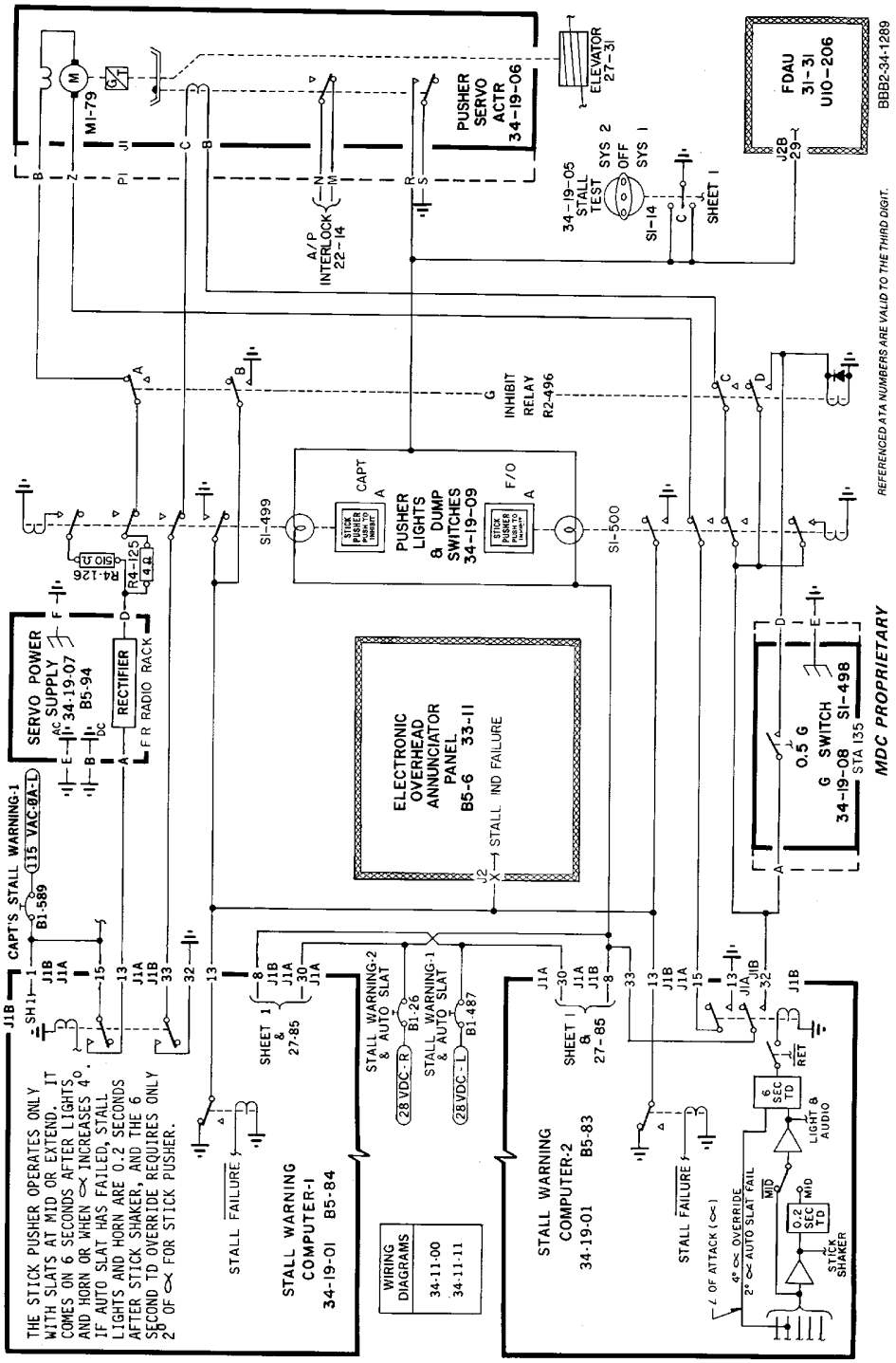
Post Stall Recovery System
Figure 103/34-19-00-990-812 (Sheet 1 of 5)



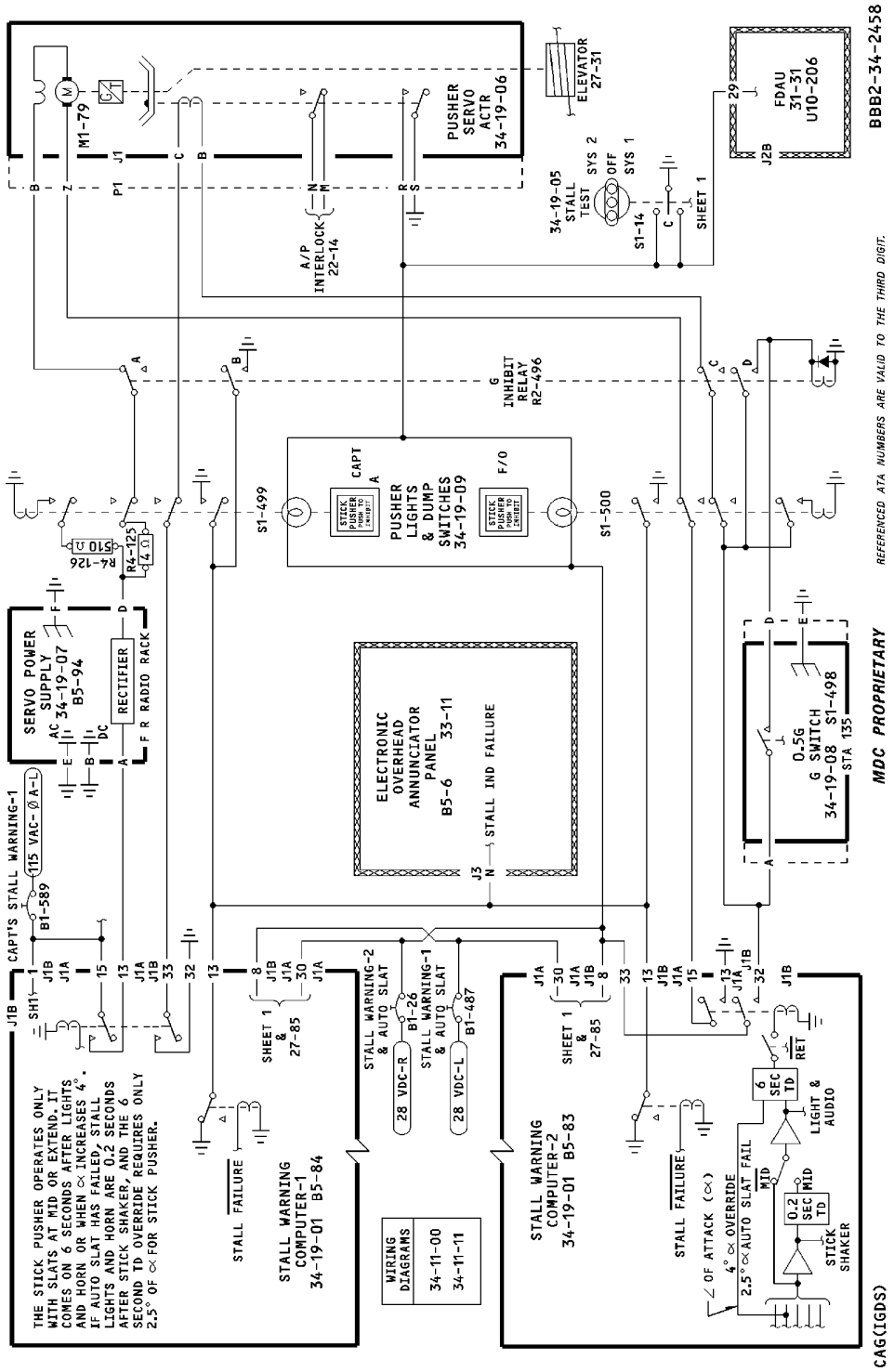
Post Stall Recovery System
Figure 103/34-19-00-990-812 (Sheet 2 of 5)



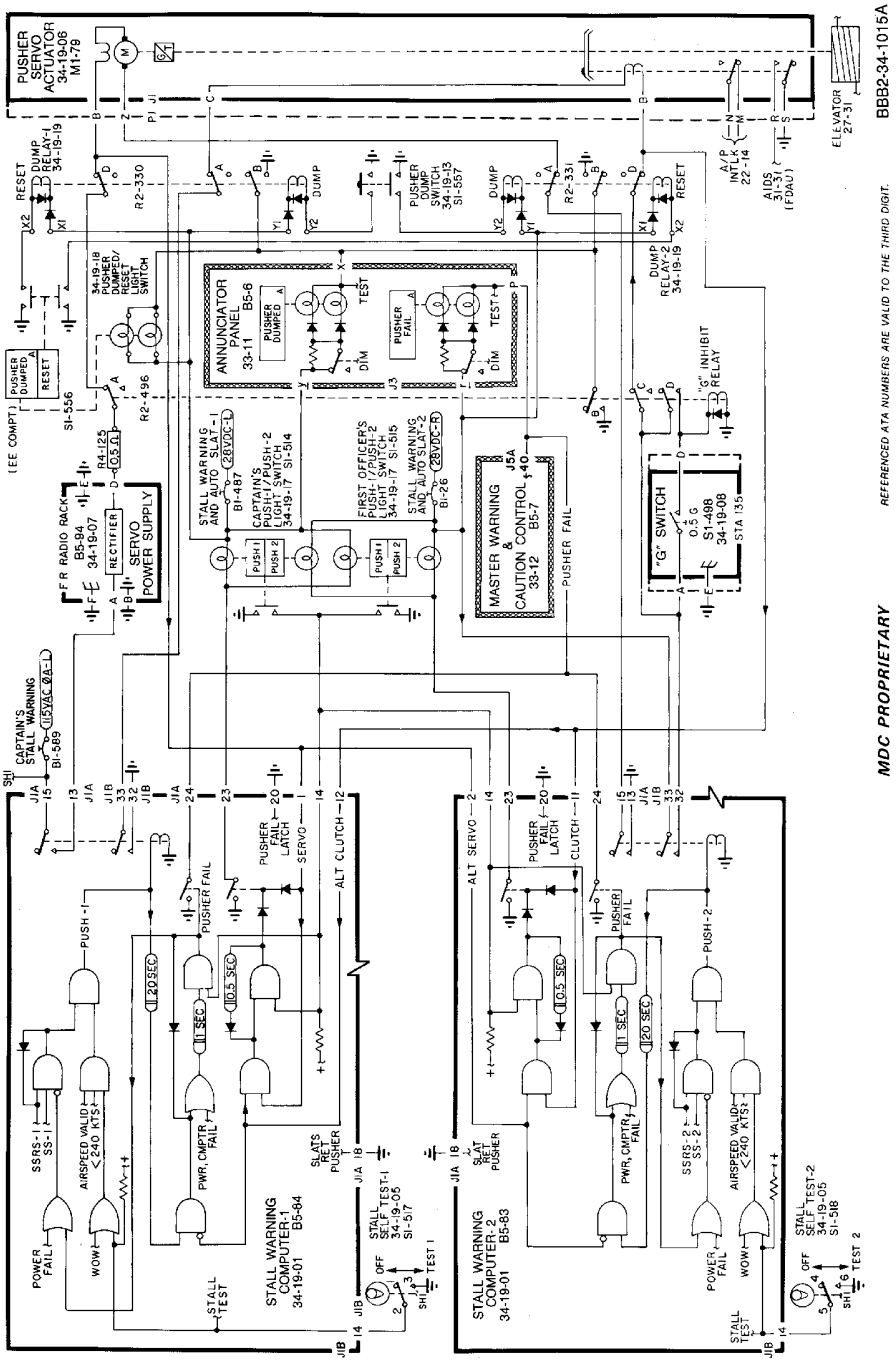
Post Stall Recovery System
Figure 103/34-19-00-990-812 (Sheet 3 of 5)



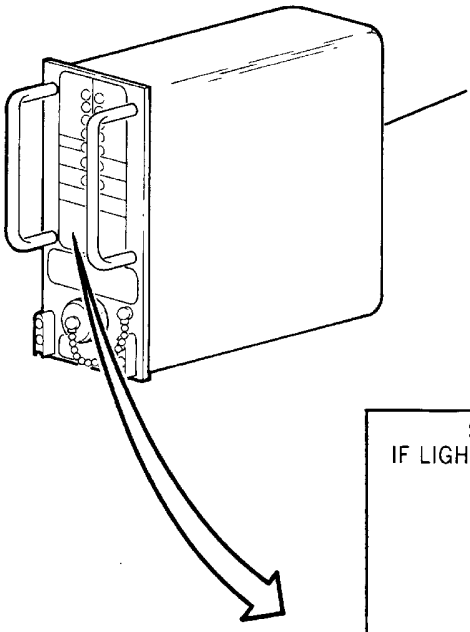
Post Stall Recovery System
Figure 103/34-19-00-990-812 (Sheet 4 of 5)



Post Stall Recovery System
Figure 103/34-19-00-990-812 (Sheet 5 of 5)



Stick Pusher System
Figure 104/34-19-00-990-813



SENSOR FAILURE IF LIGHT ON, REPLACE SENSOR		SYSTEM DIFFERENCE IF LIGHT ON, DO MAINT TEST	
STAB	(R)	(A)	STAB
VANE	(R)	(A)	VANE
FLAPS	(R)	(A)	FLAPS
SLATS	(R)	(A)	SLATS
SIF	(R)	(A)	COMPUTER
COMPUTER FAILURE REPLACE COMPUTER	(R)	(G)	COMPUTER OUTPUT
AUTOSLAT FAILURE CHECK ACTUATORS IF BOTH COMPUTERS SHOW AUTO SLAT FAILURE	(R)	(O)	MEMORY RESET TO RESET HOLD TEST SW TO NORMAL TEST AND PUSH MEMORY RESET

(A) LED–AMBER
(G) LED–GREEN
(R) LED–RED
(O) SWITCH

NORM TEST ← (O) → MAINT TEST

TEST INSTRUCTIONS

NORMAL TEST

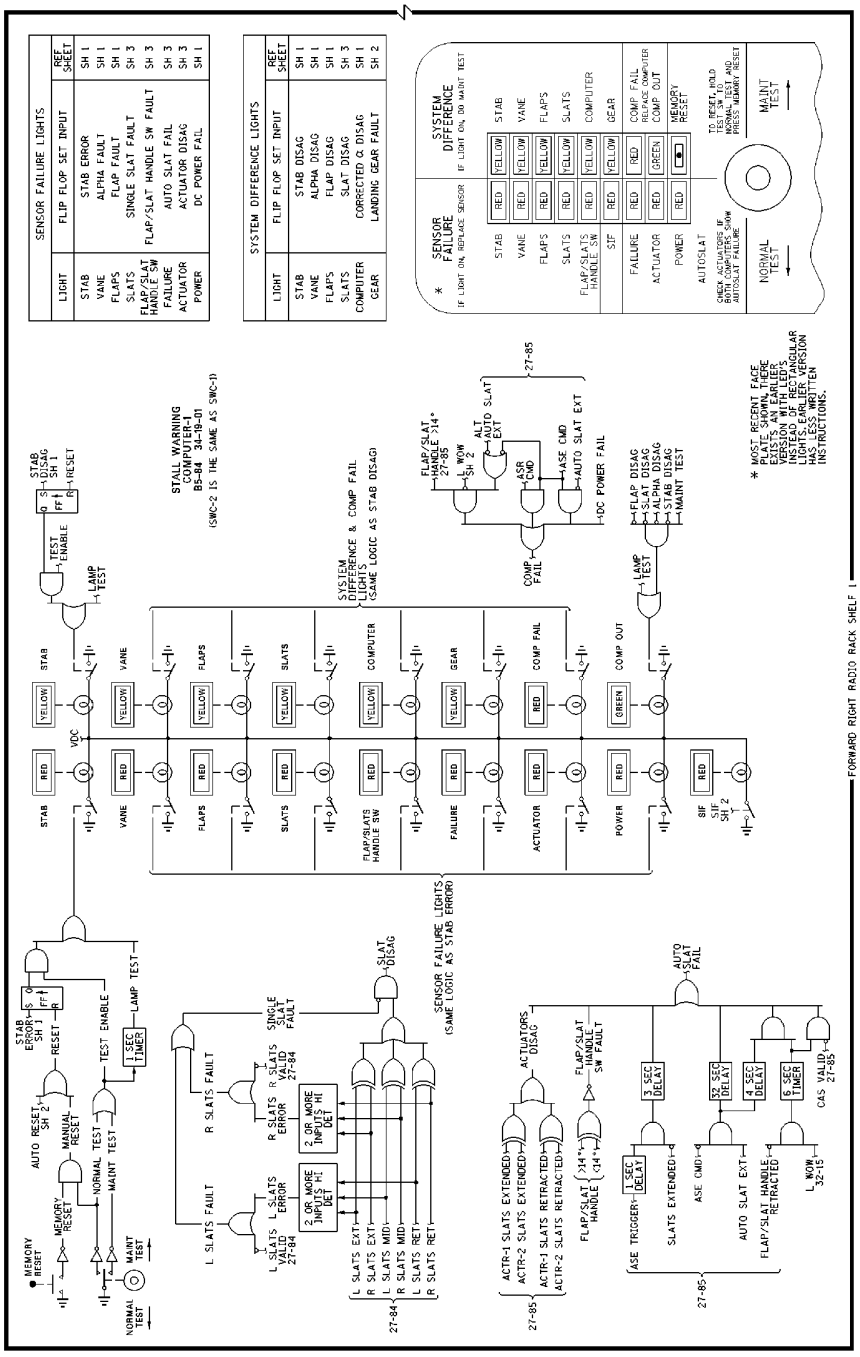
1. SENSORS MAY BE SET TO ANY POSITION – HOLD TEST SWITCH AT NORMAL TEST POSITION – ALL LAMPS, EXCEPT SIF, WILL FLASH MOMENTARILY (LAMP TEST).
2. GOOD TEST INDICATED BY COMPUTER OUTPUT LAMP ON.
3. BAD TEST INDICATED BY COMPUTER OUTPUT LAMP OFF AND ONE OR MORE FAULT LAMPS LIGHTED – REPAIR FAULTS BEFORE RESETTING MEMORY – IF DIFFERENCE FAULT SHOWS DO MAINT TEST.

MAINT TEST

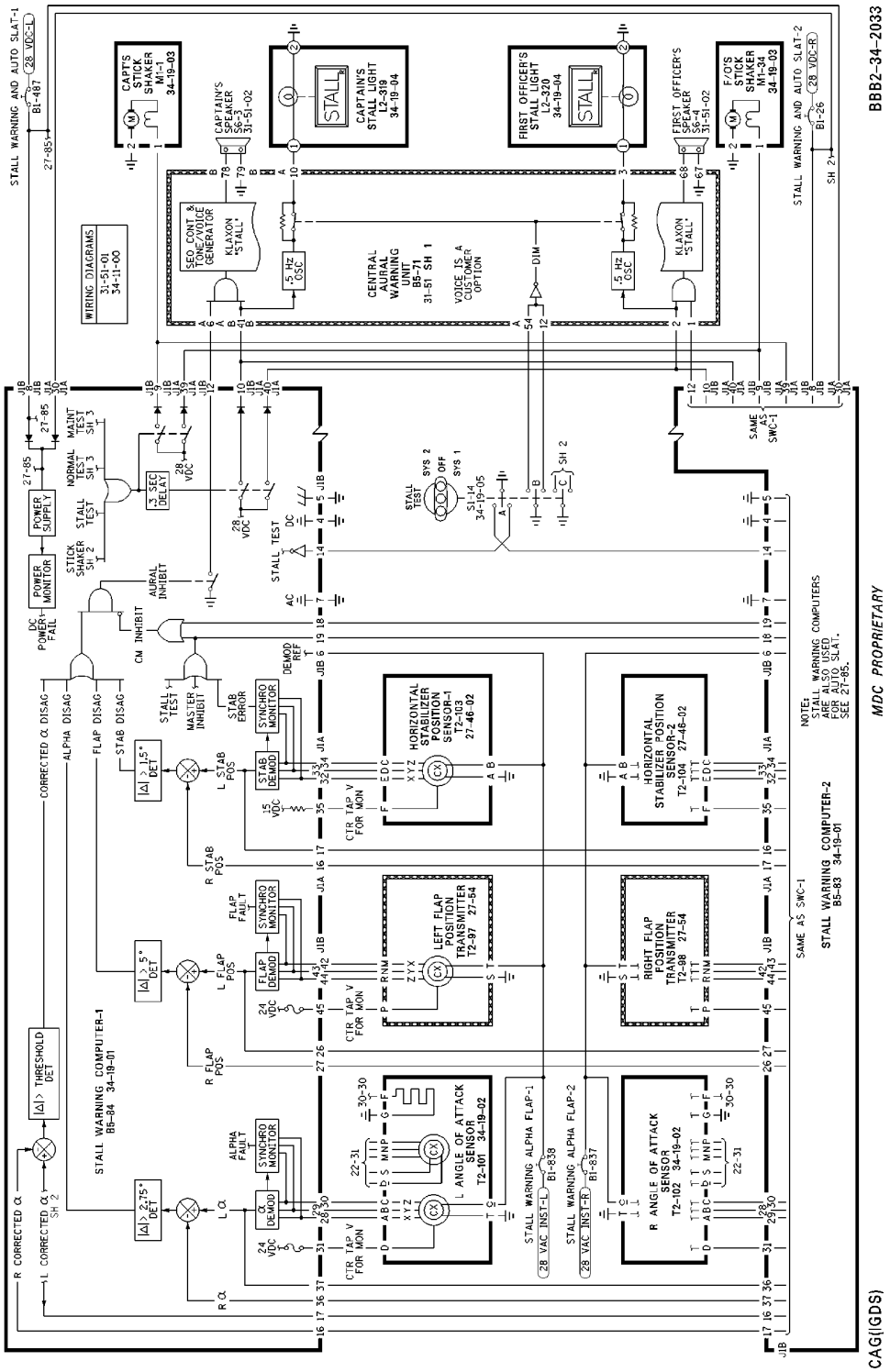
1. SET BOTH VANES TO MID POINT, FLAPS FULL UP, SLATS RETRACTED AND STABILIZER AT 5 DEGREES NOSE UP.
2. RESET MEMORY PER RESET INSTRUCTIONS.
3. HOLD TEST SWITCH AT MAINT TEST POSITION – LAMP TEST WILL OCCUR – FAULTS WILL BE INDICATED WITHIN 10 SECONDS OF SETTING SWITCH TO MAINT TEST.
4. CHECK POSITION OR ALIGNMENT OF SENSOR ON SYSTEM INDICATING DIFFERENCE FAULT.

BBB2-34-265B

Stall Warning Computers
Figure 105/34-19-00-990-814 (Sheet 1 of 2)



Stall Warning Computers
Figure 105/34-19-00-990-814 (Sheet 2 of 2)



Stall Warning System -- Schematic
Figure 106/34-19-00-990-815

4. Computer Designated Faults Trouble Shooting

A. Preliminary

NOTE: The following self test operations provide instructions for conducting NORMAL and Maintenance self tests at the Stall Warning Computers. Faults designated by the computers will be outlined under Trouble Shooting paragraph Paragraph 4.B. with trouble shooting procedures for each fault.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: Also see Slat Disagree, Auto Slat Fail, and Stall Indication Fail (SIF) trouble shooting flow charts, Chapter SLAT DISAGREE/AUTOSLAT AND STALL INDICATION FAILURE - TROUBLE SHOOTING, PAGEBLOCK 27-81-00/101.

WJE 892

NOTE: The following self test operations provide instructions for conducting NORMAL and MAINT self tests at the Stall Warning Computers. Faults designated by the computers will be outlined under Trouble Shooting paragraph Paragraph 4.B. with trouble shooting procedures for each fault.

WJE ALL

(1) Normal Self-Test

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(a) At front panel of each Stall Warning (S/W) Computer, there should normally be no indicators on. (The only one that could be on would be the SIF light emitting diodes (LED).) If both SIF's LEDs are on, it usually means a difference between the two sides or a fault common to both sides. If only one SIF LED is on, then the search for the fault should be confined to that side. (The SIF light in the cockpit would also be on.)

(b) Press the front panel Test Switch to Normal Test position. All indicators except the SIF LED should blink on for one second as a LED test then only the Computer Output LED should remain on for a valid test. (The shaker, aural warning or horn and stall lights should also be on in the cockpit.)

(c) If any fault indicator LEDs other than Computer Output LED remain on after the one second LED test, record indicators. Any fault indicator LED which is on during self-test could be on due to a fault which is present at the moment or it could be due to a past fault stored in the Fault Memory. At main gear lift-off all faults stored in memory are erased and any subsequent faults are stored until the next takeoff. With all power off the computer, faults will be stored up to 7 hours.

WJE 892

(d) At front panel of each Stall Warning (S/W) Computer, there should normally be no indicators on. (The only one that could be on would be the SIF.) If both SIF's are on, it usually means a difference between the two sides or a fault common to both sides. If only one SIF is on, then the search for the fault should be confined to that side. (The SIF in the cockpit would also be on.)

(e) Press the front panel Test Switch to Normal Test position. All indicators except the SIF should blink on for one second as a light test then only the Computer Output should remain on for a valid test. (The shaker, aural warning, stall lights, and pusher lights of affected computer should also be on in the cockpit.)

WJE 892 (Continued)

(f) If any indicators other than Computer Output remain on after the one second light test, record indicators. Any fault light which is on during self-test could be on due to a fault which is present at the moment or it could be due to a past fault stored in the Fault Memory. At main gear lift-off all faults stored in memory are erased and any subsequent faults are stored until the next takeoff. With all power off the computer, faults will be stored up to 7 hours.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(g) Erase the fault memory by holding the Test Switch to Norm Test position and momentarily pressing the Memory Reset pushbutton, then release both. Wait at least 6 seconds for any present faults to be stored in memory.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(h) Press Test Switch to Normal Test position again and note any fault indicator LEDs which turn on. These indicate faults which are present at the moment. Trouble shoot the system based on the past or present faults as described in the following paragraphs. Perform a MAINT Self-Test on the system to further isolate the problem if it is convenient to position the flaps, slats and stabilizer as required by the MAINT test.

WJE 892

(i) Press Test Switch to Normal Test position again and note any fault indicators which turn on. These indicate faults which are present at the moment. Trouble shoot the system based on the past or present faults as described in the following paragraphs. Perform a MAINT Self-Test on the system to further isolate the problem if it is convenient to position the flaps, slats and stabilizer as required by the MAINT test.

WJE ALL

(2) Maintenance Self-Test

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(a) Set both vanes to the mid point scribe line, flaps to 0°, slats to retract and stabilizer to 5° aircraft nose up (ANU). Press the front panel Test Switch to the MAINT TEST position. All indicators except SIF LED should blink on for one second, then the Computer Output LED should remain on for a valid test. Shaker, aural warning or horn and lights should also be on in cockpit.

NOTE: Due to maintenance test tolerance and cross monitor tolerance within the stall warning computer, a dead band exists at both ends of tolerance range where no LEDs will illuminate on the front panel of the SWC. If this should occur, sensors should be reset to maintenance test position using voltage measurement method. Rerun maintenance test to verify successful test.

WJE 892

(b) Set both vanes to mid-point scribe line, flaps to 0°, slats to retract and stabilizer to 5°. Press front panel Test Switch to MAINT TEST position. All indicators except SIF should blink on for one second, then Computer Output should remain on for valid test. Shaker, aural warning and lights should also be on in cockpit.

NOTE: Due to maintenance test tolerance and cross monitor tolerance within the stall warning computer, a dead band exists at both ends of tolerance range where no lights will illuminate on the front panel of the SWC. If this should occur, sensors should be reset to maintenance test position using voltage measurement method. Rerun maintenance test to verify successful test.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(c) If Computer Output LED does not turn on, then that system is failing the test. This indicates that one of the inputs is probably in error or not set correctly. For instance, if one stabilizer synchro is mis-rigged, then that side would not test and STAB DIFF would be indicated on that side. If the stabilizer has been incorrectly set (for instance to 0°), then neither side would test and both sides would indicate STAB DIFF. Similar indications occur for flap, slat, and alpha vane errors.

If the input sensors are in error by the following amounts, the MAINT TEST will fail:

- Vane more than ±2.0° alpha local
- Flap more than ±3.4° flap
- Stabilizer more than ±1.2° from 5° position

NOTE: For trouble shooting purposes, the following voltages may be read on the S/W Test plug.

- Alpha (mid point) , Pin 2 , V = 0(±0.8) VDC
- Flaps (zero) , Pin 4 , V = 0(±0.5) VDC
- Stabilizer (5° NU), Pin 23, V = 2.83(±1.0) VDC
- Signal Ground = Pin 1

WJE 892

(d) If Computer Output light does not turn on, then that system is failing test. This indicates that one of the inputs is probably in error or not set correctly. For instance, if one stabilizer synchro is mis-rigged, then that side would not test and STAB DIFF would be indicated on that side. If stabilizer has been incorrectly set (for instance to 0°), then neither side would test and both sides would indicate STAB DIFF. Similar indications occur for flap, slat, and alpha vane errors.

1) If input sensors are in error by following amounts, MAINT TEST will fail:

- Vane more than ±2.0° alpha local
- Flap more than ±3.4° of flap
- Stabilizer more than ±1.2° from 5° position

NOTE: For trouble shooting purposes, the following voltages may be read on the S/W Test plug:

- Alpha (mid point) , Pin 2 , V = 0(±0.8) VDC
- Flaps (zero) , Pin 4 , V = 0(±0.5) VDC
- Stabilizer (5° NU), Pin 23, V = 2.83(±1.0) VDC
- Signal Ground = Pin 1

WJE ALL

B. Trouble Shooting

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(1) Stabilizer Failure - Stab LED in the Sensor Failure column is on, check the following: most likely cause listed first.

WJE 892

Stabilizer Failure - Stab light in Sensor Failure column is on, check following: most likely cause listed first.

WJE ALL

(a) Loss of excitation to stabilizer synchro.

(b) Open or short in synchro wiring.

(c) Failure in synchro demodulator or fault monitor part of S/W Computer.

(d) Synchro defective internally.

(e) Check per paragraph Paragraph 6.A..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(2) Stabilizer Difference - Stab LED in System Difference column on, check the following: most likely listed first.

WJE 892

Stabilizer Difference - Stab light in System Difference column on, check following: most likely listed first.

WJE ALL

(a) One stabilizer synchro mis-rigged by more than 1.5 degree stabilizer. (Rig synchro per HORIZONTAL STABILIZER - ADJUSTMENT/TEST, PAGEBLOCK 27-40-00/501.)

(b) Mechanical linkage to synchro loose.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(c) Failure in synchro demodulator or comparator in the S/W Computer.

WJE 892

(d) Failure in synchro demodulator or comparator in S/W Computer.

WJE ALL

(e) Defective synchro.

(f) Check per Paragraph 6.A..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

NOTE: Synchro is nulled with stabilizer set to 1.6° NU, Pin 23 Hi to pin 1 Lo voltage (S/W computer test connector) should read 0.(±0.2) VDC. Linearity may be checked at 10° NU stabilizer by reading 7.0(±0.3) VDC on Pin 23.

WJE ALL

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(3) Vane Failure - Vane LED in Sensor Failure column on, check the following: most likely failure listed first.

WJE 892

Vane Failure - Vane light in Sensor Failure column on, check following: most likely failure listed first.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: Interchange Stall Warning Computers. If vane LED follows computer, replace Stall Warning Computer. If not, check steps (Paragraph 4.B.(3)(a)) through (Paragraph 4.B.(3)(g)).

WJE 892

NOTE: Interchange stall warning computers. If vane light follows computer, replace stall warning computer. If not, check steps (Paragraph 4.B.(3)(a)) through (Paragraph 4.B.(3)(g)).

WJE ALL

(a) Vane was not in Takeoff Window on last takeoff due to a bent or sticky vane. (Replace vane.)

NOTE: Takeoff Window is between -3 degrees and -10 degrees local alpha (measured with respect to the FRP). The computer automatically tests the vane at nose oleo extension. See Figure 107 or Figure 108.

(b) Failure of nose oleo switch, linkage or relay on ground where vane is generally in some position other than Takeoff Window, generating an erroneous takeoff test.

(c) Loss of excitation to vane synchro.

(d) Open or short in synchro wiring.

(e) Failure in synchro demodulator or fault monitor portion of S/W Computer.

(f) Defective synchro.

(g) Check per Paragraph 6.B..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(4) Vane Difference - Vane LED in System Difference column on, check the following:

WJE 892

Vane Difference - Vane light in System Difference column on, check following:

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(a) Bent or sticky vane causing a difference of more than 2.75 degrees alpha local between the left and right vanes in flight.

(b) Failure of the synchro demodulator or comparator portion of the S/W Computer.

WJE ALL

(c) Failure of main gear Weight On Wheels (WOW) signal to flight mode when aircraft is on the ground or failure to ground mode when the aircraft is in flight.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: When the WOW signal goes to ground, S/W Computer switches from using the vane input signal to a fixed 0 degree alpha local (0° alpha local corresponds to the fuselage reference plane (FRP)) reference. If the opposite computer is receiving a signal other than 0 degree ±2.75 degrees, the Vane Diff LED will turn on.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

1) For ground sensor failures, perform Flight Fault Review (FFR) on Status Test Panel (STP). On aircraft with Electronic Flight Instrument System (EFIS), check FFR on both Symbol Generators (SG)/WOW. SG-1 will register L/H WOW fail, SG-2 will register R/H WOW fail.

WJE 892

(d) Bent or sticky vane causing difference of more than 2.75 degrees alpha local between left and right vanes in flight.

(e) Failure of synchro demodulator or comparator portion of S/W Computer.

(f) Failure of main gear Weight On Wheels (WOW) signal to flight mode when aircraft is on ground or failure to ground mode when aircraft is in flight.

NOTE: When the WOW signal goes to ground, S/W Computer switches from using the vane input signal to a fixed 0 degree alpha local (0° alpha local corresponds to the FRP) reference. If the opposite computer is receiving a signal other than 0 degree ±2.75 degrees, the Vane Diff light will turn on.

1) For ground sensor failures, perform Flight Fault Review (FFR) on STP. On aircraft with EFIS, check FFR on both Symbol Generators SG/WOW. SG-1 will register L/H WOW fail, SG-2 will register R/H WOW fail.

WJE ALL

(g) Defective synchro.

(h) Check per Paragraph 6.B..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: Vane Linearity can be checked by setting vane to second scribe line trailing edge up (TEU) from mid point and reading 8.1(±0.2) VDC on Pin 2 Hi to Pin 1 Lo to ground at S/W computer test plug. This will be 28.3° TEU position (alpha local).

WJE 892

NOTE: Vane Linearity can be checked by setting vane to second scribe line TEU from mid point and reading 8.1(±0.2) VDC on Pin 2 Hi to Pin 1 Lo to ground at S/W computer test plug. This will be 28.3° TEU position (alpha local).

WJE ALL

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(5) Flap Failure - Flap LED in Sensor Failure column on, check the following: most likely failure first.

WJE 892

Flap Failure - Flap light in Sensor Failure column on, check following: most likely failure first.

WJE ALL

(a) Loss of excitation to flap synchro.

(b) Open or short in flap synchro wiring.

(c) Failure in synchro demodulator or fault monitor part of S/W Computer.

(d) Defective synchro.

(e) Check per Paragraph 6.C..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(6) Flap Difference - Flap LED in System Difference column on, check the following:

WJE 892

Flap Difference - Flap light in System Difference column on, check following:

WJE ALL

(a) One flap transmitter is mis-rigged by more than 5 degrees of flap. (Test and rig per FLAP POSITION INDICATING TRANSMITTER - MAINTENANCE PRACTICES, PAGEBLOCK 27-54-01/201.)

(b) Mechanical split in flaps.

(c) Failure in synchro demodulator or comparator in the S/W Computer.

(d) Defective flap transmitter.

(e) Check per Paragraph 6.C..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(7) Slat Failure - Slats LED in Sensor Failure column on, check the following:

WJE 892

Slat Failure - Slats light in Sensor Failure column on, check following:

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(a) Loss of slat valid signal from Prox box due to; mis-rigged slat proximity sensors on wing, defective Prox sensors or wiring, or Prox box failure.

WJE ALL

(b) Loss of slat input signals from Prox box due to; mis-rigged proximity sensors, defective wiring, or Prox box failure.

(c) Failure in slat fault monitor part of S/W Computer.

(d) Check per Paragraph 6.D..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(8) Slat Difference - Slats LED in System Difference column on, check the following:

WJE 892

Slat Difference - Slats light in System Difference column on, check following:

WJE ALL

NOTE: Also see Slat Disagree light trouble shooting flow chart, Chapter SLAT DISAGREE/AUTOSLAT AND STALL INDICATION FAILURE - TROUBLE SHOOTING, PAGEBLOCK 27-81-00/101.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(a) Difference between left and right slat signals from Prox box due to; mis-rigged or defective Bull Wheel sensors, or defective Prox box.

WJE ALL

(b) Defective wiring.

(c) Failure in slat comparator part of S/W Computer.

(d) Check per Paragraph 6.D..

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(9) Computer Failure - Computer Failure LED on, check the following:

WJE 892

Computer Failure - Computer Failure light on, check following:

WJE ALL

(a) Failure of one of power supplies in S/W Computer.

(b) Failure of fault monitoring in S/W Computer.

(c) Replace the computer.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(10) Computer Difference - Computer LED in System Difference column on, check the following:

WJE 892

Computer Difference - Computer light in System Difference column on, check following:

WJE ALL

(a) Failure of computation circuits in one S/W Computer.

(b) Failure of comparator circuits in one S/W Computer.

(c) Replace computer.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(11) Autoslat Failure - Autoslat Failure LED on, on both boxes, check the following:

WJE 892

Autoslat Failure - Autoslat Failure light on, on both boxes, check following:

WJE ALL

NOTE: Also see Auto Slat Fail light trouble shooting flow chart, Chapter SLAT DISAGREE/AUTOSLAT AND STALL INDICATION FAILURE - TROUBLE SHOOTING, PAGEBLOCK 27-81-00/101.

(a) Power failure to actuator, defective actuator or defective wiring to actuator causing a disagreement between actuators.

(b) Failure of flap handle switch or wiring which can then cause an actuator disagreement especially during an Autoslat BITE test or when retracting slats.

(c) False stall warning due to defective vane or computer on one side when slats are retracted.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(d) Slats do not extend from MID to EXT within 3 seconds during BITE due to hydraulic problems.

WJE ALL

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(12) If only one box shows an Autoslat Failure LED, cause may be because that system is failing the Autoslat BITE test. Each box automatically performs on Autoslat BITE test when the handle is out of the 0° RET detent, aircraft is on the ground and slats have extended to MID position. The BITE test will fail and turn on and latch the Autoslat Failure LED due to the following causes:

WJE 892

If only one box shows an Autoslat Failure light, cause may be because that system is failing Autoslat BITE test. Each box automatically performs on Autoslat BITE test when handle is out of 0° RET detent, aircraft is on ground and slats have extended to MID position. BITE test will fail and turn on and latch the Autoslat Failure light due to following causes:

WJE ALL

(a) Loss of Airspeed Valid signal or erroneous airspeed signal from Air Data Computer during BITE only.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(b) Fault in autoslat part of S/W Computer (Computer Failure LED will also be on).

WJE 892

(c) Fault in autoslat part of S/W Computer (Computer Failure light will also be on).

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(d) Open or defective wiring or defective 14° flap handle switch.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 886, 887, 891

(e) Defective wiring or defective 0° RET flap handle switch.

WJE ALL

(f) Failure of box to sense successful extension of slats due to failure in proximity system or wiring.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(g) If only one system gives a command to extend the slats, the other computer will turn on its Autoslat Failure LED in about 6 seconds during a BITE test. If this type of failure occurs at any time other than BITE, the Failure LED will turn on in about 32 seconds.

WJE 892

(h) If only one system gives a command to extend slats, other computer will turn on its Autoslat Failure light in about 6 seconds during BITE test. If this type of failure occurs at any time other than BITE, Failure light will turn on in about 32 seconds.

WJE ALL

(i) Failure of one system to BITE test due to loss of main gear WOW signal from prox box.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(j) Autoslat extend from one box, at MID slats, due to vane failure or system enabled due to failure of WOW signal to the flight mode. The Vane difference LED would also be on as well as the SIF LED.

NOTE: Trouble shooting of the above problems may be done as follows:

NOTE: The following voltage measurements should be performed using a meter with greater than 1 Meg input impedance.

- Auto slat actuator position may be checked visually by wrapping tape around the push rod when the actuator is retracted, then it is easy to verify extension by noting that the tape moves about 3/4 inch. Electrical actuator position may be checked by measuring the voltage for S/W SYS-1 at S30-28, pin 22X or at S30-119, pin 87A for S/W SYS-2. Extend should be greater than +6.3 VDC and Retract should be less than +3.7 VDC.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893 (Continued)

- For slat signal problems use the prox box test tool to indicate the various sensor positions or use self-test function of prox box.
- Flap handle 14° switches may be checked by measuring approximately +10 VDC for S/W SYS-1 at S30-28, between ground and 24A; and S/W SYS-2 at S30-119, between ground and 88A.
- Autoslat may be functioned per Paragraph 6.E..

WJE 892

(k) Autoslat extend from one box, at MID slats, due to vane failure or system enabled due to failure of WOW signal to flight mode. Vane difference light would also be on as well as SIF.

(13) Trouble shooting of above problems may be done as follows:

NOTE: The following voltage measurements should be performed using a meter with greater than 1 Meg input impedance.

(a) Auto slat actuator position may be checked visually by wrapping tape around pushrod when actuator is retracted, then it is easy to verify extension by noting that tape moves about 3/4 inch (19.05 mm). Electrical actuator position may be checked by measuring the voltage for S/W SYS-1 at S30-28, pin 22X or at S30-119, pin 87A for S/W SYS-2. Extend should be greater than +6.3 VDC and Retract should be less than +3.7 VDC.

(b) For slat signal problems use prox box test tool to indicate various sensor positions or use self-test function of prox box.

(c) Flap handle 14° switches may be checked by measuring approximately +10 VDC for S/W SYS-1 at S30-28, between ground and 24A; and S/W SYS-2 at S30-119, between ground and 88A.

(d) Autoslat may be functioned per Paragraph 6.E..

WJE ALL

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(14) SIF - SIF LED on, check the following:

WJE 892

SIF Light - SIF light on, check following:

WJE ALL

NOTE: Also see Stall Indication Fail light trouble shooting flow chart, Chapter SLAT DISAGREE/AUTOSLAT AND STALL INDICATION FAILURE - TROUBLE SHOOTING, PAGEBLOCK 27-81-00/101.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(a) Differences between any of the left and right sensor inputs greater than their thresholds. (The corresponding sensor difference LED will also be on.)

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(b) Faults in any of the input sensors or computers.

(c) Loss of power to any input sensor or the computers.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(d) Any combination of sensor or computer errors which results in one computer output differing from the other by more than 4° alpha local equivalent.

(e) If only the SIF LED is on, it usually means a loss of 28 vdc or the nose and main gear are either not both on ground or not both in flight. Gear signal difference alone will turn on SIF in 32 seconds, but in most cases either the VANE DIFF or VANE FAULT will also be indicated.

NOTE: The Computer Output LED should be on whenever one is holding the Test Switch in the NORMAL TEST position and there are no flap, alpha or computer faults which would inhibit a normal Test output.

WJE 892

(f) Differences between any of left and right sensor inputs greater than their thresholds. (Corresponding sensor difference light will also be on.)

(g) Faults in any of input sensors or computers.

(h) Loss of power to any input sensor or computers.

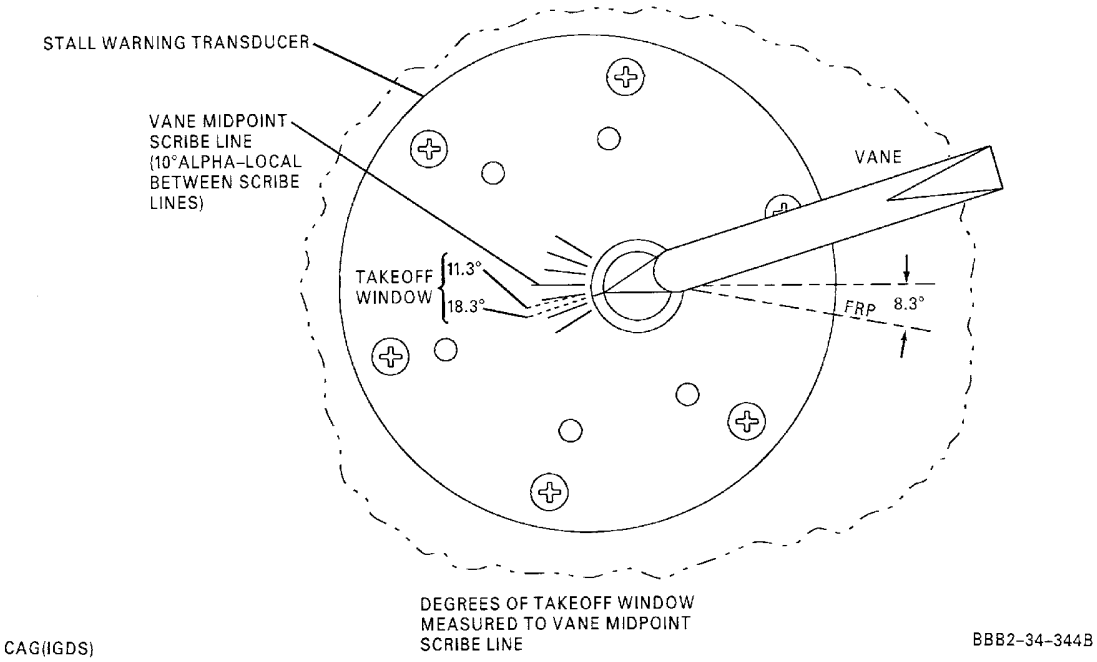
(i) Any combination of sensor or computer errors which results in one computer output differing from other by more than 4° alpha local equivalent.

(j) If only SIF is on, it usually means loss of 28 vdc or nose and main gear are either not both on ground or not both in flight. Gear signal difference alone will turn on SIF in 32 seconds, but in most cases either VANE DIFF or VANE FAULT will also be indicated.

NOTE: The Computer Output light should be on whenever one is holding the Test Switch in the NORMAL TEST position and there are no flap, alpha or computer faults which would inhibit a normal Test output.

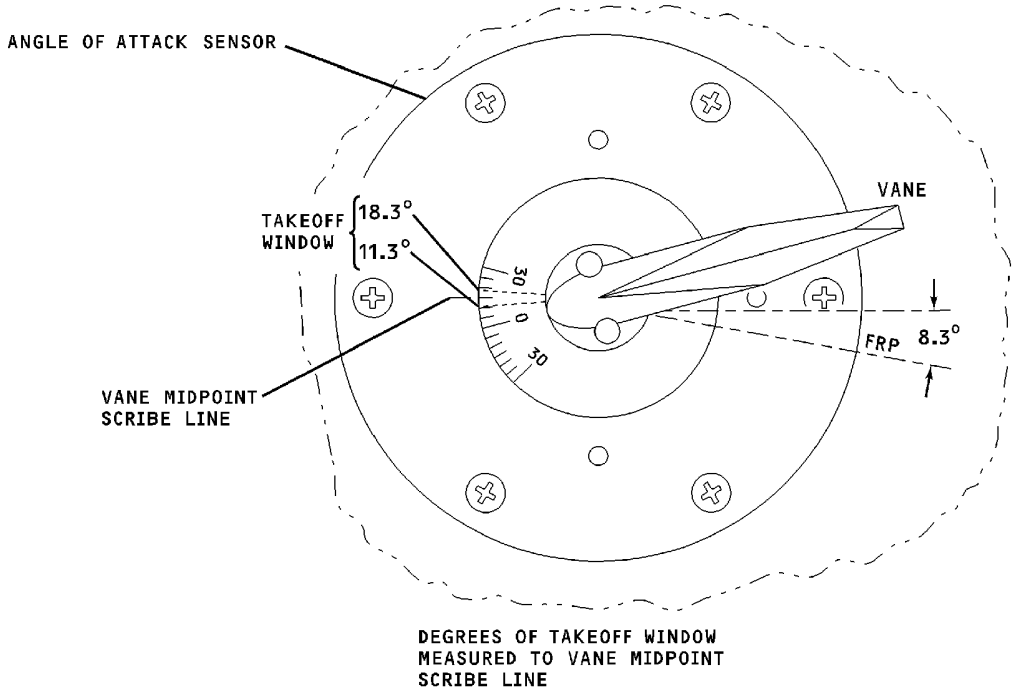
WJE ALL

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893



Vane Position Takeoff
Figure 107/34-19-00-990-816

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893



CAG(IGDS)

BBB2-34-2406

Vane Position Takeoff for Rosemount AOA Sensor Vane
Figure 108/34-19-00-990-817

WJE ALL

5. Trouble Shooting - Stick Pusher

A. Trouble Shoot

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

NOTE: The stick pusher normally operates only in-flight with the slats not retracted. With slats extended, the pusher will operate if both vanes exceed the recognition trip alpha by 4° or remain above the trip level for more than 6 seconds whichever occurs first. With slats in MID, the trip alpha must be exceeded by 2.5° or 6 seconds whichever occurs first. The G switch will turn the pusher off if the aircraft reaches about 0.5 g during the nose down recovery and latches out as long as S/W-2 has a pusher output. The pusher dump switches will disconnect the pusher and latch it out any time there is a pusher signal output thru the respective switch. Airplanes with Service Bulletin 34-144 incorporated and production incorporated aircraft, the dump switch will latch only when there is a pusher signal output.

WJE 892

(1) The stick pusher normally operates only in flight without Self Test. The pusher operates simultaneously with the SSRS in all slat configurations (RET, MID, EXT). Once activated, the pusher will remain latched until stick shaker turns off. G switch will turn pusher off if aircraft reaches about 0.6 g during nose down recovery and latches out as long as S/W-2 has pusher output. PUSHER DUMPED lights are illuminated whenever G switch is activated. The pusher dump switch causes two magnetic latching relays to change state and remove power from servo and clutch and illuminate PUSHER DUMPED light on overhead switch panel. These relays can only be reset by pressing reset switch in E/E compartment.

(2) A "PUSHER FAIL" light is activated by any one of following conditions:

(a) Presence of pusher signal in one computer not followed by pusher signal from other computer within 20 seconds OR

(b) Power loss or computer faults.

(3) Fail condition lasting more than 1.0 second will turn on and latch "PUSHER FAIL" light on overhead switch panel and master caution lights on glareshield and will inhibit stick pusher. FAIL may be reset by pressing either PUSH light on glareshield.

WJE ALL

(4) Stick pusher fails to operate when tested in a simulated in-flight condition, check the following:

(a) Inhibit caused by an alpha, flap or computer fault. The appropriate indicator on the front panel should be on.

(b) Loss of Airspeed Valid or erroneous airspeed greater than 240 knots from Air Data System.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(c) One or both S/W systems sensing a slat retracted condition or WOW on ground due to a Proximity system fault.

(d) Dump switch failed. SIF light on the OAP will be on. (SIF LED on box front panel will not be on.)

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(e) Dump switch failed. SIF light on the OAP will be on. (SIF LED on box front panel will not be ON.)

WJE ALL

(f) Failure in pusher output portion of one S/W Computer. Check for output voltage if there are no other faults indicated.

WJE 892

(g) One or both S/W systems sensing slat retracted condition or WOW on ground due to Proximity system fault.

(h) Dump switch failed. PUSHER DUMPED light on overhead switch panel will be on.

(i) Failure in pusher output portion of one S/W Computer. Pusher lights of affected computer will not be illuminated.

WJE ALL

(j) Failure in servo power supply or wiring.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(k) G switch tilted up at an angle greater than about 60 degrees or failure in G switch or wiring.

WJE 892

(l) G switch tilted up at an angle greater than about 60 degrees or failure in G switch or wiring. PUSHER DUMPED light on overhead switch panel will be on.

WJE ALL

(m) Failure in servo or wiring.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(5) Stick pusher fails to operate when testing on the ground by pressing both Test Switches to the NORMAL position, check the following:

(a) All of the above failures will inhibit a pusher test except in this condition the Proximity system must now be supplying a ground WOW signal to each S/W Computer and, again, the slat signal must not be RETRACT.

(b) Computer faults causing a failure to self-test. The Computer Output light will not be on.

WJE 892

(6) Stick pusher fails to operate when testing on ground by pressing both Test Switches to the NORMAL position, check following:

(a) All of above failures will inhibit pusher test except in this condition proximity system must now be supplying ground WOW signal to each S/W Computer.

(b) Computer faults causing failure to self-test. Computer Output light will not be on.

WJE ALL

(7) Stick pusher does not move to full forward position and remain there when testing on ground by holding both test switches in NORMAL TEST position; check the following:

(a) Hydraulic power not applied.

(b) Servo power supply (low output).

(c) Servo drive (weak, clutch ratcheting may be heard if clutch engage voltage or current is low).

(d) Servo drive bracket (slip clutch weak, ratcheting sound heard, forces low).

6. **Trouble Shooting Reference Operational Checks**

NOTE: The following operational checks are referenced for test in the Trouble Shooting Procedures. Checks accomplished only as required.

A. Stabilizer Inputs

NOTE: This test checks the stabilizer position inputs and the corresponding demodulator portion of the S/W computer.

CAUTION: PRIOR TO MOVING THE STABILIZER, VERIFY THAT ALL AREAS AROUND THE STABILIZER AND ASSOCIATED CABLES ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(1) Position stabilizer to 1.6 degrees nose up on the cockpit stabilizer position indicator.

(2) Measure voltage from pin 23 to pin 1 (gnd) on front panel connector. If voltage is out of tolerance (0(±0.2) vdc), loosen clamp bolt on stabilizer synchro and turn synchro body until voltage is in tolerance. Tighten synchro clamp bolt and re-check that synchro is still nulled. Check both systems.

(3) Position stabilizer to 10° nose up.

(4) Measure voltage from pin 23 to pin 1 (gnd) on front panel test connector of each S/W connector or test connector tool should be +7.0(±.3) VDC. Check both systems.

(5) Reset fault memory on front panel of each S/W computer.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(6) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no STAB SENSOR FAILURE or STAB SYSTEM DIFFERENCE LED's on. Check both systems.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(7) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no STAB SENSOR FAILURE or STAB SYSTEM DIFFERENCE lights on. Check both systems.

WJE ALL

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

B. AOA Transducer

WJE 892

Angle of Attack Transducer

WJE ALL

NOTE: This test checks the alpha vane and the demodulator portion of the S/W computer.

(1) Position left and right alpha vanes to 28.3°(±0.2°) TEU.

NOTE: Vane 28.3° TEU (alpha local) position can be determined by setting vane to second scribe line TEU from mid point.

(2) Measure voltage from pin 2 to pin 1 (gnd) on front panel test connector of each stall warning computer. Should be +8.10(±.20) VDC.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(3) Press MEMORY RESET button on front panel of each S/W computer, while holding Test Switch in NORM TEST position to reset S/W fault memory.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(4) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no VANE SENSOR FAILURE or VANE SYSTEM DIFFERENCE LEDs on. Check both systems.

WJE 892

(5) Press MEMORY RESET button on front panel of each S/W computer, while holding Test Switch in NORMAL TEST position to reset S/W fault memory.

(6) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no VANE SENSOR FAILURE or VANE SYSTEM DIFFERENCE lights on. Check both systems.

WJE ALL

C. Flap Transmitter

NOTE: This test functions the flap transducer output and corresponding demodulator portion of S/W computer.

CAUTION: PRIOR TO TURNING ON HYDRAULIC POWER, VERIFY THAT AREA AROUND ALL POWERED SURFACES IS CLEAR OF EQUIPMENT AND PERSONNEL. SLATS MAY AUTOMATICALLY MOVE FROM MID TO EXT OR FROM EXT TO MID.

(1) Apply hydraulic power necessary for operation of flaps and slats.

(2) Position flaps to 40°.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(3) Measure voltage from pin 4 to pin 1 (gnd) on the front panel test connector or on test tool should be +6.0(±.4) VDC.

WJE 892

(4) Measure voltage from pin 4 to pin 1 (gnd) on front panel test connector or on test tool should be +6.0(±.4) VDC.

WJE ALL

(5) Reset fault memory on front panel of each S/W computer.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(6) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no FLAP SENSOR FAILURE or FLAP SYSTEM DIFFERENCE LED's on. Check both systems.

WJE ALL

D. Slat Inputs

NOTE: This test functions the slat inputs from the proximity switch unit and the slat logic portions of the S/W computer.

CAUTION: PRIOR TO TURNING ON HYDRAULIC POWER, VERIFY THAT AREA AROUND ALL POWERED SURFACES IS CLEAR OF EQUIPMENT AND PERSONNEL. SLATS MAY AUTOMATICALLY MOVE FROM MID TO EXT OR FROM EXT TO MID.

(1) Apply hydraulic power necessary for operation of the flaps and slats.

(2) Position flaps/slats to UP/RET.

(3) Reset fault memory on front panel of each S/W computer.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(4) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there is no SLAT SENSOR FAILURE or SLAT SYSTEM DIFFERENCE LEDs on. Check both systems.

WJE 892

(5) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there is no SLAT SENSOR FAILURE or SLAT SYSTEM DIFFERENCE lights on. Check both systems.

WJE ALL

(6) Position flaps/slats to 0°/T.O. EXT.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(7) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no SLAT FAILURE or SLAT DIFFERENCE LEDs on. Check both systems.

WJE 892

(8) Momentarily hold TEST switch on front panel of S/W computer in NORMAL TEST position and note there are no SLAT FAILURE or SLAT DIFFERENCE lights on. Check both systems.

WJE ALL

(9) Position the flaps/slats to 15°/T.O. EXT.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(10) Momentarily hold TEST switch on front panel of S/W computer in NORM TEST position and note there are no SLAT FAILURE or SLAT DIFFERENCE LEDs on. Check both systems.

WJE 892

(11) Momentarily hold TEST switch on front panel of S/W computer in NORM TEST position and note there are no SLAT FAILURE or SLAT DIFFERENCE lights on. Check both systems.

WJE ALL

E. Auto Slat Self Test

NOTE: This test checks the complete auto slat system automatically whenever slats are in takeoff position on the ground and flap handle is moved out of UP/RET detent.

(1) Position flap/slat handle to UP/RET, and place nose gear and main gear in ground position.

(2) Apply hydraulic power necessary to operate flaps and slats and verify flaps/slats are UP/RET.

(3) Position flap/slat handle to 0°/T.O. EXT and verify the following:

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(a) Slats go to MID position as indicated by slat TAKEOFF annunciator on Center Instrument panel turning on.

(b) After slat TAKEOFF annunciator turns on, slat DISAGREE annunciator and AUTO annunciator on Center Instrument panel will momentarily turn on for approximately 5 seconds and slats should fully extend momentarily for approximately 5 seconds then retract to mid.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(c) AUTO SLAT FAIL light on OAP should not come on.

WJE 892

(d) AUTO SLAT FAIL light on overhead annunciator panel should not come on.

WJE ALL

(4) Position flap/slat handle to 15°/T.O. EXT and verify following:

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(a) Slats go to fully EXT position as indicated by slat TAKEOFF annunciator on Center Instrument panel turning on and slat DISAGREE annunciator turning off.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(b) AUTO SLAT FAIL light on OAP should not come on.

WJE 892

(c) AUTO SLAT FAIL light on overhead annunciator panel should not come on.

WJE ALL

(5) Position flap/slat handle to UP/RET.

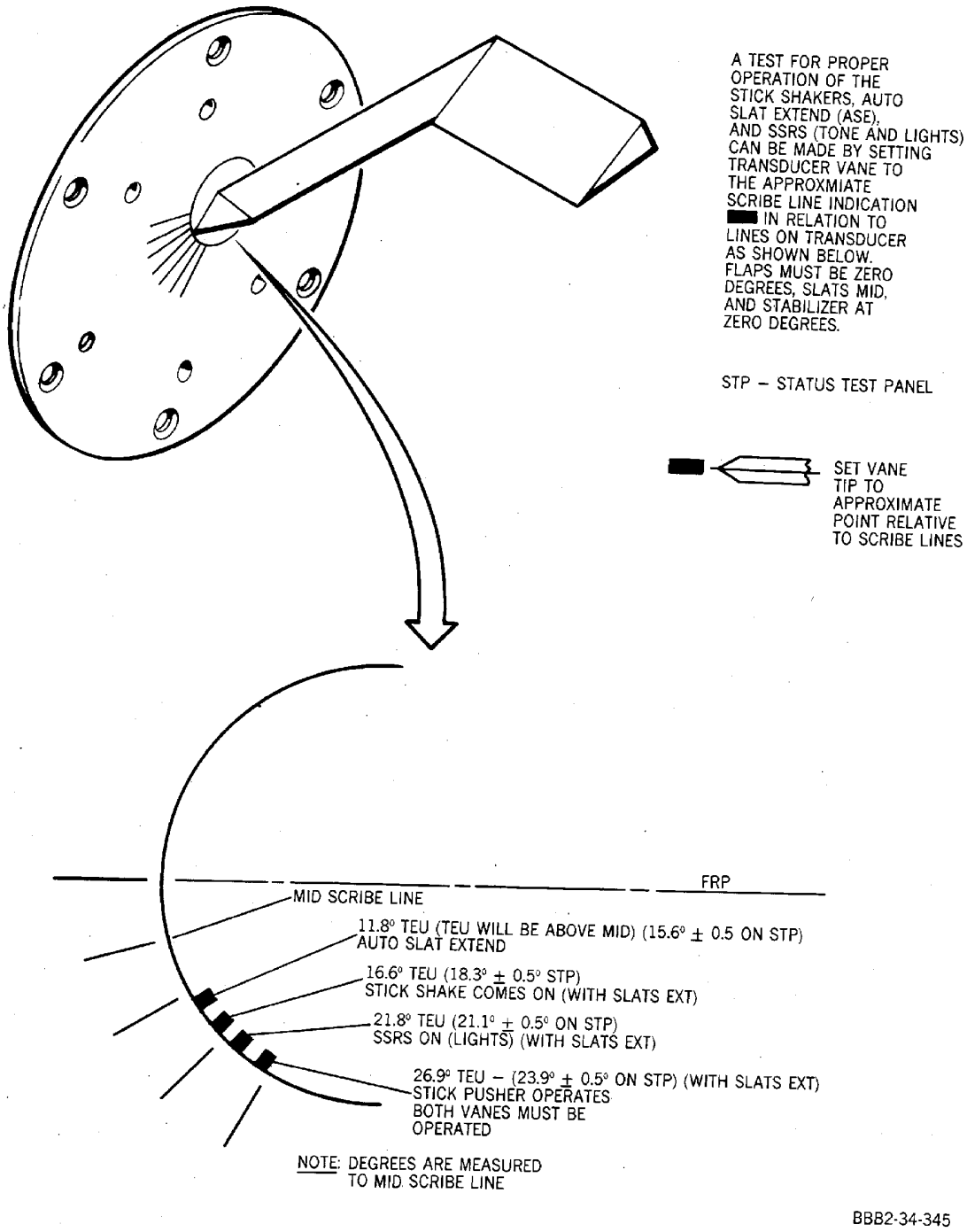
WJE 892

(a) Slat DISAGREE light is ON and slat LAND light is OFF when slats are in transit.

(b) STALL INDICATION FAILURE and AUTO SLAT FAIL lights are OFF.

(c) Slat DISAGREE light is OFF when slats are fully retracted.

WJE ALL



Transducer Vane Settings - Operational Check
Figure 109/34-19-00-990-819

STALL WARNING SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 892

A. Stall Warning System (Stall Warning/Auto Slat System) Maintenance Practices consist of a self-test, a maintenance test, a normal test, a Stick Shaker test, a Lift Off Inhibit and Alpha Rate BIAS test, an Auto Slat test, a Stick pusher test, a G switch test, and a dump switch test.

B. Self-test is accomplished from the flight compartment through use of the stall warning test switches located on the overhead panel. The self-test checks most functions of the stall warning computers, operation of the stick shakers, stall lights, aural warnings, and pusher lights.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

C. Stall Warning System Maintenance Practices consists of a self-test, a maintenance test, a normal test, a Stick Shaker test, a Lift Off Inhibit and Alpha Rate BIAS test, an Auto Slat test, a Stick pusher test, and a G switch test.

D. Self-test is accomplished from the flight compartment through use of the stall warning test switch located on the overhead panel. The self-test checks most functions of the stall warning computers, operation of the stick shakers, stall lights, and aural warnings.

WJE ALL

E. The NORMAL TEST is accomplished at the stall warning computers located in the electrical/electronics compartment. This test duplicates the test as conducted from the flight compartment, but also recalls from memory any sensor failures and input signal comparator differences stored in computer memory.

F. The MAINTENANCE TEST is accomplished at the stall warning computers through use of the test switch on the front panels of the computers. The test checks the validity of all sensor inputs and compares side 1 and side 2 values to reference values.

G. The Stick Shaker operation test checks the individual operation of each stick shaker.

H. The Lift Off Inhibit and Alpha Rate BIAS test is performed during periodic aircraft checks.

I. The Auto Slat tests check the automatic operation of the slat extension by built-in test (BIT) Slat/Flap handle movement and ALPHA Vane position.

WJE 892

J. The Stick Pusher System tests check the operation of the stick pusher servo, the stick pusher G switch, and the pusher dump switch. It also verifies that each computer can independently actuate each shaker, and turn on its pusher light.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

K. The Post Stall Recovery System (PSRS) tests check the operation of the stick pusher servo and the stick pusher G switch.

WJE ALL

L. The tests can be performed in entirety or individually at the requirements of the operator. All procedures in this Maintenance Practices are applicable to left and right (NO. 1/NO. 2) Stall Warning systems.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

M. With AOL 9-2532 incorporated the stick pusher drum and housing assembly, P/N 7002588-902, will be incorporated on future MD-80 aircraft. This drum and housing assembly is interchangeable with drum and housing assembly, P/N 7002588-901. There will be difference in stick pusher force required as called out in Paragraph 6.A., test procedures that follow.

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of following listed items.

Table 201

Name and Number	Manufacturer
Proximity Switch Dummy Targets (2) P/N 4952969-1	Douglas Aircraft Co.
Push/Pull Force Gauge capable of reading up to 160 pounds	Hunter
Control Column Push Pull Bar Fixture P/N 5965694-1	Douglas Aircraft Co.

3. Adjustment/Test Stall Warning System

NOTE: For the following tests, the aircraft must be in ground mode (weight on wheels).

NOTE: Flight faults should be corrected or noted before resetting computer memory.

NOTE: If flight faults have been noted, the memory should be erased before Normal/Maintenance Test is performed.

NOTE: If self test is performed on the proximity switch electronics unit, faults stored in the stall warning computer memory may be erased.

NOTE: Captain's and first officer's aural warnings may not be synchronized. The warnings come from independent systems, and the difference in tolerances between the systems may result in warnings not occurring at the same time.

A. Self-Test

Table 202

Step	Operation	Desired Result
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(1)	Verify that STALL INDICATION FAILURE (SIF) light on overhead annunciator panel (OAP) is not on.	
(2)	Place STALL TEST switch on overhead panel to SYS 1 position.	Both stick shakers operate, both STALL and STICK PUSHER lights come on. Aural stall warning (tone/voice) comes on.
(3)	Place STALL TEST switch to OFF.	Stick shakers, STALL and STICK PUSHER lights, and aural warning go off.
(4)	Place STALL TEST switch to SYS 2.	Both stick shakers operate, both STALL and STICK PUSHER lights come on. Aural stall warning (tone/voice) comes on.
(5)	Place STALL TEST switch to OFF position.	Stick shakers, STALL and STICK PUSHER lights and aural warning go off.
WJE 892		
(1)	Verify that STALL INDICATION FAILURE (SIF) light on overhead annunciator panel is not on.	

WJE 892 (Continued)

Table 202 (Continued)

Step	Operation	Desired Result
(2)	Place STALL SELF TEST-1 switch on overhead panel in the TEST position. Hold switch in TEST-1 position for 20 seconds.	Both stick shakers operate, both STALL and PUSH 1 lights come on, and stall warning aural tone and voice "STALL" comes on. After 20 seconds, PUSHER FAIL light (overhead) and MASTER CAUTION lights (glareshield) come on. PUSH 1 lights go off.
(3)	Place STALL SELF TEST-1 switch in OFF position.	Stick shakers, STALL and PUSH 1 lights, and aural warning should go off.
(4)	Press Capt's PUSH 1/ PUSH 2 switch to reset PUSHER FAIL light on overhead annunciator panel.	PUSHER FAIL light off.
(5)	Press either MASTER CAUTION light to reset both M/C lights.	MASTER CAUTION lights off.
(6)	Place STALL SELF TEST-2 switch in TEST-2 position.	Both stick shakers operate, both STALL and PUSH 2 lights come on and stall warning aural tone and voice "STALL" comes on. After 20 seconds, PUSHER FAIL and MASTER CAUTION lights come on. PUSH 2 lights go off.
(7)	Place STALL SELF TEST-2 switch in OFF position.	Stick shakers, STALL and PUSH 2 lights and aural warning should go off.
(8)	Press F.O.'s PUSH 1/PUSH 2 switch to reset PUSHER FAIL light.	PUSHER FAIL light off.
(9)	Press either MASTER CAUTION light to reset both M/C lights.	MASTER CAUTION lights off.

WJE ALL

B. Normal Test

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

Table 203

Step	Operation	Desired Result
(1)	Place test switch on front of (-1 or -2) stall warning computer in NORMAL TEST position and hold.	Stick shakers, STALL lights and aural warning come on. On computer, all light emitting diodes (LEDs) except SIF come on momentarily for LED test. If COMPUTER OUTPUT LED stays on and all other LEDs go off, the test is good. Any other LEDs that stay on indicate a present fault or a fault stored in memory.
(2)	Release NORMAL TEST switch to OFF position.	If faults were indicated, reset memory and repeat test. If a fault LED comes on again, the fault is still present.

NOTE: If any faults are stored in the computer memory the corresponding LED on front of computer will remain on while test switch is pressed.

Faults should be corrected or noted before resetting memory. Memory is automatically reset at main gear lift off.

If difference fault shows, perform maintenance test.

Check alignment of sensors on system indicating the difference fault.

WJE 892

Table 204

Step	Operation	Desired Result
(1)	Place test switch on front of (-1 or -2) stall warning computer in NORMAL TEST position and hold.	A good test is indicated by COMPUTER OUTPUT light on and no other lights on steady, lamps (except SIF) will momentarily come on denoting that lamps are good. Stick shakers will operate and PUSHER and STALL lights and aural warning will also come on.
(2)	Release test switch.	Stick shakers, STALL and PUSHER lights, and aural warning should go off.

NOTE: Any faults stored in the computer memory, the corresponding light on front of computer will remain on while test switch is pressed. Faults should be corrected or noted before resetting memory. Memory is automatically reset at main gear lift off. If difference fault shows, perform maintenance test. Check alignment of sensors on system indicating the difference fault.

WJE ALL

C. Maintenance Test

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

Table 205

Step	Operation	Desired Result
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(1)	Set both angle of attack (AOA) vanes to mid-point, flaps full up, slats full retracted, and horizontal stabilizer at 5 degrees aircraft nose up (ANU).	
(2)	Place test switch on front of computer to MAINT TEST position and hold.	Stick shakers, STALL lights and aural warning come on. On computer, all LEDs except SIF come on momentarily for LED test. If COMPUTER OUTPUT LED stays on and all other LEDs go off, the test is good. Any other LEDs that stay on indicate a present fault or a fault stored in memory.
(3)	Release MAINT TEST switch to OFF position.	If faults were indicated, reset memory and repeat test. If a fault LED comes on again, the fault is still present.
NOTE: Faults stored in memory will remain lighted while test switch is held. Repair or note faults before resetting memory. If difference fault shows, check alignment of faulted sensor on system indicating the fault.		

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893 (Continued)

Table 205 (Continued)

Step	Operation	Desired Result
(4)	Make certain AOA vanes are free to move after test completion. (Remove any agent used to hold vanes in mid-position.)	
(5)	Return aircraft to required configuration.	
WJE 892		
(1)	Set both angle of attack vanes to mid-point, flaps full up, slats full retracted, and horizontal stabilizer at 5 degrees ANU (aircraft nose up).	
NOTE: Vanes may be held at mid-point with tape, if necessary. Tape must be highly visible or have long, red streamer attached.		
(2)	Place test switch on front of (-1 or -2) computer in MAINT TEST position and hold.	A good test is indicated by COMPUTER OUTPUT light on and no other lights on steady; lamps (except SIF) will momentarily come on denoting lamps are good. Stick shakers will operate and STALL and PUSHER lights and aural warning will also come on.
NOTE: Faults stored in memory will remain lighted while test switch is held. Repair or note faults before resetting memory. If difference fault shows, check alignment of faulted sensor on system indicating the fault.		
(3)	Release TEST switch.	Shakers, STALL and PUSHER lights and aural warning should go off.
(4)	Remove tape from angle of attack vanes, if installed.	
(5)	Make certain angle of attack vanes are free to move after test completion. (Remove any agent used to hold vanes in mid-position.)	
(6)	Return aircraft to required configuration.	

WJE ALL

D. Check Stick Shaker

NOTE: The following test checks the individual operation of the Captain's and First Officer's stick shakers by either computer.

Table 206

Step	Operation	Desired Result
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(1)	Disconnect electrical connector from First Officer's stick shaker located on First Officer's control column.	
(2)	Place STALL TEST switch located on overhead panel in number 1 position then in number 2 position.	Control columns should shake in either position indicating Captain's stick shaker is operating from either computer.
(3)	Place STALL TEST switch to OFF position.	Control columns stop shaking.
(4)	Connect electrical connector to First Officer's stick shaker.	

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893 (Continued)

Table 206 (Continued)

Step	Operation	Desired Result
(5)	Disconnect electrical connector from Captain's stick shaker located on Captain's control column.	
(6)	Place STALL TEST switch in number 2 position then number 1 position.	Control columns should shake in either position indicating First Officer's stick shaker is operating from either computer.
(7)	Place STALL TEST switch in OFF position.	Control columns should stop shaking.
(8)	Connect electrical connector to Captain's stick shaker.	
WJE 892		
(1)	Disconnect electrical connector from First Officer's stick shaker located on First Officer's control column.	
(2)	Place STALL SELF TEST-1 switch located on overhead panel in TEST position.	Capt's stick shaker comes on.
(3)	Place STALL SELF TEST-1 switch in OFF position.	Capt's shaker goes off.
(4)	Place STALL SELF TEST-2 switch in TEST position.	Capt's shaker comes on.
(5)	Place STALL SELF TEST-2 switch in OFF position.	Capt's shaker goes off.
(6)	Connect electrical connector to First Officer's stick shaker.	
(7)	Disconnect electrical connector from Captain's stick shaker located on Captain's control column.	
(8)	Place GND PROX WARN TEST switch, on overhead switch panel, in TEST position.	"GLIDE SLOPE" and "WHOOP WHOOP-PULL UP" aural warnings are activated.
(9)	Place STALL SELF TEST-1 switch in TEST position.	F.O.'s shaker comes on. GPWS aural warnings stay on.
(10)	Place STALL SELF TEST-1 switch in OFF position and place GND PROX WARN TEST switch in NORM position.	F.O.'s shaker goes off. GPWS aural warnings go off.
(11)	Place STALL SELF TEST-2 switch in TEST position.	First Officer's stick shaker comes on.
(12)	Place STALL SELF TEST-2 switch in OFF position.	F.O.'s shaker goes off.
(13)	Connect electrical connector to Capt's stick shaker.	

WJE ALL

E. Test Lift Off Inhibit and Alpha Rate Bias

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE 892

CAUTION: DURING FOLLOWING OPERATION CONTROL COLUMNS WILL MOVE FORWARD RAPIDLY. MAKE CERTAIN THERE IS NO EQUIPMENT IN CONTROL COLUMNS PATH OF MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CHECK BEING CONDUCTED AND CONTROL COLUMN MOVEMENT.

WJE ALL

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

WJE 892

(2) Place both stall warning angle of attack transducer vanes in full trailing edge up (TEU) position. Flap/slat handles at UP/RET.

NOTE: A SIF light may come on any time the main and nose gear differ in position for more than 30 seconds.

(3) Install main gear proximity switch dummy targets (main gear sensors are in flight mode). Stall warning (SW) shakers and supplementary stall recognition system (SSRS) indications (tone and lights) should come on. Control columns move to full forward position and PUSH 1/PUSH 2 lights comes on.

NOTE: If main gear sensors are not in flight mode within 3 seconds of each other, VANE DIFFERENCE light on stall warning computer may come on. If light comes on, reset computer memory by holding test switch to NORMAL TEST and pressing MEMORY RESET button. Continue with test.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(4) Place both stall warning AOA transducer vanes in full trailing edge up (TEU) position. Flap/slat handles at UP/RET.

NOTE: A SIF light on OAP may come on any time the main and nose gear differ in position for more than 38 seconds.

(5) Install main gear proximity switch dummy targets (main gear sensors are in flight mode). Stall warning (SW) shakers and supplementary stall recognition system (SSRS) indications (tone and lights) should come on.

NOTE: If main gear sensors are not in flight mode within 3 seconds of each other, VANE DIFFERENCE LED on stall warning computer may come on. If LED comes on, reset computer memory by holding test switch to NORMAL TEST and pressing MEMORY RESET button. Continue with test.

WJE ALL

(6) Open LEFT and RIGHT GROUND CONTROL RELAY circuit breakers, located on upper EPC.

NOTE: L and R vane faults will be stored in the S/W fault memory.

WJE 892

(7) Stick shakers, SSRS, and stick pusher should go off for approximately 18 seconds and then come on again.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(8) Stick shakers and SSRS should go off for approximately 18 seconds and then come on again.

WJE ALL

(9) Place transducer vanes full trailing edge down (TED) and cycle left and right 115 VAC stall warning circuit breakers to clear the takeoff alpha faults in both stall warning computers.

(10) Measure voltage from pin 3 to ground (pin 1) at stall warning test plug (on side being tested) as vane is moved from full TED to TEU at rate of approximately one scribe line every two seconds. Rate voltage will momentarily indicate greater than +7 VDC.

(11) Measure voltage from pin 25 to ground (pin 1) at stall warning test plug (on side being tested) as vane is moved from full TED to TEU at rate of approximately one scribe line every two seconds. Rate voltage will momentarily indicate greater than +5 VDC.

(12) Repeat steps (Paragraph 3.E.(10)) and (Paragraph 3.E.(11)) for opposite system.

WJE 892

(13) Remove main gear proximity switch dummy targets, and press either PUSH1/PUSH2 switch to reset lights.

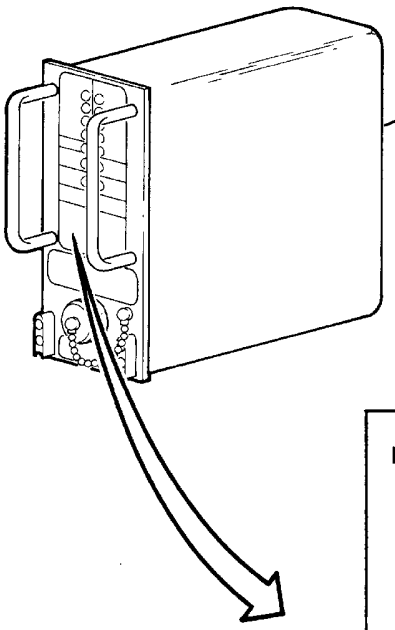
(14) Return airplane to required configuration.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(15) Remove main gear proximity switch dummy targets.

(16) Return aircraft to required configuration.

WJE ALL



(A) LED–AMBER
(G) LED–GREEN
(R) LED–RED
(O) SWITCH

SENSOR FAILURE IF LIGHT ON, REPLACE SENSOR		SYSTEM DIFFERENCE IF LIGHT ON, DO MAINT TEST	
STAB	(R)	(A)	STAB
VANE	(R)	(A)	VANE
FLAPS	(R)	(A)	FLAPS
SLATS	(R)	(A)	SLATS
SIF	(R)	(A)	COMPUTER
COMPUTER FAILURE REPLACE COMPUTER	(R)	(G)	COMPUTER OUTPUT
AUTOSLAT FAILURE CHECK ACTUATORS IF BOTH COMPUTERS SHOW AUTO SLAT FAILURE	(R)	(O)	MEMORY RESET TO RESET HOLD TEST SW TO NORMAL TEST AND PUSH MEMORY RESET

NORM TEST ← (O) → MAINT TEST

TEST INSTRUCTIONS

NORMAL TEST

1. SENSORS MAY BE SET TO ANY POSITION – HOLD TEST SWITCH AT NORMAL TEST POSITION – ALL LAMPS, EXCEPT SIF, WILL FLASH MOMENTARILY (LAMP TEST).
2. GOOD TEST INDICATED BY COMPUTER OUTPUT LAMP ON.
3. BAD TEST INDICATED BY COMPUTER OUTPUT LAMP OFF AND ONE OR MORE FAULT LAMPS LIGHTED – REPAIR FAULTS BEFORE RESETTING MEMORY – IF DIFFERENCE FAULT SHOWS DO MAINT TEST.

MAINT TEST

1. SET BOTH VANES TO MID POINT, FLAPS FULL UP, SLATS RETRACTED AND STABILIZER AT 5 DEGREES NOSE UP.
2. RESET MEMORY PER RESET INSTRUCTIONS.
3. HOLD TEST SWITCH AT MAINT TEST POSITION – LAMP TEST WILL OCCUR – FAULTS WILL BE INDICATED WITHIN 10 SECONDS OF SETTING SWITCH TO MAINT TEST.
4. CHECK POSITION OR ALIGNMENT OF SENSOR ON SYSTEM INDICATING DIFFERENCE FAULT.

BBB2-34-265B

Stall Warning Computer
Figure 201/34-19-00-990-820

4. **Test Auto Slats**

NOTE: This test should be accomplished after both stall warning systems have passed the test at the front of the computer.

WARNING: WHEN AIRCRAFT IS ON GROUND, WITH WEIGHT ON WHEELS, BITE TEST OF AUTO-SLAT EXTEND SYSTEM IS ENABLED EACH TIME FLAP/SLAT HANDLE IS MOVED FROM RET DETENT TOWARD EXT DETENTS AND SLATS REACH MID. SLATS WILL AUTOMATICALLY EXTEND TO FULL EXTEND POSITION THEN RETURN TO MID EXTEND POSITION. SLATS WILL REMAIN IN FULL EXTEND POSITION IF HANDLE IS MOVED BEYOND 14 DEGREES.

A. Test Auto Slat Extension (ASE) Flap/Slat Handle Built-in Test (BIT)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

Table 207

Step	Operation	Desired Result
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(1)	Pressurize No. 1 and No. 2 Hydraulic Systems.	Aux Pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 PSI.
(2)	Verify front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat retraction.
(3)	Position Flap/Slat handles to UP/RET.	Slats retracted and flaps at zero degrees.
(4)	Verify front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat extension.
WJE 892		
(5)	Move Flap/Slat handles from UP/RET to ZERO/EXT.	Observe that slat indication lights, on center instrument panel, come on in following order: slat DISAGREE, slat TAKE OFF, slat DISAGREE, and AUTO. Then, after four or five seconds AUTO light will go off, slat DISAGREE light will go off, and slat TAKE OFF light will come on.
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(5)		On center instrument panel, observe the following: SLAT DISAGREE light comes on and then goes off, SLAT TAKEOFF light comes on and then goes off, SLAT DISAGREE and AUTO lights come on. After four to five seconds, SLAT AUTO and DISAGREE lights go off, and SLAT TAKEOFF light comes on.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893 (Continued)

Table 207 (Continued)

Step	Operation	Desired Result
WJE ALL		
(6)	Move Flap/Slat handles from ZERO/EXT to UP/RET.	Slats retracted and flaps at zero degrees.
(7)	Deenergize hydraulic system.	
(8)	Return aircraft to required configuration.	

B. Test Auto Slat Extension (ASE) by ALPHA Vane Movement

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, R AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
L	30	B1-24	RIGHT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
L	33	B1-24	RIGHT GROUND CONTROL RELAY

WJE ALL

Table 208

Step	Operation	Desired Result
(1)	Position both ALPHA vanes to 1 1/2 line position (TED).	
NOTE: On aircraft with Rosemount angle of attack vanes, set to 15 ° (TED).		
(2)	Install left and right prox switch dummy targets over WOW sensors. Pull ground control relay breakers.	

Table 208 (Continued)

Step	Operation	Desired Result
(3)	Cycle CAPTAIN'S and FIRST OFFICER'S STALL WARNING AC circuit breakers located on lower EPC. Breakers should be out for at least 10 seconds.	
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(4)	Pressurize No. 1 and No. 2 Hydraulic Systems.	Aux Pump ON. Transfer switch to ON. No. 1 and No. 2 Hydraulic Pressure Gages show at least 1000 PSI.
(5)	Verify front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat movement.
(6)	Position Flap/Slat handles to ZERO/EXT.	
(7)	Slowly rotate left alpha vane to full TEU position.	Slats should extend to full out position. Check that disagree and autoslat extend lights are on.
WJE 892		
(8)	Return left alpha vane to 1 1/2 line position (TED).	Slats should retract to mid position. Disagree & auto slat extend lights should go out.
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(8)	Return left alpha vane to 1 1/2 line position (TED), or 15° (TED).	Slats should retract to mid position. Disagree & auto slat extend lights should go out.
WJE ALL		
(9)	Slowly rotate right alpha vane to full TEU position.	Slats should extend to full out position. Check that disagree and autoslat extend lights are on.
WJE 892		
(10)	Return right alpha vane to 1 1/2 line position (TED).	Slats should retract to mid position. Disagree & auto slat extend lights should go out.
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(10)	Return right alpha vane to 1 1/2 line position (TED), or 15° (TED).	Slats should retract to mid position. Disagree & auto slat extend lights should go out.
WJE ALL		
(11)	Return Flap/Slat handles to UP/RET position.	Slats will retract and flaps should be at zero degrees.
(12)	Remove hydraulic power.	
(13)	Remove left and right proximity switch dummy targets from WOW sensors.	
(14)	Return aircraft to required configuration.	

WJE 892

5. Test Stick Pusher System

A. Check Stick Pusher Operation

NOTE: For the following test, the aircraft must be in the ground mode (weight on wheels) and the slats not retracted.

NOTE: This portion of the test requires 2 persons in the flight compartment.

Table 209

Step	Operation	Desired Result
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(1)	Pressurize No. 1 and No.2 hydraulic systems.	AUX pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 PSI.
(2)	Make sure front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat movement.
(3)	Place FLAP/SLAT handle to ZERO/EXT position.	Slats extend to full position then return to mid.
CAUTION: THIS TEST APPLIES FORCES OF APPROXIMATELY 80 POUNDS ON THE CONTROL COLUMN. DURING THE STICK PUSHER OPERATION CHECK, THE CONTROL COLUMN WILL MOVE FORWARD RAPIDLY. MAKE SURE THERE IS NO EQUIPMENT IN PATH OF CONTROL COLUMN MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CHECK BEING CONDUCTED AND CONTROL COLUMN MOVEMENT. CHECK CONTROL COLUMN OPERATION FOR FREEDOM OF MOVEMENT.		
(4)	With 1 person lightly holding control column in neutral position, place and hold both STALL SELF TEST switches on overhead panel in TEST position.	Control column moves forward rapidly to approximately half travel, then more slowly and with less force to approximately full travel and holds. Column moves to full forward position in approximately one second. Capt's and F/O's PUSH 1/PUSH 2 lights come on.
(5)	With both SELF TEST switches in TEST position, place PUSHER DUMP switch on aft center pedestal in DUMP position.	Control column moves to neutral position, both PUSHER DUMPED lights, located on overhead annunciator panel and in electrical/electronics (E/E) compartment, come on.
(6)	Place both SELF TEST switches in OFF position.	PUSH 1/PUSH 2 and PUSHER DUMPED lights remain on.
(7)	Press PUSHER DUMPED/RESET switch in E/E compartment.	Both PUSHER DUMPED lights go off.
(8)	Press either PUSH 1/PUSH 2 switch on glareshield.	PUSH 1/PUSH 2 lights go off.
(9)	Remove hydraulic power.	
(10)	Return aircraft to required configuration.	

B. Check Stick Pusher Force

NOTE: For the following test, the aircraft must be in the ground mode (weight on wheels) and the slats not retracted.

NOTE: This portion of the test requires 2 persons in the flight compartment.

WJE 892 (Continued)

Table 210

Step	Operation	Desired Result
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(1)	Pressurize No. 1 and No.2 hydraulic systems.	AUX pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 PSI.
(2)	Make sure front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat movement.
(3)	Place FLAP/SLAT handle to ZERO/EXT position.	Slats extend to full position then return to mid.
CAUTION: THIS TEST APPLIES FORCES OF APPROXIMATELY 80 POUNDS ON THE CONTROL COLUMN. DURING THE STICK PUSHER OPERATION CHECK, THE CONTROL COLUMN WILL MOVE FORWARD RAPIDLY. MAKE SURE THERE IS NO EQUIPMENT IN PATH OF CONTROL COLUMN MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CHECK BEING CONDUCTED AND CONTROL COLUMN MOVEMENT. CHECK CONTROL COLUMN OPERATION FOR FREEDOM OF MOVEMENT.		
(4)	On overhead panel, place and hold both STALL SELF TEST switches in TEST position.	Control columns move forward.
(5)	Install control column push pull bar check fixture to the Capt's control wheel. Attach force gauge to check fixture.	
(6)	With force gauge parallel to the floor, pull control column to the neutral position and measure force. Avoid any twisting motion.	Force required is 60 to 120 inch-pounds (6.8 to 13.6 N·m).
(7)	Continue pulling on control column until clutch in servo drive bracket slips or ratchets.	Force required is 100 to 160 inch-pounds (11.3 to 18.1 N·m).
(8)	Stop pulling on control column.	Control columns return to forward position.
(9)	Repeat steps (5) through (8) for F/O's column.	
(10)	On overhead panel, place STALL SELF TEST switches to OFF.	Control columns return to neutral.
(11)	Remove hydraulic power.	
(12)	Remove the control column push pull bar check fixture and return aircraft to required configuration.	

CAUTION: CONTROL COLUMN WILL MOVE RAPIDLY FORWARD. MAKE SURE NO PANELS OR EQUIPMENT ARE BLOCKING FORWARD TRAVEL OF COLUMN.

C. Check G Switch Operation

NOTE: This portion of the test requires one person in the E/E compartment and one person in the flight compartment.

WJE 892 (Continued)

Table 211

Step	Operation	Desired Result
(1)	Disconnect the two dzus fasteners on G switch bracket, located in forward overhead E/E compartment, so G switch can rotate about hinge. Do not move from vertical position.	
(2)	Have another person place STALL SELF TEST switches on overhead switch panel in TEST position.	Control column should move forward, and PUSH 1/PUSH 2 lights should come on.
(3)	Rotate G switch aft until bracket contacts stop.	Servo returns to neutral. PUSHER DUMPED lights, located on overhead annunciator panel and in E/E compartment, come on.
(4)	Rotate G switch back to normal horizontal position.	Servo should not move from neutral.
(5)	Place both STALL SELF TEST switches in OFF position, and secure G switch. Press either PUSH 1/PUSH 2 switch.	PUSHER DUMPED and PUSH 1/ PUSH 2 lights go off.
(6)	Return aircraft to required configuration.	

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

6. Test Post Stall Recovery System

A. Check Stick Pusher Operation

NOTE: For the following test, the aircraft must be in the ground mode (weight on wheels) and the slats not retracted.

NOTE: This portion of the test requires 1 person in the cockpit and 1 person in the avionics compartment.

Table 212

Step	Operation	Desired Result
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(1)	Pressurize No. 1 and No.2 hydraulic systems.	AUX pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 PSI.
(2)	Make sure front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat movement.
(3)	Place FLAP/SLAT handle to ZERO/EXT position.	Slats extend to full position then return to mid.
CAUTION: THIS TEST APPLIES FORCES OF APPROXIMATELY 80 POUNDS ON THE CONTROL COLUMN. DURING THE STICK PUSHER OPERATION CHECK, THE CONTROL COLUMN WILL MOVE FORWARD RAPIDLY. MAKE SURE THERE IS NO EQUIPMENT IN PATH OF CONTROL COLUMN MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CHECK BEING CONDUCTED AND CONTROL COLUMN MOVEMENT. CHECK CONTROL COLUMN OPERATION FOR FREEDOM OF MOVEMENT.		

Table 212 (Continued)

Step	Operation	Desired Result
(4)	With 1 person lightly holding control column in neutral position, press and hold test switches on both stall warning computers to NORMAL TEST position.	Control column moves forward rapidly to approximately half travel, then more slowly and with less force to approximately full travel and holds. Column moves to full forward position in approximately one second. Capt's and F/O's STICK PUSHER PUSH TO INHIBIT lights come on.
(5)	While holding both TEST switches in NORMAL position, press Capt's STICK PUSHER PUSH TO INHIBIT light switch.	Control column moves to neutral position, STICK PUSHER lights go off. SIF light on OAP comes on.
(6)	Release test switches.	SIF light on OAP goes off.
(7)	Repeat steps (4), (5), and (6) using FO's STICK PUSHER PUSH TO INHIBIT light switch.	Stick pusher force is inhibited whenever either Capt. or FO's INHIBIT light switch is pressed.
(8)	Remove hydraulic power.	
(9)	Return aircraft to required configuration.	

B. Check Stick Pusher Force

NOTE: For the following test, the aircraft must be in the ground mode (weight on wheels) and the slats not retracted.

NOTE: This portion of the test requires 1 person in the cockpit and 1 person in the avionics compartment.

Table 213

Step	Operation	Desired Result
WARNING: PRIOR TO APPLICATION OF HYDRAULIC POWER, MAKE CERTAIN AREAS AROUND AIRPLANE HYDRAULIC POWERED SURFACES ARE CLEAR OF PERSONNEL AND EQUIPMENT.		
(1)	Pressurize No. 1 and No.2 hydraulic systems.	AUX pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 PSI.
(2)	Make sure front and rear of wing are clear of personnel and equipment.	Wing clear for flap and slat movement.
(3)	Place FLAP/SLAT handle to ZERO/EXT position.	Slats extend to full position then return to mid.
CAUTION: THIS TEST APPLIES FORCES OF APPROXIMATELY 80 POUNDS ON THE CONTROL COLUMN. DURING THE STICK PUSHER OPERATION CHECK, THE CONTROL COLUMN WILL MOVE FORWARD RAPIDLY. MAKE SURE THERE IS NO EQUIPMENT IN PATH OF CONTROL COLUMN MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CHECK BEING CONDUCTED AND CONTROL COLUMN MOVEMENT. CHECK CONTROL COLUMN OPERATION FOR FREEDOM OF MOVEMENT.		
(4)	Install control column push pull bar check fixture to Capt's control column. Attach force gauge to check fixture on control wheel.	

Table 213 (Continued)

Step	Operation	Desired Result
(5)	With force gauge parallel to the floor, apply a force to the control column to maintain the neutral position. On both stall warning computers, press and hold test switches to NORMAL TEST position. As control column attempts to move forward, measure force avoiding twisting motion.	Control columns move forward. Force required is 50 to 80 pounds (222.4 to 355 N).
(6)	Apply an additional force on control column until clutch in servo drive bracket slips or ratchets.	Force required is 110 to 130 pounds (489. to 579. N) with part number 7002588-901 drum and housing (bracket) assembly installed.
		Force required is 90 to 110 pounds (399. to 489. N) with part number 7002588-902 drum and housing (bracket) assembly installed.
(7)	On stall warning computers, release TEST switches.	Control columns return to neutral.
(8)	Remove hydraulic power.	
(9)	Remove the control column push pull bar check fixture and return aircraft to required configuration.	

WARNING: DURING THE FOLLOWING CHECK OF THE "G" SWITCH OPERATION, THE CONTROL COLUMNS MAY MOVE FORWARD RAPIDLY. ENSURE THAT ALL EQUIPMENT IS FREE OF CONTROL COLUMNS PATH OF MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CONTROL COLUMN MOVEMENT.

C. Check G Switch Operation

NOTE: Verify aircraft in ground mode and slats not retracted.

(1) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Remove two forward fasteners on "G" switch mounting bracket. Tilt and hold "G" switch to full aft position.

NOTE: When test is performed by one person, the "G" switch may be held in full aft position with tape.

(3) Press and hold test switches on the stall warning computers (SWC) in the NORMAL TEST position.

(4) Control columns should remain in the neutral position; SIF light on the OAP should come on.

(5) While still holding test switch on SWC-2 in NORMAL TEST position, release test switch on SWC-1, and return "G" switch to normal horizontal position. Remove tape if used.

(6) Control columns should remain in the neutral position; SIF light on OAP should remain on.

(7) While still holding test switch on SWC-2 in NORMAL TEST position, press and hold test switch on SWC-1 in NORMAL TEST position.

(8) Control columns should remain in neutral position; SIF light on OAP should remain on.

(9) Release both test switches on stall warning computers; SIF lights on OAP should go off.

(10) Make certain "G" switch bracket has been secured in place by fasteners.

(11) Return aircraft to required configuration.

ANGLE-OF-ATTACK TRANSDUCER - MAINTENANCE PRACTICES

1. General

A. There are two angle-of-attack (AOA) transducers installed on the aircraft, one each on the right and left sides of the forward nose section.

B. Removal/installation procedures are identical for each transducer except for circuit breaker callout.

NOTE: The AOA transducer P/N 10000165-101 may have up to four (4) unplugged holes in the vane blade without causing operational degradation. Two (2) of the holes are for boresight indexing used in calibration and should not be plugged. The other two (2) holes are plugged during the manufacturing process for cosmetic purposes. If plugs are missing, accuracy and reliability are unaffected and vane may be considered serviceable.

C. The aircraft stall warning system has sufficient monitoring to check the angle of attack (AOA) sensor for tolerance exceedence. If system tolerances are exceeded, a Stall Indication Failure (SIF) light on Overhead Annunciator Panel (OAP) will alert the crew to the need for maintenance action. If the previous flight has reported no abnormalities, the AOA vanes should be considered serviceable and safe for flight.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Cleaner, handwipe DS-108 DPM 6380-4	Dynamold Solvents, Inc.
Mold release DPM 5355 (FREKOTE 700-NC)	Henkel Corporation, Aerospace Group, Rocky Hill, CT.
Alodine 1200, DPM 1453, MIL-C-81706, Class 1A	Parker & Amchem
Black enamel, DPM 1242	Continental Coatings, Inc.
FR Primer, DMS QPL 1786	Courtaulds Aerospace, Inc.
Silicone carbide abrasive paper, waterproof, DPM 923	
Sealant PR-1422 DMS 2082	Courtaulds Aerospace Inc.

3. **Removal/Installation Angle-of-Attack Transducer**

A. Remove Angle-of-Attack Transducer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

(2) Remove attaching screws around periphery of AOA transducer.

(3) Remove AOA transducer sufficiently to disconnect electrical connector from transducer and remove transducer.

(4) Cap aircraft wiring and transducer electrical connectors.

(5) If new transducer is to be installed, package removed transducer to prevent damage.

B. Install Angle-of-Attack Transducer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

(2) Remove old sealant from aircraft skin.

WARNING: HANDWIPE CLEANER IS AN AGENT THAT IS FLAMMABLE, A SENSITIZER, AN ASPHYXIANT, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN HANDWIPE CLEANER IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET HANDWIPE CLEANER IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(3) Clean mounting surface with handwipe cleaner, DPM 6380-4 and a clean cloth.

WARNING: PARTING AGENT IS AN AGENT THAT IS FLAMMABLE, EXPLOSIVE, AND POISONOUS. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN PARTING AGENT IS USED.

- GAS/AIR MIXTURES MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET PARTING AGENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(4) Apply two coats of mold release, DPM 5355 to the faying surfaces of the Angle of Attack transducer and aircraft skin. Let the mold release air dry for 15 minutes after each coat is applied.

(5) Use AN960D10L washers for shims as necessary for the transducer to have ±.015 inch (±0.381 mm) mismatch to the fuselage skin. Adjust the grip length of the bolts as necessary.

WARNING: INTEGRAL FUEL TANKS SEALING COMPOUND (POLYSULFIDE SEALANT B1/2 AND B2) IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN INTEGRAL FUEL TANKS SEALING COMPOUND IS USED.

- GAS/AIR MIXTURES MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET INTEGRAL FUEL TANKS SEALING COMPOUND IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(6) Apply DMS 2082 sealant to the transducer mounting surface. Use enough sealant to provide sealant squeeze-out that will over-fill the butt gap between the edge of the transducer and the fuselage skin.

(7) Place transducer in proximity of aircraft mounting and connect aircraft wiring electrical connector to transducer electrical connector.

(8) Align transducer index mounting pins to index holes in aircraft mounting plate and install screws. Electrical connector should face forward.

(9) Verify sensor index pins are flush with exterior surface of sensor flange. If it is not flush, recheck the alignment of the sensor into doubler plate.

(10) Remove the excess sealant.

NOTE: External surface seal is not immediately required if cure time will cause a flight delay, however, external surface seal must be applied at the next available opportunity to avoid any moisture/corrosion damage to the transducer and fuselage surfaces.

(11) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	22	B1-25	LEFT ANGLE OF ATTACK VANE HTR
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	22	B1-341	RIGHT ANGLE OF ATTACK VANE HTR
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

(12) Perform return to service (RTS) test (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201).

(13) Perform stall warning system Maintenance Test (PAGEBLOCK 34-19-00/201).

C. Angle-of-Attack Transducer Heater Check

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE ALL			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(2) Verify RIGHT AND LEFT ANGLE-OF-ATTACK VANE HEATER circuit breakers on lower EPC circuit breaker panel are closed.

(3) Place METER SEL & HEAT switch on overhead panel to following positions and note reading on meter after one minute:

(a) LEFT STALL PROBE - Indicator - initial surge - 5.0-10.0 and then stabilize at not less than 3.0.

(b) RIGHT STALL PROBE - Indicator - initial surge - 5.0-10.0 and then stabilize at not less than 3.0.

(4) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	29	B1-62	RAM AIR TEMP & PROBE HEATER
Z	30	B1-476	RUDDER Q LIMITER PITOT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE ALL

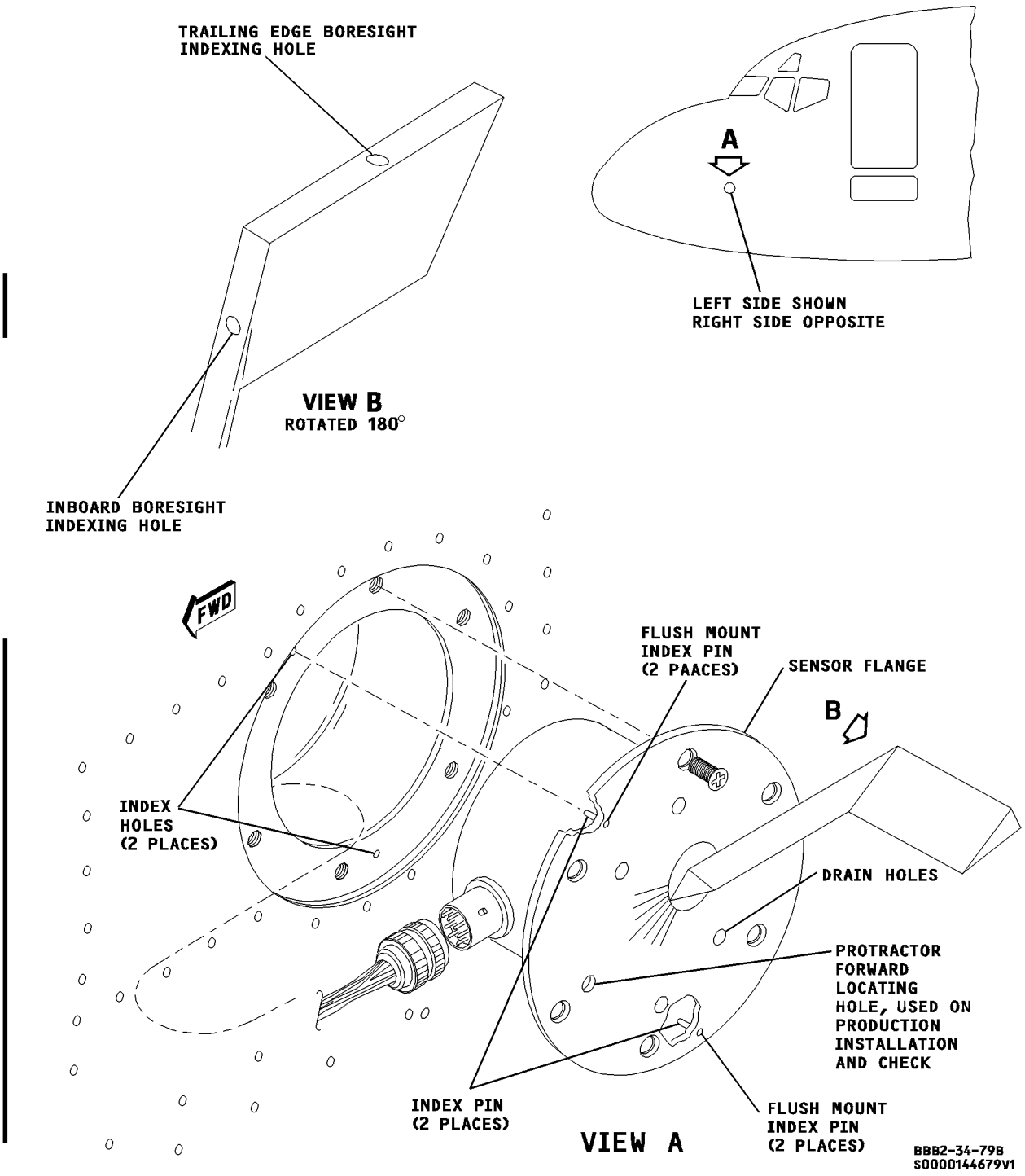
LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

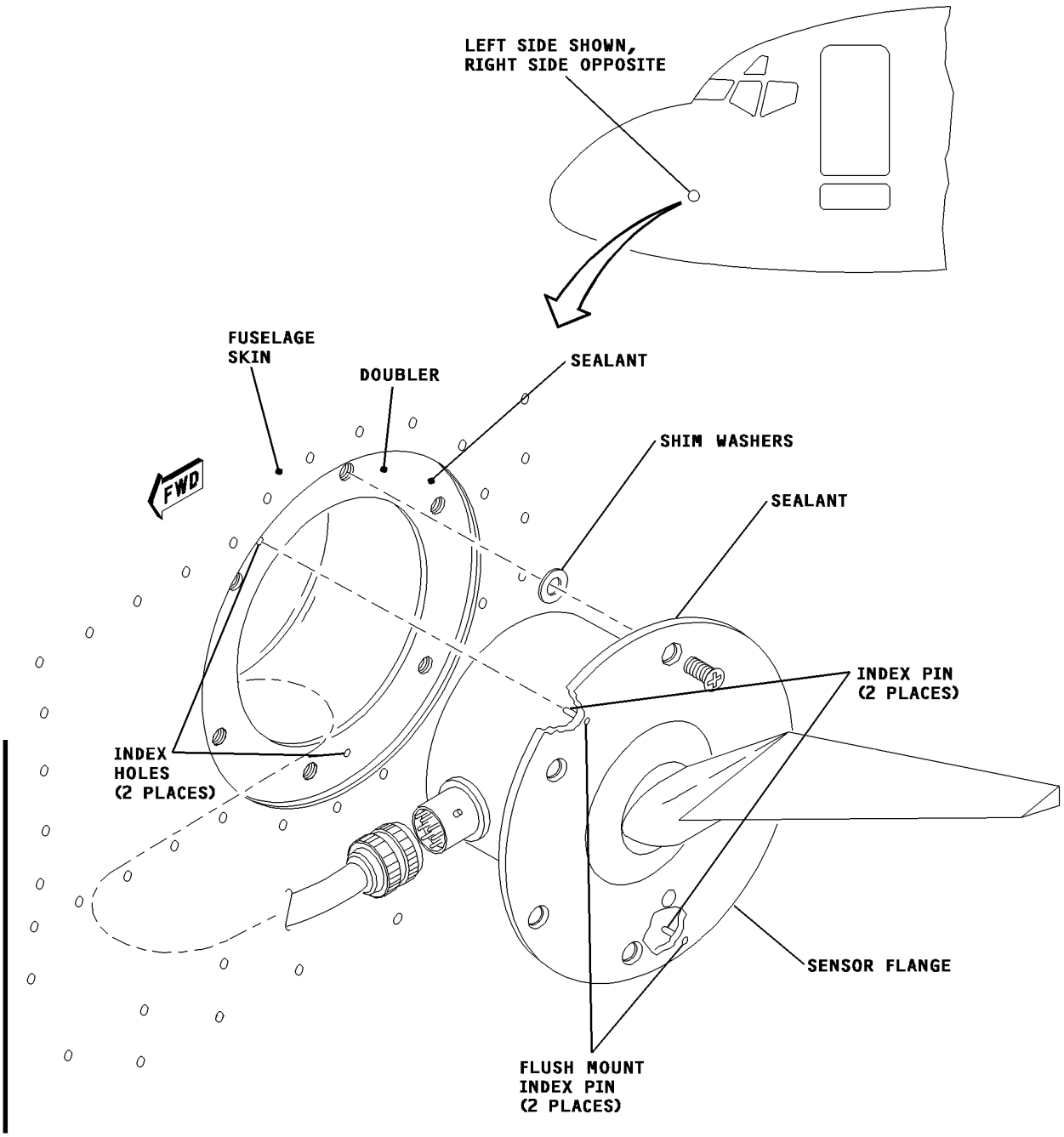
OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

(5) Return aircraft to required configuration.



Angle-of-Attack Transducer -- Removal/Installation
Figure 201/34-19-01-990-801



Angle-of-Attack Transducer -- Removal/Installation (Rosemount AOA Vane)
Figure 202/34-19-01-990-802

4. Approved Repairs Angle-of-Attack Transducer

A. Surface Repair.

(1) Remove corrosion with 120 grit silicon carbide abrasive paper, DPM 923.

(2) Touch-up black anodized surfaces which are worn or polished to bare metal with one coat of FR Primer, DMS QPL 1786. Allow the FR primer to dry thoroughly.

(3) Apply one coat of black enamel, DPM 1242 over the layer of FR Primer. Allow the enamel to dry thoroughly.

(4) Touch-up repaired areas of aluminum parts, which are not black anodized with alodine 1200, DPM 1453.

B. Vane Assembly Repair.

(1) Remove Angle-of-Attack transducer from aircraft. (Paragraph Paragraph 3.A.)

NOTE: Do not attempt repair of vane assembly if vane arm is excessively bent or distorted, if boresight holes or dowel pin seating holes are damaged or oversized, or if 0.3748 in. (9.52 mm) diameter hub on vane arm shows signs of damage or galling. Repair of the vane assembly is limited to correcting the defects identified in the following paragraphs.

(2) Vane hub repair.

(a) Light damage or galling to 0.3748 in. (9.52 mm) diameter hub or vane arm may be touched-up in accordance with surface repair step (Paragraph 4.A.(2)).

(b) After repair, check hub diameter at a minimum or 90° positions. Diameter shall be 0.3745 in. to 0.3748 in. (9.51 mm to 9.52 mm).

(3) Vane leading edge repair.

NOTE: Only limited damage to, or erosion of vane leading edge may be repaired. Wedge symmetry of the repaired area must be maintained to prevent aerodynamic alignment errors.

(a) Determine the location of the reworked (new) leading edge by tracing a line parallel to the wedge trailing edge just below the deepest damaged area (Figure 203).

(b) Measure the cord length of the wedge symmetry plane (length from the new leading edge to the trailing edge). Make certain that cord length is a minimum of 1.528 in. (38.8 mm).

NOTE: If cord length is less than 1.528 in. (38.8 mm) replace the vane assembly.

(c) Machine the damaged portion of the leading edge down to reference line. The machine plane shall be parallel to wedge base (trailing edge)(Figure 204).

(d) Round-off new leading edge with a radius of approximately one-half the width of machined area. Blend the radius into wedge flats (Figure 204).

(e) Inspect reworked leading edge as follows:

1) Make certain leading edge is straight and remains parallel to trailing edges.

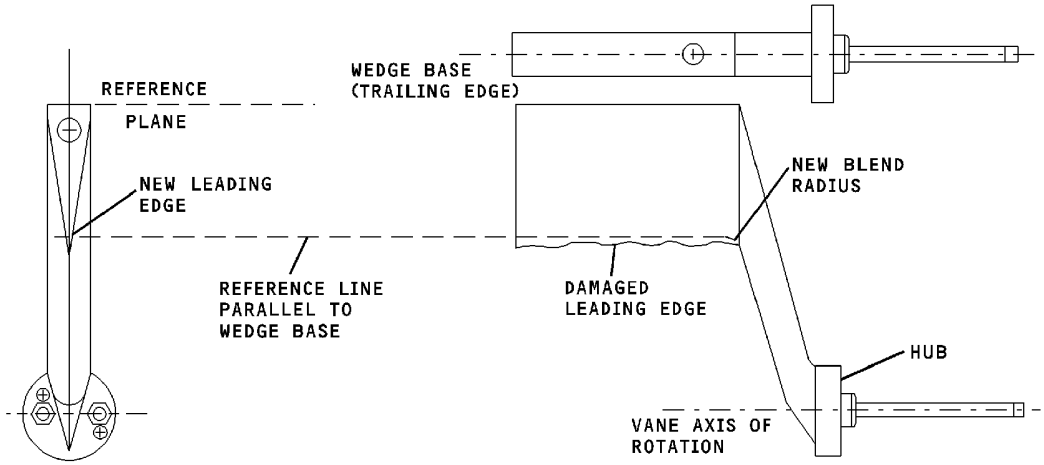
2) Make certain reworked area is smooth with no visible tool marks.

3) Make certain leading edge radius is uniform and symmetrical to wedge centerline.

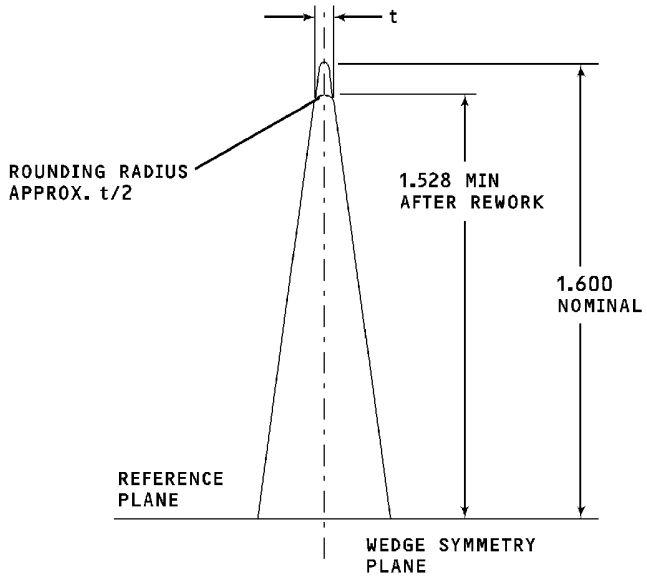
4) Make certain radius connecting wedge to vane arm is smooth and blended to vane arm.

(f) Hard anodize reworked area, (Ref. MIL-A-8625, Type III, Class 2).

(4) Install Angle-of-Attack transducer on aircraft. (Paragraph Paragraph 3.B.)



AOA Vane Assembly Repair - Leading Edge Location
Figure 203/34-19-01-990-803



AOA Vane Assembly Repair - Machining Requirements
Figure 204/34-19-01-990-804

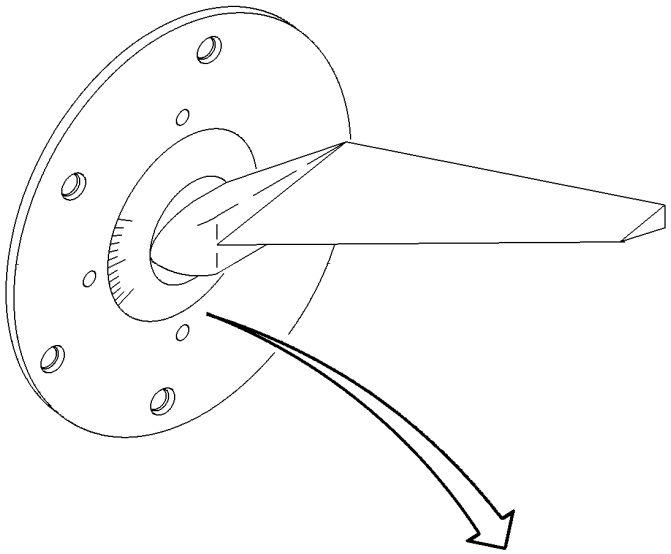
5. Rosemount AOA Vane Settings

A. Sensor Vane Settings for Rosemount AOA vane are as shown in (Figure 205) and (Figure 206).

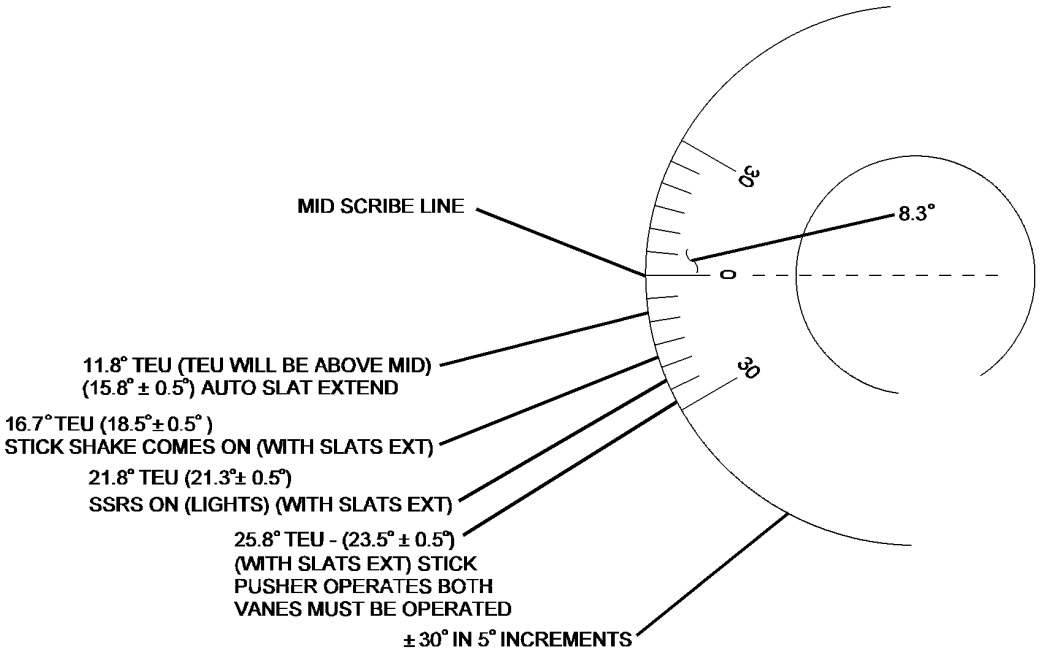
(1) Test for proper operation of stick shakers, auto slat extend (ASE), and central aural warnings SSRS (tone and lights) can be made by setting sensor vane to approximate angle in relation to midpoint scribe line on sensor face plate (Figure 205) and (Figure 206).

(2) Flaps must be zero degrees, slats mid, and stabilizers at zero degrees.

NOTE: On MD-80 aircraft, the STALL and STICK PUSHER lights may be activated and the tone and voice warning STALL may be heard for the SSRS.



NOTE: TEU IS TRAINING EDGE UP.



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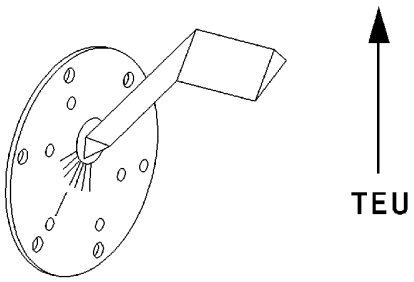
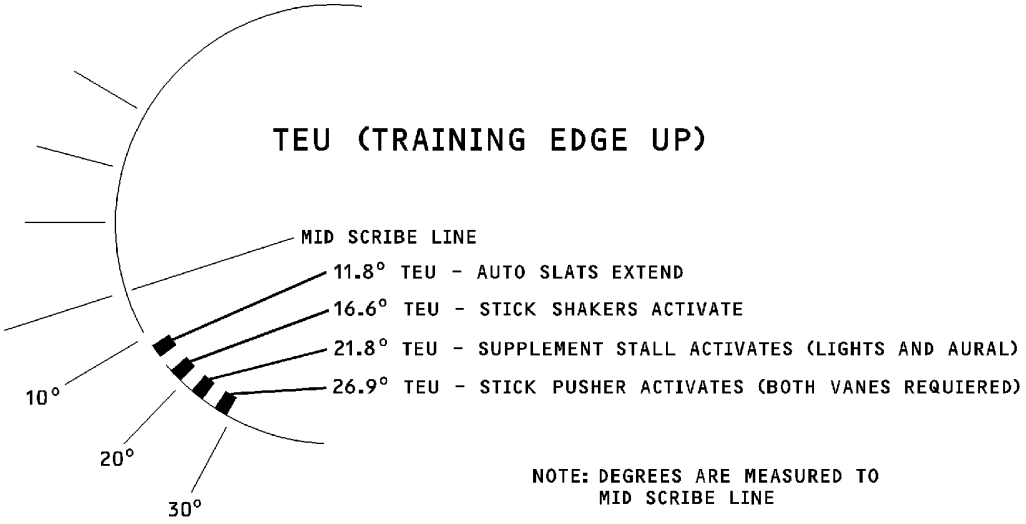
Sensor Vane Settings -- Operational Test
Figure 205/34-19-01-990-805





CAG(IGDS)

BBB2-34-2413

AOA Training Edge Up (TEU) Definition
Figure 206/34-19-01-990-806

EFFECTIVITY
WJE ALL

STALL WARNING COMPUTER - MAINTENANCE PRACTICES

1. General

A. There are two stall warning computers (SWC) installed on the aircraft, one each on the right and left sides of the forward right radio rack in the electrical/electronics compartment.

B. Removal/installation procedures are identical for each except for circuit breaker callout.

2. Removal/Installation

A. Remove Stall Warning Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

(2) Unscrew knurled holddown nut from computer holddown flange.

(3) Remove computer from rack.

B. Install Stall Warning Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

(2) Place SWC in mounting rack and carefully push into place until electrical connectors are seated.

(3) Place knurled mounting nut on computer holddown flange and tighten.

(4) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

3. **Adjustment/Test Stall Warning Computer**

A. Self-Test SWC

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(1) Verify STALL INDICATOR FAILURE (SIF) light on overhead annunciator panel (OAP) not on.

WJE 892

(2) Verify SIF light on OAP is not on.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(3) Place STALL TEST switch on overhead panel to SYS 1 position.

WJE 892

(4) Place STALL SELF TEST-1 switch on overhead panel in TEST-1 position.

WJE 410

(5) Verify both stick shakers operate, both STALL and STICK PUSHER lights come on, and both cockpit console speakers sound warning tone.

WJE 401-409, 411, 412, 414, 873-881, 883, 884, 886, 887, 893

(6) Verify both stick shakers operate, both STALL and STICK PUSHER lights come on, and both cockpit console speakers sound warning tone and voice "STALL".

WJE 892

(7) Verify both stick shakers operate, both STALL lights come on, both cockpit console speakers sound warning tone and voice "STALL", and both PUSH 1 lights come on.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

(8) Verify both stick shakers operate, both STALL and STICK PUSHER lights come on, and both cockpit console speakers sound warning tone and voice "STALL" (if voice option is installed).

WJE 410

(9) Place STALL TEST switch to OFF position. Shakers and tone should stop and lights should go off.

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(10) Place STALL TEST switch to OFF position. Shakers and aural warning should stop and lights should go off.

WJE 892

(11) Place STALL SELF TEST-1 switch in OFF position. Shakers and aural warning should stop and lights should go off.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(12) Place STALL TEST switch to SYS 2 position.

WJE 892

(13) Place STALL SELF TEST-2 switch in TEST-2 position.

WJE 410

(14) Verify both stick shakers operate; both STALL and STICK PUSHER lights come on; both cockpit console speakers sound warning tone.

WJE 401-409, 411, 412, 414, 873-881, 883, 884, 886, 887, 893

(15) Verify both stick shakers operate; both STALL and STICK PUSHER lights come on; both cockpit console speakers sound warning tone and voice "STALL".

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

(16) Verify both stick shakers operate; both STALL and STICK PUSHER lights come on; both cockpit console speakers sound warning tone and voice "STALL" (if voice option is installed).

WJE 892

(17) Verify both stick shakers operate; both STALL lights come on; both cockpit console speakers sound warning tone and voice "STALL"; both PUSH 2 lights come on.

WJE 410

(18) Place STALL TEST switch to OFF position. Shakers and tone should stop and lights should go off.

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(19) Place STALL TEST switch to OFF position. Shakers and aural warning should stop and lights should go off.

WJE 892

(20) Place STALL SELF TEST-2 switch in OFF position. Shakers and aural warning should stop and lights should go off.

WJE ALL

(21) Return aircraft to required configuration.

STICK PUSHER SERVO DRIVE AND BRACKET ASSEMBLY - MAINTENANCE PRACTICES

1. General

A. The stick pusher servo drive and bracket assembly provides the mechanical actuation that drives the control column forward if an aircraft post stall recovery action is initiated by the stall warning computers.

B. The assembly is located in the upper forward section of the electrical/electronics compartment. The assembly is coupled to the elevator control cable system by the bracket cable drum. The servo drive is installed in the bracket and coupled to the bracket drum through an electrically actuated clutch.

C. The Maintenance Practices provides removal/installation of the servo drive from the bracket.

WARNING: IF SERVO DRIVE IS DISABLED, JUMPER PLUG (P1-2003) STOWED ADJACENT TO SERVO DRIVE PLUG TO RECEPTACLE CONNECTION (R5-520) MUST BE INSTALLED IN THE AIRCRAFT ELECTRICAL RECEPTACLE. AUTO PILOT WILL NOT OPERATE WHEN SERVO DRIVE PLUG IS DISCONNECTED.

D. A stall avoidance system (stick pusher) disconnect electrical plug stowage panel is located adjacent to the stick pusher servo. The panel contains stowage receptacles for the servo electrical plugs. If disabling of the stick pusher system is required, the system is disabled by stowing the servo electrical plugs at the stowage receptacles.

2. Removal/Installation

A. Remove Servo Drive and Servo Drive Bracket

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Disconnect the electrical plug at the servo drive.

(3) Disconnect the servo drive wire harness electrical plug from the receptacle located on the adjacent disconnect bracket.

NOTE: Install protective covers on electrical plugs and receptacles.

(4) Remove bonding jumper from servo drive.

(5) Remove screws attaching servo drive to bracket and remove drive from bracket.

(6) Install a protective cover over open side of the servo drive bracket, if servo drive bracket is not being removed.

NOTE: If servo drive bracket is also being removed, perform steps (7) and (8).

(7) Disconnect control cables from servo drive bracket (GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 27-00-00/201, Rigging Procedures).

(8) Support servo drive bracket and remove mount bolts. Remove bracket.

B. Install Servo Drive Bracket and Servo Drive

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

NOTE: If servo drive bracket was removed, perform (Paragraph 2.B.(2)) through (Paragraph 2.B.(4)).

(2) Support servo drive bracket in mounting position and install mount bolts.

(3) Connect control cables to servo drive bracket (GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 27-00-00/201, Rigging Procedures).

(4) Perform control cable Adjustment/Test (ELEVATOR AND TAB - ADJUSTMENT/TEST, PAGEBLOCK 27-30-00/501).

(5) Remove protective covers from electrical plugs and receptacles for servo drive and from servo drive bracket.

(6) Check electrical plugs and receptacles for electrical pin damage, corrosion, or dirt, check bracket for any internal damage, corrosion, or dirt.

(7) Insert servo drive into bracket and install attaching screws.

(8) Connect bonding jumper to servo drive.

(9) Connect electrical plug to servo drive receptacle and servo wire harness electrical plug to receptacle at adjacent disconnect bracket.

(10) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

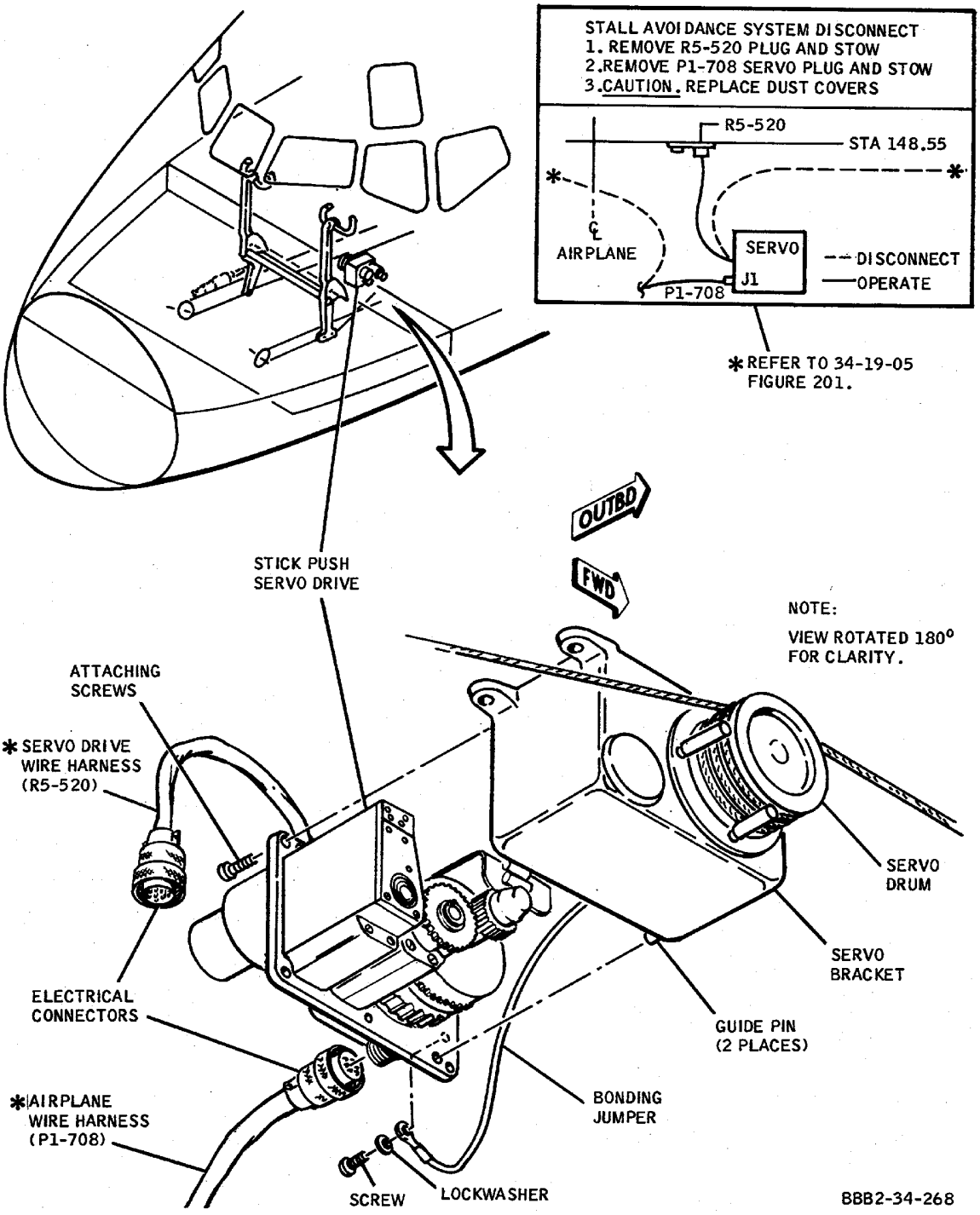
Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2



Stick Pusher Servo Drive and Bracket - Removal/Installation
Figure 201/34-19-03-990-801

3. **Check Operation of Servo Drive**

   A. Perform Stick Pusher Operation check and Stick Pusher Force Check STALL WARNING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-19-00/201.

STICK PUSHER SERVO POWER SUPPLY - MAINTENANCE PRACTICES

1. General

A. The stick pusher servo power supply provides the electrical power to the stick pusher servo motor. The power supply is located on the forward right radio rack in the electrical/ electronic compartment. A resistor in series with the power supply to the servo is installed on the power supply mount.

2. Removal/Installation Servo Power Supply

A. Remove Servo Power Supply

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

(2) Remove electrical plug from servo power supply, install protective covers on electrical plugs and receptacles.

(3) Remove screws attaching power supply to rack mount and remove power supply.

B. Install Servo Power Supply

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

(2) Place servo power supply in rack mount and install attaching screws.

(3) Remove protective covers from power supply electrical receptacle and airplane wiring plug, check plug and receptacle for corrosion, dirt, and damaged pins.

(4) Connect electrical plug to servo power supply electrical receptacle.

(5) Remove the safety tag and close this circuit breaker:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

(6) Check power supply operation per paragraph Paragraph 3..

3. Check Operation of Servo Power Supply

A. Perform Stick Pusher Operation Check and Stick Pusher Force Check, STALL WARNING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-19-00/201.

STICK PUSHER ACCELERATION (G) SWITCH - MAINTENANCE PRACTICES

1. General

A. The stick pusher "G" switch removes electrical power from the stick pusher as an additional protection against inadvertent operation and limits negative "G" levels during stall recovery stimulus.

B. The "G" switch is located in the upper forward section of the electrical/electronics compartment adjacent to the stick pusher electrical plug disconnect stowage bracket.

2. Removal/Installation "G" Switch

A. Remove "G" Switch

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Disconnect "G" switch electrical connector from disconnect receptacle.

(3) Install protective covers at electrical plug and receptacle.

(4) Remove the two screws attaching "G" switch to bracket, the bracket with switch can be removed first by unfastening the fasteners securing the bracket to aircraft structure, then removing the switch attaching screws and the switch.

B. Install "G" Switch

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Remove protective covers from "G" switch electrical plug and disconnect receptacle and check electrical contact pins for damage, check pins and plug and receptacle for corrosion and dirt.

(3) Install "G" switch on bracket with attaching screws.

NOTE: Make certain "G" switch is installed on bracket with arrow on switch pointing up.

(4) If bracket was removed with switch attached, install bracket in place and fasten the two fasteners attaching bracket to airplane structure.

(5) Connect "G" switch electrical connector to disconnect electrical receptacle.

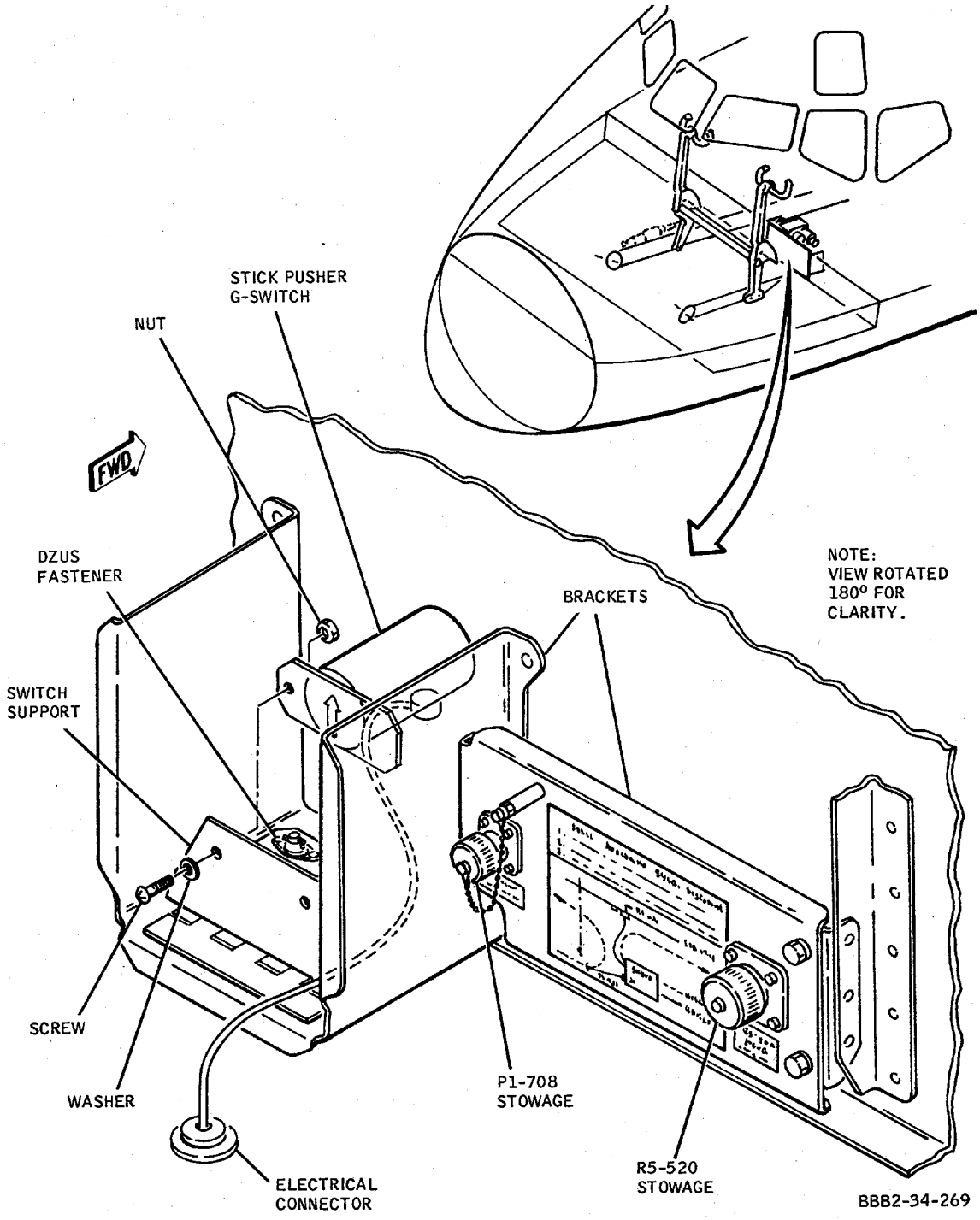
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

(6) Check "G" switch operation per paragraph Paragraph 3..

WJE 892

(7) Check "G" switch operation per paragraph Paragraph 4..

WJE ALL



Stick Pusher "G" Switch -- Removal/Installation
Figure 201/34-19-05-990-801

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

3. Check "G" Switch Operation

A. Check Operation

NOTE: Verify airplane in ground mode and slats not retracted.

WARNING: DURING THE FOLLOWING CHECK OF THE "G" SWITCH OPERATION, THE CONTROL COLUMNS MAY MOVE FORWARD RAPIDLY. ENSURE THAT ALL EQUIPMENT IS FREE OF CONTROL COLUMNS PATH OF MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CONTROL COLUMN MOVEMENT.

(1) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Remove two forward fasteners on "G" switch mounting bracket. Tilt and hold "G" switch to full aft position.

NOTE: When test is performed by one person, the "G" switch may be held in full aft position with tape.

(3) Press and hold test switches on the stall warning computers (SWC) in the NORMAL TEST position.

(4) Control columns should remain in the neutral position; Stall Indication Failure (SIF) light on the Overhead Annunciator Panel (OAP) should come on.

(5) While still holding test switch on SWC-2 in NORMAL TEST position, release test switch on SWC-1, and return "G" switch to normal horizontal position. Remove tape if used.

(6) Control columns should remain in the neutral position; SIF light on the OAP should remain on.

(7) While still holding test switch on SWC-2 in NORMAL TEST position, press and hold test switch on SWC-1 in NORMAL TEST position.

(8) Control columns should remain in neutral position; SIF light on OAP should remain on.

(9) Release both test switches on stall warning computers; SIF lights on OAP should go off.

(10) Make certain "G" switch bracket has been secured in place by fasteners.

(11) Return aircraft to required configuration.

WJE 892

4. Check "G" Switch Operation

A. Check Operation

NOTE: Check that aircraft is in ground mode and slats are not retracted.

WJE 892 (Continued)

WARNING: DURING FOLLOWING CHECK OF "G" SWITCH OPERATION, CONTROL COLUMNS WILL MOVE FORWARD RAPIDLY. ENSURE THAT ALL EQUIPMENT IS FREE OF CONTROL COLUMNS PATH OF MOVEMENT AND ALL PERSONNEL IN FLIGHT COMPARTMENT ARE AWARE OF CONTROL COLUMN MOVEMENT.

(1) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

(2) Remove two forward fasteners on "G" switch mounting bracket.

(3) Place both STALL SELF TEST switches on overhead switch panel in the TEST position. Control columns should move to full forward position and remain there.

(4) Tilt "G" switch to full aft position. Control columns should return to neutral position. PUSHER DUMPED lights, on overhead annunciator panel and in E/E compartment, should come on.

(5) Return "G" switch to normal horizontal position and install two forward fasteners. Control columns should remain in neutral position and PUSHER DUMPED lights should go off.

(6) Place both STALL SELF TEST switches in OFF position and press either PUSH 1/PUSH 2 switch on glareshield. PUSH 1/PUSH 2 lights go off.

(7) Make certain "G" switch bracket has been secured in place by fasteners.

(8) Return aircraft to required configuration.

STICK SHAKER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation and test procedures for the stick (control column) shaker. Two shakers are installed, one each, on the captain's and first officer's control columns. Procedures given are typical for either column.

2. Removal/Installation Stick Shaker

A. Remove Stick Shaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

(2) Disconnect electrical plug at the stick shaker.

NOTE: Install protective covers on electrical plug and receptacle.

(3) Support stick shaker; and remove four mount screws and associated washers.

(4) Remove stick shaker.

B. Install Stick Shaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING

(Continued)

LOWER EPC, AC BUS

Row	Col	Number	Name
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

(2) Place shaker in mounting position on control column; and install mount screws, lock washers, and flat washers.

(3) Remove covers from electrical plug and receptacle.

(4) Check electrical plug and receptacle for corrosion, dirt, and damaged pins.

(5) Connect electrical plug and receptacle.

3. **Adjustment/Test Stick Shaker**

A. Test Stick Shaker

(1) Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	23	B1-589	CAPTAIN'S STALL WARNING
Z	23	B1-590	FIRST OFFICER'S STALL WARNING

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT INSTR BUS

Row	Col	Number	Name
A	13	B1-838	STALL WARNING ALPHA FLAP-1

UPPER EPC, RIGHT INSTRUMENT BUS

Row	Col	Number	Name
A	9	B1-837	STALL WARNING ALPHA FLAP-2

WJE 892

NOTE: The following test checks the individual operation of the Captain's and First Officer's stick shakers by either computer.

WJE ALL

Table 201

Step	Operation	Desired Result
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893		
(1)	Verify that STALL INDICATION FAILURE (SIF) light on over head annunciator panel is not on.	
(2)	Place STALL TEST switch on overhead panel to SYS 1 position.	Both stick shakers should operate, both STALL lights come on, and stall warning aural tone and voice "STALL" comes on. Both STICK PUSHER, PUSH TO INHIBIT lights should come on.
(3)	Place STALL TEST switch to OFF.	Stick shakers, STALL and STICK PUSHER lights, and aural warnings should go off.
(4)	Place STALL TEST switch to SYS 2.	Both stick shakers should operate, both STALL lights come on, and stall warning aural tone and voice "STALL" comes on. Both STICK PUSHER, PUSH TO INHIBIT lights should come on.
(5)	Place STALL TEST switch to OFF.	Stick shakers, STALL and STICK PUSHER lights, and aural warning should go off.
(6)	Return airplane to required configuration.	
WJE 892		
(1)	Disconnect electrical connector from F.O.'s stick shaker located on F.O.'s control column.	
(2)	Place STALL SELF TEST-1 switch located on overhead switch panel in TEST position.	Capt's stick shaker comes on.
(3)	Place STALL SELF TEST-1 switch in OFF position.	Capt's shaker goes off.
(4)	Place STALL SELF TEST-2 switch in TEST position.	Capt's shaker comes on.
(5)	Place STALL SELF TEST-2 switch in OFF position.	Capt's shaker goes off.
(6)	Connect electrical connector to F.O.'s stick shaker.	
(7)	Disconnect electrical connector from Capt's stick shaker located on Capt's control column.	
(8)	Place GND PROX WARN TEST switch, on overhead switch panel, in TEST position.	"GLIDE SLOPE" and "WHOOP WHOOP-PULL UP" aural warnings are activated.

WJE 892 (Continued)

Table 201 (Continued)

Step	Operation	Desired Result
(9)	Place STALL SELF TEST-1 switch in TEST position.	F.O.'s shaker comes on. GPWS aural warnings are inhibited.
(10)	Place STALL SELF TEST-1 switch in OFF position and place GND PROX WARN TEST switch in NORM position.	F.O.'s shaker goes off.
(11)	Place STALL SELF TEST-2 switch in TEST position.	F.O.'s stick shaker comes on.
(12)	Place STALL SELF TEST-2 switch in OFF position.	F.O.'s shaker goes off.
(13)	Connect electrical connector to Capt's stick shaker.	

ATTITUDE AND DIRECTION - DESCRIPTION AND OPERATION

1. General

A. This section describes that portion of equipment which uses magnetic, gyroscopic, and inertial forces to provide a presentation of aircraft course and heading deviation, direction, and attitude. Data from the heading, horizon, ILS and VHF NAV systems are utilized to operate three dimensional indicators and annunciator lights.

WJE 405-411, 880, 881, 883, 884, 886, 887

2. Heading System

WJE 405-411, 880, 881, 883, 884

A. The heading system supplies both pilots with directional data used in navigating the aircraft. Magnetic heading information, supplied by each of the two primary attitude and heading reference systems (AHRS) is displayed on the applicable EFIS Navigation Display (ND) and Radio Magnetic Indicator. An AHRS transfer switch permits selection of an auxiliary AHRS in place of one of the primary systems. Output signals from the heading system are provided for other systems in the aircraft requiring a heading reference. A standby magnetic compass is also provided.

WJE 886, 887

B. The heading system supplies both pilots with directional data used in navigating the aircraft. Magnetic heading information, supplied by each of the two primary attitude and heading reference systems (AHRS) is displayed on the applicable EFIS Navigation Display (ND) and Radio Distance Magnetic Indicator RDMI. Output signals from the heading system are provided for other systems in the aircraft requiring a heading reference. A standby magnetic compass is also provided.

WJE 405-411, 880, 881, 883, 884, 886, 887

C. The attitude and heading reference systems, in addition to providing heading data, are the primary sources for aircraft pitch and roll data. Pitch and roll data is output to other systems requiring attitude reference signals.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 891-893

3. Compass System

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

A. The compass system supplies both pilots with directional data used in navigating the airplane. The magnetic and gyroscopic information supplied by each compass system is displayed on the applicable HSI and Compass Indicator. Output signals from the compass system are provided for other systems in the airplane requiring a heading reference. A standby magnetic compass is also provided.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 891-893

B. The compass system consists of a standby magnetic compass and a radio distance magnetic indicator (RDMI). The standby compass supplies the captain and first officer with directional data used in navigating the aircraft. Magnetic heading information is supplied by an inertial reference system (IRS)(Ref. 34-43-00) and is displayed on the applicable EFIS Navigation Display (ND) and Radio Distance Magnetic Indicator (RDMI). Output signals from the IRS are provided for other systems in the aircraft requiring a heading reference.

WJE 415, 418, 863, 864, 866

C. The compass system supplies both pilots with directional data used in navigating the aircraft. The magnetic and gyroscopic information supplied by each compass system is displayed on the Captains and First Officer's Navigation Displays (ND's) and Compass Indicators. Output signals from the compass system are provided for other systems in the aircraft requiring a heading reference. A standby magnetic compass is also provided.

WJE ALL

4. Navigation Displays

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887, 893

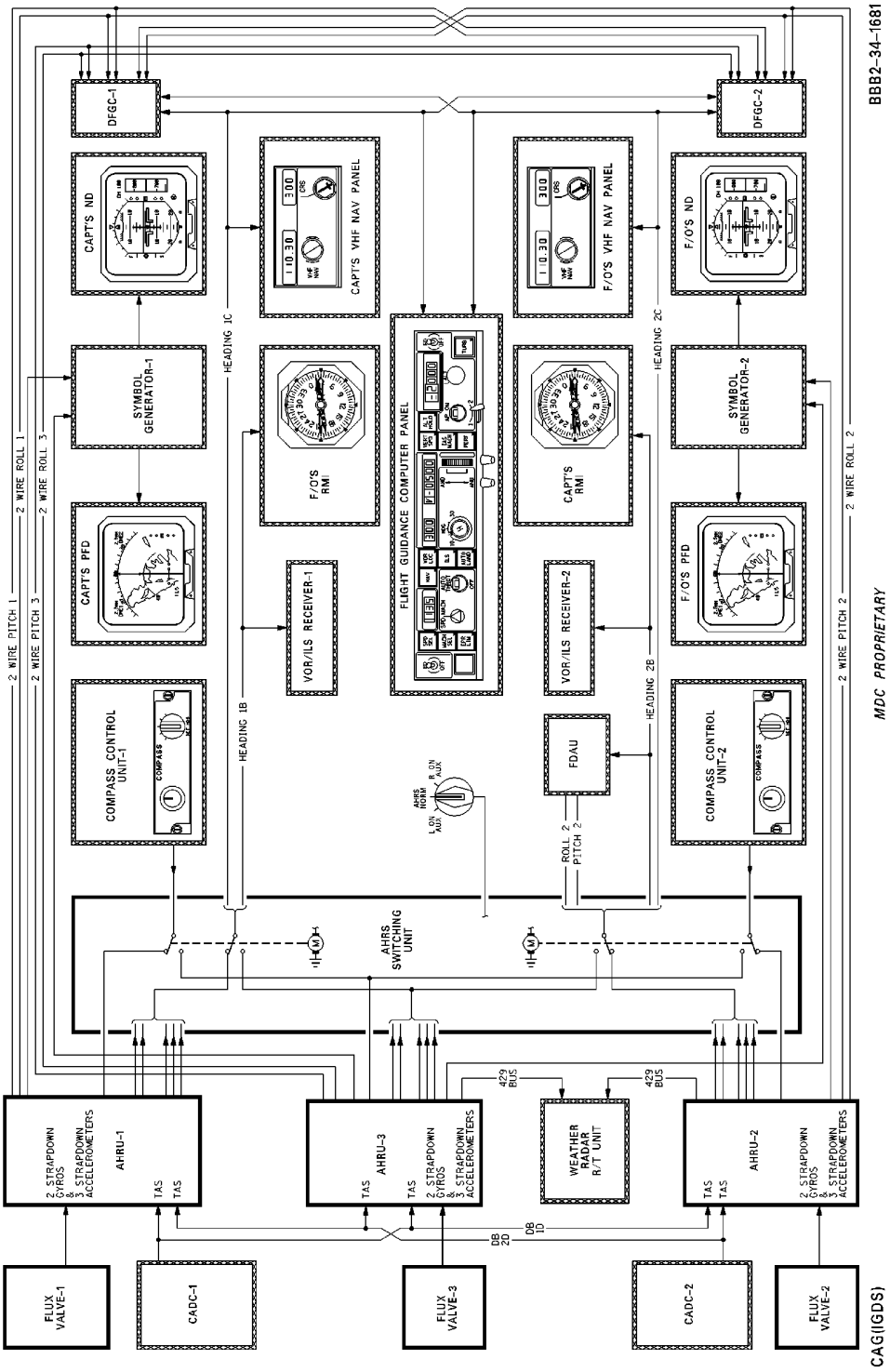
A. The Electronic Flight Instrument System (EFIS) uses inputs from several systems to display magnetic heading, ADF bearing, radio altitude, marker beacon, VOR/LOC/GS deviation, DME DISTANCE, heading selection, course selection, and to-from data.

WJE 405-411, 880, 881, 883, 884

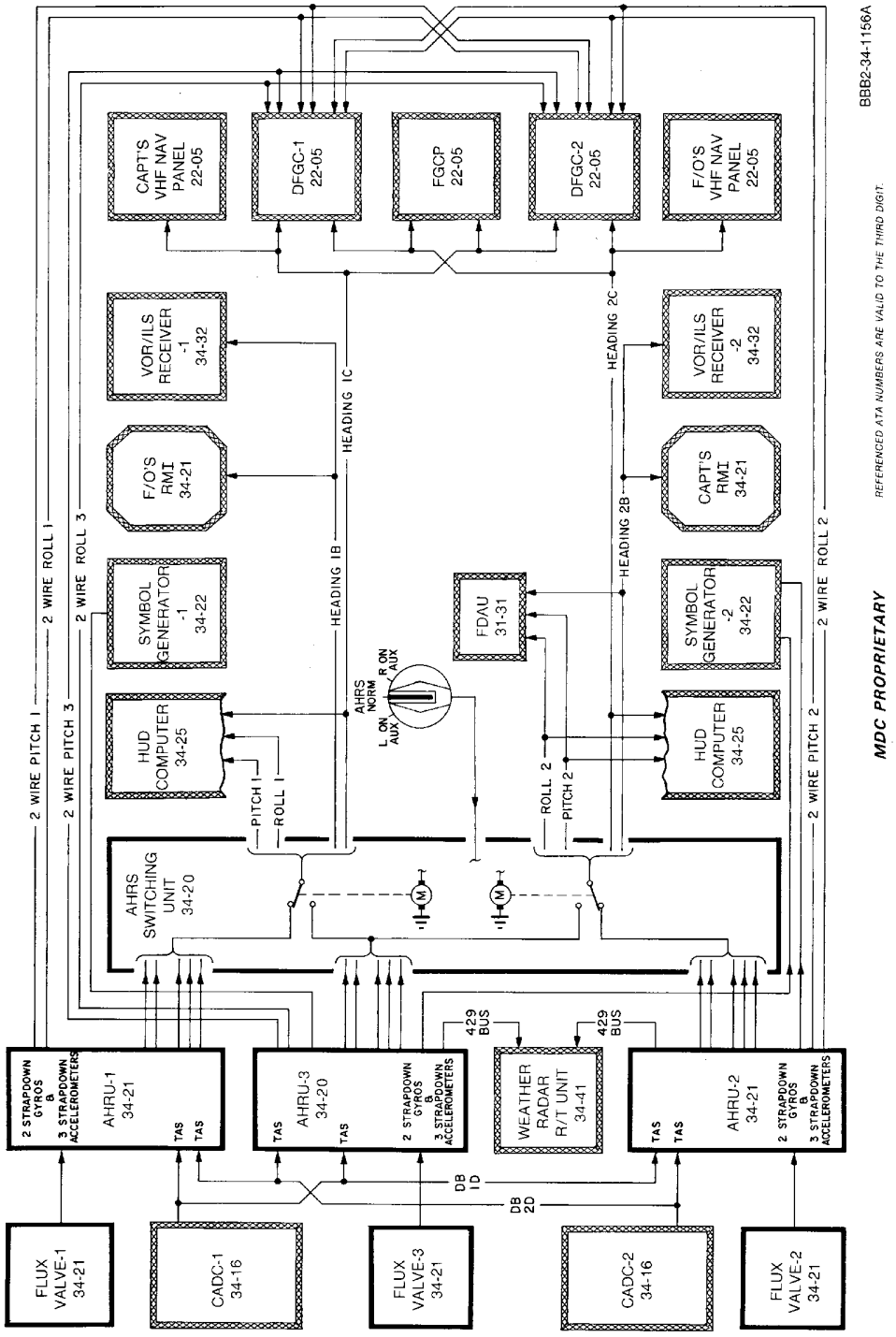
B. The Horizontal Situation Indicators (HSI) use inputs from several systems to display compass heading, VOR/LOC/GS deviation, DME distance, heading selection, course selection, and to-from data.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

C. The horizontal situation indicators (HSI) use inputs from several systems to display magnetic heading, ADF bearing, VOR/LOC/GS deviation, DME distance, heading selection, course selection, and to-from data.



AHRS -- Functional Diagram
Figure 1/34-20-00-990-805 (Sheet 1 of 2)



AHRS -- Functional Diagram
Figure 1/34-20-00-990-805 (Sheet 2 of 2)

WJE ALL

5. Attitude System

WJE 415, 418, 863, 864, 866

A. The attitude (horizon) system uses data from the vertical gyro system to cause roll and pitch attitude to be displayed on the captain's and first officers EFIS Primary Flight Displays (PFD).

WJE 405-411, 880, 881, 883, 884

B. The attitude (horizon) system uses data from the vertical gyros to cause roll and pitch attitude to be displayed on the captain's and first officers ADI. An attitude switching unit allows a choice of input from three vertical gyros to the applicable indicator. A standby attitude indicator is also provided.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 886, 887, 891-893

C. The attitude (horizon) system uses data from the vertical gyros to cause roll and pitch attitude to be displayed on the captain's and first officers ADI. A standby Horizon Indicator is also provided.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

D. The attitude (horizon) system uses data from the inertial reference system to cause roll and pitch attitude to be displayed on the captain's and first officers EFIS Primary Flight Displays (PFD). A standby attitude indicator is also provided.

WJE 405-411, 880, 881, 883, 884

6. Heading System (Aircraft with AHRS)

A. The heading system supplies both pilots with directional data used in navigating the aircraft. Magnetic heading information, supplied by each of the two primary attitude and heading reference systems (AHRS) is displayed on the applicable EFIS Navigation Display (ND) and Radio Distance Magnetic Indicator RDMI. Output signals from the heading system are provided for other systems in the aircraft requiring a heading reference. A standby magnetic compass is also provided

B. The attitude and heading reference systems, in addition to providing heading data, are the primary sources for aircraft pitch and roll data. Pitch and roll data is output to other systems requiring attitude reference signals.

(1) Attitude System

(2) The attitude and heading reference systems, in addition to providing heading data, are the primary sources for aircraft pitch and roll data. Pitch and roll data is output to other systems requiring attitude reference signals.

7. Navigation Displays (Aircraft without EFIS)

A. The Horizontal Situation Indicators (HSI) use inputs from several systems to display compass heading, VOR/LOC/GS deviation, DME distance, heading selection, course selection, and to-from data.

B. The Electronic Flight Instrument System (EFIS) uses inputs from several systems to display magnetic heading, ADF bearing, radio altitude, marker beacon, VOR/LOC/GS deviation, DME distance, heading selection, course selection, and to-from data.

8. Attitude System (Aircraft with AHRS)

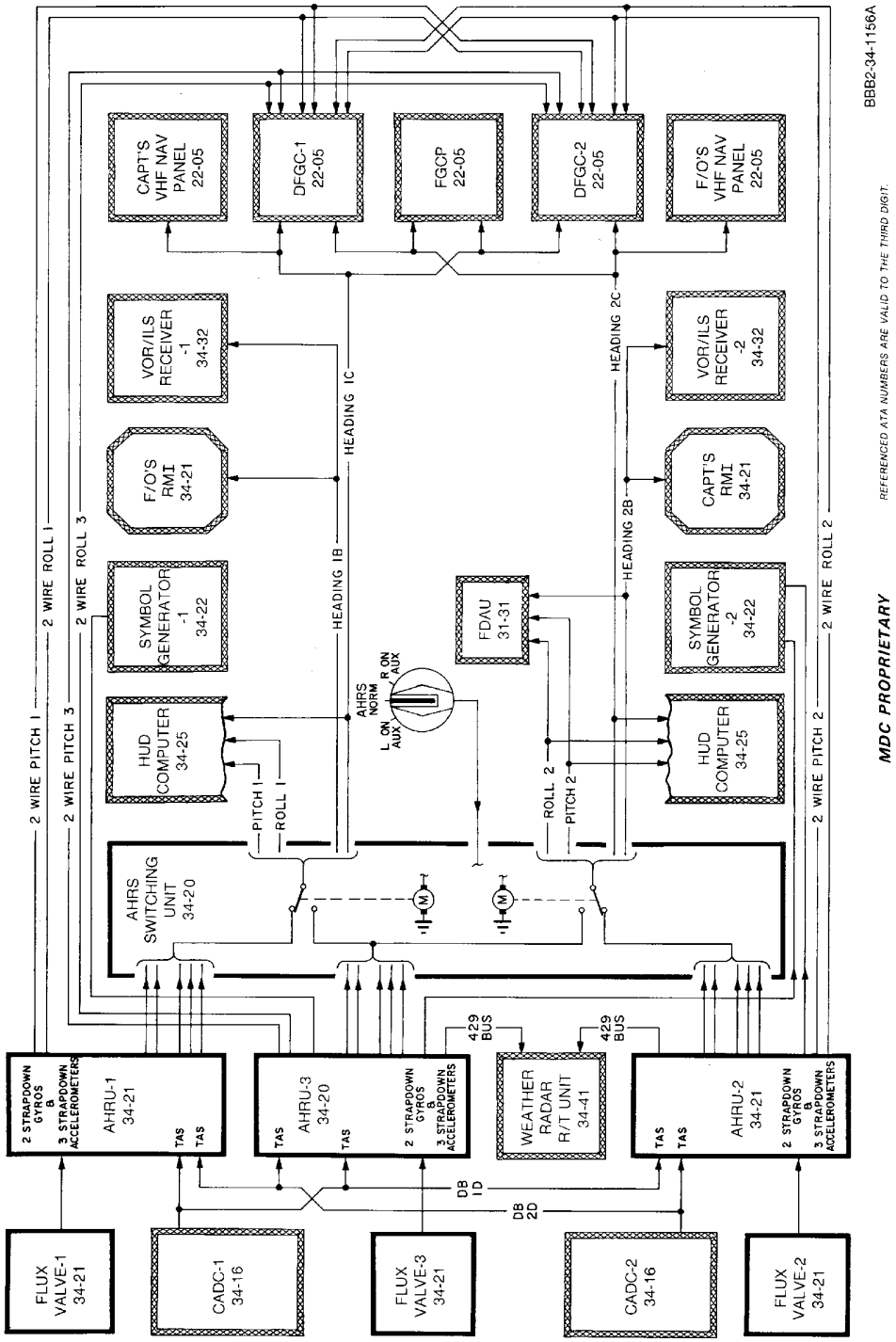
A. The attitude (horizon) system uses data from the attitude and heading reference systems to cause roll and pitch attitude to be displayed on the captain's and first officers EFIS Primary Flight Displays (PFD). An AHRS transfer switch permits selection of an auxiliary AHRS for input to either the captain's or first officers PFD. A standby attitude indicator is also provided.

WJE 405-411, 880, 881, 883, 884 (Continued)

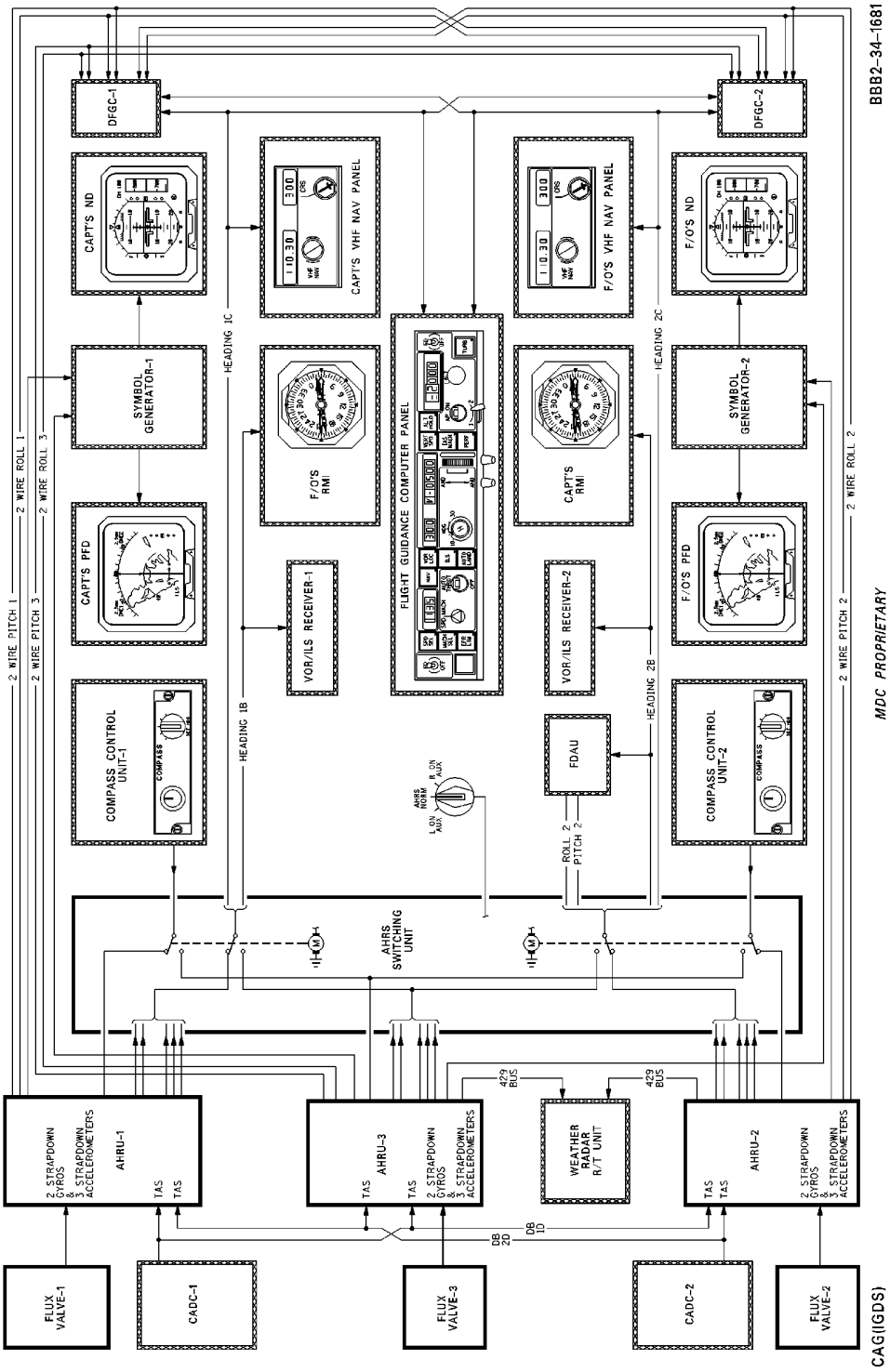
9. Attitude System (Aircraft with Vertical Gyros)

A. The attitude (horizon) system uses data from the vertical gyros to cause roll and pitch attitude to be displayed on the captain's and first officers ADI. An attitude switching unit allows a choice of input from three vertical gyros to the applicable indicator. A standby attitude indicator is also provided.

B. The attitude (horizon) system uses data from the vertical gyro systems to cause roll and pitch attitude to be displayed on the captain's and first officers EFIS Primary Flight Displays (PFD). An attitude switching unit allows a choice of input from three vertical gyros to the applicable indicator. A standby attitude indicator is also provided.



AHRS - Functional Diagram (Aircraft with AHRS, EFIS and HUD)
Figure 2/34-20-00-990-803



AHRS - Functional Diagram (Aircraft with AHRS, EFIS and COMPASS Controllers)
Figure 3/34-20-00-990-804

COMPASS SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) The captain's and first officer's compass indicators read out the heading sensed by the opposite system. D/G 2 inputs supply the captain's compass indicator and D/G 1 supplies the first officer's compass indicator.

B. Components

(1) For EFIS equipped aircraft, references to ADI are equivalent to PFD and references to HSI are equivalent to ND. The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the aircraft.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR or ADF indication as read against the compass card. Selection of ADF or VOR is by placing the switches on the indicator in position required. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to systems such as flight director and VHF/NAV components.

(4) A standby magnetic compass is located in the flight compartment overhead ceiling above the First Officer. The compass face is mounted aft. The compass display is reflected into an adjustable mirror just aft of the compass. This in turn is reflected into a captains and a first officers mirror located on the instrument panels glare shield.

2. Operation

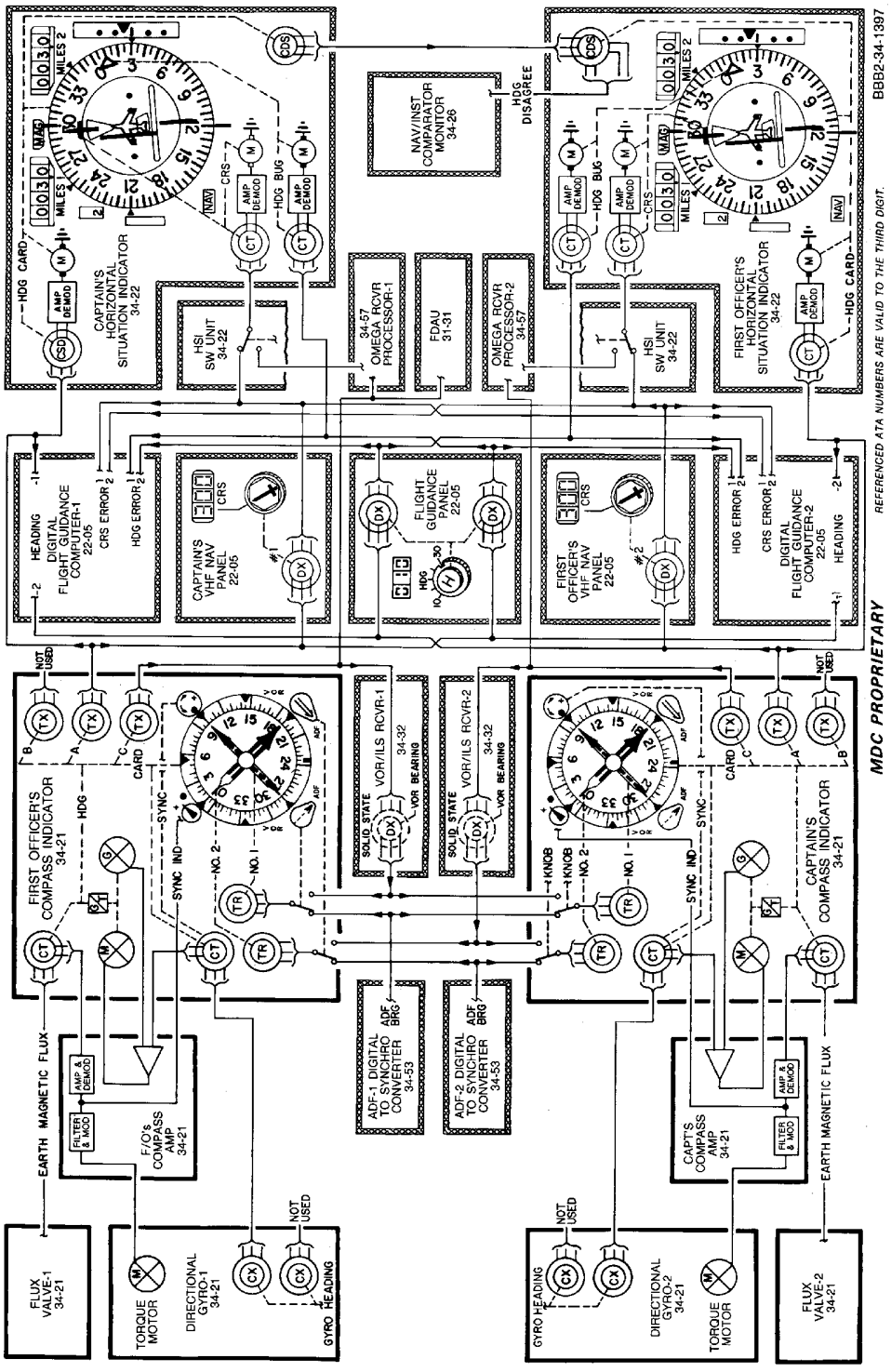
A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (aircraft) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servoloop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the airplane magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor which causes the azimuth gimbal to turn to the sensed magnetic heading.

C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer.

D. The captain's compass indicator provides heading output signals to the first officer's HSI as well as the VHF/NAV -1 system. The first officer's compass indicator provides heading output signals to the captain's HSI, and the VHF/NAV -2 system.

E. Each compass indicator contains two pointers, superimposed over the compass card for relative, radio bearings for VOR or ADF as selected.



Compass System Functional Diagram
Figure 1/34-21-00-990-835

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) The captain's and first officer's compass indicators read out the heading sensed by the opposite system. Such as D/G 2 inputs are to captain's compass indicator and D/G 1 to first officers compass indicator.

B. Components

(1) The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the airplane.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR indication as read against the compass card. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to the VOR/ILS receivers, digital flight guidance computers (DFGC), flight guidance control panels (FGCP), VHF/NAV panels and flight recorder. On aircraft equipped with the Electronic Flight Instrument System (EFIS), the compass indicator provides heading information to the EFIS symbol generators.

(4) A standby magnetic compass is located in the flight compartment overhead ceiling above the First Officer. The compass face is mounted aft. The compass display is reflected into an adjustable mirror just aft of the compass. This in turn is reflected into a captains and a first officers mirror located on the instrument panels glare shield.

2. Operation

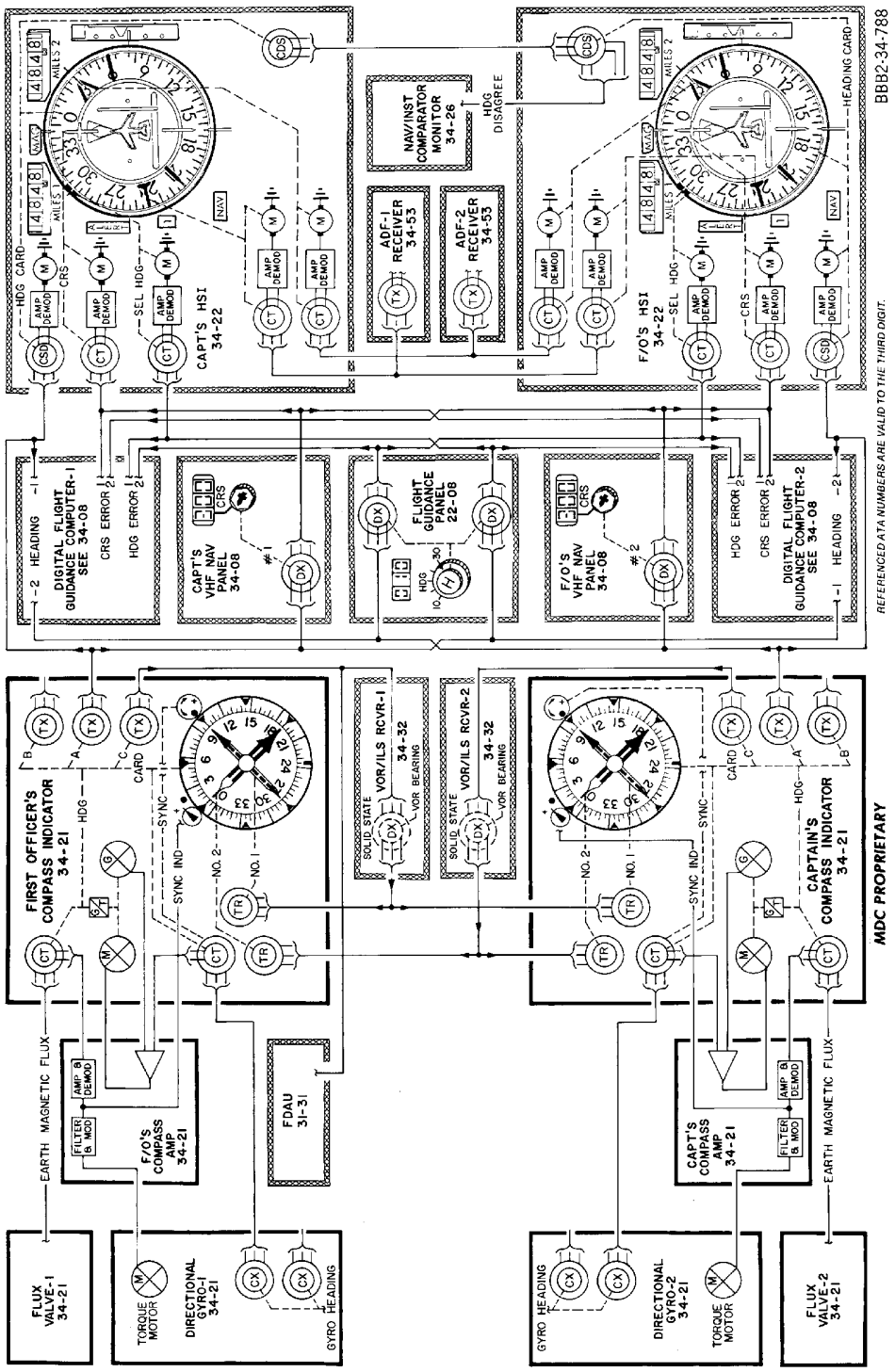
A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (airplane) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servoloop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the airplane magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor which causes the azimuth gimbal to turn to the sensed magnetic heading.

C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer.

D. The captain's compass indicator provides heading output signals to the first officer's HSI as well as the VHF/NAV -1 system. The first officer's compass indicator provides heading output signals to the captain's HSI, and the VHF/NAV -2 system.

E. Each compass indicator contains two pointers, superimposed over the compass card for relative, radio bearings for VOR.



Compass System Functional Diagram
Figure 1/34-21-00-990-839

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

WJE 406-408

(1) The heading system is comprised of two gyro-stabilized systems with remote magnetic sensing, an Attitude/Heading Switching Unit (AHSU), and a standby magnetic compass. Each gyro-stabilized system includes an Attitude/Heading Reference Unit (AHRU), a flux valve, a Radio Magnetic Indicator (RMI). Each AHRU, its associated flux valve and CCU comprise an Attitude and Heading Reference System (AHRS). In addition to the two primary AHRS's, a third AHRS is installed that can be manually selected by either the captain or first officer. The following paragraphs describe the AHRS system outputs when the AHRS source select switch is in the NORM, L ON AUX and R ON AUX positions.

NOTE: A Compass Controller Unit (CCU) is used on airceaft 110. Also on 110 the AHRU and CCU comprise an AHRS.

(2) AHRS NORM: With the AHRS source select switch in the NORM position, the three AHRS systems supply data as follows:

(a) AHRS-1: Attitude & heading to Capt EFIS, DFGC-1, DFGC-2; HUD; heading to F/O RMI, VOR-1, Capt. VHF/NAV Panel and FGCP.

NOTE: On airceaft 110. a head up display (HUD) is not used.

(b) AHRS-2: Attitude & heading to F/O EFIS, DFGC-1, DFGC-2, HUD; flight recorder; heading to Capt. RMI, VOR-2, F/O VHF/NAV Panel, FGCP; attitude to WXR.

(c) AHRS-3: Attitude to DFGC-1, DFGC-2, HUD.

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(3) AHRS L ON AUX: With the AHRS source select switch in the L ON AUX position, the three systems supply data as follows:

(a) AHRS-1: Attitude to DFGC-1, DFGC-2.

(b) AHRS-2: Attitude & heading to F/O EFIS, DFGC-1, DFGC-2, flight recorder; heading to Capt. RMI, VOR-2, F/O VHF/HAV Panel, FGCP; attitude to WXR.

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NOTE: On airceaft 110. a head up display (HUD) is not used.

(c) AHRS-3: Attitude & heading to Capt EFIS, DFGC-1, DFGC-2; HUD; heading to F/O RMI, VOR-1, Capt. VHF/NAV Panel and FGCP.

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(4) AHRS R ON AUX: With the AHRS source select switch in the R ON AUX position, the three systems supply data as follows:

WJE 406-408

(a) AHRS-1: Attitude & heading to Capt. EFIS, DFGC-1, DFGC-2; HUD; heading to F/O RMI, VOR-1, Capt. VHF/NAV Panel and FGCP.

NOTE: On airceaft 110. a head up display (HUD) is not used.

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(b) AHRS-2: Attitude to DFGC-1, DFGC-2.

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(c) AHRS-3: Attitude & heading to F/O EFIS, DFGC-1, DFGC-2, HUD; flight recorder; heading to Capt. RMI, VOR-2, F/O VHF/NAV Panel, FGCP; attitude to WXR.

NOTE: On airceaft 110. a head up display (HUD) is not used.

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B. Componentsl

(1) The AHRU's, located in the forward accessory compartment, are the primary sources of aircraft heading and attitude data. Each AHRU contains an inertial instrument assembly, computer module, and associated electronics modules. The function of the AHRU is to generate and provide magnetic heading, pitch, and roll signals to user avionics in the appropriate signal format, as follows:

Table 1

Signal	Signal Format	User Avionic
Magnetic Heading	3 wire Synchro	RMI's, VOR/ILS Receivers, VHF NAV Control Panels, Digital Flight Guidance Computers (DFGC's), Flight Guidance Control Panel, and Flight Data Aquisition Unit (FDAU).
Magnetic Heading	429 Digital Data Bus	EFIS Symbol Generators
Pitch and Roll	429 Digital Data Bus	EFIS Symbol Generators and FDAU.
NOTE: The symbol generators generate the symbology for display of attitude and heading data on the EFIS navigation displays (ND) and primary flight display (PFD).		
Pitch and Roll	2 Wire AC	DFGC's
Pitch and Roll	ARINC 429 Bus	Weather Radar Receiver Transmitter.
Heading Valid	28 VDC	RMI's, EFIS and DFGC's.
Attitude Valid	28 VDC	EFIS and DFGC's.

(a) The inertial instrument assembly is comprised of two hermetically sealed 2 degree of freedom tuned rotor gyros, three torque balanced pendulous accelerometers, a calibration memory, and an instrument block. The instrument block provides a vibration isolated mounting platform for the inertial instruments (gyros and accelerometers) and calibration memory. The function of the instrument assembly is to provide the raw angular and velocity data which is then processed by the computer and electronics modules and output as magnetic heading, pitch, and roll signals.

(b) The computer module is a self contained general purpose computer, utilizing two microprocessors mounted on a single layer circuit board. On board logic provides the clock, control and buffer circuitry which enables the microprocessors to operate as the system controllers.

(c) The associated electronics modules provides the control circuitry, signal processing, data interface, and DC power necessary to the proper functioning of the AHRS.

(2) The flux valves, two in the left wing outboard trailing edge and one in the right wing outboard trailing edge, are magnetic detectors that transmit magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in pitch and roll. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the airplane. The magnetic heading information is sent from each flux valve to its associated AHRU as long term reference for magnetic heading.

(3) The RMI is a panel mounted instrument that combines compass heading with dual radio navigation pointers.Heading information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR bearing as read against the compass card. Each indicator includes a HDG (heading) flag and two VOR pointer flags.

(4) The Attitude/Heading Switching Unit (AHSU) is a rack mounted unit located in the electrical/electronics compartment. The unit contains two motor driven switches. The switching assembly in the unit controls selection of input from one of the three AHRS. The switching unit is remotely actuated by a three position rotary switch (placarded AHRS) on the overhead panel. Whenever the switch is out of the normal center position, an ATT3 annunciation appears on the EFIS Primary Flight Displays.

(5) Normal instrumentation furnishes data from AHRS-1 to the EFIS Symbol generator (SG-1) (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1), captain's VHF NAV control panel, DFGC's, FDAU, and first officer's RMI; and data from AHRS-2 to the opposite associated instruments and systems, and the weather radar receiver transmitter. Whenever the AHRS switch is out of the normal position, AHRS-3 data is substituted for AHRS-1 or AHRS-2 data, as applicable to switch position. An amber AHRS-3 INOP annunciator light, located adjacent to the AHRS source select switch, will come on to denote a failure in AHRS-3, and warn the operator not to switch out of normal instrumentation.

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NOTE: On aircraft 110, the dual pointers display VOR bearing as read against the compass card. Each indicator includes a HDG flag and two VOR pointer flags.

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(6) Three AHRS BASIC mode annunciators (AHRS 1 BASIC, AHRS 2 BASIC and AHRS 3 BASIC) are located on the overhead, adjacent to the AHRS source select switch. These annunciators come on to signal that the system is no longer operating in the NORMAL mode (no TAS inputs are being supplied to the AHRU). An AHRS BASIC annunciator on the overhead annunciator panel signals that one of these 3 annunciators has come on.

(7) A standby magnetic compass is located in the flight compartment overhead ceiling above the first officer. The compass face is mounted aft. This, in turn, is reflected into a captain's and first officer's mirror located on the instrument panels glareshield.

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(8) On aircraft 110, two Compass Controller Units (CCU's) are mounted on the pedestal, with the Capt's unit on the left and the F/O's unit on the right. Each unit contains a SET HDG knob and a sync indicator.

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2. Operation

A. The AHRS automatically erects and aligns to the local vertical (in pitch and roll) and to the output of the flux valve (in heading). When the aircraft is stationary on the ground, this is done within 45 seconds of power application.

(1) The heading portion of the AHRS is aligned and operated in the Slaved Magnetic Heading mode of operation (gyros slaved to flux valve inputs), which utilizes flux valve inputs as long term heading reference. During turns and decelerations, the AHRU automatically inhibits use of the flux valve signals as heading reference. However, once the maneuver is completed, the flux valve signals are again utilized.

(2) The attitude portion of the AHRS is erected/aligned and operated in the Normal mode. (Basic mode is used as backup.) In Normal mode operation, True Airspeed (TAS) inputs from each Central Air Data Computer (CADC) are fed to the on-side AHRU as aids in system alignment and operation. In this case, system alignment can be accomplished in 45 seconds. (The attitude flag is pulled at 45 seconds from power on. The heading flag is also pulled then, or once the aircraft assumes steady level flight.) In Normal mode on the ground, the aircraft is assumed to have zero velocity. If the aircraft is moved during the first 45 seconds from power on while on the ground (Normal mode on ground alignment), the system will drop to the Basic mode. Also, if TAS is lost when in flight, the AHRS drops to Basic mode.

(3) In the Basic mode, the AHRS operation is similar to that of a Vertical/Directional Gyro combination. TAS inputs are not used by the AHRU to assist in alignment and operation. In Basic mode, alignment/erection takes 55 seconds. During this time, certain on-ground and in-flight combination maneuver limitations must be observed (straight and level).

B. The AHRS contains extensive built in tests. These tests include reasonableness tests on instrument and external data, and internal software. If invalid data or a failure condition is detected, the appropriate warning annunciation will be commanded. The AHRU contains an Electrically Erasable Read-Only Memory for fault data retention and read-out.

C. The RMI's located in the captain's and first officer's instrument panels, combine compass heading with dual radio navigation pointer. Each indicator also includes HDG flag and two VOR/ADF pointer flags.

NOTE: On aircraft 110, instead of VOR/ADF pointer flags the VOR pointer flags are used. The description and operation is the same except substitute VOR for VOR/ADF.

(1) Magnetic heading is displayed on a rotating compass card read against a fixed index (lubber line) at the top of the indicator. A magnetic heading signal, received from the RMI's associated AHRU, is applied to a synchro controlled motor, which in turn positions the compass card.

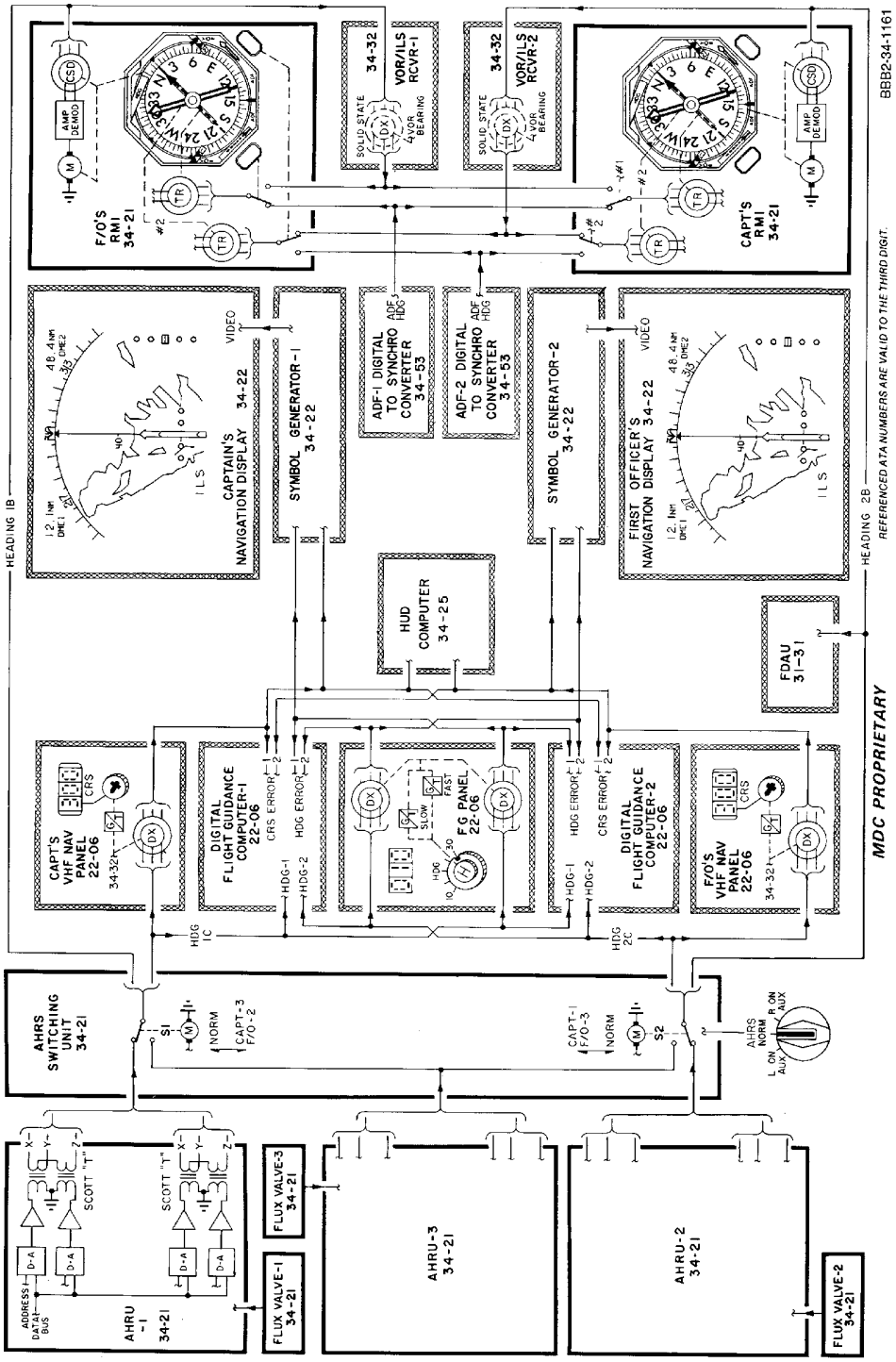
(2) Each RMI contains two Synchro positioned pointers, superimposed over the compass card, for relative VOR bearing.

(3) The HDG warning flag contained on each RMI is normally biased out of view. Should the associated AHRU detect an invalid magnetic heading condition, the bias voltage is removed and the OFF flag is displayed.

(4) The VOR/ADF pointer flags (1 and 2) are biased out of view whenever the associated VHF NAV control panel is tuned to an ILS or Localizer frequency; or a valid VOR/LOC condition exists. If the VHF NAV control panel is not tuned to an ILS or localizer frequency and an invalid VOR/LOC condition exists, the biasing voltage to the associated pointer flags is removed and the flags come into view. Selection of ADF or VOR is made by placing the ADF/VOR switches on the indicators to the required position.

NOTE: On aircraft 110, there is no ADF/VOR switch.

D. On aircraft 110, 151–153, the SET HDG knob on the CCU may be used to manually slave the AHRU to the flux valve outputs. This provides fast slaving capabilities and nulling of compass error. The set HDG knob is a five position rotray switch which is spring-loaded to return to center (off) position. The set HDG knob provides slow and fast CW or CCW control rates of 30 or 300 degrees per minute, when released the system will automatically synchronize back to aircraft magnetic heading at a rate of less than 2 degree per minute. The sync indicator provides a dispaly of slaving error between the flux valve and the heading output of the system. In normal flight the indicator will fluctuate, indicating that the flux valve is functioning.



Heading Systm -- Functional Diagram
Figure 1/34-21-00-990-850

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The heading system is comprised of two gyro-stabilized systems with remote magnetic sensing, and a standby magnetic compass. Each gyro-stabilized system includes an Attitude/ Heading Reference Unit (AHRU), a flux valve, and a Radio Distance Magnetic Indicator (RDMI). Each AHRU and its associated flux valve comprise an Attitude and Heading Reference System (AHRS).

B. Components

(1) The AHRU's, located in the forward accessory compartment, are the primary sources of aircraft heading and attitude data. Each AHRU contains an inertial instrument assembly, computer module, and associated electronics modules. The function of the AHRU is to generate and provide magnetic heading, pitch, and roll signals to user avionics in the appropriate signal format, as follows:

Table 1

Signal	Signal Format	User Avionic
Magnetic Heading	3 wire Synchro	RDMI's, VOR/ILS Receivers, VHF NAV Control Panels, Digital Flight Guidance Computers (DFGC's), Flight Guidance Control Panel, and Flight Data Aquisition Unit (FDAU).
Magnetic Heading	429 Digital Data Bus	EFIS Symbol Generators
Pitch and Roll	429 Digital Data Bus	EFIS Symbol Generators and FDAU.
NOTE: The symbol generators generate the symbology for display of attitude and heading data on the EFIS navigation displays (ND) and primary flight display (PFD).		
Pitch and Roll	2 Wire AC	DFGC's
Pitch and Roll	ARINC 429 Bus	Weather Radar Receiver Transmitter.
Heading Valid	28 VDC	RDMI, EFIS and DFGC's.
Attitude Valid	28 VDC	EFIS and DFGC's.

(a) The inertial instrument assembly is comprised of two hermetically sealed 2 degree of freedom tuned rotor gyros, three torque balanced pendulous accelerometers, a calibration memory, and an instrument block. The instrument block provides a vibration isolated mounting platform for the inertial instruments (gyros and accelerometers) and calibration memory. The function of the instrument assembly is to provide the raw angular and velocity data which is then processed by the computer and electronics modules and output as magnetic heading, pitch, and roll signals.

(b) The computer module is a self contained general purpose computer, utilizing two microprocessors mounted on a single layer circuit board. On board logic provides the clock, control and buffer circuitry which enables the microprocessors to operate as the system controllers.

(c) The associated electronics modules provides the control circuitry, signal processing, data interface, and DC power necessary to the proper functioning of the AHRS.

(2) The flux valves, one in the left wing outboard trailing edge and one in the right wing outboard trailing edge, are magnetic detectors that transmit magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in pitch and roll. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the aircraft. The magnetic heading information is sent from each flux valve to its associated AHRU as long term reference for magnetic heading.

(3) The RDMI is a panel mounted instrument that combines compass heading with dual radio navigation pointers. Heading information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR/ADF bearing as read against the compass card. Each indicator includes a HDG (heading) flag and two VOR/ADF pointer flags.

(4) Normal instrumentation furnishes data from AHRS-1 to the EFIS Symbol generator (SG-1), captain's VHF NAV control panel, DFGC's, FDAU, and first officer's RDMI; and data from AHRS-2 to the opposite associated instruments and systems, and the weather radar receiver transmitter.

(5) Two AHRS BASIC mode annunciators, AHRS 1 BASIC, AHRS 2 BASIC, are located on the overhead annunciator panel. These annunciators come on to signal that the system is no longer operating in the NORMAL mode.

(6) A standby magnetic compass is located in the flight compartment overhead ceiling above the first officer. The compass face is mounted aft. This, in turn, is reflected into a captain's and first officer's mirror located on the instrument panels glareshield.

(7) Two COMPASS Controller Units (CCUs) are mounted on the pedestal, with the Capt's (AHRS-1) unit on the left and the F.O.'s (AHRS-2) unit on the right. Each unit contains a SET HDG knob and a sync indicator.

2. Operation

A. The AHRS automatically erects and aligns to the local vertical (in pitch and roll) and to the output of the flux valve (in heading). When the aircraft is stationary on the ground, this is done within 45 seconds of power application.

(1) The heading portion of the AHRS is aligned and operated in the Slaved Magnetic Heading mode of operation (gyros slaved to flux valve inputs), which utilizes flux valve inputs as long term heading reference. During turns and decelerations, the AHRU automatically inhibits use of the flux valve signals as heading reference. However, once the maneuver is completed, the flux valve signals are again utilized.

(2) The attitude portion of the AHRS is erected/aligned and operated in the Normal mode. (Basic mode is used as backup.) In Normal mode operation, True Airspeed (TAS) inputs from each Central Air Data Computer (CADC) are fed to the on-side AHRU as aids in system alignment and operation. In this case, system alignment can be accomplished in 45 seconds. (The attitude flag is pulled at 45 seconds from power on. The heading flag is also pulled then, or once the aircraft assumes steady level flight.) In Normal mode on the ground, the aircraft is assumed to have zero velocity. If the aircraft is moved during the first 45 seconds from power on while on the ground (Normal mode on ground alignment), the system will drop to the Basic mode. Also, if TAS is lost when in flight, the AHRS drops to Basic mode.

(3) In the Basic mode, the AHRS operation is similar to that of a Vertical/Directional Gyro combination. TAS inputs are not used by the AHRU in system alignment and operation. In Basic mode, alignment/erection takes 55 seconds. During this time, certain on-ground and in-flight combination maneuver limitations must be observed (straight and level).

B. The AHRS contains extensive built in tests. These tests include reasonableness tests on instrument and external data, and internal software. If invalid data or a failure condition is detected, the appropriate warning annunciation will be commanded. The AHRU contains an Electrically Erasable Read-Only Memory for fault data retention and read-out.

C. The RDMI located in the captain's and first officer's instrument panels, combine compass heading with dual radio navigation pointer. Each indicator also includes HDG flag and two VOR/ADF pointer flags.

(1) Magnetic heading is displayed on a rotating compass card read against a fixed index (lubber line) at the top of the indicator. A magnetic heading signal, received from the RDMI associated AHRU, is applied to a synchro controlled motor, which in turn positions the compass card.

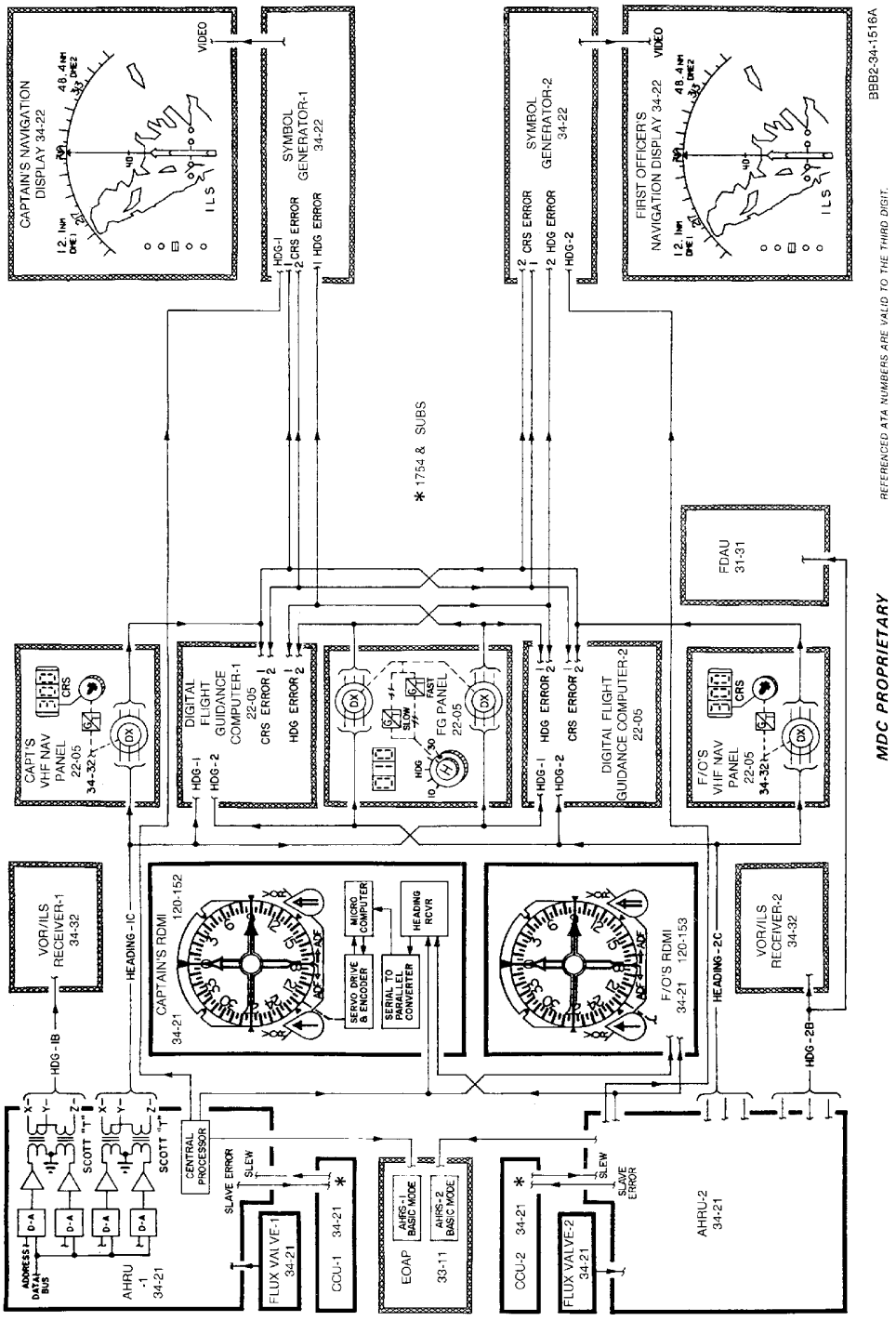
(2) Each RDMI contains two Synchro positioned pointers, superimposed over the compass card, for relative VOR/ADF bearing.

(3) The HDG warning flag contained on each RDMI is normally biased out of view. Should the associated AHRU detect an invalid magnetic heading condition, the bias voltage is removed and the OFF flag is displayed.

(4) The VOR/ADF pointer flags (1 and 2) are biased out of view whenever the associated VHF NAV control panel is tuned to an ILS or Localizer frequency; or a valid VOR/LOC condition exists. If the VHF NAV control panel is not tuned to an ILS or localizer frequency and an invalid VOR/LOC condition exists, the biasing voltage to the associated pointer flags is removed and the flags come into view. Selection of ADF or VOR is made by placing the ADF/VOR switches on the indicators to the required position.

(5) The AHRUs provide the data through the symbol generators for aircraft heading and attitude oriented displays on the EFIS NDs and PFDs.

D. The SET HDG knob on the CCU may be used to manually slave the AHRU to the flux valve outputs to provide fast slaving capabilities, and nulling of compass error. The SET HDG knob is a five position rotary switch which is spring-loaded to return to center (off) position. The SET HDG knob provides slow and fast CW or CCW control rates of 30 or 300 degrees per minute, when released the system will automatically synchronize back to aircraft magnetic heading at a rate of less than 2 degrees per minute. The sync indicator provides a display of slaving error between the flux valve and the heading output of the system. In normal flight the indicator will fluctuate, indicating that the flux valve is functioning.



Heading System -- Functional Diagram
Figure 1/34-21-00-990-851

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of the Radio Distance Magnetic Indicator (RDMI) and the standby magnetic compass. The RDMI receives digital information from the inertial reference units (IRUs) to display the inertial reference system (IRS) heading input.

(2) The captain's and first officer's RDMIs read out the heading sensed by the opposite system. IRU-2 inputs supply the captain's heading dial and IRU-1 inputs supply the first officer's heading dial.

(3) During normal operation, the captain's and first officer's RDMI's, and Electronic Flight Instrument System (EFIS) Navigation displays (ND) and primary flight displays (PFD) display the magnetic heading and attitude sensed by the IRS.

B. Components

(1) The IRS provides outputs for angular rates, acceleration, attitude, true heading, magnetic heading, velocity and present position of the aircraft. Although the IRS is not considered a component of the compass system, it is mentioned here because of the outputs the system supplies to the RDMI. For more information on the IRS. (SUBJECT 34-43-00, Page 1

(2) The RDMI is a panel mounted instrument that combines compass heading with dual radio navigation pointers. Heading information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR heading as read against the compass card. Each indicator includes a HDG (heading) flag, two VOR pointers and two DME readout windows. The RDMI has two VOR/ADF select knobs to change from VOR heading as read against the compass card to the ADF heading as read against the compass card.

(3) The RDMI is a panel mounted instrument that combines compass heading with dual radio navigation pointers. Heading information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR heading as read against the compass card. Each indicator includes a HDG (heading) flag, two VOR pointers and two DME readout windows.

(4) A standby magnetic compass is located in the flight compartment overhead ceiling above the first officer. The compass face is mounted aft. This, in turn, is reflected into a captain's and first officer's mirror located on the instrument panels glareshield.

2. Operation

A. The RDMI's located in the captain's and first officer's instrument panels, combine compass heading with dual radio navigation pointer. Each indicator includes HDG flag and two VOR pointer flags.

(1) Magnetic heading is displayed on a rotating compass card read against a fixed index (lubber line) at the top of the indicator. A magnetic heading signal, received from the RDMIs associated AHRU, is applied to a synchro controlled motor, which in turn positions the compass card.

(2) Each RDMI contains two Synchro positioned pointers, superimposed over the compass card, for relative VOR bearing.

(3) The HDG warning flag contained on each RDMI is normally biased out of view. Should the associated IRU detect an invalid magnetic heading condition, the bias voltage is removed and the OFF flag is displayed.

(4) The VOR pointer flags (1 and 2) are biased out of view whenever the associated VHF NAV control panel is tuned to an ILS or localizer frequency; or a valid VOR/LOC condition exists. If the VHF NAV control panel is not tuned to an ILS or localizer frequency and an invalid VOR/LOC condition exists, the biasing voltage to the associated pointer flags is removed and the flags come into view.

(5) The DME-L and DME-R display is blanked when a fault is detected due to any of the following conditions: loss of power, input signal loss, message validity loss, software failure and loss of computed data. White dashes appear when input data exceeds range limit of display.

(6) The RDMI consists of five channels: one heading channel, two VOR bearing channels and two DME channels. The indicator receives heading data, VOR bearing data, and DME data, which is converted into a visual display of aircraft heading, VOR bearing data and DME distance respectively.

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) During normal operation, the captain's and first officer's compass indicators read out the heading sensed by their respective system. However, a compass selector switch permits selection of heading from either compass system for input to both compass indicators.

B. Components

(1) The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the aircraft.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR or ADF indication as read against the compass card. Selection of ADF or VOR is by placing the switches on the indicator in position required. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to systems such as flight director and VHF/NAV components.

(4) The compass transfer switch is used to select NORM (normal), BOTH ON -1, or BOTH ON -2 operation. When in NORM position, the captain's compass indicator receives, displays, and repeats compass signals from the -2 directional gyro, and the first officer's compass indicator receives, displays, and repeats compass signals from the -1 directional gyro. When the switch is turned to BOTH ON -1 position, both compass indicators and all other systems that receive heading output from either compass indicator are controlled by the -1 system directional gyro. BOTH ON -2 position transfers all heading output to the -2 system directional gyro. The transfer switch operates in conjunction with a remote switching unit, located in the forward accessory compartment.

2. Operation

A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (aircraft) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servo loop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the aircraft magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor, which causes the azimuth gimbal to turn to the sensed magnetic heading.

C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer.

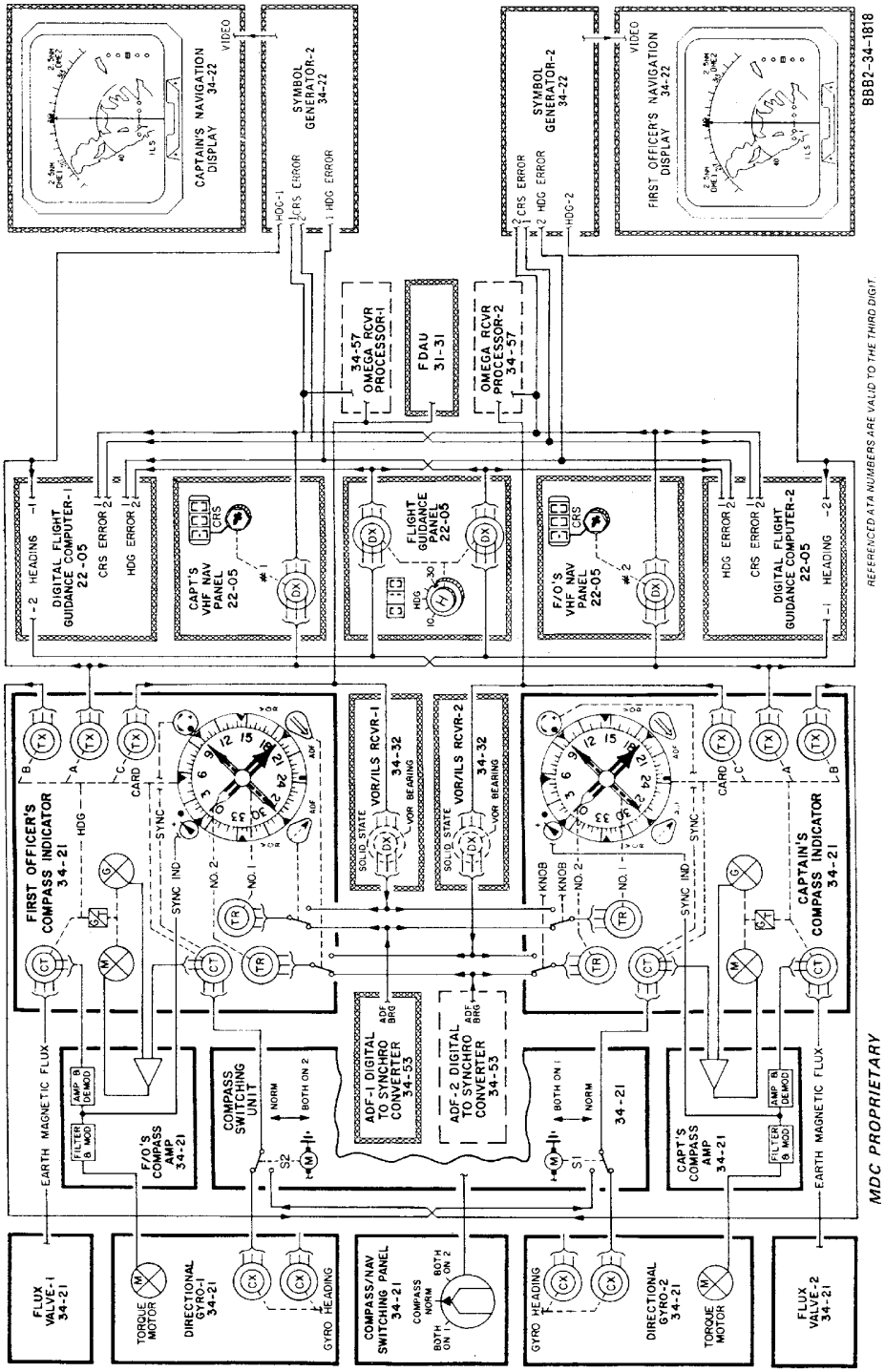
D. The captain's compass indicator provides heading output signals to the first officer's HSI as well as the VHF/NAV -2 system. The first officer's compass indicator provides heading output signals to the captain's HSI, and the VHF/NAV -1 system. Heading input data to each compass indicator is controlled by the position of the compass transfer switch. When BOTH ON -1 position is selected, the captain's compass indicator is the primary readout for directional gyro -1 and the captain's compass indicator becomes a second repeater for heading output from the first officer's compass indicator. In the same manner, BOTH ON -2 position results in the captain's compass indicator receiving heading output from the first officer's compass indicator, derived from directional gyro -2.

E. The captain's compass indicator provides heading output signals to the first officer's Electronic Flight Instrument System (EFIS) Navigation Display (ND) as well as the VHF/NAV -2 system. The first officer's compass indicator provides heading output signals to the captain's ND, and the VHF/NAV -1 system. Heading input data to each compass indicator is controlled by the position of the compass transfer switch. When BOTH ON -1 position is selected, the captain's compass indicator is the primary readout for directional gyro -1 and the captain's compass indicator becomes a second repeater for heading output from the first officer's compass indicator. In the same manner, BOTH ON -2 position results in the captain's compass indicator receiving heading output from the first officer's compass indicator, derived from directional gyro -2.

F. Each compass indicator contains two pointers, superimposed over the compass card for relative, radio bearings for VOR or ADF as selected.

G. The system warning flags/messages in the compass indicators and ND are dependent on the position of the compass transfer switch. The flag warning logic with the transfer switch in NORM position, an OFF flag will appear in the captain's compass indicator as a warning that compass information from the -2 directional gyro is unreliable, system interlocks and logic circuits will cause a HEADING warning message to appear in the first officer's ND. An OFF flag in the first officer's compass indicator will result in a HEADING warning message in the captain's ND.

H. With the compass transfer switch turned to BOTH ON -1 position, an OFF flag in the captain's compass indicator will cause all systems depending on compass inputs to display warning flags and lights. When all compass information is dependent on system -2 (BOTH ON -2 position), an OFF flag in the first officer's compass indicator indicates unreliable compass outputs to all systems using heading information.



Compass System Functional Diagram
Figure 1/34-21-00-990-842

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) The captain's and first officer's compass indicators read out the heading sensed by the opposite system. D/G 2 inputs supply the captain's compass indicator and D/G 1 supplies the first officer's compass indicator.

B. Components

(1) The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the aircraft.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR or ADF indication as read against the compass card. Selection of ADF or VOR is made by placing the switches on the indicator in position required. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to the VOR/ILS receivers, digital flight guidance computers (DFGC), flight guidance control panels (FGCP), VHF/NAV panels and flight recorder. With the Electronic Flight Instrument System (EFIS), the compass indicator provides heading information to the EFIS symbol generators.

(4) A standby magnetic compass is located in the flight compartment overhead ceiling above the First Officer. The compass face is mounted aft. The compass display is reflected into an adjustable mirror just aft of the compass. This in turn is reflected into a captain's and a first officer's mirror located on the glareshield.

2. Operation

A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (aircraft) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servo loop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the aircraft magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor, which causes the azimuth gimbal to turn to the sensed magnetic heading.

C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer. When rotating the sync knob rapidly, the compass rose on the EFIS Navigation Display may blank momentarily.

D. The captain's compass indicator provides heading output signals to the first officer's EFIS symbol generator -2 as well as the VHF/NAV -1 system. The first officer's compass indicator provides heading output signals to the captain's EFIS symbol generator -1, and the VHF/NAV -2 system. On aircraft with EFIS, the EFIS Navigation Displays (ND) are used. The EFIS Mode Select Panel (MSP) is used in selecting a compass rose or arc heading format.

E. Each compass indicator contains two pointers, superimposed over the compass card for relative radio bearings (VOR or ADF).

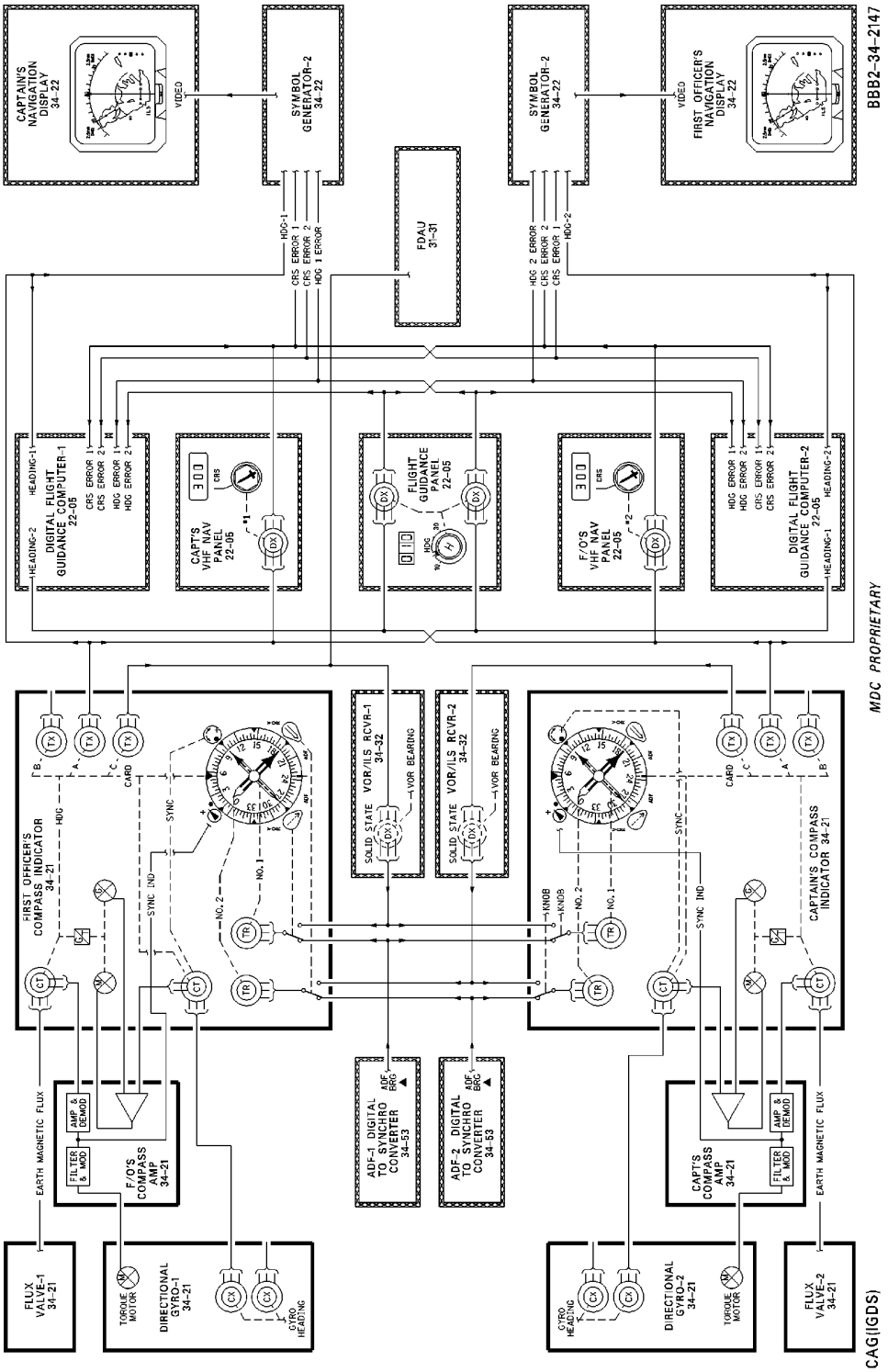
F. The Captain's and First Officer's Navigation Display HDG FAIL messages and the compass indicator OFF flags should come into view if any of the following functions are not operating correctly:

(1) Power to the Compass System.

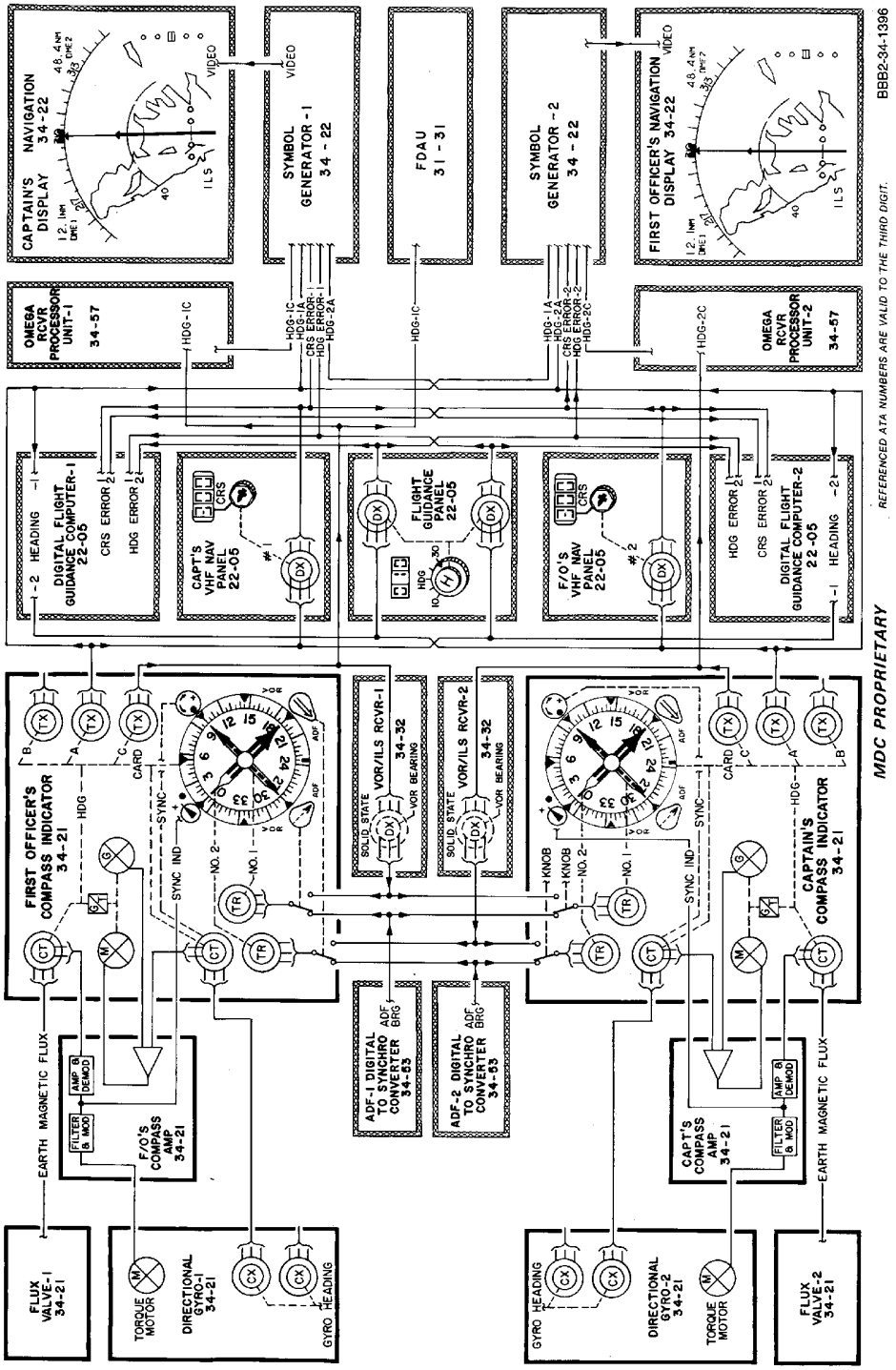
(2) Directional gyro not level.

(3) Directional gyro not operating at sufficient speed.

(4) Excessive error signal in the Heading Servo loops.



Compass System Functional Diagram
Figure 1/34-21-00-990-843 (Sheet 1 of 2)



Compass System Functional Diagram
Figure 1/34-21-00-990-843 (Sheet 2 of 2)

COMPASS SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) During normal operation, the captain's and first officer's compass indicators read out the heading sensed by their respective system. However, a compass selector switch permits selection of heading from either compass system for input to both compass indicators.

B. Components

(1) The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the airplane.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR or ADF indication as read against the compass card. Selection of ADF or VOR is by placing the switches on the indicator in position required. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to systems such as flight director and VHF/NAV components.

(4) The compass transfer switch is used to select NORM (normal), BOTH ON -1, or BOTH ON -2 operation. When in NORM position, the captain's compass indicator receives, displays, and repeats compass signals from the -2 directional gyro, and the first officer's compass indicator receives, displays, and repeats compass signals from the -1 directional gyro. When the switch is turned to BOTH ON -1 position, both com-pass indicators and all other systems that receive heading output from either compass indicator are controlled by the -1 system directional gyro. BOTH ON -2 position transfers all heading output to the -2 system directional gyro. The transfer switch operates in conjunction with a remote switching unit, located in the forward accessory compartment.

2. Operation

A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (airplane) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servoloop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the airplane magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor which causes the azimuth gimbal to turn to the sensed magnetic heading.

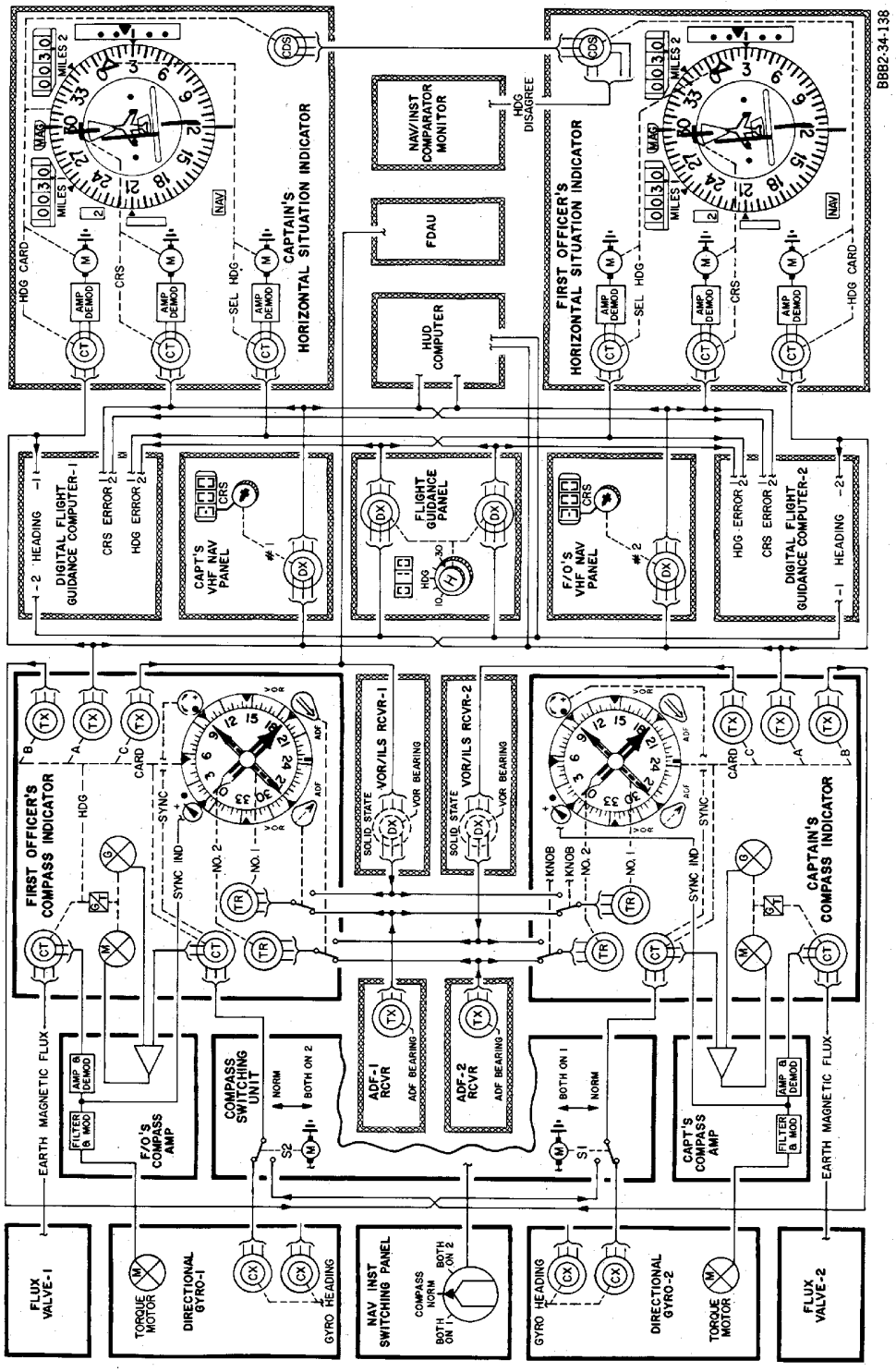
C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer.

D. The captain's compass indicator provides heading output signals to the first officer's HSI as well as the VHF/NAV -2 system. The first officer's compass indicator provides heading output signals to the captain's HSI, and the VHF/NAV -1 system. Heading input data to each compass indicator is controlled by the position of the compass transfer switch. When BOTH ON -1 position is selected, the captain's compass indicator is the primary readout for directional gyro -1 and the captain's compass indicator becomes a second repeater for heading output from the first officer's compass indicator. In the same manner, BOTH ON -2 position results in the captain's compass indicator receiving heading output from the first officer's compass indicator, derived from directional gyro -2.

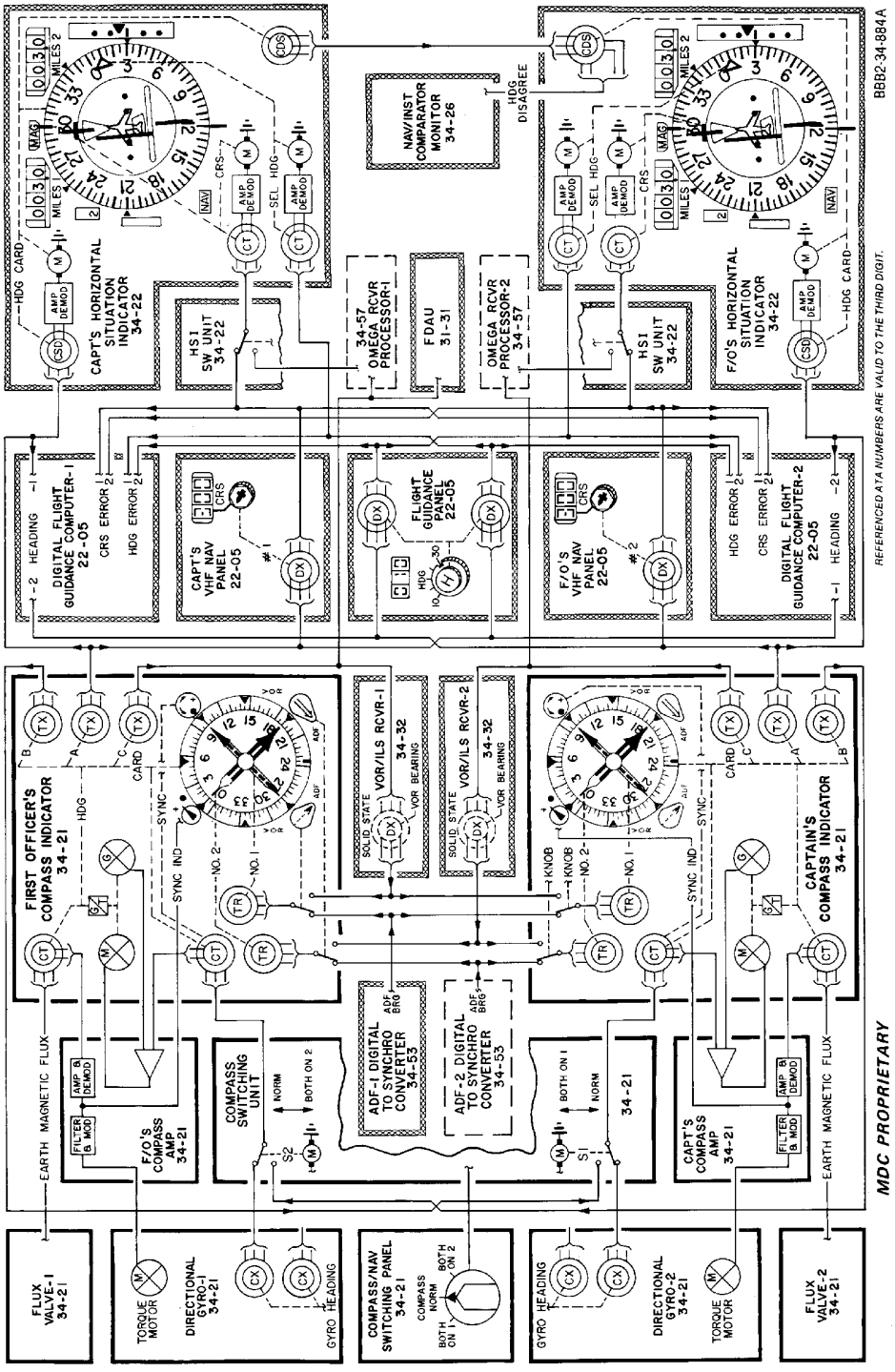
E. Each compass indicator contains two pointers, superimposed over the compass card for relative, radio bearings for VOR or ADF as selected.

F. The system warning flags in the compass indicators and HSI are dependent on the position of the compass transfer switch. The flag warning logic with the transfer switch in NORM position, an OFF flag will appear in the captain's compass indicator as a warning that compass information from the -2 directional gyro is unreliable, system interlocks and logic circuits will cause a HEADING warning flag to appear in the first officer's HSI. An OFF flag in the first officer's compass indicator will result in a HEADING warning flag in the captain's HSI.

G. With the compass transfer switch turned to BOTH ON -1 position, an OFF flag in the captain's compass indicator will cause all systems depending on compass inputs to display warning flags and lights. When all compass information is dependent on system -2 (BOTH ON -2 position), an OFF flag in the first officer's compass indicator indicates unreliable compass out-puts to all systems using heading information.



Compass System Functional Diagram
Figure 1/34-21-00-990-846 (Sheet 1 of 2)



Compass System Functional Diagram
Figure 1/34-21-00-990-846 (Sheet 2 of 2)

HEADING SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The compass system is comprised of two gyro-stabilized systems with remote magnetic sensing. Each system includes a directional gyro, flux valve, and compass indicator. Slaving and amplifier circuits, together with certain logic and monitor functions, are provided by the compass rack.

(2) The captain's and first officer's compass indicators read out the heading sensed by the opposite system. D/G 2 inputs supply the captain's compass indicator and D/G 1 supplies the first officer's compass indicator.

B. Components

(1) The directional gyro consists of a gyroscope assembly, hermetically sealed in a metal case, which is mounted on a base assembly by means of four vibration isolators. The base assembly houses the major electronic circuits. The gyro motor assembly is surrounded by two gimbals that allow the gyro rotor to maintain its orientation in space despite any movement of the aircraft (gyro case) about its yaw axis, and up to 85 degrees about the roll axis.

(2) The flux valve is a magnetic detector that transmits magnetic heading information as electrical energy. A pendulous sensing element is mounted in a damping fluid with 30 degrees freedom in roll and pitch. No rotation is allowed about the vertical axis, thus maintaining alignment with the fore and aft axis of the aircraft.

(3) The compass indicator is a panel-mounted instrument that combines compass heading with dual radio navigational pointers. Compass information is displayed by a rotating compass card read against a fixed index (lubber line) at the top of the indicator. The dual pointers display VOR or ADF indication as read against the compass card. Selection of ADF or VOR is made by placing the switches on the indicator in position required. Each indicator includes an OFF warning flag as well as system synchronization annunciation and control. Three output synchros provide heading signals to the VOR/ILS receivers, digital flight guidance computers (DFGC), flight guidance control panels (FGCP), VHF/NAV panels and flight recorder. On aircraft equipped with the Electronic Flight Instrument System (EFIS), the compass indicator provides heading information to the EFIS symbol generators.

(4) A standby magnetic compass is located in the flight compartment overhead ceiling above the First Officer. The compass face is mounted aft. The compass display is reflected into an adjustable mirror just aft of the compass. This in turn is reflected into a captains and a first officers mirror located on the instrument panels glare shield.

2. Operation

A. The directional gyro spin axis is maintained and stabilized by means of leveling circuits. The gyro rotor tends to remain fixed in direction (azimuth), and the gyro case (aircraft) rotates about it as heading is changed. This relative rotation is sensed by two synchros that communicate this azimuth angle information to the compass system.

B. Sensed magnetic heading is supplied by the flux valve, which takes the lines of flux of the earth's magnetic field and converts them into an electrical output. This output is used in a servoloop to generate an error signal whenever the position of the azimuth gimbal of the directional gyro does not agree with the airplane magnetic heading, as sensed by the flux valve. The error signal is amplified and applied to a torque motor which causes the azimuth gimbal to turn to the sensed magnetic heading.

C. The compass indicator is the primary readout for magnetic heading. Any slaving of the directional gyro azimuth gimbal is displayed by means of a synchronization annunciator pointer on the compass indicator. The amount and direction of the error is indicated by the position of the pointer between the cross and dot symbols. Normal slaving rate is only 1 or 2 degrees per minute. For fast slaving to the proper heading, a synchronization knob, located on the compass indicator, can be turned in the direction of the symbol indicated by the annunciator pointer. When rotating the sync knob rapidly, the compass rose on the EFIS Navigation Display may blank momentarily.

D. The captain's compass indicator provides heading output signals to the first officer's HSI (or EFIS symbol generator -2) as well as the VHF/NAV -1 system. The first officer's compass indicator provides heading output signals to the captain's HSI (or EFIS symbol generator -1), and the VHF/NAV -2 system. On aircraft equipped with EFIS, the HSI's are replaced by the EFIS Navigation Displays (ND). The EFIS Mode Select Panel (MSP) is used in selecting a compass rose or arc heading format.

E. Each compass indicator contains two pointers, superimposed over the compass card for relative, radio bearings for VOR or ADF as selected.

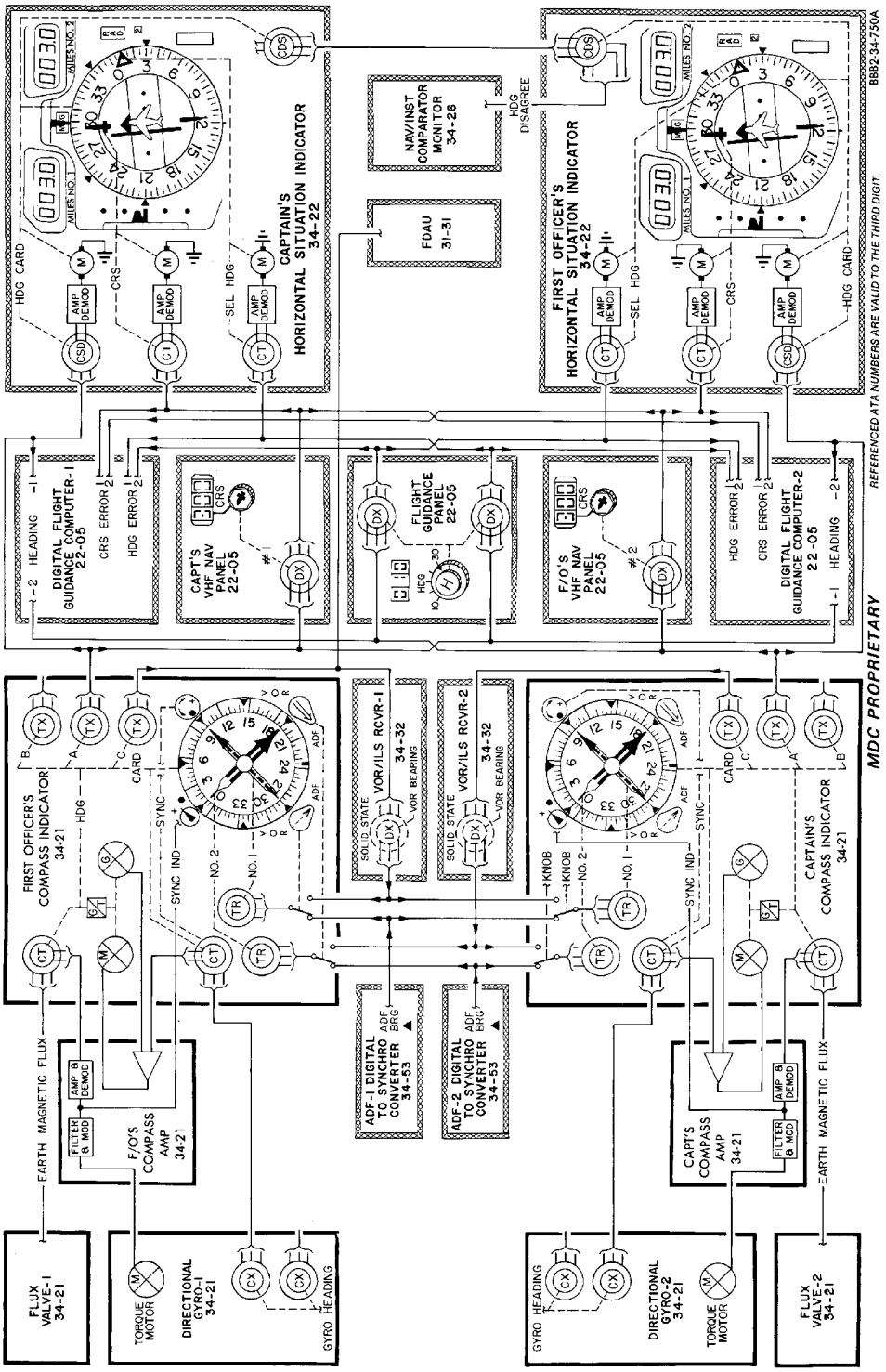
F. The Captain's and First Officer's Navigation Display HDG FAIL messages and the compass indicator OFF flags should come into view if any of the following functions are not operating correctly:

(1) Power to the Compass System.

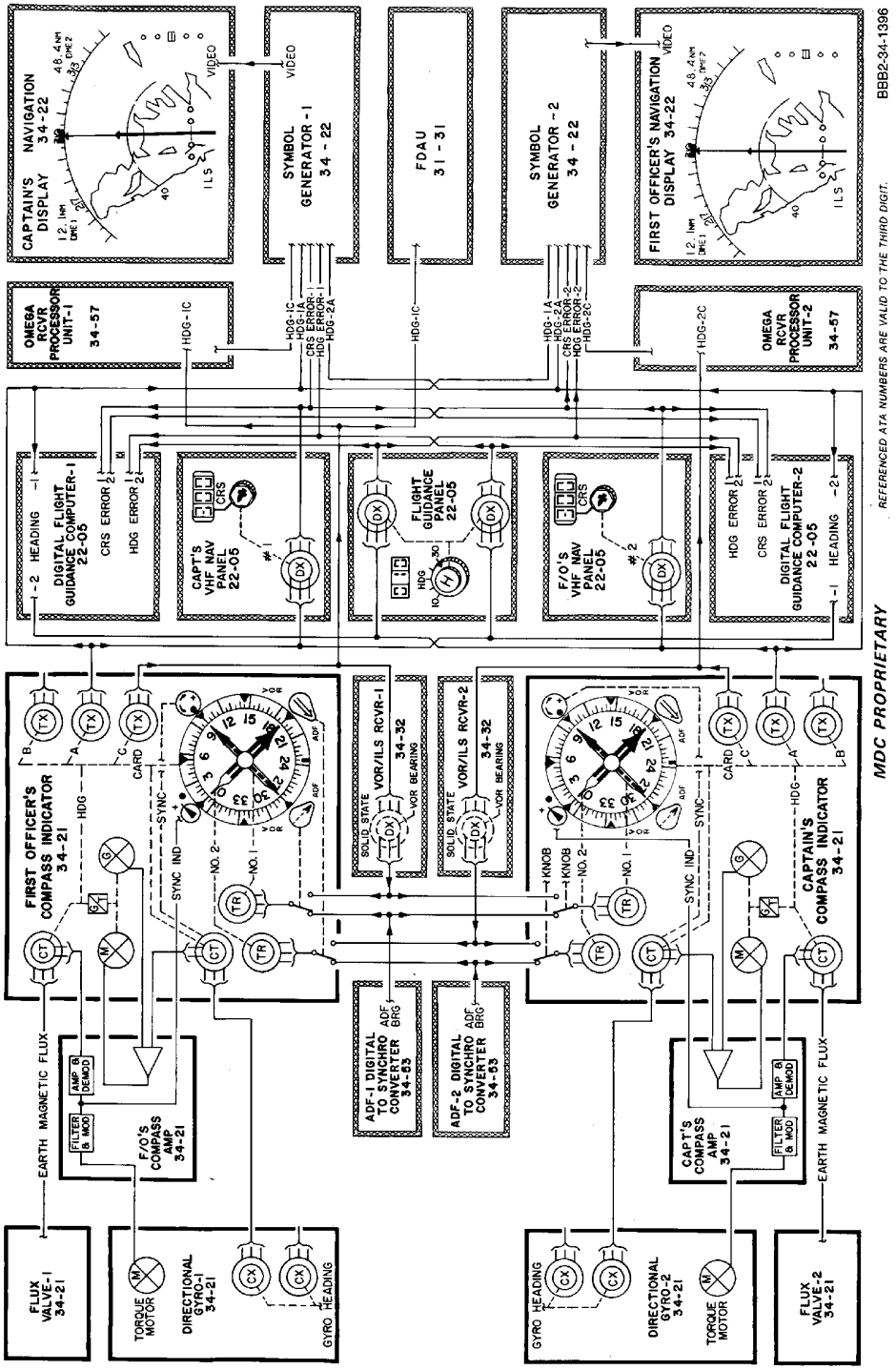
(2) Directional gyro not level.

(3) Directional gyro not operating at sufficient speed.

(4) Excessive error signal in the Heading Servo loops.



Compass System Functional Diagram
Figure 1/34-21-00-990-845 (Sheet 1 of 2)



Compass System Functional Diagram
Figure 1/34-21-00-990-845 (Sheet 2 of 2)

COMPASS SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty compass system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the compass system operation are: directional gyros, flux valves, compass indicators, Horizontal Situation indicators (on non-EFIS aircraft) and Navigation Displays (on aircraft with EFIS). On aircraft with EFIS, the compass system interfaces with the EFIS symbol generators. In trouble shooting, some checks to the EFIS may have to be made. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

E. The compass system components are located as follows:

Table 101

Component	Location
Compass Indicators	Captain's and First Officer's Instrument Panels
Horizontal Situation Indicators (on aircraft without EFIS)	Captain's and First Officer's Instrument Panels
EFIS Navigation Displays (on aircraft with EFIS)	Captain's and First Officer's Instrument Panels
Integrated Instrument Amplifier	Electrical/Electronics Compartment
Flux Valves (earlier aircraft)	Left and Right Wingtips
Flux Valves (later aircraft)	Left and Right Wing (outboard trailing edge)
Directional Gyros-1 and -2	Forward Accessory Compartment
Compass Switching Unit (if installed)	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Compass System

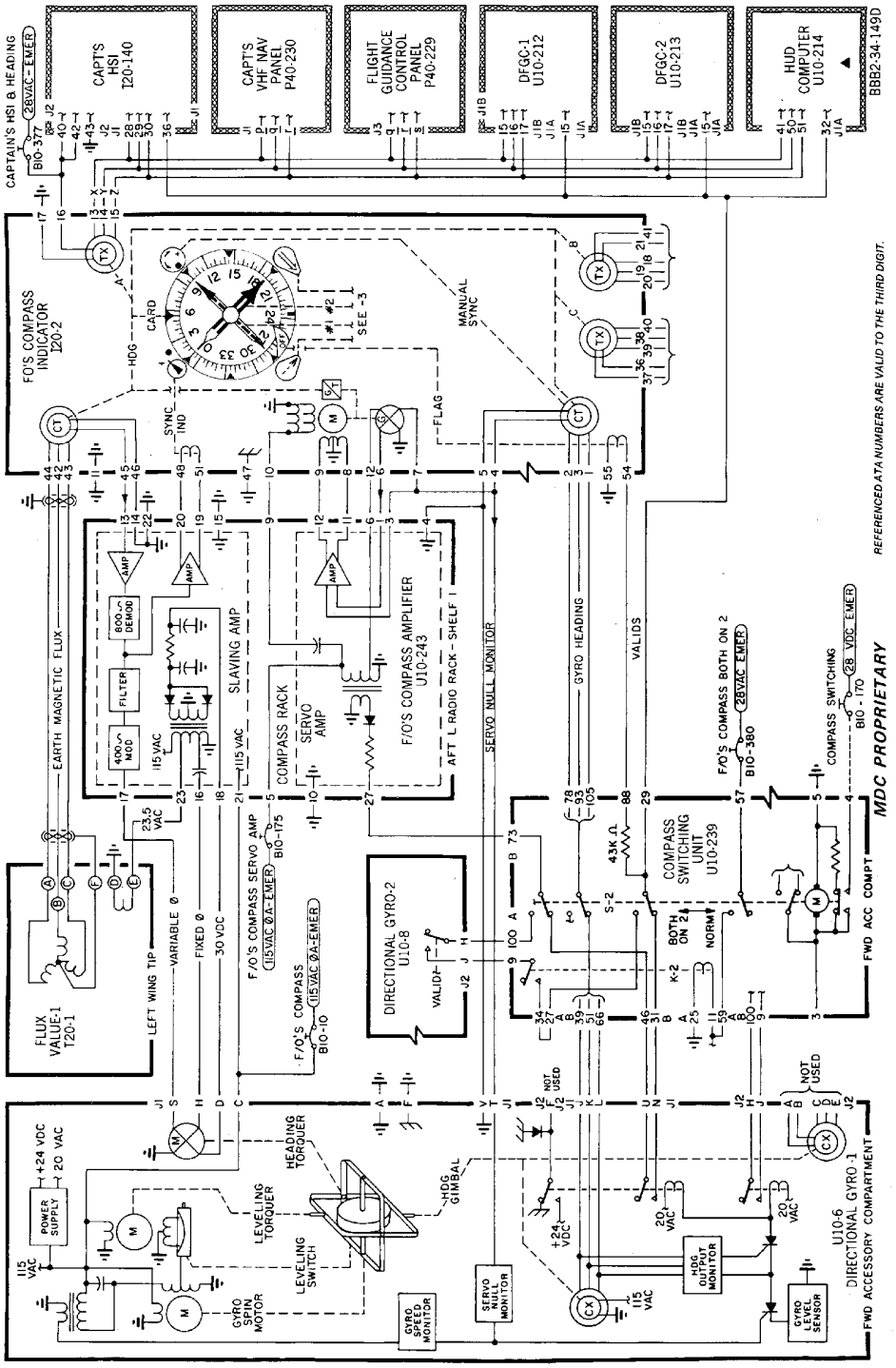
A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are directional gyros, flux valves, compass indicators, and Horizontal Situation Indicators (EFIS Navigation Displays).

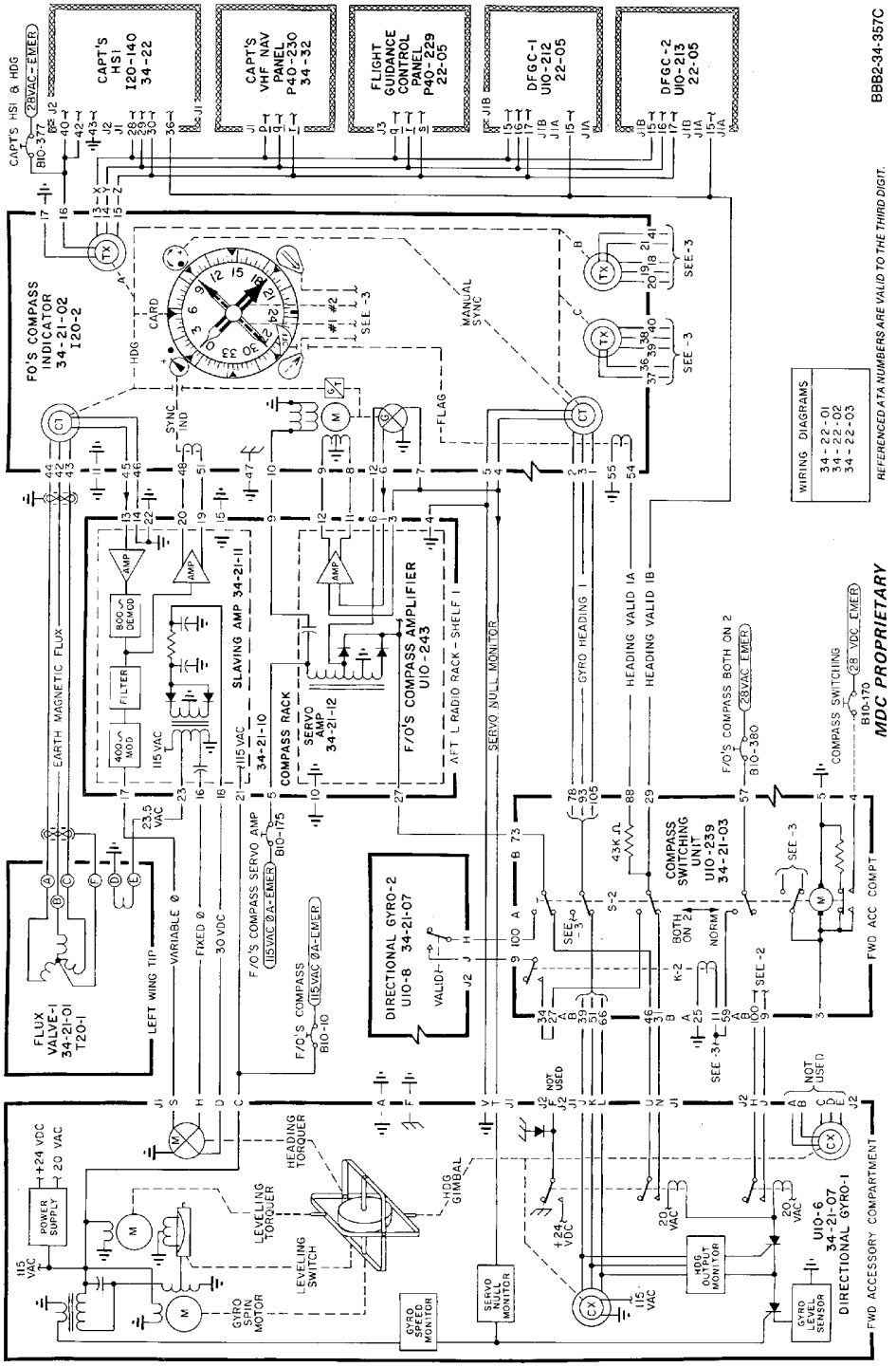
NOTE: On some aircraft, integrated instrument amplifier is an LRU.

Table 103

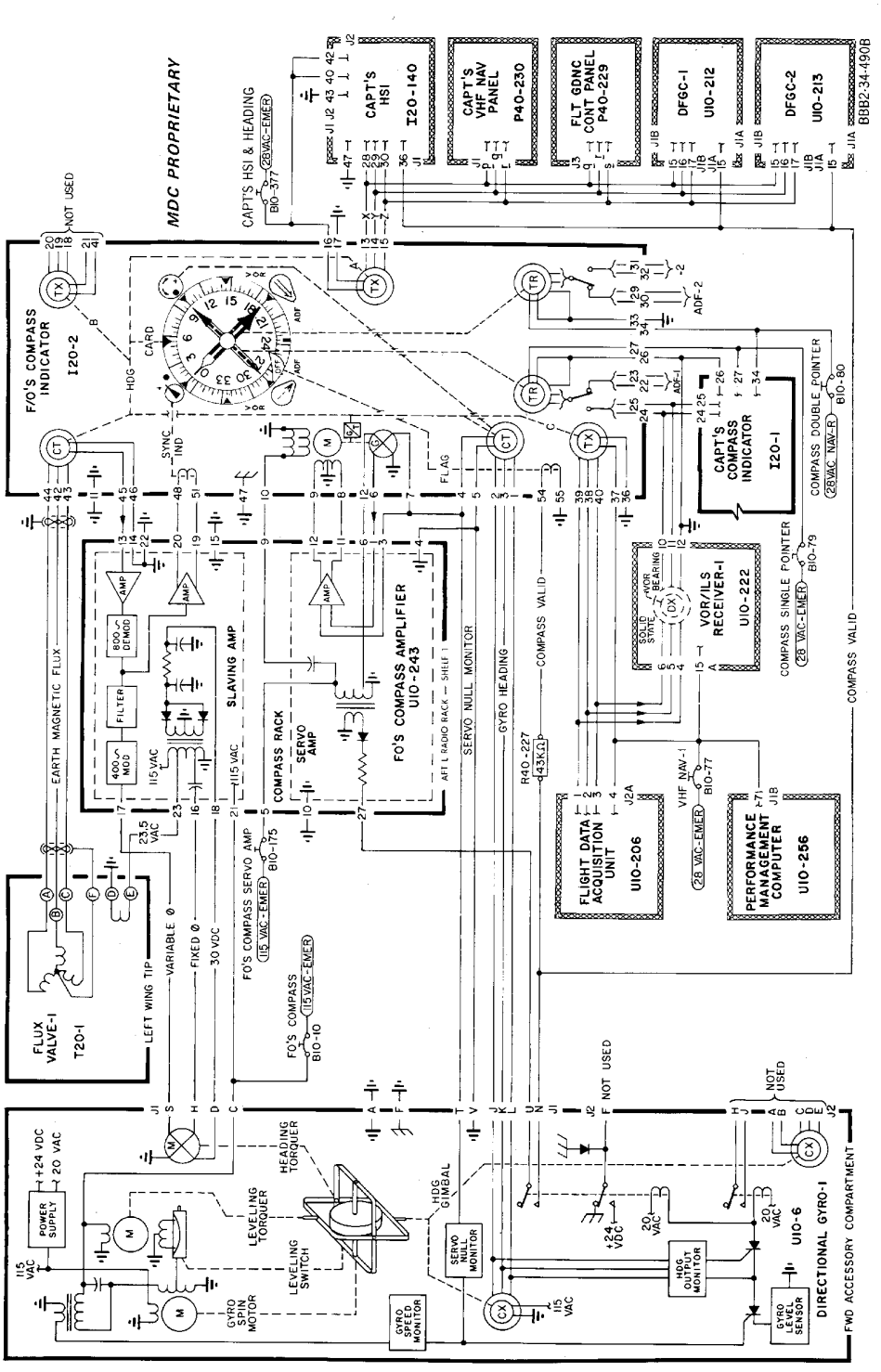
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Use compass switching to dectect faulty compass indicator or directional Gyro.	Replace as necessary.
(7)	Perform Return to Service (RTS) Test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201)	



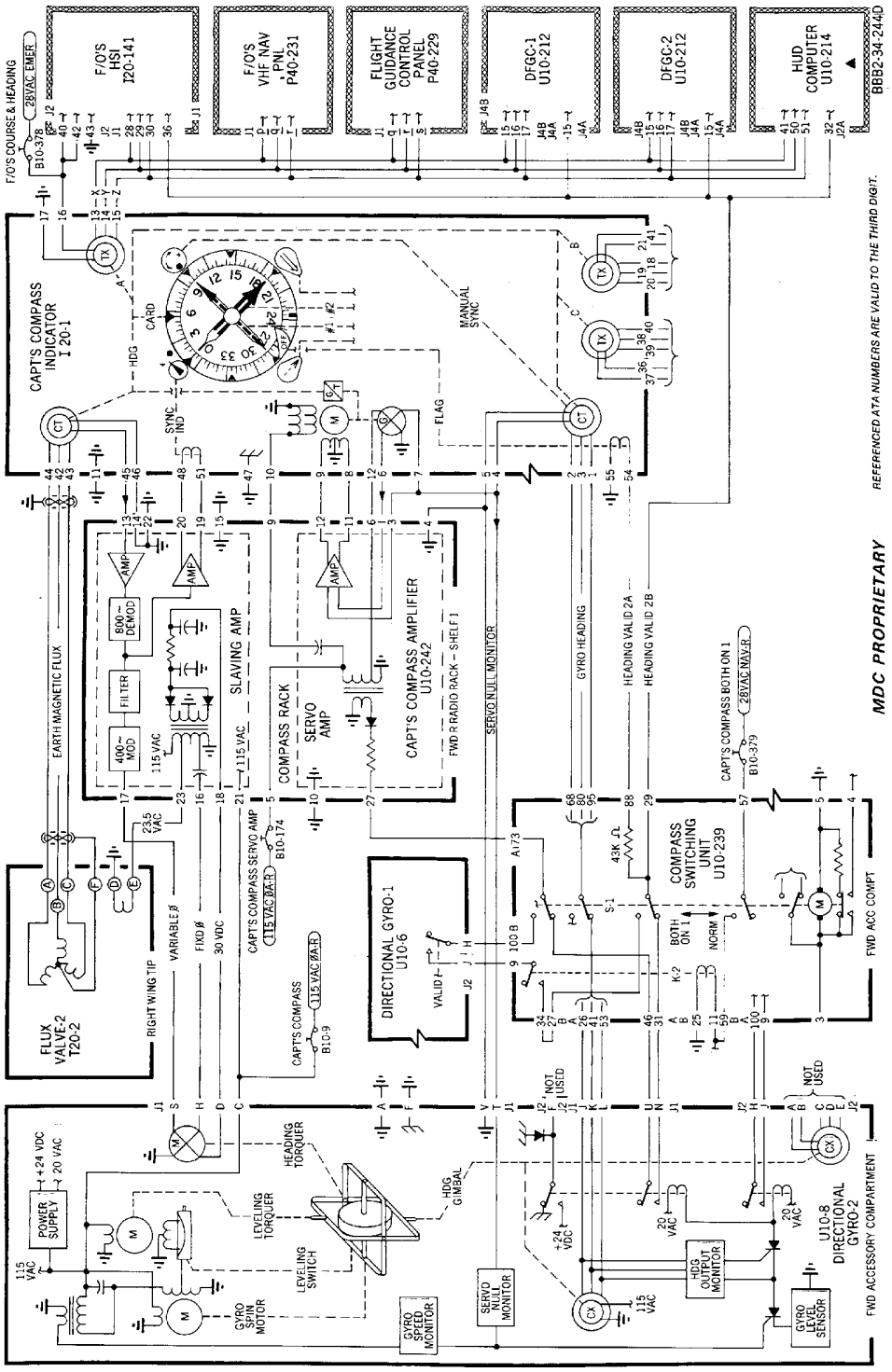
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-804 (Sheet 1 of 3)



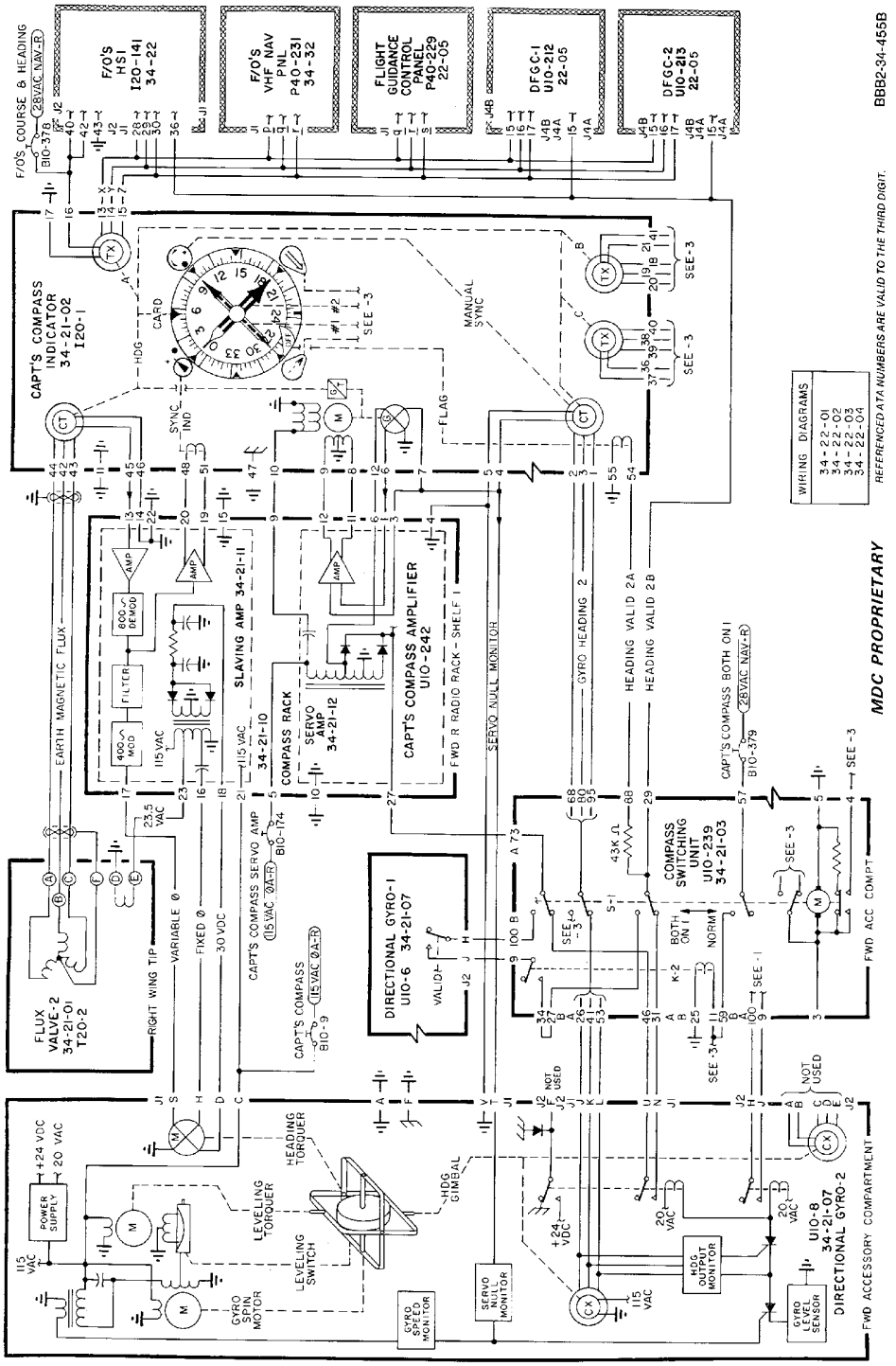
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-804 (Sheet 2 of 3)



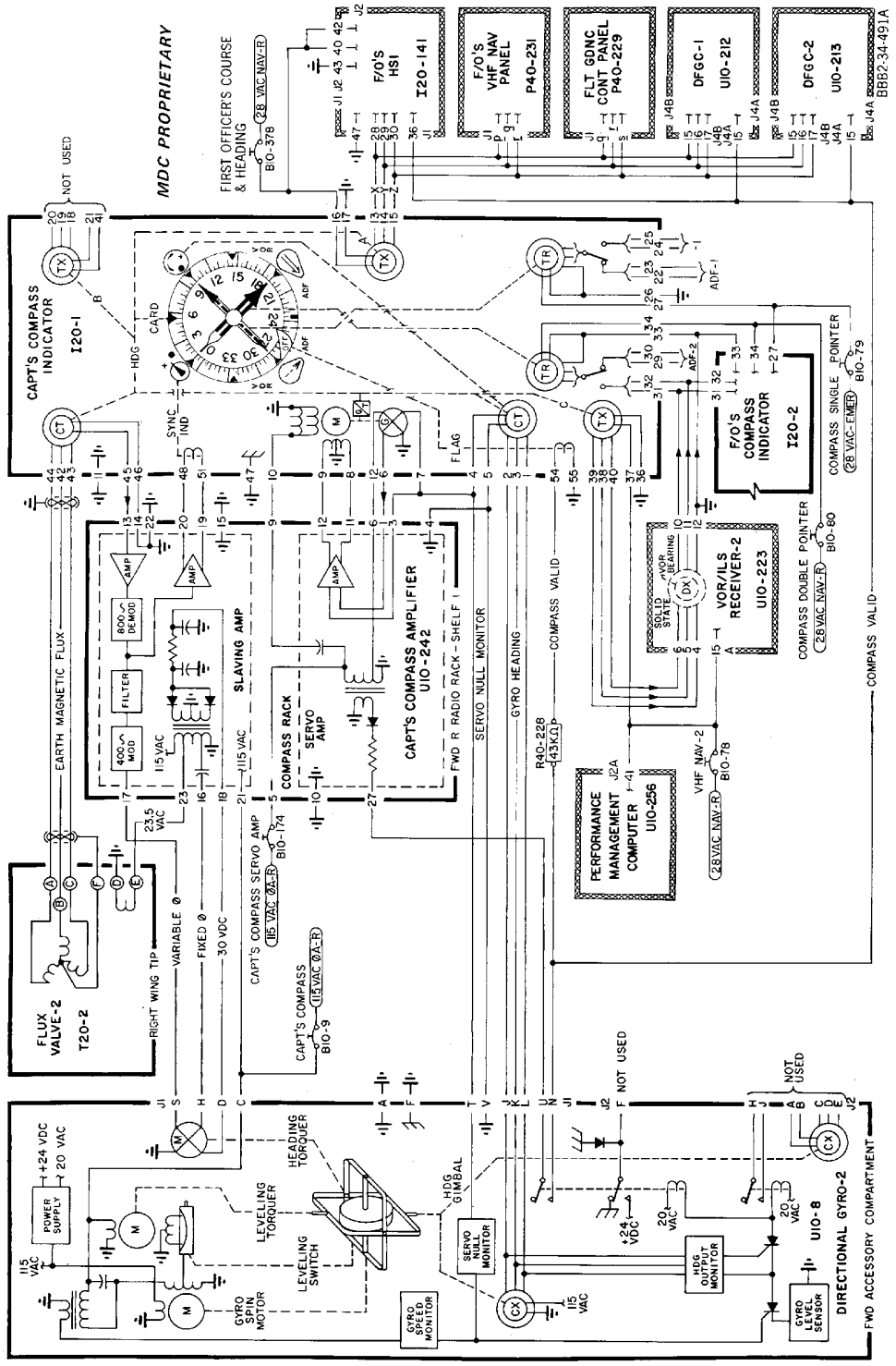
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-804 (Sheet 3 of 3)



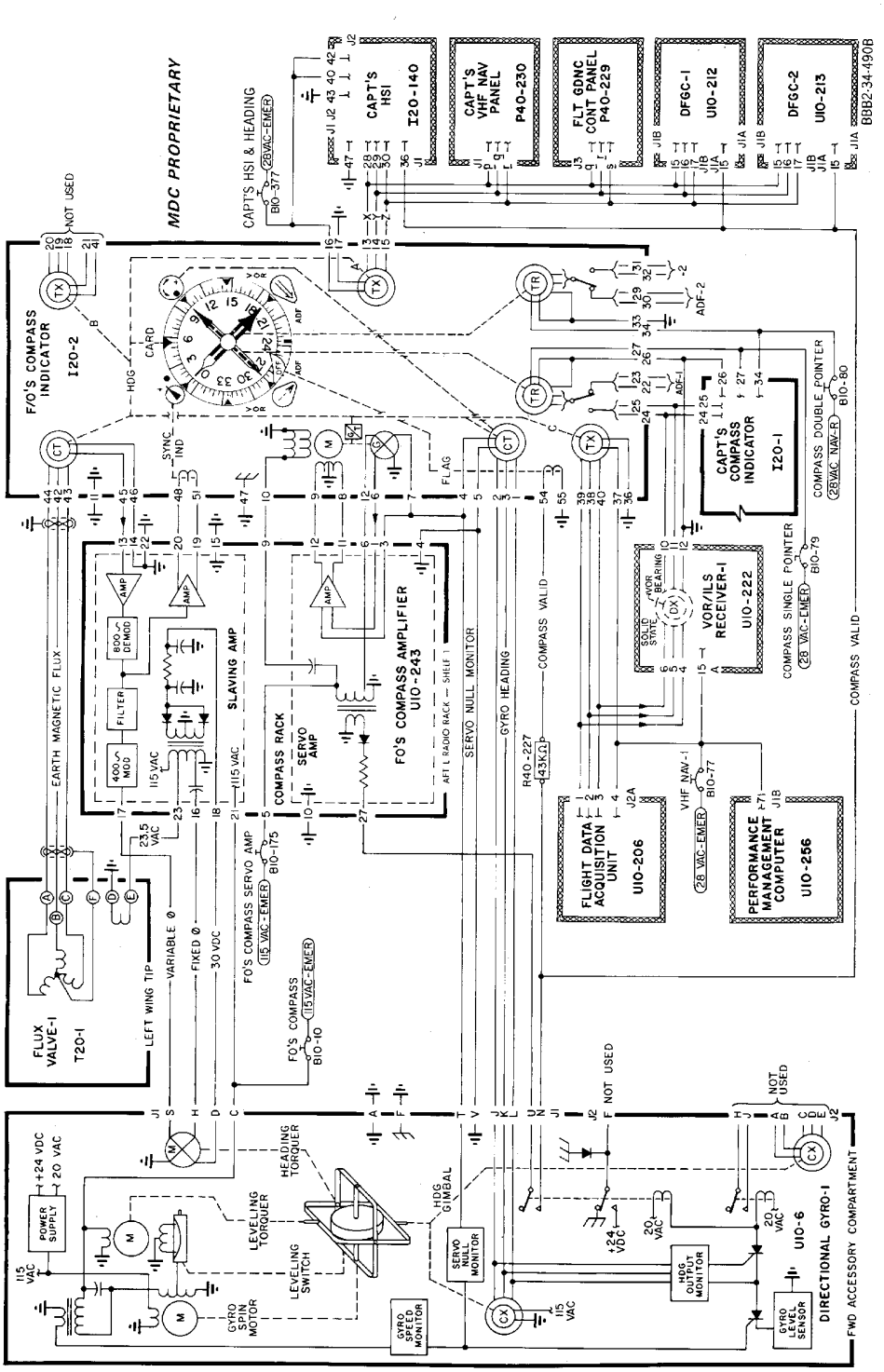
Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-805 (Sheet 1 of 4)



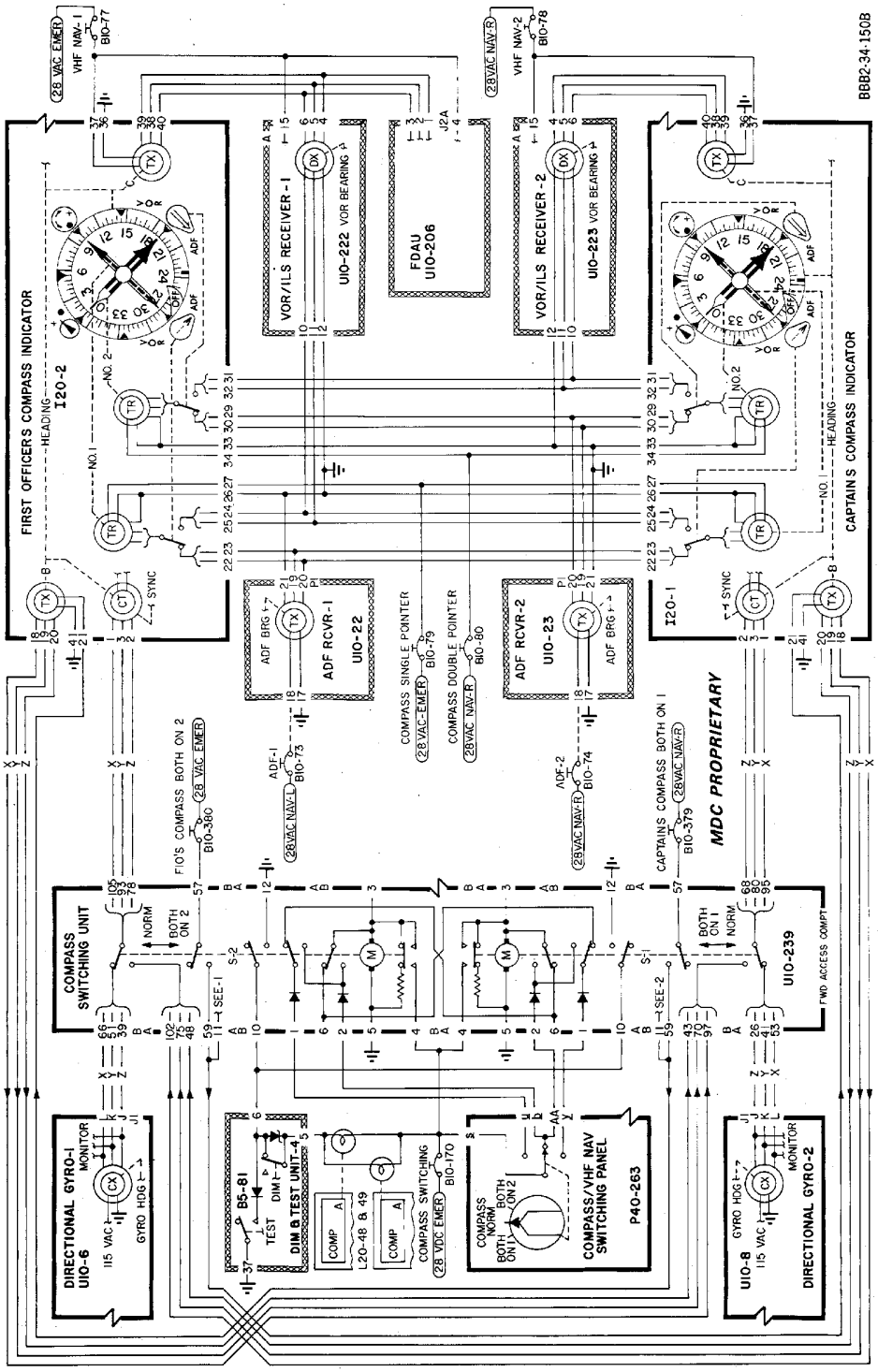
Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-805 (Sheet 2 of 4)



Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-805 (Sheet 3 of 4)



Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-805 (Sheet 4 of 4)



Compass Switching and Pointers
Figure 103/34-21-00-990-806

COMPASS SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty compass system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891

D. The basic components of the compass system operation are: directional gyros, flux valves, compass indicators, Horizontal Situation indicators (on non-EFIS aircraft) and Navigation Displays (on aircraft with EFIS). On aircraft with EFIS, the compass system interfaces with the EFIS symbol generators. In trouble shooting, some checks to the EFIS may have to be made. (PAGEBLOCK 34-22-00/201 Config 1, Page 201)

WJE 873, 874, 892, 893

E. The basic components of the compass system operation are: directional gyros, flux valves, compass indicators, and Horizontal Situation indicators.

WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 891-893

F. The compass system components are located as follows:

Table 101

Component	Location
Compass Indicators	Captain's and First Officer's Instrument Panels
WJE 873, 874, 892, 893	
Horizontal Situation Indicators	Captain's and First Officer's Instrument Panels
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891	
Horizontal Situation Indicators (on Non-EFIS Aircraft)	Captain's and First Officer's Instrument Panels
EFIS Navigation Displays (on aircraft with EFIS)	Captain's and First Officer's Instrument Panels
WJE 873, 874, 892, 893	
Flux Valves	Left and Right Wing (outboard trailing edge)
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891	
Flux Valves (earlier aircraft)	Left and Right Wingtips
Flux Valves (later aircraft)	Left and Right Wing (outboard trailing edge)
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 891-893	
Directional Gyros-1 and -2	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
WJE 873, 874, 892, 893	
Multimeter 2000A	Dana
Multimeter 8025A	Fluke
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891	
Multimeter 8025A	Fluke
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 891-893	

3. Trouble Shooting Compass System

A. Trouble Shoot

WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are directional gyros, flux valves, compass indicators, and Horizontal Situation Indicators (EFIS Navigation Displays).

WJE 873, 874, 892, 893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are directional gyros, flux valves, compass indicators, and Horizontal Situation Indicator.

WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 891-893

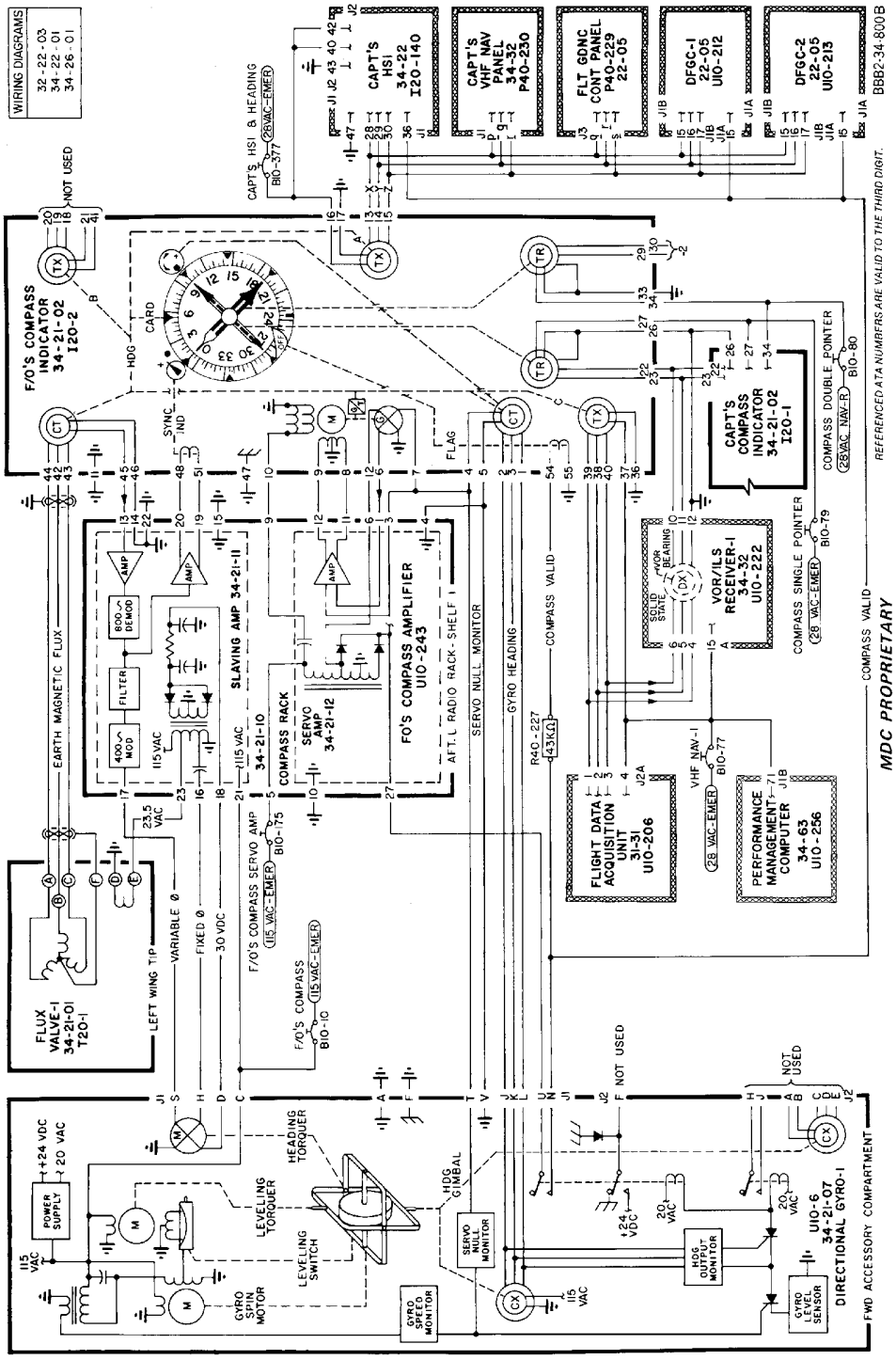
Table 103

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known	Replace faulty LRUs or components. operational unit.
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891		
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201) or (non EFIS aircraft only).	
WJE 873, 874, 892, 893		
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201)	

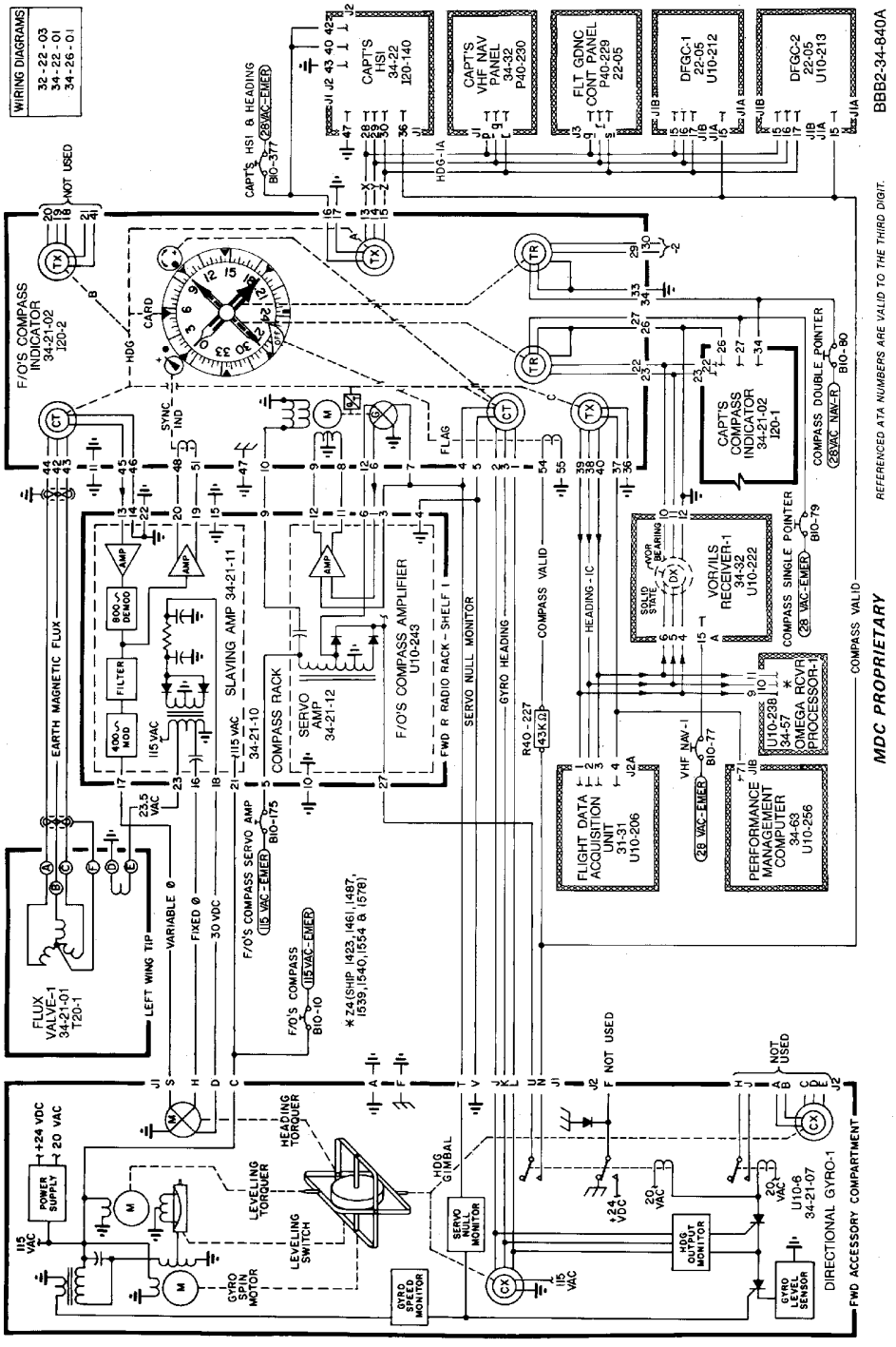
WJE 873, 874, 892, 893 (Continued)

Table 103 (Continued)

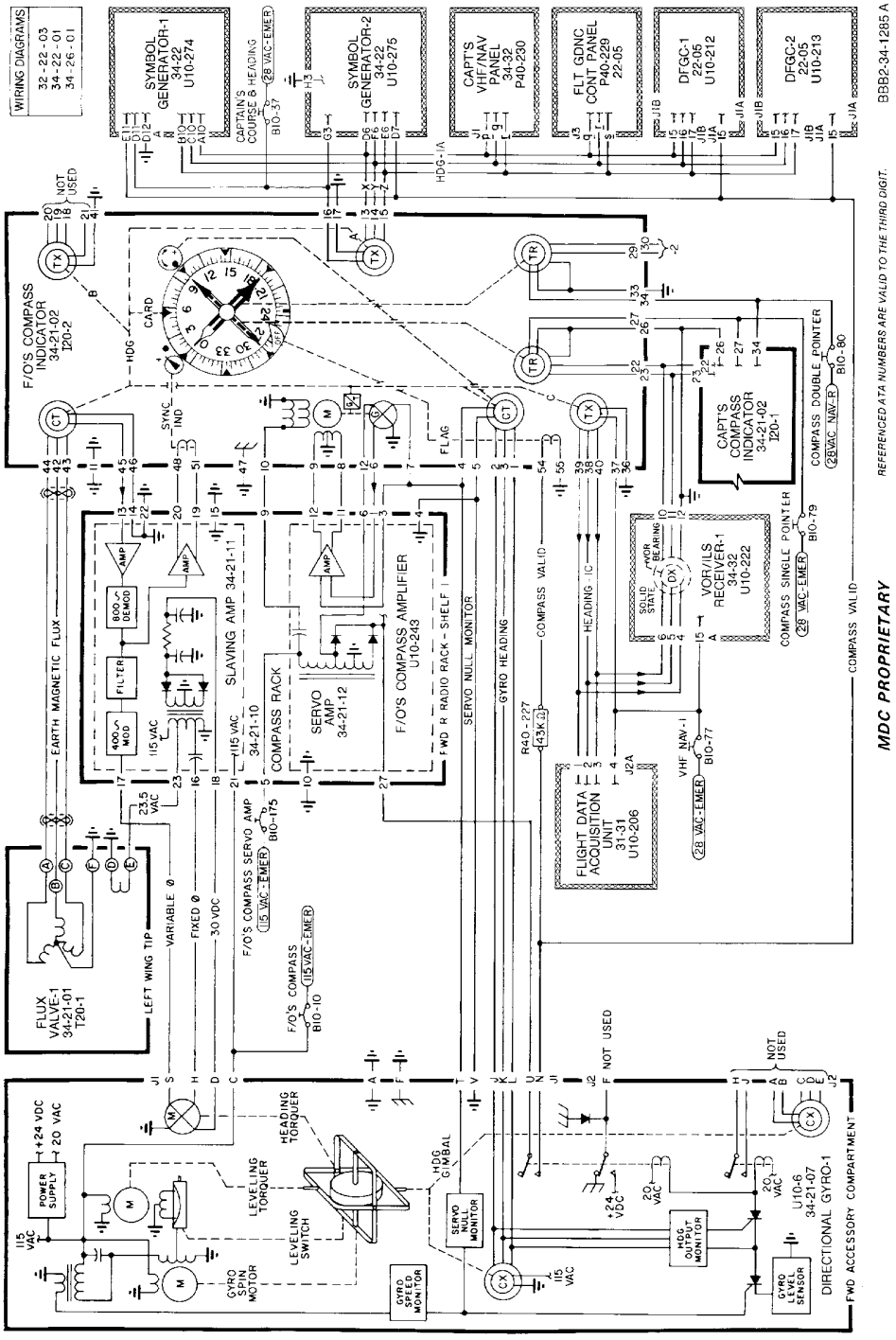
Step	Procedure	Correction
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 891-893		



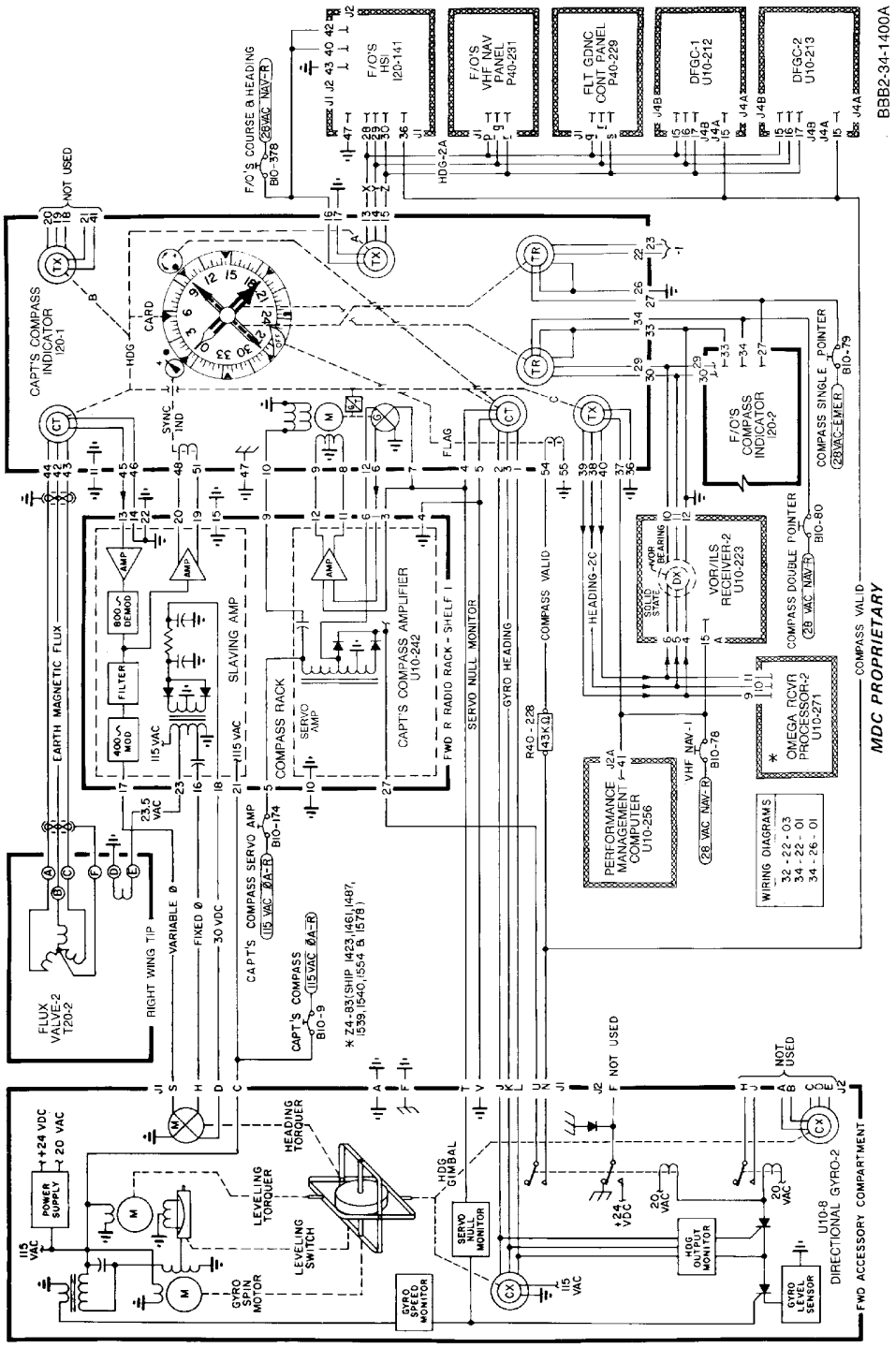
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-807 (Sheet 1 of 3)



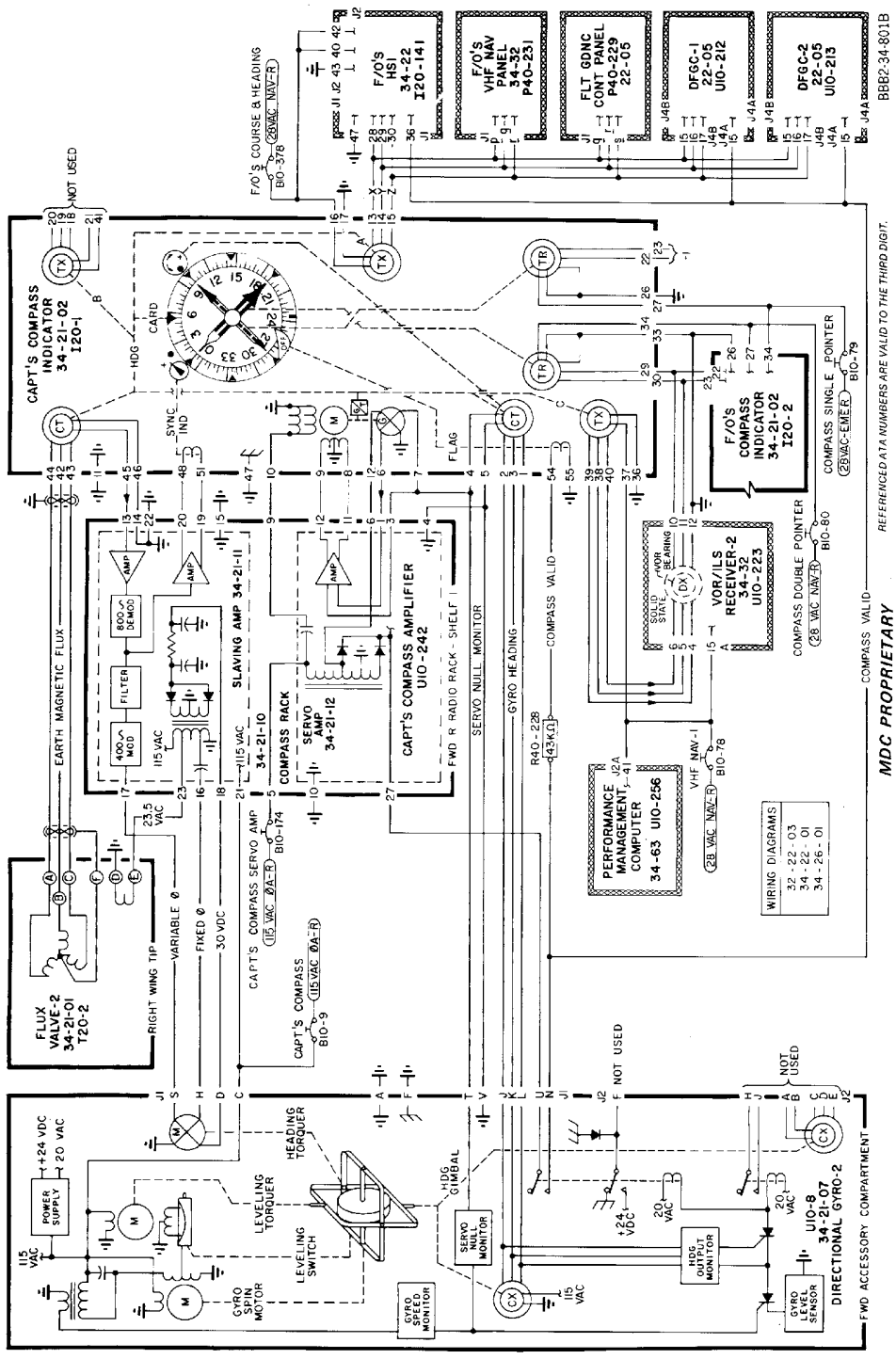
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-807 (Sheet 2 of 3)



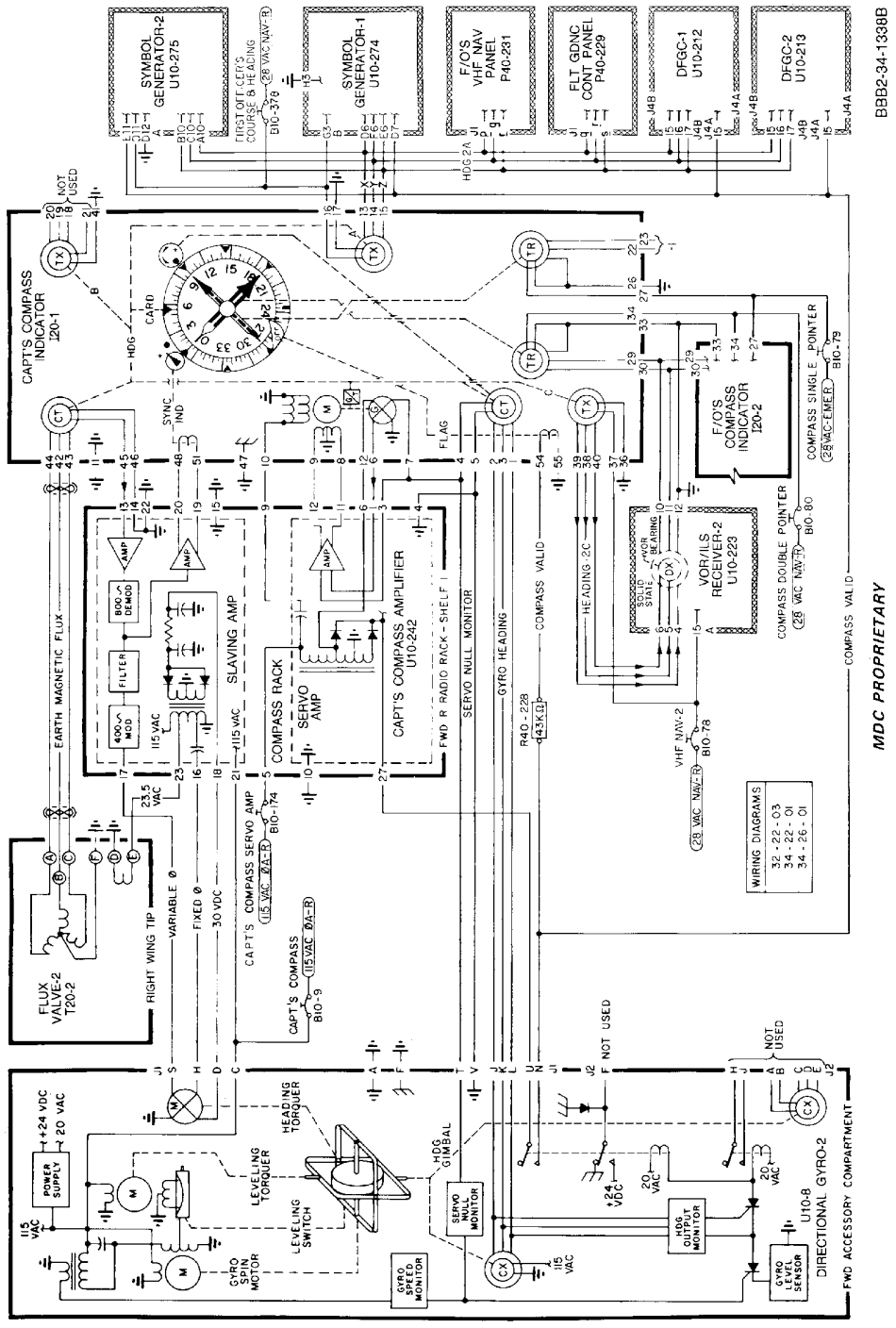
Gyro Compass System-1 -- Schematic
Figure 101/34-21-00-990-807 (Sheet 3 of 3)



Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-808 (Sheet 1 of 3)



Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-808 (Sheet 2 of 3)



Gyro Compass System-2 -- Schematic
Figure 102/34-21-00-990-808 (Sheet 3 of 3)

HEADING SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section contains basic procedures for isolating and correcting a faulty compass system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 886, 887

D. The basic components of the Heading system operation are:

attitude/heading reference units (AHRU), flux valves, and radio distance magnetic indicators. The EFIS Navigation displays are listed for reference.

WJE 407, 408, 411

E. The basic components of the Heading system operation are:

attitude/heading reference units (AHRU), flux valves, and radio distance magnetic indicators. The EFIS Navigation displays are listed for reference.

The EFIS Navigation Displays are listed for reference.

WJE 406

F. The basic components of the Heading system operation are:

attitude/heading reference units (AHRU), attitude/heading switching units, flux valves, radio magnetic indicators, and compass controller units. The EFIS Navigation displays are listed for reference.

WJE 406-408, 411, 886, 887

G. The Heading system components are located as follows:

WJE 406

Table 101

Component	Location
Radio Magnetic Indicators	Captain's and First Officer's Instrument Panels
EFIS Navigation Display (ND) Indicators	Captain's and First Officer's Instrument Panels
Flux Valves	Two on Left Wing and One on Right Wing (outboard trailing edge)
Attitude/Heading Reference Units -1, -2, and -3	Forward Accessory Compartment
Attitude/Heading Switching Unit	Electrical/Electronics Compartment
Compass Controller Units	Aft Pedestal

WJE 886, 887

Table 102

Component	Location
Radio Distance Magnetic Indicators	Captain's and First Officer's Instrument Panels

WJE 886, 887 (Continued)

Table 102 (Continued)

Component	Location
EFIS Navigation Display (ND) Indicators	Captain's and First Officer's Instrument Panels
Flux Valves	Left and Right Wing (outboard trailing edge)
Attitude/Heading Reference Units -1 and -2	Forward Accessory Compartment

WJE 407, 408, 411

Table 103

Component	Location
Compass Indicators	Captain's and First Officer's Instrument Panels
EFIS Navigation Display (ND)	Captain's and First Officer's Instrument Panels
Flux Valves	Left and Right Wing (outboard trailing edge)
Attitude/Heading Reference Units -1 and -2	Forward Accessory Compartment
Compass Controller Units (if installed)	Aft Pedestal

WJE 406-408, 411, 886, 887

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 104

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Compass System

WJE 886, 887

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units (AHRU), flux valves, radio distance magnetic indicators, and EFIS Navigation displays (ND).

Table 105

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

WJE 886, 887 (Continued)

Table 105 (Continued)

Step	Procedure	Correction
CAUTION: DO NOT APPLY DC VOLTAGES FROM MULTIMETER ACROSS FLUX VALVE. MAGNETIZATION OF ANY SOFT IRON MATERIAL INSTALLED IN VICINITY OF FLUX VALVE WILL AFFECT DIRECTION SENSING.		
(4)	Verify that Captain's EFIS Navigation Display (ND) and First Officer's RMI read same value within ±2 degrees.	Replace faulty LRU.
(5)	Verify that First Officer's EFIS Navigation Display (ND) and Captain's RMI read same value within ±2 degrees.	Replace faulty LRU.
(6)	In a triple system installation, switch AHRU-3 in place of suspected faulty AHRU to isolate faulty AHRU.	Replace faulty LRU.
(7)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(8)	Use compass switching to detect faulty compass or course indicator, or directional Gyro.	Replace as necessary.
(9)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(10)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	

(1) If the test in the above table does not identify the source of the malfunction, perform the tests that follows:

(a) Test the heading Paragraph 3..

(b) Do the Attitude and Heading Reference System (AHRS) operational test. (HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 8).

(c) Do the Compass Controller Unit Operational Test. (HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 8 and AHRS COMPASS CONTROLLER UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-13/201 Config 1)

(d) For continued heading errors, check for magnetized areas and perform the demagnetizing procedures. (HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 8)

(e) Check flux valve operation. (FLUX VALVE - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-06/201 Config 2)

WJE 407, 408, 411

B. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units (AHRU), attitude/heading switching unit, flux valves, radio magnetic indicators, and EFIS Navigation Display.

WJE 407, 408, 411 (Continued)

Table 106

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
CAUTION: DO NOT APPLY DC VOLTAGES FROM MULTIMETER ACROSS FLUX VALVE. MAGNETIZATION OF ANY SOFT IRON MATERIAL INSTALLED IN VICINITY OF FLUX VALVE WILL AFFECT DIRECTION SENSING.		
(4)	Verify that Captain's EFIS Navigation Display (ND) and First Officer's RMI read same value within ±2 degrees.	Replace faulty LRU.
(5)	Verify that First Officer's EFIS Navigation Display (ND) and Captain's RMI read same value within ±2 degrees.	Replace faulty LRU.
(6)	In a triple system installation, switch AHRU-3 in place of suspected faulty AHRU to isolate faulty AHRU.	Replace faulty LRU.
(7)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(8)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(9)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	

WJE 406

C. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units (AHRU), attitude/heading switching unit, flux valves, radio magnetic indicators, compass controller units, and EFIS Navigation Display.

Table 107

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.

WJE 406 (Continued)

Table 107 (Continued)

Step	Procedure	Correction
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
CAUTION: DO NOT APPLY DC VOLTAGES FROM MULTIMETER ACROSS FLUX VALVE. MAGNETIZATION OF ANY SOFT IRON MATERIAL INSTALLED IN VICINITY OF FLUX VALVE WILL AFFECT DIRECTION SENSING.		
(4)	Verify that Captain's EFIS Navigation Display (ND) and First Officer's RMI read same value within ±2 degrees.	Replace faulty LRU.
(5)	Verify that First Officer's EFIS Navigation Display (ND) and Captain's RMI read same value within ±2 degrees.	Replace faulty LRU.
(6)	In a triple system installation, switch AHRU-3 in place of suspected faulty AHRU to isolate faulty AHRU.	Replace faulty LRU.
(7)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(8)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(9)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	

WJE 406-408, 411, 886, 887

D. Trouble Shoot

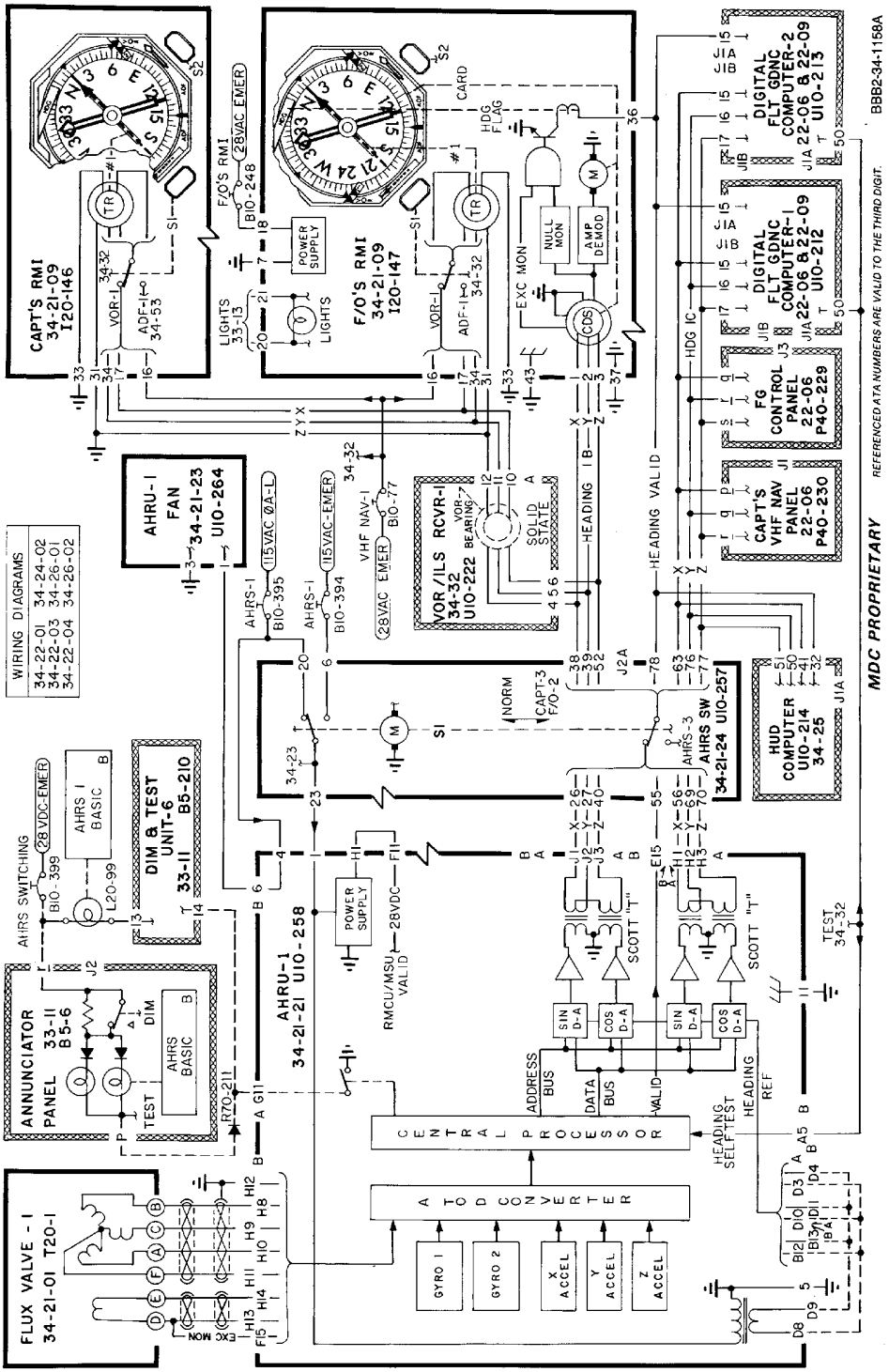
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units (AHRU), compass controller units, flux valves, radio magnetic indicators (RMI), and EFIS Navigation Display.

Table 108

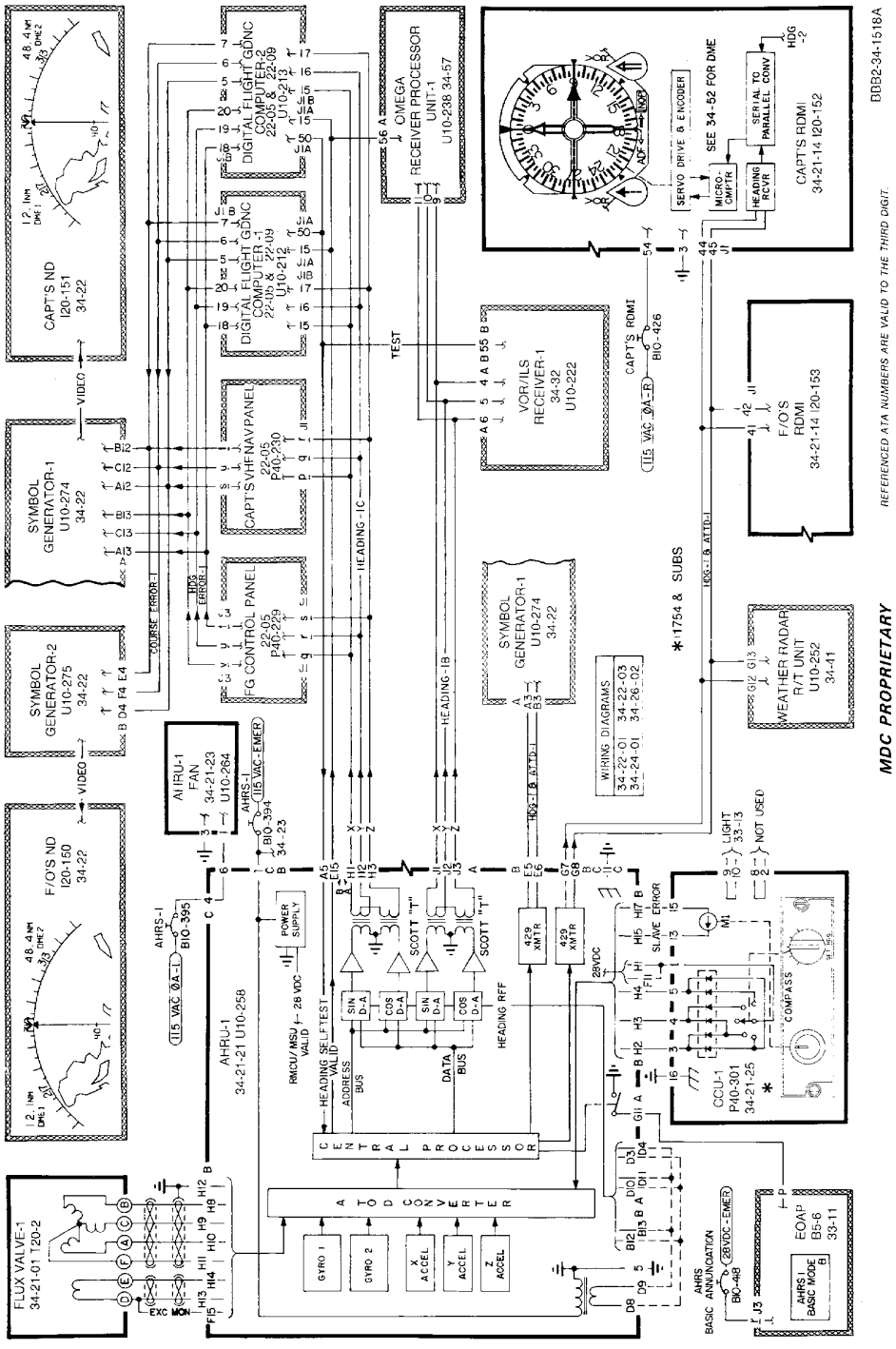
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 108 (Continued)

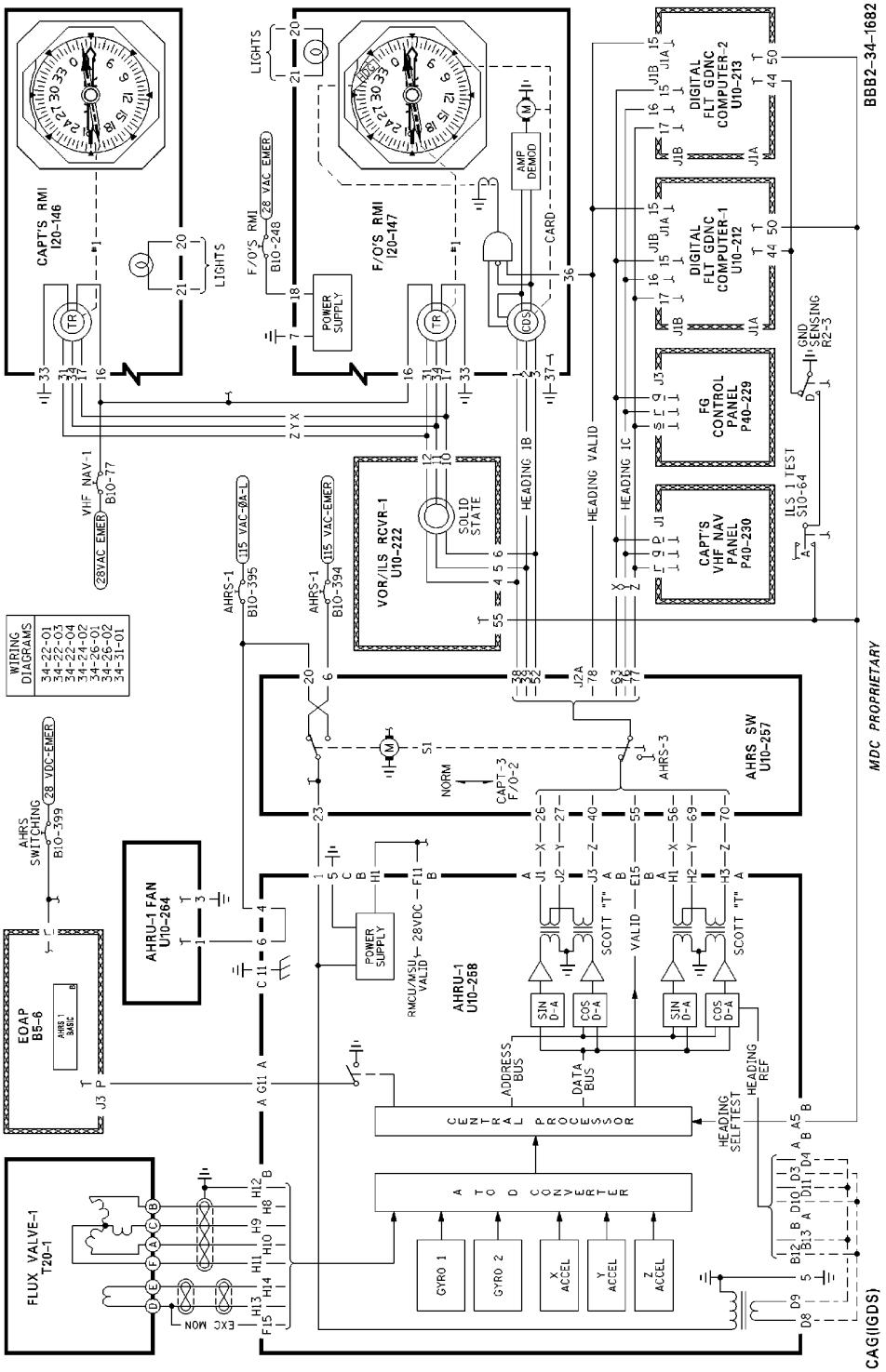
Step	Procedure	Correction
CAUTION: DO NOT APPLY DC VOLTAGES FROM MULTIMETER ACROSS FLUX VALVE. MAGNETIZATION OF ANY SOFT IRON MATERIAL INSTALLED IN VICINITY OF FLUX VALVE WILL AFFECT DIRECTION SENSING.		
(4)	Verify that Captain's EFIS Navigation Display (ND) and First Officer's RMI read same value within ±2 degrees.	Replace faulty LRU.
(5)	Verify that First Officer's EFIS Navigation Display (ND) and Captain's RMI read same value within ±2 degrees.	Replace faulty LRU.
(6)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(7)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(8)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	



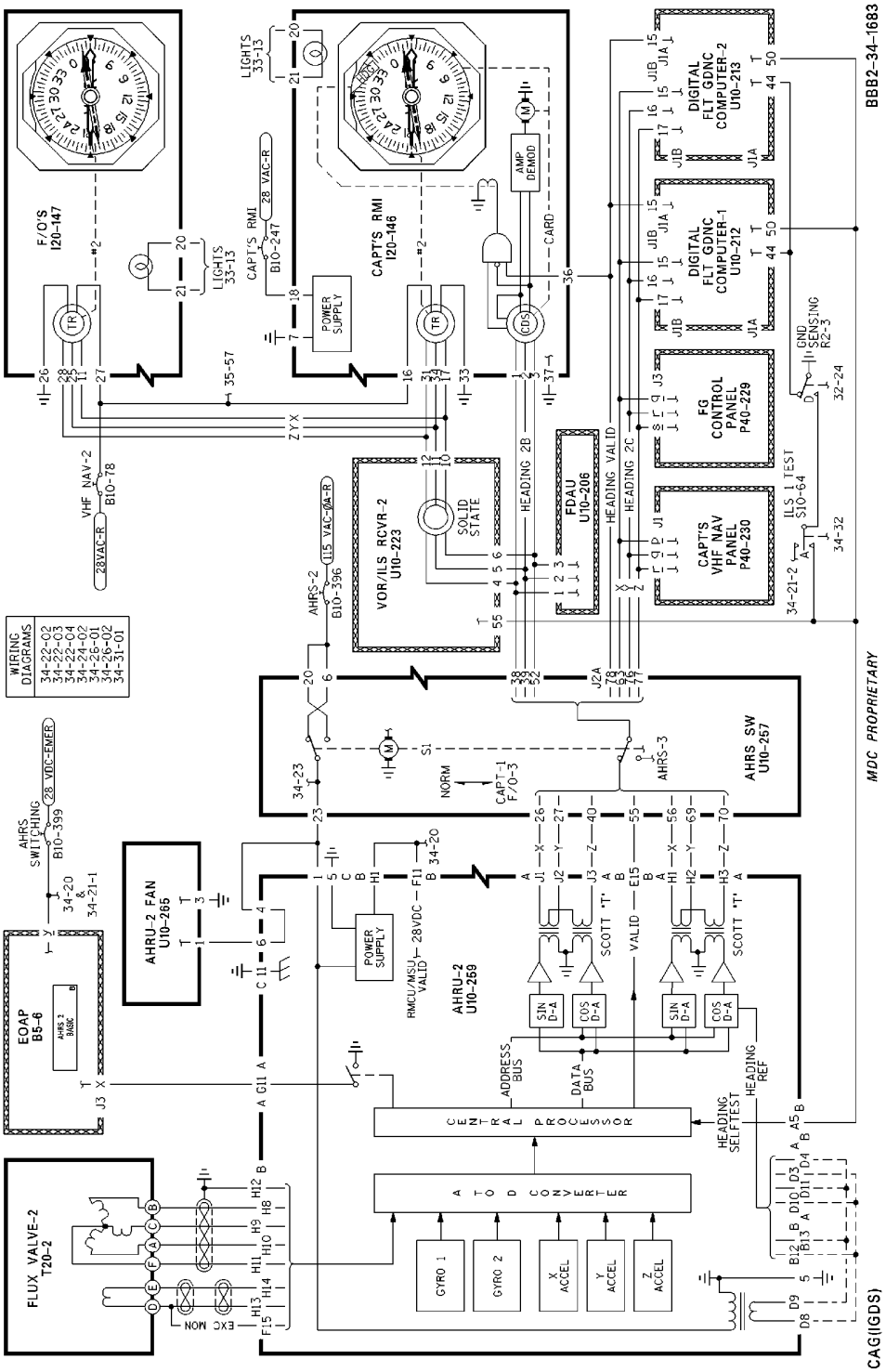
Heading System -1 -- Schematic
Figure 101/34-21-00-990-823 (Sheet 1 of 3)



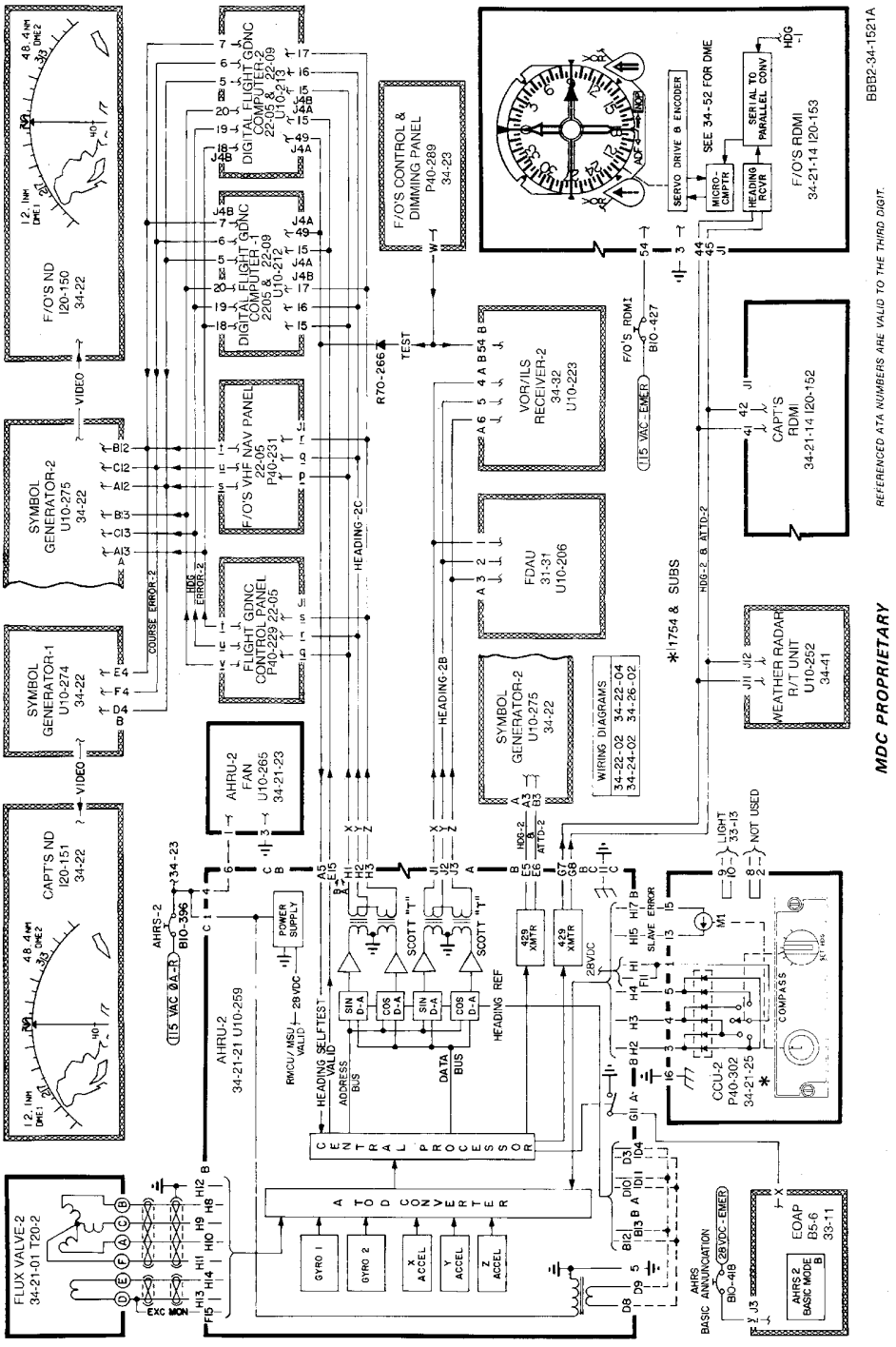
Heading System -1 -- Schematic
Figure 101/34-21-00-990-823 (Sheet 2 of 3)



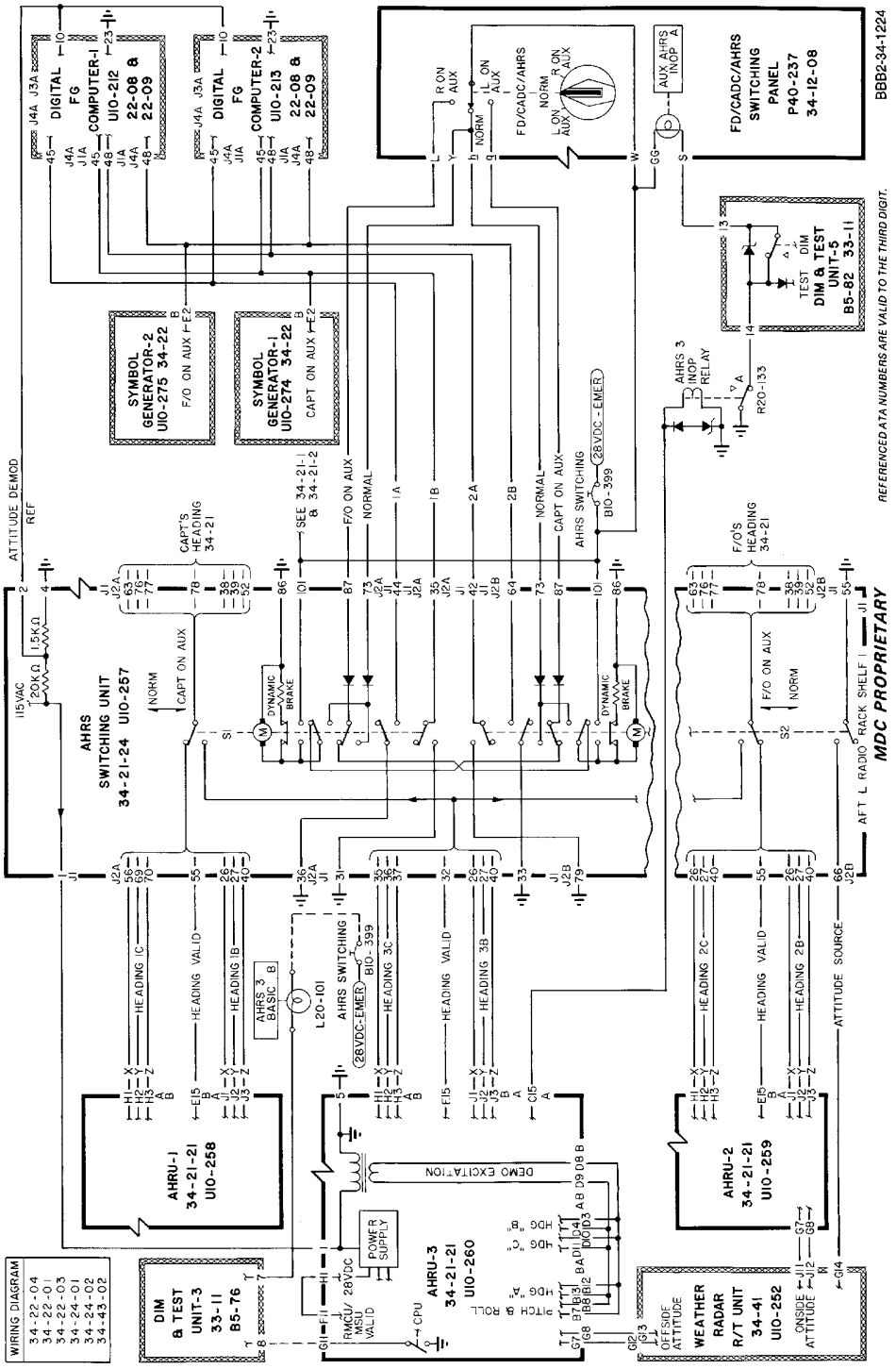
Heading System -1 -- Schematic
Figure 101/34-21-00-990-823 (Sheet 3 of 3)



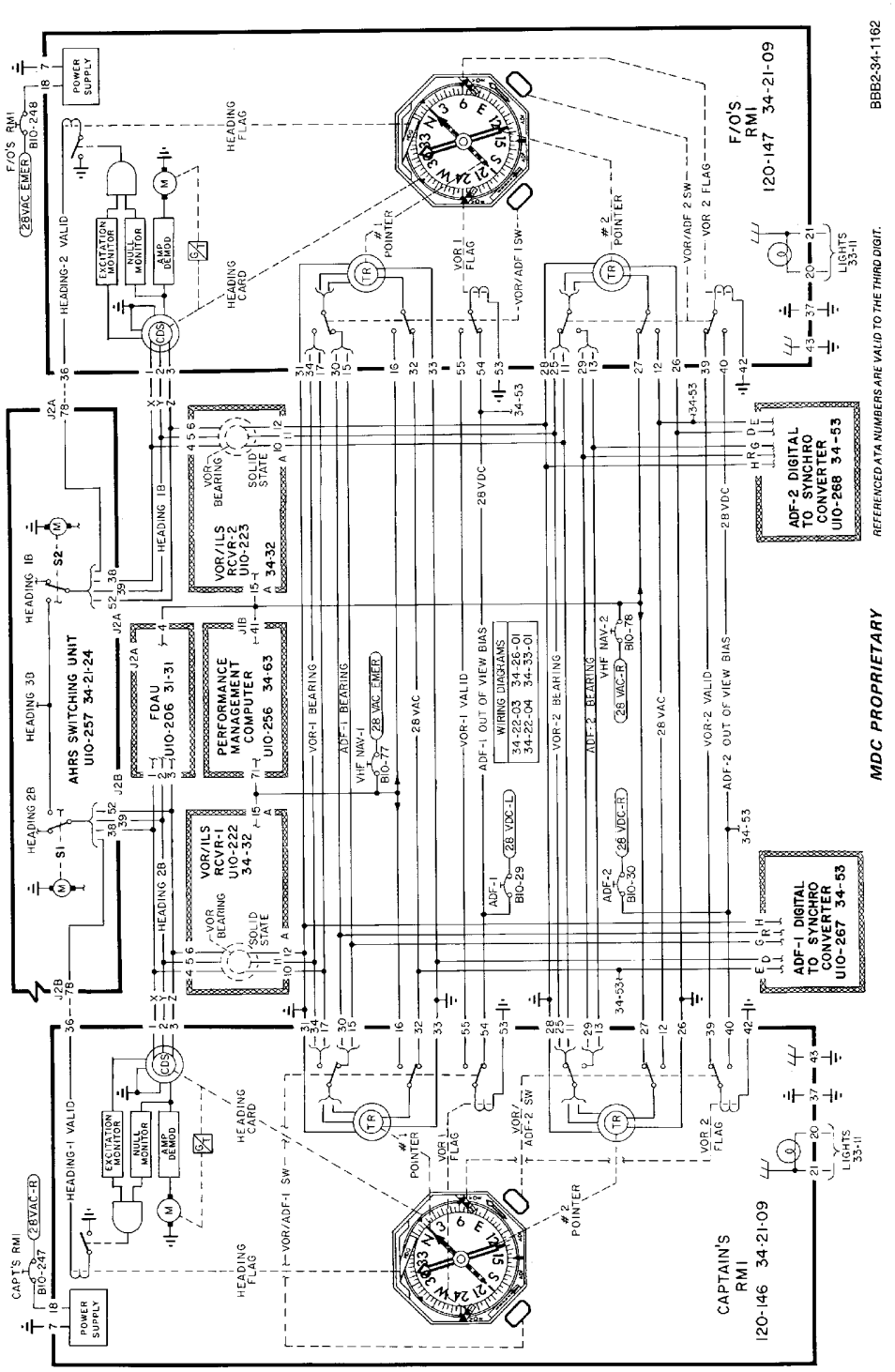
Heading System -2 -- Schematic
Figure 102/34-21-00-990-824 (Sheet 1 of 2)



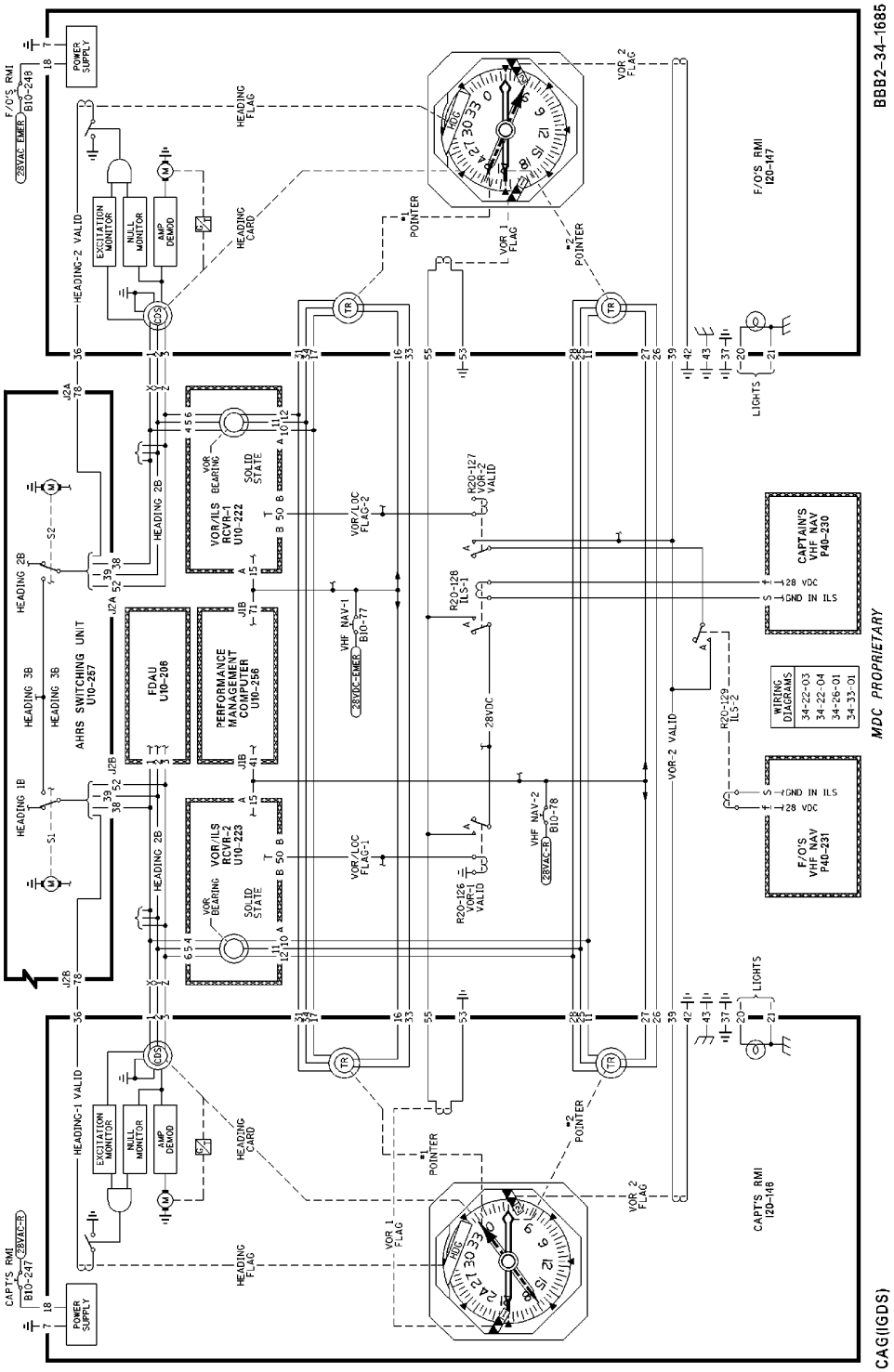
Heading System -2 -- Schematic
Figure 102/34-21-00-990-824 (Sheet 2 of 2)



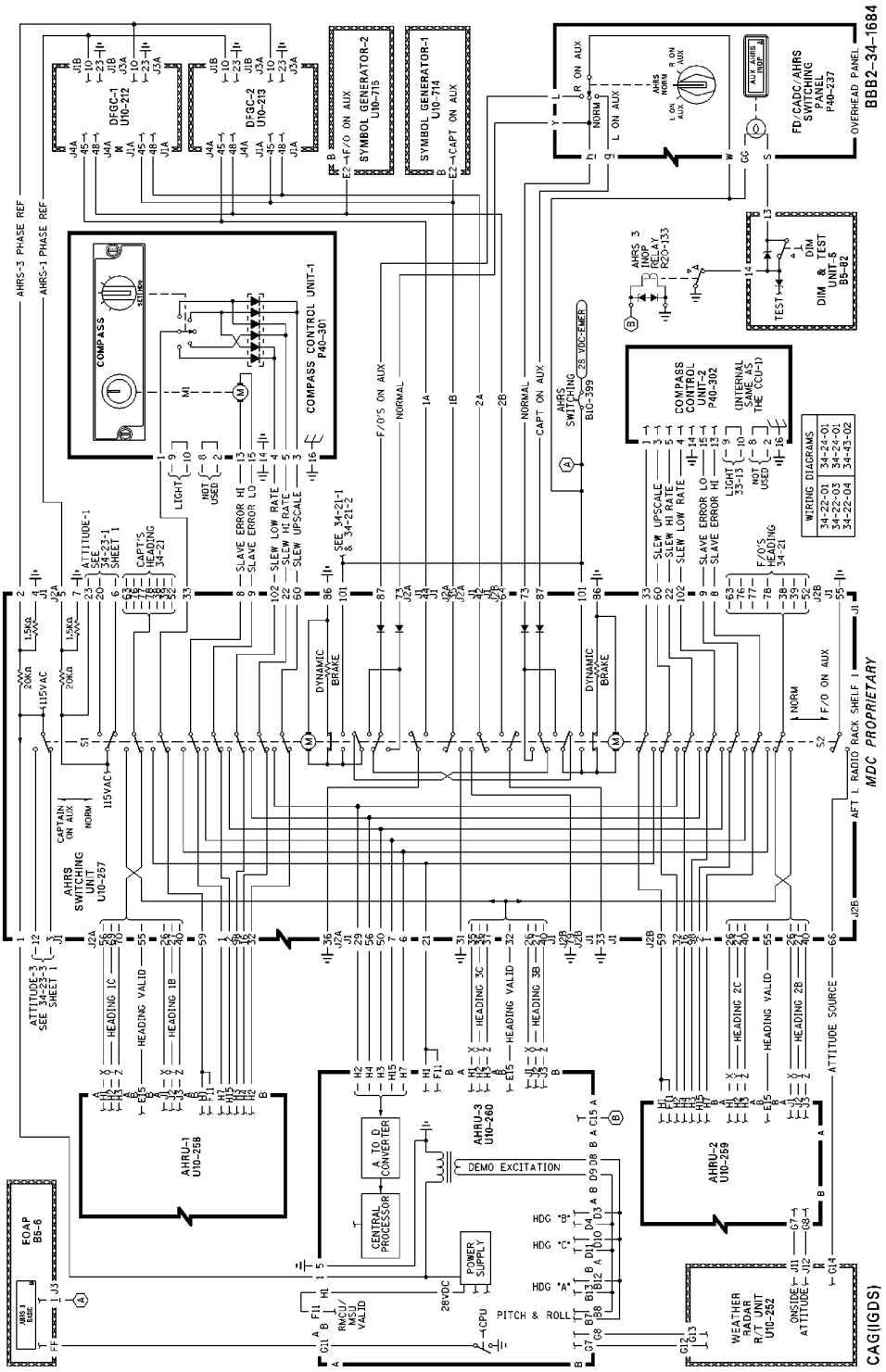
AHRS Switching -- Schematic
Figure 103/34-21-00-990-825



Radio Magnetic Indicators -- Schematic
Figure 104/34-21-00-990-826 (Sheet 1 of 2)



Radio Magnetic Indicators -- Schematic
Figure 104/34-21-00-990-826 (Sheet 2 of 2)



AHRU-3 & Switching -- Schematic
Figure 105/34-21-00-990-827

COMPASS SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section contains basic procedures for isolating and correcting a faulty compass system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic component of the compass system operation are radio distance magnetic indicators. The EFIS Navigation displays (NAVIGATION DISPLAYS, SUBJECT 34-22-00) and inertial reference system units INERTIAL REFERENCE SYSTEM, SUBJECT 34-43-00 are listed for reference.

E. The compass system components are located as follows:

Table 101

Component	Location
Radio Distance Magnetic Indicators	Captain's and First Officer's Instrument Panels
EFIS Navigation Display (ND) Indicators	Captain's and First Officer's Instrument Panels
Inertial Reference Units (IRU's) -1 and -2. (INERTIAL REFERENCE SYSTEM, SUBJECT 34-43-00)	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Compass System

A. Trouble Shoot

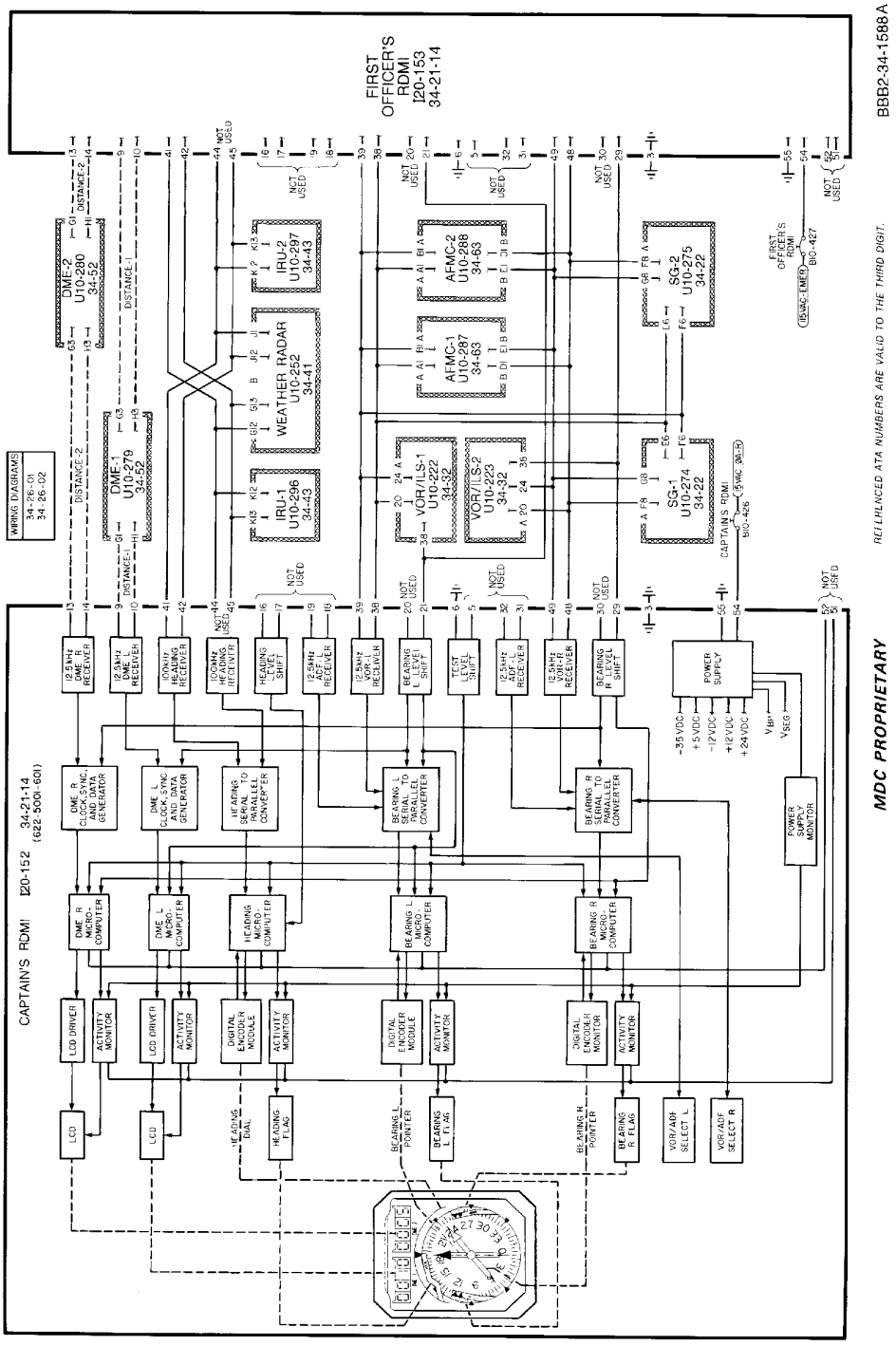
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are inertial reference units (IRU) INERTIAL REFERENCE SYSTEM, SUBJECT 34-43-00 radio distance magnetic indicators, and EFIS Navigation displays (ND).

Table 103

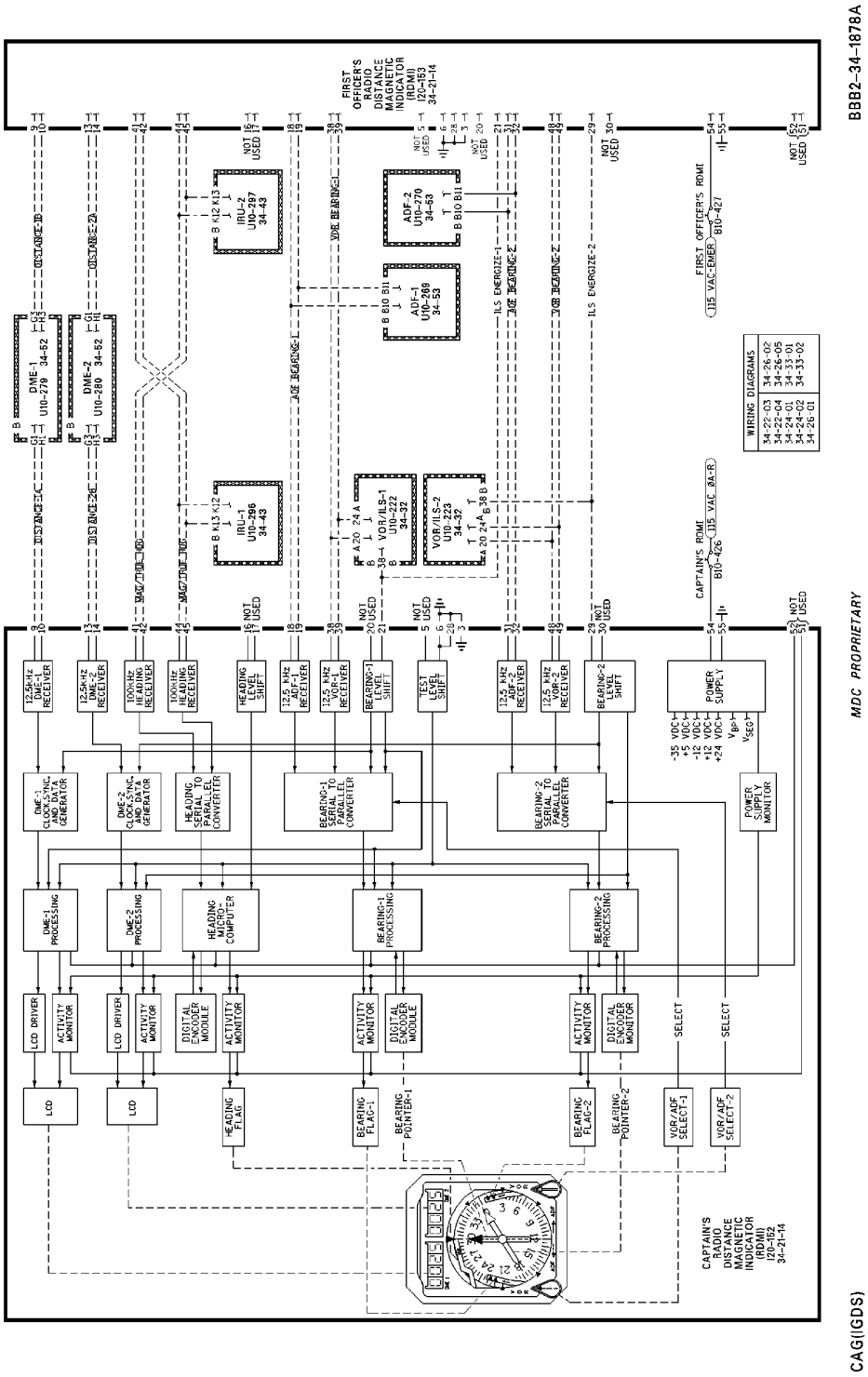
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 103 (Continued)

Step	Procedure	Correction
(4)	Verify that Captain's EFIS navigation display (ND) and First Officer's RDMI read same value within ±2 degrees.	Replace faulty LRU.
(5)	Verify that First Officer's EFIS Navigation display (ND) and Captain's RDMI read same value within ±2 degrees.	Replace faulty LRU.
(6)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(7)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.



Radio Distance Magnetic Indicators
Figure 101/34-21-00-990-809 (Sheet 1 of 2)



Radio Distance Magnetic Indicators
Figure 101/34-21-00-990-809 (Sheet 2 of 2)

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The gyrosyn compass system is a gyroscope stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, horizontal situation indicator (HSI), compass indicator (CI), and compass instrument amplifier. Other components or systems which may receive heading information from the compass system are the FDAU, VOR/ILS receivers and digital flight guidance computers. Heading selection is also provided for the automatic pilot.

B. To check the complete system, the test should be performed in its entirety. The individual compass system functions can be checked by performing only the appropriate portions of the applicable tests.

C. The compass system comprises two (captain's -1 and first officer's -2) complete individual systems. Procedures for testing captain's and first officers's compass systems are similar, differences are shown in parentheses.

D. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or gyro compass system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred. Refer to Paragraph 4. for demagnetizing procedures.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Compass System

A. Test Compass System - Preliminary

(1) Energize airplane electrical buses, wait 5 minutes for systems warm-up, then verify following conditions:

(2) Captain's and first officer's HSI HEADING and CI OFF warning flags should be out of view.

NOTE: The captain's and first officer's HSI HEADING and CI OFF warning flags will appear if any one of the following functions is not operating correctly:

(a) Electrical power to compass system

(b) Directional gyro not level

(c) Directional gyro not operating at sufficient speed

(d) Excessive error signal in heading servo loop.

B. Test Compass System - Functional

Table 202

Step	Operation	Desired Result
(1)	Set 1/2 Selector Switch on Flight Guidance Control Panel to Position 1.	

Table 202 (Continued)

Step	Operation	Desired Result
(2)	Depress and rotate First Officer's compass indicator sync knob 3 or more turns in clockwise direction and observe following:	Capt's HSI and F.O.'s compass indicator compass cards rotate CCW. Capt's HSI HDG bug and CRS arrow retains relative position with compass card.
(3)	Synchronize First Officer's compass indicator.	Capt's HSI HDG flag out-of view.
		F.O.'s compass indicator OFF flag out-of-view.
		F.O.'s compass indicator compass card agrees with Capt's HSI compass card heading indicator (±2°).
(4)	Depress and rotate Captain's compass indicator sync knob 3 or more turns in counter- clockwise direction and observe following:	F.O.'s HSI and Capt's compass indicator compass cards rotate CW. F.O.'s HSI HDG bug & CRS arrow retains relative position with compass card.
(5)	Synchronize Captain's compass indicator.	F.O.'s HSI HDG flag out-of view.
		Capt's compass indicator OFF flag out-of-view.
		Capt's compass indicator compass card agrees with F.O.'s HSI compass card head ing indicator within (±2°).
(6)	On Flight Guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	Capt's HSI HDG bug as read against compass card agree with HDG readout on Flight Guidance control panel within (±2°).
		F.O.'s HSI HDG bug as read against compass card agrees with HDG readout on Flight Guidance control panel within (±2°).
(7)	On Captain's VHF NAV Control Panel, increase selected CRS readout by plus 60°.	Capt's HSI course arrow as read against compass card agrees with CRS readout on Capt's VHF NAV control panel within (±2°).
(8)	On F.O.'s VHF NAV Control Panel, decrease selected CRS readout by minus 60°.	F.O.'s HSI course arrow as read against compass card agrees with CRS readout on F.O.'s VHF NAV control panel within (±2°).
	On Flight Guidance Control Panel, set AP-ON 1/2 selector switch to position 1.	
(9)	Return airplane to required configuration.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 feet (3.05 M) of any part of airplane UNLESS IT IS ENERGIZED.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from airplane. (STANDBY COMPASS - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-01/201 Config 1)

(2) Energize degausser at a distance of at least 10 feet (3.05 M) from airplane.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure. Move degausser slowly towards magnetized areas, bringing degausser as close as possible to the structure without touching the structure. The degausser produces demagnetizing pulses. Move the coil between pulses, in a left to right direction, beginninig at the left most extremity of the magnetized area. Overlap each area previously covered by the coil by 50%.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 feet (3.05 M) from airplane before deenergizing.

(6) Check areas degaussed with handheld compass or field strength meter for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass. (STANDBY COMPASS - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-01/201 Config 1)

C. Demagnetize Flux Valves

(1) Remove flux valve and place it carefully in a safe place.

(2) Energize degausser at distance of at least 10 feet (3.05 M) away from aircraft and move it towards appropriate area in wing.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to point at least 10 feet (3.05 M) from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve area.

(7) Install flux valve.

(8) Perform operational check of compass system.

(9) Return aircraft to required configuration.

5. Compass Tolerances

A. In service compass tolerances are as follows:

Table 203

Indicators	Flight Attitude	Tolerance
Capt's Compass Indicator (CI) to F.O.'s Horizontal Situation Indicator (HSI)		Less than or equal to 2°
F.O.'s CI to Capt's HSI		Less than or equal to 2°
Capt's and F.O.'s CIs to Standby Compass		Less than or equal to 10°
Capt's CI to F.O.'s CI	Level	Less than or equal to 4°
Capt's CI to F.O.'s CI	360° steady turn at 30° bank angle.	Max. 12°
Capt's CI to F.O.'s CI	Wings level from 360° turn at 30° bank angle.	Max. 6°

Table 203 (Continued)

Indicators	Flight Attitude	Tolerance
Normal Slave Rate	90° turn	1.5° to 4.5° per minute.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides adjustment/test procedures for the Heading System.

B. The Attitude and Heading Unit (AHRU) is the primary source of attitude and heading information utilized by aircraft avionics systems. The test procedure checks both the attitude and heading portions of the AHRU.

(1) Electronic Flight Instrument System must be operational for test.

2. Adjustment/Test Heading System

A. Test Heading

Table 201

Operation		Desired Result
(1)	Set AHRS switch (on overhead switching panel) to center position.	AHRS switch in center position.
(2)	Energize aircraft electrical buses. Ensure aircraft is stationary during 1 minute alignment period.	(a) Up to 15 seconds after power application, HSI's and RMI's display 0 degrees heading.
		(b) 45 seconds after power application, RMI HDG, and HSI HEADING flags out of view.
		(c) AHRS-3 INOP annunciator light (on overhead panel) off.
CAUTION: INCORRECT WIRING OF AHRU COOLING FAN WILL CAUSE FAN MOTOR TO OPERATE IN REVERSE. SIGNIFICANT DECREASE IN MTBF WILL RESULT FROM IMPROPER COOLING OF AHRU. REFER TO FIGURE 201 FOR AIRFLOW DIAGRAM AND FAN CIRCUIT DIAGRAM. AIRFLOW MUST GO DOWNWARD, THROUGH PLENUM IN AHRU MOUNTING BASE, AND UP THROUGH AND AROUND AHRU.		
(2a)	Verify AHRU fans are operating. Verify fan operation by touch, or by sliding an 8 1/2 X 11 inch (215.9 X 279.4 mm) piece of paper on top of the AHRU (the paper will lift if the fan is operating correctly).	Fan operation and correct airflow are verified.
NOTE: Whenever power to an AHRS is interrupted for 500 milliseconds or longer, 1 minute must be allowed for system realignment and output of valid data (aircraft on ground and stationary).		
(3)	Open AHRS-1 circuit breaker, on overhead panel.	First officer's RMI HDG, captain's HSI HEADING and ADI ATT warning flags in view.
(4)	Close AHRS-1 circuit breaker, on overhead panel.	45 seconds after breaker reset, warning flags observed in step (3) go out of view.
(5)	Open AHRS-2 circuit breaker.	Captain's RMI HDG, first officer's HSI HEADING and ADI ATT warning flags in view (aircraft stationary).
(6)	Close AHRS-2 circuit breaker.	45 seconds after breaker reset, warnings displays observed in step (5) go out of view (aircraft stationary).
(7)	Open AHRS-3 circuit breaker, on EPC.	AHRS-3 INOP annunciator light comes on.
(8)	Close AHRS-3 circuit breaker, on EPC.	Immediately after breaker reset, AHRS-3 INOP annun ciator goes off.

Table 201 (Continued)

Operation		Desired Result
(9)	Observe magnetic heading on captain's and first officer's RMI's.	RMI magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		RMI magnetic headings agree within ±4 degrees.
NOTE: Magnetic anomalies due to parked vehicles, power cables, etc. may cause a difference in magnetic heading exceeding ±4 degrees.		
(10)	Observe magnetic heading on captain's and first officer's ND's and PFD attitude.	ND magnetic heading aligned within ±2 degrees of airplane magnetic heading. ND magnetic headings agree within ±4 degrees.
		PFD attitude aligned within 2 degrees of airplane attitude and 4 degrees between ADIs.
(11)	If AHRS switching test is not to be performed, perform Return to Service (RTS) test (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 10 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 11).	
(12)	Return aircraft to required configuration.	

B. AHRS Operational Test

NOTE: This test may be performed to check operation of the AHRU on EMER power in normal mode in simulated flight and of the AHRS Basic Mode annunciators.

Table 202

Operation		Desired Result
(1)	Place CADC-1 and CADC-2 MODE SELECT switches in FUNCTION TEST position.	
(2)	On CADC-1 and -2 press and hold PUSH TO TEST switches.	
NOTE: Steps (3) through (7) must be completed within 3 minutes of step (2).		
(3)	Open and close all AHRS-1 and -2 circuit breakers.	
(4)	On Upper EPC, open LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	AHRS-1, and -2 BASIC MODE annunciators are off after 15 seconds.
(5)	On Overhead, place EMER PWR switch in ON position.	
(6)	Release CADC-2 PUSH TO TEST switch.	After 5 seconds, AHRS-2 BASIC MODE annunciator comes on. AHRS-1 BASIC MODE annunciator is off.
(7)	Release CADC-1 PUSH TO TEST switch.	After 5 seconds, AHRS-1 BASIC MODE annunciator comes on.
(8)	On overhead, place EMER PWR switch in OFF position, and on upper EPC, CLOSE LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	Return the aircraft to required normal operation.

Table 202 (Continued)

	Operation	Desired Result
(9)	Open and close all AHRS -1 and -2 circuit breakers. Wait 45 seconds for warning displays to go out of view (aircraft stationary).	
(10)	Perform Return to Service (RTS) test (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 10 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 11)	
(11)	Return aircraft to required configuration.	

C. Test Heading Switching

Table 203

	Operation	Desired Result
(1)	On overhead panel, make cer- tain AHRS-3 INOP annunciator light is off.	AHRS-3 on and operating properly.
NOTE: Due to switching transient time, actuation of the AHRS switch may cause RMI HDG, ND HEADING, and PFD ATT warning displays to momentarily come into view.		
(2)	Set AHRS switch to L ON AUX position.	ATT3 appears on Capt's PFD and HDG3 appears on Capt's ND.
(3)	Observe magnetic heading on captain's and first officer's	Compare Capt's and F/O's RMI's.
		RMI magnetic headings agree within ±4 degrees.
(4)	Observe magnetic heading on Capt's and F/O's NDs.	Compare Capt's and F/O's ND headings.
(5)	Set AHRS switch to R ON AUX position.	ND magnetic headings agree within ±4 degrees. ATT3 appears on F/O's PFD and HDG3 appears on F/O's ND.
(6)	Repeat steps (3) and (4).	
(7)	Compare headings between Capt's and F/O's RMI's and ND's with AHRS switch L ON AUX and R ON AUX.	Headings should agree within 4 degrees.

3. Adjustment/Test Heading System

A. AHRS Operational Test

NOTE: This test may be performed to check operation of the AHRU on EMER power in normal mode in simulated flight and of the AHRS Basic Mode annunciators.

Table 204

	Operation	Desired Result
(1)	Place CADC-1 and CADC-2 MODE SELECT switches in FUNCTION TEST position.	
(2)	On CADC-1 and -2 press and hold PUSH TO TEST switches.	
NOTE: Steps (3) through (7) must be completed within 3 minutes of step (2).		

Table 204 (Continued)

Operation		Desired Result
(3)	On Overhead, open and close AHRS-1 circuit breaker; on Upper EPC, open and close AHRS-2 and -3 circuit breakers.	
(4)	On Upper EPC, open LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	AHRS-1, -2 and -3 BASIC MODE annunciators are off after 15 seconds.
(5)	On Overhead, place EMER PWR switch in ON position.	
(6)	Release CADC-2 PUSH TO TEST switch.	After 5 seconds, AHRS-2 and -3 BASIC MODE annunciators come on. AHRS-1 BASIC MODE annunciator is off.
(7)	Release CADC-1 PUSH TO TEST switch.	After 5 seconds, AHRS-1 BASIC MODE annunciator comes on.
(8)	On Upper EPC, open AHRS-3 circuit breaker.	On overhead, AHRS-3 INOP annunciator comes on.
(9)	On CADC-2, press and hold PUSH TO TEST switch.	
(10)	On Upper EPC, close AHRS-3 circuit breaker.	On Overhead, AHRS-3 INOP annunciator goes off.
(11)	On Upper EPC, Right Radio AC Bus, open AIR DATA CMPTR-2 circuit breaker.	After 5 seconds, and after 15 seconds from step (9), AHRS-3 BASIC MODE annunciator is off.
(12)	Release CADC-1 PUSH TO TEST switch.	
(13)	Place EMER PWR switch to OFF position and on upper EPC, close LEFT and RIGHT GRND control circuit breakers.	
(14)	Open and then close all AHRS circuit breakers and wait for ATT and HDG flags to go out of view (aircraft stationary for 45 seconds).	
(15)	Return aircraft to required configuration.	

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The gyrosyn compass system is a gyroscope-stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, horizontal situation indicator (HSI) (or Electronic Flight Instrument System (EFIS) Navigation Display on aircraft with EFIS, Compass Indicator (CI), and compass instrument amplifier. Other components or systems which receive heading information from the compass system are the FDAU, VOR/ILS receivers, digital flight guidance computers, automatic pilot, and the EFIS symbol generators.

B. To check the complete system, the test should be performed in its entirety. The individual compass system functions can be checked by performing only the appropriate portions of the applicable tests.

C. The compass system comprises two (captain's -1 and first officer's -2) complete and independent systems. Procedures for testing captain's and first officers's compass systems are provided.

D. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or gyro compass system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred. Refer to Paragraph 4. for demagnetizing procedures.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Compass System

A. Test Compass System - Preliminary

(1) Before energizing electrical buses, observe that CAPT (Captain) and First Officer (F/O) Navigation Display (ND) "HDG FAIL" message, and CI OFF warning flags are in view.

(2) After energizing aircraft electrical buses, wait 5 minutes for systems warm-up, then verify following conditions:

(3) CAPT and F/O ND "HDG FAIL" message and CI OFF warning flags should be out of view.

(a) The CAPT and F/O Navigation Display "HDG FAIL" message and CI OFF warning flags will appear if any one of the following functions is not operating correctly:

- Electrical power to compass system
- Directional gyro not level
- Directional gyro not operating at sufficient speed
- Excessive error signal in heading servo loop.

B. Test Compass System - Functional

Table 202 Test Compass System - Functional

Step	Operation	Desired Result
(1)	Set 1/2 Selector Switch on Flight Guidance Control Panel to Position 1. Place mode select knob on EFIS Mode Select Panels in ROSE position.	
(2)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW (Clockwise) direction and observe following:	CAPT EFIS ND and F/O compass indicator compass cards rotate CCW (Counterclockwise). CAPT ND HDG bug and course arrow retain their position relative to compass card as card rotates.
NOTE: Rapid rotation of compass indicator sync knob may cause compass rose display onND to momentarily go blank.		
(3)	Synchronize F/Ocompass indicator.	CAPT ND "HDG FAIL" message is out of view.
		F/O compass indicator OFF flag is out of view.
		F/O compass indicator compass card agrees with CAPT ND compass card heading indicator (±2°).
(4)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CCW direction and observe following:	F/O ND and CAPT compass indicator compass card rotate CW.
		F/O ND HDG bug & course arrow retain their position relative to compass card as card rotates.
(5)	Synchronize CAPTcompass indicator.	F/O ND "HDG FAIL" message is out of view.
		CAPT compass indicator OFF flag is out of view.
		CAPT compass indicator compass card agrees with F/O ND compass card heading indicator (±2°).
(6)	On Flight Guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	CAPT ND HDG bug, as read against compass card, agrees with HDG readout on Flight Guidance control panel (±2°).
		F/O ND HDG bug, as read against compass card, agrees with HDG readout on Flight Guidance control panel (±2°).
(7)	On CAPT VHF NAV Control Panel, increase selected CRS readout by plus 60°.	CAPT ND course arrow as read against compass card agrees with CRS readout on CAPT VHF NAV control panel (±2°).
(8)	On F/O VHF NAV Control Panel, decrease selected CRS readout by minus 60°.	F/O ND course arrow as read against compass card agrees with CRS readout on F/O VHF NAV control panel (±2°).
(9)	On Flight Guidance Control Panel, set AP-ON 1/2 selector switch to position 1.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of aircraft, UNLESS IT IS ENERGIZED.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Energize degausser at a distance of at least 10 ft (3 m) from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(2) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in a series of parallel strokes over entire area from top of windshield aft for a distance of 36 inches and bounded on each side by left and right sliding windshields.

(3) Demagnetize windshield screws by moving degausser in line with screws.

(4) Withdraw degausser at least 10 ft (3 m) from aircraft before deenergizing.

(5) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(6) When area is satisfactorily demagnetized, install standby compass.

(7) Swing compass, if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place it carefully in a safe place.

(2) Energize degausser at distance of at least 10 ft (3 m) away from aircraft and move it towards appropriate area in wing.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to point at least 10 ft (3 m) from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve area.

(7) Install flux valve.

(8) Perform operational check of compass system.

(9) Return aircraft to required configuration.

5. Compass Tolerances

A. In service compass tolerances are as follows:

Table 203 compass tolerances

Indicators	Flight Attitude	Tolerance
CAPT and F/O CI to Standby Compass		< or =10°
CAPT CI to F/O CI	Level	< or =4°
CAPT CI to F/O CI	360° steady turn at 30° bank angle.	Max. 12°
CAPT CI to F/O CI	Wings level from 360° turn at 30° bank angle.	Max. 6°
Normal Slave Rate	90° turn	1.5° to 4.5° per minute.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The gyrosyn compass system is a gyroscope stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, compass indicator (CI), and compass instrument amplifier. Other components or systems which may receive heading information from the compass system are the FDAU, VOR/ILS receivers and digital flight guidance computers. Aircraft horizontal situation is displayed on the electronic flight instrument system (EFIS) navigation displays (ND's), located on captain's and first officer's instrument panels. Heading selection is also provided for the automatic pilot.

B. To check the complete system, the test should be performed in its entirety. The individual compass system functions can be checked by performing only the appropriate portions of the applicable tests.

C. The compass system comprises two (captain's -1 and first officer's -2) complete individual systems. Procedures for testing captain's and first officers's compass systems are similar, differences are shown in parentheses.

D. The compass system comprises two (captain's -2 and first officer's -1) complete and independent systems. Procedures for testing captain's and first officers's compass systems are provided.

E. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or gyro compass system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred. Paragraph 4. for demagnetizing procedures.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Compass System

A. Test Compass System - Preliminary

(1) Energize aircraft electrical buses, wait 5 minutes for systems warm-up, then verify following conditions:

(2) Captain's and first officer's ND HDG FAIL and CI OFF warning flags should be out of view.

NOTE: The captain's and first officer's HDG FAIL and CI OFF warning flags will appear if any one of the following functions is not operating correctly:

(a) Electrical power to compass system

(b) Directional gyro not level

(c) Directional gyro not operating at sufficient speed

(d) Excessive error signal in heading servo loop.

B. Test Compass System - Functional

Table 202

Step	Operation	Desired Result
(1)	Set 1/2 selector switch on flight guidance control panel to Position 1.	
(2)	Depress and rotate First Officer's compass indicator sync knob 3 or more turns in clockwise direction and observe following:	Capt's ND and F.O.'s compass indicator compass displays rotate CCW. Capt's ND HDG bug and CRS arrow retains relative position with compass card.
(3)	Synchronize First Officer's compass indicator.	Capt's ND HDG FAIL display flag out-of-view.
		F.O.'s compass indicator OFF flag out-of-view.
		F.O.'s compass indicator compass card agrees with Capt's ND compass display heading indicator (±1°).
(4)	Depress and rotate Captain's compass indicator sync knob 3 or more turns in counterclockwise direction and observe following:	F.O.'s ND and Capt's compass indicator compass displays rotate CW. F.O.'s ND HDG bug & CRS arrow retains relative position with compass card.
(5)	Synchronize Captain's compass indicator.	F.O.'s ND HDG FAIL display out-of-view.
		Capt's compass indicator OFF flag out-of-view.
		Capt's compass indicator compass card agrees with Capt's ND compass display heading indicator within (±1°).
(6)	On flight guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	Capt's ND HDG bug as read against compass display agrees with HDG readout on flight guidance control panel within (±2°).
		F.O.'s ND HDG bug as read against compass display agrees with HDG readout on fight guidance control panel within (±2°).
(7)	On Captain's VHF NAV control panel, increase selected CRS readout by plus 60°.	Capt's ND course arrow as read against compass display agrees with CRS readout on Capt's VHF NAV control panel within (±2°).
(8)	On F.O.'s VHF NAV control panel, decrease selected CRS readout by minus 60°.	F.O.'s ND course arrow as read against compass display agrees with CRS readout on F.O.'s VHF NAV control panel within (±2°).
(8a)	On flight guidance control panel, set AP-ON 1/2 selector switch to position 1.	
(9)	Return aircraft to required configuration.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 feet of any part of aircraft, UNLESS IT IS ENERGIZED.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from aircraft.

(2) Energize degausser at distance of at least 10 feet from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in a series of parallel strokes over entire area from top of windshield aft for a distance of 36 inches and bounded on each side by left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 feet from aircraft before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place carefully in a safe place.

(2) Remove flux valve and place it carefully in safe place.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to point at least 10 feet from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve area.

(7) Install flux valve.

(8) Perform operational check of compass system.

(9) Return aircraft to required configuration.

5. Compass Tolerances

A. In service compass tolerances are as follows:

Table 203

Indicators	Flight Attitude	Tolerance
Capt's Compass Indicator (CI) to F.O.'s Navigation Display (ND)		< or =2°
F.O.'s CI to Capt's ND		< or =2°
Capt's and F.O.'s CIs to Standby Compass		< or =10°
Capt's CI to F.O.'s CI	Level	< or =4°
Capt's CI to F.O.'s CI	360° steady turn at 30° bank angle.	Max. 12°
Capt's CI to F.O.'s CI	Wings level from 360° turn at 30° bank angle.	Max. 6°
Normal Slave Rate	90° turn	1.5° to 4.5° per minute.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides adjustment/test procedures for the Heading System.

B. The Attitude and Heading Unit (AHRU) is the primary source of attitude and heading information utilized by aircraft avionics systems. The test procedure checks both the attitude and heading portion of the AHRU.

C. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or attitude and heading system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Heading System

A. Test Heading

Table 202 Test Heading

Step	Operation	Desired Result
(1)	Energize aircraft electrical buses. Ensure aircraft is stationary during 1 minute alignment period.	(a) Up to 15 seconds after power application, Radio Distance Magnetic Indicator's (RDMI's) display 0 degrees heading.
(1a)	EFIS, must be operational. Place MODE selector on EFIS mode selector panel in ROSE position.	(b) 45 seconds after power application, CAPT and F/O ND, and RDMIs warning displays out of view, cards steady.
		(c) Two BASIC MODE annunciators on Overhead Panel are off.
NOTE: Both the Right and Left Radio AC Buses must be energized within 10 seconds of each other. If not, the BASIC MODE annunciators may come on. This is because the FLT/GRND control relays supplying the AIR/GRND indication are in series, and separately powered from the Left and Right buses. With only one bus powered, IN FLT indication is given to the AHRS, causing the AHRS to look for True Airspeed within the next 10 seconds. If no TAS is supplied in 5 seconds, the system reverts to Basic Mode. To return the AHRS to Normal Mode, recycle the AHRS circuit breakers (Refer to Step 3 and 4).		
CAUTION: INCORRECT WIRING OF AHRU COOLING FAN WILL CAUSE FAN MOTOR TO OPERATE IN REVERSE. SIGNIFICANT DECREASE IN MTBF WILL RESULT FROM IMPROPER COOLING OF AHRU. REFER TO FIGURE 201 FOR AIRFLOW DIAGRAM AND FAN CIRCUIT DIAGRAM. AIRFLOW MUST GO DOWNWARD, THROUGH PLENUM IN AHRU MOUNTING BASE, AND UP THROUGH AND AROUND AHRU.		

Table 202 Test Heading (Continued)

Step	Operation	Desired Result
(2)	Verify AHRU fan operation by touch, or by sliding an 8 1/2 X 11 inch (215.9 X 279.4 mm) piece of paper on top of AHRU (paper will lift off if fan is operating correctly).	Fan operation and correct airflow are verified.
NOTE: Whenever power to an AHRS is interrupted for 500 milliseconds or longer, 1 minute must be allowed for system realignment and output of valid data (aircraft on ground and stationary).		
(3)	Open and close these circuit breakers:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW /COL
B10-394	AHRS-1	OVERHEAD	ENERGENCY AC BUS	B/5
B10-395	AHRS-1	UPPER EPC	LEFT RADIO AC BUS	F/15

		F/O RDMI HDG, CAPT ND heading and Primary Flight Display (PFD) warning displays in view.
		45 seconds after breaker reset, warning displays go out of view (aircraft stationary).
(4)	Open and close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW /COL
B10-396	AHRS-2	UPPER EPC	RIGHT RADIO AC BUS	F/2

		CAPT RDMI HDG, F/O ND heading and PFD attitude warning displays in view.
		45 seconds after breaker reset, warning displays go out of view (aircraft stationary).
(5)	Observe magnetic heading on CAPT and F/O RDMIs	RDMI magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		RDMI magnetic headings agree within +4 degrees.
NOTE: Magnetic anomalies due to parked vehicles, power cables, etc. may cause a difference in magnetic heading exceeding ±4 degrees.		
(6)	Observe magnetic heading on CAPT and F/O ND and PFD attitude.	ND magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		ND magnetic headings agree within +4 degrees.
		PFD attitude aligned within 2 degrees of airplane attitude and 4 degrees betweenPFDs.

B. AHRS Operational Test

NOTE: This test may be performed to check operation of the AHRU on EMER power in normal mode in simulated flight and of the AHRS Basic Mode annunciators.

Table 203 AHRS Operational Test

Step	Operation	Desired Result
(1)	Place CADC-1 and CADC-2 MODE SELECT switches in FUNCTION TEST position.	
(2)	On CADC-1 and -2 press and hold PUSH TO TEST switches.	
NOTE: Steps (3) through (7) must be completed within 3 minutes of step (2).		
(3)	Open and close these circuit breakers:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-394	AHRS-1	OVERHEAD	EMERGENCY AC BUS	B/5
B10-395	AHRS-1	UPPER EPC	LEFT RADIO AC BUS	F/15
B10-396	AHRS-2	UPPER EPC	RIGHT RADIO AC BUS	F/2

WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.

(4)	Open these circuit breakers:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
B-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33

		AHRS-1, and -2 BASIC MODE annunciators are off after 15 seconds.
(5)	On Overhead, place EMER PWR switch in ON position.	
(6)	Release CADC-2 PUSH TO TEST switch.	After 5 seconds, AHRS-2 BASIC MODE annunciator comes on. AHRS-1 BASIC MODE annunciator is off.
(7)	Release CADC-1 PUSH TO TEST switch.	After 5 seconds, AHRS-1 BASIC MODE annunciator comes on.
(8)	On overhead, place EMER PWR switch in OFF position.	
(9)	Close these circuit breakers:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33

Table 203 AHRS Operational Test (Continued)

Step	Operation	Desired Result
	B-24 RIGHT GROUND CONTROL RELAY	UPPER EPC R AC BUS L/33
		Return the aircraft to required normal operation.
(10)	Open and close these circuit breakers	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B10-394 / AHRS-1 / OVERHEAD / EMERGENCY AC BUS / B/5	
	B10-395 / AHRS-1 / UPPER EPC / LEFT RADIO AC BUS / F/15	
	B10-396 / AHRS-2 / UPPER EPC / RIGHT RADIO AC BUS / F/2	
		Wait 45 seconds for ATT and HDG FLAGS to pull (aircraft stationary).
(10)	Perform Return-to-Service (RTS) test (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 6)	
(11)	Return aircraft to required configuration.	

C. COMPASS Controller Unit (CCU) Operational Test (Aircraft with CCUs)

COMPASS Controller Unit (CCU) Operational Test (Aircraft with CCUs)

Step	Operation	Desired Result
(1)	On AHRS-1 Compass Controller Unit (CCU), sync indicator pointer is in 12 o'clock position. Note aircraft heading that is displayed on CAPT ND.	Sync indicator pointer in 12 o'clock position. Aircraft heading noted.
(2)	On AHRS-1 CCU, rotate SET HDG knob CW to first index mark and hold for 10 seconds.	Compass rose on CAPT ND. rotates upscale (CCW) 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects CW to right of index mark.
(3)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.
(4)	Rotate SET HDG knob CCW to first index mark and hold until compass rose returns to headings noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(5)	Rotate SET HDG knob CW to second index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates upscale (CCW) 50 degrees (±10°) within 10 seconds. Sync indicator pointer deflects CW full scale to right of index mark.
(6)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.

COMPASS Controller Unit (CCU) Operational Test (Aircraft with CCUs) (Continued)

Step	Operation	Desired Result
(7)	Rotate SET HDG knob CCW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(8)	Rotate SET HDG knob CCW to first index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates downscale CW 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects CCW to left of index mark.
(9)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.
(10)	Rotate SET HDG knob CW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(11)	Rotate SET HDG knob CCW to second index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates downscale (CW) 50 degrees (± 10°) within 10 seconds. Sync indicator pointer deflects CCW full scale to left of index mark
(12)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.
(13)	Rotate SET HDG knob clockwise to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(14)	Repeat steps (1) through (13) using AHRS-2 CCU and F/O ND.	
(15)	Return aircraft to required configuration.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of aircraft unless it is energized.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from aircraft.

(2) Energize degausser at a distance of at least 10 ft (3 m) from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in series of parallel strokes over entire area from top of windshield aft for distance of 36 in. (914 mm) and bounded on each side by left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 ft (3 m) from aircraft before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place carefully in a safe place.

(2) Energize degausser at a distance of at least 10 ft (3 m) away from aircraft and move towards appropriate area in wing or nose.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to a point at least 10 ft (3 m) from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve areas.

(7) Install flux valve.

(8) Perform operational check of heading system. (ATTITUDE AND HEADING REFERENCE UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-10/201 Config 2, ,)

(9) Return aircraft to required configuration.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides adjustment/test procedures for the Heading System.

B. The Attitude and Heading Unit (AHRU) is the primary source of attitude and heading information utilized by aircraft avionics systems. The test procedure checks both the attitude and heading portion of the AHRU. The Electronic Flight Instrument System must be operational for test.

C. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or attitude and heading system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Heading System

A. AHRS Operational Test

Table 202 AHRS Operational Test

Step	Operation	Desired Result
(1)	On overhead instrument panel, verify AHRS switch in center position.	AHRS switch is centered.
(2)	Energize aircraft electrical buses. Ensure aircraft is stationary during 1 minute alignment period.	Buses energized.
CAUTION: INCORRECT WIRING OF AHRU COOLING FAN WILL CAUSE FAN MOTOR TO OPERATE IN REVERSE. SIGNIFICANT DECREASE IN MTBF WILL RESULT FROM IMPROPER COOLING OF AHRU. REFER TO FIGURE 201 FOR AIRFLOW DIAGRAM AND FAN CIRCUIT DIAGRAM. AIRFLOW MUST GO DOWNWARD, THROUGH PLENUM IN AHRU MOUNTING BASE, AND UP THROUGH AND AROUND AHRU.		
NOTE: Whenever power to an AHRS is interrupted for 500 milliseconds or longer, 1 minute must be allowed for system realignment and output of valid data (aircraft on ground and stationary).		
NOTE: Both the Right and Left Radio AC Buses must be energized within 10 seconds of each other. If not, the BASIC MODE annunciators may come on. This is because the FLT/GRND control relays supplying the AIR/GRND indication are in series, and separately powered from the Left and Right buses. With only one bus powered, IN FLT indication is given to the AHRS, causing the AHRS to look for True Airspeed within the next 10 seconds. If no TAS is supplied in 5 seconds, the system reverts to Basic Mode. To return the AHRS to Normal Mode, cycle the AHRS circuit breakers (Refer step (13) for circuit breaker location).		

Table 202 AHRS Operational Test (Continued)

Step	Operation	Desired Result
(3)	Verify the AHRU cooling fans are operating by placing a hand on top of each AHRU and feeling for air exiting the top of the unit.	Fans for each AHRU are operating.
(4)	On EFIS Mode Select Panel, place mode selector switch in ROSE position.	ND in ROSE mode.
(5)	Wait approximately 45 seconds (after power is applied) for system to align, then observe on the CAPT and F/O PFD and ND:	(a) No ATT FAIL indications on the PFDs and both horizons steady.
		(b) No HDG FAIL indications on the NDs and compass roses steady.
		(c) CAPT and F/O PFD pitch and roll indications are 0 degrees ± 5 degrees.
		(d) CAPT and F/O pitch and roll indications agree within 2.5 degrees.
		(e) CAPT and F/O RMI heading flags out of view and cards steady.
(6)	On overhead annunciator panel, verify that three AHRS BASIC and AHRS 3 INOP lights are out.	Lights out.
NOTE: If lights do not go out then do step (13).		
(7)	Verify that there are no ATT3 indications on either PFD.	No ATT3 indications.
(8)	On overhead switch panel, place AHRS switch in left position (Capt on AHRS-3).	ATT3 shown on CAPT PFD. HDG3 shown on CAPT ND. No ATT FAIL indications on CAPT orF/O PFD. No HDG FAIL indications on CAPT or F/O ND. CAPT and F/O RMI heading flags remain out of view.
(9)	On overhead switch panel, place AHRS switch in the center position.	No ATT3 on either PFD. No HDG3 on either ND. No ATT FAIL indications on CAPT or F/O PFDs. No HDG FAIL indications on CAPT or F/O NDs. CAPT and F/O RMI heading flags remain out of view.
(10)	On overhead switch panel, place AHRS switch in right position (F/O on AHRS-3).	ATT3 shown on F/O PFD. HDG3 shown on F/O ND. No ATT FAIL indications on CAPT or F/O PFDs. No HDG FAIL indications on CAPT or F/O NDs. CAPT and F/O RMI heading flags remain out of view.
(11)	On overhead switch panel, place AHRS switch in the center position.	No ATT3 on either PFD. No HDG3 on either ND. No ATT FAIL indications on CAPT or F/O PFDs. No HDG FAIL indications on CAPT or F/O NDs. CAPT and F/O RMI heading flags remain out of view.
(12)	On radio rack, place each CADC function selector switch to FUNCTION TEST, then press and hold SELF TEST buttons.	CADC-1 and -2 in self test mode.
NOTE: Steps (13) through (16) must be completed within 3 minutes.		
(13)	Open and close these circuit breakers:	

Table 202 AHRS Operational Test (Continued)

Step	Operation	Desired Result

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-394	AHRS-1	OVERHEAD	EMERGENCY AC BUS	B/5
B10-395	AHRS-1	UPPER EPC	LEFT RADIO AC BUS	F/15
B10-396	AHRS-2	UPPER EPC	RIGHT RADIO AC BUS	F/2
B10-397	AHRS-3	UPPER EPC	RIGHT RADIO AC BUS	F/1
B10-398	AHRS-3	OVERHEAD	EMERGENCY AC BUS	C/1

WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.

Step	Operation	Desired Result
(14)	Open these circuit breakers:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33
B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33

		Verify AHRS -1, -2 and -3 BASIC lights on the overhead panel are not on 15 seconds after GROUND CONTROL relay breakers are opened.
(15)	On overhead, place EMER PWR switch to ON. Release CADC-2 SELF TEST button.	Verify AHRS-1 BASIC light does not come on, and AHRS-2 and -3 BASIC MODE do come on 5 seconds after SELF TEST button release.
(16)	Release CADC-1 SELF TEST button.	Verify AHRS-1 BASIC light does come on 5 seconds after SELF TEST button release.
(17)	Open this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-397	AHRS-3	UPPER EPC	RIGHT RADIO AC BUS	F/1
B10-398	AHRS-3	OVERHEAD	EMERGENCY AC BUS	C/1

		AHRS INOP light on overhead comes on.
(18)	Press and hold in CADC-1 SELF TEST pushbutton.	CADC-1 in SELF TEST mode.
(19)	Close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-397	AHRS-3	UPPER EPC	RIGHT RADIO AC BUS	F/1
B10-398	AHRS-3	OVERHEAD	EMERGENCY AC BUS	C/1

		AHRS-3 INOP light not on.
(20)	Open this circuit breaker:	

Table 202 AHRS Operational Test (Continued)

Step	Operation		Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	UPPER EPC	RIGHT RADIO AC BUS	F/12
			Verify AHRS-3 BASIC light is not on after 5 seconds and not on after 15 seconds have elapsed from step (18).		
(21)	Release CADC-1 SELF TEST button.				
(22)	On overhead, place EMER PWR switch to OFF. .		EMER PWR is off.		
(23)	Close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	UPPER EPC	RIGHT RADIO AC BUS	F/12
	B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33
	B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
(24)	Open and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-394	AHRS-1	OVERHEAD	EMERGENCY AC BUS	B/5
	B10-395	AHRS-1	UPPER EPC	RIGHT RADIO AC BUS	F/15
	B10-396	AHRS-2	UPPER EPC	RIGHT RADIO AC BUS	F/2
	B10-397	AHRS-3	UPPER EPC	RIGHT RADIO AC BUS	F/1
	B10-398	AHRS-3	OVERHEAD	EMERGENCY AC BUS	C/1
			Wait approximately 45 seconds for warning displays out of view.		
(25)	Return aircraft to required configuration.				

B. Compass Controller Unit (CCU) Operational Test

Table 203 Compass Controller Unit (CCU) Operational Test

Step	Operation	Desired Result
(1)	Verify AHRS switch is in center position.	
(2)	On CAPT CCU, check that sync indicator pointer is in 12 o'clock position. Note aircraft heading that is displayed on CAPT ND.	Sync indicator pointer in 12 o'clock position. Aircraft heading noted.
(3)	On CAPT CCU, rotate SET HDG knob CW to first index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates upscale (CCW) 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects CW to right of index mark.
(4)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.

Table 203 Compass Controller Unit (CCU) Operational Test (Continued)

Step	Operation	Desired Result
(5)	Rotate SET HDG knob CCW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(6)	Rotate SET HDG knob CW to second index mark and hold 10 seconds.	Compass rose on CAPT ND. rotates upscale (CCW) 50 degrees (±10°) within 10 seconds. Sync indicator pointer deflects CW full scale to right of index mark.
(7)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.
(8)	Rotate SET HDG knob CCW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(9)	Rotate SET HDG knob CCWto first index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates downscale (CW) 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects CCW to left of index mark.
(10)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1). Sync indicator pointer begins to creep back to 12 o'clock position.
(11)	Rotate SET HDG knob CW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(12)	Rotate SET HDG knob CCW to second index mark and hold for 10 seconds.	Compass rose on CAPT ND rotates downscale (CW) 50 degrees (±10°) within 10 seconds. Sync indicator pointer deflects CCW full scale to left of index mark.
(13)	Release SET HDG knob.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1), sync indicator pointer begins to creep back to 12 o'clock position.
(14)	Rotate SET HDG knob CW to first index mark and hold until compass rose returns to heading noted in step (1), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1), sync indicator pointer in 12 o'clock position.
(15)	Repeat steps (1) through (14) using AHRS-2 CCU and F/O ND	
(16)	On overhead switch panel, place AHRS switch in left position (Capt on AHRS-3).	ATT3 displayed on CAPT PFD. HDG3 displayed on CAPT ND.
(17)	Repeat steps (2) through (14) using CAPT CCU and ND.	
(18)	On overhead switch panel, place AHRS switch in right position (F/O on AHRS-3).	ATT3 displayed on F/O PFD. HDG3 displayed on F/O ND.

Table 203 Compass Controller Unit (CCU) Operational Test (Continued)

Step	Operation	Desired Result
(19)	Repeat steps (2) through (14) using F/O CCU and ND.	
(20)	On overhead switch panel, place AHRS switch in center position.	No ATT3 on either PFD. No HDG3 on either ND.
(21)	End of functional test. Return aircraft to required configuration unless demagnetizing procedures are required.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of aircraft unless it is energized.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from aircraft.

(2) Energize degausser at a distance of at least 10 ft (3 m) from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in series of parallel strokes over entire area from top of windshield aft for distance of 36 in. (914 mm) and bounded on each side by left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 ft (3 m) from aircraft before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place carefully in a safe place.

(2) Energize degausser at a distance of at least 10 ft (3 m) away from aircraft and move towards appropriate area in wing or nose.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to a point at least 10 ft (3 m) from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(6) for other flux valve areas.

(7) Install flux valve.

(8) Perform operational check of heading system. (, ATTITUDE AND HEADING REFERENCE UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-10/201 Config 2)

(9) Return aircraft to required configuration.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The gyrosyn compass system is a gyroscope stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, EFIS ND, CI, and compass amplifier. Other components or systems which receive heading information from the compass system are the FDAU, VOR/ILS receivers, digital flight guidance computers and HUD computer. Heading selection is also provided for the automatic pilot.

B. To check the complete system, the test should be performed in its entirety. The individual compass system functions can be checked by performing only the appropriate portions of the applicable tests.

C. The compass system comprises two (captain's -1 and first officer's -2) complete individual systems. Procedures for testing captain's and first officers's compass systems are similar, differences are shown in parentheses.

D. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or gyro compass system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred. Paragraph 4. for demagnetizing procedures.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Compass System

A. Test Compass System - Preliminary

(1) Before energizing electrical buses, observe that captain's and first officer's ND HEADING and CI OFF warning flags are in view.

(2) Captain's and first officer's ND HEADING and CI OFF warning flags should be out of view.

(a) The captain's and first officer's ND HEADING and CI OFF warning flags will appear if any one of the following functions is not operating correctly:

- Electrical power to compass system
- Directional gyro not level
- Directional gyro not operating at sufficient speed
- Excessive error signal in heading servo loop.

B. Test Compass System - Functional

Table 202 Test Compass System - Functional

Step	Operation	Desired Result
(1)	Set AP-ON 1/2 selector switch Flight Guidance Control Panel to position 1.	

Table 202 Test Compass System - Functional (Continued)

Step	Operation	Desired Result
(2)	Place compass switch to normal position and observe that compass lights are OFF.	Compass lights OFF.
(3)	Depress and rotate F/O compass indicator sync knob 3 or more turns in the CW direction.	CAPT ND and F/O compass indicator compass cards rotate CCW.
		CAPTND HDG bug and CRS arrow retains relative position with compass card.
NOTE: If the flight guidance control panel is missing, the CAPT ND heading bug may move erratically.		
NOTE: If the CAPT VHF NAV-1 panel is missing, the CAPT ND course arrow may move erratically.		
(4)	Synchronize F/O compass indicator.	CAPT ND HDG FAIL flag out-of-view.
		F/O compass indicator OFF flag out-of-view.
		F/O compass indicator compass card agrees with CAPTND compass card heading indicator (±1°).
(5)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CCW direction.	F/O ND and CAPT compass indicator compass cards rotate CW.
		F/O ND HDG BUG & CRS arrow retains relative position with compass card.
(6)	Synchronize CAPT compass indicator.	F/O ND "HDG FAIL" message out-of-view.
		CAPT compass indicator OFF flag out-of-view.
		CAPT compass indicator compass card agrees with CAPT ND compass card heading indicator (±1°).
(7)	On Flight Guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	CAPT ND HDG bug as read against compass card agree with HDG readout on Flight Guidance control panel (±2°).
		F/OND HDG bug as read against compass card agrees with HDG readout on Flight Guidance control panel (±2°).
(8)	On CAPT VHF NAV Control Panel, increase selected CRS readout by plus 60°.	CAPT ND course arrow as read against compass card agrees with CRS readout on CAPT VHF NAV control panel (±2°).
(9)	On F/O VHF NAV Control Panel, decrease selected CRS readout by minus 60°.	F/O ND course arrow as read against compass card agrees with CRS readout on F/O VHF NAV control panel (±2°).
(10)	On Flight Guidance Control Panel, set AP-ON 1/2 selector switch to position 1.	

C. Test Compass Switching

Table 203 Test Compass Switching

Step	Operation	Desired Result
(1)	Place compass switch to "Both on 1" position and observe following:	Both on 1 set.
	a Compass lights on corresponding instrument panels are ON.	Capt 1/F/O 1 compass light is ON.
	b Flags in CAPT and F/O NDs and compass indicators are out of view.	Message/flags are out of view.
(2)	Open this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-379	CAPTAIN'S COMPASS BOTH ON 1	UPPER EPC	RIGHT RADIO BUS	C/5

		Observe that CAPT compass indicator OFF flag and F/O ND "HDG Fail" messages are in view
(3)	Close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-379	CAPTAIN'S COMPASS BOTH ON 1	UPPER EPC	RIGHT RADIO BUS	C/5

(4)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW direction and observe following:	
	a Compass cards in CAPTand F/O ND and compass indicators rotate CCW.	Compass cards rotate CCW.
	b Heading bug and course arrow on CAPT and F/O ND retain relative position with compass card or compass card rotates.	Heading bug and course arrow retain relative position with compass card.
(5)	Synchronize F/O compass indicator.	CAPT and F/OND HDG Fail message not displayed.
		F/O and CAPT compass indicator's OFF flags out of view.
		F/O and CAPT ND and compass indicators compass cards agree with each other (±2°).
(6)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CW direction and observe following:	
	a Compass cards in the CAPT compass indicator and F/O ND rotate CCW.	Compass cards rotate CCW.

Table 203 Test Compass Switching (Continued)

Step	Operation	Desired Result
(7)	Rotate CAPT compass indicator sync knob until CAPTcompass indicator compass card agrees with F/O compass indicator compass card.	F/O and CAPT ND "HDG Fail" message not displayed.
		CAPT and F/O compass indicator flags are out of view.
		CAPT and F/O ND and compass indicator's compass cards agree with each other to (±2°).
(8)	Place compass switch to "Both on 2" position and observe following:	Both on 2 set.
	a Compass lights on correspond ing instrument panels are ON.	Capt 2/F/O 2 light is ON.
	b Flags in CAPT and F/O ND and compass indicators are out of view.	Message/flags are out of view.
(9)	Open this circut breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-380	F/O COMPASS BOTH ON 2 28 VAC	OVERHEAD	EMERGENCY AC BUS	B/2

		Observe that CAPT ND and F/O compass indicator flags are in view
(10)	Close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-380	F/O COMPASS BOTH ON 2 28 VAC	OVERHEAD	EMERGENCY AC BUS	B/2

(11)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW direction and observe following:	
	a Compass cards in CAPT ND and F/O compass indicator rotate CCW.	Compass cards rotate CCW.
(12)	Synchronize F/O compass indicator.	CAPT and F/O ND "HDG FAIL" message not displayed.
		F/O and CAPT compass indicator's OFF flags out of view.
		F/O and CAPT NDs and compass indicators compass cards agree with each other to (±2°).

Table 203 Test Compass Switching (Continued)

Step	Operation	Desired Result
(13)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CW direction and observe following:	
	a Compass cards in CAPT and F/O ND and compass indicators rotate CCW.	Compass cards rotate CCW.
	b Heading bug and course arrow on CAPT and F/O ND retain relative position with compass card as compass card rotates.	Heading bug and course arrow retain relative position with compass card.
(14)	Synchronize CAPT Compass indicator.	Synchronized.
(15)	Set compass switch located on CAPT instrument panel to normal position.	Normal set.
(16)	Compass lights on CAPT instrument panel are OFF.	"Comp" lights are OFF.
(17)	Return aircraft to required configuration.	

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of aircraft unless it is energized.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from aircraft.

(2) Energize degausser at a distance of at least 10 ft (3 m) from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in a series of parallel strokes over entire area from top of windshield aft for a distance of 36 in. (914 mm) and bounded on each side by the left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 ft (3 m) from aircraft before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place in safe place.

(2) Energize degausser at a distance of at least 10 ft (3 m) away from the airplane and move it towards appropriate area in wing.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to a point at least 10 ft (3 m) from aircraft and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve area.

(7) Install flux valve.

(8) Perform operational check of compass system.

(9) Return aircraft to required configuration.

5. Compass Tolerances

A. In service compass tolerances are as follows:

Table 204 In service compass tolerances

Indicators	Flight Attitude	Tolerance
Pilot's CI to Copilot's ND		Less than or equal to 2°
Copilot's CI to Pilot's ND		Less than or equal to 2°
Pilot's and Copilot's CIs to Standby Compass		Less than or equal to 10°
Pilot's CI to Copilot's CI	Level	Less than or equal to 4°
Pilot's CI to Copilot's CI	360° steady turn at 30° bank angle.	Max. 12°
Pilot's CI to Copilot's CI	Wings level from 360° turn at 30° bank angle.	Max. 6°
Normal Slave Rate	90° turn	1.5° to 4.5° per minute.

HEADING SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 880, 881, 883, 884 PRE MD80-34-285

A. The gyrosyn compass system is a gyroscope stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, radio direction indicator (RDI), radio magnetic indicator (RMI), and integrated instrument amplifier. Other components or systems which may receive heading information from the compass system are the FDAU VOR/ILS receivers and digital flight guidance computers and HUD computer. Heading selection is also provided for the automatic pilot.

WJE 881, 883; PRE SB 34-385 REV 3

B. The gyrosyn compass system is a gyroscope stabilized, remote magnetic sensing compass system. The basic components of the system are the flux valve, directional gyro, horizontal situation indicator (HSI), CI, and compass instrument amplifier. Other components or systems which may receive heading information from the compass system are the FDAU, VOR/ILS receivers and digital flight guidance computers. Heading selection is also provided for the automatic pilot.

WJE 405, 409, 880, 881, 883, 884

C. To check the complete system, the test should be performed in its entirety. The individual compass system functions can be checked by performing only the appropriate portions of the applicable tests.

D. The compass system comprises two (captain's -1 and first officer's -2) complete individual systems. Procedures for testing captain's and first officers's compass systems are similar, differences are shown in parentheses.

E. Certain parts of the aircraft structure surrounding the standby magnetic compass and flux valves may be magnetized by heavy static electrical discharges or lightning strike. Such magnetization may cause excessive errors in the standby compass or gyro compass system. Verification of such magnetization can be confirmed by using a handheld magnetic compass in the areas suspected. Excessive deflections of the compass as it is moved about the areas should confirm that magnetization of aircraft parts has occurred. Paragraph 4. for demagnetizing procedures.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Degausser Model 990A or C	Magnetic Instrumentation Inc.
Degaussing Coil HC7010-3	Magnetic Instrumentation Inc.
Degausser Output Cable 201992	Magnetic Instrumentation Inc.

3. Adjustment/Test Compass System

A. Test Compass System - Preliminary

(1) Before energizing electrical buses, observe that CAPT and F/O HSI HEADING and CI OFF warning flags are in view.

(2) After energizing airplane electrical buses, wait 5 minutes for systems warm-up, then verify following conditions:

(3) CAPT and F/O HSI HEADING and CI OFF warning flags should be out of view.

(a) The CAPT and F/O HSI HEADING and CI OFF warning flags will appear if any one of the following functions is not operating correctly:

- Electrical power to compass system
- Directional gyro not level
- Directional gyro not operating at sufficient speed
- Excessive error signal in heading servo loop.

B. Test Compass System - Functional

WJE 405, 409, 880, 881, 883, 884 PRE MD80-34-285

Table 202 Test Compass System - Functional

Step	Operation	Desired Result
(1)	Set AP-ON 1/2 selector switch Flight Guidance Control Panel to position 1.	
(2)	Place compass switch to normal position and observe that compass lights are OFF.	Compass lights OFF.
(3)	Depress and rotate F/O compass indicator sync knob 3 or more turns in the CW direction.	CAPT HSI andF/O compass indicator compass cards rotate CCW. CAPT HSI HDG bug & CRS arrow retains relative position with compass card.
(4)	Synchronize F/O compass indicator.	CAPT HSI HDG flag out-of view.
		F/O compass indicator OFF flag out-of-view.
		F/O compass indicator compass card agrees with CAPT HSI compass card heading indicator (±2°).
(5)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CCW direction.	F/O HSI and CAPT compass indicator compass cards rotate CW. F/O HSI HDG bug & CRS arrow retains relative position with compass card.
(6)	Synchronize CAPT compass indicator.	F/O HSI HDG flag out-of view.
		CAPT compass indicator OFF flag out-of-view.
		CAPT compass indicator compass card agrees with F/O HSI compass card heading indicator (±2°).
(7)	On Flight Guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	CAPT HSI HDG bug as read against compass card agree with HDG readout on Flight Guidance control panel (±2°).
		F/O HSI HDG bug as read against compass card agrees with HDG readout on Flight Guidance control panel (±2°).
(8)	On CAPT VHF NAV Control Panel, increase selected CRS readout by plus 60°.	CAPT HSI course arrow as read against compass card agrees with CRS readout on CAPT VHF NAV control panel (±2°).
(9)	On F/O VHF NAV Control Panel, decrease selected CRS readout by minus 60°.	F/O HSI course arrow as read against compass card agrees with CRS readout on F/OVHF NAV control panel (±2°).
(10)	On Flight Guidance Control Panel, set AP-ON 1/2 selector switch to position 1.	

WJE 881, 883; PRE SB 34-385 REV 3

Table 203 Test Compass System - Functional

Step	Operation	Desired Result
(1)	Set 1/2 Selector Switch on Flight Guidance Control Panel to Position 1.	
(2)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW direction and observe following:	CAPT HSI and F/O compass indicator compass cards rotate CCW. CAPT HSI HDG bug and CRS arrow retains relative position with compass card.
(3)	Synchronize F/O compass indicator.	CAPT HSI HDG flag out-of view.
		F/O compass indicator OFF flag out-of-view.
		F/O compass indicator compass card agrees with CAPT HSI compass card heading indicator (±2°).
(4)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CCW direction and observe following:	F/O HSI and CAPT compass indicator compass cards rotate CW.F/O HSI HDG bug & CRS arrow retains relative position with compass card.
(5)	Synchronize CAPT compass indicator.	F/O HSI HDG flag out-of view.
		CAPT compass indicator OFF flag out-of-view.
		CAPT compass indicator compass card agrees with F/O HSI compass card head ing indicator within (±2°).
(6)	On Flight Guidance control panel, set AP-ON 1/2 selector switch to position 2; increase selected HDG readout by plus 90°.	CAPT HSI HDG bug as read against compass card agree with HDG readout on Flight Guidance control panel within (±2°).
		F/O HSI HDG bug as read against compass card agrees with HDG readout on Flight Guidance control panel within (±2°).
(7)	On CAPT VHF NAV Control Panel, increase selected CRS readout by plus 60°.	CAPT HSI course arrow as read against compass card agrees with CRS readout on CAPT VHF NAV control panel within (±2°).
(8)	On F/O VHF NAV Control Panel, decrease selected CRS readout by minus 60°.	F/O HSI course arrow as read against compass card agrees with CRS readout on F/O VHF NAV control panel within (±2°).
	On Flight Guidance Control Panel, set AP-ON 1/2 selector switch to position 1.	
(9)	Return airplane to required configuration.	

WJE 405, 409, 880, 881, 883, 884 PRE MD80-34-285

C. Test Compass Switching

WJE 405, 409, 880, 881, 883, 884 PRE MD80-34-285 (Continued)

Table 204 Test Compass Switching

Step	Operation		Desired Result
(1)	Place compass switch to "Both on 1" position and observe following:		CAPT compass indicator and F/O HSI may indicate up to 180° from F/O compass indicator and CAPT HSI.
	a	Compass lights on corresponding instrument panels are ON.	COMP lights are ON.
	b	Flags in CAPT and F/O HSI's and compass indicators are out of view.	Flags are out of view.
(2)	Open and close this circuit breaker:		
	REF DES: B10-379	CIRCUIT BREAKER: CAPTAIN'S COMPASS BOTH ON 1	LOCATION: UPPER EPC / PANEL AREA: RIGHT RADIO BUS / ROW/COL: C/5
			Observe that CAPT compass indicator and F/O HSI flags are in view, When the circuit breaker is opened.
(3)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW direction and observe following:		
	a	Compass cards in CAPT and F/O HSI and compass indicators rotate CCW.	Compass cards rotate CCW.
	b	Heading bug and course arrow on CAPT and F/O HSI retain relative position with compass card or compass card rotates.	Heading bug and course arrow retain relative position with compass card.
(4)	Synchronize F/O compass indicator.		CAPT and F/O HSI HDG flags out of view.
			F/O and CAPT compass indicator's OFF flags out of view.
			F/O and CAPT HSI's and compass indicators compass cards agree with each other (±2°).
(5)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in CW direction and observe following:		
	a	Compass cards in the CAPT compass indicator and F/O HSI rotate CCW.	Compass cards rotate CCW.
(6)	Rotate CAPT compass indicator sync knob until CAPT compass indicator compass card agrees with F/O compass indicator compass card.		F/O and CAPT HSI heading flags are out of view.
			CAPT and F/O compass indicator flags are out of view.
			CAPT and F/O HSI and compass indicator's compass cards agree with each other to (±2°).

WJE 405, 409, 880, 881, 883, 884 PRE MD80-34-285 (Continued)

Table 204 Test Compass Switching (Continued)

Step	Operation		Desired Result
(7)	Place compass switch to "Both on 2" position and observe following:		F/O compass indicator and CAPT HSI may indicate up to 180° from CAPT compass indicator and F/O HSI.
	a	Compass lights on both instrument panels are ON.	COMP lights are ON.
	b	Flags in CAPT and F/O HSI's and compass indicator are out of view.	Flags are out of view.
(8)	Open and close this circuit breaker:		
	REF DES: B10-380	CIRCUIT BREAKER: F/O COMPASS BOTH ON 2 28 VAC	LOCATION: OVERHEAD / PANEL AREA: EMERGENCY AC BUS / ROW/COL: B/2
			Observe that CAPT HSI and F/O compass indicator flag is in view. When the circuit breaker is opened.
(9)	Depress and rotate F/O compass indicator sync knob 3 or more turns in CW direction and observe following:		Compass cards rotate CCW.
	a	Compass cards in CAPT HSI and F/O compass indicator rotate CCW.	
(10)	Synchronize F/Ocompass indicator.		CAPT and F/O HSI's HDG flags out of view.
			F/O and CAPTcompass indicator's OFF flags out of view.
			F/O and CAPT HSI's and compass indicators compass cards agree with each other to (±2°).
(11)	Depress and rotate CAPT compass indicator sync knob 3 or more turns in clockwise direction and observe following:		
	a	Compass cards in CAPT and F/O HSI and compass indicators rotate CCW.	Compass cards rotate CCW.
	b	Heading bug and course arrow on CAPT and F/O HSI retain relative position with compass card as compass card rotates.	Heading bug and course arrow retain relative position with compass card.
(12)	Return airplane to required configuration.		

WJE 405, 409, 880, 881, 883, 884

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of airplane UNLESS IT IS ENERGIZED.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from airplane.

(2) Energize degausser at a distance of at least 10 ft (3 m) from airplane.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in a series of parallel strokes over entire area from top of windshield aft for a distance of 36 in. (914 mm) and bounded on each side by the left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 ft (3 m) from airplane before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Swing compass if deemed necessary.

C. Demagnetize Flux Valves

(1) Remove flux valve and place in safe place.

(2) Energize degausser at a distance of at least 10 ft (3 m) away from the airplane and move it towards appropriate area in wing.

(3) Demagnetize all steel bolts and screws in area.

(4) Withdraw degausser to a point at least 10 ft (3 m) from airplane and switch OFF.

(5) Check area for residual magnetism with handheld magnetic compass and repeat Paragraph 4.C.(3) as necessary.

(6) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(5) for other flux valve area.

(7) Install flux valve.

(8) Perform operational check of compass system.

(9) Return aircraft to required configuration.

5. Compass Tolerances

A. In service compass tolerances are as follows:

Table 205 In Service Compass Tolerances

Indicators	Flight Attitude	Tolerance
Pilot's CI to Copilot's Horizontal Situation Indicator (HSI)		Less than or equal to 2°
Copilot's CI to Pilot's HSI		Less than or equal to 2°
Pilot's and Copilot's CI to Standby Compass		Less than or equal to 10°
Pilot's CI to Copilot's CI	Level	Less than or equal to 4°
Pilot's CIto Copilot's CI	360° steady turn at 30° bank angle.	Max. 12°
Pilot's CI to Copilot's CI	Wings level from 360° turn at 30° bank angle.	Max. 6°

Table 205 In Service Compass Tolerances (Continued)

Indicators	Flight Attitude	Tolerance
Normal Slave Rate	90° turn	1.5° to 4.5° per minute.

STANDBY COMPASS - MAINTENANCE PRACTICES

1. General

A. The magnetic standby compass contains a two-axis magnetic compensating mechanism to correct for magnetic deviation caused by the airplane structure. Compensating screws for N-S (North-South) and E-W (East-West) adjustments are located on the compass face, and are accessible by rotating the dust cover plate.

B. The standby compass is located in the ceiling in the flight compartment above the First Officer.

NOTE: Air bubbles can occur in the standby magnetic compass because of temperature change and/or decrease of liquid. Maintenance limits made for liquid quantity make sure of satisfactory compass operation. When an air bubble is larger than 3/8-inch wide and 1/8-inch high, with the compass in the normal operating position, replace the standby compass.

2. Removal/Installation

A. Remove Standby Compass

(1) Disconnect electrical connector at back of compass. (Figure 201)

(2) Loosen clamp screws and remove compass.

B. Install Standby Compass

WJE ALL POST MD80-SL-34-111

CAUTION: USE TOOLS AND HARDWARE THAT ARE NOT MAGNETIC WHEN YOU REPLACE OR ADJUST THE STANDBY COMPASS. MAGNETIC TOOLS AND HARDWARE CAN CAUSE DAMAGE TO THE STANDBY COMPASS.

(1) Align the E-W and N-S line markings on the top of the standby compass as follows: (Figure 201)

(a) Turn the coverplate screw clockwise to open the compensator coverplate.

(b) Adjust the N-S compensator screw and E-W compensator screw until the four line markings on the top of the standby compass are aligned.

(c) Turn the coverplate screw counterclockwise to close the compensator coverplate.

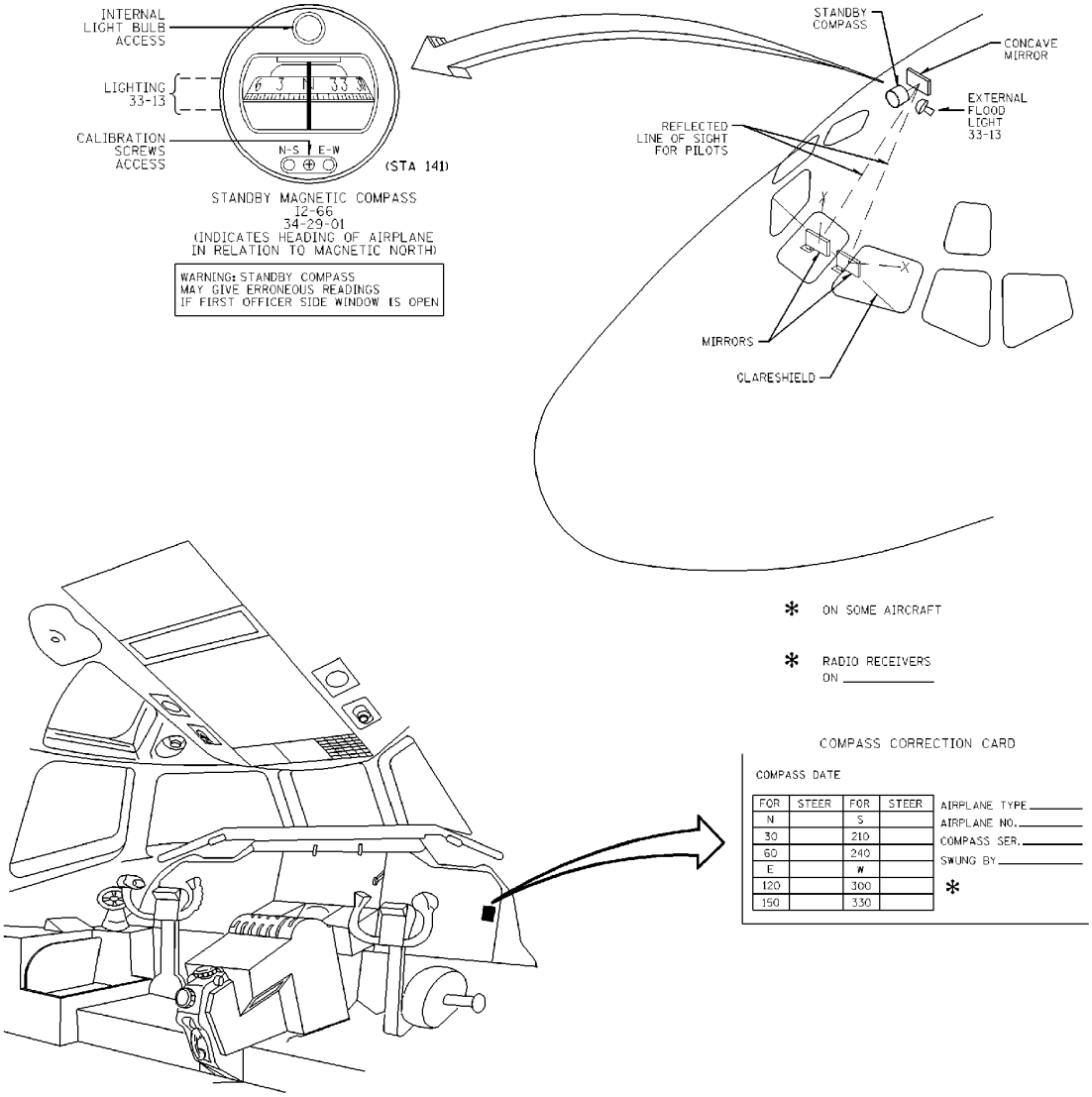
WJE ALL

(2) Insert compass in clamp.

CAUTION: USE ONLY BRASS SCREWS FOR MOUNTING COMPASS.

(3) Tighten clamp screws.

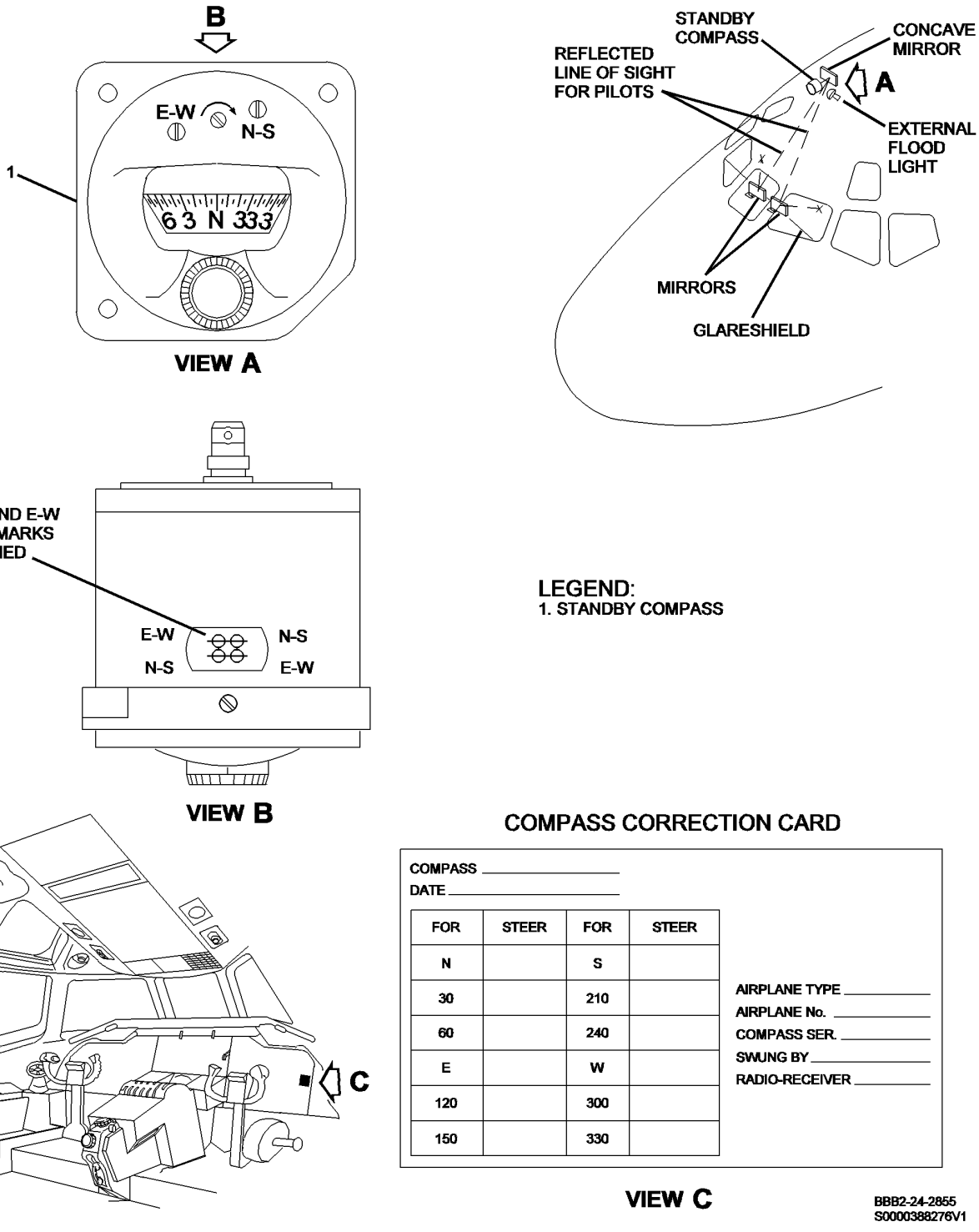
(4) Adjust mirror so Captain and First Officer can see compass dial in mirror on glareshield when sitting in a normal position.



CAG(IGDS) *MDC PROPRIETARY* BBB2-34-117A

Standby Magnetic Compass
Figure 201/34-21-01-990-807 (Sheet 1 of 2)

EFFECTIVITY
WJE 401-411, 415-427, 429, 884, 893 PRE
MD80-SL-34-111



Standby Magnetic Compass
Figure 201/34-21-01-990-807 (Sheet 2 of 2)

3. **Adjustment/Test Standby Compass**

A. Preparation

(1) Do the demagnetizing procedures, Paragraph 4.

(2) Tow aircraft to compass rose or an approved swing site.

NOTE: Swing site should be free from traffic and large ferrous/magnetic objects and in an area which has been found to be magnetically stable.

(3) An alternate swing procedure when a compass rose or an approved swing site is not available is: position the aircraft on a site that is free of magnetic influence (i.e., traffic, large metallic objects) and continue with standby compass adjustment/test as follows.

NOTE: When accomplishing the alternate swing procedure the aircraft indicators (Horizontal Situation Indicator (HSI) or ND) are used to align the aircraft to the headings required to accomplish swing procedure. For aircraft equipped with AHRS, place the compass selector switch in the norm position. For aircraft equipped with Inertial Reference System (IRS), alignment of the IRS will need to be accomplished prior to starting swing procedure. Verify the heading displayed on the aircraft indicators (HSI or ND) is within 2 degrees of the ramp line used to align aircraft for alternate swing procedure.

(4) Remove any equipment containing ferrous metal in area immediately surrounding compass rose.

(5) Advise all personnel to remove tools and other ferrous metal objects from clothing.

(6) Position ground power unit forward and to left of nosewheel; or preferably, use APU for power.

(7) Position tow truck forward and to right of nosewheel.

(8) Energize all electrical/electronics circuits that draw current for more than 50 percent of time during flight, except following:

(a) Lights: Lower compartments, taxi, ground flood, landing, flight compartment, and scanning lights.

(b) Engine: Starters and ignition.

(c) Fuel: Tank fill valves, fuel pumps, and tank boost pumps.

(d) Fire warning and control, anti-icing, and warning.

(e) Miscellaneous: Pilot and mechanic call, ground control relay, and utility outlets.

(9) Ensure Captain's and First Officer's clear view windows are closed.

NOTE: A 5-6 degree variation can occur when windows are opened and closed.

WJE ALL POST MD80-SL-34-111

(10) Align the E-W and N-S line marks on the top of the standby compass as follows:

NOTE: The lines are aligned at the installation task. This is not necessary if a new standby compass is installed and the marks were aligned at the installation task.

(a) Remove the standby compass, Paragraph 2.A..

(b) Install the standby compass, Paragraph 2.B..

WJE ALL

B. Test

(1) Check that compass is properly installed with brass screws and that dial is centered in window.

(2) Place compass light switch in dim position and check that compass integral light comes on.

(3) Place compass light switch in bright position. Check that compass external light comes on and compass internal light goes off.

NOTE: For compass verification swing, steps Paragraph 3.B.(4) through Paragraph 3.B.(12) may be omitted. Compass deviation compensation checks are required when the standby compass has been removed and/or replaced.

(4) Check deviation compensation as follows:

(a) Rotate N-S screw in both directions and check that compass card deflects.

(b) Rotate E-W screw in both directions and check that compass card deflects.

(c) Rotate both compensator screws to zero and check that dots are adjacent.

(5) Check compass card for freedom of movement as follows:

(a) Deflect compass card 5 degrees or more with small magnet.

(b) Deflect compass card 5 degrees or more in opposite direction.

(c) Remove small magnet. Compass card shall return to original indication within 1 degree without tapping.

(6) Determine indicated heading as follows:

(a) Position airplane on east heading and record compass reading.

(b) Repeat substep 3.B.(6)(a) for south, west, and north headings and record readings.

(7) Solve formula for N-S compass compensation:

(a) N-S compensation coefficient equals C.

(b) North deviation equals actual heading (000), minus indicated heading.

(c) South deviation equals actual heading (180), minus indicated heading.

(d) N-S Compass Formula:

$$C = \frac{\text{North Dev} - \text{South Dev}}{2}$$

(8) Adjust N-S compensator for coefficient C with airplane on north heading. See example Figure 202

(9) Solve formula for E-W compass compensation:

(a) E-W compensation coefficient equals B.

(b) East deviation equals actual heading (090), minus indicated heading.

(c) West deviation equals actual heading (270), minus indicated heading.

(d) E-W Compass Formula:

$$B = \frac{\text{East Dev} - \text{West Dev}}{2}$$

(10) Adjust E-W compensator for coefficient B with airplane on east heading. See example Figure 202

(11) Solve formula for case index error as follows:

(a) Swing aircraft through four cardinal headings and record readings.

(b) Calculate coefficient A to determine index correction and algebraic sign with following formula:

(c) Case Index Formula:

$$A = \frac{(Dn) + (De) + (Ds) + (Dw)}{4}$$

(12) Realign compass until compass reading is changed by amount equal to index correction and algebraic sign of coefficient A. Loosen Compass Mounting Screw in slotted hole to permit movement of the compass in azimuth.

NOTE: The slotted hole is incorporated on later production aircraft. Brackets with unslotted hole, hole can be slotted as required for azimuth alignment.

(13) Swing aircraft in increments of 30 degrees beginning at any 30 degree interval from 000 degrees to 330 degrees.

(14) Record standby compass headings on aircraft compass correction card. No deviation shall be greater than 8 degrees.

NOTE: The standby compass should be considered serviceable if the corrected heading is within 10 degrees of the heading indicated by the operable remote compass system.

(15) Record the following data on the aircraft compass correction card:

Table 201

1)	Compass	_____	5)	Compass S/N	_____
2)	Date	_____	6)	Swung By	_____
3)	Airplane Type	_____	7)	Radio Receiver	_____
4)	Airplane No.	_____			

NOTE: The RADIO RECEIVER may not be on some cards for certain aircraft.

(16) Return aircraft to required configuration.

STANDBY COMPASS COMPENSATION

EXAMPLE:

NOTE: IN CALCULATING AND APPLYING COMPENSATION, BE CAREFUL TO OBSERVE PROPER ALGEBRAIC SIGNS.

1. WITH AIRPLANE POSITIONED ON EAST, SOUTH, WEST, AND NORTH HEADINGS, COMPASS AND DEVIATION EXAMPLE READINGS ARE OBTAINED AS FOLLOWS:

ACTUAL MAGNETIC HEADING	INDICATED COMPASS HEADING	DEVIATION (DEGREES)
090 (EAST)	90	0.0
180 (SOUTH)	175.5	+4.5
270 (WEST)	276	-6.0
000 (NORTH)	006.5	-6.5

2. SOLVE FOR COEFFICIENT C:

$$C = \frac{\text{NORTH DEV - SOUTH DEV}}{2} \rightarrow C = \frac{-6.5 - (+4.5)}{2}$$

$$C = \frac{-6.5 - 4.5}{2} \rightarrow C = \frac{-11}{2} \rightarrow C = -5.5 \text{ DEGREES}$$

3. WITH AIRPLANE ON NORTH HEADING (COMPASS INDICATING 006.5 DEGREES), ADUST N-S COMPENSATOR UNTIL COMPASS READS 001.0 DEGREES. (C 6.5-5.5)

4. SOLVE FOR COEFFICIENT B:

$$B = \frac{\text{EAST DEV - WEST DEV}}{2} \rightarrow B = \frac{0 - (-6.0)}{2}$$

$$B = \frac{0 + 6}{2} \rightarrow B = \frac{+6}{2} \rightarrow B = +3$$

5. WITH AIRPLANE ON EAST HEADING (COMPASS INDICATING 090 DEGREES), ADJUST E-W COMPENSATOR UNTIL COMPASS INDICATES 093 DEGREES.

CAG(IGDS) BBB2-34-2405

Standby Compass Compensation Example
Figure 202/34-21-01-990-806

4. Demagnetizing Procedures

A. Precautions

(1) Do not permit degausser to remain within 10 ft (3 m) of any part of aircraft unless it is energized.

(2) Do not operate degausser in vicinity of magnetic compass or remote compass transmitter (flux gate or flux valve).

(3) Care should be taken to ensure that degausser is not actually in contact with surface when used. (To be effective, it should be used as close to surface as possible.)

B. Demagnetize Standby Compass Area (Area about Windshields and Flight Compartment)

(1) Remove standby compass and store in an area away from aircraft.

(2) Energize degausser at a distance of at least 10 ft (3 m) from aircraft.

CAUTION: IN FOLLOWING PROCEDURES OF DEGAUSSING WINDSHIELD AND FLIGHT COMPARTMENT AREAS, MAKE CERTAIN TO KEEP DEGAUSSER ABOVE LOWER PART OF WINDSHIELD SILLS. THIS IS TO PREVENT ANY DAMAGE TO INSTRUMENTS.

(3) Move degausser slowly towards windshield areas, bring degausser as close as possible to structure without touching structure, move it in series of parallel strokes over entire area from top of windshield aft for distance of 36 in. (914 mm) and bounded on each side by left and right sliding windshields.

(4) Demagnetize windshield screws by moving degausser in line with screws.

(5) Withdraw degausser at least 10 ft (3 m) from aircraft before deenergizing.

(6) Check areas degaussed with handheld compass for signs of any remaining magnetization. If magnetization still exists, repeat process of degaussing until evidence of magnetization disappears.

(7) When area is satisfactorily demagnetized, install standby compass.

(8) Return aircraft to required configuration.

STANDBY COMPASS - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-21-01-720-801

2. Functional Check of the Standby Compass for Calibration

A. Prepare for Functional Check of Standby Compass for Calibration

SUBTASK 34-21-01-584-001

(1) Tow aircraft to compass rose or an approved swing site.

NOTE: Swing site should be free from traffic and large ferrous/magnetic objects and in an area which has been found to be magnetically stable.

(2) An alternate swing procedure when a compass rose or an approved swing site is not available is: position the aircraft on a site that is free of magnetic influence (i.e., traffic, large metallic objects) and continue with standby compass adjustment/test as follows.

NOTE: When accomplishing the alternate swing procedure the aircraft indicators (Horizontal Situation Indicator (HSI) or Navigation Display (ND)) are used to align the aircraft to the headings required to accomplish swing procedure. For aircraft equipped with Attitude and Heading Reference System (AHRS), place the compass selector switch in the norm position. For aircraft equipped with Inertial Reference System (IRS), alignment of the IRS will need to be accomplished prior to starting swing procedure. Verify the heading displayed on the aircraft indicators (HSI or ND) is within 2 degrees of the ramp line used to align aircraft for alternate swing procedure.

SUBTASK 34-21-01-840-001

(3) Remove any equipment containing ferrous metal in area immediately surrounding compass rose.

(a) Advise all personnel to remove tools and other ferrous metal objects from clothing.

SUBTASK 34-21-01-560-001

(4) Position ground power unit forward and to left of nosewheel; or preferably, use APU for power.

(5) Position tow truck forward and to right of nosewheel.

SUBTASK 34-21-01-861-001

(6) Energize all electrical/electronics circuits that draw current for more than 50 percent of time during flight, except following:

(a) Lights: Lower compartments, taxi, ground flood, landing, flight compartment, and scanning lights.

(b) Engine: Starters and ignition.

(c) Fuel: Tank fill valves, fuel pumps, and tank boost pumps.

(d) Fire warning and control, anti-icing, and warning.

(e) Miscellaneous: Pilot and mechanic call, ground control relay, and utility outlets.

(7) Ensure Captain's and First Officer's clear view windows are closed.

NOTE: A 5-6 degree variation can occur when windows are opened and closed.

B. Functional Check of the Standby Compass for Calibration

SUBTASK 34-21-01-210-001

(1) Check that compass is properly installed with brass screws and that dial is centered in window.

SUBTASK 34-21-01-720-001

(2) Place compass light switch in dim position and check that compass integral light comes on.

(3) Place compass light switch in bright position. Check that compass external light comes on and compass internal light goes off.

SUBTASK 34-21-01-720-002

(4) Swing aircraft in increments of 30 degrees beginning at any 30 degree interval from 000 degrees to 330 degrees.

(5) Record standby compass headings on aircraft compass correction card. No deviation shall be greater than 8 degrees.

NOTE: The standby compass should be considered serviceable if the corrected heading is within 10 degrees of the heading indicated by the operable remote compass system.

C. Job Close-up

SUBTASK 34-21-01-840-002

(1) Return aircraft to required configuration.

——— END OF TASK ———

STANDBY COMPASS - INSPECTION/CHECK

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-21-01-211-801

2. Detailed Inspection of the Standby Compass for Leaks and Freedom of Movement

A. Detailed Inspection of the Standby Compass for Leaks and Freedom of Movement of the Compass Card

SUBTASK 34-21-01-211-001

(1) Do a detailed inspection of the standby compass.

(a) Check compass for fluid leaks.

(b) Check compass card for freedom of movement.

——— END OF TASK ———

TASK 34-21-01-211-802

3. Detailed Inspection of the Standby Compass Clamps and Brackets

A. Detailed Inspection of the Standby Compass Clamps and Brackets

SUBTASK 34-21-01-211-002

(1) Do a detailed inspection of the standby compass.

(a) Check compass clamps for damage and security.

(b) Check the compass brackets for damage, cracks, and security.

——— END OF TASK ———

DIRECTIONAL GYRO - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the directional gyros (DG). There are two DG's installed in the forward accessory compartment. Access is through the accessory compartment door located in the nosewheel well.

NOTE: Removal/installation procedures for the two directional gyros are identical except for circuit breaker placarding.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	

3. Removal/Installation - Directional Gyro

CAUTION: DEPENDING ON THE ROTOR AND THE TYPE OF BEARINGS INSTALLED, ALLOW 15 TO 25 MINUTES FOR THE GYROS TO RUN DOWN BEFORE REMOVING THE UNIT. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE GIMBAL(S). USE CARE DURING THE REMOVAL TO PREVENT DAMAGE TO THE AIRFLOW SEAL. THE UNIT SHOULD BE TRANSPORTED IN ITS SHIPPING CONTAINER AT ALL TIMES.

A. Remove Directional Gyro

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT REMOVE/INSTALL THIS UNIT WHEN POWER IS APPLIED. THIS CAN CAUSE LARGE OUTPUT VOLTAGE SPIKES WHICH CAN CAUSE DAMAGE TO THE UNIT AND THE ASSOCIATED EQUIPMENT.

(1) Open these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) Remove safety wire, and remove cap directional gyro electrical connectors.

(a) Install protective caps and plugs.

(3) Remove screws from base mount and carefully remove directional gyro from rack.

B. Install Directional Gyro

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) Carefully place directional gyro into mounting position and install screws in base mount.

(3) Remove protective caps and plugs and install electrical connectors.

(a) Check condition of connectors.

(b) Tighten connectors into mating receptacle on DG by hand until they are mated with each other.

(c) Install safety wire so connectors will not become loose.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(5) Perform operational test as follows:

(6) Allow a minimum of 5 minutes for gyros to erect.

(7) Verify that Compass System is operating properly with HDG flag out of view on both Compass Indicators.

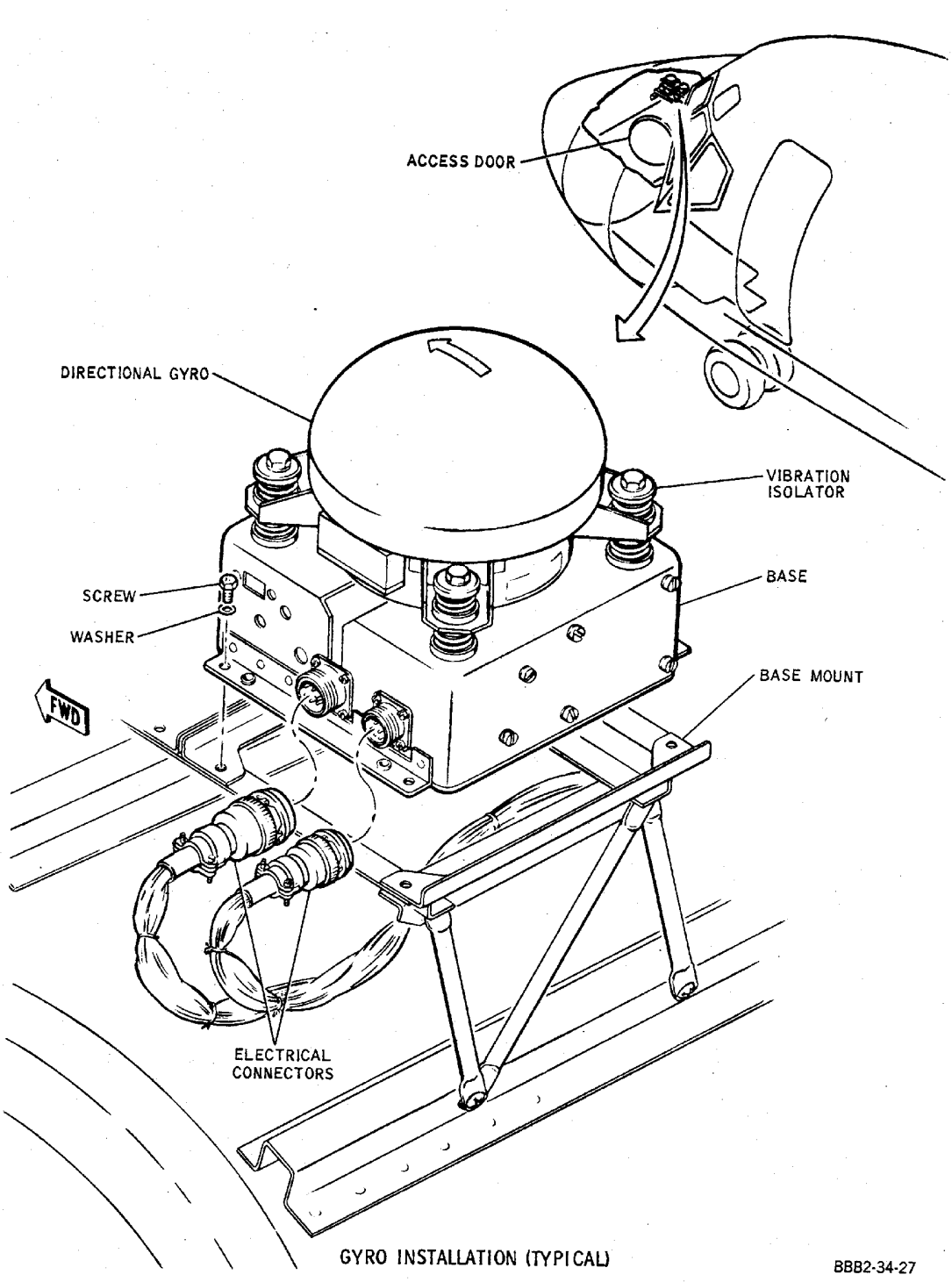
(8) Read present Captain's (First Officer's) compass heading and press and rotate sync knob to increase heading 10 degrees.

(9) Slaving rate of directional gyro as it slaves back to original heading in Paragraph 3.B.(8) should be a minimum of 1 degree/minute.

(10) Read present Captain's (First Officer's) compass heading and press and rotate sync knob to decrease heading 10 degrees.

(11) Slaving rate of directional gyro as it slaves back to original heading in Paragraph 3.B.(10) should be a minimum of 1 degree/minute.

(12) Return aircraft to required configuration.



Directional Gyro -- Removal/Installation
Figure 201/34-21-04-990-802

EFFECTIVITY
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

RADIO MAGNETIC INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the radio magnetic indicator (RMI). There are two RMI's located in the flight compartment, one on the captain's instrument panel, and one on the first officer's instrument panel.

B. Removal/installation of the captain's and first officer's RMI is identical except for circuit breakers which must be opened. If necessary to facilitate removal/installation of indicators, the captain's and first officer's instrument panels can be opened for access to the indicator. (PANELS, SUBJECT 31-10-00, Page 201)

2. Removal/Installation Radio Magnetic Indicator

A. Remove Radio Magnetic Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC
WJE 406-408			
B	2	B10-248	FIRST OFFICER'S RMI 28 VAC
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 877			
F	15	B10-395	AHRS-1
WJE 406-408, 411, 877			

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 877			
F	2	B10-396	AHRS-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
WJE 406-408, 877			
B	9	B10-247	CAPTAIN'S RMI

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
G	7	B10-24	VHF NAV-2

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on RMI.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

B. Install Radio Magnetic Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			
B	2	B10-248	FIRST OFFICER'S RMI 28 VAC
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 877			
F	15	B10-395	AHRS-1

WJE 406-408, 877 (Continued)

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 877			
F	2	B10-396	AHRS-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
WJE 406-408, 877			
B	9	B10-247	CAPTAIN'S RMI

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
G	7	B10-24	VHF NAV-2

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: ENSURE CLAMP ADJUSTMENT SCREWS ARE TIGHT OR INDICATOR CAN FALL FROM PANEL AND BE DAMAGED.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(5) Remove the safety tags and close these circuit breakers:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			
B	2	B10-248	FIRST OFFICER'S RMI 28 VAC

WJE 406-408 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 877			
F	15	B10-395	AHRS-1
WJE 406-408, 411, 877			

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 877			
F	2	B10-396	AHRS-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
WJE 406-408, 877			
B	9	B10-247	CAPTAIN'S RMI

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
G	7	B10-24	VHF NAV-2

(6) Verify HDG flag on both RMI's are out of view.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(7) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			
B	5	B10-394	AHRS-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 877			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 877			
F	2	B10-396	AHRS-2

HDG flag on applicable RMI in view when circuit breaker is open, and out of view within 1 minute of when circuit breaker is closed, provided aircraft is stationary.

(8) Return airplane to required configuration.

WJE 406-408, 411

NOTE: If necessary, perform Attitude and Heading Reference System Test. (ATTITUDE AND HEADING REFERENCE UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-10/201 Config 2)

FLUX VALVE - MAINTENANCE PRACTICES

1. General

CAUTION: USE TOOLS AND HARDWARE THAT ARE NOT MAGNETIC WHEN YOU WORK ON OR NEAR THE FLUX VALVES. THIS WILL HELP PREVENT INTERFERENCE TO THE CALIBRATION OF THE FLUX VALVE AND DAMAGE TO THE EQUIPMENT.

A. The flux valve for compass 1 system is located in the left wingtip and the flux valve for compass 2 system is located in the right wingtip. On later aircraft compass 1 and compass 2 flux valves are located in the left and right wing outboard trailing edge respectively. Access is through the access doors in each wingtip. The removal and installation procedure for each flux valve is similar.

2. Removal/Installation

A. Remove Flux Valve

WARNING: TAG AND SAFETY CIRCUIT BREAKERS.

CAUTION: DO NOT REMOVE/INSTALL THIS UNIT WHEN POWER IS APPLIED. THIS CAN CAUSE LARGE OUTPUT VOLTAGE SPIKES WHICH CAN CAUSE DAMAGE TO THE UNIT AND THE ASSOCIATED EQUIPMENT.

(1) Open and tag following circuit breakers, as applicable to flux valve being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) Gain access to flux valve through applicable access door as follows:

Compass System	Access Door Earlier Aircraft	Access Door Later Aircraft
Compass -1	1135A	1187C
Compass -2	1252A	1280C

(3) Tag and remove electrical wires from flux valve terminal strip.

(4) Remove mounting screws and remove flux valve. (Figure 201)

B. Install Flux Valve

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) Install mounting screws, and lightly tighten for positioning of flux valve.

(3) Position flux valve so that scribe line and scribe line on support bracket are aligned within 1/2 line width.

NOTE: If the new installed flux valve scribe line is aligned with the support bracket scribe line to within 1/2 line width, a compass swing is not required.

CAUTION: TO PREVENT INTERFERENCE WITH CALIBRATED POSITION OF FLUX VALVE, USE ONLY STAINLESS STEEL, NON-MAGNETIC HARDWARE FOR INSTALLATION.

(4) Tighten mounting screws.

(5) Connect electrical wires to flux valve terminal strip and remove tags.

(6) Install access door.

(7) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

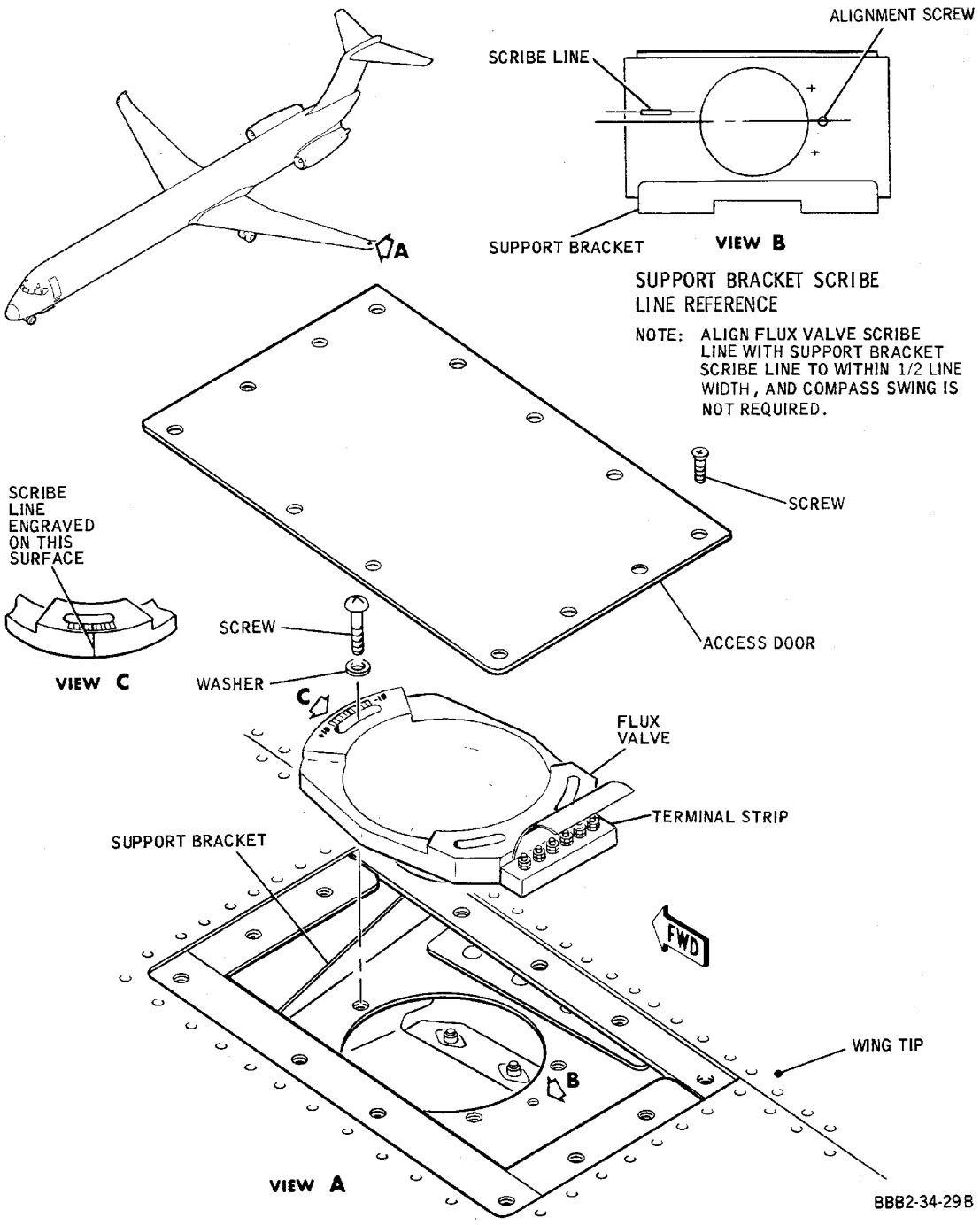
UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(8) With compass system synchronized, compass heading cards and HSI's compass cards should agree within ±4 degrees (0.07 rad).

NOTE: On aircraft with Radio Magnetic Indicators (RMIs) compass card and RDI compass cards, the RMI and RDI compass cards should agree within ±4 degrees (0.07 rad).

(9) If complete system test is required. (HEADING SYSTEM, SUBJECT 34-21-00, Page 201)



Flux Valve -- Removal/Installation
Figure 201/34-21-06-990-803

EFFECTIVITY
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

3. Calibration Procedure (Compass Swing)

A. Preliminary

NOTE: The following procedure can be used to verify the accuracy of the flux valve and the alignment of the flux valve bracket.

(1) Position aircraft on compass rose at magnetic north.

(2) Remove any nonessential portable equipment containing ferrous metal from area immediately surrounding compass rose.

(3) Advise all personnel who may be on wing in area of flux valve to remove tools and other ferrous metal objects from clothing.

(4) Use APU for power supply and position tow truck forward of aircraft.

(5) Check all components of compass system for proper installation and verify that both pre-indexed flux valves are in alignment with their tooling calibration scribe lines.

(6) Energize airplane electrical buses and allow approximately 5 minutes for gyros to properly become stable.

(7) Energize all electrical/electronic circuits that draw current for more than 50 percent of time during flight (including wing lights), except following:

(a) Lights: Lower compartment, taxi, ground flood, and flight compartment white.

(b) Engine: Starters, ignition, noise suppressors, oil cooler doors.

(c) Fuel: Tank fill valves and fuel pump, main and alternate tank boost pumps, dump valves.

(d) Fire warning and control, anti-icing, and all warning flights.

(e) Miscellaneous: Jet pump valves, pilot and mechanic call, ground control relay, recirculating fan, utility outlets, freon and flare release.

(8) Power OFF warning flag in both radio magnetic indicators should be out of view.

(9) Power OFF warning flag in both compass indicators should be out of view.

B. Flux Valve Index Error Correction

NOTE: It is recommended that when performing a compass swing, a precision synchro repeater with calibrated vernier dial reading in tenths be used. Remove aircraft wiring from flux valve at pins A, B, and C. Tie test synchro into the flux valve at pins B, C, and A (synchro output) and also pin F (neutral shield) maintain excitation voltage from compass rack. This precision synchro will eliminate the possibility that errors are caused by any components of the compass system, other than the flux valve.

(1) Allow sufficient time at each cardinal heading for compass readout to display stabilized heading.

(2) Starting at magnetic north, record difference between indicated headings and actual NORTH heading. Error is positive if indicated heading is greater, and negative if less than actual heading.

(3) Reposition aircraft, and repeat Paragraph 3.B.(1) and Paragraph 3.B.(2) for EAST, SOUTH, and WEST headings.

NOTE: In calculating flux valve index error (alignment), proper algebraic signs must be observed. Index error is determined by algebraically adding the individual error readings obtained at the four cardinal headings and dividing the result by four.

(4) If N, E, S, and W heading errors are all positive or all negative, verify that the error is or is not being caused by the flux valve. Try a new flux valve and see if the problem persists. If the error can be definitely traced to the flux valve bracket misaligned with the airplane fuselage reference plane, realign system flux valve for a zero error, rescribe the flux valve bracket, and repeat Paragraph 3.B.(1) through Paragraph 3.B.(3).

(5) Determine compass error and perform compensation as shown in following example:

(a) With aircraft positioned on NORTH, EAST, SOUTH, and WEST headings, following typical data is obtained:

Table 201

ACTUAL HEADING	INDICATED COMPASS HEADING	ERRORS
000	001.1	+1.1
090	089.5	-0.5
180	180.4	+0.4
270	271.2	+1.2

(b) Algebraically add error:

$$\text{COMPASS ERROR} = \frac{\text{NORTH error + EAST error + SOUTH error + WEST error}}{4}$$

$$\text{COMPASS ERROR} = \frac{(+1.1) + (-0.5) + (+0.4) + (+1.2)}{4}$$

$$\text{COMPASS ERROR} = \frac{+2.2}{4} = +.55 \text{ DEGREE}$$

CAUTION: AFTER CORRECTION, ENSURE FLUX VALVE MOUNTING SCREWS ARE PROPERLY TIGHTENED.

(c) To correct compass error, loosen applicable flux valve and rotate unit. If error is negative, rotate flux valve CW as viewed from top of unit. If error is positive rotate flux valve CCW as viewed from top of unit. Amount of rotation should equal compass error determined in the algebraic addition.

C. Final Check

(1) Swing airplane to 12 headings at 30 degree intervals, allowing sufficient time for compass system to stabilize at each heading. Maximum error recorded at each 30 degree heading should not exceed 1 degree.

(2) Remove the precision synchro and repeat the compass swing at 30 degree intervals, taking readings at the respective compass indicator. Maximum error at each 30 degree heading should not exceed 2 degrees.

(3) Captain's and first officer's primary compass readouts should agree with each other to within 4 degrees (0.7 rad). Secondary compass readouts, on other instruments with compass cards should agree (Capt. and F/O) to within 4 degrees (0.7 rad).

(4) Return aircraft to required configuration.

FLUX VALVE - MAINTENANCE PRACTICES

1. General

WJE 406-408, 411

A. The flux valves for AHRS-1 and -3 are (if installed) located in the left wing outboard trailing edge, the flux valve for AHRS-2 is located in the right wing outboard trailing edge. Access is through the access doors in each wing. The removal and installation procedure for each flux valve is similar.

WJE 406

NOTE: On this aircraft, flux valves AHRS-1 and -3 may or may not be located in the left wing outboard trailing edge.

WJE 886, 887

CAUTION: USE NON-MAGNETIC TOOLS AT ALL TIMES AROUND FLUX VALVES TO PREVENT INTERFERENCE WITH CALIBRATED POSITION OF FLUX VALVE.

B. The flux valve for AHRS-1 is located in the left wing outboard trailing edge, the flux valve for AHRS-2 is located in the right wing outboard trailing edge. Access is through the access doors in each wing. The removal and installation procedure for each flux valve is the same.

WJE 406-408, 411, 886, 887

2. Removal/Installation

CAUTION: USE TOOLS AND HARDWARE THAT ARE NOT MAGNETIC WHEN YOU WORK ON OR NEAR THE FLUX VALVES. THIS WILL HELP PREVENT INTERFERENCE TO THE CALIBRATION OF THE FLUX VALVE AND DAMAGE TO THE EQUIPMENT.

A. Remove Flux Valve

WARNING: TAG AND SAFETY CIRCUIT BREAKERS.

CAUTION: DO NOT REMOVE/INSTALL THIS UNIT WHEN POWER IS APPLIED. THIS CAN CAUSE LARGE OUTPUT VOLTAGE SPIKES WHICH CAN CAUSE DAMAGE TO THE UNIT AND THE ASSOCIATED EQUIPMENT.

(1) Open and tag following circuit breakers, as applicable to flux valve being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3

WJE 406-408, 411 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

(2) Verify AHRS switch, on captains instrument panel, is in normal center-lock position.

(3) Verify AHRS switch, on overhead, is in normal position.

(4) Gain access to flux valve through applicable access door as follows:

(if installed)

AHRS SYSTEM	ACCESS DOOR
AHRS-1	1187C
AHRS-2	1280C
AHRS-3	1186C

(5) Tag and remove electrical wires from flux valve terminal strip.

(6) Remove mounting screws and remove flux valve.

B. Install Flux Valve

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

(2) Install mounting screws, and lightly tighten for positioning of flux valve.

(3) Position flux valve so that scribe line and scribe line on support bracket are aligned within 1/2 line width.

NOTE: If the newly installed flux valve scribe line is aligned with the support bracket scribe line to within 1/2 line width, a compass swing is not required.

CAUTION: USE TOOLS AND HARDWARE THAT ARE NOT MAGNETIC WHEN YOU WORK ON OR NEAR THE FLUX VALVES. THIS WILL HELP PREVENT INTERFERENCE TO THE CALIBRATION OF THE FLUX VALVE AND DAMAGE TO THE EQUIPMENT.

(4) Tighten mounting screws.

(5) Connect electrical wires to flux valve terminal strip and remove tags.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

NOTE: If complete system test is required. (ATTITUDE/HEADING REFERENCE UNIT, SUBJECT 34-21-10, Page 201)

3. Calibration Procedure (Compass Swing)

A. Preliminary

NOTE: The following procedure can be used to verify the accuracy of the flux valve and the alignment of the flux valve bracket.

(1) Position aircraft on compass rose at magnetic north.

(2) Remove any nonessential portable equipment containing ferrous metal from area immediately surrounding compass rose.

(3) Advise all personnel who may be on wing in area of flux valve to remove tools and other ferrous metal objects from clothing.

(4) Use APU for power supply and position tow truck forward of aircraft.

(5) Check all components of compass system for proper installation and verify that both pre-indexed flux valves are in alignment with their tooling calibration scribe lines.

(6) Energize aircraft electrical buses and wait 1 minute to allow the attitude/heading reference systems to become stable and aligned (aircraft must be kept stable).

(7) Energize all electrical/electronic circuits that draw current for more than 50 percent of time during flight (including wing lights), except following:

(a) Lights: Lower compartment, taxi, ground flood, and flight compartment white.

(b) Engine: Starters, ignition, noise suppressors, oil cooler doors.

(c) Fuel: Tank fill valves and fuel pump, main and alternate tank boost pumps, dump valves.

(d) Fire warning and control, anti-icing, and all warning flights.

(e) Miscellaneous: Jet pump valves, pilot and mechanic call, ground control relay, recirculating fan, utility outlets, freon and flare release.

(8) Power OFF warning flag in both radio magnetic indicators should be out of view.

B. Flux Valve Index Error Correction

NOTE: It is recommended that when performing a compass rose swing, a precision synchro repeater with calibrated vernier dial reading in tenths be used (Figure 202). Remove aircraft wiring from flux valve at pins A, B, and C. Tie test synchro into the flux valve at pins B, C, and A (synchro output) and also pin F (neutral shield); maintain excitation voltage from compass rack. This precision synchro will eliminate the possibility that errors are caused by any components of the compass system, other than the flux valve.

(1) Allow sufficient time at each cardinal heading for compass readout to display stabilized heading.

(2) Starting at magnetic north, record difference between indicated headings and actual NORTH heading. Error is positive if indicated heading is greater, and negative if less than actual heading.

(3) Reposition aircraft, and Paragraph 3.B.(1) and Paragraph 3.B.(2) for EAST, SOUTH, and WEST headings.

Reposition airplane, and Paragraph 3.B.(1) and Paragraph 3.B.(2) for EAST, SOUTH, and WEST headings.

NOTE: In calculating flux valve index error (alignment), proper algebraic signs must be observed. Index error is determined by algebraically adding the individual error readings obtained at the four cardinal headings and dividing the result by four.

(4) If N, E, S, and W heading errors are all positive or all negative, verify that the error is or is not being caused by the flux valve. Try a new flux valve and see if the problem persists. If the error can be definitely traced to the flux valve bracket misaligned with the aircraft fuselage reference plane, realign system flux valve for a zero error, rescribe the flux valve bracket, and repeat Paragraph 3.B.(1) through Paragraph 3.B.(2).

(5) Determine compass error and perform compensation as shown in following example:

(a) With aircraft positioned on NORTH, EAST, SOUTH, and WEST headings, following typical data is obtained:

Table 201

ACTUAL HEADING	INDICATED COMPASS HEADING	ERRORS
000	001.1	+1.1
090	089.5	-0.5
180	180.4	+0.4
270	271.2	+1.2

(b) Algebraically add error:

Table 202

COMPASS ERROR	=NORTH error	+EAST error	+SOUTH error	+WEST error
		4		

Table 203

COMPASS ERROR	= (+1.1)	+ (-0.5)	+ (+0.4)	+ (1.2)
		4		

Table 204

COMPASS ERROR	= (+2.2)	= +.55 DEGREE
	4	

CAUTION: AFTER CORRECTION, ENSURE FLUX VALVE MOUNTING SCREWS ARE PROPERLY TIGHTENED.

(c) To correct compass error, loosen applicable flux valve and rotate unit. If error is negative, rotate flux valve CW as viewed from top of unit. If error is positive rotate flux valve CCW as viewed from top of unit. Amount of rotation should equal compass error determined in the algebraic addition.

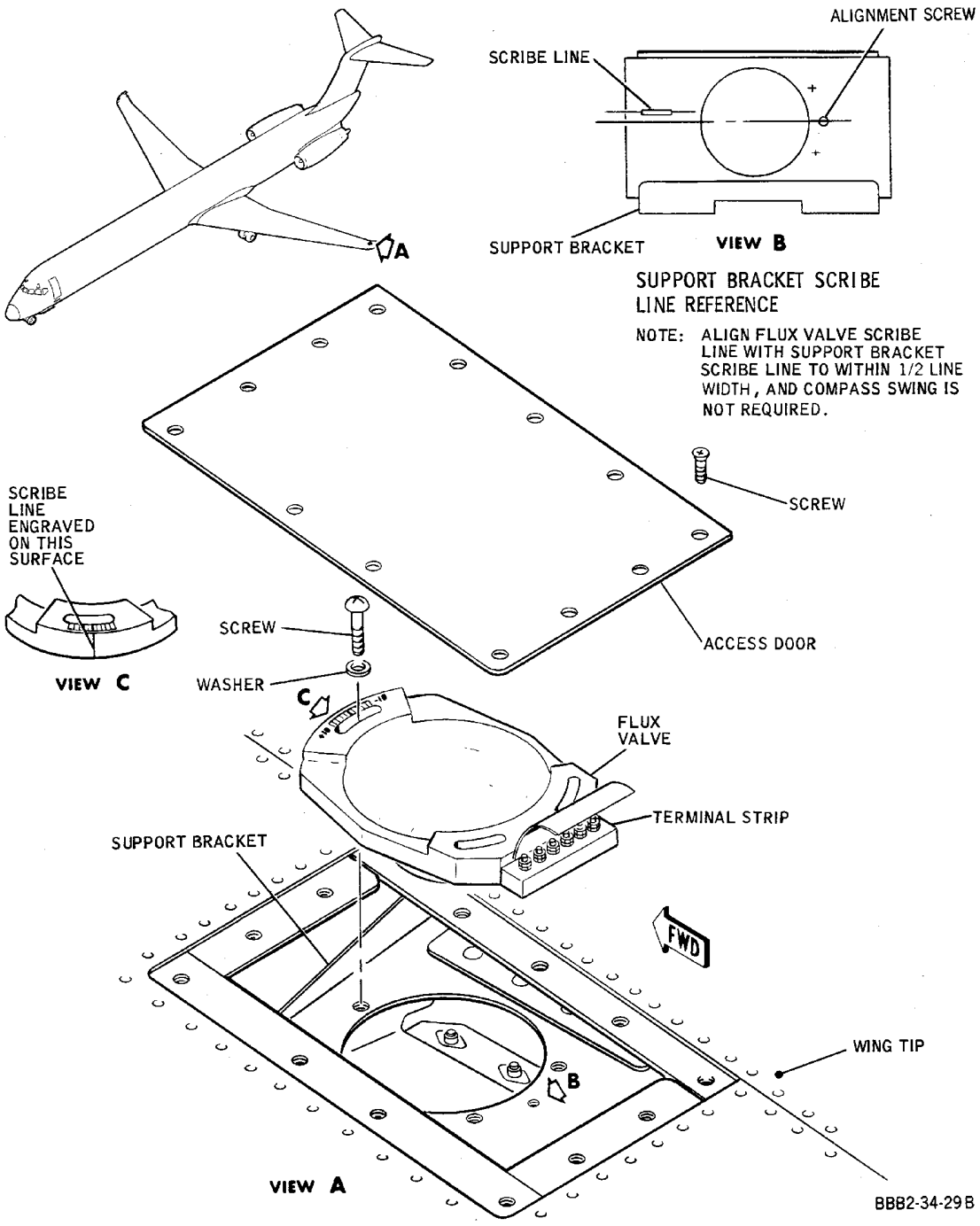
C. Final Check

(1) Swing airplane to 12 headings at 30 degree intervals, allowing sufficient time for compass system to stabilize at each heading. Maximum error recorded at each 30 degree heading should not exceed 1 degree.

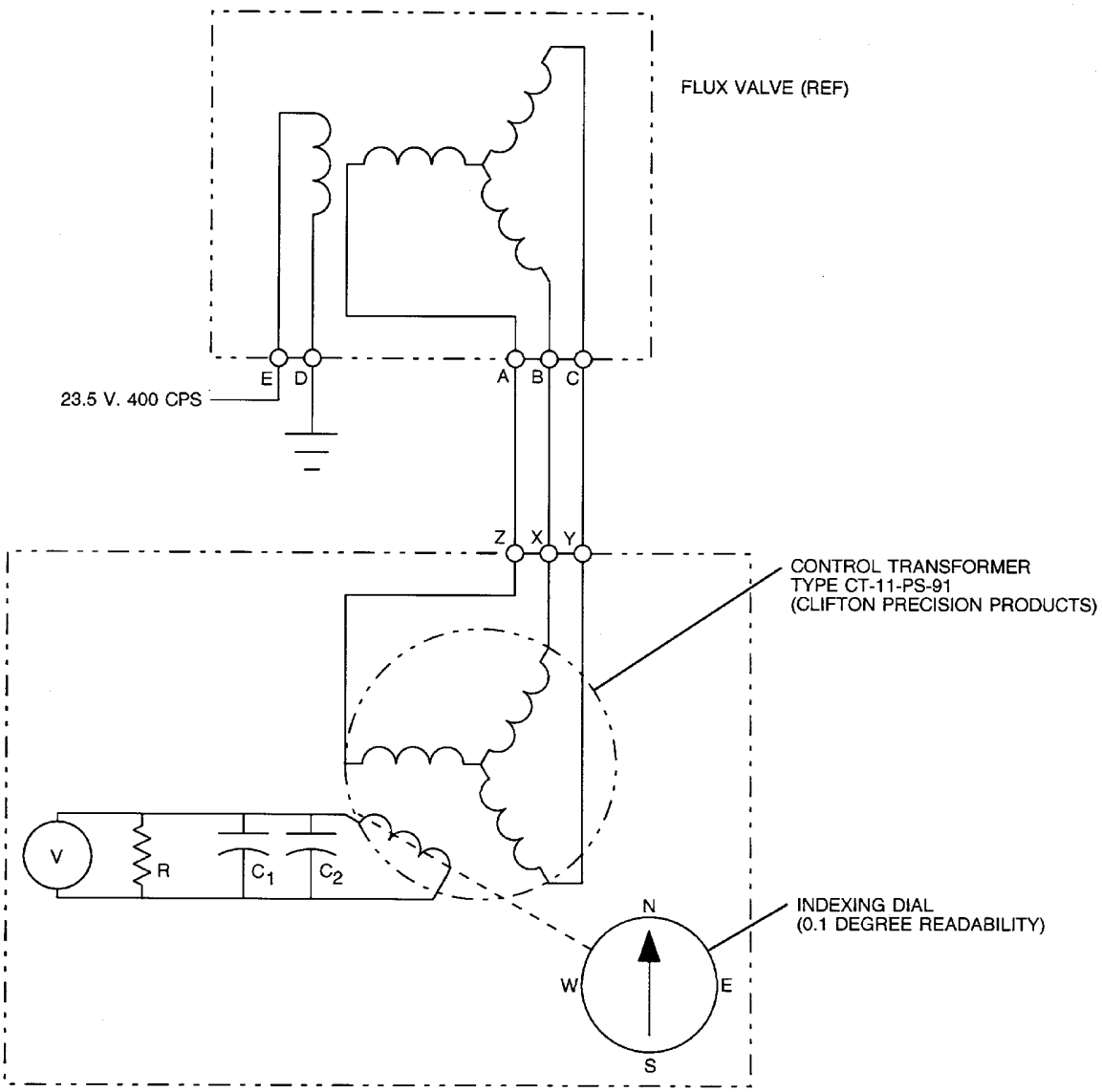
(2) Remove the precision synchro and repeat the compass swing at 30 degree intervals, taking readings at the respective compass indicator. Maximum error at each 30 degree heading should not exceed 2 degrees.

(3) Captain's and first officer's primary compass readouts should agree with each other within 4 degrees. Secondary compass readouts, on other instruments with compass cards should agree (Capt. and F/O) within 4 degrees.

(4) Return airplane to required configuration.



Flux Valve -- Removal/Installation -- Typical
Figure 201/34-21-06-990-801



NOTE:
1. VOLTMETER WILL INDICATE NULL WHEN FLUX VALVE IS ALIGNED TO HEADING SET ON POINTER.
2. R IS EQUIVALENT TO INTERNAL RESISTANCE VOLTMETER.
3. C_1 IS EQUAL TO 0.030 MICRO-FARAD.
   C_2 IS EQUAL TO 0.005 MICRO-FARAD.
4. VOLTMETER RANGE 0-100, 0-10 MILLI-VOLT.

CAG(IGDS)

BBB2-34-1212

Precision Synchro Repeater -- Schematic
Figure 202/34-21-06-990-802

COMPASS INDICATOR - MAINTENANCE PRACTICE

1. General

A. This maintenance practice provides removal/installation procedures for the compass indicator. There are two indicators located in the flight compartment, one on the captain's instrument panel, and one on the first officer's instrument panel.

B. Removal/installation of the captain's and first officer's compass indicator is identical except for circuit breakers which must be opened. If necessary to facilitate removal/ installation of indicators, the captain's and first officer's instrument panels can be opened for access to the indicator. (PANELS - DESCRIPTION AND OPERATION, PAGEBLOCK 31-10-00/001)

2. Removal/Installation Compass Indicator

A. Remove Compass Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open the applicable circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC
WJE 405, 861, 864, 880			
A	6	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 884, 891-893			
A	7	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
B	9	B10-80	COMPASS DOUBLE POINTER
WJE 405, 409, 410, 880, 884			
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
G	7	B10-24	VHF NAV-2

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install Compass Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that the applicable circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC
WJE 405, 861, 864, 880			
A	6	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 884, 891-893			
A	7	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL

WJE 410 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
B	9	B10-80	COMPASS DOUBLE POINTER
WJE 405, 409, 410, 880, 884			
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
G	7	B10-24	VHF NAV-2

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: MAKE SURE THE ATTACHED CLAMP SCREWS ARE TIGHT. IF THE CLAMP SCREWS ARE NOT TIGHT, THE INDICATOR CAN FALL FROM THE PANEL.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tag and close the applicable circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC
WJE 405, 861, 864, 880			
A	6	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 862, 863, 866, 868, 873, 874, 881, 883, 884, 891-893			
A	7	B10-79	COMPASS SINGLE POINTER 28 VAC
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2
B	9	B10-80	COMPASS DOUBLE POINTER
WJE 405, 409, 410, 880, 884			
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

WJE 405, 409, 410, 880, 884 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
G	7	B10-24	VHF NAV-2

(6) Perform Return-to-Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05)

WJE 873, 874, 892, 893

NOTE: If functional check required, perform Paragraph 2.B.(7) through Paragraph 2.B.(10).

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

NOTE: Steps Paragraph 2.B.(7) through Paragraph 2.B.(11) are provided as an Line Replaceable Unit (LRU) functional check. The functional check may be performed at the mechanic's discretion to check the LRU before performing the RTS test. However, the criteria covered in the functional test are also covered in the RTS test.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(7) Allow 3 minutes for system warmup and gyro erection.

(8) Verify flag on both compass indicators are out of view.

(9) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(a) Flag on applicable indicator in view when circuit breaker is open.

(b) Flag on applicable indicator and out of view when circuit breaker is closed.

WJE 873, 874, 892, 893

(10) Observe HSI and compass indicator compass card heading readings at indicator lubber lines. Captain's (first officer's) HSI heading indication must agree with first officer's (captain's) compass indicator heading indication within ±1 degree. If compass card on both compass indicators agree to same angular displacement as HSI compass cards within ±2 degrees, applicable compass indicator is considered operable.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

(11) Observe HSI (or EFIS Navigation Display (ND) on aircraft with EFIS) and compass indicator compass card heading readings at indicator lubber lines. Captain's (first officer's) HSI/ND heading indication must agree with first officer's (captain's) compass indicator heading indication within ±1 degree. If compass card on both compass indicators agree to same angular displacement as HSI/ND compass cards within ±2 degrees, applicable compass indicator is considered operable.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(12) Return airplane to required configuration.

NOTE: If necessary, perform Compass System Test. (HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 3 or HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 6 or HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 7 or HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 10 or HEADING SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-00/201 Config 15)

COMPASS SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the compass switching unit (CSU). The CSU is installed on the radio rack in the forward accessory compartment. The CSU is remotely actuated by the compass switch on the overhead panel. Switch positions are placarded BOTH ON 1/NORM/BOTH ON 2.

2. Removal/Installation Compass Switching Unit

A. Remove Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 880, 884			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
A	9	B10-170	COMPASS SWITCHING
WJE 410			
A	10	B10-170	COMPASS SWITCHING

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Attitude Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 880, 884			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
A	9	B10-170	COMPASS SWITCHING
WJE 410			
A	10	B10-170	COMPASS SWITCHING

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holdown nuts.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 880, 884			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

WJE 410 (Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
A	9	B10-170	COMPASS SWITCHING
WJE 410			
A	10	B10-170	COMPASS SWITCHING

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

(7) Allow 5 minutes for system warmup, and gyro erection.

(8) On overhead panel, verify COMPASS switch is in NORM position.

(9) On both compass indicators and HSIs, flags should be out of view.

(10) Place COMPASS switch in BOTH ON 1 position, then switch to BOTH ON 2 position; flags on compass indicators and HSIs will momentarily be in view then go out of view when switching, compass lights on corresponding instrument panel should come on during switching.

(11) Return switch to NORM position.

NOTE: If necessary, HEADING SYSTEM, SUBJECT 34-21-00, Page 201, for complete system test.

(12) Return aircraft to required configuration.

COMPASS SWITCHING UNIT - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-21-08-710-801

2. Operational Check of the Compass Switching

A. Prepare for an Operational Check of the Compass Switching

SUBTASK 34-21-08-865-001

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 405, 409, 880, 884			
B	6	B10-10	FIRST OFFICER'S COMPASS
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
A	9	B10-170	COMPASS SWITCHING
WJE 410			
A	10	B10-170	COMPASS SWITCHING

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 880, 884			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 880, 884			
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	5	B10-379	CAPTAIN'S COMPASS BOTH ON 1

SUBTASK 34-21-08-860-001

(2) Allow 5 minutes for system warm-up, and gyro erection.

B. Operational Check of the Compass Switching

SUBTASK 34-21-08-710-001

(1) On overhead panel, verify COMPASS switch is in NORM position.

(a) On both compass indicators and HSIs, flags should be out of view.

SUBTASK 34-21-08-710-002

(2) On overhead panel, place COMPASS switch in BOTH ON 1 position

(a) On both compass indicators and HSIs, flags should be out of view.

SUBTASK 34-21-08-710-003

(3) Open these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

WJE 405, 409, 410, 880, 884

(a) On both compass indicators and HSIs, flags should be in view.

SUBTASK 34-21-08-710-004

(4) Close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

WJE 405, 409, 410, 880, 884

(a) On both compass indicators and HSIs, flags should be out of view.

SUBTASK 34-21-08-710-005

(5) On overhead panel, place COMPASS switch in BOTH ON 2 position

(a) On both compass indicators and HSIs, flags should be out of view.

SUBTASK 34-21-08-710-006

(6) Open these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 880, 884			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL

WJE 405, 409, 410, 880, 884

(a) On both compass indicators and HSIs, flags should be in view.

SUBTASK 34-21-08-710-007

(7) Close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL

WJE 410 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL

WJE 405, 409, 410, 880, 884

(a) On both compass indicators and HSIs, flags should be out of view.

SUBTASK 34-21-08-710-008

(8) On overhead panel, place COMPASS switch in NORM position.

(a) On both compass indicators and HSIs, flags should be out of view.

C. Job Close-up

SUBTASK 34-21-08-840-001

(1) Return airplane to required configuration.

——— END OF TASK ———

COMPASS RACK - MAINTENANCE PRACTICES

1. General

A. This Maintenance Practice provides removal/installation of the compass racks and the slave and servo amplifiers that are installed in the compass racks. Compass rack-1 is located in the aft left radio rack in the electrical/electronics compartment and the compass rack-2 is located in the forward right radio rack in the compartment.

B. Removal/installation of both racks is identical except for applicable circuit breakers required to de-energize the electrical power to the racks.

2. Removal/Installation

A. Remove Compass Rack

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) Unscrew knurled holddown nut assembly at front of compass rack mounting tray and swing assemblies down.

(3) Remove compass rack by pulling rack straight out of mounting tray, exercising care to not damage contact pins in rack or mounting tray electrical connectors.

(4) To remove slave or servo amplifier, unscrew knurled screws at each end of compass rack top and remove top. Pull amplifier straight up, taking care not to damage the contact pins on amplifier or compass rack electrical connectors.

B. Install Compass Rack

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	6	B10-10	FIRST OFFICER'S COMPASS
B	7	B10-175	F/O COMPASS SERVO AMPLIFIER
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS
B	8	B10-175	F/O COMPASS SERVO AMPLIFIER

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	7	B10-174	CAPTAIN'S COMPASS SERVO AMPL
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	08	B10-9	CAPTAIN'S COMPASS

(2) To install slave or servo amplifier, check amplifier and compass rack electrical connector contact pins for loose, dirty, broken, bent, or corroded pins.

(3) Position amplifier over compass rack receptacle and insert amplifier, taking care to properly align and mate electrical connectors. Make certain amplifier is fully engaged, then install compass rack top. Tighten knurled screws at each end of compass rack top.

(4) Check compass rack and mounting tray electrical connector contact pins for loose, dirty, broken, or corroded pins.

CAUTION: BEFORE INSTALLING COMPASS RACK, VERIFY THAT CORRECT SLAVE AND SERVO AMPLIFIERS ARE INSTALLED IN COMPASS RACK (REF. ILLUSTRATED PARTS CATALOG).

(5) Position compass rack on mounting tray and slide rack straight into tray exercising care to properly mate rack and tray electrical connectors. Make certain rack is fully engaged into mounting tray.

(6) Engage holddown nut assembly with lugs on compass rack and tighten knurled holddown nut.

(7) Perform compass system check. (HEADING SYSTEM, SUBJECT 34-21-00, Page 201)

(8) Return aircraft to required configuration.

ATTITUDE AND HEADING REFERENCE UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides the following:

(1) Removal/installation procedures for the Attitude and Heading Reference Unit (AHRU).

(2) Test procedures for the Attitude and Heading Reference System (AHRS).

(3) Removal/installation procedures for the AHRU rack blower.

(4) Test procedures for the AHRU rack blower.

B. The AHRU is the primary source of attitude and heading information utilized by airplane avionics systems. Therefore, the test procedures check both the attitude and heading portions of the AHRU.

C. The AHRUs are located in the forward accessory compartment. Access is through the accessory compartment door located in the nosewheel well. The removal and installation procedures for the AHRUs are similar.

D. Heading and attitude displays are displayed on the Electronic Flight Instrument System (EFIS), Navigation Display (ND), and Primary Flight Display (PFD). During the AHRU test procedures, noted Horizontal Situation Indicator (HSI) displays are displayed on the EFIS ND and Attitude Direction Indicator (ADI) displays are displayed on the EFIS PFD.

2. Removal/Installation AHRU

A. Remove AHRU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 406-408, 411, 886, 887			
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
C	11	B10-418	AHRS BASIC ANN

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

WJE 406-408, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2
F	12	B10-317	AIR DATA CMPTR -2

(2) Unscrew knurled holddown nuts at front end of mounting.

(3) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install AHRU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 406-408, 411, 886, 887			
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
C	11	B10-418	AHRS BASIC ANN

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2
F	12	B10-317	AIR DATA CMPTR -2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 406-408, 411, 886, 887			
C	1	B10-316	AIR DATA CMPTR-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
C	11	B10-418	AHRS BASIC ANN

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2
F	12	B10-317	AIR DATA CMPTR -2

3. Removal/Installation AHRU Rack Blower

A. Remove Rack Blower as follows:

(1) Open the applicable circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

(2) Gain access to AHRU rack blower located in forward accessory compartment (Figure 201).

(3) Disconnect electrical connector from backplate and remove terminals from blower.

(4) Mark terminals for later reinstallation. Remove blower mounting hardware and save for reinstallation.

(5) Remove AHRU blower.

B. Install AHRU Rack Blower

(1) Mount blower on rear of AHRU tray and reinstall mounting hardware (Figure 201).

(2) Reconnect wire terminals on blower and reconnect electrical connector on tray backplate. Check capacitor and associated terminal strip for secure connections.

(3) Close the applicable circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

C. Test AHRS Rack Blower

Table 201 Test AHRS Rack Blower

Step	Operation	Desired Result
(1)	Verify AHRU fan is operating and that airflow is as shown in Figure 201. Verify fan operation by touch, or by sliding an 8 1/2 x 11 inch (or equivalent) piece of paper on top of AHRU (the paper will lift off if fan is operating correctly).	Fan operation and correct airflow are verified.
(2)	Also verify that fan blades are not contaminated.	If contaminated, clean blades of fan for proper airflow.

4. Adjustment/Test Attitude and Heading Reference System

WJE 406-408, 411

A. Test AHRS

Table 202 Test AHRS

Step	Operation	Desired Result
(1)	Set AHRS switch (on CAPT (Captain) instrument panel) to center position.	AHRS switch in center position.
(2)	Energize aircraft electrical buses. Ensure aircraft is stationary during 1 minute alignment period.	(a) Up to 15 seconds after power application, NDs and Radio Magnetic Indicator (RMI)s display 0 degrees heading.
		(b) 45 seconds after power application, RMI HDG, ND heading, and PFD attitude warning displays out of view; and PFDs indicate actual aircraft attitude.
		(c) AHRS-3 INOP annunciator light (on overhead panel) off.

WJE 406-408, 411 (Continued)

Table 202 Test AHRS (Continued)

Step	Operation	Desired Result
CAUTION:	INCORRECT WIRING OF AHRU COOLING FAN WILL CAUSE FAN MOTOR TO OPERATE IN REVERSE. SIGNIFICANT DECREASE IN MTBF WILL RESULT FROM IMPROPER COOLING OF AHRU. REFER TO FIGURE FOR AIRFLOW DIAGRAM AND FAN CIRCUIT DIAGRAM. AIRFLOW MUST GO DOWNWARD, THROUGH PLENUM IN THRU MOUNTING BASE, AND UP THROUGH AND AROUND AHRU.	
(2a)	Verify fan operation by touch, or by sliding an 8 1/2 x 11 inch (or equivalent) piece of paper on top of the AHRU (the paper will lift if the fan is operating correctly). (Figure 201)	Fan operation and correct airflow are verified.
NOTE:	Whenever power to an AHRS is interrupted for 500 milliseconds or longer, 1 minute must be allowed for system realignment and output of valid data (aircraft on ground and stationary).	
(3)	Open and close this circuit breaker:	
	REF DES: B10-394 / CIRCUIT BREAKER: AHRS-1 / LOCATION: OVERHEAD / PANEL AREA: EMERGENCY AC BUS / ROW/COL: B/5	
		First Officer (F/O) RMI HDG, CAPT ND heading, and CAPT PFD attitude warning displays in view. When circuit breaker is opened.
		45 seconds after breaker reset, warning displays go out of view (aircraft stationary).
(4)	Open and close this circuit breaker:	
	REF DES: B10-396 / CIRCUIT BREAKER: AHRS-2 / LOCATION: UPPER EPC / PANEL AREA: RIGHT RADIO AC BUS / ROW/COL: F/2	
		CAPT RMI HDG, F/O NDheading, and F/O PFD attitude warning displays in view (aircraft stationary). When circuit breaker is opened.
		45 seconds after breaker reset, warning displays go out of view (aircraft stationary).
(5)	Open and close this circuit breaker:	
	REF DES: B10-397 / CIRCUIT BREAKER: AHRS-3 / LOCATION: UPPER EPC / PANEL AREA: RIGHT RADIO AC BUS / ROW/COL: F/1	

WJE 406-408, 411 (Continued)

Table 202 Test AHRS (Continued)

Step	Operation	Desired Result
WJE 406-408		
	B10-398 AHRS-3	OVERHEAD EMERGENCY AC BUS C/1
WJE 406-408, 411		
		AHRS-3 INOP annunciator light comes on. When circuit breaker is opened.
		Immediately after circuit breaker reset, AHRS-3 INOP annunciator goes off.
(6)	Observe magnetic heading on CAPT and F/O RMI.	RMI magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		RMI magnetic headings agree within +4 degrees.
NOTE: Magnetic anomalies due to parked vehicles, power cables, etc. may cause a difference in magnetic heading exceeding ±4 degrees.		
(7)	Observe magnetic heading on CAPT and F/O ND.	ND magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		NDs magnetic headings agree within +4 degrees.
(8)	Observe attitude spheres on CAPT and F/O PFD.	PFD attitude aligned within ±2 degrees of aircraft attitude.
		PFDs attitude agree within +4 degrees.
(9)	Return aircraft to required configuration.	

WJE 886, 887

B. System Test AHRS

Table 203 Test AHRS

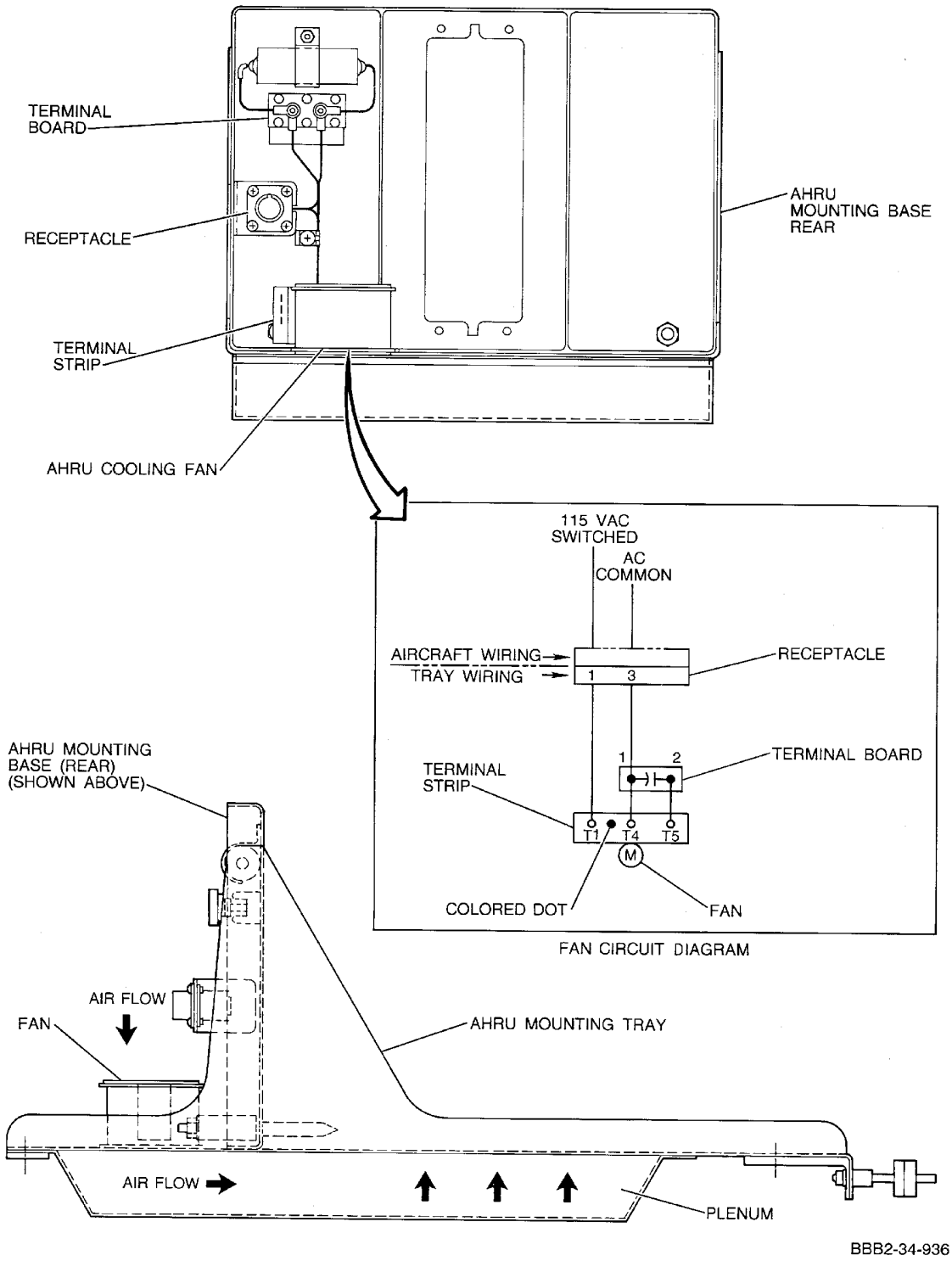
Step	Operation	Desired Result
(1)	Energize aircraft electrical buses. Ensure aircraft is stationary during 1 minute alignment period.	(a) Up to 15 seconds after power application, NDs and Compass Indicator (CI) displays are 0 degrees heading.
NOTE: Ensure EFIS is operational.		
		(b) 45 seconds after power application, CAPT and F/O PFD attitude and ND HDG warning displays out of view, CI HDG flags out of view, cards steady.
		(c) Two BASIC MODE annunciators on Overhead Panel are off.
CAUTION: INCORRECT WIRING OF AHRU COOLING FAN WILL CAUSE FAN MOTOR TO OPERATE IN REVERSE. SIGNIFICANT DECREASE IN MTBF WILL RESULT FROM IMPROPER COOLING OF AHRU. REFER TO FIGURE FOR AIRFLOW DIAGRAM AND FAN CIRCUIT DIAGRAM. AIRFLOW MUST GO DOWNWARD, THROUGH PLENUM IN THRU MOUNTING BASE, AND UP THROUGH AND AROUND AHRU.		

WJE 886, 887 (Continued)

Table 203 Test AHRS (Continued)

Step	Operation	Desired Result
(2a)	Verify fan operation by touch, or by sliding an 8 1/2 x 11 inch (or equivalent) piece of paper on top of the AHRU (the paper will lift if the fan is operating correctly). (Figure 201)	Fan operation and correct airflow are verified.
NOTE: Whenever power to an AHRS is interrupted for 500 milliseconds or longer, 1 minute must be allowed for system realignment and output of valid data (aircraft on ground and stationary).		
(3)	Open and close this circuit breaker:	
	REF DES: B10-394 / CIRCUIT BREAKER: AHRS-1 / LOCATION: OVERHEAD / PANEL AREA: EMERGENCY AC BUS / ROW/COL: B/5	
		F/O Radio Distance Magnetic Indicator (RDMI) HDG, CAPT ND heading, and CAPT PFD attitude warning flags in view. When circuit breaker is opened.
		45 seconds after breaker reset, warning displays will go out of view (aircraft stationary).
(4)	Open and close this circuit breaker:	
	REF DES: B10-396 / CIRCUIT BREAKER: AHRS-2 / LOCATION: UPPER EPC / PANEL AREA: RIGHT RADIO BUS / ROW/COL: F/1	
		CAPT RMI HDG, F/O ND heading, and F/O PFD attitude warning flags in view. When circuit breaker is opened.
		45 seconds after breaker reset, warning displays go out of view (aircraft stationary).
(5)	Observe magnetic heading on CAPT and F/O RDMI.	RDMI magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		RDMI magnetic headings agree within +4 degrees.
NOTE: Magnetic anomalies due to parked vehicles, power cables, etc. may cause a difference in magnetic heading exceeding ±4 degrees.		
(6)	Observe magnetic heading on CAPT and F/O ND.	ND magnetic heading aligned within ±2 degrees of aircraft magnetic heading.
		ND magnetic headings agree within +4 degrees.
(7)	Observe attitude on CAPT and F/O PFD.	PFD attitude aligned within ±2 degrees of aircraft attitude.
		PFDs attitude agree within +4 degrees.
(8)	Return aircraft to required configuration.	

WJE 406-408, 411, 886, 887



AHRU Cooling Fan -- Circuit/Airflow Diagram
Figure 201/34-21-10-990-801

ATTITUDE/HEADING SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the attitude/heading switching unit (AHSU). The AHSU is installed on the radio rack in the forward accessory compartment. The AHSU is remotely actuated by the AHRS switch located on the overhead panel. The AHRS switch is a three position rotary type placarded L ON AUX, NORM, and R ON AUX. Should the number three AHRU fail, an INOP output discrete lights the amber advisory annunciator which is located near the AHRS switch.

2. Removal/Installation Attitude/Heading Switching Unit

A. Remove Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT REMOVE/INSTALL THIS UNIT WHEN POWER IS APPLIED. THIS CAN CAUSE LARGE OUTPUT VOLTAGE SPIKES WHICH CAN CAUSE DAMAGE TO THE UNIT AND THE ASSOCIATED EQUIPMENT.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-399	AHRS SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Switching Unit

(1) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			

WJE 406-408 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-399	AHRS SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408			
B	5	B10-394	AHRS-1
C	1	B10-398	AHRS-3

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-399	AHRS SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

WJE 406-408 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2

(7) Allow 1 minute for system alignment (aircraft must be stationary).

(8) On overhead panel, verify AHRS switch is in NORM position.

(9) On overhead annunciator panel, verify that AHRS-1, -2 and -3 BASIC MODE annunciators are off.

(10) On radio magnetic indicators (RMI's), flag should be out of view. On captain's and first officer's navigation displays (ND) and primary flight displays warning displays should be out of view.

(11) On overhead panel, place AHRS switch to L ON AUX position. Flags on RMI's momentarily in view, then go out of view when switching. Warning displays on PFD's and ND's momentarily in view, then go out of view when switching.

(12) Return AHRS switch to NORM position. Flags on RMI's momentarily in view, then go out of view when switching. Warning displays on PFD's and ND's momentarily in view, then go out of view when switching.

(13) Place AHRS switch to R ON AUX position. Flags on RMI's momentarily in view, then go out of view when switching. Warning displays on PFD's and ND's momentarily in view, then go out of view when switching.

(14) Return AHRS switch to NORM position. Flags on RMI's momentarily in view, then go out of view when switching. Warning displays on PFD's and ND's momentarily in view, then go out of view when switching.

(15) Return aircraft to required configuration.

RADIO DISTANCE MAGNETIC INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for RDMI. There are two RDMI's located in the flight compartment, one on the Captain's instrument panel, and one on the First Officer's instrument panel.

B. Removal/installation of the Captain's and First Officer's RDMI is identical except for circuit breakers which must be opened. If necessary to facilitate removal/installation of indicators, the Captain's and First Officer's instrument panels can be opened for access to the indicator. (PANELS - DESCRIPTION AND OPERATION, PAGEBLOCK 31-10-00/001)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	

3. Removal/Installation Radio Distance Magnetic Indicator

A. Remove Radio Distance Magnetic Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-301	PANEL WHITE INTEGRAL LTS - CAPT INST
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC
WJE 886, 887			
B	5	B10-394	AHRS-1
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
B	7	B10-427	FIRST OFFICER'S RDMI

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 877, 886, 887			
F	15	B10-395	AHRS-1

WJE 877, 886, 887 (Continued)

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2
WJE 877, 886, 887			
F	2	B10-396	AHRS-2
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879, 886, 887			
F	7	B10-426	CAPTAIN'S RDMI

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on RDMI.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face.

(6) Disconnect electrical connector and install dust caps.

B. Install Radio Distance Magnetic Indicator

(1) Make sure that these circuit breakers are open and have safety tags:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-301	PANEL WHITE INTEGRAL LTS - CAPT INST
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

WJE 886, 887

B	5	B10-394	AHRS-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B	7	B10-427	FIRST OFFICER'S RDMI

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name

WJE 877, 886, 887

F	15	B10-395	AHRS-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879

F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879

F	1	B10-438	IRU-2

WJE 877, 886, 887

F	2	B10-396	AHRS-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879, 886, 887

F	7	B10-426	CAPTAIN'S RDMI

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(2) Remove dust caps and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: MAKE SURE THE ATTACHED CLAMP SCREWS ARE TIGHT. IF THE CLAMP SCREWS ARE NOT TIGHT, THE INDICATOR CAN FALL FROM THE PANEL.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tags and close these circuit breakers:

CAPTS, CENTER PANEL & PEDESTAL CBP

Row	Col	Number	Name
		B1-301	PANEL WHITE INTEGRAL LTS - CAPT INST
		B1-302	PANEL WHITE INTEGRAL LTS - CAPT INST

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

WJE 886, 887

B	5	B10-394	AHRS-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B	7	B10-427	FIRST OFFICER'S RDMI

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name

WJE 877, 886, 887

F	15	B10-395	AHRS-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879

F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879

F	1	B10-438	IRU-2

WJE 877, 886, 887

F	2	B10-396	AHRS-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879, 886, 887

F	7	B10-426	CAPTAIN'S RDMI

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(6) Allow 1 minute for system alignment (aircraft must be stationary).

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

(7) Align IRS. (INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-43-00/201)

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(8) Verify HDG flag on both RDMI's are out of view.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(9) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

WJE 886, 887

(10) Open and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-396	AHRS-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

(11) Open and close these circuit breakers:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(12) HDG flag on applicable RDMI in view when circuit breaker is open, and out of view within 1 minute of when circuit breaker is closed, provided aircraft is stationary.

NOTE: The IRS must realign before the flag is out of view.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

(13) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(14) Observe ND and RDMI compass card heading readings at indicator lubber lines. Captain's (First Officer's) ND heading indication must agree with First Officer's (Captain's) RDMI heading indication within ±1 degree. If compass card on both RDMI's agree to same angular displacement as ND compass cards within ±2 degrees, applicable RDMI is considered operable.

(15) Return aircraft to required configuration.

WJE 886, 887

C. If necessary, perform attitude and heading reference system test. (ATTITUDE AND HEADING REFERENCE UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 34-21-10/201 Config 2)

AHRS COMPASS CONTROLLER UNIT - MAINTENANCE PRACTICES

1. General

A. Two Compass Controller Units (CCU's) are mounted on the overhead switch panel, with the Capt's (AHRS-1) unit on the left and the F.O.'s (AHRS-2) unit on the right. Each unit contains a SET HDG knob and a sync indicator (Figure 201). The SET HDG knob provides for fast slaving and nulling of compass error. The sync indicator provides a display of slaving error.

2. Removal/Installation Compass Controller Unit

A. Remove Compass Controller Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

WJE 405-411, 880, 881, 883, 884, 886, 887

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

WJE 405-411, 880, 881, 883, 884, 886, 887

(2) Turn mounting screws counterclockwise approximately 1/4 turn until controller unit is loose.

(3) Disconnect and cap wire harness, and remove controller unit from overhead.

(4) Disconnect and cap wire harness, and remove controller unit from pedestal.

B. Install Compass Controller Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

WJE 405-411, 880, 881, 883, 884, 886, 887

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

WJE 405-411, 880, 881, 883, 884, 886, 887

(2) Remove cap from wire harness connector and connect to controller unit.

(3) Insert controller unit into cavity and tighten mounting screws until secure.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406-408, 886, 887			
B	5	B10-394	AHRS-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-395	AHRS-1

WJE 405-411, 880, 881, 883, 884, 886, 887

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411, 886, 887			
F	2	B10-396	AHRS-2

WJE 405-411, 880, 881, 883, 884, 886, 887

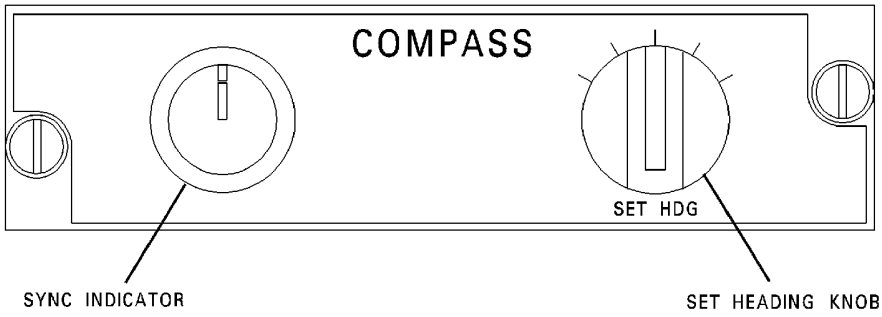
C. Test Compass Controller Unit

Table 201

Step	Operation	Desired Result
(1)	Allow one minute for system alignment (aircraft must be stationary). Check that DG/SLAVED switch is selected to SLAVED position.	
(1a)	On overhead, on applicable CCU, check that sync indicator pointer is in 12 o'clock position. Note aircraft heading that is displayed on applicable ND.	Sync indicator pointer in 12 o'clock position. Aircraft heading noted.
(1b)	Select DG/SLAVED switch to DG position on applicable controller.	
(2)	On applicable CCU, rotate SET HDG knob clockwise to first index mark and hold for 10 seconds.	Compass rose on applicable ND rotates upscale (counterclockwise) 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects clockwise to right of index mark.
(3)	Release SET HDG knob and set DG/SLAVED switch to SLAVED position.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1a). Sync indicator pointer begins to creep back to 12 o'clock position.
(3a)	Select DG/SLAVED switch to DG position on applicable controller.	
(4)	Rotate SET HDG knob counterclockwise to first index mark and hold until compass rose returns to heading noted in step (1a), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1a), sync indicator pointer in 12 o'clock position.
(5)	Rotate SET HDG knob clockwise to second index mark and hold for 10 seconds.	Compass rose on applicable ND rotates upscale (counterclockwise) 50 degrees (±10°) within 10 seconds. Sync indicator pointer deflects clockwise full scale to right of index mark.
(6)	Release SET HDG knob and set DG/SLAVED switch to SLAVED position.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1a). Sync indicator pointer begins to creep back to 12 o'clock position.
(6a)	Select DG/SLAVED switch to DG position on applicable controller.	Compass rose on applicable ND stops rotating.
(6b)	Select DG/SLAVED switch to SLAVED position on applicable controller.	Compass rose on applicable ND begins to creep back to heading noted in step (1a).
(6c)	Select DG/SLAVED switch to DG position on applicable controller.	Compass rose on applicable ND stops rotating.

Table 201 (Continued)

Step	Operation	Desired Result
(7)	Rotate SET HDG knob counterclockwise to first index mark and hold until compass rose returns to heading noted in step (1a), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1a), sync indicator pointer in 12 o'clock position.
(8)	Rotate SET HDG knob counterclockwise to first index mark and hold for 10 seconds.	Compass rose on applicable ND rotates downscale (clockwise) 5 degrees (±1°) within 10 seconds. Sync indicator pointer deflects counterclockwise to left of index mark.
(9)	Release SET HDG knob and set DG/SLAVED switch to SLAVED position.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1a). Sync indicator pointer begins to creep back to 12 o'clock position.
(9a)	Select DG/SLAVED switch to DG position on applicable controller.	
(10)	Rotate SET HDG knob clockwise to first index mark and hold until compass rose returns to heading noted in step (1a), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1a), sync indicator pointer in 12 o'clock position.
(11)	Rotate SET HDG knob counterclockwise to second index mark and hold for 10 seconds.	Compass rose on applicable ND rotates downscale (clockwise) 50 degrees (±10°) within 10 seconds. Sync indicator pointer deflects counterclockwise full scale to left of index mark.
(12)	Release SET HDG knob and set DG/SLAVED switch to SLAVED position.	SET HDG knob returns to center position. Compass rose begins to creep back to heading noted in step (1a). Sync indicator pointer begins to creep back to 12 o'clock position.
(12a)	Select DG/SLAVED switch to DG position on applicable controller.	
(13)	Rotate SET HDG knob clockwise to first index mark and hold until compass rose returns to heading noted in step (1a), and sync indicator pointer returns to 12 o'clock position.	Aircraft heading as noted in step (1a), sync indicator pointer in 12 o'clock position.
(13a)	Select DG/SLAVED switch to SLAVED position on applicable controller.	
(13b)	Check that ND heading warning displays and RMI heading flags are out-of-view.	ND heading warning displays and RMI heading flags are out-of-view.
(13c)	Operate pilot's overhead panel lighting control and check compass controller for proper panel lighting in the bright and dim brilliance configurations.	Compass controller panel lights come on in bright and dim brilliance configurations.
(14)	Return aircraft to required configuration.	



CAG(IGDS) BBB2-34-1664

Compass Controller Unit
Figure 201/34-21-13-990-803

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. Description

A. Navigation data is displayed on the horizontal situation indicators (HSI) and attitude director indicators (ADI). The indicators use inputs from several systems to display airplane attitude, and navigation commands.

B. HSI - the captain's and first officer's HSI's are located on their respective instrument panels. Each indicator has a fixed miniature airplane symbol in the center with the forward direction of the airplane toward the top of the instrument face. A rotating heading dial marked in 5-degree increments, repeats airplane magnetic heading in conjunction with a lubber line, and is also used as the readout for selected course and selected heading. A reciprocal heading mark extends over the bottom edge of the heading dial, and there are triangular reference marks at 45 and 90 degrees on either side of the lubber line. A separated marker, read against the heading dial, indicates selected heading. Selected course is displayed by a dagger-shaped pointer rotating in the center of the heading dial, with an opposite pointer indicating the reciprocal of selected course. The dagger and reciprocal pointer, together with the airplane symbol, serve as an index for the 4-dot course deviation scale painted on the rotating center mask. Deviation from a selected course is indicated by movement of a course deviation bar across the course deviation scale. Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the left side of the indicator face. Slant distance from DME stations is displayed in two 4-digit display windows. The window in the upper left corner of the indicator is placarded MILES NO. 1, and in the upper right corner, MILES NO. 2. A triangular pointer in the course mask designates display of to/from. An annunciator above the lubber line displays the legend MAG. A navigation annunciator on the right denotes RAD in operation.

(1) Power failure and/or invalid signal data from the applicable input systems will cause the GS flag to come into view and glideslope pointer to be biased out of view, and a shutter covers the DME display, navigation annunciator, and heading.

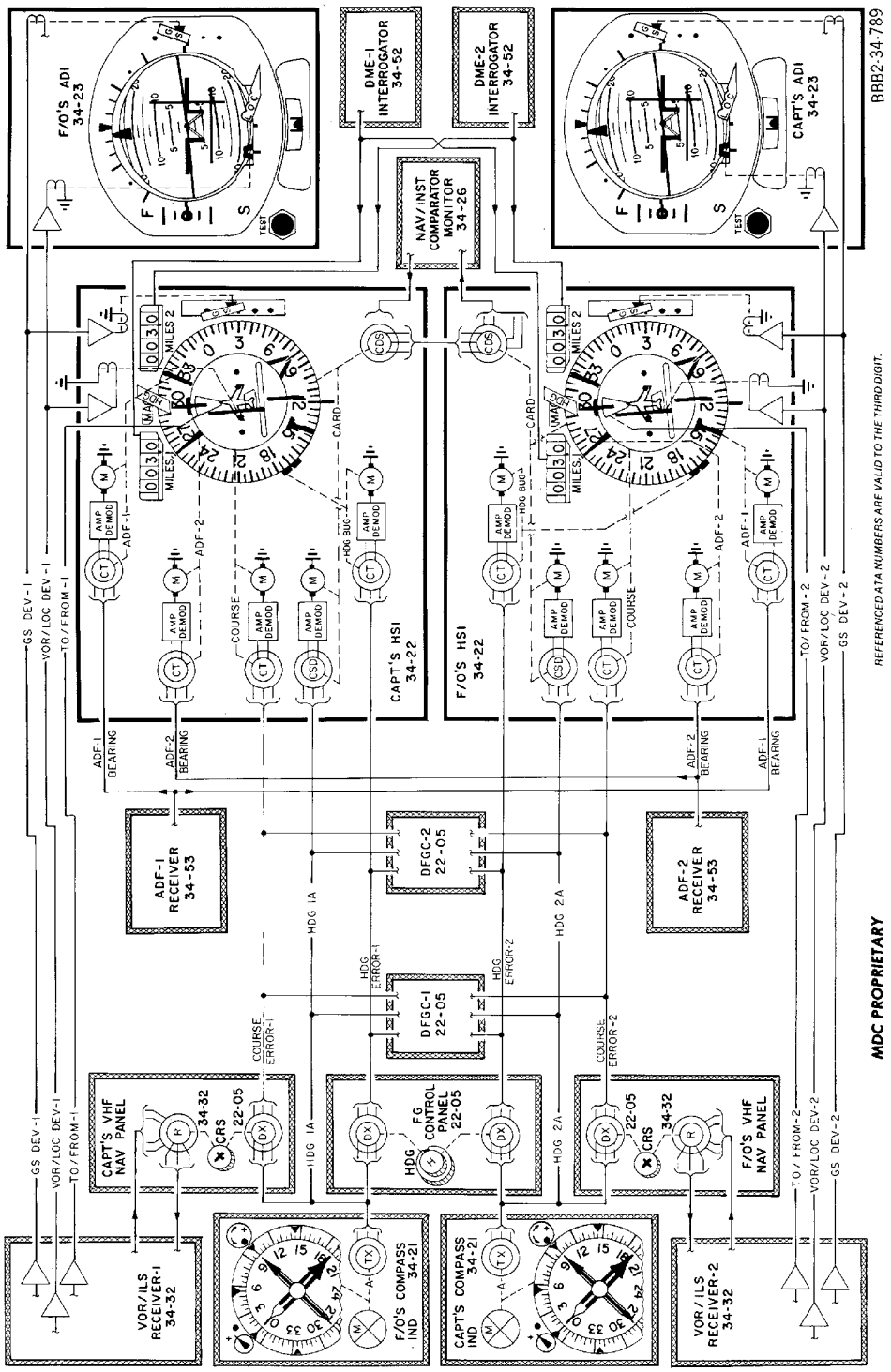
C. ADI - the captain's and first officer's ADI's are located on their respective instrument panels. Each indicator has a fixed airplane symbol as a reference for attitude, and flight guidance command bars. Roll attitude and expanded pitch attitude are displayed by a sphere with the upper and lower half separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed airplane symbol, and roll attitude by rotation of the sphere with respect to the symbol and a fixed scale and lubber line. Cross-pointer bars are used to display flight guidance commands. The horizontal (pitch) bar indicates below the air-plane symbol to command pitchdown attitude, and above the airplane symbol to command pitchup. The vertical (roll) bar indicates to the right of center to command right roll, and to the left of center to command left roll. Speed control is displayed by a circular marker moving over a vertical fixed scale on the left side of the indicator face. Upper end of scale is placarded F (fast); lower end is marked S (slow). Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the right side of the indicator face. Rate of turn is displayed by a vertical pointer moving below a horizontal fixed scale near the center of the bottom of the indicator. A ball inclinometer, read against two centering bars is located at the bottom of the indicator bezel. An isosceles trapazoid pointer at bottom of ADI designates localizer deviation. The ADI also displays Windshear Alert and Guidance System (WAGS) data (if installed). Whenever windshear guidance is active, the Windshear Computer (WSC) will command the fast/slow pointers. These commands are based upon shaker margin information from the Stall Warning System. The center position corresponds to stick shaker, fast position is shaker minus 10 degrees and slow positionis shaker plus 5 degrees. In addition, flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

(1) A light in the upper right corner is placarded DH (decision height) and comes on at a preset altitude signal from the radio altimeter system.

(2) A push-to-test switch placarded TEST is located in the lower left corner of the bezel. Depressing TEST button actuates self-test circuits which cause the indicator to display the following:

(a) The attitude sphere will simultaneously indicate a change in attitude of 20(±5) degrees right bank, and 10(±5) degrees climb.

(3) Power failure and/or invalid signal data from the applicable input systems will cause flag to come into view.



Navigation Displays - Block Diagram
Figure 1/34-22-00-990-807

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

2. Operation

A. Navigation display input data to the HSI, and ADI is supplied from the VOR/ILS receiver, the DME interrogator, the compass system, and the CRS and HDG select portions of th flight guidance control panel. The ADI flight guidance command and speed control display are actuated by signals from Digital Flight Guidance computers.

B. The HSI provides signals as follows:

(1) Signals from a control transmitter in the integrated instrument amplifier to a control differential synchro in the RDI, cause the motor-driven heading card to repeat airplane magnetic heading, when read against the indicator lubber line. The heading card is also used as a readout for selected course and selected heading.

(2) When the HDG select knob on the flight guidance control panel is rotated, a synchro transmitter sends an error signal to a control transformer in the indicator which drives a servo motor that mechanically positions the heading select pointer. The motor continues to drive the pointer until the servo loop is nulled, and the indicator read against the heading dial indicates selected heading. The dagger-shaped course select pointer is remotely positioned by an identical servo loop when the CRS knob is rotated.

(3) Deviation from selected course (with proper VOR frequency selected) will cause the VOR/ILS receiver to send a VOR deviation signal to a meter movement in the HSI. The meter movement displaces the course deviation bar to indicate whether the airplane is to the left or right of, or centered on, the selected VOR radial. When tuned to a localizer frequency, a signal from the ILS receiver to the meter movement, causes the deviation bar to indicate the airplane attitude in relation to the localizer beam. After localizer capture (approximately 2 dots deviation), flying the airplane to the bars will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on the beam condition.

(4) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(5) DME slant range distance in nautical miles is digitally displayed in the MILES -1 and MILES -2 display windows. Each window provides a 3-digit display on three wheels with each wheel driven independently by a synchro torque receiver. The output of the DME interrogator to the indicator is an analog output in synchro form. A bar covering the display indicates a no valid information.

C. The ADI provides attitude and command signals as follows:

(1) Signals from a pitch angle CX and a bank angle CX in each VG, to a CDS in the ADI, cause the horizon sphere to display airplane attitude in relation to the fixed airplane symbol and lubber line. The sphere is driven by a dc torquer motor and has approximately ±85 degrees freedom in pitch and full 360 degrees freedom in roll. The roll scale on the sphere has a 1-to-1 relationship with airplane attitude, but the pitch scale sensitivity is electrically expanded.

(2) The flight guidance V command bar is driven by a meter movement in the indicator, actuated by signals from the Digital Flight Guidance Computers.

(3) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(4) A signal from the radio altimeter operates a servo motor to drive the radio altimeter symbol. At a preset altitude, a signal from the radio altimeter will cause the decision height (DH) light to come on. When tuned to localizer, deviation signals from the VOR/ILS receiver to a second servo will cause the localizer symbol to indicate the direction the airplane must be flown to center on the localizer beam.

D. Flag and out-of-view logic for the ADI is controlled by both external circuits and internal monitors. The flags are externally operated and will come into view if there is loss of valid information. The flags are held out of view when the proper bias voltage is received from the applicable input system. Circuits within the ADI monitor for power loss, failure of a servo loop and absence of external data valid signals. Invalid attitude data will cause flag display.

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. Description

A. Navigation data is displayed on the horizontal situation indicators (HSI) and attitude director indicators (ADI). The indicators use inputs from several systems to display airplane attitude, and navigation commands.

B. HSI - the captain's and first officer's HSI's are located on their respective instrument panels. Each indicator has a fixed miniature airplane symbol in the center with the forward direction of the airplane toward the top of the instrument face. A rotating heading dial marked in 5-degree increments, repeats airplane magnetic heading in conjunction with a lubber line, and is also used as the readout for selected course and selected heading. A reciprocal heading mark extends over the bottom edge of the heading dial, and there are triangular reference marks at 45 and 90 degrees on either side of the lubber line. A separated marker, read against the heading dial, indicates selected heading. Selected course is displayed by a dagger-shaped pointer rotating in the center of the heading dial, with an opposite pointer indicating the reciprocal of selected course. The dagger and reciprocal pointer, together with the airplane symbol, serve as an index for the 4-dot course deviation scale painted on the rotating center mask. Deviation from a selected course is indicated by movement of a course deviation bar across the course deviation scale. Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the left side of the indicator face. Slant distance from DME stations is displayed in two 4-digit display windows. The window in the upper left corner of the indicator is placarded MILES NO. 1, and in the upper right corner, MILES NO. 2. A triangular pointer in the course mask designates display of to/from. An annunciator above the lubber line displays the legend MAG. A navigation annunciator on the right denotes RAD in operation.

(1) Power failure and/or invalid signal data from the applicable input systems will cause the GS flag to come into view and glideslope pointer to be biased out of view, and a shutter covers the DME display, navigation annunciator, and heading.

C. ADI - the captain's and first officer's ADI's are located on their respective instrument panels. Each indicator has a fixed symbol as an airplane reference for attitude, and flight guidance command bars. Roll attitude and expanded pitch attitude are displayed by a sphere with the upper and lower half separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed airplane symbol, and roll attitude by rotation of the sphere with respect to the symbol and a fixed scale and lubber line. Cross-pointer bars are used to display flight guidance commands. The horizontal (pitch) bar indicates below the air-plane symbol to command pitchdown attitude, and above the airplane symbol to command pitchup. The vertical (roll) bar indicates to the right of center to command right roll, and to the left of center to command left roll. Speed control is displayed by a circular marker moving over a vertical fixed scale on the left side of the indicator face. Upper end of scale is placarded F (fast); lower end is marked S (slow). Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the right side of the indicator face. Bank angle is displayed by a vertical pointer at top of indicator. A ball inclinometer, read against two centering bars is located at the bottom of the indicator bezel. An isosceles trapazoid pointer at bottom of ADI designates localizer deviation. The ADI also displays Windshear Alert and Guidance System (WAGS) data (if installed). Whenever windshear guidance is active, the Windshear Computer (WSC) will command the fast/slow pointers. These commands are based upon shaker margin information from the Stall Warning System. The center position corresponds to stick shaker, fast position is shaker minus 10 degrees and slow position is shaker plus 5 degrees. In addition, flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

(1) A light in the upper right corner is placarded DH (decision height) and comes on at a preset altitude signal from the radio altimeter system.

(2) A push-to-test switch placarded TEST is located in the lower left corner of the bezel. Depressing TEST button actuates self-test circuits which cause the indicator to display the following:

(a) The attitude sphere will simultaneously indicate a change in attitude of 20(±5) degrees right bank, and 10(±5) degrees climb.

(3) Power failure and/or invalid signal data from the applicable input systems will cause flag to come into view.

2. Operation

A. The HSI provides signals as follows:

(1) Signals from a control transmitter in the integrated instrument amplifier to a control differential synchro in the RDI, cause the motor-driven heading card to repeat airplane magnetic heading, when read against the indicator lubber line. The heading card is also used as a readout for selected course and selected heading.

(2) When the HDG select knob on the flight guidance control panel is rotated, a synchro transmitter sends an error signal to a control transformer in the indicator which drives a servo motor that mechanically positions the heading select pointer. The motor continues to drive the pointer until the servo loop is nulled, and the indicator read against the heading dial indicates selected heading. The dagger-shaped course select pointer is remotely positioned by an identical servo loop when the CRS knob is rotated.

(3) Deviation from selected course (with proper VOR frequency selected) will cause the VOR/ILS receiver to send a VOR deviation signal to a meter movement in the HSI. The meter movement displaces the course deviation bar to indicate whether the airplane is to the left or right of, or centered on, the selected VOR radial. When tuned to a localizer frequency, a signal from the ILS receiver to the meter movement, causes the deviation bar to indicate the airplane attitude in relation to the localizer beam. After localizer capture (approximately 2 dots deviation), flying the airplane to the bars will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on the beam condition.

(4) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(5) DME slant range distance in nautical miles is digitally displayed in the MILES NO. -1 and MILES NO. -2 display windows. Each window provides a 3-digit display on three wheels with each wheel driven independently by a synchro torque receiver. The output of the DME interrogator to the indicator is an analog output in synchro form. A bar covering the display indicates a no valid information.

B. The ADI provides attitude and command signals as follows:

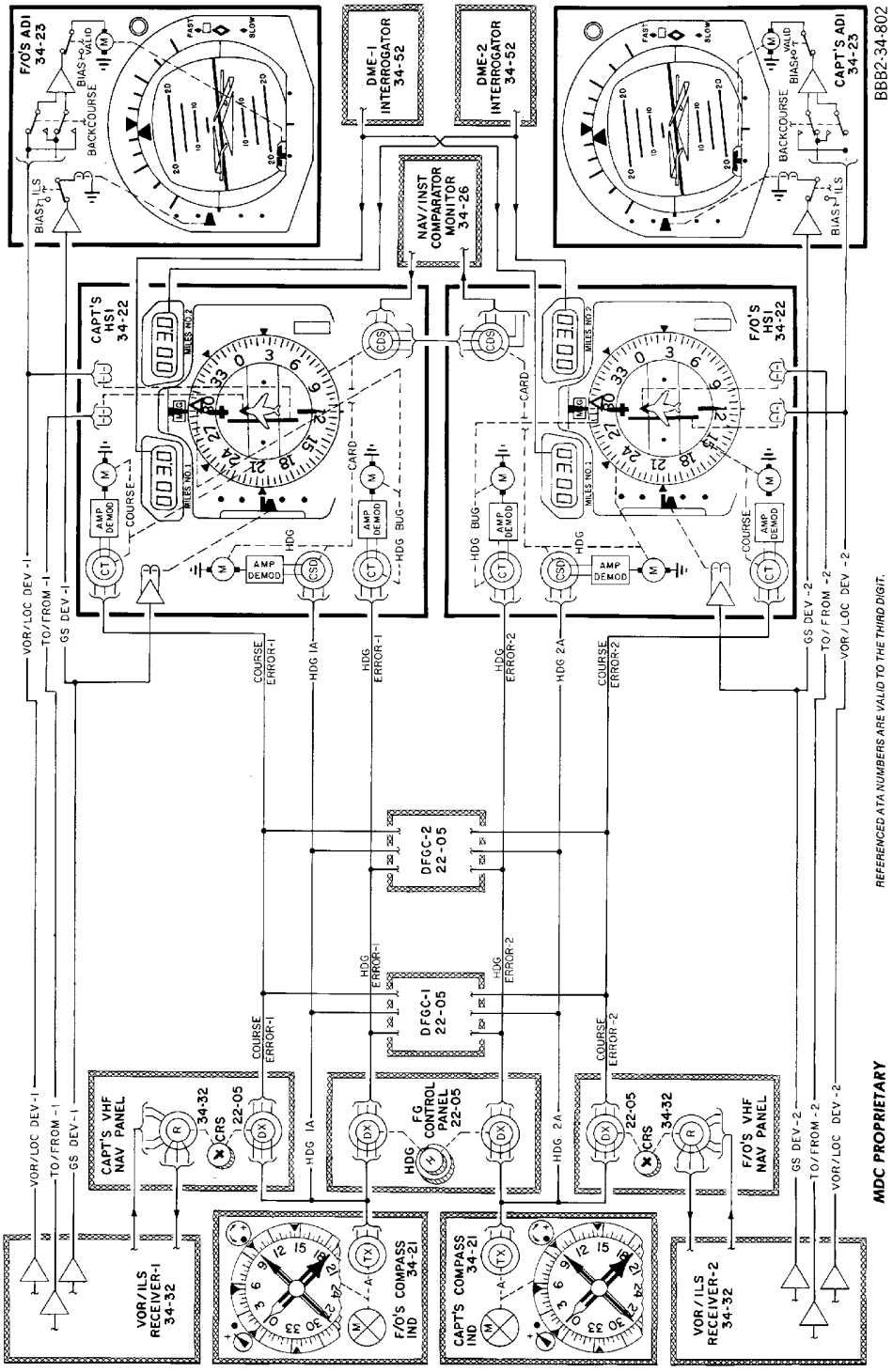
(1) The flight guidance V command bar is driven by a meter movement in the indicator, actuated by signals from the Digital Flight Guidance Computers.

(2) Signals from a pitch angle CX and a bank angle CX in each VG, to a CDS in the ADI, cause the horizon sphere to display airplane attitude in relation to the fixed airplane symbol and lubber line. The sphere is driven by a dc torquer motor and has approximately ±85 degrees freedom in pitch and full 360 degrees freedom in roll. The roll scale on the sphere has a 1-to-1 relationship with airplane attitude, but the pitch scale sensitivity is electrically expanded.

(3) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(4) A signal from the radio altimeter operates a servo motor to drive the radio altimeter symbol. At a preset altitude, a signal from the radio altimeter will cause the decision height (DH) light to come on. When tuned to localizer, deviation signals from the VOR/ILS receiver to a second servo will cause the localizer symbol to indicate the direction the airplane must be flown to center on the localizer beam.

C. Flag and out-of-view logic for the ADI is controlled by both external circuits and internal monitors. The flags are externally operated and will come into view if there is loss of valid information. The flags are held out of view when the proper bias voltage is received from the applicable input system. Circuits within the ADI monitor for power loss, failure of a servo loop and absence of external data valid signals. Invalid attitude data will cause flag display.



Navigation Displays - Block Diagram
Figure 1/34-22-00-990-808

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. Description

A. Navigation data is displayed on the horizontal situation indicators (HSI) and attitude director indicators (ADI). The indicators use inputs from several systems to display aircraft attitude, and navigation commands. The HSI displays navigation data in two different modes depending on position of the captain's and first officer's HSI display selector switches.

B. Horizontal Situation Indicator (HSI)

(1) The captain's and first officer's HSI's are located on their respective instrument panels. Each indicator has a fixed miniature airplane symbol in the center of a rotating heading dial. Triangular reference marks are located outside the dial at 45 and 90 degrees from the lubber line. The airplane symbol points toward the top of the instrument face, pointing in the direction of the nose of the aircraft. A heading annunciator above the vertical lubber line displays MAG for magnetic heading. The rotating heading dial is marked in 5-degree increments. Aircraft magnetic heading is read where the vertical lubber line intersects the heading dial. Reciprocal heading is read where the lubber line extends below the rotating heading dial, at the bottom of the indicator. The heading dial is also used when reading selected course and selected heading. Selected course is indicated by the dagger-shaped pointer which rotates in the center of the heading dial. Its reciprocal pointer shows the reciprocal of the selected course. Selected heading is indicated by the triangular heading marker located inside the outer rim of the heading dial.

(2) The dagger and reciprocal pointer are connected by the course deviation bar when the aircraft is on course. The dagger and reciprocal pointer, together with the airplane symbol, serve as an index for the 4-dot course deviation scale in the center of the rotating heading dial. Deviation from a selected course is indicated by movement of the course deviation bar across the 4-dot scale. Glideslope deviation is indicated by movement of a pointer along another 4-dot scale, located to the left of the rotating heading dial. Slant distance from DME stations is displayed in the two 4-digit display windows located above the indicator face. The upper left window is placarded MILES NO. 1, and the upper right window MILES NO. 2.

(3) The heading information displayed on the HSI's is dependent on the mode selected on the captain's and first officer's HSI display selector switches. These switches, located on the captain's and first officer's instrument panels, have a green annunciator (RADIO) to indicate RAD mode and a blue annunciator (OMEGA) to indicate NAV mode. In NAV mode, the Omega/VLF navigation system is in use. The navigation annunciator to the bottom left of the rotating dial on the HSI will also read RAD or NAV according to the selected mode. The window above the navigation annunciator will show a 1 on the Captain's HSI and a 2 on the FO's HSI. The window on the upper left-hand side of the indicator will display ALERT two minutes prior to an ONS (OMEGA) track change.

(4) When the HSI navigation annunciator window shows RADIO mode, the following HSI indications are displayed: the selected course is read against the heading card, VOR/LOC course deviation is shown by the course deviation bar, VOR to/from is shown by the triangular pointer in the course mask, and glideslope deviation is shown on the left-hand vertical scale. The upper left and right windows show slant distance from the nearest DME station. In (OMEGA) mode, the corresponding indications are: desired track against the heading card, OMEGA cross-track deviation at the crosstrack deviation bar, and OMEGA/VLF waypoint to/from at the triangular pointer. The vertical left-hand glideslope deviation scale is out of view in OMEGA mode. The upper windows still show distance to the nearest DME station.

(5) Power failure and/or invalid signal data input to the HSI will cause the following to occur: GS flag comes into view over the glideslope deviation scale, glideslope pointer is biased out of view, and shutters cover the DME display, navigation annunciator and heading indicator.

C. ADI - the captain's and first officer's ADI's are located on their respective instrument panels. Each indicator has a fixed symbol as an airplane reference for attitude, and flight guidance command bars. Roll attitude and expanded pitch attitude are displayed by a sphere with the upper and lower half separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed airplane symbol, and roll attitude by rotation of the sphere with respect to the symbol and a fixed scale and lubber line. Cross-pointer bars are used to display flight guidance commands. The horizontal (pitch) bar indicates below the airplane symbol to command pitchdown attitude, and above the airplane symbol to command pitchup. The vertical (roll) bar indicates to the right of center to command right roll, and to the left of center to command left roll. Speed control is displayed by a circular marker moving over a vertical fixed scale on the left side of the indicator face. Upper end of scale is placarded F (fast); lower end is marked S (slow). Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the right side of the indicator face. Bank angle is displayed by a vertical pointer at top of indicator. A ball inclinometer, read against two centering bars is located at the bottom of the indicator bezel. An isosceles trapazoid pointer at bottom of ADI designates localizer deviation. The ADI also displays Windshear Alert and Guidance System (WAGS) data (if installed). Whenever windshear guidance is active, the Windshear Computer (WSC) will command the fast/slow pointers. These commands are based upon shaker margin information from the Stall Warning System. The center position corresponds to stick shaker, fast position is shaker minus 10 degrees and slow position is shaker plus 5 degrees. In addition, flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

(1) A light in the upper right corner is placarded DH (decision height) and comes on at a preset altitude signal from the radio altimeter system.

(2) A push-to-test switch placarded TEST is located in the lower left corner of the bezel. Depressing TEST button actuates self-test circuits which cause the indicator to display the following:

(a) The attitude sphere will simultaneously indicate a change in attitude of 20(±5) degrees right bank, and 10(±5) degrees climb, and the ATT flag will be in view.

(3) Power failure and/or invalid signal data from the applicable input systems will cause the ATT flag, FD flag, SPD flag, GS, LOC, and HT to come into view.

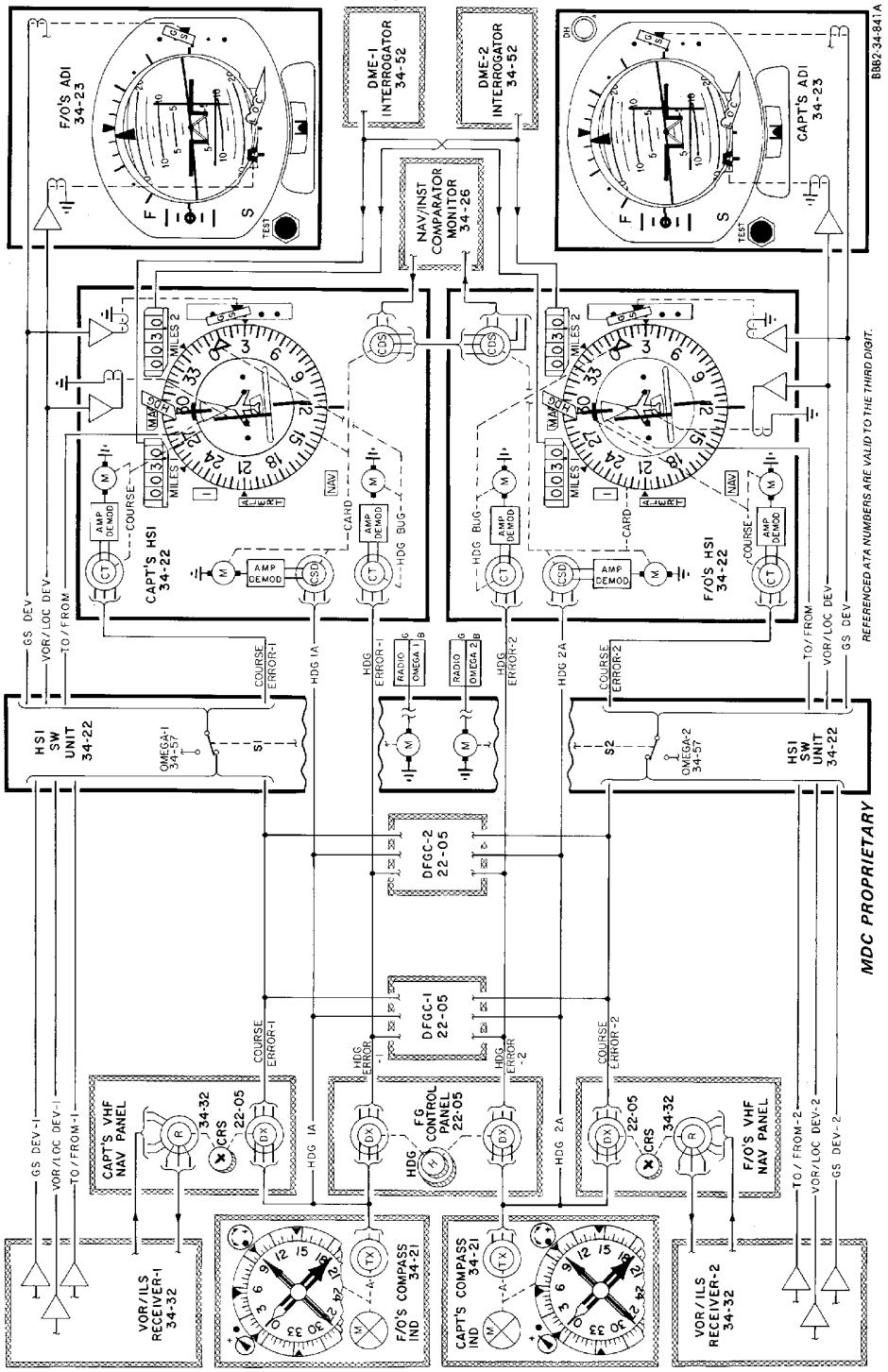
D. HSI (RAD/INS) Switching Unit - The switching unit is a rack mounted unit, located in the electrical/electronics compartment. The front panel contains two annunciator windows, placarded CAPT. ON, and F.O. ON. The words RAD (RADIO) or INS (OMEGA) will appear in the windows, depending on flight crew selection with the HSI display selector switches (placarded RADIO/OMEGA) on the captain's and first officer's instrument panels. When the captain selects RADIO (green light), his HSI will display VOR/LOC course deviation. With the switch in the OMEGA position (blue light), the captain's HSI displays crosstrack deviation. The first officer's HSI display selector switch controls input to his HSI in the same manner.

(1) When the HSI switch is in the RADIO position, rotating the captain's or first officer's CRS select knob on the flight guidance control panel, allows selection of desired course for the applicable (-1, or -2) system. Selected course is displayed on the HSI by the dagger-shaped pointer rotating around the inner periphery of the heading dial. An opposite pointer provides the reciprocal of selected course. A digital readout of the selected course is displayed in a window adjacent to the applicable CRS knob.

(2) When the HSI switch is in either the RADIO or OMEGA position, rotating the HDG select knob on the flight guidance control panel allows selection of desired heading. The heading bug on both HSI's indicates the selected heading as read against the heading dial. A digital readout of the selected heading is displayed in a window adjacent to the HDG knob.

(3) When the HSI switch is in the OMEGA position, the selected CRS signals are replaced by track angle error + drift angle (TKE + DA) signals from the ONS. In this mode, the triangular-shaped bug is displaying drift angle.

(OMEGA/VLF NAVIGATION SYSTEM, SUBJECT 34-55-00, Page 1)



Navigation Displays - Block Diagram
Figure 1/34-22-00-990-809

2. Operation

A. Navigation display input data to the HSI and ADI are supplied from the VOR/ILS receiver, the DME interrogator, the compass system, radio altimeter system, the CRS and HDG select portions of the flight guidance control panel, and the Omega Navigation System (ONS). The ADI flight guidance command bars and speed control display are actuated by signals from Digital Flight Guidance computers.

B. When RADIO is selected on the HSI display selector switch, the HSI provides displays as follows:

(1) Signals traveling from a control transmitter in the integrated instrument amplifier to a control differential synchro in the HSI, cause the motor-driven heading card to repeat aircraft magnetic heading, as read against the indicator lubber line. The heading card is also used as a readout for selected course and selected heading.

(2) When the HDG select knob on the flight guidance control panel is rotated, a synchro transmitter sends an error signal to a control transformer (CT) in the indicator. The CT drives a servo motor that mechanically positions the heading select pointer. The motor continues to drive the pointer until the servo loop is nulled, and the indicator read against the heading dial indicates selected heading. The dagger-shaped course select pointer is remotely positioned by an identical servo loop when the CRS knob is rotated.

(3) Deviation from selected course (with proper VOR frequency selected) will cause the VOR/ILS receiver to send a VOR deviation signal to a meter movement in the HSI. The meter movement displaces the course deviation bar to indicate whether the aircraft is to the left or right of, or centered on, the selected VOR radial. When tuned to a localizer frequency, a signal from the ILS receiver to the meter movement, causes the deviation bar to indicate the aircraft position in relation to the localizer beam. After localizer capture (approximately 2 dots deviation), flying the aircraft to the bars will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on-the-beam condition.

(4) The glideslope pointer is controlled by a meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. When the aircraft is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the aircraft is on the glidepath.

(5) DME slant range distance in nautical miles is digitally displayed in the MILES NO. 1 and MILES NO. 2 display windows. Each window provides a 4-digit display.

C. When OMEGA is selected on the HSI display selector switch, the HSI provides displays as follows:

(1) Signals from the ONS cause a meter movement in the HSI to displace the course deviation bar to display cross-track deviation. The bar (read against the 4-dot scale) indicates whether the airplane is to the left or right of, or centered on, the desired track.

(2) Signals from the ONS cause a CT in the HSI to drive a servo motor which mechanically moves the dagger-shaped course arrow. The motor continues to drive the course arrow until the servo loop is nulled, and the pointer read against the heading dial indicates track angle error + drift angle (TKE + DA).

(3) DME slant range distance, in nautical miles, is digitally displayed in the MILES NO. 1 window of the captain's HSI and/or MILES NO. 2 window of the F/O's HSI. Each window provides a 4-digit display.

D. The HSI (RAD/INS) switching unit contains two motor-driven switches. The rotor shaft of each motor is mechanically connected to a rotary wafer switch, and an indicator wheel. When either the captain's or first officer's HSI switch is operated, the applicable motor drives the switch to a new position. The switch position is repeated by the annunciator wheel to display the legend RAD, or INS in either the CAPT. ON, or F.O. ON window on the switching unit front panel. The annunciator window on the applicable HSI will repeat the switch position by displaying either RAD or NAV.

E. The ADI provides attitude and command signals as follows:

(1) A switch within the attitude switching unit (ASU) is remotely actuated from the VERT GYRO switch on the over-head switch panel, to control selection of the applicable vertical gyro (VG) signal output. The three-position switch is placarded L ON AUX, NORM, and R ON AUX. Placing the switch in other than NORM position, allows the captain or first officer to select the AUX GYRO output to replace the VG-1 or VG-2 output which normally feeds their applicable attitude system.

(2) Signals from a pitch angle CX and a bank angle CX in each VG, to a CDS in the ADI, cause the horizon pitch tape to display aircraft attitude in relation to the fixed airplane symbol and lubber line. The pitch tape is driven by a dc torquer motor.

(3) The flight guidance command bars are driven by a meter movement in the indicator, actuated by signals from the Digital Flight Guidance Computers.

(4) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. When the aircraft is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the aircraft is on the glidepath.

(5) A signal from the radio altimeter operates a servo motor to drive the radio altimeter symbol. At a preset altitude, a signal from the radio altimeter will cause the decision height (DH) light to come on. When tuned to localizer, deviation signals from the VOR/ILS receiver to a second servo will cause the localizer symbol to indicate the direction the airplane must be flown to center on the localizer beam.

F. Flag and out-of-view logic for the ADI is controlled by both external circuits and internal monitors. The SPD and HT flags are externally operated and will come into view if there is loss of valid information. The flags are held out of view when the proper bias voltage is received from the applicable input system. Circuits within the ADI monitor for power loss, failure of a servo loop and absence of external data valid signals. Invalid attitude data will cause flag display. Flag displays are ATT, FD, GS, LOC, HT, and SPD.

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The Electronic Flight Instrument System (EFIS) replaces the conventional ADI and HSI on the Captain's and First Officer's instrument panels with four five-by-six inch color CRT display units. The upper units, the Primary Flight Displays, provide information normally found on the ADI, plus radio altitude, marker beacons, and Windshear Alert and Guidance System (WAGS) data. The lower units, the Navigation Displays, provide information normally found on the HSI, ADF bearing plus coordinated weather radar.

B. The EFIS interfaces with the Flight Management System (FMS) to provide FMS information display on the EFIS navigation display (ND) and the EFIS primary flight display (PFD). FMS data is displayed on the ND when the EFIS mode control panel selected mode is PLAN or MAP. The PFD displays speed error relative to the FMS command speed and displays MCDU MSG (Multipurpose Control Display Unit Messages) when an alert message appears on the MCDU. See Paragraph 1.N.(1), EFIS/FMS Interface for description of FMS information displays on the EFIS, PFD, and ND.

C. The Electronic Flight Instrument System (EFIS) consists of two identical and independent systems. (FMS components and controls are shown.) Each system consists of the following:

WJE 401-404, 412, 414

(Figure 1)

WJE 875, 876

(Figure 2)

WJE 401-404, 412, 414, 875, 876

(Figure 3)

Table 1 Systems

Component	Location
One Symbol Generator (SG)	Electrical/Electronics Compartment
Two CRT Display Units (PFD & ND)	Main Instrument Panel
One Control & Dimming Panel (CDP)	Main Instrument Panel
One Mode Select Panel (MSP)	Below Clearview Window
One Remote Light Sensor (RLS) (Shared by both systems)	Top of Glareshield.

(1) There are two switches which are also used in conjunction with EFIS:

(a) EFIS Source Select Switch: Located on the overhead panel, allows either system to be run from the cross-side Symbol Generator in the event of an on-side SG failure.

(b) EFIS/DFGC Toggle Switch: Located under the captains briefcase holder, allows ground maintenance personnel to use the Status Test Panel pushbutton in conjunction with the EFIS display units in performing comprehensive system tests and troubleshooting.

D. System Displays:

(1) The Primary Flight Display (PFD) format displays aircraft attitude, flight director commands, glideslope and localizer deviations, radio altitude, speed error, decision height set and status, marker beacon indication, and WAGS data.

(2) The Navigation Display (ND) operates in ROSE and ARC modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, distance measuring equipment (DME) and ADF bearing. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, ADF bearing and weather radar.

(3) A compacted PFD/ND display format combines both PFD and ND data into a single-screen display. This format is used in the event of a display unit failure.

E. Description and Operation Overview: The Description and Operation is broken down into the following paragraphs:

General (Description)

A.	System Overview
B.	System Overview
C.	System Components
D.	System Displays
E.	Description and Operation Overview
F.	Symbol Generator Description
G.	Display Unit Description
H.	Control & Dimming Panel Description
I.	Mode Select Panel Description
J.	Remote Light Sensor Description
K.	Primary Flight Display (PFD) Symbology
L.	Navigation Display Symbology and Weather Radar
M.	Compacted PFD/ND Display
N.	EFIS/Fight Management System (FMS) Interface

Operation

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground Maintenance

F. Symbol Generator Description

(1) The symbol generator contains all of the circuitry required to interface with aircraft sensors and systems, compute CRT display parameters, and transmit display data to the display units (Figure 4). In addition, the SG provides an instrument comparator monitor function, which performs cross-side comparisons between ILS, attitude, and heading. In the event of a miscompare, the corresponding annunciators on the Flight Mode Annunciator (FMA) panel come on.

(2) The SG monitors its own internal operation and aids in monitoring the cross-side SG. The SG tests its internal functioning by performing dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. In the event of a SG failure or miscompare, the MONITOR lights on the FMA will come on. The SG is also responsible for monitoring all aircraft systems and sensors which provide inputs to the EFIS, as well as the EFIS components. Continuous BIT monitors the EFIS throughout each flight profile, and logs all failures for later retrieval by ground maintenance.

(3) The left symbol generator (SG-1) drives the Captain's PFD and ND displays; the right symbol generator (SG-2) drives the First Officer's displays. Either Symbol Generator can drive all four CRT displays. In the event of a SG failure, the SG source selection switch, located on the Overhead Panel, may be put in the BOTH ON 1 or BOTH ON 2 position. This will cause the display data from the functioning SG to be transferred to the cross-side display units via data buses from the on-side display units. (Figure 4)

(4) The symbol generators also receive data from the flight management system (FMS) advanced flight management computer (AFMC). The generators process the data to provide symbology for FMS, MAP or PLAN displays on the EFIS ND.

(5) Symbol Generator Components: (Figure 5)

(a) Two Display Processor circuit card assemblies (CCA's), one for the PFD and one for the ND, which contain a processor, memory and a vector generator.

(b) Input/Output CCA's, which contain the serial data receivers and transmitters, synchro-to-digital, analog-to-digital, and discrete receivers required to interface with the aircraft sensors and systems.

(c) An Input/Output (IO) Controller, which manages all of the output devices and transfers data between them and system memory.

(d) A System Monitor CCA, which monitors display outputs, system BIT and weather radar processing.

(e) A Weather Radar Scan Converter CCA which converts color radar signals to a format suitable for display on the EFIS color display units.

(6) Symbol Generator Inputs: The SG receives serial data, synchro, analog and discrete inputs from the various aircraft sensors and systems (Figure 6). Program pins and configuration words enable the SG hardware and software to interface with these various types of inputs. SG programming is checked on the ground at power up to verify proper equipment configurations and selected options.

(7) Symbol Generator Outputs: The SG generates serial data outputs, open/ground discrete outputs and audio outputs. The Symbol Generator has two independent display output channels. Video and deflection signals are sent via the display output channels to the Primary Flight Display and to the Navigation Display. A low-speed SG cross-talk bus enables each SG to monitor both its own operation and that of the cross-side SG. This monitoring consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(8) Audio Output: The SG has one audio output for annunciating the decision height. This tone slews from 400 Hz at or above decision height + 50 feet to 800 Hz at DH. The frequency changes linearly from DH + 50 feet to DH. Figure 6 shows the decision height audio output graphically.

(9) Commands are sent to the SG from the cockpit via the Control & Dimming Panel (display unit on/off and brightness, weather radar on/off and brightness, DH set and TEST) and the Mode Select Panel (Navigation Display format selection and range control). The weather radar control panel is used to set the WXR display mode, TILT, GAIN and STAB. Range is controlled from the EFIS Mode Select Panel.

(10) Flight management system navigation and guidance data and EFIS mode control panel input are supplied to the advanced flight management computer (AFMC). The computer processes the information and outputs the data to the EFIS symbol generators to provide the MAP or PLAN displays on the EFIS ND.

(11) The SG's are housed in ARINC 600 4 MCU chassis, and are located in the electrical/electronics compartment. The SG operates on 115 VAC 400 Hz single phase power. The SG power supply converts aircraft power to the DC voltages required by the SG electronics. The SG is able to withstand power interruptions of up to 3 milliseconds without loss of function, and up to 1 second without change of operating mode or loss of digital filter data. Temperature sensing of the power supply is provided to activate an internal SG fan, in the event of an over temperature condition. Forced air (blow-through) cooling is also provided to both units.

(12) Whenever a new Symbol Generator is installed, it must be programmed by ground maintenance before the SG can be used. This programming consists of entering the Options/Register and Check Register numbers into the SG via the Status Test Panel. These numbers, when combined with the configuration identification wired into the aircraft, define the aircraft for the Symbol Generator.

(13) In case of a serious SG failure, the PFD and ND for that system will be blanked. Display data may be transferred from the functioning system by placing the EFIS source select switch in the appropriate position. EFI1 or EFI2 annunciations will appear on all display screens during single-system operation. If a fault can be isolated to a single source, a flag or warning message will appear on screen to signal the affected parameter.

G. Display Unit Description

(1) The Primary Flight Display (PFD) and Navigation Display (ND) units are identical CRT's, clamp-mounted to the main instrument panel. Each display unit (DU) provides a full color (15 plus black) electronic display. The DU's receive display data through analog, digital and discrete interfaces with the symbol generator. Each DU is capable of operating as a PFD or ND. During reversionary mode (either the PFD or ND is turned off), a single display is capable of acting as both a PFD and ND in the compacted PFD/ND mode.

(2) The DU is capable of operating in either raster scan mode (background shading and weather radar) or stroke writing mode (display symbology). Raster dimming is controlled independently of stroke intensity to provide adjustable display contrast capability (Navigation Display only). SG display unit monitoring verifies that the DU is receiving display data. Upon detection of a fault, the DU is blanked. At this time, the DU should be turned off at the Control and Dimming Panel. The system will revert to reversionary mode, and a compacted PFD/ND display will appear on the functioning screen.

(3) A system monitor is incorporated in the DU to provide CRT phosphor protection. The system monitor drives the CRT to cutoff when X-or Y-deflection has stopped, when power supply outputs are abnormal, or when the CRT filament opens or takes excessive current. In case of a DU overheat, the SG will log the failure and remove the raster (background) from the applicable display to reduce the display power required. The message 'WXR OFF' appears on the ND to signal loss of WXR display.

(4) Display unit brightness is controlled in part by the two internal light sensors. These sensors are located on the front of each unit, and feed into the auto-dimming system. The stroke and raster brightness levels are normally set using a combination of brightness data from the Remote Light Sensor, the DU internal light sensors and the Control and Dimming Panel (CDP). Should the DU monitor detect a loss of brightness commands from the CDP, the display unit will revert to a nominal brightness level.

(5) Each DU has two input ports. The primary input port carries analog deflection and digital video information from the on-side symbol generator. The secondary input port is used to either send or receive data, to or from the cross-side display unit. This port allows the DU to be driven from the cross-side symbol generator, if the on-side symbol generator fails.

(6) Each display unit is contained in a 5 x 6 x 10.5 inch outline, and is forced-air cooled. An externally adjustable inclinometer (slip skid indicator) is located on the bottom center of the DU bezel. The CRT display surfaces are covered with a filter, coated with a reflection-reducing coating. There are two extraction aids, on the front bottom left and right corners, to aid in removal/installation of the DU's. Two power transistors, located on the back panel of each DU, dissipate 65 watts.

H. Control & Dimming Panel Description

(1) The Control & Dimming Panel (CDP) provides three functions: (Figure 8)

(a) Display unit manual brightness control

(b) Decision Height set control

(c) TEST pushbutton

(2) The CDP's are located on the main instrument panel, to the right of the display units. They are powered from both Primary Flight Display power (±15 VDC) and lighting power. All CDP control knobs move clockwise from the off position, through an increasing range to the full on position.

(3) Display Unit Manual Brightness Control: The CDP mixes data received from the Remote Light Sensor (RLS) and display unit (DU) internal light sensors with CDP manual brightness control inputs to generate an overall brightness control signal for the DU's. The display unit brightness controls on the CDP are PFD BRT for the Primary Flight Display, and a combined ND/WX BRT for the Navigation Display. The WX BRT control knob is concentric with the ND BRT control, and is used to adjust the weather radar display intensity independently of the ND display symbology.

(4) Full counterclockwise (ccw) rotation of the PFD BRT or ND BRT knobs past the detent causes the corresponding display screen to go blank. Whenever either the PFD or ND BRT knob is turned OFF, the corresponding display screen goes blank, and a compacted PFD/ND display will appear on the remaining on-side display screen. Turning the WX BRT ccw knob past the detent turns the WX display off. The message WXR OFF will be continuously displayed on the ND whenever this knob is in the off position.

(5) Decision Height Set Control: This knob is used to set decision height between zero and 500 feet (any value less than zero feet causes the DH readout on the PFD to go blank). DH data is displayed on the top, right-hand corner of PFD.

(6) TEST pushbutton: The TEST pushbutton is used to initiate a EFIS system self-test. Self-testing begins when the TEST pushbutton is depressed and ends approximately 3 seconds after release. The tests conducted include: VOR/ILS self-test, Radio Altimeter self-test, Marker Beacon self-test, Decision Height Aural Warning self-test and Failure Flag test. All but the DH aural warning and failure flag tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The DH aural warning test consists of a one-second tone slewing from 400-800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. TEST pushbutton function is inhibited in flight.

NOTE: When performing the EFIS self test from the dimming panel test button, the monitor lights on the FMA will flash.

(7) In the event of a Control and Dimming Panel failure, the PFD, ND and WXR displays will remain on. Brightness will be controlled by the auto-dimming system. Since there is no default setting for a DH control failure, DH information should be ignored when the CDP fails.

I. Mode Select Panel Description

(1) The Mode Select Panels (MSP) are located outboard and aft of the glareshield, below the clearview windows. The MSP is used to select the display format for the Navigation Display (Figure 9). Each panel contains an ADF control switch, a MODE switch and a RANGE switch and four pushbutton switches for Flight Management system (FMS) selections.

(2) The MSP interfaces with the Symbol Generator through digital discrete signals. The control panel monitor in the SG verifies correct operation of the MSP. In the event of a MSP failure, the ARC mode will be displayed on the ND. The range will default to 40 nm; the indices and range lines will turn yellow.

(3) The MODE switch is a rotary switch which allows the pilots to select from the following ND display modes:

Table 2

ROSE	Conventional HSI display
ARC	Compass arc display, with coordinated weather radar.
MAP	FMS MAP Display
PLAN	FMS PLAN Display

(4) The RANGE control is a rotary switch that is used in ARC, MAP or PLAN Modes, and allows the crew to select among the following display ranges: 10, 20, 40, 80, 160, and 320 nautical miles. Both the ARC and WXR display ranges are set simultaneously with this control.

(5) The ADF bearing control consists of a rotary switch which is used to control the ADF bearing pointer in the ROSE and ARC modes. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

(6) The FMS pushbuttons selections control the display on the ND as follows:

Table 3

N-AID	(Navigation Aids) Controls Display of Navigation Aids
ARPT	(Airports) Controls Display of Airport
DATA	Controls Display of Ground Reference Points
WPT	(Waypoints) Controls Display of Waypoints data

J. Remote Light Sensor Description

(1) There is one Remote Light Sensor (RLS), installed on top of the glareshield. (Figure 10) The RLS is installed looking forward of the aircraft, to measure the light levels outside of the cockpit. The RLS is powered from the F.O.'s Control & Dimming Panel (CDP). Light level data is transmitted from the RLS to the CDP, where it is combined with manual brightness control and DU light sensor inputs. The resultant mixed signal is used in controlling display intensity and contrast. If the RLS fails, the CDP manual control setting and DU internal sensor signals will be combined to control DU brightness.

K. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format contains the following navigation parameters: (Figure 11)

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(h) FMS data

(i) WAGS data

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

(3) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

(5) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude sphere.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The EFIS also produces a DH tone as the aircraft nears decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

WJE 875, 876

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. A rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

WJE 401-404, 412, 414

Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. A rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

WJE 401-404, 412, 414, 875, 876

(9) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

WJE 401-404, 412, 414

(10) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 1500 feet (457.2 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

WJE 401-404, 412, 414, 875, 876

(11) FMS DATA: FMS "MCDU MSG" and Fast/Slow display will appear relative to MCDU alert messages and FMS speed commands when V-NAV is engaged.

(12) WAGS Data: When the Windshear Computer (WSC) detects an increasing performance windshear (headwind or up draft) it will enable the PFD to display an amber "WIND SHR" message. A detected decreasing performance windshear (tailwind or down draft) will result in a red "WIND SHR" message. The PFD will also display a WSC determined Pitch Limit Indication (PLI) which is the margin between aircraft angle of attack (AOA) and the AOA for shaker onset. In addition, speed deviation and flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

L. Navigation Display (ND) Symbology and Weather Radar

(1) The Navigation Display (ND) appears on the lower CRT. The ND provides HSI information, ADF, coordinated weather radar and FMS MAP or PLAN displays. The display format varies, depending on the display mode selected on the Mode Select Panel (MSP). The following modes are available on the EFIS:

(2) ROSE Mode: display resembles a conventional HSI . The compass rose is located at the center of the screen, with large tick marks at 10 degree increments and small tick marks at 5 degree increments. The tick marks are labeled at 30 degree increments with characters straddling the tick marks. The ROSE Mode display shows:

(Figure 12)

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course and course deviation
(d)	Vertical deviation
(e)	ADF bearing
(f)	TO/FROM indication
(g)	Distance Measuring (DME)

(a) Aircraft Heading: Heading indices consist of tick marks at 45 degree increments around the outside of the compass rose. The digital value of the current heading is displayed in a box above the compass rose. A symbolic reference aircraft is located at the center of the compass rose.

(b) Selected Heading: is indicated by an "M"-shaped pointer which moves along the outside of the compass rose.

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass rose, pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a scale consisting of four small dots. The course pointer and deviation scale rotate with the selected course about the center of the compass rose.

(d) Vertical Deviation: is indicated with a scale and pointer identical to that used on the PFD display.

(e) TO/FROM Indications: A Triangle pointer is provided, which points in the direction of (TO) or 180 degrees away from (FROM) the course deviation pointer. TO/FROM is blanked while in ILS mode.

(f) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

(3) ARC Mode: Display shows a compass arc , centered below the center of the screen, with major tick marks every 10 degrees, and minor tick marks every five degrees. The major tick marks are labeled every 30 degrees. The ARC Mode display shows:

(Figure 13)

(a)	aircraft heading
(b)	selected heading
(c)	selected course

(Continued)

(d)	course deviation
(e)	vertical deviation
(f)	TO/FROM indication
(g)	weather radar
(h)	ADF bearing
(i)	Distance Measuring (DME)

(a) Aircraft Heading: is displayed at the top of the range lubber line. A symbolic reference airplane is located at the center of the compass arc.

(b) Selected Heading: is indicated by an "M" shaped symbol which moves along the outside of the arc, and by a dotted line from the airplane symbol to the "M".

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass arc, with an extension pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a four dot scale. The pointer and deviation scale rotate with the selected course about the center of the arc.

(d) Vertical Deviation: is displayed using a scale and pointer identical to those on the PFD display.

(e) TO/FROM Indications: are displayed under the right end of the heading arc when tuned to a VOR station. TO/FROM indication is blanked while in ILS mode.

(f) Selected course and heading is displayed on the left upper part of the ND by an inverted M, arrow and digital display. These correspond to the selected heading and course on the compass arc. When a change is selected they will be shown momentarily.

(g) Weather Radar: Weather radar data may be displayed within the compass arc. The display range is selected from the Mode Select Panel (MSP). A half-range index mark, centered between the aircraft reference symbol and the outer periphery of the arc, will indicate one-half of the range selected on the MSP. The brightness of the weather radar image can be adjusted relative to the ND symbology from the CDP. When fault codes are received, weather radar status messages will appear on the display screen. The message "WX OFF" will appear on the display screen when a DU overheat is detected or when the CDP WX BRT control knob is in the off position. Tilt angle is annunciated only momentarily, when the WXR antenna tilt angle is changed.

(h) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

(i) DME: DME is displayed in the upper left and right corners of the ND.

M. Compacted PFD/ND Display

(1) The compacted PFD/ND display appears whenever either (but not both) of the Display Units is turned OFF at the CDP. This format contains all data shown on the normal PFD display. However, the bottom third of the attitude sphere is removed and replaced with a heading indicator. The following symbology is available on this display:

(Figure 14)

(a)	Attitude indicator
(b)	Flight director command indicator

(Continued)

(c)	Glideslope deviation
(d)	Speed deviation
(e)	Decision height
(f)	Radio altitude
(g)	Marker beacons
(h)	Altitude alert
(i)	Course deviation
(j)	Compacted heading display
(k)	Selected heading
(l)	Digital course
(m)	Windshear
(n)	Dead reckoning (DR)

(2) All symbology characteristics for the top two-thirds of the display are the same as for the PFD format. The compacted heading display, on the bottom third of the screen, contains the same symbology used on the ND-ROSE display.

N. EFIS/FMS Interface

(1) The Flight Management System interfaces with the EFIS to provide FMS oriented displays on the EFIS primary flight display (PFD) and the navigation display (ND). The advanced flight management computer (AFMC) is the primary source of data for display on the PFD or ND when the EFIS mode selector panel MODE selector is placed in the MAP or PLAN position. The FMS data is supplied to the EFIS symbol generators that provide the symbology display on the PFD and ND. Figure 15 and Figure 16 indicate the FMS controlled displays on the PFD and ND. The mode selector panel also provides the means for selection of Capt/F/O initiated optional (background) data selections; RANGE, N-AID (navigation aids), ARPT (airport), DATA and WPT (waypoint). The N-AIDS selection will initiate VOR-DME navigation aids that are within the current range to be displayed on the ND. The ARPT selection will initiate display on the ND of the airports that are in the data base within the current range. The DATA selection will initiate a display of constraint altitudes and ETA (estimated time of arrival) of every waypoint defined in the active route. WPT selection will initiate data base waypoints not on the active route when the range of the display is 40 nautical miles or less. To remove (declutter) unwanted data, press the selection pushbuttons a second time.

(a) PFD - When the FMS initiates an alert message display on the FMS multipurpose control display unit (MCDU), "MCDU MSG" will be displayed in the upper left corner of the PFD. The PFD FAST/SLOW indicator will follow the FMS speed command. The PFD flight director bars will follow when FMS commands when V-NAV is engaged.

(b) ND - The MAP, PLAN, ROSE or ARC mode selections are displayed on the ND. The MAP mode displays the aircraft position relative to the route and other ground reference data in a track-up format. The map reference point (MRP) for the MAP mode is dynamic with the background moving about the MRP. The PLAN mode display is used by the CAPT/F/O to look ahead in the flight plan and review what a portion of the flight plan looks like. The MRP for the PLAN mode is referenced to a waypoint that is currently displayed on the MCDU and identified by the legend CTR on the LEGS page (SUBJECT 34-63-00, Description and Operation, paragraph K; Line Select Key 6L)

(c) MAP MODE - The MAP mode displays the following FMS provided dynamic information (except as noted):

Distance To Waypoint (DTW) - The distance to the next waypoint.

Estimated Time of Arrival (ETA) - The estimated time of arrival at the next waypoint.

Drift Angle - Drift angle is the difference between computed track angle and heading.

Source of Course/Track Data - The source of the Course/track and deviation data are ILS, VOR or NAV (not FMS generated).

Wind Direction - Indicates FMS calculated wind direction.

Windspeed - Indicates FMS calculated windspeed. Display of wind direction and speed is inhibited below 10,000 feet altitude.

Vertical Deviation - FMS calculated vertical path error when in the descent phase.

Range to Altitude - An arc, the position at which the aircraft will reach the clearance altitude with present flight path and track.

(d) The following represent failure displays (not generated by FMS):

TRK FAIL - Displayed when track data invalid.

NAV FAIL - Displayed when track deviation data invalid.

VNAV FAIL - Displayed when vertical deviation invalid.

MAP FAIL - Displayed, in MAP mode, when EFIS removes map symbology due to loss of data parameters.

(e) PLAN MODE - FMS provided dynamic information for the MAP mode is also applicable to the PLAN mode display on the ND (no FMS background data is displayed on the PLAN mode).

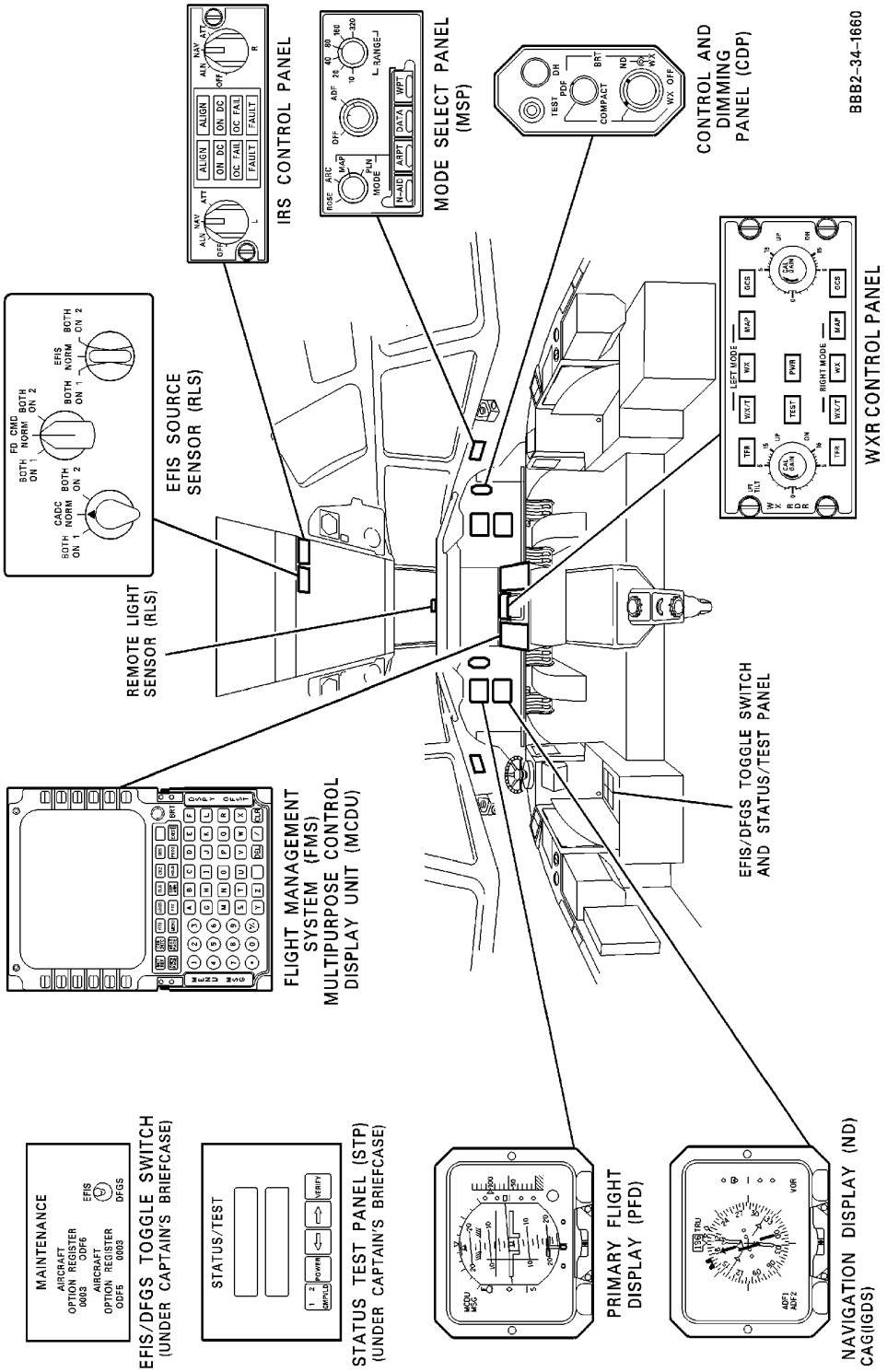
(f) ROSE MODE - The ROSE display resembles a conventional horizontal situation indicator (HSI). FMS information provides the following additional information for display on the ND:

DESIRED COURSE - Displays the desired course when the source of course/track data is NAV.

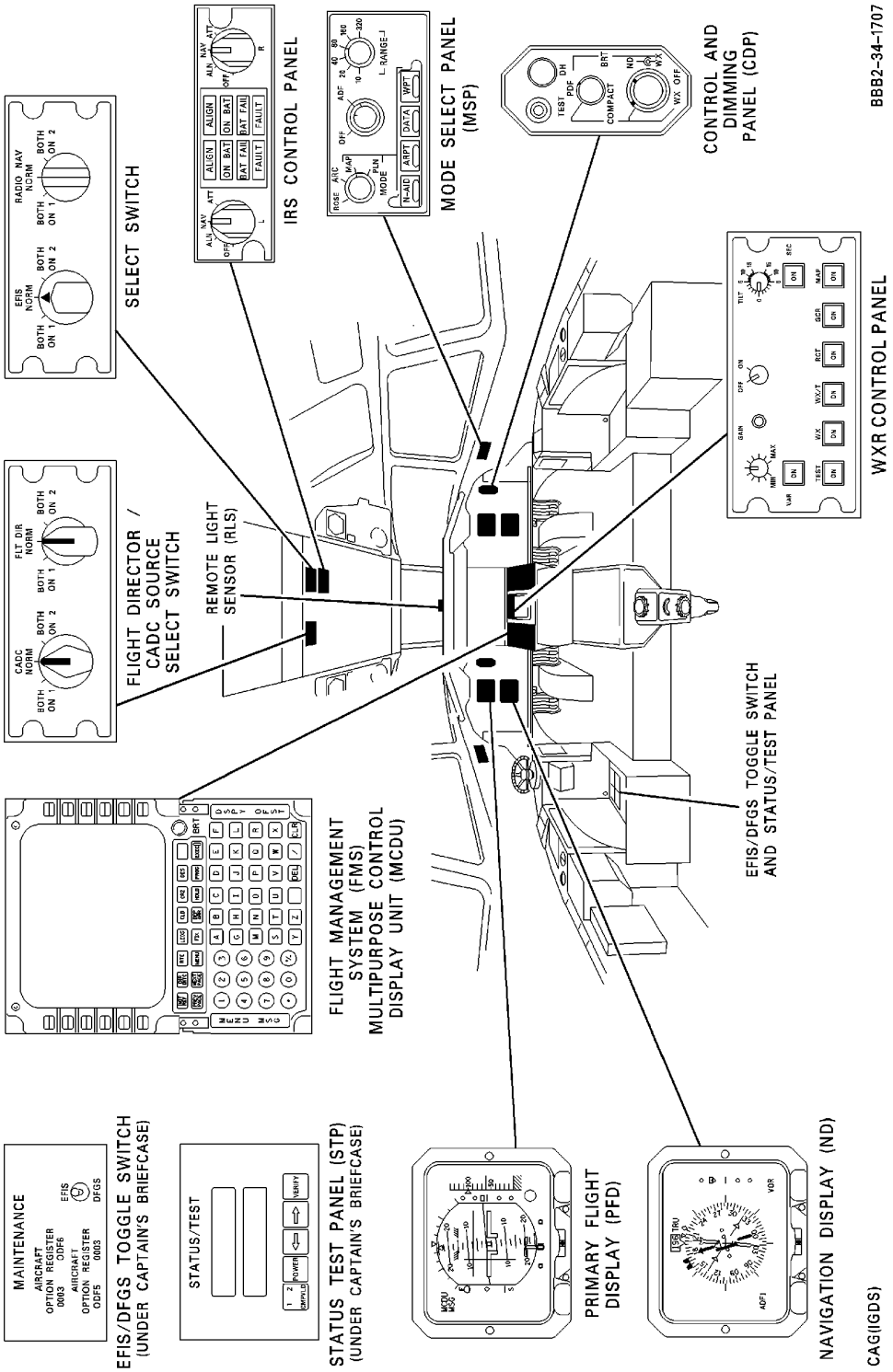
COURSE DEVIATION - Displays FMS lateral deviation when the source of course/track data is NAV.

WAYPOINT ALERT - Displays an annunciation of an upcoming waypoint or course change in the FMS flight plan.

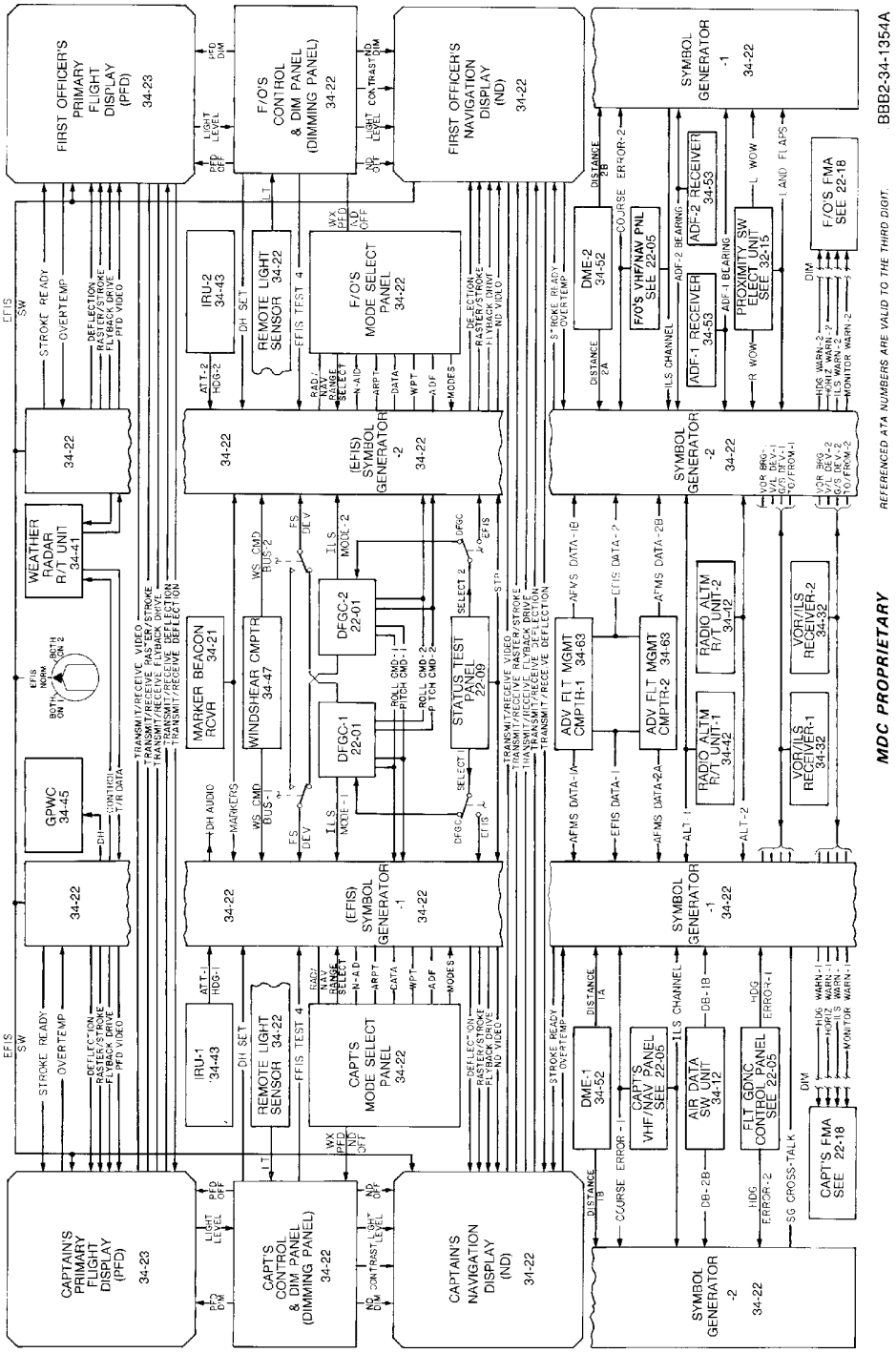
(g) ARC MODE - The ARC mode displays the same information on the ND as the ROSE mode but as a compass arc.



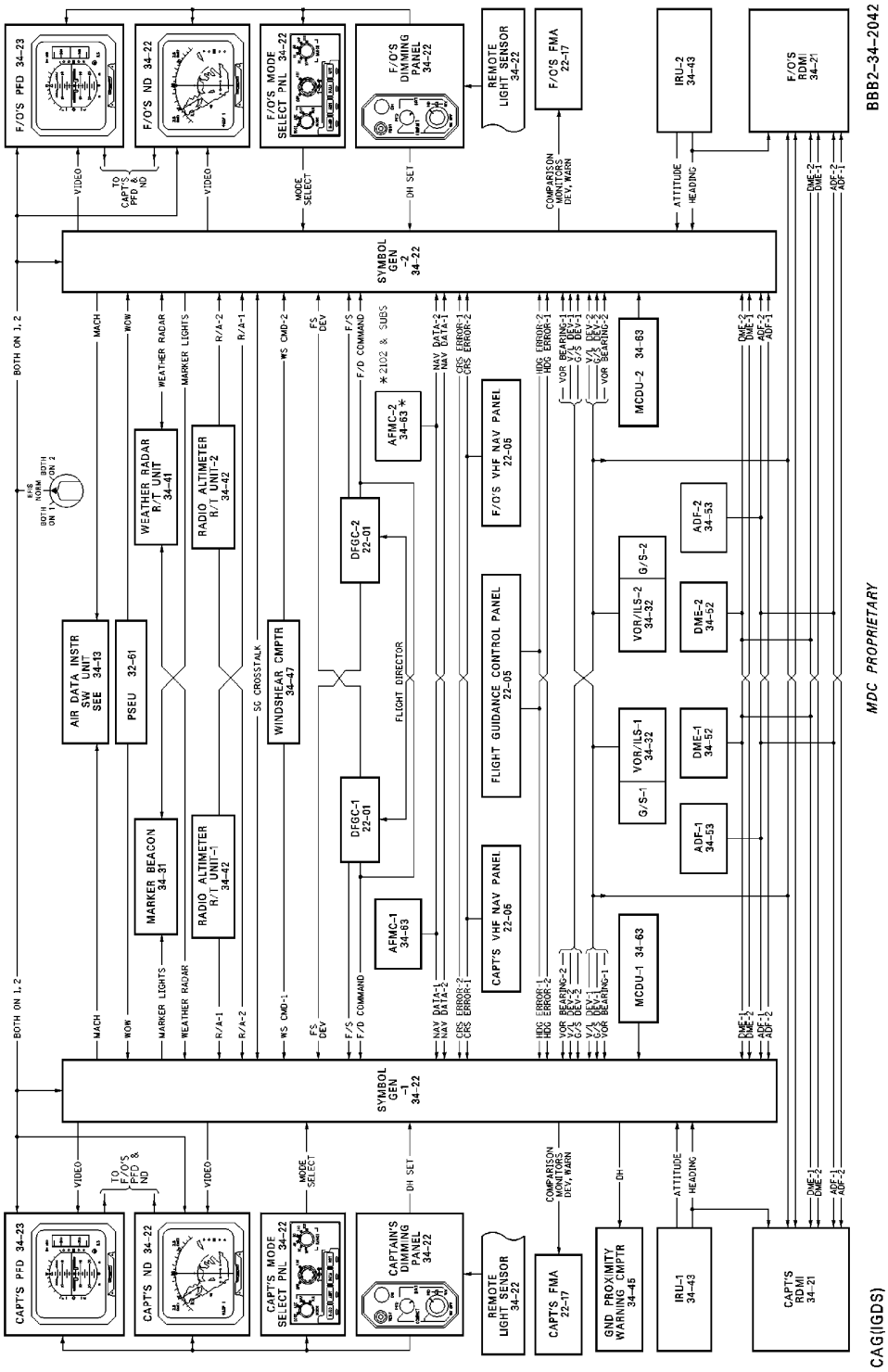
Electronic Flight Instrument System (EFIS) With Flight Management/System (FMS) Interface Flight Compartment Configuration
Figure 1/34-22-00-990-894



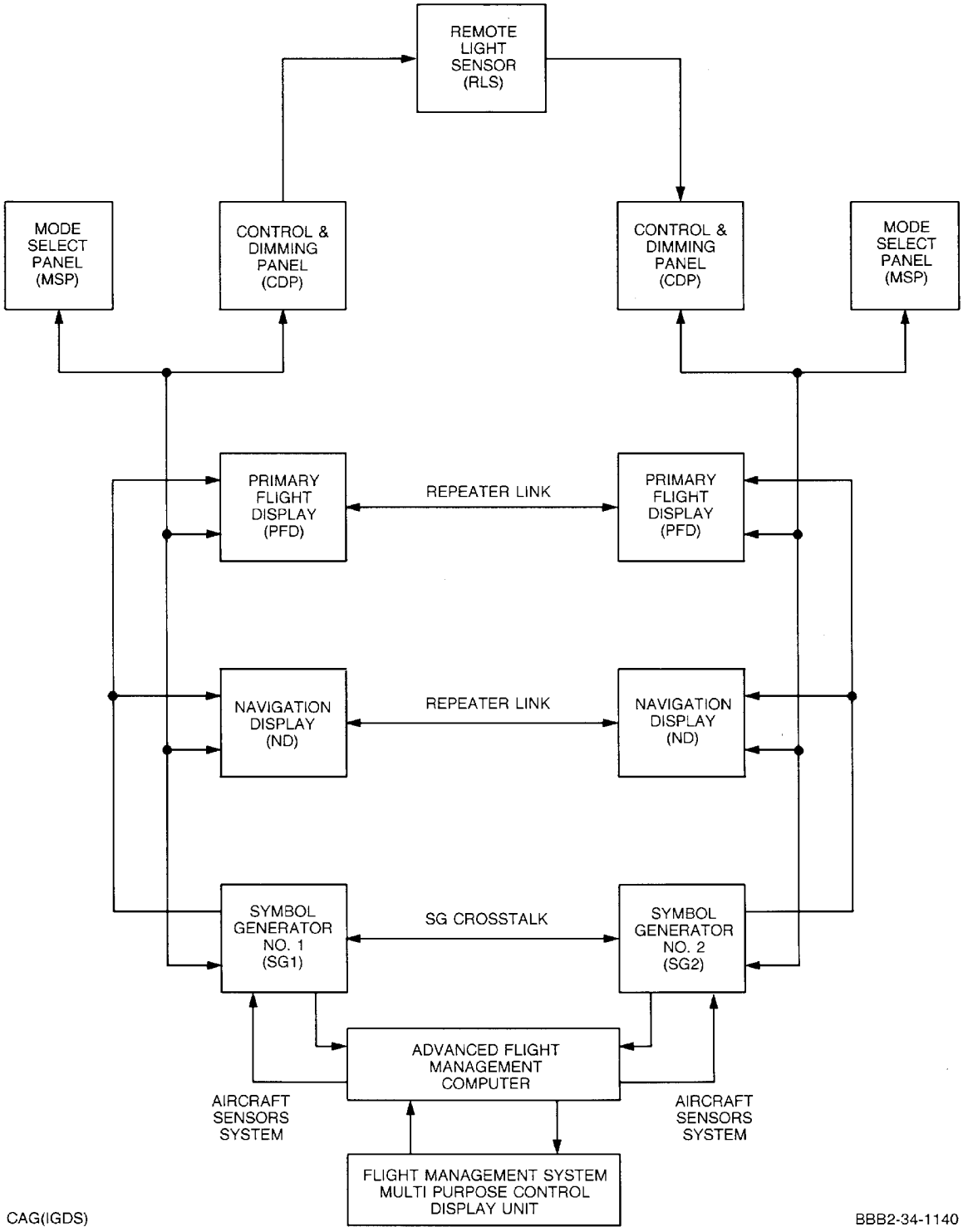
EFIS/FMS Flight Compartment Configuration
Figure 2/34-22-00-990-895



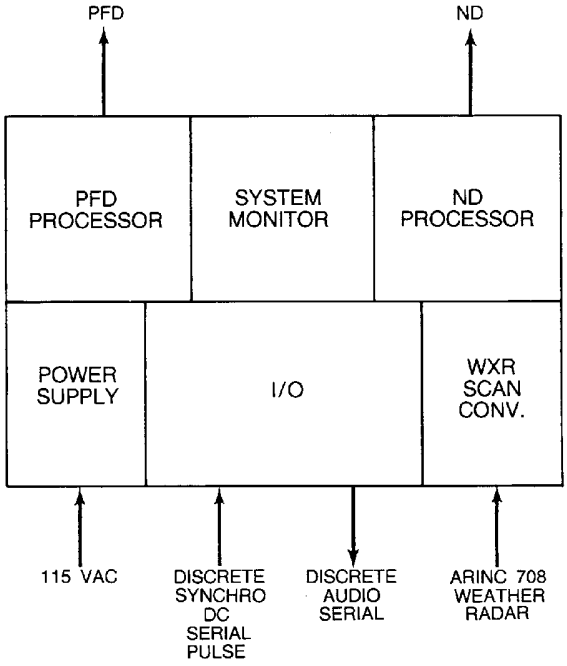
EFIS Block Diagram
Figure 3/34-22-00-990-896 (Sheet 1 of 2)



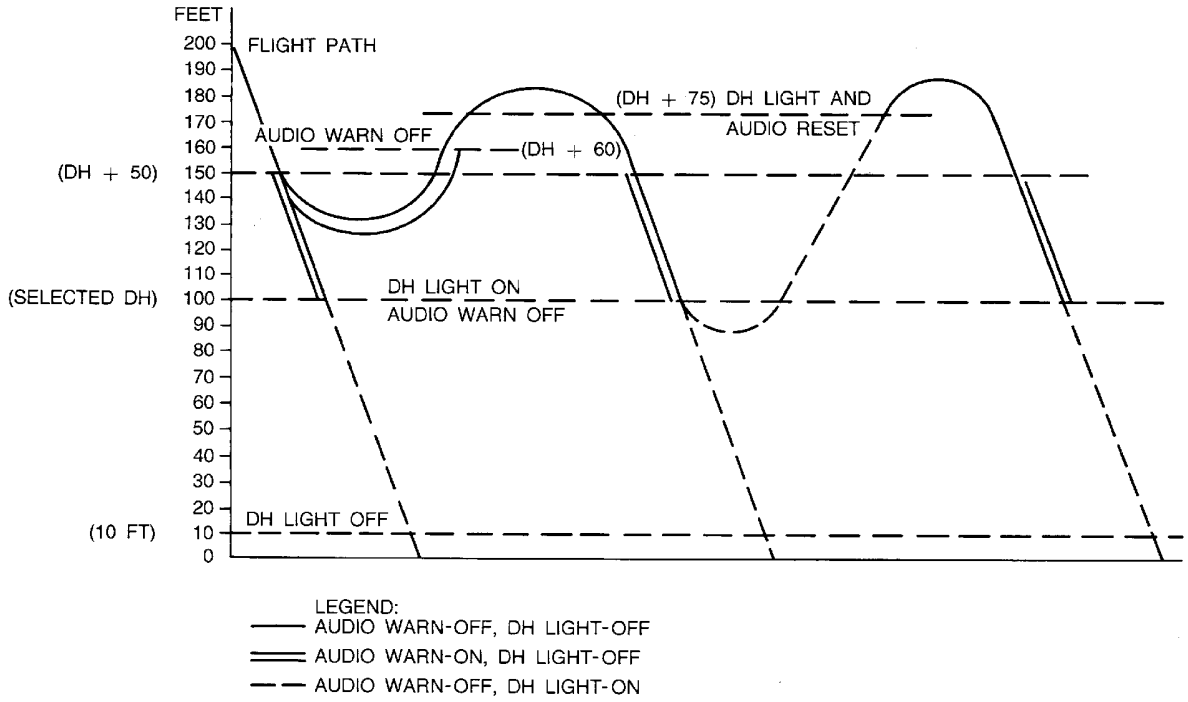
EFIS Block Diagram
Figure 3/34-22-00-990-896 (Sheet 2 of 2)



EFIS - System Interface Diagram
Figure 4/34-22-00-990-897

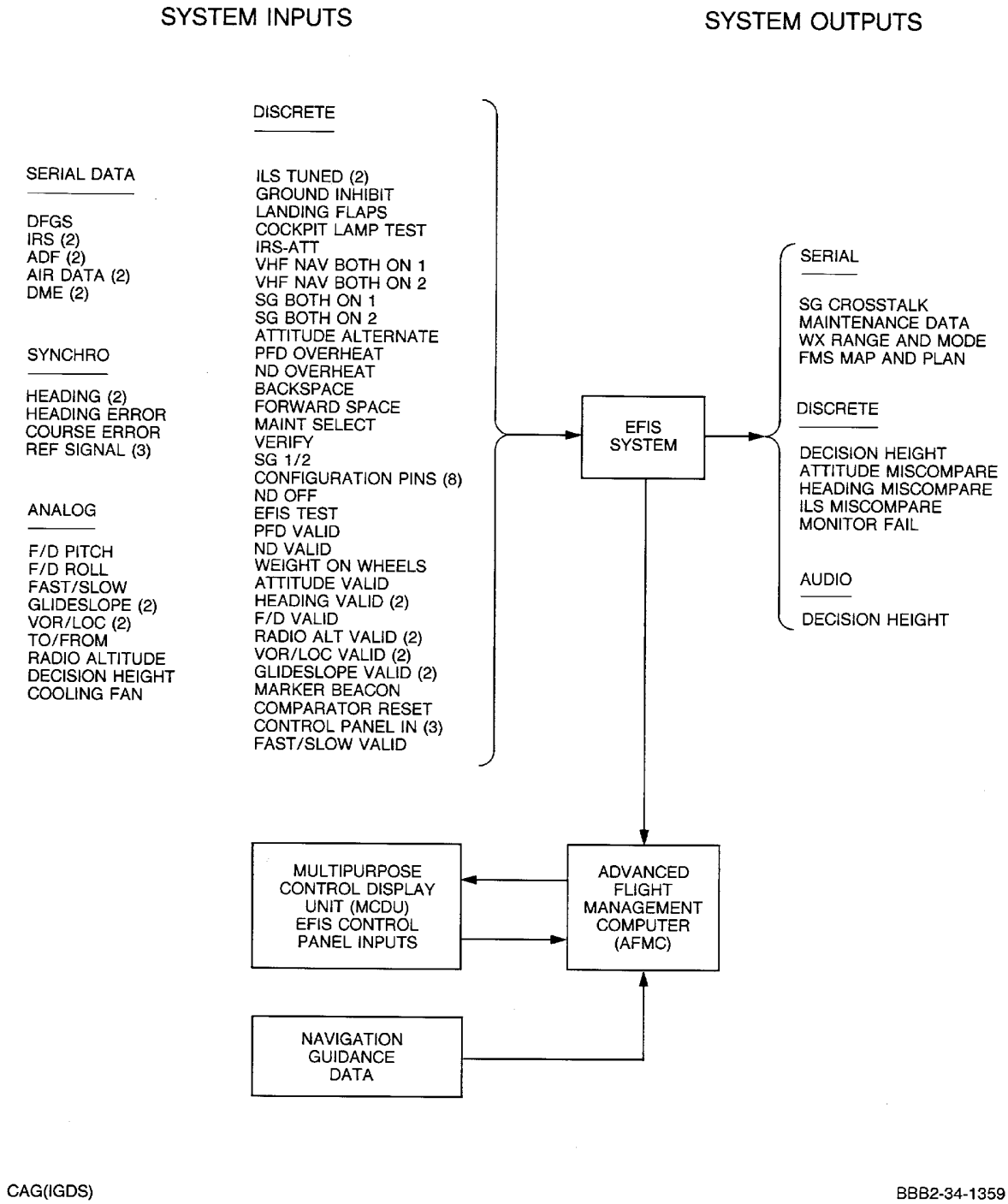


EFIS Symbol Generator - Component Diagram
Figure 5/34-22-00-990-898

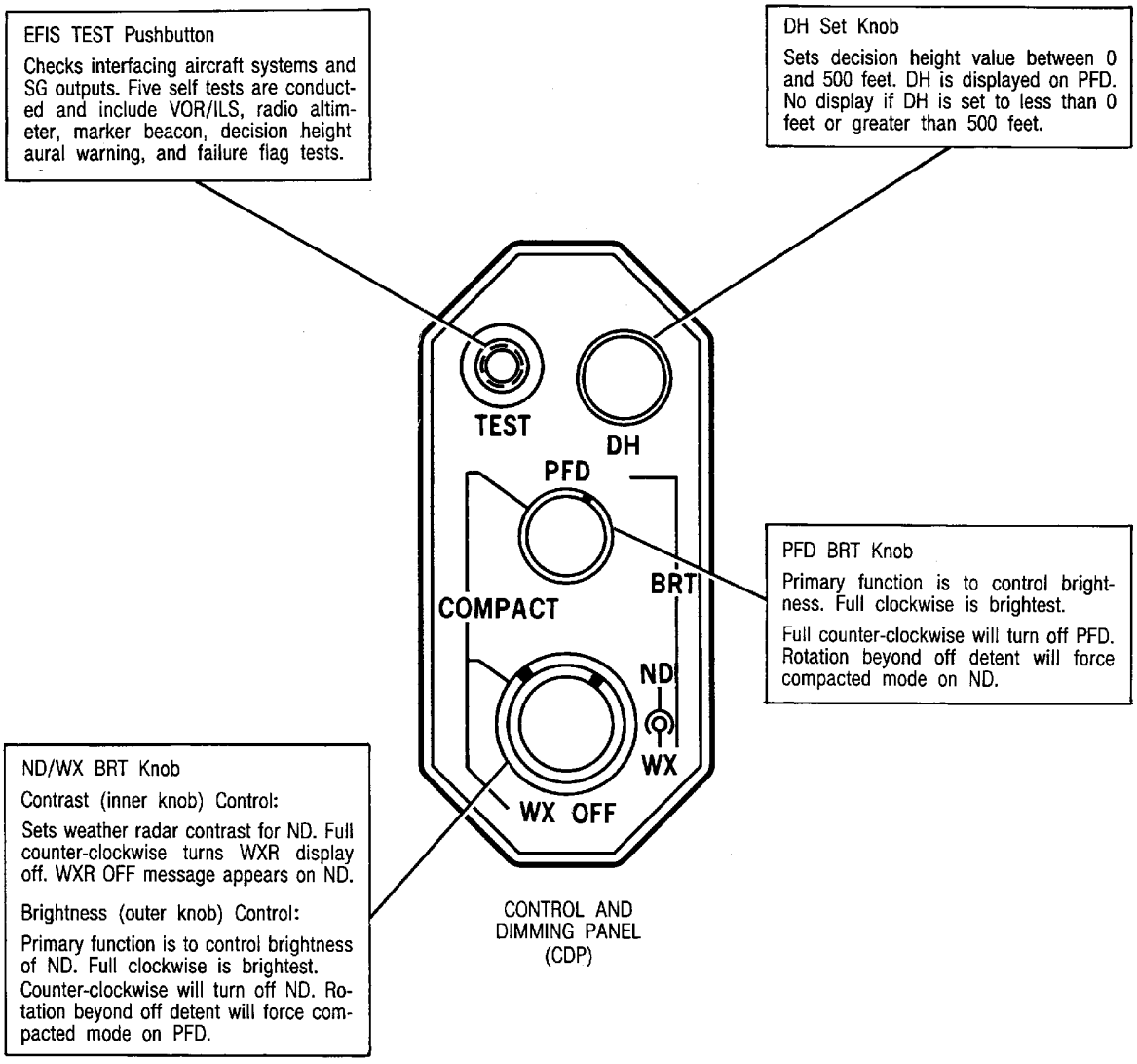


BBB2-34-951

EFIS Audio Output
Figure 6/34-22-00-990-899

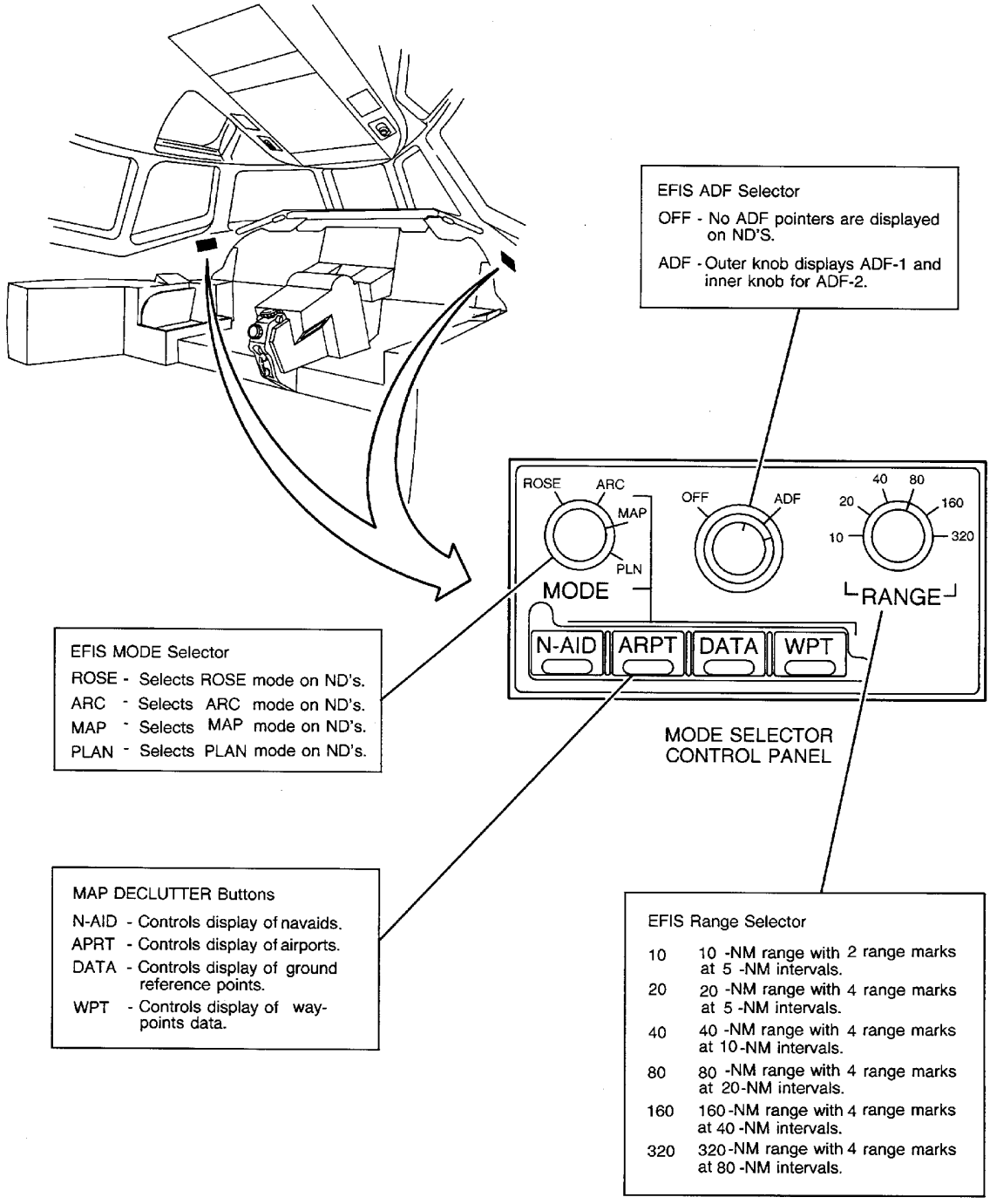


EFIS Inputs and Outputs
Figure 7/34-22-00-990-900

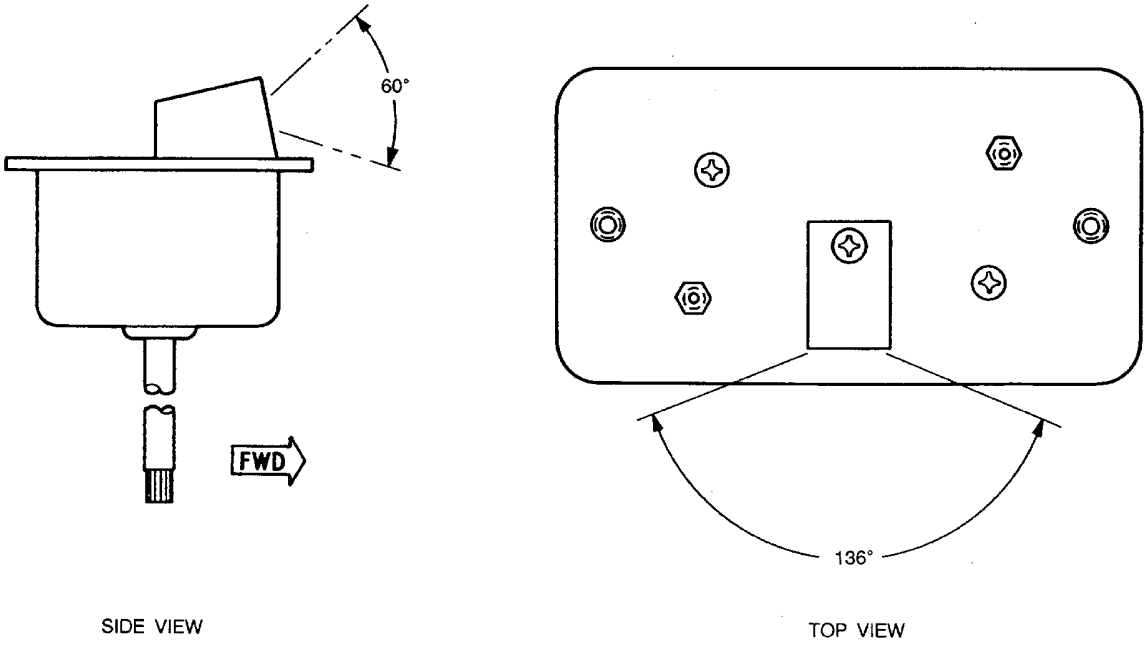


BBB2-34-953

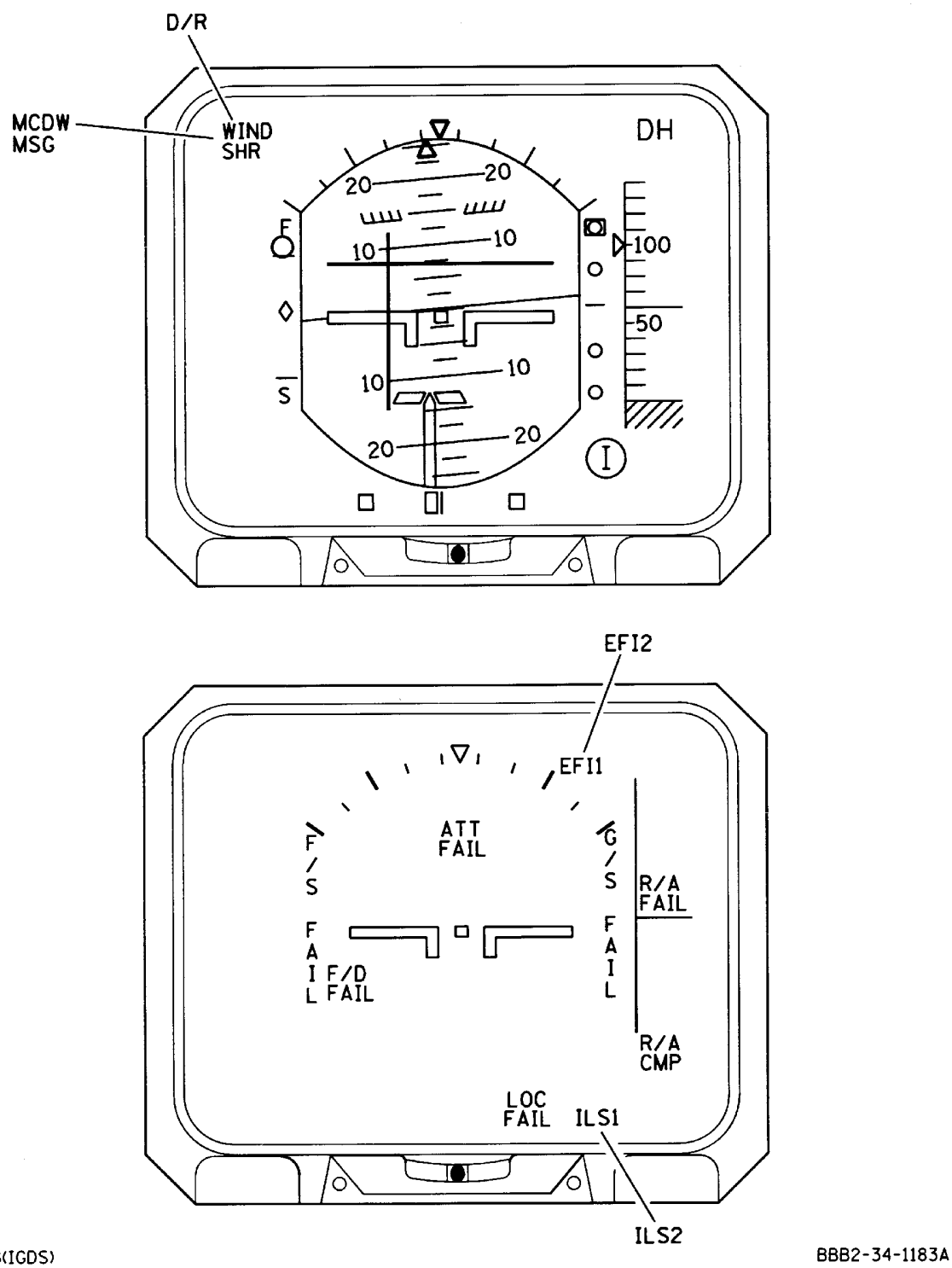
EFIS Control and Dimming Panel
Figure 8/34-22-00-990-901



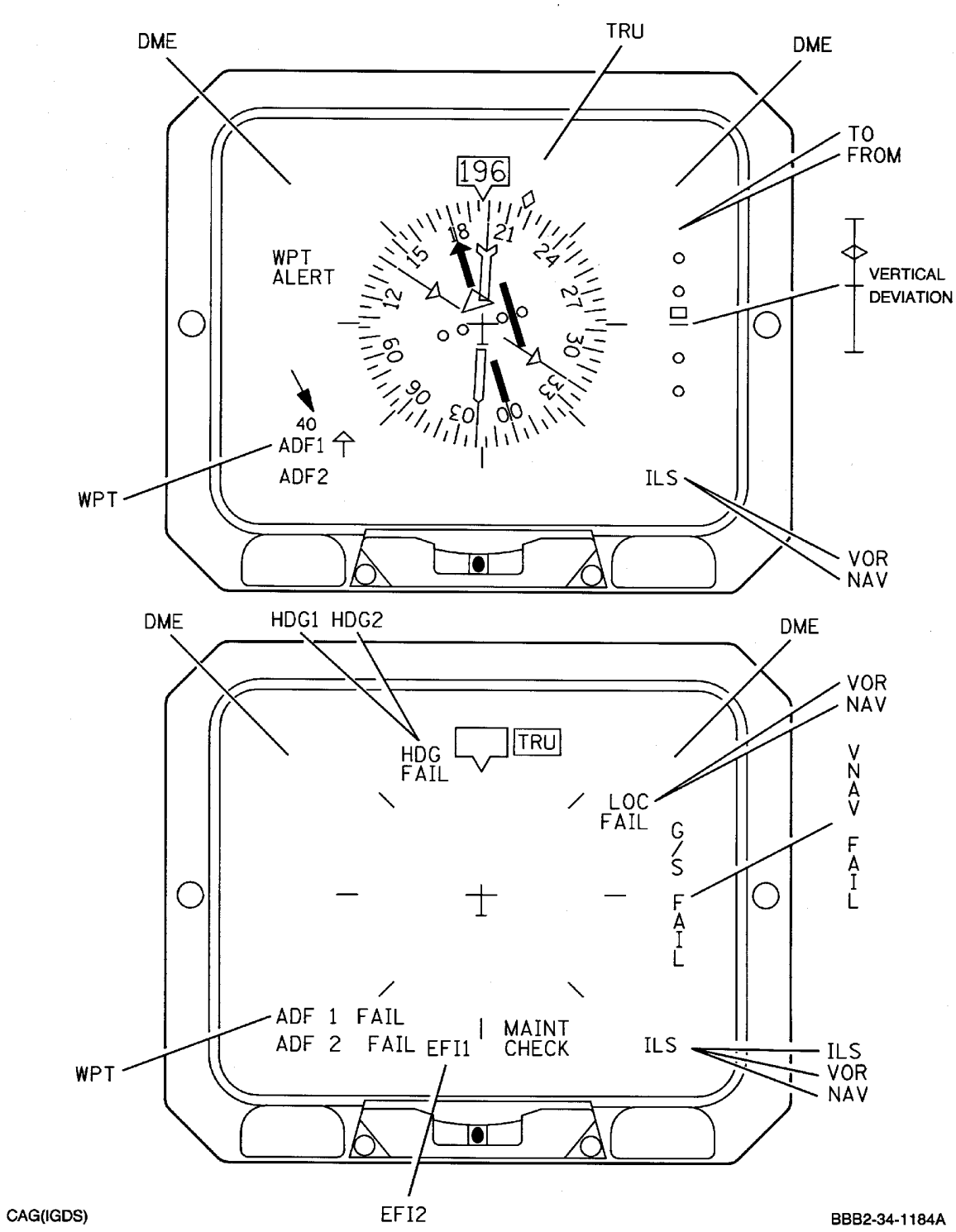
EFIS Mode Selector Control Panel With FMS Mode Selection
Figure 9/34-22-00-990-902



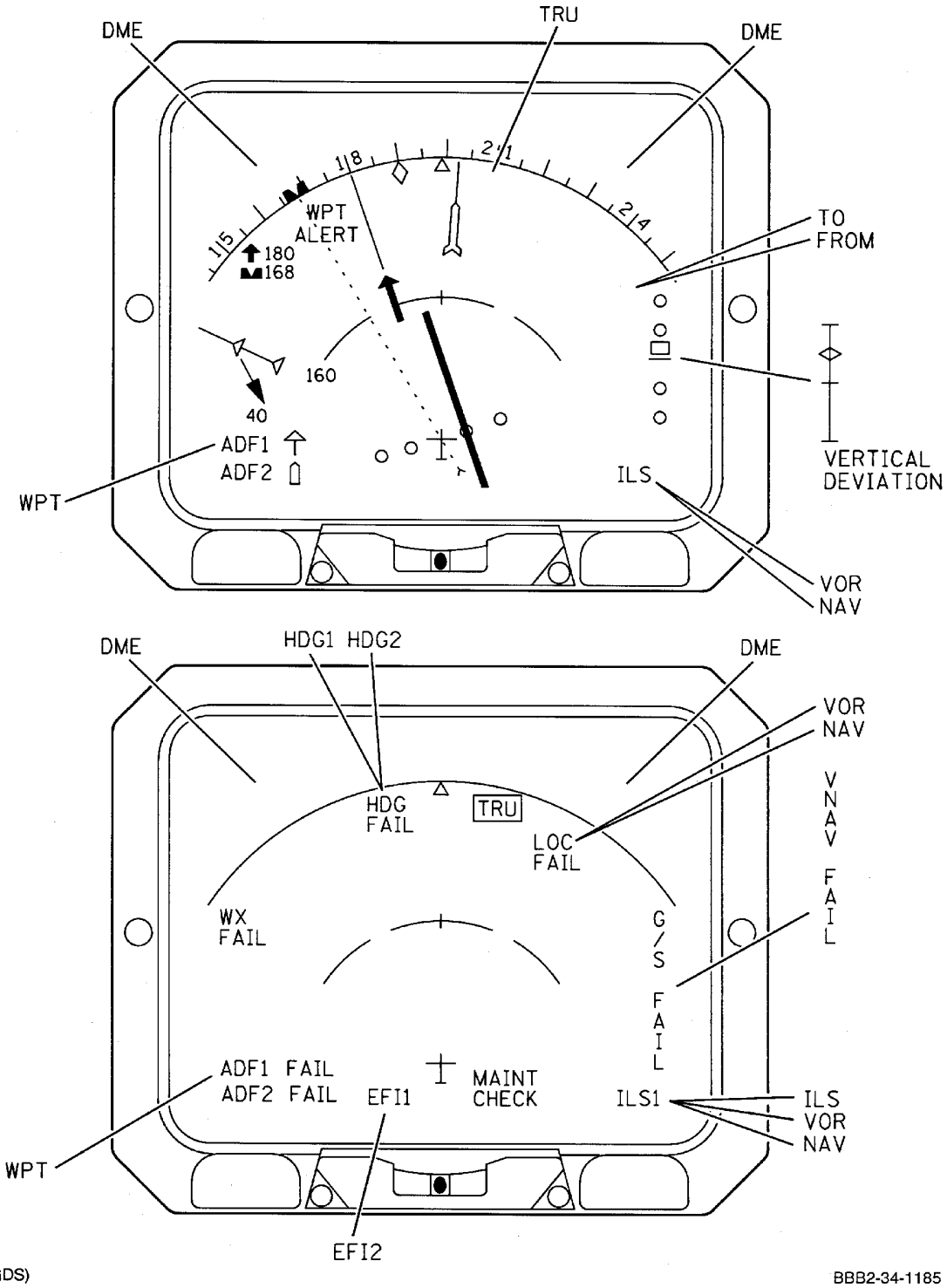
EFIS Remote Light Sensor
Figure 10/34-22-00-990-903



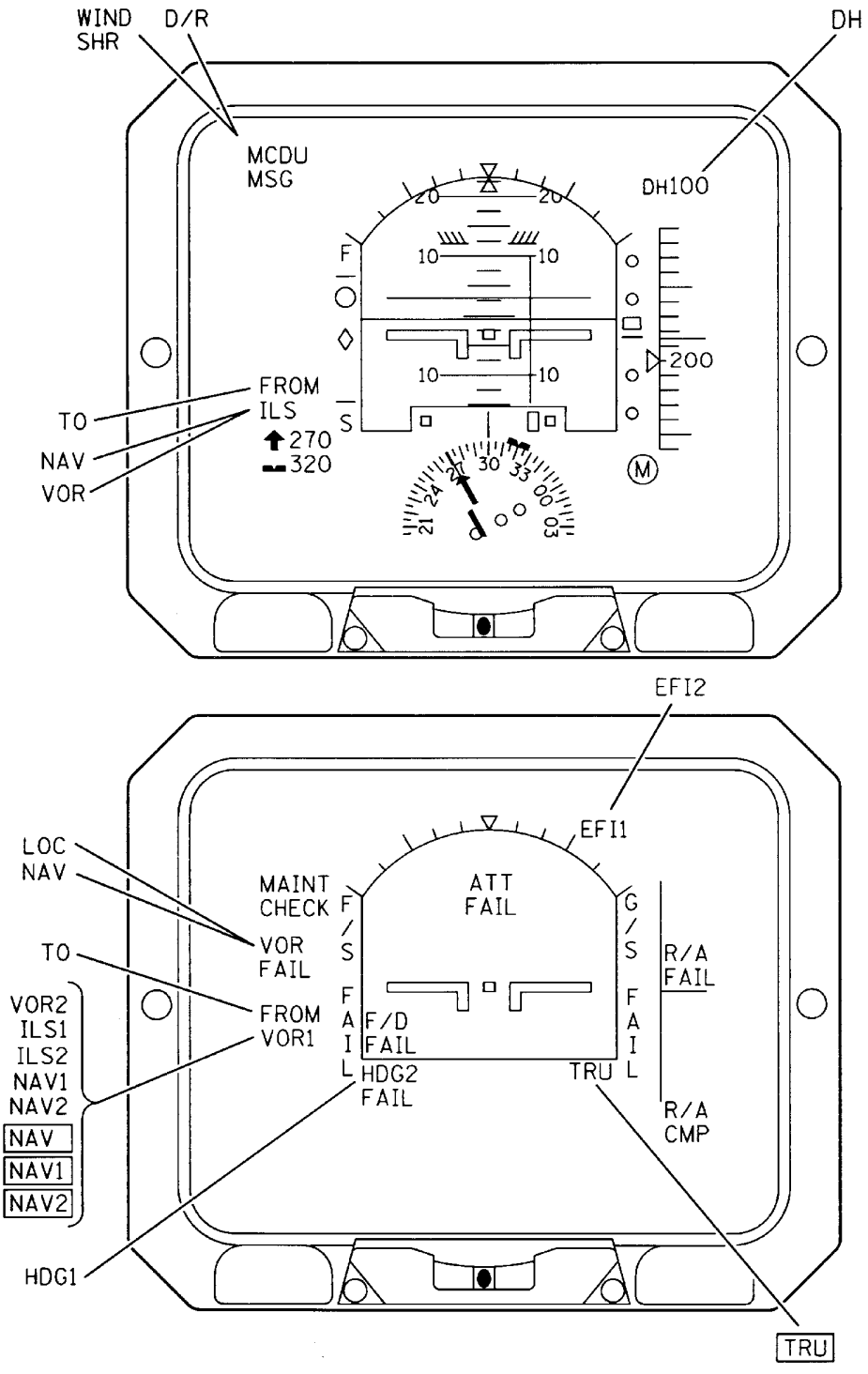
Primary Flight Display (with Flags and Warnings)
Figure 11/34-22-00-990-904



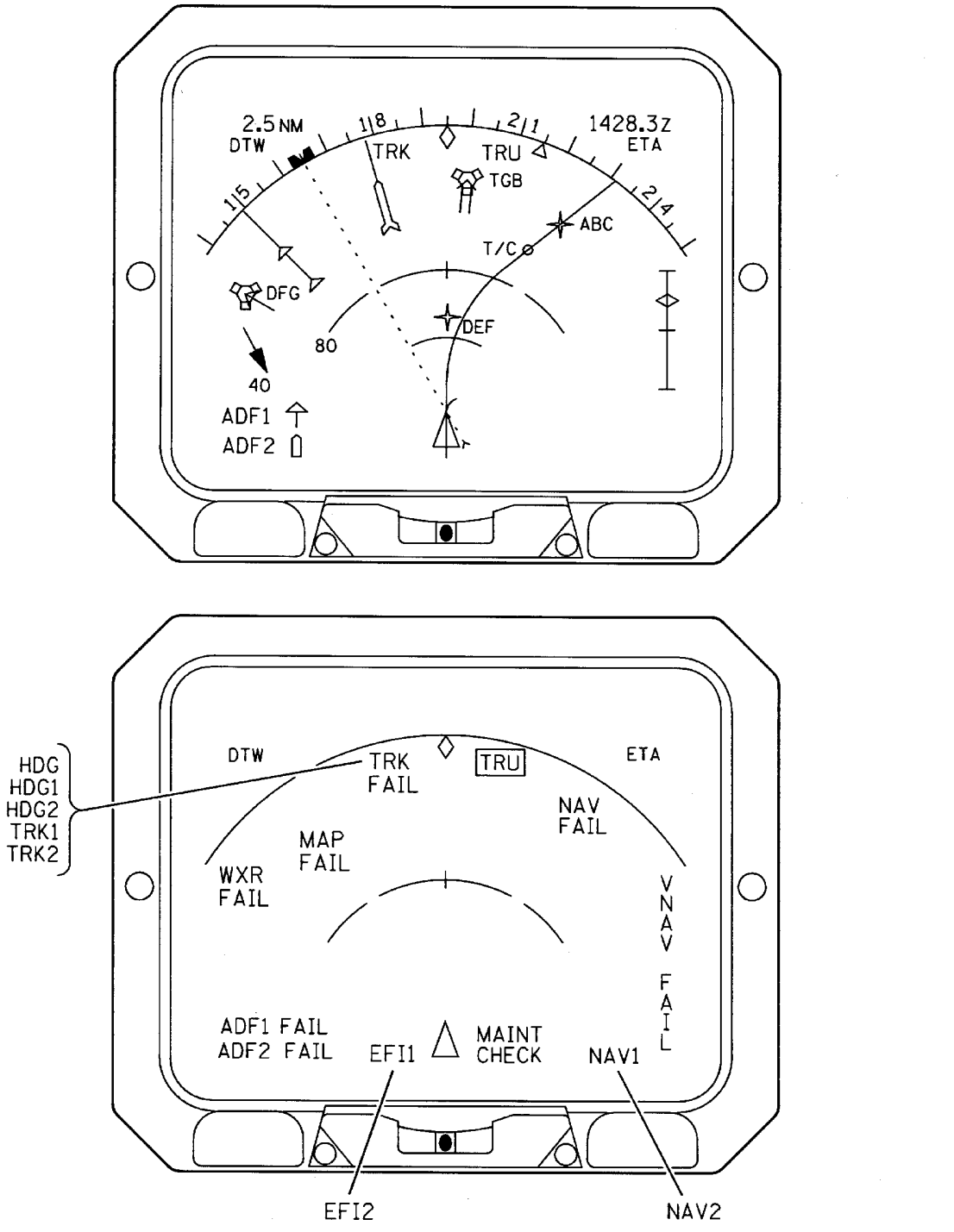
Navigation Display - ROSE Mode (with Flags and Warnings)
Figure 12/34-22-00-990-906



Navigation Display - ARC Mode (with Flags and Warnings)
Figure 13/34-22-00-990-908



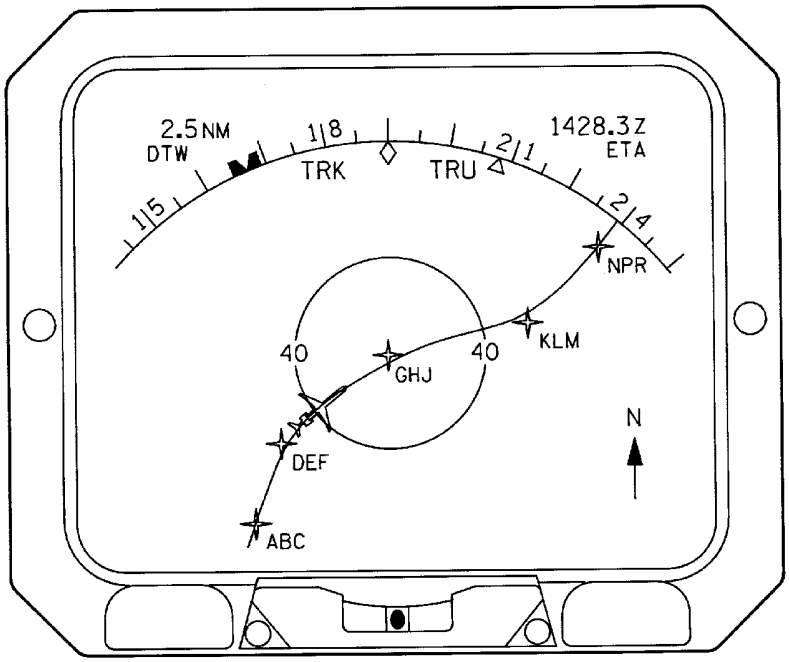
Compacted PFD/ND Format (with Flags and Warnings)
Figure 14/34-22-00-990-910



CAG(IGDS)

BBB2-34-1187

Navigation Display - MAP Mode (With Flags and Warnings)
Figure 15/34-22-00-990-911



CAD(IGDS)

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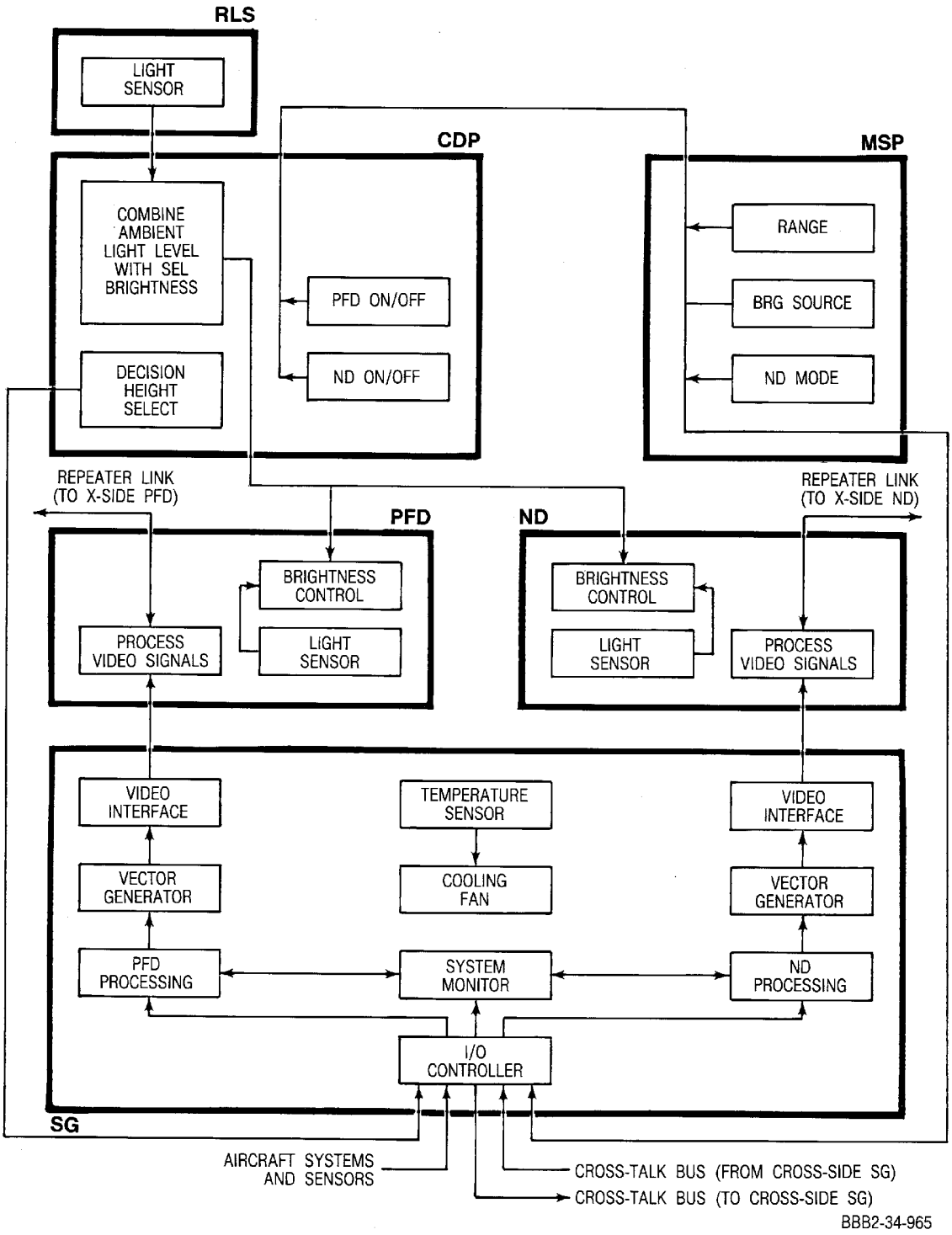
Navigation Display - PLAN Mode
Figure 16/34-22-00-990-912



EFIS - Block Diagram (Single Side)
Figure 17/34-22-00-990-913

	LEFT SYMBOL GENERATOR INPUTS (SG-1)		RIGHT SYMBOL GENERATOR INPUTS (SG-2)	
SENSOR	"A" DISPLAY	"B" MONITOR	"A" DISPLAY	"B" MONITOR
IRS DUAL	IRS1	IRS2	IRS2	IRS1
COURSE ERROR	CRS ERR1	CRS ERR2	CRS ERR2	CRS ERR1
RADIO ALTITUDE	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

CAG(IGDS) BBB2-34-1360

SG Display/Monitor Sensor Inputs
Figure 18/34-22-00-990-914

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Inoperative
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

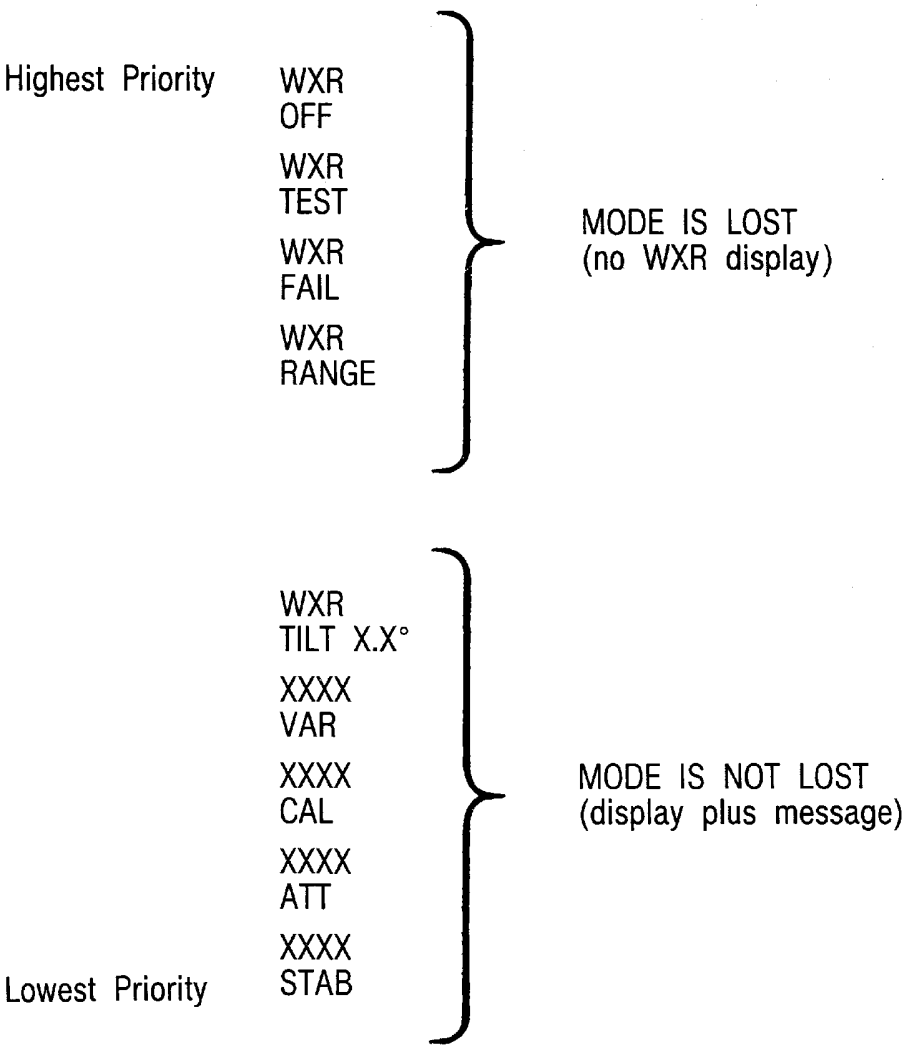
BBB2-34-967

Symbol Generator Operating Modes
Figure 19/34-22-00-990-915

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99	10 feet	No FMA Annunciation		R/A CMP
	100-499	(0.1)(Average R/A) feet	Both R/A CMP displays steady		
	500-2500	(0.1)(Average R/A) feet + 10 feet			
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

BBB2-34-968

FMA Annunciations for SG Instrument Comparator Function
Figure 20/34-22-00-990-916



Weather Radar Message Priority
Figure 21/34-22-00-990-917

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 22/34-22-00-990-918

2. Operation

A. Overview: The Symbol Generators (SG's) are the master control units for the EFIS. Their job is to receive input data from aircraft sensors and systems, check the data for presence and validity, compute the display parameters for the display units, and transmit display data to the display units.

(1) The SG's are also responsible for monitoring the EFIS, for performing continuous self-tests, and for logging faults in the flight log. System monitoring includes input monitoring, SG-internal monitoring, control panel monitoring (CDP and MSP), and display unit (DU) monitoring. Each SG also monitors the cross-side SG and performs a navigation instrument comparator monitor function.

(2) The EFIS logs its own failures, and failures of all interfacing aircraft systems. In-flight failures are stored in a flight log for later retrieval by maintenance personnel. The EFIS has an extensive built in test (BIT) capability, comprised of both continuous BIT (for continuous in-flight monitoring) and initiated BIT (used only in maintenance and preflight tests).

(3) The EFIS system operation is presented in the following sequence:

Table 4

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground Maintenance

B. EFIS Inputs, Outputs and Data Flow: Navigation data are sent from the various aircraft systems and sensors to the SG Input/Output (I/O) controller for processing. The I/O controller writes all input data to each of the symbol generator processors: the PFD and ND processors, and the system monitor processor. (Figure 17) Input data are checked for presence and validity, processed, and sent to the PFD and ND for display. The display data are also sent to the cross-side SG for comparison purposes. Display format and brightness are controlled from the Control and Dimming Panel (CDP) and from the Mode Select Panel (MSP).

(1) Each EFIS display is driven by its own display processor, vector generator, and video interface. The system monitor processor in the SG verifies the proper operation of each of the display processors. There are separate PFD and ND display output channels from the SG. Each display output channel consists of six digital output signals and two analog output signals which contain color settings, raster control, display mode setting (raster/stroke), and X-and Y-beam deflection signals. The SG receives a digital ready signal from the PFD and ND when the display deflection amplifiers are ready to write.

(2) Weather radar signals are sent to the WXR scan converter. This digital circuit is designed to convert the color WXR signal to EFIS color display format. The resultant map is an offset center sector scan, oriented with heading up in the ARC mode. The displayed sector is variable from +45 degrees to +90 degrees, as determined by the radar. The display map can be rotated and translated in response to aircraft heading and positional changes. Range marks and NAV marks are generated by the display generator in the ND processor. Range is controlled from the Mode Select Panel (MSP). An on-board test pattern generator provides a visual means of operational verification. The ND processor accesses the necessary hardware in the scan converter to control the source and display of the WXR data.

(3) Data from the on-side SG enters the DU through the primary display data input port. Each DU also has a secondary display data input port through which cross-side video signals may be sent/received. These bi-directional cross-side port lines are used in the event of a SG failure. By placing the EFIS source select switch in the BOTH ON 1 or BOTH ON 2 position, display data may be transferred directly from the PFD and ND on the functioning side to the cross-side DU's. The compacted PFD/ND display (reversionary mode) is obtained whenever one of the two system display units is turned off. This allows dual system operation should one of the display units fail.

(4) There are two brightness command signals for each DU: a brightness level command and a raster/stroke contrast ratio command. The raster/stroke contrast ratio is set to a default level for the PFD, compacted PFD/ND, and ND-ROSE displays to provide standard levels of raster shading for the ADI sky/ground shading and for the background scale shading. The voltage ratio is variable for the ND-ARC format, to allow the intensity of the weather radar imagery to be varied.

C. System Monitoring: System monitoring is designed to detect failures that may affect operation of the EFIS. EFIS monitoring consists of:

(a)	Input monitoring
(b)	Symbol Generator internal monitoring
(c)	SG-to-SG instrument comparator monitoring
(d)	Control panel monitoring
(e)	Display Unit monitoring
(f)	Weather radar input monitoring

(1) Input Monitoring: Input monitoring verifies that sensor or system inputs are present and valid, and that the SG input hardware is functioning properly. Input monitoring includes data and hardware.

(a) Input Data Monitoring: Analog and digital inputs to the SG are continuously monitored for presence and validity. If an input parameter is missing, invalid or out of range, the SG will remove all symbology dependent on the input from the PFD/ND. An appropriate failure message will be displayed where the data would normally appear on screen. The symbology will not be re-drawn until the valid input has returned for a minimum period of time.

(b) SG Input Hardware Monitoring: The SG monitor processor tests input hardware by feeding test values to the analog, synchro and digital input hardware.

1) Analog input hardware monitoring: The analog input hardware test verifies proper operation of the A-to-D conversion function. Failure of the analog input test will result in failure annunciation of all analog signals associated with the failed multiplexer. This test is performed at a 20 Hz rate.

2) Synchro input hardware monitoring: The synchro input hardware performs a bias test which verifies proper operation of the synchro to sin/cos conversion and demodulation network. This test is performed upon a cold start or during system testing.

3) Digital input hardware monitoring: Digital input receivers are continuously tested by sending test words from the four controlling transmitters to each of the receivers. When a receiver is in test mode, the monitor receives, checks and clears the test inputs. If an error is detected on two or more of the four test signals received, the receiver is inoperable, and appropriate symbology is blanked or flagged.

(2) Symbol Generator internal monitoring: consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(3) SG-to-SG Instrument Comparator Monitoring: The SG receives two types of sensor inputs: "A" (on-side) inputs for display on the on-side DU's, and "B" (off-side) inputs for monitoring the cross-side SG. (Figure 18). The SG performs a Nav Instrument Comparator Monitor (NICM) function by comparing the following "A" and "B" parameters:

- ILS (localizer and glideslope deviations)
- Attitude (pitch and roll)
- Heading
- Radio Altitude.

(a) If significant cross-channel differences are found between the "A" and "B" values of ILS, attitude or heading parameters, the SG's will signal the discrepancy on the FMA. The ILS, ATTITUDE or HEADING annunciator will flash on the side associated with the fault, and glow steady on the cross-side FMA. A flag and/or warning will also appear on the display screen. Radio Altitude mis-compare is annunciated on the PFD by a "R/A CMP" message. Flashing logic is the same as for the other parameters. Mis-compare annunciations will clear automatically if the deviation returns to within limits. They may be manually cleared on the FMA by resetting the FMA annunciator. Loss of valid results in annunciations on both FMA's, removal of faulty parameters from the screen, and display of fail messages. (Figure 20).

(b) The MONITOR annunciator on the FMA is used to signal SG failures in one of three conditions. The first condition involves internal SG tests which are performed under the direction of the system monitor processor. These tests are performed at a 2 Hz rate, and the results compared with the cross-side system results. When a miscomparison occurs on either side, both MONITOR annunciators come on.

The second condition occurs when the SG-to-SG cross-talk link fails due to invalid or interrupted updates. This also will cause both MONITOR annunciators to come on. The third condition is when a SG fails. The remaining SG continues to monitor its own displayed data, but the comparison function is deactivated. The MONITOR annunciator will come on, on the failed side.

(c) There are six distinct SG-to-SG Instrument Comparison Operating Modes. (Figure 19). The operating mode determines if, and when, the NICM annunciators on the FMA will come on. These modes are prioritized from Cruise mode (5 - lowest priority) to Test mode (1 - highest priority). Higher priority modes will always override lower priority modes. During the course of the flight leg, the system will primarily operate in Cruise mode.

(4) Control Panel monitoring: verifies correct operation of the Control and Dimming Panel and Mode Select Panel.

(5) Display Unit monitoring: Verifies that the DU is receiving display data.

(6) Weather Radar Input monitoring: The SG weather radar (WXR) scan converter converts color WXR signals to a format suitable for display on an EFIS color display unit. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages. There are two types of WXR messages: those for which the mode selected on the WXR control panel is lost, and those for which the mode is not lost. If the mode is lost, warnings will appear on screen, but there will be no WXR display. If the mode is not lost, the messages will appear along with the WXR display. (Figure 21) WXR messages are prioritized as follows:

WXR OFF - WXR BRT knob is OFF on CDP, or DU overheat condition

WXR TEST - System in TEST mode. Test pattern is displayed, plus R/T fault messages including:

R/T - receiver/transmitter fault

ANT - antenna fault

CNTL - control fault

ATT - attitude fault

CAL - calibration fault

RANGE - range fault (MSP fault)

COOL - R/T unit cooling fault.

NOTE: If any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

XXXX VAR - WXR input sensitivity not calibrated to any precipitation rate (XXXX represents operating mode selected on WXR control panel).

XXXX CAL - loss of calibration

XXXX ATT - attitude input fault

XXXX STAB - stabilization is off

WXR TILT - momentarily annunciated on screen when antenna tilt angle is changed.

D. Built In Test and Ground Maintenance: The EFIS built in test (BIT) is designed to aid maintenance in isolating faults related to the EFIS and the systems with which it interfaces. There are two types of BIT for the EFIS: continuous BIT for in-flight monitoring, and initiated BIT for preflight and LRU functional checks. Other maintenance functions require interface with the Status Test Panel (STP) for in-depth system tests and fault isolation.

(1) Continuous BIT: Continuous BIT monitors the EFIS throughout each flight profile and logs all failures in the flight log for later retrieval by maintenance personnel. The EFIS logs its own failures, and also those of the aircraft systems with which it interfaces. The SG maintains a log in non-volatile memory of failures detected by the system monitors, whenever the system power is on. The continuous BIT logs the failure type and time of occurrence (time after start of flight leg). The log can contain 20 failures on each of the last 10 flight legs. Intermittent failures are recorded only once per hour of flight time. Continuous failures are recorded only once per flight leg. (Faults are also recorded while the aircraft is on the ground and the system is functioning.) Failures are retrieved via the Status Test Panel.

(2) Initiated BIT: Initiated BIT provides a means of self-testing the EFIS on the ground. Tests are initiated by pushing the TEST button on the Control and Dimming Panel. Tests include: initiated EFIS System Self-Test, Initiated Functional Self-Test and Initiated Cockpit Lamp Test. Initiated BIT is used both in preflight testing and in LRU functional checks (SUBJECT 34-22-00, Page 201).

(a) EFIS System Self-Test (BIT) is initiated through the TEST pushbutton on the Dimming Panel. Test begins when the pushbutton is depressed, and ends approximately 3 seconds after release. This test includes:

- VOR/ILS Self-Test

- Radio Altimeter Self-Test
- Marker Beacon Self-Test
- Failure Flag Test.

(b) The first three tests are under control of the associated receiver units (the EFIS is only used to display the input parameters). The decision height aural warning test and failure flag test are under the control of the SG. Failure flag annunciations appear on the DU screen only while the TEST pushbutton is being depressed. The Failure Flag Test annunciations for the various display screens are shown in Figure 22.

(c) EFIS Functional Self Test is used by maintenance personnel to verify proper installation and operation of the SG. This test is initiated via the Status Test Panel (STP), by calling up the SG SELF-TEST selection on the Maintenance Menu (see EFIS Ground Maintenance following). The test consists of a synchro bias test, a system RAM check and an SG cooling fan test. The test takes approximately 2 seconds. Upon completion, both display units show software part numbers, aircraft equipment/options configuration, and test results (SUBJECT 34-22-00, Page 201). This test is inhibited except when aircraft is on the ground and weight-on-wheels discrete is set.

(d) The cockpit lamp test checks the EFIS lamp displays by driving the FMA comparison lamps. Approximately 0.5 seconds after release of the DIGITAL/ANNUN pushbutton on the Overhead, the ILS, HEADING, HORIZON and MONITOR lamps on the FMA come on for 5 seconds.

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The Electronic Flight Instrument System (EFIS) replaces the conventional ADI and HSI on the Captain's and First Officer's instrument panels with four five-by-six inch color CRT display units. The upper units, the Primary Flight Displays, provide information normally found on the ADI, plus radio altitude, marker beacons, and Windshear Alert and Guidance System (WAGS) data (if installed). The lower units, the Navigation Displays, provide information normally found on the HSI, ADF bearing plus coordinated weather radar.

B. The EFIS interfaces with the Flight Management System (FMS) to provide FMS information display on the EFIS navigation display (ND) and the EFIS primary flight display (PFD). FMS data is displayed on the ND when the EFIS mode control panel selected mode is PLAN or MAP. The PFD displays speed error relative to the FMS command speed and displays MCDU MSG (Multipurpose Control Display Unit Messages) when an alert message appears on the MCDU. See Paragraph 1.N., for description of FMS information displays on the EFIS, PFD, and ND.

C. The Electronic Flight Instrument System (EFIS) consists of two identical and independent systems (Figure 1). (FMS components and controls are shown.) Each system consists of the following:

Table 1

Component	Location
One Symbol Generator (SG)	Electrical/Electronics Compartment
Two CRT Display Units (PFD & ND)	Main Instrument Panel
One Control & Dimming Panel (CDP)	Main Instrument Panel
One Mode Select Panel (MSP)	Below Clearview Window
One Remote Light Sensor (RLS) (Shared by both systems)	Top of Glareshield.

(1) An EFIS Source Select switch is located on the Overhead which is also used in conjunction with EFIS:

(a) EFIS Source Select Switch: allows either system to be run from the cross-side Symbol Generator in the event of an on-side SG failure.

D. System Displays:

(1) The Primary Flight Display (PFD) format displays aircraft attitude, flight director commands, glideslope and localizer deviations, radio altitude, speed error, decision height set and status, marker beacon indication, and WAGS data (if installed).

(2) The Navigation Display (ND) operates in ROSE and ARC modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, distance measuring (DME) and ADF bearing. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, ADF bearing and weather radar.

(3) A compacted PFD/ND display format combines both PFD and ND data into a single-screen display. This format is used in the event of a display unit failure.

E. Description and Operation Overview: The Description and Operation is broken down into the following paragraphs:

Paragraph 1. General (Description)

A.	System Overview

(Continued)

B.	System Overview
C.	System Components
D.	System Displays
E.	Description and Operation Overview
F.	Symbol Generator Description
G.	Display Unit Description
H.	Control & Dimming Panel Description
I.	Mode Select Panel Description
J.	Remote Light Sensor Description
K.	Primary Flight Display (PFD) Symbology
L.	Navigation Display Symbology and Weather Radar
M.	Compacted PFD/ND Display
N.	EFIS/Fight Management System (FMS) Interface

Paragraph 2. Operation

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground Maintenance

F. Symbol Generator Description

(1) The symbol generator contains all of the circuitry required to interface with aircraft sensors and systems, compute CRT display parameters, and transmit display data to the display units (Figure 3). In addition, the SG provides an instrument comparator monitor function, which performs cross-side comparisons between ILS, attitude, and heading. In the event of a mis-compare, the corresponding annunciators on the Flight Mode Annunciator (FMA) panel come on.

(2) The SG monitors its own internal operation and aids in monitoring the cross-side SG. The SG tests its internal functioning by performing dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. In the event of a SG failure or mis-compare, the MONITOR lights on the FMA will come on. The SG is also responsible for monitoring all aircraft systems and sensors which provide inputs to the EFIS, as well as the EFIS components. Continuous BIT monitors the EFIS throughout each flight profile, and logs all failures for later retrieval by ground maintenance.

(3) The left symbol generator (SG-1) drives the Captain's PFD and ND displays; the right symbol generator (SG-2) drives the First Officer's displays. Either Symbol Generator can drive all four CRT displays. In the event of a SG failure, the SG source selection switch, located on the Overhead Panel, may be put in the BOTH ON 1 or BOTH ON 2 position. This will cause the display data from the functioning SG to be transferred to the cross-side display units via data buses from the on-side display units (Figure 3).

(4) The symbol generators also receive data from the flight management system (FMS) advanced flight management computer (AFMC). The generators process the data to provide symbology for FMS, MAP or PLAN displays on the EFIS ND.

(5) Symbol Generator Components (Figure 4):

(a) Two Display Processor circuit card assemblies (CCA's), one for the PFD and one for the ND, which contain a processor, memory and a vector generator.

(b) Input/Output CCA's, which contain the serial data receivers and transmitters, synchro-to-digital, analog-to-digital, and discrete receivers required to interface with the aircraft sensors and systems.

(c) An Input/Output (IO) Controller, which manages all of the output devices and transfers data between them and system memory.

(d) A System Monitor CCA, which monitors display outputs, system BIT and weather radar processing.

(e) A Weather Radar Scan Converter CCA which converts color radar signals to a format suitable for display on the EFIS color display units.

(6) Symbol Generator Inputs: The SG receives serial data, synchro, analog and discrete inputs from the various aircraft sensors and systems (Figure 5). Program pins and configuration words enable the SG hardware and software to interface with these various types of inputs. SG programming is checked on the ground at power up to verify proper equipment configurations and selected options.

(7) Symbol Generator Outputs: The SG generates serial data outputs, open/ground discrete outputs and audio outputs. The Symbol Generator has two independent display output channels. Video and deflection signals are sent via the display output channels to the Primary Flight Display and to the Navigation Display. A low-speed SG cross-talk bus enables each SG to monitor both its own operation and that of the cross-side SG. This monitoring consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(8) Audio Output: The SG has one audio output for annunciating the decision height. This tone slews from 400 Hz at or above decision height + 50 feet to 800 Hz at DH. The frequency changes linearly from DH + 50 feet to DH. Figure 4 shows the decision height audio output graphically.

(9) Commands are sent to the SG from the cockpit via the Control & Dimming Panel (display unit on/off and brightness, weather radar on/off and brightness, DH set and TEST) and the Mode Select Panel (Navigation Display format selection and range control). The weather radar control panel is used to set the WXR display mode, TILT, GAIN and STAB. Range is controlled from the EFIS Mode Select Panel.

(10) Flight management system navigation and guidance data and EFIS mode control panel input are supplied to the advanced flight management computer (AFMC). The computer processes the information and outputs the data to the EFIS symbol generators to provide the MAP or PLAN displays on the EFIS ND.

(11) The SG's are housed in ARINC 600 4 MCU chassis, and are located in the electrical/electronics compartment. The SG operates on 115 VAC 400 Hz single phase power. The SG power supply converts aircraft power to the DC voltages required by the SG electronics. The SG is able to withstand power interruptions of up to 3 milliseconds without loss of function, and up to 1 second without change of operating mode or loss of digital filter data. Temperature sensing of the power supply is provided to activate an internal SG fan, in the event of an over temperature condition. Forced air (blow-through) cooling is also provided to both units.

(12) Whenever a new Symbol Generator is installed, it must be programmed by ground maintenance before the SG can be used. This programming consists of entering the Options/Register and Check Register numbers into the SG via the Status Test Panel. These numbers, when combined with the configuration identification wired into the aircraft, define the aircraft for the Symbol Generator.

(13) In case of a serious SG failure, the PFD and ND for that system will be blanked. Display data may be transferred from the functioning system by placing the EFIS source select switch in the appropriate position. EFI1 or EFI2 annunciations will appear on all display screens during single-system operation. If a fault can be isolated to a single source, a flag or warning message will appear on screen to signal the affected parameter.

G. Display Unit Description

(1) The Primary Flight Display (PFD) and Navigation Display (ND) units are identical CRT's, clamp-mounted to the main instrument panel. Each display unit (DU) provides a full color (15 plus black) electronic display. The DU's receive display data through analog, digital and discrete interfaces with the symbol generator. Each DU is capable of operating as a PFD or ND. During reversionary mode (either the PFD or ND is turned off), a single display is capable of acting as both a PFD and ND in the compacted PFD/ND mode.

(2) The DU is capable of operating in either raster scan mode (background shading and weather radar) or stroke writing mode (display symbology). Raster dimming is controlled independently of stroke intensity to provide adjustable display contrast capability (Navigation Display only). SG display unit monitoring verifies that the DU is receiving display data. Upon detection of a fault, the DU is blanked. At this time, the DU should be turned off at the Control and Dimming Panel. The system will revert to reversionary mode, and a compacted PFD/ND display will appear on the functioning screen.

(3) A system monitor is incorporated in the DU to provide CRT phosphor protection. The system monitor drives the CRT to cutoff when X-or Y-deflection has stopped, when power supply outputs are abnormal, or when the CRT filament opens or takes excessive current. In case of a DU overheat, the SG will log the failure and remove the raster (background) from the applicable display to reduce the display power required. The message 'WXR OFF' appears on the ND to signal loss of WXR display.

(4) Display unit brightness is controlled in part by the two internal light sensors. These sensors are located on the front of each unit, and feed into the auto-dimming system. The stroke and raster brightness levels are normally set using a combination of brightness data from the Remote Light Sensor, the DU internal light sensors and the Control and Dimming Panel (CDP). Should the DU monitor detect a loss of brightness commands from the CDP, the display unit will revert to a nominal brightness level.

(5) Each DU has two input ports. The primary input port carries analog deflection and digital video information from the on-side symbol generator. The secondary input port is used to either send or receive data, to or from the cross-side display unit. This port allows the DU to be driven from the cross-side symbol generator, if the on-side symbol generator fails.

(6) Each display unit is contained in a 5 x 6 x 10.5 inch outline, and is forced-air cooled. An externally adjustable inclinometer (slip skid indicator) is located on the bottom center of the DU bezel. The CRT display surfaces are covered with a filter, coated with a reflection-reducing coating. There are two extraction aids, on the front bottom left and right corners, to aid in removal/installation of the DU's. Two power transistors, located on the back panel of each DU, dissipate 65 watts.

H. Control & Dimming Panel Description

(1) The Control & Dimming Panel (CDP) provides three functions (Figure 7):

(a) Display unit manual brightness control

(b) Decision Height set control

(c) TEST pushbutton

(2) The CDP's are located on the main instrument panel, to the right of the display units. They are powered from both Primary Flight Display power (+ 15 VDC) and lighting power. All CDP control knobs move clockwise from the off position, through an increasing range to the full on position.

(3) Display Unit Manual Brightness Control: The CDP mixes data received from the Remote Light Sensor (RLS) and display unit (DU) internal light sensors with CDP manual brightness control inputs to generate an overall brightness control signal for the DU's. The display unit brightness controls on the CDP are PFD BRT for the Primary Flight Display, and a combined ND/WX BRT for the Navigation Display. The WX BRT control knob is concentric with the ND BRT control, and is used to adjust the weather radar display intensity independently of the ND display symbology.

(4) Full counterclockwise (ccw) rotation of the PFD BRT or ND BRT knobs past the detent causes the corresponding display screen to go blank. Whenever either the PFD or ND BRT knob is turned OFF, the corresponding display screen goes blank, and a compacted PFD/ND display will appear on the remaining on-side display screen. Turning the WX BRT ccw knob past the detent turns the WX display off. The message WXR OFF will be continuously displayed on the ND whenever this knob is in the off position.

(5) Decision Height Set Control: This knob is used to set decision height between zero and 500 feet (any value less than zero feet causes the DH readout on the PFD to go blank). DH data is displayed on the top, right-hand corner of PFD.

(6) TEST pushbutton: The TEST pushbutton is used to initiate a EFIS system self-test. Self-testing begins when the TEST pushbutton is depressed and ends approximately 3 seconds after release. The tests conducted include: VOR/ILS self-test, Radio Altimeter self-test, Marker Beacon self-test, Decision Height Aural Warning self-test and Failure Flag test. All but the DH aural warning and failure flag tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The DH aural warning test consists of a one-second tone slewing from 400-800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. TEST pushbutton function is inhibited in flight.

NOTE: When performing the EFIS self test from the dimming panel test button, the monitor lights on the FMA will flash.

(7) In the event of a Control and Dimming Panel failure, the PFD, ND and WXR displays will remain on. Brightness will be controlled by the auto-dimming system. Since there is no default setting for a DH control failure, DH information should be ignored when the CDP fails.

I. Mode Select Panel Description

(1) The Mode Select Panels (MSP) are located outboard and aft of the glareshield, below the clearview windows. The MSP is used to select the display format for the Navigation Display (Figure 8). Each panel contains an ADF control switch, a MODE switch and a RANGE switch and four pushbutton switches for Flight Management system (FMS) selections.

(2) The MSP interfaces with the Symbol Generator through digital discrete signals. The control panel monitor in the SG verifies correct operation of the MSP. In the event of a MSP failure, the ARC mode will be displayed on the ND. The range will default to 40 nm; the indices and range lines will turn yellow.

(3) The MODE switch is a rotary switch which allows the pilots to select from the following ND display modes:

Table 2

ROSE	Conventional HSI display
ARC	Compass arc display, with coordinated weather radar.
MAP	FMS MAP Display
PLAN	FMS PLAN Display

(4) The RANGE control is a rotary switch that is used in ARC, MAP or PLAN Modes, and allows the crew to select among the following display ranges: 10, 20, 40, 80, 160, and 320 nautical miles. Both the ARC and WXR display ranges are set simultaneously with this control.

(5) The ADF bearing control consists of a rotary switch which is used to control the ADF bearing pointer in the ROSE and ARC modes. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

(6) The FMS pushbuttons selections control the display on the ND as follows:

Table 3

N-AID	(Navigation Aids) Controls Display of Navigation Aids
ARPT	(Airports) Controls Display of Airport
DATA	Controls Display of Ground Reference Points
WPT	(Waypoints) Controls Display of Waypoints data

J. Remote Light Sensor Description

(1) There is one Remote Light Sensor (RLS), installed on top of the glareshield (Figure 9. The RLS is installed looking forward of the aircraft, to measure the light levels outside of the cockpit. The RLS is powered from the F.O.'s Control & Dimming Panel (CDP). Light level data is transmitted from the RLS to the CDP, where it is combined with manual brightness control and DU light sensor inputs. The resultant mixed signal is used in controlling display intensity and contrast. If the RLS fails, the CDP manual control setting and DU internal sensor signals will be combined to control DU brightness.

K. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format Figure 10 contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(h) FMS data

(i) WAGS data (if installed)

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

(3) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

(5) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude sphere.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The EFIS also produces a DH tone as the aircraft nears decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. A rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

(9) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

(10) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 2500 feet (762 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

(11) FMS DATA: FMS "MCDU MSG" and Fast/Slow display will appear relative to MCDU alert messages and FMS speed commands when V-NAV is engaged.

(12) WAGS Data (if installed): When the Windshear Computer (WSC) detects an increasing performance windshear (head wind or up draft) it will enable the PFD to display an amber "WIND SHR" message. A detected decreasing performance windshear (tail wind or down draft) will result in a red "WIND SHR" message. The PFD will also display a WSC determined Pitch Limit Indication (PLI) which is the margin between aircraft angle of attack (AOA) and the AOA for shaker onset. In addition, speed deviation and flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

L. Navigation Display (ND) Symbology and Weather Radar

(1) The Navigation Display (ND) appears on the lower CRT. The ND provides HSI information, ADF, coordinated weather radar and FMS MAP or PLAN displays. The display format varies, depending on the display mode selected on the Mode Select Panel (MSP). The following modes are available on the EFIS:

(2) ROSE Mode: display resembles a conventional HSI (Ref. Figure 10). The compass rose is located at the center of the screen, with large tick marks at 10 degree increments and small tick marks at 5 degree increments. The tick marks are labeled at 30 degree increments with characters straddling the tick marks. The ROSE Mode display shows:

(a) Aircraft heading

(b) Selected heading

(c) Selected course and course deviation

(d) Vertical deviation

(e) TO/FROM indication

(f) ADF bearing

(g) Distance Measuring (DME)

(a) Aircraft Heading: Heading indices consist of tick marks at 45 degree increments around the outside of the compass rose. The digital value of the current heading is displayed in a box above the compass rose. A symbolic reference aircraft is located at the center of the compass rose.

(b) Selected Heading: is indicated by an "M"-shaped pointer which moves along the outside of the compass rose.

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass rose, pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a scale consisting of four small dots. The course pointer and deviation scale rotate with the selected course about the center of the compass rose.

(d) Vertical Deviation: is indicated with a scale and pointer identical to that used on the PFD display.

(e) TO/FROM Indications: A Triangle pointer is provided, which points in the direction of (TO) or 180 degrees away from (FROM) the course deviation pointer. TO/FROM is blanked while in ILS mode.

(f) ADF Bearing: One bearing pointer shows current bearing to ADF station. The source for pointer is annunciated in the lower left hand corner of the ND.

(g) DME: DME is displayed in the upper left and right corners of the ND.

(3) ARC Mode: Display shows a compass arc Figure 12, centered below the center of the screen, with major tick marks every 10 degrees, and minor tick marks every five degrees. The major tick marks are labeled every 30 degrees. The ARC Mode display shows:

(a) aircraft heading

(b) selected heading

(c) selected course

(d) course deviation

(e) vertical deviation

(f) TO/FROM indications

(g) weather radar

(h) ADF bearing

(i) Distance Measuring (DME)

(a) Aircraft Heading: is displayed at the top of the range lubber line. A symbolic reference airplane is located at the center of the compass arc.

(b) Selected Heading: is indicated by an "M" shaped symbol which moves along the outside of the arc, and by a dotted line from the airplane symbol to the "M".

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass arc, with an extension pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a four dot scale. The pointer and deviation scale rotate with the selected course about the center of the arc.

(d) Vertical Deviation: is displayed using a scale and pointer identical to those on the PFD display.

(e) TO/FROM Indications: are displayed under the right end of the heading arc when tuned to a VOR station. TO/FROM indication is blanked while in ILS mode.

(f) Selected course and heading is displayed on the left upper part of the ND by an inverted M, arrow and digital display. These correspond to the selected heading and course on the compass arc. When a change is selected they will be shown momentarily.

(g) Weather Radar: Weather radar data may be displayed within the compass arc. The display range is selected from the Mode Select Panel (MSP). A half-range index mark, centered between the aircraft reference symbol and the outer periphery of the arc, will indicate one-half of the range selected on the MSP. The brightness of the weather radar image can be adjusted relative to the ND symbology from the CDP. When fault codes are received, weather radar status messages will appear on the display screen. The message "WX OFF" will appear on the display screen when a DU overheat is detected or when the CDP WX BRT control knob is in the off position. Tilt angle is annunciated only momentarily, when the WXR antenna tilt angle is changed.

(h) ADF Bearing: One bearing pointer shows current bearing to ADF station. The source for pointer is annunciated in the lower left hand corner of the ND.

(i) DME: DME is displayed in the upper left and right corners of the ND.

M. Compacted PFD/ND Display

(1) The compacted PFD/ND display (Figure 13) appears whenever either (but not both) of the Display Units is turned OFF at the CDP. This format contains all data shown on the normal PFD display. However, the bottom third of the attitude sphere is removed and replaced with a heading indicator. The following symbology is available on this display:

(a) Attitude indicator

(b) Flight director command indicator

(c) Glideslope deviation

(d) Speed deviation

(e) Decision height

(f) Radio altitude

(g) Marker beacons

(h) Altitude alert

(i) Course deviation

(j) Compacted heading display

(k) Selected heading

(l) Digital course

(m) Windshear

(n) Dead reckoning (DR)

(2) All symbology characteristics for the top two-thirds of the display are the same as for the PFD format. The compacted heading display, on the bottom third of the screen, contains the same symbology used on the ND-ROSE display.

N. EFIS/FMS Interface

(1) The Flight Management System interfaces with the EFIS to provide FMS oriented displays on the EFIS primary flight display (PFD) and the navigation display (ND). The advanced flight management computer (AFMC) is the primary source of data for display on the PFD or ND when the EFIS mode selector panel MODE selector is placed in the MAP or PLAN position. The FMS data is supplied to the EFIS symbol generators that provide the symbology display on the PFD and ND. Figure 14 and Figure 15 indicate the FMS controlled displays on the PFD and ND. The mode selector panel also provides the means for selection of Capt/F/O initiated optional (background) data selections; RANGE, N-AID (navigation aids), ARPT (airport), DATA and WPT (waypoint). The N-AIDS selection will initiate VOR-DME navigation aids that are within the current range to be displayed on the ND. The ARPT selection will initiate display on the ND of the airports that are in the data base within the current range. The DATA selection will initiate a display of constraint altitudes and ETA (estimated time of arrival) of every waypoint defined in the active route. WPT selection will initiate data base waypoints not on the active route when the range of the display is 40 nautical miles or less. To remove (declutter) unwanted data, press the selection pushbuttons a second time.

(a) PFD - When the FMS initiates an alert message display on the FMS multipurpose control display unit (MCDU), "MCDU MSG" will be displayed in the upper left corner of the PFD. The PFD FAST/SLOW indicator will follow the FMS speed command. The PFD flight director bars will follow when FMS commands when V-NAV is engaged.

(b) ND - The MAP, PLAN, ROSE or ARC mode selections are displayed on the ND. The MAP mode displays the aircraft position relative to the route and other ground reference data in a track-up format. The map reference point (MRP) for the MAP mode is dynamic with the background moving about the MRP. The PLAN mode display is used by the CAPT/F/O to look ahead in the flight plan and review what a portion of the flight plan looks like. The MRP for the PLAN mode is referenced to a waypoint that is currently displayed on the MCDU and identified by the legend CTR on the LEGS page (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00), Description and Operation, paragraph K; Line Select Key 6L)

(c) MAP MODE - The MAP mode displays the following FMS provided dynamic information (except as noted):

Distance To Waypoint (DTW) - The distance to the next waypoint.

Estimated Time of Arrival (ETA) - The estimated time of arrival at the next waypoint.

Drift Angle - Drift angle is the difference between computed track angle and heading.

Source of Course/Track Data - The source of the Course/track and deviation data are ILS, VOR or NAV (not FMS generated).

Wind Direction - Indicates FMS calculated wind direction.

Windspeed - Indicates FMS calculated windspeed. Display of wind direction and speed is inhibited below 10,000 feet altitude.

Vertical Deviation - FMS calculated vertical path error when in the descent phase.

Range to Altitude - An arc, the position at which the aircraft will reach the clearance altitude with present flight path and track.

(d) The following represent failure displays (not generated by FMS):

TRK FAIL - Displayed when track data invalid.

NAV FAIL - Displayed when track deviation data invalid.

VNAV FAIL - Displayed when vertical deviation invalid.

MAP FAIL - Displayed, in MAP mode, when EFIS removes map symbology due to loss of data parameters.

(e) PLAN MODE - FMS provided dynamic information for the MAP mode is also applicable to the PLAN mode display on the ND (no FMS background data is displayed on the PLAN mode).

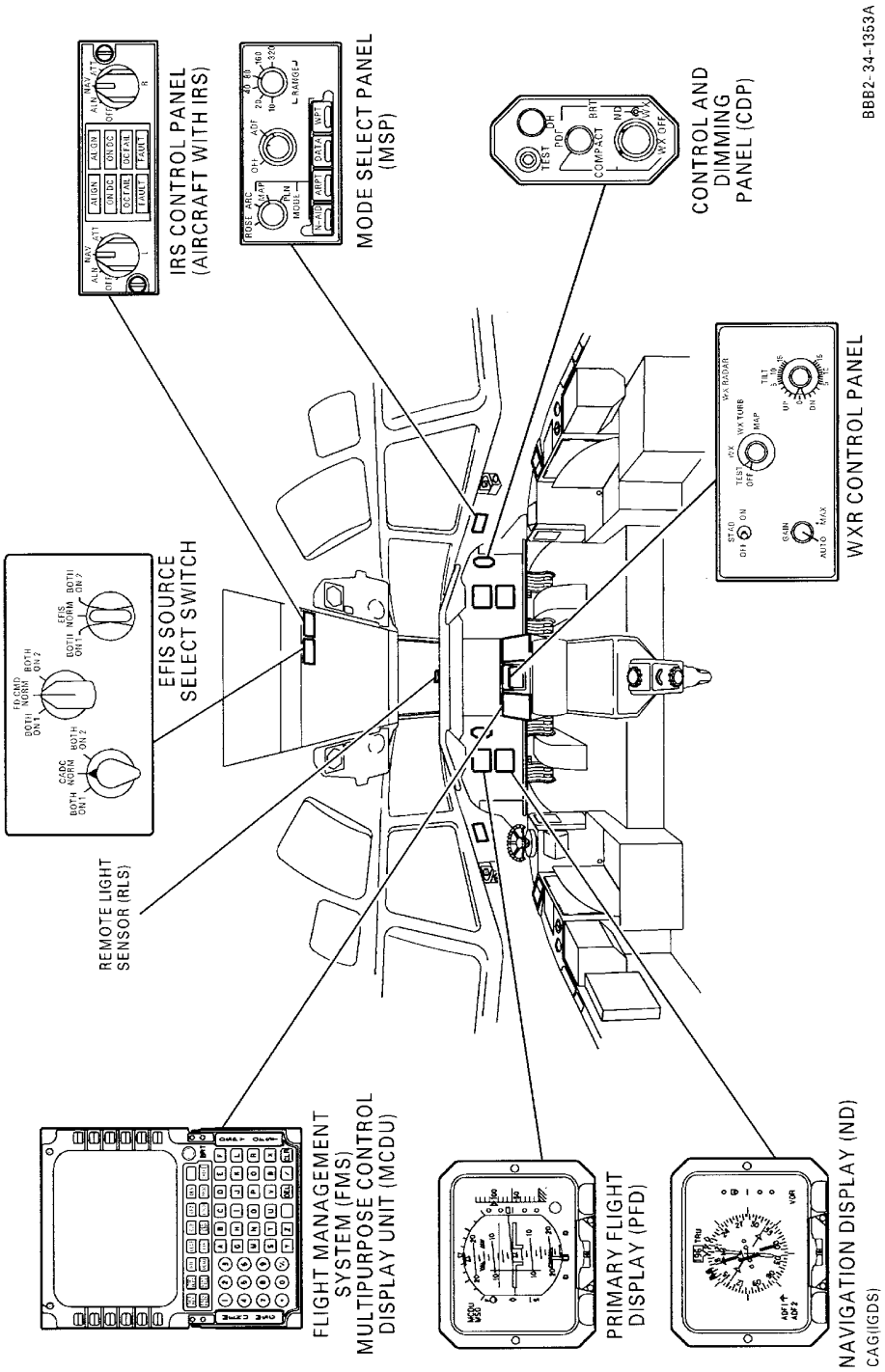
(f) ROSE MODE - The ROSE display resembles a conventional horizontal situation indicator (HSI). FMS information provides the following additional information for display on the ND:

DESIRED COURSE - Displays the desired course when the source of course/track data is NAV.

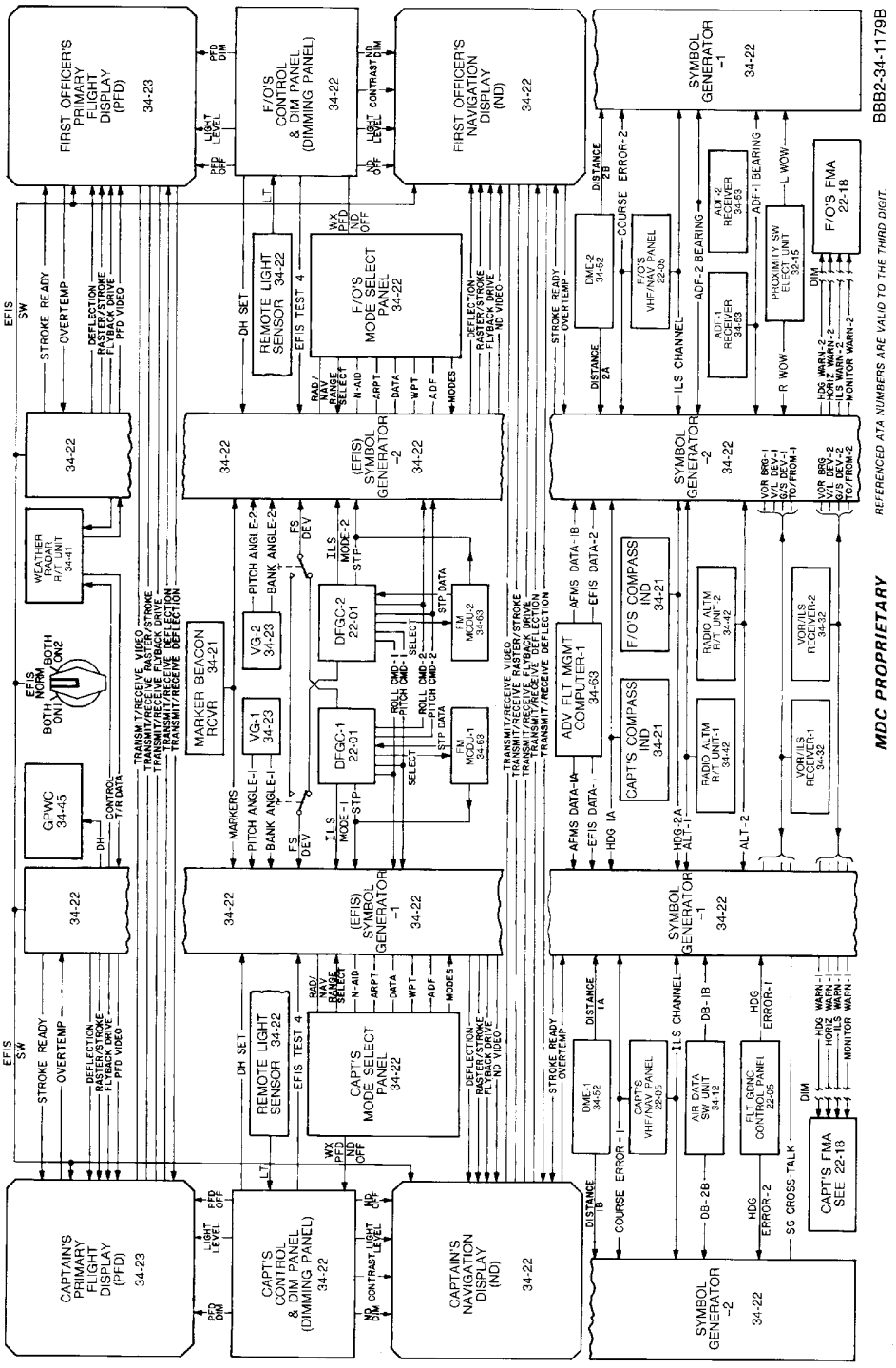
COURSE DEVIATION - Displays FMS lateral deviation when the source of course/track data is NAV.

WAYPOINT ALERT - Displays an annunciation of an upcoming waypoint or course change in the FMS flight plan.

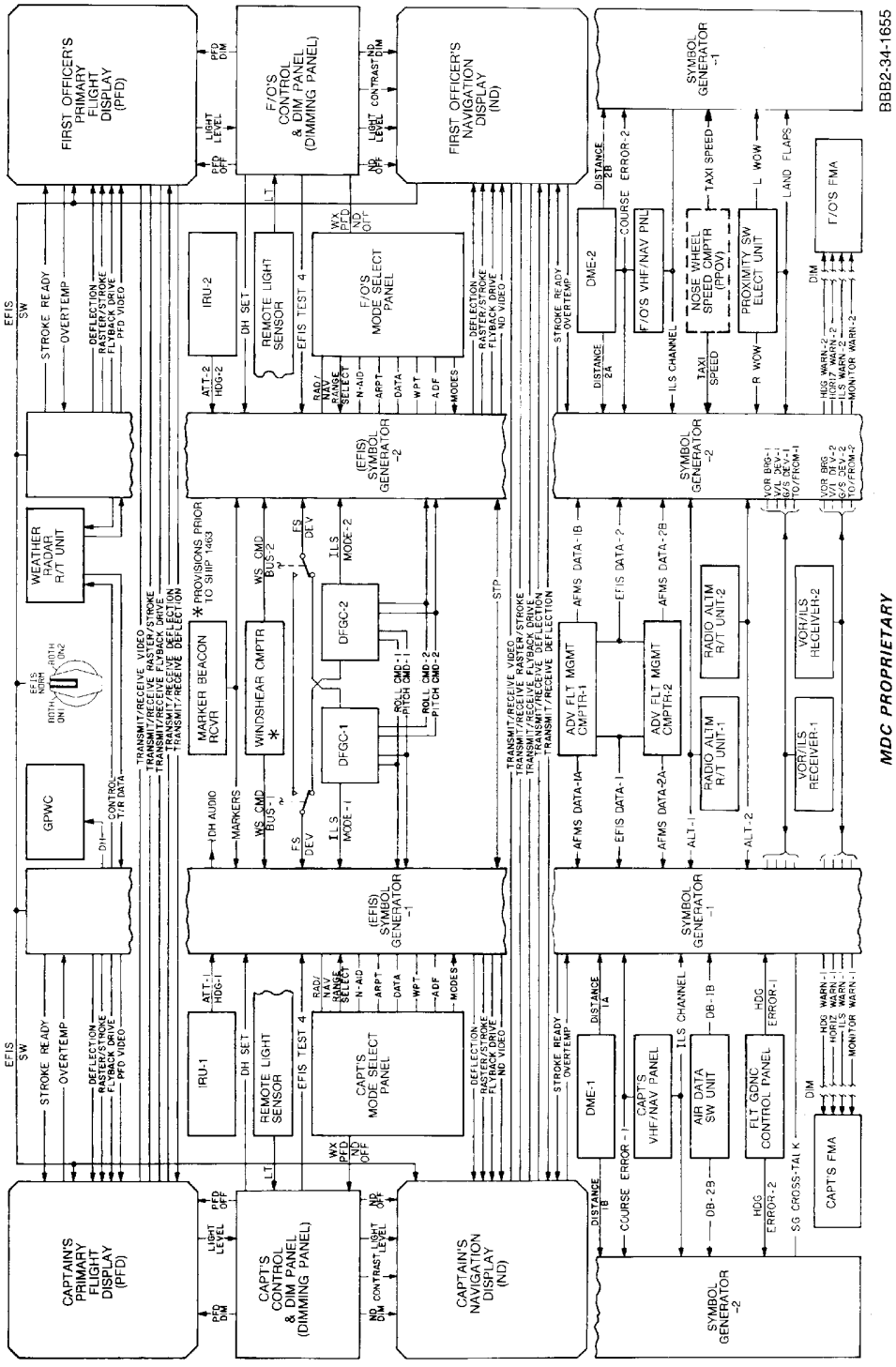
(g) ARC MODE - The ARC mode displays the same information on the ND as the ROSE mode but as a compass arc.



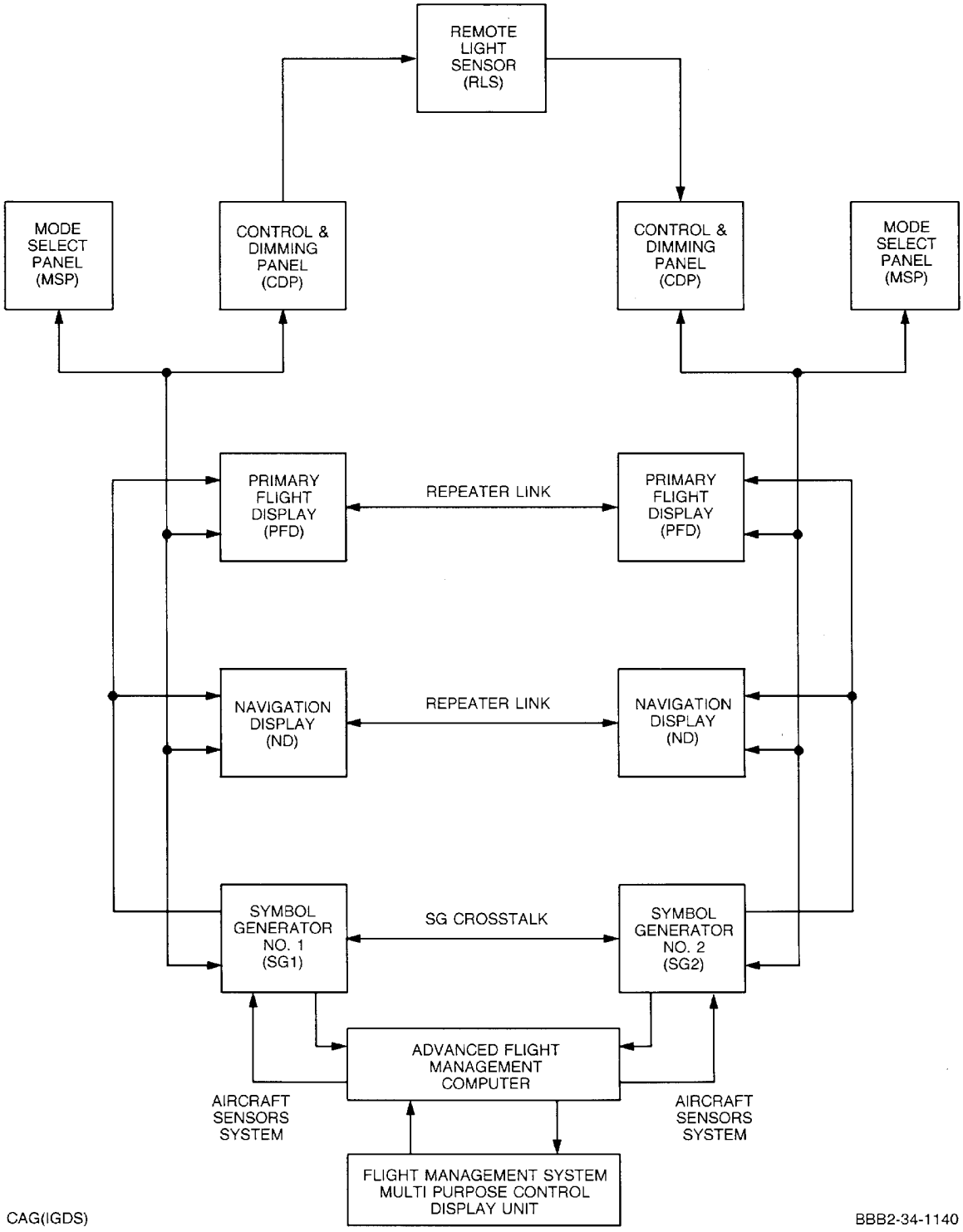
Electronic Flight Instrument System (EFIS) With Flight Management/ System (FMS) Interface Flight Compartment Configuration
Figure 1/34-22-00-990-A91



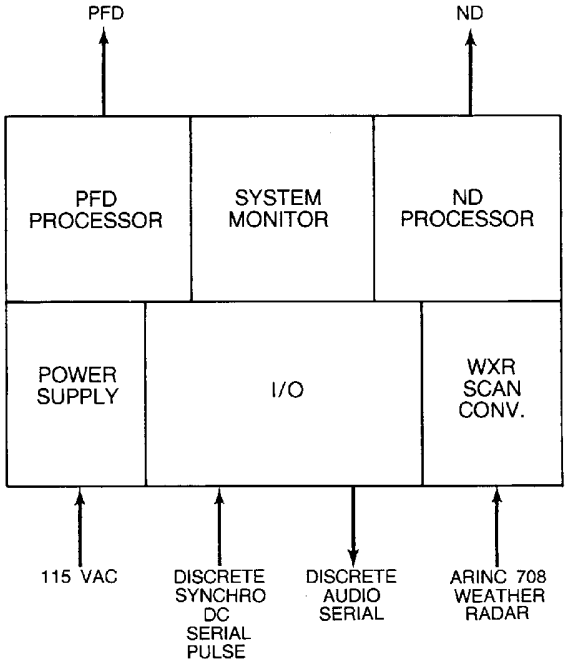
EFIS Block Diagram
Figure 2/34-22-00-990-A92 (Sheet 1 of 2)



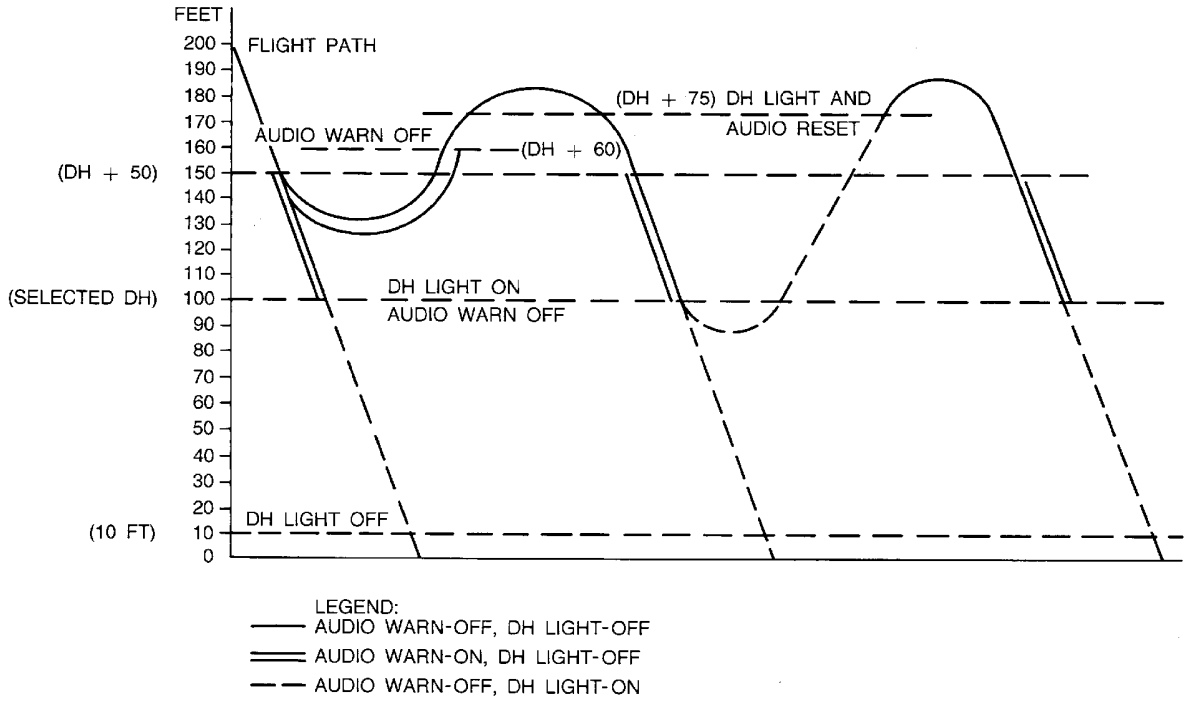
EFIS Block Diagram
Figure 2/34-22-00-990-A92 (Sheet 2 of 2)



EFIS -- System Interface Diagram
Figure 3/34-22-00-990-A93



EFIS Symbol Generator -- Component Diagram
Figure 4/34-22-00-990-A94



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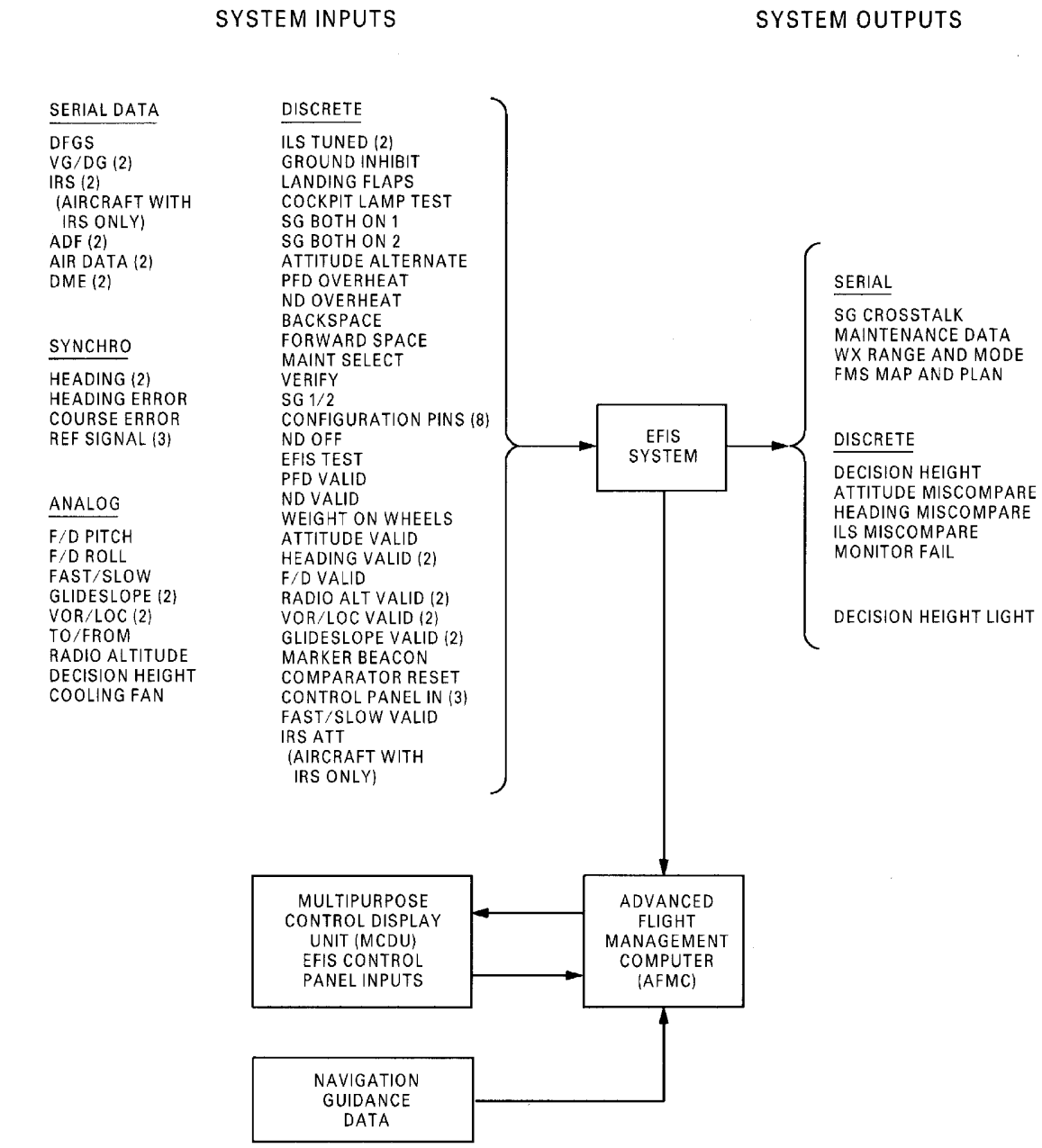
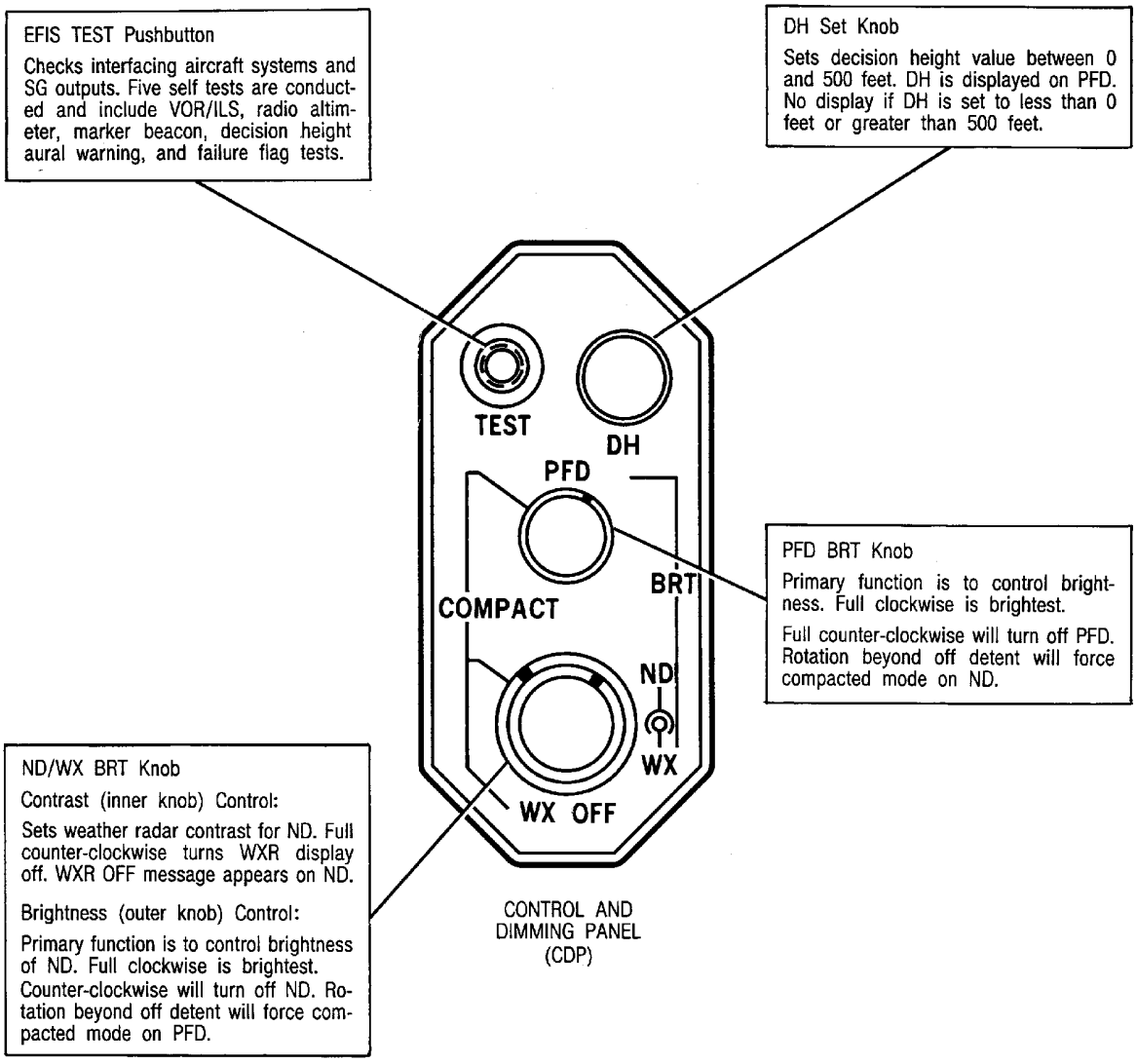
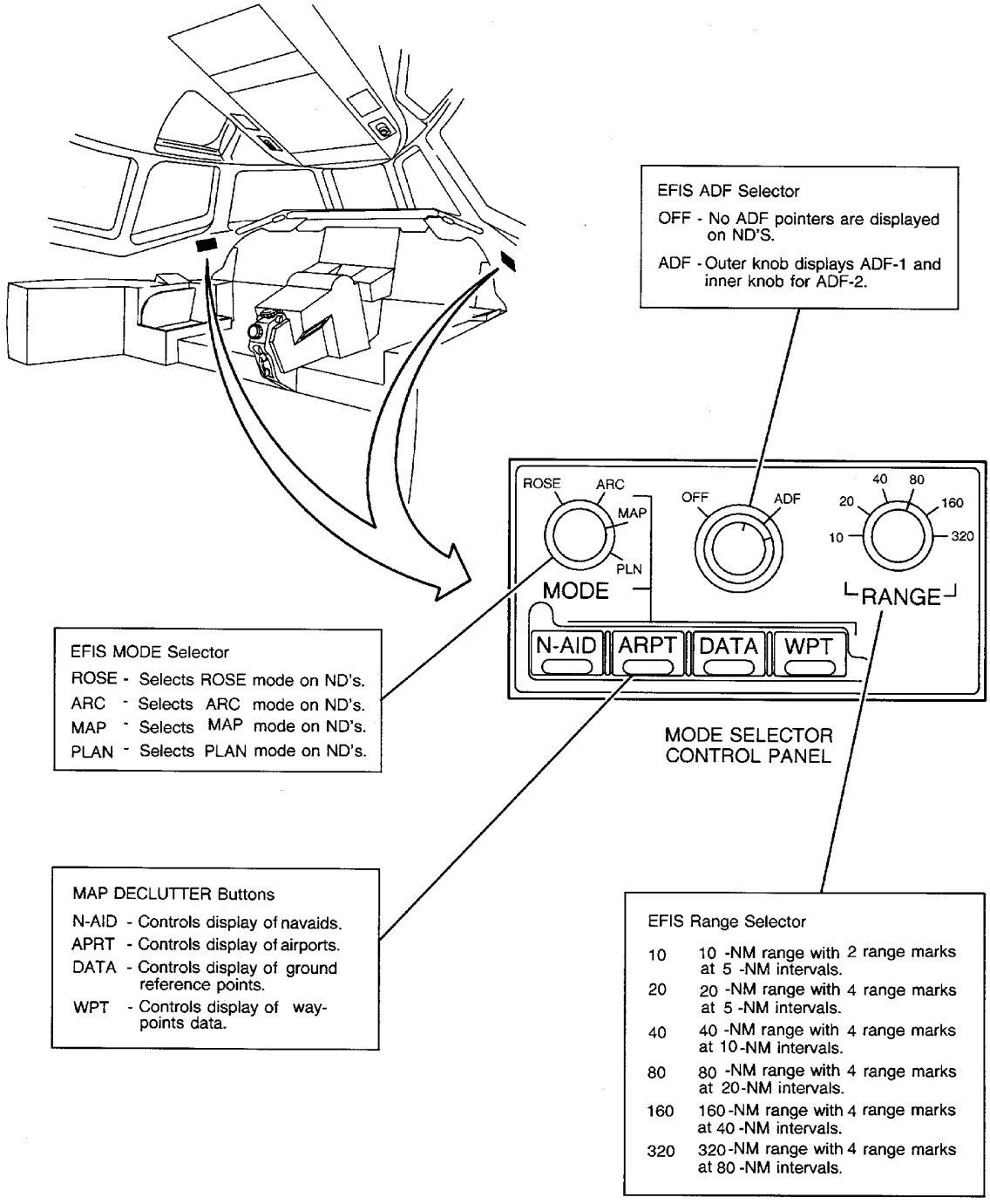
EFIS Decision Height Output
Figure 5/34-22-00-990-A95



EFIS Inputs and Outputs
Figure 6/34-22-00-990-A96

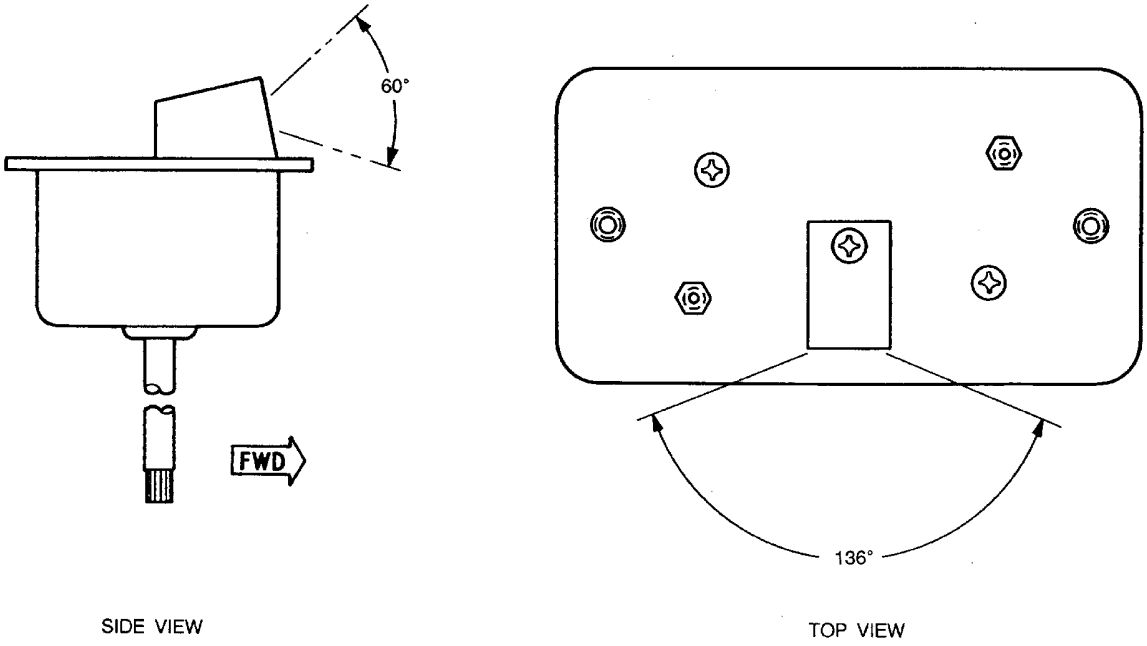


EFIS Control and Dimming Panel
Figure 7/34-22-00-990-A97

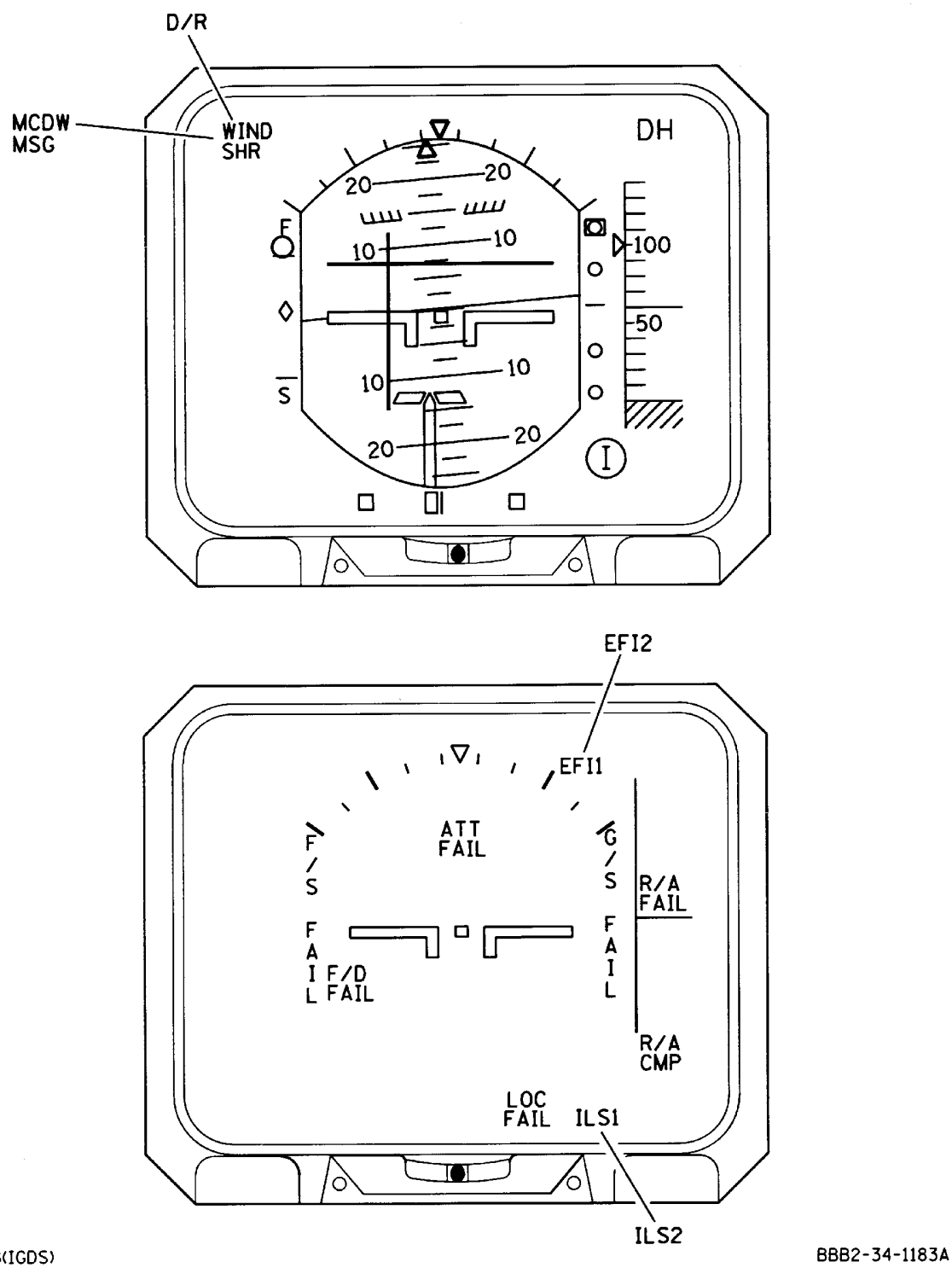


EFIS Mode Selector Control Panel With FMS Mode Selection
Figure 8/34-22-00-990-A98

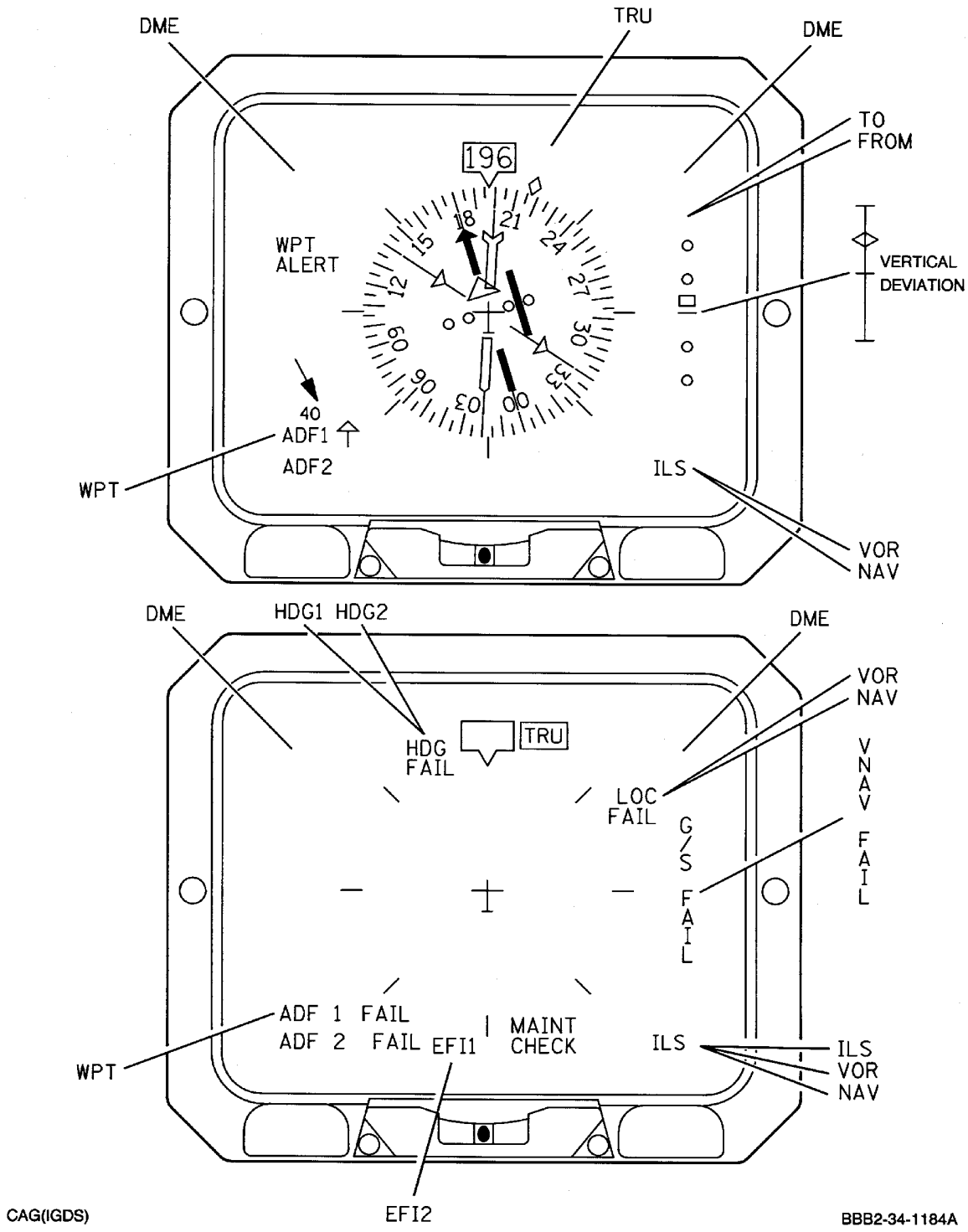
EFFECTIVITY
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



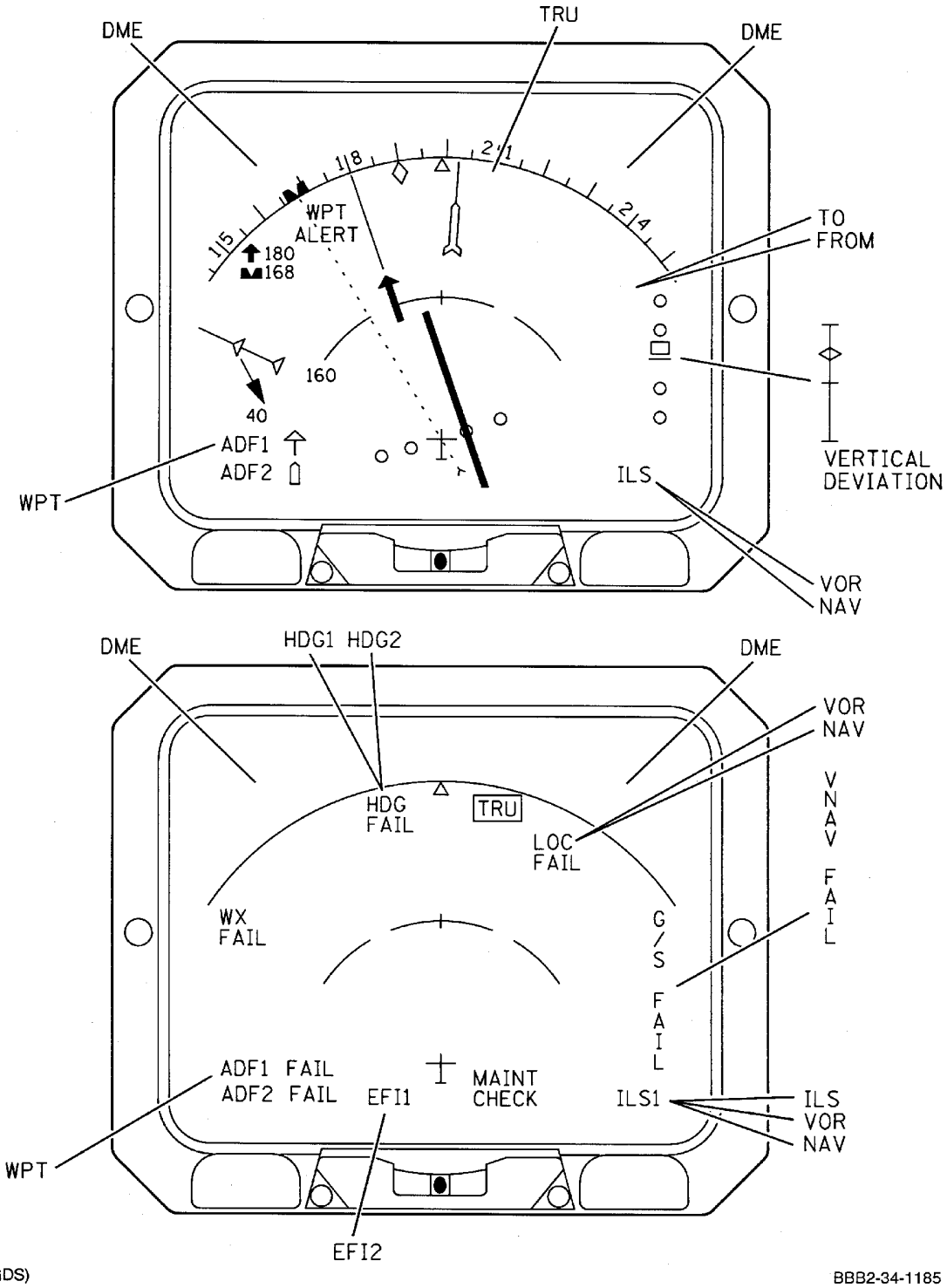
EFIS Remote Light Sensor
Figure 9/34-22-00-990-A99



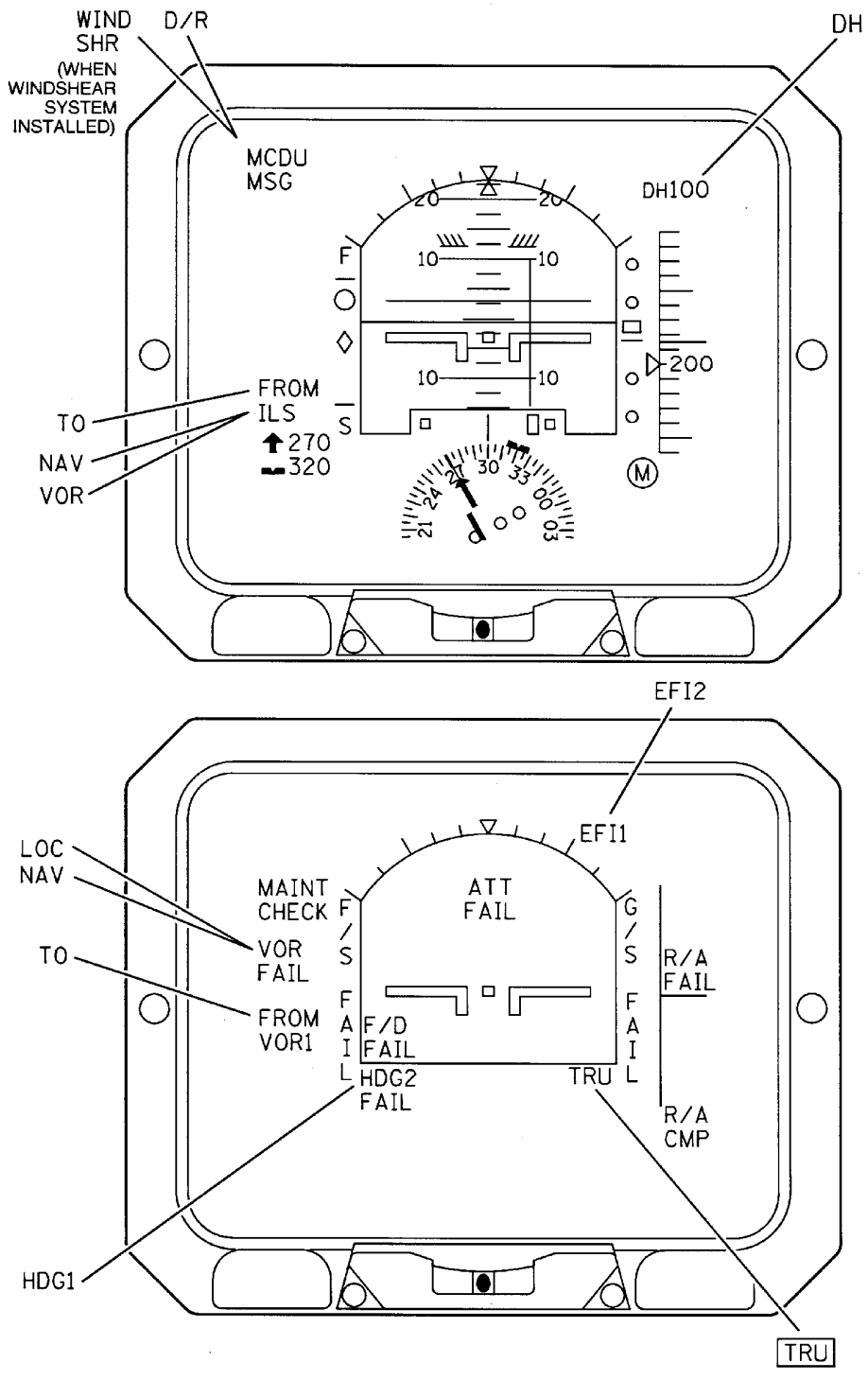
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-B00



Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-B01



Navigation Display -- ARC Mode (with Flags and Warnings)
Figure 12/34-22-00-990-B02



CAG(IGDS)

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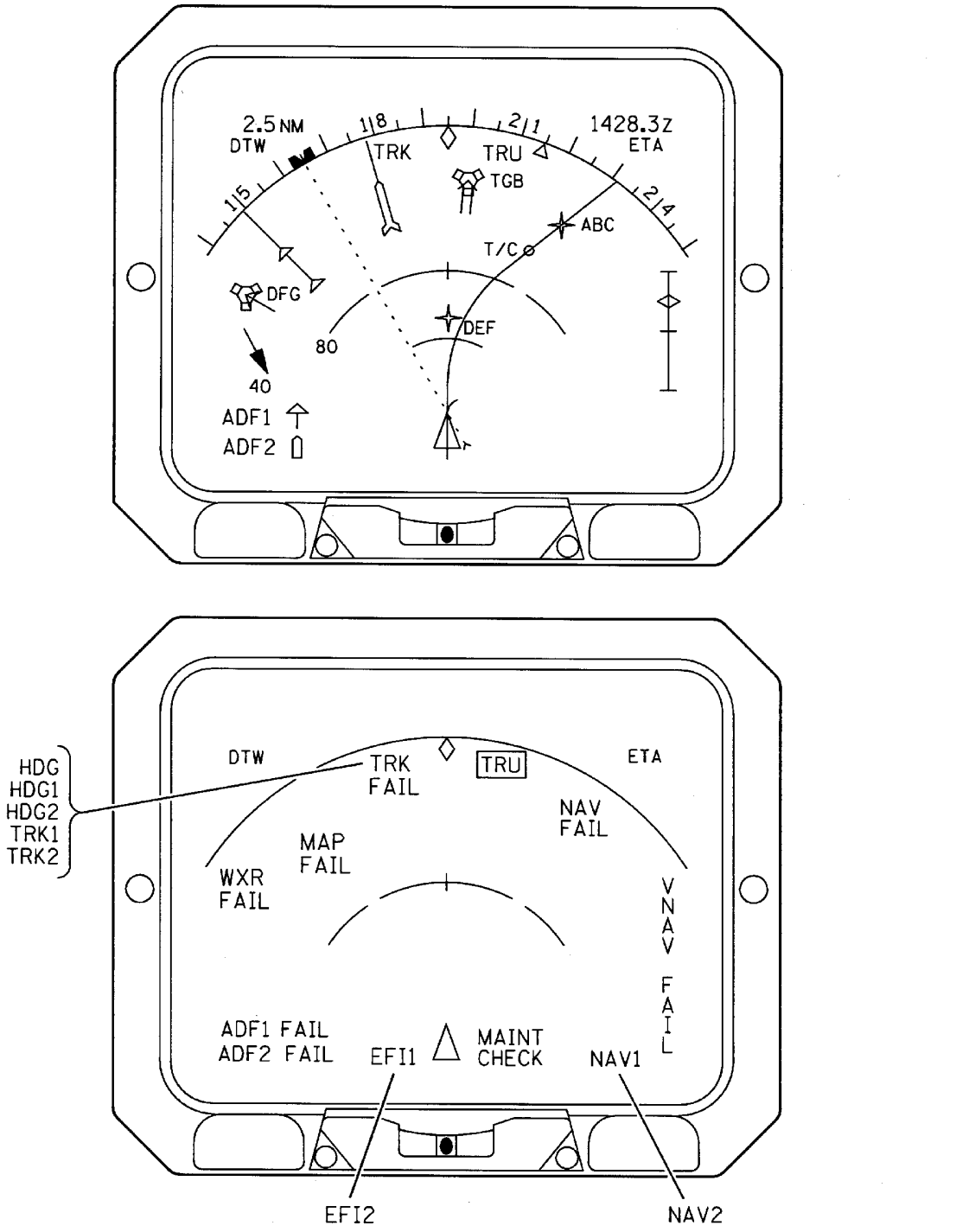
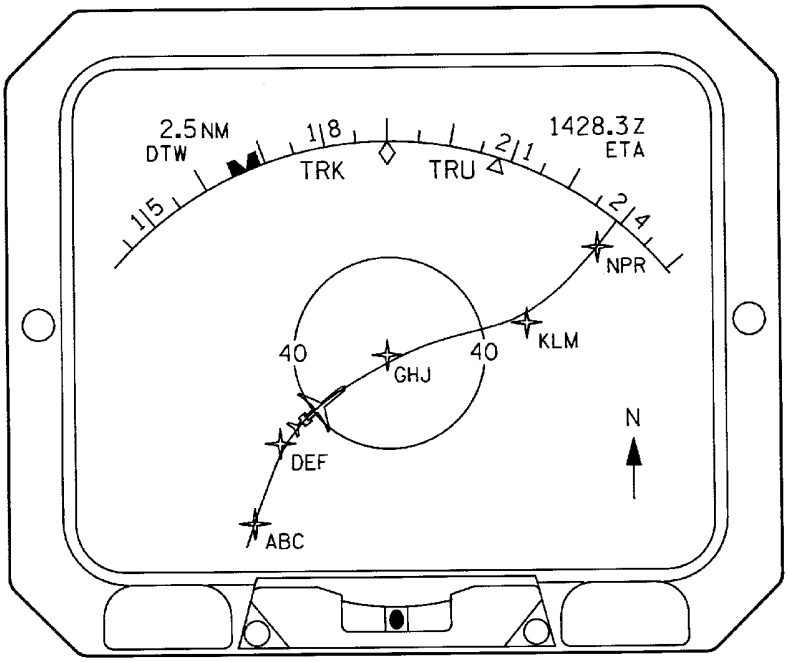
Cofmpacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-B03



CAG(IGDS)

BBB2-34-1187

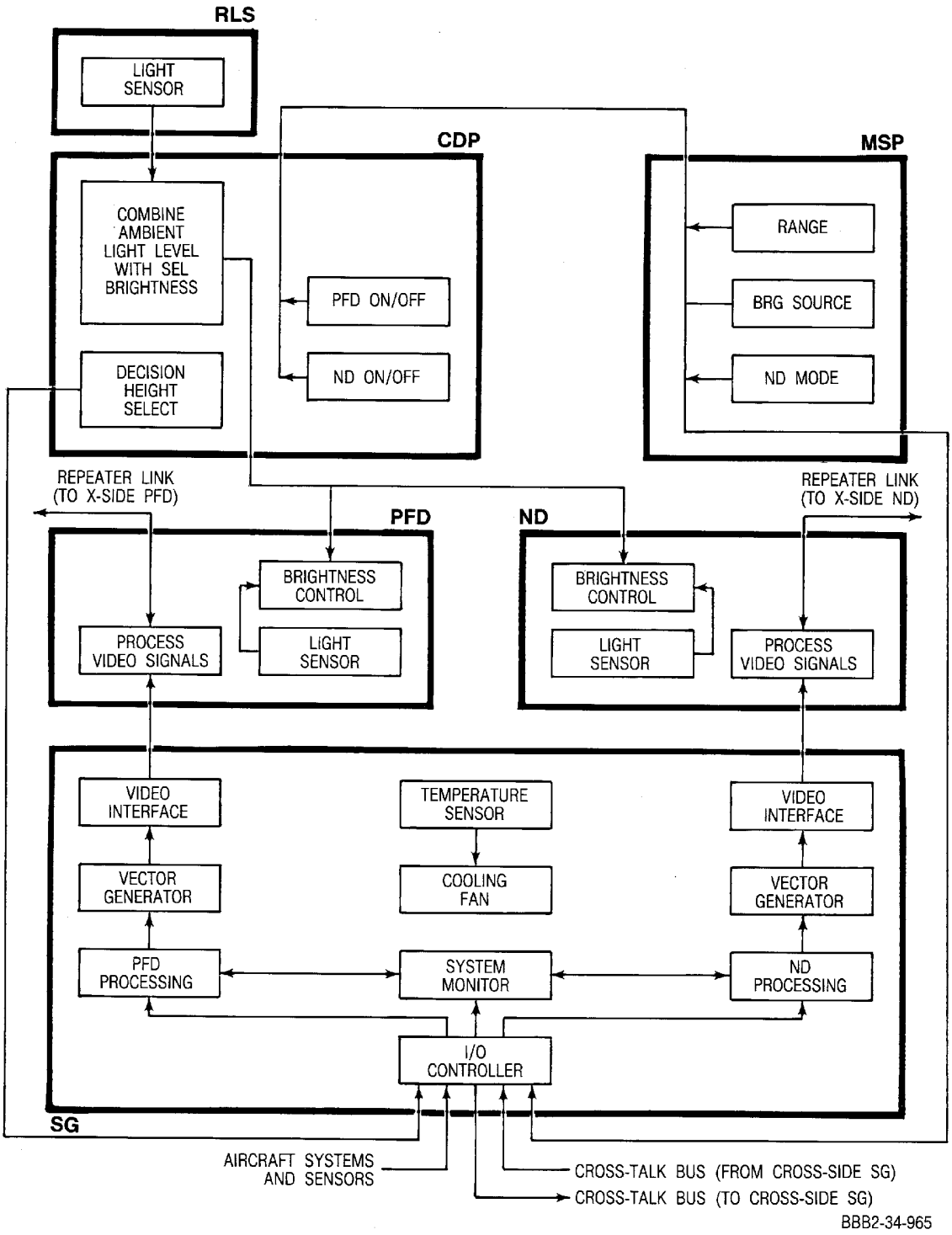
Navigation Display -- MAP Mode (with Flags and Warnings)
Figure 14/34-22-00-990-B04



CAD(IGDS)

BBB2-34-1147

Navigation Display -- PLAN Mode
Figure 15/34-22-00-990-B05



EFIS -- Block Diagram (Single Side)
Figure 16/34-22-00-990-B06

Sensor	Left Symbol Generator Inputs (SG-1)		Right Symbol Generator Inputs (SG-2)	
	"A" Display	"B" Monitor	"A" Display	"B" Monitor
VERTICAL GYRO (VG)	VG1	VG2	VG-2	VG-1
IRS DUAL (On aircraft with IRS)	IRS1	IRS2	IRS1	IRS2
COURSE ERROR	Crs Err1	Crs Err2	Crs Err2	Crs Err1
RADIO ALTITUDE	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

CAG(IGDS) BBB2-34-1188A

SG Display/Monitor Sensor Inputs
Figure 17/34-22-00-990-B07

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Inoperative
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

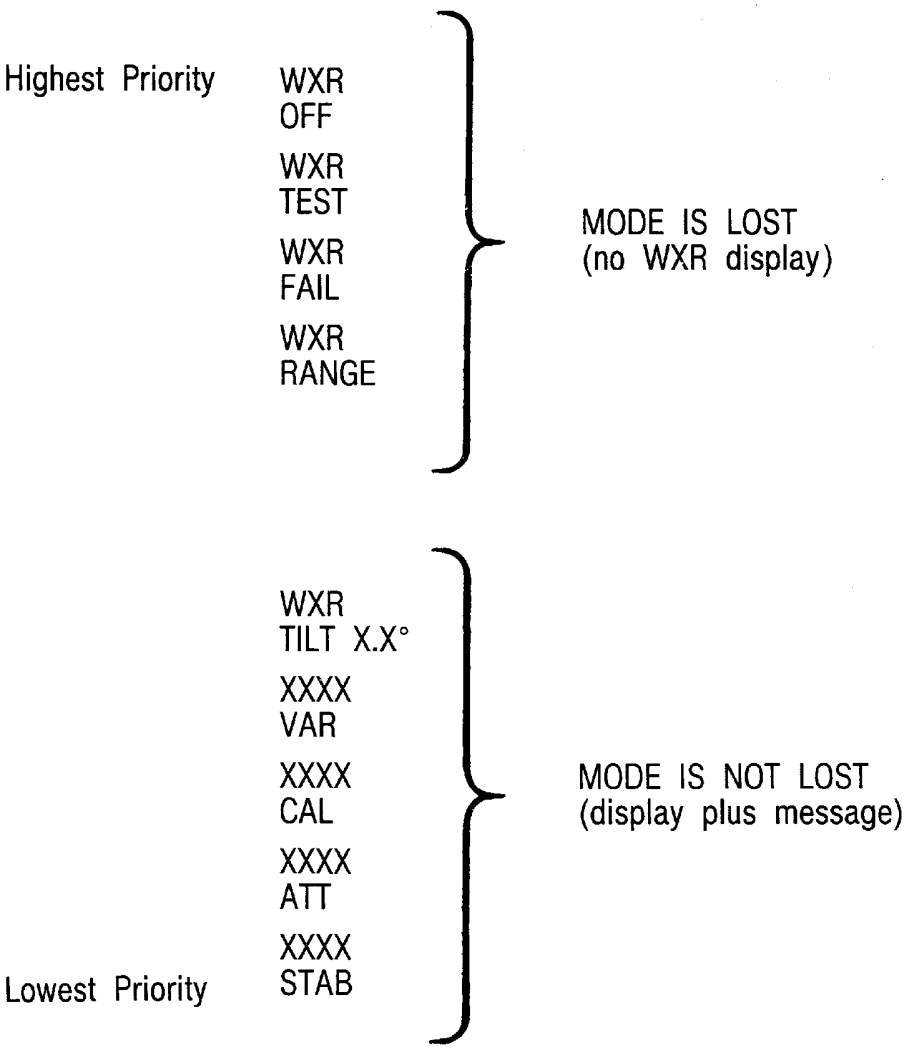
BBB2-34-967

Symbol Generator Operating Modes
Figure 18/34-22-00-990-B08

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99	10 feet	No FMA Annunciation		R/A CMP
	100-499	(0.1)(Average R/A) feet	Both R/A CMP displays steady		
	500-2500	(0.1)(Average R/A) feet + 10 feet			
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

BBB2-34-968

FMA Annuciations for SG Instrument Comparator Function
Figure 19/34-22-00-990-B09



Weather Radar Message Priority
Figure 20/34-22-00-990-B10

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

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Failure Flag Test Annunciations
Figure 21/34-22-00-990-B11

2. Operation

A. Overview: The Symbol Generators (SG's) are the master control units for the EFIS. Their job is to receive input data from aircraft sensors and systems, check the data for presence and validity, compute the display parameters for the display units, and transmit display data to the display units.

(1) The SG's are also responsible for monitoring the EFIS, for performing continuous self-tests, and for logging faults in the flight log. System monitoring includes input monitoring, SG-internal monitoring, control panel monitoring (CDP and MSP), and display unit (DU) monitoring. Each SG also monitors the cross-side SG and performs a navigation instrument comparator monitor function.

(2) The EFIS logs its own failures, and failures of all interfacing aircraft systems. In-flight failures are stored in a flight log for later retrieval by maintenance personnel. The EFIS has an extensive built in test (BIT) capability, comprised of both continuous BIT (for continuous in-flight monitoring) and initiated BIT (used only in maintenance and preflight tests).

(3) The EFIS system operation is presented in the following sequence:

A. Overview

B. EFIS Inputs, Outputs and Data Flow

C. System Monitoring

D. Built In Test and Ground Maintenance

B. EFIS Inputs, Outputs and Data Flow: Navigation data are sent from the various aircraft systems and sensors to the SG Input/Output (I/O) controller for processing. The I/O controller writes all input data to each of the symbol generator processors: the PFD and ND processors, and the system monitor processor (Figure 16). Input data are checked for presence and validity, processed, and sent to the PFD and ND for display. The display data are also sent to the cross-side SG for comparison purposes. Display format and brightness are controlled from the Control and Dimming Panel (CDP) and from the Mode Select Panel (MSP).

(1) Each EFIS display is driven by its own display processor, vector generator, and video interface. The system monitor processor in the SG verifies the proper operation of each of the display processors. There are separate PFD and ND display output channels from the SG. Each display output channel consists of six digital output signals and two analog output signals which contain color settings, raster control, display mode setting (raster/stroke), and X-and Y-beam deflection signals. The SG receives a digital ready signal from the PFD and ND when the display deflection amplifiers are ready to write.

(2) Weather radar signals are sent to the WXR scan converter. This digital circuit is designed to convert the color WXR signal to EFIS color display format. The resultant map is an offset center sector scan, oriented with heading up in the ARC mode. The displayed sector is variable from +45 degrees to +90 degrees, as determined by the radar. The display map can be rotated and translated in response to aircraft heading and positional changes. Range marks and NAV marks are generated by the display generator in the ND processor. Range is controlled from the Mode Select Panel (MSP). An on-board test pattern generator provides a visual means of operational verification. The ND processor accesses the necessary hardware in the scan converter to control the source and display of the WXR data.

(3) Data from the on-side SG enters the DU through the primary display data input port. Each DU also has a secondary display data input port through which cross-side video signals may be sent/received. These bi-directional cross-side port lines are used in the event of a SG failure. By placing the EFIS source select switch in the BOTH ON 1 or BOTH ON 2 position, display data may be transferred directly from the PFD and ND on the functioning side to the cross-side DU's. The compacted PFD/ND display (reversionary mode) is obtained whenever one of the two system display units is turned off. This allows dual system operation should one of the display units fail.

(4) There are two brightness command signals for each DU: a brightness level command and a raster/stroke contrast ratio command. The raster/stroke contrast ratio is set to a default level for the PFD, compacted PFD/ND, and ND-ROSE displays to provide standard levels of raster shading for the ADI sky/ground shading and for the background scale shading. The voltage ratio is variable for the ND-ARC format, to allow the intensity of the weather radar imagery to be varied.

C. System Monitoring: System monitoring is designed to detect failures that may affect operation of the EFIS. EFIS monitoring consists of:

(a) input monitoring

(b) Symbol Generator internal monitoring

(c) SG-to-SG instrument comparator monitoring

(d) control panel monitoring

(e) display Unit monitoring

(f) weather radar input monitoring

(1) Input Monitoring: Input monitoring verifies that sensor or system inputs are present and valid, and that the SG input hardware is functioning properly. Input monitoring consists of:

(a) Input Data Monitoring: Analog and digital inputs to the SG are continuously monitored for presence and validity. If an input parameter is missing, invalid or out of range, the SG will remove all symbology dependent on the input from the PFD/ND. An appropriate failure message will be displayed where the data would normally appear on screen. The symbology will not be re-drawn until the valid has returned for a minimum period of time.

(b) SG Input Hardware Monitoring: The SG monitor processor tests input hardware by feeding test values to the analog, synchro and digital input hardware.

1) Analog input hardware monitoring: The analog input hardware test verifies proper operation of the A-to-D conversion function. Failure of the analog input test will result in failure annunciation of all analog signals associated with the failed multiplexer. This test is performed at a 20 Hz rate.

2) Synchro input hardware monitoring: The synchro input hardware performs a bias test which verifies proper operation of the synchro to sin/cos conversion and demodulation network. This test is performed upon a cold start or during system testing.

3) Digital input hardware monitoring: Digital input receivers are continuously tested by sending test words from the four controlling transmitters to each of the receivers. When a receiver is in test mode, the monitor receives, checks and clears the test inputs. If an error is detected on two or more of the four test signals received, the receiver is inoperable, and appropriate symbology is blanked or flagged.

(2) Symbol Generator internal monitoring: consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(3) SG-to-SG Instrument Comparator Monitoring: The SG receives two types of sensor inputs: "A" (on-side) inputs for display on the on-side DU's, and "B" (off-side) inputs for monitoring the cross-side SG (Figure 17). The SG performs a Nav Instrument Comparator Monitor (NICM) function by comparing the following "A" and "B" parameters:

- ILS (localizer and glideslope deviations)
- Attitude (pitch and roll)
- Heading
- Radio Altitude.

(a) If significant cross-channel differences are found between the "A" and "B" values of ILS, attitude or heading parameters, the SG's will signal the discrepancy on the FMA. The ILS, ATTITUDE or HEADING annunciator will flash on the side associated with the fault, and glow steady on the cross-side FMA. A flag and/or warning will also appear on the display screen. Radio Altitude mis-compare is annunciated on the PFD by a "R/A CMP" message. Flashing logic is the same as for the other parameters. Mis-compare annunciations will clear automatically if the deviation returns to within limits. They may be manually cleared on the FMA by resetting the FMA annunciator. Loss of valids results in annunciations on both FMA's, removal of faulty parameters from the screen, and display of fail messages. (Figure 19).

(b) The MONITOR annunciator on the FMA is used to signal SG failures in one of three conditions. The first condition involves internal SG tests which are performed under the direction of the system monitor processor. These tests are performed at a 2 Hz rate, and the results compared with the cross-side system results. When a mis-compare occurs on either side, both MONITOR annunciators come on.

The second condition occurs when the SG-to-SG cross-talk link fails due to invalid or interrupted updates. This also will cause both MONITOR annunciators to come on. Third, when a SG fails, the remaining SG continues to monitor its own displayed data, but the comparison function is deactivated; the MONITOR annunciator will come on, on the failed side.

(c) There are six distinct SG-to-SG Instrument Comparison Operating Modes (Figure 18). The operating mode determines if, and when, the NICM annunciators on the FMA will come on. These modes are prioritized from Cruise mode (5 - lowest priority) to Test mode (1 - highest priority). Higher priority modes will always override lower priority modes. During the course of the flight leg, the system will primarily operate in Cruise mode.

(4) Control Panel monitoring: verifies correct operation of the Control and Dimming Panel and Mode Select Panel.

(5) Display Unit monitoring: verifies that the DU is receiving display data.

(6) Weather Radar Input monitoring: The SG weather radar (WXR) scan converter converts color WXR signals to a format suitable for display on an EFIS color display unit. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages. There are two types of WXR messages: those for which the mode selected on the WXR control panel is lost, and those for which the mode is not lost. If the mode is lost, warnings will appear on screen, but there will be no WXR display. If the mode is not lost, the messages will appear along with the WXR display (Figure 20). WXR messages are prioritized as follows:

WXR OFF - WXR BRT knob is OFF on CDP, or DU overheat condition

WXR TEST - System in TEST mode. Test pattern is displayed, plus R/T fault messages including:

- R/T - receiver/transmitter fault
- ANT - antenna fault
- CNTL - control fault
- ATT - attitude fault
- CAL - calibration fault
- RANGE - range fault (MSP fault)
- COOL - R/T unit cooling fault.

NOTE: If any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

XXXX VAR - WXR input sensitivity not calibrated to any precipitation rate (XXXX represents operating mode selected on WXR control panel).

XXXX CAL - loss of calibration

XXXX ATT - attitude input fault

XXXX STAB - stabilization is off

WXR TILT - momentarily annunciated on screen when antenna tilt angle is changed.

D. Built In Test and Ground Maintenance: The EFIS built in test (BIT) is designed to aid maintenance in isolating faults related to the EFIS and the systems with which it interfaces. There are two types of BIT for the EFIS: continuous BIT for in-flight monitoring, and initiated BIT for pre-flight and LRU functional checks. Other maintenance functions require interface with the Multipurpose Control Display Unit (MCDU) for in-depth system tests and fault isolation.

(1) Continuous BIT: Continuous BIT monitors the EFIS throughout each flight profile and logs all failures in the flight log for later retrieval by maintenance personnel. The EFIS logs its own failures, and also those of the aircraft systems with which it interfaces. The SG maintains a log in non-volatile memory of failures detected by the system monitors, whenever the system power is on. The continuous BIT logs the failure type and time of occurrence (time after start of flight leg). The log can contain 20 failures on each of the last 10 flight legs. Intermittent failures are recorded only once per hour of flight time. Continuous failures are recorded only once per flight leg. (Faults are also recorded while the aircraft is on the ground and the system is functioning.) Failures are retrieved via the Status Test Panel.

(2) Initiated BIT: Initiated BIT provides a means of self-testing the EFIS on the ground. Tests are initiated by pushing the TEST button on the Control and Dimming Panel. Tests include: initiated EFIS System Self-Test, Initiated Functional Self-Test and Initiated Cockpit Lamp Test. Initiated BIT is used both in preflight testing and in LRU functional checks (PAGEBLOCK 34-22-00/201 Config 1).

(a) EFIS System Self-Test (BIT) is initiated through the TEST pushbutton on the Dimming Panel. Test begins when the pushbutton is depressed, and ends approximately 3 seconds after release. This test includes:

- VOR/ILS Self-Test
- Radio Altimeter Self-Test
- Marker Beacon Self-Test

- Failure Flag Test.

(b) The first three tests are under control of the associated receiver units (the EFIS is only used to display the input parameters). The decision height aural warning test and failure flag test are under the control of the SG. Failure flag annunciations appear on the DU screen only while the TEST pushbutton is being depressed. The Failure Flag Test annunciations for the various display screens are shown in Figure 20.

(c) EFIS Functional Self Test is used by maintenance personnel to verify proper installation and operation of the SG. This test is initiated via the Status Test Panel (STP), by calling up the SG SELF-TEST selection on the Maintenance Menu (see EFIS Ground Maintenance following). The test consists of a synchro bias test, a system RAM check and an SG cooling fan test. The test takes approximately 2 seconds. Upon completion, both display units show software part number, aircraft equipment/options configuration, and test results (PAGEBLOCK 34-22-00/201 Config 1). This test is inhibited except when aircraft is on the ground and weight-on-wheels discrete is set.

(d) The cockpit lamp test checks the EFIS lamp displays by driving the FMA comparison lamps. Approximately 0.5 seconds after release of the DIGITAL/ANNUN pushbutton on the Overhead, the ILS, HEADING, HORIZON and MONITOR lamps on the FMA come on for 5 seconds.

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The Electronic Flight Instrument System (EFIS) replaces the conventional ADI and HSI on the Captain's and FO's instrument panels with four five-by-six inch color CRT display units. The upper units, the Primary Flight Displays, provide information normally found on the ADI, plus radio altitude, marker beacons and Windshear Alert and Guidance System (WAGS) data (if installed). The lower units, the Navigation Displays, provide information normally found on the HSI, plus ADF bearing, map displays and coordinated weather radar.

B. The EFIS interfaces with the Omega/VLF Navigation System (ONS) to provide ONS information displays on the EFIS navigation display (ND) and the EFIS primary flight display (PFD). ONS data displayed on the ND and PFD is dependent upon positioning of the MODE switch and NAV/RAD switch on the Mode Select Panel (MSP). Paragraph 1.N. for description of ONS information displays on the EFIS ND and PFD.

C. The Electronic Flight Instrument System (EFIS) consists of two identical and independent systems (Figure 1). Each system consists of the following:

Table 1

Component	Location
One Symbol Generator (SG)	Electrical/Electronics Compartment
Two CRT Display Units (PFD & ND)	Main Instrument Panel
One Control & Dimming Panel (CDP)	Main Instrument Panel
One Mode Select Panel (MSP)	Below Clearview Window
One Remote Light Sensor (RLS) (Shared by both systems)	Top of Glareshield.

(1) There are two switches located on the Overhead which are also used in conjunction with EFIS:

(a) EFIS Source Select Switch: allows either system to be run from the cross-side Symbol Generator in the event of an on-side SG failure.

(b) EFIS/DFGC Toggle Switch: allows ground maintenance personnel to use the Status Test Panel pushbuttons in conjunction with the EFIS display units in performing comprehensive system tests and troubleshooting.

D. System Displays:

(1) The Primary Flight Display (PFD) format displays aircraft attitude, flight director commands, glideslope and localizer deviations, radio altitude, speed error, decision height set and status, marker beacon indication, and WAGS data (if installed).

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(2) The Navigation Display (ND) operates in ROSE, ARC and MAP modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, ADF bearing and DME distances. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, DME distances, ADF bearing and weather radar. The MAP mode is EFIS OMEGA interface to display aircraft position relative to the route.

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(3) The Navigation Display (ND) operates in ROSE, ARC and MAP modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, ADF 1 bearing and DME distances. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, DME distances, ADF 1 bearing and weather radar. The MAP mode is EFIS OMEGA interface to display aircraft position relative to the route.

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(4) A compacted PFD/ND display format combines both PFD and ND data into a single-screen display. This format is used in the event of a display unit failure.

E. Description and Operation Overview: The Description and Operation is broken down into the following paragraphs:

(1) General (Description)

(a) System Overview

(b) System Overview

(c) System Components

(d) System Displays

(e) Description and Operation Overview

(f) Symbol Generator Description

(g) Display Unit Description

(h) Control & Dimming Panel Description

(i) Mode Select Panel Description

(j) Remote Light Sensor Description

(k) Primary Flight Display (PFD) Symbology

(l) Navigation Display Symbology and Weather Radar

(m) Compacted PFD/ND Display

(n) EFIS/OMEGA/VLF Navigation System (ONS) Interface

(2) Operation

(a) Overview

(b) EFIS Inputs, Outputs and Data Flow

(c) System Monitoring

(d) Built In Test and Ground Maintenance

F. Symbol Generator Description

(1) The symbol generator contains all of the circuitry required to interface with aircraft sensors and systems, compute CRT display parameters, and transmit display data to the display units . In addition, the SG provides an instrument comparator monitor function, which performs cross-side comparisons between ILS, attitude, and heading. In the event of a mis-compare, the corresponding annunciators on the Flight Mode Annunciator (FMA) panel come on. (Figure 3)

(2) The SG monitors its own internal operation and aids in monitoring the cross-side SG. The SG tests its internal functioning by performing dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. In the event of a SG failure or mis-compare, the MONITOR lights on the FMA will come on. The SG is also responsible for monitoring all aircraft systems and sensors which provide inputs to the EFIS, as well as the EFIS components. Continuous BIT monitors the EFIS throughout each flight profile, and logs all failures for later retrieval by ground maintenance.

(3) The left symbol generator (SG-1) drives the Captain's PFD and ND displays; the right symbol generator (SG-2) drives the First Officer's displays. Either Symbol Generator can drive all four CRT displays. In the event of a SG failure, the SG source selection switch, located on the Overhead Panel, may be put in the BOTH ON 1 or BOTH ON 2 position. This will cause the display data from the functioning SG to be transferred to the cross-side display units via data buses from the on-side display units. (Figure 3)

(4) Symbol Generator Components (Figure 4):

(a) Two Display Processor circuit card assemblies (CCA's), one for the PFD and one for the ND, which contain a processor, memory and a vector generator.

(b) Input/Output CCA's, which contain the serial data receivers and transmitters, synchro-to-digital, analog-to-digital, and discrete receivers required to interface with the aircraft sensors and systems.

(c) An Input/Output (IO) Controller, which manages all of the output devices and transfers data between them and system memory.

(d) A System Monitor CCA, which monitors display outputs, system BIT and weather radar processing.

(e) A Weather Radar Scan Converter CCA which converts color radar signals to a format suitable for display on the EFIS color display units.

(5) Symbol Generator Inputs: The SG receives serial data, synchro, analog and discrete inputs from the various aircraft sensors and systems . Program pins and configuration words enable the SG hardware and software to interface with these various types of inputs. SG programming is checked on the ground at power up to verify proper equipment configurations and selected options. (Figure 6)

(6) Symbol Generator Outputs: The SG generates serial data outputs, open/ground discrete outputs and audio outputs. The Symbol Generator has two independent display output channels. Video and deflection signals are sent via the display output channels to the Primary Flight Display and to the Navigation Display. A low-speed SG cross-talk bus enables each SG to monitor both its own operation and that of the cross-side SG. This monitoring consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(7) Audio Output: The SG has one audio output for annunciating the decision height. This tone slews from 400 Hz at or above decision height + 50 feet to 800 Hz at DH. The frequency changes linearly from DH + 50 feet to DH. Figure 5 shows the decision height audio output graphically.

(8) Commands are sent to the SG from the cockpit via the Control & Dimming Panel (display unit on/off and brightness, weather radar on/off and brightness, DH set and TEST) and the Mode Select Panel (Navigation Display format selection and range control). The weather radar control panel is used to set the WXR display mode, TILT, GAIN and STAB. Range is controlled from the EFIS Mode Select Panel.

(9) The SG's are housed in ARINC 600 4 MCU chassis, and are located in the electrical/electronics compartment. The SG operates on 115 VAC 400 Hz single phase power. The SG power supply converts aircraft power to the DC voltages required by the SG electronics. The SG is able to withstand power interruptions of up to 3 milliseconds without loss of function, and up to 1 second without change of operating mode or loss of digital filter data. Temperature sensing of the power supply is provided to activate an internal SG fan, in the event of an over temperature condition. Forced air (blow-through) cooling is also provided to both units.

(10) Whenever a new Symbol Generator is installed, it must be programmed by ground maintenance before the SG can be used. This programming consists of entering the Options/Register and Check Register numbers into the SG via the Status Test Panel. These numbers, when combined with the configuration identification wired into the aircraft, define the aircraft for the Symbol Generator.

(11) In case of a serious SG failure, the PFD and ND for that system will be blanked. Display data may be transferred from the functioning system by placing the EFIS source select switch in the appropriate position. EFI1 or EFI2 annunciations will appear on all display screens during single-system operation. If a fault can be isolated to a single source, a flag or warning message will appear on screen to signal the affected parameter.

G. Display Unit Description

(1) The Primary Flight Display (PFD) and Navigation Display (ND) units are identical CRT's, clamp-mounted to the main instrument panel. Each display unit (DU) provides a full color (15 plus black) electronic display. The DU's receive display data through analog, digital and discrete interfaces with the symbol generator. Each DU is capable of operating as a PFD or ND. During reversionary mode (either the PFD or ND is turned off), a single display is capable of acting as both a PFD and ND in the compacted PFD/ND mode.

(2) The DU is capable of operating in either raster scan mode (background shading and weather radar) or stroke writing mode (display symbology). Raster dimming is controlled independently of stroke intensity to provide adjustable display contrast capability (Navigation Display only). SG display unit monitoring verifies that the DU is receiving display data. Upon detection of a fault, the DU is blanked. At this time, the DU should be turned off at the Control and Dimming Panel. The system will revert to reversionary mode, and a compacted PFD/ND display will appear on the functioning screen.

(3) A system monitor is incorporated in the DU to provide CRT phosphor protection. The system monitor drives the CRT to cutoff when X-or Y-deflection has stopped, when power supply outputs are abnormal, or when the CRT filament opens or takes excessive current. In case of a DU overheat, the SG will log the failure and remove the raster (background) from the applicable display to reduce the display power required. The message 'WXR OFF' appears on the ND to signal loss of WXR display.

(4) Display unit brightness is controlled in part by the two internal light sensors. These sensors are located on the front of each unit, and feed into the auto-dimming system. The stroke and raster brightness levels are normally set using a combination of brightness data from the Remote Light Sensor, the DU internal light sensors and the Control and Dimming Panel (CDP). Should the DU monitor detect a loss of brightness commands from the CDP, the display unit will revert to a nominal brightness level.

(5) Each DU has two input ports. The primary input port carries analog deflection and digital video information from the on-side symbol generator. The secondary input port is used to either send or receive data, to or from the cross-side display unit. This port allows the DU to be driven from the cross-side symbol generator, if the on-side symbol generator fails.

(6) Each display unit is contained in a 5 x 6 x 10.5 inch outline, and is forced-air cooled. An externally adjustable inclinometer (slip skid indicator) is located on the bottom center of the DU bezel. The CRT display surfaces are covered with a filter, coated with a reflection-reducing coating. There are two extraction aids, on the front bottom left and right corners, to aid in removal/installation of the DU's. Two power transistors, located on the back panel of each DU, dissipate 65 watts.

H. Control & Dimming Panel Description

(1) The Control & Dimming Panel (CDP) provides three functions (Figure 7):

(a) Display unit manual brightness control

(b) Decision Height set control

(c) TEST pushbutton

(2) The CDP's are located on the main instrument panel, to the right of the display units. They are powered from both Primary Flight Display power (+ 15 VDC) and lighting power. All CDP control knobs move clockwise from the off position, through an increasing range to the full on position.

(3) Display Unit Manual Brightness Control: The CDP mixes data received from the Remote Light Sensor (RLS) and display unit (DU) internal light sensors with CDP manual brightness control inputs to generate an overall brightness control signal for the DU's. The display unit brightness controls on the CDP are PFD BRT for the Primary Flight Display, and a combined ND/WX BRT for the Navigation Display. The WX BRT control knob is concentric with the ND BRT control, and is used to adjust the weather radar display intensity independently of the ND display symbology.

(4) Full counterclockwise (ccw) rotation of the PFD BRT or ND BRT knobs past the detent causes the corresponding display screen to go blank. Whenever either the PFD or ND BRT knob is turned OFF, the corresponding display screen goes blank, and a compacted PFD/ND display will appear on the remaining on-side display screen. Turning the WX BRT ccw knob past the detent turns the WX display off. The message WXR OFF will be continuously displayed on the ND whenever this knob is in the off position.

(5) Decision Height Set Control: This knob is used to set decision height between zero and 500 feet (any value less than zero feet causes the DH readout on the PFD to go blank). DH data is displayed on the top, right-hand corner of PFD.

(6) TEST pushbutton: The TEST pushbutton is used to initiate a complete EFIS system self-test. Self-testing begins when the TEST pushbutton is depressed and ends approximately 3 seconds after release. The tests conducted include: VOR/ILS self test, Radio Altimeter self test, Marker Beacon self test and a failure flag test. All but the failure flag test are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions. TEST pushbutton function is inhibited in flight.

NOTE: When performing the EFIS self test from the dimming panel test button, the monitor lights on the FMA will flash.

(7) In the event of a Control and Dimming Panel failure, the PFD, ND and WXR displays will remain on. Brightness will be controlled by the auto-dimming system. Since there is no default setting for a DH control failure, DH information should be ignored when the CDP fails.

I. Mode Select Panel Description

(1) The Mode Select Panels (MSP) are located outboard and aft of the glareshield, below the clearview windows. The MSP is used to select the display format for the Navigation Display . Each panel contains four control switches: MODE switch, RANGE switch, ADF bearing switch and NAV/RAD switch. (Figure 8)

(2) The MSP interfaces with the Symbol Generator through digital discrete signals. The control panel monitor in the SG verifies correct operation of the MSP. In the event of a MSP failure, the ARC mode will be displayed on the ND. The range will default to 40 nm; the indices and range lines will turn yellow.

(3) The MODE switch is a rotary switch which allows the pilots to select from the following ND display modes:

Table 2

ROSE	Conventional HSI display
ARC	Compass arc display, with coordinated weather radar.
MAP	ONS MAP Display

(4) The RANGE control is a rotary switch that is used in ARC, MAP or PLAN Modes, and allows the crew to select among the following display ranges: 10, 20, 40, 80, 160, and 320 nautical miles. Both the ARC and WXR display ranges are set simultaneously with this control.

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(5) The ADF bearing control consists of a rotary switch which is used to control the ADF bearing pointer in the ROSE and ARC modes. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

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(6) The ADF bearing control consists of two concentric rotary switches the inner of which is used to control the ADF 1 bearing pointer in the ROSE and ARC modes. The outer ADF control switch is provisional for ADF 2 and placing it to the ADF position will cause ADF 2 FAIL to be displayed. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

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(7) The NAV/RAD switch is used to toggle between VOR/ILS (RAD) and OMEGA (NAV).

J. Remote Light Sensor Description

(1) There is one Remote Light Sensor (RLS), installed on top of the glareshield . The RLS is installed looking forward of the aircraft, to measure the light levels outside of the cockpit. The RLS is powered from the F.O.'s Control & Dimming Panel (CDP). Light level data is transmitted from the RLS to the CDP, where it is combined with manual brightness control and DU light sensor inputs. The resultant mixed signal is used in controlling display intensity and contrast. If the RLS fails, the CDP manual control setting and DU internal sensor signals will be combined to control DU brightness. (Figure 9)

K. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format (Figure 10) contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(h) ONS data

(i) WAGS data (if installed)

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(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

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(3) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below. When the AUX VG is used, ATT3 will be displayed in yellow characters on the applicable PFD.

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(4) Flight Director Command Indication: consists of a chevron-shaped reference aircraft and two wedge-shaped flight director bars. The wedges rotate to indicate roll command, and move up or down to indicate pitch command. Desired attitude is indicated when the chevron just fits inside the wedges. The wedges appear to be located in front of the attitude indication, but behind the reference chevron.

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(5) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

WJE 886, 887

(6) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the left of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

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(7) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

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(8) Expanded Localizer Deviation: is indicated by a downward-pointing triangle moving over a scale consisting of two small circles and a "sideways E" center reference line. The scale is centered beneath the attitude sphere.

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(9) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude sphere.

(10) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

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(11) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the right side of the PFD.

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(12) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(13) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. A rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

(14) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

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(15) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 2500 feet (762 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

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(16) ONS Data: See Paragraph 1.N..

(17) WAGS data (if installed): When the Windshear Computer (WSC) detects an increasing performance windshear (headwind or up draft) it will enable the PFD to display an amber "WIND SHR" message. A detected decreasing performance windshear (tailwind or down draft) will result in a red "WIND SHR" message. The PFD will also display a WSC determined Pitch Limit Indication (PLI) which is the margin between aircraft angle of attack (AOA) and the AOA for shaker onset. In addition, speed deviation and flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

L. Navigation Display (ND) Symbology and Weather Radar

(1) The Navigation Display (ND) appears on the lower CRT. The ND provides HSI information plus ADF and coordinated weather radar. The display format varies, depending on the display mode selected on the Mode Select Panel (MSP). The following modes are available on the EFIS:

(2) ROSE Mode: display resembles a conventional HSI (Figure 11). The compass rose is located at the center of the screen, with large tick marks at 10 degree increments and small tick marks at 5 degree increments. The tick marks are labeled at 30 degree increments with characters straddling the tick marks. The ROSE Mode display shows:

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course and course deviation
(d)	Vertical deviation
(e)	TO/FROM indication
(f)	DME distances
(g)	ADF bearing
(h)	ONS data

(a) Aircraft Heading: Heading indices consist of tick marks at 45 degree increments around the outside of the compass rose. The digital value of the current heading is displayed in a box above the compass rose. A symbolic reference aircraft is located at the center of the compass rose.

(b) Selected Heading: is indicated by an "M"-shaped pointer which moves along the outside of the compass rose.

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass rose, pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a scale consisting of four small dots. The course pointer and deviation scale rotate with the selected course about the center of the compass rose.

(d) Vertical Deviation: is indicated with a scale and pointer identical to that used on the PFD display.

(e) TO/FROM Indications: A Triangle pointer is provided, which points in the direction of (TO) or 180 degrees away from (FROM) the course deviation pointer. TO/FROM is blanked while in ILS mode.

(f) DME Distances: are displayed to the left (DME-1) and right (DME-2) of the digital heading display. Each DME distance is displayed above its source.

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(g) ADF Bearing: A single bearing pointer (ADF 1) may be selected to show current bearing to ADF stations. The source for the pointer is annunciated in the lower left hand corner of the ND.

WJE 410

(h) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

WJE 410, 877, 886, 887

(i) ONS Data: See Paragraph 1.N..

(3) ARC Mode: Display shows a compass arc (Figure 12)), centered below the center of the screen, with major tick marks every 10 degrees, and minor tick marks every five degrees. The major tick marks are labeled every 30 degrees. The ARC Mode display shows:

(a)	aircraft heading
(b)	selected heading
(c)	selected course
(d)	course deviation
(e)	vertical deviation
(f)	TO/FROM indications
(g)	DME distances
(h)	weather radar
(i)	ADF bearing
(j)	ONS data

(a) Aircraft Heading: is displayed at the top of the range lubber line. A symbolic reference airplane is located at the center of the compass arc.

(b) Selected Heading: is indicated by an "M" shaped symbol which moves along the outside of the arc, and by a dotted line from the airplane symbol to the "M".

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass arc, with an extension pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a four dot scale. The pointer and deviation scale rotate with the selected course about the center of the arc.

(d) Vertical Deviation: is displayed using a scale and pointer identical to those on the PFD display.

(e) TO/FROM Indications: are displayed under the right end of the heading arc when tuned to a VOR station. TO/FROM indication is blanked while in ILS mode.

(f) DME Distances: are shown to the left (DME-1) and to the right (DME-2) of the digital heading display. Each DME distance is displayed above its source. If there are no computed data, the distance display is replaced by three dash marks.

(g) Weather Radar: Weather radar data may be displayed within the compass arc. The display range is selected from the Mode Select Panel (MSP). A half-range index mark, centered between the aircraft reference symbol and the outer periphery of the arc, will indicate one-half of the range selected on the MSP. The brightness of the weather radar image can be adjusted relative to the ND symbology from the CDP. When fault codes are received, weather radar status messages will appear on the display screen. The message "WX OFF" will appear on the display screen when a DU overheat is detected or when the CDP WX BRT control knob is in the off position. Tilt angle is annunciated only momentarily, when the WXR antenna tilt angle is changed. (Paragraph 2.C.)

WJE 886, 887

(h) ADF Bearing: A single bearing pointer (ADF 1) may be selected to show current bearing to ADF stations. The source for the pointer is annunciated in the lower left hand corner of the ND.

WJE 410, 877

(i) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

WJE 410, 877, 886, 887

(j) ONS Data: See Paragraph 1.N..

M. Compacted PFD/ND Display

(1) The compacted PFD/ND display (Figure 13) appears whenever either (but not both) of the Display Units is turned OFF at the CDP. This format contains all data shown on the normal PFD display. However, the bottom third of the attitude sphere is removed and replaced with a heading indicator. The following symbology is available on this display:

(a)	Aircraft attitude
(b)	Flight director command indicator
(c)	Glideslope Deviation
(d)	Speed Deviation
(e)	Decision Height
(f)	Radio Altitude
(g)	Marker beacons
(h)	Altitude alert
(i)	Course deviation
(j)	Compacted heading display
(k)	Selected heading
(l)	Digital course
(m)	ONS data
(n)	WAGS data (if installed)

(2) All symbology characteristics for the top two-thirds of the display are the same as for the PFD format. The compacted heading display, on the bottom third of the screen, contains the same symbology used on the ND-ROSE display.

N. EFIS/ONS Interface

(1) The Omega/VLF Navigation System interfaces with the EFIS to provide ONS oriented displays on the EFIS primary flight display (PFD) and the navigation display (ND). The ONS receiver processor units (RPU's) provide ONS data to the EFIS symbol generators, which in turn provide the symbology display on the PFD and ND. The mode selector panel (MSP) MODE switch in conjunction with the NAV/RAD switch determine the ONS symbology that will be displayed.

WJE 410, 877

(a) PFD - When the ONS detects a change in system status that requires pilot attention, "CDU MSG" will be displayed in the upper left corner of the PFD. When the ONS determines that Omega and VLF signals are unreliable, ONS will revert to Dead Reckoning mode and "D/R" will be displayed in the upper left corner of the PFD. When the MODE switch is in MAP and the NAV/RAD switch is in NAV, course deviation will be displayed at the bottom of the attitude sphere. The course deviation display has a scale of 3.75 NM/dot and is annunciated fail by "NAV FAIL" being displayed in the lower right corner of the PFD. With the MODE switchin MAP and the NAV/RAD switch in NAV the source annunciation will also be displayed as "NAV" above the glideslope display area of the PFD. The "NAV" annunciation will appear in a box when altitude is below 10,000 feet.

WJE 886, 887

(b) PFD - When the ONS detects a change in system status that requires pilot attention, "CDU MSG" will be displayed in the upper left corner of the PFD. When the ONS determines that Omega and VLF signals are unreliable, ONS will revert to Dead Reckoning mode and "D/R" will be displayed in the upper left corner of the PFD. When the MODE switch is in MAP and the NAV/RAD switch is in NAV, course deviation will be displayed at the bottom of the attitude sphere. The course deviation display has a scale of 3.75 NM/dot and is annunciated fail by "NAV FAIL" being displayed in the lower right corner of the PFD. With the MODE switchin MAP and the NAV/RAD switch in NAV the source annunciation will also be displayed as "NAV 1" above the glideslope display area of the PFD. The "NAV 1" annunciation will appear in a box when altitude is below 10,000 feet.

WJE 410, 877, 886, 887

(c) ND - The ROSE, ARC or MAP mode selections are displayed on the ND. The ROSE mode resembles a conventional HSI display with the addition of ONS data when the NAV/RAD switch is in the NAV position. The ARC mode displays the same data on the ND as the ROSE mode but in a compass arc format. The MAP mode displays the aircraft position relative to the route and other ground reference data in a track-up format.

(d) ROSE MODE - The ROSE mode displays the following ONS provided data. (Figure 11)

Distance To Waypoint (DTW) - The distance to the next waypoint.

Estimated Time of Arrival (ETA) - The estimated time of arrival at the next waypoint.

Drift Angle/Track Pointer - The point on the compass rose where the diamond is parked is the track. The drift angle is the displacement of the diamond to the heading lubber line.

Waypoint Alert (WPT ALERT) - The "WPT ALERT" annunciation will flash three times, then remain on steady when the ONS detects an upcoming waypoint.

Selected Course/Course Deviation - The selected course is displayed by a filled pointer inside the compass rose pointing at the selected course. The course deviation is displayed by movement of the center portion of the pointer across a scale consisting of four small dots.

Waypoint Bearing - The waypoint bearing to the next active waypoint will be displayed by pointer 1. The waypoint bearing will be displayed by pointer 2 if ADF is selected for display by pointer 1.

WJE 410, 877

Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the word "NAV" above 10,000 feet or "NAV" enclosed in a box below 10,000 feet.

WJE 886, 887

Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the word "NAV 1" above 10,000 feet or "NAV 1" enclosed in a box below 10,000 feet.

WJE 410, 877, 886, 887

1) The following represent failure displays (generated by ONS) in the ROSE mode:

DTW/ETA - No computed data will be annunciated by three dashes in the data field. Failure annunciation will be displayed by blanking the data field.

NAV FAIL - Displayed at the top center of format when selected course/course deviation data is invalid.

WPT FAIL - Displayed at lower left corner of format when waypoint bearing data is invalid.

(e) ARC MODE - The ARC mode displays the same ONS data on the ND as the ROSE mode but in a compass arc background format. (Figure 12)

(f) MAP MODE - The MAP mode displays the following ONS provided data.(Figure 14)

Distance to Waypoint (DTW) - The distance to the next waypoint.

Estimated Time of Arrival (ETA) - The estimated time of arrival at the next waypoint.

Drift Angle/Track Pointer - The point on the compass arc where the diamond is parked is the track. The drift angle is the displacement of the diamond to triangular heading pointer. The track pointer symbol is fixed as the reference for the compass in the MAP mode. Due to the track-up format the word "TRK" will be displayed in the top center of the format.

Waypoint Bearing - The waypoint bearing to the next active waypoint will be displayed by pointer 1. The waypoint bearing will be displayed by pointer 2 if ADF is selected for display by pointer 1.

Map Background - The map background symbol consists of aircraft reference, waypoints and waypoint identifiers, and the flight plan.

WJE 410, 877

Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the "NAV" above 10,000 feet or "NAV" enclosed in a box below 10,000 feet.

WJE 886, 887

Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the "NAV 1" above 10,000 feet or "NAV 1" enclosed in a box below 10,000 feet.

WJE 410, 877, 886, 887

1) The following represent failure displays (generated by ONS) in the MAP mode:

DTW/ETA - No computed data will be annunciated by three dashes in the data field. Failure annunciation will be displayed by blanking the data field.

TRK FAIL - Displayed when track cannot be computed. Additionally, the associated track symbology will be blanked, map symbology will be blanked, and MAP FAIL will be displayed.

MAP FAIL - Displayed when total ONS RPU failure occurs, or when track source or map background source within the RPU fails.

WPT FAIL - Displayed when the identified bearing pointer has failed.

(g) COMPACT MODE - The COMPACT mode displays the following ONS provided data (Figure 13):

CDU MSG - Displayed when the ONS detects a change in system status that requires pilot attention.

D/R - Displayed when ONS reverts to the Dead Reckoning mode due to unreliable Omega and VLF signals.

NAV FAIL - Displayed when selected course/course deviation data is invalid.

WJE 410, 877

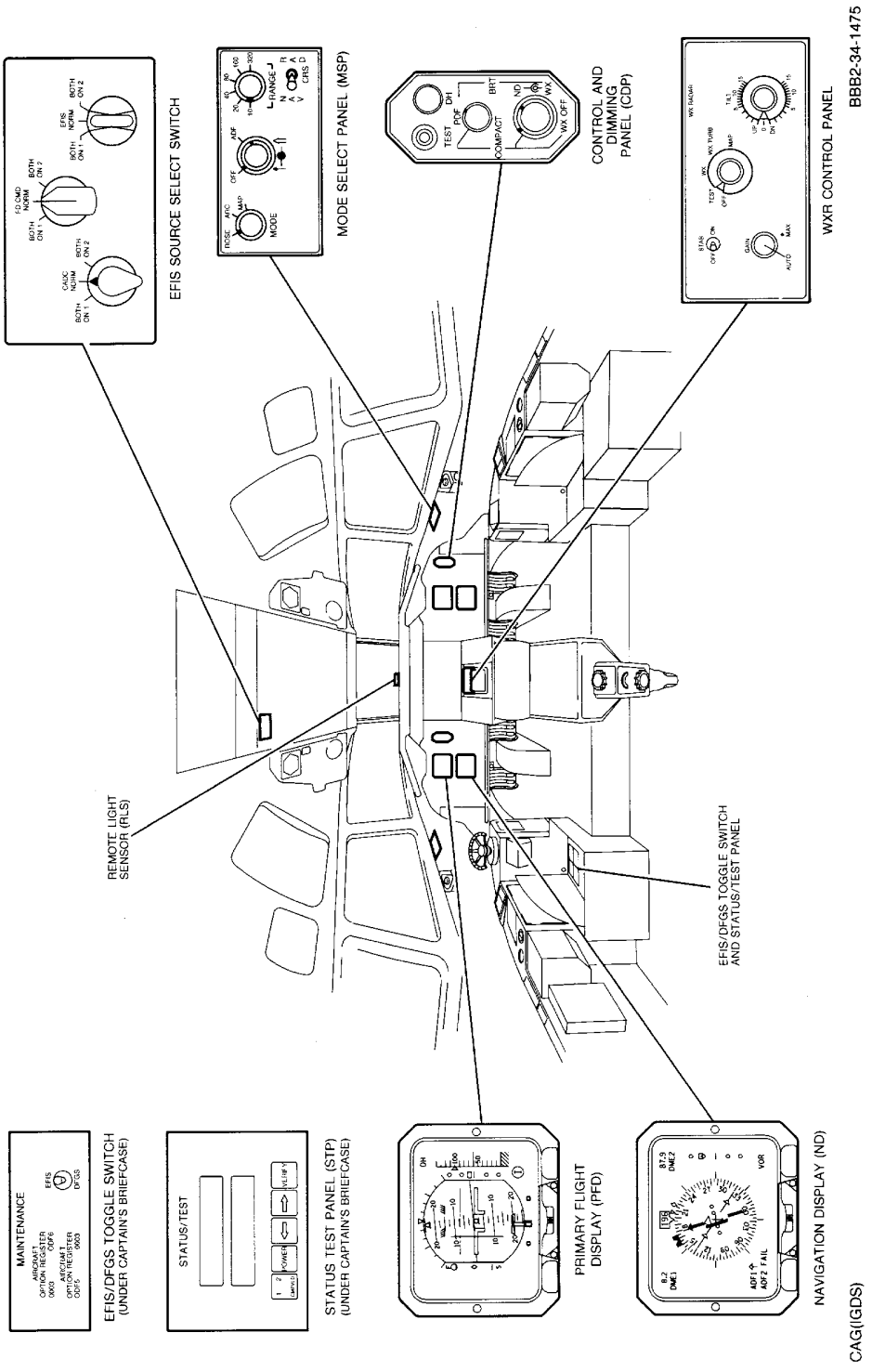
Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the word "NAV" above 10,000 feet or "NAV" enclosed in a box below 10,000 feet.

WJE 886, 887

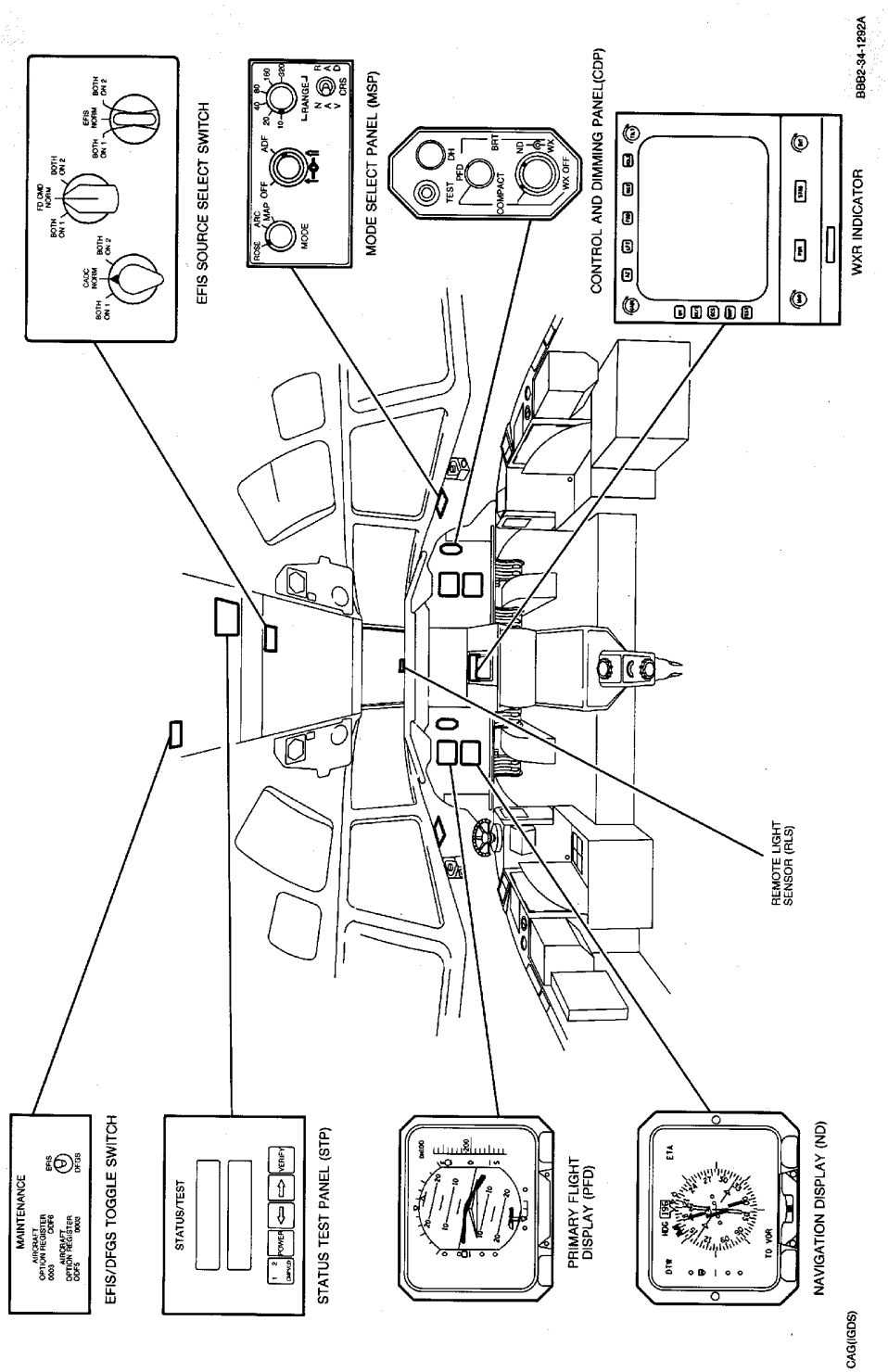
Source Annunciation - The source annunciation appears in the top left corner of the format and will consist of the word "NAV 1" above 10,000 feet or "NAV 1" enclosed in a box below 10,000 feet.

WJE 410, 877, 886, 887

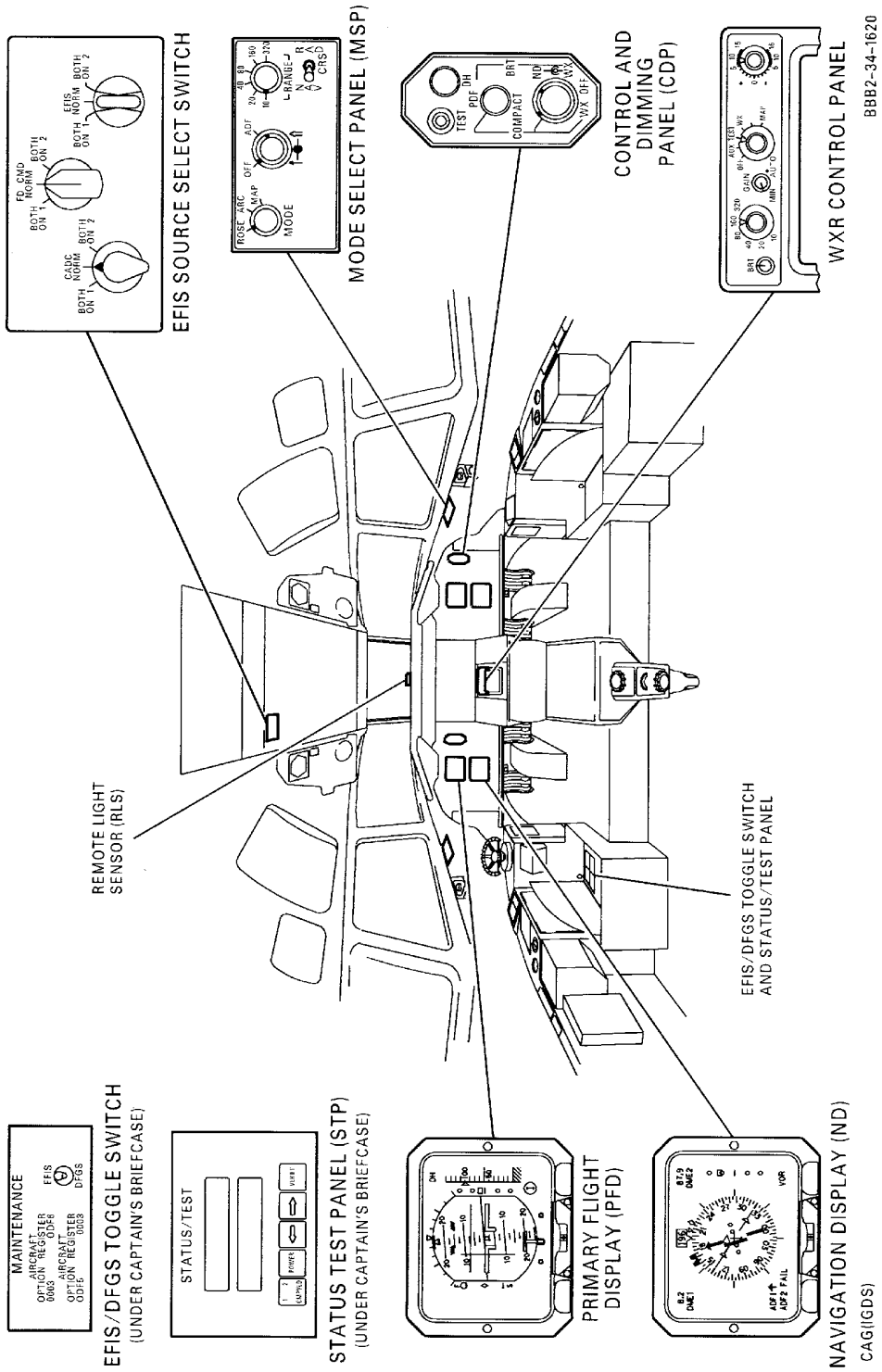
Selected Course/Course Deviation - The selected course is displayed by a filled pointer inside the compass rose pointing at the selected course. The course deviation is displayed by movement of the center portion of the pointer across a scale consisting of four small dots.



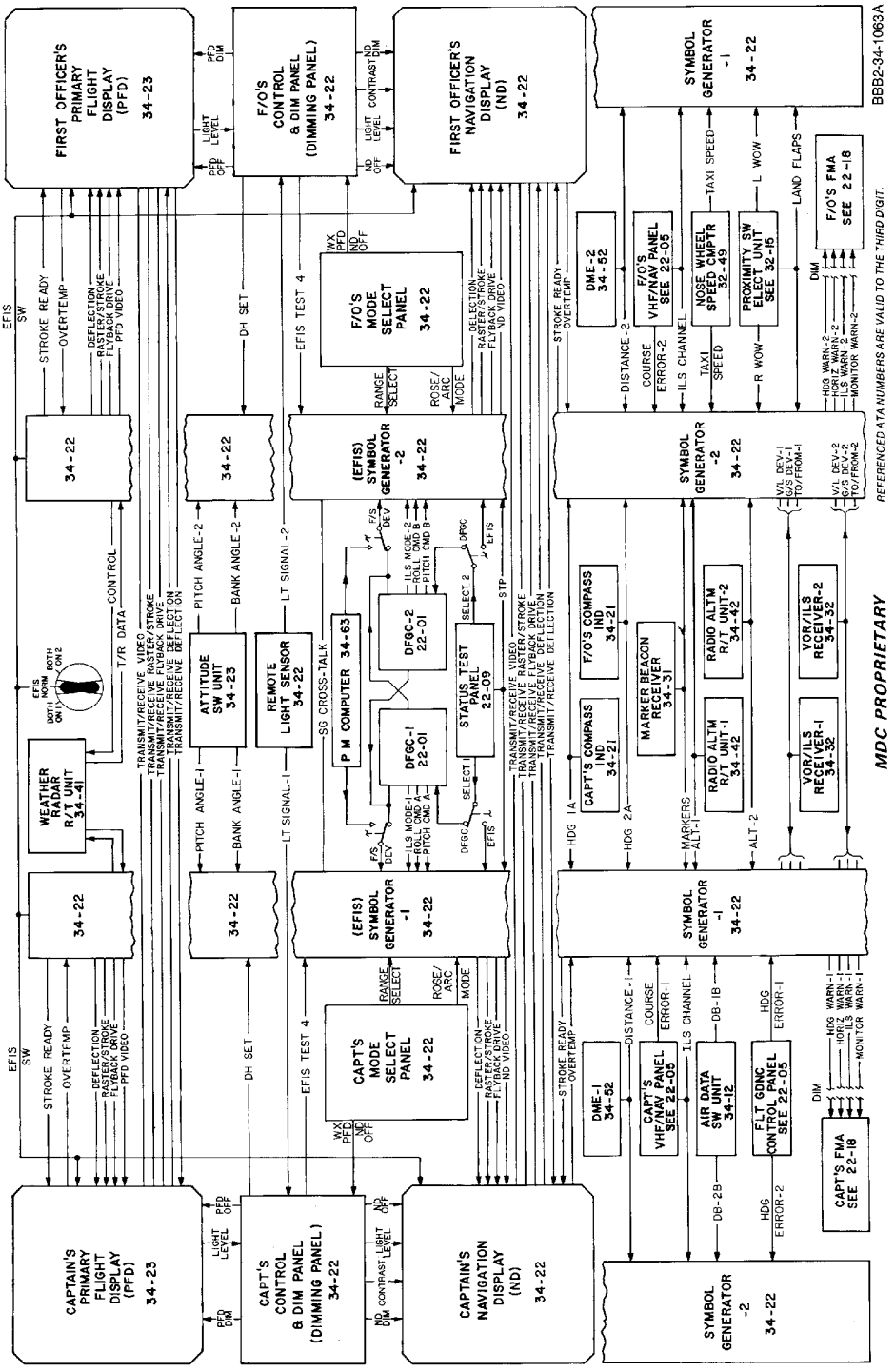
EFIS Cockpit Configuration
Figure 1/34-22-00-990-831 (Sheet 1 of 3)



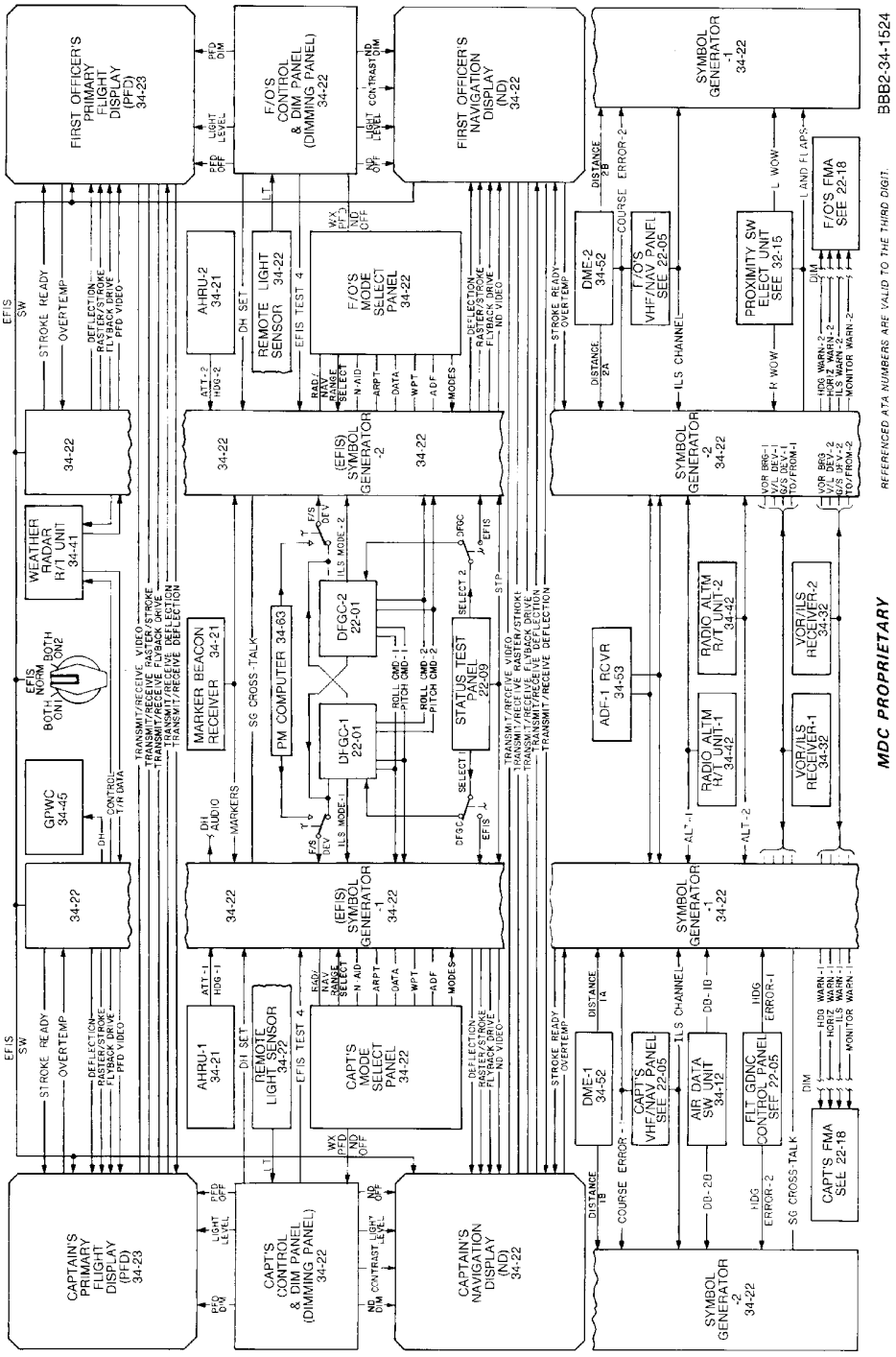
EFIS Cockpit Configuration
Figure 1/34-22-00-990-831 (Sheet 2 of 3)



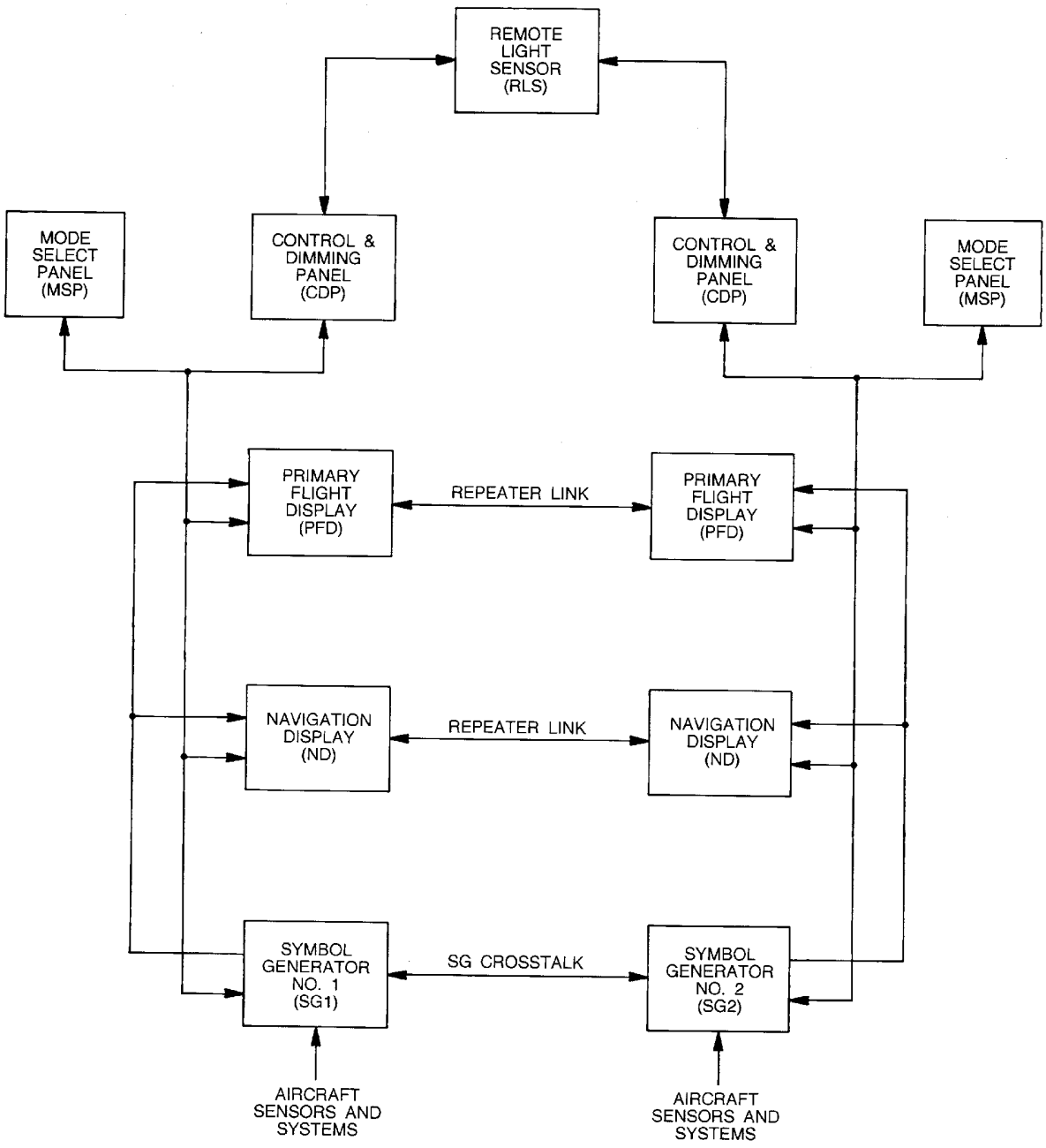
EFIS Cockpit Configuration
Figure 1/34-22-00-990-831 (Sheet 3 of 3)



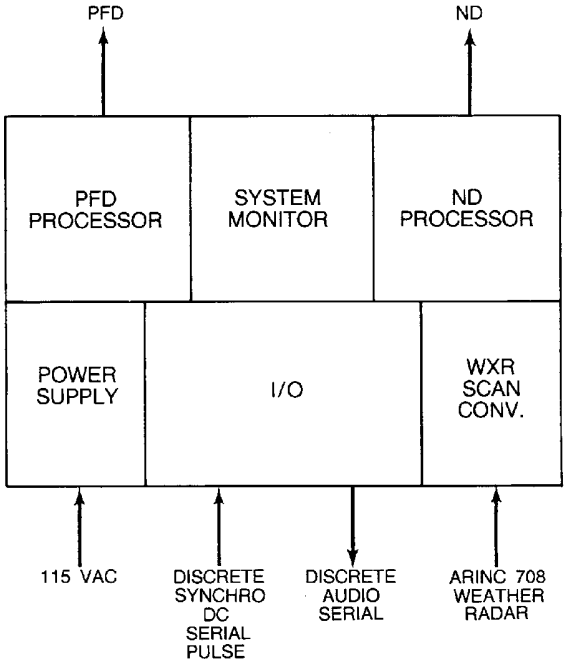
EFIS Block Diagram
Figure 2/34-22-00-990-832 (Sheet 1 of 2)



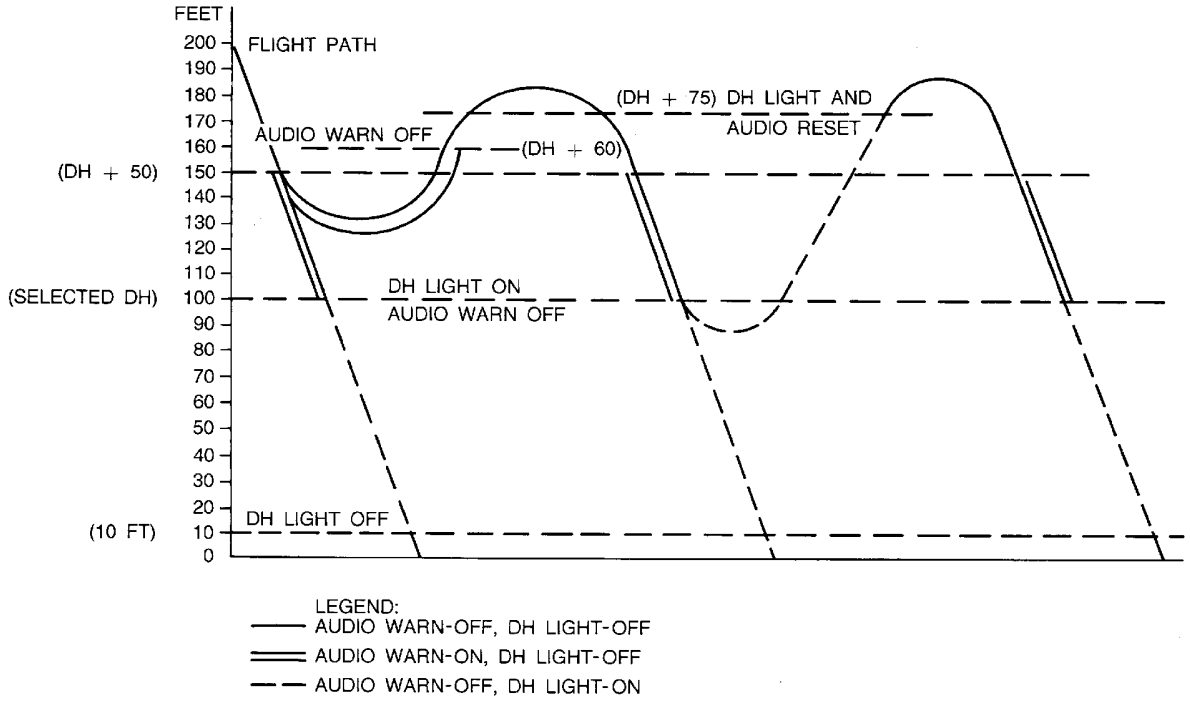
EFIS Block Diagram
Figure 2/34-22-00-990-832 (Sheet 2 of 2)



EFIS -- System Interface Diagram
Figure 3/34-22-00-990-B12

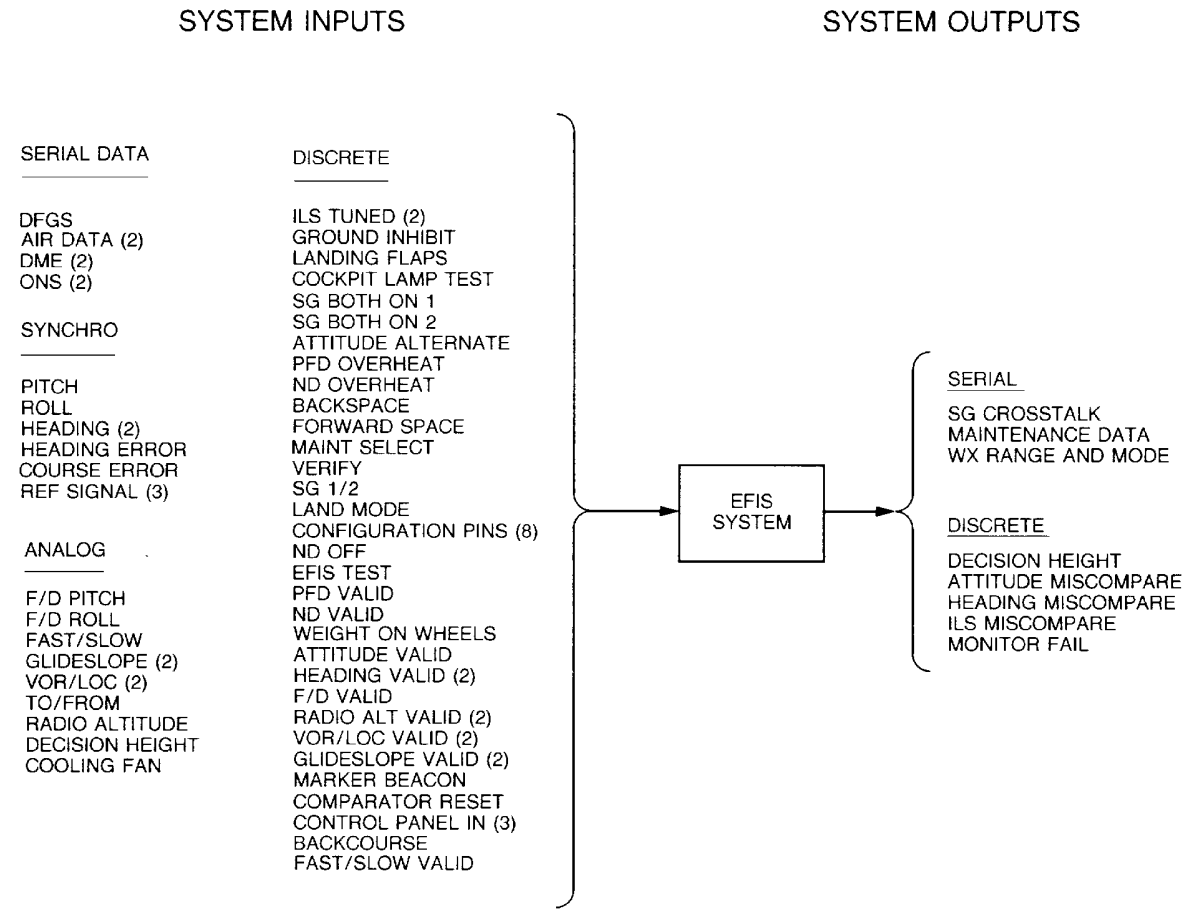


EFIS Symbol Generator -- Component Diagram
Figure 4/34-22-00-990-835

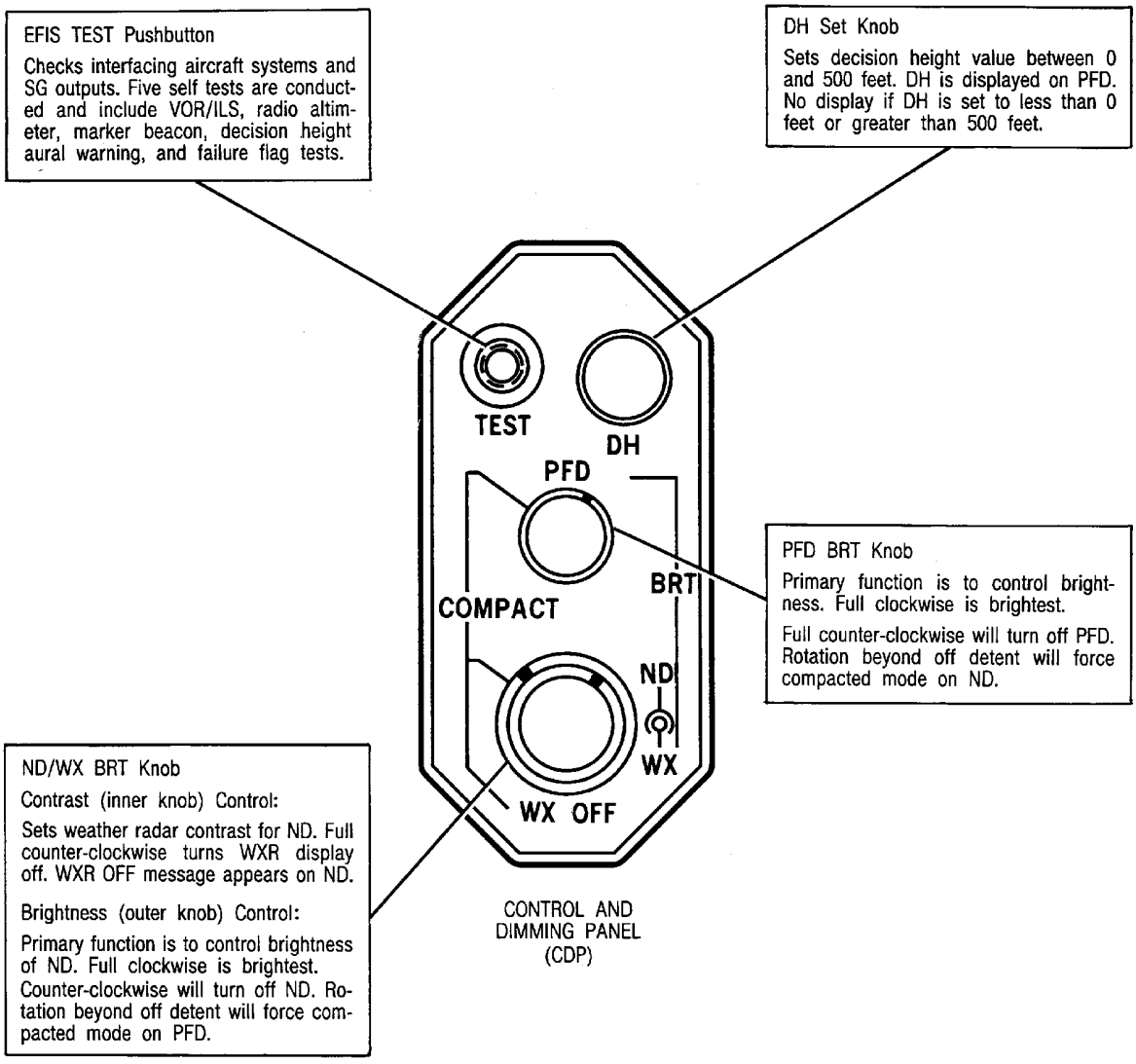


BBB2-34-951

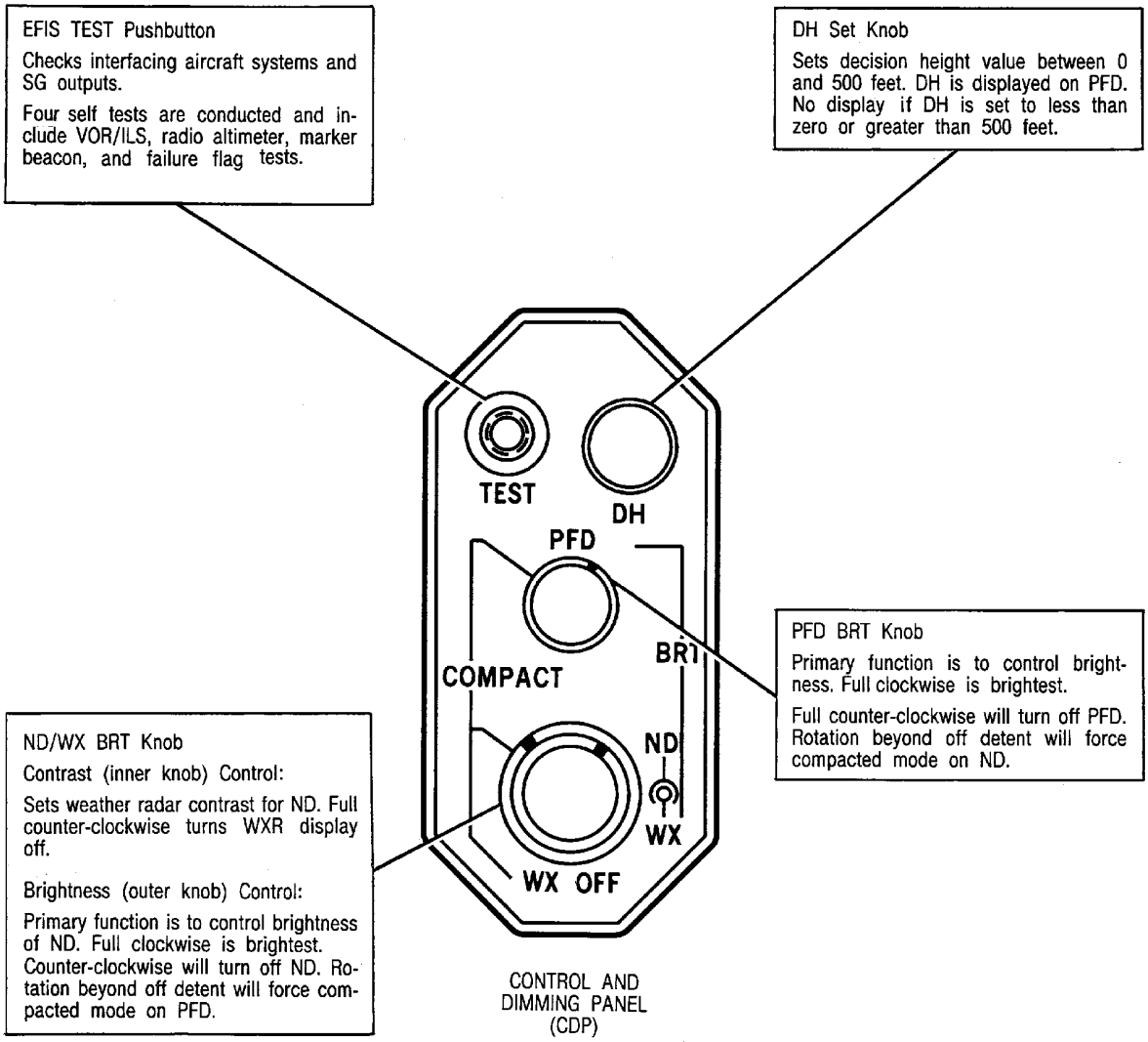
EFIS Audio Output
Figure 5/34-22-00-990-836



EFIS Inputs and Outputs
Figure 6/34-22-00-990-837



EFIS Control and Dimming Panel
Figure 7/34-22-00-990-838 (Sheet 1 of 2)



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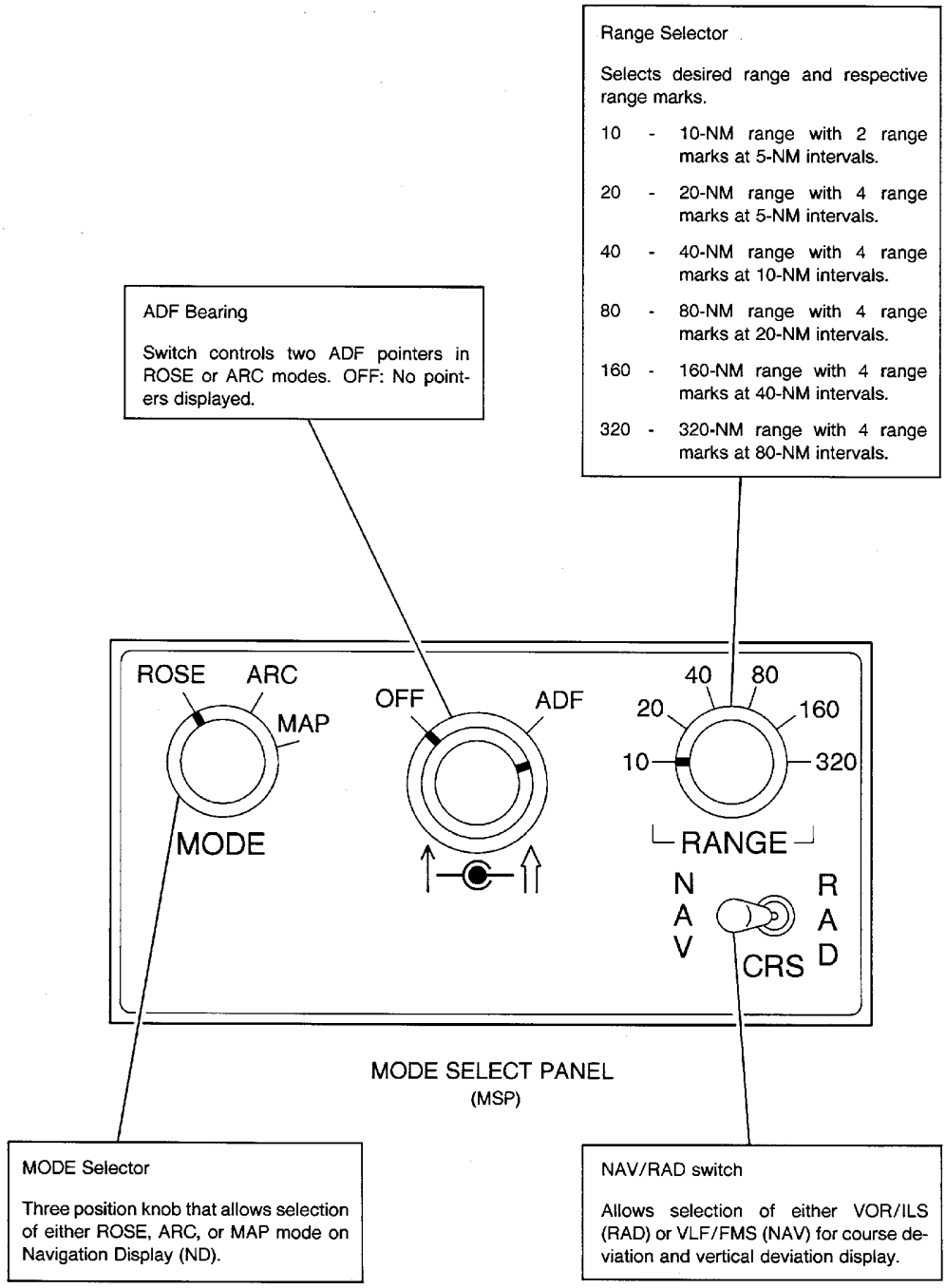
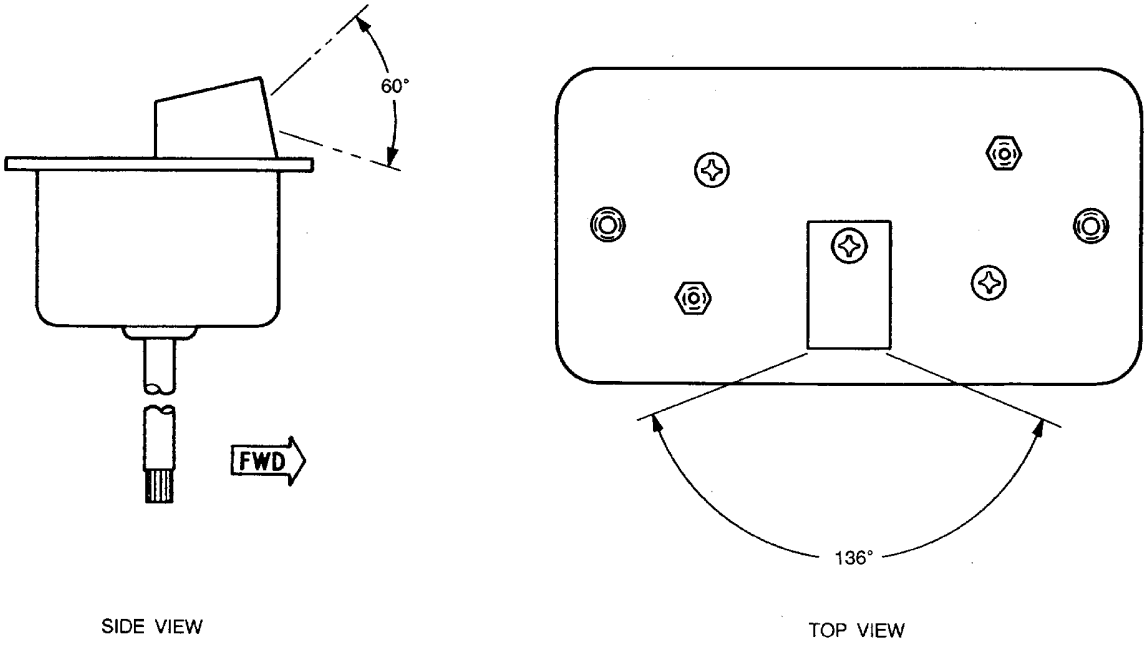
EFIS Control and Dimming Panel
Figure 7/34-22-00-990-838 (Sheet 2 of 2)



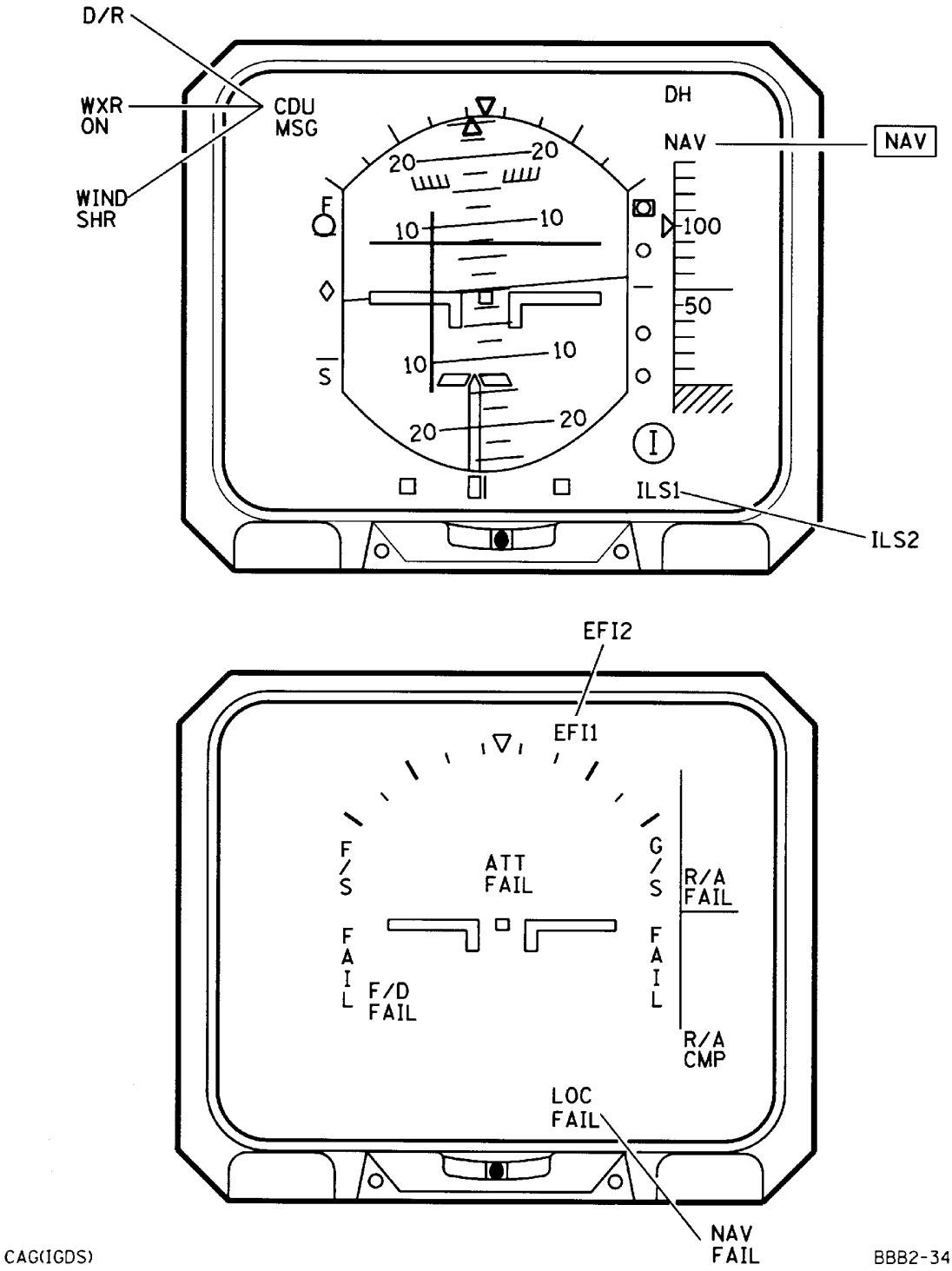
CAG(IGDS)

BBB2-34-1293

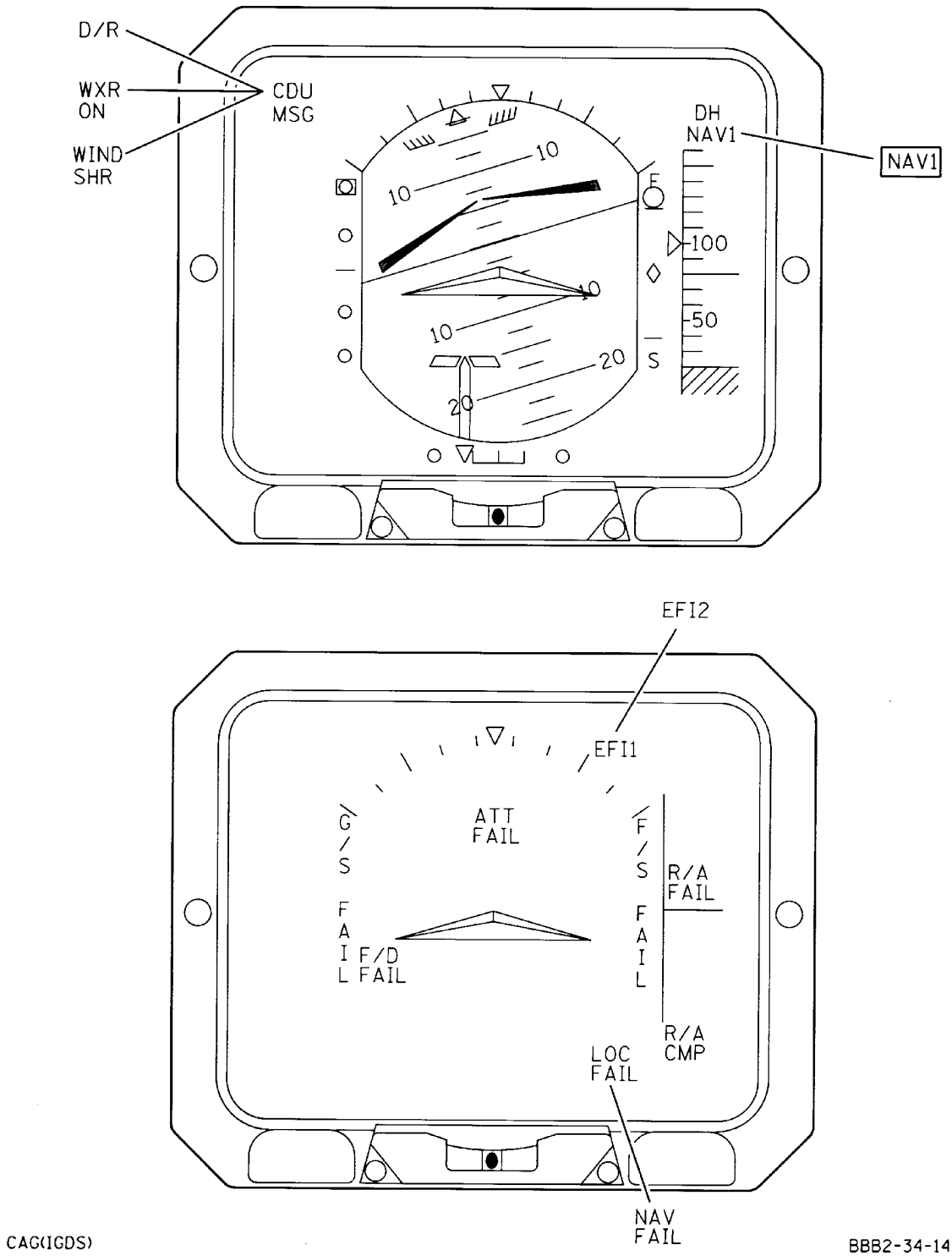
EFIS Mode select Panel
Figure 8/34-22-00-990-839



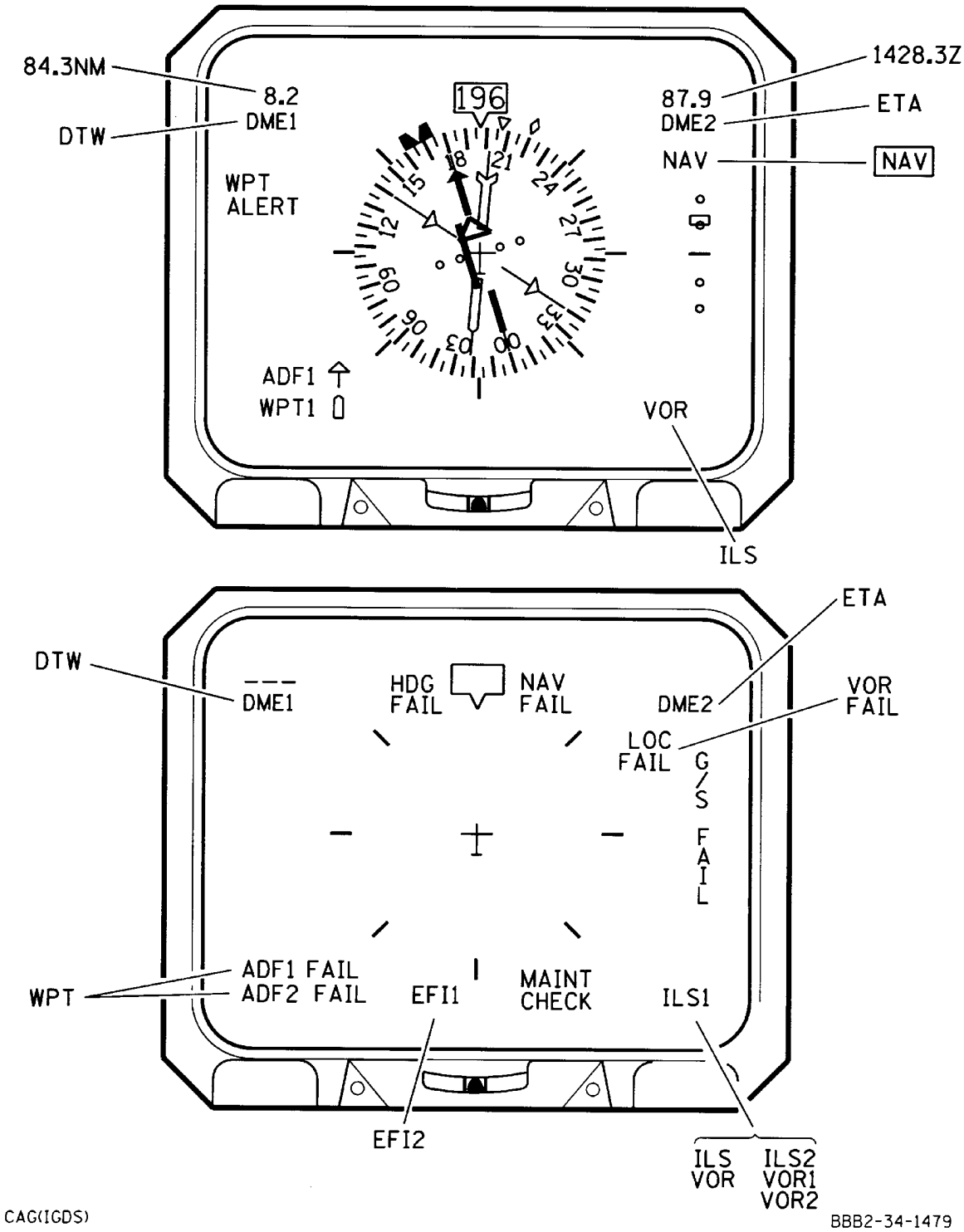
EFIS Remote Light Sensor
Figure 9/34-22-00-990-840



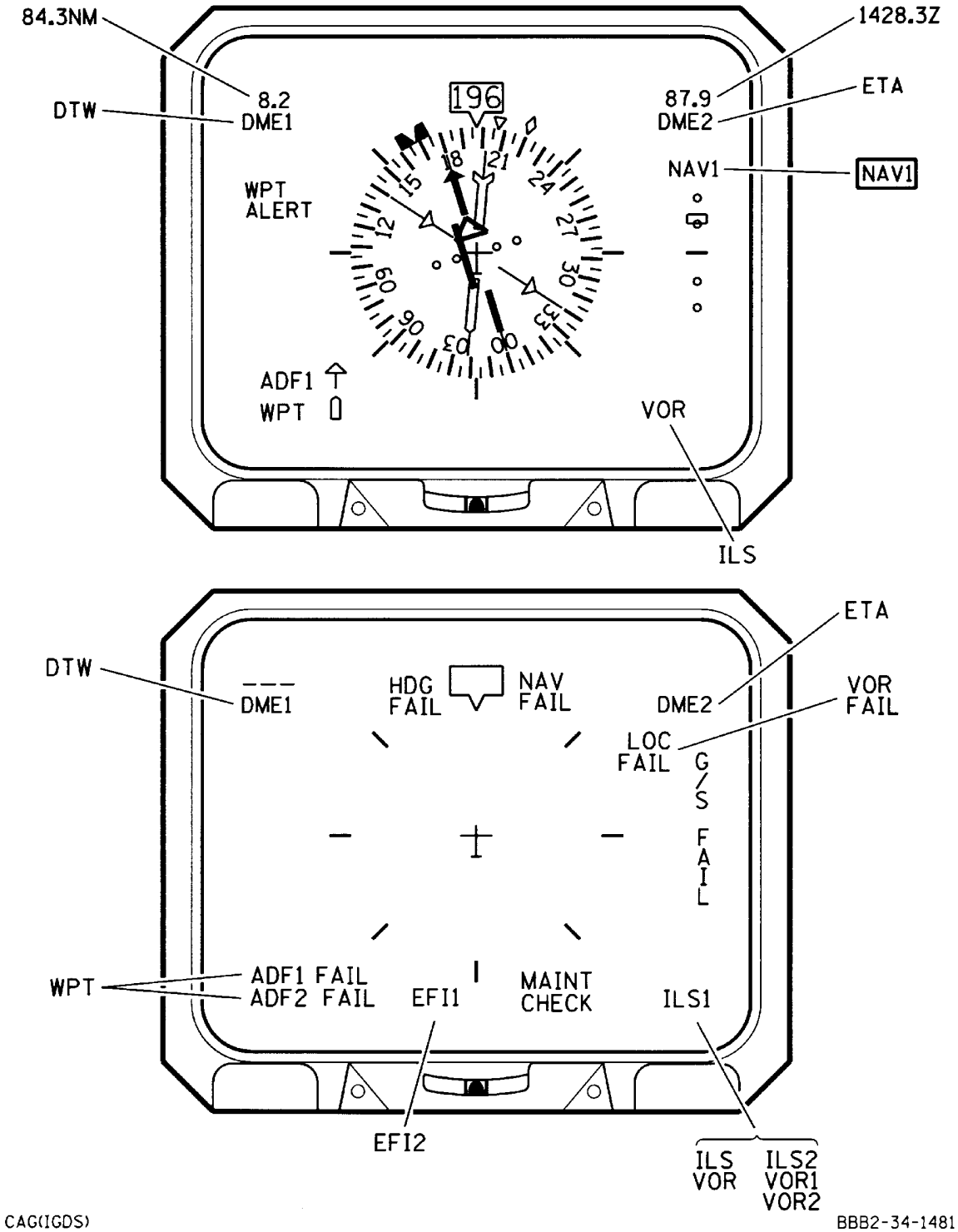
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-841 (Sheet 1 of 2)



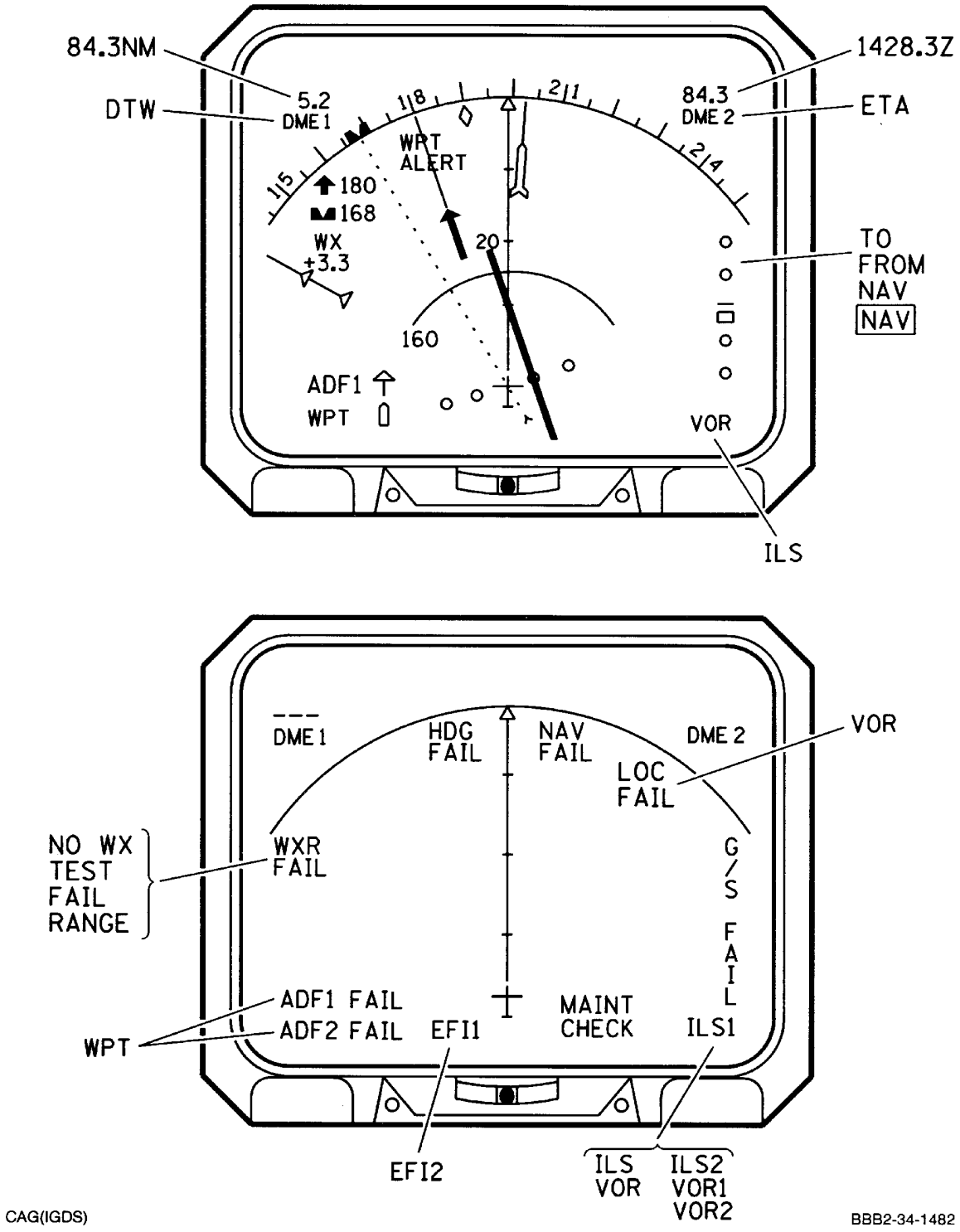
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-841 (Sheet 2 of 2)



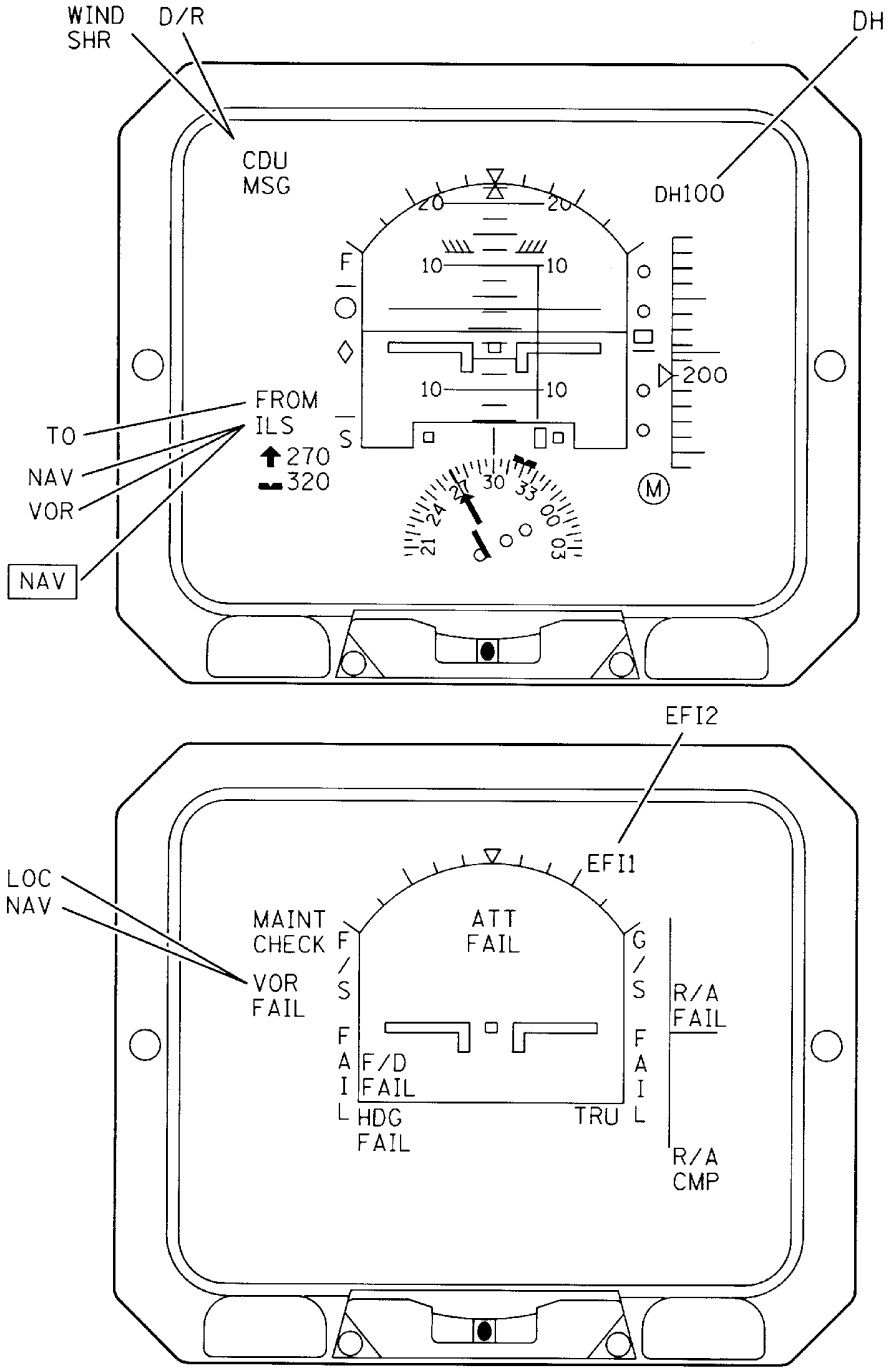
Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-843 (Sheet 1 of 2)



Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-843 (Sheet 2 of 2)



Navigation Display -- ARC Mode (with Flags and Warnings)
Figure 12/34-22-00-990-845



CAG(IGDS)

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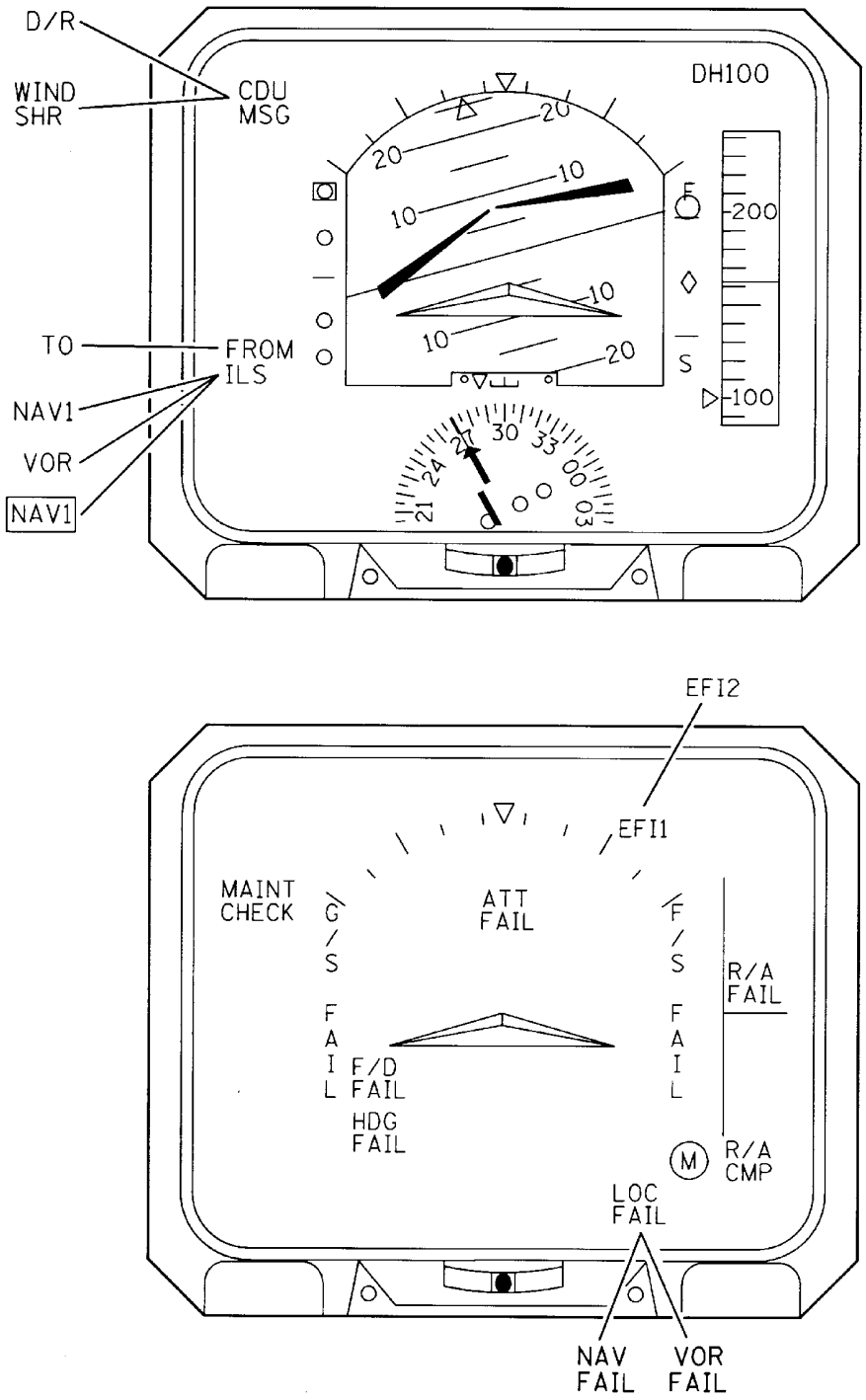
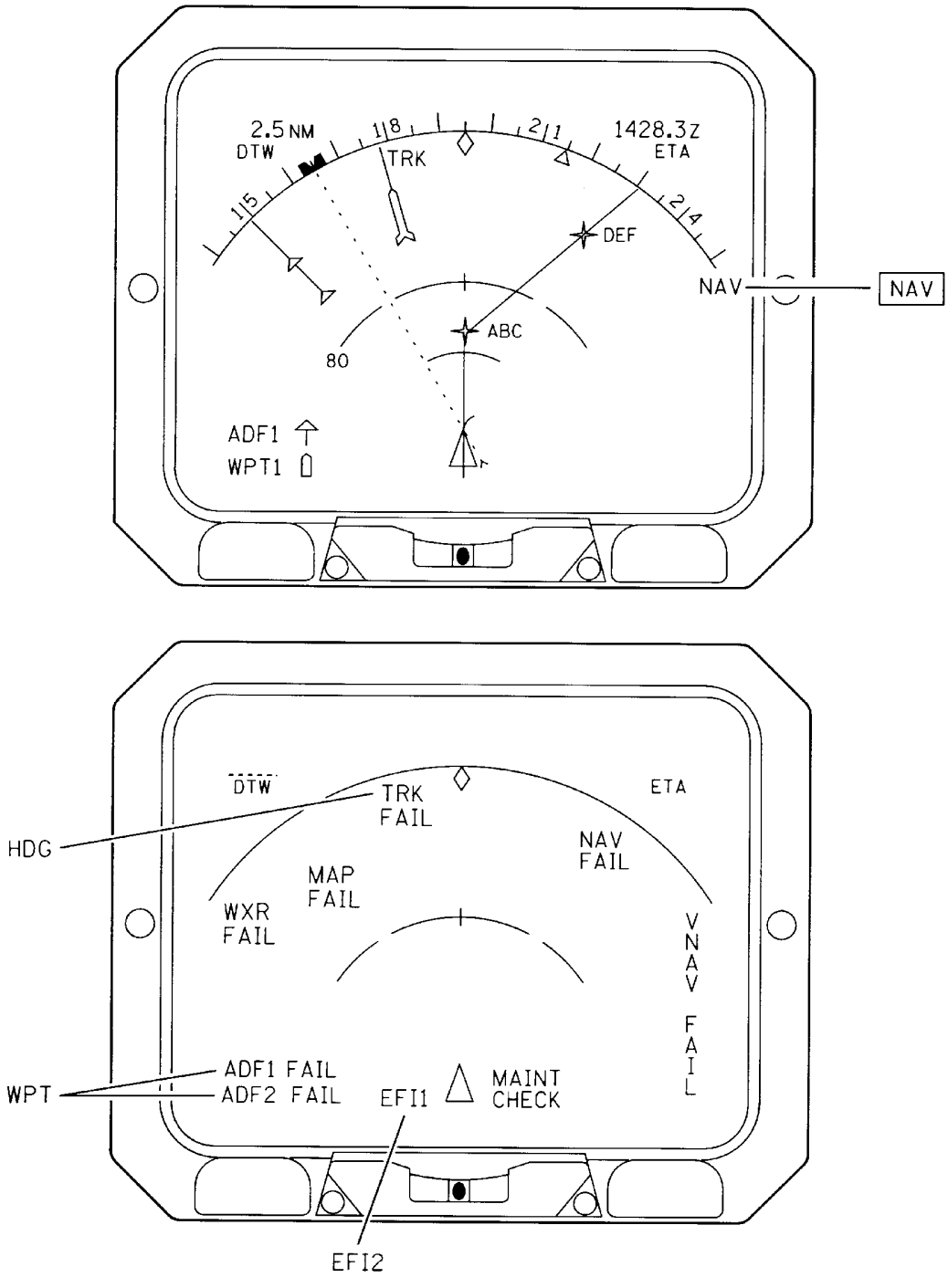
Compacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-847 (Sheet 1 of 2)



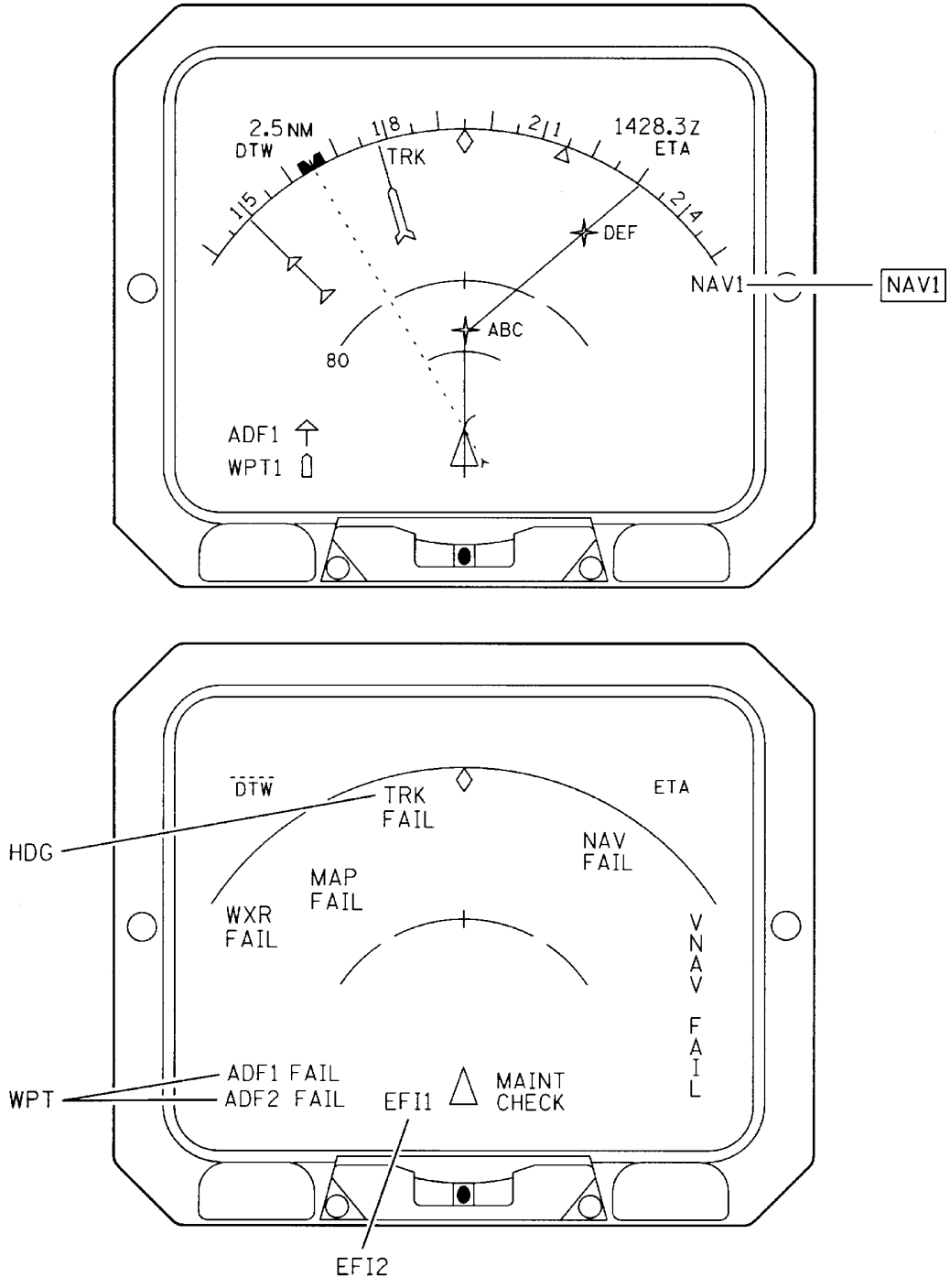
CAG(IGDS)

BBB2-34-1485

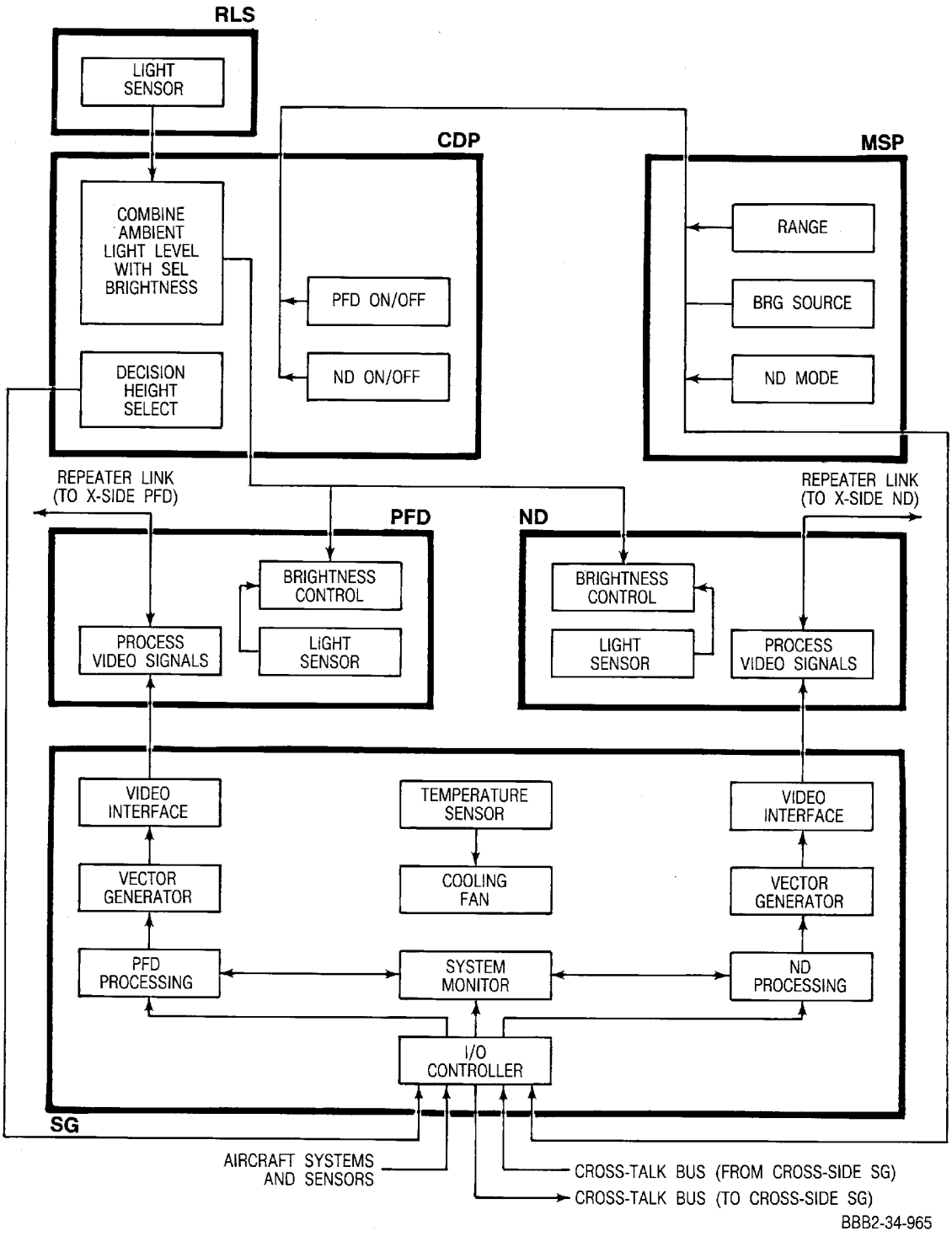
Compacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-847 (Sheet 2 of 2)



Navigation Display -- MAP Mode (with Flags and Warnings)
Figure 14/34-22-00-990-848 (Sheet 1 of 2)



Navigation Display -- MAP Mode (with Flags and Warnings)
Figure 14/34-22-00-990-848 (Sheet 2 of 2)



EFIS -- Block Diagram (Single Side)
Figure 15/34-22-00-990-849

	Left Symbol Generator Inputs (SG-1)		Right Symbol Generator Inputs (SG-2)	
Sensor	"A" Display	"B" Monitor	"A" Display	"B" Monitor
Vert. Gyro	VG1 or Aux	VG2	VG2 or Aux	VG1
Heading	Heading1	Heading2	Heading2	Heading1
Course Error	Crs Err1	Crs Err2	Crs Err2	Crs Err1
Radio Altitude	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

BBB2-34-980

SG Display/Monitor Sensor Inputs
Figure 16/34-22-00-990-850 (Sheet 1 of 2)

	Left Symbol Generator Inputs (SG-1)		Right Symbol Generator Inputs (SG-2)	
Sensor	"A" Display	"B" Monitor	"A" Display	"B" Monitor
AHRS DUAL	AHRS1	AHRS2	AHRS2	AHRS1
Course Error	Crs Err1	Crs Err2	Crs Err2	Crs Err1
Radio Altitude	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

BBB2-34-1148

SG Display/Monitor Sensor Inputs
Figure 16/34-22-00-990-850 (Sheet 2 of 2)

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Inoperative
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

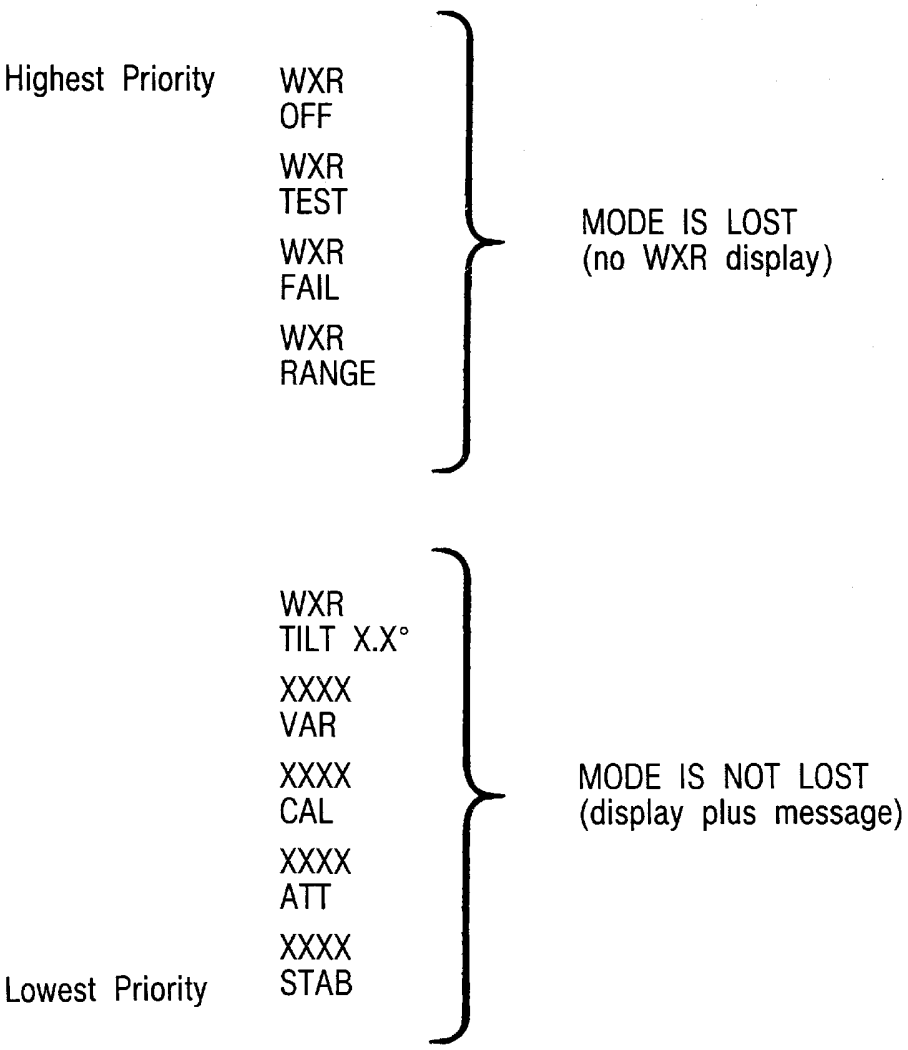
BBB2-34-967

Symbol Generator Operating Modes
Figure 17/34-22-00-990-851

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99	10 feet	No FMA Annunciation		R/A CMP
	100-499	(0.1)(Average R/A) feet	Both R/A CMP displays steady		
	500-2500	(0.1)(Average R/A) feet + 10 feet			
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

BBB2-34-968

FMA Annunciations for SG Instrument Comparator Function
Figure 18/34-22-00-990-852



Weather Radar Message Priority
Figure 19/34-22-00-990-853

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 20/34-22-00-990-854

2. Operation

A. Overview: The Symbol Generators (SG's) are the master control units for the EFIS. Their job is to receive input data from aircraft sensors and systems, check the data for presence and validity, compute the display parameters for the display units, and transmit display data to the display units.

(1) The SG's are also responsible for monitoring the EFIS, for performing continuous self-tests, and for logging faults in the flight log. System monitoring includes input monitoring, SG-internal monitoring, control panel monitoring (CDP and MSP), and display unit (DU) monitoring. Each SG also monitors the cross-side SG and performs a navigation instrument comparator monitor function.

(2) The EFIS logs its own failures, and failures of all interfacing aircraft systems. In-flight failures are stored in a flight log for later retrieval by maintenance personnel. The EFIS has an extensive built in test (BIT) capability, comprised of both continuous BIT (for continuous in-flight monitoring) and initiated BIT (used only in maintenance and preflight tests).

(3) The EFIS system operation is presented in the following sequence:

(A)	Overview
(B)	EFIS Inputs, Outputs and Data Flow
(C)	System Monitoring
(D)	Built In Test and Ground Maintenance

B. EFIS Inputs, Outputs and Data Flow: Navigation data are sent from the various aircraft systems and sensors to the SG Input/Output (I/O) controller for processing. The I/O controller writes all input data to each of the symbol generator processors: the PFD and ND processors, and the system monitor processor . Input data are checked for presence and validity, processed, and sent to the PFD and ND for display. The display data are also sent to the cross-side SG for comparison purposes. Display format and brightness are controlled from the Control and Dimming Panel (CDP) and from the Mode Select Panel (MSP). (Figure 15)

(1) Each EFIS display is driven by its own display processor, vector generator, and video interface. The system monitor processor in the SG verifies the proper operation of each of the display processors. There are separate PFD and ND display output channels from the SG. Each display output channel consists of six digital output signals and two analog output signals which contain color settings, raster control, display mode setting (raster/stroke), and X-and Y-beam deflection signals. The SG receives a digital ready signal from the PFD and ND when the display deflection amplifiers are ready to write.

(2) Weather radar signals are sent to the WXR scan converter. This digital circuit is designed to convert the color WXR signal to EFIS color display format. The resultant map is an offset center sector scan, oriented with heading up in the ARC mode. The displayed sector is variable from +45 degrees to +90 degrees, as determined by the radar. The display map can be rotated and translated in response to aircraft heading and positional changes. Range marks and NAV marks are generated by the display generator in the ND processor. Range is controlled from the Mode Select Panel (MSP). An on-board test pattern generator provides a visual means of operational verification. The ND processor accesses the necessary hardware in the scan converter to control the source and display of the WXR data.

(3) Data from the on-side SG enters the DU through the primary display data input port. Each DU also has a secondary display data input port through which cross-side video signals may be sent/received. These bi-directional cross-side port lines are used in the event of a SG failure. By placing the EFIS source select switch in the BOTH ON 1 or BOTH ON 2 position, display data may be transferred directly from the PFD and ND on the functioning side to the cross-side DU's. The compacted PFD/ND display (reversionary mode) is obtained whenever one of the two system display units is turned off. This allows dual system operation should one of the display units fail.

(4) There are two brightness command signals for each DU: a brightness level command and a raster/stroke contrast ratio command. The raster/stroke contrast ratio is set to a default level for the PFD, compacted PFD/ND, and ND-ROSE displays to provide standard levels of raster shading for the ADI sky/ground shading and for the background scale shading. The voltage ratio is variable for the ND-ARC format, to allow the intensity of the weather radar imagery to be varied.

C. System Monitoring: System monitoring is designed to detect failures that may affect operation of the EFIS. EFIS monitoring consists of:

(a)	input monitoring
(b)	Symbol Generator internal monitoring
(c)	SG-to-SG instrument comparator monitoring
(d)	control panel monitoring
(e)	display unit monitoring
(f)	weather radar input monitoring

(1) Input Monitoring: Input monitoring verifies that sensor or system inputs are present and valid, and that the SG input hardware is functioning properly. Input monitoring consists of:

(a) Input Data Monitoring: Analog and digital inputs to the SG are continuously monitored for presence and validity. If an input parameter is missing, invalid or out of range, the SG will remove all symbology dependent on the input from the PFD/ND. An appropriate failure message will be displayed where the data would normally appear on screen. The symbology will not be re-drawn until the valid has returned for a minimum period of time.

(b) SG Input Hardware Monitoring: The SG monitor processor tests input hardware by feeding test values to the analog, synchro and digital input hardware.

1) Analog input hardware monitoring: The analog input hardware test verifies proper operation of the A-to-D conversion function. Failure of the analog input test will result in failure annunciation of all analog signals associated with the failed multiplexer. This test is performed at a 20 Hz rate.

2) Synchro input hardware monitoring: The synchro input hardware performs a bias test which verifies proper operation of the synchro to sin/cos conversion and demodulation network. This test is performed upon a cold start or during system testing.

3) Digital input hardware monitoring: Digital input receivers are continuously tested by sending test words from the four controlling transmitters to each of the receivers. When a receiver is in test mode, the monitor receives, checks and clears the test inputs. If an error is detected on two or more of the four test signals received, the receiver is inoperable, and appropriate symbology is blanked or flagged.

(2) Symbol Generator internal monitoring: consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. (Paragraph 1.E.)

(3) SG-to-SG Instrument Comparator Monitoring: The SG receives two types of sensor inputs: "A" (on-side) inputs for display on the on-side DU's, and "B" (off-side) inputs for monitoring the cross-side SG (Figure 16). The SG performs a Nav Instrument Comparator Monitor (NICM) function by comparing the following "A" and "B" parameters:

- ILS (localizer and glideslope deviations)
- Attitude (pitch and roll)
- Heading
- Radio Altitude.

(a) If significant cross-channel differences are found between the "A" and "B" values of ILS, attitude or heading parameters, the SG's will signal the discrepancy on the FMA. The ILS, ATTITUDE or HEADING annunciator will flash on the side associated with the fault, and glow steady on the cross-side FMA. A flag and/or warning will also appear on the display screen. Radio Altitude mis-compare is annunciated on the PFD by a "R/A CMP" message. Flashing logic is the same as for the other parameters. Mis-compare annunciations will clear automatically if the deviation returns to within limits. They may be manually cleared on the FMA by resetting the FMA annunciator. Loss of valid results in annunciations on both FMA's, removal of faulty parameters from the screen, and display of fail messages. (Figure 18).

(b) The MONITOR annunciator on the FMA is used to signal SG failures in one of three conditions. The first condition involves internal SG tests which are performed under the direction of the system monitor processor. These tests are performed at a 2 Hz rate, and the results compared with the cross-side system results. When a mis-compare occurs on either side, both MONITOR annunciators come on. The second condition occurs when the SG-to-SG cross-talk link fails due to invalid or interrupted updates. This also will cause both MONITOR annunciators to come on. Third, when a SG fails, the remaining SG continues to monitor its own displayed data, but the comparison function is deactivated; the MONITOR annunciator will come on, on the failed side.

(c) There are six distinct SG-to-SG Instrument Comparison Operating Modes . The operating mode determines if, and when, the NICM annunciators on the FMA will come on. These modes are prioritized from Cruise mode (5 - lowest priority) to Test mode (1 - highest priority). Higher priority modes will always override lower priority modes. During the course of the flight leg, the system will primarily operate in Cruise mode. (Figure 17)

(4) Control Panel monitoring: verifies correct operation of the Control and Dimming Panel and Mode Select Panel. (Paragraph 1.G. and Paragraph 1.H.)

(5) Display Unit monitoring: verifies that the DU is receiving display data. (Paragraph 1.F.)

(6) Weather Radar Input monitoring: The SG weather radar (WXR) scan converter converts color WXR signals to a format suitable for display on an EFIS color display unit. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages. There are two types of WXR messages: those for which the mode selected on the WXR control panel is lost, and those for which the mode is not lost. If the mode is lost, warnings will appear on screen, but there will be no WXR display. If the mode is not lost, the messages will appear along with the WXR display (Figure 19). WXR messages are prioritized as follows:

WXR OFF - WXR BRT knob is OFF on CDP, or DU overheat condition

WJE 877, 886, 887

WXR TEST - System in TEST mode. Test pattern is displayed, plus R/T fault messages including:

- R/T - receiver/transmitter fault
- ANT - antenna fault
- CNTL - control fault
- ATT - attitude fault
- CAL - calibration fault
- RANGE - range fault (MSP fault)
- COOL - R/T unit cooling fault.

WJE 410

WXR TEST - System in TEST mode. Test pattern is displayed.

WJE 410, 877, 886, 887

NOTE: If any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

WJE 410

NOTE: Range information from the WXR R/T is compared with the range selected on the EFIS Mode Select Panel. If they disagree for five seconds or more, the WXR RANGE message is displayed. EFIS will default to 40nm if the MSP fails, and display 40nm of weather radar.

WJE 410, 877, 886, 887

XXXX VAR - WXR input sensitivity not calibrated to any precipitation rate (XXXX represents operating mode selected on WXR control panel).

XXXX CAL - loss of calibration

XXXX ATT - attitude input fault

XXXX STAB - stabilization is off

WXR TILT - momentarily annunciated on screen when antenna tilt angle is changed.

D. Built In Test and Ground Maintenance: The EFIS built in test (BIT) is designed to aid maintenance in isolating faults related to the EFIS and the systems with which it interfaces. There are two types of BIT for the EFIS: continuous BIT for in-flight monitoring, and initiated BIT for pre-flight and LRU functional checks. Other maintenance functions require interface with the Status Test Panel (STP) for in-depth system tests and fault isolation.

(1) Continuous BIT: Continuous BIT monitors the EFIS throughout each flight profile and logs all failures in the flight log for later retrieval by maintenance personnel. The EFIS logs its own failures, and also those of the aircraft systems with which it interfaces. The SG maintains a log in non-volatile memory of failures detected by the system monitors, whenever the system power is on. The continuous BIT logs the failure type and time of occurrence (time after start of flight leg). The log can contain 20 failures on each of the last 10 flight legs. Intermittent failures are recorded only once per hour of flight time. Continuous failures are recorded only once per flight leg. (Faults are also recorded while the aircraft is on the ground and the system is functioning). Failures are retrieved via the Status Test Panel.

(2) Initiated BIT: Initiated BIT provides a means of self-testing the EFIS on the ground. Tests are initiated by pushing the TEST button on the Control and Dimming Panel. Tests include: initiated EFIS System Self-Test, Initiated Functional Self-Test and Initiated Cockpit Lamp Test. Initiated BIT is used both in preflight testing and in LRU functional checks. (NAVIGATION DISPLAYS, SUBJECT 34-22-00)

(a) EFIS System Self-Test (BIT) is initiated through the TEST pushbutton on the Dimming Panel. Test begins when the pushbutton is depressed, and ends approximately 3 seconds after release. This test includes:

- VOR/ILS Self-Test
- Radio Altimeter Self-Test
- Marker Beacon Self-Test
- Decision Height Aural Warning Test
- Failure Flag Test.

(b) The first three tests are under control of the associated receiver units (the EFIS is only used to display the input parameters). The decision height aural warning test and failure flag test are under the control of the SG. Failure flag annunciations appear on the DU screen only while the TEST pushbutton is being depressed. The Failure Flag Test annunciations for the various display screens are shown in Figure 20.

(c) EFIS Functional Self Test is used by maintenance personnel to verify proper installation and operation of the SG. This test is initiated via the Status Test Panel (STP), by calling up the SG SELF-TEST selection on the Maintenance Menu (see EFIS Ground Maintenance following). The test consists of a synchro bias test, a system RAM check and an SG cooling fan test. The test takes approximately 2 seconds. Upon completion, both display units show software part number, aircraft equipment/options configuration, and test results . This test is inhibited except when aircraft is on the ground and weight-on-wheels discrete is set. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

(d) The cockpit lamp test checks the EFIS lamp displays by driving the FMA comparison lamps. Approximately 0.5 seconds after release of the DIGITAL/ANNUN pushbutton on the Overhead, the ILS, HEADING, HORIZON and MONITOR lamps on the FMA come on for 5 seconds.

(3) EFIS Ground Maintenance: Ground maintenance procedures are performed using the Status Test Panel (STP). The purpose of these procedures is to call up and review faults in the flight log, perform diagnostic tests and troubleshooting, isolate and replace faulty LRU's, program the Symbol Generator options/configuration (only when SG's are replaced), and perform comprehensive system testing. The STP is used to call up the EFIS Maintenance Menu onto the system displays. The displays on the STP are not used when performing EFIS maintenance; only the STP pushbuttons are used. In order to use the STP in conjunction with the EFIS, the EFIS/DFGC toggle switch on the overhead must be in the EFIS position, and the aircraft must be on the ground. For a detailed description of the Maintenance Menu functions, refer to the Maintenance Practices section (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201). For a complete listing of system faults, refer to the Trouble Shooting section. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101).

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. Description

A. Navigation data is displayed on the horizontal situation indicators (HSI) and attitude director indicators (ADI). The indicators use inputs from several systems to display airplane attitude, and navigation commands.

B. HSI - the captain's and first officer's HSI's are located on their respective instrument panels. Each indicator has a fixed miniature airplane symbol in the center with the forward direction of the airplane toward the top of the instrument face. A rotating heading dial marked in 5-degree increments, repeats airplane magnetic heading in conjunction with a lubber line, and is also used as the readout for selected course and selected heading. A reciprocal heading mark extends over the bottom edge of the heading dial, and there are triangular reference marks at 45 and 90 degrees on either side of the lubber line. A separated marker, read against the heading dial, indicates selected heading. Selected course is displayed by a dagger-shaped pointer rotating in the center of the heading dial, with an opposite pointer indicating the reciprocal of selected course. The dagger and reciprocal pointer, together with the airplane symbol, serve as an index for the 4-dot course deviation scale painted on the rotating center mask. Deviation from a selected course is indicated by movement of a course deviation bar across the course deviation scale. Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the right side of the indicator face. Slant distance from DME stations is displayed in two 4-digit display windows. The window in the upper left corner of the indicator is placarded MILES 1, and in the upper right corner, MILES 2. A triangular pointer in the course mask designates display of to/from. A window on the upper left side of the indicator shows display of the legends 1 or 2 for Navigation Data Source. Windows on left middle and lower of indicator respectively are ALERT and RAD/NAV indications. ALERT and NAV are for inertial NAV system installations. Windows will be blank for ALERT window and RAD for RAD/NAV window. At top of indicator a TRU/MAG window will display MAG. TRU indication is for inertial NAV system installation.

(1) Power failure and/or invalid signal data from the applicable input systems will cause the VERT flag to come into view and a shutter covers the DME display, navigation annunciator, and HDG flag comes into view.

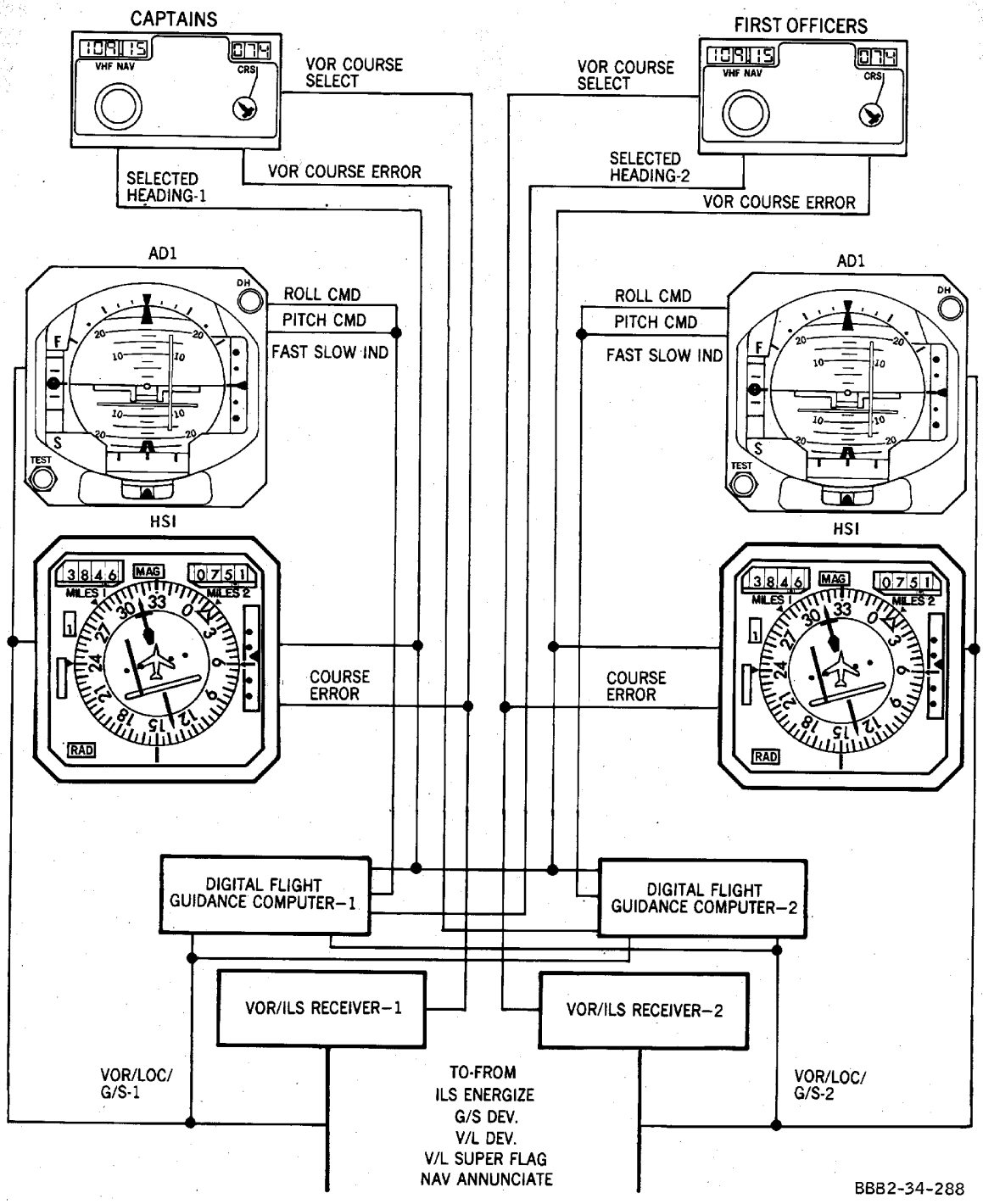
C. ADI - the captain's and first officer's ADI's are located on their respective instrument panels. Each indicator has a fixed symbol as an airplane reference for attitude, and flight guidance command bars. Roll attitude and expanded pitch attitude are displayed by a sphere with the upper and lower half separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed airplane symbol, and roll attitude by rotation of the sphere with respect to the symbol and a fixed scale and lubber line. Cross-pointer bars are used to display flight guidance commands. The horizontal (pitch) bar indicates below the air-plane symbol to command pitchdown attitude, and above the airplane symbol to command pitchup. The vertical (roll) bar indicates to the right of center to command right roll, and to the left of center to command left roll. Speed control is displayed by a circular marker moving over a vertical fixed scale on the left side of the indicator face. Upper end of scale is placarded F (fast); lower end is marked S (slow). Glideslope deviation is displayed by a pointer moving beside a vertical 4-dot scale on the right side of the indicator face. Bank angle is displayed by a vertical pointer at top of indicator. A ball inclinometer, read against two centering bars is located at the bottom of the indicator bezel. An isosceles trapazoid pointer at bottom of ADI designates localizer deviation.

(1) A light in the upper right corner is placarded DH (decision height) and comes on at a preset altitude signal from the radio altimeter system.

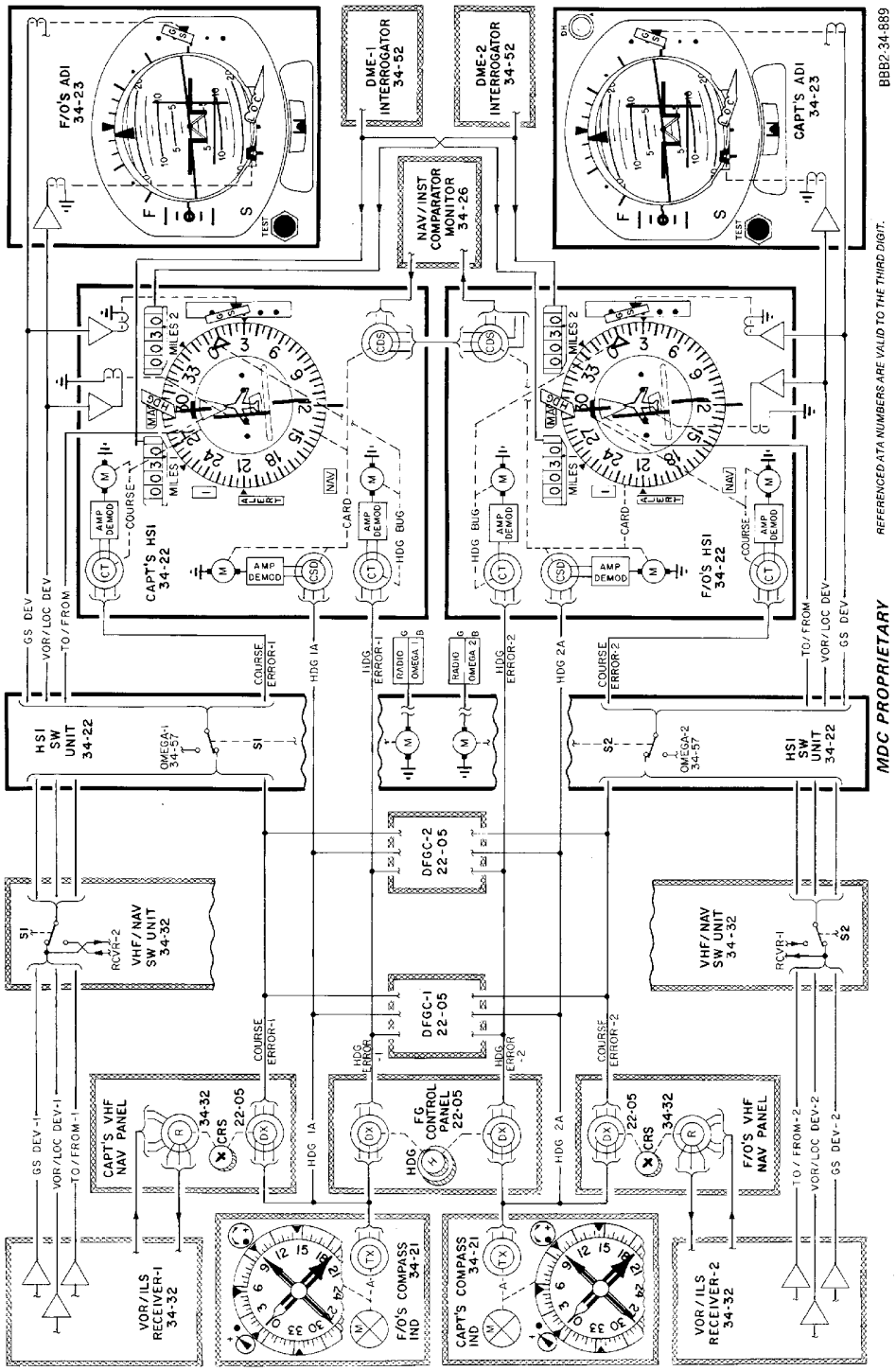
(2) A push-to-test switch placarded TEST is located in the lower left corner of the bezel. Depressing TEST button actuates self-test circuits which cause the indicator to display the following:

(a) The attitude sphere will simultaneously indicate a change in attitude of 20(±5) degrees right bank, and 10(±5) degrees climb, and the ATT flag will be in view.

(3) Power failure and/or invalid signal data from the applicable input systems will cause the ATT flag, FD flag, SPD flag, GS, LOC, and HT to come into view.



Navigation Displays - Block Diagram
Figure 1/34-22-00-990-E00 (Sheet 1 of 2)



Navigation Displays - Block Diagram
Figure 1/34-22-00-990-E00 (Sheet 2 of 2)

2. Operation

A. Navigation display input data to the HSI, and ADI is supplied from the VOR/ILS receiver, the DME interrogator, the compass system, radio altimeter system and the CRS and HDG select portions of the flight guidance control panel. The ADI flight guidance command bars, and speed control display are actuated by signals from Digital Flight Guidance computers.

B. The HSI provides signals as follows:

(1) Signals from a control transmitter in the integrated instrument amplifier to a control differential synchro in the HSI, cause the motor-driven heading card to repeat airplane magnetic heading, when read against the indicator lubber line. The heading card is also used as a readout for selected course and selected heading.

(2) When the HDG select knob on the flight guidance control panel is rotated, a synchro transmitter sends an error signal to a control transformer in the indicator which drives a servo motor that mechanically positions the heading select pointer. The motor continues to drive the pointer until the servo loop is nulled, and the indicator read against the heading dial indicates selected heading. The dagger-shaped course select pointer is remotely positioned by an identical servo loop when the CRS knob is rotated.

(3) Deviation from selected course (with proper VOR frequency selected) will cause the VOR/ILS receiver to send a VOR deviation signal to a meter movement in the HSI. The meter movement displaces the course deviation bar to indicate whether the airplane is to the left or right of, or centered on, the selected VOR radial. When tuned to a localizer frequency, a signal from the ILS receiver to the meter movement, causes the deviation bar to indicate the airplane attitude in relation to the localizer beam. After localizer capture (approximately 2 dots deviation), flying the airplane to the bars will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on the beam condition.

(4) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(5) DME slant range distance in nautical miles is digitally displayed in the MILES -1 and MILES -2 display windows. Each window provides a 3-digit display on three wheels with each wheel driven independently by a synchro torque receiver. The output of the DME interrogator to the indicator is an analog output in synchro form. A bar covering the display indicates a no valid information.

C. The ADI provides attitude and command signals as follows:

(1) A switch within the attitude switching unit (ASU) is remotely actuated from the VERT GYRO switch on the over-head switch panel, to control selection of the applicable vertical gyro (VG) signal output. The three-position switch is placarded L ON AUX, NORM, and R ON AUX. Placing the switch in other than NORM position, allows the captain or first officer to select the AUX GYRO output to replace the VG-1 or VG-2 output which normally feeds their applicable attitude system.

(2) Signals from a pitch angle CX and a bank angle CX in each VG, to a CDS in the ADI, cause the horizon sphere to display airplane attitude in relation to the fixed airplane symbol and lubber line. The sphere is driven by a dc torquer motor.

(3) The flight guidance command bars are driven by a meter movement in the indicator, actuated by signals from the Digital Flight Guidance Computers.

(4) The glideslope pointer is controlled by a servoed meter movement in the indicator, actuated by deviation signals from the glideslope portion of the VOR/ILS receiver. The pointer indicates above the center index if the airplane is below the glidepath, and below the index if the airplane is above the glidepath. When the airplane is flown to the pointer, a signal from the receiver will cause the pointer to center on the scale index to indicate that the airplane is on the glidepath.

(5) A signal from the radio altimeter operates a servo motor to drive the radio altimeter symbol. At a preset altitude, a signal from the radio altimeter will cause the decision height (DH) light to come on. When tuned to localizer, deviation signals from the VOR/ILS receiver to a second servo will cause the localizer symbol to indicate the direction the airplane must be flown to center on the localizer beam.

D. Flag and out-of-view logic for the ADI is controlled by both external circuits and internal monitors. The SPD and HT flags are externally operated and will come into view if there is loss of valid information. The flags are held out of view when the proper bias voltage is received from the applicable input system. Circuits within the ADI monitor for power loss, failure of a servo loop and absence of external data valid signals. Invalid attitude data will cause flag display. Flag displays are ATT, FD, GS, LOC, HT, and SPD.

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The Electronic Flight Instrument System (EFIS) replaces the conventional ADI and HSI on the Captain's and FO's instrument panels with four five-by-six inch color CRT display units. The upper units, the Primary Flight Displays, provide information normally found on the ADI, plus radio altitude, marker beacons, and Windshear Alert and Guidance System (WAGS) data (if installed). The lower units, the Navigation Displays, provide information normally found on the HSI, plus ADF bearing and coordinated weather radar.

B. The Electronic Flight Instrument System (EFIS) consists of two identical and independent systems (Figure 1). Each system consists of the following:

Table 1

Component	Location
One Symbol Generator (SG)	Electrical/Electronics Compartment
Two CRT Display Units (PFD & ND)	Main Instrument Panel
One Control & Dimming Panel (CDP)	Main Instrument Panel
One Mode Select Panel (MSP)	Below Clearview Window
One Remote Light Sensor (RLS)	
(Shared by both systems)	Top of Glareshield.

(1) There are two switches which are also used in conjunction with EFIS:

(a) EFIS Source Select Switch: Located on the overhead panel, allows either system to be run from the cross-side Symbol Generator in the event of an on-side SG failure.

(b) EFIS/DFGC Toggle Switch: Located under the captains briefcase holder, allows ground maintenance personnel to use the Status Test Panel pushbuttons in conjunction with the EFIS display units in performing comprehensive system tests and troubleshooting.

C. System Displays:

(1) The Primary Flight Display (PFD) format displays aircraft attitude, flight director commands, glideslope and localizer deviations, radio altitude, speed error, decision height set and status, marker beacon indication, and WAGS data (if installed).

(2) The Navigation Display (ND) operates in ROSE and ARC modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, ADF bearing and DME distances. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, DME distances, ADF bearing and weather radar.

(3) A compacted PFD/ND display format combines both PFD and ND data into a single-screen display. This format is used in the event of a display unit failure.

D. Description and Operation Overview: The Description and Operation is broken down into the following paragraphs:

Paragraph 1. General (Description)

A.	System Overview
B.	System Components
C.	System Displays

(Continued)

D.	Description and Operation Overview
E.	Symbol Generator Description
F.	Display Unit Description
G.	Control & Dimming Panel Description
H.	Mode Select Panel Description
I.	Remote Light Sensor Description
J.	Primary Flight Display (PFD) Symbology
K.	Navigation Display Symbology and Weather Radar
L.	Compacted PFD/ND Display

Paragraph 2. Operation:

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground maintenance

E. Symbol Generator Description

(1) The symbol generator contains all of the circuitry required to interface with aircraft sensors and systems, compute CRT display parameters, and transmit display data to the display units (Figure 3). In addition, the SG provides an instrument comparator monitor function, which performs cross-side comparisons between ILS, attitude, and heading. In the event of a mis-compare, the corresponding annunciators on the Flight Mode Annunciator (FMA) panel come on.

(2) The SG monitors its own internal operation and aids in monitoring the cross-side SG. The SG tests its internal functioning by performing dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. In the event of a SG failure or mis-compare, the MONITOR lights on the FMA will come on. The SG is also responsible for monitoring all aircraft systems and sensors which provide inputs to the EFIS, as well as the EFIS components. Continuous BIT monitors the EFIS throughout each flight profile, and logs all failures for later retrieval by ground maintenance.

(3) The left symbol generator (SG-1) drives the Captain's PFD and ND displays; the right symbol generator (SG-2) drives the First Officer's displays. Either Symbol Generator can drive all four CRT displays. In the event of a SG failure, the SG source selection switch, located on the Overhead Panel, may be put in the BOTH ON 1 or BOTH ON 2 position. This will cause the display data from the functioning SG to be transferred to the cross-side display units via data buses from the on-side display units (Figure 3).

(4) Symbol Generator Components (Figure 4):

Symbol Generator Components (Figure 6):

(a) Two Display Processor circuit card assemblies (CCA's), one for the PFD and one for the ND, which contain a processor, memory and a vector generator.

(b) Input/Output CCA's, which contain the serial data receivers and transmitters, synchro-to-digital, analog-to-digital, and discrete receivers required to interface with the aircraft sensors and systems.

(c) An Input/Output (IO) Controller, which manages all of the output devices and transfers data between them and system memory.

(d) A System Monitor CCA, which monitors display outputs, system BIT and weather radar processing.

(e) A Weather Radar Scan Converter CCA which converts color radar signals to a format suitable for display on the EFIS color display units.

(5) Symbol Generator Inputs: The SG receives serial data, synchro, analog and discrete inputs from the various aircraft sensors and systems (Figure 6). Program pins and configuration words enable the SG hardware and software to interface with these various types of inputs. SG programming is checked on the ground at power up to verify proper equipment configurations and selected options.

(6) Symbol Generator Outputs: The SG generates serial data outputs, open/ground discrete outputs and audio outputs. The Symbol Generator has two independent display output channels. Video and deflection signals are sent via the display output channels to the Primary Flight Display and to the Navigation Display. A low-speed SG cross-talk bus enables each SG to monitor both its own operation and that of the cross-side SG. This monitoring consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(7) Audio Output: The SG has one audio output for annunciating the decision height. This tone slews from 400 Hz at or above decision height + 50 feet to 800 Hz at DH. The frequency changes linearly from DH + 50 feet to DH. (Figure 5) shows the decision height audio output graphically.

(8) Commands are sent to the SG from the cockpit via the Control & Dimming Panel (display unit on/off and brightness, weather radar on/off and brightness, DH set and TEST) and the Mode Select Panel (Navigation Display format selection and range control). The weather radar control panel is used to set the WXR display mode, TILT, GAIN and STAB. Range is controlled from the EFIS Mode Select Panel.

(9) The SG's are housed in ARINC 600 4 MCU chassis, and are located in the electrical/electronics compartment. The SG operates on 115 VAC 400 Hz single phase power. The SG power supply converts aircraft power to the DC voltages required by the SG electronics. The SG is able to withstand power interruptions of up to 3 milliseconds without loss of function, and up to 1 second without change of operating mode or loss of digital filter data. Temperature sensing of the power supply is provided to activate an internal SG fan, in the event of an over temperature condition. Forced air (blow-through) cooling is also provided to both units.

(10) Whenever a new Symbol Generator is installed, it must be programmed by ground maintenance before the SG can be used. This programming consists of entering the Options/Register and Check Register numbers into the SG via the Status Test Panel. These numbers, when combined with the configuration identification wired into the aircraft, define the aircraft for the Symbol Generator.

(11) In case of a serious SG failure, the PFD and ND for that system will be blanked. Display data may be transferred from the functioning system by placing the EFIS source select switch in the appropriate position. EFI1 or EFI2 annunciations will appear on all display screens during single-system operation. If a fault can be isolated to a single source, a flag or warning message will appear on screen to signal the affected parameter.

F. Display Unit Description

(1) The Primary Flight Display (PFD) and Navigation Display (ND) units are identical CRT's, clamp-mounted to the main instrument panel. Each display unit (DU) provides a full color (15 plus black) electronic display. The DU's receive display data through analog, digital and discrete interfaces with the symbol generator. Each DU is capable of operating as a PFD or ND. During reversionary mode (either the PFD or ND is turned off), a single display is capable of acting as both a PFD and ND in the compacted PFD/ND mode.

(2) The DU is capable of operating in either raster scan mode (background shading and weather radar) or stroke writing mode (display symbology). Raster dimming is controlled independently of stroke intensity to provide adjustable display contrast capability (Navigation Display only). SG display unit monitoring verifies that the DU is receiving display data. Upon detection of a fault, the DU is blanked. At this time, the DU should be turned off at the Control and Dimming Panel. The system will revert to reversionary mode, and a compacted PFD/ND display will appear on the functioning screen.

(3) A system monitor is incorporated in the DU to provide CRT phosphor protection. The system monitor drives the CRT to cutoff when X-or Y-deflection has stopped, when power supply outputs are abnormal, or when the CRT filament opens or takes excessive current. In case of a DU overheat, the SG will log the failure and remove the raster (background) from the applicable display to reduce the display power required. The message 'WXR OFF' appears on the ND to signal loss of WXR display.

(4) Display unit brightness is controlled in part by the two internal light sensors. These sensors are located on the front of each unit, and feed into the auto-dimming system. The stroke and raster brightness levels are normally set using a combination of brightness data from the Remote Light Sensor, the DU internal light sensors and the Control and Dimming Panel (CDP). Should the DU monitor detect a loss of brightness commands from the CDP, the display unit will revert to a nominal brightness level.

(5) Each DU has two input ports. The primary input port carries analog deflection and digital video information from the on-side symbol generator. The secondary input port is used to either send or receive data, to or from the cross-side display unit. This port allows the DU to be driven from the cross-side symbol generator, if the on-side symbol generator fails.

(6) Each display unit is contained in a 5 x 6 x 10.5 inch outline, and is forced-air cooled. An externally adjustable inclinometer (slip skid indicator) is located on the bottom center of the DU bezel. The CRT display surfaces are covered with a filter, coated with a reflection-reducing coating. There are two extraction aids, on the front bottom left and right corners, to aid in removal/installation of the DU's. Two power transistors, located on the back panel of each DU, dissipate 65 watts.

G. Control & Dimming Panel Description

(1) The Control & Dimming Panel (CDP) provides three functions (Figure 7):

(a) Display unit manual brightness control

(b) Decision Height set control

(c) TEST pushbutton

(2) The CDP's are located on the main instrument panel, to the right of the display units. They are powered from both Primary Flight Display power (+ 15 VDC) and lighting power. All CDP control knobs move clockwise from the off position, through an increasing range to the full on position.

(3) Display Unit Manual Brightness Control: The CDP mixes data received from the Remote Light Sensor (RLS) and display unit (DU) internal light sensors with CDP manual brightness control inputs to generate an overall brightness control signal for the DU's. The display unit brightness controls on the CDP are PFD BRT for the Primary Flight Display, and a combined ND/WX BRT for the Navigation Display. The WX BRT control knob is concentric with the ND BRT control, and is used to adjust the weather radar display intensity independently of the ND display symbology.

(4) Full counterclockwise (ccw) rotation of the PFD BRT or ND BRT knobs past the detent causes the corresponding display screen to go blank. Whenever either the PFD or ND BRT knob is turned OFF, the corresponding display screen goes blank, and a compacted PFD/ND display will appear on the remaining on-side display screen. Turning the WX BRT knob ccw past the detent turns the WX display off. When radar is OFF, WXR OFF will be continuously displayed on the ND whenever this knob is in the off position. When radar is on, and WX BRT knob is off, WXR ON is displayed on the PFD. No message will be displayed on the ND.

(5) Decision Height Set Control: This knob is used to set decision height between zero and 500 feet (any value less than zero feet causes the DH readout on the PFD to go blank). DH data is displayed on the top, right-hand corner of PFD.

(6) TEST pushbutton: The TEST pushbutton is used to initiate a complete EFIS system self-test. Self-testing begins when the TEST pushbutton is depressed and ends approximately 3 seconds after release. The tests conducted include: VOR/ILS self-test, Radio Altimeter self-test, Marker Beacon self-test, Decision Height Aural Warning self-test and Failure Flag test. Also the captain's AHRS-3 and first officer's AHRS-2 are checked on earlier series 87 aircraft. When the pushbutton is activated the heading will go to 15 degrees plus or minus 3 degrees. All but the DH aural warning and failure flag tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The DH aural warning test consists of a one-second tone slewing from 400-800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. TEST pushbutton function is inhibited in flight.

NOTE: When performing the EFIS self test from the dimming panel test button, the monitor lights on the FMA will flash.

(7) In the event of a Control and Dimming Panel failure, the PFD, ND and WXR displays will remain on. Brightness will be controlled by the auto-dimming system. Since there is no default setting for a DH control failure, DH information should be ignored when the CDP fails.

H. Mode Select Panel Description

(1) The Mode Select Panels (MSP) are located outboard and aft of the glareshield, below the clearview windows. The MSP is used to select the display format for the Navigation Display (Figure 8). Each panel contains three control switches: a MODE switch, a RANGE switch, and an ADF bearing switch.

(2) The MSP interfaces with the Symbol Generator through digital discrete signals. The control panel monitor in the SG verifies correct operation of the MSP. In the event of a MSP failure, the ARC mode will be displayed on the ND. The range will default to 40 nm; the indices and range lines will turn yellow.

(3) The MODE switch is a rotary switch which allows the pilots to select from the following ND display modes:

Table 2

ROSE	Conventional HSI display
ARC	Compass arc display, with coordinated weather radar.
MAP	Inoperative

(4) The RANGE control is a six-position rotary switch. It is used only in ARC Mode, and allows the crew to select among the following display ranges: 10, 20, 40, 80, 160, and 320 nautical miles. Both the ARC and WXR display ranges are set simultaneously with this control.

(5) The ADF bearing control consists of two concentric rotary switches which are used to control the two ADF bearing pointers in the ROSE and ARC modes. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

(6) The NAV/RAD switch is used to toggle between VOR/ILS (RAD) and area navigation (NAV). This switch is inoperative.

I. Remote Light Sensor Description

(1) There is one Remote Light Sensor (RLS), installed on top of the glareshield (Figure 9). The RLS is installed looking forward of the aircraft, to measure the light levels outside of the cockpit. The RLS is powered from the F.O.'s Control & Dimming Panel (CDP). Light level data is transmitted from the RLS to the CDP, where it is combined with manual brightness control and DU light sensor inputs. The resultant mixed signal is used in controlling display intensity and contrast. If the RLS fails, the CDP manual control setting and DU internal sensor signals will be combined to control DU brightness.

J. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format (Figure 10 or Figure 11 or Figure 12 or Figure 13) contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(h) WAGS data (if installed)

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below. When the AUX VERT GYRO is used, ATT3 will be displayed in yellow characters on the applicable PFD.

(3) Flight Director Command Indication: consists of a chevron-shaped reference aircraft and two wedge-shaped flight director bars. The wedges rotate to indicate roll command, and move up or down to indicate pitch command. Desired attitude is indicated when the chevron just fits inside the wedges. The wedges appear to be located in front of the attitude indication, but behind the reference chevron.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the left of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation. During backcourse approaches, the scale is replaced by BACK CRS annunciation.

(5) Expanded Localizer Deviation: is indicated by a downward-pointing triangle moving over a scale consisting of two small circles and a "sideways E" center reference line. The scale is centered beneath the attitude sphere.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the right side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet.

WJE 407, 408, 411

(9) On these aircraft, a yellow wedge appears to the right side of the tape below 200 feet.

WJE 406

(10) On this aircraft, a rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

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(11) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

(12) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 1000 feet (304.8 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

(13) WAGS data (if installed): When the Windshear Computer (WSC) detects an increasing performance windshear (headwind or up draft) it will enable the PFD to display an amber "WIND SHR" message. A detected decreasing performance windshear (tailwind or down draft) will result in a red "WIND SHR" message. The PFD will also display a WSC determined Pitch Limit Indication (PLI) which is the margin between aircraft angle of attack (AOA) and the AOA for shaker onset. In addition, speed deviation and flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

K. Navigation Display (ND) Symbology and Weather Radar

(1) The Navigation Display (ND) appears on the lower CRT. The ND provides HSI information plus coordinated weather radar. The display format varies, depending on the display mode selected on the Mode Select Panel (MSP). The following modes are available on the EFIS:

(2) ROSE Mode: display resembles a conventional HSI (Figure 10 or Figure 11 or Figure 12 or Figure 13). The compass rose is located at the center of the screen, with large tick marks at 10 degree increments and small tick marks at 5 degree increments. The tick marks are labeled at 30 degree increments with characters straddling the tick marks. The ROSE Mode display shows:

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course and course deviation
(d)	Vertical deviation
(e)	TO/FROM indication
(f)	DME distances
(g)	ADF bearing

(a) Aircraft Heading: Heading indices consist of tick marks at 45 degree increments around the outside of the compass rose. The digital value of the current heading is displayed in a box above the compass rose. A symbolic reference aircraft is located at the center of the compass rose.

(b) Selected Heading: is indicated by an "M"-shaped pointer which moves along the outside of the compass rose.

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass rose, pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a scale consisting of four small dots. The course pointer and deviation scale rotate with the selected course about the center of the compass rose.

(d) Vertical Deviation: is indicated with a scale and pointer identical to that used on the PFD display. This display is blanked on a backcourse approach.

(e) TO/FROM Indications: A Triangle pointer is provided, which points in the direction of (TO) or 180 degrees away from (FROM) the course deviation pointer. TO/FROM is blanked while in ILS mode.

(f) DME Distances: are displayed to the left (DME-1) and right (DME-2) of the digital heading display. Each DME distance is displayed above its source. If there are no computed data, the distance is replaced by three dash marks.

(g) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

(3) ARC Mode: Display shows a compass arc (Figure 10 or Figure 11 or Figure 12 or Figure 13), centered below the center of the screen, with major tick marks every 10 degrees, and minor tick marks every five degrees. The major tick marks are labeled every 30 degrees. The ARC Mode display shows:

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course and

(Continued)

(d)	course deviation
(e)	Vertical deviation
(f)	TO/FROM indication
(g)	DME distances
(h)	weather radar
(i)	ADF bearing

(a) Aircraft Heading: is displayed at the tope of the range lubber line. A symbolic reference airplane is located at the center of the compass arc.

(b) Selected Heading: is indicated by an "M" shaped symbol which moves along the outside of the arc, and by a dotted line from the airplane symbol to the "M".

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass arc, with an extension pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a four dot scale. The pointer and deviation scale rotate with the selected course about the center of the arc.

(d) Vertical Deviation: is displayed using a scale and pointer identical to those on the PFD display. Glideslope display is blanked on a backcourse approach.

(e) TO/FROM Indications: are displayed under the left end of the heading arc, when tuned to a VOR station. Indication is blanked while in ILS mode.

(f) DME Distances: are shown to the left (DME-1) and to the right (DME-2) of the digital heading display. Each DME distance is displayed above its source. If there are no computed data, the distance display is replaced by three dash marks.

(g) Weather Radar: Weather radar data may be displayed within the compass arc. The display range is selected from the Mode Select Panel (MSP). A half-range index mark, centered between the aircraft reference symbol and the outer periphery of the arc, will indicate one-half of the range selected on the MSP. The brightness of the weather radar image can be adjusted relative to the ND symbology from the CDP. When fault codes are received, weather radar status messages will appear on the display screen. The message "WX OFF" will appear on the display screen when a DU overheat is detected or when the CDP WX BRT control knob is in the off position. Tilt angle is annunciated only momentarily, when the WXR antenna tilt angle is changed. (Paragraph 2.C.)

(h) ADF Bearing: Two bearing pointers may be selected to show current bearing to ADF stations. The source for each pointer is annunciated in the lower left hand corner of the ND.

L. Compacted PFD/ND Display

(1) The compacted PFD/ND display appears whenever either (but not both) of the Display Units is turned OFF at the CDP. This format contains all data shown on the normal PFD display. However, the bottom third of the attitude sphere is removed and replaced with a heading indicator. The following symbology is available on this display:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Glideslope Deviations

(d) Speed Deviations

(e) Radio altitude

(f) Marker beacon

(g) Altitude alert

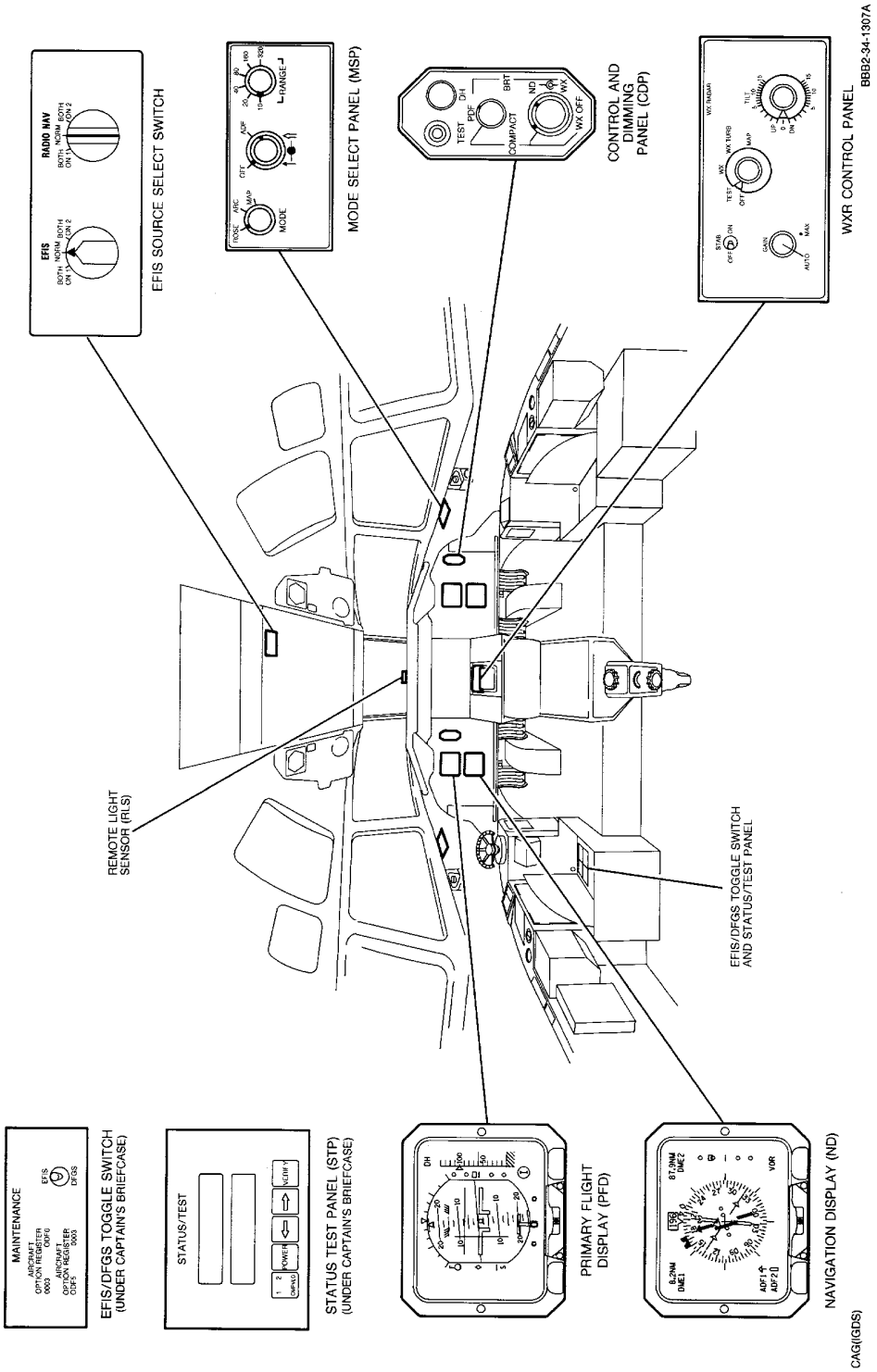
(h) Course Deviations

(i) Compacted heading display

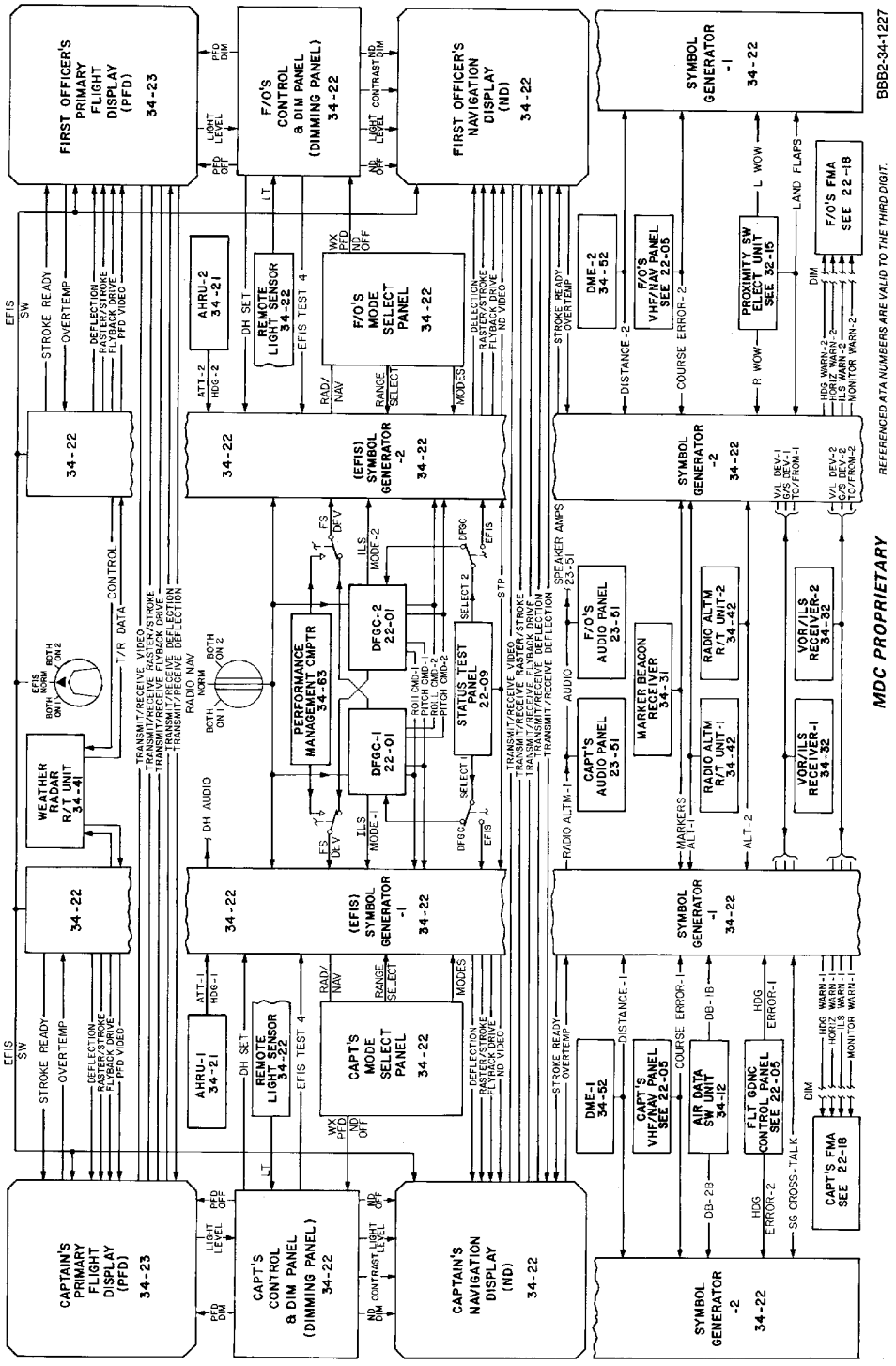
(j) selected heading

(k) Digital course

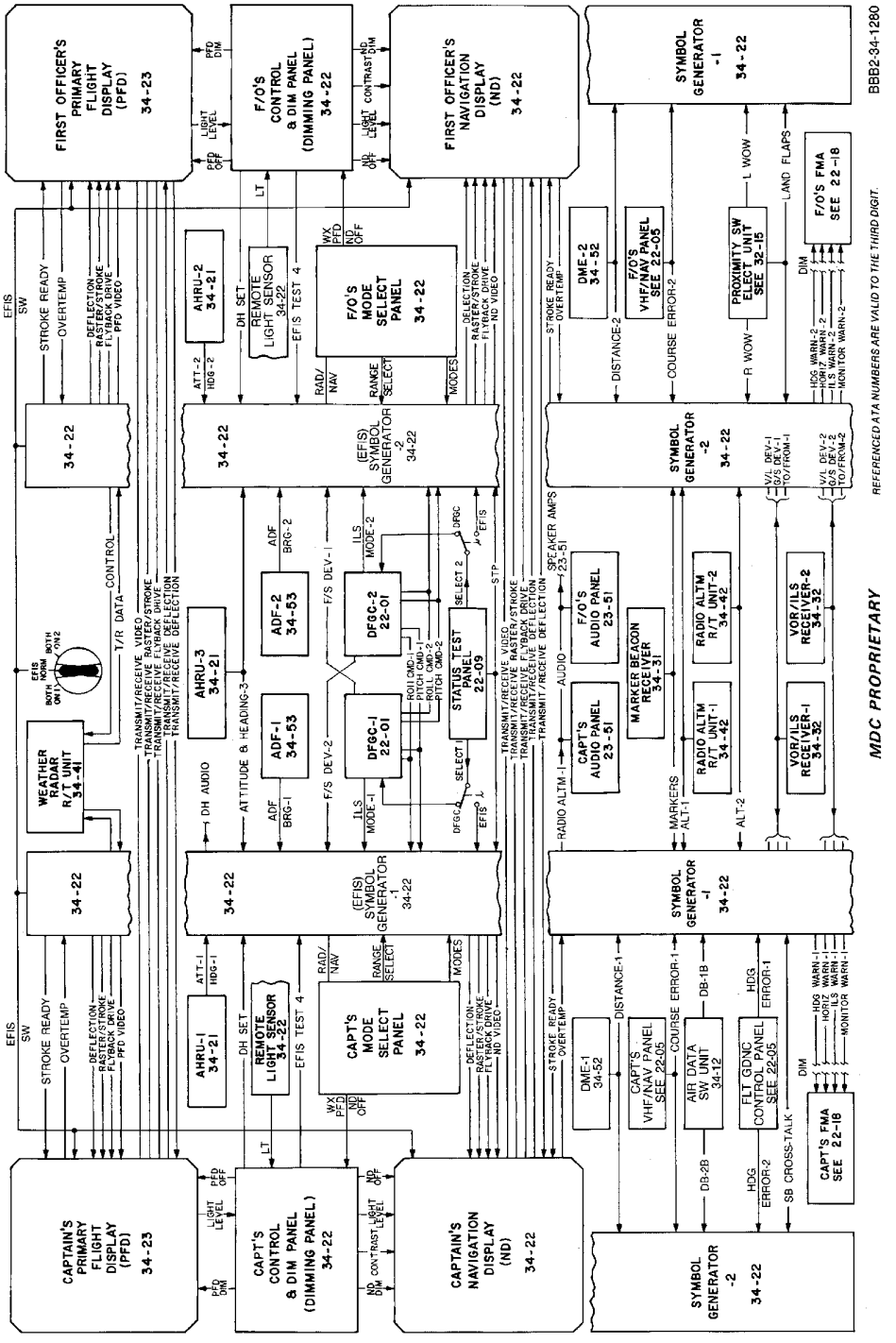
(2) All symbology characteristics for the top two-thirds of the display are the same as for the PFD format. The compacted heading display, on the bottom third of the screen, contains the same symbology used on the ND-ROSE display.



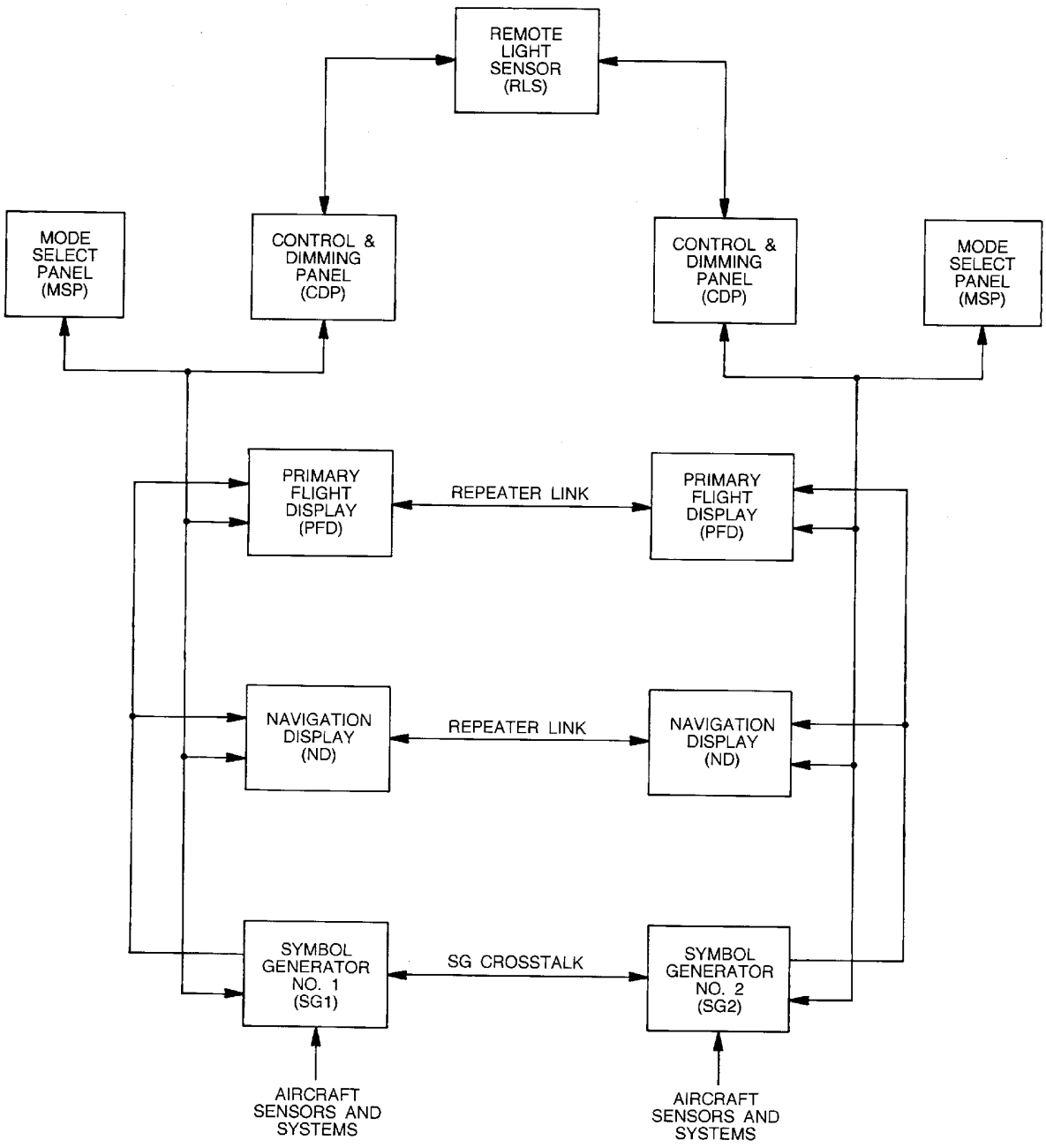
EFIS Cockpit Configuration
Figure 1/34-22-00-990-B13



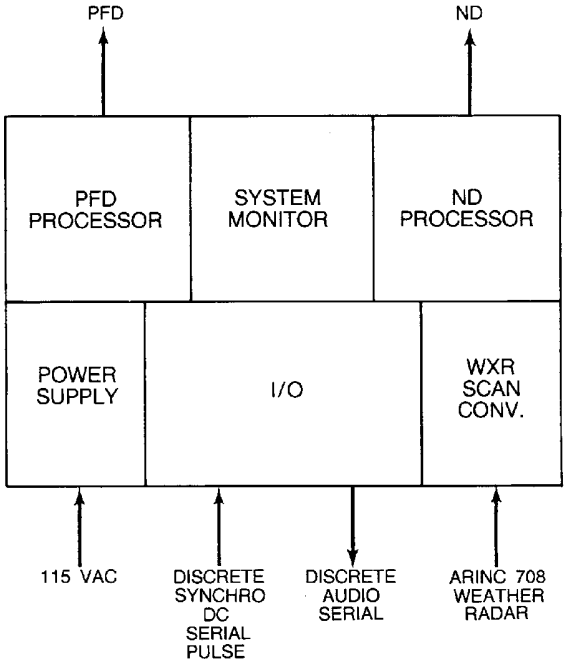
EFIS Block Diagram
Figure 2/34-22-00-990-B14 (Sheet 1 of 2)



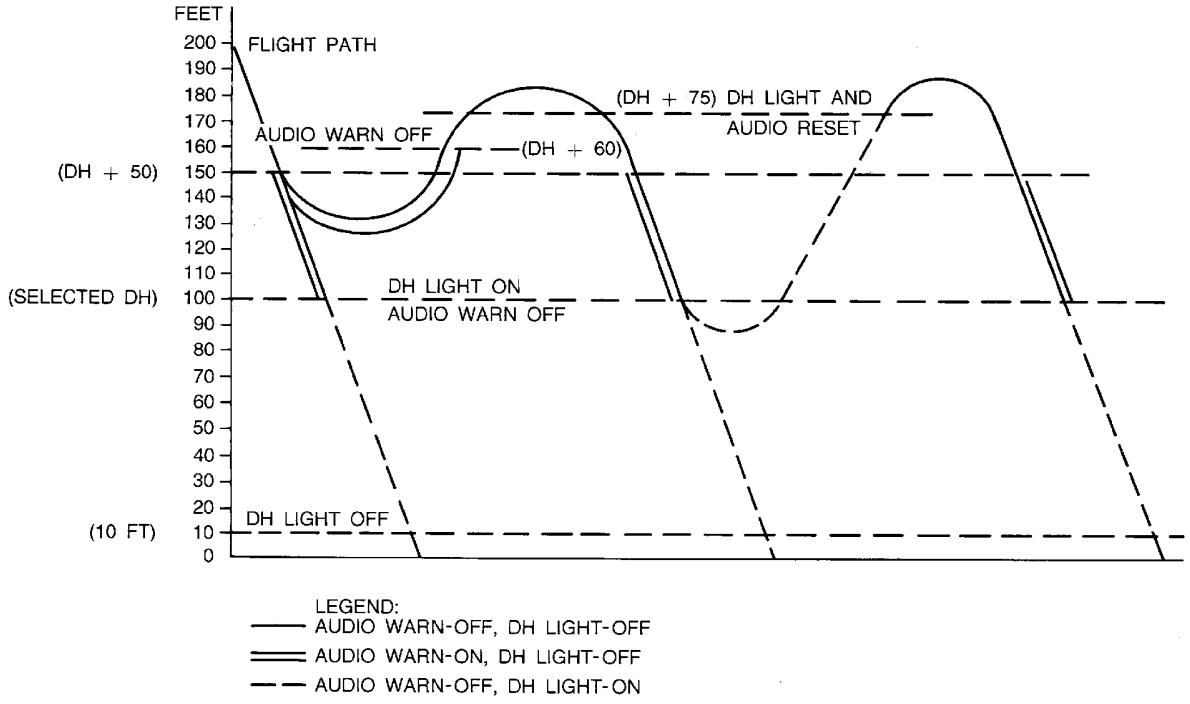
EFIS Block Diagram
Figure 2/34-22-00-990-B14 (Sheet 2 of 2)



EFIS -- System Interface Diagram
Figure 3/34-22-00-990-B15

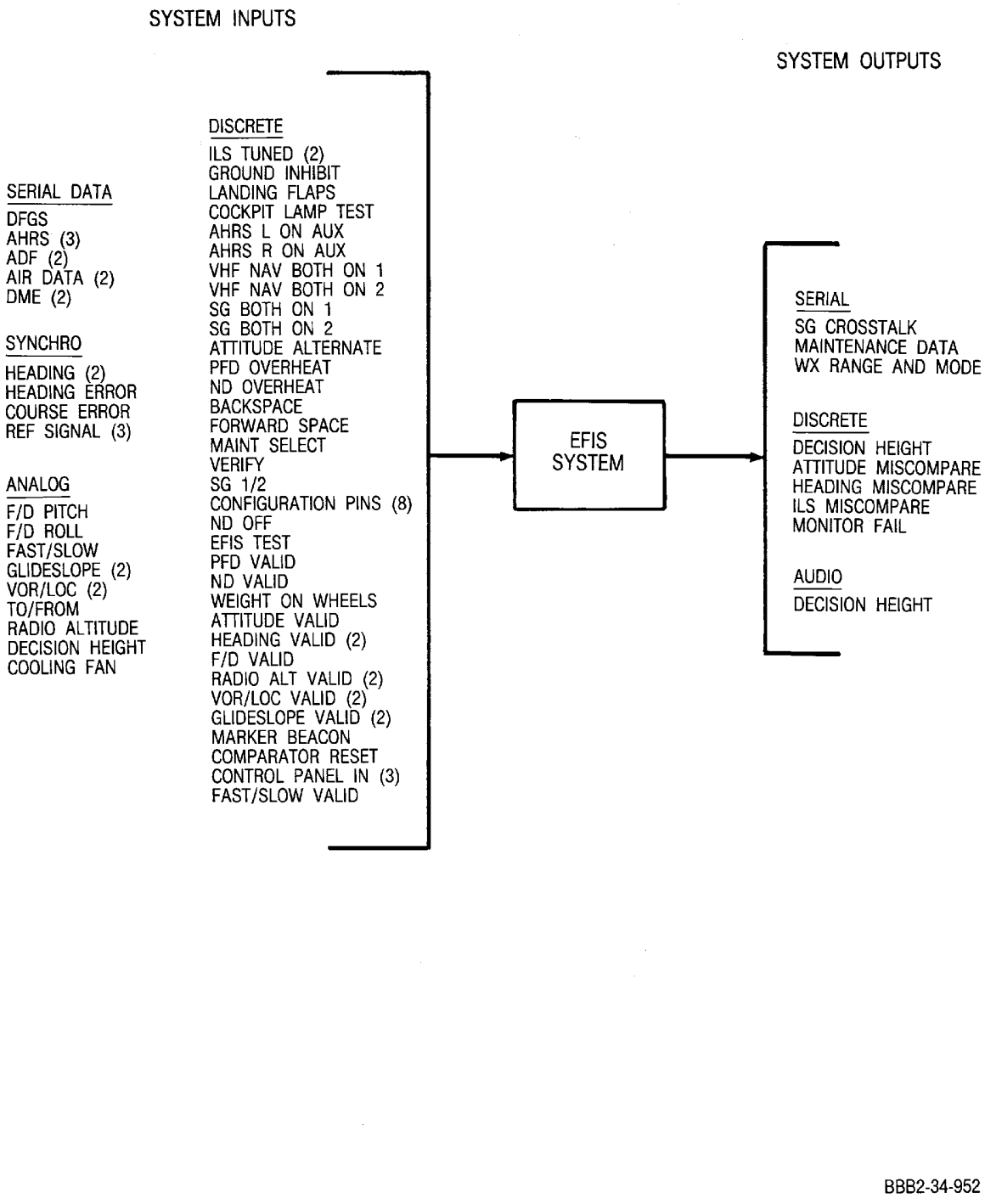


EFIS Symbol Generator -- Component Diagram
Figure 4/34-22-00-990-B16

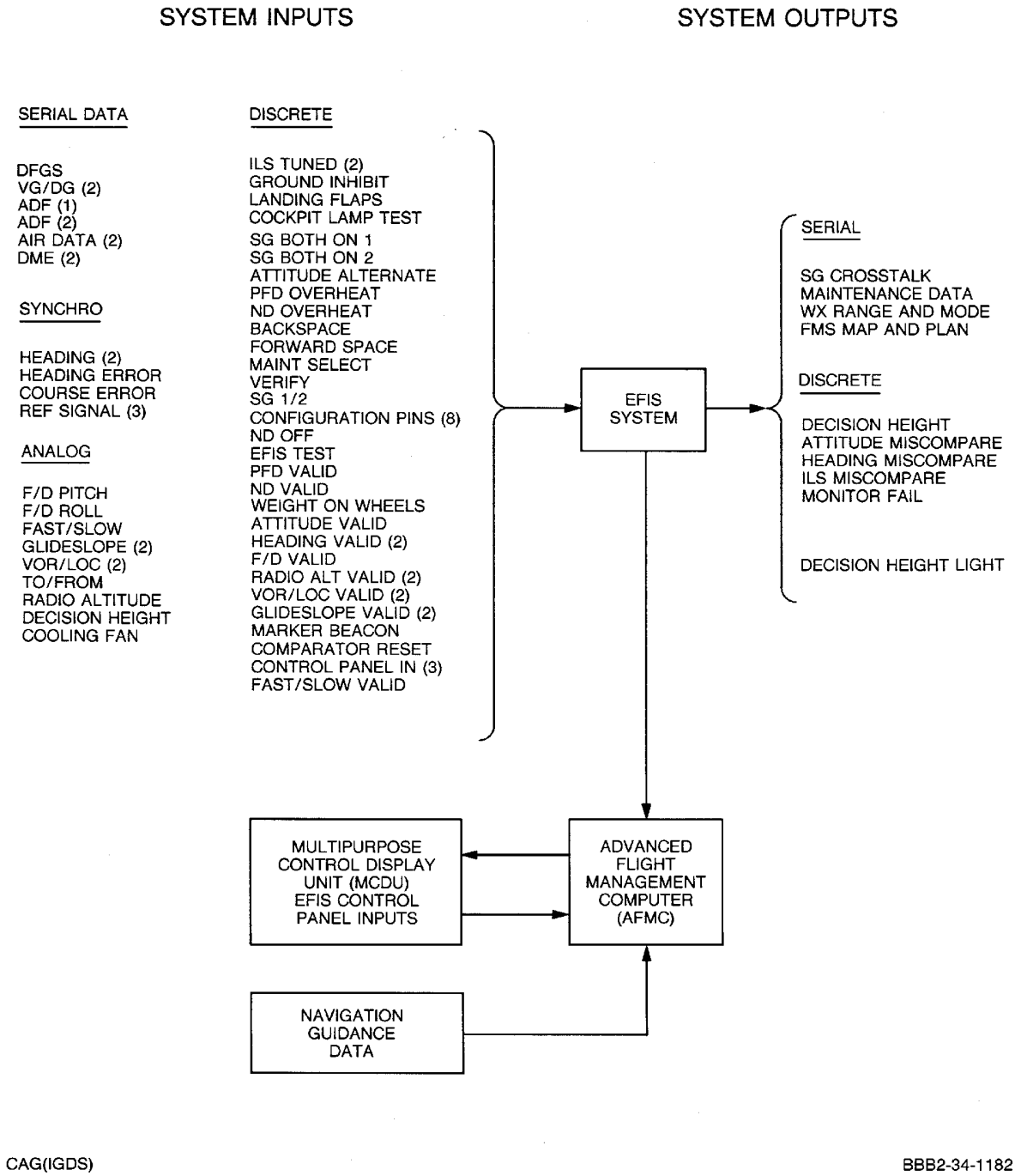


BBB2-34-951

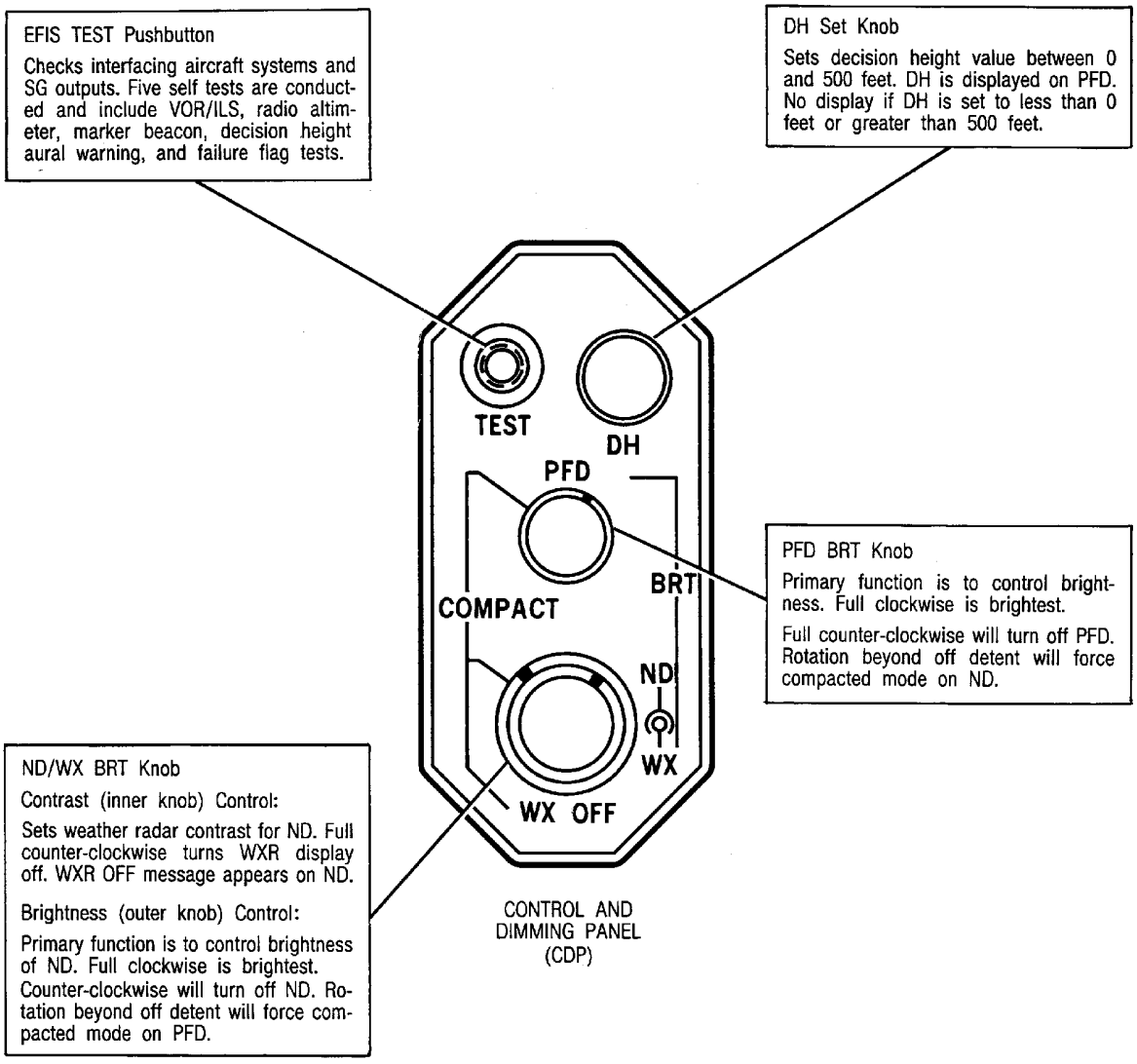
EFIS Audio Output
Figure 5/34-22-00-990-B17



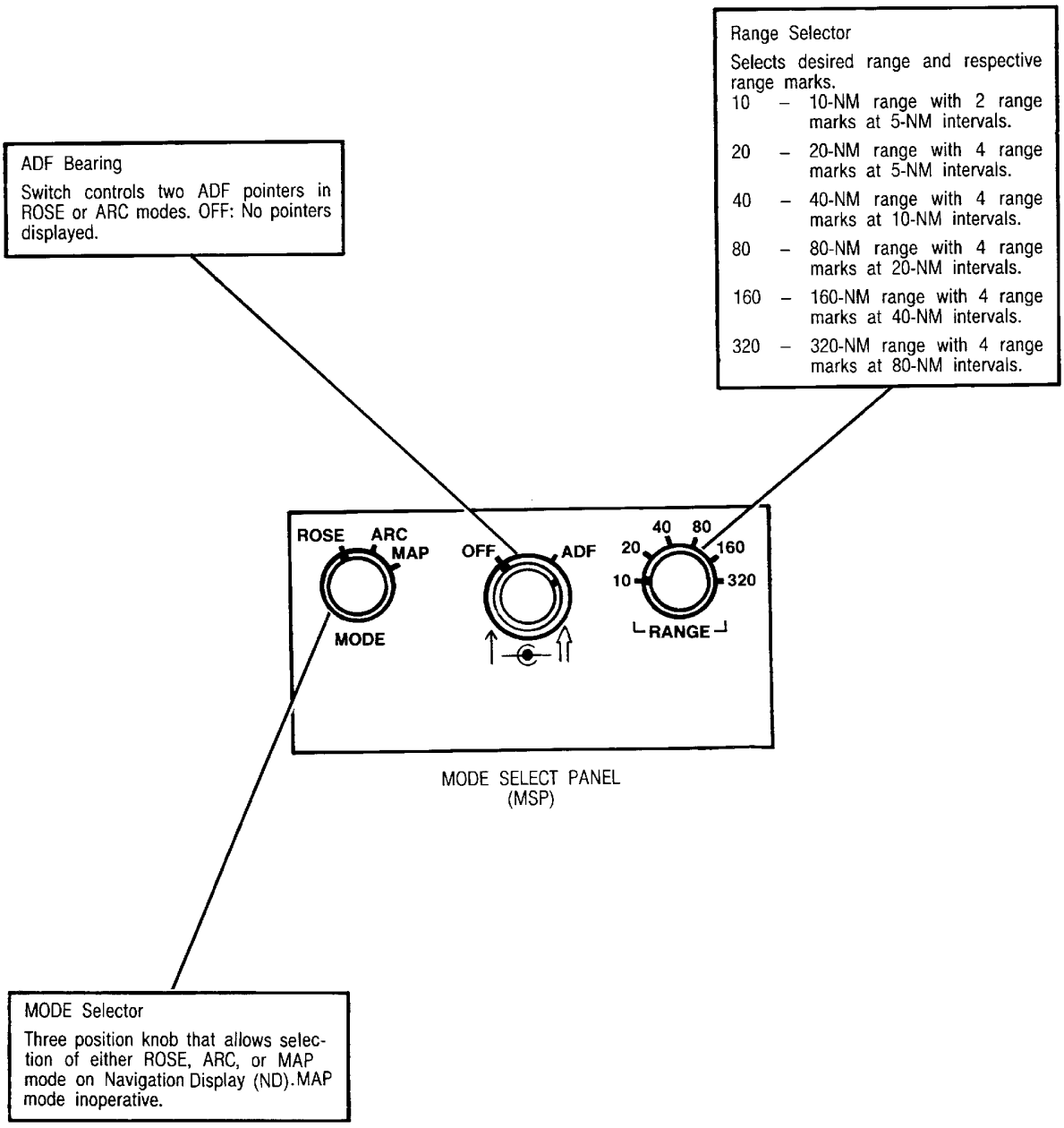
EFIS Inputs and Outputs
Figure 6/34-22-00-990-B18 (Sheet 1 of 2)



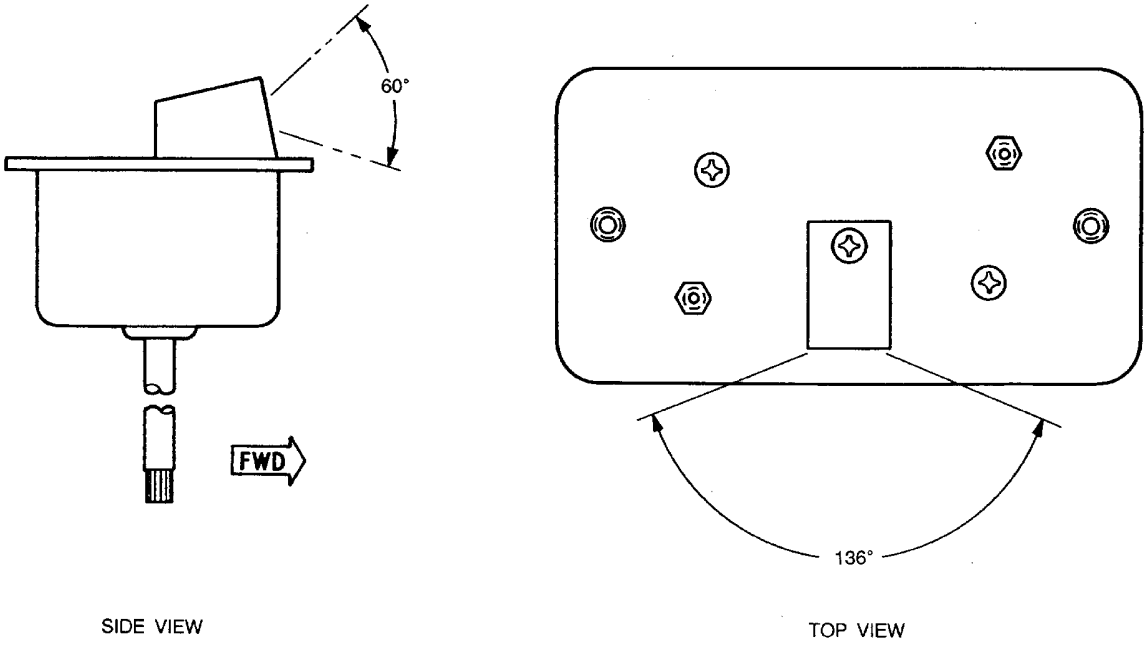
EFIS Inputs and Outputs
Figure 6/34-22-00-990-B18 (Sheet 2 of 2)



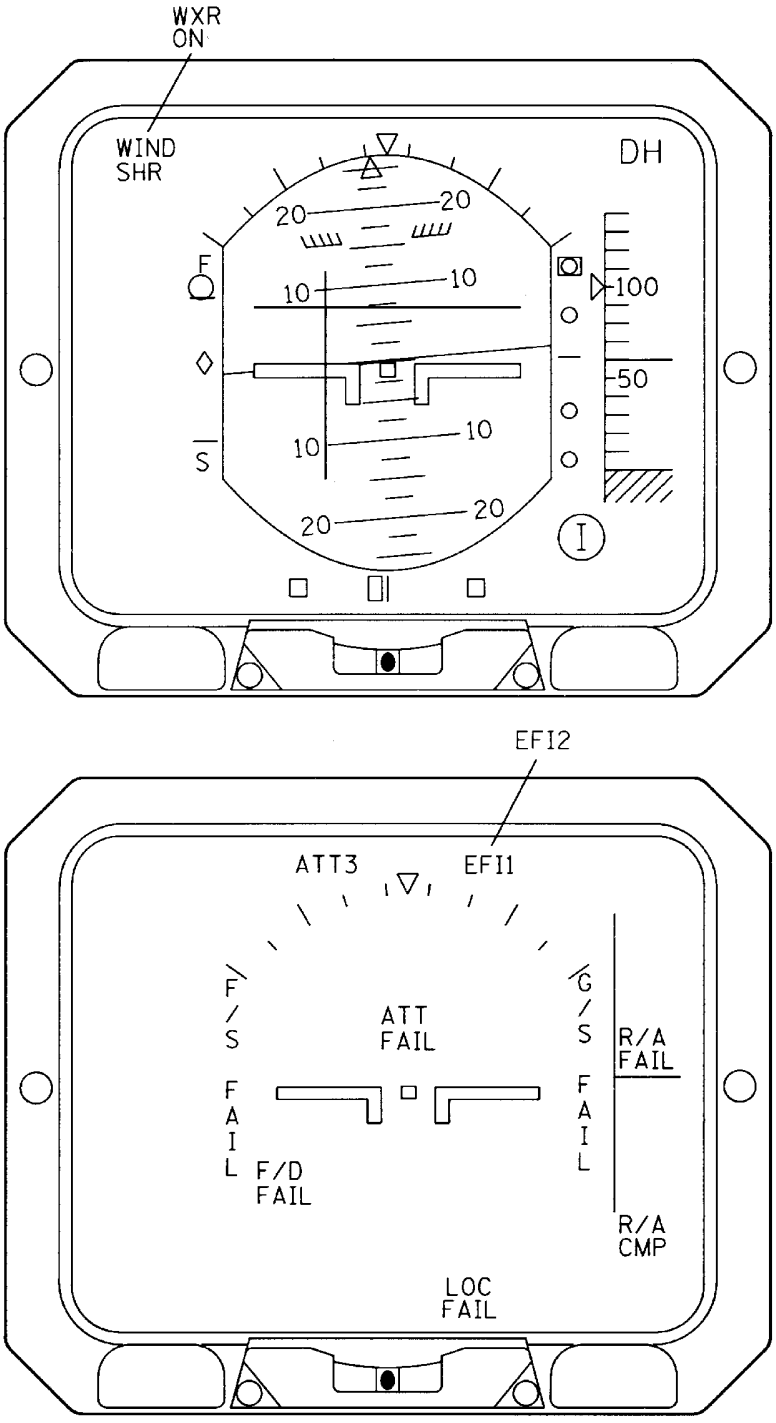
EFIS Control and Dimming Panel
Figure 7/34-22-00-990-B19



EFIS Mode Select Panel
Figure 8/34-22-00-990-B20



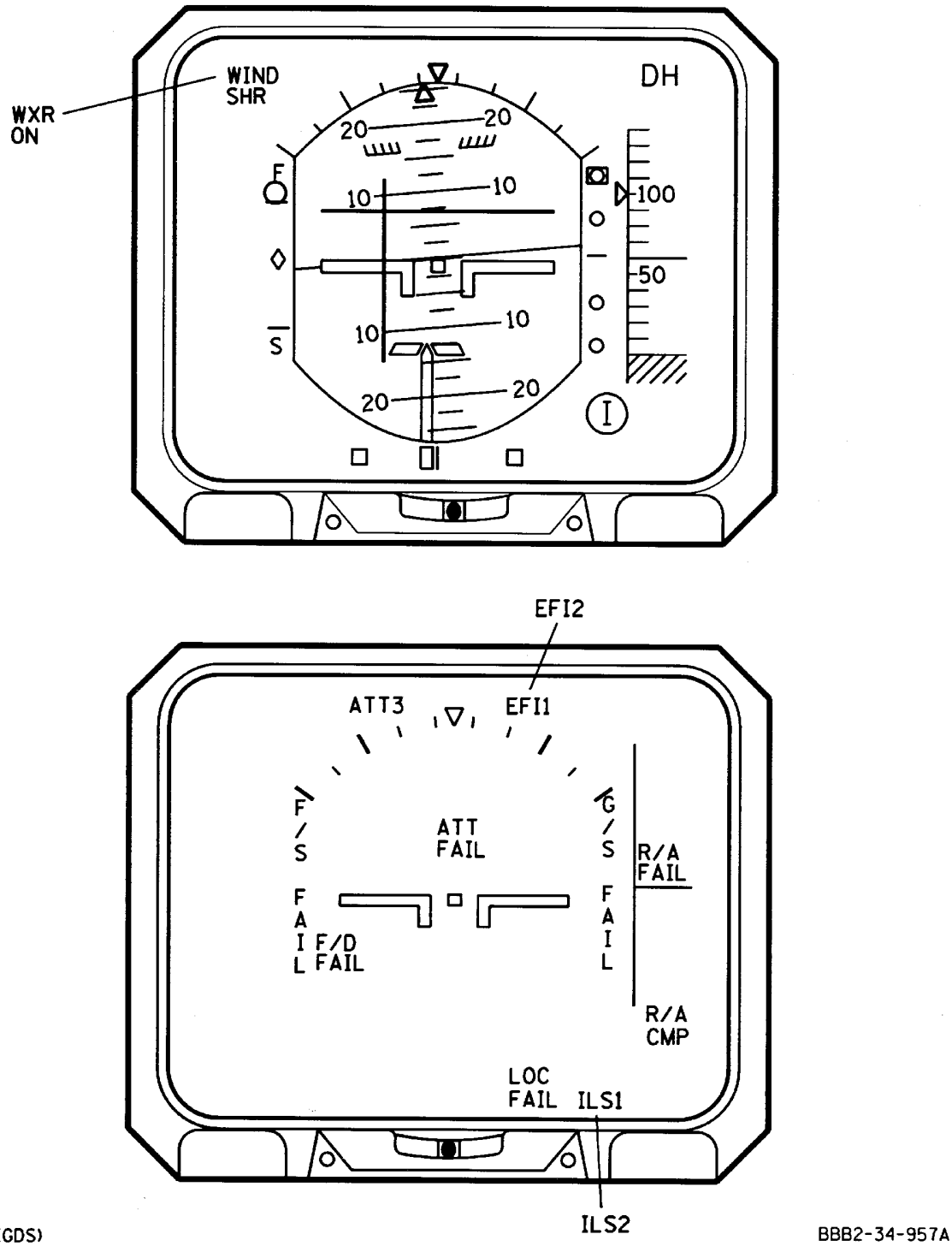
EFIS Remote Light Sensor
Figure 9/34-22-00-990-B21



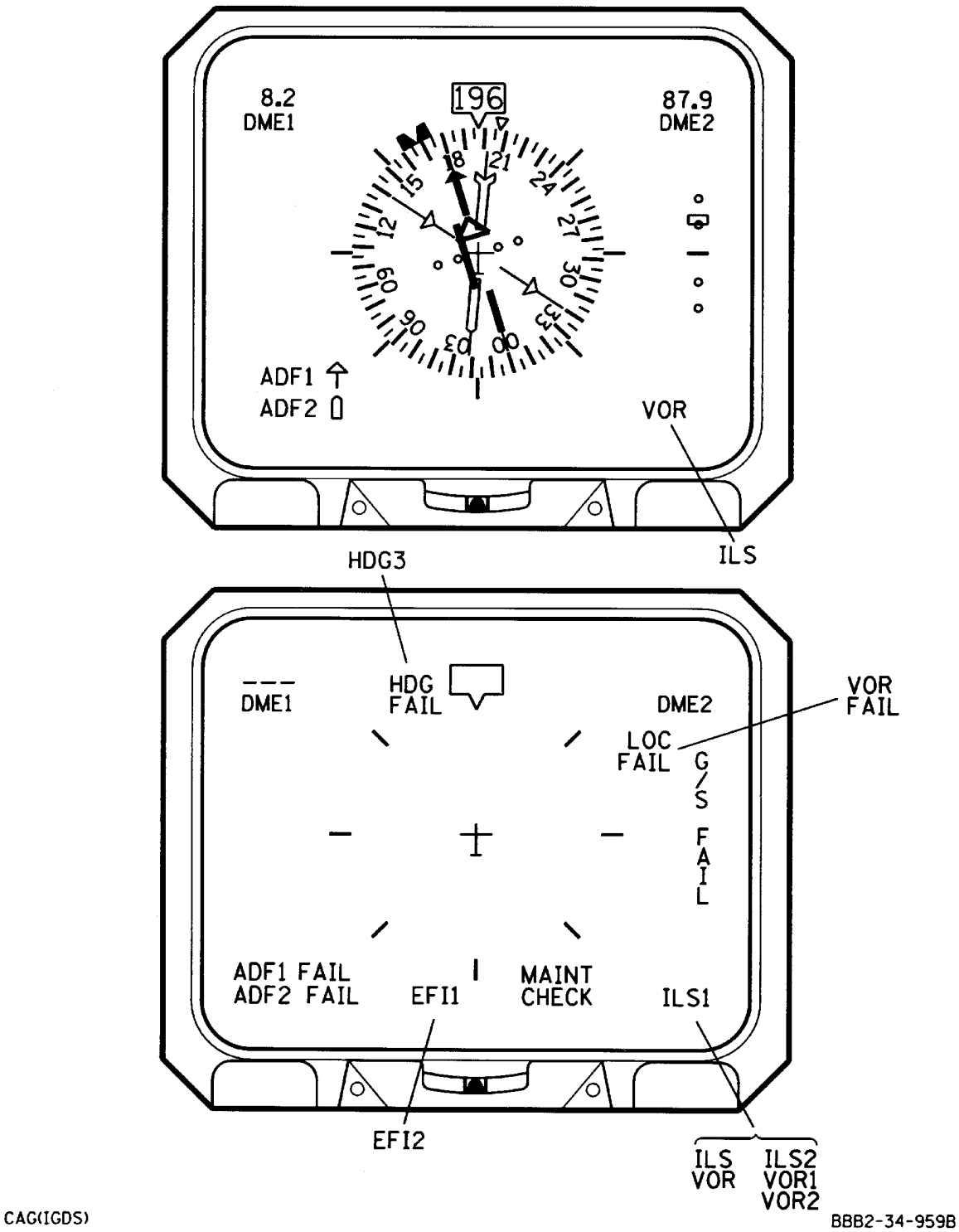
CAG(IGDS)

BBB2-34-958A

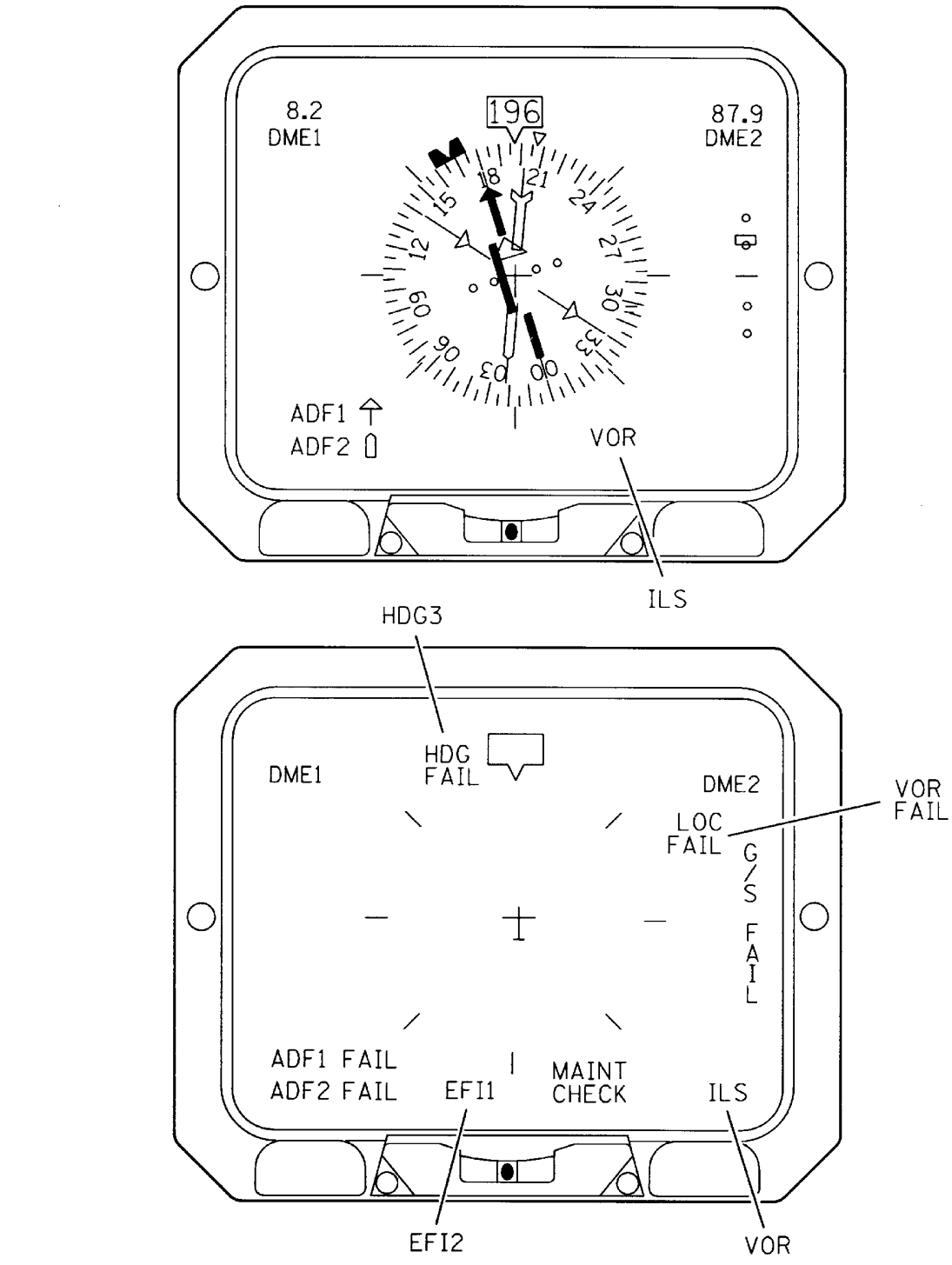
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-B22 (Sheet 1 of 2)



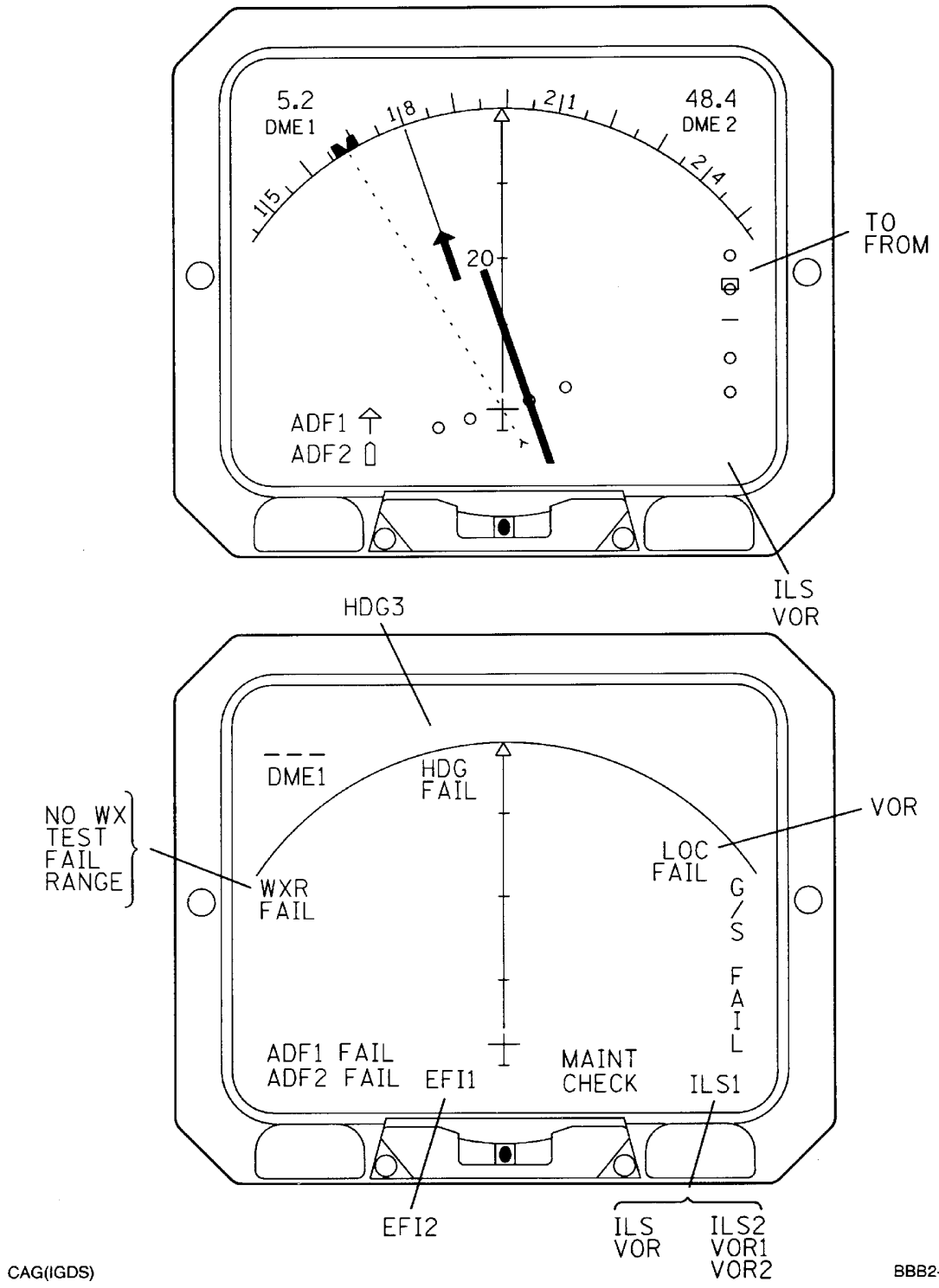
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-B22 (Sheet 2 of 2)



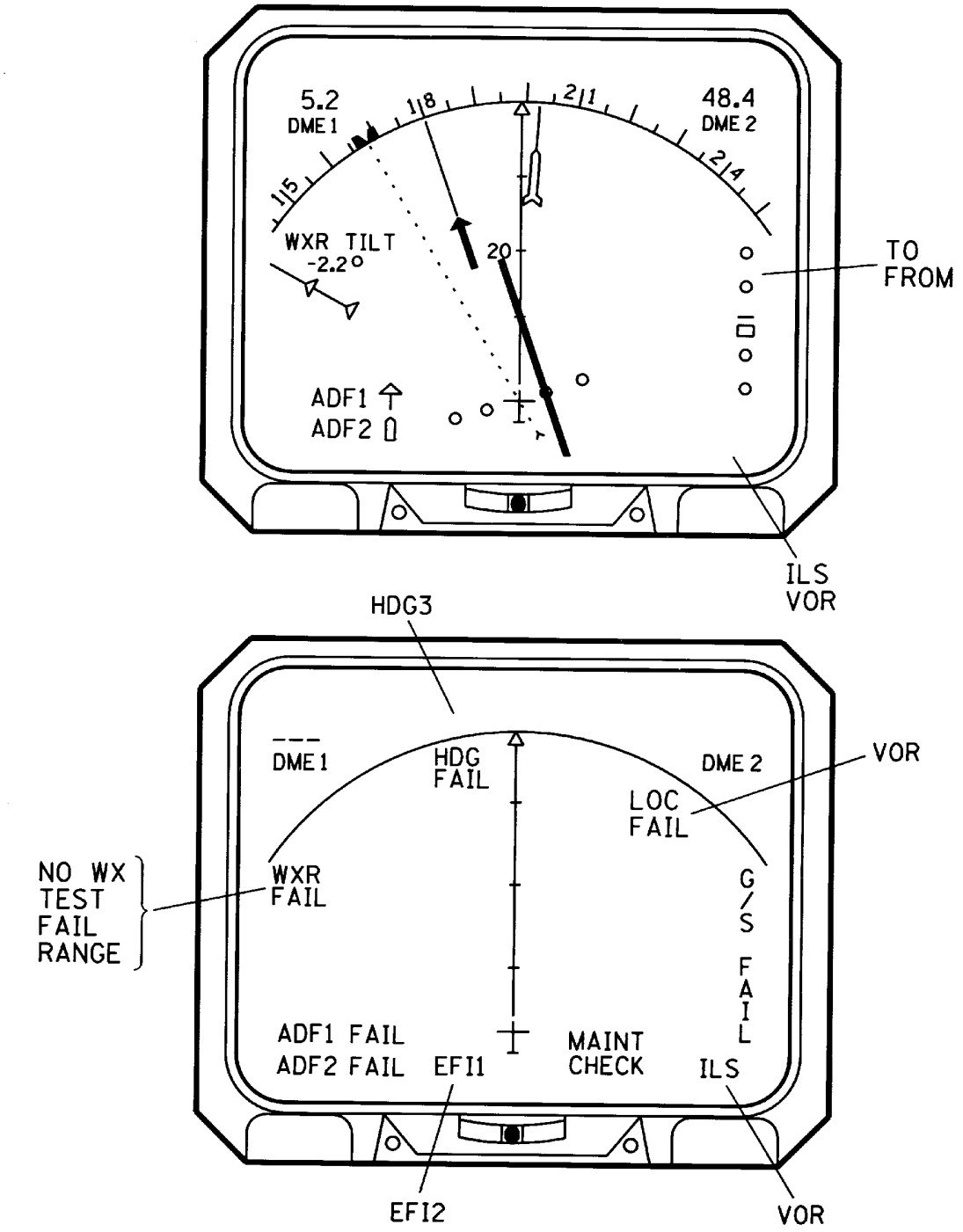
Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-B23 (Sheet 1 of 2)



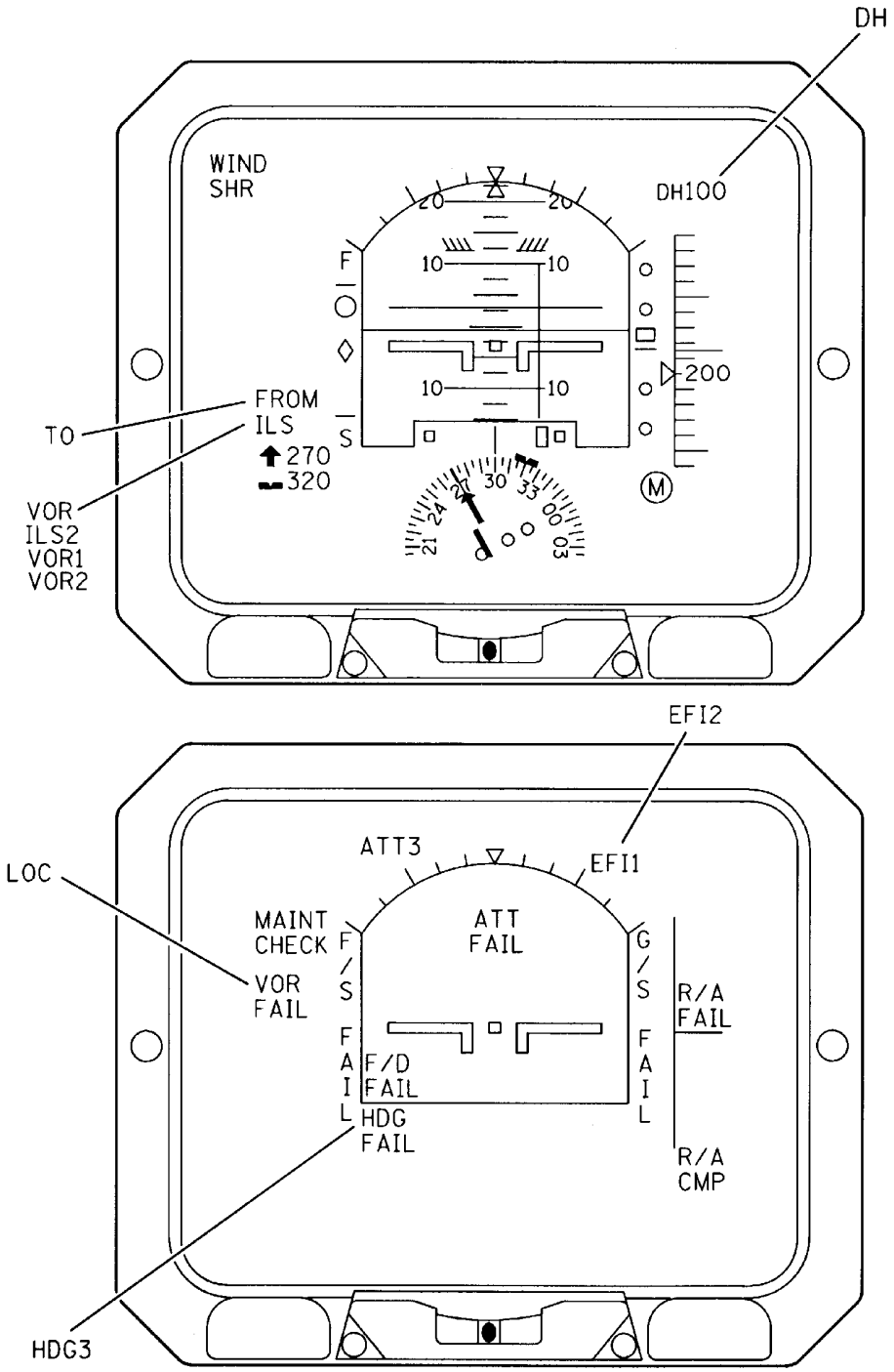
Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-B23 (Sheet 2 of 2)



Navigation Display -- ARC Mode (with Flags and Warnings)
Figure 12/34-22-00-990-B24 (Sheet 1 of 2)



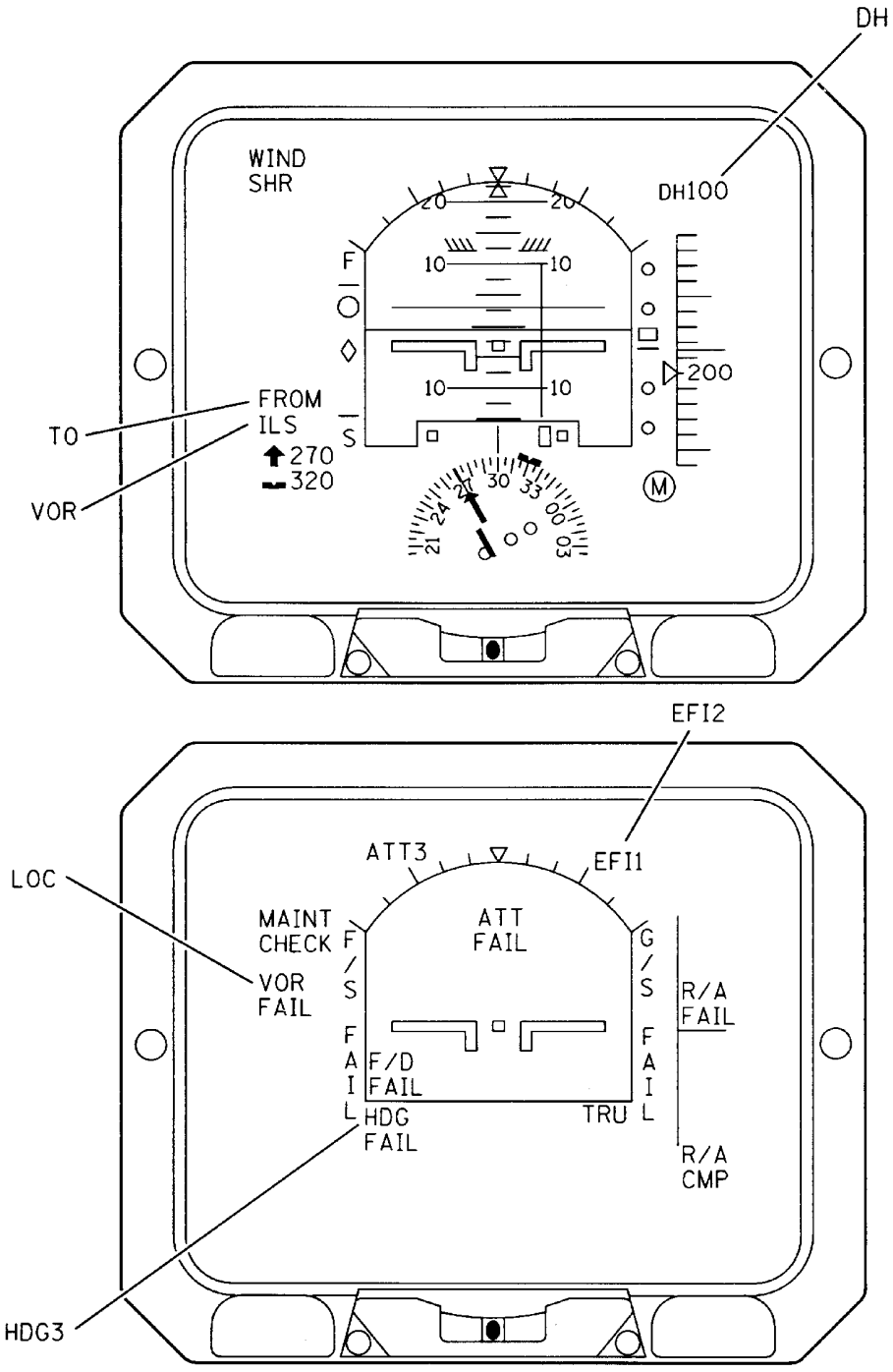
Navigation Display -- ARC Mode (with Flags and Warnings)
Figure 12/34-22-00-990-B24 (Sheet 2 of 2)



CAG(IGDS)

BBB2-34-963A

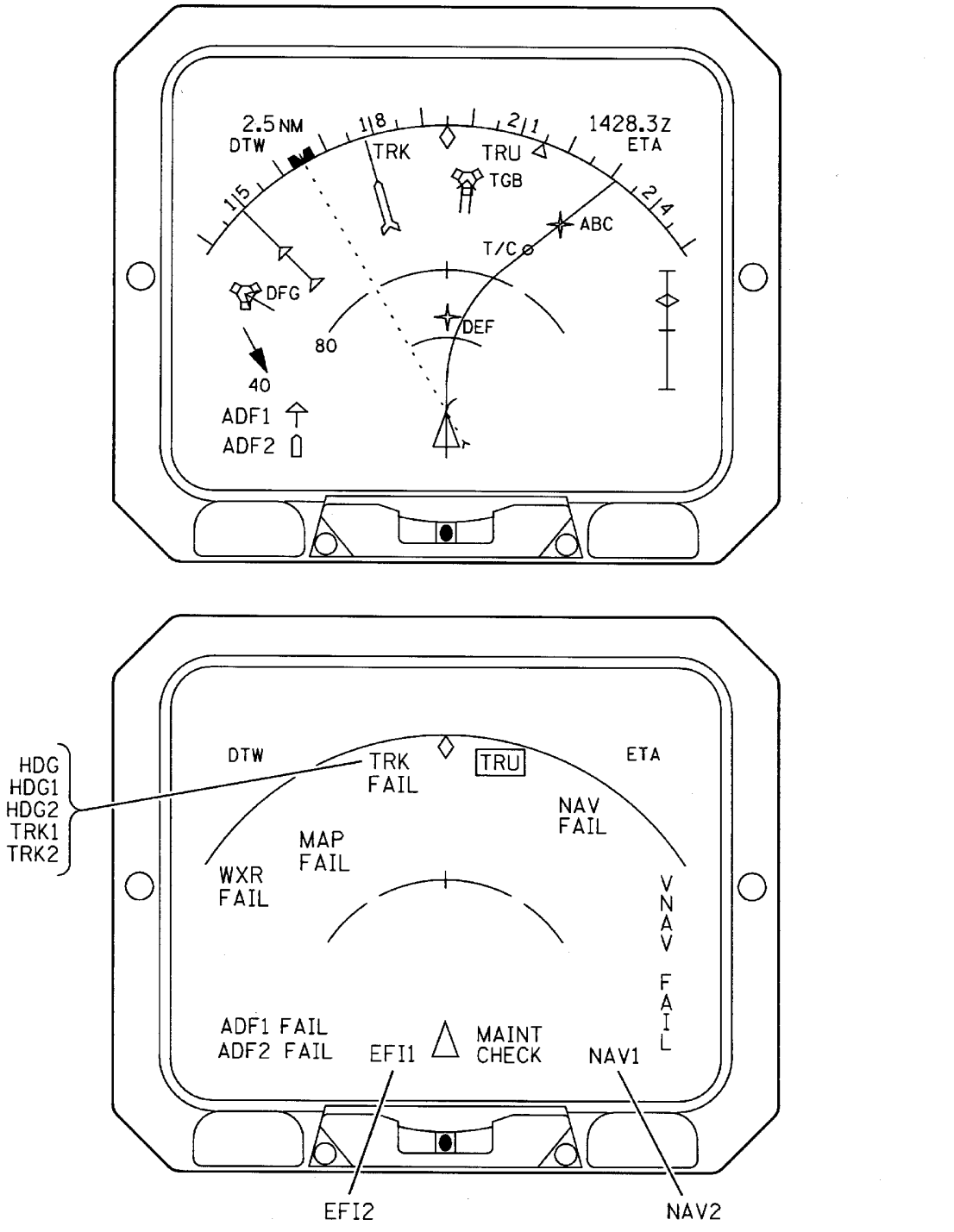
Compacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-B25 (Sheet 1 of 2)



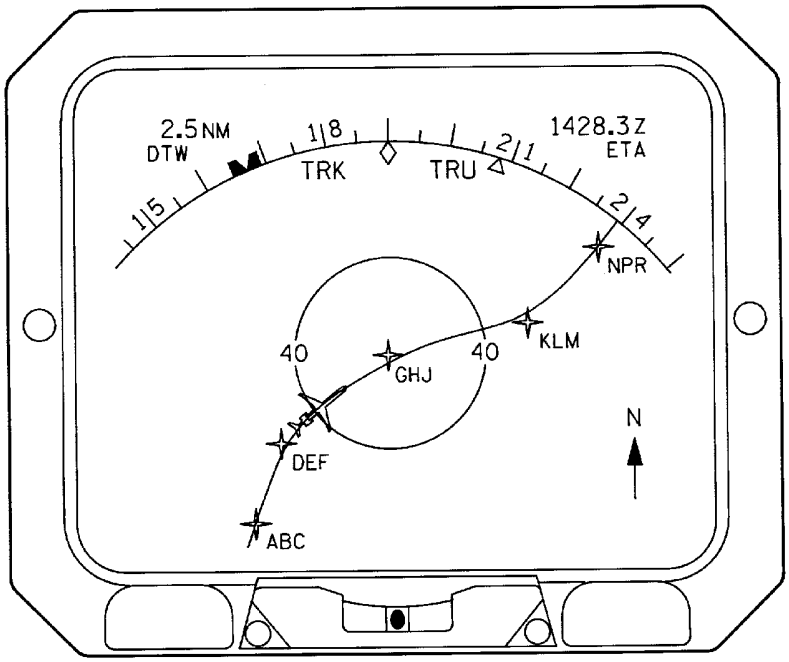
CAG(IGDS)

BBB2-34-964A

Compacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-B25 (Sheet 2 of 2)



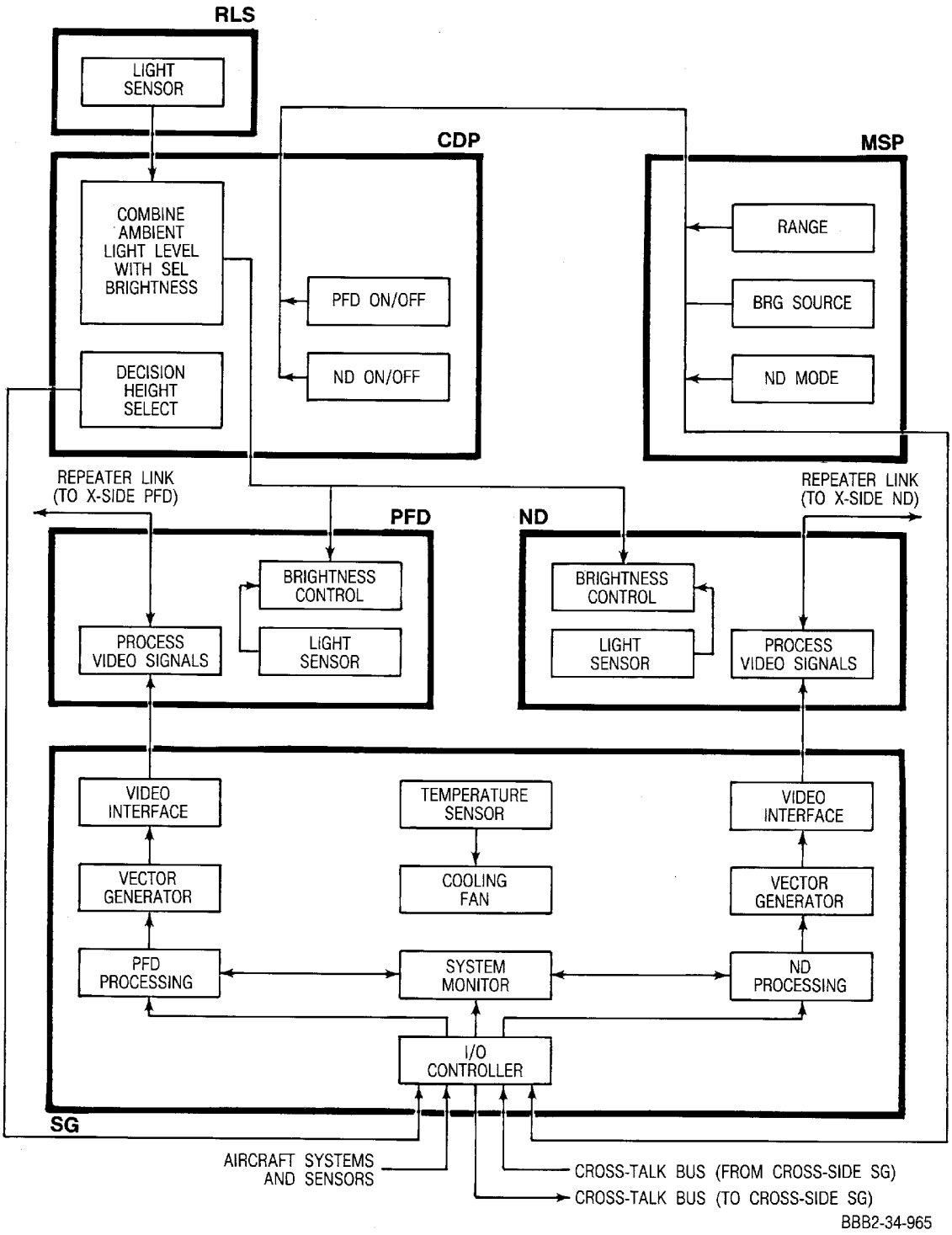
Navigation Display - MAP Mode (with Flags and Warnings)
Figure 14/34-22-00-990-B26



CAD(IGDS)

BBB2-34-1147

Navigation Display - PLAN Mode
Figure 15/34-22-00-990-B27



EFIS -- Block Diagram (Single Side)
Figure 16/34-22-00-990-B28

	Left Symbol Generator Inputs (SG-1)		Right Symbol Generator Inputs (SG-2)	
Sensor	"A" Display	"B" Monitor	"A" Display	"B" Monitor
AHRS Triple	AHRS1	AHRS3	AHRS2	AHRS3
Course Error	Crs Err1	Crs Err2	Crs Err2	Crs Err1
Radio Altitude	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

BBB2-34-966

SG Display/Monitor Sensor Inputs
Figure 17/34-22-00-990-B29

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Inoperative
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

BBB2-34-967

Symbol Generator Operating Modes
Figure 18/34-22-00-990-B30 (Sheet 1 of 2)

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency. This mode is identical to ILS mode, but provides additional ILS deviaiton warnings for CAA-certified aircraft.
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

BBB2-34-981

Symbol Generator Operating Modes
Figure 18/34-22-00-990-B30 (Sheet 2 of 2)

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99	10 feet	No FMA Annunciation		R/A CMP
	100-499	(0.1)(Average R/A) feet	Both R/A CMP displays steady		
	500-2500	(0.1)(Average R/A) feet + 10 feet			
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

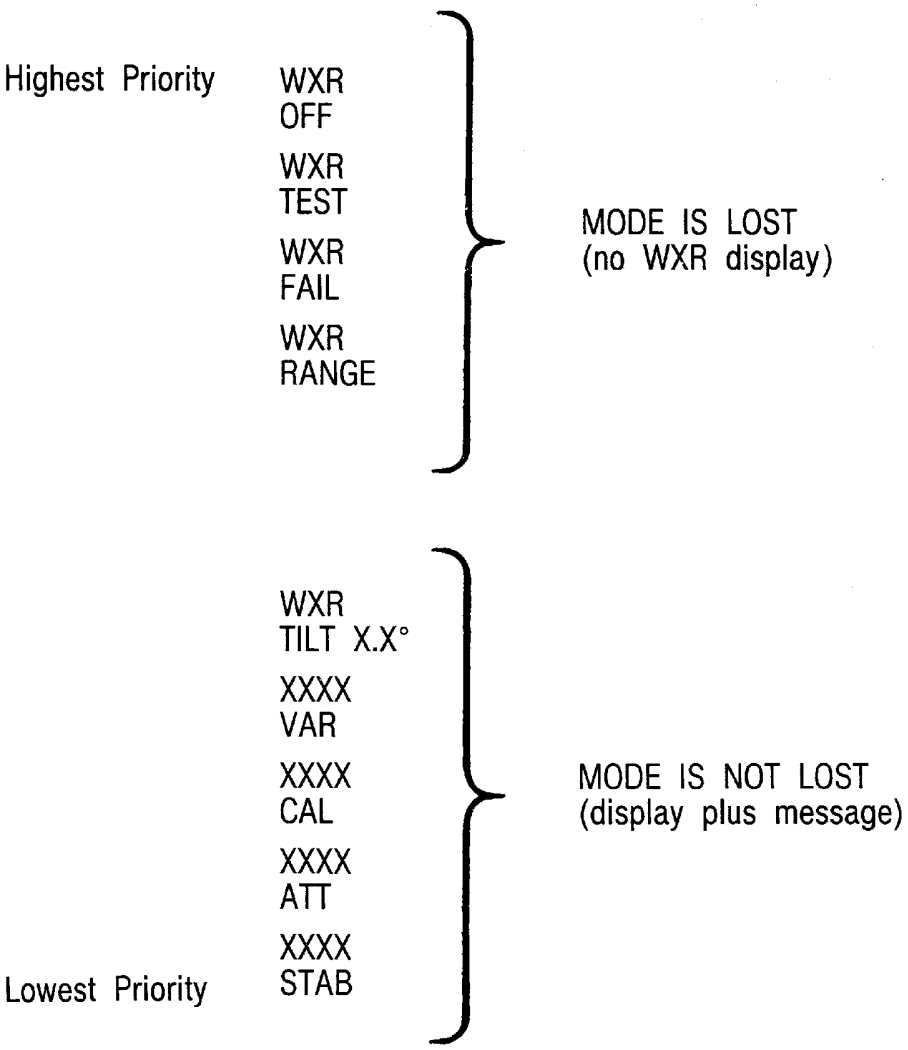
BBB2-34-968

FMA Annuciations for SG Instrument Comparator Function
Figure 19/34-22-00-990-B31 (Sheet 1 of 2)

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS, LAND	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
	LAND only	+1.2 dot or −1 dot for 0.25 sec.	Flashing ILS on-side		Flashing G/S pointer
		+.27 dot for 0.5 sec.	Flashing ILS on-side		Flashing LOC pointer
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS, LAND	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99 100-499 500-2500	10 feet (0.1)(Average R/A) feet (0.1)(Average R/A) feet + 10 feet	No FMA Annunciation Both R/A CMP displays steady		R/A CMP
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

BBB2-34-982

FMA Annuciations for SG Instrument Comparator Function
Figure 19/34-22-00-990-B31 (Sheet 2 of 2)



Weather Radar Message Priority
Figure 20/34-22-00-990-B32

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 21/34-22-00-990-B33

2. Operation

A. Overview: The Symbol Generators (SG's) are the master control units for the EFIS. Their job is to receive input data from aircraft sensors and systems, check the data for presence and validity, compute the display parameters for the display units, and transmit display data to the display units.

(1) The SG's are also responsible for monitoring the EFIS, for performing continuous self-tests, and for logging faults in the flight log. System monitoring includes input monitoring, SG-internal monitoring, control panel monitoring (CDP and MSP), and display unit (DU) monitoring. Each SG also monitors the cross-side SG and performs a navigation instrument comparator monitor function.

(2) The EFIS logs its own failures, and failures of all interfacing aircraft systems. In-flight failures are stored in a flight log for later retrieval by maintenance personnel. The EFIS has an extensive built in test (BIT) capability, comprised of both continuous BIT (for continuous in-flight monitoring) and initiated BIT (used only in maintenance and preflight tests).

(3) The EFIS system operation is presented in the following sequence:

(a) Overview

(b) EFIS Inputs, Outputs and Data Flow

(c) System Monitoring

(d) Built In Test and Ground Maintenance

B. EFIS Inputs, Outputs and Data Flow: Navigation data are sent from the various aircraft systems and sensors to the SG Input/Output (I/O) controller for processing. The I/O controller writes all input data to each of the symbol generator processors: the PFD and ND processors, and the system monitor processor (Figure 16). Input data are checked for presence and validity, processed, and sent to the PFD and ND for display. The display data are also sent to the cross-side SG for comparison purposes. Display format and brightness are controlled from the Control and Dimming Panel (CDP) and from the Mode Select Panel (MSP).

(1) Each EFIS display is driven by its own display processor, vector generator, and video interface. The system monitor processor in the SG verifies the proper operation of each of the display processors. There are separate PFD and ND display output channels from the SG. Each display output channel consists of six digital output signals and two analog output signals which contain color settings, raster control, display mode setting (raster/stroke), and X-and Y-beam deflection signals. The SG receives a digital ready signal from the PFD and ND when the display deflection amplifiers are ready to write.

(2) Weather radar signals are sent to the WXR scan converter. This digital circuit is designed to convert the color WXR signal to EFIS color display format. The resultant map is an offset center sector scan, oriented with heading up in the ARC mode. The displayed sector is variable from +45 degrees to +90 degrees, as determined by the radar. The display map can be rotated and translated in response to aircraft heading and positional changes. Range marks and NAV marks are generated by the display generator in the ND processor. Range is controlled from the Mode Select Panel (MSP). An on-board test pattern generator provides a visual means of operational verification. The ND processor accesses the necessary hardware in the scan converter to control the source and display of the WXR data.

(3) Data from the on-side SG enters the DU through the primary display data input port. Each DU also has a secondary display data input port through which cross-side video signals may be sent/received. These bi-directional cross-side port lines are used in the event of a SG failure. By placing the EFIS source select switch in the BOTH ON 1 or BOTH ON 2 position, display data may be transferred directly from the PFD and ND on the functioning side to the cross-side DU's. The compacted PFD/ND display (reversionary mode) is obtained whenever one of the two system display units is turned off. This allows dual system operation should one of the display units fail.

(4) There are two brightness command signals for each DU: a brightness level command and a raster/stroke contrast ratio command. The raster/stroke contrast ratio is set to a default level for the PFD, compacted PFD/ND, and ND-ROSE displays to provide standard levels of raster shading for the ADI sky/ground shading and for the background scale shading. The voltage ratio is variable for the ND-ARC format, to allow the intensity of the weather radar imagery to be varied.

C. System Monitoring: System monitoring is designed to detect failures that may affect operation of the EFIS. EFIS monitoring consists of:

(a)	Input monitoring
(b)	Symbol Generator internal monitoring
(c)	SG-to-SG instrument comparator monitoring
(d)	Control panel monitoring
(e)	Display Unit monitoring
(f)	Weather radar input monitoring

(1) Input Monitoring: Input monitoring verifies that sensor or system inputs are present and valid, and that the SG input hardware is functioning properly. Input monitoring consists of:

(a) Input Data Monitoring: Analog and digital inputs to the SG are continuously monitored for presence and validity. If an input parameter is missing, invalid or out of range, the SG will remove all symbology dependent on the input from the PFD/ND. An appropriate failure message will be displayed where the data would normally appear on screen. The symbology will not be re-drawn until the valid has returned for a minimum period of time.

(b) SG Input Hardware Monitoring: The SG monitor processor tests input hardware by feeding test values to the analog, synchro and digital input hardware.

1) Analog input hardware monitoring: The analog input hardware test verifies proper operation of the A-to-D conversion function. Failure of the analog input test will result in failure annunciation of all analog signals associated with the failed multiplexer. This test is performed at a 20 Hz rate.

2) Synchro input hardware monitoring: The synchro input hardware performs a bias test which verifies proper operation of the synchro to sin/cos conversion and demodulation network. This test is performed upon a cold start or during system testing.

3) Digital input hardware monitoring: Digital input receivers are continuously tested by sending test words from the four controlling transmitters to each of the receivers. When a receiver is in test mode, the monitor receives, checks and clears the test inputs. If an error is detected on two or more of the four test signals received, the receiver is inoperable, and appropriate symbology is blanked or flagged.

(2) Symbol Generator internal monitoring: consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. (Paragraph 1.E.)

(3) SG-to-SG Instrument Comparator Monitoring: The SG receives two types of sensor inputs: "A" (on-side) inputs for display on the on-side DU's, and "B" (off-side) inputs for monitoring the cross-side SG (Figure 17). The SG performs a Nav Instrument Comparator Monitor (NICM) function by comparing the following "A" and "B" parameters:

- ILS (localizer and glideslope deviations)
- Attitude (pitch and roll)
- Heading
- Radio Altitude.

(a) If significant cross-channel differences are found between the "A" and "B" values of ILS, attitude or heading parameters, the SG's will signal the discrepancy on the FMA. The ILS, ATTITUDE or HEADING annunciator will flash on the side associated with the fault, and glow steady on the cross-side FMA. A flag and/or warning will also appear on the display screen. Radio Altitude mis-compare is annunciated on the PFD by a "R/A CMP" message. Flashing logic is the same as for the other parameters. Mis-compare annunciations will clear automatically if the deviation returns to within limits. They may be manually cleared on the FMA by resetting the FMA annunciator. Loss of valids results in annunciations on both FMA's, removal of faulty parameters from the screen, and display of fail messages. (Figure 19)

(b) The MONITOR annunciator on the FMA is used to signal SG failures in one of three conditions. The first condition involves internal SG tests which are performed under the direction of the system monitor processor. These tests are performed at a 2 Hz rate, and the results compared with the cross-side system results. When a mis-compare occurs on either side, both MONITOR annunciators come on. The second condition occurs when the SG-to-SG cross-talk link fails due to invalid or interrupted updates. This also will cause both MONITOR annunciators to come on. Third, when a SG fails, the remaining SG continues to monitor its own displayed data, but the comparison function is deactivated; the MONITOR annunciator will come on, on the failed side.

(c) There are six distinct SG-to-SG Instrument Comparison Operating Modes (Figure 18). The operating mode determines if, and when, the NICM annunciators on the FMA will come on. These modes are prioritized from Cruise mode (5 - lowest priority) to Test mode (1 - highest priority). Higher priority modes will always override lower priority modes. During the course of the flight leg, the system will primarily operate in Cruise mode.

(4) Control Panel monitoring: verifies correct operation of the Control and Dimming Panel and Mode Select Panel. (Paragraph 1.G.) and (Paragraph 1.H.)

(5) Display Unit monitoring: verifies that the DU is receiving display data. (Paragraph 1.F.)

(6) Weather Radar Input monitoring: The SG weather radar (WXR) scan converter converts color WXR signals to a format suitable for display on an EFIS color display unit. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages. If the mode is lost, warnings will appear on screen, but there will be no WXR display (Figure 20).

WXR messages are prioritized as follows:

WXR OFF - WXR BRT knob is OFF on CDP, or DU overheat condition

WJE 406

WXR TEST - System in TEST mode. Test pattern is displayed.

WJE 407, 408, 411

WXR TEST - System in TEST mode. Test pattern is displayed, plus R/T fault messages including:

R/T - receiver/transmitter fault

ANT - antenna fault

CNTL - control fault

ATT - attitude fault

CAL - calibration fault

RANGE - range fault (MSP fault)

COOL - R/T unit cooling fault.

WJE 406-408, 411; PRE SB 34-285 REV 3

NOTE: If any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

NOTE: Range information from the WXR R/T is compared with the range selected on the EFIS Mode Select Panel. If they disagree for five seconds or more, the WXR RANGE message is displayed. EFIS will default to 40nm if the MSP fails, and display 40nm of weather radar.

(7)

NOTE: f any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

NOTE: Range information from WXR R/T (if installed) is compared with range selected on EFIS Mode Select Panel. If they disagree for five seconds or more, WXR RANGE message is displayed. EFIS will default to 40nm if MSP fails, and display 40nm of weather radar.

XXXX VAR - WXR input sensitivity not calibrated to any precipitation rate (XXXX represents operating mode selected on WXR control panel).

XXXX CAL - loss of calibration

XXXX ATT - attitude input fault

XXXX STAB - stabilization is off

WXR TILT - momentarily annunciated on screen when antenna tilt angle is changed.

D. Built In Test and Ground Maintenance: The EFIS built in test (BIT) is designed to aid maintenance in isolating faults related to the EFIS and the systems with which it interfaces. There are two types of BIT for the EFIS: continuous BIT for in-flight monitoring, and initiated BIT for pre-flight and LRU functional checks. Other maintenance functions require interface with the Status Test Panel (STP) for in-depth system tests and fault isolation.

(1) Continuous BIT: Continuous BIT monitors the EFIS throughout each flight profile and logs all failures in the flight log for later retrieval by maintenance personnel. The EFIS logs its own failures, and also those of the aircraft systems with which it interfaces. The SG maintains a log in non-volatile memory of failures detected by the system monitors, whenever the system power is on. The continuous BIT logs the failure type and time of occurrence (time after start of flight leg). The log can contain 20 failures on each of the last 10 flight legs. Intermittent failures are recorded only once per hour of flight time. Continuous failures are recorded only once per flight leg. (Faults are also recorded while the aircraft is on the ground and the system is functioning.) Failures are retrieved via the Status Test Panel.

(2) Initiated BIT: Initiated BIT provides a means of self-testing the EFIS on the ground. Tests are initiated by pushing the TEST button on the Control and Dimming Panel. Tests include: initiated EFIS System Self-Test, Initiated Functional Self-Test and Initiated Cockpit Lamp Test. Initiated BIT is used both in preflight testing and in LRU functional checks (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201).

(a) EFIS System Self-Test (BIT) is initiated through the TEST pushbutton on the Dimming Panel. Test begins when the pushbutton is depressed, and ends approximately 3 seconds after release. This test includes:

- VOR/ILS Self-Test
- Radio Altimeter Self-Test
- Marker Beacon Self-Test
- Decision Height Aural Warning Test
- Failure Flag Test.

(b) The first three tests are under control of the associated receiver units (the EFIS is only used to display the input parameters). The decision height aural warning test and failure flag test are under the control of the SG. Failure flag annunciations appear on the DU screen only while the TEST pushbutton is being depressed. The Failure Flag Test annunciations for the various display screens are shown in Figure 21.

(c) EFIS Functional Self Test is used by maintenance personnel to verify proper installation and operation of the SG. This test is initiated via the Status Test Panel (STP), by calling up the SG SELF-TEST selection on the Maintenance Menu (see EFIS Ground Maintenance following). The test consists of a synchro bias test, a system RAM check and an SG cooling fan test. The test takes approximately 2 seconds. Upon completion, both display units show software part number, aircraft equipment/options configuration, and test results (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201). This test is inhibited except when aircraft is on the ground and weight-on-wheels discrete is set.

(d) The cockpit lamp test checks the EFIS lamp displays by driving the FMA comparison lamps. Approximately 0.5 seconds after release of the DIGITAL/ANNUN pushbutton on the Overhead, the ILS, HEADING, HORIZON and MONITOR lamps on the FMA come on for 5 seconds.

3. MD-80 -906 Symbol Generator (SG)

NOTE: The following applies per AOL 9-2524 dated April 8, 1997.

A. The -906 symbol generator change requirements include:

(1) Future air navigation system (FANS) requirements for global navigation systems (GNS).

No new wiring or interfaces are required. The existing ARINC 429 bus from the flight management computer (FMC) will supply additional labels to provide the needed input to display the requirement navigation performance (RNP) message, dead reckoning mode display revisions, and the air traffic control (ATC) message.

(a) RNP annunciation

RNP message shall be displayed (in medium size characters) on the primary flight display (PFD) and compact mode below the multifunction control display unit (MCDU) MSG annunciation. The FMC will transmit the following digital discrete on the existing ARINC 429 bus for the actual navigation performance (ANP)>RNP annunciation RNP.

The RNP message shall flash five seconds at initial trigger and then display steady. The RNP message shall also flash five seconds when transiting from one state to another.

Amber RNP shall have priority over white RNP.

(b) Dead reckoning mode

The symbol generator (SG) shall display the flight path on the navigation display (ND) as a dashed amber line in lieu of the current solid magenta line, 2.5 minutes after entering the dead reckoning mode.

(c) ATC message display

ATC messages shall be displayed, in medium size characters, in the upper left corner on the PFD and compact mode, in the same location as the current MCDU MSG message, when the ATC uplink has been received.

The ATC MSG shall flash at 1.25 Hz until the crew has acknowledged the message. Then it shall remain on steady. Once a response to the ATC uplink has been initiated, the ATC MSG shall be extinguished. If another ATC uplink is received while the ATC MSG is flashing, it shall continue to flash. If another ATC uplink is received while ATC MSG is steady, ATC MSG shall begin to flash again. ATC NO COMM message shall be displayed on the PFD and compact mode, when the FMC detects that ATC communication has been lost or interrupted.

A flashing message has priority over a steady message.

(2) Single system predictive windshear

No new wiring or interfaces are required. The existing ARINC 708 (ARINC 453) bus from the weather radar R/T (WXR) will supply additional label definitions to provide the needed input, and the existing symbol generator ARINC 429 ISDAS bus shall supply additional label definitions to provide the needed output to the digital flight data acquisition unit (DFDAU).

(a) Predictive windshear annuciation The predictive windshear (PWS) annuciation (WSHR AHEAD) shall be displayed in the upper left corner in the same location as the reactive windshear (WIND SHR) annunciation. The WXR R/T will transmit digital discrete on the existing ARINC 453 bus. All predictive windshear annunciations shall be in large size characters.

WSHR AHEAD shall be displayed in amber for a PWS caution and a red for a PWS warning. The annunciation shall flash three times upon initial onset and then remain steady. If PWS option is selected, the reactive windshear (RWS) logic shall be as follows:

1) If the RWS caution is detected and no PWS warning is detected, then WIND SHR shall be displayed in amber.

2) If the RWS caution is detected in conjunction with a PWS warning, then WIND SHR shall be displayed in red.

RWS warning (tail shear) annunciation shall remain the same. The symbol generator will perform signal flashing for PWS and RWS transitions and monitor the windshear computer for other than symbol generator initiated state transitions. There shall be a 1 frame hysteresis (i.e. 1 frame = 200 msec) for all state transitions. If PWS fail, bit 64, is high (1), indicating data valid, or if the ARINC 453 data is invalid (off or failed) then no PWS annunciation shall be displayed.

In order to provide a more rapid response to the PWS warning and PWS caution signals from the weather radar ARINC 453 bus, the data shall be read and processed for both pilots based on either of the control accept bits being active.

(b) Navigation display weather radar modes The windshear only mode, which is a new mode provided by the WXR R/T, shall be displayed as WSHEAR in the same location as the current WXR modes. The input requirement changes are additional bit definitions on label 055 on the existing ARINC 708 (ARINC 453) bus from the WXR R/T.

There is no change required for PWS raster display. The input is supplied by the same data stream as the current weather raster display. The WXR OFF and WXR FAIL logic shall remain unchanged except the timing window for the control and data bits shall be expanded to a 26 seconds on lieu of 18 seconds.

(c) Predictive windshear messages

WSHR OFF shall be displayed on the ROSE, ARC, MAP, PLAN, and compact mode. On the ARC and MAP modes, WSHR OFF shall be displayed in the same location as WXR OFF. WSHR OFF will be displayed in the same location on the ROSE and PLAN modes as it is on the ARC and MAP modes. On the compact mode, WSHR OFF shall be displayed in the same location as the current MAINT CHECK message. There is no requirement for PWS FAIL annunciation. WSHR OFF shall be displayed in cyan with the following logic, and shall have the highest priority over all the other XR modes. The WSHR OFF message shall have a 25 second time delay in order to prevent flickering at touchdown.

1) Weight on wheels (pin MP15D = ground) and PWS option pins selected and not ground inhibit (pin TP14G = open) and both captain and F/O WXR OFF.

2) Not weight on wheels (pin MP15D = open) and PWS option pins selected and radio altitude < 1300 feet (pin TP5D, TP5C) and radio altitude valid (pin TP8C) and both captain and F/O WXR OFF.

(d) DFDAU requirements

Additional bit definition on label 104 are required on the existing ISDAS bus to interface with the digital flight data acquisition unit (DFDAU).

(e) Two software option bits are required for PWS. One for Bendix installation and one for Collins installation.

(3) SG/VOR bearing fail nuisance fault log fix

The symbol generator fault log currently registers SG/VOR 1 BEARING FAIL X31-086 and SG/VOR 2 BEARING FAIL X31-128 faults whenever an ILS is tuned. The symbol generator is still expecting VOR bearing refresh data and logs the faults, when it fails to see the updates from the VOR/ILS receivers. With the -906 SG, when the VOR is out of range, the VOR/ILS will set the SSM bits to fail not NCD; the SG shall not log a fault in this case in order to aviod nuisance fault logging.

(4) Map fail fix

When runway heading of 180° is selected, the symbol generator erroneously replaces the MAP data with MAP FAIL for the remainder of the flight. After the aircraft has landed, the MAP recovers. This is corrected in the -906 SG.

(5) WXR ON message display priority

D/R message currently has priority over the WXR ON message. This priority should be reversed. The final priority for all messages should be as follows (highest to lowest):

- Reactive Windshear Warning (Red - WIND SHR)
- Reactive Windshear Caution and Predictive Windshear Warning (Red - WIND SHR)
- Predictive Windshear Warning (Red - WSHR AHEAD)
- Reactive Windshear Caution and No PWS Warning (Amber - WIND SHR)
- Predictive Windshear Caution (Amber - WSHR AHEAD)
- Weather Radar ON (WXR ON)
- ATC Message (ATC MSG)
- RNAV Message (MCDU MSG)
- ATC NO COMM Message (ATC NO COMM)
- Dead Reckoning (D/R or DR)

NAVIGATION DISPLAYS - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The Electronic Flight Instrument System (EFIS) replaces the conventional ADI and HSI on the Captain's and First Officer's instrument panels with four five-by-six inch color CRT display units. The upper units, the Primary Flight Displays, provide information normally found on the ADI, plus radio altitude, marker beacons, and Windshear Alert and Guidance System (WAGS) data. The lower units, the Navigation Displays, provide information normally found on the HSI, ADF bearing plus coordinated weather radar.

B. The EFIS interfaces with the Flight Management System (FMS) to provide FMS information display on the EFIS navigation display (ND) and the EFIS primary flight display (PFD). FMS data is displayed on the ND when the EFIS mode control panel selected mode is PLAN or MAP. The PFD displays speed error relative to the FMS command speed and displays MCDU MSG (Multipurpose Control Display Unit Messages) when an alert message appears on the MCDU. See Paragraph 1.O., EFIS/FMS Interface for description of FMS information displays on the EFIS, PFD, and ND.

C. The Electronic Flight Instrument System (EFIS) consists of two identical and independent systems (Figure 1). (FMS components and controls are shown.) Each system consists of the following:

Table 1

Component	Location
One Symbol Generator (SG)	Electrical/Electronics Compartment
Two CRT Display Units (PFD & ND)	Main Instrument Panel
One Control & Dimming Panel (CDP)	Main Instrument Panel
One Mode Select Panel (MSP)	Below Clearview Window
One Remote Light Sensor (RLS) (Shared by both systems)	Top of Glareshield.

(1) There are two switches which are also used in conjunction with EFIS:

(a) EFIS Source Select Switch: Located on the overhead panel, allows either system to be run from the cross-side Symbol Generator in the event of an on-side SG failure.

(b) EFIS/DFGC Toggle Switch: Located under the captains briefcase holder, allows ground maintenance personnel to use the Status Test Panel pushbuttons in conjunction with the EFIS display units in performing comprehensive system tests and troubleshooting.

D. System Displays:

(1) The Primary Flight Display (PFD) format displays aircraft attitude, flight director commands, glideslope and localizer deviations, radio altitude, speed error, decision height set and status, marker beacon indication, and WAGS data.

(2) The Navigation Display (ND) operates in ROSE and ARC modes. The ROSE mode format resembles a conventional HSI, displaying aircraft heading, selected course, course deviation, vertical deviation, TO/FROM indication, and ADF bearing. In the ARC mode, the ND display shows heading, selected heading, selected course, course deviation, TO/FROM, ADF bearing and weather radar.

(3) A compacted PFD/ND display format combines both PFD and ND data into a single-screen display. This format is used in the event of a display unit failure.

E. Description and Operation Overview: The Description and Operation is broken down into the following paragraphs:

Paragraph 1. General (Description)

A.	System Overview
B.	System Overview
C.	System Components
D.	System Displays
E.	Description and Operation Overview
F.	Symbol Generator Description
G.	Display Unit Description
H.	Control & Dimming Panel Description
I.	Mode Select Panel Description
J.	Remote Light Sensor Description
K.	Primary Flight Display (PFD) Symbology
L.	Navigation Display Symbology and Weather Radar
M.	Compacted PFD/ND Display
N.	EFIS/Fight Management System (FMS) Interface

F. Paragraph 2. Operation

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground Maintenance

G. Symbol Generator Description

(1) The symbol generator contains all of the circuitry required to interface with aircraft sensors and systems, compute CRT display parameters, and transmit display data to the display units (Figure 2). In addition, the SG provides an instrument comparator monitor function, which performs cross-side comparisons between ILS, attitude, and heading. In the event of a mis-compare, the corresponding annunciators on the Flight Mode Annunciator (FMA) panel come on.

(2) The SG monitors its own internal operation and aids in monitoring the cross-side SG. The SG tests its internal functioning by performing dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks. In the event of a SG failure or mis-compare, the MONITOR lights on the FMA will come on. The SG is also responsible for monitoring all aircraft systems and sensors which provide inputs to the EFIS, as well as the EFIS components. Continuous BIT monitors the EFIS throughout each flight profile, and logs all failures for later retrieval by ground maintenance.

(3) The left symbol generator (SG-1) drives the Captain's PFD and ND displays; the right symbol generator (SG-2) drives the First Officer's displays. Either Symbol Generator can drive all four CRT displays. In the event of a SG failure, the SG source selection switch, located on the Overhead Panel, may be put in the BOTH ON 1 or BOTH ON 2 position. This will cause the display data from the functioning SG to be transferred to the cross-side display units via data buses from the on-side display units (Figure 2).

(4) The symbol generators also receive data from the flight management system (FMS) advanced flight management computer (AFMC). The generators process the data to provide symbology for FMS, MAP or PLAN displays on the EFIS ND.

(5) Symbol Generator Components (Figure 3):

(a) Two Display Processor circuit card assemblies (CCA's), one for the PFD and one for the ND, which contain a processor, memory and a vector generator.

(b) Input/Output CCA's, which contain the serial data receivers and transmitters, synchro-to-digital, analog-to-digital, and discrete receivers required to interface with the aircraft sensors and systems.

(c) An Input/Output (IO) Controller, which manages all of the output devices and transfers data between them and system memory.

(d) A System Monitor CCA, which monitors display outputs, system BIT and weather radar processing.

(e) A Weather Radar Scan Converter CCA which converts color radar signals to a format suitable for display on the EFIS color display units.

(6) Symbol Generator Inputs: The SG receives serial data, synchro, analog and discrete inputs from the various aircraft sensors and systems (Figure 4). Program pins and configuration words enable the SG hardware and software to interface with these various types of inputs. SG programming is checked on the ground at power up to verify proper equipment configurations and selected options.

(7) Symbol Generator Outputs: The SG generates serial data outputs, open/ground discrete outputs and audio outputs. The Symbol Generator has two independent display output channels. Video and deflection signals are sent via the display output channels to the Primary Flight Display and to the Navigation Display. A low-speed SG cross-talk bus enables each SG to monitor both its own operation and that of the cross-side SG. This monitoring consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(8) Audio Output: The SG has one audio output for annunciating the decision height. This tone slews from 400 Hz at or above decision height + 50 feet to 800 Hz at DH. The frequency changes linearly from DH + 50 feet to DH. Figure 5 shows the decision height audio output graphically.

(9) Commands are sent to the SG from the cockpit via the Control & Dimming Panel (display unit on/off and brightness, weather radar on/off and brightness, DH set and TEST) and the Mode Select Panel (Navigation Display format selection and range control). The weather radar control panel is used to set the WXR display mode, TILT, GAIN and STAB. Range is controlled from the EFIS Mode Select Panel.

(10) Flight management system navigation and guidance data and EFIS mode control panel input are supplied to the advanced flight management computer (AFMC). The computer processes the information and outputs the data to the EFIS symbol generators to provide the MAP or PLAN displays on the EFIS ND.

(11) The SG's are housed in ARINC 600 4 MCU chassis, and are located in the electrical/electronics compartment. The SG operates on 115 VAC 400 Hz single phase power. The SG power supply converts aircraft power to the DC voltages required by the SG electronics. The SG is able to withstand power interruptions of up to 3 milliseconds without loss of function, and up to 1 second without change of operating mode or loss of digital filter data. Temperature sensing of the power supply is provided to activate an internal SG fan, in the event of an over temperature condition. Forced air (blow-through) cooling is also provided to both units.

(12) Whenever a new Symbol Generator is installed, it must be programmed by ground maintenance before the SG can be used. This programming consists of entering the Options/Register and Check Register numbers into the SG via the Status Test Panel. These numbers, when combined with the configuration identification wired into the aircraft, define the aircraft for the Symbol Generator.

(13) In case of a serious SG failure, the PFD and ND for that system will be blanked. Display data may be transferred from the functioning system by placing the EFIS source select switch in the appropriate position. EFI1 or EFI2 annunciations will appear on all display screens during single-system operation. If a fault can be isolated to a single source, a flag or warning message will appear on screen to signal the affected parameter.

H. Display Unit Description

(1) The Primary Flight Display (PFD) and Navigation Display (ND) units are identical CRT's, clamp-mounted to the main instrument panel. Each display unit (DU) provides a full color (15 plus black) electronic display. The DU's receive display data through analog, digital and discrete interfaces with the symbol generator. Each DU is capable of operating as a PFD or ND. During reversionary mode (either the PFD or ND is turned off), a single display is capable of acting as both a PFD and ND in the compacted PFD/ND mode.

(2) The DU is capable of operating in either raster scan mode (background shading and weather radar) or stroke writing mode (display symbology). Raster dimming is controlled independently of stroke intensity to provide adjustable display contrast capability (Navigation Display only). SG display unit monitoring verifies that the DU is receiving display data. Upon detection of a fault, the DU is blanked. At this time, the DU should be turned off at the Control and Dimming Panel. The system will revert to reversionary mode, and a compacted PFD/ND display will appear on the functioning screen.

(3) A system monitor is incorporated in the DU to provide CRT phosphor protection. The system monitor drives the CRT to cutoff when X-or Y-deflection has stopped, when power supply outputs are abnormal, or when the CRT filament opens or takes excessive current. In case of a DU overheat, the SG will log the failure and remove the raster (background) from the applicable display to reduce the display power required. The message 'WXR OFF' appears on the ND to signal loss of WXR display.

(4) Display unit brightness is controlled in part by the two internal light sensors. These sensors are located on the front of each unit, and feed into the auto-dimming system. The stroke and raster brightness levels are normally set using a combination of brightness data from the Remote Light Sensor, the DU internal light sensors and the Control and Dimming Panel (CDP). Should the DU monitor detect a loss of brightness commands from the CDP, the display unit will revert to a nominal brightness level.

(5) Each DU has two input ports. The primary input port carries analog deflection and digital video information from the on-side symbol generator. The secondary input port is used to either send or receive data, to or from the cross-side display unit. This port allows the DU to be driven from the cross-side symbol generator, if the on-side symbol generator fails.

(6) Each display unit is contained in a 5 x 6 x 10.5 inch outline, and is forced-air cooled. An externally adjustable inclinometer (slip skid indicator) is located on the bottom center of the DU bezel. The CRT display surfaces are covered with a filter, coated with a reflection-reducing coating. There are two extraction aids, on the front bottom left and right corners, to aid in removal/installation of the DU's. Two power transistors, located on the back panel of each DU, dissipate 65 watts.

I. Control & Dimming Panel Description

(1) The Control & Dimming Panel (CDP) provides three functions (Figure 7):

(a) Display unit manual brightness control

(b) Decision Height set control

(c) TEST pushbutton

(2) The CDP's are located on the main instrument panel, to the right of the display units. They are powered from both Primary Flight Display power (±15 VDC) and lighting power. All CDP control knobs move clockwise from the off position, through an increasing range to the full on position.

(3) Display Unit Manual Brightness Control: The CDP mixes data received from the Remote Light Sensor (RLS) and display unit (DU) internal light sensors with CDP manual brightness control inputs to generate an overall brightness control signal for the DU's. The display unit brightness controls on the CDP are PFD BRT for the Primary Flight Display, and a combined ND/WX BRT for the Navigation Display. The WX BRT control knob is concentric with the ND BRT control, and is used to adjust the weather radar display intensity independently of the ND display symbology.

(4) Full counterclockwise (ccw) rotation of the PFD BRT or ND BRT knobs past the detent causes the corresponding display screen to go blank. Whenever either the PFD or ND BRT knob is turned OFF, the corresponding display screen goes blank, and a compacted PFD/ND display will appear on the remaining on-side display screen. Turning the WX BRT ccw knob past the detent turns the WX display off. The message WXR OFF will be continuously displayed on the ND whenever this knob is in the off position.

(5) Decision Height Set Control: This knob is used to set decision height between zero and 500 feet (any value less than zero feet causes the DH readout on the PFD to go blank). DH data is displayed on the top, right-hand corner of PFD.

(6) TEST pushbutton: The TEST pushbutton is used to initiate a EFIS system self-test. Self-testing begins when the TEST pushbutton is depressed and ends approximately 3 seconds after release. The tests conducted include: VOR/ILS self-test, Radio Altimeter self-test, Marker Beacon self-test, Decision Height Aural Warning self-test and Failure Flag test. All but the DH aural warning and failure flag tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The DH aural warning test consists of a one-second tone slewing from 400-800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. TEST pushbutton function is inhibited in flight.

NOTE: When performing the EFIS self test from the dimming panel test button, the monitor lights on the FMA will flash.

(7) In the event of a Control and Dimming Panel failure, the PFD, ND and WXR displays will remain on. Brightness will be controlled by the auto-dimming system. Since there is no default setting for a DH control failure, DH information should be ignored when the CDP fails.

J. Mode Select Panel Description

(1) The Mode Select Panels (MSP) are located outboard and aft of the glareshield, below the clearview windows. The MSP is used to select the display format for the Navigation Display (Figure 8). Each panel contains an ADF control switch, a MODE switch and a RANGE switch and four pushbutton switches for Flight Management system (FMS) selections.

(2) The MSP interfaces with the Symbol Generator through digital discrete signals. The control panel monitor in the SG verifies correct operation of the MSP. In the event of a MSP failure, the ARC mode will be displayed on the ND. The range will default to 40 nm; the indices and range lines will turn yellow.

(3) The MODE switch is a rotary switch which allows the pilots to select from the following ND display modes:

Table 2

ROSE	Conventional HSI display
ARC	Compass arc display, with coordinated weather radar.
MAP	FMS MAP Display
PLAN	FMS PLAN Display

(4) The RANGE control is a rotary switch that is used in ARC, MAP or PLAN Modes, and allows the crew to select among the following display ranges: 10, 20, 40, 80, 160, and 320 nautical miles. Both the ARC and WXR display ranges are set simultaneously with this control.

(5) The ADF bearing control consists of a rotary switch which is used to control the ADF bearing pointer in the ROSE and ARC modes. Turning the rotary switches counterclockwise to the full detent position will turn the ADF display off.

(6) The FMS pushbuttons selections control the display on the ND as follows:

Table 3

N-AID (Navigation Aids)	Controls Display of Navigation Aids
ARPT	(Airports) Controls Display of Airport
DATA	Controls Display of Ground Reference Points
WPT	(Waypoints) Controls Display of Waypoints data

K. Remote Light Sensor Description

(1) There is one Remote Light Sensor (RLS), installed on top of the glareshield (Figure 9). The RLS is installed looking forward of the aircraft, to measure the light levels outside of the cockpit. The RLS is powered from the F.O.'s Control & Dimming Panel (CDP). Light level data is transmitted from the RLS to the CDP, where it is combined with manual brightness control and DU light sensor inputs. The resultant mixed signal is used in controlling display intensity and contrast. If the RLS fails, the CDP manual control setting and DU internal sensor signals will be combined to control DU brightness.

L. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format (Figure 10) contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(h) FMS data

(i) WAGS data

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

(3) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indicator. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

(5) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude sphere.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The EFIS also produces a DH tone as the aircraft nears decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The numerical digits and tick marks are white throughout the scale. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. A rising runway appears at 200 feet. The rising runway begins coming into view at 200 feet (60.95 m) and touches the bottom of the airplane symbol at zero radio altitude. The rising runway symbol moves laterally with the localizer pointer. The rising runway symbol is driven by the cross-side R/A inputs (from the cross-side SG). The R/A tape is driven by the on-side R/A inputs (from the on-side SG).

(9) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

(10) FMS DATA: FMS "MCDU MSG" and Fast/Slow display will appear relative to MCDU alert messages and FMS speed commands when V-NAV is engaged.

(11) WAGS Data: When the Windshear Computer (WSC) detects an increasing performance windshear (headwind or up draft) it will enable the PFD to display an amber "WIND SHR" message. A detected decreasing performance windshear (tailwind or down draft) will result in a red "WIND SHR" message. The PFD will also display a WSC determined Pitch Limit Indication (PLI) which is the margin between aircraft angle of attack (AOA) and the AOA for shaker onset. In addition, speed deviation and flight director pitch and roll commands will be supplied by the DFGC in conjunction with inputs from the WSC.

M. Navigation Display (ND) Symbology and Weather Radar

(1) The Navigation Display (ND) appears on the lower CRT. The ND provides HSI information, ADF, coordinated weather radar and FMS MAP or PLAN displays. The display format varies, depending on the display mode selected on the Mode Select Panel (MSP). The following modes are available on the EFIS:

(2) ROSE Mode: display resembles a conventional HSI (Figure 11). The compass rose is located at the center of the screen, with large tick marks at 10 degree increments and small tick marks at 5 degree increments. The tick marks are labeled at 30 degree increments with characters straddling the tick marks. The ROSE Mode display shows:

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course and course deviation
(d)	Vertical deviation
(e)	TO/FROM indication
(f)	ADF bearing
(g)	Distance Measuring (DME)

(a) Aircraft Heading: Heading indices consist of tick marks at 45 degree increments around the outside of the compass rose. The digital value of the current heading is displayed in a box above the compass rose. A symbolic reference aircraft is located at the center of the compass rose.

(b) Selected Heading: is indicated by an "M"-shaped pointer which moves along the outside of the compass rose.

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass rose, pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a scale consisting of four small dots. The course pointer and deviation scale rotate with the selected course about the center of the compass rose.

(d) Vertical Deviation: is indicated with a scale and pointer identical to that used on the PFD display.

(e) TO/FROM Indications: A Triangle pointer is provided, which points in the direction of (TO) or 180 degrees away from (FROM) the course deviation pointer. TO/FROM is blanked while in ILS mode.

(f) ADF Bearing: One bearing pointer shows current bearing to ADF station. The source for pointer is annunciated in the lower left hand corner of the ND.

(3) ARC Mode: Display shows a compass arc (Figure 12), centered below the center of the screen, with major tick marks every 10 degrees, and minor tick marks every five degrees. The major tick marks are labeled every 30 degrees. The ARC Mode display shows:

(a)	Aircraft heading
(b)	Selected heading
(c)	Selected course
(d)	Course deviation
(e)	Vertical deviation
(f)	TO/FROM indication
(g)	Weather radar
(h)	ADF bearing

(a) Aircraft Heading: is displayed at the top of the range lubber line. A symbolic reference airplane is located at the center of the compass arc.

(b) Selected Heading: is indicated by an "M" shaped symbol which moves along the outside of the arc, and by a dotted line from the airplane symbol to the "M".

(c) Selected Course and Course Deviation: Selected course is indicated by a filled pointer inside the compass arc, with an extension pointing at the selected course. Lateral deviation is indicated by movement of the center portion of the pointer across a four dot scale. The pointer and deviation scale rotate with the selected course about the center of the arc.

(d) Vertical Deviation: is displayed using a scale and pointer identical to those on the PFD display.

(e) TO/FROM Indications: are displayed under the right end of the heading arc when tuned to a VOR station. TO/FROM indication is blanked while in ILS mode.

(f) Selected course and heading is displayed on the left upper part of the ND by an inverted M, arrow and digital display. These correspond to the selected heading and course on the compass arc. When a change is selected they will be shown momentarily.

(g) Weather Radar: Weather radar data may be displayed within the compass arc. The display range is selected from the Mode Select Panel (MSP). A half-range index mark, centered between the aircraft reference symbol and the outer periphery of the arc, will indicate one-half of the range selected on the MSP. The brightness of the weather radar image can be adjusted relative to the ND symbology from the CDP. When fault codes are received, weather radar status messages will appear on the display screen. The message "WX OFF" will appear on the display screen when a DU overheat is detected or when the CDP WX BRT control knob is in the off position. Tilt angle is annunciated only momentarily, when the WXR antenna tilt angle is changed.

(h) ADF Bearing: One bearing pointer shows current bearing to ADF station. The source for pointer is annunciated in the lower left hand corner of the ND.

N. Compacted PFD/ND Display

(1) The compacted PFD/ND display (Figure 13) appears whenever either (but not both) of the Display Units is turned OFF at the CDP. This format contains all data shown on the normal PFD display. However, the bottom third of the attitude sphere is removed and replaced with a heading indicator. The following symbology is available on this display:

(a) Attitude indicator

(b) Flight director command indicator

(c) Glideslope deviation

(d) Speed deviation

(e) Decision height

(f) Radio altitude

(g) Marker beacons

(h) Altitude alert

(i) Course deviation

(j) Compacted heading display

(k) Selected heading

(l) Digital course

(m) Windshear

(n) Dead reckoning (DR)

(2) All symbology characteristics for the top two-thirds of the display are the same as for the PFD format. The compacted heading display, on the bottom third of the screen, contains the same symbology used on the ND-ROSE display.

O. EFIS/LNMS Interface

(1) The Flight Management System interfaces with the EFIS to provide FMS oriented displays on the EFIS primary flight display (PFD) and the navigation display (ND). The advanced flight management computer (AFMC) is the primary source of data for display on the PFD or ND when the EFIS mode selector panel MODE selector is placed in the MAP or PLAN position. The FMS data is supplied to the EFIS symbol generators that provide the symbology display on the PFD and ND. (Figure 14) and (Figure 15) indicate the FMS controlled displays on the PFD and ND. The mode selector panel also provides the means for selection of Capt/F/O initiated optional (background) data selections; RANGE, N-AID (navigation aids), ARPT (airport), DATA and WPT (waypoint). The N-AIDS selection will initiate VOR-DME navigation aids that are within the current range to be displayed on the ND. The ARPT selection will initiate display on the ND of the airports that are in the data base within the current range. The DATA selection will initiate a display of constraint altitudes and ETA (estimated time of arrival) of every waypoint defined in the active route. WPT selection will initiate data base waypoints not on the active route when the range of the display is 40 nautical miles or less. To remove (declutter) unwanted data, press the selection pushbuttons a second time.

(a) PFD - When the FMS initiates an alert message display on the FMS Multipurpose Control Display Unit (MCDU), "MCDU MSG" will be displayed in the upper left corner of the PFD. The PFD FAST/SLOW indicator will follow the LNMS speed command. The PDF flight director bars will follows when FMS commands when V-NAV is engaged.

(b) ND - The MAP, PLAN, ROSE or ARC mode selections are displayed on the ND. The MAP mode displays the aircraft position relative to the route and other ground reference data in a track-up format. The map reference point (MRP) for the MAP mode is dynamic with the background moving about the MRP. The PLAN mode display is used by the CAPT/F/O to look ahead in the flight plan and review what a portion of the flight plan looks like. The MRP for the PLAN (if active) mode is referenced to a waypoint that is currently displayed on the MCDU and identified by the legend CTR on the LEGS page (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Description and Operation, paragraph K; Line Select Key 6L)

(c) MAP MODE - The MAP mode displays the following FMS provided dynamic information (except as noted):

Distance To Waypoint (DTW) - The distance to the next waypoint.

Estimated Time of Arrival (ETA) - The estimated time of arrival at the next waypoint.

Drift Angle - Drift angle is the difference between computed track angle and heading.

Source of Course/Track Data - The source of the Course/track and deviation data are ILS, VOR or NAV (not LNMS generated).

Wind Direction - Indicates FMS calculated wind direction.

Windspeed - Indicates FMS calculated windspeed. Display of wind direction and speed is inhibited below 10,000 feet altitude.

Vertical Deviation - FMS calculated vertical path error when in the descent phase.

Range to Altitude - An arc, the position at which the aircraft will reach the clearance altitude with present flight path and track.

(d) The following represent failure displays (not generated by FMS):

TRK FAIL - Displayed when track deviation data invalid.

NAV FAIL - Displayed when track deviation data invalid.

VNAV FAIL - Displayed when vertical deviation invalid.

MAP FAIL - Displayed, in MAP mode, when EFIS removes map symbology due to loss of data parameters.

(e) PLAN MODE - FMS provided dynamic information for the MAP mode is also applicable to the PLAN mode display on the ND (no FMS background data is displayed on the PLAN mode).

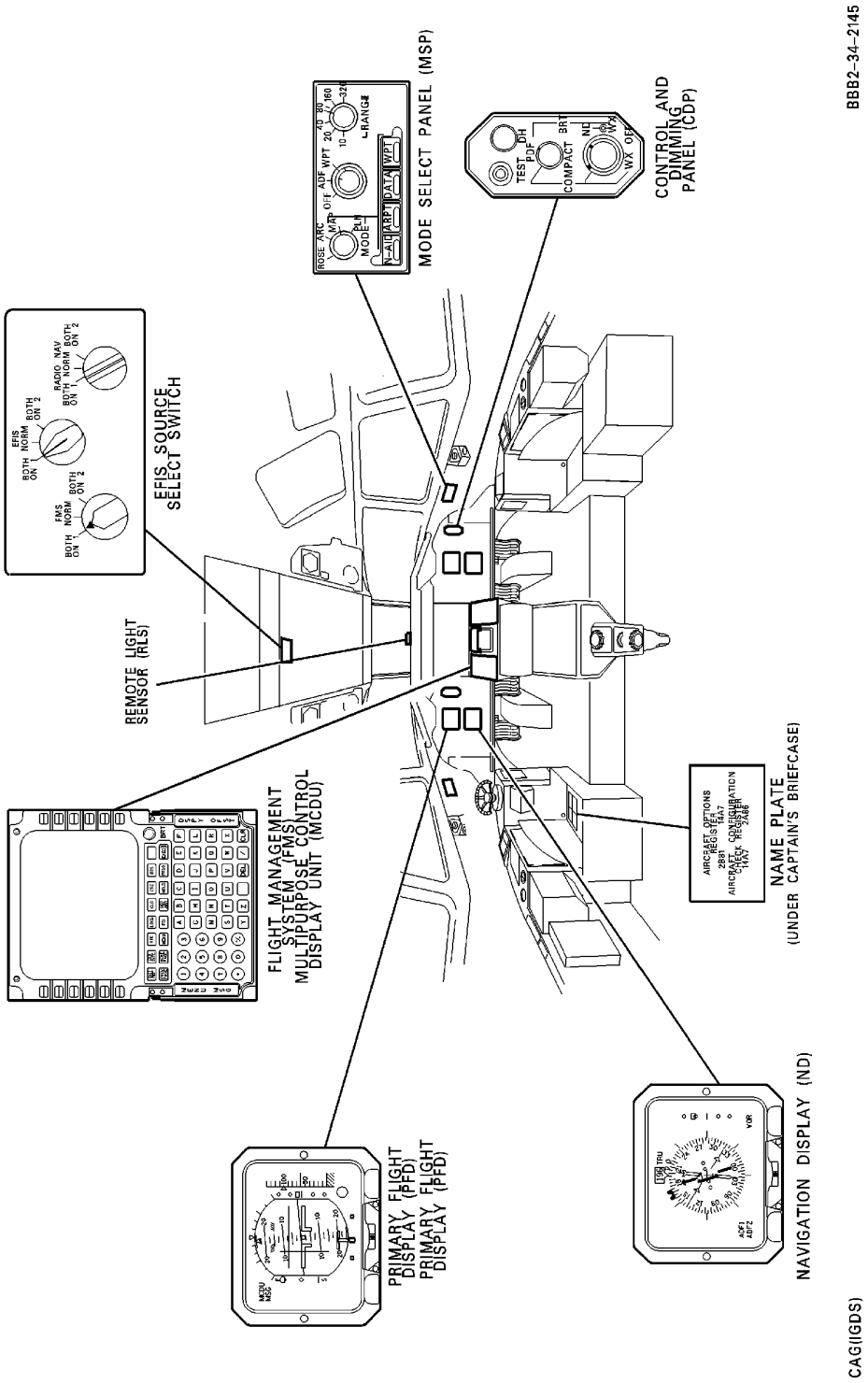
(f) ROSE MODE - The ROSE display resembles a conventional horizontal situation indicator (HSI). FMS information provides the following additional information for display on the ND:

DESIRED COURSE - Displays the desired course when the source of course/track data is NAV.

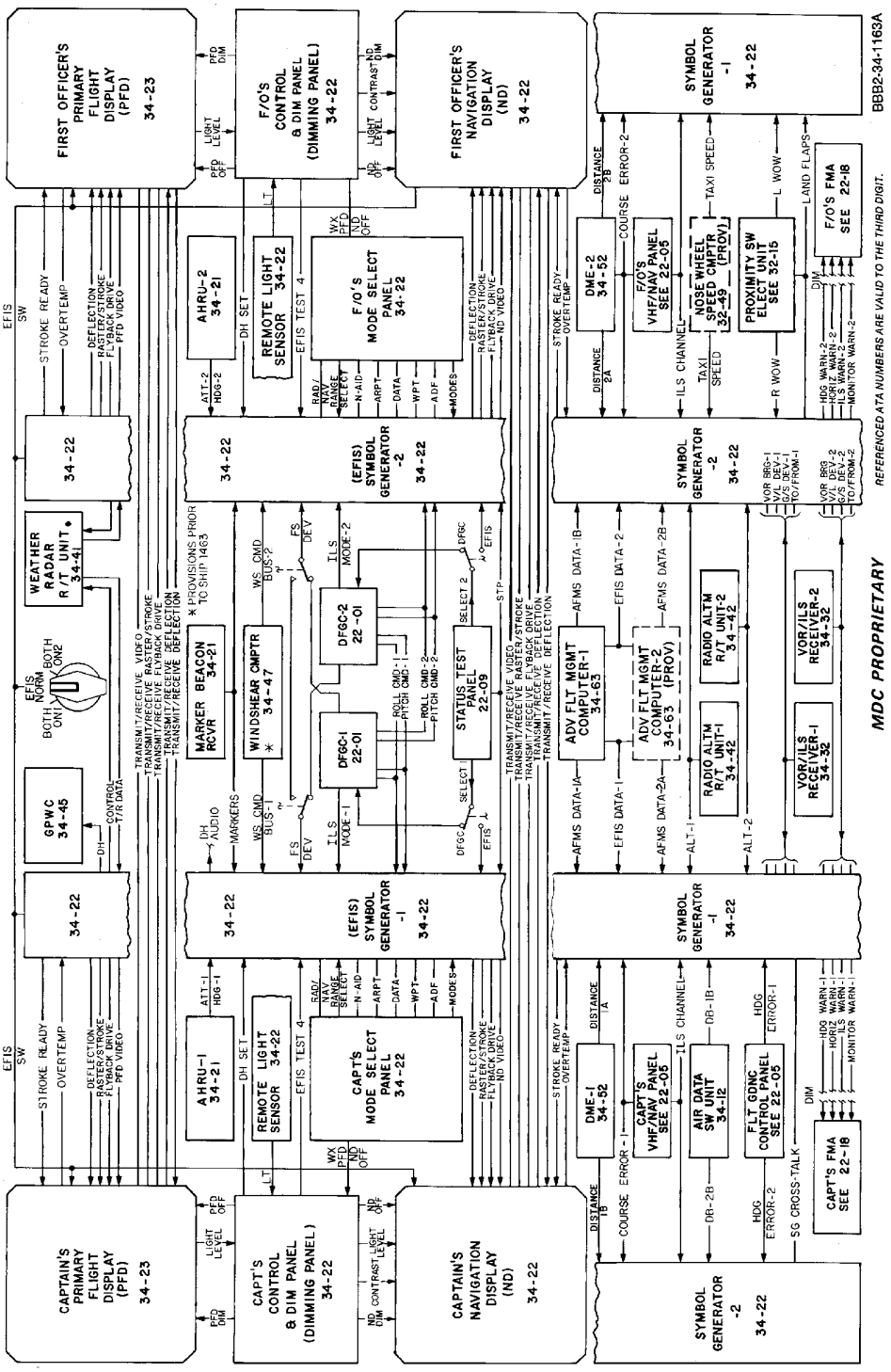
COURSE DEVIATION - Displays LNMS lateral deviation when the source of course/track data is NAV.

WAYPOINT ALERT - Displays an annunciation of an upcoming waypoint or course change in the FMS flight plan.

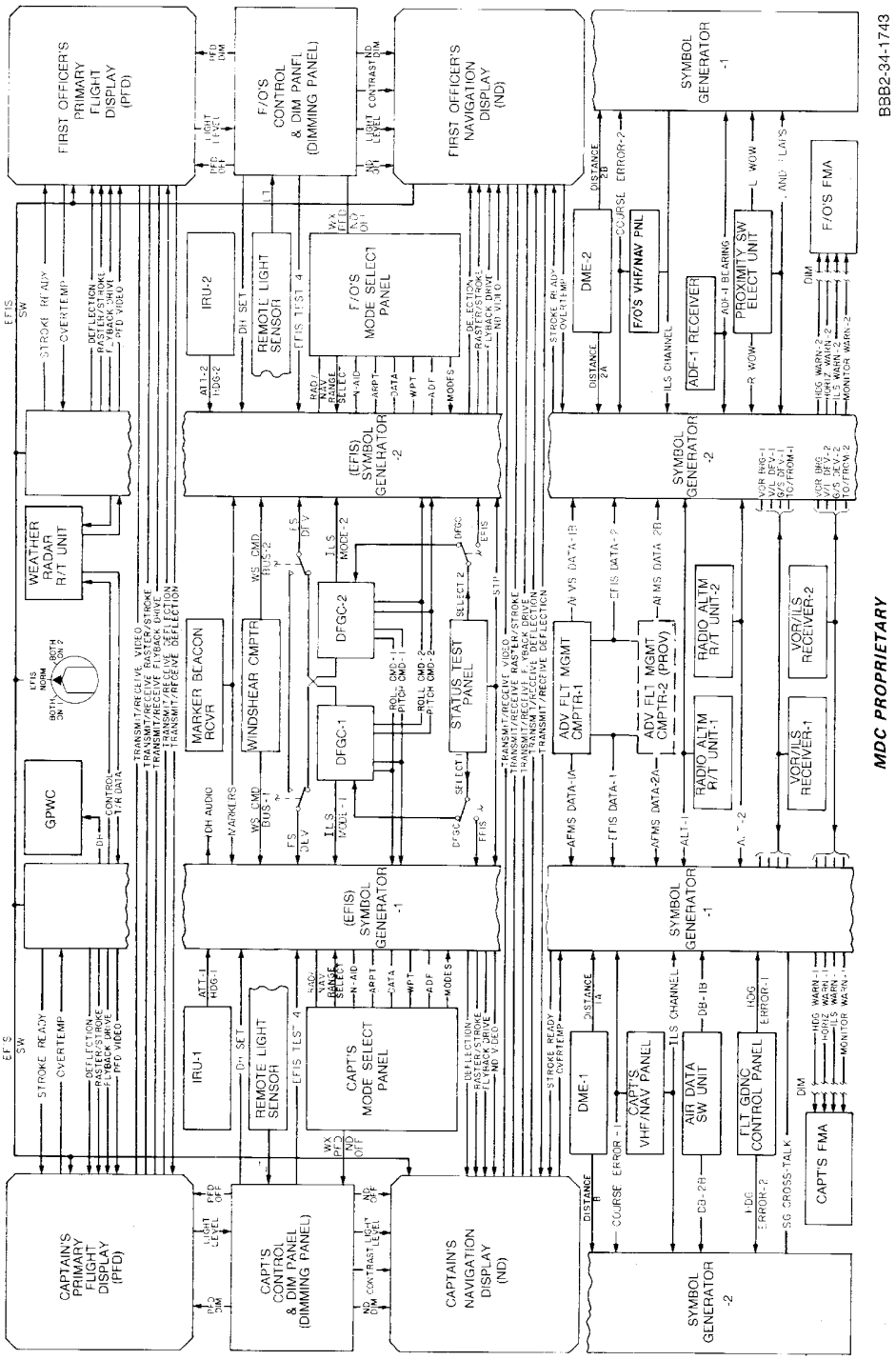
(g) ARC MODE - The ARC mode displays the same information on the ND as the ROSE mode but as a compass arc.



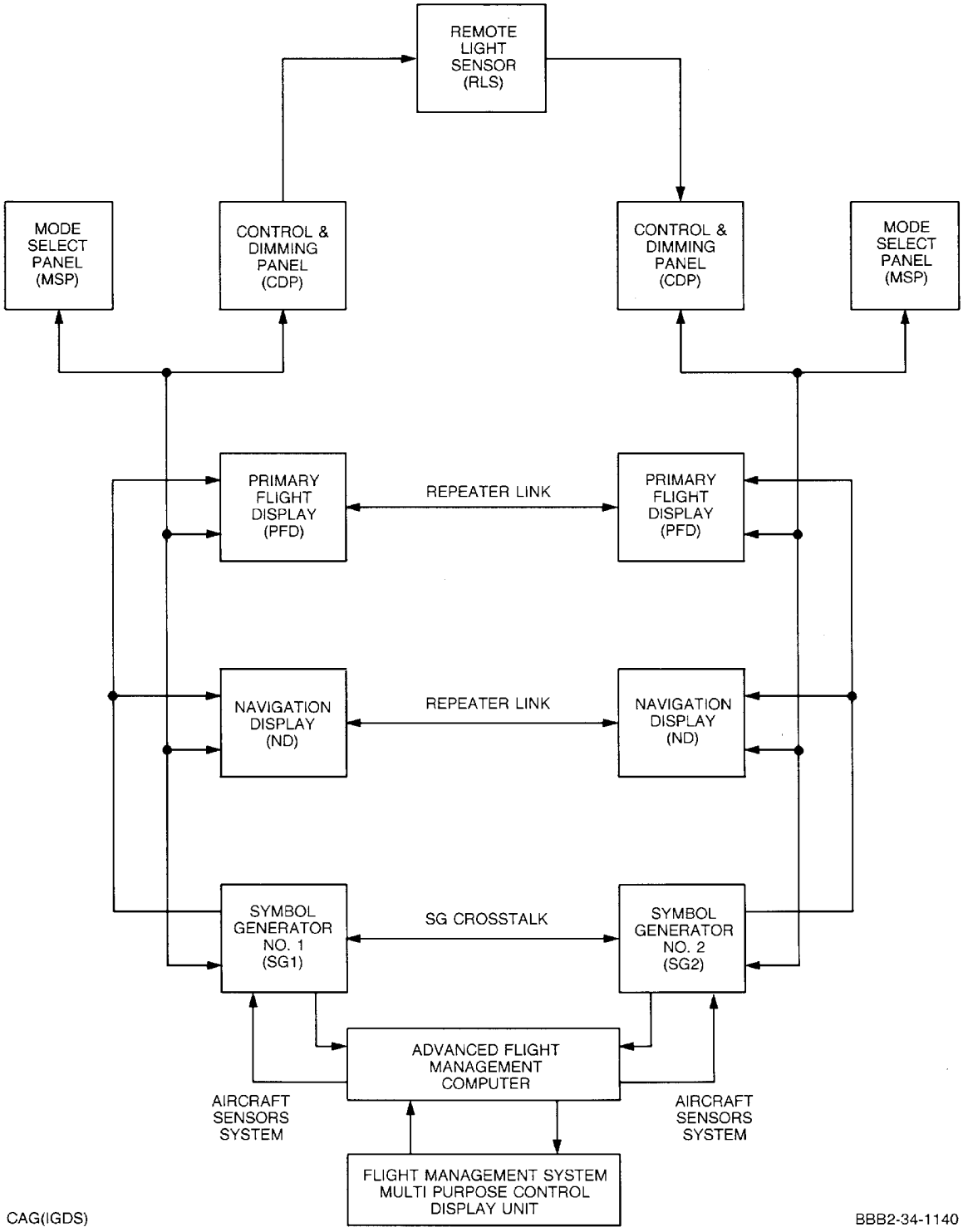
Electronic Flight Instrument System (EFIS) With Flight Management/ System (FMS) Interface Flight Compartment Configuration
Figure 1/34-22-00-990-919



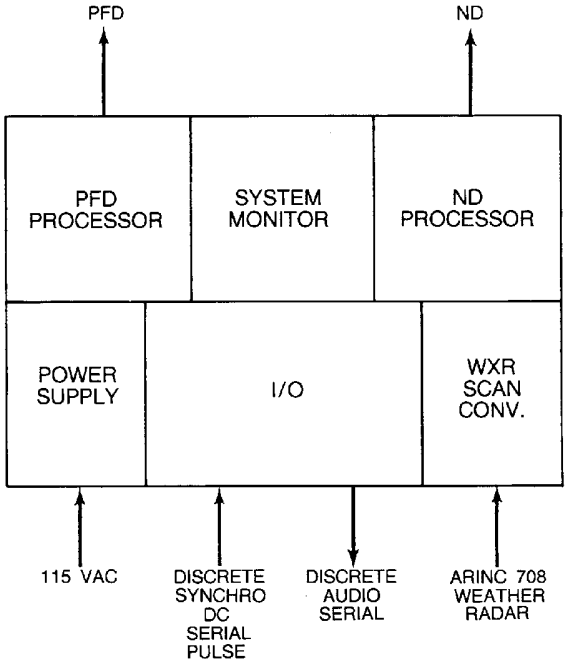
EFIS Block Diagram
Figure 2/34-22-00-990-920 (Sheet 1 of 2)



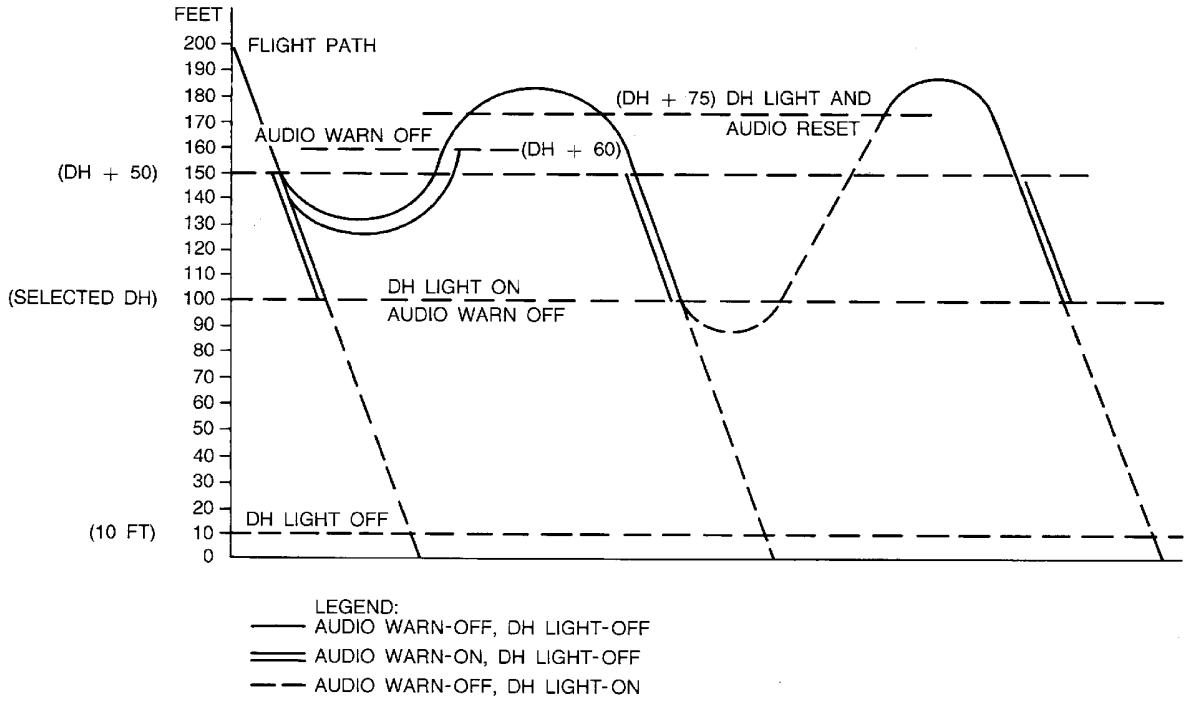
EFIS Block Diagram
Figure 2/34-22-00-990-920 (Sheet 2 of 2)



EFIS -- System Interface Diagram
Figure 3/34-22-00-990-921

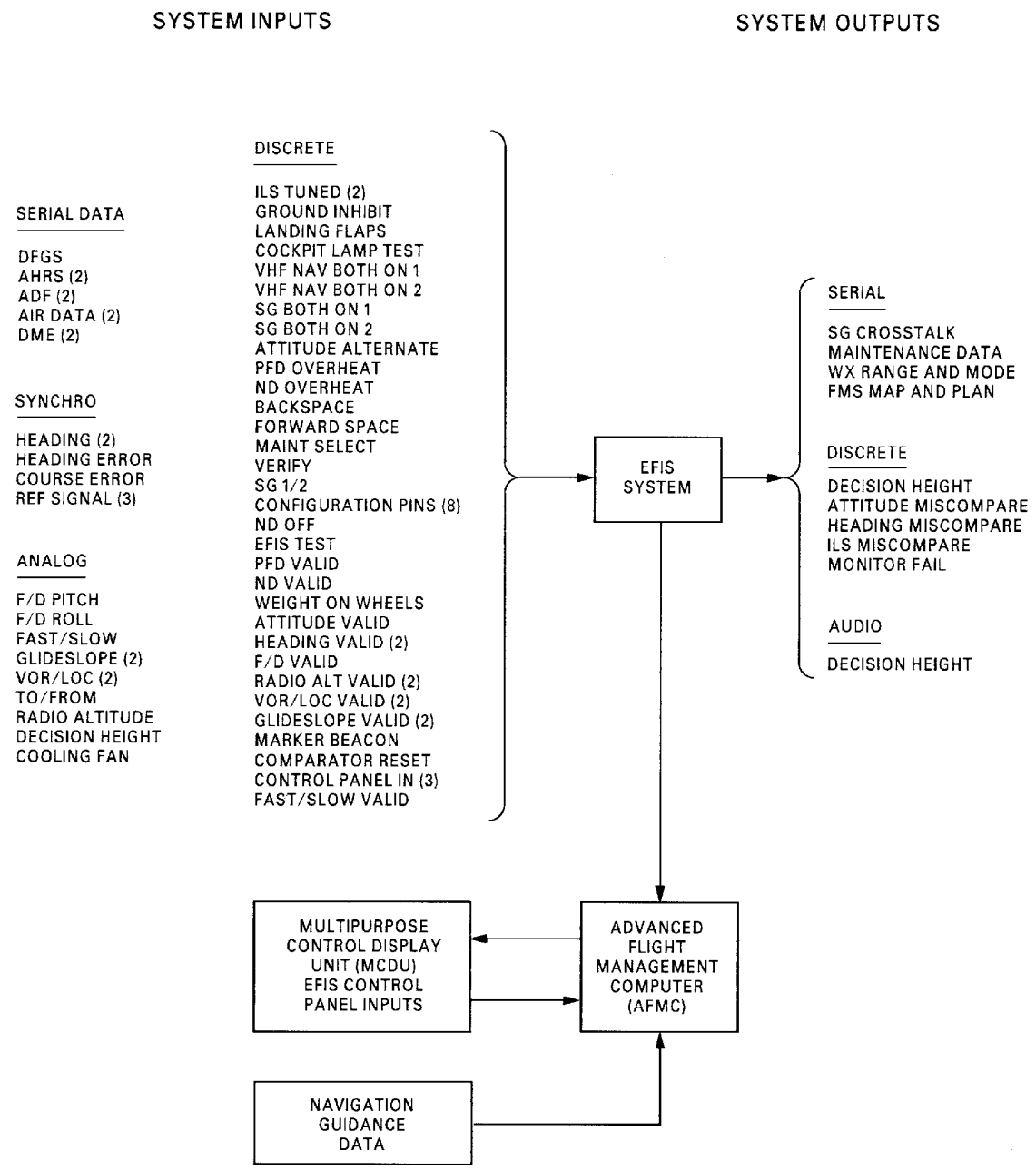


EFIS Symbol Generator -- Component Diagram
Figure 4/34-22-00-990-922

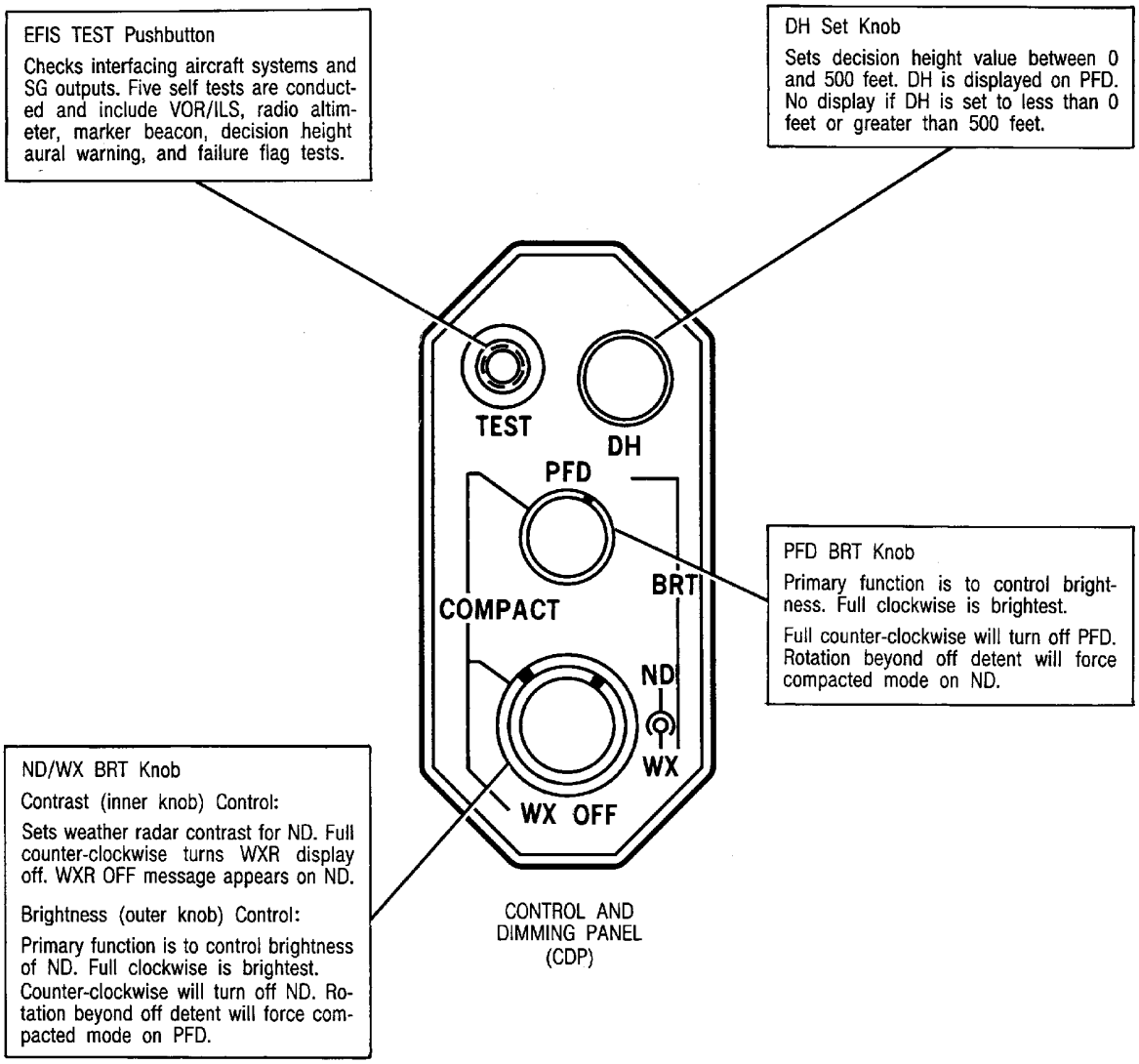


BBB2-34-951

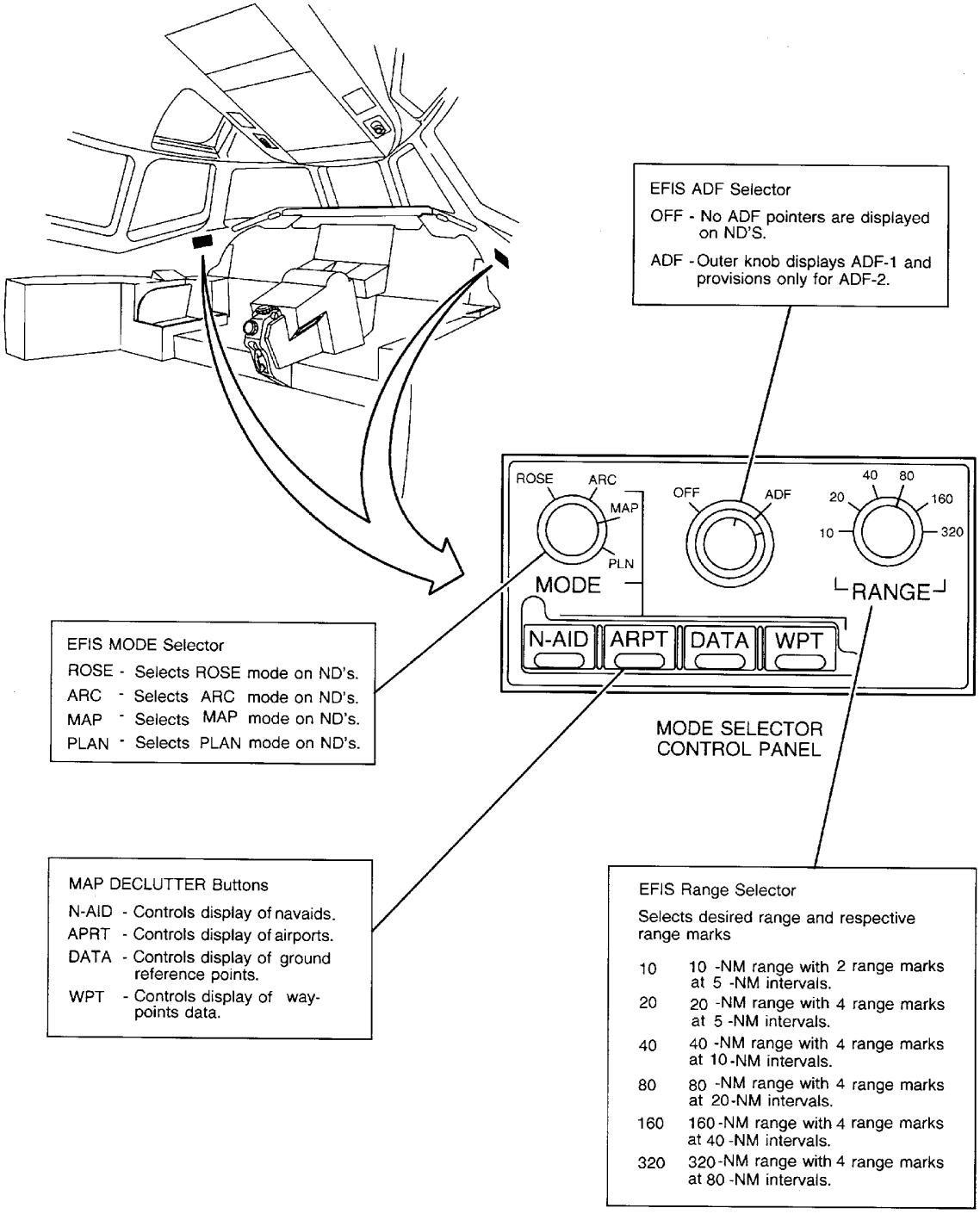
EFIS Audio Output
Figure 5/34-22-00-990-923



EFIS Inputs and Outputs
Figure 6/34-22-00-990-924

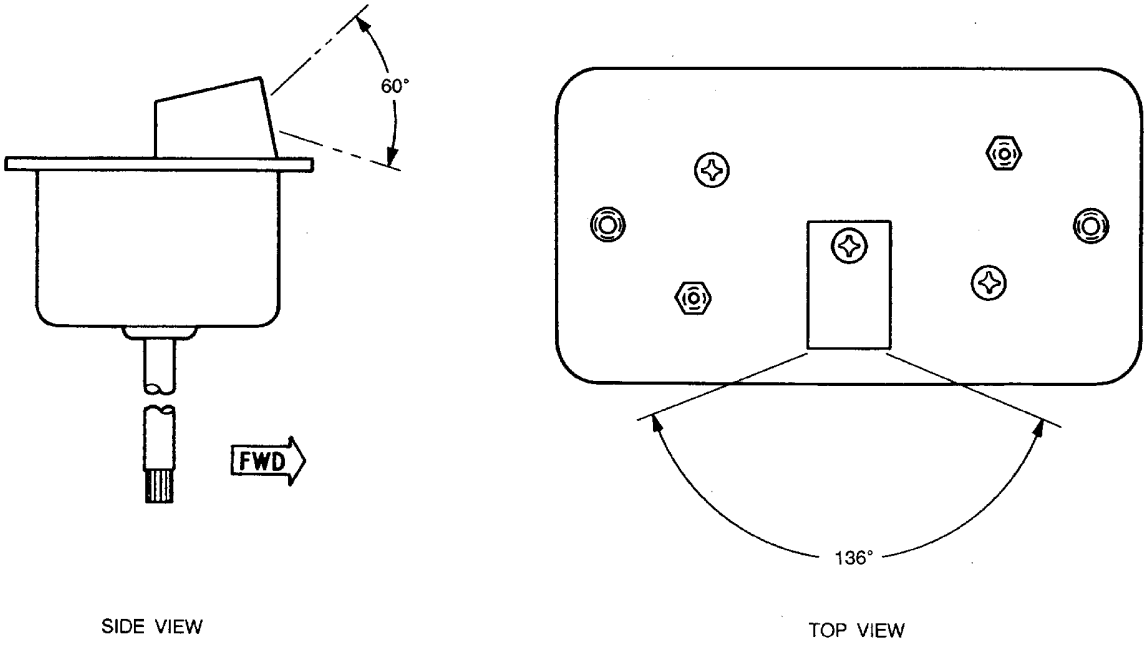


EFIS Control and Dimming Panel
Figure 7/34-22-00-990-925

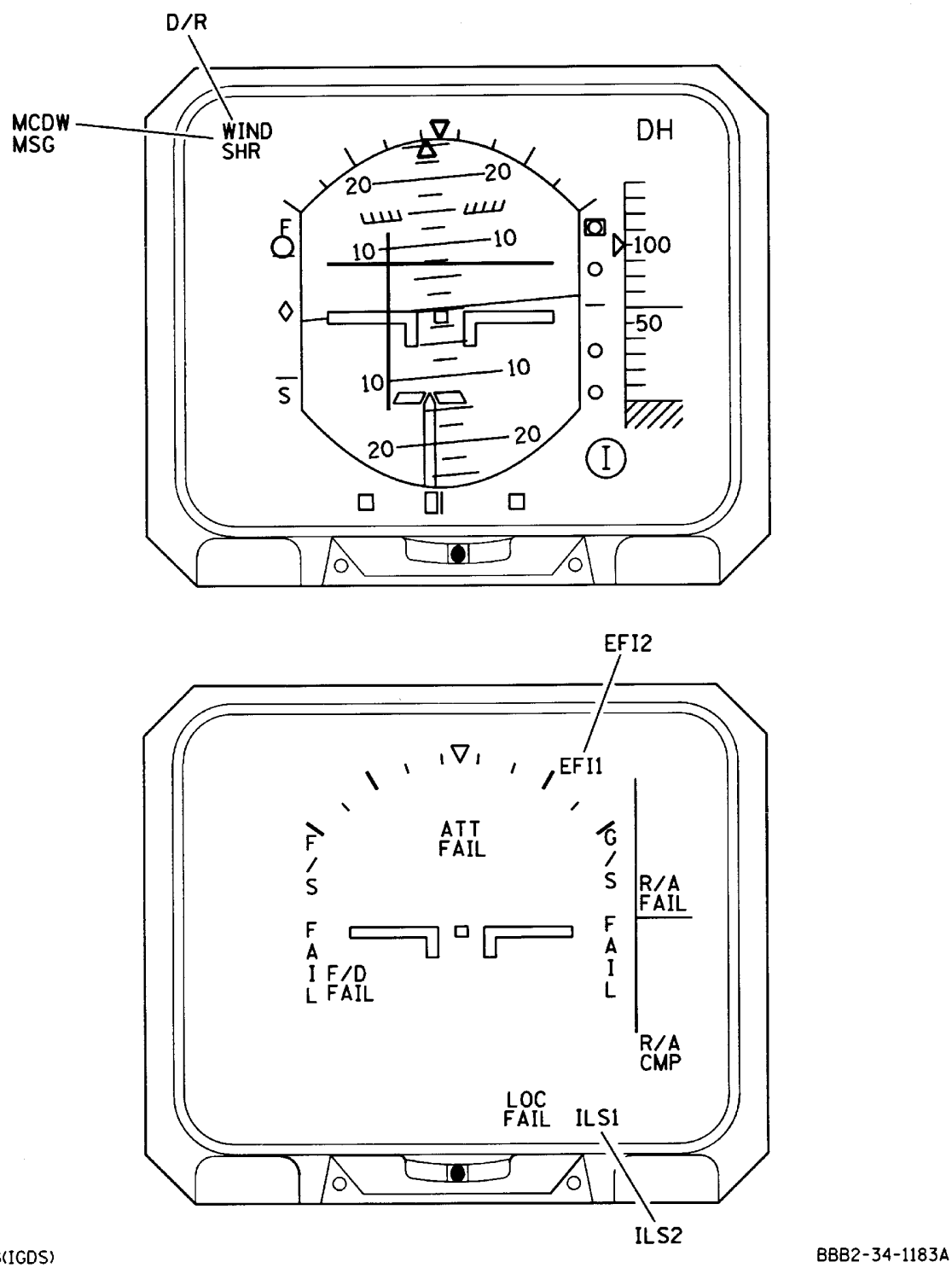


EFIS Mode Selector Control Panel With FMS Mode Selection
Figure 8/34-22-00-990-926

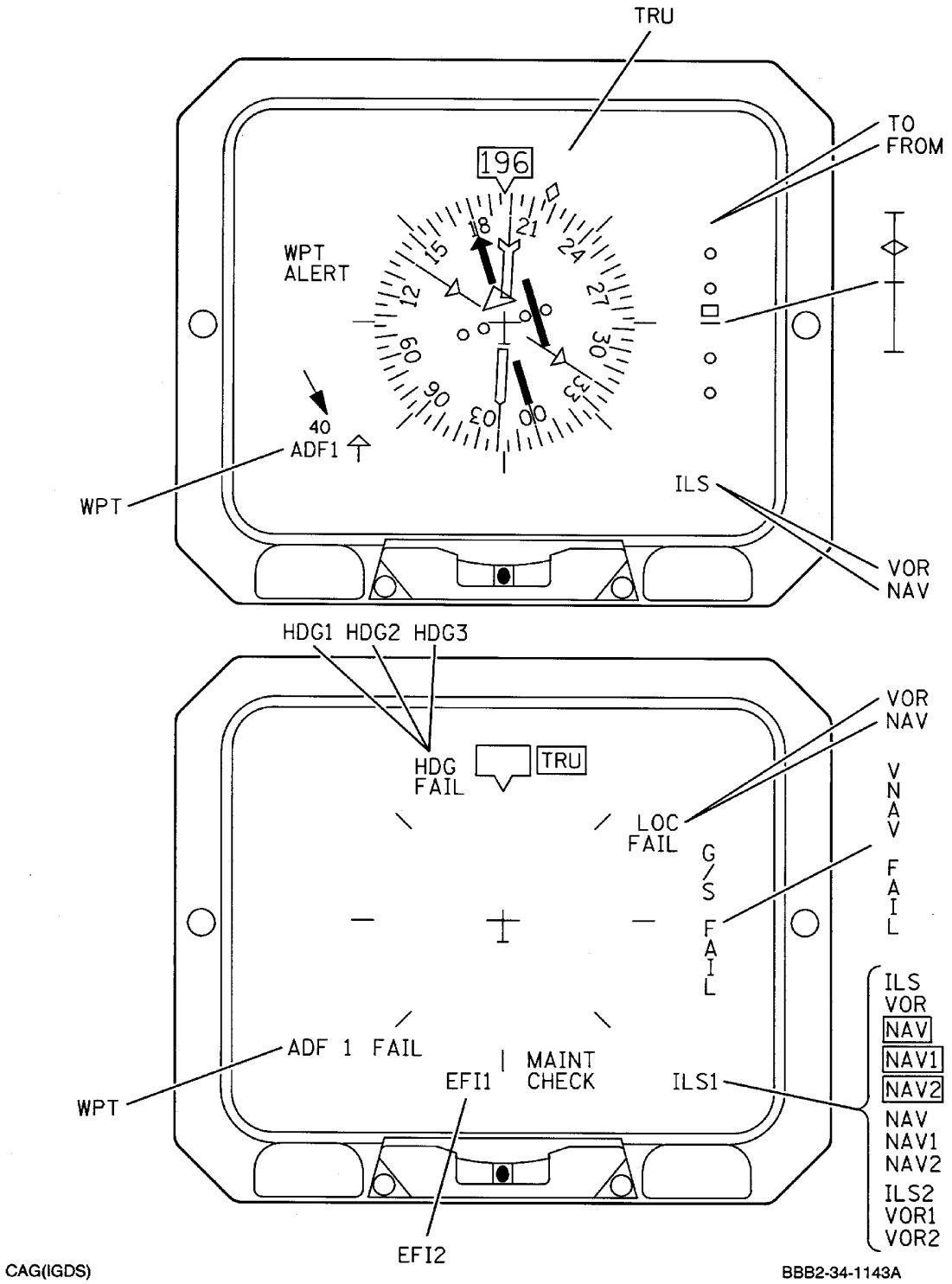
EFFECTIVITY
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285



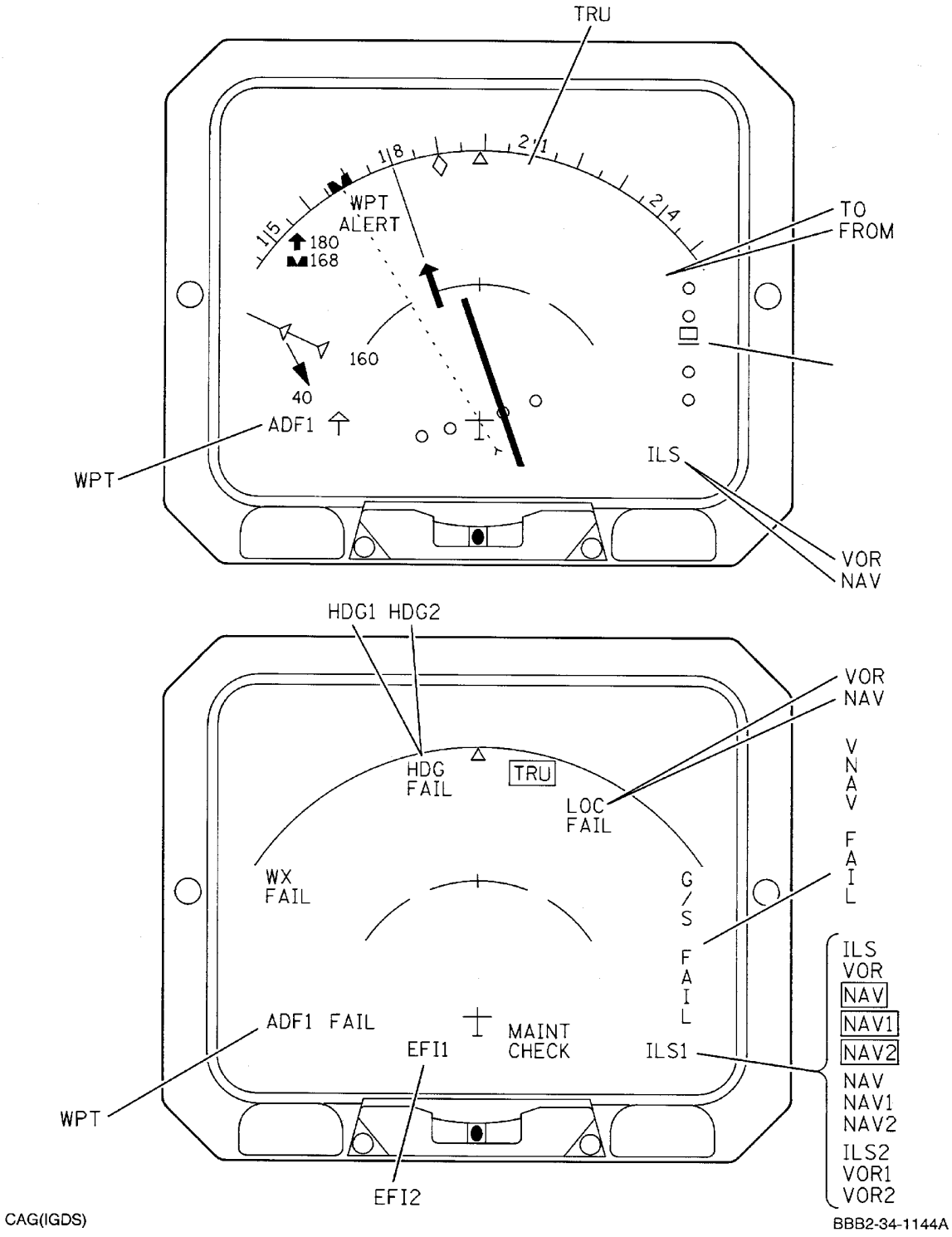
EFIS Remote Light Sensor
Figure 9/34-22-00-990-927



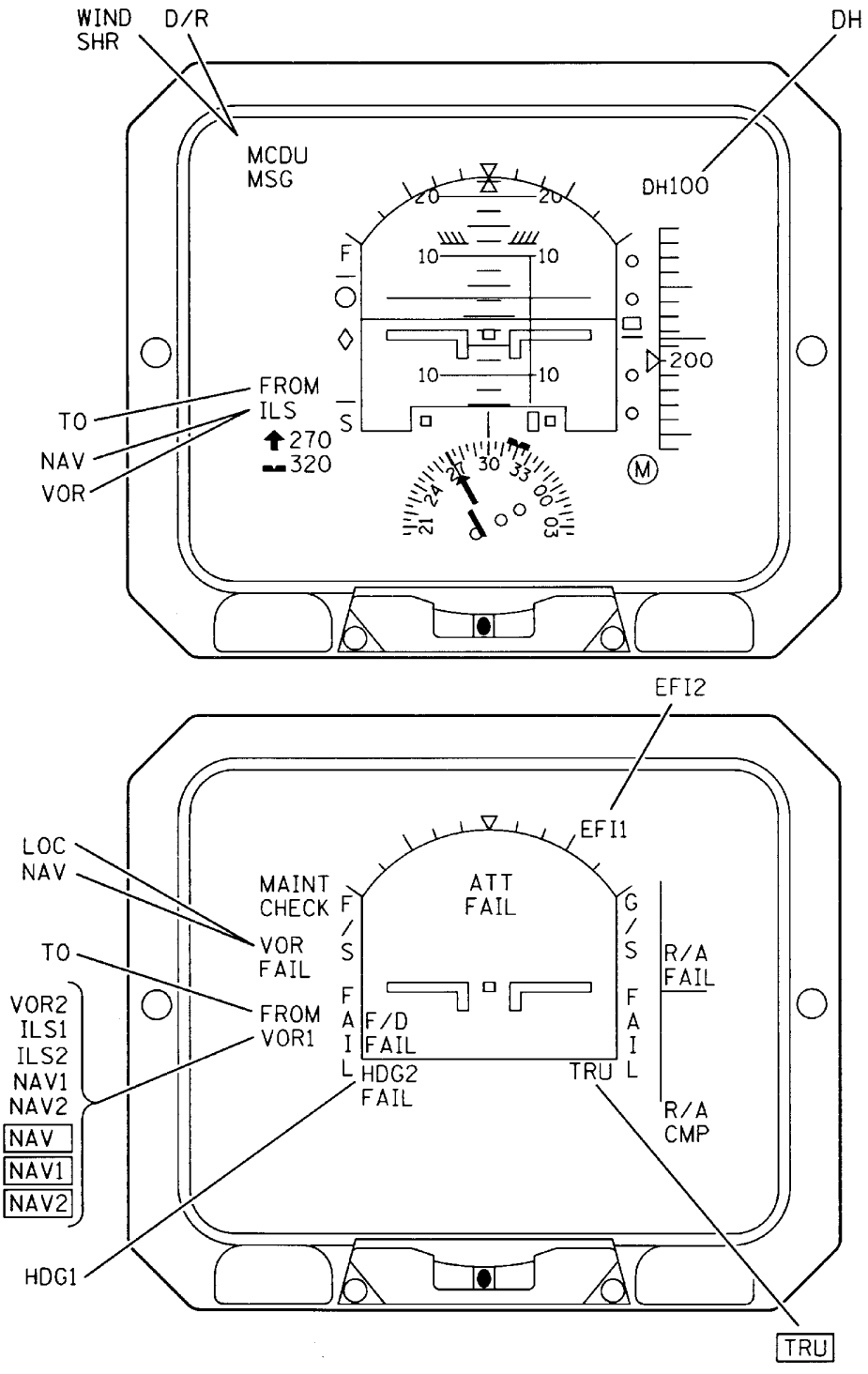
Primary Flight Display (with Flags and Warnings)
Figure 10/34-22-00-990-928



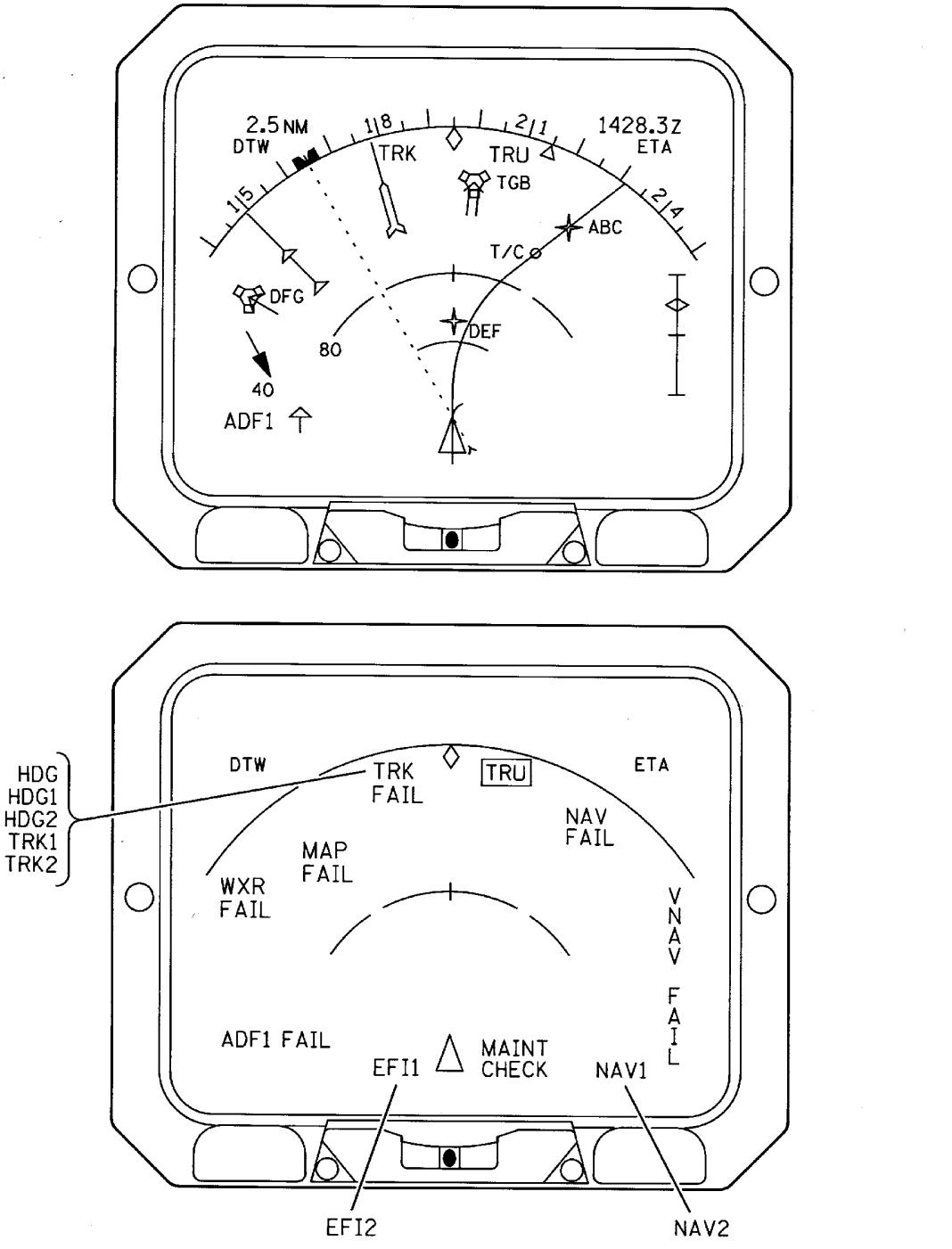
Navigation Display -- ROSE Mode (with Flags and Warnings)
Figure 11/34-22-00-990-929



Navigation Display -- ARC Mode (with Flags and Warnings)
Figure 12/34-22-00-990-930



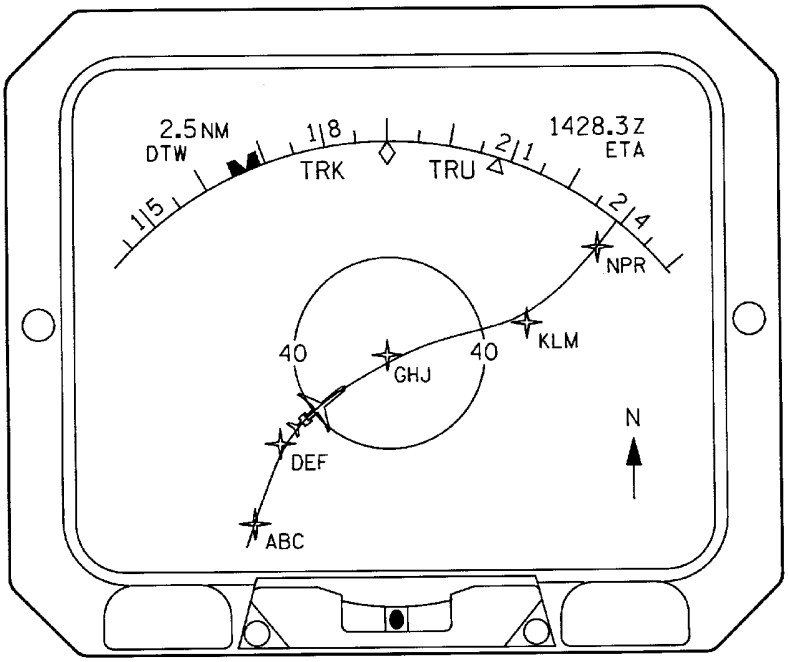
Compacted PFD/ND Format (with Flags and Warnings)
Figure 13/34-22-00-990-931



CAG(IGDS)

BBB2-34-1146A

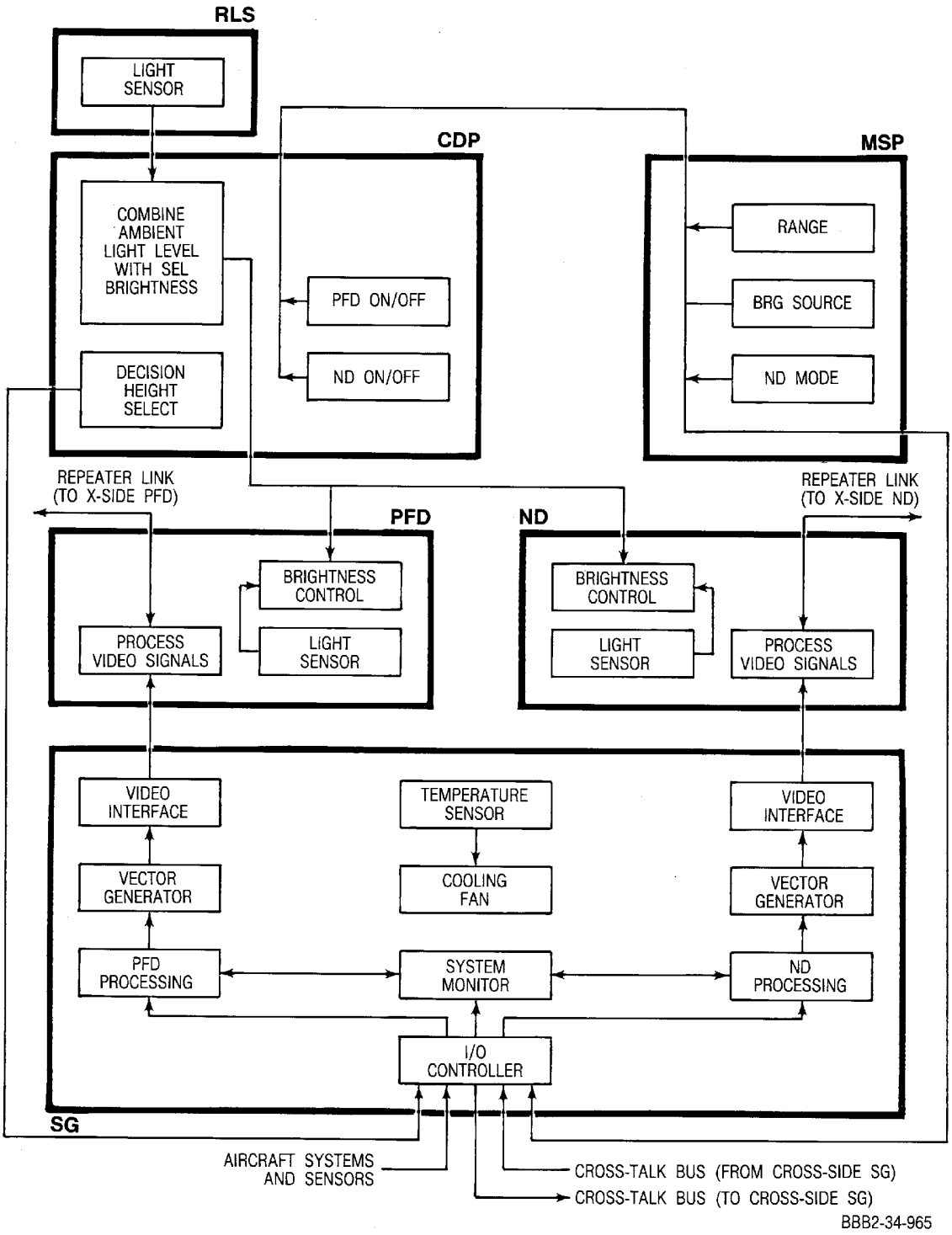
Navigation Display - MAP Mode (With Flags and Warnings)
Figure 14/34-22-00-990-932



CAD(IGDS)

BBB2-34-1147

Navigation Display - PLAN Mode
Figure 15/34-22-00-990-933



EFIS -- Block Diagram (Single Side)
Figure 16/34-22-00-990-934

	Left Symbol Generator Inputs (SG-1)		Right Symbol Generator Inputs (SG-2)	
Sensor	"A" Display	"B" Monitor	"A" Display	"B" Monitor
AHRS DUAL	AHRS1	AHRS2	AHRS2	AHRS1
Course Error	Crs Err1	Crs Err2	Crs Err2	Crs Err1
Radio Altitude	RA1	RA2	RA2	RA1
VOR/ILS	VOR/ILS1	VOR/ILS2	VOR/ILS2	VOR/ILS1

BBB2-34-1148

SG Display/Monitor Sensor Inputs
Figure 17/34-22-00-990-935

(1) Test mode:	Cockpit light test initiated by pressing ANNUN/DIGITAL LTS TEST pushbutton on Overhead. Causes HORIZON, ILS, HEADING and MONITOR lights to come on for 5 seconds. This mode is inhibited in flight.
(2) Reset mode:	FMA reset initiated by pressing one or both FMA reset buttons. Inhibits all failure warnings. Subsequent pressing will cause inhibited warnings to be displayed while button is pressed.
(3) Ground Inhibit mode:	Aircraft is below 50 feet radio altitude, or ground inhibit discrete is set (aircraft on ground and neither throttle advanced to takeoff thrust).
(4) Land mode:	Inoperative
(5) ILS mode:	Either DFGC is in ILS Mode, either VOR/ILS receiver is tuned to an ILS frequency.
(6) Cruise mode:	If none of above modes are selected, monitor is in Cruise mode.

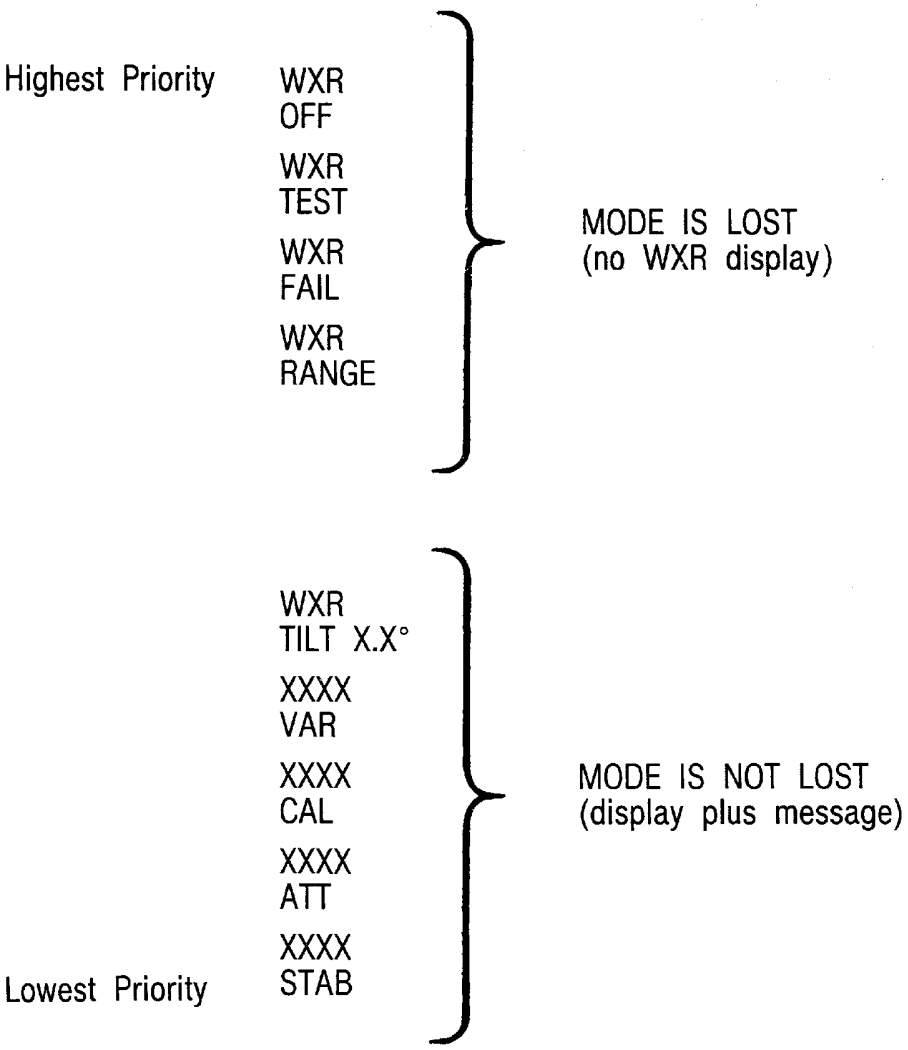
BBB2-34-967

Symbol Generator Operating Modes
Figure 18/34-22-00-990-936

PARAMETER	SG OPERATING MODE	DEVIATION THRESHOLD	FMA ANNUNCIATION	SCREEN DISPLAY SYMBOLOGY REMOVED	SCREEN DISPLAY FLAG DISPLAYED
ILS	ILS	.4 G/S dot .5 Loc dot	Both ILS lamps steady Both ILS lamps steady		
		Loss of valid	Flashing ILS on-side Steady ILS cross-side	G/S scale & pointer LOC scale & pointer	G/S FAIL LOC FAIL
HEADING	ILS, LAND	4 deg. + .3|bank angle|	Both HEADING lamps steady		
	CRUISE	6 deg. + .3|bank angle|	Both HEADING lamps steady		
		Loss of valid	Flashing HEADING on-side Steady HEADING cross-side	Compass/Arc symbology Digital Hdg display	HDG FAIL
HORIZON	ILS	Pitch: 3 degrees Roll: 3 degrees	Both HORIZON lamps steady		
	CRUISE	Pitch: 4 degrees Roll: 4 degrees	Both HORIZON lamps steady		
		Loss of valid	Flashing HORIZON on-side	Attitude scale	ATT FAIL
R/A	0-99	10 feet	No FMA Annunciation		R/A CMP
	100-499	(0.1)(Average R/A) feet	Both R/A CMP displays steady		
	500-2500	(0.1)(Average R/A) feet + 10 feet			
		Loss of valid	No FMA Annunciation Flashing R/A CMP on-side Steady R/A CMP cross-side	R/A tape	R/A FAIL

BBB2-34-968

FMA Annuciations for SG Instrument Comparator Function
Figure 19/34-22-00-990-937



Weathr Radar Message Priority
Figure 20/34-22-00-990-938

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 21/34-22-00-990-939

2. Operation

A. Overview: The Symbol Generators (SG's) are the master control units for the EFIS. Their job is to receive input data from aircraft sensors and systems, check the data for presence and validity, compute the display parameters for the display units, and transmit display data to the display units.

(1) The SG's are also responsible for monitoring the EFIS, for performing continuous self-tests, and for logging faults in the flight log. System monitoring includes input monitoring, SG-internal monitoring, control panel monitoring (CDP and MSP), and display unit (DU) monitoring. Each SG also monitors the cross-side SG and performs a navigation instrument comparator monitor function.

(2) The EFIS logs its own failures, and failures of all interfacing aircraft systems. In-flight failures are stored in a flight log for later retrieval by maintenance personnel. The EFIS has an extensive built in test (BIT) capability, comprised of both continuous BIT (for continuous in-flight monitoring) and initiated BIT (used only in maintenance and preflight tests).

(3) The EFIS system operation is presented in the following sequence:

Table 4

A.	Overview
B.	EFIS Inputs, Outputs and Data Flow
C.	System Monitoring
D.	Built In Test and Ground Maintenance

B. EFIS Inputs, Outputs and Data Flow: Navigation data are sent from the various aircraft systems and sensors to the SG Input/Output (I/O) controller for processing. The I/O controller writes all input data to each of the symbol generator processors: the PFD and ND processors, and the system monitor processor (Figure 16). Input data are checked for presence and validity, processed, and sent to the PFD and ND for display. The display data are also sent to the cross-side SG for comparison purposes. Display format and brightness are controlled from the Control and Dimming Panel (CDP) and from the Mode Select Panel (MSP).

(1) Each EFIS display is driven by its own display processor, vector generator, and video interface. The system monitor processor in the SG verifies the proper operation of each of the display processors. There are separate PFD and ND display output channels from the SG. Each display output channel consists of six digital output signals and two analog output signals which contain color settings, raster control, display mode setting (raster/stroke), and X-and Y-beam deflection signals. The SG receives a digital ready signal from the PFD and ND when the display deflection amplifiers are ready to write.

(2) Weather radar signals are sent to the WXR scan converter. This digital circuit is designed to convert the color WXR signal to EFIS color display format. The resultant map is an offset center sector scan, oriented with heading up in the ARC mode. The displayed sector is variable from +45 degrees to +90 degrees, as determined by the radar. The display map can be rotated and translated in response to aircraft heading and positional changes. Range marks and NAV marks are generated by the display generator in the ND processor. Range is controlled from the Mode Select Panel (MSP). An on-board test pattern generator provides a visual means of operational verification. The ND processor accesses the necessary hardware in the scan converter to control the source and display of the WXR data.

(3) Data from the on-side SG enters the DU through the primary display data input port. Each DU also has a secondary display data input port through which cross-side video signals may be sent/received. These bi-directional cross-side port lines are used in the event of a SG failure. By placing the EFIS source select switch in the BOTH ON 1 or BOTH ON 2 position, display data may be transferred directly from the PFD and ND on the functioning side to the cross-side DU's. The compacted PFD/ND display (reversionary mode) is obtained whenever one of the two system display units is turned off. This allows dual system operation should one of the display units fail.

(4) There are two brightness command signals for each DU: a brightness level command and a raster/stroke contrast ratio command. The raster/stroke contrast ratio is set to a default level for the PFD, compacted PFD/ND, and ND-ROSE displays to provide standard levels of raster shading for the ADI sky/ground shading and for the background scale shading. The voltage ratio is variable for the ND-ARC format, to allow the intensity of the weather radar imagery to be varied.

C. System Monitoring — System monitoring is designed to detect failures that may affect operation of the EFIS. EFIS monitoring consists of:

(a)	Input monitoring
(b)	Symbol Generator internal monitoring
(c)	SG-to-SG instrument comparator monitoring
(d)	Control panel monitoring
(e)	Display Unit monitoring
(f)	Weather radar input monitoring

(1) Input Monitoring - Input monitoring verifies that sensor or system inputs are present and valid, and that the SG input hardware is functioning properly. Input monitoring includes data and hardware.

(a) Input Data Monitoring - Analog and digital inputs to the SG are continuously monitored for presence and validity. If an input parameter is missing, invalid or out of range, the SG will remove all symbology dependent on the input from the PFD/ND. An appropriate failure message will be displayed where the data would normally appear on screen. The symbology will not be re-drawn until the valid input has returned for a minimum period of time.

(b) SG Input Hardware Monitoring: The SG monitor processor tests input hardware by feeding test values to the analog, synchro and digital input hardware.

1) Analog input hardware monitoring: The analog input hardware test verifies proper operation of the A-to-D conversion function. Failure of the analog input test will result in failure annunciation of all analog signals associated with the failed multiplexer. This test is performed at a 20 Hz rate.

2) Synchro input hardware monitoring: The synchro input hardware performs a bias test which verifies proper operation of the synchro to sin/cos conversion and demodulation network. This test is performed upon a cold start or during system testing.

3) Digital input hardware monitoring: Digital input receivers are continuously tested by sending test words from the four controlling transmitters to each of the receivers. When a receiver is in test mode, the monitor receives, checks and clears the test inputs. If an error is detected on two or more of the four test signals received, the receiver is inoperable, and appropriate symbology is blanked or flagged.

(2) Symbol Generator internal monitoring: consists of dissimilar processor comparisons, sample problem executions, program execution time checks and program memory checks.

(3) SG-to-SG Instrument Comparator Monitoring: The SG receives two types of sensor inputs: "A" (on-side) inputs for display on the on-side DU's, and "B" (off-side) inputs for monitoring the cross-side SG (Figure 17). The SG performs a Nav Instrument Comparator Monitor (NICM) function by comparing the following "A" and "B" parameters:

- ILS (localizer and glideslope deviations)
- Attitude (pitch and roll)
- Heading
- Radio Altitude.

(a) If significant cross-channel differences are found between the "A" and "B" values of ILS, attitude or heading parameters, the SG's will signal the discrepancy on the FMA. The ILS, ATTITUDE or HEADING annunciator will flash on the side associated with the fault, and glow steady on the cross-side FMA. A flag and/or warning will also appear on the display screen. Radio Altitude mis-compare is annunciated on the PFD by a "R/A CMP" message. Flashing logic is the same as for the other parameters. Mis-compare annunciations will clear automatically if the deviation returns to within limits. They may be manually cleared on the FMA by resetting the FMA annunciator. Loss of valids results in annunciations on both FMA's, removal of faulty parameters from the screen, and display of fail messages. (Figure 19).

(b) The MONITOR annunciator on the FMA is used to signal SG failures in one of three conditions. The first condition involves internal SG tests which are performed under the direction of the system monitor processor. These tests are performed at a 2 Hz rate, and the results compared with the cross-side system results. When a miscomparison occurs on either side, both MONITOR annunciators come on.

The second condition occurs when the SG-to-SG cross-talk link fails due to invalid or interrupted updates. This also will cause both MONITOR annunciators to come on. The third condition is when a SG fails. The remaining SG continues to monitor its own displayed data, but the comparison function is deactivated. The MONITOR annunciator will come on, on the failed side.

(c) There are six distinct SG-to-SG Instrument Comparison Operating Modes (Figure 18). The operating mode determines if, and when, the NICM annunciators on the FMA will come on. These modes are prioritized from Cruise mode (5 - lowest priority) to Test mode (1 - highest priority). Higher priority modes will always override lower priority modes. During the course of the flight leg, the system will primarily operate in Cruise mode.

(4) Control Panel monitoring: verifies correct operation of the Control and Dimming Panel and Mode Select Panel.

(5) Display Unit monitoring: Verifies that the DU is receiving display data.

(6) Weather Radar Input monitoring: The SG weather radar (WXR) scan converter converts color WXR signals to a format suitable for display on an EFIS color display unit. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages. There are two types of WXR messages: those for which the mode selected on the WXR control panel is lost, and those for which the mode is not lost. If the mode is lost, warnings will appear on screen, but there will be no WXR display. If the mode is not lost, the messages will appear along with the WXR display (Figure 20). WXR messages are prioritized as follows:

WXR OFF - WXR BRT knob is OFF on CDP, or DU overheat condition

WXR TEST - System in TEST mode. Test pattern is displayed, plus R/T fault messages including:

R/T - receiver/transmitter fault

ANT - antenna fault

CNTL - control fault

ATT - attitude fault

CAL - calibration fault

RANGE - range fault (MSP fault)

COOL - R/T unit cooling fault.

NOTE: If any of the above failures exists during TEST, "TEST" will be replaced by "FAIL" along with appropriate messages.

WXR FAIL - R/T, Antenna or Control faults exist, or no data are being received by SG, or data not valid.

NOTE: When -905 symbol generators are installed, EFIS will display WXR OFF when no WXR data are being received by the SG.

WXR RANGE - Computed range does not agree with range selected on MSP.

XXXX VAR - WXR input sensitivity not calibrated to any precipitation rate (XXXX represents operating mode selected on WXR control panel).

XXXX CAL - loss of calibration

XXXX ATT - attitude input fault

XXXX STAB - stabilization is off

WXR TILT - momentarily annunciated on screen when antenna tilt angle is changed.

D. Built In Test and Ground Maintenance: The EFIS built in test (BIT) is designed to aid maintenance in isolating faults related to the EFIS and the systems with which it interfaces. There are two types of BIT for the EFIS: continuous BIT for in-flight monitoring, and initiated BIT for pre-flight and LRU functional checks. Other maintenance functions require interface with the Status Test Panel (STP) for in-depth system tests and fault isolation.

(1) Continuous BIT: Continuous BIT monitors the EFIS throughout each flight profile and logs all failures in the flight log for later retrieval by maintenance personnel. The EFIS logs its own failures, and also those of the aircraft systems with which it interfaces. The SG maintains a log in non-volatile memory of failures detected by the system monitors, whenever the system power is on. The continuous BIT logs the failure type and time of occurrence (time after start of flight leg). The log can contain 20 failures on each of the last 10 flight legs. Intermittent failures are recorded only once per hour of flight time. Continuous failures are recorded only once per flight leg. (Faults are also recorded while the aircraft is on the ground and the system is functioning.) Failures are retrieved via the Status Test Panel.

(2) Initiated BIT: Initiated BIT provides a means of self-testing the EFIS on the ground. Tests are initiated by pushing the TEST button on the Control and Dimming Panel. Tests include: initiated EFIS System Self-Test, Initiated Functional Self-Test and Initiated Cockpit Lamp Test. Initiated BIT is used both in preflight testing and in LRU functional checks (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201).

(a) EFIS System Self-Test (BIT) is initiated through the TEST pushbutton on the Dimming Panel. Test begins when the pushbutton is depressed, and ends approximately 3 seconds after release. This test includes:

- VOR/ILS Self-Test

- Radio Altimeter Self-Test
- Marker Beacon Self-Test
- Failure Flag Test.

(b) The first three tests are under control of the associated receiver units (the EFIS is only used to display the input parameters). The decision height aural warning test and failure flag test are under the control of the SG. Failure flag annunciations appear on the DU screen only while the TEST pushbutton is being depressed. The Failure Flag Test annunciations for the various display screens are (Figure 20).

(c) EFIS Functional Self Test is used by maintenance personnel to verify proper installation and operation of the SG. This test is initiated via the Status Test Panel (STP), by calling up the SG SELF-TEST selection on the Maintenance Menu (see EFIS Ground Maintenance following). The test consists of a synchro bias test, a system RAM check and an SG cooling fan test. The test takes approximately 2 seconds. Upon completion, both display units show software part numbers, aircraft equipment/options configuration, and test results (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201). This test is inhibited except when aircraft is on the ground and weight-on-wheels discrete is set.

(d) The cockpit lamp test checks the EFIS lamp displays by driving the FMA comparison lamps. Approximately 0.5 seconds after release of the DIGITAL/ANNUN pushbutton on the Overhead, the ILS, HEADING, HORIZON and MONITOR lamps on the FMA come on for 5 seconds.

3. MD-80 -906 Symbol Generator (SG)

NOTE: The following applies per AOL 9-2524 dated April 8, 1997.

A. The -906 symbol generator change requirements include:

(1) No new wiring or interfaces are required. The existing ARINC 429 bus from the flight management computer (FMC) will supply additional labels to provide the needed input to display the requirement navigation performance (RNP) message, dead reckoning mode display revisions, and the air traffic control (ATC) message.

(a) RNP annunciation RNP message shall be displayed (in medium size characters) on the primary flight display (PFD) and compact mode below the multifunction control display unit (MCDU) MSG annunciation. The FMC will transmit the following digital discrete on the existing ARINC 429 bus for the actual navigation performance (ANP)>RNP annunciation RNP.

The RNP message shall flash five seconds at initial trigger and then display steady. The RNP message shall also flash five seconds when transiting from one state to another.

Amber RNP shall have priority over white RNP.

(b) Dead reckoning mode

The symbol generator (SG) shall display the flight path on the navigation display (ND) as a dashed amber line in lieu of the current solid magenta line, 2.5 minutes after entering the dead reckoning mode.

(c) ATC message display

ATC messages shall be displayed, in medium size characters, in the upper left corner on the PFD and compact mode, in the same location as the current MCDU MSG message, when the ATC uplink has been received.

The ATC MSG shall flash at 1.25 Hz until the crew has acknowledged the message. Then it shall remain on steady. Once a response to the ATC uplink has been initiated, the ATC MSG shall be extinguished. If another ATC uplink is received while the ATC MSG is flashing, it shall continue to flash. If another ATC uplink is received while ATC MSG is steady, ATC MSG shall begin to flash again. ATC NO COMM message shall be displayed on the PFD and compact mode, when the FMC detects that ATC communication has been lost or interrupted.

A flashing message has priority over a steady message.

(2) Single system predictive windshear

No new wiring or interfaces are required. The existing ARINC 708 (ARINC 453) bus from the weather radar R/T (WXR) will supply additional label definitions to provide the needed input, and the existing symbol generator ARINC 429 ISDAS bus shall supply additional label definitions to provide the needed output to the digital flight data acquisition unit (DFDAU).

(a) Predictive windshear annuciation

The predictive windshear (PWS) annuciation (WSHR AHEAD) shall be displayed in the upper left corner in the same location as the reactive windshear (WIND SHR) annunciation. The WXR R/T will transmit digital discrete on the existing ARINC 453 bus. All predictive windshear annunciations shall be in large size characters.

WSHR AHEAD shall be displayed in amber for a PWS caution and a red for a PWS warning. The annunciation shall flash three times upon initial onset and then remain steady. If PWS option is selected, the reactive windshear (RWS) logic shall be as follows:

1) If the RWS caution is detected and no PWS warning is detected, then WIND SHR shall be displayed in amber.

2) If the RWS caution is detected in cunjunction with a PWS warning, then WIND SHR shall be displayed in red.

RWS warning (tail shear) annunciation shall remain the same. The symbol generator will perform signal flashing for PWS and RWS transitions and monitor the windshear computer for other than symbol generator initiated state transitions. There shall be a 1 frame hysteresis (i.e. 1 frame = 200 msec) for all state transitions. If PWS fail, bit 64, is high (1), indicating data valid, or if the ARINC 453 data is invalid (off or failed) then no PWS annunciation shall be displayed.

In order to provide a more rapid response to the PWS warning and PWS caution signals from the weather radar ARINC 453 bus, the data shall be read and processed for both pilots based on either of the comntrol accept bits being active.

(b) Navigation display weather radar modes

The windshear only mode, which is a new mode provided by the WXR R/T, shall be displayed as WSHEAR in the same location as the current WXR modes. The input requirement changes are additional bit definitions on label 055 on the existing ARINC 708 (ARINC 453) bus from the WXR R/T.

There is no change required for PWS raster display. The input is supplied by the same data stream as the current weather raster display. The WXR OFF and WXR FAIL logic shall remain unchanged except the timing window for the control and data bits shall be expanded to a 26 seconds on lieu of 18 seconds.

(c) Predictive windshear messages

WSHR OFF shall be displayed on the ROSE, ARC, MAP, PLAN, and compact mode. On the ARC and MAP modes, WSHR OFF shall be displayed in the same location as WXR OFF. WSHR OFF will be displayed in the same location on the ROSE and PLAN modes as it is on the ARC and MAP modes. On the compact mode, WSHR OFF shall be displayed in the same location as the current MAINT CHECK message. There is no requirement for PWS FAIL annunciation. WSHR OFF shall be displayed in cyan with the following logic, and shall have the highest priority over all the other XR modes. The WSHR OFF message shall have a 25 second time delay in order to prevent flickering at touchdown.

1) Weight on wheels (pin MP15D = ground) and PWS option pins selected and not ground inhibit (pin TP14G = open) and both captain and F/O WXR OFF.

2) Not weight on wheels (pin MP15D = open) and PWS option pins selected and radio altitude < 1300 feet (pin TP5D, TP5C) and radio altitude valid (pin TP8C) and both captain and F/O WXR OFF.

(d) DFDAU requirements

Additional bit definition on label 104 are required on the existing ISDAS bus to interface with the digital flight data acquisition unit (DFDAU).

(e) Two software option bits are required for PWS. One for Bendix installation and one for Collins installation.

(3) SG/VOR bearing fail nuisance fault log fix

The symbol generator fault log currently registers SG/VOR 1 BEARING FAIL X31-086 and SG/VOR 2 BEARING FAIL X31-128 faults whenever an ILS is tuned. The symbol generator is still expecting VOR bearing refresh data and logs the faults, when it fails to see the updates from the VOR/ILS receivers. With the -906 SG, when the VOR is out of range, the VOR/ILS will set the SSM bits to fail not NCD; the SG shall not log a fault in this case in order to aviod nuisance fault logging.

(4) Map fail fix

When runway heading of 180° is selected, the symbol generator erroneously replaces the MAP data with MAP FAIL for the remainder of the flight. After the aircraft has landed, the MAP recovers. This is corrected in the -906 SG.

(5) WXR ON message display priority

D/R message currently has priority over the WXR ON message. This priority should be reversed. The final priority for all messages should be as follows (highest to lowest):

- Reactive Windshear Warning (Red - WIND SHR)
- Reactive Windshear Caution and Predictive Windshear Warning (Red - WIND SHR)
- Predictive Windshear Warning (Red - WSHR AHEAD)
- Reactive Windshear Caution and No PWS Warning (Amber - WIND SHR)
- Predictive Windshear Caution (Amber - WSHR AHEAD)
- Weather Radar ON (WXR ON)
- ATC Message (ATC MSG)
- RNAV Message (MCDU MSG)
- ATC NO COMM Message (ATC NO COMM)
- Dead Reckoning (D/R or DR)

NAVIGATION DISPLAYS - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting faulty navigation displays in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude system operation are: Captain's and First Officer's HSIs and ADIs, VOR/ILS receiver, course control and heading control.

E. The navigation displays components are located as follows:

Table 101

Component	Location
Attitude Direction Indicators (ADI)	Captain's and First Officer's Instrument Panels
Horizontal Situation Indicator (HSI)	Captain's and First Officer's Instrument Panels
VOR/ILS Receiver	Avionics Compartment
CRS (course) Control	Flight Guidance Control Panel
Heading (HDG) Control	Flight Guidance Control Panel

F. Trouble Shooting procedures in this section interface with Trouble Shooting procedures in the following sections:

Table 102

Compass System	(HEADING SYSTEM, SUBJECT 34-21-00)
Attitude System	(ATTITUDE SYSTEM, SUBJECT 34-23-00)
ILS System	(INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00)
VHF/NAV System	(VHF NAVIGATION, SUBJECT 34-51-00)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 103

Name and Number	Manufacturer
Multimeter 2000A	Dana

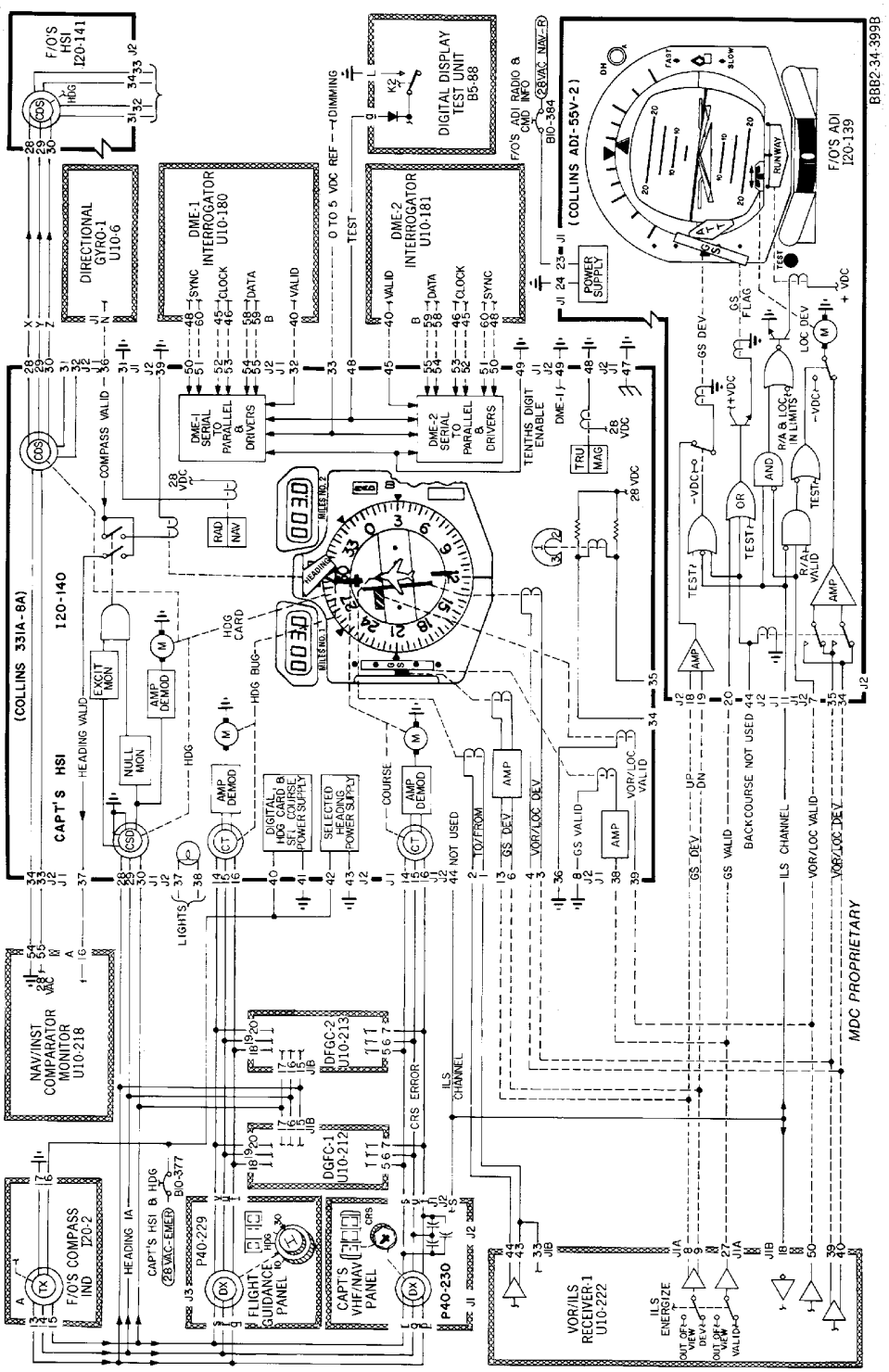
3. Trouble Shooting Navigation Displays

A. Trouble Shoot

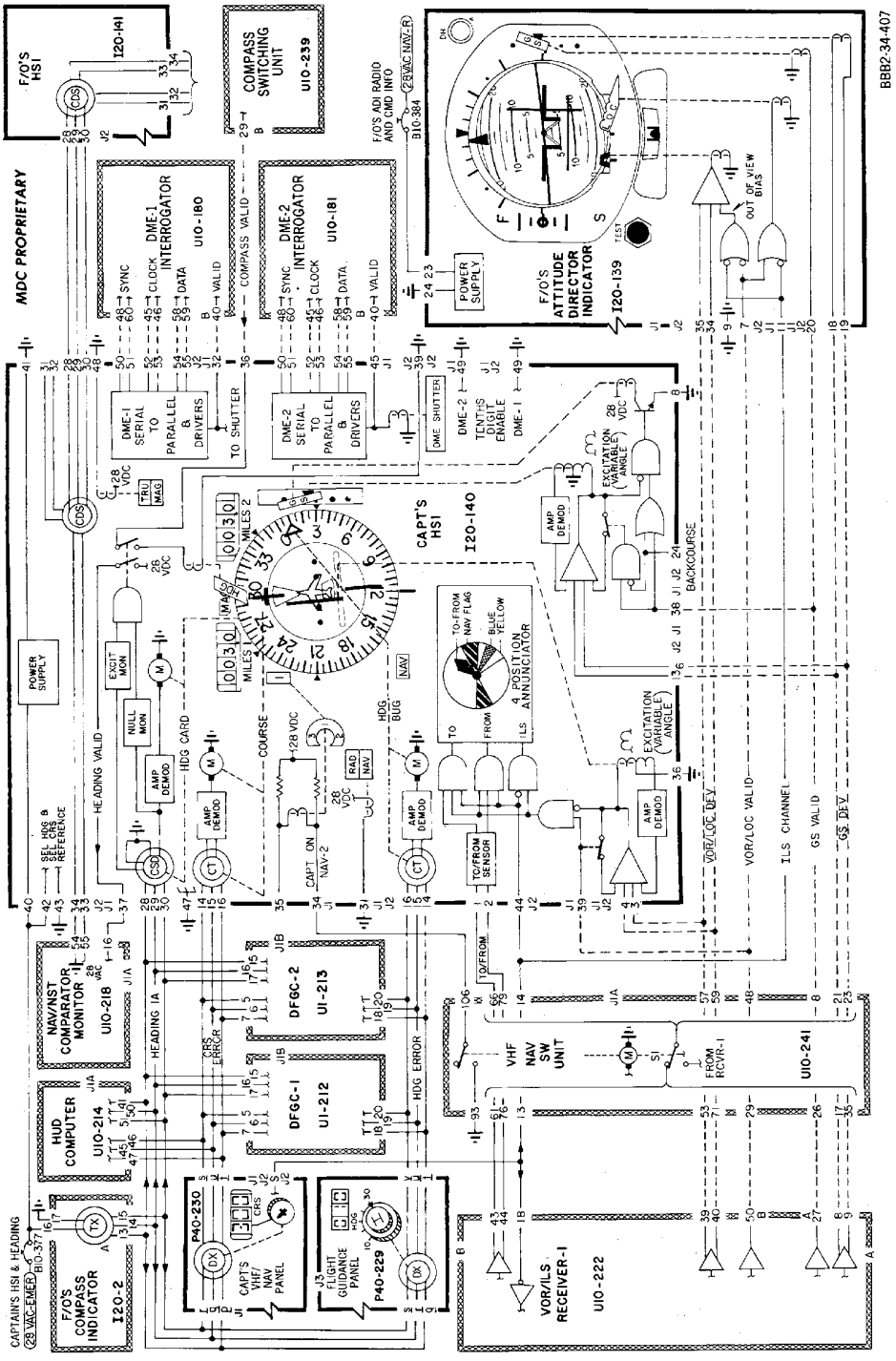
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are ADIs, HSIs, and VOR/ILS receiver.

Table 104

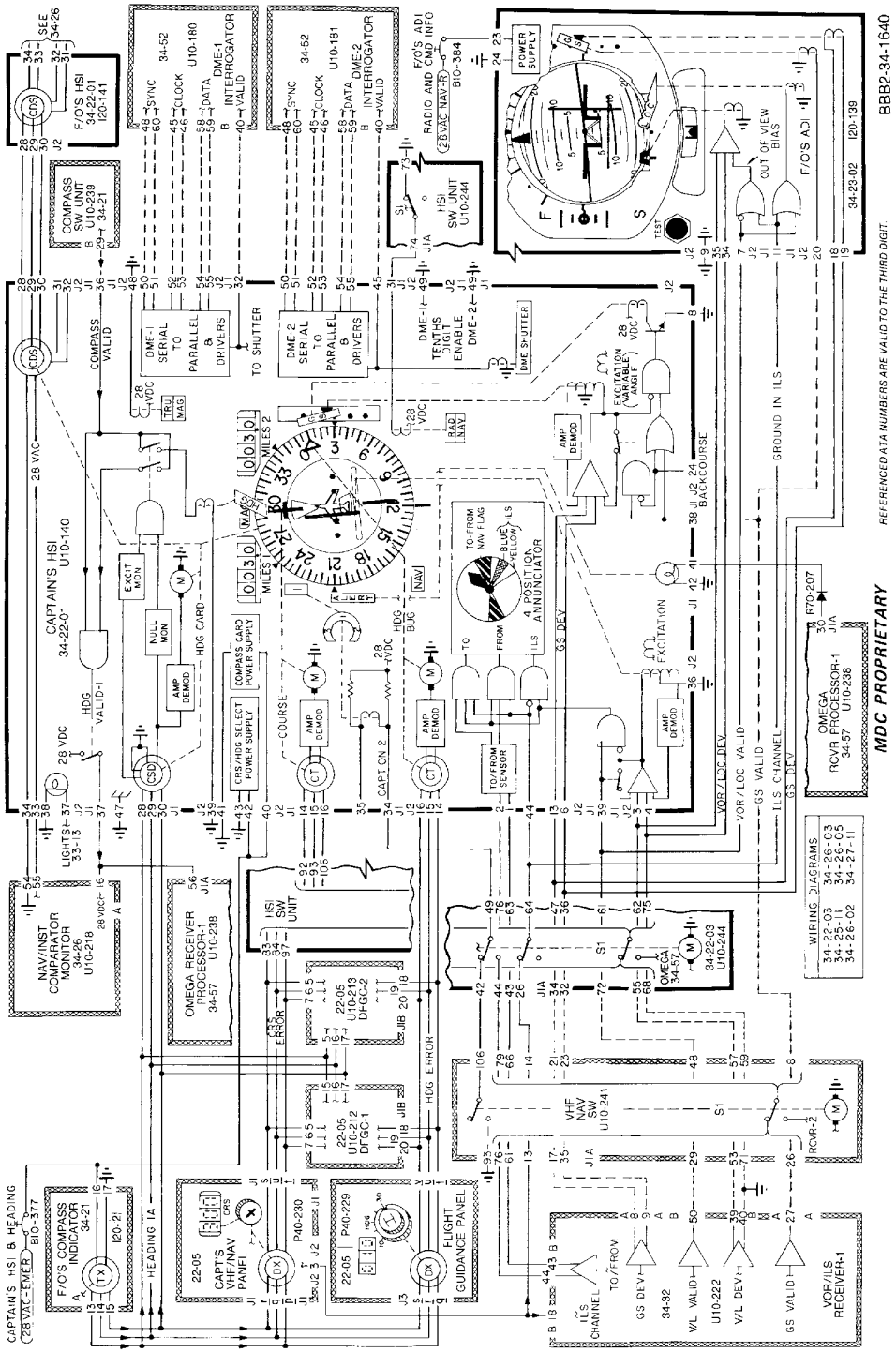
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



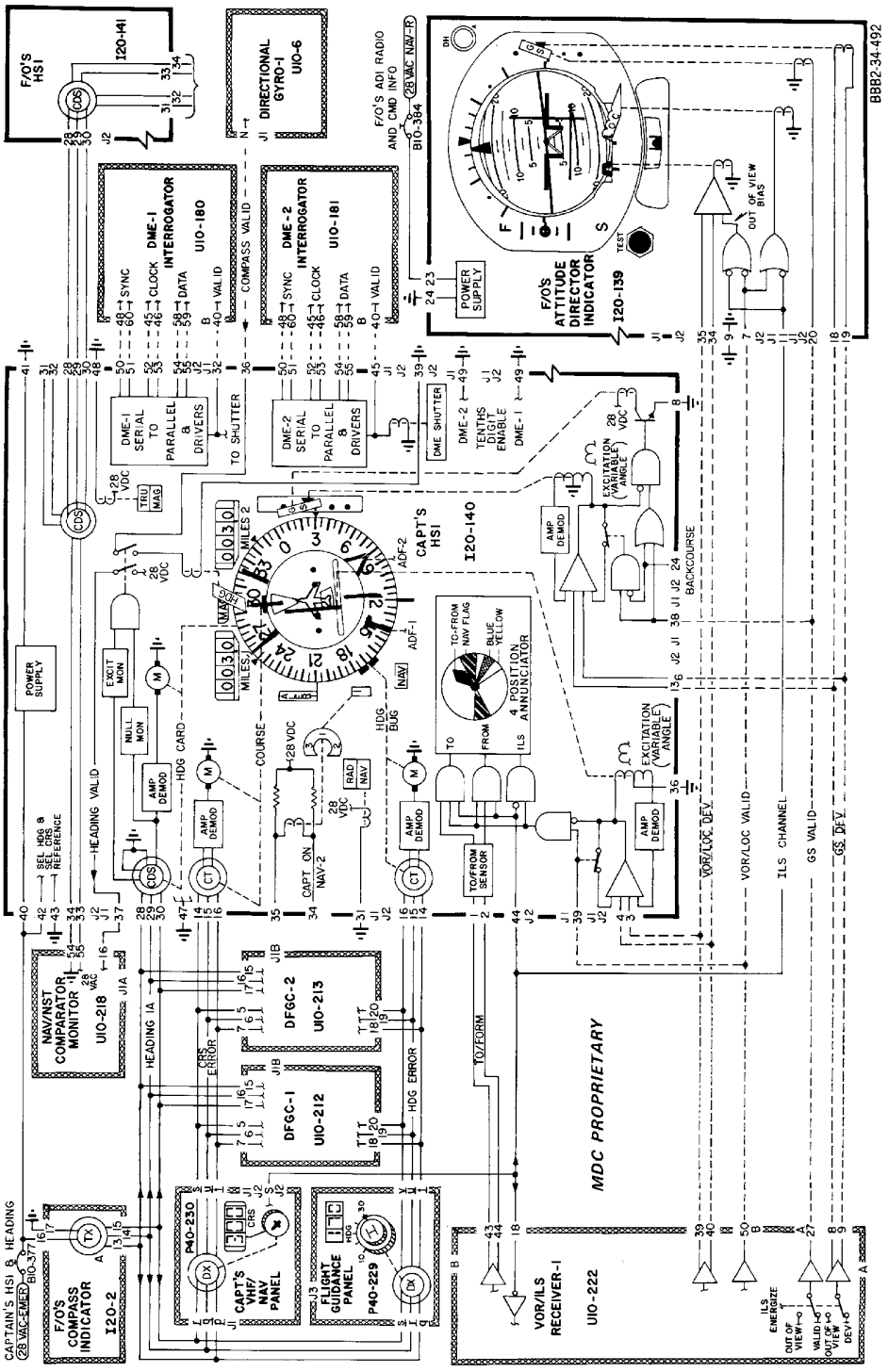
Navigation Displays - Captain's -- Schematic
Figure 101/34-22-00-990-948



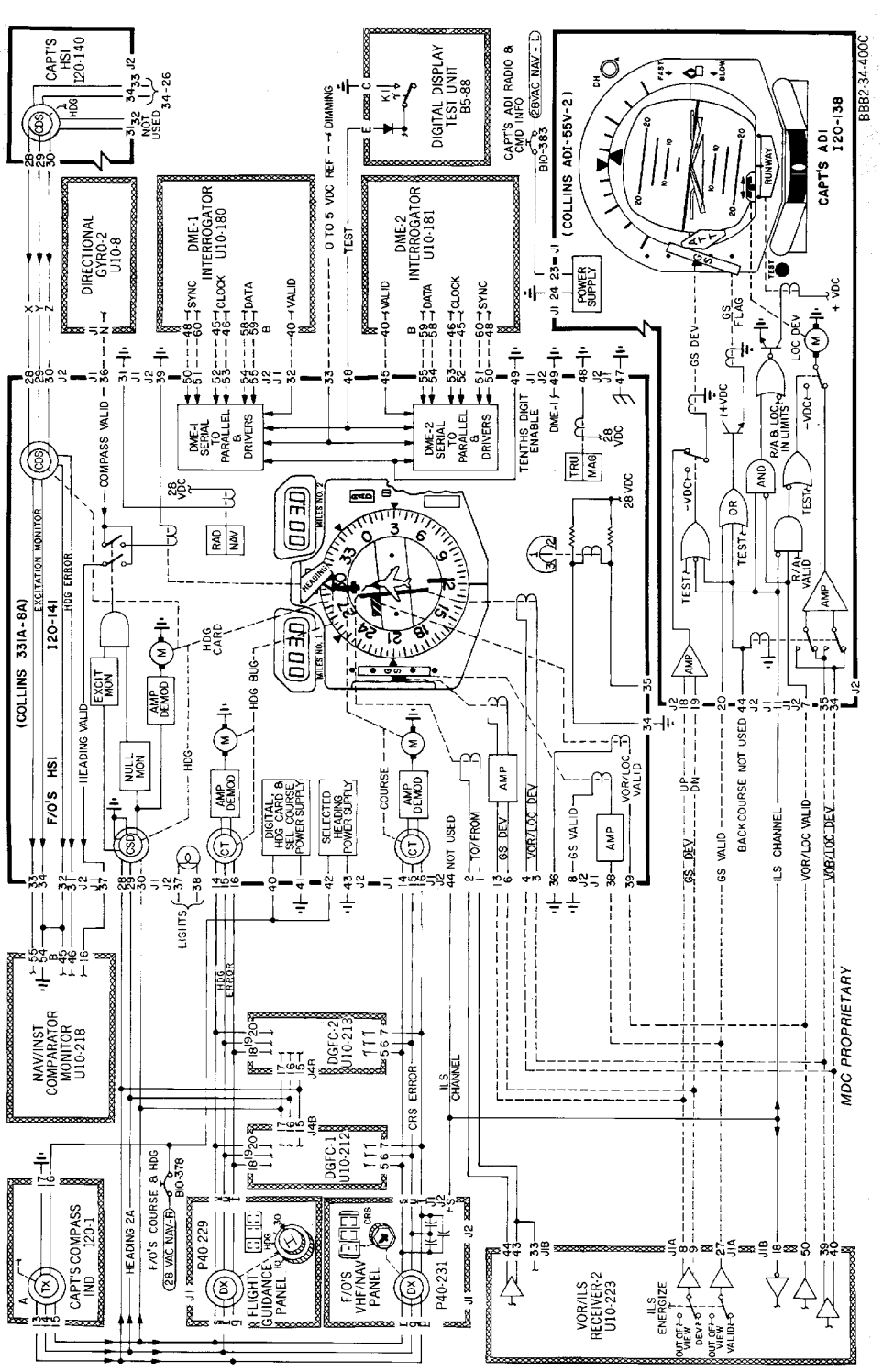
Navigation Displays - Captain's -- Schematic
Figure 102/34-22-00-990-951



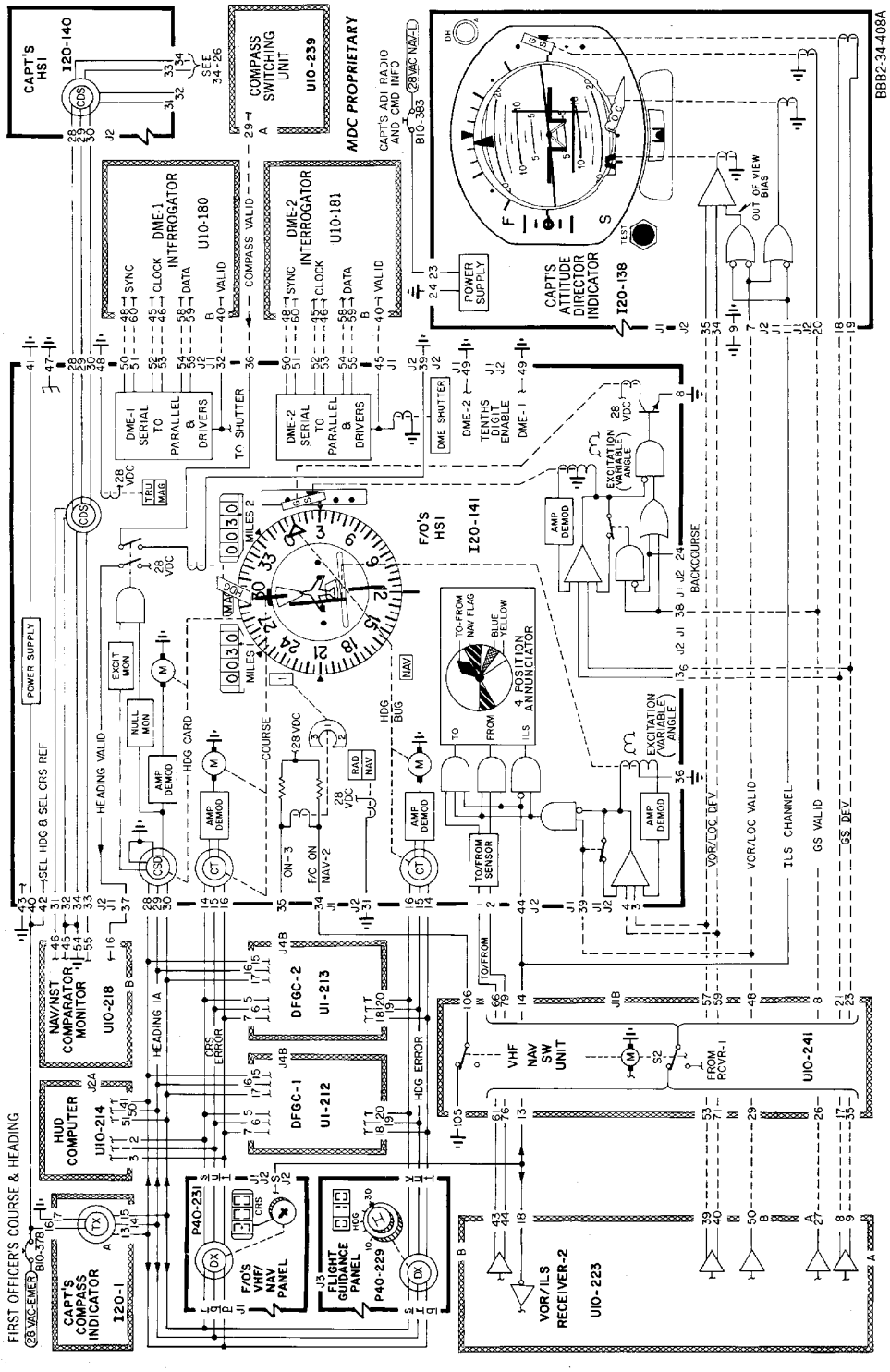
Navigation Displays - Captain's -- Schematic
Figure 103/34-22-00-990-954



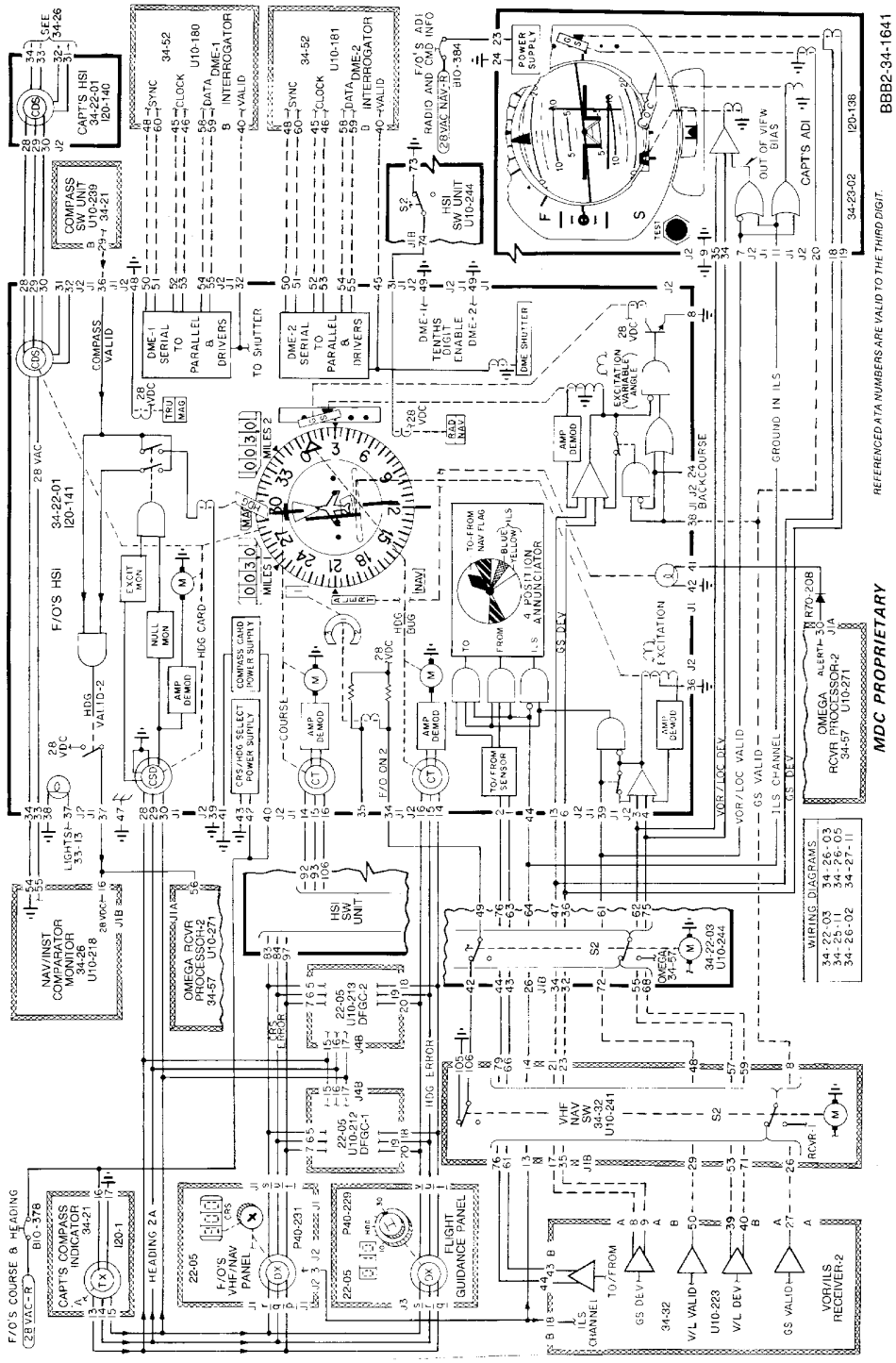
Navigation Displays - Captain's -- Schematic
Figure 104/34-22-00-990-955



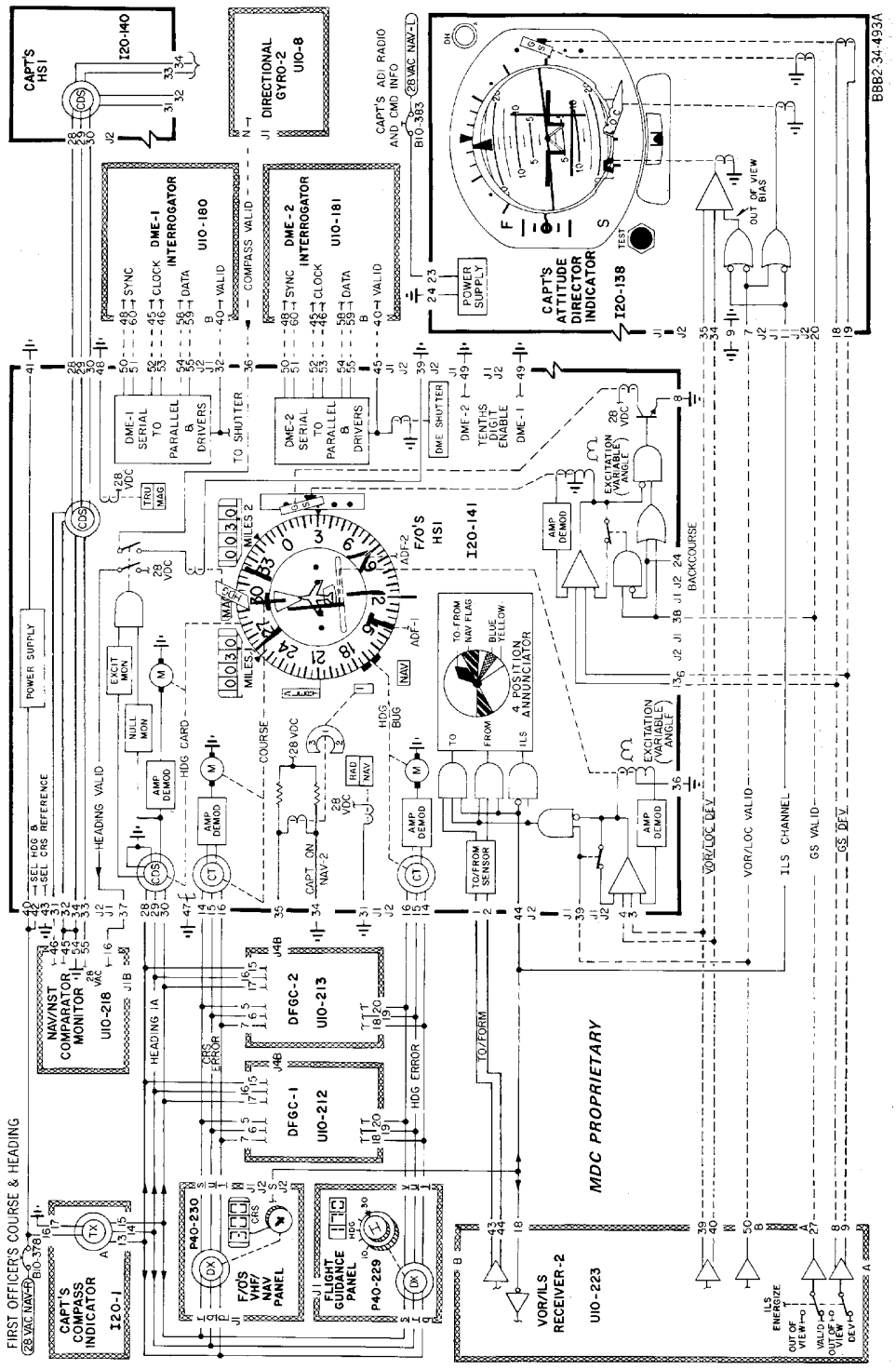
Navigation Displays - First Officer's -- Schematic
Figure 105/34-22-00-990-959



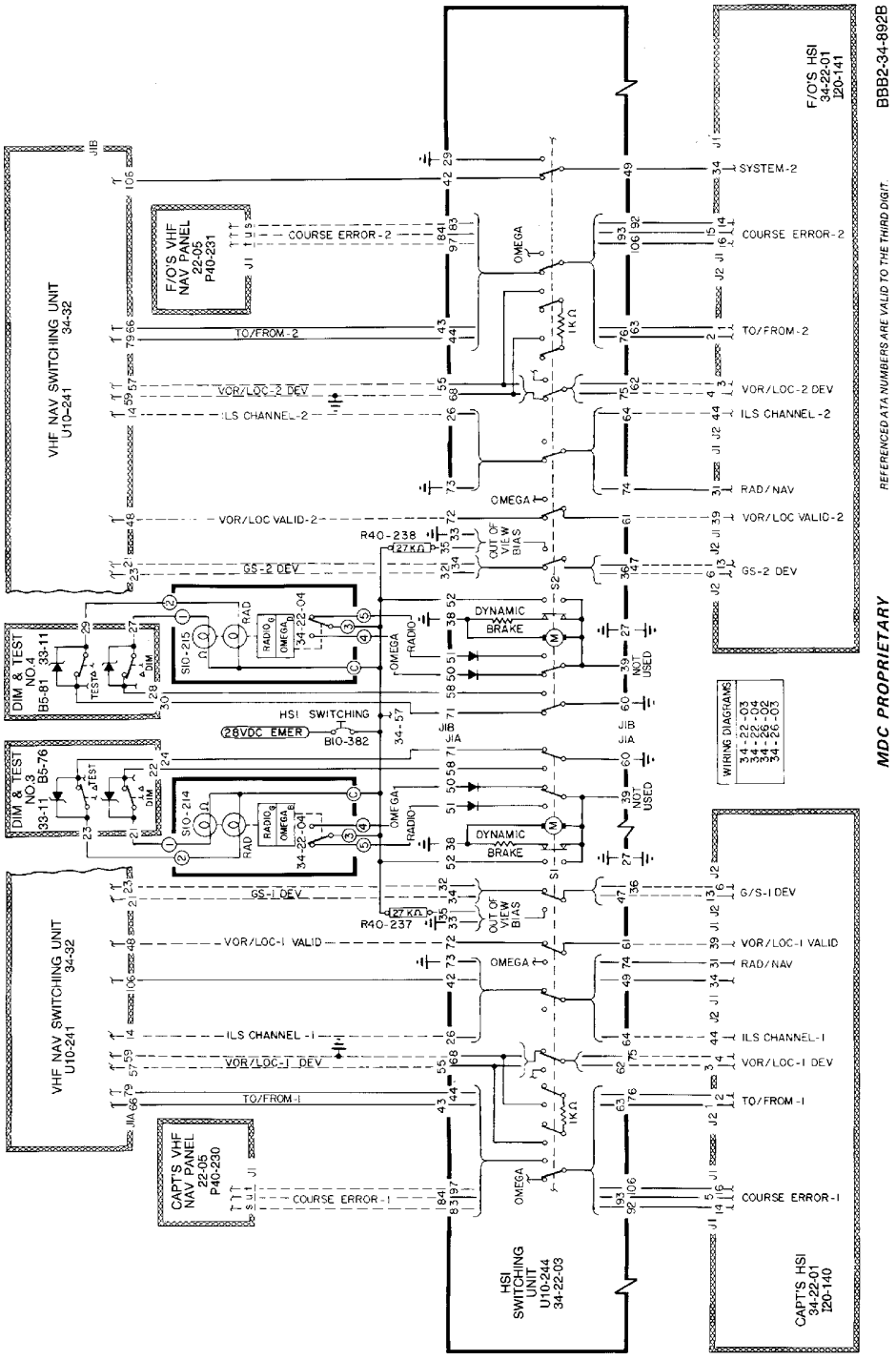
Navigation Displays - First Officer's -- Schematic
Figure 106/34-22-00-990-962



Navigation Displays - First Officer's -- Schematic
Figure 107/34-22-00-990-965



Naviagtion Displays - First Officer's -- Schematic
Figure 108/34-22-00-990-966



HSI Switching Unit (Radio Position) -- Schematic
Figure 109/34-22-00-990-968

NAVIGATION DISPLAYS - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting faulty navigation displays in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude system operation are: Captain's and First Officer's HSIs and ADIs, VOR/ILS receiver, course control, heading control, OMEGA Receiver Processor Unit (RPU), OMEGA Control Display Unit (CDU), and HSI (RAD/INS) switching unit.

E. The navigation displays components are located as follows:

Table 101

Component	Location
Attitude Direction Indicators (ADI)	Captain's and First Officer's Instrument Panels
Horizontal Situation Indicator (HSI)	Captain's and First Officer's Instrument Panels
VOR/ILS Receiver	Avionics Compartment
CRS (course) Control	Flight Guidance Control Panel
Heading (HDG) Control	Flight Guidance Control Panel
OMEGA RPU	Electrical/Electronics Compartment
OMEGA CDU	Pedestal
RAD/INS (OMEGA) switching unit	Electrical/Electronics Compartment
HSI (RAD/INS) switching unit	Electrical/Electronics Compartment

F. Trouble Shooting procedures in this section interface with Trouble Shooting procedures in the following sections:

Table 102

Compass System	(HEADING SYSTEM, SUBJECT 34-21-00)
Attitude System	(ATTITUDE SYSTEM, SUBJECT 34-23-00)
ILS System	(INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00)
VHF/NAV System	(VHF NAVIGATION, SUBJECT 34-51-00)
OMEGA System	(OMEGA/VLF NAVIGATION SYSTEM, SUBJECT 34-55-00)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 103

Name and Number	Manufacturer
Multimeter 2000A	Dana

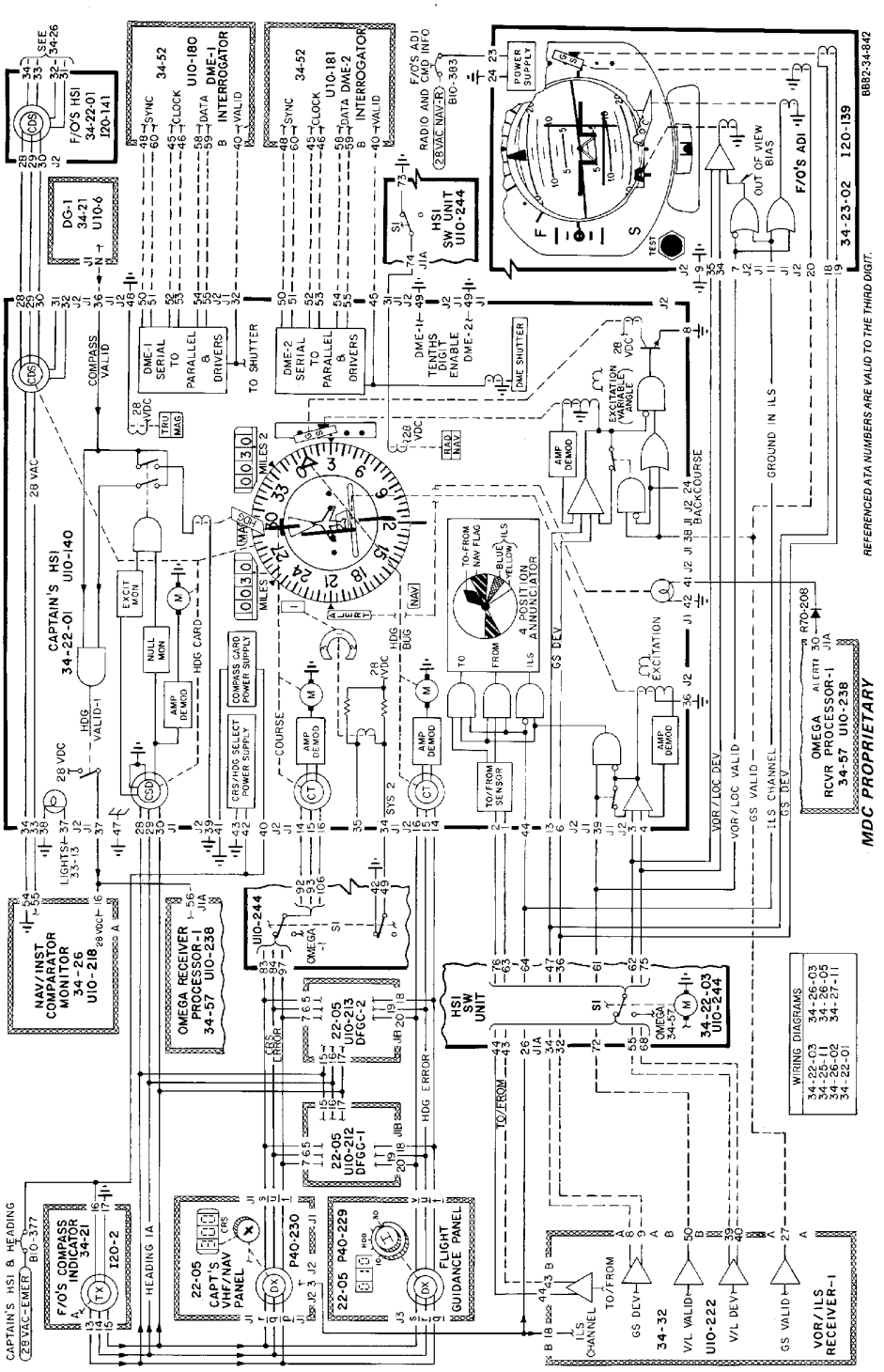
3. Trouble Shooting Navigation Displays

A. Trouble Shoot

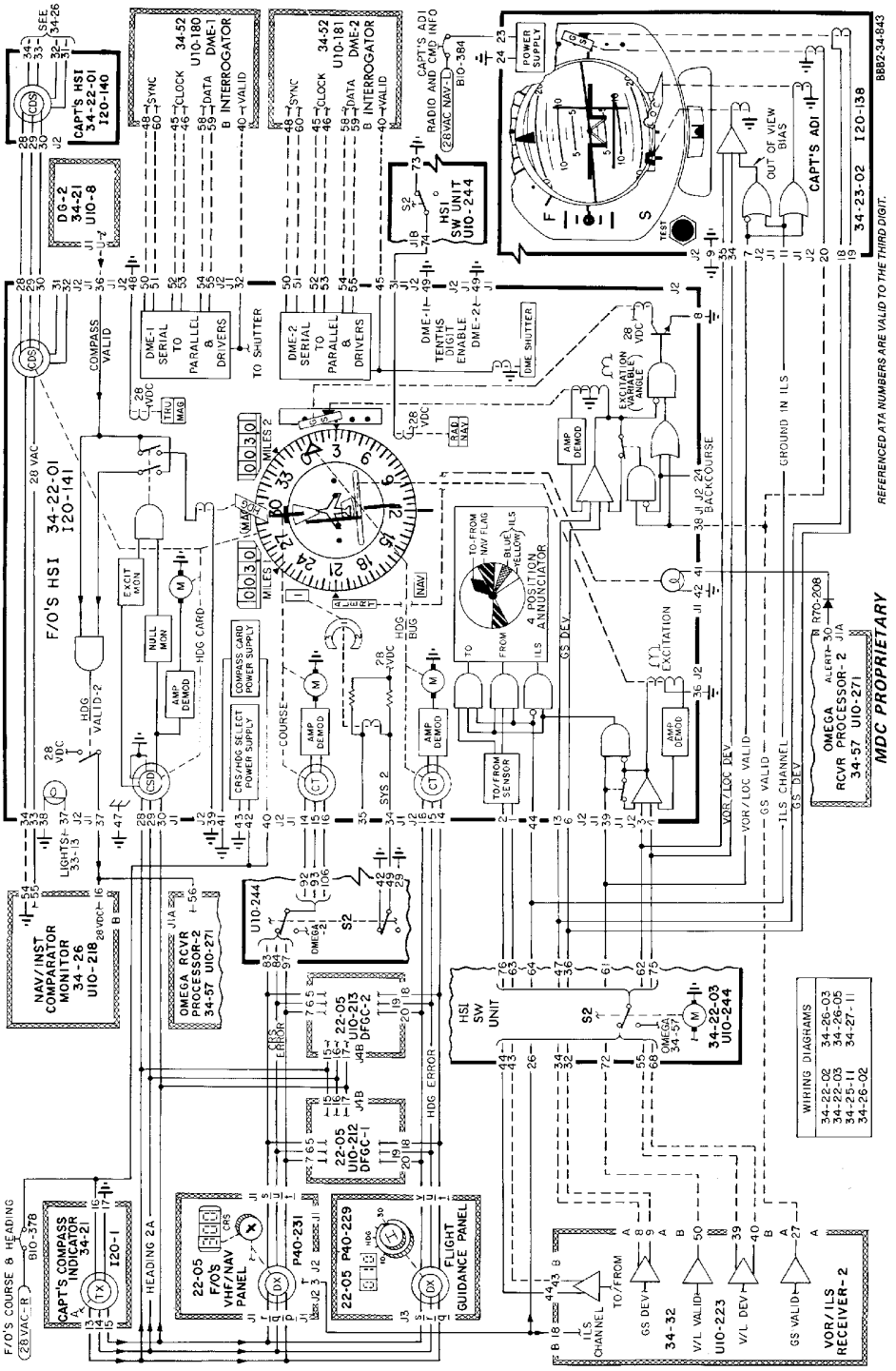
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are ADIs, HSIs, VOR/ILS receiver, OMEGA RPU, OMEGA CDU, and HSI (RAD/INS) switching unit.

Table 104

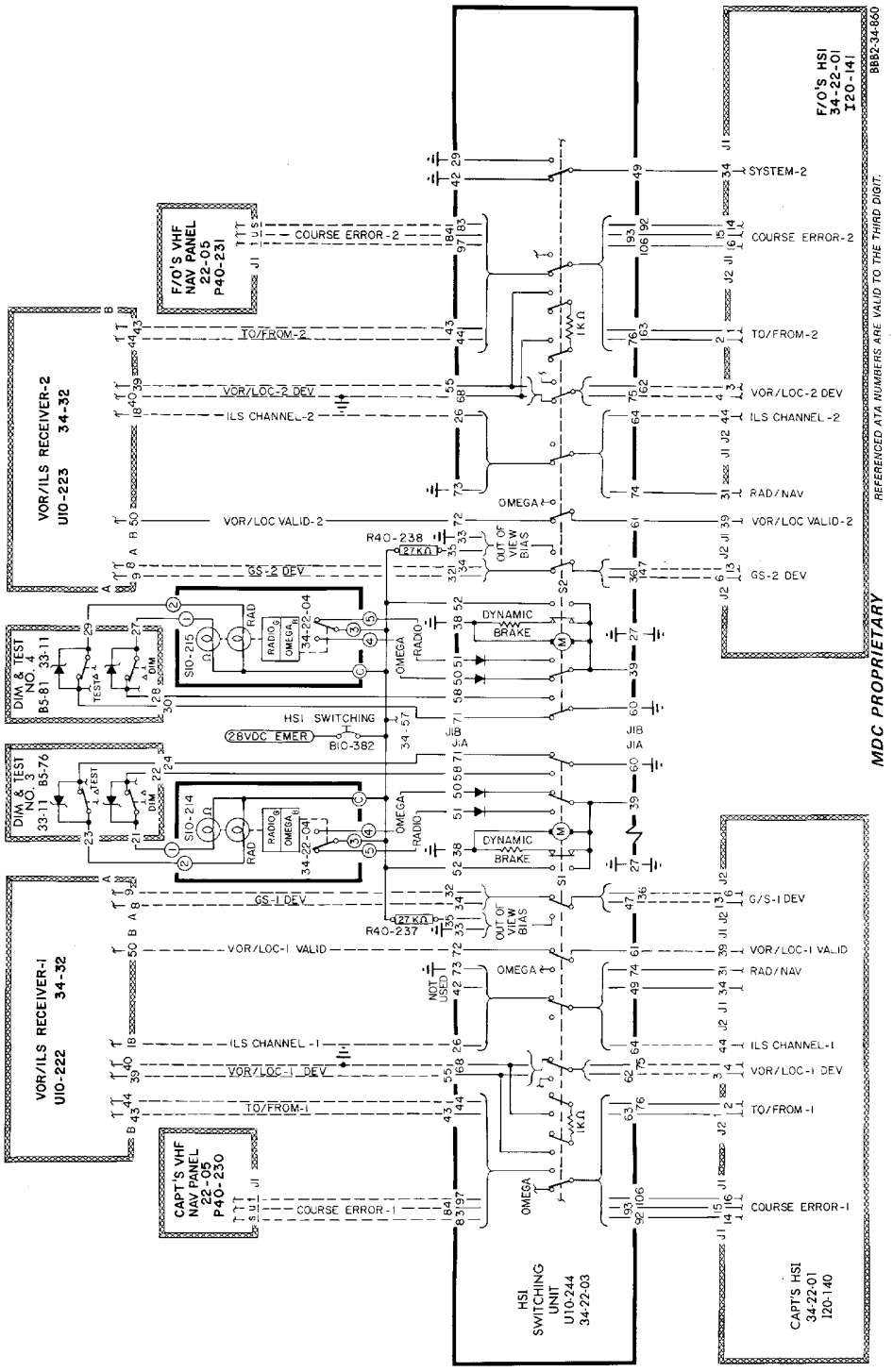
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



Navigation Displays - Captain's -- Schematic
Figure 101/34-22-00-990-980



Naviagtion Displays - First Officer's -- Schematic
Figure 102/34-22-00-990-984



HSI (RAD/INS) Switching Unit
Figure 103/34-22-00-990-991

NAVIGATION DISPLAYS - TROUBLE SHOOTING

1. General

A. This section contains trouble shooting procedures for the Electronic Flight Instrument System (EFIS). The primary causes of faulty system operation are generally faulty aircraft wiring or faulty Line Replaceable Units (LRU's). The trouble shooting procedures in this section should be used in conjunction with the system schematics in isolating and correcting system failures.

B. The Status Test Panel (STP) is the primary EFIS trouble shooting tool. Trouble shooting is performed by calling up the EFIS Maintenance Menu on the EFIS display screens. The first two menu entries, FAULT REVIEW and FAULT ERASE are used for trouble shooting the system. The CMPVLD, FORWARD SPACE, BACKSPACE, and VERIFY pushbuttons on the Status Test Panel (STP) are used to cycle through the Fault Review pages. (Figure 101)

NOTE: In order to use the STP with the EFIS, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. The display area on the STP is not used during EFIS troubleshooting and maintenance practices. Only the STP pushbuttons are used.

C. The system components and their locations are listed as follows: Figure 103 contains a list of fault symptoms which occur if one of these components fails.

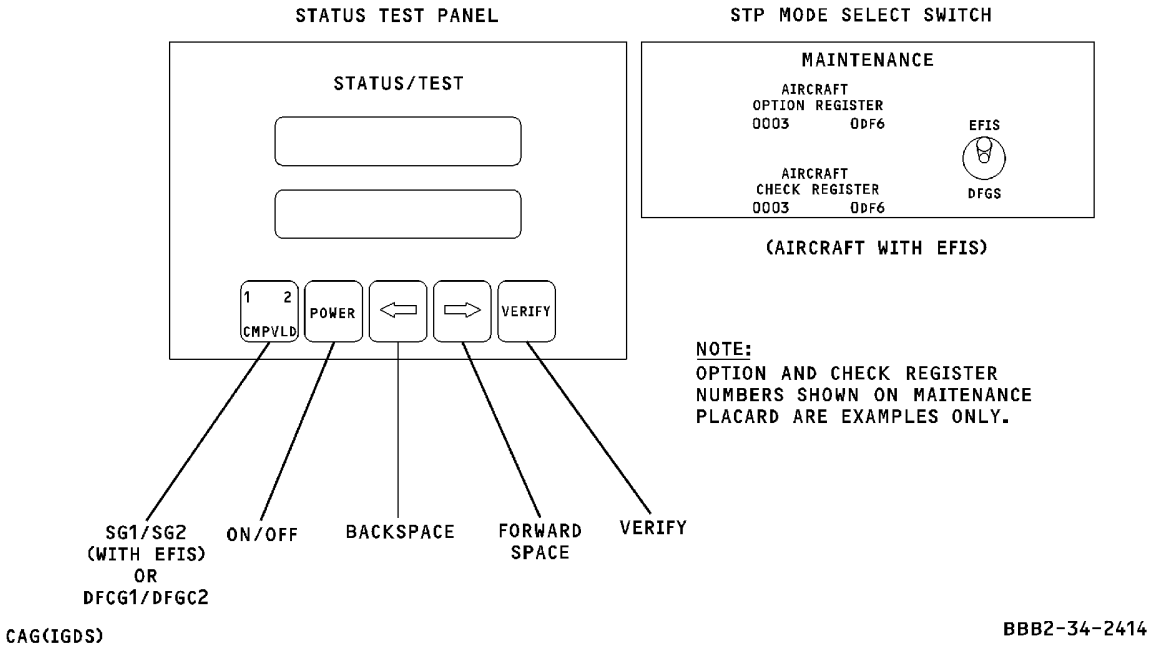
Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and F.O.'s Instrument Panels
EFIS Navigation Display (ND)	Captain's and F.O.'s Instrument Panels
EFIS Symbol Generator (SG)	Electrical/Electronics Compartment
EFIS Mode Select Panel (MSP)	Beneath Captain's and F.O.'s Clearview Windows
EFIS Dimming Panel (DP)	Captain's and F.O.'s Instrument Panels
EFIS Remote Light Sensor (RLS)	Glareshield.

D. Trouble Shooting procedures in this section interface with Trouble Shooting procedures in the following sections:

Table 102

Compass/Heading System	(HEADING SYSTEM, SUBJECT 34-21-00)
Attitude System	(ATTITUDE SYSTEM, SUBJECT 34-23-00)
Marker Beacon	(MARKER BEACON, SUBJECT 34-31-00)
ILS System	(INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00)
Weather Radar System	(WEATHER RADAR SYSTEM, SUBJECT 34-41-00)
Radio Altimeter	(RADIO ALTIMETER SYSTEM, SUBJECT 34-42-00)
VOR System	(VHF NAVIGATION, SUBJECT 34-51-00)
DME	(DISTANCE MEASURING EQUIPMENT SYSTEM, SUBJECT 34-52-00)
ADF (if displayed)	(AUTOMATIC DIRECTION FINDING (ADF), SUBJECT 34-53-00)



Trouble Shooting EFIS with Status Test Panel (STP)
Figure 101/34-22-00-990-993

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 103

Name and Number	Manufacturer
Multimeter Model Nr. 1026A	Fluke

3. Trouble Shooting Navigation Displays EFIS

A. Trouble Shooting EFIS Using STP

(1) Make sure that system power is on and that POWER pushbutton on STP is ON. Make sure that all EFIS circuit breakers are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

(2) Place STP Mode Select Switch (placarded EFIS/DFGS), located under Captains's briefcase (left console), in EFIS position.

(3) Press the CMPVLD pushbutton on the STP so that the -1 or -2 system is selected ('1' or '2' light comes on).

(4) Observe EFIS Maintenance Menu on PFD/ND for selected system. Make sure cursor is pointing to FAULT REVIEW selection. If not, use FORWARD SPACE pushbutton on STP to position cursor. (Figure 102)

(5) Press VERIFY pushbutton on STP. FLIGHT 1 FAILURES page appears on PFD/ND.

(6) Review faults for most recent flight. Refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Description and Operation, for a detailed description of the flight log and fault coding. (Figure 104)

NOTE: When cycling through the FAULT REVIEW page, the most recent flight appears first. Flight 0 indicates present flight condition. To cycle forwards and backwards through the various flight legs, use the FORWARD SPACE and BACKSPACE keys on the STP. Refer to Figure 104 for a complete explanation of EFIS fault codes.

(7) Press FORWARD SPACE key on STP to cycle through all previous flights. Take necessary action, as indicated on EFIS Fault Code Diagram. (Figure 104)

(8) To exit FAULT REVIEW, press FORWARD SPACE from last page in flight log, or press BACKSPACE from flight 0 review.

B. Continuity, Power, and Ground Checks

NOTE: During continuity, power, and ground checks, it may be necessary to refer to the wiring diagram manual for terminal board connections and wire identification.

(1) Check for proper power sources at main buses, circuit breakers, and LRU input and output ports. Correct main power supply to buses if necessary. Replace faulty circuit breakers, wires, or LRU's.

(2) Check for proper grounds at LRU's. (This may require operation of relays in units to contact ground). Repair or replace faulty wiring. Make sure ground terminals are tight and properly bonded.

(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity. Repair or replace faulty wiring, terminal junctions, relays, etc. on aircraft.

(4) Replace suspected faulty LRU's or component with known operational unit. (Figure 103)

C. Flight Log Fault Erase

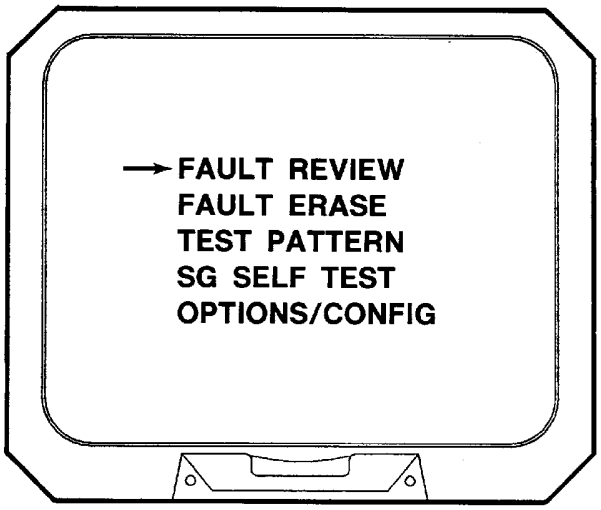
(1) Make sure that EFIS Maintenance Menu is displayed on PFD/ND.

(2) Press FORWARD SPACE pushbutton on STP to position cursor next to FAULT ERASE selection on Maintenance Menu.

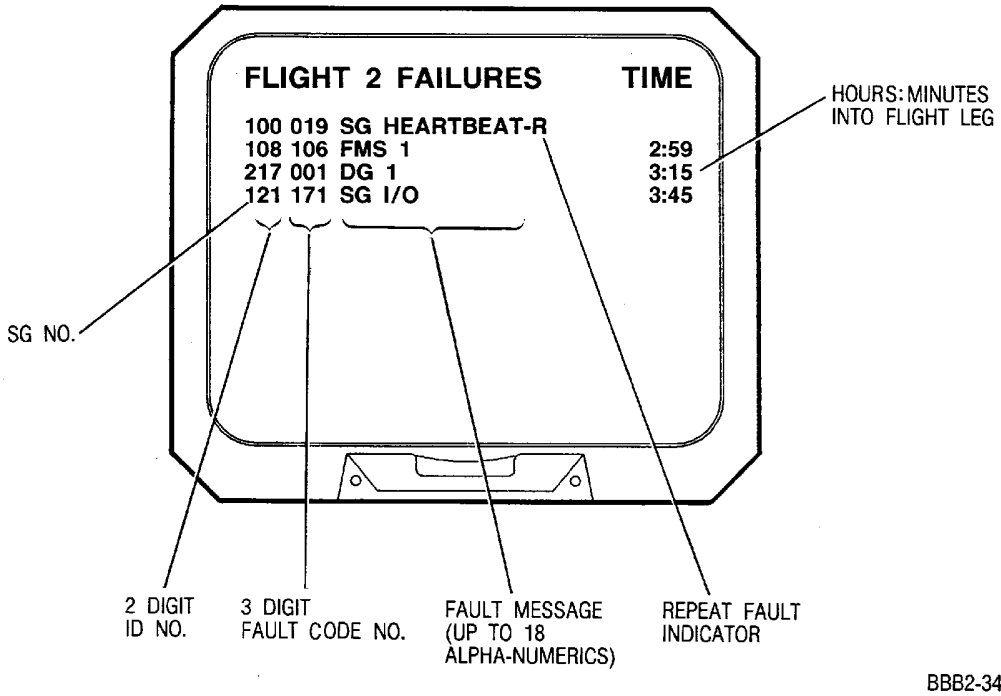
(3) Press VERIFY pushbutton on STP.

(4) Press FORWARD SPACE pushbutton to erase all flight faults.

NOTE: To abort FAULT ERASE, press BACKSPACE or VERIFY pushbutton on STP. This will allow you to exit FAULT ERASE mode without erasing faults.



EFIS MAINTENANCE MENU



EFIS Maintenance Menu - FAULT REVIEW
Figure 102/34-22-00-990-994

EFIS COMPONENT FAILURE	COMPONENT FAILURE SYMPTOMS
Primary Flight Display	Loss of symbology on PFD.
Navigation Display	Loss of symbology on ND.
Symbol Generator	Loss of symbology on PFD or ND
Control & Dimming Panel	
PFD OFF control ND OFF control WX OFF control	PFD remains on ND remains on WXR remains on.
Mode Select Panel	
Range control	Default to 40 NM range. Index line and range reading change to yellow color.
Mode Control	Default to ARC mode.
Remote Light Sensor	CDP manual controls and Display Unit internal sensor signals combine to control DU brightness.

BBB2-34-985

EFIS LRU Failure Symptoms
Figure 103/34-22-00-990-995

EFIS FLIGHT LOG FAULT

EFIS faults are displayed as six-digit code number, followed by failure message and time indication (Ref. Figure 102). First digit of six-digit code will be "1" or "2" (system-1 or system-2 fault). Ignore this digit when using the table below.

NOTE:

When performing FAULT REVIEW, or after performing self-test on Symbol Generator-1, all diagnostic ID numbers will be preceded by digit "1". Similarly, on Symbol Generator-2 all ID numbers will be preceded by digit "2".

Only two-digit ID number and three-digit fault code number are shown on table below. Probable Failure column lists probable failures from most probable to least probable, separated by comma. INT failures mean there is symbol generator interface problem.

TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
00	SC MEMORY/CPU	2-17,22-25,34-49,54-57	ONSIDE SYMBOL GENERATOR
		66,68-69,78-81,84-86,88	
	SG DU BLANKING	18,50,82	ONSIDE SYMBOL GENERATOR
	SG HEARTBEAT	19,51,83	ONSIDE SYMBOL GENERATOR
	SG SERIAL RECEIVER	113-140	ONSIDE SYMBOL GENERATOR
	SG SERIAL XMITTER	141-144	ONSIDE SYMBOL GENERATOR
	SG SYNCHRO	145-153	ONSIDE SYMBOL GENERATOR
01	SG MEMORY/CPU	1-88	ONSIDE SYMBOL GENERATOR
02	SG MEMORY/CPU	2-17,22-25,34-49,54-57	ONSIDE SYMBOL GENERATOR
		66,68-69,78-81,84-86,88	
	SG DU BLANKING	18,50,82	ONSIDE SYMBOL GENERATOR
	SG HEARTBEAT	19,51,83	ONSIDE SYMBOL GENERATOR
	SG SERIAL RECEIVER	113-140	ONSIDE SYMBOL GENERATOR
	SG SERIAL XMITTER	141-144	ONSIDE SYMBOL GENERATOR
	SG SYNCHRO	145-153	ONSIDE SYMBOL GENERATOR
	SG DH TONE	160	ONSIDE SYMBOL GENERATOR
	SG COOLING FAN	161	ONSIDE SYMBOL GENERATOR
03	SG MEMORY/CPU	212	ONSIDE SYMBOL GENERATOR
	CONFIG/OPTIONS	213	ONSIDE SYMBOL GENERATOR
	SG A/D MUX	97-99	ONESIDE SYMBOL GENERATOR
04	SG CRITICAL MON	1-128	ONSIDE SYMBOL GENERATOR
05	SG HEARTBEAT	1-70,1-14,33-46,65-74	ONSIDE SYMBOL GENERATOR
	SG MEMORY/CPU	21-32,53-64	ONSIDE SYMBOL GENERATOR
06	X-TALK MISCOMPARE	1	CROSS-SIDE PITCH SOURCE, INT.
		2	CROSS-SIDE ROLL SOURCE, INT.
		3	CROSS-SIDE HEADING SOURCE, INT.
		4 (see NOTE)	CROSS-SIDE PFD G/S SOURCE, INT.
		5	CROSS-SIDE ND G/S SOURCE, INT.
		6 (see NOTE)	CROSS-SIDE PFD G/S SOURCE, INT.
		7	CROSS-SIDE ND LOC SOURCE, INT.
		8	CROSS-SIDE R/A SOURCE, INT.
		9	CROSS-SIDE MAG/TRU DISCRETE
		10	CROSS-SIDE SAMPLE PROBLEM.
		17	EITHER SG OPTIONS PROGRAMMING

NOTE: For crossed navigation wiring, the PFD displays the cross-side ILS source.

BBB2-34-986A

EFIS Fault Code Diagram
Figure 104/34-22-00-990-996 (Sheet 1 of 3)

TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
07*	AHRS 1 (2)	1,2,3	CAPT's (F/O's) AHRS SOURCE
	AHRS AUX	43,44,45	AUXILIARY AHRS SOURCE
	SG/AHRS 1 (2)	86,87,89	ONSIDE SG, CAPT's (F/O's) AHRS
			SOURCE OR SG-AHRS INTERFACE
	SC/AHRS AUX	128-130	AUX AHRS SOURCE OR
			SG-AUX AHRS INTERFACE
	SG I/O	171-173,213-215	ONSIDE SYMBOL GENERATOR
08*	FMS 1 (2)	1-19,43-61	CAPT's (F/O's) FLIGHT
			MANAGEMENT COMPUTER
	SG/FMS 1 (2)	86-104,128-146	ONSIDE SG, CAPT's (F/O's) FMC
			OR SG-FMC INTERFACE
	SG I/O	171-189,213-231	ONSIDE SYMBOL GENERATOR
09*	OMEGA 1 (2)	1-24,43-66	CAPT's (F/O's) OMEGA RECEIVER
	SG/OMEGA 1 (2)	86-109,128-151	ONSIDE SG, CAPT's (F/O's) OMEGA
			OR SG-OMEGA INTERFACE
	SG I/O	171-194,213-236	ONSIDE SYMBOL GENERATOR
11	DME 1 (2)	1,43	CAPT's (F/O's) DME RECEIVER
	SG/DME 1 (2)	86,128	ONSIDE SG, CAPT's (F/O's) DME
			OR SG-DME INTERFACE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
12	ADF 1 (2)	1,43	CAPT's (F/O's) ADF RECEIVER
	SG/ADF 1 (2)	86,128	ONSIDE SG, CAPT's (F/O's) ADF
			OR SG-ADF INTERFACE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
13	CADC 1 (2)	1-5	CAPT's (F/O's) CENTRAL AIR DATA COMP.
	SG/CADC 1 (2)	86-90	ONSIDE SG, CAPT's (F/O's) CADC
			OR SG-CADC INTERFACE
	SG I/O	171-175	ONSIDE SYMBOL GENERATOR
14	SG 2 (1) CROSS-TALK	1-19	F/O's (CAPT's) SG
	CROSS-TALK	86-104,170	ONSIDE SYMBOL GENERATOR
	SG I/O	171-189	ONSIDE SYMBOL GENERATOR
16*	VG 1 (2)	1,2	CAPT's (F/O's) VERTICAL GYRO
	VG AUX	43,44	AUXILIARY VERTICAL GYRO
	SG I/O	171-214	ONSIDE SYMBOL GENERATOR
17*	DG 1 (2)	1,43	CAPT's (F/O's) DIRECTIONAL GYRO
	COMPASS 1 (2) REF	85,127	CAPT's (F/O's) REFERENCE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR

* IF SYSTEM INSTALLED

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EFIS Fault Code Diagram
Figure 104/34-22-00-990-996 (Sheet 2 of 3)

TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
18	SG I/O	171	ONSIDE SYMBOL GENERATOR
19	RADIO ALT 1 (2)	1,43	CAPT's (F/O's) RADIO ALTITUDE
			RECEIVER
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
20	VOR/LOC 1 (2)	1,43	CAPT's (F/O's) VOR/ILS RECEIVER
	SG I/O	171-172,213-214	ONSIDE SYMBOL GENERATOR
21	G/S 1 (2)	1,43	CAPT's (F/O's) VOR/ILS RECEIVER
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
22	DFGC 1 (2)	1	CAPT's (F/O's) DFGC
	SG I/O	172,173	ONSIDE SYMBOL GENERATOR
23	FAST SLOW	1	EITHER DFGC
	SG I/O	171	ONSIDE SYMBOL GENERATOR
24	SG I/O	171-173,214	ONSIDE SYMBOL GENERATOR
25	WINDSHEAR	1	WINDSHEAR DISCRETES SSM
		2	WINDSHEAR PLI SSM
	SG/WINDSHEAR	86	WINDSHEAR DISCRETES REFRESH
		87	WINDSHEAR PLI REFRESH
	SG I/O	171-172	ONSIDE SYMBOL GENERATOR
26	SG/WOW	1	ONSIDE SG, GND PROX UNIT, INT.
	SG/GND INHIBIT	2	ONSIDE SG, AIRCRAFT LOGIC
			(S129 AND S130), INT
	SG/FMA	3	ONSIDE SG, FMA RESET KEY, INT.
	SG/COCKPIT LAMP	4	ONSIDE SG, COCKPIT LAMP TEST
			KEY/INT.
	SG/STP	5	STP FWD SPACE STUCK KEY
		6	STP BACK SPACE STUCK KEY
		7	STP VERIFY STUCK KEY
	SG/SG 1/2 IDENT	8	OFFSIDE SG1/SG2 DISCRETES ONSIDE
27	SG/CONTROL &	1	ONSIDE SG, ONESIDE CONTROL
	DIMMING PANEL		& DIMMING PANEL, INT.
	SG/DP/MSP MON	2,3,4	ONSIDE SG, MSP, OR SG-MSP INT.
	SG/MSP MONITOR	5-12	ONSIDE SG, MSP,OR SG-MSP INT.
28	PFD FAIL	1,2	ONSIDE PRIMARY FLIGHT DISPLAY
	ND FAIL	33,34	ONSIDE NAVIGATION DISPLAY
29	WEATHER RADAR	1	WXR RECEIVER/TRANSMITTER UNIT
	SG/WEATHER RADAR	86	ONSIDE SG, MSP, OR WXR R/T UNIT
	SG I/O	171	ONSIDE SYMBOL GENERATOR
30	SG MEM/CPU	1-2,33-34,65-68	ONSIDE SYMBOL GENERATOR
31	VOR BEARING 1 (2)	1,43	VOR BEARING A (B) SSM
	SG/VOR BEARING 1 (2)	86,128	ONSIDE SYMBOL GENERATOR
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR

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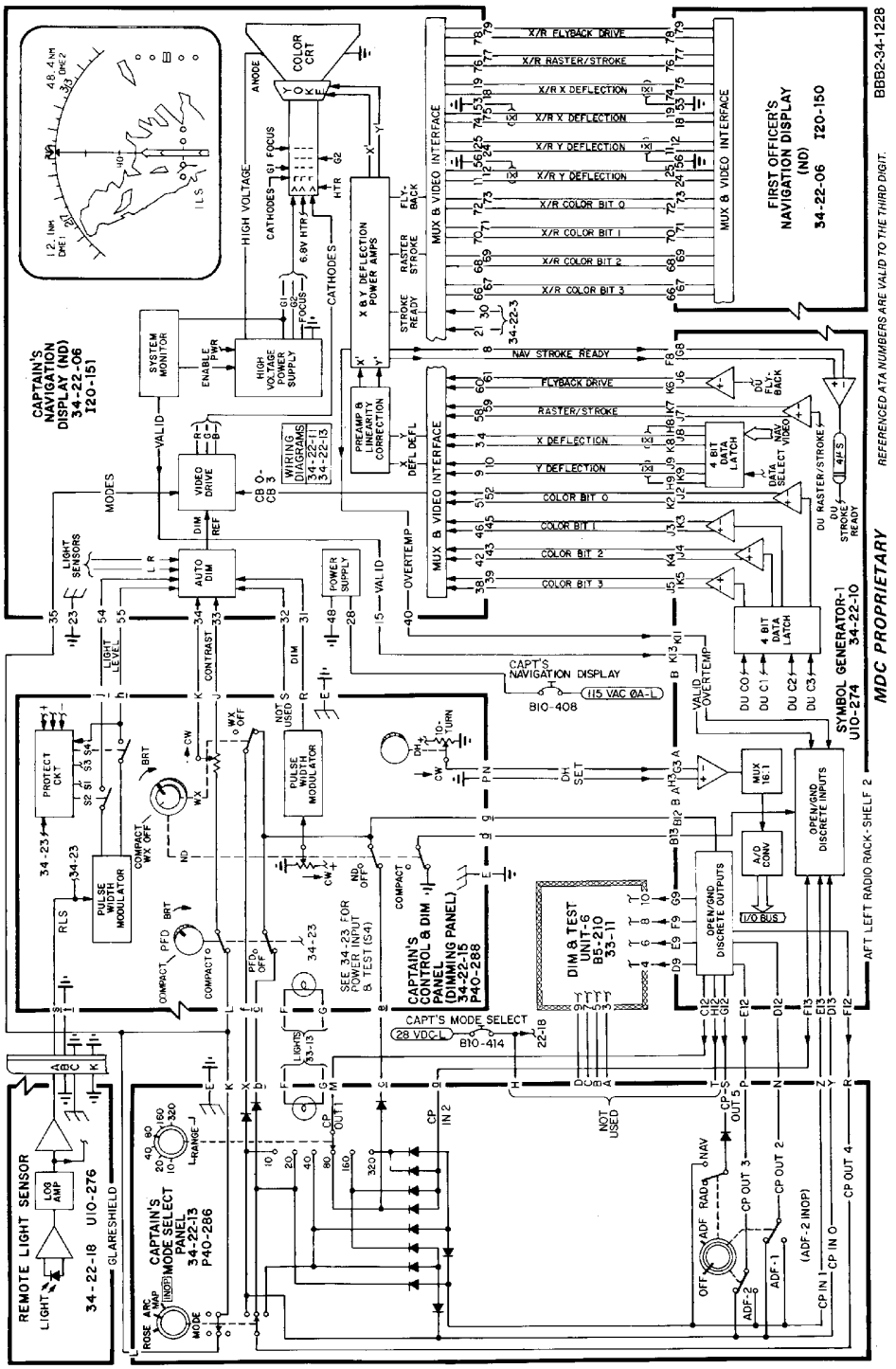
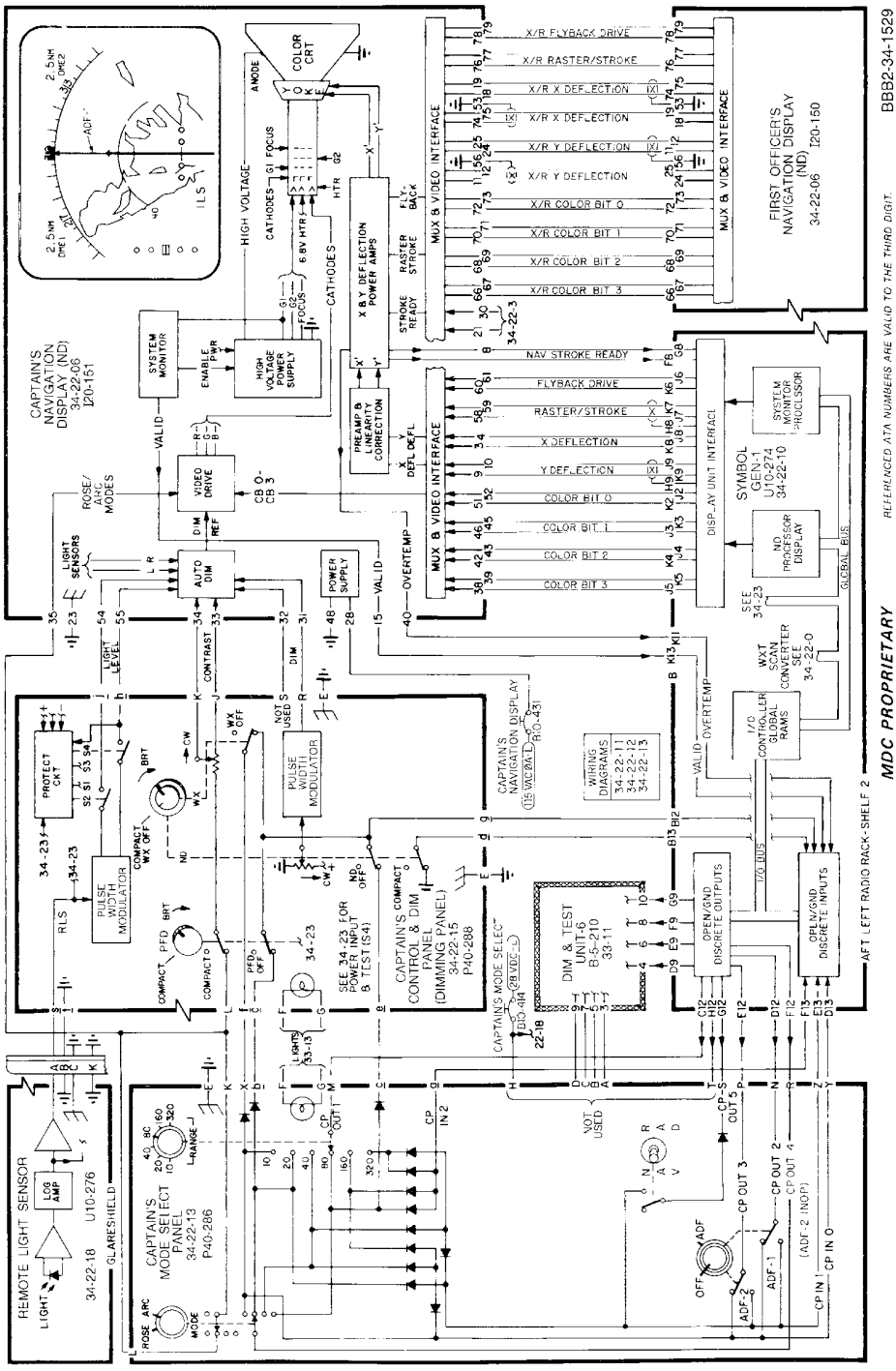
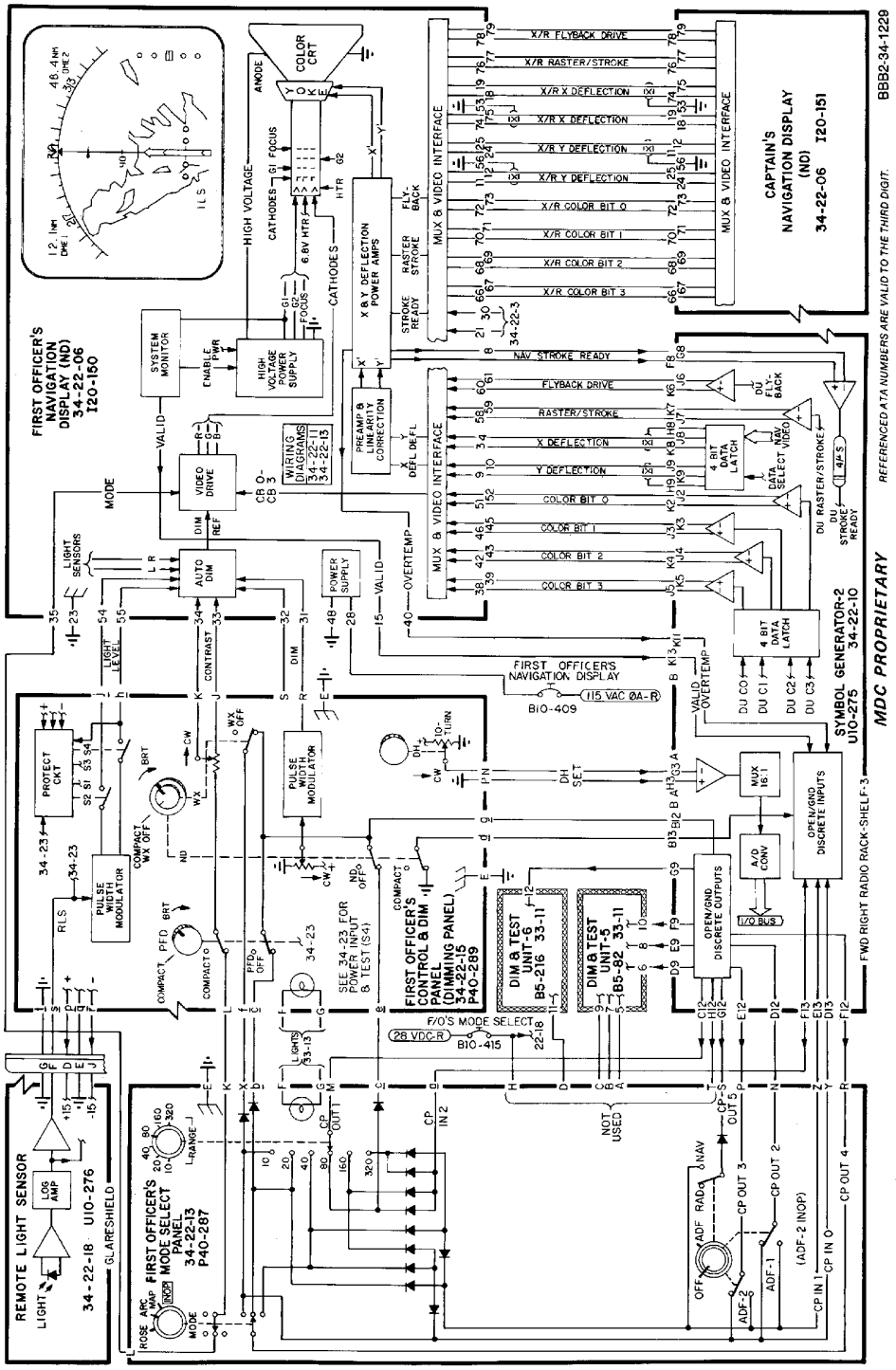
EFIS Fault Code Diagram
Figure 104/34-22-00-990-996 (Sheet 3 of 3)



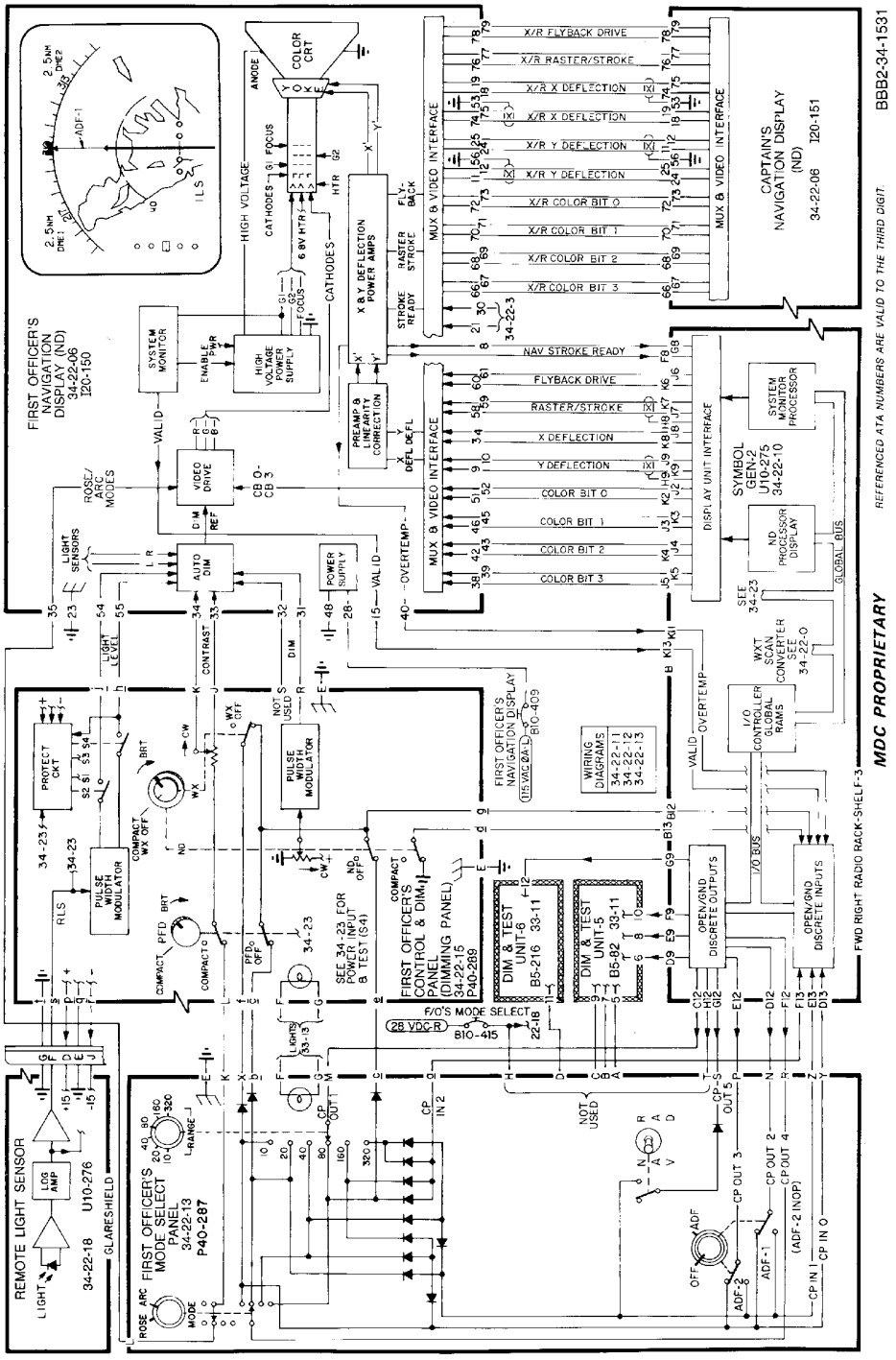
EFIS Navigation Displays -1
Figure 105/34-22-00-990-997



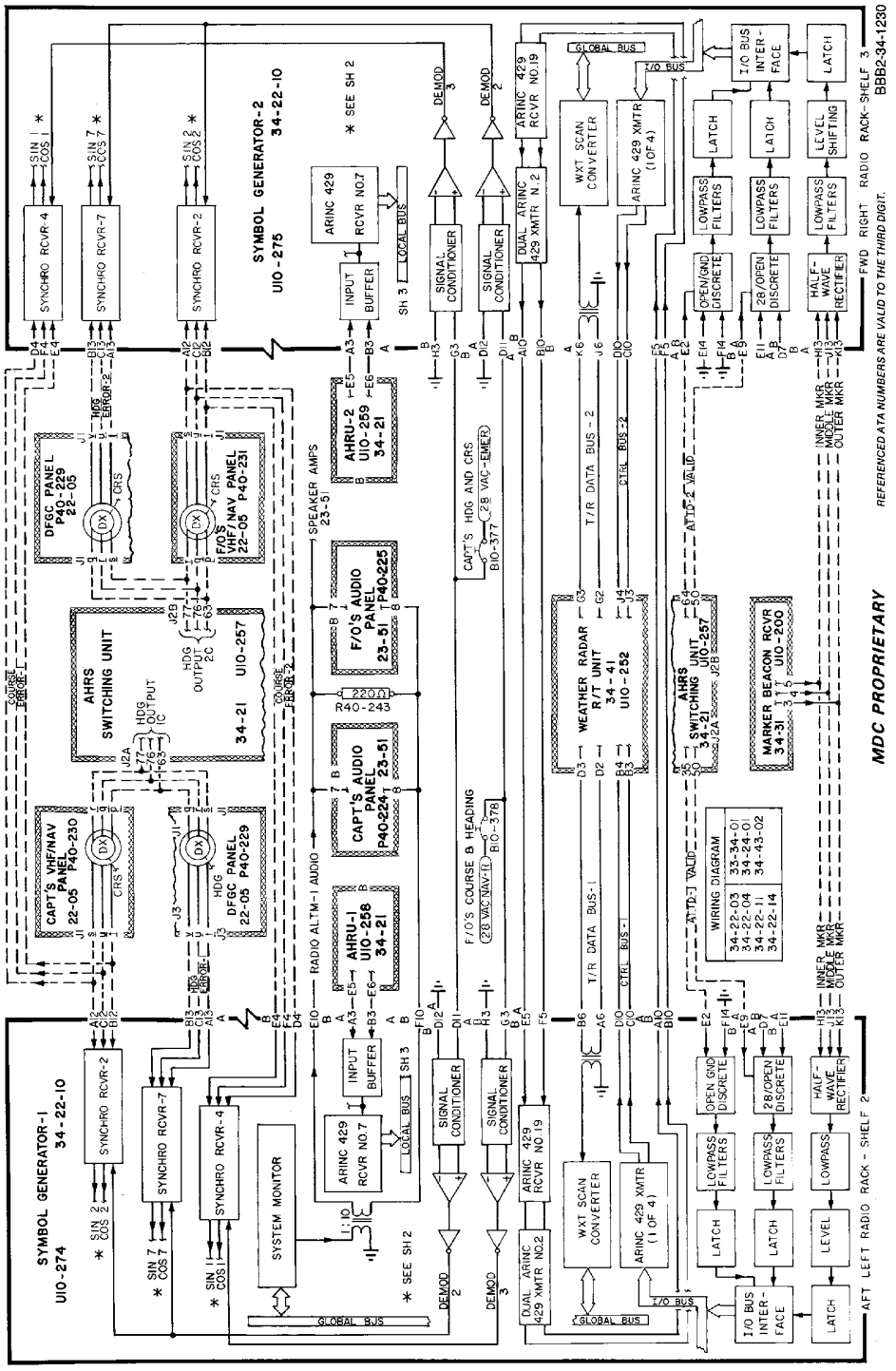
EFIS Navigation Displays -1
Figure 106/34-22-00-990-A01



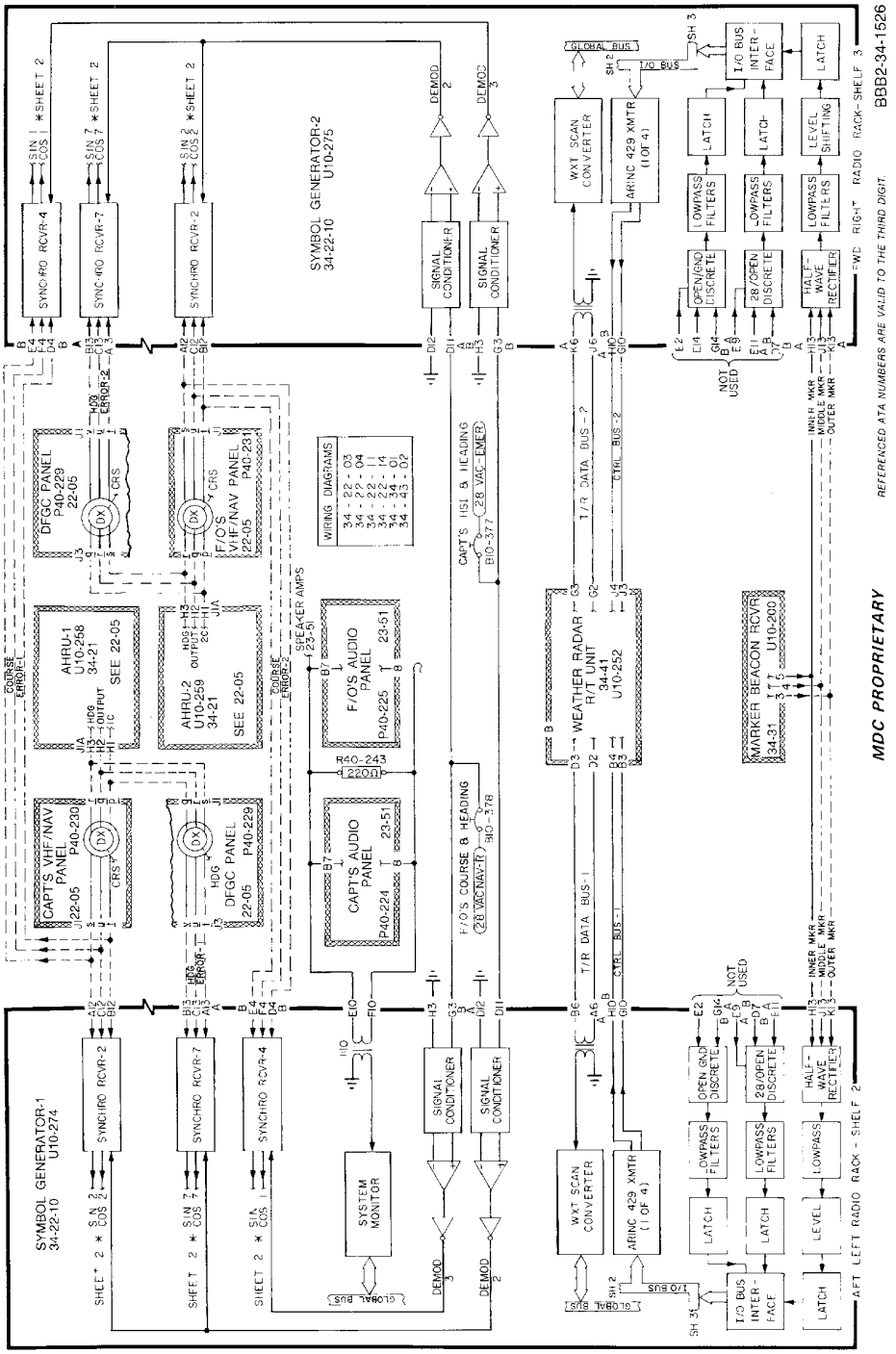
EFIS Navigation Displays -2
Figure 107/34-22-00-990-A08



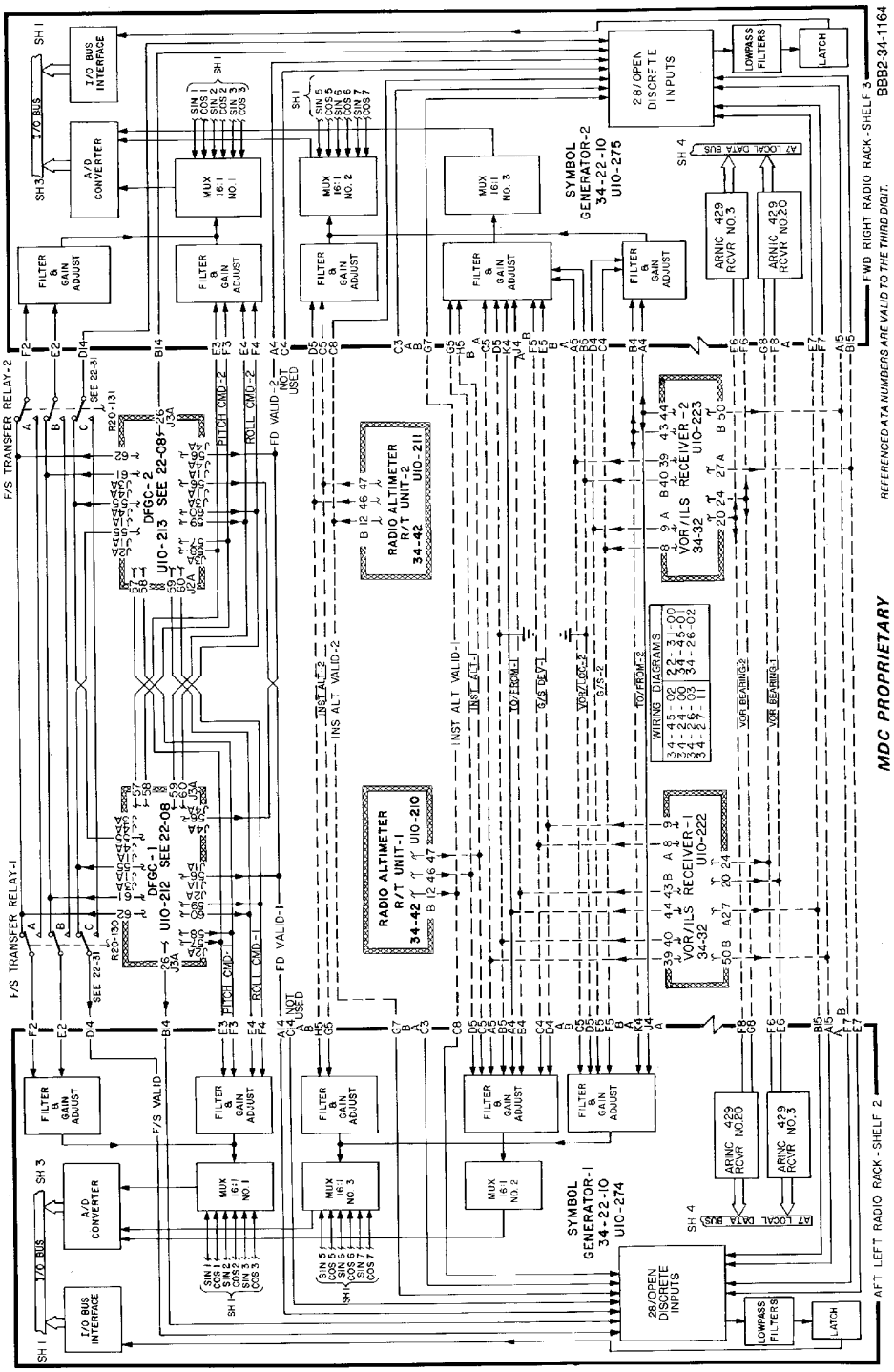
EFIS Navigation Displays -2
Figure 108/34-22-00-990-A11



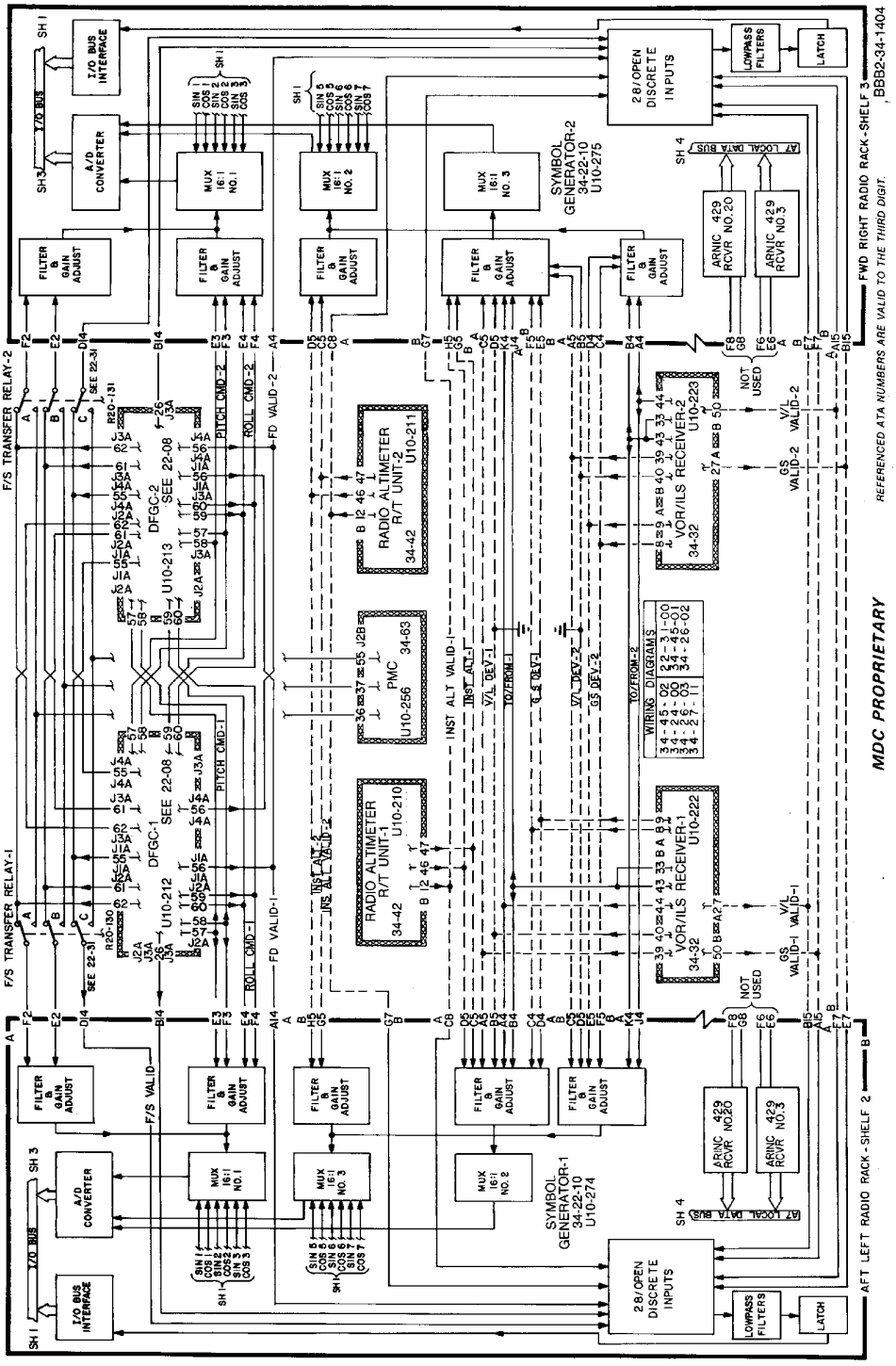
EFIS Inputs
Figure 109/34-22-00-990-A18



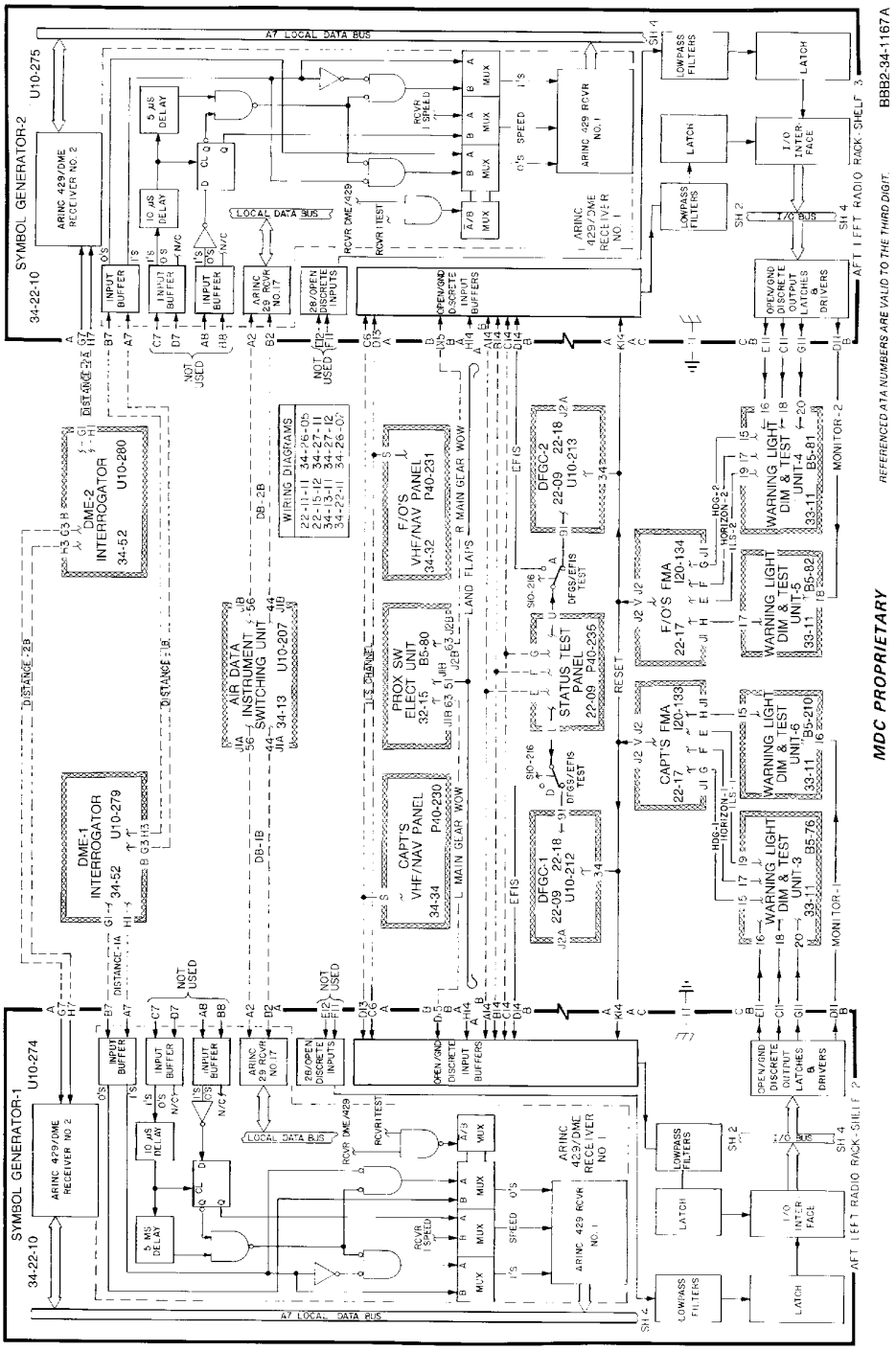
EFIS Inputs
Figure 110/34-22-00-990-A21



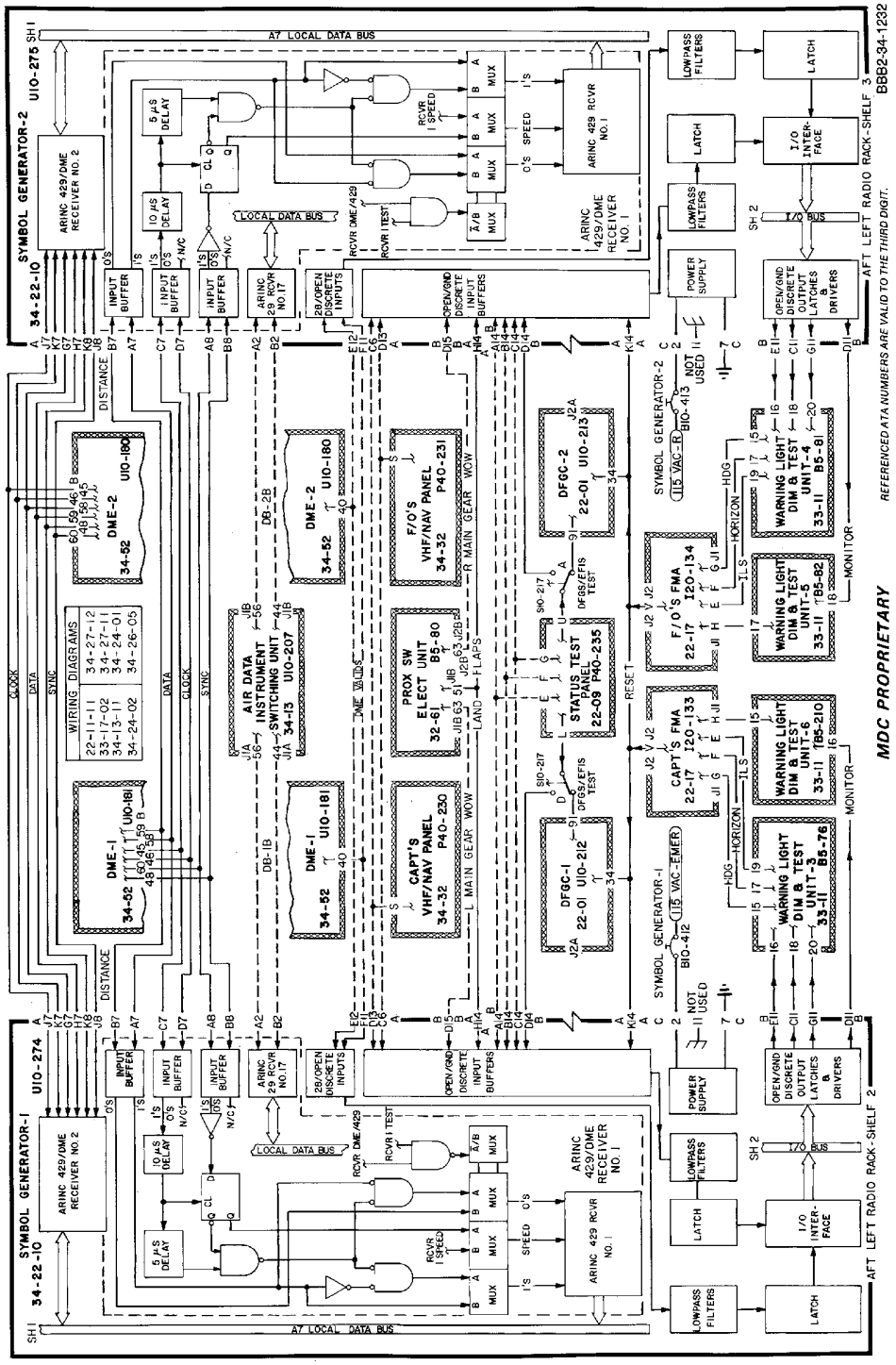
EFIS Inputs
Figure 111/34-22-00-990-A27



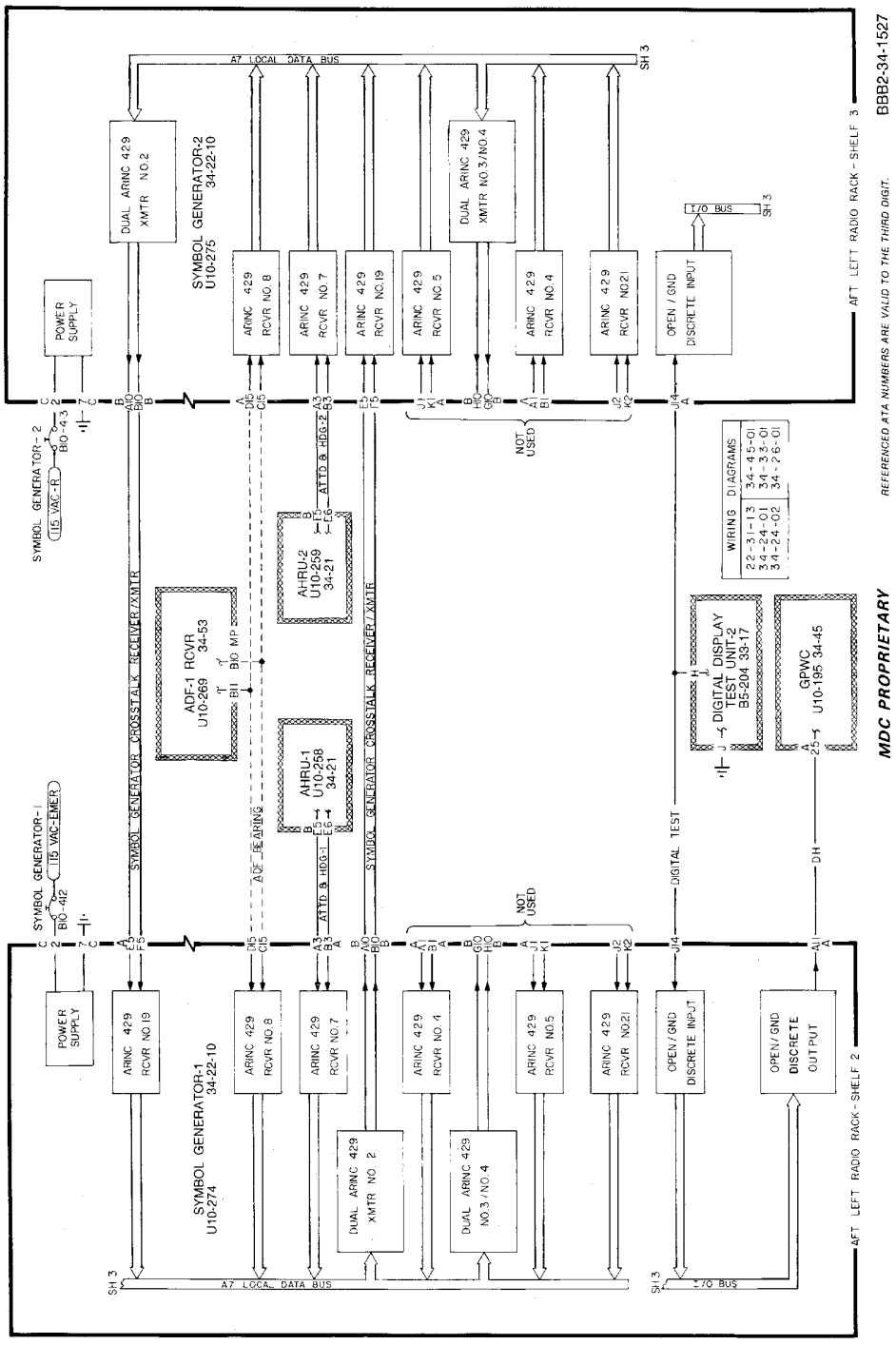
EFIS Inputs
Figure 112/34-22-00-990-A29



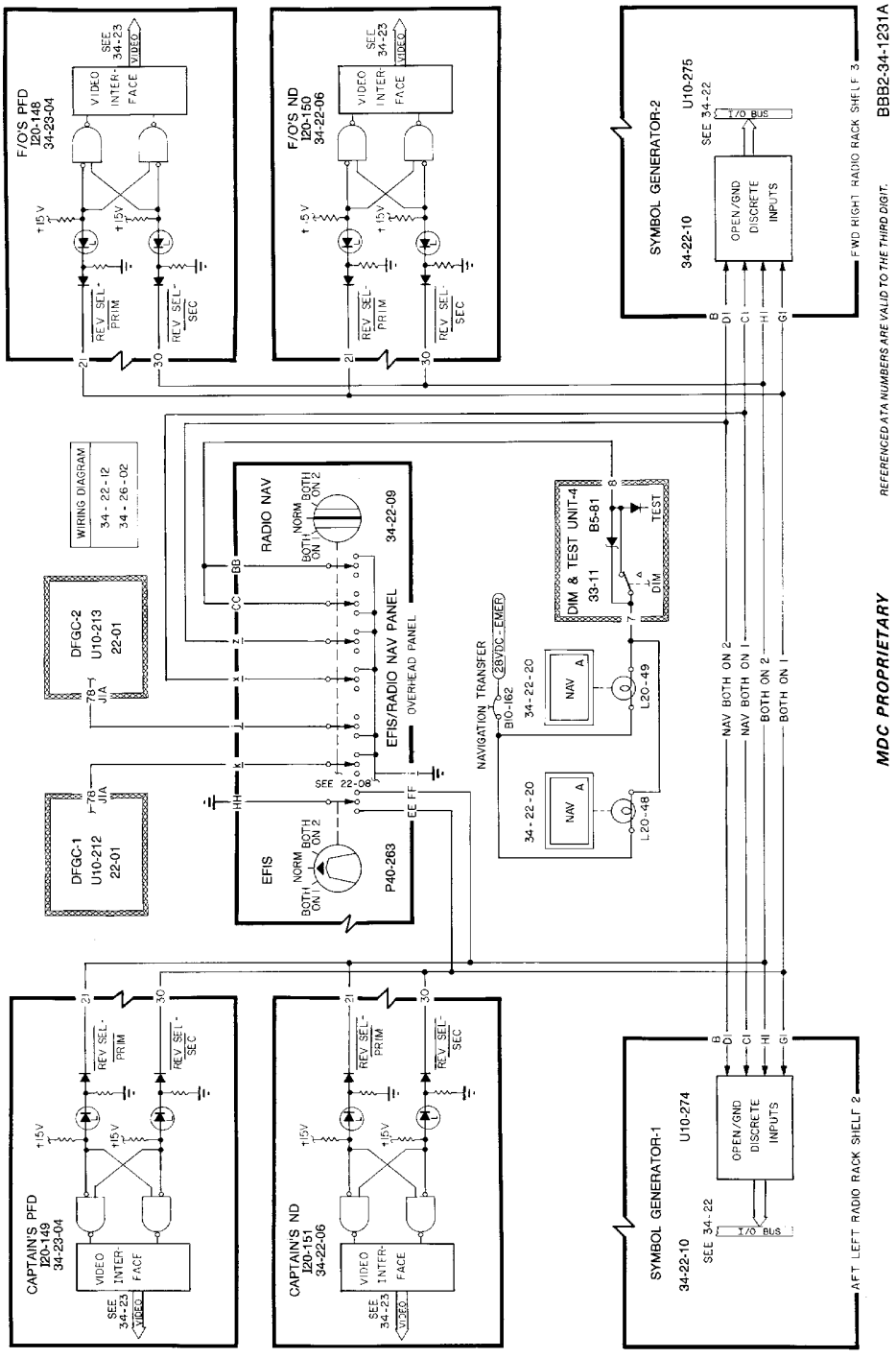
EFIS Inputs
Figure 113/34-22-00-990-A36



EFIS Inputs
Figure 114/34-22-00-990-A37



EFIS Inputs
Figure 115/34-22-00-990-A40



EFIS Switching
Figure 116/34-22-00-990-A43

NAVIGATION DISPLAYS - TROUBLE SHOOTING

1. General

A. This section contains trouble shooting procedures for the Electronic Flight Instrument System (EFIS). The primary causes of faulty system operation are generally faulty aircraft wiring or faulty Line Replaceable Units (LRU's). The trouble shooting procedures in this section should be used in conjunction with the system schematics in isolating and correcting system failures.

WJE 401-404, 412, 414, 875-879

B. The Status Test Panel (STP) is the primary EFIS trouble shooting tool. Trouble shooting is performed by calling up the EFIS Maintenance Menu on the EFIS display screens. The first two menu entries, FAULT REVIEW and FAULT ERASE are used for trouble shooting the system. The CMPVLD, FORWARD SPACE, BACKSPACE, and VERIFY pushbuttons on the Status Test Panel (STP) are used to cycle through the Fault Review pages. (Figure 101)

NOTE: In order to use the STP with the EFIS, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. The display area on the STP is not used during EFIS troubleshooting and maintenance practices. Only the STP pushbuttons are used.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

C. The Flight Management Multipurpose Control Display Unit (MCDU) is the primary EFIS trouble shooting tool. The MCDU pushbuttons (keys) are used to call up the EFIS maintenance menu display on the PFD/ND. The first two menu entries, FAULT REVIEW and FAULT ERASE are used for trouble shooting the system. The FWD, BACK, and VERIFY pushbuttons on the MCDU are used to cycle through the Fault Review pages. Figure 102 illustrates MCDU keys which are used to perform EFIS Trouble Shooting. (Figure 102)

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

D. The system components and their locations are listed as follows: Figure 104 contains a list of fault symptoms which occur if one of these components fails.

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and F.O.'s Instrument Panels
EFIS Navigation Display (ND)	Captain's and F.O.'s Instrument Panels
EFIS Symbol Generator (SG)	Electrical/Electronics Compartment
EFIS Mode Select Panel (MSP)	Beneath Captain's and F.O.'s Clearview Windows
EFIS Dimming Panel (DP)	Captain's and F.O.'s Instrument Panels
EFIS Remote Light Sensor (RLS)	Glareshield.

E. Trouble Shooting procedures in this section interface with Trouble Shooting procedures in the following sections:

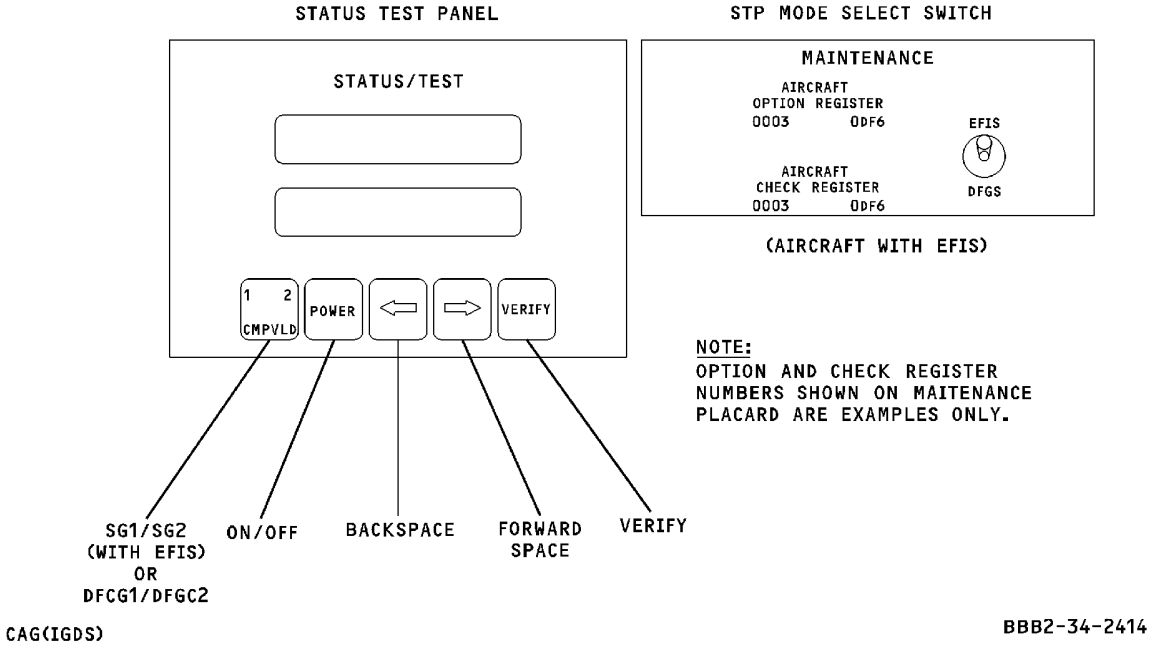
Table 102

Compass/Heading System	(HEADING SYSTEM, SUBJECT 34-21-00)
Attitude System	(ATTITUDE SYSTEM, SUBJECT 34-23-00)
Marker Beacon	(MARKER BEACON, SUBJECT 34-31-00)
ILS System	(INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00)
Weather Radar System	(WEATHER RADAR SYSTEM, SUBJECT 34-41-00)

Table 102 (Continued)

Radio Altimeter	(RADIO ALTIMETER SYSTEM, SUBJECT 34-42-00)
Inertial Reference System	(INERTIAL REFERENCE SYSTEM, SUBJECT 34-43-00)
VOR System	(VHF NAVIGATION, SUBJECT 34-51-00)
DME	(DISTANCE MEASURING EQUIPMENT SYSTEM, SUBJECT 34-52-00)
ADF (if displayed)	(AUTOMATIC DIRECTION FINDING (ADF), SUBJECT 34-53-00)

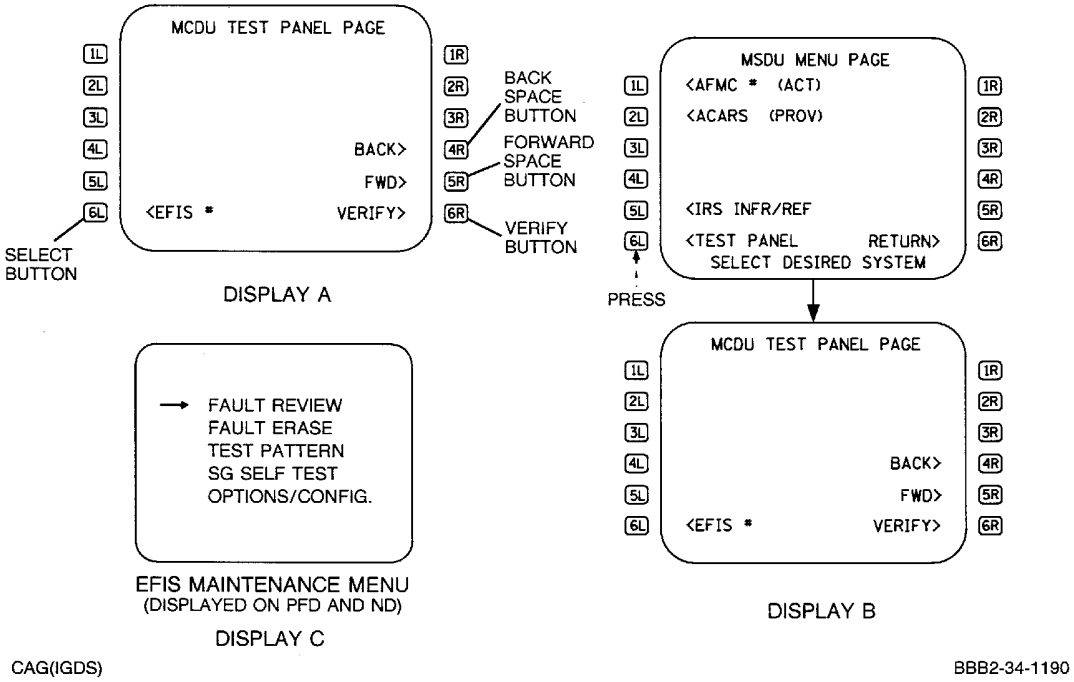
WJE 401-404, 412, 414, 875-879



Trouble Shooting EFIS with Status Test Panel (STP)
Figure 101/34-22-00-990-A69

WJE 401-404, 412, 414, 875-879

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



Trouble Shooting EFIS with FMS MCDU
Figure 102/34-22-00-990-A70

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 103

Name and Number	Manufacturer
Multimeter Model Nr. 1026A	Fluke

3. Trouble Shooting Navigation Displays EFIS

WJE 401-404, 412, 414, 875-879

A. Trouble Shooting EFIS Using STP

(1) Make sure that system power is on and that POWER pushbutton on STP is ON. Make sure that all EFIS circuit breakers are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

(2) Place STP Mode Select Switch (placarded EFIS/DFGS), located under Captains's briefcase (left console), in EFIS position.

(3) Press the CMPVLD pushbutton on the STP so that the -1 or -2 system is selected ('1' or '2' light comes on).

WJE 401-404, 412, 414, 875-879 (Continued)

(4) Observe EFIS Maintenance Menu on PFD/ND for selected system. Make sure cursor is pointing to FAULT REVIEW selection. If not, use FORWARD SPACE pushbutton on STP to position cursor. (Figure 103)

(5) Press VERIFY pushbutton on STP. FLIGHT 1 FAILURES page appears on PFD/ND.

(6) Review faults for most recent flight. Refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Description and Operation, for a detailed description of the flight log and fault coding. (Figure 105)

NOTE: When cycling through the FAULT REVIEW page, the most recent flight appears first. Flight 0 indicates present flight condition. To cycle forwards and backwards through the various flight legs, use the FORWARD SPACE and BACKSPACE keys on the STP. Refer to Figure 105 for a complete explanation of EFIS fault codes.

(7) Press FORWARD SPACE key on STP to cycle through all previous flights. Take necessary action, as indicated on EFIS Fault Code Diagram. (Figure 105)

(8) To exit FAULT REVIEW, press FORWARD SPACE from last page in flight log, or press BACKSPACE from flight 0 review.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

B. Trouble Shooting EFIS Using MCDU

(1) Make sure that EFIS system power is on and also power to MCDU is on. Make sure that all EFIS circuit breakers are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

(2) On MCDU press line select key 6L adjacent to TEST PANEL display.

(3) Observe EFIS Maintenance Menu on PFD/ND for selected system. Make sure cursor is pointing to FAULT REVIEW selection. If not, use FORWARD SPACE pushbutton on MDCDU to position cursor. (Figure 103)

(4) Press VERIFY pushbutton on MCDU. FLIGHT 1 FAILURES page appears on PFD/ND.

(5) Review faults for most recent flight. Refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Description and Operation, for a detailed description of the flight log and fault coding. (Figure 105)

NOTE: When cycling through the FAULT REVIEW page, the most recent flight appears first. Flight 0 indicates present flight condition. To cycle forwards and backwards through the various flight legs, use the FORWARD SPACE and BACKSPACE keys on the MCDU. Refer to Figure 105 for a complete explanation of EFIS fault codes.

(6) Press FORWARD SPACE key on MCDU to cycle through all previous flights. Take necessary action, as indicated on EFIS Fault Code Diagram. (Figure 105)

(7) To exit FAULT REVIEW, press FORWARD SPACE from last page in flight log, or press BACKSPACE from flight 0 review.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

C. Continuity, Power, and Ground Checks

NOTE: During continuity, power, and ground checks, it may be necessary to refer to the wiring diagram manual for terminal board connections and wire identification.

(1) Check for proper power sources at main buses, circuit breakers, and LRU input and output ports. Correct main power supply to buses if necessary. Replace faulty circuit breakers, wires, or LRU's.

(2) Check for proper grounds at LRU's. (This may require operation of relays in units to contact ground). Repair or replace faulty wiring. Make sure ground terminals are tight and properly bonded.

(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity. Repair or replace faulty wiring, terminal junctions, relays, etc. on aircraft.

(4) Replace suspected faulty LRU's or component with known operational unit. (Figure 104)

D. Flight Log Fault Erase

(1) Make sure that EFIS Maintenance Menu is displayed on PFD/ND.

WJE 401-404, 412, 414, 875-879

(2) Press FORWARD SPACE pushbutton on STP to position cursor next to FAULT ERASE selection on Maintenance Menu.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(3) Press FORWARD SPACE pushbutton on MCDU to position cursor next to FAULT ERASE selection on Maintenance Menu.

WJE 401-404, 412, 414, 875-879

(4) Press VERIFY pushbutton on STP.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(5) Press VERIFY pushbutton on MCDU.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(6) Press FORWARD SPACE pushbutton to erase all flight faults.

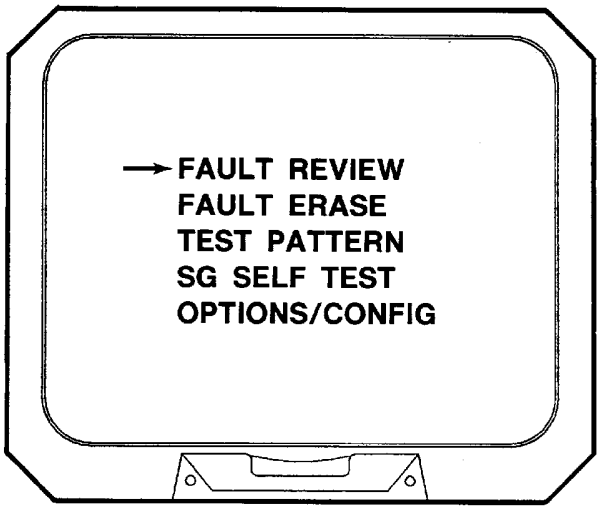
WJE 401-404, 412, 414, 875-879

NOTE: To abort FAULT ERASE, press BACKSPACE or VERIFY pushbutton on STP. This will allow you to exit FAULT ERASE mode without erasing faults.

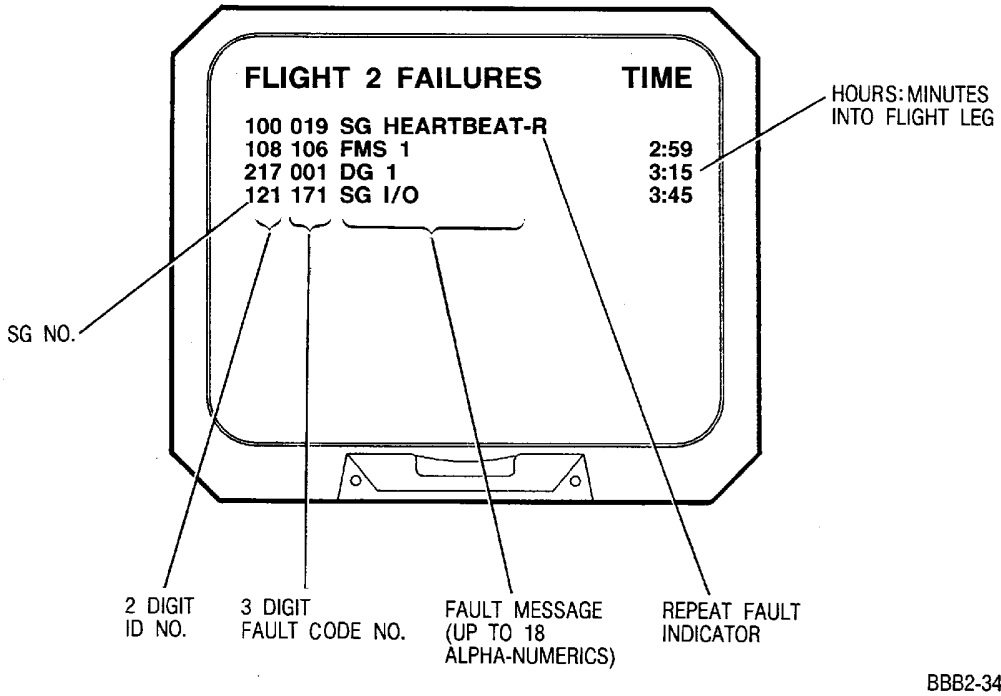
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

NOTE: To abort FAULT ERASE, press BACKSPACE or VERIFY pushbutton on MCDU. This will allow you to exit FAULT ERASE mode without erasing faults.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



EFIS MAINTENANCE MENU



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EFIS Maintenance Menu - FAULT REVIEW
Figure 103/34-22-00-990-A71

EFIS COMPONENT FAILURE	COMPONENT FAILURE SYMPTOMS
Primary Flight Display	Loss of symbology on PFD.
Navigation Display	Loss of symbology on ND.
Symbol Generator	Loss of symbology on PFD or ND
Control & Dimming Panel	
PFD OFF control ND OFF control WX OFF control	PFD remains on ND remains on WXR remains on.
Mode Select Panel	
Range control	Default to 40 NM range. Index line and range reading change to yellow color.
Mode Control	Default to ARC mode.
Remote Light Sensor	CDP manual controls and Display Unit internal sensor signals combine to control DU brightness.

BBB2-34-985

EFIS LRU Failure Symptoms
Figure 104/34-22-00-990-A72

EFIS FLIGHT LOG FAULT

EFIS faults are displayed as six-digit code number, followed by failure message and time indication (Ref. Figure 102). First digit of six-digit code will be "1" or "2" (system-1 or system-2 fault). Ignore this digit when using the table below.

NOTE:

When performing FAULT REVIEW, or after performing self-test on Symbol Generator-1, all diagnostic ID numbers will be preceded by digit "1". Similarly, on Symbol Generator-2 all ID numbers will be preceded by digit "2".

Only two-digit ID number and three-digit fault code number are shown on table below. Probable Failure column lists probable failures from most probable to least probable, separated by comma. INT failures mean there is symbol generator interface problem.

TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
00	SC MEMORY/CPU	2-17,22-25,34-49,54-57	ONSIDE SYMBOL GENERATOR
		66,68-69,78-81,84-86,88	
	SG DU BLANKING	18,50,82	ONSIDE SYMBOL GENERATOR
	SG HEARTBEAT	19,51,83	ONSIDE SYMBOL GENERATOR
	SG SERIAL RECEIVER	113-140	ONSIDE SYMBOL GENERATOR
	SG SERIAL XMITTER	141-144	ONSIDE SYMBOL GENERATOR
	SG SYNCHRO	145-153	ONSIDE SYMBOL GENERATOR
01	SG MEMORY/CPU	1-88	ONSIDE SYMBOL GENERATOR
02	SG MEMORY/CPU	2-17,22-25,34-49,54-57	ONSIDE SYMBOL GENERATOR
		66,68-69,78-81,84-86,88	
	SG DU BLANKING	18,50,82	ONSIDE SYMBOL GENERATOR
	SG HEARTBEAT	19,51,83	ONSIDE SYMBOL GENERATOR
	SG SERIAL RECEIVER	113-140	ONSIDE SYMBOL GENERATOR
	SG SERIAL XMITTER	141-144	ONSIDE SYMBOL GENERATOR
	SG SYNCHRO	145-153	ONSIDE SYMBOL GENERATOR
	SG DH TONE	160	ONSIDE SYMBOL GENERATOR
	SG COOLING FAN	161	ONSIDE SYMBOL GENERATOR
03	SG MEMORY/CPU	212	ONSIDE SYMBOL GENERATOR
	CONFIG/OPTIONS	213	ONSIDE SYMBOL GENERATOR
	SG A/D MUX	97-99	ONESIDE SYMBOL GENERATOR
04	SG CRITICAL MON	1-128	ONSIDE SYMBOL GENERATOR
05	SG HEARTBEAT	1-70,1-14,33-46,65-74	ONSIDE SYMBOL GENERATOR
	SG MEMORY/CPU	21-32,53-64	ONSIDE SYMBOL GENERATOR
06	X-TALK MISCOMPARE	1	CROSS-SIDE PITCH SOURCE, INT.
		2	CROSS-SIDE ROLL SOURCE, INT.
		3	CROSS-SIDE HEADING SOURCE, INT.
		4 (see NOTE)	CROSS-SIDE PFD G/S SOURCE, INT.
		5	CROSS-SIDE ND G/S SOURCE, INT.
		6 (see NOTE)	CROSS-SIDE PFD G/S SOURCE, INT.
		7	CROSS-SIDE ND LOC SOURCE, INT.
		8	CROSS-SIDE R/A SOURCE, INT.
		9	CROSS-SIDE MAG/TRU DISCRETE
		10	CROSS-SIDE SAMPLE PROBLEM.
		17	EITHER SG OPTIONS PROGRAMMING

NOTE: For crossed navigation wiring, the PFD displays the cross-side ILS source.

BBB2-34-986A

EFIS Fault Code Diagram
Figure 105/34-22-00-990-A73 (Sheet 1 of 3)

TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
07*	AHRS 1 (2)	1,2,3	CAPT's (F/O's) AHRS SOURCE
	AHRS AUX	43,44,45	AUXILIARY AHRS SOURCE
	SG/AHRS 1 (2)	86,87,89	ONSIDE SG, CAPT's (F/O's) AHRS
			SOURCE OR SG-AHRS INTERFACE
	SC/AHRS AUX	128-130	AUX AHRS SOURCE OR
			SG-AUX AHRS INTERFACE
	SG I/O	171-173,213-215	ONSIDE SYMBOL GENERATOR
08*	FMS 1 (2)	1-19,43-61	CAPT's (F/O's) FLIGHT
			MANAGEMENT COMPUTER
	SG/FMS 1 (2)	86-104,128-146	ONSIDE SG, CAPT's (F/O's) FMC
			OR SG-FMC INTERFACE
	SG I/O	171-189,213-231	ONSIDE SYMBOL GENERATOR
09*	OMEGA 1 (2)	1-24,43-66	CAPT's (F/O's) OMEGA RECEIVER
	SG/OMEGA 1 (2)	86-109,128-151	ONSIDE SG, CAPT's (F/O's) OMEGA
			OR SG-OMEGA INTERFACE
	SG I/O	171-194,213-236	ONSIDE SYMBOL GENERATOR
11	DME 1 (2)	1,43	CAPT's (F/O's) DME RECEIVER
	SG/DME 1 (2)	86,128	ONSIDE SG, CAPT's (F/O's) DME
			OR SG-DME INTERFACE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
12	ADF 1 (2)	1,43	CAPT's (F/O's) ADF RECEIVER
	SG/ADF 1 (2)	86,128	ONSIDE SG, CAPT's (F/O's) ADF
			OR SG-ADF INTERFACE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
13	CADC 1 (2)	1-5	CAPT's (F/O's) CENTRAL AIR DATA COMP.
	SG/CADC 1 (2)	86-90	ONSIDE SG, CAPT's (F/O's) CADC
			OR SG-CADC INTERFACE
	SG I/O	171-175	ONSIDE SYMBOL GENERATOR
14	SG 2 (1) CROSS-TALK	1-19	F/O's (CAPT's) SG
	CROSS-TALK	86-104,170	ONSIDE SYMBOL GENERATOR
	SG I/O	171-189	ONSIDE SYMBOL GENERATOR
16*	VG 1 (2)	1,2	CAPT's (F/O's) VERTICAL GYRO
	VG AUX	43,44	AUXILIARY VERTICAL GYRO
	SG I/O	171-214	ONSIDE SYMBOL GENERATOR
17*	DG 1 (2)	1,43	CAPT's (F/O's) DIRECTIONAL GYRO
	COMPASS 1 (2) REF	85,127	CAPT's (F/O's) REFERENCE
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR

* IF SYSTEM INSTALLED

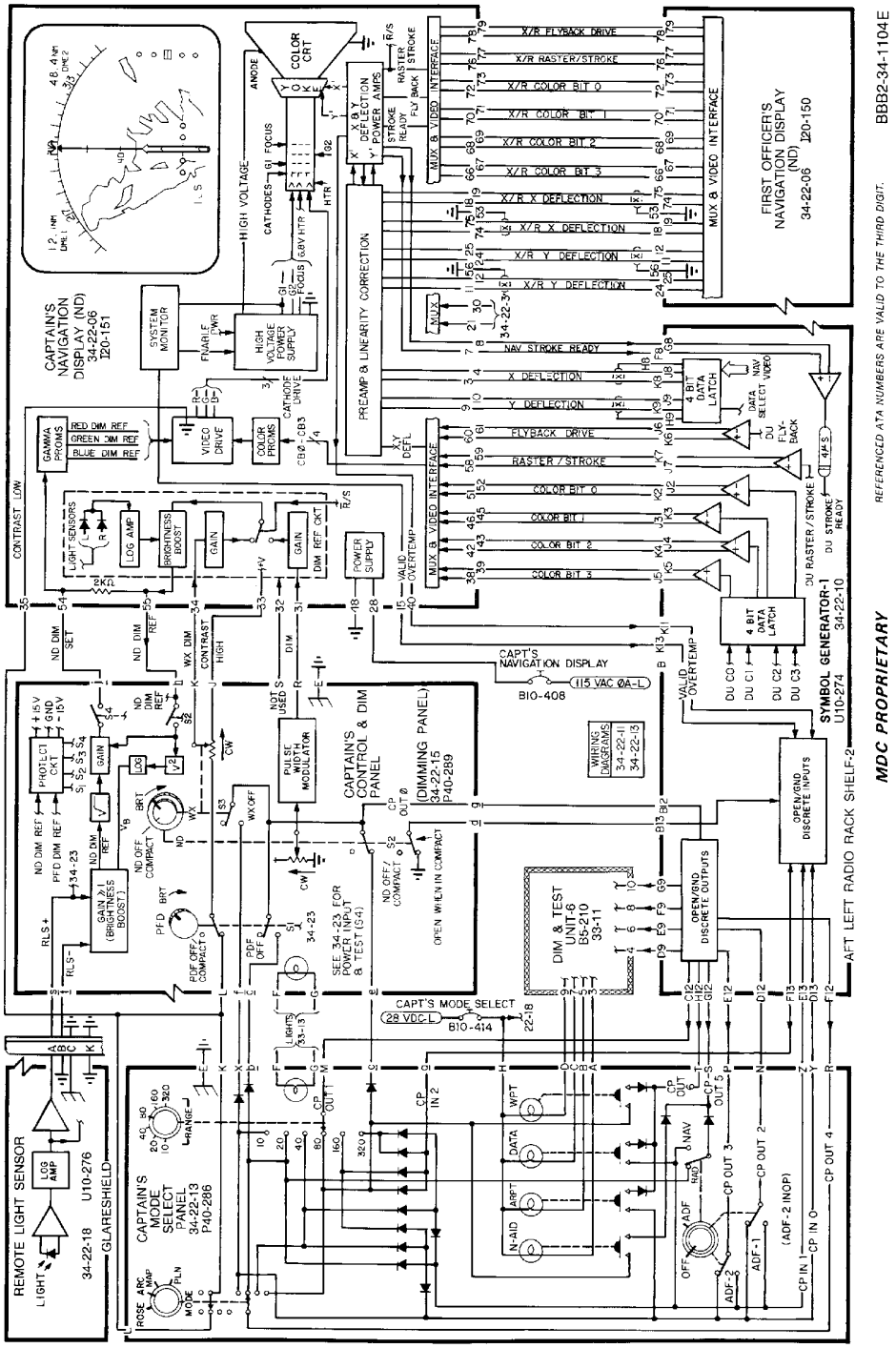
BBB2-34-987A

EFIS Fault Code Diagram
Figure 105/34-22-00-990-A73 (Sheet 2 of 3)

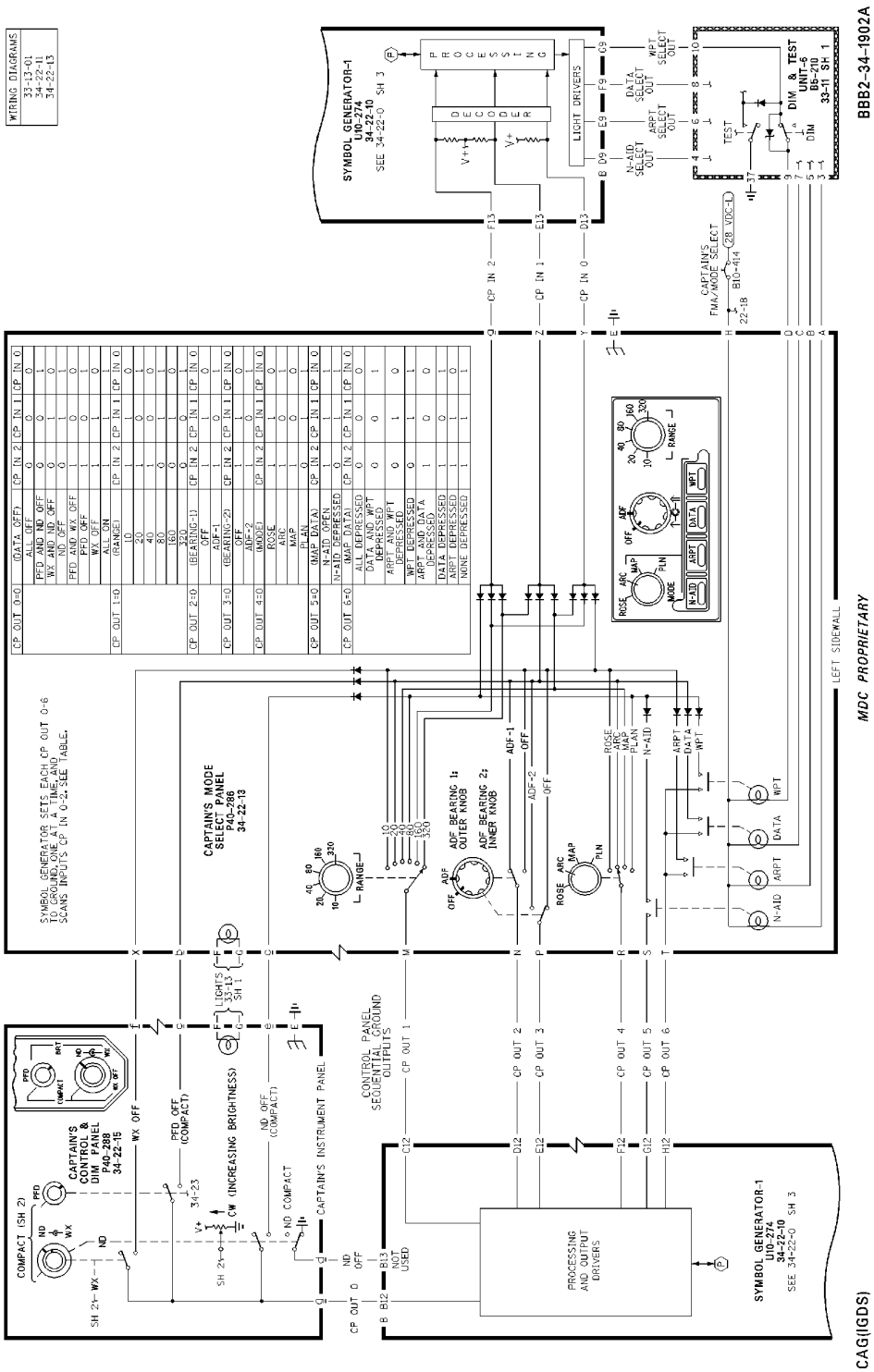
TWO-DIGIT ID NO.	FAULT MESSAGE	THREE-DIGIT FAULT CODE NO.	PROBABLE FAILURE
18	SG I/O	171	ONSIDE SYMBOL GENERATOR
19	RADIO ALT 1 (2)	1,43	CAPT's (F/O's) RADIO ALTITUDE
			RECEIVER
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
20	VOR/LOC 1 (2)	1,43	CAPT's (F/O's) VOR/ILS RECEIVER
	SG I/O	171-172,213-214	ONSIDE SYMBOL GENERATOR
21	G/S 1 (2)	1,43	CAPT's (F/O's) VOR/ILS RECEIVER
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR
22	DFGC 1 (2)	1	CAPT's (F/O's) DFGC
	SG I/O	172,173	ONSIDE SYMBOL GENERATOR
23	FAST SLOW	1	EITHER DFGC
	SG I/O	171	ONSIDE SYMBOL GENERATOR
24	SG I/O	171-173,214	ONSIDE SYMBOL GENERATOR
25	WINDSHEAR	1	WINDSHEAR DISCRETES SSM
		2	WINDSHEAR PLI SSM
	SG/WINDSHEAR	86	WINDSHEAR DISCRETES REFRESH
		87	WINDSHEAR PLI REFRESH
	SG I/O	171-172	ONSIDE SYMBOL GENERATOR
26	SG/WOW	1	ONSIDE SG, GND PROX UNIT, INT.
	SG/GND INHIBIT	2	ONSIDE SG, AIRCRAFT LOGIC
			(S129 AND S130), INT
	SG/FMA	3	ONSIDE SG, FMA RESET KEY, INT.
	SG/COCKPIT LAMP	4	ONSIDE SG, COCKPIT LAMP TEST
			KEY/INT.
	SG/STP	5	STP FWD SPACE STUCK KEY
		6	STP BACK SPACE STUCK KEY
		7	STP VERIFY STUCK KEY
	SG/SG 1/2 IDENT	8	OFFSIDE SG1/SG2 DISCRETES ONSIDE
27	SG/CONTROL &	1	ONSIDE SG, ONESIDE CONTROL
	DIMMING PANEL		& DIMMING PANEL, INT.
	SG/DP/MSP MON	2,3,4	ONSIDE SG, MSP, OR SG-MSP INT.
	SG/MSP MONITOR	5-12	ONSIDE SG, MSP,OR SG-MSP INT.
28	PFD FAIL	1,2	ONSIDE PRIMARY FLIGHT DISPLAY
	ND FAIL	33,34	ONSIDE NAVIGATION DISPLAY
29	WEATHER RADAR	1	WXR RECEIVER/TRANSMITTER UNIT
	SG/WEATHER RADAR	86	ONSIDE SG, MSP, OR WXR R/T UNIT
	SG I/O	171	ONSIDE SYMBOL GENERATOR
30	SG MEM/CPU	1-2,33-34,65-68	ONSIDE SYMBOL GENERATOR
31	VOR BEARING 1 (2)	1,43	VOR BEARING A (B) SSM
	SG/VOR BEARING 1 (2)	86,128	ONSIDE SYMBOL GENERATOR
	SG I/O	171,213	ONSIDE SYMBOL GENERATOR

BBB2-34-988A

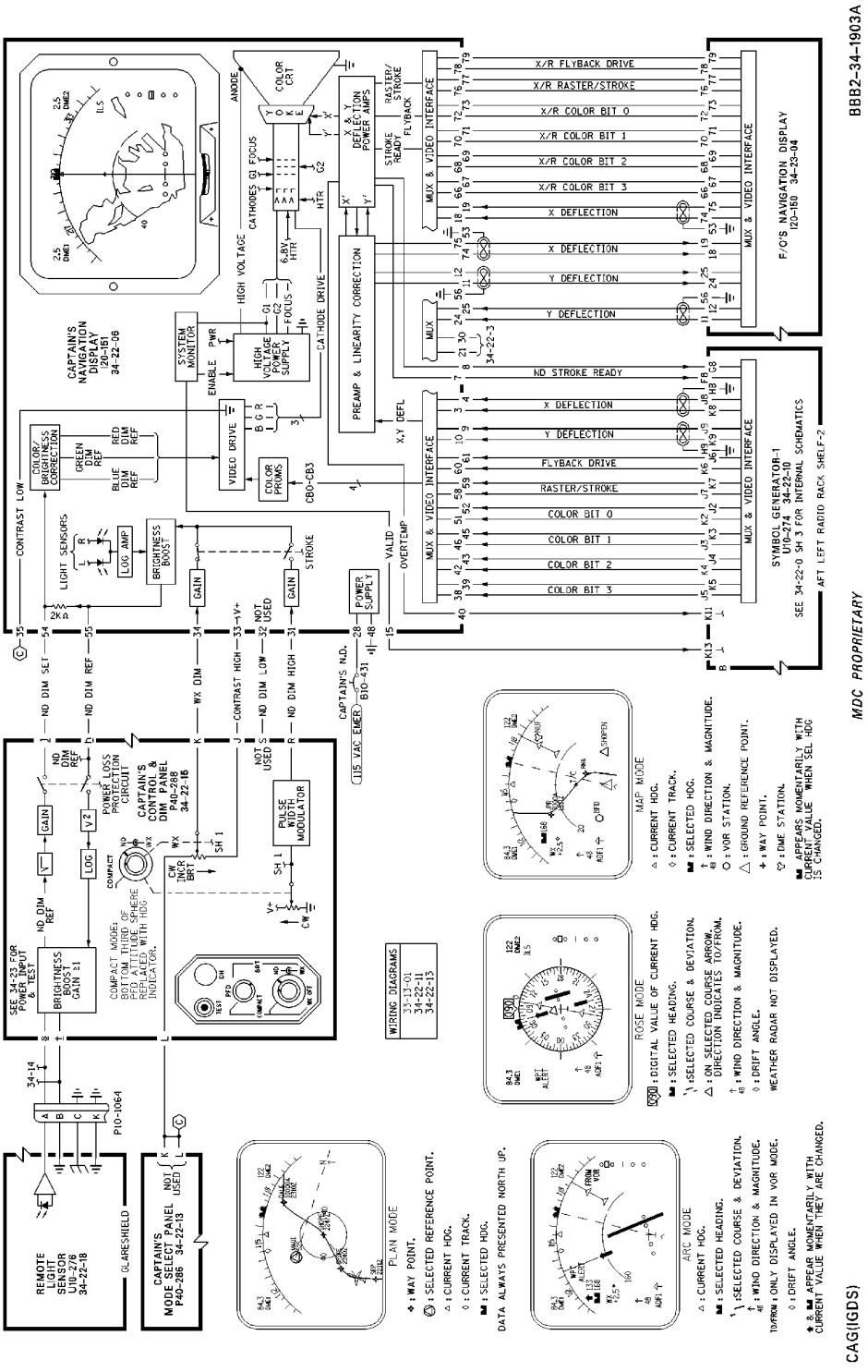
EFIS Fault Code Diagram
Figure 105/34-22-00-990-A73 (Sheet 3 of 3)



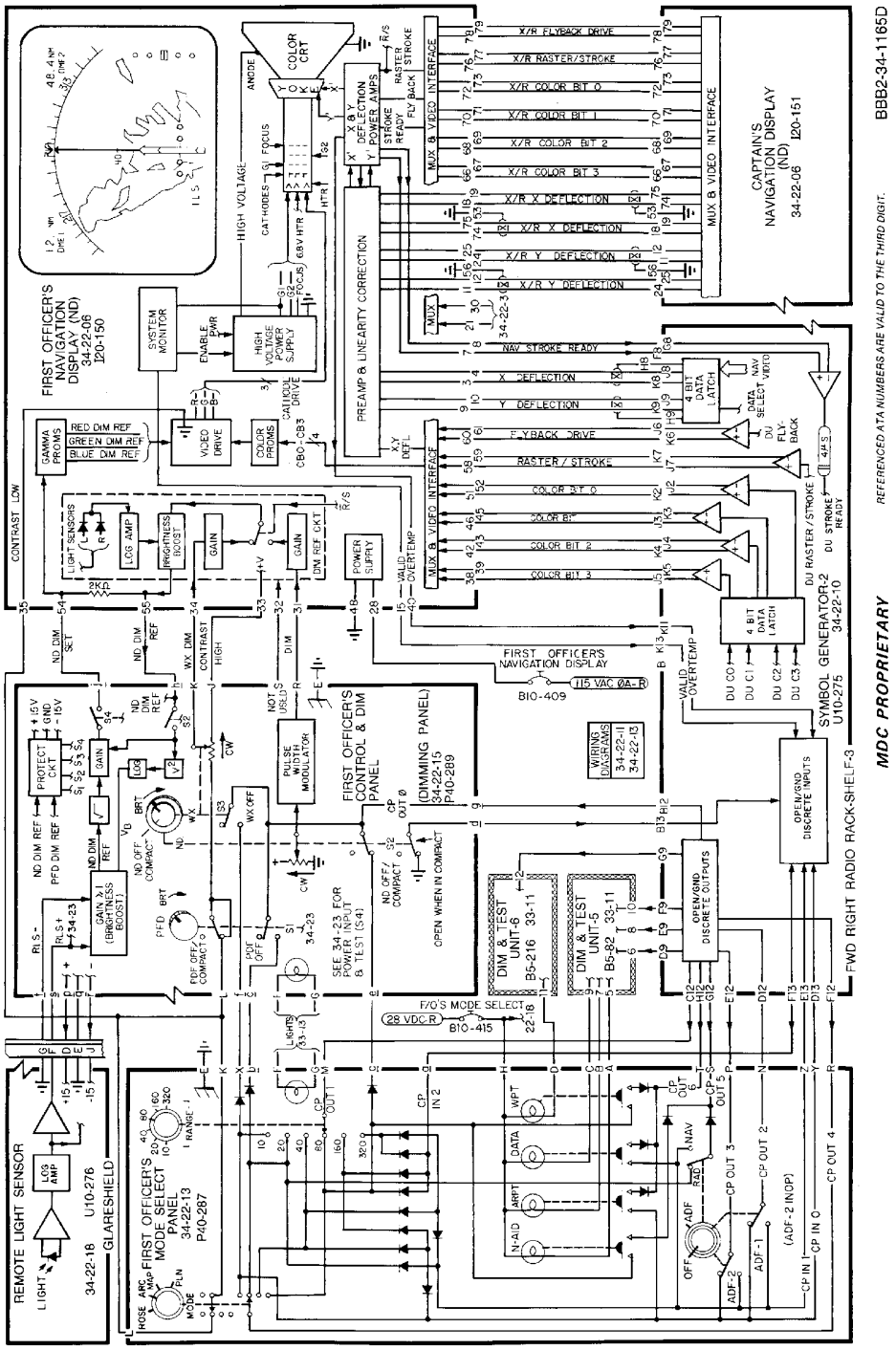
EFIS Navigation Displays -1
Figure 106/34-22-00-990-A74



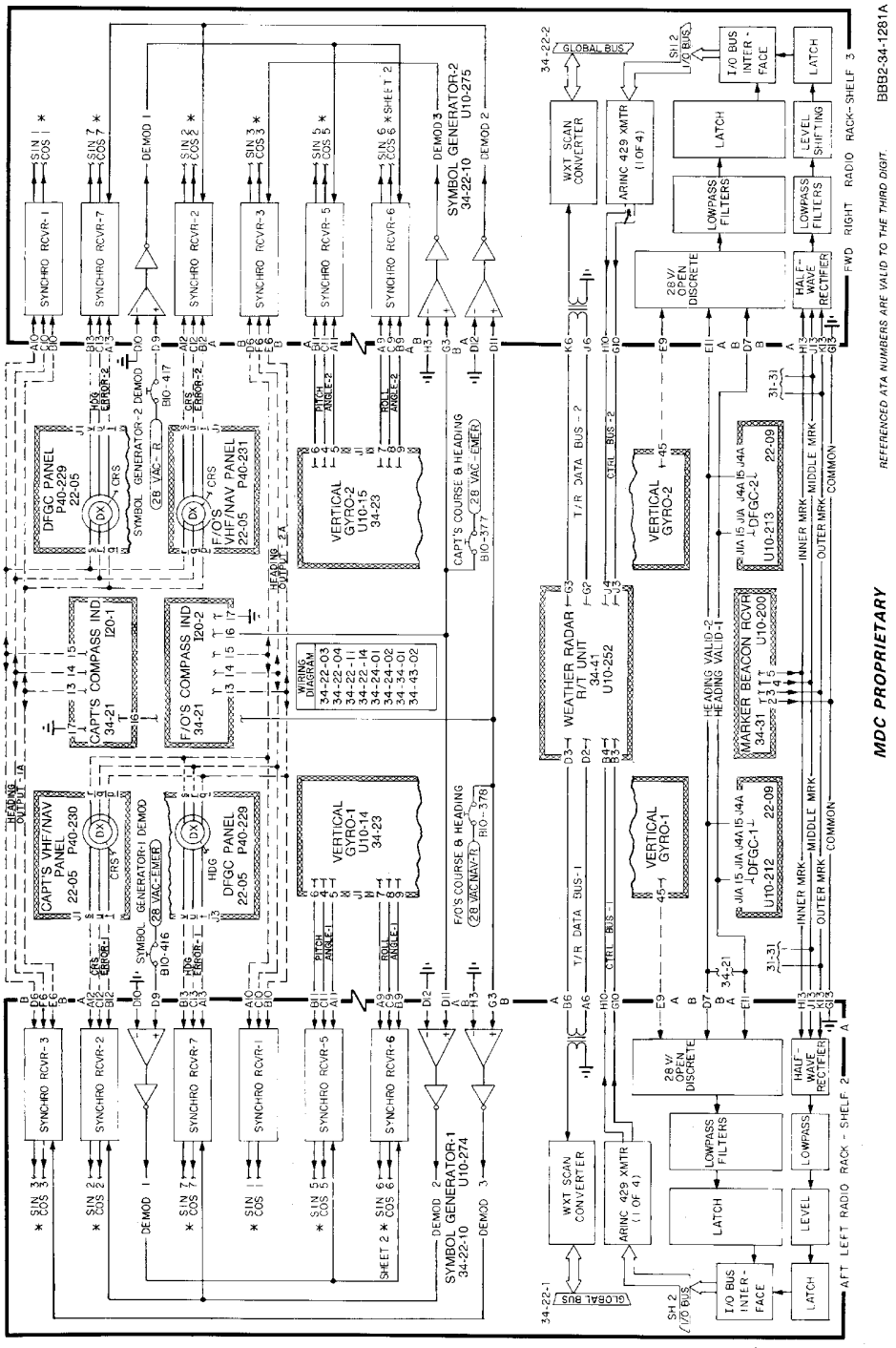
EFIS Navigation Displays -1
Figure 107/34-22-00-990-A75 (Sheet 1 of 2)



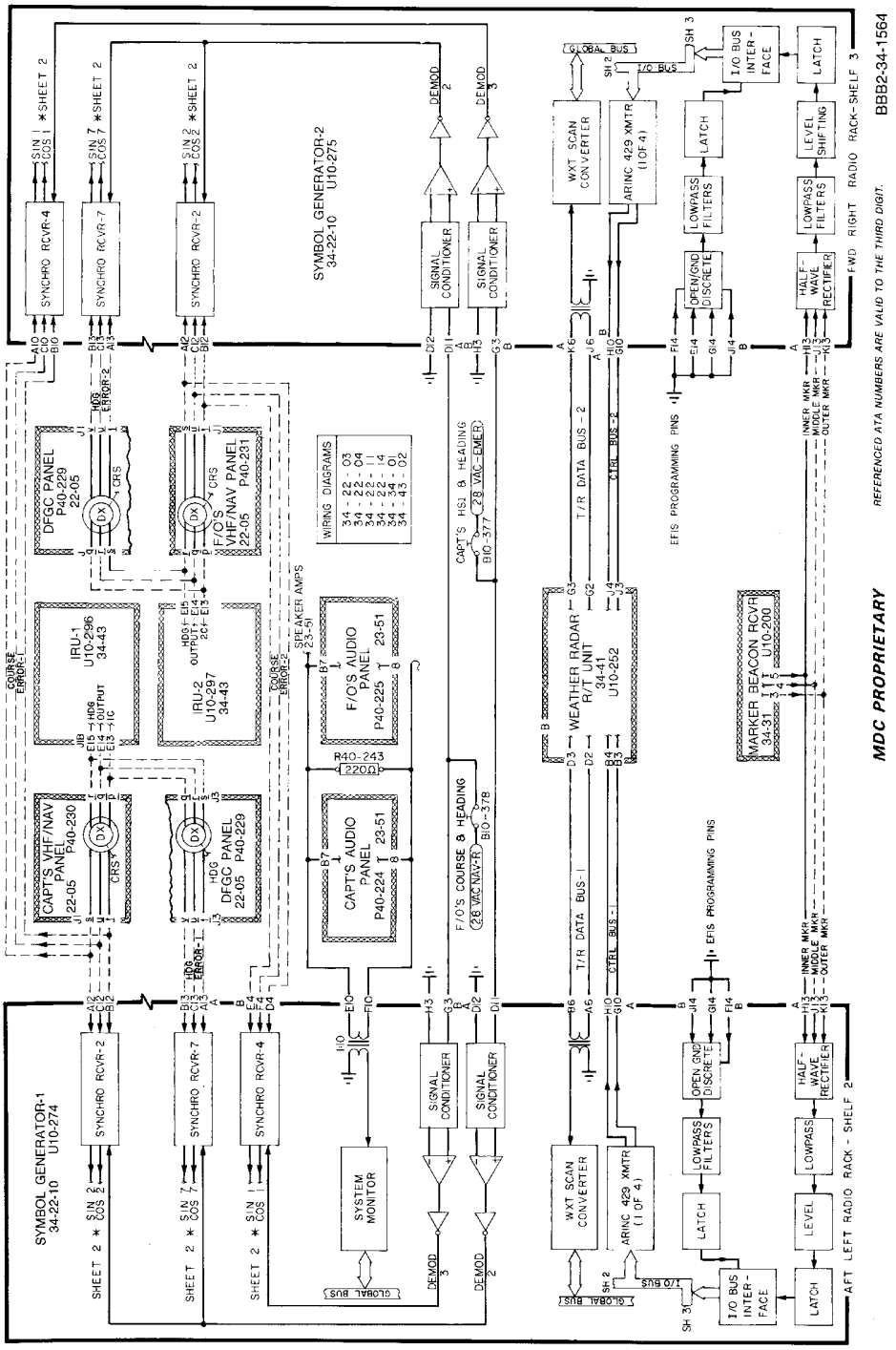
EFIS Navigation Displays -1
Figure 107/34-22-00-990-A75 (Sheet 2 of 2)



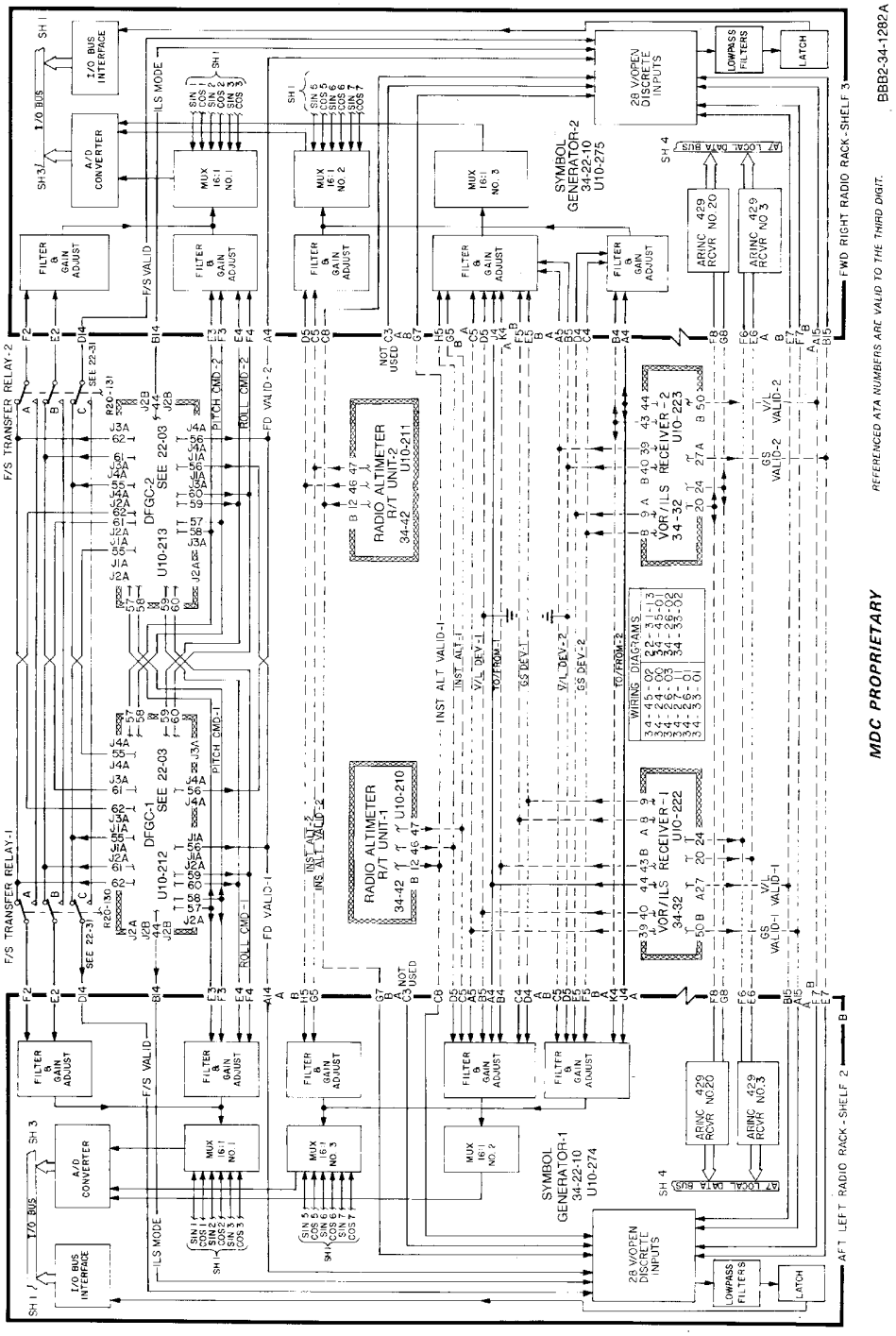
EFIS Navigation Displays -2
Figure 108/34-22-00-990-A76



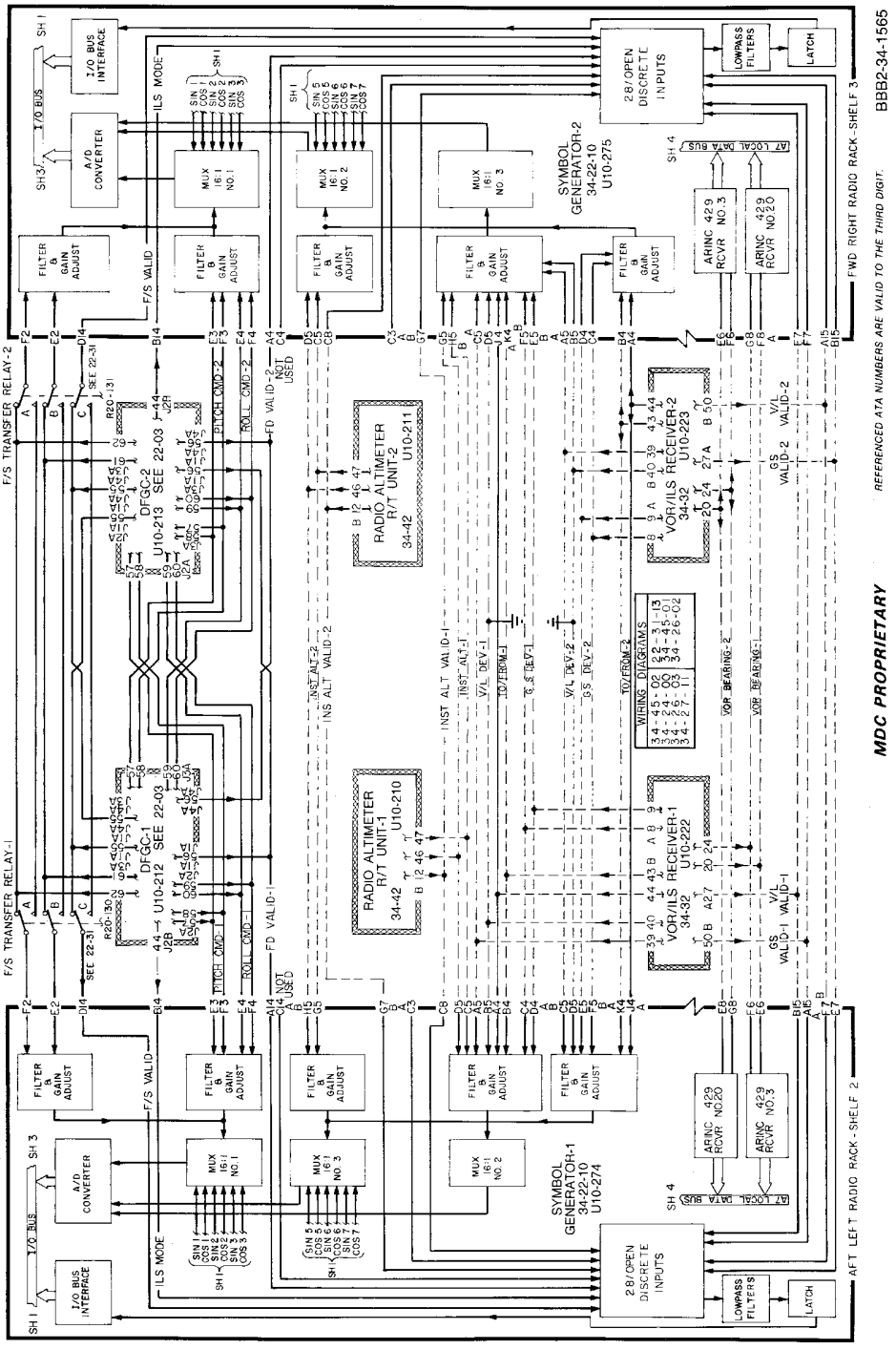
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 1 of 10)



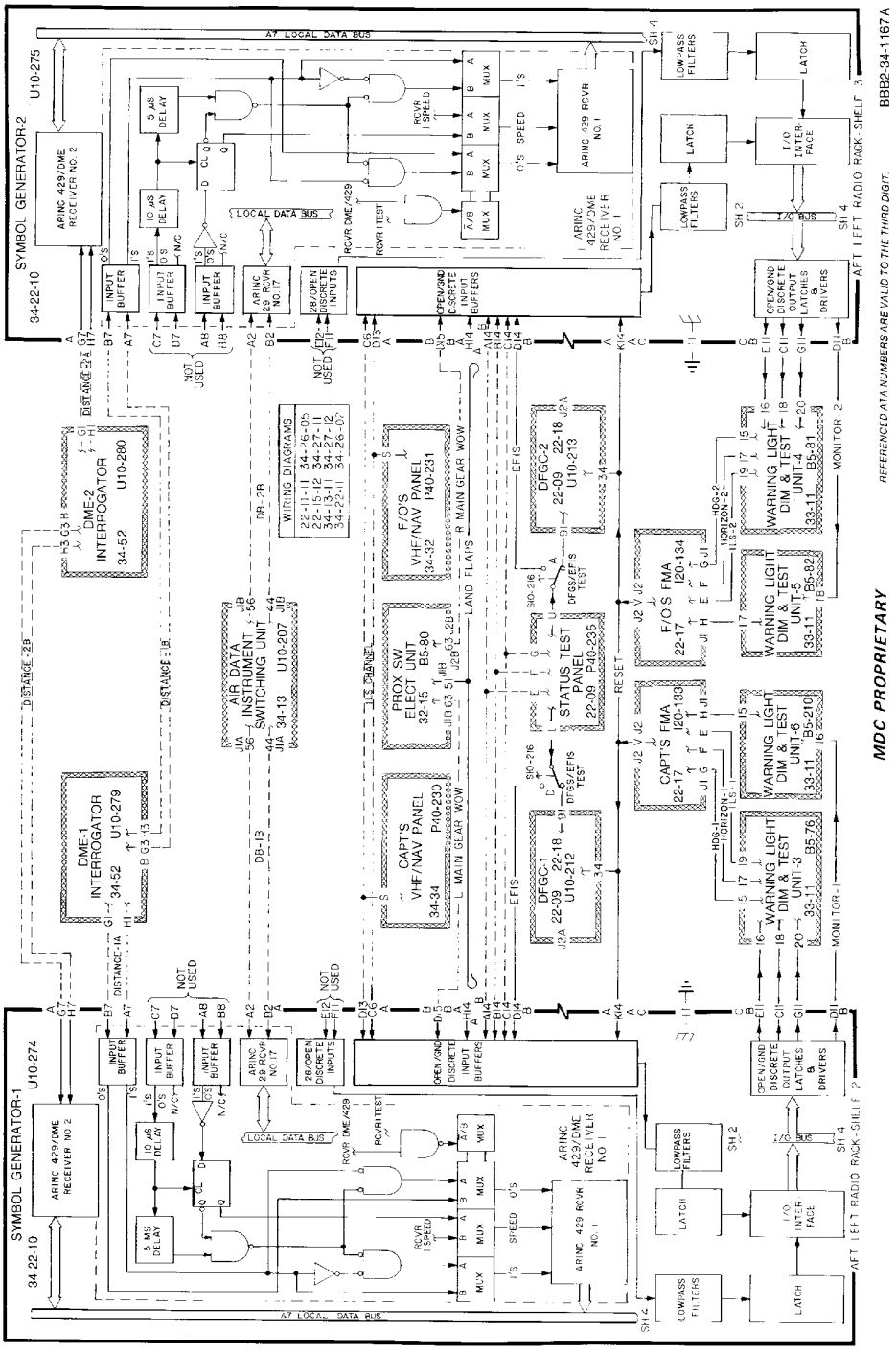
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 2 of 10)



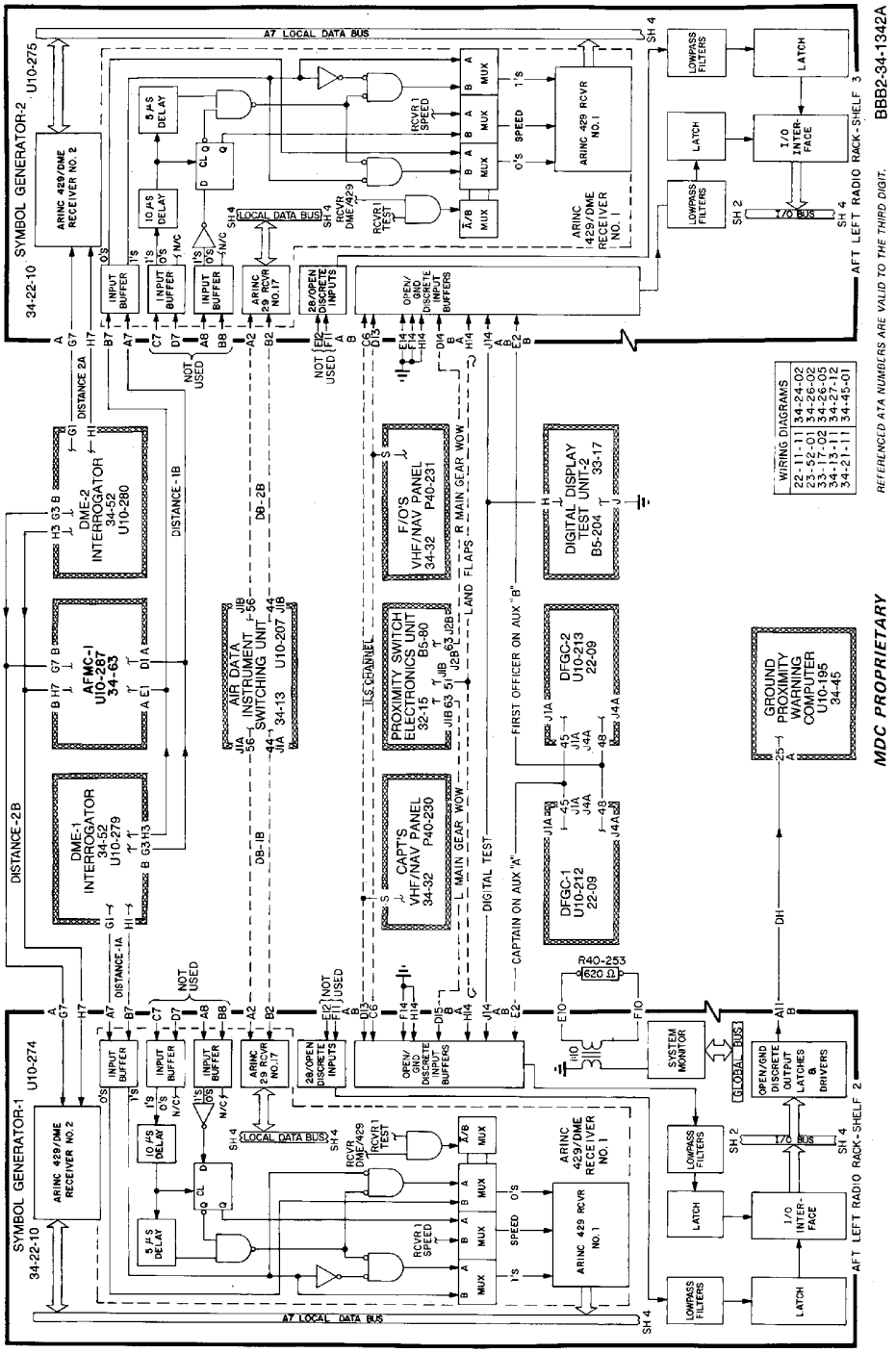
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 3 of 10)



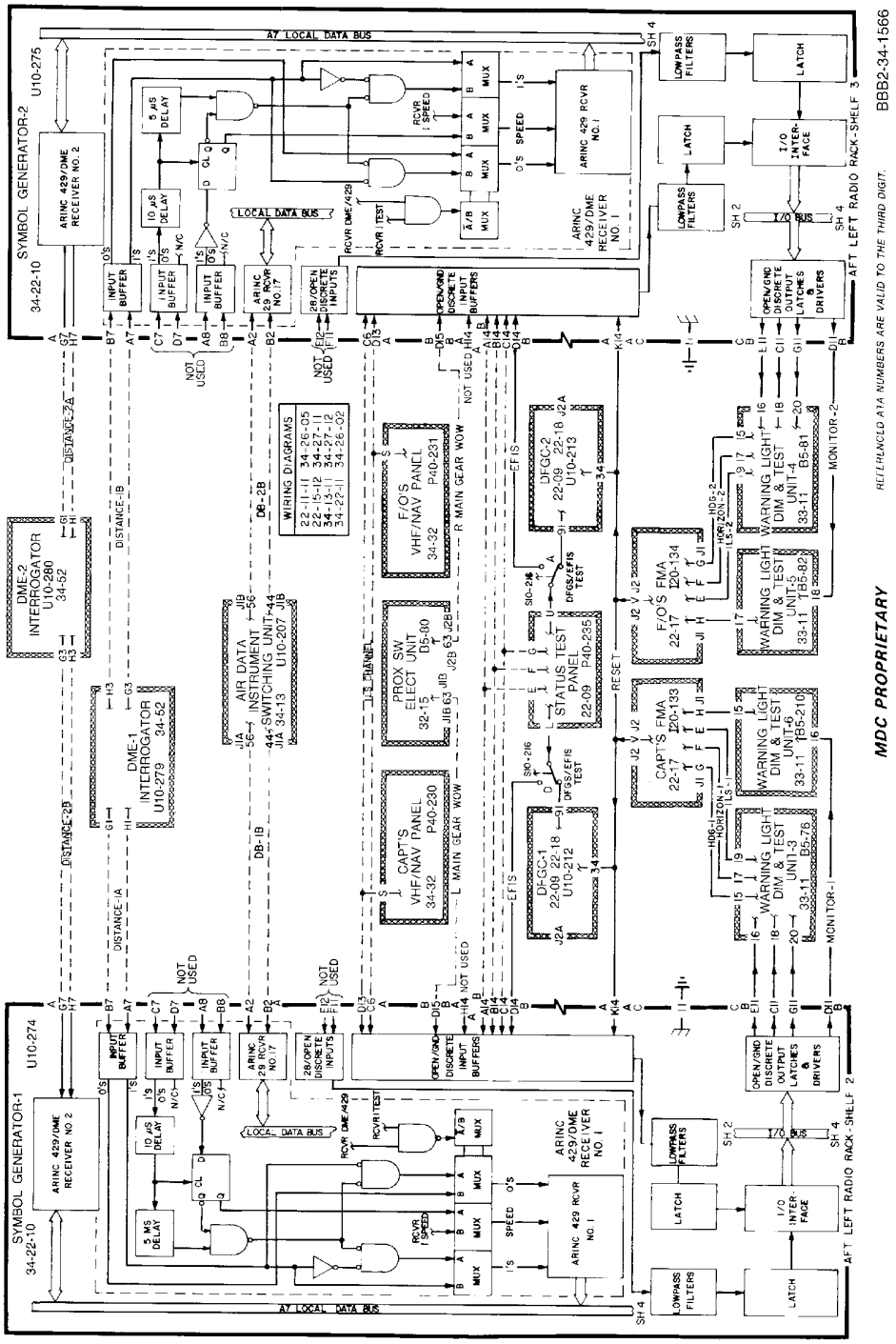
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 4 of 10)



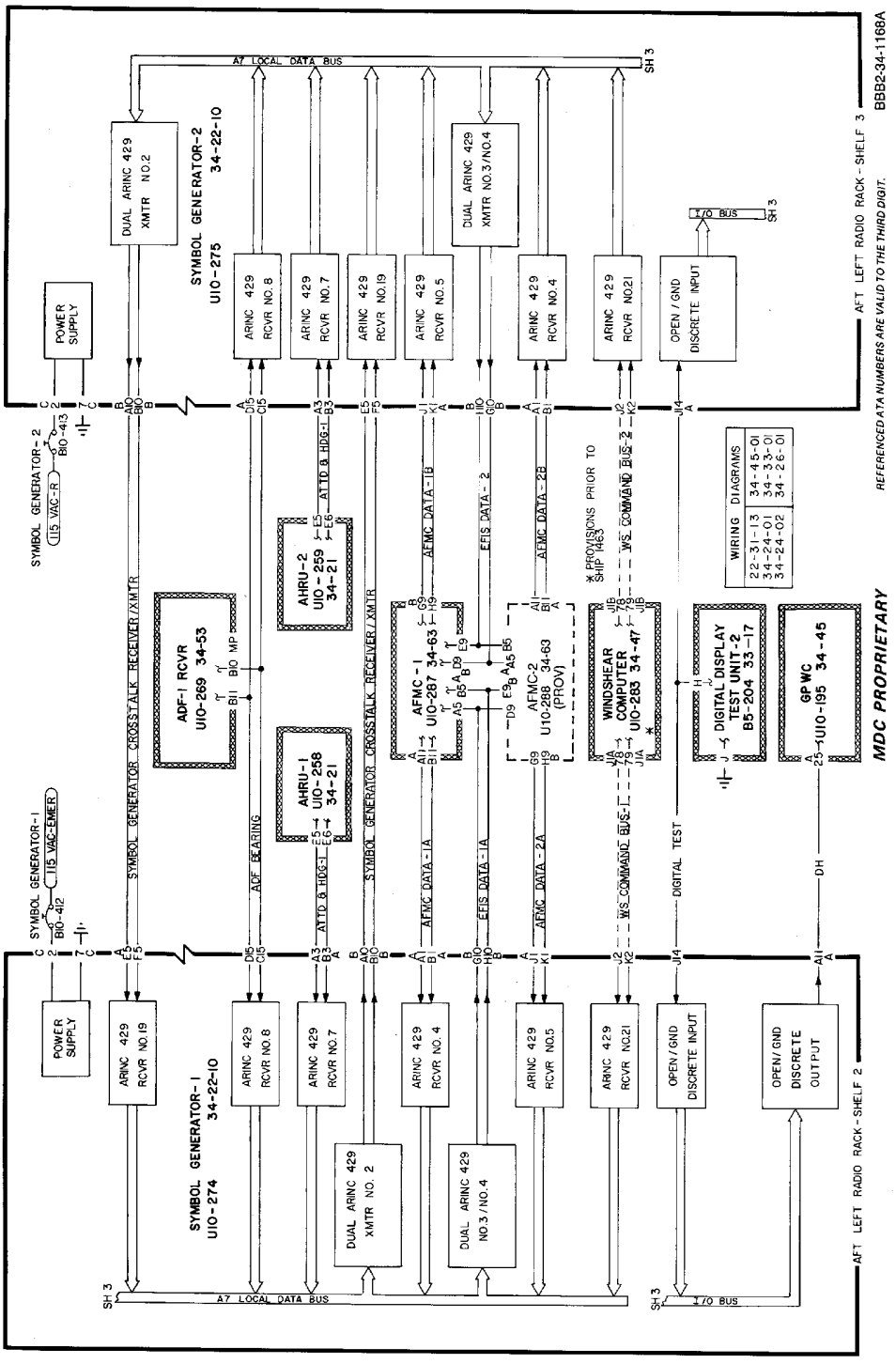
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 5 of 10)



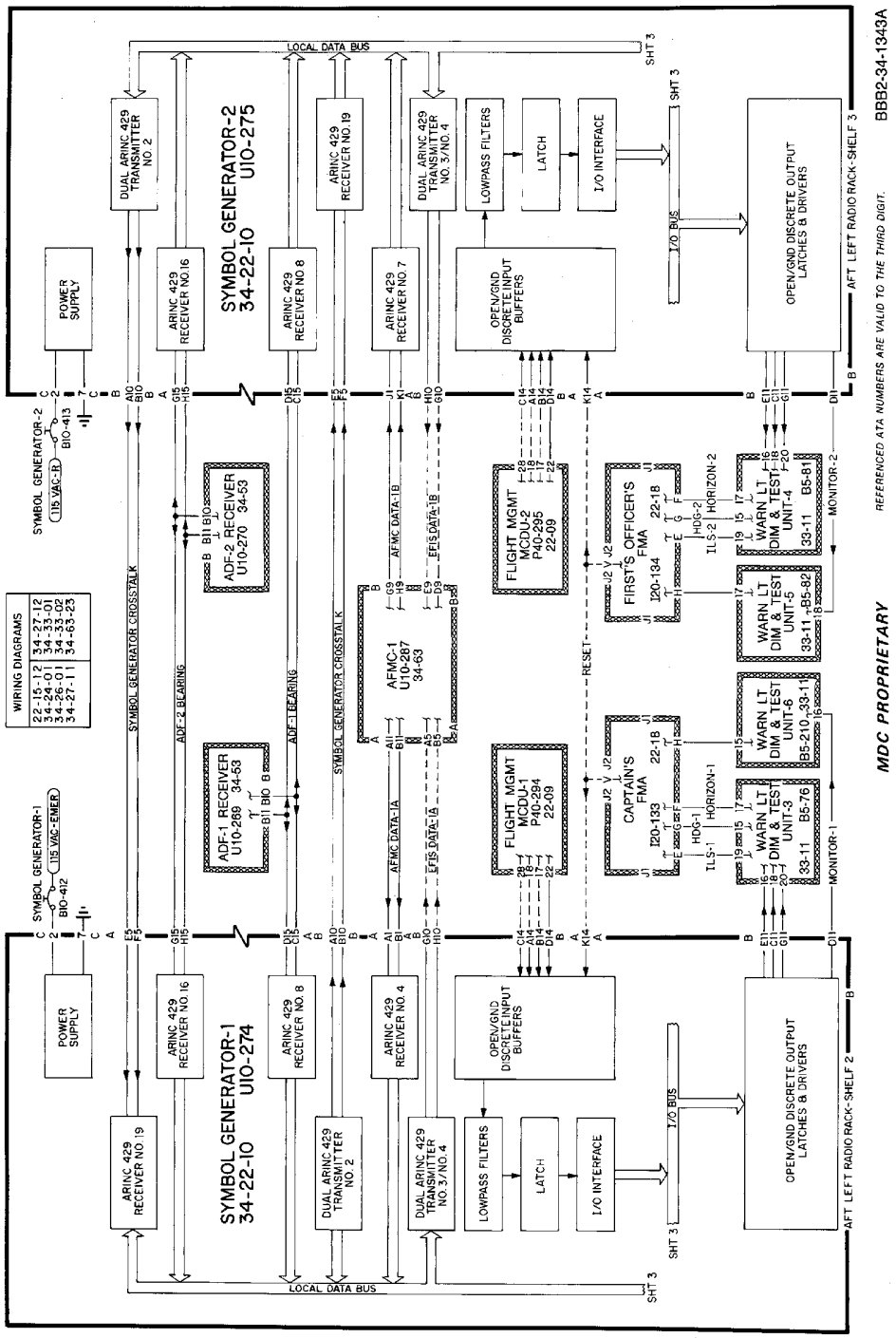
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 6 of 10)



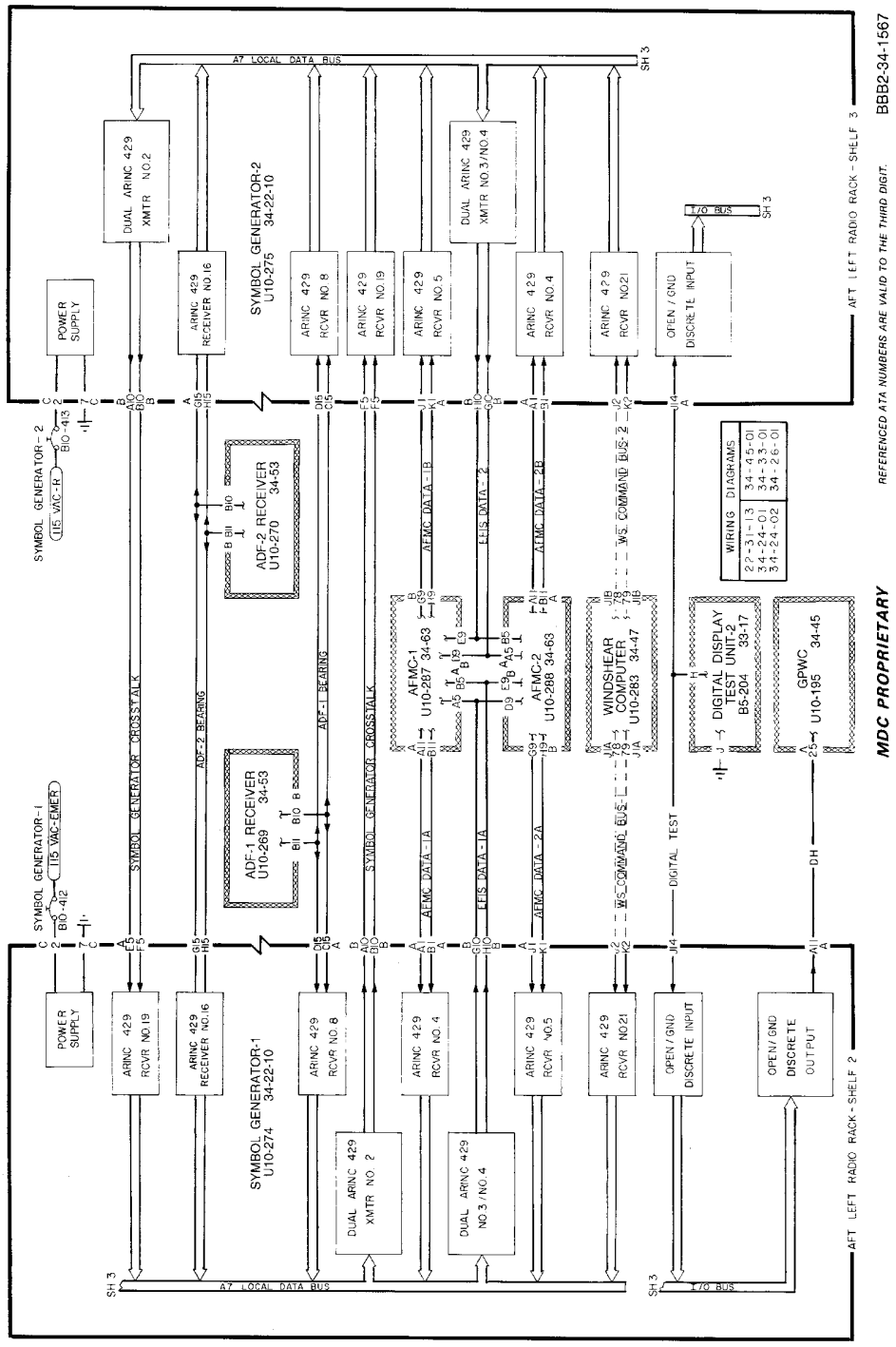
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 7 of 10)



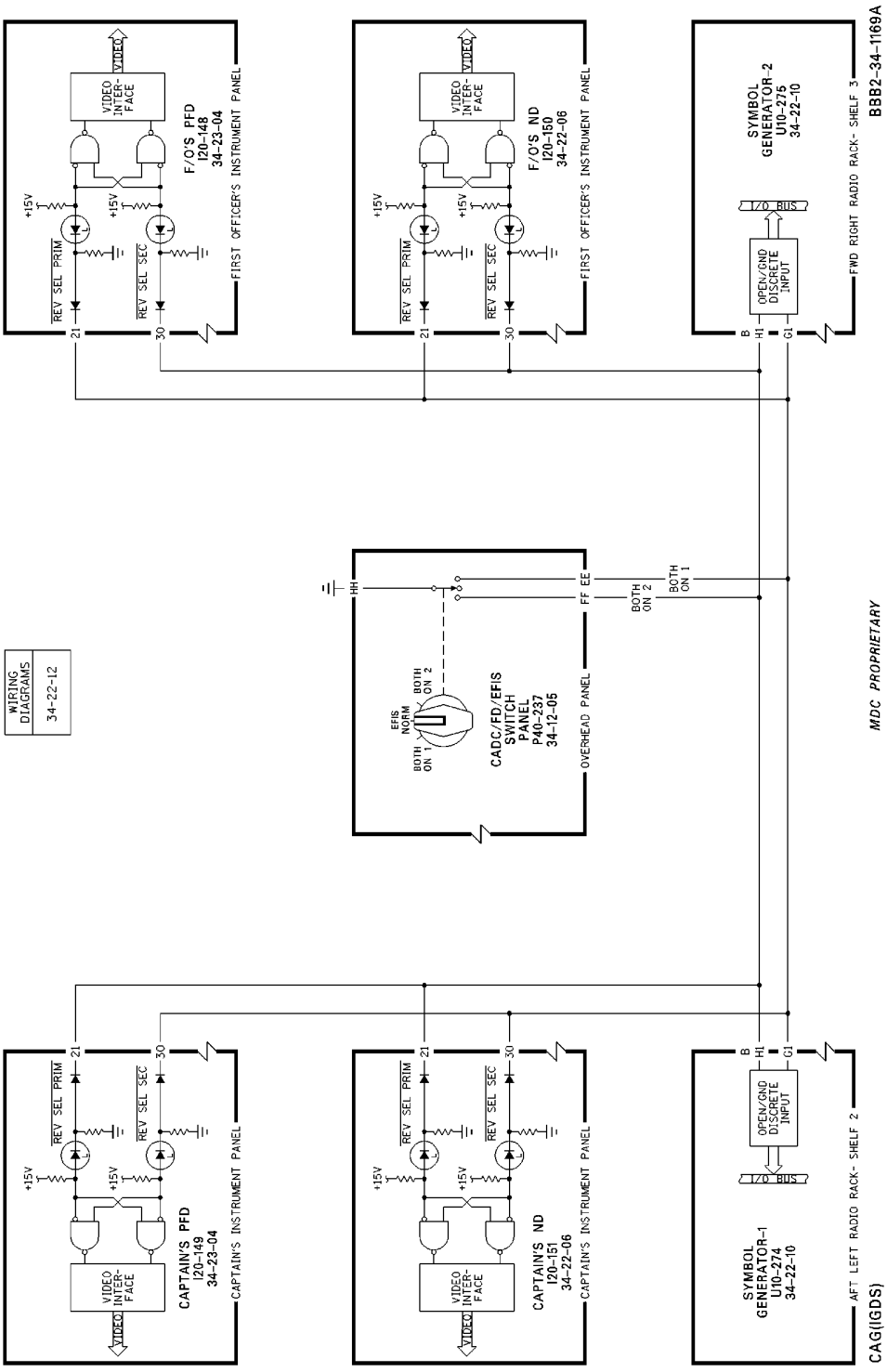
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 8 of 10)



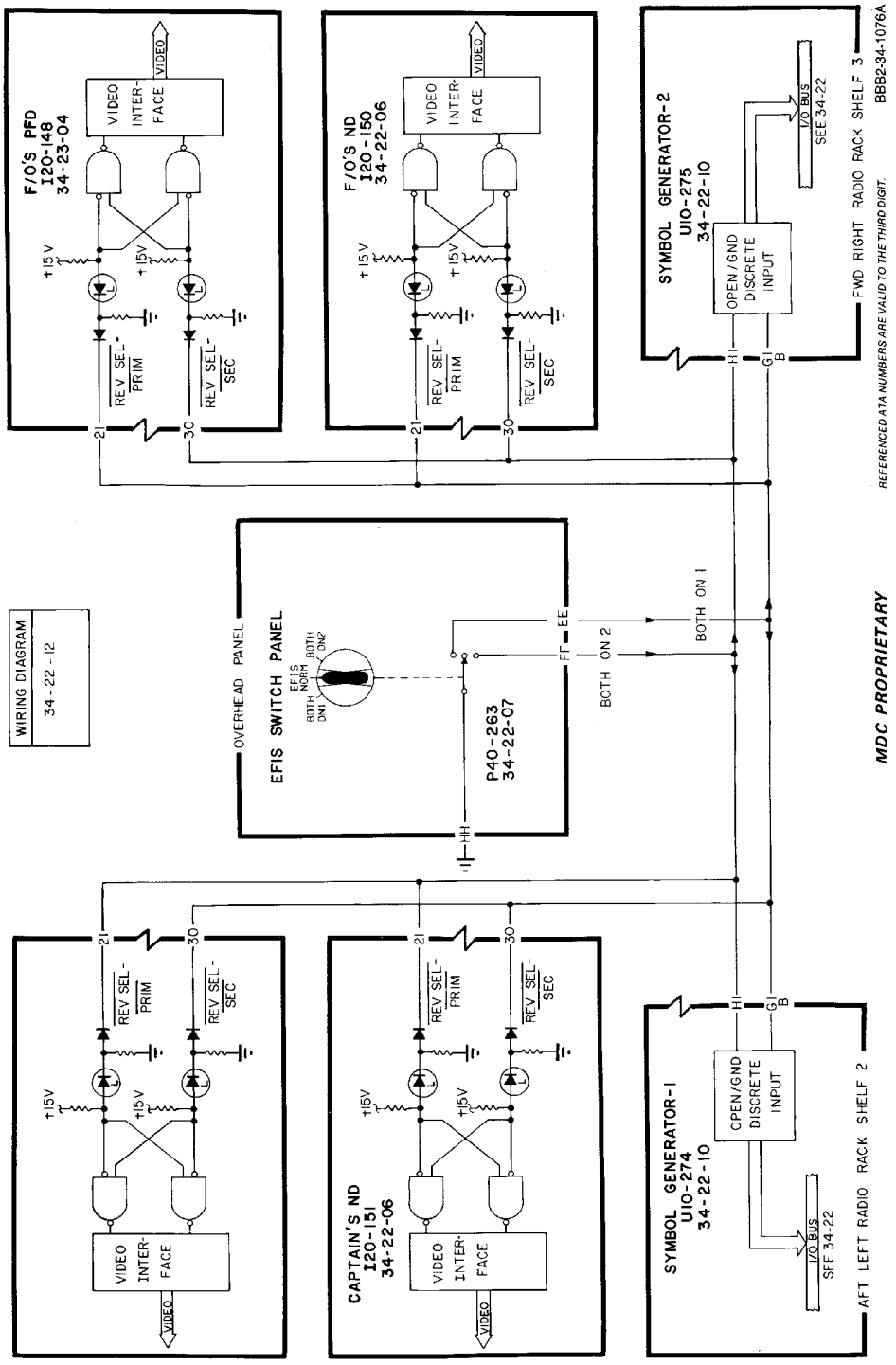
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 9 of 10)



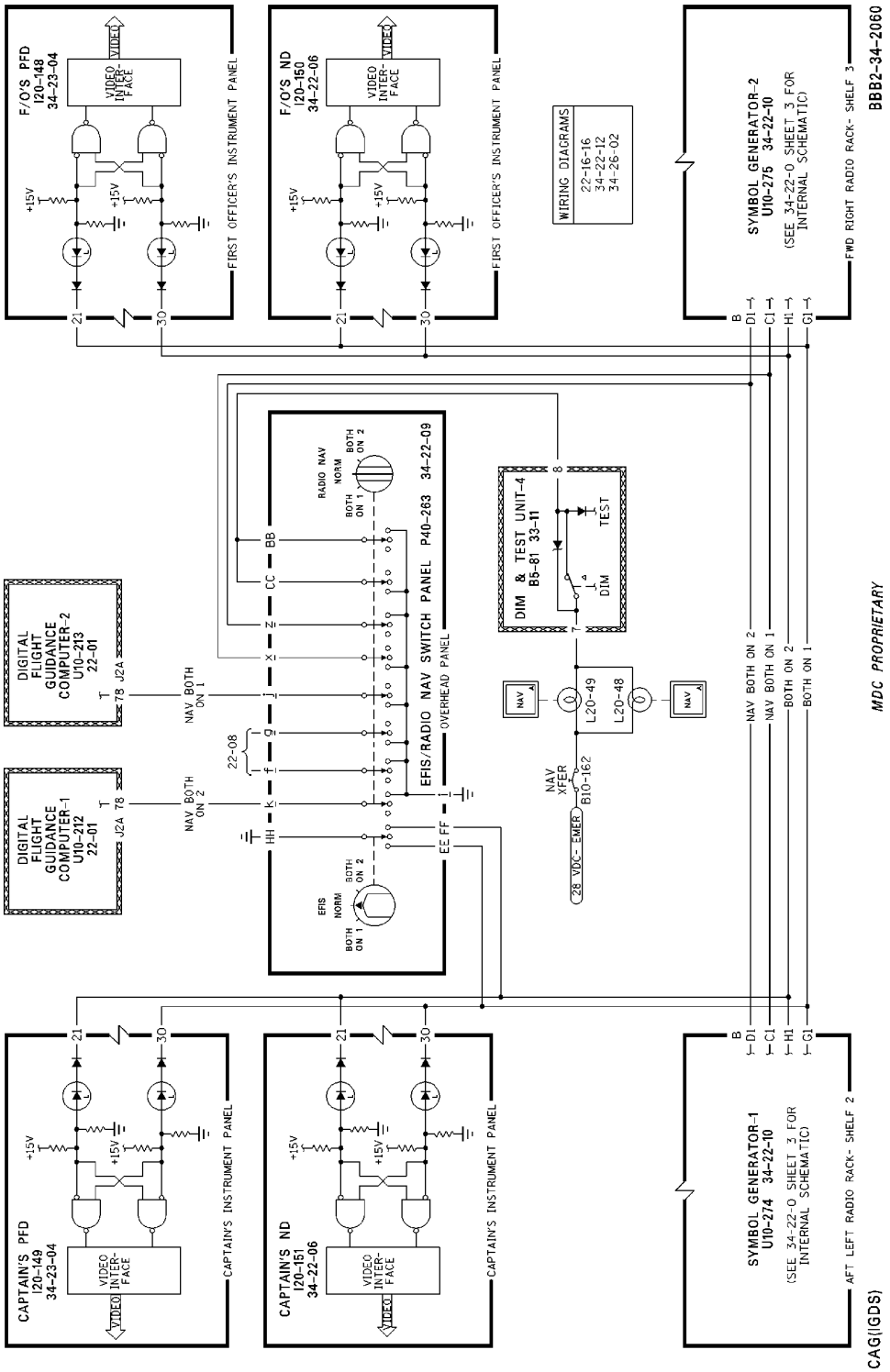
EFIS Inputs
Figure 109/34-22-00-990-A78 (Sheet 10 of 10)



EFIS Switching
Figure 110/34-22-00-990-A82 (Sheet 1 of 3)



EFIS Switching
Figure 110/34-22-00-990-A82 (Sheet 2 of 3)



EFIS Switching
Figure 110/34-22-00-990-A82 (Sheet 3 of 3)

NAVIGATION DISPLAYS - MAINTENANCE PRACTICES

1. General

WJE 401-404, 412, 414, 875-879

General Maintenance Features

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

A. This section contains an overview of the maintenance practices required for the electronic flight instrument system (EFIS). This is followed by a complete listing of circuit breakers for the EFIS and interfacing systems which must be closed when performing system tests. Ground maintenance consists of the following:

(1) Options/Configuration programming of the symbol generator. This is performed only when a new SG is installed on the aircraft, or when a SG is transferred from another aircraft. Each aircraft has its own "finger print" which must be fed into the SG upon installation. Options/Config. programming matches the SG software to the aircraft wiring.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(2) SG Self Test: Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Multipurpose Control Display Panel (MCDU).

WJE 401-404, 412, 414, 875-879

(3) SG Self Test: Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Status Test Panel (STP).

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(4) EFIS System Self-Test (BIT) - This 3-second test is initiated from the TEST pushbutton on the control and dimming panel (CDP). Used to test the following systems which provide inputs to the SG: VOR/ILS, radio altimeter, marker beacon. The EFIS system self-test includes a failure flag test.

(5) All input systems tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the test pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(6) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons.

WJE 401-404, 412, 414, 875-879

(7) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons and Taxi Speed, if installed.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

B. To Perform a Complete System Test: The symbol generator is the heart of the EFIS, so thorough testing of the SG ensures proper operation of the system. The maintenance practices for the symbol generator include all of the above-mentioned tests. To perform a thorough system test, perform the symbol generator maintenance practices (SUBJECT 34-22-10, Page 201). Separate LRU functional tests are also provided for the EFIS control and dimming panel (CDP), mode select panel (MSP), display units (PFD/ND), and remote light sensor (RLS). These are to be performed following Removal/Installation of the LRU's.

2. General Maintenance Practices

A. The following instructions contain a detailed explanation of how the STP is used in conjunction with the EFIS maintenance menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS maintenance menu and TEST pushbutton (BIT) are used in performing a complete system test.

WJE 401-404, 412, 414, 875-879

B. Status Test Panel - The Status Test Panel (STP) pushbuttons are used to call up the EFIS Maintenance Menu display on the PFD/ND. In order to use the STP pushbuttons for this purpose, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. When the aircraft is on the ground and power to the STP is on, the Maintenance Menu appears on both the PFD and ND of the system being tested (Figure 201).

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

C. The following instructions contain a detailed explanation of how the Flight Management System (FMS) Multipurpose Control Display Unit (MCDU) is used in conjunction with the EFIS maintenance menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS maintenance menu and TEST pushbutton (BIT) are used in performing a complete system test.

D. MCDU - The MCDU pushbuttons (keys) are used to call up the EFIS maintenance menu display on the PFD/ND. When the aircraft is on the ground and power to the MCDU is on, the maintenance menu appears on both the PFD and ND of the system being tested (Figure 201).

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

WJE 401-404, 412, 414, 875-879

E. The EFIS Maintenance Menu - There are five menu pages which can be selected from the Maintenance Menu (Figure 201): FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The TEST PATTERN is used for bench tests and is not included in the Maintenance Practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the Maintenance Menu, and pressing the VERIFY pushbutton on the STP (Figure 203). The FORWARD and BACKSPACE keys are used to move the cursor vertically on the Maintenance Menu. The following five selections can be made from the EFIS Maintenance Menu:

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

The EFIS Maintenance Menu - There are five menu pages which can be selected from the maintenance menu (Figure 201): FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The test pattern is used for bench tests and is not included in the maintenance practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the maintenance menu and pressing the VERIFY pushbutton on the MCDU. The FORWARD and BACKSPACE keys are used to move the cursor vertically on the maintenance menu. The following five selections can be made from the EFIS maintenance menu:

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(1) Fault Review - Used in trouble shooting, to read failures logged in the flight log. The fault code consists of two 3-digit numbers. The first digit is the SG (or system) number. The next two digits are fault ID numbers; these are main category fault classifications. The last three digits are the fault code numbers; they are subordinate to the fault ID numbers. The fault ID and fault code are used to provide a complete fault definition. Fault messages appear on the fault review screen next to the 6-digit entries. An "-R" after the message indicates a repeat failure. The fault messages are followed by a time entry, which is the time into the flight leg from takeoff (SUBJECT 34-22-00, Page 101) for complete listing of EFIS fault codes).

(2) Fault Erase - This mode is used to erase all flight faults from the flight log. The cursor is cycled to the FAULT ERASE selection on the menu, and the VERIFY key is pressed. Pressing the FORWARD SPACE key at this time will cause all flight faults to be erased. Pressing BACKSPACE or VERIFY will abort the erase function (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101).

(3) Test Pattern - The test pattern is used in bench testing only. The test pattern is a color display of stroke-drawn lines and raster patches. The lines consists of one line for each stroke color: cyan, yellow, green, red, dim white, white and magenta. The three patches are raster patches, one for each of the raster test colors: blue, green and red.

(4) SG Self-test - This is a comprehensive test for the system SG's and all interfacing systems. This three second test generates two displays: the Interface Status page, containing ID codes, fault codes and fault messages for all currently monitored interface failures, and the self-test failures page, listing diagnostic numbers of all internal SG failures.

(5) Options/Config.: This mode is used by maintenance personnel whenever a new SG is installed. It allows the user to enter or modify the aircraft configuration and options words. These words are located on a placard next to the STP mode select switch (EFIS/DFGS). When -905 symbol generators are installed, MAINT CHECK will appear on both displays if the option words of SG1 do not match the option words of SG2. If an incompatibility exists between the check register, the options register, and the configuration identification, MAINT CHECK will appear on both displays. This would normally occur if one SG is replaced but has not had the check register and options registers modified to reflect the current aircraft configuration. When -905 symbol generators are installed, MAINT CHECK will appear on the display of the failed SG only.

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

F. TEST Pushbutton - Control and Dimming Panel (CDP): The TEST pushbutton is used during the SG maintenance practices to self-test interfacing systems and display unit failure flags. There are separate TEST pushbuttons for system-1 and system-2, on the Capt's and F.O.'s CDP's. Pressing the TEST pushbutton, VOR/ILS, radio altimeter, and marker beacon self-tests. The appropriate test responses are under the control of the respective receiver units. When testing a single parameter (i.e., radio altimeter), all other symbology appearing on the display screens should be ignored. The test is successful if the appropriate failure/flag/warning replaces the parameter on the display screen (i.e., an R/A FAIL flag will replace the radio altimeter tape on the PFD).

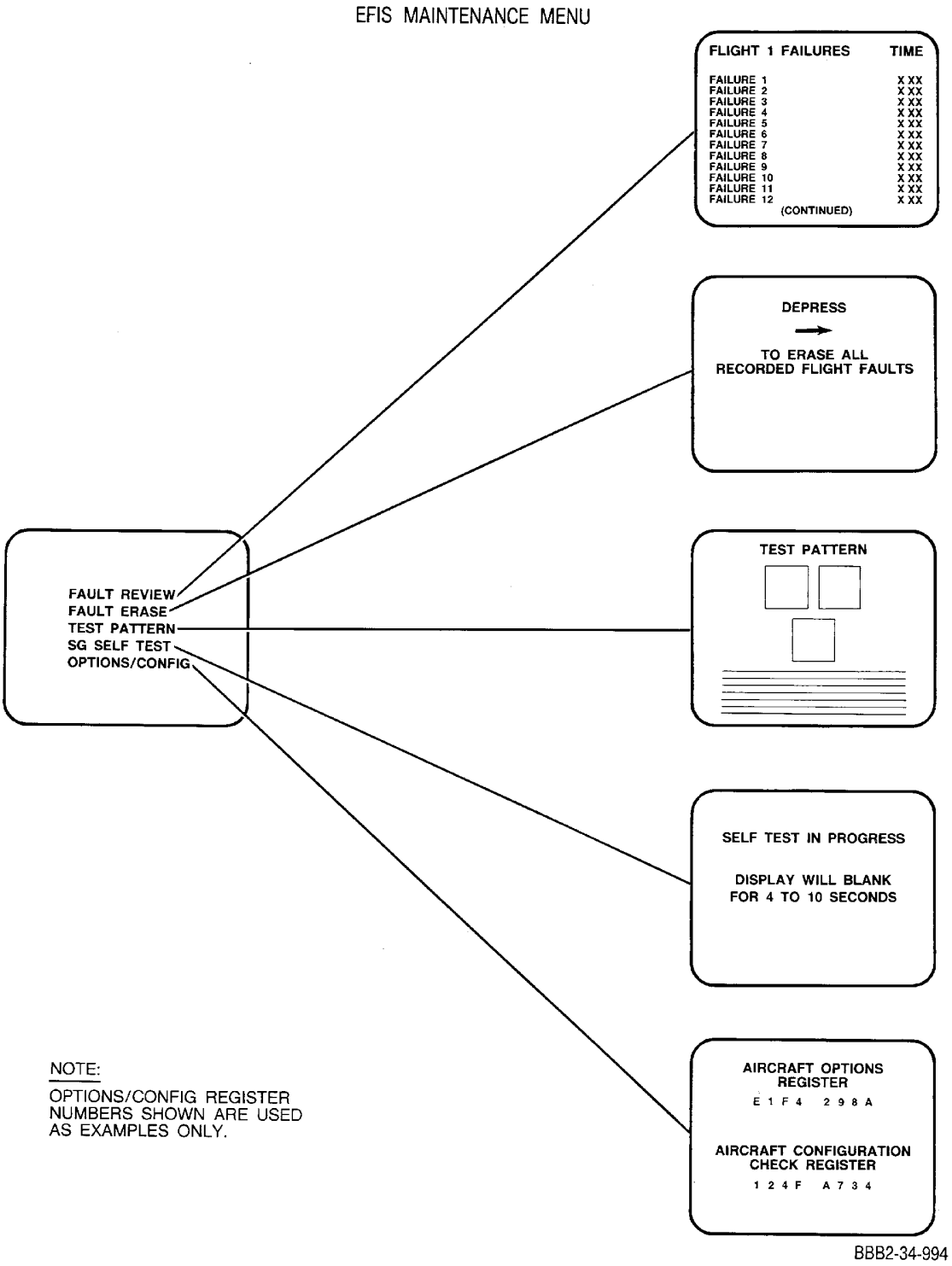
(1) The TEST pushbutton also initiates a failure flag test, and DH aural warning test (if installed). The DH aural warning test consists of a one-second tone slewing from 400 to 800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions (Figure 204).

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

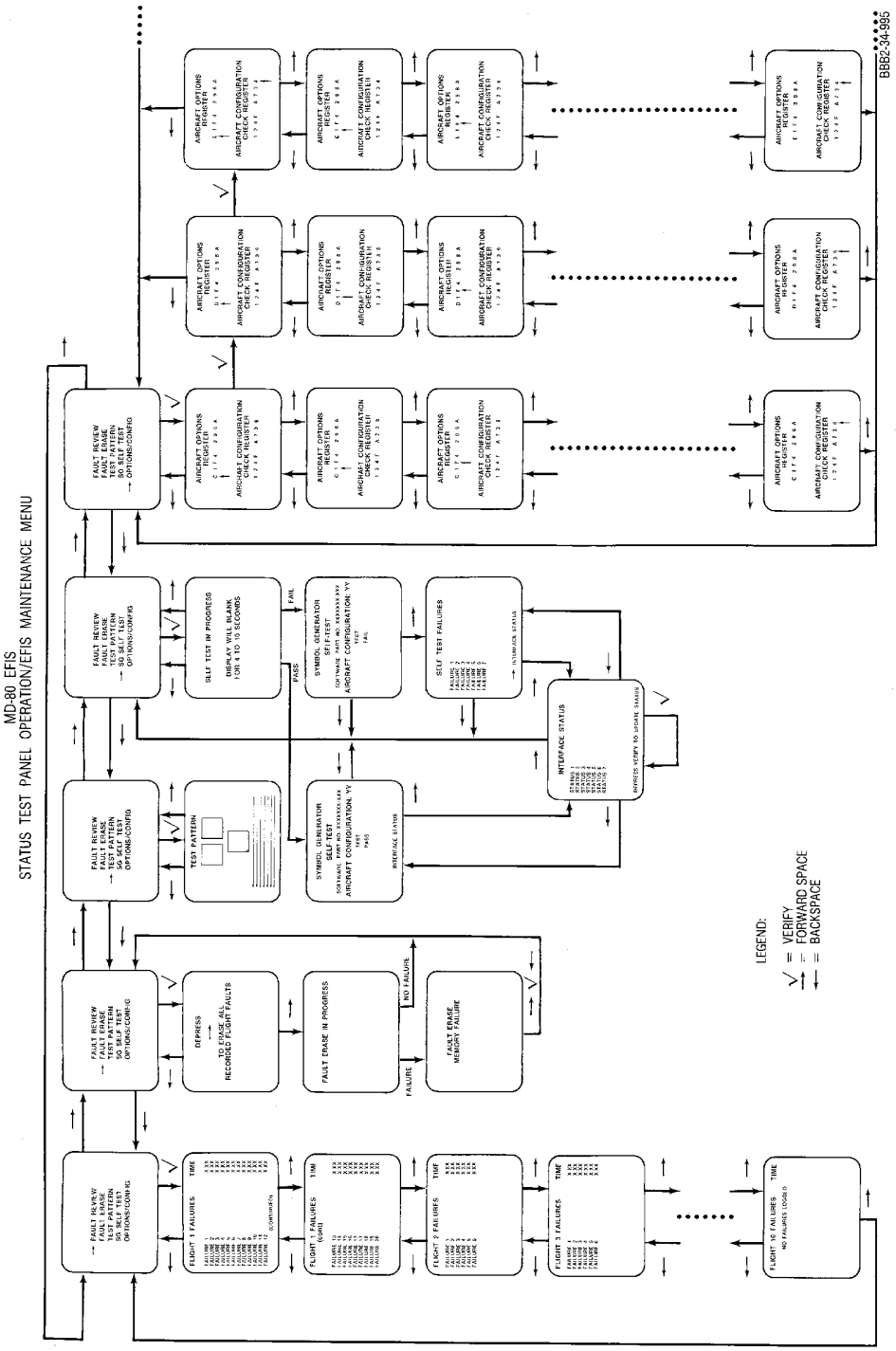
G. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons are also tested.

WJE 401-404, 412, 414, 875-879

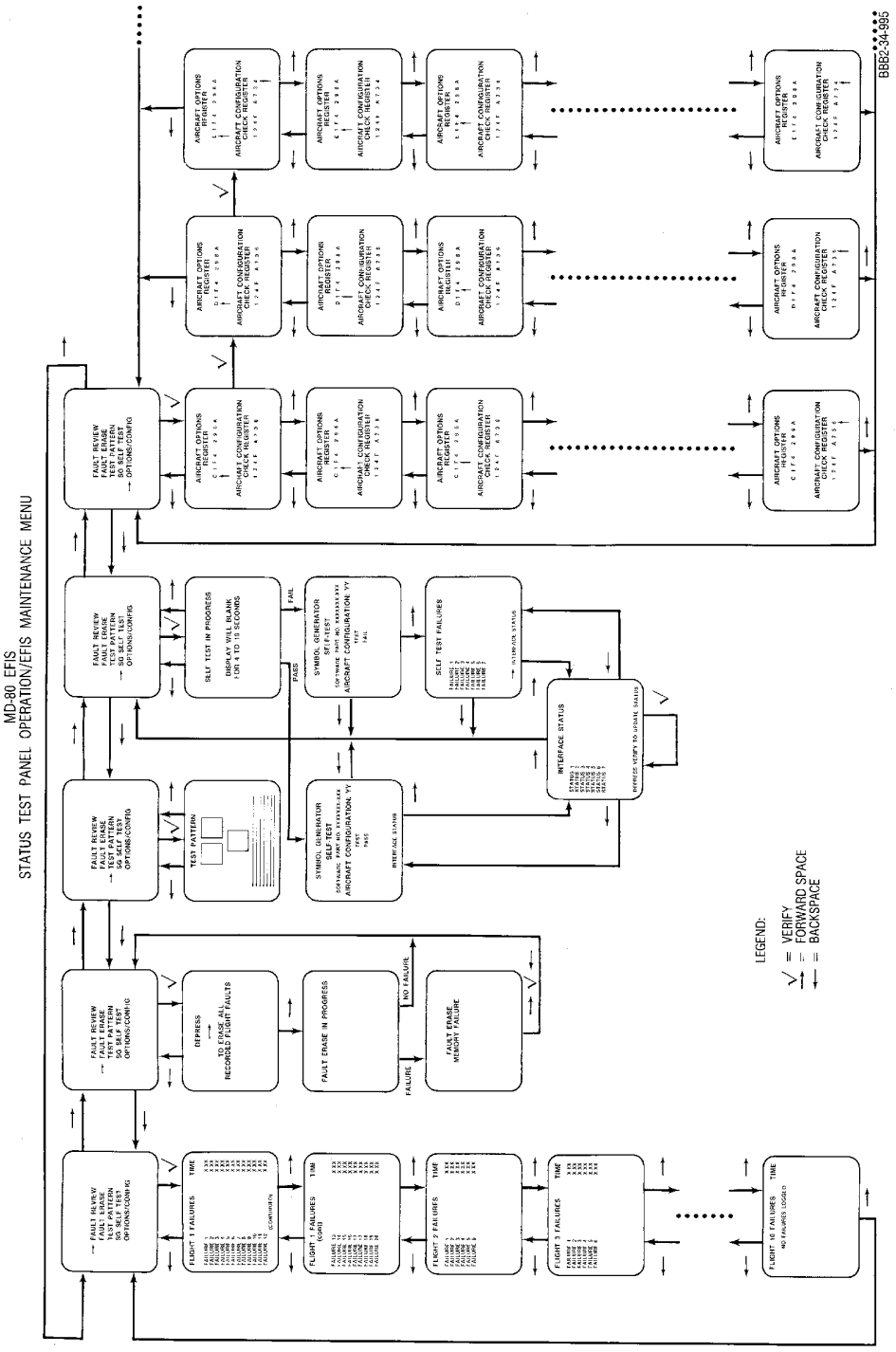
H. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons and Taxi Speed are also tested, if installed.



EFIS Maintenance Menu
Figure 201/34-22-00-990-D09



EFIS Maintenance Menu -- MCDU Operation
Figure 202/34-22-00-990-D10



EFIS Maintenance Menu -- STP Operation
Figure 203/34-22-00-990-E03

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 204/34-22-00-990-D12

WJE 401-404, 412, 414, 875-879 (Continued)

3. **Equipment and Materials**

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
TIC 30A or TIC 30B Signal Generator	TEL - Instrument Electronics Corp.
980N-1 Radio Altimeter, Test Set	Collins

4. **Adjustment/Test Electronic Flight Instrument System (EFIS)**

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Adjustment/Test Navigation Displays (Electronic Flight Instrument System (EFIS))

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

NOTE: The following adjustment/test procedures provide for an on ground aircraft EFIS functional checks. Tests can be performed as a complete system test or as individual item tests.

A. Following is a Glossary of Acronyms used in the following tests procedures.

Table 202 Glossary of Acronyms

CAPT	Instrument Landing System (ILS)
Decision Height (DH)	Mode Select Panel (MSP)
Distance Measuring Equipment (DME)	ND
Control and Dimming Panel (CDP)	PFD
EFIS	Symbol Generator (SG)
Flight Mode Annunciator (FMA)	Status Test Panel (STP)
F/O	VHF Omnidirectional Range (VOR)
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872	
Flight Management System (FMS)	Multifunction Control Display Unit (MCDU)
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879	
Remote Light Sensor (RLS)	Weather Radar (WXR)

B. Make Sure the Circuit Breakers for EFIS and Interfacing Systems are Closed:

LOWER EPC, LIGHTS - R DC BUS

Row	Col	Number	Name
N	34	B1-848	DIGITAL DISPLAY WARNING LIGHT & TEST

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	26	B1-187	LANDING GEAR WARNING
P	39	B1-827	LEFT PROXIMITY SWITCH CONTROL

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	39	B1-828	RIGHT PROXIMITY SWITCH CONTROL

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	10	B10-26	GLIDESLOPE-1

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	18	B10-332	AUTO THROTTLE-1
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
F	17	B10-105	RADIO ALTMETER-1
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 877			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	17	B10-29	ADF-1

(Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	18	B10-365	AUTO THROTTLE-1
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	24	B10-353	AUTOPILOT-1
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS
G	25	B10-359	FLIGHT GUIDANCE STATUS & MAINT PNL
G	26	B10-343	MACH TRIM-1
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	6	B10-333	AUTO THROTTLE-2
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
D	12	B10-404	ADF-2
F	3	B10-106	RADIO ALTMETER-2
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 401-404, 412, 414			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
B	5	B10-78	VHF NAV-2
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 412, 414, 415, 418, 863, 864, 866, 877			
C	6	B10-74	ADF-2
WJE 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 415, 418, 863, 864, 866 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	5	B10-30	ADF-2
E	6	B10-366	AUTO THROTTLE -2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	12	B10-354	AUTOPILOT-2
WJE 415, 418, 863, 864, 866, 877			
G	3	B10-28	GLIDESLOPE -2
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
G	7	B10-24	VHF NAV-2
G	13	B10-346	YAW DAMPER-2

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

C. The following ground mode criteria must be met before performing the Options/Check Register Word Test.

(1) Throttles full aft.

(2) Radio Altitude scale on CAPT's and F/O's PFD.

(3) Aircraft weight on wheels.

(4) Nose gear Oleo switch in ground mode.

(5) Make sure that these circuit breakers are closed:

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875-879			
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, R AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
L	30	B1-24	RIGHT GROUND CONTROL RELAY
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875-879			
L	33	B1-24	RIGHT GROUND CONTROL RELAY

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(6) Ground proximity computer installed.

D. Options/Check Register Words Test (Preliminary)

NOTE: During following tests, observe only the symbology depicted in the figures as called for. Disregard any other symbology that may appear on the PFD or ND.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Table 203 Register Words Test (Preliminary)

Step	Operation	Desired Result
(1)	Set up Flight Management System (FMS) Multipurpose Control Display Unit (MCDU).	FMS MCDU set up and operational.
(2)	For location of EFIS select key, FWD (forward) space key, BACK space key and VERIFY key on MCDU, (Figure 205, Display A).	
(3)	Press TEST PANEL key (line select key 6L) on Capt's MCDU. Verify Menu page changes to Test panel page (Figure 205, Display B).	TEST page displayed.
(4)	Verify EFIS 1 on Capt's MCDU is displayed (Figure 205, Display B).	EFIS 1 displayed.
(5)	SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND. (Figure 205, Display C).	Maintenance Menu displayed on PFD and ND.

WJE 401-404, 412, 414, 875-879

Table 204 Register Words Test (Preliminary)

Step	Operation	Desired Result
(1)	Set up Status Test Panel (STP).	STP set up and operational.
(2)	On STP, check location of STP POWER button, SELECT button, BACKSPACE button, FORWARDSPACE button and VERIFY button (Figure 206, Display A.)	
(3)	Press STP POWER button.	STP POWER on.
(4)	Place EFIS/DFGS switch in EFIS position.	Switch in EFIS position.
(5)	Verify the 1 on STP SELECT button is illuminated. If 1 is not illuminated, press SELECT button.	STP SELECT button 1 is illuminated.
(6)	SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND (Figure 206, Display B.).	Maintenance Menu displayed on Capt's PFD and ND.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

E. Options/Check Register Words Test--Programming Symbol Generator 1

WJE 401-404, 412, 414, 875-879

Table 205 Programming SG 1

Step	Operation	Desired Result
(1)	Press FORWARDSPACE button on STP until arrow is pointing to selection OPTIONS/CONFIG (Figure 207, Display A.)	Arrow pointing to OPTIONS/CONFIG.

WJE 401-404, 412, 414, 875-879 (Continued)

Table 205 Programming SG 1 (Continued)

Step	Operation	Desired Result
(2)	Press VERIFY button on STP and verify on PFD and ND and aircraft configuration placard have identical OPTION/ CHECK REGISTER WORDS Figure 207, Display B.)	OPTION/CHECK REGISTER WORDS on PFD, ND and aircraft configuration placard are identical.
NOTE: OPTIONS/CHECK REGISTER WORDS: Shown on following figures are examples only. Check aircraft configuration placard for actual words.		
(3)	Verify on PFD and ND that arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.	Arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.
(4)	Press VERIFY button on STP, each press of button will roll digit one time. Continue to press VERIFY button until digit on PFD and ND matches same digit on aircraft placard Ref. Figure 209, Display A.)	PFD and ND digits match placard.
(5)	When digit is correct, press FORWARD SPACE button on STP to move to next digit on right (Figure 209, Display B.)	Arrow moves to next digit on right.
(6)	Repeat steps (4) and (5) until options/register and check register words on PFD and ND are same as aircraft placard.	Options/check register words same as aircraft placard.
(7)	When right most digit of check register word is complete, press FORWARD SPACE button on STP. Display will return to main menu (Figure 211).	Main menu display.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Table 206 Programming SG 1

Step	Operation	Desired Result
(1)	Press FWD space key on MCDU until the arrow is pointing to the selection OPTIONS/CONFIG (Figure 208, Display A) .	Arrow pointing to OPTIONS/CONFIG.
(2)	Press VERIFY key on MCDU and verfiy that aircraft configuration placard and OPTIONS/CONFIG REGISTER WORDS are identical (Figure 205, Display B) .	OPTION/CHECK REGISTER WORDS and placard are identical.
NOTE: Aircraft options register words and aircraft configuration check register words shown in following figures are examples only, see aircraft configuration placard for actual words.		
(3)	Verify on PFD and ND that arrow is pointing to the left most digit of aircraft OPTIONS REGISTER WORD (Figure 210, Display A) .	Arrow under left most digit of WORD 0.
(4)	Press VERIFY key on the MCDU. Each press of VERIFY key will roll the digit one time. Continue to press VERIFY key until digit on PFD and ND matches same digit on aircraft placard (Figure 210, Display B).	PFD and ND digits match aircraft placard.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872 (Continued)

Table 206 Programming SG 1 (Continued)

Step	Operation	Desired Result
(5)	When the digit is correct, press FWD space key on MCDU to move to next digit on the right (Figure 210, Display C) .	Arrow moves to next digit on the right.
(6)	Repeat steps (4) and (5) until OPTIONS REGISTER and CHECK REGISTER WORDS on PFD and ND are same as the placard.	OPTIONS/CHECK REGISTER WORDS same as placard.
(7)	When the right most digit of CHECK/REGISTER WORD is complete, press FWD space key on MCDU. Display will return to the main menu. (Figure 211).	Main MENU display

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

F. Options/Check Register Words Test--Programming Symbol Generator 2

WJE 401-404, 412, 414, 875-879

Table 207 Programming SG 2

Step	Operation	Desired Result
(1)	Place EFIS Mode Select panel switch to BOTH ON 2. Capt's PFD and ND should display EFI 2.	EFI 2 displayed.
(2)	Press CMPVLD button on STP so 2 is illuminated on CMPVLD button.	CMPVLD button 2 illuminated.
(3)	Repeat following steps for programming SG 2, substituting 2 for 1:	Results same as programming symbol generator 1 test.
	Table 205	

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Table 208 Programming SG 2

Step	Operation	Desired Result
(1)	Use First Officer's MCDU for programming symbol generator 2.	
(2)	Repeat the following steps for programming symbol generator 2 substituting F/O (symbol generator 2) for Captain (symbol generator 1) in the test procedures.	Results same as programming symbol generator 1.
	Table 203	
	Table 206	

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

CAUTION: RADIO RACK COOLING FANS MUST BE OPERATING DURING ANY EFIS TEST OPERATIONS.

G. Verification of Programming Options (Preliminary)

NOTE: The following tests verify the options were programmed into the system correctly and options will be displayed. The tests also verify correct operation of the symbol generators and display units.

WJE 401-404, 412, 414, 875-879

Table 209

Step	Operation	Desired Result
(1)	Place EFIS switch in NORM position.	Switch in NORM position.
(2)	Make certain STP power is off.	STP power off.
(3)	Verify Capt's ND and PFD displays are normal.	ND and PFD displays normal.
(4)	Verify on Capt's ND words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.		
(5)	Set up TIC-30 A or B generator.	TIC 30 generator set up.
(6)	Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 MHz).	VHF NAV receivers tuned to ILS frequency.
(7)	Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSP MODE select switch in ROSE position.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Table 210

Step	Operation	Desired Result
(1)	Press MENU key on Capt's and F/O's MCDU.	MCDU's display MENU page.
(2)	Verify Capt's and F/O's ND and PFD displays are normal.	ND and PFD displays normal.
(3)	Verify on Capt's and F/O's ND the words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.		
(4)	Set up the TIC-30 generator	TIC 30 generator set up.
(5)	Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 Mhz).	VHF NAV receivers tuned to ILS frequency.
(6)	Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSPs MODE select switch in ROSE position.

WJE 875-879

H. Verification of Programming Options (Uncrossed Navigation and G/S Side Selection Options)

WJE 875-879 (Continued)

Table 211

Step	Operation	Desired Result
(1)	Press and hold G/S switch on TIC-30 generator.	
(2)	Open VHF NAV-2 circuit breaker.	Circuit breaker open.
(3)	Verify that G/S FAIL appears on right side of F/O's PFD and ND screens.	G/S FAIL displayed on F/O's PFD and ND screens.
(4)	Verify symbology on F/O's PFD and ND per Figure 212. Disregard any other symbology displayed.	PFD and ND displays per Figure 212.
(5)	Close VHF NAV-2 circuit breaker and verify G/S FAIL display disappears.	G/S FAIL display disappears.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872

I. Verification of Programming Options (Crossed Navigation and G/S Side Selection Options)

Table 212

Step	Operation	Desired Results
(1)	Press and hold G/S switch on the TIC-30 generator.	
(2)	Open G/S-2 circuit breaker.	Circuit breaker open.
(3)	Verify that G/S FAIL appears on Capt's PFD right side and F/O's ND right screens.	G/S FAIL displayed on F/O's PFD and ND screens.
(4)	Verify symbology on Capt's and F/O's PFD and ND per Figure 213. Disregard any other symbology displayed.	PFD and ND displays per Figure 213.
(5)	Close G/S-2 circuit breaker and verify G/S FAIL message disappears.	G/S FAIL message disappears.

WJE 412, 414

Table 213

Step	Operation	Desired Result
(1)	Press and hold G/S switch on TIC-30 generator.	
(5)	Close VHF G/S circuit breaker and verify G/S FAIL display disappears.	G/S FAIL display disappears.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

J. Verification of Programming Options -- Split Cue Flight Director Display and Rising Runway Option

Table 214

Step	Operation	Desired Results
(1)	Verify symbology on Capt's and F/O's PFD is split cue display (Figure 214, Display A).	Split cue display on Capt's and F/O's PFD.

Table 214 (Continued)

Step	Operation	Desired Results
(2)	Tune VHF NAV-1 and VHF NAV-2 to an ILS frequency (Example, 108.10 Mhz).	VHF receivers tunes to ILS frequency.
(3)	TIC-30 generator set up.	TIC-30 generator set up.
(4)	Press and hold LOC switch down on TIC-30 generator.	LOC switch in down position.
(5)	Verify rising runway symbology displayed on Capt's and F/O's PFD. Disregard any other symbology displayed (Figure 214, Display B).	

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

K. Verification of Programming Options -- No ILS Beam Deviation Warning

Table 215

Step	Operation	Desired Results
(1)	Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-118, station 110.	
(2)	Tune VHF NAV-1 and VHF NAV-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3)	Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4)	Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5)	Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6)	On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7)	Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8)	Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale, not flashing.	G/S deviation indicator at top of scale on PFD and is not flashing.
(9)	Verify G/S deviation symbology on PFD's is per Figure 215.	Display per Figure 215.
(10)	Release G/S switch on TIC generator.	
(11)	Remove 980N-1 test set.	
(12)	Remove ground jumpers from terminal 52 and terminal 28.	

WJE 401-404, 412, 414

L. Verification of Programming Options -- ILS Beam Deviation Warning

WJE 401-404, 412, 414 (Continued)

Table 216

Step	Operation	Desired Results
(1)	Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-18, station 110.	
(2)	Tune VHF NAV-1 and VHF-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3)	Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4)	Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5)	Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6)	On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7)	Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8)	Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale and flashing.	G/S deviation indicator at top of scale on PFD and is flashing.
NOTE: When -905 symbol generators are installed, the G/S deviation scale will change color from white to amber and the indicator will flash.		
(9)	Verify G/S deviation symbology on PFD's is per Figure 215.	Display per Figure 215.
(10)	Release G/S switch on TIC generator.	
(11)	Remove 980N-1 test set.	
(12)	Remove ground jumpers from terminal 52 and terminal 28.	

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

M. Verification of Programming Options -- Vertical Gyros Option

Verification of Programming Options -- Vertical Gyros Option (Aircraft with Vertical Gyros)

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	05	B10-19	VERTICAL GYRO-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-20	VERTICAL GYRO-2

WJE 415, 418, 863, 864, 866 (Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(2) Verify symbology on Capt's and F/O's PFD are per Figure 216.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

N. Verification of Programming Options -- Long Range Navigation and Track Options

Table 217

Step	Operation	Desired Results
(1)	Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2)	Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3)	Verify MAP symbology on Capt's and F/O's ND is per Figure 217. Disregard all other symbology.	MAP displays per Figure 217.

O. Verification of Programming Options -- ETA and DTW and Track Options

Table 218

Step	Operation	Desired Results
(1)	Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2)	Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3)	Verify MAP symbology on Capt's and F/O's ND is per Figure 218. Disregard all other symbology.	MAP displays per Figure 218.

P. Verification of Programming Options -- DME-1 and DME-2 Option

Table 219

Step	Operation	Desired Result
(1)	Place Capt's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(2)	Place F/O's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(3)	Verify DME symbology is displayed on Capt's and F/O's ND per Figure 219.	DME symbology displayed on NDs.

Q. Verification of Programming Options -- ADF Bearing Option

Table 220

Step	Operation	Desired Result
(1)	Make certain ADF circuit breakers are closed.	ADF circuit breakers closed.

Table 220 (Continued)

Step	Operation	Desired Result
(2)	Tune ADF-1 to local broadcast frequency. Tune ADF-2 to different local broadcast frequency.	ADFs tuned to local broadcast frequency.
(3)	Place Capt's and F/O's MSP mode select switch in ROSE position.	MSPs mode select switch in ROSE position.
(4)	Place Capt's and F/O's MSP center knobs in ADF position.	MSPs center knobs in ADF position.
(5)	Place ADF/ANT switches on ADF-1 and ADF-2 CONTRL PNL's in ADF position.	Switches in ADF position.
(6)	Verify ADF-1 and ADF-2 symbology display on Capt's and F/O's ND (Figure 220).	Symbology per (Figure 220).
(7)	Place knobs in step (4) to OFF.	

R. Mode Select Panel Functional Test -- Rose Mode

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 221

Step	Operation	Desired Result
(1)	Place Capt's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(2)	Place F/O's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(3)	Verify Rose mode symbology is displayed on Capt's and F/O's ND (Figure 221).	Rose mode symbology displayed.

S. Mode Select Panel Functional Test -- ARC MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 222

Step	Operation	Desired Result
(1)	Place Capt's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(2)	Place F/O's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(3)	Verify ARC mode symbology is displayed on Capt's and F/O's ND (Figure 222).	ARC mode symbology displayed.

T. Mode Select Panel Functional Test -- MAP MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 223

Step	Operation	Desired Result
(1)	Place Capt's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(2)	Place F/O's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(3)	Verify MAP mode symbology is displayed on Capt's and F/O's ND (Figure 223).	MAP mode symbology displayed.

U. Mode Select Panel Functional Test -- PLAN MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 224

Step	Operation	Desired Result
(1)	Place Capt's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(2)	Place F/O's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(3)	Verify Plan mode symbology is displayed on Capt's and F/O's ND (Figure 224) .	Plan mode symbology displayed.

V. Mode Select Panel Functional Test -- Range Selector

WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

Table 225

Step	Operation		Desired Result	
(1)	Place Capt's and F/O's MSP mode selector switch in ARC position.			
(2)	Rotate Capt's WX OFF control on Captain's CDP to full clockwise position.		WXR OFF displayed on Capt's ND.	
(3)	Rotate F/O's WX OFF control on F/O's CDP to full clock- wise position.		WXR OFF displayed on F/O's ND.	
(4)	Place RANGE selector on Capt's and F/O's MSP in each range listed following:		Verify range index number in location on NDs as in Figure 225.	
	10	80	5	40
	20	160	10	80
	40	320	20	160
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.				
(5)	Rotate Capt's and F/O's WX OFF control to OFF position.		WXR OFF display on Capt's and F/O's ND blanked out.	

WJE 412, 414

Table 226

Step	Operation		Desired Result
(1)	Place Capt's and F/O's MSP mode selector switch in ARC position.		
(4)	Place RANGE selector on Capt's and F/O's MSP in each range listed following:		Verify range index number in location on NDs as in Figure 225.
	10	80	
	20	160	
	40	320	
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.			
(5)	Rotate Capt's and F/O's WX OFF control to OFF position.		WXR OFF display on Capt's and F/O's ND blanked out.

WJE 401-404, 412, 414, 875-879

W. Declutter Button Functional Test

NOTE: This procedure is for aircraft with Declutter buttons.

Table 227

Step	Operation		Desired Result
(1)	Locate Annunciator/Digital Lights TEST button in lower right corner of Overhead panel.		
(2)	Push TEST button and verify following response on Captain's and F/O's MSPs.		Verify lights illuminate.
(3)	Verify upon release of Annunciator/Digital Lights TEST button that Declutter button:		Verify Declutter buttons go out for 0.5 seconds and come on for 5.0 seconds.
	(a)	Extinguish for approximately 0.5 seconds.	
	(b)	Illuminate for approximately 5.0 seconds.	

X. PFD/ND Manual Brightness Test

Table 228

Step	Operation	Desired Result
(1)	Place Capt's MSP selector switch to ARC position.	MSP switch in ARC position.
(2)	Rotate the Control and Dimming Panel (CDP) PFD knob counterclockwise.	Capt's PFD decreases in brightness.
(3)	Rotate CDP PFD knob clockwise.	Capt's PFD increases in brightness.
(4)	Rotate CDP ND knob counterclockwise.	Capt's ND decreases in brightness.
(5)	Rotate CDP ND knob clockwise.	Capt's ND increases in brightness.
(6)	Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.

WJE 401-404, 412, 414, 875-879 (Continued)

Table 228 (Continued)

Step	Operation	Desired Result
(7)	Repeat steps (2) through (5) substituting F/O's for Capt's.	Results same as steps (2) through (5).

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

Y. MSP Declutter Buttons and Control Dimming Panel (CDP) Test

Table 229

Step	Operation	Desired Result
(1)	Press annunciator/digital lights TEST button located on lower right corner of overhead panel.	Declutter buttons on MSP come on.
(2)	Release the annunciator/digital lights test button.	Declutter buttons on MSP go off for approximately half a second and then come on for approximately five seconds.
(3)	Place Captain's MSP selector switch to ARC position.	MSP switch in ARC position.
(4)	Rotate the CDP PFD knob counterclockwise.	Captain's PFD decreases in brightness.
(5)	Rotate CDP PFD knob clockwise.	Captain's PFD increases in brightness.
(6)	Rotate CDP ND knob counterclockwise.	Captain's ND decreases in brightness.
(7)	Rotate CDP ND knob clockwise.	Captain's ND increases in brightness.
(8)	Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.
(9)	Repeat steps (4) through (7) substituting F/O's for Captain's.	Results same as steps (4) through (7).

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

Z. Captain's and First Officer's Decision Height Test

Table 230

Step	Operation	Desired Result
(1)	Rotate DH knob on Capt's CDP clockwise. Check for display number on Capt's PFD in the top right corner (Figure 226) .	DH number increases.
(2)	Rotate DH knob counterclockwise.	DH number decreases.
NOTE: DH number will blank when DH number is less than 0 (zero) feet.		
(3)	Rotate DH knob on F/O's CDP clockwise. Check for display number on F/O's PFD in the top right corner (Figure 226) .	DH number increases.
(4)	Rotate DH knob counterclockwise.	DH number decreases.

AA. ND and PFD Compact Mode Test

Table 231

Step	Operation	Desired Result
WJE 401-404, 412, 414, 875-879		
(1)	Rotate ND BRT knob on Capt's CDP counterclockwise to the detent position.	ND BRT knob counterclockwise to detent position.
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872		
(1)	Rotate ND BRT knob on Capt's CDP counterclockwise to detent position.	ND BRT knob counterclockwise to detent position.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(2)	Verify compact mode symbology display is on Capt's PFD as shown in Figure 227.	Compact mode display on Capt's PFD per Figure 227.
(3)	Rotate ND BRT knob full clockwise.	Displays return to normal.
(4)	Rotate PFD BRT knob on Capt's CDP counterclockwise to detent position.	PFD BRT knob counterclockwise to detent position.
(5)	Verify compact mode symbology display on Capt's ND as shown in Figure 227.	Compact mode display on Capt's ND per Figure 227.
(6)	Rotate PFD BRT knob full clockwise.	Displays return to normal.
(7)	Repeat steps (1) through (6) substituting F/O's test procedures.	F/O's results same as Capt's desired results.

AB. ND and PFD Auto Brightness Tests

NOTE: The following test verifies that the remote light sensor and (RLS) will provide brightness boost to NDs and PFDs in high intensity light conditions.

Table 232

Step	Operation	Desired Results
WJE 401-404, 412, 414, 875-879		
(1)	Shine flashlight on each photocell area of Capt's and F/O's PFD and ND. (Figure 228) for photocell location on NDs and PFDs.	Note increase in ND's and PFD's brightness.
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872		
(1)	Shine flashlight on each photocell area of Captain's and F/O's PFD and ND. (Figure 228) for photocell location on NDs and PFDs.	Note increase in ND's and PFD's brightness.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(2)	Cover the RLS located on glareshield with your hand for approximately 5 seconds.	
(3)	Remove your hand from RLS and shine flashlight on the RLS.	PFD's and ND's increase in brightness.
(4)	Remove flashlight.	PFD's and ND's brightness returns to previous brightness.

AC. Instrument Comparator Monitoring Test -- Capt's and F/O's FMA Lamp Test and SG Crosstalk Test

NOTE: The following tests verify the FMA lamps come on and symbol generators crosstalk bus is operating correctly.

Table 233

Step	Operation	Desired Result
(1)	Press and release Annunciator/Digital Light Test button.	Verify all FMA lamps come on.
NOTE: Disregard Starbursts on FMAs.		
(2)	Release test button and verify Capt's FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.	FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.
WJE 401-404, 412, 414, 875-879		
(3)	Repeat steps (1) and (2) substituting F/O's for Capt's in test procedures.	Desired results same as Capt's.
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872		
(3)	Repeat steps (1) and (2) substituting F/O's for Captain's in test procedures.	Desired results same as Captain's.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(4)	Open SG-1 Power circuit breaker.	F/O's FMA Monitor lamp comes on.
(5)	Close SG-1 Power circuit breaker.	F/O's FMA Monitor lamp goes off.
(6)	Open SG-2 Power circuit breaker.	Capt's FMA Monitor lamp comes on.
(7)	Close SG-2 Power circuit breaker.	Capt's FMA Monitor lamp goes off.

AD. Symbol Generator Switching Tests

NOTE: The following test verifies that NDs and PFDs can be driven by the off-side symbol generator.

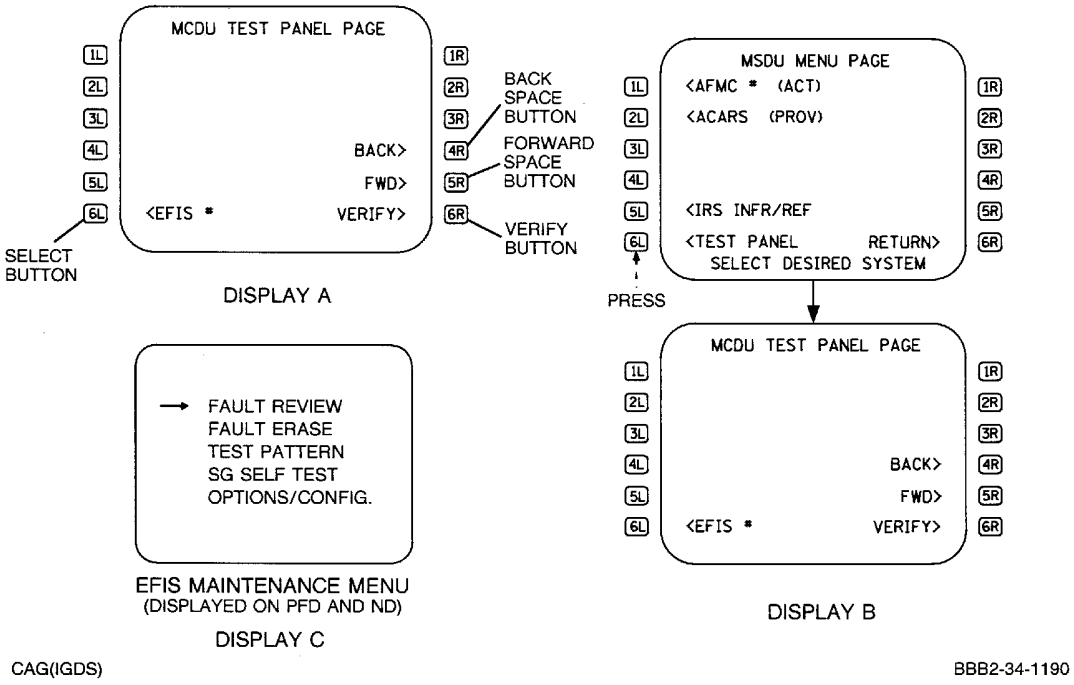
Table 234

Step	Operation	Desired Result
(1)	Place Capt's and F/O's MSP selector switch in ARC position.	MSP switch in ARC mode.
(2)	Place EFIS switch to BOTH ON 1 position.	EFIS switch in BOTH ON 1 position.
(3)	Verify symbology on Capt's and F/O's ND and PF display EFI 1. (Figure 229, Display A).	PFD and ND display EFI 1 symbology per (Figure 229, Display A).
(4)	Place EFIS to BOTH on 2 position.	EFIS switch in BOTH ON 2 position.
(5)	Verify symbology on Capt's and F/O's ND and PFD display EFI 2. (Figure 229, Display B).	PFD and ND display EFI 2 symbology per (Figure 229, Display B).
(6)	Return EFIS switch to NORM position.	EFIS switch in NORM position.

AE. EFIS SELF TEST

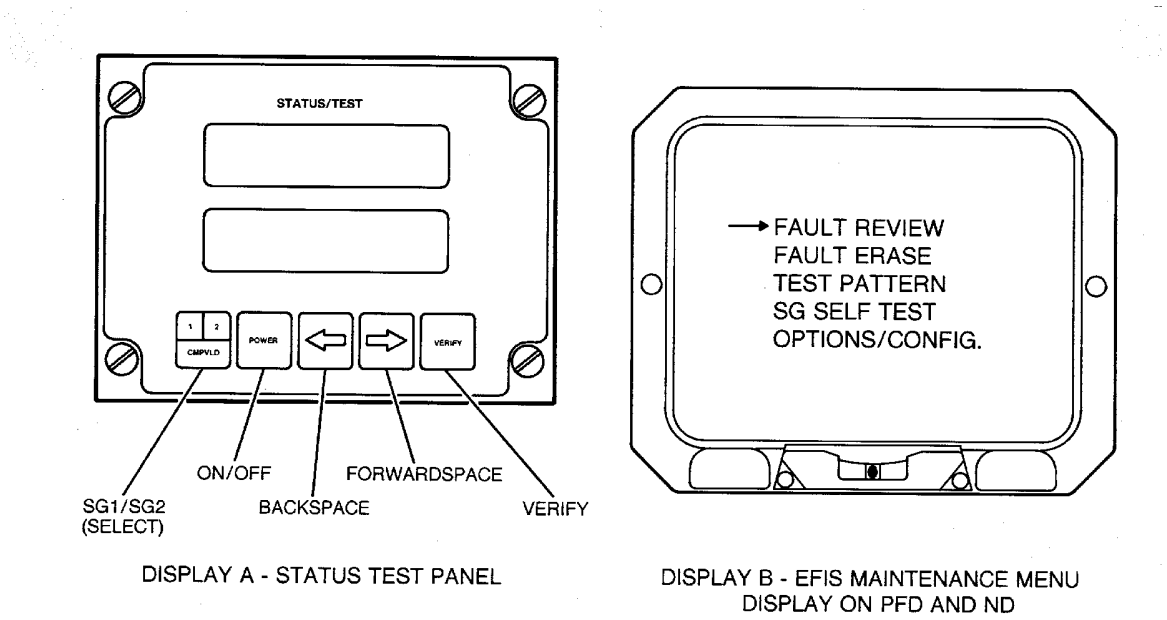
Table 235

Step	Operation	Desired Result
WJE 401-404, 412, 414, 875-879		
(1)	Press FORWARD SPACE key on STP until arrow is pointing to SG SELF TEST on STP.	Verify Capt's PFD and ND display like Figure 230, Display A .
(2)	Press VERIFY key on STP. This initiates self test.	Verify Capt's ND display like Figure 230, Display B.
(3)	Do steps (1) and (2) for F/O PFD with SG switching panel set to BOTH ON 2.	Verify F/O PFD and ND per steps (1) and (2). Should have similar display to Capt's ND display.
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872		
(1)	Press FORWARD SPACE key on MCDU until arrow is pointing to SG SELF TEST on MCDU.	Verify Captain's PFD and ND display like Figure 230, Display A.
(2)	Press VERIFY key on MCDU. This initiates self test.	Verify Captain's ND display like Figure 230, Display B.



Multipurpose Control Display Unit Displays
Figure 205/34-22-00-990-D13

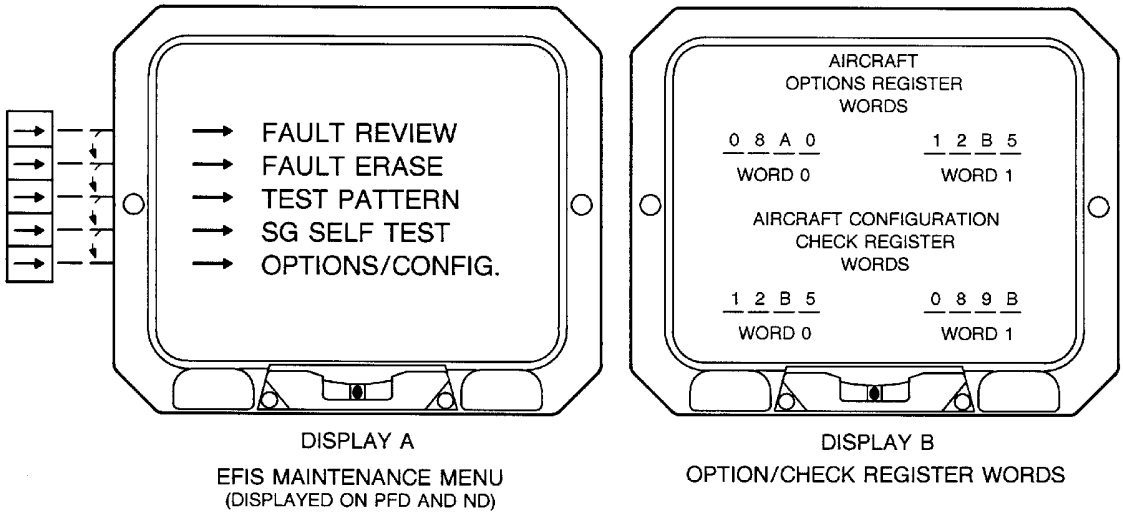
WJE 401-404, 412, 414, 875-879



Status Test Panel and Maintenance Menu Display on PFD and ND
Figure 206/34-22-00-990-E02

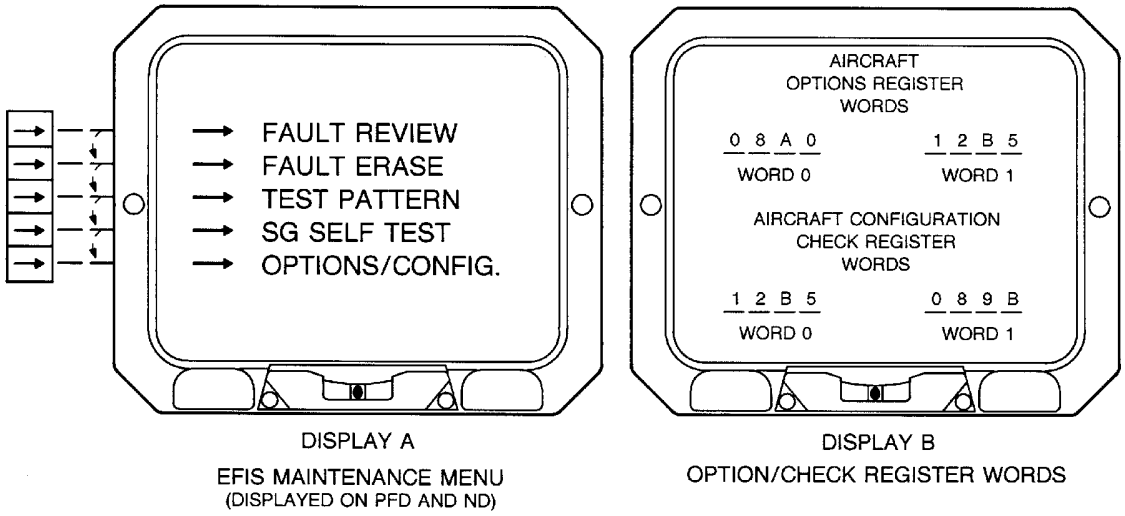
WJE 401-404, 412, 414, 875-879

WJE 401-404, 875-879



Options/Check Register Words Displays
Figure 207/34-22-00-990-D15

WJE 401-404, 875-879



DISPLAY A
EFIS MAINTENANCE MENU
(DISPLAYED ON PFD AND ND)

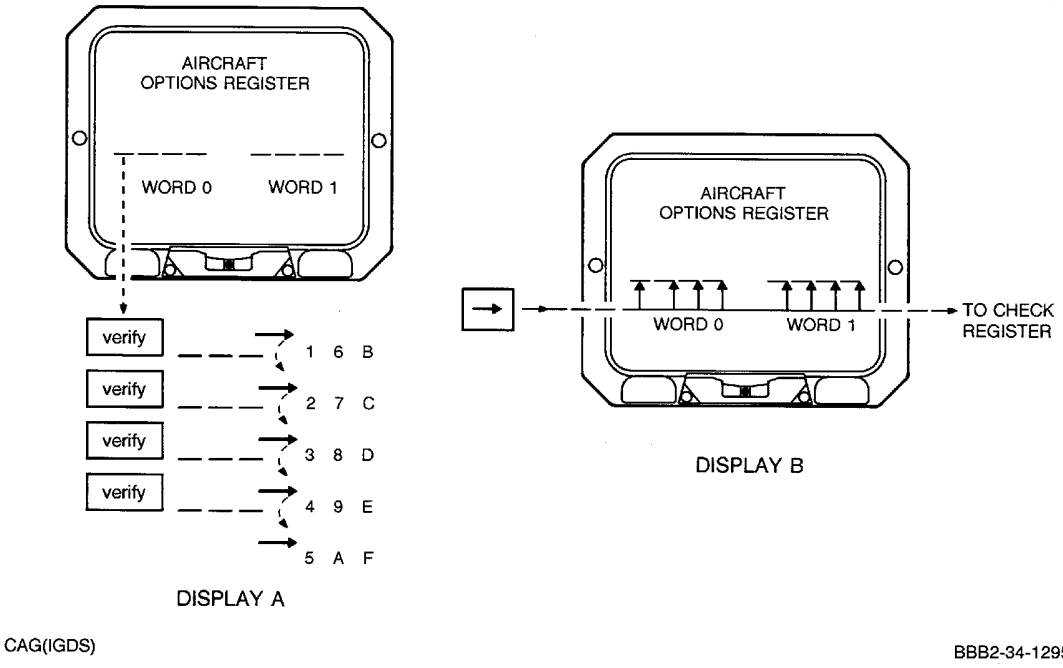
DISPLAY B
OPTION/CHECK REGISTER WORDS

CAG(IGDS)

BBB2-34-1191

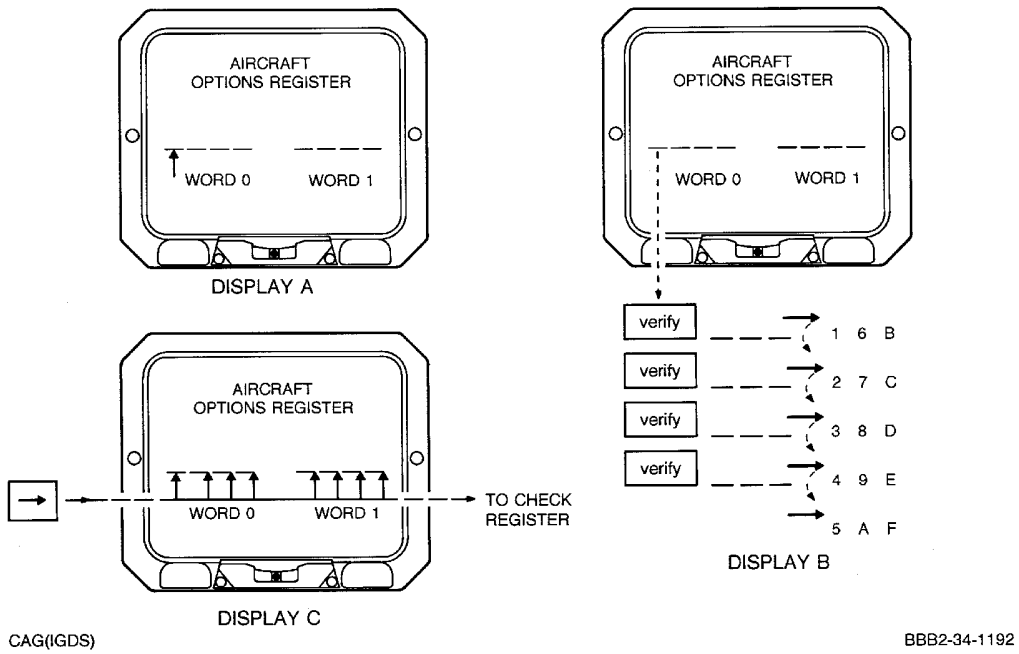
Symbol Generator Programming Displays
Figure 208/34-22-00-990-D16

WJE 401-404, 412, 414, 875-879



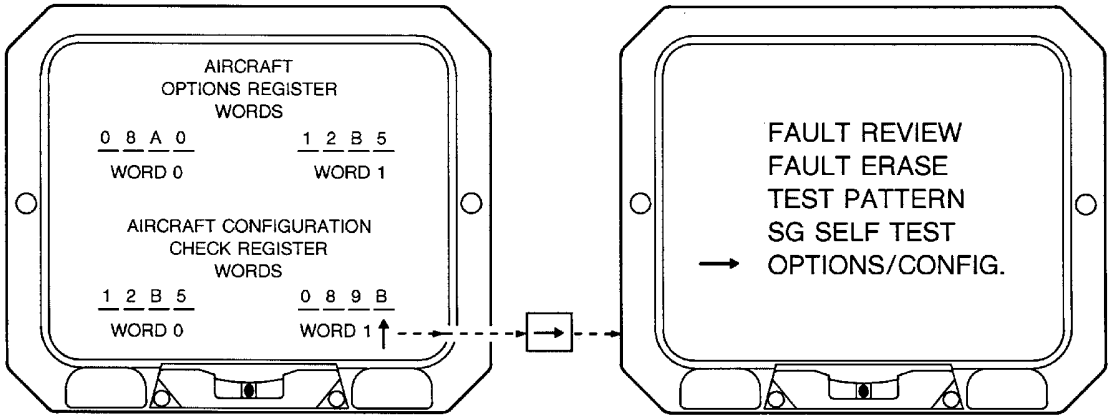
Aircraft Options Register
Figure 209/34-22-00-990-D18

WJE 401-404, 412, 414, 875-879



Aircraft Options Register Words Arrow Displays
Figure 210/34-22-00-990-D19

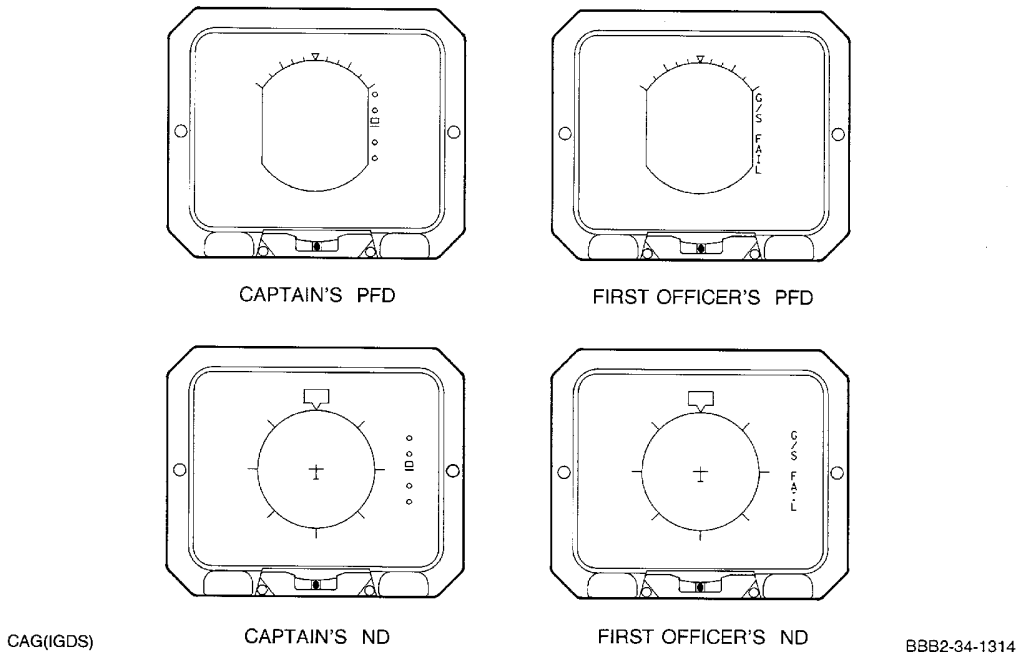
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Options Register and Check Register Words and Main Menu Display Return
Figure 211/34-22-00-990-D20

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

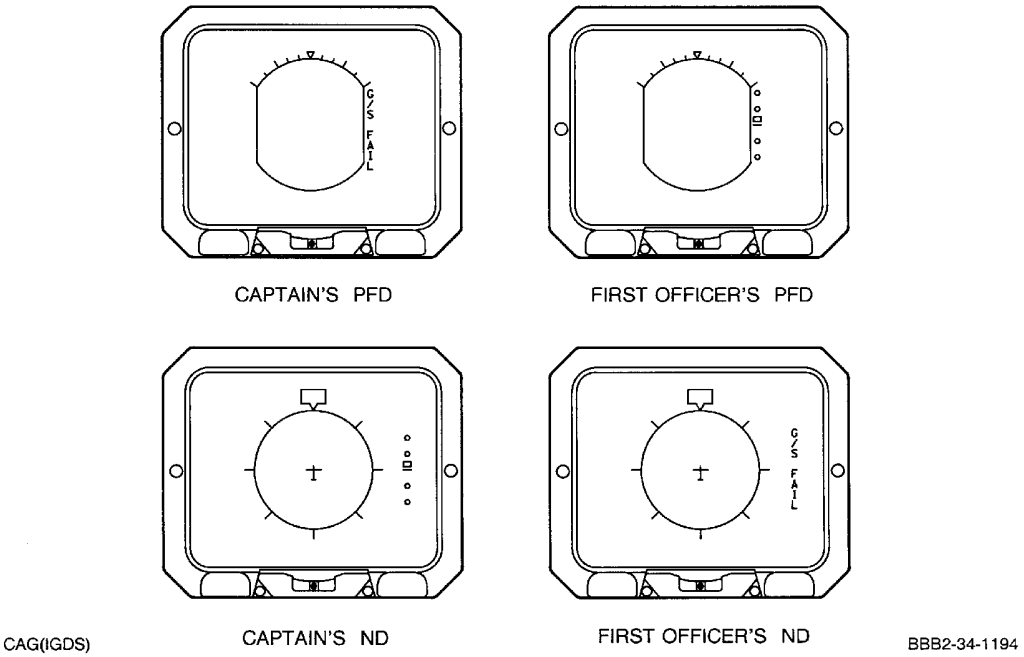
WJE 875-879



Uncrossed Navigation and G/S Side Selection Options
Figure 212/34-22-00-990-D21

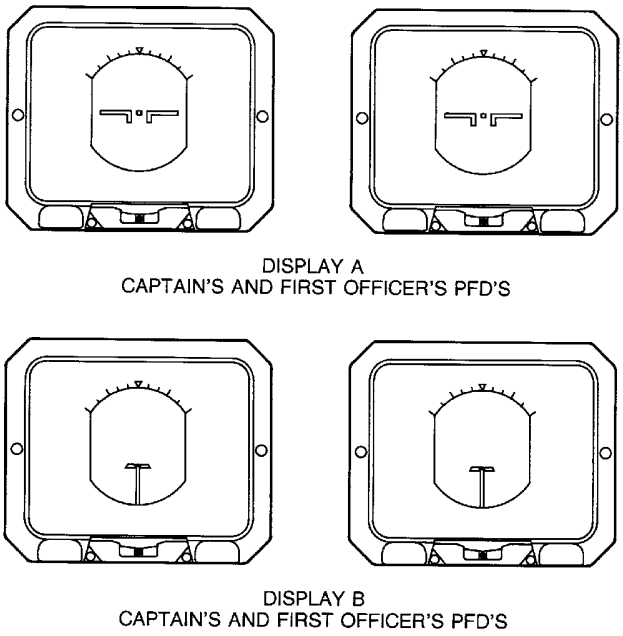
WJE 875-879

EFFECTIVITY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Crossed Navigation and G/S Side Selection Options
Figure 213/34-22-00-990-D22

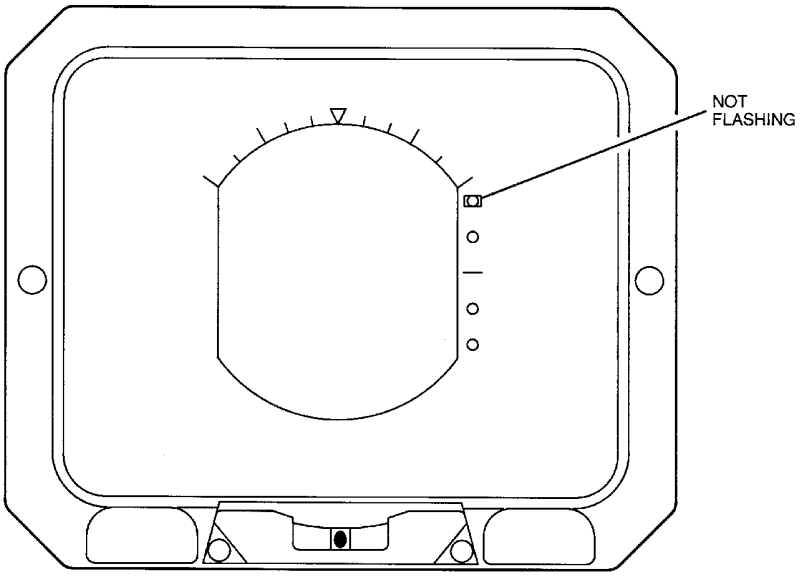
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Split Cue Flight Director Display and Rising Runway Display
Figure 214/34-22-00-990-D23

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

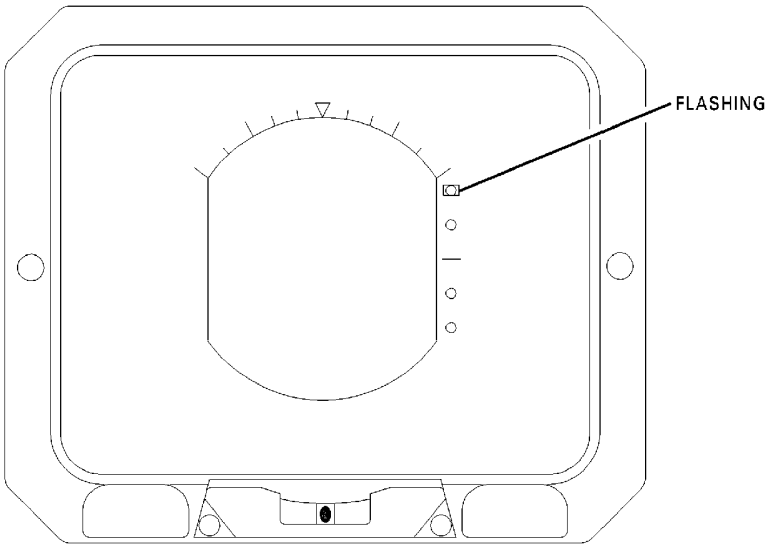
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



ILS Beam Deviation Warning Display
Figure 215/34-22-00-990-D28 (Sheet 1 of 2)

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

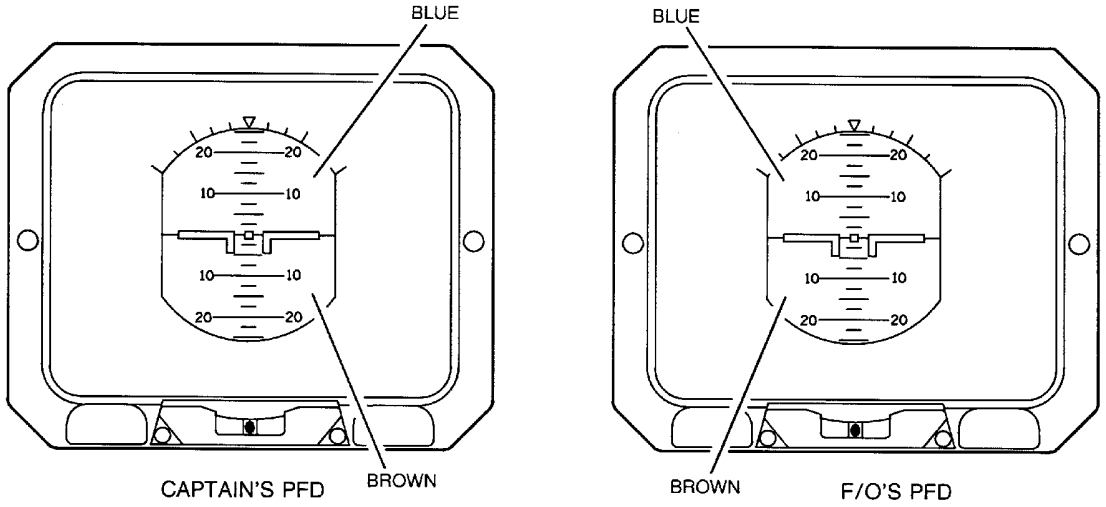
WJE 401-404, 412, 414



ILS Beam Deviation Warning Display
Figure 215/34-22-00-990-D28 (Sheet 2 of 2)

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

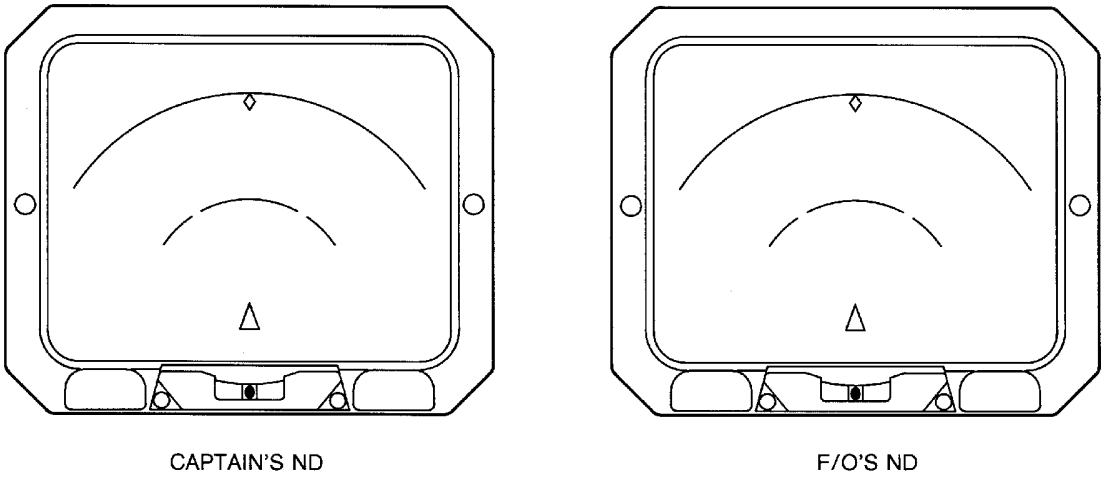
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



Vertical Gyros Option PFD Display
Figure 216/34-22-00-990-D30

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

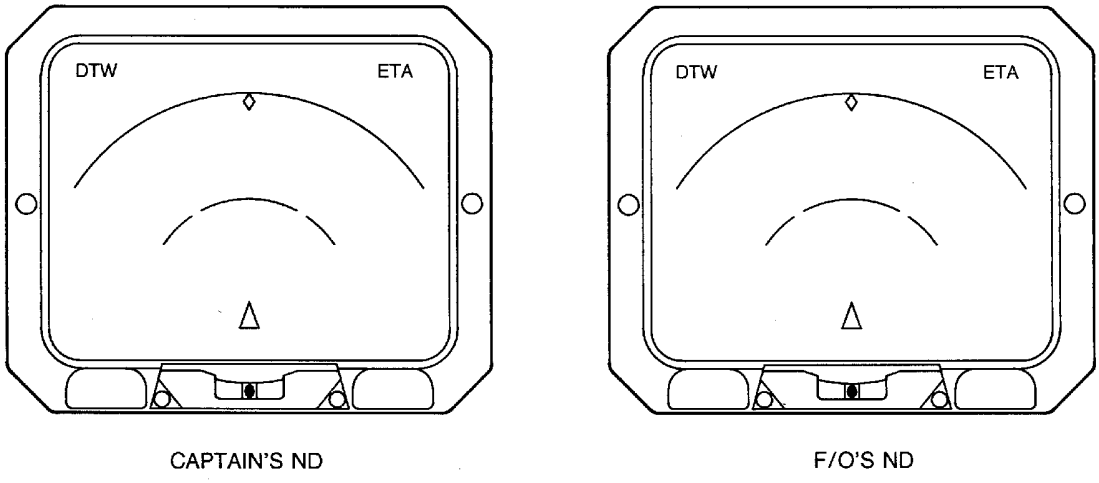
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Navigation Display (ND) MAP Display
Figure 217/34-22-00-990-D31

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

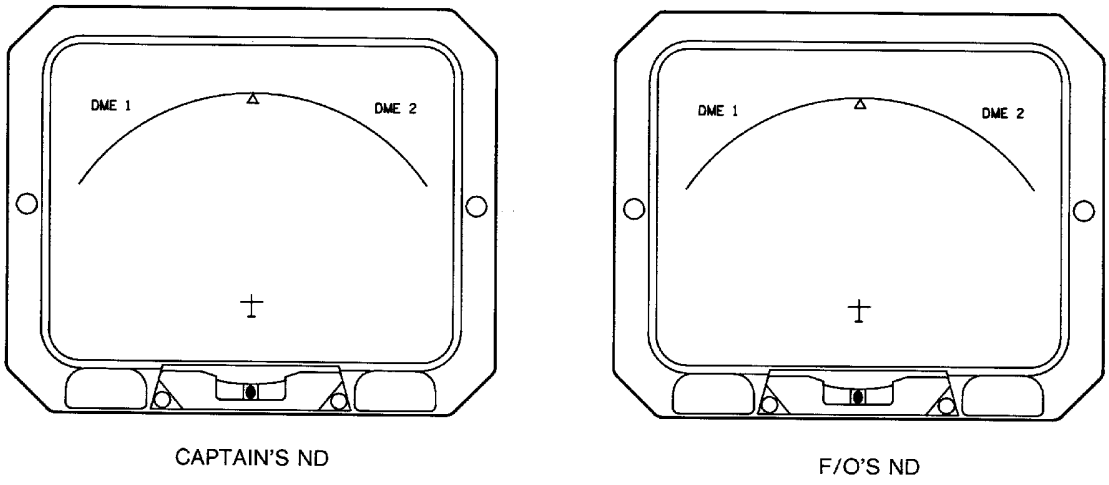
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Navigation Display (ND) ETA and DTW MAP Display
Figure 218/34-22-00-990-D33

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

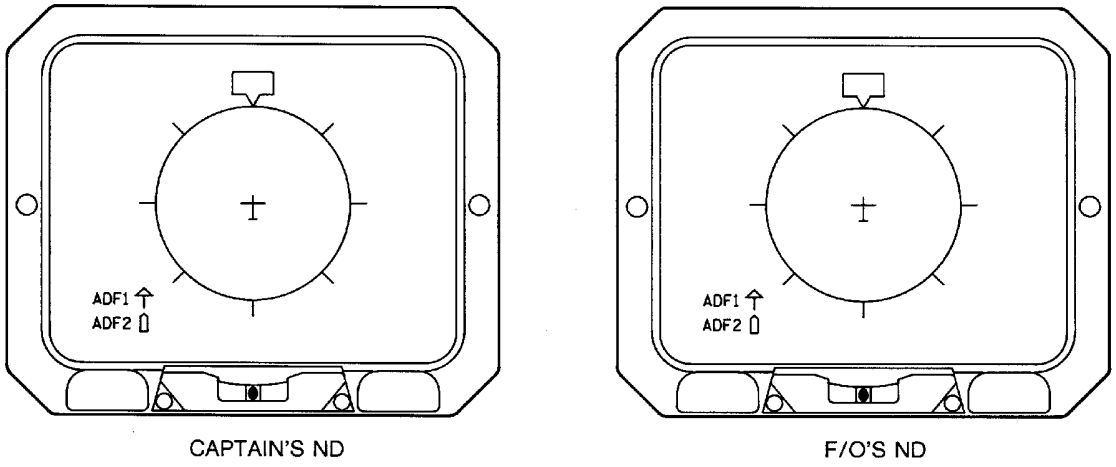
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Navigation Display (ND) DME Displays
Figure 219/34-22-00-990-D34

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

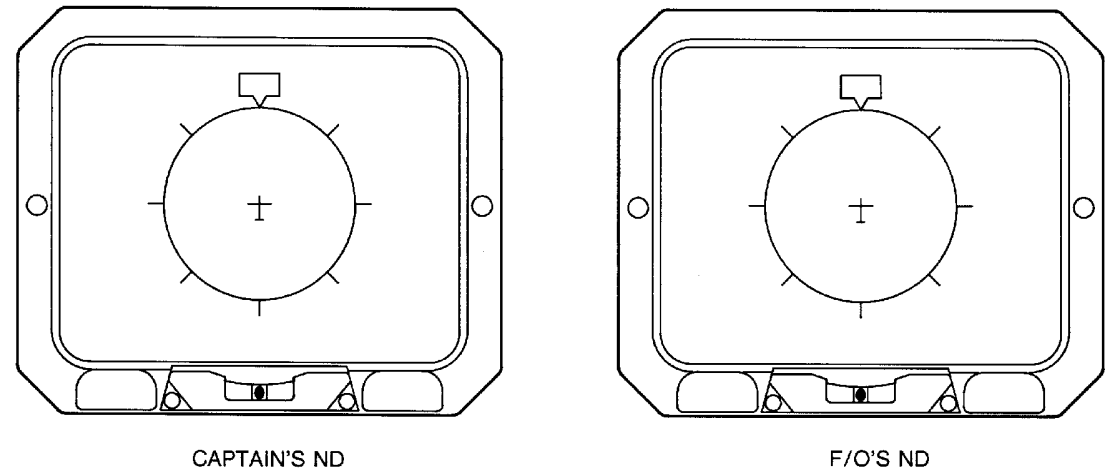
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



ADF Bearing Display
Figure 220/34-22-00-990-D35

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

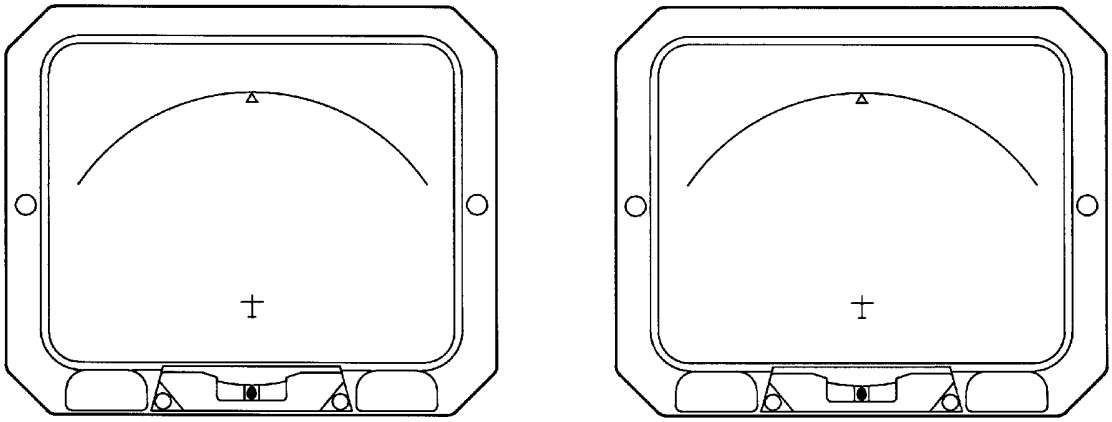
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Rose Mode Display on NDs
Figure 221/34-22-00-990-D36

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

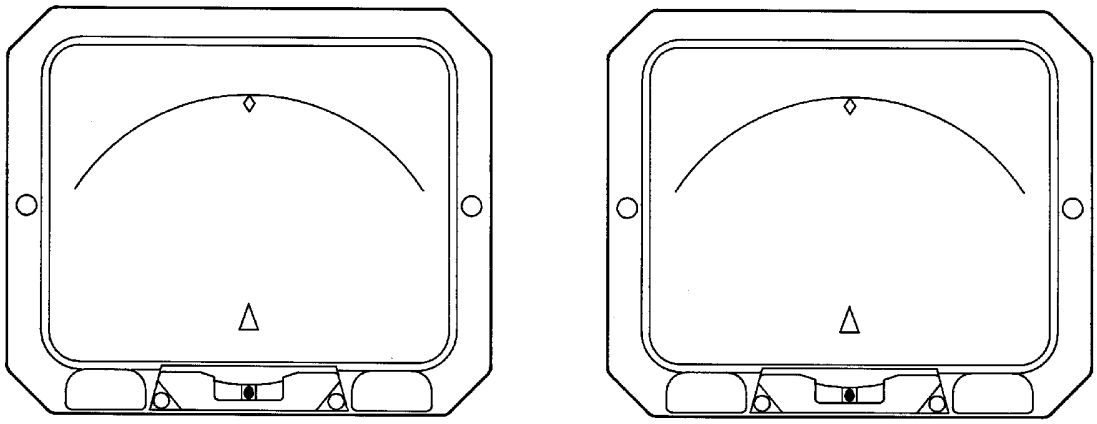
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



ARC Mode Display on NDs
Figure 222/34-22-00-990-D37

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

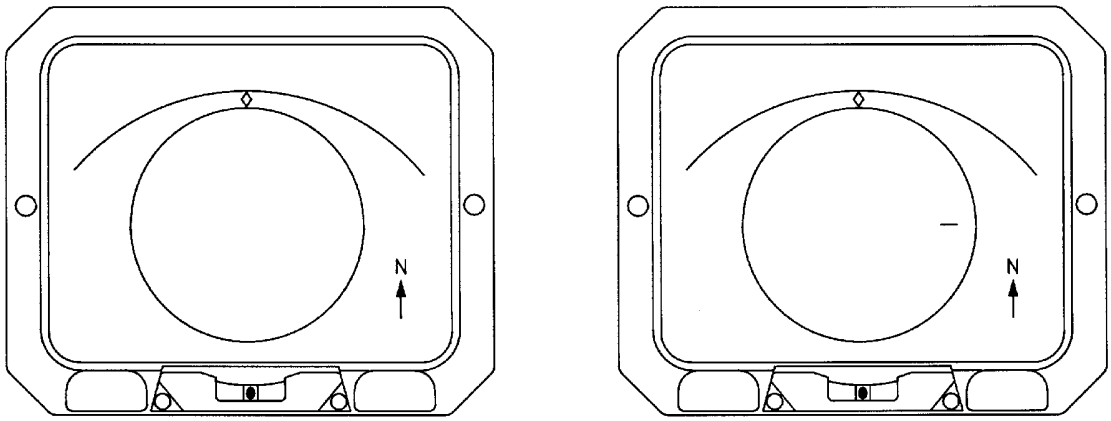
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



MAP Mode Display on NDs
Figure 223/34-22-00-990-D38

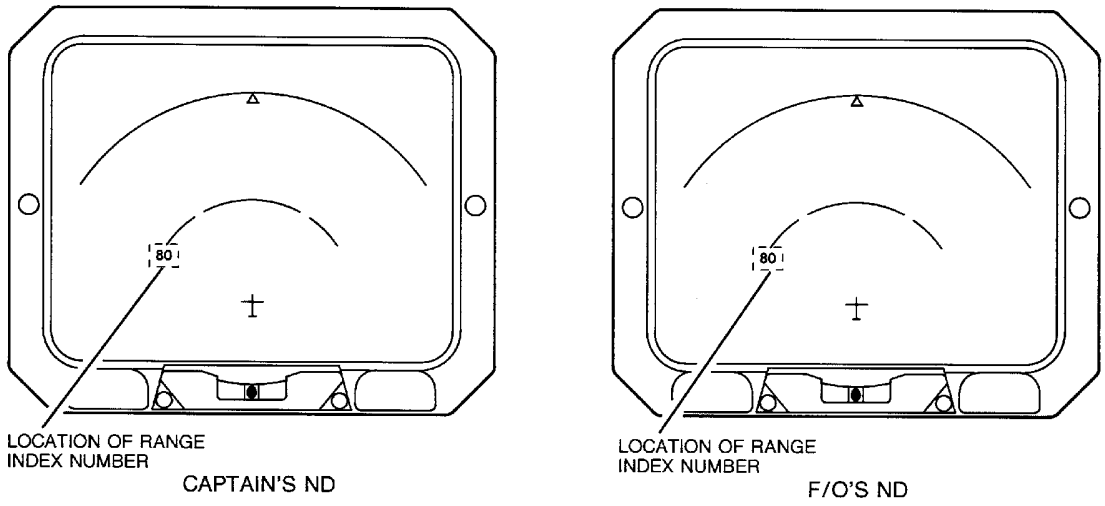
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

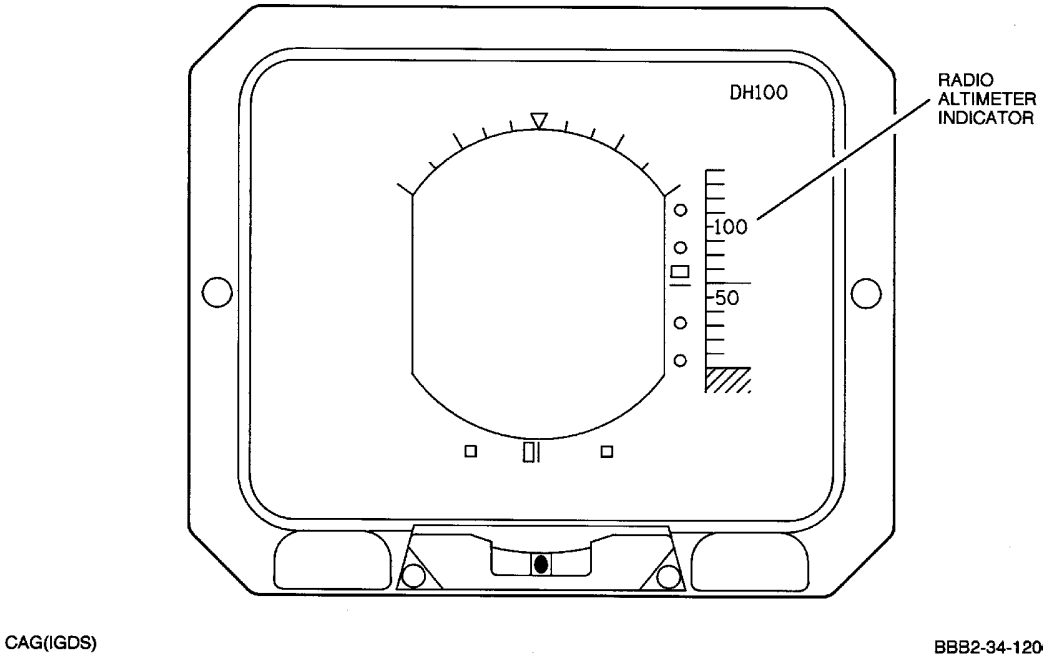


Plan Mode Display on NDs
Figure 224/34-22-00-990-D39

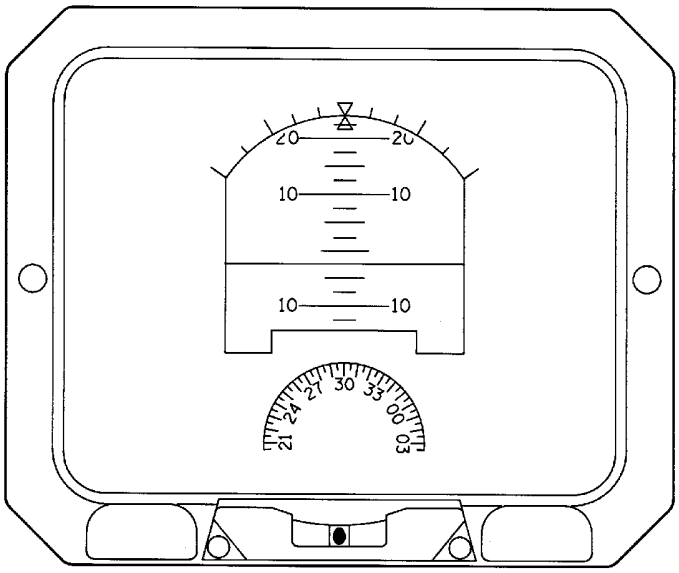
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



Range Selector Displays
Figure 225/34-22-00-990-D40



Decision Height Display On PFD
Figure 226/34-22-00-990-D41

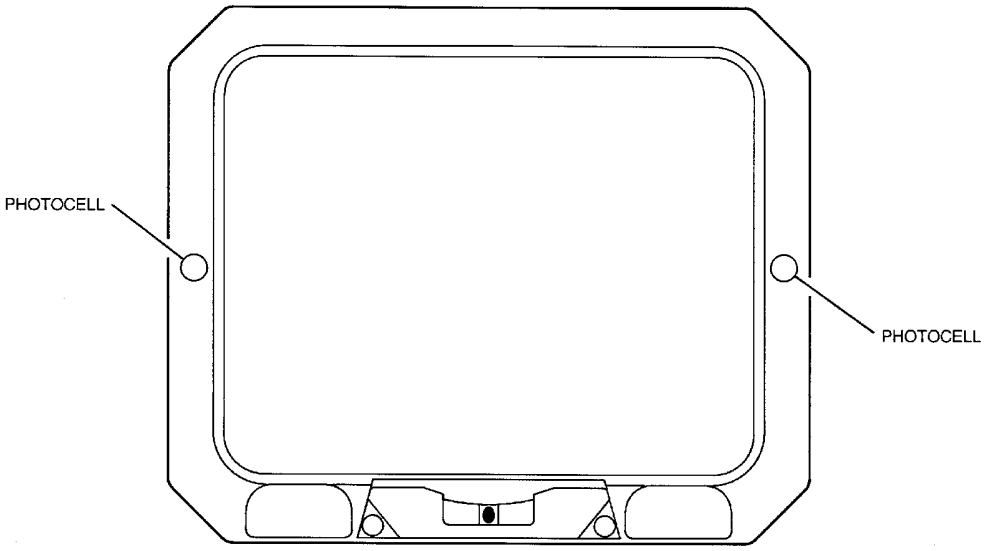


NOTE: DISPLAY WILL BE IDENTICAL FOR CAPTAIN'S AND FIRST OFFICER'S PFD.

CAG(IGDS)

BBB2-34-1207

ND and PFD Compact Mode Displays
Figure 227/34-22-00-990-D42

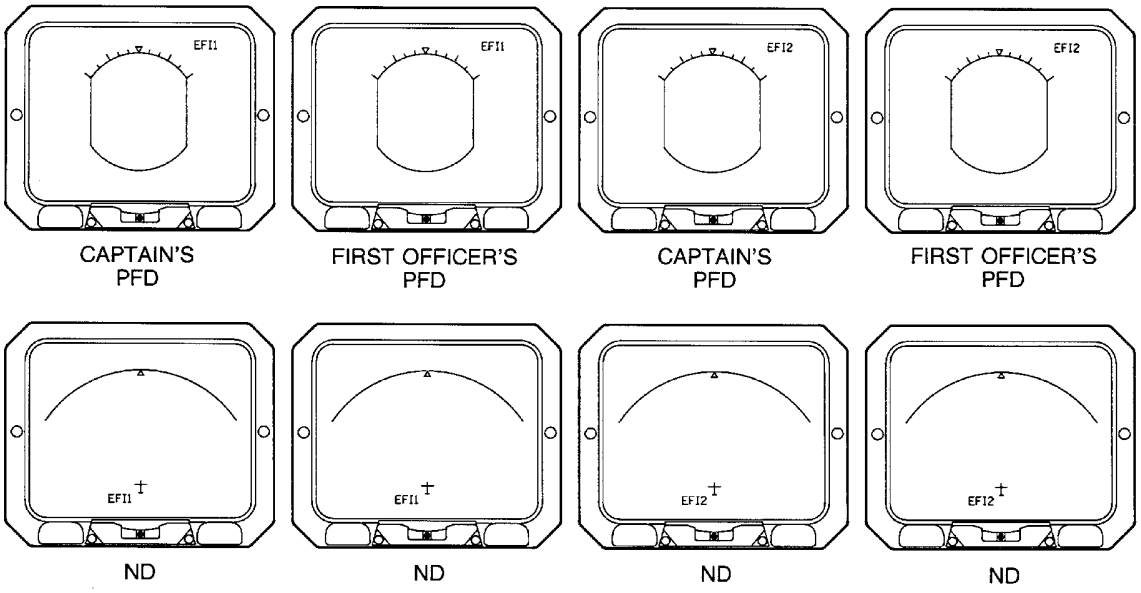


NOTE: PHOTOCELLS LOCATION SAME FOR CAPTAIN'S AND FIRST OFFICER'S PFDS AND NDS.

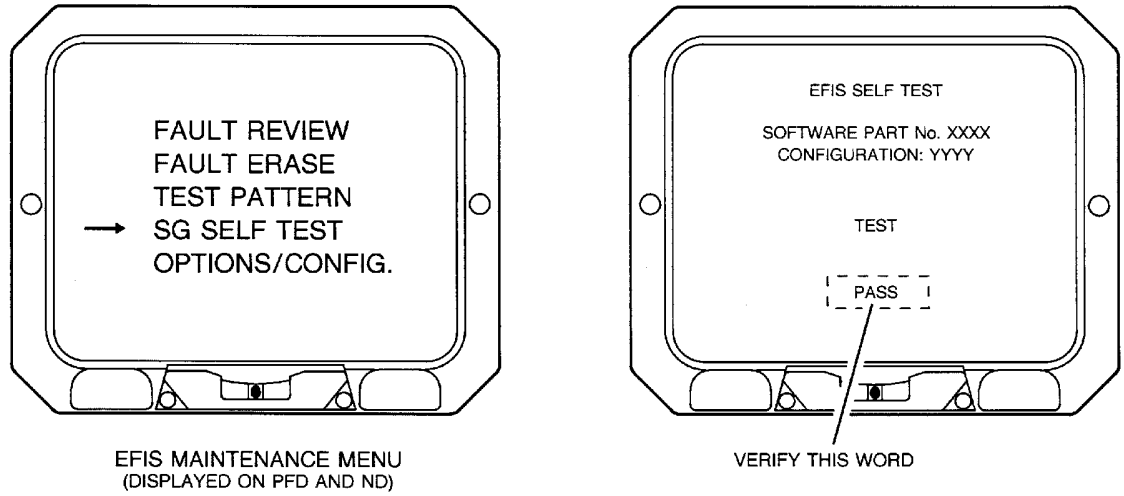
CAG(IGDS)

BBB2-34-1208

PFD's and ND's Photocell Locations
Figure 228/34-22-00-990-D44



PFD and ND EFIS Switching Display
Figure 229/34-22-00-990-D45



EFIS Self Test Display on Captain's ND
Figure 230/34-22-00-990-D46

NAVIGATION DISPLAYS - MAINTENANCE PRACTICES

1. General

A. This section contains an overview of the maintenance practices required for the electronic flight instrument system (EFIS). This is followed by a complete listing of circuit breakers for the EFIS and interfacing systems which must be closed when performing system tests. Ground maintenance consists of the following:

(1) Options/Configuration programming of the symbol generator. This is performed only when a new SG is installed on the aircraft, or when a SG is transferred from another aircraft. Each aircraft has its own "finger print" which must be fed into the SG upon installation. Options/Config. programming matches the SG software to the aircraft wiring.

(2) SG Self Test: Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Multipurpose Control Display Panel (MCDU).

(3) EFIS System Self-Test (BIT) - This 3-second test is initiated from the TEST pushbutton on the control and dimming panel (CDP). Used to test the following systems which provide inputs to the SG: VOR/ILS, radio altimeter, marker beacon. The EFIS system self-test includes a failure flag test.

(4) All input systems tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the test pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions.

(5) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons.

B. To Perform a Complete System Test: The symbol generator is the heart of the EFIS, so thorough testing of the SG ensures proper operation of the system. The maintenance practices for the symbol generator include all of the above-mentioned tests. To perform a thorough system test, perform the symbol generator maintenance practices. Separate LRU functional tests are also provided for the EFIS control and dimming panel (CDP), mode select panel (MSP), display units (PFD/ND), and remote light sensor (RLS). These are to be performed following Removal/Installation of the LRU's.

WJE 406-408, 410, 411 POST MD80-34-285

(EFIS SYMBOL GENERATOR (SG) - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-10/201 Config 1)

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

2. General Maintenance Practices

A. The following instructions contain a detailed explanation of how the Flight Management System (FMS) Multipurpose Control Display Unit (MCDU) is used in conjunction with the EFIS maintenance menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS maintenance menu and TEST pushbutton (BIT) are used in performing a complete system test.

B. MCDU - The MCDU pushbuttons (keys) are used to call up the EFIS maintenance menu display on the PFD/ND. When the aircraft is on the ground and power to the MCDU is on, the maintenance menu appears on both the PFD and ND of the system being tested (Figure 201).

C. The EFIS Maintenance Menu - There are five menu pages which can be selected from the maintenance menu (Figure 201): FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The test pattern is used for bench tests and is not included in the maintenance practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the maintenance menu and pressing the VERIFY pushbutton on the MCDU. The FORWARD and BACKSPACE keys are used to move the cursor vertically on the maintenance menu. The following five selections can be made from the EFIS maintenance menu:

(1) Fault Review - Used in trouble shooting, to read failures logged in the flight log. The fault code consists of two 3-digit numbers. The first digit is the SG (or system) number. The next two digits are fault ID numbers; these are main category fault classifications. The last three digits are the fault code numbers; they are subordinate to the fault ID numbers. The fault ID and fault code are used to provide a complete fault definition. Fault messages appear on the fault review screen next to the 6-digit entries. An "-R" after the message indicates a repeat failure. The fault messages are followed by a time entry, which is the time into the flight leg from takeoff for complete listing of EFIS fault codes. (NAVIGATION DISPLAYS, SUBJECT 34-22-00)

(2) Fault Erase - This mode is used to erase all flight faults from the flight log. The cursor is cycled to the FAULT ERASE selection on the menu, and the VERIFY key is pressed. Pressing the FORWARD SPACE key at this time will cause all flight faults to be erased. Pressing BACKSPACE or VERIFY will abort the erase function. (NAVIGATION DISPLAYS, SUBJECT 34-22-00).

(3) Test Pattern - The test pattern is used in bench testing only. The test pattern is a color display of stroke-drawn lines and raster patches. The lines consists of one line for each stroke color: cyan, yellow, green, red, dim white, white and magenta. The three patches are raster patches, one for each of the raster test colors: blue, green and red.

(4) SG Self-test - This is a comprehensive test for the system SG's and all interfacing systems. This three second test generates two displays: the Interface Status page, containing ID codes, fault codes and fault messages for all currently monitored interface failures, and the self-test failures page, listing diagnostic numbers of all internal SG failures.

(5) Options/Config. - This mode is used by maintenance personnel whenever a new SG is installed. It allows the user to enter or modify the aircraft configuration and options words. These words are located on a placard next to the STP mode select switch (EFIS/DFGS). When -905 symbol generators are installed, MAINT CHECK will appear on both displays if the options words of SG1 do not match the option words of SG2. If an incompatibility exists between the check register, the options register, and the configuration identification, MAINT CHECK will appear on both displays. This would normally occur if one SG is replaced but has not had the check register and options registers modified to reflect the current aircraft configuration. When -905 symbol generators are installed, MAINT CHECK will appear on the display of the failed SG only.

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

D. TEST Pushbutton - Control and Dimming Panel (CDP): The TEST pushbutton is used during the SG maintenance practices to self-test interfacing systems and display unit failure flags. There are separate TEST pushbuttons for system-1 and system-2, on the Capt's and F.O.'s CDP's. Pressing the TEST pushbutton, VOR/ILS, radio altimeter, and marker beacon self-tests. The appropriate test responses are under the control of the respective receiver units. When testing a single parameter (i.e., radio altimeter), all other symbology appearing on the display screens should be ignored. The test is successful if the appropriate failure/flag/warning replaces the parameter on the display screen (i.e., an R/A FAIL flag will replace the radio altimeter tape on the PFD).

(1) The TEST pushbutton also initiates a failure flag test, and DH aural warning test (if installed). The DH aural warning test consists of a one-second tone slewing from 400 to 800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. (Figure 203)

E. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons are also tested.

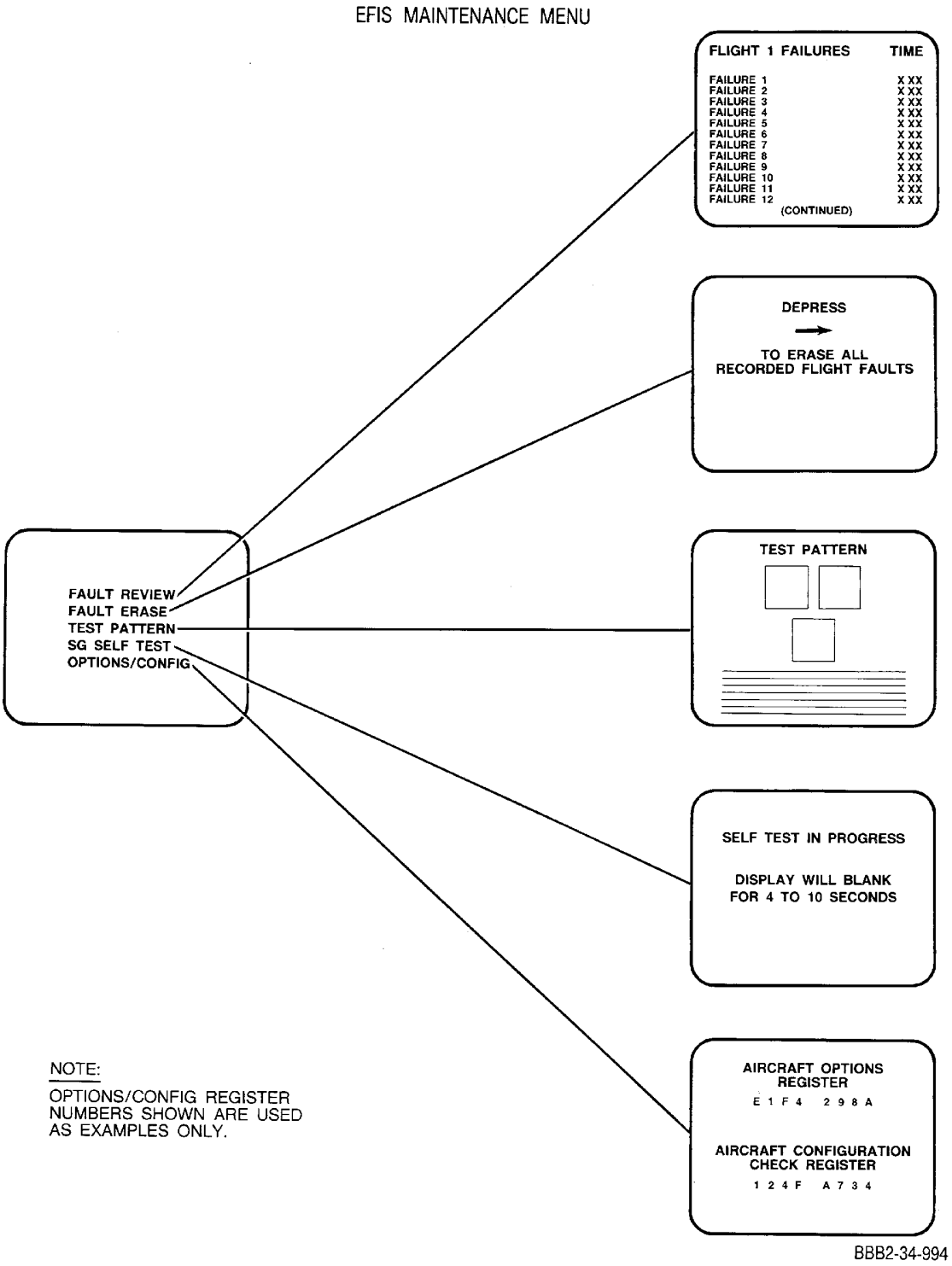
F. Circuit Breakers for EFIS and Interfacing Systems

Table 201

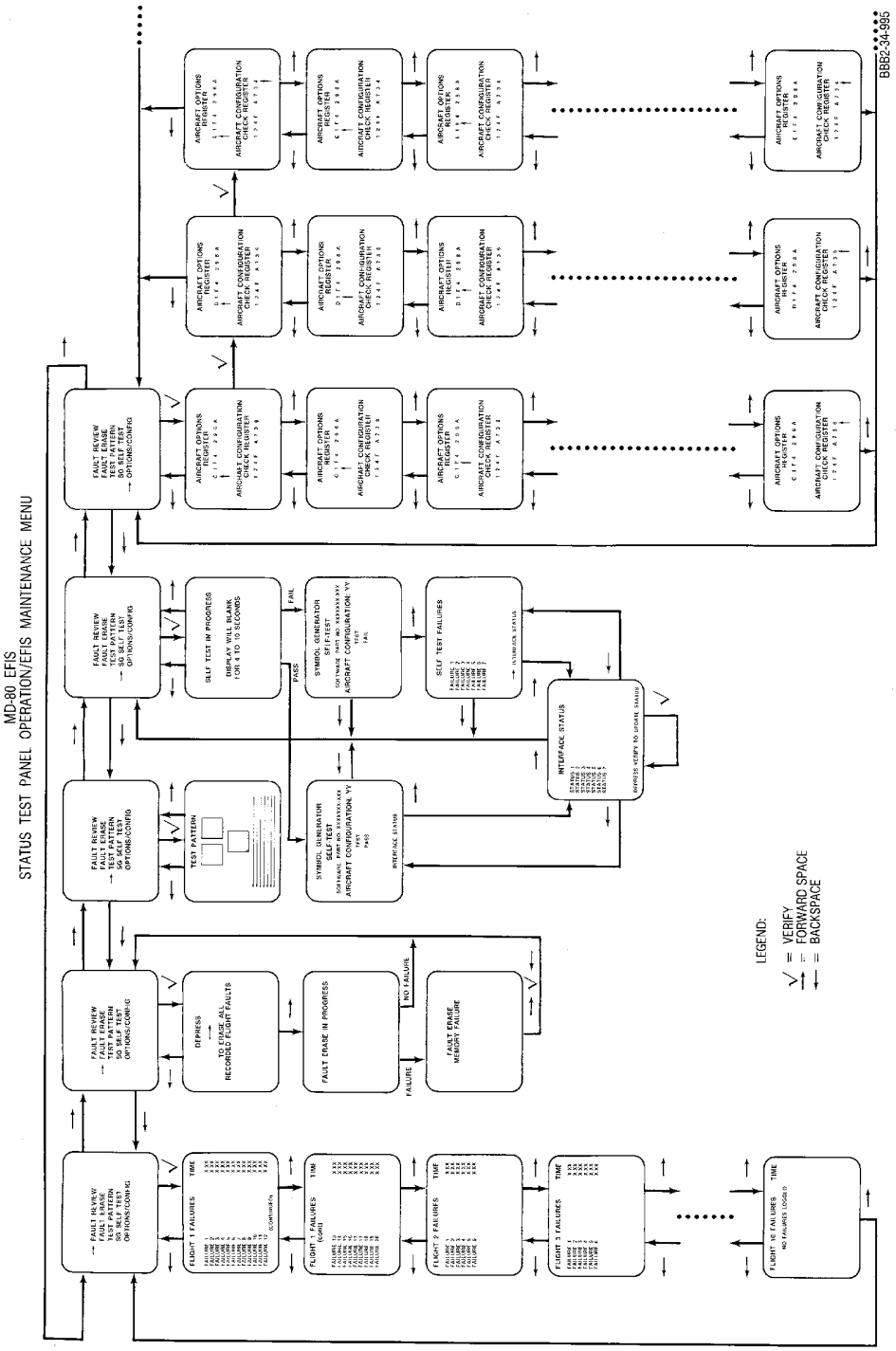
Circuit Breaker	Panel Location	Panel Area
CAPTAINS PFD	Overhead	EMER AC BUS
F.O.'S PFD	Upper EPC	RIGHT RADIO AC BUS
CAPTAINS ND	Overhead	EMER AC BUS
FIRST OFFICER'S ND	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1	Overhead	EMER AC BUS
SYMBOL GEN -2	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1 DEMOD (Aircraft with VG/DG)	Overhead	EMER AC BUS
SYMBOL GEN -2 DEMOD (Aircraft with VG/DG)	Upper EPC	RIGHT RADIO BUS
CAPTS/FMA/MSP	Upper EPC	LEFT RADIO DC BUS
F/OS FMA/MSP	Upper EPC	RIGHT RADIO DC BUS
CAPTAIN'S HSI & HEADING	Overhead	EMER AC BUS
FIRST OFFICER'S COURSE & HEADING	Upper EPC	RIGHT RADIO AC BUS
VHF-NAV-1	Overhead	EMER AC and DC BUSES
VHF-NAV-2	Upper EPC	RIGHT RADIO AC and DC BUSES
RADIO ALTIMETER-1	Upper EPC	LEFT RADIO AC BUS
RADIO ALTIMETER-2	Upper EPC	RIGHT RADIO AC BUS
MCDU - 1	Upper EPC	
MCDU - 2	Upper EPC	
AFMC - 1	Upper EPC	
AFMC - 2	Upper EPC	
FMS DATA LOADER	Upper EPC	
LEFT PROXIMITY SWITCH CONTROL	Lower EPC	LEFT RADIO DC BUS
RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	RIGHT RADIO DC BUS
ADF-1	Upper EPC	LEFT RADIO AC and DC BUS
ADF-2	Upper EPC	RIGHT RADIO AC and DC BUS

Table 201 (Continued)

Circuit Breaker	Panel Location	Panel Area
DIGITAL FLIGHT GUIDANCE COMPUTER CIRCUIT BREAKERS	Upper EPC	RIGHT RADIO 28 VAC BUS LEFT RADIO 28 VAC BUS RIGHT RADIO AC BUS LEFT RADIO AC BUS RIGHT RADIO DC BUS LEFT RADIO DC BUS
GND PROXIMITY WARN COMPUTER	Upper EPC	LEFT RADIO AC BUS
GPW LIGHTS	Upper EPC	
AUTO THROTTLE -1	Upper EPC	LEFT RADIO AC and DC BUSES
AUTO THROTTLE -2	Upper EPC	
AUTOPILOT -1	Upper EPC	LEFT RADIO DC BUS
AUTOPILOT -2	Upper EPC	RIGHT RADIO DC BUS
MACH TRIM -1	Upper EPC	LEFT RADIO DC BUS
MACH TRIM -2	Upper EPC	RIGHT RADIO DC BUS
YAW DAMPER -1	Upper EPC	LEFT RADIO DC BUS
YAW DAMPER -2	Upper EPC	RIGHT RADIO DC BUS
G/S -2	Upper EPC	RIGHT RADIO DC BUS
G/S -1	Overhead	EMER DC BUS
LDG GEAR WARN	Lower EPC	MISC LEFT DC BUS
ANNUN/DGTL LTS	Lower EPC	LIGHTS -R DC BUS.
NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.		



EFIS Maintenance Menu
Figure 201/34-22-00-990-D47



EFIS Maintenance Menu -- MCDU Operation
Figure 202/34-22-00-990-D48

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 203/34-22-00-990-D49

3. **Equipment and Materials**

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed items:

Table 202

Name and Number	Manufacturer
Signal Generator, TIC 30A or TIC 30B	TEL - Instrument Electronics Corp.
Radio Altimeter Test Set, TRT SIM-530	Thomson - TRT Defense

4. **Adjustment/Test Navigation Displays (Electronic Flight Instrument System (EFIS)**

NOTE: The following adjustment/test procedures provide for an on ground aircraft EFIS functional checks. Tests can be performed as a complete system test or as individual item tests.

A. Following is a Glossary of Acronyms used in the following tests procedures.

Table 203

CAPTS--Captains	ILS--Instrument Landing System
DH--Decision Height	MCDU--Multipurpose Control Display Unit
DME--Distance Measuring Equipment	MSP--Mode Select Panel
CDP--Control and Dimming Panel	ND---Navigation Display
EFIS--Electronic Flight Instrument System	PFD--Primary Flight Display
FMA--Flight Mode Annunciator	SG---Symbol Generator
F/O--First Officer	VOR--VHF Omnidirectional Range
FMS--Flight Management System	WXR--Weather Radar

B. The following ground mode criteria must be met before performing the Options/Check Register Word Test.

(1) Throttles full aft.

(2) Radio Altitude scale on Captain's and F/O's PFD.

(3) Aircraft weight on wheels.

(4) Nose gear Oleo switch in ground mode.

(5) Left and right ground control relay circuit breakers closed.

(6) Ground proximity computer installed.

C. Options/Check Register Words Test (Preliminary)

NOTE: During following tests, observe only the symbology depicted in the figures as called for. Disregard any other symbology that may appear on the PFD or ND.

Table 204 Register Words Test (Preliminary)

Operation		Desired Result
(1)	Set up Flight Management System (FMS) Multipurpose Control Display Unit (MCDU).	FMS MCDU set up and operational.

Table 204 Register Words Test (Preliminary) (Continued)

Operation		Desired Result
(2)	For location of EFIS select key, FWD (forward) space key, BACK space key and VERIFY key on MCDU, (Figure 204, Display A).	
(3)	Press TEST PANEL key (line select key 6L) on Capt's MCDU. Verify Menu page changes to Test panel page (Figure 204, Display B).	TEST page displayed.
(4)	Verify EFIS 1 on Capt's MCDU is displayed (Figure 204, Display B).	EFIS 1 displayed.
(5)	SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND. (Figure 204, Display C).	Maintenance Menu displayed on PFD and ND.

D. Options/Check Register Words Test--Programming Symbol Generator 1

Table 205 Programming SG 1

Operation		Desired Result
(1)	Press FWD space key on MCDU until the arrow is pointing to the selection OPTIONS/ CONFIG (Figure 205, Display A) .	Arrow pointing to OPTIONS/ CONFIG.
(2)	Press VERIFY key on MCDU and verfiy that aircraft configuration placard and OPTIONS/CONFIG REGISTER WORDS are identical (Figure 204, Display B) .	OPTION/CHECK REGISTER WORDS and placard are identical.
NOTE: Aircraft options register words and aircraft configuration check register words shown in following figures are examples only, see aircraft configuration placard for actual words.		
(3)	Verify on PFD and ND that arrow is pointing to the left most digit of aircraft OPTIONS REGISTER WORD (Figure 206, Display A) .	Arrow under left most digit of WORD 0.
(4)	Press VERIFY key on the MCDU. Each press of VERIFY key will roll the digit one time. Continue to press VERIFY key until digit on PFD and ND matches same digit on aircraft placard (Figure 206, Display B).	PFD and ND digits match aircraft placard.
(5)	When the digit is correct, press FWD space key on MCDU to move to next digit on the right (Figure 206, Display C) .	Arrow moves to next digit on the right.
(6)	Repeat steps (4) and (5) until OPTIONS REGISTER and CHECK REGISTER WORDS on PFD and ND are same as the placard.	OPTIONS/CHECK REGISTER WORDS same as placard.
(7)	When the right most digit of CHECK/REGISTER WORD is complete, press FWD space key on MCDU. Display will return to the main menu. (Figure 207).	Main MENU display

E. Options/Check Register Words Test--Programming Symbol Generator 2

Table 206

Operation		Desired Result
(1)	Use First Officer's MCDU for programming symbol generator 2.	
(2)	Repeat the following steps for programming symbol generator 2 substituting F/O (symbol generator 2) for Captain (symbol generator 1) in the test procedures.	Results same as programming symbol generator 1.
	Table 204	
	Table 205	

CAUTION: RADIO RACK COOLING FANS MUST BE OPERATING DURING ANY EFIS TEST OPERATIONS.

F. Verification of Programming Options (Preliminary)

NOTE: The following tests verify the options were programmed into the system correctly and options will be displayed. The tests also verify correct operation of the symbol generators and display units.

Table 207

Operation		Desired Result
(1)	Press MENU key on Capt's and F/O's MCDU.	MCDU's display MENU page.
(2)	Verify Capt's and F/O's ND and PFD displays are are normal.	ND and PFD displays normal.
(3)	Verify on Capt's and F/O's ND the words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.		
(4)	Set up the TIC-30 generator	TIC 30 generator set up.
(5)	Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 Mhz).	VHF NAV receivers tuned to ILS frequency.
(6)	Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSPs MODE select switch in ROSE position.

G. Verification of Programming Options (Uncrossed Navigation and G/S Side Selection Options)

Table 208

Operation		Desired Result
(1)	Press and hold G/S switch on TIC-30 generator.	
(2)	Open G/S-2 DC circuit breaker.	Circuit breaker open.
(3)	Verify that G/S FAIL appears on right side of F/O's PFD and ND screen.	G/S FAIL displayed on F/O's PFD and ND screens.
(4)	Verify symbology on Capt's and F/O's PFD and ND per Figure 208. Disregard any other symbology displayed.	PFD and ND displays per Figure 208.
(5)	Close G/S-2 DC circuit breaker and verify G/S FAIL message disappears.	G/S FAIL message disappears.

H. Verification of Programming Options -- Split Cue Flight Director Display Option

Table 209

Operation		Desired Results
(1)	Verify symbology on Capt's and F/O's PFD is split cue display (Figure 209) .	Split cue display on Capt's and F/O's PFD.

I. Verification of Programming Options -- No ILS Beam Deviation Warning

Table 210

Operation		Desired Results
(1)	Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-118, station 110.	
(2)	Tune VHF NAV-1 and VHF NAV-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3)	Set up 980N-1 radio alti meter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4)	Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5)	Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6)	On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7)	Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8)	Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale, not flashing.	G/S deviation indicator at top of scale on PFD and is not flashing.
(9)	Verify G/S deviation symbology on PFD's is per Figure 210.	Display per Figure 210.
(10)	Release G/S switch on TIC generator.	
(11)	Remove 980N-1 test set.	
(12)	Remove ground jumpers from terminal 52 and terminal 28.	

J. Verification of Programming Options -- Vertical Gyros Option (Aircraft with Vertical Gyros)

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 406, 409, 881, 883, 884 POST MD80-34-285			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 410 POST MD80-34-285			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 405, 409, 880, 881, 883, 884 POST MD80-34-285			
B	05	B10-19	VERTICAL GYRO-1

WJE 405, 409, 880, 881, 883, 884 POST MD80-34-285 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 410 POST MD80-34-285			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884 POST MD80-34-285			
C	2	B10-167	AUX VERTICAL GYRO

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285			
C	11	B10-169	VERTICAL GYRO SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884 POST MD80-34-285			
F	15	B10-364	VERTICAL GYRO-1
WJE 410 POST MD80-34-285			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884 POST MD80-34-285			
F	1	B10-168	AUXILIARY VERTICAL GYRO
WJE 405, 409, 410, 880, 881, 883, 884 POST MD80-34-285			
F	2	B10-20	VERTICAL GYRO-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410 POST MD80-34-285			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

(2) For aircraft with AHRS system, proceed to Paragraph 4.K.(1)

K. Verification of Programming Options -- AHRS Option

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 409, 884 POST MD80-34-285			
B	4	B10-412	SYMBOL GENERATOR-1 POWER
WJE 406-408 POST MD80-34-285			
B	5	B10-394	AHRS-1
WJE 405-408, 410, 411, 880, 881, 883 POST MD80-34-285			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

WJE 405-408, 410, 411, 880, 881, 883 POST MD80-34-285 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408 POST MD80-34-285			
F	15	B10-395	AHRS-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411 POST MD80-34-285			
F	2	B10-396	AHRS-2
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 405, 409, 881, 883, 884 POST MD80-34-285			
F	10	B10-413	SYMBOL GENERATOR-2 POWER
WJE 410 POST MD80-34-285			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

(2) Verify symbology on Capt's and F/O's PFD are per Figure 211 or Figure 212.

L. Verification of Programming Options -- Long Range Navigation and Track Options

Table 211

Operation		Desired Results
(1)	Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2)	Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3)	Verify MAP symbology on Capt's and F/O's ND is per Figure 213. Disregard all other symbology.	MAP displays per Figure 213.

M. Verification of Programming Options -- ETA and DTW and Track Options

Table 212

Operation		Desired Results
(1)	Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2)	Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3)	Verify MAP symbology on Capt's and F/O's ND is per Figure 214. Disregard all other symbology.	MAP displays per Figure 214.

N. Verification of Programming Options -- DME-1 and DME-2 Option

Table 213

Operation		Desired Result
(1)	Place Capt's MSP mode select switch in ARC position.	MSP select switch in ARC position.

Table 213 (Continued)

Operation		Desired Result
(2)	Place F/O's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(3)	Verify DME symbology is displayed on Capt's and F/O's ND per Figure 215.	DME symbology displayed on NDs.

O. Verification of Programming Options -- ADF Bearing Option

Table 214

Operation		Desired Result
(1)	Make certain ADF circuit breakers are closed.	ADF circuit breakers closed.
(2)	Tune ADF-1 to local broadcast frequency. Tune ADF-2 to different local broadcast frequency.	ADFs tuned to local broadcast frequency.
(3)	Place Capt's and F/O's MSP mode select switch in ROSE position.	MSPs mode select switch in ROSE position.
(4)	Place Capt's and F/O's MSP center knobs in ADF position.	MSPs center knobs in ADF position.
(5)	Place ADF/ANT switches on ADF-1 and ADF-2 CONTRL PNL's in ADF position.	Switches in ADF position.
(6)	Verify ADF-1 and ADF-2 symbology display on Capt's and F/O's ND (Figure 216).	Symbology per (Figure 216).
(7)	Place knobs in step (4) to OFF.	

P. Mode Select Panel Functional Test -- Rose Mode

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 215

Operation		Desired Result
(1)	Place Captain's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(2)	Place F/O's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(3)	Verify Rose mode symbology is displayed on Captain's and F/O's ND (Figure 217).	Rose mode symbology displayed.

Q. Mode Select Panel Functional Test -- ARC MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 216

Operation		Desired Result
(1)	Place Captain's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(2)	Place F/O's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.

Table 216 (Continued)

Operation		Desired Result
(3)	Verify ARC mode symbology is displayed on Captain's and F/O's ND (Figure 218).	ARC mode symbology displayed.

R. Mode Select Panel Functional Test -- MAP MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 217

Operation		Desired Result
(1)	Place Captain's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(2)	Place F/O's MSP mode sel- lector switch in MAP position.	Mode selector switch in MAP position.
(3)	Verify MAP mode symbology is displayed on Captain's and F/O's ND (Figure 219).	MAP mode symbology displayed.

S. Mode Select Panel Functional Test -- PLAN MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 218

Operation		Desired Result
(1)	Place Capt's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(2)	Place F/O's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(3)	Verify Plan mode symbology is displayed on Capt's and F/O's ND (Figure 220) .	Plan mode symbology displayed.

T. Mode Select Panel Functional Test -- Range Selector

Table 219

Operation			Desired Result	
(1)	Place Captain's and F/O's MSP mode selector switch in ARC position.			
(2)	Rotate Captain's WX OFF control on Captain's CDP to full clockwise position.		WXR OFF displayed on Captain's ND.	
(3)	Rotate F/O's WX OFF control on F/O's CDP to full clockwise position.		WXR OFF displayed on F/O's ND.	
(4)	Place RANGE selector on Captain's and F/O's MSP in each range listed following:		Verify range index number in location on NDs as in Figure 221.	
	10	80	5	40
	20	160	10	80
	40	320	20	160

Table 219 (Continued)

Operation		Desired Result
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.		
(5)	Rotate Captain's and F/O's WX OFF control to OFF position.	WXR OFF display on Captain's and F/O's ND blanked out.

U. MSP Declutter Buttons and Control Dimming Panel (CDP) Test

Table 220

Operation		Desired Result
(1)	Press annunciator/digital lights TEST button located on lower right corner of overhead panel.	Declutter buttons on MSP come on.
(2)	Release the annunciator/ digital lights test button.	Declutter buttons on MSP go off for approximately half a second and then come on for approximately five seconds.
(3)	Place Captain's MSP selector switch to ARC position.	MSP switch in ARC position.
(4)	Rotate the CDP PFD knob counterclockwise.	Captain's PFD decreases in brightness.
(5)	Rotate CDP PFD knob clockwise.	Captain's PFD increases in brightness.
(6)	Rotate CDP ND knob counterclockwise.	Captain's ND decreases in brightness.
(7)	Rotate CDP ND knob clockwise.	Captain's ND increases in brightness.
(8)	Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.
(9)	Repeat steps (4) through (7) substituting F/O's for Captain's.	Results same as steps (4) through (7).

V. Captain's and First Officer's Decision Height Test

Table 221

Operation		Desired Result
(1)	Rotate DH knob on Capt's CDP clockwise. Check for display number on Capt's PFD in the top right corner (Figure 222) .	DH number increases.
(2)	Rotate DH knob counterclockwise.	DH number decreases.
NOTE: DH number will blank when DH number is less than 0 (zero) feet.		
(3)	Rotate DH knob on F/O's CDP clockwise. Check for display number on F/O's PFD in the top right corner (Figure 222) .	DH number increases.
(4)	Rotate DH knob counterclockwise.	DH number decreases.

W. ND and PFD Compact Mode Test

Table 222

Operation		Desired Result
WJE 406, 410 POST MD80-34-285		
(1)	Rotate ND BRT knob on Capt's CDP counterclockwise to the detent position.	ND BRT knob counterclockwise to detent position.
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285		
(1)	Rotate ND BRT knob on Capt's CDP counterclockwise to detent position.	ND BRT knob counterclockwise to detent position.
(2)	Verify compact mode symbology display is on Capt's PFD as shown in Figure 223.	Compact mode display on Capt's PFD per Figure 223.
(3)	Rotate ND BRT knob full clockwise.	Displays return to normal.
(4)	Rotate PFD BRT knob on Capt's CDP counterclockwise to detent position.	PFD BRT knob counterclockwise to detent position.
(5)	Verify compact mode symbology display on Capt's ND as shown in Figure 223.	Compact mode display on Capt's ND per Figure 223.
(6)	Rotate PFD BRT knob full clockwise.	Displays return to normal.
(7)	Repeat steps (1) through (6) substituting F/O's test procedures.	F/O's results same as Capt's desired results.

X. ND and PFD Auto Brightness Tests

NOTE: The following test verifies that the remote light sensor and (RLS) will provide brightness boost to NDs and PFDs in high intensity light conditions.

Table 223

Operation		Desired Results
WJE 406, 410 POST MD80-34-285		
(1)	Shine flashlight on each photocell area of Capt's and F/O's PFD and ND. (Figure 224) for photocell location on NDs and PFDs.	Note increase in ND's and PFD's brightness.
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285		
(1)	Shine flashlight on each photocell area of Captain's and F/O's PFD and ND. (Figure 224) for photocell location on NDs and PFDs.	Note increase in ND's and PFD's brightness.
(2)	Cover the RLS located on glareshield with your hand for approximately 5 seconds.	
(3)	Remove your hand from RLS and shine flashlight on the RLS.	PFD's and ND's increase in brightness.
(4)	Remove flashlight.	PFD's and ND's brightness returns to previous brightness.

Y. Instrument Comparator Monitoring Test -- Captain's and F/O's FMA Lamp Test and SG Crosstalk Test

NOTE: The following tests verify the FMA lamps come on and symbol generators crosstalk bus is operating correctly.

Table 224

Operation		Desired Result
(1)	Press and release Annunciator/Digital Light Test button.	Verify all FMA lamps come on.
NOTE: Disregard Starbursts on FMAs.		
(2)	Release test button and verify Capt's FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.	FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.
WJE 406, 410 POST MD80-34-285		
(3)	Repeat steps (1) and (2) substituting F/O's for Capt's in test procedures.	Desired results same as Capt's.
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285		
(3)	Repeat steps (1) and (2) substituting F/O's for Captain's in test procedures.	Desired results same as Captain's.
(4)	Open SG-1 Power circuit breaker.	F/O's FMA Monitor lamp comes on.
(5)	Close SG-1 Power circuit breaker.	F/O's FMA Monitor lamp goes off.
(6)	Open SG-2 Power circuit breaker.	Capt's FMA Monitor lamp comes on.
(7)	Close SG-2 Power circuit breaker.	Capt's FMA Monitor lamp goes off.

Z. Symbol Generator Switching Tests

NOTE: The following test verifies that NDs and PFDs can be driven by the off-side symbol generator.

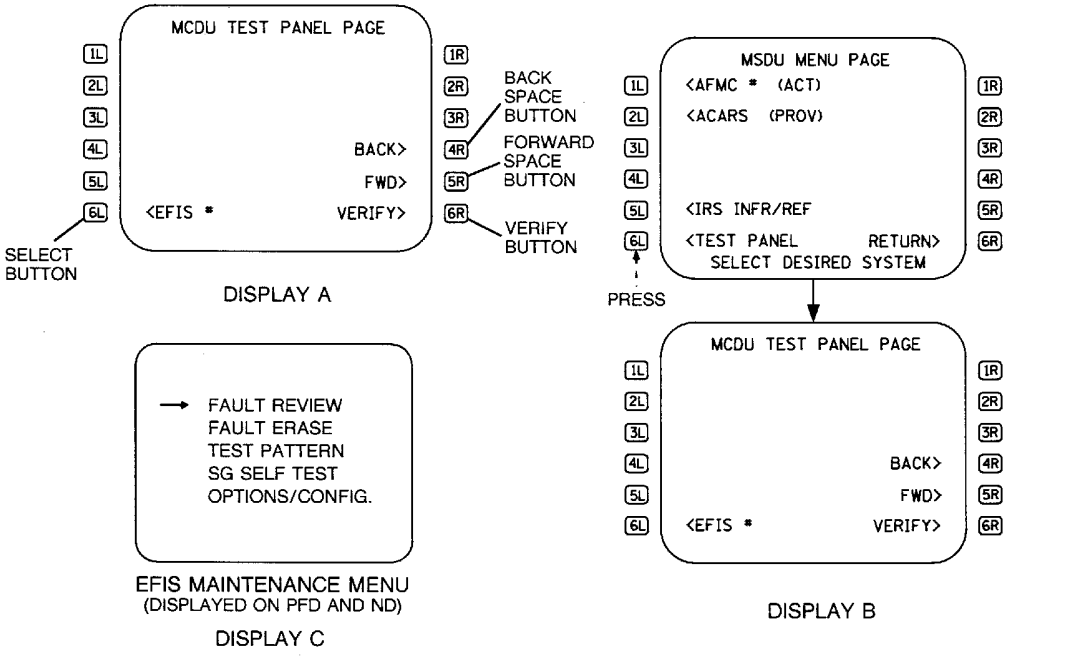
Table 225

Operation		Desired Result
(1)	Place Captain's and F/O's MSP selector switch in ARC position.	MSP switch in ARC mode.
(2)	Place EFIS switch to BOTH ON 1 position.	EFIS switch in BOTH ON 1 position.
(3)	Verify symbology on Captain's and F/O's ND and PF display EFI 1. (Figure 225, Display A).	PFD and ND display EFI 1 symbology per (Figure 225, Display A)
(4)	Place EFIS to BOTH on 2 position.	EFIS switch in BOTH ON 2 position.
(5)	Verify symbology on Captain's and F/O's ND and PFD display EFI 2. (Figure 225, Display B).	PFD and ND display EFI 2 symbology per (Figure 225, Display B).
(6)	Return EFIS switch to NORM position.	EFIS switch in NORM position.

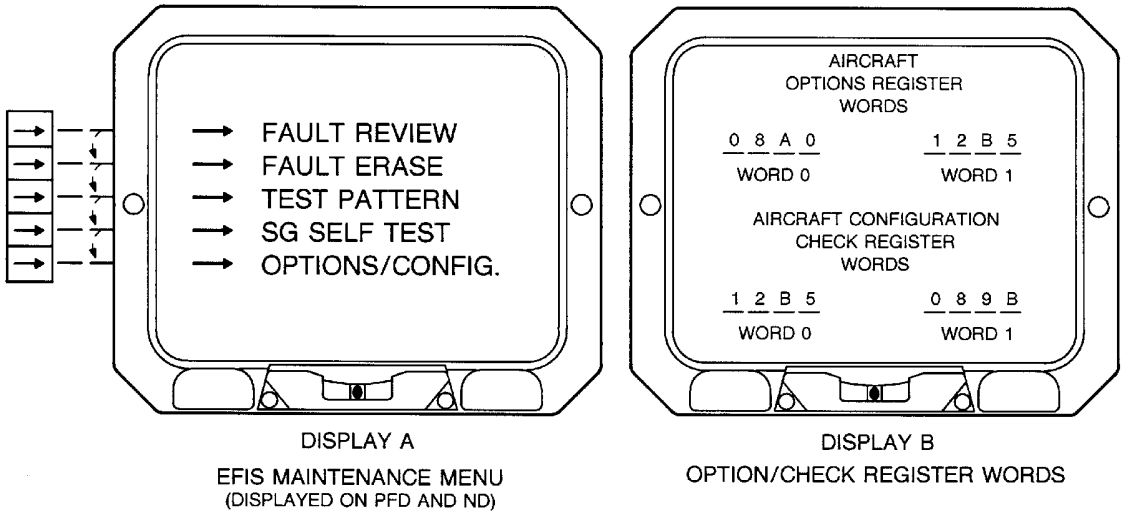
AA. EFIS SELF TEST

Table 226

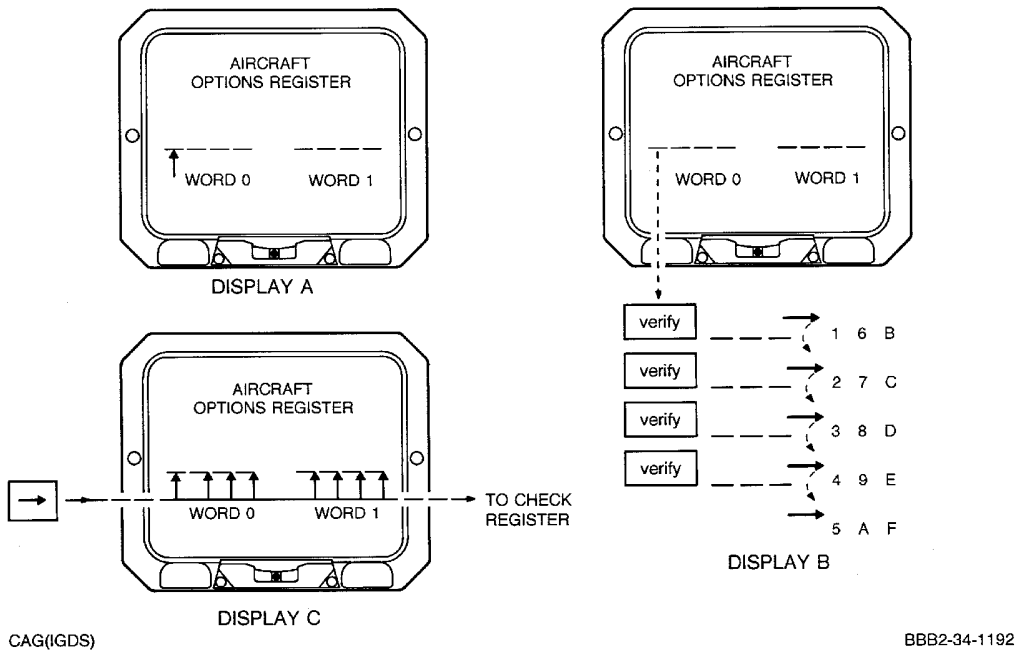
Operation		Desired Result
(1)	Press FORWARD SPACE key on MCDU until arrow is pointing to SG SELF TEST on MCDU.	Verify Captain's PFD and ND display like Figure 226, Display A.
(2)	Press VERIFY key on MCDU. This initiates self test.	Verify Captain's ND display like Figure 226, Display B.



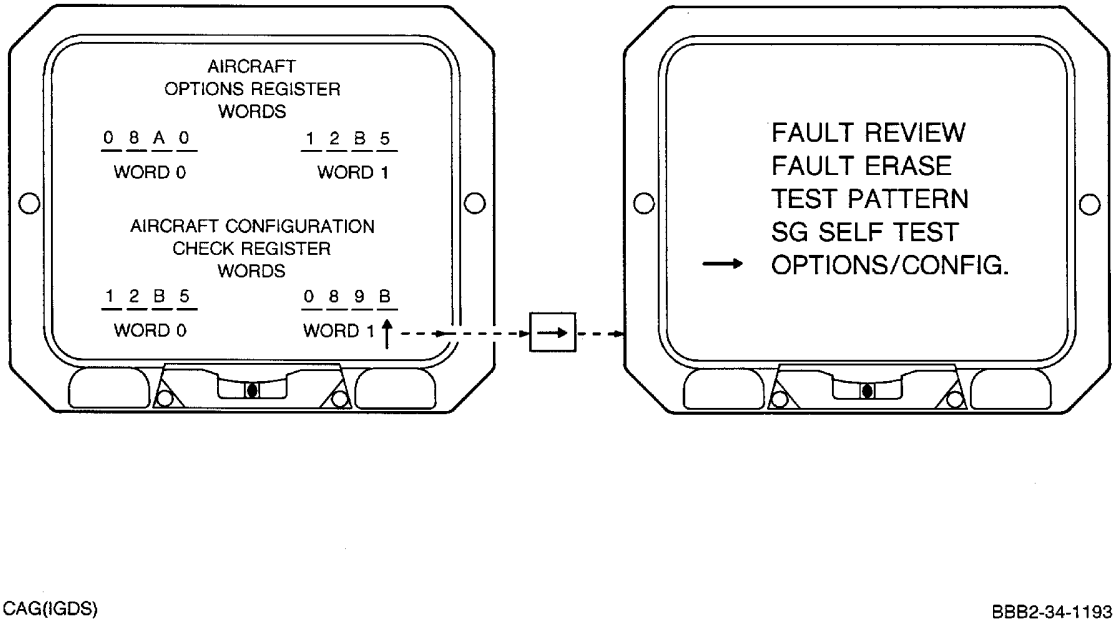
Multipurpose Control Display Unit Displays
Figure 204/34-22-00-990-D50



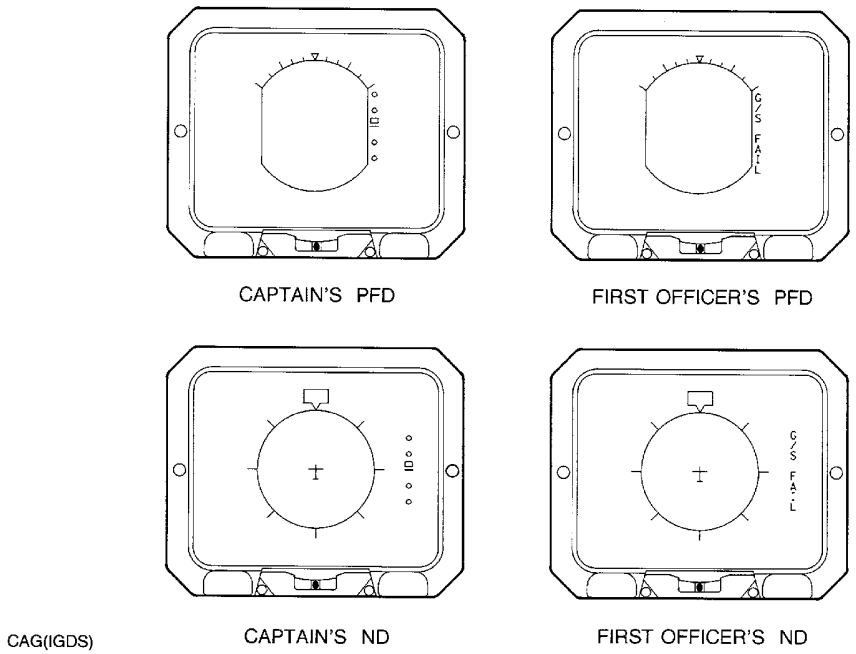
Symbol Generator Programming Displays
Figure 205/34-22-00-990-D51



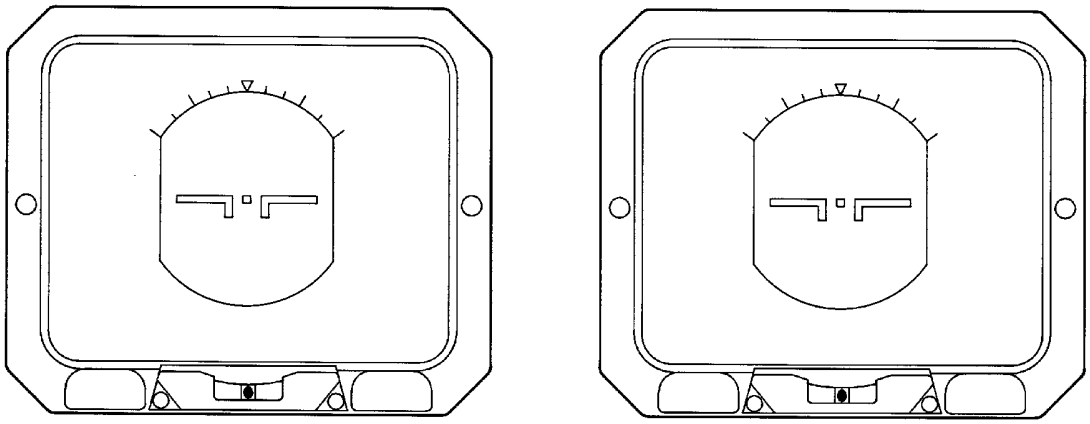
Aircraft Options Register Words Arrow Displays
Figure 206/34-22-00-990-D52



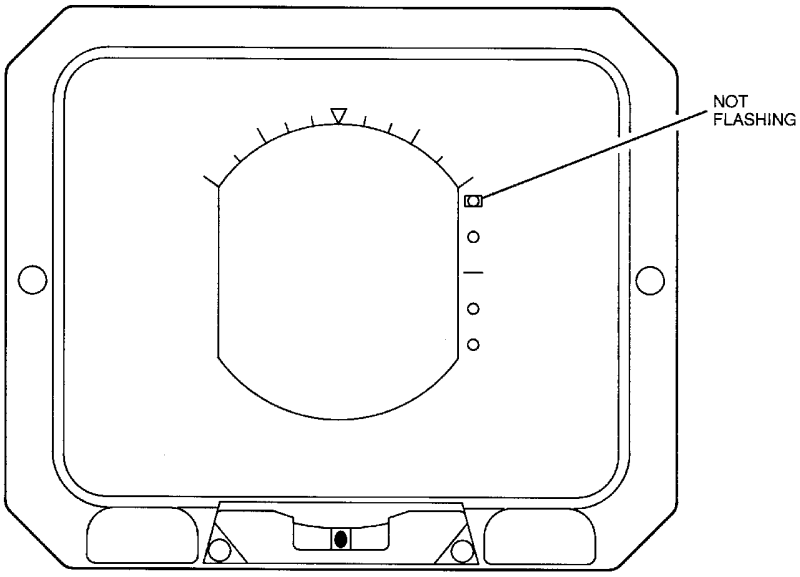
Options Register and Check Register Words and Main Menu Display Return
Figure 207/34-22-00-990-D53



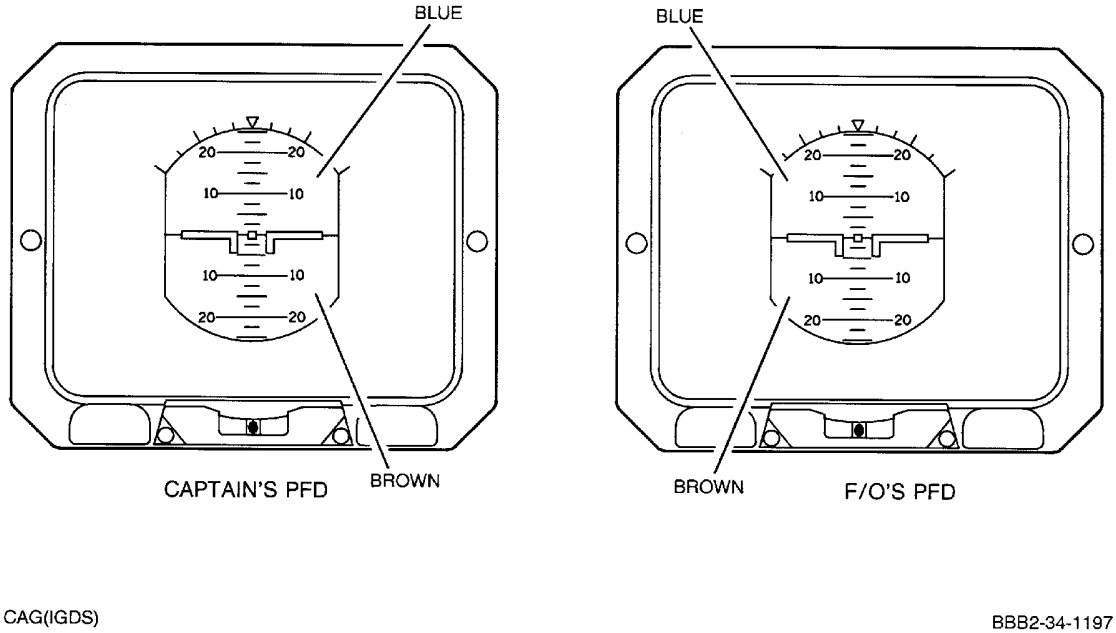
Uncrossed Navigation and G/S Side Selection Options
Figure 208/34-22-00-990-D54



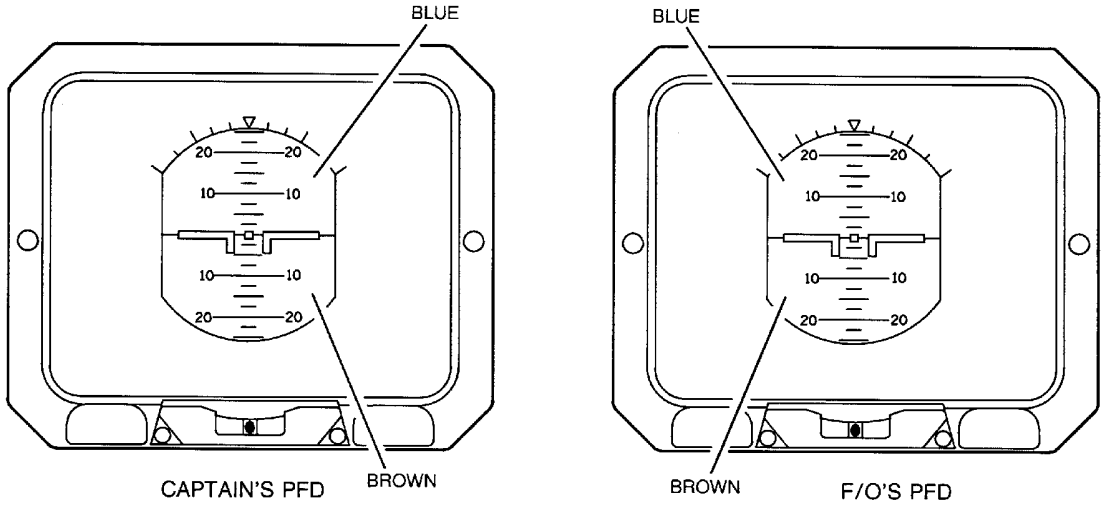
Split Cue Flight Director Display
Figure 209/34-22-00-990-D55



ILS Beam Deviation Warning Display
Figure 210/34-22-00-990-D56



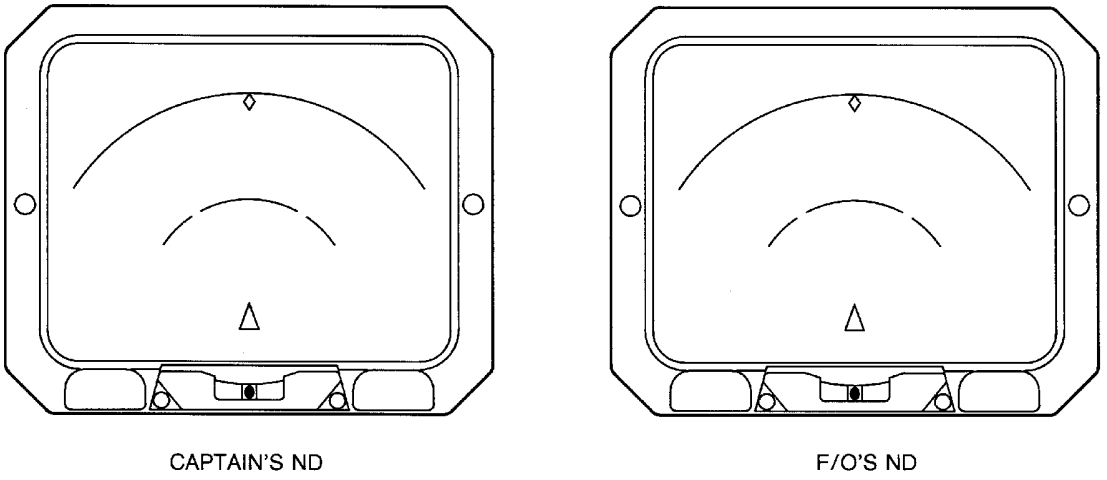
AHRS Option PFD Display
Figure 211/34-22-00-990-D57



CAG(IGDS)

BBB2-34-1197

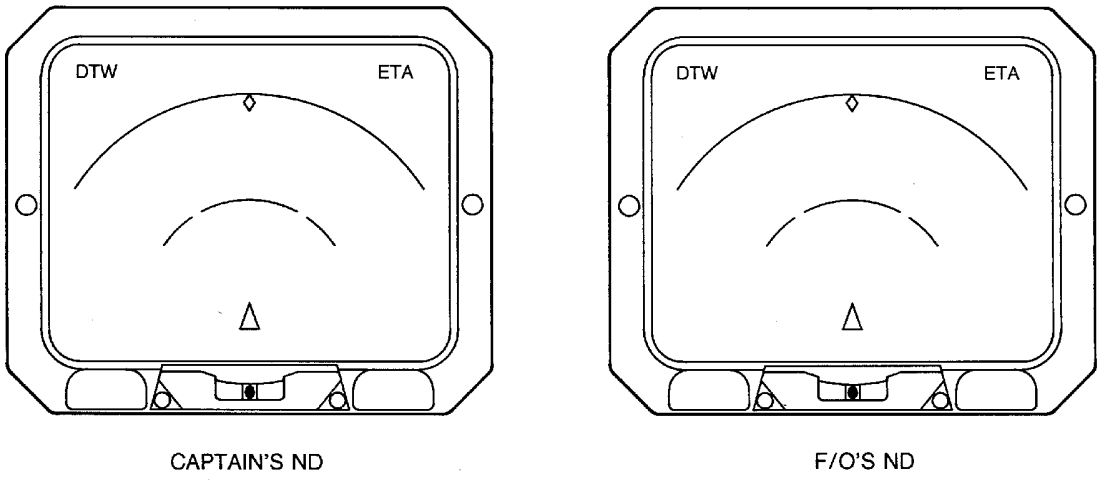
Vertical Gyros Option PFD Display
Figure 212/34-22-00-990-D58



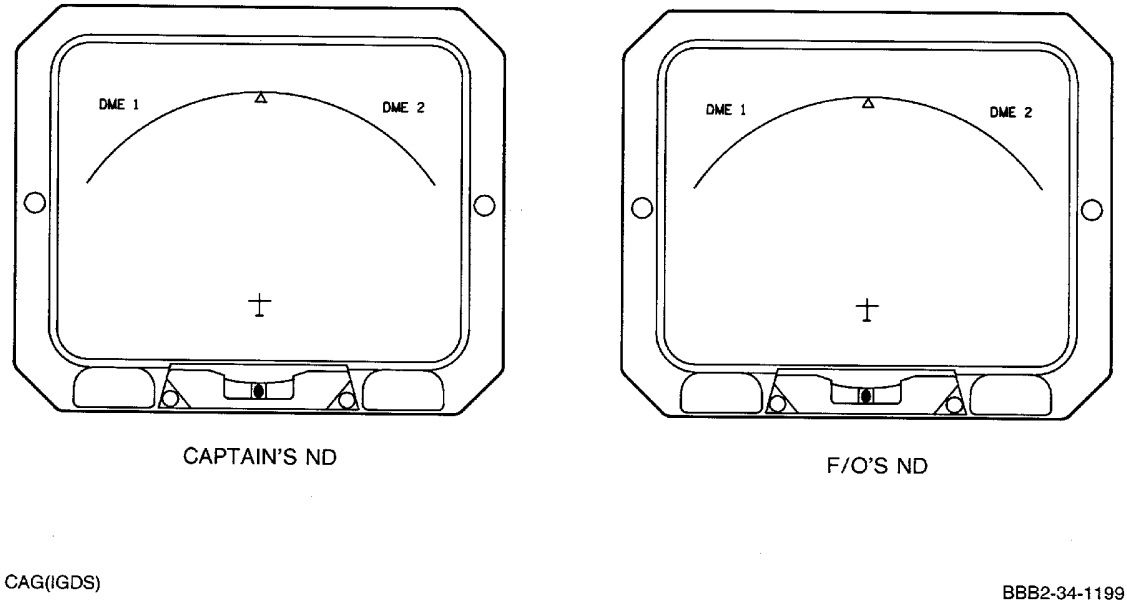
CAG(IGDS)

BBB2-34-1198

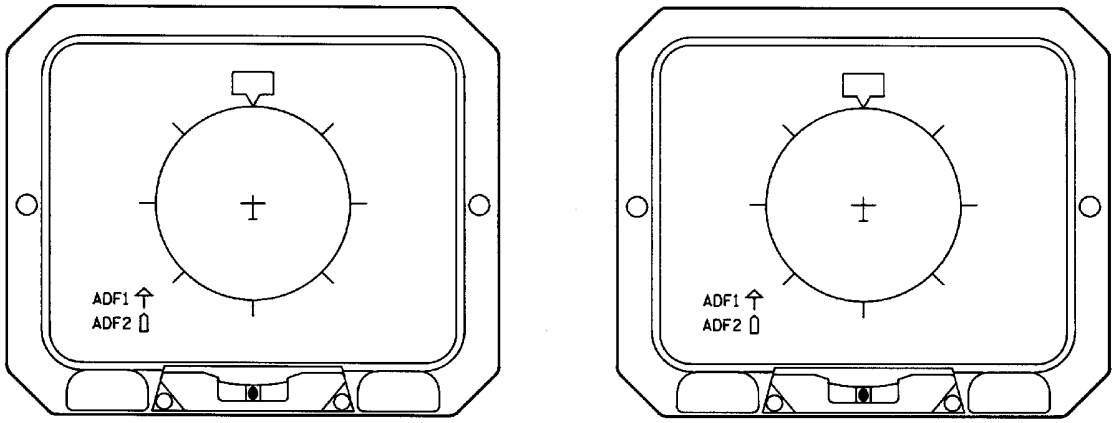
Navigation Display (ND) MAP Display
Figure 213/34-22-00-990-D59



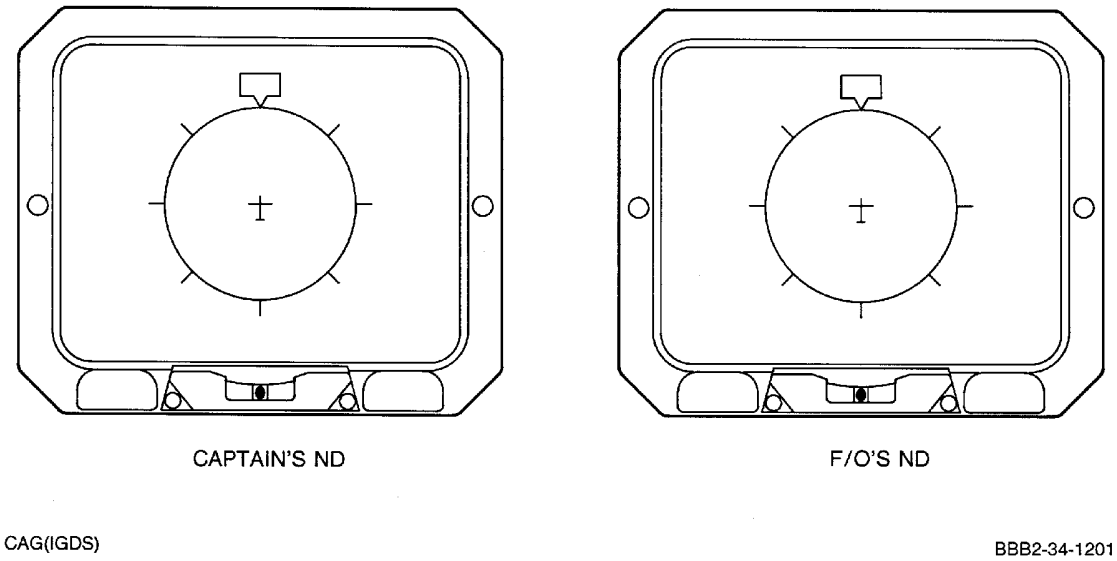
Navigation Display (ND) ETA and DTW MAP Display
Figure 214/34-22-00-990-D60



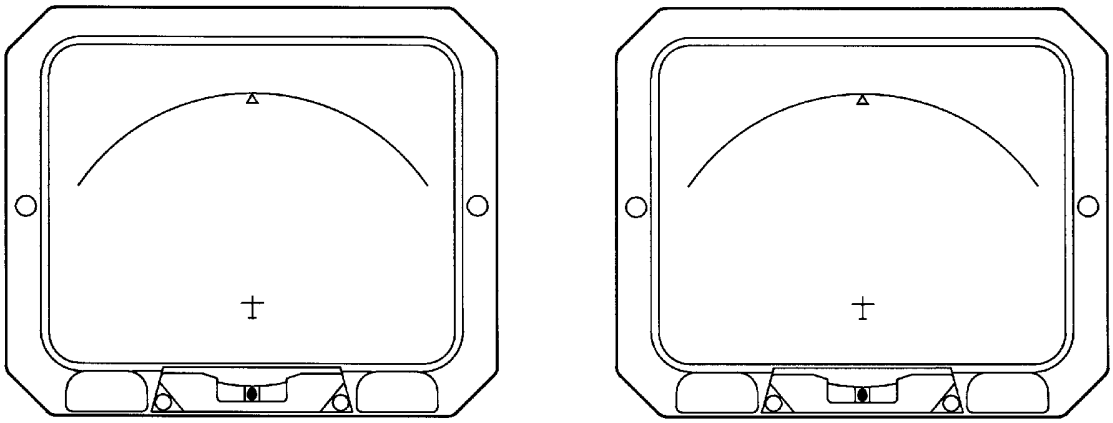
Navigation Display (ND) DME Displays
Figure 215/34-22-00-990-D61



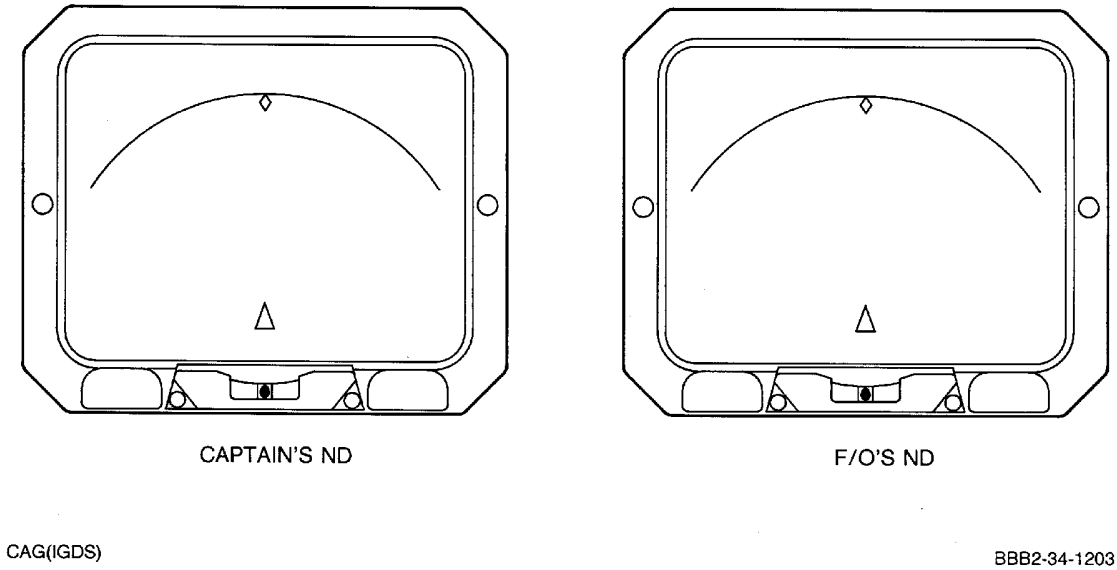
ADF Bearing Display
Figure 216/34-22-00-990-D62



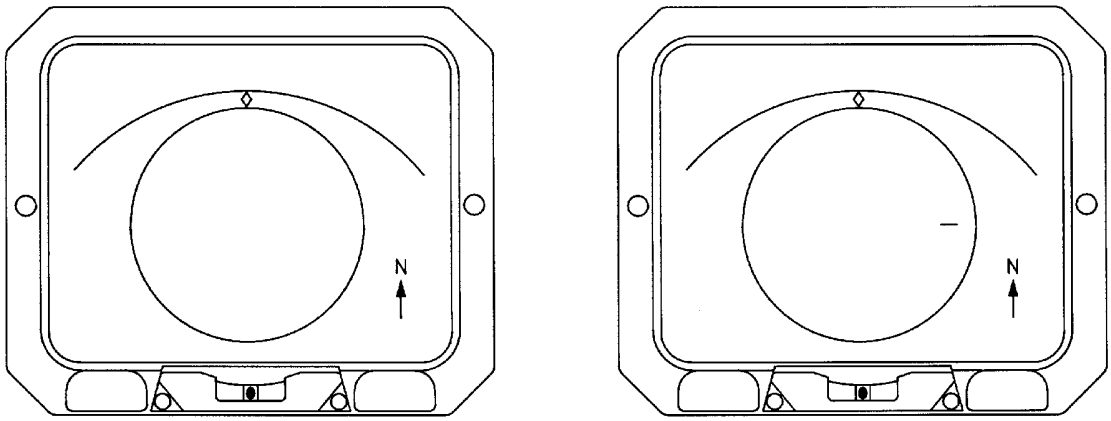
Rose Mode Display on NDs
Figure 217/34-22-00-990-D63



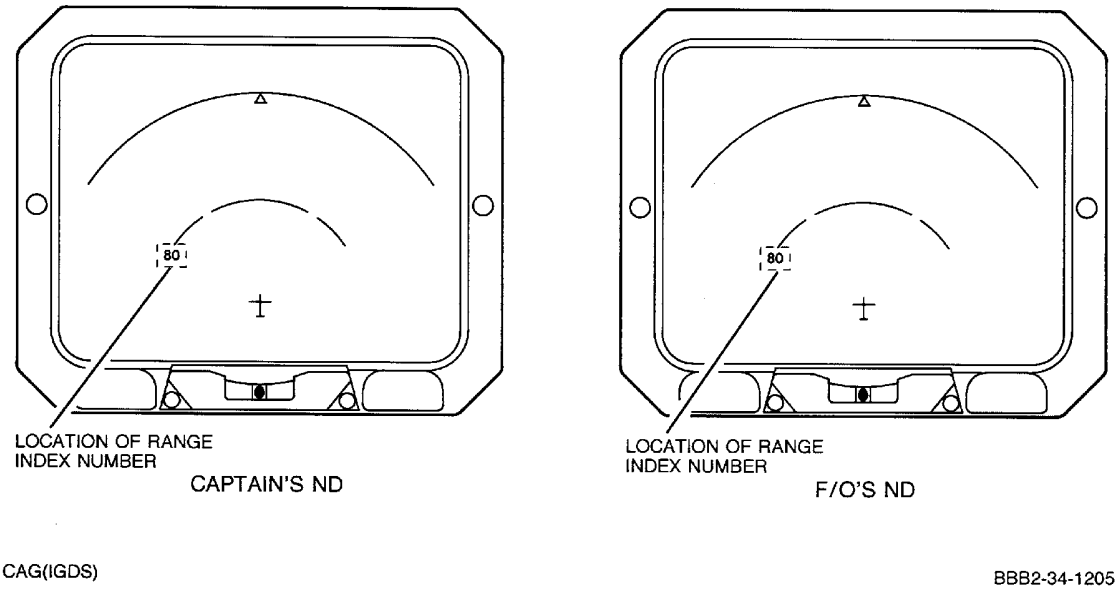
ARC Mode Display on NDs
Figure 218/34-22-00-990-D64



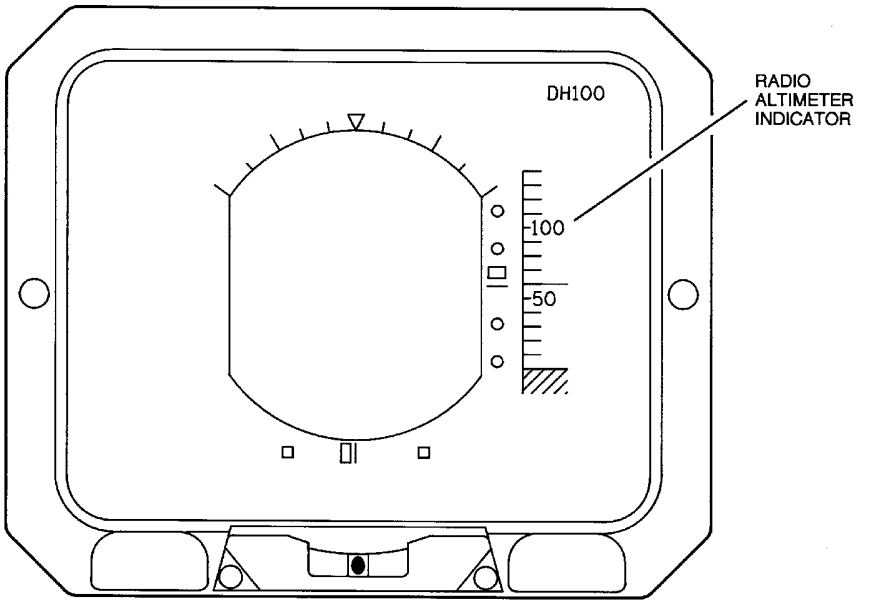
MAP Mode Display on NDs
Figure 219/34-22-00-990-D65



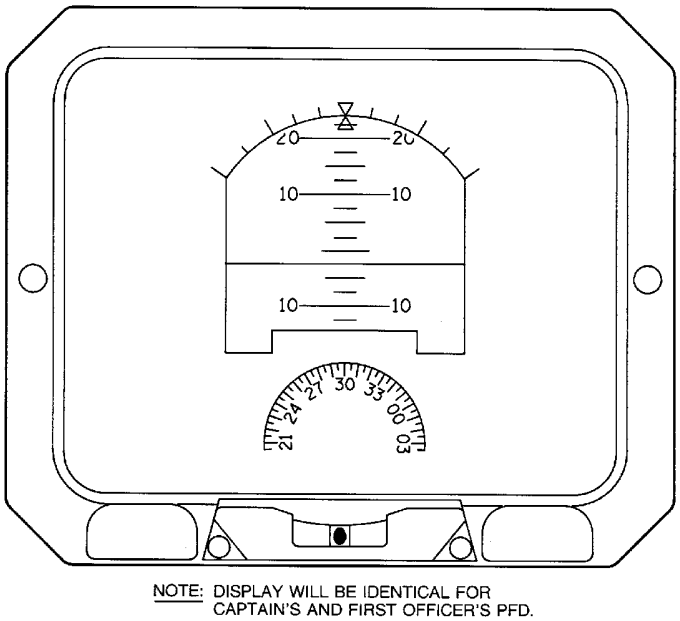
Plan Mode Display on NDs
Figure 220/34-22-00-990-D66



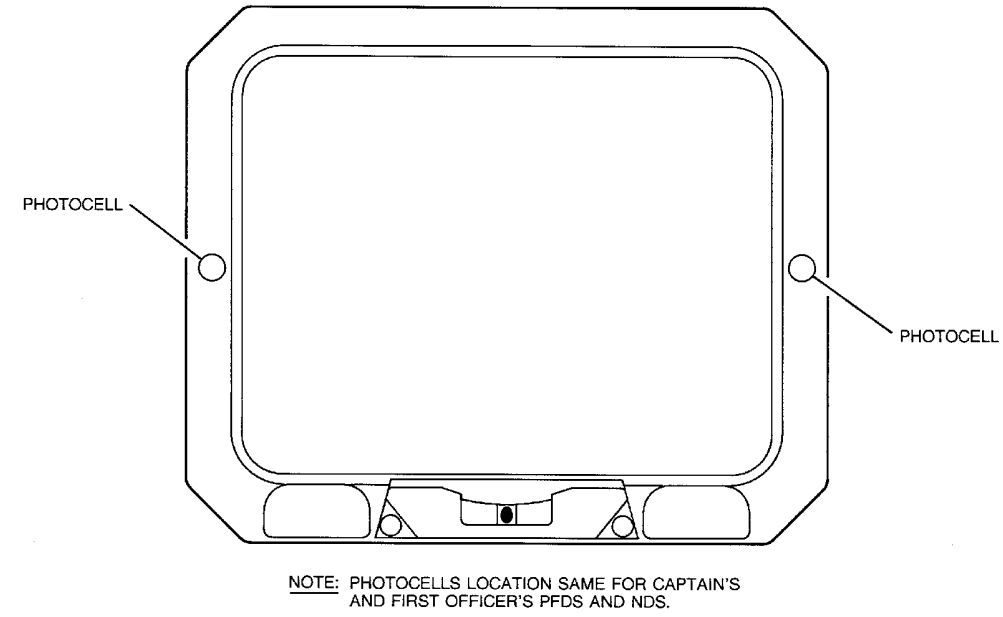
Range Selector Displays
Figure 221/34-22-00-990-D67



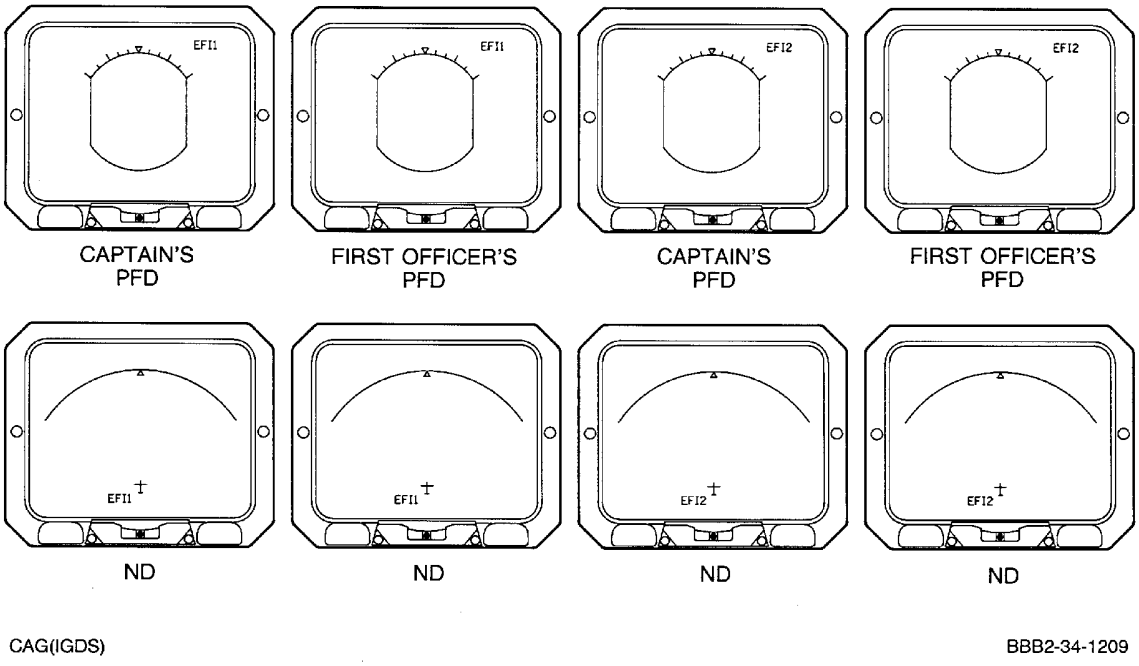
Decision Height Display On PFD
Figure 222/34-22-00-990-D68



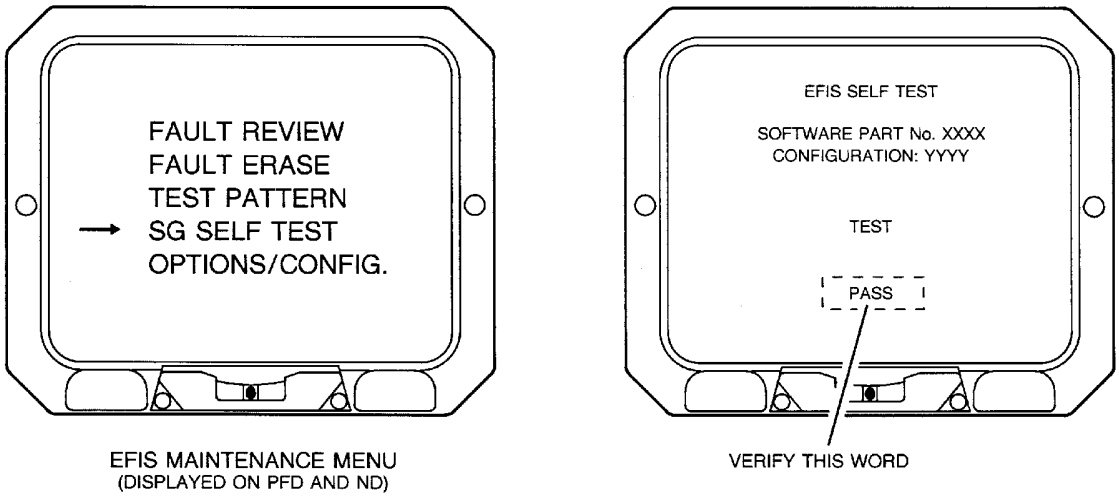
ND and PFD Compact Mode Displays
Figure 223/34-22-00-990-D69



PFD's and ND's Photocell Locations
Figure 224/34-22-00-990-D70



PFD and ND EFIS Switching Display
Figure 225/34-22-00-990-D71



EFIS Self Test Display on Captain's ND
Figure 226/34-22-00-990-D72

NAVIGATION DISPLAYS - MAINTENANCE PRACTICES

1. General

A. This section contains an overview of the maintenance practices required for the electronic flight instrument system (EFIS). This is followed by a complete listing of circuit breakers for the EFIS and interfacing systems which must be closed when performing system tests. Ground maintenance consists of the following:

(1) Options/Configuration programming of the symbol generator. This is performed only when a new SG is installed on the aircraft, or when a SG is transferred from another aircraft. Each aircraft has its own "finger print" which must be fed into the SG upon installation. Options/Config. programming matches the SG software to the aircraft wiring.

(2) SG Self Test - Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Multipurpose Control Display Panel (MCDU).

(3) EFIS System Self-Test (BIT) - This 3-second test is initiated from the TEST pushbutton on the control and dimming panel (CDP). Used to test the following systems which provide inputs to the SG: VOR/ILS, radio altimeter, marker beacon. The EFIS system self-test includes a failure flag test.

(4) All input systems tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the test pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions.

(5) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons.

B. To Perform a Complete System Test - The symbol generator is the heart of the EFIS, so thorough testing of the SG ensures proper operation of the system. The maintenance practices for the symbol generator include all of the above-mentioned tests. To perform a thorough system test, perform the symbol generator maintenance practices. Separate LRU functional tests are also provided for the EFIS Control and Dimming Panel (CDP), Mode Select Panel (MSP), Display Units (PFD/ND), and Remote Light Sensor (RLS). These are to be performed following removal/installation of the LRU's. (EFIS SYMBOL GENERATOR, SUBJECT 34-22-10, Page 201)

2. General Maintenance Practices

A. The following instructions contain a detailed explanation of how the STP is used in conjunction with the EFIS Maintenance Menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS Maintenance Menu and TEST pushbutton (BIT) are used in performing a complete system test.

B. Status Test Panel - The Status Test Panel (STP) pushbuttons are used to call up the EFIS Maintenance Menu display on the PFD/ND. In order to use the STP pushbuttons for this purpose, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. When the aircraft is on the ground and power to the STP is on, the Maintenance Menu appears on both the PFD and ND of the system being tested. (Figure 201)

C. The EFIS Maintenance Menu - There are five menu pages which can be selected from the Maintenance Menu: FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The TEST PATTERN is used for bench tests and is not included in the Maintenance Practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the Maintenance Menu, and pressing the VERIFY pushbutton on the STP. The FORWARD and BACKSPACE keys are used to move the cursor vertically on the Maintenance Menu. The following five selections can be made from the EFIS Maintenance Menu: (Figure 201 and Figure 202)

(1) Fault Review - Used in trouble shooting the EFIS only, to read failures logged in the flight log. The fault code consists of two 3-digit numbers. The first digit is the SG (or system) number. The next two digits are Fault ID numbers; these are main category fault classifications. The last three digits are the Fault Code Numbers; they are subordinate to the Fault ID numbers. The Fault ID and Fault Code are used to provide a complete fault definition. Fault messages appear on the Fault Review screen next to the 6-digit entries. An "-R" after the message indicates a repeat failure. The fault messages are followed by a Time entry, which is the time into the flight leg from takeoff. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101 for complete listing of EFIS Fault Codes)

(2) Fault Erase - This mode is used to erase all flight faults from the flight log. The cursor is cycled to the FAULT ERASE selection on the menu, and the VERIFY key is pressed. Pressing the FORWARD SPACE key at this time will cause all flight faults to be erased. Pressing BACKSPACE or VERIFY will abort the erase function. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101)

(3) Test Pattern - The test pattern is used in bench testing only. The test pattern is a color display of stroke-drawn lines and raster patches. The lines consists of one line for each stroke color: cyan, yellow, green, red, dim white, white and magenta. The three patches are raster patches, one for each of the raster test colors: blue, green and red.

(4) SG Self-test - This is a comprehensive test for the system SG's and all interfacing systems. This three second test generates two displays: the Interface Status page, containing ID codes, fault codes and fault messages for all currently monitored interface failures, and the self-test failures page, listing diagnostic numbers of all internal SG failures.

(5) Options/Config. - This mode is used by maintenance personnel whenever a new SG is installed. It allows the user to enter or modify the aircraft configuration and options words. These words are located on a placard next to the STP mode select switch (EFIS/DFGS). When -905 symbol generators are installed, MAINT CHECK will appear on both displays if the option words of SG1 do not match the option words of SG2. If an incompatibility exists between the check register, the options register, and the configuration identificaton, MAINT CHECK will appear on both displays. This would normally occur if one SG is replaced but has not had the check register and options registers modified to reflect the current aircraft configuration. When -905 symbol generators are installed, MAINT CHECK will appear on the display of the failed SG only.

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

D. TEST Pushbutton - Control and Dimming Panel (CDP): The TEST pushbutton is used during the SG Maintenance Practices to self-test interfacing systems and display unit failure flags. There are separate TEST pushbuttons for system-1 and system-2, on the Capt's and F.O.'s CDP's. Pressing the TEST pushbutton VOR/ILS, Radio Altimeter, and Marker Beacon self-tests. The appropriate test responses are under the control of the respective receiver units. When testing a single parameter (i.e., radio altimeter), all other symbology appearing on the display screens should be ignored. The test is successful if the appropriate failure/flag/warning replaces the parameter on the display screen (i.e., an R/A FAIL flag will replace the radio altimeter tape on the PFD).

(1) The TEST pushbutton also initiates a failure flag test, and DH aural warning test (if installed). The DH aural warning test consists of a one-second tone slewing from 400 to 800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. (Figure 203)

E. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons are also tested.

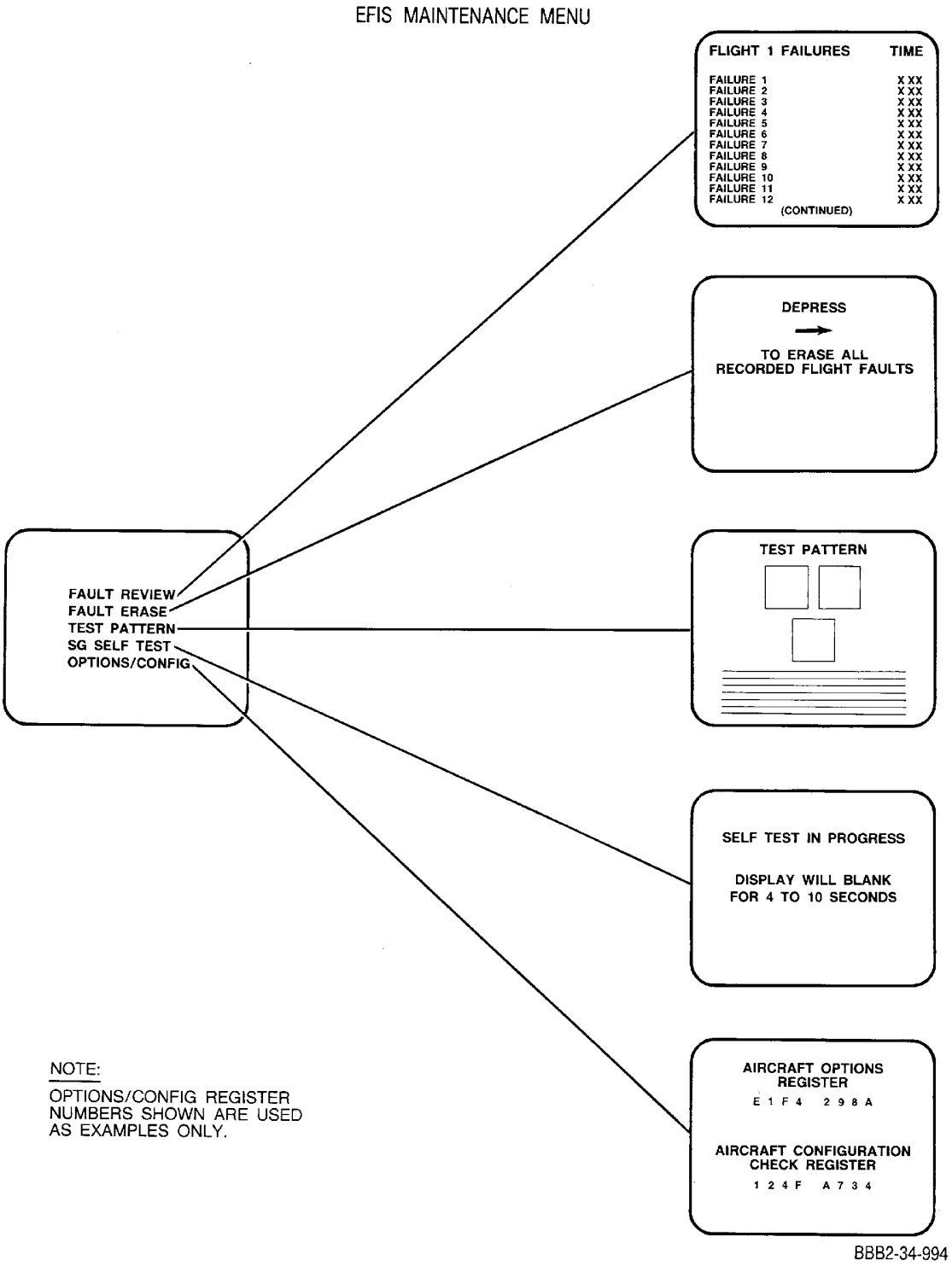
F. Circuit Breakers for EFIS and Interfacing Systems

Table 201

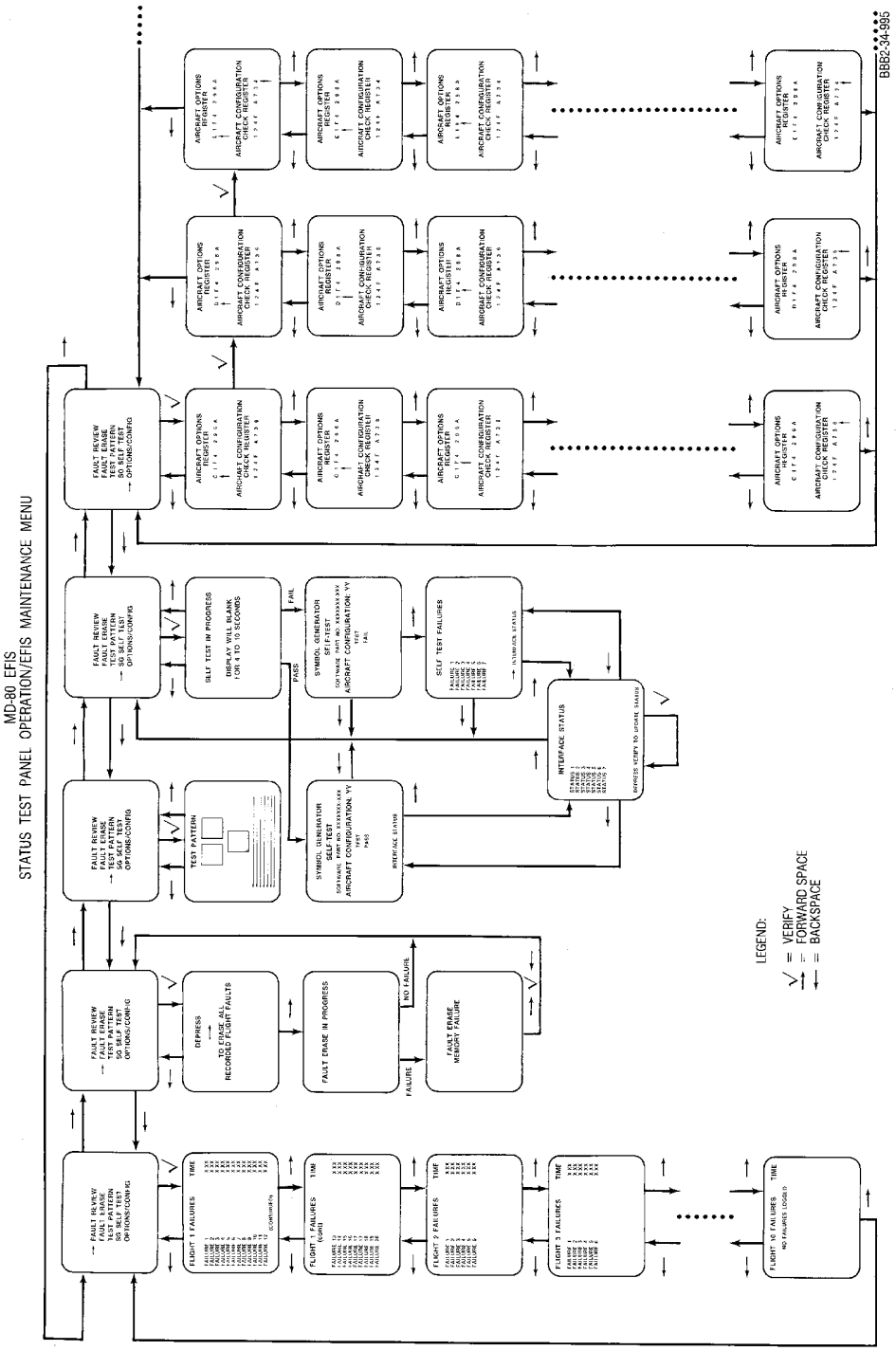
Circuit Breaker	Panel Location	Panel Area
CAPTAINS PFD	Overhead	EMER AC BUS
F.O.'S PFD	Upper EPC	RIGHT RADIO AC BUS
CAPTAINS ND	Overhead	EMER AC BUS
FIRST OFFICER'S ND	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1	Overhead	EMER AC BUS
SYMBOL GEN -2	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1 DEMOD (Aircraft with VG/DG)	Overhead	EMER AC BUS
SYMBOL GEN -2 DEMOD (Aircraft with VG/DG)	Upper EPC	RIGHT RADIO BUS
CAPTS/FMA/MSP	Upper EPC	LEFT RADIO DC BUS
F/OS FMA/MSP	Upper EPC	RIGHT RADIO DC BUS
CAPTAIN'S HSI & HEADING	Overhead	EMER AC BUS
FIRST OFFICER'S COURSE & HEADING	Upper EPC	RIGHT RADIO AC BUS
VHF-NAV-1	Overhead	EMER AC and DC BUSES
VHF-NAV-2	Upper EPC	RIGHT RADIO AC and DC BUSES
RADIO ALTIMETER-1	Upper EPC	LEFT RADIO AC BUS
RADIO ALTIMETER-2	Upper EPC	RIGHT RADIO AC BUS
DIGITAL FLIGHT GUIDANCE COMPUTER CIRCUIT BREAKERS	Upper EPC	RIGHT RADIO 28 VAC BUS LEFT RADIO 28 VAC BUS RIGHT RADIO AC BUS LEFT RADIO AC BUS RIGHT RADIO DC BUS LEFT RADIO DC BUS
GND PROXIMITY WARN COMPUTER	Upper EPC	LEFT RADIO AC BUS
GPW LIGHTS	Upper EPC	
AUTO THROTTLE -1	Upper EPC	LEFT RADIO AC and DC BUSES
AUTO THROTTLE -2	Upper EPC	
AUTOPILOT -1	Upper EPC	LEFT RADIO DC BUS
AUTOPILOT -2	Upper EPC	RIGHT RADIO DC BUS
MACH TRIM -1	Upper EPC	LEFT RADIO DC BUS

Table 201 (Continued)

Circuit Breaker	Panel Location	Panel Area
MACH TRIM -2	Upper EPC	RIGHT RADIO DC BUS
YAW DAMPER -1	Upper EPC	LEFT RADIO DC BUS
YAW DAMPER -2	Upper EPC	RIGHT RADIO DC BUS
G/S -1	Overhead	EMER DC BUS
G/S -2	Upper EPC	RIGHT RADIO DC BUS
LDG GEAR WARN	Lower EPC	MISC LEFT DC BUS
ANNUN/DGTL LTS	Lower EPC	LIGHTS -R DC BUS.
NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.		



EFIS Maintenance Menu
Figure 201/34-22-00-990-B63



EFIS Maintenance Menu -- STP Operation
Figure 202/34-22-00-990-B64

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 203/34-22-00-990-B65

3. Equipment and Materials

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed items:

Table 202

Name and Number	Manufacturer
TIC 30A or TIC 30B Signal Generator	TEL - Instrument Electronics Corp.
980N-1 Radio Altimeter Test Set	Collins

4. Adjustment/Test Electronic Flight Instrument System (EFIS)

NOTE: The following adjustment/test procedures provide for an on ground aircraft EFIS functional checks. Tests can be performed as a complete system test or as individual item tests.

A. Following is a Glossary of Acronyms used in the following tests procedures.

Table 203 Glossary of Acronyms

CAPTs----	Captains	ILS----------	Instrument Landing System
CMPVLD-	Computer Valid	MSP--------	Mode Select Panel
DH---------	Decision Height	ND----------	Navigation Display
DME-------	Distance Measuring Equipment	PFD---------	Primary Flight Display
CDP-------	Control and Dimming Panel	SG----------	Symbol Generator
EFIS-------	Electronic Flight Instrument System	STP---------	Status Test Panel
FMA--------	Flight Mode Annunciator	VOR--------	VHF Omnidirectional Range
F/O---------	First Officer	WXR--------	Weather Radar

B. The following ground mode criteria must be met before performing the Options/Check Register Word Test.

(1) Throttles full aft.

(2) Radio Altitude scale on Captain's and F/O's PFD.

(3) Aircraft weight on wheels.

(4) Nose gear Oleo switch in ground mode.

(5) Left and right ground control relay circuit breakers closed.

(6) Ground proximity computer installed.

C. Options/Check Register Words Test -- Preliminary

Table 204

Operation	Desired Result
(1) Set up Status Test Panel (STP).	STP set up and operational.
(2) On STP, check location of STP POWER button, SELECT button, BACKSPACE button, FORWARDSPACE button and VERIFY button. (Figure 204, Display A)	
(3) Press STP POWER button.	STP POWER on.
(4) Place EFIS/DFGS switch in EFIS position.	Switch in EFIS position.

Table 204 (Continued)

Operation	Desired Result
(5) Verify the 1 on STP SELECT button is illuminated. If 1 is not illuminated, press SELECT button.	STP SELECT button 1 is illuminated.
(6) SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND. (Figure 204, Display B)	Maintenance Menu displayed on Capt's PFD and ND.

D. Options/Check Register Words Test -- Programming Symbol Generator 1

Table 205

Operation	Desired Result
(1) Press FORWARDSPACE button on STP until arrow is pointing to selection OPTIONS/CONFIG. (Figure 205, Display A)	Arrow pointing to OPTIONS/ CONFIG.
(2) Press VERIFY button on STP and verify on PFD and ND and aircraft configuration placard have identical OPTION/ CHECK REGISTER WORDS. (Figure 205, Display B)	OPTION/CHECK REGISTER WORDS on PFD, ND and aircraft configuration placard are identical.
NOTE: OPTIONS/CHECK REGISTER WORDS: Shown on following figures are examples only. Check aircraft configuration placard for actual words.	
(3) Verify on PFD and ND that arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.	Arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.
(4) Press VERIFY button on STP, each press of button will roll digit one time. Continue to press VERIFY button until digit on PFD and ND matches same digit on aircraft placard. (Figure 206, Display A)	PFD and ND digits match placard.
(5) When digit is correct, press FORWARD SPACE button on STP to move to next digit on right. (Figure 206, Display B)	Arrow moves to next digit on right.
(6) Repeat steps (4) and (5) until options/ register and check register words on PFD and ND are same as aircraft placard.	Options/check register words same as aircraft placard.
(7) When right most digit of check register word is complete, press FORWARD SPACE button on STP. Display will return to main menu. (Figure 207)	Main menu display.

E. Options/Check Register Words Test -- Programming Symbol Generator 2

Table 206

Operation	Desired Result
(1) Place EFIS Mode Select panel switch to BOTH ON 2. Capt's PFD and ND should display EFI 2.	EFI 2 displayed.
(2) Press CMPVLD button on STP so 2 is illuminated on CMPVLD button.	CMPVLD button 2 illuminated.

Table 206 (Continued)

Operation	Desired Result
(3) Repeat steps (1) through (7) in Table 205 for programming SG 2, substituting 2 for 1.	Results same as programming symbol generator 1 test.

F. Verification of Programming Options -- Preliminary

NOTE: The following tests verify the options were programmed into the system correctly and options will be displayed. The tests also verify correct operation of the symbol generators and display units.

Table 207

Operation	Desired Result
CAUTION: RADIO RACK COOLING FANS MUST BE OPERATING DURING ANY EFIS TEST OPERATIONS.	
(1) Place EFIS switch in NORM position.	Switch in NORM position.
(2) Make certain STP power is off.	STP power off.
(3) Verify Capt's ND and PFD displays are normal.	ND and PFD displays normal.
(4) Verify on Capt's ND words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.	
(5) Set up TIC-30 A or B generator.	TIC 30 generator set up.
(6) Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 MHz).	VHF NAV receivers tuned to ILS frequency.
(7) Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSP MODE select switch in ROSE position.

G. Verification of Programming Options -- Uncrossed Navigation and G/S Side Selection Options

Table 208

Operation	Desired Results
(1) Press and hold G/S switch on the TIC-30 generator.	
(2) Open VHF NAV-2 DC circuit breaker.	Circuit breaker open.
NOTE: On aircraft 131-132 the circuit breaker is VHF NAV-2 and not VHF NAV-2 DC.	
(3) Verify that G/S FAIL appears on right side of F/O's PFD and ND screen.	G/S FAIL displayed on F/O's PFD and ND screens.
(4) Verify symbology on Capt's and F/O's PFD and ND per Figure 208. Disregard any other symbology displayed.	PFD and ND displays per Figure 208.
(5) Close VHF NAV-2 DC circuit breaker and verify G/S FAIL message disappears.	G/S FAIL message disappears.

H. Verification of Programming Options -- Split Cue Flight Director Display and Rising Runway Option

Table 209

Operation	Desired Results
(1) Verify symbology on Capt's and F/O's PFD is split cue display. (Figure 209, Display A)	Split cue display on Capt's and F/O's PFD.
(2) Tune VHF NAV-1 and VHF NAV-2 to an ILS frequency (Example, 108.10 Mhz).	VHF receivers tuned to ILS frequency.
(3) TIC-30 generator set up.	TIC-30 generator set up.
(4) Press and hold LOC switch down on TIC-30 generator.	LOC switch in down position.
(5) Verify rising runway symbology displayed on Capt's and F/O's PFD. Disregard any other symbology displayed. (Figure 209, Display B)	

WJE 410

I. Verification of Programming Options -- No ILS Beam Deviation Warning

Table 210

Operation	Desired Results
(1) Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-18, station 110.	
(2) Tune VHF NAV-1 and VHF-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3) Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4) Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5) Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6) On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7) Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8) Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale and not flashing.	G/S deviation indicator at top of scale on PFD and is not flashing.
(9) Verify G/S deviation symbology on PFD's is per Figure 210.	Display per Figure 210.
(10) Release G/S switch on TIC generator.	
(11) Remove 980N-1 test set.	
(12) Remove ground jumpers from terminal 52 and terminal 28.	

WJE 406

J. Verification of Programming Options -- ILS Beam Deviation Warning

WJE 406 (Continued)

Table 211

Operation	Desired Results
(1) Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-18, station 110.	
(2) Tune VHF NAV-1 and VHF-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3) Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4) Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5) Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6) On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7) Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8) Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale and flashing.	G/S deviation indicator at top of scale on PFD and is flashing.
NOTE: When -905 symbol generators are installed, the G/S deviation scale will change color from white to amber, and the indicator will flash.	
(9) Verify G/S deviation symbology on PFD's is per Figure 210.	Display per Figure 210.
(10) Release G/S switch on TIC generator.	
(11) Remove 980N-1 test set.	
(12) Remove ground jumpers from terminal 52 and terminal 28.	

WJE 406, 410; BEFORE AVIONICS UPGRADE MOD

K. Verification of Programming Options -- AHRS Option

Table 212

Operation	Desired Results
(1) Verify following circuit breakers are closed: AHRS-1 (Overhead) AHRS-1 (Upper EPC) AHRS-2 (Upper EPC)	Circuit breakers closed.
(2) Verify symbology on Capt's and F/O's PFD are per Figure 211.	Symbology per Figure 211.

L. Verification of Programming Options -- Long Range Navigation and Track Options (aircraft with Omega)

Table 213

Operation	Desired Results
(1) Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2) Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3) Verify MAP symbology on Capt's and F/O's ND is per Figure 212. Disregard all other symbology.	MAP displays per Figure 212.

M. Verification of Programming Options -- ETA and DTW and Track Options (aircraft with Omega)

Table 214

Operation	Desired Results
(1) Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2) Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3) Verify MAP symbology on Capt's and F/O's ND is per Figure 213. Disregard all other symbology.	MAP displays per Figure 213.

N. Verification of Programming Options -- DME-1 and DME-2 Option

Table 215

Operation	Desired Results
(1) Place Capt's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(2) Place F/O's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(3) Verify DME symbology is displayed on Capt's and F/O's ND per Figure 214.	DME symbology displayed on NDs.

O. Verification of Programing Options -- ADF Bearing Option (if installed)

Table 216

Operation	Desired Results
(1) Make certain ADF circuit breakers are closed.	ADF circuit breakers closed.
(2) Tune ADF CNTRL PNL knobs to dissimilar local frequencies.	ADF-1 and ADF-2 are tuned.
(3) Place Capt's and F/O's MSP mode select switch in ROSE position.	MSP mode select switch in ROSE position
(4) Place Capt's and F/O's MSP center knobs in ADF position.	MSP center knobs in ADF position.
NOTE: If installed, place both the ADF/ANT switches on the ADF CNTRL PNL to the ADF position.	
(5) Verify ADF symbology display on Capt's and F/O's ND's.	Symbology per Figure 215.
(6) Place Capt's and F/O's MSP center knobs in OFF position.	MSP center knobs in OFF position.

P. Mode Select Panel Functional Test -- Rose Mode

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 217

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(2) Place F/O's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(3) Verify Rose mode symbology is displayed on Capt's and F/O's ND. (Figure 216)	Rose mode symbology displayed.

Q. Mode Select Panel Functional Test -- ARC MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 218

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(2) Place F/O's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(3) Verify ARC mode symbology is displayed on Capt's and F/O's ND. (Figure 217)	ARC mode symbology displayed.

R. Mode Select Panel Functional Test -- MAP MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 219

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(2) Place F/O's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(3) Verify MAP mode symbology is displayed on Capt's and F/O's ND. (Figure 218)	MAP mode symbology displayed.

S. Mode Select Panel Functional Test -- Range Selector

Table 220

Operation	Desired Result
(1) Place Capt's and F/O's MSP mode selector switch in ARC position.	
(2) Rotate Capt's WX OFF control on Captain's CDP to full clockwise position.	WXR FAIL displayed on Capt's ND.

Table 220 (Continued)

Operation	Desired Result
(3) Rotate F/O's WX OFF control on F/O's CDP to full clockwise position.	WXR FAIL displayed on F/O's ND.
(4) Place RANGE selector on Capt's and F/O's MSP in each range listed following: 10 80 20 160 40 320	Verify range index number in location on NDs as in Figure 219. 5 40 10 80 20 160
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.	
(5) Rotate Capt's and F/O's WX OFF control to OFF position.	WXR FAIL display on Capt's and F/O's ND blanked out.

T. NAV/RAD Switch Functional Test

Table 221

Operation	Desired Result
(1) Place Capt's and F/O's mode select panel (MSP) to ROSE position.	Capt's and F/O's MSP to ROSE position.
(2) On Capt's and F/O's respective MSP, place NAV/RAD switch to RAD position.	Capt's and F/O's MSP NAV/RAD switch to RAD.
(3) Place Capt's NAV/RAD switch to NAV position and verify NAV displayed at bottom of Capt's ND.	Capt's ND displays NAV.
(4) Place Capt's NAV/RAD switch to RAD position.	Capt's switch to RAD.
(5) Place F/O's NAV/RAD switch to NAV position and verify NAV displayed at bottom of F/O's ND.	F/O's ND displays NAV.
(6) Place F/O's NAV/RAD switch to RAD position.	F/O's switch to RAD.

U. PFD/ND Manual Brightness Test

Table 222

Operation	Desired Result
(1) Place Capt's MSP selector switch to ARC position.	MSP switch in ARC position.
(2) Rotate the Control and Dimming Panel (CDP) PFD knob counterclockwise.	Capt's PFD decreases in brightness.
(3) Rotate CDP PFD knob clockwise.	Capt's PFD increases in brightness.
(4) Rotate CDP ND knob counterclockwise.	Capt's ND decreases in brightness.
(5) Rotate CDP ND knob clockwise.	Capt's ND increases in brightness.
(6) Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.
(7) Repeat steps (2) through (5) substituting F/O's for Capt's.	Results same as steps (2) through (5).

V. Captain's and First Officer's Decision Height Test

Table 223

Operation	Desired Result
(1) Rotate DH knob on Capt's CDP clockwise. Check for display number on Capt's PFD in the top right corner. (Figure 220)	DH number increases.
(2) Rotate DH knob counterclockwise.	DH number decreases.
NOTE: DH number will blank when DH number is less than 0 (zero) feet.	
(3) Rotate DH knob on F/O's CDP clockwise. Check for display number on F/O's PFD in the top right corner. (Figure 220)	DH number increases.
(4) Rotate DH knob counterclockwise.	DH number decreases.

W. ND and PFD Compact Mode Test

Table 224

Operation	Desired Result
(1) Rotate ND BRT knob on Capt's CDP counterclockwise to the detent position.	ND BRT knob counterclockwise to detent position.
(2) Verify compact mode symbology display is on Capt's PFD as shown in Figure 221.	Compact mode display on Capt's PFD per Figure 221.
(3) Rotate ND BRT knob full clockwise.	Displays return to normal.
(4) Rotate PFD BRT knob on Capt's CDP counterclockwise to detent position.	PFD BRT knob counterclockwise to detent position.
(5) Verify compact mode symbology display on Capt's ND as shown in Figure 221.	Compact mode display on Capt's ND per Figure 221.
(6) Rotate PFD BRT knob full clockwise.	Displays return to normal.
(7) Repeat steps (1) through (6) substituting F/O's test procedures.	F/0's results same as Capt's desired results.

X. ND and PFD Auto Brightness Tests

NOTE: The following test verifies that the remote light sensor (RLS) and the display unit photocells will provide brightness boost to ND's and PFD's in high intensity light conditions.

Table 225

Operation	Desired Results
(1) Shine flashlight on each photocell area of Capt's and F/O's PFD and ND. (Figure 222 for photocell location on ND's and PFD's)	Note increase in ND's and PFD's brightness.
(2) Cover the RLS located on glareshield with your hand for approximately 5 seconds.	
(3) Remove your hand from RLS and shine flashlight on the RLS.	PFD's and ND's increase in brightness.
(4) Remove flashlight.	PFD's and ND's brightness returns to previous brightness.

Y. Instrument Comparator Monitoring Test -- Capt's and F/O's FMA Lamp Test and SG Crosstalk Test

NOTE: The following tests verify the FMA lamps come on and symbol generators crosstalk bus is operating correctly.

Table 226

Operation	Desired Result
(1) Press and release Annunciator/Digital Light Test button.	Verify all FMA lamps come on.
NOTE: Disregard Starbursts on FMAs.	
(2) Release test button and verify Capt's FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.	FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.
(3) Repeat steps (1) and (2) substituting F/O's for Capt's in test procedures.	Desired results same as Capt's.
(4) Open SG-1 Power circuit breaker.	F/O's FMA Monitor lamp comes on.
(5) Close SG-1 Power circuit breaker.	F/O's FMA Monitor lamp goes off.
(6) Open SG-2 Power circuit breaker.	Capt's FMA Monitor lamp comes on.
(7) Close SG-2 Power circuit breaker.	Capt's FMA Monitor lamp goes off.

Z. Symbol Generator Switching Tests

NOTE: The following test verifies that NDs and PFDs can be driven by the off-side symbol generator.

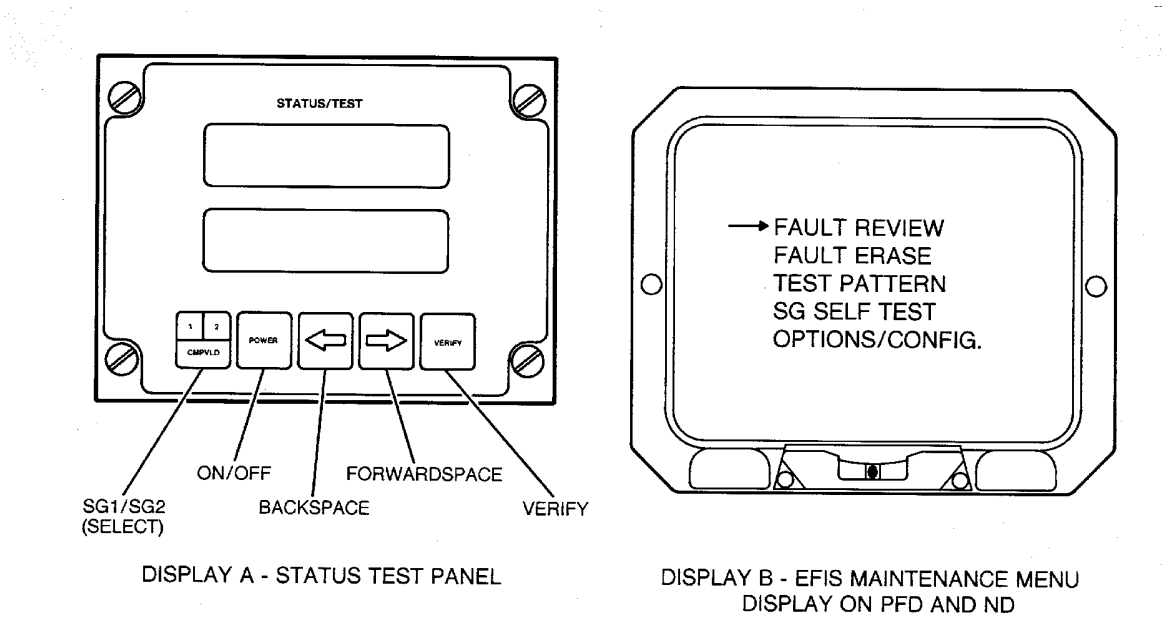
Table 227

Operation	Desired Result
(1) Place Capt's and F/O's MSP selector switch in ARC position.	MSP switch in ARC mode.
(2) Place EFIS switch to BOTH ON 1 position.	EFIS switch in BOTH ON 1 position.
(3) Verify symbology on Capt's and F/O's ND and PFD display EFI 1. (Figure 223, Display A)	PFD and ND display EFI 1 symbology per Figure 223, Display A.
(4) Place EFIS to BOTH on 2 position.	EFIS switch in BOTH ON 2 position.
(5) Verify symbology on Capt's and F/O's ND and PFD display EFI 2. (Figure 223, Display B)	PFD and ND display EFI 2 symbology per Figure 223, Display B.
(6) Return EFIS switch to NORM position.	EFIS switch in NORM position.

AA. EFIS SELF TEST

Table 228

Operation	Desired Result
(1) Press FORWARD SPACE key on STP until arrow is pointing to SG SELF TEST on STP.	Verify Capt's PFD and ND display like Figure 224, Display A.
(2) Press VERIFY key on STP. This initiates self test.	Verify Capt's ND display like Figure 224, Display B.



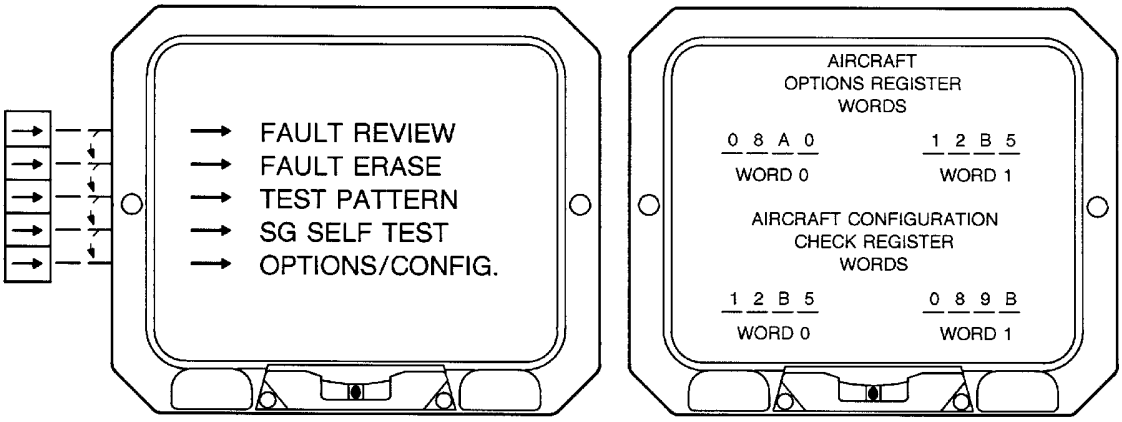
DISPLAY A - STATUS TEST PANEL

DISPLAY B - EFIS MAINTENANCE MENU DISPLAY ON PFD AND ND

CAG(IGDS)

BBB2-34-1294

Status Test Panel and Maintenance Menu Display on PFD and ND
Figure 204/34-22-00-990-B66



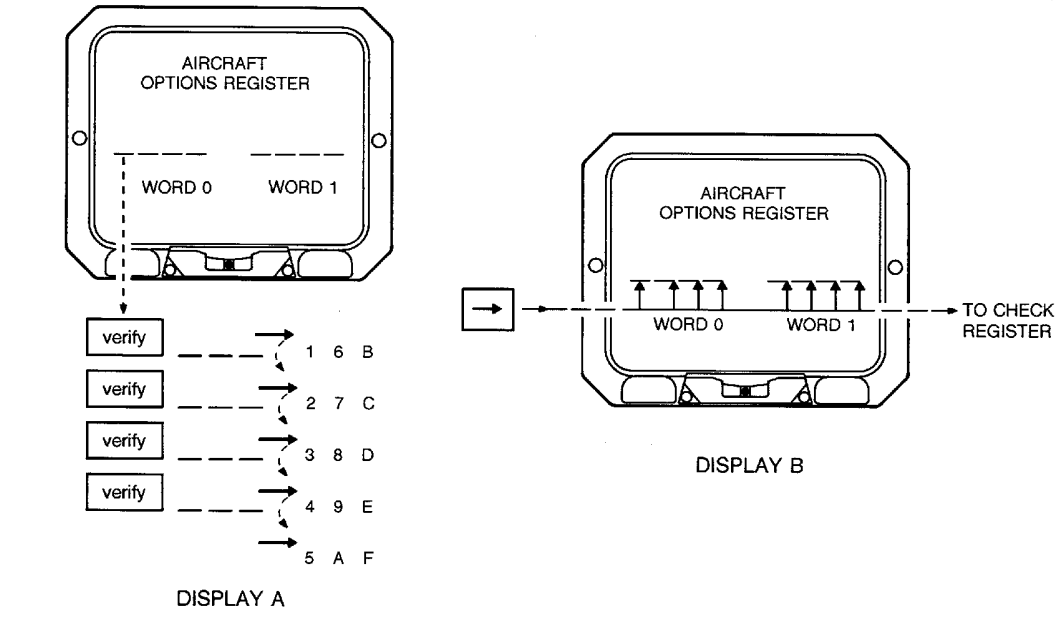
DISPLAY A
EFIS MAINTENANCE MENU
(DISPLAYED ON PFD AND ND)

DISPLAY B
OPTION/CHECK REGISTER WORDS

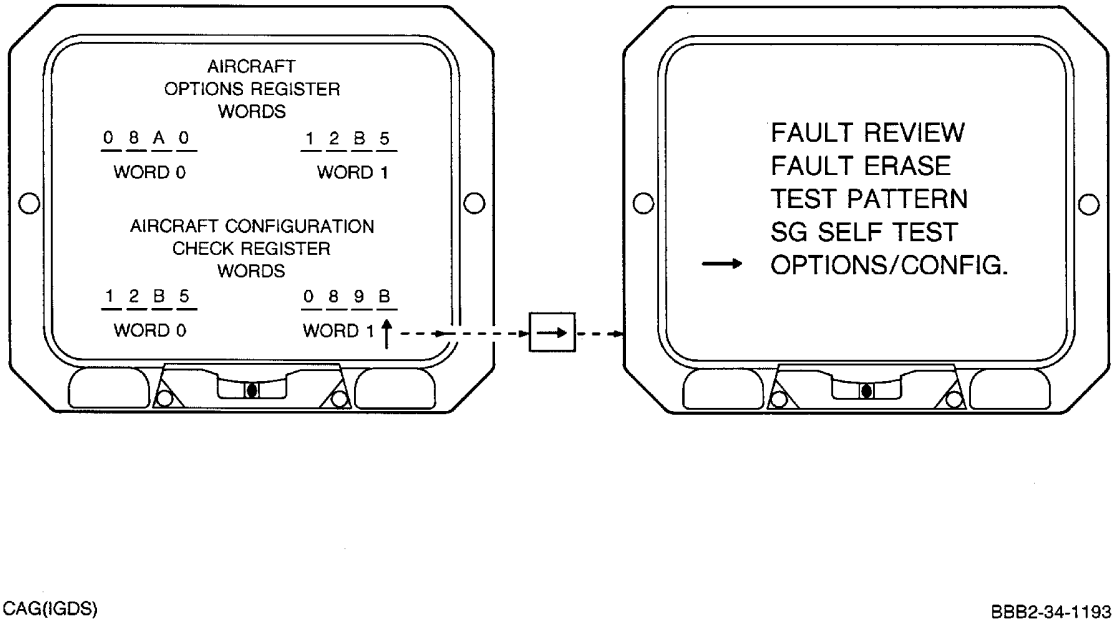
CAG(IGDS)

BBB2-34-1191

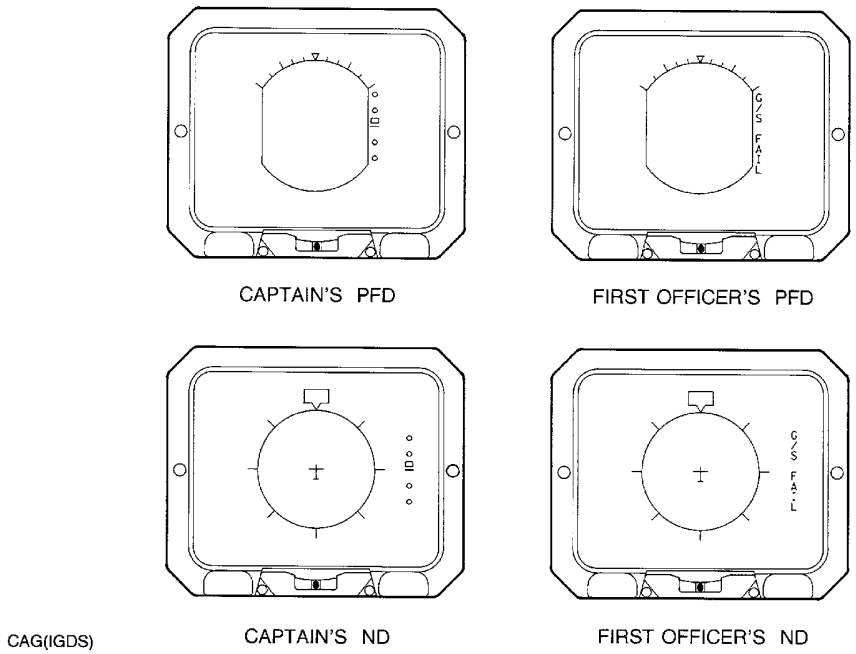
Options/Check Register Words Displays
Figure 205/34-22-00-990-B67



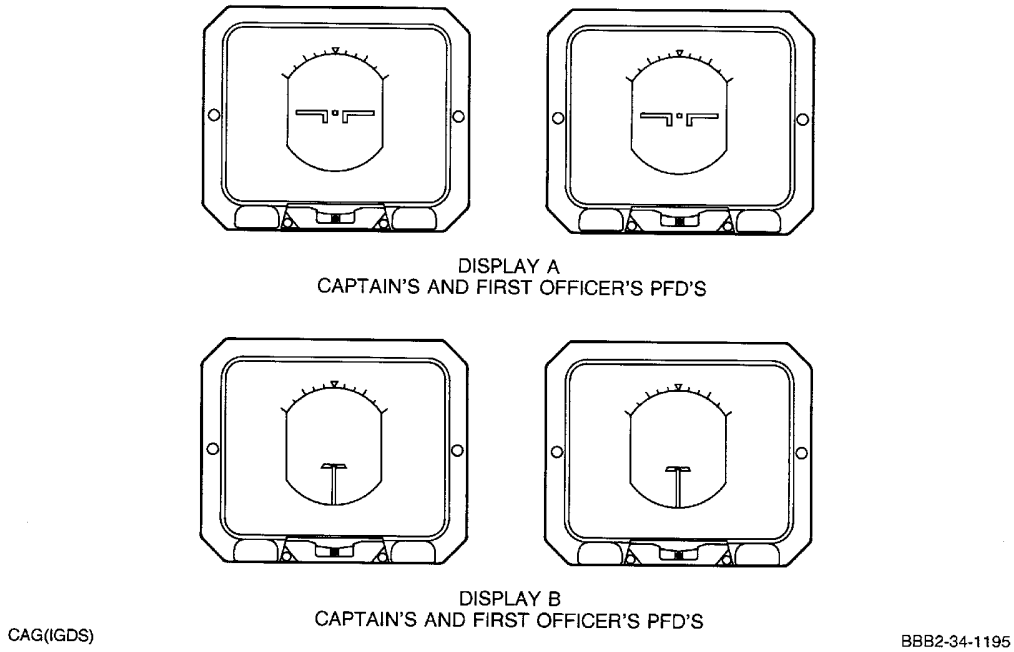
Aircraft Options Register
Figure 206/34-22-00-990-B68



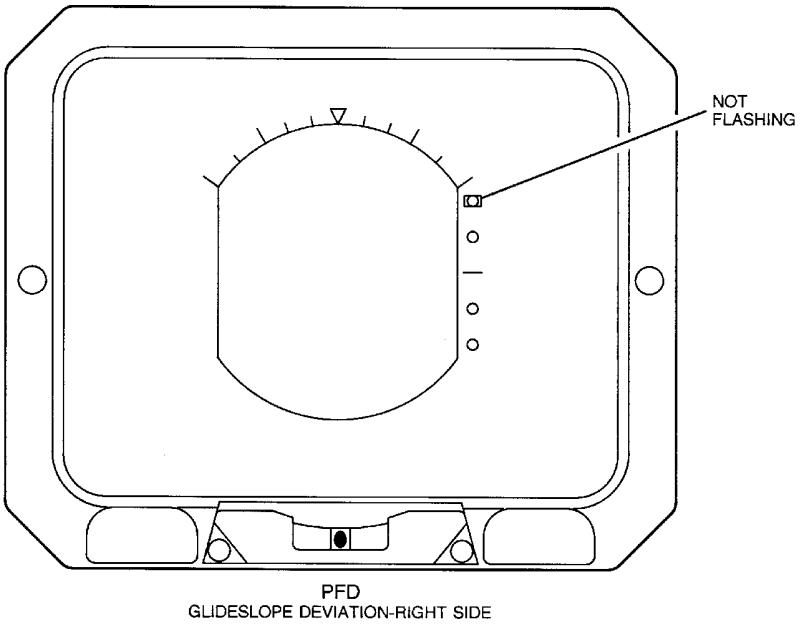
Options Register and Check Register Words and Main Menu Display Return
Figure 207/34-22-00-990-B69



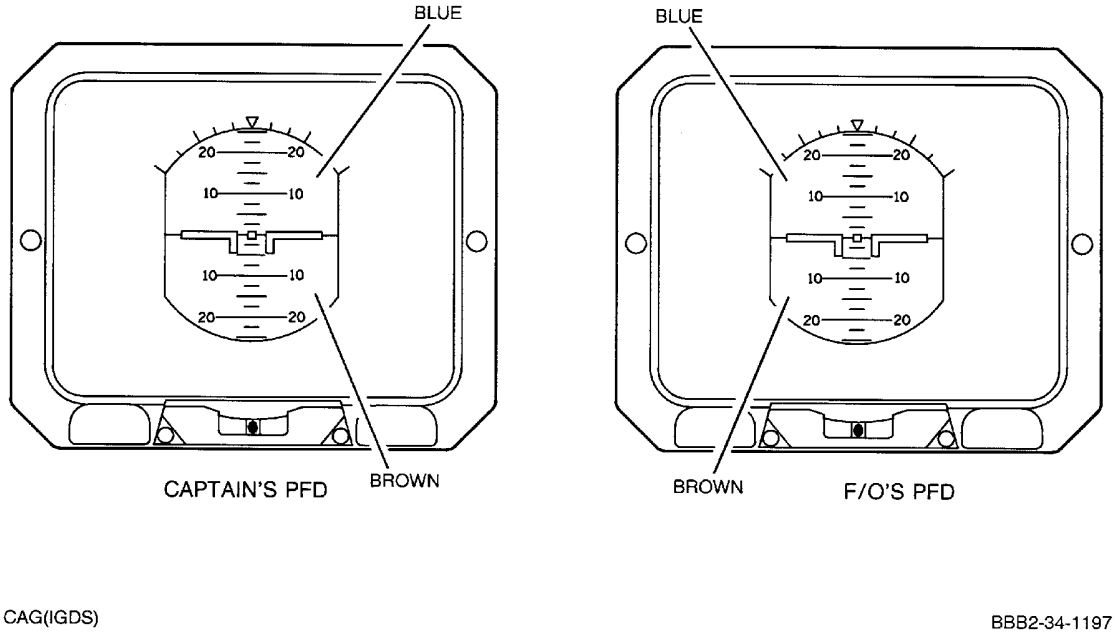
Uncrossed Navigation and G/S Side Selection Options
Figure 208/34-22-00-990-B70



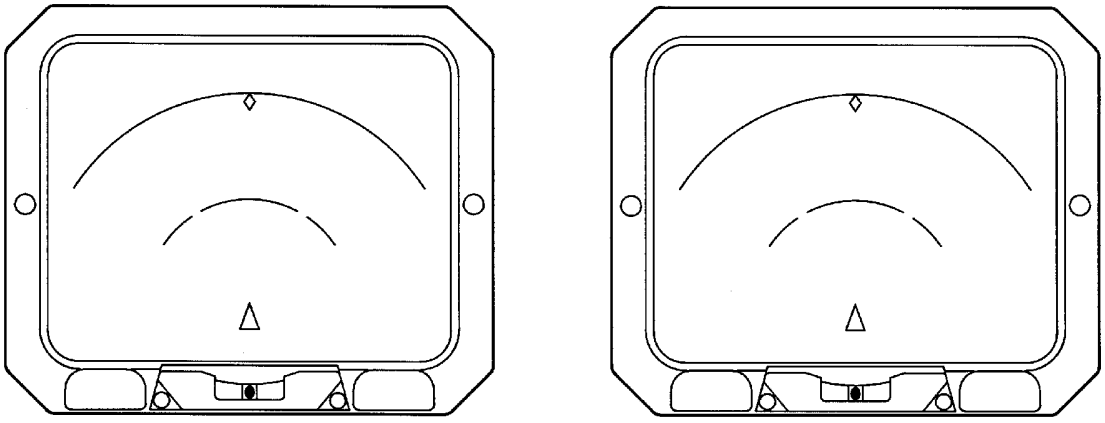
Split Cue Flight Director Display and Rising Runway Display
Figure 209/34-22-00-990-B71



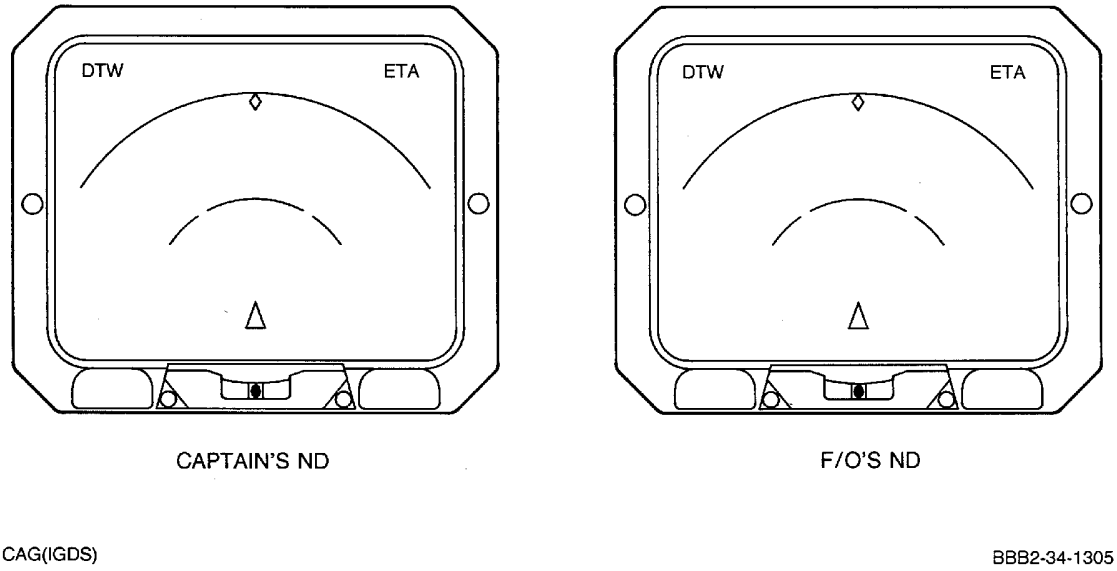
Split Cue Flight Director Display and ILS Beam Deviation Warning Display
Figure 210/34-22-00-990-B72



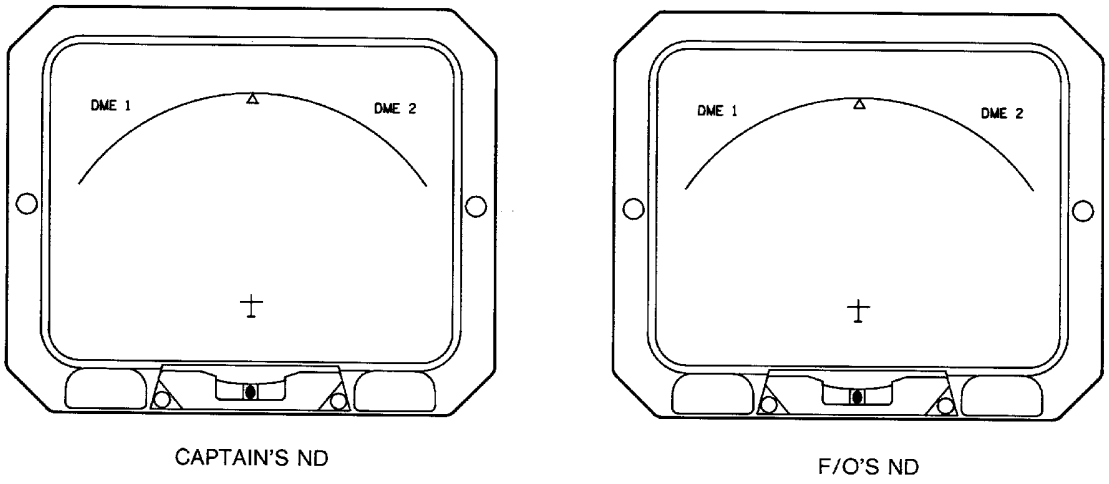
AHRS Option PFD Display
Figure 211/34-22-00-990-B73



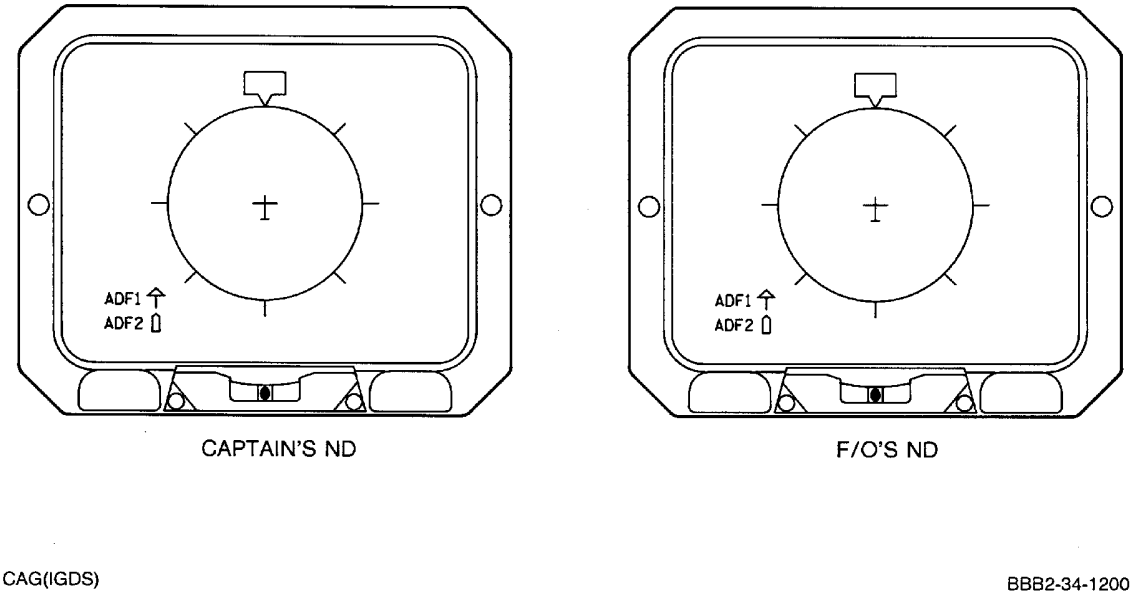
Navigation Display (ND) MAP Display
Figure 212/34-22-00-990-B74



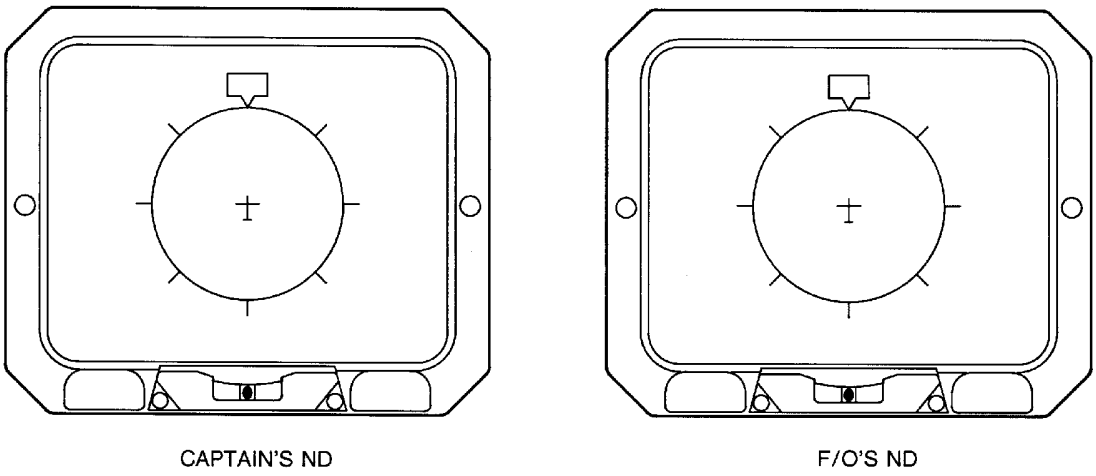
Navigation Display (ND) ETA and DTW MAP Display
Figure 213/34-22-00-990-B75



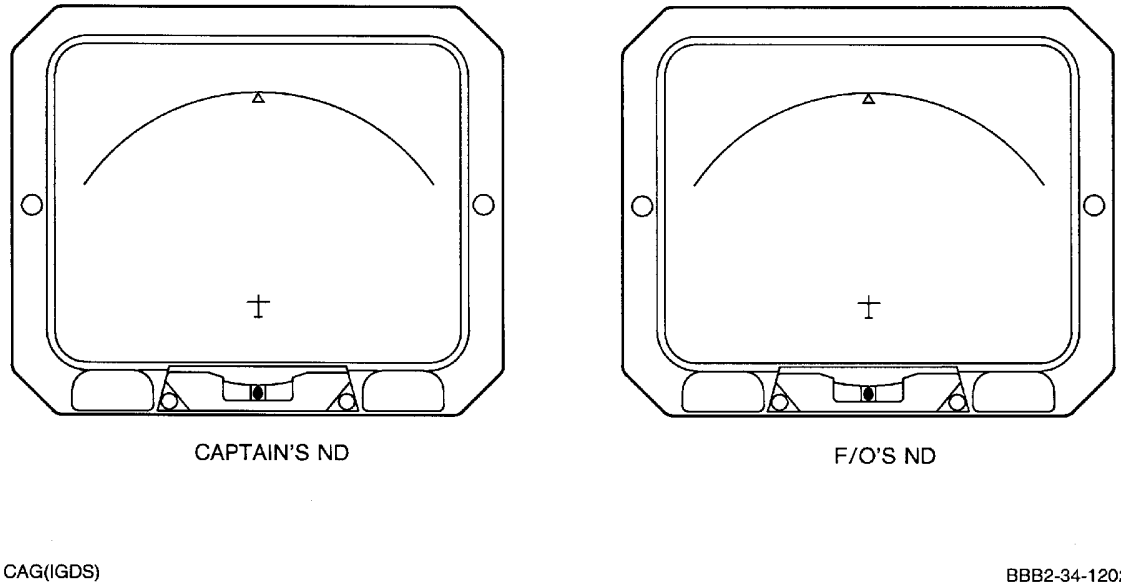
Navigation Display (ND) DME Displays
Figure 214/34-22-00-990-B76



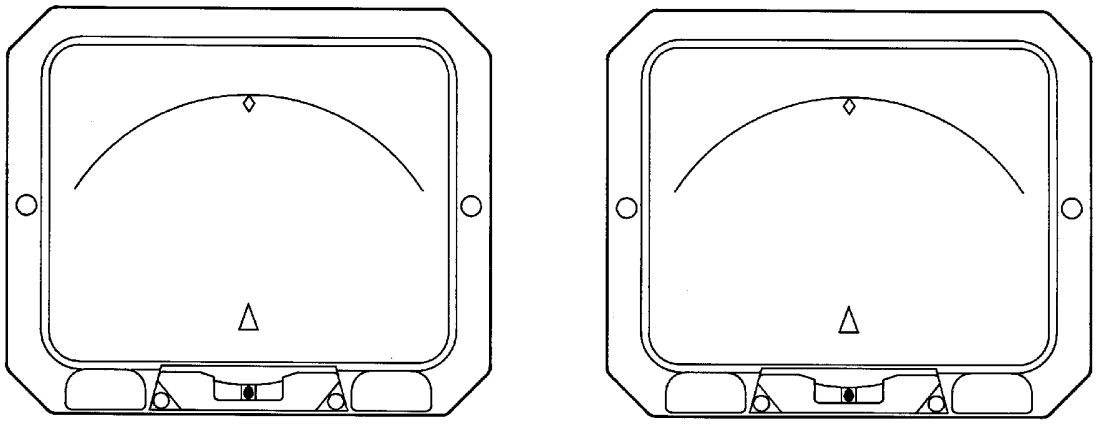
ADF Bearing Display
Figure 215/34-22-00-990-B77



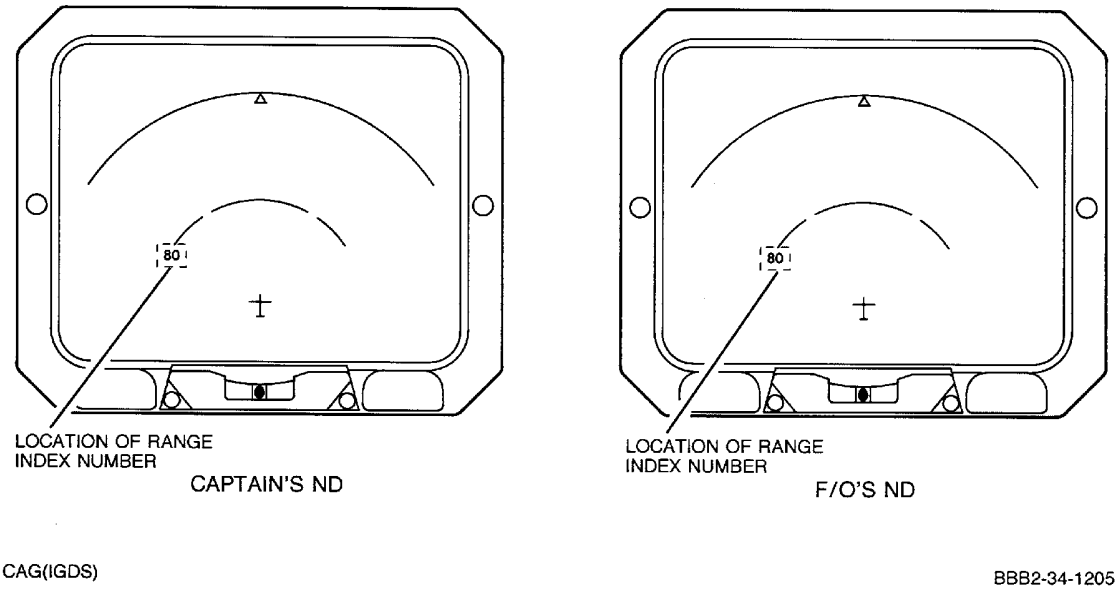
Rose Mode Display on ND's
Figure 216/34-22-00-990-B78



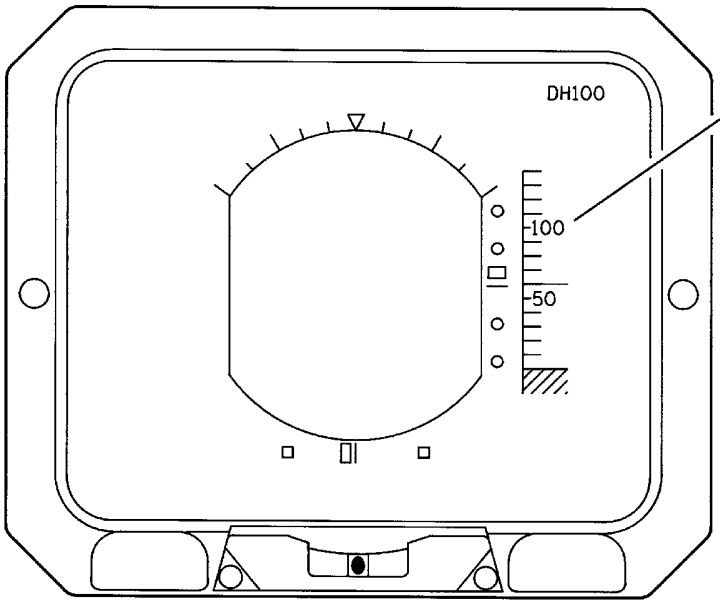
ARC Mode Display on ND's
Figure 217/34-22-00-990-B79



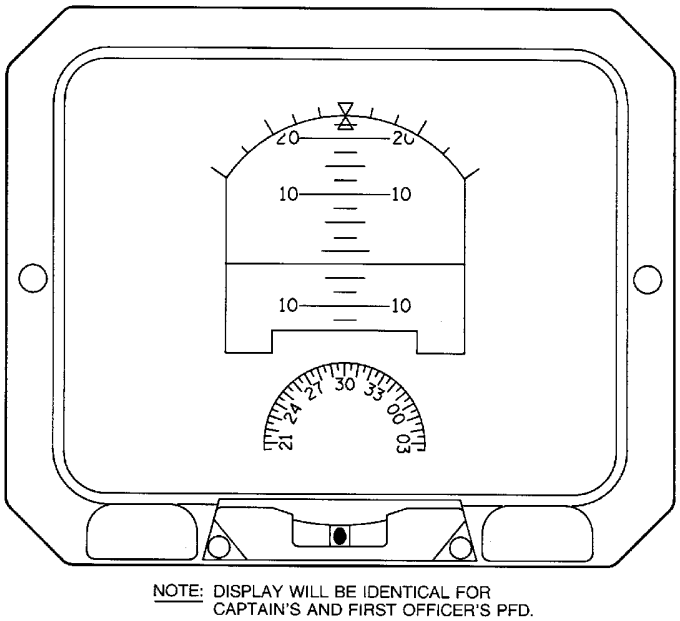
MAP Mode Display on ND's
Figure 218/34-22-00-990-B80



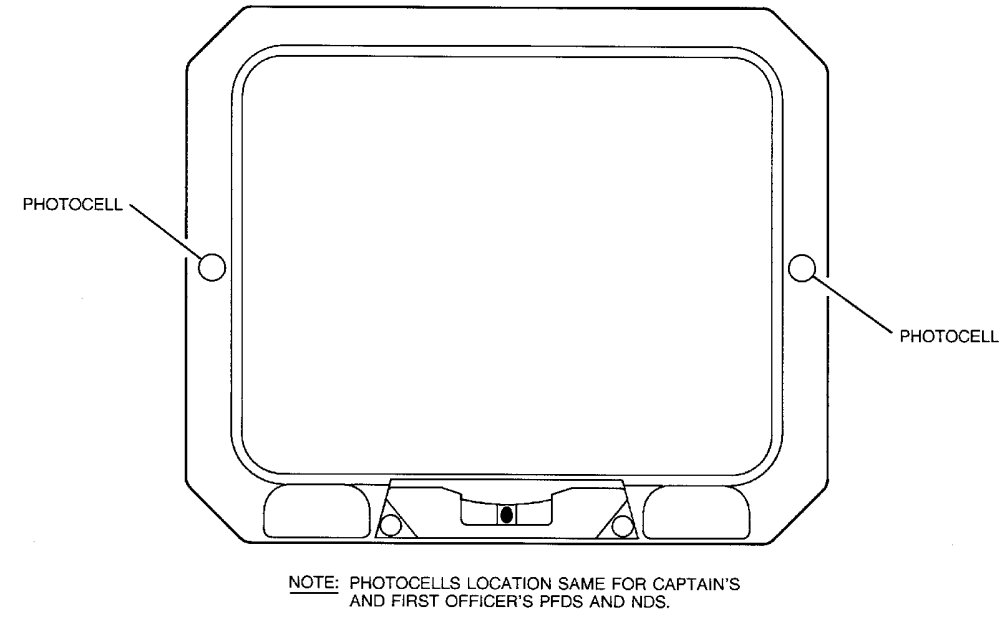
Range Selector Displays
Figure 219/34-22-00-990-B81



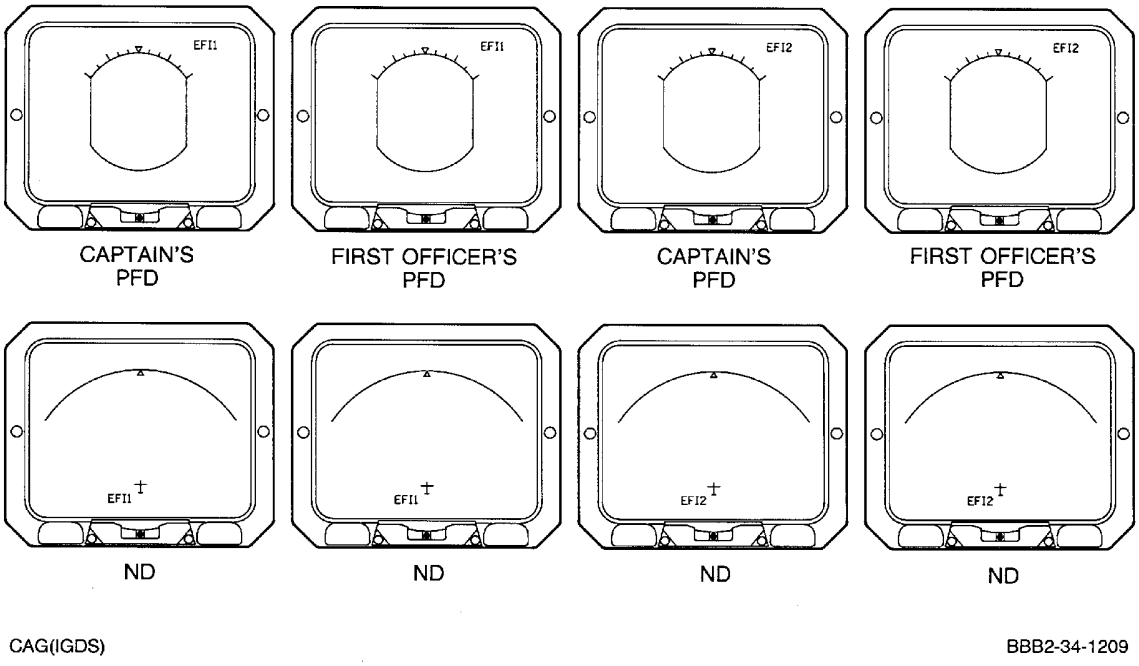
Decision Height Display On PFD
Figure 220/34-22-00-990-B82



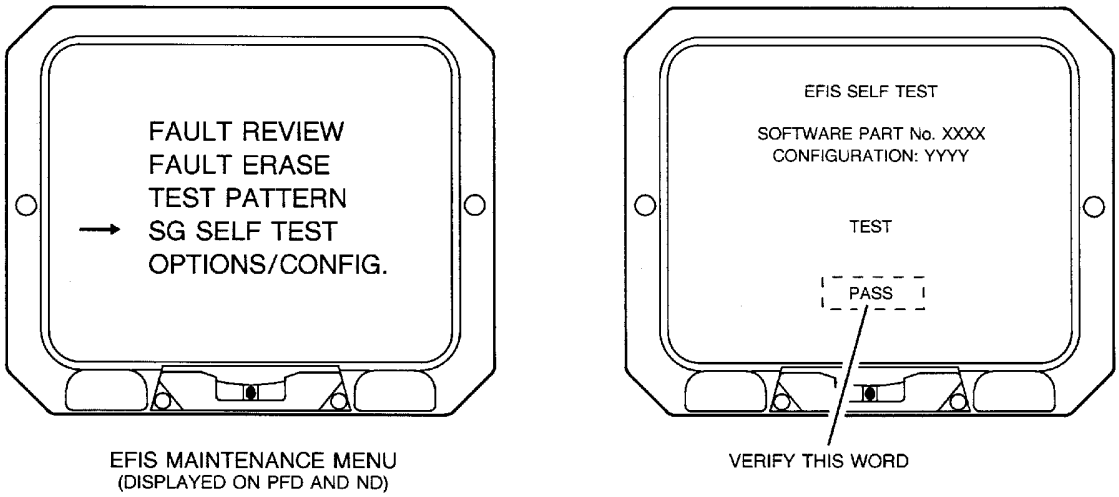
ND and PFD Compact Mode Displays
Figure 221/34-22-00-990-B83



PFD's and ND's Photocell Locations
Figure 222/34-22-00-990-B84



PFD and ND EFIS Switching Display
Figure 223/34-22-00-990-B85



EFIS Self Test Display on Captain's ND
Figure 224/34-22-00-990-B86

NAVIGATION DISPLAYS - MAINTENANCE PRACTICES

1. General Maintenance Features

A. This section contains an overview of the maintenance practices required for the electronic flight instrument system (EFIS). This is followed by a complete listing of circuit breakers for the EFIS and interfacing systems which must be closed when performing system tests. Ground maintenance consists of the following:

(1) Options/Configuration programming of the symbol generator. This is performed only when a new SG is installed on the aircraft, or when a SG is transferred from another aircraft. Each aircraft has its own "finger print" which must be fed into the SG upon installation. Options/Config. programming matches the SG software to the aircraft wiring.

(2) SG Self Test - Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Status Test Panel (STP).

(3) EFIS System Self-Test (BIT) - This 3-second test is initiated from the TEST pushbutton on the control and dimming panel (CDP). Used to test the following systems which provide inputs to the SG: VOR/ILS, radio altimeter, marker beacon. The EFIS system self-test includes a failure flag test.

All input systems tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the test pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions.

(4) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons and Taxi Speed, if installed.

B. To Perform a Complete System Test - The symbol generator is the heart of the EFIS, so thorough testing of the SG ensures proper operation of the system. The maintenance practices for the symbol generator include all of the above-mentioned tests. To perform a thorough system test, perform the symbol generator maintenance practices. Separate LRU functional tests are also provided for the EFIS Control and Dimming Panel (CDP), Mode Select Panel (MSP), Display Units (PFD/ND), and Remote Light Sensor (RLS). These are to be performed following removal/installation of the LRU's. (EFIS SYMBOL GENERATOR, SUBJECT 34-22-10, Page 201)

2. General Maintenance Practices

A. The following instructions contain a detailed explanation of how the STP is used in conjunction with the EFIS Maintenance Menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS Maintenance Menu and TEST pushbutton (BIT) are used in performing a complete system test.

B. Status Test Panel - The Status Test Panel (STP) pushbuttons are used to call up the EFIS Maintenance Menu display on the PFD/ND. In order to use the STP pushbuttons for this purpose, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. When the aircraft is on the ground and power to the STP is on, the Maintenance Menu appears on both the PFD and ND of the system being tested. (Figure 201)

C. The EFIS Maintenance Menu - There are five menu pages which can be selected from the Maintenance Menu: FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The TEST PATTERN is used for bench tests and is not included in the Maintenance Practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the Maintenance Menu, and pressing the VERIFY pushbutton on the STP. The FORWARD and BACKSPACE keys are used to move the cursor vertically on the Maintenance Menu. The following five selections can be made from the EFIS Maintenance Menu: (Figure 201 and Figure 202)

(1) Fault Review - Used in trouble shooting the EFIS only, to read failures logged in the flight log. The fault code consists of two 3-digit numbers. The first digit is the SG (or system) number. The next two digits are Fault ID numbers; these are main category fault classifications. The last three digits are the Fault Code Numbers; they are subordinate to the Fault ID numbers. The Fault ID and Fault Code are used to provide a complete fault definition. Fault messages appear on the Fault Review screen next to the 6-digit entries. An "-R" after the message indicates a repeat failure. The fault messages are followed by a Time entry, which is the time into the flight leg from takeoff. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101 for complete listing of EFIS Fault Codes)

(2) Fault Erase - This mode is used to erase all flight faults from the flight log. The cursor is cycled to the FAULT ERASE selection on the menu, and the VERIFY key is pressed. Pressing the FORWARD SPACE key at this time will cause all flight faults to be erased. Pressing BACKSPACE or VERIFY will abort the erase function. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101)

(3) Test Pattern - The test pattern is used in bench testing only. The test pattern is a color display of stroke-drawn lines and raster patches. The lines consists of one line for each stroke color: cyan, yellow, green, red, dim white, white and magenta. The three patches are raster patches, one for each of the raster test colors: blue, green and red.

(4) SG Self-test - This is a comprehensive test for the system SG's and all interfacing systems. This three second test generates two displays: the Interface Status page, containing ID codes, fault codes and fault messages for all currently monitored interface failures, and the self-test failures page, listing diagnostic numbers of all internal SG failures.

(5) Options/Config. - This mode is used by maintenance personnel whenever a new SG is installed. It allows the user to enter or modify the aircraft configuration and options words. These words are located on a placard next to the STP mode select switch (EFIS/DFGS). When -905 symbol generators are installed, MAINT CHECK will appear on both displays if the option words of SG1 do not match the option words of SG2. If an incompatibility exists between the check register, the options register, and the configuration identificaton, MAINT CHECK will appear on both displays. This would normally occur if one SG is replaced but has not had the check register and options registers modified to reflect the current aircraft configuration. When -905 symbol generators are installed, MAINT CHECK will appear on the display of the failed SG only.

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

D. TEST Pushbutton - Control and Dimming Panel (CDP): The TEST pushbutton is used during the SG Maintenance Practices to self-test interfacing systems and display unit failure flags. There are separate TEST pushbuttons for system-1 and system-2, on the Capt's and F.O.'s CDP's. Pressing the TEST pushbutton VOR/ILS, Radio Altimeter, and Marker Beacon self-tests. The appropriate test responses are under the control of the respective receiver units. When testing a single parameter (i.e., radio altimeter), all other symbology appearing on the display screens should be ignored. The test is successful if the appropriate failure/flag/warning replaces the parameter on the display screen (i.e., an R/A FAIL flag will replace the radio altimeter tape on the PFD).

The TEST pushbutton also initiates a failure flag test, and DH aural warning test (if installed). The DH aural warning test consists of a one-second tone slewing from 400 to 800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. (Figure 203)

E. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons and Taxi Speed are also tested, if installed.

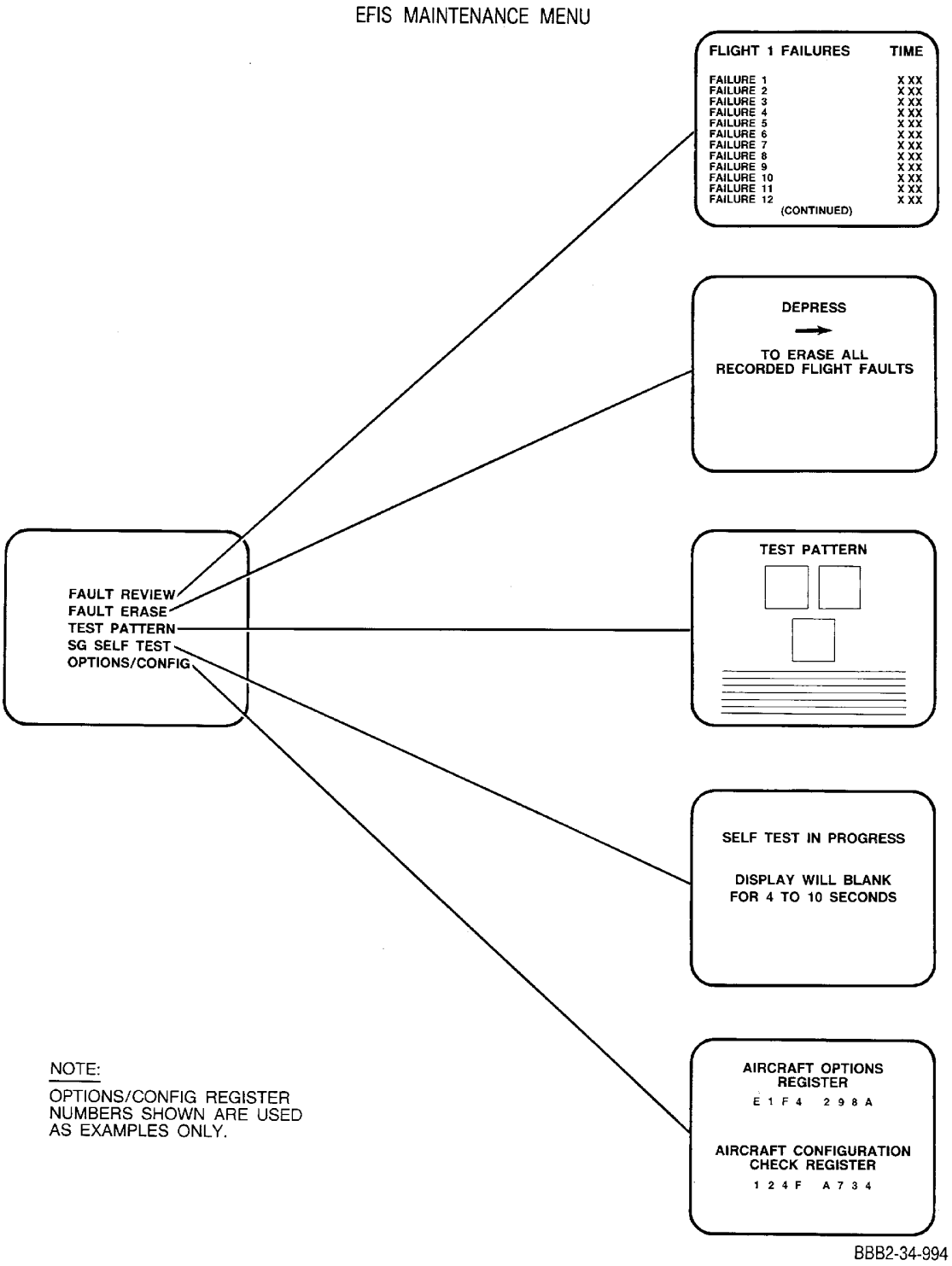
F. Circuit Breakers for EFIS and Interfacing Systems

Table 201

Circuit Breaker	Panel Location	Panel Area
CAPTAINS PFD	Overhead	EMER AC BUS
F.O.'S PFD	Upper EPC	RIGHT RADIO AC BUS
CAPTAINS ND	Overhead	EMER AC BUS
FIRST OFFICER'S ND	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1	Overhead	EMER AC BUS
SYMBOL GEN -2	Upper EPC	RIGHT RADIO AC BUS
CAPT/FMA/MODE SELECT LIGHTING	Upper EPC	LEFT RADIO DC BUS
F/O FMA/MODE SELECT LIGHTING	Upper EPC	RIGHT RADIO DC BUS
CAPTAIN'S HSI & HEADING	Overhead	EMER AC BUS
FIRST OFFICER'S COURSE & HEADING	Upper EPC	RIGHT RADIO AC BUS
VHF-NAV-1	Overhead	EMER AC and DC BUSES
VHF-NAV-2	Upper EPC	RIGHT RADIO AC and DC BUSES
RADIO ALTIMETER-1	Upper EPC	LEFT RADIO AC BUS
RADIO ALTIMETER-2	Upper EPC	RIGHT RADIO AC BUS
DIGITAL FLIGHT GUIDANCE COMPUTER CIRCUIT BREAKERS	Upper EPC	RIGHT RADIO 28 VAC BUS LEFT RADIO 28 VAC BUS RIGHT RADIO AC BUS LEFT RADIO AC BUS RIGHT RADIO DC BUS LEFT RADIO DC BUS
GND PROXIMITY WARN COMPUTER	Upper EPC	LEFT RADIO AC BUS
GPW LIGHTS	Upper EPC	
AUTO THROTTLE -1	Upper EPC	LEFT RADIO AC and DC BUSES
AUTO THROTTLE -2	Upper EPC	
AUTOPILOT -1	Upper EPC	LEFT RADIO DC BUS
AUTOPILOT -2	Upper EPC	RIGHT RADIO DC BUS
MACH TRIM -1	Upper EPC	LEFT RADIO DC BUS
MACH TRIM -2	Upper EPC	RIGHT RADIO DC BUS
YAW DAMPER -1	Upper EPC	LEFT RADIO DC BUS

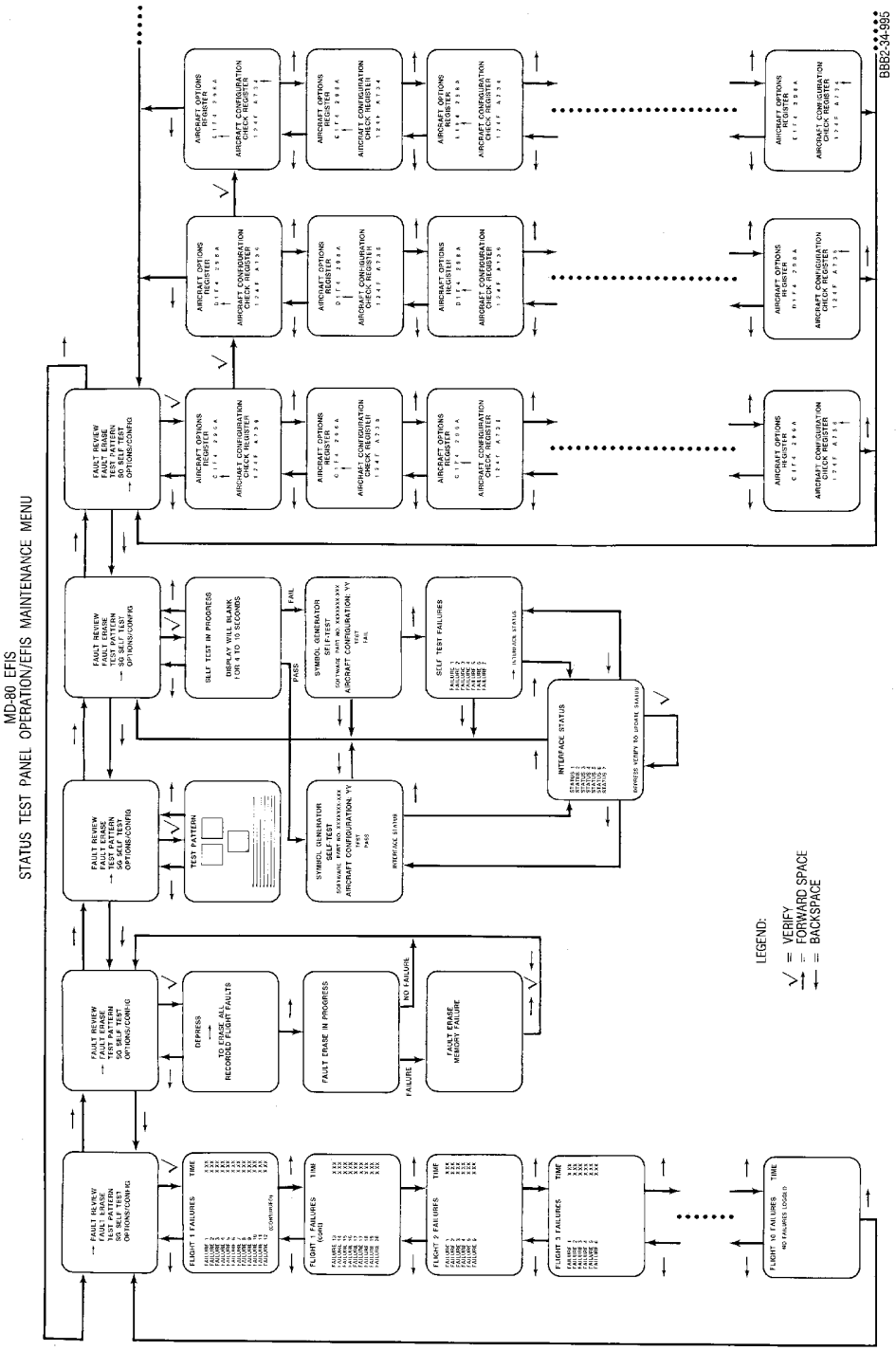
Table 201 (Continued)

Circuit Breaker	Panel Location	Panel Area
YAW DAMPER -2	Upper EPC	RIGHT RADIO DC BUS
G/S -1	Overhead	EMER DC BUS
FLIGHT GUIDANCE STATUS & MAINT PNL	Upper EPC	LEFT RADIO DC BUS
LDG GEAR WARN	Lower EPC	MISC LEFT DC BUS
ANNUN/DGTL LTS	Lower EPC	LIGHTS -R DC BUS.
NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.		



EFIS Maintenance Menu
Figure 201/34-22-00-990-C37

EFFECTIVITY
WJE 407, 408, 411; BEFORE AVIONICS UPGRADE MOD



EFIS Maintenance Menu -- STP Operation
Figure 202/34-22-00-990-C38

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

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Failure Flag Test Annunciations
Figure 203/34-22-00-990-C39

3. Equipment and Materials

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed items:

Table 202

Name and Number	Manufacturer
TIC 30A or TIC 30B Signal Generator	TEL - Instrument Electronics Corp.
980N-1 Radio Altimeter Test Set	Collins

4. Adjustment/Test Electronic Flight Instrument System (EFIS)

NOTE: The following adjustment/test procedures provide for an on ground aircraft EFIS functional checks. Tests can be performed as a complete system test or as individual item tests.

A. Following is a Glossary of Acronyms used in the following tests procedures.

Table 203 Glossary of Acronyms

CAPTs----	Captains	ILS----------	Instrument Landing System
CMPVLD-	Computer Valid	MSP--------	Mode Select Panel
DH---------	Decision Height	ND----------	Navigation Display
DME-------	Distance Measuring Equipment	PFD---------	Primary Flight Display
CDP-------	Control and Dimming Panel	SG----------	Symbol Generator
EFIS-------	Electronic Flight Instrument System	STP---------	Status Test Panel
FMA--------	Flight Mode Annunciator	VOR--------	VHF Omnidirectional Range
F/O---------	First Officer	WXR--------	Weather Radar

B. The following ground mode criteria must be met before performing the Options/Check Register Word Test.

(1) Throttles full aft.

(2) Radio Altitude scale on Captain's and F/O's PFD.

(3) Aircraft weight on wheels.

(4) Nose gear Oleo switch in ground mode.

(5) Left and right ground control relay circuit breakers closed.

(6) Ground proximity computer installed.

C. Options/Check Register Words Test -- Preliminary

Table 204

Operation	Desired Result
(1) Set up Status Test Panel (STP).	STP set up and operational.
(2) On STP, check location of STP POWER button, SELECT button, BACKSPACE button, FORWARDSPACE button and VERIFY button. (Figure 204, Display A)	
(3) Press STP POWER button.	STP POWER on.
(4) Place EFIS/DFGS switch in EFIS position.	Switch in EFIS position.

Table 204 (Continued)

Operation	Desired Result
(5) Verify the 1 on STP SELECT button is illuminated. If 1 is not illuminated, press SELECT button.	STP SELECT button 1 is illuminated.
(6) SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND. (Figure 204, Display B)	Maintenance Menu displayed on Capt's PFD and ND.

D. Options/Check Register Words Test -- Programming Symbol Generator 1

Table 205

Operation	Desired Result
(1) Press FORWARDSPACE button on STP until arrow is pointing to selection OPTIONS/CONFIG. (Figure 205, Display A)	Arrow pointing to OPTIONS/ CONFIG.
(2) Press VERIFY button on STP and verify on PFD and ND and aircraft configuration placard have identical OPTION/ CHECK REGISTER WORDS. (Figure 205, Display B)	OPTION/CHECK REGISTER WORDS on PFD, ND and aircraft configuration placard are identical.
NOTE: OPTIONS/CHECK REGISTER WORDS: Shown on following figures are examples only. Check aircraft configuration placard for actual words.	
(3) Verify on PFD and ND that arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.	Arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.
(4) Press VERIFY button on STP, each press of button will roll digit one time. Continue to press VERIFY button until digit on PFD and ND matches same digit on aircraft placard. (Figure 206, Display A)	PFD and ND digits match placard.
(5) When digit is correct, press FORWARD SPACE button on STP to move to next digit on right. (Figure 206, Display B)	Arrow moves to next digit on right.
(6) Repeat steps (4) and (5) until options/ register and check register words on PFD and ND are same as aircraft placard.	Options/check register words same as aircraft placard.
(7) When right most digit of check register word is complete, press FORWARD SPACE button on STP. Display will return to main menu. (Figure 207)	Main menu display.

E. Options/Check Register Words Test -- Programming Symbol Generator 2

Table 206

Operation	Desired Result
(1) Place EFIS Mode Select panel switch to BOTH ON 2. Capt's PFD and ND should display EFI 2.	EFI 2 displayed.
(2) Press CMPVLD button on STP so 2 is illuminated on CMPVLD button.	CMPVLD button 2 illuminated.

Table 206 (Continued)

Operation	Desired Result
(3) Repeat steps (1) through (7) in Table 205 for programming SG 2, substituting 2 for 1.	Results same as programming symbol generator 1 test.

F. Verification of Programming Options -- Preliminary

NOTE: The following tests verify the options were programmed into the system correctly and options will be displayed. The tests also verify correct operation of the symbol generators and display units.

Table 207

Operation	Desired Result
CAUTION: RADIO RACK COOLING FANS MUST BE OPERATING DURING ANY EFIS TEST OPERATIONS.	
(1) Place EFIS switch in NORM position.	Switch in NORM position.
(2) Make certain STP power is off.	STP power off.
(3) Verify Capt's ND and PFD displays are normal.	ND and PFD displays normal.
(4) Verify on Capt's ND words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.	
(5) Set up TIC-30 A or B generator.	TIC 30 generator set up.
(6) Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 MHz).	VHF NAV receivers tuned to ILS frequency.
(7) Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSP MODE select switch in ROSE position.

G. Verification of Programming Options -- Uncrossed Navigation and G/S Side Selection Options

Table 208

Operation	Desired Results
(1) Press and hold G/S switch on the TIC-30 generator.	
(2) Open G/S-2 DC circuit breaker.	Circuit breaker open.
(3) Verify that G/S FAIL appears on right side of F/O's PFD and ND screen.	G/S FAIL displayed on F/O's PFD and ND screens.
(4) Verify symbology on Capt's and F/O's PFD and ND per Figure 208. Disregard any other symbology displayed.	PFD and ND displays per Figure 208.
(5) Close G/S-2 DC circuit breaker and verify G/S FAIL message disappears.	G/S FAIL message disappears.

H. Verification of Programming Options -- Split Cue Flight Director Display Option

Table 209

Operation	Desired Results
(1) Verify symbology on Capt's and F/O's PFD is split cue display. (Figure 209)	Split cue display on Capt's and F/O's PFD.

I. Verification of Programming Options -- No ILS Beam Deviation Warning

Table 210

Operation	Desired Results
(1) Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-18, station 110.	
(2) Tune VHF NAV-1 and VHF-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3) Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4) Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5) Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6) On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7) Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8) Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale and not flashing.	G/S deviation indicator at top of scale on PFD and is not flashing.
(9) Verify G/S deviation symbology on PFD's is per Figure 210.	Display per Figure 210.
(10) Release G/S switch on TIC generator.	
(11) Remove 980N-1 test set.	
(12) Remove ground jumpers from terminal 52 and terminal 28.	

J. Verification of Programming Options -- AHRS Option

Table 211

Operation	Desired Results
(1) Verify following circuit breakers are closed: AHRS-1 (Overhead) AHRS-1 (Upper EPC) AHRS-2 (Upper EPC) SG 1 SG 2	Circuit breakers closed.
(2) Verify symbology on Capt's and F/O's PFD are per Figure 211.	Symbology per Figure 211.

K. Verification of Programming Options -- DME-1 and DME-2 Option

Table 212

Operation	Desired Results
(1) Place Capt's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(2) Place F/O's MSP mode select switch in ARC position.	MSP select switch in ARC position.
(3) Verify DME symbology is displayed on Capt's and F/O's ND per Figure 212.	DME symbology displayed on NDs.

L. Verification of Programing Options -- ADF Bearing Option

Table 213

Operation	Desired Results
(1) Make certain ADF circuit breakers are closed.	ADF circuit breakers closed.
(2) Tune ADF-1 and ADF-2 to local broadcast frequency.	ADFs tuned to local broadcast frequency.
(3) Place Capt's and F/O's MSP mode select switch in ROSE position.	MSP mode select switch in ROSE position
(4) Place Capt's and F/O's MSP center knobs in ADF position.	MSP center knobs in ADF position.
(5) Verify ADF-1 and ADF-2 symbology display on Capt's and F/O's ND. (Figure 213)	Symbology per Figure 213.
(6) Place knobs in step (4) to OFF.	

M. Mode Select Panel Functional Test -- Rose Mode

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 214

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(2) Place F/O's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(3) Verify Rose mode symbology is displayed on Capt's and F/O's ND. (Figure 214)	Rose mode symbology displayed.

N. Mode Select Panel Functional Test -- ARC MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 215

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(2) Place F/O's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.

Table 215 (Continued)

Operation	Desired Result
(3) Verify ARC mode symbology is displayed on Capt's and F/O's ND. (Figure 215)	ARC mode symbology displayed.

O. Mode Select Panel Functional Test -- MAP MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 216

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(2) Place F/O's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(3) Verify MAP mode symbology is displayed on Capt's and F/O's ND. (Figure 216)	MAP mode symbology displayed.

P. Mode Select Panel Functional Test -- PLAN MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 217

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(2) Place F/O's MSP mode selector switch in PLN position.	Mode selector switch in PLN position.
(3) Verify PLAN mode symbology is displayed on Capt's and F/O's ND. (Figure 217)	PLAN mode symbology displayed.

Q. Mode Select Panel Functional Test -- Range Selector

Table 218

Operation	Desired Result
(1) Place Capt's and F/O's MSP mode selector switch in ARC position.	
(2) Rotate Capt's WX OFF control on Captain's CDP to full clockwise position.	WXR FAIL displayed on Capt's ND.
(3) Rotate F/O's WX OFF control on F/O's CDP to full clockwise position.	WXR FAIL displayed on F/O's ND.
(4) Place RANGE selector on Capt's and F/O's MSP in each range listed following: 10 80 20 160 40 320	Verify range index number in location on NDs as in Figure 218. 5 40 10 80 20 160

Table 218 (Continued)

Operation	Desired Result
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.	
(5) Rotate Capt's and F/O's WX OFF control to OFF position.	WXR FAIL display on Capt's and F/O's ND blanked out.

R. MSP Declutter Buttons and Control Dimming Panel (CDP) Test

Table 219

Operation	Desired Result
(1) Press annunciator/digital lights TEST button located on lower right corner of overhead panel.	Declutter buttons on MSP come on.
(2) Release the annunciator/ digital lights test button.	Declutter buttons on MSP go off for approximately half a second and then come on for approximately five seconds.
(3) Place Capt's MSP selector switch to ARC position.	MSP switch in ARC position.
(4) Rotate the CDP PFD knob counterclockwise.	Capt's PFD decreases in brightness.
(5) Rotate CDP PFD knob clockwise.	Capt's PFD increases in brightness.
(6) Rotate CDP ND knob counterclockwise.	Capt's ND decreases in brightness.
(7) Rotate CDP ND knob clockwise.	Capt's ND increases in brightness.
(8) Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.
(9) Repeat steps (4) through (7) substituting F/O's for Capt's.	Results same as steps (4) through (7).

S. Captain's and First Officer's Decision Height Test

Table 220

Operation	Desired Result
(1) Rotate DH knob on Capt's CDP clockwise. Check for display number on Capt's PFD in the top right corner. (Figure 219)	DH number increases.
(2) Rotate DH knob counterclockwise.	DH number decreases.
NOTE: DH number will blank when DH number is less than 0 (zero) feet.	
(3) Rotate DH knob on F/O's CDP clockwise. Check for display number on F/O's PFD in the top right corner. (Figure 219)	DH number increases.
(4) Rotate DH knob counterclockwise.	DH number decreases.

T. ND and PFD Compact Mode Test

Table 221

Operation	Desired Result
(1) Rotate ND BRT knob on Capt's CDP counterclockwise to the detent position.	ND BRT knob counterclockwise to detent position.
(2) Verify compact mode symbology display is on Capt's PFD as shown in Figure 220.	Compact mode display on Capt's PFD per Figure 220.

Table 221 (Continued)

Operation	Desired Result
(3) Rotate ND BRT knob full clockwise.	Displays return to normal.
(4) Rotate PFD BRT knob on Capt's CDP counterclockwise to detent position.	PFD BRT knob counterclockwise to detent position.
(5) Verify compact mode symbology display on Capt's ND as shown in Figure 220.	Compact mode display on Capt's ND per Figure 220.
(6) Rotate PFD BRT knob full clockwise.	Displays return to normal.
(7) Repeat steps (1) through (6) substituting F/O's test procedures.	F/0's results same as Capt's desired results.

U. ND and PFD Auto Brightness Tests

NOTE: The following test verifies that the remote light sensor (RLS) and the display unit photocells will provide brightness boost to ND's and PFD's in high intensity light conditions.

Table 222

Operation	Desired Results
(1) Shine flashlight on each photocell area of Capt's and F/O's PFD and ND. (Figure 221 for photocell location on ND's and PFD's)	Note increase in ND's and PFD's brightness.
(2) Cover the RLS located on glareshield with your hand for approximately 5 seconds.	
(3) Remove your hand from RLS and shine flashlight on the RLS.	PFD's and ND's increase in brightness.
(4) Remove flashlight.	PFD's and ND's brightness returns to previous brightness.

V. Instrument Comparator Monitoring Test -- Capt's and F/O's FMA Lamp Test and SG Crosstalk Test

NOTE: The following tests verify the FMA lamps come on and symbol generators crosstalk bus is operating correctly.

Table 223

Operation	Desired Result
(1) Press and release Annunciator/Digital Light Test button.	Verify all FMA lamps come on.
NOTE: Disregard Starbursts on FMAs.	
(2) Release test button and verify Capt's FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.	FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.
(3) Repeat steps (1) and (2) substituting F/O's for Capt's in test procedures.	Desired results same as Capt's.
(4) Open SG-1 Power circuit breaker.	F/O's FMA Monitor lamp comes on.
(5) Close SG-1 Power circuit breaker.	F/O's FMA Monitor lamp goes off.
(6) Open SG-2 Power circuit breaker.	Capt's FMA Monitor lamp comes on.
(7) Close SG-2 Power circuit breaker.	Capt's FMA Monitor lamp goes off.

W. Symbol Generator Switching Tests

NOTE: The following test verifies that NDs and PFDs can be driven by the off-side symbol generator.

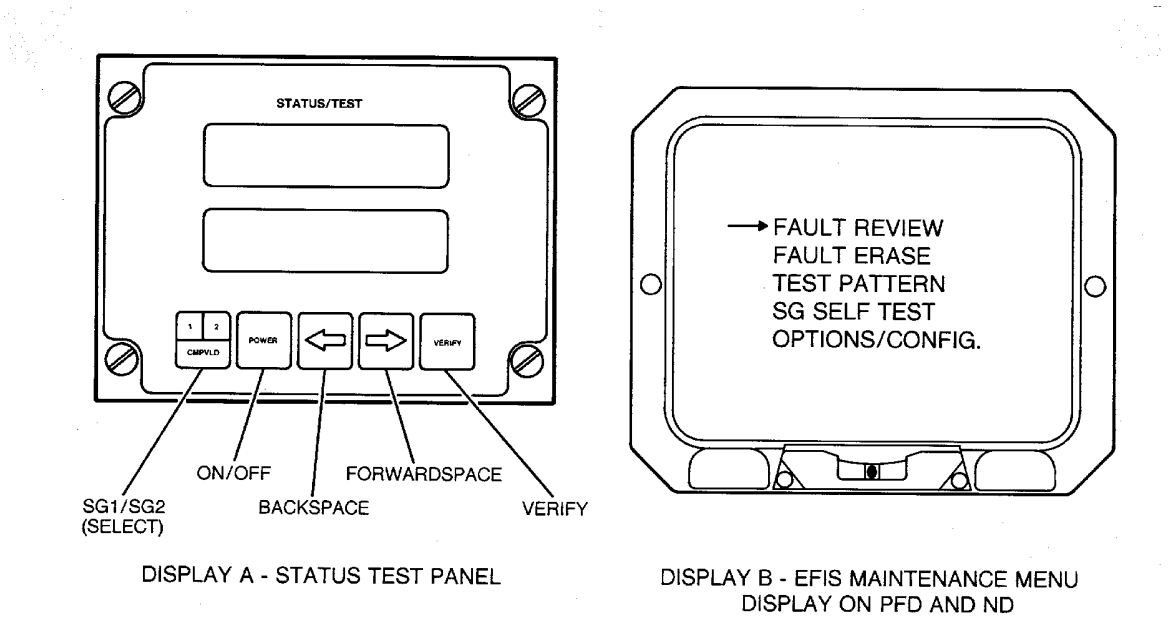
Table 224

Operation	Desired Result
(1) Place Capt's and F/O's MSP selector switch in ARC position.	MSP switch in ARC mode.
(2) Place EFIS switch to BOTH ON 1 position.	EFIS switch in BOTH ON 1 position.
(3) Verify symbology on Capt's and F/O's ND and PFD display EFI 1. (Figure 222, Display A)	PFD and ND display EFI 1 symbology per Figure 222, Display A.
(4) Place EFIS to BOTH on 2 position.	EFIS switch in BOTH ON 2 position.
(5) Verify symbology on Capt's and F/O's ND and PFD display EFI 2. (Figure 222, Display B)	PFD and ND display EFI 2 symbology per Figure 222, Display B.
(6) Return EFIS switch to NORM position.	EFIS switch in NORM position.

X. EFIS SELF TEST

Table 225

Operation	Desired Result
(1) Press FORWARD SPACE key on STP until arrow is pointing to SG SELF TEST on STP.	Verify Capt's PFD and ND display like Figure 223, Display A.
(2) Press VERIFY key on STP. This initiates self test.	Verify Capt's ND display like Figure 223, Display B.



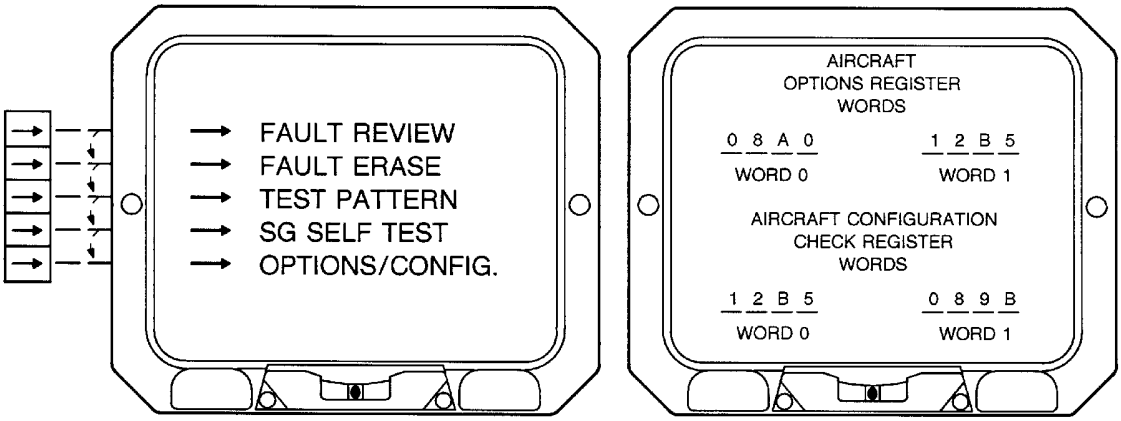
DISPLAY A - STATUS TEST PANEL

DISPLAY B - EFIS MAINTENANCE MENU DISPLAY ON PFD AND ND

CAG(IGDS)

BBB2-34-1294

Status Test Panel and Maintenance Menu Display on PFD and ND
Figure 204/34-22-00-990-C40



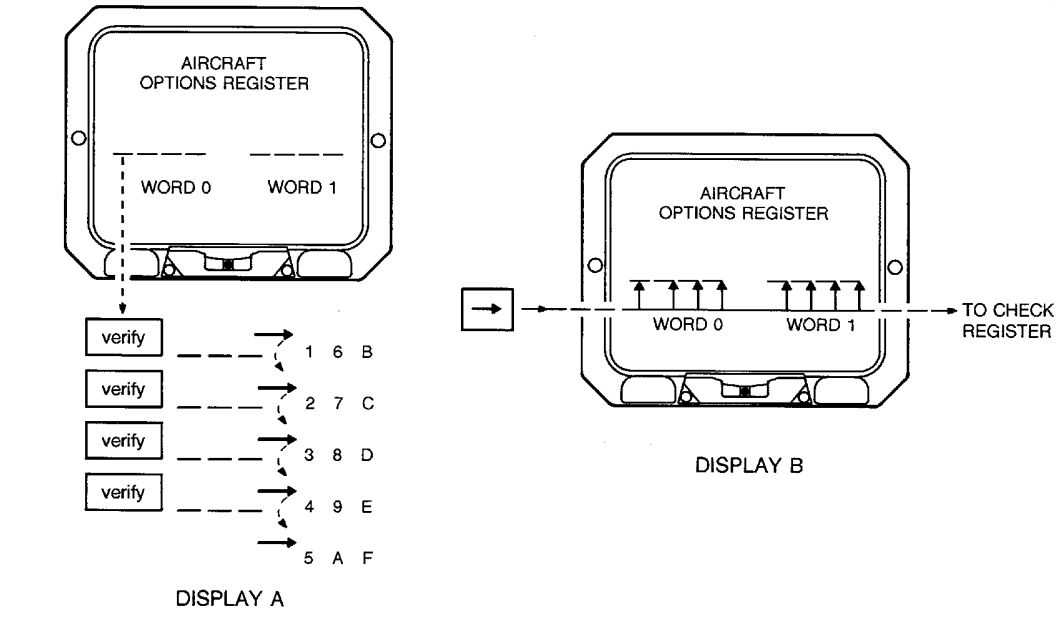
DISPLAY A
EFIS MAINTENANCE MENU
(DISPLAYED ON PFD AND ND)

DISPLAY B
OPTION/CHECK REGISTER WORDS

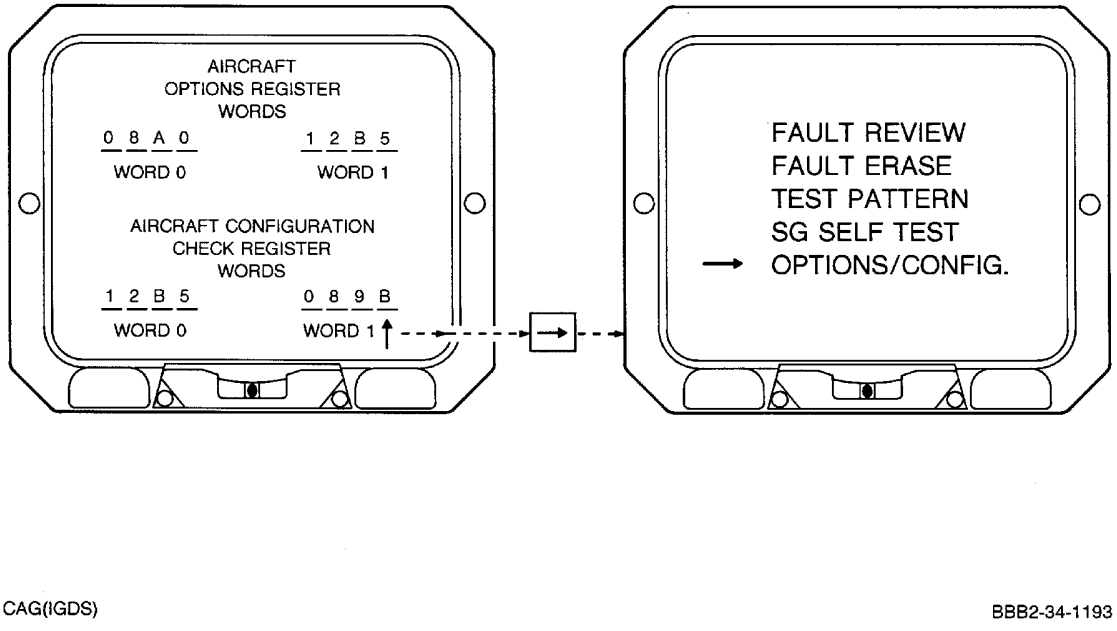
CAG(IGDS)

BBB2-34-1191

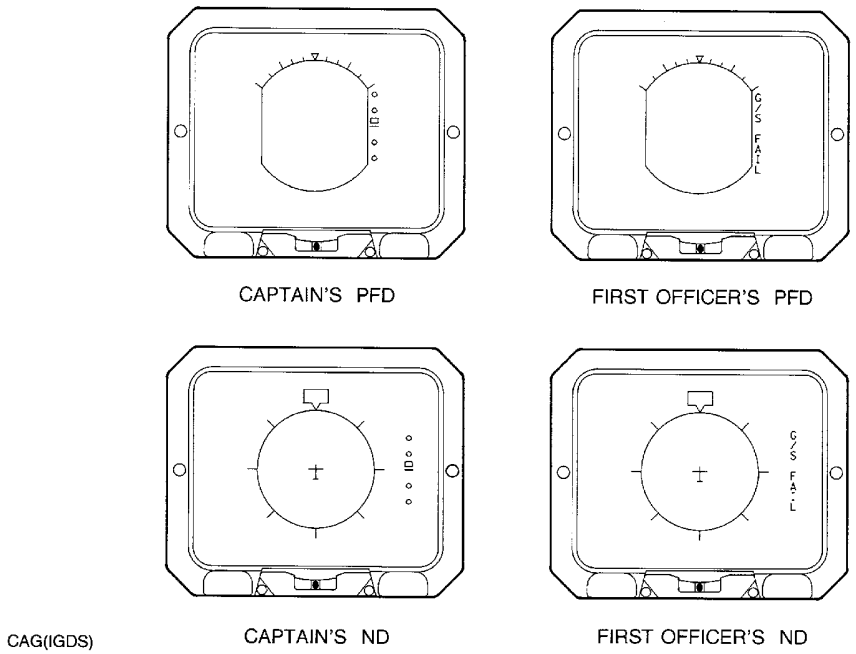
Options/Check Register Words Displays
Figure 205/34-22-00-990-C41



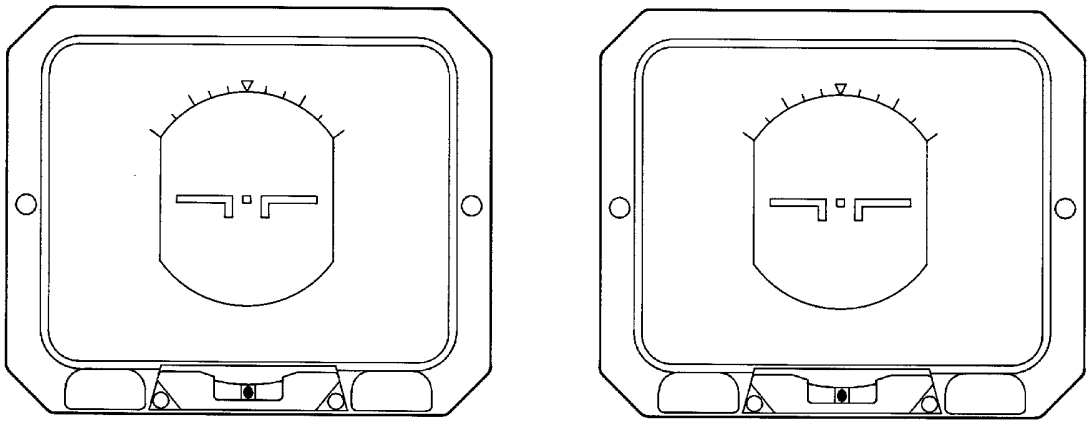
Aircraft Options Register
Figure 206/34-22-00-990-C42



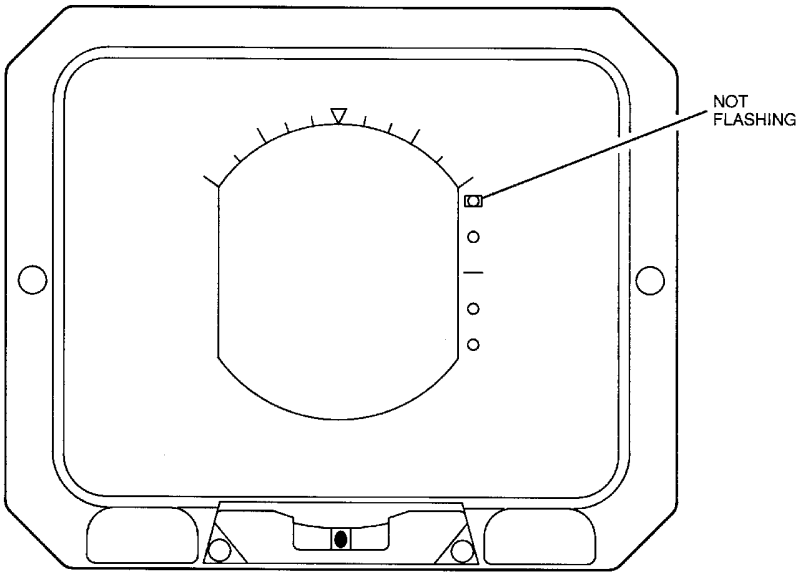
Options Register and Check Register Words and Main Menu Display Return
Figure 207/34-22-00-990-C43



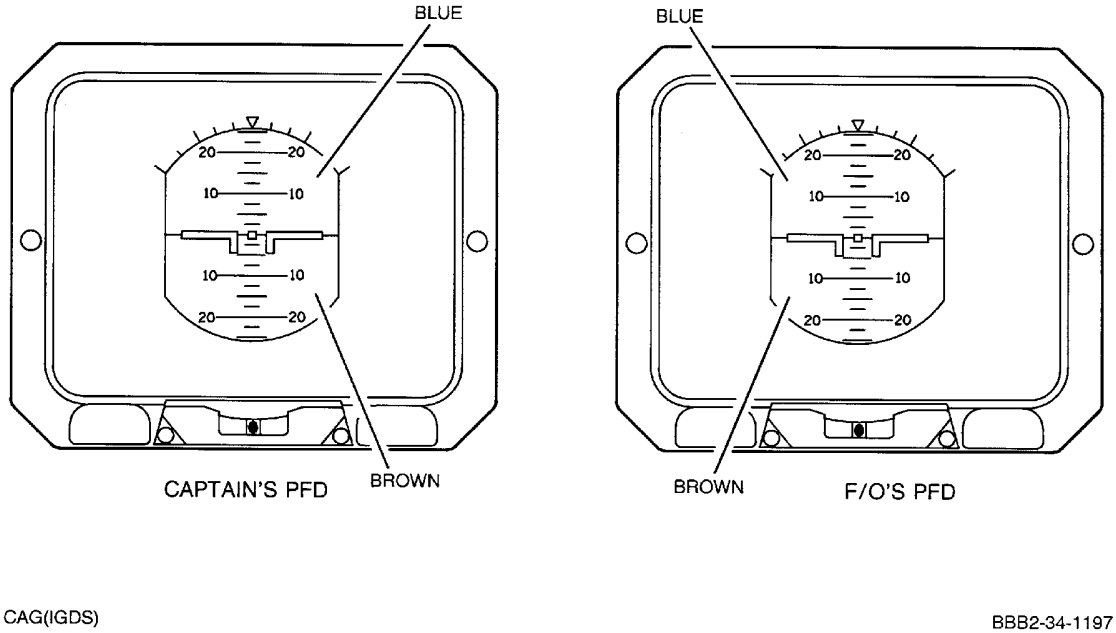
Uncrossed Navigation and G/S Side Selection Options
Figure 208/34-22-00-990-C44



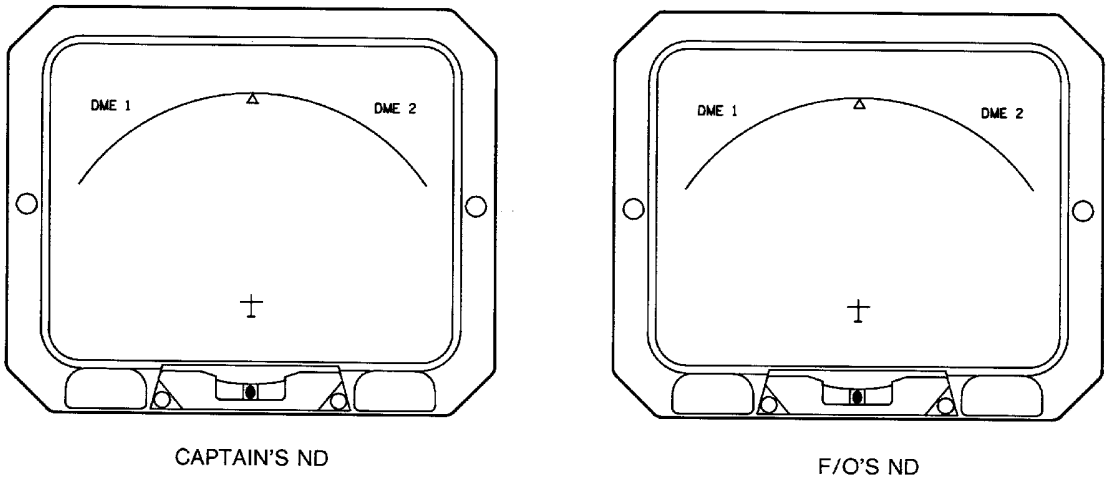
Split Cue Flight Director Display
Figure 209/34-22-00-990-C45



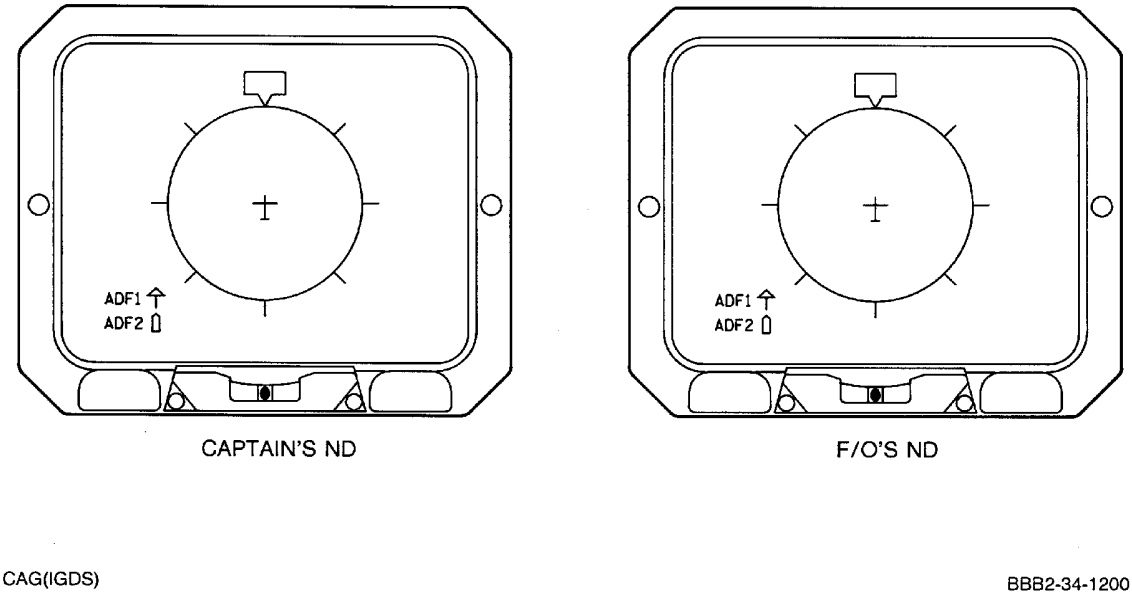
ILS Beam Deviation Warning Display
Figure 210/34-22-00-990-C46



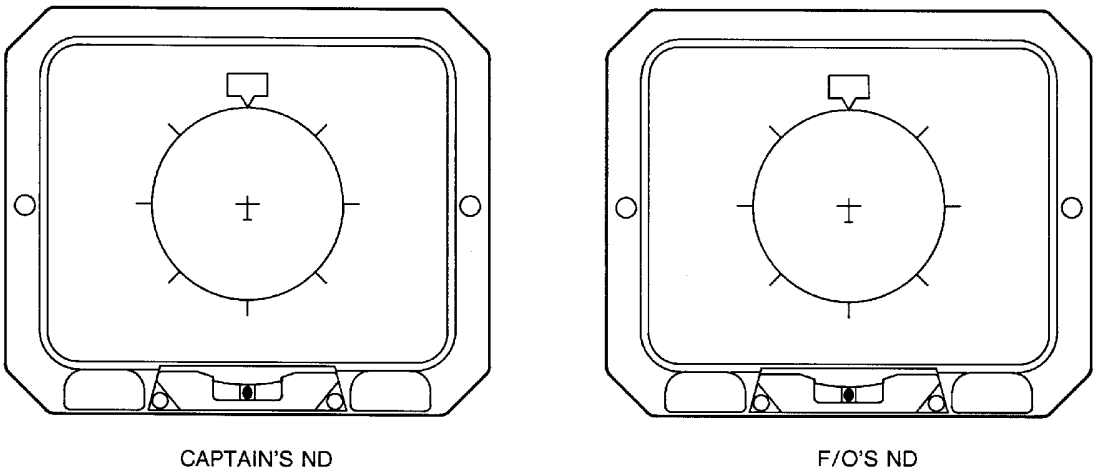
AHRS Option PFD Display
Figure 211/34-22-00-990-C47



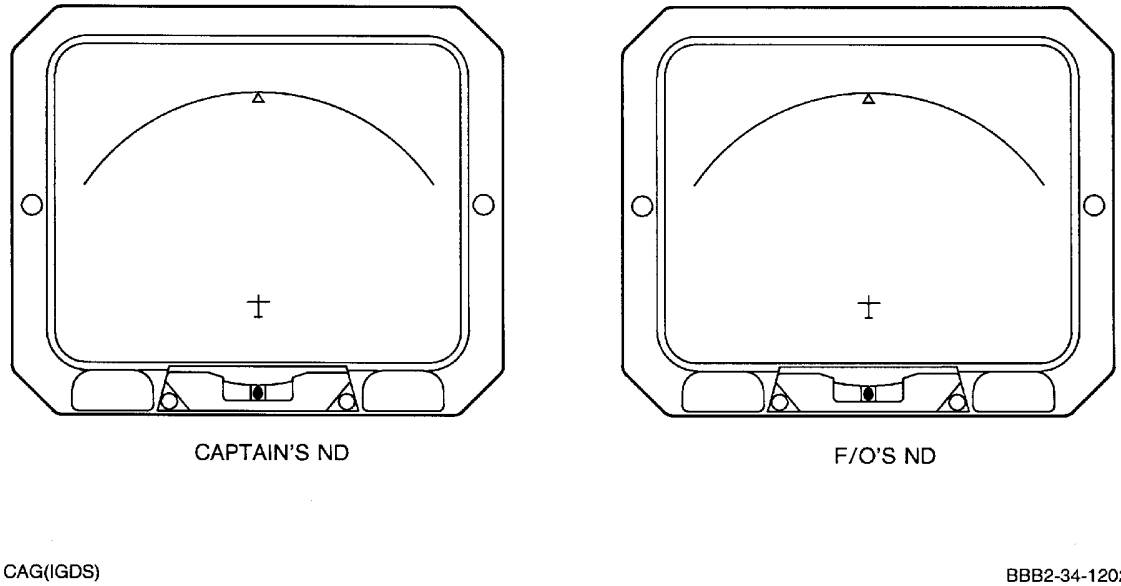
Navigation Display (ND) DME Displays
Figure 212/34-22-00-990-C48



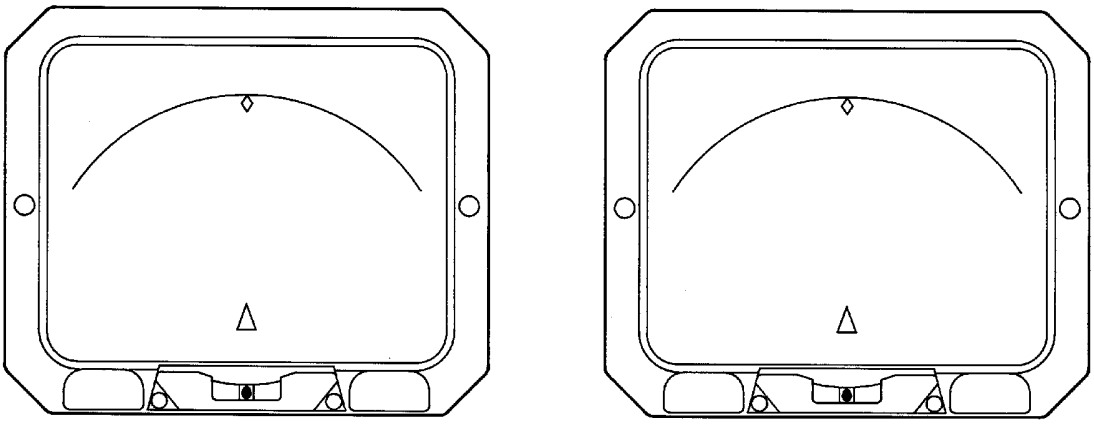
ADF Bearing Display
Figure 213/34-22-00-990-C49



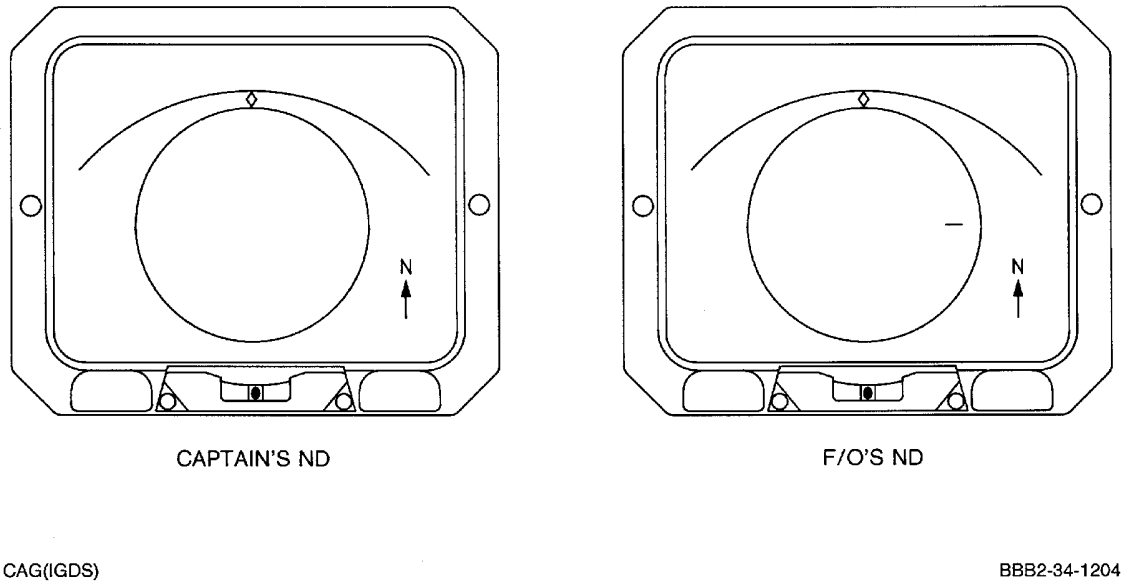
Rose Mode Display on ND's
Figure 214/34-22-00-990-C50



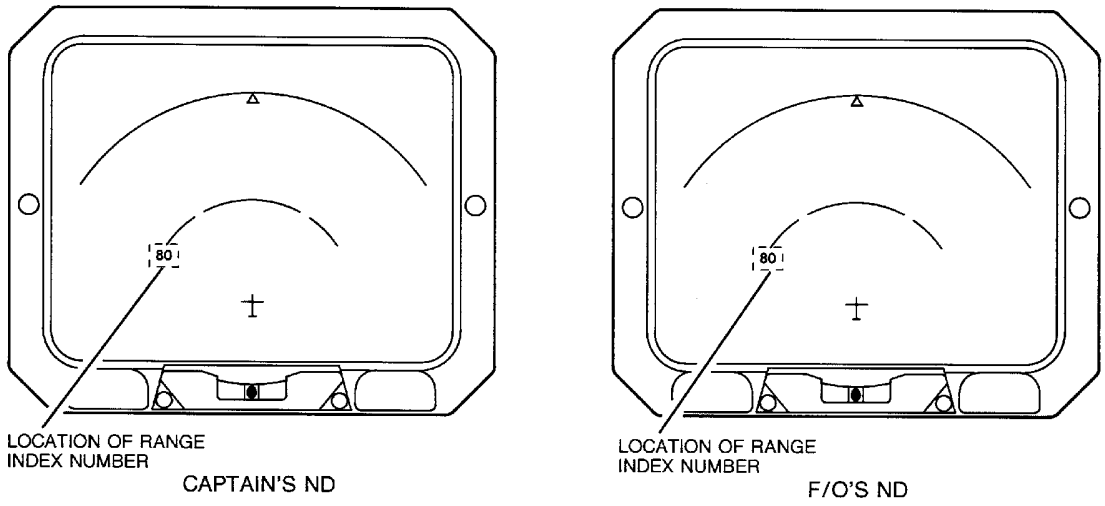
ARC Mode Display on ND's
Figure 215/34-22-00-990-C51



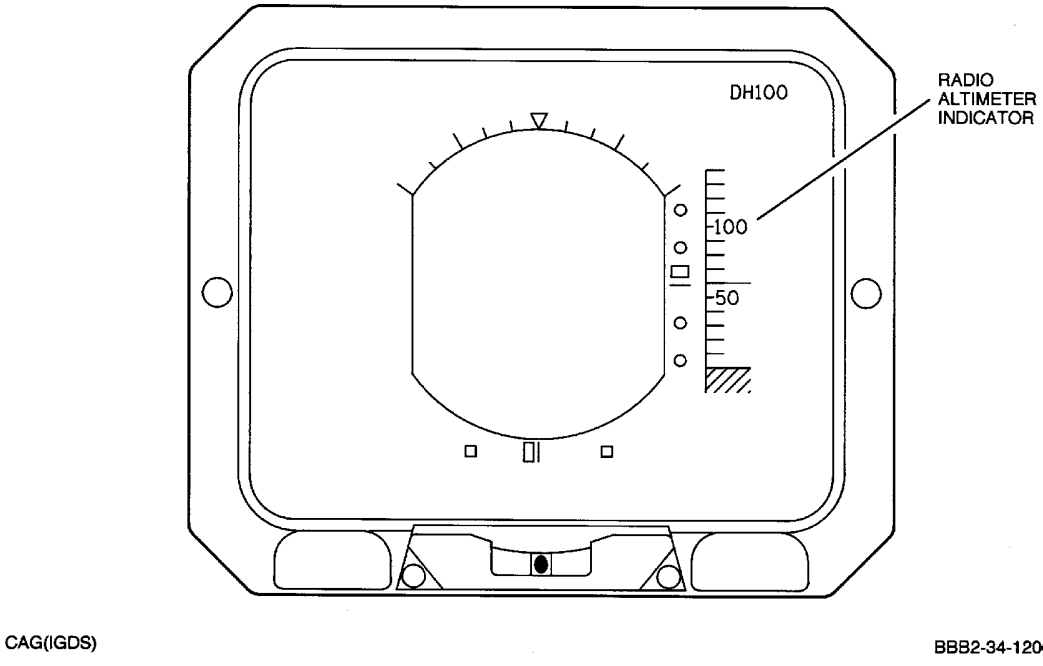
MAP Mode Display on ND's
Figure 216/34-22-00-990-C52



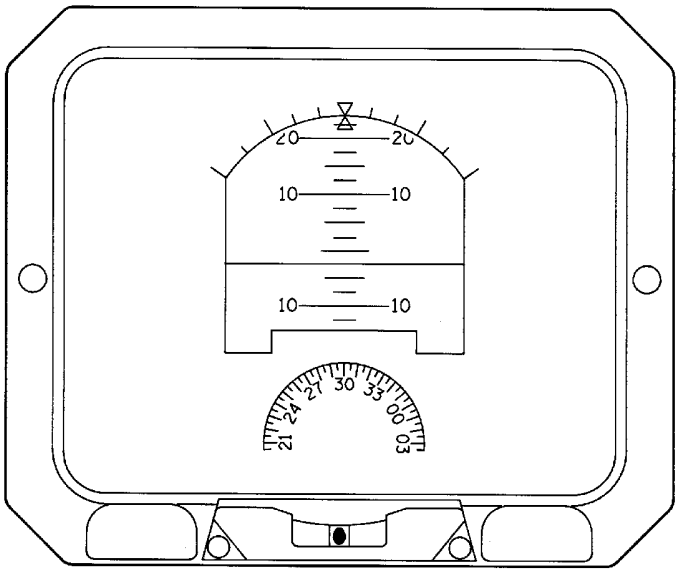
Plan Mode Display on ND's
Figure 217/34-22-00-990-C53



Range Selector Displays
Figure 218/34-22-00-990-C54



Decision Height Display On PFD
Figure 219/34-22-00-990-C55

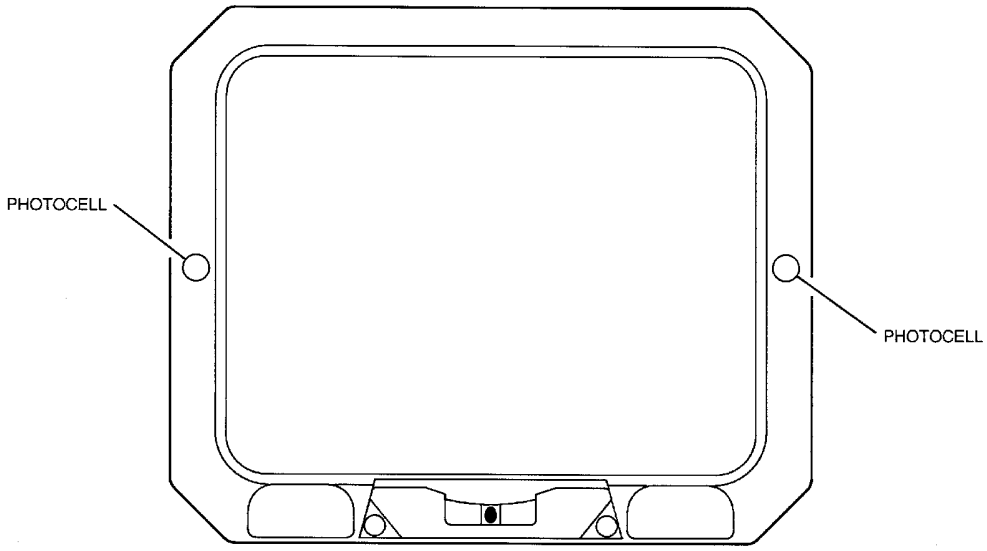


NOTE: DISPLAY WILL BE IDENTICAL FOR CAPTAIN'S AND FIRST OFFICER'S PFD.

CAG(IGDS)

BBB2-34-1207

ND and PFD Compact Mode Displays
Figure 220/34-22-00-990-C56

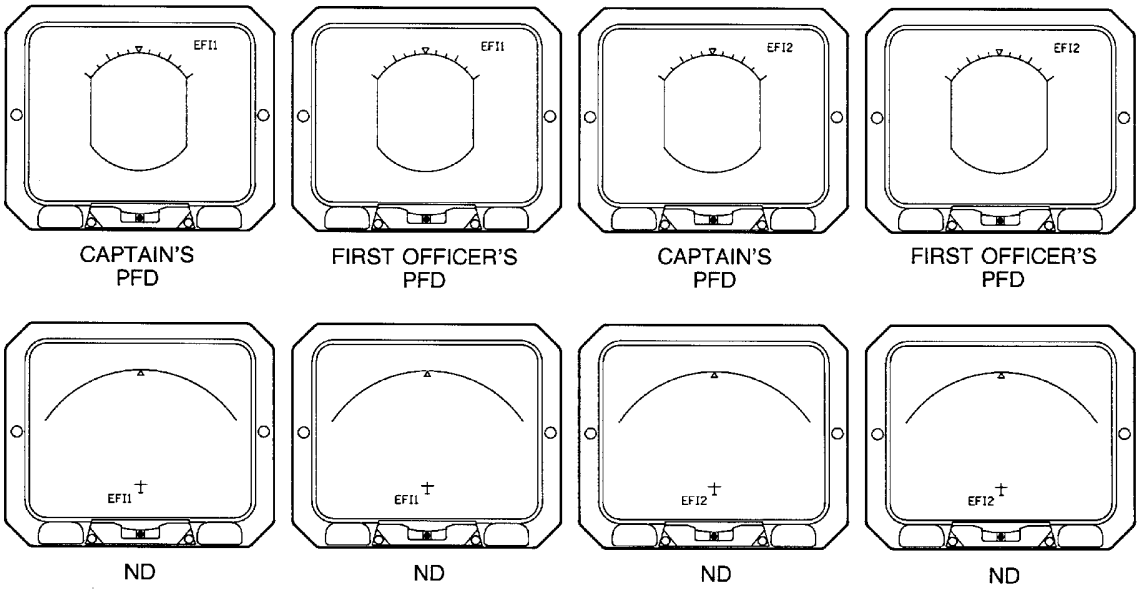


NOTE: PHOTOCELLS LOCATION SAME FOR CAPTAIN'S AND FIRST OFFICER'S PFDS AND NDS.

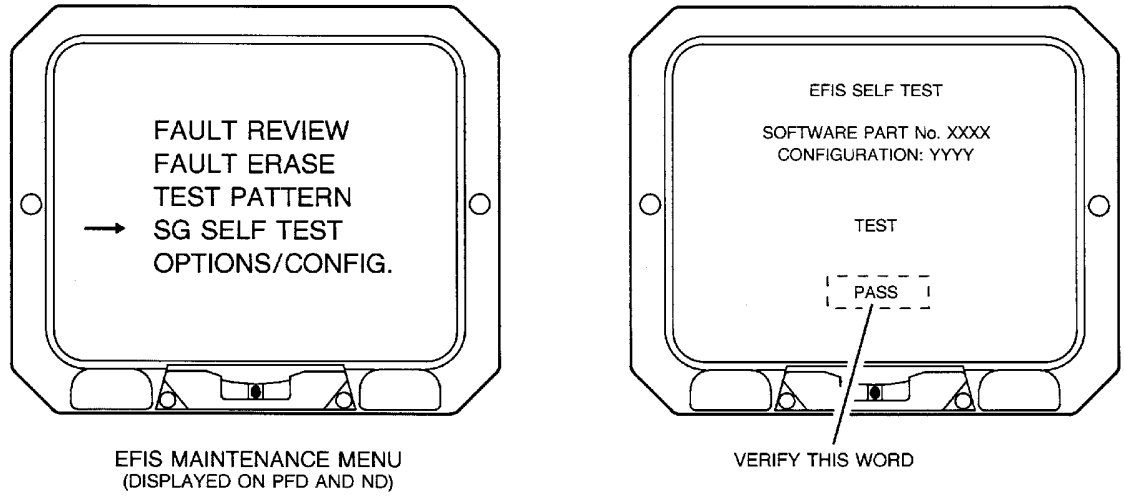
CAG(IGDS)

BBB2-34-1208

PFD's and ND's Photocell Locations
Figure 221/34-22-00-990-C57



PFD and ND EFIS Switching Display
Figure 222/34-22-00-990-C58



EFIS Self Test Display on Captain's ND
Figure 223/34-22-00-990-C59

NAVIGATION DISPLAYS - MAINTENANCE PRACTICES

1. General Maintenance Features

A. This section contains an overview of the maintenance practices required for the electronic flight instrument system (EFIS). This is followed by a complete listing of circuit breakers for the EFIS and interfacing systems which must be closed when performing system tests. Ground maintenance consists of the following:

(1) Options/Configuration programming of the symbol generator. This is performed only when a new SG is installed on the aircraft, or when a SG is transferred from another aircraft. Each aircraft has its own "finger print" which must be fed into the SG upon installation. Options/Config. programming matches the SG software to the aircraft wiring.

(2) SG Self Test - Tests the internal functioning of the SG to verify proper installation and operation. This is a two-second test which is initiated via the Status Test Panel (STP).

(3) EFIS System Self-Test (BIT) - This 3-second test is initiated from the TEST pushbutton on the control and dimming panel (CDP). Used to test the following systems which provide inputs to the SG: VOR/ILS, radio altimeter, marker beacon. The EFIS system self-test includes a failure flag test.

All input systems tests are under the control of the associated receiver units. The proper test response, therefore, is determined by the manufacturer of these units. The failure flag test is under the control of the SG. Failure flag test annunciations appear while the test pushbutton is depressed. All display parameters not tested by their respective receiver units will reflect "fail" conditions.

(4) Cockpit Lamp Test - This 0.5 second test is used to check the following FMA displays: ILS, HEADING, HORIZON, and MONITOR. It also tests the MSP declutter buttons and Taxi Speed, if installed.

B. To Perform a Complete System Test - The symbol generator is the heart of the EFIS, so thorough testing of the SG ensures proper operation of the system. The maintenance practices for the symbol generator include all of the above-mentioned tests. To perform a thorough system test, perform the symbol generator maintenance practices. Separate LRU functional tests are also provided for the EFIS Control and Dimming Panel (CDP), Mode Select Panel (MSP), Display Units (PFD/ND), and Remote Light Sensor (RLS). These are to be performed following removal/installation of the LRU's. (EFIS SYMBOL GENERATOR, SUBJECT 34-22-10, Page 201)

2. General Maintenance Practices

A. The following instructions contain a detailed explanation of how the STP is used in conjunction with the EFIS Maintenance Menu to perform in-depth system testing. This is followed by an explanation of how the TEST pushbutton function is used to test the display units and interfacing systems. Both the EFIS Maintenance Menu and TEST pushbutton (BIT) are used in performing a complete system test.

B. Status Test Panel - The Status Test Panel (STP) pushbuttons are used to call up the EFIS Maintenance Menu display on the PFD/ND. In order to use the STP pushbuttons for this purpose, the STP mode select switch (placarded EFIS/DFGS) must be placed in the EFIS position. When the aircraft is on the ground and power to the STP is on, the Maintenance Menu appears on both the PFD and ND of the system being tested. (Figure 201)

C. The EFIS Maintenance Menu - There are five menu pages which can be selected from the Maintenance Menu: FAULT REVIEW, FAULT ERASE, TEST PATTERN, SG SELF TEST, and OPTIONS/CONFIG. Only four of these are used for on-aircraft testing. (The TEST PATTERN is used for bench tests and is not included in the Maintenance Practices for the system.) Menu pages are brought up on screen by moving the cursor to the desired entry on the Maintenance Menu, and pressing the VERIFY pushbutton on the STP. The FORWARD and BACKSPACE keys are used to move the cursor vertically on the Maintenance Menu. The following five selections can be made from the EFIS Maintenance Menu: (Figure 201 and Figure 202)

(1) Fault Review - Used in trouble shooting the EFIS only, to read failures logged in the flight log. The fault code consists of two 3-digit numbers. The first digit is the SG (or system) number. The next two digits are Fault ID numbers; these are main category fault classifications. The last three digits are the Fault Code Numbers; they are subordinate to the Fault ID numbers. The Fault ID and Fault Code are used to provide a complete fault definition. Fault messages appear on the Fault Review screen next to the 6-digit entries. An "-R" after the message indicates a repeat failure. The fault messages are followed by a Time entry, which is the time into the flight leg from takeoff. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101 for complete listing of EFIS Fault Codes)

(2) Fault Erase - This mode is used to erase all flight faults from the flight log. The cursor is cycled to the FAULT ERASE selection on the menu, and the VERIFY key is pressed. Pressing the FORWARD SPACE key at this time will cause all flight faults to be erased. Pressing BACKSPACE or VERIFY will abort the erase function. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101)

(3) Test Pattern - The test pattern is used in bench testing only. The test pattern is a color display of stroke-drawn lines and raster patches. The lines consists of one line for each stroke color: cyan, yellow, green, red, dim white, white and magenta. The three patches are raster patches, one for each of the raster test colors: blue, green and red.

(4) SG Self-test - This is a comprehensive test for the system SG's and all interfacing systems. This three second test generates two displays: the Interface Status page, containing ID codes, fault codes and fault messages for all currently monitored interface failures, and the self-test failures page, listing diagnostic numbers of all internal SG failures.

(5) Options/Config. - This mode is used by maintenance personnel whenever a new SG is installed. It allows the user to enter or modify the aircraft configuration and options words. These words are located on a placard next to the STP mode select switch (EFIS/DFGS). When -905 symbol generators are installed, MAINT CHECK will appear on both displays if the option words of SG1 do not match the option words of SG2. If an incompatibility exists between the check register, the options register, and the configuration identificaton, MAINT CHECK will appear on both displays. This would normally occur if one SG is replaced but has not had the check register and options registers modified to reflect the current aircraft configuration. When -905 symbol generators are installed, MAINT CHECK will appear on the display of the failed SG only.

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

D. TEST Pushbutton - Control and Dimming Panel (CDP) - The TEST pushbutton is used during the SG Maintenance Practices to self-test interfacing systems and display unit failure flags. There are separate TEST pushbuttons for system-1 and system-2, on the Capt's and F.O.'s CDP's. Pressing the TEST pushbutton VOR/ILS, Radio Altimeter, and Marker Beacon self-tests. The appropriate test responses are under the control of the respective receiver units. When testing a single parameter (i.e., radio altimeter), all other symbology appearing on the display screens should be ignored. The test is successful if the appropriate failure/flag/warning replaces the parameter on the display screen (i.e., an R/A FAIL flag will replace the radio altimeter tape on the PFD).

The TEST pushbutton also initiates a failure flag test, and DH aural warning test (if installed). The DH aural warning test consists of a one-second tone slewing from 400 to 800 Hz. This and the failure flag test are under the control of the SG. Failure flag test annunciations appear while the TEST pushbutton is depressed. All display parameters not tested by their respective receiver units will show "fail" conditions. (Figure 203)

E. Cockpit Lamp Test - This test is performed by pressing the ANNUN/DIGITAL LTS TEST pushbutton on the Overhead. It is used to check the ILS, HORIZON, HEADING, and MONITOR lamps on the on-side FMA. The Mode Select Panel declutter buttons and Taxi Speed are also tested, if installed.

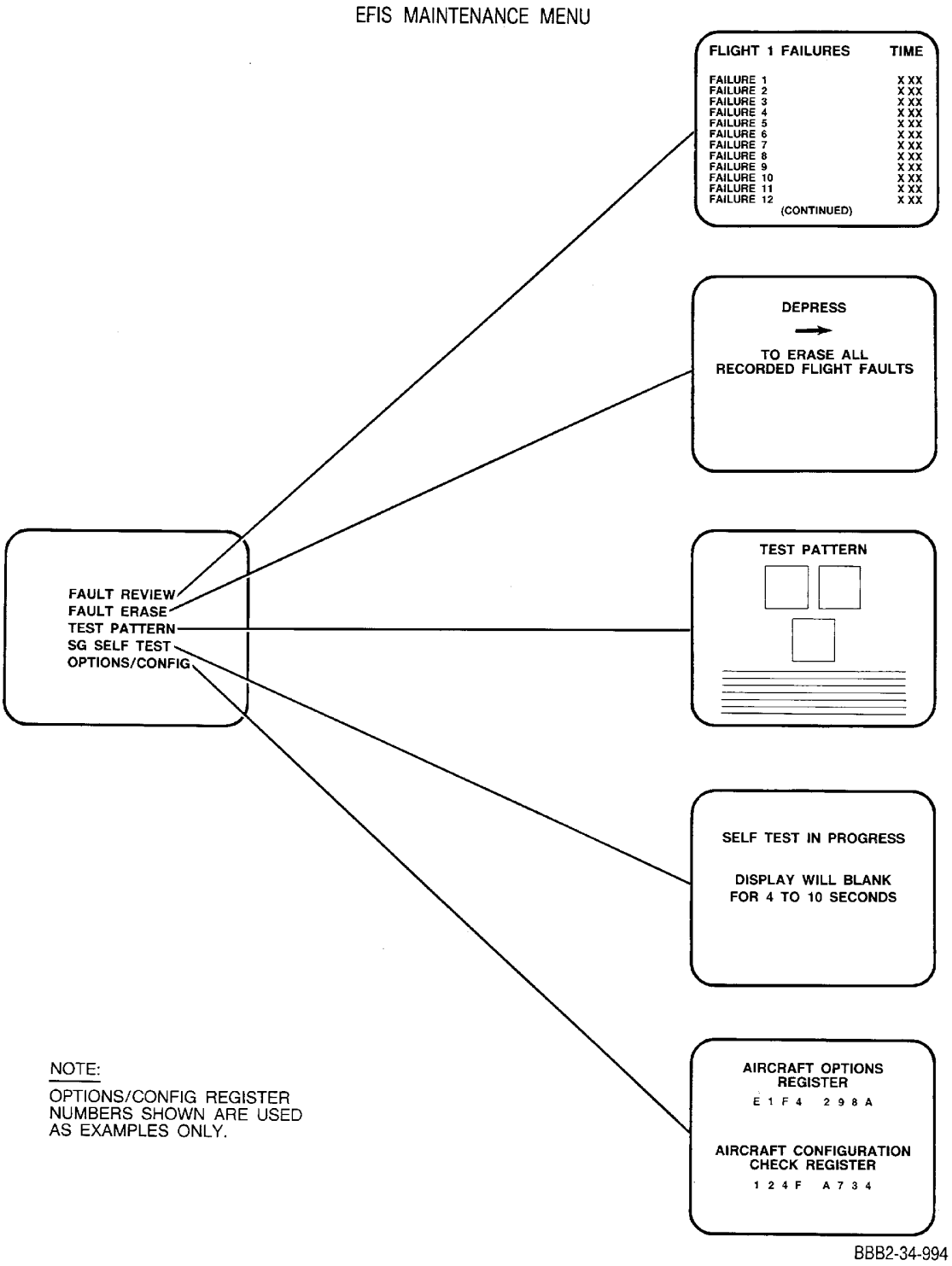
F. Circuit Breakers for EFIS and Interfacing Systems

Table 201

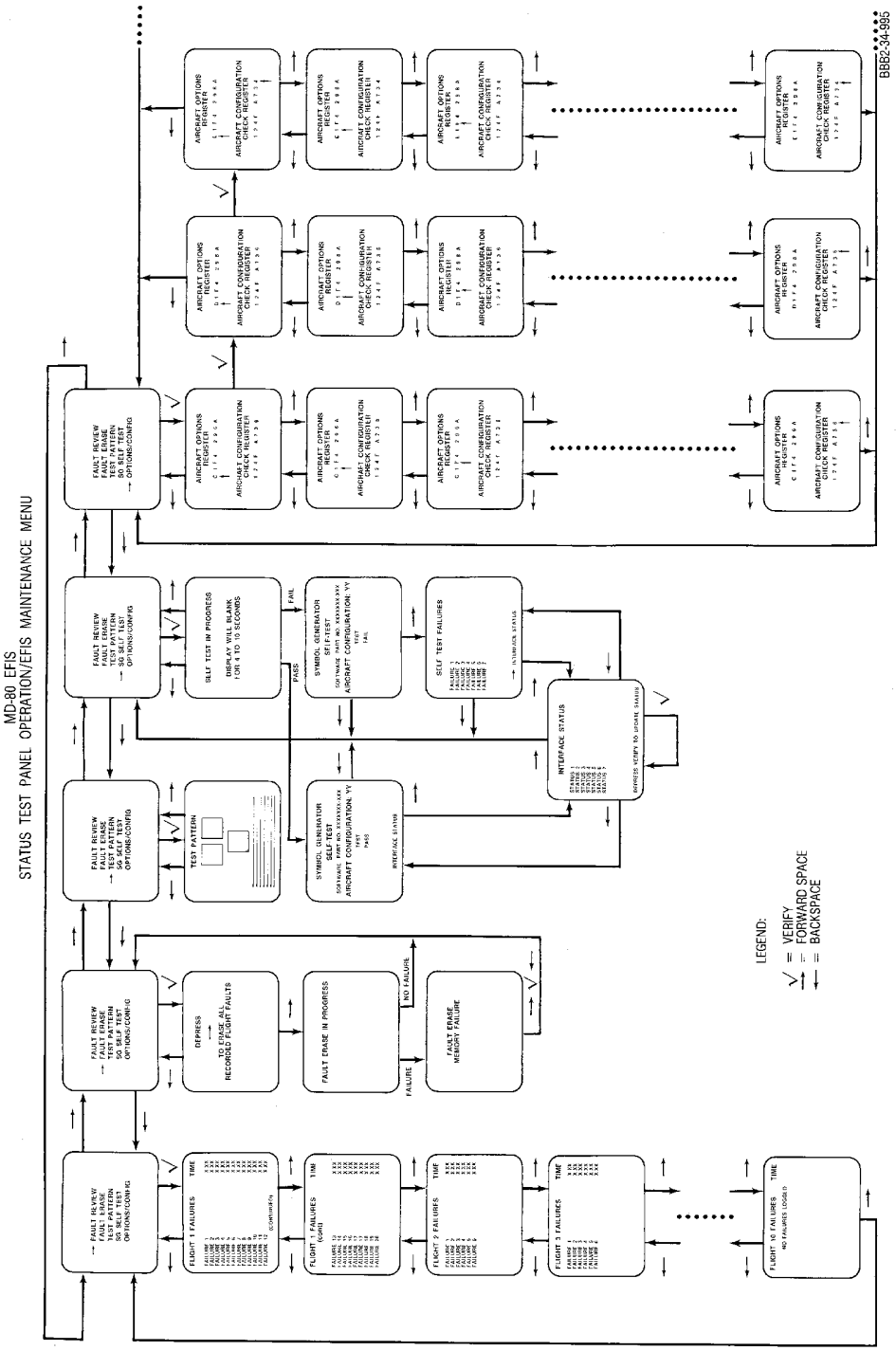
Circuit Breaker	Panel Location	Panel Area
CAPTAINS PFD	Overhead	EMER AC BUS
F.O.'S PFD	Upper EPC	RIGHT RADIO AC BUS
CAPTAINS ND	Overhead	EMER AC BUS
FIRST OFFICER'S ND	Upper EPC	RIGHT RADIO AC BUS
SYMBOL GEN -1	Overhead	EMER AC BUS
SYMBOL GEN -2	Upper EPC	RIGHT RADIO AC BUS
CAPT/FMA/MODE SELECT LIGHTING	Upper EPC	LEFT RADIO DC BUS
F/O FMA/MODE SELECT LIGHTING	Upper EPC	RIGHT RADIO DC BUS
CAPTAIN'S HSI & HEADING	Overhead	EMER AC BUS
FIRST OFFICER'S COURSE & HEADING	Upper EPC	RIGHT RADIO AC BUS
VHF-NAV-1	Overhead	EMER AC and DC BUSES
VHF-NAV-2	Upper EPC	RIGHT RADIO AC and DC BUSES
RADIO ALTIMETER-1	Upper EPC	LEFT RADIO AC BUS
RADIO ALTIMETER-2	Upper EPC	RIGHT RADIO AC BUS
DIGITAL FLIGHT GUIDANCE COMPUTER CIRCUIT BREAKERS	Upper EPC	RIGHT RADIO 28 VAC BUS LEFT RADIO 28 VAC BUS RIGHT RADIO AC BUS LEFT RADIO AC BUS RIGHT RADIO DC BUS LEFT RADIO DC BUS
GND PROXIMITY WARN COMPUTER	Upper EPC	LEFT RADIO AC BUS
GPW LIGHTS	Upper EPC	
AUTO THROTTLE -1	Upper EPC	LEFT RADIO AC and DC BUSES
AUTO THROTTLE -2	Upper EPC	
AUTOPILOT -1	Upper EPC	LEFT RADIO DC BUS
AUTOPILOT -2	Upper EPC	RIGHT RADIO DC BUS
MACH TRIM -1	Upper EPC	LEFT RADIO DC BUS
MACH TRIM -2	Upper EPC	RIGHT RADIO DC BUS
YAW DAMPER -1	Upper EPC	LEFT RADIO DC BUS

Table 201 (Continued)

Circuit Breaker	Panel Location	Panel Area
YAW DAMPER -2	Upper EPC	RIGHT RADIO DC BUS
G/S -1	Overhead	EMER DC BUS
FLIGHT GUIDANCE STATUS & MAINT PNL	Upper EPC	LEFT RADIO DC BUS
LDG GEAR WARN	Lower EPC	MISC LEFT DC BUS
ANNUN/DGTL LTS	Lower EPC	LIGHTS -R DC BUS.
NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.		



EFIS Maintenance Menu
Figure 201/34-22-00-990-C60



EFIS Maintenance Menu -- STP Operation
Figure 202/34-22-00-990-C61

1. Failure flag test annunciations appear while TEST pushbutton is depressed. All display parameters not tested by receiver-controlled test will reflect "fail" conditions. Following annunciations appear:

   A. Primary Flight Display:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed

   B. Compact Format:
      (1) Attitude reference lines are removed
      (2) "ATT FAIL" is displayed in place of attitude ball
      (3) Fast/Slow scale is removed
      (4) "F/S FAIL" is displayed in place of fast/slow scale
      (5) Flight director bars are removed
      (6) "F/D FAIL" is displayed
      (7) Compass card and digital heading are blanked
      (8) "HDG FAIL" is displayed
      (9) Selected heading bug is removed
      (10) To/From information is removed
      (11) DME distance is removed

   C. Navigation Display – Rose
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed

   D. Navigation Display – Arc
      (1) Compass card and digital heading are blanked
      (2) "HDG FAIL" is displayed
      (3) Selected heading bug is removed
      (4) Drift pointer is removed (If RNAV equipped)
      (5) Bearing Pointer fail message appears (If option active)
      (6) Bearing Pointers are removed (If option active)
      (7) Wind direction and magnitude are removed (If FMS equipped)
      (8) To/From information is removed
      (9) Vertical Deviation scale is removed (Nav mode only – FMS equipped)
      (10) "VNAV FAIL" is displayed (Nav mode only – FMS equipped)
      (11) DME distance is removed.

BBB2-34-1013

Failure Flag Test Annunciations
Figure 203/34-22-00-990-C62

3. Equipment and Materials

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed items:

Table 202

Name and Number	Manufacturer
TIC 30A or TIC 30B Signal Generator	TEL - Instrument Electronics Corp.
980N-1 Radio Altimeter Test Set	Collins

4. Adjustment/Test Electronic Flight Instrument System (EFIS)

NOTE: The following adjustment/test procedures provide for an on ground aircraft EFIS functional checks. Tests can be performed as a complete system test or as individual item tests.

A. Following is a Glossary of Acronyms used in the following tests procedures.

Table 203 Glossary of Acronyms

CAPTs----	Captains	ILS----------	Instrument Landing System
CMPVLD-	Computer Valid	MSP--------	Mode Select Panel
DH---------	Decision Height	ND----------	Navigation Display
DME-------	Distance Measuring Equipment	PFD---------	Primary Flight Display
CDP-------	Control and Dimming Panel	SG----------	Symbol Generator
EFIS-------	Electronic Flight Instrument System	STP---------	Status Test Panel
FMA--------	Flight Mode Annunciator	VOR--------	VHF Omnidirectional Range
F/O---------	First Officer	WXR--------	Weather Radar

B. The following ground mode criteria must be met before performing the Options/Check Register Word Test.

(1) Throttles full aft.

(2) Radio Altitude scale on Captain's and F/O's PFD.

(3) Aircraft weight on wheels.

(4) Nose gear Oleo switch in ground mode.

(5) Left and right ground control relay circuit breakers closed.

(6) Ground proximity computer installed.

C. Options/Check Register Words Test -- Preliminary

Table 204

Operation	Desired Result
(1) Set up Status Test Panel (STP).	STP set up and operational.
(2) On STP, check location of STP POWER button, SELECT button, BACKSPACE button, FORWARDSPACE button and VERIFY button. (Figure 204, Display A)	
(3) Press STP POWER button.	STP POWER on.
(4) Place EFIS/DFGS switch in EFIS position.	Switch in EFIS position.

Table 204 (Continued)

Operation	Desired Result
(5) Verify the 1 on STP SELECT button is illuminated. If 1 is not illuminated, press SELECT button.	STP SELECT button 1 is illuminated.
(6) SG 1 is now ready to be programmed. EFIS Maintenance Menu should now be displayed on Capt's PFD and ND. (Figure 204, Display B)	Maintenance Menu displayed on Capt's PFD and ND.

D. Options/Check Register Words Test -- Programming Symbol Generator 1

Table 205

Operation	Desired Result
(1) Press FORWARDSPACE button on STP until arrow is pointing to selection OPTIONS/CONFIG. (Figure 205, Display A)	Arrow pointing to OPTIONS/ CONFIG.
(2) Press VERIFY button on STP and verify on PFD and ND and aircraft configuration placard have identical OPTION/ CHECK REGISTER WORDS. (Figure 205, Display B)	OPTION/CHECK REGISTER WORDS on PFD, ND and aircraft configuration placard are identical.
NOTE: OPTIONS/CHECK REGISTER WORDS: Shown on following figures are examples only. Check aircraft configuration placard for actual words.	
(3) Verify on PFD and ND that arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.	Arrow is pointing to left most digit of aircraft OPTIONS REGISTER WORD.
(4) Press VERIFY button on STP, each press of button will roll digit one time. Continue to press VERIFY button until digit on PFD and ND matches same digit on aircraft placard. (Figure 206, Display A)	PFD and ND digits match placard.
(5) When digit is correct, press FORWARD SPACE button on STP to move to next digit on right. (Figure 206, Display B)	Arrow moves to next digit on right.
(6) Repeat steps (4) and (5) until options/ register and check register words on PFD and ND are same as aircraft placard.	Options/check register words same as aircraft placard.
(7) When right most digit of check register word is complete, press FORWARD SPACE button on STP. Display will return to main menu. (Figure 207)	Main menu display.

E. Options/Check Register Words Test -- Programming Symbol Generator 2

Table 206

Operation	Desired Result
(1) Place EFIS Mode Select panel switch to BOTH ON 2. Capt's PFD and ND should display EFI 2.	EFI 2 displayed.
(2) Press CMPVLD button on STP so 2 is illuminated on CMPVLD button.	CMPVLD button 2 illuminated.

Table 206 (Continued)

Operation	Desired Result
(3) Repeat steps (1) through (7) in Table 205 for programming SG 2, substituting 2 for 1.	Results same as programming symbol generator 1 test.

F. Verification of Programming Options -- Preliminary

NOTE: The following tests verify the options were programmed into the system correctly and options will be displayed. The tests also verify correct operation of the symbol generators and display units.

Table 207

Operation	Desired Result
CAUTION: RADIO RACK COOLING FANS MUST BE OPERATING DURING ANY EFIS TEST OPERATIONS.	
(1) Place EFIS switch in NORM position.	Switch in NORM position.
(2) Make certain STP power is off.	STP power off.
(3) Verify Capt's ND and PFD displays are normal.	ND and PFD displays normal.
(4) Verify on Capt's ND words MAINT CHECK are not displayed.	MAINT CHECK not displayed.
NOTE: If MAINT CHECK is displayed, then verify words on aircraft options placard are identical to those displayed. If the displays are correct and MAINT CHECK is still displayed, then call engineering.	
(5) Set up TIC-30 A or B generator.	TIC 30 generator set up.
(6) Tune VHF NAV 1 and VHF NAV 2 receivers to an ILS frequency (Example, 108.10 MHz).	VHF NAV receivers tuned to ILS frequency.
(7) Place Capt's and F/O's MSP MODE select switch to ROSE position.	MSP MODE select switch in ROSE position.

G. Verification of Programming Options -- Crossed Navigation and G/S Side Selection Options

Table 208

Operation	Desired Results
(1) Press and hold G/S switch on the TIC-30 generator.	
(2) Open VHF NAV DC circuit breaker.	Circuit breaker open.
(3) Verify that G/S FAIL appears on left side of F/O's PFD and ND screen.	G/S FAIL displayed on F/O's PFD and ND screens.
(4) Verify symbology on Capt's and F/O's PFD and ND per Figure 208. Disregard any other symbology displayed.	PFD and ND displays per Figure 208.
(5) Close VHF NAV DC circuit breaker and verify G/S FAIL message disappears.	G/S FAIL message disappears.

H. Verification of Programming Options -- Single Cue Flight Director Display and Rising Runway Option

Table 209

Operation	Desired Results
(1) Verify symbology on Capt's and F/O's PFD is single cue display. (Figure 209, Display A)	Single cue display on Capt's and F/O's PFD.
(2) Tune VHF NAV-1 and VHF NAV-2 to an ILS frequency (Example, 108.10 Mhz).	VHF receivers tuned to ILS frequency.
(3) TIC-30A or B generator set up.	TIC-30 generator set up.
(4) Press and hold LOC switch down on TIC-30 generator.	LOC switch in down position.
(5) Verify rising runway symbology displayed on Capt's and F/O's PFD. Disregard any other symbology displayed. (Figure 209, Display B)	

I. Verification of Programming Options -- No ILS Beam Deviation Warning

Table 210

Operation	Desired Results
(1) Connect a ground jumper to terminal 52 of MOD BLOCK S30-214, station 218L and terminal 28 of MOD BLOCK S30-18, station 110.	
(2) Tune VHF NAV-1 and VHF-2 to an ILS frequency.	VHF NAV-1 and -2 tuned to ILS frequency.
(3) Set up 980N-1 radio altimeter test set and adjust ALTITUDE control to a value greater than 100 feet and less than 800 feet.	
(4) Set up TIC-30 signal generator.	TIC-30 signal generator set up.
(5) Place knob on TIC-30 generator to VARIABLE position.	TIC-30 generator knob in VARIABLE position.
(6) On TIC-30 generator, press and hold G/S switch down.	G/S switch held down.
(7) Rotate G/S VARIABLE knob so G/S marker indicates 2 dots of deviation up.	G/S marker up at top of scale.
(8) Wait approximately 5 seconds, then verify on PFD rectangle of G/S deviation indicator is up at top of scale and not flashing.	G/S deviation indicator at top of scale on PFD and is not flashing.
(9) Verify G/S deviation symbology on PFD's is per Figure 210.	Display per Figure 210.
(10) Release G/S switch on TIC generator.	
(11) Remove 980N-1 test set.	
(12) Remove ground jumpers from terminal 52 and terminal 28.	

J. Verification of Programming Options -- AHRS

Table 211

Operation	Desired Results
(1) Verify following circuit breakers are closed: AHRS-1 (Overhead) AHRS-1 (Upper EPC) AHRS-2 (Upper EPC)	Circuit breakers closed.
(2) Verify symbology on Capt's and F/O's PFD are per Figure 211.	Symbology per Figure 211.

K. Verification of Programming Options -- ETA and DTW and Track Options

Table 212

Operation	Desired Results
(1) Place Capt's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(2) Place F/O's MSP mode select switch in MAP position.	MSP select switch in MAP position.
(3) Verify MAP symbology on Capt's and F/O's ND is per Figure 212. Disregard all other symbology.	MAP displays per Figure 212.

L. Verification of Programing Options -- ADF Bearing Option

Table 213

Operation		Desired Results
(1) Make certain ADF circuit breakers are closed.		ADF circuit breakers closed.
(2) Tune ADF-1 and ADF-2 to local broadcast frequency.		ADFs tuned to local broadcast frequency.
(3) Place Capt's and F/O's MSP mode select switch in ROSE position.		MSP mode select switch in ROSE position
(4) Place Capt's and F/O's MSP center knobs in ADF position.		MSP center knobs in ADF position.
(5) Verify ADF-1 and ADF-2 symbology display on Capt's and F/O's ND. (Figure 213)		Symbology per Figure 213.
(6) Place knobs in step (4) to OFF.		
(7)	On upper EPC open ADF-1 and ADF-2 circuit breakers.	Breakers open.
(8)	Verify ADF-1 and ADF-2 symbology display on Capt's and F/O's ND. (Figure 214)	Symbology per Figure 214.

M. Mode Select Panel Functional Test -- Rose Mode

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 214

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(2) Place F/O's MSP mode selector switch in ROSE position.	Mode selector switch in ROSE position.
(3) Verify Rose mode symbology is displayed on Capt's and F/O's ND. (Figure 215)	Rose mode symbology displayed.

N. Mode Select Panel Functional Test -- ARC MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 215

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(2) Place F/O's MSP mode selector switch in ARC position.	Mode selector switch in ARC position.
(3) Verify ARC mode symbology is displayed on Capt's and F/O's ND. (Figure 216)	ARC mode symbology displayed.

O. Mode Select Panel Functional Test -- MAP MODE

NOTE: This test is performed to verify that mode select panels communicate properly with the symbol generators.

Table 216

Operation	Desired Result
(1) Place Capt's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(2) Place F/O's MSP mode selector switch in MAP position.	Mode selector switch in MAP position.
(3) Verify MAP mode symbology is displayed on Capt's and F/O's ND. (Figure 217)	MAP mode symbology displayed.

P. Mode Select Panel Functional Test -- Range Selector

Table 217

Operation	Desired Result
(1) Place Capt's and F/O's MSP mode selector switch in ARC position.	
(2) Rotate Capt's WX OFF control on Captain's CDP to full clockwise position.	WXR OFF displayed on Capt's ND.
(3) Rotate F/O's WX OFF control on F/O's CDP to full clockwise position.	WXR OFF displayed on F/O's ND.

Table 217 (Continued)

Operation	Desired Result
(4) Place RANGE selector on Capt's and F/O's MSP in each range listed following: 10 80 20 160 40 320	Verify range index number in location on NDs as in Figure 218. 5 40 10 80 20 160
NOTE: Range Numbers on ND will be 1/2 of range selected on MSP.	
(5) Rotate Capt's and F/O's WX OFF control to OFF position.	WXR OFF display on Capt's and F/O's ND blanked out.

Q. NAV/RAD Switch Functional Test

Table 218

Operation	Desired Result
(1) Place Capt's and F/O's mode select panel (MSP) to ROSE position.	Capt's and F/O's MSP to ROSE position.
(2) On Capt's and F/O's respective MSP, place NAV/RAD switch to RAD position.	Capt's and F/O's MSP NAV/RAD switch to RAD.
(3) Place Capt's NAV/RAD switch to NAV position and verify NAV displayed at bottom of Capt's ND.	Capt's ND displays NAV.
(4) Place Capt's NAV/RAD switch to RAD position.	Capt's switch to RAD.
(5) Place F/O's NAV/RAD switch to NAV position and verify NAV displayed at bottom of F/O's ND.	F/O's ND displays NAV.
(6) Place F/O's NAV/RAD switch to RAD position.	F/O's switch to RAD.

R. PFD/ND Manual Brightness Test

Table 219

Operation	Desired Result
(1) Place Capt's MSP selector switch to ARC position.	MSP switch in ARC position.
(2) Rotate the Control and Dimming Panel (CDP) PFD knob counterclockwise.	Capt's PFD decreases in brightness.
(3) Rotate CDP PFD knob clockwise.	Capt's PFD increases in brightness.
(4) Rotate CDP ND knob counterclockwise.	Capt's ND decreases in brightness.
(5) Rotate CDP ND knob clockwise.	Capt's ND increases in brightness.
(6) Place F/O's MSP selector switch to ARC position.	MSP switch in ARC position.
(7) Repeat steps (2) through (5) substituting F/O's for Capt's.	Results same as steps (2) through (5).

S. Captain's and First Officer's Decision Height Test

Table 220

Operation	Desired Result
(1) Rotate DH knob on Capt's CDP clockwise. Check for display number on Capt's PFD in the top right corner. (Figure 219)	DH number increases.
(2) Rotate DH knob counterclockwise.	DH number decreases.
NOTE: DH number will blank when DH number is less than 0 (zero) feet.	
(3) Rotate DH knob on F/O's CDP clockwise. Check for display number on F/O's PFD in the top right corner. (Figure 219)	DH number increases.
(4) Rotate DH knob counterclockwise.	DH number decreases.

T. ND and PFD Compact Mode Test

Table 221

Operation	Desired Result
(1) Rotate ND BRT knob on Capt's CDP counterclockwise to the detent position.	ND BRT knob counterclockwise to detent position.
(2) Verify compact mode symbology display is on Capt's PFD as shown in Figure 220.	Compact mode display on Capt's PFD per Figure 220.
(3) Rotate ND BRT knob full clockwise.	Displays return to normal.
(4) Rotate PFD BRT knob on Capt's CDP counterclockwise to detent position.	PFD BRT knob counterclockwise to detent position.
(5) Verify compact mode symbology display on Capt's ND as shown in Figure 220.	Compact mode display on Capt's ND per Figure 220.
(6) Rotate PFD BRT knob full clockwise.	Displays return to normal.
(7) Repeat steps (1) through (6) substituting F/O's test procedures.	F/0's results same as Capt's desired results.

U. ND and PFD Auto Brightness Tests

NOTE: The following test verifies that the remote light sensor (RLS) and the display unit photocells will provide brightness boost to ND's and PFD's in high intensity light conditions.

Table 222

Operation	Desired Results
(1) Shine flashlight on each photocell area of Capt's and F/O's PFD and ND. (Figure 221 for photocell location on ND's and PFD's)	Note increase in ND's and PFD's brightness.
(2) Cover the RLS located on glareshield with your hand for approximately 5 seconds.	
(3) Remove your hand from RLS and shine flashlight on the RLS.	PFD's and ND's increase in brightness.
(4) Remove flashlight.	PFD's and ND's brightness returns to previous brightness.

V. Instrument Comparator Monitoring Test -- Capt's and F/O's FMA Lamp Test and SG Crosstalk Test

NOTE: The following tests verify the FMA lamps come on and symbol generators crosstalk bus is operating correctly.

Table 223

Operation	Desired Result
(1) Press and release Annunciator/Digital Light Test button.	Verify all FMA lamps come on.
NOTE: Disregard Starbursts on FMAs.	
(2) Release test button and verify Capt's FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.	FMA lamps go off for approximately 0.5 seconds and then come on for approximately 5 seconds.
(3) Repeat steps (1) and (2) substituting F/O's for Capt's in test procedures.	Desired results same as Capt's.
(4) Open SG-1 Power circuit breaker.	F/O's FMA Monitor lamp comes on.
(5) Close SG-1 Power circuit breaker.	F/O's FMA Monitor lamp goes off.
(6) Open SG-2 Power circuit breaker.	Capt's FMA Monitor lamp comes on.
(7) Close SG-2 Power circuit breaker.	Capt's FMA Monitor lamp goes off.

W. Symbol Generator Switching Tests

NOTE: The following test verifies that NDs and PFDs can be driven by the off-side symbol generator.

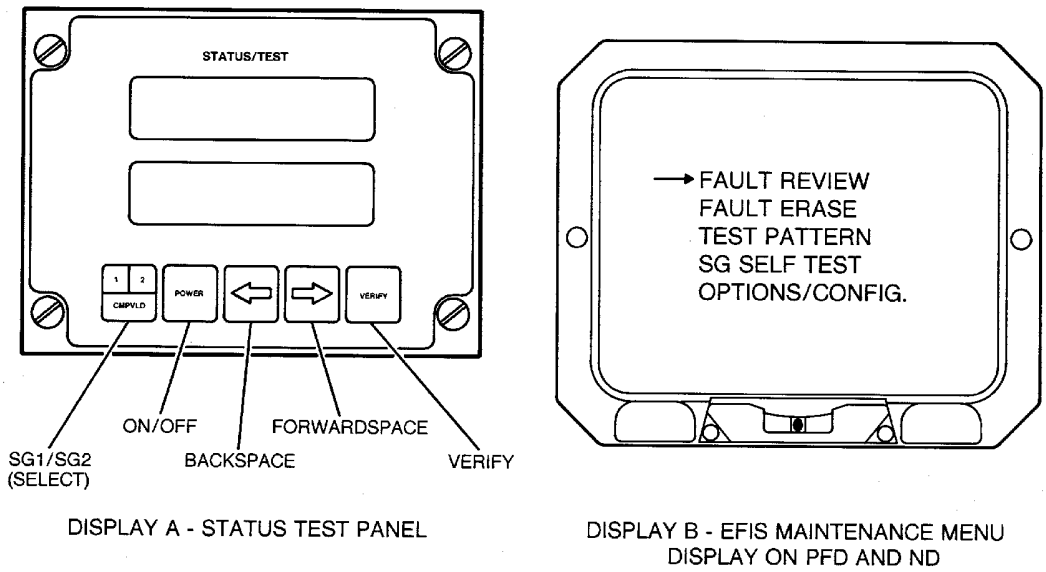
Table 224

Operation	Desired Result
(1) Place Capt's and F/O's MSP selector switch in ARC position.	MSP switch in ARC mode.
(2) Place EFIS switch to BOTH ON 1 position.	EFIS switch in BOTH ON 1 position.
(3) Verify symbology on Capt's and F/O's ND and PFD display EFI 1. (Figure 222, Display A)	PFD and ND display EFI 1 symbology per Figure 222, Display A.
(4) Place EFIS to BOTH on 2 position.	EFIS switch in BOTH ON 2 position.
(5) Verify symbology on Capt's and F/O's ND and PFD display EFI 2. (Figure 222, Display B)	PFD and ND display EFI 2 symbology per Figure 222, Display B.
(6) Return EFIS switch to NORM position.	EFIS switch in NORM position.

X. EFIS SELF TEST

Table 225

Operation	Desired Result
(1) Press FORWARD SPACE key on STP until arrow is pointing to SG SELF TEST on STP.	Verify Capt's PFD and ND display like Figure 223, Display A.
(2) Press VERIFY key on STP. This initiates self test.	Verify Capt's ND display like Figure 223, Display B.



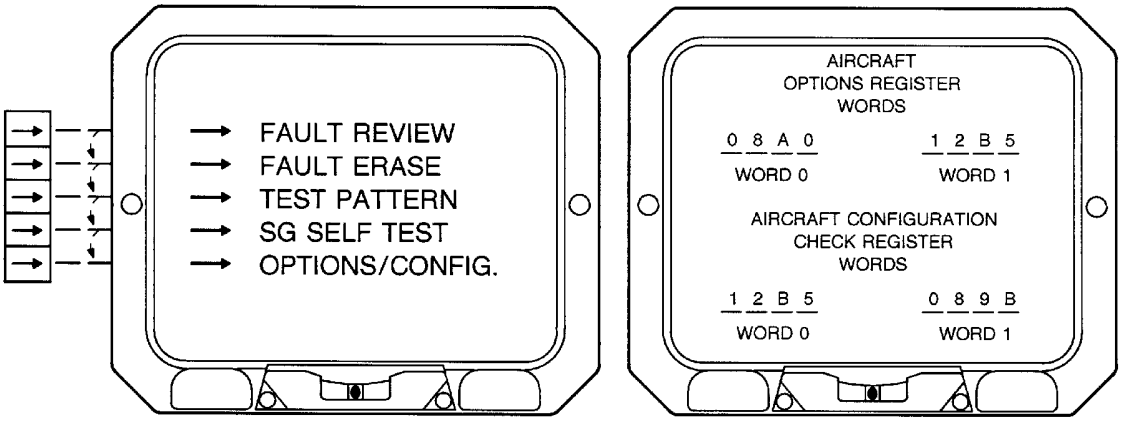
DISPLAY A - STATUS TEST PANEL

DISPLAY B - EFIS MAINTENANCE MENU DISPLAY ON PFD AND ND

CAG(IGDS)

BBB2-34-1294

Status Test Panel and Maintenance Menu Display on PFD and ND
Figure 204/34-22-00-990-C63



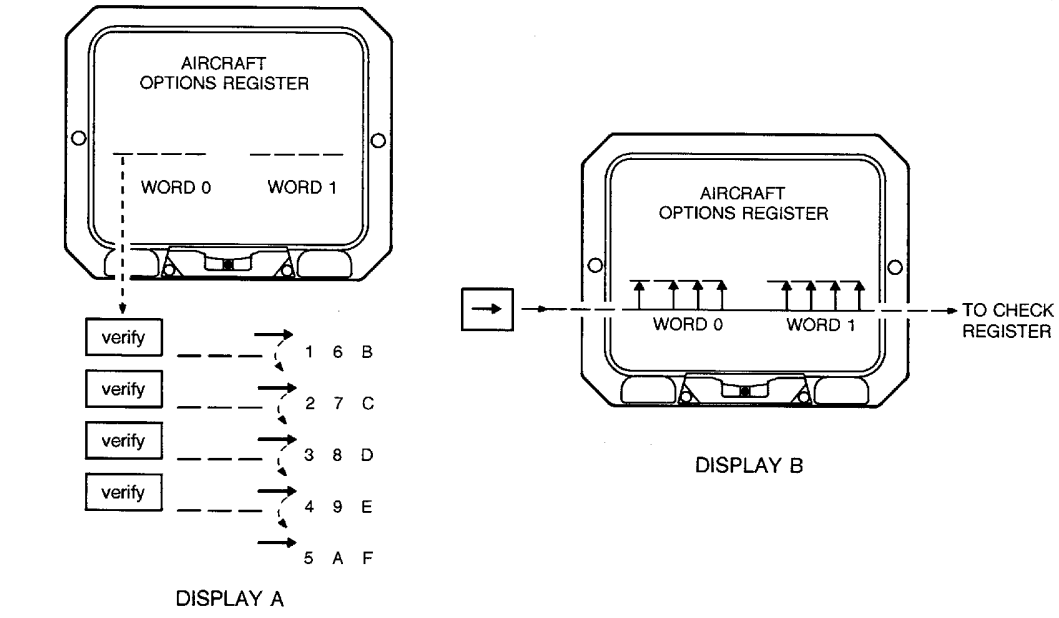
DISPLAY A
EFIS MAINTENANCE MENU
(DISPLAYED ON PFD AND ND)

DISPLAY B
OPTION/CHECK REGISTER WORDS

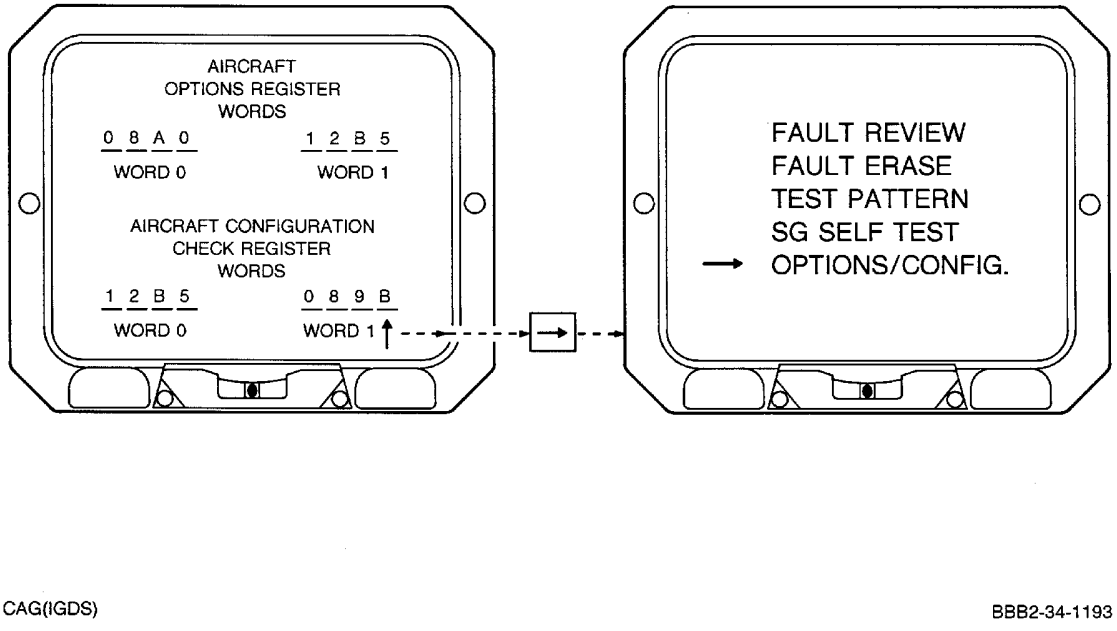
CAG(IGDS)

BBB2-34-1191

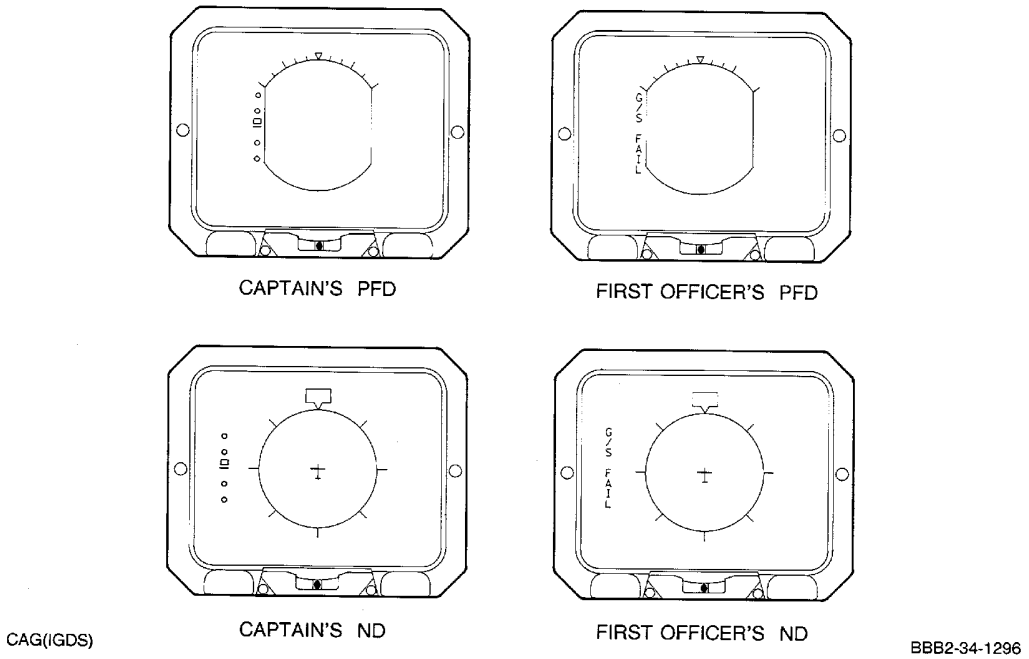
Options/Check Register Words Displays
Figure 205/34-22-00-990-C64



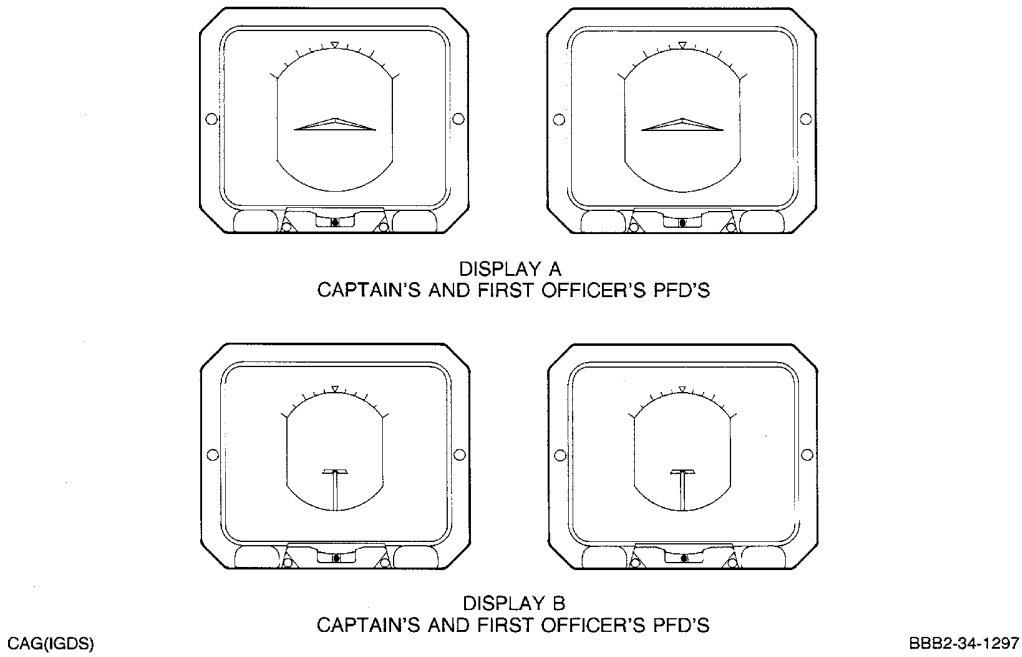
Aircraft Options Register
Figure 206/34-22-00-990-C65



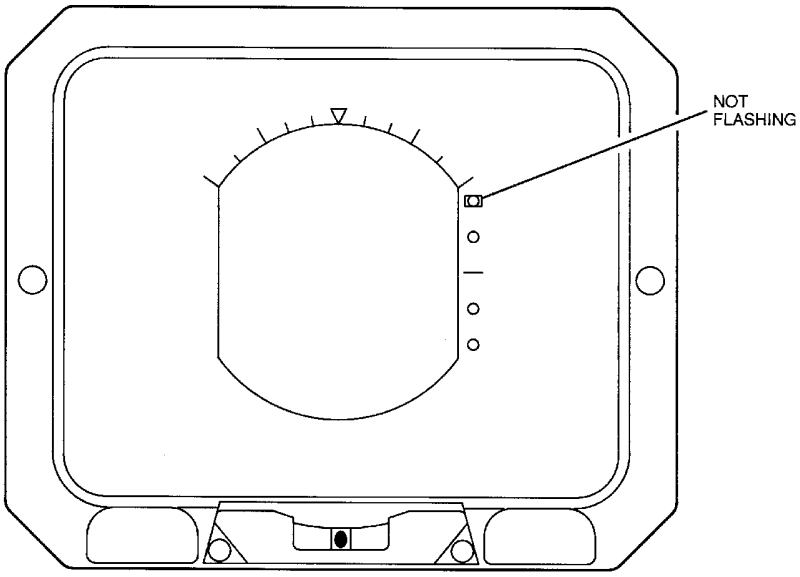
Options Register and Check Register Words and Main Menu Display Return
Figure 207/34-22-00-990-C66



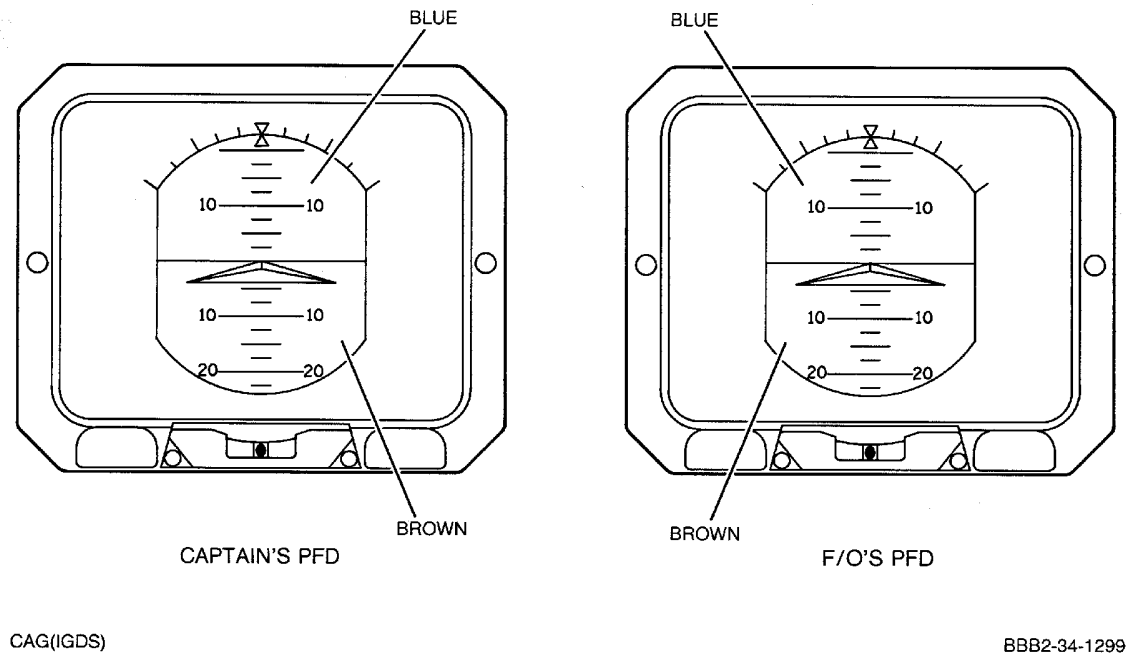
Uncrossed Navigation and G/S Side Selection Options
Figure 208/34-22-00-990-C67



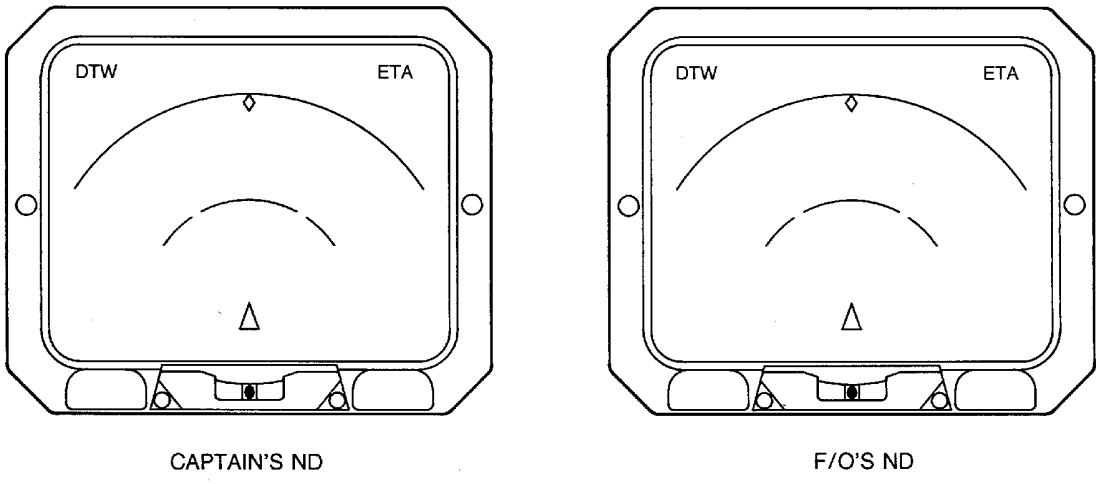
Single Cue Flight Director Display and Rising Runway Display
Figure 209/34-22-00-990-C69



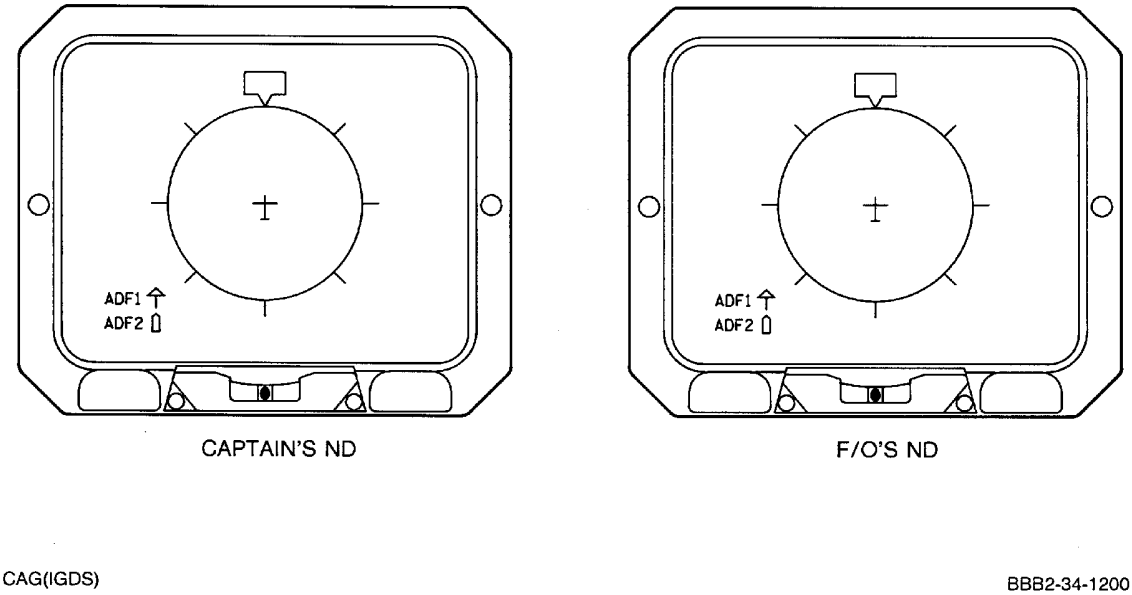
ILS Beam Deviation Warning Display
Figure 210/34-22-00-990-C70



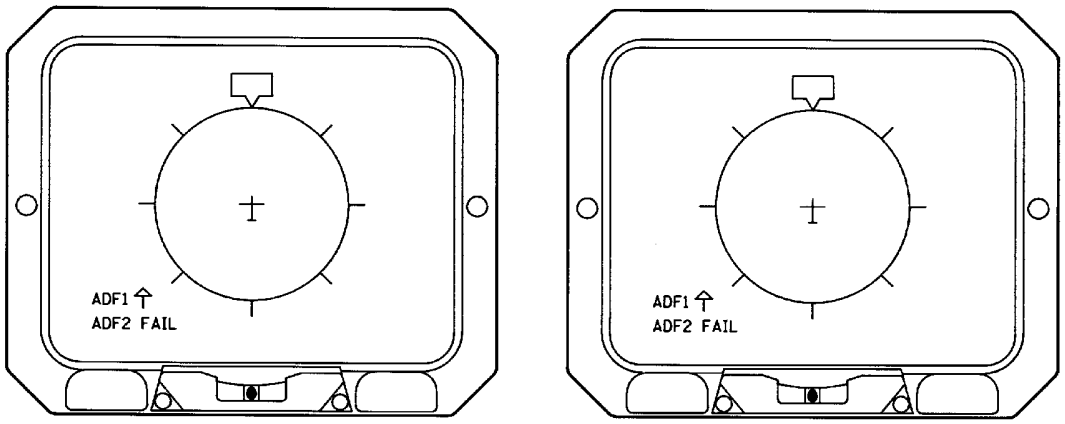
AHRS Option PFD Display
Figure 211/34-22-00-990-C72



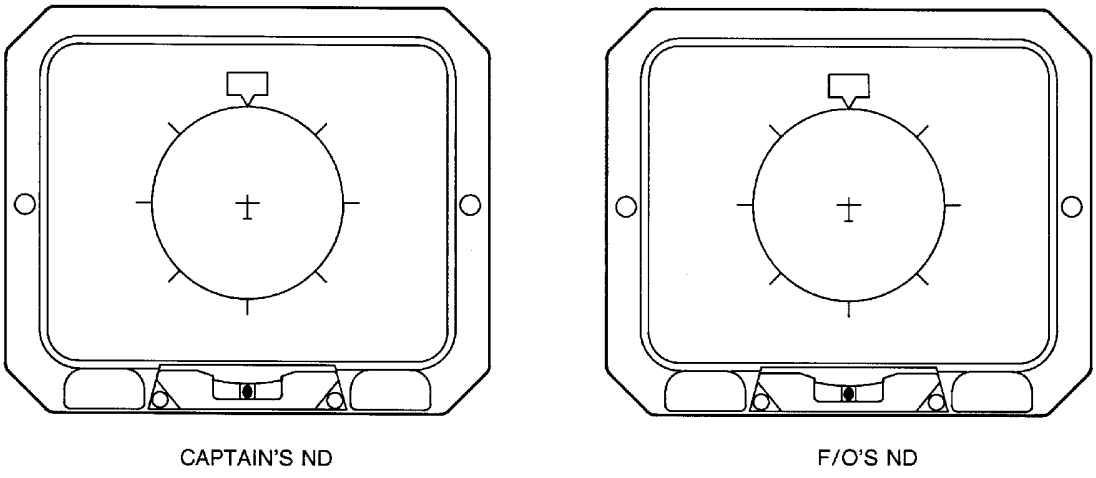
Navigation Display (ND) ETA and DTW MAP Display
Figure 212/34-22-00-990-C73



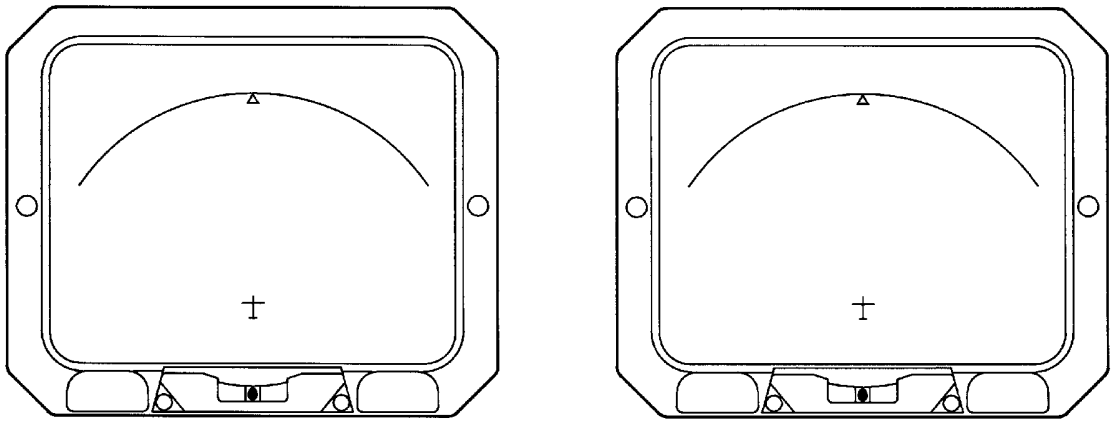
ADF Bearing Display
Figure 213/34-22-00-990-C74



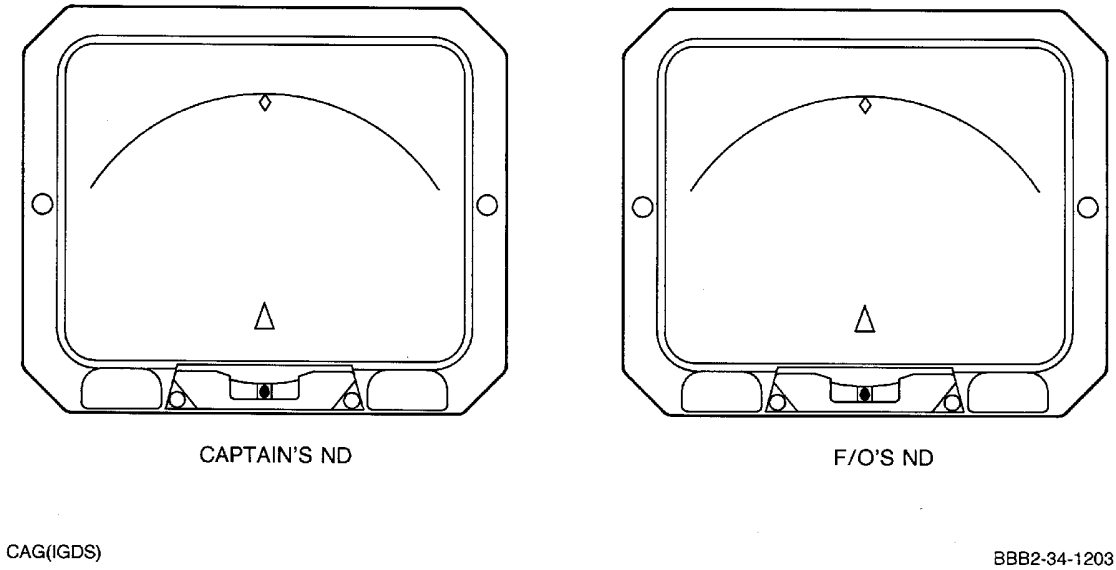
ADF Bearing Fail Display
Figure 214/34-22-00-990-C75



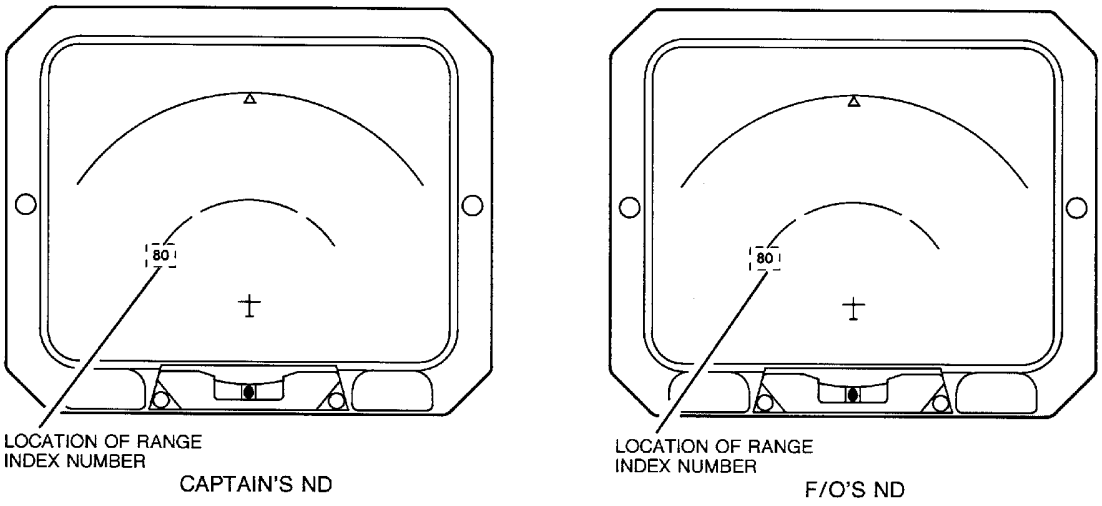
Rose Mode Display on ND's
Figure 215/34-22-00-990-C76



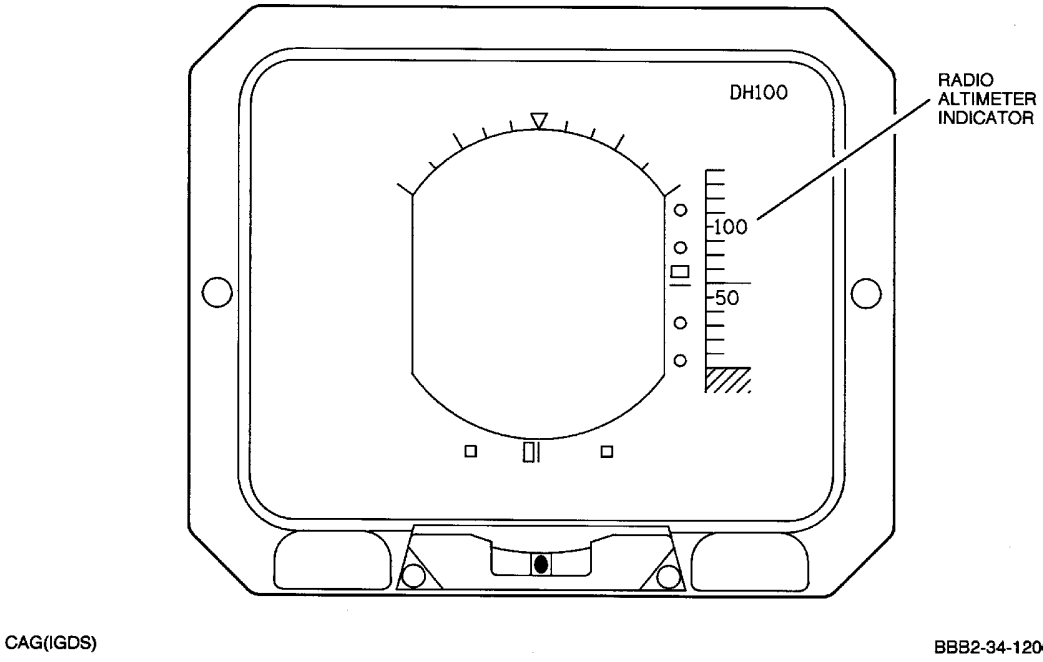
ARC Mode Display on ND's
Figure 216/34-22-00-990-C77



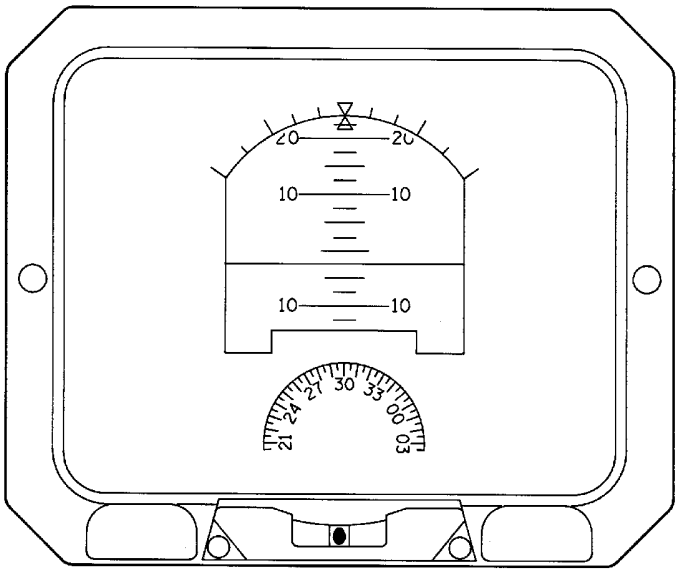
MAP Mode Display on ND's
Figure 217/34-22-00-990-C78



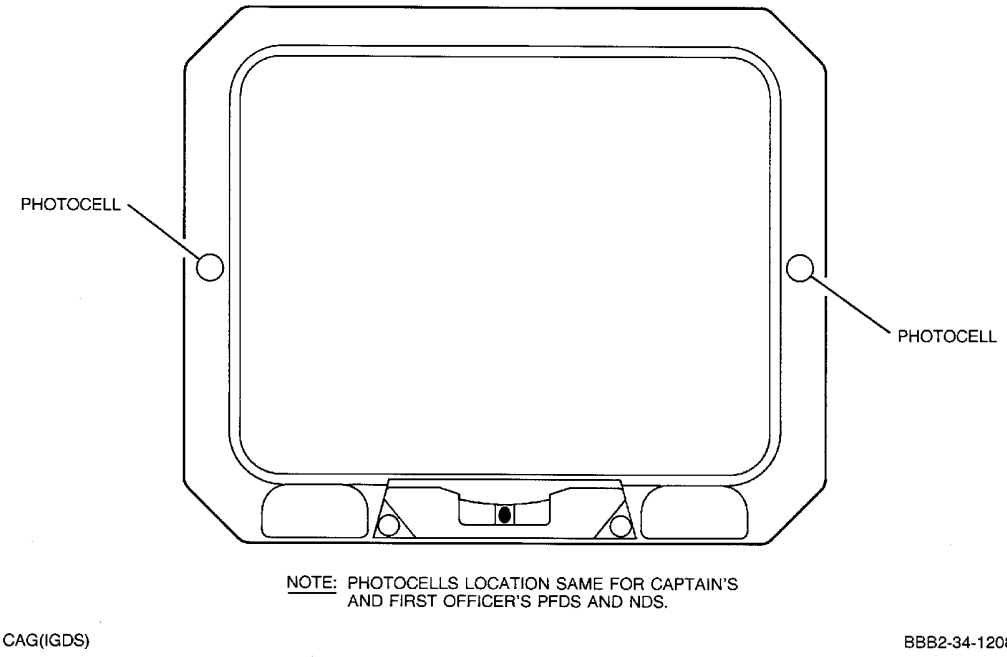
Range Selector Displays
Figure 218/34-22-00-990-C79



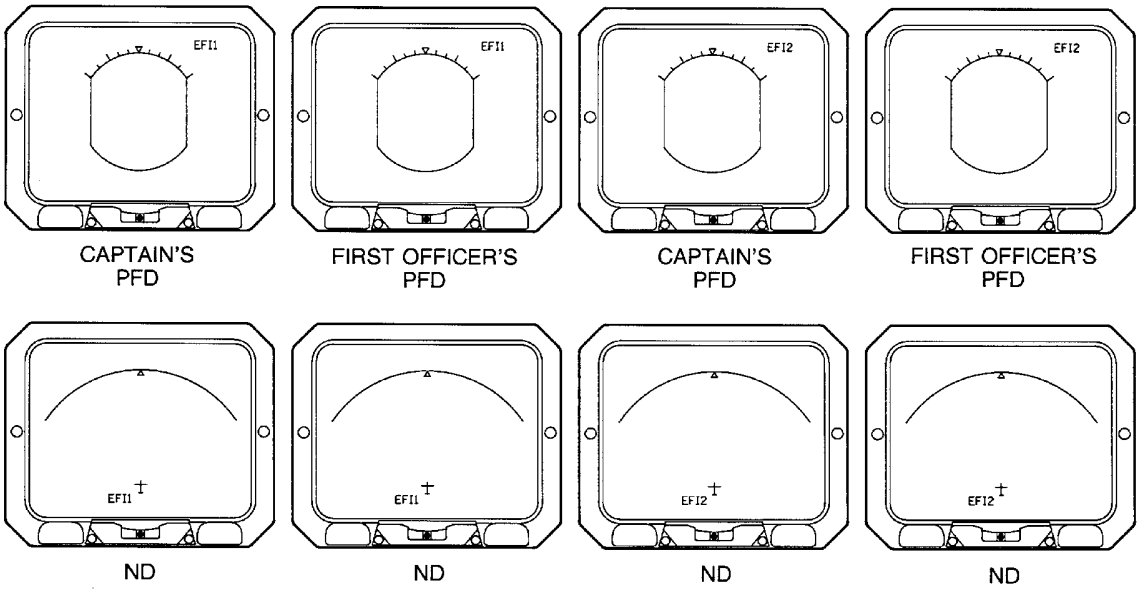
Decision Height Display On PFD
Figure 219/34-22-00-990-C80



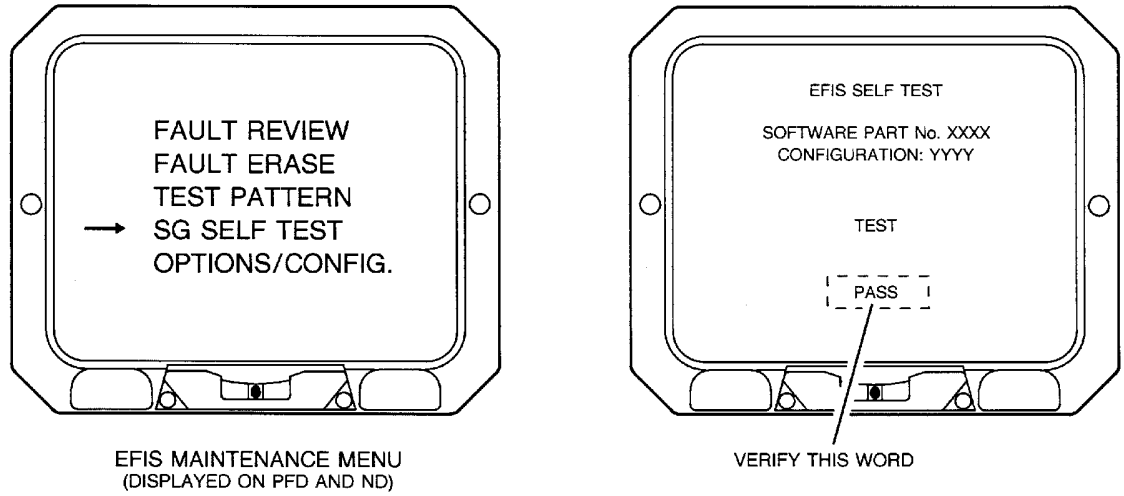
ND and PFD Compact Mode Displays
Figure 220/34-22-00-990-C81



PFD's and ND's Photocell Locations
Figure 221/34-22-00-990-C82



PFD and ND EFIS Switching Display
Figure 222/34-22-00-990-C83



EFIS Self Test Display on Captain's ND
Figure 223/34-22-00-990-C84

HORIZONTAL SITUATION INDICATOR (HSI) - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Horizontal Situation Indicator (HSI). There are two HSIs located in the flght compartment, one on the captain's instrument panel, and one on the first officer's panel.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring.

WJE 873, 874, 892, 893

NOTE: Aircraft that have Collins/Rockwell HSI, models 331A-8A/8K, may have the distance/ground speed display modules replaced to preclude the removal/replacement of the HSI for malfunctioning digits. (Paragraph 3.)

WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893

2. Removal/Installation Horizontal Situation Indicator

A. Remove HSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags, as applicable to HSI being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 873, 874, 881, 883, 892, 893			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893			
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED. REMOVE INDICATOR CAREFULLY TO AVOID STRIKING CONTROL COLUMN AND DAMAGING GLASS.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install HSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that applicable circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 873, 874, 881, 883, 892, 893			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893			
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

NOTE: Instrument clamp should be checked for clamp rivet failure at eyelets before instrument installation.

CAUTION: MAKE SURE THE CLAMP ATTACHMENT SCREWS ARE TIGHT. THIS WILL NOT LET THE COMPONENT MOVE FROM THE PANEL WHEN THE AIRCRAFT ACCELERATES.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws. Tighten screws to torque of 6 to 8 inch-pounds (0.678 to 0.904 N·m).

(5) Remove the safety tags and close applicable circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 873, 874, 881, 883, 892, 893			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893			
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

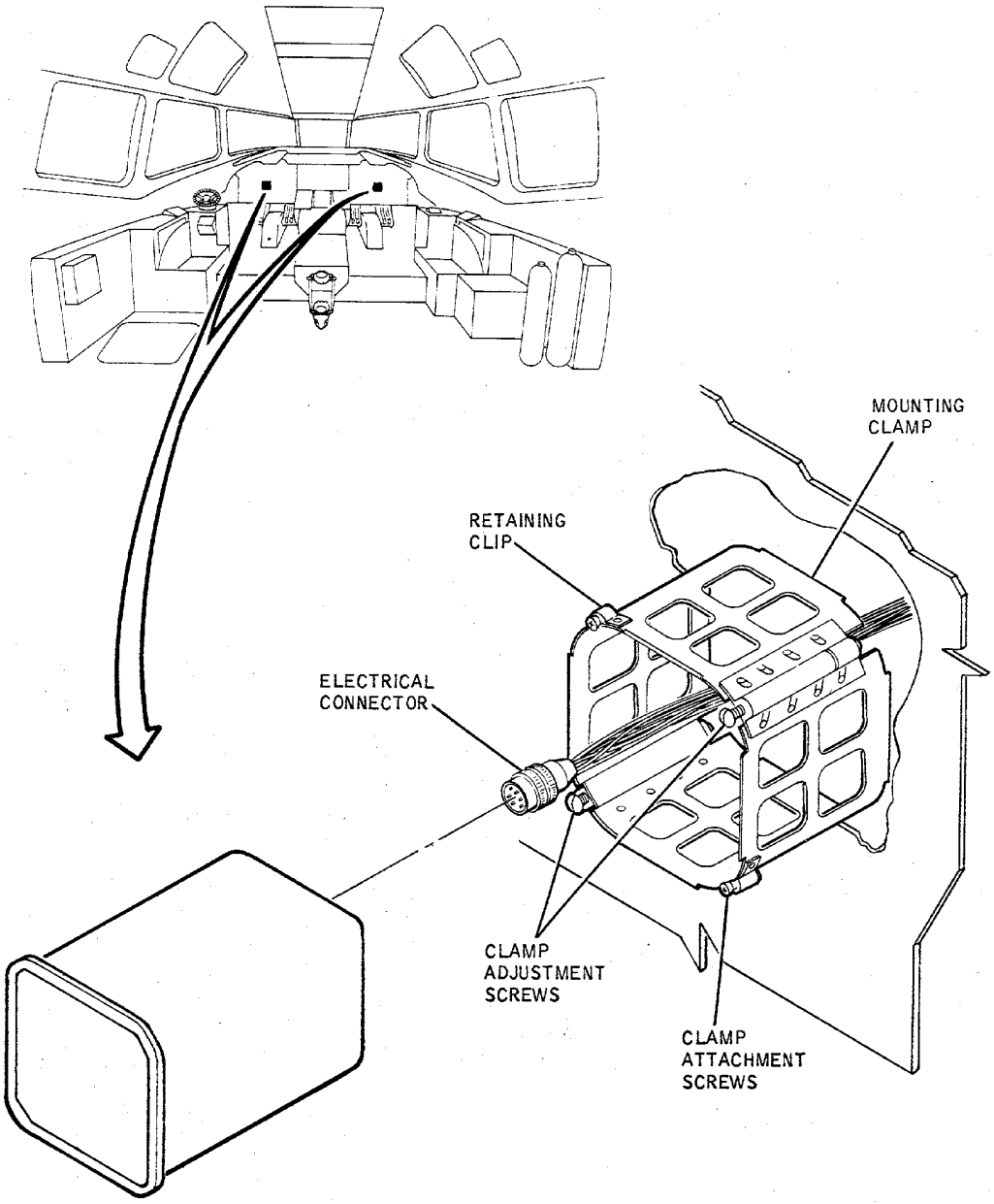
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(6) With aircraft navigation systems operational, flags should be out of view. Heading card should agree with opposite HSI ±2 degrees.

NOTE: HSI operations are checked in INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00 Page 201, VHF NAVIGATION, SUBJECT 34-51-00 Page 201, and DISTANCE MEASURING EQUIPMENT SYSTEM, SUBJECT 34-52-00 Page 201. Refer to these sections for interfacing applicable system test if required.

(7) Return aircraft to required configuration.



Horizontal Situation Indicator -- Removal/Installation
Figure 201/34-22-03-990-801

EFFECTIVITY
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893

WJE 873, 874, 892, 893

3. Removal/Installation - Distance/Ground Speed Display Modules

A. Remove Display Modules (Figure 202)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags, as applicable to Display Module being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

WJE 873, 874, 892, 893 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Remove two bezel retaining screws for intended display and remove bezel.

(3) Using non-metallic prying device, remove display module from HSI.

(4) Remove two mounting plate screws from display module and remove mounting plate.

B. Install Display Modules (Figure 202)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that applicable circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1

WJE 873, 874, 892, 893 (Continued)

(Continued)

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Install mounting plate, using two screws previously removed, onto replacement display module.

(3) Install replacement display module, with mounting plate, into HSI.

(4) Install bezel, using two screws previously removed.

WJE 873, 874, 892, 893 (Continued)

(5) Remove the safety tags and close applicable circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1

WJE 873, 874, 892, 893 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

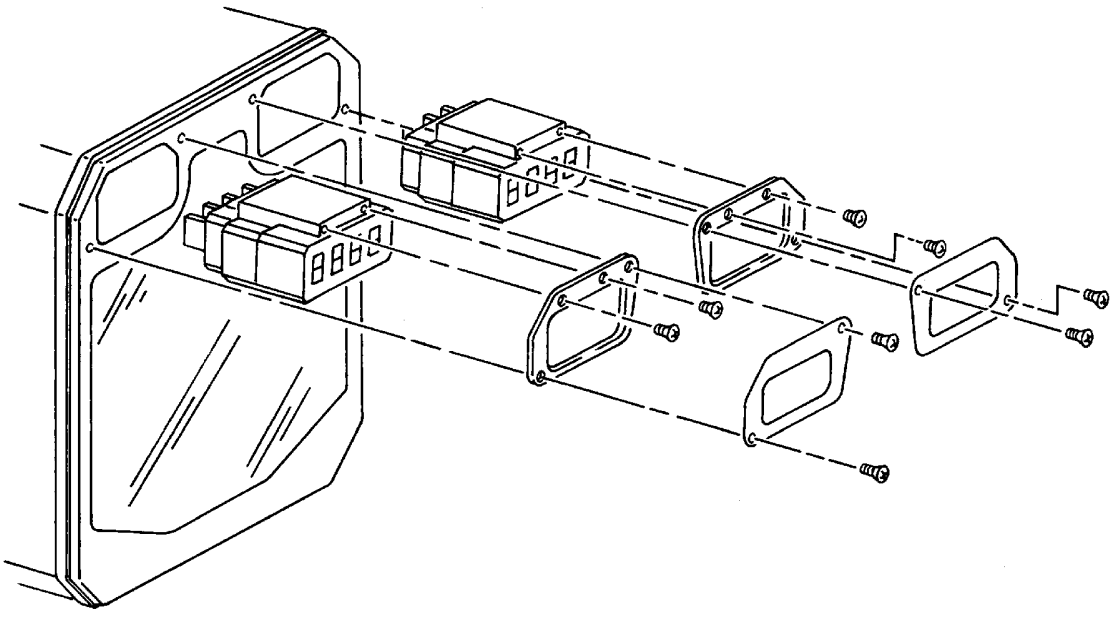
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(6) With aircraft navigation systems operational, flags should be out of view. Heading card should agree with opposite HSI ±2 degrees.

NOTE: HSI operations are checked in INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00 Page 201, VHF NAVIGATION, SUBJECT 34-51-00 Page 201, andDISTANCE MEASURING EQUIPMENT SYSTEM, SUBJECT 34-52-00 Page 201. Refer to these sections for interfacing applicable system test if required.

(7) Return aircraft to required configuration.



BBB2-34-1442

Distance/Ground Speed Display Module -- Removal/Installation
Figure 202/34-22-03-990-803

HORIZONTAL SITUATION INDICATOR (HSI) - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Horizontal Situation Indicator (HSI). There are two HSIs located in the flght compartment, one on the captain's instrument panel, and one on the first officer's panel.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring.

2. Removal/Installation Horizontal Situation Indicator

A. Remove HSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags, as applicable to HSI being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED. REMOVE INDICATOR CAREFULLY TO AVOID STRIKING CONTROL COLUMN AND DAMAGING GLASS.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install HSI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that applicable circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

NOTE: Instrument clamp should be checked for clamp rivet failure at eyelets before instrument installation.

CAUTION: MAKE SURE THE CLAMP ATTACHMENT SCREWS ARE TIGHT. THIS WILL NOT LET THE COMPONENT MOVE FROM THE PANEL WHEN THE AIRCRAFT ACCELERATES.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws. Tighten screws to torque of 6 to 8 inch-pounds (0.678 to 0.904 N·m).

(5) Remove the safety tags and close applicable circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
B	6	B10-10	FIRST OFFICER'S COMPASS

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	08	B10-9	CAPTAIN'S COMPASS

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	6	B10-74	ADF-2

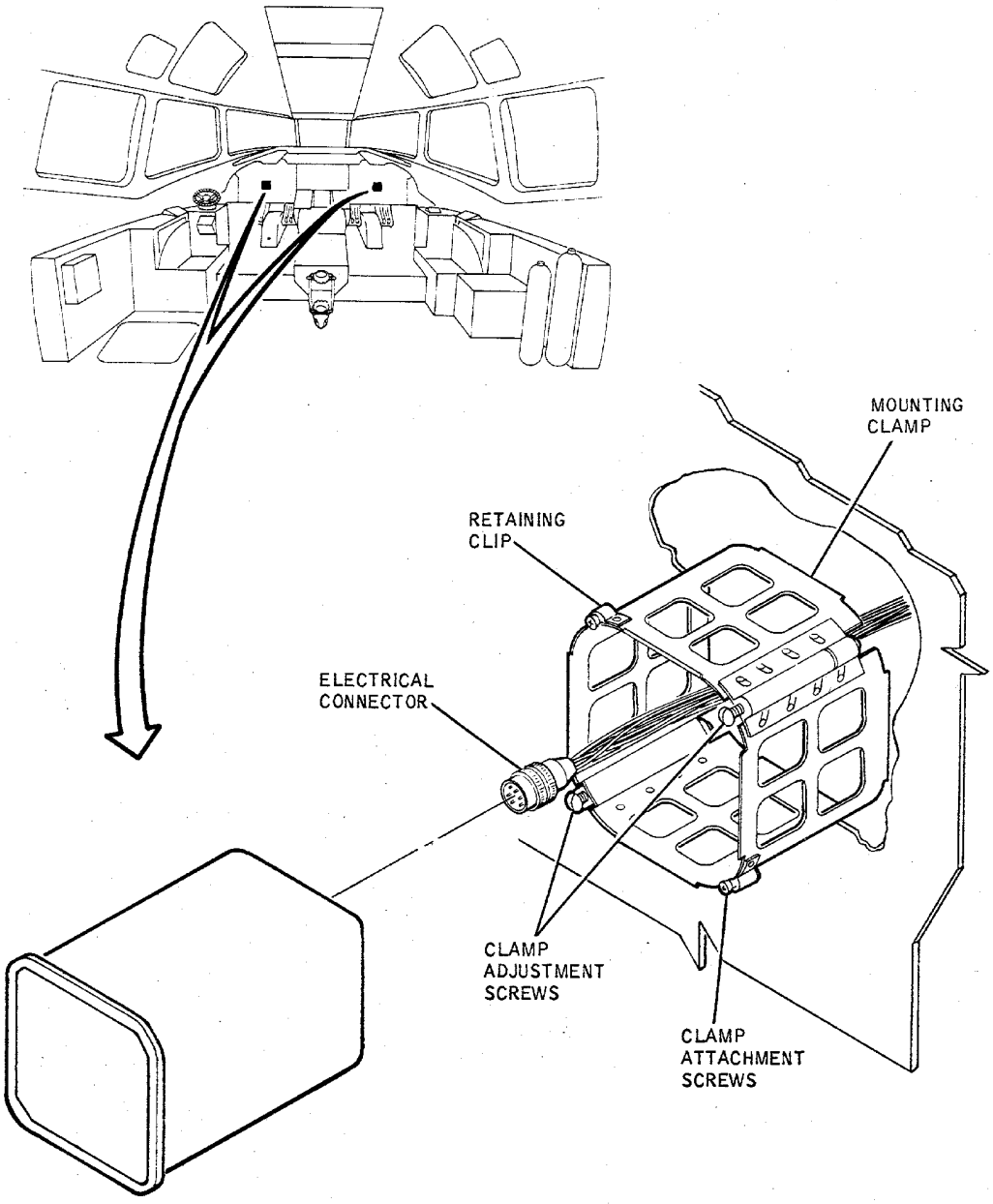
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(6) With aircraft navigation systems operational, flags should be out of view. Heading card should agree with opposite HSI ±2 degrees.

NOTE: HSI operations are checked in INSTRUMENT LANDING SYSTEM (ILS), SUBJECT 34-32-00 Page 201, VHF NAVIGATION, SUBJECT 34-51-00 Page 201, DISTANCE MEASURING EQUIPMENT SYSTEM, SUBJECT 34-52-00 Page 201, and AUTOMATIC DIRECTION FINDING (ADF), SUBJECT 34-53-00 Page 201. Refer to these sections for interfacing applicable system test if required.

(7) Return aircraft to required configuration.



Horizontal Situation Indicator -- Removal/Installation
Figure 201/34-22-03-990-810

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

HSI (RAD/INS) SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the HSI (RAD/INS) switching unit. The unit is rack mounted in the electrical/electronics compartment. Operation of the switching unit is controlled by the captain's or the first officer's HSI switches located on their respective instrument panels.

2. Removal/Installation HSI (RAD/INS) Switching Unit

A. Remove Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
WJE 405, 409, 881, 883, 884			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884			
A	11	B10-382	HSI SWITCHING
WJE 405, 409, 881, 883, 884, 892			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 881, 883, 892			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING

WJE 881, 883, 892 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove switching unit.

B. Install Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
WJE 405, 409, 881, 883, 884			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884			
A	11	B10-382	HSI SWITCHING
WJE 405, 409, 881, 883, 884, 892			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	25	B10-288	OMEGA-1

WJE 405, 409, 884 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 881, 883, 892			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

(2) Visually check switching unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide switching unit straight into rack, ensuring that electrical connectors are properly aligned with mounting rack connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until switching unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on switching unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
WJE 405, 409, 881, 883, 884			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884			
A	11	B10-382	HSI SWITCHING
WJE 405, 409, 881, 883, 884, 892			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 881, 883, 892			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 892			
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

(7) Energize aircraft electrical buses, and allow 3 minutes for system warmup.

(8) Tune VOR receivers to convenient VOR frequency.

(9) On Captain's and F/O's instrument panels, select RADIO with both HSI switches.

(10) On both HSI's, ensure that annunciator displays RAD. On front panel of HSI (RAD/INS) switching unit, ensure that CAPT ON, and F/O ON annunciators display RAD.

(11) On Captain's and F/O's instrument panels, select OMEGA with both HSI switches.

(12) On both HSI's, ensure that annunciator displays NAV. On front panel of HSI (RAD/INS) switching unit, ensure that CAPT ON, and F/O ON annunciators display INS.

HSI SWITCHING UNIT - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-22-05-710-801

2. Operational Check of the VHF NAV Switching

A. Prepare for the Operational Check of the VHF NAV Switching

SUBTASK 34-22-05-861-001

(1) Energize aircraft electrical buses, and allow 3 minutes for system warm-up.

B. Do a Operational Check of the VHF NAV Switching

SUBTASK 34-22-05-710-001

(1) Verify RADIO NAV switch is in the NORM position.

(2) At the VHF NAV control panel, select applicable VOR/ILS frequency.

(3) Check Capt's and F/O's VOR/ILS NAV displays on HSI/ND that fail flags/messages are out of view.

(4) Open these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

(a) Fail flag/message on Capt's HSI/ND comes into view.

(5) Select RADIO NAV switch to BOTH ON 2 position.

(a) Verify NAV light / message (NAV2) on instrument panel / ND comes on.

(b) Fail flag/message on Capt's HSI/ND goes out of view.

(6) Rotate either CRS knob on the VHF NAV control panel left and right.

(7) Observe coordinated course deviation needle movement between both Capt's and F/O's HSI's/ND's.

(8) Close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

(9) Return RADIO NAV switch to NORM position.

(10) Check Capt's and F/O's VOR/ILS NAV displays on HSI/ND that fail flags/messages are out of view.

(11) Open these circuit breakers:

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(a) Fail flag/message on F/O's HSI/ND comes into view.

(12) Select RADIO NAV switch to BOTH ON 1 position.

(a) Verify NAV light on instrument panel comes on.

(b) Fail flag/message on F/O's HSI/ND goes out of view.

(13) Rotate either CRS knob on the VHF NAV control panel left and right.

(a) Observe coordinated course deviation needle movement between both Capt's and F/O's HSI's/ND's.

(14) Close these circuit breakers:

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(15) Return RADIO NAV switch to NORM position.

(16) Check Capt's and F/O's VOR/ILS NAV displays on HSI/ND that fail flags/messages are out of view.

C. Job Close-up

SUBTASK 34-22-05-862-001

(1) De energize aircraft electrical buses.

SUBTASK 34-22-05-942-001

(2) Remove all the tools and equipment from the work area. Make sure the area is clean.

——— END OF TASK ———

EFIS NAVIGATION DISPLAY (ND) UNIT - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test for the EFIS Navigation Display Units. There are two Display Units, located on the Captain's and First Officer's Instrument Panels. These units occupy panel positions previously held by the HSI's.

WJE 412, 414

B. These maintenance practices provide removal/installation and adjustment/test for the EFIS Navigation Display Units. There are two Display Units, located on the Captain's and First Officer's Instrument Panels. These units occupy panel positions previously held by the ADI and HSI's.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

C. Removal/installation is the same for both units. When opening circuit breakers, open only those breakers which apply to the unit being replaced.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Non-ammoniated mild window cleaner	
Lens paper Cat No. S68	VWR Science Co.

3. Removal/Installation EFIS Navigation Display (ND) Unit

A. Remove Display Unit (DU)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	3	B10-431	CAPTAIN'S N.D.
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

CAUTION: WHEN REMOVING EFIS NAVIGATION DISPLAY (ND) UNIT EXERCISE EXTREME CAUTION IN PULLING ND FROM INSTRUMENT PANEL TO PREVENT STRAIN ON ELECTRICAL CONNECTOR AND WIRING. STRAIN ON ELECTRICAL CONNECTOR AND WIRING HAS CAUSED WIRES TO BE PULLED FROM CONNECTOR OR DAMAGED. CLOSE PROXIMITY OF CONTROL COLUMN TO ND MAKES IT DIFFICULT FOR ND REMOVAL AND HAS BEEN CAUSE FOR STRAIN ON CONNECTOR. IT IS SUGGESTED ADDITIONAL PERSONNEL BE UTILIZED TO HOLD CONTROL COLUMN IN AFT POSITION WHEN REMOVING ND.

(2) Using extraction aids on lower corners of display unit (DU), pull unit straight out from instrument panel, far enough to gain access to electrical wiring connector.

(3) Disconnect electrical connector from DU and remove DU.

(4) Install protective covers on aircraft electrical connector and on DU electrical receptacle.

B. Install Display Unit (DU)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC

WJE 415, 418, 863, 864, 866 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	3	B10-431	CAPTAIN'S N.D.
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Check DU receptacle and aircraft electrical connector for damaged, corroded, or dirty electrical contacts.

(3) Place DU in position at instrument panel and connect aircraft electrical connector to DU electrical connector.

(4) Install DU in instrument panel.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC

WJE 406 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	3	B10-431	CAPTAIN'S N.D.
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

4. Adjustment/Test EFIS Navigation Display (ND) Unit

A. Navigation Display Functional Test

(1) Make sure that all EFIS system circuit breakers, and all other aircraft sensor circuit breakers, are closed. (NAVIGATION DISPLAYS - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-00/201 Config 1 or NAVIGATION DISPLAYS - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-00/201 Config 2 or NAVIGATION DISPLAYS - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-00/201 Config 4 or NAVIGATION DISPLAYS - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-00/201 Config 7 or NAVIGATION DISPLAYS - MAINTENANCE PRACTICES, PAGEBLOCK 34-22-00/201 Config 8 for complete listing of EFIS and interfacing system circuit breakers)

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures.

(2) Rotate ND BRT control knobs on both Control & Dimming Panels (CDP) to turn all Display Units on. Captain's and F.O.'s ND's show similar display symbology and color.

NOTE: Mode Select knobs for Captain's and F.O.'s ND should be in identical positions.

(3) Place EFIS source select switch in BOTH ON 1 position. Displays show appropriate ND symbology; both ND's show EFI1 source selection at bottom of screen.

(4) Place EFIS source select switch in BOTH ON 2 position. Displays show appropriate ND symbology; both units show EFI2 source selection at bottom of screen.

(5) Rotate ND BRT control knob on on-side Control & Dimming Panel (CDP) clockwise, from full counterclockwise position. On-side ND display intensity increases when knob is rotated clockwise; decreases when knob is rotated counterclockwise.

(6) Rotate on-side ND BRT control knob fully counterclockwise, past detent. ND display goes off; compact mode display appears on on-side PFD.

(7) Rotate on-side ND BRT control knob fully clockwise.

(8) Place MODE select switch on on-side Mode Select Panel in ARC position.

(9) Rotate WX BRT control knob clockwise and counterclockwise on on-side CDP. Intensity of weather radar display increases and decreases as knob is rotated.

(10) Rotate WX BRT control knob fully counterclockwise. Weather radar display goes off.

(11) Return aircraft to required configuration.

5. Cleaning/Painting EFIS Navigation Display Screen

A. Clean EFIS Navigation Display Screen

(1) Moisten lens paper with window cleaner, then lightly wipe off surface to be cleaned in one pass.

(2) Obtain fresh piece of lens paper, moisten, then wipe again. Continue this procedure until all marks have been completely removed, taking fresh piece of lens paper each time, in order not to scratch optical parts with dust collected on lens paper.

(3) Wipe screen with dry, clean lens paper, again replacing paper after each pass.

NOTE: Always moisten lens paper with window cleaner and not screen. Do not press hard when wiping. It is advisable to mist surface to be wiped before wiping with lens paper to avoid scratches. The more often lens paper is replaced, the faster and more efficient the cleaning.

6. Relocation of PFD, ND Display Units

A. Relocate Display Unit (DU)

(1) In order to extend lifetime of CRT, display units have to be frequently relocated to avoid extensive burn-in.

B. Procedure

(1) Removal/installation of display units has to be performed in accordance with Paragraph 3..

(2) Remove display unit out of Capt's PFD position and install display unit into Capt's ND position.

(3) Remove display unit out of Capt's ND position and install display unit into Capt's PFD position.

(4) Remove display unit out of F.O.'s ND position and install display unit into F.O.'s PFD position.

(5) Remove display unit out of F.O.'s PFD position and install display unit into F.O.'s ND position.

C. Adjustment/Test

(1)

The tests have to be performed in accordance with Paragraph 4..

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

D. Inclinometer Adjustment

(1) Level aircraft. (LEVELING AND WEIGHING, CHAPTER 08)

(2) Loosen screws on either end of inclinometer.

(3) Move applicable end up or down to center bubble between two vertical lines within ±0.03 inches (0.76 mm).

(4) Tighten inclinometer screws.

(5) Secure aircraft leveling.

NAVIGATION DISPLAY UNIT (ND) - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-22-06-710-801

2. Operational Check of the EFIS Source Switching

A. Prepare for Operational Check of the EFIS Source Switching

SUBTASK 34-22-06-860-001

(1) Make sure that all EFIS system circuit breakers, and all other aircraft sensor circuit breakers, are closed.

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures.

SUBTASK 34-22-06-860-002

(2) Rotate ND BRT control knobs on both Control & Dimming Panels (CDP) to turn all Display Units on.

B. Operational Check of the EFIS Source Switching

SUBTASK 34-22-06-710-001

(1) Place the captain's and first officer's MSP MODE select switches in ARC position.

NOTE: Mode Select knobs for Captain's and F.O.'s ND should be in identical positions.

(a) Captain's and F.O.'s ND's show similar display symbology and color.

SUBTASK 34-22-06-710-002

(2) On the overhead panel place EFIS source select switch in BOTH ON 1 position.

(a) Make sure the displays show appropriate ND symbology.

(b) Make sure the captain's and first officer's PFDs and NDs display EFI1 source selection on screens.

SUBTASK 34-22-06-710-003

(3) Place EFIS source select switch in BOTH ON 2 position.

(a) Make sure the displays show appropriate ND symbology.

(b) Make sure the captain's and first officer's PFDs and NDs display EFI2 source selection on screens.

SUBTASK 34-22-06-710-004

(4) Place EFIS source select switch in NORM position.

(a) Make sure the displays show appropriate ND symbology.

(b) Make sure the captain's and first officer's PFDs and NDs do not display EFI1 or EFI2 source selection on screens.

C. Job Close-up

SUBTASK 34-22-06-840-001

(1) Return airplane to required configuration.

END OF TASK

EFIS SYMBOL GENERATOR (SG) - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Symbol Generator (SG). There are two EFIS Symbol Generators, located on the radio racks in the electrical/electronics compartment. SG-1 controls the Captain's PFD and ND displays; SG-2 controls the F.O.'s displays. Each unit weighs approximately 19 pounds (8.62 kg).

B. Removal/installation is the same for both units. When opening circuit breakers, open only those breakers which apply to the system being worked. On-side display units should be observed when performing adjustment/test. (Paragraph 1.D.)

C. The following adjustment/test procedures are provided in this section:

(1) SG Options Programming: This procedure is performed ONLY in conjunction with removal/installation of an SG. It's function is to provide the SG with the configuration and options of the aircraft on which it is installed.

(2) Symbol Generator (SG) Self-Test: Tests the internal functioning of the SG.

(3) Cockpit Lamp Test: Tests the ILS, HEADING, HORIZON, and MONITOR annunciators on the Flight Mode Annunciator (FMA) panel; also tests MSP declutter buttons and taxi speed indication, if installed.

(4) EFIS System Self-Test: Utilizes the TEST pushbutton on the Control & Dimming Panel (CDP) to test the aircraft systems which provide inputs to the SG.

NOTE: The SG Self-Test, EFIS System Self-Test and Cockpit Lamp Test combined constitutes a complete system test for the EFIS.

D. The terms "on-side" and "cross-side" are used throughout the procedures. The term "on-side" refers to those LRU's and displays which belong to the system (SG) being tested. For example, if system-1 is being tested, the "on-side" displays and panels would be those located on the Captain's instrument panel. The "cross-side" displays and panels would belong to the F.O.

E. For a complete explanation of the General Maintenance Features of the EFIS and instructions for using the STP in conjunction with the EFIS displays, refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201.

2. Removal/Installation EFIS Symbol Generator (SG)

A. Remove Symbol Generator (SG)

WJE 401-404, 406-408, 410, 411, 875-879, 886, 887

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-431	CAPTAIN'S N.D.

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 412, 414, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 411, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 410

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(2) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
B	5	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	11	B10-411	FIRST OFFICER'S P.F.D.
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(3) Unscrew knurled holddown nuts at front end of mounting rack and swing holddown assembly down.

(4) Pull unit straight out from rack.

B. Install Symbol Generator (SG)

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 412, 414, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 411, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 410

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
B	5	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	11	B10-411	FIRST OFFICER'S P.F.D.
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(3) Visually check unit connector plugs and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(4) Slide unit straight into rack. Make sure that guide pin bushing and connectors are properly aligned with mounting rack guide pins and connectors.

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 412, 414, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 412, 414, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 411, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 410

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
B	5	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	11	B10-411	FIRST OFFICER'S P.F.D.
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

3. Adjustment/Test EFIS Symbol Generator (SG)

A. SG Options Programming (Figure 201)

NOTE: Do not perform SG Options Programming unless a new SG has been installed.

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887

(1) Make sure that all EFIS circuit breakers and other applicable system breakers are closed:

LOWER EPC, LIGHTS - R DC BUS

Row	Col	Number	Name
N	34	B1-848	DIGITAL DISPLAY WARNING LIGHT & TEST
N	35	B1-574	SPARE ANN LIGHTS TEST

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	26	B1-187	LANDING GEAR WARNING

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 407, 408, 875-879			
A	1	B10-377	CAPTAIN'S COURSE & HEADING 28VAC
WJE 401-404, 406, 412, 414, 886, 887			
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC
WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887			
A	4	B10-77	VHF NAV-1 28 VAC
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1
WJE 406-408, 411			
B	10	B10-26	GLIDESLOPE-1
WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887			

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887 (Continued)

(Continued)

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	18	B10-365	AUTO THROTTLE-1
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	24	B10-353	AUTOPILOT-1
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS
G	25	B10-359	FLIGHT GUIDANCE STATUS & MAINT PNL
G	26	B10-343	MACH TRIM-1
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 412, 414, 886, 887			
D	7	B10-409	FIRST OFFICER'S N.D.
WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887			
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2
WJE 401-404, 412, 414, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 411, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
WJE 401-404, 412, 414			
B	4	B10-378	FIRST OFFICER'S HSI & HEADING
WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887			
B	5	B10-78	VHF NAV-2
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	6	B10-366	AUTO THROTTLE -2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

WJE 406-408, 411, 875-879, 886, 887

E	12	B10-354	AUTOPILOT-2

WJE 401-404, 406-408, 411, 412, 414, 875-879, 886, 887

G	7	B10-24	VHF NAV-2
G	13	B10-346	YAW DAMPER-2

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

WJE 410

(2) Make sure that all EFIS circuit breakers and other applicable system breakers are closed:

LOWER EPC, LIGHTS - R DC BUS

Row	Col	Number	Name
N	34	B1-848	DIGITAL DISPLAY WARNING LIGHT & TEST
N	35	B1-574	SPARE ANN LIGHTS TEST

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	26	B1-187	LANDING GEAR WARNING

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S COURSE & HEADING 28VAC
A	5	B10-77	VHF NAV-1 28 VAC
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
B	4	B10-431	CAPTAIN'S N.D.
B	5	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

WJE 410 (Continued)

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	18	B10-365	AUTO THROTTLE-1
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	24	B10-353	AUTOPILOT-1
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS
G	25	B10-359	FLIGHT GUIDANCE STATUS & MAINT PNL
G	26	B10-343	MACH TRIM-1
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2
F	11	B10-411	FIRST OFFICER'S P.F.D.
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
B	5	B10-78	VHF NAV-2
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1

WJE 410 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	6	B10-366	AUTO THROTTLE -2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	12	B10-354	AUTOPILOT-2
G	7	B10-24	VHF NAV-2
G	13	B10-346	YAW DAMPER-2

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(3) Place EFIS/DFGS toggle switch, located adjacent to Status Test Panel (STP), in EFIS position.

(4) On STP, press and release POWER pushbutton. POWER annunciator light comes on.

(5) On STP, press CMPVLD pushbutton until applicable system light (1 or 2) comes on. Observe EFIS Maintenance Menu on system display units (DU).

(6) On STP, press and release FORWARD SPACE (right-pointing arrow) key until cursor arrow on Maintenance Menu points to OPTIONS/CONFIG page.

(7) On STP, press and release VERIFY pushbutton.

(8) Locate Aircraft Options Register Words placard, adjacent to the EFIS/DFGC toggle switch.

(9) On STP, press and release VERIFY pushbutton until first digit on Aircraft Options Register matches first digit on placard.

(10) On STP, press and release FORWARD SPACE pushbutton once. On DU, arrow moves to second digit of Aircraft Options Register page.

(11) On STP, press and release VERIFY pushbutton until second digit on DU matches second digit on placard.

(12) Repeat Paragraph 3.A.(10) and Paragraph 3.A.(11) until Options Register/Check Register words on DU match Aircraft Options Register Words on the placard.

NOTE: BACKSPACE (left-pointing arrow) pushbutton may be used to move the pointer arrow to the left. This key is used to go back and correct digits entered on screen incorrectly.

(13) On STP, press and release FORWARD SPACE pushbutton once. EFIS Maintenance Menu appears on display screens.

(14) On STP, press and release POWER pushbutton. STP POWER pushbutton goes off, DU screens show EFIS symbology.

NOTE: The display mode shown on the ND is not important. Make sure that display screens are not blank.

B. Symbol Generator (SG) Self Test (Figure 202)

(1) Make sure that all EFIS circuit breakers and other applicable system breakers are closed. Make sure brightness controls on Dimming Panel are not in OFF position. Place EFIS/DFGS toggle switch in EFIS position.

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

(2) On Status Test Panel (STP), press POWER pushbutton. POWER annunciator light comes on.

(3) If replacing SG-1, perform Paragraph 3.B.(3)(a); perform Paragraph 3.B.(3)(b) if replacing SG-2.

(a) On STP, press CMPVLD pushbutton until "1" annunciator on CMPVLD pushbutton comes on. EFIS Maintenance Menu appears on on-side display units (DU).

(b) On STP, press CMPVLD pushbutton until "2" annunciator on CMPVLD pushbutton comes on. EFIS Maintenance Menu appears on on-side display units (DU).

(4) On STP, press FORWARD SPACE pushbutton (right-pointing arrow) until cursor arrow on Maintenance Menu page points to SG SELF TEST.

(5) On STP, press VERIFY pushbutton to initiate SG Self Test. Self Test is initiated, and lasts for approximately 3 seconds. After test is complete, SYMBOL GENERATOR SELF TEST screen will appear on display units. Bottom line on display will read either PASS or FAIL.

(6) If bottom line on SG SELF TEST display reads PASS, perform Paragraph 3.B.(6)(b). If bottom line reads FAIL, discontinue test and perform Paragraph 3.B.(6)(a):

(a) Press FORWARD SPACE pushbutton to observe SELF TEST FAILURES page. Diagnostic numbers of all internal SG failures appear on screen. Take necessary action. Proceed with Paragraph 3.B.(6)(b). (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101, for cross-reference listing of number definitions and appropriate action for failures listed on screen)

(b) On STP, press FORWARD SPACE pushbutton to observe INTERFACE STATUS page. Diagnostic numbers of any interface failures will appear on screen. Take necessary action. Proceed with Paragraph 3.B.(7). (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101, for cross-reference listing of number definitions and appropriate action for failures listed on screen)

(7) On STP, press POWER pushbutton to turn power OFF.

C. Cockpit Lamp Test: Press ANNUN/DIGITAL LTS TEST pushbutton, located on Overhead panel. The following FMA annunciators come on: ILS, HORIZON, HEADING, and MONITOR.

D. EFIS System Self Test (Figure 203 or Figure 204)

(1) Make sure that all EFIS circuit breakers and other applicable system breakers are closed. Make sure brightness controls on Dimming Panel are not in OFF position.

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

NOTE: The procedures in this test refer to the EFIS symbology which MUST appear on the display screen for a successful test. Disregard any other symbology appearing on the display screen.

WJE 407, 408, 411

(2) Radio Altitude System test.

(a) On on-side Control and Dimming Panel (CDP), press and hold TEST pushbutton. On on-side PFD, Radio Altitude (R/A) tape rises to 40 feet; then R/A FAIL flag replaces R/A tape.

WJE 407, 408, 411 (Continued)

(b) On on-side CDP, release TEST button. R/A tape falls to zero feet.

NOTE: R/A tape may momentarily rise before falling to zero feet.

WJE 401-404, 406, 410, 412, 414, 875-879, 886, 887

(3) Radio Altitude System test.

(a) On VHF NAV-1 and VHF NAV-2 control panels, select a valid ILS frequency.

NOTE: A valid ILS signal is verified by no LOC FAIL failure message being displayed on Navigation Display.

(b) On on-side Control and Dimming Panel (CDP), press and hold TEST pushbutton. On on-side PFD, Radio Altitude (R/A) tape rises to 40 feet; then R/A FAIL flag replaces R/A tape.

(c) On on-side CDP, release TEST button. R/A tape falls to zero feet.

NOTE: R/A tape may momentarily rise before falling to zero feet.

(d) On on-side CDP, press and hold TEST button. On on-side PFD, rising runway symbol moves, then disappears.

WJE 401-404, 410, 412, 414, 886, 887

NOTE: Rising runway display is fed from cross-side SG.

WJE 401-404, 406, 410, 412, 414, 875-879, 886, 887

(e) Release on-side TEST pushbutton. On on-side PFD, rising runway symbol reappears.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(4) VOR/ILS system test.

(a) On VHF NAV-1 and VHF NAV-2 control panels, select unused (non-transmitting) ILS frequency.

(b) Release on-side TEST pushbutton.

WJE 406-408, 875-879

(c) If replacing SG-1, perform Paragraph 3.D.(4)(c)1); if replacing SG-2, perform Paragraph 3.D.(4)(c)2).

1) On RADIO NAV switching panel (Overhead), place switch in BOTH ON 2 position.

2) On RADIO NAV switching panel (Overhead), place switch in BOTH ON 1 position.

(d) On cross-side CDP, press and hold TEST pushbutton. GS FAIL and LOC FAIL flags appear momentarily on on-side PFD; G/S pointer moves up; localizer bar moves left.

(e) Place RADIO NAV switch in NORM position.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(5) Marker Beacon system test.

(a) On on-side DP, press and hold TEST button. Marker beacon annunciator appears on lower right PFD display. Annunciator reads, sequentially: "O" in blue/green color, "M" in yellow color, "I" in white.

(b) Release on-side TEST button.

WJE 406-408, 411

(6) Decision Height aural warning test.

WJE 406-408, 411 (Continued)

(a) On on-side CDP, press and hold TEST button. Tone is heard after depressing TEST button; tone lasts for one second. Tone should increase in frequency and volume.

(b) Release on-side CDP TEST button.

WJE 401-404, 410, 412, 414, 875-879, 886, 887

(7) Decision Height aural warning test: not applicable.

WJE 406-408, 411

(8) EFIS source select switch test.

(a) On EFIS switching panel (Overhead), place source select switch in BOTH ON 1 position. "EFI1" displayed at top of DU screens.

(b) On EFIS switching panel, place source select switch in BOTH ON 2 position. "EFI2" displayed at top of DU screens.

(c) Place source select switch in NORM position. Source annunciation on DUs is blank.

WJE 401-404, 410, 412, 414, 875-879, 886, 887

(9) EFIS source select switch test.

(a) On EFIS switching panel (Overhead), place EFIS source select switch in BOTH ON 1 position. "EFI1" displayed on PFDs and NDs.

(b) On EFIS switching panel, place EFIS source select switch in BOTH ON 2 position. "EFI2" displayed on PFDs and NDs.

(c) Place source select switch in NORM position. Source annunciation on PFDs and NDs is blank.

WJE 406-408, 411

(10) Attitude switching test.

(a) Perform 1) if SG-1 has been replaced; perform 2) if SG-2 has been replaced:

1) On AHRS switching panel (Overhead), place source select switch in L ON AUX position. ATT3 appears at top of Captain's PFD.

2) On AHRS switching panel (Overhead), place source select switch in R ON AUX position. ATT3 appears at top of F.O.'s PFD.

(b) On AHRS switching panel (Overhead), place source select switch in NORM position. No ATT3 annunciation on PFD.

(11) Heading source select test.

(a) On Mode Select Panel (MSP), place mode select switch in ARC position. ND shows ARC mode symbology.

(b) Perform 1) if SG-1 has been replaced; perform 2) if SG-2 has been replaced:

1) On AHRS switching panel (Overhead), place source select switch in L ON AUX position. "HDG3" appears on Captain's ND, to left of digital HDG window.

2) On AHRS switching panel (Overhead), place source select switch in R ON AUX position. "HDG3" appears on F.O.'s ND, to left of digital heading window.

(c) On AHRS switching panel (Overhead), place source select switch in NORM position. No "HDGs" annunciation on ND.

WJE 406-408, 410, 411, 875-879

(12) VHF/NAV switching test.

(a) On VHF NAV-1 and VHF NAV-2 control panels, select unused (non-transmitting) ILS frequency.

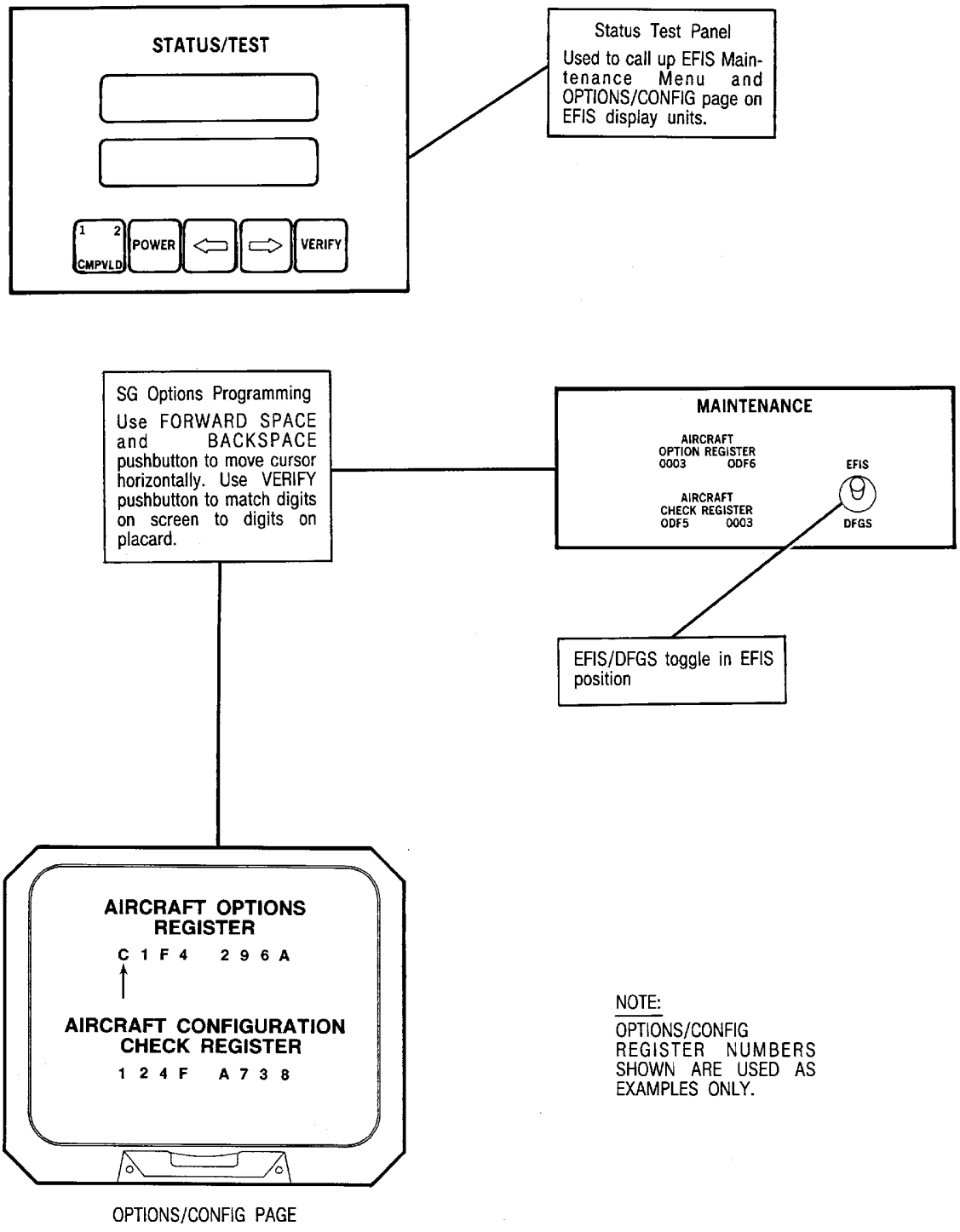
(b) On RADIO NAV switching panel (Overhead), place source select switch in BOTH ON 1 position. ILS1 appears on PFD, in lower right corner.

(c) On RADIO NAV switching panel, place source select switch in BOTH ON 2 position. ILS2 appears on PFD, in lower right corner.

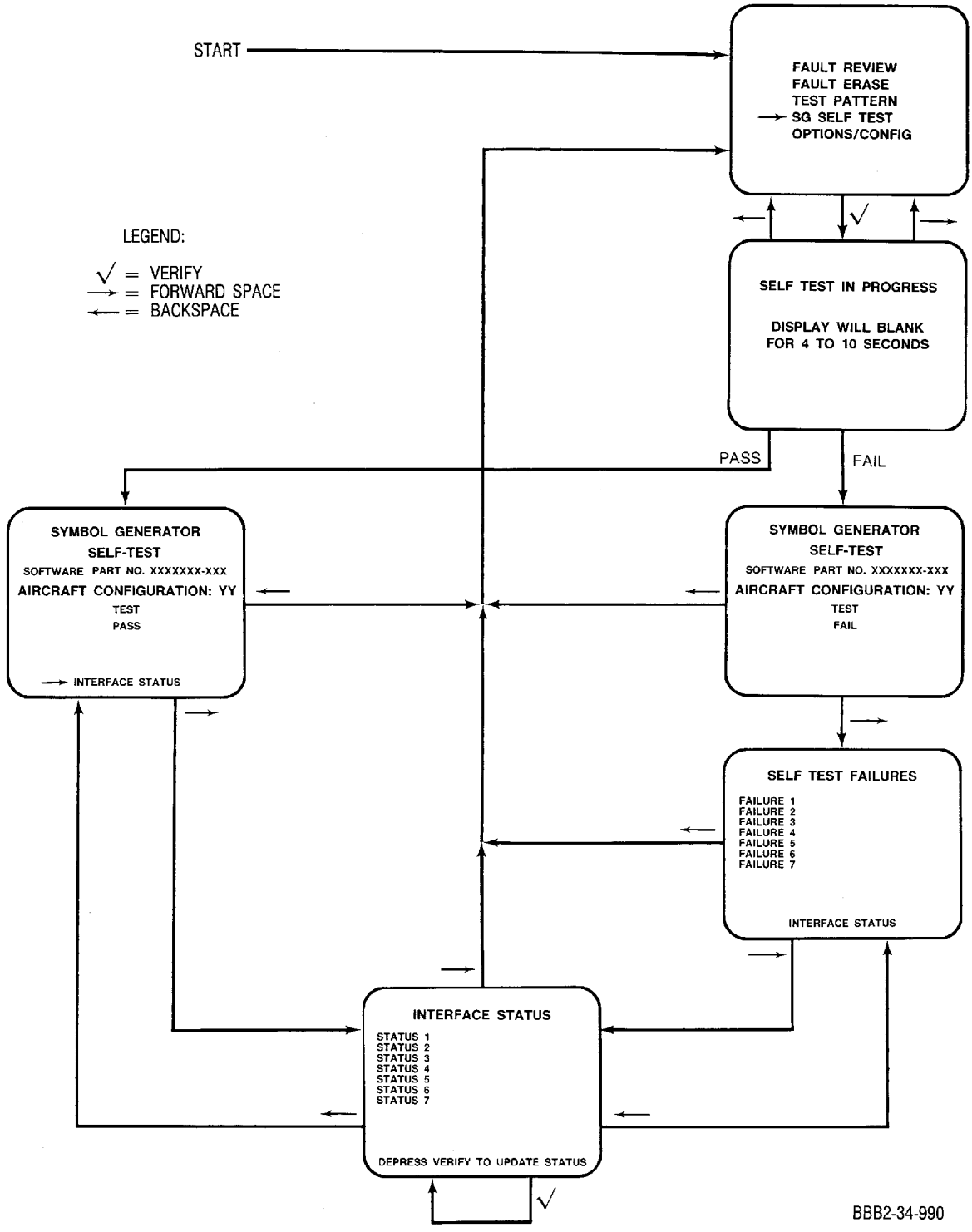
(d) Place RADIO NAV source select switch in NORM position. No ILS annunciation appears on PFD.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

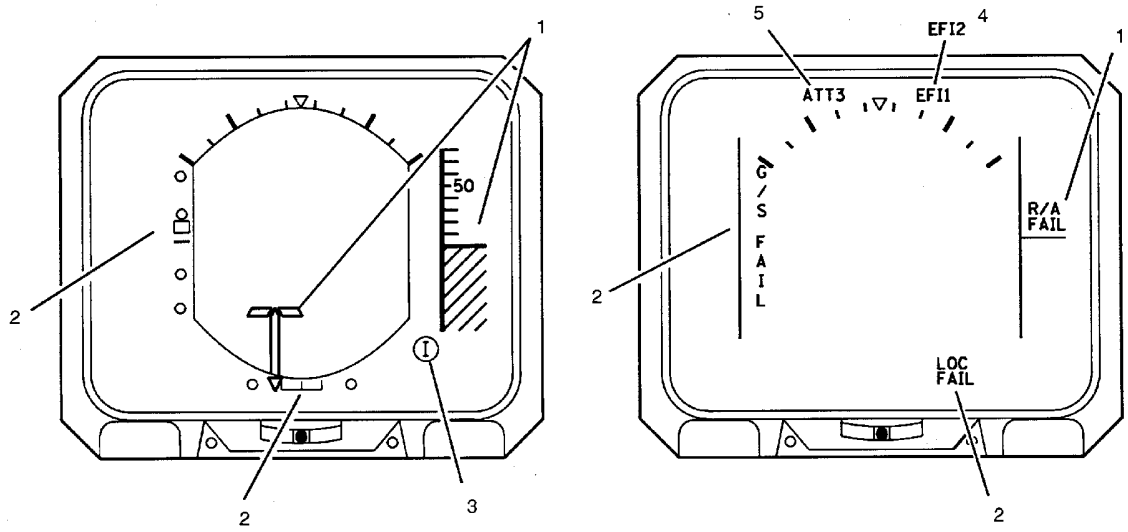
(13) Return aircraft to required configuration.



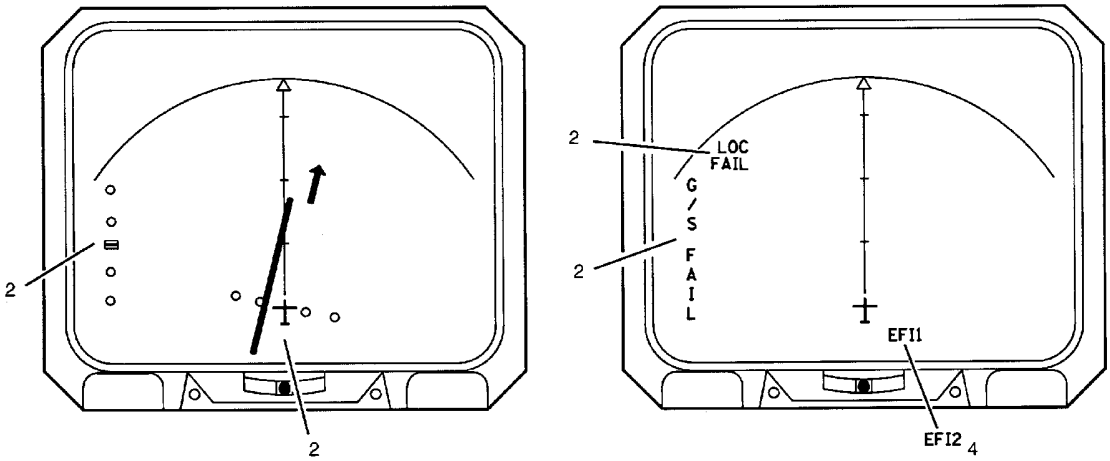
EFIS SG Options Programming
Figure 201/34-22-10-990-801



SG Self Test - Maintenance Menu Displays
Figure 202/34-22-10-990-803



PRIMARY FLIGHT DISPLAY



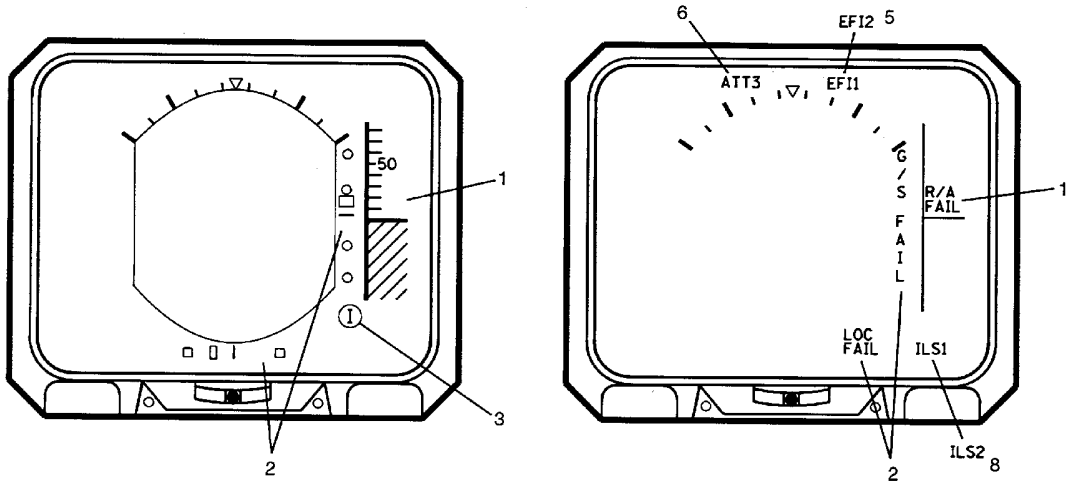
NAVIGATION DISPLAYS

1. RADIO ALTITUDE SYSTEM TEST
2. VOR/ILS SYSTEM TEST
3. MARKER BEACON SYSTEM TEST
4. EFIS SOURCE SELECT TEST
5. ATTITUDE SWITCHING TEST

CAG(IGDS)

BBB2-34-991B

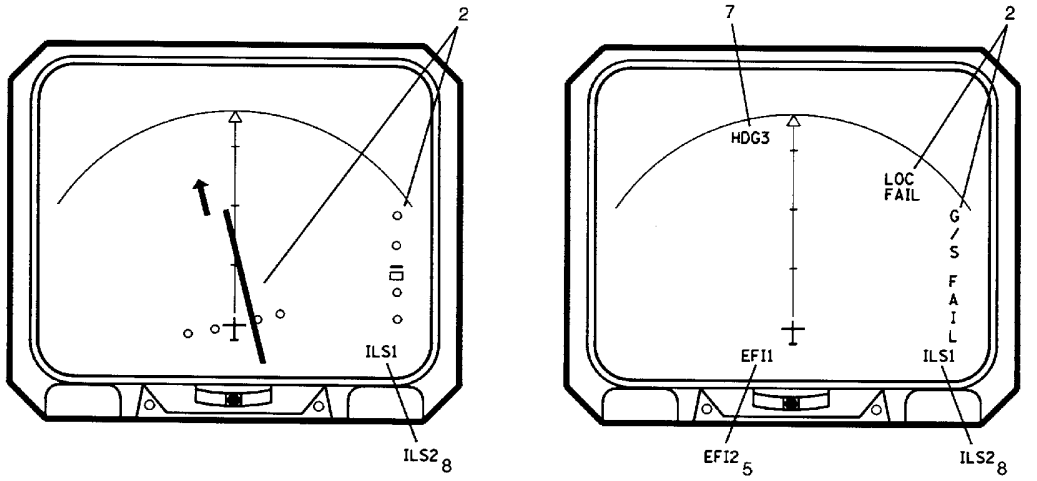
EFIS System Self Test - PFD/ND Displays
Figure 203/34-22-10-990-804



PRIMARY FLIGHT DISPLAYS

1. RADIO ALTITUDE SYSTEM TEST
2. VOR/ILS SYSTEM TEST
3. MARKER BEACON SYSTEM TEST
4. DECISION HEIGHT AURAL WARNING TEST
5. EFIS SOURCE SELECT TEST
6. ATTITUDE SWITCHING TEST
7. HEADING SOURCE SELECT TEST
8. VHF/NAV SWITCHING TEST

NAVIGATION DISPLAYS



CAG(IGDS)

BBB2-34-992A

EFIS System Self Test - PFD/ND Displays
Figure 204/34-22-10-990-805

EFIS SYMBOL GENERATOR (SG) - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Symbol Generator (SG). There are two EFIS Symbol Generators, located on the radio racks in the electrical/electronics compartment. SG-1 controls the Captain's PFD and ND displays; SG-2 controls the F.O.'s displays. Each unit weighs approximately 19 pounds (8.62 kg).

B. Removal/installation is the same for both units. When opening circuit breakers, open only those breakers which apply to the system being worked. On-side display units should be observed when performing adjustment/test. (Paragraph 1.D.)

C. The following adjustment/test procedures are provided in this section:

(1) SG Options Programming: This procedure is performed ONLY in conjunction with removal/installation of an SG. It's function is to provide the SG with the configuration and options of the aircraft on which it is installed.

(2) Symbol Generator (SG) Self-Test: Tests the internal functioning of the SG.

(3) Cockpit Lamp Test: Tests the ILS, HEADING, HORIZON, and MONITOR annunciators on the Flight Mode Annunciator (FMA) panel; also tests MSP declutter buttons and taxi speed indication, if installed.

(4) EFIS System Self-Test: Utilizes the TEST pushbutton on the Control & Dimming Panel (CDP) to test the aircraft systems which provide inputs to the SG.

NOTE: The SG Self-Test, EFIS System Self-Test and Cockpit Lamp Test combined consititute a complete system test for the EFIS.

D. The terms "on-side" and "cross-side" are used throughout the procedures. The term "on-side" refers to those LRU's and displays which belong to the system (SG) being tested. For example, if system-1 is being tested, the "on-side" displays and panels would be those located on the Captain's instrument panel. The "cross-side" displays and panels would belong to the F.O.

E. For a complete explanation of the General Maintenance Features of the EFIS and instructions for using the MCDU in conjunction with the EFIS displays, refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201, Navigation Displays - Maintenance Practices.

2. Removal/Installation EFIS Symbol Generator (SG)

A. Remove Symbol Generator (SG)

NOTE: Before replacing symbol generator, verify that option register and check register have been set per aircraft placard.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
B	3	B10-431	CAPTAIN'S N.D.

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	4	B10-413	SYMBOL GEN -2 POWER
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

NOTE: Circuit breakers B10-416 and B10-417 are for aircraft with VG/DG.

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing holddown assembly down.

(3) Pull unit straight out from rack.

B. Install Symbol Generator (SG)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	4	B10-413	SYMBOL GEN -2 POWER
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

NOTE: Circuit breakers B10-416 and B10-417 are for aircraft with VG/DG.

(2) Visually check unit connector plugs and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack. Make sure that guide pin bushing and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
F	4	B10-413	SYMBOL GEN -2 POWER
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

NOTE: Circuit breakers B10-416 and B10-417 are for aircraft with VG/DG.

3. **Adjustment/Test EFIS Symbol Generator (SG)**

A. SG Options Programming (Figure 201)

NOTE: Do not perform SG Options Programming unless a new SG has been installed.

(1) Make sure that all EFIS circuit breakers and other applicable system breakers are closed:

LOWER EPC, LIGHTS - R DC BUS

Row	Col	Number	Name
N	34	B1-848	DIGITAL DISPLAY WARNING LIGHT & TEST
N	35	B1-574	SPARE ANN LIGHTS TEST

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	26	B1-187	LANDING GEAR WARNING

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S COURSE & HEADING 28VAC
A	4	B10-77	VHF NAV-1 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
B	3	B10-431	CAPTAIN'S N.D.
B	4	B10-410	CAPTAIN'S PFD
C	3	B10-412	SYMBOL GENERATOR-1 POWER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1
WJE 415, 418, 863, 864, 866			
B	10	B10-26	GLIDESLOPE-1
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	18	B10-365	AUTO THROTTLE-1
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS
G	25	B10-359	FLIGHT GUIDANCE STATUS & MAINT PNL
G	26	B10-343	MACH TRIM-1
G	27	B10-345	YAW DAMPER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-409	FIRST OFFICER'S N.D.
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2
F	4	B10-413	SYMBOL GEN -2 POWER
F	11	B10-411	FIRST OFFICER'S P.F.D.

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S COURSE & HEADING
B	5	B10-78	VHF NAV-2
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2

WJE 415, 418, 863, 864, 866

C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

E	6	B10-366	AUTO THROTTLE -2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1
G	7	B10-24	VHF NAV-2
G	13	B10-346	YAW DAMPER-2

NOTE: Circuit breakers B10-416 and B10-417 are for aircraft with VG/DG.

NOTE: Failure messages will appear on EFIS display units if all applicable circuit breakers are not closed.

(2) Ensure MCDU MENU page is displayed on MCDU-1. Press NEXT PAGE key and verify MCDU CONFIG INDEX page is displayed. (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201)

(3) On MCDU-1, type DAC into scratchpad. Press line select key 6R then 4L. ACTIVATED prompt under TEST PANEL OPTION begins flashing.

(4) Press RETURN key. Verify MCDU MENU page is displayed. TEST PANEL prompt is displayed adjacent to line select key 6L.

(5) Press line select key 6L. Verify MCDU TEST PANEL is displayed. Press EFIS #1 SELECT button. Verify EFIS Maintenance Menu is displayed on EFIS Display Units (DU's).

(6) Repeat Paragraph 3.A.(2) through Paragraph 3.A.(5) for MCDU-2 and EFIS #2.

(7) On MCDU, press and release FORWARD SPACE key until cursor arrow on Maintenance Menu points to OPTIONS/CONFIG page.

(8) On MCDU, press and release VERIFY pushbutton.

(9) Locate Aircraft Options Register Words placard, under Captain's briefcase holder.

(10) On MCDU, press and release VERIFY pushbutton until first digit on Aircraft Options Register matches first digit on placard.

(11) On MCDU, press and release FORWARD SPACE pushbutton once. On DU, arrow moves to second digit of Aircraft Options Register page.

(12) On MCDU, press and release VERIFY pushbutton until second digit on DU matches second digit on placard.

(13) Repeat Paragraph 3.A.(11) and Paragraph 3.A.(12) until Options Register/Check Register words on DU match Aircraft Options Register Words on the placard.

NOTE: BACKSPACE pushbutton may be used to move the pointer arrow to the left. This key is used to go back and correct digits entered on screen incorrectly.

(14) On MCDU, press and release FORWARD SPACE pushbutton once. EFIS Maintenance Menu appears on display screens.

NOTE: The display mode shown on the ND is not important. Make sure that display screens are not blank.

B. Symbol Generator (SG) Self Test (Figure 202)

(1) Make sure that all EFIS circuit breakers and other applicable system breakers are closed. Make sure brightness controls on Dimming Panel are not in OFF position.

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

(2) Ensure EFIS Maintenance Menu is displayed on EFIS Display Units (DU's).

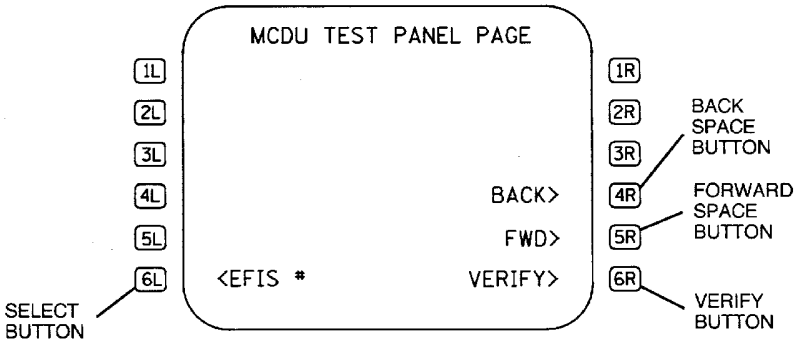
(3) On MCDU, press FORWARD SPACE pushbutton until cursor arrow on Maintenance Menu page points to SG SELF TEST.

(4) On MCDU, press VERIFY pushbutton to initiate SG Self Test. Self Test is initiated, and lasts for approximately 3 seconds. After test is complete, SYMBOL GENERATOR SELF TEST screen will appear on display units. Bottom line on display will read either PASS or FAIL.

(5) If bottom line on SG SELF TEST display reads PASS, perform Paragraph 3.B.(5)(b). If bottom line reads FAIL, discontinue test and perform Paragraph 3.B.(5)(a):

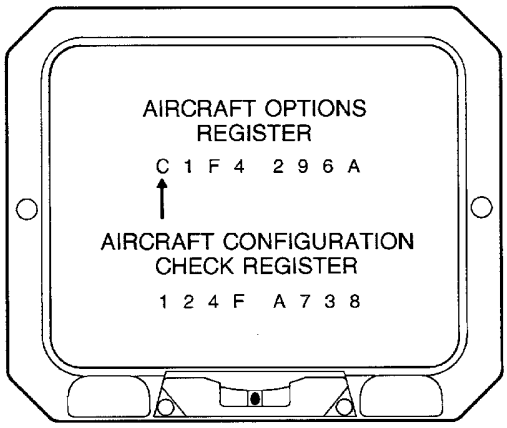
(a) Press FORWARD SPACE pushbutton to observe SELF TEST FAILURES page. Diagnostic numbers of all internal SG failures appear on screen. Take necessary action. Proceed with Paragraph 3.B.(5)(b). (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101, for cross-reference listing of number definitions and appropriate action for failures listed on screen)

(b) On MCDU, press FORWARD SPACE pushbutton to observe INTERFACE STATUS page. Diagnostic numbers of any interface failures will appear on screen. Take necessary action. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101, for cross-reference listing of number definitions and appropriate action for failures listed on screen)



MULTI PURPOSE CONTROL DISPLAY UNIT (MCDU)

Used to call up EFIS Maintenance Menu and OPTIONS/CONFIG page on EFIS display units.



NOTE:

OPTIONS/CONFIG REGISTER NUMBERS SHOWN ARE USED AS EXAMPLES ONLY.

OPTIONS/CONFIG PAGE

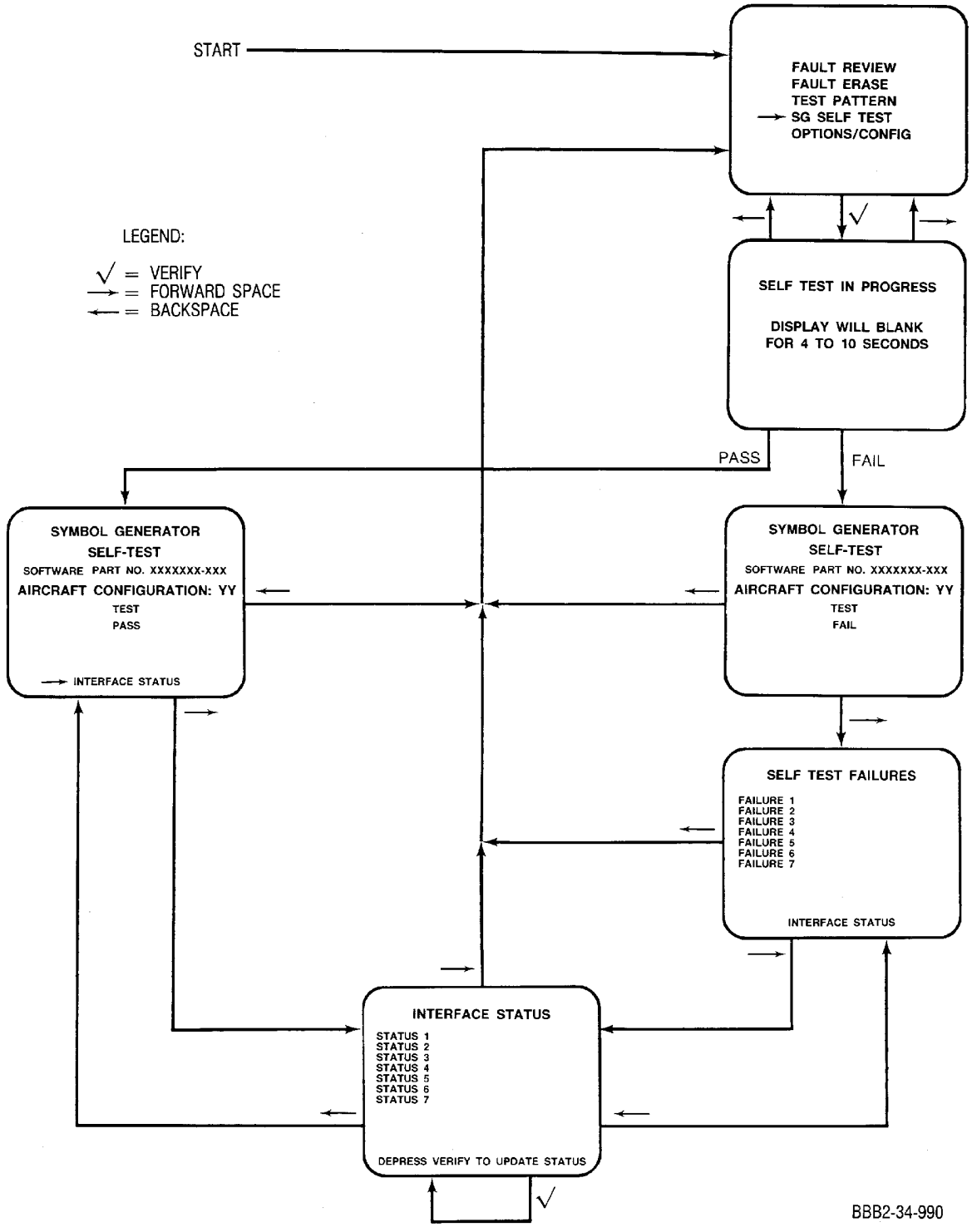
SG Options Programming. Use FORWARD SPACE and BACKSPACE pushbutton to move cursor horizontally. to match digits on screen to digits on placard.

CAG(IGDS)

BBB2-34-1213

EFIS SG Options Programming
Figure 201/34-22-10-990-809

EFFECTIVITY
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



SG Self Test - Maintenance Menu Displays
Figure 202/34-22-10-990-810

EFIS MODE SELECT PANEL (MSP) - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Mode Select Panel (MSP). The MSP's are located aft and outside of the glareshield, below the Captain's and F.O.'s clearview windows. A panel has been cut out of the liner surrounding the unit, to facilitate removal and installation. A molded gasket may be inserted between the MSP and the panel to prevent moisture from entering the unit. This gasket must be removed and retained during Maintenance Practices (if installed).

B. Removal/installation of the MSP's is the same for both units. When opening circuit breakers, open only those breakers which apply to the unit being replaced. Symbol Generator-1 (SG-1) drives the Captain's MSP and display units; SG-2 drives the F.O.'s MSP and display units. The on-side display units should be observed when performing LRU functional tests.

2. Removal/Installation EFIS Mode Select Panel (MSP)

A. Remove MSP

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Remove four captive screws holding MSP to bracket assembly, while supporting the unit. Pull unit far enough out to gain access to electrical wiring connector. (Figure 201)

(3) Disconnect MSP from aircraft wiring at electrical connector, and remove MSP.

(4) Install protective covers on aircraft electrical connector and on MSP electrical receptacle.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

NOTE: Perform Paragraph 2.A.(5) through Paragraph 2.A.(7) only if FMS pushbutton lamps are to be replaced.

(5) On MSP, remove two screws attaching bezel to front of panel, remove bezel. (Figure 205)

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879 (Continued)

(6) Remove lamp board and replace lamps as required.

(7) Install lamp board and bezel on front of MSP.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

B. Install MSP

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Check MSP receptacle and aircraft electrical connector for damaged, corroded, or dirty electrical contacts.

(3) Place MSP in position near bracket assembly and connect aircraft electrical connector to MSP electrical connector.

(4) Install unit mounting screws to remount MSP to bracket.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

3. **Adjustment/Test EFIS Mode Select Panel (MSP)**

A. MSP Functional Test

(1) Make sure that all EFIS circuit breakers, and all other aircraft sensor circuit breakers, are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201, for complete listing of EFIS-related circuit breakers)

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

(2) On MSP, rotate MODE select switch to ROSE position. On-side Navigation Display (ND) shows appropriate display symbology.

(Figure 202 or Figure 203 or Figure 204)

(3) Rotate MODE select switch to ARC position. ND shows appropriate display symbology.

(Figure 202 or Figure 203 or Figure 204)

(4) Rotate RANGE select switch to 40 NM position. Range display on ND reads 20 NM at half-range tick mark.

(Figure 202 or Figure 203 or Figure 204)

(5) Return aircraft to required configuration.

WJE 412, 414

B. FMS Pushbutton Lamp Test (Aircraft with FMS)

(1) On overhead panel, press annunciator/digital lights TEST button. FMS pushbutton lights come on.

(2) Release TEST button. FMS pushbutton lights go off for about a half second then come on for about five seconds.

(3) Return aircraft to required configuration.

WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

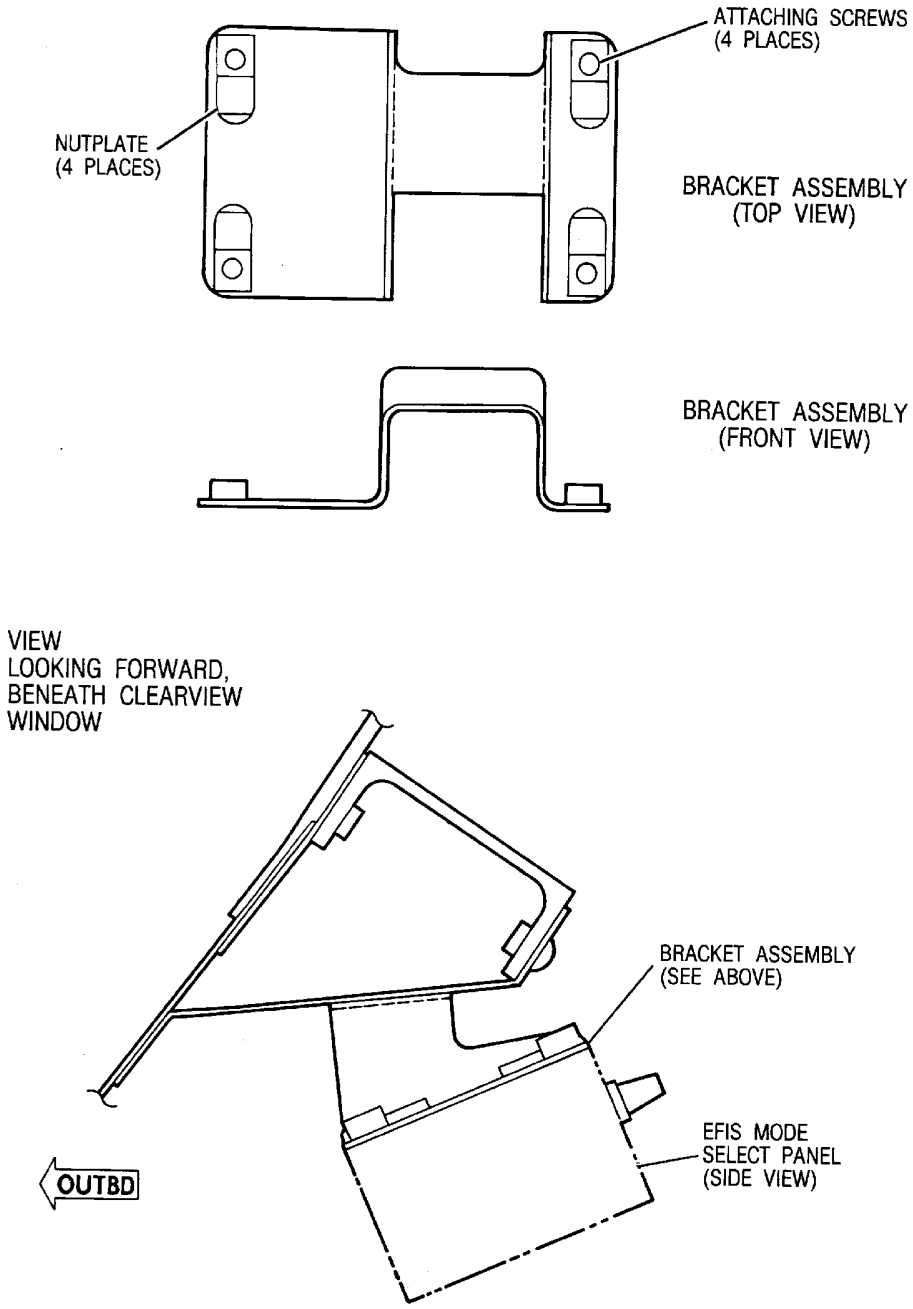
C. FMS Pushbutton Lamp Test

(1) On overhead panel, press annunciator/digital lights TEST button. FMS pushbutton lights come on.

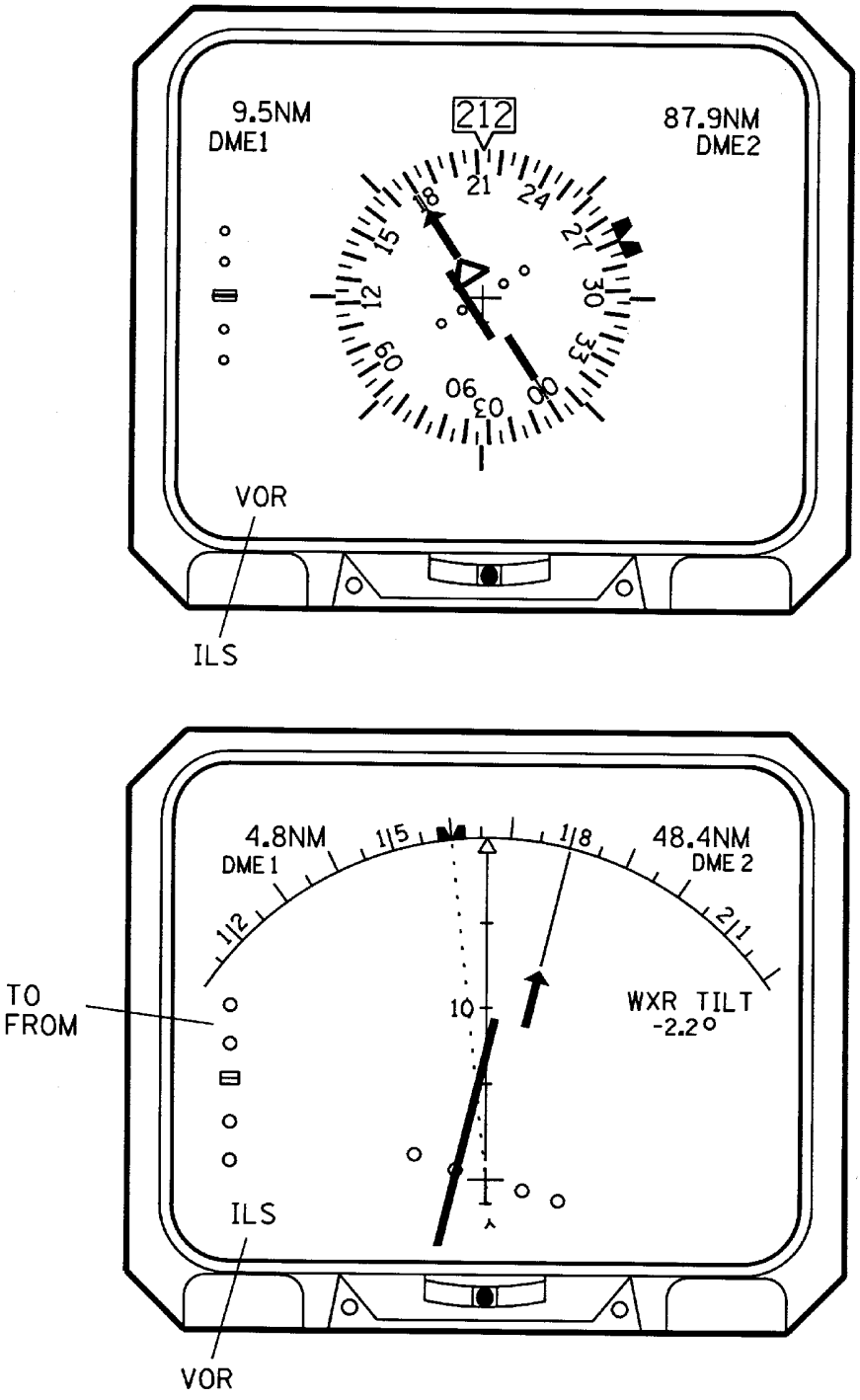
(2) Release TEST button. FMS pushbutton lights go off for about a half second then come on for about five seconds.

(3) Return aircraft to required configuration.

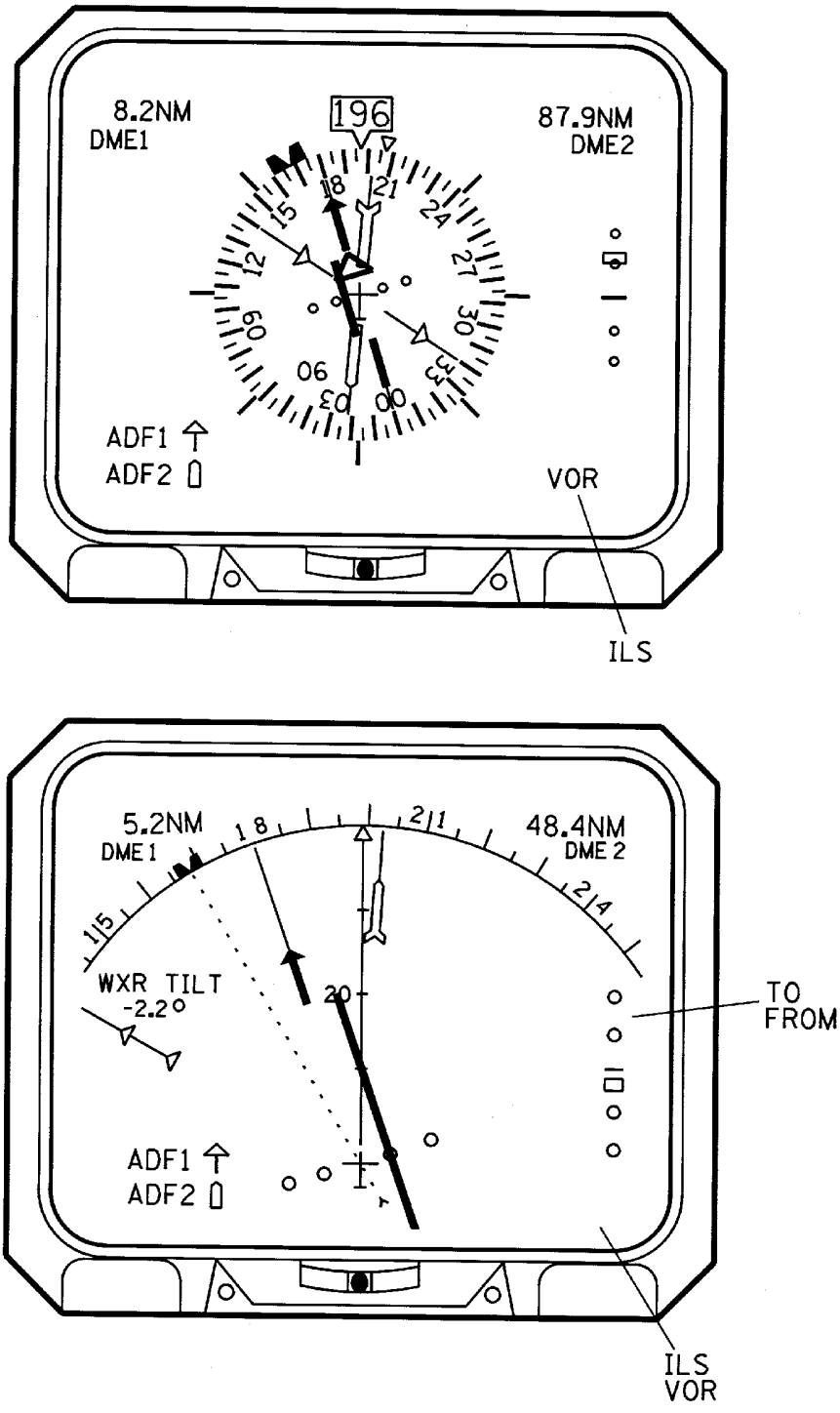
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887



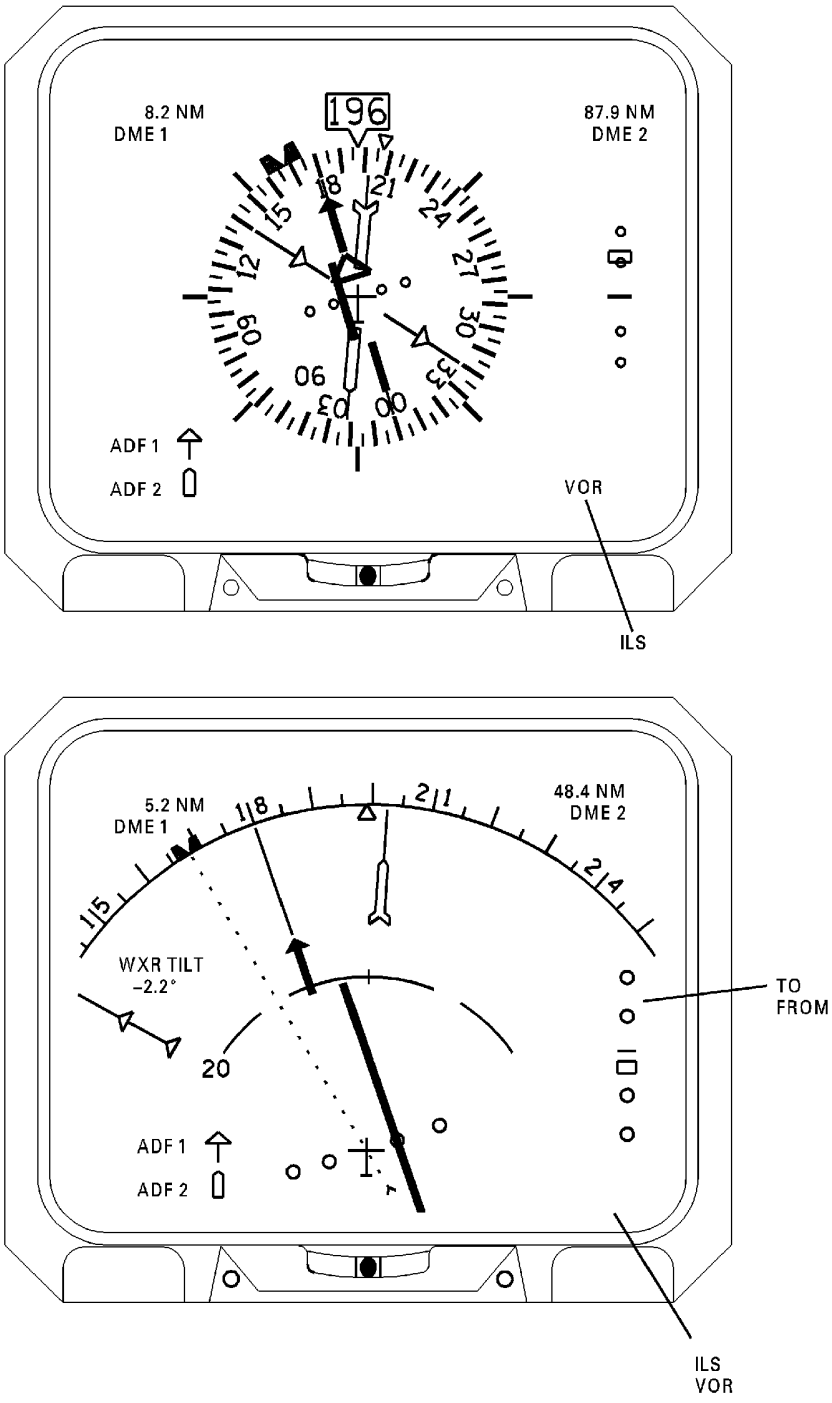
EFIS Mode Select Panel -- Removal/Installation
Figure 201/34-22-13-990-801



Navigation Displays -- MSP Functional Test
Figure 202/34-22-13-990-802

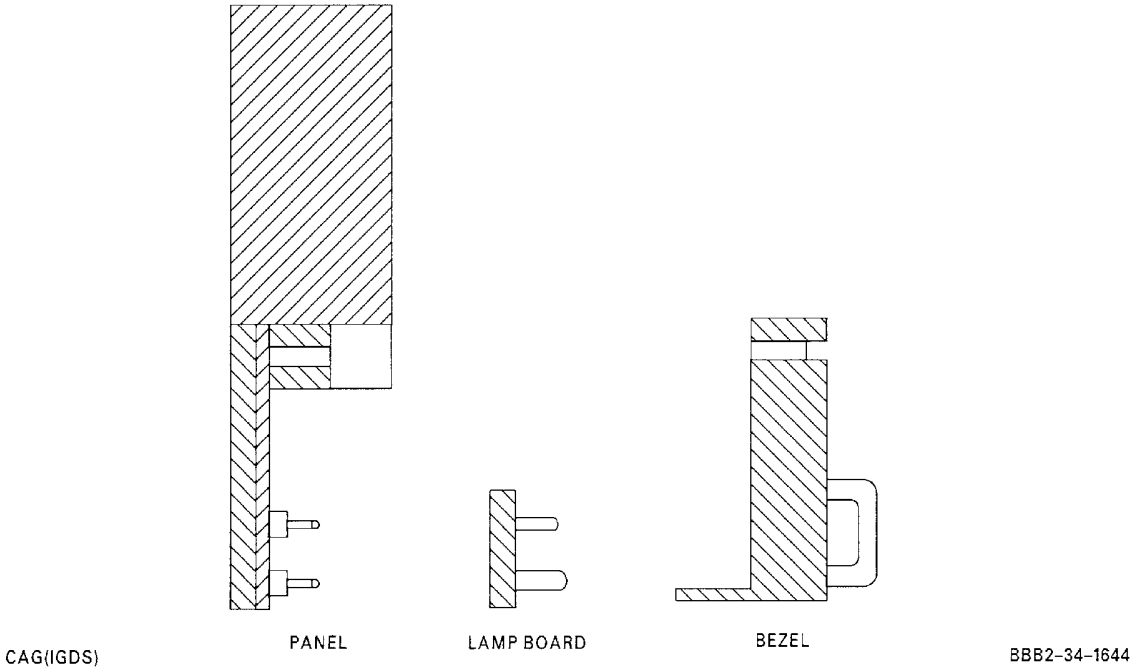


Navigation Displays -- MSP Functional Test
Figure 203/34-22-13-990-803



Navigation Displays -- MSP Functional Test
Figure 204/34-22-13-990-804

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



MSP FMS Pushbutton Lamp Replacement
Figure 205/34-22-13-990-807

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

EFIS CONTROL & DIMMING PANEL (CDP) - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Control & Dimming Panel (CDP). There are two CDP's, located on the Captain's and F.O.'s Main Instrument Panels.

B. Removal/installation of the CDP's is the same for both systems. On-side PFD's and ND's should be observed when performing LRU functional test. When opening circuit breakers, open only those breakers which apply to the unit being replaced.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following items:

Table 201

Name and Number	Manufacturer
Hand Held Photometer, Model 505	Photo Research

3. Removal/Installation EFIS Control & Dimming Panel (CDP)

A. Remove CDP

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	4	B10-410	CAPTAIN'S PFD
WJE 410			
B	5	B10-410	CAPTAIN'S PFD

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Loosen indicator retaining screws.

(3) Press loosened adjustment screws back flush against main instrument panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on CDP.

(5) Pull CDP out of panel face; disconnect electrical connector.

(6) Install protective cap on electrical connector.

B. Install CDP

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	4	B10-410	CAPTAIN'S PFD
WJE 410			
B	5	B10-410	CAPTAIN'S PFD

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Remove protective cap, and connect aircraft electrical connector to back of CDP.

(3) Insert CDP through panel face and mounting clamp.

NOTE: CDP clamp should be checked for clamp rivet failure at eyelets before panel installation.

CAUTION: MAKE SURE THAT CLAMP ATTACHMENT SCREWS ARE TIGHT, OR DIMMING PANEL MAY SLIDE OUT OF INSTRUMENT PANEL DURING AIRCRAFT ACCELERATION.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws. Torque screws 6 to 8 inch-pounds (0.68 to 0.90 N·m).

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			

WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	4	B10-410	CAPTAIN'S PFD

WJE 410

B	5	B10-410	CAPTAIN'S PFD

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 412, 414

F	8	B10-411	FIRST OFFICER'S P.F.D.

WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

F	11	B10-411	FIRST OFFICER'S P.F.D.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

4. Adjustment/Test EFIS Control & Dimming Panel (CDP)

A. CDP Functional Test

(1) Make sure that all EFIS circuit breakers, and all other interfacing system circuit breakers, are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201, for complete listing of EFIS and interfacing system circuit breakers)

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures or shown in the reference figure.

(2) On EFIS Control & Dimming Panel (CDP), rotate PFD BRT control knob. PFD display intensity increases when knob is rotated clockwise; decreases when knob is rotated counterclockwise.

(3) Rotate PFD BRT control knob fully counterclockwise, past detent. PFD display goes off; compact mode display appears on Navigation Display (ND/)(Figure 201 or Figure 202)

(4) Rotate PFD BRT control clockwise, and adjust to comfortable viewing intensity.

(5) On CDP, rotate ND BRT control knob. ND display intensity increases when knob is rotated clockwise; decreases when knob is rotated counterclockwise.

(6) Rotate ND BRT knob fully counterclockwise, past detent. ND display goes off; compact mode display appears on PFD. (Figure 201 or Figure 202)

(7) Rotate ND BRT control clockwise, and adjust to comfortable viewing intensity.

(8) On Mode Select Panel, rotate MODE switch to ARC position.

(9) On weather radar control panel, activate TEST. Weather radar test pattern appears on ND. (Figure 203 or Figure 204 or Figure 205)

(10) On CDP, rotate WX BRT control knob. Weather radar test pattern intensity increases when knob is rotated clockwise; decreases when knob is rotated counterclockwise.

(11) On CDP, rotate WX BRT control knob counterclockwise, past the detent. WXR ON message appears on PFD; no message on ND.

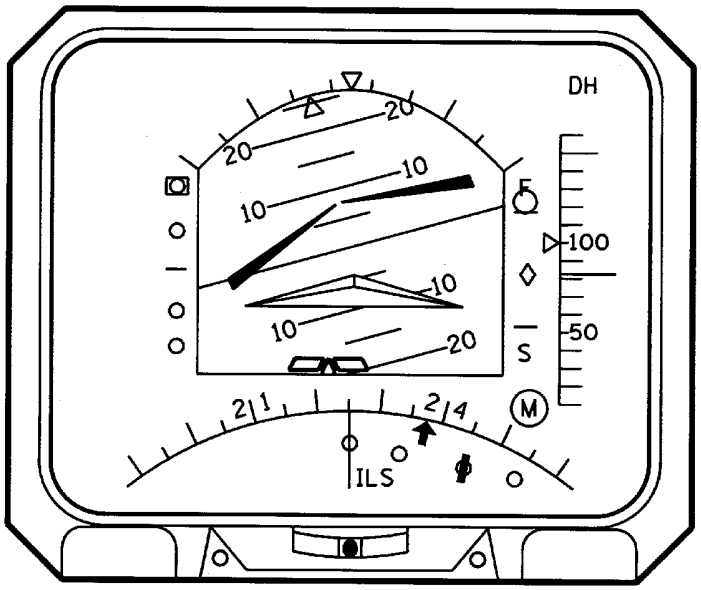
(12) On CDP, rotate DH knob clockwise from full counterclockwise position. DH numerical readout on upper right corner of PFD display goes from zero to 500, as knob is rotated clockwise.

NOTE: DH numerical readout is blank if DH is less than zero feet, or greater than 500 feet.

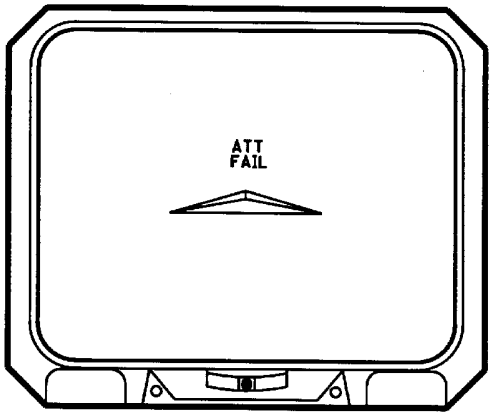
(13) On CDP, press and hold TEST pushbutton. ATT FAIL flag appears on PFD; HDG FAIL flag appears on ND.

NOTE: Flags indicate EFIS self-test function is operational.

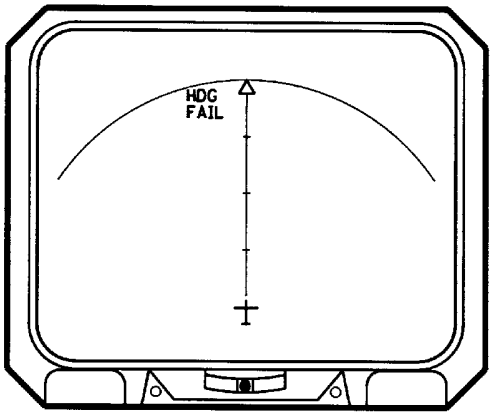
(14) Return aircraft to required configuration.



COMPACTED PFD/ND FORMAT



PFD TEST PUSHBUTTON DISPLAY

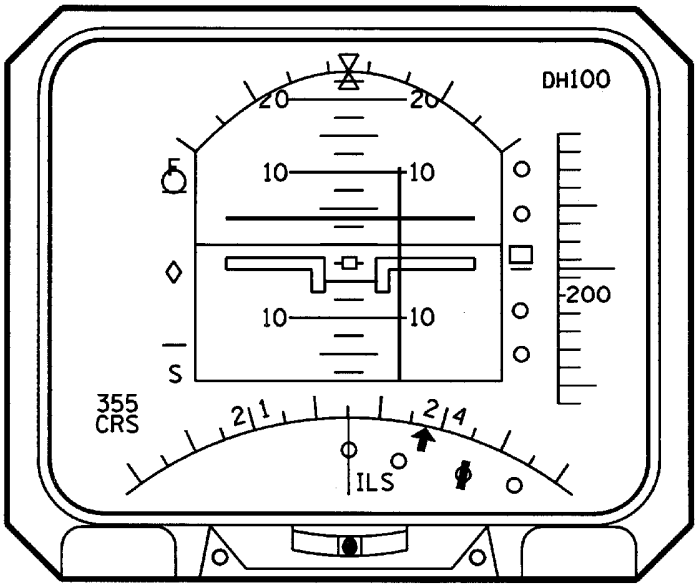


ND TEST PUSHBUTTON DISPLAY

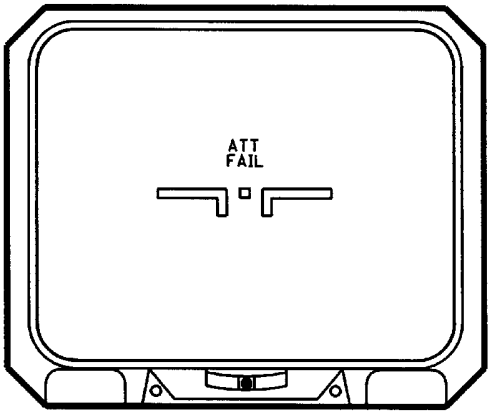
CAG(IGDS)

BBB2-34-1000

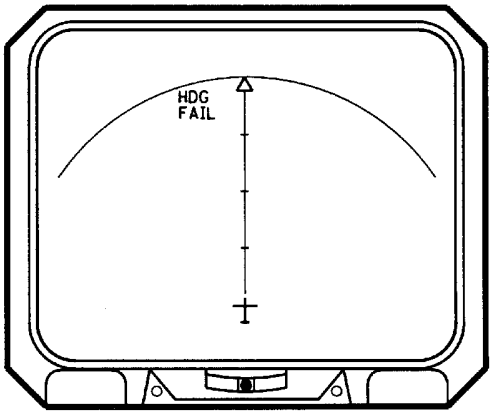
EFIS Displays -- CDP Functional Test
Figure 201/34-22-15-990-801



COMPACTED PFD/ND FORMAT



PFD TEST PUSHBUTTON DISPLAY



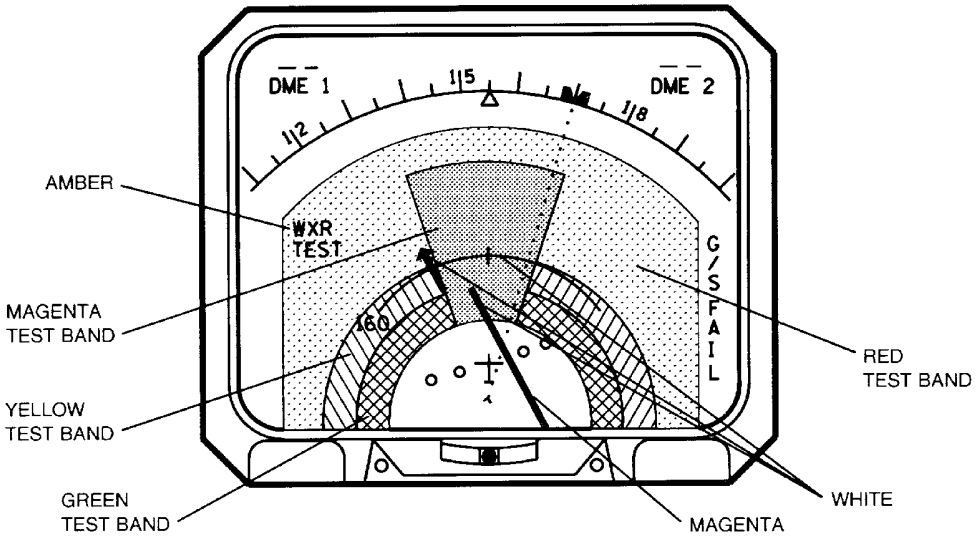
ND TEST PUSHBUTTON DISPLAY

CAG(IGDS)

BBB2-34-1001

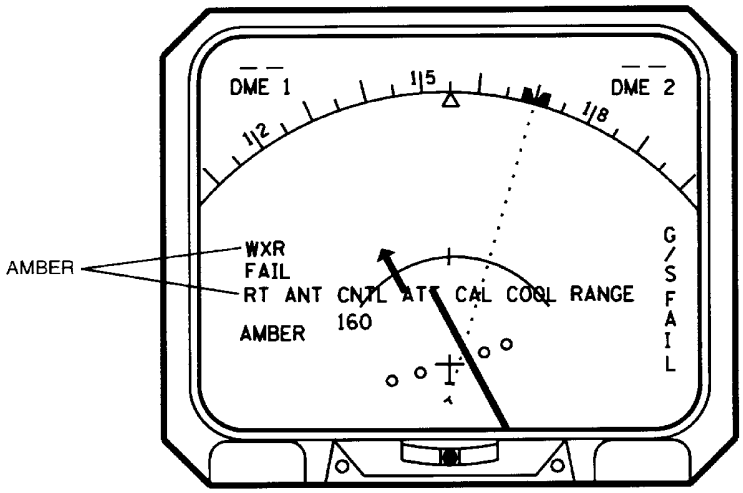
EFIS Displays -- CDP Functional Test
Figure 202/34-22-15-990-802

EFFECTIVITY
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.

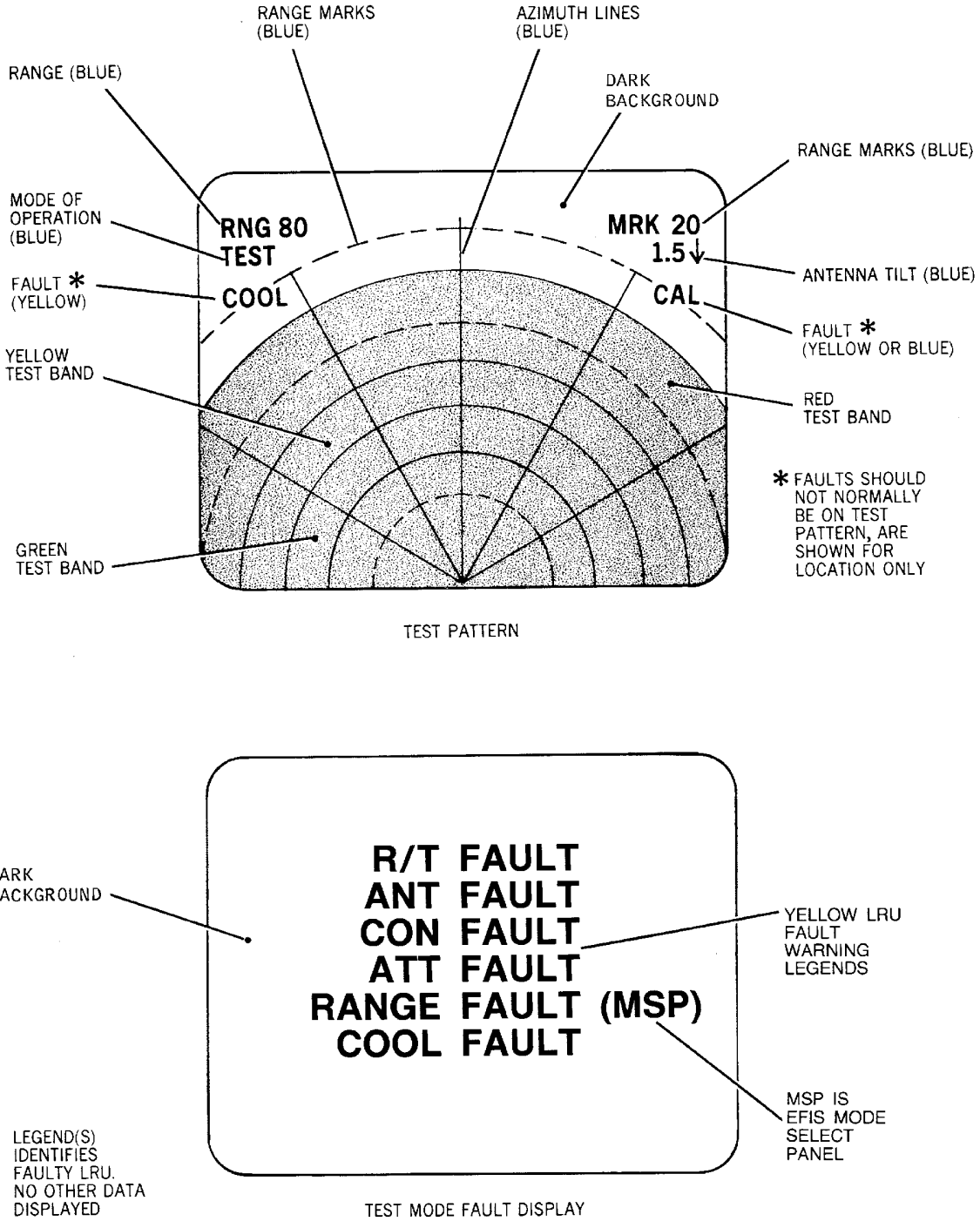


TEST MODE FAULT DISPLAY

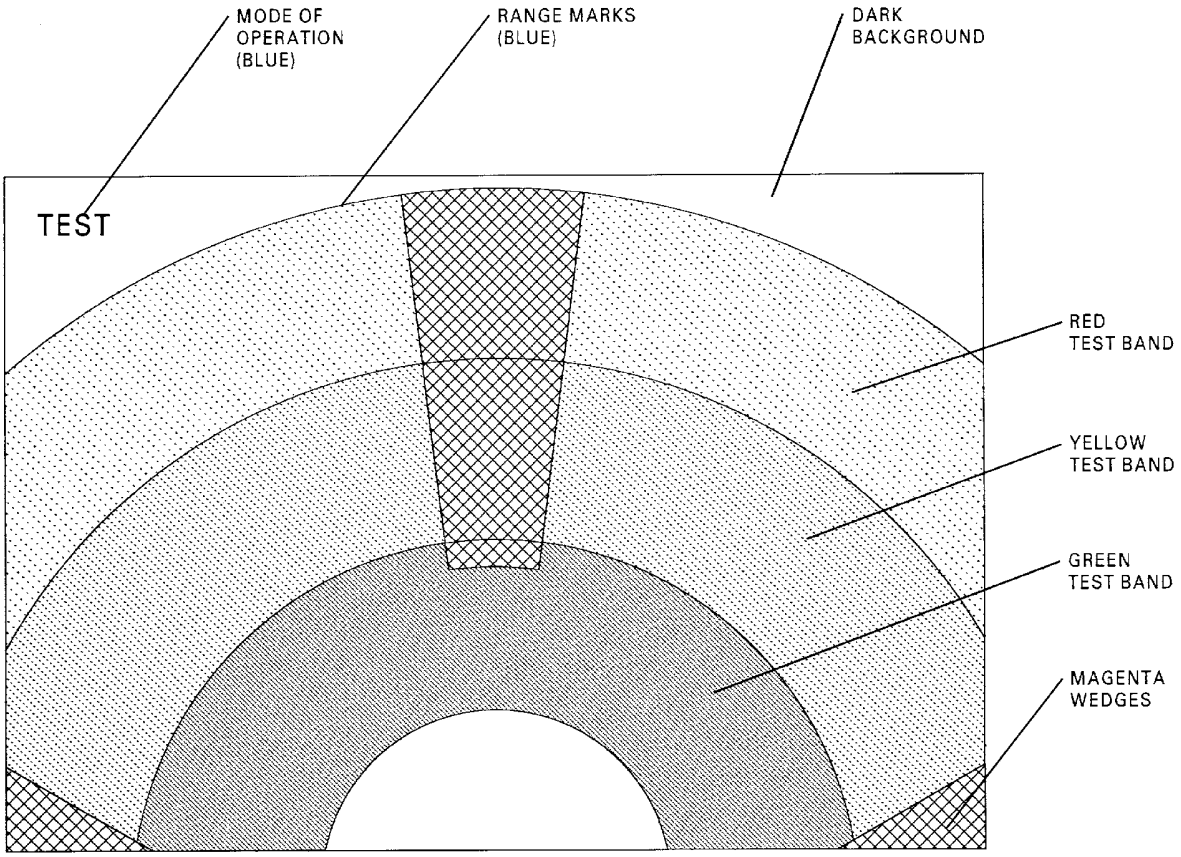
CAG(IGDS)

BBB2-34-1134A

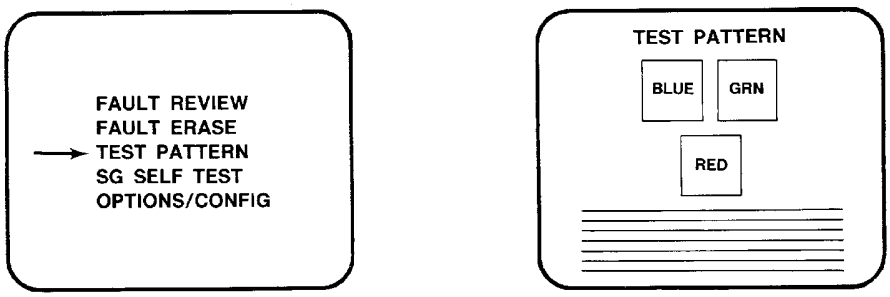
Weather Radar Test Pattern -- CDP Functional Test
Figure 203/34-22-15-990-804



Weather Radar Test Pattern - CDP Functional Test
Figure 204/34-22-15-990-805



Weather Radar Test Pattern -- CDP Functional Test
Figure 205/34-22-15-990-806



BBB2-34-1103

Test Pattern -- CDP Functional Test
Figure 206/34-22-15-990-807

5. EFIS Display Brightness Verification

A. Display Brightness Verification

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

(1) On Status Test Panel, enter EFIS Maintenance Menu.

(2) Move cursor to align with TEST PATTERN item. (Figure 206)

(3) On Status Test Panel, press VERIFY key to obtain test pattern.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(4) On multipurpose control display unit (MCDU), MENU page, press test panel key.

(5) Press forward space key on MCDU until arrow points to test pattern.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(6) Rotate Dimming Panel brightness knobs (3) to maximum. If cockpit ambient light is low, it may be necessary to shine flashlight on one of bezel light sensors to obtain maximum brightness (manual dimming controls do not have full bright authority in low light levels).

(7) Center Photometer on each of three raster patches and verify following minimum brightness:

- Red > or = 3.4 Foot Lamberts
- Green > or = 7.1 Foot Lamberts
- Blue > or = 1.25 Foot Lamberts

EFIS REMOTE LIGHT SENSOR (RLS) - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Remote Light Sensor (RLS). The RLS is located on top of the glareshield.

2. Removal/Installation EFIS Remote Light Sensor

A. Remove Sensor

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Remove two retaining screws which secure RLS to glareshield.

(3) Lift RLS up from top of glareshield, and locate connector along cable which extends from underside of unit.

(4) Disconnect unit from aircraft wiring at connector. Place protective covering over connector ends.

B. Install Sensor

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Remove protective coverings from connector ends.

(3) Connect RLS cable to aircraft connector, and position RLS on glareshield.

(4) Install attaching screws to secure unit in place.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

3. Adjustment/Test EFIS Remote Light Sensor (RLS)

A. RLS Functional Test

Table 201

Step	Operation	Desired Result
(1)	Make sure that all EFIS circuit breakers, and all other aircraft sensor circuit breakers, are closed.	
NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.		

Table 201 (Continued)

Step	Operation	Desired Result
(2)	Cover RLS and Captain's and F/O's PFD and ND light sensors with masking tape.	Display brightness on Captain's and F/O's display units decreases.
(3)	Remove masking tape from RLS. Shine a light into the sensor.	Display brightness on all display units increases.
(4)	Return aircraft to required configuration.	

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude system provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The attitude system consists of a vertical gyro-1, vertical gyro-2, and an auxiliary gyro, two attitude director indicators (ADI) and an attitude switching unit.

B. The vertical gyros sense the degree of aircraft movement about the pitch and roll axis. This mechanical displacement is converted to electrical signals which are processed through the digital flight guidance computers (via the attitude switching unit) for operation of the noted systems. The ADIs also receive pitch and roll attitude signals and the weather radar system receives stabilization signals directly from the vertical gyros.

C. Vertical Gyros - The vertical gyros are located in the forward accessory compartment.

D. Attitude Switching Unit - The unit is mounted on the rack in the forward accessory compartment. The unit contains two motor-driven switches. The switching assembly in the unit controls the selection of input from one of three vertical gyros. The switching unit is remotely actuated by a transfer switch (placarded VERT GYRO) on the overhead switch panel. Three switch positions are marked L ON AUX/NORM/R ON AUX. Normal instrumentation furnishes data from VG-1 to the digital flight guidance computers, HUD computer, comparator monitor, and the captains's ADI; and from VG-2 to the digital flight guidance computers, HUD computer, Flight Data Acquisition Unit, first officer's ADI, and the weather radar. Placing the switch in other than NORM position, causes either subsystem 1 or subsystem-2 to receive signals from the auxiliary vertical gyro. An AUX GYRO INOP annunciator light (adjacent to the VERT GYRO switch) will come on to denote a failure in the auxiliary gyro, and warn the operator not to switch out of normal instrumentation.

NOTE: On aircraft 134-135, 137, there is not a HUD computer. The VG-1 supplies data to the components listed except the HUD computer.

E. Attitude Director Indicator - One ADI is mounted on the captain's flight instrument panel, and one on the first officer's. Each ADI provides a display of roll and pitch attitude, cross-pointer flight director command bars, speed command indication, glideslope deviation indication, slip inclinometer, and expanded localizer deviation. The indicator bezel contains a self-test button, and a decision height (DH) warning light. In addition to certain bar and pointer retractions, flags on the indicator lableled FD, ATT, SPD, GS, HT, and LOC come into view to indicate a failure in the applicable system. A fixed miniature aircraft symbol is provided as a reference for attitude. The required changes in attitude to obtain the desired flight path are accomplished by flying the aircraft symbol to the command bars. (Paragraph 2.)

2. Operation

A. When power is applied to the attitude system, each vertical gyro erects to level condition and attains nominal rotational speed within minimum of 5 minutes. The vertical gyro equipment senses the degree of aircraft movement about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical drive signals to the digital flight guidance computers, ADIs, and weather radar antenna.

B. The switching unit within the attitude switching unit, when remotely actuated from the VERT GYRO switch on the overhead switch panel, controls the selection of vertical gyro signal outputs. Internal to the unit, one switch for the captain, and one for the first officer, allows selection of the AUX GYRO output to replace the output of the -1, or -2 gyro which normally feeds their applicable subsystem.

C. Each ADI displays aircraft attitude by the relationship of a fixed aircraft symbol with respect to a movable sphere. The sphere is driven by a dc torque motor and has approximately ±85 degrees of freedom in pitch and full 360 degree freedom in roll. The upper and lower half of the sphere is separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed aircraft symbol, and roll attitude by rotation of the sphere with respect to the aircraft symbol and a fixed scale and lubber line. The attitude sphere is unbalanced in the roll axis so that, on loss of power or loss of the attitude valid input, the attitude sphere dramatically rotates to indicate approximately a 90-degree bank. This sphere dumping augments the gyro ATT flag to indicate an invalid attitude indication.

(1) Flight director commands are displayed using a horizontal (pitch), and vertical (roll) bar, in relation to the fixed aircraft symbol. The appropriate flight director command bar will disappear from view upon the application of an external bias signal, indicator failures of the flight director ON/OFF input signal.

(2) Speed deviation is displayed by a circular marker moving over a vertical fixed scale. Upper end of scale is marked F (fast), and lower end is marked S (slow). The speed deviation marker is driven upward out of view upon the application of an external bias signal.

(3) Glideslope deviation is displayed by a pointer moving beside a vertical scale, and read in relation to an index and the fixed aircraft symbol. Aircraft above the glideslope beam is indicated by the pointer below the scale index, and aircraft below the beam is indicated by the pointer above the index. The glideslope pointer always indicates the direction the aircraft must be flown to reach the center of the glidepath. The glideslope pointer will be driven out of view, upon application of an external bias signal, upon loss of the external glideslope valid signal, or indicator failure.

(4) An expanded localizer pointer at bottom of instrument indicates to right of a fixed scale if the aircraft is to left of localizer beam, and to the left if the aircraft is the right of the beam.

(5) A striped bar indicates radio altitude and will appear to touch the aircraft symbol at touchdown.

(6) A ball-type inclinometer is located near the center of the bottom of the instrument bezel. The ball responds to acceleration parallel to the pitch axis of the aircraft, thus indicating whether a coordinated turn is being made. For a particular rate-of-turn at a given speed, the ball will remain centered (coordinated turn) only when the bank angle of the aircraft is such that the resultant centrifugal and gravitational forces acting on the ball axis of freedom are zero.

(7) A decision height light, placarded DH, comes on at a preset altitude signal from the radio altimeter system. A GA light comes on when in a go-around operation. A pitch trim knob is used for pitch fine adjustment.

D. Depressing the TEST button on lower left corner of the indicator actuates self-test circuits which cause the indicator to display the following:

(1) The attitude sphere will simultaneously indicate a change in the attitude of 20(±5) degrees right bank, and 10(±5) degrees climb, and the ATT flag will be in view. VG must be on and valid for attitude test.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses.

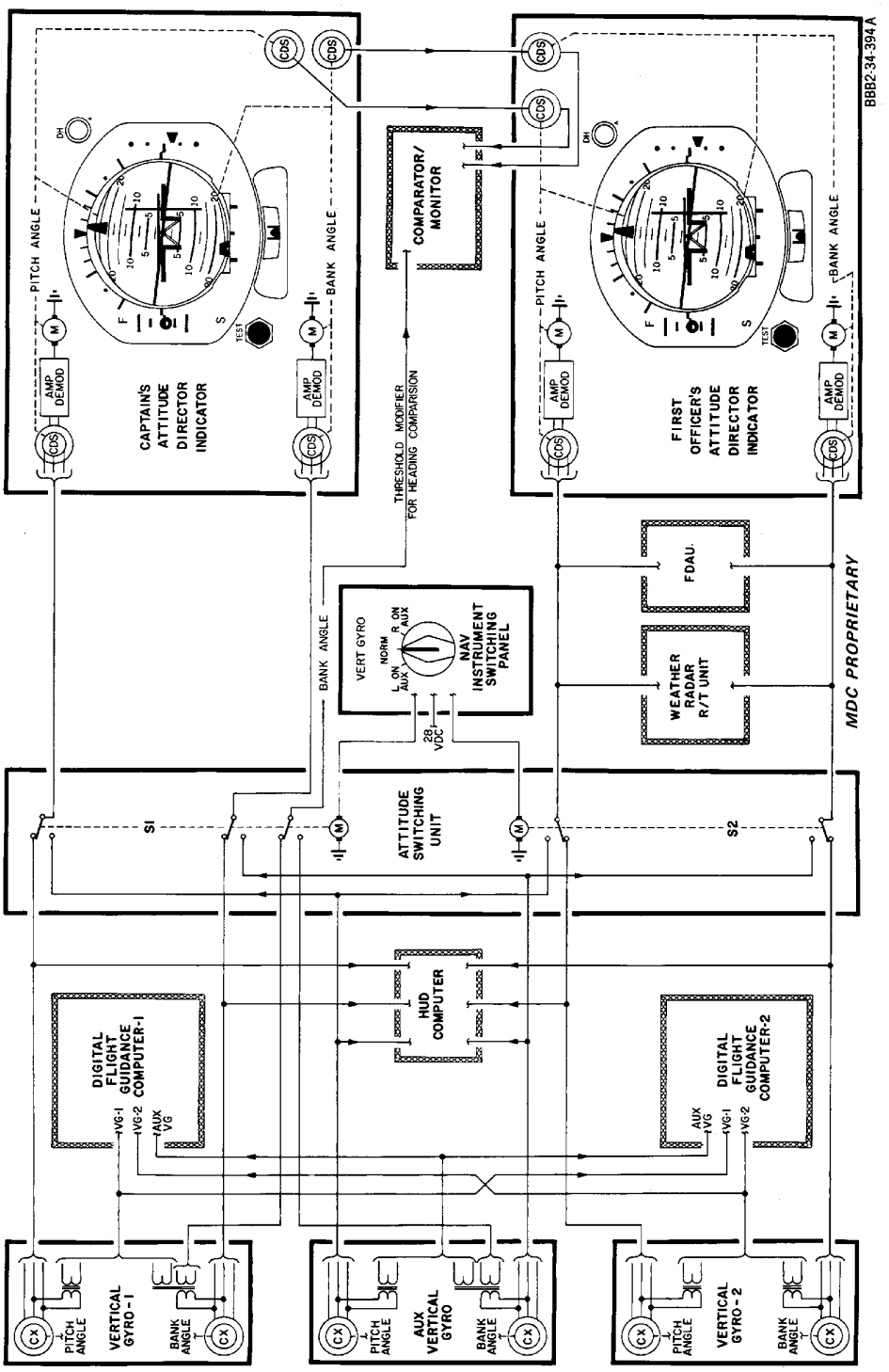
(2) On overhead switch panel, set VERT GYRO switch to NORM position.

(3) After allowing approximately 5 minutes for vertical gyros to erect, ensure that ATT flag disappears from view in both attitude director indicators.

(4) On both indicators, depress TEST switch and observe that pitch and roll indications display an additional 20(±5) degrees right bank, and 10(±5) degrees climb, and ATT flag in view. When test button is released, the ATT flag should disappear from view, and sphere rotate back to indicate the true attitude of the aircraft.

(5) On overhead switch panel, observe that AUX GYRO INOP light is off. Alternately switch captain's and first officer's system to auxiliary gyro by selecting switch positions L ON AUX, and R ON AUX. ATT flag should remain out of view on applicable indicator.

(6) Set VERT GYRO switch to NORM position; system is ready to operate.



Attitude System -- Schematic
Figure 1/34-23-00-990-807

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude system provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The attitude system consists of a Vertical Gyro-1 (VG-1), Vertical Gyro-2 (VG-2), and two Attitude Director Indicators (ADI).

B. The vertical gyros sense the degree of airplane movement about the pitch and roll axis. This mechanical displacement is converted to electrical signals which are processed through the digital flight guidance computer for operation of the noted systems. The ADIs also receive pitch and roll attitude signals and the weather radar system receives stabilization signals directly from the vertical gyros.

C. Vertical Gyros - The vertical gyros are located in the forward accessory compartment.

D. Attitude Director Indicator - One ADI is mounted on the captain's flight instrument panel, and one on the first officer's. ADI provides a display of roll and pitch attitude, flight director command bars, speed command indication, glideslope deviation indication, bank angle, and expanded localizer deviation. Flags on the indicator come into view to indicate a failure in the applicable system. A fixed aircraft symbol is provided as a reference for attitude. The required changes in attitude to obtain the desired flight path are accomplished by flying the aircraft symbol to the flight director command bars.

2. Operation

A. When power is applied to the attitude system, each vertical gyro erects to level condition and attains nominal rotational speed within minimum of 5 minutes. The vertical gyro equipment senses the degree of aircraft movement about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical signals. Electrical signals from VG-1 go to the Digital Flight Guidance Computers (DFGCs), NAV/INST Comparator Monitor, captain's ADI, and VG-2. Signals from VG-2 go to the DFGCs, Flight Data Acquisition Unit (FDAU), Weather Radar R/T, first officer's ADI, and VG-1.

B. Each ADI displays aircraft attitude by the relationship of a fixed aircraft symbol with respect to a movable sphere. The sphere is driven by a dc torque motor and has approximately ±85 degrees of freedom in pitch and full 360 degree freedom in roll. The upper and lower half of the sphere is separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed aircraft symbol, and roll attitude by rotation of the sphere with respect to the aircraft symbol and a fixed scale and lubber line. The attitude sphere is unbalanced in the roll axis so that, on loss of power or loss of the attitude valid input, the attitude sphere dramatically rotates to indicate approximately a 90-degree bank. This sphere dumping augments the GYRO flag to indicate an invalid attitude indication.

(1) Flight director commands are displayed using the command bars in relation to the fixed aircraft symbol.

(2) Speed deviation is displayed by a circular marker moving over a vertical fixed scale. Upper end of scale is marked F (fast), and lower end is marked S (slow). The speed flag comes into view upon the application of an external bias signal.

(3) Glideslope deviation is displayed by a pointer moving beside a vertical scale, and read in relation to an index. Aircraft above the glideslope beam is indicated by the pointer below the scale index, and aircraft below the beam is indicated by the pointer above the index. The glideslope pointer always indicates the direction the aircraft must be flown to reach the center of the glidepath. The glideslope flag will come into view, upon application of an external bias signal, upon loss of the external glideslope valid signal, or indicator failure.

(4) A ball-type inclinometer is located near the center of the bottom of the instrument bezel. The ball responds to acceleration parallel to the pitch axis of the aircraft, thus indicating whether a coordinated turn is being made. For a particular rate-of-turn at a given speed, the ball will remain centered (coordinated turn) only when the bank angle of the aircraft is such that the resultant centrifugal and gravitational forces acting on the ball axis of freedom are zero.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses.

(2) On overhead switch panel, set F/D switch to NORM position.

(3) After allowing approximately 5 minutes for vertical gyros to erect, ensure that flag disappears from view in both attitude director indicators.

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude portion of the attitude and heading reference units (AHRU), HEADING SYSTEM, SUBJECT 34-21-00, provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The EFIS Symbol Generator processes data from the AHRU and attitude/heading switching unit (AHSU) to provide a pitch and roll attitude display on the EFIS Primary Flight Display (PFD).

B. The AHRU's sense the degree of aircraft rotation about the pitch and roll axis. This mechanical rotation is converted to electrical drive signals which are processed through the digital flight guidance computers and sent to the EFIS Symbol Generators. The AHRU's also supply the weather radar R/T units with pitch and blank angle data for antenna stabilization.

C. Attitude Display - Aircraft attitude is displayed on the EFIS Primary Flight Display. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

2. Operation

A. When power is applied to the AHRS, each AHRU erects and aligns to level condition and outputs valid data within a minimum of 45 seconds, provided the aircraft is stationary on the ground. The AHRU senses the degree of aircraft rotation about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical drive signals to the digital flight guidance computers, EFIS Symbol Generators, and weather radar receiver transmitters.

B. The switching unit within the attitude/heading switching unit (AHSU), when remotely actuated from the AHRS switch on the captain's overhead panel, controls the selection of AHRU signal outputs. Internal to the unit, one switch for the captain, and one for the first officer, allows selection of the AHRU-3 output to replace the output of the -1, or -2 AHRU which normally feeds their applicable subsystem.

3. To Operate System

A. Operate

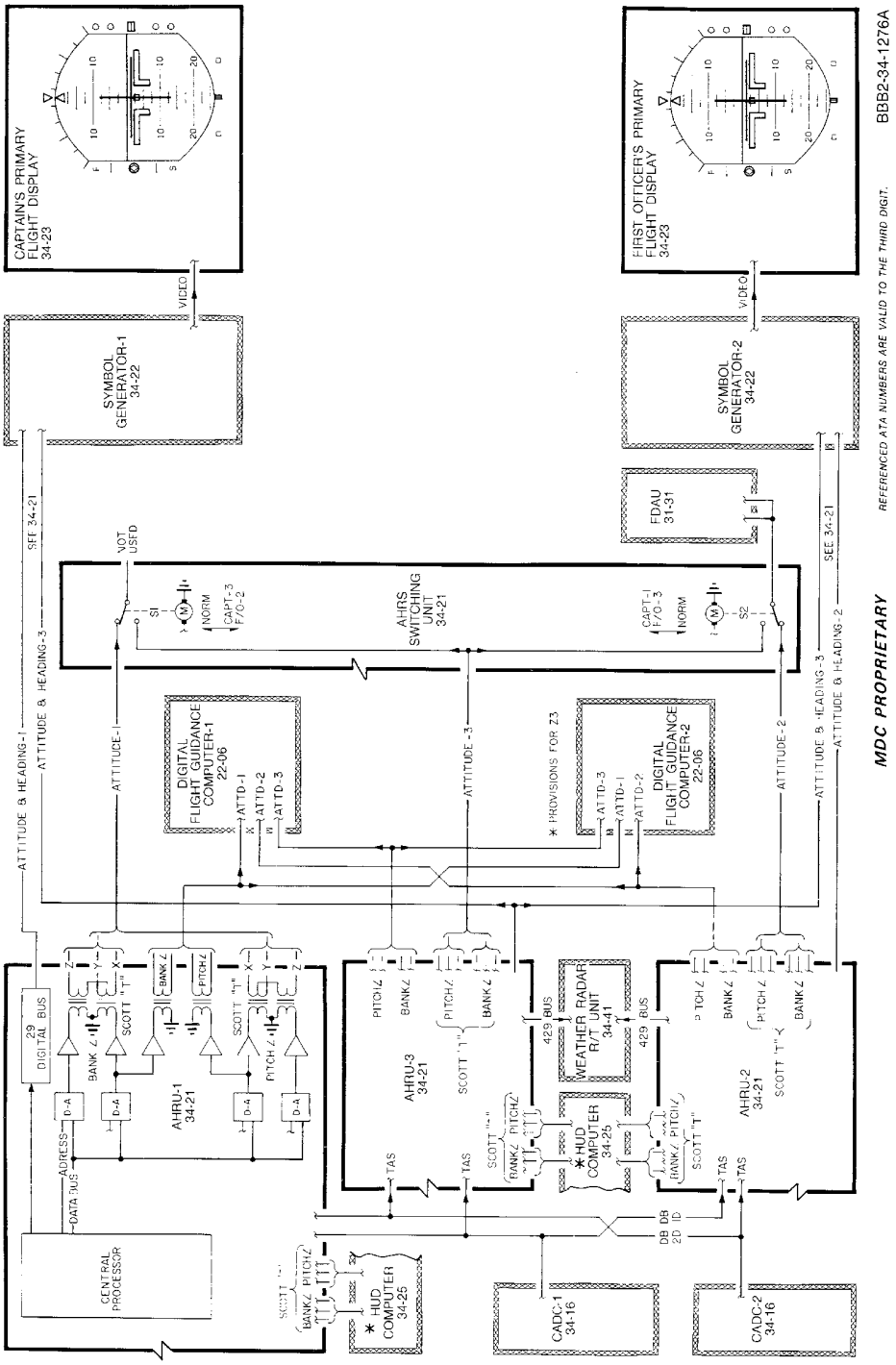
(1) Energize aircraft electrical buses. Make sure that aircraft remains stationary during one minute alignment period.

(2) On overhead panel, set AHRS switch to NORM center position.

(3) After allowing approximately one minute for system alignment, EFIS PFD should show attitude display; ATT3 message and ATT FAIL warnings should not appear on screen. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

(4) Alternately switch captain's and first officer's system to AHRS-3 by placing AHRS switch in L ON AUX, and R ON AUX position. "ATT3" should appear on applicable PFD.

(5) Set AHRS switch to center NORM position; system is ready to operate.



Attitude System - Block Diagram
Figure 1/34-23-00-990-811

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude portion of the attitude and heading reference units (AHRU), HEADING SYSTEM, SUBJECT 34-21-00 , provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The EFIS Symbol Generator processes data from the AHRU to provide a pitch and roll attitude display on the EFIS Primary Flight Display (PFD).

B. The AHRU's sense the degree of aircraft rotation about the pitch and roll axis. This mechanical rotation is converted to electrical drive signals which are processed through the digital flight guidance computers and sent to the EFIS Symbol Generators. The AHRU's also supply the weather radar R/T units with pitch and blank angle data for antenna stabilization.

C. Attitude Display - Aircraft attitude is displayed on the EFIS Primary Flight Display. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1)

2. Operation

A. When power is applied to the AHRS, each AHRU erects and aligns to level condition and outputs valid data within a minimum of 45 seconds, provided the aircraft is stationary on the ground. The AHRU senses the degree of aircraft rotation about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical drive signals to the digital flight guidance computers, EFIS Symbol Generators, which provide the attitude display on the PFDs, and weather radar receiver transmitters.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses. Make sure that aircraft remains stationary during one minute alignment period.

(2) After allowing approximately one minute for system alignment, EFIS PFD should show attitude display; ATT FAIL warnings should not appear on screen. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude system provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The attitude system consists of a Vertical Gyro-1 (VG-1), Vertical Gyro-2 (VG-2), and two Attitude Director Indicators (ADI), two Primary Flight Displays (PFD).

B. The vertical gyros sense the degree of aircraft movement about the pitch and roll axis. This mechanical displacement is converted to electrical signals which are processed through the digital flight guidance computer for operation of the noted systems. The ADI/PFDs also receive pitch and roll attitude signals and the weather radar system receives stabilization signals directly from the vertical gyros.

C. Vertical Gyros - The vertical gyros are located in the forward accessory compartment.

D. Attitude Director Indicator - One ADI is mounted on the captain's flight instrument panel, and one on the first officer's. ADI provides a display of roll and pitch attitude, cross pointer flight director command bars, speed command indication, glideslope deviation indication, bank angle, and expanded localizer deviation. Flags on the indicator come into view to indicate a failure in the applicable system. A fixed aircraft symbol is provided as a reference for attitude. The required changes in attitude to obtain the desired flight path are accomplished by flying the aircraft symbol to the command bars.

E. Primary Flight Display (PFD) - Two PFD's are installed, one each on the captain's instrument panel and first officer's instrument panel. Displays are the same as the ADI's except displays are shown on the PFD cathode ray tube (CRT).

2. Operation

A. When power is applied to the attitude system, each vertical gyro erects to level condition and attains nominal rotational speed within minimum of 5 minutes. The vertical gyro equipment senses the degree of aircraft movement about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical signals. Electrical signals from VG-1 go to the Digital Flight Guidance Computers (DFGCs), NAV/INST Comparator Monitor, Flight Data Acquisition Unit (FDAU), captain's ADI/PFD, and VG-2. Signals from VG-2 go to the DFGCs, FDAU, Weather Radar R/T, first officer's ADI/PFD, and VG-1.

B. ADI - Each ADI displays aircraft attitude by the relationship of a fixed aircraft symbol with respect to a movable sphere. The sphere is driven by a dc torque motor and has approximately ±85 degrees of freedom in pitch and full 360 degree freedom in roll. The upper and lower half of the sphere is separated by a horizon line. Pitch attitude is indicated by position of the horizon line with respect to the fixed aircraft symbol, and roll attitude by rotation of the sphere with respect to the aircraft symbol and a fixed scale and lubber line. The attitude sphere is unbalanced in the roll axis so that, on loss of power or loss of the attitude valid input, the attitude sphere dramatically rotates to indicate approximately a 90-degree bank. This sphere dumping augments the GYRO flag to indicate an invalid attitude indication.

(1) Flight director commands are displayed using the command bars in relation to the fixed aircraft symbol.

(2) Speed deviation is displayed by a circular marker moving over a vertical fixed scale. Upper end of scale is marked F (fast), and lower end is marked S (slow). The speed flag comes into view upon the application of an external bias signal.

(3) Glideslope deviation is displayed by a pointer moving beside a vertical scale, and read in relation to an index. Aircraft above the glideslope beam is indicated by the pointer below the scale index, and aircraft below the beam is indicated by the pointer above the index. The glideslope pointer always indicates the direction the aircraft must be flown to reach the center of the glidepath. The glideslope flag will come into view, upon application of an external bias signal, upon loss of the external glideslope valid signal, or indicator failure.

(4) A ball-type inclinometer is located near the center of the bottom of the instrument bezel. The ball responds to acceleration parallel to the pitch axis of the aircraft, thus indicating whether a coordinated turn is being made. For a particular rate-of-turn at a given speed, the ball will remain centered (coordinated turn) only when the bank angle of the aircraft is such that the resultant centrifugal and gravitational forces acting on the ball axis of freedom are zero.

C. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference aircraft symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

(3) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indication. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

(5) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude sphere.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The EFIS also produces a DH tone as the aircraft nears decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The scale is white above the decision height and yellow below. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet.

(9) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

(10) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 2500 feet (762 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

(11) FMS DATA: FMS "MCDU MSG" and Fast/Slow display will appear relative to MCDU alert messages and FMS speed commands when V-NAV is engaged.

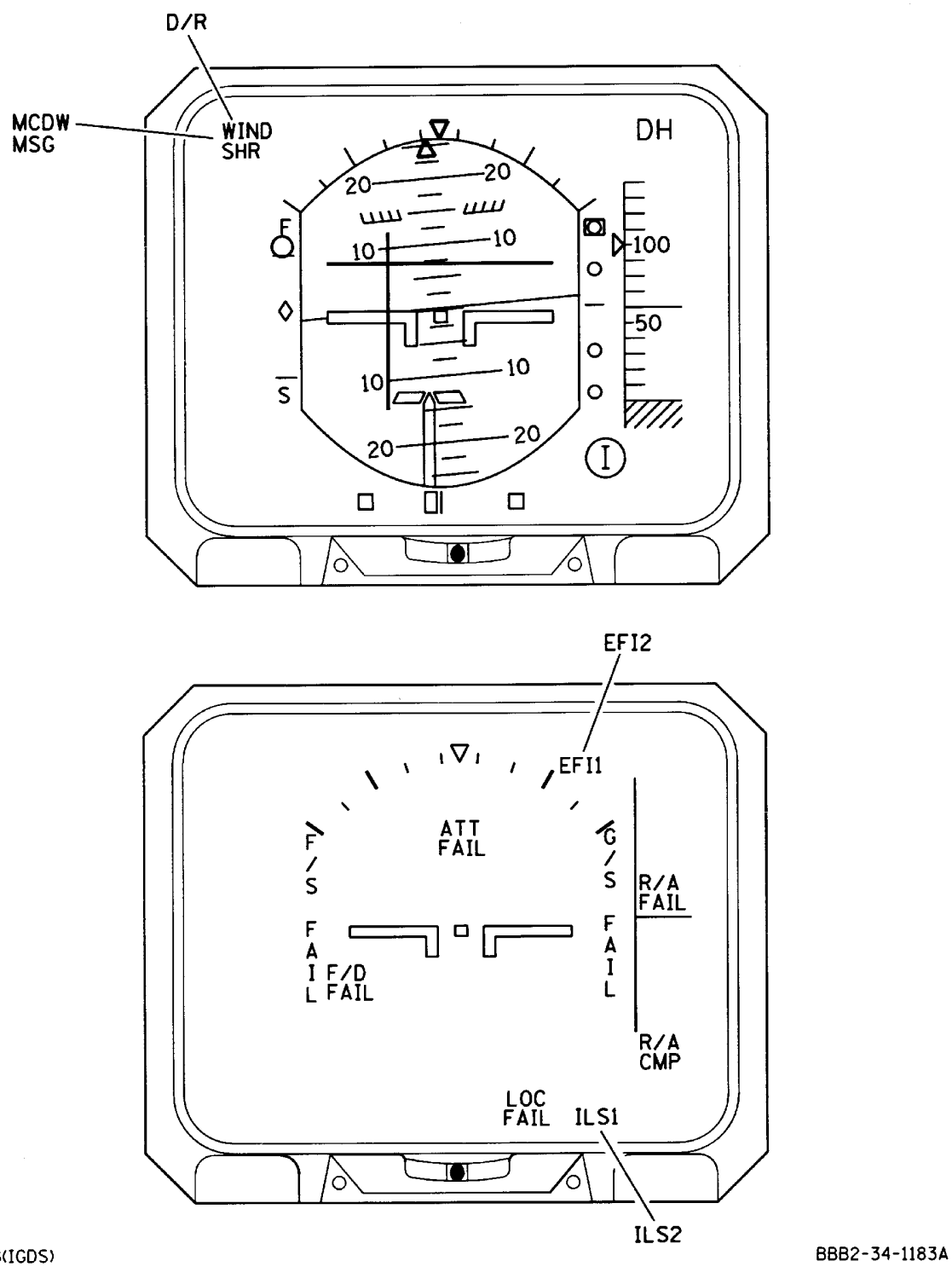
3. To Operate System

A. Operate

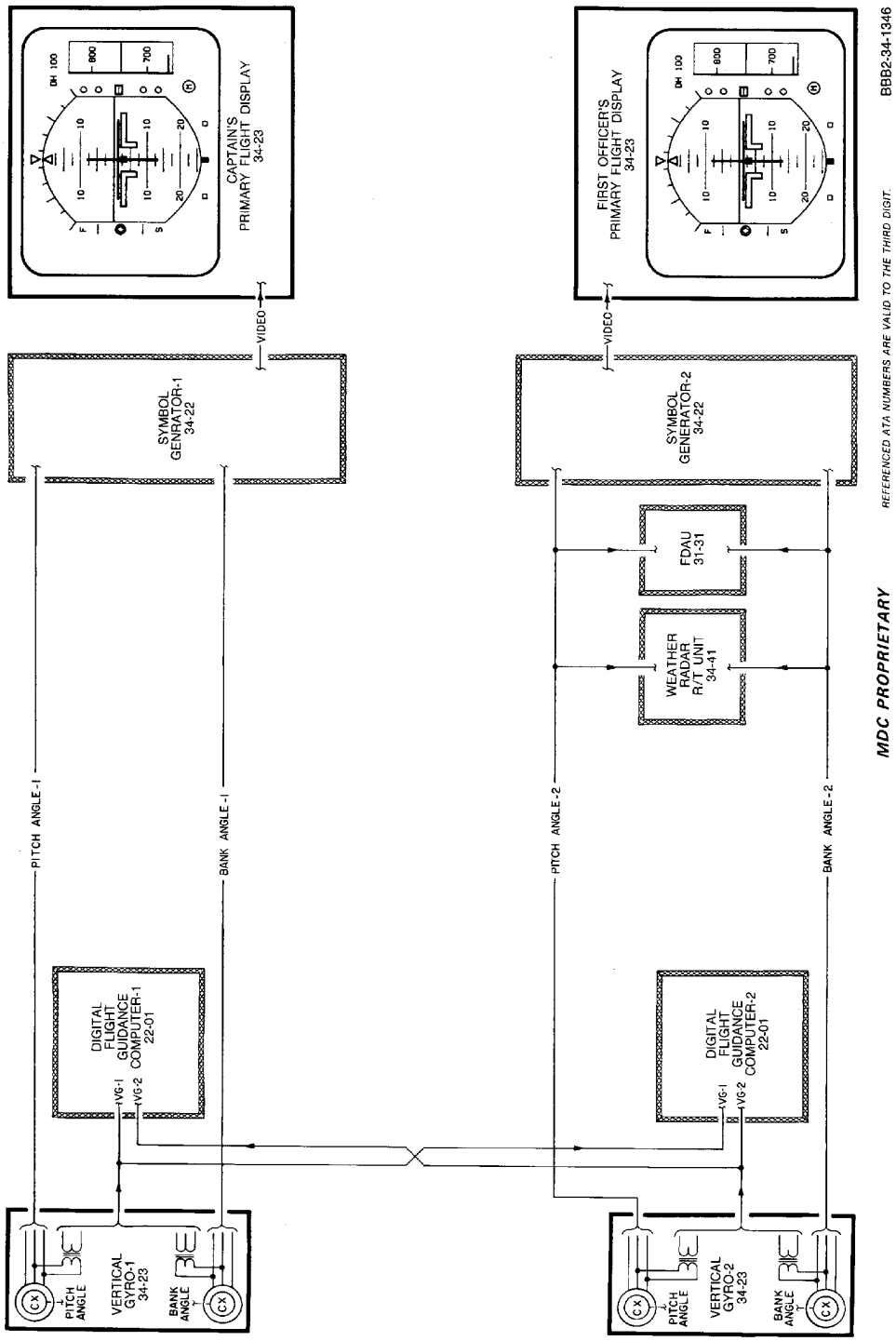
(1) Energize aircraft electrical buses.

(2) On overhead switch panel, set F/D switch to NORM position.

(3) After allowing approximately 5 minutes for vertical gyros to erect, ensure that flag disappears from view in both attitude director indicators, NO FAIL warnings appear on PFD's.



Attitude Display (with Flags and Warnings)
Figure 1/34-23-00-990-815



Attitude System - Block Diagram
Figure 2/34-23-00-990-816

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude system provides gyro stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, Electronic Flight Instrument System (EFIS), and the weather radar system. The attitude system consists of a vertical gyro-1 (VG-1), vertical gyro-2 (VG-2) auxiliary gyro (AUX VG), and an attitude switching unit (ASU). Aircraft attitude is displayed on the EFIS Primary Flight Display (PFD).

B. Vertical Gyros - The vertical gyros, located in the forward accessory compartment, sense the degree of movement about the pitch and roll axis of the aircraft. Electrical signals, generated at the gimbal-mounted synchros, are sent directly to the digital flight guidance computers. The EFIS Symbol Generators (SG), Flight Data Acquisition Units (FDAU), weather radar R/T and weather radar antenna receive pitch and roll attitude signals from the VG's via the Attitude Switching Unit.

C. Attitude Switching Unit (ASU) - This rack-mounted unit is located in the forward accessory compartment. The unit contains two motor-driven switches which control the selection of VG-1, VG-2 or the AUX VG. The ASU is remotely actuated by a transfer switch (placarded VERT GYRO) on the overhead panel. The switch positions are L ON AUX/NORM/R ON AUX. When the switch is in the NORM position, data from VG-1 is supplied to the DFGC's and the captain's EFIS Symbol Generator (SG-1). Data from VG-2 is supplied to the DFGC's, the first officer's EFIS SG (SG-2), the FDAU and the weather radar system. Placing the switch in the L ON AUX or R ON AUX position causes data from the AUX VG to be supplied to either system-1 or system-2. An AUX GYRO INOP annunciator on the VERT GYRO switching panel will come on to signal an AUX VG failure, and warn the operator not to switch out of normal instrumentation.

D. Attitude Display - Attitude is displayed on the EFIS Primary Flight Display (PFD), located on the captain's and first officer's instrument panels, in positions normally occupied by the ADI's. The PFD displays the following navigation parameters: attitude, flight director pitch and roll commands, deviations (glideslope/localizer), radio altitude, speed error, decision height set and status, and marker beacon indication. Loss of the attitude valid discrete to the EFIS SG results in attitude information being removed from the display and replaced with an ATT FAIL message.

2. Operation

A. When power is applied to the attitude system, each vertical gyro erects to level condition and attains nominal rotational speed within minimum of 5 minutes. The vertical gyro equipment senses the degree of aircraft movement about the pitch and roll axis. Mechanical displacement of the gyros is converted to electrical signals. Electrical signals from VG-1 go to the Digital Flight Guidance Computers (DFGCs), Flight Data Acquisition Unit (FDAU), captain's PFD, and VG-2. Signals from VG-2 go to the DFGCs, FDAU, Weather Radar R/T, first officer's PFD, and VG-1.

B. The attitude switching unit, when remotely actuated from the VERT GYRO switch on the overhead switch panel, controls the selection of VG signal outputs. Switches internal to the unit allow selection of the AUX VG to replace the output of either the captain's (-1) or first officer's (-2) system. When the L ON AUX or R ON AUX selection has been made, an Attitude Alternate discrete is sent to the EFIS Symbol Generator. The SG causes an ATT3 message to appear on the applicable PFD.

C. Primary Flight Display (PFD) Symbology

(1) The Primary Flight Display (PFD) format contains the following navigation parameters:

(a) Aircraft attitude

(b) Flight director pitch and roll commands

(c) Deviations (glideslope/localizer)

(d) Radio altitude

(e) Speed error

(f) Decision height set and status

(g) Marker beacon indication

(2) Attitude Indication: consists of a circle, truncated at the sides. Within the circle are a pitch scale, showing aircraft pitch attitude, a roll pointer, showing roll attitude, and an artificial horizon line. The apex of the reference airplane symbol is centered in the attitude circle. The aircraft and flight director bars appear in front of the pitch tape. The interior of the circle has blue raster shading above the horizon line, and brown shading below.

(3) Flight Director Command Indication: The cross pointer indication consists simply of two crossed bars, one vertical indicating roll command (moves left and right) and the other horizontal indicating pitch command (moves up and down). The movement of these bars are limited so that they always intersect. The desired attitude is indicated when the bar intersection falls inside the centered square.

(4) Glideslope (Vertical) Deviation: is indicated by the movement of a rectangular pointer over a scale located to the right of the attitude indication. The scale consists of a center reference line and two small dots above and below the reference. The scale and pointer are blanked during VOR operation.

(5) Expanded Localizer Deviation: is indicated by a rectangular pointer moving over a scale consisting of two small squares and a center reference line. The scale is centered beneath the attitude indication.

(6) Speed Deviation: is indicated by the movement of a circle over a scale consisting of a center reference diamond, two lines which indicate fast or slow deviation, and the letters "F" and "S" for fast and slow deviation. The scale is located on the left side of the PFD.

(7) Decision Height: The set value for the decision height appears in green letters in the upper right corner of the PFD. The display reads "DH" plus the set value (0 to 500 feet). At decision height, the DH set value is removed and replaced by a large amber "DH" which blinks for three seconds and then remains steady. The DH set value is also indicated by a small triangle on the radio altitude scale, which turns yellow at decision height. The EFIS also produces a DH tone as the aircraft nears decision height. The set value is displayed continuously, except when set to less than zero, or when the aircraft is below DH. There is no fail annunciation for DH set.

(8) Radio Altitude (R/A): is indicated by a non-linear scale on the right side of the display. Current radio altitude is indicated by a center line reference. The scale is white above the decision height and yellow below. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The radio altitude display is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet.

(9) Marker Beacons: are indicated by a color-coded circle enclosing the appropriate marker beacon indicator (I): Airways (Inner) (white), (M): Middle (yellow), and (O): Outer (cyan). There is no failure annunciation for the marker beacon.

(10) Altitude Alert: The message "ALT" will appear in yellow characters below the decision height symbology at 2500 feet (762 m). The message will be blanked at 500 feet (152.4 m). If on-side R/A information is lost "R/A FAIL" will appear and the "ALT" message will not appear.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses.

(2) On overhead switch panel, set F/D and VERT GYRO switches to NORM position.

(3) After allowing approximately 5 minutes for vertical gyros to erect, make sure that ATT FAIL message goes blank on both EFIS Primary Flight Displays (PFD).

(4) On overhead switch panel, observe that AUX GYRO INOP light is off. Alternately switch captain's and first officer's system to auxiliary gyro by selecting switch positions L ON AUX, and R ON AUX. ATT3 message should appear on applicable PFD.

(5) Set VERT GYRO switch to NORM position; system is ready to operate.

ATTITUDE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The attitude portion of the inertial reference units (IRU's), provides stabilized attitude (pitch and roll) references for the flight guidance system, flight director system, auto throttle speed command system, and weather radar system. The EFIS Symbol Generator processes data from the IRU's to provide a pitch and roll attitude display on the EFIS Primary Flight Display (PFD). (INERTIAL REFERENCE SYSTEM, SUBJECT 34-43-00)

B. The IRU's sense the degree of aircraft rotation about the pitch and roll axis. This mechanical rotation is converted to electrical drive signals which are processed through the digital flight guidance computers and sent to the EFIS Symbol Generators. The IRU's also supply the weather radar R/T units with pitch angle data for antenna stabilization.

C. Attitude Display - Aircraft attitude is displayed on the EFIS Primary Flight Display. (NAVIGATION DISPLAYS, SUBJECT 34-22-00)

2. Operation

A. When power is applied to the inertial reference system (IRS), each IRU erects and aligns to level condition and outputs valid data, provided the aircraft is stationary on the ground. The IRU senses the degree of aircraft rotation about the pitch and roll axis. Displacement of the IRU's is converted to electrical drive signals to the digital flight guidance computers, EFIS Symbol Generators, which provide the attitude display on the PFDs, and weather radar receiver transmitters.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses. Make sure that aircraft remains stationary during alignment period.

(2) After allowing four to twelve (depending on location) minutes for system alignment, EFIS PFD should show attitude display; ATT FAIL warnings should not appear on screen.

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude system operation are: vertical gyros (2) and attitude direction indicators.

E. The attitude system components are located as follows:

Table 101

Component	Location
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
Vertical Gyros-1, -2	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are vertical gyros and ADIs.

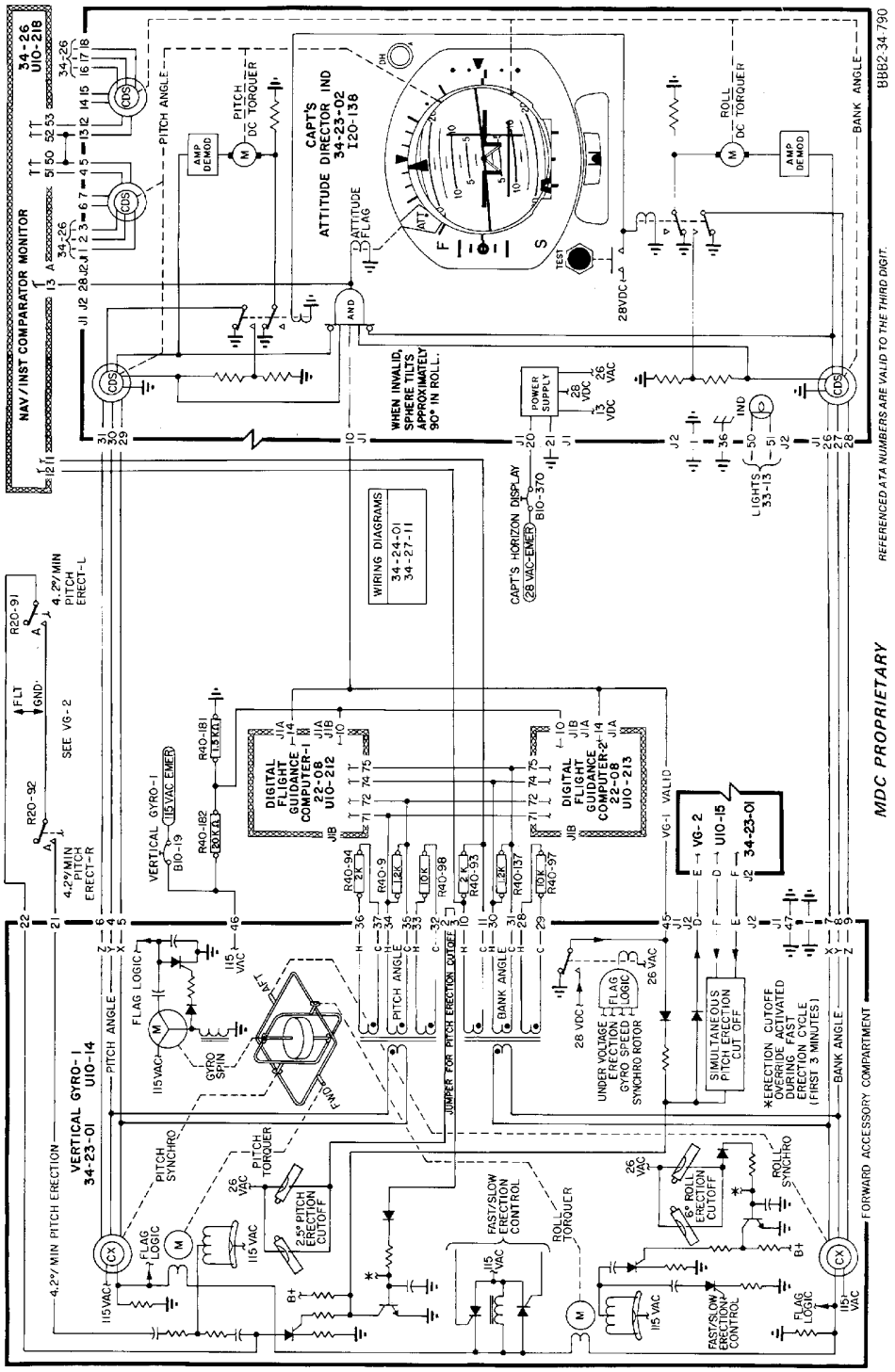
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

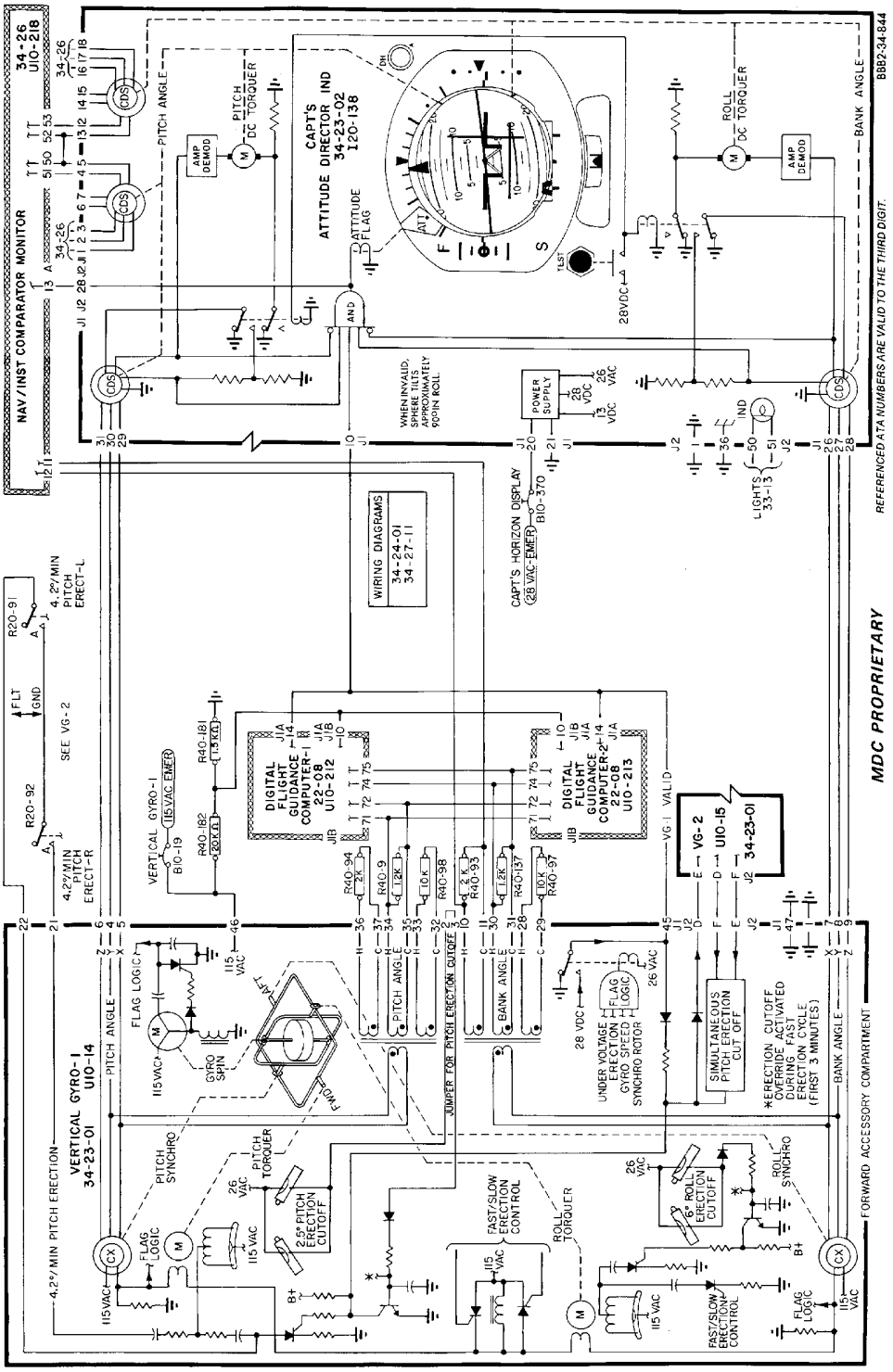
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

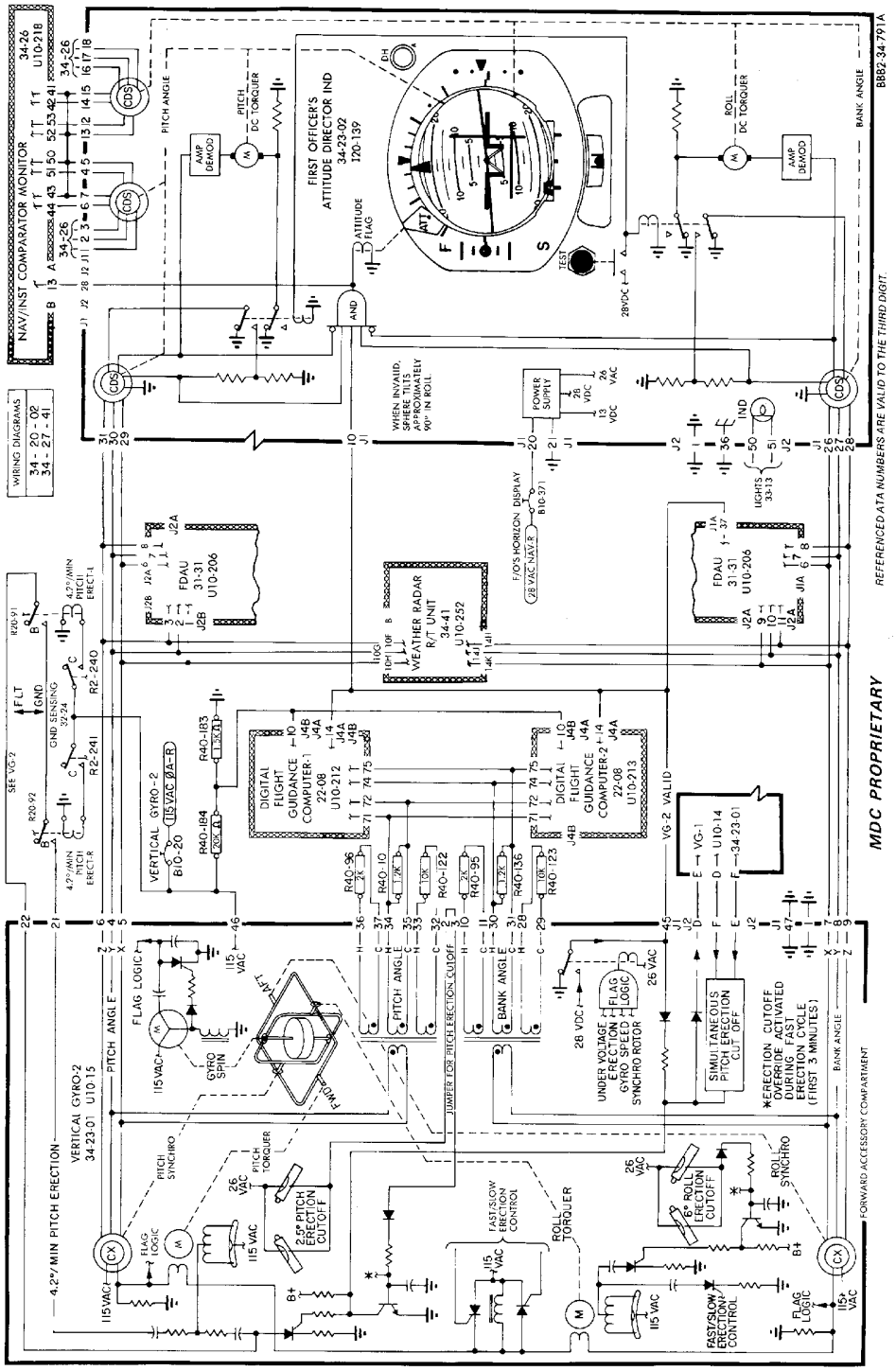
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05-2)	



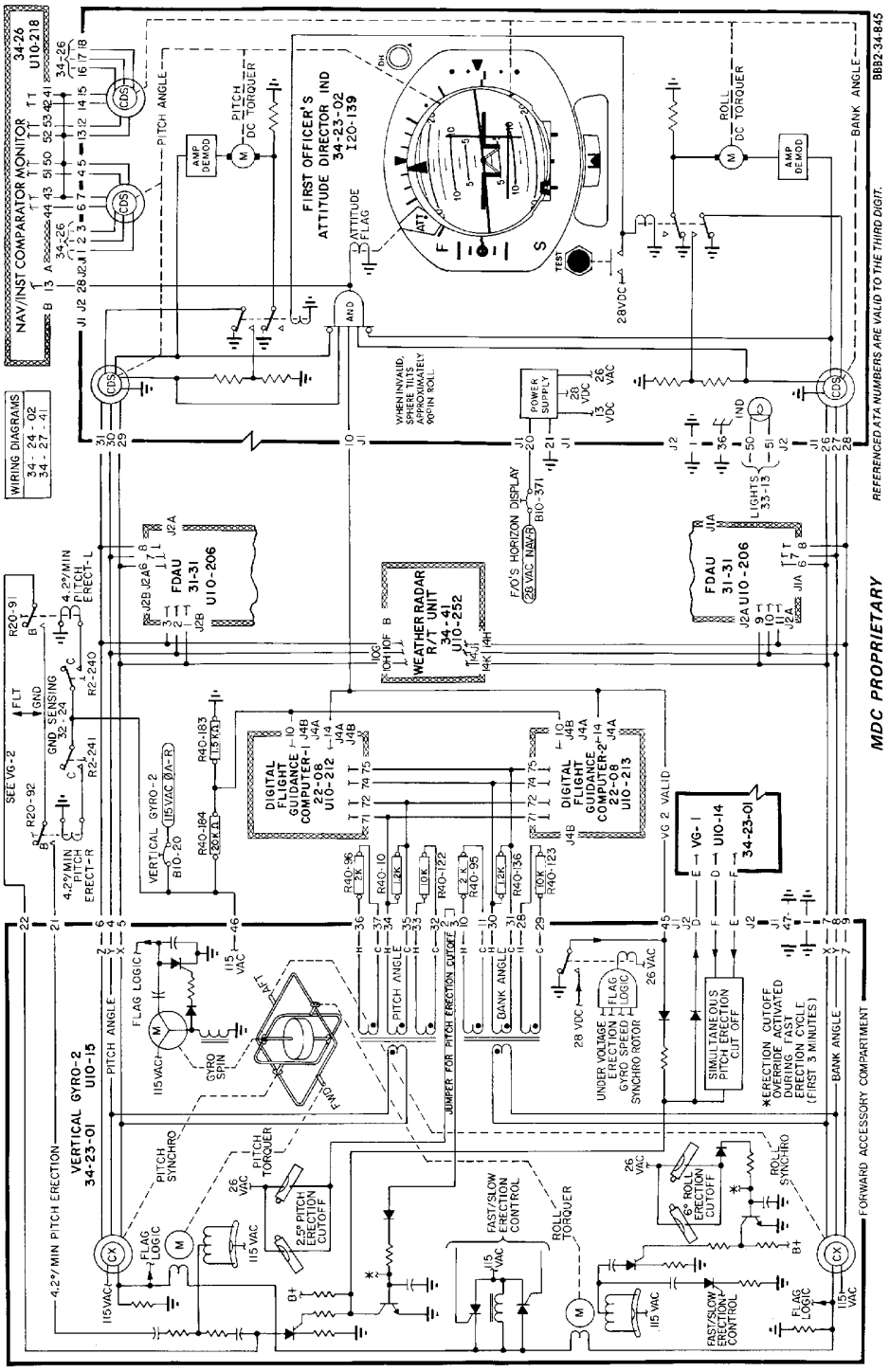
Attitude System-1 -- Schematic
Figure 101/34-23-00-990-831



Attitude System-1 -- Schematic
Figure 102/34-23-00-990-832



Attitude System-2 -- Schematic
Figure 103/34-23-00-990-837



Attitude System-2 -- Schematic
Figure 104/34-23-00-990-838

EFFECTIVITY
WJE 873, 874, 881, 883, 892, 893

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude system operation are: vertical gyros (3), attitude direction indicators, and attitude switching unit.

E. The attitude system components are located as follows:

Table 101

Component	Location
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
Vertical Gyros-1, -2 and Aux	Forward Accessory Compartment
Attitude Switching Unit	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are vertical gyros, attitude direction indicators, and attitude switching unit.

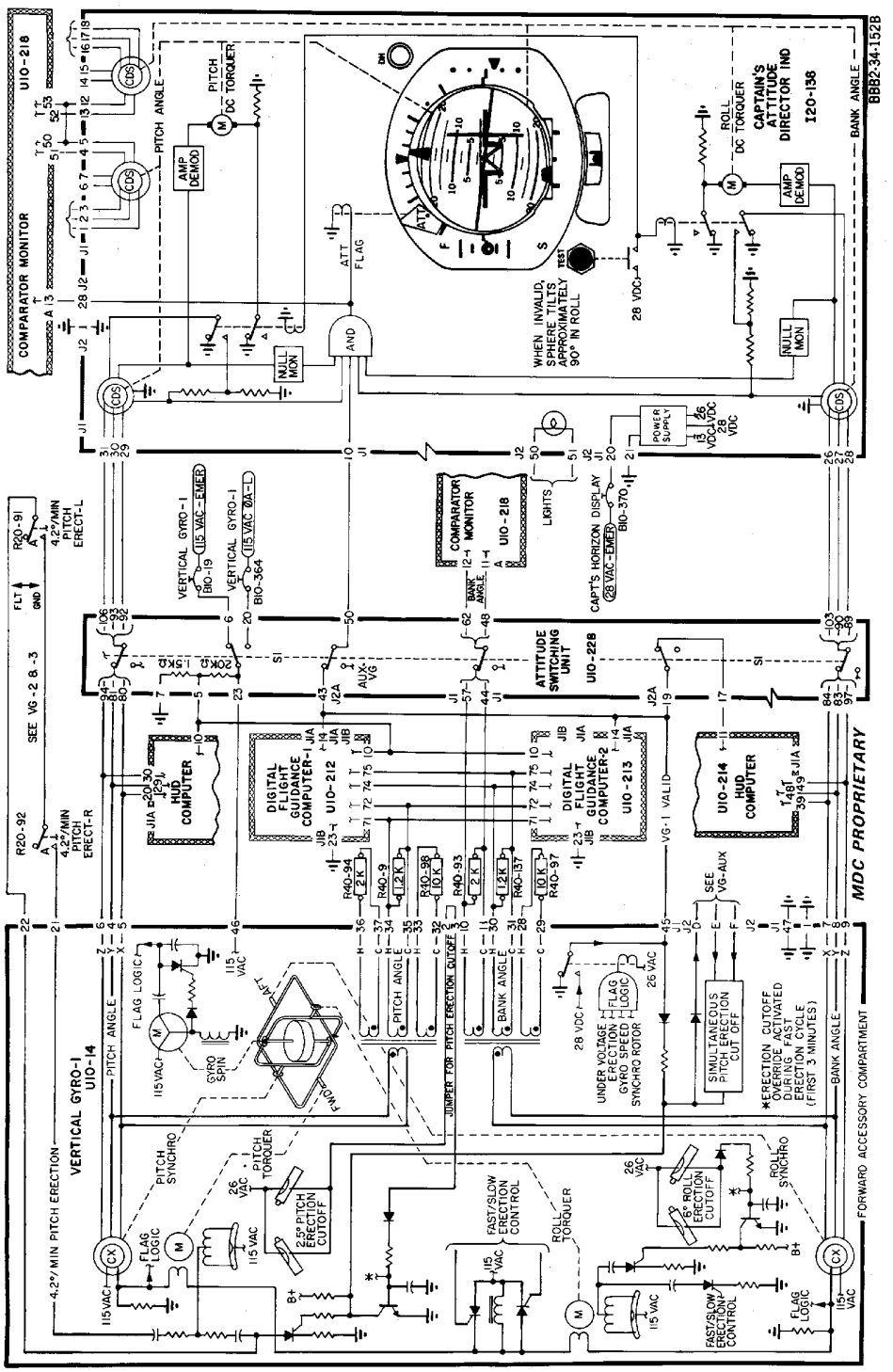
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

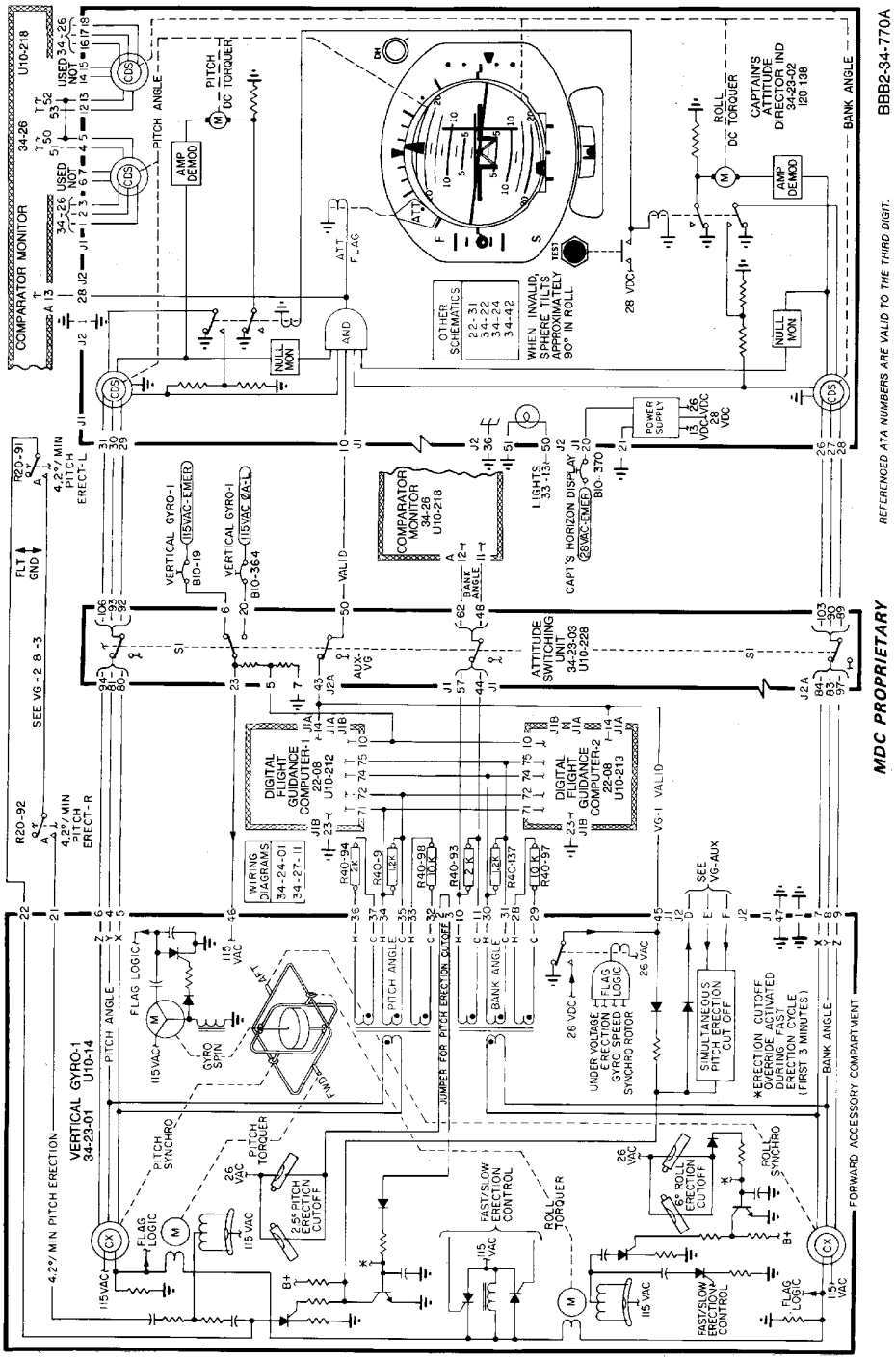
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

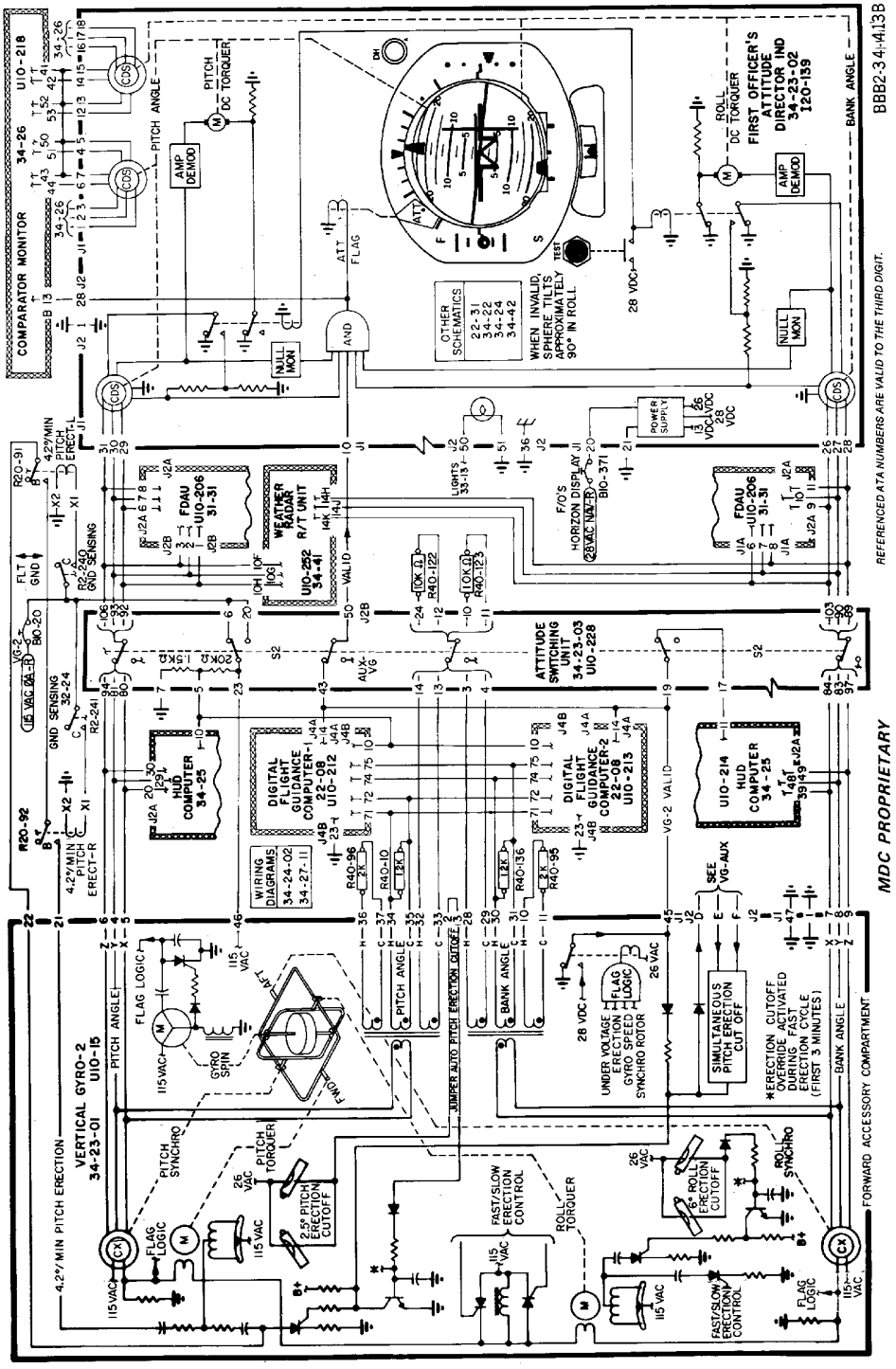
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Switch gyros through VERT GYRO switch on NAV INSTRUMENT TRANSFER PANEL to check for a faulty gyro.	Replace faulty gyro.
(7)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05-2)	



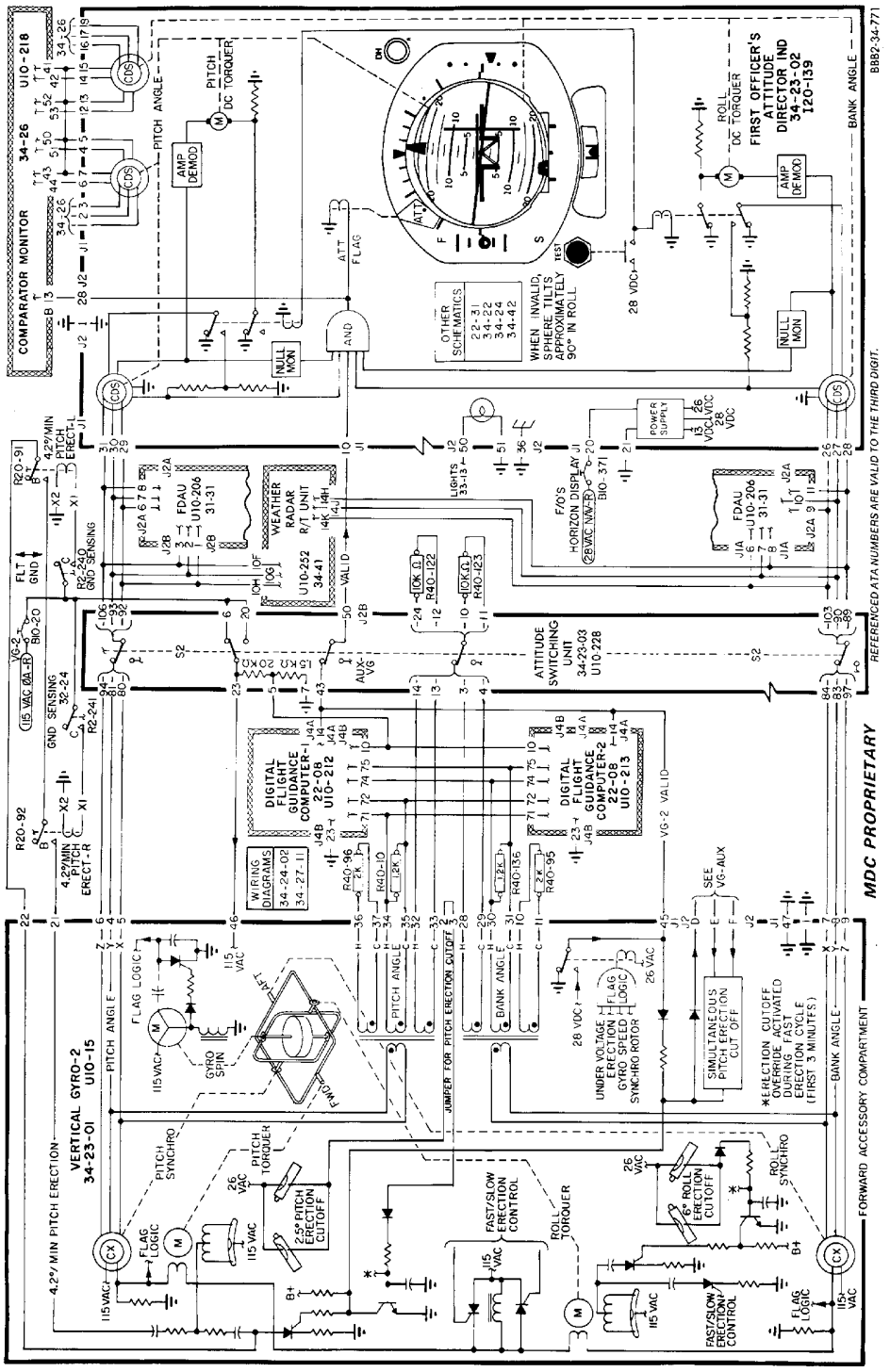
Attitude System-1 -- Schematic
Figure 101/34-23-00-990-841



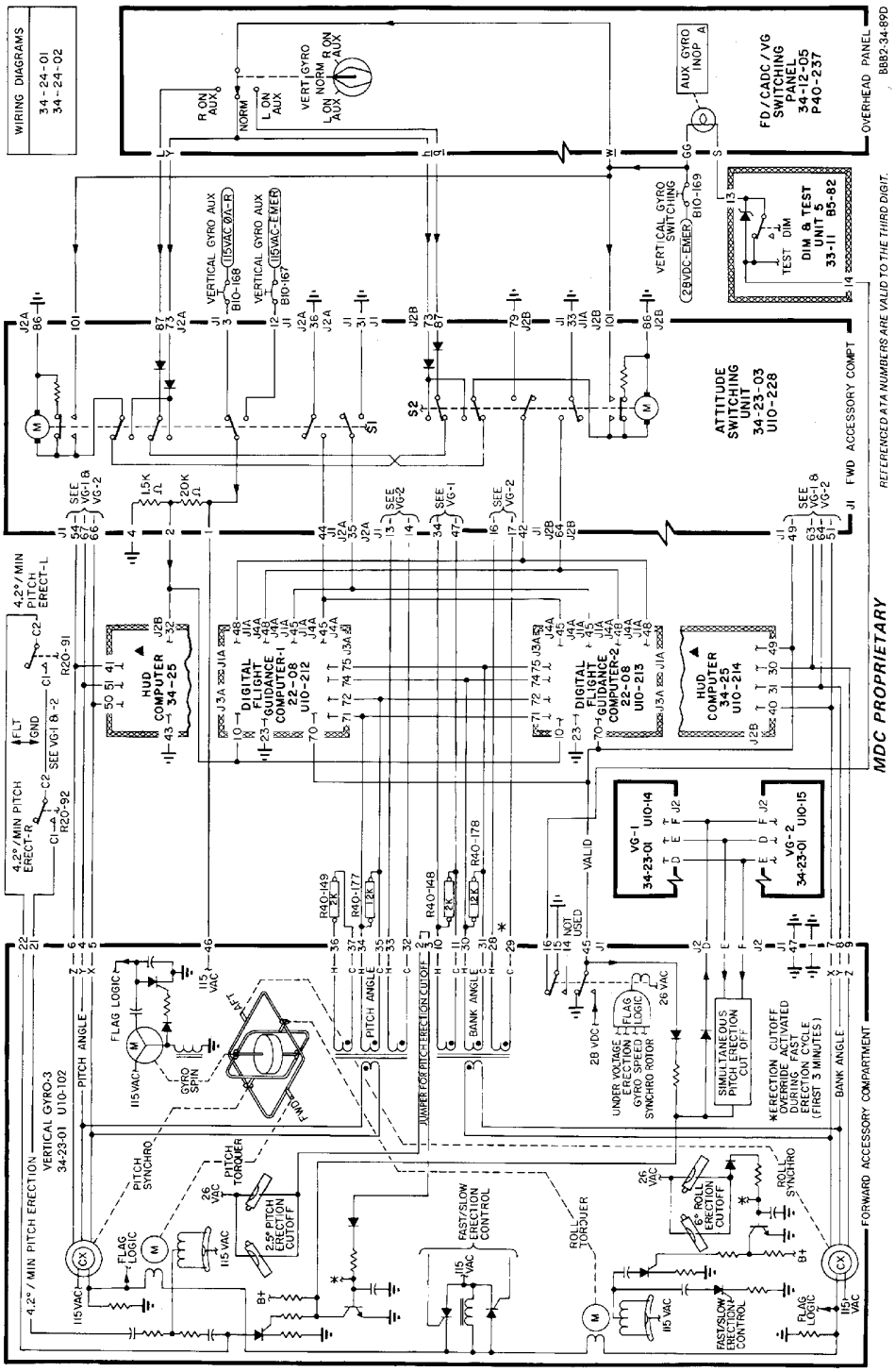
Attitude System-1 -- Schematic
Figure 102/34-23-00-990-843



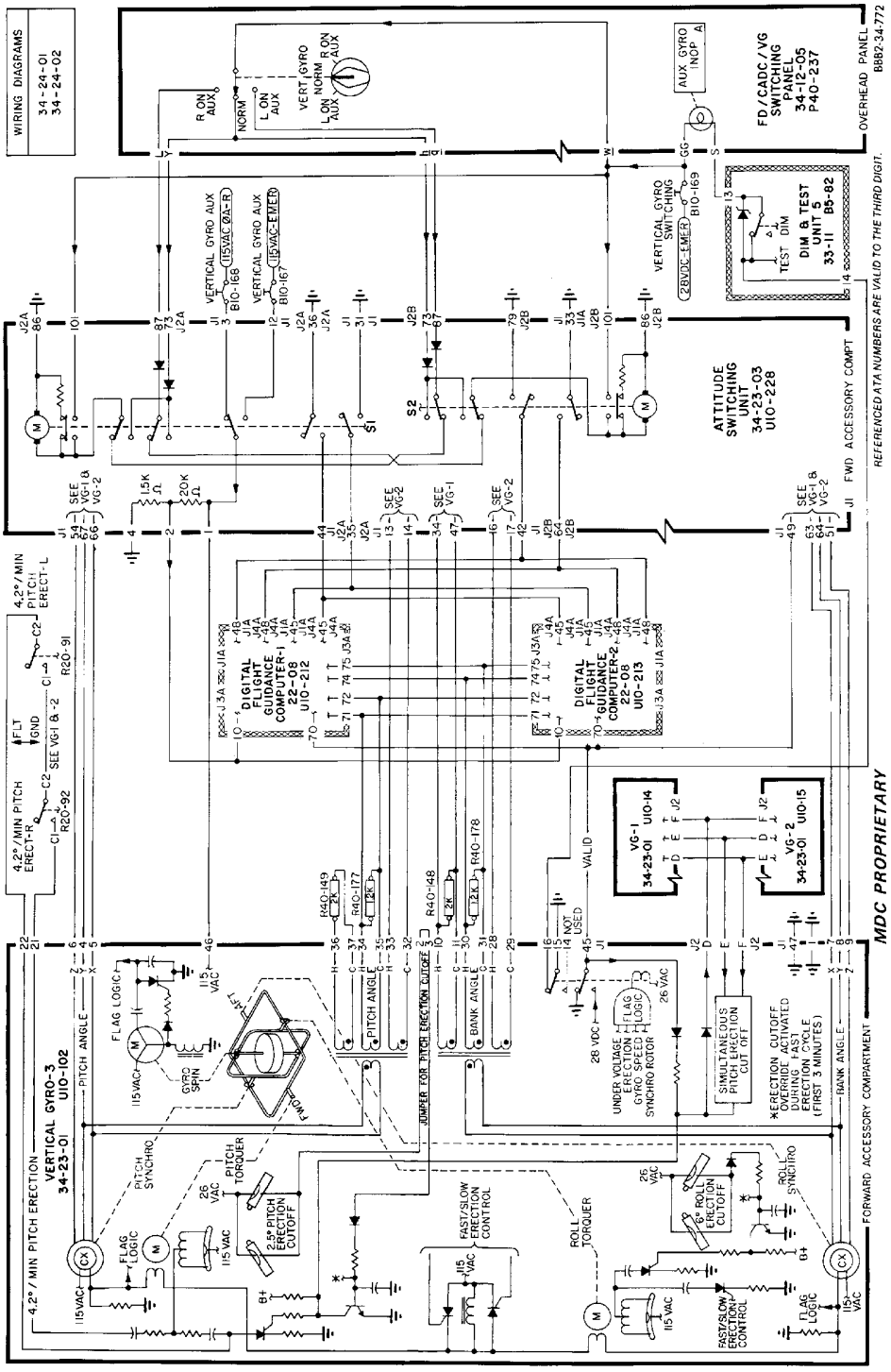
Attitude System-2 - Schematic
Figure 103/34-23-00-990-849



Attitude System-2 -- Schematic
Figure 104/34-23-00-990-850



Auxiliary Attitude System -- Schematic
Figure 105/34-23-00-990-855



Auxiliary Attitude System -- Schematic
Figure 106/34-23-00-990-857

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude system operation are: vertical gyros (3), and an attitude switching unit. Attitude is displayed on the EFIS Primary Flight Display (PFD).

E. The compass system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
Vertical Gyros-1, -2 and Aux	Forward Accessory Compartment
Attitude Switching Unit	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are vertical gyros, EFIS symbol generators, EFIS display unit, and attitude switching unit.

NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Switch gyros through VERT GYRO switch on NAV INSTRUMENT TRANSFER PANEL to check for a faulty gyro.	Replace faulty gyro.
(7)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude and interfacing systems are: two attitude/heading reference units (AHRU) and two EFIS Primary Flight Displays (PFD) which display attitude.

E. The attitude system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
AHRS-1 and -2	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units, EFIS Symbol Generators, and EFIS Display Units.

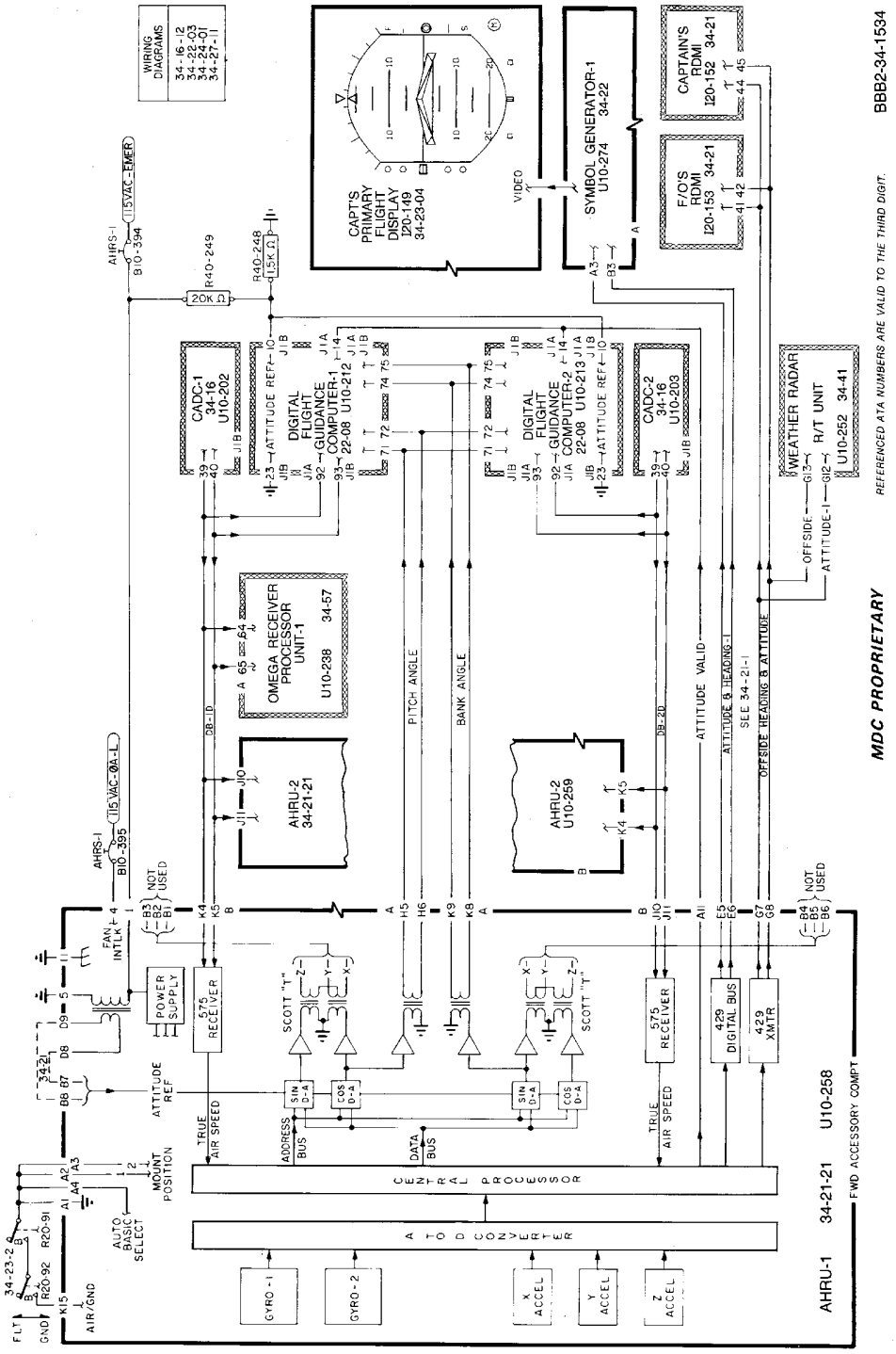
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

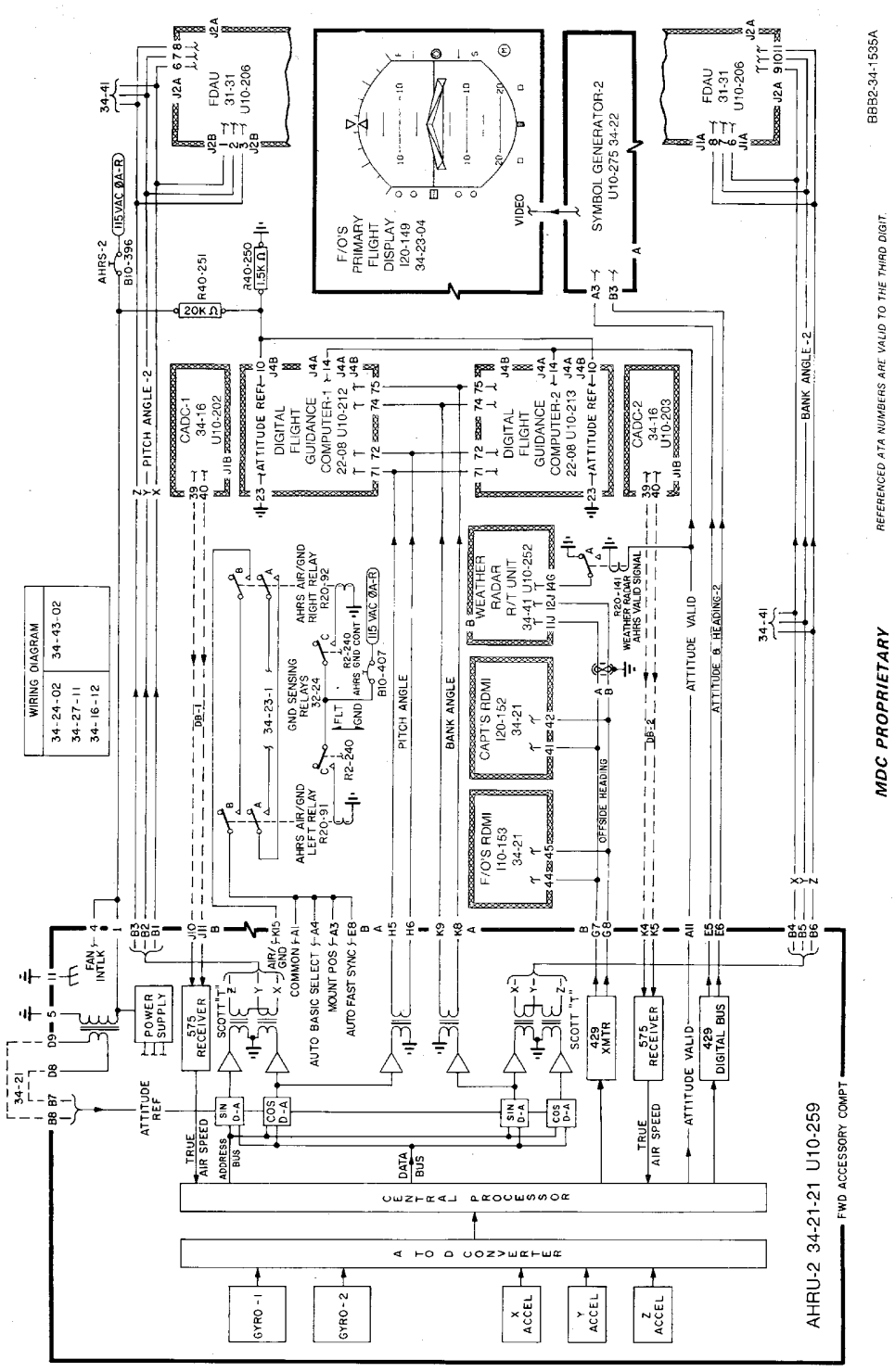
	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

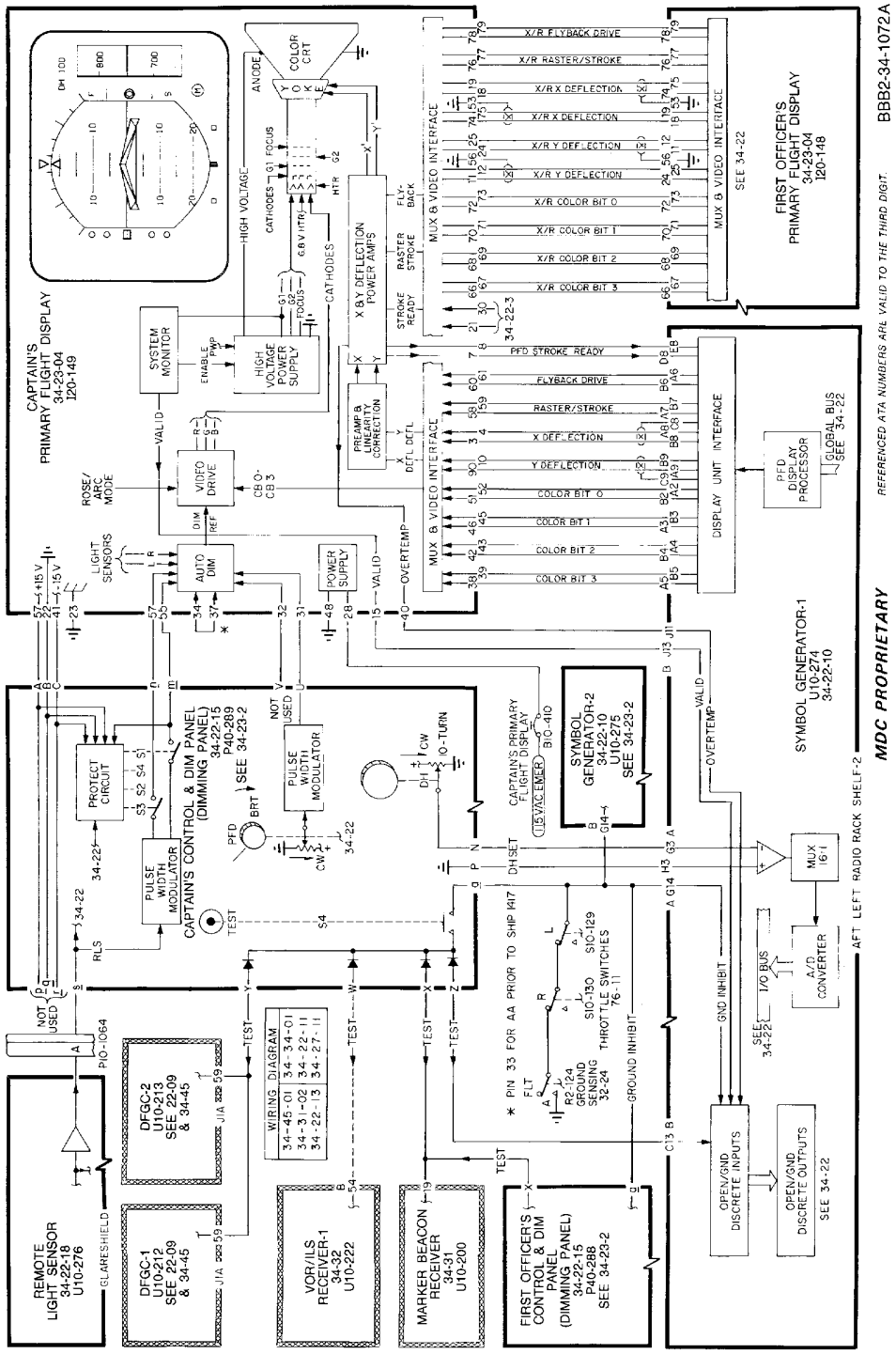
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05-2)	



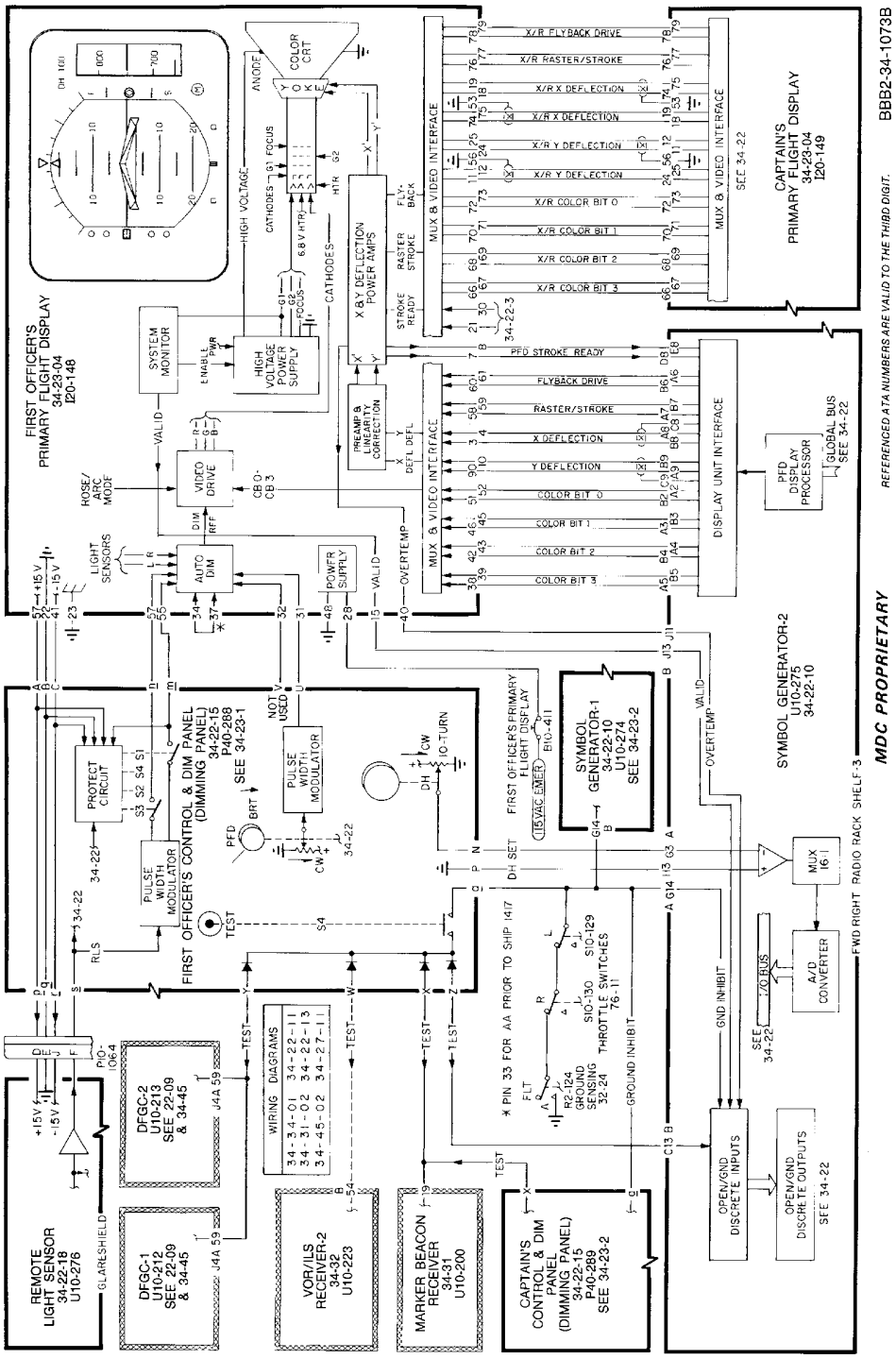
Attitude System-1 -- Schematic
Figure 101/34-23-00-990-872



Attitude System-2 -- Schematic
Figure 102/34-23-00-990-876



Primary Flight Display -1 -- Schematic
Figure 103/34-23-00-990-881



Primary Flight Display -2 -- Schematic
Figure 104/34-23-00-990-886

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude and interfacing systems are: vertical and directional gyros and two EFIS Primary Flight Displays (PFD) which display attitude.

E. The attitude system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
Directional Gyros Vertical Gyros	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are vertical and directional gyros, EFIS Symbol Generators, and EFIS Display Units.

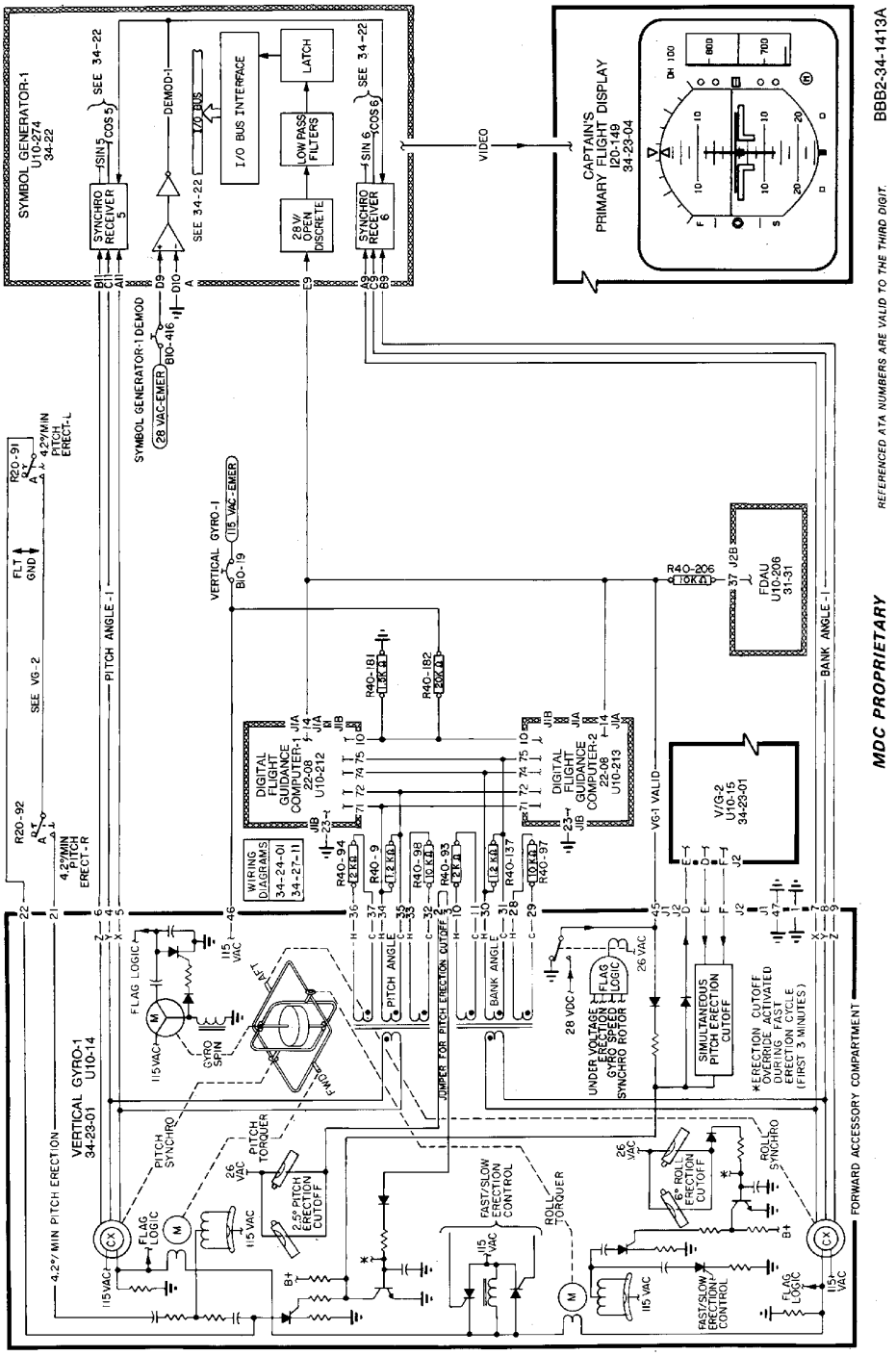
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

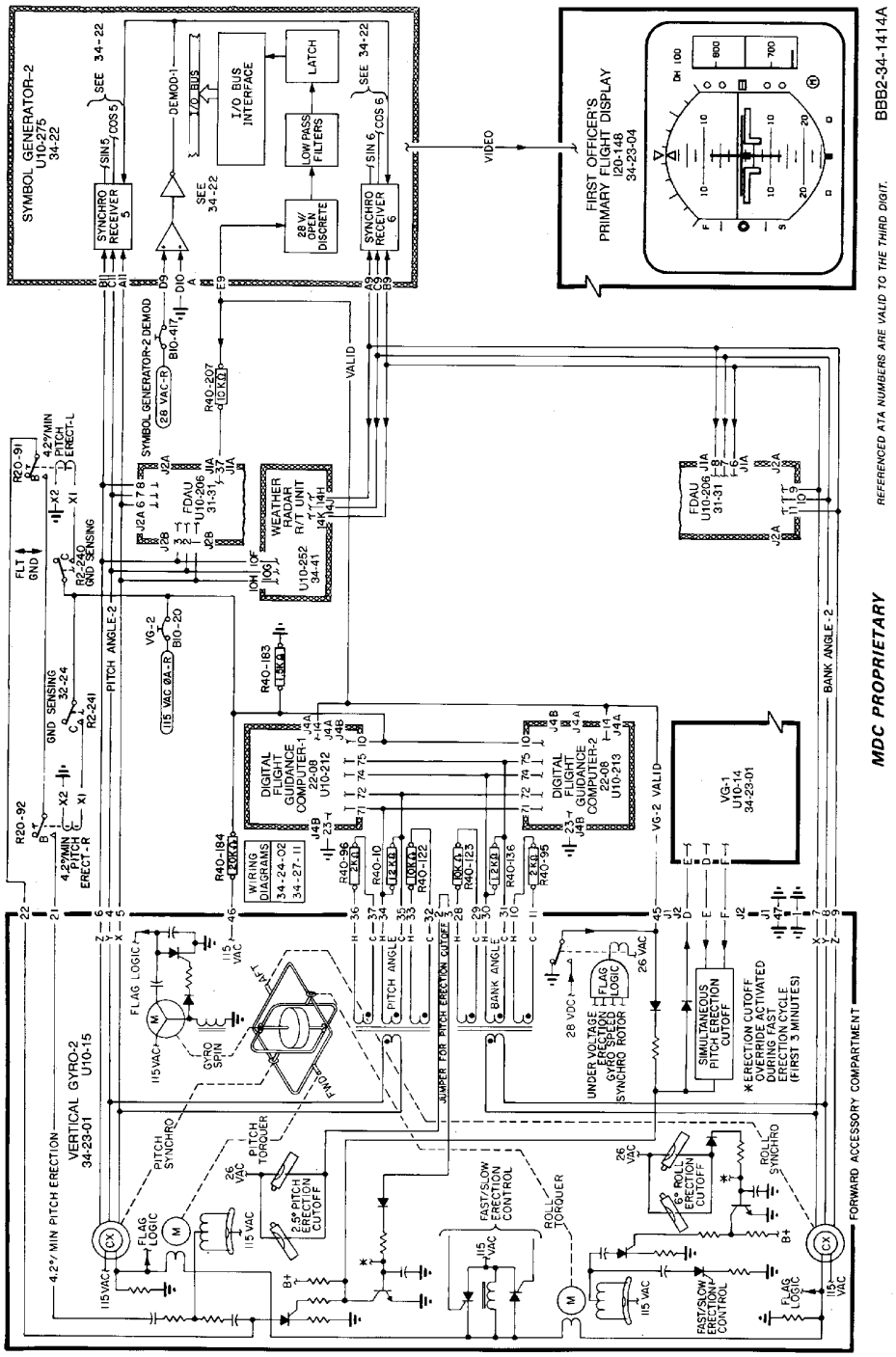
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

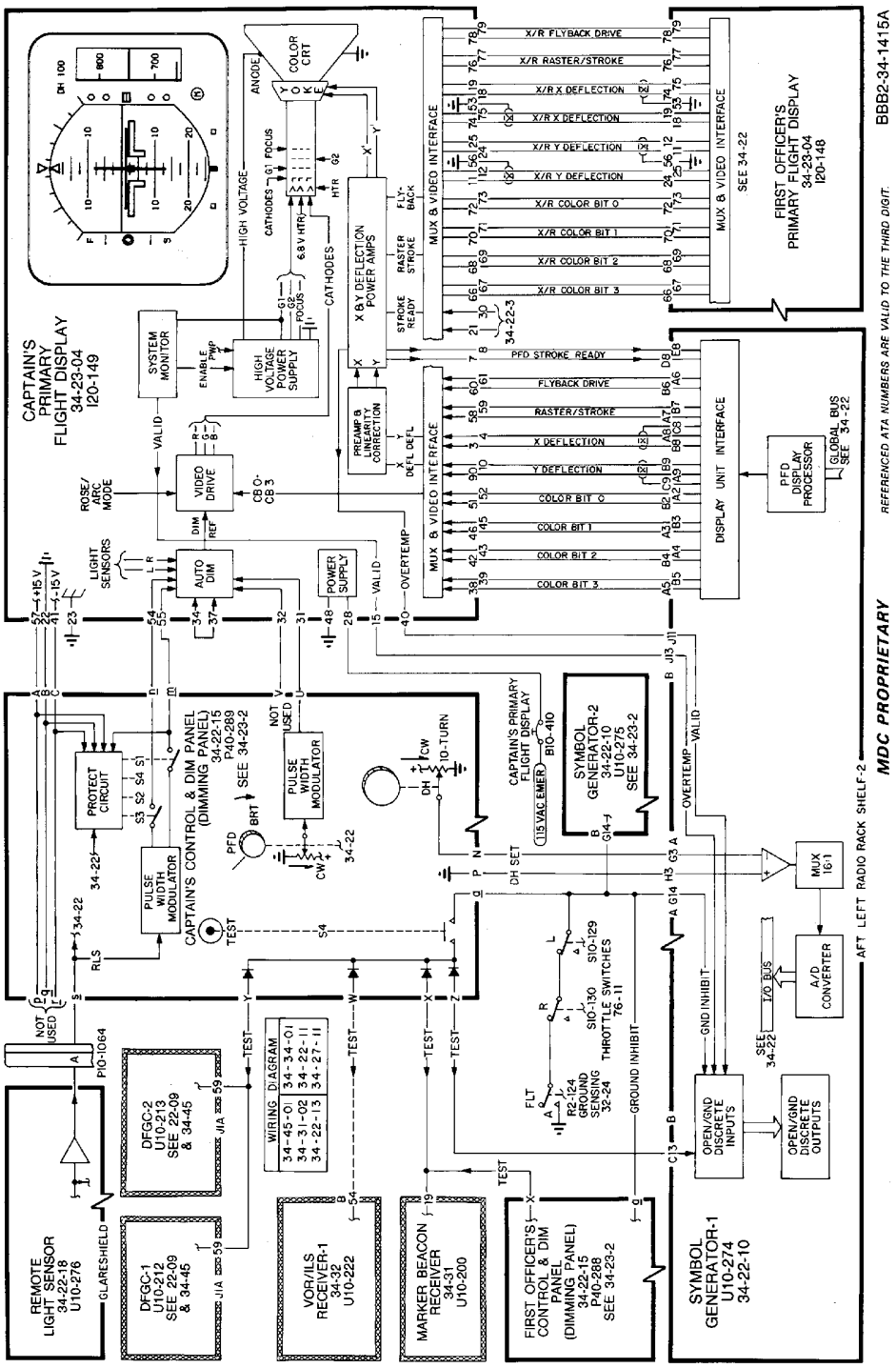
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.



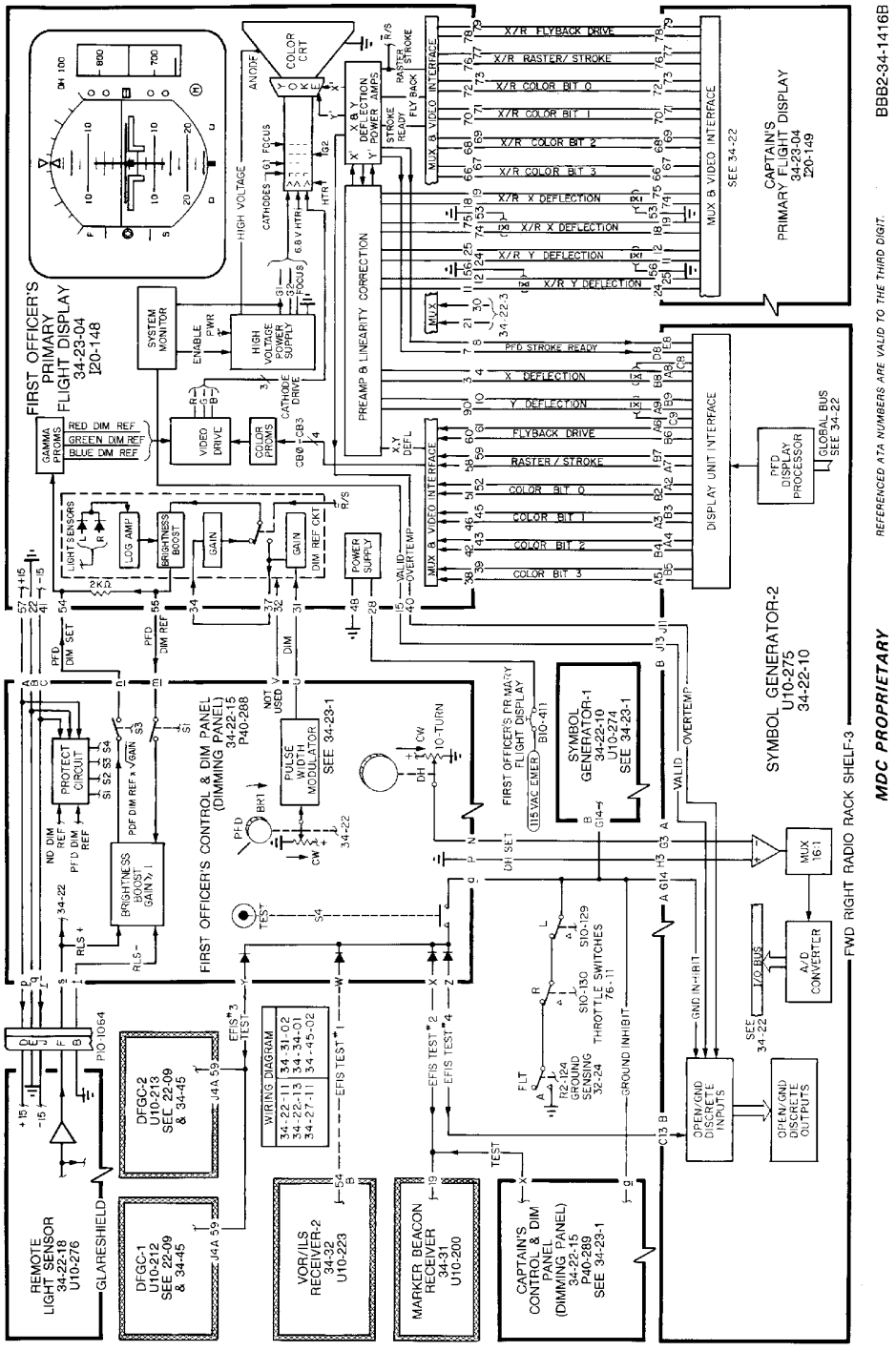
Attitude System-1 -- Schematic
Figure 101/34-23-00-990-890



Attitude System-2 -- Schematic
Figure 102/34-23-00-990-892



Primary Flight Display -1 -- Schematic
Figure 103/34-23-00-990-894



Primary Flight Display -2 -- Schematic
Figure 104/34-23-00-990-897

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the attitude and interfacing systems are: (3) attitude/heading reference units (AHRU), (2) EFIS Primary flight display (PFD), and an attitude/heading switching unit (AHSU).

E. The attitude system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Displays (PFD)	Captain's and First Officer's Instrument Panels
AHRS-1, -2, and -3	Forward Accessory Compartment
Attitude/Heading Switching Unit	Electrical/Electronics Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are attitude/heading reference units, EFIS Primary flight displays, and attitude/heading switching unit.

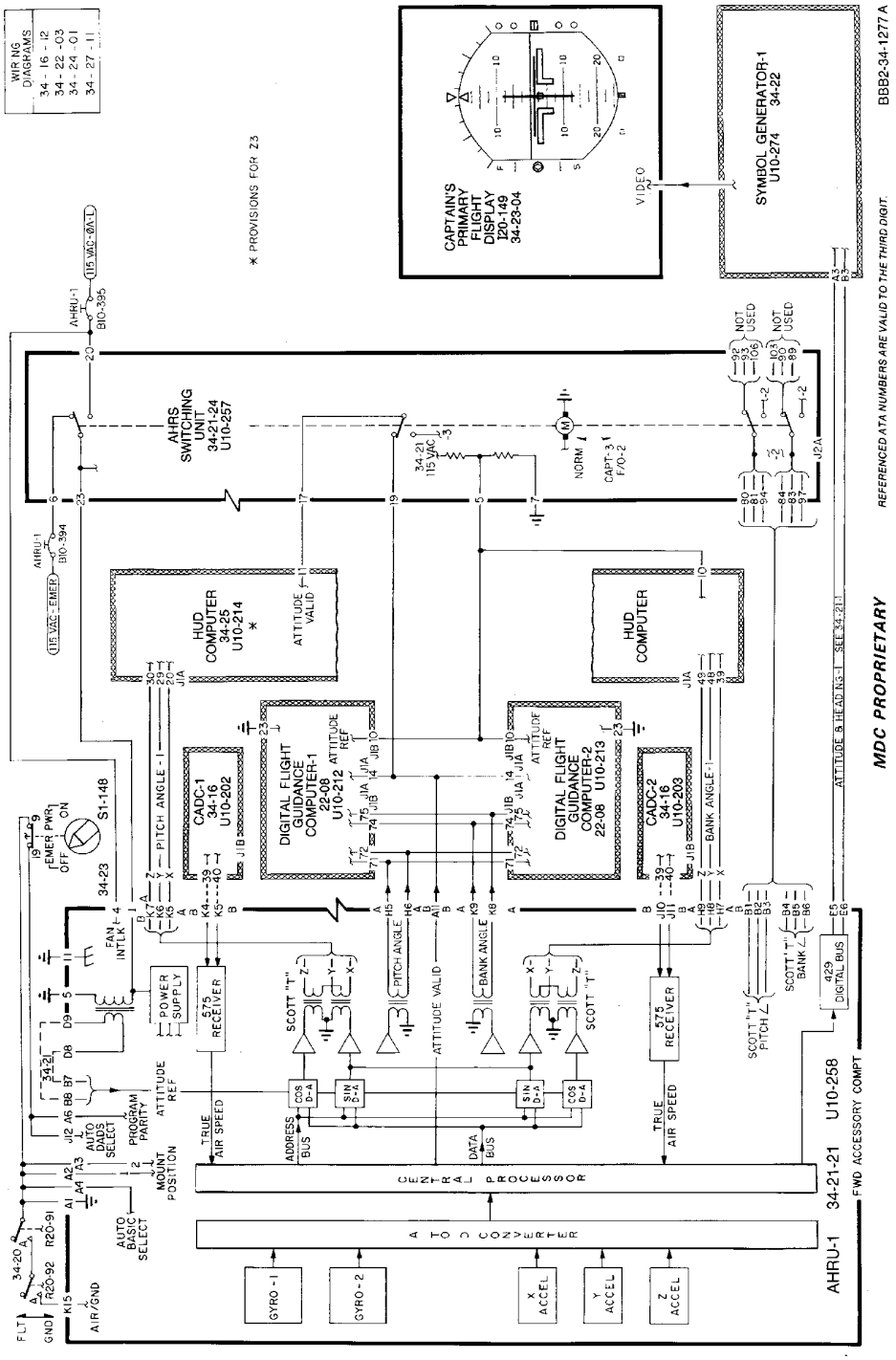
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

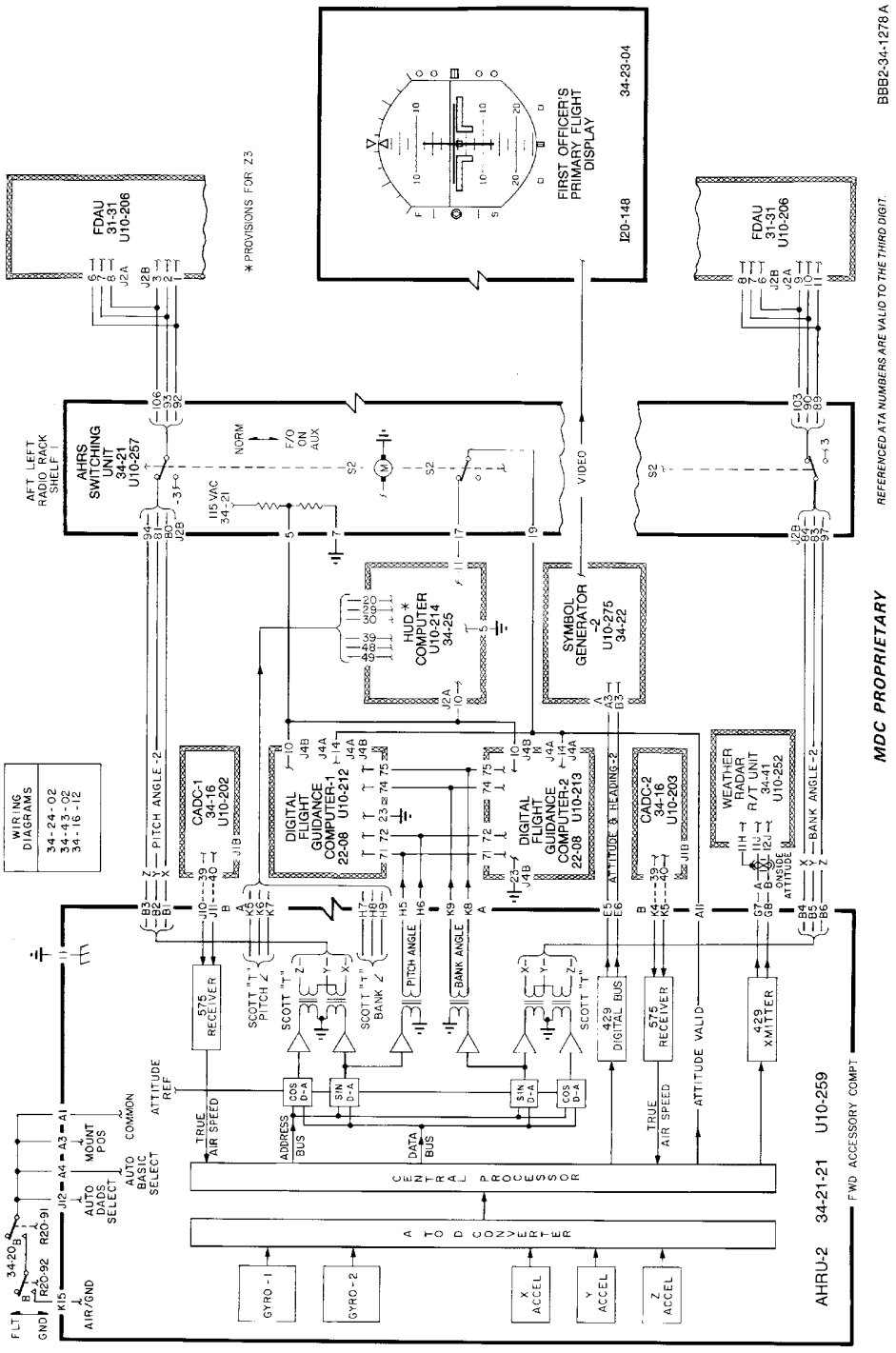
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

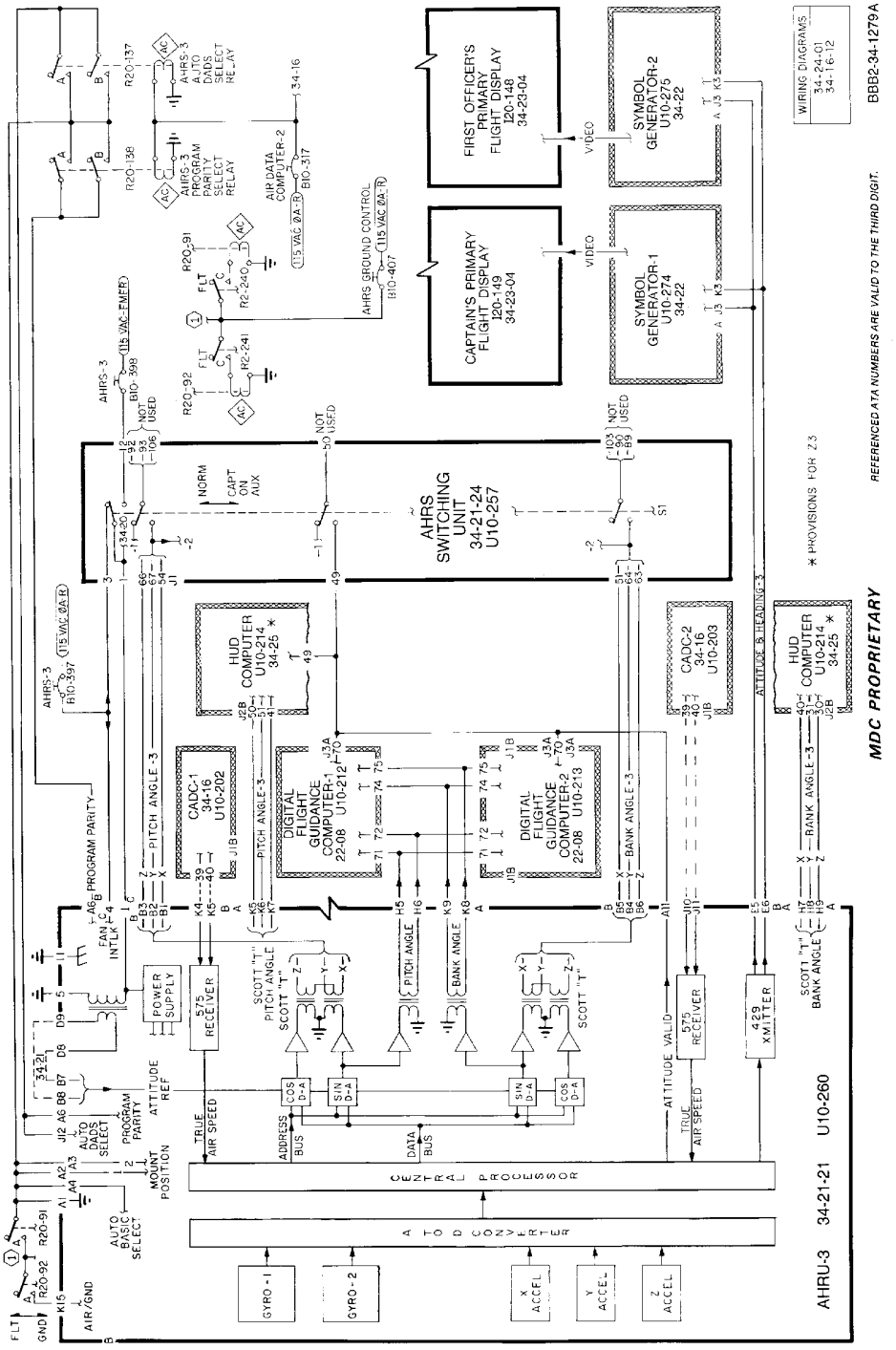
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
(6)	Switch AHRUs through AHRS switch on captain's instrument panel to check for faulty AHRU.	Replace faulty AHRU.
(7)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05)	



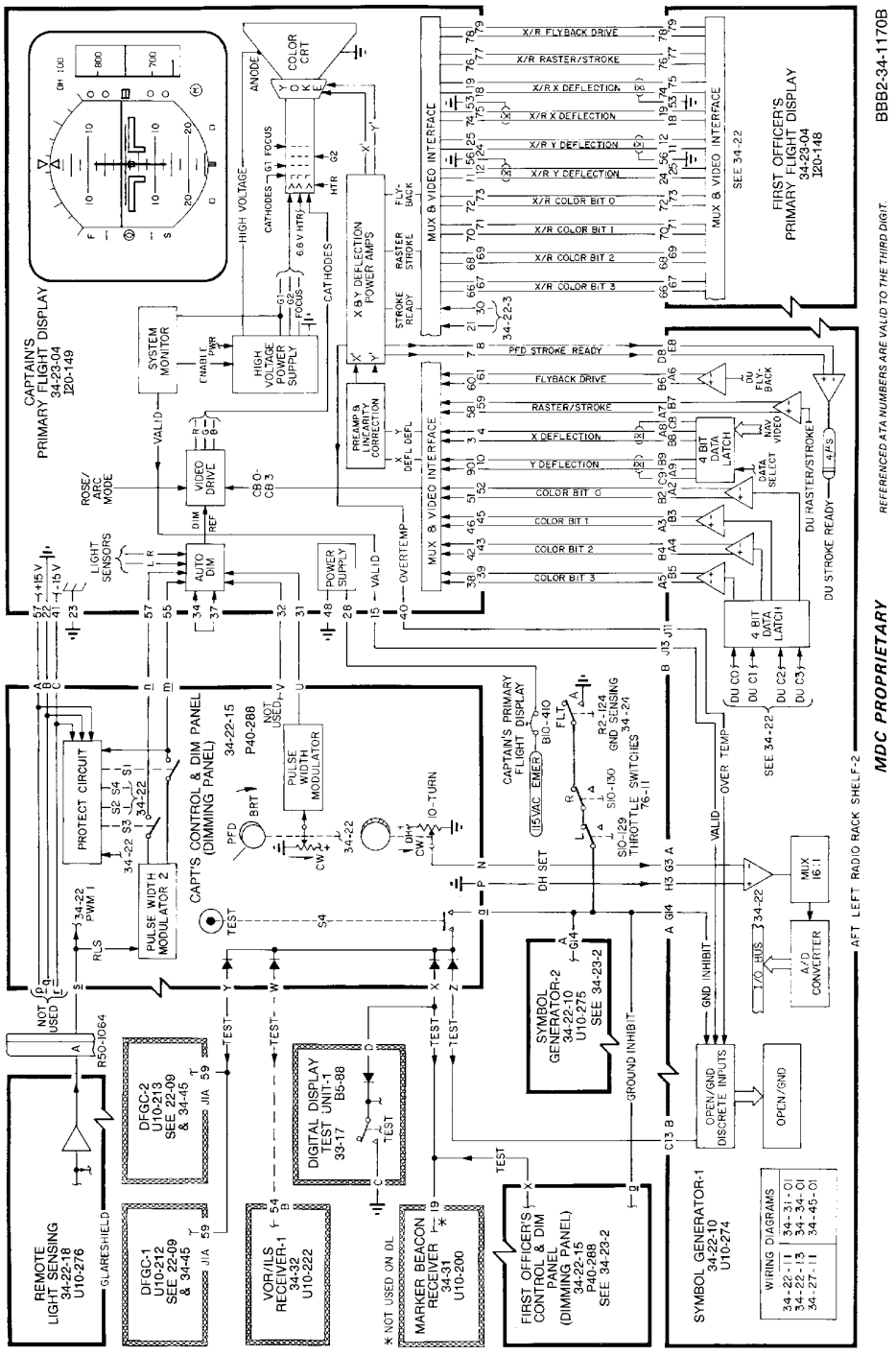
Attitude System-1 -- Schematic
Figure 101/34-23-00-990-914



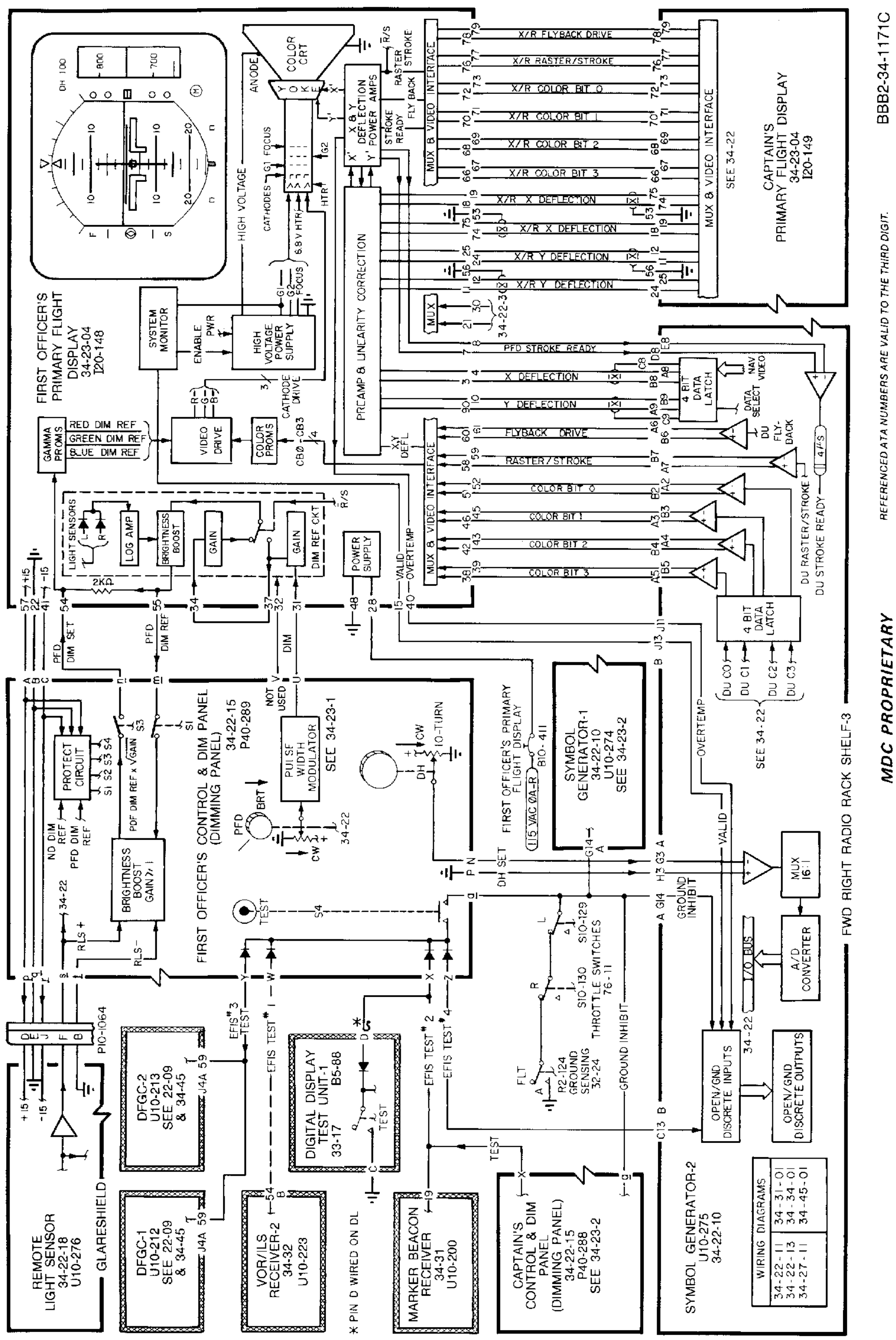
Attitude System-2 -- Schematic
Figure 102/34-23-00-990-915



Attitude System-3 -- Schematic
Figure 103/34-23-00-990-916



Primary Flight Display -1 -- Schematic
Figure 104/34-23-00-990-917



Primary Flight Display -2 -- Schematic
Figure 105/34-23-00-990-918

ATTITUDE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty attitude system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic component of the attitude system is two EFIS Primary Flight Displays (PFD) which display attitude. The Inertial Reference System (IRS) components interface with the attitude system.

E. The attitude system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
EFIS Symbol Generators	Electrical/Electronics Compartment
IRS - Inertial Reference -1 and -2 Units (IRU) (Interfacing System)	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting Attitude System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS Symbol Generators and EFIS Primary Flight Displays (PFD's).

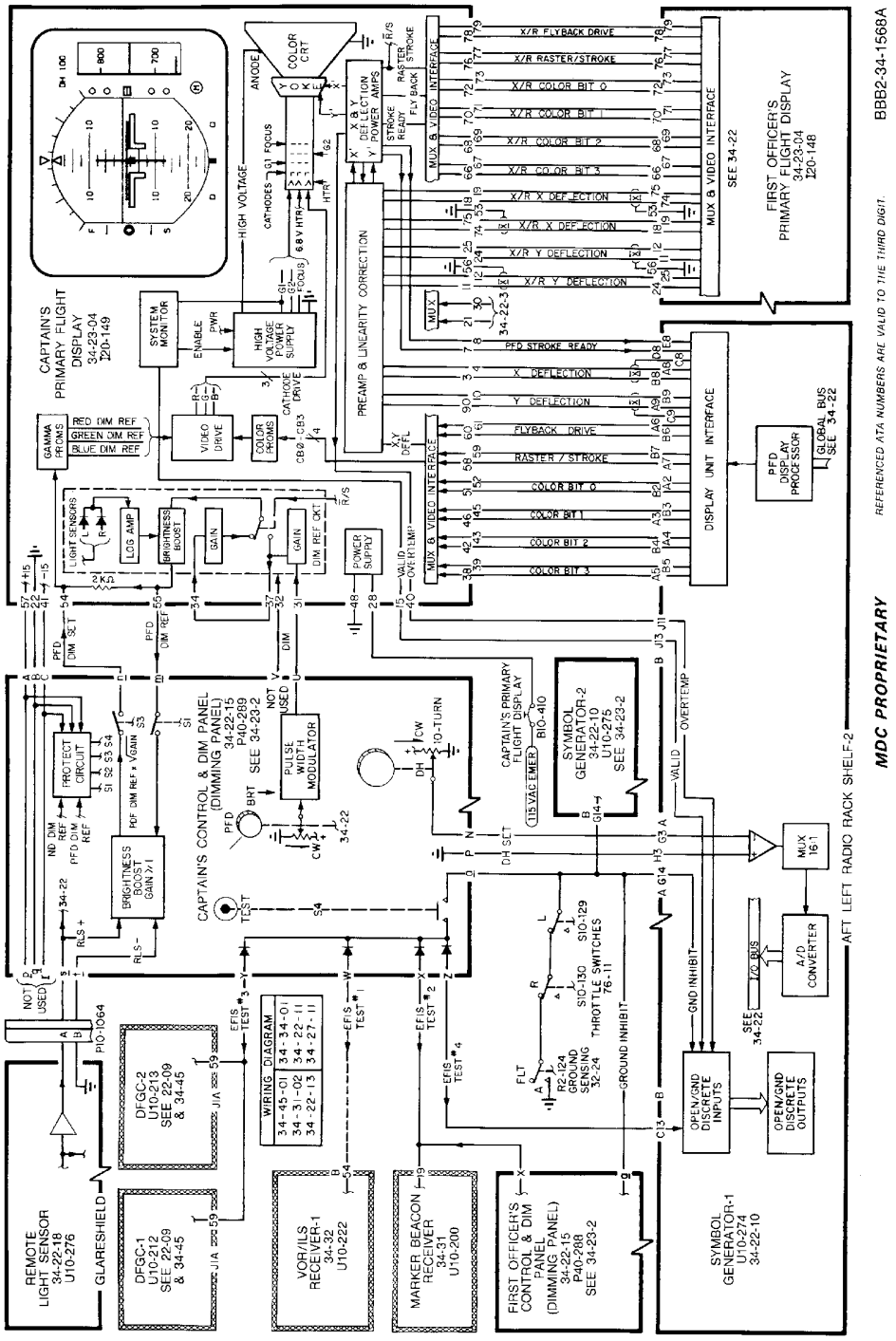
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

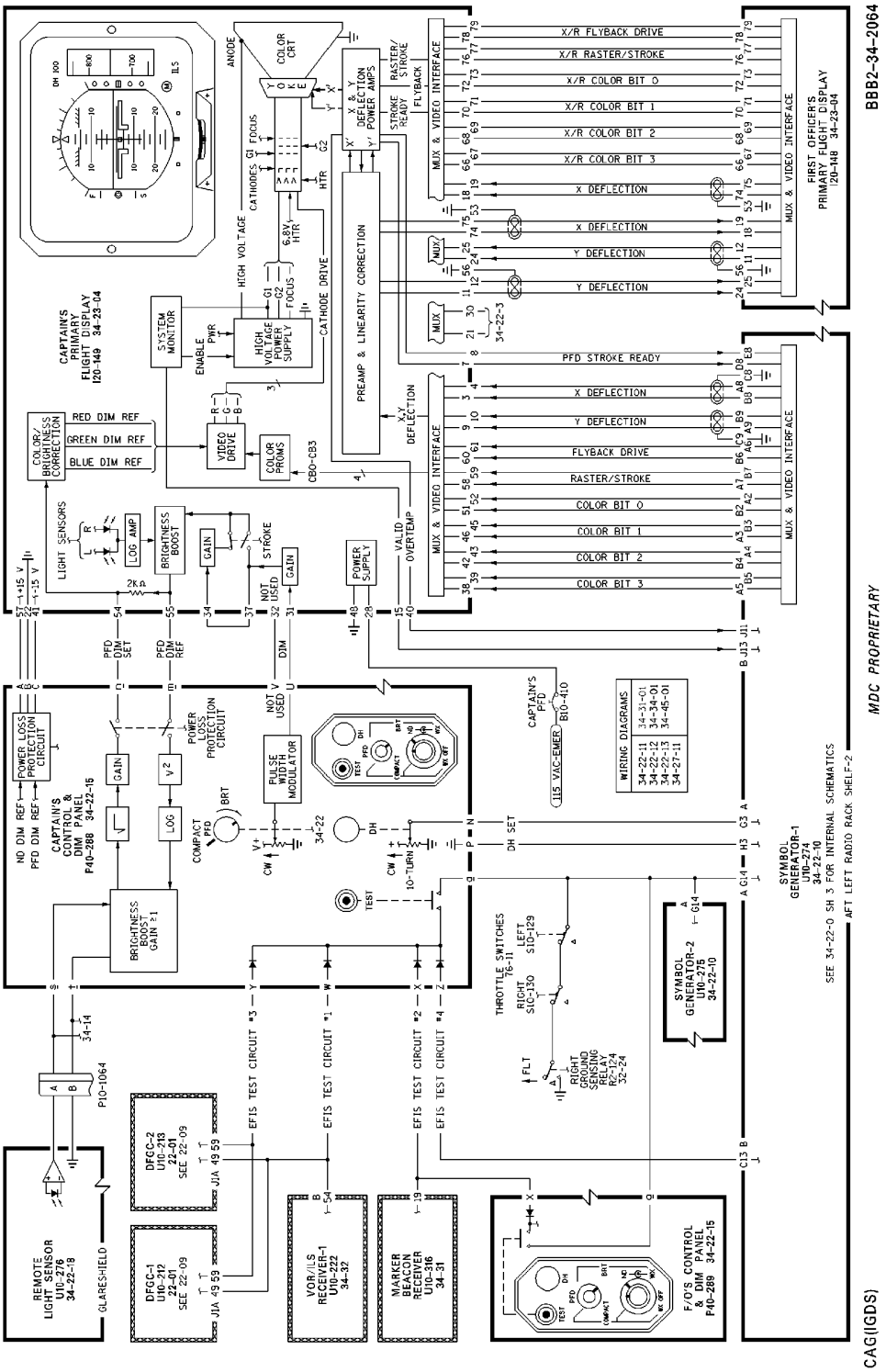
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 103 (Continued)

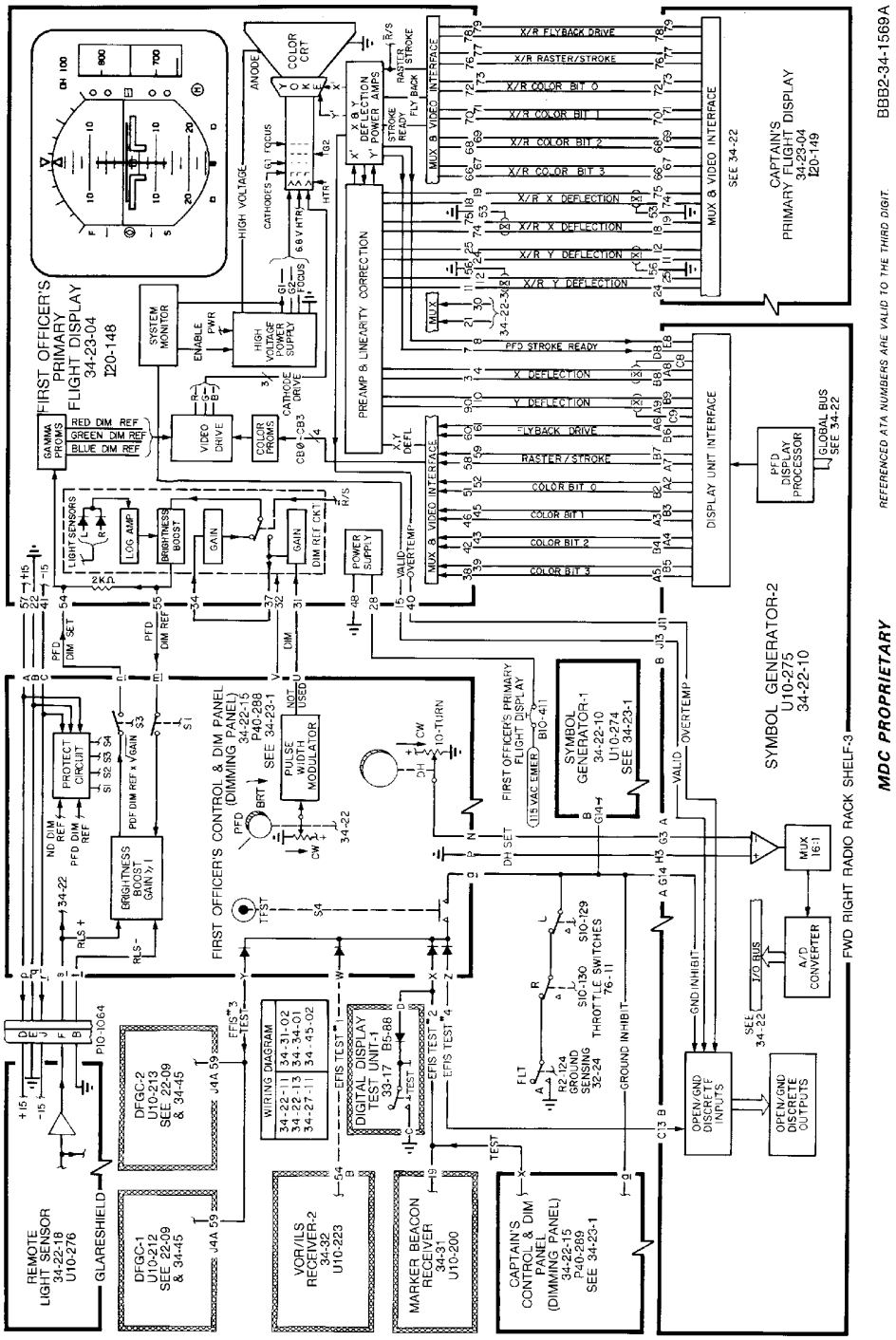
Procedure		Correction
(4)	In dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 201)	



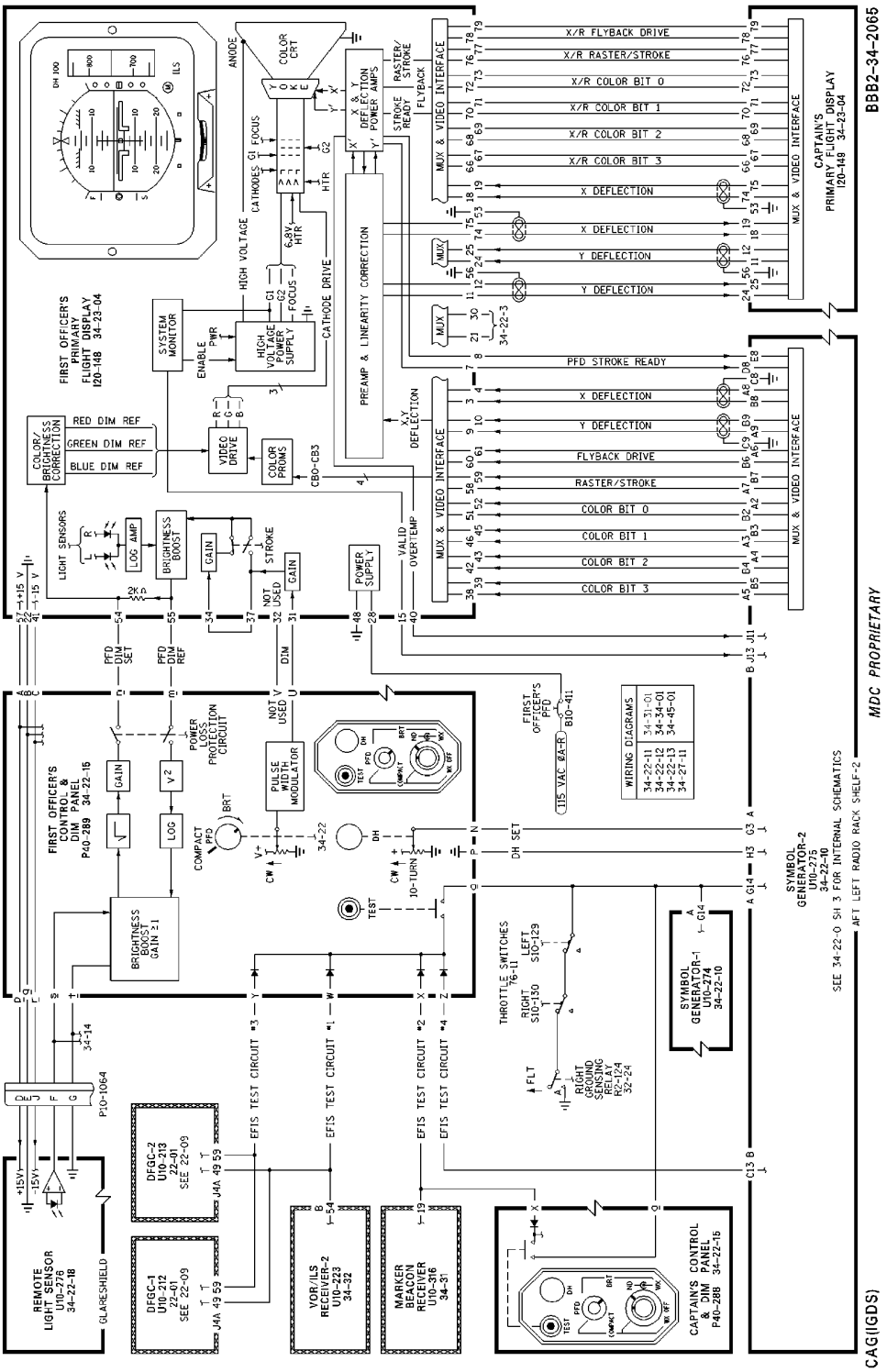
Primary Flight Display -1 -- Schematic
Figure 101/34-23-00-990-904



Primary Flight Display -1 -- Schematic
Figure 102/34-23-00-990-906



Primary Flight Display -2 -- Schematic
Figure 103/34-23-00-990-908



Primary Flight Display -2 -- Schematic
Figure 104/34-23-00-990-910

ATTITUDE SYSTEM - MAINTENANCE PRACTICES

1. General

A. The attitude system is the primary flight system for sensing and displaying aircraft pitch and roll attitude. The system consists of two vertical gyros (VGs) and two attitude direction indicators (ADIs). The vertical gyro senses pitch and roll attitudes which are transmitted to control differential synchros which drive the sphere in the ADI.

2. Adjustment/Test Attitude System

A. Test Attitude System

Table 201

CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.

	Operation	Desired Result
(1)	Energize aircraft electrical buses and allow 5 minutes for system warmup and for gyros to erect.	ATT flag on ADI's should disappear from view within 5 minutes.
(2)	On Overhead Circuit Breaker panel, open VERTICAL GYRO-1 circuit breaker.	ATT flag on captain's ADI comes into view.
(3)	Close VERTICAL GYRO-1 circuit breaker.	ATT flag on captain's ADI goes out of view.
(4)	On RIGHT RADIO BUS section of Upper EPC Circuit Breaker panel, open VERTICAL GYRO-2 circuit breaker.	ATT flag on first officer's ADI comes into view.
(5)	Close VERTICAL GYRO-2 circuit breaker.	ATT flag on first officer's ADI goes out of view.
(6)	On captain's ADI, press TEST button to activate self-test circuit.	Attitude sphere will simultaneously indicate a change in attitude indication of 20 (±5) degrees right bank and 10 (±5) degrees pitchup, with ATT flag in view.
(7)	Repeat step (6) for first officer's ADI.	Results same as step (6).
(8)	Return aircraft to required configuration.	

ATTITUDE SYSTEM - MAINTENANCE PRACTICES

1. General

A. The attitude system is the primary flight system for sensing and displaying aircraft pitch and roll attitude. The system consists of two vertical gyros (VGs) and two attitude direction indicators (ADIs). On aircraft with EFIS, the ADIs are replaced by the EFIS system primary flight displays (PFDs). The vertical gyro senses pitch and roll attitudes which are transmitted to control differential synchros which drive the sphere in the ADI. On aircraft with EFIS, vertical gyro pitch and roll attitudes are transmitted to the EFIS symbol generators to provide display on the PFD's.

2. Adjustment/Test Attitude System

A. Test Attitude System (Aircraft with ADI's)

CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.

Table 201

	Operation	Desired Result
(1)	Energize aircraft electrical buses and allow 5 minutes for system warmup and for gyros to erect.	ATT flag on ADI's should disappear from view within 5 minutes.
(2)	On overhead circuit breaker panel, open VERTICAL GYRO-1 circuit breaker.	ATT flag on Captain's ADI comes into view.
(3)	Close VERTICAL GYRO-1 circuit breaker.	ATT flag on captain's ADI goes out of view.
(4)	On RIGHT RADIO BUS section of upper EPC circuit breaker panel, open VERTICAL GYRO-2 circuit breaker.	ATT flag on first officer's ADI comes into view.
(5)	Close VERTICAL GYRO-2 circuit breaker.	ATT flag on first officer's ADI goes out of view.
(6)	On captain's ADI, press TEST button to activate self-test circuit.	Attitude sphere will simultaneously indicate a change in attitude indication of 20(±5) degrees right bank and 10(±5) degrees pitchup, with ATT flag in view.
(7)	Repeat step (6) for first officer's ADI.	Results same as step (7).
(8)	Return aircraft to required configuration.	

B. Test Attitude System (Aircraft with EFIS)

Table 202

	Operation	Desired Result
(1)	Energize aircraft electrical buses and allow 5 minutes for system warmup and for gyros to erect.	ATT FAIL message on PFD's should go blank within 5 minutes, and AUX GYRO INOP light on overhead switch panel should be off.

CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.

Table 202 (Continued)

Operation		Desired Result
(2)	On overhead circuit breaker panel, open VERTICAL GYRO-1 circuit breaker.	ATT FAIL message appears on captain's PFD.
(3)	Close VERTICAL GYRO-1 circuit breaker.	ATT FAIL mesage on captain's PFD goes blank.
(4)	On RIGHT RADIO BUS section of upper EPC circuit breaker panel, open VERTICAL GYRO-2 circuit breaker.	ATT FAIL message appears on first officer's PFD.
(5)	Close VERTICAL GYRO-2 circuit breaker.	ATT FAIL message on first officer's PFD goes blank.
(6)	Return aircraft to required configuration.	

ATTITUDE SYSTEM - MAINTENANCE PRACTICES

1. General

NOTE: After avionics upgrade mod, the term ADI is replaced by EFIS Primary Flight Display (PFD).

WJE 881, 883

A. The attitude system is the primary flight system for sensing and displaying aircraft pitch and roll attitude. The system consists of two vertical gyros (VG), and two attitude direction indicators (ADI). The vertical gyro senses pitch and roll attitudes which are transmitted to control differential synchros which drive the sphere in the ADI.

WJE 405, 409, 410, 880, 881, 883, 884

B. The attitude system is the primary flight system for sensing and displaying aircraft pitch and roll attitude. The system consists of three vertical gyros (VG) and an attitude switching unit (ASU). Attitude is displayed on the ADI or EFIS Primary Flight Display (PFD). The VG provides pitch and roll attitude data directly to the digital flight guidance computers and, through the ASU, provides attitude data to the weather radar R/T unit, weather radar antenna, FDAU, and on EFIS equipped aircraft, EFIS Symbol Generators (SG).

C. The ASU switching unit is controlled from a VERT GYRO transfer switch (placarded VERT GYRO) on the overhead switch panel. When the transfer switch is in NORM position, the captain's system receives data from VG-1, and the first officer's system from VG-2. Placing the VERT GYRO switch in other than NORM position, causes either Captain's or First Officer's system to receive signals from the auxiliary VG. An AUX GYRO INOP annunciator light, adjacent to the VERT GYRO switch, will come on to denote a failure in the AUX VG, and warn the operator not to switch out of normal instrumentation.

2. Adjustment/Test Attitude System

A. Test Attitude System

NOTE: The following test combines aircraft with 2 VG's and 3 VG's. Also combined are aircraft with and without EFIS equipment.

Table 201

Step	Operation	Desired Result
(1)	On overhead switch panel, set VERT GYRO switch to NORM position.	
(2)	Energize aircraft electrical buses and allow 5 minutes for system warmup and for gyros to erect.	ATT FAIL message on PFD's or ATT flag on ADI's should go blank within 5 minutes, and if installed, AUX GYRO INOP light on overhead switch panel should be off.
CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.		
(3)	On EMERGENCY AC BUS section of Overhead Circuit Breaker panel, open VERTICAL GYRO-1 circuit breaker.	ATT FAIL message appears on captain's PFD or ATT flag on ADI comes into view.
(4)	Close VERTICAL GYRO-1 circuit breaker.	ATT FAIL mesage on captain's PFD goes blank or ATT flag on ADI goes out of view.

Table 201 (Continued)

Step	Operation	Desired Result
(5)	On RIGHT RADIO BUS section of Upper EPC Circuit Breaker panel, open VERTICAL GYRO-2 circuit breaker.	ATT FAIL message appears on first officer's PFD or ATT flag on ADI comes into view.
(6)	Close VERTICAL GYRO-2 circuit breaker.	ATT FAIL message on first officer's PFD goes blank or ATT flag on ADI goes out of view.
NOTE: Step (7) only applicable to non-EFIS aircraft.		
(7)	On captain's ADI, press TEST button to activate self-test circuit.	Attitude sphere will simultaneously indicate a change in attitude indication of 20(±5) degrees right bank and 10(±5) degrees pitchup, with ATT flag in view.

B. Test Vertical Gyro Switching

Table 202

Step	Operation	Desired Result
(1)	On overhead switch panel, make sure that AUX GYRO INOP annunciator light is off.	Auxiliary vertical gyro on and operating properly.
(2)	On overhead switch panel, set attitude transfer switch to L ON AUX position.	Due to switching transient time, ATT FAIL message on captain's ADI/PFD may appear momentarily, and then ATT3 should be displayed.
(3)	On overhead switch panel, set attitude transfer switch to R ON AUX position.	Due to switching transient time, ATT FAIL message on first officer's ADI/PFD may appear momentarily, and then ATT3 should be displayed.
(4)	On overhead switch panel, set attitude transfer switch to NORM position.	
(5)	Return aircraft to required configuration.	

ATTITUDE - MAINTENANCE PRACTICES

1. General

A. The attitude system and the interfacing attitude and heading reference system (AHRS) are the primary flight systems for sensing and displaying aircraft pitch and roll attitude. The system consists of two attitude/heading reference units (AHRUs) and two radio direction magnetic indicators (RDMIs). The AHRUs sense pitch and roll attitudes. The pitch and roll information is sent to the EFIS symbol generators which effect attitude and direction display on the EFIS Primary flight display (PFD) and navigation display (ND).

2. Adjustment/Test Attitude System

A. Test Attitude System

Table 201

Operation	Desired Result
(1) Place the selector switch on the EFIS mode control panel (MDP) in the ROSE mode position.	
(2) Energize aircraft electrical buses and allow one minute for system to align.	ATT FAIL display on captain's and F/O's PFD and HDG FAIL display on Captain's and F/O's ND should not be in view within 45 seconds. Captain's and F/O's RDMI heading flag should be out of view. Captain's and F/O's PFD roll should agree within 0°(±5°), pitch 0°(±2.5°). Horizon and heading displays should be steady.
(3) Make certain two AHRS basic lights on overhead annunciator panel are not on.	Lights not on.
NOTE: If lights do not go out, cycle AHRS circuit breakers.	
(4) Place selector switch on front panel of each CADC to FUNCTION TEST and press and hold self-test buttons.	CADC-1 and CADC-2 in self-test mode.
(5) Cycle AHRS-1 and -2 circuit breakers.	
NOTE: Steps (5) through (10) must be completed within 3 minutes.	
(6) Open left and right ground control relay circuit breakers.	
(7) On overhead annunciator panel, make certain that AHRS-1 and 2 basic lights are not on after 15 seconds from step (6).	Basic lights not on.
(8) Place emergency power switch ON.	
(9) Release CADC-2 self-test button and make certain that AHRS 2 basic light does come on.	AHRS-2 basic light on.
(10) Release CADC-1 self-test button and make certain that AHRS-1 basic light comes on after 5 seconds.	AHRS-1 basic light on.
(11) Return aircraft to required configuration.	

ATTITUDE - MAINTENANCE PRACTICES

1. General

A. The attitude system and the interfacing attitude and heading reference system are the primary flight systems for sensing and displaying aircraft pitch and roll attitude. The systems consist of three attitude/heading reference units (AHRU), an attitude/heading switching unit (AHSU), and two radio magnetic indicators (RMIs). The AHRU senses pitch and roll attitudes which are processed through the EFIS symbol generators to provide pitch and roll on the EFIS primary flight displays (PFD) and direction on the EFIS navigation displays (NDs).

B. The AHSU is controlled from an AHRS transfer switch (placarded AHRS) on the overhead panel. When the transfer switch is in NORM position, the captain's system receives data from AHRS-1, and the first officer's system from AHRS-2. Placing the AHRS switch in other than normal position, causes either Captain's or First Officer's system to receive signals from AHRS-3. An AHRS-3 INOP annunciator light, on the overhead annunciator panel, will come on to denote a failure in AHRS-3, and warn the operator not to switch out of normal instrumentation.

2. Adjustment/Test Attitude System

A. Test Attitude System

Table 201

Operation	Desired Result
(1) On overhead panel, place AHRS switch to NORM position.	
(2) Place selector switch on EFIS mode control panel (MCP) to ROSE mode position.	
(3) Energize aircraft electrical buses and allow 45 seconds for system warmup.	ATT FAIL display on Captain's and F/O's PFD and HDG FAIL display on Captain's and F/O's ND should not be in view within 45 seconds. RMI heading flag should be out of view. Captain's and F/O's PFD roll should agree within 0°(±5°), pitch 0°(±2.5°). Horizon and heading displays should be steady.
(4) Check that three AHRS basic lights on overhead annunciator panel are not on.	Lights not on.
NOTE: If lights not out, cycle AHRS circuit breakers.	
(5) Place AHRS switch on overhead switch panel to LEFT ON AUX position.	No ATT FAIL on Capt. and F/O PFD. No HDG FAIL on Capt. and F/O ND. Heading flags on Capt. and F/O RMIs remain out of view.
(6) Return AHRS switch on overhead switch panel to center position.	No ATT FAIL on Capt. and F/O PFD. No HDG FAIL on Capt. and F/O ND. Heading flags on Capt. and F/O RMIs remain out of view.
(7) Place AHRS switch on overhead switch panel to RIGHT ON AUX position.	No ATT FAIL on Capt. and F/O PFD. No HDG FAIL on Capt. and F/O ND. Heading flags on Capt. and F/O RMIs remain out of view.
(8) Return AHRS switch on overhead switch panel to center position.	No ATT FAIL on Capt. and F/O PFD. No HDG FAIL on Capt. and F/O ND. Heading flags on Capt. and F/O RMIs remain out of view.
(9) Select FUNCTION TEST on front panel of each CADC and press and hold self-test buttons.	CADC-1 and CADC-2 self-test mode.

Table 201 (Continued)

Operation	Desired Result
NOTE: Steps (10) through (15) must be completed within 3 minutes.	
(10) Cycle AHRS-1, 2 and 3 circuit breakers.	
(11) Open left and right ground control relay circuit breakers.	Breakers open.
(12) On overhead annunciator panel, check that AHRS-1, 2 and 3 basic lights are not on after 15 seconds from step (11).	Basic lights not on.
(13) Place emergency power switch to ON.	EMER PWR on.
(14) Release CADC-2 self-test button and check that AHRS-1 basic light does not come on, AHRS 2, 3 basic lights do come on after 5 seconds of self-test button release.	AHRS 2, 3 basic lights on.
(15) Release CADC-1 self-test button and check that AHRS-1 basic light comes on after 5 seconds.	AHRS 1 light on.
(16) Open AHRS-3 circuit breaker on upper EPC.	
(17) Check that AHRS-3 INOP light on overhead annunciator panel comes on.	AHRS 3 INOP on.
(18) Press and hold in CADC-1 self-test button.	
(19) Close AHRS-3 circuit breaker.	ARHS 3 INOP not on.
(20) Open CADC-2 115 VAC circuit breaker.	
(21) Check that AHRS-3 basic light is not on after 5 seconds from step (20) and when over 15 seconds have elapsed from step (19).	AHRS-3 basic light not on.
(22) Release CADC-1 self-test button.	
(23) Return aircraft to required configuration.	

ATTITUDE SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

WJE 406

TASK 34-23-00-710-801

2. Operational Check of the Attitude/Heading Reference System (AHRS) Switching

A. Operational Check of the Attitude Heading Reference System (AHRS) Switching

SUBTASK 34-23-00-710-001

(1) On overhead panel, place AHRS switch to NORM position.

(2) Place selector switch on EFIS mode control panel (MCP) to ROSE mode position.

(3) Energize aircraft electrical buses and allow 45 seconds for system warm-up.

(a) ATT FAIL display on Captain's and F/O's PFD and HDG FAIL display on Captain's and F/O's ND should not be in view within 45 seconds.

(b) RMI heading flag should be out of view.

(c) Captain's and F/O's PFD roll should agree within 0°(±5°), pitch 0°(±2.5°).

(d) Horizon and heading displays should be steady.

(4) Check that three AHRS basic lights on overhead annunciator panel are not on.

NOTE: If lights not out, cycle AHRS circuit breakers.

(5) Place AHRS switch on overhead switch panel to LEFT ON AUX position.

(a) No ATT FAIL on Capt. and F/O PFD.

(b) No HDG FAIL on Capt. and F/O ND.

(c) Heading flags on Capt. and F/O RMIs remain out of view.

(6) Return AHRS switch on overhead switch panel to center position.

(a) No ATT FAIL on Capt. and F/O PFD.

(b) No HDG FAIL on Capt. and F/O ND.

(c) Heading flags on Capt. and F/O RMIs remain out of view.

(7) Place AHRS switch on overhead switch panel to RIGHT ON AUX position.

(a) No ATT FAIL on Capt. and F/O PFD.

(b) No HDG FAIL on Capt. and F/O ND.

(c) Heading flags on Capt. and F/O RMIs remain out of view.

(8) Return AHRS switch on overhead switch panel to center position.

(a) No ATT FAIL on Capt. and F/O PFD.

(b) No HDG FAIL on Capt. and F/O ND.

(c) Heading flags on Capt. and F/O RMIs remain out of view.

B. Job Close-up

SUBTASK 34-23-00-840-001

(1) Return aircraft to required configuration.

END OF TASK

WJE 406 (Continued)

TASK 34-23-00-710-802

3. Operational Check of the AUX Attitude/Heading Reference System (AHRS) Inoperative Indication

A. Prepare for Operational Check of the AUX Attitude Heading Reference System (AHRS) Inoperative Indication

SUBTASK 34-23-00-860-001

(1) On overhead panel, place AHRS switch to NORM position.

(2) Place selector switch on EFIS mode control panel (MCP) to ROSE mode position.

(3) Energize aircraft electrical buses and allow 45 seconds for system warm-up.

(a) ATT FAIL display on Captain's and F/O's PFD and HDG FAIL display on Captain's and F/O's ND should not be in view within 45 seconds.

(b) RMI heading flag should be out of view.

(c) Captain's and F/O's PFD roll should agree within 0°(±5°), pitch 0°(±2.5°).

(d) Horizon and heading displays should be steady.

(4) Check that three AHRS basic lights on overhead annunciator panel are not on.

NOTE: If lights not out, cycle AHRS circuit breakers.

B. Operational Check of the AUX Attitude Heading Reference System (AHRS) Inoperative Indication

SUBTASK 34-23-00-865-001

(1) Open AHRS-3 circuit breaker on upper EPC.

(2) Check that the AHRS-3 INOP light on the overhead annunciator panel come on.

SUBTASK 34-23-00-710-002

(3) Press and hold in CADC-1 self-test button. While holding the CADC-1 self-test button, do the following:

(a) Close AHRS-3 circuit breaker.

(b) Check that the AHRS-3 INOP light on the overhead annunciator panel is not on.

(c) Open CADC-2 115 VAC circuit breaker.

(d) Check that AHRS-3 basic light is not on after 5 seconds from step (3) (c) and when over 15 seconds have elapsed from step (3)(a).

(4) Release CADC-1 self-test button.

C. Job Close-up

SUBTASK 34-23-00-840-002

(1) Return the aircraft to required configuration.

——— END OF TASK ———

WJE 405, 409, 410, 880, 884

TASK 34-23-00-710-803

4. Operational Check of the Attitude Switching

A. Operational Check of the Attitude Switching

SUBTASK 34-23-00-860-002

(1) Make sure that you allow 5 minutes for system warm-up, and vertical gyro erection.

WJE 405, 409, 880, 884

SUBTASK 34-23-00-710-003

(2) Perform the operational check of the attitude switching (for NON EFIS aircraft);

(a) On overhead panel, make sure that the VERT GYRO switch is in the NORM position.

(b) Verify that ATT flags are not displayed on both ADI's. Pitch and bank angles should indicate attitude of aircraft.

(c) Open these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	05	B10-19	VERTICAL GYRO-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-364	VERTICAL GYRO-1

(d) Make sure that the ATT failure flag is visible in captain's ADI.

(e) Place the VERT GYRO switch in the L ON AUX position.

(f) The ATT flag must go out of view from the captain's ADI.

(g) Return the VERT GYRO switch to the NORM position.

(h) Close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	05	B10-19	VERTICAL GYRO-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	15	B10-364	VERTICAL GYRO-1

(i) The ATT flag must go out of view from the captain's ADI.

(j) Open this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-20	VERTICAL GYRO-2

(k) Make sure that the ATT failure flag is visible in first officer's ADI.

(l) Place the VERT GYRO switch in the R ON AUX position.

(m) The ATT flag must go out of view from the first officer's ADI.

(n) Return the VERT GYRO switch to the NORM position.

WJE 405, 409, 880, 884 (Continued)

(o) Close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-20	VERTICAL GYRO-2

(p) The ATT flag must not be in view from the first officer's ADI.

WJE 405, 409, 410, 880, 884

B. Job Close-up

SUBTASK 34-23-00-840-003

(1) Return the aircraft to required configuration.

——— END OF TASK ———

VERTICAL GYRO - TROUBLE SHOOTING

1. General

A. This section provides the trouble shooting procedure for the vertical gyro.

2. Trouble Shooting Vertical Gyro

A. Trouble Shoot

Table 101

Symptom	Potential Action
Yoke/Pitch Oscillations	Verify that the left and right generator frequencies are within 1 Hz of each other. (GENERATOR DRIVE - ADJUSTMENT/TEST, PAGEBLOCK 24-10-00/501) Ensure that the Attitude Switching Unit is correctly and securely installed.
If ATT 1, ATT 2 and ATT 3 all fail on the STP, but there was little to no operational impact in the Primary Flight Display.	Verify that the Attitude Switching Unit is properly seated (verify there are no obstructions in the tray) and that there are no loose pins in the connector.
If a Primary Flight Display goes blank.	Check the symbol generator and the display. Do not replace a gyroscope. (ATTITUDE SYSTEM, SUBJECT 34-23-00, Page 101, and NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101)
There was an autopilot disconnected or other autopilot anomaly, including failure to maintain altitude, but no indication of an attitude problem.	Trouble shoot the DFGC. (DFGS STATUS/TEST, SUBJECT 22-01-05, Page 501)

VERTICAL GYRO - MAINTENANCE PRACTICES

1. General

A. This procedure has the maintenance practice for the removal and installation and an operational test for the vertical gyro. The removal and installation procedures for the vertical gyros are similar.

B. The vertical gyros are located in the forward accessory compartment. Access is through the accessory compartment door located in the nosewheel well.

2. Equipment and Materials

NOTE: Equivalent substitutes (with applicable instructions) may be used instead of the following listed item:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Inconel Lockwire 0.020 in NASM20995N20, DPM 684	Not specified
Corrosion Resistant Steel Lockwire 0.020 in NASM20995C20, DPM 5865	Not specified
Dust caps, electrical connector MS90376	

3. Removal/Installation Vertical Gyro

CAUTION: DEPENDING ON THE ROTOR AND THE TYPE OF BEARINGS INSTALLED, ALLOW 15 TO 25 MINUTES FOR THE GYROS TO RUN DOWN BEFORE REMOVING THE UNIT. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE GIMBAL(S). USE CARE DURING THE REMOVAL TO PREVENT DAMAGE TO THE AIRFLOW SEAL. THE UNIT SHOULD BE TRANSPORTED IN ITS SHIPPING CONTAINER AT ALL TIMES.

A. Remove Vertical Gyro

WJE 405, 409, 410, 880, 884

NOTE: Vertical Gyro-1 must be removed first when removing AUX Gyro-3.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	05	B10-19	VERTICAL GYRO-1

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, POWER - LEFT AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
K	1	B1-128	LEFT TRANSFORMER RECTIFIER - 1 PHASE A
K	2	B1-129	LEFT TRANSFORMER RECTIFIER - 1 PHASE B
K	3	B1-130	LEFT TRANSFORMER RECTIFIER - 1 PHASE C

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	2	B10-20	VERTICAL GYRO-2

WJE 405, 409, 410, 880, 884

(2) If AUX Vertical Gyro to be removed, remove Vertical Gyro-1.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(3) Disconnect electrical connector.

(a) Install protective dust caps.

(4) Remove ground strap (if installed).

(5) Remove gyro mounting bolts.

CAUTION: DO NOT REMOVE VERTICAL GYRO FROM INSTALLATION MOUNT WHEN GYRO IS ROTATING. ALWAYS KEEP GYRO IN UPRIGHT POSITION AND HANDLE WITH CARE.

(6) Remove vertical gyro.

B. Install Vertical Gyro

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, POWER - LEFT AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
K	1	B1-128	LEFT TRANSFORMER RECTIFIER - 1 PHASE A
K	2	B1-129	LEFT TRANSFORMER RECTIFIER - 1 PHASE B
K	3	B1-130	LEFT TRANSFORMER RECTIFIER - 1 PHASE C

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	2	B10-20	VERTICAL GYRO-2

(2) Position vertical gyro on mounting bracket with directional arrow on cover pointing forward.

(3) Install mounting bolts.

(4) Install ground strap (if applicable).

(5) Remove protective dust caps and check connector for damage and unwanted material.

(6) Tighten connector hand tight to receptacle until they are mated with each other.

(7) Safety connector with lockwire. (LOCKWIRE SAFETYING - MAINTENANCE PRACTICES, PAGEBLOCK 20-10-18/201)

WJE 405, 409, 410, 880, 884

(8) If removed, install Vertical Gyro-1.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(9) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, POWER - LEFT AC BUS

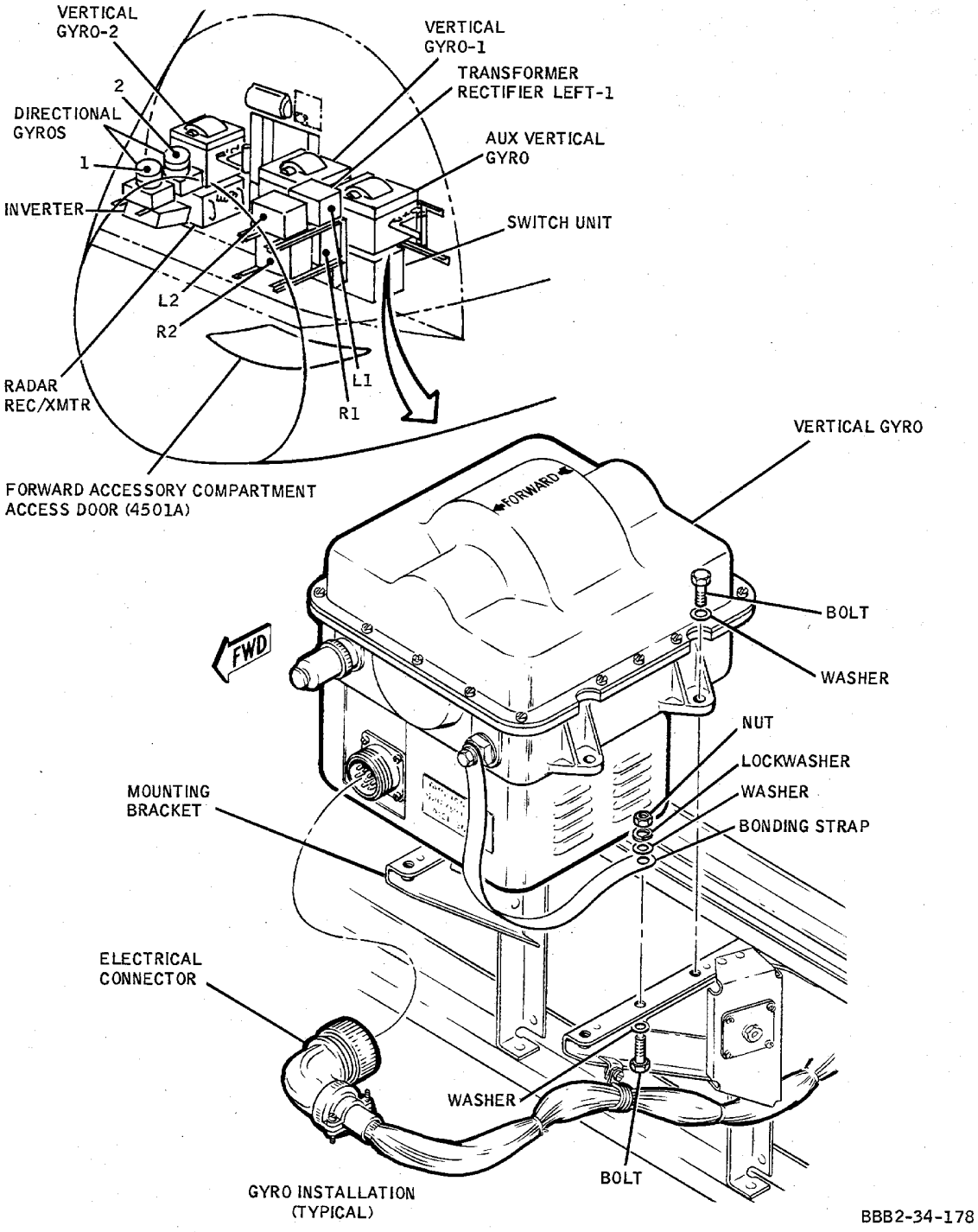
Row	Col	Number	Name
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
K	1	B1-128	LEFT TRANSFORMER RECTIFIER - 1 PHASE A
K	2	B1-129	LEFT TRANSFORMER RECTIFIER - 1 PHASE B
K	3	B1-130	LEFT TRANSFORMER RECTIFIER - 1 PHASE C

UPPER EPC, RIGHT RADIO AC BUS

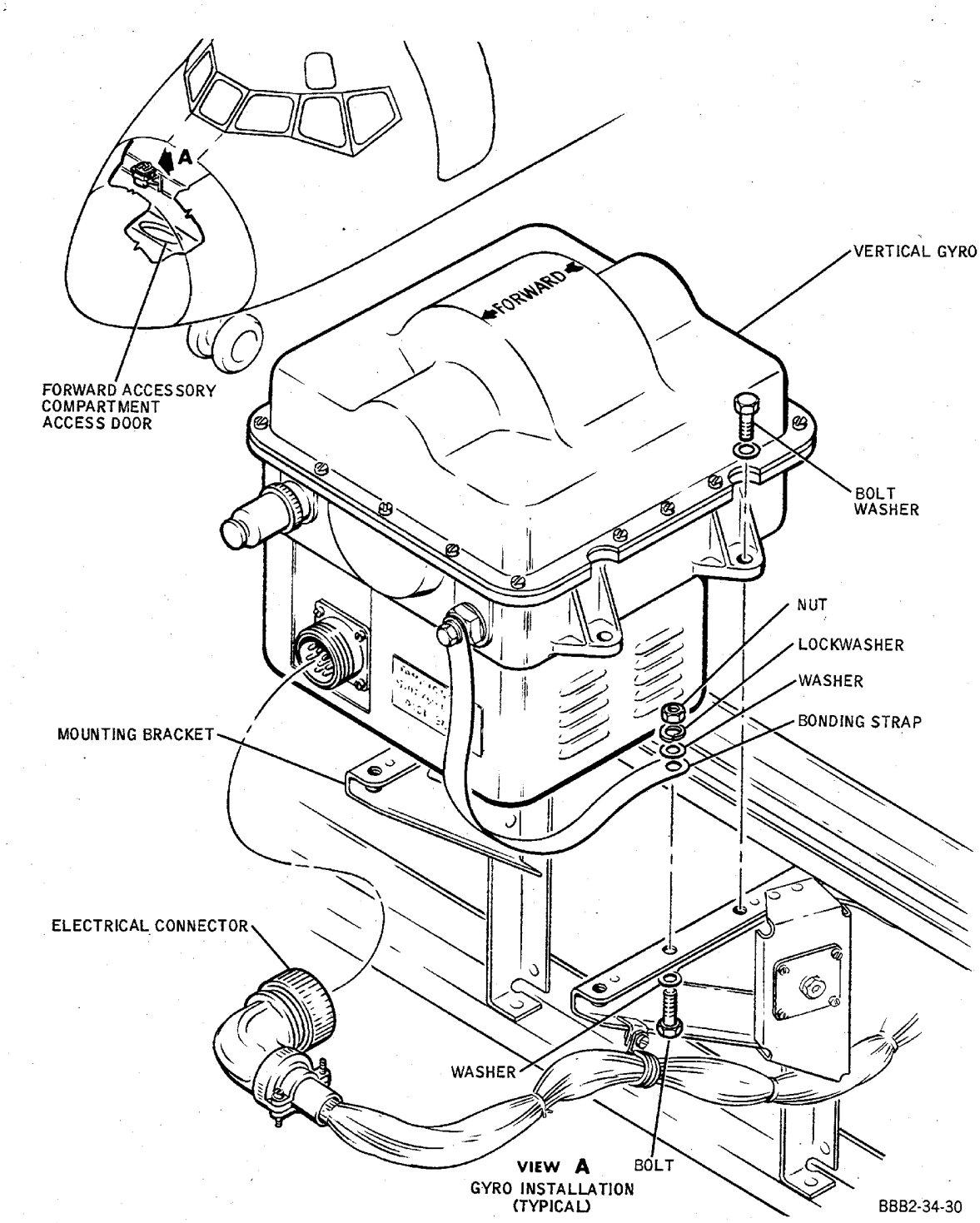
Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	2	B10-20	VERTICAL GYRO-2

(10) Perform Return-to-Service (RTS) test. (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 3 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 5 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 10 or DFGS STATUS/TEST (STP) PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 11)

NOTE: The following operational check may be performed at the mechanic's discretion to check the vertical gyros before performing the RTS test. However, the criteria covered in the operational test are also covered in the RTS test.



Vertical Gyro
Figure 201/34-23-01-990-801 (Sheet 1 of 2)



Vertical Gyro
Figure 201/34-23-01-990-801 (Sheet 2 of 2)

4. Operational Test

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 874, 880, 881, 883, 884, 891-893

A. Vertical Gyros (Aircraft with Attitude Direction Indicator (ADI)s)

(1) Verify that circuit breakers controlling power to the vertical gyros, and Captain's and First Officer's ADI are closed.

(2) Captain's and First Officer's ADIs have a press-to-test feature that checks proper continuity from vertical gyro supplying pitch and roll signals.

(3) Self-test is performed as follows:

(a) Verify that ATT flag is retracted from view in both ADIs approximately 3 minutes after gyro circuit breakers are closed. (Presence of other flags in indicator will not effect test.)

(b) Push press-to-test attitude test button on Captain's and First Officer's ADIs; each attitude sphere should display 10(±5) degrees pitchup, and 20(±5) degrees right roll (bank index pointer rotates counterclockwise to second index), and ATT flag should appear.

(c) Release test buttons; both attitude spheres should align with aircraft attitude within ±2 degrees. (Check attitude of aircraft on ramp, if necessary.) Both indicators should agree with each other within +4 degrees.

CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.

(4) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	05	B10-19	VERTICAL GYRO-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 874, 880, 881, 883, 884, 891-893

(5) Verify that ATT flag appears in Captain's attitude display, then immediately disappears as power is reapplied.

(6) Open and close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-20	VERTICAL GYRO-2

(7) Verify that ATT flag appears in First Officer's attitude display then immediately disappears as power is reapplied.

WJE 405, 409, 880, 884

(8) Place VERT GYRO switch on overhead panel in L ON AUX or R ON AUX.

WJE 405, 409, 880, 884 (Continued)

(9) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	2	B10-167	AUX VERTICAL GYRO

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	1	B10-168	AUXILIARY VERTICAL GYRO

(10) Verify ATT flag appears in Captain's/First Officer's attitude display then immediately disappears as power is reapplied.

WJE 410, 415, 418, 863, 864, 866

B. Test Vertical Gyros (Aircraft with EFIS)

(1) Allow 5 minutes for system warmup, and vertical gyro erection. Set Primary Flight Display (PFD) BRT knob on Electronic Flight Instrument System (EFIS) Control & Dimming Panel to comfortable viewing intensity.

NOTE: Failure messages will appear on EFIS displays if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures.

(2) Attitude indications should align with aircraft attitude within ±2 degrees. (Check attitude of aircraft on ramp, if necessary.) Both indicators should agree with each other within +4 degrees.

(3) Make sure that ATT FAIL message goes blank on both PFD approximately 3 minutes after gyro circuit breakers are closed. (Presence of other messages in indicator will not effect test.)

CAUTION: WHENEVER IT IS NECESSARY TO REMOVE ELECTRICAL POWER FROM THE VERTICAL GYRO FOR 90 SECONDS OR MORE, POWER SHOULD REMAIN OFF FOR AT LEAST TEN MINUTES TO ASSURE PROPER ERECTION OF THE GYRO UPON REAPPLICATION OF POWER.

(4) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	16	B10-364	VERTICAL GYRO-1

WJE 410, 415, 418, 863, 864, 866

(5) Verify that ATT FAIL appears on Captain's PFD then immediately disappears as power is reapplied.

WJE 410, 415, 418, 863, 864, 866 (Continued)

(6) Open and close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	2	B10-20	VERTICAL GYRO-2

(7) Verify that ATT FAIL appears on First Officer's PFD then immediately disappears as power is reapplied.

WJE 410

(8) Place VERT GYRO switch on overhead panel in L ON AUX or R ON AUX.

(9) Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	2	B10-167	AUX VERTICAL GYRO

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	1	B10-168	AUXILIARY VERTICAL GYRO

(10) Verify that ATT FAIL appears on Captain's/First Officer's PFD then immediately disappears as power is reapplied.

WJE 405, 409, 410, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

5. Test Termination

A. Return aircraft to required configuration.

ATTITUDE DIRECTOR INDICATOR (ADI) - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Attitude Director Indicators (ADI). There are two attitude director indicators located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring.

2. Removal/Installation ADI

A. Remove ADI

NOTE: Only one ADI should be removed at a time. When removed ADI is reinstalled, its inclinometer is adjusted to match the roll attitude indicated by the inclinometer of the ADI that was left in place.

NOTE: If both ADI's have to be removed at the same time, or if inclinometer adjustments on both ADI's are in doubt, it is necessary to adjust both inclinometers. (Paragraph 2.C.)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags, as applicable to ADI being removed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-370	CAPTIAN'S HORIZON DISPLAY 28 VAC

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	16	B10-383	CAPTAIN'S ADI RADIO & CMD INFO

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	7	B10-371	FIRST OFFICER'S HORIZON DISPLAY
C	9	B10-384	FIRST OFFICER'S ADI RADIO & CMD INFO

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

NOTE: If applicable to your aircraft, perform operation designated for circuit breakers B10-383 and B10-384.

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install ADI

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-370	CAPTIAN'S HORIZON DISPLAY 28 VAC

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	16	B10-383	CAPTAIN'S ADI RADIO & CMD INFO

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	7	B10-371	FIRST OFFICER'S HORIZON DISPLAY
C	9	B10-384	FIRST OFFICER'S ADI RADIO & CMD INFO

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

NOTE: If applicable to your aircraft, perform operation designated for circuit breakers B10-383 and B10-384.

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

NOTE: Instrument clamp should be checked for clamp rivet failure at eyelets before instrument installation.

CAUTION: MAKE SURE THE CLAMP ATTACHMENT SCREWS ARE TIGHT. THIS WILL NOT LET THE COMPONENT MOVE FROM THE PANEL WHEN THE AIRCRAFT ACCELERATES.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws. Tighten to torque of 6-8 inch lbs.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	3	B10-370	CAPTIAN'S HORIZON DISPLAY 28 VAC

UPPER EPC, 28 VAC

Row	Col	Number	Name
C	17	B10-367	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH A
C	18	B10-368	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH B
C	19	B10-369	DIGITAL FLIGHT GUIDANCE SYSTEM SWITCH C

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	10	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	11	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2

(Continued)

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	12	B10-339	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-1
C	13	B10-337	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-1
C	16	B10-383	CAPTAIN'S ADI RADIO & CMD INFO

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	15	B1-300	INTEGRAL LIGHTS CAPTAIN'S INST PANEL

UPPER EPC, LIGHTS - RIGHT AC BUS

Row	Col	Number	Name
L	17	B1-303	INTEGRAL LIGHTS F/O INST PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
F	3	B10-106	RADIO ALTMETER-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	1	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1
C	2	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2
C	3	B10-340	DIGITAL FLIGHT GUIDANCE SYSTEM ALPHA-2
C	4	B10-338	DIGITAL FLIGHT GUIDANCE SYSTEM FLAP POSITION-2
C	7	B10-371	FIRST OFFICER'S HORIZON DISPLAY
C	9	B10-384	FIRST OFFICER'S ADI RADIO & CMD INFO

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

NOTE: If applicable to your aircraft, perform operation designated for these circuit breakers.

(6) Press the push-to-test switch placarded TEST on the lower left corner of the applicable ADI. This switch actuates self-test circuits to cause the attitude sphere of the ADI to indicate a change in attitude of 20(±5) degrees right bank, 10(±5) degrees pitchup, and the ATT flag will be in view.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

NOTE: If necessary, perform Attitude System Test. (ATTITUDE SYSTEM, SUBJECT 34-23-00, Page 201)

WJE 874, 892, 893

(7) When replacing Captain's ADI, or when swapping F/O ADI into Captain's position, following must be accomplished. Pull CAPTAIN'S ADI RADIO & CMD INFO circuit breaker and observe that there is not an attitude flag in view.

(8) When replacing F/O ADI, pull associated FIRST OFFICER'S ADI RADIO & CMD INFO circuit breaker and check that there is not an attitude flag in view.

NOTE: If a flag is in view, replace the indicator.

NOTE: If necessary, perform Attitude System Test. (ATTITUDE SYSTEM, SUBJECT 34-23-00, Page 201)

WJE 405, 409, 880, 881, 883, 884

(9) On aircraft with Collins ADIs, when replacing the Captain's ADI, or when swapping the F/O ADI into the Captain's position, the following must be accomplished. Pull the CAPTAIN'S ADI RADIO & CMD INFO circuit breaker and observe that there is not an attitude flag in view.

(10) On aircraft with Collins ADIs, when replacing the F/O ADI, pull the associated FIRST OFFICER'S ADI RADIO & CMD INFO circuit breaker and check that there is not an attitude flag in view.

NOTE: On aircraft with Collins ADIs, if a flag is in view, replace the indicator.

NOTE: If necessary, perform Attitude System Test. (ATTITUDE SYSTEM, SUBJECT 34-23-00, Page 201)

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 874, 880, 881, 883, 884, 891-893

(11) Return aircraft to required configuration.

C. Inclinometer Adjustment

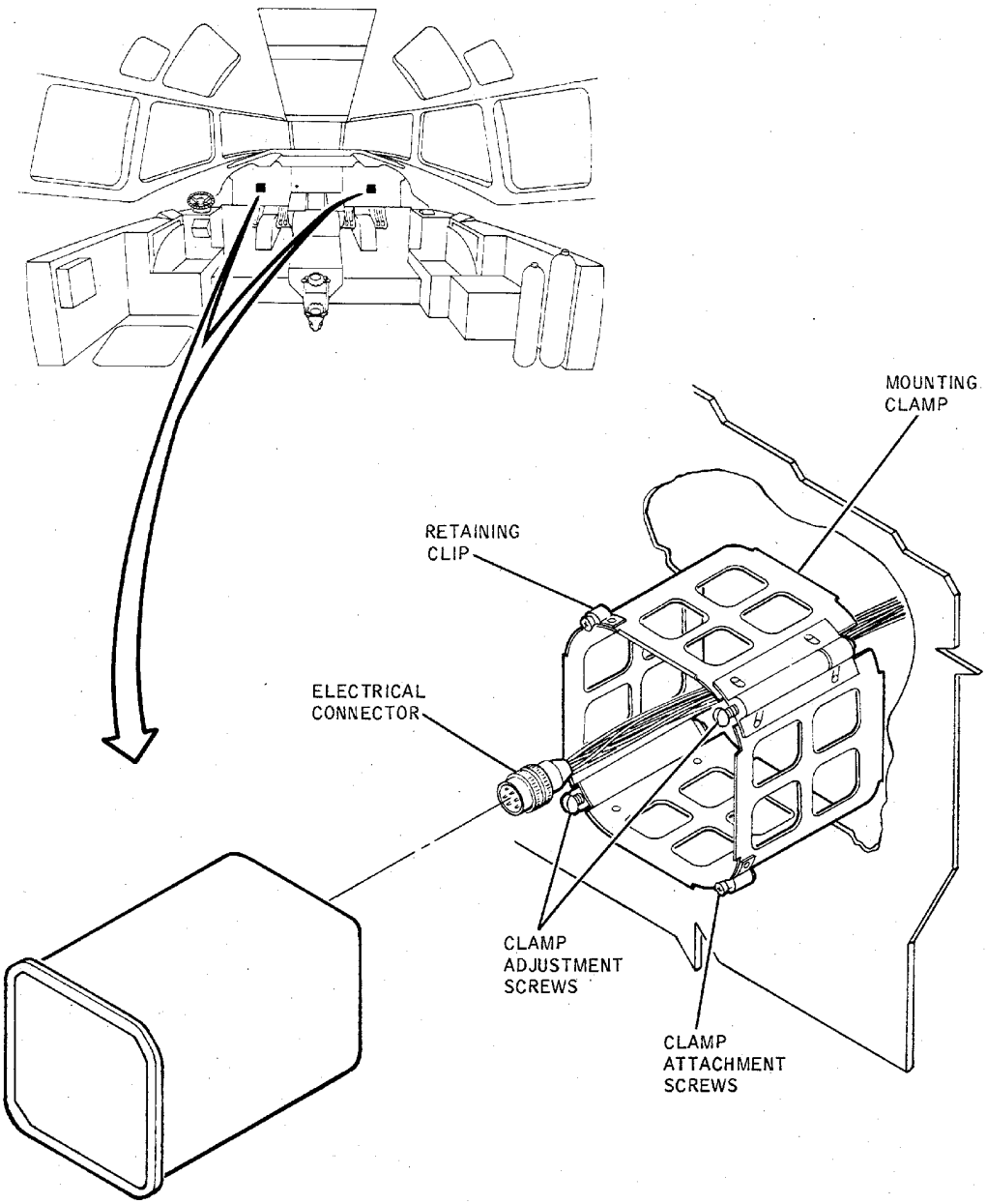
(1) Level aircraft. (LEVELING AND WEIGHING, CHAPTER 08)

(2) Loosen screws on either end of inclinometer.

(3) Move applicable end up or down to center ball between two vertical lines.

(4) Tighten inclinometer screws.

(5) Secure aircraft leveling.



Attitude Director Indicator - Removal/Installation
Figure 201/34-23-02-990-802

EFFECTIVITY
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 874, 880, 881, 883, 884, 891-893

ATTITUDE (VERTICAL GYRO) SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the attitude switching unit (ASU). The ASU is installed on the rack in the forward accessory compartment. The ASU is remotely actuated by the VERT GYRO switch on the overhead panel. Three possible switch positions are placarded L ON AUX, NORM, R ON AUX.

2. Removal/Installation Attitude Switching Unit

A. Remove Attitude Switching Unit

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-169	VERTICAL GYRO SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
F	2	B10-20	VERTICAL GYRO-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Attitude Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-169	VERTICAL GYRO SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
F	2	B10-20	VERTICAL GYRO-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holdown nuts.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 405, 409, 410, 880, 884			
C	2	B10-167	AUX VERTICAL GYRO

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	11	B10-169	VERTICAL GYRO SWITCHING UNIT

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 884			
F	15	B10-364	VERTICAL GYRO-1
WJE 410			
F	16	B10-364	VERTICAL GYRO-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
F	1	B10-168	AUXILIARY VERTICAL GYRO
F	2	B10-20	VERTICAL GYRO-2

WJE 405, 409, 880, 884

(7) Allow 5 minutes for system warmup, and vertical gyro erection.

(8) On overhead panel, verify VERT GYRO switch is in NORM position.

(9) On both ADIs, ATT flag should be out of view and pitch and bank angle should indicate attitude of aircraft.

(10) Place VERT GYRO switch in L. ON AUX position, then switch to R. ON AUX position; ATT flag will momentarily be in view then go out of view when switching, ADIs pitch and bank angle indication should not change more than ±2 degrees.

(11) Return switch to NORM position.

NOTE: If necessary, refer to ATTITUDE SYSTEM, SUBJECT 34-23-00, Page 201 for complete system test.

(12) Return aircraft to required configuration.

WJE 410

(13) Perform LRU functional test below.

NOTE: On aircraft with EFIS, failure messages will appear on EFIS display unit if all applicable circuit breakers are not closed.

NOTE: On aircraft with EFIS, the following procedures refer to EFIS symbology which MUST appear on the display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures or shown in the reference figure.

C. LRU Functional Test

(1) Allow 5 minutes for system warmup, and vertical gyro erection. Set PFD BRT knob on EFIS Control & Dimming Panel to comfortable viewing intensity.

(2) On overhead panel, check that VERT GYRO switch is in NORM position.

(3) On aircraft with ADI's, ATT flag should be out of view on ADI's. Pitch and bank angles should indicate attitude of aircraft.

(4) On aircraft with EFIS, ATT FAIL message should go blank on EFIS PFD's. Pitch and bank angles should indicate attitude of aircraft.

WJE 410 (Continued)

(5) Place VERT GYRO switch in L ON AUX position, then switch to R ON AUX position.

(6) On aircraft with ADI's, ATT flag will momentarily be in view then go out of view when switching; ADI's pitch and bank angle indication should not change more than ±2 degrees.

(7) On aircraft with EFIS, ATT FAIL message may appear when switching; ATT3 message is displayed on applicable PFD.

(8) Return switch to NORM position.

NOTE: If necessary, refer to ATTITUDE SYSTEM, SUBJECT 34-23-00, page 201 for complete system test.

(9) Return aircraft to required configuration.

EFIS PRIMARY FLIGHT DISPLAY (PFD) UNIT - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation and adjustment/test instructions for the EFIS Primary Flight Display (PFD) units. There are two PFD units, located one each on the Captain's Instrument Panel and the First Officer's Instrument Panel. These units occupy panel positions previously held by the ADI's.

B. Removal/installation for both units is the same. When opening circuit breakers, open only those breakers which apply to the unit being replaced.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Non-ammoniated mild window cleaner	
Lens paper	VWR Science Co. Cat No. S68

3. Removal/Installation EFIS Primary Flight Display (PFD) Unit

A. Remove Primary Flight Display (PFD) Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	4	B10-410	CAPTAIN'S PFD
WJE 410			
B	5	B10-410	CAPTAIN'S PFD
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

CAUTION: WHEN REMOVING EFIS PRIMARY FLIGHT DISPLAY (PFD) UNIT EXERCISE EXTREME CAUTION IN PULLING PFD FROM INSTRUMENT PANEL TO PREVENT STRAIN ON ELECTRICAL CONNECTOR AND WIRING. STRAIN ON ELECTRICAL CONNECTOR AND WIRING HAS CAUSED WIRES TO BE PULLED FROM CONNECTOR OR DAMAGED. CLOSE PROXIMITY OF CONTROL COLUMN TO PFD MAKES IT DIFFICULT FOR PFD REMOVAL AND HAS BEEN CAUSE FOR STRAIN ON CONNECTOR. IT IS SUGGESTED ADDITIONAL PERSONNEL BE UTILIZED TO HOLD CONTROL COLUMN IN AFT POSITION WHEN REMOVING PFD.

(2) Using extraction aids on lower corners of PFD, pull unit straight out of instrument panel, far enough to gain access to electrical wiring connector.

(3) Disconnect electrical connector from PFD and remove PFD.

(4) Install protective covers on aircraft electrical connector and on PFD electrical receptacle.

B. Install Primary Flight Display (PFD) Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC

WJE 410 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	4	B10-410	CAPTAIN'S PFD
WJE 410			
B	5	B10-410	CAPTAIN'S PFD
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(2) Check PFD receptacle and aircraft electrical connector for damaged, corroded, or dirty electrical contacts.

(3) Place PFD in position at instrument panel and connect aircraft electrical connector to PFD electrical connector.

(4) Install PFD in instrument panel.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			

WJE 406 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	2	B10-416	SYMBOL GEN-1 DEMOD 28 VAC
WJE 415, 418, 863, 864, 866			
B	2	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 410			
B	3	B10-416	SYMBOL GENERATOR-1 DEMOD 28 VAC
WJE 401-404, 406-408, 411, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
B	4	B10-410	CAPTAIN'S PFD
WJE 410			
B	5	B10-410	CAPTAIN'S PFD
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	7	B10-415	FIRST OFFICER'S FMA/MODE SELECT
E	19	B10-414	CAPTAIN'S FMA/MODE SELECT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 401-404, 412, 414			
F	8	B10-411	FIRST OFFICER'S P.F.D.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887			
F	11	B10-411	FIRST OFFICER'S P.F.D.
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 410, 415, 418, 863, 864, 866			
C	7	B10-417	SYMBOL GENERATOR-2 DEMOD

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

4. Adjustment/Test EFIS Primary Flight Display (PFD) Unit

A. PFD Functional Test

(1) Make sure that all EFIS system circuit breakers, and all other aircraft sensor circuit breakers, are closed. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201 for complete listing of EFIS and interfacing system circuit breakers)

NOTE: Failure messages will appear on PFD if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the PFD screen for a successful test. Disregard any symbology appearing on the PFD which is not referred to in the procedures.

(2) Rotate PFD BRT control knobs on both Control & Dimming Panels (CDP) to turn PFD's on. Captain's and F.O.'s PFD's show similar display symbology and color.

NOTE: Captain's and F.O.'s mode select knobs should be in identical positions.

(3) Place EFIS source select switch to BOTH ON 1 position. Displays show appropriate PFD symbology; both PFD's show EFI1 source selection at top of screen.

(4) Place EFIS source select switch to BOTH ON 2 position. Displays show appropriate PFD symbology; all PFD's show EFI2 source selection at top of screen.

(5) Rotate PFD BRT knob on on-side dimming panel clockwise, from full counterclockwise position. On-side PFD display intensity increases when knob is rotated clockwise; decreases when knob is rotated counterclockwise.

(6) Rotate PFD BRT knob counterclockwise, past detent. PFD display goes off; compact mode display appears on on-side ND.

(7) Return aircraft to required configuration.

5. Cleaning/Painting EFIS Primary Flight Display Screen

A. Clean EFIS Primary Flight Display Screen

(1) Moisten lens paper with window cleaner, then lightly wipe off surface to be cleaned in one pass.

(2) Obtain fresh piece of lens paper, moisten, then wipe again, continue this procedure until all marks have been completely removed, taking fresh piece of lens paper each time, in order not to scratch optical parts with dust collected on lens paper.

(3) Wipe screen with dry clean lens paper, again replacing paper after each pass.

NOTE: Always moisten lens paper with window cleaner and not screen. Do not press hard when wiping. It is advisable to mist surface to be wiped before wiping with lens paper to avoid scratches. The more often lens paper is replaced, the faster and more efficient the cleaning.

6. Turn/Slip Indicator Adjustment Captain's and F/O's Primary Flight Display (PFD)

A. Adjust PFD Turn/Slip Indicator Assembly

NOTE: For turn/slip indicator to be properly adjusted, aircraft must be level.

(1) Level aircraft. (LEVELING - MAINTENANCE PRACTICES, PAGEBLOCK 08-10-00/201)

(2) After aircraft is level, verify turn/slip indicator is centered. If turn/slip indicator is not centered, loosen both assembly mounting/adjustment screws on PFD.

(3) Adjust turn/slip indicator assembly until ball is centered.

(4) Tighten both turn/slip indicator assembly mounting/ adjustment screws on PFD.

(5) Repeat as necessary for remaining PFD.

(6) Return aircraft to required configuration.

FLIGHT DIRECTOR DISPLAYS - DESCRIPTION AND OPERATION

1. General

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 886, 887, 891

A. Description and operation of the flight director in this section describes only the flight director displays for manual guidance of the aircraft. Refer to DIGITAL FLIGHT GUIDANCE SYSTEM (DFGS) - DESCRIPTION AND OPERATION, PAGEBLOCK 22-01-00/001 Config 1 or DIGITAL FLIGHT GUIDANCE SYSTEM (DFGS) - DESCRIPTION AND OPERATION, PAGEBLOCK 22-01-00/001 Config 2 or DIGITAL FLIGHT GUIDANCE SYSTEM (DFGS) - DESCRIPTION AND OPERATION, PAGEBLOCK 22-01-00/001 Config 3, for integrated operation of the flight director and autopilot.

WJE 873, 874, 892, 893

B. Description and operation of the flight director in this section describes only the flight director displays for manual guidance of the airplane. Refer to DIGITAL FLIGHT GUIDANCE SYSTEM (DFGS) - DESCRIPTION AND OPERATION, PAGEBLOCK 22-01-00/001 Config 2, for integrated operation of the flight director and autopilot.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

C. Flight director data is displayed on the attitude director indicator (ADI) and the flight mode annunciators (FMA). On aircraft with EFIS, the ADI's are replaced by the Primary Flight Displays (PFD). The ADI's/PFD's and FMA's are located on the Captain's and First Officer's instrument panels. Flight director (FD) switches for engaging the flight director are located on the flight guidance control panel, one on the Captain's side for the Captain's (-1) system and one on the First Officer's side for the First Officer's (-2) system. Flight director system switching is provided by a flight director (FLT DIR) switch located on the overhead panel. An amber FD light located on Captain's and First Officer's instrument panel will come on corresponding to system switched to, when in NORM position, neither light will be on. Flight director mode of operation is displayed in the FMA's, located on the Captain's and First Officer's instrument panel. Compatibility between flight director and autopilot modes is also displayed on the FMA by AP1, AP2, and FD light displays.

WJE 873, 874, 892, 893

D. Flight director data is displayed on the attitude director indicator (ADI) and the flight mode annunciators (FMA). The ADI's and FMA's are located one each on the Captain's and First Officer's instrument panels. Flight director (FD) switches for engaging the flight director are located on the flight guidance control panel, one on the Captain's side for the Captain's (-1) system and one on the First Officer's side for the First Officer's (-2) system. Flight director system switching is provided by a flight director (FLT DIR) switch located on the overhead panel. An amber FD light located on Captain's and First Officer's instrument panel will come on corresponding to system switched to, when in NORM position, neither light will be on. Flight director mode of operation is displayed in the FMA's, one each located on the Captain's and First Officer's instrument panel. Compatibility between flight director and autopilot modes is also displayed on the FMA by AP1, AP2, and FD light displays.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E. Flight director data is displayed on the EFIS Primary Flight display (PFD) and the flight mode annunciators (FMA). The PFD's and FMA's are located one each on the Captain's and First Officer's instrument panels. Flight director (FD) switches for engaging the flight director are located on the flight guidance control panel, one on the Captain's side for the Captain's (-1) system and one on the First Officer's side for the First Officer's (-2) system. Flight director system switching is provided by a flight director (FLT DIR) switch located on the overhead panel. Flight director mode of operation is displayed in the FMA's, one each located on the Captain's and First Officer's instrument panel. Compatibility between flight director and autopilot modes is also displayed on the FMA by AP1, AP2, and FD light displays.

WJE 873, 874, 892, 893

F. Signals to drive the ADI command bar and initiate flight mode annunciator displays are processed in the flight guidance computers -1 and -2.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

G. Signals to drive the ADI/PFD command bars and initiate flight mode annunciator displays are processed in the flight guidance computers -1 and -2.

WJE 406, 886, 887

H. The EFIS symbol generators process data from the Attitude and Heading System (AHRS) to provide a pitch and roll display on the PFDs.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

I. The EFIS symbol generators process data from the Inertial Reference System (IRS) to provide a pitch and roll display on the PFDs.

WJE ALL

2. Description

WJE 873, 874, 892, 893

A. Roll and pitch guidance control of the airplane is displayed by the roll and pitch command bar on the ADI. The fixed airplane symbol on the ADI is used as a reference for the command bar. The command bar indicates below the airplane symbol to command pitch down attitude and above the airplane symbol to indicate pitch up attitude. The bar indicates to the right of center to command right roll and to left of center to indicate command left roll. The stationary airplane symbol in relation to the movable sphere denotes degrees of up and down pitch.

WJE 405, 407-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

B. Roll and pitch guidance control of the aircraft is displayed by the roll and pitch command bars on the ADI/PFD. The fixed airplane symbol on the ADI/PFD is used as a reference for the command bars. The horizontal (pitch) command bar indicates below the airplane symbol to command pitch down attitude and above the airplane symbol to indicate pitch up attitude. The vertical (roll) bar indicates to the right of center to command right roll and to left of center to indicate command left roll. The stationary airplane symbol in relation to the movable sphere denotes degrees of up and down pitch.

WJE 410

C. Roll and pitch guidance control of the aircraft is displayed by the roll and pitch command bars on the ADI/PFD. The fixed airplane symbol on the ADI/PFD is used as a reference for the command bars. The command bars indicate below the airplane symbol to command pitch down attitude and above the airplane symbol to indicate pitch up attitude. The bars indicate to the right of center to command right roll and to left of center to indicate command left roll. The stationary airplane symbol in relation to the movable sphere denotes degrees of up and down pitch.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D. Roll and pitch guidance control of the aircraft is displayed by the roll and pitch command bar on the PFD's. The fixed airplane symbol on the PFD's is used as a reference for the command bar. The command bar indicates below the airplane symbol to command pitch down attitude and above the airplane symbol to indicate pitch up attitude. The bar indicates to the right of center to command right roll and to left of center to indicate command left roll. The stationary airplane symbol in relation to the movable sphere denotes degrees of up and down pitch.

WJE ALL

E. Flight director modes of operation are activated by controls located on the flight guidance panel and throttle lever TO/GA switches. The mode of operation of the flight director is displayed on the flight mode annunciators. The following chart lists the modes, activation of the modes, and display on the flight mode annunciators.

Table 1

FD MODE	MODE ACTIVATION	FMA DISPLAYS		
		ARM	ROLL	PITCH
Take Off	TO/GA switch-On Ground (Throttle Lever)		TAK OFF	TAK OFF
Heading Hold	FD switches to FD, or H knob to second detent when in another roll mode		HDG HLD	
Heading Select	H knob momentarily pull out		HDG SEL	
VOR	Tune VHF/NAV to VOR frequency Press VOR/LOC pushbutton	VOR		
Capture			VOR CAP	
Tracking			VOR TRK	
Over Station			VOR CRS	
Localizer	Tune VHF/NAV to ILS frequency Press VOR/LOC pushbutton	LOC		
Capture			LOC CAP	
Tracking			LOC TRK	
Vertical Speed	FD switches to FD and vertical speed exceeding 100 feet/min climb or descent, or move pitch wheel to greater than 100 feet per minute ANU (A/P nose up), or AND (A/P nose down).			VERT SPD
ILS	VHF/NAV tuned to ILS frequency. ILS pushbutton pressed	ILS	LOC CAP	

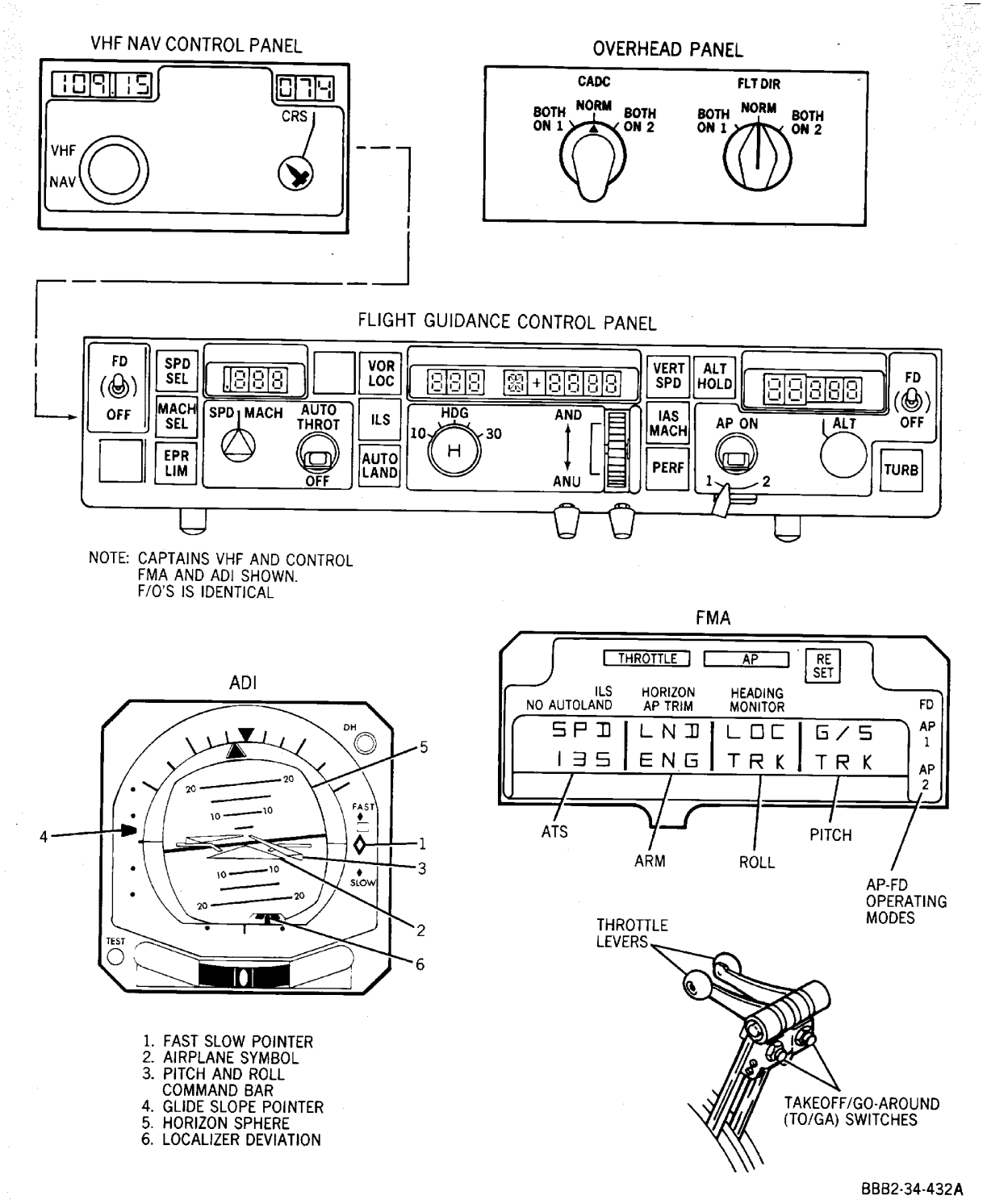
Table 1 (Continued)

FD MODE	MODE ACTIVATION	FMA DISPLAYS		
			LOC TRK	
			LOC TRK	G/S CAP
			LOC TRK	G/S TRK
		FD GA	LOC TRK	G/S TRK
Altitude Hold	FD switches to FD, pitch wheel less than 100 feet per minute ANU (A/P nose up) or AND (A/P nose down). Press ALT HOLD pushbutton			ALT HLD
Altitude Preselect	Momentarily pull out ALT knob	ALT		ALT CAP
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
Indicated Airspeed Control	IAS/MACH pushbutton			IAS
WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893				
Indicated Airspeed Control	IAS pushbutton			IAS
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
MACH Control	IAS/MACH pushbutton			MACH
WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893				
MACH Control	MACH pushbutton			MACH
WJE ALL				
Turbulence Penetration	TURB pushbutton		WNG LVL	TURB
Go Around	TO/GA switch-in flight (throttle levers)		GO RND	GO RND
ALT Preselect and ILS	ILS pushbutton	ILS ALT		
ALT Preselect and VOR	VOR pushbutton	VOR ALT		
ALT Preselect and LOC	LOC pushbutton	LOC ALT		
WJE 410, 873, 874, 892, 893				
Performance Management	FD on or autopilot engaged; flaps less than 26 degrees; TRI in CLB, CRZ, or MCT; PMS valid. Press PERF pushbutton.			PERF (CLB,CRZ,DES)
WJE 406, 886, 887				
Performance Management	FD on or autopilot engaged; flaps less than 26 degrees; TRI in CLB, CRZ, or MZT; PMS valid. Press PERF pushbutton.			PERF (CLB,CRZ,DES)

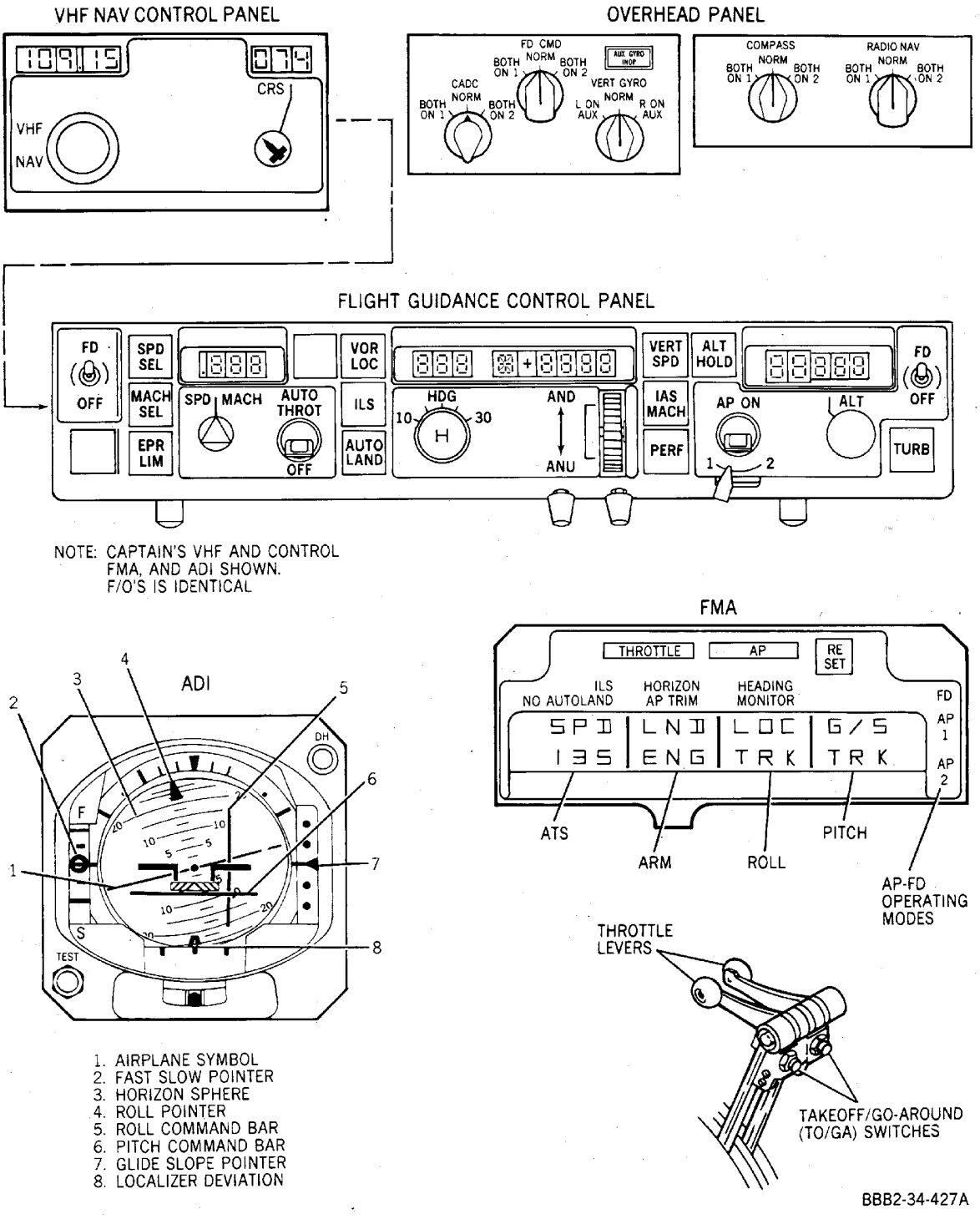
WJE 406, 886, 887 (Continued)

Table 1 (Continued)

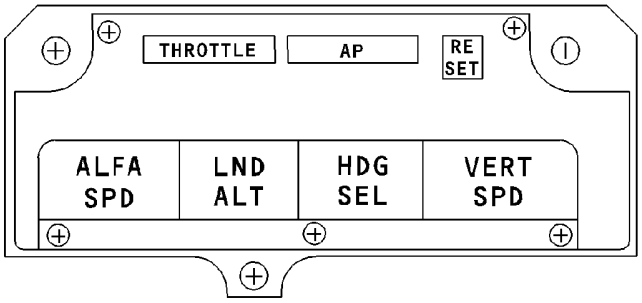
FD MODE	MODE ACTIVATION	FMA DISPLAYS		
WJE 405, 407-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891				
Performance Management	FD on or autopilot engaged; flaps less than 26 degrees; TRI in CLB, CRZ, or MCT; PMS valid. Press PERF pushbutton.			PERF (CLB,CRZ,DES)
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879				
Flight Management System	FD on or autopilot engaged; flaps less than 26 degrees; TRI in CLB, CRZ, or MCT; FMS valid. Press VNAV pushbutton.			VNAV (CLB,CRZ,DES)
WJE ALL				

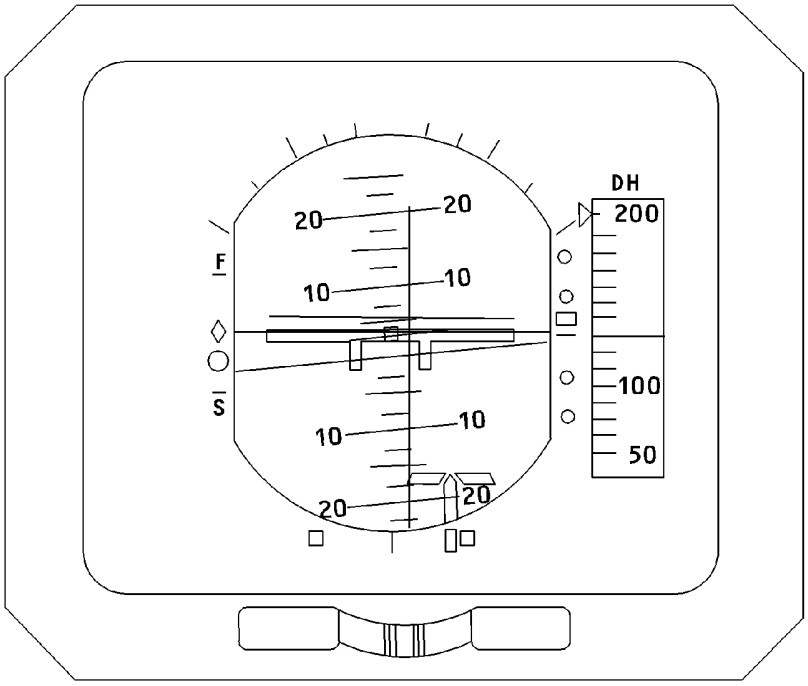


Flight Director System Displays
Figure 1/34-24-00-990-804 (Sheet 1 of 4)



Flight Director System Displays
Figure 1/34-24-00-990-804 (Sheet 2 of 4)





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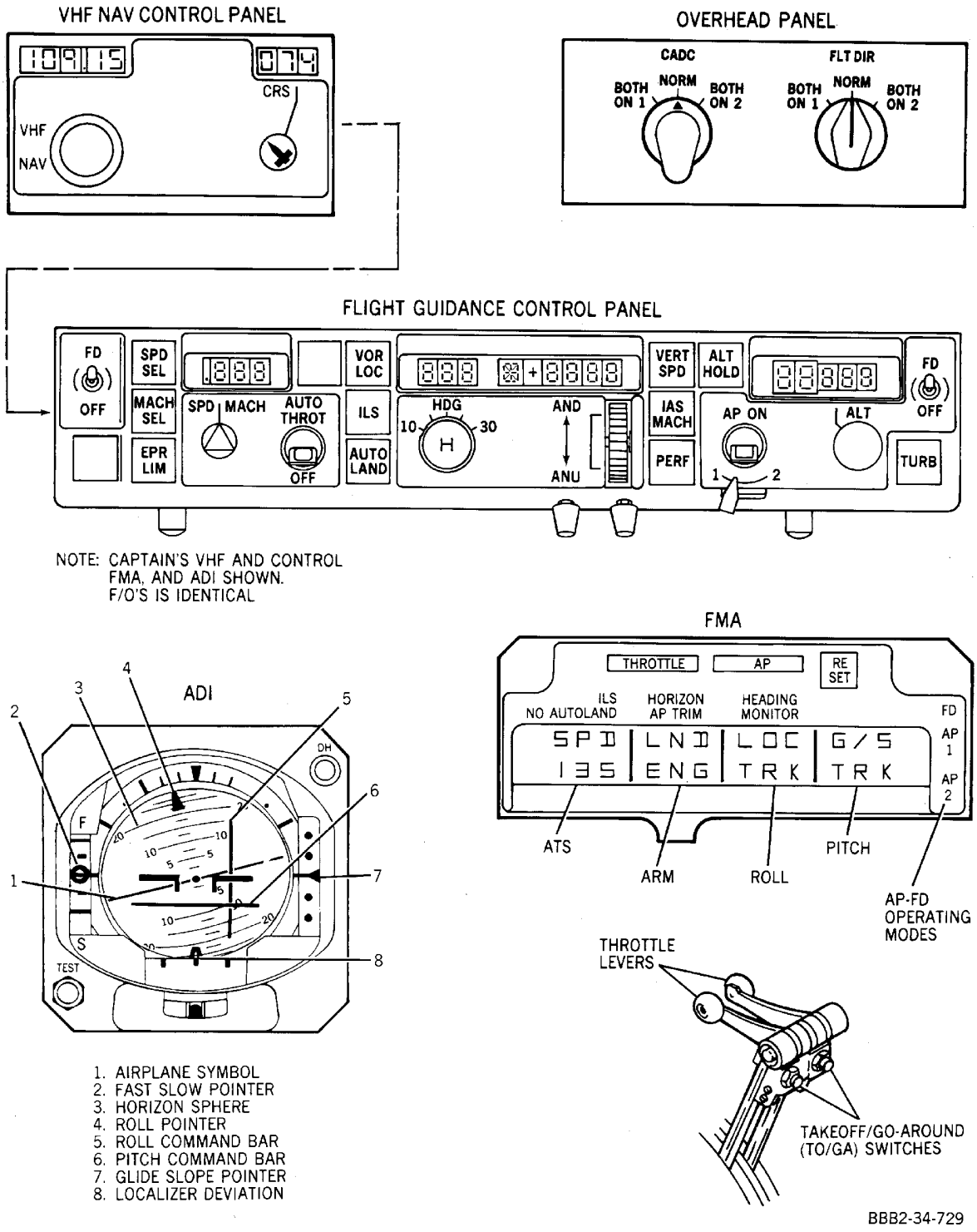
Flight Director System Displays
Figure 1/34-24-00-990-804 (Sheet 3 of 4)



Flight Director System Displays
Figure 1/34-24-00-990-804 (Sheet 4 of 4)

3. Operation

A. Takeoff

(1) The flight director takeoff mode is activated when either or both flight director switches are placed to FD, the airplane is on the ground, and either throttle TO/GA switch is pressed. TAK OFF is displayed in the pitch and roll windows of the flight mode annunciator.

WJE 406, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 886, 887, 891

(2) After nosegear lift-off, the pitch command bar and slow-fast pointer in the ADI/PFD provides the flight crew visual indication to maintain a climb path within safe limits to prevent stall. Takeoff is a flight director mode only. However, the autopilot can be engaged into an existing flight director Takeoff mode after airplane has left the ground.

WJE 405, 407-409, 411, 880, 881, 883, 884

(3) After nosegear lift-off, the pitch command bar and slow-fast pointer in the ADI provides the flight crew visual indication to maintain a climb path within safe limits to prevent stall. Takeoff is a flight director mode only. However, the autopilot can be engaged into an existing flight director Takeoff mode after airplane has left the ground.

WJE 410, 873, 874, 892, 893

(4) After nosegear lift-off, the command bar and slow-fast pointer in the ADI provides the flight crew visual indication to maintain a climb path within safe limits to prevent stall. Takeoff is a flight director mode only. However, the autopilot can be engaged into an existing flight director Takeoff mode after airplane has left the ground.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

(5) After nosegear lift-off, the pitch command bar and slow-fast pointer in the PFD provides the flight crew visual indication to maintain a climb path within safe limits to prevent stall. Takeoff is a flight director mode only. However, the autopilot can be engaged into an existing flight director Takeoff mode after aircraft has left the ground.

WJE ALL

(6) The flight director takeoff mode becomes terminated when autopilot and both flight director control switches are placed off, or when another pitch command has been selected.

B. Heading Hold

(1) Heading hold is the primary turn on mode of the flight director. If the aircraft is in a bank angle when the flight director(s) are turned on, the DFGC will provide roll attitude commands for wings level. HDG HLD will be annunciated in the roll window of the flight mode annunciator only after the bank angle has been decreased less than 5 degrees.

(2) When operating in a flight director roll mode of operation, i.e. heading select, pushing in the H knob on the Flight Guidance Control panel to the second detent position will automatically establish the heading hold mode. Heading hold mode takes precedence over any flight director mode, including localizer track.

C. Heading Select

(1) Flight director heading select mode of operation is established when either or both flight director switches are placed to FD, and the H knob on the Flight Guidance Control panel is pulled out.

(2) Heading select mode provides roll steering commands to maneuver the airplane to acquire and maintain a selected heading. The mode commands a turn in the direction of the smallest radial angle between existing airplane heading and the selected heading. Roll steering commands provide roll attitude to maintain the selected heading. A heading may be selected before or after mode activation.

(3) Heading select mode will be terminated when a directional radio beam is captured, or the H knob is pushed full in.

D. VOR Capture and Tracking

(1) Arm Phase

(a) The flight director VOR mode is armed when either or both flight director switches are placed to FD, VHF NAV receivers are tuned to a VOR frequency, (if only one FD is on, only the receiver on that side need be tuned) and the VOR LOC pushbutton is pressed. VOR will be displayed in the arm window of the flight mode annunciator.

(b) The flight director VOR arm phase of operation allows the airplane to be directed to the selected VOR radial while flying manually. Roll steering commands are followed for selected heading to intercept and capture the VOR beam.

(2) Capture Phase

(a) The flight director VOR capture phase is automatically initiated when the airplane arrives at the beam capture threshold. At time of capture, VOR CAP is displayed in the roll window of the flight mode annunciator.

(b) VOR capture phase will be disabled if both flight director switches are placed off, another roll mode has been selected, or VHF NAV receivers are detuned from the selected VOR frequency.

(3) Track Phase

(a) The track phase of VOR operation is automatically initiated when the aircraft is established on the center of the VOR radial. When the aircraft is in the track phase, the roll mode annunciator will automatically display VOR TRK. VOR crosswind correction and over-the-station passage is provided during VOR track phase.

(b) During over-the-station (zone of confusion) passage, the roll mode annunciators will display VOR CRS, and a new VOR radial may be selected without disengaging the VOR mode. If the airplane is in the VOR CRS mode for more than 3 minutes, the roll mode annunciator will automatically switch to flight director basic roll control mode HDG HLD.

(c) VOR track phase will be disabled if both flight director switches are placed off, another roll mode has been selected, the VHF NAV receivers are tuned to a different frequency, or VOR CRS mode has been established for more than 3 minutes.

E. Localizer Capture and Tracking

(1) Arm Phase

(a) The flight director localizer mode is in the arm phase when either or both flight director switches are placed to FD, VHF NAV receivers are tuned to an ILS frequency, (if only one FD is on, only the receiver on that side need be tuned) and either the VOR LOC or ILS pushbutton is pressed. LOC or ILS, depending which pushbutton is pressed, will be displayed in the arm window of the flight mode annunciator.

(b) The flight director localizer arm phase of operation, allows the airplane to be directed to the localizer beam while flying manually. Roll steering commands are followed for selected heading to intercept and capture the localizer beam.

(c) Localizer arm phase will be disabled if both flight director switches are placed off, another roll mode has been selected, or the VHF NAV receivers are detuned from the selected ILS frequency.

(2) Capture Phase

(a) Localizer capture phase is automatically initiated when the airplane arrives at the localizer beam threshold. At time of capture, LOC CAP is displayed in the roll window of the flight mode annunciator.

(b) Localizer capture phase will be disabled if both flight director switches are placed off, another roll mode has been selected, or VHF NAV receivers are detuned from the selected ILS frequency.

(3) Track Phase

(a) The on-course or tracking phase of operation is automatically initiated when the airplane is established on the center of the localizer beam. When in the track phase, the roll mode annunciator will display LOC TRK. Automatic gain programming is provided during the on-course phase to compensate for localizer beam convergence.

(b) Localizer track phase will be disabled if both flight director switches are placed off, another roll mode is selected, or VHF NAV receivers are detuned from the selected ILS frequency.

F. ILS Mode

(1) Arm Phase

(a) The flight director ILS mode is in the arm phase when either or both flight director switches are placed to FD, VHF NAV receivers are tuned to an ILS frequency, (if only one FD is on, only the receiver on that side need be tuned) and the ILS pushbutton is pressed. ILS will be displayed in the arm window of the flight mode annunciator.

(b) The flight director ILS arm phase of operation, allows the airplane to be directed to the localizer beam while flying manually. Roll steering commands are followed for heading to intercept and capture the localizer beam.

(c) Localizer arm phase will be disabled if both flight director switches are placed off, another roll mode has been selected, or the VHF NAV receivers are detuned from the selected ILS frequency.

(2) LOC Capture Phase

(a) Localizer capture phase is automatically initiated when the airplane arrives at the localizer beam threshold. At time of capture, LOC CAP is displayed in the roll window of the flight mode annunciator.

(b) Localizer capture phase will be disabled if both flight director switches are placed off, another roll mode has been selected, or VHF NAV receivers are detuned from the selected ILS frequency.

(3) LOC Track Phase

(a) The on-course or tracking phase of operation is automatically initiated when the airplane is established on the center of the localizer beam. When in the track phase, the roll mode annunciator will display LOC TRK. Automatic gain programming is provided during the on-course phase to compensate for localizer beam convergence.

(b) Localizer track phase will be disabled if both flight director switches are placed off, another roll mode is selected, or VHF NAV receivers are detuned from the selected ILS frequency.

(4) G/S Capture Phase

WJE 873, 874, 892, 893

(a) The capture phase of the glideslope operation is initiated when the airplane is directed to the glideslope beam threshold. Monitors within the DFGC continuously compute beam deviation and closure rate to initiate the glideslope capture phase. The flight director command bar displays pitch commands to enable a smooth capture above or below the beam. The flight guidance mode annunciators pitch window will display G/S CAP. After glideslope capture, pitch gain programming as a function of radio altitude, is used to compensate for beam convergence. The G/S pointer on the HSI/ADI will display on G/S beam or above, or below G/S beam.

WJE 405, 407-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

(b) The capture phase of the glideslope operation is initiated when the airplane is directed to the glideslope beam threshold. Monitors within the DFGC continuously compute beam deviation and closure rate to initiate the glideslope capture phase. The flight director command bar displays pitch commands to enable a smooth capture above or below the beam. The flight guidance mode annunciators pitch window will display G/S CAP. After glideslope capture, pitch gain programming as a function of radio altitude, is used to compensate for beam convergence. The G/S pointer on the HSI (or PFD/ND) will display on G/S beam or above, or below G/S beam.

WJE 410

(c) The capture phase of the glideslope operation is initiated when the airplane is directed to the glideslope beam threshold. Monitors within the DFGC continuously compute beam deviation and closure rate to initiate the glideslope capture phase. The flight director command bar displays pitch commands to enable a smooth capture above or below the beam. The flight guidance mode annunciators pitch window will display G/S CAP. After glideslope capture, pitch gain programming as a function of radio altitude, is used to compensate for beam convergence. The G/S pointer on the HSI/ADI (or PFD/ND), will display on G/S beam or above, or below G/S beam.

WJE 401-404, 406, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(d) The capture phase of the glideslope operation is initiated when the airplane is directed to the glideslope beam threshold. Monitors within the DFGC continuously compute beam deviation and closure rate to initiate the glideslope capture phase. The flight director command bar displays pitch commands to enable a smooth capture above or below the beam. The flight guidance mode annunciators pitch window will display G/S CAP. After glideslope capture, pitch gain programming as a function of radio altitude, is used to compensate for beam convergence. The G/S pointer on the HSI will display on G/S beam or above, or below G/S beam.

WJE ALL

(e) ILS operation will become disabled if both flight director switches are placed off, or the VHF NAV receivers are detuned from the ILS frequency.

(5) G/S Track Phase

(a) The flight director glideslope tracking phase begins when the aircraft arrives at beam center. Pitch command guidance for the flight crew to follow is computed as a function of glideslope deviation and rate estimation and summed with pitch acceleration and pitch rate. The pitch windows will change from G/S CAP to G/S TRK.

(b) The ARM display will change to FD-GA to indicate that flight director go-around mode is available. ARM will stay blank if it is inoperative.

G. Go-Around

(1) Flight director go-around mode provides the flight crew pitch steering commands to climb-out at a safe margin above stall airspeed, consistent with engine thrust settings and roll commands to manually roll the airplane to wings level, and to maintain the existing heading when the airplane bank-angle is reduced to less than 3 degrees. Go-around mode disables any previously selected approach function.

(2) Go-around mode of operation is initiated when the airplane is in the flight mode and flaps are extended. Pressing the TO/GA switch on the throttle lever establishes the go-around mode of operation. The pitch and roll mode annunciators display GO RND.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(3) The DFGC processes speed control information combined with pitch control information to maintain an optimum airspeed. This information represents a constant value times the airplane stall speed, plus an increment to allow for engine loss without approaching a stall condition. The pitch command and slow-fast pointer on the ADI's, provide computed speed reference to the flight crew to climb-out at a maximum rate.

WJE 405, 407-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

(4) The DFGC processes speed control information combined with pitch control information to maintain an optimum airspeed. This information represents a constant value times the aircraft stall speed, plus an increment to allow for engine loss without approaching a stall condition. The pitch command and slow-fast pointer on the ADI's/PFD's, provide computed speed reference to the flight crew to climb-out at a maximum rate.

WJE 410

(5) The DFGC processes speed control information combined with pitch control information to maintain an optimum airspeed. This information represents a constant value times the aircraft stall speed, plus an increment to allow for engine loss without approaching a stall condition. The pitch command and slow-fast pointer on the ADI's/PFD's, provide computed speed reference to the flight crew to climb-out at a maximum rate.

WJE ALL

(6) Flight director control in the go-around mode is terminated when both flight director switches are placed off, or when a pitch command, other than altitude preselect, is activated.

H. Altitude Hold

(1) The flight director altitude hold mode is provided by the ALT HOLD pushbutton or by rotating the pitch wheel to detent feel (zero vertical speed). The pitch profile readout indicates that zero vertical speed is established by displaying a V, blank, and the last four windows display zeros. Manually rotating the pitch wheel to the detent feel position, will automatically provide altitude control to the barometric altitude reference existing at time of altitude mode engagement. ALT HLD will be displayed in the pitch window on the flight mode annunciator.

(2) The altitude hold mode will become disabled when another pitch mode is selected, an altitude has been captured, or at glideslope capture.

I. Mach Control

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(1) The Mach Control mode is established when either or both flight director switches are in the FD position, and the IAS/MACH pushbutton on the Flight Guidance Control panel is pressed. The Mach Control mode provides flight director pitch commands to maintain the Mach number existing at time of mode selection. The flight mode annunciator(s) pitch window will display MACH.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(2) The Mach Control mode is established when either or both flight director switches are in the FD position, and the MACH pushbutton on the Flight Guidance Control panel is pressed. The Mach Control mode provides flight director pitch commands to maintain the Mach number existing at time of mode selection. The flight mode annunciator(s) pitch window will display MACH.

WJE ALL

(3) The pitch profile readout will display an M, + or -, and the mach airspeed at time of mode engagement. The mach airspeed reference can be adjusted as required by use of the pitch wheel to select a different value mach airspeed. The pitch profile readout will display the new value, as the pitch wheel is adjusted.

(4) If the autothrottle is operating in either the SPD SEL or MACH SEL mode, and the flight director MACH mode is established, the ATS mode annunciators will display CLMP and flash for approximately 3 seconds. CLMP will remain displayed in the ATS mode annunciators as long as the flight director is operating in the Mach Control mode of operation. If the SPD SEL or MACH SEL autothrottle modes are reestablished: the flight director Mach Control mode will automatically be overriden, and the pitch window will flash for approximately 3 seconds, displaying either VERT SPD or ALT HLD depending on the vertical speed of the airplane. This mode will remain displayed until another pitch mode is selected.

(5) The Mach Control mode of operation will also become disabled when the glideslope beam is intercepted or an altitude is captured.

J. Altitude Preselect and Advisory

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(1) The flight director altitude preselect mode provides manual capture of a pre-set barometric altitude, which is selected by an altitude set knob located on the Flight Guidance Control panel. The altitude set knob has three positions, spring-loaded to center. The center position provides 1000 feet increment altitude adjustments that are read on a selected altitude readout window directly above the altitude set knob. The momentary pull-out position arms the system for a preselected altitude capture, and for altitude advisory. The pushing and turning provides 100 feet increment adjustments, and resets the altitude preselect mode.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(2) The flight director altitude preselect mode provides manual capture of a pre-set barometric altitude, which is selected by an altitude set knob located on the Flight Guidance Control panel. The altitude set knob has three positions, spring-loaded to center. The center position provides 1000 feet increment altitude adjustments that are read on a selected altitude readout window directly above the altitude set knob. The momentary pull-out position arms the system for a preselected altitude capture, and for altitude advisory. The push-in position provides 100 feet increment adjustments, and cancels the altitude preselect mode.

WJE ALL

(3) The altitude advisory function is provided to alert the flight crew that the airplane is approaching a preselected altitude, or the airplane is deviating from the preselected altitude. The altitude advisory lights are located in the upper left hand corner of the altimeters.

(4) Arm Phase

(a) The arm phase of the altitude preselect mode allows the airplane to be directed to a preselected altitude. Altitude preselect mode is armed when the altitude set knob is momentarily pulled out. At time of altitude preselect arm, ALT will be displayed in the arm window of the flight mode annunciators.

(b) Altitude preselect arm phase will become disabled if the altitude set knob is pushed-in, or when the glideslope beam is intercepted.

(5) Capture Phase

(a) The automatic capture phase of the altitude preselect mode is variable and is a function of existing vertical speed. As the airplane arrives at approximately 750 feet from the selected altitude a steady altitude advisory light will come on in the altimeters. At the capture threshold, the pitch mode (i.e. vertical speed) provided to capture the preselected altitude, will be terminated and ALT CAP will be displayed on the flight mode annunciators pitch window. If the airplane deviates from the altitude capture threshold, the altitude advisory lights will come on and flash, and a 2-second aural warning tone will sound.

(b) As the airplane arrives at the capture threshold, the DFGC provides pitch commands for the flight crew to make a smooth capture maneuver to the preselected altitude. At approximately 250 feet from the preselected altitude, the steady altitude advisory lights will go off, advising the flight crew that the preselected altitude capture function has been accomplished.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(c) Altitude preselect capture phase will become disabled if another pitch mode has been selected, or the glideslope beam is intercepted.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(d) Altitude preselect capture phase will become disabled if the altitude set knob is pushed-in, another pitch mode has been selected, or when the glideslope beam is intercepted.

WJE ALL

(6) Track Phase

(a) As the airplane is leveled off at the preselected altitude, the flight mode annunciators pitch window will display ALT HLD. The airplane will remain in the preselected altitude hold mode as long as ALT HOLD mode is engaged. If the airplane deviates from the selected altitude ±250 feet, the altitude advisory lights will come and flash, and a 2-second aural warning tone will sound, to alert the flight crew that the airplane has deviated from the selected altitude. The flashing advisory lights can only be turned off by selecting a new altitude greater than 750 feet or reestablishing the existing altitude.

K. Indicated Airspeed Control

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(1) The indicated airspeed (IAS) control mode is established when either or both flight director switches are in the FD position, and the IAS/MACH pushbutton located on the Flight Guidance Control panel is pressed. The flight director pitch command bars provide the proper pitch command to maintain existing indicated airspeed by controlling pitch attitude. The flight mode annunciator(s) pitch window will display IAS.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(2) The indicated airspeed (IAS) control mode is established when either or both flight director switches are in the FD position, and the IAS pushbutton located on the Flight Guidance Control panel is pressed. The flight director pitch command bars provide the proper pitch command to maintain existing indicated airspeed by controlling pitch attitude. The flight mode annunciator(s) pitch window will display IAS.

WJE ALL

(3) The pitch profile readout will display an S, + or -, and the indicated airspeed at time of mode engagement. The airspeed reference can be adjusted as required by use of the pitch wheel to select a different value indicated airspeed. The pitch profile readout will display the new value, as the pitch wheel is adjusted.

L. Turbulence Penetration

(1) Turbulence penetration provides flight director roll attitude hold and control and dampened pitch response during turbulent atmospheric conditions. The mode is established when either flight director is engaged, and the TURB pushbutton on the Flight Guidance Control panel is pressed.

(2) When the TURB pushbutton is pressed, any control mode previously selected is automatically disengaged, including arm modes. The DFGC automatically reduces the gains and increases the damping ratio in the pitch and roll control logic. The pitch command will respond to existing pitch attitude, and the roll command will remain approximately centered. The pitch window in the flight mode annunciators display TURB and the roll window displays WNG LVL. If the autothrottle is engaged, the autothrottle will automatically disengage when the TURB pushbutton is pressed.

(3) The pitch profile readout will display P, + or -, and the existing pitch attitude at time of mode engagement. The pitch attitude reference can be adjusted as required by use of the pitch wheel to select a different value pitch attitude.

(4) The turbulence penetration mode becomes disengaged when any other control mode is selected, or both flight director switches are placed OFF.

M. Vertical Speed Control

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 886, 887, 891

(1) Vertical speed control is provided by the pitch wheel located on the Flight Guidance Control panel. Directly above the pitch wheel is a pitch profile readout that provides vertical speed readout reference. The pitch wheel has a detent feel which provides altitude hold mode of operation. Manually rotating the vertical speed wheel for less than 100 feet per minute readout in the increase or decrease position engages the pitch wheel into the altitude hold mode position and provides the detent feel.

WJE 410, 873, 874, 892, 893

(2) Vertical speed control is provided by the VERT SPD push-button or a pitch wheel located on the Flight Guidance Control panel. Directly above the pitch wheel is a pitch profile readout that provides vertical speed readout reference. The pitch wheel has a detent feel which provides altitude hold mode of operation. Manually rotating the vertical speed wheel for less than 100 feet per minute readout in the increase or decrease position engages the pitch wheel into the altitude hold mode position and provides the detent feel.

WJE 873, 874, 892, 893

(3) Placing either or both flight director switches to FD, will establish the flight director vertical speed mode. The pitch command bar in the ADI will provide the flight crew the pitch attitude reference for the flight crew to follow. The pitch window in the flight mode annunciator will display VERT SPD. The pitch profile readout displays V, + or - (depending on the polarity of the pitch response) and the numeric value of the vertical speed. When glideslope track is initiated, the output from the vertical speed wheel is inhibited. The vertical speed mode of operation will become disabled when another pitch mode is selected, an altitude has been captured, or at glideslope capture.

WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 886, 887, 891

(4) Placing either or both flight director switches to FD, will establish the flight director vertical speed mode. The pitch command bar in the ADI/PFD will provide the flight crew the pitch attitude reference for the flight crew to follow. The pitch window in the flight mode annunciator will display VERT SPD. The pitch profile readout displays V, + or - (depending on the polarity of the pitch response) and the numeric value of the vertical speed. When glideslope track is initiated, the output from the vertical speed wheel is inhibited. The vertical speed mode of operation will become disabled when another pitch mode is selected, an altitude has been captured, or at glideslope capture.

WJE 401-404, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

(5) Placing either or both flight director switches to FD, will establish the flight director vertical speed mode. The pitch command bar in the PFD will provide the flight crew the pitch attitude reference for the flight crew to follow. The pitch window in the flight mode annunciator will display VERT SPD. The pitch profile readout displays V, + or - (depending on the polarity of the pitch response) and the numeric value of the vertical speed. When glideslope track is initiated, the output from the vertical speed wheel is inhibited. The vertical speed mode of operation will become disabled when another pitch mode is selected, an altitude has been captured, or at glideslope capture.

WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893

N. Performance Management

(1) The Performance Management (PERF) mode is engaged when flaps are less than 26 degrees; TRI is in CLB, CRZ, or MCT; Flight Director on or Autopilot engaged; PMS valid; and the PERF pushbutton is operated. PERF will be displayed in the ATS and pitch windows on the flight mode annunciator.

(2) The PERF mode provides automatic control of pitch and thrust during climb, cruise, and descent phases of flight; automatic altitude capture; and automatic STEP climbs.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

O. Flight Management System

(1) The Flight Management System (FMS) is coupled to the flight director system, autopilot and autothrottle to provide guidance through integrated commands for controlling roll, pitch and engine thrust (FLIGHT MANAGEMENT SYSTEM - DESCRIPTION AND OPERATION, PAGEBLOCK 34-63-00/001 Config 2).

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

4. To Operate

A. Operate

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(1) For normal operation, FD CMD switch on overhead panel should be in NORM position.

WJE 401-404, 406, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(2) For normal operation, FLT DIR switch on captain's instrument panel should be in normal center position.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(3) Place FD switches on flight guidance panel to FD position.

(4) Flight director will be in Heading Hold mode.

(5) Select desired mode of operation.

FLIGHT DIRECTOR SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Flight Director system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893

D. The basic components of the Flight Director system operation are: attitude direction indicators, and the Flight Director and Lights switching. The Flight Director system interfaces with the Digital Flight Guidance computers for information of Roll and Pitch commands.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

E. The basic components of the Flight Director system operation are: attitude direction indicators, Primary Flight Display (PFD) aircraft with EFIS and the Flight Director and Lights switching. The Flight Director system interfaces with the Digital Flight Guidance computers for information of Roll and Pitch commands.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

F. The basic components of the Flight Director system operation are: EFIS Primary Flight Display and the Flight Director and Lights switching. The Flight Director system interfaces with the Digital Flight Guidance computers for information of Roll and Pitch commands.

WJE ALL

G. The Flight Director system components are located as follows:

Table 101

Component	Location
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893	
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887	
Primary Flight Displays	Captain's and First Officer's Instrument Panels
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
Attitude Direction Indicators (Primary Flight Display (PFD) on aircraft with EFIS)	Captain's and First Officer's Instrument Panels
WJE ALL	
Flight Director Switching	Overhead Panel
Flight Director Switches	Glareshield
Flight Director Lights	Captain's and First Officer's Instrument Panels and Flight Mode Annunciators (FMAs)

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana
Multimeter Model 8025A	Fluke

3. Trouble Shooting Flight Director System

A. Trouble Shoot

WJE 405, 409, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 891-893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are ADIs switching panel, and digital flight guidance computer.

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887

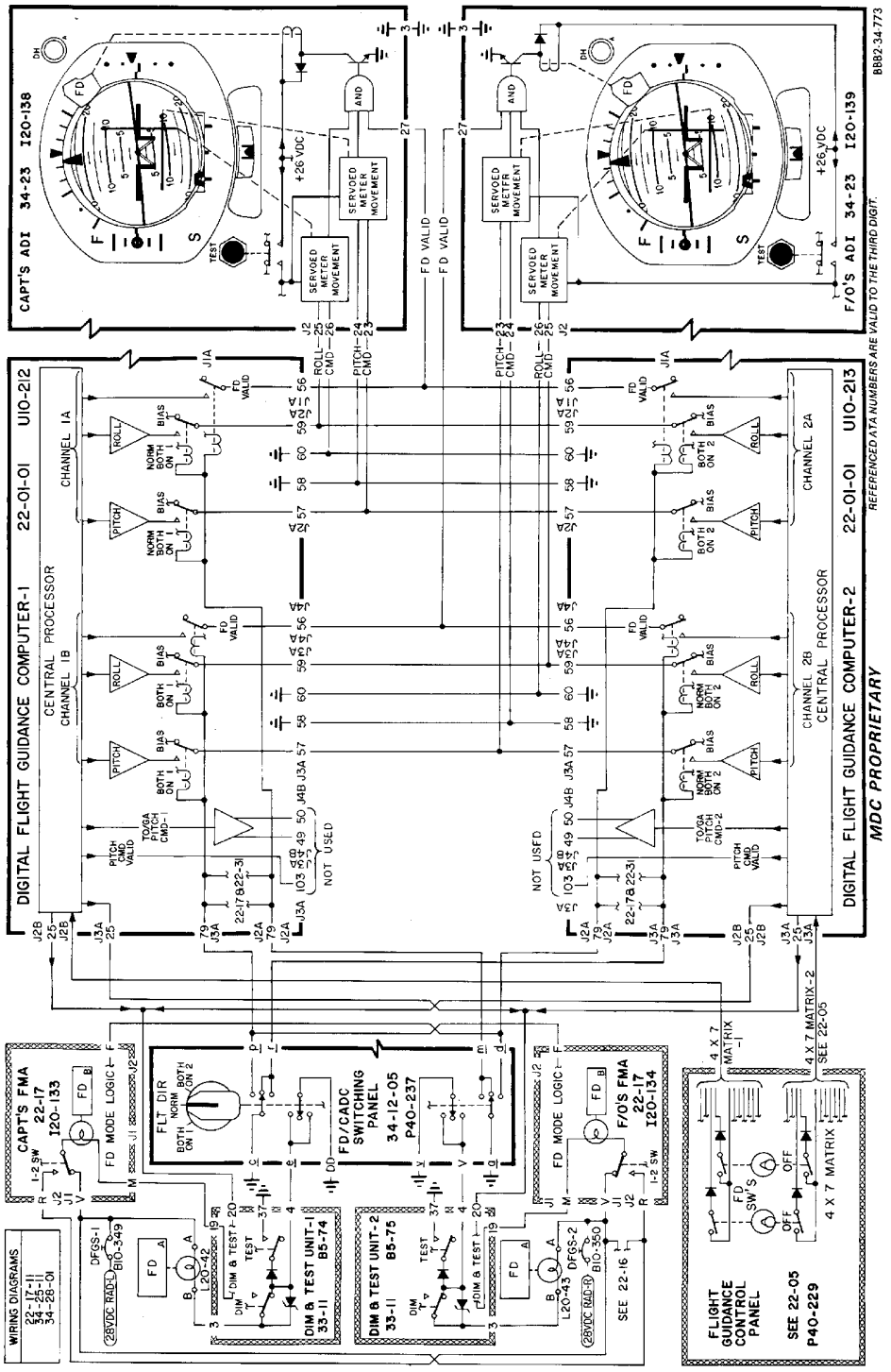
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS PFD's, switching panel, and digital flight guidance computer.

WJE ALL

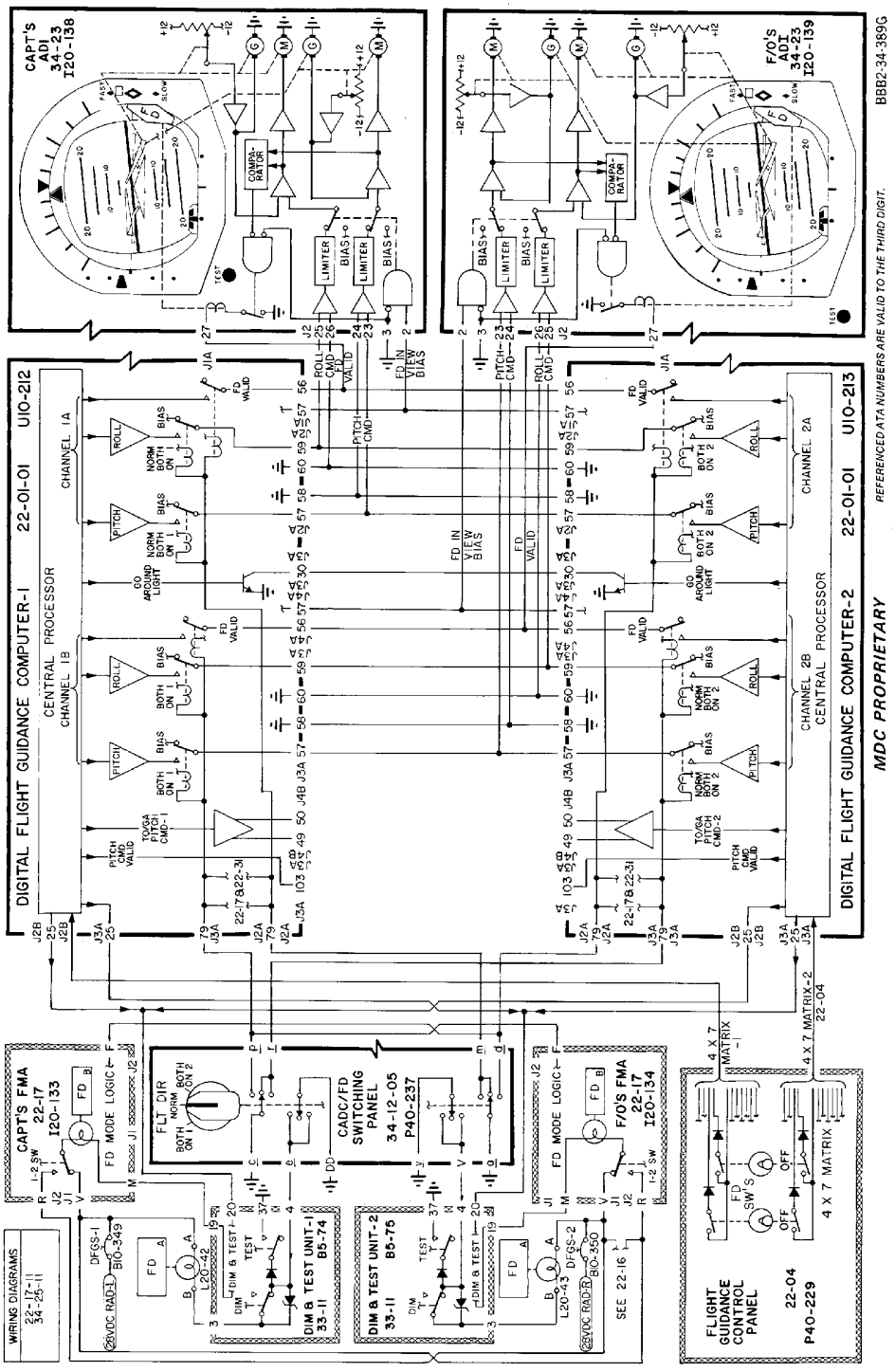
NOTE: Moisture over air data static ports may cause air data computer to become invalid. This would cause altitude preselect window to blank and may cause speed flags.

Table 103

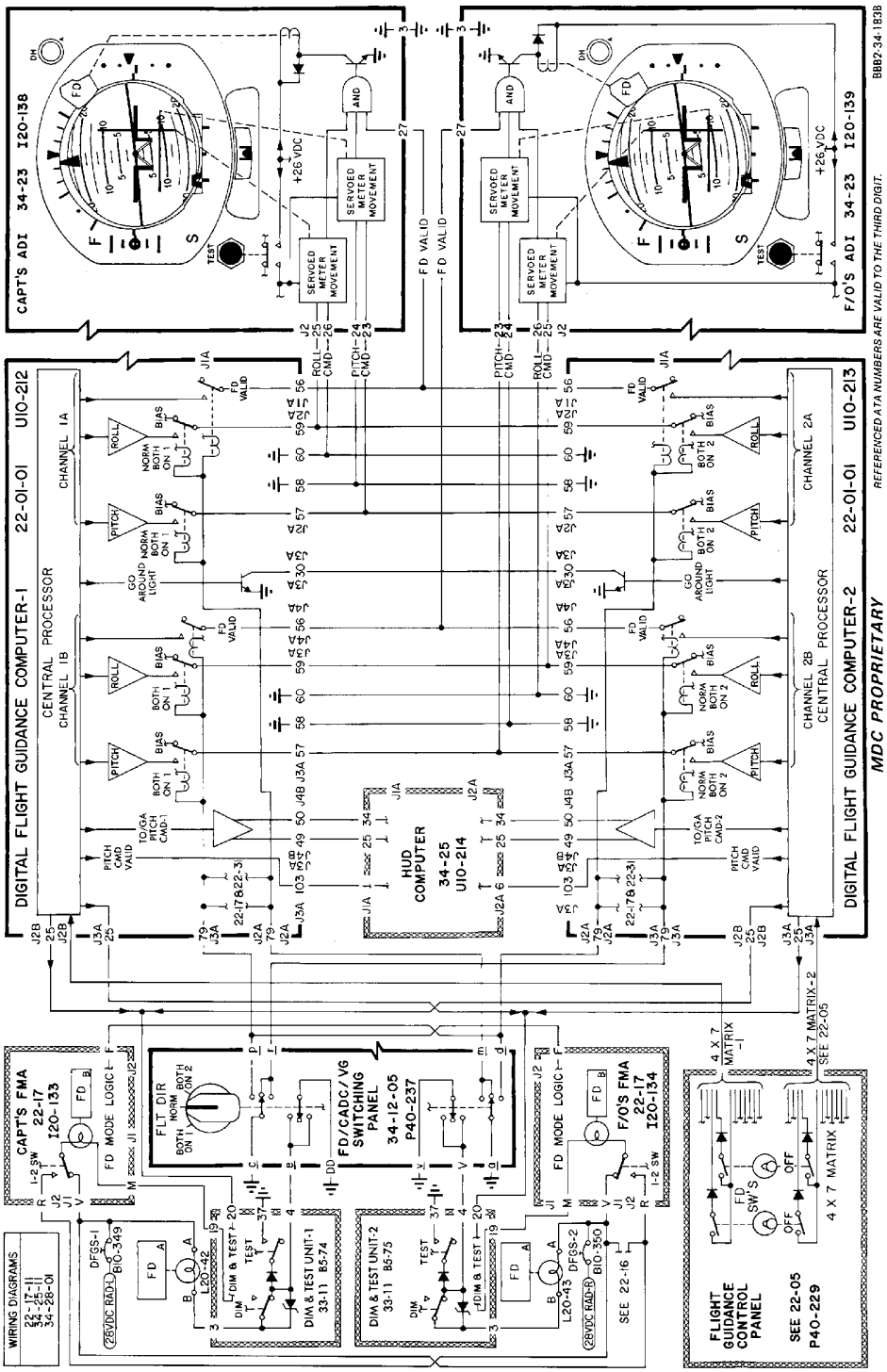
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



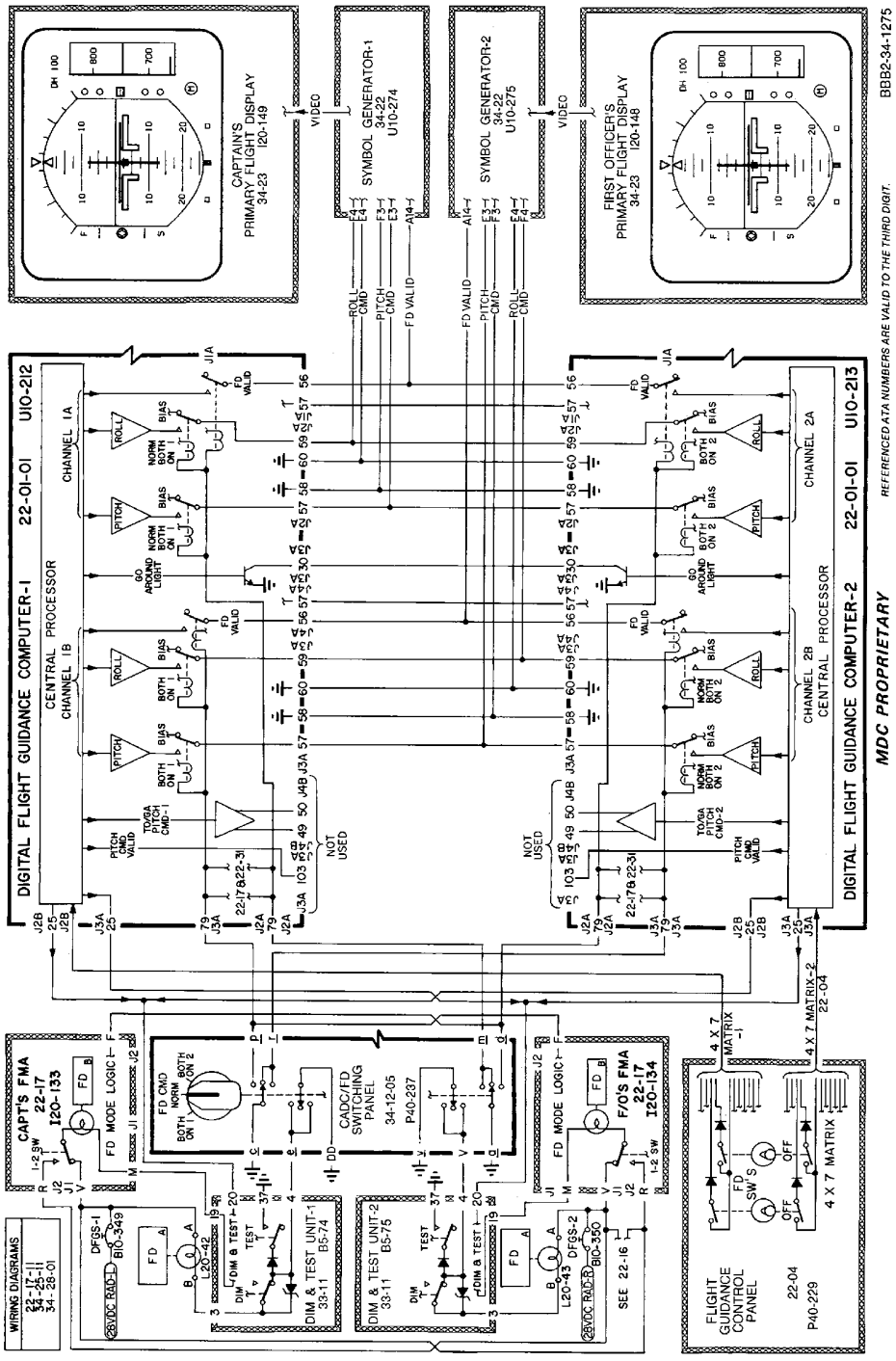
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 1 of 9)



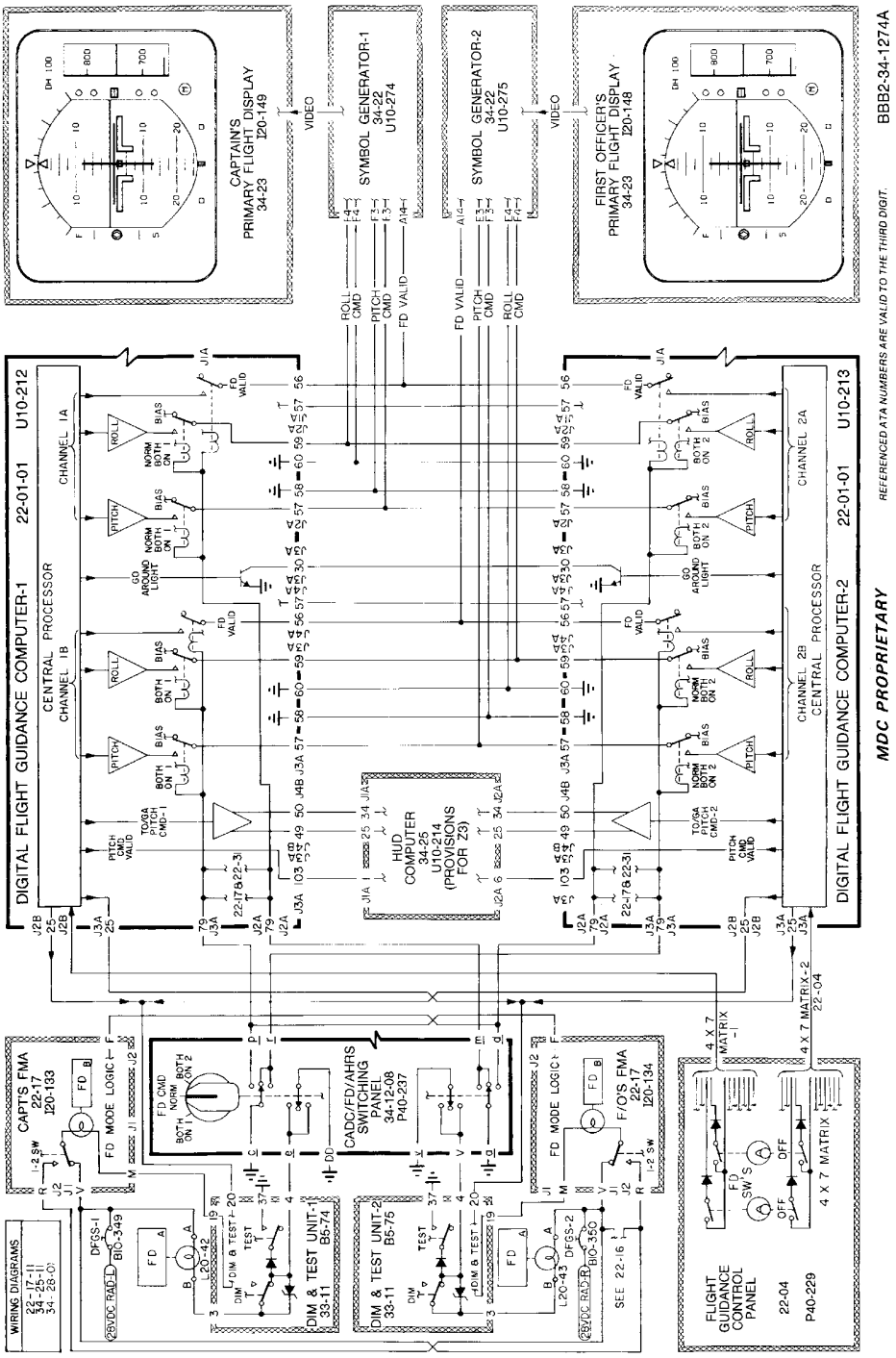
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 2 of 9)



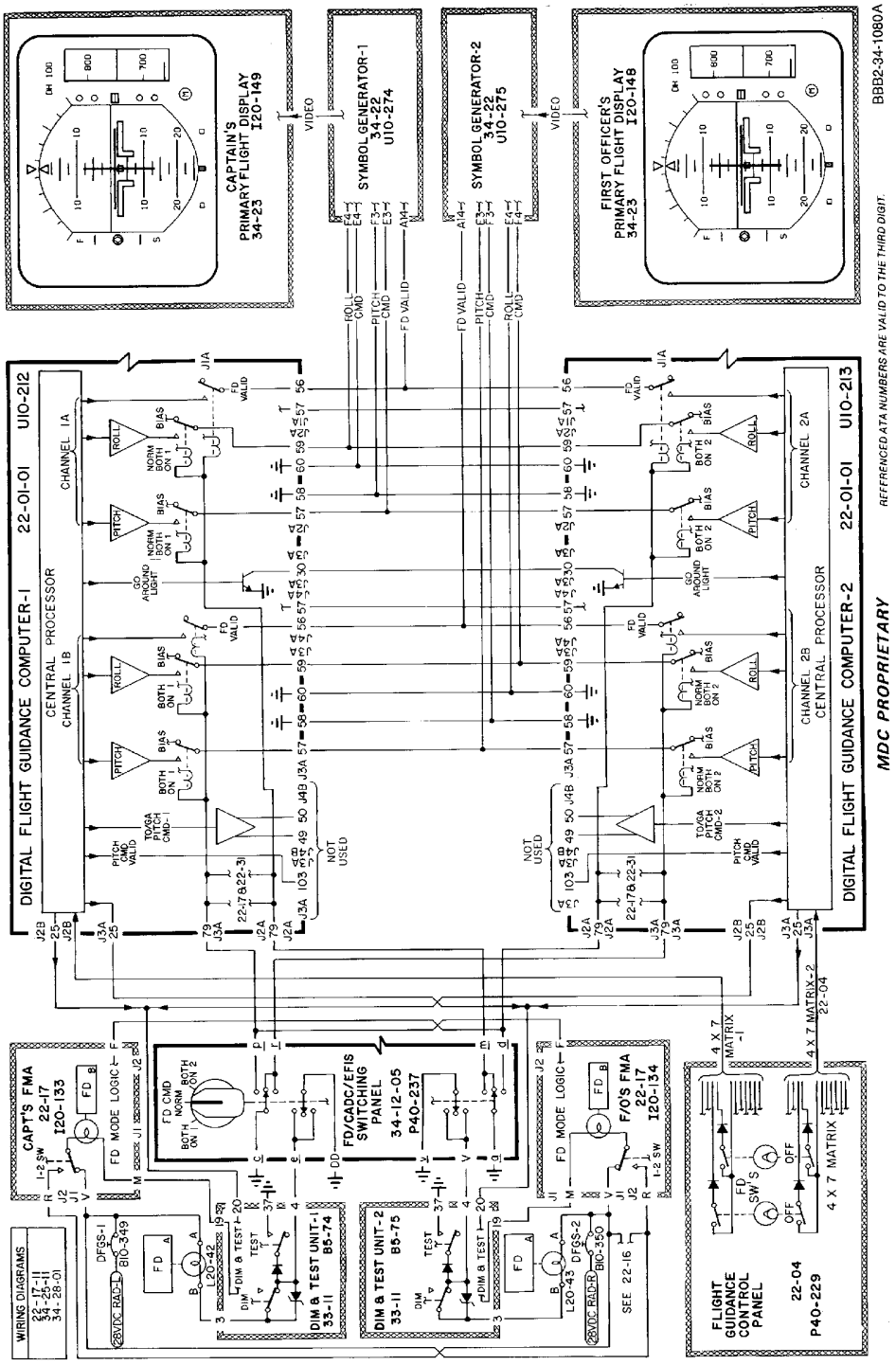
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 3 of 9)



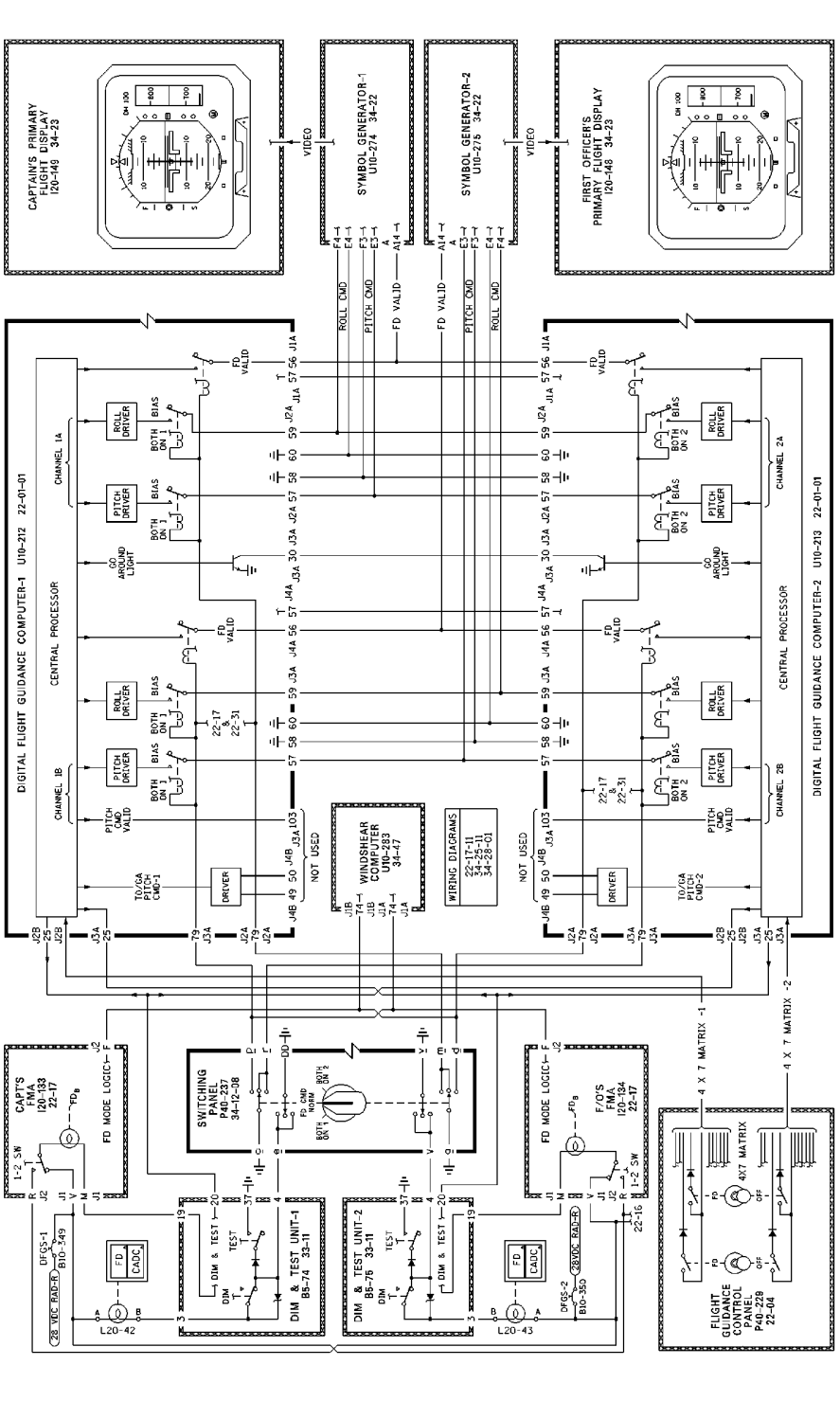
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 4 of 9)



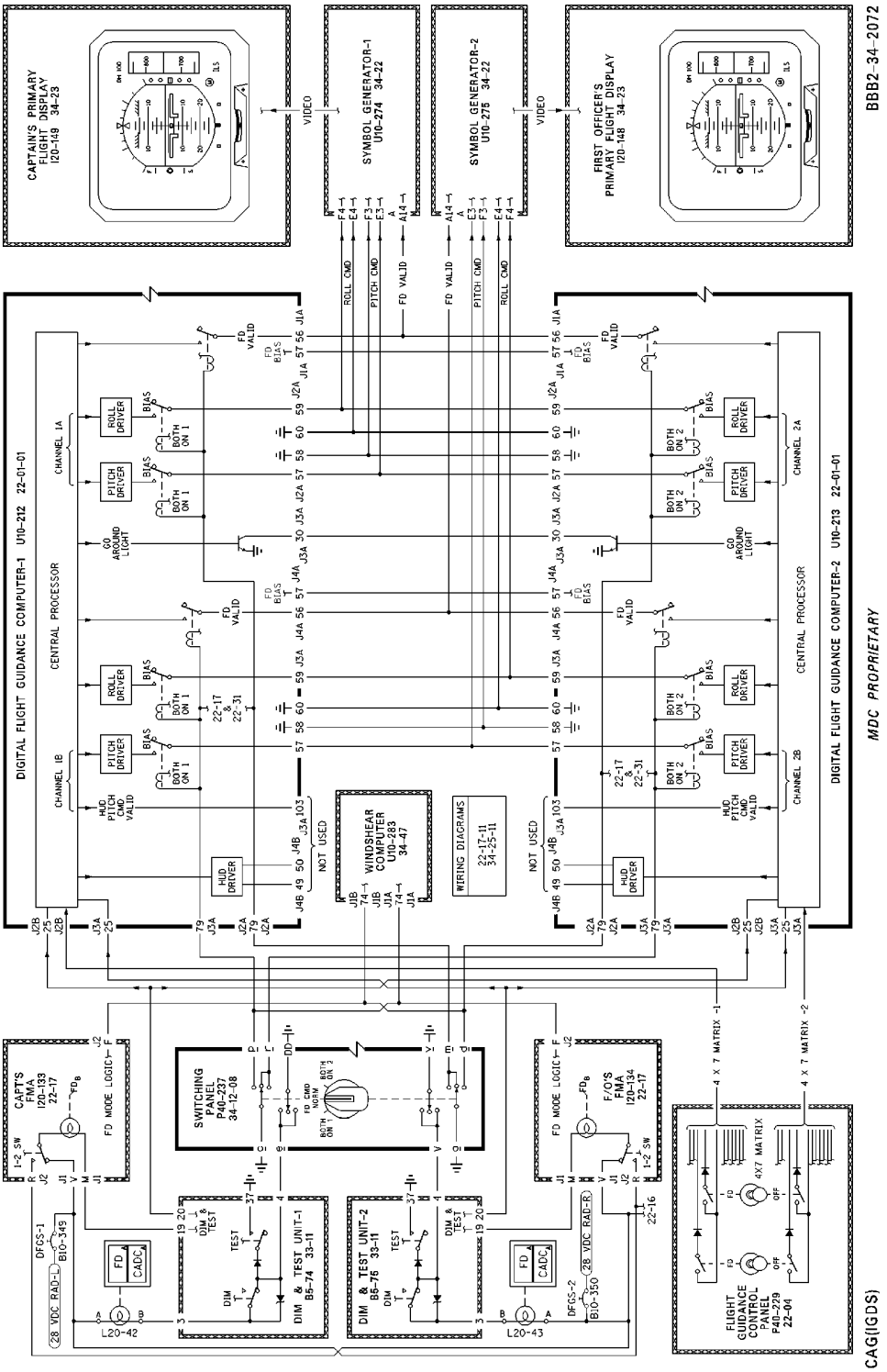
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 5 of 9)



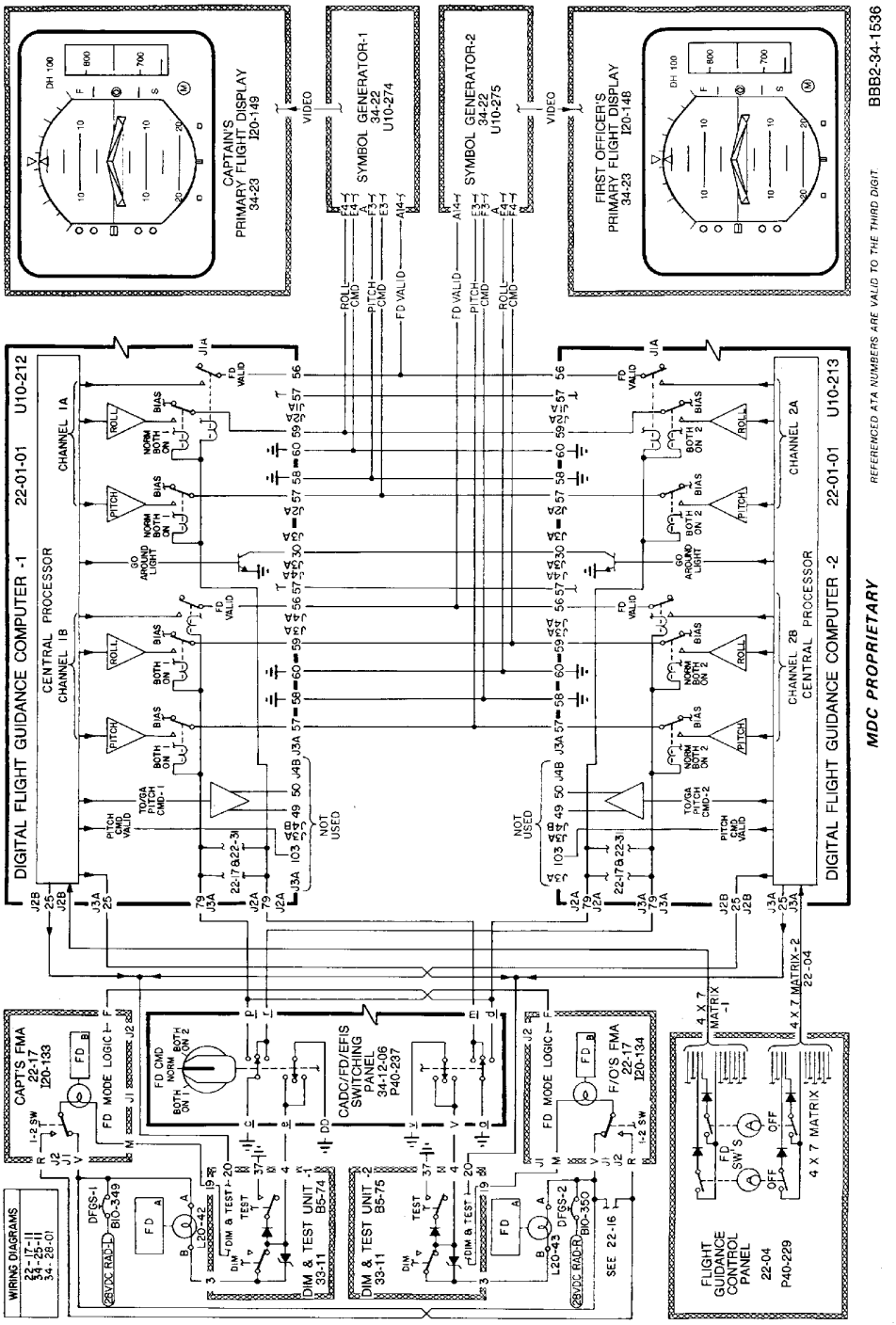
Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 6 of 9)



Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 7 of 9)



Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 8 of 9)



Flight Director System -- Schematic
Figure 101/34-24-00-990-801 (Sheet 9 of 9)

HEADS UP DISPLAY (HUD) - DESCRIPTION AND OPERATION

1. General

A. The Heads Up Display (HUD) system provides a direct viewing guidance display to the Captain during takeoff, approach (initial phase, flare and rollout), and go-around mode. HUD guidance symbology is displayed on the pilot's optics display unit in the Captain's forward field of view. Operation of the HUD system is compatible with the autopilot and flight director systems. The HUD system consists of the following units (Figure 1):

- Pilot Display Unit (PDU)
- HUD Computer
- HUD Control Panel

2. Description

CAUTION: PILOT DISPLAY UNIT MUST BE HANDLED WITH CARE. IN MOVING OPTICAL ELEMENT TO VIEWING POSITION USE EXTREME CARE TO PREVENT EXCESSIVE FORCE IN ANY DIRECTION OR RAPID MOTION OF OPTICAL ELEMENT DURING EXTENSION OR RETRACTION. LATCH MUST BE OPENED BEFORE OPTICAL ELEMENT IS MOVED FROM THE STOWED POSITION. CAUTION SHOULD ALSO BE EXERCISED TO PREVENT FINGERPRINTS ON EITHER FRONT OR AFT SURFACES OF THE OPTICS. OPTIC LENS IS MADE FROM ACRYLIC PLASTIC WHICH MAKES IT MORE SUSCEPTIBLE TO SCRATCHING AND ABRASION DAMAGE. OPTICS SURFACES SHOULD NOT BE CLEANED WITH ANY CLOTH, HAND OR HANDKERCHIEFS. USE ONLY CLEAN FLANNEL CLOTH, WITH OR WITHOUT PLASTIC LENS CLEANER.

A. Pilot's Display Unit (PDU) - The PDU permits the pilot to receive important aircraft flight guidance information in the same field of view as the outside world. The PDU is located above the Captain's windshield. Provisions are installed for a PDU installation above the First Officer's windshield. The PDU contains the optics display element, a cathode ray tube, and power supply, Captain's communication speaker, air outlet, map light and switch, display brightness control, two LED fault indicators, and three electrical connectors for connection to aircraft wiring harness. The optics display element has a stowed and viewing position. In the viewing position, it is in the Captain's forward field of view and the HUD system is in operation. Display brightness contrast is automatically maintained, and the display is refreshed every 20 milliseconds. (COLD WEATHER PROTECTION - SERVICING, PAGEBLOCK 12-30-01/301)

B. Computer

(1) The HUD computer can accept input sensor data in discrete, digital, analog or synchronization. Signal inputs to the HUD computer (Figure 3) are integrated and processed under the direction of the central processing unit (CPU). The CPU sends display data and output commands to the internal symbol generator. The symbol generator provides the necessary instructions for the cathode ray tube (CRT) presentation of the HUD symbology. HUD symbology is continuously updated and electronically projected on the face of the CRT. From there it is projected onto the optical display element in the pilot's forward field of view. All symbols are continuously written, but only those symbols applicable to the current mode of operation are visible; all others are blanked. Five fault lamps are located on the front panel of the computer. Non-illumination of a lamp indicates a fault in the system as noted on the placarding of the fault indicator. The fault indicators represent the following as placarded.

Table 1

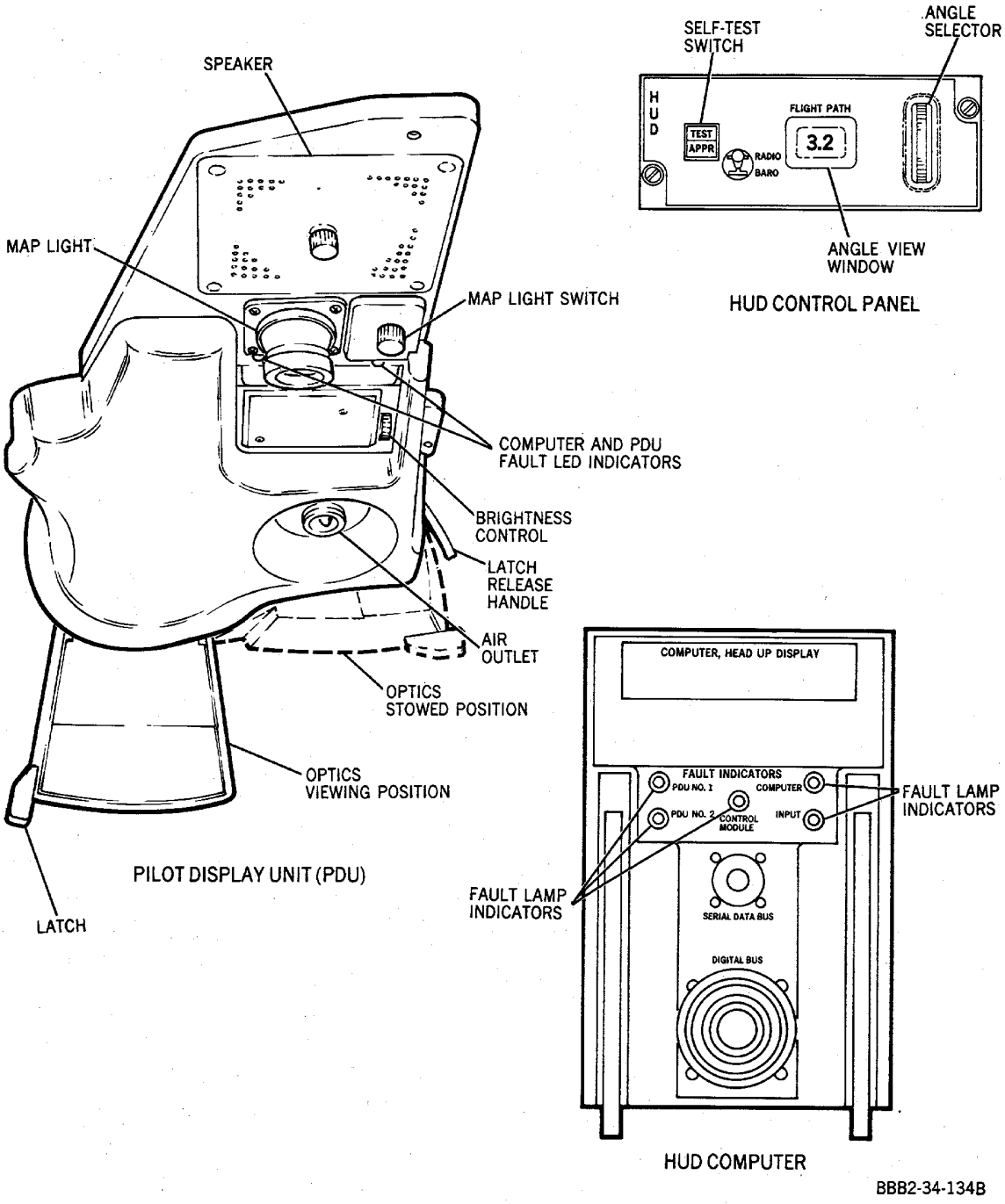
(1) PDU NO. 1	(3) COMPUTER	(5) CONTROL PANEL
(2) PDU NO. 2	(4) INPUT	

Table 1 (Continued)

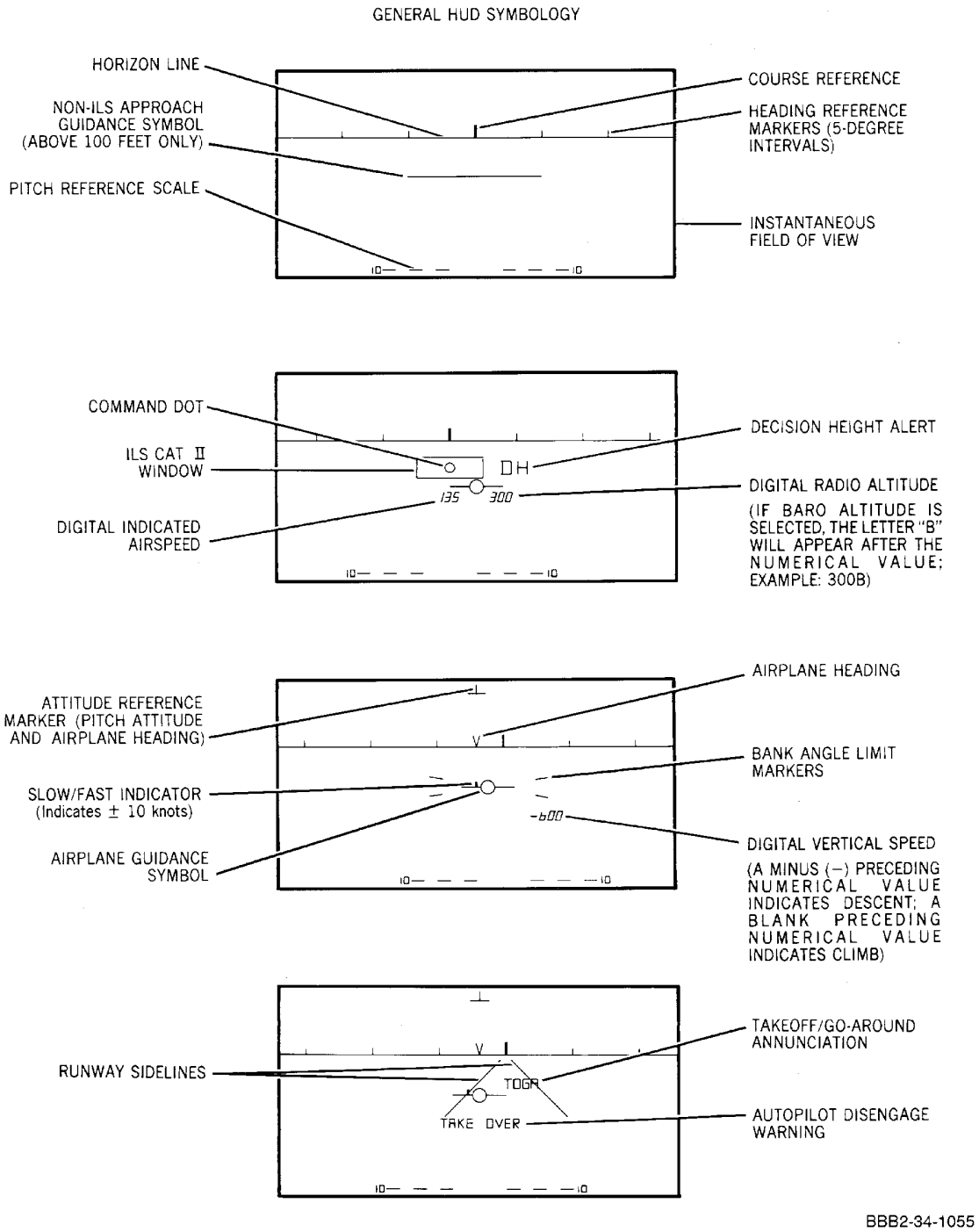
Test electrical connectors are also located on the front panel. These are used in conjunction with a portable line tester and for bench tests.

(2) The HUD computer is located in the electrical/electronics compartment. It is a line replaceable unit weighing approximately 15 pounds.

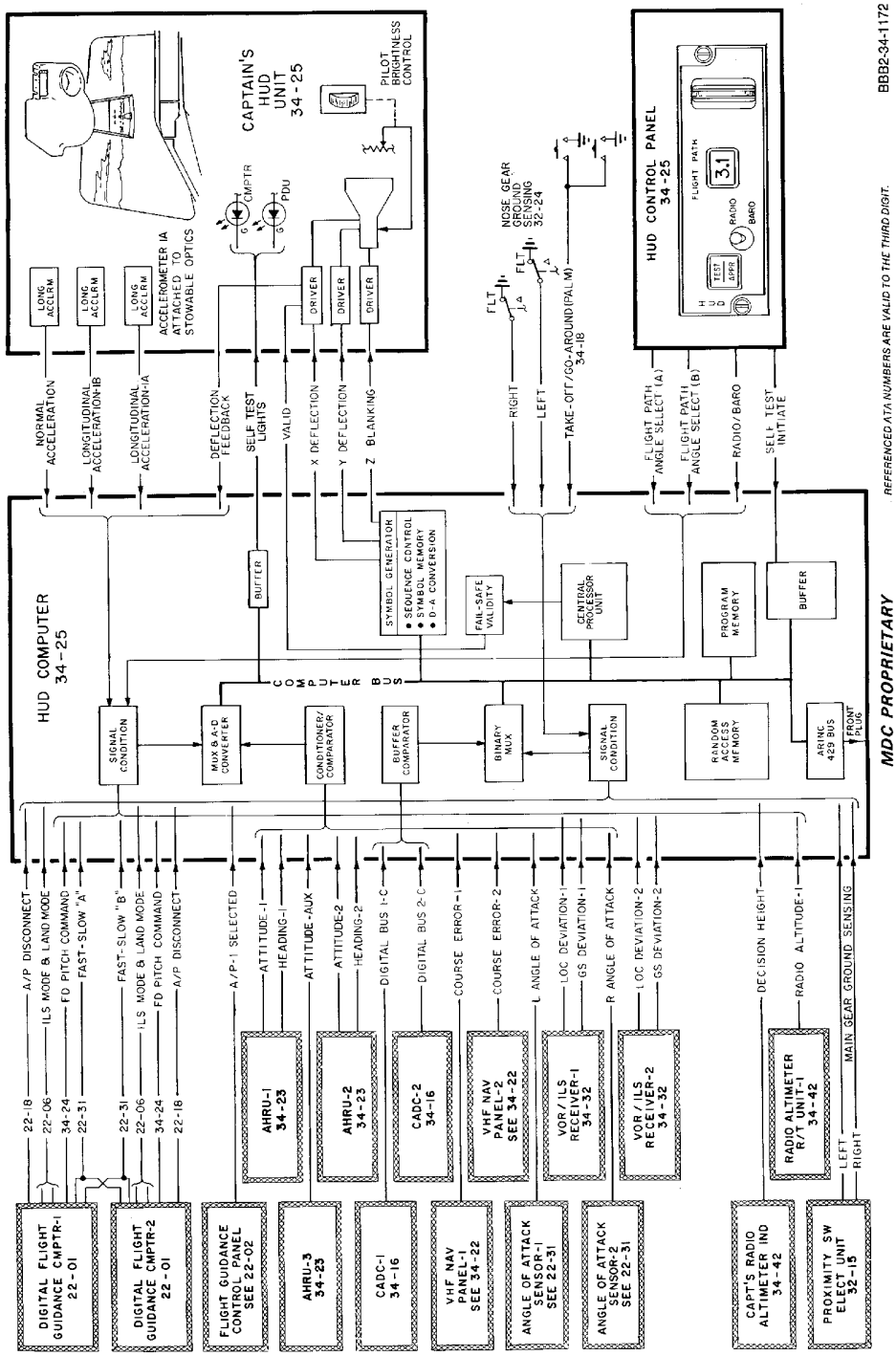
C. Control Panel - The control panel is located on the pedestal. It incorporates a thumbwheel, which is used to select the desired flightpath angle and readout, a radio altimeter/ barometric altitude display switch, and a self-test switch/approach mode reset. The TEST/APPR switch permits the pilot to perform a confidence self-test of the system while on the ground. When pressed in flight, the TEST/ APPR switch terminates the takeoff/go around mode and reverts system back to approach mode. The control panel is located on the pedestal in the flight compartment, and is a line replaceable unit.



Heads Up Display (HUD) - Components
Figure 1/34-25-00-990-805



General HUD Symbology
Figure 2/34-25-00-990-806



Heads Up Display (HUD) - Block Diagram
Figure 3/34-25-00-990-807

3. Operation

A. The following sensor and discrete signals input to the HUD system must be valid for proper operation of the system in flight:

Table 2

HUD Sensors and Interfacing Systems	Discrete Systems
Vertical Gyro	Ground Control (Nose Gear)
Air Data Computer	TO/GA Signal (Throttles)
Angle-of-Attack Sensor	Main Gear Compressed (WOW)*
VOR/ILS Receiver	Decision Height
Radio Altimeter	Autopilot Disconnect
Radio Altimeter Indicator	Pitch Command Valid
Course Error	Fast-Slow Valid
VHF/NAV Control Panel	ILS Mode
Compass System	LAND Mode
HUD Pitch Command	Autopilot-1 Selected
(Digital Flight Guidance)	Course/Heading Valid
Fast-Slow	Vertical Gyro Valid
(Digital Flight Guidance)	ILS Energize
	ILS Valid
	LOC Valid/Glideslope Valid
	Radio Alt Valid
	Baro Alt/Radio Alt Select Switch
	* WOW - Weight on Wheels.

B. When the HUD system is energized and the optical display element is in the stowed position, the system is in a standby mode. (The warming element in the cathode ray tube is operational.) When the optical display is placed in the viewing position, the system is operational; it may take several seconds before the display appears.

C. The flight path angle for HUD display is selected using the thumbwheel selector on the control panel. Angle selected is displayed in the FLIGHT PATH view window.

(1) On ILS approach, the angle selected should coincide with the glide path angle. The maximum range for selected flight path angle which the computer will accept on an ILS approach is from -2.0 to -3.5 degrees.

(2) On non-ILS approach, the maximum range for the selected flight path angle is from -3.0 to -4.5 degrees. Flight path angle on a non-ILS approach is determined using the operational requirement angle chart.

D. HUD Guidance Functions - The HUD operates in two major modes: Approach and Takeoff/Go Around (TOGA). When the HUD system is in takeoff or go-around mode, termination of the mode for reversion to approach mode is accomplished by pressing the TEST/APPR switch on the control panel, or by stowing the PDU optics. Each major mode has sub-modes as follows: (Figure 4)

(1) APPROACH

- * Above Transition Height (TH)

- * Between TH and Flare initiate point (FH)
- * Between FH and Touchdown (TD)
- * Landing roll out.

(2) TOGA

- * Take-off Roll
- - Rotation after take-off roll (between nose gear liftoff and main gear liftoff)
- # Climb out (after main gear lift-off)
- # Airborne go around.

(3) All above modes marked with (*) can occur under either NON-ILS or ILS conditions. A NON-ILS condition occurs with none, or only one, ILS receiver tuned. An ILS condition requires that both ILS receivers be tuned. (The HUD reverts to NON-ILS display whenever signals required for ILS control law computation are missing or faulty.)

(a) There are two levels of ILS conditions. Level 1 is for CAT III, indicated by the land mode discrete from the autopilot. Level 2 is for CAT I or CAT II whenever the autopilot is not in LAND MODE. The control laws and symbology for both ILS levels are essentially the same. The only difference is the value of the Transition Height.

(4) Modes marked with (#) have a reversion capability to fixed pitch guidance. If the TOGA command from the autopilot is invalid, the reversion is automatic by blanking the Aim Dot.

(5) The HUD display symbology for NON-ILS approach, ILS approach and takeoff. (Figure 5), (Figure 6) and (Figure 7)

E. System Monitoring - The HUD computer provides comprehensive monitoring and self-test functions. The monitoring sequence is repeated every computer cycle; i.e., every 60 milliseconds, as follows:

(1) Monitoring to detect any fault which would affect the CPU's ability to process data

(2) Monitoring the sensor input data to detect any invalid input data

(3) Monitoring the PDU electronic output to detect any error in symbology positioning.

F. Fault Indications - In order to be fail safe, the HUD must present no erroneous data to the pilots, unless it also gives some obvious indication that the data is wrong. Faults are indicated to the pilots as follows:

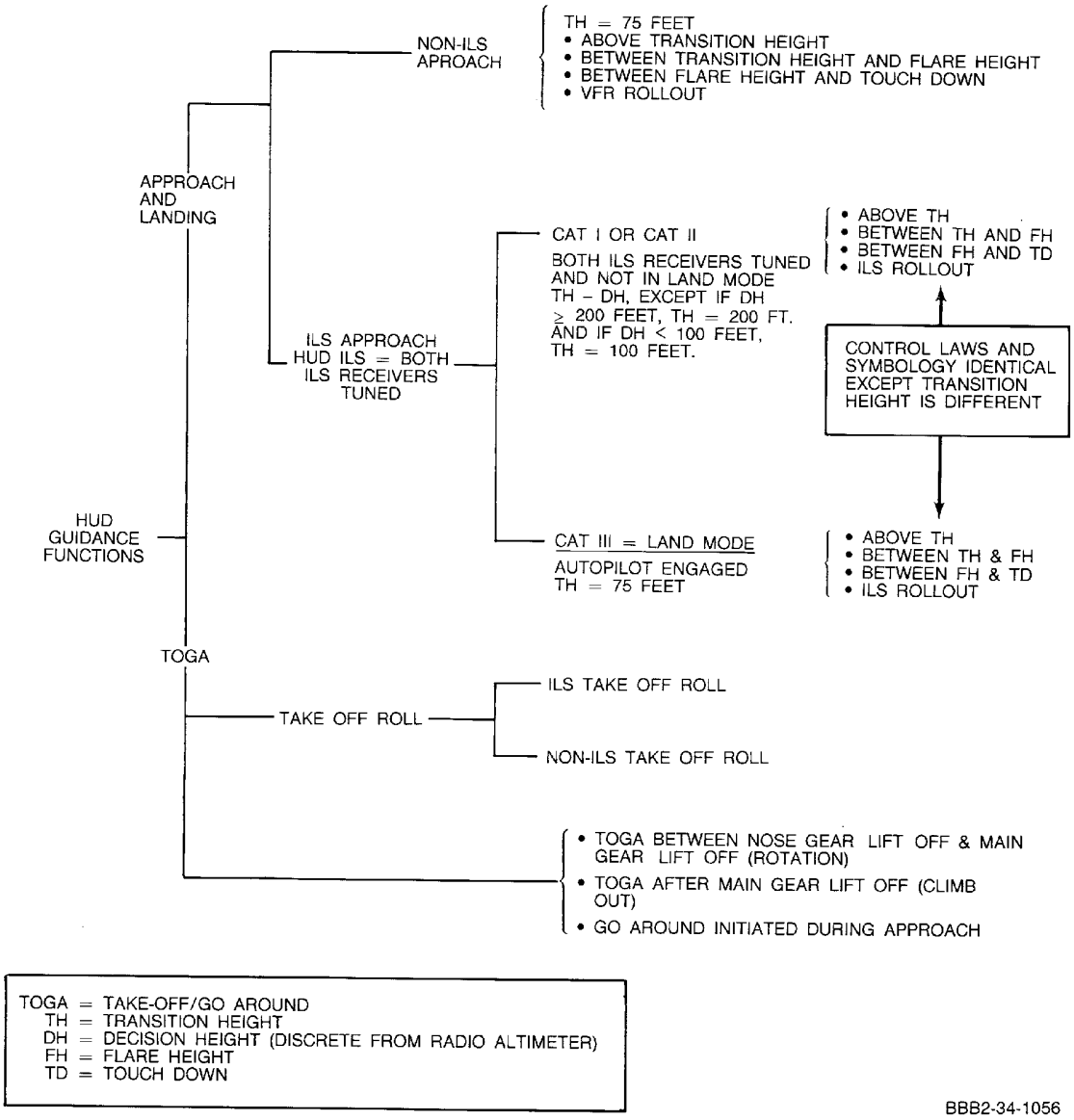
(1) If certain symbols are affected by a fault, the affected symbols are blanked

(2) If the entire display is unreliable, all symbols are blanked

(3) If a fault affects the computer's ability to make decisions, the entire display will be blanked.

G. Self test of the HUD system is accomplished by pressing and holding the TEST switch on the control panel (Figure 8). When the test switch is released, the display should revert to normal mode logic control. Those symbols required for the mode of operation will be present, and only the symbols which have valid inputs will be displayed.

(1) During self test, both LED fault indicators on the PDU should be on green, which indicates no fault in the PDU or computer. If the X display flashes or is not in view, or either LED is not illuminated, the system has determined that a failure is present. The fault indications should be reviewed and correct LRU replaced.

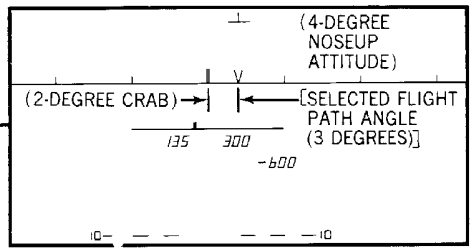


HUD Guidance Functions
Figure 4/34-25-00-990-808

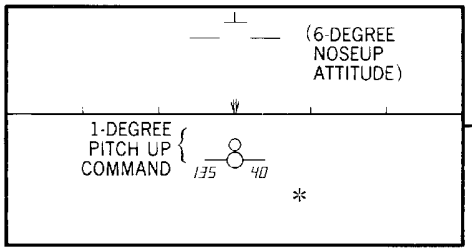
NON-ILS APPROACH SYMBOLOGY

Basic Non-ILS Approach Symbology

Example:
Display indicates 4 degrees noseup attitude, 2 degrees right crab, 3 degrees selected flight path angle, 135 KIAS, 300 feet radio altitude, 600 fpm rate of descent, approximately 3 knots fast.



✻ (Vertical speed blanks below 50 feet radio altitude.)



Flare Symbology (Non-ILS Approach)

The command dot appears flashing in airplane symbol between 60 and 45 feet radio altitude. Flare command will occur at 45 feet radio altitude.

Example:

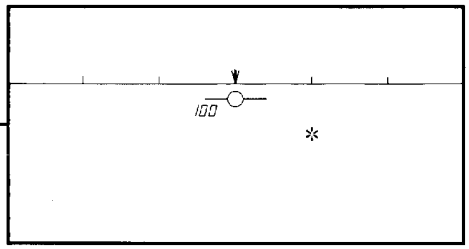
Display indicates 6 degrees noseup attitude, zero degrees crab, 3 degrees flight path angle, 135 KIAS, 40 feet radio altitude, and one-degree pitch attitude command.

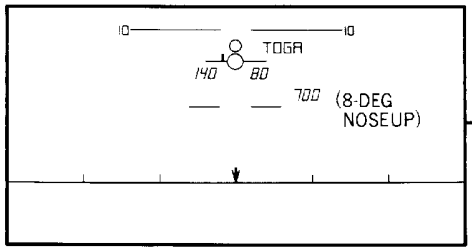
Rollout Symbology (Non-ILS Approach)

Pitch scale, radio altitude, dot pitch reference and command blanked at touchdown.

Example:

Display indicates airplane on centerline at 100 KIAS.





Go-Around Symbology (Non-ILS Approach)

Go-around mode is initiated by pushing TOGA button on either throttle lever. Command dot commands pitch attitude to maintain required airspeed and roll attitude to maintain heading. Airplane symbol is referenced to pitch attitude. Command dot flashes until positive rate-of-climb is attained.

Example:

Display indicates TOGA mode initiated, 8 degrees noseup attitude, 9 degrees pitch attitude commanded, 140 KIAS, 80 feet radio altitude, 700 fpm rate of climb, and approximately 3 knots fast.

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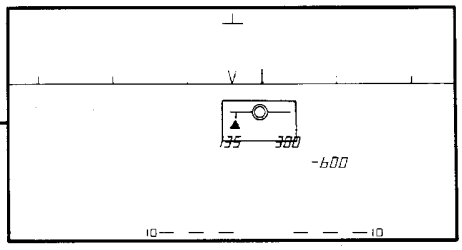
HUD NON-ILS Approach Symbology
Figure 5/34-25-00-990-809

Basic ILS Approach Symbology

Pilot flies airplane symbol to command dot.

Example:

Display indicates 4 degrees noseup attitude, 2 degrees left crab, on localizer course, on glide slope, 135 KIAS, 300 feet radio altitude, 600 fpm rate of descent and approximately 3 knots slow.

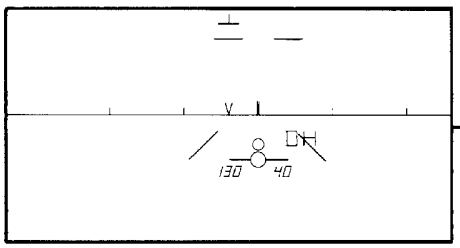


Flare Symbology (ILS Approach)

Runway side lines replace window below 100 feet altitude. DH alert appears flashing for 2 seconds at decision height and is then continuous until touchdown. Command dot flashes between 60 and 45 feet radio altitude. Flare is commanded at 45 feet radio altitude. Slow/fast indicator is blanked at 45 feet radio altitude.

Example:

Display indicates at or below decision height, 6 degrees nose up attitude, 2 degrees left crab, 130 KIAS, 40 feet radio altitude, 150 fpm descent rate, and one degree pitch up attitude command.

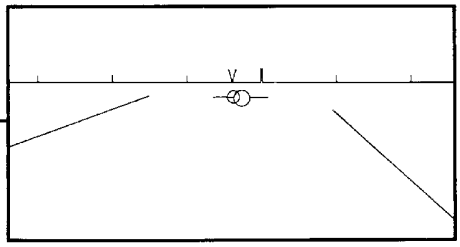


Rollout Symbology (ILS Approach)

Command dot provides guidance to runway centerline. Pitch reference scale, radio altitude, and attitude reference blanked at touchdown. Indicated airspeed blanked below 30 KIAS.

Example:

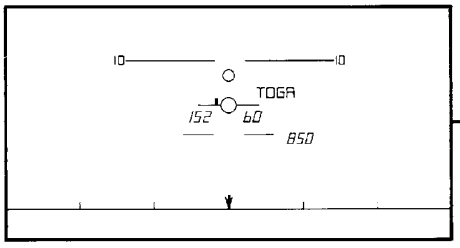
Display indicates airplane symbol halfway between airplane heading and runway heading, airplane heading is 2 degrees to left of runway centerline.



Go-Around Symbology (Identical to non-ILS go-around symbology.)

Example:

Display indicates TOGA mode initiated, 7 degrees noseup attitude, 9 degrees pitch, attitude commanded, 152 KIAS, 60 feet radio altitude, 850 fpm rate of climb and approximately 3 knots fast.



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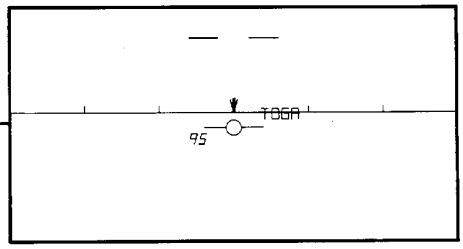
HUD ILS Approach Symbology
Figure 6/34-25-00-990-810

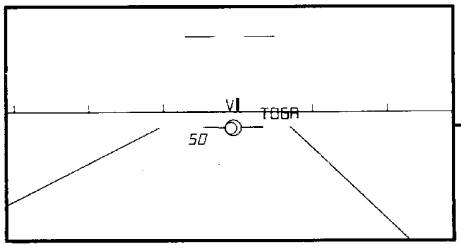
Non-ILS Takeoff Roll Symbology

Basic takeoff symbology is displayed.

Example:

Display indicates TOGA mode initiated, airplane heading is aligned with runway centerline, 95 KIAS.





ILS Takeoff Roll Symbology

Command dot provides guidance to runway centerline and runway side lines are provided while the nosewheel is on the ground.

Example:

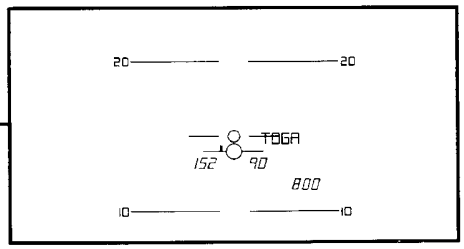
Display indicates TOGA mode initiated, airplane right of runway centerline, 50 KIAS.

After Takeoff (ILS and Non-ILS)

Command dot commands pitch attitude to maintain reference speed and roll attitude to maintain heading. Command dot flashes if negative climb rate is sensed. Slow/fast indicator shows deviation from reference speed.

Example:

Display indicates TOGA mode initiated, 14 degrees noseup attitude, 152 KIAS, 90 feet radio altitude, 800 fpm rate of climb, approximately 3 knots fast, and 15 degrees pitch up attitude commanded.



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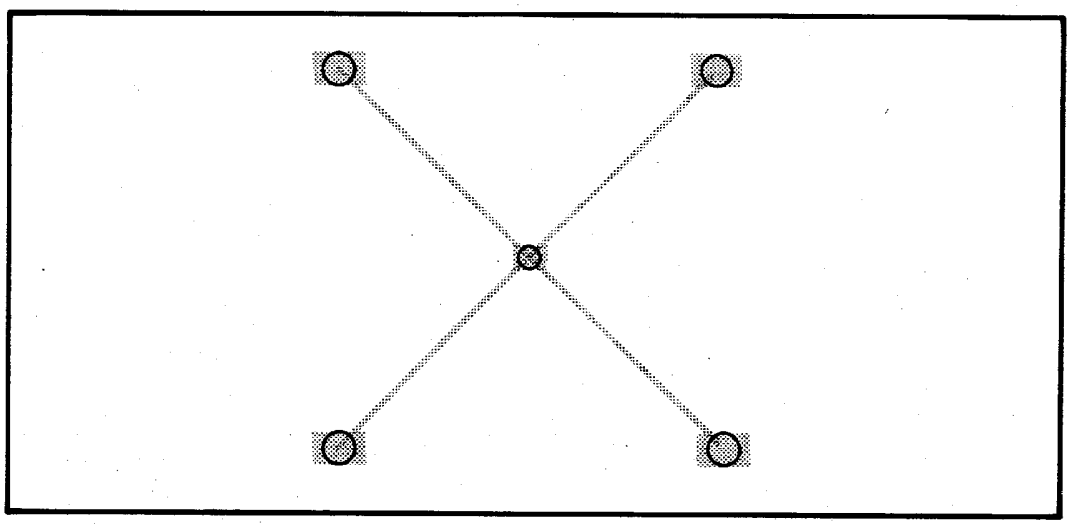
HUD Takeoff Symbology
Figure 7/34-25-00-990-811



SYMBOLOGY DISPLAY DURING HUD SELF-TEST

BBB2-34-135B

Optics Test Display
Figure 8/34-25-00-990-812

4. To Operate

A. HUD and all interfacing systems energized.

B. Lower optics display on PDU to viewing position.

CAUTION: DO NOT LEAVE BRIGHTNESS CONTROL IN FULL BRIGHT POSITION.

C. Adjust brightness control for best viewing display.

D. Manual Self-Test

(1) Displays "X" and Test Pattern. (Figure 8)

(2) When "X" is displayed steady, computer and PDU are valid; if "X" flashes, computer and/or PDU are invalid.

(3) The electronically-generated Test Pattern must overlay a fixed test pattern consisting of 5 circles located on the optic block, if alignment relative to the cathode ray tube is correct.

(4) Two green fault isolation lamps, located near the PDU dimming control, are illuminated, one for the computer and one for the PDU.

- Lights on = valid
- Lights off = invalid.

HEADS UP DISPLAY (HUD) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble shooting provided in this section are basic procedures for isolating and correcting a faulty HUD system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable Units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the system are: The Pilot Display Unit, Control Panel and Computer. The system interfaces with the digital flight guidance computer. In trouble shooting some checks may have to be made to the interfacing system. See applicable trouble shooting section.

E. The components are located as follows:

Table 101

Component	Location
Pilot Display Unit	Captain's and First Officer's Overhead
Control Panel	Pedestal Flight Compartment
Computer	Electrical/Electronics Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting HUD System

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are pilot display unit, pilot control module, digital display computer unit and digital flight guidance computers.

Table 103

Procedures		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs. or LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires,
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground. LRUs.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	When a dual system is installed, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

B. HUD Fault Indications - There are five fault indicators on the front of the HUD computer. A fault is signaled when any of these indicators fails to come on. There are four different types of fault indications, as follows:

(1) Input Fault Indicator: When this indicator fails to come on, one of the aircraft sensor inputs is in error.

(2) PDU NO. 1 and PDU NO. 2 Fault Indicators: When either of these indicators fails to come on, the PDU itself is at fault, and should be replaced.

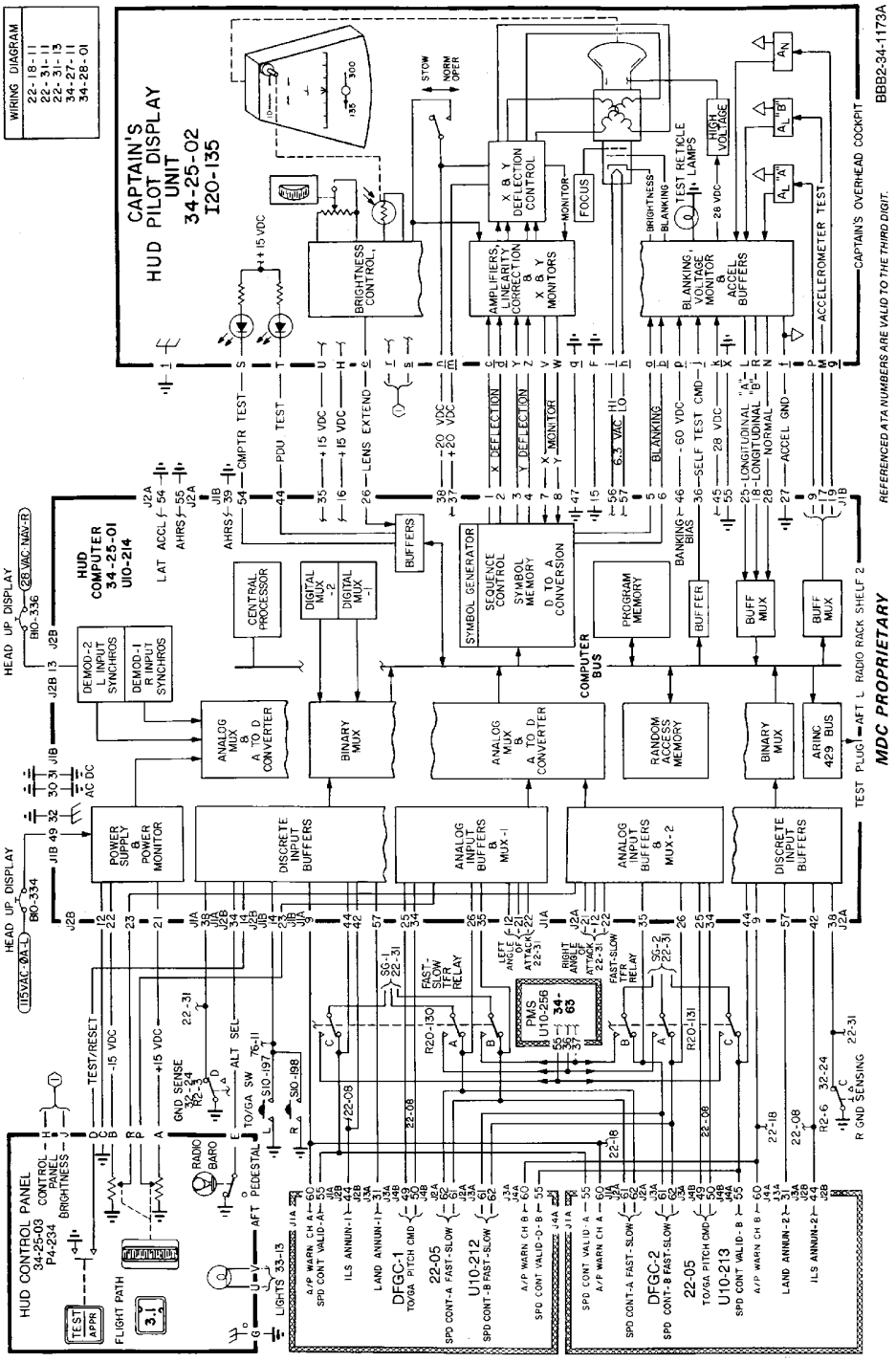
NOTE: If the pilot presses the control panel module TEST/APPR switch, this will cause the Computer and PDU indicators on the PDU to come on. Failure of these indicators to come on is a direct indication that the HUD component LRU must be replaced.

(3) Control Module Fault Indicator: When this indicator fails to come on, the control module is at fault (flight path signals fail to compare).

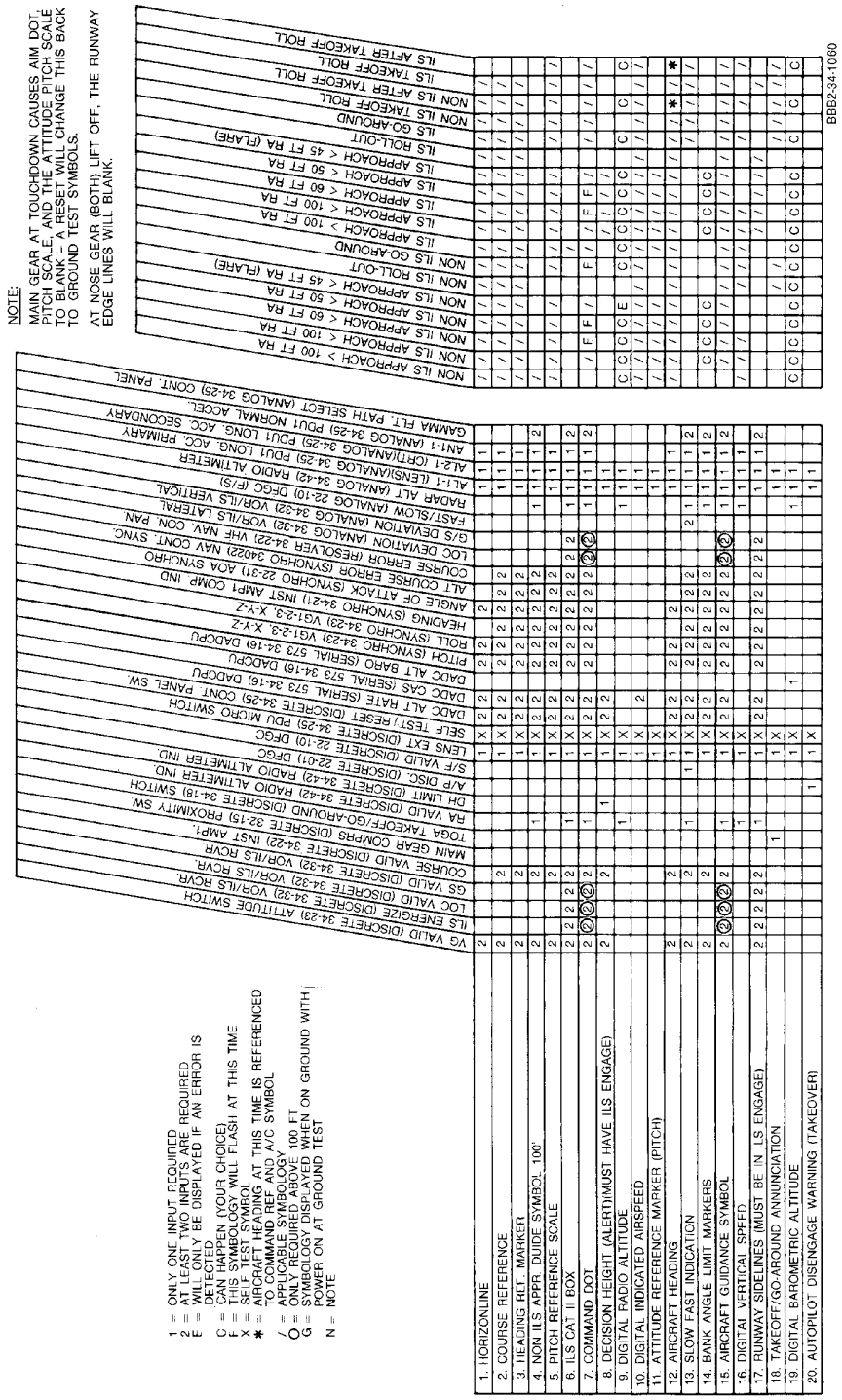
(4) Computer Fault Indicator: When this indicator fails to come on, computer failure is the cause.

NOTE: Many input faults will cause a computer fault, due to the inability of the computer to process the sensor input signal as required.

C. Checking Sensor Input - Input monitoring, performed by the HUD computer, checks the integrity of the various input signals. If an input fault is detected, any symbols on the HUD display which are a function of the faulty input are blanked. Most of the input tests reside in the software. The CPU makes all of the pass/fail decisions. When situations occur which cause a symbol or symbols to be blanked, the sensor input that caused the fault can be traced back using the matrix chart. (Figure 102)



Captain's Heads Up Display -- Schematic
Figure 101/34-25-00-990-802



HUD Trouble Shooting Matrix
Figure 102/34-25-00-990-804

HEADS UP DISPLAY (HUD) - MAINTENANCE PRACTICES

1. General

A. The following maintenance practices contain a self test of the HUD system and a mechanical check of the optics display block on the pilot's display unit for operation and clearance.

B. The pilot's display unit is located in the overhead cavity above the captain's windshield. The pilot's control panel is located in the center pedestal in the flight compartment. The computer is located in the electrical/electronics compartment.

C. The following systems should be installed and functioning:

- Digital Flight Guidance Systems
- Vertical Gyros
- Central Air Data Computers
- VHF/NAV Receivers
- Angle-of-Attack Sensors
- DG Compass Systems
- Radio Altimeter
- Proximity Unit

2. Equipment and Materials

NOTE: Equivalent substitutes can be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
Cloth - cotton (flannel) lintless	
Snap Glass and Plastic Anti-Static optic cleaner	MIST Products Huntington Sta., New York
Soft bristle brush	

3. Adjustment/Test HUD System

CAUTION: PILOT DISPLAY UNIT MUST BE HANDLED WITH CARE. IN MOVING OPTICAL ELEMENT TO VIEWING POSITION USE EXTREME CARE TO PREVENT EXCESSIVE FORCE IN ANY DIRECTION OR RAPID MOTION OF OPTICAL ELEMENT DURING EXTENSION OR RETRACTION. LATCH MUST BE OPENED BEFORE OPTICAL ELEMENT IS MOVED FROM THE STOWED POSITION. CAUTION SHOULD ALSO BE EXERCISED TO PREVENT FINGERPRINTS ON EITHER FRONT OR AFT SURFACES OF THE OPTICS. OPTIC LENS IS MADE FROM ACRYLIC PLASTIC WHICH MAKES IT MORE SUSCEPTIBLE TO SCRATCHING AND ABRASION DAMAGE. OPTICS SURFACES SHOULD NOT BE CLEANED WITH ANY CLOTH, HAND OR HANDKERCHIEFS. USE ONLY CLEAN FLANNEL CLOTH, WITH OR WITHOUT PLASTIC LENS CLEANER.

A. Self Test

(1) Place the optic display on the PDU in the viewing position; allow a short delay for display to come on.

CAUTION: DO NOT LEAVE BRIGHTNESS CONTROL IN FULL BRIGHT POSITION.

(2) Adjust the brightness for medium intensity (determined by viewing the display through the optics).

(3) Press and hold TEST switch located on the pilot's control module. The LED indicators on the PDU should come on and the following should be displayed on the optics display. (Figure 201)

B. Optics Display Mechanical Check

(1) Place optic display in stowed position and verify optics contacts its stowed position with no interference with structure.

(2) Extend (viewing position) optic display and verify it contacts the extend stop.

(3) Position optic display to the override position by applying a forward force to the optic display; it should move forward and stop in the forward detent (override) position.

NOTE: If sunvisor is directly in front of optic display, it may interfere with optic display, caution should be used to avoid scratching optic display or sunvisor.

(4) Ensure optic display will remain in the override detent until pulled aft into viewing position, check that optic display does not interfere with structure while in the overide position.

4. Cleaning Optic Lens and CRT

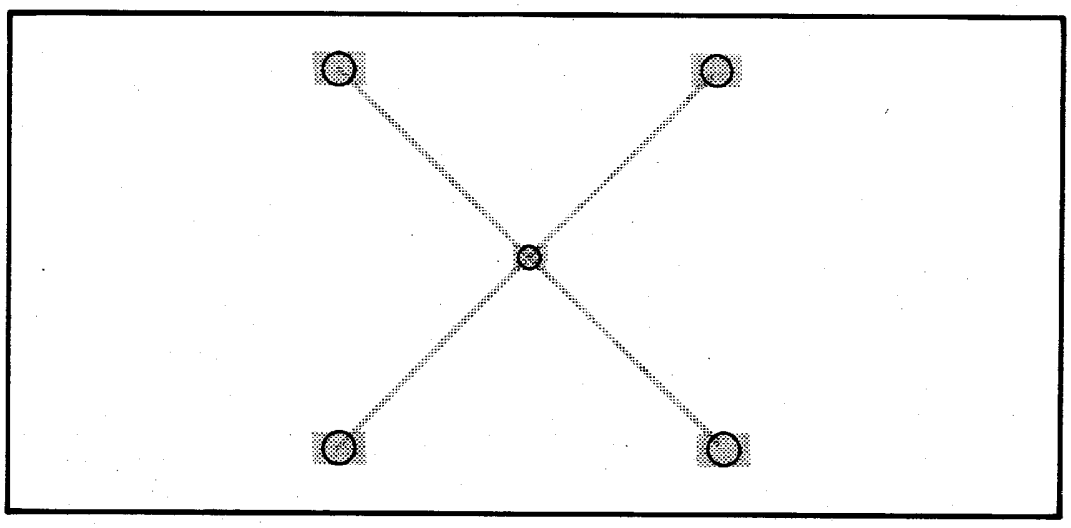
A. Cleaning

(1) Remove surface dust with soft bristle brush.

(2) Clean optic lens or CRT using only a clean cotton (flannel) lintless cloth. Approved plastic lens cleaner can be used as required.

CAUTION: EXERCISE CARE TO PREVENT CLEANER FROM CONTACTING SURROUNDING PILOT DISPLAY UNIT PARTS.

(3) Dry lens/CRT with clean dry lintless soft cotton cloth.



SYMBOLOGY DISPLAY DURING HUD SELF-TEST

BBB2-34-135B

Optics Test Display
Figure 201/34-25-00-990-801

DISPLAY UNIT-PILOT - MAINTENANCE PRACTICES

1. General

A. The pilot display unit (PDU) is the unit in the Heads Up Display system that provides the Captain with a direct viewing guidance display during takeoff, approach, and go-around maneuvers. The unit contains the optic display, a cathode ray tube and power supply, communication speaker, fresh air outlet, map light and switch, display brightness control, two LED fault indicators, and three electrical connectors for connection to the airplane wiring.

B. The PDU is mounted in the overhead cavity above the Captain's windshield. Provisions are provided for mounting a PDU in the cavity over the First Officer's windshield.

C. The optics display, on the PDU, has a stowed and viewing position. The optics display is moved to the viewing position to initiate operation of the system.

2. Removal/Installation PDU

CAUTION: PILOT DISPLAY UNIT MUST BE HANDLED WITH CARE. IN MOVING OPTICAL ELEMENT TO VIEWING POSITION USE EXTREME CARE TO PREVENT EXCESSIVE FORCE IN ANY DIRECTION OR RAPID MOTION OF OPTICAL ELEMENT DURING EXTENSION OR RETRACTION. LATCH MUST BE OPENED BEFORE OPTICAL ELEMENT IS MOVED FROM THE STOWED POSITION. CAUTION SHOULD ALSO BE EXERCISED TO PREVENT FINGERPRINTS ON EITHER FRONT OR AFT SURFACES OF THE OPTICS. OPTIC LENS IS MADE FROM ACRYLIC PLASTIC WHICH MAKES IT MORE SUSCEPTIBLE TO SCRATCHING AND ABRASION DAMAGE. OPTICS SURFACES SHOULD NOT BE CLEANED WITH ANY CLOTH, HAND OR HANDKERCHIEFS. USE ONLY CLEAN FLANNEL CLOTH, WITH OR WITHOUT PLASTIC LENS CLEANER.

A. Remove PDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, DC AIR CONDITIONING & MISCELLANEOUS

Row	Col	Number	Name
W	29	B1-267	MAP & BRIEFCASE

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Support the PDU and remove the three mounting bolts that attach PDU to airplane structure, after removal of screws, carefully release support on PDU until it is supported by the lanyard. (Figure 201)

NOTE: The PDU weighs approximately 19 pounds. A lanyard is attached from the PDU to overhead airplane structure to hold the PDU in place after the mounting screws are removed for access to the electrical connectors and fresh air duct connection.

NOTE: Access to one mounting bolt is through head pad on PDU. A plug in pad is removed for access to bolt.

(3) Disconnect the three electrical connectors and the fresh air duct, cap electrical connectors and fresh air duct ends.

(4) Support the PDU and remove the lanyard attaching bolt at the PDU.

(5) Remove the PDU.

B. Install PDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, DC AIR CONDITIONING & MISCELLANEOUS

Row	Col	Number	Name
W	29	B1-267	MAP & BRIEFCASE

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Remove optic block cover and stow, (map case), remove caps from electrical connectors and fresh air ducts and check for loose, bent, or dirty connector pins, check ducts for any obstructions or dirt.

(3) Place PDU into mounting position and connect lanyard to PDU.

(4) Connect electrical connectors and fresh air duct to PDU.

(5) Position PDU into mounting position and install the three PDU mounting bolts, install plug in head pad.

(6) Remove the safety tags and close these circuit breakers:

LOWER EPC, DC AIR CONDITIONING & MISCELLANEOUS

Row	Col	Number	Name
W	29	B1-267	MAP & BRIEFCASE

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(7) Place optics display on PDU in the viewing position.

(8) On the pilot's control panel, press and hold the test switch, test pattern should come into view on optics display; the two LED fault indicators on PDU should come on green; actuate DIM control; test pattern should dim and brighten as applicable to dim control movement. (Figure 202) for Test Pattern)

(9) Release test switch.

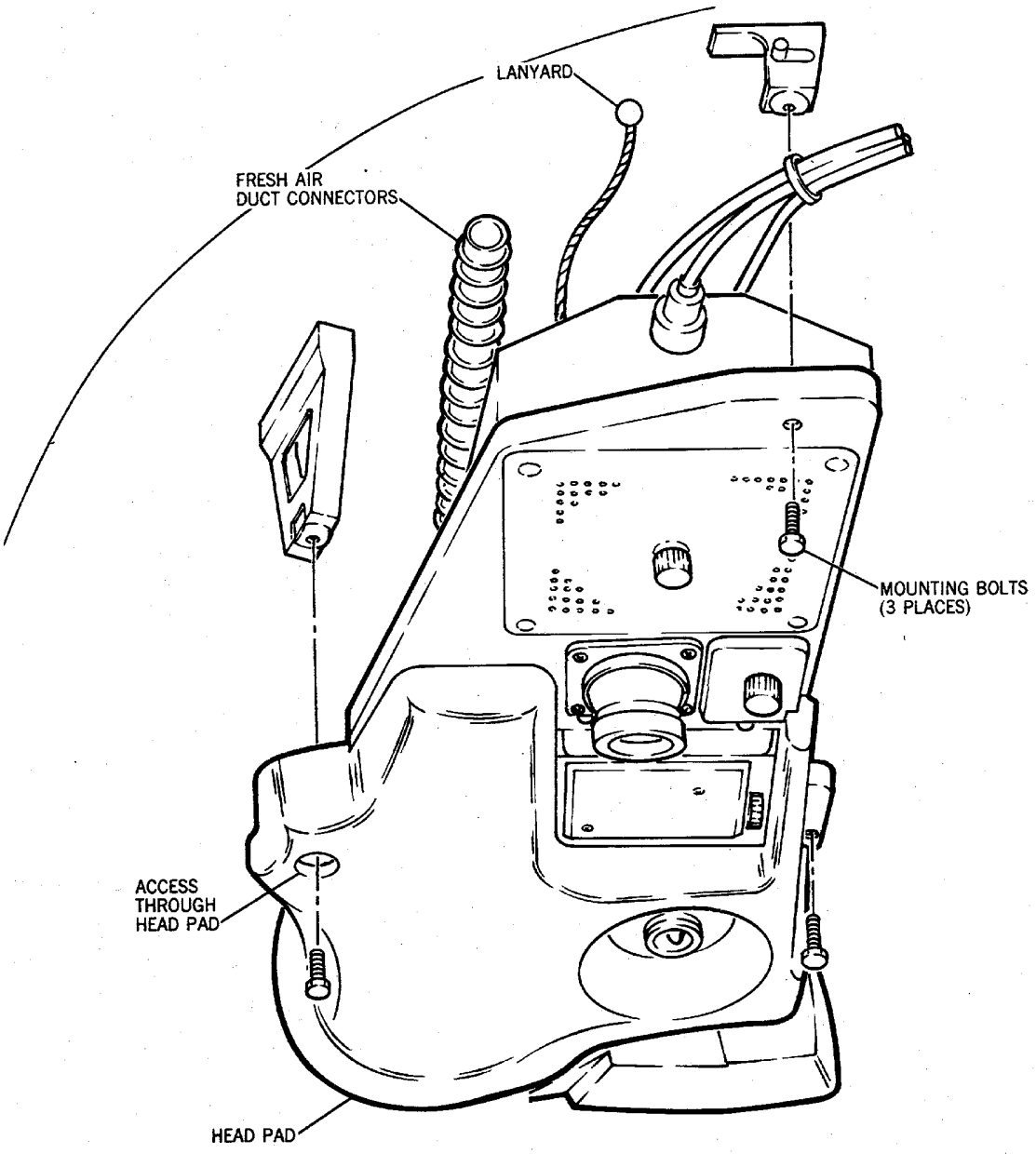
(10) Place map light switch to ON position; light should come on; place switch to OFF position; light should go out.

(11) Check communications speaker by communicating through flight interphone system.

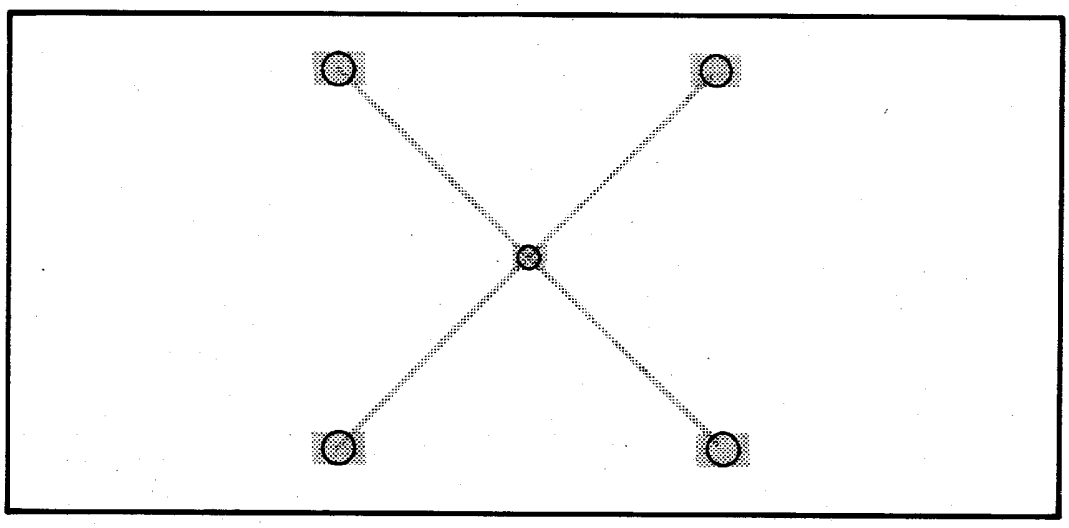
(12) Proper results as noted in Paragraph 2.B.(8), Paragraph 2.B.(10) and Paragraph 2.B.(11), indicate an operable PDU.

(13) Place optics display in stowed position.

(14) Return airplane to required configuration.



Pilot Display Unit -- Removal/Installation
Figure 201/34-25-01-990-801



SYMBOLOGY DISPLAY DURING HUD SELF-TEST

BBB2-34-135B

Pilot Display Unit -- Test Display
Figure 202/34-25-01-990-802

HUD COMPUTER - MAINTENANCE PRACTICES

1. General

A. The HUD system computer receives sensor and discrete signal input from the interfacing systems, and integrates and processes the signals into acceptable information for the Heads Up Display.

B. The computer is located in the aft left radio rack in the electrical/electronics compartment.

2. Removal/Installation

A. Remove Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Press release button at top of computer handles and pull inner portion of handles out and down to release locking pins.

(3) Pull computer straight out of rack until electrical connectors are disengaged from mounting rack connector and remove computer. Cap electrical connectors.

B. Install Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Uncap electrical connectors and check computer and mounting rack electrical connectors for broken, loose, or dirty connector pins.

(3) Slide computer straight into mounting rack, ensuring that electrical connectors engage smoothly, and latch handles engage keeper pins on rack.

(4) Close locking handles and press firmly until securely locked in place.

NOTE: Handles should lock into place with a firm snap without excessive force. Computer should not have any looseness in rack.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(6) Place optics display on PDU into viewing position.

(7) Fault indicators on front of computer should come on.

NOTE: Input fault indicators may not come on, since all sensor and discrete inputs are not valid or operating on the ground.

(8) Press and hold test switch located on Pilot Control Panel in flight compartment, both LED fault indicators on PDU should come on green and a steady X test pattern should be visible on the PDU optics display. (HEADS UP DISPLAY (HUD) - MAINTENANCE PRACTICES, PAGEBLOCK 34-25-00/201)

(9) Indications as stated in Paragraph 2.B.(6) and Paragraph 2.B.(7), indicates an operable unit.

(10) Place optics display in stowed position.

NOTE: If necessary for complete system test. (HEADS UP DISPLAY (HUD) - MAINTENANCE PRACTICES, PAGEBLOCK 34-25-00/201)

(11) Return airplane to required configuration.

HUD CONTROL PANEL - MAINTENANCE PRACTICES

1. General

A. The Control Panel provides Captain's/First Officer's selection of desired flight path angle and readout, system self test, inflight approach mode reset, and radio/barometric altitude display selection.

B. The Control Panel is located in the center pedestal in the Flight Compartment.

2. Removal/Installation Control Panel

A. Remove Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Unfasten the two fasteners in the Control Panel unit.

(3) Pull unit straight out of pedestal and disconnect airplane electrical connector from unit.

(4) Cap electrical connector on unit and airplane wiring connector.

B. Install Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(2) Uncap airplane wiring and panel electrical connectors and check for damaged, loose, or dirty electrical connector pins.

(3) Connect airplane wiring electrical connector to panel electrical connector.

(4) Insert panel into mounting space in pedestal and fasten the two fasteners.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	26	B10-334	HEAD UP DISPLAY

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	8	B10-336	HEAD UP DISPLAY

(6) Place optics display on the PDU in the viewing position.

(7) Press and hold the TEST switch located on the panel, fault indicator LEDs on PDU should come on green and a steady X TEST display should be displayed on the PDU optics.

(8) Rotate the flight path angle selector on the panel, flight path readout window should indicate digital degree readout.

(9) Indications in Paragraph 2.B.(7) and Paragraph 2.B.(8) indicate an operable PCM.

(10) Place optics display in stowed position.

NOTE: If complete system check is required. (HEADS UP DISPLAY (HUD) - MAINTENANCE PRACTICES, PAGEBLOCK 34-25-00/201)

(11) Return airplane to required configuration.

STANDBY ATTITUDE - DESCRIPTION AND OPERATION

1. Description

A. General

(1) The Standby Attitude System provides a continuous indication of airplane attitude in pitch and roll. The system consists of a standby horizon indicator, located on the center instrument panel, powered by 115 VAC, three-phase current supplied by a static inverter and 0-5 VAC power for lighting.

B. Standby Horizon Indicator

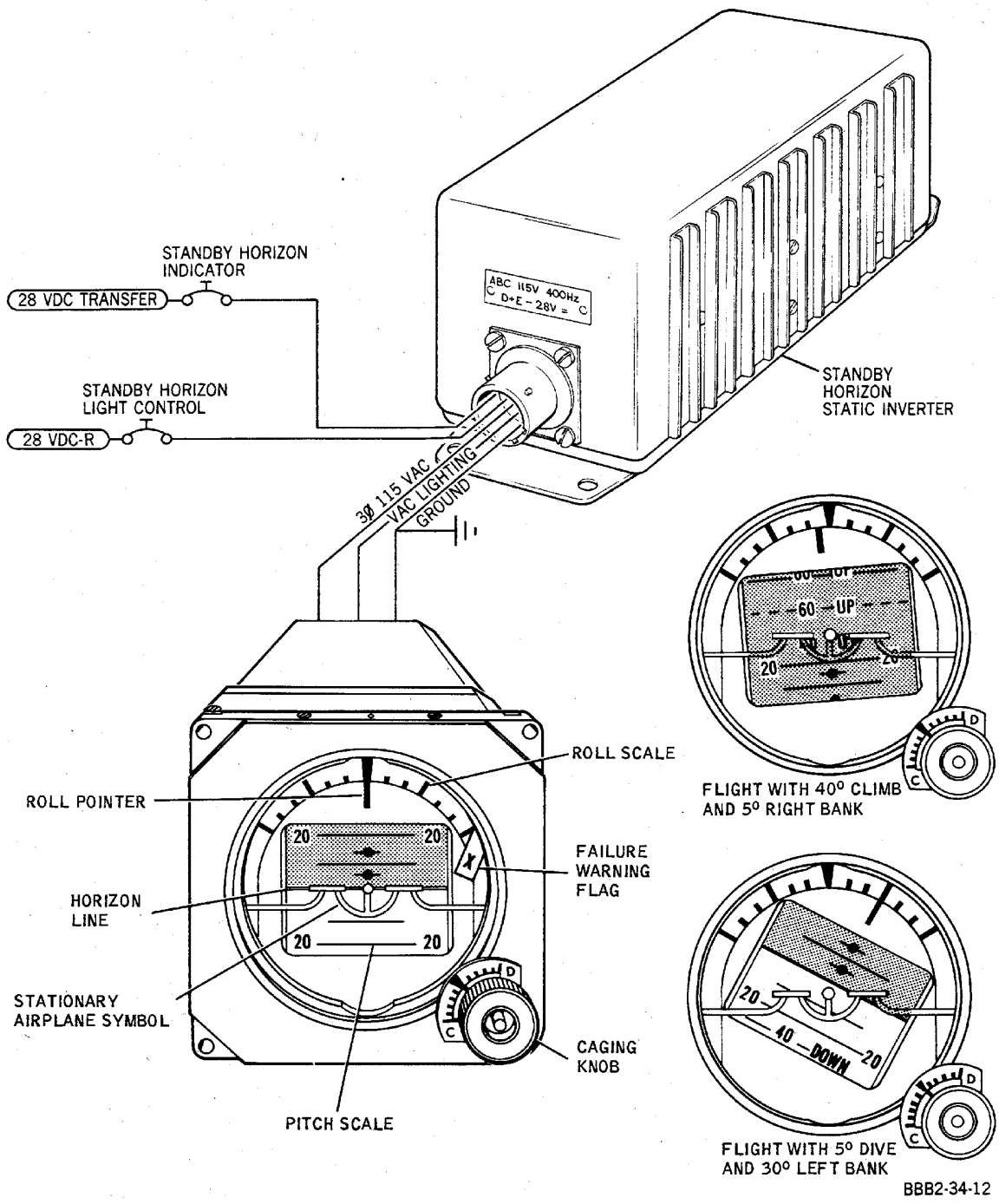
(1) A drum indicator, the axis of which always remains horizontal, rotates around the axis and shows a series of marks indicating positive and negative pitch angle. The upper half of the drum displays climb-positive angles; the lower half displays dive-negative angles. The division line between the halves is engraved with a circle at the center of the line and represents the true horizon. The horizon display, when read against an airplane symbol at the center of the indicator, presents the attitude of the airplane with respect to the horizon.

(2) Pitch indications are available up to 80 degrees in climb and 60 degrees in dive. The indicator has 360 degrees of freedom in roll, however, the bank angle scale at the top of the indicator is marked to display only 60 degrees roll to the left or right in 10 degree increments.

(3) A pitch trim/erection knob (caging knob) is located in the lower right corner of the indicator. Rotating the knob, when it is in normal (in) position, allows pitch adjustment of the airplane symbol ±5 degrees. Pulling the knob out and holding it, initiates fast gyro caging to decrease the erection time which normally is approximately 3 degrees per minute. A failure warning flag placarded X, located on the upper right side of the indicator, will appear when the horizon information is unreliable.

C. Static Inverter

(1) The static inverter is mounted in the forward accessory compartment. The transistorized unit is designed to give an output of 115 VAC, 400 Hertz, three-phase power and 0-5 VAC power for lighting. The front panel of the unit contains a single electrical connector, and cooling fins are riveted to the sides for heat dissipation. The base is extended to front and rear to provide mounting holes.



Standby Horizon Indicator
Figure 1/34-28-00-990-801

2. Operation

A. The standby horizon indicator operates independently from all other navigation systems. Whenever the inverter is on, 115 VAC, 400 Hertz, three-phase power is applied to the indicator from the static inverter, 0-5 VAC power is also supplied for lighting. The indicator is basically a gyro rotating in such a manner that its spin axis is vertical to the surface of the earth. The electric motor gyroscope with mechanical erection cut-off (to prevent false erection during turns of 10 degrees or more), and a mechanical quick-caging device, operates with 2 degrees of freedom to define a vertical stable reference. The display mechanism translates this reference to pitch and roll indications. The gyro normally comes up to operating speed in 3-5 minutes.

B. When power is applied, the warning flag must disappear from view. As the gyro wheel comes up to speed, the gyro spin axis may move away from the vertical position. Erection to the aircraft vertical may be quickly affected by gently pulling the pitch trim/erection knob (caging knob) out and holding until the horizon mark and roll pointer settle to a steady-state condition.

STANDBY ATTITUDE - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Standby Attitude System in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the system are: Standby Horizon Indicator and Standby Horizon Inverter.

E. The Standby Attitude System components are located as follows:

Table 101

Component	Location
Standby Horizon Indicator	Center Instrument Panel
Standby Horizon Circuit Breaker	Lower EPC Circuit Breaker Panel
Standby Horizon Light Control Circuit Breaker	Upper Instrument Panel
Static Inverter	Forward Accessory Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 630A	Triplett

3. Trouble Shooting Standby Attitude System

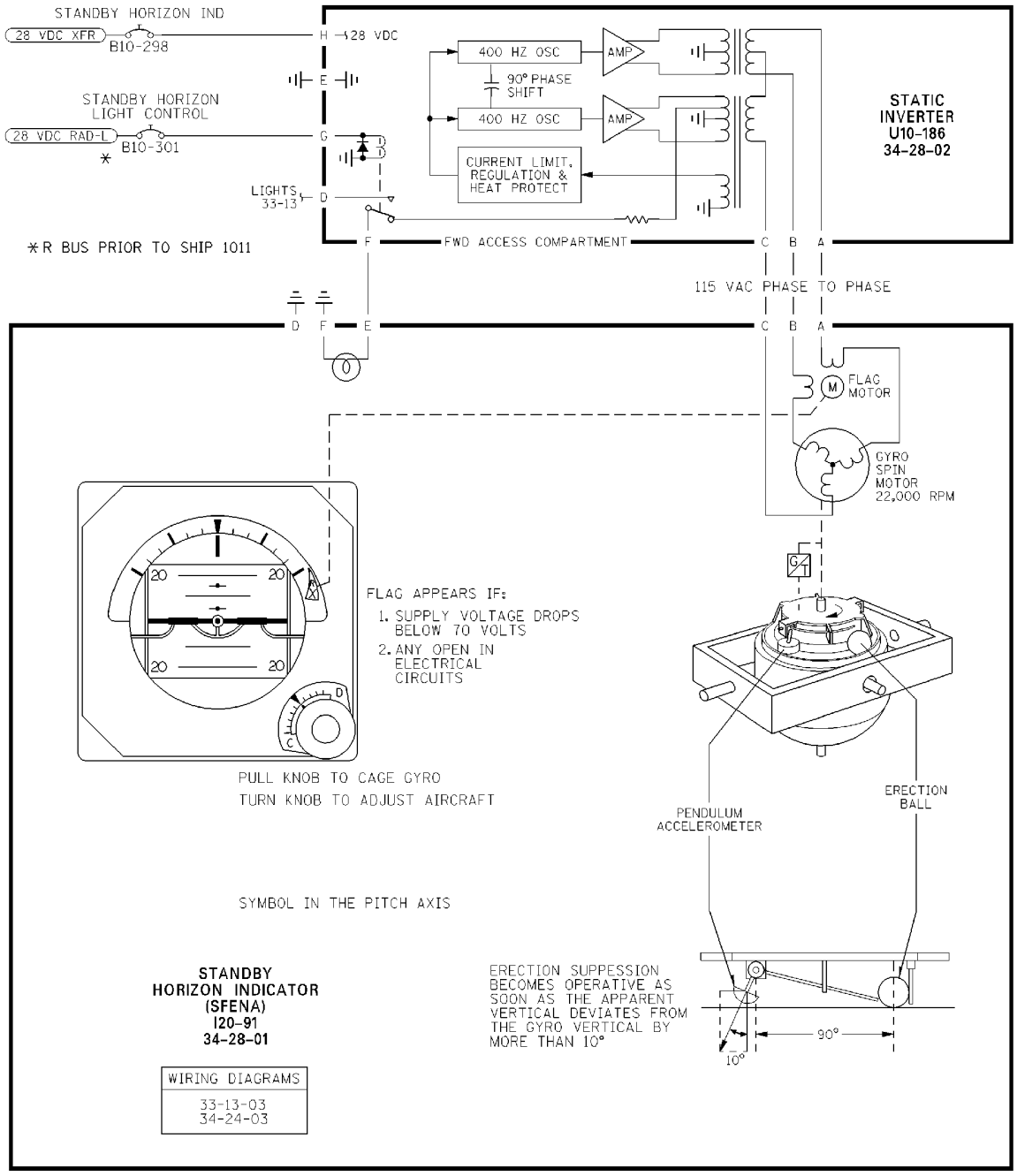
A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Standby Horizon Indicator, and Standby Horizon Inverter.

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
NOTE: When measuring three phase output from the static inverter, the voltage must be read from phase leg to phase leg; that is, Phase A to Phase B, Phase B to Phase C, and Phase C to Phase A. Each phase to phase voltage reading should be 115 VAC. Do not make measurements from a phase leg to ground. This will lead to an erroneous reading. This should prevent inadvertently sending this LRU to the shop for mistaken voltage readings.		
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.

(Continued)

Step	Procedure	Correction
(4)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



Standby Attitude System -- Schematic
Figure 101/34-28-00-990-802

STANDBY ATTITUDE - MAINTENANCE PRACTICES

1. General

A. The standby attitude system consists of an indicator (located on center instrument panel) and a static inverter, in the forward accessory compartment. The standby indicator consists of an electrically driven gyroscope spinning about a vertical axis, with the roll and pitch attitude mechanically translated to display the true attitude of the airplane. The indicator is powered by 115 VAC, three-phase current supplied by static inverter, 0-5 VAC power is also supplied for lighting.

2. Adjustment/Test - Standby Attitude System

A. Test

(1) Energize airplane electrical buses, and allow a minimum of 5 minutes for vertical gyros to erect.

(2) Verify that Attitude System is operating properly with ATT flag out of view on both attitude director indicators.

(3) Indicator dial lamps must be on, and power failure flag (X) out of view.

NOTE: Failure of the warning flag to disappear immediately from view will indicate: either an improper phase rotation connection, total power failure, open or short circuit.

CAUTION: THE GYRO ERECTION KNOB MUST NOT BE PULLED OUT TO THE QUICK CAGING POSITION UNLESS THE INSTRUMENT HAS BEEN RUNNING FOR AT LEAST 60 SECONDS, AND AT NO TIME SHOULD IT BE HELD OUT FOR MORE THAN 120 SECONDS.

(4) After 2 minutes operation, pull pitch trim/erection knob out to quick caging position and hold until horizon drum and roll pointer becomes stationary (this should occur near the zero degrees roll and pitch positions), release cage knob gently.

(5) Rotate pitch trim/erection knob clockwise and counterclockwise observing that airplane symbol moves up and down respectively over horizon drum.

(6) Align pitch trim/erection knob pointer to zero degree position on pitch trim scale and verify that airplane symbol is aligned with drum horizontal line.

(7) Standby horizon indicator roll and pitch display should agree with the Captain's and First Officer's attitude director indicators within ±3 degrees.

(8) Check that indicator lamps are on.

(9) Return airplane to required configuration.

STANDBY HORIZON INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the standby horizon indicator. The standby horizon indicator (located on center instrument panel) consists of an electrically driven gyroscope spinning about a vertical axis, with the roll and pitch attitude mechanically translated to display the true attitude of the airplane. The indicator is powered by 115 vac, three phase current supplied by a static inverter, and 0-5 vac power for lighting.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 201

Name and Number	Manufacturer
Locking brake	Sextant Avionique

3. Removal/Installation Standby Horizon Indicator

A. Remove Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

(a) Changed to LEFT RADIO DC BUS.

CAUTION: LOCKING DEVICE MUST BE INSTALLED TO LOCK THE PITCH TRIM/ERECTION KNOB IN CAGE POSITION TO AVOID DAMAGE TO GYRO WHEN MOVING OR STORING INDICATOR.

(2) Pull pitch trim/erection knob out and install locking brake.

(3) Support indicator; remove mounting screws (two top and one bottom left), and carefully withdraw indicator from panel ensuring that pitch trim/erection knob is not damaged.

(4) Disconnect and cap electrical connector; remove indicator.

B. Install Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

(2) Remove cap and insert airplane electrical connector into plug at rear of indicator unit.

(3) Position indicator in mounting panel. Insert three mounting screws and secure.

CAUTION: THE INDICATOR MAY BE DAMAGED IF THE PITCH TRIM/ERECTION KNOB IS RELEASED WITH A "SNAP". RELEASE THE PITCH TRIM/ERECTION KNOB AVOIDING A "SNAP" RELEASE.

(4) Remove locking brake from pitch trim/erection knob as follows:

(a) Pull pitch trim/erection knob out and remove locking brake.

(b) Release pitch trim/erection knob.

(5) Remove the safety tags and close these circuit breakers:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

(6) Allow a minimum of 5 minutes for vertical gyros to erect.

(7) Verify that Attitude System is operating properly with ATT flag out of view on both attitude director indicators.

(8) Indicator dial lamps must be on, and power failure flag (X) out of view. Horizon bar and roll pointer should erect to approximately zero degrees.

NOTE: Failure of the warning flag to disappear immediately from view will indicate: either an improper phase rotation connection, total power failure, open or short circuit.

CAUTION: THE PITCH TRIM/ERECTION KNOB MUST NOT BE OPERATED UNLESS THE INSTRUMENT HAS BEEN RUNNING FOR AT LEAST 60 SECONDS, AND AT NO TIME SHOULD THE PERIOD OF OPERATION EXCEED 120 SECONDS.

(9) After 2 minutes operation, pull pitch trim/erection knob out to quick caging position and hold until horizon drum and roll pointer becomes stationary (this should occur near the zero degrees roll and pitch positions), release pitch trim/erection knob gently.

(10) Rotate pitch trim/erection knob clockwise and counterclockwise observing that airplane symbol moves up and down respectively over horizon drum.

(11) After 3 minutes of operation, align pitch trim/erection knob pointer to zero degree position on caging knob scale and verify that airplane symbol is aligned with drum horizon line.

(12) Standby horizon indicator roll and pitch display should agree with Captain's and First Officer's attitude director indicators within ±3 degrees.

(13) Return airplane to required configuration.

STANDBY HORIZON STATIC INVERTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the standby horizon static inverter. The inverter is mounted in the forward accessory compartment.

2. Equipment and Materials

NOTE: Equivalent substitute may be used instead of the following listed item:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Solvent, cleaning P-D-680, Type 1 DPM 518	Arco Corp.

3. Removal/Installation - Static Inverter

A. Remove Static Inverter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

NOTE: On some aircraft, the STANDBY HORIZON LIGHT CONTROL circuit breaker will be at the panel area LEFT RADIO DC BUS in the upper EPC. Also, Service Bulletin 24-61 and late production aircraft changed to LEFT RADIO DC BUS.

(2) Disconnect and cap electrical connector.

(3) Remove screws and washers, and remove static inverter.

B. Install Static Inverter

WARNING: P-D-680 TYPE 1 SOLVENT IS AN AGENT THAT IS FLAMMABLE AND POISONOUS. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN P-D-680 TYPE 1 SOLVENT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET P-D-680 TYPE 1 SOLVENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(WARNING PRECEDES)

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THESE HAZARDOUS AGENTS.

WARNING: CLEANING OPERATIONS USING SOLVENTS SHOULD BE PERFORMED IN A WELL VENTILATED ATMOSPHERE. EXERCISE NORMAL SAFETY PRECAUTIONS DURING USE.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

NOTE: On some aircraft, the STANDBY HORIZON LIGHT CONTROL circuit breaker will be at the panel area LEFT RADIO DC BUS in the upper EPC. Also, Service Bulletin 24-61 and late production aircraft changed to LEFT RADIO DC BUS.

(2) Clean attach points of static inverter and mounting bracket with solvent (P-D-680, or equivalent) to ensure proper electrical bond.

(3) Install static inverter on mounting bracket.

(4) Remove cap and connect electrical connector.

(5) Remove the safety tags and close these circuit breakers:

LOWER EPC, DC TRANSFER BUS

Row	Col	Number	Name
X	31	B10-298	STANDBY HORIZON INDICATOR

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	16	B10-301	STANDBY HORIZON LIGHT CONTROL

NOTE: On some aircraft the STANDBY HORIZON LIGHT CONTROL circuit breaker will be at the panel area LEFT RADIO DC BUS in the upper EPC. Also Service Bulletin 24-61 and late production aircraft changed to LEFT RADIO DC BUS.

(6) Verify that Attitude System is operating properly with ATT flag out of view on both attitude director indicators.

(7) Standby Attitude Indicator dial lamps must be on, and power failure flag (OFF) out of view. Sphere horizon line and roll pointer should erect to approximately zero degrees.

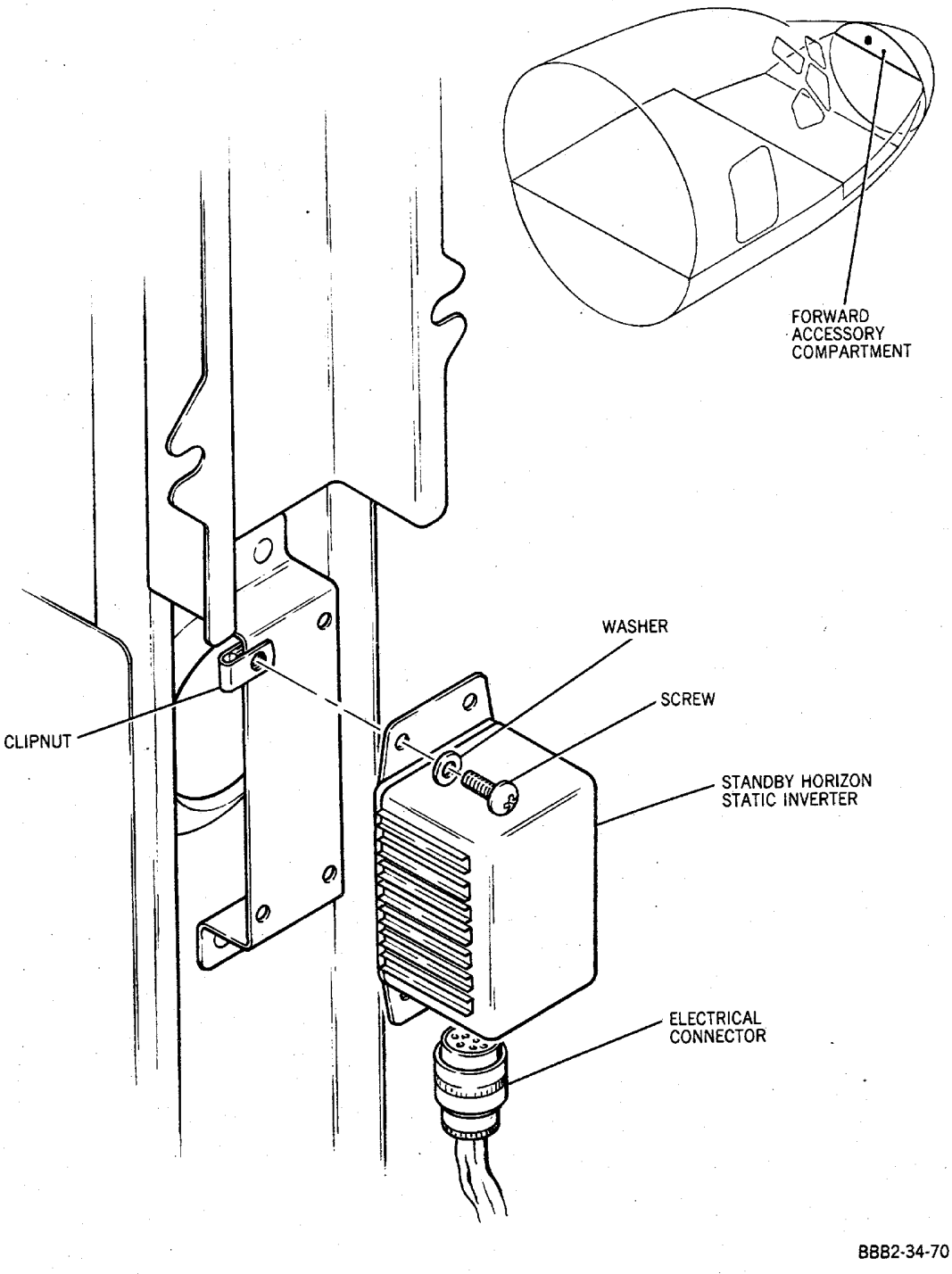
NOTE: Failure of the warning flag to disappear immediately from view will indicate: either an improper phase rotation connection, total power failure, open or short circuit.

CAUTION: THE GYRO ERECTION KNOB MUST NOT BE OPERATED UNLESS THE INSTRUMENT HAS BEEN RUNNING FOR AT LEAST 60 SECONDS, AND AT NO TIME SHOULD THE PERIOD OF OPERATION EXCEED 120 SECONDS.

(8) After 2 minutes operation, pull caging knob out to quick caging position and hold until horizon line and roll pointer becomes stationary (this should occur near zero degrees roll and pitch positions), release cage knob gently.

(9) Standby HORIZON indicator roll and pitch display should agree with Captain's and First Officer's attitude director indicators within ±3 degrees. Static inverter is considered operable.

(10) Return airplane to required configuration.



Standby Horizon Static Inverter -- Removal/Installation
Figure 201/34-28-02-990-801

NAVIGATION INSTRUMENT COMPARATOR/MONITOR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Navigation Instrument Comparator/Monitor (NICM) System continuously compares and/or monitors the Attitude Display, Compass Display, Navigation Receivers and self tests the NICM circuitry. The monitoring and comparing of signals provides a visual warning to the flight crew should a significant dis-agreement or an invalid condition exist.

2. Description

A. The NICM system is a single line replaceable unit (SLRU) that compares and monitors four navigation systems to provide a visual warning if an invalid condition should exist. Four warning indicator lights are displayed on the captain's and first officer's Flight Mode Annunciators (FMA's), HORIZON, HEADING, ILS and MONITOR. All warning lights except MONITOR are inhibited below 50 feet altitude.

3. Operation

A. The HORIZON legend will illuminate steady on both FMA's when the comparator detects any difference between the captain's and first officer's ADI's that exceed a predetermined limit. When a failure affects the horizon (ADI attitude), the horizon system that has failed will flash the HORIZON legend on the failed side, the opposite side will come on steady.

B. The HEADING legend will illuminate steady on both FMA's when the comparator detects a difference between the captain's and first officer's HSIs that exceed a predetermined limit. When a failure affects the heading (flag in view), the compass system that has failed will flash the HEADING legend on the failed side. The opposite side will come on steady.

C. The ILS legend will illuminate steady on both FMA's when the comparator detects a deviation difference between No. 1 and No. 2 localizer/glideslope radio signals that exceed a predetermined limit. When a failure affects localizer or glide-slope (flag in view), the ILS system that has failed will flash the ILS legend on the failed side. The opposite side will come on steady.

D. The MONITOR legend on both FMA's will come on steady anytime a failure affects the validity of the comparator monitor.

4. To Operate

A. The system is in operation when system circuit breakers are closed.

NAVIGATION INSTRUMENT COMPARATOR/MONITOR - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Navigation Instrument Comparator/Monitor (NICM) System in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the system are: Navigation Instrument Comparator/Monitor and the Flight Mode Annunciators.

E. The System components are located as follows:

Table 101

Component	Location
Navigation Instrument Comparator/Monitor	Avionics Compartment
Comparator Monitor - 1 Circuit Breakers	Upper EPC Circuit Breaker Panel
Comparator Monitor - 2 Circuit Breakers	Upper EPC Circuit Breaker Panel
Flight Mode Annunciators	Captain's and First Officer's Instrument Panels.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

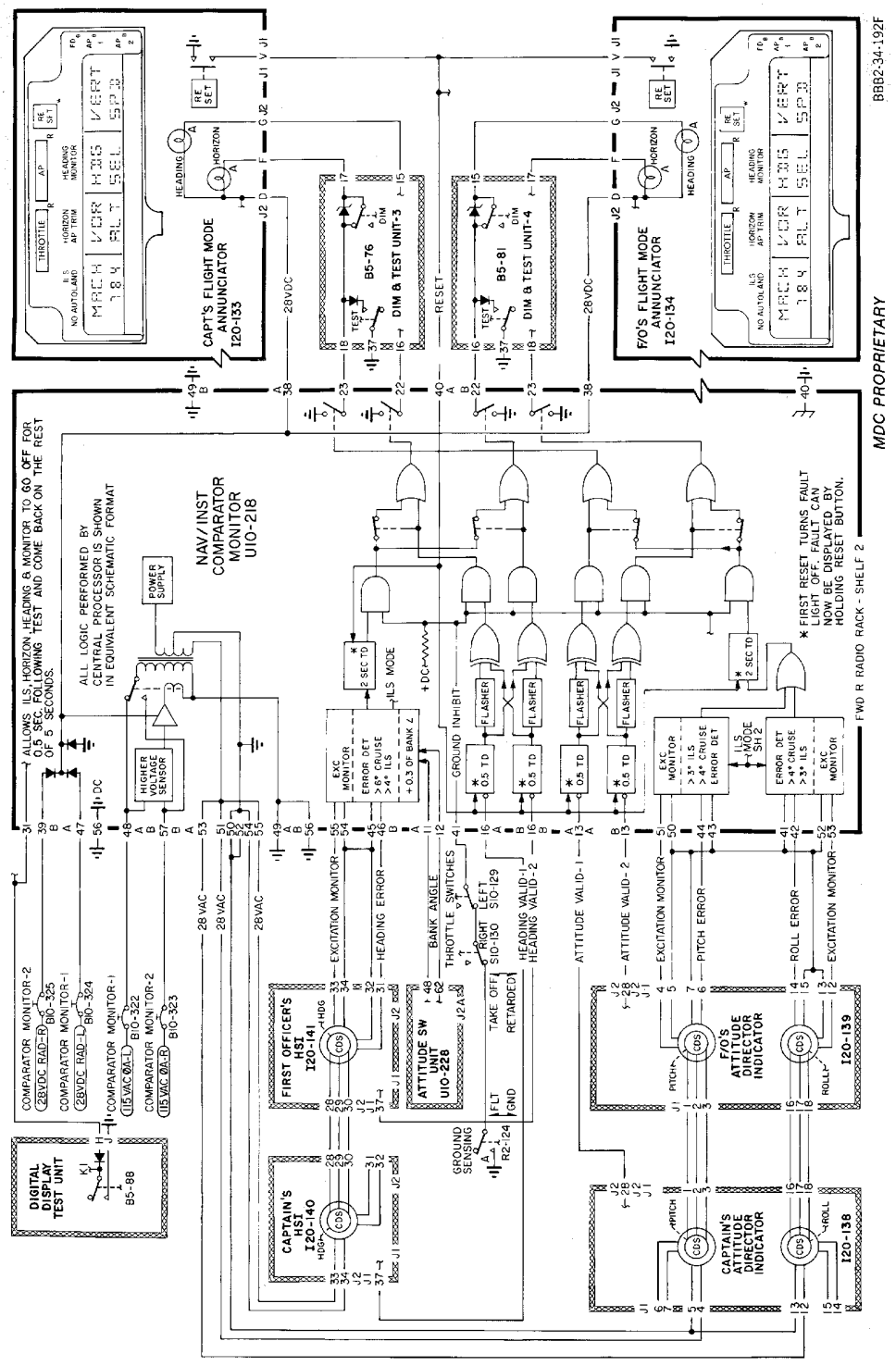
3. Trouble Shooting Navigation Instrument Comparator/Monitor

A. Trouble Shoot

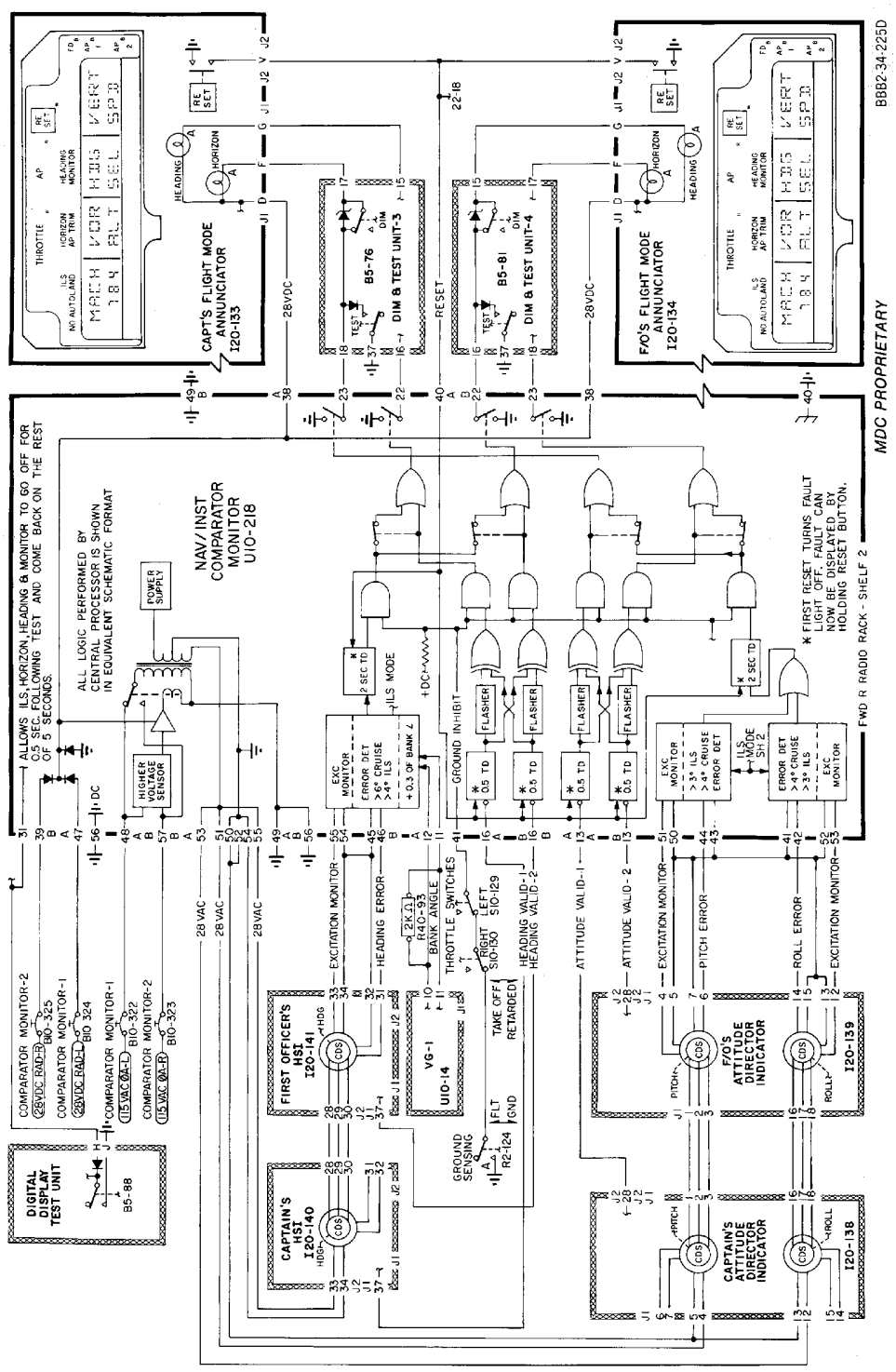
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Navigation Instrument Comparator/Monitor and Flight Mode Annunciators.

Table 103

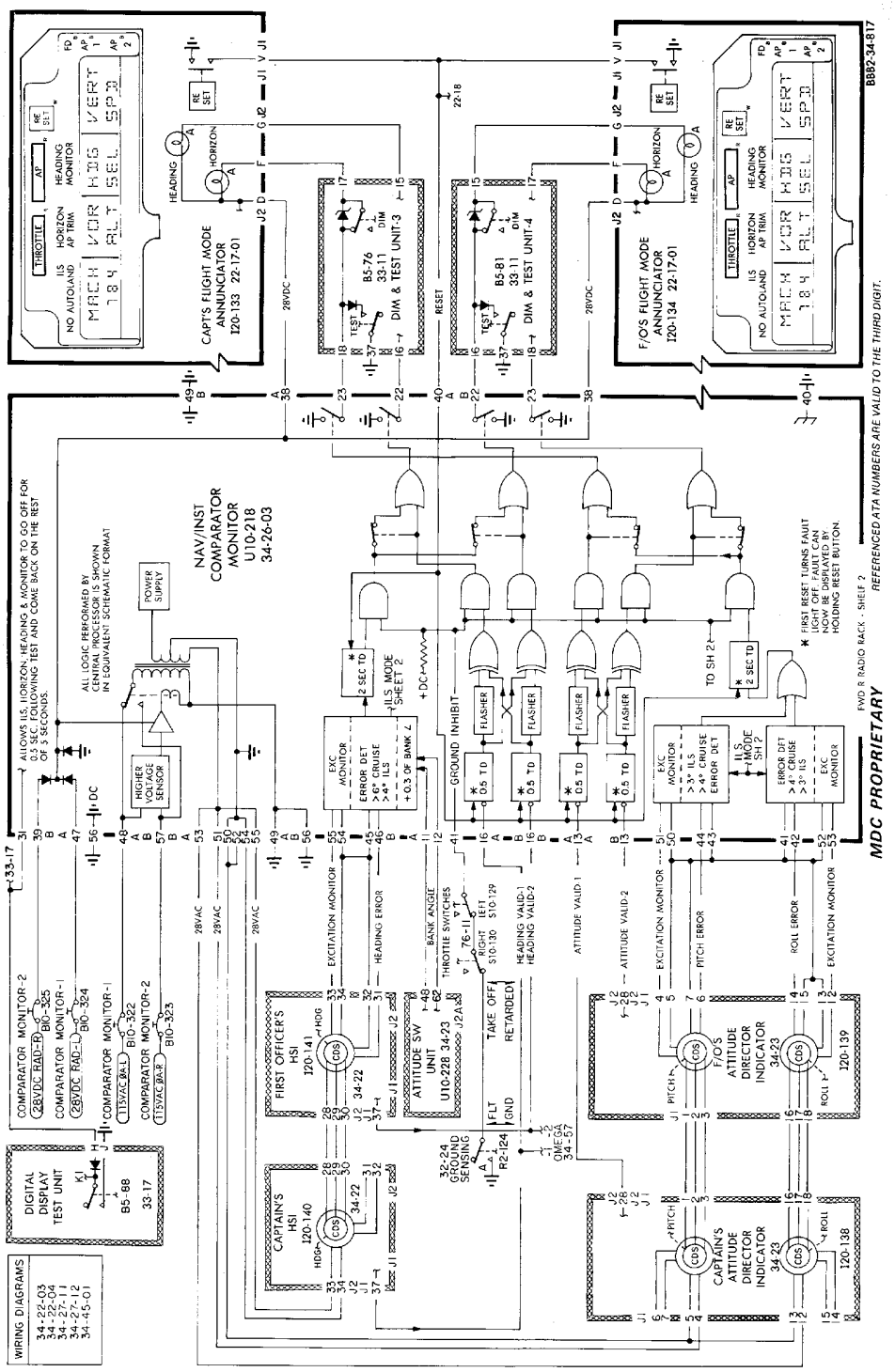
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3) Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



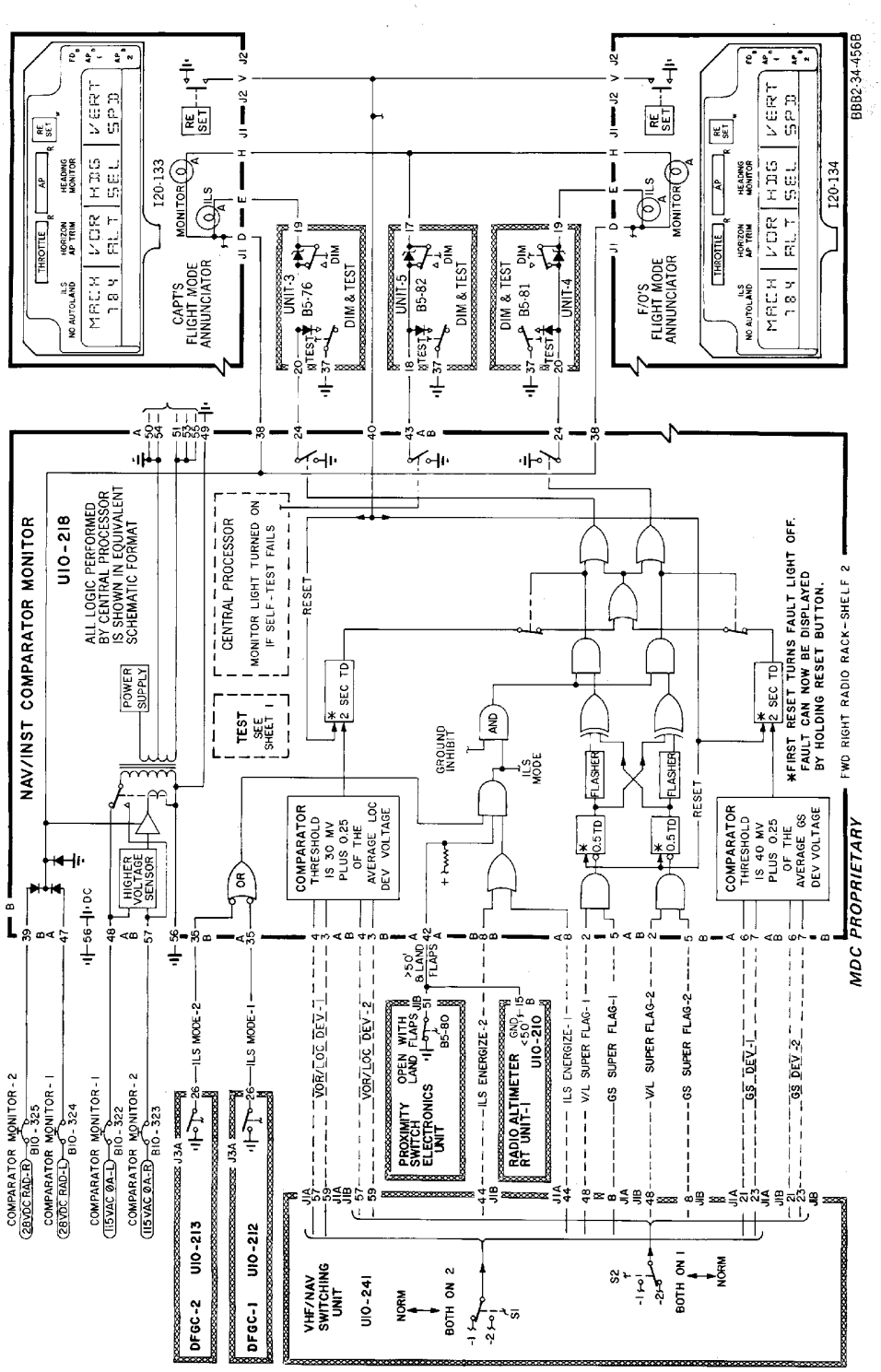
Heading and Attitude Comparator Monitor - Schematic
Figure 101/34-29-00-990-801 (Sheet 1 of 3)



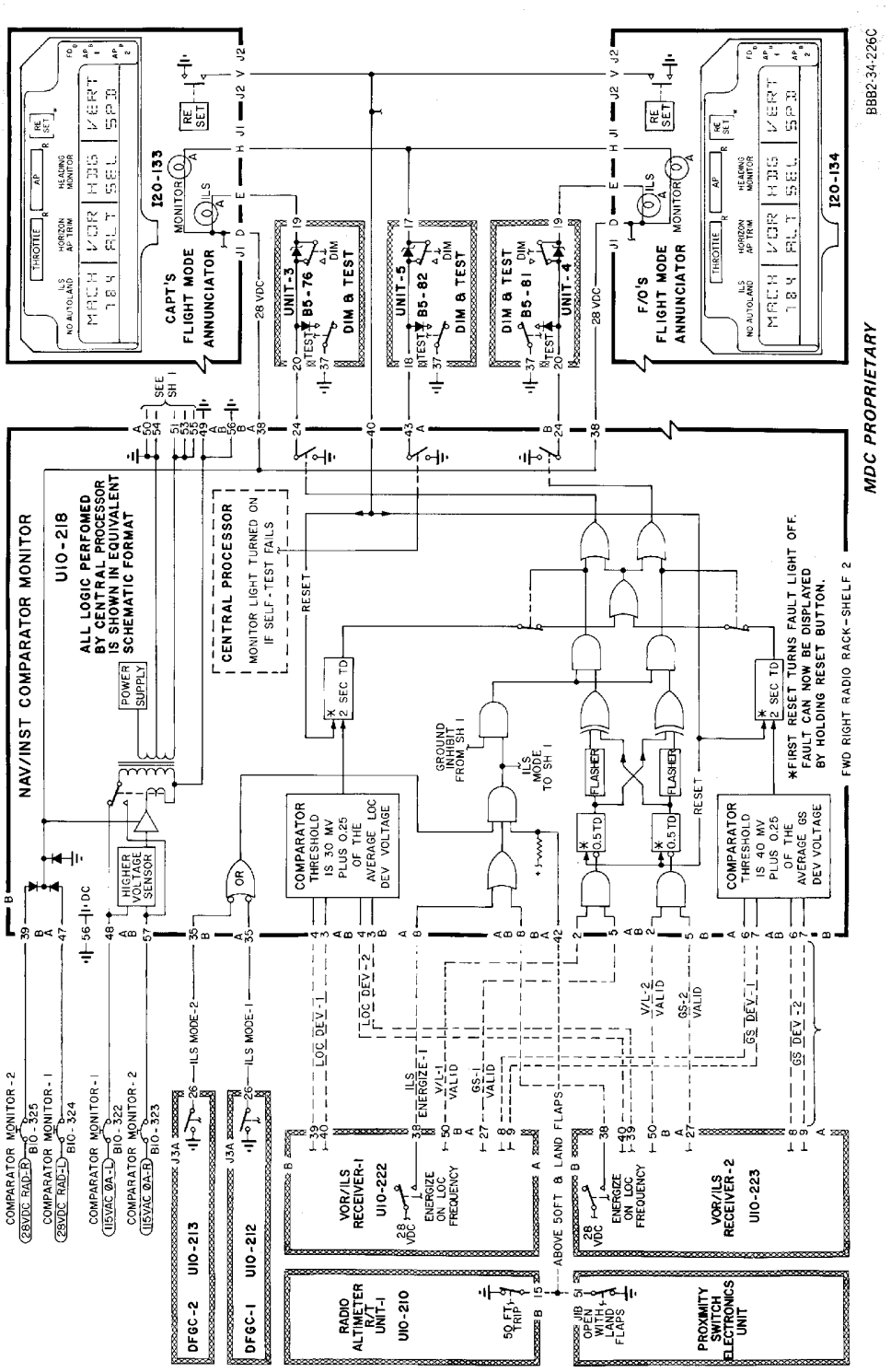
Heading and Attitude Comparator Monitor - Schematic
Figure 101/34-29-00-990-801 (Sheet 2 of 3)



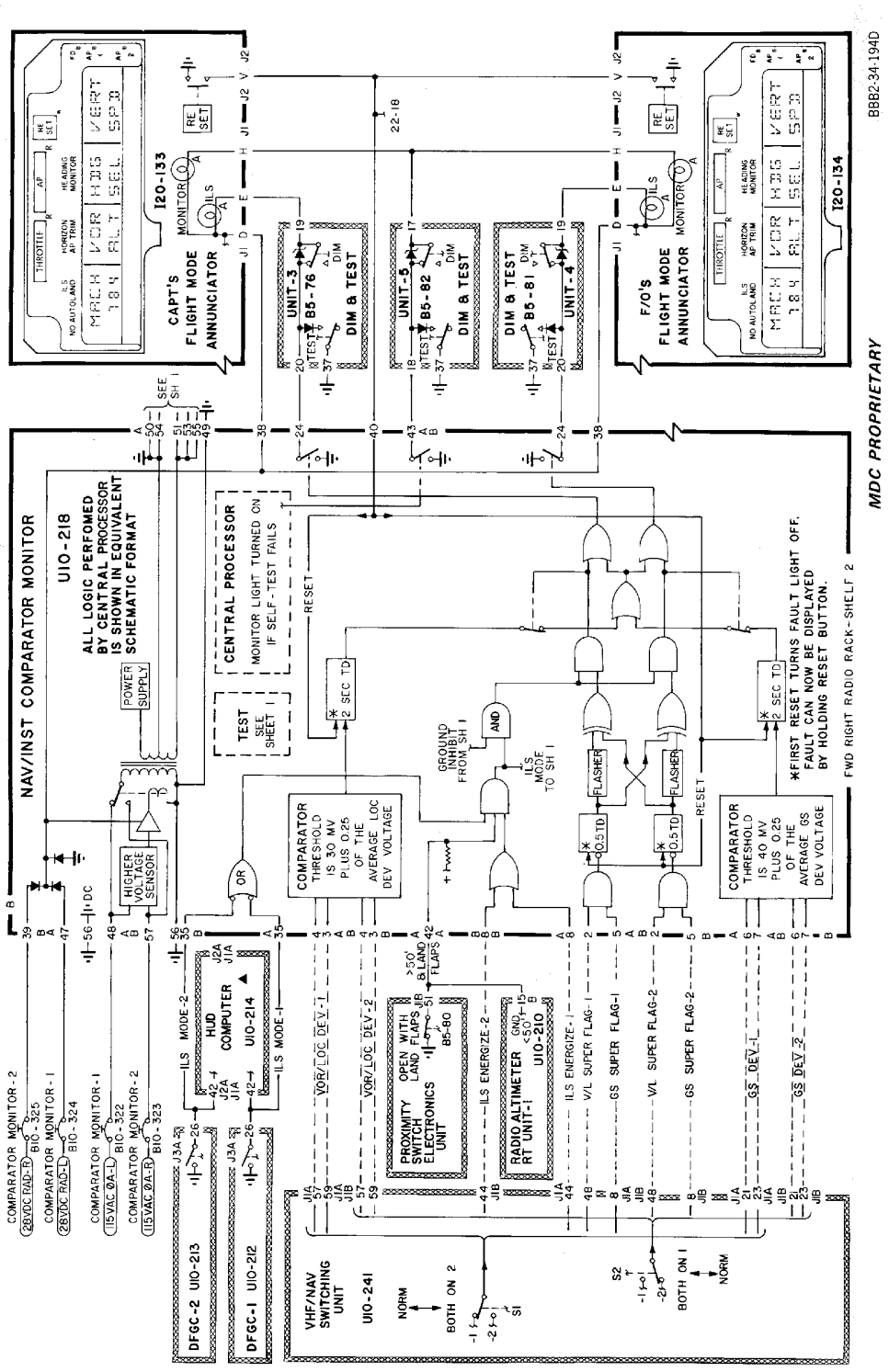
Heading and Attitude Comparator Monitor - Schematic
Figure 101/34-29-00-990-801 (Sheet 3 of 3)



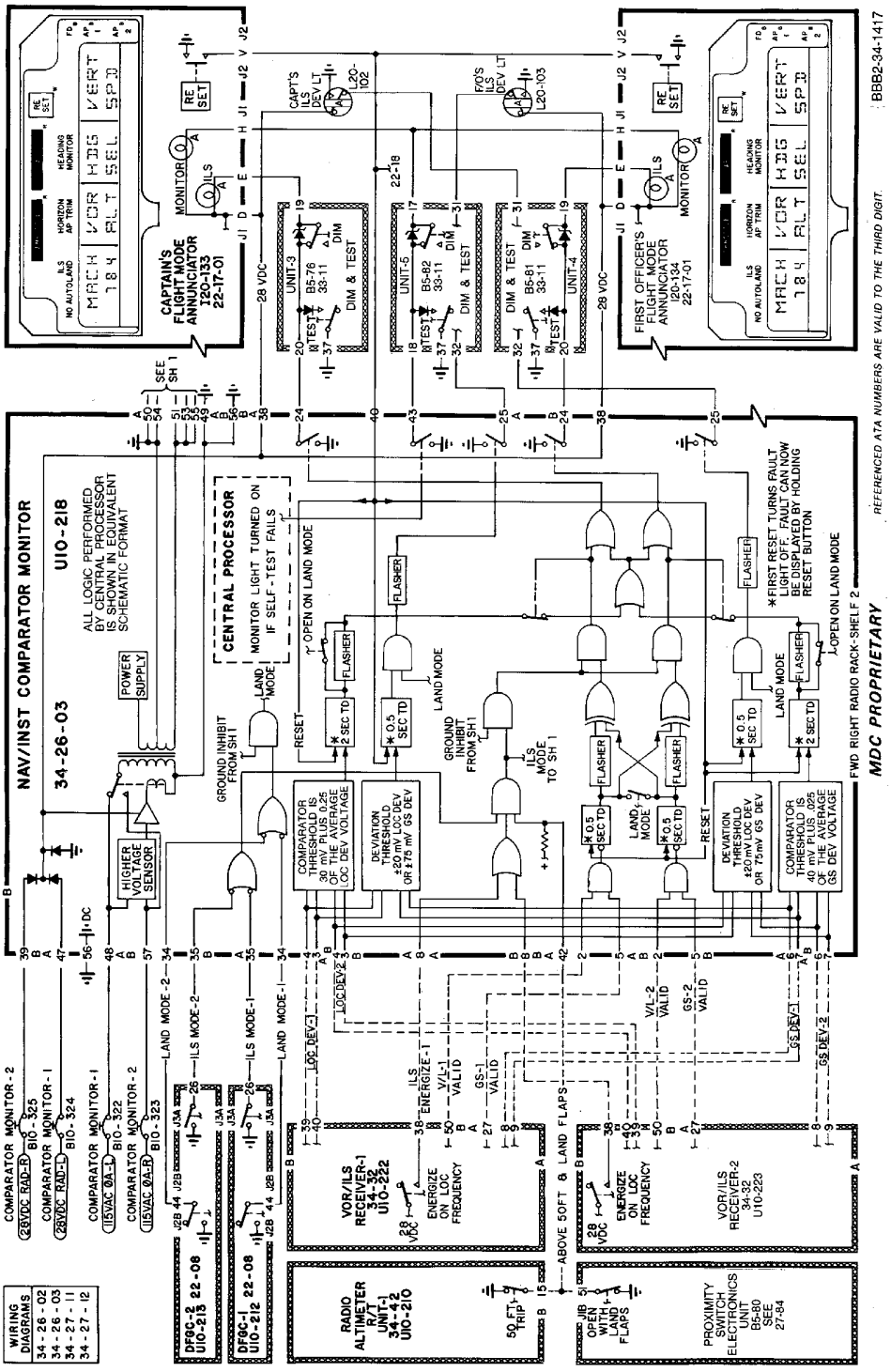
Monitor and ILS Comparator Monitor - Schematic
Figure 102/34-29-00-990-802 (Sheet 1 of 4)



Monitor and ILS Comparator Monitor - Schematic
Figure 102/34-29-00-990-802 (Sheet 2 of 4)



Monitor and ILS Comparator Monitor - Schematic
Figure 102/34-29-00-990-802 (Sheet 3 of 4)



Monitor and ILS Comparator Monitor - Schematic
Figure 102/34-29-00-990-802 (Sheet 4 of 4)

NAVIGATION INSTRUMENT COMPARATOR/MONITOR SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Navigation Instrument Comparator/Monitor (NICM) System consists of a single line replaceable unit which compares and/ or monitors four systems - Attitude Display, Compass Display, Navigation Receivers, and the NICM itself - to provide a visual warning to the flight crew if a significant disagreement or an invalid condition should exist.

B. The NICM drives four pair of warning indicator lights on the Flight Mode Annunciators (FMA's): HORIZON lights for Attitude Display failures, HEADING for Compass Display, ILS for Localizer and Glideslope signals, and MONITOR for NICM failures detected by built-in test equipment.

C. ILS comparison and monitoring is performed only when ILS operation is detected by the NICM.

D. All warning lights except MONITOR WARN are inhibited below 50' altitude.

E. The condition of the VHF/NAV receiver is monitored by the NICM, and is displayed through the NAV annunciator on each HSI.

2. Equipment and Materials

Table 201

Name and Number	Manufacturer
Vertical Gyro Simulator	Local
NOTE: During tests for attitude display for horizon lights, pitch and roll signals must be simulated from the vertical gyros. Simulation of these signals must be accomplished by tilting of the gyros or use of a vertical gyro simulator. (Paragraph 3.)	
VOR/ILS Simulator TIC-30B or equivalent	TEL Instruments

3. Adjustment/Test

A. Self Test

NOTE: The following self test will test the integrity of the Navigation Instrument Comparator/Monitor and the Flight Mode Annunciators. If testing of the roll and pitch signals from the vertical gyros is required, the additional tests in Paragraph 3.B. and Paragraph 3.C. should be required. Tests in Paragraph 3.B. and Paragraph 3.C. are at the discretion of the Customer. Normal operation of the vertical gyros is checked in ATTITUDE SYSTEM, SUBJECT 34-23-00 and VERTICAL GYRO, SUBJECT 34-23-01, and should not necessarily need to be checked in this section.

Table 202

Operation	Desired Result
(1) Press and release ANNUN/ DIGITAL LTS TEST button located on overhead panel.	ILS, HORIZON, HEADING and MONITOR legends on Captain's and First Officer's flight mode annunciators on instru ment panels should come on steady and remain on for 5(±2) seconds.

B. Attitude and Heading Comparator Test

NOTE: This test is performed to test attitude and heading comparison and warning light wiring of the NICM System.

NOTE: Attitude and compass systems must be operational in order to perform test. Both ADI's and HSIs/RDIs must be installed in order to perform test.

Table 203

Operation	Desired Result
(1) If a vertical gyro simulator is to be used, connect simulator to vertical gyro-1 wire harness. Set controls to normal positions. If no simulator is used, vertical gyro will have to be tipped as necessary in following steps to simulate roll and pitch signals to NICM.	
(2) Open GROUND CONTROL RELAY RIGHT circuit breaker located on upper EPC circuit breaker panel.	
(3) Place VERT GYRO switch on overhead panel to NORM position (if VERT GYRO switch applicable).	
(4) Attitude simulator controls/ vertical gyro set for normal level position.	Captain's and First Officer's ADIs should agree in pitch and roll, ±2 degrees. Captain's and First Officer's HORIZON legends on FMAs should be off.
NOTE: During initial power application, Captain's legend may be flashing and First Officer's legend will be steady. After 5 seconds time delay, they should go off.	
(5) Simulate a pitch attitude to make Captain's and First Officer's ADIs to disagree in pitch by more than 6 degrees.	Captain's and First Officer's HORIZON warning legend should come on steady (after 5 second time delay).
(6) Simulate pitch so Captain's and First Officer's ADIs agree.	Captain's and First Officer's HORIZON legends go off.
(7) Simulate a roll attitude so Captain's and First Officer's ADIs disagree in roll attitude by more than 6 degrees, wait 5 seconds for time delay.	Captain's and First Officer's HORIZON warning legends come on steady.
(8) Open VERTICAL GYRO-2 circuit breaker.	Captain's HORIZON warning light comes on steady, First Officer's HORIZON warning light comes on flashing.
(9) Close VERTICAL GYRO-2 circuit breaker and simulate roll attitude so Captain's and First Officer's ADIs agree.	Captain's and First Officer's HORIZON warning lights off.
(10) Open F/O COMPASS circuit breaker located on overhead circuit breaker panel.	First Officer's HEADING warning legend comes on steady, Captain's HEADING warning legend comes on flashing.
(11) Close F/O COMPASS circuit breaker.	HEADING legends go off.
(12) Synchronize CAPT's Compass Indicator by depressing and rotating sync knob into cross (+) or dot (·) direction, depending on whether a cross (+) or dot (·) appears in annunciator window. System is synchronized when annunciator window is blank.	Turn sync knob in direction indicated in annunciator window.
(13) Depress and rotate sync knob on F/O's Compass Indicator until heading indication agrees with CAPT's HSI heading indication.	Heading agree (±2°) CAPT's & F/O's HEADING warn legend off.
NOTE: Wait 5 seconds for time delay.	
(14) Depress and rotate sync knob on F/O's Compass Indicator until heading indication disagrees with CAPT's HSI heading indication by 10° either direction.	Heading disagree by 10°(±2°). CAPT's & F/O's HEADING warn legend on steady.
NOTE: Wait 5 seconds for time delay.	
(15) *Simulate 30° roll either direction.	CAPT's roll 30°. CAPT's & F/O's HEADING warn legend off. CAPT's and F/O's HORIZON legend on steady.

Table 203 (Continued)

Operation	Desired Result
NOTE: Wait 5 seconds for time delay.	
*Set simulation roll angle as close as possible to 30°. If roll angle is set higher than about 35°, the N/CM can malfunction and heading light will not go off.	
(16) Open CAPT's COMPASS circuit breaker.	First Officer's HEADING warn legend flashing. Captain's HEADING warn legend on steady.
(17) Close CAPTAIN's COMPASS circuit breaker and set roll attitude to 0°.	HEADING legends OFF.

C. VOR/ILS Comparator/Monitor Test

NOTE: This test is performed to test GS and VOR/LOC deviation biasing, RDI NAV annunciator, monitor warning, and associated logic input and output wiring.

NOTE: VHF NAV receiver systems must be operational in order to perform test. Both ADIs and HSIs must be operational in order to perform test. Ground sensing in ground position.

NOTE: Following steps (1) through (12) checks NAV annunciator and ILS pointer biasing.

Table 204

Operation	Desired Result
(1) Set up VOR/ILS signal generator.	
(2) On signal generator, place:	
Power switch to "ON".	ON.
LOC switch to "CENTERED".	LOC CENTERED.
GS switch to "CENTERED".	GS CENTERED.
(3) Tune ILS receiver Number One to 108.10 MHz.	108.10 MHz LOC and GS pointer on CAPT'S HSI are centered ±1 needle width. CAPT's HSI NAV fail flag out of view. GS pointer on F/O's ADI is centered ±1 needle width.
(4) Tune ILS receiver Number Two to 108.10 MHz.	108.10 MHz LOC and GS pointer on F/O's HSI are centered ±1 needle width. F/O's HSI NAV fail flag out of view. GS pointer on CAPT's ADI is centered ±1 needle width.
(5) Open VHF NAV-1 (28VDC) circuit breaker on overhead circuit breaker panel.	CAPT's HSI NAV fail flag in view.
(6) Open VHF NAV-2 (28VDC) circuit breaker on upper EPC circuit breaker panel.	-F/O's HSI NAV fail flag in view. Scale and pointer removed from display.
(7) Close following circuit breakers on overhead circuit breaker panel.	CAPT's HSI NAV flag out of view.
VHF NAV-1 (28 VAC)	
VHF NAV-1 (28 VDC)	
(8) Close following circuit breakers on upper EPC circuit breaker panel.	F/O's HSI NAV flag out of view.
VHF NAV-2 (28 VAC)	

Table 204 (Continued)

Operation	Desired Result
VHF NAV-2 (28 VDC)	
(9) Verify GLIDESLOPE-1 circuit breaker on overhead circuit breaker panel is closed.	
(10) Verify GLIDESLOPE-2 circuit breaker on upper EPC circuit breaker panel is closed.	LOC and GS pointer on both HSIs are in view.
(11) Open following circuit breakers on upper EPC circuit breaker panel:	"MONITOR" light illuminates on CAPT's and F/O's FMA.
COMPARATOR MONITOR-1 (115 VAC)	
COMPARATOR MONITOR-2 (115 VAC)	
(12) Close following circuit breakers on upper EPC circuit breaker panel:	"MONITOR" light goes out.
COMPARATOR MONITOR-1 (115 VAC)	
COMPARATOR MONITOR-2 (115 VAC)	
NOTE: Steps (13) through (21) check ILS comparator.	
(13) Open LEFT PROXIMITY SWITCH CONTROL circuit breaker on lower EPC circuit breaker panel.	
(14) Open following circuit breakers on upper EPC circuit breaker panel:	
RADIO ALTIMETER-1	
GROUND CONTROL RELAY RIGHT	
(15) Retard throttle levers to full aft stop.	
(16) Connect ground jumper to terminal 28 on mod block S30-118 (STA. 110).	CAPT's and F/O's ILS warn lights OFF.
(17) On signal generator:	
Adjust localizer to two dots deviation left.	Both LOC pointers show 2 dots deviation left.
Adjust localizer to center.	Both LOC pointers show in center position.
Adjust glideslope to two dots deviation up.	All GS pointers show 2 dots deviation up.
Adjust glideslope to center. All GS pointers show in	center position.
Set glideslope power switch to OFF.	CAPT's and F/O's ILS warn light flashes. CAPT's and F/O's GS flag come into view.
Set glideslope power switch to ON.	ILS warn lights go off. All GS flags are out of view.
Set localizer power switch to OFF.	CAPT's and F/O's ILS warn light flashes. CAPT's and F/O's LOC flag come into view.
Set localizer power switch to ON.	ILS warn lights go off. LOC flags are out of view.
(18) On GS simulator set:	
Power switch to OFF.	CAPT's and F/O's ILS warn light flashes. CAPT's and F/O's GS flag comes into view.
Power switch to ON.	ILS warn lights go off. GS flags are out of view.

Table 204 (Continued)

Operation	Desired Result
On LOC simulator, set power switch to OFF.	CAPT's and F/O's ILS warn light flashes. CAPT's and F/O's LOC flags come into view.
NOTE: HEADING warn lights may be on steady, be off, or flash during various stages of the following procedure.	
(19) Verify flaps less than 25°. Close LEFT PROXIMITY SWITCH CONTROL circuit breaker.	CAPT's and F/O's ILS warn lights OFF.
(20) Open LEFT PROXIMITY SWITCH CONTROL circuit breaker.	CAPT's and F/O's ILS warn lights flash.
(21) Close RADIO ALTIMETER-1 circuit breaker. Verify RADIO ALTIMETER indicates less than 50 feet.	CAPT's and F/O's ILS warn lights OFF.
NOTE: Wait a few moments for warm-up.	
(22) Open RADIO ALTIMETER-1 circuit breaker.	CAPT's ILS warn light flashes. F/O's ILS warn light on steady.
(23) Close GROUND CONTROL RELAY RIGHT circuit breaker.	CAPT's and F/O's ILS warn lights are OFF.
(24) Advance left throttle lever to full forward stop.	CAPT's and F/O's ILS warn lights flash.
(25) Retard left throttle lever to full aft stop.	CAPT's and F/O's ILS warn lights are OFF.
(26) Advance right throttle lever to full forward stop.	CAPT's and F/O's ILS warn lights flash.
(27) Depress and release RESET button on CAPT's FMA.	All warning lights go OFF on both FMA's.
(28) Retard right throttle lever to full aft stop.	CAPT's and F/O's ILS warn lights OFF.
(29) Open following circuit breakers on upper EPC circuit breaker panel:	CAPT's and F/O's MONITOR warn lights come on steady.
COMPARATOR MONITOR-2 (115 VAC)	
COMPARATOR MONITOR-1 (115 VAC)	
(30) Close COMPARATOR MONITOR-1 and -2 circuit breakers, and advance right throttle to forward stop.	ILS warn lights return to flashing condition on FMA's.
(31) Depress and release RESET button on F/O's FMA.	All warning lights go off on both FMA's.
(32) Close circuit breakers opened during test and retard throttles.	

D. Test Termination

Table 205

Operation	Desired Result
(1) Remove jumper wire from terminal 28 on mod block S30-118, STATION 110.	
(2) Remove signal generators.	
(3) Return airplane to required configuration.	

NAVIGATION INSTRUMENT COMPARATOR/MONITOR - MAINTENANCE PRACTICES

1. General

A. This Maintenance Practices provides Removal/Installation of the Navigation Instrument Comparator/ Monitor (NICM). The NICM is located in the forward right radio rack in the electrical/ electronics compartment.

2. Removal/Installation

A. Remove NICM

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	19	B10-322	COMPARATOR MONITOR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-323	COMPARATOR MONITOR-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

(2) Unscrew knurled holddown nuts at front of mounting rack and swing assemblies down.

(3) Pull NICM unit straight out of rack.

B. Install NICM

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	19	B10-322	COMPARATOR MONITOR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	7	B10-323	COMPARATOR MONITOR-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

(2) Check NICM and mounting rack electrical connectors for loose, broken, or dirty connector pins.

(3) Slide NICM straight into mounting rack ensuring that NICM electrical connector mate rack electrical connector properly.

(4) Engage holddown assembly with lugs on NICM and tighten knurled holddown nut.

(5) Close circuit breakers opened in Paragraph 2.B.(1) and remove warning tags.

(6) Press ANNUN DIGITAL LTS TEST button on overhead panel; ILS, HORIZON, HEADING, and MONITOR legends on Captain's and First Officer's flight mode annunciators should come on, and remain on for 5(±2) seconds.

(7) Return airplane to required configuration.

LANDING AND TAXIING AIDS - DESCRIPTION AND OPERATION

1. General

A. This section describes that portion of equipment which provides guidance during approach, landing and taxiing. The marker beacon and ILS systems are used in conjunction with the VHF navigation system to indicate position during approach and landing operations.

2. Marker Beacon System

A. The marker beacon system uses signals from ground stations to provide both aural and visual indications of passage over any 75-megahertz marker beacon transmitter. In addition to the three marker beacon lights, aural identification signals are fed to the flight interphone system, and a middle marker signal to the flight guidance system. On aircraft with Honeywell EFIS, marker beacon signals are fed through the symbol generator then to the primary flight display (PFD). On aircraft with Smith's SDS-2000 EFIS, marker beacon signals are fed directly to the PFD's and ND's.

3. Instrument Landing System (ILS)

A. The instrument landing system uses LOC and glideslope signals from ground stations to provide visual indications of the position of the aircraft in relation to the glidepath and localizer.

MARKER BEACON - DESCRIPTION AND OPERATION

1. Description

WJE 405, 406, 409, 410, 415-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 891-893

A. The marker beacon system provides indication of passage over any 75 megahertz marker beacon transmitter. Visual identification is provided by one of three indicating lights, and aural identification by reception of one of three audible tones. The marker beacon system consists of an antenna and receiver. Marker beacon indication is displayed on the EFIS Primary flight displays (PFD).

WJE 401-406, 409, 410, 412, 414-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 886, 887, 891-893

B. Marker Beacon Antenna - The antenna is a low-drag, lightweight, externally mounted antenna, located on the centerline of the lower forward fuselage just aft of the radome. The hermetically sealed antenna is pretuned and designed to receive 75 megahertz marker beacon signals.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 881, 883, 884, 891-893

C. Marker Beacon Lights - Three marker beacon indicating lights are mounted on the captain's, and the first officer's instrument panels. Each set of lights contains a white light placarded A for airway marker, an amber light placarded MM for middle marker, and a blue light placarded OM for outer marker. All of the lights are wired for press-to-test function. When the lens is depressed, proper lamp operation is verified by the light coming on.

(1) If the MKR switch on the applicable audio selector panel is on, aural identification of each marker beacon is provided by reception of one of three audible tones at the same time the applicable lights come on. The airway marker provides an intermittent 3000 Hertz tone, the outer marker provides an intermittent 400 Hertz tone, and the middle marker provides an intermittent 1300 Hertz tone.

WJE 401-404, 406, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

D. Marker Beacon annunciations (Lights) - Marker beacon annunciations appear on the EFIS Primary Flight Display (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1, paragraph Primary Flight Display (PFD) Symbology). Indications are as follows: (I): Airways/Inner (white), (M): Middle (yellow), and (O): Outer (cyan). Upon detecting a marker beacon signal, the EFIS Symbol Generator will initiate a blinking light on the PFD's for the beacon symbol, similar to the previous flashing lights. This indication is located in the lower right corner, left of the Radio Altitude tape on the Primary Flight Display (PFD).

(1) If the MKR switch on the applicable audio selector panel is on, aural identification of each marker beacon is provided by reception of one of three audible tones at the same time the applicable lights come on. The airway marker provides an intermittent 3000 Hertz tone, the outer marker provides an intermittent 400 Hertz tone, and the middle marker provides an intermittent 1300 Hertz tone.

WJE 401-406, 409, 410, 412, 414-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 886, 887, 891-893

E. Marker Beacon Receiver - The marker beacon receiver is a transistorized, crystal controlled, receiver operating at a fixed frequency of 75 megahertz. The receiver is mounted on the radio rack in the electrical/electronics compartment. Electrical and antenna connections are made through a single connector on the rear of the chassis.

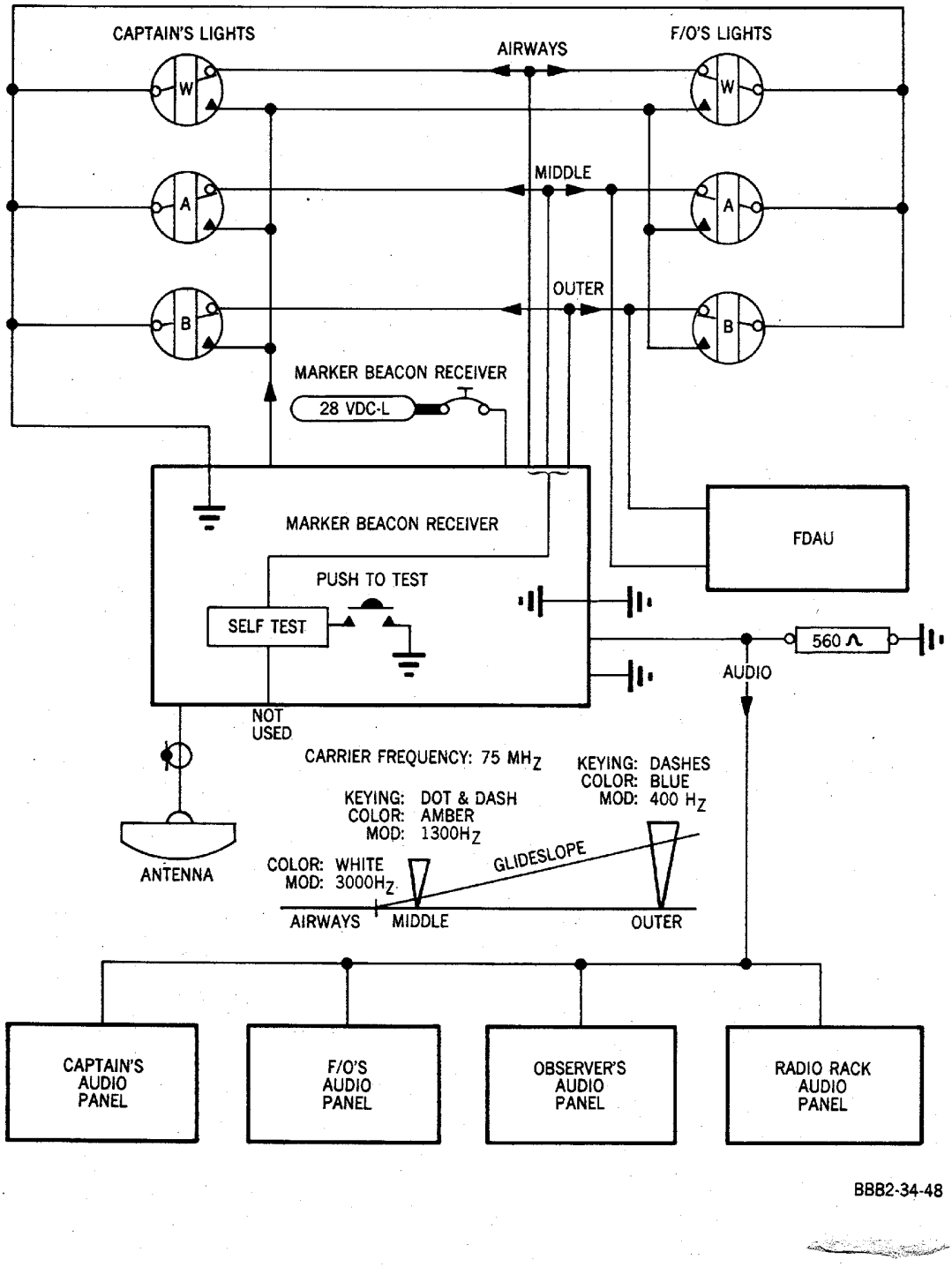
(1) The receiver operates directly from the MARKER BEACON circuit breaker, and there is no ON/OFF switch provided.

(2) There is no high-low sensitivity switch installation, and the receiver operates continuously in the low sensitivity mode.

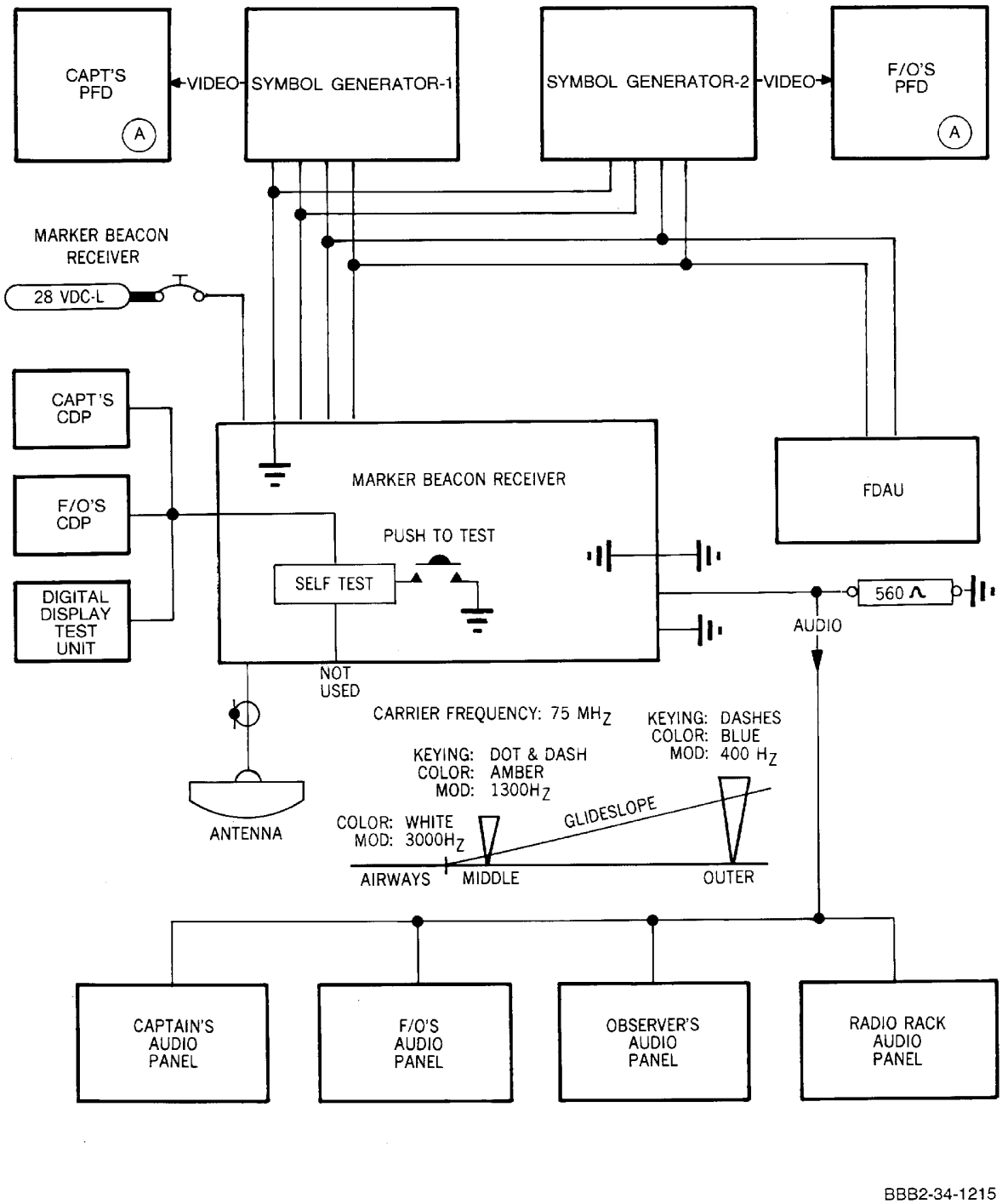
2. Operation

A. The marker beacon system is turned on when the airplane electrical buses are energized, and the applicable MKR BCN circuit breaker is closed. The system receives VHF signals consisting of a 75 megahertz carrier, amplitude modulated with 400, 1300, or 3000 Hertz, depending on which of the three marker beacon signals received. These signals are converted to an aural and visual output to indicate passage over a marker beacon transmitter.

B. Specific types of marker beacons include those for airways, outer markers, and middle markers. Airway markers are usually associated with specific aids to enroute navigation (or holding points) and provide the operator with an exact position at the time of passing over the associated range station. Airway marker facilities are identified when the white lights come on and a 3000 Hertz tone is heard. Outer and middle markers are associated with an instrument landing system. The outer marker is usually located directly below the point where an airplane on a localizer course should intersect the glide slope and start descending. An outer marker is identified when the blue lights come on and a 400 Hertz tone is emitted. The middle marker is located near the runway, usually under the point on the glide path where instrument descent should be discontinued and a VFR landing be executed. A middle marker is identified when the amber lights come on and a 1300 Hertz tone is emitted.



Marker Beacon System -- Block Diagram
Figure 1/34-31-00-990-807 (Sheet 1 of 2)



Marker Beacon System -- Block Diagram
Figure 1/34-31-00-990-807 (Sheet 2 of 2)

MARKER BEACON - DESCRIPTION AND OPERATION

1. Description

A. The marker beacon system provides indication of passage over any 75 megahertz marker beacon transmitter. Visual identification is provided by one of three indicating lights, and aural identification by reception of one of three audible tones. The marker beacon system consists of an antenna, receiver, and two sets of indicating lights wired in parallel.

B. Marker Beacon Antenna - The antenna is a low-drag, lightweight, externally mounted antenna, located on the centerline of the lower forward fuselage just aft of the radome. The hermetically sealed antenna is pretuned and designed to receive 75 megahertz marker beacon signals.

C. Marker Beacon Lights (aircraft without EFIS) - Three marker beacon indicating lights are mounted on the captain's, and the first officer's instrument panels. Each set of lights contains a white light placarded A for airway marker, an amber light placarded MM for middle marker, and a blue light placarded OM for outer marker. All of the lights are wired for press-to-test function. When the lens is depressed, proper lamp operation is verified by the light coming on.

(1) On aircraft with EFIS, marker beacon annunciations appear on the EFIS Primary Flight Display (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1, paragraph Primary Flight Display (PFD) Symbology). Indications are as follows: (I): Airway/Inner (white), (M): Middle (yellow), and (O): Outer (cyan). Upon detecting a marker beacon signal, the EFIS Symbol Generator will initiate a blinking routine for the beacon symbol, similar to the previous flashing lights. This indicator is located in the lower right corner, left of the Radio Altitude tape on the Primary Flight Display (PFD).

(2) If the MKR switch on the applicable audio selector panel is on, aural identification of each marker beacon is provided by reception of one of three audible tones at the same time the applicable lights come on. The airway marker provides an intermittent 3000 Hertz tone, the outer marker provides an intermittent 400 Hertz tone, and the middle marker provides an intermittent 1300 Hertz tone.

D. Marker Beacon Receiver - The marker beacon receiver is a transistorized, crystal controlled, receiver operating at a fixed frequency of 75 megahertz. The receiver is mounted on the radio rack in the electrical/electronics compartment. Electrical and antenna connections are made through a single connector on the rear of the chassis.

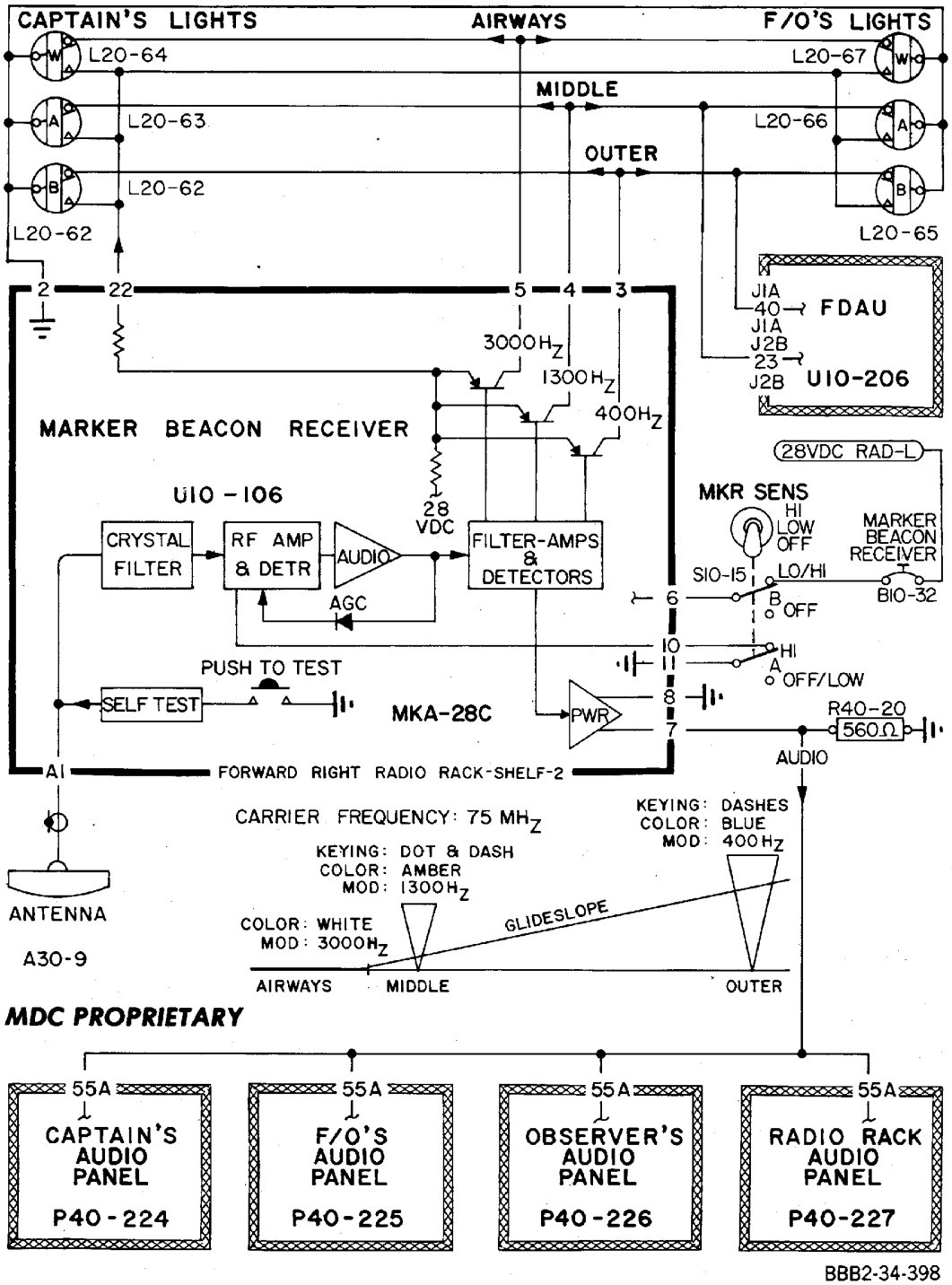
(1) The receiver operates directly from the MARKER BEACON circuit breaker, and there is no ON/OFF switch provided.

(2) There is a HI-LO-OFF (Marker Beacon (MKR SENS) sensitivity) switch located on the Captain's instrument panel. The switch controls off and on of marker beacon operation and intensity of the marker beacon lights.

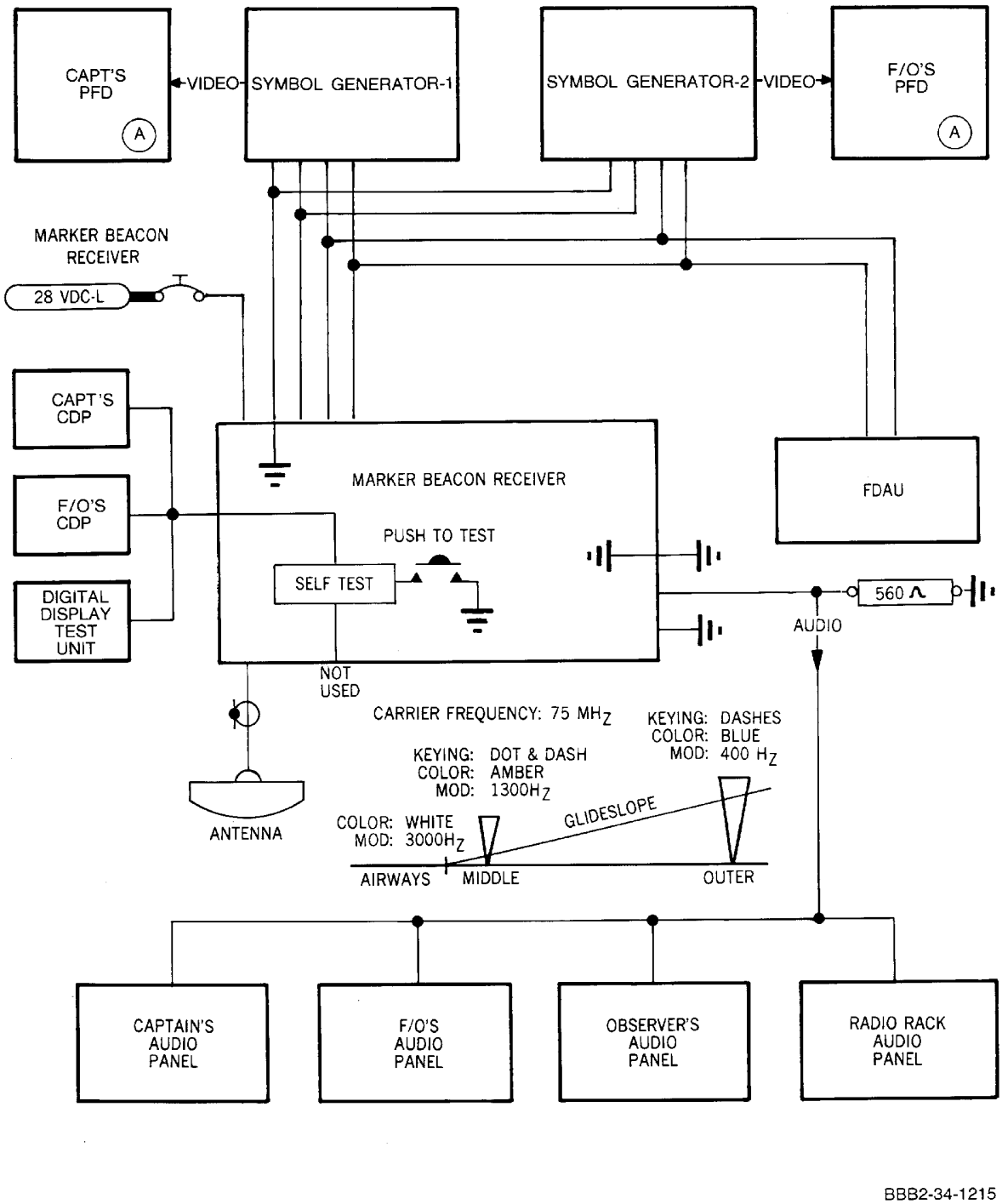
2. Operation

A. The marker beacon system is turned on when the aircraft electrical buses are energized, the applicable MKR BCN circuit breaker is closed, and HI-LO-OFF switch is placed out of OFF position. The system receives VHF signals consisting of a 75 megahertz carrier, amplitude modulated with 400, 1300, or 3000 Hertz, depending on which of the three marker beacon signals received. These signals are converted to an aural and visual output to indicate passage over a marker beacon transmitter.

B. Specific types of marker beacons include those for airways, outer markers, and middle markers. Airway markers are usually associated with specific aids to enroute navigation (or holding points) and provide the operator with an exact position at the time of passing over the associated range station. Airway marker facilities are identified when the white lights come on and a 3000 Hertz tone is heard. Outer and middle markers are associated with an instrument landing system. The outer marker is usually located directly below the point where an airplane on a localizer course should intersect the glide slope and start descending. An outer marker is identified when the blue lights come on and a 400 Hertz tone is emitted. The middle marker is located near the runway, usually under the point on the glide path where instrument descent should be discontinued and a VFR landing be executed. A middle marker is identified when the amber lights come on and a 1300 Hertz tone is emitted.



Marker Beacon System -- Block Diagram
Figure 1/34-31-00-990-808 (Sheet 1 of 2)



Marker Beacon System -- Block Diagram
Figure 1/34-31-00-990-808 (Sheet 2 of 2)

MARKER BEACON - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty marker beacon system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 405-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

D. The major components of the Marker Beacon system on aircraft with EFIS are: marker beacon displays on EFIS PFD's, receiver and antenna. On aircraft without EFIS: Marker Beacon Lights, receiver and antenna.

WJE 401-404, 412, 414, 886, 887

E. The major components of the Marker Beacon system are: marker beacon displays on EFIS PFD's, receivers, and antenna.

WJE ALL

F. The Marker Beacon components are located as follows:

Table 101

Component	Location
WJE 405-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893	
Marker Beacon Lights	Captain's and First Officer's instrument panels (non-EFIS aircraft)
Marker Beacon Display	Captain's and First Officer's EFIS Primary Flight Displays (on aircraft with EFIS)
WJE 401-404, 412, 414, 886, 887	
Marker Beacon Display	Captain's and First Officer's EFIS Primary Flight Displays
WJE ALL	
Marker Beacon Circuit Breakers	Upper EPC Circuit Breaker Panel
Marker Beacon Receiver	Electrical/Electronics Compartment
Marker Beacon Antenna	Forward Lower Fuselage Nose Section

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

Table 102

Name and Number	Manufacturer
Multimeter Model 8025A	Fluke

3. Trouble Shooting Marker Beacon System

A. Trouble Shoot

WJE 401-404, 412, 414, 886, 887

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are marker beacon receivers, and antennas. Marker beacon indications are displayed on the EFIS PFD.

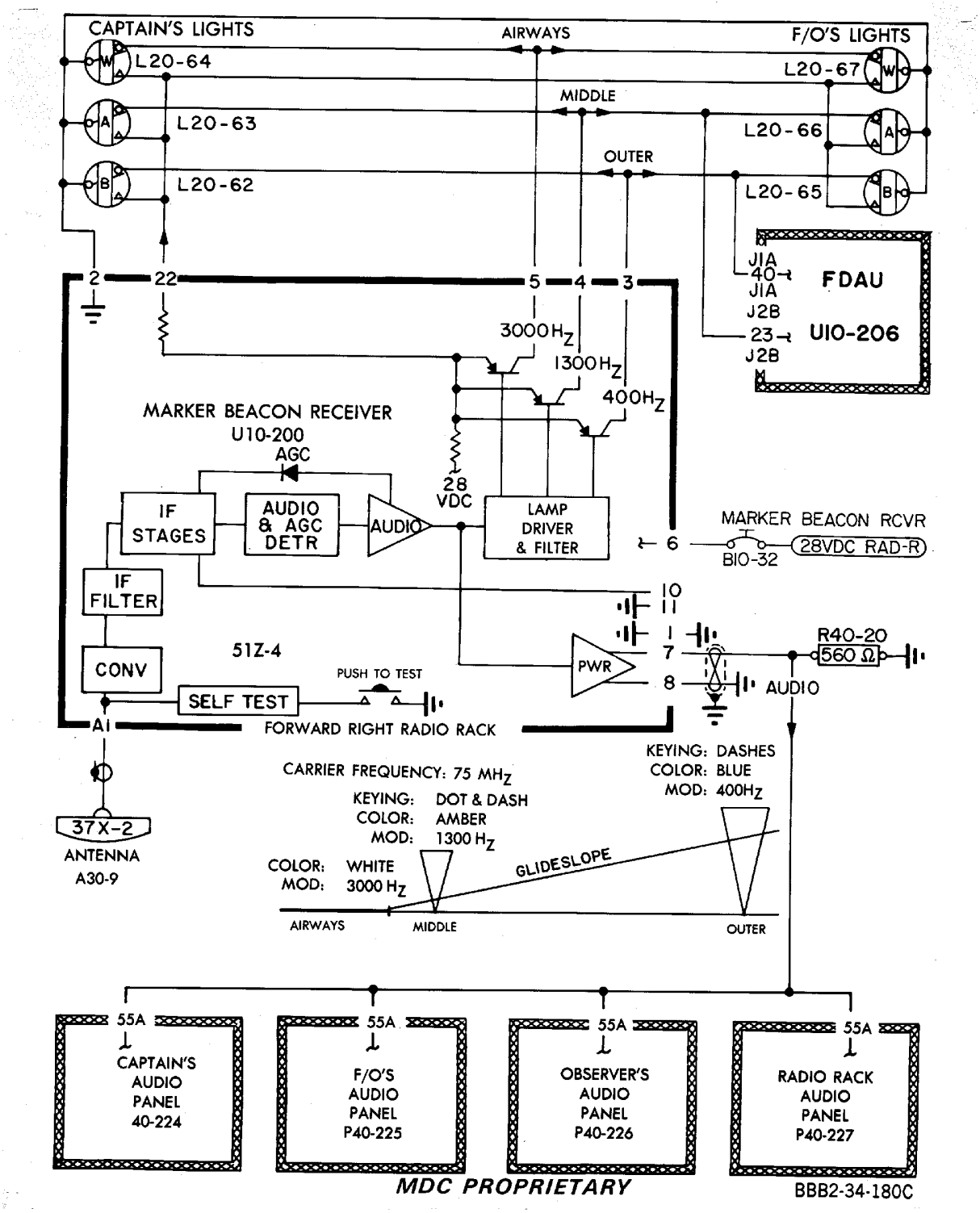
WJE 405-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are marker beacon receivers, and antennas, and marker beacon lights on non-EFIS aircraft. On aircraft with EFIS, marker beacon indications are displayed on the EFIS PFD.

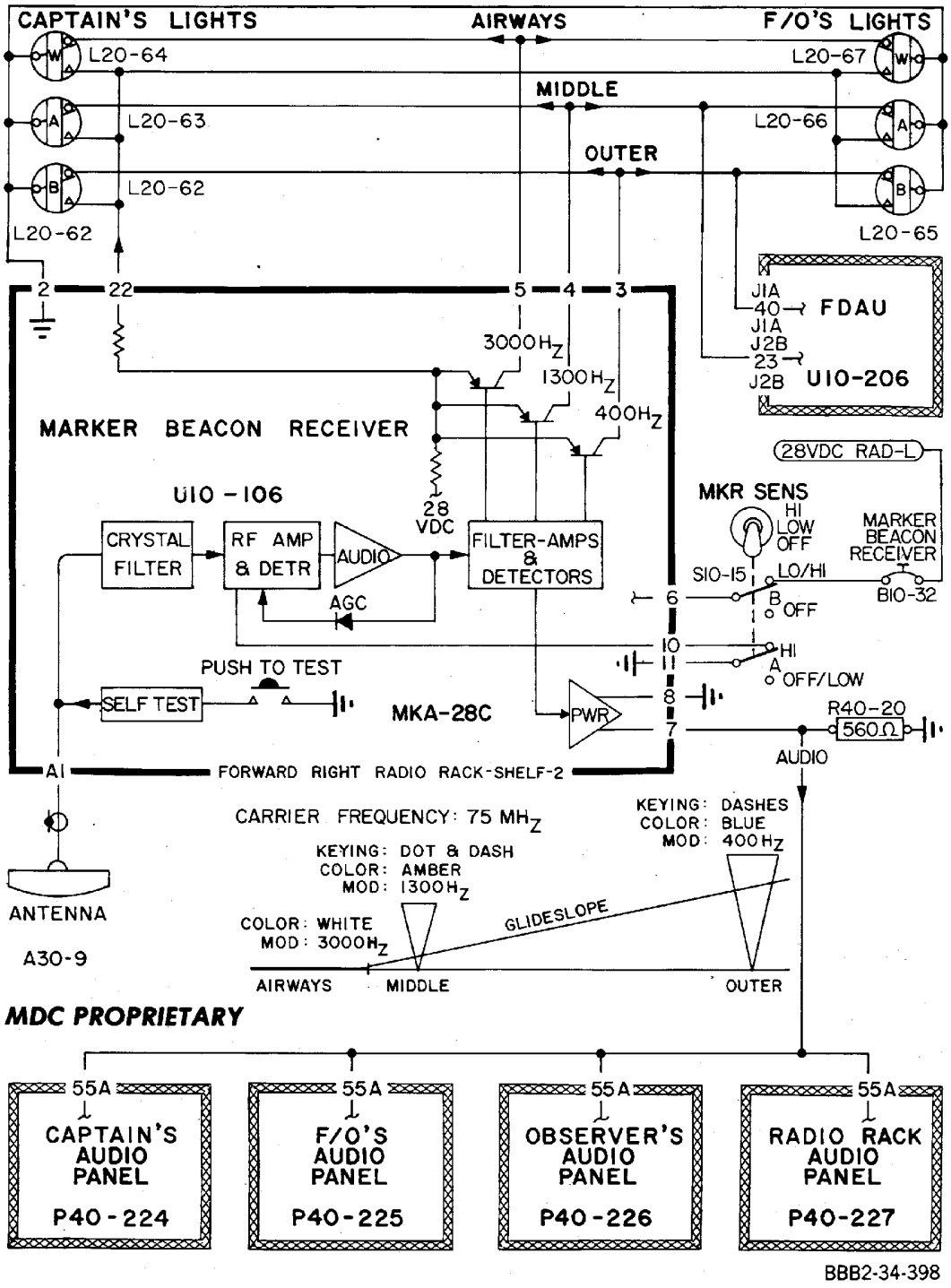
WJE ALL

Table 103

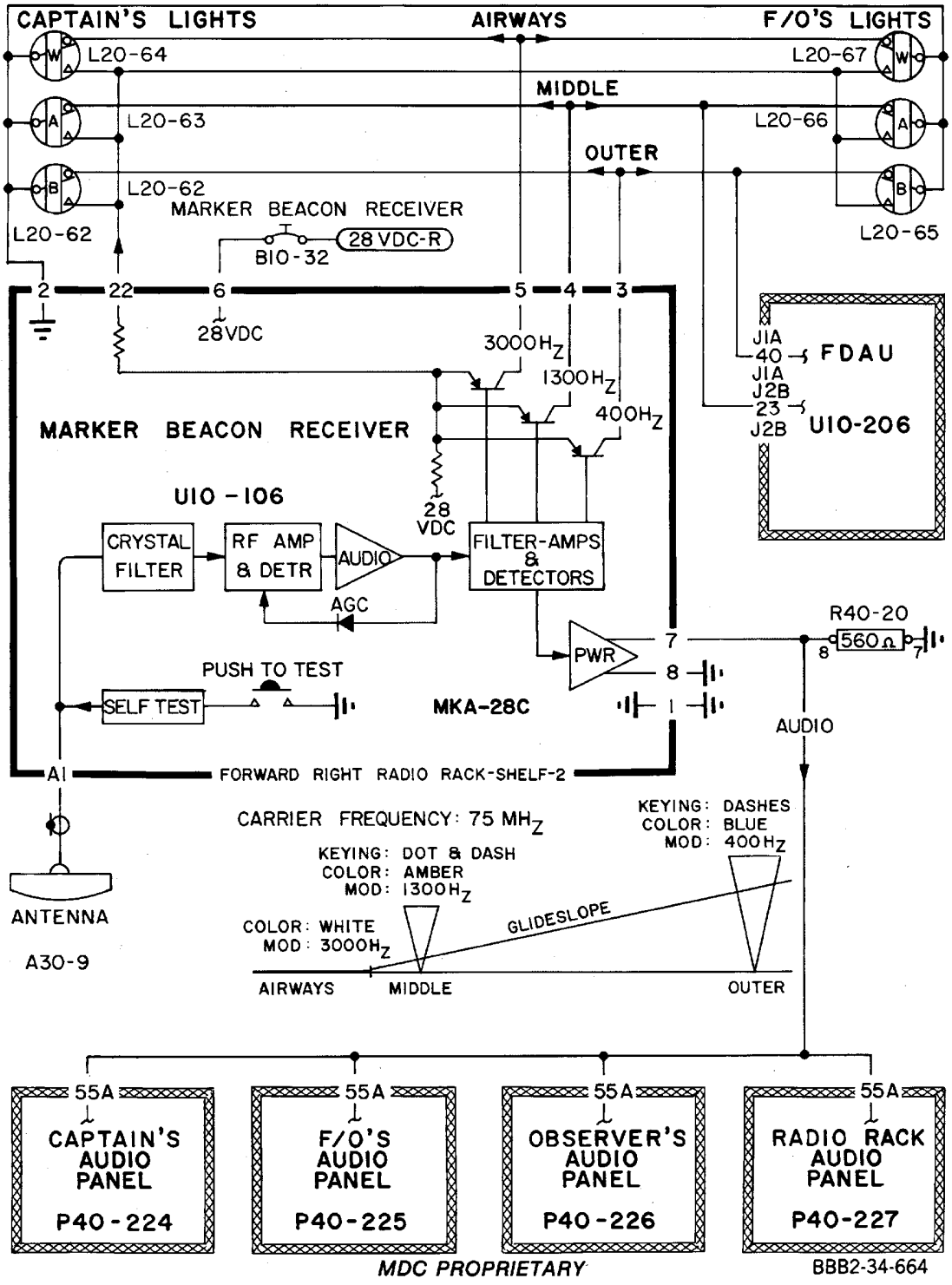
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.



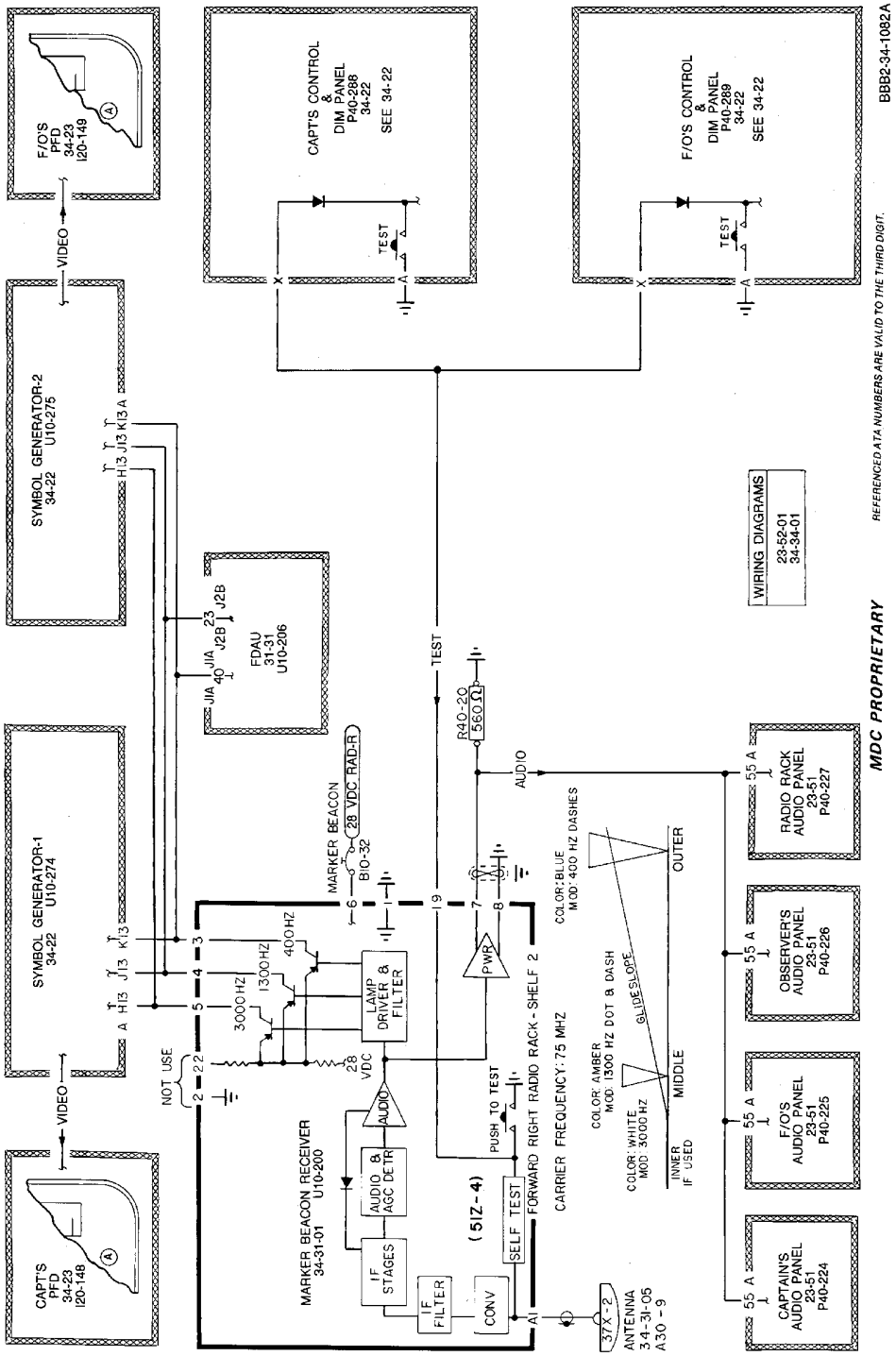
Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 1 of 7)



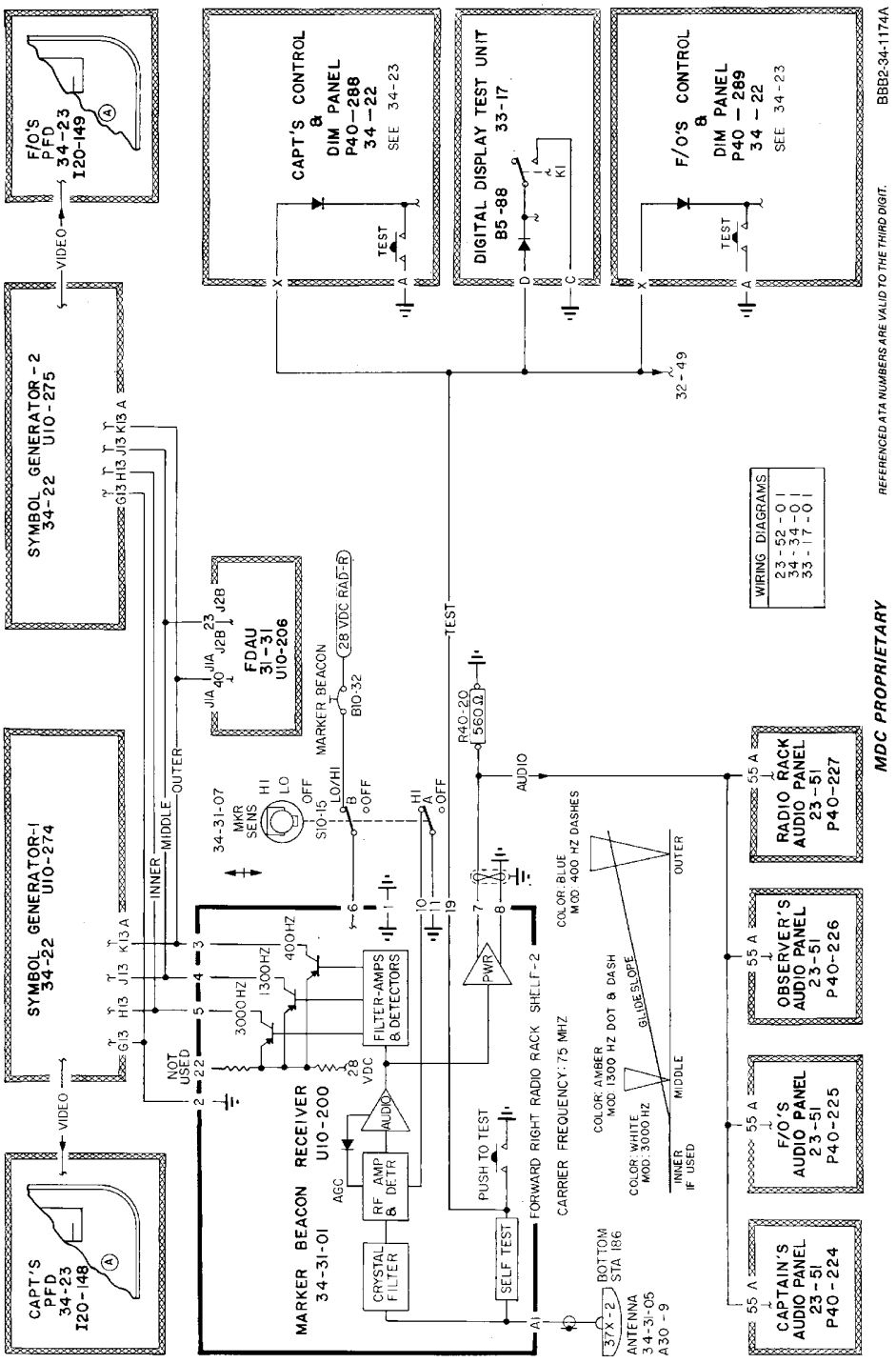
Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 2 of 7)



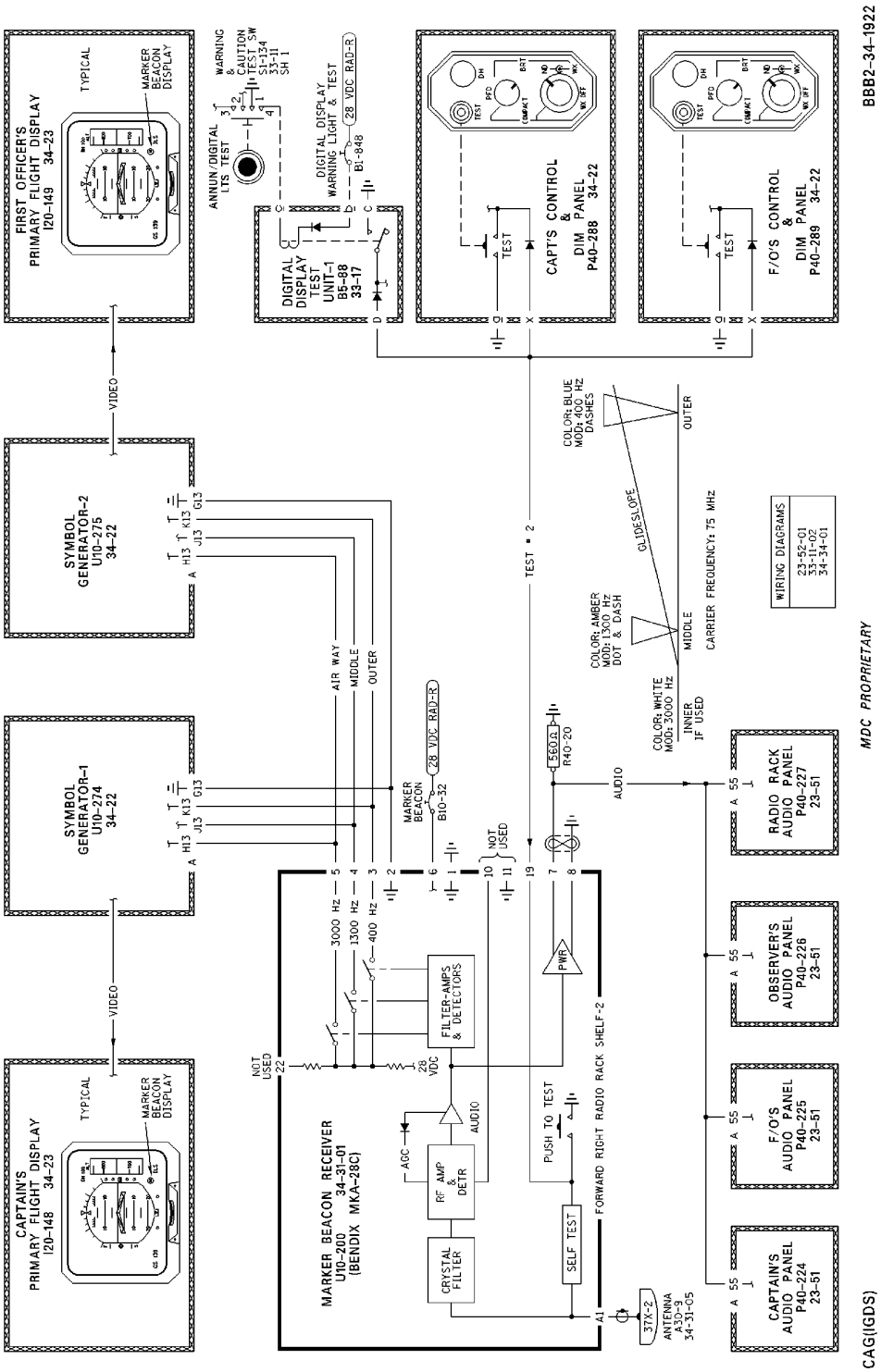
Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 3 of 7)



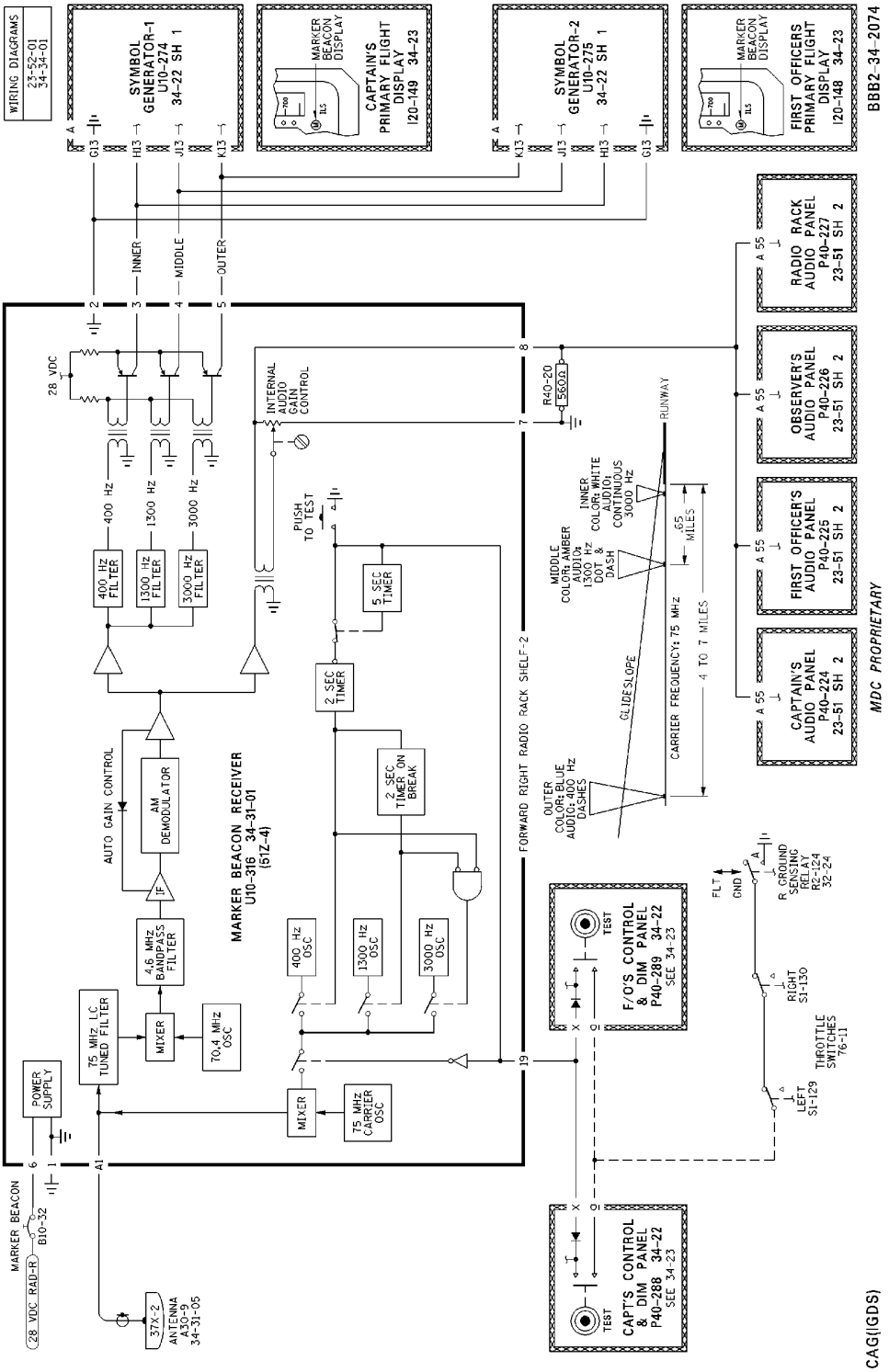
Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 4 of 7)



Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 5 of 7)



Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 6 of 7)



Marker Beacon System - Schematic
Figure 101/34-31-00-990-804 (Sheet 7 of 7)

MARKER BEACON - MAINTENANCE PRACTICES

1. General

WJE 405, 407-412, 414, 416, 420, 422, 424-427, 429, 861, 862, 868, 873-881, 883, 884, 891-893

A. The Marker Beacon (MB) system provides indication of passage over any 75 megahertz marker beacon transmitter. Visual identification is provided by one of three indicating lights, and aural identification by reception of one of three audible tones.

WJE 401-404, 406, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

B. The MB system provides indication of passage over any 75 megahertz MB transmitter. Visual identification is provided by one of three flashing MB symbols on the EFIS PFD's, and aural identification by reception of one of three audible tones.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

C. The system consists of an antenna, located on centerline of lower fuselage; receiver, located on radio rack in electrical/electronics compartment; and two sets of indicating lights wired in parallel, located on the Captain's and First Officer's instrument panel.

WJE 401-404, 406, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

D. The system consists of an antenna, located on centerline of lower fuselage; receiver, located on radio rack in electrical/electronics compartment; marker beacon symbology appears on the lower right corner of the PFD's.

WJE 405, 407-411, 875-881, 883, 884

E. The system consists of an antenna, located on centerline of lower fuselage; receiver, located on radio rack in electrical/electronics compartment; and two sets of indicating lights wired in parallel, located on the instrument panel. On aircraft with EFIS, marker beacon symbology is displayed on the PFD.

WJE 401-406, 409, 410, 412, 414-427, 429, 861-866, 868, 869, 871-879, 881, 883, 884, 886, 887, 891-893

F. The MB receiver operates directly from the MB 28 Volts Direct Current (VDC) circuit breaker. There is no ON/OFF switch provided.

WJE 407, 408, 411, 880

G. The MB system receives electrical power from the MB 28 VDC circuit breaker through a HI-LOW-OFF switch located on the center instrument panel.

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887	
Oscillator T-30A	Tel-Instrument Electronics Corp.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887 (Continued)

Table 201 (Continued)

Name and Number	Manufacturer
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893	
Marker Beacon Oscillator BC-376H	Packard Bell
WJE ALL	

3. **Adjustment/Test**

A. Preliminary

(1) With test oscillator located close to aircraft MB antenna, attach oscillator antenna, and energize test set.

(2) Energize aircraft electrical buses, and make sure that MB and flight interphone circuit breakers are closed.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893

(3) On aircraft with EFIS, make sure that both symbol generator (power) circuit breakers and both PFD circuit breakers are closed.

WJE ALL

(4) On both cockpit speakers, rotate VOL control to ON position, and set for comfortable volume.

WJE 407, 408, 411, 880

(5) Place MB HI-LO switch in LO position.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

(6) Depress each marker indicator light lens to verify that light comes on, and then goes off when released.

WJE 407, 408, 411, 875-880

(7) On non-EFIS aircraft, depress each marker indicator light lens to verify that light comes on, and then goes off when released.

(8) On EFIS aircraft, verify that blue MB symbols, on Captain's and First Officer's PFDs, are flashing.

WJE ALL

B. Test Marker Beacon System

WJE 401-412, 414-417, 419-427, 429, 861-866, 868, 873-881, 883, 884, 886, 887, 891-893

Table 202

Step	Operation	Desired Result
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 881, 883, 884, 886, 887, 891-893		
(1)	On test oscillator, set MODULATION control to 400 Hz position.	Both blue indicator lights tone come on, and 400 Hz tone heard in both cockpit speakers.
(2)	On test oscillator, set MODULATION control to 1300 Hz position.	Both amber lights must come on, and 1300 Hz tone heard in both cockpit speakers.
(3)	On test oscillator, set MODULATION control to 3000 Hz position.	Both white indicator lights must come on, and 3000 Hz tone heard in both cockpit speakers.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 881, 883, 884, 886, 887, 891-893 (Continued)

Table 202 (Continued)

Step	Operation	Desired Result
WJE 401-404, 406, 412, 414, 415, 417, 419, 421, 423, 863-866		
(1)	On test oscillator, set MODULATION control to 400 Hz position.	Both flashing blue MB symbols come on, and 400 Hz tone heard in both cockpit speakers.
(2)	On test oscillator, set MODULATION control to 1300 Hz position.	Both flashing amber MB symbols come on, and 1300 Hz tone heard in both cockpit speakers.
(3)	On test oscillator, set MODULATION control to 3000 Hz position.	Both flashing white MB symbols come on, and 3000 Hz tone heard in both cockpit speakers.
WJE 407, 408, 410, 411, 875-880		
(1)	On test oscillator, set MODULATION control to 400 Hz position.	Both blue indicator lights come on (on EFIS PFD's, MB symbol flashes), and 400 Hz tone heard in both cockpit speakers.
(2)	On test oscillator, set MODULATION control to 1300 Hz position.	Both amber lights come on (on EFIS PFD's, MB symbol flashes), and 1300 Hz tone heard in both cockpit speakers.
(3)	On test oscillator, set MODULATION control to 3000 Hz position.	Both white indicator lights come on (on EFIS PFD's, MB symbol flashes), and 3000 Hz tone heard in both cockpit speakers.
WJE 401-406, 409, 410, 412, 414-417, 419-427, 429, 861-866, 868, 873-879, 881, 883, 884, 886, 887, 891-893		
(4)	If an audio bleedthrough occurs during this test, remove the MB receiver and send it to the shop for the applicable adjustment and tests.	
(5)	Remove test equipment and return aircraft to required configuration.	Test completed.
WJE 407, 408, 411, 880		
(4)	Move test set away from aircraft until white lights go off.	
(5)	Place HI-LO-OFF switch in HI position.	White lights should come on. (On PFD's, white marker beacon symbol flashes.)
(6)	Place HI-LO-OFF switch in OFF position.	
(7)	If an audio bleedthrough occurs during this test, remove the MB receiver and send it to the shop for the applicable adjustment and tests.	
(8)	Remove test equipment and return aircraft to required configuration.	Test completed.

WJE 405-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

C. Self-Test

NOTE: Self test does not test antenna operation.

WJE 405-409, 411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

Table 203

Step	Operation	Desired Result
WJE 406		
(1)	Depress MKR BCN test switch on RADIO NAV TEST panel, and maintain in depressed position.	On PFD's, 400 Hz blue symbols should come on; then go off. 1300 Hz amber symbols should come on, then go off. 3000 Hz white symbols should come on and remain on until TEST switch is released.
WJE 415, 417-419, 421, 423, 863-866, 869, 871-874, 892, 893		
(1)	Depress TEST switch on marker beacon receiver and maintain in depressed position.	400 Hz blue symbols should come on; then go off. 1300 Hz amber symbols should come on, then go off. 3000 Hz white symbols should come on and remain on until TEST switch is released. 400 Hz, 1300 Hz and 3000 Hz tones should be heard on loudspeakers.
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891		
(1)	Depress TEST switch on marker beacon receiver and maintain in depressed position.	400 Hz blue lamps should come on; then go off. 1300 Hz amber lamps should come on, then go off. 3000 Hz white lamps should come on and remain on until TEST switch is released. 400 Hz, 1300 Hz and 3000 Hz tones should be heard on loudspeakers.
WJE 875-879		
(1)	Depress TEST switch on marker beacon receiver and maintain in depressed position.	400 Hz blue lamps/symbology should come on; then go off. 1300 Hz amber lamps/symbology should come on, then go off. 3000 Hz white lamps/symbology should come on and remain on until TEST switch is released.
		400 Hz, 1300 Hz and 3000 Hz tones should be heard on loudspeakers.
WJE 415, 417-419, 421, 423, 863-866, 869, 871-874, 892, 893		
(2)	Release TEST switch on marker beacon receiver.	No marker beacon symbology on PFD; tone ceases.
WJE 406		
(2)	Release MKR BCN test switch.	No symbols on PFD.
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891		
(2)	Release TEST switch on marker beacon receiver.	White lamps go off; tone ceases.
WJE 875-879		
(2)	Release TEST switch on marker beacon receiver.	White lamps go off; tone ceases. No symbology on PFD (EFIS aircraft).

WJE 875-879 (Continued)

Table 203 (Continued)

Step	Operation	Desired Result
WJE 407, 408, 411, 880		
(1)	Place HI-LOW-OFF switch to HI position.	
(2)	Depress TEST switch on MB receiver and maintain in depressed position.	400 Hz blue symbols should come on; then go off. 1300 Hz amber symbols should come on, then go off. 3000 Hz white symbols should come on and remain on until TEST switch is released.
		400 Hz, 1300 Hz and 3000 Hz tones should be heard on loudspeakers.
(3)	Release TEST switch on MB receiver.	No MB symbology on PFD; tone ceases.
(4)	Place HI-LOW-OFF switch in OFF position.	
(5)	Return aircraft to required configuration.	

MARKER BEACON ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the MB antenna.

B. The MB antenna is mounted on the underside of the forward fuselage. The antenna is sealed in a foam filled fiberglass fairing, and serves to intercept 75 megacycle marker beacon signals.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Sealant, Rapid Cure PR-1828 B 1/4 DPM 6407	PRC-DeSoto International, Inc. Mojave, CA
Plastic Scraper DPM 6587	Commercially available.

3. Removal/Installation - Marker Beacon Antenna

A. Remove MB Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scraper.

(3) Remove antenna mounting screws and carefully remove antenna assembly from the fuselage.

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

CAUTION: DO NOT USE FORCE TO REMOVE THE ANTENNA FROM THE AIRCRAFT. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE ANTENNA. TO REMOVE THE ANTENNA, CAREFULLY AND CONTINUOUSLY PULL ON ONE SIDE OF THE ANTENNA. THIS WILL LET THE SEALANT CORRECTLY COME APART AT THE SURFACE.

(a) If necessary, use an approved plastic scraper, to help remove antenna from the fuselage.

(4) Carefully move antenna to get access to the coaxial connector.

(5) Disconnect and cap coaxial cable and antenna receptacle.

(6) Attach the coaxial connector to the fuselage using masking tape.

NOTE: Due to the difficulty of retrieval, ensure coax cable does not fall completely inside fuselage.

B. Install MB Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(2) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Prepare the surface of the MB antenna and aircarft for Radio Frequency (RF) bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(4) Apply faying surface seal to the base of the antenna at the proper locations. (Figure 201) (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(5) Install MB antenna as follows: (Figure 201)

(a) Remove protective cap and check connector and receptacle for damage and unwanted material.

1) Connect antenna coaxial cable connector.

(b) Place antenna in mounting position and install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws.

a) Torque the attachment screws again 10 minutes after the initial torque.

(6) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(7) Do a RF bond check of the MB antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

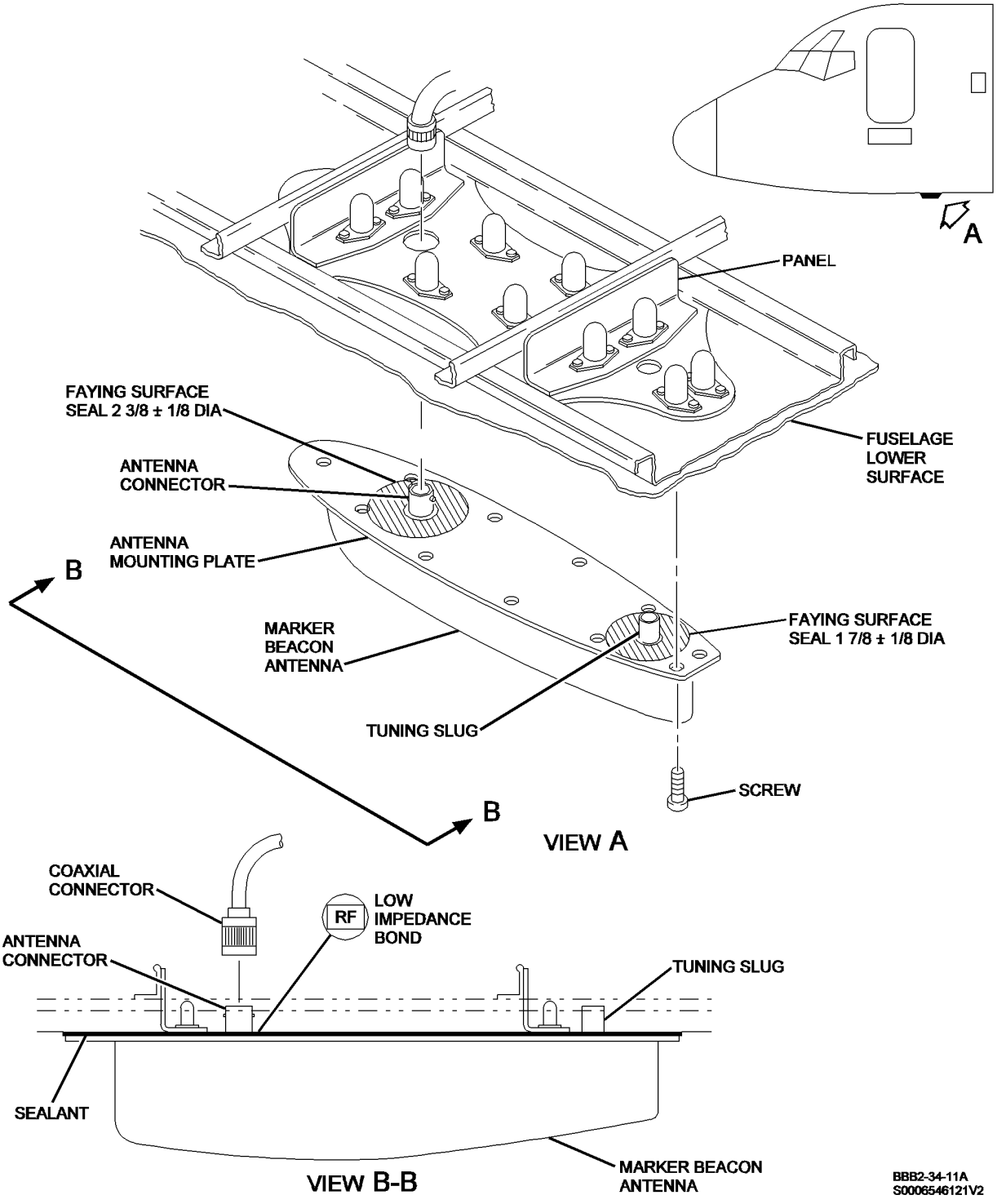
(8) Apply periphery (fillet) seal around antenna edge at fuselage skin. Sealant PR 1828 B 1/4 may be substituted for PR 1422. PR 1828 has a shorter (1.5 Hour) cure time. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(9) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

C. Test MB antenna. (MARKER BEACON - MAINTENANCE PRACTICES, PAGEBLOCK 34-31-00/201)



Marker Beacon Antenna -- Removal/Installation
Figure 201/34-31-01-990-803

MARKER BEACON LIGHTS - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the marker beacon lights. The marker beacon lights are installed on the Captain's and First Officer's instrument panels. Each light (base, socket, and lamp assembly) may be removed or installed as a separate unit. Both the Captain's and First Officer's lights are electrically paralleled to a single marker beacon receiver. Electrical power is supplied from the marker beacon receiver which in turn is energized by the MARKER BEACON circuit breaker.

2. Removal/Installation

A. Remove

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(2) Gain access to back side of Captain's or First Officer's panel, by opening instrument panel. (INSTRUMENT PANELS - GENERAL - MAINTENANCE PRACTICES, PAGEBLOCK 31-00-02/201)

(3) Disconnect electrical leads from base of marker beacon light assembly.

(4) Remove screws holding lamp base assembly in place, and gently slide assembly from instrument panel.

B. Install

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(2) Insert lamp base assembly in place, install four flat head brass screws and nuts to secure base to instrument panel.

(3) Connect electrical leads to base of assembly.

(4) Return instrument panel to normally closed position and secure camloc fasteners.

(5) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(6) Verify light bulb operation by pressing marker beacon light lens.

MARKER BEACON RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the marker beacon receiver. The receiver is installed on the forward right radio rack in the electrical/ electronics compartment. The receiver converts 75 megahertz signals to aural and visual outputs to indicate passage over a marker beacon transmitter.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 201

Name and Number	Manufacturer
Marker beacon oscillator BC-376H	Packard Bell

3. Removal/Installation Marker Beacon Receiver

A. Remove Marker Beacon Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT REMOVE/INSTALL THIS UNIT WHEN POWER IS APPLIED. THIS CAN CAUSE LARGE OUTPUT VOLTAGE SPIKES WHICH CAN CAUSE DAMAGE TO THE UNIT AND THE ASSOCIATED EQUIPMENT.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(2) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(3) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Marker Beacon Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lug on unit, and tighten holddown nut.

(5) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	6	B10-32	MARKER BEACON

(6) Allow 3 minutes for equipment warmup.

WJE 405, 407-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

NOTE: On aircraft with Electronic Flight Instrument System (EFIS), the blue, amber, and white indicator lights in the following steps will be displayed as flashing lights within the color coded circles on the Captain's and First Officer's primary flight displays. The color coded circles represent the respective marker beacons, inner, middle, and outer markers.

(7) Press SELF TEST switch on marker beacon receiver, all marker beacon lights should come on one after another.

NOTE: Following Paragraph 3.B.(10) through Paragraph 3.B.(13) can be accomplished if required to check antenna reception.

WJE 401-404, 412, 414, 886, 887

(8) Press and hold MKR BCN switch on marker beacon receiver, all marker beacon symbols should come on flashing one after another on the EFIS Primary Flight Display Unit (PFD).

NOTE: Following Paragraph 3.B.(10) through Paragraph 3.B.(14) can be accomplished if required to check antenna reception.

WJE 406

(9) Press and hold MKR BCN switch on RADIO NAV test panel, all marker beacon symbols should come on flashing one after another on the EFIS Primary Flight Display Unit (PFD).

NOTE: Following Paragraph 3.B.(10) through Paragraph 3.B.(13) can be accomplished if required to check antenna reception.

WJE ALL

(10) Set up test oscillator located close to aircraft marker beacon antenna, attach oscillator antenna, and energize test set.

(11) On test oscillator, set MODULATION control to 400 Hz position. Both blue indicator lights must come on, and 400 Hz tone heard in cockpit speakers.

(12) On test oscillator, set MODULATION control to 1300 Hz position. Both amber indicator lights must come on, and 1300 Hz tone heard in cockpit speakers.

(13) On test oscillator, set MODULATION control to 3000 Hz position. Both white indicator lights must come on and 3000 Hz tone heard in cockpit speakers.

WJE 401-404, 412, 414, 886, 887

(14) On test oscillator, set MODULATION control to 3000 Hz position. White symbols on PFD should come on flashing and 3000 Hz tone heard in cockpit speakers.

WJE ALL

(15) The following adjustment to the marker beacon receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 1.3 volts RMS ±10% across a 600 ohm load using a VTVM or equivalent voltmeter. Refer to the appropriate equipment overhaul manual for detailed instructions of how to perform the adjustment.

(16) Remove test equipment and return aircraft to required configuration.

INSTRUMENT LANDING SYSTEM (ILS) - DESCRIPTION AND OPERATION

1. Description

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are: VOR/LOC antenna, glideslope antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel .

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891

B. ILS-1 provides signals to the captains attitude director indicator (ADI) and horizontal situation indicator (HSI); and ILS-2 provides signals to the first officers ADI and HSI. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

WJE 405, 409, 873, 874, 880, 881, 883, 884, 893

C. ILS-1 provides signals to the First Officer's attitude director indicator (ADI) and Captain's horizontal situation indicator (HSI); and ILS-2 provides signals to the Captain's ADI and First Officer's HSI. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

WJE 892

D. ILS-1 provides signals to the First Officer's attitude director indicator (ADI) and Captain's horizontal situation indicator (HSI); and ILS-2 provides signals to the Captain's ADI and First Officer's HSI. ILS-1 and ILS-2 signals are also provided to the ILS DEV (deviation) annunciators on the Captain's and First Officer's instrument panels. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

WJE 401-404, 407, 408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

E. ILS-1 provides signals to the captains Primary Flight Display (PFD) and Navigation Display (ND); and ILS-2 provides signals to the first officers PFD and ND. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

WJE 406

F. ILS-1 provides signals to the captains Primary Flight Display (PFD) and Navigation Display (ND); and ILS-2 provides signals to the first officers PFD and ND. ILS-1 and ILS-2 signals are also provided to the ILS deviation pointers. The pointers will blink when excessive left or right deviation is detected. Both systems provide data to the Flight Guidance Control System and audio identification signals to the Flight Interphone System.

WJE ALL

G. VOR/LOC Antenna - Two VOR/LOC antennas are located on the forward section of the vertical stabilizer. They are located one above the rudder limiter pitot tube and one below the pitot tube. Each antenna consists of two flush mounted antenna panel assemblies. Two panels are located on the right side of the stabilizer and two on left side of the stabilizer. The antenna panels are attached with screws and flush form the exterior surface of the vertical stabilizer. The two lower panels are interconnected to form one antenna and supply VOR/LOC signals to the Captain's system (ILS-1). The two upper panels are so connected and supply signals to the First Officer's system (ILS-2).

H. Glideslope Antenna - One glideslope antenna is mounted inside the nose radome, below the weather radar antenna. Coax cables from the antenna are routed through the pressure bulkhead to the VOR/ILS receivers.

WJE 401-404, 407, 408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

I. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/electronics compartment. The localizer receiver section is designed to receive and process signals in the frequency range of 108.10 to 111.95 megahertz. The localizer frequencies are divided into 40 channels. The LOC deviation output signal is processed by the EFIS symbol generator and used to operate the expanded localizer portion of the PFD, and the course deviation bar on the ND. The glideslope receiver section is designed to receive and process signals from 329.3 to 335.0 megahertz in 40 channels. The G/S deviation output signal is used to operate glideslope deviation pointers on both the PFD and ND.

(1) Frequency selection controls are located on the VHF-NAV control panel, adjacent to the flight guidance control panel on the glareshield. The captains (-1) controls are on the left, and first officers (-2) controls are on the right. Selecting the applicable ground station localizer frequency automatically causes the correct matching glideslope frequency to be selected. When a VOR frequency is selected, the LOC and G/S portion of the receivers are operating in standby.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

J. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/electronics compartment. The localizer receiver section is designed to receive and process signals in the frequency range of 108.10 to 111.95 megahertz. The localizer frequencies are divided into 40 channels. The LOC deviation output signal is used to operate the expanded localizer portion of the ADI, and the course deviation bar on the HSI. The glideslope receiver section is designed to receive and process signals from 329.3 to 335.0 megahertz in 40 channels. The G/S deviation output signal is used to operate glideslope deviation pointers on both the ADI and HSI.

(1) Frequency selection controls are located on the VHF-NAV control panel, adjacent to the flight guidance control panel on the glareshield. The captains (-1) controls are on the left, and first officers (-2) controls are on the right. Selecting the applicable ground station localizer frequency automatically causes the correct matching glideslope frequency to be selected. When a VOR frequency is selected, the LOC and G/S portion of the receivers are operating in standby.

K. The captains and first officers ADI's display localizer deviation by lateral movement of the localizer deviation pointer as read against an expanded 2-dot scale. The pointer indicates to the right of the scale index if the aircraft is to the left of the localizer beam, and to the left of the index if the aircraft is to the right of the beam. Glideslope deviation is displayed by vertical movement of a pointer as read against a 4-dot scale. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. Loss of power or invalid glideslope signal will cause a GS flag to come into view.

L. The captains and first officers HSI's display localizer deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the localizer beam, and to the right when the airplane is to the left of the beam. Flying the airplane symbol to the bar will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on the beam condition. Glideslope deviation is displayed by vertical movement of a pointer as read against a 4-dot scale. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. Loss of power, or invalid glideslope signal will cause a GS flag on the ADI and a flag on the HSI to come into view over the G/S indicator.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

M. The captains and first officers PFD's display localizer deviation by lateral movement of the localizer deviation pointer as read against an expanded 2-dot scale. The pointer indicates to the right of the scale index if the aircraft is to the left of the localizer beam, and to the left of the index if the aircraft is to the right of the beam. Loss of power or valid signal will cause the localizer symbology to be removed from the PFD and replaced by a LOC FAIL message. Glideslope deviation is displayed by vertical movement of a pointer as read against a 4-dot scale. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. Loss of power or invalid glideslope signal will cause the glideslope symbology to be removed from the PFD and replaced by a G/S FAIL message.

N. The captain's and first officer's ND's display localizer deviation by movement of a course deviation bar as read against a 4-dot scale. The course deviation bar moves to the left when the aircraft is to the right of the localizer beam, and to the right when the aircraft is to the left of the beam. Flying the airplane symbol to the bar will cause the course deviation bar, the airplane symbol, and the course select pointer to line up to indicate an on the beam condition. Loss of power or valid signal will cause the localizer symbology to be removed from the PFD and replaced by a LOC FAIL message. Glideslope deviation is displayed by vertical movement of a pointer as read against a 4-dot scale. The pointer indicates above the center index if the aircraft is below the glidepath, and below the index if the aircraft is above the glidepath. Loss of power, or invalid glideslope signal will cause the glideslope symbology to be removed from the display and replaced with a G/S FAIL message.

WJE 406

O. When localizer deviation is 2 dots left or right of localizer beam, or 2 dots up or down from the glideslope beam, the EFIS ILS pointers will flash.

WJE 892

P. An ILS deviation annunciator is located one each on the Captain's and First Officer's instrument panels. When localizer deviation is 2 dots, (as indicated on the HSI) left or right of localizer beam, or 2 dots up or down from the glideslope beam, the ILS deviation annunciators will flash.

WJE ALL

2. Operation

A. The localizer rf carrier is radiated from a ground transmitter in the 108.10 to 111.95 megahertz range. A complex antenna array effectively radiates two intersecting lobes, each directed along one side of the runway. The lobe to left of the approach end of the runway is predominately modulated with 90 Hz, and the lobe to the right with 150 Hz. The two audio signals are equal in magnitude along a line bisecting the extended center line of the runway. The line of equal modulation in a vertical plane defines the localizer course.

B. The glideslope signal (329.3 to 335.0 megahertz) is radiated to effectively produce two intersecting lobes, one above the other. The upper lobe is predominately modulated with 90 Hz, and the lower lobe with 150 Hz. On a line at an angle of 2.5 to 3 degrees from the ground, the two audio signals are equal. This line of equal modulation defines the glidepath.

WJE 401-405, 407-412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891, 893

C. When the airplane is flying on the intersecting planes of the guidepath and localizer beam, signals of equal modulation are received and compared by the ILS receiver. At this point the glideslope and localizer deviation indicators are centered. When the airplane is to the right of the localizer beam, a stronger 150 Hz signal is detected, providing an output to deflect the localizer deviation indicators to the left. The glideslope deviation pointers will deflect down when the airplane is above the glidepath where the 90 Hz signal is stronger. The localizer deviation indicators will deflect to the right, and the glideslope deviation pointers will deflect up when the airplane is to left of the localizer beam, where the localizer 90 Hz signal, and the glideslope 150 Hz signal is stronger.

WJE 406

D. When the aircraft is flying on the intersecting planes of the guidepath and localizer beam, signals of equal modulation are received and compared by the ILS receiver. At this point the glideslope and localizer deviation indicators are centered. When the aircraft is to the right of the localizer beam, a stronger 150 Hz signal is detected, providing an output to deflect the localizer deviation indicators to the left. The glideslope deviation pointers will deflect down when the aircraft is above the glidepath where the 90 Hz signal is stronger. The localizer deviation indicators will deflect to the right, and the glideslope deviation pointers will deflect up when the aircraft is to left of the localizer beam, and aircraft is below the glideslope path, where the localizer 90 Hz signal, and the glideslope 150 Hz signal is stronger. If localizer or glideslope deviation is 2 dots from the beam, the EFIS ILS pointers will flash.

WJE 892

E. When the aircraft is flying on the intersecting planes of the guidepath and localizer beam, signals of equal modulation are received and compared by the ILS receiver. At this point the glideslope and localizer deviation indicators are centered. When the aircraft is to the right of the localizer beam, a stronger 150 Hz signal is detected, providing an output to deflect the localizer deviation indicators to the left. The glideslope deviation pointers will deflect down when the airplane is above the glidepath where the 90 Hz signal is stronger. The localizer deviation indicators will deflect to the right, and the glideslope deviation pointers will deflect up when the aircraft is to left of the localizer beam, and aircraft is below the glideslope path, where the localizer 90 Hz signal, and the glideslope 150 Hz signal is stronger. The ILS DEV annunciators will flash if localizer or glideslope are 2 dots (as depicted on the HSI) deviation from the localizer or glideslope beam.

WJE ALL

3. To Operate System

A. Operate

(1) Energize airplane electrical buses.

(2) At VHF-NAV control panel, on glareshield, select applicable localizer frequency.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(3) On both ADI's and both HSI's, ensure that flags are out of view.

WJE 401-404, 407, 408, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

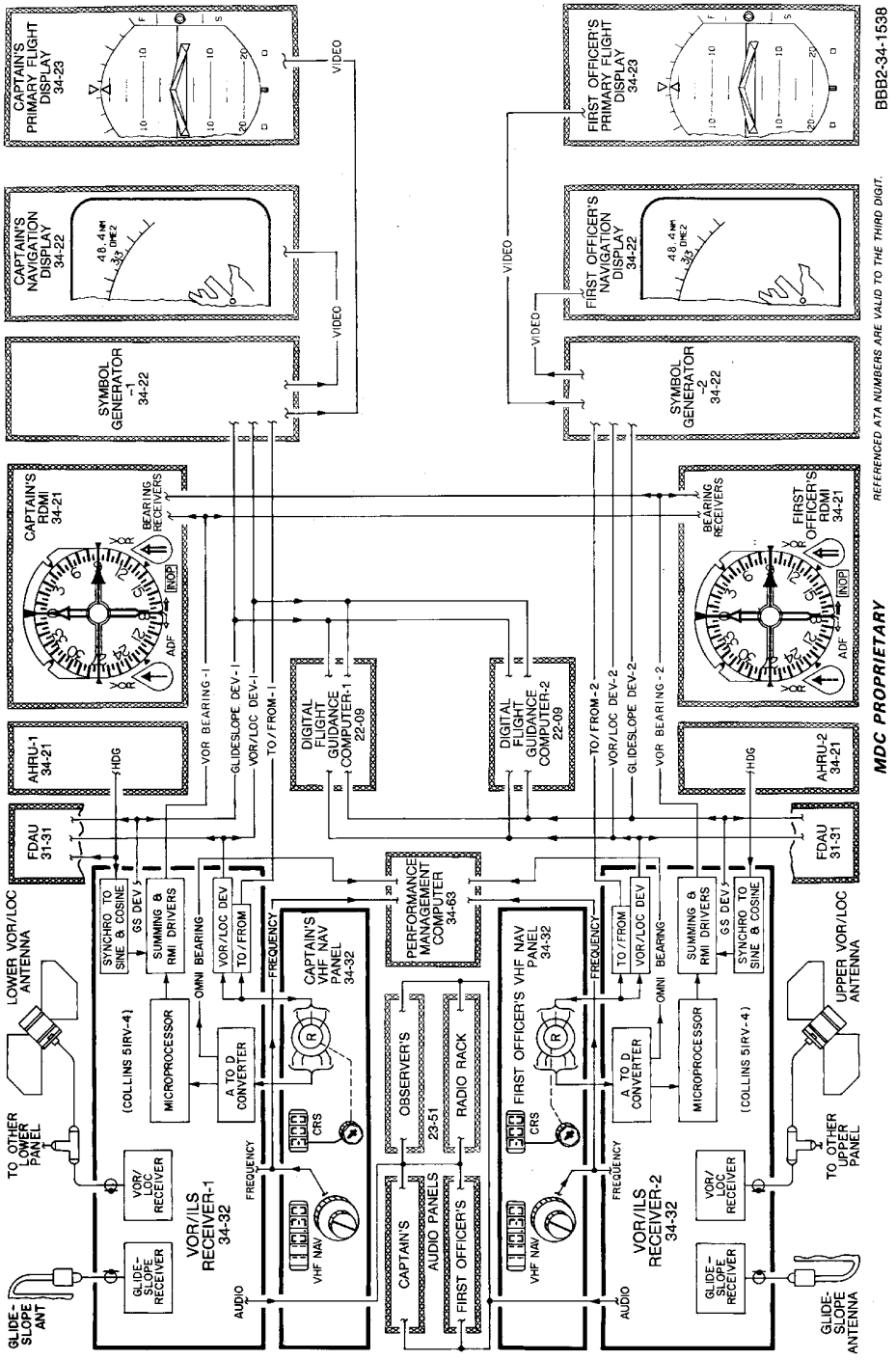
(4) On both PFD's and both ND's, make sure that G/S FAIL and LOC FAIL messages are not displayed.

WJE 406

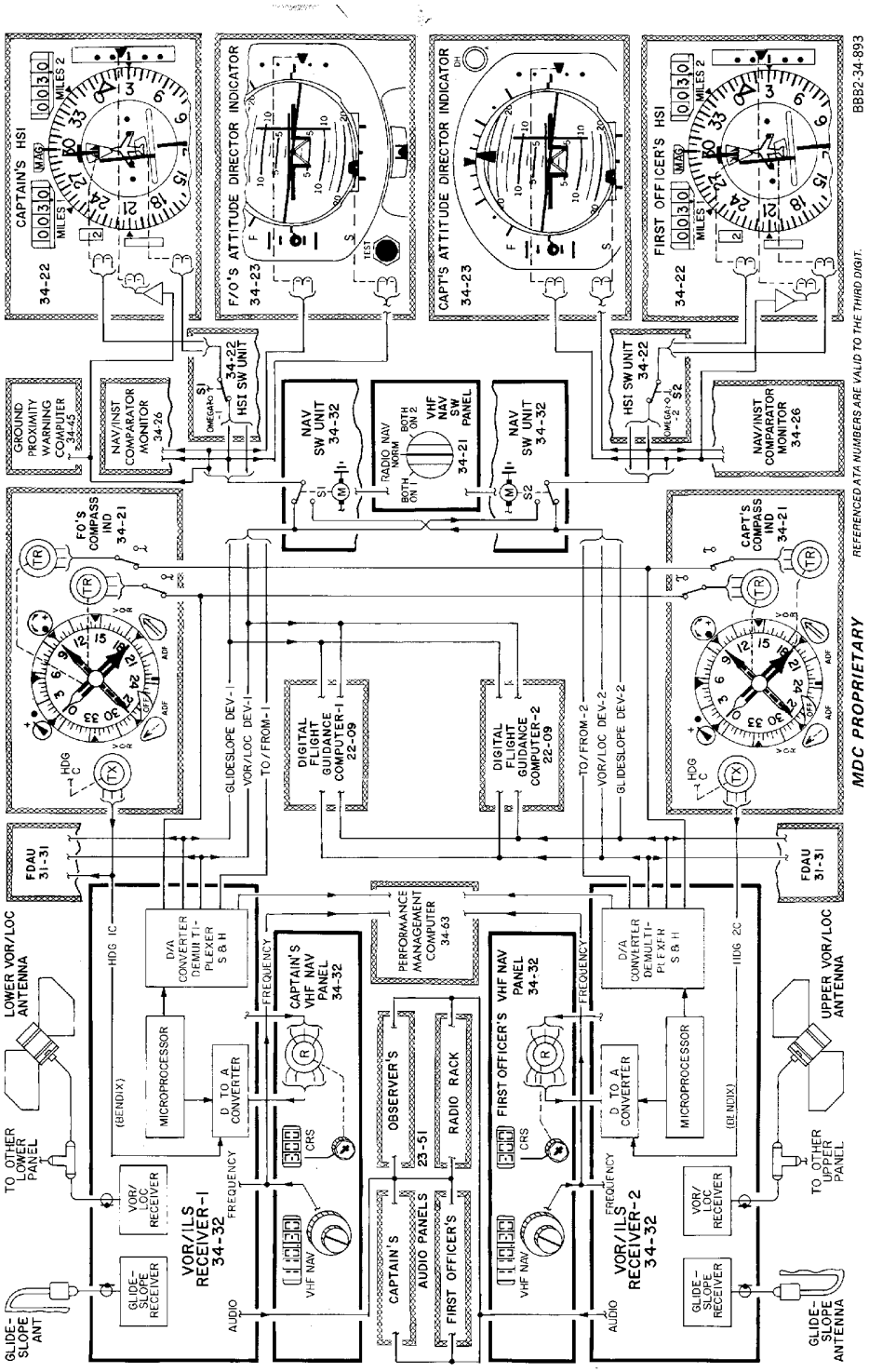
(5) On both EFIS PFD's and both EFIS ND's, ensure that flags are out of view.

WJE ALL

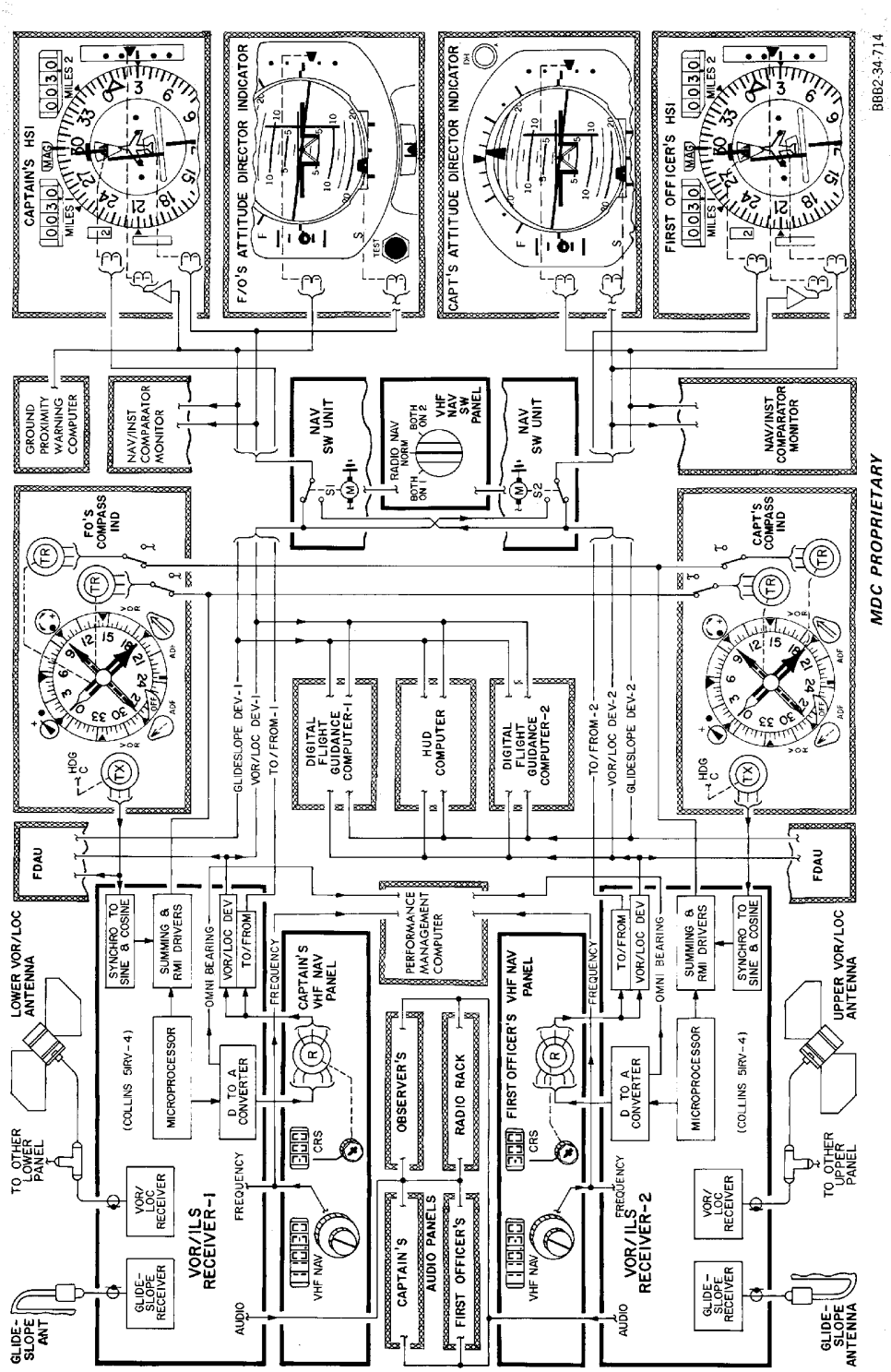
(6) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



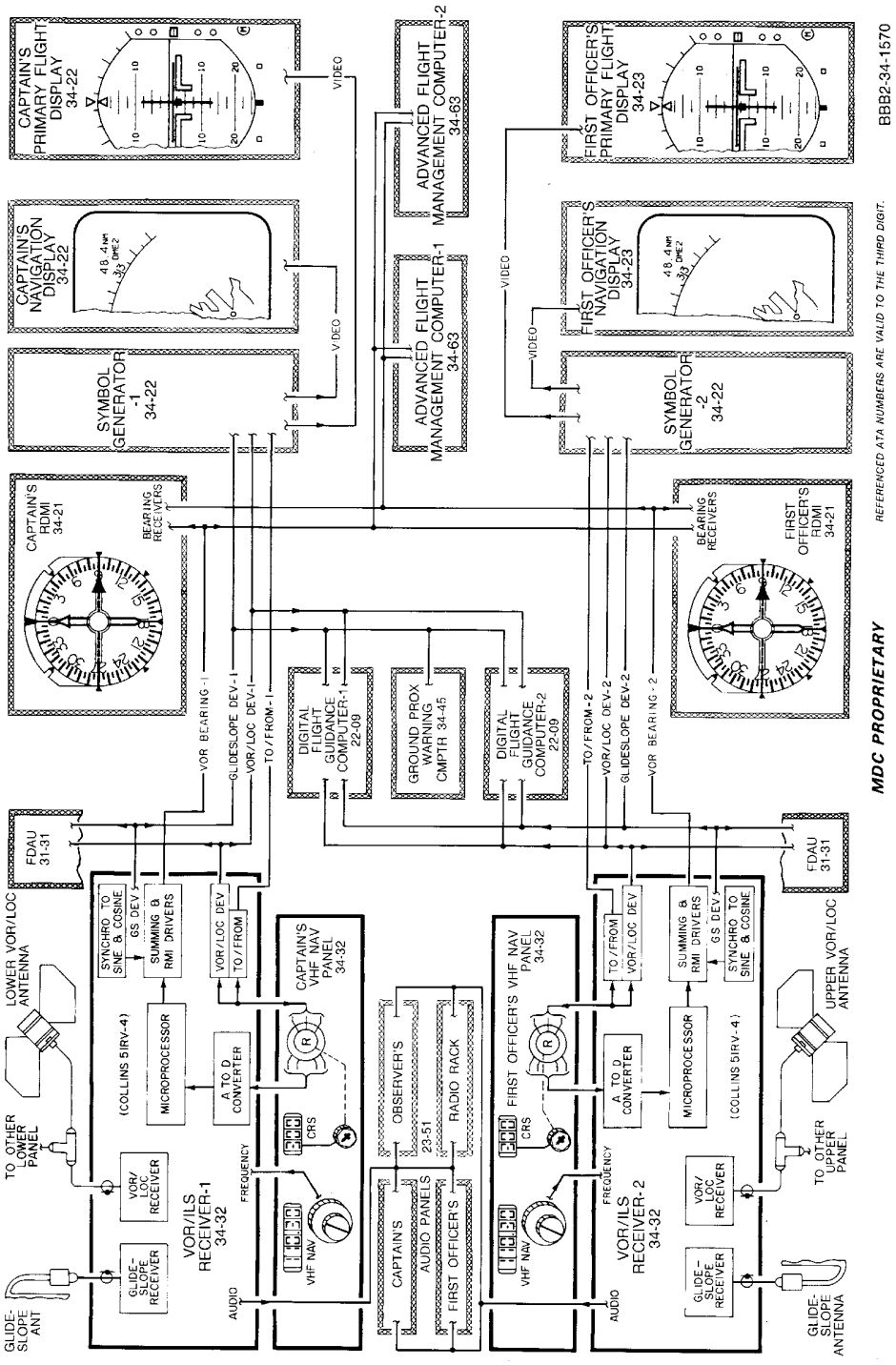
ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 1 of 7)



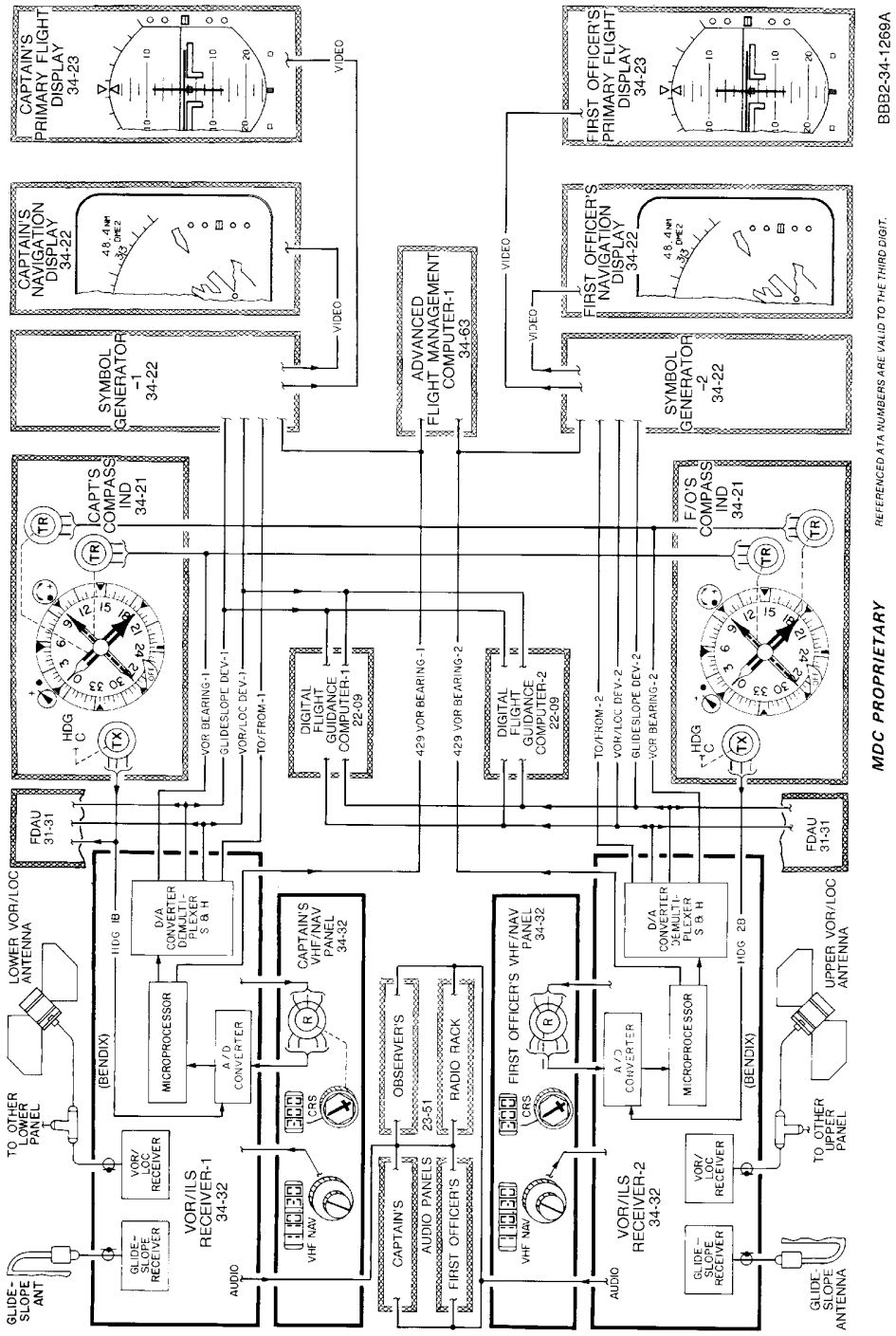
ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 2 of 7)



ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 3 of 7)

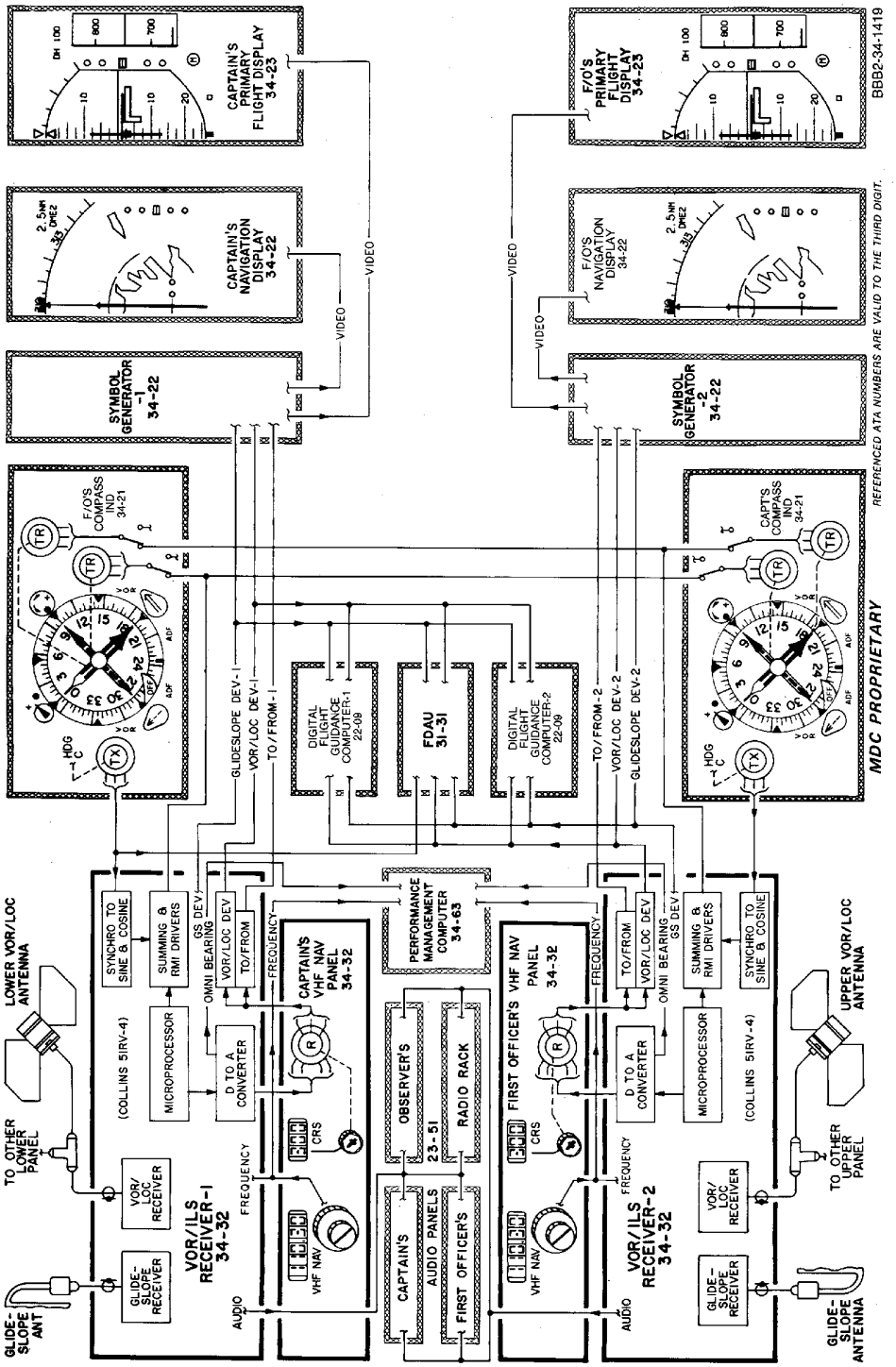


ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 4 of 7)

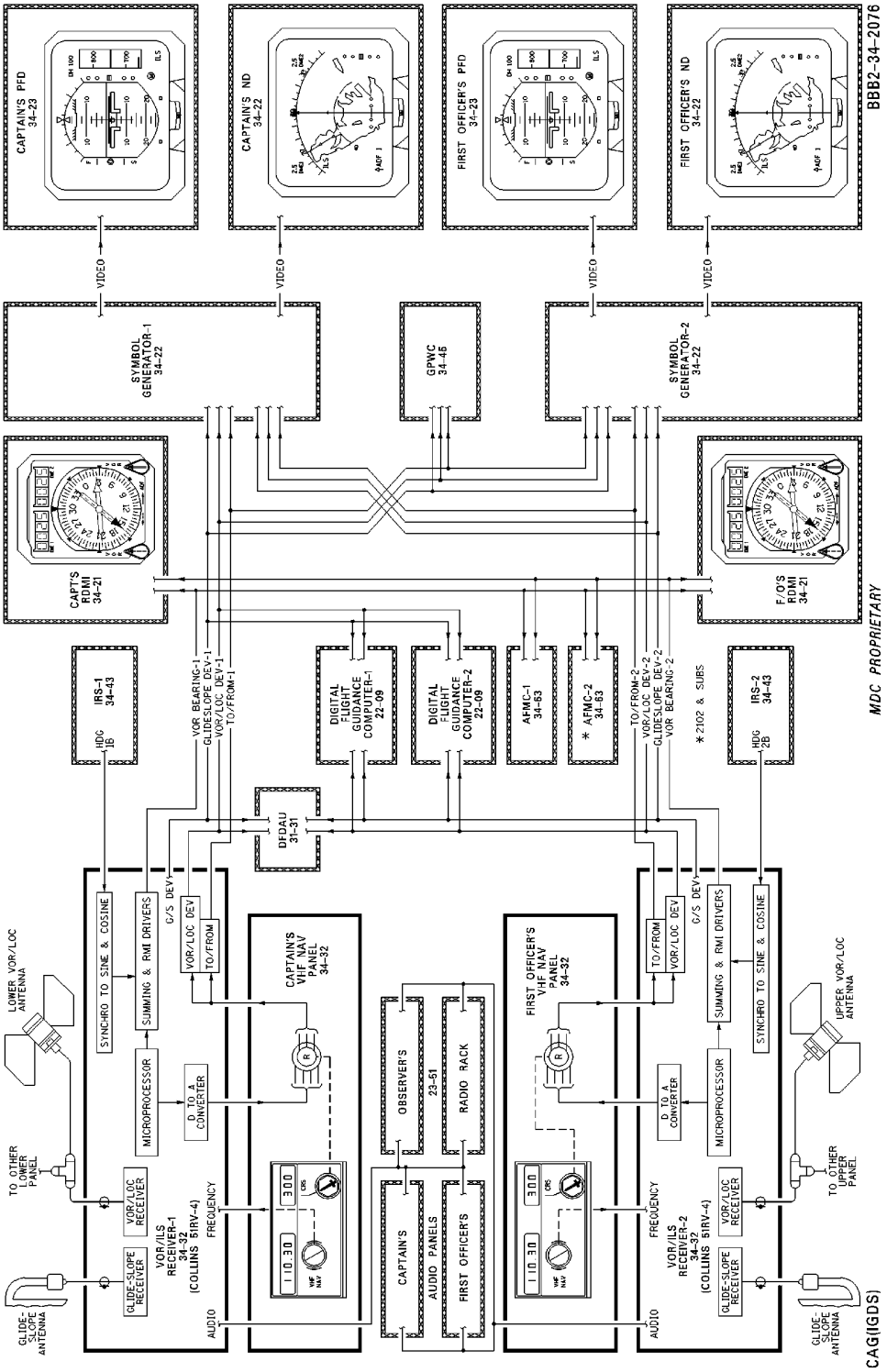


ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 5 of 7)

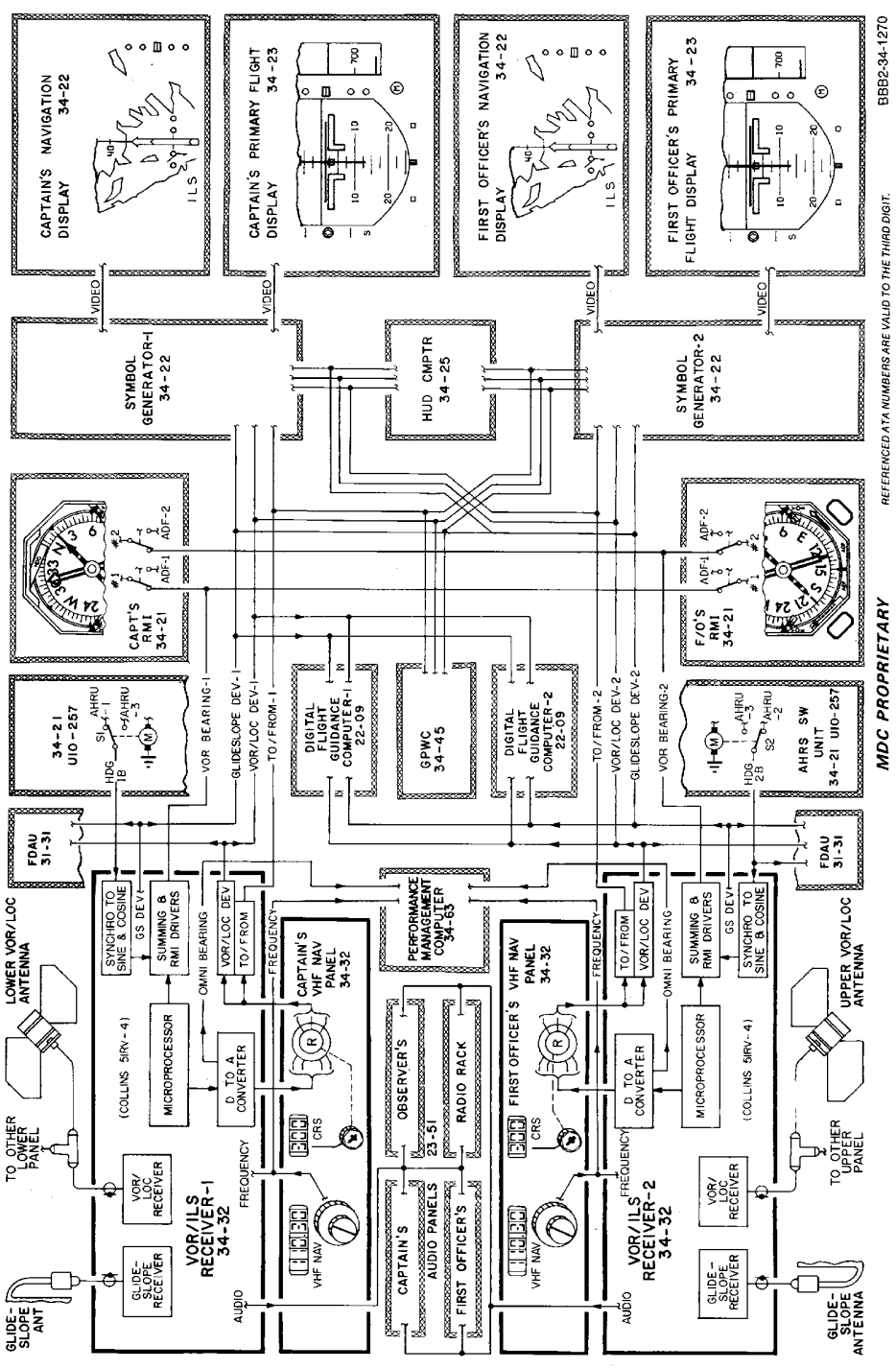
EFFECTIVITY
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872



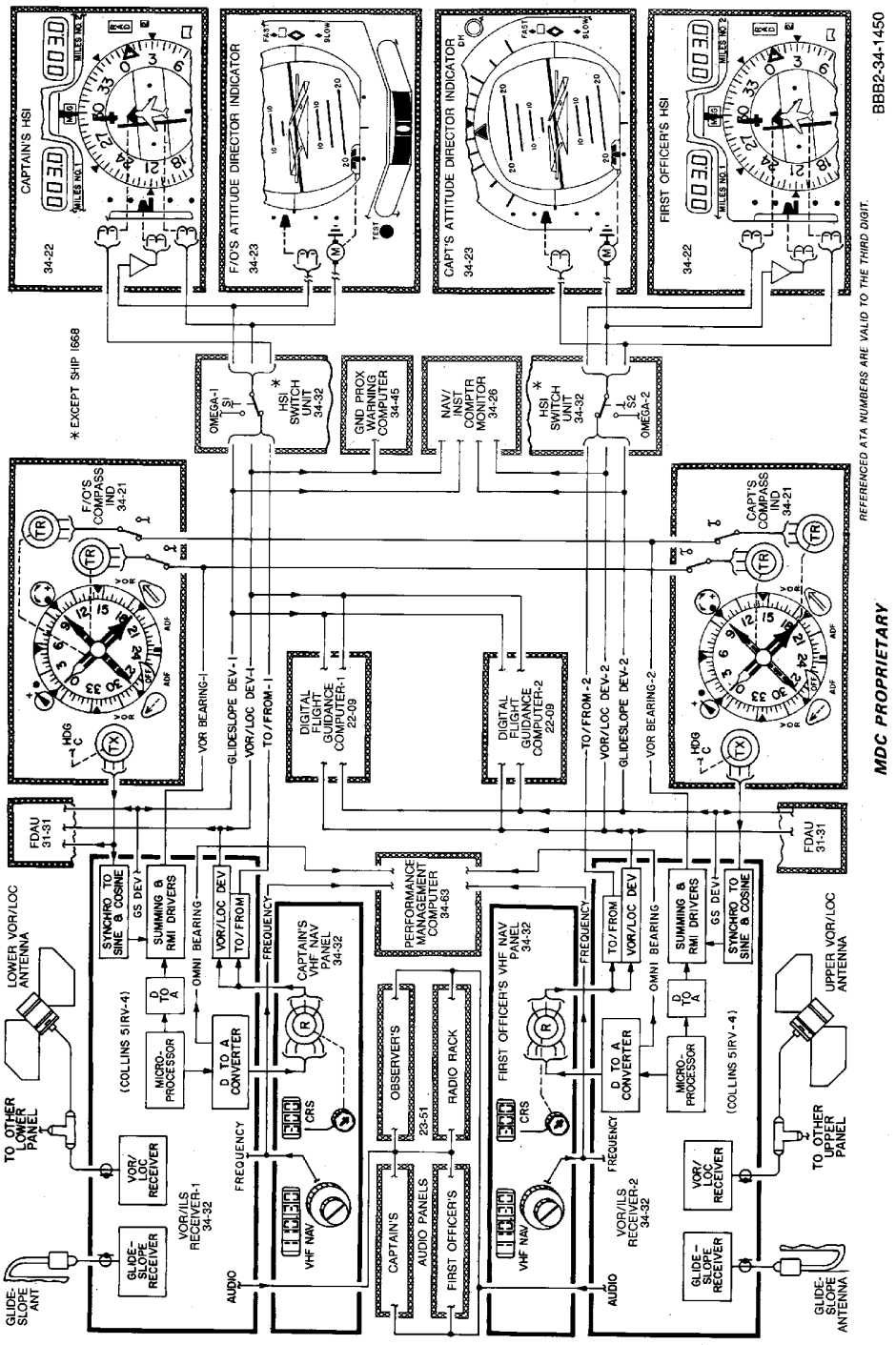
ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 6 of 7)



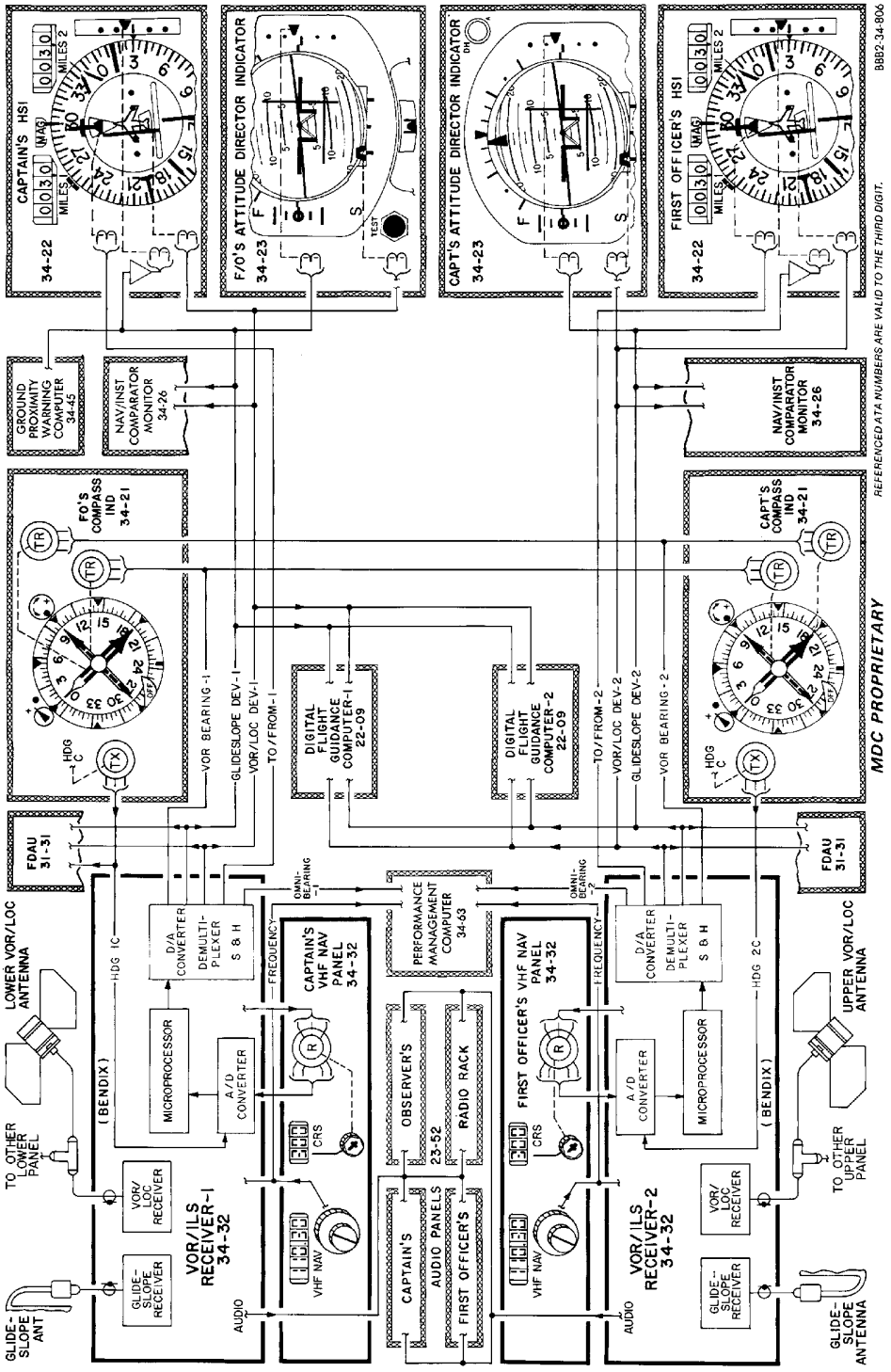
ILS -- Block Diagram
Figure 1/34-32-00-990-835 (Sheet 7 of 7)



ILS -- Schematic
Figure 2/34-32-00-990-839 (Sheet 1 of 2)



ILS -- Schematic
Figure 2/34-32-00-990-839 (Sheet 2 of 2)



ILS -- Simplified Schematic
Figure 3/34-32-00-990-841

INSTRUMENT LANDING (ILS) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ILS system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the ILS system operation are Captain's and First Officer's horizontal situation indicators, compass indicators, VHF navigation panels, attitude direction indicators, navigation instrument switching unit, and VOR/LOC antenna. Interfacing units are DFGC-1 and DFGC-2.

E. The ILS system components are located as follows:

Table 101

Component	Location
Horizontal Situation (HSI)	Captain's and First Officer's instrument panels
Compass Indicators	Captain's and First Officer's instrument panels
Attitude Direction Indicator (ADI)	Captain's and First Officer's instrument panels
VHF NAV control panel	Flight guidance control panel
Navigation Switching Unit	Electrical/Electronic compartment
VOR/LOC Antenna	Vertical Stabilizer

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting ILS System

A. Trouble Shoot

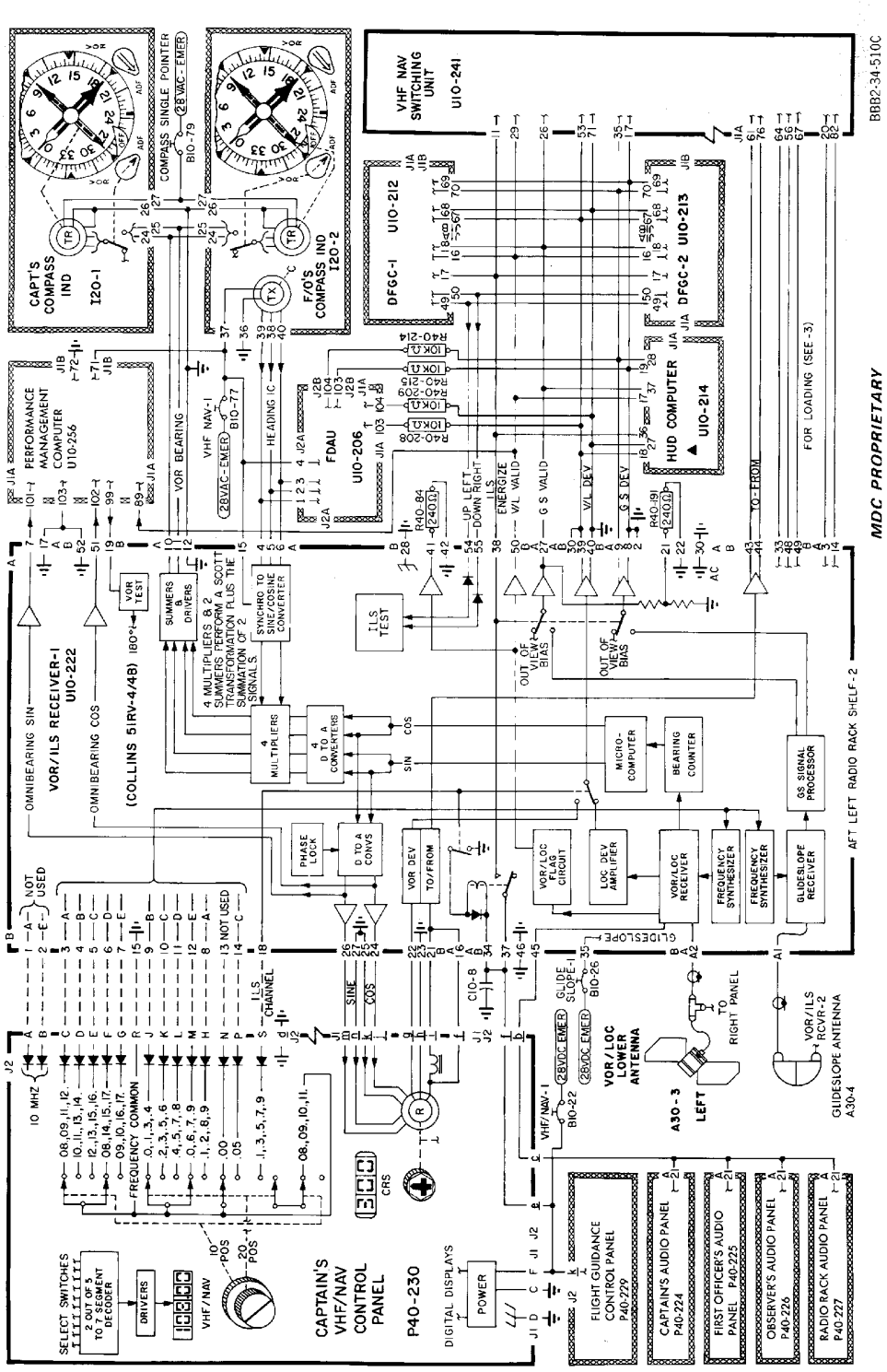
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are ND, PFD, VOR/ILS receiver, VHF NAV control panels, navigation switching panel, and VOR/LOC antenna.

Table 103

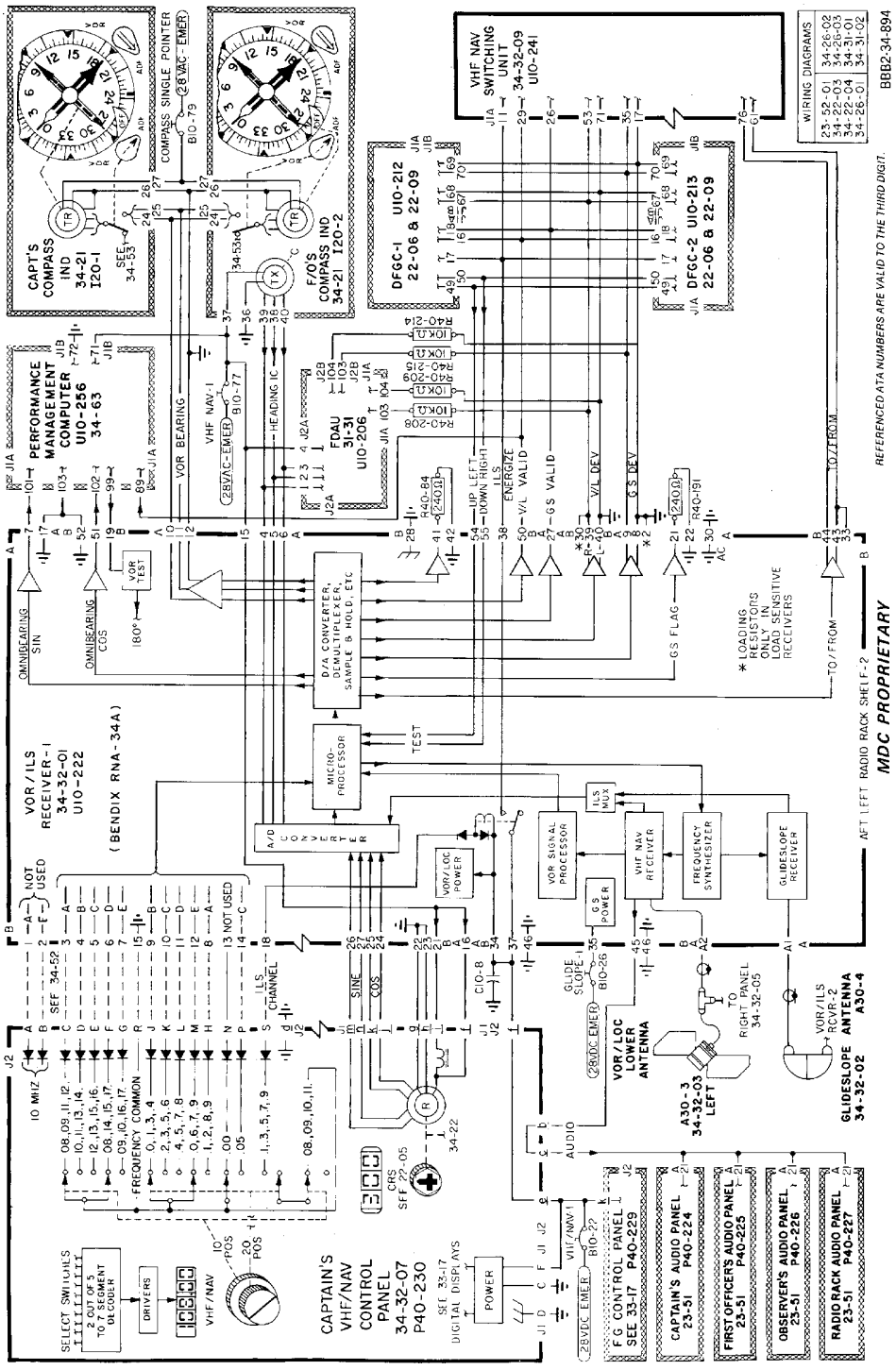
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.

Table 103 (Continued)

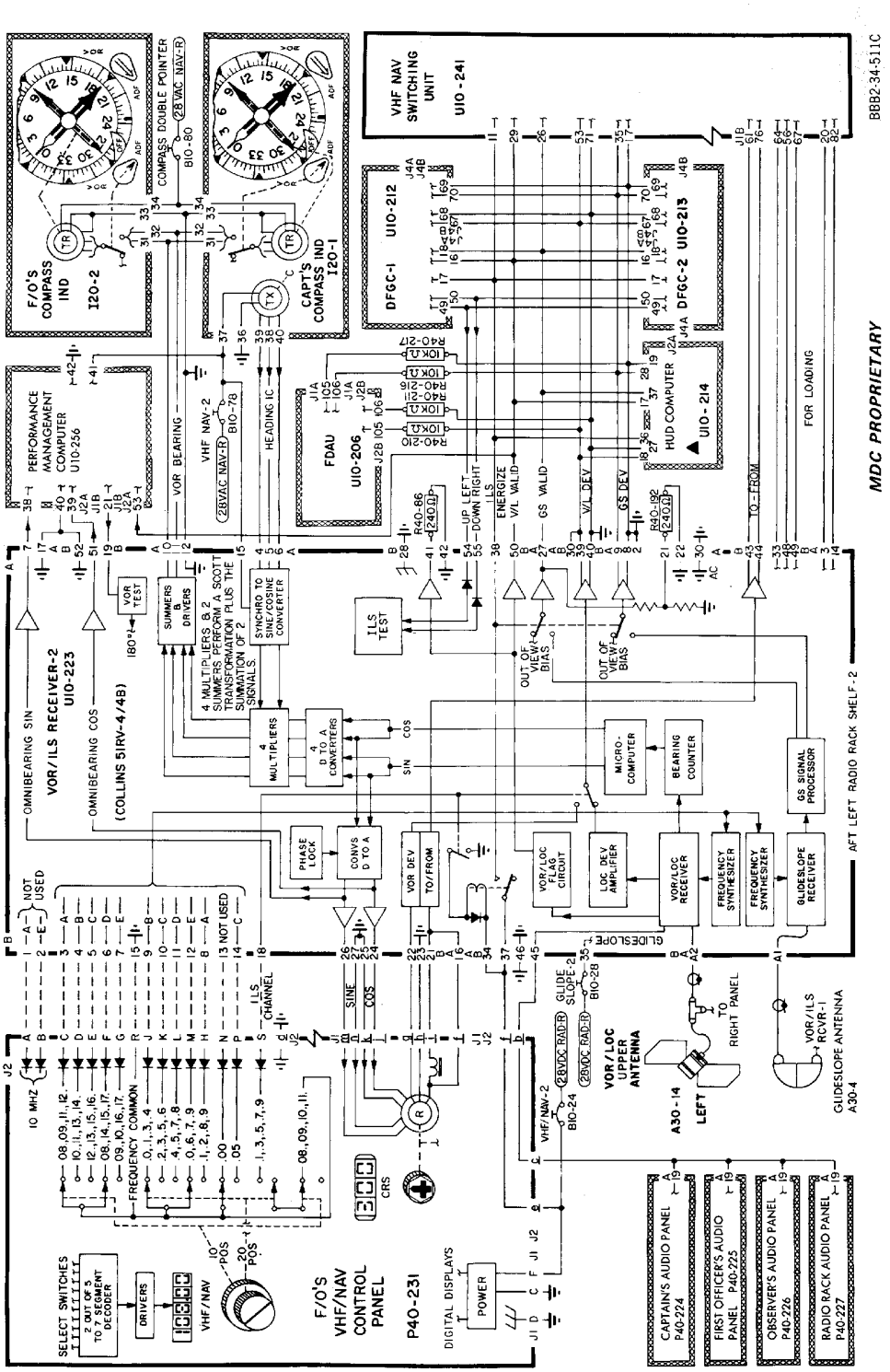
Procedure		Correction
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201).	



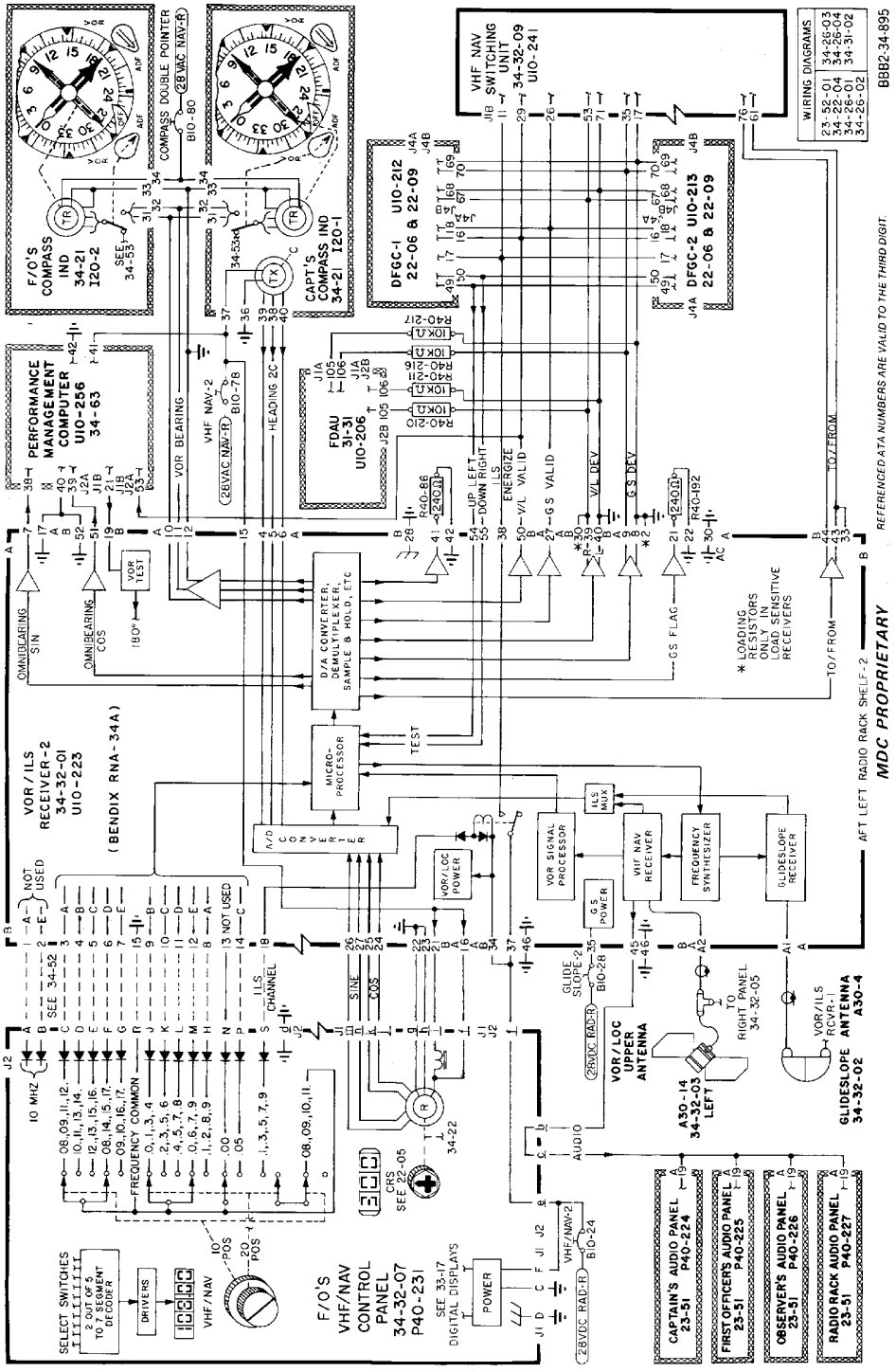
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-801 (Sheet 1 of 2)



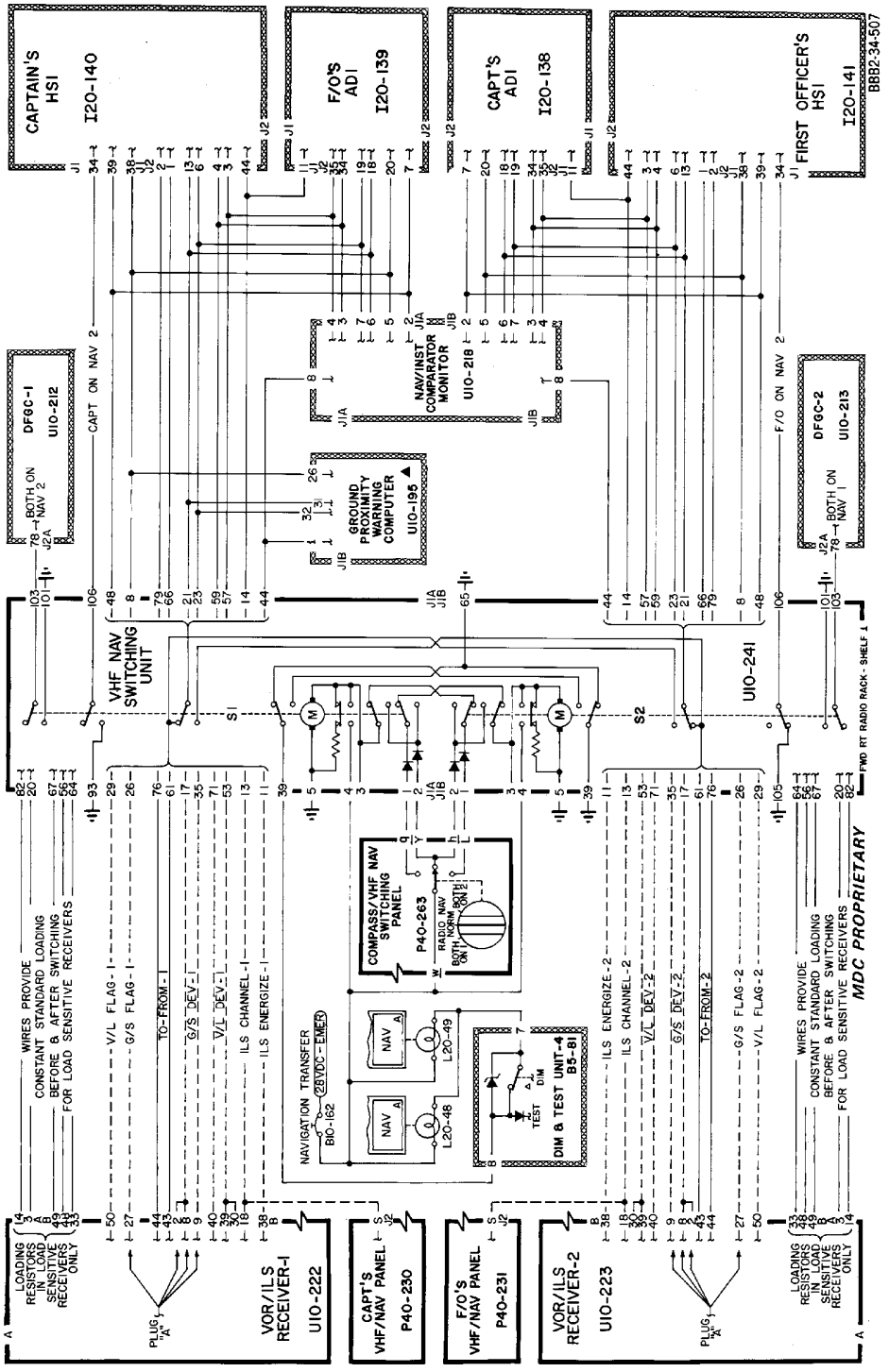
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-801 (Sheet 2 of 2)



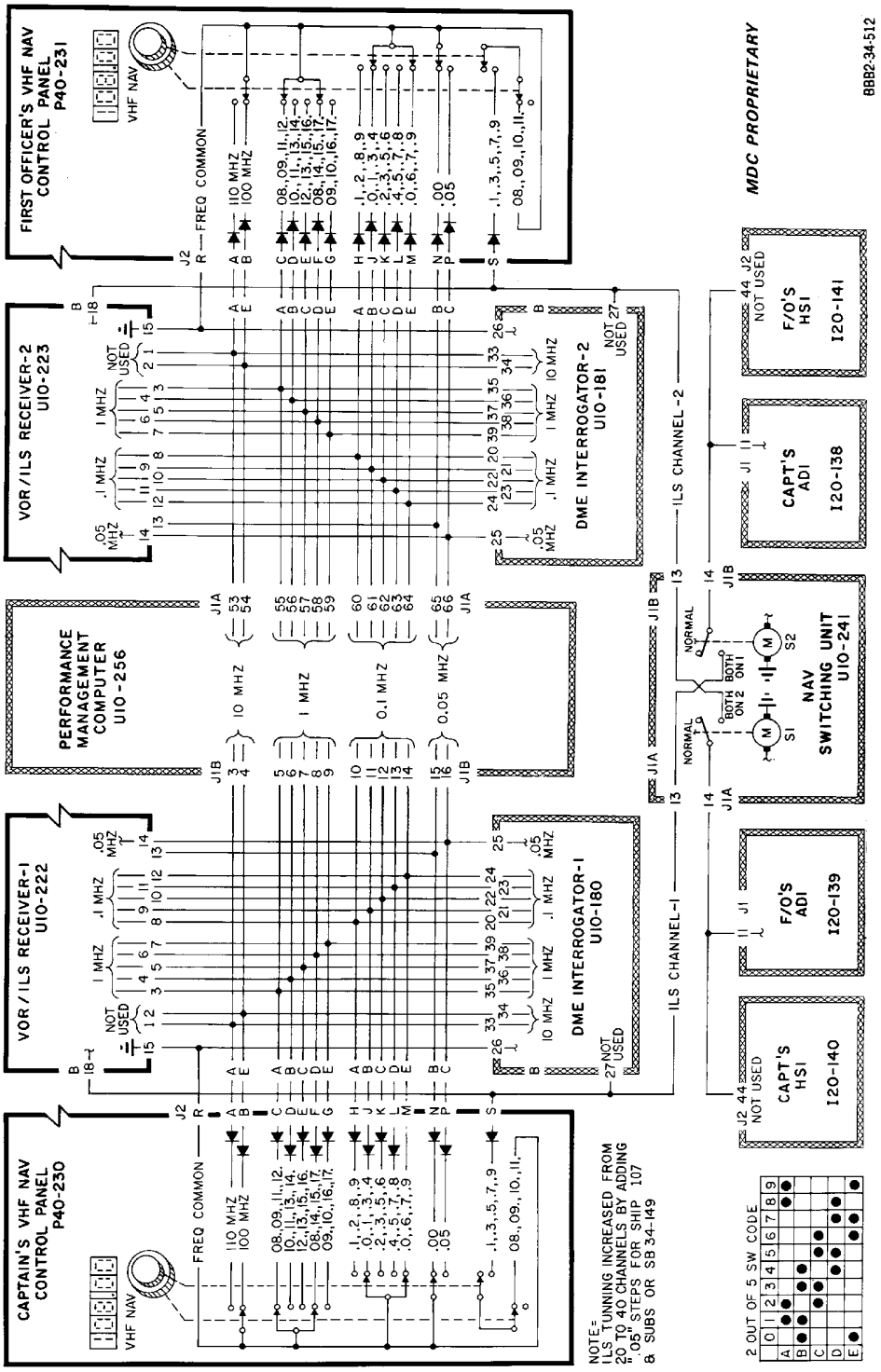
VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-802 (Sheet 1 of 2)



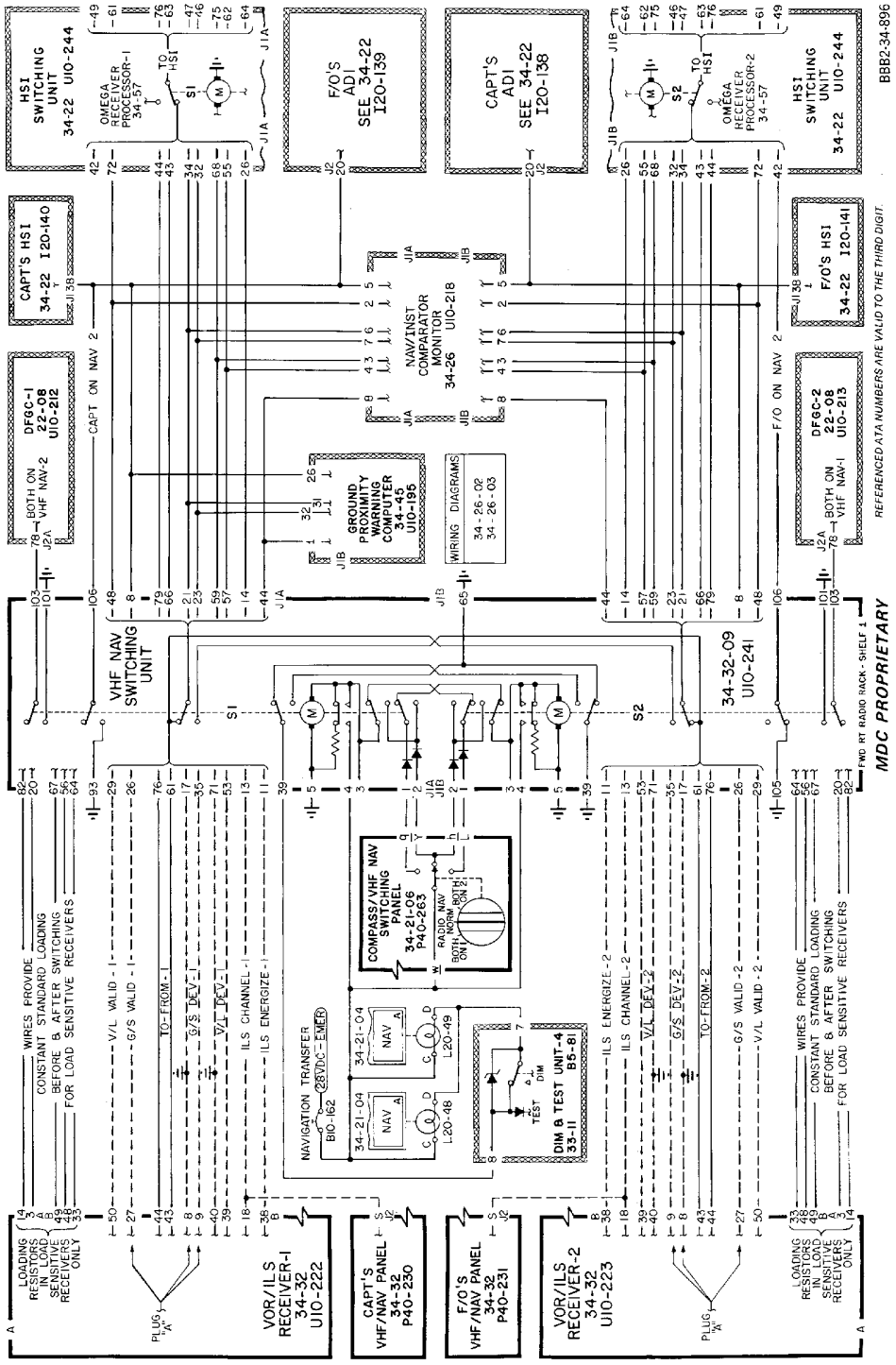
VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-802 (Sheet 2 of 2)



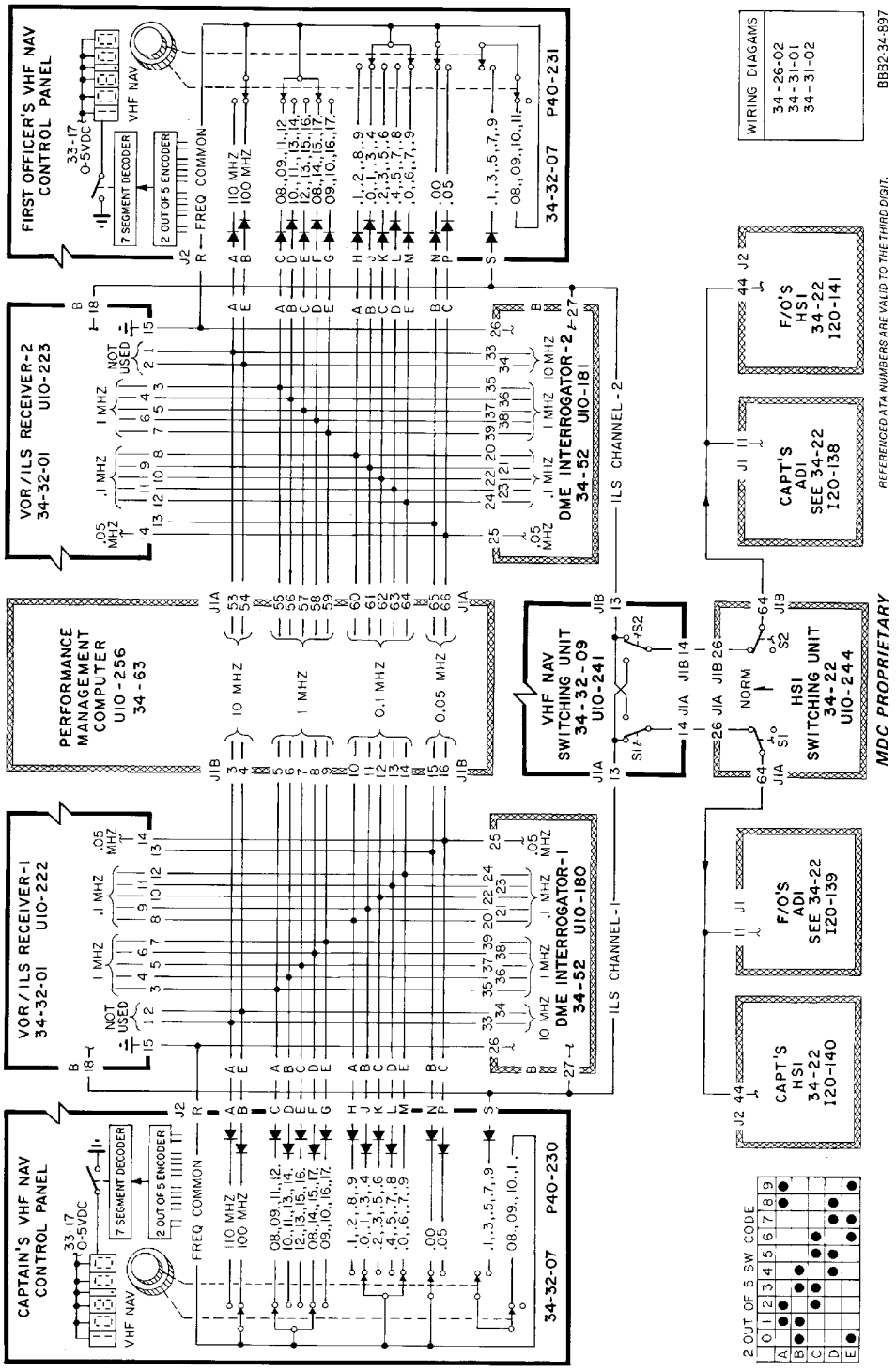
VOR/ILS (VHF NAV) Switching -- Schematic
Figure 103/34-32-00-990-803 (Sheet 1 of 3)



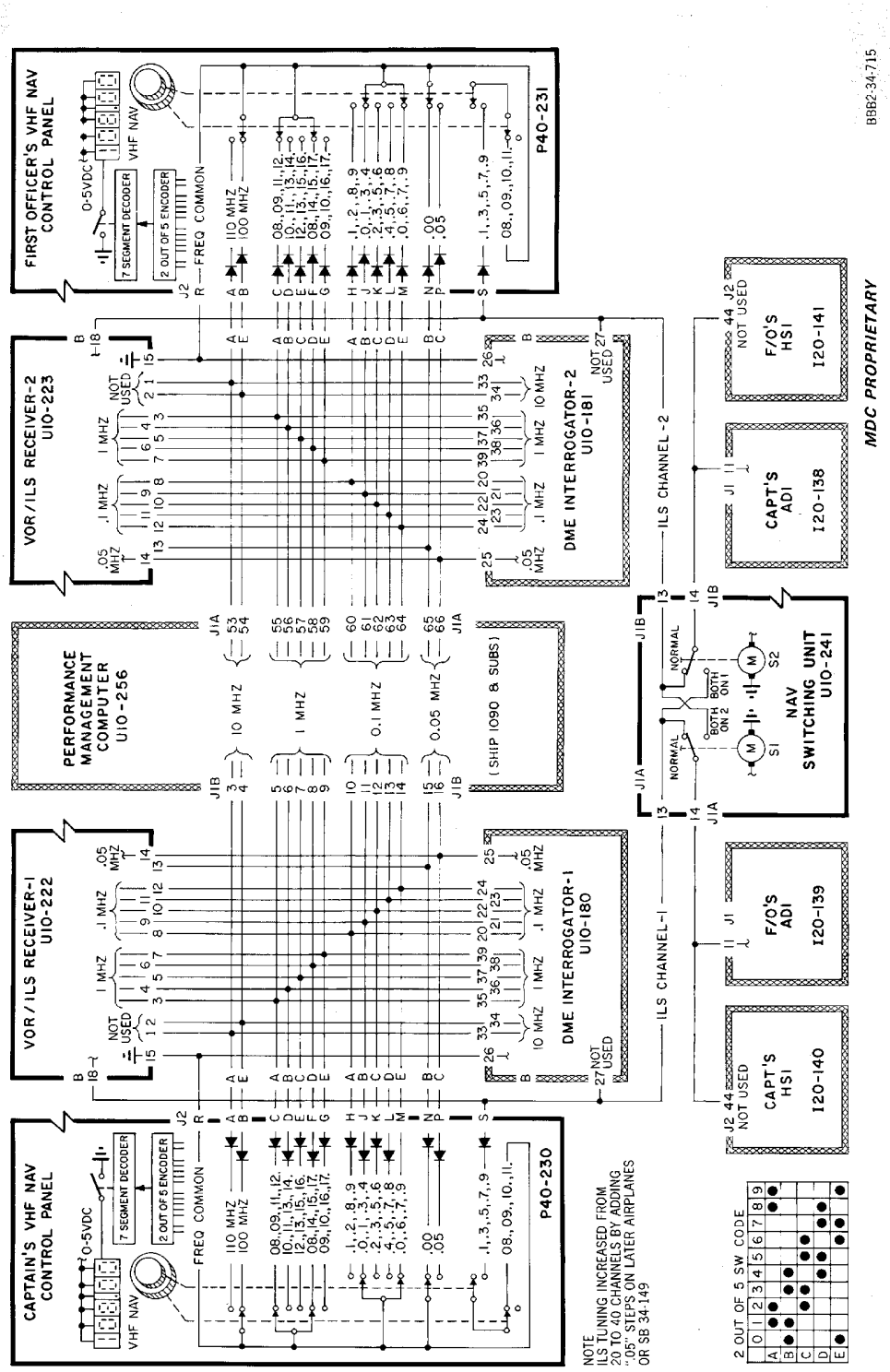
VOR/ILS (VHF NAV) Switching -- Schematic
Figure 103/34-32-00-990-803 (Sheet 2 of 3)



VOR/ILS (VHF NAV) Switching -- Schematic
Figure 103/34-32-00-990-803 (Sheet 3 of 3)



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 104/34-32-00-990-837 (Sheet 1 of 2)



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 104/34-32-00-990-837 (Sheet 2 of 2)

INSTRUMENT LANDING (ILS) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ILS system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the ILS system operation are Captain's and First Officer's horizontal situation indicators, compass indicators, VHF navigation panels, attitude direction indicators, and VOR/LOC antenna. Interfacing units are DFGC-1 and DFGC-2.

E. The ILS system components are located as follows:

Table 101

Component	Location
Horizontal Situation (HSI)	Captain's and First Officer's instrument panels
Compass Indicators	Captain's and First Officer's instrument panels
Attitude Direction Indicator (ADI)	Captain's and First Officer's instrument panels
VHF NAV control panel	Flight guidance control panel
Navigation Switching Unit	Electrical/Electronic compartment
VOR/LOC Antenna	Vertical Stabilizer

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting ILS System

A. Trouble Shoot

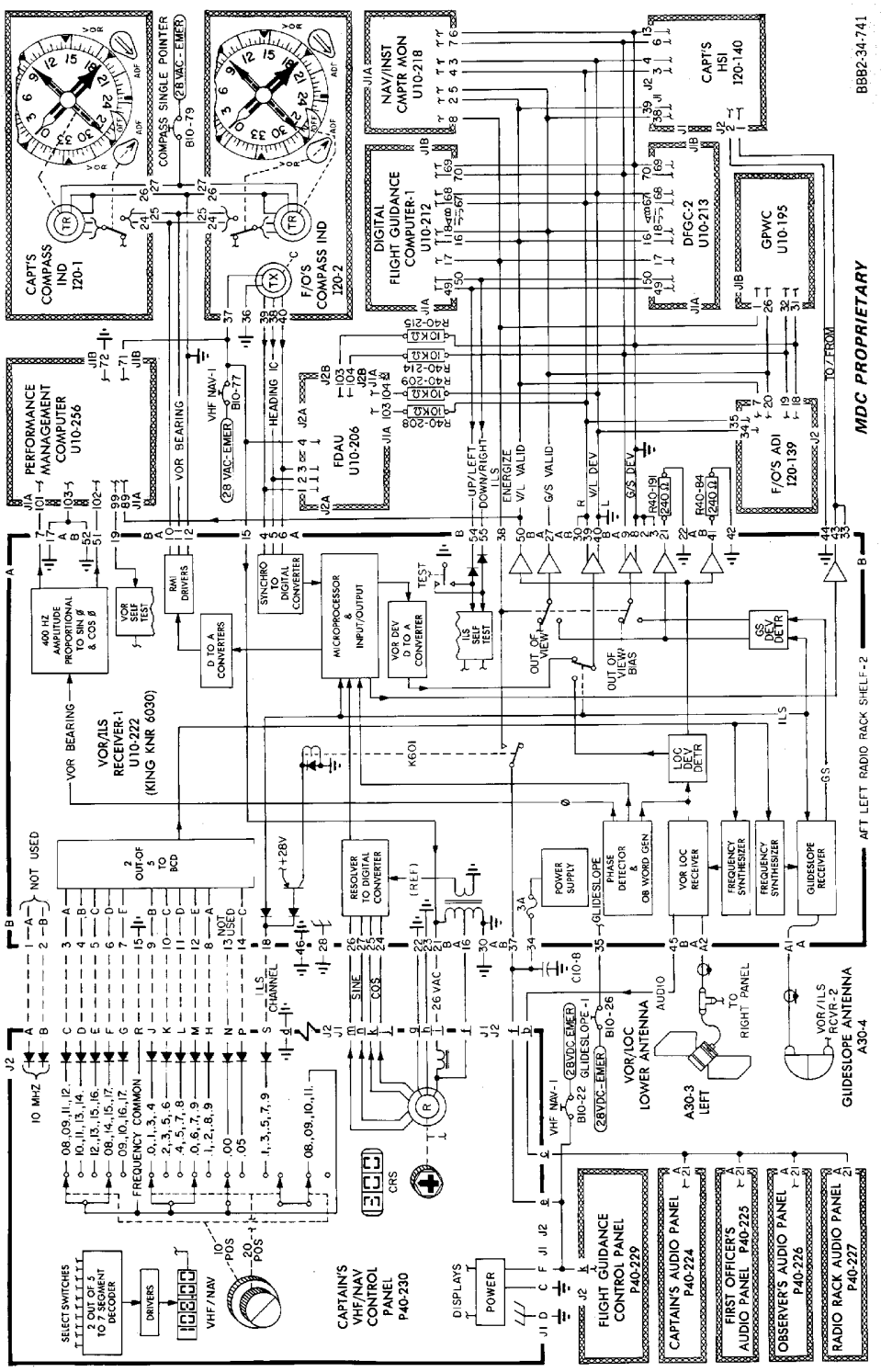
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are HSI, ADI indicators, VOR/ILS receiver, VHF NAV control panels, navigation switching unit, and VOR/LOC antenna.

Table 103

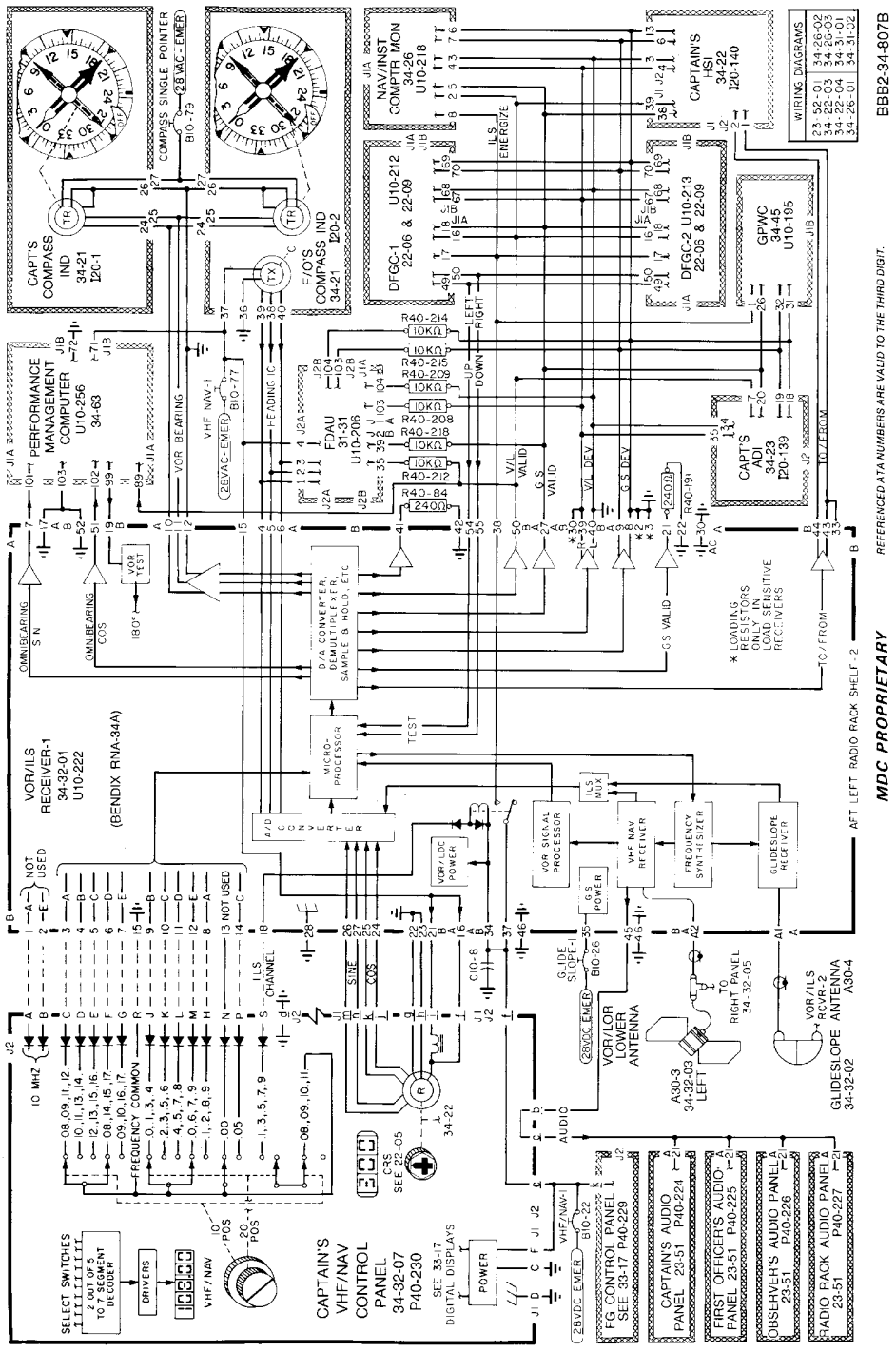
	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.

Table 103 (Continued)

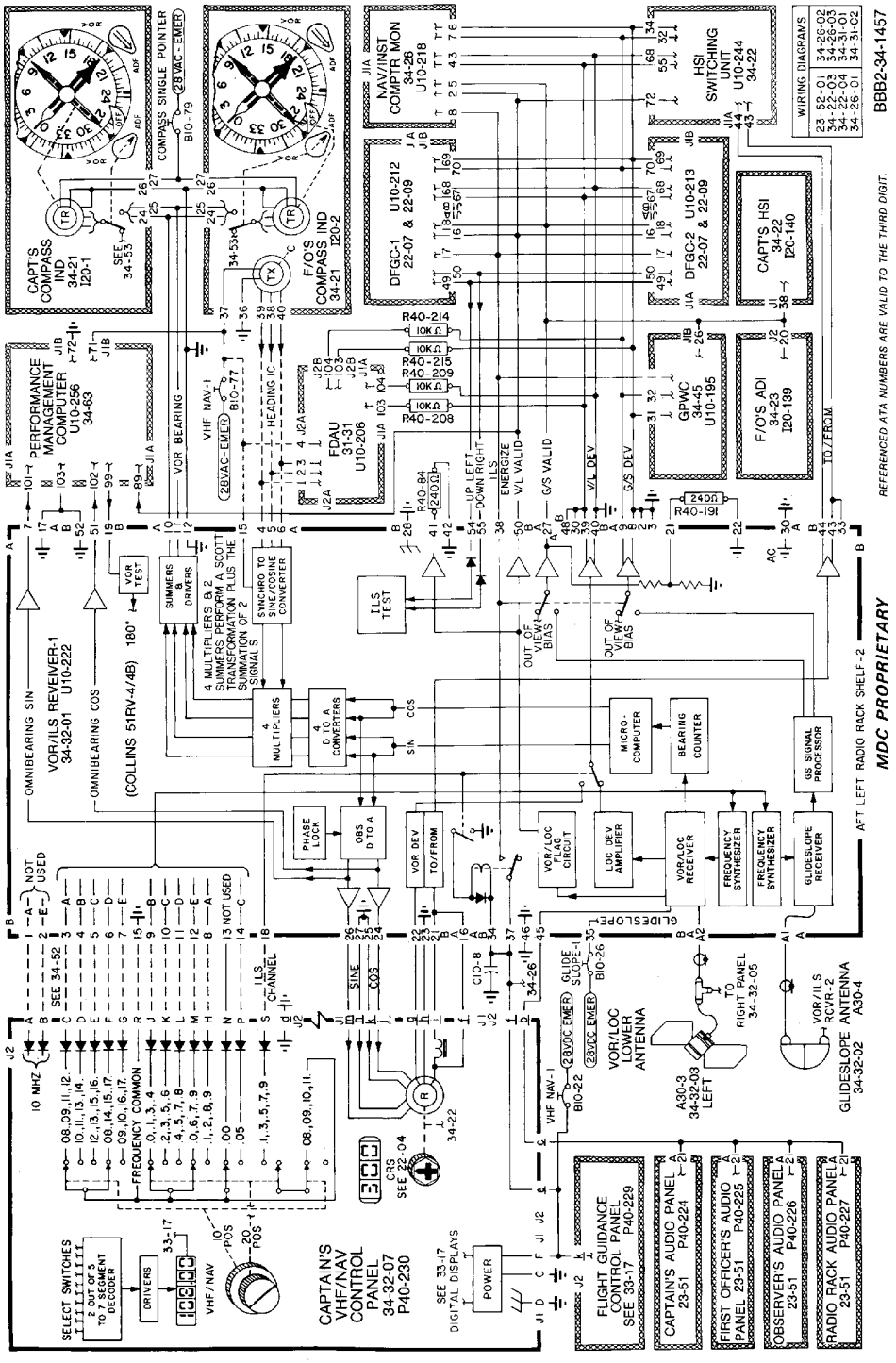
Procedure		Correction
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201).	



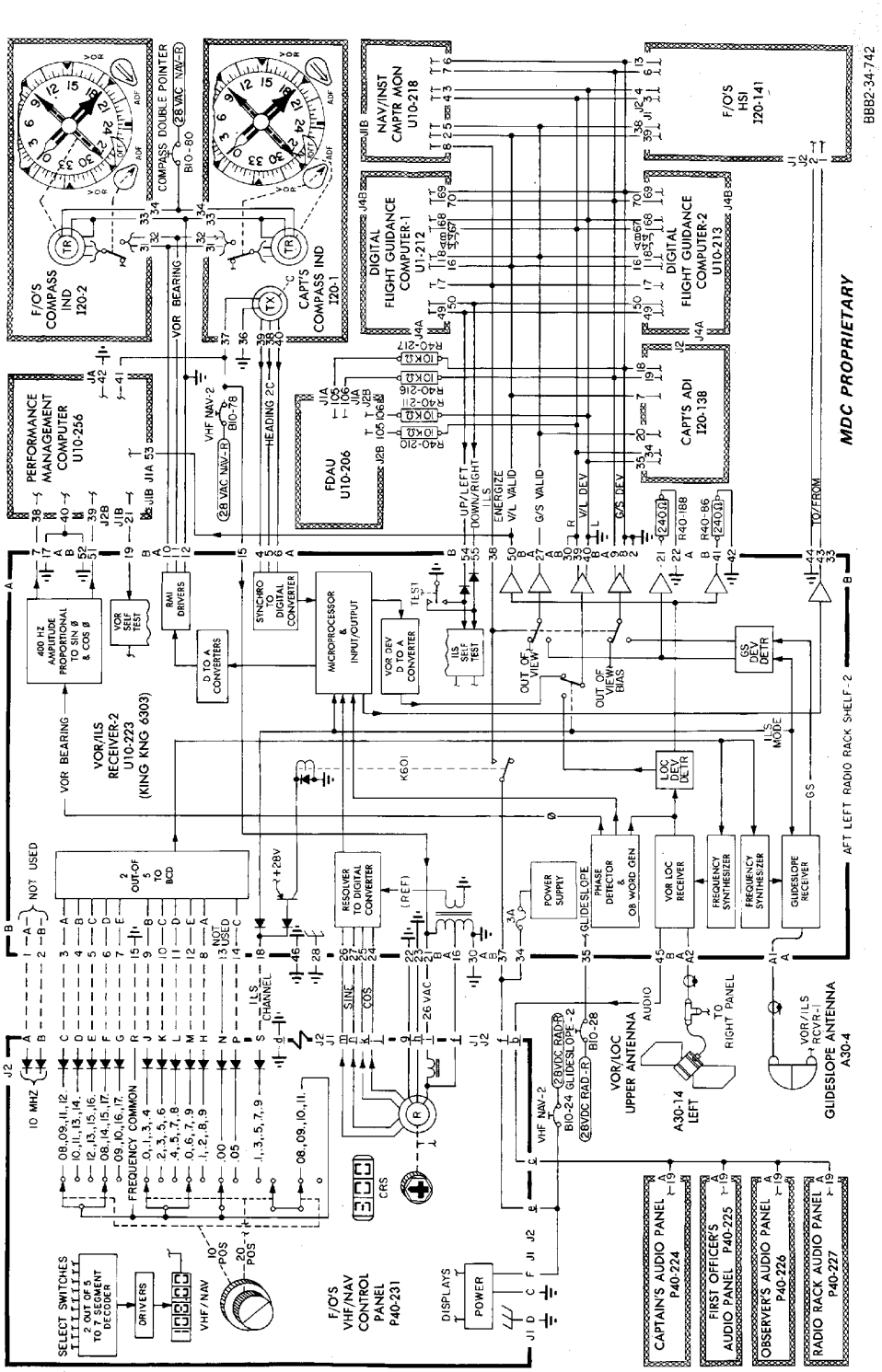
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-807 (Sheet 1 of 3)



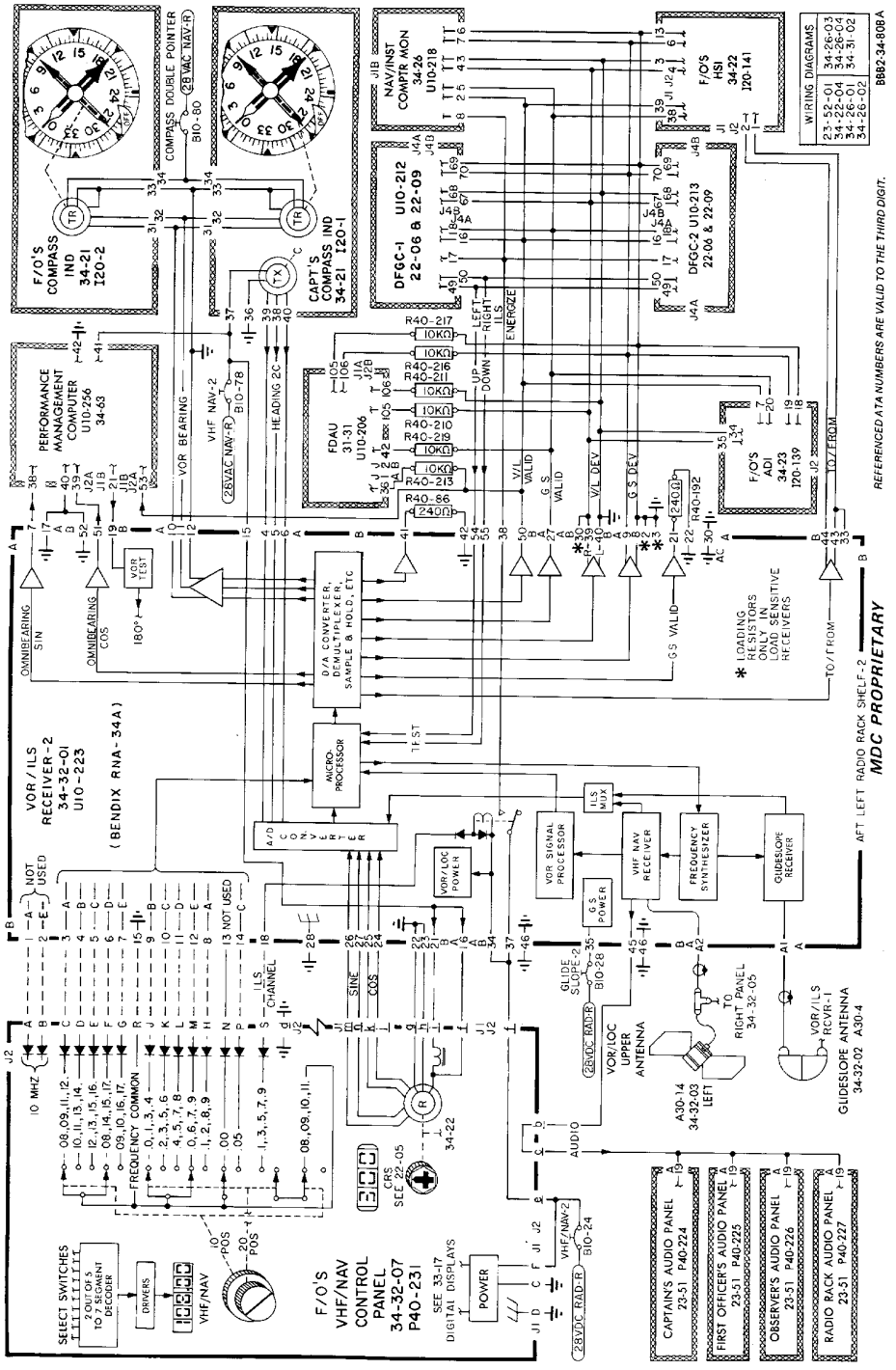
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-807 (Sheet 2 of 3)



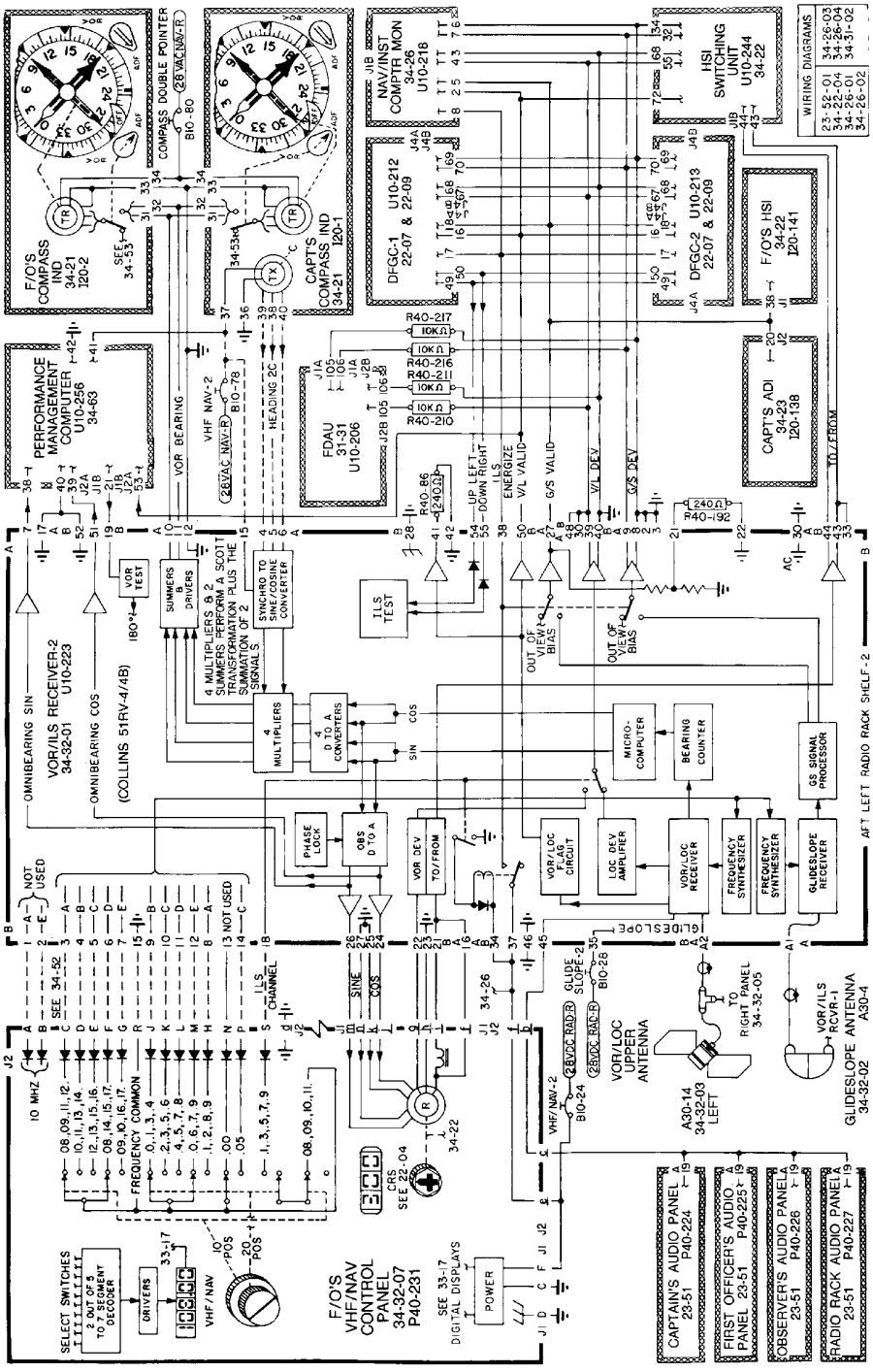
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-807 (Sheet 3 of 3)



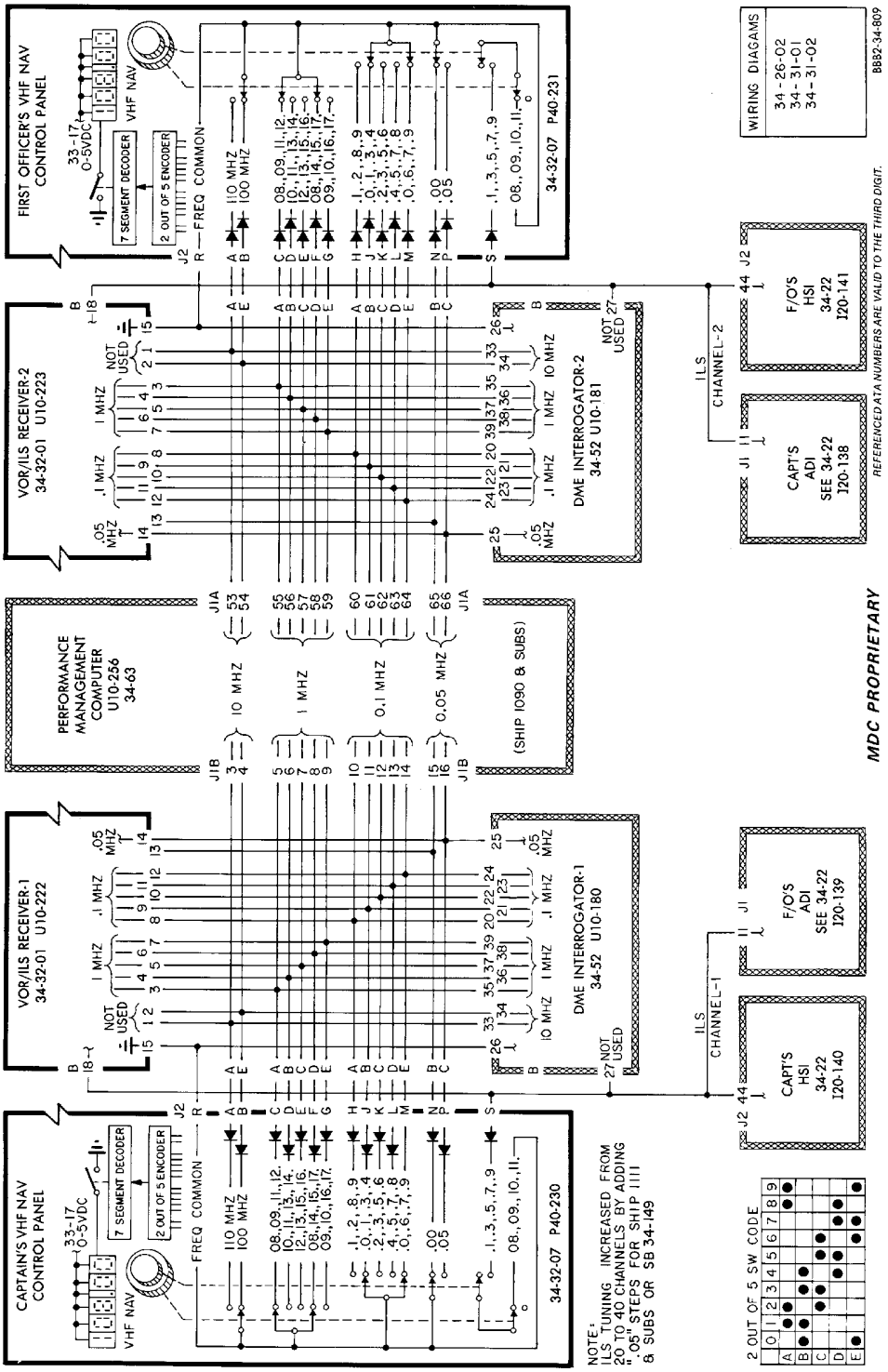
VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-808 (Sheet 1 of 3)



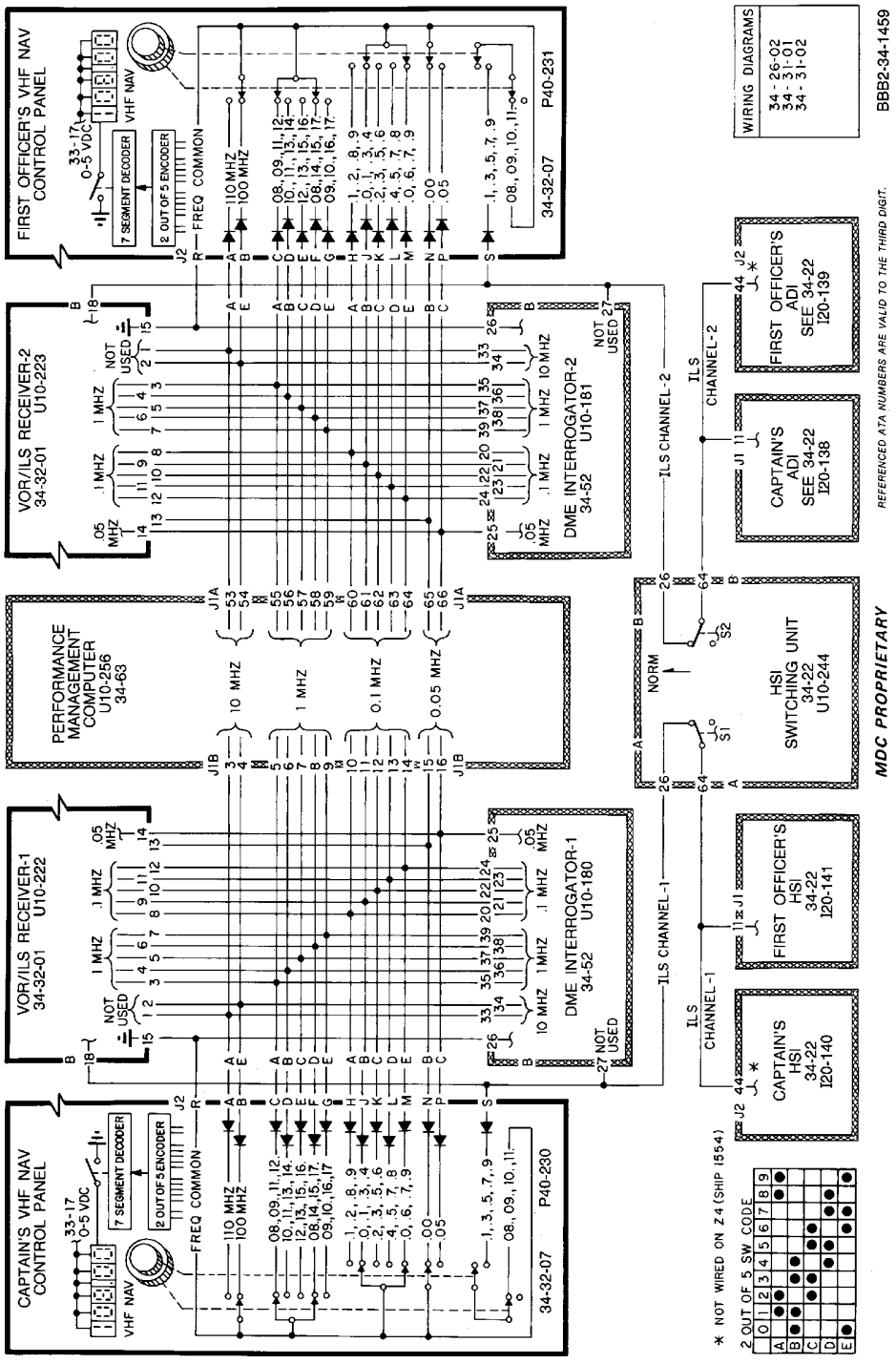
VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-808 (Sheet 2 of 3)



VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-808 (Sheet 3 of 3)



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 103/34-32-00-990-809 (Sheet 1 of 2)



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 103/34-32-00-990-809 (Sheet 2 of 2)

INSTRUMENT LANDING (ILS) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ILS system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 415, 418, 863, 864, 866

D. The basic components of the ILS system operation are Captain's and First Officer's EFIS primary flight displays and navigation displays, compass indicators, VHF navigation panels, and VOR/LOC antenna. Interfacing units are DFGC-1 and DFGC-2.

WJE 406-408, 410, 411, 415, 418, 863, 864, 866

E. The basic components of the ILS system operation are Captain's and First Officer's EFIS primary flight displays and navigation displays, compass/radio magnetic indicators, VHF navigation panels, and VOR/LOC antenna. Interfacing units are DFGC-1 and DFGC-2.

NOTE: On some aircraft the compass indicators replace the compass/radio magnetic indicators in the same location.

F. The ILS system components are located as follows:

Table 101

Component	Location
Primary Flight Display (PFD)	Captain's and First Officer's instrument panels
WJE 415, 418, 863, 864, 866	
Compass Indicators	Captain's and First Officer's instrument panels
WJE 406-408, 410, 411	
Compass/Radio Magnetic Indicators	Captain's and First Officer's instrument panels
WJE 406-408, 410, 411, 415, 418, 863, 864, 866	
Navigation Display (ND)	Captain's and First Officer's instrument panels
VHF NAV control panel	Flight guidance control panel
VOR/LOC Antenna	Vertical Stabilizer

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting ILS System

A. Trouble Shoot

WJE 415, 418, 863, 864, 866

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS PFD and ND, VOR/ILS receiver, VHF NAV control panels, navigation switching unit, and VOR/LOC antenna.

WJE 406-408, 410, 411

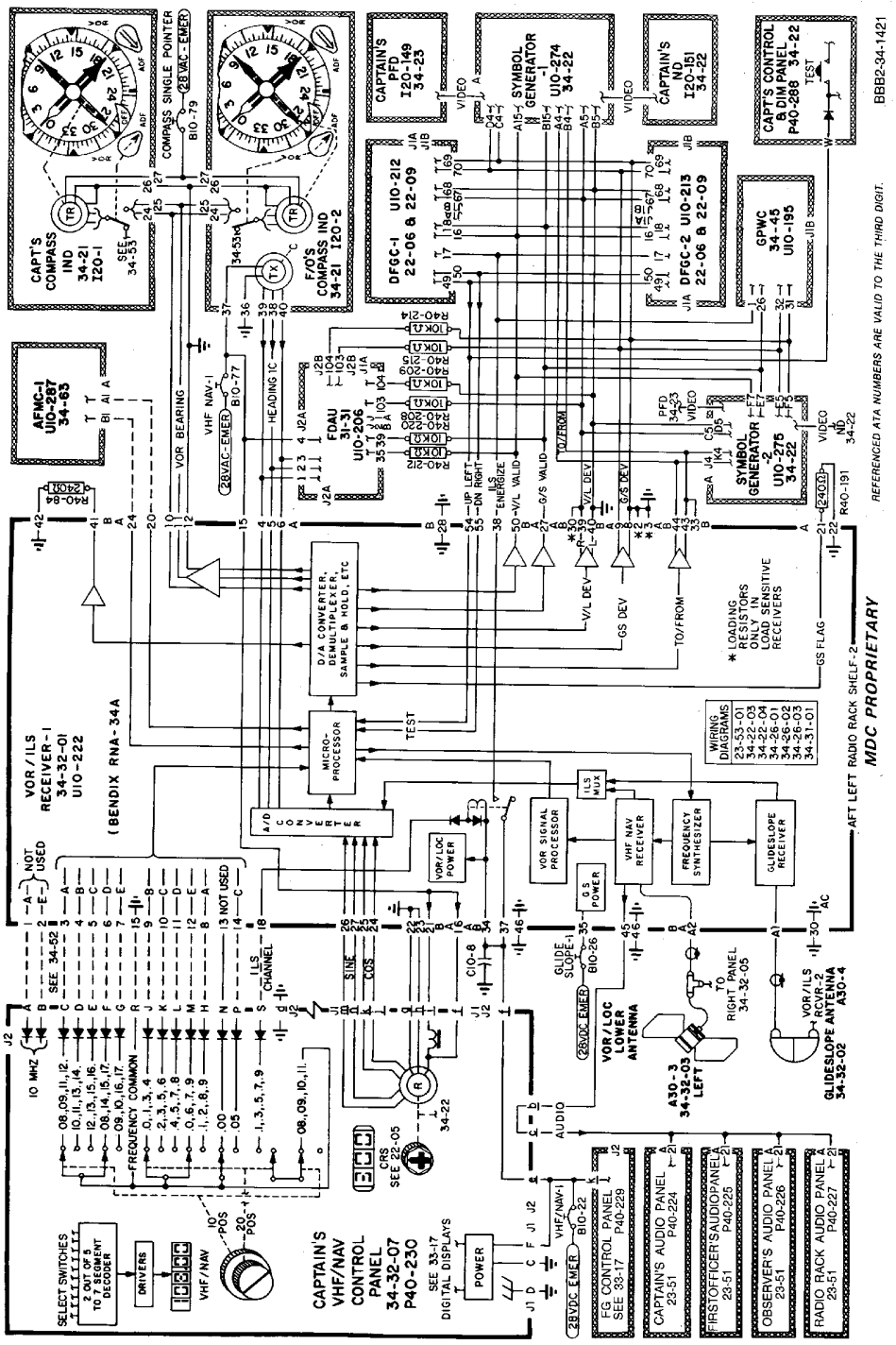
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS PFD and ND, VOR/ILS receiver, VHF NAV control panels, compass/radio magnetic indicators, VOR/LOC antenna, and on some aircraft, the navigation switching unit.

NOTE: On some aircraft a radio magnetic indicator is used instead of compass/radio magnetic indicators.

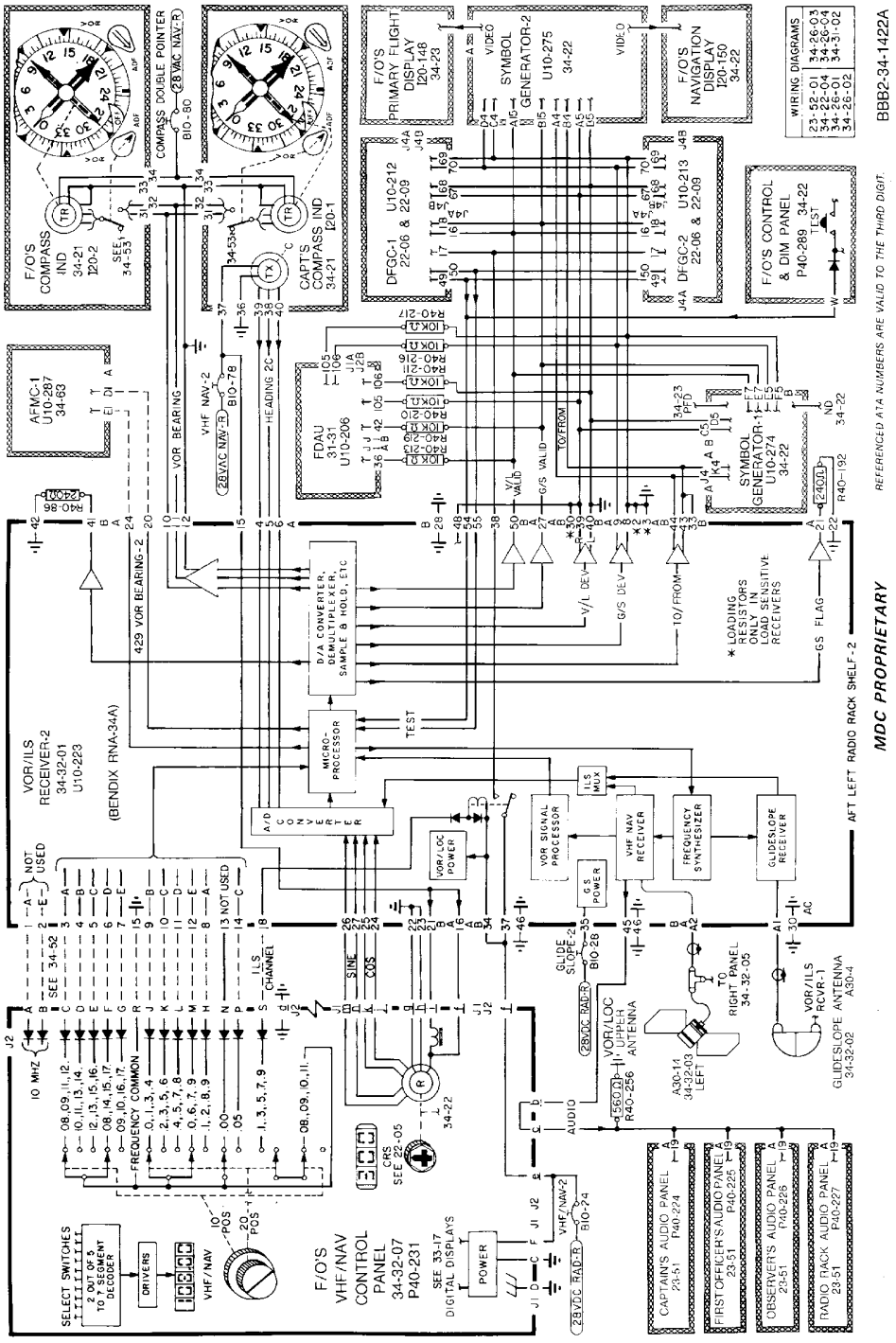
WJE 406-408, 410, 411, 415, 418, 863, 864, 866

Table 103

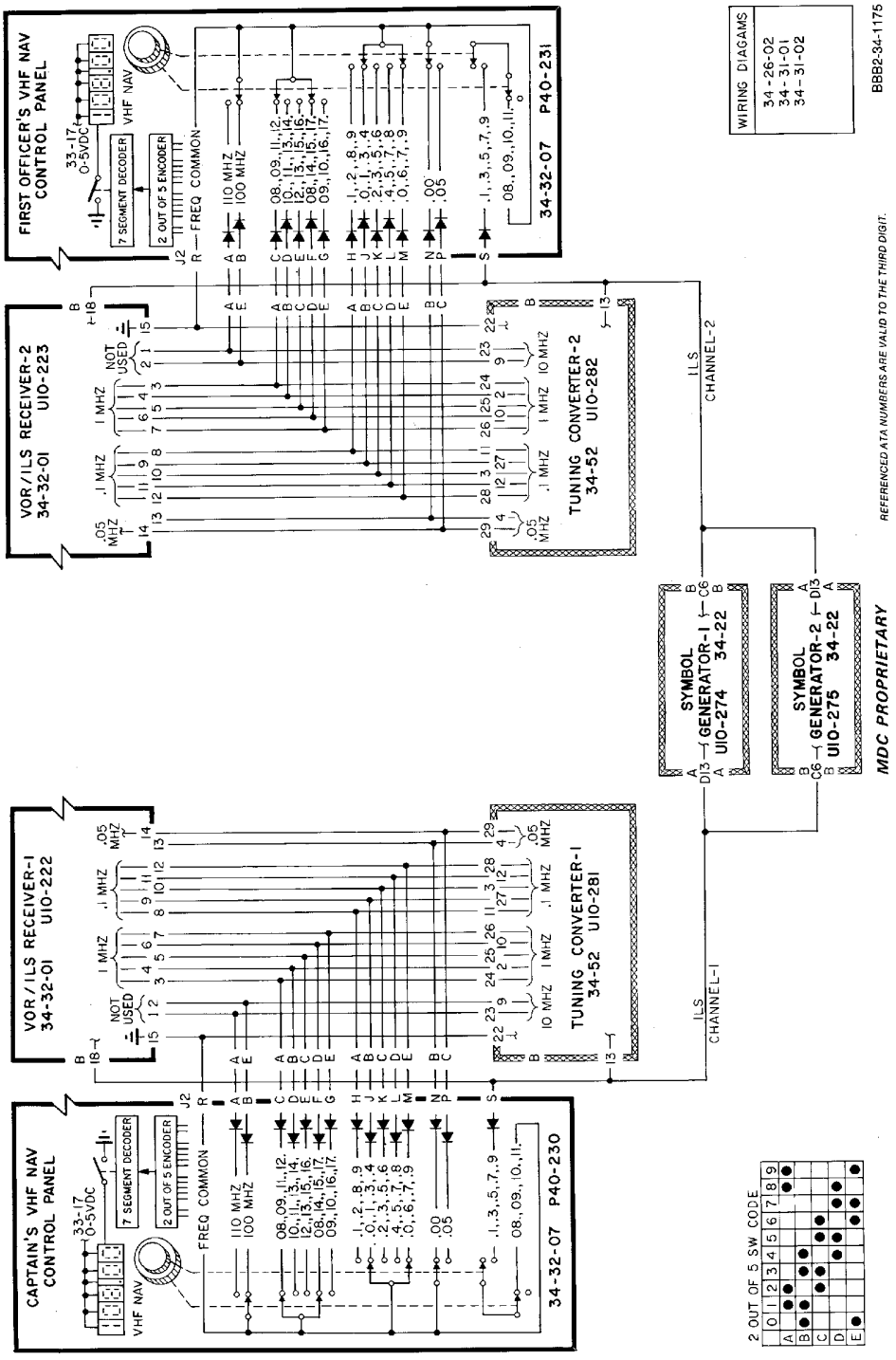
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201).	



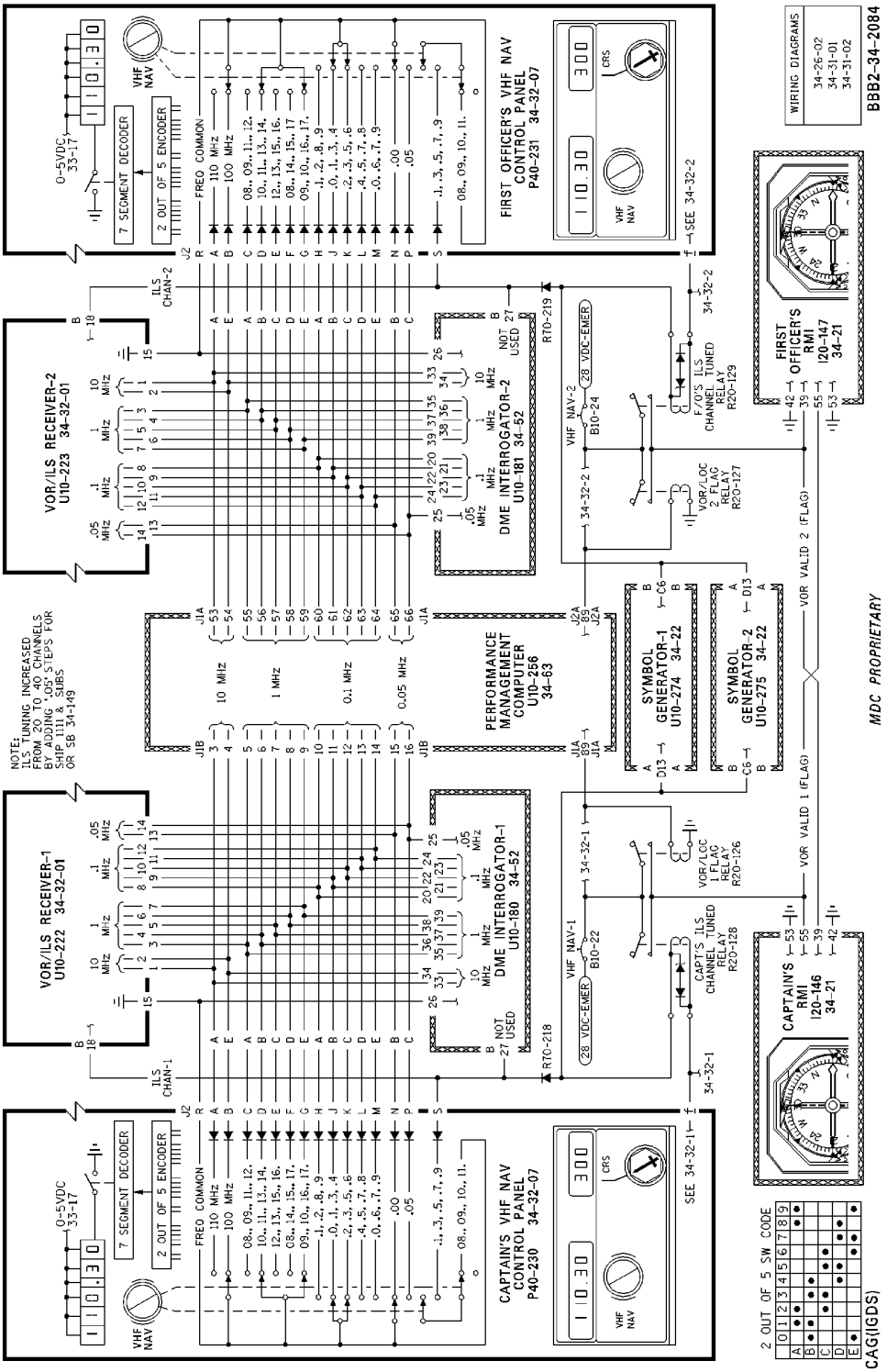
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-819



VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-820



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 103/34-32-00-990-821 (Sheet 1 of 2)



VOR/ILS (VHF NAV) Tuning -- Schematic
Figure 103/34-32-00-990-821 (Sheet 2 of 2)

INSTRUMENT LANDING (ILS) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ILS system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872

D. The basic components of the ILS system operation are Captain's and First Officer's EFIS primary flight displays and navigation displays, Radio Distance Magnetic indicators, VHF navigation panels, and VOR/LOC antenna. Interfacing units are DFGC-1, DFGC-2, Flight Management Computer and EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

WJE 875-879

E. The basic components of the ILS system operation are Captain's and First Officer's EFIS primary flight displays and navigation displays, Radio Distance Magnetic indicators, VHF navigation panels, VOR/LOC antenna, and navigation switching unit. Interfacing units are DFGC-1, DFGC-2, Flight Management Computer and EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

WJE 886, 887

F. The basic components of the ILS system operation are Captain's and First Officer's EFIS primary flight displays and navigation displays, Radio Distance Magnetic indicators, VHF navigation panels, and VOR/LOC antenna. Interfacing units are DFGC-1, DFGC-2, and EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201)

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

G. The ILS system components are located as follows:

Table 101

Component	Location
Primary Flight Display (PFD)	Captain's and First Officer's instrument panels
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887	
Radio Distance Magnetic Indicators (RDMI)	Captain's and First Officer's instrument panels
WJE 875-879	
Radio Direction Magnetic Indicators (RDMI)	Captain's and First Officer's instrument panels
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
Navigation Display (ND)	Captain's and First Officer's instrument panels
VHF NAV control panel	Flight guidance control panel
VOR/LOC Antenna	Vertical Stabilizer

Table 101 (Continued)

Component	Location
WJE 875-879	
Navigation Switching Unit	Electrical/Electronics compartment

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 8025A	Fluke

3. Trouble Shooting ILS System

A. Trouble Shoot

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS PFD and ND, VOR/ILS receiver, VHF NAV control panels, and VOR/LOC antenna.

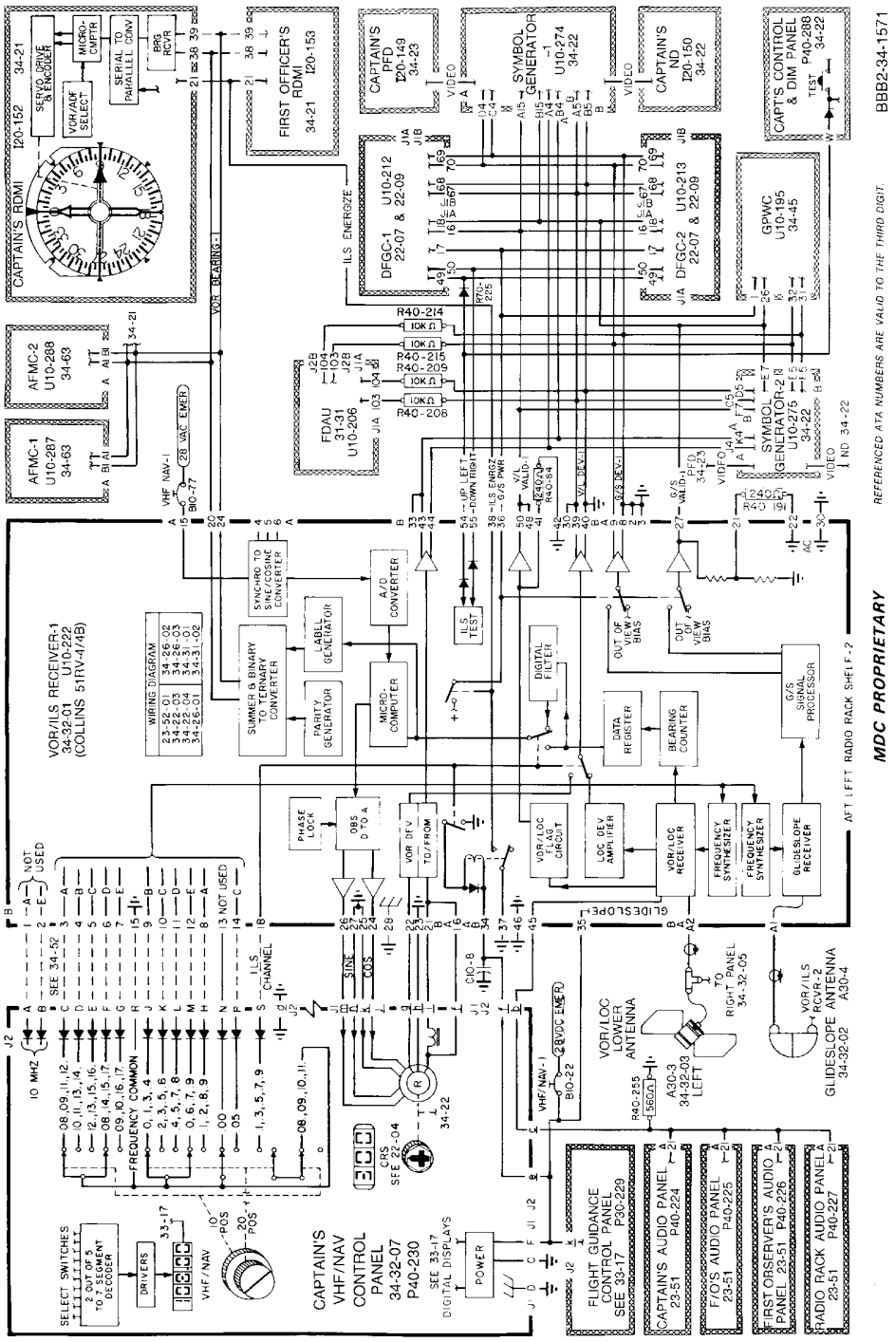
WJE 875-879

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are EFIS PFD and ND, VOR/ILS receiver, VHF NAV control panels, VOR/LOC antenna, and navigation switching unit.

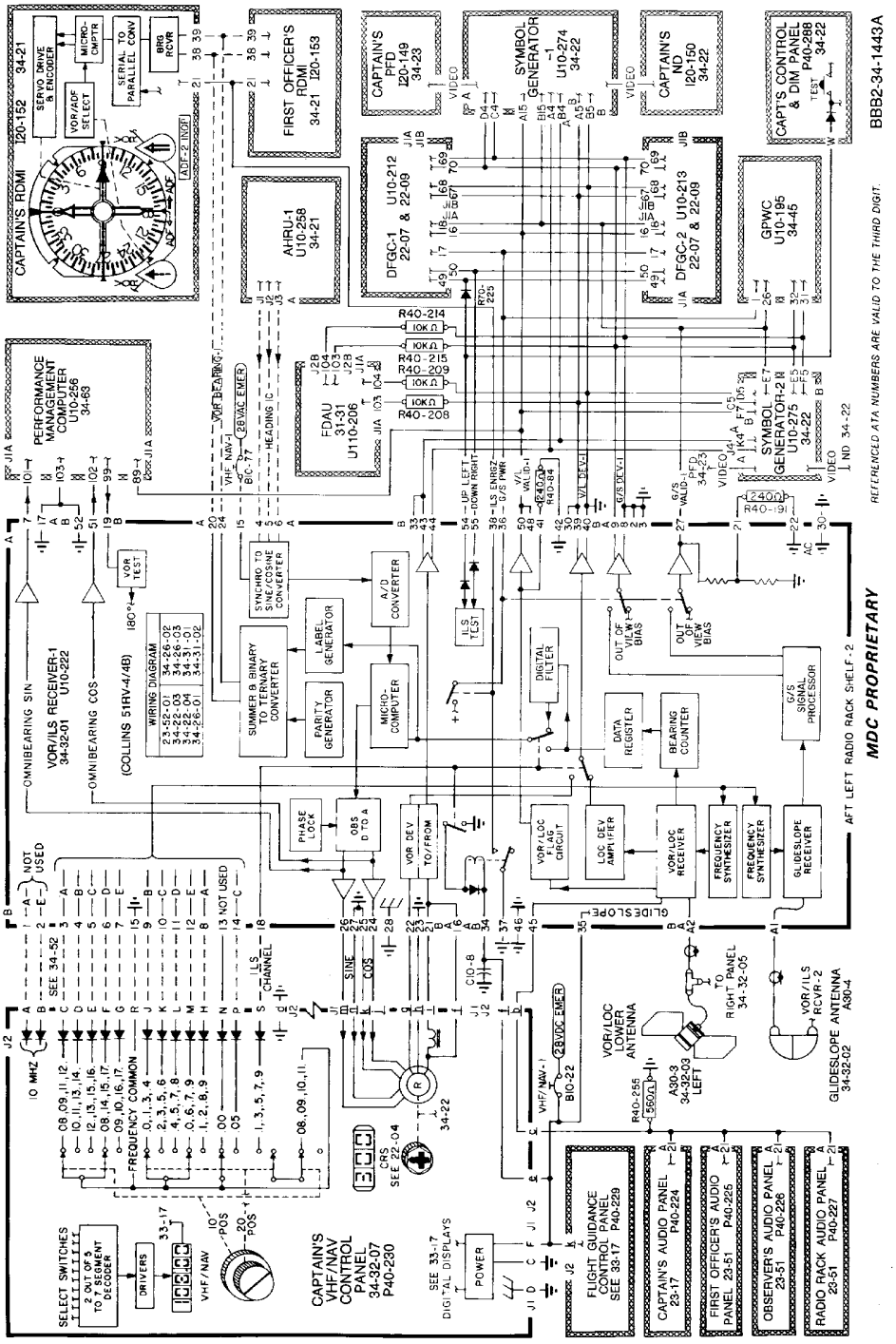
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

Table 103

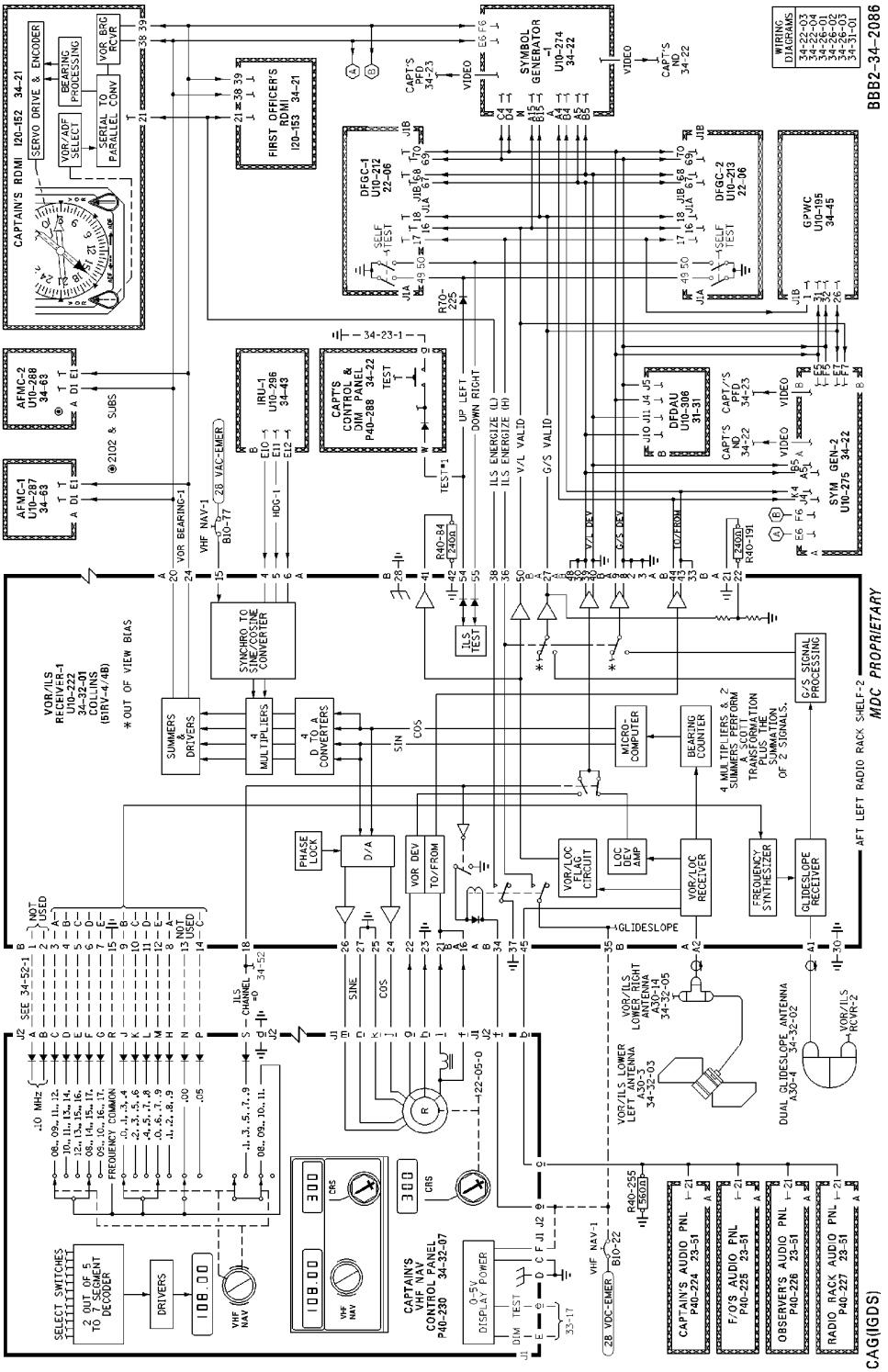
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201).	



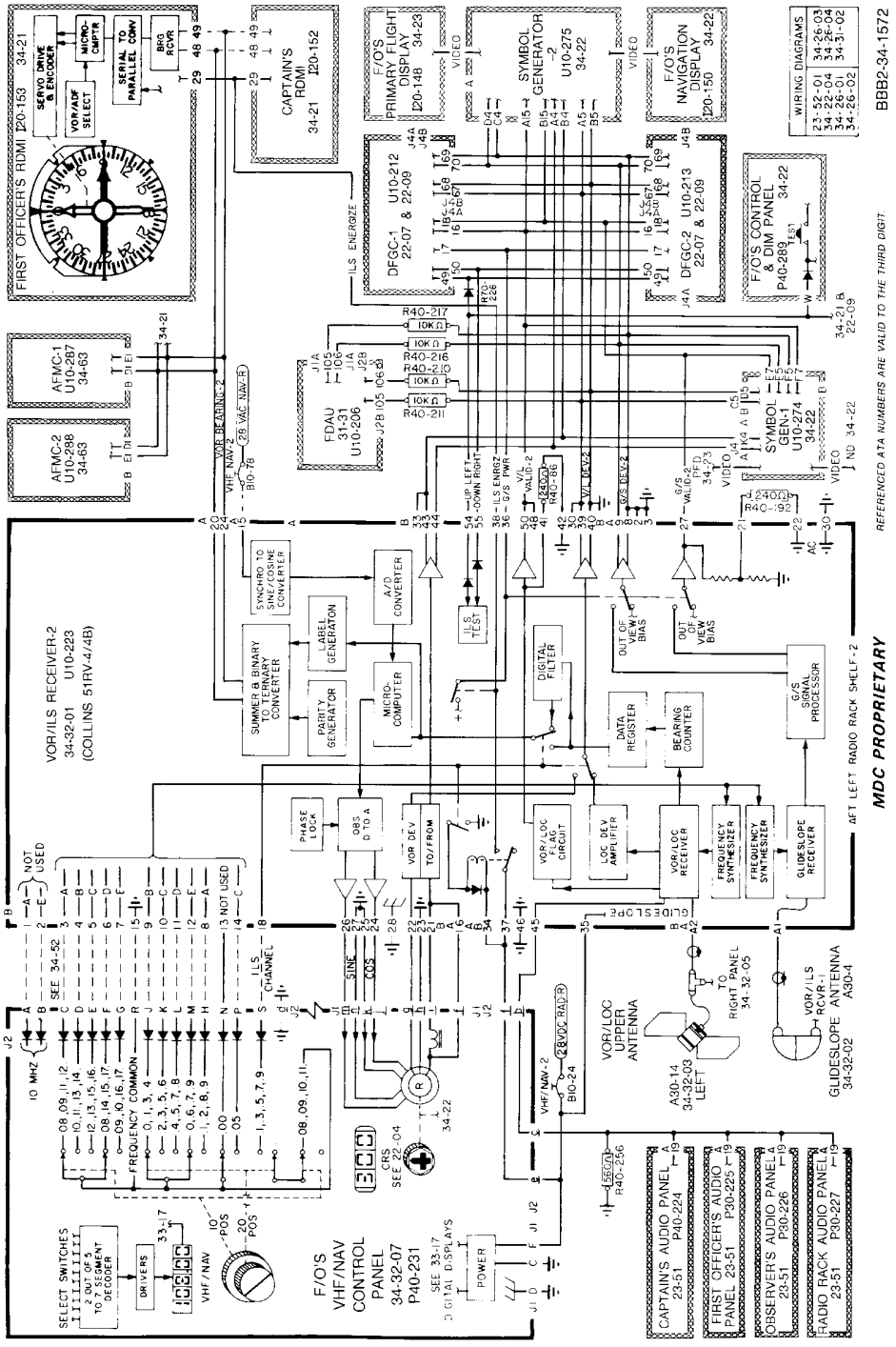
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-824 (Sheet 1 of 3)



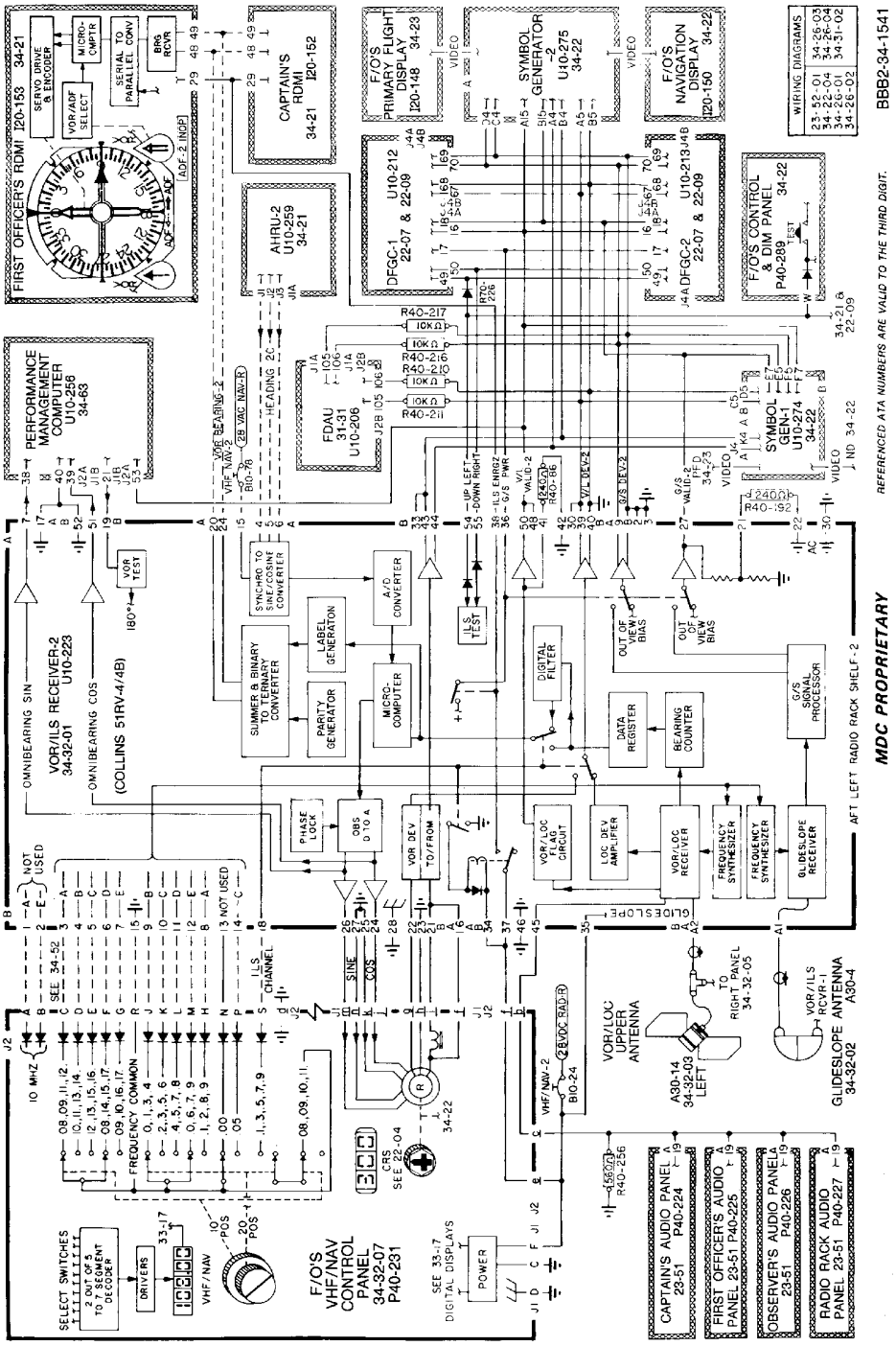
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-824 (Sheet 2 of 3)



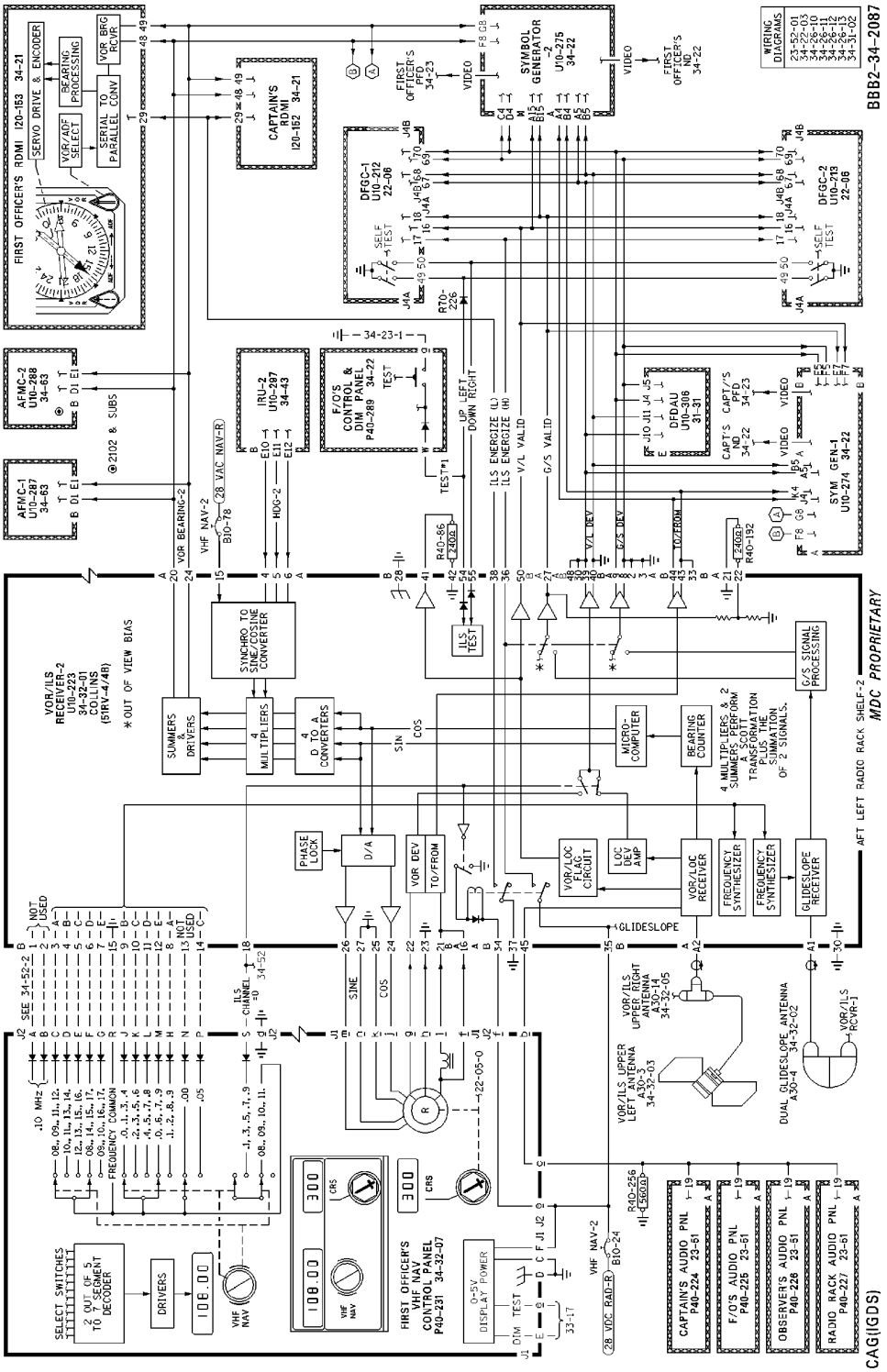
VOR/ILS-1 (VHF NAV) -- Schematic
Figure 101/34-32-00-990-824 (Sheet 3 of 3)



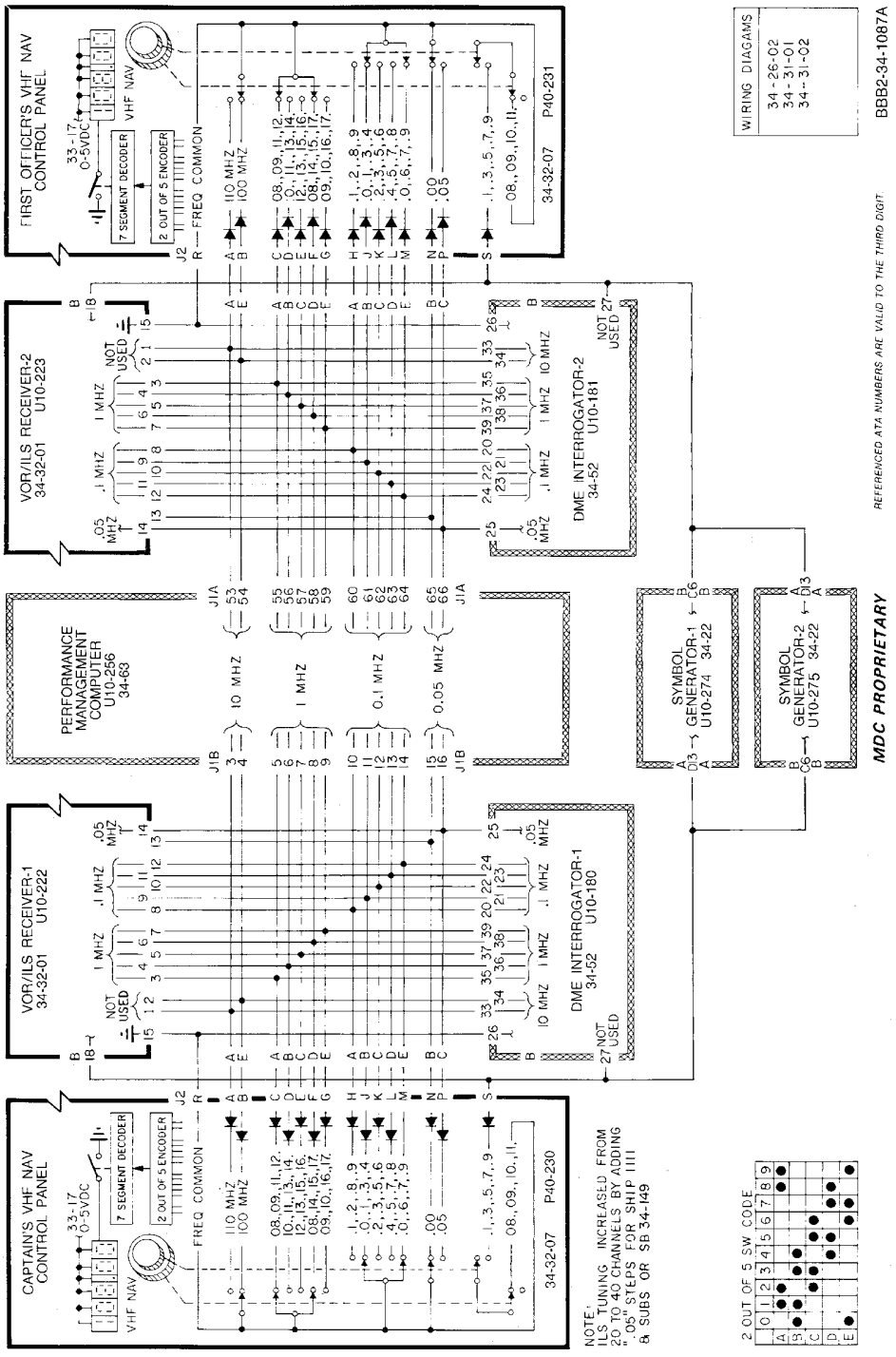
VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-825 (Sheet 1 of 3)



VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-825 (Sheet 2 of 3)



VOR/ILS-2 (VHF NAV) -- Schematic
Figure 102/34-32-00-990-825 (Sheet 3 of 3)



VHF NAV Tuning -- Schematic
Figure 103/34-32-00-990-823 (Sheet 1 of 2)

VHF NAV Tuning -- Schematic
Figure 103/34-32-00-990-823 (Sheet 2 of 2)

INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES

1. General

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are: VOR/LOC antenna, glideslope antenna, and VOR/ILS receiver, receivers are tuned on the VHF NAV control panel on the flight guidance control panel.

B. ILS-1 provides signals to the First Officer's attitude director indicator (ADI) and Captain's Horizontal Situation Indicator (HSI); and ILS-2 provides signals to the Captain's ADI and First Officer's HSI.

C. Maintenance Practices in this section tests the localizer and glideslope functions.

D. VOR signals are also processed through the VOR/ILS receiver. These are described and tested in section VHF NAVIGATION, SUBJECT 34-51-00of the maintenance manual.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator 479S-6A	Collins Radio Co.
Signal Generator T-30B (TES 9166 or equivalent)	Tel-Instrument Electronics Corp.
NOTE: During test procedures use applicable setup procedures for type of signal generator used.	

3. Adjustment/Test ILS System

A. Test Localizer Function

(1) Set up Signal Generator to provide a localizer signal.

(2) Set both VHF NAV 1/VHF NAV 2 frequencies, on VHF NAV Control, to Signal Generator frequency.

(3) On flight guidance control panel, rotate course knob to center course pointer on HSI under lubber line.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891, 893

(4) On aircraft with Omega Navigation, place HSI switches (RADIO/OMEGA), on Captain's and FO's instrument panels, in RADIO position.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891, 893

(5) At Signal Generator, rotate deviation control to left, Course Deviation bar on HSI and ADI localizer pointer should move to left.

(6) At Signal Generator, rotate deviation control to right, Course Deviation bar of HSI and ADI localizer pointer should move to right.

(7) Set deviation control pointer at center position, Course Deviation bar of HSI should center itself over miniature airplane and ADI localizer pointer should center.

B. Test Glideslope Function

(1) Select localizer frequency on Captain's/First Officer's VHF/NAV Control. This sets up a glideslope frequency on VOR/ILS receivers.

(2) Locate signal generator in front of airplane and place signal generator antenna parallel to glideslope antenna.

(3) Tune signal generator to applicable glideslope frequency and adjust to provide a centered glideslope pointer. Signal generator should be adjusted for maximum output.

(4) Relocate signal generator until deviation indicator flag on Captain's/First Officer's Indicators, disappear.

(5) Adjust generator to provide an UP deviation and observe that glideslope pointers follow upward.

(6) Adjust generator to provide a down deviation and observe that glideslope pointers follow down.

(7) At Captain's/First Officer's control panel, set control to an OFF channel Glideslope frequency. Glideslope Horizontal Bars should move upward to limit and Glideslope Flags should be fully masked.

C. Test Termination

(1) Remove test equipment.

(2) Return airplane to required configuration.

INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES

1. General

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are: VOR/LOC antenna, glideslope antenna, and VOR/ILS receiver. Receivers are tuned on the VHF NAV control panel adjacent to the flight guidance control panel.

B. ILS-1 provides localizer and glideslope deviation signals to the Capt's ND and PFD, and to both DFGS's; ILS-2 provides signals to the First Officer's ND and PFD, and to both DFGC's.

C. Maintenance Practices in this section test the localizer and glideslope functions.

D. VOR signals are also processed through the VOR/ILS receiver. These are described and tested in section VHF NAVIGATION, SUBJECT 34-51-00of the maintenance manual.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator T-30B	Tel Instrument Electronics Corp.

3. Adjustment/Test ILS System

A. Test Instrument Landing System

(1) Make sure that all applicable EFIS system circuit breakers are closed (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 201), for complete listing of EFIS and interfacing system circuit breakers). Adjust PFD and ND BRT controls on Control and Dimming Panels to comfortable viewing level.

NOTE: Failure messages will appear on display unit if all applicable circuit breakers are not closed.

NOTE: The following procedures refer to EFIS symbology which MUST appear on the PFD/ND display screen for a successful test. Disregard any symbology appearing on the display screens which is not referred to in the procedures.

(2) Hold T-30B test set (TES9166) while sitting in Captain's or First Officer's seat.

(3) Set both VHF NAV-1/VHF NAV-2 frequencies on VHF NAV controls to 108.10 MHz.

(4) Extend LOC and GS antennas in test set.

(5) Set LOC and GS knobs on test set to ON COURSE position.

(6) On Capt's and F.O.'s EFIS Mode Select Panel, place MODE switches in ROSE position.

(7) On flight guidance control panel, rotate Captain's and F/O's course select knobs to center course pointer on each ND under the lubber line.

(8) Hold LOC/GS bar switch on test set down and check that VOR FAIL, LOC FAIL and GS FAIL messages on ND are out of view.

NOTE: The display of localizer deviation, LOC FAIL, and G/S FAIL on the PFD follows the corresponding display on the off-side ND (i.e., Capt's PFD follows F/O's ND, and F.O.'s PFD follows Capt's ND).

(9) On test set turn localizer course knob to RIGHT and glideslope course knob to DOWN position. Hold bar switch down. Course deviation bar on ND should move right approximately 2 dots and rising runway/localizer display on PFD should move right. Glideslope pointers should move down approx. 2 dots on ND and PFD.

(10) On test set, turn LOC course knob to LEFT and GS course knob to UP position while holding the bar switch down.

(11) On ND, check that course deviation bar moves approx. two dots left and the localizer display on PFD moves left. GS pointers should move up two dots on both PFD and ND.

(12) Return LOC and GS knobs to ON COURSE position.

(13) Hold LOC and GS DELETE switches to 90 cycle position while holding bar switch on. Both localizer and glideslope symbology disappear on PFD and ND. LOC FAIL and GS FAIL messages appear on PFD and ND.

(14) Repeat previous step while holding LOC and GS DELETE switches to 150 cycle position. GS pointers will move down, dev bar will move to right, all messages as before.

(15) Tune in local airport ILS frequency on NAV-1 and NAV-2 control panels. On Captain's audio select panel, turn up NAV-1 and NAV-2 one at a time. Verify audio ident is heard over cockpit speaker or headphones.

(16) Verify ident audio at remaining audio select panels (F/O and OBS) by repeating previous step at each panel.

(17) Remove test set and return aircraft to normal configuration.

INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES

1. General

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are: VOR/LOC antenna, glideslope antenna, and VOR/ILS receiver, receivers are tuned on the VHF NAV control panel on the flight guidance control panel.

B. ILS-1 provides signals to the First Officer's attitude director indicator (ADI) and Captain's Horizontal Situation Indicator (HSI); and ILS-2 provides signals to the Captain's ADI and First Officer's HSI.

C. Maintenance Practices in this section tests the localizer and glideslope functions.

D. VOR signals are also processed through the VOR/ILS receiver. These are described and tested in section VHF NAVIGATION, SUBJECT 34-51-00 of the maintenance manual.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator T-30	Tel-Instrument Electronics Corp.
Ground Jumper	
NOTE: During test procedures use applicable setup procedures for type of signal generator used.	

3. Adjustment/Test ILS System

A. Preliminary Setup

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	39	B1-827	LEFT PROXIMITY SWITCH CONTROL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Set up signal generator to provide a LOC/GS signal.

(3) To do captain's ILS beam deviation warning, connect ground jumper to terminal 52 of mod block S30-214, Station 218L.

(4) To do first officer's ILS beam deviation warning, connect ground jumper to terminal 28 of mod block S30-118, Station 110.

B. Test ILS

Table 202

Step	Operation	Desired Result
(1)	Turn on T-30 signal generator.	
(2)	On Capt's and F.O.'s VHF/NAV control panels, set frequency to 108.10 MHz.	
(3)	On flight guidance control panel, rotate course knob to center course pointer on HSI under lubber line.	VOR/LOC and GS flags are out of view on HSI's. GS flags are out of view on ADI's.
(4)	On signal generator, set LOC and G/S knobs to ON COURSE position.	LOC and G/S pointers are centered. ILS DEV lights on Capt's and F.O.'s instrument panels should be off.
(5)	On signal generator, adjust localizer 2 dots deviation LEFT.	Capt's and F.O.'s localizer pointers move left; pointers agree. Capt's and F.O.'s ILS DEV lights flash.
(6)	On signal generator, adjust localizer to ON COURSE position.	Capt's and F.O.'s ILS DEV lights go off.
(7)	On signal generator, adjust localizer 2 dots deviation RIGHT.	Capt's and F.O.'s localizer pointers move right; pointers agree. Capt's and F.O.'s ILS DEV lights flash.
(8)	On signal generator, adjust localizer to ON COURSE.	Capt's and F.O.'s ILS DEV lights go off.
(9)	On signal generator, adjust glideslope course deviation two dots UP.	Glideslope pointers on Capt's and F.O.'s HSI's move up; pointers agree. Capt's and F.O.'s ILS DEV lights flash.
(10)	On signal generator, adjust GS to ON COURSE.	Capt's and F.O.'s ILS DEV lights go off.
(11)	On signal generator, adjust glideslope course deviation two dots DOWN.	Glideslope pointers on Capt's and F.O.'s HSI's move down; pointers agree. Capt's and F.O.'s ILS DEV lights flash.
(12)	On signal generator, adjust GS to ON COURSE position.	Capt's and F.O.'s ILS DEV lights go off.
(13)	Remove test equipment.	
(14)	Remove ground jumper connected to terminal 52 of mod block S30-214, Station 218L and to terminal 28 of mod block S30-118, Station 110.	

(1) Remove the safety tags and close these circuit breakers:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	39	B1-827	LEFT PROXIMITY SWITCH CONTROL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Return aircraft to required configuration.

INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES

1. General

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are: VOR/LOC antenna, glideslope antenna, and VOR/ILS receiver, receivers are tuned on the VHF NAV control panel on the flight guidance control panel.

B. ILS-1 provides signals to the Captain's Primary Flight Display (PFD) and First Officer's Navigation Display (ND). ILS-2 provides signals to the First Officer's PFD and Captain's ND.

NOTE: On aircraft 163, ILS-1 provides signals to the captain's Primary Flight Display (PFD) and Navigation Display (ND) and ILS-2 provides signals to the first officer's PFD and ND.

C. Maintenance Practices in this section tests the localizer and glideslope functions.

D. VOR signals are also processed through the VOR/ILS receiver. These are described and tested in section VHF NAVIGATION, SUBJECT 34-51-00of the maintenance manual.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator T-30	Tel-Instrument Electronics Corp.
Ground Jumper	
NOTE: During test procedures use applicable setup procedures for type of signal generator used.	

3. Adjustment/Test ILS System

A. Preliminary Setup

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	39	B1-827	LEFT PROXIMITY SWITCH CONTROL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Set up signal generator to provide a LOC/GS signal.

(3) To do captain's ILS beam deviation warning, connect ground jumper to terminal 52 of mod block S30-214, Station 218L.

(4) To do first officer's ILS beam deviation warning, connect ground jumper to terminal 28 of mod block S30-118, Station 210.

B. Test ILS

Table 202

	Operation	Desired Result
(1)	Turn on T-30 signal generator.	
(2)	On Capt's and F.O.'s VHF/NAV control panels, set frequency to 108.10 MHz.	
(3)	On flight guidance control panel, rotate course knob to center course pointer on ND under lubber line.	VOR/LOC and GS flags are out of view on ND's and PFD's.
(4)	On signal generator, set LOC and G/S knobs to ON COURSE position.	LOC and G/S pointers are centered and not flashing.
(5)	On signal generator, adjust localizer 2 dots deviation LEFT.	Capt's and F.O.'s localizer pointers move left and begin flashing; pointers agree.
(6)	On signal generator, adjust localizer to ON COURSE position.	Capt's and F.O.'s EFIS ILS pointers centered and on steady.
(7)	On signal generator, adjust localizer 2 dots deviation RIGHT.	Capt's and F.O.'s localizer pointers move right and begin flashing; pointers agree.
(8)	On signal generator, adjust localizer to ON COURSE.	Capt's and F.O.'s EFIS ILS pointers centered and on steady.
(9)	On signal generator, adjust glideslope course deviation two dots UP.	Capt's and F.O.'s glideslope pointers move up and begin flashing; pointers agree.
(10)	On signal generator, adjust GS to ON COURSE.	Capt's and F.O.'s EFIS ILS pointers centered and on steady.
(11)	On signal generator, adjust glideslope course deviation two dots DOWN.	Capt's and F.O.'s glideslope pointers move down and begin flashing; pointers agree.
(12)	On signal generator, adjust GS to ON COURSE position.	Capt's and F.O.'s EFIS ILS pointers center and on steady.
(13)	On F.O.'s VHF/NAV control panel, set frequency to 109.10.	ILS flags in view on Capt's ND and F.O.'s PFD; flags out of view on F.O.'s ND and Capt's PFD.
(14)	On overhead panel, place RADIO NAV switch to BOTH ON 1.	Flags out of view; Capt's and F.O.'s ILS pointers centered and on steady.
(15)	On VHF/NAV control panels, set F.O.'s frequency to 108.10 and Capt's frequency to 109.10.	ILS flags in view on Capt's and F.O.'s ND's and PFD's.
(16)	On overhead panel, place RADIO NAV switch to BOTH ON 2.	Flags out of view; Capt's and F.O.'s ILS pointers centered and on steady.
(17)	On Capt's VHF/NAV control panel, set frequency to 108.10; place RADIO NAV switch to NORM.	Flags out of view; Capt's and F.O.'s ILS pointers centered and on steady.

(1) Remove test equipment.

(2) Remove ground jumpers connected to terminals 52 of mod block S30-214, Station 218L and 28 of mod block S30-118, Station 210.

(3) Remove the safety tags and close these circuit breakers:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	39	B1-827	LEFT PROXIMITY SWITCH CONTROL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(4) Return aircraft to required configuration.

INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES

1. General

A. The dual ILS system uses localizer (LOC) and glideslope (G/S) signals transmitted from ground stations to provide indications of the position of the aircraft in relation to the localizer beam and glidepath. The basic components of each system are VOR/LOC antenna, glideslope antenna, and VOR/ILS receivers.

B. The ILS system uses the Captain's and First Officer's Radio Magnetic Indicators (RMI), EFIS Navigation Displays (ND) and Primary Flight Displays (PFD), VHF NAV-1 and VHF NAV-2 control panels, and Captain's and First Officer's Audio Panels.

C. This maintenance practice tests the VOR flags, NAV audio and frequency controls, VOR tracking, localizer deviation, and glideslope deviation.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
VOR Signal Generator 479S-6A	Collins
Multimeter 8000 Series Fluke or Dane 2000A	Fluke or Dane
NAV Hardwire Kit C652-7956623 PTE1	DAC
Headsets (4 each) H3370 or 710HB	David Clark
Adapter (for H3370 headset only) C652-7951103 PTE7	
115/208 VAC, 400 Hz - 3 Phase Power supply	
Signal generator T-30A or T-30B or T-30C	
Compass bar magnet C652-7910894 PTE12	DAC

3. Adjustment/Test ILS System

A. Preliminary Setup

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1
WJE 405-409, 411, 880, 881, 883, 884			
B	12	B1-164	EMERGENCY DC BUS SENSING

WJE 405-409, 411, 880, 881, 883, 884 (Continued)

(Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 410			
B	13	B1-164	EMERGENCY DC BUS SENSING

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
F	16	B10-83	NAV INST XFMR-1
WJE 410			
f	17	B10-83	NAV INST XFMR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884			
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

(2) Install tool C652-7956623 PTE1 NAV hardwire kit.

NOTE: The VHF NAV-1 and VHF NAV-2 receivers will have to be removed to install the NAV hardwire kit. (VOR/ILS RECEIVER, SUBJECT 34-32-02, Page 201)

(3) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1
WJE 405-409, 411, 880, 881, 883, 884			
B	12	B1-164	EMERGENCY DC BUS SENSING
WJE 410			
B	13	B1-164	EMERGENCY DC BUS SENSING

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
F	16	B10-83	NAV INST XFMR-1

WJE 405-409, 411, 880, 881, 883, 884 (Continued)

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
f	17	B10-83	NAV INST XFMR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884			
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

B. VOR Flag Test

Table 202

Step	Operation	Desired Result
(1)	Locate signal generator (479S-6A) in close proximity to Electrical/Electronics compartment.	
(2)	Hardwire 479S-6A to coax input on both VHF NAV receivers.	Hardwired to receivers.
NOTE: To comply with Douglas Aircraft Company Radio Station License, only VOR frequency 108.00 MHz and Localizer frequency 108.10 MHz may be radiated. All others must be hardwired into the Receiver using NAV Hardwire Kit C652-7956623 PTE1 and 479S-6A signal generator.		
(3)	Set 479S-6A signal generator for VOR operation as follows:	
(a)	Press POWER switch ON.	Power is ON.
(b)	Verify that RDL/DDM/MOD indications are:	
1)	000.00	000.00
2)	FROM	FROM
3)	RDL (DEG)	RDL (DEG)
(c)	Verify that AUDIO STATUS is STANDARD.	STANDARD set.
(d)	Set FREQUENCY to 112.80 MHz.	112.80 MHz set.
(e)	Verify MODE is VOR.	VOR set.
(f)	Verify RF LEVEL is -30 dB mw.	-30 dB mw set.
(g)	Verify that RF STATUS is PH LOCK, LEVEL CAL.	PH LOCK LEVEL CAL set.
(h)	Verify that TONE SELECT 30 Hz VAR and 9960 FM buttons are lit.	30 Hz VAR and 9960 FM are lit.
(i)	Verify that RF SELECT RF frequency key is lit.	RF FREQ key is lit.
(j)	Press TONE SELECT 1020/ AUX KEY.	1020/AUX KEY is illuminated.

Table 202 (Continued)

Step	Operation	Desired Result
(4)	Set both VHF NAV Control Panels and circuit breakers as shown in Table 203 below and check for correct responses on NDs	Should be correct response.

Table 203 VOR FAIL MESSAGE

VHF NAV-1 28 VDC CKT BKR	VHF NAV-2 28 VDC CKT BKR	CAPT'S VHF NAV PANEL FREQUENCY	F/O'S VHF NAV PANEL FREQUENCY	CAPT'S ND VOR FAIL MESSAGE	F/O'S ND VOR FAIL MESSAGE
CLOSED	CLOSED	112.8	112.8	NONE	NONE
OPEN	CLOSED	112.8	112.8	IN VIEW	NONE
CLOSED	OPEN	112.8	112.8	NONE	IN VIEW
CLOSED	CLOSED	112.9	112.8	IN VIEW	NONE
CLOSED	CLOSED	112.8	112.9	NONE	IN VIEW

C. NAV/Audio and Frequency Control Test

NOTE: This test is performed to test the NAV-1 and NAV-2 receivers, control panels, and associated aircraft wiring.

Table 204

Step	Operation	Desired Result
(1)	Plug headset into headset jack at Captain's, First Officer's, Observer's, and electrical/electronics compartment.	Headset installed.
(2)	Select audio panel filter for tone operation.	Response is as shown in Table 205.
NOTE: Selector may be identified as Range, R, IDENT, ID, deactivated VOICE ONLY, etc.. Set volume control on audio selector panel for a comfortable level. Using the headset, check for correct audio response at Audio Selector Panel as indicated in Table 205Table 205 .		
(3)	Repeat Table 205, step 1 with VOR/LOC MHz set to following frequencies:	Response is as indicated in Table 205 , step 1.
1)	113.65	
2)	117.10	

Table 205 AUDIO MATRIX

STEP	SIG GEN FREQ	CAPT'S VHF NAV PANEL	F/O'S VHF NAV PANEL	LOCATION	NAV-1 VOLUME CONTROL	NAV-2 VOLUME CONTROL	1020 Hz TONE
1	112.8	112.8	112.8	CAPT	ON	OFF	YES
	112.8	112.8	112.8	CAPT	OFF	ON	YES
	112.8	112.8	112.8	CAPT	OFF	OFF	NO

Table 205 AUDIO MATRIX (Continued)

STEP	SIG GEN FREQ	CAPT'S VHF NAV PANEL	F/O'S VHF NAV PANEL	LOCATION	NAV-1 VOLUME CONTROL	NAV-2 VOLUME CONTROL	1020 Hz TONE
2	112.8	112.8	112.8	F/O	ON	OFF	YES
	112.8	112.8	112.8	F/O	OFF	ON	YES
	112.8	112.8	112.8	F/O	OFF	OFF	NO
3	112.8	112.8	112.8	OBSERVER	ON	OFF	YES
	112.8	112.8	112.8	OBSERVER	OFF	ON	YES
	112.8	112.8	112.8	OBSERVER	OFF	OFF	NO
4	112.8	112.8	112.8	E/E	ON	OFF	YES
	112.8	112.8	112.8	E/E	OFF	ON	YES
	112.8	112.8	112.8	E/E	OFF	OFF	NO

D. VOR Tracking Test

During following test, course arrows change orientation as selected VOR course is varied. Right and left deviations in Table 207 are called out as if course arrows were pointing upward. It should be noted that for "RT" deviation, bar appears below course arrow when course equals heading plus 80X, to left of arrow for heading plus 170X, and above arrow for heading plus 260X.

Table 206

Step	Operation	Desired Result
(1)	Set frequency on Capt's and F/O's VHF NAV Control panels and signal generator to 108.00 MHz.	Control panels and signal generator tuned to same frequency set.
(2)	Set 479S-6A signal generator as follows:	
(a)	If FUNCTION CONTROL RDL/DDM key is not lit, press RDL/DDM KEY to enable entry of bearing data.	RDL/DDL key is lit.
(b)	Verify that RDL/DDM/MOD display reads 000.00 RDL (DEG).	Display reads 000.00 RDL (DEG).
(c)	Press FUNCTION CONTROL T/F U/L D/R key to change to TO output.	TO set.
(3)	On Capt's and F/O's ND's:	
(a)	HDG Fail message should be out of view.	HDG Fail out of view on NDs.
(b)	VOR fail message should be out of view.	VOR Fail message is out of view on NDs.
(c)	On Capt's and F/O's RMI or Compass indicator, warning flags should be out of view.	RMI flags are out of view.
(d)	Momentarily turn off power to 479S-6A signal generator.	Both VOR-1 and VOR-2 bearing pointer flags on Capt's and F/O's indicators are in view while signal generator power is OFF.
(4)	Set AZIMUTH on signal generator and adjust SET knobs on VHF NAV-1 and VHF NAV-2 Control panels and check for correct responses as shown in Table 207 .	Responses are as in Table 207.

Table 206 (Continued)

Step	Operation	Desired Result
NOTE: Press the Function Control + 10 Step key successively to set the radio values in Table 207 .		
NOTE: If a split exists between the heading indications at the Captain's and F/O's RMI's, use the C652-7910894 PTE12 compass bar magnet to adjust one RMI heading equal to the indication of the opposite RMI.		

Table 207 VOR TRACKING CHART

STEP	SET AZIMUTH ON SIG. GEN. TO:	ADJUST COURSE KNOBS ON VF-NAV CONTROL PANELS TO:	COURSE ARROWS ON BOTH ND'S INDICATE:	BOTH POINTERS ON RMI'S/ COMPASS INDICATORS INDICATE:	TO-FROM ARROW ON ND
1	0°	Align Dev. Bar with CRS arrow	0°	0°	TO
	0°	Move Dev. Bar 2 dots RT of CRS arrow	350°	0°	TO
	0°	Move Dev. Bar 2 dots LT of CRS arrow	10°	0°	TO
2	45°	Align Dev. Bar with CRS arrow	45°	45°	TO
	45°	Move Dev. Bar 2 dots RT of CRS arrow	35°	45°	TO
	45°	Move Dev. Bar 2 dots LT of CRS arrow	55°	45°	TO
3	90°	Align Dev. Bar with CRS arrow	90°	90°	TO
	90°	Move Dev. Bar 2 dots RT of CRS arrow	80°	90°	TO
	90°	Move Dev. Bar 2 dots LT of CRS arrow	100°	90°	TO
4	135°	Align Dev. Bar with CRS arrow	135°	135°	TO
	135°	Move Dev. Bar 2 dots RT of CRS arrow	125°	135°	TO
	135°	Move Dev. Bar 2 dots LT of CRS arrow	145°	135°	TO
5	180°	Align Dev. Bar with CRS arrow	180°	180°	TO
	180°	Move Dev. Bar 2 dots RT of CRS arrow	170°	180°	TO
	180°	Move Dev. Bar 2 dots LT of CRS arrow	190°	180°	TO

Table 207 VOR TRACKING CHART (Continued)

STEP	SET AZIMUTH ON SIG. GEN. TO:	ADJUST COURSE KNOBS ON VF-NAV CONTROL PANELS TO:	COURSE ARROWS ON BOTH ND'S INDICATE:	BOTH POINTERS ON RMI'S/ COMPASS INDICATORS INDICATE:	TO-FROM ARROW ON ND
6	225°	Align Dev. Bar with CRS arrow	225°	225°	TO
	225°	Move Dev. Bar 2 dots RT of CRS arrow	215°	225°	TO
	225°	Move Dev. Bar 2 dots LT of CRS arrow	235°	225°	TO
7	270°	Align Dev. Bar with CRS arrow	270°	270°	TO
	270°	Move Dev. Bar 2 dots RT of CRS arrow	260°	270°	TO
	270°	Move Dev. Bar 2 dots LT of CRS arrow	280°	270°	TO
8	315°	Align Dev. Bar with CRS arrow	315°	315°	TO
	315°	Move Dev. Bar 2 dots RT of CRS arrow	305°	315°	TO
	315°	Move Dev. Bar 2 dots LT of CRS arrow	325°	315°	TO
9	0°	Align Dev. Bar with CRS arrow	180°	0°	FROM
NOTE: Tolerances are ± 2.5° for NDs and RMIs/compass.					

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1
WJE 405-409, 411, 880, 881, 883, 884			
B	12	B1-164	EMERGENCY DC BUS SENSING
WJE 410			
B	13	B1-164	EMERGENCY DC BUS SENSING

WJE 410 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
F	16	B10-83	NAV INST XFMR-1
WJE 410			
f	17	B10-83	NAV INST XFMR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884			
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

(2) Remove tool C652-7956623 PTE1 and reinstall VOR/ILS -1 and -2 receivers. (VOR/ILS RECEIVER, SUBJECT 34-32-02, Page 201)

(3) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1
WJE 405-409, 411, 880, 881, 883, 884			
B	12	B1-164	EMERGENCY DC BUS SENSING
WJE 410			
B	13	B1-164	EMERGENCY DC BUS SENSING

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
F	16	B10-83	NAV INST XFMR-1
WJE 410			
f	17	B10-83	NAV INST XFMR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884			
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	3	B10-28	GLIDESLOPE -2
G	7	B10-24	VHF NAV-2

E. Localizer Deviation Test

Table 208

Step	Operation	Desired Result
(1)	(Locate T-30A or T-30B or T-30C signal generator in convenient location which will provide reliable signals to aircraft VOR/LOC and glideslope antennas. Pull out LOC and glideslope antennas on signal generators.	Test set positioned.
(2)	On VHF NAV control panels set frequency to 108.10 MHz.	NAV panels set to 108.10 MHz.
(3)	Set switches as shown in Table 209 and check for correct responses on both NDs.	Responses are correct as shown in Table 209.

Table 209 LOCALIZER DEVIATION MATRIX

STEP	LOC DEV ON SIGNAL GENER.	CAPT VHF NAV PANEL FREQ.	F/O VHF NAV PANEL FREQ.	RADIO NAV SWITCH	CAPT ND VERT. BAR	F/O ND VERT. FAIL BAR	CAPT ND LOC MESSAGE	F/O ND LOC FAIL MESSAGE
1	LEFT	109.10	109.10	NORMAL	NOTE 2	NOTE 2	IN VIEW	IN VIEW
2	LEFT	108.10	109.10	NORMAL	LEFT	NOTE 2	NONE	IN VIEW
3	LEFT	108.10	108.10	NORMAL	LEFT	LEFT	NONE	NONE
4	RIGHT	108.10	108.10	NORMAL	RIGHT	RIGHT	NONE	NONE
5	ON COURSE	108.10	108.10	NORMAL	CENT-ERED	CENT-ERED	NONE	NONE
6	RIGHT	108.10	109.10	BOTH ON 1	RIGHT	RIGHT	NONE	NONE
7	RIGHT	109.10	108.10	BOTH ON 2	RIGHT	RIGHT	NONE	NONE
NOTE: The localizer deviation information and flag on the PFDs follow the information displayed on the NDs. Thus, the Captain's PFD follows the Captain's ND and vice versa.								
NOTE: Vertical bar is biased out-of-view with the LOC Fail in view.								

F. Glideslope Deviation Test

Table 210

Step	Operation	Desired Result
(1)	Set switches on T-30A or T-30B and NAV panels as shown in Table 211 and check for correct responses on both NDs.	Responses are correct as shown in Table 211, Table 211 .
(2)	On Radio NAV Test panel place ILS-1 and ILS-2 test switches in UP/L position. While holding switches in position, note following:	Test switches set to UP/L.

Table 210 (Continued)

Step	Operation	Desired Result
(a)	For approximately 3 seconds, Captain's and F/O's ND LOC and GS flags are in view and LOC and GS deviation bars are out of view.	Flags are in view and deviation bars are out of view for 3 seconds.
(b)	For approximately 24 seconds, flags are out of view and LOC and GS deviation bars deflect up and left, respectively.	Flags are out of view. Deviation bars are up and left deflected for 24 seconds.
(c)	After 24 seconds out of view, flags reappear and deviation bars bias out of view.	Flags reappear and deviation bars are out of view.
(3)	Repeat step (2) with test switches in DN/R position. Note that responses are similar except that deviation bars deflect right and down.	Down and right deflection movements is similar to step (2) sequence.
(4)	Return aircraft to required configuration.	

G.

Table 211 GLIDESLOPE DEVIATION MATRIX

STEP	GS DEV ON SIGNAL GENER.	CAPT VHF NAV PANEL FREQ.	F/O VHF NAV PANEL FREQ.	RADIO NAV SWITCH	CAPT ND GS DEV BAR	F/O ND GS ND GS DEV BAR	CAPT FAIL MESSAGE	F/O ND GS FAIL MESSAGE
1	UP	109.10	109.10	NORMAL	NOTE 2	NOTE 2	IN VIEW	IN VIEW
2	UP	108.10	109.10	NORMAL	UP	NOTE 2	NONE	IN VIEW
3	UP	108.10	108.10	NORMAL	UP	UP	NONE	NONE
4	DOWN	108.10	108.10	NORMAL	DOWN	DOWN	NONE	NONE
5	ON COURSE	108.10	108.10	NORMAL	CENT-ERED	CENT- ERED	NONE	NONE
6	DOWN	108.10	109.10	BOTH ON 1	DOWN	DOWN	NONE	NONE
7	DOWN	109.10	108.10	BOTH ON 2	DOWN	DOWN	NONE	NONE

NOTE: The glideslope deviation information and flag on the PFDs follow the information displayed on the NDs. Thus, the Captain's PFD follows the Captain's ND and vice versa.

NOTE: Deviation is biased out-of-view with the flag in view.

NOTE: Glideslope is GS in Table 211 . Frequency is FREQ. in Table 211.

GLIDESLOPE ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the G/S (Glideslope) antenna.

B. The G/S antenna is installed on a support attached to the forward bulkhead inside the nose radome, below the weather radar antenna. The G/S antenna is mounted on the support by six attaching screws. Coaxial cables to the Instrument Landing System (ILS) receivers are attached to the antenna through a bulkhead cutout.

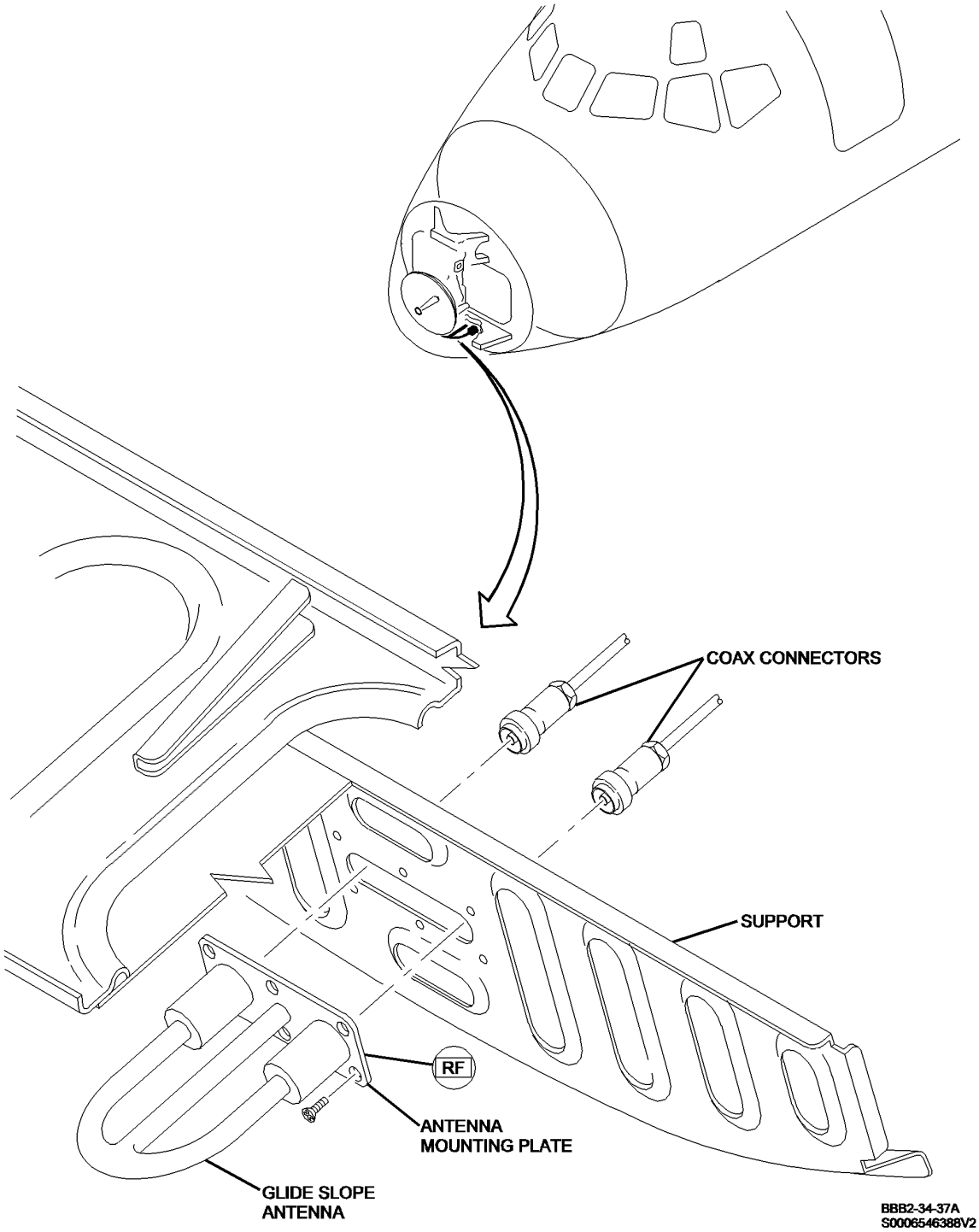
2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Signal generator 479T-2	Collins Radio Co.
or	
T-30A	TEL Instruments Corp.
Dust caps, electrical connector MS90376	



Glideslope Antenna -- Removal/Installation
Figure 201/34-32-01-990-801

3. Removal/Installation Glideslope Antenna

WARNING: DO NOT OPERATE THE WEATHER RADAR WHEN PERSONNEL ARE IN THE AREA USUALLY CONTAINED BY THE AIRCRAFT NOSE RADOME. DO NOT OPERATE THE WEATHER RADAR IN A HANGAR. IF YOU DO NOT OBEY THESE PRECAUTIONS, INJURIES TO PERSONNEL CAN OCCUR.

A. Remove G/S Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(2) Open nose radome and ensure that both supports latch securely in position.

(3) Disconnect and cap coax connectors.

(4) Remove antenna mounting screws.

(5) Remove antenna from aircraft.

WARNING: DO NOT OPERATE THE WEATHER RADAR WHEN PERSONNEL ARE IN THE AREA USUALLY CONTAINED BY THE AIRCRAFT NOSE RADOME. DO NOT OPERATE THE WEATHER RADAR IN A HANGAR. IF YOU DO NOT OBEY THESE PRECAUTIONS, INJURIES TO PERSONNEL CAN OCCUR.

B. Install G/S Antenna

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(2) Make sure that radome is open.

(3) Prepare the surface of the G/S antenna for RF bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(4) Install antenna assembly as follow: (Figure 201)

(a) Remove protective cap and check for damage and unwanted material.

1) Connect antenna coaxial cable connector.

(b) Place antenna in mounting position and install antenna mounting screws.

(5) Do the RF bonding check of the antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(6) Close and latch nose radome.

(7) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(8) Allow 3 minutes for equipment warm-up.

(9) Position signal generator forward of airplane with fully extended antenna broadside to G/S antenna in radome.

(10) Set AUDIO SELECTOR switch to GLIDESLOPE, NAV-GS switch to GS position, and MEGACYCLES control for output of 334.7 megahertz.

(11) On Captain's and First Officer's VHF NAV control panels, tune VOR frequency selector to 108.1 megahertz.

WJE 401-404, 412, 414, 875-879, 886, 887

(12) Rotate LOC-GS control to maximum up position on signal generator. Glideslope display pointers should move up on Captain's and First Officer's EFIS PFDs and Navigation Display (ND)s.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 891-893

(13) Rotate LOC-GS control to maximum up position on signal generator. Captain's and First Officer's glideslope pointers should move up on the ADI's and Horizontal Situation Indicator (HSI)'s. On aircraft with EFIS, glideslope indication will be displayed on ND and PFD.

WJE ALL

(14) Rotate LOC-GS control to maximum down position. Captain's and First Officer's glideslope pointers should move down.

(15) Set LOC-GS control to center position. Both glideslope pointers should center. G/S antenna is considered operable.

(16) Remove test equipment and return aircraft to required configuration.

VOR/ILS RECEIVER - MAINTENANCE PRACTICES

1. General

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

A. This maintenance practice provides removal/installation procedures for the VOR/ILS receivers. Two receivers are installed on the radio racks in the electrical/electronics compartment. Operation of each receiver is controlled by the VHF NAV control panel on the flight guidance control panel.

NOTE: Removal/installation procedures for both units are identical except for circuit breaker placarding.

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator 479T-2	Collins Radio Co.
Cossar 555	Cossar Mfg.
NOTE: During test procedures use applicable setup procedures for type of signal generator used.	

3. Removal/Installation ILS Receiver

A. Remove VOR/ILS Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1

(Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW (Counterclockwise) until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install VOR/ILS Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1

(Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW (Clockwise) until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

WJE 410 (Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 405-409, 411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
B	10	B10-26	GLIDESLOPE-1
WJE 410			
B	10	B10-22	VHF NAV-1
B	11	B10-26	GLIDESLOPE-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 415, 416, 418, 420, 422, 424-427, 429, 863, 864, 866, 868, 873, 874, 877, 880, 881, 883, 884, 891-893			
G	3	B10-28	GLIDESLOPE -2
WJE ALL			
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(7) Perform Autoland Preflight Test. (PAGEBLOCK 22-01-05/201 Config 1 or PAGEBLOCK 22-01-05/201 Config 3 or PAGEBLOCK 22-01-05/201 Config 6 or PAGEBLOCK 22-01-05/201 Config 4 or PAGEBLOCK 22-01-05/201 Config 5 or PAGEBLOCK 22-01-05/201 Config 10 or PAGEBLOCK 22-01-05/201 Config 11)

NOTE: Paragraph 4. is provided as an LRU functional check. The functional check may be performed at the mechanic's discretion to check the LRU before performing the Autoland Pre-Flight test. However, the criteria covered in the functional test are also covered in the Autoland Pre-Flight test.

4. Adjustment/Test VOR/ILS Receiver

A. Test Localizer Function

NOTE: Electronic Flight Instrument System (EFIS) must be operational for the following test.

(1) Set up Signal Generator to provide a localizer signal.

(2) Set both VHF NAV 1/VHF NAV 2 frequencies, on VHF NAV Control, to Signal Generator frequency.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(3) On flight guidance control panel, rotate course knob to center course pointer on Navigation Display (ND) under lubber line.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(4) On flight guidance control panel, rotate course knob to center course pointer on HSI under lubber line.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(5) At Signal Generator, rotate deviation control to left, Course deviation bar on ND and Primary Flight Display (PFD) should move to left.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(6) At Signal Generator, rotate deviation control to left, Course deviation bar on HSI and ADI should move to left.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(7) At Signal Generator, rotate deviation control to right, Course Deviation bar on ND and PFD should move to right.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(8) At Signal Generator, rotate deviation control to right, Course Deviation bar on HSI and ADI should move to right.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(9) Set deviation control pointer at center position, Course Deviation bar on ND should center itself over miniature airplane and PFD localizer pointer should center.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(10) Set deviation control pointer at center position, Course Deviation bar on HSI should center itself over miniature aircraft and ADI localizer pointer should center.

WJE ALL

B. Test Glideslope Function.

(1) Tune signal generator to applicable glideslope frequency and adjust to provide centered glideslope indication. Signal generator should be adjusted for maximum output.

(2) Adjust generator to provide an UP deviation and observe that glideslope pointers follow upward.

(3) Adjust generator to provide down deviation and observe that glideslope pointers follow down.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(4) At Captain's/First Officer's control panel, set control to an OFF channel Glideslope frequency. Glideslope indication should move upward to limit.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(5) At Captain's/First Officer's control panel, set control to an OFF channel Glideslope frequency. Glideslope Horizontal Bars should move upward to limit and Glideslope Flags should be fully masked.

WJE ALL

C. Test VOR Function

NOTE: During the following tests, alternately check the Captain's -1 and First Officer's -2 system using the applicable controls and instrument readings.

(1) Tune VHF NAV controls to a common frequency with signal generator, or local VOR TEST frequency.

WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872

(2) Turn sync knobs on both Compass Indicators (if installed) until both indicator cards read zero degrees.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 891-893

(3) Turn sync knobs on both Compass Indicators until both indicator cards read zero degrees.

WJE 401-404, 412, 414, 875-879, 886, 887

(4) If local VOR TEST frequency used, VOR pointers on RDMI should point towards known bearing of VOR station (±4) degrees.

WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872

(5) If local VOR TEST frequency used, VOR pointers on RMI/CI should point towards known bearing of VOR station (±4) degrees.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(6) If local VOR TEST frequency used, VOR pointers on CI should point towards known bearing of VOR station (±4) degrees.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(7) If signal generator is used, perform Paragraph 4.C.(8) and Paragraph 4.C.(9).

(8) Set signal generator VOR azimuth control to aircraft compass heading plus values as noted in following table, both VOR pointers should indicate as noted in the following table:

(9) Adjust course control until course deviation bar aligns with course error pointer on ND's, To-From arrow should indicate compass heading plus values as noted in the following table:

Table 202

555 Signal Generator (or equivalent) VOR Azimuth Control	479T-2 Signal Generator (or equivalent VOR Azimuth Control	Radio Distance Magnetic Indicator Pointer	Navigation Display (ND)	
			Course Setting	To-From Indicator
0°	180°	0°(±2.5°)	0°(±2.5°)	To
45°	225°	45°(±2.5°)	45°(±2.5°)	To
90°	270°	90°(±2.5°)	90°(±2.5°)	To
135°	315°	135°(±2.5°)	135°(±2.5°)	To
180°	0°	180°(±2.5°)	180°(±2.5°)	To
225°	45°	225°(±2.5°)	225°(±2.5°)	To
270°	90°	270°(±2.5°)	270°(±2.5°)	To
315°	135°	315°(±2.5°)	315°(±2.5°)	To
0°	180°	0°(±2.5°)	180°(±2.5°)	From

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(10) If signal generator is used, perform Paragraph 4.C.(11) and Paragraph 4.C.(12).

(11) Set signal generator VOR azimuth control to positions as noted in adjacent table, both VOR pointers should indicate as noted in the following table.

(12) Adjust course control until course deviation bar aligns with course error pointer on HSIs, To-From arrow should indicate as noted in the following table.

Table 203

555 Signal Generator (or equivalent) VOR Azimuth Control	479T-2 Signal Generator (or equivalent VOR Azimuth Control	Radio Distance Magnetic Indicator Pointer	Horizontal Situation Indicator	
			Course Setting	To-From Indicator
0°	180°	0(±4°)	0(±4°)	Upwards
45°	225°	45(±4°)	45(±4°)	Upwards
90°	270°	90(±4°)	90(±4°)	
135°	315°	135(±4°)	135(±4°)	Downwards
180°	0°	180(±4°)	180(±4°)	Downwards
225°	45°	225(±4°)	225(±4°)	Downwards
270°	90°	270(±4°)	270(±4°)	
315°	135°	315(±4°)	315(±4°)	Upwards

WJE ALL

(13) The following adjustment to VOR/ILS receiver is authorized upon experiencing audio bleedthrough:

(a) Adjust audio and sidetone output levels for 2.3 volts RMS ±10 percent across 600 ohm load using a VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.

5. Test Termination

A. Remove test equipment and return aircraft to required configuration.

VHF NAV CONTROL PANEL -- MAINTENANCE PRACTICES

1. General

A. Two VHF NAV control panels are located one each on the left and right side of the flight guidance control panel on the glareshield panel in the flight compartment.

B. Each panel contains a VHF NAV frequency control and a course set (CRS) control. The left panel provides VHF NAV tuning and course setting for the Captain's side and the right panel provides same for the First Officer's side.

C. The following Maintenance Practices provides Removal/Installation procedures for the VHF NAV control panels.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Signal Generator 479T-2 or Cossar 555	Collins Radio Co. Cossar Mfg.
Tool Kit 4037494	Sperry
4035956-1 Display	Sperry
4035956-3 Display	Sperry
NOTE: During test procedures, use applicable setup procedures for type of signal generator used.	

3. Removal/Installation VHF NAV Control Panel

A. Remove Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(2) Remove attaching screws that secure VHF NAV panel to glareshield; screws are located at bottom side of panel underneath glareshield, retain screws.

(3) Remove panel sufficiently from glareshield for access to electrical connector and disconnect connectors.

(4) Remove panel from glareshield.

(5) Install protective covering to aircraft and VHF NAV panel electrical connectors.

B. Install Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(2) Check electrical connector on VHF NAV panel and aircraft harness for damaged or dirty pins.

(3) Place panel in position in glareshield and connect aircraft electrical connector to panel.

(4) Slide panel into position in glareshield.

CAUTION: MAKE CERTAIN PANEL ATTACHING SCREWS ARE SAME LENGTH AS THOSE REMOVED IF ATTACHING SCREWS WERE NOT RETAINED. OVER LENGTH SCREWS WILL BOTTOM OUT IN CAP NUT AND CAUSE DAMAGE TO THE COMPONENT.

(5) Install panel attaching screws.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 886, 887, 891

(7) Perform return to service (RTS) test (SUBJECT 22-01-05, Page 201). If functional check required, perform Paragraph 4..

WJE 873, 874, 892, 893

(8) Perform return to service (RTS) test or autoland preflight test, (SUBJECT 22-01-05, Page 201). If functional check required, perform Paragraph 4..

WJE ALL

4. Check VHF NAV Panel Operation

A. Check Operation

(1) Set up signal generator to provide a localizer frequency.

(2) Tune VHF NAV frequency control to frequency of signal generator.

WJE 875-879, 886, 887

(3) Place Mode Select Switch on EFIS mode select panel in ROSE position.

(4) Adjust CRS control on panel until deviation bar on EFIS navigation display (ND) aligns with course pointer.

WJE 873, 874, 892, 893

(5) Adjust CRS control on flight guidance control panel until deviation bar on radio course indicator/horizontal situation indicator (navigation display (ND) on aircraft with EFIS) aligns with course pointer.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

(6) Adjust CRS control on flight guidance panel until deviation bar on horizontal situation indicator (navigation display (ND) on aircraft with EFIS) aligns with course pointer.

WJE ALL

(7) Rotate deviation control on signal generator to right, then left; deviation bar on course indicator should move correspondingly.

(8) Tune frequency control to a local VOR station or to a frequency as set on signal generator.

WJE 875-879, 886, 887

(9) Pointer on radio direction magnetic indicator (RDMI) should point to direction of VOR frequency source.

NOTE: On some aircraft a radio magnetic indicator (RMI) is used instead of an RDMI. The pointer on RMI should do the same as the RDMI.

WJE 873, 874, 892, 893

(10) Pointer on radio magnetic indicator/compass indicator should point to direction of VOR frequency source.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

(11) Pointer on compass indicator should point to direction of VOR frequency source.

WJE ALL

(12) Return aircraft to required configuration.

WJE 875-879, 886, 887

(13) Perform return to service (RTS) test (SUBJECT 22-01-05, Page 201). If functional check required, perform Paragraph 4..

WJE ALL

5. Removal/Installation Displays

A. Remove Displays

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name

WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(2) Remove display cover.

(3) Insert removal tool over display until tool engages slots in display.

(4) Pull tool straight out to disengage display from connector and remove display.

B. Install Displays

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1

(Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

CAUTION: EXERCISE CARE WHEN INSTALLING DISPLAYS SO AS NOT TO DAMAGE FACE OF DISPLAY WITH REMOVAL/INSTALLATION TOOL.

(2) Insert display in Removal/Installation Tool.

(3) Insert display straight into panel taking care to engage pins in connector.

(4) Carefully remove tool from display.

(5) Install display cover.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

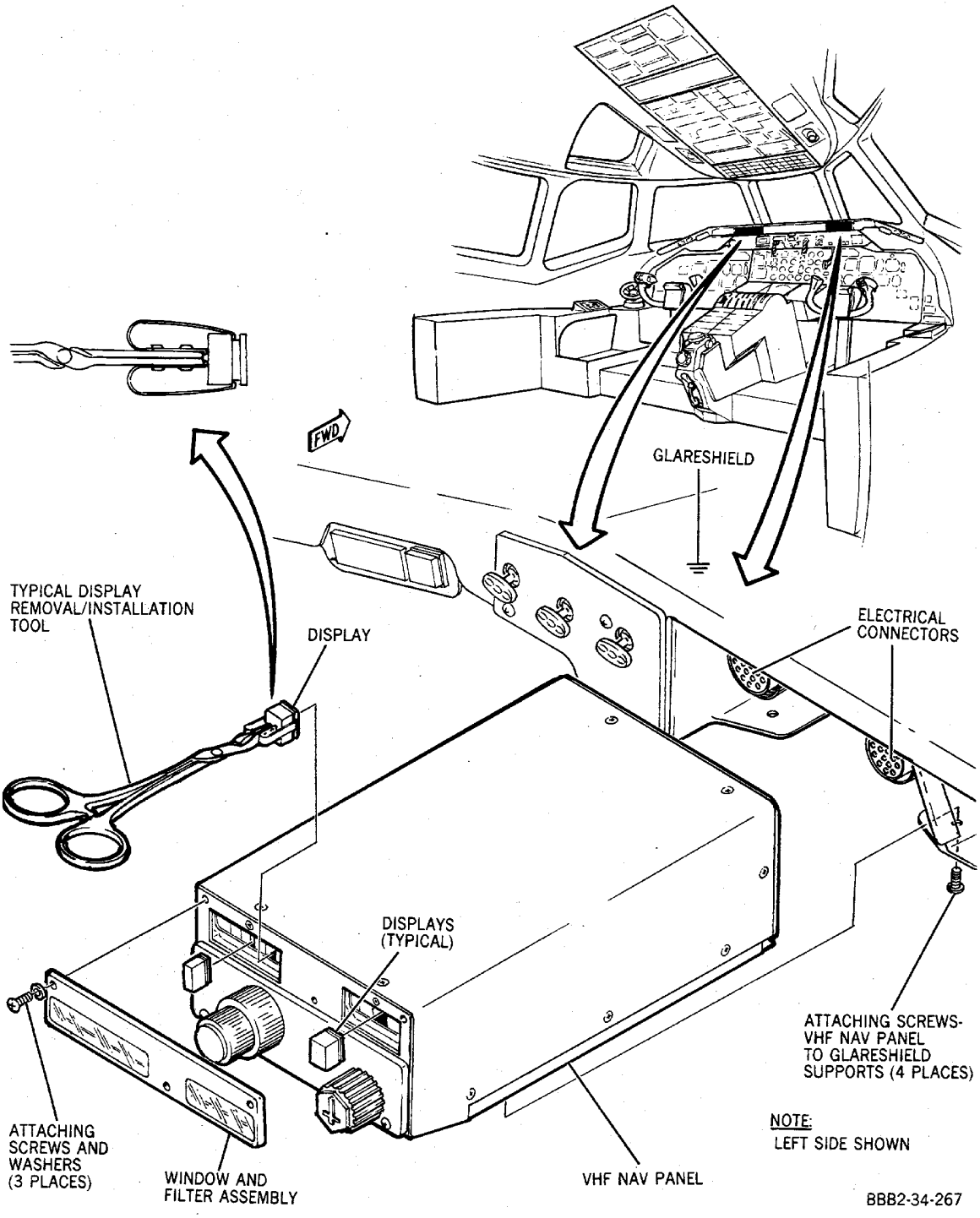
Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

(7) Rotate frequency control and CRS knob, Frequency displays and CRS displays should be on and change with tuning.

(8) Return aircraft to required configuration.



VHF NAV Panel Display -- Removal/Installation
Figure 201/34-32-03-990-802

NAVIGATION SWITCHING UNIT - MAINTENANCE PRACTICES

1. General

A. This Maintenance Practices provides Removal/Installation procedures for the Navigation Switching Unit. The Navigation Switching Unit is located in the forward right radio rack in the Electrical/ Electronics compartment.

2. Removal/Installation

A. Remove Navigation Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1
WJE 405, 409, 880, 884			
C	10	B10-162	NAV SWITCHING

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 881, 883, 884			
G	7	B10-24	VHF NAV-2

(2) Unscrew knurled holddown nut assembly at front of Navigation Switching Unit mounting tray and swing assembly down.

(3) Remove Navigation Switching Unit by pulling unit straight out of mounting tray, exercising care to not damage contact pins in unit or mounting tray electrical connectors.

B. Install Navigation Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1
WJE 405, 409, 880, 884			
C	10	B10-162	NAV SWITCHING

WJE 405, 409, 880, 884 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 881, 883, 884			
G	7	B10-24	VHF NAV-2

(2) Check Navigation Switching Unit and mounting tray electrical connector contact pins for loose, dirty, broken, or corroded pins.

(3) Position Navigation Switching Unit on mounting tray and slide unit straight into tray exercising care to properly mate the unit and tray electrical connectors. Make certain switching unit is fully engaged into mounting tray.

(4) Engage holddown nut assembly with lug on front of switching unit and tighten knurled holddown nut.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1
WJE 405, 409, 880, 884			
C	10	B10-162	NAV SWITCHING

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 881, 883, 884			
G	7	B10-24	VHF NAV-2

(6) Set RADIO NAV switch on overhead panel to NORM position, NAV lights on instrument panels should not be on.

(7) Place RADIO NAV switch to BOTH ON 1, NAV light on instrument panels should come on.

(8) Place RADIO NAV switch to BOTH ON 2, NAV light on instrument panels should come on.

(9) Place RADIO NAV switch to NORM position, both NAV lights should go off.

(10) Return aircraft to required configuration.

INDEPENDENT POSITION DETERMINING - DESCRIPTION AND OPERATION

1. General

A. This section describes that portion of equipment which provides navigation and flight safety information, and is completely independent from any ground station or ground control.

2. Weather Radar System

A. The weather radar system is provided primarily for the detection and display of storm fronts, heavy precipitation areas, or other turbulent weather. The system may be used as a navigation aid and can present a plan view of cities, rivers, islands, shorelines, and mountains.

3. Radio Altimeter System

A. The radio altimeter provides the pilots with accurate low-level altitude readings of the aircraft above the terrain for use in approach and automatic landing operations.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 891

4. INS/IRS/ISS (if installed)

A. The inertial reference system (IRS) provides accurate and reliable attitude, heading and navigation information for display on the EFIS primary flight display (PFDs) and navigation displays (NDs) as well as the radio distance magnetic indicators (RDMIs).

WJE 405-411, 873-881, 883, 884, 886, 887, 892, 893

5. Ground Proximity Warning

WJE 405-411, 873, 874, 880, 881, 883, 884, 886, 887, 892, 893

A. The Ground Proximity Warning System (when installed) provides the following advance notice of unsafe flight path relative to the ground:

Terrain closure rate Excessive rate of descent Descent in wrong configuration Descent after takeoff

WJE 875-879

B. The ground proximity warning system utilizes radio altimeter height, barometric rate and glideslope deviation informtion to determine close undue proximity with the ground and provides distinct audible and visual annunciations for unsafe flight paths relative to the ground.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 891

6. Ground Proximity Warning System

A. The ground proximity warning system utilizes radio altimeter height, barometric rate and glideslope deviation information to determine close undue proximity with the ground and provides distinct audible and visual annunciations for unsafe flight paths relative to the ground.

WJE 401-412, 414, 873-881, 883, 884, 886, 887, 892, 893

7. Collision Avoidance/TCAS (if installed)

A. When the traffic collision avoidance system (TCAS) is installed with the air traffic control system MODE S transponder, the added data link capability allows the ATC transponder to perform additional air traffic control and aircraft separation assurance functions.

WJE ALL

8. Windshear Alert and Guidance (if installed)

A. The windshear computer (WSC) receives attitude, acceleration and other information from the digital flight guidance computers (DFGC) and air data information from the central air data computers (CADC) to provide windshear (WS) detection warning and guidance during a windshear encounter.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The weather radar system provides the airplane Captain and First Officer with visual indication of storm conditions (weather mapping) and terrain mapping. Storm conditions can be indicated up to a range of 320 miles. This visual indication is depicted on the weather radar indicator located in the flight compartment center pedestal. The storm areas in the flight path of the airplane and the intensity of the storm are depicted on the indicator in colors of red, green, and yellow, (also magenta on some indicators). By observing the visual storm indications the Captain/F.O. can determine corridors of calm in the storm areas and maneuver the airplane through these corridors to provide safety of the airplane and passenger comfort.

WJE 416, 420, 422, 424-427, 429, 862, 868, 891

B. The weather radar system consists of a weather radar indicator, radar receiver transmitter, and the radar antenna. The components are described in the following Description paragraph.

WJE 407, 408, 411, 880

C. The weather radar system consists of a weather radar indicator, radar receiver transmitter, and the radar antenna. On aircraft with the Electronic Flight Instrument System (EFIS), weather radar is also displayed on the EFIS Navigation Displays (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 101). The components are described in the following Description paragraphs.

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 891

2. Description

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 862, 868, 880, 891

A. Receiver/Transmitter -- The weather radar receiver/transmitter is a completely solid state unit. It generates the microwave energy that is transmitted through the waveguides to the antenna for transmission. Reflected energy received by the antenna is transmitted to the R/T unit, processed and converted into digital signals which are sent to and displayed on the radar indicator as visual information. Seven annunciator lights and a TEST switch located on the front panel of the R/T unit provide a self test of the weather radar units. When the TEST switch is pressed, all lights should come on for approximately one second to verify integrity of the lights; when the TEST switch is released all lights should go denoting a good system. Any light remaining on, designates the faulty unit noted. The receiver/transmitter is located in the forward accessory compartment and is accessible through the nosewheel access door. The mounting tray in which the R/T unit is installed contains a fan for cooling of the R/T unit.

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 891

B. Radar Indicator -- The weather radar indicator provides a color display of weather and ground targets within the area scanned by the antenna. Digital processing enables presentation of several levels of rainfall density by using colors to display each level. The displays in the weather mode is as follows:

Green	Light precipitation
Yellow	Medium precipitation
Red	High precipitation
Black	Low or no precipitation
Magenta	Very heavy precipitation - Only applicable on certain indicators

In the MAP mode, displays are as follows:

Table 1

Green	Ground targets with low reflectivity (open ground, calm water)
Yellow	Medium reflectivity (Very rough water)
Red	High reflectivity (Cities)

All controls for operation of the weather radar system are located on the front of the radar indicator and are as follows:

Table 2

Control	Function
RANGE SELECTOR	Enables power to indicator in any range position and selects range position of 10/5 mile marks, 20/5 mile marks, 40/10 mile marks, 80/20 mile marks, 160/ 40 mile marks 320/80 mile marks.
BRT (Brightness Control)	Variable adjust for cockpit light conditions. During ground mapping mode, adjusts with control panel GAIN for best presentation.
Selector Switch	
OFF position	System made inoperative by interrupting the 28 volt supply.
WX position	Energizes the system for normal weather search operation and also energizes the contour function circuitry.
MAP position	Energize the system for normal weather search operation, except as follows:
TEST position	Test circuitry is energized and test pattern appears on the indicator. Antenna will not transmit unless antenna lock release button is activated.
Antenna Tilt Control	Antenna tilt control, calibrated in 5 degree increments, provides remote control of the antenna elevation and depression.
GAIN Control	
AUTO	Provides for manual control of the receiver gain. The gain is increased by a clockwise rotation of the control. The detented full clockwise position (AUTO) provides an automatic gain control function.
NOTE: The weather radar system is designed to operate with the gain control in the AUTO position. Manual gain adjustments may be used, as required, in the MAP position to improve resolution of selected targets or to distinguish prominent targets from surrounding terrain.	
STAB	When in OFF position, antenna will not be stabilized with respect to Gyro signals. The antenna will then rotate about the aircraft axis (as opposed to the vertical axis in the stabilized modes). The stabilization cut out feature allows near normal radar performance even though the gyro signals develop a malfunction.

C. Radar Antenna -- The weather radar antenna is located on the forward fuselage nose bulkhead and is accessible by opening and raising the aircraft nose radome. The antenna consists of a drive unit and flat plate array (reflector). The flat plate array is the means for radiating the pencil beam of rf energy and receiving the reflected signals for subsequent processing in the R/T unit and visual display on the radar indicator. On aircraft with EFIS, signals processed by the R/T unit are sent to the EFIS symbol generator for subsequent display on the EFIS ND. The drive unit consists of an azimuth drive motor, tilt drive motor, an azimuth position synchro, and an elevation position synchro and moves the flat plate array in a 180 degree (90°L, 90°R) azimuth scan and a 45 degree (22-1/2° up, 22-1/2° dn) elevation scan. The antenna can be manually tilted +/ - 15 degrees from the horizontal (zero degrees) and is stabilized over a combined tilt, pitch, and roll input of +/ - 45 degrees.

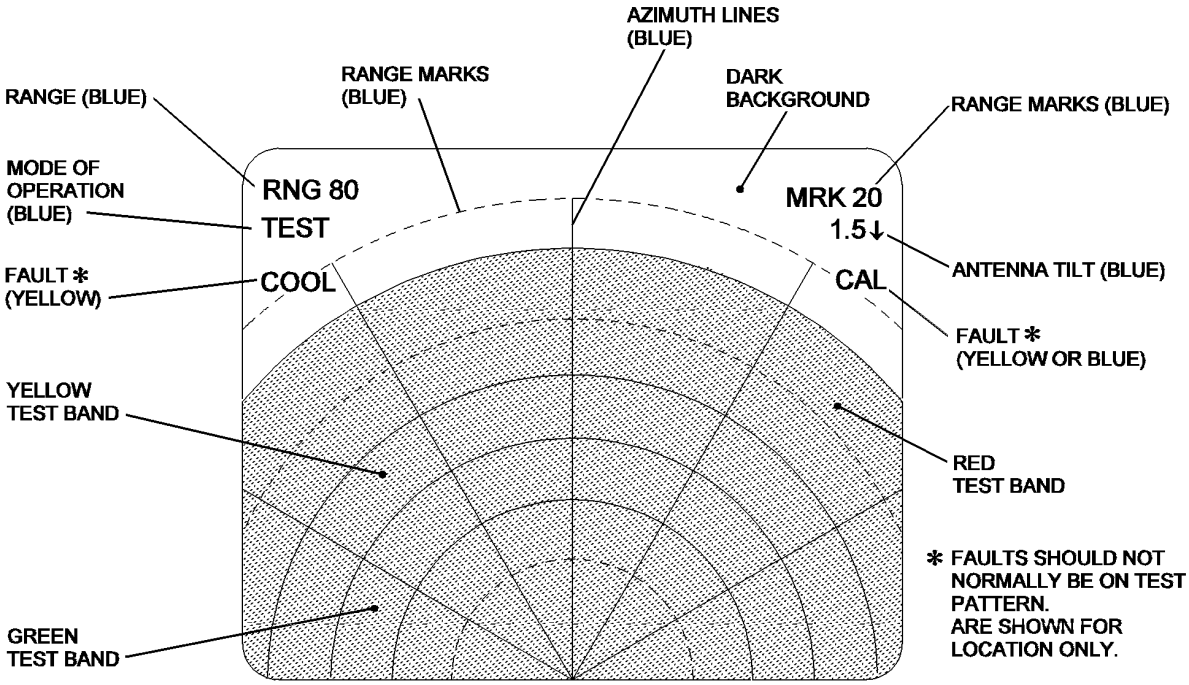
WJE 407, 408, 411, 880

D. Weather Radar Display on the EFIS (aircraft with EFIS) - Weather radar data may be displayed on the Electronic Flight Instrument System (EFIS), when the EFIS Mode Select switch on the EFIS Mode Select Panel (MSP) is in the ARC position. The WXR display is turned on using the WXR BRT knob on the EFIS Control & Dimming Panel (CDP). Turning the knob clockwise will increase WXR display brightness. Turning the knob fully counterclockwise, past the detent position, will turn the display off. A WXR OFF message will appear on the ND display screen whenever the WXR BRT knob is off.

(1) The range selected on the EFIS CDP should match the range selected on the WXR indicator, or a miscompare will occur. The half-range is displayed halfway between the aircraft symbol and the periphery of the arc. This number will be one-half the range selected on the EFIS and WXR range switches. The display colors on the EFIS are the same as those used on the indicator.

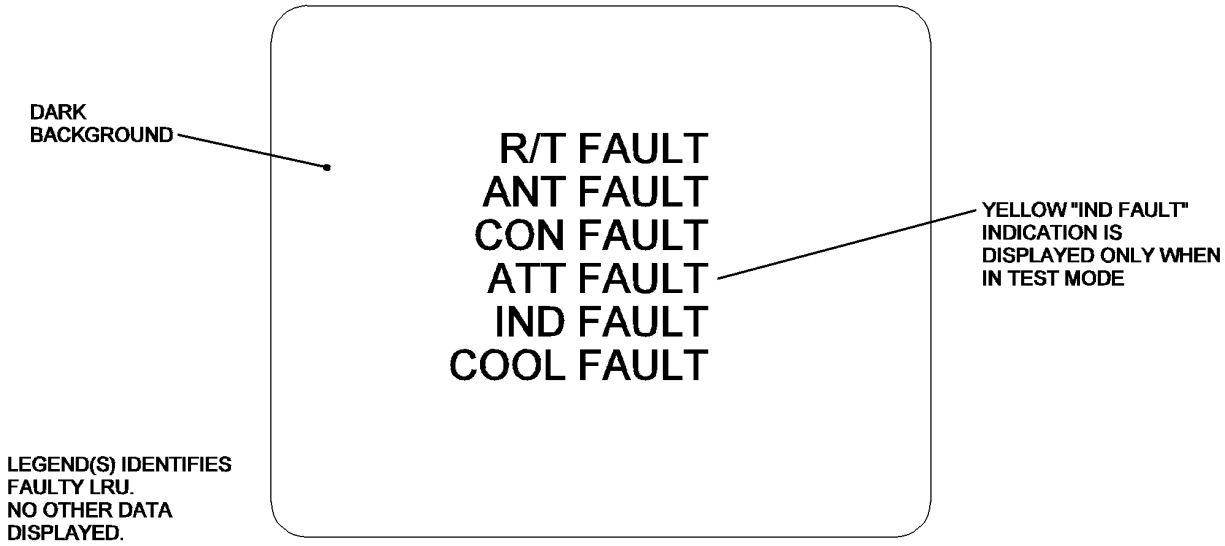
(2) There are two types of WXR messages which may appear on the ND. The first type occurs when the WXR mode is lost: WXR OFF, TEST, FAIL and RANGE. When these messages appear on screen, the WXR display itself is lost. The second type of message appears along with the WXR display (mode is not lost): WXR TILT, VAR, CAL, ATT and STAB. Antenna tilt angle (WXR TILT X.X degrees) appears only momentarily on screen, whenever tilt angle is changed.

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 891



TEST PATTERN

NOTE:
MAGENTA AREA ALSO APPEARS ON THE CENTER OF THE INDICATORS, IF THE SYSTEM HAS TURBULENCE CAPABILITY.



TEST MODE FAULT DISPLAY

BBB2-34-294C
S0006546568V2

Test Pattern and Fault Display
Figure 1/34-41-00-990-855

3. Operation

A. The weather radar system operates by emitting very short intense pulses of microwave energy which are reflected by objects within the range of the system provided they have reflective characteristics. This reflected energy is picked up by the radar antenna and sent to the R/T unit. The signal is then amplified, detected, and converted into digital signals which are routed to the ND indicators. In the indicator, the digital signals produce visual indications that are representative of the size, intensity, bearing and distance of the target that reflected the radar signal.

WJE 407, 408, 411, 880

(1) On aircraft with EFIS, WXR data is transmitted from the R/T unit to the EFIS Symbol Generator (SG). The WXR scan converter converts the color WXR signals to a format suitable for display on the ND. The scan converter accepts or rejects incoming data (based on presence and validity), monitors inputs, and issues caution messages Ref. 34-22-00, Page 1.

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 891

B. In the weather mapping mode of operation, the visual indications on the radar indicator provide distinct levels of rainfall density by using three (four on some indicators) different colors.

C. The maximum range of the weather radar is dependent upon many factors of which the most important are: antenna gain, beam width of radiated energy, transmitter power, pulse width, prf, noise figure, receiver gain, radome, and interconnecting waveguide.

D. Weather Mapping

(1) The radar system provides storm detection up to a distance of approximately 320 nautical miles under defined penetration environment.

(2) Cloud formations having less moisture content than is required to reflect a minimum discernible echo signal will not appear on the ND indicators display.

(3) The color presentation gives immediate indication of the location of severe storm areas; these areas might contain air turbulence which should be avoided.

E. Ground Mapping

(1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the ND indicators in slant range and in azimuth bearing with respect to the heading of the aircraft.

(2) Of prime importance is the extension of the range of vision of the Captain/F.O. and ability to see this terrain map even during darkness and overcast conditions when visibility is restricted. The display in ground mapping resembles a pilotage chart and is easily interpreted. Cities, open ground, and bodies of water are distinguished by the intensity of the signals they reflect back to the antenna. Cities usually provide the most intense reflections; open ground and water provide progressively less intense reflections. Calm water reflects very little signal back to the antenna, very rough water provides a signal return of considerable strength.

4. Test and Fault Indication

A. Fault isolation of the weather radar system can be performed by observing the display on the indicator or by observing the fault annunciator LEDs on the receiver/transmitter unit.

B. The microprocessor based monitor system in the receiver/transmitter unit checks and/or compares selected voltages/signals during each program loop. If these checks or comparisons reveal any abnormality, one or more fault legends are displayed on the indicator. On aircraft with EFIS, WXR faults detected by the Symbol Generator will be displayed on the EFIS Navigation Display Ref. 34-22-00, Page 1. Also the annunciator control circuit stores the fault information. For display of fault legends, reference Figure 1. IND FAULT will be annunciated only when the selector switch is in the TEST mode.

C. If there is a fault in one or more LRUs the appropriate LED on the front panel of the R/T unit will remain on when the TEST switch on the R/T unit is pressed. When the TEST switch is initially pressed and held, all the LEDs will come on for approximately one second to denote integrity of the LEDs. The LEDs are as follows:

R/T ---------- Receiver/Transmitter

ANT --------- Antenna

IND ---------- Indicator

CON -------- Control Panel

WG SW ---- Waveguide Switch

GYRO ------ Gyro

AIR ---------- Cooling

NOTE: Control panel and waveguide switch not applicable to aircraft configuration.

WJE 416, 420, 422, 424-427, 429, 862, 868, 891

D. When system is in Test Mode, a good test pattern look like the one in Figure 1, except for CAL (out of calibration) and COOL (cooling malfunction) fault displays, which are shown for location only.

WJE 407, 408, 411, 880

E. When system is in Test Mode, a good test pattern look like the one in Figure 1, except for CAL (out of calibration) and COOL (cooling malfunction) fault displays, which are shown for location only. The test pattern display on the EFIS ND (aircraft with EFIS) will be identical to the display on the indicator. The WXR TEST function remains under the control of the WXR receiver.

WJE 407, 408, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 891

5. To Operate System

WARNING: MAKE SURE YOU DO NOT OPERATE RADAR DURING REFUELING OPERATIONS OR NEAR TRUCKS OR CONTAINERS THAT CONTAIN FLAMMABLE OR EXPLOSIVE LIQUIDS. THIS WILL PREVENT INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

A. Preparation

(1) Set BRT control on radar indicator fully counterclockwise.

(2) Set mode selector control to 160 miles.

(3) Adjust TILT control to 10 degrees UP.

(4) Set GAIN control to AUTO position.

(5) Set mode selector to TEST position.

(6) Adjust BRT control for a convenient viewing level.

(7) Observe test pattern on indicator; a satisfactory pattern indicates an operational system.

(8) After 3 minutes from initial turn-on the transmitter will be operative and test pattern should not change.

(9) Set mode selector to desired mode of operation.

(a) WX, for normal weather search operation.

(b) MAP, for ground mapping function.

(10) To shut down system, place control panel function switch in OFF position.

WJE 407, 408, 411, 880

B. Preparation (on aircraft with EFIS)

WARNING: MAKE SURE YOU DO NOT OPERATE RADAR DURING REFUELING OPERATIONS OR NEAR TRUCKS OR CONTAINERS THAT CONTAIN FLAMMABLE OR EXPLOSIVE LIQUIDS. THIS WILL PREVENT INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(1) Make sure that EFIS Symbol Generator and Navigation Display circuit breakers are closed.

NOTE: Failure messages will appear on screen if all EFIS related circuit breakers are not closed (Ref. 34-22-00, Page 201).

(2) Place mode select switch on EFIS Mode Select Panel (MSP) in ARC position.

(3) Place range select switches on EFIS MSP and on WXR indicator at 160 miles.

(4) Adjust TILT control to 10 degrees UP.

(5) Set GAIN control to AUTO position.

(6) Set mode selector on WXR indicator to TEST position.

(7) Adjust BRT control on EFIS ND, from Control & Dimming Panel WXR BRT knob, to a comfortable viewing level.

(8) Observe test pattern on EFIS ND; a satisfactory pattern indicates an operational system.

(9) After 3 minutes from initial turn-on, the transmitter will be operative and test pattern should not change.

(10) Set mode selector on WXR indicator to desired mode of operation.

(a) WX, for normal weather search operation.

(b) MAP, for ground mapping function.

(11) To shut down system, place control panel function switch in OFF position.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The weather radar system furnishes continuous enroute weather information relative to rainfall rate, thunderstorms, and areas of storm turbulence and icing conditions. The system provides the pilot with a display of storm conditions at extended ranges (maximum display range setting is 250 nautical miles). The area of radar surveillance is 180 degrees of azimuth (90 degrees right and left of airplane heading) and 30 degrees of pitch (15 degrees above and below the stabilized horizontal). The major system components are the antenna assembly, receiver-transmitter, and indicator. The system incorporates built-in test and monitor circuitry to provide system performance checks on the ground and in the air.

B. Antenna - The radar antenna is located in the radome covered portion of the airplane nose section. The antenna provides both a transmitting and receiving function while scanning the 180 degree azimuth arc at a 15 look per minute rate. The antenna tilt angle, variable through the 30 degree pitch arc, determines the azimuth plane scanned. Antenna stabilization is provided to compensate for airplane pitch and roll and maintains the antenna beam on a horizontal plane (as referenced to ground) or at a predetermined angle of tilt from the horizontal plane. The stabilization is accomplished by the vertical gyro pitch and roll information being processed and the tilt command signals from the manual tilt control. These are utilized to introduce corresponding changes to the antenna rotation planes. The antenna flat plate phased array radiator projects a beam for the weather mapping or ground surveillance functions. Ground surveillance is accomplished by pitching the antenna downwards with the manual tilt control. The stabilization circuitry is located in the receiver-transmitter unit. The pitch and roll stabilization assemblies, tilt assemblies, azimuth assemblies, and the waveguide assembly is contained within the antenna pedestal and linkage housing.

C. Receiver-Transmitter - The receiver-transmitter (R/T) provides the processing of all weather radar data, control and rf processes. It also provides supervision of antenna behavior and stabilization, and provides the processed data for the indicator. The R/T produces the microwave signals, processes the received return signals and generates the digital word used by the display unit to create the crt image. The signal produced is in the weather radar X-band. The following controls and indicators are located on the front panel of the R/T:

Table 1

Control	FUNCTION
OVERTEMPERATURE indicator	When set, indicates an overtemperature condition has occurred and that external cooling system should be checked. Indicator is manually reset.
RESET pushbutton	Resets the overtemperature indicator.
TIME indicator	Indicates elapsed operating time in hours.

D. Indicator - The indicator is a color weather radar indicator that provides a constant, nonfading display of all detectable targets within the scan angle and range selected. The indicator can display ground maps or weather maps. The controls for the indicator are as follows:

WJE 406

Table 2

Control	FUNCTION
INT control	Controls the brightness of entire crt display. The intensity control is augmented by a photocell dimming system which controls crt brightness, due to lighting conditions. Clockwise rotation of the control will cause the display brightness to increase.
MKR intensity control	The MKR controls the brightness of the range circles and azimuth lines/ticks (relative to the overall crt brightness). Clockwise rotation of the MKR control will increase the brightness of the range circles and azimuth lines/ticks.
PWR pushbutton	System power is applied by depressing the mechanically latching PWR pushbutton. Depressing the PWR pushbutton a second time will cause it to unlatch and remove system power.
STAB pushbutton	When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for aircraft pitch and roll. When not engaged, antenna aligns to aircraft attitude.
LFT/FWD/RGT pushbuttons	Left, forward, and right pushbuttons select the view desired by depressing the appropriate pushbutton. Depressing the LFT pushbutton displays a left view with the origin at the bottom right of the crt. Depressing the RGT pushbutton displays the right view with the origin at the bottom left of the crt. Depressing the FWD pushbutton displays the forward view with the origin at bottom center of the crt. The indicator automatically powers on to the forward view.
HOLD	Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.
RNG pushbutton	The indicator automatically powers on to a preselected range. Depressing any of the other range pushbuttons causes that range to be selected. Range is displayed in the top right corner of the display.
MODE controls	The indicator powers on to the selected mode of operation. The top left corner of the crt displays the system mode.
TEST pushbutton	Depressing the TEST pushbutton activates the test mode for the system and causes the following to occur:
	a. The transmitter is enabled for less than 1 second and then muted for the remaining portion of the test.
	b. The indicator displays a test pattern containing three concentric arcs consisting of one color each: red, yellow, and green, from top to bottom.
	c. The antenna system performs a test sequence, ending with the antenna stopping at the boresight (electrical zero) position. During the test sequence the actual elevation angle will be displayed on the indicator.
WX pushbutton	Depressing the WX pushbutton activates the weather mode within the receiver-transmitter.

WJE 406 (Continued)

Table 2 (Continued)

Control	FUNCTION
WX/T	(Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed, but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will by WX+T).
MAP pushbutton	Depressing the MAP pushbutton activates the ground map mode within the receiver-transmitter.
GCS pushbutton	Provides Ground Clutter Suppression when in WX mode. IDNT message is displayed. Any mode or range change will deactivate IDNT mode.
MAP GAIN control	The system gain is controlled in the MAP mode by rotating the GAIN control through its ten detented positions. Counterclockwise rotation decreases the gain.
TILT control	Antenna tilt position is controlled by the TILT control. The tilt range is from 15° DOWN to 15° UP.

WJE 886, 887, 892, 893

Table 3

Control	FUNCTION
INT control	Controls the brightness of entire crt display. The intensity control is augmented by a photocell dimming system which controls crt brightness, due to lighting conditions. Clockwise rotation of the control will cause the display brightness to increase.
MKR intensity control	The MKR controls the brightness of the range circles and azimuth lines/ticks (relative to the overall crt brightness). Clockwise rotation of the MKR control will increase the brightness of the range circles and azimuth lines/ticks.
PWR pushbutton	System power is applied by depressing the mechanically latching PWR pushbutton. Depressing the PWR pushbutton a second time will cause it to unlatch and remove system power.
WJE 892, 893	
STAB pushbutton	When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for aircraft pitch and roll. When not engaged, antenna aligns to aircraft attitude.
SPRS pushbutton switch	Suppresses the ground return when in the WX mode of operation.

WJE 892, 893 (Continued)

Table 3 (Continued)

Control	FUNCTION
WJE 886, 887, 892, 893	
LFT/FWD/RGT pushbuttons	Left, forward, and right pushbuttons select the view desired by depressing the appropriate pushbutton. Depressing the LFT pushbutton displays a left view with the origin at the bottom right of the crt. Depressing the RGT pushbutton displays the right view with the origin at the bottom left of the crt. Depressing the FWD pushbutton displays the forward view with the origin at bottom center of the crt. The indicator automatically powers on to the forward view.
HOLD	Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.
WJE 892, 893	
RNG pushbutton	The indicator automatically powers on to a preselected range. Depressing any of the other range pushbuttons causes that range to be selected. Range is displayed in the top right corner of the display.
WJE 886, 887	
RANGE pushbutton	The indicator automatically powers on to a preselected range. Depressing any of the other range pushbuttons causes that range to be selected. Range is displayed in the top right corner of the display.
WJE 886, 887, 892, 893	
MODE controls	The indicator powers on to the selected mode of operation. The top left corner of the crt displays the system mode.
WJE 886, 887	
AZ pushbutton	Spaces azimuth ticks on range rings 30 degrees apart.
WJE 886, 887, 892, 893	
TEST pushbutton	Depressing the TEST pushbutton activates the test mode for the system and causes the following to occur:
a.	The transmitter is enabled for less than 1 second and then muted for the remaining portion of the test.
b.	The indicator displays a test pattern containing three concentric arcs consisting of one color each: red, yellow, and green, from top to bottom.
c.	The antenna system performs a test sequence, ending with the antenna stopping at the boresight (electrical zero) position. During the test sequence the actual elevation angle will be displayed on the indicator.
WX pushbutton	Depressing the WX pushbutton activates the weather mode within the receiver-transmitter.

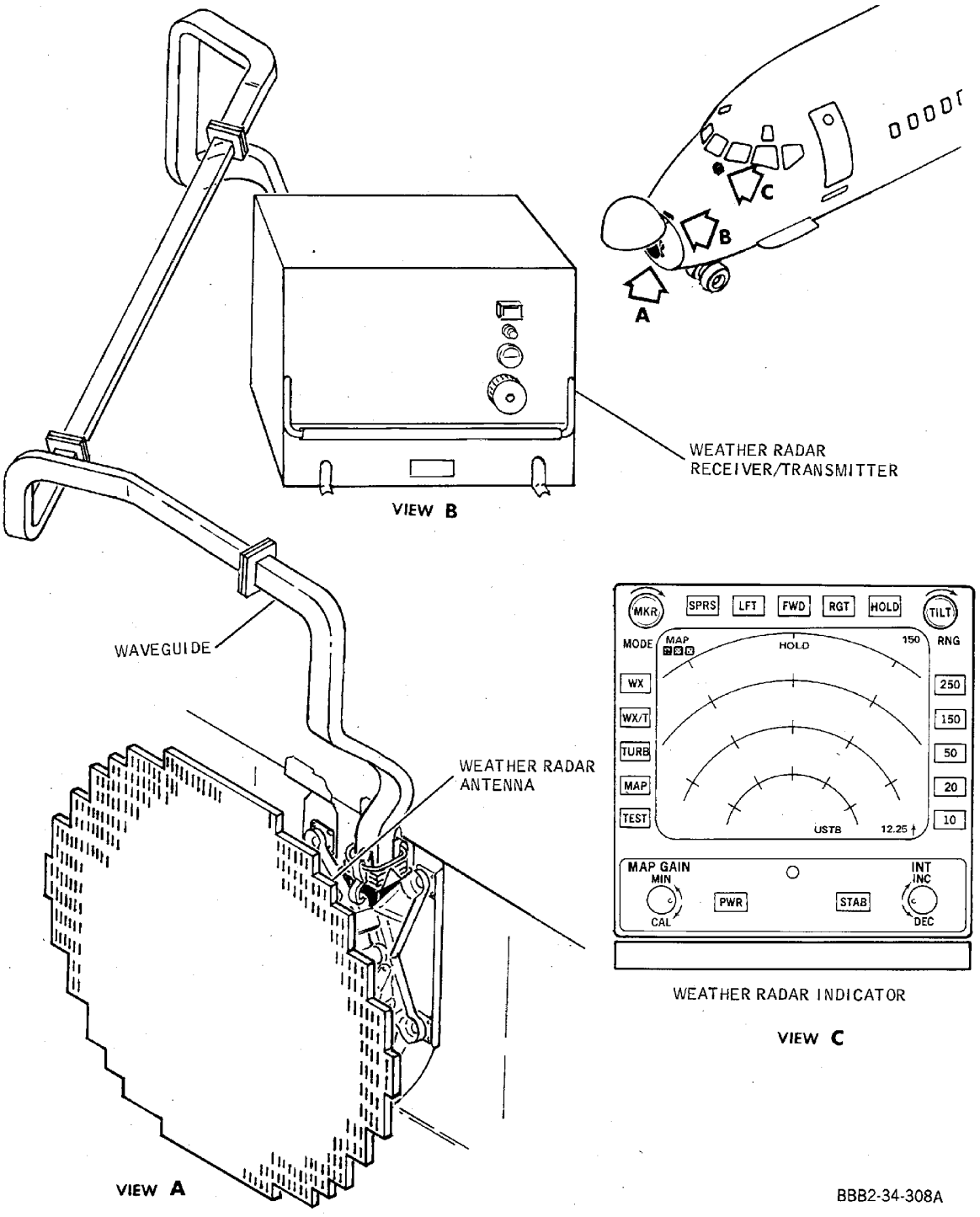
WJE 886, 887, 892, 893 (Continued)

Table 3 (Continued)

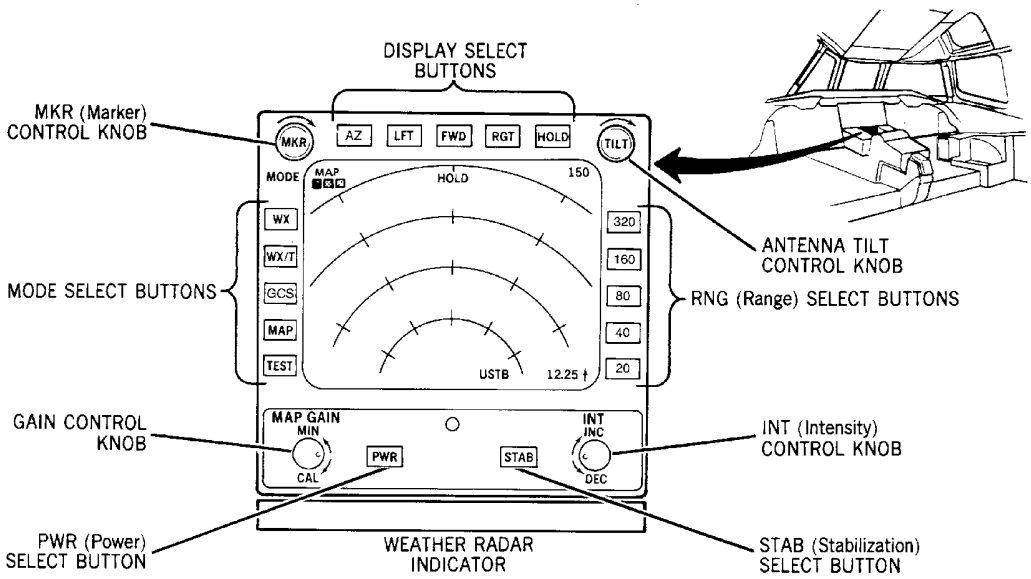
Control	FUNCTION
WX/T	Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will by WX+T).
WJE 892, 893	
TURB	Distance of 50 miles or less, Turbulence only is displayed. Mode select message will be TURB.
WJE 886, 887, 892, 893	
MAP pushbutton	Depressing the MAP pushbutton activates the ground map mode within the receiver-transmitter.
WJE 886, 887	
GCS pushbutton	Provides Ground Clutter Suppression when in WX mode. IDNT message is displayed. Any mode or range change will deactivate IDNT mode.
WJE 886, 887, 892, 893	
MAP GAIN control	The system gain is controlled in the MAP mode by rotating the GAIN control through its ten detented positions. Counterclockwise rotation decreases the gain.
TILT control	Antenna tilt position is controlled by the TILT control. The tilt range is from 15° DOWN to 15° UP.

WJE 406, 886, 887, 892

E. Weather radar indications can also be displayed on the Electronic Flight Instrument Navigation Displays (NDs), refer to NAVIGATION DISPLAYS, SUBJECT 34-22-00, Description and Operation.



Weather Radar - System Components
Figure 1/34-41-00-990-890



Weather Radar Controls

MODE Select Buttons – Desired mode is activated by pushing applicable button. When another mode is selected, previously selected mode is deactivated.

WX – Weather is displayed on the indicator (red represents areas of high density precipitation; yellow represents areas of lower density precipitation; green represents areas of light precipitation; black represents areas of extremely low precipitation). Automatic turbulence function is inhibited. Mode select message will be WX.

WX/T – Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will be WX+T.

If WX/T is selected and weather display only, without turbulence display, is desired (distance of 50 miles or less), deselect turbulence by pushing WX button. Mode select message will be WX.

If WX/T is selected and turbulence display only, without weather display, is desired (distance of 50 miles or less), deselect weather by pushing TURB button. Mode select message will be TURB.

GCS – Ground Clutter Suppression.

MAP – Ground mapping is displayed (yellow represents targets with high reflectivity; green represents targets with low reflectivity; black represents targets with extremely low reflectivity). Mode select message will be MAP.

TEST – Initiates self-test of system. Mode select message will be TEST.

MKR (Marker) Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Display Select Button – Desired function is activated by pushing applicable button.

AZ – Azimuth ticks on range rings spaced 30 degrees apart.

LFT – Radar scans area to the left of area directly ahead of airplane.

FWD – Radar scans area directly ahead of airplane.

RGT – Radar scans area to the right of area directly ahead of airplane.

HOLD – Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.

INT Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

Range Select Buttons – Pushing applicable button selects 10, 20, 50, 150, or 250 nautical miles range. Selected range is displayed on range readout.

Antenna TILT Control Knob – Rotate as necessary to tilt antenna UP or DN for desired radar scanning. Antenna tilt readout displays antenna tilt angle selected. Tilt limits are from 15° UP to 15° DN in 0.25° increments.

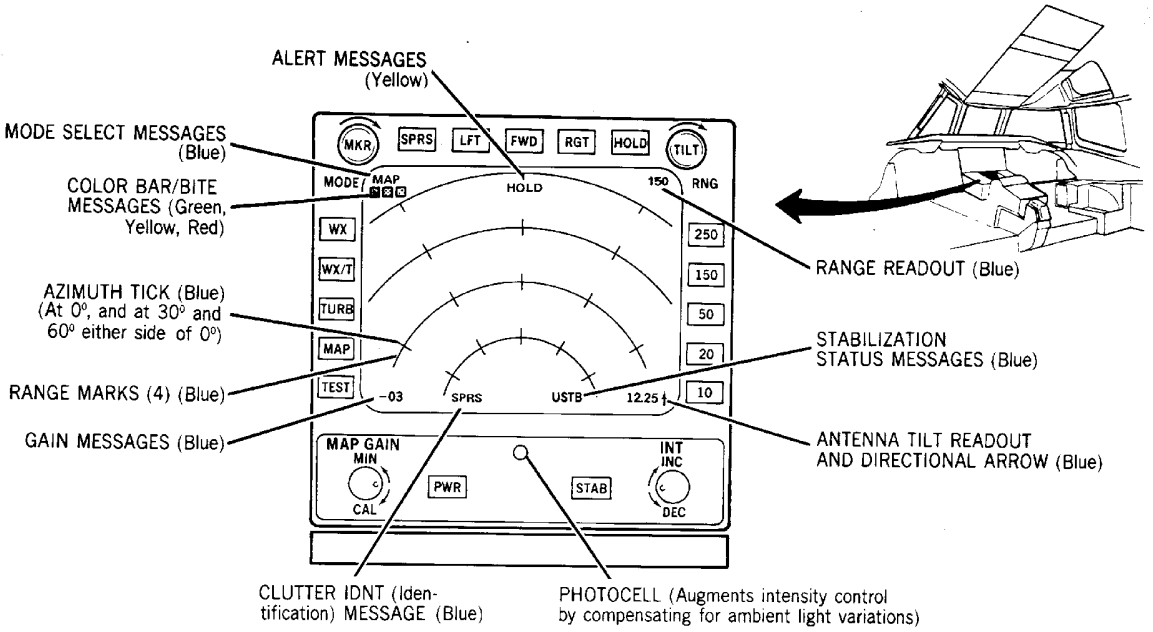
STAB Select Button – When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for airplane pitch and roll. When not engaged, antenna aligns to airplane attitude.

PWR Button – Pushing button applies power to system. Pushing button a second time removes system power.

MAP Gain Control Knob – System gain is controlled in MAP mode by rotating knob counterclockwise to decrease gain. Gain control in weather mode is automatic.

BBB2-34-1235

Weather Radar Indicator - Controls
Figure 2/34-41-00-990-891



WEATHER RADAR INDICATOR

Weather Radar Messages and Readouts

Alert Messages – Messages annunciated are HOLD, WEAK, FAIL, WX-P, and WX-T.

HOLD – Annunciates (flashing) when HOLD Mode is selected. Should hazardous weather be detected when in HOLD mode, an alert message, WX-T or WX-P will annunciate alternately with HOLD annunciation.

WEAK – Annunciates (flashing) when the system detects a loss of calibration.

FAIL – Annunciates (flashing) when the system detects LRU failure.

Range Readout – Digital readout of range (10, 20, 50, 150, or 250 nautical miles) as selected with applicable RNG select button.

Antenna Tilt Readout – Digital readout of antenna tilt angle from 15° up to 15° down, in 0.25° increments, selected with antenna TILT knob. Directional arrows indicate ↑ (up) or ↓ (down) as applicable.

Stabilization Status Messages – Messages annunciated to indicate status of antenna stabilization are USTB, ATT, and SAT.

USTB – Annunciates when unstabilized condition exists.

ATT – Annunciates (flashing) when operating in STAB mode to indicate that an attitude input failure has occurred.

SAT – Annunciates when operating in STAB mode to indicate that system stabilization has reached saturated limits, generally due to unusual attitude maneuvers.

SPRS Message – Ground clutter is suppressed (reduction of ground return intensity) when in WX mode. Continuous operation in SPRS mode is not recommended because some precipitation returns may also be reduced in intensity.

Gain Messages – Annunciation of messages for system gain setting (MAP mode only) selected with GAIN control knob. Messages displayed are as follows:

MAX – Displayed to indicate maximum gain is selected (GAIN control knob rotated full clockwise).

-01,-02, -03,-04, -05,-06, or -07 – Displayed to indicate progressive decreased gain as GAIN control knob is progressively rotated counterclockwise toward MIN (minimum) gain, or progressive increased gain as GAIN control knob is progressively rotated clockwise toward CAL (maximum) gain.

MIN – Displayed to indicate minimum gain is selected (GAIN control knob rotated full counterclockwise).

Color Bar/BITE Messages – A three-color bar (left to right – green, yellow, red) is normally displayed below the mode select message. If a system detected LRU fault occurs, a three-character BITE message will be displayed (first character in green; second character in yellow; and third character in red). BITE messages are T/R (indicates transmitter/receiver fault), ANT (indicates antenna fault), CTL (indicates control fault), and IND (indicates an indicator fault).

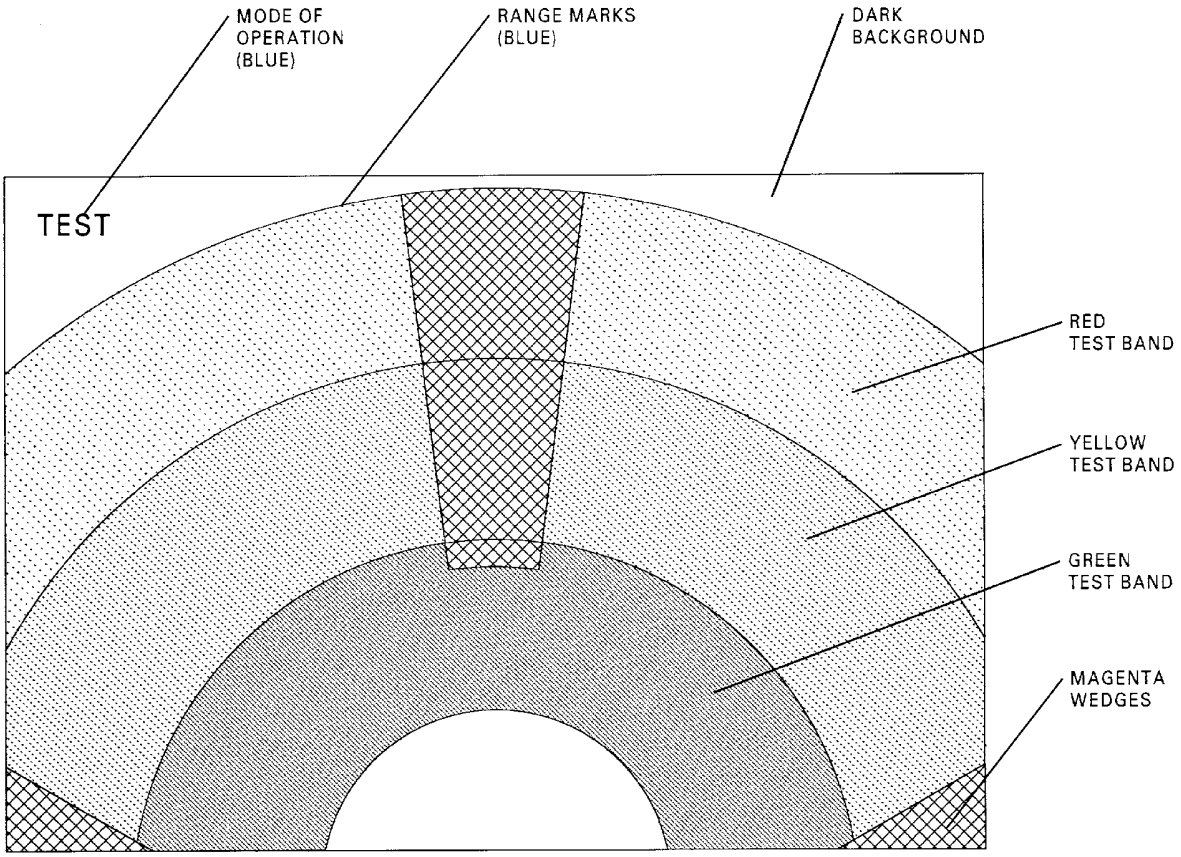
Should a failure affecting color occur, the message slot will identify the modified color scheme.

Mode Select Messages – Annunciation (WX, MAP, or TEST) as selected with applicable MODE select button.

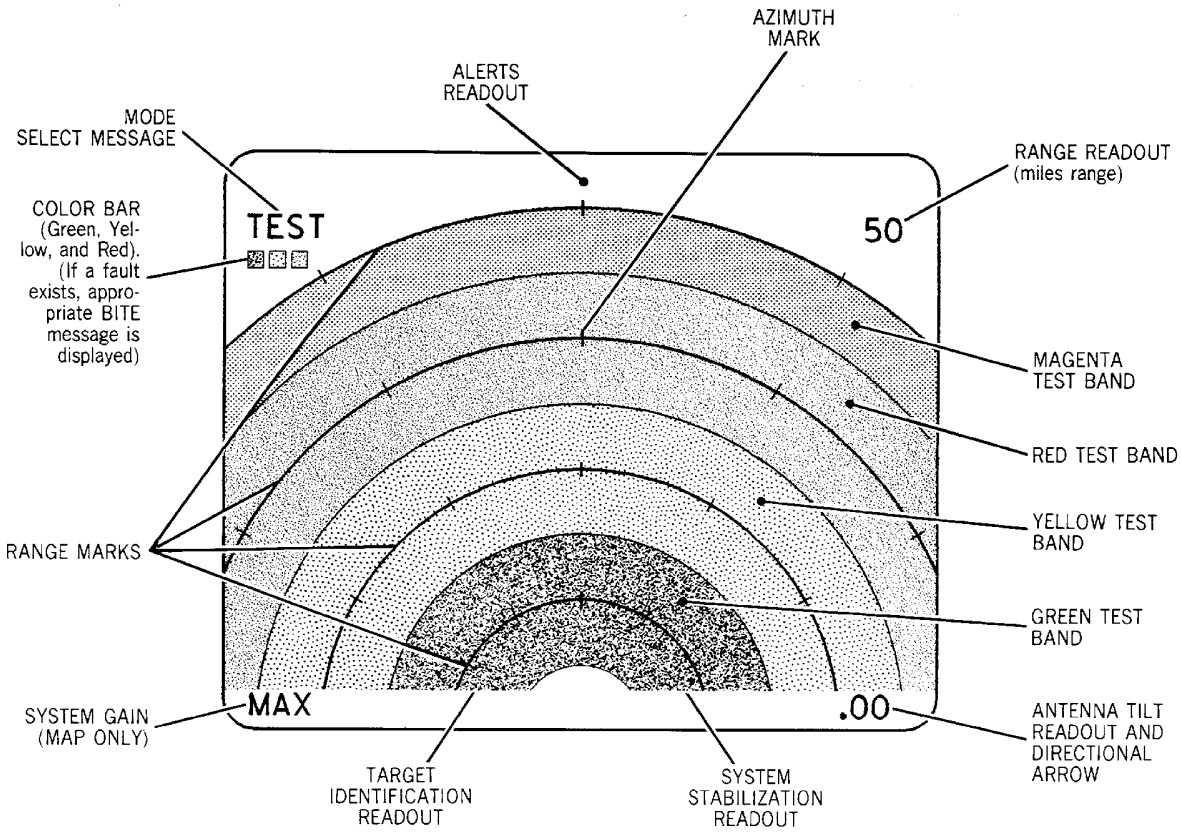
Range Marks – Four range marks for each selected range (increments of 2.5 miles for 10 miles range; increments of 5 miles for 20 miles range; increments of 12.5 miles for 50 miles range; increments of 37.5 miles for 150 miles range; and increments of 62.5 miles for 250 miles range).

BBB2-34-309B

Weather Radar Indicator - Annunciations
Figure 3/34-41-00-990-892



Weather Radar Indicator - Test Pattern
Figure 4/34-41-00-990-893



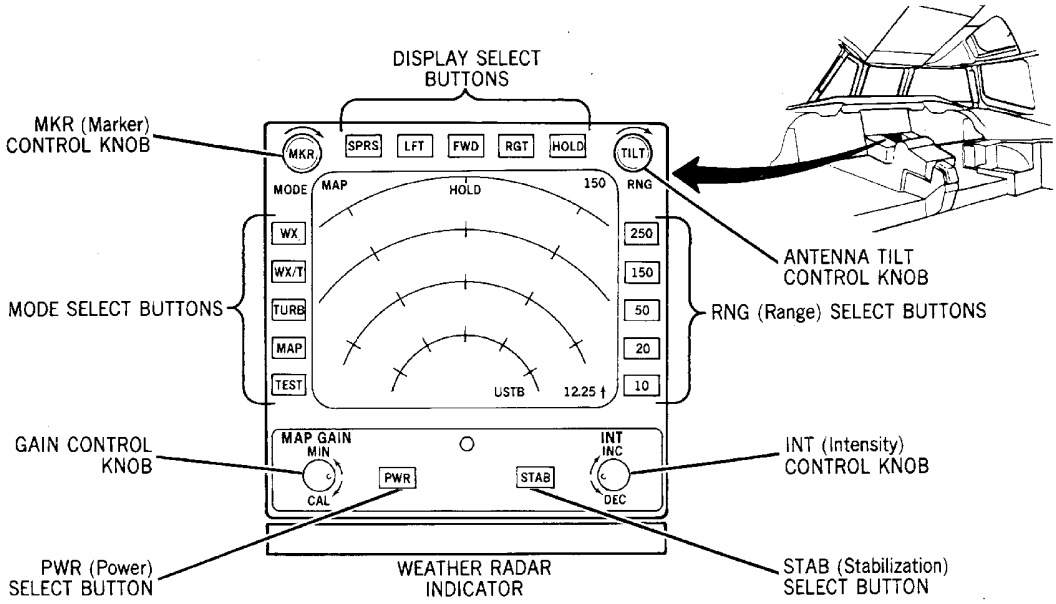
TYPICAL RADAR TEST PATTERN

WEATHER RADAR PREFLIGHT TEST PROCEDURE

1. Verify following on display:
   a. Antenna tilt readout automatically cycles to 15.00↑ to 15.00↓ and then stabilizes at 0.00.
   b. Four distinct color bands (green, yellow, red, and magenta) are displayed as shown above on typical radar test pattern.
   c. Mode select message annunciates TEST.
   d. Color bar (green, yellow, red) is displayed. No BITE (fault messages, T/R, ANT, CTL, or IND) are annunciated. Alert message slot is blank.
   e. Stabilization status message slot is blank.
   f. Range readout displays 50.

BBB2-34-848

Weather Radar Indicator - Test Pattern
Figure 5/34-41-00-990-894



Weather Radar Controls

MODE Select Buttons – Desired mode is activated by pushing applicable button. When another mode is selected, previously selected mode is deactivated.

WX – Weather is displayed on the indicator (red represents areas of high density precipitation; yellow represents areas of lower density precipitation; green represents areas of light precipitation; black represents areas of extremely low precipitation).

WX/T – (Inoperative on some aircraft.) Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will be WX+T.

If WX/T is selected and weather display only, without turbulence display, is desired (distance of 50 miles or less), deselect turbulence by pushing WX button. Mode select message will be WX.

If WX/T is selected and turbulence display only, without weather display, is desired (distance of 50 miles or less), deselect weather by pushing TURB button. Mode select message will be TURB.

TURB – (Inoperative on some aircraft.) (Distance of 50 miles or less) Turbulence only is displayed. Mode select message will be TURB.

MAP – Ground mapping is displayed (yellow represents targets with high reflectivity; green represents targets with low reflectivity; black represents targets with extremely low reflectivity.) Mode select message will be MAP.

TEST – Initiates self-test of system. Mode select message will be TEST.

MKR (Marker) Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Display Select Buttons – Desired function is activated by pushing applicable button.

SPRS – Ground clutter is suppressed (reduction of ground return intensity) when in WX mode. Continuous operation in SPRS mode is not recommended because some precipitation intensity returns may also be reduced.

LFT – Radar scans area to the left of area directly ahead of airplane.

FWD – Radar scans area directly ahead of airplane.

RGT – Radar scans area to the right of area directly ahead of airplane.

HOLD – Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.

INT Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

RNG Select Buttons – Pushing applicable button selects 10, 20, 50, 150, or 250 nautical miles range. Selected range is displayed on range readout.

Antenna TILT Control Knob – Rotate as necessary to tilt antenna up or down for desired radar scanning. Antenna tilt readout displays antenna tilt angle selected. Tilt limits are from 15° down in 0.25° increments.

STAB Select Button – When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for airplane pitch and roll. When not engaged, antenna aligns to airplane attitude.

PWR Button – Pushing button applies power to system. Pushing button a second time removes system power.

MAP GAIN Control Knob – System gain is controlled in MAP mode by rotating knob counterclockwiseto decrease gain. Gain control in weather mode is automatic.

BBB2-34-300B

Weather Radar Indicator - Controls
Figure 6/34-41-00-990-895

WJE 406, 886, 887, 892 (Continued)

2. Operation

A. The weather radar system is designed primarily to furnish continuous enroute weather information relative to rainfall rate, thunderstorms, and areas of storm turbulence and icing conditions. The system operates on the radar echo principle that transmitted radio waves are returned to their source as a result of reflection qualities of the elements and objects in their path. The system alternately operates as a short duration, high powered transmitter and as a long duration, sensitive receiver.

(1) During the transmission period, the receiver-transmitter unit, transmitter section, generates the RF pulse. The RF pulse is coupled from the receiver-transmitter unit to the antenna by the waveguide assembly. The flat plate antenna radiates the RF pulse.

(2) During the reception period, the transmitter rests, the reflected signals are received by the flat plate antenna and coupled to the receiver-transmitter unit, receiver section, by the waveguide assembly. The receiver interprets intelligence from the reflected signal as a result of both the returned signal strength and the elapsed time since transmission.

B. The indicator is utilized to display the intelligence to the flight crew. The indicator sweep, initiated in coincidence with the transmitted pulse, traverses the scope at a rate equated to the elapsed time. As the receiver interprets the reflected signal, the information is provided to the indicator and displayed, by illumination of the sweep, at the point on the scope corresponding to the range at which the signal was reflected. Rotation of the sweep, to coincide with the antenna direction, results in painting the indicator with a picture of the detected weather conditions. The intensity of the signal denotes the reflective qualities of the target and permits interpretation of the various rainfall rates.

C. Weather Mapping - The primary function of a weather radar system is to detect and display areas of severe weather. The weather radar aids the captain in avoiding these areas and the associated turbulence by determining their range and bearing. The radar does this by emitting microwave pulses through a flat plate antenna to illuminate any targets ahead of the aircraft. The microwave pulses are reflected and the returned echo is picked up by the antenna and displayed on the indicator. The bearing of the target is determined by noting the position of the antenna at the time the echo is received. The range is determined by the amount of time required for the echo to return.

D. Flight hazards due to weather conditions are primarily the result of precipitation and turbulence. Precipitation (rainfall, hail, snow, etc) can be detected by radar, but turbulent air by itself will not provide a radar echo. Turbulence is associated with areas having high rainfall gradients, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with rainfall is inferred. Different levels of rainfall can be detected because the amount of energy echoed back from the rainfall will increase as the microwave pulses strike more and larger water droplets. The fewer the droplets to reflect the microwave pulses, the smaller the return echo will be.

E. Factors which affect the maximum range and azimuth accuracy of weather radar are transmitter output power, antenna gain, receiver gain, antenna beam width, rf pulse width, system prf (pulse-repetition frequency), and rf attenuation by areas of rainfall.

F. Ground Mapping - Some weather radar systems are useful for ground mapping. Ground mapping essentially extends the captain's vision by providing a terrain map of the area ahead of the aircraft. This is especially useful to the captain during times of restricted visibility such as darkness or overcast weather conditions.

G. The terrain map provides a picture of prominent terrain features such as cities, mountains, coastlines and rivers. Highly reflective surfaces, such as buildings in a city or the side of a mountain, provide the most intense echo return, while calm bodies of water provide no echo return. However, turbulent waters caused by swells or large waves will provide return echo. With some experience, these terrain features can be easily interpreted.

WJE 406, 886, 887, 892 (Continued)

H. Antenna beam width, aircraft altitude, and the amount of downward tilt of the antenna all affect the area of terrain that can be detected and displayed. The greater the amount of downward tilt, the closer the detected terrain will be to the aircraft and the smaller the area displayed.

3. To Operate System

NOTE: The weather radar system is equipped with self-test features that provide for a rapid check of the system operation on the ground.

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

WARNING: MAKE SURE YOU DO NOT OPERATE RADAR DURING REFUELING OPERATIONS OR NEAR TRUCKS OR CONTAINERS THAT CONTAIN FLAMMABLE OR EXPLOSIVE LIQUIDS. THIS WILL PREVENT INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

CAUTION: WHEN AIRPLANE IS ON THE GROUND RADAR SHOULD BE IN OFF, OR TEST MODE ONLY. IF IT IS DESIRED TO OPERATE THE RADAR IN THE MAP OR WX, PRECAUTIONS MUST BE TAKEN TO ENSURE THAT THE 180 DEGREE SECTOR FORWARD OF THE AIRPLANE IS FREE OF LARGE METALLIC OBJECT FOR A DISTANCE OF 100 YARDS AND THAT THE ANTENNA IS TILTED UPWARD 15 DEGREES.

A. Preparation - Before activating the radar, set the controls and switches on the indicator to the following positions:

INDICATOR:	
MAP GAIN	Max CW
TILT	0°
PWR	OFF
MKR	Full CW
RNG	150 (pressed)
INT	Full CW
OVERHEAD SWITCH PANEL:	
VERT GYRO	NORM

B. Turn-On - To turn-on the radar, proceed as follows:

(1) Verify circuit breakers for receiver-transmitter and indicator are closed.

(2) Press PWR switch on indicator to on.

(3) Press MODE TEST switch on indicator.

(4) Word TEST will appear at top left on indicator. Antenna will scan left-to-right and up-to-down tilt cycle. Antenna completes one scan/tilt cycle and stops at zero tilt angle.

NOTE: Tilt angle will be shown in lower right-hand corner of display (±15° -0° -15° -0°). Observe if any fail message appears on indicator.

(5) Observe Test Pattern.

(6) Select MODE and RNG as desired for operation.

WJE 406, 886, 887, 892 (Continued)

(7) Turn off system by pressing PWR pushbutton on indicator.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The weather radar system furnishes continuous enroute weather information relative to rainfall rate, thunderstorms, and areas of storm turbulence and icing conditions. The system provides the pilot with a display of storm conditions at extended ranges (maximum display range setting is 320 nautical miles). The area of radar surveillance is 180 degrees of azimuth (90 degrees right and left of airplane heading) and 30 degrees of pitch (15 degrees above and below the stabilized horizontal). The major system components are the antenna assembly, receiver-transmitter, and indicator. The system incorporates built-in test and monitor circuitry to provide system performance checks on the ground and in the air.

B. Antenna - The radar antenna is located in the radome covered portion of the airplane nose section. The antenna provides both a transmitting and receiving function while scanning the 180 degree azimuth arc at a 15 look per minute rate. The antenna tilt angle, variable through the 30 degree pitch arc, determines the azimuth plane scanned. Antenna stabilization is provided to compensate for airplane pitch and roll and maintains the antenna beam on a horizontal plane (as referenced to ground) or at a predetermined angle of tilt from the horizontal plane. The stabilization is accomplished by the vertical gyro pitch and roll information being processed and the tilt command signals from the manual tilt control. These are utilized to introduce corresponding changes to the antenna rotation planes. The antenna flat plate phased array radiator projects a beam for the weather mapping or ground surveillance functions. Ground surveillance is accomplished by pitching the antenna downwards with the manual tilt control. The stabilization circuitry is located in the receiver-transmitter unit. The pitch and roll stabilization assemblies, tilt assemblies, azimuth assemblies, and the waveguide assembly is contained within the antenna pedestal and linkage housing.

C. Receiver-Transmitter - The receiver-transmitter (R/T) provides the processing of all weather radar data, control and rf processes. It also provides supervision of antenna behavior and stabilization, and provides the processed data for the indicator. The R/T produces the microwave signals, processes the received return signals and generates the digital word used by the display unit to create the crt image. The signal produced is in the weather radar X-band.

D. Indicator - The indicator is a color weather radar indicator that provides a constant, nonfading display of all detectable targets within the scan angle and range selected. The indicator can display ground maps or weather maps. (Figure 3) The controls for the indicator are as follows:

Table 1

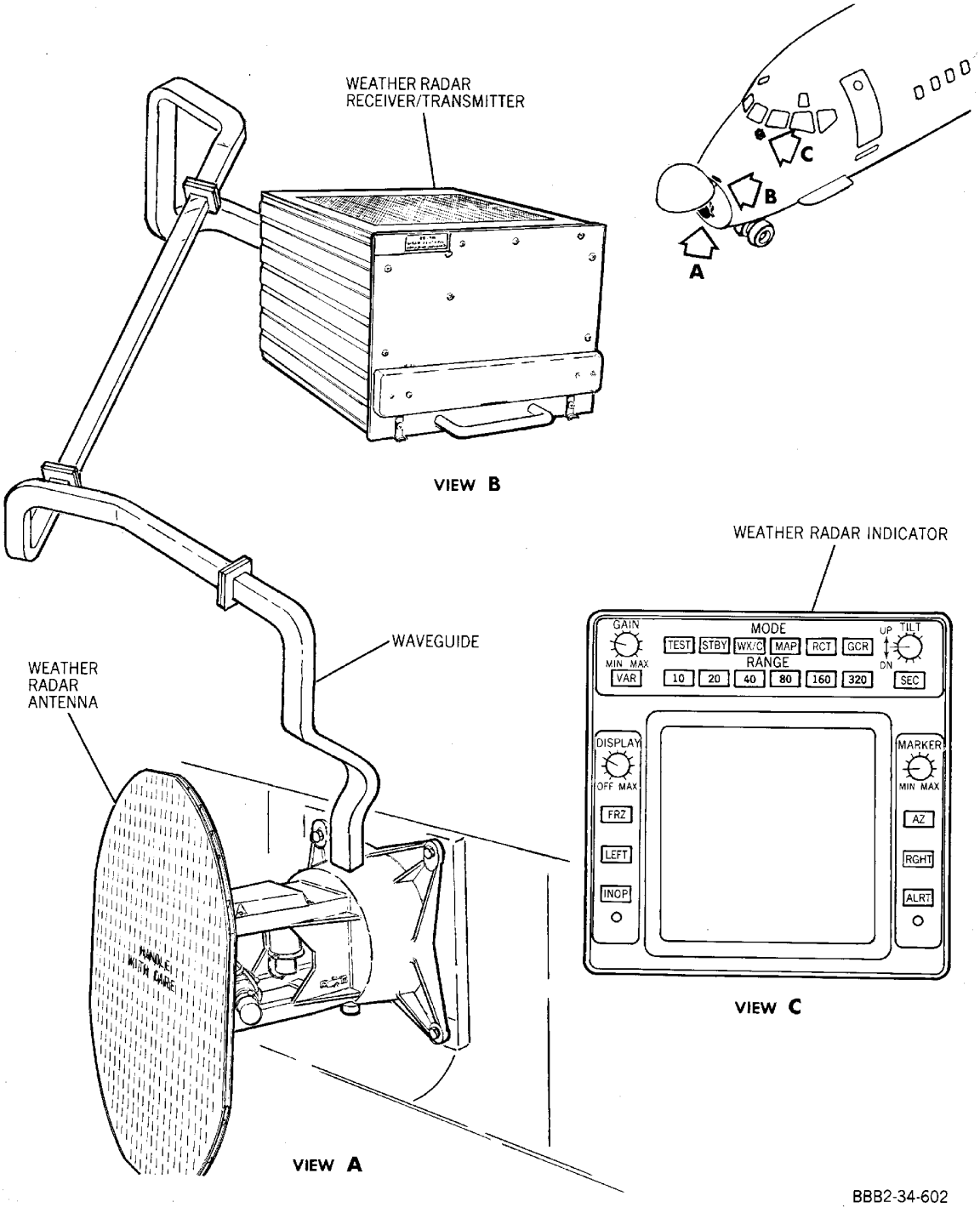
Control	FUNCTION
DISPLAY control	Rotary control used to apply system power, and to adjust brightness of display.
TEST pushbutton	Momentary pushbutton used to select the test mode of operation. Pressing the TEST button causes the following to occur: a. Transmitter output power is radiated. b. Indicator displays test pattern (Figure 4). c. Antenna scans.
STBY pushbutton	Momentary pushbutton used to select standby after radar has been used in an operating mode. In standby, antenna does not scan, transmitter is disabled, and radar memory is erased.

Table 1 (Continued)

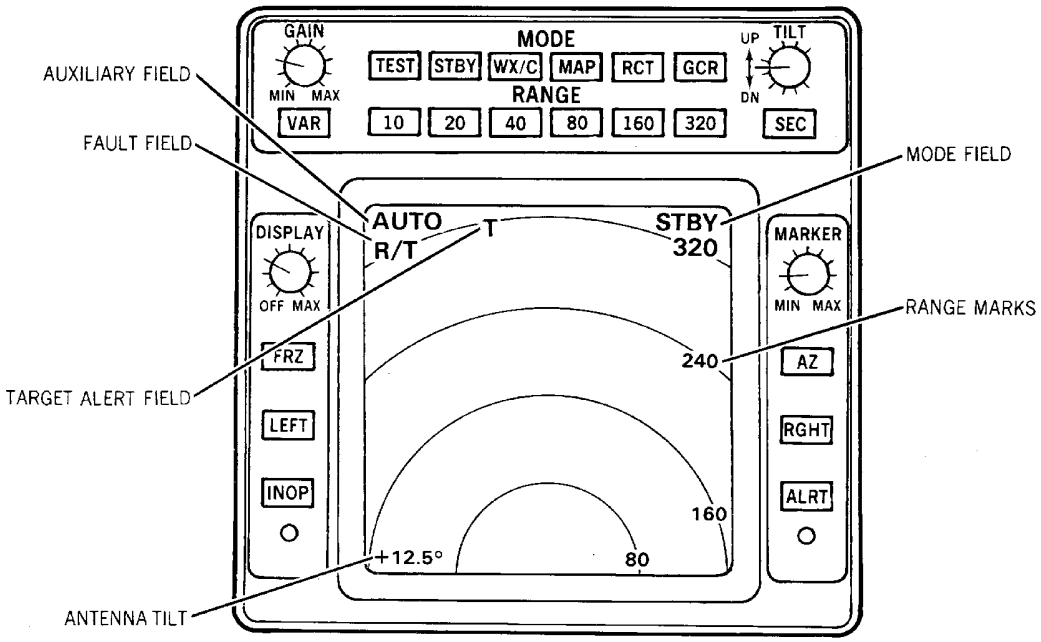
Control	FUNCTION
WX/C pushbutton	Alternate action momentary pushbutton used to select weather detection or cyclic operation. a. After initial system turn-on, first depression of WX/C selects basic weather operation. b. Second depression of pushbutton selects cyclic weather display. Displayed magenta and red targets flash on and off once per second; gain is automatically set to preset level.
MAP pushbutton	Momentary pushbutton used to select ground mapping display.
RCT pushbutton	Momentary pushbutton used to enable the rain echo attenuation compensation technique (REACT) circuity. Maintains system calibration, when operating in an unknown intervening rain situation, through automatic compensation for signal attenuation caused by intervening rain. When RCT is selected, system operates in WX mode and system gain is automatically preset.
GCR pushbutton	Momentary pushbutton used to enable the ground clutter reduction circuits. Signals having a high probability of originating from ground returns are automatically removed from the display. GCR can be activated in all ranges except 160 and 320. When GCR is selected, system operates in WX or RCT mode.
GAIN control	Rotary control used to adjust system gain during ground mapping. Clockwise rotation of the control uniformly increases gain until the 12 o'clock position is reached, then short range gain is increased at a faster rate. GAIN control is enabled only when VAR has been selected.
VAR pushbutton	Momentary pushbutton used to select variable gain control.
TILT control	Rotary control used to select tilt angle of the antenna. The tilt range is from 15° DN (down) to 15° UP.
SEC pushbutton	Momentary pushbutton used to select antenna sector scan of 90 or 180 degrees. After system turn-on, scan is 180 degrees. First depression selects 90 degree scan, and second depression reselects 180 degree scan.
10/20/40/80/160/320 pushbuttons	Momentary pushbuttons used to select one of six ranges. At system turn-on, 320 mile range is automatically selected.
FRZ pushbutton	Momentary pushbutton used to stop updating of the radar display. Last image presented will remain until FRZ function is deactivated by a second depression of the FRZ pushbutton.
LEFT pushbutton	Momentary pushbutton used to select left half of display. When selected, airplane zero heading is on the right side of display. A second depression of the LEFT pushbutton returns the display to normal.
MARKER control	Rotary control used to adjust brightness of range marks, azimuth marks, and alphanumeric.

Table 1 (Continued)

Control	FUNCTION
AZ pushbutton	Momentary pushbutton used to select or deselect azimuth marks on display.
RGHT pushbutton	Momentary pushbutton used to select right half of display. When selected, airplane zero heading is on the left side of display. A second depression of the RGHT pushbutton returns the display to normal.
ALRT pushbutton	Momentary pushbutton used to enable the target alert function. TGT with an upward pointing arrow is displayed and flashes once each second whenever a red or magenta-level target is detected within the target alert sector (range from 10-90, 20-100, 40-120, or 60-160 nm depending on range selected and within ±7.5 degrees of airplane heading). Target alert is deactivated if MAP or VAR is selected, but is reactivated when operating controls are restored to valid alert settings. Target alert is active only when radar gain is calibrated.



Weather Radar - System Components
Figure 1/34-41-00-990-842



WEATHER RADAR INDICATOR

Weather Radar Messages and Readouts

Fault Field – BITE messages (identifying a fault) annunciated are: DSPL, RT, ANT, CNTL, ATT, STAB, COOL or CAL.

- DSPL – Indicates a problem with indicator.
- RT – Indicates a problem with the RT. Also indicates loss of serial data input to indicator.
- ANT – Indicates antenna has stopped scanning.
- CNTL – Indicates loss of serial control input to RT.
- ATT – Indicates loss of serial attitude input to RT.
- STAB – Indicates when antenna elevation drive has exceeded its limits and is being driven into its mechanical stops.
- COOL – Indicates operating temperature within RT is excessive.
- CAL – Indicates transmitter output power low.

Auxiliary Field – Messages annunciated are: TGT, FRZ, VAR or AUTO.

- TGT↑ – Indicates a red or magenta-level target is detected within the target alert section. Comes on red and flashing.
- FRZ – Indicates freeze mode has been selected. Comes on in cyan or green and flashing.
- VAR – Indicates variable gain has been selected and operation is in WX or MAP mode.
- AUTO – Indicates system is in pre-set gain (automatically selected in TEST, CYC, RCT modes.

Antenna Tilt – Digital readout of antenna tilt angle from 0° to 15°, up or down, in 0.1° increments; selected with TILT knob.

Target Alert Field – Blank unless ALRT pushbutton used to select target alert function. Annunciation is "T".

- T – Indicates target alert function is active (letter comes on red).

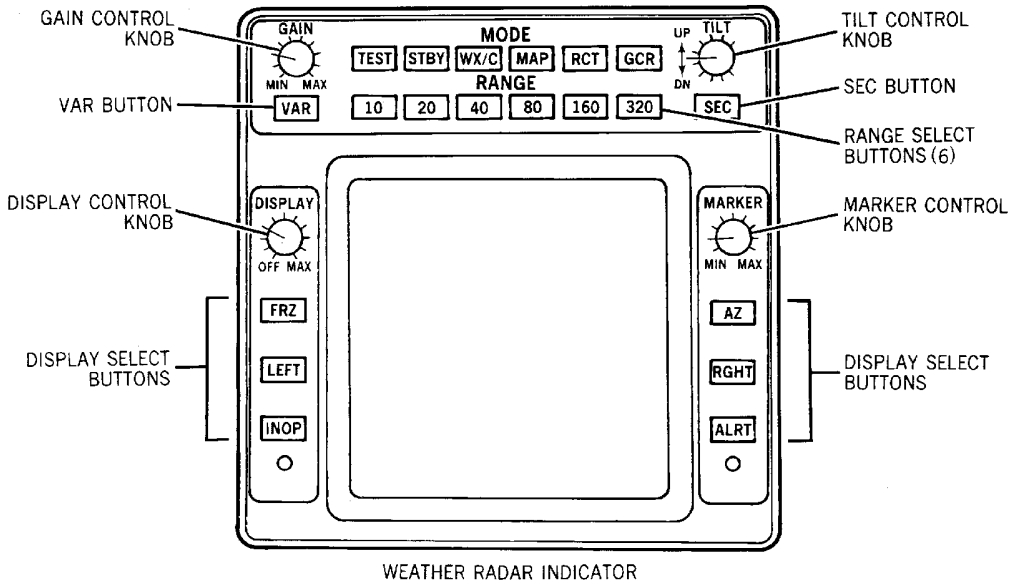
Mode Field – Messages annunciated are: STBY, WX, CYC, MAP, RCT, W/CR, R/CR or TEST.

- STBY – Indicates radar in standby mode.
- WX – Indicates system in weather detection mode.
- CYC – Indicates WX system in cyclic operation.
- MAP – Indicates system in ground mapping mode.
- RCT – Indicates rain echo compensation technique (REACT) selected.
- W/CR – Indicates GCR mode selected.
- R/CR – Indicates both GCR and RCT modes selected.
- TEST – Indicates TEST mode selected.

Range Marks – Four range marks are displayed on each range. Range, azimuth marks and numerics are displayed in cyan for WX, CYC, RCT, GCR and TEST; in green for MAP.

BBB2-34-605

Weather Radar Indicator - Annunciations
Figure 2/34-41-00-990-843



WEATHER RADAR INDICATOR

Weather Radar Controls – Control Knobs/Display Select Buttons

GAIN Control Knob – System gain is controlled in MAP mode by rotating knob clockwise to increase intensity. GAIN is uniformally increased as control is turned clockwise until the 12 o'clock position is reached where short gain range is increased at a faster rate.

VAR – Variable gain selected. First depression enables GAIN control; second depression disables GAIN control. When activated, VAR is displayed in auxiliary field. When deactivated, AUTO is displayed in auxiliary field.

TILT Control Knob – Rotate as necessary to tilt antenna up or down for desired radar scanning. Antenna tilt readout displays antenna tilt angle. Clockwise rotation tilts beam upward 0 to 15 degrees; counterclockwise rotation tilts beam downward 0 to 15 degrees.

SEC – Antenna scan sector of either 90 or 180 degrees selected. After system turn-on, scan is 180 degrees. First depression selects 90 degree scan, second depression selects 180 degree scan.

MARKER Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Range Select Buttons – Pushing applicable button selects 10, 20, 40, 80, 160 or 320 nautical miles. Selected range is displayed on range readout. At system turn-on, 320 mile range is automatically selected.

Display Select Buttons – Desired function is activated by pushing applicable button (momentary).

FRZ – Radar memory stops update. Existing displayed information will remain until FRZ is deactivated by pushing button again. When activated, FRZ is displayed in Auxiliary Field. FRZ symbol will flash on and off once per second as reminder that data is not being updated.

LEFT – Radar scans area to left of area directly ahead of airplane.

INOP – Not used.

AZ – Azimuth ticks are eliminated from display. Pushing button second time causes azimuth ticks to be displayed. Indicator powers on with azimuth ticks displayed.

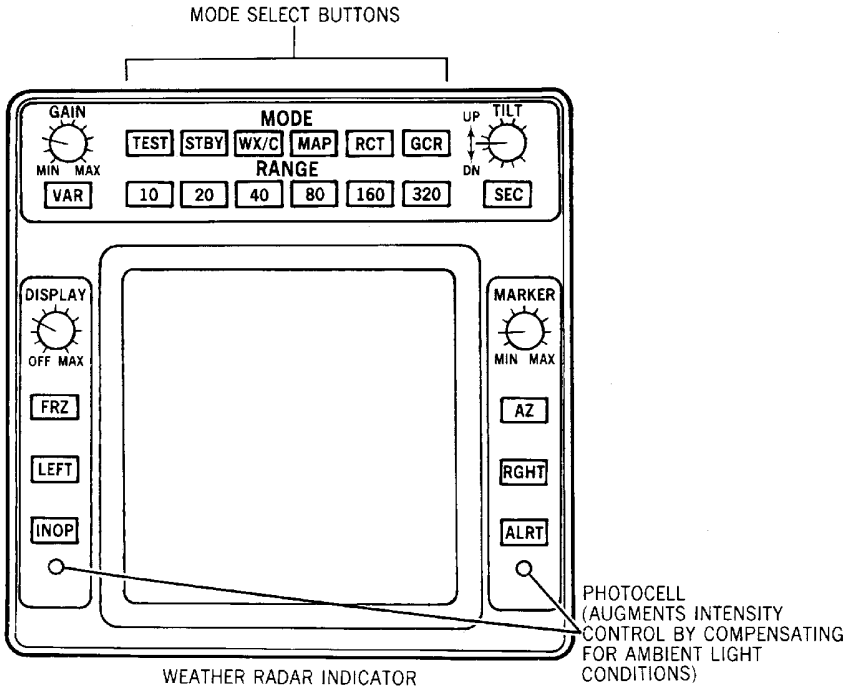
RIGHT – Radar scans area to right of area directly ahead of airplane.

ALRT – Target alert function selected. When enabled, a red letter T is displayed. Target alert is active only when radar gain is calibrated; i.e., in WX with GAIN preset and in CYC, TEST, or RCT. The symbol TGT▲(in red) is displayed and flashes once each second whenever a red or magenta-level target is detected within the target alert sector (range from 10-90, 20-100, 40-120 or 80-160 nm depending on range selected and within + 7.5 degrees of aircraft heading). Target alert is deactivated automatically if MAP is selected or if variable GAIN is used, but is reactivated automatically when operating controls are restored to valid alert settings.

Display Control Knob – Rotate knob clockwise to turn on system. Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

BBB2-34-603

Weather Radar Indicator - Controls
Figure 3/34-41-00-990-844 (Sheet 1 of 2)



Weather Radar Controls – Mode Select Buttons

Mode Select Buttons – Desired mode is activated by pushing applicable button (momentary). When another mode is selected, previously selected mode is deactivated.

TEST – Self-test is initiated. During self-test, a test pattern of four equal width arcs with black at bottom followed by green, yellow, red, and magenta will be displayed in indicator and a 20 mile "Noise Band" between 130 and 150 mile will be predominantly green and extend unbroken across the display; 160 mile range is automatically selected; TEST is displayed in Mode Field.

STBY – Operating radar goes to standby. Antenna does not scan, transmitter is disabled, and radar memory erased. STBY is displayed in Mode Field.

WX/C – Weather detection or cyclic operation selected. After initial turn-on, first actuation of WX/C selects basic weather operation. WX is displayed in Mode Field. Second actuation of WX/C selects cyclic weather display. CYC is displayed in Mode Field. Displayed magenta and red targets flash on and off once per second.

MAP – Ground mapping is displayed (magenta represents targets of high reflectivity, yellow represents targets of medium reflectivity, cyan (blue) represents targets of low reflectivity, black represents targets that are non-reflective). MAP is displayed in Mode Field.

RCT – REACT (Rain Echo Attenuation Compensation Technique) is selected. Receiver gain is automatically adjusted according to received signal strength. When the receiver is in its calibration range, displayed colors are as in weather mode. When the calibration range is exceeded, the back-ground will be blue. Signals occurring in the uncalibrated range will be displayed in red. RCT mode is active in all ranges. When RCT mode is selected, system operates in WX mode.

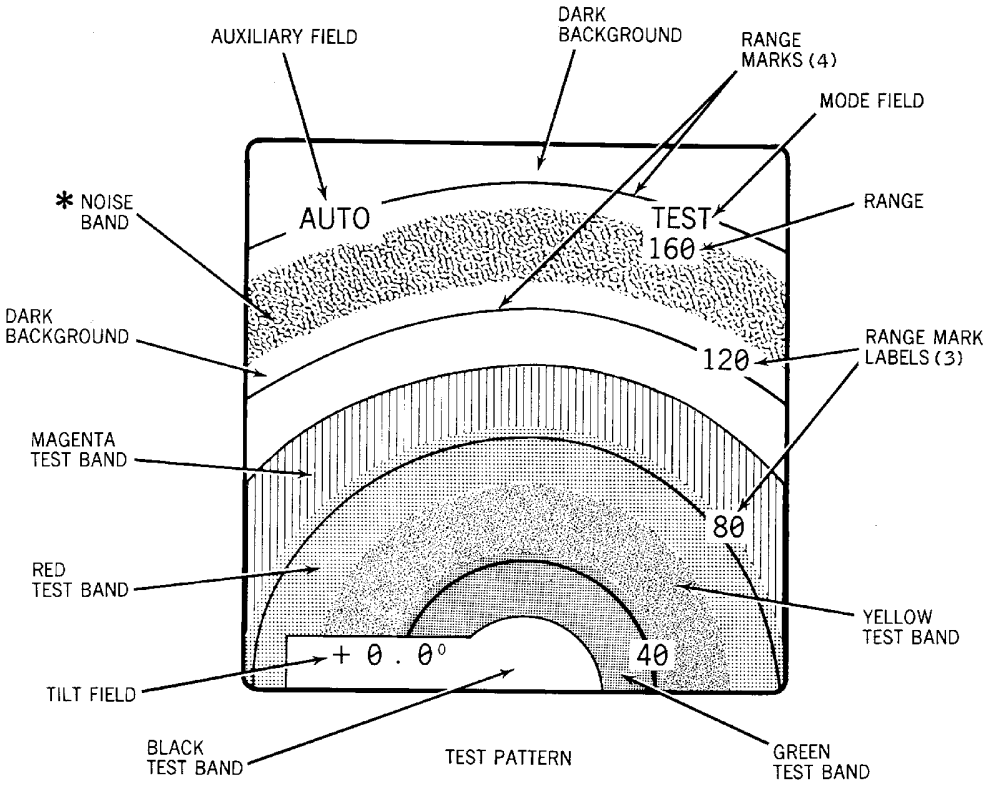
System gain is automatically in Preset. RCT is displayed in Mode Field. RCT mode may be operated simultaneously with ground clutter reduction (GCR). With both modes selected, R/CR is displayed in Mode Fields.

GCR – Ground clutter is suppressed (reduction of ground return intensity) when in WX/C. Continuous operation in GCR mode is not recommended because some precipitation returns may also be reduced in intensity.

GCR is active in all ranges except 160 and 320 mile ranges. When GCR Mode is selected, system operates in either WX or RCT mode. In WX mode, W/CR is displayed in the Mode Field. GCR may be operated simultaneously with RCT mode. When selected, R/CR is displayed in the Mode Field on the indicator and the system is placed automatically in Preset gain.

BBB2-34-604

Weather Radar Indicator - Controls
Figure 3/34-41-00-990-844 (Sheet 2 of 2)



1. VERIFY THE FOLLOWING ON THE DISPLAY:
   a. TEST DISPLAYED IN MODE FIELD.
   b. RANGE MARKS AND ALPHANUMERICS DISPLAYED IN CYAN.
   c. COLORS OF FIRST FIVE TEST BANDS ARE BLACK, GREEN, YELLOW, RED, AND MAGENTA.
   d. 20 NM NOISE BAND BETWEEN 130 and 150 NM IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.
   e. AUTO (PRE-SET GAIN) DISPLAYED IN AUXILIARY FIELD.
   f. +0.0° DISPLAYED IN TILT FIELD.
   g. 160 (NM) DISPLAYED IN UPPER RIGHT CORNER, AND FIRST THREE RANGE MARKS LABELED 40, 80, AND 120 RESPECTIVELY.

NOTE

* 20 NM WIDE NOISE BAND BETWEEN 130 AND 150 NM. BAND IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.

BBB2-34-606

Weather Radar Indicator - Test Pattern
Figure 4/34-41-00-990-845

2. Operation

A. The weather radar system is designed primarily to furnish continuous enroute weather information relative to rainfall rate, thunderstorms, and areas of storm turbulence and icing conditions. The system operates on the radar echo principle that transmitted radio waves are returned to their source as a result of reflection qualities of the elements and objects in their path. The system alternately operates as a short duration, high powered transmitter and as a long duration, sensitive receiver.

(1) During the transmission period, the receiver-transmitter unit, transmitter section, generates the RF pulse. The RF pulse is coupled from the receiver-transmitter unit to the antenna by the waveguide assembly. The flat plate antenna radiates the RF pulse.

(2) During the reception period, the transmitter rests, the reflected signals are received by the flat plate antenna and coupled to the receiver-transmitter unit, receiver section, by the waveguide assembly. The receiver interprets intelligence from the reflected signal as a result of both the returned signal strength and the elapsed time since transmission.

B. The indicator is utilized to display the intelligence to the flight crew. The indicator sweep, initiated in coincidence with the transmitted pulse, traverses the scope at a rate equated to the elapsed time. As the receiver interprets the reflected signal, the information is provided to the indicator and displayed, by illumination of the sweep, at the point on the scope corresponding to the range at which the signal was reflected. Rotation of the sweep, to coincide with the antenna direction, results in painting the indicator with a picture of the detected weather conditions. The intensity of the signal denotes the reflective qualities of the target and permits interpretation of the various rainfall rates.

C. Weather Mapping - The primary function of a weather radar system is to detect and display areas of severe weather. The weather radar aids the captain in avoiding these areas and the associated turbulence by determining their range and bearing. The radar does this by emitting microwave pulses through a flat plate antenna to illuminate any targets ahead of the aircraft. The microwave pulses are reflected and the returned echo is picked up by the antenna and displayed on the indicator. The bearing of the target is determined by noting the position of the antenna at the time the echo is received. The range is determined by the amount of time required for the echo to return.

D. Flight hazards due to weather conditions are primarily the result of precipitation and turbulence. Precipitation (rainfall, hail, snow, etc.) can be detected by radar, but turbulent air by itself will not provide a radar echo. Turbulence is associated with areas having high rainfall gradients, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with rainfall is inferred. Different levels of rainfall can be detected because the amount of energy echoed back from the rainfall will increase as the microwave pulses strike more and larger water droplets. The fewer the droplets to reflect the microwave pulses, the smaller the return echo will be.

E. Factors which affect the maximum range and azimuth accuracy of weather radar are transmitter output power, antenna gain, receiver gain, antenna beam width, rf pulse width, system prf (pulse-repetition frequency), and rf attenuation by areas of rainfall.

F. Ground Mapping - Some weather radar systems are useful for ground mapping. Ground mapping essentially extends the captain's vision by providing a terrain map of the area ahead of the aircraft. This is especially useful to the captain during times of restricted visibility such as darkness or overcast weather conditions.

G. The terrain map provides a picture of prominent terrain features such as cities, mountains, coastlines and rivers. Highly reflective surfaces, such as buildings in a city or the side of a mountain, provide the most intense echo return, while calm bodies of water provide no echo return. However, turbulent waters caused by swells or large waves will provide return echo. With some experience, these terrain features can be easily interpreted.

H. Antenna beam width, aircraft altitude, and the amount of downward tilt of the antenna all affect the area of terrain that can be detected and displayed. The greater the amount of downward tilt, the closer the detected terrain will be to the aircraft and the smaller the area displayed.

3. To Operate System

NOTE: The weather radar system is equipped with self-test features that provide for a rapid check of the system operation on the ground.

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

WARNING: MAKE SURE YOU DO NOT OPERATE RADAR DURING REFUELING OPERATIONS OR NEAR TRUCKS OR CONTAINERS THAT CONTAIN FLAMMABLE OR EXPLOSIVE LIQUIDS. THIS WILL PREVENT INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

CAUTION: WHEN AIRPLANE IS ON THE GROUND RADAR SHOULD BE IN OFF, OR TEST MODE ONLY. IF IT IS DESIRED TO OPERATE THE RADAR IN THE MAP OR WX, PRECAUTIONS MUST BE TAKEN TO ENSURE THAT THE 180 DEGREE SECTOR FORWARD OF THE AIRPLANE IS FREE OF LARGE METALLIC OBJECT FOR A DISTANCE OF 100 YARDS AND THAT THE ANTENNA IS TILTED UPWARD 15 DEGREES.

A. Preparation - Before activating the radar, set the controls and switches on the indicator to the following positions:

INDICATOR:	GAIN ..... Max CCW
	TILT..... +15°
	DISPLAY..... OFF
OVERHEAD SWITCH PANEL:	VERT GYRO ..... NORM

B. Turn-On - To turn-on the radar proceed as follows:

(1) Verify circuit breakers for receiver-transmitter and indicator are closed.

(2) Rotate DISPLAY control on indicator, to mid-point.

(3) Press TEST switch on indicator.

(4) Word TEST will appear at top right on indicator. Antenna will scan.

NOTE: Tilt angle will be shown in lower left-hand corner of display (+0.0°). Observe if any fail message appears on indicator.

(5) Observe Test Pattern.

(6) Select MODE and RNG as desired for operation.

(7) Turn off system by rotating DISPLAY control on indicator to OFF.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The weather radar system provides the Captain and First Officer with weather mapping, terrain mapping, and turbulence detection in the presence of precipitation. Storm conditions can be indicated up to a range of 320 nautical miles. Visual indications are depicted on the weather radar indicator located in the flight compartment center pedestal. The storm areas in the flight path of the aircraft and the intensity of the storm are depicted on the indicator in green, yellow, red and magenta. By observing the visual storm indications the Captain/F.O. can determine corridors of calm in the storm areas and maneuver the aircraft through these corridors to provide for the safety of the aircraft and passenger comfort.

B. The weather radar system consists of a weather radar indicator, radar receiver transmitter, and the radar antenna. The components are described in the following Description paragraphs.

C. On aircraft 131-132, the weather radar display is displayed on the weather radar indicator and can also be displayed on the EFIS navigation display (ND) unit. There are two ND units located one each on the Captain's and First Officer's instrument panels. Description of the interface between the weather radar system and the EFIS is described in Paragraph 6..

D. With Service Bulletin No. M-3269 (PPI-4B-34-38) for PPI-4B Weather Radar Indicator (PN 2041222-0426 and -0402, -0405, -0418, -0419, -0421, -0423-0425, -0429, -0430, -0431, and -0435) incorporated, it is possible to display Traffic Alert Collision Avoidance System (TCAS) traffic with weather radar.

2. Description

A. Receiver/Transmitter -- The weather radar receiver/transmitter is a completely solid state unit. It generates the microwave energy that is transmitted through the waveguides to the antenna for transmission. Reflected energy received by the antenna is transmitted to the R/T unit, processed and converted into digital signals which are sent to and displayed on the radar indicator as visual information. Seven annunciator lights and a TEST switch located on the front panel of the R/T unit provide a self test of the weather radar units. When the TEST switch is pressed, all lights should come on for approximately one second to verify integrity of the lights; when the TEST switch is released all lights should go out denoting a good system. Any light remaining on, designates the faulty unit noted. The receiver/transmitter is located in the forward accessory compartment and is accessible through the nose wheel access door. The mounting tray in which the R/T unit is installed contains a fan for cooling of the R/T unit.

B. Radar Indicator -- The weather radar indicator provides a color display of weather and ground targets within the area scanned by the antenna. Digital processing enables presentation of several levels of rainfall density by using colors to display each level. The displays in the weather mode is as follows:

Table 1

Dark Screen	- level 1 (low or no precipitation)
Green	- level 2 (light precipitation)
Yellow	- level 3 (medium precipitation)
Red	- level 4 (and above (high precipitation))
Magenta	- turbulence detection
Blue	- range marks, azimuth lines, and alphanumerics

In the MAP mode, displays are as follows:

Green -- Ground targets with low reflectivity (open ground, calm water)

Yellow -- Medium reflectivity (Very rough water)

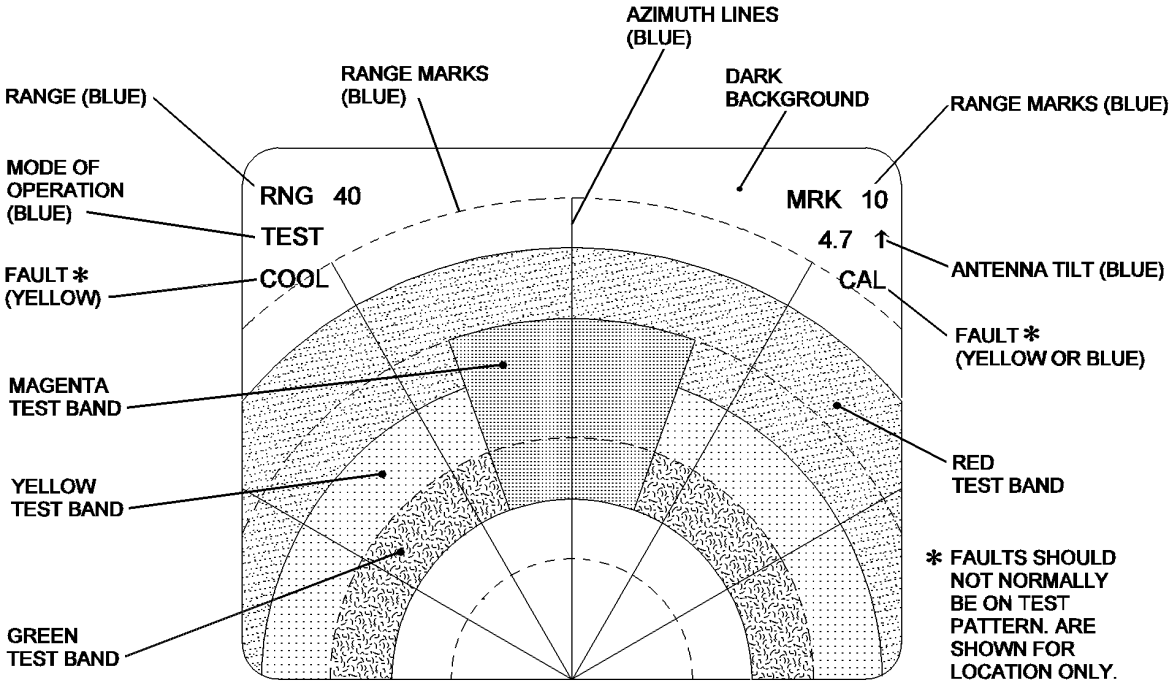
Red -- High reflectivity (Cities)

All controls for operation of the weather radar system are located on the front of the radar indicator and are as follows:

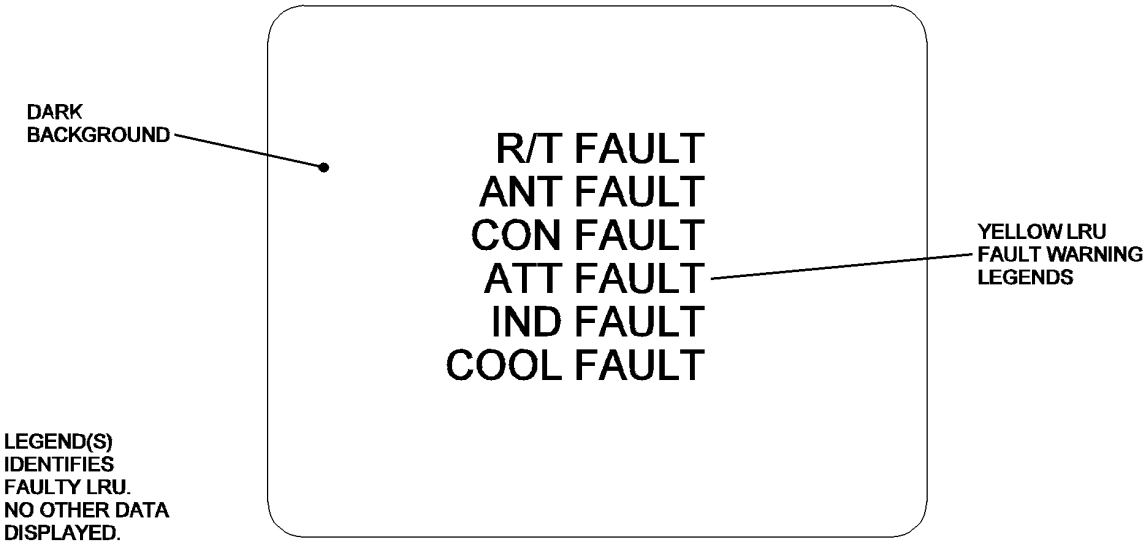
Table 2

Control	Function
RANGE SELECTOR	Enables power to indicator in any range position and selects range position of 10/5 mile marks, 20/5 mile marks, 40/10 mile marks, 80/20 mile marks, 160/40 mile marks, 320/80 mile marks.
BRT (Brightness Control)	Variable adjust for cockpit light conditions. During ground mapping mode, adjusts with control panel GAIN for best presentation.
Selector Switch	
OFF position	System made inoperative by interrupting the 28 volt supply.
TEST position	Test circuitry is energized and test pattern appears on the indicator.
WX position	Energizes the system for normal weather search operation and also energizes the contour function circuitry.
TURB position	Used to isolate turbulence in storm cells where severe wind shear conditions may exist. Maximum turbulence display range 40 nm.
MAP position	Energizes the system for normal ground mapping operation.
GAIN Control	
AUTO	Provides for manual control of the receiver gain. The gain is increased by a clockwise rotation of the control. The detented full clockwise position (AUTO) provides an automatic gain control function.
NOTE: The weather radar system is designed to operate with the gain control in the AUTO position. Manual gain adjustments may be used, as required, in the MAP position to improve resolution of selected targets or to distinguish prominent targets from surrounding terrain.	
Antenna Tilt Control	Antenna tilt control, calibrated in 5 degree increments, provides remote control of the antenna elevation and depression.
STAB On/Off Switch	When in OFF position, antenna will not be stabilized with respect to Gyro signals. The antenna will then rotate about the aircraft axis (as opposed to the vertical axis in the stabilized modes). The stabilization cut out feature allows near normal radar performance even though the gyro signals develop a malfunction.

C. Radar Antenna -- The weather radar antenna is located on the forward fuselage nose bulkhead and is accessible by opening and raising the aircraft nose radome. The antenna consists of a drive unit and flat plate array (reflector). The flat plate array is the means for radiating the pencil beam of rf energy and receiving the reflected signals for subsequent processing in the R/T unit and visual display on the radar indicator. The drive unit consists of an azimuth drive motor, tilt drive motor, an azimuth position synchro, and an elevation position synchro and moves the flat plate array in a 180 degree (90°L, 90°R) azimuth scan and a 45 degree (22-1/2° up, 22-1/2° dn) elevation scan. The antenna can be manually tilted ±15 degrees from the horizontal (zero degrees) and is stabilized over a combined tilt, pitch, and roll input of ±45 degrees.



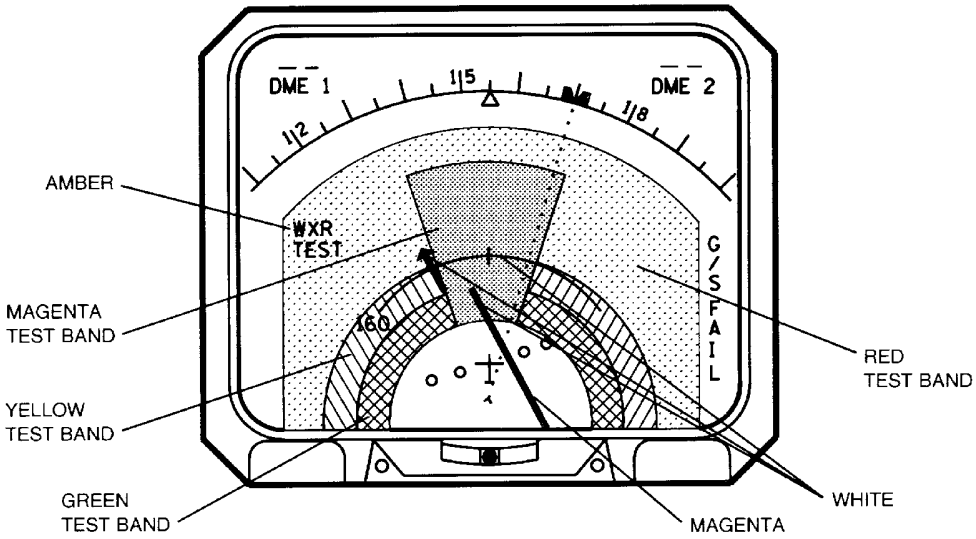
TEST PATTERN



TEST MODE FAULT DISPLAY

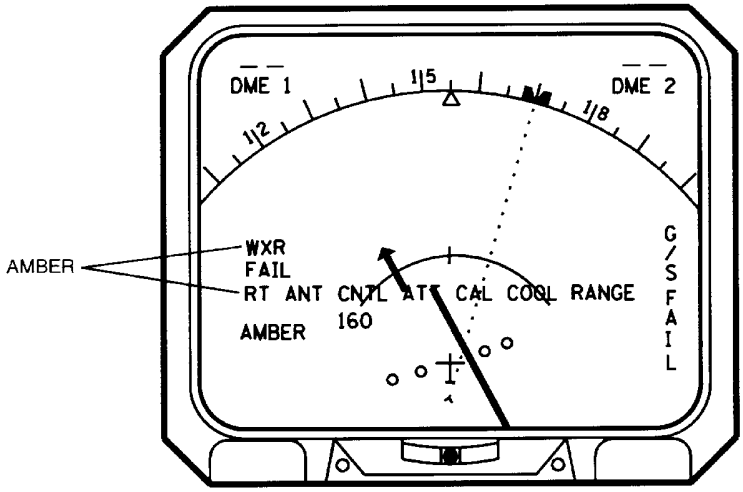
BBB2-34-849B
S0006546565V3

Test Pattern and Fault Display
Figure 1/34-41-00-990-850



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-1134A

Weather Radar Indicator test Pattern and Fault Display on EFIS Navigation Display Unit
Figure 2/34-41-00-990-852

3. Operation

A. The weather radar system operates by emitting very short intense pulses of microwave energy which are reflected by objects within the range of the system provided they have reflective characteristics. This reflected energy is picked up by the radar antenna and sent to the R/T unit. The signal is then amplified, detected, and converted into digital signals which are routed to the ND indicators. In the indicator, the digital signals produce visual indications that are representative of the size, intensity, bearing and distance of the target that reflected the radar signal.

B. In the weather mapping mode of operation, the visual indications on the ND indicators provide distinct levels of rainfall density by using four different colors.

C. The maximum range of the weather radar is dependent upon many factors of which the most important are: antenna gain, beam width of radiated energy, transmitter power, pulse width, prf, noise figure, receiver gain, radome, and interconnecting waveguide. When range limits greater than 40 nm. are selected, only weather displays (green, yellow, red) will appear on the display beyond the 40 nm. mark.

D. Weather Mapping

(1) The radar system provides storm detection up to a distance of approximately 320 nautical miles under defined penetration environment.

(2) Cloud formations having less moisture content than is required to reflect a minimum discernible echo signal will not appear on the ND indicators display.

(3) The color presentation gives immediate indication of the location of severe storm areas; these areas might contain air turbulence which should be avoided.

E. Turbulence Detection

(1) Turbulence detection is used to isolate turbulence in storm cells where severe wind shear conditions may exist. Turbulence detection requires the presence of precipitation and does not display clear air turbulence.

(2) Turbulence display on the indicator (magenta) is limited to a range of 40 nm. When ranges greater than 40 nm. are selected, only weather mapping will appear beyond the 40 nm. mark.

F. Ground Mapping

(1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the indicators in slant range and in azimuth bearing with respect to the heading of the aircraft.

(2) Of prime importance is the extension of the range of vision of the Capt/F.O. and ability to see this terrain map even during darkness and overcast conditions when visibility is restricted. The display in ground mapping resembles a pilotage chart and is easily interpreted. Cities, open ground, and bodies of water are distinguished by the intensity of the signals they reflect back to the antenna. Cities usually provide the most intense reflections; open ground and water provide progressively less intense reflections. Calm water reflects very little signal back to the antenna, very rough water provides a signal return of considerable strength.

4. Test and Fault Indication

A. Fault isolation of the weather radar system can be performed by observing the display on the indicator or by observing the fault annunciator Led on the receiver/transmitter unit.

B. The microprocessor based monitor system in the receiver/transmitter unit checks and/or compares selected voltages/signals during each program loop. If these checks or comparisons reveal any abnormality, one or more fault legends are displayed on the indicator. On aircraft with EFIS, WXR faults detected by the Symbol Generator will be displayed on the EFIS Navigation Display Ref. 34-22-00, Page 1. Also the annunciator control circuit stores the fault information. For display of fault legends, (Ref. Figure 1). IND FAULT will be annunciated only when the selector switch is in the TEST mode.

C. If there is a fault in one or more LRUs the appropriate LED on the front panel of the R/T unit will remain on when the TEST switch on the R/T unit is pressed. When the TEST switch is initially pressed and held, all the LEDs will come on for approximately one second to denote integrity of the LEDs. The LEDs are as follows:

R/T ---------- Receiver/Transmitter

ANT ---------- Antenna

IND ---------- Indicator

CON -------- Control Panel

WG SW ---- Waveguide Switch

GYRO ------ Gyro

AIR ---------- Cooling

NOTE: Control panel and waveguide switch not applicable to aircraft configuration.

D. When system is in Test Mode, a good test pattern look like the one in Figure 1, except for CAL (out of calibration) and COOL (cooling malfunction) fault displays, which are shown for location only.

5. To Operate System

WARNING: MAKE SURE YOU DO NOT OPERATE RADAR DURING REFUELING OPERATIONS OR NEAR TRUCKS OR CONTAINERS THAT CONTAIN FLAMMABLE OR EXPLOSIVE LIQUIDS. THIS WILL PREVENT INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

A. Preparation

(1) Set BRT control on radar indicator fully counterclockwise.

(2) Set mode selector control to 160 miles.

(3) Adjust TILT control to 10 degrees UP.

(4) Set GAIN control to AUTO position.

(5) Set mode selector to TEST position.

(6) Adjust BRT control for a convenient viewing level.

(7) Observe test pattern on indicator; a satisfactory pattern indicates an operational system.

(8) After 3 minutes from initial turn-on the transmitter will be operative and test pattern should not change.

(9) Set mode selector to desired mode of operation.

(a) WX, for normal weather search operation.

(b) TURB, for turbulence detection to 40 nm.

(c) MAP, for ground mapping function.

(10) Place EFIS mode selector panel MODE select in the ARC position for weather radar test pattern display on the EFIS ND unit.

(11) Brightness of the ND can be adjusted by the BRT control on the EFIS control and dimming panels located one each on the Captains and First Officer's instrument panels.

(12) To shut down system, place control panel function switch in OFF position.

6. Weather Radar EFIS Interface

A. A weather radar display can be initiated for display on the EFIS navigation display (ND) unit by placing the MODE selector on the EFIS mode selector control panel in the ARC position. The display on the ND will depict weather patterns as shown on the weather radar indicator. The weather radar test pattern is also displayed on the ND when the weather radar indicator control panel selector switch is placed in the TEST position. The fault display on the ND is same as the weather radar indicator fault display except RANGE FAULT will be displayed in place of the weather radar IND FAULT to indicate a fault in the EFIS MODE select panel (Ref. Figure 2).

B. Hard failures which are displayed on the ND, are those which occur when major function of the system is lost (Ref. Figure 1), Test Mode Fault Display. Hard failures are typically a total loss of transmitter power, receiver gain or no antenna scan. The hard failure ATT is displayed when both AHRS 1 and AHRS 2 fail (no source of attitude information).

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The weather radar system provides the Captain and First Officer with weather mapping and terrain mapping in the presence of precipitation. Storm conditions can be indicated up to a range of 320 nautical miles. Visual indications are depicted on the EFIS navigation display (ND) indicators located one each on the Captain's and First Officer's instrument panels in the flight compartment. The storm areas in the flight path of the aircraft and the intensity of the storm are depicted on the indicators in green, yellow, and red. By observing the visual storm indications the Captain/F.O. can determine corridors of calm in the storm areas and maneuver the aircraft through these corridors to provide for the safety of the aircraft and passenger comfort.

B. The weather radar system consists of a weather radar receiver transmitter, control panel and the radar antenna. The components are described in the following Description paragraphs.

C. With Service Bulletin No. M-3269 (PPI-4B-34-38) for PPI-4B Weather Radar Indicator (PN 2041222-0426 and -0402, -0405, -0418, -0419, -0421, -0423-0425, -0429, -0430, -0431, and -0435) incorporated, it is possible to display Traffic Alert Collision Avoidance System (TCAS) traffic with weather radar.

2. Description

A. Receiver/Transmitter -- The weather radar receiver/transmitter is a completely solid state unit. It generates the microwave energy that is transmitted through the waveguides to the antenna for transmission. Reflected energy received by the antenna is transmitted to the R/T unit, processed and converted into digital signals which are sent to and displayed on the EFIS NDs as visual information. Seven annunciator lights and a TEST switch located on the front panel of the R/T unit provide a self test of the weather radar units. When the TEST switch is pressed, all lights should come on for approximately one second to verify integrity of the lights; when the TEST switch is released all lights should go out denoting a good system. Any light remaining on, designates the faulty unit noted. The receiver/transmitter is located in the forward accessory compartment and is accessible through the nosewheel access door. The mounting tray in which the R/T unit is installed contains a fan for cooling of the R/T unit. The weather radar control panel is located on the forward pedestal in the flight compartment.

B. EFIS Navigation Display (ND) Indicators -- The ND indicators provide a color display of weather and ground targets within the area scanned by the antenna. Digital processing enables presentation of several levels of rainfall density by using colors to display each level. The displays in the weather mode is as follows:

Table 1

Dark Screen	- level 1 (low or no precipitation)
Green	- level 2 (light precipitation)
Yellow	- level 3 (medium precipitation)
Red	- level 4 (and above (high precipitation))
Blue	- range marks, azimuth lines, and alphanumerics

In the MAP mode, displays are as follows:

Green -- Ground targets with low reflectivity (open ground, calm water)

Yellow -- Medium reflectivity (Very rough water)

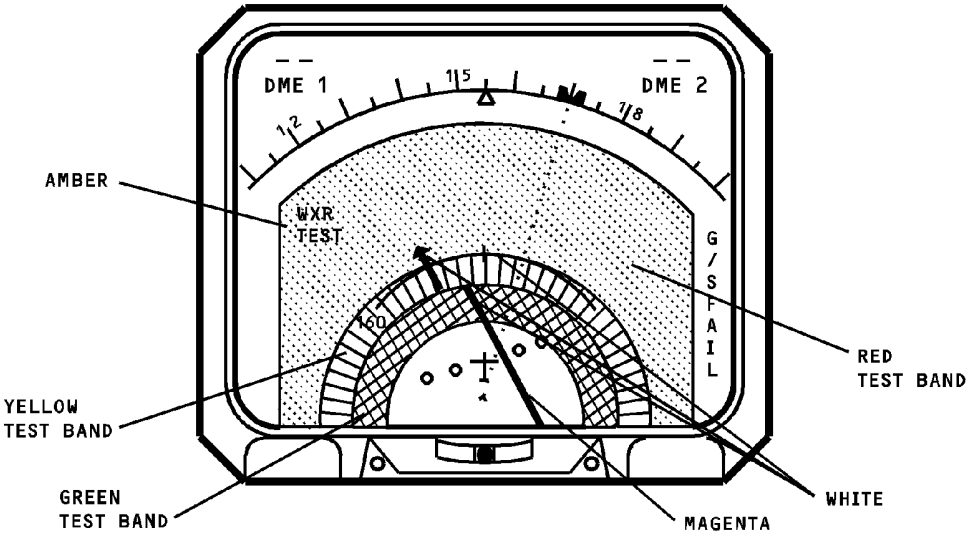
Red -- High reflectivity (Cities)

All controls for operation of the weather radar system are located on the weather radar control panel except as noted and are as follows:

Table 2

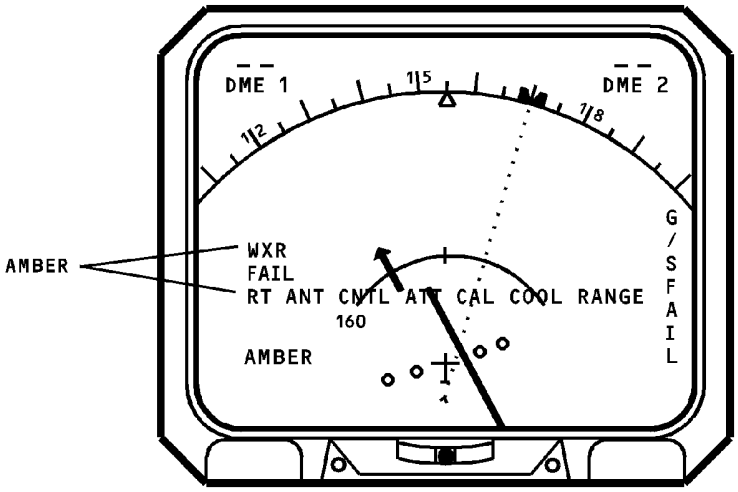
Control	Function
RANGE SELECTOR (Located on mode select panel)	Enables power to indicator in any range position and selects range position of 10/5 mile marks, 20/5 mile marks, 40/10 mile marks, 80/20 mile marks, 160/40 mile marks, 320/80 mile marks.
Selector Switch	
OFF position	System made inoperative by interrupting the 28 volt supply.
GAIN Control	
AUTO	Provides for manual control of the receiver gain. The gain is increased by a clockwise rotation of the control. The detented full clockwise position (AUTO) provides an automatic gain control function.
NOTE: The weather radar system is designed to operate with the gain control in the AUTO position. Manual gain adjustments may be used, as required, in the MAP position to improve resolution of selected targets or to distinguish prominent targets from surrounding terrain.	
Antenna Tilt Control	Antenna tilt control, calibrated in 5 degree increments, provides remote control of the antenna elevation and depression.
BRT	A BRT control for adjusting the light viewing level on the EFIS NDs is located on the EFIS control and dimming panels (CDP). A CDP is located on both the Captain's and First Officer's instrument panels.
WX/TURB	Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed.
STAB On/Off Switch	When in OFF position, antenna will not be stabilized with respect to Gyro signals. The antenna will then rotate about the aircraft axis (as opposed to the vertical axis in the stabilized modes). The stabilization cut out feature allows near normal radar performance even though the gyro signals develop a malfunction.

C. Radar Antenna -- The weather radar antenna is located on the forward fuselage nose bulkhead and is accessible by opening and raising the aircraft nose radome. The antenna consists of a drive unit and flat plate array (reflector). The flat plate array is the means for radiating the pencil beam of rf energy and receiving the reflected signals for subsequent processing in the R/T unit and visual display on the ND indicators. The drive unit consists of an azimuth drive motor, tilt drive motor, an azimuth position synchro, and an elevation position synchro and moves the flat plate array in a 180 degree (90°L, 90°R) azimuth scan and a 45 degree (22-1/2° up, 22-1/2° dn) elevation scan. The antenna can be manually tilted ±15 degrees from the horizontal (zero degrees) and is stabilized over a combined tilt, pitch, and roll input of ±45 degrees.



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-2455

Test Pattern and Fault Display
Figure 1/34-41-00-990-841

3. Operation

A. The weather radar system operates by emitting very short intense pulses of microwave energy which are reflected by objects within the range of the system provided they have reflective characteristics. This reflected energy is picked up by the radar antenna and sent to the R/T unit. The signal is then amplified, detected, and converted into digital signals which are routed to the ND indicators. In the indicator, the digital signals produce visual indications that are representative of the size, intensity, bearing and distance of the target that reflected the radar signal.

B. In the weather mapping mode of operation, the visual indications on the ND indicators provide distinct levels of rainfall density by using four different colors. Refer to paragraph 2.B. for density of rainfall for each color.

C. The maximum range of the weather radar is dependent upon many factors of which the most important are: antenna gain, beam width of radiated energy, transmitter power, pulse width, prf, noise figure, receiver gain, radome, and interconnecting waveguide. When range limits greater than 40 nm are selected, only weather displays (green, yellow, red) will appear on the display beyond the 40 nm mark.

D. Weather Mapping

(1) The radar system provides storm detection up to a distance of approximately 320 nautical miles under defined penetration environment.

(2) Cloud formations having less moisture content than is required to reflect a minimum discernible echo signal will not appear on the ND indicators display.

(3) The color presentation gives immediate indication of the location of severe storm areas; these areas might contain air turbulence which should be avoided. E. Ground Mapping (1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the ND indicators in slant range and in azimuth bearing with respect to the heading of the aircraft.

E. Ground Mapping

(1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the ND indicators in slant range and in azimuth bearing with respect to the heading of the aircraft.

(2) Of prime importance is the extension of the range of vision of the Capt/F.O. and ability to see this terrain map even during darkness and overcast conditions when visibility is restricted. The display in ground mapping resembles a pilotage chart and is easily interpreted. Cities, open ground, and bodies of water are distinguished by the intensity of the signals they reflect back to the antenna. Cities usually provide the most intense reflections; open ground and water provide progressively less intense reflections. Calm water reflects very little signal back to the antenna, very rough water provides a signal return of considerable strength.

4. Test and Fault Indication

A. A. Fault isolation of the weather radar system can be performed by observing the display on the ND indicators or by observing the fault annunciator LEDs on the receiver/transmitter unit.

B. The microprocessor based monitor system in the receiver/transmitter unit checks and/or compares selected voltages/signals during each program loop. If these checks or comparisons reveal any abnormality, one or more fault legends are displayed on the indicator. Also the annunciator control circuit stores the fault information. For display of fault legends, (Figure 1).

C. If there is a fault in one or more LRUs the appropriate LED on the front panel of the R/T unit will remain on when the TEST switch on the R/T unit is pressed. When the TEST switch is initially pressed and held, all the LEDs will come on for approximately one second to denote integrity of the LEDs. The LEDs are as follows:

R/T ---------- Receiver/Transmitter

ANT --------- Antenna

RANGE------MSP is Mode Select Panel (MSP)

CON -------- Control Panel

WG SW ---- Waveguide Switch

GYRO ------ Gyro

AIR ---------- Cooling

D. When system is in Test Mode, a good test pattern looks like the one shown in Figure 1, except for CAL (out of calibration) and COOL (cooling malfunction) fault displays, which are shown for location only.

5. To Operate System

A. Preparation

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(1) Set BRT control on EFIS control and dimming panels (CDP) fully counterclockwise.

(2) Set mode selector control to 160 miles.

(3) Adjust TILT control to 10 degrees UP.

(4) Set GAIN control to AUTO position.

(5) Set mode selector to TEST position.

(6) Adjust BRT controls for a convenient viewing level.

(7) Observe test pattern on ND indicators, for a satisfactory pattern indicates an operational system.

(8) After 3 minutes from initial turn-on the transmitter will be operative and test pattern should not change.

(9) Set mode selector to desired mode of operation.

(a) WX, for normal weather search operation.

(b) MAP, for ground mapping function.

(10) To shut down system, place control panel function switch in OFF position.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The weather radar system furnishes continuous enroute weather information relative to rainfall rate, thunderstorms, and areas of storm turbulence and icing conditions. The system provides the pilot with a display of storm conditions at extended ranges (maximum display range setting is 320 nautical miles). The area of radar surveillance is 180 degrees of azimuth (90 degrees right and left of aircraft heading) and 30 degrees of pitch (15 degrees above and below the stabilized horizontal). The major system components are the antenna assembly, receiver-transmitter, control panel and EFIS navigation display (ND) for visual indication. The system incorporates built-in test and monitor circuitry to provide system performance checks on the ground and in the air.

B. Antenna - The radar antenna is located in the radome covered portion of the aircraft nose section. The antenna provides both a transmitting and receiving function while scanning the 180 degree azimuth arc at a 15 look per minute rate. The antenna tilt angle, variable through the 30 degree pitch arc, determines the azimuth plane scanned. Antenna stabilization is provided to compensate for aircraft pitch and roll and maintains the antenna beam on a horizontal plane (as referenced to ground) or at a predetermined angle of tilt from the horizontal plane. The stabilization is accomplished with attitude system pitch and roll information and the tilt command signals from the manual tilt control. These are utilized to introduce corresponding changes to the antenna rotation planes. The antenna flat plate phased array radiator projects a beam for the weather mapping or ground surveillance functions. Ground surveillance is accomplished by pitching the antenna downwards with the manual tilt control. The stabilization circuitry is located in the receiver-transmitter unit. The pitch and roll stabilization assemblies, tilt assemblies, azimuth assemblies, and the waveguide assembly is contained within the antenna pedestal and linkage housing.

C. Receiver-Transmitter - The receiver-transmitter (R/T) provides the processing of all weather radar data, control and rf processes. It also provides supervision of antenna behavior and stabilization, and provides the processed data for the indicator. The R/T produces the microwave signals, processes the received return signals and generates the digital word used by the display unit to create the crt image. The signal produced is in the weather radar X-band. The following controls and indicators are located on the front panel of the R/T:

Table 1

Control	FUNCTION
OVERTEMPERATURE indicator	When set, indicates an overtemperature condition has occurred and that external cooling system should be checked. Indicator is manually reset.
RESET pushbutton	Resets the overtemperature indicator.
TIME indicator	Indicates elapsed operating time in hours.

D. EFIS Navigation Display (ND) Indicators -- The ND indicators provide a color display of weather and ground targets within the area scanned by the antenna. Digital processing enables presentation of several levels of rainfall density by using colors to display each level. The displays in the weather mode is as follows:

Table 2

Green	- level 1 (light precipitation)
Yellow	- level 2 (medium precipitation)
Red	- level 3 (and above (high precipitation))
Magenta	- turbulence detection

Table 2 (Continued)

Blue	- range marks, azimuth lines, and alphanumerics

In the MAP mode, displays are as follows:

Table 3

Green	Ground targets with low reflectivity (open ground, calm water)
Yellow	Medium reflectivity (Very rough water)
Red	High reflectivity (Cities)

E. All controls for operation of the weather radar system are located on the weather radar control panel except as noted and are as follows:

Table 4

Control	Function
RANGE SELECTOR (Located on EFIS mode select panel)	Enables power to indicator in any range position and selects range position of 10/5 mile marks, 20/5 mile marks, 40/10 mile marks, 80/20 mile marks, 160/40 mile marks, 320/80 mile marks.
PWR pushbutton	System power is applied by depressing the mechanically latching PWR pushbutton. Depressing the PWR pushbutton a second time will cause it to unlatch and remove system power.
TEST position	Activates test mode for both left and right ND's. Depressing TEST pushbutton a second time deactivates test mode and returns mode control to left and right sides of the control panel. During the test mode the transmitter is enabled for less than one second then muted for remaining portion of test. The ND's display a test pattern containing 3 concentric arcs consisting of one color each: red, yellow and green (from top to bottom). The pattern will also contain magenta wedges at +90, 0 and -90. The antenna system performs a test sequence, ending with the antenna stopping at bore sight (electrical zero) position.
WX position	Energizes the system for normal weather search operation and also energizes the contour function circuitry.
MAP position	Energizes the system for normal ground mapping operation.
TFR position	Depressing only the left TFR pushbutton causes the left ND to display the same mode, tilt, ground clutter suppression (GCS) and gain as the right ND. Depressing only the right TFR button causes the right ND to display the same mode, tilt, CGS, and gain as the left ND.
GCS pushbutton	Ground clutter suppression is enabled by selecting GCS pushbutton. In any of the weather detection modes (WX WX/T) clutter suppression reduces the intensity of the ground return. GCS should be disabled off during normal operation.
CAL GAIN Knob	Adjusts receiver sensitivity to enhance ground mapping (MAP mode only).
WX+T	Weather and turbulence (areas of turbulence represented by magenta (deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed.
TILT	Antenna tilt position is controlled by TILT control. The tilt range is from 15° DN (down) to 15° UP.

Table 4 (Continued)

Control	Function
Turbulence targets (detected precipitation moving at 5 m/s or more) are displayed only for selected ranges of 50 nm or less.	

F. Radar Antenna -- The weather radar antenna is located on the forward fuselage nose bulkhead and is accessible by opening and raising the aircraft nose radome. The antenna consists of a drive unit and flat plate array (reflector). The flat plate array is the means for radiating the pencil beam of rf energy and receiving the reflected signals for subsequent processing in the R/T unit and visual display on the ND indicators. The drive unit consists of an azimuth drive motor, tilt drive motor, an azimuth position synchro, and an elevation position synchro and moves the flat plate array in a 180 degree (90°L, 90°R) azimuth scan and a 45 degree (22-1/2° up, 22-1/2° dn) elevation scan. The antenna can be manually tilted ±15 degrees from the horizontal (zero degrees) and is stabilized over a combined tilt, pitch, and roll input of ±45 degrees.

2. Operation

A. The weather radar system operates by emitting very short intense pulses of microwave energy which are reflected by objects within the range of the system provided they have reflective characteristics. This reflected energy is picked up by the radar antenna and sent to the R/T unit. The signal is then amplified, detected, and converted into digital signals which are routed to the ND indicators. In the indicator, the digital signals produce visual indications that are representative of the size, intensity, bearing and distance of the target that reflected the radar signal.

B. In the weather mapping mode of operation, the visual indications on the ND indicators provide distinct levels of rainfall density by using four different colors.

C. The maximum range of the weather radar is dependent upon many factors of which the most important are: antenna gain, beam width of radiated energy, transmitter power, pulse width, prf, noise figure, receiver gain, radome, and interconnecting waveguide. When range limits greater than 40 nm are selected, only weather displays (green, yellow, red) will appear on the display beyond the 40 nm mark.

D. Weather Mapping

(1) The radar system provides storm detection up to a distance of approximately 320 nautical miles under defined penetration environment.

(2) Cloud formations having less moisture content than is required to reflect a minimum discernible echo signal will not appear on the ND indicators display.

(3) The color presentation gives immediate indication of the location of severe storm areas; these areas might contain air turbulence which should be avoided.

E. Ground Mapping

(1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the ND indicators in slant range and in azimuth bearing with respect to the heading of the aircraft.

(2) Of prime importance is the extension of the range of vision of the Capt/F.O. and ability to see this terrain map even during darkness and overcast conditions when visibility is restricted. The display in ground mapping resembles a pilotage chart and is easily interpreted. Cities, open ground, and bodies of water are distinguished by the intensity of the signals they reflect back to the antenna. Cities usually provide the most intense reflections; open ground and water provide progressively less intense reflections. Calm water reflects very little signal back to the antenna, very rough water provides a signal return of considerable strength.

F. Turbulence Detection

(1) Turbulence detection is used to isolate turbulence in storm cells where severe wind shear conditions may exist. Turbulence detection requires the presence of precipitation and does not display clear air turbulence.

(2) Turbulence display on the indicator (magenta) is limited to a range of 40 nm. When ranges greater than 40 nm are selected, only weather mapping will appear beyond the 40 nm mark.

3. To Operate System

NOTE: The weather radar system is equipped with self-test features that provide for a rapid check of the system operation on the ground.

WARNING: STAY CLEAR OF THE WEATHER RADAR ANTENNA WHEN THE SYSTEM IS IN OPERATION AND THE RADOME IS OPEN. THE ANTENNA CAN HIT OR CATCH PERSONNEL WHILE IT MOVES. DO NOT TOUCH THE ANTENNA SURFACE WHILE THE ANTENNA TRANSMITS MICROWAVE ENERGY. THESE CONDITIONS CAN CAUSE INJURY TO PERSONS.

A. Preparation - Before activating the radar, set the controls and switches on the indicator to the following positions:

CONTROL PANEL:	MAP GAIN	Max CW
	TILT	0°
	PWR	OFF
EFIS MSP:	RNG	160
OVERHEAD SWITCH PANEL:	IRS	NAV
EFIS CDP:	BRT	Max CW

B. Turn-On - To turn-on the radar, proceed as follows:

(1) Verify circuit breakers for receiver-transmitter and EFIS are closed.

(2) Press PWR switch on control panel.

(3) Press TEST pushbutton on control panel.

(4) Word TEST will appear at top left on ND. Antenna will scan left-to-right and up-to-down tilt cycle. Antenna completes one scan/tilt cycle and stops at zero tilt angle.

NOTE: Tilt angle will be shown in lower right-hand corner of display (±15° -0° -15° -0°). Observe if any fail message appears on indicator.

(5) Observe Test Pattern. ND should display red, yellow and green (top to bottom) plus magenta wedges at +90, 0 and -90.

(6) Select MODE and RNG as desired for operation.

(7) Turn off system by pressing PWR pushbutton on control panel.

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The weather radar system provides the Captain and First Officer with weather mapping, terrain mapping, and turbulence detection in the presence of precipitation. Storm conditions can be indicated up to a range of 320 nautical miles. Visual indications are depicted on the EFIS Navigation Displays (ND's) on the Captain's and First Officer's instrument panels. The storm areas in the flight path of the aircraft and the intensity of the storm are depicted on the indicator in green, yellow, red and magenta. By observing the visual storm indications the pilot can determine corridors of calm in the storm areas and maneuver the aircraft through these corridors to provide for the safety of the aircraft and passenger comfort.

B. The weather radar system consists of a weather radar control panel, radar receiver transmitter, and the radar antenna. The components are described in the following Description paragraphs.

2. Description

A. Receiver/Transmitter -- The weather radar R/T is a completely solid state unit. It generates the microwave energy that is transmitted through the waveguides to the antenna for transmission. Reflected energy received by the antenna is transmitted to the R/T unit, processed and converted into digital signals which are sent to and displayed on the ND's radar indicator as visual information.

B. The receiver/transmitter is located in the forward accessory compartment and is accessible through the nosewheel access door. The mounting tray in which the R/T unit is installed contains a fan for cooling of the R/T unit. The front panel of the R/T has maintenance controls and adjustments, and LED fault code display.

C. EFIS Navigation Display (ND) -- Provide a color display of weather and ground targets within the area scanned by the antenna. Digital processing enables presentation of several levels of rainfall density by using colors to display each level. The displays in the weather mode is as follows:

Table 1

Black	- level 0 (very low or no precipitation)
Green	- level 1 (light precipitation)
Yellow	- level 2 (medium precipitation)
Red	- level 3 (high precipitation)
Magenta	- level 4 (turbulence detection when precipitation is present; clear air turbulence is not displayed)
Blue	- range marks, azimuth lines, and alphanumerics

D. In the MAP mode, display are as follows:

Table 2

Black	- No reflectivity
Cyan	- Ground, targets with low reflectivity (open ground, calm water)
Yellow	- Medium reflectivity (very rough water)
Magenta	- High reflectivity (cities)

E. Controls for operation of the weather radar system are located on the weather radar and EFIS control panels (as noted) and are as follows:(Figure 1).

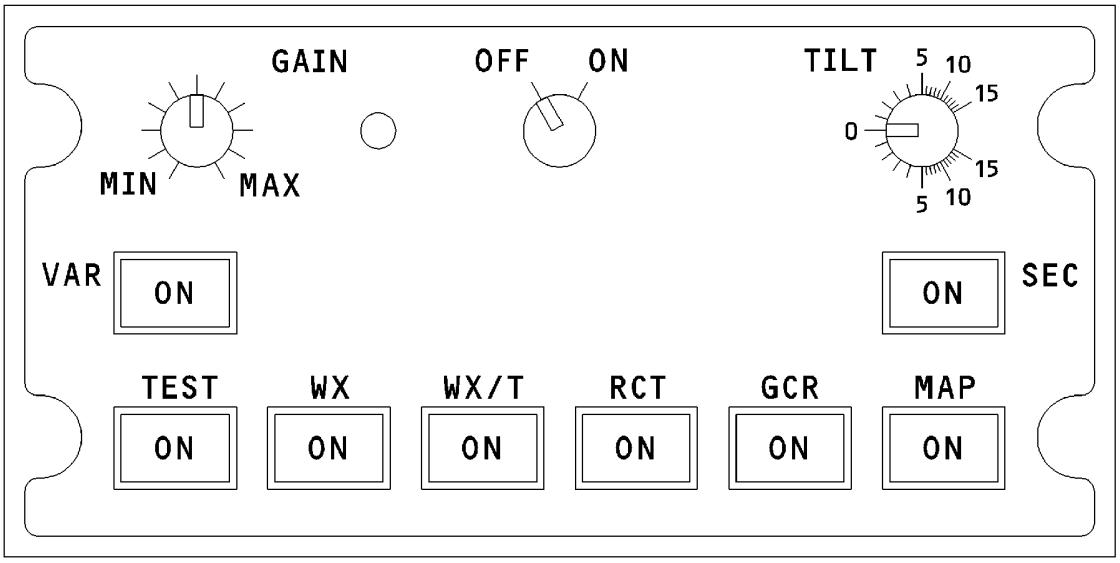
Table 3

Control	FUNCTION
RANGE SELECTOR (on EFIS Mode Select Panels)	Selects range position of 10, 20, 40, 80, 160, or 320 miles. MSP's are below clearview windows.
WX BRT (on EFIS Control and Dimming Panels)	Variable adjust for cockpit light conditions. During ground mapping mode, adjusts with control panel GAIN for best presentation. Turns off weather radar display when rotated fully counterclockwise. CDP's are on Capt's and F/O's instrument panels.
WXR Control Panel	
OFF/ON switch	Controls power to WXR system. Puts system in STBY mode when turned ON, until another mode is selected.
TEST pushbutton	Starts self test; test pattern comes into view on the ND's.
VAR pushbutton	Selects variable gain. Enables GAIN control when ON. Disables GAIN control when OFF.
WX pushbutton	Selects normal weather search operation.
WX/T pushbutton	Used to isolate turbulence in storm cells where severe wind shear conditions may exist. Maximum turbulence display range 40 nm.
RCT pushbutton	Enables the Rain Echo Attenuation Compensation Technique (REACT) circuits. Receiver gain is automatically adjusted according to received signal strength.
GCR pushbutton	Enables the Ground Clutter Reduction (GCR) circuits. Any signal with a high probability of originating from ground returns will automatically be reduced in the display.
MAP pushbutton	Selects normal ground mapping operation.
SEC pushbutton	Reduces displayed scan on ND's to 90 degree sector when ON. Scan returns to 180 degree sector when SEC button is off.
GAIN control knob	Adjusts receiver gain, as required, to improve resolution of selected targets or to distinguish prominent targets from surrounding terrain. Gain control is activated only when VAR button is ON.
Antenna Tilt Control	Antenna tilt control, calibrated in 5 degree increments, provides remote control of the antenna elevation and depression.

NOTE: Control Panel pushbutton lights come on when mode is selected.

F. Radar Antenna -- The weather radar antenna is located on the forward fuselage nose bulkhead and is accessible by opening and raising the aircraft nose radome. The antenna consists of a drive unit and flat plate array (reflector). The flat plate array is the means for radiating the pencil beam of rf energy and receiving the reflected signals for subsequent processing in the R/T unit and visual display on the indicators.

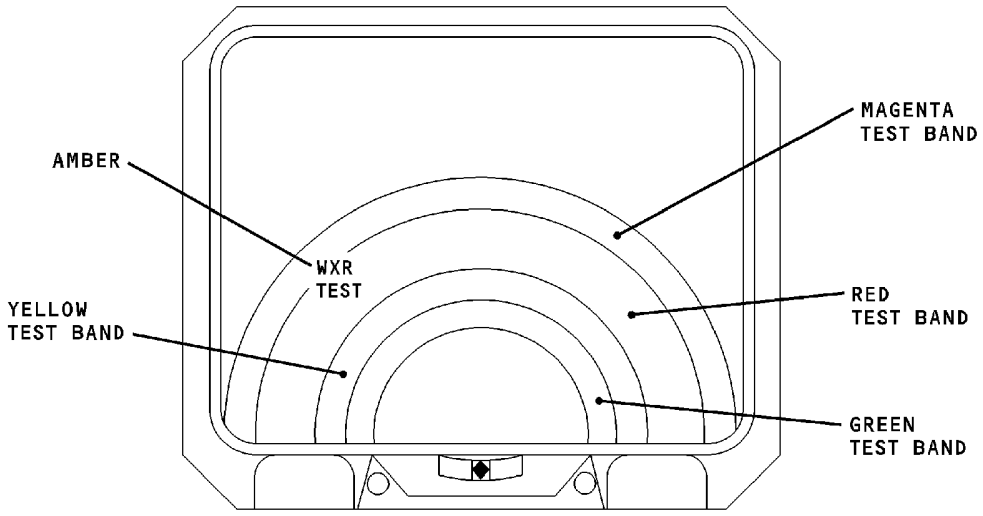
(1) The drive unit consists of an azimuth drive motor, tilt drive motor, an azimuth position synchro, and an elevation position synchro and moves the flat plate array in a 180 degree (90°L, 90°R) azimuth scan and a 45 degree (45° up, 45° dn) elevation scan. The antenna can be manually tilted ±15 degrees from the horizontal (zero degrees) and is stabilized over a combined tilt, pitch, and roll input of ±45 degrees. When system is turned off, antenna is held in position by azimuth and elevation brakes.



CAG(IGDS)

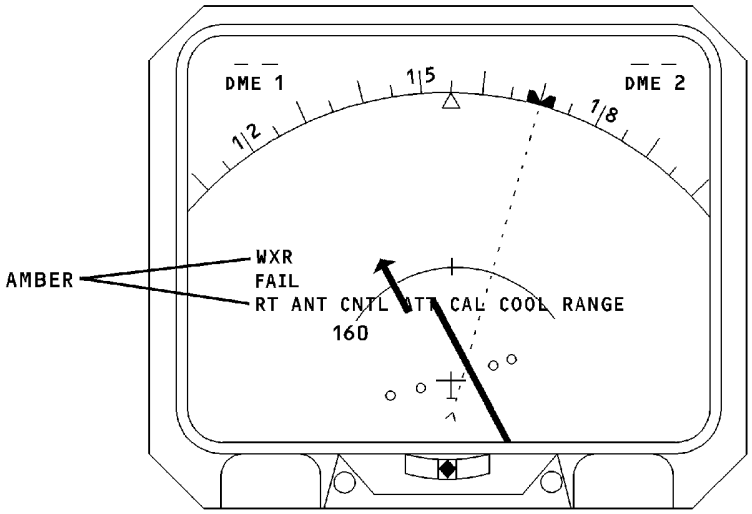
BBB2-34-1708

Weather Radar Control Panel
Figure 1/34-41-00-990-829



TEST PATTERN

NOTE: MAGENTA TEST BAND WILL BE DISPLAYED IF RANGE IS 40 NM OR LESS. AN UNBROKEN 20 NM WIDE NOISE BAND WILL BE DISPLAYED IF RANGE IS 160 NM.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-1709

Weather Radar Test Pattern and Fault Display
Figure 2/34-41-00-990-830

3. Operation

A. The weather radar system operates by emitting very short intense pulses of microwave energy which are reflected by objects within the range of the system provided they have reflective characteristics. This reflected energy is picked up by the radar antenna and sent to the R/T unit. The signal is then amplified, detected, and converted into digital signals which are routed to the indicator. On the ND's, the digital signals produce visual indications that are representative of the size, intensity, bearing and distance of the target that reflected the radar signal.

B. In the weather mapping mode of operation, the visual indications on the ND's provide distinct levels of rainfall density by using four different colors. Refer to Paragraph 2.B. for density of rainfall for each color.

C. The maximum range of the weather radar is dependent upon many factors of which the most important are: antenna gain, beam width of radiated energy, transmitter power, pulse width, prf, noise figure, receiver gain, radome, and interconnecting waveguide. Turbulence display (magenta) is limited to 40 nm. When range limits greater than 40 nm are selected, only weather displays (green, yellow, red) will appear on the display beyond 40 miles.

D. Weather Mapping

(1) The radar system provides storm detection up to a distance of approximately 320 nautical miles.

(2) Cloud formations having less moisture content than is required to reflect a minimum discernible echo signal will not appear on the indicator display.

(3) The color presentation gives immediate indication of the location of severe storm areas; these areas might contain air turbulence which should be avoided.

E. Turbulence Detection

(1) Turbulence detection is used to isolate turbulence in storm cells where severe wind shear conditions may exist. Turbulence detection requires the presence of precipitation and does not display clear air turbulence.

(2) Turbulence display on the indicator (magenta) is limited to a range of 40 nm. When ranges greater than 40 nm are selected, only weather mapping will appear beyond 40 miles.

F. Ground Mapping

(1) Ground mapping with the radar system provides a plan picture of prominent landmarks and terrain features such as cities, shore lines, mountains, islands, bays, bridges, etc. These terrain features are presented on the indicator in slant range and in azimuth bearing with respect to the heading of the aircraft.

(2) Of prime importance is the extension of the range of vision of the pilot and of his ability to see this terrain map even during darkness and overcast conditions when visibility is restricted. The display in ground mapping resembles a pilotage chart and is easily interpreted. Cities, open ground, and bodies of water are distinguished by the intensity of the signals they reflect back to the antenna. Cities usually provide the most intense reflections; open ground and water provide progressively less intense reflections. Calm water reflects very little signal back to the antenna, very rough water provides a signal return of considerable strength.

4. Test and Fault Indication

A. Fault isolation of the weather radar system can be performed by observing the display on the ND or by observing the LED fault codes on the receiver/transmitter unit.

B. The microprocessor based monitor system in the receiver/transmitter unit checks and/or compares selected voltages/signals during each program loop. If these checks or comparisons reveal any abnormality, one or more fault legends are displayed on the ND as follows:

- WXR FAIL
- RT
- ANT
- CNTL
- ATT
- CAL
- COOL
- RANGE

C. When TEST button is ON, the test pattern is displayed on the ND's (Figure 2).

5. To Operate System

WARNING: STAY CLEAR OF THE WEATHER RADAR ANTENNA WHEN THE SYSTEM IS IN OPERATION AND THE RADOME IS OPEN. THE ANTENNA CAN HIT OR CATCH PERSONNEL WHILE IT MOVES. DO NOT TOUCH THE ANTENNA SURFACE WHILE THE ANTENNA TRANSMITS MICROWAVE ENERGY. THESE CONDITIONS CAN CAUSE INJURY TO PERSONS.

A. Preparation

(1) Make sure Inertial Reference Systems are aligned (INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-43-00/201).

(2) On EFIS MSP's, place MODE knob to ARC, and RANGE knob to 160.

(3) On EFIS CDP's, place WX BRT knob to mid range.

(4) On WXR control panel, adjust TILT control clockwise to +15 degrees.

(5) Set GAIN control to MIN position.

(6) Set OFF/ON switch to ON position. STBY appears on ND's.

(7) Press TEST button. WXR TEST and test pattern is displayed on ND's (Figure 2).

(8) On EFIS CDP's, adjust WX BRT knob for a convenient viewing level.

(9) Select desired mode of operation.

WEATHER RADAR SYSTEM - TROUBLESHOOTING

1. General

A. Trouble shooting provided in this section are basic procedures for isolating and correcting a faulty weather radar system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable Units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 401-404, 412, 414

D. The major components of the system are: the weather radar indicator, antenna, receiver/transmitter and waveguides. For operation of the system, refer to WEATHER RADAR SYSTEM, SUBJECT 34-41-00, Page 201.

WJE 405-411, 873-881, 883, 884, 886, 887, 892, 893

E. The major components of the system are: the weather radar indicator, antenna, and receiver/transmitter. For operation of the system, refer to WEATHER RADAR SYSTEM, SUBJECT 34-41-00, Page 201.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

F. The major components of the system are: the weather radar indicator, (non-EFIS aircraft), antenna, receiver/transmitter and waveguides. For operation of the system, refer to WEATHER RADAR SYSTEM, SUBJECT 34-41-00, Page 201.

G. On aircraft with Electronic Flight Instrument System (EFIS) weather radar indications are displayed on the EFIS navigation displays (NDs) located on the captain's and first officer's instrument panels.

WJE 875-879

H. Weather radar indications can also be displayed on the EFIS navigation displays (NDs).

WJE 407, 408, 411, 880

I. On aircraft with Electronic Flight Instrument System (EFIS) weather radar indications can also be displayed on the EFIS navigation displays (NDs).

WJE 401-404, 412, 414

J. Weather radar indications are displayed on the Electronic Flight Instrument System (EFIS) navigation displays (NDs) located on the captain's and first officer's instrument panels.

WJE ALL

WJE 401-404, 412, 414

K. The components and interfacing EFIS indicators are located as follows:

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

The components are located as follows:

WJE ALL

Table 101

Component	Location
WJE 407, 408, 411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-880, 891	
Weather Radar Indicator (non-EFIS aircraft)	Flight Compartment
WJE 401-404, 412, 414, 875-879	
EFIS Navigation Display (ND)	Captain's and F/O's instrument panels
WJE 401-404, 412, 414	
EFIS Primary Flight Display (PFD)	Captain's and F/O's instrument panels
WJE 406, 873, 874, 886, 887	
Weather Radar Indicator	Flight Compartment
WJE ALL	
Weather Radar Antenna	Nose Radome
Weather Radar Receiver/Transmitter	Forward Accessory Compartment
Weather Radar XCVR Circuit Breaker	Upper EPC Circuit Breaker Panel
WJE 406, 873, 874, 886, 887, 892, 893	
Weather Radar Ind. Circuit Breaker	Upper EPC Circuit Breaker Panel
WJE 407, 408, 411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-880, 891	
Weather Radar Ind. Circuit Breaker (NON-EFIS AIRCRAFT)	Upper EPC Circuit Breaker Panel
WJE ALL	

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A Dana	

3. Trouble Shooting Weather Radar System

A. Trouble Shoot

WJE 406, 873, 874, 886, 887, 892, 893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are weather radar indicator, antenna, and receiver.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are weather radar indicator, (non-EFIS aircraft), antenna, and receiver.

WJE 401-404, 412, 414

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are weather radar antenna, and receiver. Interfacing EFIS displays are the EFIS ND AND PFD.

WJE ALL

Table 103

Procedures		Correction
WJE 875-879		
(1)	Note indicator (weather radar or EFIS ND) for any fault displays in TEST mode of operation.	If fault indicated perform step (2) and investigate LRU indicated.
WJE 401-404, 412, 414		
(1)	Note NDs for any faults displayed in TEST mode of operation.	If fault indicated perform step (2) and investigate LRU indicated.
WJE 873, 874		
(1)	Note indicator for any fault displays in TEST mode of operation.	If fault indicated perform step (2) and investigate LRU indicated.
WJE 406, 886, 887, 892, 893		
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
WJE 405, 407-409, 411, 873-881, 883, 884		
(2)	Press and hold TEST pushbutton on Receiver Transmitter Unit (after initial check, release TEST pushbutton).	If any fault annunciator remains on after initial annunciator LEDs come on and go off, check LRU indicated as fault.
WJE 401-404, 410, 412, 414-427, 429, 861-866, 868, 869, 871-874, 891		
(2)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
WJE 406, 886, 887, 892, 893		
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
WJE 401-405, 407-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 891		
(3)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
WJE 406, 886, 887, 892, 893		
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

WJE 406, 886, 887, 892, 893 (Continued)

Table 103 (Continued)

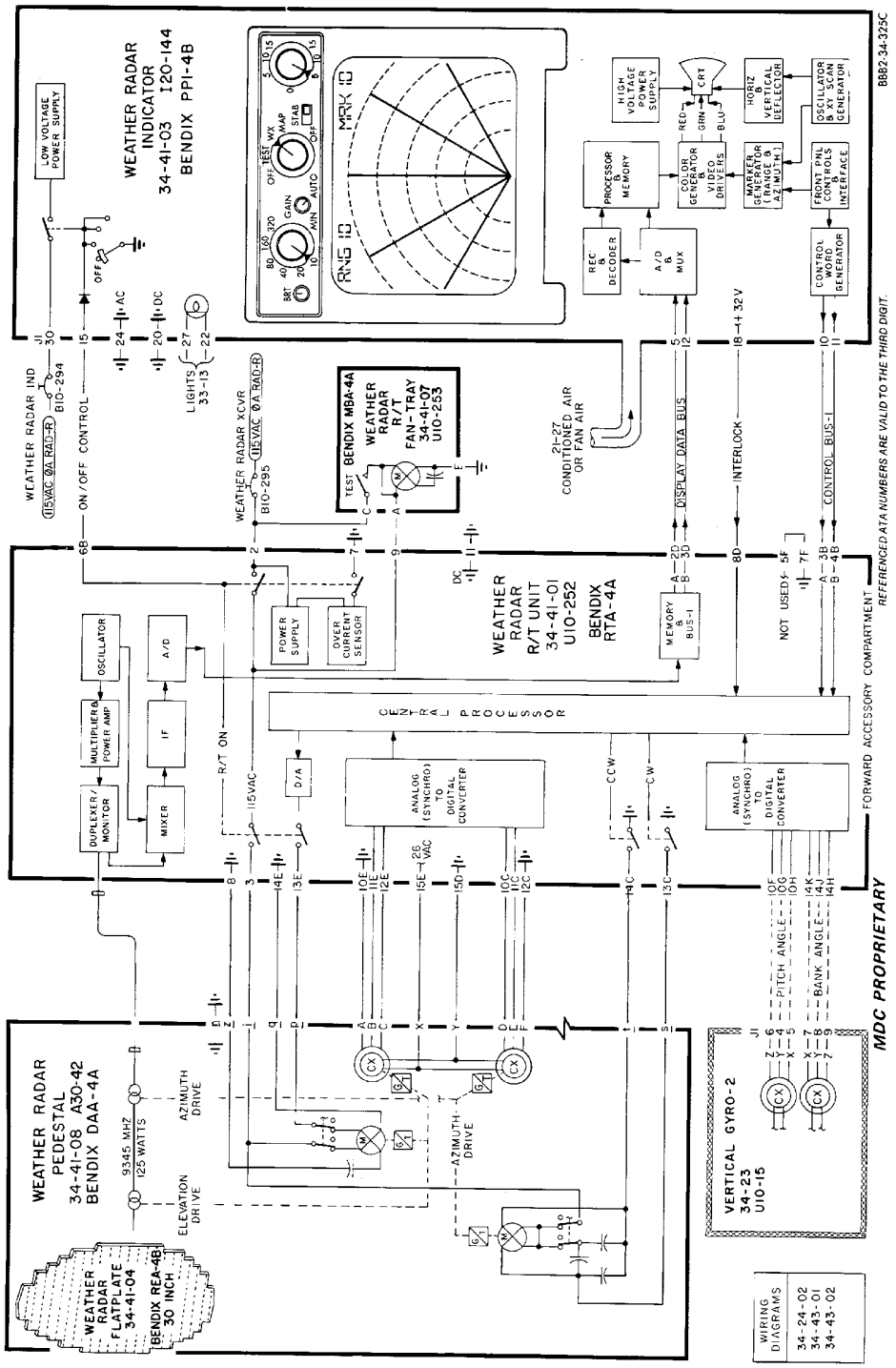
Procedures		Correction
WJE 875-879		
(3)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(4)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
WJE 401-405, 407-412, 414-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891		
(4)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
WJE 873, 874		
(4)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
WJE 406, 886, 887, 892, 893		
(4)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
WJE 875-879		
(5)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
WJE 401-405, 407-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 891		
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
WJE 406		
(5)	Erratic operation of antenna, switch AHRS switch to R on AUX.	If corrected check or replace AHRS-2.
NOTE: On some aircraft for the erratic operation of antenna, place VERT GYRO switch to R on AUX. If corrected, check or replace vertical gyro-2.		
WJE 886, 887, 892, 893		
(5)	Erratic operation of antenna, switch VERT GYRO switch to R on AUX.	If corrected check or replace vertical gyro-2.
WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893		
(6)	Check waveguides for loose connections or damaged waveguides.(WEATHER RADAR WAVEGUIDES - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-05/201) Inspect waveguides for internal moisture.	Replace or correct as necessary.

WJE 401-412, 414-427, 429, 861-866, 868, 869, 871-874, 880, 881, 883, 884, 886, 887, 891-893 (Continued)

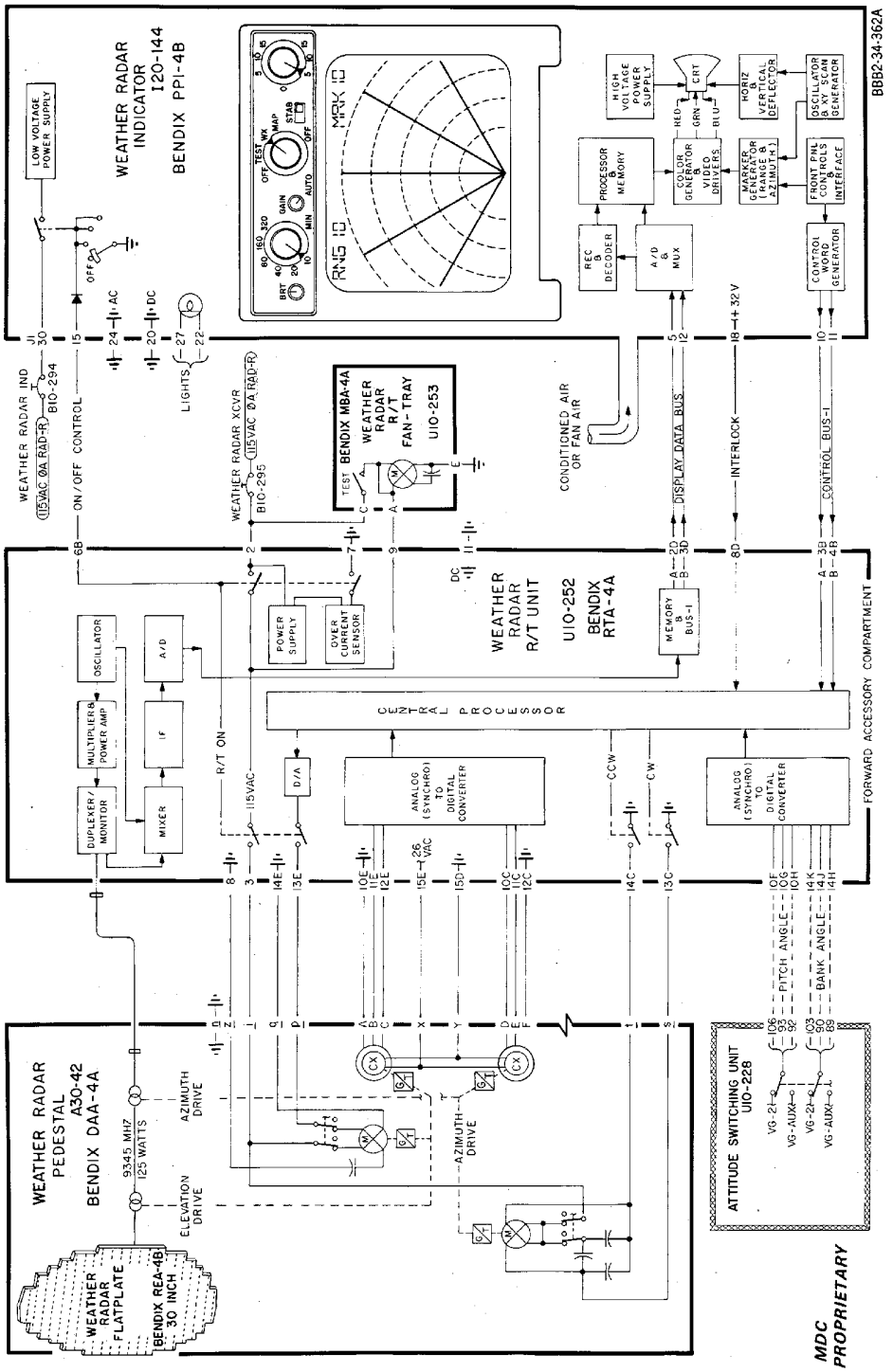
Table 103 (Continued)

Procedures		Correction
WJE 875-879		
(6)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.
(7)	Check waveguides for loose connections or damaged waveguides.(WEATHER RADAR WAVEGUIDES - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-05/201) Inspect waveguides for internal moisture.	Replace or correct as necessary.

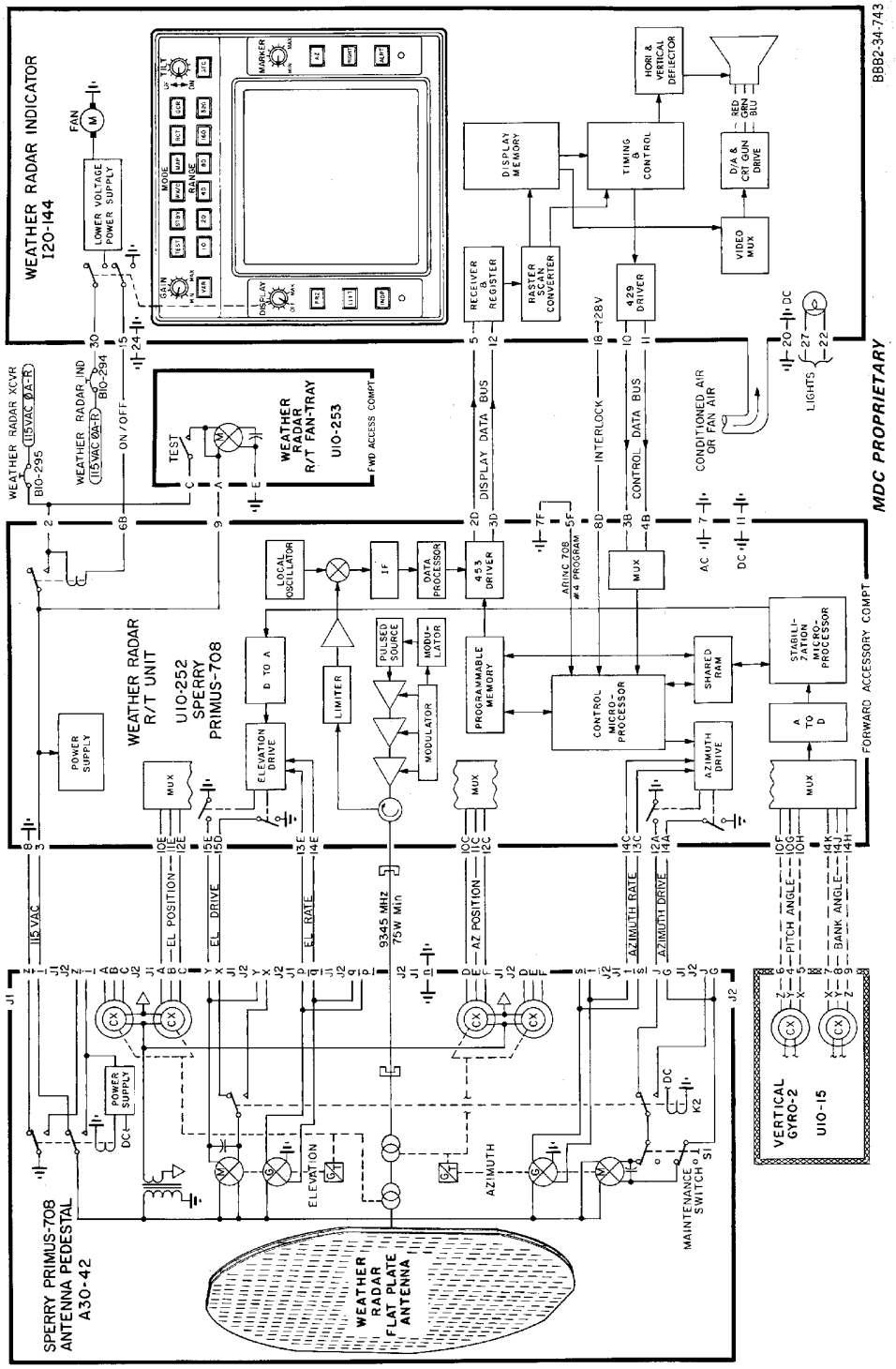
WJE ALL



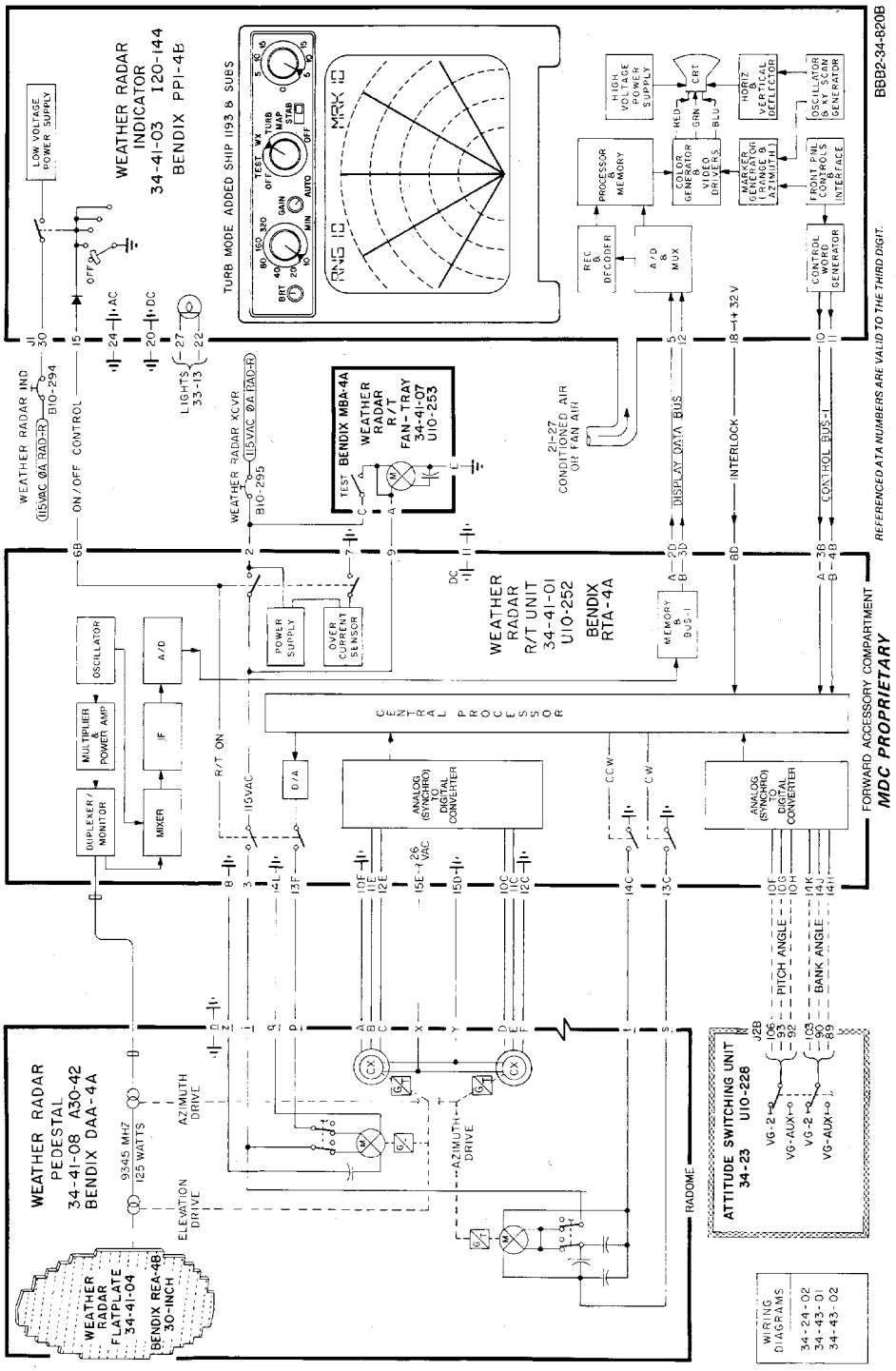
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 1 of 11)



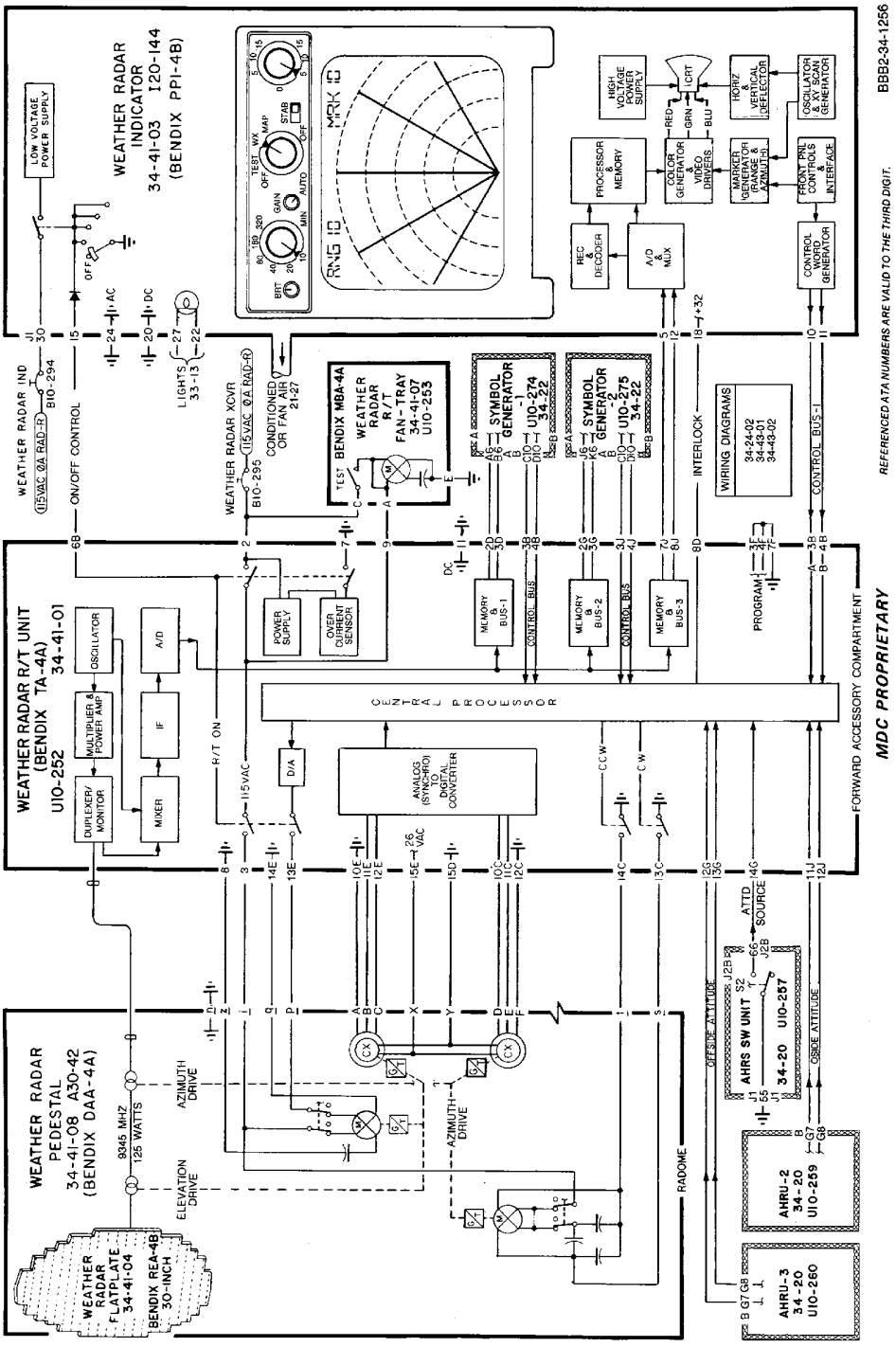
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 2 of 11)



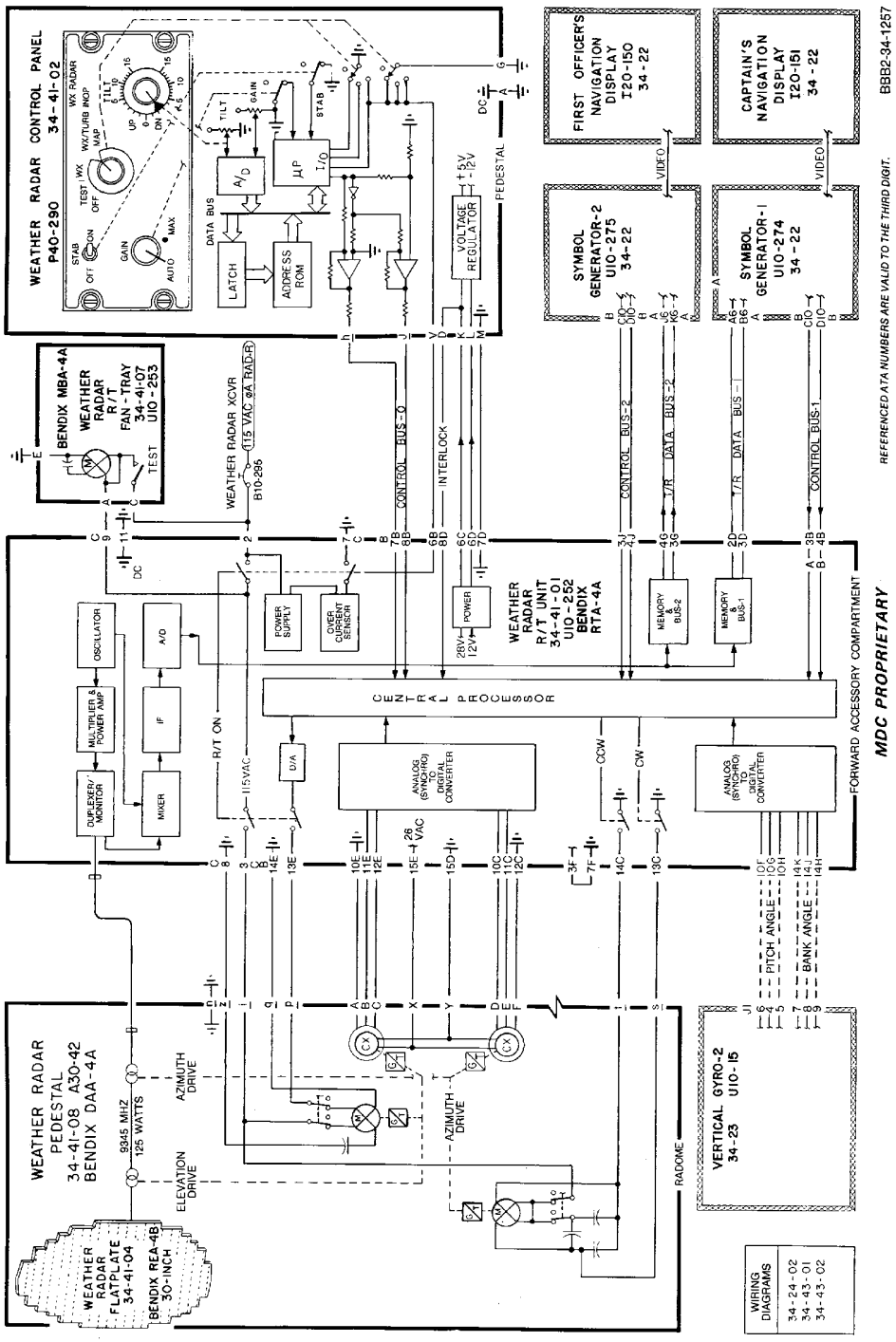
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 3 of 11)



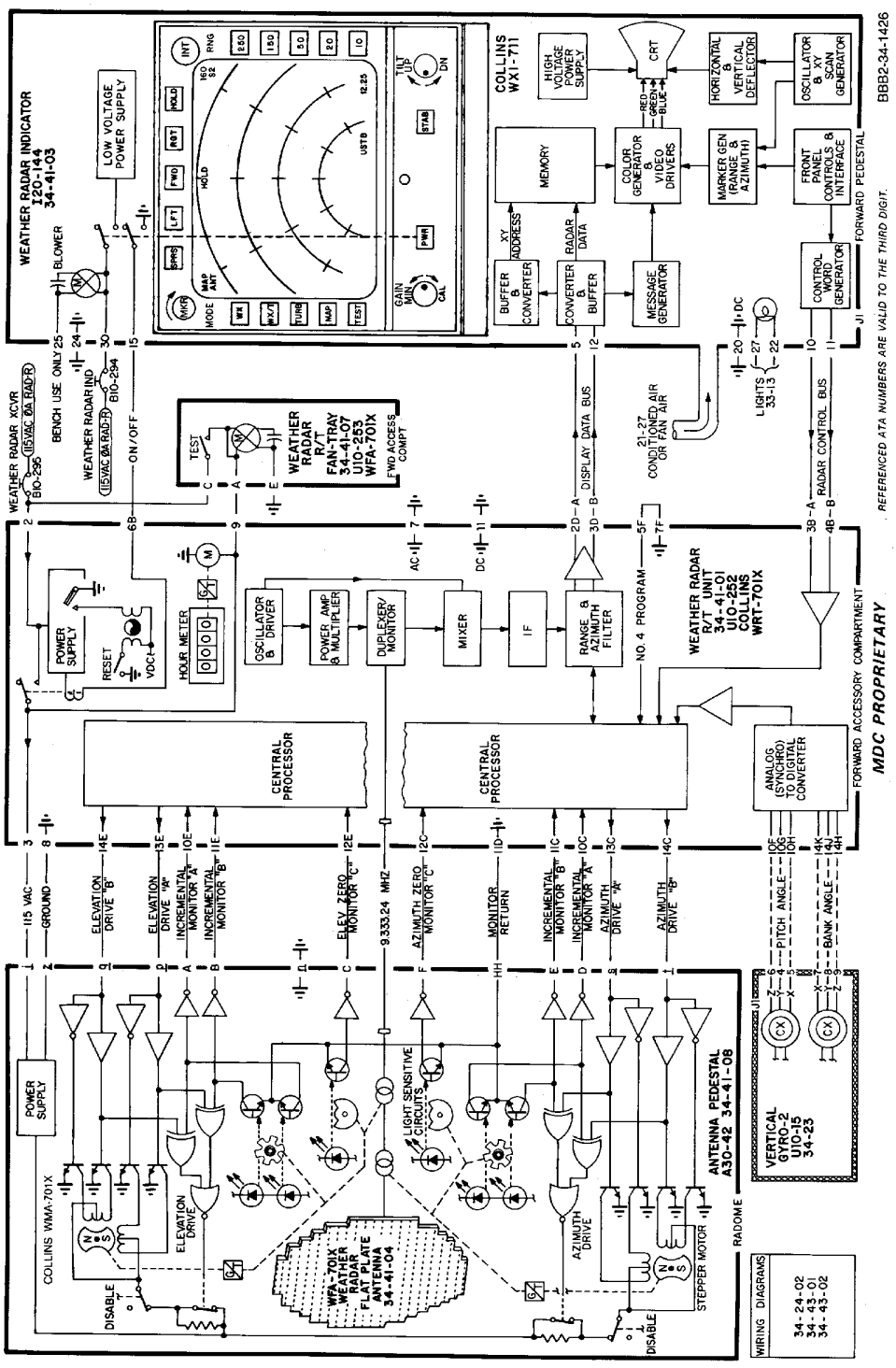
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 4 of 11)



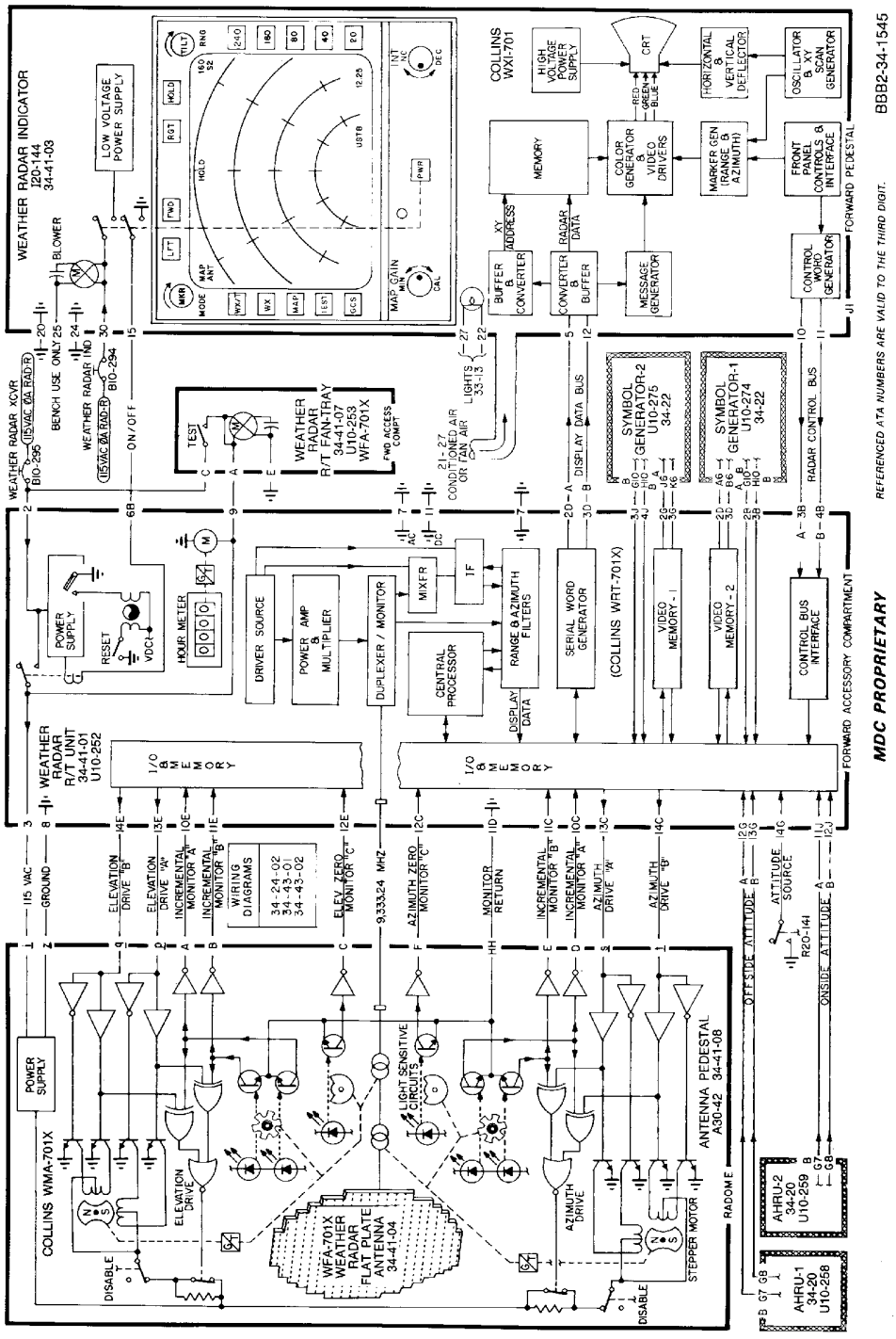
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 5 of 11)



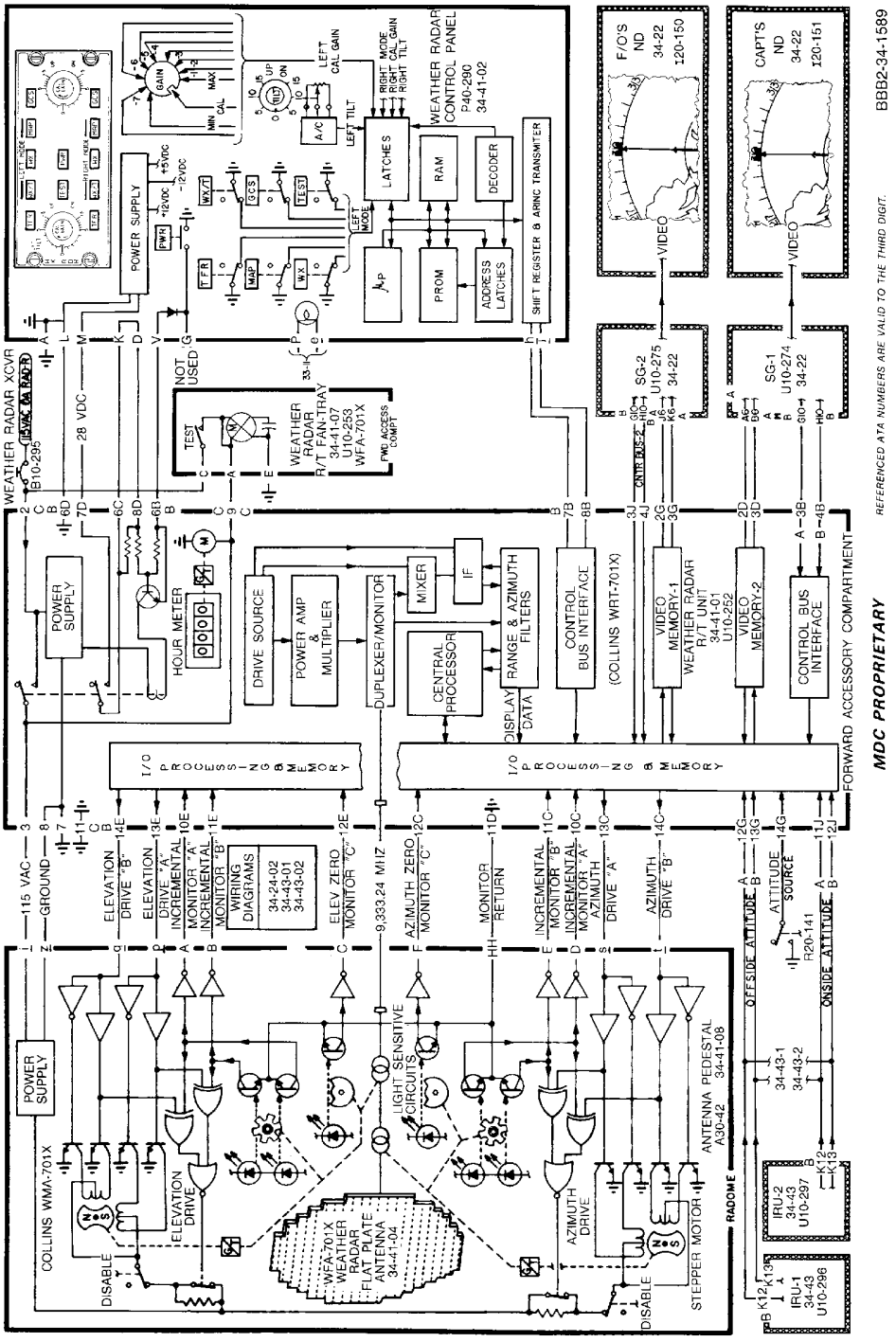
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 6 of 11)



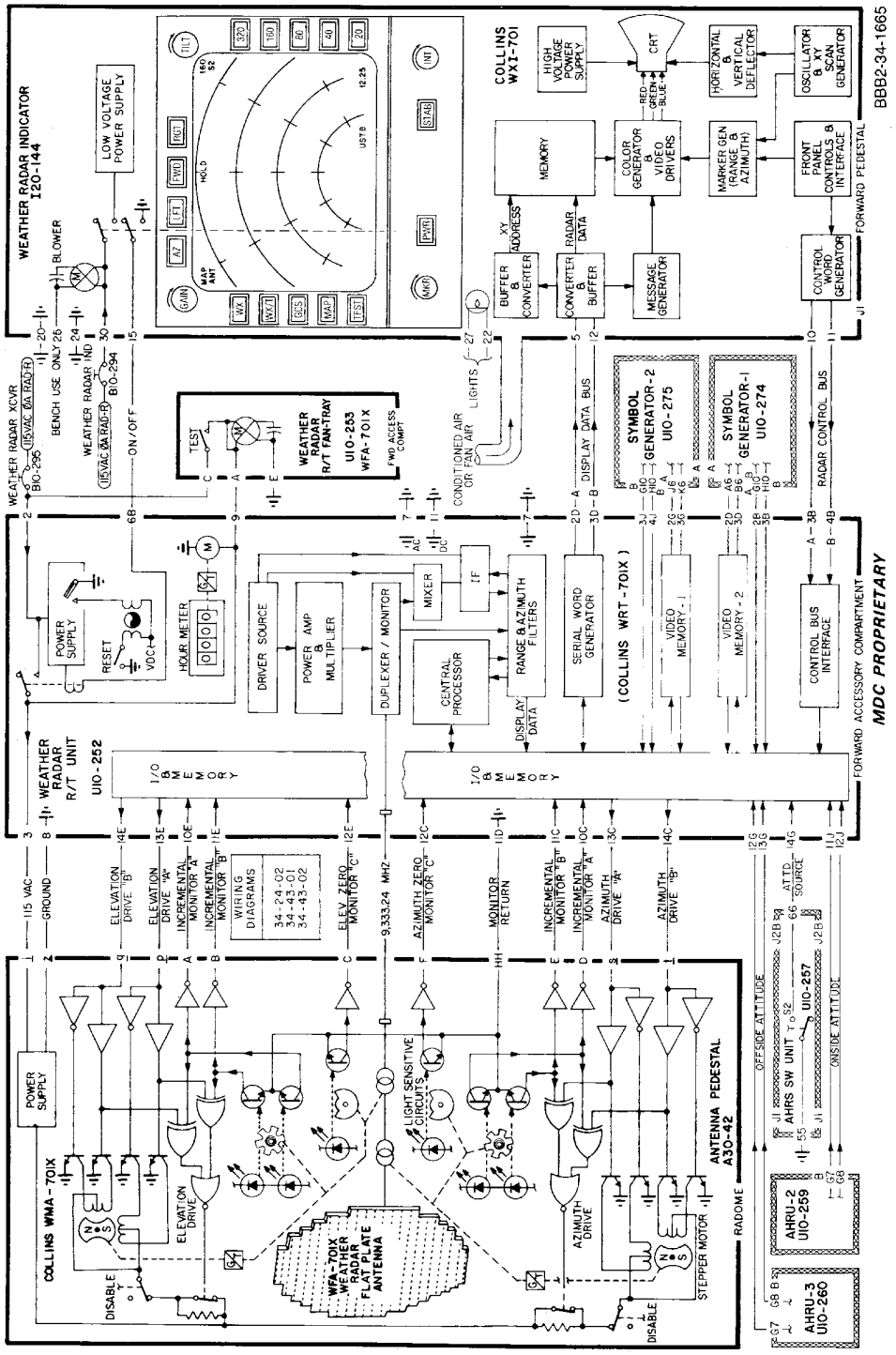
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 7 of 11)



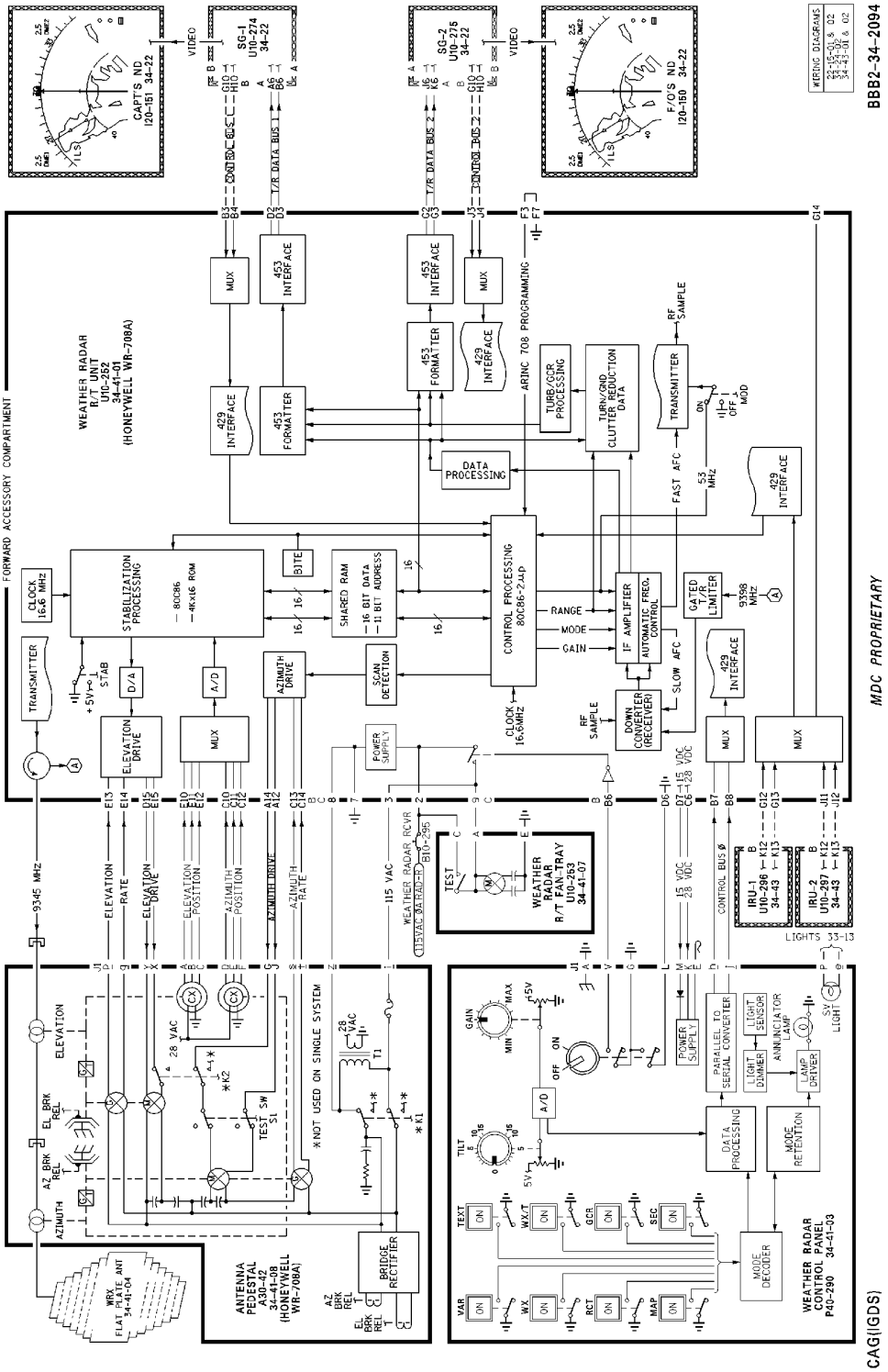
Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 8 of 11)



Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 9 of 11)



Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 10 of 11)



Weather Radar System -- Schematic
Figure 101/34-41-00-990-856 (Sheet 11 of 11)

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure they are held securely and free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the TEST button on the weather radar control panel is ON, a special test pattern is displayed on the Navigation Displays (ND's) for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of malfunctions within the system. Malfunctions are shown by messages displayed on the ND's.

C. The ND's will display weather radar patterns when the MODE knob on the EFIS Mode Select Panel is in ARC position, and the WX BRT knob on the Control and Dimming Panel is not in WX OFF position.

2. Adjustment/Test

WARNING: DO NOT DO INTERNAL MAINTENANCE WHILE ELECTRICAL POWER IS SUPPLIED TO THE EQUIPMENT. PERMIT ONLY APPROVED PERSONS WHO FULLY KNOW THE EQUIPMENT TO DO THE TEST. ALWAYS OBEY THE SAFETY PRECAUTIONS. IF SAFETY PRECAUTIONS ARE NOT FOLLOWED, INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

A. Open Radome

WARNING: MAKE SURE THE RADOME IS FULLY OPENED AND THE HOLD-OPEN STRUTS ARE FULLY EXTENDED AND CORRECTLY LOCKED. IF THE HOLD-OPEN STRUTS ARE NOT FULLY EXTENDED AND LOCKED, THE RADOME CAN ACCIDENTALLY MOVE OR CLOSE. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: DO NOT OPEN THE RADOME WHEN THERE ARE WINDS OF MORE THAN 60 MPH (52 KNOTS). TOO MUCH WIND CAN BREAK THE SUPPORT ARMS OF THE OPEN RADOME. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: GET SUFFICIENT AID FROM PERSONS AND EQUIPMENT TO HOLD THE RADOME UP. MAKE SURE YOU PREVENT SUDDEN MOVEMENTS OF THE RADOME AGAINST THE AIRCRAFT WHEN YOU REMOVE OR INSTALL THE HINGE BOLTS. THE RADOME WEIGHS APPROXIMATELY 65 LBS (29.5 KG). IF YOU LET THE RADOME MOVE SUDDENLY OR FALL, INJURY TO PERSONS OR DAMAGE TO THE RADOME CAN OCCUR.

WARNING: GET SUFFICIENT AID FROM PERSONS TO OPEN OR CLOSE THE RADOME SAFELY DURING SUDDEN WIND CHANGE CONDITIONS. THE RADOME WEIGHS APPROXIMATELY 65 LBS (29.5 KG). IF THE RADOME MOVES SUDDENLY WITHOUT CONTROL, INJURY TO PERSONS AND DAMAGE TO THE RADOME CAN OCCUR.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

Table 201

	Operation	Desired Result
(1)	On control panel, rotate TILT knob fully clockwise to +15 position. Rotate GAIN knob fully counter clockwise to MIN position.	
(2)	On antenna mount, place SCAN switch to ON position.	
(3)	On Capt's and F/O's MSP's, place MODE knob to ARC, and RANGE knob to 160.	
(4)	On Capt's and F/O's CDP's, place WX BRT knob to midrange position.	
(5)	If IRS is not initialized, perform steps (6) through (8). See 34-43-00, Page 201, if necessary.	
(6)	On overhead panel, place IRS MODE SELECT switch to NAV. On MCDU-1 (or -2), press MENU button.	MCDU MENU page displayed on MCDU.
(7)	On MCDU, press 5L key to select IRS INIT/REF page. Enter correct latitude and longitude, and press 5R key to set IRS position.	IRS position entered.
(8)	Wait for IRS to align (2.5 to 10 minutes).	On PFD's, ATT FAIL message goes off. On ND's, HDG FAIL message goes off. On RDMI's, heading flag is out of view.

C. EFIS Display Test

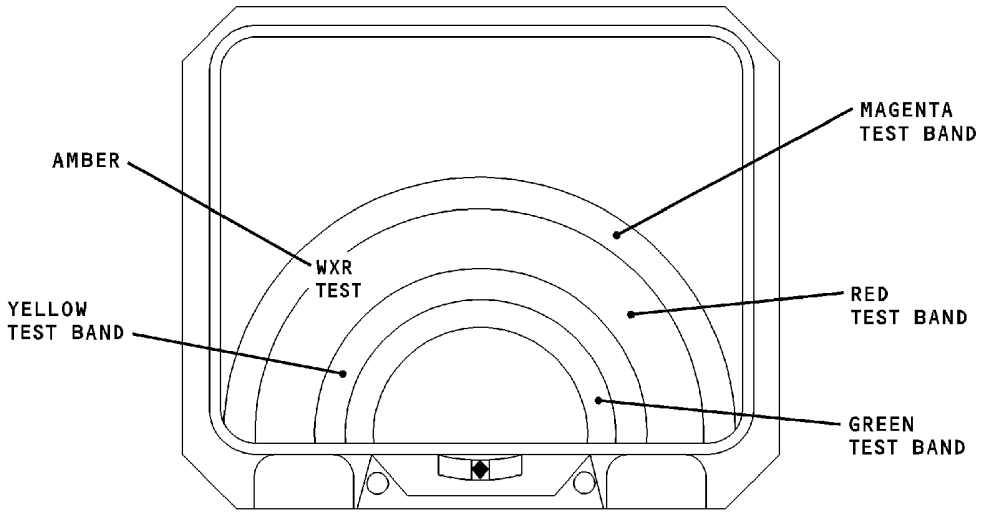
	operation	Desired Result
(1)	On WXR control panel, place OFF/ON switch to ON position.	STBY is shown on ND's until another mode is selected.
(2)	Place hand over top of the receiver/transmitter and feel for airflow coming out of top of unit.	Receiver/transmitter cooling fan working correctly.
(3)	On WXR control panel, press and release WX button.	WX button light comes on. If WX ATT is shown on ND's, make sure IRS is initialized.
(4)	Press and release TEST button.	TEST button light comes on. WXR TEST shown on ND's. Test pattern is similar to Figure 201, with noise band outside red test band.
(5)	On Capt's and F/O's MSP's, place RANGE knobs to 40.	Magenta test band comes on ND test pattern. (Figure 201)

(Continued)

operation		Desired Result
(6)	Make sure no fault legends are shown on ND's as follows: • RT -- R/T failure • ANT -- Antenna failure • CNTL -- Control panel failure • ATT -- Attitude failure • CAL -- Calibration • COOL -- R/T cooling failure • RANGE -- Range failure (MSP)	No faults displayed on ND's. If any faults are shown, stop test and replace defective part before repeating test.
(7)	On WXR control panel, press and release SEC button and check display on ND's.	SEC button light comes on. Radar scan on ND's reduces from a 180 degree sector to a 90 degree sector.
(8)	Press and release SEC again and check ND's.	SEC button light goes off. Radar scan on ND's returns to 180 degree sector.
(9)	Press and release WX/T button and check ND's. Adjust TILT knob as necessary to get targets on ND's.	WX/T button light comes on. WX+T message shown on ND's.
(10)	On Capt's and F/O's MSP's, rotate RANGE knobs to different ranges and check ND's.	On ND's, range numerics change when different ranges are selected (range numerics are equal to 1/2 of range selected on MSP's. When range of more than 40 nm is selected, WX+T message changes to WX.
(11)	On Capt's and F/O's MSP's, rotate RANGE knob to 160.	160 selected. WX message is shown on ND's.
(12)	On WXR control panel, press and release MAP button and check ND's.	MAP button light comes on. MAP message is shown on ND's.
(13)	On WXR control panel, press and release VAR button. Slowly rotate GAIN knob to fully clockwise (MAX) position.	VAR button light comes on; GAIN set to MAX. On ND's, noise display increases between origin to 160 nm.
(14)	On WXR control panel, rotate TILT knob fully counterclockwise and clockwise.	Tilt angle display on ND's decreases and increases. Radar antenna moves to agree with TILT control.
(15)	On WXR control panel, press and release WX button. On Capt's and F/O's MSP's, rotate RANGE knobs to 320.	WX button light comes on. WX message and range numeric shown on ND's.
(16)	Press and release RCT button and check ND's.	RCT button light comes on. REAC message is shown on ND's. A blue field is shown on ND's from approximately 180 to 320 nm range.
(17)	On WXR control panel, press and release GCR button.	GCR button light comes on. ND target displays do not change; REAC message stays on.
(18)	On Capt's and F/O's MSP's, rotate RANGE knobs to 80.	On ND's, ground return is reduced. REAC message stays on.
(19)	On WXR control panel, press and release MAP button.	MAP button light comes on; RCT and GCR button lights go out. MAP message is shown on ND's.
(20)	Rotate ON/OFF switch to OFF.	

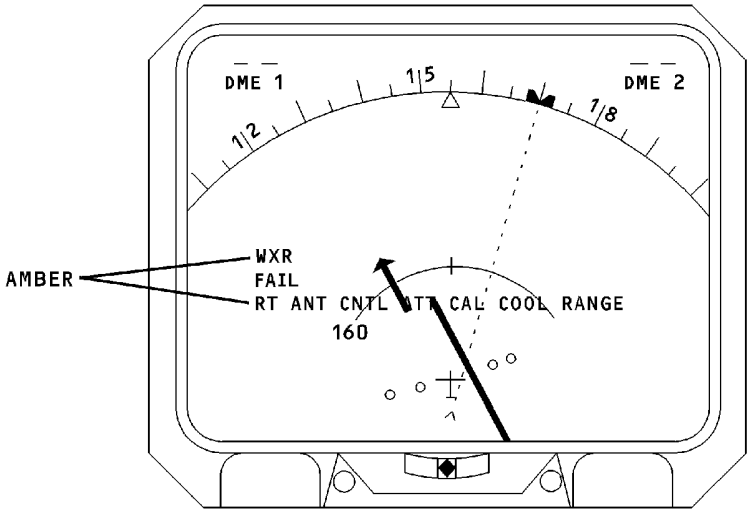
(Continued)

operation	Desired Result
(21) Return aircraft to required configuration.	



TEST PATTERN

NOTE: MAGENTA TEST BAND WILL BE DISPLAYED IF RANGE IS 40 NM OR LESS. AN UNBROKEN 20 NM WIDE NOISE BAND WILL BE DISPLAYED IF RANGE IS 160 NM.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-1709

Weather Radar Test Pattern and Fault Display
Figure 201/34-41-00-990-867

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the mode selector switch on the control panel is placed in the TEST position, a special test pattern is displayed on the indicator for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of existent malfunctions within the system. This is accomplished by the use of locking fault indicators located on front of the receiver-transmitter. In the event that a malfunction occurs, the test pattern, displayed on the indicator, is altered to alert the operator that one or more of the fault indicators on the receiver-transmitter are tripped. This arrangement provides the capability of detecting most system malfunctions without the use of additional test equipment.

C. The stabilization test requires a vertical gyro simulator or unbolting and tilting the vertical gyro, if a vertical gyro simulator is available, use the simulator. Requirement of this test is at the customer's option.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 201

Name and Number	Manufacturer
Gyro Simulator (as required)	Local

3. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

A. Open Radome

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

(1) Set controls on indicator to positions indicated.

Table 202

Control	Position
BRT control	Full CCW
RANGE Selector	320 mi.
MODE Selector	OFF
TILT	10 degrees (up)
GAIN	AUTO
STAB	ON

(2) Set switches on antenna to positions indicated.

Table 203

Control	Position
AZ (Azimuth Motor Switch)	ON
EL (Elevation Motor Switch)	ON

(3) Ensure F/O's VG circuit breaker is closed.

(4) Ensure WEATHER RADAR circuit breakers are closed.

(5) On overhead switch panel, set VERT GYRO switch to NORM.

(6) On indicator, set mode selector to TEST position. After approximately 25 seconds following should occur:

(a) Antenna should begin scanning. Indicator sweep trace will occur between 90(±3) degrees left and 90(±3) degrees right of center in approximately 4 seconds.

(b) Ensure fan is operating on Receiver/Transmitter mount, audible sound can be heard.

(c) Press TEST pushbutton on front of R/T unit, and observe that R/T, ANT, IND, CON, WG SW, GYRO and AIR annunciator lights come on for one second to verify their condition, and then go off.

C. Test Indicator

Operation		Desired Result
(1)	Set GAIN control to AUTO.	
(2)	Turn BRT control indicator clockwise.	Image of reasonable brightness appears.
(3)	Check that indicator sweep trace is scanning smoothly between 90(±3) degrees left and 90(±3) degrees right of dead ahead in approximately 4 seconds.	
(4)	Observe TEST pattern on the indicator.	Test pattern observed.

(Continued)

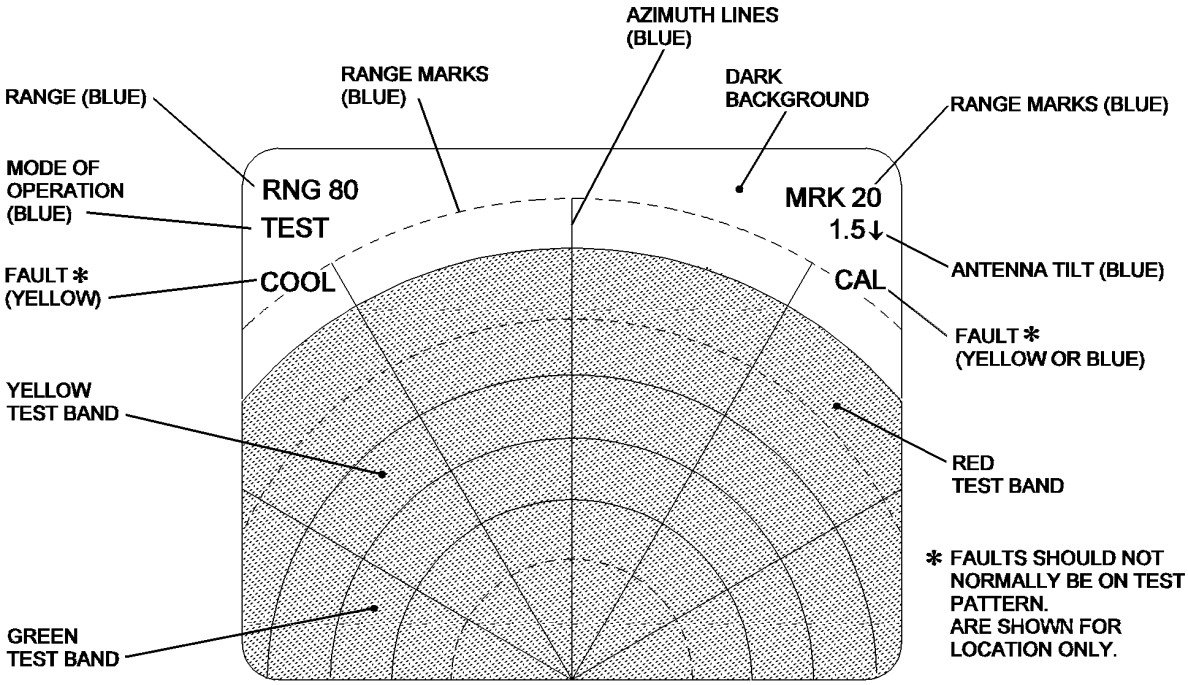
Operation	Desired Result
(5) Observe if LRU fault warning legends appear on indicator in TEST mode.	LRU fault warning legend may be one or more of the following: • R/T FAULT (R-T unit fault) • ANT FAULT (Antenna fault) • CON FAULT (Control fault) • ATT FAULT (Attitude input fault) • IND FAULT (Indicator fault) • COOL FAULT (R-T cooling fault)
NOTE: ATTITUDE FAULTS will be displayed as STAB, in yellow during an operational mode, and as an ATT FAULT during TEST MODE. CALIBRATION FAULTS will be displayed as CAL, in yellow during an operational mode, and as an R/T FAULT during TEST MODE. INDICATOR FAULTS will be displayed on the indicator only during TEST MODE.	

D. Stabilization Test

Operation	Desired Result
(1) Ensure that MODE Selector Switch is in TEST position.	MODE selector to TEST.
(2) Ensure BRT control is adjusted to comfortable viewing level.	Brightness adjusted.
(3) Set antenna AZ switch to OFF.	ANT FAULT displayed.
(4) Set TILT switch on indicator front panel to 0° tilt.	TILT set to 0°.
(5) Slowly rotate antenna in azimuth and towards LEFT wing.	Antenna rotated towards LEFT wing.
(6) Observe indicator and ensure that sweep is in the same direction. Also, make sure that TILT readout is 0°. (Top right hand corner of indicator.)	
(7) Slowly rotate antenna in azimuth and towards the RIGHT wing.	Antenna rotated towards RIGHT wing.
(8) Observe indicator and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°.	
(9) Set antenna AZ switch to ON.	
NOTE: The following steps requires use of a gyro simulator. If gyro simulator is not available, the gyro must be tipped to simulate pitch and roll. To accomplish this, gyro attaching bolts must be loosened or removed. This portion of test is at customer's option.	
(10) Connect Gyro Simulator.	Gyro Simulator connected.
(11) Adjust Gyro Simulator to 10° pitch up.	Gyro to 10° pitch up.

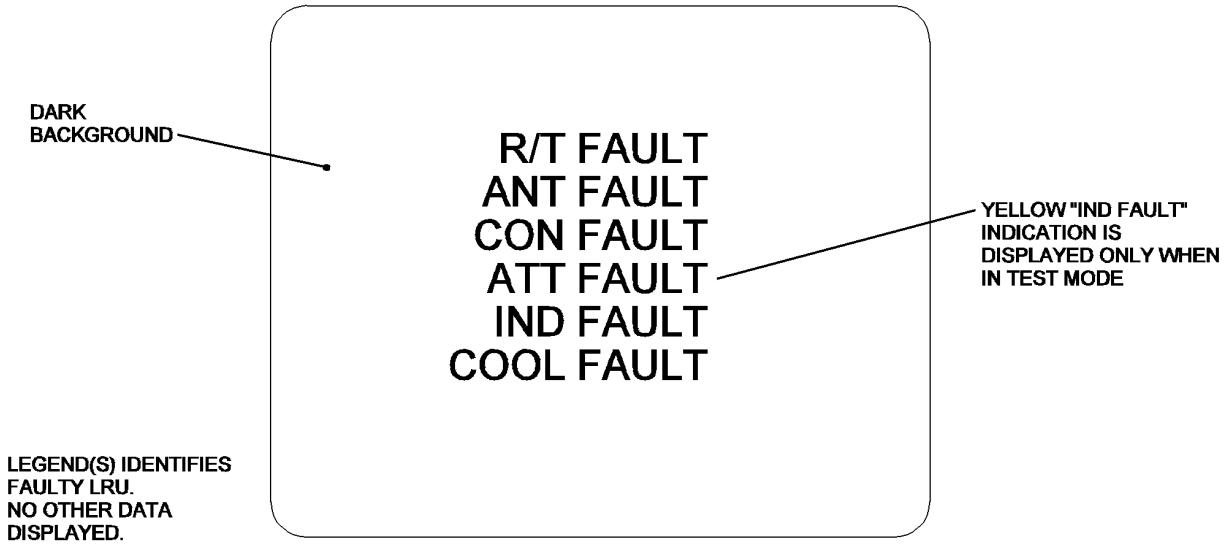
(Continued)

	Operation	Desired Result
(12)	Observe that antenna is at dead ahead (0° in Azimuth) and tilts down 10°. Observe also that at 90° and 270° azimuth scan points, and antenna tilt is 0°.	
(13)	Adjust Gyro Simulator to 10° pitch down.	Gyro to 10° pitch down.
(14)	Observe that antenna is at dead ahead (0° in azimuth), and tilts UP 10°. Observe also that at 90° and 270° azimuth scan points, and antenna tilt is 0°.	
(15)	Adjust Gyro Simulator to 10° roll right.	Gyro 10° Roll right.
(16)	Observe that antenna at 90° azimuth scan point tilts UP 10°. At dead ahead, antenna tilt is 0°; and at 270° azimuth scan point tilt is 10° down.	
(17)	Adjust Gyro Simulator to 10° ROLL left.	Gyro to 10° roll left.
(18)	Observe that Antenna at 90° azimuth scan points tilts DOWN 10°. At dead ahead, antenna tilt is 0°; and at 270° azimuth scan point tilt is 10° up.	
(19)	Set STAB switch on indicator front panel to OFF.	Stab to OFF.
(20)	Observe that antenna tilt is 0° throughout its entire scan.	
(21)	Disconnect and remove the Gyro Simulator.	Gyro Simulator disconnected and removed.
NOTE: If gyro bolts were loosened or removed to simulate pitch and roll, make certain gyro is secured in original position.		
(22)	Return airplane to required configuration.	



TEST PATTERN

NOTE:
MAGENTA AREA ALSO APPEARS ON THE CENTER OF THE INDICATORS, IF THE SYSTEM HAS TURBULENCE CAPABILITY.



TEST MODE FAULT DISPLAY

BBB2-34-294C
S0006546568V2

Test Pattern and Fault Display
Figure 201/34-41-00-990-880

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all of the units of the weather radar system including the waveguide components, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required. It will be necessary to open the radome and gain access to forward accessory compartment.

B. Self test features incorporated into the system provide a means of evaluating system performance on the ground. The TEST mode of operation provides a multicolor test pattern display which the pilot can use to verify proper operation of the system.

C. Vertical Gyro system must be operational for Weather Radar System Tests.

2. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

WARNING: DO NOT OPERATE RADAR EQUIPMENT IN OTHER THAN TEST MODE, EXCEPT AT AN AUTHORIZED TEST LOCATION. R-F ENERGY IN SUFFICIENT DOSES CAN BE HAZARDOUS TO PERSONNEL. DURING OPERATION IN WX OR MAP MODES, NO PERSONNEL SHOULD BE PERMITTED IN IMMEDIATE AREA OF ANTENNA.

A. Preliminary Setup

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	4	B10-294	WEATHER RADAR IND
F	5	B10-295	WEATHER RADAR XCVR

(2) Check that antenna scan switch to ON.

(3) Check that VERT GYRO switch on overhead panel is in NORM.

(4) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	4	B10-294	WEATHER RADAR IND
F	5	B10-295	WEATHER RADAR XCVR

(5) Place Indicator controls as follows:

Table 201

INT	CCW
RNG	250
STAB	Pressed on
MAP GAIN	MIN
TILT	Mid position

B. Functional Test

Table 202

Operation		Desired Results
CAUTION: R-T UNIT IS IN "ON" CONDITION. DO NOT PLACE MODE SWITCHES IN OTHER THAN OFF OR TEST. ONLY USE TEST INSIDE BUILDINGS UNLESS OTHERWISE NOTED.		
(1)	On indicator press TEST button.	Function in TEST.
(2)	Deleted.	
(3)	Rotate indicator INT knob clockwise to desired viewing brightness level.	
(4)	Observe test pattern on indicator.	Four concentric arcs consisting of following colors from top to bottom; magenta, red, yellow, and green (black at bottom). (Figure 202)
(5)	Following action also takes place:	
	Word TEST will appear at top left on indicator.	TEST appears.
	Antenna will scan left- to-right and up-to-down tilt cycle.	Antenna Scans and tilts.
	Antenna completes Scan/Tilt cycle and stops at zero tilt angle.	Antenna at zero tilt.
NOTE: Tilt angle will be shown in lower right hand corner of display (ie. +15° -0-15°-0°). Selected range appears in upper right of display.		
(6)	Observe display for stabilization message. If word ATT appears check aircraft attitude system.	ATT indicates faulty attitude input.
(7)	Observe indicator for any fail message.	FAIL check (ANT, T/R, IND, CTL) (Antenna, Transmitter/Receiver, Indicator Controls) for fault.
NOTE: Any defective LRU will be noted in upper left and word FAIL in upper center of display. If system is inoperative and does not indicate a failed LRU, replace R/T unit.		
(8)	Select MAP mode and observe:	Sweep starts from dead ahead (Zero degrees). MAP displayed on upper left corner of indicator.
(9)	Rotate GAIN control and observe amount of gain on DISPLAY.	Gain changes.
(10)	Select WX mode.	WX displayed on upper left of indicator.
NOTE: Steps (8), (9), (10) should be accomplished in radiation free area.		
(11)	Rotate MKR and INT controls on indicator and observe display.	Display markers and intensity should vary.

Table 202 (Continued)

Operation		Desired Results
(12)	Select RNG (Range) and observe indicator display.	Range varies on display.
(13)	Rotate TILT and observe display.	Tilt angle is displayed on lower right corner as control is marked.
(14)	Select LFT, FWD and RGT functions (one at a time) on indicator.	Display on indicator should move accordingly Left, Right, and Forward view.
(15)	Select HOLD function.	HOLD flashes on center portion of display.
(16)	Press HOLD function button in and hold.	Display freezes; sweep is present.
(17)	Release HOLD function.	Indicator display returns to normal operation.
NOTE: Steps (18) through (22) apply to systems with TURB mode and WX/T mode operational.		
(18)	Select RNG of 50. Select WX/T mode.	WX + T displayed on upper left of indicator.
(19)	Select TURB mode.	TURB displayed on upper left of indicator.
(20)	Select WX mode.	WX displayed on upper left of indicator.
(21)	Select SPRS function.	SPRS displayed on lower center portion of indicator.
(22)	Select RNG of 150.	SPRS no longer displayed on indicator.

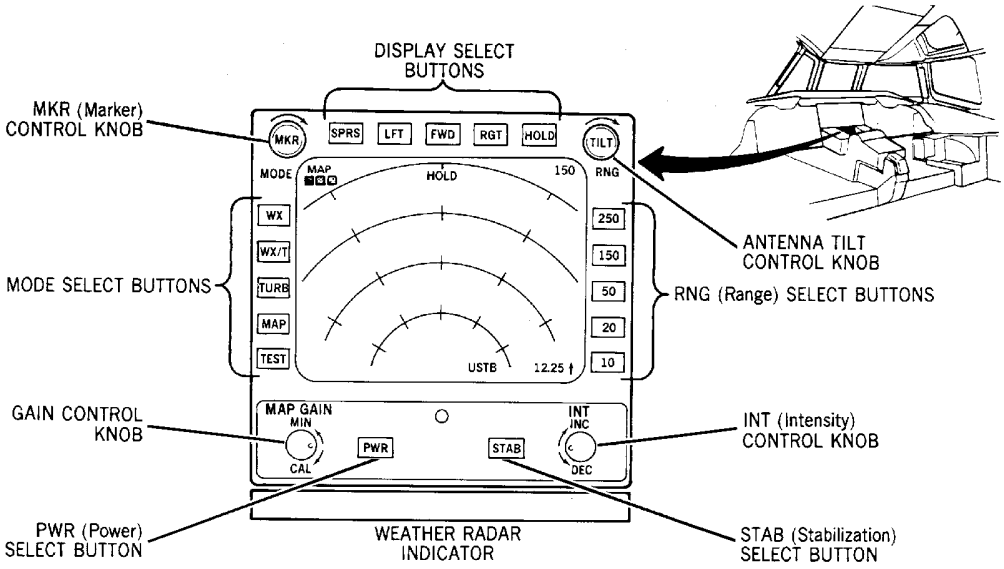
C. Antenna Check

Operation		Desired Results
(1)	Place TILT control to 0°.	Tilt angle displayed on lower right hand corner of indicator.
(2)	Cycle TILT control through TILT positions.	Tilt angle display on indicator should change to TILT set.
(3)	Return TILT control to 0° (degree).	Check antenna for 0 degree tilt.

D. Test Termination

(1) Press PWR pushbutton to OFF.

(2) Return aircraft to required configuration.



Weather Radar Controls

MODE Select Buttons – Desired mode is activated by pushing applicable button. When another mode is selected, previously selected mode is deactivated.

WX – Weather is displayed on the indicator (red represents areas of high density precipitation; yellow represents areas of lower density precipitation; green represents areas of light precipitation; black represents areas of extremely low precipitation). Automatic turbulence function is inhibited. Mode select message will be WX.

WX/T – Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will be WX+T.

If WX/T is selected and weather display only, without turbulence display, is desired (distance of 50 miles or less), deselect turbulence by pushing WX button. Mode select message will be WX.

If WX/T is selected and turbulence display only, without weather display, is desired (distance of 50 miles or less), deselect weather by pushing TURB button. Mode select message will be TURB.

TURB – (Distance of 50 miles or less) Turbulence only is displayed. Mode select message will be TURB.

MAP – Ground mapping is displayed (yellow represents targets with high reflectivity; green represents targets with low reflectivity; black represents targets with extremely low reflectivity). Mode select message will be MAP.

TEST – Initiates self-test of system. Mode select message will be TEST.

MKR (Marker) Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Display Select Button – Desired function is activated by pushing applicable button.

SPRS – Ground clutter is suppressed (reduction of ground return intensity) when in WX or WX/T mode. Continuous operation in SPRS mode is not recommended because some precipitation intensity returns may also be reduced.

LFT – Radar scans area to the left of area directly ahead of airplane.

FWD – Radar scans area directly ahead of airplane.

RGT – Radar scans area to the right of area directly ahead of airplane.

HOLD – Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.

INT Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

RNG Select Buttons – Pushing applicable button selects 10, 20, 50, 150, or 250 nautical miles range. Selected range is displayed on range readout.

Antenna TILT Control Knob – Rotate as necessary to tilt antenna UP or DN for desired radar scanning. Antenna tilt readout displays antenna tilt angle selected. Tilt limits are from 15° UP to 15° DN in 0.25° increments.

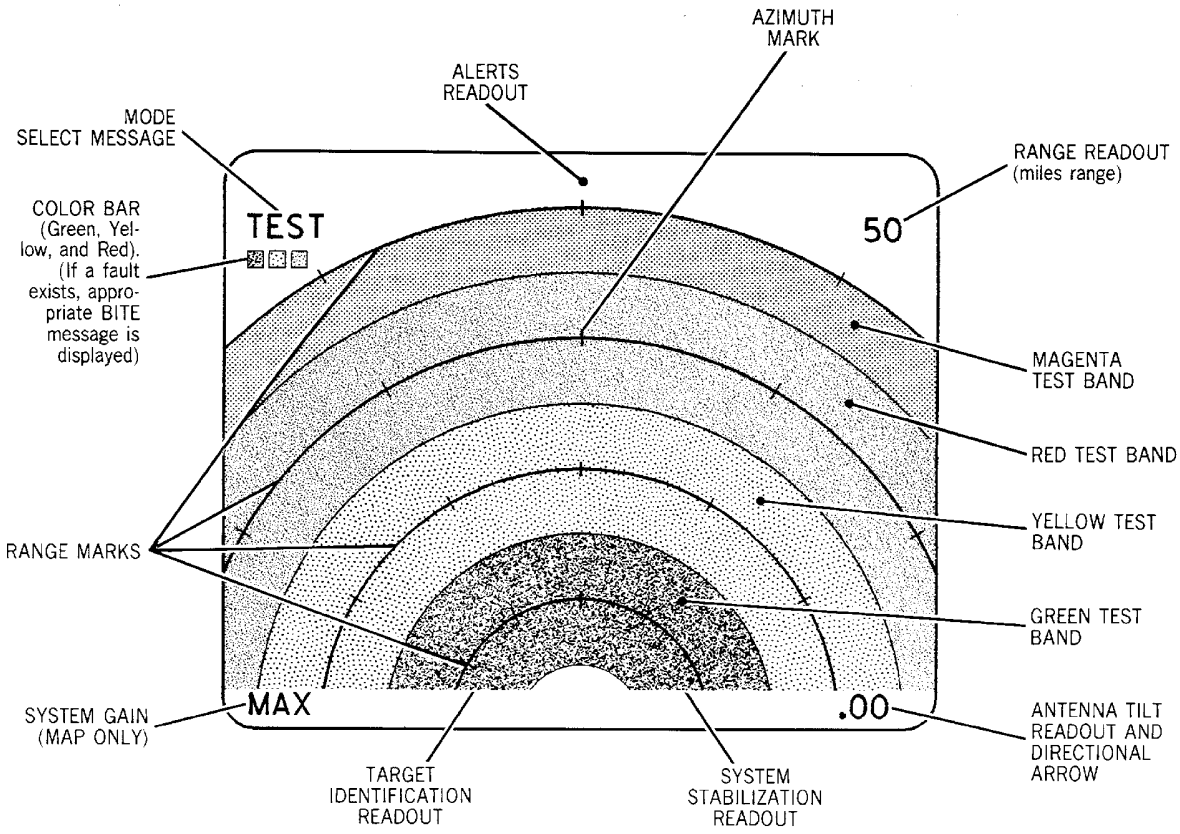
STAB Select Button – When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for airplane pitch and roll. When not engaged, antenna aligns to airplane attitude.

PWR Button – Pushing button applies power to system. Pushing button a second time removes system power.

GAIN Control Knob – System gain is controlled in MAP mode by rotating knob counterclockwise to decrease gain. Gain control in weather mode is automatic.

BBB2-34-847

Weather Radar Indicator -- Controls
Figure 201/34-41-00-990-868



TYPICAL RADAR TEST PATTERN

WEATHER RADAR PREFLIGHT TEST PROCEDURE

1. Verify following on display:
   a. Antenna tilt readout automatically cycles to 15.00↑ to 15.00↓ and then stabilizes at 0.00.
   b. Four distinct color bands (green, yellow, red, and magenta) are displayed as shown above on typical radar test pattern.
   c. Mode select message annunciates TEST.
   d. Color bar (green, yellow, red) is displayed. No BITE (fault messages, T/R, ANT, CTL, or IND) are annunciated. Alert message slot is blank.
   e. Stabilization status message slot is blank.
   f. Range readout displays 50.

BBB2-34-848

Weather Radar Indicator -- Test Pattern
Figure 202/34-41-00-990-871

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all of the units of the weather radar system including the waveguide components, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required. It will be necessary to open the radome and gain access to forward accessory compartment.

B. Self test features incorporated into the system provide a means of evaluating system performance on the ground. The TEST mode of operation provides a multi-color test pattern display which the pilot can use to verify proper operation of the system.

C. Vertical Gyro system must be operational for Weather Radar System Tests.

2. Adjustment/Test

A. Open Radome

WARNING: MAKE SURE THE RADOME IS FULLY OPENED AND THE HOLD-OPEN STRUTS ARE FULLY EXTENDED AND CORRECTLY LOCKED. IF THE HOLD-OPEN STRUTS ARE NOT FULLY EXTENDED AND LOCKED, THE RADOME CAN ACCIDENTALLY MOVE OR CLOSE. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: DO NOT OPEN THE RADOME WHEN THERE ARE WINDS OF MORE THAN 60 MPH (52 KNOTS). TOO MUCH WIND CAN BREAK THE SUPPORT ARMS OF THE OPEN RADOME. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: GET SUFFICIENT AID FROM PERSONS AND EQUIPMENT TO HOLD THE RADOME UP. MAKE SURE YOU PREVENT SUDDEN MOVEMENTS OF THE RADOME AGAINST THE AIRCRAFT WHEN YOU REMOVE OR INSTALL THE HINGE BOLTS. THE RADOME WEIGHS APPROXIMATELY 65 LBS (29.5 KG). IF YOU LET THE RADOME MOVE SUDDENLY OR FALL, INJURY TO PERSONS OR DAMAGE TO THE RADOME CAN OCCUR.

WARNING: GET SUFFICIENT AID FROM PERSONS TO OPEN OR CLOSE THE RADOME SAFELY DURING SUDDEN WIND CHANGE CONDITIONS. THE RADOME WEIGHS APPROXIMATELY 65 LBS (29.5 KG). IF THE RADOME MOVES SUDDENLY WITHOUT CONTROL, INJURY TO PERSONS AND DAMAGE TO THE RADOME CAN OCCUR.

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

CAUTION: DO NOT CONDUCT TESTS INVOLVING RADIATION OF R-F ENERGY IN THE VICINITY OF FUELING OPERATIONS OR WHEN ANTENNA IS FACING LARGE OBJECTS SUCH AS AIRCRAFT OR HANGARS OR DOORS.

(1) Open radome and raise until support arms lock into place.

(2) With radome open, check weather radar moves appropriately in accordance to test procedures that follow:

NOTE: As stated in WARNINGS, do not transmit radar microwave frequencies while observing antenna movement.

(3) Perform Check Weather Radar Operation. (WEATHER RADAR ANTENNA, SUBJECT 34-41-01)

(4) Continue with Paragraph 2.B..

B. Preliminary Setup

(1) Verify VERT GYRO switch on overhead panel is in NORM.

(2) Place Indicator controls as follows:

Table 201

DISPLAY	OFF
GAIN	MAX CCW
TILT	+15°

(3) Rotate Display control, on indicator, to mid-point.

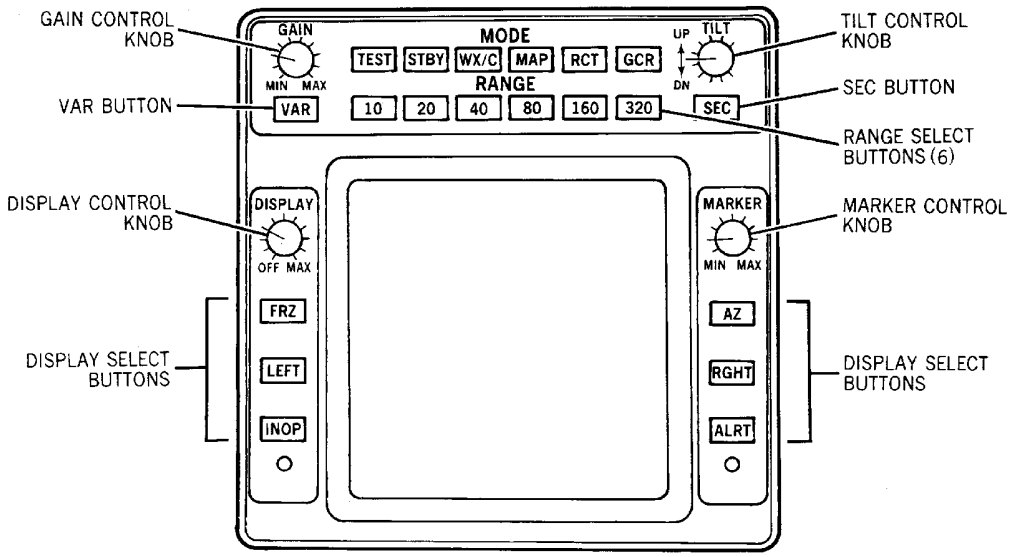
C. Functional Test

Table 202

Operation		Desired Results
(1)	On indicator press TEST pushbutton.	Function in TEST.
(2)	Adjust DISPLAY control to desired viewing brightness level.	
(3)	Observe test pattern on indicator.	Test pattern observed. (Figure 202)
(4)	Following action also takes place:	
	Word TEST and numeric 160 appear at top right on indicator.	TEST and "160" appears.
	Word AUTO appears at top left on indicator.	AUTO appears.
	Numeric +0.0° appears at bottom left on indicator.	+0.0° appears.
	First three range marks on display are labeled 40, 80, and 120 respectively.	Range marks labeled.
(5)	Press AZ pushbutton on indicator.	Cyan azimuth marks displayed at 30° intervals.
(6)	Press AZ pushbutton.	Azimuth marks removed from display.
(7)	Press SEC pushbutton on indicator.	Displayed scan reduced to 90° sector.
(8)	Press SEC pushbutton.	Displayed scan increased to 180° sector.
(9)	Press WX/C pushbutton on indicator.	WX appears in Mode Field (top right) of display. Numeric +15.0 appears in Tilt Field (bottom left) of display.
(10)	Press each range pushbutton in succession (10/20/40/80/ 160/320) and verify corresponding range numerics appear in top right of display.	Range numerics appear.
(11)	Press WX/C pushbutton.	CYC appears in Mode Field.
(12)	Press VAR pushbutton on indicator.	Display remains unchanged.
(13)	Press WX/C and VAR pushbuttons in succession.	WX appears in Mode Field and VAR appears in Auxiliary Field (top left) of display.
(14)	Slowly rotate GAIN control to maximum clockwise position.	On indicator, noise display increases between origin and 320 nm.
(15)	Press MAP pushbutton on indicator.	MAP appears in Mode Field, and VAR remains in Auxiliary Field. Range marks and alpha-numerics are green.

Table 202 (Continued)

Operation		Desired Results
(16)	Rotate TILT control, on indicator, to full counterclockwise position.	Numeric -15.0 appears in Tilt Field of display.
(17)	Press WX/C pushbutton.	WX appears in Mode Field. Range marks and alpha-numerics cyan.
(18)	Press RCT pushbutton on indicator.	RCT appears in Mode Field and AUTO appears in Auxiliary Field.
(19)	Press "320" pushbutton on indicator.	Range numerics appear. Blue field is present on display from approximately 180 nm to 320 nm.
(20)	Press GCR pushbutton on indicator.	Display does not change.
(21)	Press "40" pushbutton on indicator.	Appropriate range numerics appear. R/CR appears in Mode Field.
(22)	Press LEFT pushbutton on indicator.	Airplane zero heading moves to right side of display.
(23)	Press RGHT pushbutton on indicator.	Airplane zero heading moves to left side of display.
(24)	Press RGHT pushbutton.	Display returns to normal.
(25)	Press GCR pushbutton.	RCT appears in Mode Field.
(26)	Press ALRT pushbutton on indicator.	A red T appears in Target Alert Field (left top center) of display. Flashing red TGT and upward pointing arrow may appear in Auxiliary Field.
(27)	Press MAP pushbutton.	MAP appears in Mode Field. T disappears from Target Alert Field. Flashing red TGT and upward pointing arrow, if applicable, disappears from Auxiliary Field.
(28)	Press FRZ pushbutton on indicator.	FRZ appears in Auxiliary Field of display and flashes once per second. Displayed information ceases updating and remains the same.
(29)	Press FRZ pushbutton.	FRZ disappears from Auxiliary Field. Displayed information updates.
(30)	Press STBY pushbutton on indicator.	STBY appears in Mode Field.
(31)	Rotate DISPLAY control, on indicator, to OFF position.	System off.



WEATHER RADAR INDICATOR

Weather Radar Controls – Control Knobs/Display Select Buttons

GAIN Control Knob – System gain is controlled in MAP mode by rotating knob clockwise to increase intensity. GAIN is uniformally increased as control is turned clockwise until the 12 o'clock position is reached where short gain range is increased at a faster rate.

VAR – Variable gain selected. First depression enables GAIN control; second depression disables GAIN control. When activated, VAR is displayed in auxiliary field. When deactivated, AUTO is displayed in auxiliary field.

TILT Control Knob – Rotate as necessary to tilt antenna up or down for desired radar scanning. Antenna tilt readout displays antenna tilt angle. Clockwise rotation tilts beam upward 0 to 15 degrees; counterclockwise rotation tilts beam downward 0 to 15 degrees.

SEC – Antenna scan sector of either 90 or 180 degrees selected. After system turn-on, scan is 180 degrees. First depression selects 90 degree scan, second depression selects 180 degree scan.

MARKER Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Range Select Buttons – Pushing applicable button selects 10, 20, 40, 80, 160 or 320 nautical miles. Selected range is displayed on range readout. At system turn-on, 320 mile range is automatically selected.

Display Select Buttons – Desired function is activated by pushing applicable button (momentary).

FRZ – Radar memory stops update. Existing displayed information will remain until FRZ is deactivated by pushing button again. When activated, FRZ is displayed in Auxiliary Field. FRZ symbol will flash on and off once per second as reminder that data is not being updated.

LEFT – Radar scans area to left of area directly ahead of airplane.

INOP – Not used.

AZ – Azimuth ticks are eliminated from display. Pushing button second time causes azimuth ticks to be displayed. Indicator powers on with azimuth ticks displayed.

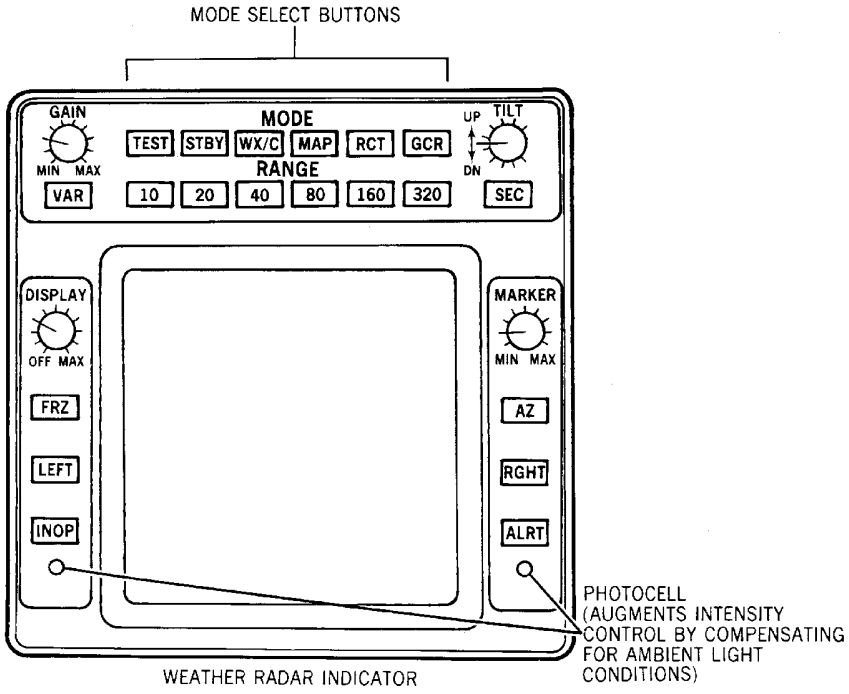
RIGHT – Radar scans area to right of area directly ahead of airplane.

ALRT – Target alert function selected. When enabled, a red letter T is displayed. Target alert is active only when radar gain is calibrated; i.e., in WX with GAIN preset and in CYC, TEST, or RCT. The symbol TGT▲(in red) is displayed and flashes once each second whenever a red or magenta-level target is detected within the target alert sector (range from 10-90, 20-100, 40-120 or 80-160 nm depending on range selected and within + 7.5 degrees of aircraft heading). Target alert is deactivated automatically if MAP is selected or if variable GAIN is used, but is reactivated automatically when operating controls are restored to valid alert settings.

Display Control Knob – Rotate knob clockwise to turn on system. Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

BBB2-34-603

Weather Radar Indicator -- Controls
Figure 201/34-41-00-990-878 (Sheet 1 of 2)



Weather Radar Controls – Mode Select Buttons

Mode Select Buttons – Desired mode is activated by pushing applicable button (momentary). When another mode is selected, previously selected mode is deactivated.

TEST – Self-test is initiated. During self-test, a test pattern of four equal width arcs with black at bottom followed by green, yellow, red, and magenta will be displayed in indicator and a 20 mile "Noise Band" between 130 and 150 mile will be predominantly green and extend unbroken across the display; 160 mile range is automatically selected; TEST is displayed in Mode Field.

STBY – Operating radar goes to standby. Antenna does not scan, transmitter is disabled, and radar memory erased. STBY is displayed in Mode Field.

WX/C – Weather detection or cyclic operation selected. After initial turn-on, first actuation of WX/C selects basic weather operation. WX is displayed in Mode Field. Second actuation of WX/C selects cyclic weather display. CYC is displayed in Mode Field. Displayed magenta and red targets flash on and off once per second.

MAP – Ground mapping is displayed (magenta represents targets of high reflectivity, yellow represents targets of medium reflectivity, cyan (blue) represents targets of low reflectivity, black represents targets that are non-reflective). MAP is displayed in Mode Field.

RCT – REACT (Rain Echo Attenuation Compensation Technique) is selected. Receiver gain is automatically adjusted according to received signal strength. When the receiver is in its calibration range, displayed colors are as in weather mode. When the calibration range is exceeded, the back-ground will be blue. Signals occurring in the uncalibrated range will be displayed in red. RCT mode is active in all ranges. When RCT mode is selected, system operates in WX mode.

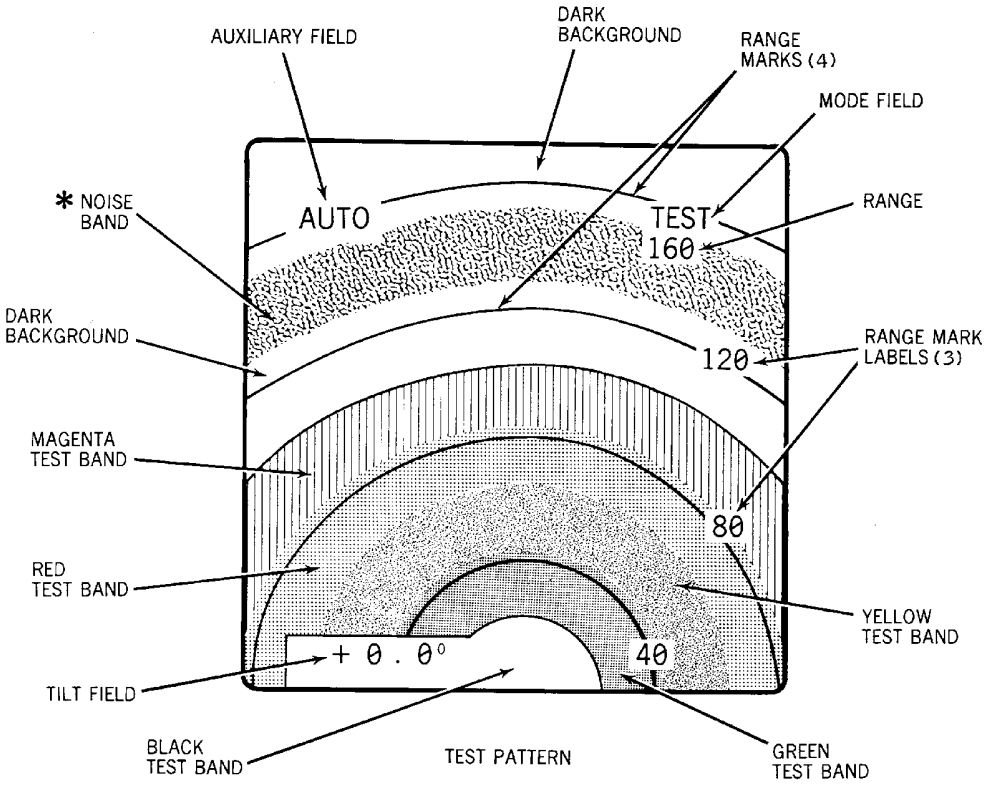
System gain is automatically in Preset. RCT is displayed in Mode Field. RCT mode may be operated simultaneously with ground clutter reduction (GCR). With both modes selected, R/CR is displayed in Mode Fields.

GCR – Ground clutter is suppressed (reduction of ground return intensity) when in WX/C. Continuous operation in GCR mode is not recommended because some precipitation returns may also be reduced in intensity.

GCR is active in all ranges except 160 and 320 mile ranges. When GCR Mode is selected, system operates in either WX or RCT mode. In WX mode, W/CR is displayed in the Mode Field. GCR may be operated simultaneously with RCT mode. When selected, R/CR is displayed in the Mode Field on the indicator and the system is placed automatically in Preset gain.

BBB2-34-604

Weather Radar Indicator -- Controls
Figure 201/34-41-00-990-878 (Sheet 2 of 2)



1. VERIFY THE FOLLOWING ON THE DISPLAY:
   a. TEST DISPLAYED IN MODE FIELD.
   b. RANGE MARKS AND ALPHANUMERICS DISPLAYED IN CYAN.
   c. COLORS OF FIRST FIVE TEST BANDS ARE BLACK, GREEN, YELLOW, RED, AND MAGENTA.
   d. 20 NM NOISE BAND BETWEEN 130 and 150 NM IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.
   e. AUTO (PRE-SET GAIN) DISPLAYED IN AUXILIARY FIELD.
   f. +0.0° DISPLAYED IN TILT FIELD.
   g. 160 (NM) DISPLAYED IN UPPER RIGHT CORNER, AND FIRST THREE RANGE MARKS LABELED 40, 80, AND 120 RESPECTIVELY.

NOTE

*20 NM WIDE NOISE BAND BETWEEN 130 AND 150 NM. BAND IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.

BBB2-34-606

Weather Radar Indicator -- Test Pattern
Figure 202/34-41-00-990-879

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the mode selector switch on the control panel is placed in the TEST position, a special test pattern is displayed on the EFIS navigation display (ND) indicator for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of existent malfunctions within the system. In the event that a malfunction occurs, the test pattern, displayed on the ND indicator, is altered to alert the operator that one or more of the fault indicators on the receiver/transmitter are tripped. This arrangement provides the capability of detecting most system malfunctions without the use of additional test equipment.

2. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

A. Open Radome

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

(1) Set controls on weather control panel to positions indicated.

Control	Position
MODE Selector	OFF
TILT	0 degrees
GAIN	AUTO
STAB	ON

(2) Set switches on antenna mount to positions indicated.

AZ (Azimuth Motor Switch)	ON
EL (Elevation Motor Switch)	ON

WJE 877

(3) Check that attitude and heading system (AHRS) is operational.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(4) Check that VG/DG system (or IRS, if installed) is operational.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 877

(5) Make sure that this circuit breaker is closed:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

(6) Place both ND and Wx controls on EFIS control and dimming panel (CDP) to on position.

(7) Place MODE selector on MODE selector panel (MSP) to ARC position

(8) Adjust BRT control on CDP for comfortable viewing level on EFIS navigation display (ND) indicator.

(9) On radar control panel, set mode selector to TEST position. After approximately 25 seconds following should occur:

(a) Antenna should begin scanning. ND indicators sweep trace should occur between 90(±3) degrees left and 90(±3) degrees right of center in approximately 4 seconds.

(b) Check that fan is operating on Receiver/Transmitter mount, audible sound can be heard.

(c) Press TEST pushbutton on front of R/T unit, and observe that R/T, ANT, IND, CON, WG SW, GYRO and AIR annunciator lights come on for one second to verify their condition, and then go off.

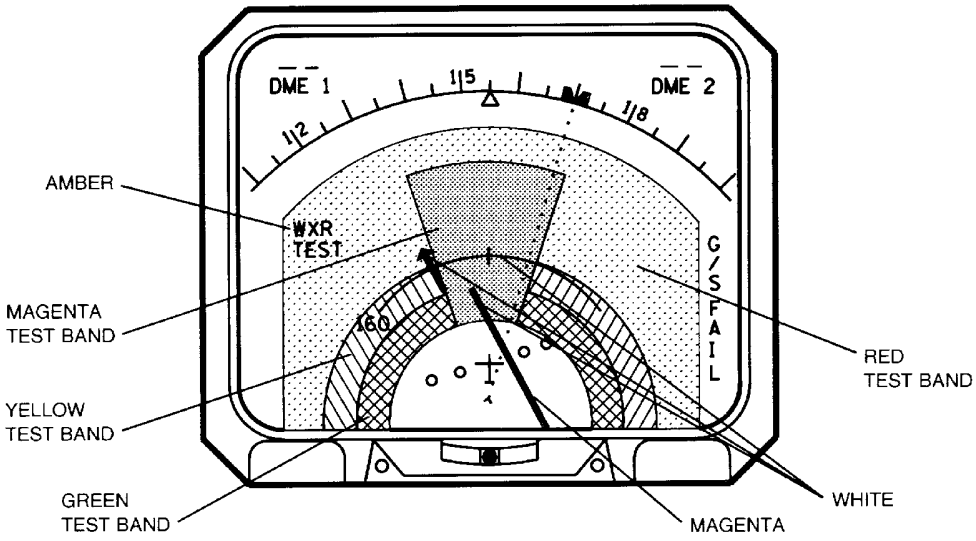
C. Test Indicator

Table 201

Operation	Desired Result
(1) Check that both ND indicators sweep trace is scanning smoothly between 90(±3) degrees left and 90(±3) degrees right of dead ahead in approximately 4 seconds.	
(2) Observe TEST pattern on the ND indicators. (Figure 201)	Test pattern observed.
NOTE: Disregard all other symbols and alpha-numerics that pertain to EFIS on the NDs.	
(3) Observe if LRU fault warning legends appear on indicator in TEST mode. LRU fault legends will appear in yellow with dark background.	LRU fault warning legend may be one or more of the following: R/T FAULT (R-T unit fault) ANT FAULT (Antenna fault) CON FAULT (Control fault) ATT FAULT (Attitude input fault) RANGE FAULT (Range failure (MSP)) COOL FAULT (R-T cooling fault)
NOTE: MSP is EFIS MODE select panel. INDICATOR FAULTS will be displayed on the indicator only during TEST MODE.	

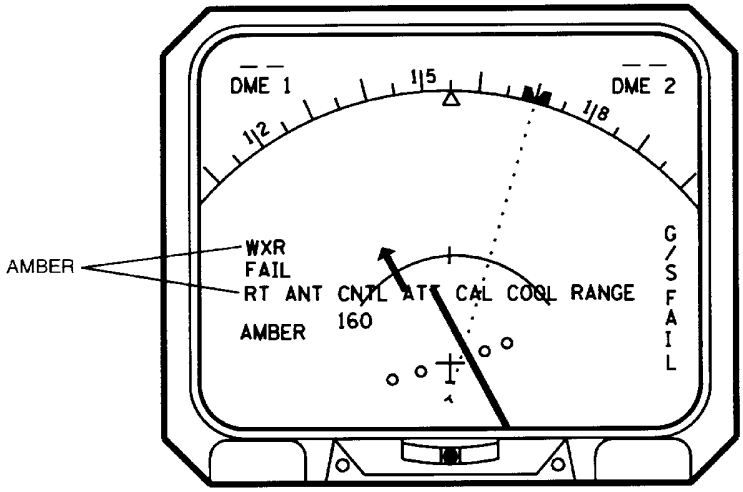
D. Stabilization Test

Operation		Desired Result
(1)	Check that MODE Selector Switch is in TEST position.	MODE selector to TEST.
(2)	Check that BRT control is adjusted to a comfortable viewing level.	Brightness adjusted.
(3)	Set TILT switch on control panel front panel to 0° tilt.	TILT set to 0°.
(4)	Electrically rotate antenna in azimuth and towards LEFT wing.	Antenna rotated towards LEFT wing.
(5)	Observe ND's and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°.	
NOTE: On EFIS ND's, TEST is shown instead of TILT.		
(6)	Electrically rotate antenna in azimuth and towards the RIGHT wing.	Antenna rotated towards RIGHT wing.
(7)	Observe ND's and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°.	
(8)	Return aircraft to required configuration.	



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.

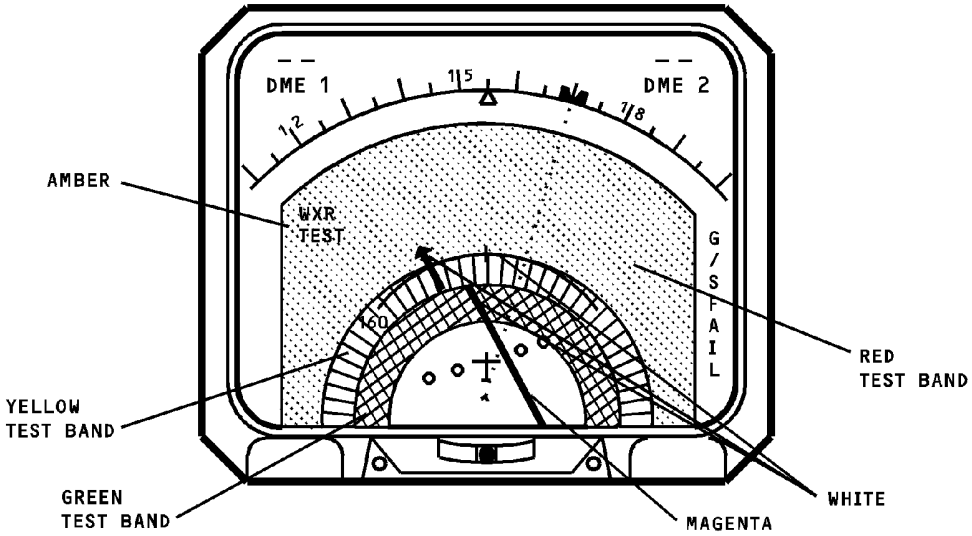


TEST MODE FAULT DISPLAY

CAG(IGDS)

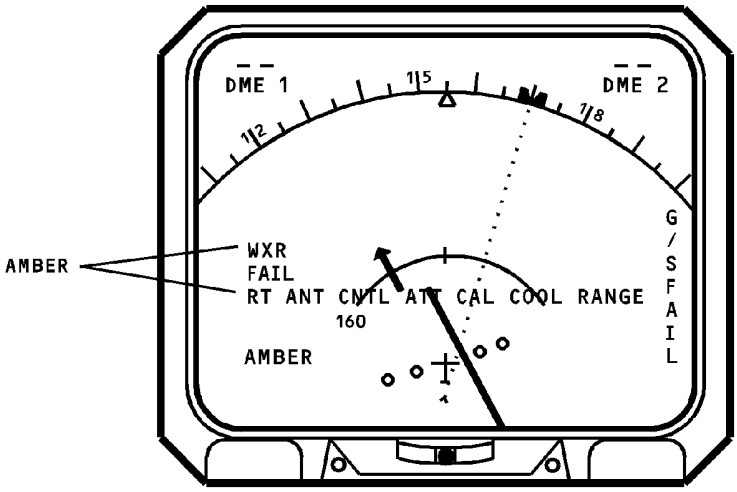
BBB2-34-1134A

Test Pattern and Fault Display
Figure 201/34-41-00-990-884 (Sheet 1 of 2)



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-2455

Test Pattern and Fault Display
Figure 201/34-41-00-990-884 (Sheet 2 of 2)

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the mode selector switch on the weather radar indicator control panel is placed in the TEST position, a special test pattern is displayed on the indicator for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of existent malfunctions within the system. This is accomplished by the use of locking fault indicators located on front of the receiver-transmitter. In the event that a malfunction occurs, the test pattern, displayed on the indicator, is altered to alert the operator that one or more of the fault indicators on the receiver-transmitter are tripped. This arrangement provides the capability of detecting most system malfunctions without the use of additional test equipment.

C. The EFIS navigation displays (NDs) will also display weather radar patterns as follows: When the WX and ND controls are activated on the EFIS control and dimming panels and the mode switch on the EFIS mode control panels are in ARC mode, a test pattern will be displayed on the Captain's and First Officer's navigation displays (NDs).

2. Adjustment/Test

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

A. Open Radome

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

(1) Set controls on indicator to positions indicated.

Table 201

Control	Position
BRT control	Full CCW
RANGE Selector	320 mi.
MODE Selector	OFF

Table 201 (Continued)

Control	Position
TILT	0 degrees
GAIN	AUTO
STAB	ON

(2) Set switches on antenna mount to positions indicated.

Table 202

AZ (Azimuth Motor Switch)	ON
EL (Elevation Motor Switch)	ON

(3) Ensure attitude and heading reference system (AHRS) is operational.

(4) Ensure WEATHER RADAR system is operational.

(5) On weather radar indicator, set mode selector to TEST position. After approximately 25 seconds following should occur:

(a) Antenna should begin scanning. Indicator sweep trace will occur between 90(±3) degrees left and 90(±3) degrees right of center in approximately 4 seconds.

(b) Ensure fan is operating on Receiver/Transmitter mount, audible sound can be heard.

C. Test Indicator

Table 203

Operation		Desired Result
(1)	Set GAIN control to AUTO.	
(2)	Turn weather radar indicator BRT control clockwise.	Image of reasonable brightness and range marks appear.
(3)	Check that indicator sweep trace is scanning smoothly between 90(±3) degrees left and 90(±3) degrees right of dead ahead in approximately 4 seconds.	
(4)	Observe TEST pattern on the indicator. (Figure 201)	Test pattern observed.
(5)	Observe if LRU fault warning legends appear on indicator in TEST mode.	LRU fault warning legend may be one or more of the following: R/T FAULT (R-T unit fault) ANT FAULT (Antenna fault) CON FAULT (Control fault) ATT FAULT (Attitude input fault) IND FAULT (Indicator fault) COOL FAULT (R-T cooling fault)
NOTE: INDICATOR FAULTS will be displayed on the indicator only during TEST MODE.		

D. Test EFIS Navigation Display (ND) Unit

Table 204

Operation		Desired Result	
(1)	Place ND and WX controls on both EFIS dimmer control panels to ON position.	Dimmer controls ON.	
(1a)	Place EFIS MODE select panel selector switch in ARC MODE position.		
(2)	Adjust BRT control on both EFIS dimmer control panels for comfortable viewing level on both NDs.	Brightness adjusted.	
(3)	Check that both ND indicators sweep traces are scanning smoothly between 90 plus or minus 3 degrees right and left of dead ahead in approximately 4 seconds.		
(4)	Place weather radar indicator mode select in TEST position.		
(5)	Observe test pattern on ND indicator. (Figure 201)	Test Pattern observed.	
NOTE: Disregard all other symbols and alpha numerics that pertain to other EFIS functions.			
(6)	Observe if any fault legends appear on ND indicator while in TEST mode . (Figure 201)	Fault legends that can appear are as follows:	
		R/T FAULT ANT FAULT failure	R/T failure Antenna
		CON FAULT	Control panel failure
NOTE: If any fault legends appear, do not proceed with test. Correct fault and repeat test.			
		ATT FAULT	Attitude failure
		RANGE FAULT	Range failure (MSP)
NOTE: (MSP) is EFIS MODE select panel.			
		COOL FAULT	R/T cooling failure

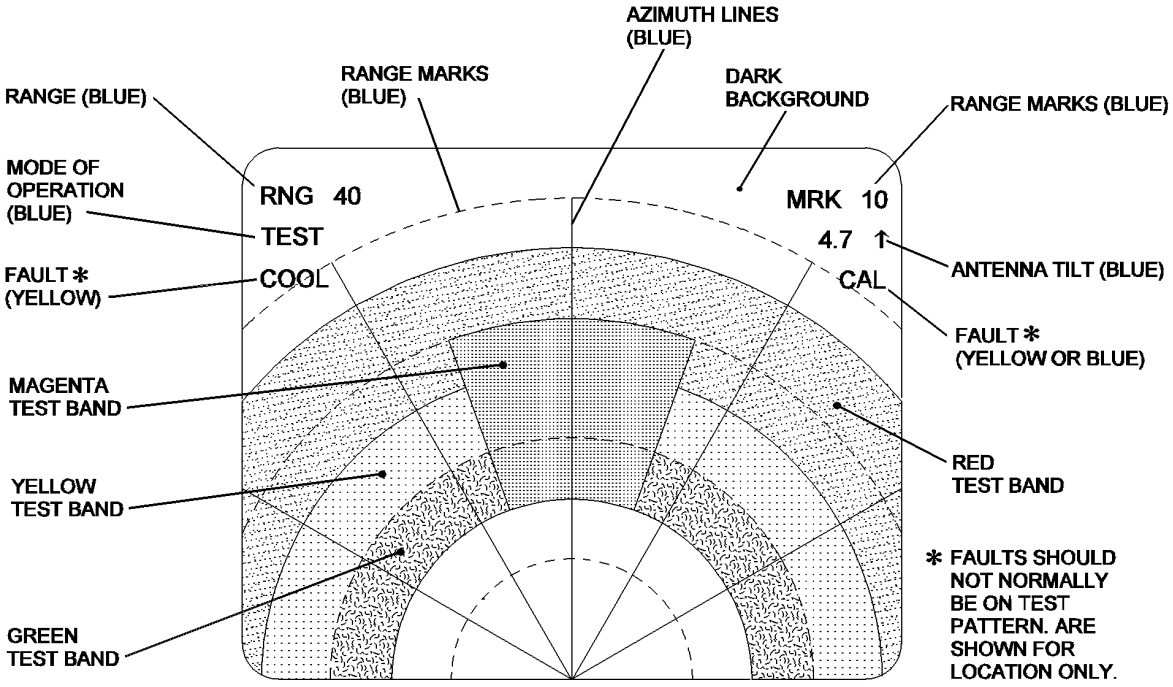
E. Stabilization test

Table 205

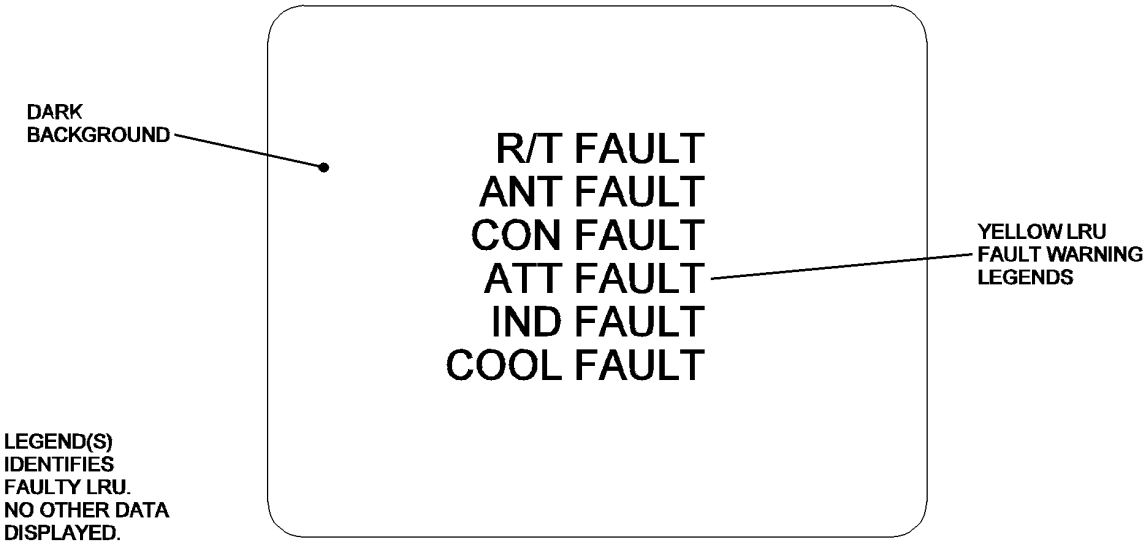
Operation		Desired Result
(1)	Ensure that MODE Selector Switch is in TEST position.	MODE selector to TEST.
(2)	Ensure BRT control is adjusted to comfortable viewing level.	Brightness adjusted.
(3)	Set TILT switch on indicator front panel to 0° tilt.	TILT set to 0°.
(4)	Electrically rotate antenna in azimuth and towards LEFT wing.	Antenna rotated towards LEFT wing.
(5)	Observe indicator and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°. (Top right hand corner of indicator.)	

Table 205 (Continued)

Operation		Desired Result
(6)	Electrically rotate antenna in azimuth and towards the RIGHT wing.	Antenna rotated towards RIGHT wing.
(7)	Observe indicator and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°.	
(8)	Return aircraft to required configuration.	



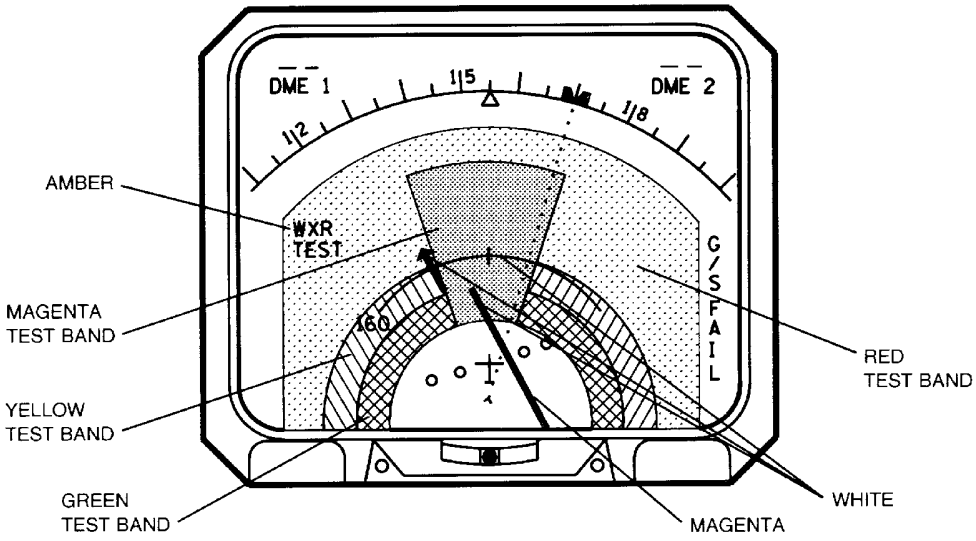
TEST PATTERN



TEST MODE FAULT DISPLAY

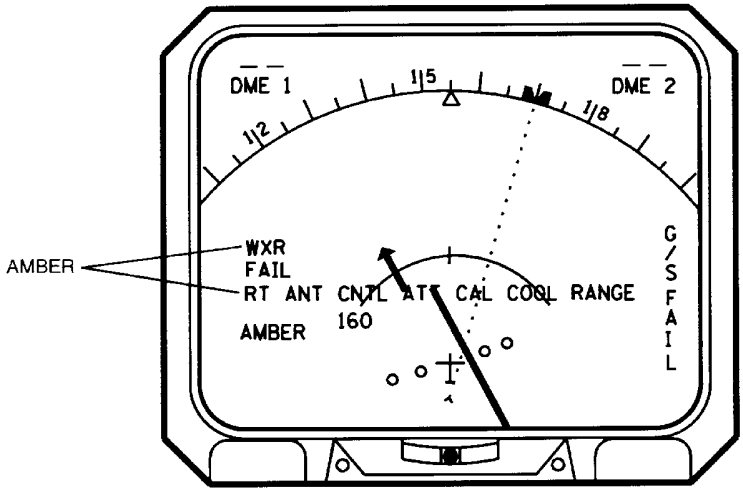
BBB2-34-849B
S0006546565V3

Test Pattern and Fault Display
Figure 201/34-41-00-990-888 (Sheet 1 of 2)



TEST PATTERN

NOTE: THE COURSE POINTER AND DEVIATION BAR WILL BE MAGENTA UNTIL THEY OVERLAP A BACKGROUND COLOR AT WHICH POINT THAT PORTION OF THE POINTER WILL TURN WHITE.



TEST MODE FAULT DISPLAY

CAG(IGDS)

BBB2-34-1134A

Test Pattern and Fault Display
Figure 201/34-41-00-990-888 (Sheet 2 of 2)

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all of the units of the weather radar system including the waveguide components, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required. It will be necessary to open the radome and gain access to forward accessory compartment.

B. Self test features incorporated into the system provide a means of evaluating system performance on the ground. The TEST mode of operation provides a multi-color test pattern display which the pilot can use to verify proper operation of the system.

C. Attitude and Heading Reference System (AHRS) must be operational for Weather Radar System Tests.

2. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

WARNING: DO NOT OPERATE RADAR EQUIPMENT IN OTHER THAN TEST MODE, EXCEPT AT AN AUTHORIZED TEST LOCATION. R-F ENERGY IN SUFFICIENT DOSES CAN BE HAZARDOUS TO PERSONNEL. DURING OPERATION IN WX OR MAP MODES, NO PERSONNEL SHOULD BE PERMITTED IN IMMEDIATE AREA OF ANTENNA.

A. Preliminary Setup

(1) Verify AHRS switch on overhead panel is in normal position.

(2) Place Indicator controls as follows:

INT	CCW
RNG	320
MAP GAIN	MIN
TILT	Mid position
STAB	Pressed

(3) Press PWR pushbutton on indicator to on.

CAUTION: R-T UNIT IS IN "ON" CONDITION. DO NOT PLACE MODE SWITCHES IN OTHER THAN OFF OR TEST. ONLY USE TEST INSIDE BUILDINGS UNLESS OTHERWISE NOTED.

B. Functional Test

Table 201

Operation		Desired Results
(1)	On indicator press TEST button.	Function in TEST.
(2)	Deleted.	

Table 201 (Continued)

Operation		Desired Results
(3)	Rotate indicator INT knob clockwise to desired viewing brightness level.	
(4)	Observe test pattern on indicator.	Four concentric arcs consisting of following colors from top to bottom; magenta, red, yellow, and green (black at bottom). (Figure 202)
(5)	Following action also takes place:	
	Word TEST will appear at top left on indicator.	TEST appears.
	Antenna will scan left- to-right and up-to-down tilt cycle.	Antenna Scans and tilts.
	Antenna completes Scan/Tilt cycle and stops at zero tilt angle.	Antenna at zero tilt.
NOTE: Tilt angle will be shown in lower right hand corner of display. (ie. +15° -0-15°-0°). Selected range appears in upper right of display.		
(6)	Observe display for stabilization message. If word ATT appears check aircraft attitude system.	ATT indicates faulty attitude input.
(7)	Observe indicator for any fail message.	FAIL check (ANT, T/R, IND, CTL) (Antenna, Transmitter/Receiver, Indicator Controls) for fault.
NOTE: Any defective LRU will be noted in upper left and word FAIL in upper center of display. If system is inoperative and does not indicate a failed LRU, replace R/T unit.		
(8)	Select MAP mode and observe:	Sweep starts from dead ahead (Zero degrees). MAP displayed on upper left corner of indicator.
(9)	Rotate GAIN control and observe amount of gain on DISPLAY.	Gain changes.
(10)	Select WX mode.	WX displayed on upper left of indicator.
NOTE: * Steps (8), (9), (10) should be accomplished in radiation free area.		
(11)	Rotate MKR and INT controls on indicator and observe display.	Display markers and intensity should vary.
(11a)	Cycle STAB switch on indicator and observe display.	USTB displayed on lower center of display when system is in unstabilized mode.
(12)	Select Range switches and observe indicator display.	Range changes on display with each range selection.
(13)	Rotate TILT and observe display.	Tilt angle, displayed on lower right corner of display, changes as control is adjusted.
(14)	Select LFT, FWD and RGT functions (one at a time) on indicator.	Display on indicator should move accordingly Left, Forward and Right view.
(15)	Select RNG of 40. Select WX/T mode.	WX+T displayed on upper left of indicator.
(16)	Select RNG of 80.	WX+T no longer displayed on upper left of indicator.
(17)	Re-select RNG of 40.	WX+T reappears on upper left of indicator.
(18)	Select WX mode.	WX displayed on upper left of indicator.

Table 201 (Continued)

Operation		Desired Results
(19)	Select GCS function.	GCS displayed on lower center portion of indicator.
(20)	Select RNG of 160.	GCS no longer displayed on indicator.

C. EFIS Display Test

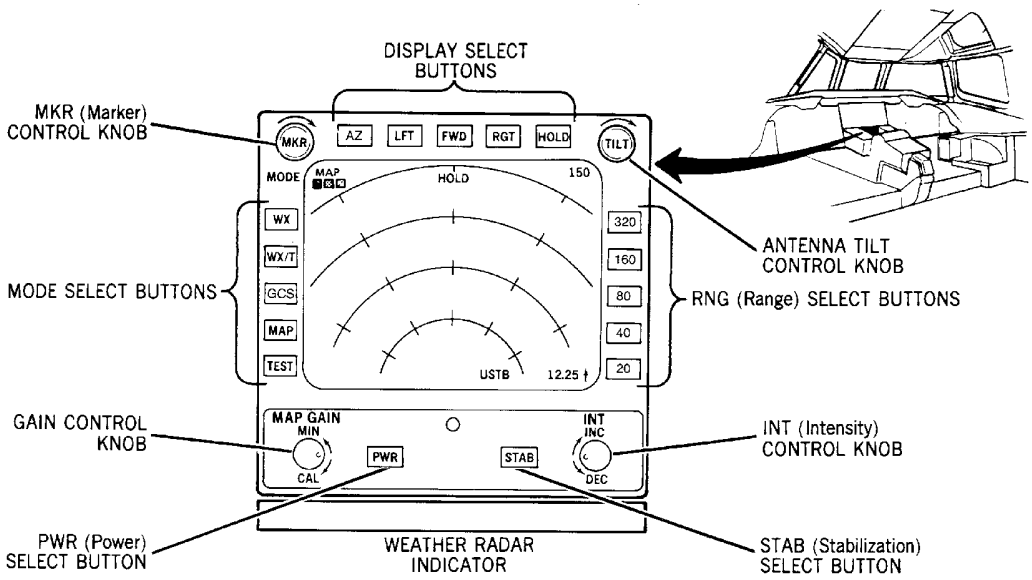
Table 202

Operation		Desired Results
(1)	Place ND and WX controls on both EFIS dimmer control panels to ON.	Controls ON.
(2)	Place EFIS Mode Select Panel selector to ARC position.	
(3)	On radar indicator press TEST button.	Both ND's display test pattern similar to Figure 202. WXR TEST message displayed on both ND's.
(4)	On upper EPC, open WEATHER RADAR XCVR circuit breaker.	WXR FAIL message displayed on both ND's.
(5)	Close WEATHER RADAR XCVR circuit breaker.	WXR FAIL message disappears (can take up to 2 minutes).
(6)	Place ND and WX controls on both EFIS dimmer control panels to OFF.	

D. Test Termination

(1) On radar indicator, press PWR pushbutton to OFF.

(2) Return aircraft to required configuration.



Weather Radar Controls

MODE Select Buttons – Desired mode is activated by pushing applicable button. When another mode is selected, previously selected mode is deactivated.

WX – Weather is displayed on the indicator (red represents areas of high density precipitation; yellow represents areas of lower density precipitation; green represents areas of light precipitation; black represents areas of extremely low precipitation). Automatic turbulence function is inhibited. Mode select message will be WX.

WX/T – Weather and turbulence (areas of turbulence represented by deep purplish red) is displayed but is range dependent. Weather only is displayed at distances exceeding 50 miles. At distances of 50 miles or less, weather plus turbulence is displayed. Mode select message will be WX+T.

If WX/T is selected and weather display only, without turbulence display, is desired (distance of 50 miles or less), deselect turbulence by pushing WX button. Mode select message will be WX.

If WX/T is selected and turbulence display only, without weather display, is desired (distance of 50 miles or less), deselect weather by pushing TURB button. Mode select message will be TURB.

GCS – Ground Clutter Suppression.

MAP – Ground mapping is displayed (yellow represents targets with high reflectivity; green represents targets with low reflectivity; black represents targets with extremely low reflectivity). Mode select message will be MAP.

TEST – Initiates self-test of system. Mode select message will be TEST.

MKR (Marker) Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of range marks and azimuth ticks relative to overall brightness of indicator display.

Display Select Button – Desired function is activated by pushing applicable button.

AZ – Azimuth ticks on range rings spaced 30 degrees apart.

LFT – Radar scans area to the left of area directly ahead of airplane.

FWD – Radar scans area directly ahead of airplane.

RGT – Radar scans area to the right of area directly ahead of airplane.

HOLD – Last image presented is held for longer evaluation. When HOLD function is deactivated, the presentation will be updated with latest data.

INT Control Knob – Rotate knob clockwise or counterclockwise as necessary to establish desired brightness of entire display.

Range Select Buttons – Pushing applicable button selects 10, 20, 50, 150, or 250 nautical miles range. Selected range is displayed on range readout.

Antenna TILT Control Knob – Rotate as necessary to tilt antenna UP or DN for desired radar scanning. Antenna tilt readout displays antenna tilt angle selected. Tilt limits are from 15° UP to 15° DN in 0.25° increments.

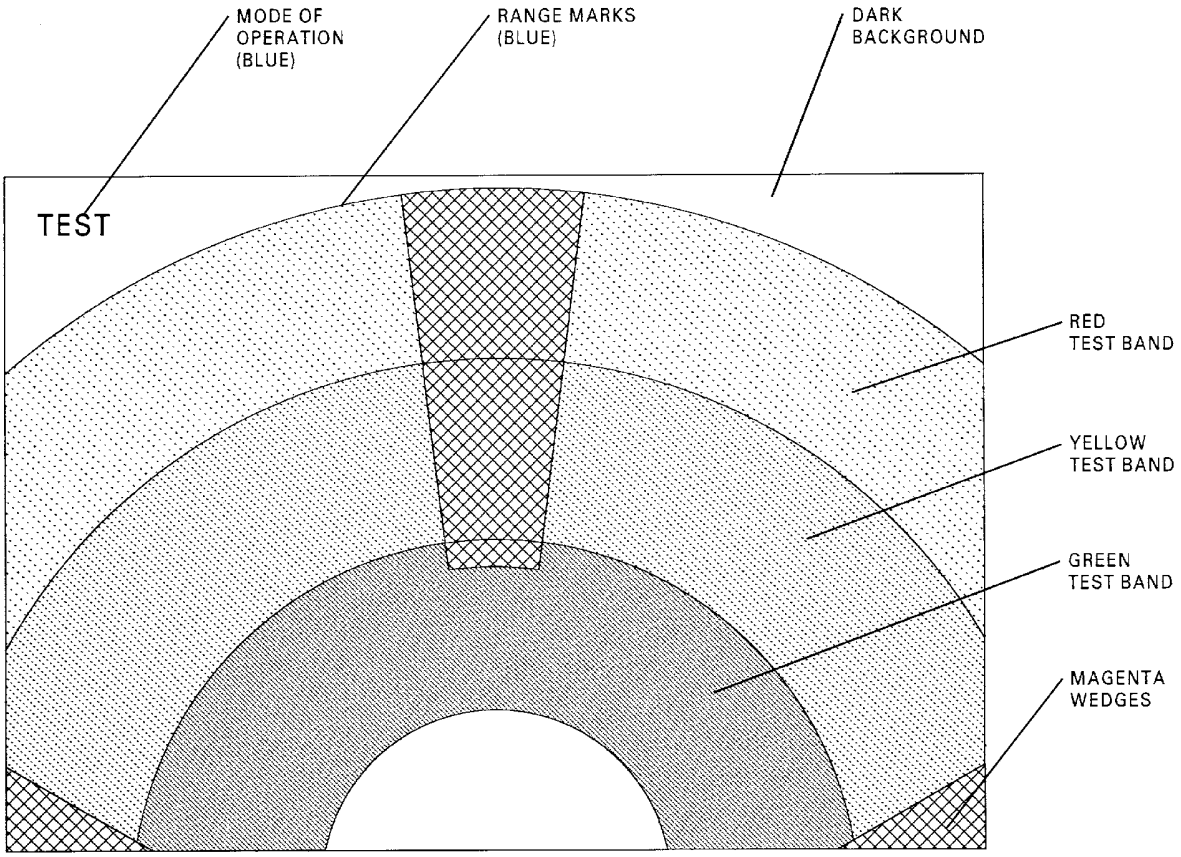
STAB Select Button – When pushed, gyro stabilization is engaged to provide a stabilized plane of scanning for the radar antenna to compensate for airplane pitch and roll. When not engaged, antenna aligns to airplane attitude.

PWR Button – Pushing button applies power to system. Pushing button a second time removes system power.

MAP Gain Control Knob – System gain is controlled in MAP mode by rotating knob counterclockwise to decrease gain. Gain control in weather mode is automatic.

BBB2-34-1235

Weather Radar Indicator -- Controls
Figure 201/34-41-00-990-886



Weather Radar Indicator -- Test Pattern
Figure 202/34-41-00-990-887

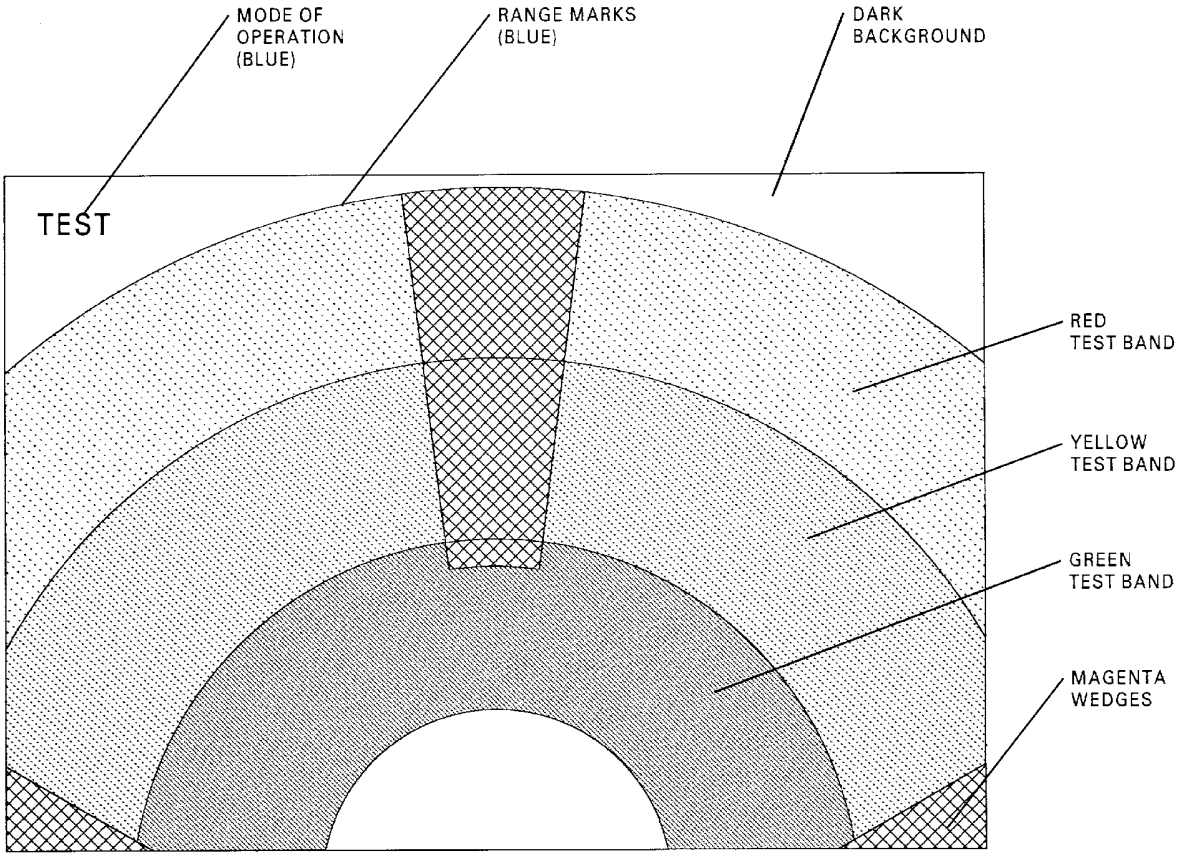
WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all of the units of the weather radar system including the waveguide components, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required. It will be necessary to open the radome and gain access to forward accessory compartment.

B. Self test features incorporated into the system provide a means of evaluating system performance on the ground. The TEST mode of operation provides a multicolor test pattern display which the pilot can use to verify proper operation of the system.

C. Inertial Reference System (IRS) must be operational for Weather Radar System Tests.



Weather Radar Indicator -- Test Pattern
Figure 201/34-41-00-990-885

2. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

WARNING: DO NOT OPERATE RADAR EQUIPMENT IN OTHER THAN TEST MODE, EXCEPT AT AN AUTHORIZED TEST LOCATION. R-F ENERGY IN SUFFICIENT DOSES CAN BE HAZARDOUS TO PERSONNEL. DURING OPERATION IN WX OR MAP MODES, NO PERSONNEL SHOULD BE PERMITTED IN IMMEDIATE AREA OF ANTENNA.

A. Preliminary Setup

(1) Verify all Weather Radar, IRS and EFIS circuit breakers are closed.

(2) Verify IRS switch on overhead panel is in NAV position.

B. EFIS Display Test

Table 201

Operation	Desired Results
(1) On EFIS control and dimming panels, place ND and WX to ON.	Dimmer controls to ON position.
(2) On EFIS mode select panel, place control knob to ARC or MAP position.	Mode select panel to ARC or MAP position.
(3) On WXR control panel, press PWR pushbutton.	PWR pushbutton pressed.
NOTE: The split function control panel allows the left side control functions to operate during the clockwise sweep of the antenna and the right side control functions to operate during the counterclockwise sweep of the antenna.	
(4) On WXR control panel, press TEST pushbutton. Ensure gain in CAL position.	WXR test pattern displayed on EFIS ND. Test pattern contains three concentric arcs consisting of one color each: red, yellow and green (Figure 201). Magenta wedges displayed at center and both lower corners of display. Antenna system performs test sequence, ending with antenna stopping at boresight (electrical zero). Transmitter enabled for less than one second then muted for remainder of test. WXR TEST displayed on ND.
NOTE: Selecting TEST mode activates test mode for both Captain and First Officer's ND. Depressing TEST pushbutton a second time deactivates test mode and returns mode control back to left and right sides of control panel.	
(5) On EFIS dimming panel, rotate WX brightness control to comfortable viewing level.	Brightness adjusted.
(6) On WXR control panel, press TEST pushbutton.	Test pattern and WXR TEST removed from display.
(7) On WXR control panel, press WX pushbuttons.	WX pressed.
(8) Open all IRS-1 and -2 circuit breakers.	WXR ATT displayed on ND. Antenna tilt angle displayed in degrees between WX and ATT.

Table 201 (Continued)

Operation		Desired Results
(9)	Close all IRS-1 and -2 circuit breakers.	WXR ATT message removed after approx. 2 minutes.
(10)	Open all weather radar circuit breakers.	WXR FAIL displayed on ND.
(11)	Close all weather radar circuit breakers.	WXR FAIL removed from ND after approx. 2 minutes.
(12)	On WXR control panel, place TILT control knobs to +5 degrees.	Tilt angle of +5.0(±.3) degrees displayed on ND.
(13)	On WXR control panel, place TILT control knobs to -5 degrees.	Tilt angle of -5.0(±.3) degrees displayed on ND.
(14)	On WXR control panel, press LEFT MODE WX and RIGHT MODE MAP pushbuttons.	Captain's ND displays WX mode. F/O's ND displays MAP mode.
(15)	On WXR control panel, press left TFR pushbutton.	Captain's ND same mode, tilt and gain as F/O's.
(16)	On WXR control panel, press LEFT MODE WX pushbutton.	Captain's ND displays WX mode.
(17)	On WXR control panel, press right TFR pushbutton.	F/O's ND same mode, tilt and gain as Captain's.
(18)	On WXR control panel, press RIGHT MODE MAP pushbutton.	F/O's ND displays MAP mode.
(19)	End test. Return aircraft to required configuration.	

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the mode selector switch on the control panel is placed in the TEST position, a special test pattern is displayed on the indicator for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of existent malfunctions within the system. This is accomplished by the use of locking fault indicators located on front of the receiver-transmitter. In the event that a malfunction occurs, the test pattern, displayed on the indicator, is altered to alert the operator that one or more of the fault indicators on the receiver-transmitter are tripped. This arrangement provides the capability of detecting most system malfunctions without the use of additional test equipment.

C. The stabilization test requires a vertical gyro simulator or unbolting and tilting the vertical gyro, if a vertical gyro simulator is available, use the simulator. Requirement of this test is at the customer's option.

D. The Electronic Flight Instrument system (EFIS) also shows weather radar on navigation display (ND) indicators. When there is no separate or dedicated Wx Radar Indicator, a separate radar control panel is installed and the weather picture will appear only on EFIS Nav display indicator. The weather display is enabled by a separate NAV/WX dimming control panel, located on the Captain's and F/O's main instrument panel.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 201

Name and Number	Manufacturer
Gyro Simulator (as required)	Local
Color master tool 79951154 PTE 1 (without doppler)	

3. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

A. Open Radome

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

(1) Set controls on indicator to positions indicated.

Table 202

Control	Position
BRT control	Mid-position
RANGE Selector	
MODE Selector	OFF
TILT	Mid-position
GAIN	AUTO

(2) Set switches on antenna mount to positions indicated.

Table 203

AZ (Azimuth Motor Switch)	ON
EL (Elevation Motor Switch)	ON

(3) Ensure F/O's VG circuit breaker is closed.

(4) Ensure WEATHER RADAR circuit breakers are closed.

(5) On overhead switch panel, set VERT GYRO switch to NORM.

(6) On indicator, set mode selector to TEST position.

NOTE: Allow a few minutes for the indicator to warm up.

(a) Adjust BRT to comfortable viewing level.

(b) Antenna should begin scanning. Indicator sweep trace will occur between 90(±3) degrees left and 90(±3) degrees right of center in approximately 4 seconds.

(c) Ensure fan is operating on Receiver/Transmitter mount, audible sound can be heard.

(d) Press TEST pushbutton on front of R/T unit, and observe that R/T, ANT, IND, CON, WG SW, GYRO and AIR annunciator lights come on for one second to verify their condition, and then go off.

C. Test Indicator

Table 204

Operation		Desired Result
(1)	Set GAIN control to AUTO.	
(2)	Turn BRT control indicator clockwise.	Image of reasonable brightness and range marks appear.
(3)	Check that indicator sweep trace is scanning smoothly between 90(±3) degrees left and 90(±3) degrees right of dead ahead in approximately 4 seconds.	

Table 204 (Continued)

Operation		Desired Result
(4)	Observe TEST pattern on the indicator. Compare pattern to color master tool number 79951154 PTE 1. Both patterns should be similar.	Test pattern observed.
(5)	Observe if LRU fault warning legends appear on indicator in TEST mode.	LRU fault warning legend may be one or more of the following: T/R FAULT (R-T unit fault) ANT FAULT (Antenna fault) CON FAULT (Control fault) ATT FAULT (Attitude input fault) IND FAULT (Indicator fault) COOL FAULT (R-T cooling fault)
NOTE: Replace faulty LRU and repeat the test. Do not proceed further with the test that follows if an LRU has a fault.		
NOTE: ATTITUDE FAULTS will be displayed as STAB, in yellow during an operational mode, and as an ATT FAULT during TEST MODE. CALIBRATION FAULTS will be displayed as CAL, in yellow during an operational mode, and as an R/T FAULT during TEST MODE. INDICATOR FAULTS will be displayed on the indicator only during TEST MODE.		

D. EFIS Display Test

Table 205

Operation		Desired Result
(1)	Energize EFIS system.	EFIS is ON.
(2)	Place both ND and WX on EFIS dimming panel to ON position.	ND and WX are set to ON position.
(3)	Place EFIS MSP to ARC.	
(4)	Set RADAR Control/Indicator to TEST and adjust gain as required.	EFIS display shows RADAR test pattern.
(5)	EFIS ND shows test pattern similar to that shown in Figure 201.	Display test pattern comparison should be similar.
(6)	Observe message "WXR TEST" on EFIS ND.	Message is observed.
(7)	Select "WX" mode on RADAR control/indicator panel.	WX mode selected.
(8)	Open WEATHER RADAR IND circuit breaker in Upper EPC.	Circuit breaker is opened.
(9)	Observe message "WXR FAIL" on EFIS ND.	Message observed.
(10)	Close WEATHER RADAR IND circuit breaker.	Weather radar indicator is reenergized.
(11)	Observe "WXR FAIL" is removed from EFIS ND.	Message is not observed.
NOTE: The message will take up to 2 minutes to disappear.		

E. WXR/EFIS Control Test

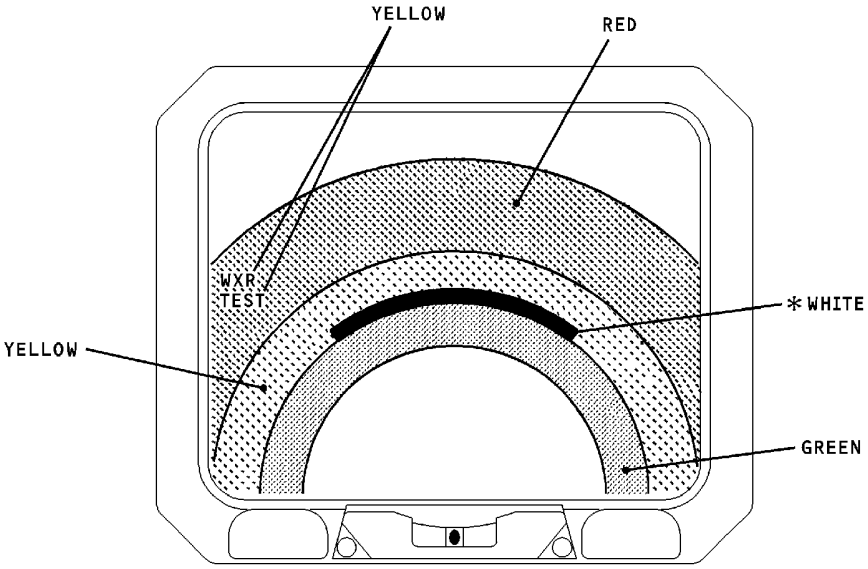
Table 206

Operation		Desired Result
(1)	Select "MAP" mode on RADAR control/indicator panel.	MAP mode is selected.
(2)	Observe "MAP" mode annunciation on RADAR control/indicator panel.	MAP is shown on indicator.
(3)	Observe "MAP" mode annunciation on EFIS NDs.	MAP is shown on NDs.
(4)	Select "TEST" mode on RADAR control/indicator panel.	TEST mode selected.
(5)	Turn RANGE switch on RADAR control/indicator panel from 10 to 320. Observe that selected range appears on RADAR control/indicator panel and neither of NDs' range has changed.	Range changes on indicator. There are no range changes on EFIS NDs.
(6)	Turn RANGE knob on CAPT'S MSP from 10 to 320. Observe range changes on CAPT'S ND as RANGE knob changes, and no range change occurs on RADAR control/indicator panel and F/O's ND.	Range changes on CAPT'S ND. There are no range changes on indicator and F/O's ND.
(7)	Turn RANGE knob on F/O's MSP from 10 to 320. Observe range changes on F/O'S ND as RANGE knob changes, and no range change occurs on RADAR control/indicator panel and CAPT'S ND.	Range changes on F/O's ND. There are no range changes on indicator and CAPT'S ND.

F. Test Completion

Table 207

Operation		Desired Result
(1)	Select "OFF" mode on RADAR control/indicator.	OFF is selected.
(2)	Deenergize EFIS, VG, and weather RADAR system.	EFIS, VG, and WXR Radar are OFF.
(3)	Close nose RADOME.	RADOME is closed.
(4)	Set in required configuration.	



*NOTE: THE WHITE ARC MAY NOT APPEAR

CAG(IGDS)

BBB2-34-2148

Test Pattern
Figure 201/34-41-00-990-858

WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES

1. General

A. Check all units of the weather radar system including the waveguide, to determine that they are mechanically and electrically secure. Examine all operating controls to ensure that they are held securely and are free to move as required.

B. Self-test features incorporated into the system provide a means of evaluating system performance on the ground or while airborne. When the mode selector switch on the control panel is placed in the TEST position, a special test pattern is displayed on the indicator for evaluation of a large portion of the system. In addition, the system incorporates fault isolation circuitry which provides a visual indication of existent malfunctions within the system. This is accomplished by the use of locking fault indicators located on front of the receiver-transmitter. In the event that a malfunction occurs, the test pattern, displayed on the indicator, is altered to alert the operator that one or more of the fault indicators on the receiver-transmitter are tripped. This arrangement provides the capability of detecting most system malfunctions without the use of additional test equipment.

C. The stabilization test requires a vertical gyro simulator or unbolting and tilting the vertical gyro, if a vertical gyro simulator is available, use the simulator. Requirement of this test is at the customer's option.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 201

Name and Number	Manufacturer
Gyro Simulator (as required)	Local

3. Adjustment/Test

WARNING: OPERATION OF EQUIPMENT INVOLVES USE OF EXTREMELY HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. DO NOT MAKE ADJUSTMENTS OR CHANGE COMPONENTS INSIDE EQUIPMENT WITH SYSTEM ENERGIZED. ONLY QUALIFIED PERSONNEL, THOROUGHLY FAMILIAR WITH OPERATION OF RADAR SYSTEMS, SHOULD PERFORM TESTS. OBSERVE SAFETY PRECAUTIONS AT ALL TIMES.

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 160 FEET OF PERSONNEL AND/OR WITHIN 50 FEET OF FUELING OPERATION OR FUEL SPILLS. WARM UP RADAR IN STBY POSITION ONLY. THESE CONDITIONS CAN CAUSE FIRE OR INJURIES TO PERSONNEL.

A. Open Radome

NOTE: When any part of the weather radar system fails to meet prescribed test results, do not continue test until the cause of failure has been determined and corrected.

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(1) Open radome and raise until support arms lock into place.

B. Preliminary Control Settings

(1) Set controls on indicator to positions indicated.

Table 202

Control	Position
BRT control	Full CCW
RANGE Selector	320 mi.
MODE Selector	OFF
TILT	10 degrees (up)
GAIN	AUTO
STAB	ON

(2) Set switches on antenna mount to positions indicated.

Table 203

Control	Position
AZ (Azimuth Motor Switch)	ON
EL (Elevation Motor Switch)	ON

(3) Ensure F/O's VG circuit breaker is closed.

(4) Ensure WEATHER RADAR circuit breakers are closed.

(5) On overhead switch panel, set VERT GYRO switch to NORM.

(6) On indicator, set mode selector to TEST position. After approximately 25 seconds following should occur:

(a) Antenna should begin scanning. Indicator sweep trace will occur between 90(±3) degrees left and 90(±3) degrees right of center in approximately 4 seconds.

(b) Ensure fan is operating on Receiver/Transmitter mount, audible sound can be heard.

(c) Press TEST pushbutton on front of R/T unit, and observe that R/T, ANT, IND, CON, WG SW, GYRO and AIR annunciator lights come on for one second to verify their condition, and then go off.

C. Test Indicator

	Operation	Desired Result
(1)	Set GAIN control to AUTO.	
(2)	Turn BRT control indicator clockwise.	Image of reasonable brightness and range marks appear.
(3)	Check that indicator sweep trace is scanning smoothly between 90(±3) degrees left and 90(±3) degrees right of dead ahead in approximately 4 seconds.	
(4)	Observe TEST pattern on the indicator.	Test pattern observed.
(5)	Observe if LRU fault warning legends appear on indicator in TEST mode.	LRU fault warning legend may be one or more of the following: • R/T FAULT (R-T unit fault) • ANT FAULT (Antenna fault) • CON FAULT (Control fault) • ATT FAULT (Attitude input fault) • IND FAULT (Indicator fault) • COOL FAULT (R-T cooling fault)

(Continued)

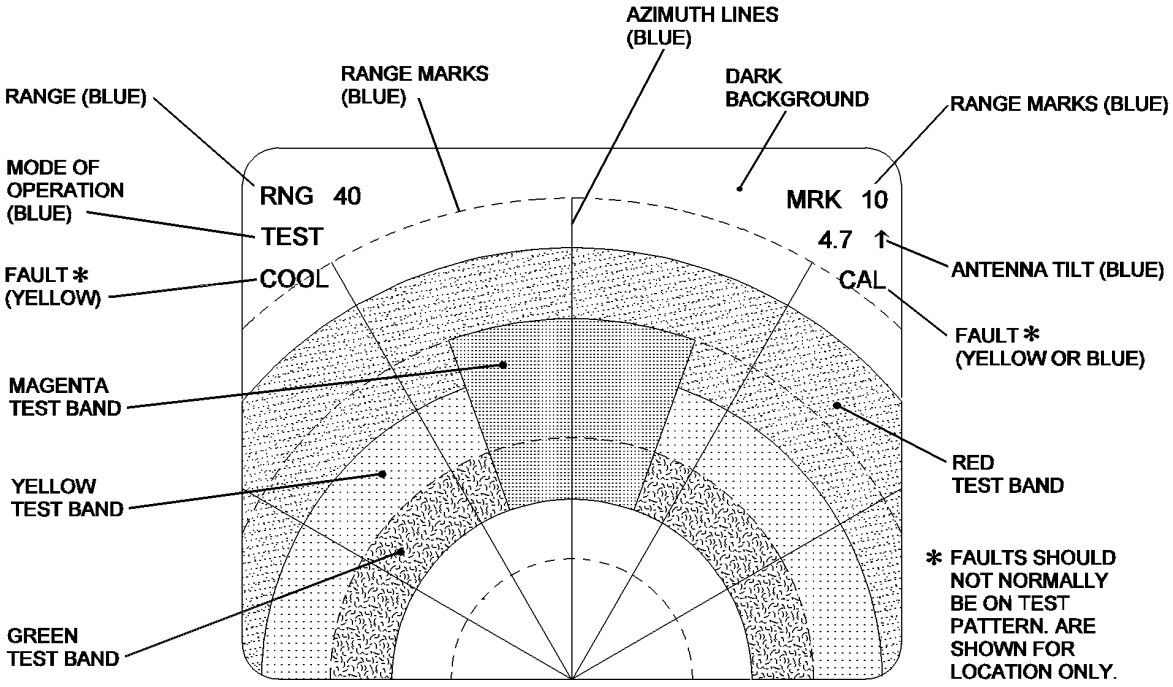
	Operation	Desired Result
NOTE: ATTITUDE FAULTS will be displayed as STAB, in yellow during an operational mode, and as an ATT FAULT during TEST MODE. CALIBRATION FAULTS will be displayed as CAL, in yellow during an operational mode, and as an R/T FAULT during TEST MODE. INDICATOR FAULTS will be displayed on the indicator only during TEST MODE.		

D. Stabilization Test

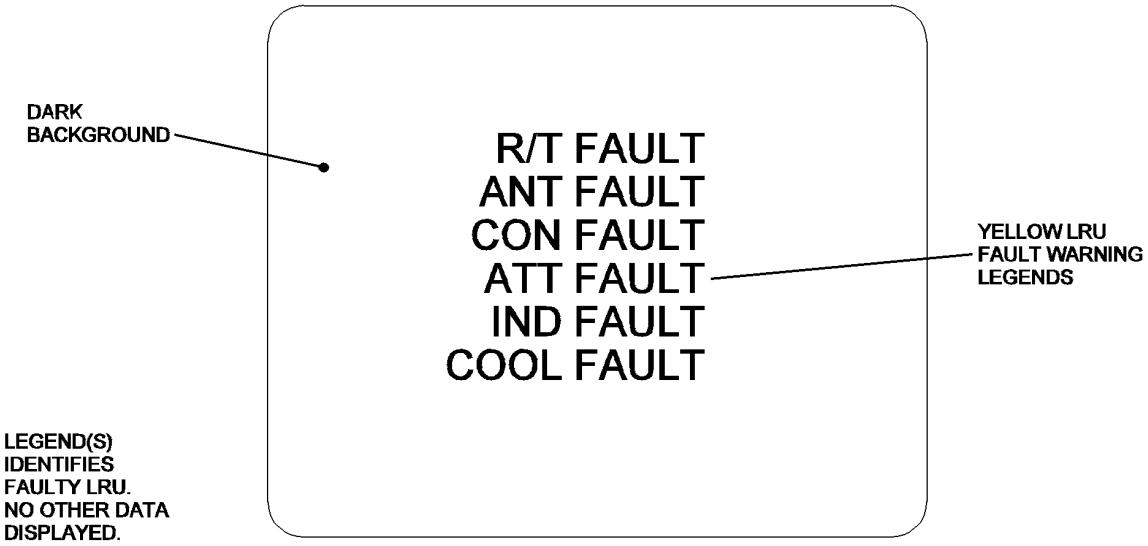
	Operation	Desired Result
(1)	Ensure that MODE Selector Switch is in TEST position.	MODE selector to TEST.
(2)	Ensure BRT control is adjusted to comfortable viewing level.	Brightness adjusted.
(3)	Deleted.	
(4)	Set TILT switch on indicator front panel to 0° tilt.	TILT set to 0°.
(5)	Electrically rotate antenna in azimuth and towards LEFT wing.	Antenna rotated towards LEFT wing.
(6)	Observe indicator and ensure that sweep is in the same direction. Also, make sure that TILT readout is 0°. (Top right hand corner of indicator.)	
(7)	Electrically rotate antenna in azimuth and towards the RIGHT wing.	Antenna rotated towards RIGHT wing.
(8)	Observe indicator and ensure that sweep is in same direction. Also, make sure that TILT readout is 0°.	
(9)	Deleted.	
NOTE: The following steps requires use of a gyro simulator. If gyro simulator is not available, the gyro must be tipped to simulate pitch and roll. To accomplish this, gyro attaching bolts must be loosened or removed. This portion of test is at customer's option.		
(10)	Connect Gyro Simulator.	Gyro Simulator connected.
(11)	Adjust Gyro Simulator to 10° pitch up.	Gyro to 10° pitch up.
(12)	Observe that antenna is at dead ahead (0° in Azimuth) and tilts down 10°. Observe also that at 90° and 270° azimuth scan points, and antenna tilt is 0°.	
(13)	Adjust Gyro Simulator to 10° pitch down.	Gyro to 10° pitch down.
(14)	Observe that antenna is at dead ahead (0° in azimuth), and tilts UP 10°. Observe also that at 90° and 270° azimuth scan points, and antenna tilt is 0°.	
(15)	Adjust Gyro Simulator to 10° roll right.	Gyro 10° Roll right.

(Continued)

	Operation	Desired Result
(16)	Observe that antenna at 90° azimuth scan point tilts UP 10°. At dead ahead, antenna tilt is 0°; and at 270° azimuth scan point tilt is 10° down.	
(17)	Adjust Gyro Simulator to 10° ROLL left.	Gyro to 10° roll left.
(18)	Observe that Antenna at 90° azimuth scan points tilts DOWN 10°. At dead ahead, antenna tilt is 0°; and at 270° azimuth scan point tilt is 10° up.	
(19)	Set STAB switch on indicator front panel to OFF.	Stab to OFF.
(20)	Observe that antenna tilt is 0° throughout its entire scan.	
(21)	Disconnect and remove the Gyro Simulator.	Gyro Simulator disconnected and removed.
NOTE: If gyro bolts were loosened or removed to simulate pitch and roll, make certain gyro is secured in original position.		
(22)	Return airplane to required configuration.	



TEST PATTERN



TEST MODE FAULT DISPLAY

BBB2-34-849B
S0006546565V3

Test Pattern and Fault Display
Figure 201/34-41-00-990-882

WEATHER RADAR ANTENNA - MAINTENANCE PRACTICES

1. General

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

A. This maintenance practice provides removal/installation procedures for the weather radar antenna. The antenna is a 180 degree scanning antenna. The antenna has a flat plate 30 inch reflector. The antenna assembly is located in the nose section of the aircraft behind the radome.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

B. This maintenance practice provides removal/installation procedures for the weather radar antenna. The antenna consists of an antenna flat plate and a pedestal. The antenna assembly is located in the nose section of the aircraft behind the radome.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

NOTE: Removal/installation of the flat plate antenna and pedestal can be accomplished at the option of the operator by separately removing and installing the antenna flat plate, then the pedestal, or by removing/installing the antenna flat plate and pedestal assembled (Weather Radar Antenna).

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Waveguide gasket MS 90064-13	
WJE 401-404, 406, 412, 414, 874, 886, 887, 892, 893	
Inconel Lockwire 0.032 in NASM20995N32, DPM 684	Not specified
Corrosion Resistant Steel Lockwire 0.032 in NASM20995C32, DPM 5865.	Not specified
Torque Wrench 0 - 40 in-lb (0-5 N·m)	Local
WJE ALL	

3. Removal/Installation - Weather Radar Antenna

A. Remove Weather Radar Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(2) Open radome and raise until support arms lock into place.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(3) Disconnect and cap antenna electrical connector.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(4) Release quick-disconnect clamp and disconnect antenna waveguide input; cap waveguide.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

(5) Loosen upper antenna mounting bolts.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(6) Remove and cap electrical connector at lower part of antenna.

(7) Loosen quick-disconnect clamp and disconnect and cap waveguide from antenna pedestal.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

CAUTION: CONFIGURATION OF ANTENNA MAKES UNEVEN DISTRIBUTION OF WEIGHT AN INHERENT PROBLEM AND RESULTS IN AWKWARD HANDLING OF ANTENNA UNIT. IT IS RECOMMENDED THAT SUITABLE SUPPORT OR ASSISTANCE BE PROVIDED TO PREVENT EQUIPMENT FROM BEING DROPPED OR MISHANDLED.

(8) Remove antenna lower mounting bolts, and carefully remove antenna from antenna support bracket.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

CAUTION: CONFIGURATION OF ANTENNA MAKES UNEVEN DISTRIBUTION OF WEIGHT AN INHERENT PROBLEM AND RESULTS IN AWKWARD HANDLING OF ANTENNA UNIT. IT IS RECOMMENDED THAT SUITABLE SUPPORT OR ASSISTANCE BE PROVIDED TO PREVENT EQUIPMENT FROM BEING DROPPED OR MISHANDLED.

(9) Loosen upper antenna mounting bolts and remove lower bolts and washers securing antenna pedestal and carefully remove antenna from aircraft.

WJE ALL

(10) Provide protective storage for antenna.

B. Install Weather Radar Antenna

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

(2) Clean antenna mounting bracket and four aircraft attach surfaces for electrical bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(3) Place antenna in mounting position on upper mounting bolts and insert lower mounting bolts through holes in antenna mounting bracket.

WJE 401-404, 406, 412, 414, 874, 886, 887, 892, 893

(4) Position antenna over upper mounting bolts on aircraft mounting surface, install lower bolts and washers, and tighten upper and lower bolts.

(a) Ensure slotted holes on pedestal base are placed in the 12 o'clock position.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(5) Tighten upper and lower mounting bolts.

(6) Tighten bolts to 96 in-lb (10.8 N·m) to 114 in-lb (12.9 N·m).

(7) Remove waveguide cap and install a new waveguide gasket. Mate antenna input waveguide choke flange with cover flange and reset quick-disconnect clamp.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

(8) Remove cap and connect electrical connector.

WJE 401-404, 406, 412, 414, 874, 886, 887, 892, 893

(9) Connect electrical connector to antenna electrical receptacle.

(10) Install new waveguide gasket and connect waveguide to pedestal waveguide flange and secure quick disconnect waveguide clamp.

CAUTION: WHEN TILTING ANTENNA FLAT PLATE DO NOT FORCE AGAINST LIMIT STOPS.

(11) Manually scan antenna flat plate in azimuth and check that antenna is free to scan ±90 degrees when in zero tilt position, and when tilted in maximum up and down position.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

CAUTION: WHEN TILTING REFLECTOR, DO NOT FORCE AGAINST LIMIT STOPS.

(12) Manually rotate antenna and check that reflector is free to scan 180 degrees when in zero tilt position, and when tilted in maximum up and down position, do not force reflector against tilt stops.

WJE ALL

(13) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(14) Perform operational test as follows:

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY THE RADAR ANTENNA MUST NOT BE MADE IN THE VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF THE RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OF AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(a) Set mode selector switch to TEST.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(b) Observe video bands on indicator test pattern. If video bands are missing then antenna is malfunctioning. (WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 4 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 7 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 13 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 14 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 19 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 20)

(c) Observe antenna. Antenna should be scanning Left & Right 90 degrees.

WJE ALL

(15) Satisfactory results of quick checks indicate that antenna is operable. If additional checks are required, perform applicable portion of system test. (WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 4 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 7 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 13 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 14 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 16 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 19 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 20 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 8 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 11 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15)

(16) Ensure that antenna cavity is free of loose hardware.

(17) Close and latch radome.

(18) Return aircraft to required configuration.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

C. Remove antenna flat plate as follows:

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406, 892, 893			
F	4	B10-294	WEATHER RADAR IND
WJE 401-404, 406, 412, 414, 886, 887, 892, 893			
F	5	B10-295	WEATHER RADAR XCVR

WARNING: SIZE OF RADOME AND HEIGHT FROM GROUND MAY PRESENT SOME HAZARD TO MAINTENANCE PERSONNEL, THEREFORE, ENSURE THAT RADOME IS FULLY OPENED AND THAT SUPPORT ARMS ARE COMPLETELY EXTENDED AND SECURELY LOCKED INTO PLACE.

(2) Open radome and raise until support arms lock into place.

(3) Remove lockwire and discard. Loosen captive bolts located on antenna pedestal mounting flange to open spring-loaded clamp jaw.

(4) Carefully lift antenna flat plate away from mount.

D. Install antenna flat plate as follows:

WJE 401-404, 406, 412, 414, 886, 887, 892, 893 (Continued)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406, 892, 893			
F	4	B10-294	WEATHER RADAR IND
WJE 401-404, 406, 412, 414, 886, 887, 892, 893			
F	5	B10-295	WEATHER RADAR XCVR

(2) Turn captive bolts located on pedestal mounting flange CCW to open spring-loaded clamp jaw.

(3) Position antenna flat plate over antenna pedestal mounting flange. Make sure the nameplate is at the 3 o'clock position.

(4) Carefully place antenna flat plate on antenna pedestal mounting flange.

NOTE: Ensure guide pins located on pedestal mounting flange engage pilot holes on antenna flat-plate mounting flange.

(5) Secure antenna flat plate to pedestal by alternately tightening each bolt 2 to 3 turns until flanges are fully seated. Torque each captive bolt to 20 in-lb (2 N·m).

(6) Safety the bolts from bolthead-to-bolthead with lockwire. (LOCKWIRE SAFETYING - MAINTENANCE PRACTICES, PAGEBLOCK 20-10-18/201)

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406, 892, 893			
F	4	B10-294	WEATHER RADAR IND
WJE 401-404, 406, 412, 414, 886, 887, 892, 893			
F	5	B10-295	WEATHER RADAR XCVR

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

E. Check weather radar operation as follows:

WJE 873, 874

(1) Rotate DISPLAY control to mid-position.

NOTE: RF energy is transmitted during TEST mode of operation.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY THE RADAR ANTENNA MUST NOT BE MADE IN THE VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF THE RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT TEST. DO NOT ALLOW PERSONNEL WITHIN IMMEDIATE AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(2) Press PWR switch ON.

WJE 873, 874

(3) Depress TEST switch.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

(4) Depress MODE TEST switch.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(5) Observe indicator test pattern. (WEATHER RADAR SYSTEM, SUBJECT 34-41-00).

WJE 873, 874

(6) Observe antenna. Antenna should scan 180°.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

(7) Observe antenna. Antenna should be pitched-up and should be rolling alternately left and right.

WJE 873, 874

(8) Satisfactory results of quick checks in Paragraph 3.E.(5) and Paragraph 3.E.(6), indicate that antenna is operable.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

(9) Satisfactory results of quick checks in Paragraph 3.E.(5) and Paragraph 3.E.(7), indicate that antenna is operable.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(10) If additional checks are required, perform applicable portion of system test. (WEATHER RADAR SYSTEM, SUBJECT 34-41-00)

WJE 873, 874

(11) Rotate DISPLAY control to OFF position.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

(12) Press PWR switch OFF.

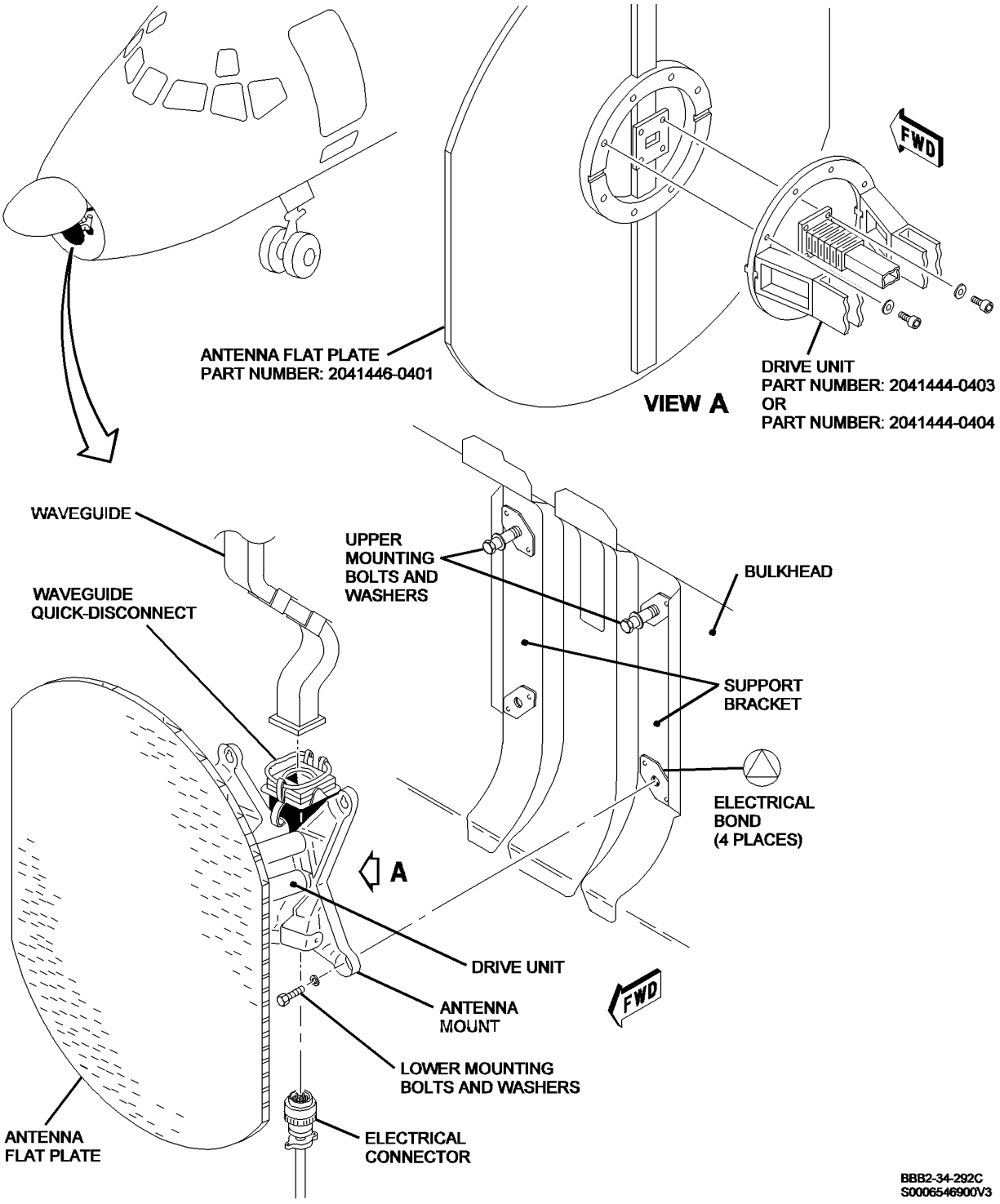
WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(13) Ensure that antenna cavity is free of loose hardware.

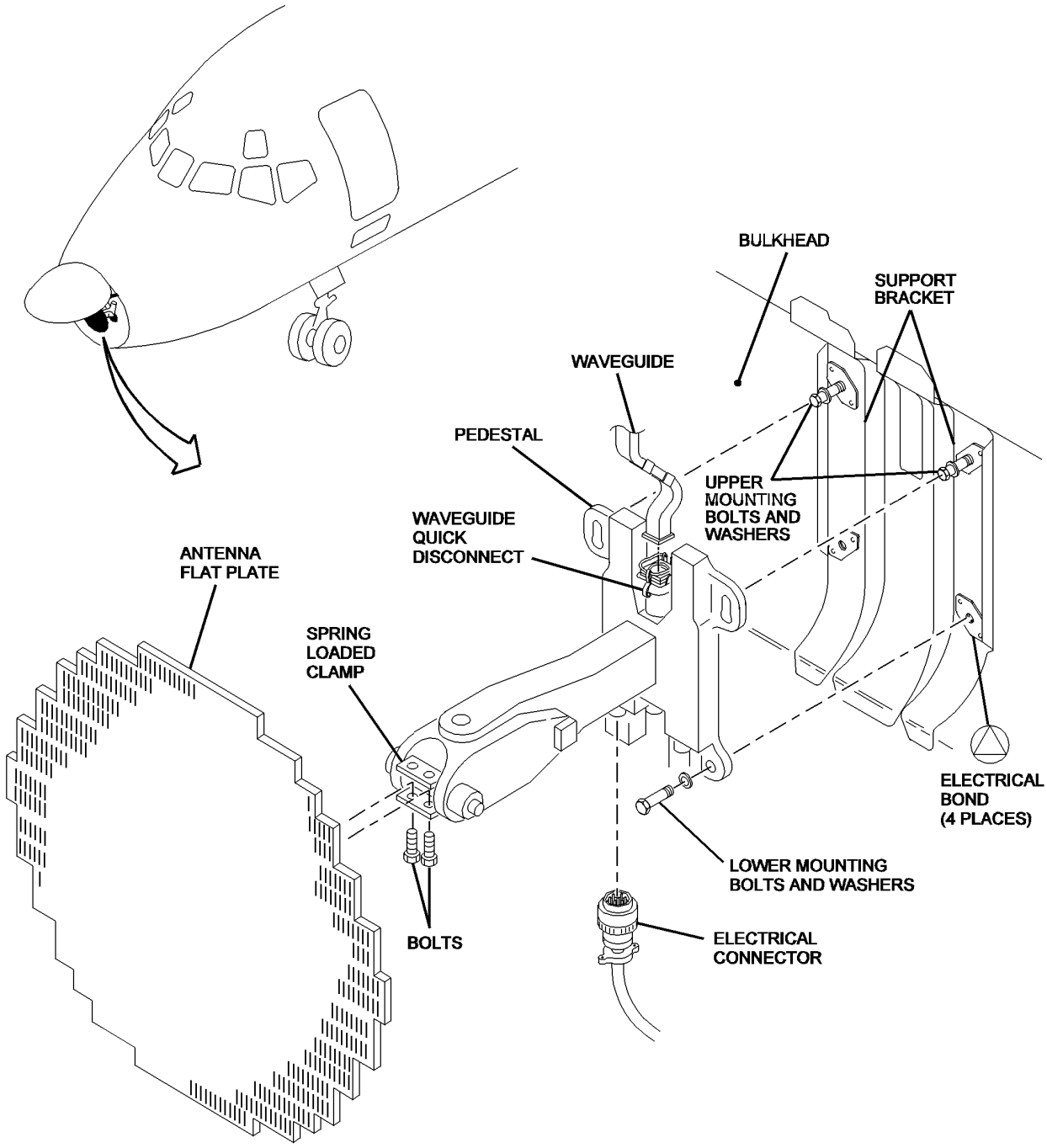
(14) Close and latch radome.

(15) Return aircraft to required configuration.

WJE ALL



Weather Radar Antenna -- Removal/Installation
Figure 201/34-41-01-990-803 (Sheet 1 of 2)



Weather Radar Antenna -- Removal/Installation
Figure 201/34-41-01-990-803 (Sheet 2 of 2)

WEATHER RADAR INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the weather radar indicator. The radar indicator is installed in the forward pedestal in the flight compartment. The indicator contains all the controls for radar operation.

2. Removal/Installation - Weather Radar Indicator

A. Remove Weather Radar Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893			
F	5	B10-295	WEATHER RADAR XCVR

(2) Deactivate engine thrust reversers (PAGEBLOCK 78-00-00/201).

(3) Place engine thrust reverser levers in reverse thrust position.

(4) Rotate locking lever which is located directly beneath face of indicator to right as far as it will go.

(5) Carefully draw indicator out of its mount and remove from aircraft.

WJE 406, 873, 874, 886, 887, 892, 893

(6) Install protective covers on indicator electrical receptacle and face, and airplane wire harness electrical plug.

WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893

B. Install Weather Radar Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893			
F	5	B10-295	WEATHER RADAR XCVR

(2) Deactivate engine thrust reversers. (PAGEBLOCK 78-00-00/201)

(3) Place engine thrust reverser levers in reverse thrust position.

WJE 406, 873, 874, 886, 887, 892, 893

(4) Check indicator electrical receptacle and airplane wire harness electrical plug for damaged pins, corrosion, and dirt.

WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893

(5) Carefully slide indicator into mount, ensuring that electrical connector mates perfectly.

(6) Rotate locking lever to left until indicator is securely in position.

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893			
F	5	B10-295	WEATHER RADAR XCVR

(8) Place engine thrust reverser levers in engine reverser stowed position.

(9) Activate and test engine thrust reversers (PAGEBLOCK 78-00-00/201).

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

C. Check Operation of Indicator After Installation

WJE 406, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891

NOTE: Vertical Gyro system must be operational.

WJE 405, 407-411, 880, 881, 883, 884

NOTE: Vertical Gyro/AHRS System as applicable must be operational.

WJE 886, 887

NOTE: Attitude Heading and Reference System-2 must be operational.

WJE 892, 893

NOTE: VG-2 (or AHRS-2) must be operational.

WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 886, 887, 891

(1) Set range selector on WXR indicator to 160 mile position.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 886, 887, 891

(2) Rotate BRT control fully CCW.

(3) Rotate antenna tilt control to zero degree.

(4) Rotate GAIN control to AUTO position.

(5) Turn function switch to TEST. (After 3 minutes transmitter will be operative.)

(6) Adjust BRT control for comfortable brightness level.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891

(7) Check that indicator sweep trace is scanning smoothly between 90(±3) degrees (1.57 (0.052) rad) left and 90(±3) degrees (1.57 (0.052) rad) right of dead ahead. Sweep scan should take approximately 4 seconds.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 886, 887, 891

(8) A satisfactory test pattern will indicate indicator is operational. (For test pattern WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION, PAGEBLOCK 34-41-00/001 Config 5 or WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION, PAGEBLOCK 34-41-00/001 Config 6 or WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION, PAGEBLOCK 34-41-00/001 Config 11)

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 7 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 14 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 19 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 20 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15, for complete system test.

WJE 873, 874

(9) Rotate DISPLAY control to mid-position.

(10) Press TEST pushbutton on Indicator.

(11) A satisfactory test pattern will indicate indicator is operational. (For test pattern refer to Figure 201)

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 11 for complete system test.

(12) Press STBY pushbutton on Indicator.

(13) Rotate DISPLAY control to OFF position.

WJE 406, 886, 887, 892, 893

(14) Press PWR pushbutton (on).

WJE 886, 887, 892, 893

(15) Press range on indicator to 160 mile position.

WJE 406, 886, 887, 892, 893

(16) Set TILT control to center and INT control to mid position.

(17) Press WXR indicator TEST pushbutton.

(18) Word TEST appears in top left portion of WXR indicator.

(19) Color bar top left of WXR indicator shows green, yellow and red NO FAIL message on indicator.

(20) Antenna should be scanning left-right.

WJE 406, 886, 887, 892, 893 (Continued)

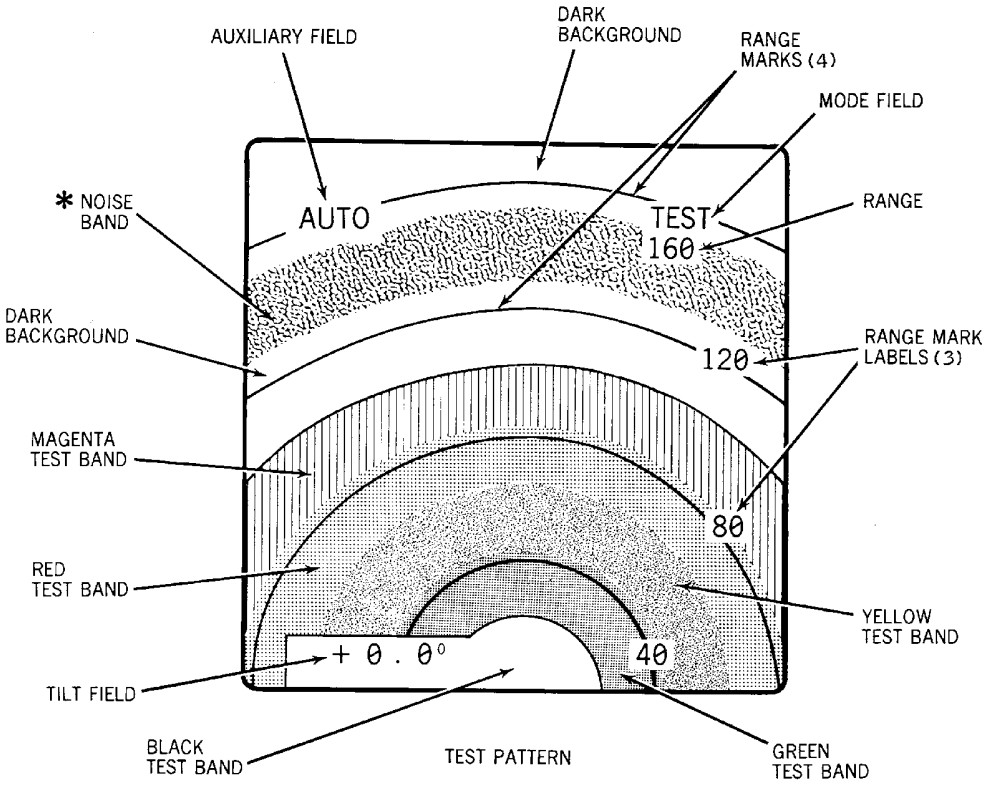
(21) Test pattern on indicator should show color rings from bottom, green, yellow, red, and magenta and four range marks. (For test pattern refer to WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION, PAGEBLOCK 34-41-00/001 Config 6)

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 8 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15 for complete system test.

(22) Press WXR indicator PWR pushbutton (off).

WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 886, 887, 891-893

(23) Return aircraft to required configuration.



1. VERIFY THE FOLLOWING ON THE DISPLAY:
   a. TEST DISPLAYED IN MODE FIELD.
   b. RANGE MARKS AND ALPHANUMERICS DISPLAYED IN CYAN.
   c. COLORS OF FIRST FIVE TEST BANDS ARE BLACK, GREEN, YELLOW, RED, AND MAGENTA.
   d. 20 NM NOISE BAND BETWEEN 130 and 150 NM IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.
   e. AUTO (PRE-SET GAIN) DISPLAYED IN AUXILIARY FIELD.
   f. +0.0° DISPLAYED IN TILT FIELD.
   g. 160 (NM) DISPLAYED IN UPPER RIGHT CORNER, AND FIRST THREE RANGE MARKS LABELED 40, 80, AND 120 RESPECTIVELY.

NOTE

*20 NM WIDE NOISE BAND BETWEEN 130 AND 150 NM. BAND IS PREDOMINATELY GREEN BUT MAY CONTAIN YELLOW AND RED DOTS.

BBB2-34-606

Weather Radar Indicator - Test Pattern
Figure 201/34-41-02-990-801

WEATHER RADAR CONTROL PANEL - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the weather radar control panel, mounted on the pedestal. The control panel contains a function switch, gain control, antenna tilt control and stabilization switch.

2. Removal/Installation

A. Remove Weather Radar Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

(2) Turn mounting screws CCW approximately 1/4 turn until control panel is loose.

(3) Lift control panel; disconnect and cap wire harness connector, and remove control panel from pedestal.

B. Install Weather Radar Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

(2) Remove cap from wire harness connector and connect to weather radar control panel.

(3) Insert control panel carefully into cavity and tighten mounting screws until secure.

(4) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(5) Check operation of panel after installation as follows:

WJE 401-404, 412, 414, 875-879

(a) Place IRS selector switch to NAV and wait 3 minutes for inertial reference units (IRU's).

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(b) Place ANT STAB selector switch to STBY and wait 3 minutes for vert gyro to stabilize. On aircraft with IRS, place IRS selector switch to NAV and wait 3 minutes for inertial reference units.

WJE 401-404, 412, 414, 875-879

(c) On WXR control panel press TEST pushbutton.

(d) Place selector switch on EFIS MODE selector panel in ARC position.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(e) Place selector switch on MODE selector panel in ARC position.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(f) Note that antenna scans and that display appears on Navigation display indicator.

(g) Turn TILT knob and observe that antenna tilts upward and downward as knob is manipulated.

(h) If preceding checks are satisfactory, control panel is considered operable.

WJE 875, 876, 878, 879

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 4, for complete system check.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 877

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 13, for complete system check.

WJE 401-404, 412, 414

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 16, for complete system check.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(i) Return aircraft to required configuration.

WEATHER RADAR RECEIVER/TRANSMITTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the weather radar Receiver Transmitter (RT) unit. The RT unit is installed in forward accessory compartment. The RT unit is controlled by the weather radar control panel on the pedestal.

2. Remove/Install Weather Radar Receiver/Transmitter

A. Remove Receiver/Transmitter

(1) Remove unit.

B. Install Receiver/Transmitter

(1) Visually check unit connector plugs and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(2) Slide unit straight into rack, ensuring that connectors are properly aligned with mounting rack connectors.

(3) Return aircraft to required configuration.

WEATHER RADAR RECEIVER/TRANSMITTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the weather radar RT unit. The RT unit is installed in the forward accessory compartment. Operation of the RT unit is controlled by the weather radar control panel.

2. Removal/Installation Weather Radar Receiver/Transmitter

A. Remove Weather Radar R/T Unit

WJE 406, 873, 874, 886, 887, 892, 893

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406, 873, 874, 892, 893			
F	4	B10-294	WEATHER RADAR IND
WJE 406, 873, 874, 886, 887, 892, 893			
F	5	B10-295	WEATHER RADAR XCVR

WJE 401-404, 412, 414

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(3) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(4) Turn drive/extractor handle CCW until unit electrical connectors and waveguide connector are disengaged from mounting rack support, and remove unit.

B. Install Receiver/Transmitter

WJE 406, 886, 887, 892, 893

WARNING: DO NOT TOUCH RADAR RECEIVER/TRANSMITTER MOUNT TRAY ELECTRICAL CONNECTOR PINS. WITH WEATHER RADAR XCVR CIRCUIT BREAKER CLOSED, ELECTRICAL POWER IS PRESENT ON MOUNT TRAY CONNECTOR PINS, AND SHOCK HAZARD EXISTS.

(1) Close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WARNING: DO NOT TOUCH RADAR RECEIVER/TRANSMITTER MOUNT TRAY ELECTRICAL CONNECTOR PINS. WITH WEATHER RADAR XCVR CIRCUIT BREAKER CLOSED, ELECTRICAL POWER IS PRESENT ON MOUNT TRAY CONNECTOR PINS, AND SHOCK HAZARD EXISTS.

(2) Push and hold PUSH TO TEST switch on back plate of receiver/transmitter mount; and verify mount fan is operating. After verification of mount fan operation, release PUSH TO TEST switch.

(3) Open this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(4) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(5) Slide unit straight into rack, ensuring that connectors are properly aligned with mounting rack connectors.

(6) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(7) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

WJE 406, 873, 874, 886, 887, 892, 893

(8) Close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406, 873, 874, 892, 893			
F	4	B10-294	WEATHER RADAR IND
WJE 406, 873, 874, 886, 887, 892, 893			
F	5	B10-295	WEATHER RADAR XCVR

WJE 401-404, 412, 414

(9) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WJE 406, 873, 874, 886, 887, 892, 893

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(10) On radar indicator, press PWR pushbutton, then push TEST pushbutton.

WJE 873, 874

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(11) On radar indicator, press PWR pushbutton, rotate DISPLAY control to mid-position, then push TEST pushbutton.

WJE 401-404, 412, 414

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(12) On radar control panel, press PWR pushbutton, then push TEST pushbutton.

(13) Wait approximately 4 minutes for equipment warm-up, and check fault warning legends are not displayed on EFIS ND's.

WJE 406, 873, 874, 886, 887, 892, 893

(14) Wait approximately 4 minutes for equipment warm-up, and check fault warning legends do not light on front of indicator.

WJE 401-404, 412, 414

(15) Check for good test pattern on ND's. See test pattern in WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 16.

WJE 892, 893

(16) Check for good test pattern on weather radar indicator. See test pattern in WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 8.

WJE 873, 874

(17) Check for good test pattern on weather radar indicator. See test pattern in WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 11.

WJE 406, 886, 887

(18) Check for good test pattern on weather radar indicator. See test pattern in WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15.

WJE 401-404, 406, 412, 414, 886, 887, 892, 893

(19) Check overtemp indicator on receiver/transmitter is not on.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(20) System ready to operate.

WJE 892, 893

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 8, for complete system test.

WJE 873, 874

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 11, for complete system test.

WJE 406, 886, 887

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15 , for complete system test.

WJE 401-404, 412, 414

NOTE: If necessary, refer to WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 16, for complete system test.

WJE 406, 873, 874, 886, 887, 892, 893

(21) Press PWR pushbutton on indicator to turn system off.

WJE 401-404, 412, 414

(22) Press PWR pushbutton on control panel to turn system off.

WJE 873, 874

(23) Press PWR pushbutton on indicator to turn system off; press STBY pushbutton, then rotate DISPLAY control to OFF.

WJE 401-404, 406, 412, 414, 873, 874, 886, 887, 892, 893

(24) Return aircraft to required configuration.

WEATHER RADAR RECEIVER/TRANSMITTER - MAINTENANCE PRACTICES

1. General

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

A. This maintenance practice provides removal/installation procedures for the weather radar RT unit. The RT unit is installed in the forward accessory compartment. Operation of the RT unit is controlled by the weather radar control panel on the indicator.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891

B. This maintenance practice provides removal/installation procedures for the weather radar RT unit. The RT unit is installed in the forward accessory compartment. Operation of the RT unit is controlled by the weather radar control panel on the Indicator.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

2. Removal/Installation Weather Radar Receiver/Transmitter

A. Remove Receiver/Transmitter

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891			
F	4	B10-294	WEATHER RADAR IND
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891			
F	5	B10-295	WEATHER RADAR XCVR

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open this circuit breaker and install safety tag:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(3) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(4) Turn drive/extractor handle CCW until unit electrical connectors and waveguide connector are disengaged from mounting rack support, and remove unit.

B. Install Receiver/Transmitter

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891

WARNING: DO NOT TOUCH RADAR RECEIVER/TRANSMITTER MOUNT TRAY ELECTRICAL CONNECTOR PINS. WITH WEATHER RADAR XCVR CIRCUIT BREAKER CLOSED, ELECTRICAL POWER IS PRESENT ON MOUNT TRAY CONNECTOR PINS, AND SHOCK HAZARD EXISTS.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891			
F	4	B10-294	WEATHER RADAR IND
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891			
F	5	B10-295	WEATHER RADAR XCVR

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(3) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(4) Slide unit straight into rack, checking that connectors are properly aligned with mounting rack connectors.

(5) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(6) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891			
F	4	B10-294	WEATHER RADAR IND
WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891			
F	5	B10-295	WEATHER RADAR XCVR

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(8) Remove the safety tag and close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	5	B10-295	WEATHER RADAR XCVR

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY THE RADAR ANTENNA MUST NOT BE MADE IN THE VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF THE RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT TEST. DO NOT ALLOW PERSONNEL WITHIN IMMEDIATE AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(9) On radar control panel, initiate to TEST position.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891

WARNING: DO NOT DO TESTS THAT CAUSE THE RADAR ANTENNA TO TRANSMIT INTO LOCATIONS WHERE IT CAN CAUSE DAMAGE AND INJURIES. THE RADAR ENERGY CAN CAUSE INJURY TO PERSONS IN FRONT OF THE AIRCRAFT. THE RADAR ENERGY CAN CAUSE IGNITION OF EXPLOSIVE AND FLAMMABLE LIQUIDS IN TRUCKS OR CONTAINERS NEAR THE AIRCRAFT.

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(10) On radar indicator, set mode selector to TEST position.

WJE 875-879

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY THE RADAR ANTENNA MUST NOT BE MADE IN THE VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF THE RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT TEST. DO NOT ALLOW PERSONNEL WITHIN IMMEDIATE AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

(11) On radar control panel, press TEST button.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 875-881, 883, 884, 891

(12) On radar control panel, press PWR pushbutton, then push TEST pushbutton.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 880, 881, 883, 884, 891

(13) Wait approximately 4 minutes for equipment time delay relay, and check fault warning legends do not light on front of indicator.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(14) Wait approximately 4 minutes for equipment warmup. Make certain fault warning legends do not come on navigation display.

WJE 405, 407-411, 415-427, 429, 861-866, 868, 869, 871, 872, 880, 881, 883, 884, 891

(15) Press TEST pushbutton on front of R/T unit, and verify that R/T, ANT, IND, CON, WG SW, GYRO, and AIR fault annunciators come on for 1 second to check their condition, and then go off.

(16) System ready to operate.

NOTE: If necessary, WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 7 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 13 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 14 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 19 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 20, for complete system test.

(17) Return aircraft to required configuration.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(18) Wait approximately 4 minutes for equipment time delay relay, and check fault warning legends do not light on front of indicator.

WJE 405, 407-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 875-881, 883, 884, 891

(19) Wait approximately 4 minutes for equipment warmup. Make certain fault warning legends do not come on navigation display.

WEATHER RADAR WAVEGUIDES - MAINTENANCE PRACTICES

1. General

A. The following maintenance practices provides general procedures, precautions, and inspection for removal/installation of the waveguide sections between the radar receiver transmitter and radar antenna.

B. Disconnect of the waveguide at the antenna is covered in section WEATHER RADAR ANTENNA - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-01/201.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Waveguide gasket MS 90064-13	

3. Removal/Installation Waveguides

A. General Precautions

(1) The materials used for construction of waveguides are very soft and thin walled. During removal or installation the waveguides should be handled carefully to prevent kinks, dents, or scrapes from damaging the surfaces.

(2) Whenever a waveguide is removed, the open ends of waveguides should immediately be covered with a clean polyethylene bag with the bag secured at open end with nylon twine, (or equivalent procedure).

(3) Any waveguide received for installation that does not have the open ends properly covered should be suspicious of contamination inside the waveguide. Such waveguides should be returned for a properly sealed waveguide or checked per procedures contained in this section.

(4) During installation, waveguides must not be forced in clamping or joining of waveguides. If force is needed, the cause should be determined and rectified. No deformation of the waveguide should occur during installation.

(5) Waveguides must not be immersed in or the inside surfaces cleaned with any solvent or cleaner.

(6) During transporting of waveguides for removal/installation, care should be exercised preferably transporting in a rigid container.

B. Pre-Installation Check

(1) Check waveguide for following before installation:

(a) Inner portion of waveguide must be free of any obstruction, foreign materials, dust and dirt. Check for oxidation or corrosion.

(b) Check waveguide for any deformation.

(c) Check exterior of waveguide for dents, scratches, poor plating, oxidation or corrosion.

(d) Flange end surfaces and flange end threads should be closely inspected for any possible damage.

(e) Waveguide flanges should be checked for presence, condition, and seating of seal. For seal at waveguide quick disconnect at antenna. (WEATHER RADAR ANTENNA - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-01/201)

(2) If dirt or dust is suspected in inner surfaces of waveguide they can be cleaned by the following methods:

(a) A soft lint free cloth can be drawn through waveguide.

(b) Clean dry air with pressure of 10 to 15 PSI can be blown through waveguide, preferably dry nitrogen. Any use of shop air, a filter must be used.

C. Remove waveguides

NOTE: There are four interconnecting waveguide assemblies between the radar antenna and the receiver transmitter. The removal/installation of the waveguide support clamps and waveguide interconnecting flange joints is basically the same except where noted in the following procedures. Any waveguide section can be removed or installed without disturbing the adjoining waveguide, antenna or receiver/transmitter.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

NOTE: As applicable, for removal of two forward wave guides, the nose radome must be opened. Access to remaining waveguides is through the forward accessory compartment, accessible through the accessory compartment door located in the nosewheel well.

(2) Interconnecting flange joints of waveguide being removed should be disconnected first by removing screws in flange joints. For disconnecting waveguide quick disconnect at antenna. (WEATHER RADAR ANTENNA - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-01/201)

(3) Remove waveguide supporting clamps and carefully remove waveguide from airplane.

(4) Cover open ends of waveguide with polyethylene bag and secure bag with nylon cord, (or equivalent procedure).

(5) When removing waveguide from antenna which routes through nose bulkhead, screws must be removed from waveguide seal and seal removed with waveguide.

D. Install Waveguide

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

(2) Check waveguide to be installed. (Paragraph 3.B.)

(3) Remove the waveguide cap and install a new waveguide gasket. Mate the antenna input waveguide choke flange with the cover flange and reset the quick-disconnect clamp. Follow all precautions as noted in Paragraph 3.A.. (WEATHER RADAR ANTENNA - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-01/201)

CAUTION: MAKE CERTAIN SEALS ARE INSTALLED IN WAVEGUIDE FLANGES AND TIGHTEN SCREWS EVENLY.

(4) When installing waveguide that routes through nose bulkhead, make certain bulkhead seal is in proper position on waveguide (seal is a part of waveguide assembly) and exercise care when routing waveguide through bulkhead.

(5) Install support clamps on waveguide making certain that installation of any clamp does not force waveguide into position that may deform waveguide.

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893			
F	4	B10-294	WEATHER RADAR IND
WJE ALL			
F	5	B10-295	WEATHER RADAR XCVR

WARNING: TESTS INVOLVING RADIATION OF RF ENERGY BY RADAR ANTENNA MUST NOT BE MADE IN VICINITY OF REFUELING OPERATIONS, OR WHEN PERSONNEL ARE STANDING DIRECTLY IN FRONT OF RADAR ANTENNA. RF ENERGY IS GENERATED IN ALL MODES EXCEPT STANDBY. DO NOT ALLOW PERSONNEL WITHIN 37 FEET OR AREA BEING SCANNED BY ANTENNA WHEN SYSTEM IS TRANSMITTING.

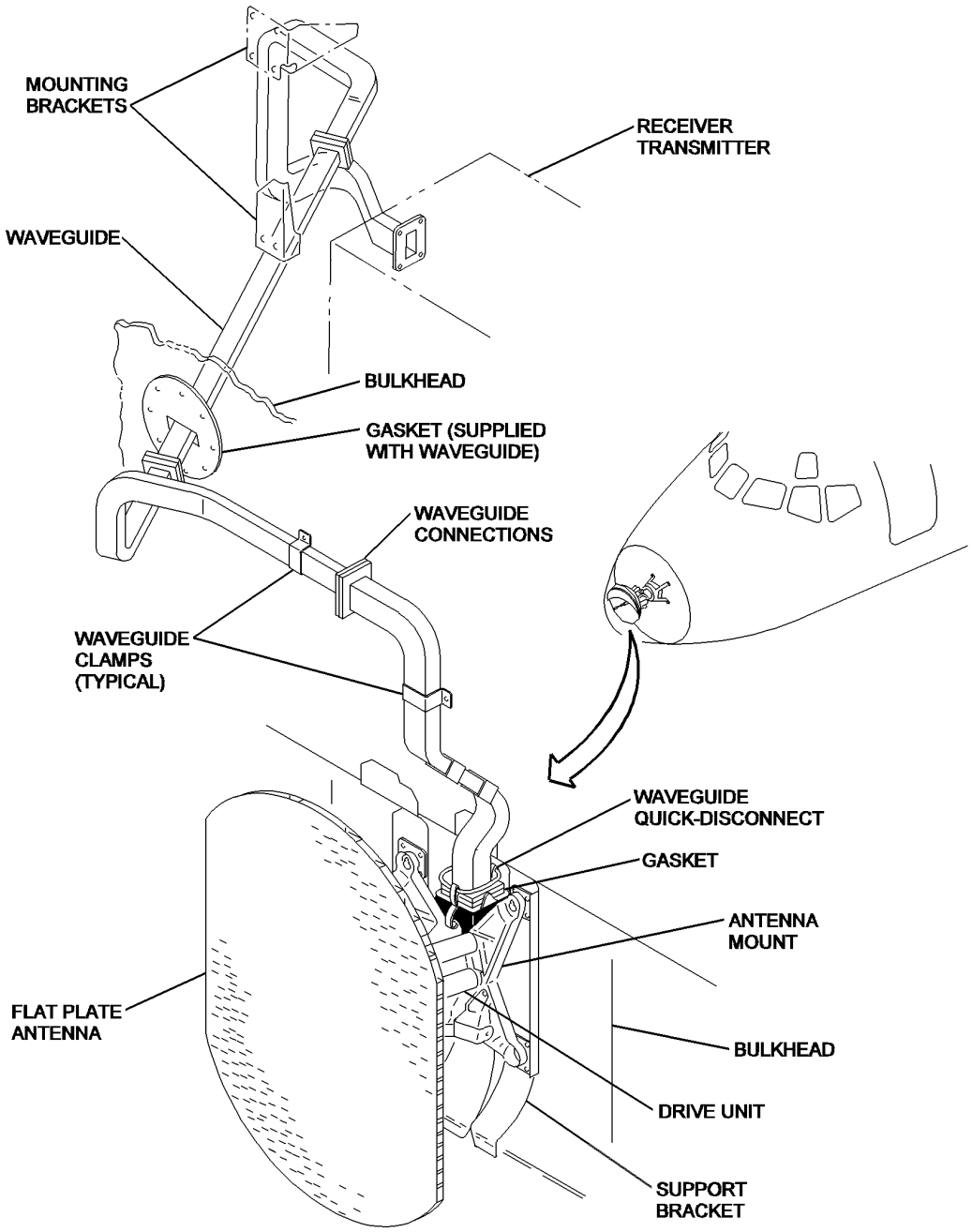
(7) With Radar System in operation, place selector switch in TEST position, following indications will denote switch is operating:

(a) Switch can be heard to switch.

(b) Test pattern on radar indicator should remain same correct test pattern.

(8) If complete system test is required. (WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 4 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 7 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 13 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 14 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 16 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 19 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 20 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 8 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 11 or WEATHER RADAR SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-41-00/201 Config 15)

(9) Return aircraft to required configuration.



Weather Radar Waveguide -- Removal/Installation
Figure 201/34-41-05-990-801

RADIO ALTIMETER SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual radio altimeter system provides an indication of the vertical height of the airplane above the terrain during the approach and landing phases from 2500 feet to touchdown. Each system consists of a transceiver, indicator, transmit antenna, and receive antenna.

B. The radio altimeter system initiates autopilot (A/P) altitude signals which are integrated in the Digital Flight Guidance computer to augment the low approach and landing system. The transceiver provides auxiliary altitude output, high and low altitude trip, and flag signals to the applicable radio altimeter indicator. In addition, radio altitude and decision height signals are fed to the heads up display (HUD).

C. Radio Altimeter Transceiver - Each transceiver unit, located in the mid cargo compartment, is of solid state design with plug-in circuit boards. A connector on the rear panel mates with a rack mounted receptacle for all wiring including antenna coaxial cables.

(1) The transceiver is a frequency-modulated, continuous-wave type, operating at 4300(±50) megahertz. Various circuits are continuously and automatically monitored, and recalibrated as necessary, to provide two dc voltage outputs directly related to airplane height above terrain.

(2) The transceiver operates directly from the respective RADIO ALTIMETER-1 or -2, 115 vac circuit breakers. There is no ON/OFF switch provided. The transceiver supplies the operating power to the corresponding radio altimeter indicator.

(3) A TEST/STATUS light and pushbutton switch is located on the front panel. When the switch is pressed, the light should come on, flag on indicator should come into view, and correct test altitude should be indicated on radio altimeter indicator. This will denote an operable condition.

D. Radio Altimeter Indicator - Identical radio altimeter indicators are installed on the captain's and first officer's instrument panels and are associated with the -1 and -2 transceivers respectively. Aircraft altitude in feet is displayed by a servo-driven vertical tape, calibrated from zero to 2500 feet, that is read against a stationary aircraft symbol. The tape below 500 feet is divided into 10-foot increments, and above 500 feet in 100-foot segments. An orange warning flag is diagonally displayed near the center of the indicator when a malfunction occurs. A DH light is at the top of the bezel, and a DH knob and adjacent 3-digit counter at the bottom. Rotating the DH knob adjusts the digital counter to the desired DH altitude from zero to 499 feet. The counter designates the altitude at which the DH light and trip output will be energized. As the aircraft approaches DH, the yellow DH symbol will come into view. At the instant DH altitude is reached, the DH light will come on. When a malfunction occurs, the tape is driven to indicate blank, and the flag is in view. The radio altimeter indicator also outputs a 1000 Hz burst audio signal to the aircraft audio control panels. This 1000 Hz tone will come on at DH +50 feet and go off after passing through DH. Also, during descent, a two second burst of 1000 Hz audio will be heard at 500 feet.

(1) DH light indication trip circuit can be reset off by pressing the DH light cap. The DH light is off and the DH function is inactive when the aircraft is below 10 ft.

(2) Depressing the SET/TEST button, causes the indicator to display 40 feet altitude with the flag in view. Autopilot interlock inhibits the radio altimeter self-test circuit when the autopilot has captured glidepath, and for the remainder of the approach.

E. Radio Altimeter Antennas - Four identical radio altimeter antennas, two used for transmit and two for receive, are flush mounted on the fuselage lower centerline. The antennas are permanently assembled, nonpressurized units, appropriately indexed for mounting to provide correct polarization.

2. Description

A. The dual radio altimeter system provides an indication of the vertical height of the airplane above the terrain during the approach and landing phases from 2500 feet to touchdown. Each system consists of a transceiver, indicator, transmit antenna, and receive antenna.

B. The radio altimeter system initiates autopilot (A/P) altitude signals which are integrated in the Digital Flight Guidance computer to augment the low approach and landing system. The transceiver provides auxiliary altitude output, high and low altitude trip, and flag signals to the applicable radio altimeter indicator. In addition, radio altitude and decision height signals are fed to the heads up display (HUD).

C. Radio Altimeter Transceiver - Each transceiver unit, located in the mid cargo compartment, is of solid state design with plug-in circuit boards. A connector on the rear panel mates with a rack mounted receptacle for all wiring including antenna coaxial cables.

(1) The transceiver is a frequency-modulated, continuous-wave type, operating at 4300(±50) megahertz. Various circuits are continuously and automatically monitored, and recalibrated as necessary, to provide two dc voltage outputs directly related to airplane height above terrain.

(2) The transceiver operates directly from the respective RADIO ALTIMETER-1 or -2, 115 vac circuit breakers. There is no ON/OFF switch provided. The transceiver supplies the operating power to the corresponding radio altimeter indicator.

(3) A TEST/STATUS light and pushbutton switch is located on the front panel. When the switch is pressed, the light should come on, flag on indicator should come into view, and correct test altitude should be indicated on radio altimeter indicator. This will denote an operable condition.

D. Radio Altimeter Antennas - Four identical radio altimeter antennas, two used for transmit and two for receive, are flush mounted on the fuselage lower centerline. The antennas are permanently assembled, nonpressurized units, appropriately indexed for mounting to provide correct polarization.

3. To Operate System

A. Operate

(1) Energize airplane electrical buses.

(2) Ensure that airplane ILS system is not in ILS operation (ILS operation inhibits radio altimeter self test).

(3) After 2 minutes warmup, radio altimeter indicator must read minus 3(±5) feet, with flag out of view.

(4) On radio altimeter indicator, depress SET/TEST button. Indicator must read 40(±2) feet, with flag in view. When SET/TEST button is released, indicator must return to normal.

(5) System ready for operation.

RADIO ALTIMETER SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual radio altimeter system provides an indication of the vertical height of the aircraft above the terrain during the approach and landing phases from 2500 feet to touchdown. Each system consists of a transceiver, transmit antenna, and receive antenna. The radio altitude display is located on the right-hand side of the Capt's and F.O.'s EFIS Primary Flight Displays (PFD).

B. The radio altimeter system initiates autopilot (A/P) altitude signals which are integrated in the Digital Flight Guidance computer to augment the low approach and landing system. The transceiver provides auxiliary altitude output, high and low altitude trip, and flag signals to the applicable EFIS symbol generator (SG). The SG checks for data presence and validity, and processes the signals for display on the PFD.

C. Radio Altimeter Transceiver - Each transceiver unit, located in the mid cargo compartment, is of solid state design with plug-in circuit boards. A connector on the rear panel mates with a rack mounted receptacle for all wiring including antenna coaxial cables.

(1) The transceiver is a frequency-modulated type, operating at 4300(±50) megahertz. Various circuits are continuously and automatically monitored, and recalibrated as necessary, to provide two dc voltage outputs directly related to aircraft height above terrain.

(2) The transceiver operates directly from the respective RADIO ALTIMETER-1 or -2, 115 vac circuit breakers. There is no ON/OFF switch provided. The transceiver supplies the operating power to the corresponding radio altimeter indicator.

(3) A TEST/STATUS light and pushbutton switch is located on the transceiver front panel. When the switch is pressed, the light should come on, R/A FAIL should come into view on the corresponding PFD and test altitude should be displayed on the PFD radio altitude scale. This will denote an operable condition. The transceiver can also be tested from the cockpit by pressing the TEST pushbutton on the EFIS Control & Dimming Panel (CDP). The appropriate test responses appear on the PFD's.

WJE 412, 414

D. Radio Altitude Display - Radio altitude and decision height (DH) are displayed on the EFIS Primary Flight Displays (PFD). Radio altimeter-1 transceiver feeds the Capt's display; radio altimeter-2 transceiver feeds the F.O.'s. The radio altimeter (R/A) scale appears on the right-hand side of the PFD. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The scale is blanked above 2500 feet. A yellow wedge appears to the right side of the tape below 200 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. Current radio altitude is indicated by a reference line in the center of the scale.

(1) DH is set from the EFIS Control & Dimming Panel (CDP). The non-linear scale is white above the DH, and yellow below. The set value is continuously displayed in green letters, in the upper right-hand corner of the PFD. The display reads "DH 100", for example, if DH is set to 100 feet. When the aircraft reaches decision height, the DH set value display is replaced by a large, amber "DH", which blinks three times and then remains steady. A small triangular pointer along the left edge of the R/A scale turns yellow when decision height is reached.

(2) In case of system malfunction, the R/A tape will be removed and an "R/A FAIL" message will appear above the center reference line. The EFIS symbol generators continuously compare R/A display data from the two radio altimeter systems. In the event of a miscompare, an "R/A COMP" message will appear on the lower right-hand corner of the PFD. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1)

WJE 412, 414 (Continued)

(3) The TEST pushbutton on the EFIS CDP is used to test the radio altimeter system from the cockpit. When pressed and held, the R/A scale will show an altitude of 40 feet, then the tape will disappear. The "R/A FAIL" message will then appear above the center reference line. The TEST pushbutton is only functional when aircraft is on the ground.

WJE 875-879

E. Radio Altitude Display - Radio altitude and decision height (DH) are displayed on the EFIS Primary Flight Displays (PFD). Radio altimeter-1 transceiver feeds the Capt's display; radio altimeter-2 transceiver feeds the F.O.'s. The radio altimeter (R/A) scale appears on the right-hand side of the PFD. The R/A tape (scale background) is shaded dim white above 500 feet, and green below 500 feet. The scale is blanked above 2500 feet. Diagonal yellow stroke lines are drawn below the scale to indicate altitude below zero feet. Current radio altitude is indicated by a reference line in the center of the scale.

(1) DH is set from the EFIS Control & Dimming Panel (CDP). The non-linear scale is white above the DH, and yellow below. The set value is continuously displayed in green letters, in the upper right-hand corner of the PFD. The display reads "DH 100", for example, if DH is set to 100 feet. When the aircraft reaches decision height, the DH set value display is replaced by a large, amber "DH", which blinks three times and then remains steady. A small triangular pointer along the left edge of the R/A scale turns yellow when decision height is reached.

(2) In case of system malfunction, the R/A tape will be removed and an "R/A FAIL" message will appear above the center reference line. The EFIS symbol generators continuously compare R/A display data from the two radio altimeter systems. In the event of a miscompare, an "R/A COMP" message will appear on the lower right-hand corner of the PFD. (NAVIGATION DISPLAYS, SUBJECT 34-22-00, Page 1)

(3) The TEST pushbutton on the EFIS CDP is used to test the radio altimeter system from the cockpit. When pressed and held, the R/A scale will show an altitude of 40 feet, then the tape will disappear. The "R/A FAIL" message will then appear above the center reference line. The TEST pushbutton is only functional when aircraft is on the ground.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

F. Radio Altimeter Antennas - Four identical radio altimeter antennas, two used for transmit and two for receive, are flush mounted on the fuselage lower centerline. The antennas are permanently assembled, nonpressurized units, appropriately indexed for mounting to provide correct polarization.

2. To Operate System

A. Operate

(1) Energize aircraft electrical buses.

(2) Make sure that aircraft ILS system is not in ILS operation (ILS operation inhibits radio altimeter self test).

(3) After 2 minutes warmup, radio altimeter display must read minus 3(±5) feet.

(4) On EFIS CDP, press and hold TEST pushbutton. R/A scale must read 40(±2) feet. R/A display will then go blank. "R/A FAIL" message will appear above center reference line. When TEST pushbutton is released, altimeter display must return to normal.

(5) System ready for operation.

RADIO ALTIMETER SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty radio altimeter system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the radio altimeter system operation are: radio altimeter indicators and radio altimeter transceivers. Interfacing units are DFGC-1 and DFGC-2.

E. The radio altimeter system components are located as follows:

Table 101

Component	Location
Radio Altimeter Readout on Primary Flight Display	Captain's and First Officer's Instrument Panels
Radio Altimeter Transceivers	Left Side Aft Section Fwd Cargo Compartment
Radio Altimeter Circuit Breakers	Upper EPC C/B Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Radio Altimeter System

A. Trouble Shoot

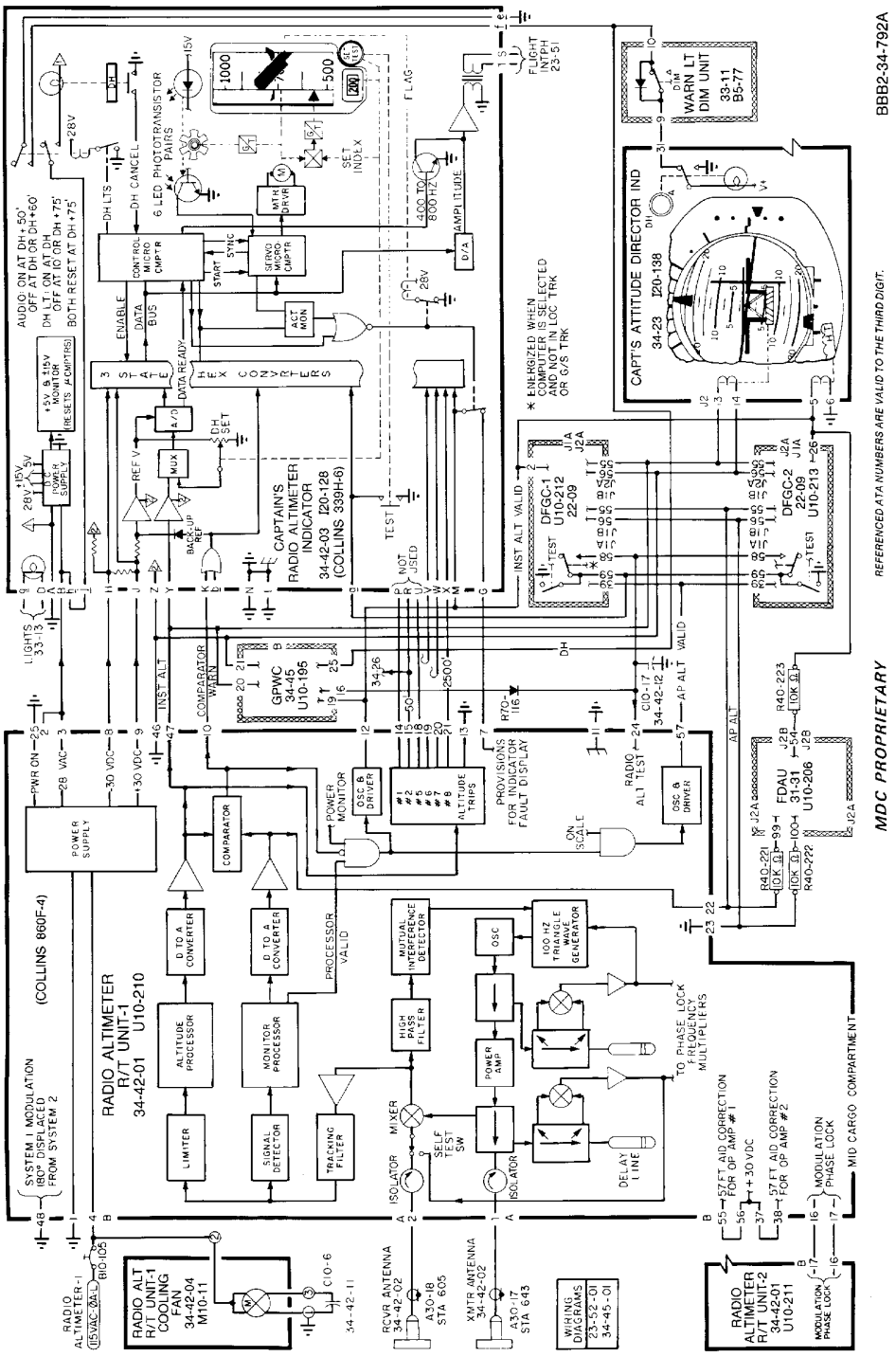
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are radio altimeter indicators and radio altimeter transceivers.

Table 103

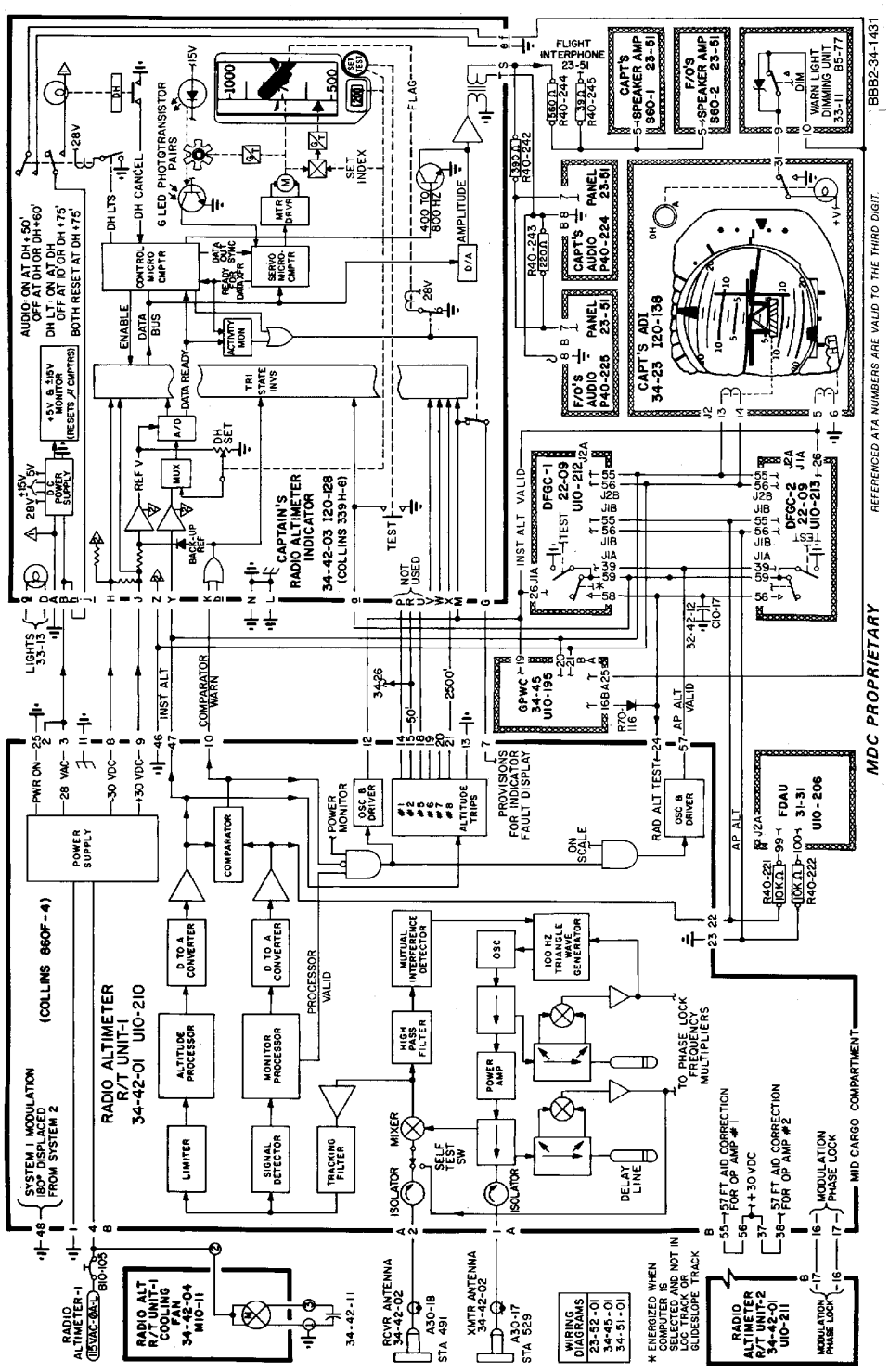
	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

Table 103 (Continued)

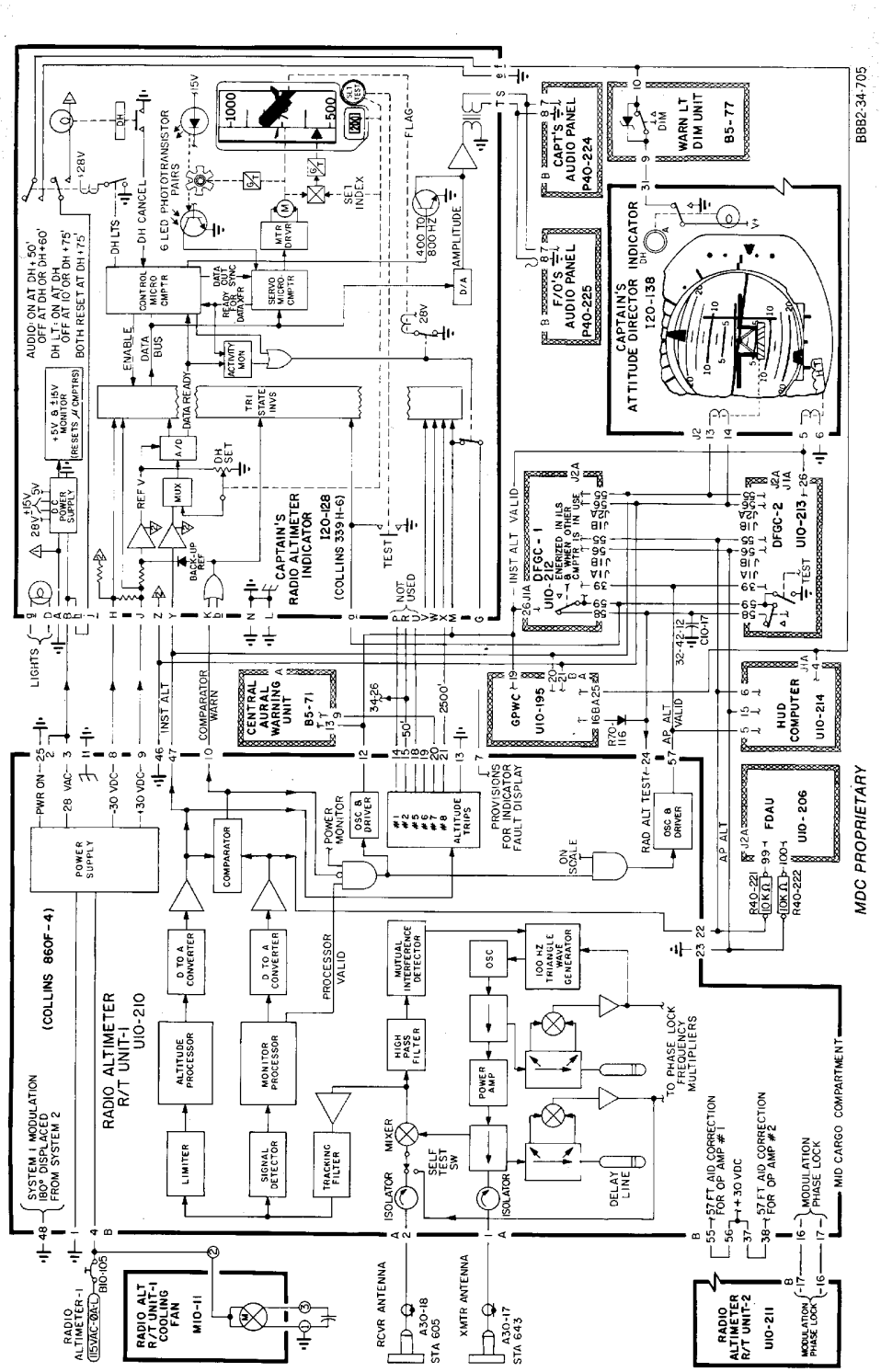
Procedure	Correction
(6) Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201)	



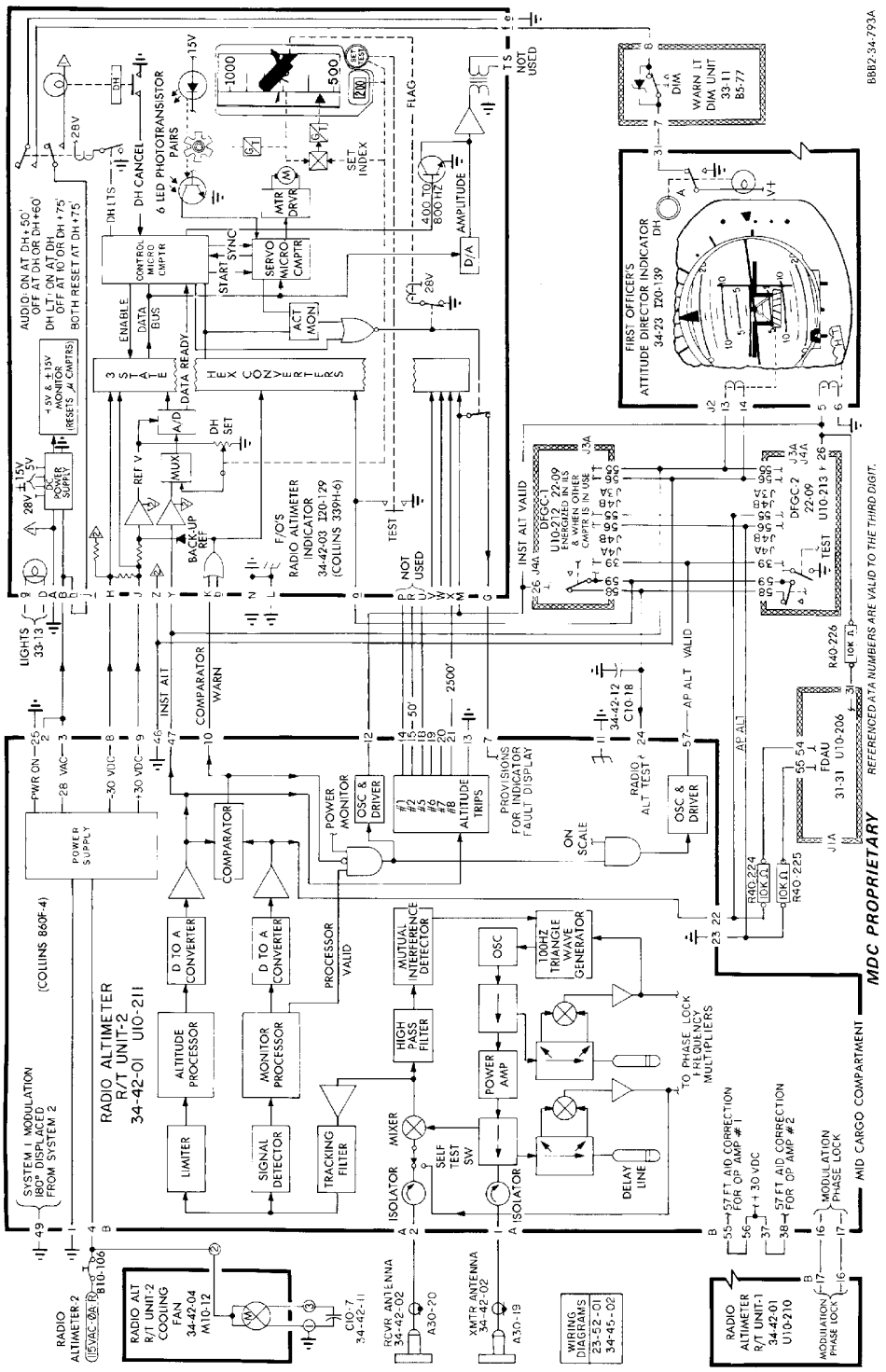
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-801 (Sheet 1 of 3)



Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-801 (Sheet 2 of 3)

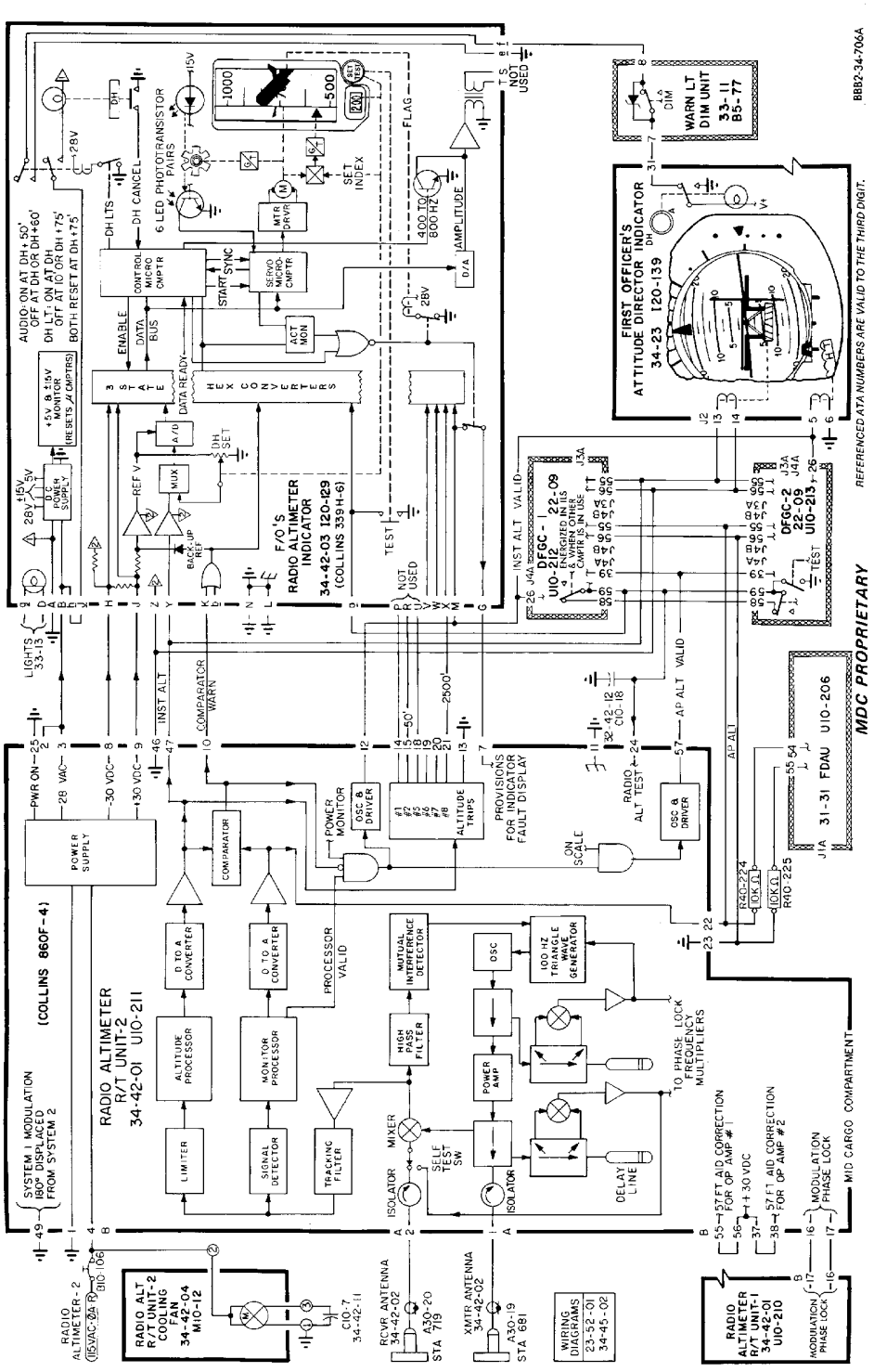


Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-801 (Sheet 3 of 3)



Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-802 (Sheet 1 of 2)

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891



Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-802 (Sheet 2 of 2)

RADIO ALTIMETER SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty radio altimeter system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the radio altimeter system operation are the radio altimeter transceivers. Interfacing units are DFGC-1 and DFGC-2, EFIS symbol generators SG-1 and SG-2, and EFIS Primary Flight Display (PFD).

E. The radio altimeter system components are located as follows:

Table 101

Component	Location
Radio Altimeter Indicators	Captain's and First Officer's Glareshields
Radio Altimeter Transceivers	Left Side Mid Cargo Compartment
Radio Altimeter Circuit Breakers	Upper EPC C/B Panel

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter Model 8025A	Fluke

3. Trouble Shooting Radio Altimeter System

A. Trouble Shoot

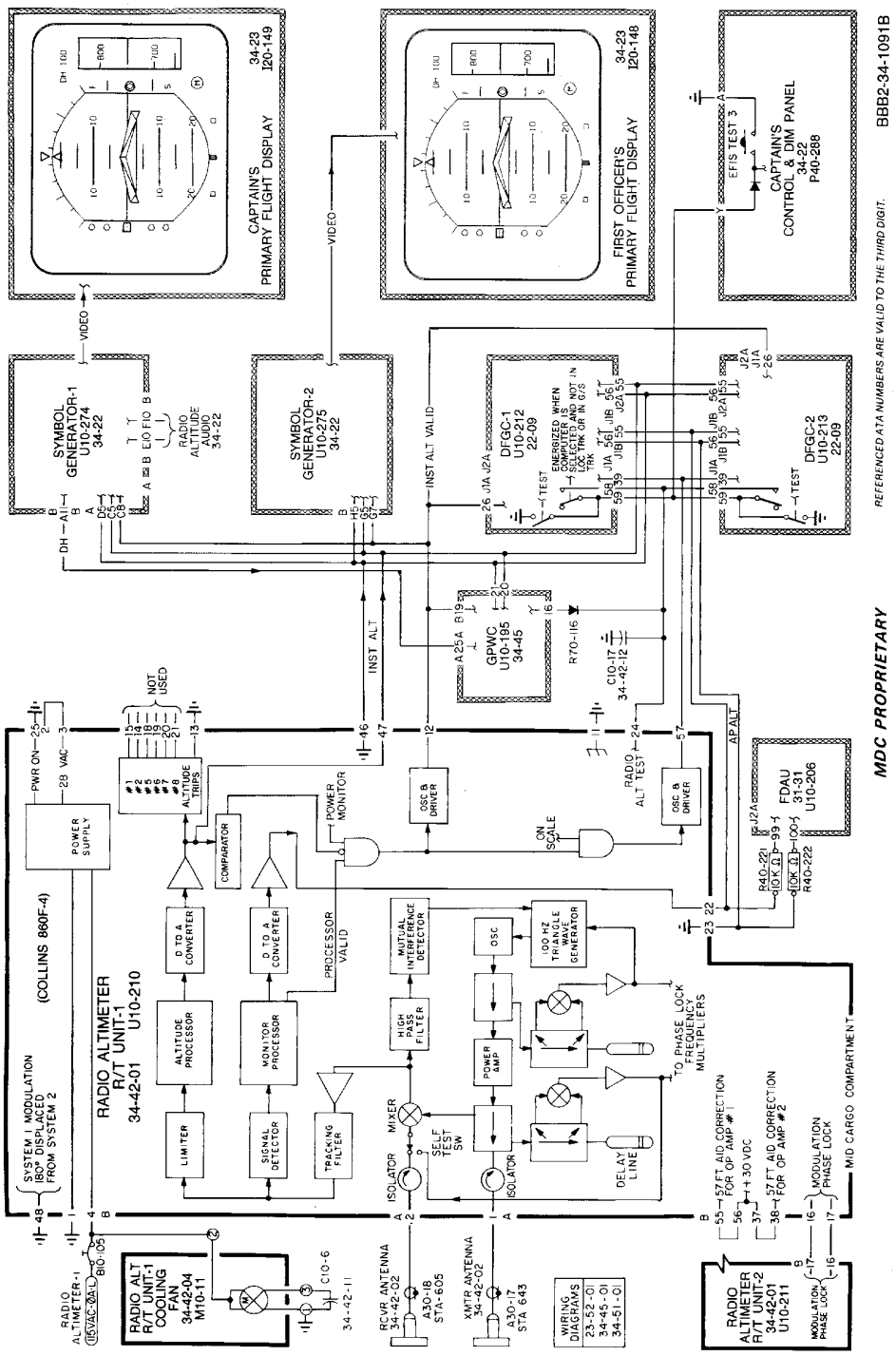
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are radio altimeter transceivers.

Table 103

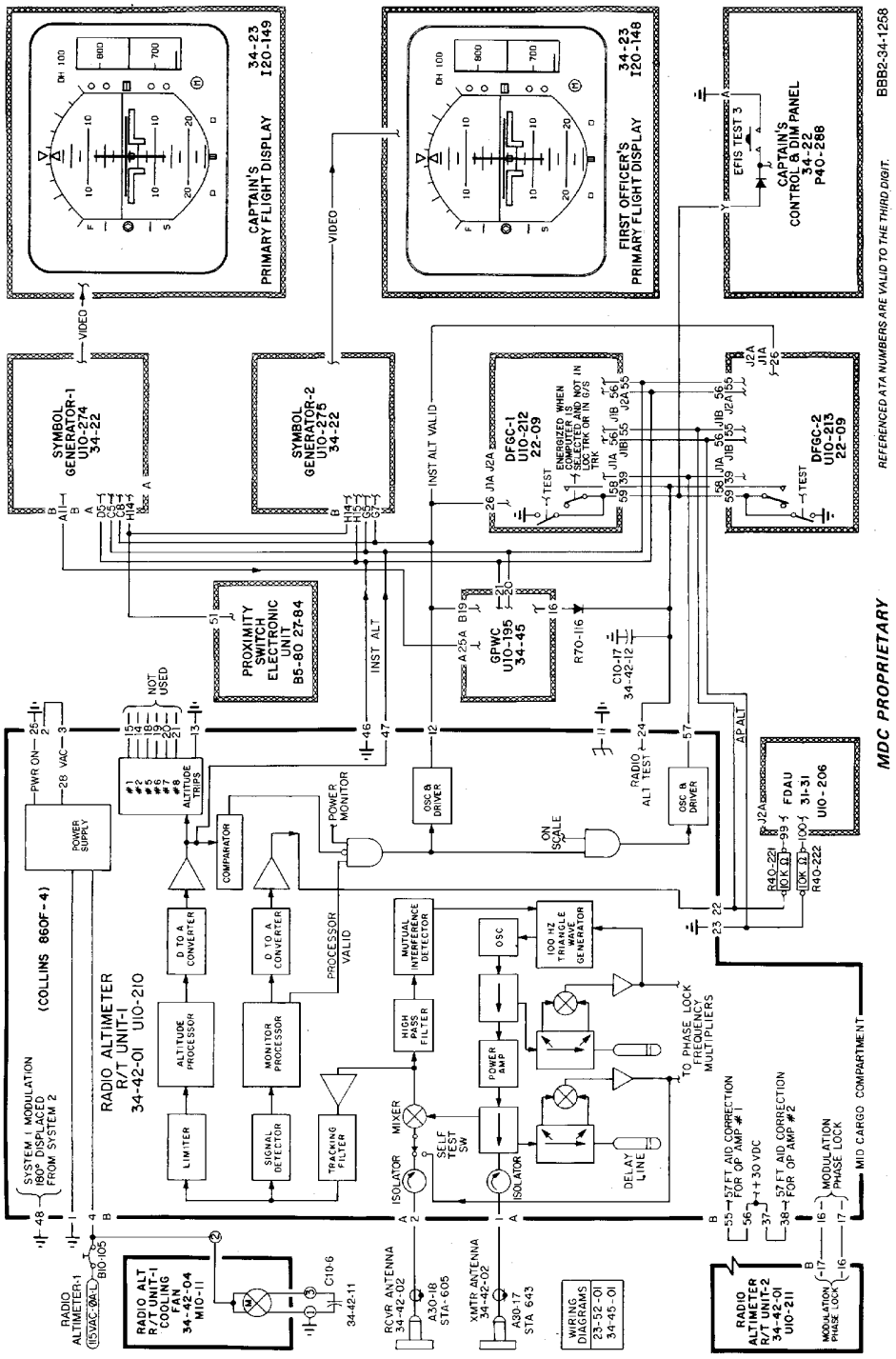
	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

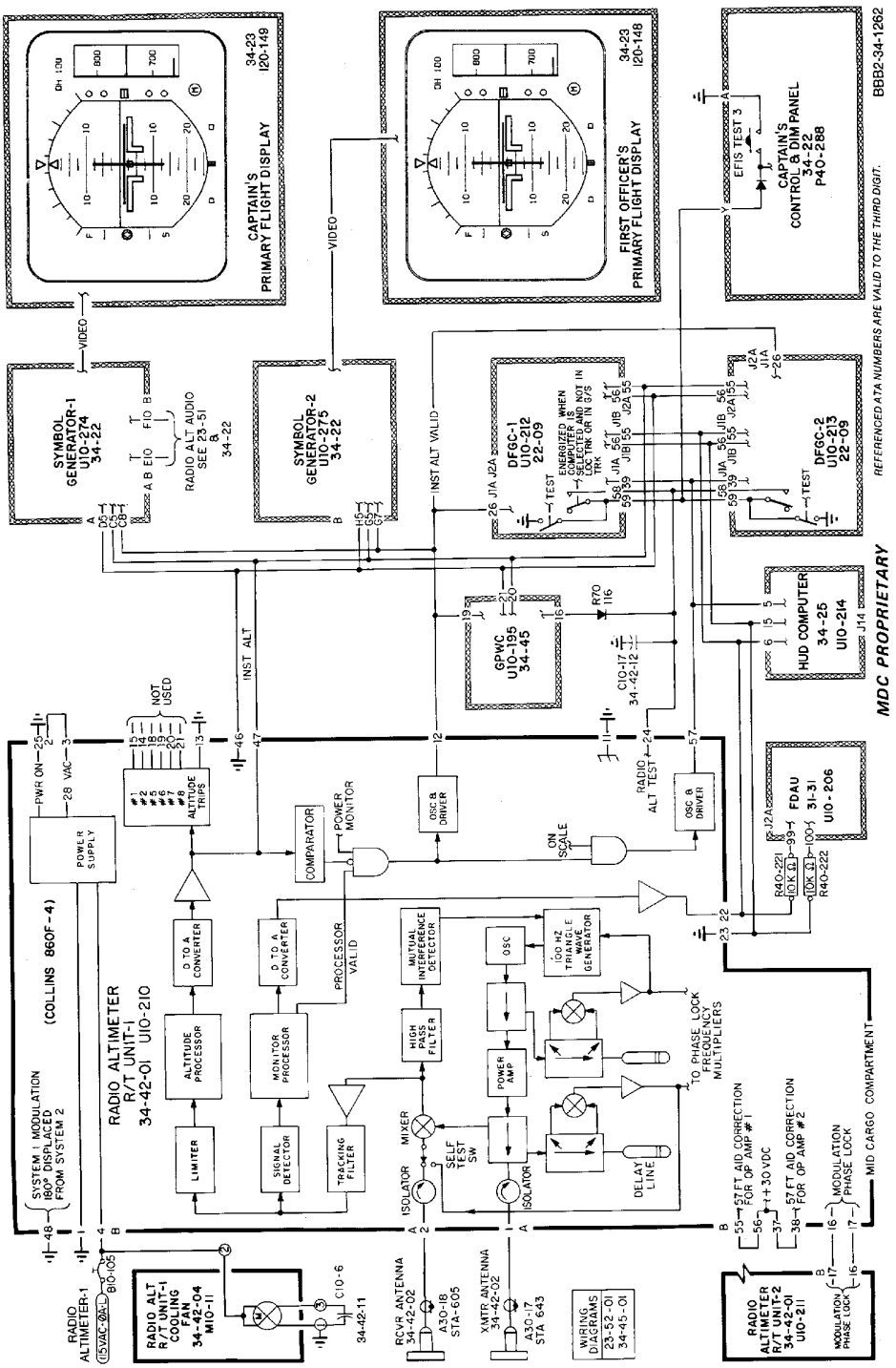
Procedure		Correction
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (DFGS STATUS/TEST, SUBJECT 22-01-05 , Page 201)	



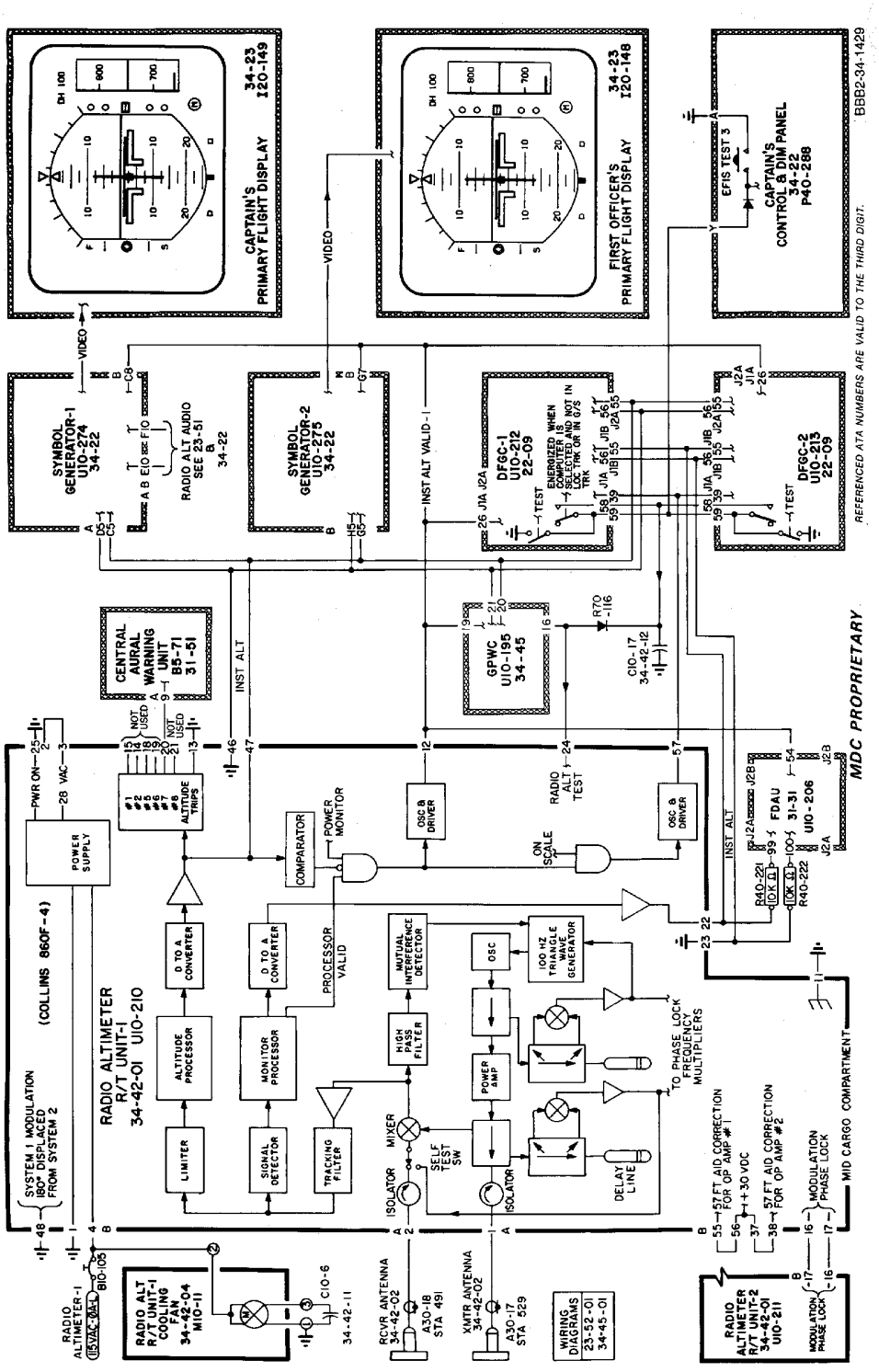
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-803 (Sheet 1 of 5)



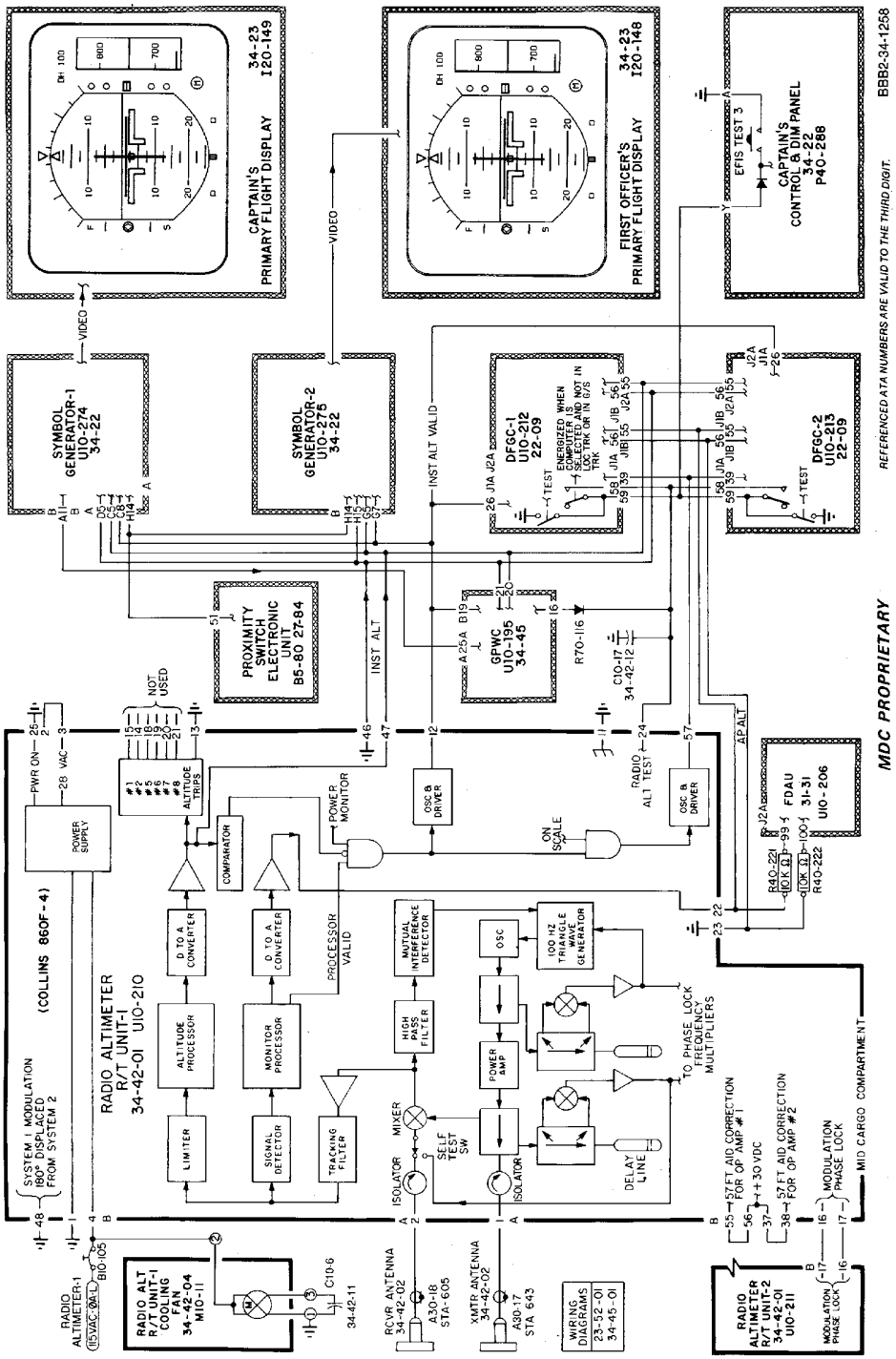
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-803 (Sheet 2 of 5)



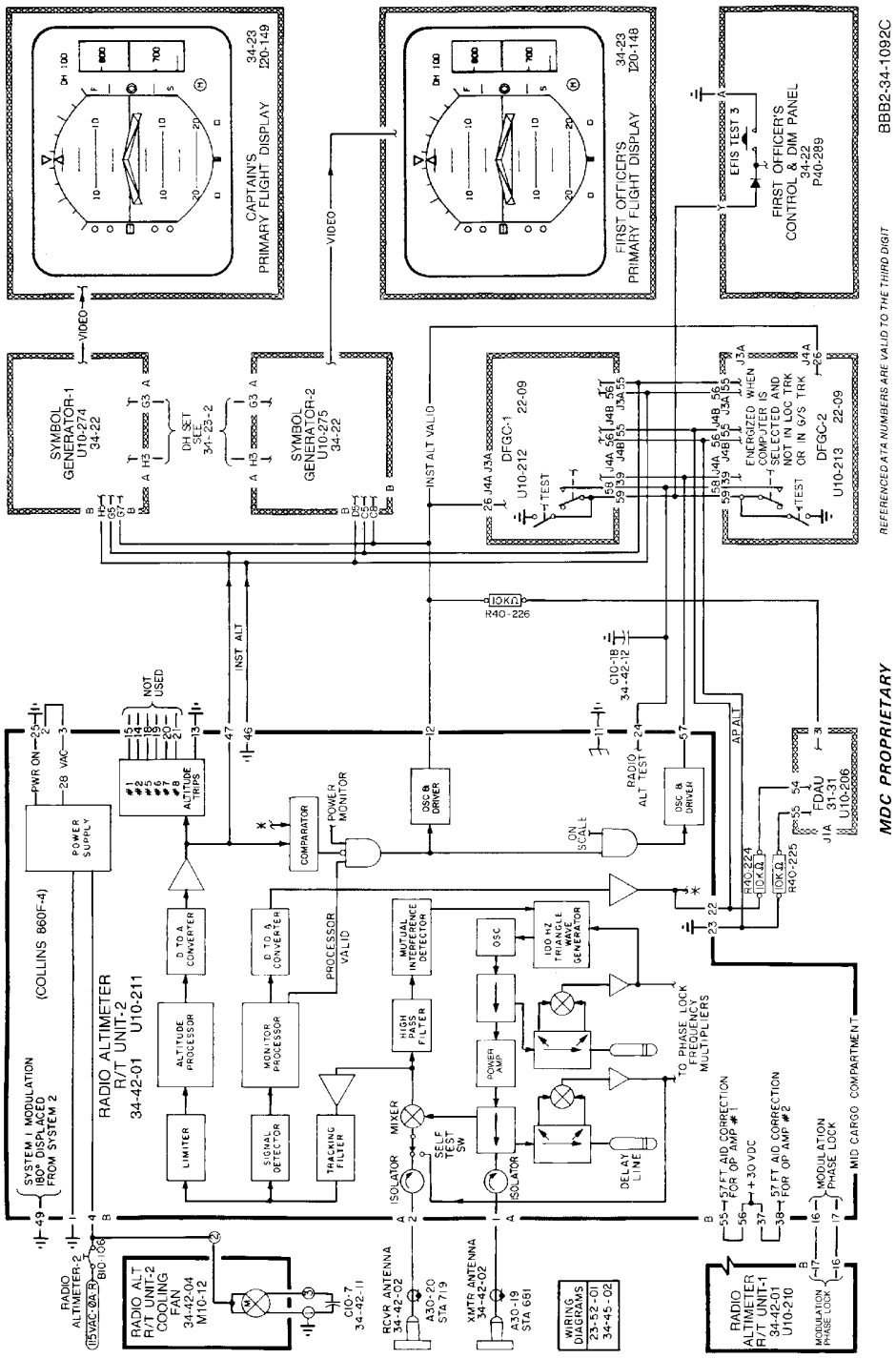
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-803 (Sheet 3 of 5)



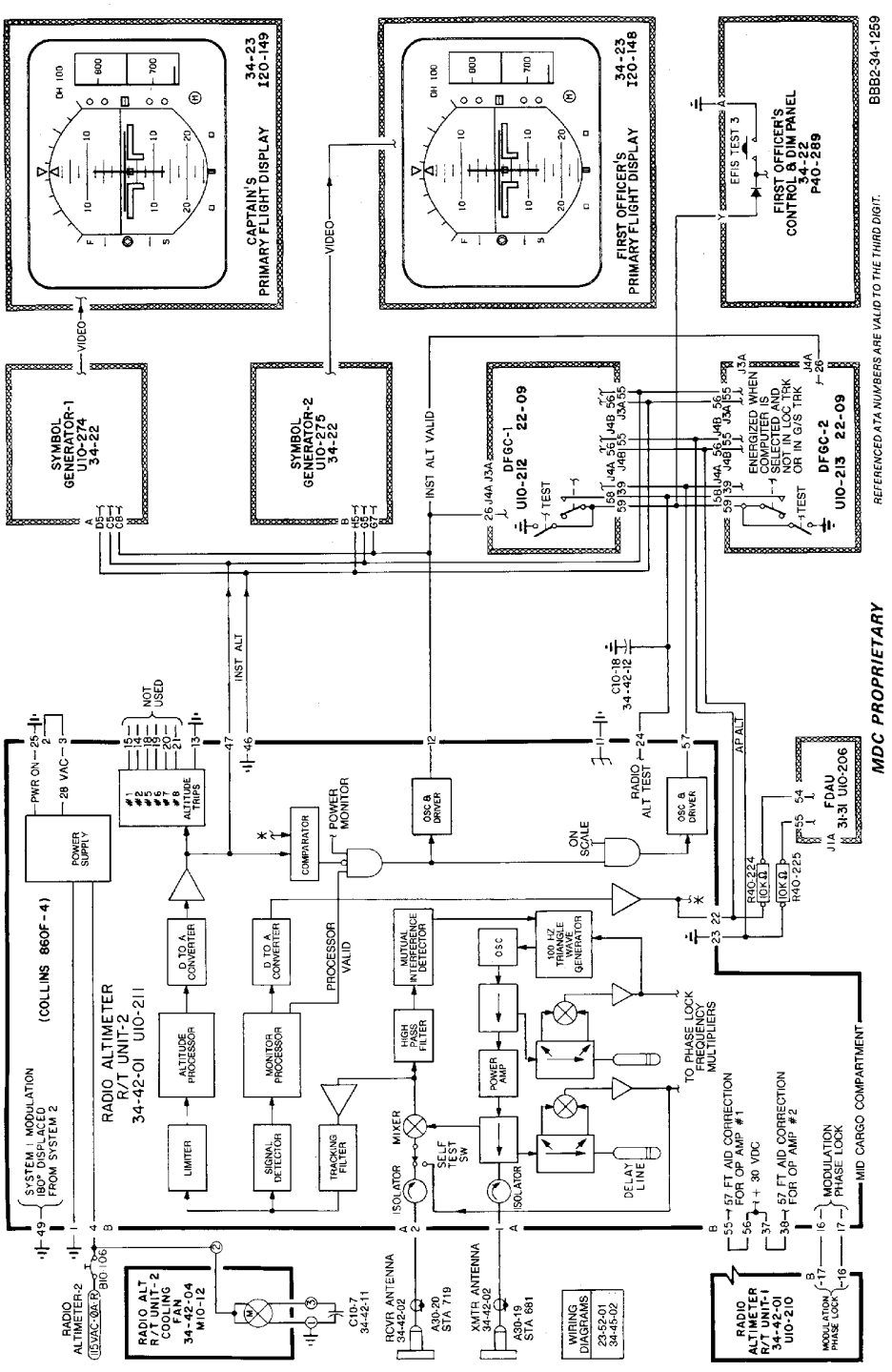
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-803 (Sheet 4 of 5)



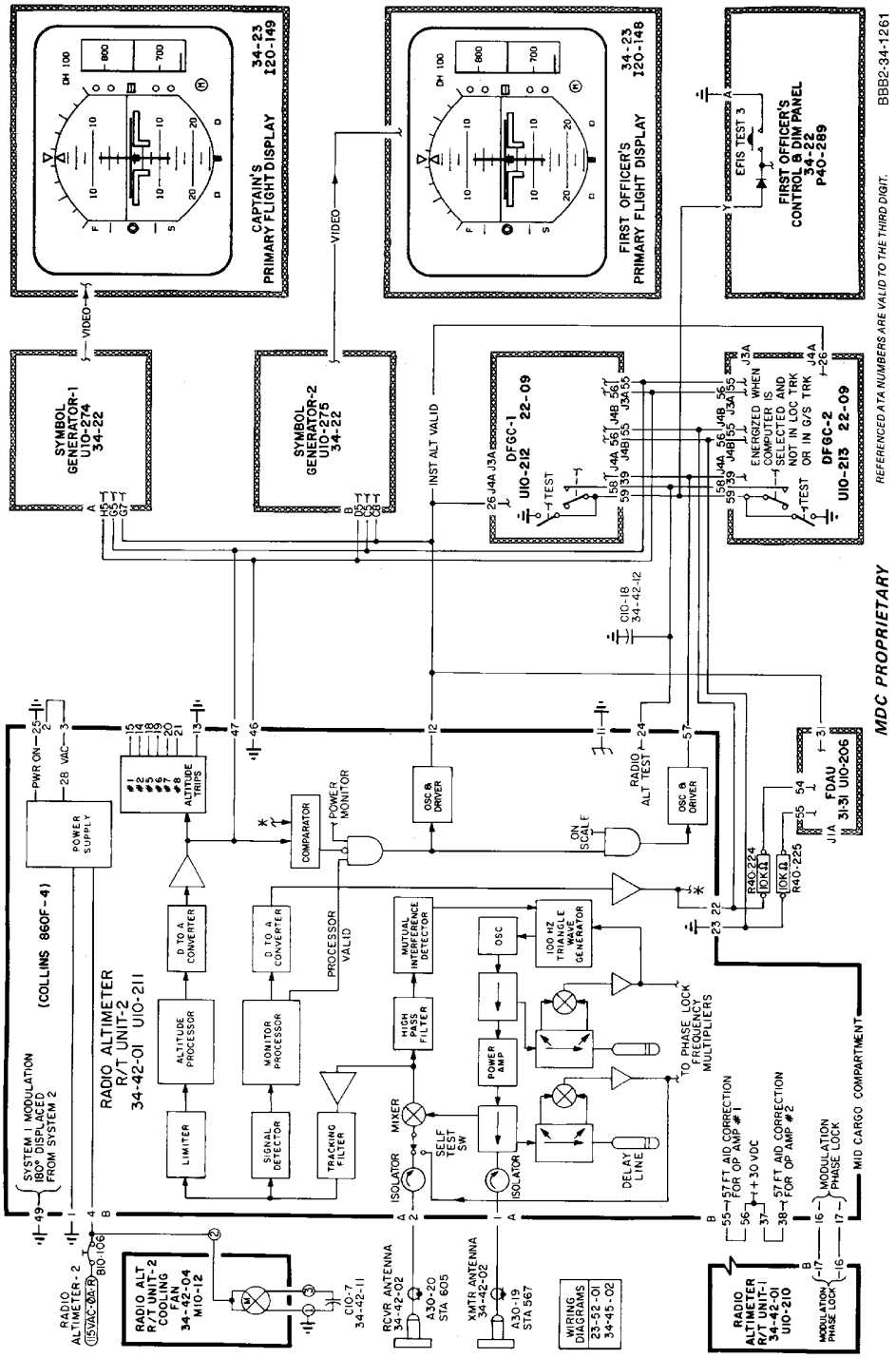
Radio Altimeter-1 -- Schematic
Figure 101/34-42-00-990-803 (Sheet 5 of 5)



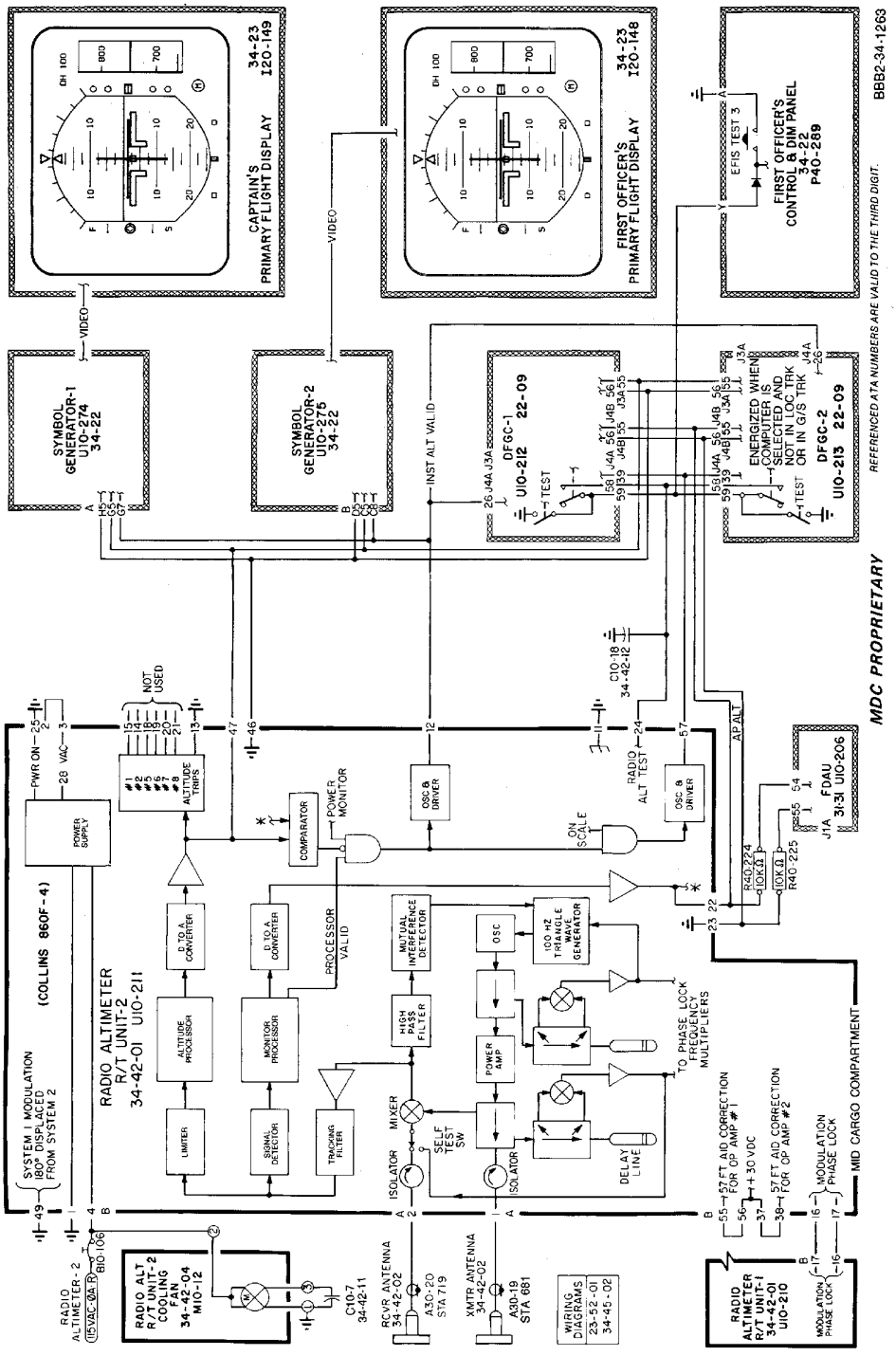
Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 1 of 6)



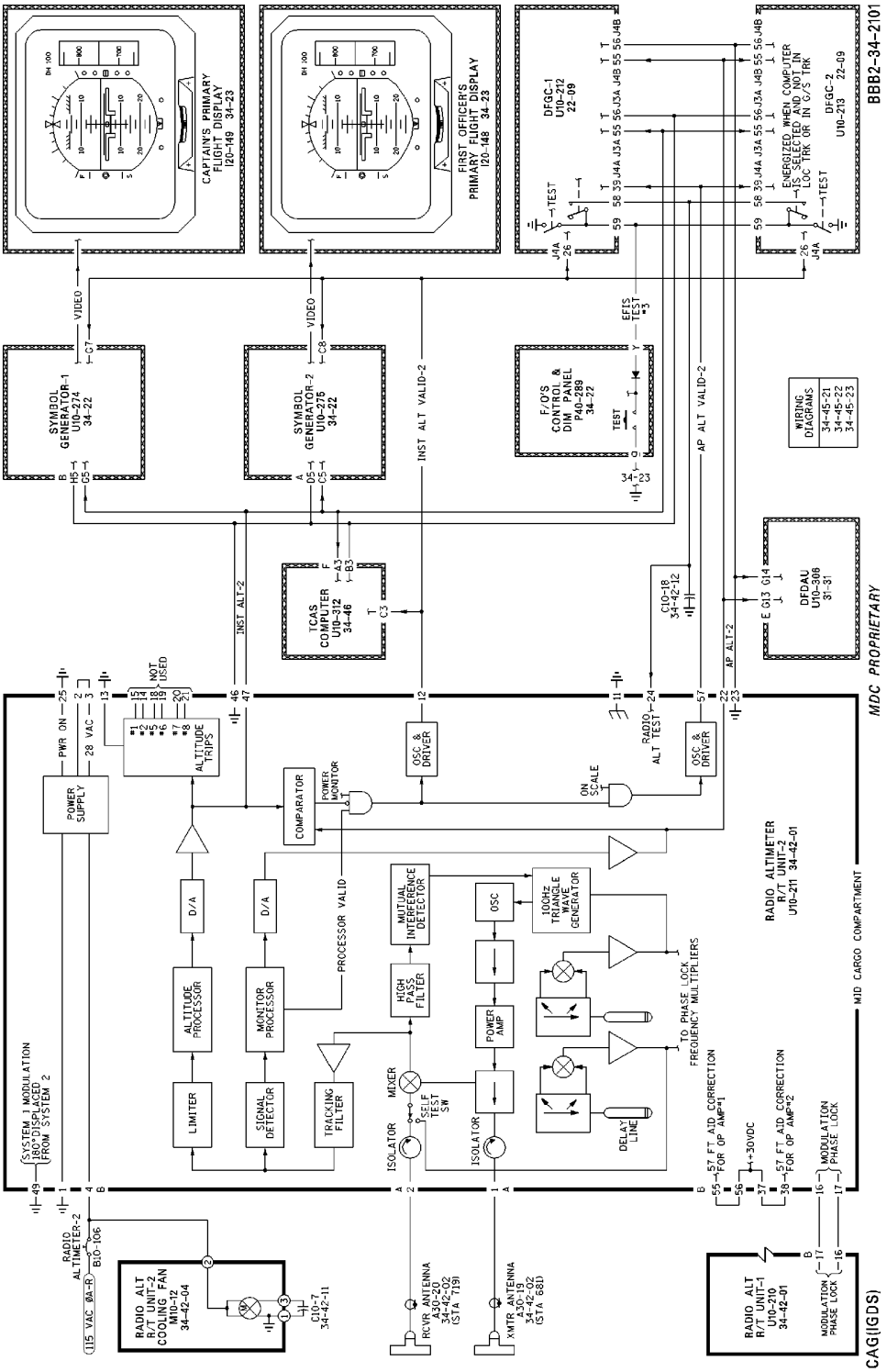
Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 2 of 6)



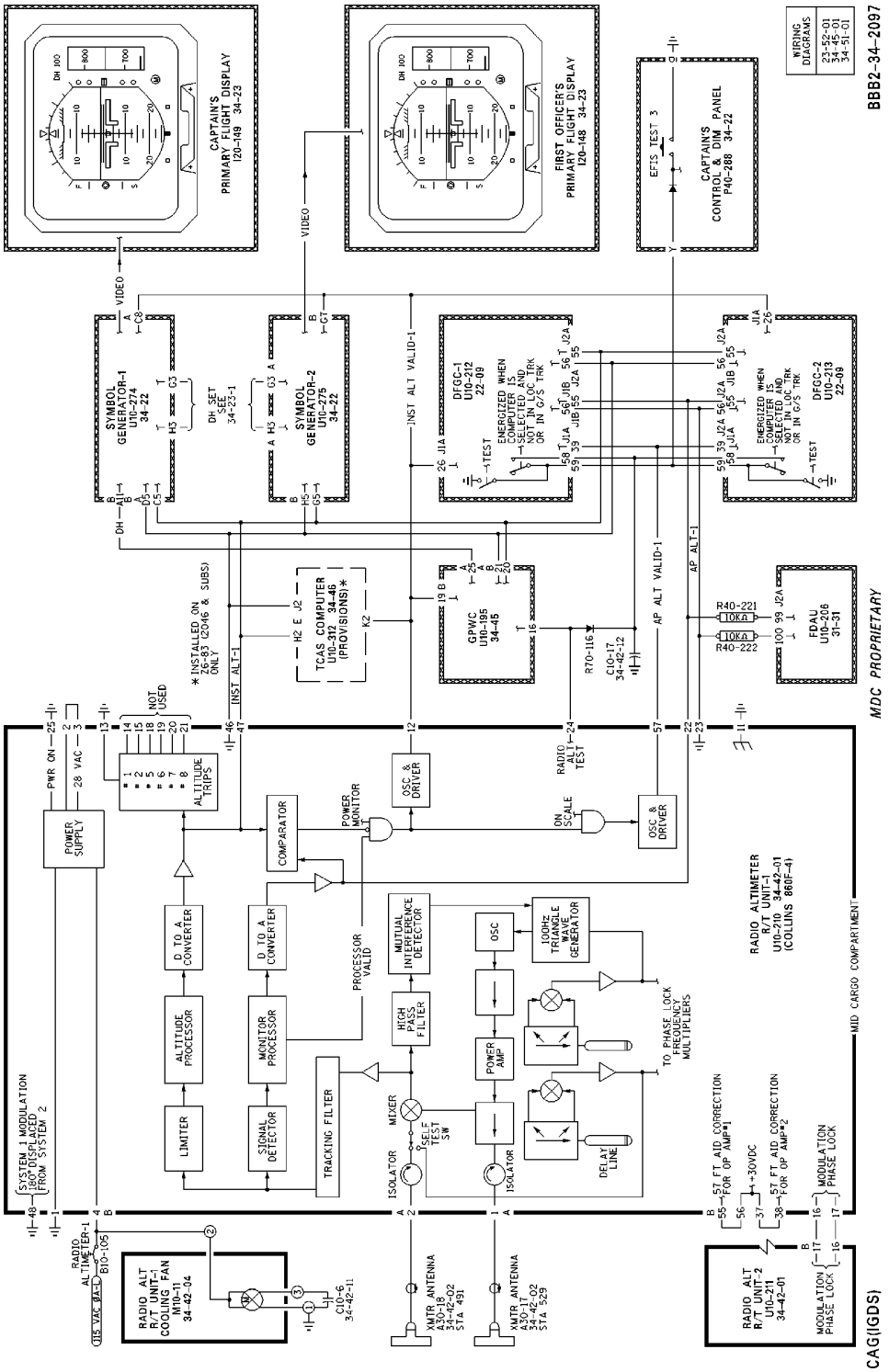
Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 3 of 6)



Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 4 of 6)



Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 5 of 6)



Radio Altimeter-2 Schematic
Figure 102/34-42-00-990-804 (Sheet 6 of 6)

RADIO ALTIMETER SYSTEM - MAINTENANCE PRACTICES

1. General

A. This procedure has the functional test instructions for the radio altimeter system.

B. The dual radio altimeter system provides an indication of the vertical height of the aircraft above the terrain during approach and landing phases from 2500 feet (762 m) to touchdown.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

C. The system consists of two FMCW transceivers operating at a fixed frequency of 4300 megahertz, located in the mid cargo compartment; two receiving and two transmitting antennas, located on fuselage lower centerline; and identical radio altimeter indicators, located one each on the Captain's and First Officer's instrument panel.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887

D. The system consists of two FMCW transceivers operating at a frequency of 4300 megahertz, located in the mid cargo compartment; two receiving and two transmitting antennas, located on fuselage lower centerline; a radio altitude (R/A) scale on the right-hand side of Captain's and First Officer's EFIS PFD; and a DH set knob and TEST push-button on the Captain's and First Officer's EFIS Control and Dimming Panel (CDP)s.

WJE ALL

E. Each transceiver operates directly from the applicable radio altimeter - 1 or -2, 115 Alternating Current Volts (VAC) circuit breaker. There is no ON/OFF switch provided.

F. In order to avoid erroneous data, test should be conducted with aircraft wheels on the ground, and in an open area away from metallic objects. If testing with aircraft on jacks, additional jacked height must be added to static reading.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887

G. Signals from the transceiver are processed by the EFIS symbol generator for display on the PFD's. The transceiver self-test is initiated from the EFIS CDP, by pressing the TEST push-button.

WJE ALL

H. One digital flight guidance computer must be installed, DFGC selector switch in applicable position, power to DFGC, and aircraft must not be in ILS operation.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Ramp Test Set Model 980N-1	Collins
Ramp Test Set Model 80N-1A	Collins
Radio Altimeter Test set TRT SIM-530	Thomson-TRT Defense 46, quai Alphonse Le Gallo B.P. 402 92103 Boulogne-Billancourt Cedex - France TEL: (33-1) 46.08.60.00 FAX: (33-1) 46.08.65.52

Table 201 (Continued)

Name and Number	Manufacturer
"C" Band absorbent material Eccosorb-CV-6 (To check warn condition).	Emerson & Cummings Inc. Canton, Mass.

3. Adjustment/Test Radio Altimeter System

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887

A. Make sure that EFIS Symbol Generator (SG)-1 and SG-2 circuit breakers, and Captain's and First Officer's PFD circuit breakers are closed when performing self-test from CDP.

WJE 405, 409, 880, 881, 883, 884; After Service Bulletin 34-285 Rev.3

NOTE: The above step is for aircraft after Service Bulletin 34-285 Rev. 3.

WJE ALL

B. Test Radio Altimeter System

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

Table 202

Step	Operation	Desired Result
(1)	Energize aircraft electrical buses and allow 3 minute warm-up. (R/T cooling fans should be operating.)	Both indicators must read approximately -3(±5) feet with flag out of view. Both indicators must agree within 5 feet, DH lights not on.
(2)	Rotate SET/TEST knob on Captain's radio altimeter indicator until D.H. counter indicates 100 feet.	
(3)	Depress TEST/STATUS switch on front of Radio Altimeter-1 transceiver.	Indicator must read 40(±5) feet with flag in view. DH lights on indicator and ADI may come on.
(4)	Release SET/TEST knob.	Both indicators must read approximately -3(±5) feet with flag out of view. Both indicators must agree within 5 feet, DH lights not on.
(5)	Repeat steps (2) through (4) on First Officer's system.	

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887

Table 203

Step	Operation	Desired Result
WJE 405, 409, 880, 881, 883, 884; After Service Bulletin 34-285 Rev.3		
NOTE: The above step is for aircraft after Service Bulletin 34-285 Rev. 3.		
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887		
(1)	Energize aircraft electrical buses and allow 2 minutes warm-up.	Center line reference on Captain's PFD R/A scale must read approximately -3(±5) feet. Both displays must agree within 5 feet.
(2)	Rotate DH set knob on Captain's CDP until "DH100" appears in upper right corner of Captain's PFD.	

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-881, 883, 884, 886, 887 (Continued)

Table 203 (Continued)

Step	Operation	Desired Result
(3)	Depress and hold TEST push-button on Captain's CDP.	On Captain's PFD, center line reference on R/A scale reads 40(±5) feet; then "R/A FAIL" flag replaces R/A scale.
NOTE: Center line reference on some aircraft will be at 100 feet.		
(4)	Release TEST push-button.	Indications same as step (1). (R/A FAIL out of view)
NOTE: Radio altitude scale may move to a higher altitude before returning to original position.		
(5)	Repeat steps (2) through (4) on First Officer's system.	

WJE ALL

C. Test With Ramp Tester

WJE 401-405, 409, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

NOTE: Following test is at customers option.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

Table 204

Step	Operation		Desired Result		
(1)	Open, safety and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-105	RADIO ALTIMETER-1	UPPER EPC	LEFT RADIO AC BUS	F/17
	B10-106	RADIO ALTIMETER-2	UPPER EPC	RIGHT RADIO AC BUS	F/3
(2)	Connect Test Set to Radio Altimeter-1 transceiver at front panel connector.				
NOTE: Wait 5 minutes before proceeding unless system was operating and warm immediately before this test.					
(3)	Remove tag and close this circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-105	RADIO ALTIMETER-1	UPPER EPC	LEFT RADIO AC BUS	F/17
(4)	Perform SELF TEST according to instructions inside test set cover.				
NOTE: SELF TEST value is 40(±5) feet.					
(5)	On test set, set TEST SELECT to AUX/IND and set AID/ALT select to variable, COM/ARM switch to ground, and altitude trip select to 8.				
(6)	Adjust ALTITUDE control on test set to provide maximum indicator (off-scale) altitude. (If DH light is on, press DH switch to make light go off.)		D.H. lights off.		

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
(6a)	Rotate D.H. SET knob on Radio Altimeter Indicator to set D.H. to 100 ft.	
(7)	Using ALTITUDE control, reduce altitude until D.H. lights come on, center test set meter with ALTITUDE STANDARD.	Test set digital readout at 2500 ft.(±100 ft.) D.H. lights come on.
(8)	Press Rad. Altimeter Indicator D.H. switch to extinguish lights.	D.H. lights go off.
(9)	Using ALTITUDE control, on test set, reduce altitude until D.H. lights come on. Radio Altimeter Indicator should be at 100 ft.	400 Hz audio tone heard at 150(±5) feet and increases in frequency to 800 Hz at 100(±5) feet. D.H. lights come on, indicator readout at 100(±5) feet, and audio tone ceases.
NOTE: Audio is associated only with Radio Altimeter System 1.		
(10)	Repeat steps (2) through (10) using Radio Altimeter-2 circuit breaker, transceiver-2, and First Officer's indicator.	
(11)	Remove test set.	
(12)	Return aircraft to required configuration.	Test complete.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

Table 205

Step	Operation				
(1)	Energize aircraft electrical buses and allow 2 minutes warm-up.		Center line reference on R/A scale must read approximately -3(±5) feet. Both displays must agree within 5 feet.		
(2)	Rotate DH set knob on Captain's CDP until "DH100" appears in upper right corner of Captain's PFD.		Captain's DH set at 100 feet.		
(3)	Depress and hold TEST push-button on Captain's CDP.		Center reference line on Captain's R/A scale reads 40(±5) feet, then "R/A FAIL" message replaces R/A scale.		
(4)	Release TEST push-button.		R/A scale reappears; center reference line reads -3(±5) feet.		
(5)	Open, safety and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-105	RADIO ALTIMETER-1	UPPER EPC	LEFT RADIO AC BUS	F/17
	B10-106	RADIO ALTIMETER-2	UPPER EPC	RIGHT RADIO AC BUS	F/3
	B10-410	CAPTAIN'S P.F.D.	OVERHEAD	EMERGENCY AC BUS	B/4
WJE 401-404, 412, 414					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/8

WJE 401-404, 412, 414 (Continued)

Table 205 (Continued)

Step	Operation		Desired Result		
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/11
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-412	SYMBOL GENERATOR-1 POWER	OVERHEAD	EMERGENCY AC BUS	C/3
	B10-413	SYMBOL GENERATOR-2 POWER	UPPER EPC	RIGHT RADIO AC BUS	F/4
(6)	Connect Radio Altimeter Test set to front connector of Radio Altimeter-1 R/T.		Test set connected.		
(7)	Set controls on test set to the following positions. • Test select switch to AUX/IND position. • AID/ALT select switch to VARIABLE position.		Controls set.		
(8)	Remove tag and close these circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-105	RADIO ALTIMETER-1	UPPER EPC	LEFT RADIO AC BUS	F/17
	B10-410	CAPTAIN'S P.F.D.	OVERHEAD	EMERGENCY AC BUS	B/4
	B10-412	SYMBOL GENERATOR-1 POWER	OVERHEAD	EMERGENCY AC BUS	C/3
(9)	Adjust ALTITUDE control on test set to maximum indicator off scale altitude.		R/A scale is blank on Captain's PFD.		
(10)	Using the ALTITUDE control, reduce altitude until ALT displayed on PFD, then center test set meter with ALTITUDE STANDARD control.		ALT displayed on PFD, blinks 3 times and remains on until 500 feet and goes off. Test set digital readout is 2500 (±100) feet.		
(11)	Using ALTITUDE control on test set, reduce altitude until radio altitude indicates 100 feet.		DH set value on PFD replaced by large DH, blinks 3 times and remains on.		
(12)	Rotate DH control on PFD to decrease setting to zero feet.		DH on PFD goes off.		
(13)	Open and tag these circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-105	RADIO ALTIMETER-1	UPPER EPC	LEFT RADIO AC BUS	F/17
	B10-410	CAPTAIN'S P.F.D.	OVERHEAD	EMERGENCY AC BUS	B/4

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 205 (Continued)

Step	Operation		Desired Result		
	B10-412	SYMBOL GENERATOR-1 POWER	OVERHEAD	EMERGENCY AC BUS	C/3
(14)	Disconnect and remove 980-1 test set and replace test connector cover on R/T.		Test set removed and test connector cover installed on R/T.		
(15)	Connect 980-1 Radio Altimeter Test Set to front test connector of radio altimeter -2 R/T.		Test set connected to R/T-2.		
(16)	Remove tags and close these circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-106	RADIO ALTIMETER-2	UPPER EPC	RIGHT RADIO AC BUS	F/3
WJE 401-404, 412, 414					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/8
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/11
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-413	SYMBOL GENERATOR-2 POWER	UPPER EPC	RIGHT RADIO AC BUS	F/4
(17)	Repeat steps (7) and (9) through (12).		Results same as steps (7) and (9) through (12).		
(18)	Open and tag these circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-106	RADIO ALTIMETER-2	UPPER EPC	RIGHT RADIO AC BUS	F/3
WJE 401-404, 412, 414					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/8
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/11
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-413	SYMBOL GENERATOR-2 POWER	UPPER EPC	RIGHT RADIO AC BUS	F/4
(19)	Disconnect and remove 980-1 test set and replace test connector cover on R/T.				
(20)	Remove tags and close these circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 205 (Continued)

Step	Operation		Desired Result		
	B10-106	RADIO ALTIMETER-2	UPPER EPC	RIGHT RADIO AC BUS	F/3
WJE 401-404, 412, 414					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/8
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-411	FIRST OFFICER'S P.F.D.	UPPER EPC	RIGHT RADIO AC BUS	F/11
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887					
	B10-413	SYMBOL GENERATOR-2 POWER	UPPER EPC	RIGHT RADIO AC BUS	F/4
(21)	Return aircraft to required configuration.				

WJE 405-412, 414, 880, 881, 883, 884

Table 206

Step	Operation	Desired Result
WJE 405-411, 880, 881, 883, 884		
NOTE: These steps are for aircraft after the avionics upgrade modification.		
WJE 405-412, 414, 880, 881, 883, 884		
(1)	Energize aircraft electrical buses and allow 2 minutes warm-up.	Centerline reference on R/A scale must read approximately -3(±5) feet. Both displays must agree within 5 feet.
(2)	Rotate Decision Height (DH) set knob on Captain's CDP until "DH100" appears in upper right corner of Captain's PFD.	Captain's DH set at 100 feet.
(3)	Depress and hold TEST push-button on Captain's CDP.	Center reference on Captain's R/A scale reads 40(±5) feet, then "R/A FAIL" comes in view.
(4)	Release TEST push-button.	R/A scale reappears; center reference line reads -3(±5) feet.
(5)	Place "C" band absorbent material alternately over each antenna.	Captain's R/A scale is blank; "R/A FAIL" is out of view.
(6)	Remove absorbent material.	Captain's R/A scale reads -3(±5) feet.
(7)	Open and tag these circuit breakers as follow:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-105	RADIO ALTIMETER 1	Upper EPC	LEFT RADIO AC BUS	F/17
B10-106	RADIO ALTIMETER 2	Upper EPC	RIGHT RADIO AC BUS	F/3

WJE 405-412, 414, 880, 881, 883, 884 (Continued)

Table 206 (Continued)

Step	Operation		Desired Result		
WJE 405-408, 411, 412, 414, 880, 881, 883					
	B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/4
WJE 410					
	B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/5
WJE 412, 414					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/8
WJE 405-411, 880, 881, 883, 884					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/11
WJE 405-408, 410-412, 414, 880, 881, 883					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
WJE 409, 884					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	B/4
WJE 412, 414					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
WJE 406-408, 411					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7
WJE 405, 409, 880, 881, 883, 884					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-412, 414, 880, 881, 883, 884					
(8)	Connect Radio Altimeter Test set to front connector of Radio Altimeter-1 R/T.		Test set connected.		
(9)	Set controls on test set to the following positions:		Controls set.		
WJE 405-411, 880, 881, 883, 884					
	Test select switch to AUX/IND position.				

WJE 405-411, 880, 881, 883, 884 (Continued)

Table 206 (Continued)

Step	Operation	Desired Result
	AID/ALT select switch to VARIABLE position.	
WJE 405-412, 414, 880, 881, 883, 884		
(10)	Remove tags and close these circuit breakers as follow:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-105	RADIO ALTIMETER 1	Upper EPC	LEFT RADIO AC BUS	F/17
WJE 405-408, 411, 412, 414, 880, 881, 883				
B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/4
WJE 409, 884				
B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/3
WJE 410				
B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/5
WJE 405-408, 410-412, 414, 880, 881, 883				
B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
WJE 409, 884				
B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	B/4

WJE 405-411, 880, 881, 883, 884		
(11)	Adjust ALTITUDE control on test set to maximum indicator off scale altitude.	R/A scale is blank on Captain's PFD.
(12)	Using the ALTITUDE control, reduce altitude until ALT displayed on PFD, then center test set meter with ALTITUDE STANDARD control.	ALT is displayed on PFD, blinks 3 times and remains on until 500 feet, then goes off. Test set digital readout is 2500 (±100) feet.
(13)	Using ALTITUDE control on test set, reduce altitude until radio altimeter indicates 100 feet.	DH set value on PFD replaced by Large DH, blinks 3 times and remains ON.
WJE 405-412, 414, 880, 881, 883, 884		
(14)	Rotate DH control on PFD to decrease setting to zero feet.	DH on PFD goes OFF.
(15)	Open and tag these circuit breakers as follow:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10-105	RADIO ALTIMETER 1	Upper EPC	LEFT RADIO AC BUS	F/17

WJE 405-412, 414, 880, 881, 883, 884 (Continued)

Table 206 (Continued)

Step	Operation		Desired Result		
WJE 409, 884					
	B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/5
WJE 405-408, 411, 412, 414, 880, 881, 883					
	B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/4
WJE 410					
	B10-410	CAPTAIN'S P.F.D.	Overhead	EMERGENCY AC BUS	B/5
WJE 405-408, 410-412, 414, 880, 881, 883					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
WJE 409, 884					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	B/4
WJE 405-411, 880, 881, 883, 884					
(16)	Disconnect and remove 980-1 test set and replace test connector cover on R/T.		Test set removed and test connector cover installed on R/T.		
(17)	Connect 980-1 Radio Altimeter Test Set to front test connector of radio altimeter -2 R/T.		Test set connected to R/T-2.		
WJE 405-412, 414, 880, 881, 883, 884					
(18)	Remove tags and close these circuit breakers as follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-106	RADIO ALTIMETER 2	Upper EPC	RIGHT RADIO AC BUS	F/3
WJE 405-411, 880, 881, 883, 884					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/11
WJE 412, 414					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/8
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
WJE 406-408, 411					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7

WJE 406-408, 411 (Continued)

Table 206 (Continued)

Step	Operation		Desired Result		
WJE 405-411, 880, 881, 883, 884					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-412, 414, 880, 881, 883, 884					
(19)	Repeat steps (9) and (11) through (14).		Results same as steps (9) and (11) through (14).		
(20)	Open and tag these circuit breakers as follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-106	RADIO ALTIMETER 2	Upper EPC	RIGHT RADIO AC BUS	F/3
WJE 405-411, 880, 881, 883, 884					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/11
WJE 412, 414					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/8
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
WJE 406-408, 411					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7
WJE 405, 409, 880, 881, 883, 884					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-411, 880, 881, 883, 884					
(21)	Disconnect and remove 980-1 test set and replace test connector cover on R/T.				
WJE 405-412, 414, 880, 881, 883, 884					
(22)	Remove tags and close these circuit breakers as follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-106	RADIO ALTIMETER 2	Upper EPC	RIGHT RADIO AC BUS	F/3

WJE 405-412, 414, 880, 881, 883, 884 (Continued)

Table 206 (Continued)

Step	Operation		Desired Result		
WJE 405-411, 880, 881, 883, 884					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/11
WJE 412, 414					
	B10-411	FIRST. OFFICER'S. P.F.D.	Upper EPC	RIGHT RADIO AC BUS	F/8
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
WJE 406-408, 411					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7
WJE 405, 409, 880, 881, 883, 884					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GENERATOR-2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-412, 414, 880, 881, 883, 884					
(23)	Return aircraft to required configuration.				

WJE ALL

4. Altimeter Tolerances

A. In-service radio altimeter tolerances are as follows:

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

Table 207

Indicators	Altitude	Tolerance
Captain to First Officer	3 Ft. to 100 Ft.	Within 10 Ft.
Captain to First Officer	100 Ft. to 500 Ft.	Max. 10%
Captain to First Officer	500 Ft. to 2500 Ft.	Max. 14%

RADIO ALTIMETER ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Radio Altimeter (RA) antennas.

B. The RA antennas are a linearly polarized horn, flush-mounted on the forward underside of the fuselage. The antenna is non-repairable and cannot be disassembled. The antennas are installed so that all four coax connectors face outboard to the left hand side of the aircraft. Removal/installation procedures for the four antennas are identical.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation Radio Altimeter Antenna

A. Remove Applicable RA Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scraper.

(3) Remove antenna mounting screws.

(4) Disconnect antenna for the aircraft structure by applying a steady pressure to one side and allow sealant to separate from the surface.

NOTE: Excessive or sudden force to the antenna may cause damage.

(5) Support antenna and disconnect antenna coaxial cable connector, cap electrical connector and antenna receptacle.

B. Install Applicable RA Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Clean mating surfaces between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Apply a faying surface seal between the base of the antenna and the aircraft structure. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(4) Install antenna assembly as follows:

(a) Remove protective cap and check for damage and unwanted material.

1) Connect antenna coaxial cable connector. Antenna connector must face the left hand side.

(b) Place gasket between antenna and aircraft structure doubler. Install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

NOTE: Do not put sealant on the screws head.

(c) Torque the attachment screws.

1) Torque the attachment screws again 10 minutes after the initial torque.

(d) Remove sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

NOTE: Make sure that there is no sealant on the screw heads.

(5) Do an electrical bond check of the RA antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(6) Apply periphery (butt) seal between antenna edge and fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

(8) Energize aircraft electrical buses. After 2 minutes warm-up, radio altimeter indicator should read -3(±5) feet with flag out of view.

(9) If the applicable warning flag is in view, the antenna possibly has a malfunction. With no warning flag in view, the antenna is considered operable.

WJE 405, 407-411, 880, 881, 883, 884

NOTE: On aircraft with Electronic Flight Instrument System (EFIS), radio altimeter readings and FAIL warnings will be displayed on the EFIS Primary Flight Display (PFD).

WJE 401-404, 412, 414, 886, 887

(10) Energize aircraft electrical buses. After 2 minutes warm-up, radio altimeter indication on EFIS Primary Flight Display (PFD) should read -3(±5) feet with no FAIL message out of view.

(11) If the RA FAIL message is in view on PFD, the antenna possibly has a malfunction. With no FAIL message in view, the antenna is considered operable.

WJE 405-411, 880, 881, 883, 884

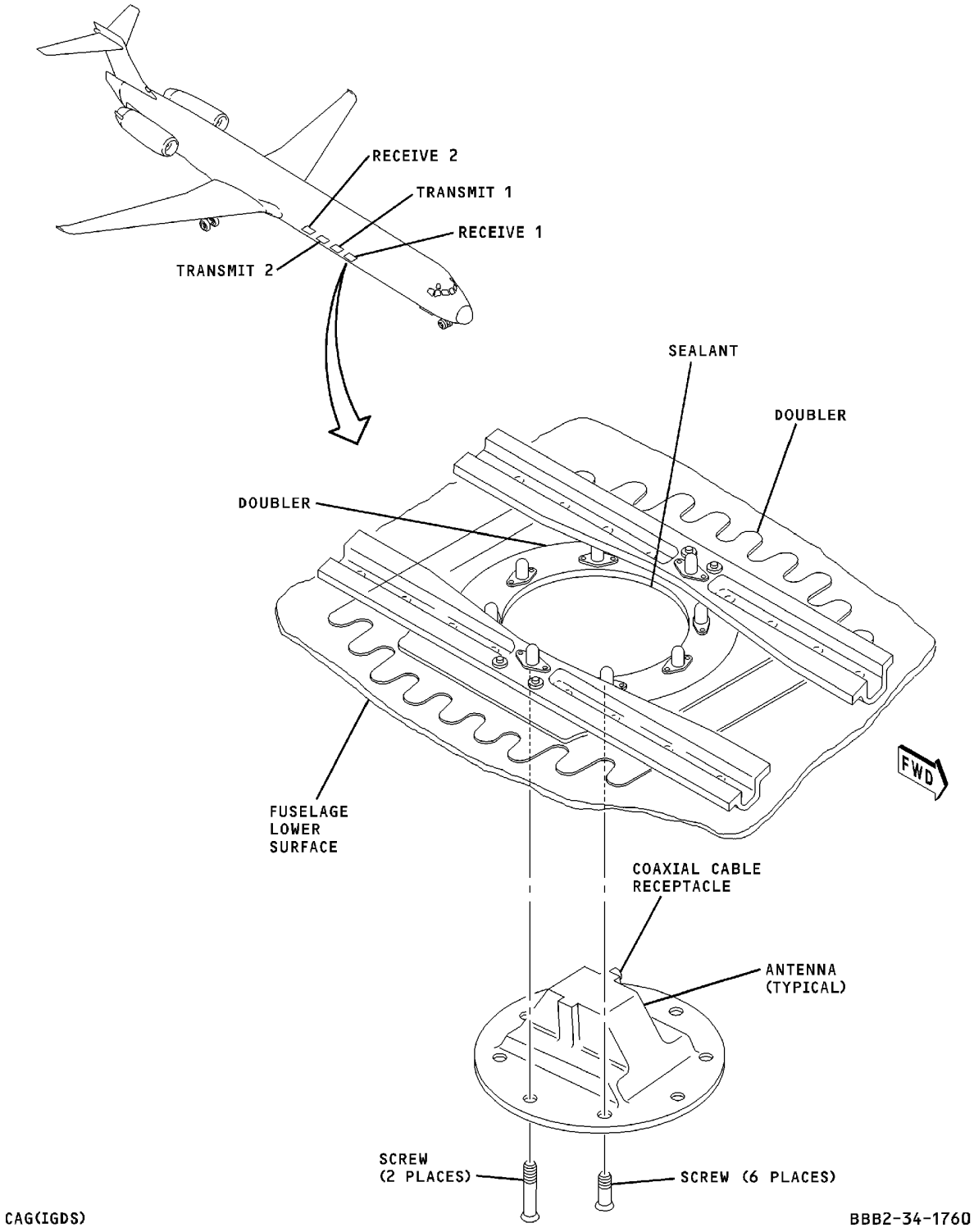
(12) Energize aircraft electrical buses. After 2 minutes warm-up, radio altimeter indicator (PFD on aircraft with EFIS) should read -3(±5) feet with warning out of view.

(13) If applicable warning is in view, antenna has malfunction. With no warning in view, antenna is considered operable.

WJE ALL

(14) Test radio altimeter system. (RADIO ALTIMETER SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-42-00/201)

(15) Return aircraft to required configuration.



Radio Altimeter Antenna -- Removal/Installation
Figure 201/34-42-01-990-801

RADIO ALTIMETER INDICATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Radio Altimeter Indicator. There are two radio altimeter indicators located in the flight compartment, one on the captain's instrument panel, and one on the first officer's panel.

B. Removal/installation for both indicators is identical except for circuit breakers which must be opened. If necessary, the captain's and first officer's instrument panels can be opened for access to the indicator wiring. (PAGEBLOCK 31-10-00/001)

WJE 873, 874, 892, 893

NOTE: DH Lamp failure is not cause for unit removal. Paragraph 4., Radio Altimeter Indicator DH Lamp Replacement before removal.

WJE 405, 409, 881, 883, 884

NOTE: DH Lamp failure is not cause for unit removal. Paragraph 3., Radio Altimeter Indicator DH Lamp Replacement before removal.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

2. Removal/Installation Radio Altimeter Indicator

A. Remove Radio Altimeter Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Loosen clamp adjustment (indicator retaining) screws.

(3) Press loosened adjustment screws back flush against panel face.

(4) Loosen clamp attachment screws to relieve pressure of clamp on indicator.

CAUTION: DO NOT PRY INDICATOR FROM PANEL WITH SCREWDRIVER OR OTHER TOOL AS INDICATOR OR PANEL CAN BE DAMAGED.

(5) Pull indicator out of panel face; disconnect, and cap electrical connector.

B. Install Radio Altimeter Indicator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Remove cap, and connect electrical connector to back of indicator.

(3) Insert indicator through panel face and mounting clamp.

CAUTION: MAKE SURE THE CLAMP ATTACHMENT SCREWS ARE TIGHT. THIS WILL NOT LET THE COMPONENT MOVE FROM THE PANEL WHEN THE AIRCRAFT ACCELERATES.

(4) Secure clamp adjustment (indicator retaining) screws and clamp attachment screws.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(6) Perform return to service (RTS) test (SUBJECT 22-01-05, Page 201). If circuit breaker of nonaffected radio altimeter is open, an autoland preflight test may be performed instead.

WJE 873, 874, 892, 893

NOTE: If functional check required, perform following Paragraph 2.B.(7) through Paragraph 2.B.(13).

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891

NOTE: If functional check required, perform following Paragraph 2.B.(7) through Paragraph 2.B.(13) or Paragraph 2.B.(14) through Paragraph 2.B.(17) as applicable.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 881, 883, 884, 891-893

(7) Energize aircraft electrical buses and allow a minimum of 2 minute warmup. Both radio altimeter indicators must read -3(±5) feet with flags out of view.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891

(8) Energize aircraft electrical buses and allow minimum of 2 minute warmup. Both radio altimeter indicators must read -3(±5) feet with flags out of view.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

NOTE: Paragraph 2.B.(7) through Paragraph 2.B.(13) are applicable to aircraft 101-108, 151-158, 175, 176 only.

WJE 405, 409, 881, 883, 884

NOTE: Paragraph 2.B.(7) through Paragraph 2.B.(13) are applicable to aircraft only with radio altimeter indicators.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

(9) Rotate SET TEST knob to increase DH setting. When tape setting of above 499 is obtained, counter is hidden by black and white mask.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

(10) Rotate SET/TEST knob to decrease DH setting. When tape setting of below zero is obtained, counter is hidden by black and white mask.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891

(11) Press and hold SET/TEST knob. Indicator must read 40(±2) feet at aircraft reference symbol with flag in view. DH lights on indicators and opposite ADI may come on.

WJE 873, 874, 892, 893

(12) Press and hold DH set knob. Indicator must read 40(±2) feet at airplane reference symbol with flag in view. DH lights on indicators and ADI may come on.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 881, 883, 884, 891-893

(13) Release DH set knob. Indicator reading must return to normal with flag out of view DH lights go off. If captain's and first officer's indicators agree within 5 feet, applicable indicator is operable.

NOTE: Self-test function of Radio Altimeter Indicator does not test DH lights on Indicator and ADI. DH lights on Indicator and ADI must be tested by pushing the DH lights.

WJE 873, 874, 892, 893

NOTE: If necessary, SUBJECT 34-42-00, Page 201 for complete system test.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

NOTE: Paragraph 2.B.(14) through Paragraph 2.B.(17) are applicable to aircraft 109, 110, 159, 161, 162, 201-999.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 881, 883, 884, 891

(14) Energize aircraft electrical buses and allow minimum of 2 minute warmup. Radio altimeter indication on both primary flight displays (PFD) should indicate -(±5) feet and warning not in view.

(15) Rotate "DH" knob on applicable control and Dimming Panel until DH counter indicates 100 feet on upper right hand corner of PFD.

(16) Depress "TEST" button on control and Dimming Panel.

NOTE: Radio Altitude scale on PFD should indicate 40 or 100 (±5) feet and "R/A FAIL" should be in view.

(17) Release "TEST" button, Radio Altitude scale may move to a higher altitude indication before returning to original position -3(±5) feet.

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

C. Termination

(1) Return aircraft to required configuration.

WJE 405, 409, 881, 883, 884

3. Radio Altimeter Indicator DH Lamp Replacement

A. Perform following procedures before removing indicator unit:

CAUTION: PRY LENS FROM INDICATOR CAREFULLY. DAMAGE TO UNIT OR LENS COULD OCCUR. REPLACE RA INDICATOR IF DH LENS CANNOT BE REMOVED WITHOUT USING EXCESSIVE FORCE.

(1) Pull DH light cap (lens) straight out from RA indicator.

(2) Rotate contact bar 90 degrees away from lamps.

(3) Remove lamps from lens, and replace them.

(4) Replace contact bar and reinstall lens assembly.

(5) Rotate SET/TEST knob to decrease DH setting. When tape setting of below zero is obtained, counter is hidden by black and white mask.

(6) Press and hold SET/TEST knob. Indicator must read 40(±2) feet at aircraft reference symbol with flag in view. DH lights on indicators and opposite ADI may come on.

(7) Release SET/TEST knob. Indicator reading must return to normal with flag out of view DH lights go off. If captain's and first officer's indicators agree within 5 feet, applicable indicator is operable.

NOTE: Paragraph 3.A.(7) through Paragraph 3.A.(11) are applicable to aircraft with EFIS.

(8) Energize aircraft electrical buses and allow minimum of 2 minute warmup. Radio altimeter indication on both primary flight displays (PFD) should indicate -(±5) feet and warning not in view.

(9) Rotate "DH" knob on applicable control and Dimming Panel until DH counter indicates 100 feet on upper right hand corner of PFD.

(10) Depress "TEST" button on control and Dimming Panel.

NOTE: Radio Altitude scale on PFD should indicate 40 or 100 (±5) feet and "R/A FAIL" should be in view.

(11) Release "TEST" button, Radio Altitude scale may move to a higher altitude indication before returning to original position -3(±5) feet.

NOTE: If necessary, SUBJECT 34-42-00, Page 201 for complete system test.

WJE 873, 874, 892, 893

4. Radio Altimeter Indicator DH Lamp Replacement

A. Perform following procedures before removing indicator unit:

CAUTION: PRY LENS FROM INDICATOR CAREFULLY. DAMAGE TO UNIT OR LENS COULD OCCUR. REPLACE RA INDICATOR IF DH LENS CANNOT BE REMOVED WITHOUT USING EXCESSIVE FORCE.

(1) Pull DH light cap (lens) straight out from RA indicator.

(2) Rotate contact bar 90 degrees away from lamps.

(3) Remove lamps from lens, and replace them.

(4) Replace contact bar and reinstall lens assembly.

RADIO ALTIMETER TRANSCEIVER - MAINTENANCE PRACTICES

1. General

WJE 401-404, 886, 887

A. This maintenance practice provides removal/installation procedures for the radio altimeter transceivers. Two transceivers are installed on left side of the mid cargo compartment directly opposite the mid cargo compartment access door. Each transceiver provides auxiliary altitude output, high and low altitude trip, and warning display to the Primary Flight Display's (PFD).

NOTE: Removal/installation procedures for both units are identical except for circuit breaker placarding.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

B. This maintenance practice provides removal/installation procedures for the radio altimeter transceivers. Two transceivers are installed on left side of the mid cargo compartment directly opposite the mid cargo compartment access door. Each transceiver provides auxiliary altitude output, high and low altitude trip, and warning display to the applicable radio altimeter indicator, or the Primary Flight Display (PFD) on aircraft with EFIS.

NOTE: Removal/installation procedures for both units are identical except for circuit breaker placarding.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

2. Removal/Installation Radio Altimeter Transceiver

WARNING: BEFORE INSTALLING NEW OR REPLACEMENT RADIO ALTIMETER IN AIRCRAFT, VERIFY THAT REPLACEMENT UNIT IS CALIBRATED.

A. Remove Radio Altimeter Transceiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install Radio Altimeter Transceiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that connectors are properly aligned.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

(7) Perform return to service (RTS) test (SUBJECT 22-01-05, Page 201); or, on aircraft with autoland option RA-552A-A, open circuit breaker of unaffected radio altimeter and run autoland preflight test.

(a) If functional check required, perform the following steps.

(8) Energize aircraft electrical buses.

(9) Check by sound or feel that applicable radio altimeter cooling fan is operating.

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

(10) After approximately 2 minute warm-up, applicable radio altimeter indication should read -3(±5) feet, with warning out of view. Altimeter indications on aircraft without EFIS are on indicator. On aircraft with EFIS, indications are on Primary Flight Display (PFD).

(11) On aircraft without EFIS, perform following:

(a) Rotate DH set knob on Capt's EFIS Control & Dimming Panel (CDP) until "DH 100" appears in upper right corner of Capt's PFD.

(b) Press and hold TEST pushbutton on Capt's CDP. Capt's R/A scale on PFD reads 40(±5) feet; then "R/A FAIL" flag replaces R/A scale.

(c) Release TEST pushbutton on Capt's CDP. R/A scale reads minus 3(±5) feet.

(12) On aircraft with EFIS, perform following:

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893 (Continued)

(a) Rotate DH set knob on Capt's EFIS Control & Dimming Panel (CDP) until "DH 100" appears in upper right corner of Capt's PFD.

(b) Press and hold TEST pushbutton on Capt's CDP. Capt's R/A scale on PFD reads 40(±5) feet; then "R/A FAIL" flag replaces R/A scale.

(c) Release TEST pushbutton on Capt's CDP. R/A scale reads minus 3(±5) feet.

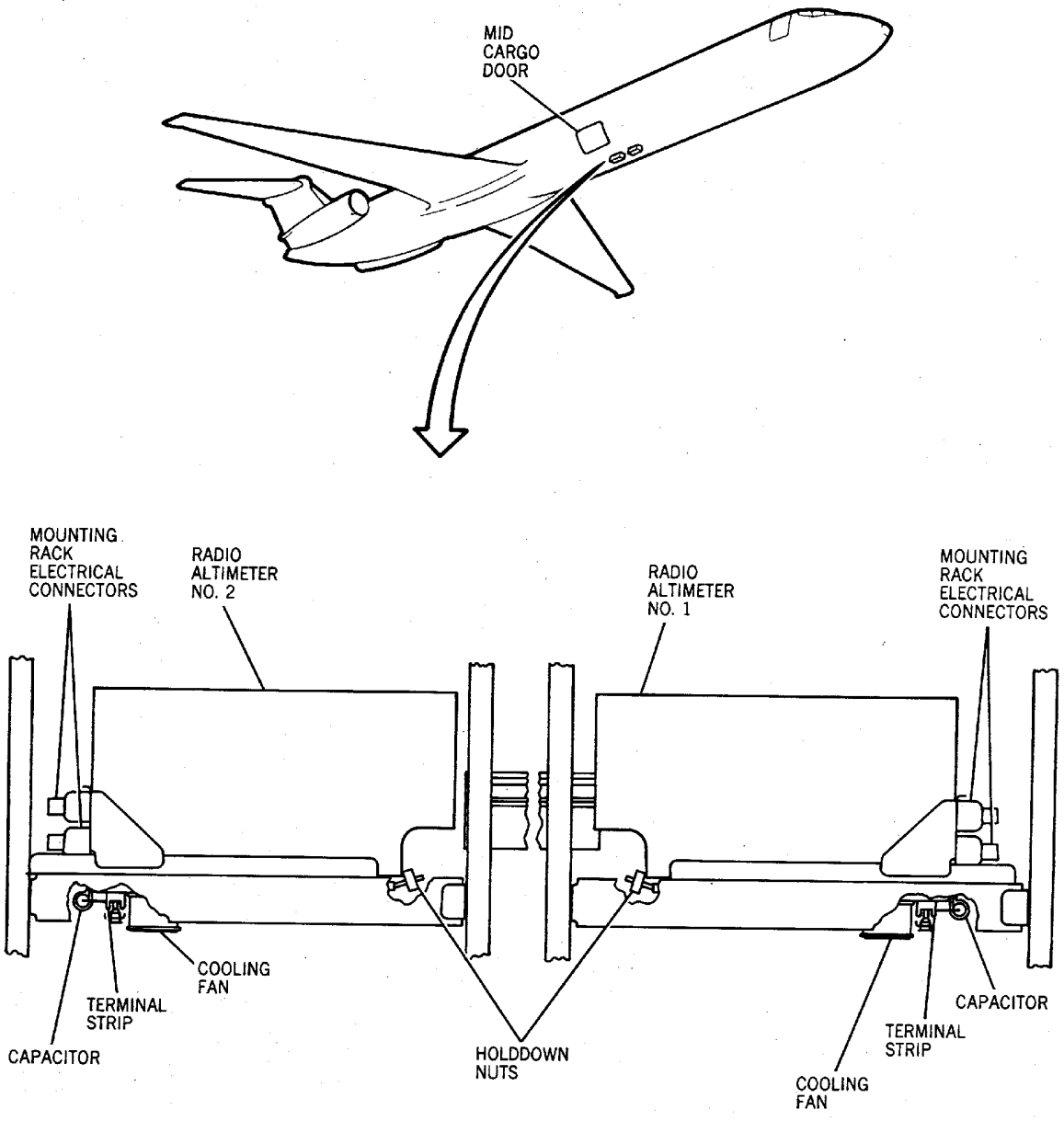
WJE 401-404, 886, 887

(13) Rotate DH set knob on Capt's EFIS Control & Dimming Panel (CDP) until "DH 100" appears in upper right corner of Capt's PFD.

(14) Press and hold TEST pushbutton on Capt's CDP. Capt's R/A scale on PFD reads 40(±5) feet; then "R/A FAIL" flag replaces R/A scale.

(15) Release TEST pushbutton on Capt's CDP. R/A scale reads minus 3(±5) feet.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893



Radio Altimeter Transceiver -- Removal/Installation
Figure 201/34-42-03-990-802

EFFECTIVITY
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

WJE

RADIO ALTIMETER TRANSCEIVER - MAINTENANCE PRACTICES

WJE

1. General

WJE A. This maintenance practice provides removal/installation procedures for the radio altimeter transceivers. Two transceivers are installed on left side of the mid cargo compartment directly opposite the mid cargo compartment access door. Each transceiver provides auxiliary altitude output, high and low altitude trip, and warning display to the Primary Flight Display (PFD).

WJE NOTE: Removal/installation procedures for both units are identical except for circuit breaker placarding.

WJE

2. Removal/Installation Radio Altimeter Transceiver

WJE **WARNING:** BEFORE INSTALLING NEW OR REPLACEMENT RADIO ALTIMETER IN AIRCRAFT, VERIFY THAT REPLACEMENT UNIT IS CALIBRATED.

WJE A. Remove Radio Altimeter Transceiver

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE **CAUTION:** EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

WJE (1) Open these circuit breakers and install safety tags:

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

WJE
WJE **UPPER EPC, RIGHT RADIO AC BUS**

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE (2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

WJE (3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

WJE B. Install Radio Altimeter Transceiver

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Make sure that these circuit breakers are open and have safety tags:

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

WJE
WJE **UPPER EPC, RIGHT RADIO AC BUS**

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE (2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

WJE (3) Slide unit straight into rack, ensuring that connectors are properly aligned.

WJE (4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW
WJE until unit is firmly engaged into rack.

WJE (5) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

WJE (6) Remove the safety tags and close these circuit breakers:

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

WJE
WJE **UPPER EPC, RIGHT RADIO AC BUS**

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE (7) Perform return to service (RTS) test (DFGS STATUS/TEST (STP) PANEL - MAINTENANCE
WJE PRACTICES, PAGEBLOCK 22-01-05/201 Config 1 or DFGS STATUS/TEST (STP) PANEL -
WJE MAINTENANCE PRACTICES, PAGEBLOCK 22-01-05/201 Config 4); or, on aircraft with
WJE autoland option RA-552A-A, open circuit breaker of unaffected radio altimeter and run autoland
WJE preflight test.

WJE NOTE: If functional check required, perform following steps:

WJE (8) Energize aircraft electrical buses.

WJE (9) Check by sound or feel that applicable radio altimeter cooling fan is operating.

WJE (10) Rotate DH set knob on Captain's EFIS Control & Dimming Panel (CDP) until "DH 100" appears
WJE in upper right corner of Captain's PFD.

WJE (11) Press and hold TEST pushbutton on Captain's CDP. Captain's R/A scale on PFD reads 40(±5)
WJE feet; then "R/A FAIL" flag replaces R/A scale.

WJE (12) Release TEST pushbutton on Captain's CDP. R/A scale reads minus 3(±5) feet.

WJE NOTE: If necessary, RADIO ALTIMETER SYSTEM - MAINTENANCE PRACTICES,
WJE PAGEBLOCK 34-42-00/201, for complete system test.

INERTIAL REFERENCE SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The Inertial Reference System (IRS) provides accurate and reliable attitude, heading, and navigation information for display on the EFIS Primary Flight Displays (PFD) and Navigation Displays (ND), as well as the Radio Distance Magnetic Indicators (RDMI).

B. Both Inertial Reference Units (IRU) are controlled by a single Mode Select Unit (MSU) located on the overhead switching panel. The MSU contains the system function switches and caution and advisory messages for the system as well. Additional messages are displayed on the Electronic Overhead Annunciator Panel (EOAP).

C. Position and heading data is initialized via the Flight Management System (FMS) Multifunction Control Display Unit (MCDU) keyboard.

D. The IRS has its own back-up continuous and emergency power supplies should main aircraft generator power become unavailable. Each IRU has its own cooling fan and battery charger. The mechanics call horn is used as a battery aural warning system.

2. Operation

A. The IRS is controlled by two 4-position switches located on the MSU. These switches operate IRU-1 (captain's side) and IRU-2 (first officer's side). Switch positions are: OFF, ALIGN, NAV and ATT.

(1) OFF de-energizes the IRU circuitry 10 seconds after selection.

(2) ALIGN initiates the alignment mode. In this mode, the IRU aligns its reference axis to the local vertical. It computes heading and latitude by measuring the horizontal earth rate components. Position information must be entered via the MCDU while the IRU is in this mode.

(3) NAV is the normal "on" position. The IRU will automatically function through the alignment mode and enter the navigate mode once position information has been entered. In the navigate mode, the IRU supplies inertial position reference for the aircraft and provides data outputs of: attitude, body rates and accelerations, true and magnetic heading, velocity vectors, latitude and longitude, inertial vertical speed and wind data.

(4) ATT selects the back-up attitude mode for alignment and navigate modes. The IRU performs a rapid 20 second in-flight or on-ground leveling. In the attitude mode, the IRU has degraded accuracies and no longer outputs true heading position, or velocities. The FMS MCDUs will permit the entry of magnetic heading to an IRU only if that IRU is in the attitude mode.

B. For normal operation the operator moves the MSU control switches from the OFF to NAV position. Enter latitude and longitude information on either MCDU-1 or MCDU-2 by selecting the IRS INIT/REF (by pressing line select key 51 on the MCDU MENU page) page and typing the data on the keyboard. The EFIS displays will illuminate and the ALIGN light on the associated side MSU will extinguish when the IRU completes the alignment mode and enters into the navigate mode. The system is now operational. For more details on the IRS INIT/REF. (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00)

C. The IRS interfaces with many aircraft avionics systems. Air data information is received on ARINC 575 data busses from the two air data computers (CADC1-2). The flight guidance computers are fed pitch and roll in analog form (200mV/degree) as well as a synchro signal for magnetic heading and discrete valid for attitude and heading. The VHF NAV control panel also receives the magnetic heading synchro signal. The FDAU receives pitch, roll, and magnetic heading synchro signals from IRU-2 only. Data is sent via an ARINC 429 digital bus to the FMS, weather radar, EFIS symbols generators and captain's and first officer's RDMI's.

D. The IRS provides advisory and caution messages to the flight crew through the MSU and EOAP. The MSU provides four messages each for the IRU-1 and IRU-2 which are: ALIGN, ON BAT, BAT FAIL and FAULT.

(1) ALIGN signifies that the IRU is in the alignment mode. A flashing light indicates that either an incorrect latitude or no position data has been entered.

(2) ON BAT will light when the IRU is operating from its back-up battery.

(3) BAT FAIL indicates that battery voltage is less than 21 VDC.

(4) FAULT indicates to the flight crew that the IRU has detected a problem in its normal alignment and navigate modes.

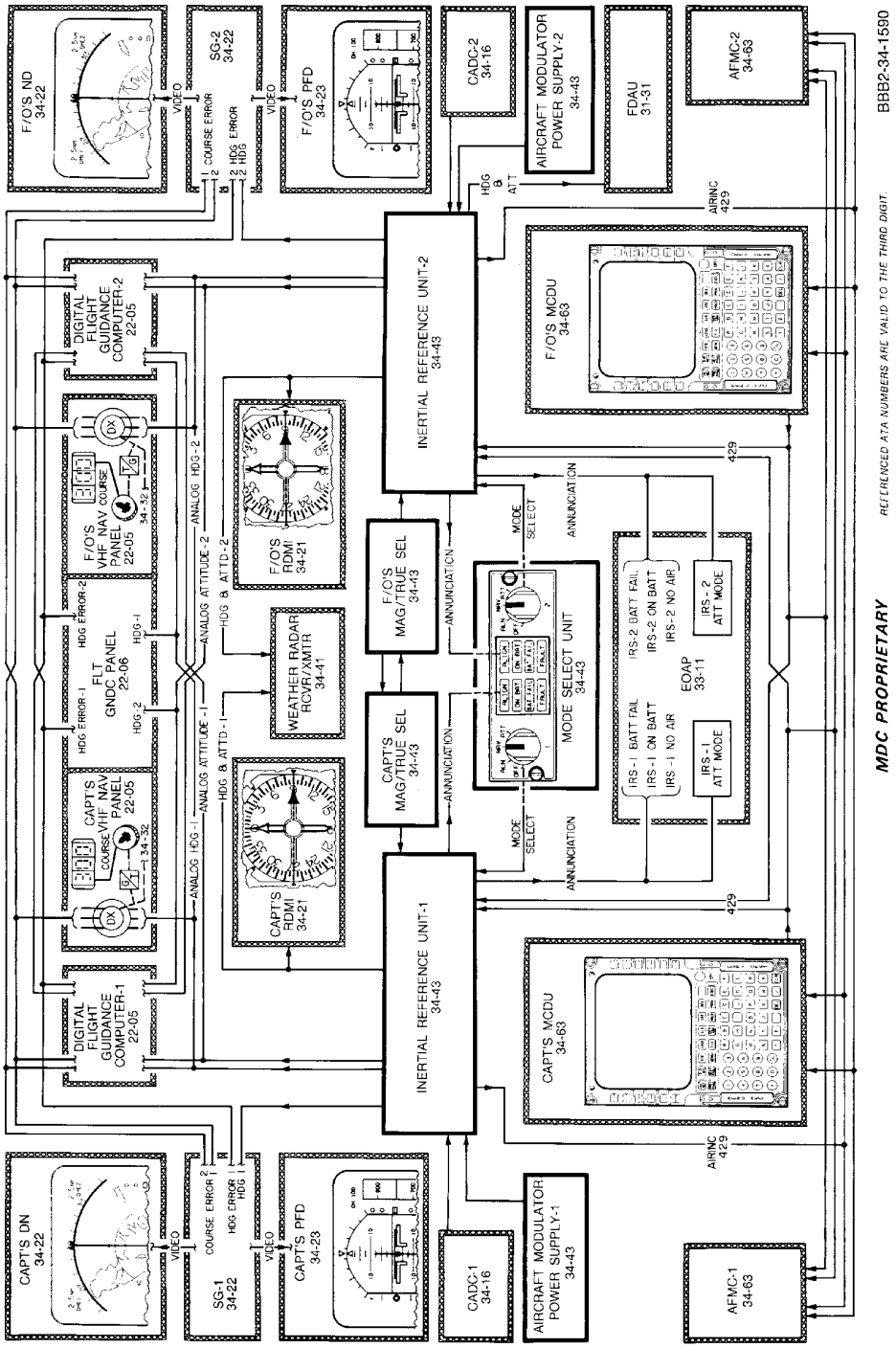
E. The EOAP duplicates the ON BAT and BAT FAIL messages for IRU-1 and IRU-2 as well as NO AIR and ATT MODE.

(1) NO AIR illuminates when IRU reaches 160°F (71°C) temperature. THE COOLING FANS DO NOT OPERATE WHILE THE IRS is on back-up battery power.

(2) ATT MODE informs the flight crew that they have selected the attitude mode of operation.

F. The IRS has independent back-up power supplies for each IRU. During normal operation these batteries are maintained at 24 VDC by their own charging units. Should the aircraft lose generator power, each battery is designed to provide power for a minimum of 30 minutes to its IRU. To prevent inadvertent battery power drain, each battery is connected to the dual Sonalert aural warning system. The mechanics call horn provides an aural warning to the flight crew and ground crew should either MSU switch be out of the OFF position, and all AC power off while the aircraft is on the ground and fuel is cut off.

G. The MAG/TRUE switch allows the pilot to change the ND to display either magnetic or true heading. Also, the FDAU, FMS and IRU receive a discrete to inform them which heading to use.



Inertial Reference Systems -- Block Diagram
Figure 1/34-43-00-990-801

INERTIAL REFERENCE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty IRS in the aircraft.

B. The basic causes of a faulty system operation are generally: faulty airplane wiring or faulty line replaceable units (LRU).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the IRS are the Inertial Reference Units (IRU), Mode Select Units (MSU) and the IRS batteries. The system interfaces with the Flight Management System (FMS), EFIS, weather radar, the EOAP, and RDMI's. In trouble shooting, some checks may have to be made to these systems.

E. The IRS components are located as follows:

Table 101

Component	Location
MSU	Forward Overhead Switch Panel
IRU-1 and 2	Forward Accessory Compartment
Battery-1 and 2	Aft Right Radio Compartment
MAG/TRUE Switches	Instrument Panel
Mechanic Call Horn	Nose Wheel Well
IRS Circuit Breakers	EPC and Overhead Circuit Breaker Panels

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shoot IRS

A. Trouble Shoot

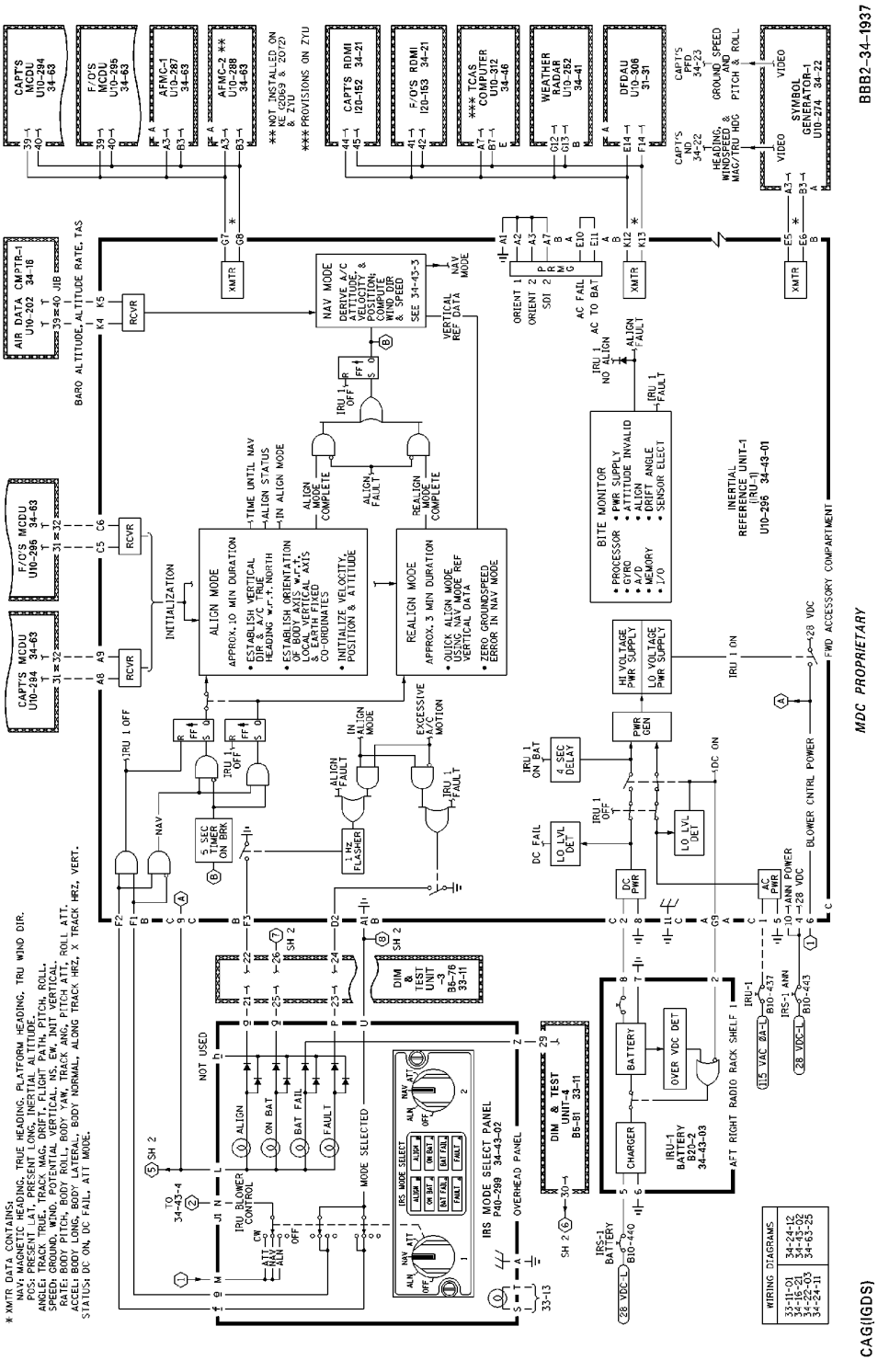
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

Table 103

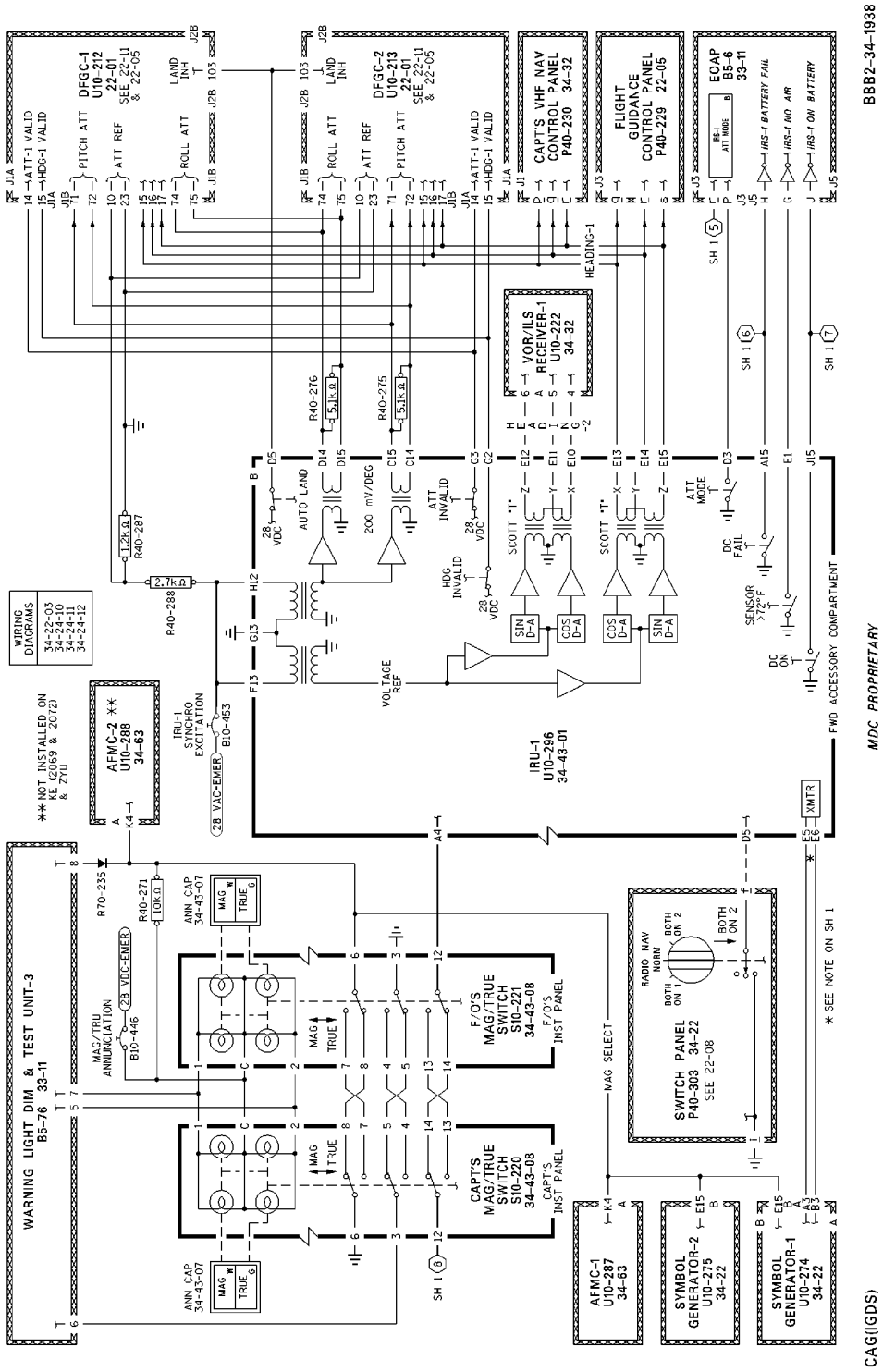
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at LRU's. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make certain ground terminals are tight and properly bonded, replace LRUs.
(3) Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 103 (Continued)

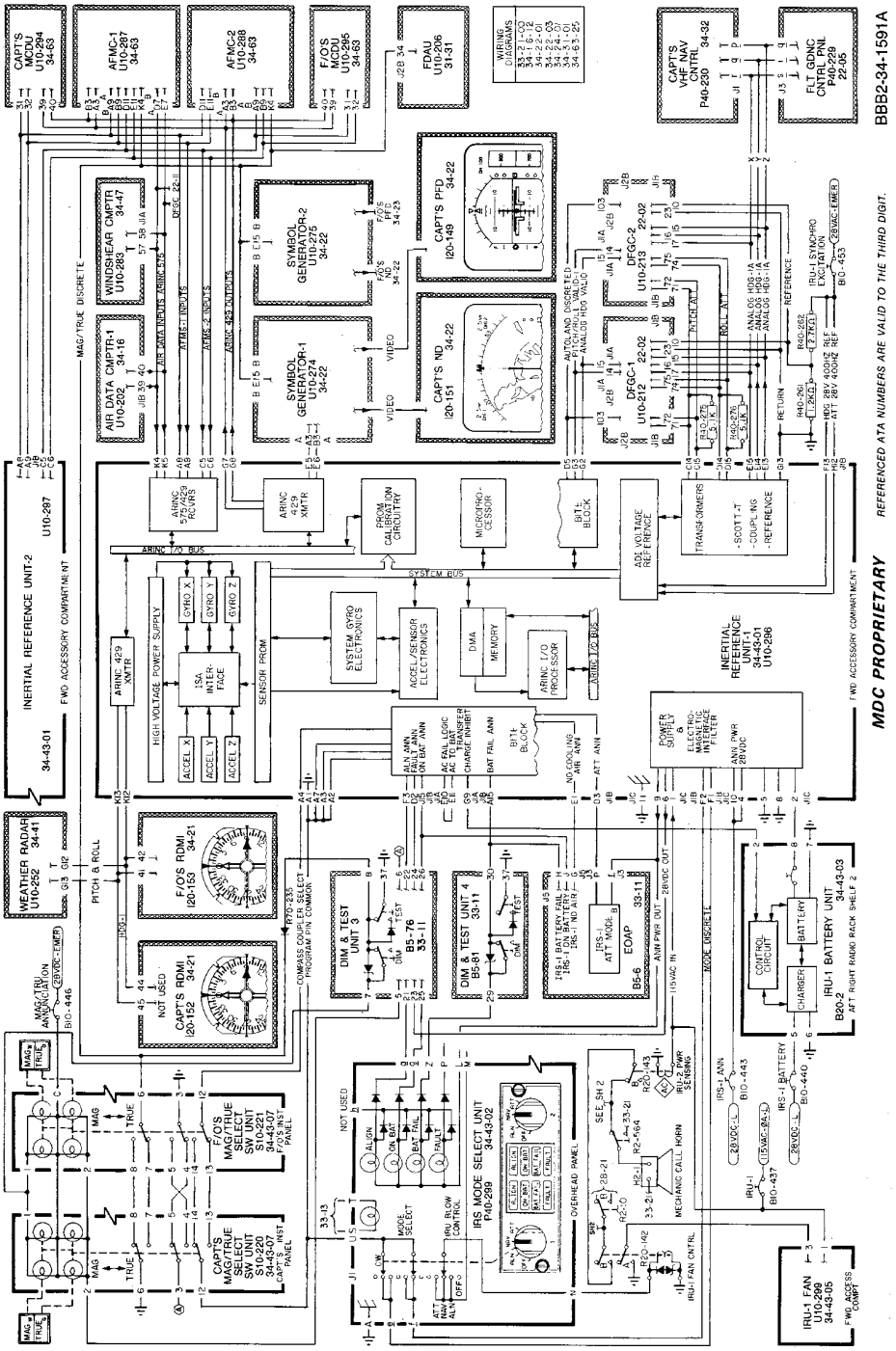
Procedure	Correction
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
Verify operation of both IRU cooling fans by placing a hand over the top of each IRU and feeling for air exiting the top of each unit. If there is no air flow then replace faulty cooling fan or remove obstructions or restrictions to airflow.	Airflow verified.



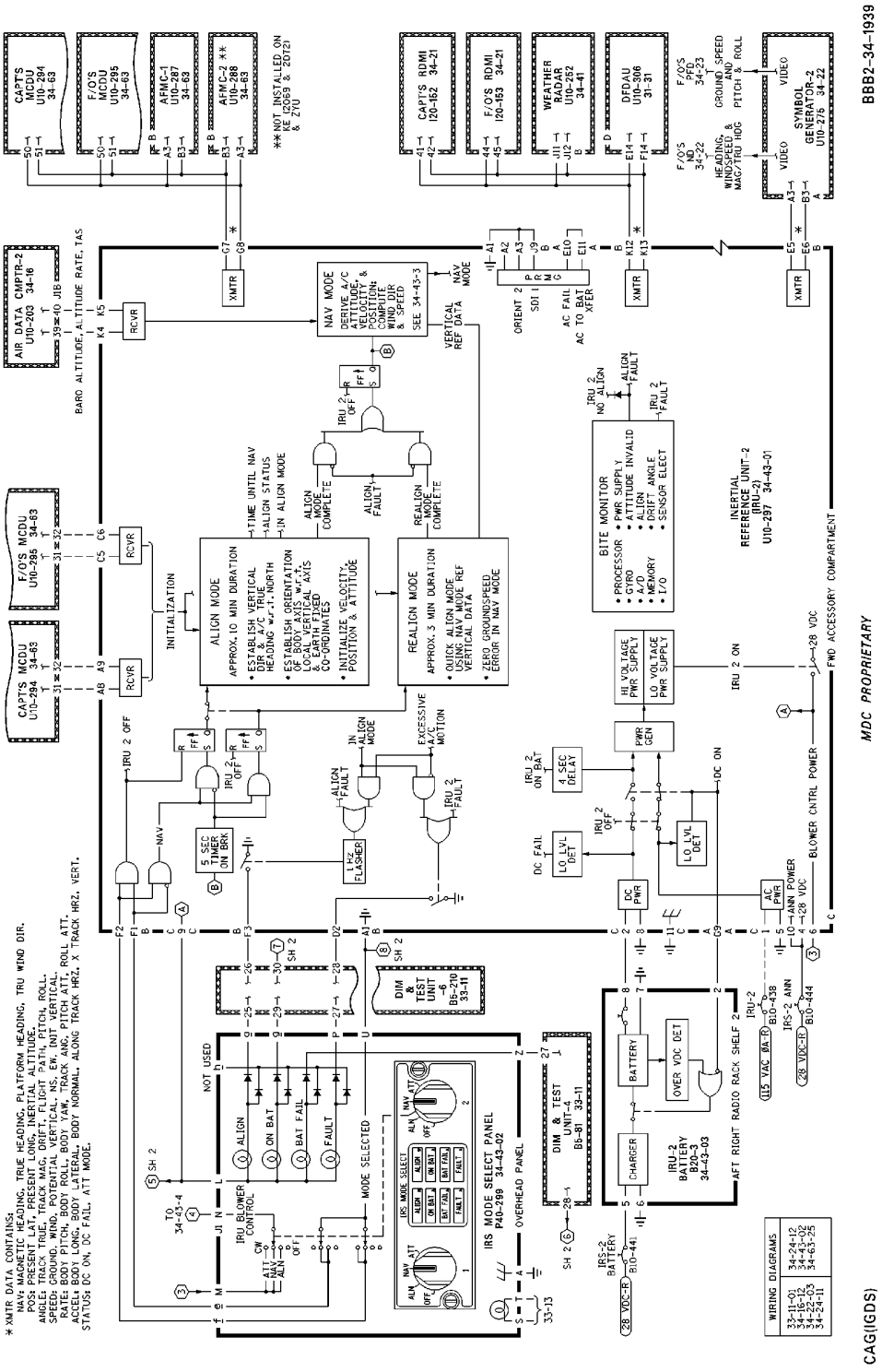
IRU-1 -- Schematic
Figure 101/34-43-00-990-802 (Sheet 1 of 3)



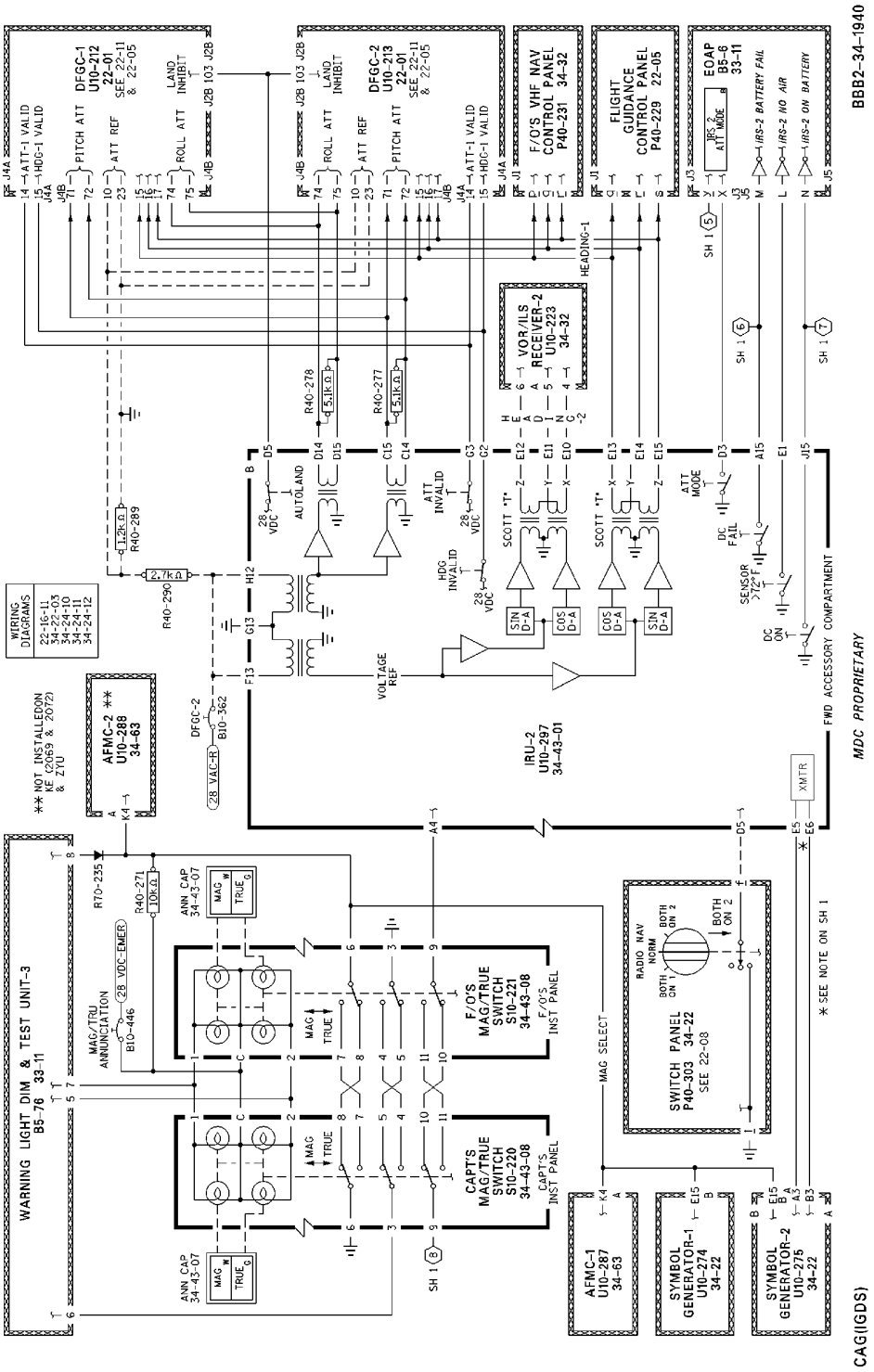
IRU-1 -- Schematic
Figure 101/34-43-00-990-802 (Sheet 2 of 3)



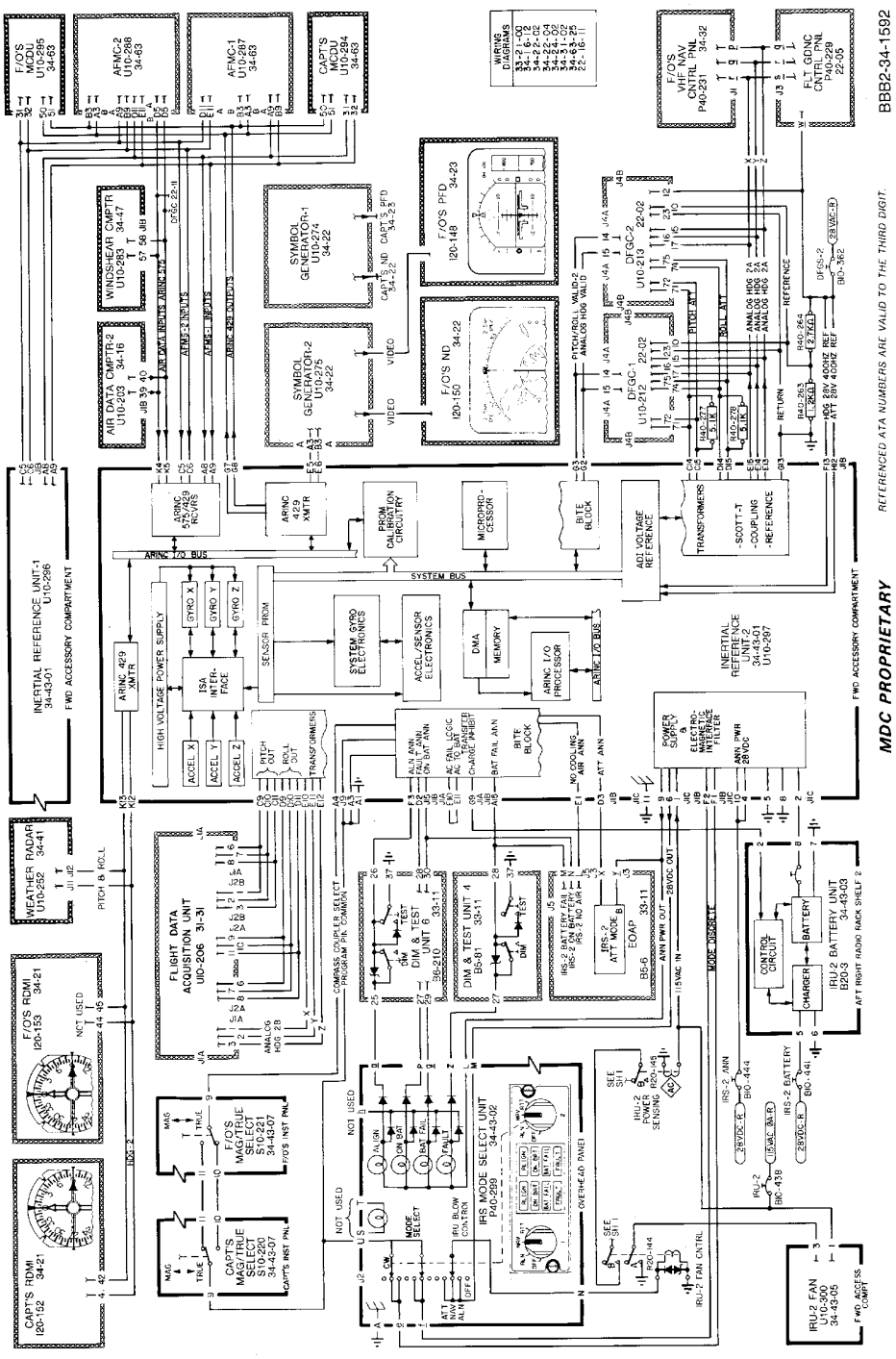
IRU-1 -- Schematic
Figure 101/34-43-00-990-802 (Sheet 3 of 3)



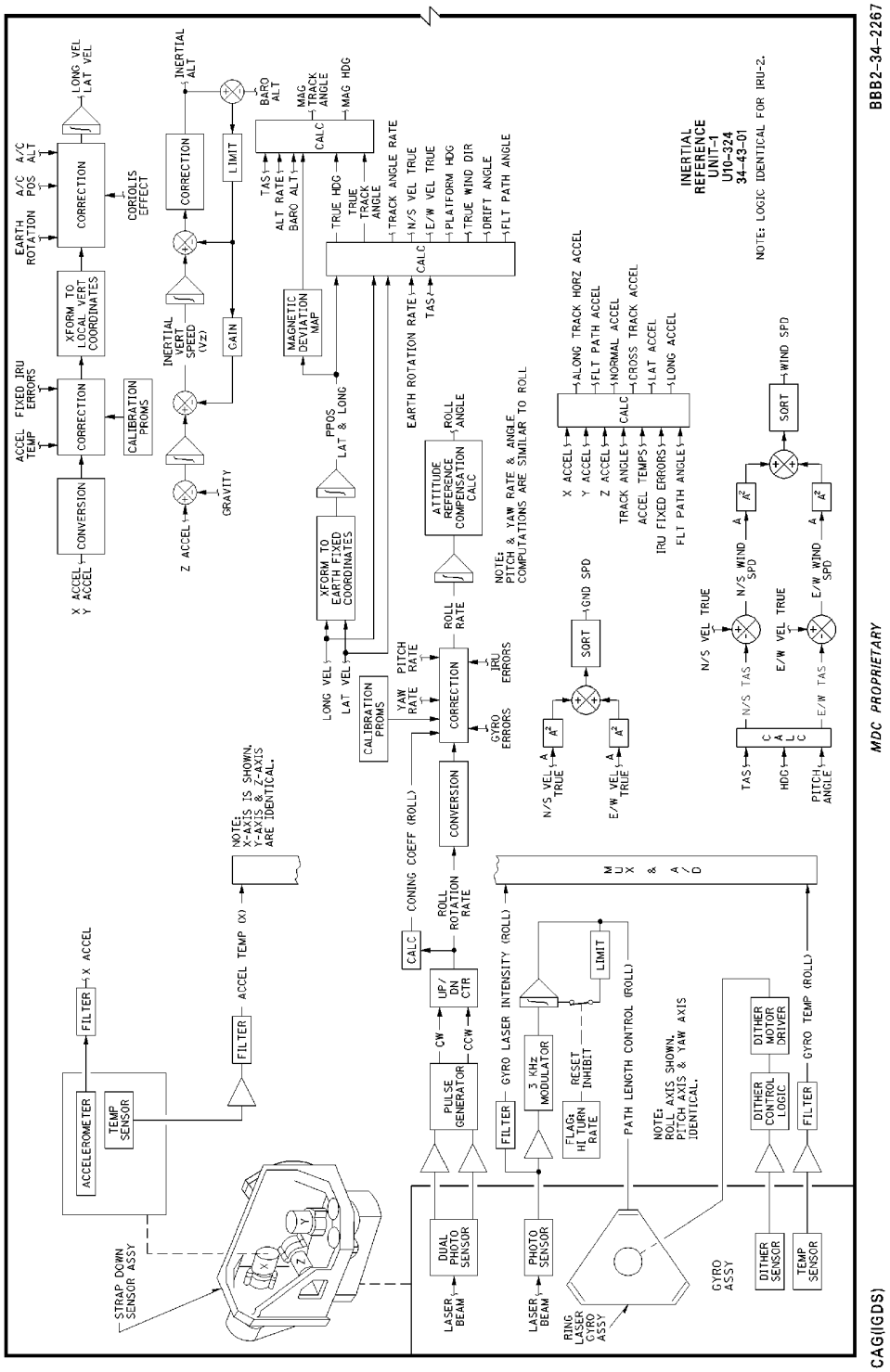
IRU-2 -- Schematic
Figure 102/34-43-00-990-803 (Sheet 1 of 3)



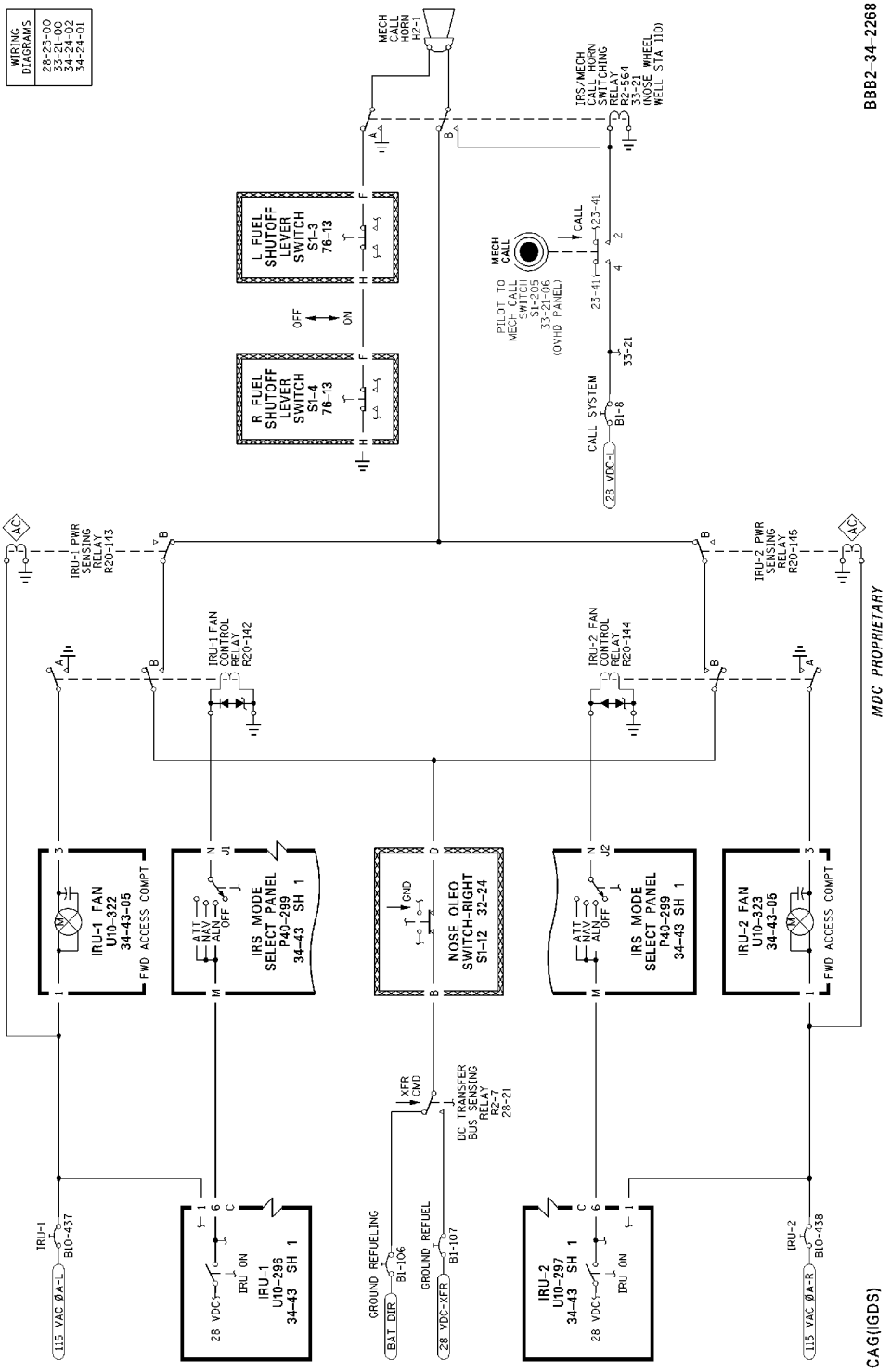
IRU-2 -- Schematic
Figure 102/34-43-00-990-803 (Sheet 2 of 3)



IRU-2 -- Schematic
Figure 102/34-43-00-990-803 (Sheet 3 of 3)



IRU Control
Figure 103/34-43-00-990-804



Inertial Aural Warning
Figure 104/34-43-00-990-805

INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Inertial Reference System (IRS) provides accurate and reliable attitude, heading, and navigation information for display on the EFIS Primary Flight Displays (PFD) and Navigation Displays (ND), as well as the Radio Distance Magnetic Indicators (RDMI).

B. Both Inertial Reference Units (IRU) are controlled by a single Mode Select Unit (MSU) located on the overhead switching panel. The MSU contains the system function switches and caution and advisory messages for the system as well. Additional messages are displayed on the Electronic Overhead Annunciator Panel (EOAP).

C. Position and heading data is initialized via the Flight Management System (FMS) Multifunction Control Display Unit (MCDU) keyboard.

D. The IRS has its own back-up continuous and emergency power supplies should main aircraft generator power become unavailable. Each IRU has its own cooling fan and battery charger. The mechanic call horn is used as a battery aural warning system.

E. Following is a list of components applicable to the IRS:

Table 201

Component	Location
IRU-1	Forward Accessory Compartment
IRU-2	Forward Accessory Compartment
Battery-1	AFT Right Radio Compartment
Battery-2	AFT Right Radio Compartment
MSU	Forward Overhead Switch Panel
CAPT & F/O PFD, ND & RDMI	Instrument Panel
Mechanic call horn	Nose Wheel Well
FMS MCDU-1, -2	Forward Pedestal
MAG/TRUE switches	Instrument Panel

2. Adjustment/Test Inertial Reference System

A. Preliminary

Table 202

Operation	Desired Result
(1) Perform check to establish all components for system are installed and cables and connectors securely fastened.	Check.
NOTE: The following steps must be accomplished if the MCDU has not activated IRS option. Procedure must be accomplished for both MCDU's.	
(2) On MCDU press MENU key.	MENU page is displayed.
(3) Press NEXT PAGE key.	MENU page is displayed.
(4) Enter DAC into scratch pad then press 6R key.	
(5) Press 2L to activate IRS option.	ACTIVATED is flashing.
(6) Press 3L to select dual IRS (when second system installed).	2 is flashing.

Table 202 (Continued)

Operation	Desired Result
(7) Press 6L to return to MENU page.	MENU page displayed.
(8) Repeat steps (2) through (7) for MCDU-2.	Same as steps (2) through (7).

B. Normal Operation Test

Table 203

Operation	Desired Result
(1) On overhead switch panel, verify Mode Select Unit (MSU) switches are in OFF position.	Verified.
(2) Press and hold ANNUN/DIGITAL LTS test switch located on overhead panel. Verify all messages come on Capt's and F/O's side of IRS MSU.	ALIGN, FAULT, BAT FAIL, and ON BAT messages come on.
(3) Verify IRS-1 ATT MODE and IRS-2 ATT MODE blue messages come on overhead annunciator panel.	IRS-1 ATT MODE, IRS-2 ATT MODE messages come on.
(4) Release ANNUN/DIGITAL LTS test switch.	Messages go off.
(5) ON Capt's and F/O's Mode Select panels place MODE selector switch to ROSE mode.	ND in ROSE mode.
(6) Before system aligns, verify Primary Flight Display (PFD) and ND display.	(a) ATT FAIL message on CAPT PFD. (b) ATT FAIL on F/O PFD. (c) HDG FAIL on CAPT ND. (d) HDG FAIL on F/O ND.
(7) Verify Capt's and F/O's RDMI's heading flags are in view.	RDMI HDG flags in view.
(8) Place Capt's IRU switch on MSU from OFF to NAV position.	Switch in NAV.
(9) Verify following MSU Capt's side messages come on:	Message lights ON as required.
ON BAT (ON for 15 seconds) ALIGN	
(10) Verify following messages come on overhead annunciator panel: IRS-1 ON BATTERY (ON for 15 seconds) IRS-1 NO AIR (ON momentarily)	Message lights ON as required.
(11) Verify ATT FAIL message on Capt's PFD and HDG FAIL message on Capt's ND go off after 15 seconds.	Capt's side ATT FAIL and HDG FAIL off.
(12) Place F/O's IRU switch from OFF to NAV position.	Switch in NAV.
(13) Verify following MSU F/O's side messages come on: ON BAT ALIGN (ON for 15 seconds)	Message lights ON as required.
(14) Verify following messages come on overhead annunciator panel: IRS-2 ON BATTERY (ON for 15 seconds) IRS-2 NO AIR (ON momentarily)	Message lights ON as required.
(15) Verify ATT FAIL message on F/O's PFD and HDG FAIL message on F/O's ND go off after 15 seconds.	F/O's side ATT FAIL and HDG FAIL off.

Table 203 (Continued)

Operation	Desired Result
(16) Verify operation of both IRU cooling fans by placing a hand over the top of each IRU and feeling for air exiting the top of each unit.	IRU-1 and -2 cooling fan airflow present.
(17) Verify ALIGN messages on MSU begin blinking after 2.5 to 10 minutes.	ALIGN blinks for Capt's and F/O's side.
(18) On instrument panel, verify Capt's and F/O's MAG/TRU switches display MAG. Press either switch if TRUE is displayed.	MAG on both switches.

C. Incorrect Position Entry Test

Table 204

Operation	Desired Result
(1) On Capt's MCDU select MENU.	MENU selected.
NOTE: If IRS INIT/REF is not displayed to right of 5L key, then perform Paragraph 2.A., steps (3) through (8).	
(2) On Capt's MCDU select IRS INIT/REF page by pressing "5L" key.	IRS INIT/REF selected.
(3) On Capt's MCDU insert following position: N1234.5W12345.6	Position entered.
(4) On Capt's MCDU press "5R" key.	Position entered.
NOTE: If position data was incorrectly entered, REENTER IRS POSITION will be displayed. Press CLR key and re-enter position.	
(5) Verify ALIGN lights on MSU remain flashing.	ALIGN remains flashing.
(6) Repeat steps (3) and (4).	Position re-entered.
(7) Verify following messages on Capt's and F/O's side of MSU:	Message lights ON as required.
ALIGN (stops flashing, remains ON) FAULT (ON)	
(8) On Capt's MCDU, verify that REENTER IRS POSITION is displayed. Press CLR key to clear message.	Message observed then cleared.

D. Correct Position Entry - Capt MCDU Test

Table 205

Operation	Desired Result
(1) On Capt's MCDU enter correct present position (Lat & Long).	Position entered and displayed in scratchpad.
(2) On Capt's MCDU press "5R" key.	Position entered.
NOTE: If position data was incorrectly entered, REENTER IRS POSITION will be displayed. Press CLR key and re-enter position.	
(3) Capt's and F/O's ALIGN and FAULT lights on MSU will go off.	ALIGN and FAULT lights go off.

Table 205 (Continued)

Operation	Desired Result
(4) Verify Capt's and F/O's RDMI's:	Capt's RDMI heading flag out of view and compass rose steady. F/O's RMDI heading flag out of view and compass rose steady.
(5) Verify Capt's and F/O's PFD and ND display:	(a) Capt's PFD no ATT FAIL and horizon steady.
	(b) F/O's PFD no ATT FAIL and horizon steady.
	(c) Capt's ND no HDG FAIL and compass rose steady.
	(d) F/O's ND no HDG FAIL and compass rose steady.
	(e) Capt's PFD pitch 0(±2) degrees.
	(f) F/O's PFD pitch 0(±2) degrees.
	(g) Capt's PFD roll 0(±2) degrees.
	(h) F/O's PFD roll 0(±2) degrees.
	(i) Capt's and F/O's pitch agree w/in 1.0 degrees.
	(j) Capt's and F/O's roll agree within 1.0 degrees.
(6) On captain's side, press MAG/TRU switch to TRU.	Verify TRU on both ND's and TRU on MAG/TRU switch.
(7) On first officer's side, press MAG/TRU switch to MAG.	Verify MAG comes on both MAG/TRU switches.
(8) Repeat step (6) for first officer's side.	Same as step (6).
(10) Repeat step (7) for captain's side.	Same as step (7).

E. Attitude Mode Test

Table 206

Operation	Desired Result
(1) Turn Capt's and F/O's switches on MSU to ATT positions.	MSU switches in ATT.
NOTE: The switch is detented in NAV position. Pull out firmly on switch before turning	
(2) Verify following messages come on on Capt's and F/O's side of MSU: ALIGN (ON for 20 seconds, then extinguishes)	Message lights ON as required.
(3) Verify following blue message lights come on overhead annunciator panel: IRS-1 ATT MODE IRS-2 ATT MODE	Blue message lights ON as required.
(4) Place Capt's and F/O's mode select switches from ATT to OFF positions.	MSU switches in OFF.
(5) Verify following blue message lights go off on overhead annunciator panel: IRS-1 ATT MODE IRS-2 ATT MODE	Blue message lights go off.

F. Correct Position Entry - F/O's MCDU Test

Table 207

Operation	Desired Result
NOTE: Capt's and F/O's mode switches must be in OFF position for 10 seconds before proceeding to step (1).	
(1) Place Capt's and F/O's mode select switches on MSU from OFF to NAV positions.	MSU switches in NAV.
(2) Verify following Capt's and F/O's messages come on MSU: ON BAT (ON for 15 seconds) ALIGN	Message lights ON as required.
(3) Verify following caution messages come on overhead annunciator panel: IRS-1 ON BATTERY (ON for 15 seconds) IRS-2 ON BATTERY (ON for 15 seconds) IRS-1 NO AIR (ON momentarily) IRS-2 NO AIR (ON momentarily)	Message lights ON as required.
(4) Select MENU on F/O's MCDU.	MENU selected:
NOTE: If IRS INIT/REF is not displayed to the right of 5L key, then perform Paragraph 2.A., steps (3) through (8), before continuing.	
(5) Select IRS INIT/REF page by pressing "5L" key.	IRS INIT/REF selected.
(6) Enter present aircraft position (lat & long).	Position entered.
(7) Press "5R" key.	Position entered.
NOTE: If the position data was incorrectly entered, REENTER IRS POSITION will be displayed. Press CLR key and re-enter position.	
(8) Capt's and F/O's ALIGN lights on MSU will go off within 10 minutes. If ALIGN lights were flashing and con tinue to flash, repeat steps (5) and (7).	ALIGN lights OFF.
NOTE: IRS alignment requires 2.5 to 10 minutes. ALIGN lights begin to flash if IRS has completed alignment without position entered. ALIGN light will extinguish with position entered and alignment completed.	
(9) Place Capt's and F/O's IRS switches on MSU to OFF position.	MSU switches OFF.

G. Mechanic Call Horn - IRS-1 Battery Test

Table 208

Operation	**Desired Result**
NOTE: Verify that IRS MSU switches are in OFF position, and fuel shutoff levers are in OFF position before proceeding.	
(1) Place IRS-1 switch on MSU from OFF to ALN position.	Switch to ALN.
(2) Verify following MSU IRS-1 side messages come on: ON BAT (on for 15 seconds) ALIGN	MSU message lights come on.
(3) Verify following messages on OAP come on: IRS-1 ON BATTERY (ON for 15 seconds) IRS-1 NO AIR (On momentarily)	OAP message lights come on.
(4) On Upper EPC open IRS-1 circuit breaker.	Breaker open.
(5) Verify ON BAT message comes on IRS-1 side of MSU.	Message lights ON.

Table 208 (Continued)

Operation	Desired Result
(6) Verify following message comes on overhead annunciator panel: IRS-1 ON BATTERY	Message light ON as required.
(7) Listen for mechanic call horn in nose wheel well.	Cal horn in nose wheel well is audible.
(8) On upper EPC close IRS-1 circuit breaker.	Breaker closed.
(9) MSU and OAP messages go off.	Message lights OFF.
(10) Mechanic call horn silent.	Horn silent.
(11) Open circuit breaker located on front of IRS BATTERY -1 in AFT right radio compartment	Breaker open.
(12) Verify BAT FAIL message on IRS-1 side of MSU comes on.	Message lights on.
(13) Verify IRS-1 BATTERY FAIL caution message comes on overhead annunciator panel.	Message lights ON.
(14) Close circuit breaker on battery.	Breaker closed.
(15) Verify MSU and OAP messages go off.	Message lights OFF.
(16) Rotate IRS-1 switch on MSU from ALN to OFF position.	MSU ALIGN message goes off.

H. Mechanic Call Horn - IRS-2 Battery Test

Table 209

Operation	Desired Result
NOTE: Verify that IRS MSU switches are in OFF position, and fuel shutoff levers are in OFF position before proceeding.	
(1) Place IRS-2 switch on MSU from OFF to ALN position.	Switch to ALN.
(2) Verify following MSU IRS-2 side messages come on: ON BAT (on for 15 seconds) ALIGN	MSU message lights come on.
(3) Verify following messages on OAP come on: IRS-2 ON BATTERY (ON for 15 seconds) IRS-2 NO AIR (On momentarily)	OAP message lights come on.
(4) On upper EPC open IRS-2 circuit breaker.	Breaker open.
(5) Verify ON BAT message comes on F/O's side of MSU.	Message lights ON.
(6) Verify following message comes on overhead annunciator panel (OAP): IRS-2 ON BATTERY	Message light ON as required.
(7) Listen for mechanic call horn in nose wheel well.	Call horn in nose wheel well is audible.
(8) On upper EPC close IRU-2 circuit breaker.	Breaker closed
(9) MSU and OAP messages go off.	Message lights OFF.
(10) Mechanic call horn silent.	Horn silent.
(11) Open circuit breaker located on front of IRS BATTERY-2 in AFT right radio compartment.	Breaker open.
(12) Verify BAT FAIL message on F/O's side of MSU comes on.	Message lights ON.

Table 209 (Continued)

(13) Verify IRS-2 BATTERY FAIL message comes on overhead annunciator panel.	Message ON.
(14) Close circuit breaker on battery.	Breaker closed.
(15) Verify MSU and OAP messages go off.	Lights OFF.
(16) Rotate IRS-2 switch on MSU from ALN to OFF position.	MSU ALIGN message lights go off.
(17) Return aircraft to required configuration.	

WJE 875-879; WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872 POST MD80-34-254

I. IRU Drift Rate Rejection Criteria for Aircraft with -925 FMS

(1) On IRS MONITOR page, check IRS drift rate at the end of a period of operation (end of flight) in NAV mode.

(2) Compare drift rate to drift rate curves in Figure 201.

(3) If drift rate falls below the lower curve (B), the IRU is within tolerance for acceptable navigation accuracy.

(4) If drift rate is above the upper curve (A), the IRU is out of tolerance and should be replaced.

(5) If drift rate is between the upper and lower curves, check the drift rate after the next flight.

(a) After the second flight, if the drift rate is still above the lower curve (B), the IRU is out of tolerance and should be replaced.

(b) If drift rate after second flight falls below the lower curve (B), the IRU is acceptable.

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

J. Perform an operational check of the autoland inhibit function with the IRS in ATT mode.

(1) Verify that DFGC's and IRU's are powered up and operational with IRU switches in NAV, and NO AUTOLAND light is extinguished. Note position of DFGC side selector switch.

(2) Position IRU 1 switch to ATT. ALIGN light on MSU, NO AUTOLAND light on FMA, IRS 1 ATT Mode light on OAP, attitude and heading displays disappear from associated ND and PFD.

(3) Wait approximately 20 seconds. ALIGN light off, IRS 1 ATT MODE light still on, NO AUTOLAND light still on, attitude and heading displays reappear on ND and PFD.

(4) Reinitialize heading 1 to agree with heading 2 within ±2 degrees.

(5) Wait 10 seconds. If NO AUTOLAND light still illuminated, check OK.

(6) Select other DFGC with DFGC side selector switch. If NO AUTOLAND light still illuminated, check OK.

(7) Position IRU 1 switch to off.

(8) Wait 5 seconds.

(9) Position IRU 1 switch to NAV, and enter present latitude and longitude.

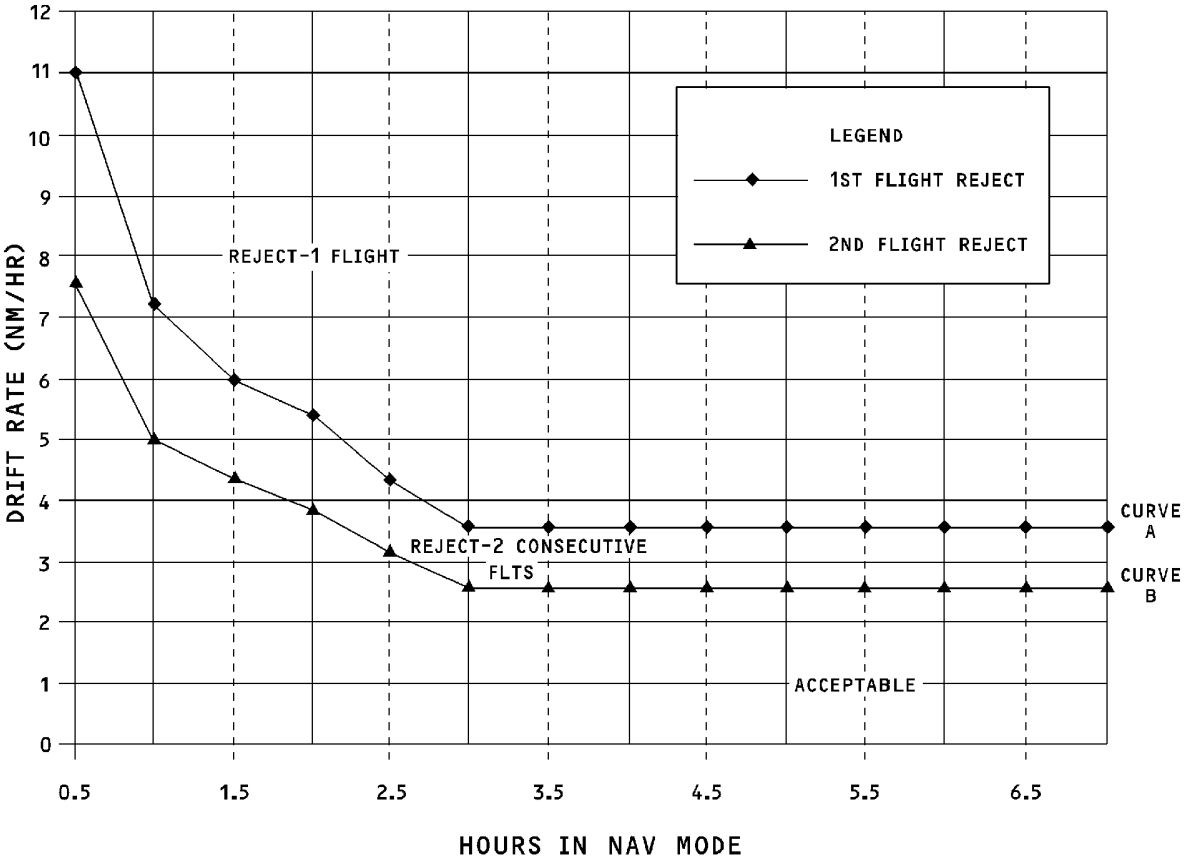
(10) Wait until IRU 1 is aligned (3 to 15 minutes), and verify NO AUTOLAND light has extinguished.

(11) Repeat Paragraph 2.J.(2) thru Paragraph 2.J.(7) for IRU 2.

NOTE: In Paragraph 2.J.(4) reinitialize heading 2 to agree with heading 1.

(12) Position other IRU switch to off.

(13) Return aircraft to required configuration.



CAG(IGDS)

BBB2-34-1734

IRU Drift Rate Rejection Criteria
Figure 201/34-43-00-990-807

INERTIAL REFERENCE SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-43-00-710-801

2. Operational Check of the Autoland Inhibit Function With IRS In ATT Mode

A. Do an Operational Check of the Autoland Inhibit Function with the IRS in ATT Mode

SUBTASK 34-43-00-710-001

(1) Verify that DFGC's and IRU's are powered up and operational with IRU switches in NAV, and NO AUTOLAND light is extinguished. Note position of DFGC side selector switch.

(2) Position IRU 1 switch to ATT. ALIGN light on MSU, NO AUTOLAND light on FMA, IRS 1 ATT Mode light on OAP, attitude and heading displays disappear from associated ND and PFD.

(3) Wait approximately 20 seconds. ALIGN light off, IRS 1 ATT MODE light still on, NO AUTOLAND light still on, attitude and heading displays reappear on ND and PFD.

(4) Reinitialize heading 1 to agree with heading 2 within ±2 degrees.

(5) Wait 10 seconds. If NO AUTOLAND light still illuminated, check OK.

(6) Select other DFGC with DFGC side selector switch. If NO AUTOLAND light still illuminated, check OK.

(7) Position IRU 1 switch to off.

(8) Wait 5 seconds.

(9) Position IRU 1 switch to NAV, and enter present latitude and longitude.

(10) Wait until IRU 1 is aligned (3 to 15 minutes), and verify NO AUTOLAND light has extinguished.

SUBTASK 34-43-00-710-002

(11) Repeat SUBTASK 34-43-00-710-001 for IRU 2, substituting IRU 2 for IRU 1 in the steps.

NOTE: Reinitialize heading 2 to agree with heading 1 in step B.(4).

B. Job Close-up

SUBTASK 34-43-00-840-001

(1) Position both IRU switches to off.

(2) Return aircraft to required configuration.

——— END OF TASK ———

TASK 34-43-00-710-802

3. Operational Check of the Inertial Warning System

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
24-00-00 P/B 001	GENERAL - DESCRIPTION AND OPERATION

B. Prepare for the Operational Check of the Inertial Warning System

SUBTASK 34-43-00-710-006

(1) Energize aircraft electrical buses and make sure all necessary circuit breakers are closed. (GENERAL - DESCRIPTION AND OPERATION, PAGEBLOCK 24-00-00/001)

(2) Verify that the Mode Select Unit (MSU) switches are in OFF position, and fuel shutoff levers are in OFF position before proceeding.

C. Operational Check of the Inertial Warning System

SUBTASK 34-43-00-710-005

(1) Place the IRS-1 switch on the MSU to ALN position. (Figure 501)

(2) Verify that the ON BAT (on for 15 seconds) and ALIGN (delayed on, steady) on the MSU messages come on.

(3) Verify the IRS-1 ON BATTERY (on for 15 seconds) and IRS-1 NO AIR (on momentarily) are on on the Electronic Overhead Annunciator Panel (EOAP).

SUBTASK 34-43-00-865-001

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(4) Open this circuit breaker:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

SUBTASK 34-43-00-710-007

(5) Verify the ON BAT message comes on the IRS-1 side of the MSU.

(6) Verify that the IRS-1 NO AIR and IRS-1 ON BATTERY messages show on the EOAP.

(7) Make sure that the mechanic call horn sounds.

SUBTASK 34-43-00-865-002

(8) Close this circuit breaker:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

SUBTASK 34-43-00-440-002

(9) Place the IRS-1 switch on the MSU to OFF position.

(10) Make sure the messages on the MSU, EOAP and the mechanic call horn are off.

SUBTASK 34-43-00-710-009

(11) Place the IRS-2 switch on the MSU to ALN position.

(12) Verify that the ON BAT (on for 15 seconds) and ALIGN (delayed on, steady) on the MSU messages come on.

(13) Verify the IRS-2 ON BATTERY (on for 15 seconds) and IRS-2 NO AIR (on momentarily) are on on the EOAP.

SUBTASK 34-43-00-865-003

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(14) Open this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

SUBTASK 34-43-00-710-010

(15) Verify the ON BAT message comes on the IRS-2 side of the MSU.

(16) Verify that the IRS-2 NO AIR and IRS-2 ON BATTERY messages show on the EOAP.

(17) Make sure that the mechanic call horn sounds.

SUBTASK 34-43-00-865-004

(18) Close this circuit breaker:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879

SUBTASK 34-43-00-440-001

(19) Place the IRS-2 switch on the MSU to OFF position.

(20) Make sure the messages on the MSU, EOAP and the mechanic call horn are off.

D. Job Close-up

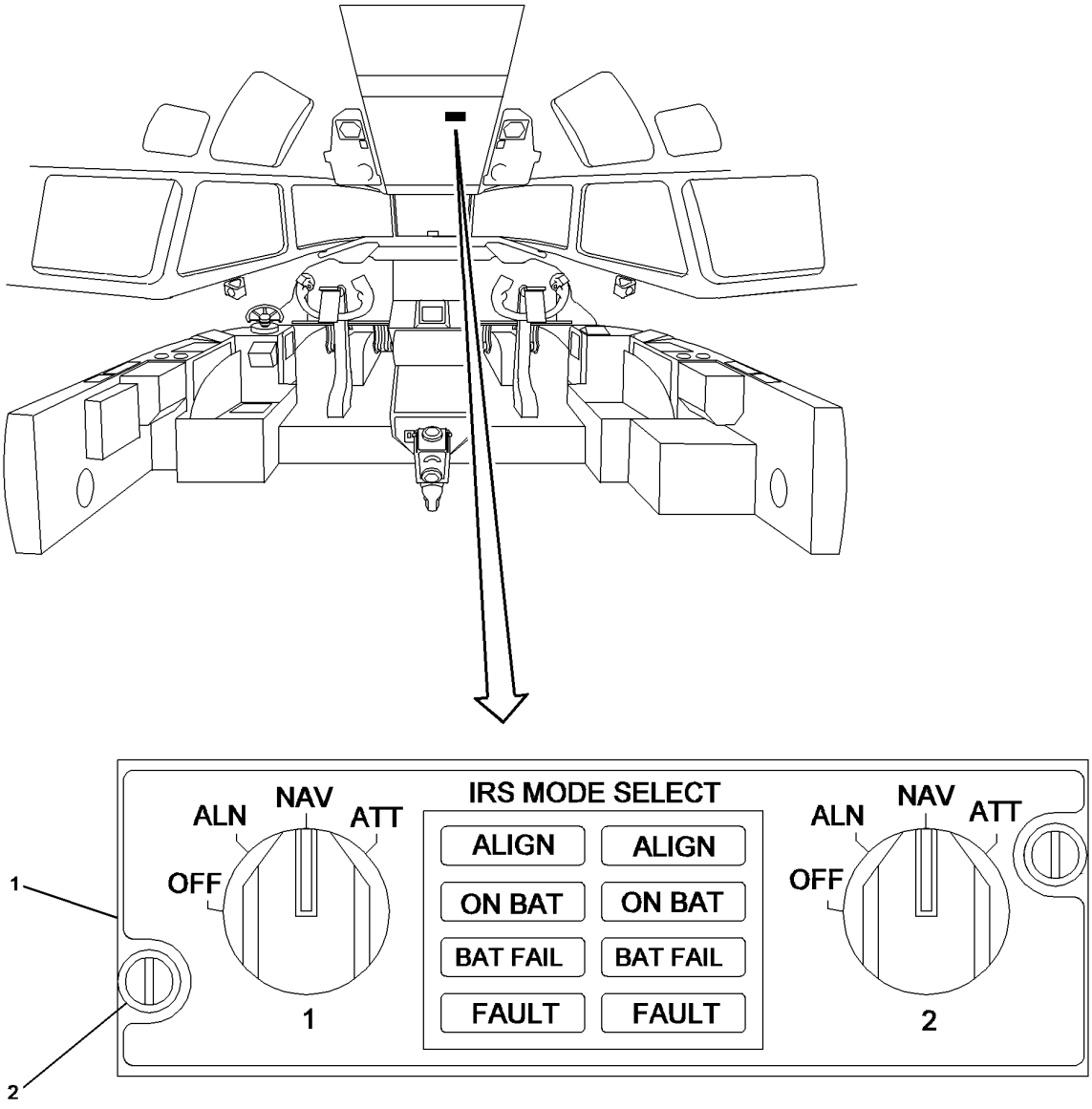
SUBTASK 34-43-00-860-002

(1) Remove power if no longer required. (GENERAL - DESCRIPTION AND OPERATION, PAGEBLOCK 24-00-00/001)

(2) Return aircraft to required configuration.

(3) Remove all the tools and equipment from the work area. Make sure the area is clean.

——— END OF TASK ———



LEGEND:
1. MODE SELECT UNIT
2. FASTNER

BBB2-34-2657
S0000174940V1

INERTIAL REFERENCE SYSTEM MSU
Figure 501/34-43-00-990-808

INERTIAL REFERENCE UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Inertial Reference Unit (IRU) and test procedures for the Inertial Reference System (IRS).

B. The IRU is the primary source of attitude, heading and navigation information utilized by aircraft avionics systems. Therefore, the test procedures check both the attitude, heading and navigation portions of the IRU.

C. The IRU's are located in the forward accessory compartment. Access is through the accessory compartment door located in the nosewheel well. The removal and installation procedures for both IRU's are the same.

2. Removal/Installation Inertial Reference Unit

A. Remove IRU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

AFT RIGHT RADIO RACK, BATTERY UNIT

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
		N/A	IRU-1 BATTERY
		NA	IRU-2 BATTERY

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 877			
A	2	B10-453	IRU-1 SYNCHRO EXCITATION 28 VAC
WJE 401-404, 412, 414, 875, 876, 878, 879			
A	6	B10-453	IRU-1 SYNCHRO EXCITATION
WJE 417, 419, 421, 423, 865, 869, 871, 872			
A	6	B10-453	SYNCHRO EXCITATION

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

(2) Unscrew knurled holddown nuts at front end of mounting.

CAUTION: THE INERTIAL REFERENCE UNIT (IRU) WEIGHS 45 POUNDS (20.4 KG). EXERCISE EXTREME CAUTION IN REMOVING OR INSTALLING IRU TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO AIRCRAFT.

(3) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install IRU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

AFT RIGHT RADIO RACK, BATTERY UNIT

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
		N/A	IRU-1 BATTERY
		NA	IRU-2 BATTERY

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 877			
A	2	B10-453	IRU-1 SYNCHRO EXCITATION 28 VAC
WJE 401-404, 412, 414, 875, 876, 878, 879			
A	6	B10-453	IRU-1 SYNCHRO EXCITATION
WJE 417, 419, 421, 423, 865, 869, 871, 872			
A	6	B10-453	SYNCHRO EXCITATION

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879 (Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

CAUTION: THE INERTIAL REFERENCE UNIT (IRU) WEIGHS 45 POUNDS (20.4 KG). EXERCISE EXTREME CAUTION IN REMOVING OR INSTALLING IRU TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO AIRCRAFT.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(5) Remove the safety tags and close these circuit breakers:

AFT RIGHT RADIO RACK, BATTERY UNIT

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
		N/A	IRU-1 BATTERY
		NA	IRU-2 BATTERY

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 877			
A	2	B10-453	IRU-1 SYNCHRO EXCITATION 28 VAC
WJE 401-404, 412, 414, 875, 876, 878, 879			
A	6	B10-453	IRU-1 SYNCHRO EXCITATION
WJE 417, 419, 421, 423, 865, 869, 871, 872			
A	6	B10-453	SYNCHRO EXCITATION

WJE 417, 419, 421, 423, 865, 869, 871, 872 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	15	B10-437	IRU-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
F	1	B10-438	IRU-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

3. **Adjustment/Test Inertial Reference System**

A. Test IRS

Table 201

Operation	Desired Result
(1) After closing required circuit breakers, verify air flow cooling is present in avionics compartment.	Verified.
(2) On Capt's and F/O's dimming panels, place Navigation Displays (ND) into ROSE mode.	ND in ROSE mode.
(3) Before system aligns, verify on Primary Flight Display (PFD) and on ND:	(a) ATT FAIL message on Capt's PFD. (b) ATT FAIL on F/O PFD. (c) HDG FAIL on Capt's ND. (d) HDG FAIL on F/O ND.
(4) Verify Capt's and F/O's RDMI's heading flags are in view.	RDMI HDG flags in view.
(5) Place Capt's IRU switch on MSU from OFF to NAV position.	Switch in NAV.
NOTE: IRS alignment requires 2.5 to 10 minutes. ALIGN lights begin to flash if IRS has completed alignment without position entered. ALIGN light will extinguish with position entered and alignment completed.	

Table 201 (Continued)

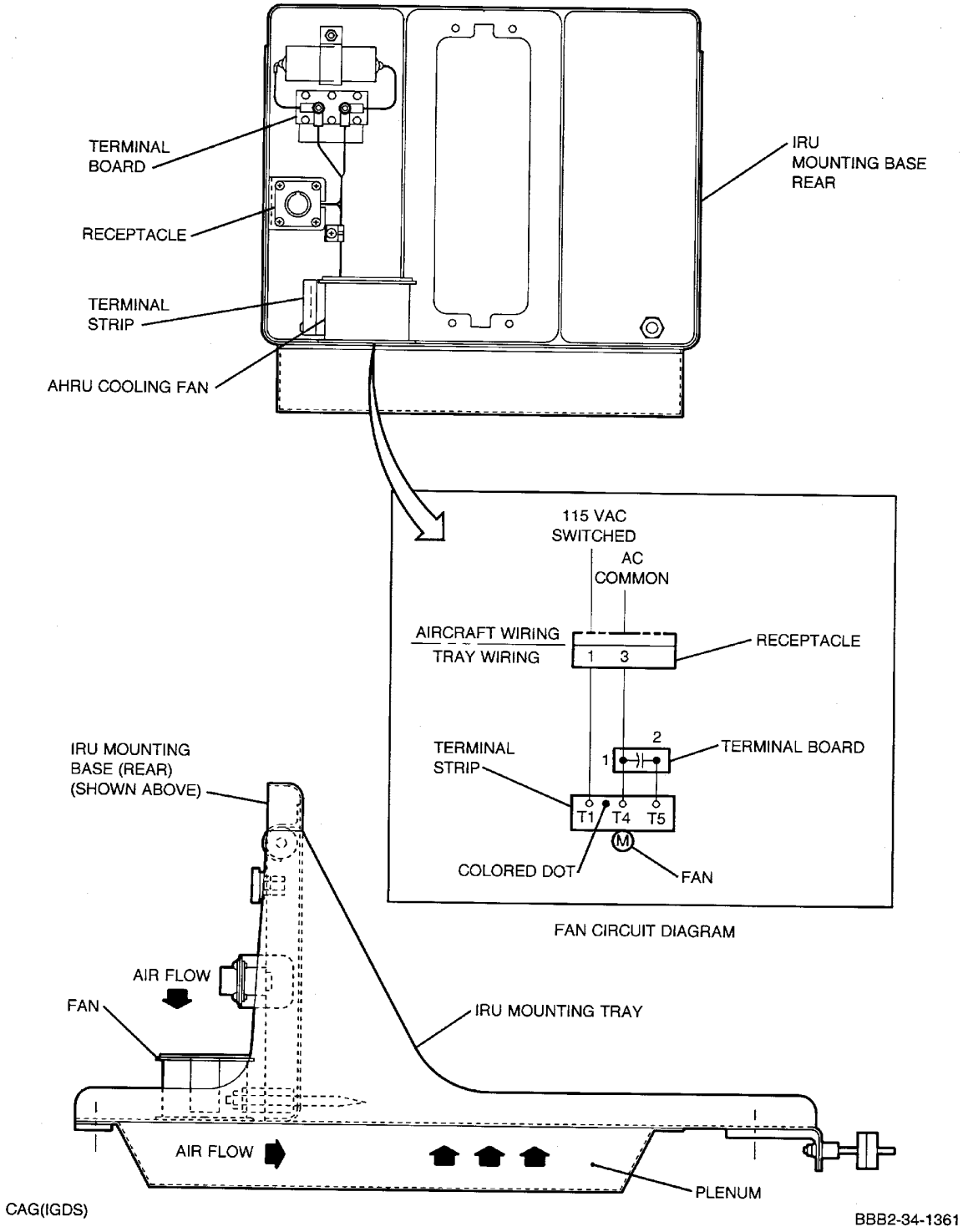
Operation	Desired Result
(6) Verify following MSU Capt's side messages come on:	Lights ON as required.
ON BAT ALIGN	(ON for 15 seconds)
(7) Verify following messages come on overhead annunciator panel:	Lights ON as required.
IRS-1 ON BATTERY (ON for 15 seconds) IIRS-1 NO AIR (ON momentarily)	
(8) Verify ATT FAIL message on Capt's PFD and HDG FAIL message on Capt's ND go off after 15 seconds.	Capt's side ATT FAIL and HDG FAIL off.
(9) Place F/O's IRU switch from OFF to NAV position.	Switch in NAV position.
(10) Verify following MSU F/O's side messages come on: ON BAT ALIGN (on for 15 seconds)	Message lights on as required.
(11) Verify following messages come on overhead annunciator panel: IRS-2 ON BATTERY (on for 15 seconds) IRS-2 NO AIR (on momemtarily)	Message lights on as required.
(12) Verify ATT FAIL message on F/O's PFD and HDG FAIL message on F/O's ND go off after 15 seconds.	F/O's side ATT FAIL and HDG FAIL off.
(13) Verify operation of both IRU cooling fans by placing a hand over the top of each IRU and feeling for air exiting the top of each unit.	IRU-1 and IRU-2 cooling fan airflow present.
(14) Select MENU on Capt's MCDU.	MENU selected.
NOTE: If IRS INIT/REF is not displayed to right of 5L key, then perform step (15) before continuing.	
(15) Select IRS INIT/REF page by pressing "5L" key.	IRS INIT/REF selected.
(16) Enter following position:	
N1234.5W12345.6	Position entered.
Press "5R" key.	Position entered.
NOTE: If position data was incorrectly entered, REENTER IRS POSITION will be displayed. Press CLR key and re-enter position.	
(17) Verify ALIGN lights on MSU remain flashing.	ALIGN remains flashing.
(18) Repeat steps (16) and (17).	Position re-entered.
(19) Verify following messages on Capt's and F/O's side of MSU:	Lights ON as required.
ALIGN (stops flashing, remains ON) FAULT (ON)	
(20) On Capt's MCDU, verify that REENTER IRS POSITION is displayed. Press CLR key to clear message.	Message observed then cleared.

Table 201 (Continued)

Operation	Desired Result
(21) Enter correct aircraft present position (lat & long).	Position entered.
(22) Press 5R key.	Position entered.
NOTE: If position data was incorrectly entered, REENTER IRS POSITION will be displayed.	
Press CLR key and re-enter position.	
(23) Capt's and F/O's ALIGN and FAULT lights on MSU will go off.	ALIGN and FAULT lights go OFF.
(24) Verify Capt's and F/O's RDMI's:	Capt's RDMI heading flag out of view and compass rose steady.
	F/O's RDMI heading flag out of view and compass rose steady.
(25) Verify Capt's and F/O's PFD and ND display:	(a) Capt's PFD no ATT FAIL and horizon steady.
	(b) F/O's PFD no ATT FAIL and horizon steady.
	(c) Capt's ND no HDG FAIL and compass rose steady.
	(d) F/O's ND no HDG FAIL and compass rose steady.
	(e) Capt's PFD pitch 0(±2) degrees.
	(f) F/O's PFD pitch 0(±2) degrees.
	(g) Capt's PFD roll 0(±2) degrees.
	(h) F/O's PFD roll 0(±2) degrees.
	(i) Capt's and F/O's pitch agree within 1.0 degrees.
	(j) Capt's and F/O's roll agree within 1.0 degrees.
(26) On captain's side, press MAG/TRU switch to TRU.	Verify TRU on both ND's and TRU on MAG/TRU switches.
(27) On first officer's side, press MAG/TRU switch to MAG.	Verify MAG comes on both MAG/TRU switches.
(28) Repeat step (26) for first officer's side.	Same as step (26).
(29) Repeat step (27) for captain's side.	Same as step (27).
(30) Turn Capt's and F/O's switches on MSU to ATT positions	MSU switches in ATT.
NOTE: The switch is detented in NAV position. Pull out firmly on switch before turning.	
(31) Verify following messages show on Capt's and F/O's side of MSU:	Message lights ON as required.
ALIGN (ON for 20 seconds, then extinguishes)	
(32) Verify following blue message lights come on overhead annunciator panel:	Blue message lights ON as required.
IRS-1 ATT MODE IRS-2 ATT MODE	
(33) Place Capt's and F/O's mode select switches from ATT to OFF positions.	MSU switches in OFF.

Table 201 (Continued)

Operation	Desired Result
(34) Verify following blue message lights go off on overhead annunciator panel: IRS-1 ATT MODE IRS-2 ATT MODE	Blue message lights go off.
(35) Return aircraft to required configuration.	



IRU Cooling Fan -- Circuit/Airflow Diagram
Figure 201/34-43-01-990-801

INERTIAL REFERENCE SYSTEM BATTERY - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the inertial reference system battery. There are two battery units installed in the aft right radio rack in the avionics compartment.

B. Removal/installation procedures for the two battery units are identical.

C. The battery pack is comprised of a sealed cell, nickel-cadmium battery which provides a 24VDC output and a charger. The battery is capable of delivering 7 amp-hours when fully charged. The charger is capable of recharging a discharged battery to 95% of the rated capacity within one hour and 100% of the rated capacity within 4 hours. The charger also contains monitoring and self-testing circuitry that guarantees safe charging under all conditions.

2. Removal/Installation Battery Unit

CAUTION: ENSURE THAT MODE SELECT UNIT ON OVERHEAD SWITCH PANEL IS TURNED TO OFF BEFORE REMOVING/INSTALLING BATTERY UNIT.

A. Remove Battery Unit (IRS-1 or -2 Battery)

(1) Open IRS-1 (-2) BATT circuit breaker on upper EPC and circuit breaker on battery unit.

(2) Loosen knurled hold-down nuts that secure battery unit to mounting rack.

(3) Slide battery unit forward until disconnected from mount connectors and guide pins.

CAUTION: ENSURE THAT MODE SELECT UNIT ON OVERHEAD SWITCH PANEL IS TURNED TO OFF BEFORE REMOVING/INSTALLING BATTERY UNIT.

B. Install Battery Unit (IRS-1 or -2 Battery)

(1) Check that IRS-1 (-2) BATT circuit breaker on upper EPC and circuit breaker on battery unit are open.

(2) Carefully position battery unit onto mounting rack and ensure that guide pins are lined up.

(3) Slide battery unit carefully into rack and engage electrical connectors.

(4) Raise hold-down nuts, mate with battery hold-down lugs, and tighten securely.

(5) Close IRU-1 (-2) circuit breaker on upper EPC and circuit breaker on battery unit.

C. Test Battery Unit (Substitute IRS-2 for IRS-1 in steps (1) through (16) to test IRS-2 Battery)

NOTE: Verify that IRS MSU switches are in OFF position, and fuel shutoff levers are in OFF position before proceeding.

Table 201

Operation	Desired Result
(1) Place IRS-1 switch on MSU from OFF to ALN position.	Switch to ALN.
(2) Verify following MSU IRS-1 side messages come on: ON BAT (on for 15 seconds) ALIGN	MSU message lights come on.
(3) Verify following messages on OAP come on: IRS-1 ON BATTERY (ON for 15 seconds)	OAP message lights come on.
(4) On Upper EPC open IRU-1 circuit breaker.	Breaker open.
(5) Verify ON BAT message comes on IRS-1 side of MSU.	Message lights ON.
(6) Verify following message comes on overhead annunciator: IRS-1 ON BATTERY	Message light ON as required.

Table 201 (Continued)

Operation	Desired Result
(7) Listen for mechanic call horn in nose wheel well.	Call horn in nose wheel well is audible.
(8) On upper EPC close IRU-1 circuit breaker.	Breaker closed.
(9) MSU and OAP messages go off.	Message lights OFF.
(10) Mechanic call horn silent.	Horn silent.
(11) Open circuit breaker located on front of IRS BATTERY -1 in AFT right radio compartment	Breaker open.
(12) Verify BAT FAIL message on IRS-1 side of MSU comes on.	Message lights on.
(13) Verify IRS-1 BATTERY FAIL caution message comes on overhead annunciator panel.	Message lights ON.
(14) Close circuit breaker on battery.	Breaker closed.
(15) Verify MSU and OAP messages go off.	Message lights OFF.
(16) Rotate IRS-1 switch on MSU from ALN to OFF position.	MSU ALIGN message goes off.
(17) Return aircraft to required configuration.	
NOTE: If a complete inertial reference system test is desired. (INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-43-00/201)	

D. Deep Cell Recharge and Reconditioning

NOTE: The Inertial Reference System Batteries are reconditioned (includes charging) only during regular maintenance cycles, when repaired, or found shorted, and when not used for three months or longer.

WJE **WJE 412, 414**

WJE NOTE: The Inertial Reference System Battery Packs (154BS101-1 and/or 225BS101-1) can be
WJE stored and maintained in a power station indefinitely.

WJE **WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879**

(1) Remove shorting wire (if connected).

(2) Connect volt meter between pins 7 and 8 and verify voltage increasing slowly. Voltage should begin to recover.

NOTE: If voltage remains at zero, the battery is damaged. Do not proceed if there is no voltage increase.

(3) Connect a 28VDC power supply to unit pin 5 (+), pin 2 (+) and pin 6 (-).

(4) Apply power and monitor current into unit. Should be approximately one amp.

(5) At least once every three hours, power to unit should be interrupted momentarily.

NOTE: This procedure uses the trickle charge circuit of the AMPS unit to recondition the battery. This circuit has a timer that allows the charger to charge the battery with a constant current of 700 milliamps for approximately three hours, after which it shuts the charger off. This three hour cycle will be reinitiated whenever the input power is interrupted. While using this method to condition the battery, all protective circuits will be operating. Therefore, occasionally, during the first minute or so while the battery voltage is low, spurious fault signals (battery indicator and charger indicator) may be present. If these occur, continue for at least five minutes before abandoning the procedure.

INERTIAL REFERENCE SYSTEM BATTERY - REMOVAL/INSTALLATION

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-43-02-960-801

2. Replacement of the IRS Batteries

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
34-43-02 P/B 201	INERTIAL REFERENCE SYSTEM BATTERY - MAINTENANCE PRACTICES

B. Prepare for Replacement of IRS Batteries

SUBTASK 34-43-02-865-001

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

AFT RIGHT RADIO RACK, BATTERY UNIT

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
		N/A	IRU-1 BATTERY
		NA	IRU-2 BATTERY

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

C. Replace the IRS Battery

SUBTASK 34-43-02-020-001

(1) Remove the IRS battery pack as follows:

(a) Loosen knurled hold-down nuts that secure battery unit to mounting rack.

(b) Slide battery unit forward until disconnected from mount connectors and guide pins.

SUBTASK 34-43-02-410-001

(2) Install a serviceable battery unit as follows:

(a) Make sure the circuit breaker on the serviceable battery unit is open.

(b) Carefully position serviceable battery unit onto mounting rack and ensure that guide pins are lined up.

(c) Raise hold-down nuts, mate with battery hold-down lugs, and tighten securely.

SUBTASK 34-43-02-865-003

(3) Remove the safety tags and close these circuit breakers:

AFT RIGHT RADIO RACK, BATTERY UNIT

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
		N/A	IRU-1 BATTERY
		NA	IRU-2 BATTERY

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

SUBTASK 34-43-02-710-001

(4) Do an operational check of the IRS battery. (INERTIAL REFERENCE SYSTEM BATTERY - MAINTENANCE PRACTICES, PAGEBLOCK 34-43-02/201)

D. Job Close-up

SUBTASK 34-43-02-840-001

(1) Return aircraft to required configuration.

——— END OF TASK ———

INERTIAL REFERENCE SYSTEM BATTERY - INSPECTION/CHECK

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-43-02-210-801

2. General Visual Inspection of the IRS Fan

A. Prepare for a General Visual Inspection of the IRS Fan

SUBTASK 34-43-02-010-001

(1) Open the forward accessory compartment door.

B. General Visual Inspection of the IRS Fan

SUBTASK 34-43-02-710-002

(1) Put No. 1 and No. 2 IRS mode select switches to ALN position.

(2) Verify that the No. 1 and No. 2 IRS cooling fans are operating.

(3) Put No. 1 and No. 2 IRS mode select switches to OFF position.

SUBTASK 34-43-02-210-001

(4) Do a visual inspection of the No. 1 and No. 2 IRS cooling fans.

NOTE: Removal of IRS units may be necessary for general visual check.

C. Job Close-up

SUBTASK 34-43-02-410-002

(1) Close the forward accessory compartment door.

——— END OF TASK ———

INERTIAL REFERENCE SYSTEM MODE SELECT UNIT - REMOVAL/INSTALLATION

1. General

A. This procedure has the removal and installation instructions for the Inertial Reference System (IRS) Mode Select Unit (MSU).

B. The MSU is located in the flight compartment on the forward overhead panel.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 401

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	The Boeing Co.

3. Removal/Installation Mode Select Unit

A. Remove MSU. (Figure 401)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

(2) Loosen fasteners and lower MSU from forward overhead panel.

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(3) Disconnect electrical connector and install dust caps.

B. Install MSU. (Figure 401)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(2) Remove dust caps and connect the electrical connector.

(3) Position MSU in forward overhead panel and tighten fasteners.

(4) Remove the safety tags and close these circuit breakers:

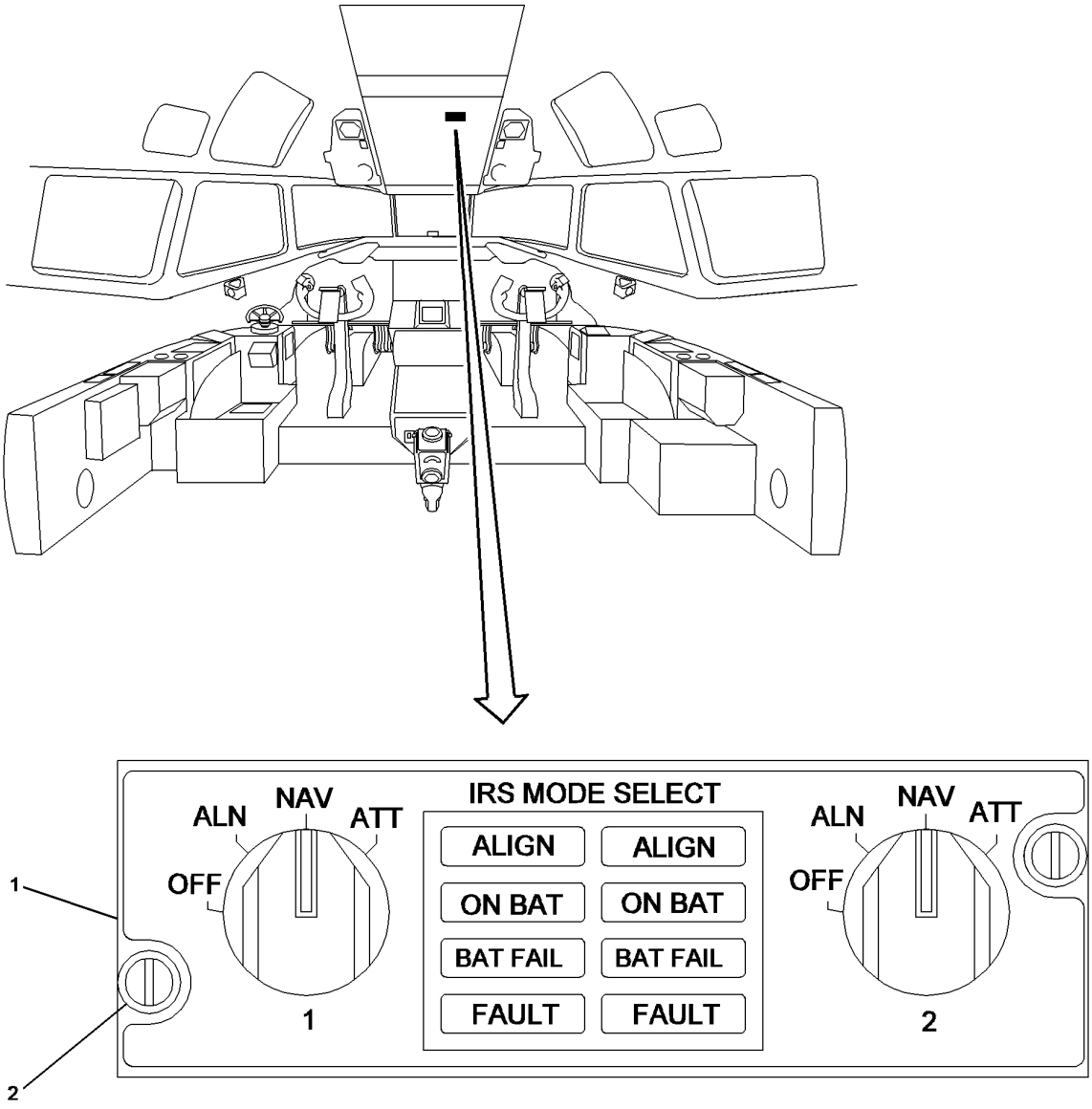
UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-440	IRS-1 BATTERY

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-441	IRS-2 BATTERY

(5) Perform IRS functional test. (INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-43-00/201)



LEGEND:
1. MODE SELECT UNIT
2. FASTNER

BBB2-34-2657
S0000174940V1

Inertial Reference System MSU - Removal/Installation
Figure 401/34-43-03-990-801

GROUND PROXIMITY WARNING SYSTEM (GPWS) - DESCRIPTION AND OPERATION

1. General

A. The ground proximity warning system (GPWS) provides visual and aural warnings to the Captain and First Officer to indicate an unsafe airplane flight path in relation to the ground or that the airplane is not in proper configuration for descent between 2450 and 50 feet altitude.

B. The system consists of a ground proximity warning computer, GPWS and BELOW G/S warning lights on Captains and First Officers panels, a GPWS fail light, a GRND PROX WARN-OVRD/NORM TEST switch, and cockpit speaker.

WJE 405, 409, 410, 415, 416, 420-427, 429, 863-866, 868, 873, 874, 881, 883, 884, 891-893

C. GPWS warning is indicated by two red GPWS warning lights located one each on the Captains and First Officers glareshield. Aural warnings are annunciated over the flight compartment speaker, vocal commands are "WHOOP WHOOP, PULL UP", "SINKRATE", "GLIDESLOPE", "TOO LOW GEAR", "TOO LOW TERRAIN" and "TOO LOW FLAPS". Below glideslope approach is indicated by amber G/S lights on Captain's and First Officer's instrument panels and aural command "Glideslope."

WJE 401-404, 406-408, 411, 417-419, 861, 862, 869, 871, 872, 875-880, 886, 887

D. GPWS warning is indicated by two red GPWS warning lights located one each on the Captains and First Officers glareshield. Aural warnings are annunciated over the flight compartment speaker, vocal commands are "WHOOP WHOOP, PULL UP", "SINKRATE", "GLIDESLOPE", "TOO LOW GEAR", "TOO LOW TERRAIN", "MINIMUMS" and "TOO LOW FLAPS". Below glideslope approach is indicated by amber G/S lights on Captain's and First Officer's instrument panels and aural command "Glideslope."

WJE 405, 409, 410, 415, 416, 420-427, 429, 863-866, 868, 873, 874, 881, 883, 884, 891-893

E. The GPWS computer utilizes inputs from the radio altimeter, air data computer, ILS receiver, and flap and landing gear sensors. The computer processes the radio altitude, barometric altitude rate, glideslope information, and landing gear and flap position information to determine undue proximity with the ground and activates the visual and aural warnings to indicate the unsafe condition.

NOTE: A guarded GND PROX WARN switch, located on the aft over-head panel provides the capability when placed in the OVRD position to inhibit the warning system during a flaps up position during landing if landing condition is intentionally accomplished.

These conditions are:

- Excessive rate of descent
- Excessive terrain closure
- Descent after takeoff or missed approach
- Inadvertent proximity to terrain in non-landing configuration
- Excessive deviation below glideslope.

WJE 401-404, 406-408, 411, 417-419, 861, 862, 869, 871, 872, 875-880, 886, 887

F. The GPWS computer utilizes inputs from the radio altimeter, air data computer, ILS receiver, and flap and landing gear sensors. The computer processes the radio altitude, barometric altitude rate, glideslope information, and landing gear and flap position information to determine undue proximity with the ground and activates the visual and aural warnings to indicate the unsafe condition.

NOTE: A guarded GND PROX WARN switch, located on the aft over-head panel provides the capability when placed in the OVRD position to inhibit the warning system during a flaps up position during landing if landing condition is intentionally accomplished.

These conditions are:

WJE 401-404, 406-408, 411, 417-419, 861, 862, 869, 871, 872, 875-880, 886, 887 (Continued)

- Excessive rate of descent
- Excessive terrain closure
- Descent after takeoff or missed approach
- Inadvertent proximity to terrain in non-landing configuration
- Excessive deviation below glideslope.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

G. The GPWS fail light located on the overhead panel will come on to indicate GPWS failure in the event of GPWS computer failure or GPWS sensor failure.

H. The GPWS can be self-tested by placing the GND PROX WARN switch located on the overhead panel, in the TEST position, while the airplane is on the ground or in flight above 1000 feet radio altitude. GPWS fail light must be off and flaps in non-landing configuration.

2. Operation

A. The Ground Proximity Warning Computer utilizes inputs from the radio altimeter, air data computer, ILS receiver, and flap and landing gear sensors in the airplane to automatically and continuously monitor the airplane flight path with respect to height above the terrain for flight altitudes between 50 and 2450 feet. The modes of operation are as follows:

- Mode 1
- Excessive rate of descent -- The warning is activated when terrain clearance is less than 2450 feet, above ground level (AGL), and barometric altitude indicates the airplane is descending at an excessive rate regardless of airplane configuration.
- Mode 2
- Excessive terrain closure rate -- The warning is activated when the terrain clearance is less than 1800 feet AGL and the terrain is rising towards the airplane or the airplane is closing with the terrain at an excessive rate.
- Mode 3
- Descent after takeoff or missed approach -- The warning is activated after takeoff or during go-around between 50 and 700 feet AGL if barometric altitude loss is excessive. The GPWS reverts to Mode 3 when the airplane is below 50 feet AGL. The GPWS will also revert to Mode 3 when airplane is below 500 feet AGL with landing gear and flaps in landing configuration and flaps are selected to a non-landing configuration.
- Mode 4
- Inadvertent proximity to terrain in non-landing configuration -- The warning will be activated during cruise or landing approach if landing gear is not down below 500 feet AGL or if flaps are in non-landing configuration below 200 feet AGL. A warning is also activated between 500 feet and 200 feet AGL with flaps in non-landing configuration and airplane sink-rate is excessive. Mode 4 is automatically armed when the airplane ascends above 700 feet AGL.
- Mode 5
- Excessive deviation below Glideslope -- The amber G/S lights will come on during an approach with landing gear down below 1000 feet. If glideslope deviation is 1.3 dots or more, an aural command "Glideslope" will also come on.

WJE 401-404, 406-408, 411, 417-419, 861, 862, 869, 871, 872, 875-880, 886, 887

- Mode 6
- Descent below Decision Height (DH) -- When the aircraft passes through the altitude setting on the radio altimeter with landing gear down, and the bug is set between 1000 and 50 feet, an aural warning of "MINIMUMS, MINIMUMS" is given. No warning lamps are turned on.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

B. The monitoring and self-test provisions in the GPWS computer are as follows:

(1) Sensor Continuous Monitoring

A SENSOR FAULT and GPWS FAIL indication will be present if one or more of the following conditions exist:

A GPWS FAIL indication will be present if one or more of the following conditions exist:

- Radio altitude validity absent
- Radio altitude less than 5 feet and gear not in landing configuration
- Barometric altitude source validity absent
- Barometric altitude rate does not indicate less than 100 ft/min when landing
- Radio altitude greater than 2450 feet and flaps or gear landing configuration
- Glideslope inputs validity absent.

(2) Continuous Monitoring

A GPWS FAIL indication will be present if one or more of the following conditions exits:

- Power supply fault.
- Self-test fault.
- Radio altitude greater than 2450 feet and less than 50 feet logic at the same time.
- Radio altitude greater than 2450 feet and TO/GA mode logic at the same time.

C. Manual GPWS Self-Test

WJE 405, 409, 410, 415, 416, 420-427, 429, 863-866, 868, 873, 874, 881, 883, 884, 891-893

(1) Placing the GRND PROX WARN switch, in the flight compartment, in the TEST position will activate the following indications:

AURAL annunciation - “GLIDESCOPE,” then WHOOP-WHOOP, PULL UP GPWS FAIL, BELOW G/S, and GPWS lights will come on.

WJE 401-404, 406-408, 411, 417-419, 861, 862, 869, 871, 872, 875-880, 886, 887

(2) Placing the GRND PROX WARN switch, in the flight compartment, in the TEST position will activate the following indications:

AURAL annunciation - "GLIDESCOPE," then WHOOP-WHOOP, PULL UP.

Visual annunciations - GPWS FAIL, BELOW G/S, and GPWS lights will come on.

WJE

WJE

ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) - DESCRIPTION AND OPERATION

WJE

1. Description

WJE A. The Enhanced Ground Proximity Warning System (EGPWS) provides visual and aural warnings to the Captain and First Officer to indicate an unsafe airplane flight path in relation to the ground surface terrain and manmade obstacles or that the airplane is not in proper configuration for descent between 2450 and 50 feet altitude.

WJE B. The system consists of a Enhanced Ground Proximity Warning Computer (EGPWC), red and amber GPWS warning lights on Captains and First Officers panels, a GPWS fail light, a GRND PROX WARN-OVRD/NORM TEST switch, and instrument panel terrain switch-lights.

WJE C. The EGPWS extends the functionality of the existing GPWS system. Performance of the basic ground proximity alerting modes of the EGPWS is identical to this existing system.

WJE D. The EGPWS integrates three main alerting functional areas into the EGPWC. These functional areas are:

WJE • Ground Proximity Warning (including Altitude Callouts and Bank Angle Alerting)

WJE • Terrain Awareness Alerting and Display (TAAD)

WJE • Terrain Clearance Floor (TCF)

WJE E. The EGPWS interfaces with the following of components:

WJE • EGPWC

WJE • Flight deck audio speakers

WJE • Alert lights

WJE • Mode and Select Switches

WJE • Terrain Display (on EFIS ND)

WJE

2. Operation

WJE A. ENHANCED GROUND PROXIMITY WARNINGS/CAUTIONS

WJE (1) The following conditions are regarded as an EGPWS warning:

WJE • Illumination of the red GPWS annunciators

WJE • “PULL UP”, “TERRAIN TERRAIN, PULL UP”, or “OBSTACLE OBSTACLE, PULL UP” aural warning.

WJE • Pop up of terrain display with red warning area displayed.

WJE (2) The following conditions are regarded as an EGPWS cautionary alert:

WJE • Illumination of the amber GPWS annunciators

WJE • “CAUTION TERRAIN, CAUTION TERRAIN”, “CAUTION OBSTACLE, CAUTION OBSTACLE”, “TOO LOW TERRAIN”, “SINKRATE”, “GLIDESLOPE”, “DON'T SINK”, “TOO LOW FLAPS”, or “TOO LOW GEAR” aural alert.

WJE • Pop up of terrain display with amber caution area displayed.

GROUND PROXIMITY WARNING SYSTEM - TROUBLE SHOOTING

1. General

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty GROUND PROXIMITY WARNING (GPWS) system in the airplane.

WJE 412, 414

WJE B. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty
WJE ENHANCED GROUND PROXIMITY WARNING (EGPWS) system in the airplane.

WJE **WJE ALL**

C. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

D. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

E. The basic components of the GPWS operation are: GPWS Computer, GPWS Warning Lights, BELOW G/S Lights, and GPWS Switch.

NOTE: The GPWS interfaces with radio altimeter system, the DFGC, CADC, and ILS.

WJE 412, 414

WJE F. The basic components of the EGPWS operation are: EGPWS Computer, EGPWS Red and Amber
WJE Warning Lights, and EGPWS Switch.

WJE NOTE: The EGPWS interfaces with radio altimeter, EFIS, GNS, DFGC, CADC, and ILS.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

G. The GPWS components are located as follows:

Table 101

Component	Location
GPWS Computer	Electrical/Electronics Compartment
GPWS Warning Lights and BELOW G/S Lights	Captain's and First Officer's Instrument Panels
GPWS Switch	Overhead Panel

WJE 412, 414

WJE H. The EGPWS components are located as follows:

WJE **Table 102**

WJE Component	Location
WJE EGPWS Computer	Electrical/Electronics Compartment
WJE GPWS red and amber lights	
WJE GPWS test switch	Overhead Panel
WJE Terrain ON/_switches	Captain's and First Officer's Instrument Panels
WJE Terrain OVRD/INOP switches	Captain's and First Officer's Instrument Panels

WJE **WJE ALL**

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 103

Name and Number	Manufacturer
Multimeter 2000A	Dana

WJE 412, 414

WJE **3. Trouble Shooting EGPWS**

WJE A. Trouble Shoot

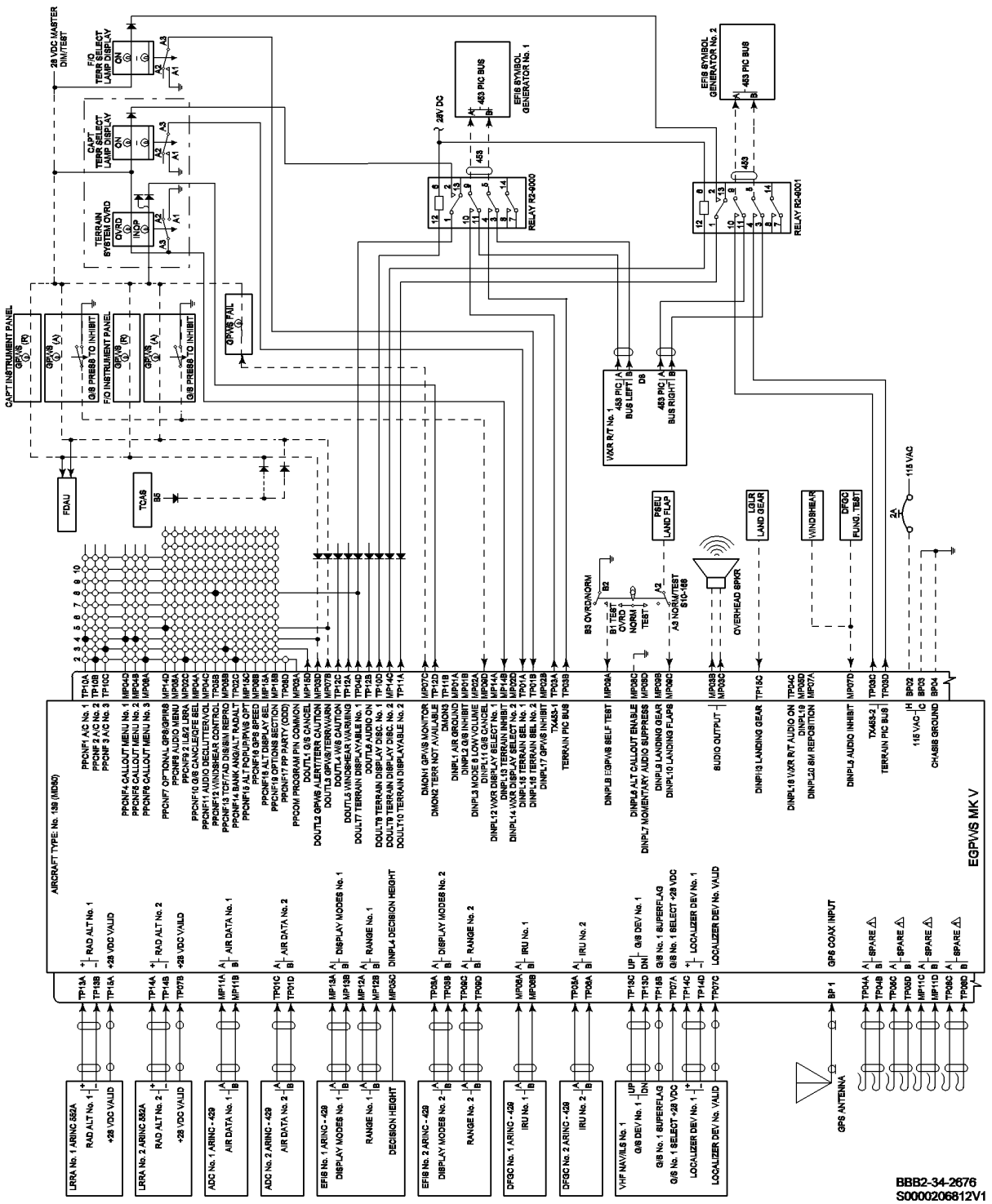
WJE NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram
WJE manual for terminal board connections and wire identification. LRUs are EGPWS Computer,
WJE EGPWS Switches and lights.

WJE **Table 104**

WJE

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	Interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

WJE



EGPWS Schematic
Figure 101/34-45-00-990-849

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

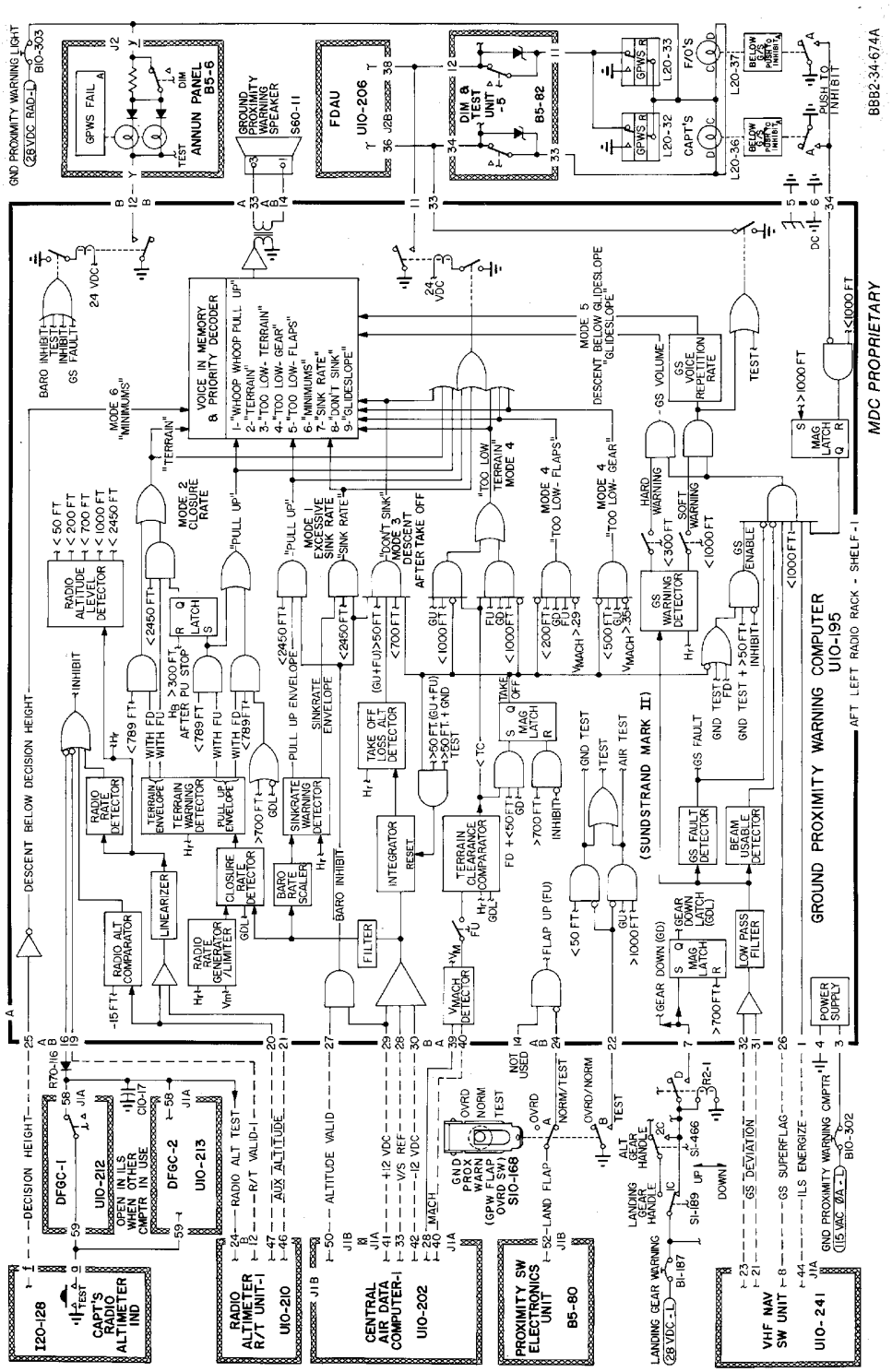
4. Trouble Shooting GPWS

A. Trouble Shoot

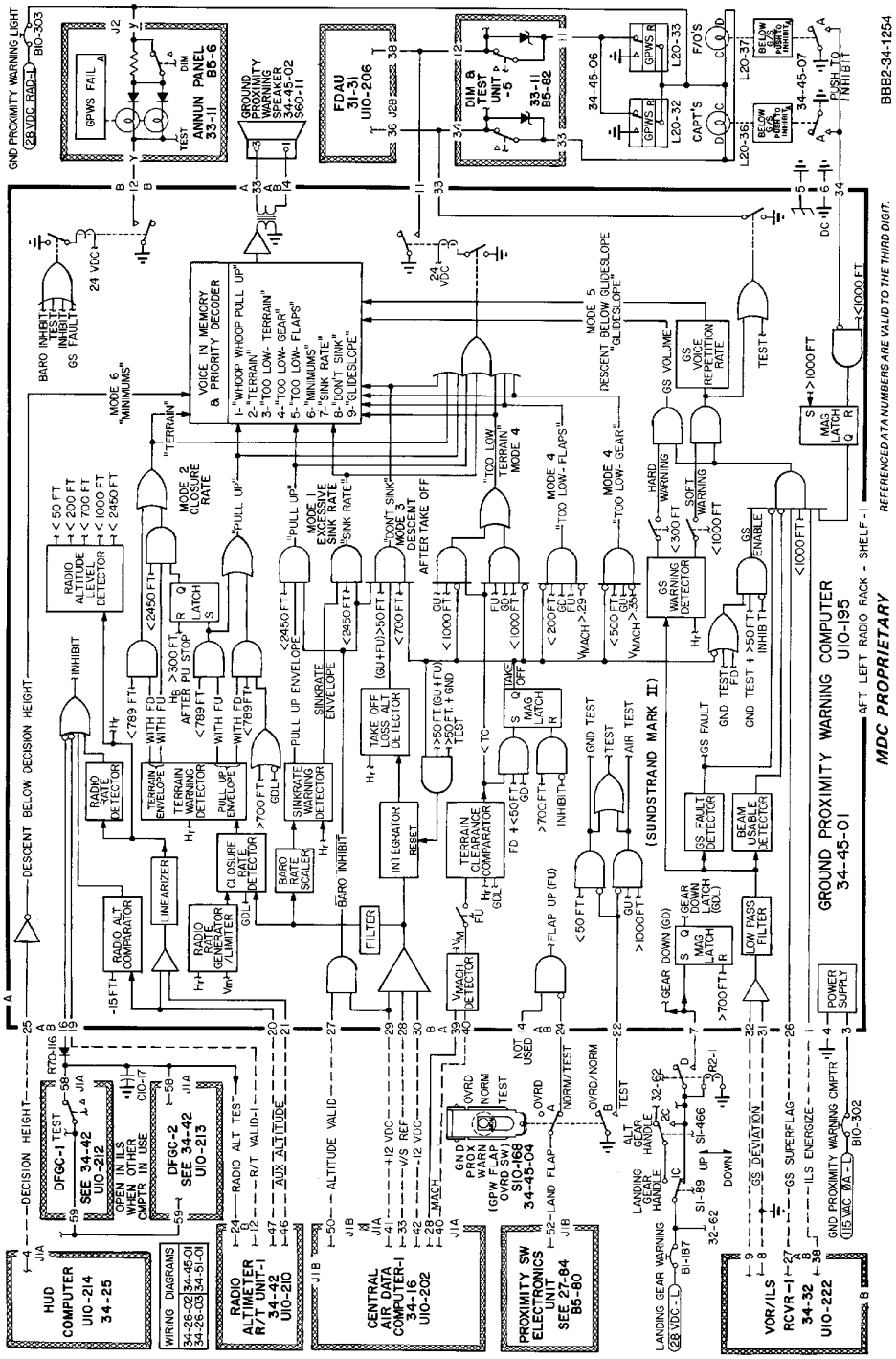
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are GPWS Computer, GPWS Switch and Warning Lights.

Table 105

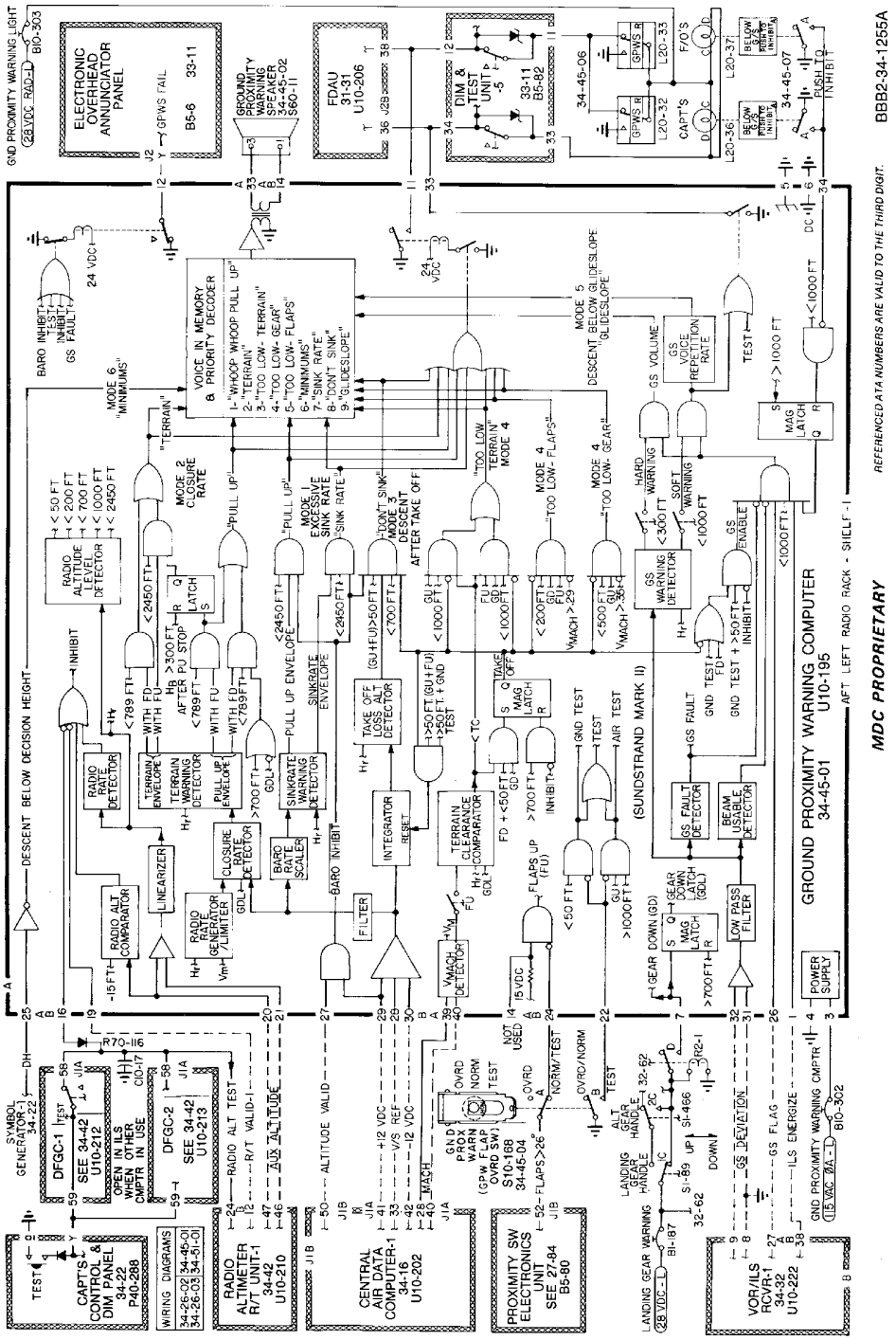
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	Interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



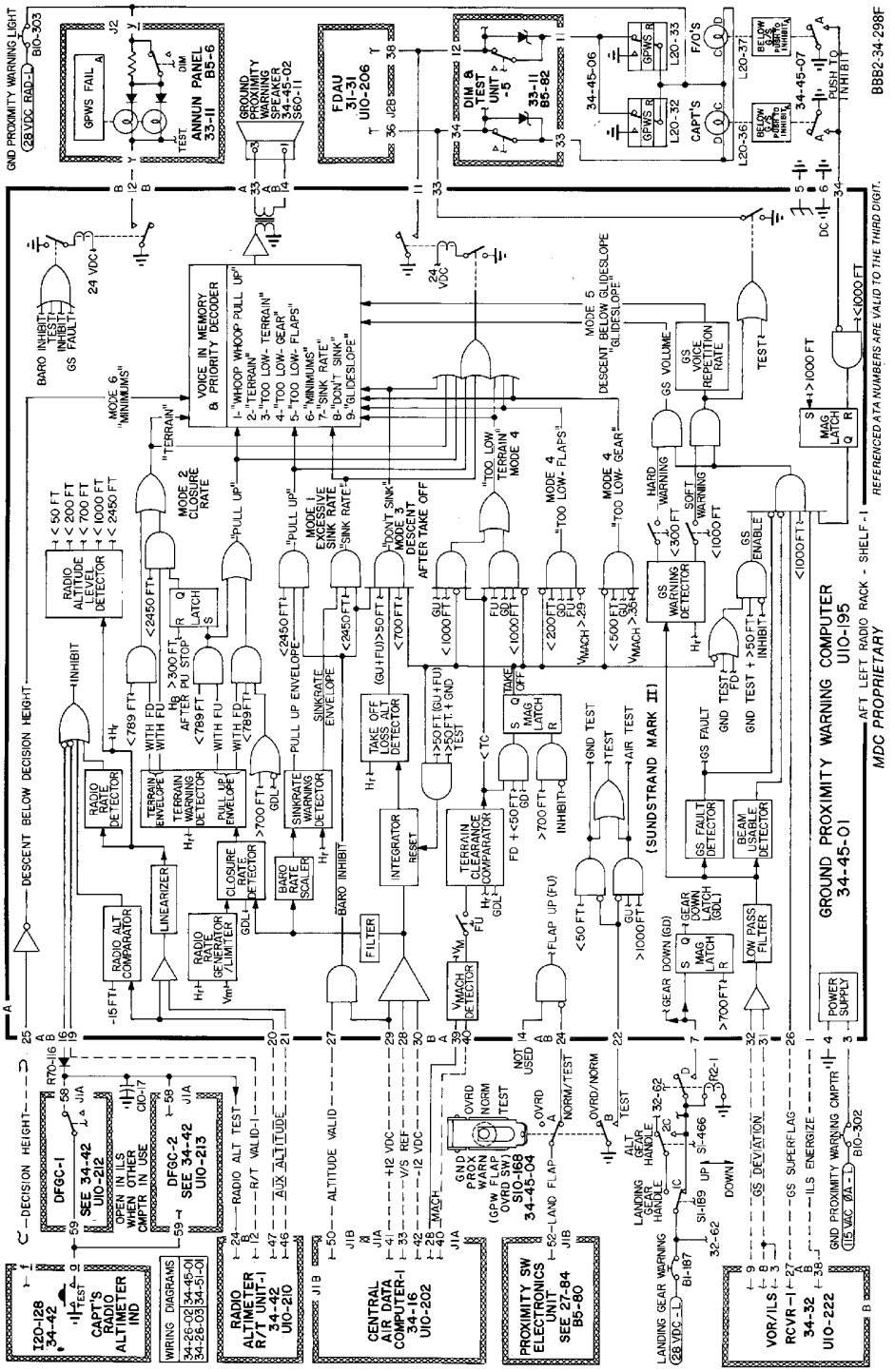
GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 1 of 7)

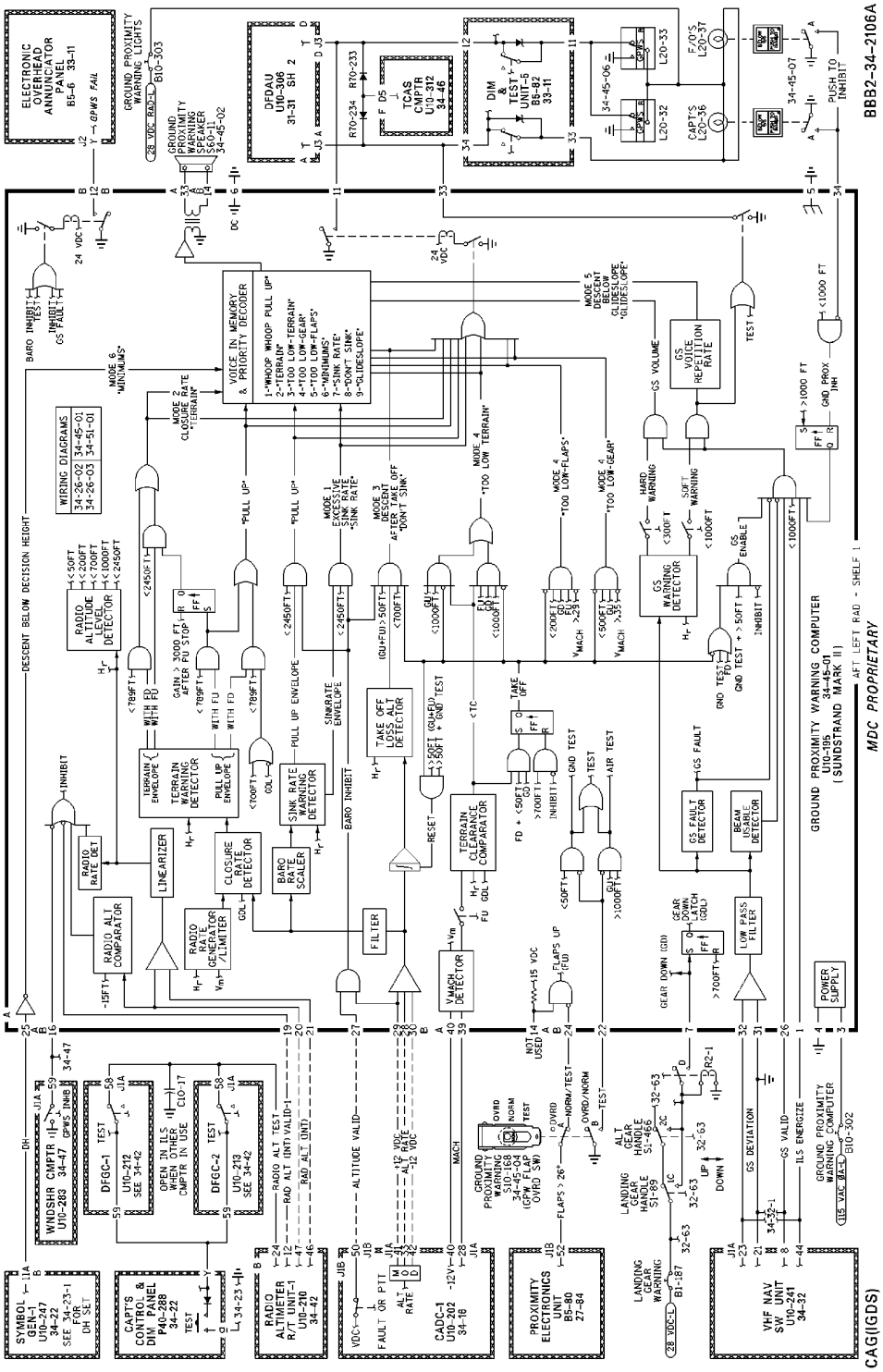


GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 2 of 7)

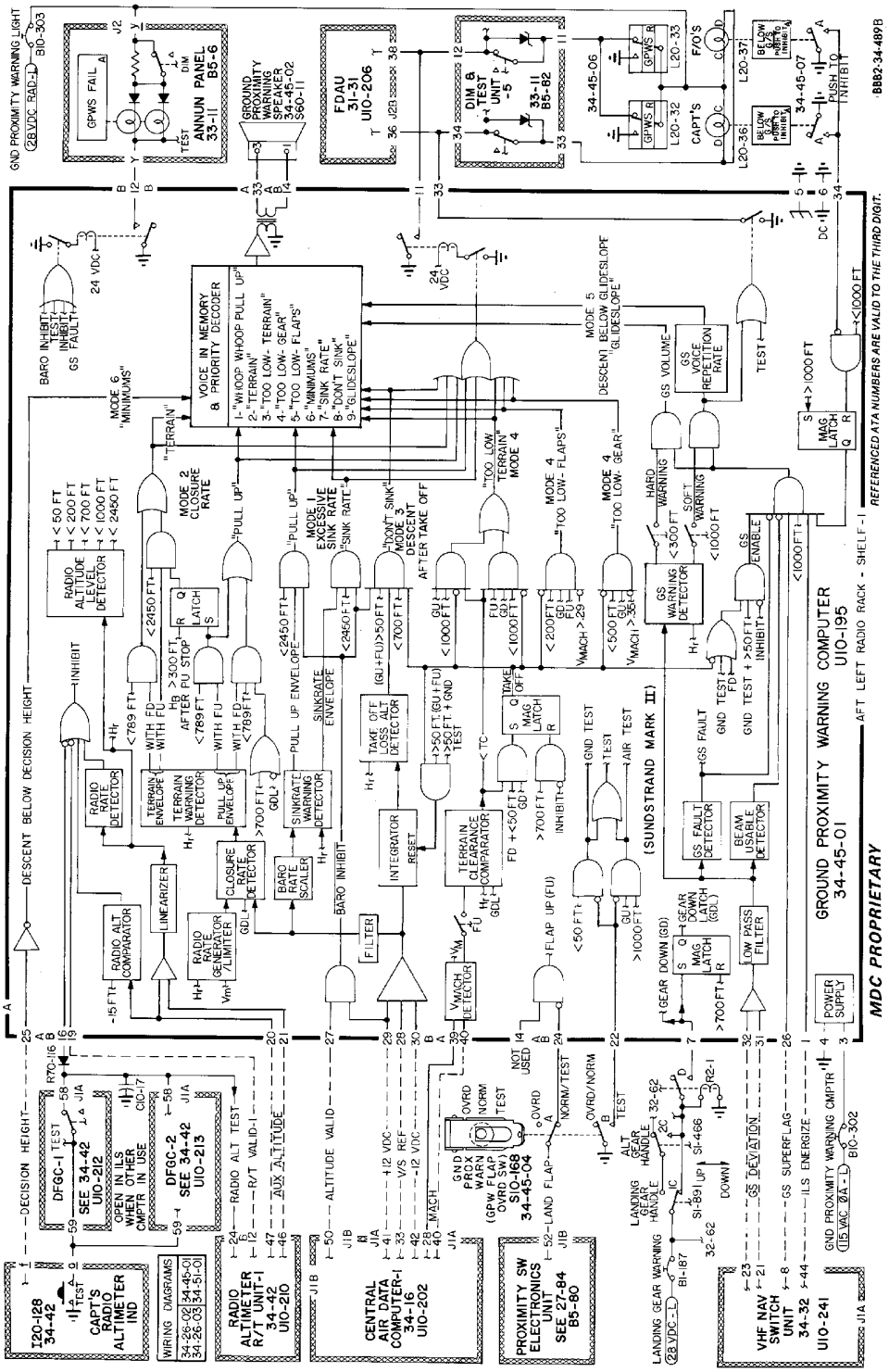


GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 3 of 7)

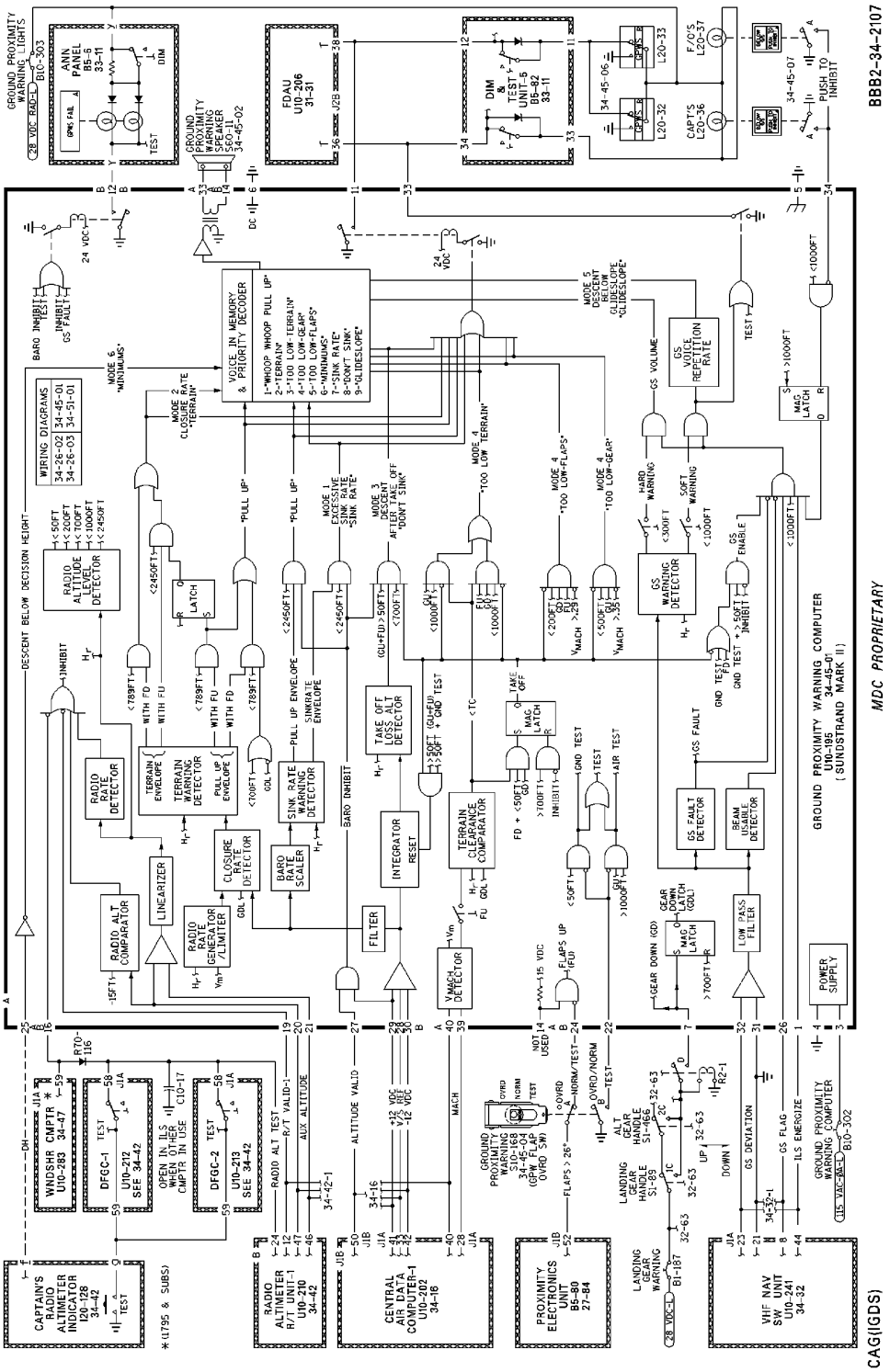




GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 5 of 7)



GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 6 of 7)



GPWS -- Schematic
Figure 102/34-45-00-990-801 (Sheet 7 of 7)

WJE 412, 414

WJE **5. LEVEL 5 SELF-TEST-ALERT HISTORY**

WJE A. Level 5 Self-Test provides enunciation of the alerts (cautions and warnings) recorded over the last 10 flight legs. Level 5 Self-Test is initiated by pressing the cockpit Self-Test button within 3 seconds of the end of Level 4 Self-Test. If any alerts were recorded in the last ten flight legs then voice sequence as described in the following table will be enunciated. Otherwise, the message “NO WARNINGS” will be enunciated. During Level 5 Self-Test, a Short Cancel bumps the enunciation to the next flight leg with faults (if any). During Level 5 Self-Test, a Log Cancel terminates the Self-Test level and “PRESS TO CONTINUE” is enunciated for proceeding to Level 6 Self-Test.

WJE B. The following information is given in the level 5 self-test:

WJE (1) Enunciate the number of the most recent flight leg with alerts as “FLIGHT X”, where “X” is a number from 1 to 10 where 1 is the most recent flight leg.

WJE (2) Enunciate any alerts stored for leg X.

WJE (3) Increment to next oldest leg with alerts (if any) and repeat the above sequence.

WJE (a) For Example:

WJE 1) If a Glideslope Alert were given 7 flight legs earlier, the messages would be:

WJE · “WARNING HISTORY”

WJE · “FLIGHT 7”

WJE · “GLIDESLOPE”

WJE · “PRESS TO CONTINUE”

WJE **6. LEVEL 6 SELF-TEST-DISCRETE INPUT TEST**

WJE A. Level 6 Self-Test provides enunciation of any changes in the status of discrete inputs for verification proper function and discrete input wiring. Level 6 Self-Test is initiated by pressing the cockpit Self-Test button within 3 seconds of the end of Level 5 Self-Test. The results are indicated in the following sections. If a state change occurs on any discrete input (other than the Self-Test input as it is directly tested in its use to control the test sequences) the EGPWC will annunciate the functional name of the discrete followed by its new state. For example, if the Glideslope Cancel discrete input in the current configuration is defined as ground = cancel, and the discrete transitions from open to ground , Level 6 Self-Test will say: “ GLIDESLOPE CANCELED”. If the input is only momentarily grounded Level 6 Self-Test will say: “GLIDESLOPE CANCELED-GLIDESLOPE ENABLED.”

WJE NOTE: See aircraft wiring diagrams to determine applicable discretes.

WJE B. During Level 6 Self-Test the message “DISCRETE INPUT TEST-PRESS TO CANCEL” is enunciated every 60 seconds. This provides additional evidence; along with the continued illumination of the INOP light/fail annunciations, that Self-Test is still in progress. During Level 6 Self-Test, a Short Cancel or Long Cancel terminates Self-Test and “END OF SELF-TEST is enunciated. As with all Self-Test levels, if the aircraft goes in air, then Self-Test is terminated.

GROUND PROXIMITY WARNING SYSTEM - MAINTENANCE PRACTICES

1. General

A. The ground proximity warning computer utilizes radio altitude and barometric altitude rate information (vertical speed) to determine undue proximity with the ground. The computer furnishes a discrete output to the warning system which provides audible and visual warnings of unsafe flight path relative to the ground.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
Air Data Tester Model No. 127-1M	Edcliff Instruments
or	
Air Data Tester 18910480000	Kollsman
Static port adapters 33410LH- 90-5	Canadian Aero Inst Co.
Pitot Head adapter 7131A-1	Edcliff Instruments
Red Tape VIP 7331 DPM 850-24	Valley Industrial Products
Radio Altimeter Test Set 980N-1	Collins Radio Co.
Signal Generator 479T-2	Collins Radio Co.
or	
Cossor 555	Cossor
Glideslope Test set TIC-29B or TIC-30B/C	TEL Instruments Co.
CADC Static Port Quick Disconnect 1177-5	
CADC Pitot Tube Quick Disconnect AE95717G	
NOTE: The CADC quick disconnect couplings can be used in lieu of the static port and pitot tube adapters and red tape. The air data tester is connected directly to the CADCs.	

3. Adjustment/Test

A. Preliminary Setup

(1) Make sure electrical power is available and all necessary circuit breakers are closed.

(2) Make sure pitot heat switch is in OFF position.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(3) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

B. Self-Test

Table 202

Operation		Desired Result
(1)	Energize aircraft electrical buses.	Both radio altimeter indicators should read approximately -3(±5) feet with flag out of view.
NOTE: Make certain flaps are in non-landing position.		
(2)	On overhead switch panel, place GND PROX WARN switch in TEST position and hold.	GLIDESLOPE and WHOOP-WHOOP, PULL UP annunciated. GPWS, GPWS FAIL and BELOW G/S lights come on.
(3)	Return GND PROX WARN switch to NORM position.	Ground proximity warning is silenced. GPWS, GPWS FAIL and BELOW G/S lights go out.

C. Connect Test Equipment

(1) Place CADC switch on overhead panel, and CAPT's and F/O's static air selector switches on gusset panels to NORM position.

(2) Seal Captain's pitot tube drain holes with tape or other suitable device.

(3) To connect Air Data Tester to pitot tubes and static ports:

(a) Connect Air Data Tester to captain's pitot tube and captain's static port using suitable adapter.

(b) Seal opposite captain's static port using tape or other suitable device.

NOTE: When Air Data Tester is connected to only one static port, only corresponding port on opposite side of aircraft should be sealed.

(4) To connect the air data tester directly to the CADCs,

(a) On the CADCs, disconnect the aircraft pitot and static quick disconnect couplings and cap the lines.

(b) Connect the air data tester to the CADC pitot and static ports using the quick disconnect couplings.

(5) Connect radio altimeter test set to Captain's radio altimeter system.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(6) Open this circuit breaker and install safety tag:

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	38	B1-832	CAWS, SSRS-1, LDG GR, T/O, A/P, SP BK, CAB ALT

D. Excessive Rate of Descent Test (MODE 1)

Table 203

Operation		Desired Result
CAUTION: THE AIR DATA TESTER CAN DAMAGE THE INSTRUMENTATION SENSING DEVICES IF NOT PROPERLY OPERATED. DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 100 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED, AND DO NOT EXCEED 12 INCHES OF MERCURY DIFFERENTIAL PRESSURE BETWEEN PITOT AND STATIC SYSTEMS AT ANY TIME. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
(1)	Adjust air data tester to altitude of 15,000 (±1000) feet above field elevation.	
(2)	Adjust radio altitude tester to 2000(±50) feet.	
(3)	Slowly decrease static pressure on air data tester at a rate of 5000 feet per minute. Immediately after "SINK RATE" warning proceed with step (4).	"SINK RATE" audio annunciated "GPWS" light comes on after descent rate of 5000(±500) feet per minute is established.
WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893		
(4)	Slowly adjust radio altimeter test set to 1300 feet.	WHOOP WHOOP, PULL UP audio heard; GPWS lights remain on at 1300(±50) feet.
(5)	Adjust static pressure on air data tester to reduce altitude at a rate of 2000 feet per minute. Return to atmospheric pressure.	Ground proximity warning annunciations deactivated at descent rate of 2000(±250) feet per minute. Aural warnings and GPWS lights go OFF.
WJE 401-404		
(4)	Slowly adjust radio altimeter test set to 1000 feet.	WHOOP WHOOP, PULL UP audio heard; GPWS lights remain on at 1000(±200) feet.

WJE 401-404 (Continued)

Table 203 (Continued)

Operation		Desired Result
(5)	Adjust static pressure on air data tester to reduce altitude at a rate of 2000 feet per minute. Return to atmospheric pressure.	Aural warnings and GPWS lights go off.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

E. Excessive Rate of Descent Test (MODE 1)

F. Excessive Closure Rate Test (MODE 2)

Table 204

Operation					Desired Result
CAUTION: THE AIR DATA TESTER CAN DAMAGE THE INSTRUMENTATION SENSING DEVICES IF NOT PROPERLY OPERATED. DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 100 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED, AND DO NOT EXCEED 12 INCHES OF MERCURY DIFFERENTIAL PRESSURE BETWEEN PITOT AND STATIC SYSTEMS AT ANY TIME. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.					
(1)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
(2)	Adjust static pressure on air data tester to obtain an altitude of 5000 feet above field elevation.		Barometric altitude 5000(±500) feet above field elevation.		
(3)	Adjust radio altitude tester to obtain a radio altitude of 2000 feet.		Radio altitude 2000(±25) feet.		
(4)	Set FLAP/SLAT handle to zero degree detent.		FLAP/SLAT handle at zero degree detent.		
(5)	Gradually reduce radio altitude, on radio altitude tester, to 1000 feet, in approximately 15 seconds.		GPWS lights and TERRAIN TERRAIN followed by repetition of WHOOP WHOOP PULL UP are activated.		
(6)	Stop reducing radio altitude when PULL UP audio is activated.		PULL UP audio ceases, GPWS lights remain on, and repetition of TERRAIN is annunciated.		
(7)	Adjust static pressure on air data tester to obtain an altitude of 5400 feet above field elevation.		Ground proximity warnings are deactivated.		
(8)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26

G. Descent After Takeoff Warning Test (MODE 3)

Table 205

Operation			Desired Result		
(1)	Make sure that the circuit breaker that follows is closed:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
(2)	Starting from zero, adjust radio altitude tester to obtain a radio altitude of 400 feet.		Radio altitude 400(±5) feet.		
CAUTION:	THE AIR DATA TESTER CAN DAMAGE THE INSTRUMENTATION SENSING DEVICES IF NOT PROPERLY OPERATED. DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 100 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED, AND DO NOT EXCEED 12 INCHES OF MERCURY DIFFERENTIAL PRESSURE BETWEEN PITOT AND STATIC SYSTEMS AT ANY TIME. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.				
(3)	Adjust static pressure on air data tester to obtain an altitude of 5000 feet above field elevation.		Barometric altitude 5000(±500) feet above field elevation.		
(4)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
(5)	Adjust static pressure on air data tester to obtain a descent rate of -300 feet per minute.		GPWS lights and DON'T SINK annunciated within 6(±3) seconds after barometric altitude loss of 40 feet.		
(6)	Adjust static pressure on air data tester to stop descent rate and to obtain climb rate of +300 feet per minute.		Ground proximity warnings are deactivated.		
(7)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26

H. Descent in Wrong Configuration Test (MODE 4)

Table 206

Operation	Desired Result
CAUTION: THE AIR DATA TESTER CAN DAMAGE THE INSTRUMENTATION SENSING DEVICES IF NOT PROPERLY OPERATED. DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 100 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED, AND DO NOT EXCEED 12 INCHES OF MERCURY DIFFERENTIAL PRESSURE BETWEEN PITOT AND STATIC SYSTEMS AT ANY TIME. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.	

Table 206 (Continued)

Operation			Desired Result		
(1)	Adjust air data tester to obtain an altitude rate of zero feet per minute, an altitude of 1000 feet and an IAS of 150 knots.		Tester set at 0(±250) feet per minute altitude rate, 1000(±100) feet altitude, and 150(±10) knots IAS.		
(2)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
WARNING:	BEFORE YOU PRESSURIZE THE HYDRAULIC SYSTEM, MAKE SURE THE LANDING GEAR GROUND LOCKPINS ARE INSTALLED. MAKE SURE ALL PERSONS AND EQUIPMENT NEAR THE CONTROL SURFACES ARE MOVED AWAY. THIS WILL PREVENT INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.				
(3)	Pressurize No. 1 and No. 2 hydraulic systems, using aux pump and transfer switch.		Aux pump ON. Transfer switch to ON. No. 1 and No. 2 hydraulic pressure gages show at least 1000 psi.		
(4)	Set FLAP handle to "15" position.		FLAP handle set to "15".		
(5)	Starting at 1300 feet radio altitude, slowly adjust radio altitude tester to 500 feet.		"GPWS" and "TOO LOW GEAR" annunciations are activated at 500(±20) feet.		
NOTE:	Decreasing radio altitude at too great a rate may result in a TERRAIN annunciation. If TERRAIN is annunciated, repeat step (5), decreasing altitude at a slower rate.				
(6)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			"GPWS" and "TOO LOW GEAR" annunciations are deactivated.		
(7)	Adjust radio altimeter tester to 300 feet.		Radio altitude 300(±20) feet.		
(8)	Adjust air data tester to increase IAS.		"GPWS" and "TOO LOW TERRAIN" annunciations are activated before reaching 250 knots IAS.		
(9)	Adjust air data tester to reduce IAS.		"GPWS" and "TOO LOW TERRAIN" annunciations are deactivated before reaching 150 knots IAS.		
(10)	Adjust radio altimeter tester to 200 feet.		"GPWS" and "TOO LOW FLAPS" annunciations are activated at 200(±10) feet.		
(11)	Lift switch guard and place GND PROX WARN TEST/OVRD switch on overhead switch panel to OVRD position.		"GPWS" and "TOO LOW FLAPS" annunciations are deactivated.		
(12)	Return GND PROX WARN TEST/OVRD switch on overhead switch panel to NORM position and lower switch guard.		Switch set to NORM position.		
(13)	Cycle radio altitude tester to above 1000 feet, then lower to 200 feet.		"GPWS" and "TOO LOW FLAPS" annunciations are activated at 200(±10) feet.		

Table 206 (Continued)

	Operation	Desired Result
(14)	Pull PULL TO DIM switch on overhead switch panel and observe red "GPWS" warning lights.	"GPWS" lights go dim.
(15)	Depress PULL TO DIM switch on overhead switch panel and observe red "GPWS" warning lights.	"GPWS" lights return to original intensity.
(16)	Set flap handle to the "40" position.	Ground proximity warning annunciations are deactivated after flaps extend to approximately 40 degrees.

I. Glideslope Deviation Test (MODE 5)

NOTE: On aircraft equipped with EFIS, CAPTAIN'S PFD and SYMBOL GEN-1 POWER circuit breakers located on overhead panel, must be closed. Radio altitude display will appear on Capt's EFIS Primary Fight Display (PFD).

Table 207

	Operation	Desired Result
(1)	Set up glideslope signal generator within 50 feet of aircraft.	
(2)	Set the VHF NAV-1 frequency selector on NAV-COMM panel to a valid localizer (G/S) frequency which retracts flag.	
(3)	Adjust radio altimeter tester to 1600 feet, then to 800 feet (observe aircraft symbol on CAPT's radio altitude indicator).	Aircraft symbol set to 800(±20) feet on radio altimeter.
	If aircraft equipped with EFIS, Primary Flight Display (PFD) R/A scale shows 800 feet.	800(±20) feet shown on PFD.
(4)	Set glideslope signal generator to FLY UP deviation in excess of 1.5 dots.	BELOW G/S light and "GLIDE SLOPE" annunciations are activated.
NOTE: Although warnings will normally commence within 3 seconds of deviation slowly increasing through 1.3 dots, deviation applied rapidly may cause warnings to be delayed up to 15 seconds.		
(5)	Depress BELOW G/S light on Captain's side of instrument panel.	Glideslope annunciations are de-activated.
(6)	Adjust radio altitude test set to 1600 feet (observe aircraft symbol on the CAPT's radio altitude indicator).	Aircraft symbol set at 1600 (±20) feet.
(7)	Decrease radio altitude test set to 1000 feet.	Capt's PFD R/A scale shows 1000(±20) feet. On aircraft with EFIS or CAPT radio altitude indicator for aircraft without EFIS. GLIDESLOPE aural warning comes ON.
(8)	Press and release BELOW G/S light.	GLIDESLOPE aural warning goes OFF.
(9)	Increase radio altitude test set to 1600 feet.	Capt's PFD R/A scale (on aircraft with EFIS) or Capt radio altitude indicator for aircraft without EFIS shows 1600(±20) feet.
(10)	Open the circuit breaker that follows:	

Table 207 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
(11)	Decrease radio altitude test set to 800 feet.		Capt's PFD R/A scale (on aircraft with EFIS) or Capt radio altitude indicator for aircraft without EFIS shows 800(±20) feet.		
(12)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			BELOW G/S lights and GLIDESLOPE aural warning comes ON.		
(13)	On glideslope test set, set GS to ON COURSE position.		On PFD, GS deviation is centered.		
			BELOW G/S lights and GLIDESLOPE aural warning go OFF.		

J. Decision Height Test (MODE 6)

WJE 401-404, 886, 887

Table 208

Operation			Desired Result		
(1)	Verify flap handle to 40 degrees.		Verified.		
(1a)	On captain's dimming panel, adjust radio altimeter decision height to 120 feet.		DH at 120(±10) feet.		
(2)	Adjust radio altimeter tester to above 1000 feet (observe aircraft symbol on Captain's radio altitude indicator), then slowly reduce radio altitude through 120 feet.		Audio annunciation MINIMUMS is heard twice only, while passing through 120 feet.		
(3)	Cycle radio altimeter tester to above 1000 feet.		Audio annunciation MINIMUMS ceases.		
(4)	Repeat steps (1) and (1a).		Same as steps (1) and (1a).		
(5)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-176	LEFT WINDSHIELD WIPER	Lower EPC	ICE PROTECTION LEFT DC BUS	M/25
	B1-177	RIGHT WINDSHIELD WIPER	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/25
(6)	On overhead switch panel, place WINDSHIELD WIPER switch to OFF position.		Switch to OFF.		
(7)	Repeat step (2).		Same as step (2).		

WJE 401-404, 886, 887 (Continued)

Table 208 (Continued)

Operation			Desired Result		
(8)	Place WINDSHIELD WIPER switch to slow position.		Switch to SLOW position.		
(9)	Repeat step (2). Ensure DH at 120.		MINIMUMS aural warning increases in volume.		
(10)	Place WINDSHIELD WIPER switch to FAST position.		Switch to FAST position.		
(11)	Repeat step (2). Ensure DH at 120.		MINIMUMS aural warning increases in volume.		
(12)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-176	LEFT WINDSHIELD WIPER	Lower EPC	ICE PROTECTION LEFT DC BUS	M/25
	B1-177	RIGHT WINDSHIELD WIPER	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/25

WJE 405-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 891-893

Table 209

Operation		Desired Result
(1)	On aircraft without EFIS, adjust radio altimeter decision height by turning "SET-TEST" button, setting decision height counter to 120 feet on Captain's radio altitude indicator. Push DH reset.	120 feet set.
(1a)	On aircraft with EFIS, adjust radio altimeter decision height to 120 feet at captain's dimming panel.	120 feet set on PFD.
(1b)	Verify flap handle at 40 degrees.	Flap handle at 40 degrees.
(2)	Adjust radio altimeter tester to above 1000 feet (observe aircraft symbol on Captain's radio altitude indicator), then slowly reduce radio altitude through 120 feet.	Audio annunciation MINIMUMS is heard twice only, while passing through 120 feet.
(3)	Cycle radio altimeter tester to above 1000 feet.	Audio annunciation MINIMUMS ceases.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

K. Remove test equipment.

L. If CADC Quick Disconnects were used:

(1) After reconnecting the Pitot and Static lines to the unit, verify proper connection by visually inspecting the bayonet interlock as seen through the inspection hole on the side of the locking collar of the quick disconnect fitting.

(2) Gently pull on the back of the quick connect fittings after reconnection to verify they are secured to the unit.

M. Remove sealant tape from static ports. (If Installed)

N. Remove the safety tags and close these circuit breakers:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

O. Return aircraft to required configuration.

WJE

WJE

GROUND PROXIMITY WARNING SYSTEM - MAINTENANCE PRACTICES

WJE **1. General**

WJE A. This procedure has the operational test instructions for the Enhanced Ground Proximity Warning System (EGPWS). This procedure includes:

WJE • Self-test level 1: GO/NO GO test

WJE • EGPWC self test

WJE • Enhanced ground proximity warning test

WJE • Self-test level 2: current faults

WJE • EGPWC operational test.

WJE B. This procedure contains the instructions to install the terrain software in the Enhanced Ground Proximity Warning Computer (EGPWC).

WJE **2. Adjustment/Test of the Enhanced Ground Proximity Warning System (EGPWS)**

WJE A. Prepare for the Enhanced Ground Proximity Warning System (EGPWS) Adjustment/Test.

WJE (1) Apply external electrical power to the aircraft. (EXTERNAL POWER, SECTION 24-40)

WJE **WARNING:** DO NOT OPERATE THE WEATHER RADAR WHEN PERSONNEL ARE IN THE AREA USUALLY CONTAINED BY THE AIRCRAFT NOSE RADOME. DO NOT OPERATE THE WEATHER RADAR IN A HANGAR. IF YOU DO NOT OBEY THESE PRECAUTIONS, INJURIES TO PERSONNEL CAN OCCUR.

WJE (2) Put the power select switch on the WX radar control panel to the OFF (deselect) position.

WJE Make sure that these circuit breakers are closed:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE B. Self-Test level 1: GO/NO GO Test

WJE (1) Do the Self-Test Level 1: GO/NO GO Test as follows:

WJE (a) Put the FLAP OVRD/TEST switch to the TEST position until GLIDESLOPE is heard from the flight compartment speakers, and release.

WJE 1) Make sure that the amber GPWS FAIL message illuminates on the overhead annunciator panel.

WJE 2) Make sure the GPWS (amber) switch light assemblies come on.

WJE 3) Make sure you hear GLIDESLOPE from the flight compartment speakers.

WJE 4) Make sure the GPWS (amber) switch light assemblies go off.

WJE 5) Make sure that the GPWS (red) light assemblies come on.

WJE 6) Make sure you hear PULL UP from the flight compartment speakers.

WJE 7) Make sure that the GPWS (red) light assemblies go off.

WJE 8) Make sure that the amber GPWS FAIL message goes off.

WJE C. Enhanced Ground Proximity Warning Computer (EGPWC) Self-Test

WJE (1) Do the Enhanced Ground Proximity Warning Computer (EGPWC) self-test from the flight compartment as follows:

(a) Press and hold the FLAP OVRD/TEST switch in the TEST position until the self-test voices start.

NOTE: Do not release the GND PROX WARN switch until SINK RATE is heard from the flight compartment speakers.

1) Make sure the amber INOP message is shown on the TERR OVRD control panel and amber GPWS FAIL message is shown on the overhead annunciator panel.
2) Make sure the GPWS (amber) switch light assemblies come on.
3) Make sure you hear GLIDESLOPE from the flight compartment speakers.
4) Make sure the GPWS (amber) switch light assemblies go off.
5) Make sure that the GPWS (red) light assemblies come on.
6) Make sure you hear PULL UP from the flight compartment speakers.

(b) Make sure you hear, in this sequence, the speaker messages as follows:

1) TERRAIN, PULL UP.
2) SINK RATE, PULL UP.
3) TERRAIN, PULL UP.
4) DON'T SINK, DON'T SINK.
5) TOO LOW TERRAIN.
6) TOO LOW GEAR.
7) TOO LOW FLAPS.
8) TOO LOW TERRAIN.
9) GLIDESLOPE (soft).
10) BANK ANGLE, BANK ANGLE.
11) MINIMUMS.
12) 1000
13) 500
14) 100
15) 50
16) 40
17) 30
18) 20
19) 10
20) TOO LOW TERRAIN.
21) CAUTION TERRAIN, CAUTION TERRAIN.
22) TERRAIN, TERRAIN, PULL UP.
23) CAUTION OBSTACLE, CAUTION OBSTACLE.
24) OBSTACLE OBSTACLE, PULL UP.

(c) Make sure the amber INOP message on the TERR OVRD control panel goes off and amber GPWS FAIL message on the overhead annunciator panel goes off.

WJE D. Enhanced Ground Proximity Warning Test

WJE NOTE: The following test requires valid GPS position data.

WJE (1) Do the system tests of the enhanced ground proximity warning system as follows:

WJE (a) Select MAP mode on the EFIS mode select panels.

WJE 1) Push the TERR ON/__ switchlight on the captain's and first officer's TERR control panels to ON.

WJE (b) Turn the WX dimming control knob on the EFIS dimming and control panels to the maximum position.

WJE 1) Make sure the terrain elevation data is shown in the bottom right hand corner of the ND screens.

WJE (c) Rotate the RANGE knob on the EFIS mode select panels to 10 mi.

WJE 1) Make sure the ND's display 10 NM range (indicated by 5 NM shown on the half-way marker).

WJE 2) Make sure the ND's are in the MAP mode.

WJE 3) Make sure that the OVRD switchlight on the TERR OVRD control panel is not on.

WJE E. Self-Test Level 2: CURRENT FAULTS

WJE (1) Do the self-test level 2: current faults test as follows:

WJE NOTE: Throughout the current faults test, the INOP message is shown on the TERR OVRD control panel and the GPWS FAIL message is shown on the overhead annunciator panel.

WJE (a) Press and hold the FLAP OVRD/TEST switch in the TEST position until the self-test voices start.

WJE NOTE: Do not release the GND PROX WARN switch until PULL UP is heard from the flight compartment speakers.

WJE (b) When SINK RATE is heard, momentarily (less than 2 seconds) press the FLAP OVRD/TEST switch in the TEST position.

WJE 1) Make sure that you hear CURRENT FAULTS from the flight compartment speakers.

WJE 2) Make sure that you hear NO FAULTS from the flight compartment speakers.

WJE 3) Make sure that you hear PRESS TO CONTINUE from the flight compartment speakers.

WJE F. Enhanced Ground Proximity Warning System (EGPWS) Operational Test

WJE NOTE: The following test requires valid GPS position data.

WJE (1) Do the Operational Test of the Enhanced Ground Proximity Warning System (EGPWS) as follows:

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (a) Open this circuit breaker and install safety tag:

WJE **UPPER EPC, LEFT RADIO AC BUS**

WJE

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE 1) Make sure that the amber GPWS FAIL message is shown on the overhead annunciator panel.

WJE 2) Make sure the amber INOP message is shown on the TERR OVRD control panel.

WJE (b) Remove the safety tag and close this circuit breaker:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE 1) Make sure that the amber GPWS FAIL message goes out of view on the overhead annunciator panel.

WJE 2) Make sure the amber INOP message goes out of view on the TERR OVRD control panel.

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (c) Open these circuit breakers and install safety tags:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

WJE **UPPER EPC, RIGHT RADIO AC BUS**

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE 1) Make sure that the amber GPWS FAIL message is shown on the overhead annunciator panel.

WJE 2) Make sure the amber INOP message is NOT shown on the TERR OVRD control panel.

WJE (d) Remove the safety tags and close these circuit breakers:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

WJE **UPPER EPC, RIGHT RADIO AC BUS**

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

WJE 1) Make sure that the amber GPWS FAIL message goes out of view on the overhead annunciator panel.

WJE 2) Make sure the amber INOP message is not shown on the TERR OVRD control panel.

WJE (e) Select MAP mode on the EFIS mode select panels.

WJE 1) Push the TERR ON/__ switchlight on the captain's and first officer's TERR control panels to ON.

WJE (f) Turn the WX dimming control knob on the EFIS dimming and control panels to the maximum position.

WJE 1) Make sure the terrain elevation data is shown in the bottom right hand corner of the ND screens.

WJE (g) Rotate the RANGE knob on the EFIS mode select panels to 160 mi.

WJE 1) Make sure the ND's display 160 NM range (80 NM shown on the half-way marker).

WJE 2) Make sure that amber or a red terrain map format is shown on the ND.

WJE (h) Push the OVRD switchlight on the TERR OVRD control panel.

WJE 1) Make sure the OVRD switch comes on blue.

WJE 2) Make sure that ON message goes out of view on the captain's and first officer's TERR control panels.

WJE 3) Make sure that the terrain format on the ND goes out of view.

WJE (i) Push the OVRD switchlight on the TERR OVRD control panel.

WJE 1) Make sure that the OVRD switch message goes out of view.

WJE 2) Make sure that the terrain format on the ND remains out of view.

WJE (j) Push the TERR ON/__ switchlight on the captain's and first officer's TERR control panels to ON.

WJE 1) Make sure that the terrain format is shown on the ND's.

WJE G. Job Close-up

WJE (1) Remove all the tools and equipment from the work area. Make sure the area is clean.

WJE **3. Installation of the Enhanced Ground Proximity Warning System Software**

WJE A. Prepare for the Enhanced Ground Proximity Warning System Software Installation

WJE (1) Apply external electrical power to the aircraft. (EXTERNAL POWER, SECTION 24-40)

WJE (2) Make sure that this circuit breaker is closed:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE (3) Open this access panel. (FUSELAGE ZONES AND ACCESS DOORS, SECTION 06-24)

Number	Name/Location
4501A	Electrical/Electronic Equipment Compartment/Nose and fuselage

WJE B. Install the Enhanced Ground Proximity Warning System Software

WJE (1) Open the Personal Computer Memory Card Interface Adapter (PCMCIA) card door on the Enhanced Ground Proximity Warning Computer (EGPWC).

WJE (a) Make sure that the Computer OK shows on the front panel of the EGPWC.

WJE (2) Put the PCMCIA card into the PCMCIA card slot.

WJE (a) Make sure that the IN PROG shows on the EGPWC.

WJE NOTE: Installation time is approximately 60 seconds.

WJE (b) After 60 seconds, make sure that the XFER COMP shows on the EGPWC.

WJE (c) After 15 seconds, make sure that the COMP OK shows on the EGPWC.

WJE NOTE: The COMP OK shows that the software is installed.

WJE (3) Remove the PCMCIA card from the EGPWC.

WJE (4) Close the door on the front of the PCMCIA card from the EGPWC.

WJE C. Job Close-up

WJE (1) Remove all the tools and equipment from the work area. Make sure the area is clean.

WJE (2) Close this access panel. (FUSELAGE ZONES AND ACCESS DOORS, SECTION 06-24)

WJE
WJE

Number	Name/Location
4501A	Electrical/Electronic Equipment Compartment/Nose and fuselage

GROUND PROXIMITY WARNING SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-45-00-720-801

2. Functional Check of the Ground Proximity Warning System (Mark II)

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
24-00-00 P/B 001	GENERAL - DESCRIPTION AND OPERATION

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1914	Test Set - Air Data Model FLMTS (Flight Line Maintenance) **MD80-81, -82, -83, -88** Part #: 18910920000 Supplier: 89944 Part #: DPS1000 Supplier: 21844 Part #: DPS350 Supplier: 21844 Part #: DPS450 Supplier: 21844 Part #: MPS34C Supplier: 48RQ2 Part #: MPS43 Supplier: A0197 Part #: MPS45 Supplier: 48RQ2 Part #: MPS49 Supplier: 48RQ2 Opt Part #: 18910480000 Supplier: 89944 Opt Part #: DPS500 Supplier: 21844 Opt Part #: MPS-24-E Supplier: A0197 Opt Part #: MPS-26 Supplier: A0197 Opt Part #: MPS-28 Supplier: A0197 Opt Part #: MPS-30 Supplier: 41364 Opt Part #: MPS31C Supplier: 48RQ2 Opt Part #: PV-100 Supplier: 1CE49
COM-1922	Test Set - Radio Altimeter **MD80-81, -82, -83, -88** Part #: 110-0460-102-05 Supplier: L04V3 Part #: 9599-607-15902 Supplier: F0052 Opt Part #: 110-0460-102-01 Supplier: L04V3

C. Prepare for the Ground Proximity Warning System Functional Check

SUBTASK 34-45-00-861-001

(1) Energize aircraft electrical buses and make sure all necessary circuit breakers are closed. (GENERAL - DESCRIPTION AND OPERATION, PAGEBLOCK 24-00-00/001)

SUBTASK 34-45-00-730-001

(2) Do the GPWS self test.

(a) On overhead switch panel, place GND PROX WARN switch in TEST position and hold.

1) GLIDESLOPE and WHOOP-WHOOP, PULL UP are heard.

2) PULL UP, GPWS INOP and BELOW G/S lights come ON.

(b) Release GND PROX WARN switch to NORM position.

1) Aural warnings go OFF.

2) PULL UP, GPWS INOP and BELOW G/S lights go OFF.

(3) Do the GPWS power validity check.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(a) Open this circuit breaker:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

1) GPWS INOP light turns on.

(b) Close this circuit breaker:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

1) GPWS INOP light turns off.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(c) Open these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

1) GPWS INOP light turns on.

(d) On overhead switch panel, place GND PROX WARN switch in TEST position and hold.

1) No GPWS warning outputs shall occur.

(e) Close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	17	B10-105	RADIO ALTMETER-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	3	B10-106	RADIO ALTMETER-2

1) GPWS INOP light turns off.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(f) Open these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

1) GPWS INOP light turns on.

(g) On overhead switch panel, place GND PROX WARN switch in TEST position and hold.

1) GLIDESLOPE voice warning is heard.

(h) Close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	12	B10-317	AIR DATA CMPTR -2

1) GPWS INOP light turns off.

SUBTASK 34-45-00-860-001

(4) Make sure the pitot heat switch is in the OFF position.

SUBTASK 34-45-00-865-001

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(5) Open these circuit breakers and install safety tags:

LOWER EPC, AC BUS

Row	Col	Number	Name
X	21	B1-415	LEFT STATIC PORT HEATER
Z	21	B1-416	RIGHT STATIC PORT HEATER

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name
WJE 401-404, 406, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 886, 887, 891			
M	28	B1-174	AUX PITOT HEATER
WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893			
M	28	B1-174	PITOT HEATER AUX

WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893 (Continued)

(Continued)

LOWER EPC, ICE PROTECTION LEFT DC BUS

Row	Col	Number	Name

WJE ALL

LOWER EPC, ICE PROTECTION RIGHT DC BUS

Row	Col	Number	Name
N	28	B1-266	F/O PITOT HEATER

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
C	12	B1-265	CAPTAIN'S PITOT HEATER

SUBTASK 34-45-00-480-001

(6) Connect the air data model test set, COM-1914 to pitot and static input ports of the system being used with GPWS.

(a) Perform a leak check of the applicable pitot static system. (PITOT STATIC - MAINTENANCE PRACTICES 34-11-00-2)

(7) Connect the radio altimeter test set, COM-1922 to the radio altimeter being used with GPWS.

(a) Adjust the tester for zero altitude indication.

SUBTASK 34-45-00-860-002

(8) Set the decision height (DH) control on the radio altitude indicator to zero feet.

(9) Assure that the flaps are in the full UP position.

(10) Assure that the GPWS FLAP OVRD switch (if installed) is in the NORMAL position.

(11) Assure that the landing gear are in the down and locked position.

D. Do a Functional Check of the Ground Proximity Warning System

SUBTASK 34-45-00-720-002

(1) Warning Mode 3 - Altitude Loss After Take-Off.

(a) Simulate the landing gear to GEAR UP position.

(b) Adjust the airspeed to approximately 200 knots.

(c) Adjust the pressure altitude to approximately 5000 ft (1524.0 m) above the local setting.

(d) Decrease the rate of change slowly as the higher altitude is approached to avoid “over-shoot”. Note the indication, within 5 ft (1.5 m), of the maximum altitude obtained.

(e) Starting from zero, adjust the radio altitude to 500 ft (152.4 m).

(f) Immediately bleed off the pressure altitude at a rate of approximately 500 ft (152.4 m) per minute. The “DON'T SINK” voice warning will turn on after a pressure altitude loss of 30 ft (9.1 m) to 80 ft (24.4 m).

(g) Stop the decrease of pressure altitude and start an increase of approximately 300 ft (91.4 m) per minute. The “DON'T SINK” voice warning shall turn off.

NOTE: This test can be re-checked by adjusting the pressure altitude to approximately 1000 ft (304.8 m) above the value obtained in test step (f).

(h) Increase the radio altitude to 1000 ft (304.8 m).

(i) Decrease the pressure altitude by approximately 300 ft (91.4 m). The “DON'T SINK” voice warning shall not turn on.

(2) Warning Mode 1 - Excessive Sink Rate.

(a) Adjust the pressure altitude to approximately 7000 ft (2133.6 m) above the local setting.

(b) Adjust the radio altitude to 2000 ft (609.6 m).

(c) Decrease the pressure altitude at a rate of change of 3000 ±300 ft (914.4 ±91.4 m) per minute. Try to maintain this descent rate as closely as possible.

(d) Decrease the radio altitude at approximately 800 ft (243.8 m) per minute. The “SINK RATE” voice warning shall turn on at a radio altitude between 1050 ft (320.0 m) to 1450 ft (442.0 m).

(e) Continue to slowly decrease the radio altitude. The “PULL UP” voice warning shall turn on at a radio altitude between 600 ft (7200.0 in.) to 950 ft (289.6 m).

(f) Stop changing radio altitude when the “PULL UP” voice warning turns on.

(g) Immediately decrease the pressure altitude rate of change to approximately 1500 ft (457.2 m) per minute. All GPWS warnings shall turn off.

(h) Adjust the pressure altitude to approximately 5000 ft (1524.0 m) above the local setting. Maintain this altitude.

(3) Warning Mode 4 - Landing Gear and Flaps.

(a) Adjust the radio altitude to 1200 ft (365.8 m).

(b) Adjust the airspeed to approximately 325 knots.

(c) Decrease the radio altitude at approximately 500 ft (152.4 m) per minute. The “TOO LOW - TERRAIN” voice warning shall turn on at a radio altitude between 900 ft (274.3 m) to 1100 ft (335.3 m).

(d) Decrease airspeed to 100 knots. The “TOO LOW TERRAIN” voice warning shall turn off between 225 to 325 knots.

(e) Continue to slowly decrease the radio altitude. The “TOO LOW - GEAR” voice warning shall turn on at a radio altitude between 450 ft (137.2 m) to 550 ft (167.6 m).

(f) Simulate the landing gear to the GEAR DOWN position. The “TOO LOW - GEAR” voice warning shall turn off.

(g) Continue to slowly decrease the radio altitude. The “TOO LOW - FLAPS” voice warning shall turn on at a radio altitude between 150 ft (45.7 m) to 250 ft (76.2 m).

(h) Set the GPWS FLAP OVRD switch to OVRD. The “TOO LOW - FLAPS” voice warning shall turn off.

(i) Reset the GPWS FLAP OVRD switch to NORMAL.

(j) Increase the radio altitude to approximately 800 ft (243.8 m) and then slowly decrease the radio altitude until the “TOO LOW - FLAPS” voice warning turns on.

(k) Set the flaps to the landing position. The “TOO LOW - FLAPS” voice warning shall turn off.

(l) Reset the flaps to the UP position.

(4) Warning Mode 2 - Terrain Closure Rate.

(a) Assure that the landing gear and the flaps are in the UP position and the GPWS FLAP OVRD switch is in the NORMAL position.

(b) Adjust the pressure altitude to approximately 3000 ft (914.4 m) above the local setting. Note the actual altitude obtained and maintain this altitude during this test.

(c) Adjust the radio altitude to its maximum range.

(d) Smoothly and continuously decrease the radio altitude to approximately 1000 ft (304.8 m) at a rate of change of approximately 5000 ft (1524 m) per minute.

NOTE: For a 2500 ft (762.0 m) altimeter this change will take approximately 15 to 18 seconds. For a 2000 ft (609.6 m) altimeter this change will take approximately 10 to 15 seconds.

(e) The “TERRAIN TERRAIN” and “PULL UP” voice warnings shall turn on at a radio altitude between 1000 ft (304.8 m) to 2000 ft (610 m).

(f) Stop changing the radio altitude when the “PULL UP” voice warning starts. The “PULL UP” voice warning will turn off in a short time and then the “TERRAIN” voice warning will sound continuously.

(g) Slowly increase the pressure altitude. The “TERRAIN” voice warning shall turn off when the pressure altitude is approximately 300 ft (91.4 m) higher than the value noted in test step (b).

SUBTASK 34-45-00-080-001

(5) Remove air data test set.

SUBTASK 34-45-00-720-003

(6) Warning Mode 6 - Descent Minimums.

(a) Adjust the radio altitude to approximately 800 ft (243.8 m).

(b) Adjust DH setting on the radio altimeter indicator to 600 ft (182.9 m).

(c) Slowly decrease the radio altitude. The “MINIMUMS” voice advisory shall turn on at a radio altitude between 580 ft (176.8 m) to 620 ft (189.0 m). The word “MINIMUMS” will sound only two times.

(7) Warning Mode 5 - Below Glideslope.

(a) The landing gear must be in the DOWN position to perform this test.

(b) Adjust the radio altitude to 1200 ft (366 m).

(c) Set the NAV 1 control to an ILS frequency that is compatible with the glideslope test set being used.

(d) Adjust the test set for a full scale “Fly Up” indication. No glideslope warnings shall occur.

(e) Adjust the test set for zero glideslope deviation indication.

(f) Adjust the radio altitude to 900 ft (274.3 m).

(g) Slowly adjust the test set for a “Fly Up” signal. The “GLIDESLOPE” voice warning and the “BELOW G/S” warning lights shall turn on at a 1.3 ± .3 DOTS indicated glideslope deviation.

(h) Adjust the test set for a full scale “Fly Up” indication.

(i) Momentarily depress one of the “BELOW G/S” lights or the (if installed) G/S INHIBIT switch. The glideslope warnings shall turn off and remain off.

(j) Adjust the radio altitude to 1200 ft (0.2 mi) then slowly decrease the radio altitude. The glideslope warnings shall turn on at a radio altitude between 900 ft (274.3 m) to 1100 ft (335.3 m).

(k) Continue to slowly decrease the radio altitude. The repetition rate of the “GLIDESLOPE” voice warning will increase as the radio altitude is decreased.

(l) Set radio altitude at 250 ft (76.2 m).

(m) On installations where a BAC/LOC signal is connected to the GPWS, set the control used for this function to BAC/LOC (it may be identified as REV course). The glideslope warnings shall turn off.

(n) Reset the control to it's normal position. The glideslope warning shall turn on.

(o) Slowly decrease the signal from the test set. The glideslope warnings shall turn off at approximately 1.0 DOTS “Fly Up” indication.

SUBTASK 34-45-00-080-002

(8) Remove radio altimeter tester.

E. Job Close-up

SUBTASK 34-45-00-862-001

(1) Remove electrical power if no longer required. (GENERAL - DESCRIPTION AND OPERATION, PAGEBLOCK 24-00-00/001)

SUBTASK 34-45-00-940-001

(2) Remove all the tools and equipment from the work area. Make sure the area is clean.

——— END OF TASK ———

ENHANCED GROUND PROXIMITY WARNING COMPUTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Ground Proximity Warning computer. The unit is mounted on the left radio rack in the electrical/electronics compartment.

2. Removal/Installation Ground Proximity Warning Computer

A. Remove Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(2) Unscrew knurled hold-down nut at front end of mounting rack and swing assembly down.

(3) Remove computer from mounting rack.

B. Install Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(2) Visually check computer unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide computer unit straight into rack, ensuring that electrical connectors are properly aligned with mounting rack connectors.

(4) Engage hold-down assembly with lug on computer unit, and tighten hold-down nut.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(6) Energize aircraft electrical buses, and allow 3 minutes for system warmup.

(7) Make sure that flap setting is less than 26°.

(8) On overhead switch panel, hold GND PROX WARN switch in TEST position. GLIDESLOPE and WHOOP-WHOOP, PULL UP audio activated. GPWS FAIL, BELOW G/S, and GPWS lights come on.

(9) Release GND PROX WARN switch in NORM position, visual and aural warnings are de-activated.

NOTE: If necessary, refer to GROUND PROXIMITY WARNING SYSTEM, SUBJECT 34-45-00, Page 201, for complete system test.

WJE 405-411, 880, 881, 883, 884

(10) On instrument panel, press and hold red GPWS light. GLIDESLOPE and WHOOP-WHOOP, PULL UP audio activated. GPWS FAIL, BELOW G/S, and GPWS lights come on.

(11) Release GPWS light to NORM position; visual and aural warnings are de-activated.

NOTE: If necessary, refer to GROUND PROXIMITY WARNING SYSTEM, SUBJECT 34-45-00, Page 201, for complete system test.

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

(12) Return aircraft to required configuration.

WJE

WJE

ENHANCED GROUND PROXIMITY WARNING COMPUTER - MAINTENANCE PRACTICES

WJE

1. General

WJE A. This maintenance practice provides removal/installation procedure for the Enhanced Ground Proximity Warning Computer (EGPWC). The unit is mounted on the left radio rack in the electrical/electronics compartment.

WJE

2. Removal/Installation of the Enhanced Ground Proximity Warning Computer

WJE A. Removal of the Computer

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Make sure that these circuit breakers are open and have safety tags:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE **CAUTION:** DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

WJE (2) Loosen the hold-down nut at the front end of the EGPWC.

WJE (3) Carefully pull the EGPWC straight out until the electrical connectors are disengaged.

WJE (4) Install the conductive dust cap(s)/plug(s), STD-150, on the electrical connectors.

WJE B. Installation of the Computer

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Make sure that these circuit breakers are open and have safety tags:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE **CAUTION:** DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

WJE (2) Remove the electrical connector dust caps from the electrical connectors.

WJE (3) Visually examine the EGPWC and the electrical connectors for damage and unwanted material.

WJE (4) Make sure the guide pin bushings on the electrical connectors are aligned.

WJE (5) Place the EGPWC on the mount tray and push straight back.

WJE (6) Install the hold-down nut on the EGPWC front panel and tighten.

WJE (7) Remove the safety tags and close these circuit breakers:

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE (8) Do the Operational Test of the EGPWS, GROUND PROXIMITY WARNING SYSTEM, SUBJECT 34-45-00.

WJE **3. Job Close-up**

WJE A. Remove all tools and equipment from the work area. Make sure the area is clean.

GROUND PROXIMITY WARNING SPEAKER - MAINTENANCE PRACTICES

1. General

A. This procedure has the removal/installation instructions for the ground proximity warning (GPWS) speaker.

B. The speaker is located on the aft overhead switch panel.

2. Removal/Installation GPWS Speaker

A. Remove Speaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(2) Apply hand pressure to speaker panel face, unlock the slot-head fasteners, and release hand pressure. (Figure 201)

(3) Lower panel from cavity until electrical connector is accessible.

(4) Disconnect electrical connector.

(5) Remove speaker attaching screws and remove mounting plate from speaker.

B. Install Speaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(2) Install mounting plate on speaker with attaching screws.

(3) Visually check speaker receptacle and mating connector for damage or foreign objects.

(4) Connect electrical connector to speaker receptacle.

(5) Position speaker panel into cavity in overhead panel.

(6) Apply hand pressure to speaker face and lock the slot-head fasteners.

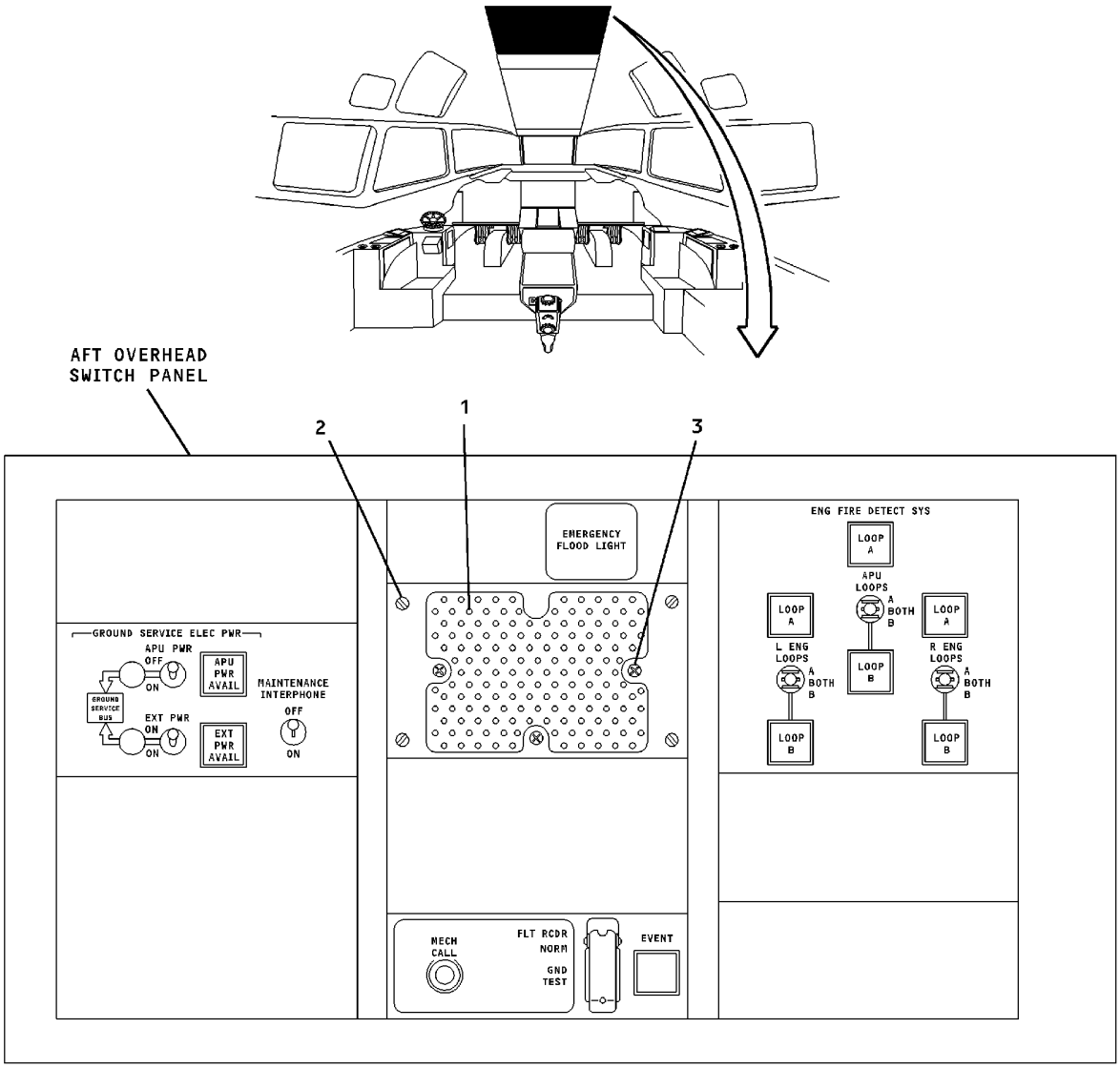
(7) Remove the safety tag and close this circuit breaker:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

(8) Perform Ground Proximity Warning System self-test. (GROUND PROXIMITY WARNING SYSTEM, SUBJECT 34-45-00, Page 201)

(9) Return aircraft to required configuration.



LEGEND:
1. SPEAKER PANEL
2. SLOT-HEAD FASTERNS
3. SCREWS

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GPWS Speaker -- Removal/Installation
Figure 201/34-45-02-990-802

WJE

GROUND PROXIMITY WARNING ANNUNCIATORS - MAINTENANCE PRACTICES

WJE **1. General**

WJE A. This procedure has the removal/installation instructions for the ANNUNCIATOR ASSEMBLIES.

WJE B. The ANNUNCIATOR ASSEMBLIES are located on the Captain's Instrument Panel (P1-1) and the First Officer's Instrument Panel (P3-1).

WJE **2. Removal/Installation**

WJE A. Remove the Enhanced Ground Proximity Warning System (EGPWS) Annunciator Assemblies as follows: (Figure 201)

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Open these circuit breakers and install safety tags:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE (2) Loosen captive fasteners to remove annunciator.

WJE (3) Pull annunciator straight out and remove the attached connector.

WJE B. Install the EGPWS Annunciator Assemblies as follows: (Figure 201)

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Make sure that these circuit breakers are open and have safety tags:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE **UPPER EPC, LEFT RADIO DC BUS**

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE (2) Attach the connector to the annunciator assembly.

WJE (3) Attach the connector to the annunciator and slide the unit straight into the opening.

WJE (4) Secure the annunciator by tightening the captive fasteners on the assembly.

WJE (5) Remove the safety tags and close these circuit breakers:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO DC BUS**

WJE

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE (6) Press ANNUN/DIGITAL LIGHTS TEST switch on the forward overhead switch panel and make
WJE sure that all EGPWS annunciator switchlights illuminate.

WJE (7) Pull and push the DIM switch on the forward overhead switch panel. Make sure all EGPWS
WJE annunciator switchlights go dim and bright respectively.

WJE (8) Release the ANNUN/DIGITAL LIGHTS TEST switch and push the DIM switch. Make sure that
WJE the annunciator lights go off.

WJE (9) Do the operational test of the EGPWS IAW GROUND PROXIMITY WARNING SYSTEM,
WJE SUBJECT 34-45-00.

WJE C. Job Close-up

WJE (1) Remove all the tools and equipment from the work area. Make sure the area is clean.
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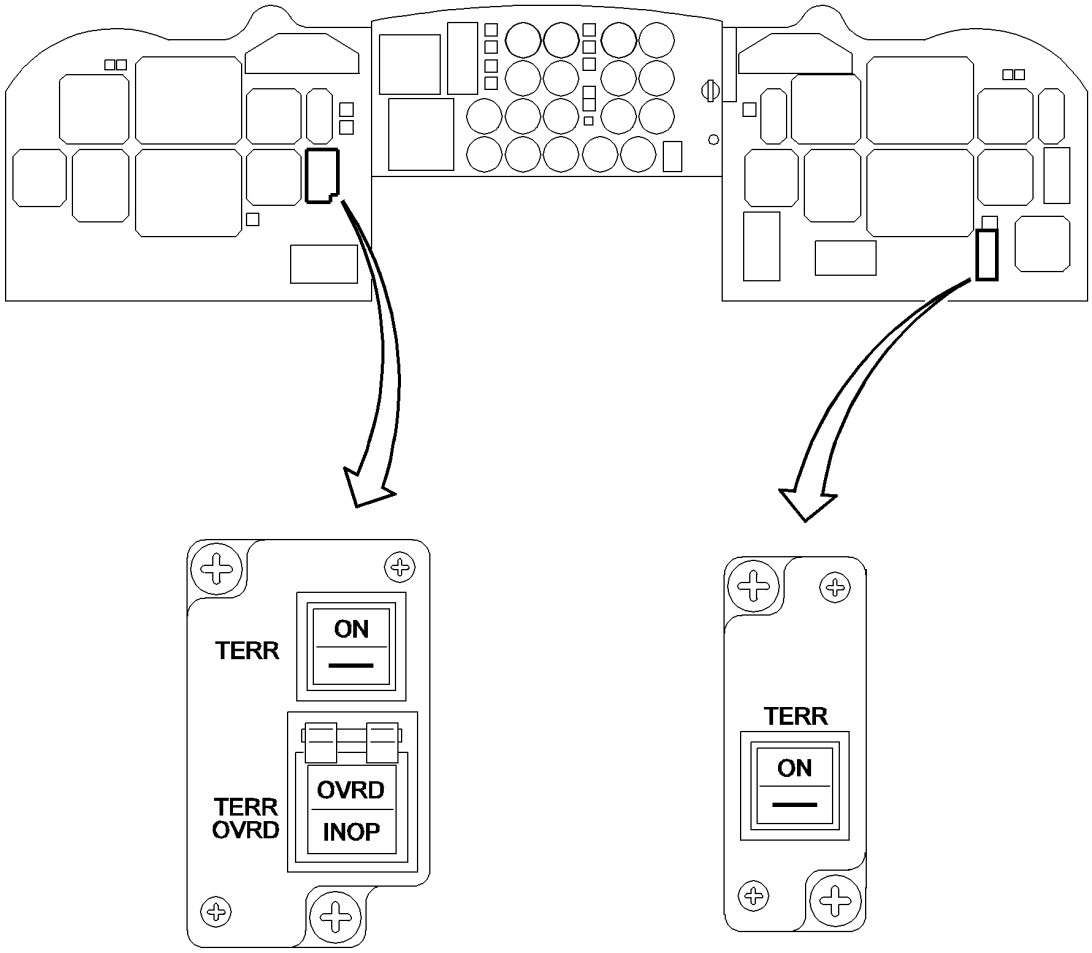

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ANNUNCIATOR ASSEMBLIES - INSTRUMENT PANEL
Figure 201/34-45-03-990-802

GROUND PROXIMITY WARNING SWITCHING RELAYS - MAINTENANCE PRACTICES

1. General

A. This procedure has the removal/installation instructions for the ground proximity warning switching relays.

B. The switching relays are located on the Electronics Equipment Rack (E2-3).

2. Removal of the Ground Proximity Warning Switching Relays

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

A. Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

B. Remove applicable ground proximity warning switching relay as follows: (Figure 201)

(1) Remove relay mount screws and washers.

(2) Pull relay straight out of relay socket.

3. Installation of the Ground Proximity Warning Switching Relays

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

A. Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

B. Install applicable ground proximity warning switching relay as follows: (Figure 201)

(1) Plug relay in socket.

(2) Secure with relay mounting screws and washers.

(3) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO DC BUS**

WJE

Row	Col	Number	Name
G	20	B10-303	GROUND PROXIMITY WARNING LIGHTS

WJE C. Do adjustment/test of the ground proximity warning system. (GROUND PROXIMITY WARNING
WJE SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-45-00/201 Config 12)

WJE D. Remove all the tools and equipment from the work area. Make sure the work area is clean.
WJE

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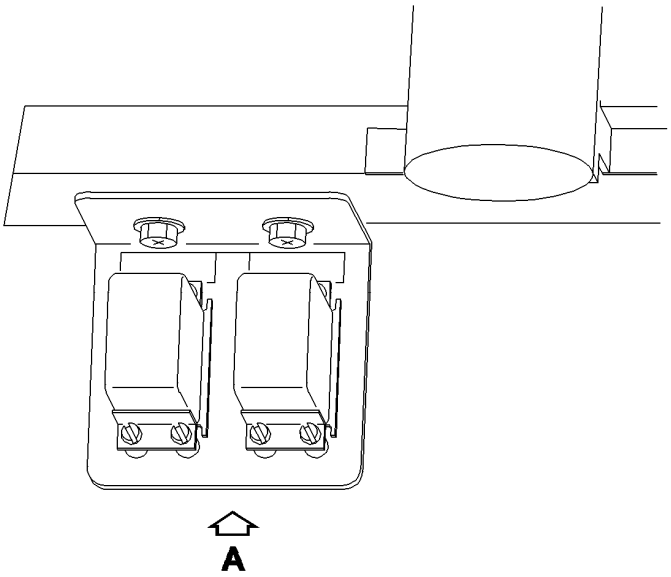

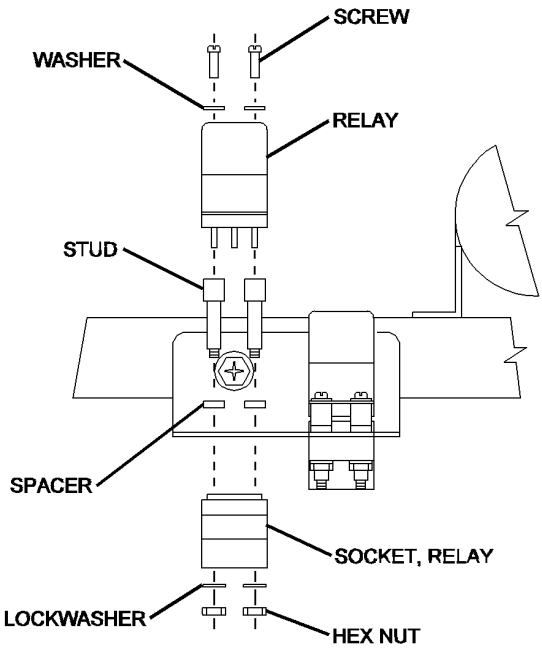

VIEW A

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WJE

RELAY BRACKET ASSEMBLY
Figure 201/34-45-04-990-801

TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - DESCRIPTION AND OPERATION

1. General

WJE 410, 875-879

A. The traffic alert and collision avoidance system (TCAS) helps the flight crew in the identification of nearby aircraft and their possible airspace threat. The TCAS interrogates the ATC transponder of the nearby aircraft and uses its reply to compute a predicted flight path for the aircraft. If a possible collision hazard exists, the TCAS issues visual and aural advisories to the crew for appropriate vertical avoidance maneuvers. The TCAS cannot detect intruding aircraft that do not have an operating transponder.

B. The TCAS supplies advisory data to the Resolution Advisory/ Traffic Advisory/Vertical Speed Indicators (RA/TA/VSI's) and the TCAS cockpit speakers. The two types of advisory data are Traffic Advisory (TA) and Resolution Advisory (RA). A resolution advisory can be corrective, requiring an active maneuver of the aircraft, or preventive, requiring that no action be taken.

C. The TCAS consists of the ATC/TCAS control panel, TCAS computer, two RA/TA/VSI's, two TCAS cockpit speaker and two directional antennas. The system uses the ATC/Mode S transponders to coordinate resolution advisories between two or more aircraft equipped with TCAS

WJE 412, 414

WJE D. TCAS II is a system which has the capability of issuing both Traffic Advisories (TA) and Resolution Advisories (RA) to assist the pilot in avoiding approaching aircraft when a potential collision threats. A detailed description and operation follows:

WJE (1) TCAS II is an airborne collision avoidance system that interrogates Air Traffic Control Transponders in nearby aircraft and uses computer processing to identify and display potential and predicted collision threats. The system is designed to protect the airspace around the TCAS equipped aircraft Figure 1. The system will provide appropriate aural and visual advisories to the flight crew to provide adequate separation when the computer analysis of the intruder aircraft's transponder replies predicts a penetration of the protected airspace. The system provides two types of advisories. Traffic Advisories (TA) indicate the relative position of intruder aircraft that are approximately 20 to 48 seconds from the closest point of approach. A Resolution Advisory (RA) will produce a threat resolution in the form of a vertical maneuver that will increase separation when the computer predicts the intruder aircraft is within approximately 20 to 35 seconds from the closest point of approach. Intruders are generally first posted as Traffic Advisories (TA) which provides the flight crew the opportunity to visually acquire the intruding aircraft. The transponder configurations and the resulting advisory capabilities for the various types of intruder is illustrated by Figure 2.

WJE (2) The TCAS II system can only generate Resolution Advisories (RA) for intruders equipped with operative Mode S or Mode C transponders, which provide information on the altitude of the intruder. Traffic Advisories (TA) can be generated for aircraft with operative Mode S or Mode C or Mode A transponders. The TCAS system provides no indication of aircraft without operative transponders. The TCAS equipment is intended to aid the pilot who retains the primary responsibility for avoiding the mid air collisions.

WJE NOTE: Mode A-equipped intruders result in display of Traffic Advisories (TA's) only. TCAS requires intruder altitude information for Resolution Advisories (RA's).

WJE **WJE 412, 414 (Continued)**
WJE

WJE (3) The TCAS II system provides two type of flight deck displays. A Traffic Display displays the relative position of proximity ATC transponder aircraft. A Resolution Advisory Display indicates the appropriate vertical maneuver to avoid a threat. These two modes are integrated into one display, the Vertical Speed Indicator/Traffic Resolution Advisory (VSI/TRA) display (Figure 3). This display, actually one for each pilot, is a special vertical speed indicator. This Vertical Speed Indicator (VSI/TRA) utilizes a flat panel liquid crystal display medium to provide for display of the normal vertical speed information and the TCAS, TA and RA information.

WJE (4) TCAS II may selectively address each aircraft equipped with a MODE S Transponder, due to the fact that each MODE S equipped aircraft has a unique MODE S address. This address is assigned by the FAA and is permanently wired into each aircraft during initial installation. Using this feature, the surveillance algorithms internal to TCAS may selectively interrogate only those aircraft which it determines necessary due to their location relative to ownership. In addition TCAS can suppress replies from non-MODE S equipped aircraft. TCAS takes advantage of these and other methods when interrogating the airspace in order to reduce the volume of replies from aircraft in the area. The result of this is that TCAS may operate in areas that otherwise overload TCAS due to the high density of aircraft replies.

WJE E. The TCAS II system consists of the following items: (Figure 4)

WJE (1) Mode S transponder (2).

WJE (2) Mode S/TCAS Control Panel (1).

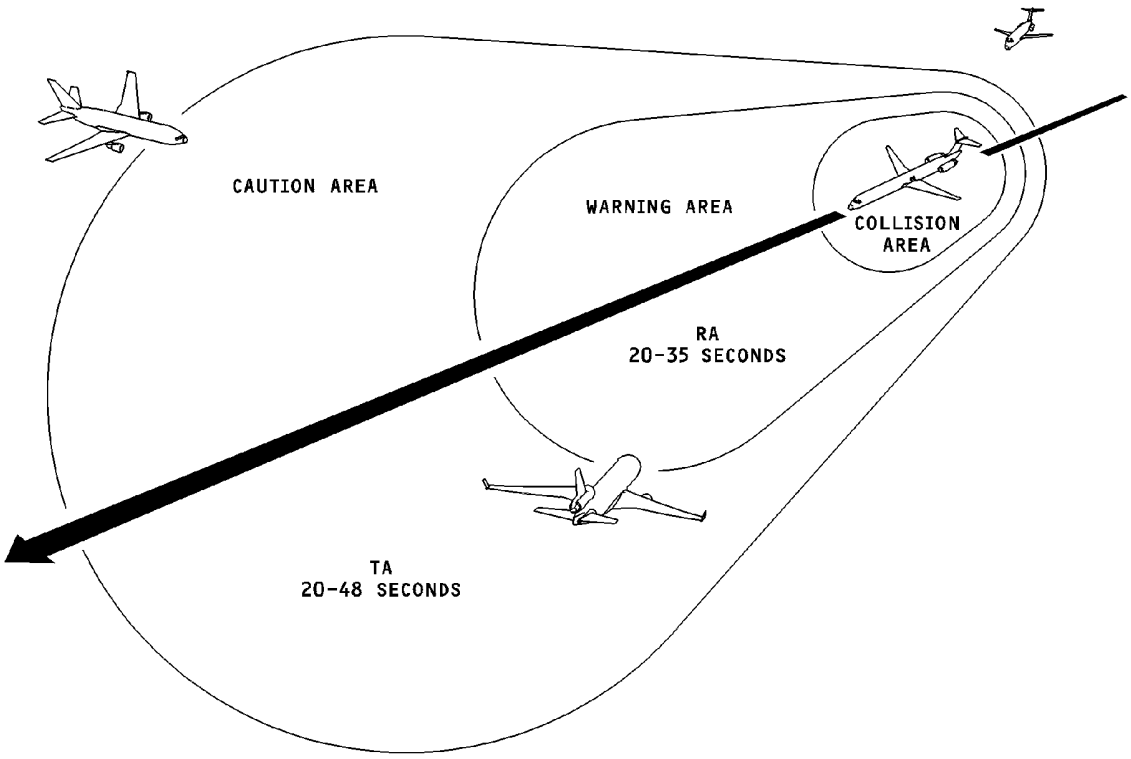
WJE (3) VSI/TRA Display (2)

WJE (4) TCAS Computer (1)

WJE (5) Warning Speaker (1)

WJE (6) Upper and Lower Antennas (2) .

WJE NOTE: These TCAS components are Line Replaceable Units (LRU).



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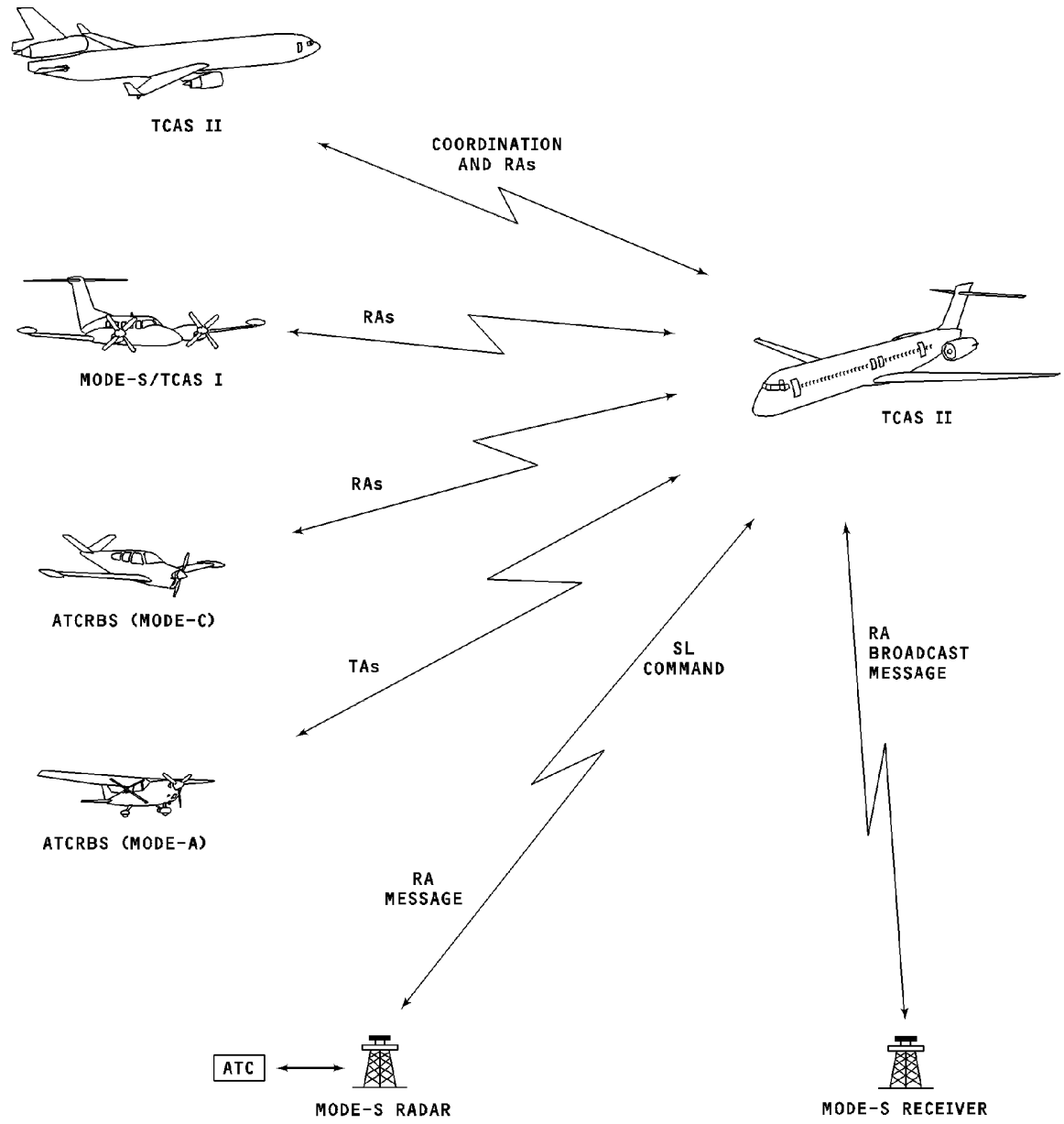
Caution and Warning Areas
Figure 1/34-46-00-990-877

EFFECTIVITY
WJE 412, 414



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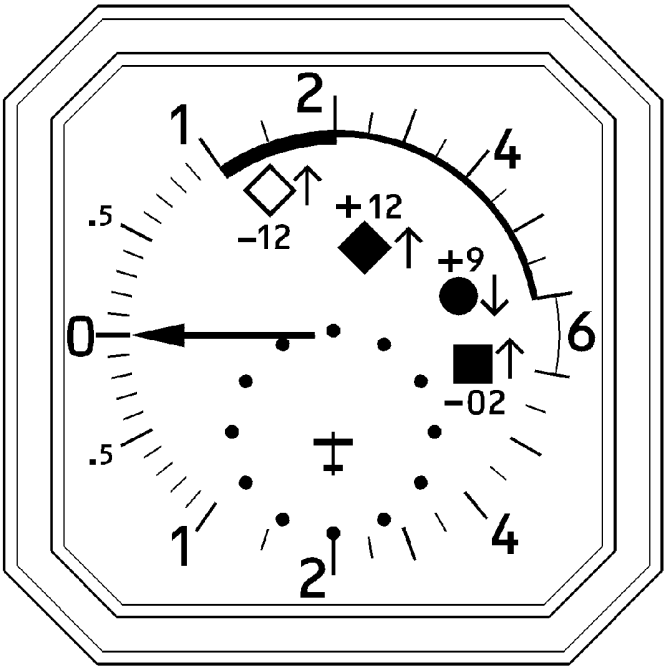
TCAS II Protection and Services
Figure 2/34-46-00-990-878



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VSI/TRA Display
Figure 3/34-46-00-990-879

WJE 412, 414

WJE **2. TCAS Definitions of Terms**

WJE A. Advisory: A message given to the pilot containing information relevant to collision avoidance.

WJE (1) Traffic Advisory (TA): Information given to the pilot pertaining to the position of another aircraft in the immediate vicinity. The information contains no resolution information. Visual display of traffic (Amber filled circle) is accompanied with voice message "TRAFFIC, TRAFFIC". Intruder is approximately 20 to 48 seconds from closest point of approach. The speaker located overhead in the cockpit provides aural commands.

WJE (2) Resolution Advisory (RA): Information provided to the flight crew for use in executing an escape maneuver. Visual information (Red filled square) is accompanied with voice message such as "CLIMB, CLIMB". Intruder is approximately 20 to 35 seconds from closest point of approach.

WJE B. ATC: Air Traffic Control.

WJE C. Air Traffic Control Radar Beacon System. Type of Secondary Surveillance Radar (SSR) equipment which replies to Mode A and Mode C interrogations.

WJE (1) ATCRBS Mode A: ATCRBS replies from the aircraft which contains the code selected by the flight crew.

WJE (2) ATCRBS Mode C: ATCRBS replies from the aircraft which contains the pressure altitude information from the aircraft.

WJE D. CAS: Collision Avoidance System. A generic term for those systems used for airborne collision avoidance detection and protection.

WJE E. GPWS: Ground Proximity Warning System. A system designed to warn the flight crew of inappropriate aircraft/terrain closure.

WJE F. Intruder: An aircraft which satisfies the TCAS II threat detection logic.

WJE G. Mode S: Type of Secondary Surveillance Radar (SSR) equipment which replies to Mode A and Mode C interrogation and discrete address interrogations from ground or air. Each aircraft is permanently assigned a unique address code which is used to identify that aircraft.

WJE H. Ownership: TCAS term for TCAS equipped aircraft being operated, a miniature aircraft symbol at aft center of VSI/TRA display.

WJE I. TCAS: Traffic Alert and Collision Avoidance System.

WJE (1) TCAS I: A TCAS system which does not have the capability to issue resolution advisory information, issuing traffic advisories only.

WJE (2) TCAS II: A TCAS system which has the capability of issuing both Traffic Advisories and Resolution Advisories. Resolution Advisories are issued for vertical escape maneuvers only. Equipment currently being installed in aircarrier aircraft is TCAS II equipment.

WJE (3) -TCAS III: A TCAS system which has the capability of issuing both Traffic Advisories and Resolution Advisories. Resolution Advisories are issued for vertical and horizontal escape maneuvers. Future use if TCAS II does not resolve avoidance problems fully.

WJE J. Traffic: An aircraft within the surveillance range of TCAS

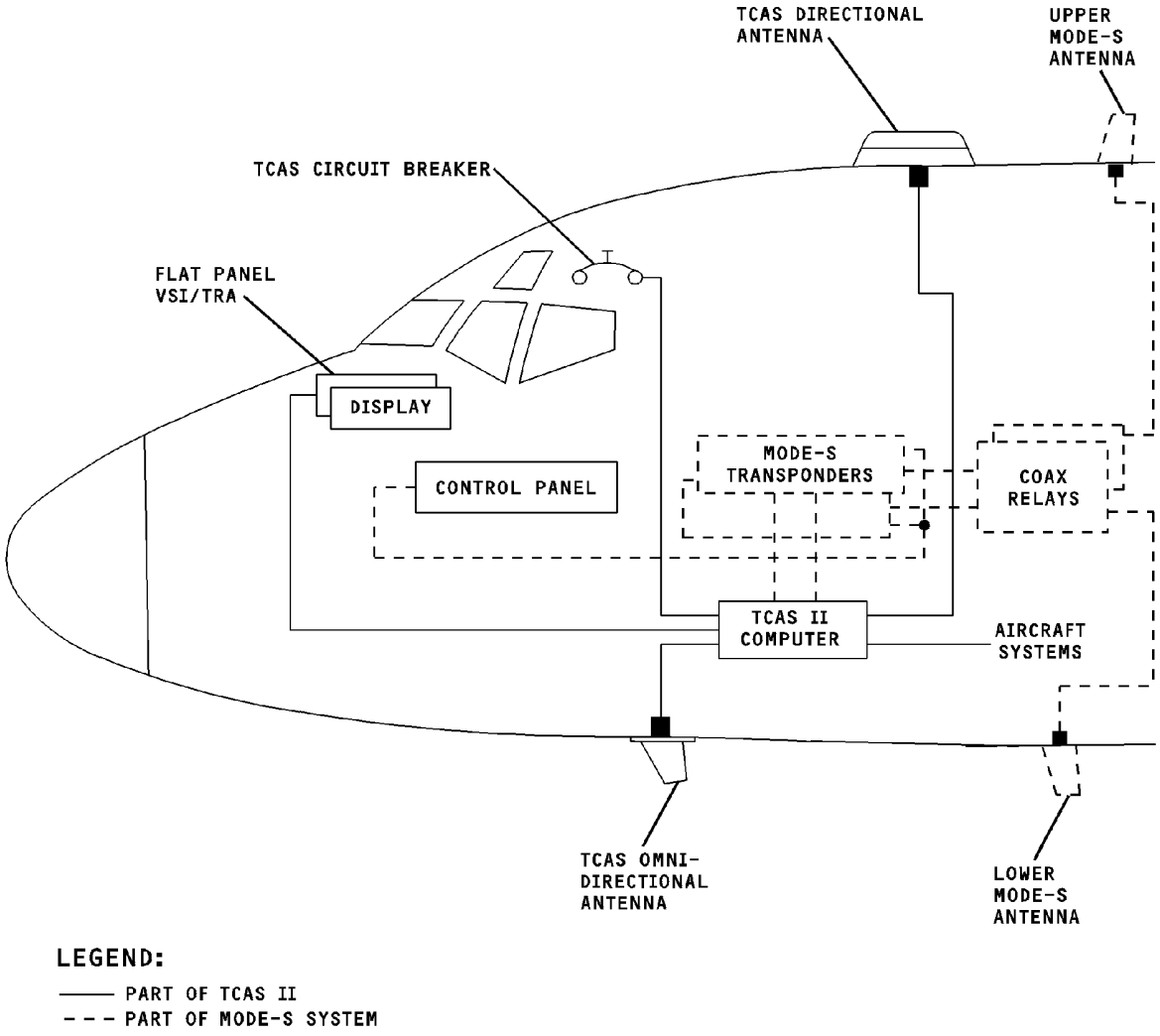
WJE (1) Other Traffic (Hollow Cyan Diamond): Traffic within +/- 2700 feet vertically and within range of the display.

WJE (2) Proximity Traffic (Solid Cyan Diamond): Traffic within +/- 1200 feet vertically and within 6 NM of ownership.

WJE **WJE 412, 414 (Continued)**
WJE

WJE K. VSI/TRA Display: Vertical Speed Indicator/Traffic-Resolution Advisory Display. A display unit to
WJE replace the existing Vertical Speed Indicator. This unit is capable of displaying vertical speed
WJE information and TCAS TA and RA information.

WJE L. Windshear: A system used to detect and warn the flight crew of an unwanted windshear encounter.
WJE



TCAS II System
Figure 4/34-46-00-990-880

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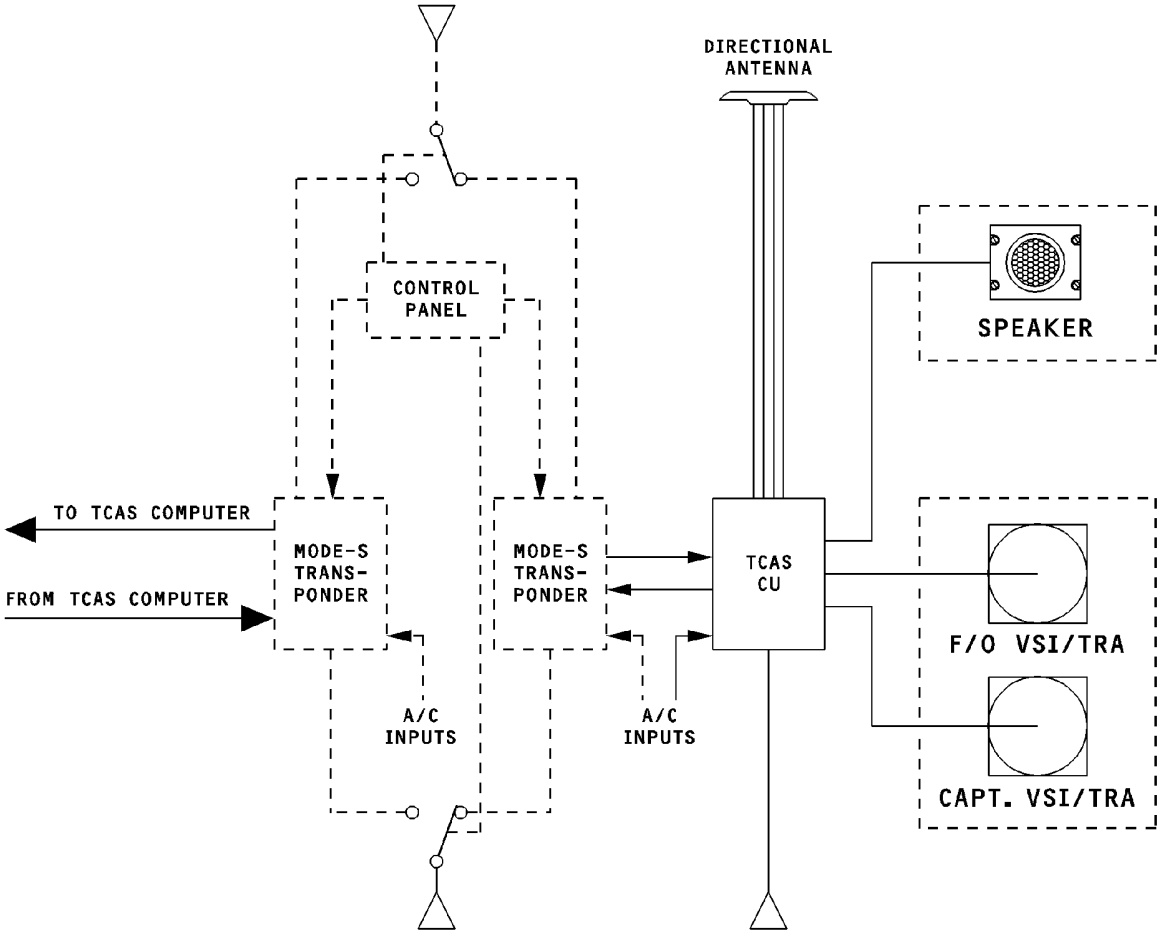
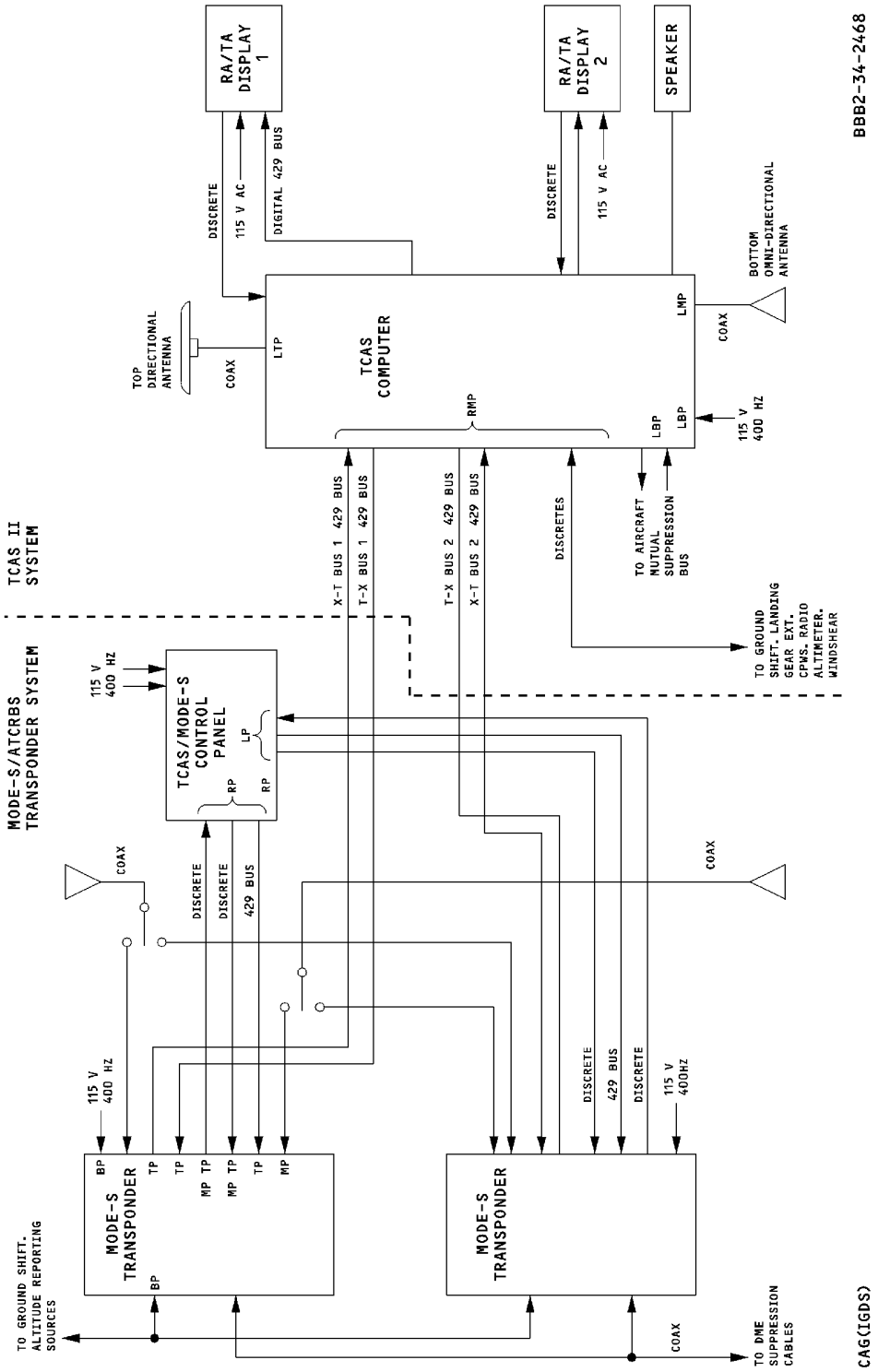


Dual Mode S/Bottom Omni Directional Antenna Installation
Figure 5/34-46-00-990-881

WJE



TCAS Block Diagram
Figure 6/34-46-00-990-882

WJE **WJE 412, 414 (Continued)**

WJE

WJE **3. Control Panel**

WJE A. Mode S and TCAS are controlled by a common control panel which replaces the previously installed ATC Control Panel (Figure 7). The function of individual controls are as follows:

WJE (1) IDENT - Initiates the standard ident reply.

WJE (2) Code Select Knobs - Used to set code in control panel window.

WJE (3) ALT RPT - Provides a means of inhibiting altitude replies independent of normal Mode A replies and selection of altitude reporting source 1 or 2.

WJE (4) STBY-XPDR ON-TA-TA/RA - Used to control the operation of the transponder and the operating mode of TCAS (TA only or both TA/RA modes). Used to select Mode S transponder ON. Regardless of switch positions, aircraft have been wired to inhibit all Mode A and C replies on the ground.

WJE (5) TEST - Used to initiate a self test of the TCAS system.

WJE (a) When TCAS is tested with the Control Panel test button, an 8 second test of the TCAS will be initiated. During this test, test targets (traffic) may be observed on the VSI/TRA display. Successful test is indicated by the "TCAS TEST PASS" being annunciated over the Warning Speaker.

WJE (6) TA DSPLY - OFF/AUTO/ON - This switch controls the display of TCAS information on the VSI/TRA Display. In the AUTO position, TCAS information is only displayed when the TCAS RA's, TA's and Proximate Traffic are detected. During the time when TCAS is not detecting threat aircraft, the VSI/TRA displays only VSI information. If TCAS detects traffic that meets the criteria for RA, TA, and Proximate Traffic, the VSI/TRA automatically display TCAS information. With the switch in the ON position, TCAS traffic information is continuously displayed and TCAS RA information is displayed when TCAS issues an RA.

WJE **4. Vertical Speed Indicator/Traffic Resolution Advisory (VSI/TRA) Display**

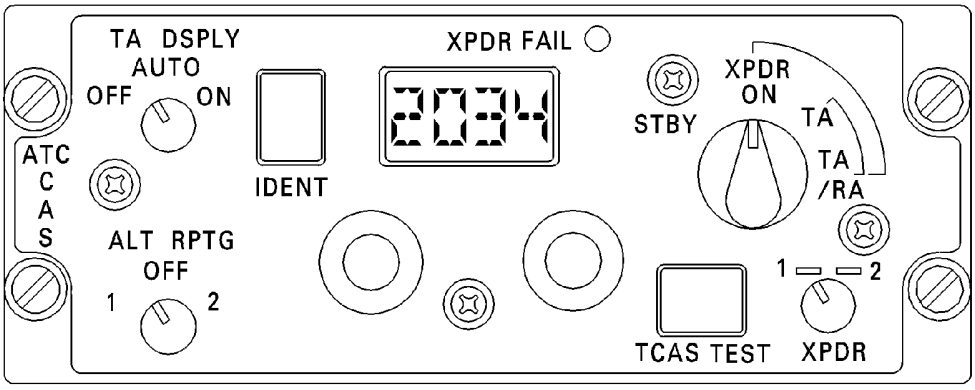
WJE A. The existing Vertical Speed Indicators are replaced with units that are capable of displaying TCAS as well as vertical speed information. The VSI/TRA display (Figure 8) is a Liquid Crystal Display (LCD). The vertical speed function itself relies completely on electric inputs.

WJE B. Lighting for the display is provided by a dimmable fluorescent lamp positioned behind the LCD glass itself. Control for the display intensity is provided by two sources. The manual control is provided by the existing control panel lighting control knob. A finer adjustment to match the intensity to ambient conditions is provided by built-in light sensor. Due to the Characteristics of the LCD displays, an internal heater is used to keep the operating temperature of the glass at a constant temperature. This heater will make the case feel warm to the touch. The heater temperature is 160°F.

WJE C. Both the TCAS Traffic Display and the TCAS Resolution Display are integrated into VSI/TRA display. TCAS traffic information is displayed in area of the display inside the vertical speed scale ring. TCAS resolution information is superimposed on the vertical speed scale itself, as either a red or green band.

WJE D. Target aircraft are shown as symbols on the display as different symbology depending on TCAS threat status as determined by the TCAS Computer. Ownership is displayed as a miniature aircraft symbol approximately 1/3 of the way up from the bottom of the display. A range ring provides a fixed range marker of 2 miles around ownership. Displayed range is 6 miles forward and 2.5 miles aft.

WJE



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Dual Mode S TCAS Control Panel
Figure 7/34-46-00-990-883

WJE **WJE 412, 414 (Continued)**

WJE

WJE **5. TCAS Computer**

WJE A. The TCAS Computer Unit is located in the Electrical/Electronics Compartment (Figure 9). This unit contains all the required receivers, transmitters, and processing units. The TCAS processor contains dual microprocessors to handle the extensive processing required for surveillance and TCAS algorithms as well as to control display and maintenance functions. In addition to the computer unit there are two antennas required. One of these antennas (top antenna) is of a directional type and one (bottom antenna) is an omni directional blade antenna. The aircraft will be configured with only one directional antenna on the top of the fuselage and one omni directional antenna on the bottom. The purpose of having dual as opposed to single directional antennas is to preclude loss of intruder bearing when the intruder is being blocked from view of the single directional antenna by the aircraft fuselage.

WJE B. Complicated techniques are used in the surveillance logic to interrogate surrounding airspace in sections. This technique is used to limit unwanted replies and increase the effective density TCAS may operate in. This technique employs transmitting in four quadrants around the aircraft individually. In addition to this, a process known as "whisper shout" is used to interrogate each quadrant multiple times, each time with increasing power. This "whisper-shout" in conjunction with manipulation of side lobe suppression, allows TCAS to receive replies from very well defined sections of airspace.

WJE C. Each target aircraft tracked by the TCAS surveillance algorithms is assigned a number. A file is then established containing past track information on that intruder. That file is called the track file. The determination of whether or not the intruder meets the criteria for TA or RA status is determined by the Collision Avoidance System (CAS) processor. That determination is based on a parameter called "Tau". Tau is a calculation of the range over range rate. If an intruder is at 0.2 miles and has no rate of closure, then no alert is issued. On the other hand, if two aircraft are closing head-on at high rates of speed, alerts are issued. From this it can be seen that TCAS is protecting a time based airspace and not a range based airspace. It should also be noted that intruder bearing has no effect on TCAS operation. TCAS has the capability of tracking multiple targets while resolving conflicts on multiple intruders, i.e. don't climb or don't descend possibly. Target bearing, derived from the directional antenna, is used primarily in the posting of traffic information on the VSI/TRA Display. This information is used by the flight crew to aid in their visual search for traffic during the TA phase of an encounter.

WJE D. The TCAS Computer Unit has provisions for software update that can be done, utilizing a Portable Data Loader.

WJE E. Description of Chassis Panel Lamps for TCAS Computer Unit (CU).

WJE (1) TCAS PASS (Green) - This lamp shows that for the flight leg displayed the TCAS system was fully operational.

WJE (2) TCAS FAIL (Red) - This lamp shows that for the flight leg displayed the TCAS system failed.

WJE (3) TOP ANT FAIL (Red) - This lamp shows for the flight leg displayed the continuity test for the top antenna failed. When this lamp is on, the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (4) BOT ANT FAIL (Red) - This lamp shows for the flight leg displayed the continuity test for the bottom antenna failed. When this lamp is on, the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (5) HDG (Red) - Heading signal fail lamp. NOT SUPPORTED IN TCAS II AT THIS TIME AND REMAINS OFF DURING FLIGHT LEG STATUS DISPLAY PERIODS.

WJE (6) RA LOG (Red) - Log contains RA lamp. NOT SUPPORTED IN TCAS II AT THIS TIME AND REMAINS OFF DURING FLIGHT LEG STATUS DISPLAY PERIODS.

WJE **WJE 412, 414 (Continued)**
WJE

WJE (7) TA DISP (Red) - Traffic Advisory Display Fail Lamp. This lamp shows that for the flight leg displayed that both TA display valid discretes indicated a failure. When this lamp is on, the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (8) RA DISP (Red) - RA Display Fail Lamp. This lamp shows that for the flight leg displayed that both RA display valid discretes indicated a failure. When this lamp is on, the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (9) RAD ALT (Red) - Radio Altitude Fail Lamp. This lamp shows that for the flight leg displayed, the signal from the Radio Altimeter source was lost, or the valid discrete indicated a failure. When both Radio Altimeter sources have failed, the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (10) XPDR BUS (Red) - Mode S Transponder Bus Fail Lamp. This lamp shows that for the flight leg displayed, the signal from both Mode S Transponder buses have failed. When all transponder buses fail the TCAS FAIL lamp is also on and the TCAS PASS lamp goes out.

WJE (11) ATT (Red) - Attitude Signal Fail Lamp - This lamp shows that for the flight leg displayed the signal from the attitude source failed. NOT SUPPORTED IN TCAS II AT THIS TIME AND REMAINS OFF DURING FLIGHT LEG STATUS DISPLAY PERIODS.

WJE F. Certain signals are provided to the TCAS computer from aircraft sensors. Key inputs consist of the following:

WJE (1) Radio Altitude: Radio Altitude is provided to inhibit certain modes of TCAS while on final approach for landing. Specific inhibits are as follows:

WJE • at 1450 feet - INCREASE DESCEND commands are inhibited (-2500 fpm)

WJE • at 1000 feet - DESCEND commands are inhibited (- 1500 fpm)

WJE • < 1100 feet - CLIMBING inhibits all Resolution and Traffic Advisories

WJE • < 900 feet - DESCENDING inhibits all Resolution and Traffic Advisories.

WJE (2) Aircraft Pitch, Roll and Heading: This information is provided to allow for future enhancements of TCAS requiring the use of intruder bearing information in the CAS algorithms. Pitch, roll, and heading information would be used to stabilize that intruder bearing. These inputs are not connected.

WJE (3) Aircraft Altitude: Aircraft pressure altitude is provided to the TCAS computer via the Mode S transponder. This altitude, and the altitude rate derived from it, is used in the surveillance and CAS logic.

WJE (4) Air/Ground: Air/Ground information is used primarily for fault and maintenance recording purposes, and inhibits the lower antenna on the ground.

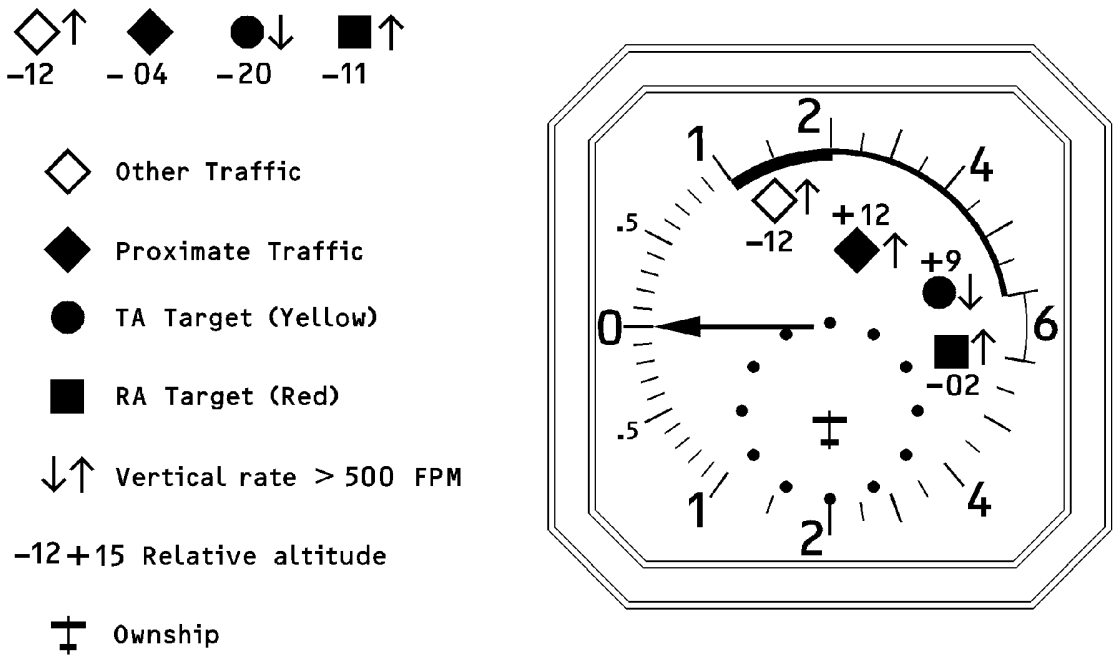
WJE (5) Altitude Inhibit Program: A fixed altitude at which all climbs are inhibited. This altitude is provided by configuration straps on the TCAS tray. For Midwest Express DC-9 aircraft this altitude is 38,000 feet.

WJE (6) Landing Gear Down: To provide performance limiting condition to TCAS when landing gear is extended. This information may be used to compensate for changes to the bottom antenna beam pattern when a directional antenna is installed.

WJE (7) GPWS Inhibit: TCAS monitors the GPWS system for a below glideslope and/or a pull up advisory when issued. The TCAS will revert to the "TRAFFIC ALERT ONLY" mode. Aural alerts will be inhibited.

WJE **WJE 412, 414 (Continued)**
WJE

WJE (8) Windshear Inhibit: TCAS monitors the windshear system warning and caution advisories.
WJE When the advisories are issued, TCAS will revert to the "TRAFFIC ALERT ONLY" mode. Aural
WJE alerts will be inhibited.
WJE



VSI/TRA
Figure 8/34-46-00-990-884

WJE

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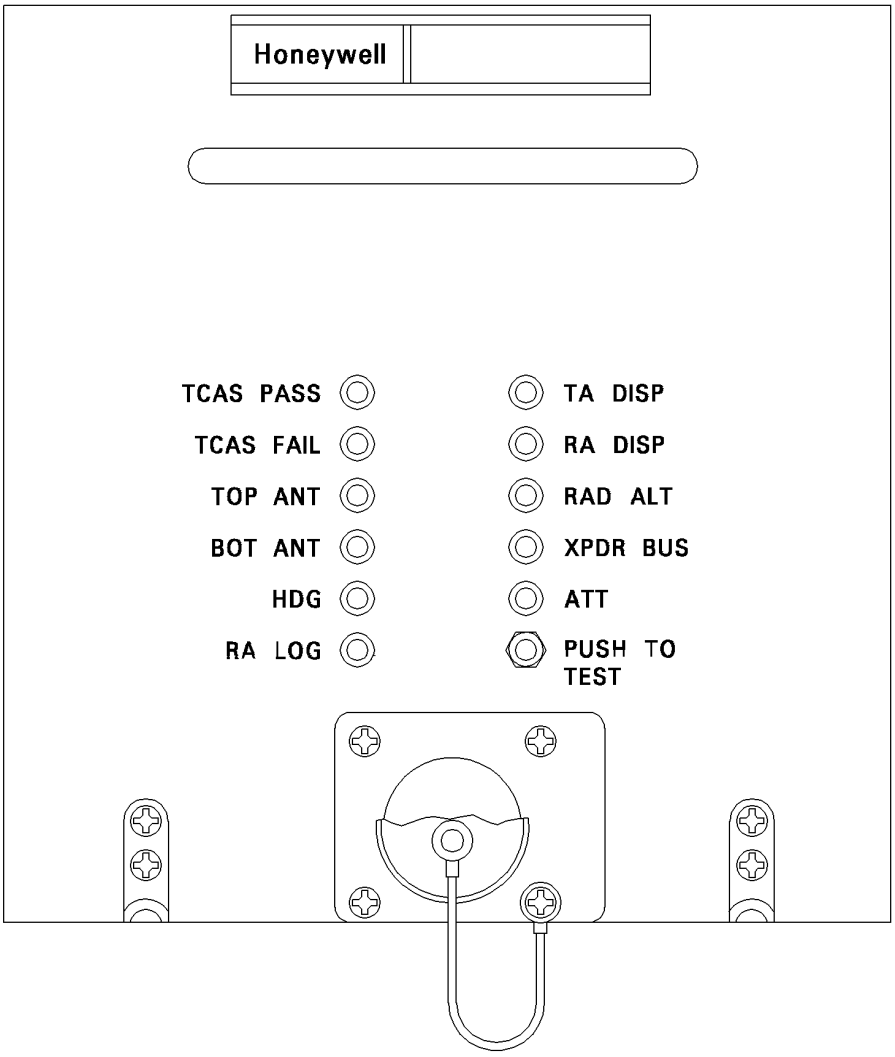

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S0006547440V2

TCAS Computer
Figure 9/34-46-00-990-885

WJE 410, 875-879

6. Description

WJE 410

A. The ATC/TCAS control panel is the master control for both the TCAS system and ATC/Mode S transponders. The control panel function selector knob provides the following functions:

(1) TEST - initiates ATC and TCAS self test.

(2) STBY - places ATC transponder and TCAS system in standby.

(3) ALT OFF - activates ATC transponder without altitude reporting. TCAS system in standby.

(4) ALT ON - activates ATC transponder with altitude reporting. TCAS system in standby.

(5) TA (Traffic Advisory) - presents traffic location on RA/TA/VSI's but does not issue resolution advisories. Activates ATC transponder and altitude reporting.

(6) TA/RA (Traffic Advisory and Resolution Advisory) - presents traffic location on RA/TA/VSI's and issues audio and visual resolution advisories for traffic determined to be a threat. Activates ATC transponder and altitude reporting.

WJE 875-879

B. The ATC/TCAS Control Panel is the master control for both the TCAS system and ATC/Mode S transponders. The control panel provides the following functions:

(1) Function Selector Knob:

(a) STBY - places ATC transponder and TCAS system in standby.

(b) XPDR ON - activates ATC transponder with altitude reporting. TCAS system in standby.

(c) TA (Traffic Advisory) - presents traffic location on RA/TA/VSI's but does not issue resolution advisories. Activates ATC transponder and altitude reporting.

(d) TA/RA (Traffic Advisory and Resolution Advisory) - presents traffic location on RA/TA/VSI's and issues audio and visual resolution advisories for traffic determined to be a threat. Activates ATC transponder and altitude reporting.

(2) TA DSPLY Knob:

(a) OFF - RA/TA/VSI's display normal vertical speed indications and resolution advisories only. Non-threat aircraft and traffic advisories are not shown.

(b) AUTO - RA/TA/VSI's display vertical speed and resolution advisories. Intruding aircraft symbols will pop-up on indicator when intruding aircraft are detected.

(c) ON - RA/TA/VSI's display vertical speed, resolution advisories and all intruding aircraft within range.

(3) TCAS TEST button: initiates TCAS self test.

WJE 410, 875-879

C. The TCAS computer performs all airspace surveillance, intruder tracking, traffic display, collision threat resolution and TCAS coordination functions. The computer is a receiver/ transmitter that interrogates the ATC transponders of other aircraft and generates traffic alerts and resolution advisories for the pilot. The computer also provides synthesized voice announcements through the TCAS cockpit speakers.

D. The Resolution Advisory/Traffic Advisory/Vertical Speed Indicators (RA/TA/VSI's) are full color LCD displays that replace the standard VSI's (Figure 10).

(1) Vertical speed is indicated by a pointer on a standard circular dial.

WJE 410, 875-879 (Continued)

(2) RA's are displayed as red and/or green arcs around the vertical speed scale. These arcs indicate whether to climb, descend or remain level. The required vertical maneuver will keep the vertical speed pointer in the green area and/or out of the red area.

(3) Own aircraft is shown as a cross symbol in bottom center of display. Dots around aircraft symbol show a fixed range of 2 nm.

(4) When the TCAS issues a TA or RA, the RA/TA/VSI will display intruding traffic. The indicators can show up to 30 intruders, each represented by one of four symbols. The symbols change shape and color to represent increasing levels of urgency. Each traffic symbol may have an altitude tag which shows the relative altitude of the intruder in hundreds of feet.

(a) A (+) sign and number above the symbol means the intruder is above own aircraft altitude.

(b) A (-) sign and number below the symbol means the intruder is below own aircraft altitude.

(c) A trend arrow appears next to the traffic symbol when the intruder's vertical rate is 500 feet per minute or greater.

(d) The range of the traffic display on the RA/TA/VSI's is fixed at 6 nm ahead of the aircraft and 3 nm behind.

(5) RA/TA/VSI's also display TCAS modes and fault messages.

WJE 410

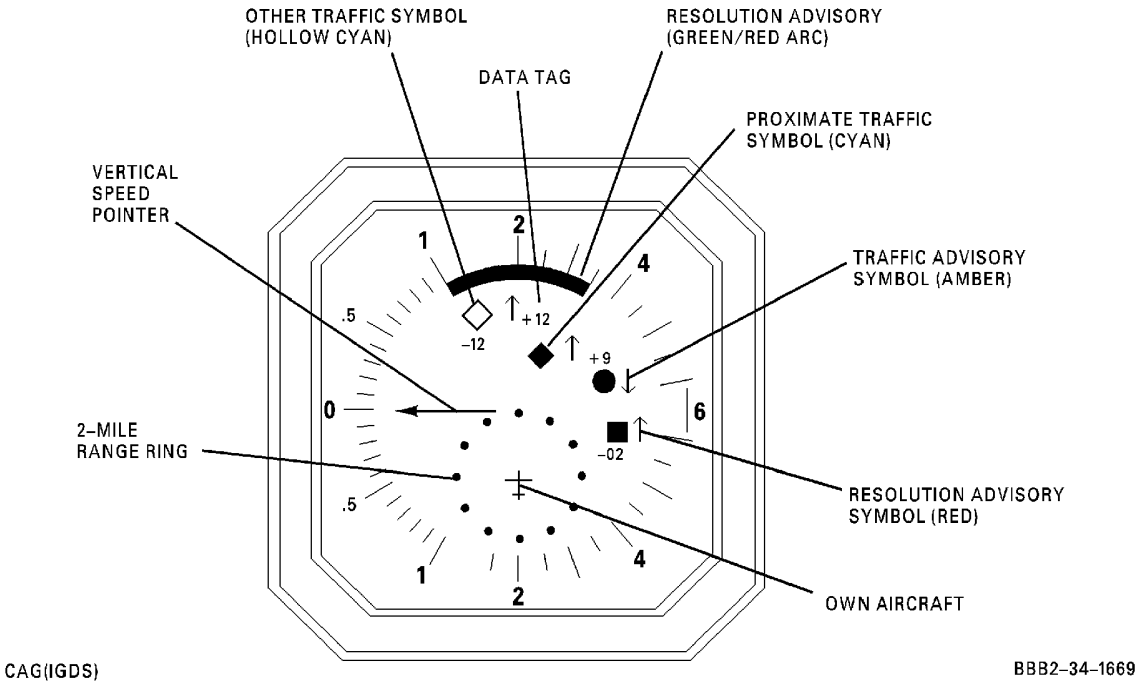
(6) TA SEL button: removes all intruding aircraft symbols from display. RA/TA/VSI's display normal vertical speed indications and resolution advisory arcs only. Intruding aircraft symbols will pop-up on indicator when a new intruding aircraft is detected.

WJE 410, 875-879

E. The TCAS provides synthesized voice warnings through two TCAS speakers located in the cockpit. The volume cannot be adjusted or turned off while TCAS is in operation.

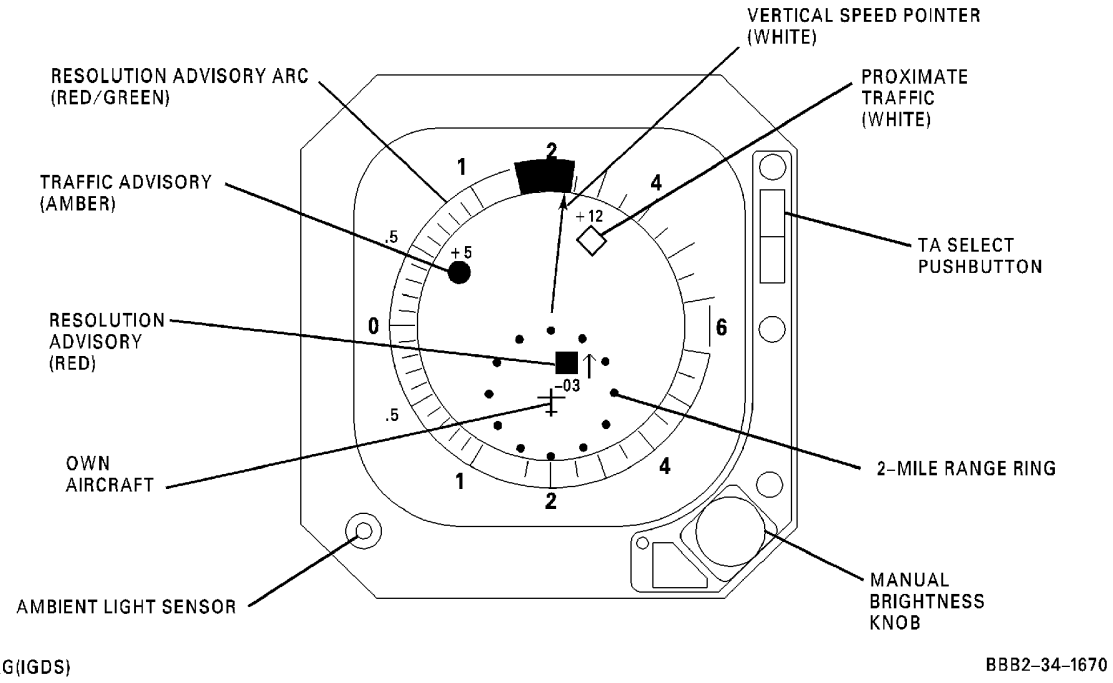
F. The TCAS uses two fuselage-mounted directional antennas, one upper and one lower. The two antennas allow the TCAS to monitor aircraft approaching from any direction and altitude within the surveillance range.

WJE 875-879



RA/TA/VSI Display
Figure 10/34-46-00-990-889 (Sheet 1 of 2)

WJE 410



RA/TA/VSI Display
Figure 10/34-46-00-990-889 (Sheet 2 of 2)

WJE 410, 875-879

7. Operation

A. The TCAS computer transmits interrogation messages at 1030 MHz to ATC transponders of nearby aircraft and receives reply messages at 1090 MHz. The computer uses the replies to compute range, relative bearing, altitude and closing rate of intruding aircraft. The TCAS works in conjunction with the ATC system AIR TRAFFIC CONTROL (ATC), SUBJECT 34-54-00.

B. ATC/Mode S transponders generate squitter messages once per second. The squitter message contains that aircraft's unique identification code (address). When a squitter message is received from a nearby Mode S transponder, the TCAS sends a Mode S interrogation to the address contained in the message. The reply is used to determine range, altitude and bearing of the intruding aircraft.

(1) In order to minimize interference with other aircraft and ATC on the 1030/1090 MHz channels, the rate at which the TCAS interrogates a Mode S aircraft depends on its range and closing speed. The interrogation rate increases to once per second when the intruder warrants a traffic advisory.

C. The TCAS interrogates Mode A and Mode C transponders once per second and uses the reply to determine range and relative bearing of the intruding aircraft. Replies from Mode C aircraft also provide altitude to the TCAS. No altitude data is received from Mode A aircraft.

D. The data from the transponders is used by the TCAS to predict the time to and the separation at the intruder's closest point of approach (CPA). If it determines that certain safe boundaries may be violated, the TCAS issues a traffic advisory to alert the crew that closing traffic is in the vicinity. If the intruder continues to close, the TCAS will issue a resolution advisory to ensure safe vertical separation between aircraft. RA's are not generated for intruders that do not report altitude.

E. When two or more TCAS equipped aircraft are involved, they coordinate their RA's by using a Mode S data link. This ensures that complementary RA's are generated in each aircraft.

F. Traffic within the range of TCAS surveillance is displayed on the RA/TA/VSI's as follows:

(1) Non-threat traffic is indicated by an open cyan diamond with an altitude tag. Non-threat traffic is more than 1200 feet above or below aircraft, or beyond 6 nautical miles.

(2) Proximity intruder traffic is indicated by a solid cyan diamond with an altitude tag. Proximity traffic is within 1200 feet and 6 nautical miles, but is still not considered a threat.

(3) A Traffic Advisory is indicated by a solid yellow circle with an altitude tag. A TA will be issued when intruding traffic is approximately 40 seconds from CPA, and will be accompanied by a voice announcing TRAFFIC, TRAFFIC. "TRAFFIC, TRAFFIC" will be annunciated down to 500 feet providing better situation awareness of traffic advisories while on approach. Aurals can be annunciated down to 500 feet.

NOTE: A trend arrow will appear next to the traffic symbol if the intruder's vertical rate is 500 feet per minute or greater. If the intruder does not report altitude, the traffic symbol will appear without an altitude tag or trend arrow. RA symbols will always have an altitude tag since altitude is required before an RA is issued.

(4) A resolution advisory is indicated by a solid red square with an altitude tag. An RA will be issued when intruding traffic is approximately 25 seconds from CPA, and will be accompanied by a voice announcing one of several vertical maneuver commands. The RA/TA/VSI's will indicate what vertical rate adjustment, if any, is necessary to provide adequate separation between aircraft. Resolution advisories are inhibited below 500 feet above ground level (AGL) or when aircraft is under windshear guidance.

(5) Off scale targets are indicated by a partial symbol located at the edge of the display area in the direction of the target. Associated data which falls outside the display area are not displayed.

WJE 410, 875-879 (Continued)

(6) RA and TA targets with no relative bearing information are indicated by range and altitude annunciations in the upper right corner of the display.

G. Resolution advisories are accompanied by voice announcements as follows:

Table 1

Announcement	Required Action
MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED	Ensure RA/VSI needle is kept out of red lighted area.
CLIMB, CLIMB, CLIMB INCREASE CLIMB, INCREASE CLIMB REDUCE CLIMB, REDUCE CLIMB	Establish vertical speed as indicated by green lighted area of RA/VSI. CLIMB RA's are inhibited when the maneuver cannot be completed safely due to performance limits.
DESCEND, DESCEND, DESCEND INCREASE DESCENT, INCREASE DESCENT REDUCE DESCENT, REDUCE DESCENT	Establish vertical speed as indicated by green lighted area of RA/VSI. INCREASE DESCENT RA is inhibited below 1800 feet AGL. DESCEND RA is inhibited below 1000 feet AGL.
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	Same as CLIMB, but indicates that own flight path will cross through intruder's.
DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND	Same as DESCEND, but indicates that own flight path will cross through intruder's.
CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	Change from DESCEND to CLIMB. Follows a DESCEND advisory when a reversal of vertical speed is necessary to provide adequate separation.
DESCEND, DESCEND NOW, DESCEND, DESCEND NOW	Change from CLIMB to DESCEND. Follows a CLIMB advisory when a reversal of vertical speed is necessary to provide adequate separation.

H. When intruder is no longer a threat a voice will announce CLEAR OF CONFLICT.

I. TCAS resolution advisories and aural warnings are inhibited:

(1) When aircraft is below 400 feet AGL.

(2) During GPWS aural warnings, except for GPWS "Minimums".

(3) When the aircraft is under windshear guidance.

WJE 875-879

J. TCAS self test is initiated when the TCAS TEST button is pressed for one second. TCAS TEST will be announced. TCAS should be tested only when aircraft is on the ground. When self test is complete a voice will announce TCAS TEST PASS or TCAS TEST FAIL.

NOTE: TCAS test can also be initiated by pressing the TEST switch on the front panel of the TCAS computer. All lamps on TCAS computer will come on for approximately 3 seconds, and TCAS PASS light on computer front panel will come on.

WJE 410

K. A Mode S transponder and TCAS self test is initiated when the function selector knob is held in the TEST position for one second. TCAS should be tested only when aircraft is on the ground. When self test is complete a voice will announce TCAS SYSTEM TEST OK or TCAS SYSTEM TEST FAIL.

NOTE: TCAS test can also be initiated by pressing the TEST switch on the front panel of the TCAS computer. All lamps on TCAS computer will come on for approximately 5 seconds, and OK will be displayed on computer front panel.

WJE 410, 875-879

L. TCAS self test is initiated when the control panel TEST button is pressed for one second. TCAS should be tested only when aircraft is on the ground. When self test is complete a voice will announce TCAS SYSTEM TEST OK or TCAS SYSTEM TEST FAIL.

8. To Operate System

A. Operate

(1) Energize aircraft electrical buses. (EXTERNAL POWER - DESCRIPTION AND OPERATION, PAGEBLOCK 24-40-00/001)

(2) On ATC/TCAS control panel, set function selector to STBY and allow approximately 5 minutes for equipment warmup. Rotate function selector to TA. Except for TEST mode, RA traffic is never displayed while aircraft is on the ground.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting procedures provided in this section are basic procedures for isolating and correcting a faulty TCAS system in the aircraft.

B. The basic causes of faulty system operation are generally, faulty aircraft wiring or faulty line replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the TCAS system are the control panel, TCAS Computer, Resolution Advisory/Traffic Advisory/Vertical Speed Indicators (RA/TA/VSI's), TCAS speakers, and TCAS antennas. The system interfaces with the ATC Mode S Transponders, Radio Altimeters, Windshear Computer, Ground Proximity Warning System, attitude and Air Data System. In trouble shooting, some checks may have to be made in those systems.

E. System components are located as follows:

Table 101

Component	Location
TCAS Computer	Radio Rack, Electrical/Electronics Compartment
ATC/TCAS Control Panel	Flight Compartment Pedestal
RA/TA/VSI's	Captain's and First Officer's Instrument Panels.
TCAS Circuit Breakers	Upper EPC and Overhead Circuit Breaker Panels
TCAS Speakers	Right and Left sides of cockpit below clearview
TCAS Antennas	Forward Top and Bottom Fuselage

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter, 2000A	Dana Instruments, Inc.

3. Trouble Shooting TCAS System

A. Trouble Shooting

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

WJE 875-879

Table 103

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	On ATC/TCAS control panel, place function selector switch to STBY.	

WJE 875-879 (Continued)

Table 103 (Continued)

Step	Procedure	Correction
(3)	Perform TCAS Self Test using TEST switch on front of the TCAS computer.	TCAS PASS light on front panel of TCAS computer comes on if test passes.
(4)	If self test fails, one or more fault lights will come on for 10 seconds.	Check the following failure description list (Table 104). Repair or replace the faulty component.
(5)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
(6)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated active components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 104

Fault Light	Failure Description
TCAS PASS	Minimum equipment required for TCAS operation is functional.
TCAS FAIL	TCAS computer failure.
TOP ANT	Top antenna failure or antenna wired incorrectly (element 1, 2, 3 or 4) - Indicates loss of continuity or incorrect resistance.
BOT ANT	Bottom antenna failure or antenna wired incorrectly (element 1, 2, 3 or 4) - Indicates loss of continuity or incorrect resistance.
HDG	NOT ACTIVE. Heading input is not required for TCAS operation. HDG light will not come on.
TA DISP	RA/TA/VSI 1 or 2 failure - Traffic advisory display function is not available.
RA DISP	RA/TA/VSI 1 or 2 failure - Resolution advisory display function is not available.
RAD ALT	Radio Altimeter failure (1, 2, or both) - If only one altimeter has failed, and no other failures exist, the TCAS PASS light will also come on.
XPDR BUS	Mode S Transponder 1 or 2 failure.
ATT	NOT ACTIVE. Attitude input is not required for TCAS operation. ATT light will not come on.
NOTE: The fault lights that come on after the initial test are for the current flight leg. If the TEST button is pressed again while the fault lights are on, the fault lights from the preceding flight leg will come on. Faults from up to 10 previous flight legs can be selected. When all flight legs have been shown, all of the fault lights will flash for 3 seconds then go off.	

Table 105

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	On ATC/TCAS control panel, place function selector switch to TA/RA.	
(3)	Perform TCAS Self Test using TEST switch on front of the TCAS computer.	Alphanumeric display on front panel of TCAS computer shows OK if test passes.
(4)	If self test fails, the front panel will show one or more fault codes.	Check the following failure description list (Table 106). Repair or replace the faulty component.
(5)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
(6)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated active components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.

Table 106

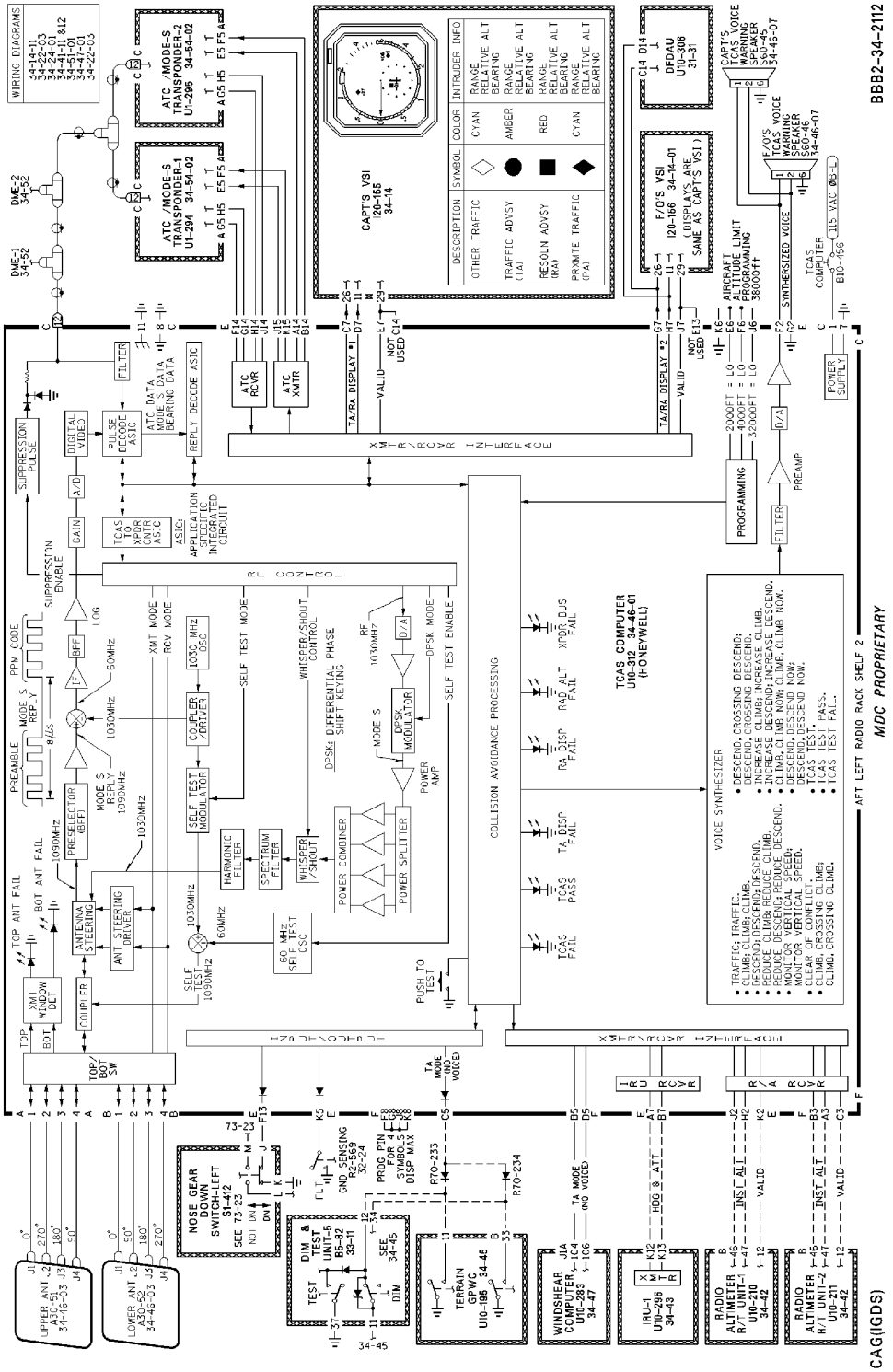
Fault Code	Failure Description
OK	No failure.
TP	TCAS computer failure.
T1, T2, T3, or T4	Top antenna failure or antenna wired incorrectly (element 1, 2, 3 or 4) - Indicates loss of continuity or incorrect resistance.
B1, B2, B3, or B4	Bottom antenna failure or antenna wired incorrectly (element 1, 2, 3 or 4) - Indicates loss of continuity or incorrect resistance.
X1 or X2	Mode S Transponder 1 or 2 failure.
RA	Radio Altimeter failure (1, 2, or both) - A single altimeter failure will not trigger a fault code unless other faults exist.
PT	Pitch attitude data failure.
RL	Roll attitude data failure.
HD	Heading data failure.
RD	RA/TA/VSI 1 or 2 failure - A single RA/TA/VSI failure will not trigger a fault code unless other faults exist.
PP	Program pin failure - One or more program pins on TCAS computer mount connector is shorted to ground.

WJE 410 (Continued)

Table 106 (Continued)

Fault Code	Failure Description
NOTE: The highest priority code will come on for approximately 3 seconds, then the next highest, continuing until all fault codes have been shown.	

WJE 410, 875-879



TCAS - Schematic
Figure 101/34-46-00-990-864

TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES

1. General

A. This section provides adjustment/test procedures to determine the operational status of the TCAS. The system is operated from a dual ATC Mode S/TCAS control panel on the pedestal. The selected Mode S transponder and the TCAS are tested at the same time when function selector knob is in TEST. TCAS self-test can also be initiated on the front panel of TCAS computer.

B. At least one radio altimeter and ATC Mode S transponder must be operational for successful TCAS test. The TCAS should be tested only on the ground.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 201

Name and Number	Manufacturer
Test Adapter, CADC Remote 5963440-1	The Boeing Company
Radio Altimeter Test Set 980N-1	Collins Mfg. Co
TCAS/ATC Mode S Ramp Test Set T-49	Tel-Instrument Electronics Corp.

3. Adjustment/Test Traffic Alert and Collision Avoidance System

A. TCAS Self Test

Table 202

	Operation	Desired Result
(1)	On overhead panel, set VERT GYRO switch to NORM position.	VERT GYRO in NORM.
(1a)	On ATC/TCAS control panel, rotate function selector knob to TA/RA position.	ATC/TCAS in TA/RA.
(2)	Rotate function selector knob to TEST position and hold for approximately one second.	Display tests initiated on RA/TA/VSI's.
NOTE: TCAS test can also be initiated by pressing the TEST switch on the front panel of the TCAS computer. All lamps on TCAS computer will come on for approximately 3 seconds, and OK will be displayed on computer front panel.		
(3)	On RA/TA/VSI's, verify that red and green arcs come on and TEST is displayed.	Red and green arcs on; TEST displayed.
(4)	Verify test patterns are displayed per Figure 201. Ignore all other symbology.	Traffic symbols verified.
(5)	After approximately 12 seconds, verify voice announcement at end of test.	Verify TCAS SYSTEM TEST OK or TCAS SYSTEM TEST FAIL is announced.
(6)	If TCAS SYSTEM TEST FAIL is announced, observe front panel of TCAS computer for failed component. (Figure 202)	Failure noted.

B. TCAS Antenna Bearing Functional Test

NOTE: This test is to be performed outdoors. Large structures such as hangar doors, blast walls, trailers, and other aircraft may reflect antenna signals and interfere with this test.

Table 203

Operation			Desired Result		
(1)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B10-436	WINDSHEAR COMPUTER	Upper EPC	POWER - RIGHT AC BUS	L/10
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(1a)	Connect the altimeter test set to Radio Altimeter-1 transceiver.		Test set connected.		
(2)	On altimeter test set, select altitude of 1500(±200) feet.		1500 feet selected.		
(3)	Connect CADC Remote Test Adapter to Air Data Computer-1.		Test adapter connected.		
(4)	On remote test adapter, select 9890 ft by placing No. 1 switch to ON; No. 2 and No. 3 switches to OFF.		1 ON; 2 and 3 OFF.		
(5)	On ATC/TCAS control panel, select ALT 1 and ATC 1; rotate function selector knob to TA/RA position.		ALT 1, ATC 1, and TA/RA selected.		
(6)	On T-49 TCAS ramp test set, connect the Flat Plate Directional Antenna to the Directional Antenna connector.		Directional Antenna connected.		
(7)	On T-49 test set, select MODE S function.		MODE S selected.		
(8)	Energize T-49 test set by pressing INTERROGATE.		Test set displays MODE S INTRUDER PRESS INTERROGATE.		
(9)	On T-49 test set scenario selector switch, select +1000'/4NMI/0 KTS position.		+1000'/4NMI/0 KTS selected.		
(10)	Place the T-49 test set at approximately the 2 o'clock position relative to the top TCAS antenna, 50 to 100 feet from aircraft.		Test set at approximately the 2 o'clock position.		
(11)	On T-49 test set, press INTERROGATE and observe display.		Test set displays +1000', 4NMI, 0 KTS. Target Alt 9890(±1000) feet.		
NOTE:	If Target Alt reads 0 ft, it may be necessary to move the T-49 test set or press INTERROGATE several times to obtain the correct readout.				
(12)	On RA/TA/VSI's, observe stationary diamond symbol.		Indicator displays diamond symbol at approximately the 2 o'clock position		
NOTE:	If the diamond symbol does not appear, or appears in a position different from the relative position of the test set, move the test set closer or farther from aircraft. Line of sight between the test set antenna and the TCAS top antenna normally ensures a target will be generated.				
NOTE:	Reflections can normally be eliminated by moving the T-49 test set to the opposite side of the aircraft. If diamond symbol does not appear in expected position, make certain antenna cables are properly connected and not crossed at the antenna or computer.				

Table 203 (Continued)

Operation		Desired Result
(13)	Repeat steps (10) through (12) with the T-49 test set at approximately the 12 o'clock position.	Diamond symbol displayed at approximately the 12 o'clock position.
(14)	Repeat steps (10) through (12) with the T-49 test at approximately the 10 o'clock position.	Diamond symbol displayed at approximately the 10 o'clock position.

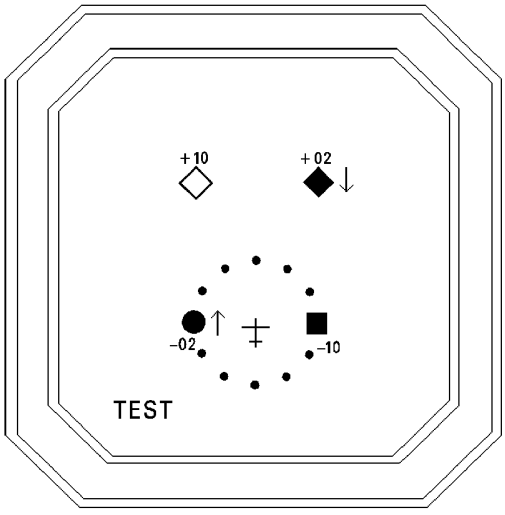
C. Ground Proximity Warning System (GPWS) Interface Test

Table 204

Operation					
			Desired Result		
(1)	Place FLAP/SLAT handle to UP/RET position.		FLAP/SLAT handle to UP/RET.		
WARNING:	MAKE SURE THE GROUND LOCK PINS ARE INSTALLED ON ALL THE LANDING GEAR. WITHOUT THE GROUND LOCK PINS, THE LANDING GEAR COULD RETRACT AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.				
(2)	With landing gear handle down, pull out and hold.		Landing gear handle down and out.		
(3)	Place the T-49 test set at approximately the 10 o'clock position relative to the top TCAS antenna, 50 to 100 feet from aircraft.		Test set at approximately the 10 o'clock position.		
(4)	On T-49 test set scenario selector switch, select 14NMI/720 KTS.		14NMI/720 KTS selected.		
(5)	On test set, press INTERROGATE and observe RA/TA/VSI's.		Within 90 seconds after INTERROGATE button was pressed, observe diamond symbol at approximately the 10 o'clock position moving toward aircraft. Altitude tag next to diamond symbol shows 00(±02).		
NOTE:	Range displayed on RA/TA/VSI's is limited to 6 nm.				
(6)	Make sure that the circuit breakers that follow are open.				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(7)	Observe RA/TA/VSI's.		Approximately one minute after INTERROGATE was pressed, diamond symbol changes to amber circle. "TRAFFIC, TRAFFIC" is heard from TCAS speakers.		
(8)	Observe RA/TA/VSI's.		Approximately 15 seconds after symbol changes to amber circle, symbol will change to red square; CLIMB or DESCEND is heard from TCAS speakers. Red and green arcs displayed on on RA/TA/VSI's.		
(9)	On T-49 test set, re-initiate scenario by pressing INTERROGATE.		INTERROGATE pressed.		

Table 204 (Continued)

Operation			Desired Result		
(10)	When CLIMB/DESCEND is commanded and RA/TA/VSI's display red and green arcs, hold GND PROX WARN switch on overhead panel in TEST position.		GND PROX WARN switch in TEST. TCAS audio stops; RA/TA/VSI red and green arcs go off.		
(11)	Observe RA/TA/VSI's.		TA ONLY displayed.		
(12)	Release GND PROX WARN switch and landing gear handle.				
(13)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B10-436	WINDSHEAR COMPUTER	Upper EPC	POWER - RIGHT AC BUS	L/10
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(14)	Remove test equipment and return aircraft to required configuration.				



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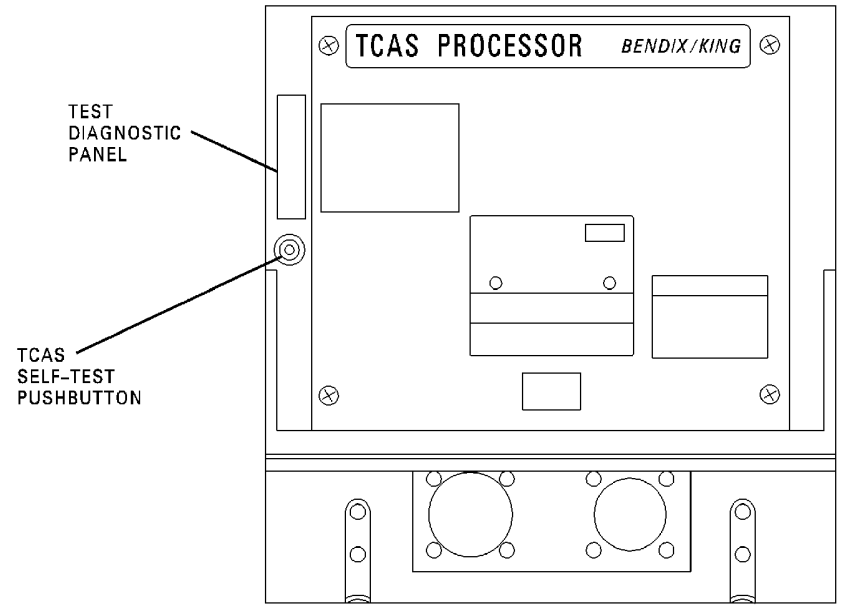
BBB2-34-1671

TCAS Test Display Pattern
Figure 201/34-46-00-990-846



TCAS Computer Front Panel
Figure 202/34-46-00-990-847

TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES

1. General

A. This section provides adjustment/test procedures to determine the operational status of the TCAS. The system is operated from a dual ATC Mode S/TCAS control panel on the pedestal. The TCAS is tested when the TCAS TEST button is pressed. TCAS self-test can also be initiated on the front panel of TCAS computer.

B. At least one radio altimeter and ATC Mode S transponder must be operational for successful TCAS test. The TCAS should be tested only on the ground.

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 201

Name and Number	Manufacturer
Test Adapter, CADC Remote 5963440-1	The Boeing Co.
Radio Altimeter Test Set 980N-1	Collins Mfg. Co.
TCAS/ATC Mode S Ramp Test Set T-49	Tel-Instrument Electronics Corp.
Foam, Microwave absorbing Eccosorb CV-6 DMS 2358	Emerson and Cuming Canton, Mass.

3. Adjustment/Test Traffic Alert and Collision Avoidance System

A. TCAS Self Test

Table 202

Operation			Desired Result		
(1)	Open these circuit breakers and install safety tags:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-223	WING & TAIL VALVE	Lower EPC	ICE PROTECTION LEFT DC BUS	M/24
	B1-509	FWD DRAIN MAST HEATER	Lower EPC	AC BUS	X/27
	B1-507	AFT DRAIN MAST HEATER	Lower EPC	AC BUS	Z/27
(2)	On overhead panel, place CADC switch to NORM position.		CADC switch at NORM.		
(3)	On ATC/TCAS control panel, rotate function selector knob to STBY position.		ATC/TCAS in STBY.		
(4)	Press TCAS TEST button and hold for approximately one second.		TCAS TEST is announced; display tests initiated on RA/TA/VSI's.		
NOTE: TCAS test can also be initiated by pressing the TEST switch on the front panel of the TCAS computer. All lamps on TCAS computer will come on for approximately 3 seconds, and TCAS PASS light on computer front panel will come on for approximately 10 seconds.					

Table 202 (Continued)

	Operation	Desired Result
(5)	On RA/TA/VSI's, verify that red and green arcs come on and TCAS TEST is displayed.	Red and green arcs on; TCAS TEST displayed.
(6)	Verify test patterns are displayed per Figure 201. Ignore all other symbology.	Traffic symbols verified.
(7)	After approximately 12 seconds, verify voice announcement at end of test.	Verify TCAS TEST PASS or TCAS TEST FAIL is announced.
(8)	If TCAS TEST FAIL is announced, observe front panel of TCAS computer for failed component. (Figure 202)	Failure noted.

B. TCAS Antenna Bearing Functional Test

NOTE: This test is to be performed outdoors. Large structures such as hangar doors, blast walls, trailers, and other aircraft may reflect antenna signals and interfere with this test. Top ATC transponder antennas (ATC-1) should be covered with RF absorbent material to prevent transmissions of false targets to other overflying aircraft.

Table 203

	Operation	Desired Result
(1)	Connect the altimeter test set to Radio Altimeter-1 transceiver.	Test set connected.
(2)	On 980N-1 test set, select altitude of 1000(±200) feet.	1000 feet selected.
(3)	Connect CADC Remote Test Adapter to Air Data Computer-1.	Test adapter connected.
(4)	On remote test adapter, select 9890 ft by placing No. 1 switch to ON; No. 2 and No. 3 switches to OFF.	1 ON; 2 and 3 OFF.
(5)	On ATC/TCAS control panel, select ALT RPTG 1, TA DSPLY ON, and XPDR 1. Rotate function selector knob to TA/RA position.	ALT RPTG 1, TA DSPLY ON, XPDR 1, and TA/RA selected.
(6)	On T-49 TCAS ramp test set, connect the flat plate directional antenna to the directional antenna connector.	Directional antenna connected.
(7)	On T-49 test set, select MODE S function.	MODE S selected.
(8)	Energize T-49 test set by pressing INTERROGATE.	Test set displays MODE S INTRUDER PRESS INTERROGATE.
(9)	On T-49 test set scenario selector switch, select +1000'/4NMI/0 KTS position.	+1000'/4NMI/0 KTS selected.
(10)	Place the T-49 test set at approximately the 2 o'clock position relative to the top TCAS antenna, 50 to 100 feet from aircraft.	Test set at approximately the 2 o'clock position.
NOTE: Test set antenna should be facing and in line of sight with aircraft bottom TCAS antenna.		
(10a)	Open the circuit breakers that follow:	

Table 203 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(11)	On T-49 test set, press INTERROGATE and observe display.		Test set displays +1000', 4NMI, 0 KTS. Target Alt 9890(±1000) feet.		
NOTE: If Target Alt reads 0 ft, it may be necessary to move the T-49 test set or press INTERROGATE several times to obtain the correct readout.					
(12)	On RA/TA/VSI's, observe stationary diamond symbol.		Indicator displays diamond symbol at approximately the 2 o'clock position, 4 nm from own aircraft symbol.		
NOTE: If the diamond symbol does not appear, or appears in a position different from the relative position of the test set, move the test set closer or farther from aircraft. Line of sight between the test set antenna and the TCAS top antenna normally ensures a target will be generated.					
NOTE: Reflections can normally be eliminated by moving the T-49 test set to the opposite side of the aircraft. If diamond symbol does not appear in expected position, make certain antenna cables are properly connected and not crossed at the antenna or computer.					
(14)	Repeat steps (10) through (12) with the T-49 test set at approximately the 9 o'clock position.		Diamond symbol displayed at approximately the 9 o'clock position, 4 nm from own aircraft symbol.		
(15)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33

C. Ground Proximity Warning System (GPWS) Interface Test

Table 204

Operation			Desired Result		
WARNING: BEFORE MOVING FLAP/SLAT HANDLE, MAKE CERTAIN THAT AREAS AROUND FLAPS AND SLATS ARE CLEAR OF PERSONNEL AND EQUIPMENT.					
(1)	Place FLAP/SLAT handle to UP/RET position.		FLAP/SLAT handle to UP/RET.		
(1a)	Open the circuit breaker that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	UPPER EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	UPPER EPC	R AC BUS	L/33

Table 204 (Continued)

Operation	Desired Result
WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND ALL LANDING GEAR GROUND LOCKPINS ARE INSTALLED. THIS WILL HELP PREVENT INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT.	
(2) With landing gear handle down, pull out and hold.	Landing gear handle down and out.
(3) Place the T-49 test set at approximately the 2 o'clock position relative to the top TCAS antenna, 50 to 100 feet from aircraft.	Test set at approximately the 2 o'clock position.
NOTE: Test set antenna should be facing and in line of sight with aircraft bottom TCAS antenna.	
(4) On T-49 test set scenario selector switch, select 14NMI/720 KTS.	14NMI/720 KTS selected.
(5) On test set, press INTERROGATE and observe RA/TA/VSI's.	Within 30 seconds after INTERROGATE button was pressed, observe diamond symbol at approximately the 2 o'clock position moving toward aircraft. Altitude tag next to diamond symbol shows 00 (±02).
NOTE: Range displayed on RA/TA/VSI's is limited to 6.5 nm.	
(6) Observe RA/TA/VSI's.	Approximately 1 minute after INTERROGATE was pressed, diamond symbol changes to amber circle. "TRAFFIC, TRAFFIC" is heard from TCAS speakers.
(7) Observe RA/TA/VSI's.	Approximately 15 seconds after symbol changes to amber circle, symbol will change to red square; CLIMB or DESCEND is heard from TCAS speakers. Red and green arcs displayed on RA/TA/VSI's.
(8) On T-49 test set, re-initiate scenario by pressing INTERROGATE.	INTERROGATE pressed.
(9) When CLIMB/DESCEND is commanded and RA/TA/VSI's display red and green arcs, hold GND PROX WARN switch on overhead panel in TEST position.	GND PROX WARN switch in TEST. TCAS audio stops; RA/TA/VSI red and green arcs go off.
(10) Observe RA/TA/VSI's.	TA ONLY displayed.
(11) Release GND PROX WARN switch and landing gear handle.	
(12) Close the circuit breakers that follow:	

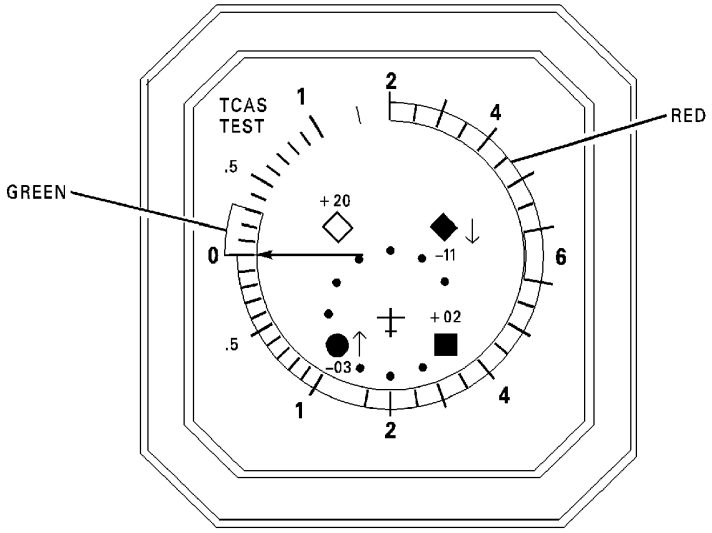
REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33

(15)	Remove test equipment.
(16)	Remove tags and close the circuit breakers that follow:

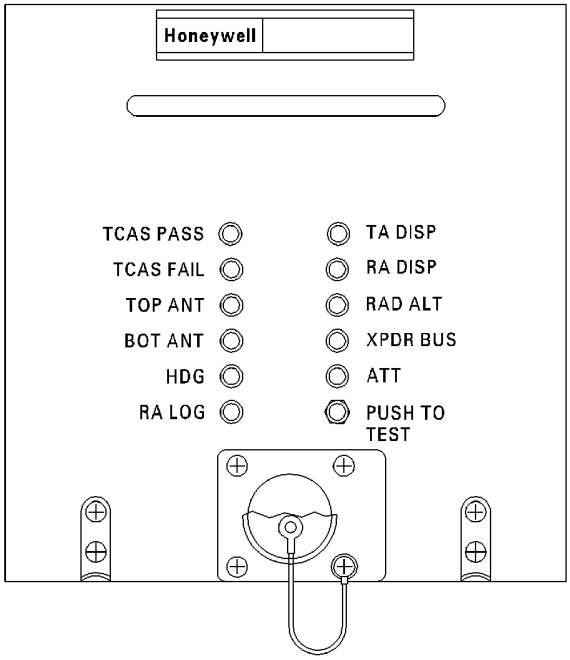
REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 204 (Continued)

	Operation		Desired Result		
	B1-223	WING & TAIL VALVE	Lower EPC	ICE PROTECTION LEFT DC BUS	M/24
	B1-509	FWD DRAIN MAST HEATER	Lower EPC	AC BUS	X/27
	B1-507	AFT DRAIN MAST HEATER	Lower EPC	AC BUS	Z/27
(17)	Return aircraft to required configuration.				



TCAS Test Display Pattern
Figure 201/34-46-00-990-843



CAG(IGDS)

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TCAS Computer Front Panel
Figure 202/34-46-00-990-844

WJE

TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES

WJE

1. General

WJE A. The TCAS System test uses the TTR-920/-921 built-in test equipment (BITE) functions to verify system operation.

WJE B. All systems interfacing with the TCAS system must be operational when performing this test.

WJE

2. TCAS SYSTEM TEST

WJE A. Select the TA/RA mode, transponder 1/L (or 2/R) and altitude reporting to the ALT on or ALT 1/L (or 2/R) position on the control panel.

WJE B. Set the ABOVE-N-BELOW switch to the N (normal) position.

WJE NOTE: In the following tests, other aircraft operating in the vicinity of the aircraft being tested may result in traffic being displayed on the TVI-920. If the TCAS system determines that this traffic is a traffic advisory, then the aircraft traffic symbol/data tag and the mode message will be displayed in yellow. Since an RA or TA will put the indicator into the traffic mode, this will prevent selection of the pop-up mode of operation.

WJE C. Observe the captain's and first-officer's VSI/RA/TA indicators and verify that they are displaying the vertical speed scale, pointer and legend VERT SPEED X1000 FPM. (Press and release the M (mode) pushbutton on the indicator if traffic is being displayed.)

WJE D. Push and release the M (mode) pushbutton on each indicator. Verify that: the VERTSPEED X1000 FPM legend is replaced by an aircraft symbol and range ring, the message ONLY TA is displayed in the upper left corner, and the message 6NM (or 12 NM) is displayed in the upper right corner of the display.

WJE E. Push and release the R (range) pushbutton and verify the range message changes to 12NM (or 6NM) and that the range ring is reduced (expanded) in size. Select the 6 NM range.

WJE F. At the TTR-920/-921 TCAS Transmitter-Receiver, perform a test of the TCAS system by pushing and releasing the front panel test switch. Verify the following:

WJE NOTE: Some system red lamps (LEDs) may come on momentarily but will go off before the end of the test. The TTR PASS lamp (green LED) should be the only lamp on when the test ends.

WJE (1) All lamps come on for approximately 1 second.

WJE (2) All lamps go off momentarily.

WJE (3) TTR PASS lamp comes on.

WJE (4) TTR PASS lamp goes off approximately 10 seconds after the TEST button is released.

WJE G. On the ATC control panel, momentarily select the TEST position or press and release the TEST pushbutton. Verify the following displays on the control panel and on the two VSI/RA/TA indicators.

WJE NOTE: The test pattern will continue to be displayed as long as the test switch/pushbutton is held in TEST. The audio message will not occur until after the switch/pushbutton is released.

WJE (1) The code readout displays 8888 for 1 second.

WJE (2) The ATC FAIL lamp comes on for 1 second and then goes off and remains off.

WJE (3) The TEST message is displayed in the lower center of the indicator under the airplane symbol.

WJE (4) An RA test pattern is displayed adjacent to the VSI scale as follows:

WJE (a) Red arc from +2000 to +6000, or the greatest positive vertical rate displayed.

WJE (b) Red arc from 0 to -6000, or the greatest negative vertical rate displayed.

WJE (c) Green arc from 0 to approximately +300.

WJE (5) A traffic test pattern is displayed in the center of the indicator as follows:

WJE (a) RA intruder (solid red square), 2 nmi distance, +90 degrees bearing (3 o'clock position), and with a relative altitude of +02(+200 feet); displayed above the intruder symbol.

WJE (b) TA intruder (solid yellow circle), 2 nmi distance, -90 degrees bearing (9 o'clock position), and with a relative altitude of -02 (-200 feet); displayed below the intruder symbol with an up arrow to the right of the intruder symbol.

WJE (c) Proximity intruder (solid cyan diamond), 3.6 nmi distance, +35 degrees bearing (1 o'clock position), and with a relative altitude of -10 (-1000 feet); displayed below the intruder symbol with a down arrow to the right of the intruder symbol.

WJE (d) Other intruder (open cyan diamond), 3.6 nmi distance, -35 degrees bearing (11 o'clock position), and with a relative altitude of +10 (+1000 feet); displayed above the intruder symbol.

WJE (6) The indicator reverts back to the normal traffic display after 8 seconds.

WJE (7) The aural annunciation “TCAS SYSTEM TEST OK occurs at the end of the self-test sequence.

WJE H. Select the TA ONLY mode on the control panel and repeat (Paragraph 2.G.)

WJE I. Set the ABOVE-N-BELOW switch to the ABOVE position. The message ABV will be displayed in the upper right corner of the display below the range message.

WJE J. Set the ABOVE-N-BELOW switch to the BELOW position. The message BLW will be displayed in the upper right corner of the display below the range message. Return the switch to the N (normal) position.

WJE K. Select the altitude reporting switch ALT/OFF to ALT 1/L (or 2/R) to the OFF position and verify that the VSI displays the TCAS OFF message in the upper right corner and no traffic is displayed on the indicator. Return the altitude switch to ALT on or ALT 1/L (or 2/R) position.

WJE L. Select the XPDR mode and verify the VSI displays the TCAS OFF message in the upper right corner and no traffic is displayed on the indicator.

WJE M. Select the STBY mode and verify the VSI displays the TCAS OFF message in the upper right corner and no traffic is displayed on the indicator.

WJE N. If the correct results are obtained in steps (1) through (13), the system is operating correctly. If incorrect results are obtained, refer to the troubleshooting procedures.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-46-00-720-801

2. Functional Check of the Traffic Alert and Collision Avoidance System (TCAS)

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
34-46-00 P/B 201 Config 1	TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES
34-46-00 P/B 201 Config 3	TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES
34-46-00 P/B 201 Config 7	TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES

B. Traffic Alert and Collision Avoidance System (TCAS) Functional Check

WJE 410, 875-879

SUBTASK 34-46-00-720-002

(1) Do a functional check of the traffic alert and collision avoidance system. (TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-46-00/201 Config 1 or TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-46-00/201 Config 3)

WJE 412, 414

SUBTASK 34-46-00-720-003

WJE (2) Do a functional check of the traffic alert and collision avoidance system. (TRAFFIC
WJE COLLISION AVOIDANCE SYSTEM (TCAS) - MAINTENANCE PRACTICES,
WJE PAGEBLOCK 34-46-00/201 Config 7)

WJE **WJE 410, 412, 414, 875-879**

C. Job Close-up

SUBTASK 34-46-00-942-001

(1) Remove all the tools and equipment from the work area. Make sure the area is clean.

END OF TASK

TCAS COMPUTER - MAINTENANCE PRACTICES

1. General

WJE 410, 875-879

A. This maintenance practice provides removal/installation procedures for the TCAS computer. The computer is installed in the left aft radio rack in the electrical/electronics compartment. Operation of the computer is controlled by the ATC/TCAS control panel on the pedestal.

WJE 412, 414

WJE B. The TCAS II Computer Unit is located in the Electrical Compartment. This unit contains all of the
WJE required receivers, transmitters, and processing units. The TCAS II processor contains dual
WJE microprocessors to handle the extensive processing required for surveillance and CAS algorithms,
WJE as well as to control display and maintenance practices.

WJE **WJE 410, 412, 414, 875-879**

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	Arco Corp.

3. Removal/Installation TCAS Computer

A. Remove TCAS Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: THE TCAS COMPUTER UNIT IS AN ELECTROSTATIC DISCHARGE SENSITIVE DEVICE. DAMAGE TO INTERNAL COMPONENTS MAY BE CAUSED BY A SINGLE STATIC DISCHARGE, I.E. TOUCHING ELECTRICAL CONNECTOR PINS. MAINTENANCE PRACTICES CONSISTING OF REMOVING ELECTRICAL POWER AND USING PROTECTIVE PIN PROTECTOR DUST CAPS WHEN REMOVING OR INSTALLING TRANSPONDER CONTROL PANELS SHOULD BE OBSERVED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
WJE H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
WJE 412, 414			
WJE F	14	B10-456	TCAS AC

WJE **WJE 410, 412, 414, 875-879**

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(3) If installed, turn driver/extractor handle CCW, otherwise pull unit straight out until electrical connectors are disengaged from rack connectors, and remove unit.

NOTE: Do not shake unit up and down to loosen connector, or connector pins may be damaged.

(4) Install a dust cap on the connectors.

B. Install TCAS Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT AC BUS

	Row	Col	Number	Name
	WJE 410, 875-879			
WJE	H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

	Row	Col	Number	Name
WJE				
WJE	**WJE 412, 414**			
WJE	F	14	B10-456	TCAS AC
WJE	**WJE 410, 412, 414, 875-879**			

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(2) Remove the protective caps from the electrical connector.

(3) Visually check unit connector plugs and mating connectors on mounting rack for loose, broken or dirty connector pins or wires.

(4) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(5) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW, if installed, otherwise push unit straight in until firmly engaged.

(6) Engage holddown assemblies on unit, and tighten holddown nuts.

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT AC BUS

	Row	Col	Number	Name
	WJE 410, 875-879			
WJE	H	16	B10-456	TCAS COMPUTER

WJE **WJE 410, 875-879 (Continued)**

WJE

WJE

WJE **UPPER EPC, LEFT RADIO AC BUS**

	Row	Col	Number	Name
WJE	**WJE 412, 414**			
WJE	F	14	B10-456	TCAS AC

WJE (8) Perform TCAS system test. (TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) -
WJE MAINTENANCE PRACTICES, PAGEBLOCK 34-46-00/201 Config 7)

WJE 410, 875-879

(9) Perform TCAS Self Test only.

(TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM, SUBJECT 34-46-00)

(10) Return aircraft to required configuration.

WJE 410, 412, 414, 875-879

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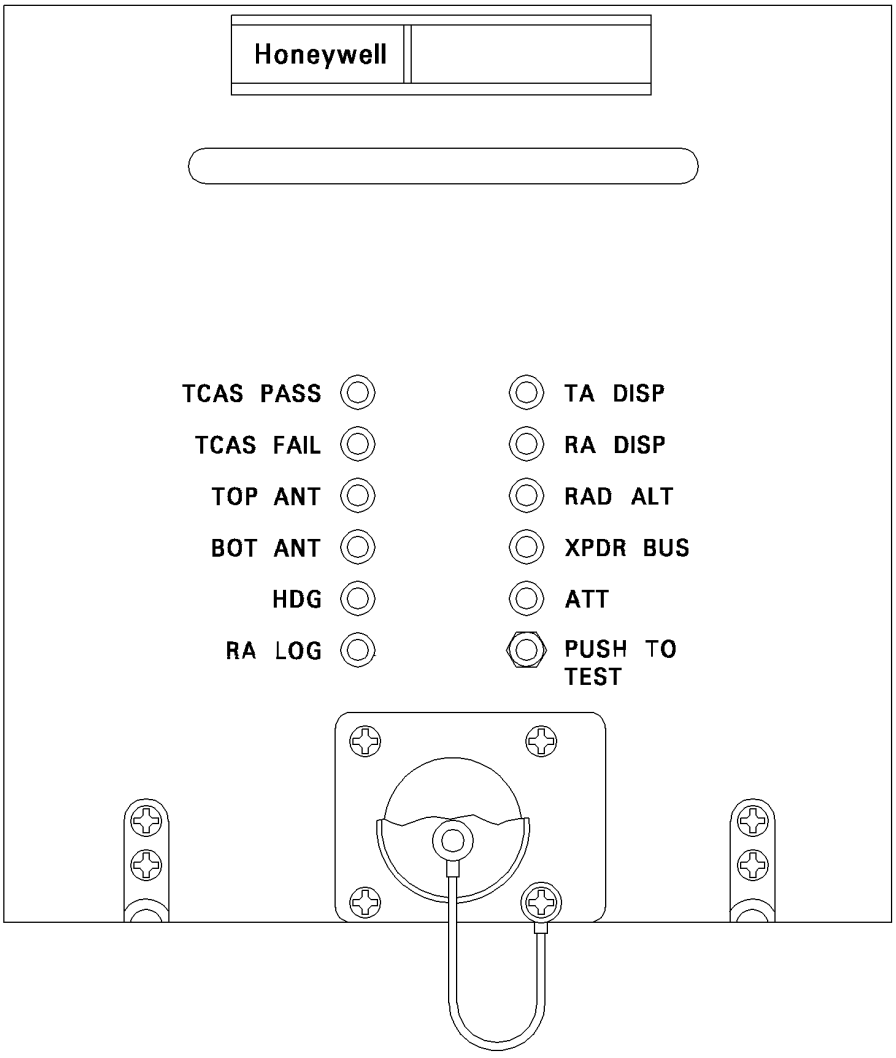

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WJE

TCAS Computer Unit
Figure 201/34-46-01-990-802

TCAS ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Traffic Alert and Collision Avoidance System (TCAS) directional antenna and cover plates.

WJE 410, 875-879

B. Two pancake-type antennas are installed on the upper and lower forward fuselage.

WJE 412, 414

WJE C. In addition the TCAS computer unit and control panel, two antennas are required.

WJE **WJE 410, 412, 414, 875-879**

D. Removal and installation procedures are typical of all installations except as noted.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	Arco Corp.
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation TCAS Antenna

A. Remove TCAS Antenna.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
WJE H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
WJE **WJE 412, 414**			
WJE F	14	B10-456	TCAS AC

WJE 412, 414 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	4	B10-294	WEATHER RADAR IND

WJE 410, 412, 414, 875-879

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scrapper.

(3) Remove antenna mounting screws.

CAUTION: CORRECT COAXIAL CABLE CONNECTION IS CRITICAL. THE COLOR CODED CABLES MUST MATCH THE COLOR CODING OF THE ANTENNA CONNECTORS.

(4) Make a record or tag each coaxial cable connectors for installation procedure.

(5) Support antenna and disconnect antenna coaxial cable connectors. Cap electrical connectors. Attach the coaxial connector to the fuselage using masking tape.

NOTE: Due to the difficulty of retrieval, ensure coax cable does not fall completely inside fuselage.

WJE 410, 875-879

(6) Remove antenna and antenna O-ring.

WJE 412, 414

WJE (7) Remove antenna and gasket.

WJE **WJE 410, 412, 414, 875-879**

B. Install TCAS Antenna.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
WJE H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
WJE **WJE 412, 414**			
WJE F	14	B10-456	TCAS AC

WJE 412, 414 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 410			
F	4	B10-294	WEATHER RADAR IND

WJE 410, 412, 414, 875-879

(2) Clean area of the antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Prepare the antenna surface for Radio Frequency (RF) bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

WJE 410, 875-879

(4) Remove antenna gasket if installed and discard (non-hazardous material).

(5) Install new O-ring in antenna base groove.

WJE 412, 414

WJE (6) Make sure antenna has a gasket.

WJE **WJE 410, 412, 414, 875-879**

(7) Apply faying surface seal between the antenna and the aircraft surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(8) Install antenna assembly.

CAUTION: CORRECT COAXIAL CABLE CONNECTION IS CRITICAL. THE COLOR CODED CABLES MUST MATCH THE COLOR CODING OF THE ANTENNA CONNECTORS.

(a) Remove protective caps and check for damage and unwanted material.

1) Connect antenna coaxial cable connectors to antenna.

WJE 412, 414

WJE 2) Directional Antenna Connector Color Code is as follows:

WJE • J1 -Yellow

WJE • J2 -Black

WJE • J3 -Blue

WJE • J4 -Red.

WJE 410, 875-879

(b) Observe the color coded connections.

WJE 410, 412, 414, 875-879

(c) Place antenna in mounting position and install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws.

a) Torque the attachment screws again 10 minutes after the initial torque.

(d) Remove sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(9) Do a RF bond check of the TCAS antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(10) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(11) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
H	16	B10-456	TCAS COMPUTER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 412, 414			
F	14	B10-456	TCAS AC

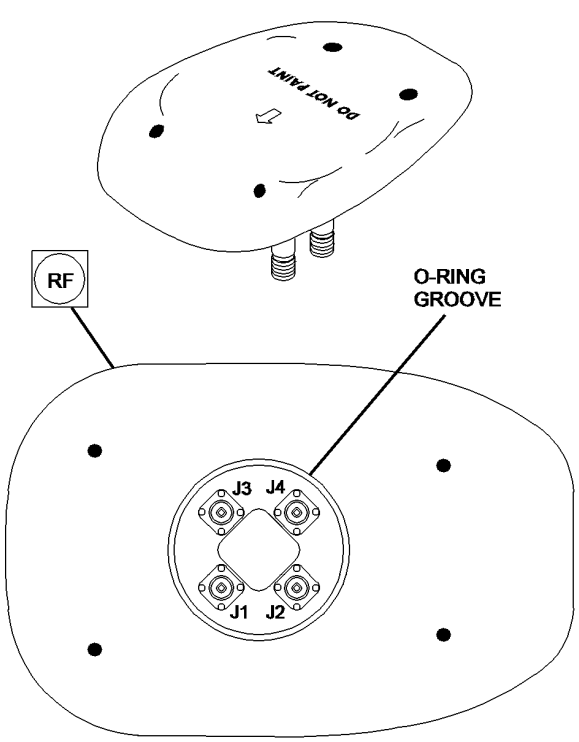
UPPER EPC, RIGHT RADIO AC BUS

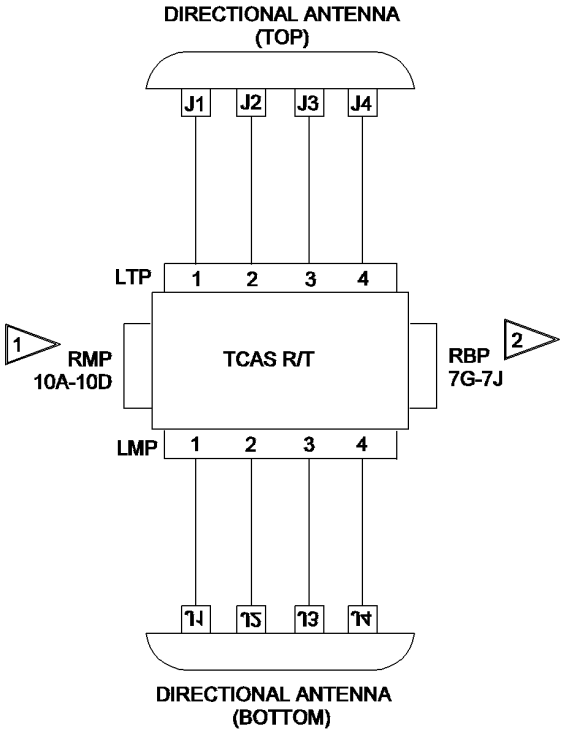
Row	Col	Number	Name
WJE 410			
F	4	B10-294	WEATHER RADAR IND

WJE 410, 412, 414, 875-879

C. Perform TCAS Self Test.

D. Return aircraft to required configuration.





DIRECTIONAL ANTENNA RESISTANCES (±20%)

J1 - YELLOW BAND	5.62K Ω
J2 - BLACK BAND	15.0K Ω
J3 - BLUE BAND	33.2K Ω
J4 - RED BAND	86.6K Ω

NO CONN. REQ'D

NOTES:

- Insertion loss for top & bottom ant. cables shall be between 0 to 4.0 dB. Measured value is programmed during system installation in acft.
- Differential insertion loos between each cable of a cable set (top or bottom) shall not vary more than .5 dB.
- Differential phase delay between each cable of a cable set (top or bottom) shall not vary more than one wavelength at 1090 MHz. and is programmed during system installation in acft.
- VSWR of each installed antenna cable must not be more than 1.4 : 1.

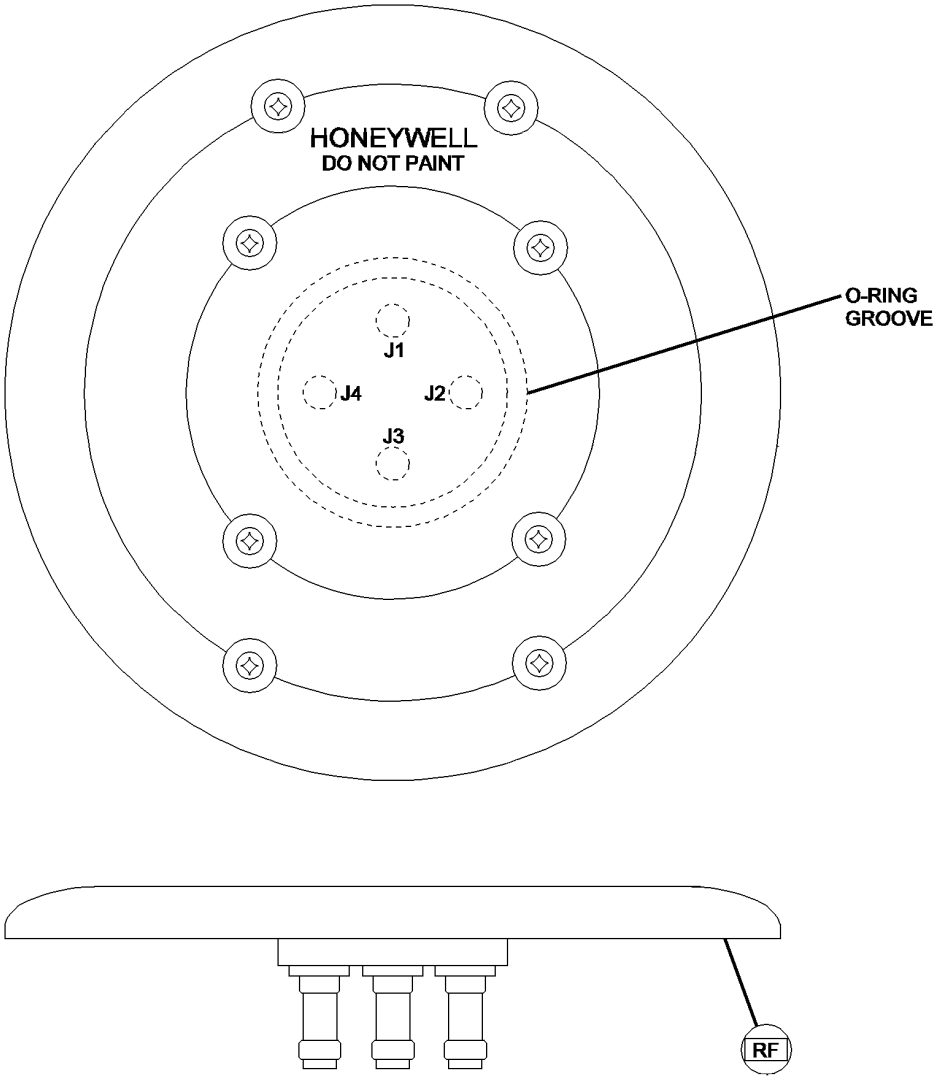
TCAS R/T ANTENNA PROGRAM PINS
(Jumpers Installed At Time Of System's Installation In Acft.)

1 • INSERTION LOSS FOR TOP & BOTTOM ANT. CABLES

2 • DIFFERENTIAL PHASE DELAY BETWEEN TOP & BOTTOM ANT. CABLES

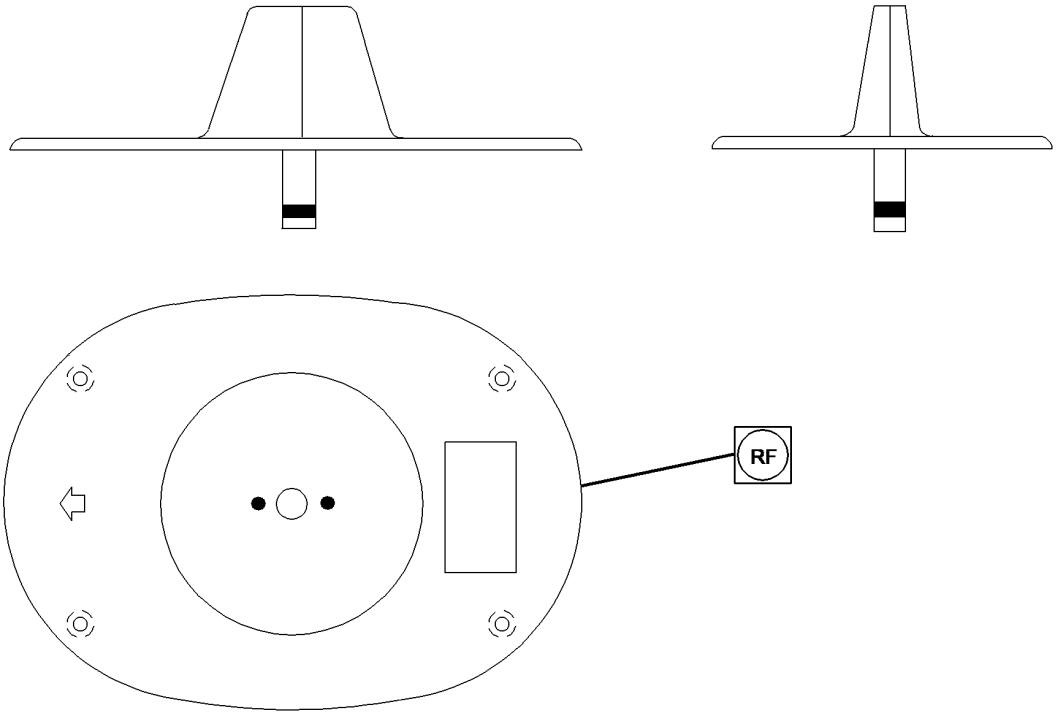
BBB2-34-1946A
S0006557608V2

TCAS Antennas - Removal/Installation
Figure 201/34-46-02-990-804



BBB2-34-2741
S0000215030V1

TCAS Antennas - Removal/Installation
Figure 202/34-46-02-990-808

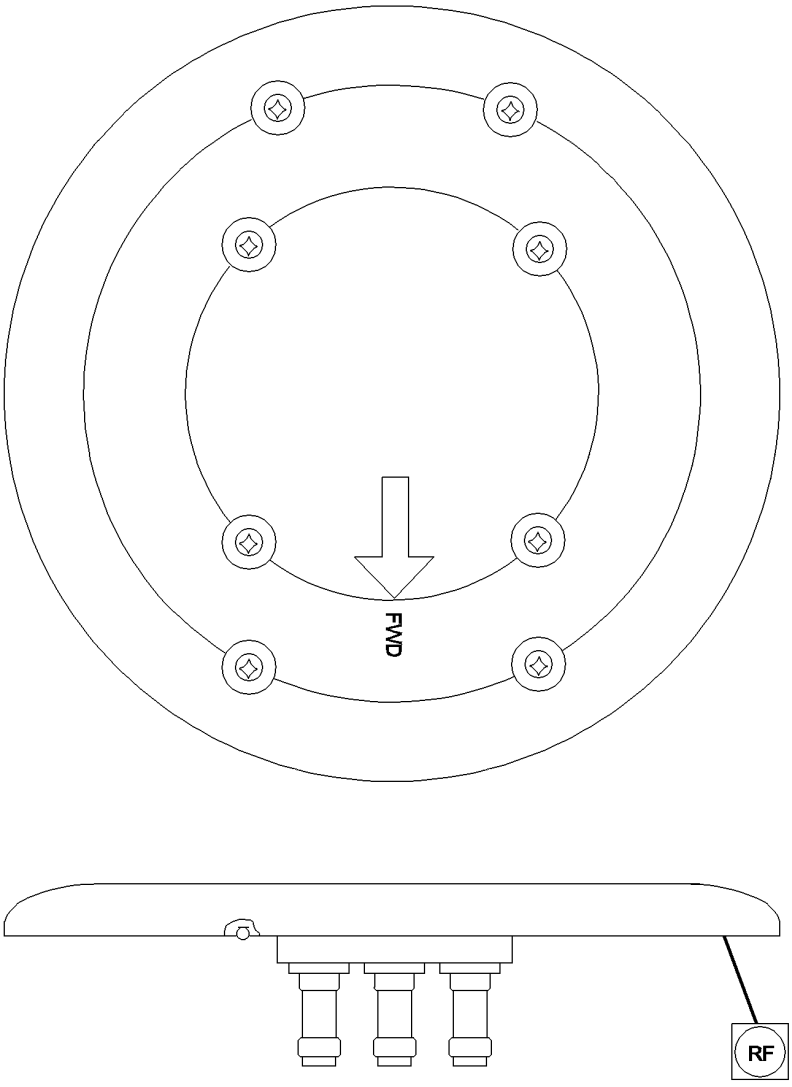


BBB2-34-2502A
S0006547598V2

WJE
WJE

Bottom Omnidirectional Antenna
Figure 203/34-46-02-990-805

EFFECTIVITY
WJE 412, 414



BBB2-34-2503A
S0006547599V2

WJE
WJE

Top Directional Antenna
Figure 204/34-46-02-990-806

TRAFFIC ALERT AND COLLISION AVOIDANCE SPEAKERS (TCAS) - MAINTENANCE PRACTICES

1. General

A. This procedure has the removal/installation instructions for the TCAS speakers.

B. The speakers are located on each side of the cockpit below the captain's and first officer's clearview windows. Removal/ installation procedures are identical for the two speakers.

2. Removal/Installation TCAS Speaker

A. Remove Speaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
WJE H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
WJE 412, 414			
WJE F	14	B10-456	TCAS AC

WJE **WJE 410, 412, 414, 875-879**

(2) Remove speaker/mounting plate attaching screws. (Figure 201)

(3) Pull speaker/mounting plate assembly from cavity until electrical connector is accessible.

(4) Disconnect electrical connector.

(5) Remove speaker attaching screws and remove mounting plate from speaker.

B. Install Speaker

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT AC BUS

Row	Col	Number	Name
WJE 410, 875-879			
WJE H	16	B10-456	TCAS COMPUTER

WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
WJE 412, 414			
WJE F	14	B10-456	TCAS AC

WJE **WJE 410, 412, 414, 875-879**

(2) Install mounting plate on speaker with attaching screws.

(3) Visually check speaker receptacle and mating connector for damage or foreign objects.

(4) Connect electrical connector to speaker receptacle.

(5) Position speaker/mounting plate assembly into cavity.

(6) Apply hand pressure to speaker face, and secure speaker mounting plate with attaching screws.

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT AC BUS

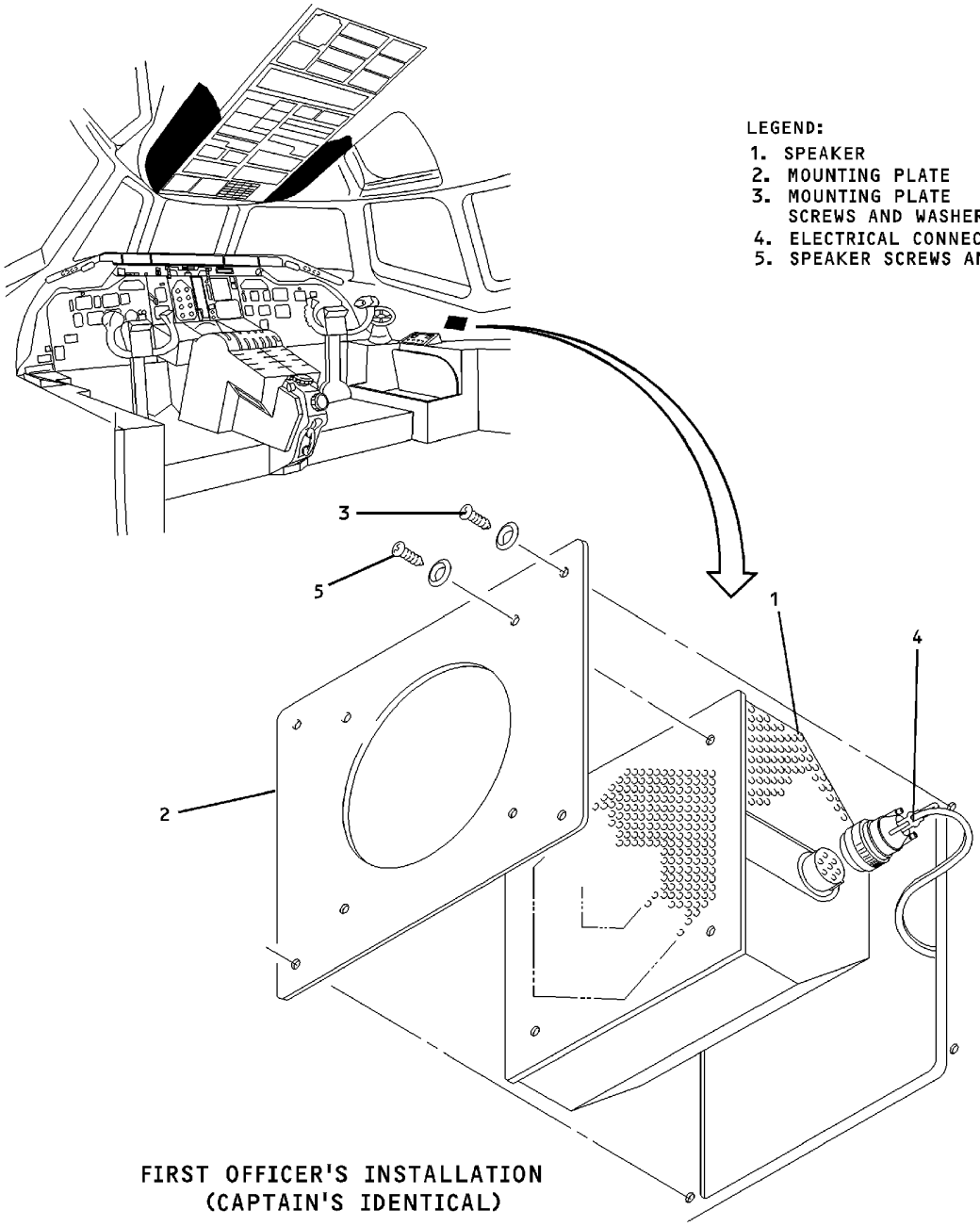
Row	Col	Number	Name
WJE 410, 875-879			
H	16	B10-456	TCAS COMPUTER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 412, 414			
F	14	B10-456	TCAS AC
WJE 410, 412, 414, 875-879			

(8) Perform TCAS self-test. (SUBJECT 34-46-00, Page 201).

(9) Return aircraft to required configuration.



TCAS Speaker -- Removal/Installation
Figure 201/34-46-04-990-803

WINDSHEAR ALERT AND GUIDANCE SYSTEM (WAGS) - DESCRIPTION AND OPERATION

1. Description

WJE 886, 887

NOTE: For aircraft with Windshear System installed.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

A. The Windshear Alert and Guidance System (WAGS) consists of an additional Line Replaceable Unit (LRU), the windshear computer (WSC). The WSC is integrated with existing aircraft avionics systems, primarily the digital flight guidance system (DFGS), to implement the WAGS. The WSC will receive attitude, acceleration and other information from the digital flight guidance computer, air data information from the central air data computers and shaker margin signals from the stall warning computers to provide windshear detection warning and guidance during a windshear encounter. The WSC declares a windshear condition when sudden drastic differences occur between the airspeed from air data and the inertial airspeed.

WJE 409, 884

NOTE: On CAA certified aircraft, the WSC provides windshear detection and alerting only. No guidance, autothrottle, or pitch control is provided.

WJE 401-404, 412, 414, 886, 887

B. Upon detection of a windshear condition the WSC provides annunciations in the cockpit. Guidance information is provided to the DFGC for the flight director and autopilot and through the Electronic Flight Instrument System (EFIS). The Central Aural Warning System (CAWS) is used to provide windshear warning or caution aural annunciation. An increasing performance windshear (head wind or up draft) causes a caution to be output, whereas a decreasing performance windshear (tail wind or down draft) causes a warning to be output. When failures are detected by the WSC which prevent the WSC from providing windshear detection and guidance, windshear inoperative annunciation is provided on the overhead annunciator panel (OAP).

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871-879, 884

C. Upon detection of a windshear condition the WSC provides annunciations in the cockpit. Guidance information is provided to the DFGC for the flight director and autopilot and through the EFIS. The CAWS is used to provide windshear warning or caution aural annunciation. An increasing performance windshear (head wind or up draft) causes a caution to be output, whereas a decreasing performance windshear (tail wind or down draft) causes a warning to be output. When failures are detected by the WSC which prevent the WSC from providing windshear detection and guidance, windshear fail is displayed on the Primary Flight Display (PFD) and windshear inoperative annunciation is provided on the overhead annunciator panel (OAP).

WJE 892, 893

D. Upon detection of a windshear condition the WSC provides annunciations in the cockpit. Guidance information is provided to the DFGC for the flight director and autopilot and through the EFIS or the Attitude Direction Indicator (ADI). The CAWS is used to provide windshear warning or caution aural annunciation. An increasing performance windshear (head wind or up draft) causes a caution to be output, whereas a decreasing performance windshear (tail wind or down draft) causes a warning to be output. When failures are detected by the WSC which prevent the WSC from providing windshear detection and guidance, windshear inoperative annunciation is provided on the overhead annunciator panel (OAP).

WJE 409, 873, 874, 884

E. On aircraft with EFIS, the WSC provides a pitch limit indication (PLI) which will be in view on EFIS when the WSC is enabled for detection and guidance or when slats are extended above 1500 feet. The PLI is the margin between aircraft fuselage Angle-Of-Attack (AOA) and the AOA for shaker onset. The PLI will be white with single stroke when the WSC is enabled or if slats are extended, and PLI will be double stroked when a decreasing or an increasing performance windshear is detected. This margin data will be transmitted from stall warning computer-1 or -2 to the WSC by 2-wire analog signals. On ground, this signal is fixed and determined by the stall warning computer.

WJE 401-404, 406-408, 410-412, 414, 875-879

F. The WSC provides a pitch limit indication (PLI) which will be in view on EFIS when the WSC is enabled for detection and guidance or when slats are extended above 1500 feet. The PLI is the margin between aircraft fuselage AOA and the AOA for shaker onset. The PLI will be white with single stroke when the WSC is enabled or if slats are extended, and PLI will be double stroked when a decreasing or an increasing performance windshear is detected. This margin data will be transmitted from stall warning computer-1 or -2 to the WSC by 2-wire analog signals. On ground, this signal is fixed and determined by the stall warning computer.

WJE 406-408, 410, 411

NOTE: On aircraft with heads up display (HUD) (if installed), the margin data will be transmitted from stall warning computer -1 or -2 to the WSC and HUD by two wire analog signal.

WJE 892, 893

G. On EFIS equipped aircraft, the WSC provides a pitch limit indication (PLI) which will be in view on EFIS when the WSC is enabled for detection and guidance or when slats are extended above 1500 feet. The PLI is the margin between aircraft fuselage AOA and the AOA for shaker onset. The PLI will be white with single stroke when the WSC is enabled or if slats are extended, and PLI will be double stroked when a decreasing or an increasing performance windshear is detected. This margin data will be transmitted from stall warning computer-1 or -2 to the WSC and HUD (if installed) by 2-wire analog signals. On ground, this signal is fixed and determined by the stall warning computer.

WJE 886, 887; with Windshear System installed

H. The WSC provides a pitch limit indication (PLI) which will be in view on EFIS when the WSC is enabled for detection and guidance or when slats are extended above 1500 feet. The PLI is the margin between aircraft fuselage AOA and the AOA for shaker onset. The PLI will be white with single stroke when the WSC is enabled or if slats are extended, and PLI will be double stroked when a decreasing or an increasing performance windshear is detected. This margin data will be transmitted from stall warning computer-1 or -2 to the WSC and HUD (if installed) by 2-wire analog signals. On ground, this signal is fixed and determined by the stall warning computer.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

I. The WSC provides a pitch limit indication (PLI) which will be in view on ADI when the WSC is enabled for detection and guidance or when slats are extended above 1500 feet. The PLI is the margin between aircraft fuselage AOA and the AOA for shaker onset. The PLI will be white with single stroke when the WSC is enabled or if slats are extended, and PLI will be double stroked when a decreasing or an increasing performance windshear is detected. This margin data will be transmitted from stall warning computer-1 or -2 to the WSC and HUD (if installed) by 2-wire analog signals. On ground, this signal is fixed and determined by the stall warning computer.

WJE 892, 893

J. Whenever windshear guidance is active, the WSC will command the fast/slow pointers on the ADI. These commands are based upon shaker margin information from the stall warning system. The center position corresponds to stick shaker onset, fast position is shaker minus 10 degrees and slow position is shaker plus 5 degrees.

WJE 409, 873, 874, 884

K. Whenever windshear guidance is active, alpha reference speed is displayed on the center of the slow-fast indication on the ADI's/PFD's. Stick shaker is displayed on the slow position and alpha reference speed plus 20 knots is displayed on the fast position of the slow-fast indication.

WJE 406, 410, 875-879

L. Whenever windshear guidance is active, alpha reference speed is displayed on the center of the slow-fast indication on the PFD's. Stick shaker is displayed on the slow position and alpha reference speed plus 20 knots is displayed on the fast position of the slow-fast indication.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

M. In general, the WSC commands a minimum flight path angle (gamma) limited so as not to allow a speed below stick shaker speed. The WSC requests the autothrottle to provide maximum power in order to increase energy when a windshear or a microburst is detected.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 886, 887, 892, 893

The WSC will request activation of the automatic reserve thrust (ART), when ART is armed and available, during takeoff or takeoff roll in order to achieve maximum thrust.

WJE 409, 873, 874, 884

The WSC will request activation of the automatic reserve thrust (ART), when ART is armed and available, during takeoff in order to achieve maximum thrust.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

2. WAGS System Functions Performed By Other Systems

A. DFGS Windshear Functions: The DFGS provides all the sensor data, via the In Service Data Acquisition System (ISDAS) data bus, to the WSC except for air data and the shaker margin data. DFGC monitoring data is also transmitted to the WSC by the ISDAS data bus. ISDAS is an ARINC 429 style data bus. The WSC provides the DFGC's with guidance commands for flight director and autopilot, fast/slow indication, FMA display data, STP maintenance data, test data words and autothrottle logic commands. The DFGS uses WSC data as if windshear was an internal DFGC mode. Windshear guidance mode is available from the DFGC take-off and go-around modes.

WJE 409, 873, 874, 884

Windshear detection is inhibited during takeoff roll.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

B. Autopilot: The WSC provides commands to drive the A/P elevator servo command through the normal autopilot inner-loop software control, such as if the windshear mode was another internal DFGC mode. The WSC transmits an autopilot mode valid to the DFGC. The WSC will only set the autopilot valid if two of each of the appropriate sensors are available for WSC guidance. The autopilot will disconnect if the valid is reset. The DFGC autopilot roll mode guidance during windshear is generated by the DFGC and not by the WSC. Wings level control is used for windshear warnings with normal TOGA (heading hold) roll guidance being provided during transition to safe conditions and hence back to DFGS TOGA guidance. A small delay is included to allow the wings to be leveled prior to commanding heading hold. Full authority parallel rudder control is available during windshear modes. Windshear guidance is activated by the DFGS when the TOGA (throttle palm) switches are pressed. The minimum pitch command is set to 12 degrees provided no thrust reduction or engine out is experienced.

C. Automatic Pitch Trim: The automatic (alternate) pitch trim is inhibited in windshear mode when the fuselage angle of attack is within two degrees of the shaker margin signal.

D. Flight Director: The WSC provides a pitch command on the ARINC serial bus to the DFGS which is scaled in DFGS software and transmitted to each flight director F/D pitch bar by each DFGC. The flight director switching functioning is unchanged by the windshear modes. The guidance command is similar to the autopilot except the integral component is omitted as is normal. A separate valid, in addition to the autopilot command valid, is transmitted to the DFGC's. This valid indicates the WSC is valid. The WSC will provide F/D guidance based on single sensor data. This is done to maximize WAGS availability. Failure of either flight director will result in bar biasing and the windshear INOP light being illuminated until the non-failed F/D is selected.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887

E. The autothrottle function during windshear is controlled by the engaged DFGC. This includes EPR limiting and aircraft configuration limiting (placard speeds, alpha speeds etc.). The WSC provides logic signals to the DFGC to request A/T functions. A/T control is still retained within the DFGC. For derated takeoff the A/T is unclamped and is increased to maximum go-around power, and reclamped. The ART is fired if it is ready and available, and the DFGS mode is takeoff or takeoff roll. The A/T mode is provided on the DFGS flight mode annunciator display. During approach mode, if windshear is detected, the autothrottle speed reference is increased from normally 1.3 VS + 20 Kts to increase aircraft energy. If windshear guidance is activated the DFGC advances the throttles to go-around power and reclamps.

WJE 409, 873, 874, 884, 892, 893

F. The autothrottle function during windshear is controlled by the engaged DFGC. This includes EPR limiting and aircraft configuration limiting (placard speeds, alpha speeds etc.). The WSC provides logic signals to the DFGC to request A/T functions. A/T control is still retained within the DFGC. For derated takeoff the A/T is unclamped and is increased to maximum go-around power, and reclamped. The ART is fired if it is ready and available, and the DFGS mode is takeoff. The A/T mode is provided on the DFGS flight mode annunciator display. During approach mode, if windshear is detected, the autothrottle speed reference is increased from normally 1.3 VS + 20 Kts to increase aircraft energy. If windshear guidance is activated the DFGC advances the throttles to go-around power and reclamps.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

G. Thrust Rating: When windshear is detected the DFGS determines the required thrust rating mode. If the current EPR limit is less than 0.02 EPR of the go-around EPR limit plus an allowance for the expected ART boost, the TRI GA mode is automatically requested. If the TRI fails to transition to the GA mode the EPR bugs and limit will be set to the go-around EPR limit. If windshear has been detected and the highest EPR is within 95% of the GA EPR limit the DFGC will automatically transition to windshear guidance. This will account for the approach case where a decreasing performance shear has caused the autothrottle to increase thrust to maintain speed or where the pilot has failed to press the TOGA switch.

H. Automatic Reserve Thrust: If ART is armed and available the DFGC will fire the ART when windshear is detected.

I. Flight Mode Annunciator Displays: Prior to the activation of windshear guidance the FMA armed window displays the available windshear mode, either AUT W/S or F/D W/S for autopilot or flight director respectively. When windshear is detected and the DFGC reverts to windshear guidance, the FMA throttle and pitch windows will display WIND SHR for windshear warnings or cautions. The FMA roll mode will display WNG LVL for wings level or TAK OFF or GO RND according to the command guidance at the time. The FMA throttle annunciation during windshear mode is CLMP except when the throttle is being adjusted during mode initiation or on approach, the throttle window will display WND SHR until the windshear pitch guidance is activated. This indicates that 20 Kts has been added to the approach reference speed of 1.3 VS.

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

J. Status Test Panel: The WSC in conjunction with the STP provides in-flight fault review, windshear history data, and maintenance functions. The WSC STP can be active when the aircraft is on the ground or in flight. The STP provides windshear maintenance functions to allow complete check out of the WSC interface.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

K. FMS MCDU Status Test: The WSC in conjunction with the FMS MCDU provides in-flight fault review, windshear history data, and maintenance functions. The WSC status review can be active when the aircraft is on the ground or in flight. The FMS MCDU provides windshear maintenance functions to allow complete check out of the WSC interface.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

L. Windshear Post Stall Recovery System Inhibit: The WSC shall inhibit the PSRS during a decreasing performance windshear.

M. Windshear GPWS Aural Warning Inhibit: The WSC will inhibit the GPWS aural annunciation during windshear guidance when the F/D command is being followed within a predetermined tolerance.

N. CADC Windshear Functions: The CADC air data and DFGS accelerometer data are used by WSC to determine the presence of a windshear. The CADC provides the WSC with pressure altitude, altitude rate, computed airspeed, mach and static air temperature.

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887

O. CAWS Windshear Functions: The CAWS monitors discrete signals from the WSC. The CAWS annunciates a windshear unique tone followed by three repetitions of either "HEADWIND SHEAR" OR "TAILWIND SHEAR" in response to settings of these discretes.

WJE 409, 873-879, 884

(1) "Headwind shear" aural warning is inhibited during takeoff/go-around modes.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

P. CAWS Windshear Functions: The CAWS monitors discrete signals from the WSC. The CAWS annunciates a windshear unique tone followed by three repetitions of "windshear" in response to settings of these discretes.

(1) "Windshear" aural caution (increasing performance) is inhibited during takeoff/go-around and approach modes.

WJE 409, 873-879, 884

Q. EFIS Annunciations/Displays (aircraft with EFIS: EFIS receives WSC data by the WSC ARINC 429 command data bus. The EFIS windshear functions are PLI, caution or warning messages. The flight director and fast/slow display information originates within the DFGC. The windshear annunciation is amber and the PLI is white for EFIS PFD caution display. The windshear annunciation is red and the PLI is white for EFIS PFD warning displays.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 886, 887

R. EFIS Annunciations/Displays: EFIS receives WSC data by the WSC ARINC 429 command data bus. The EFIS windshear functions are PLI, caution or warning messages. The flight director and fast/slow display information originates within the DFGC. The windshear annunciation is amber and the PLI is white for EFIS PFD caution display. The windshear annunciation is red and the PLI is white for EFIS PFD warning displays.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

S. Overhead Annunciator Panel: When the WSC computer determines that it is inoperative, an annunciation is provided on the overhead annunciator panel (OAP). The OAP messages is WINDSHEAR INOP.

WJE 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887

T. With Honeywell Windshear Computer Service Bulletin 4059845-34-2 (Pub. No. 21-3672-02) Revision 2 incorporated, the Flight Recorder can be connected to the Windshear Computer.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

3. Operation

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893

A. T/O on Ground: The W/S system will be automatically enabled above 60 knots during the T/O roll and will detect and warn the pilot of the presence of wind shear. Windshear warning will be displayed on W/S Warning/Caution lights and aurally through CAWS. When windshear is detected, the WAGS will command max T/O thrust through the DFGC and ART. During a derated or flex T/O, max G/A thrust will be set by unclamping the autothrottle (A/T), setting thrust, and re-clamping. ART will not fire unless armed and on with the A/T clamped during a normal takeoff. Rotation guidance will be provided at rotation on the F/D, should the pilot decide to continue the takeoff. The pilot can abort the takeoff and disengage the W/S warning by bringing the throttles back to idle.

WJE 409, 873, 874, 884

B. T/O on Ground: Windshear detection is inhibited during takeoff roll.

WJE 401-404, 406-408, 410-412, 414, 886, 887

C. T/O or G/A: Windshear detection and warning in all flight modes shall be enabled by nose oleo extension or by main gear lift-off. The WAGS will provide a smooth guidance transition from T/O on ground roll to T/O in flight when in windshear guidance. W/S warning will be displayed in the FMA roll and pitch windows through the DFGC, and aurally through the CAWS unit. Also, the separate W/S warning annunciators will be provided. At warning, the WSC will command max T/O or G/A thrust (as appropriate) through the DFGC, ART (in T/O only) and A/T. When a W/S warning is in effect, the WSC will provide guidance which aids the pilot in transition through the shear while preventing speed decay below a safe margin to stick shaker. The commands shall automatically revert to normal T/O or G/A command whenever aircraft response or performance indicates that windshear conditions no longer exist and T/O or G/A reference speed and 750 FPM has been attained. The FMA roll and pitch mode windows will flash the automatic mode change into HDG HLD and WND SHR and again on reversion in the normal way for non-pilot selected mode changes.

WJE 401-404, 412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879

D. T/O or G/A: Windshear detection and warning in all flight modes shall be enabled by nose oleo extension or by main gear lift-off. The WAGS will provide a smooth guidance transition from T/O on ground roll to T/O in flight when in windshear guidance. The PLI will be in view on EFIS when the WSC is enabled for detection and guidance. W/S warning will be displayed on EFIS , in the FMA roll and pitch windows through the DFGC, and aurally through the CAWS unit. The aural caution is inhibited during T/O or G/A. Also, the separate W/S warning annunciators will be provided. At warning, the WSC will command max T/O or G/A thrust (as appropriate) through the DFGC, ART (in T/O only) and A/T. When a W/S warning is in effect, the WSC will provide guidance which aids the pilot in transition through the shear while preventing speed decay below a safe margin to stick shaker. The commands shall automatically revert to normal T/O or G/A command whenever aircraft response or performance indicates that windshear conditions no longer exist and T/O or G/A reference speed and 750 FPM has been attained. The FMA roll and pitch mode windows will flash the automatic mode change into HDG HLD and WND SHR and again on reversion in the normal way for non-pilot selected mode changes.

WJE 409, 873, 874, 884

E. T/O or G/A: Windshear detection and warning in all flight modes shall be enabled by nose oleo extension or by main gear lift-off. The PLI will be in view on EFIS when the WSC is enabled for detection and guidance. W/S warning will be displayed on EFIS , in the FMA roll and pitch windows through the DFGC, and aurally through the CAWS unit. The aural caution is inhibited during T/O or G/A. Also, the separate W/S warning annunciators will be provided. At warning, the WSC will command max T/O or G/A thrust (as appropriate) through the DFGC. In T/O only, the DFGC will fire the ART, if ART is armed and available. When a W/S warning is in effect, the WSC will provide guidance which aids the pilot in transition through the shear while preventing speed decay below a safe margin to stick shaker. The commands shall automatically revert to normal T/O or G/A command whenever aircraft response or performance indicates that windshear conditions no longer exist and T/O or G/A reference speed and 750 FPM has been attained. The FMA roll and pitch mode windows will flash the automatic mode change into HDG HOLD and WND SHR and again on reversion in the normal way for non-pilot selected mode changes.

WJE 892, 893

F. T/O or G/A: Windshear detection and warning in all flight modes shall be enabled by nose oleo extension or by main gear lift-off. The PLI will be in view on EFIS when the WSC is enabled for detection and guidance. W/S warning will be displayed on EFIS, in the FMA roll and pitch windows through the DFGC, and aurally through the CAWS unit. Also, the separate W/S warning annunciators will be provided. At warning, the WSC will command max T/O or G/A thrust (as appropriate) through the DFGC. In T/O only, the DFGC will fire the ART, if ART is armed and available. When a W/S warning is in effect, the WSC will provide guidance which aids the pilot in transition through the shear while preventing speed decay below a safe margin to stick shaker. The commands shall automatically revert to normal T/O or G/A command whenever aircraft response or performance indicates that windshear conditions no longer exist and T/O or G/A reference speed and 750 FPM has been attained. The FMA roll and pitch mode windows will flash the automatic mode change into HDG HLD and WND SHR and again on reversion in the normal way for non-pilot selected mode changes.

WJE 417, 419, 421, 423, 864, 865, 869, 871-879

G. Approach: At windshear detection, caution or warning will be displayed on the EFIS and WND SHR will flash five times and then go steady in the FMA throttle window. An aural warning will sound when a decreasing performance shear is detected. If the A/T are engaged in the speed mode, the WSC will, through the DFGC, automatically control the A/T to add a speed bias up to 20 knots to 1.3 VS.

WJE 401-404, 406-412, 414, 884, 886, 887, 892, 893

H. Approach: At windshear detection, caution or warning will be displayed on the EFIS and WND SHR will flash five times and then go steady in the FMA throttle window. An aural caution or warning will sound through the CAWS unit. If the A/T are engaged in the speed mode, the WSC will, through the DFGC, automatically control the A/T to add a speed bias up to 20 knots to 1.3 VS.

WJE 401-404, 412, 414, 886, 887

I. Approach and G/A: Decreasing performance shear will be annunciated by a windshear warning displayed on the W/S warning lights, and aurally through the CAWS unit. At W/S warning the pilot initiates W/S guidance by activating TOGA or by advancing thrust to greater than 95% of the max G/A EPR. If the A/T is engaged, the WSC will command max G/A thrust through the DFGC. If the A/T is not engaged, the TRI and EPR bugs will provide thrust guidance for the pilot. Pitch guidance will consist of a flight director bar displayed on the ADI and autopilot commands which will go into effect once TOGA has been activated. The system will revert to normal G/A commands once the conditions for windshear no longer exist and the aircraft has returned to a safe condition. The FMA will annunciate HDG HLD and WIND SHR for a decreasing performance windshear in the FMA roll and pitch windows when TOGA is activated after windshear is detected. The FMA will annunciate the GO RND and WIND SHR in the roll and pitch window when the TOGA is activated after an increasing performance windshear is detected. On exiting the windshear, and achieving safe conditions, the FMA will flash GO RND in the FMA five times and then go steady.

WJE 406-408, 410, 411, 417, 419, 421, 423, 864, 865, 869, 871-879

J. Approach and G/A: Decreasing performance shear will be annunciated by a windshear warning displayed on the EFIS, W/S warning lights, and aurally through the CAWS unit. The PLI is in view on EFIS when WSC is enabled for detection and guidance. At W/S warning the pilot initiates W/S guidance by activating TOGA or by advancing thrust to greater than 95% of the max G/A EPR. If the A/T is engaged, the WSC will command max G/A thrust through the DFGC. If the A/T is not engaged, the TRI and EPR bugs will provide thrust guidance for the pilot. Pitch guidance will consist of a flight director bar displayed on EFIS and autopilot commands which will go into effect once TOGA has been activated. The system will revert to normal G/A commands once the conditions for windshear no longer exist and the aircraft has returned to a safe condition. The FMA will annunciate HDG HLD and WIND SHR for a decreasing performance windshear in the FMA roll and pitch windows when TOGA is activated after windshear is detected. The FMA will annunciate the GO RND and WIND SHR in the roll and pitch window when the TOGA is activated after an increasing performance windshear is detected. On exiting the windshear, and achieving safe conditions, the FMA will flash GO RND in the FMA five times and then go steady.

WJE 409, 884, 892, 893

K. Approach and G/A: Decreasing performance shear will be annunciated by a windshear warning displayed on the EFIS, W/S warning lights, and aurally through the CAWS unit. The PLI is in view on EFIS when WSC is enabled for detection and guidance. At W/S warning the pilot initiates W/S guidance by activating TOGA or by advancing thrust to greater than 95% of the max G/A EPR. If the A/T is engaged, the WSC will command max G/A thrust through the DFGC. If the A/T is not engaged, the TRI and EPR bugs will provide thrust guidance for the pilot. Pitch guidance will consist of a flight director bar displayed on the ADI/EFIS and autopilot commands which will go into effect once TOGA has been activated. The system will revert to normal G/A commands once the conditions for windshear no longer exist and the aircraft has returned to a safe condition. The FMA will annunciate HDG HLD and WIND SHR for a decreasing performance windshear in the FMA roll and pitch windows when TOGA is activated after windshear is detected. The FMA will annunciate the GO RND and WIND SHR in the roll and pitch window when the TOGA is activated after an increasing performance windshear is detected. On exiting the windshear, and achieving safe conditions, the FMA will flash GO RND in the FMA five times and then go steady.

WINDSHEAR ALERT AND GUIDANCE SYSTEM (WAGS) - TROUBLE SHOOTING

1. General

WJE 886, 887; with Windshear System installed

NOTE: The following is for aircraft with Windshear system installed.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

A. This section contains trouble shooting procedures for the Windshear Alert and Guidance System (WAGS). The primary causes of faulty system operation are generally faulty aircraft wiring or faulty LRU's. The trouble shooting procedures in this section should be used in conjunction with the system schematics in isolating and correcting system failures.

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

B. The Status Test Panel (STP) is the primary WAGS trouble shooting tool (Figure 101). Trouble shooting is performed by calling up the WAGS Maintenance Menu on the STP display. The first two menu entries, FAULT REVIEW and FAULT ERASE are used for trouble shooting the system. The CMPVLD, FORWARD SPACE, BACKSPACE, and VERIFY push-buttons on the STP are used to cycle through the Fault Review pages.

NOTE: In order to use the STP with the WAGS, the STP mode select switch (placarded EFIS/Digital Flight Guidance System (DFGS)) (on aircraft with EFIS installed) must be placed in the DFGS position. The display area on the STP is used during WAGS trouble shooting and maintenance practices.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

C. The Flight Management Multifunction Control Display Unit (MCDU) is the primary WAGS trouble shooting tool. (Figure 102)

D. The MCDU push-buttons (keys) are used to call up the WAGS maintenance menu display. The first two menu entries, FAULT REVIEW and FAULT ERASE are used for trouble shooting the system. The FORWARD SPACE, BACKSPACE, and VERIFY push-buttons on the MCDU are used to cycle through the Fault Review pages. Figure 102 illustrates MCDU keys which are used to perform WAGS Trouble Shooting.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

E. The WAGS system consists of a single LRU, the windshear computer (WSC), which is located on the aft left radio rack. The WSC interfaces with the components listed in Paragraph 1.F.. Figure 106 contains a list of failure codes which occur if one of these components fails.

F. Trouble Shooting procedures in this section interface with Trouble Shooting procedures in the following sections:

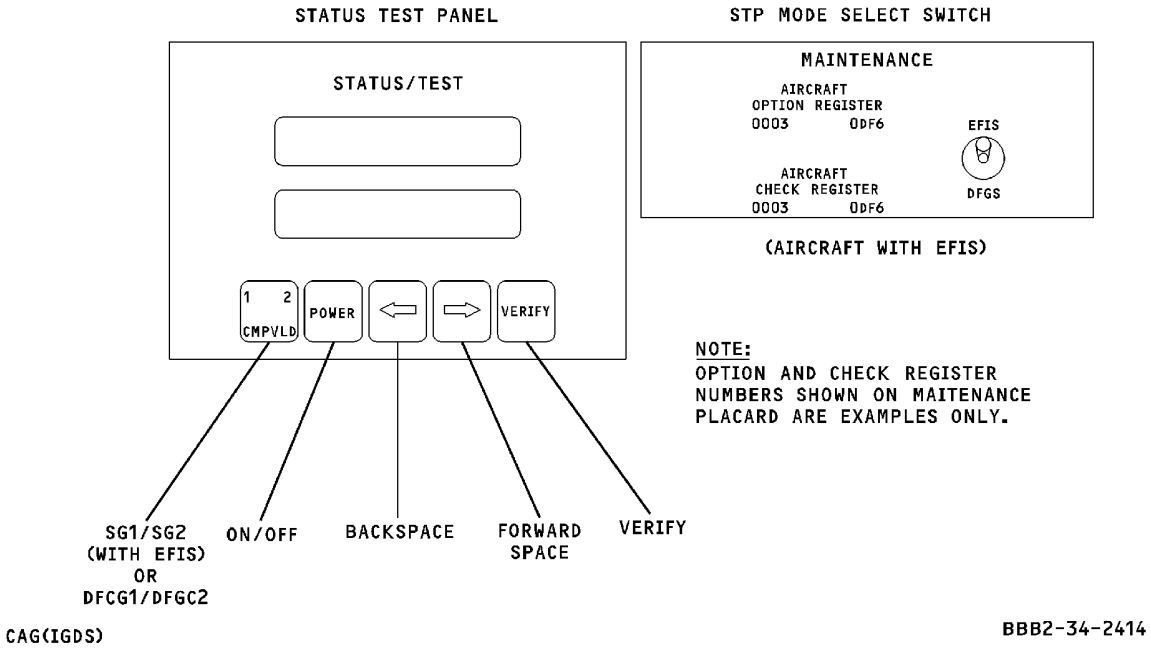
Table 101

Digital Flight Guidance System	(DFGS STATUS/TEST (STP) PANEL - TROUBLE SHOOTING, PAGEBLOCK 22-01-05/101 Config 1 or DFGS STATUS/TEST (STP) PANEL - TROUBLE SHOOTING, PAGEBLOCK 22-01-05/101 Config 2 or DFGS STATUS/TEST (STP) PANEL - TROUBLE SHOOTING, PAGEBLOCK 22-01-05/101 Config 3 or DFGS STATUS/TEST (STP) PANEL - TROUBLE SHOOTING, PAGEBLOCK 22-01-05/101 Config 4)

Table 101 (Continued)

Air Data System	(AIR DATA COMPUTING - TROUBLE SHOOTING, PAGEBLOCK 34-16-00/101)
Stall Warning System	(STALL WARNING SYSTEM - TROUBLE SHOOTING, PAGEBLOCK 34-19-00/101 Config 1)
EFIS	(NAVIGATION DISPLAYS - TROUBLE SHOOTING, PAGEBLOCK 34-22-00/101 Config 2 or NAVIGATION DISPLAYS - TROUBLE SHOOTING, PAGEBLOCK 34-22-00/101 Config 5 or NAVIGATION DISPLAYS - TROUBLE SHOOTING, PAGEBLOCK 34-22-00/101 Config 6 or NAVIGATION DISPLAYS - TROUBLE SHOOTING, PAGEBLOCK 34-22-00/101 Config 9)
WJE 401-404, 406-412, 414, 873-879, 884	
(If Installed)	
WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893	
Central Aural Warning	(CENTRAL AURAL WARNING - DESCRIPTION AND OPERATION, PAGEBLOCK 31-51-00/001)
Ground Proximity	(GROUND PROXIMITY WARNING SYSTEM - TROUBLE SHOOTING, PAGEBLOCK 34-45-00/101 Config 1)

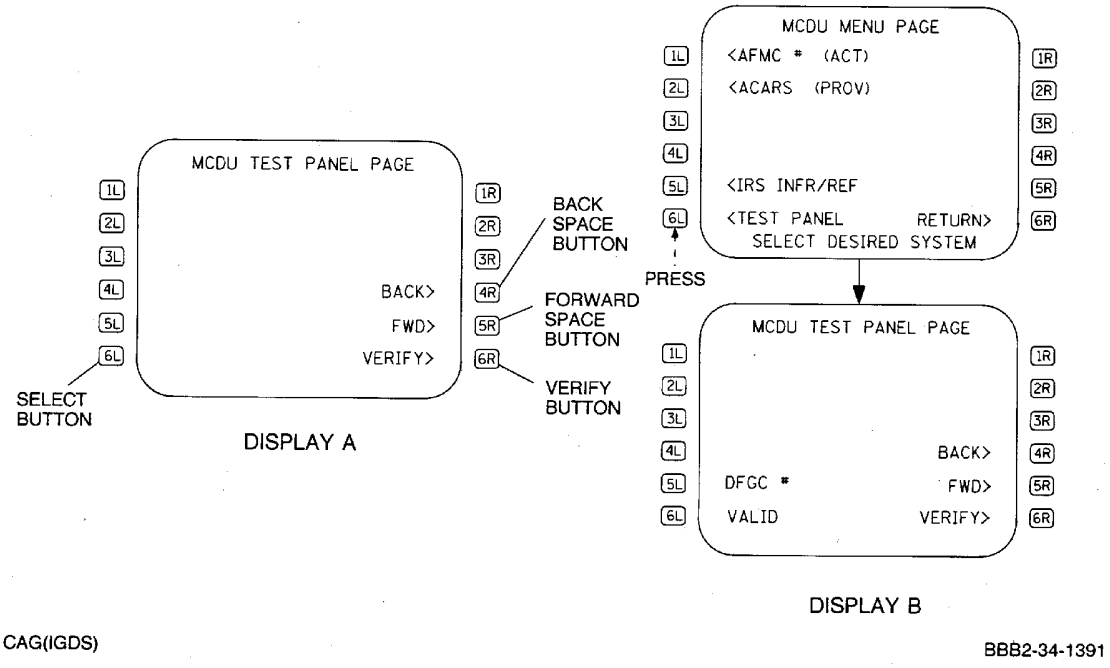
WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893



Trouble Shooting WAGS with Status Test Panel (STP)
Figure 101/34-47-00-990-801

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872



Trouble Shooting WAGS with FMS MCDU
Figure 102/34-47-00-990-802

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed item:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 102

Name and Number	Manufacturer
Multimeter Model Nr. 1026A	Fluke

3. Trouble Shooting Windshear Alert and Guidance System

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

A. Trouble Shooting WAGS Using STP

(1) Make sure that system power is on and that POWER push-button on STP is ON.

(2) Place STP Mode Select Switch (placarded EFIS/DFGS), located under Captain's briefcase (left console), in DFGS position.

(3) Press the CMPVLD push-button on the STP so that the -1 or -2 system is selected ('1' or '2' light comes on).

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893 (Continued)

(4) Cycle FORWARD SPACE push-button on STP until WINDSHEAR COMPUTER? appears on STP display.

(5) Press VERIFY push-button on STP. FLIGHT 1 FAILURES page appears on STP.

(6) Review faults for most recent flight.

NOTE: When cycling through the FAULT REVIEW page, the most recent flight appears first. Flight 0 indicates present flight condition. To cycle forwards and backwards through the various flight legs, use the FORWARD SPACE and BACKSPACE keys on the STP.

(7) Press FORWARD SPACE key on STP to cycle through all previous flights.

(8) To exit FAULT REVIEW, press FORWARD SPACE from last page in flight log, or press BACKSPACE from flight 0 review.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

B. Trouble Shooting WAGS Using MCDU

(1) Make sure that power to MCDU is on.

(2) On MCDU press MENU push-button then Line Select Key (LSK) 6L adjacent to TEST PANEL display.

(3) Press LSK 4L or 5L for DFGC 1 or 2 then press forward key. WINDSHEAR COMPUTER? is displayed.

(4) Press verify key. WINDSHEAR FLIGHT FAULT REVIEW? will be displayed.

(5) Press VERIFY push-button on MCDU. FLIGHT 1 FAILURES page appears on MCDU.

(6) Review faults for most recent flight.

NOTE: When cycling through the FAULT REVIEW page, the most recent flight appears first. Flight 0 indicates present flight condition. To cycle forwards and backwards through the various flight legs, use the FORWARD SPACE and BACKSPACE keys on the STP.

(7) Press FORWARD SPACE key on MCDU to cycle through all previous flights.

(8) To exit FAULT REVIEW, press FORWARD SPACE from last page in flight log, or press BACKSPACE from flight 0 review.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

C. Continuity, Power, and Ground Checks

NOTE: During continuity, power, and ground checks, it may be necessary to refer to the wiring diagram manual for terminal board connections and wire identification.

(1) Check for proper power sources at main buses, circuit breakers, and LRU input and output ports. Correct main power supply to buses if necessary. Replace faulty circuit breakers, wires, or LRU's.

(2) Check for proper grounds at LRU's. (This may require operation of relays in units to contact ground). Repair or replace faulty wiring. Make sure ground terminals are tight and properly bonded.

(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity. Repair or replace faulty wiring, terminal junctions, relays, etc. on aircraft.

(4) Replace suspected faulty LRU's or component with known operational unit.

D. Recommendation from Manufacturer (Honeywell) (Figure 104)

NOTE: The procedures contained herein follow the Trouble Shooting Flowchart .

(1) When WINDSHEAR INOP is indicated on OAP or Electronic Overhead Annunciator Panel (EOAP) determine which LRU is cause and whether it is hard failure.

(a) Check windshear fail light on front of windshear computer. If light is off, windshear computer is good. Do not remove it!

(b) If light is on, it is necessary to determine if windshear computer has hard failure.

1) Reset windshear circuit breaker.

2) If light is still on, WSC has hard failure and should be replaced.

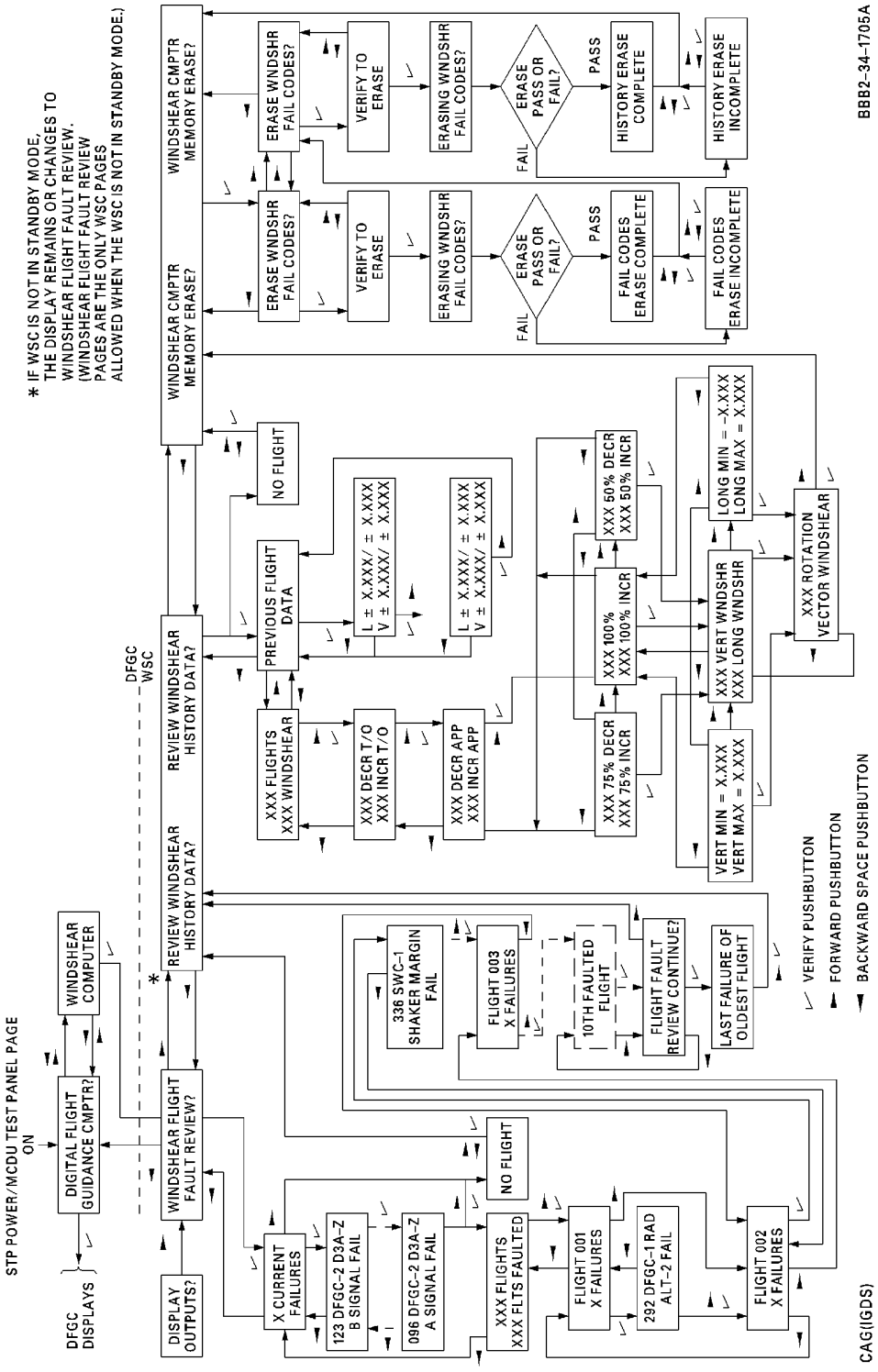
3) If light is off, windshear computer has recovered. Operate system self test of windshear system and return WAGs to service.

(c) If light is off, problem is somewhere else in system.

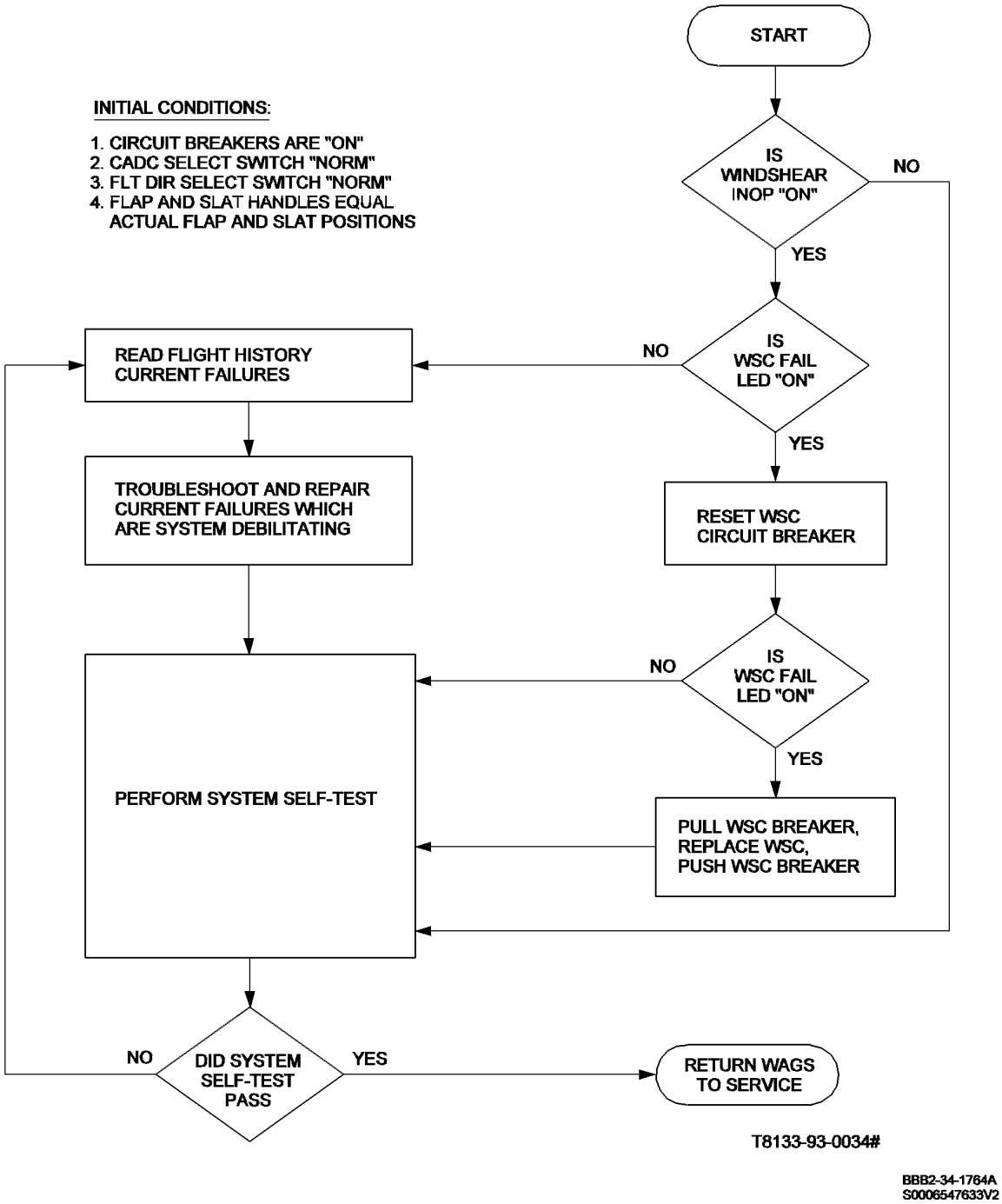
1) Use STP to read flight history and current failures.

2) Troubleshoot and repair current failures which are system debilitating.

3) Perform system self test and return WAGs to service.



Trouble Shooting Windshear Alert and Guidance System
Figure 103/34-47-00-990-803



Trouble Shooting Flowchart for WAGS
Figure 104/34-47-00-990-804

WINDSHEAR COMPUTER SELF-TEST ACTIONS

	SECONDS					
	0-2	3	4	5	6	7-8
Amber WNDSHR	Annunciated (Three cycles)			Extinguished		
Red WNDSHR	Extinguished			Annunciated (Three cycles)		
W/S Inop	Illuminated	Extinguished				
Aural Warning*	Annunciate "HEADWIND SHEAR" (One cycle)			Annunciate "TAILWIND SHEAR" (One cycle)		
F/D Pitch Bars	Centered	Pitch Up		Pitch Down		Out of View
A/P Pitch Command	Manually Engage A/P	Column Back	Column Forward		Column Neutral	A/P Disengaged
F/S***	Centered	Up		Down		Out of View
PLI (EFIS SHIPS)	Centered	Up		Down		Out of View
Pusher Inh	Inhibited (STALL INDICATION FAILURE Light On)					Not Inhibited
GPWS Inh	Inhibited (GPWS FAIL Light On)					Not Inhibited
HUD PLI (IF INSTALLED)	Enabled					Disabled
HUD W/S Caut (IF INSTALLED)	Annunciated (Three cycles)			Extinguished		
HUD W/S Warn (IF INSTALLED)	Extinguished			Annunciated (Two cycles)		
DFGC FMA	Throttle Window WIND SHR	Arm Window AUT** W/S		Roll wind HDG HLD		Pitch Window WIND SHR

NOTE: * If Program Pin Option 23 is selected, The Aural Annunciation shall consist of two cycles of WINDSHEAR.

** Indicates both A/P and F/D guidance available. If only F/D guidance is available, window will indicate F/D W/S.

*** If Program Option Pins 22 or 24 are not selected, F/S will be biased out-of-view.

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S0006547664V2

Windshear Computer Self-Test Actions
Figure 105/34-47-00-990-805

FAIL Code	STP Message	Failure Description	
001*	OXX WINDSHEAR COMPUTER FAIL	Processor Execution Failures	Task Execution Completion Failure
002*			Privileged Instruction Failure
003*			Special Opcode Failure
004*			Z8002 Segmentation Error
005*			User Stack Allocation Error
006*			User Stack Overrun Error
007*			Sample Problem Failure
016*		Memory Failures	Program Memory CRC Test
017*			Program Memory Page Failure
018*			Scratchpad RAM Address Failure
019*			Scratchpad RAM Data Failure
020*			Power Save RAM Address Failure
021*			Power Save RAM Data Test Failure
022*			Corrupt Data Failure
024*			EEPROM Read-after-write Failure
025*			EEPROM Write Queue Overflow Failure
026*			EEPROM Low Byte Pattern Failure
027*			EEPROM High Byte Pattern Failure
032*		Internal Circuitry Failures	Power Loss Timer Failure
033*			Power Loss Timer Discrete End-around Failure
034*			Stimulus Test Failure
035*			Hardware Output Reset Test Failure
036*			Access Not Granted Failure
040*			Mux A Calibration Failure
041*			A/D Conversion Complete Failure
042*			A/D 5V Input

NOTE: Fail codes designated with an "*" will be used to light the Windshear Computer front panel LED display.

CAG(IGDS) BBB2-34-1366A

WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 1 of 26)

Fail Code	STP Message	Failure Description	
048	0XX CADC-1 ALT SIGNAL FAIL	Central Air Data Computer1 (CADC-1) Failures	Pressure Altitude 1 Update Failure
049			Pressure Altitude 1 Range Failure
050			Pressure Altitude 1 Step Failure
051	05X CADC-1 ALT RATE FAIL		Altitude Rate 1 Update Failure
052			Altitude Rate 1 Range Failure
053			Altitude Rate 1 Step Failure
054	05X CADC-1 CAS SIGNAL FAIL		Computed Airspeed 1 Update Failure
055			Computed Airspeed 1 Range Failure
056			Computed Airspeed 1 Step Failure
060	06X CADC-1 SAT SIGNAL FAIL		Static Air Temperature 1 Update Failure
061			Static Air Temperature 1 Range Failure
062			Static Air Temperature 1 Step Failure

CAG(IGDS) BBB2-34-1367A

WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 2 of 26)

Fail Code	STP Message	Failure Description	
064	06X CADC-2 ALT SIGNAL FAIL	Central Air Data Computer2 (CADC-2) Failures	Pressure Altitude 2 Update Failure
065			Pressure Altitude 2 Range Failure
066			Pressure Altitude 2 Step Failure
067	06X CADC-2 ALT RATE FAIL		Altitude Rate 2 Update Failure
068			Altitude Rate 2 Range Failure
069			Altitude Rate 2 Step Failure
070	07X CADC-2 CAS SIGNAL FAIL		Computed Airspeed 2 Update Failure
071			Computed Airspeed 2 Range Failure
072			Computed Airspeed 2 Step Failure
073	07X CADC-2 MACH SIGNAL FAIL		Mach 2 Update Failure
074			Mach 2 Range Failure
075			Mach 2 Step Failure
076	07X CADC-2 SAT SIGNAL FAIL		Static Air Temperature 2 Update Failure
077			Static Air Temperature 2 Range Failure
078			Static Air Temperature 2 Step Failure

CAG(IGDS)

BBB2-34-1368A

WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 3 of 26)

Fail Code	STP Message	Failure Description	
080	080 CADC 1–2 ALT COMPARE FAIL	Central Air Data Computer (CADC) Failures	Pressure Altitude Comparison Failure
081	081 CADC 1–2 ALT RATE COMP FAIL		Altitude Rate Comparison Failure
082	082 CADC 1–2 CAS COMPARE FAIL		Computed Airspeed Comparison Failure
084	084 CADC 1–2 SAT COMPARE FAIL		Static Air Temperature Comparison Failure
085	085 CADC –1 ALT SIGNAL FAIL	Central Air Data Computer 1 (CADC–1) Failures	Pressure Altitude 1 Valid Failure
086	086 CADC –1 ALT RATE FAIL		Altitude Rate 1 Valid Failure
087	087 CADC –1 CAS SIGNAL FAIL		Computed Air Speed 1 Valid Failure
089	089 CADC –1 SAT SIGNAL FAIL		Static Air Temperature Valid Failure
090	090 CADC –2 ALT SIGNAL FAIL	Central Air Data Computer 2 (CADC–2) Failures	Pressure Altitude 2 Valid Failure
091	091 CADC –2 ALT RATE FAIL		Altitude Rate 2 Valid Failure
092	092 CADC –2 CAS SIGNAL FAIL		Computed Airspeed 2 Valid Failure
094	094 CADC –2 SAT		Static Air Temperature 2 Valid Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
096	09X DFGC-1 D3A-Z A SIGNAL FAIL	Digital Flight Guidance Computer-1 (DFGC-1) Accelerometer Failures	Z Acceleration 1-A Valid Failure
097			Z Acceleration 1-A Range Failure
099			Z Acceleration 1-A Step Failure
100	10X DFGC-1 D3A-X A SIGNAL FAIL		X Acceleration 1-A Valid Failure
101			X Acceleration 1-A Range 1 Failure
102			X Acceleration 1-A Range 2 Failure
103			X Acceleration 1-A Step Failure
104	10X DFGC-1 D3A-Z B SIGNAL FAIL		Z Acceleration 1-B Valid Failure
105			Z Acceleration 1-B Range Failure
107			Z Acceleration 1-B Step Failure
108	1XX DFGC-1 D3A-X B SIGNAL FAIL		X Acceleration 1-B Valid Failure
109			X Acceleration 1-B Range 1 Failure
110			X Acceleration 1-B Range 2 Failure
111			X Acceleration 1-B Step Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 5 of 26)

Fail Code	STP Message	Failure Description	
112	11X DFGC-2 D3A-Z A SIGNAL FAIL	Digital Flight Guidance Computer-2 (DFGC-2) Accelerometer Failures	Z Acceleration 2-A Valid Failure
113			Z Acceleration 2-A Range Failure
115			Z Acceleration 2-A Step Failure
116	11X DFGC-2 D3A-X A SIGNAL FAIL		X Acceleration 2-A Valid Failure
117			X Acceleration 2-A Range 1 Failure
118			X Acceleration 2-A Range 2 Failure
119			X Acceleration 2-A Step Failure
120	12X DFGC-2 D3A-Z B SIGNAL FAIL		Z Acceleration 2-B Valid Failure
121			Z Acceleration 2-B Range Failure
123			Z Acceleration 2-B Step Failure
124	12X DFGC-2 D3A-X B SIGNAL FAIL		X Acceleration 2-B Valid Failure
125			X Acceleration 2-B Range 1 Failure
126			X Acceleration 2-B Range 2 Failure
127			X Acceleration 2-B Step Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 6 of 26)

Fail Code	STP Message	Failure Description	
128	128 DFGC-1 DATA BUS FAIL	Digital Flight Guidance Computer-1 (DFGC- 1) Accelerometer Failures	Z Acceleration 1 A-B Update Failure
129	129 DFGC-2 DATA BUS FAIL	DFGC-2 Accelerometer Failures	Z Acceleration 2 A-B Update Failure
130	130 DFGC-1 DATA BUS FAIL	DFGC-1 Accelerometer Failures	X Acceleration 1 A-B Update Failure
131	131 DFGC-2 DATA BUS FAIL	DFGC-2 Accelerometer Failures	X Acceleration 2 A-B Update Failure
136	136 DFGC-1 D3A-Z A-B COMPARE FAIL	DFGC- 1 Accelerometer Failures	Z Acceleration 2 A-B Comparison Failure
137	137 DFGC-2 D3A-Z A-B COMPARE FAIL	DFGC- 2 Accelerometer Failures	Z Acceleration 2 A-B Comparison Failure
138	138 DFGC-1 D3A-X A-B COMPARE FAIL	DFGC- 1 Accelerometer Failures	X Acceleration 1 A-B Comparison Failure
139	139 DFGC-2 D3A-X A-B COMPARE FAIL	DFGC- 2 Accelerometer Failures	X Acceleration 2 A-B Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 7 of 26)

Fail Code	STP Message	Failure Description	
144	144 DFGC1 PITCH1 SIGNAL FAIL	Digital Flight Guidance Computer1 (DFGC-1) Pitch Failures	Pitch 1-1A Valid Failure
145	145 DFGC-1 DATA BUS FAIL		Pitch 1/1A-2A Update Failure
146	14X DFGC1 PITCH1 SIGNAL FAIL		Pitch 1-1A Range Failure
147			Pitch 1-1A Step Failure
148	1XX DFGC1 PITCH2 SIGNAL FAIL		Pitch 1-2A Valid Failure
149			Pitch 1-2A Range Failure
150			Pitch 1-2A Step Failure
151	151 DFGC1 PITCH3 SIGNAL FAIL		Pitch 1-3A Valid Failure
152	152 DFGC-1 DATA BUS FAIL		Pitch 1-3A Update Failure
153	15X DFGC1 PITCH3 SIGNAL FAIL		Pitch 1-3A Range Failure
154			Pitch 1-3A Step Failure
155	15X DFGC-1 PITCH COMPARE FAIL		Pitch 1/1A-2A Comparison Failure
156			Pitch 1/1A-3A Comparison Failure
157			Pitch 1/2A-3A Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 8 of 26)

Fail Code	STP Message	Failure Description	
160	160 DFGC2 PITCH1 SIGNAL FAIL	Digital Flight Guidance Computer2 (DFGC-2) Pitch Failures	Pitch 2-1A Valid Failure
161	161 DFGC-2 DATA BUS FAIL		Pitch 1/2A-2A Update Failure
162	16X DFGC2 PITCH1 SIGNAL FAIL		Pitch 2-1A Range Failure
163			Pitch 2-1A Step Failure
164	16X DFGC2 PITCH2 SIGNAL FAIL		Pitch 2-2A Valid Failure
165			Pitch 2-2A Range Failure
166			Pitch 2-2A Step Failure
167	167 DFGC2 PITCH3 SIGNAL FAIL		Pitch 2-3A Valid Failure
168	168 DFGC-2 DATA BUS FAIL		Pitch 2-3A Update Failure
169	1XX DFGC2 PITCH3 SIGNAL FAIL		Pitch 2-3A Range Failure
170			Pitch 2-3A Step Failure
171	17X DFGC-2 PITCH COMPARE FAIL		Pitch 2/1A-2A Comparison Failure
172			Pitch 2/1A-3A Comparison Failure
173			Pitch 2/2A-3A Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 9 of 26)

Fail Code	STP Message	Failure Description	
176	176 DFGC-1 ROLL1 SIGNAL FAIL	Digital Flight Guidance Computer1 (DFGC-1) Roll Failures	Roll 1-1A Valid Failure
177	177 DFGC-1 DATA BUS FAIL		Roll 1/1A-2A Update Failure
178	17X DFGC-1 ROLL1 SIGNAL FAIL		Roll 1-1A Range Failure
179			Roll 1-1A Step Failure
180	18X DFGC-1 ROLL2 SIGNAL FAIL		Roll 1-2A Valid Failure
181			Roll 1-2A Range Failure
182			Roll 1-2A Step Failure
183	183 DFGC-1 ROLL3 SIGNAL FAIL		Roll 1-3A Valid Failure
184	184 DFGC-1 DATA BUS FAIL		Roll 1-3A Update Failure
185	18X DFGC-1 ROLL3 SIGNAL FAIL		Roll 1-3A Range Failure
186			Roll 1-3A Step Failure
187	18X DFGC-1 ROLL COMPARE FAILURE		Roll 1-1A, 2A Comparison Failure
188			Roll 1-1A, 3A Comparison Failure
189			Roll 1-2A, 3A Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 10 of 26)

Fail Code	STP Message	Failure Description	
192	192 DFGC-2 ROLL1 SIGNAL FAIL	Digital Flight Guidance Computer2 (DFGC-2) Roll Failures	Roll 2-1A Valid Failure
193	193 DFGC-2 DATA BUS FAIL		Roll 2/1A-2A Update Failure
194	19X DFGC-2 ROLL1 SIGNAL FAIL		Roll 2-1A Range Failure
195			Roll 2-1A Step Failure
196	19X DFGC-2 ROLL2 SIGNAL FAIL		Roll 2-2A Valid Failure
197			Roll 2-2A Range Failure
198			Roll 2-2A Step Failure
199	199 DFGC-2 ROLL3 SIGNAL FAIL		Roll 2-3A Valid Failure
200	200 DFGC-2 DATA BUS FAIL		Roll 2-3A Update Failure
201	20X DFGC-2 ROLL3 SIGNAL FAIL		Roll 2-3A Range Failure
202			Roll 2-3A Step Failure
203	20X DFGC-2 ROLL COMPARE FAIL		Roll 2/1A-2A Comparison Failure
204			Roll 2/1A-3A Comparison Failure
205			Roll 2/2A-3A Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 11 of 26)

Fail Code	STP Message	Failure Description	
208	208 DFGC-1 ANGLE OF ATTACK-1 FAIL	Digital Flight Guidance Computer1 (DFGC-1) Angle of Attack Failures	Angle of Attack 1-1 Valid Failure
209	209 DFGC-1 DATA BUS FAIL		Angle of Attack 1-1, 2 Update Failure
210	21X DFGC-1 ANGLE OF ATTACK-1 FAIL		Angle of Attack 1-1 Range Failure
211			Angle of Attack 1-2 Step Failure
212	21X DFGC-1 ANGLE OF ATTACK-2 FAIL		Angle of Attack 1-2 Valid Failure
213			Angle of Attack 1-2 Range Failure
214			Angle of Attack 1-2 Step Failure
215	215 DFGC-1 ANGLE OF ATTACK FAIL		Angle of Attack 1-1, 2 Comparison Failure
224	224 DFGC-2 ANGLE OF ATTACK-1 FAIL	DFGC-2 Angle of Attack Failures	Angle of Attack 2-1 Valid Failure
225	225 DFGC-2 DATA BUS FAIL		Angle of Attack 2-1, 2 Update Failure
226	22X DFGC-2 ANGLE OF ATTACK-1 FAIL		Angle of Attack 2-1 Range Failure
227			Angle of Attack 2-1 Step Failure
228	2XX DFGC-2 ANGLE OF ATTACK-2 FAIL		Angle of Attack 2-2 Valid Failure
229			Angle of Attack 2-2 Range Failure
230			Angle of Attack 2-2 Step Failure
231	231 DFGC-2 ANGLE OF ATTACK FAIL		Angle of Attack 2-1, 2 Comparison Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
240	240 DFGC-1 FLAP1 SIGNAL FAIL	Digital Flight Guidance Computer1 (DFGC-1) Flap Failures	Flap 1-1 Valid Failure
241	241 DFGC-1 DATA BUS FAIL		Flap 1/1-2 Update Failure
242	24X DFGC-1 FLAP1 SIGNAL FAIL		Flap 1-1 Range Failure
243			Flap 1-1 Step Failure
245	24X DFGC-1 FLAP2 SIGNAL FAIL		Flap 1-2 Valid Failure
246			Flap 1-2 Range Failure
247			Flap 1-2 Step Failure
249	249 DFGC-1 FLAP COMPARE FAIL		Flap 1/1,2 Comparison Failure
256	256 DFGC-2 FLAP1 SIGNAL FAIL	DFGC-2 Flap Failures	Flap 2-1 Valid Failure
257	257 DFGC-2 DATA BUS FAIL		Flap 2/1-2 Update Failure
258	25X DFGC-2 FLAP1 SIGNAL FAIL		Flap 2-1 Range Failure
259			Flap 2-1 Step Failure
261	26X DFGC-2 FLAP2 SIGNAL FAIL		Flap 2-2 Valid Failure
262			Flap 2-2 Range Failure
263			Flap 2-2 Step Failure
265	265 DFGC-2 FLAP COMPARE FAIL		Flap 2/1-2 Comparison Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
272	27X DFGC-1 SLAT1 SIGNAL FAIL	Digital Flight Guidance Computer1 (DFGC-1) Slat Failures	Slat 1-left Valid Failure
273			Slat 1-left Invalid Pattern Failure
275	27X DFGC-1 SLAT2 SIGNAL FAIL		Slat 1-right Valid Failure
276			Slat 1-right Invalid Pattern Failure
278	278 DFGC-1 SLAT COMPARE FAIL		Slat 1-left, right Comparison Failure
279	279 DFGC-1 FLAP HANDLE FAIL		Flap Handle Valid Failure
280	28X DFGC-2 SLAT1 SIGNAL FAIL	DFGC-2 Slat Failures	Slat 2-left Valid Failure
281			Slat 2-left Invalid Pattern Failure
283	28X DFGC-2 SLAT2 SIGNAL FAIL		Slat 2-right Valid Failure
284			Slat 2-right Invalid Pattern Failure
286	286 DFGC-2 SLAT COMPARE FAIL		Slat 2-left, right Comparison Failure
287	287 DFGC-2 FLAP HANDLE FAIL		Flap Handle Valid Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
288	288 DFGC-1 RAD ALT-1 FAIL	Digital Flight Guidance Computer1 (DFGC-1) Radio Altitude Failures	Radio Altitude 1-1A Valid Failure
289	289 DFGC-1 DATA BUS FAIL		Radio Altitude 1-1A Update Failure
290	29X DFGC-1 RAD ALT-1 FAIL		Radio Altitude 1-1A Range Failure
291			Radio Altitude 1-1A Step Failure
292	292 DFGC-1 RAD ALT-2 FAIL		Radio Altitude 1-2A Valid Failure
293	293 DFGC-1 DATA BUS FAIL		Radio Altitude 1-2A Update Failure
294	29X DFGC-1 RAD ALT-2 FAIL		Radio Altitude 1-2A Range Failure
295			Radio Altitude 1-2A Step Failure
296	296 DFGC-1 RAD ALT COMPARE FAIL		Radio Altitude 1/1A-2A Comparison Failure
304	304 DFGC-2 RAD ALT-1 FAIL	DFGC-2 Radio Altitude Failures	Radio Altitude 2-1A Valid Failure
305	305 DFGC-2 DATA BUS FAIL		Radio Altitude 2-1A Update Failure
306	30X DFGC-2 RAD ALT-1 FAIL		Radio Altitude 2-1A Range Failure
307			Radio Altitude 2-1A Step Failure
308	308 DFGC-2 RAD ALT-2 FAIL		Radio Altitude 2-2A Valid Failure
309	309 DFGC-2 DATA BUS FAIL		Radio Altitude 2-2A Update Failure
310	31X DFGC-2 RAD ALT-2 FAIL		Radio Altitude 2-2A Range Failure
311			Radio Altitude 2-2A Step Failure
312	312 DFGC-2 RAD ALT COMPARE FAIL		Radio Altitude 2/1A-2A Comparison Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
320	320 DFGC-1 TO/GA SPEED REF FAIL	Digital Flight Guidance Computer1 (DFGC-1) Speed Reference Failures	T/O Speed Reference 1 Valid Failure
321	321 DFGC-1 DATA BUS FAIL		TO/GA Speed Reference 1 Update Failure
322	32X DFGC-1 TO/GA SPEED REF FAIL		T/O Speed Reference 1 Range Failure
324			G/A Speed Reference 1 Valid Failure
325			G/A Speed Reference 1 Range Failure
328	328 DFGC-2 TO/GA SPEED REF FAIL	DFGC-2 Speed Reference Failures	T/O Speed Reference 2 Valid Failure
329	329 DFGC-2 DATA BUS FAIL		TO/GA Speed Reference 2 Update Failure
330	33X DFGC-2 TO/GA SPEED REF FAIL		T/O Speed Reference 2 Range Failure
332			G/A Speed Reference 2 Valid Failure
333			G/A Speed Reference 2 Range Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
336	33X SWC-1 SHAKER MARGIN FAIL	Stall Warning Computer1 (SWC-1) Shaker Margin Signal Failures	Shaker Margin 1 Valid Failure
337			Shaker Margin 1 A/D Failure
338			Shaker Margin 1 Range Failure
340	34X SWC-2 SHAKER MARGIN FAIL	SWC-2 Shaker Margin Signal Failures	Shaker Margin 2 Valid Failure
341			Shaker Margin 2 A/D Failure
342			Shaker Margin 2 Range Failure
344	344 SWC 1-2 COMPARE FAIL	SWC 1-2 Compare Failure	Shaker Margin 1, 2 Comparison Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 17 of 26)

Fail Code	STP Message	Failure Description	
352	352 DFGC-1 MAIN GEAR FAIL	Input Discrete Failures	Digital Flight Guidance Computer-1 (DFGC-1) Main Gear Left/Right Miscompare
353	353 DFGC-1 NOSE OLEO FAIL		DFGC-1 Nose Oleo 1-2 Miscompare
354	354 DFGC-2 MAIN GEAR FAIL		DFGC-2 Main Gear Left/Right Miscompare
355	355 DFGC-2 NOSE OLEO FAIL		DFGC-2 Nose Oleo 1-2 Miscompare
356	356 A/P 1-2 SELECTOR FAIL		Both Sides Selected on A/P
357	357 F/D SELECTOR FAIL		F/D Both ON 1 and Both ON 2 Selected
361	361 28 VDC BUS FAIL		28 VDC Bus <15 VDC Failure
362	36X OPTION PIN FAIL		Configuration Options Not Supported
363			Configuration Parity Failure
364	364 DFGC-1 GND DISCRETE FAIL		DFGC-1 Main/Nose Gear Miscompare
365	365 DFGC-2 AND DISCRETE FAIL		DFGC-2 Main/Nose Gear Miscompare
366	366 DFGC-1 F/D END-AROUND FAIL		DFGC-1 F/D End-around Failure
367	367 DFGC-2 F/D END-AROUND FAIL		DFGC-2 F/D End-around Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 18 of 26)

Fail Code	STP Message	Failure Description	
368	3XX DFGC–1 DATA BUS FAIL	Digital Flight Guidance Computer1 (DFGC–1) ARINC Data Bus Update Failures	DFGC–1 STAT01 Update Failure
369			DFGC–1 STAT02 Update Failure
370			DFGC–1 STAT03 Update Failure
371			DFGC–1 STAT06 Update Failure
372			DFGC–1 STAT07 Update Failure
373			DFGC–1 STAT08 Update Failure
374			DFGC–1 ODISC0 Update Failure
375			DFGC–1 ODISC2 Update Failure
376			DFGC–1 ODISC3 Update Failure
377			DFGC–1 GOOD00 Update Failure
378			DFGC–1 GOOD01 Update Failure
379			DFGC–1 GOOD10 Update Failure
380			DFGC–1 GOOD11 Update Failure
381			DFGC–1 GOOD20 Update Failure
382			DFGC–1 ODISC6 Update Failure
383			DFGC–1 A/T Command Update Failure
384			DFGC–1 WSC STP Word Update Failure
385			Wrap Test Word 5 Update Failure
386			Wrap Test Word A Update Failure
387			DFGC–1 SLEGM0 Update Failure
388			DFGC–1 SLEGM1 Update Failure
389			DFGC–1 EAMON0 Update Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 19 of 26)

Fail Code	STP Message	Failure Description	
400	4XX DFGC-2 DATA BUS FAIL	Digital Flight Guidance Computer2 (DFGC-2) ARINC Data Bus Update Failures	DFGC-2 STAT01 Update Failure
401			DFGC-2 STAT02 Update Failure
402			DFGC-2 STAT03 Update Failure
403			DFGC-2 STAT06 Update Failure
404			DFGC-2 STAT07 Update Failure
405			DFGC-2 STAT08 Update Failure
406			DFGC-2 ODISCO Update Failure
407			DFGC-2 ODISC2 Update Failure
408			DFGC-2 ODISC3 Update Failure
409			DFGC-2 GOOD00 Update Failure
410			DFGC-2 GOOD01 Update Failure
411			DFGC-2 GOOD10 Update Failure
412			DFGC-2 GOOD11 Update Failure
413			DFGC-2 GOOD20 Update Failure
414			DFGC-2 ODISC6 Update Failure
415			DFGC-2 A/T Command Update Failure
416			DFGC-2 WSC STP Word Update Failure
417			Wrap Test Word 5 Update Failure
418			Wrap Test Word A Update Failure
419			DFGC-2 SLEGM0 Update Failure
420			DFGC-2 SLEGM1 Update Failure
421			DFGC-2 EAMON0 Update Failure

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WAGS Fault Code Diagram
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Fail Code	STP Message	Failure Description	
432*	43X WINDSHEAR COMPUTER FAIL	Windshear Computer (WSC) ARINC Data Bus Failures	ARINC Receiver A Failure, In Sim Only
433*			ARINC Receiver B Failure
434	434 DFGC-1 DATA BUS FAIL		DFGC-1 Data Bus Input Failure OR WSC ARINC Receiver C Failure
435	435 DFGC-2 DATA BUS FAIL		DFGC-2 Data Bus Input Failure OR WSC ARINC Receiver D Failure
436	436 CADC-1 DATA BUS FAIL		CADC-1 Data Bus Input Failure OR WSC ARINC Receiver E Failure
437	437 CADC-2 DATA BUS FAIL		CADC-2 Data Bus Input Failure OR WSC ARINC Receiver F Failure
438*	4XX WINDSHEAR COMPUTER FAIL		ARINC Receiver G Failure
439*			ARINC Receiver H Failure
440*			ARINC Receiver J Failure
441*			WSC/DFGC-1 Wraparound Failure
442*			WSC/DFGC-2 Wraparound Failure
443*			ARINC Bus A Transmission Completion Failure
444*			ARINC Bus B Transmission Completion Failure
445*			ARINC Bus C Transmission Completion Failure

NOTE: Fail codes designated with an "*" will be used to light the Windshear Computer front panel LED display.

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 21 of 26)

Fail Code	STP Message	Failure Description	
448*	4XX WINDSHEAR COMPUTER FAIL	Windshear Computer Output Discrete Driver Failures	HUD PLI Enable Discrete Driver Failure
449*			Windshear Inop Discrete Driver Failure
450*			Windshear Warning-1 Discrete Driver Failure
451*			Windshear Caution-1 Discrete Driver Failure
452*			Windshear Warning-2 Discrete Driver Failure
453*			Windshear Caution-2 Discrete Driver Failure
454*			Ground Proximity Warning System (GPWS) Inhibit Driver Fail
455*			Stick Pusher Inhibit Driver Failure
457*			Central Aural Warning System (CAWS) Decreasing Warning Enable Driver Failure
458*			CAWS Increasing Caution Enable Driver Failure
459*			Head-Up display (HUD) Warning Driver Failure
460*			HUD Caution Driver Failure
461*			CAWS WSC Self Test Driver Failure

NOTE: Fail codes designated with an "*" will be used to light the Windshear Computer front panel LED display.

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 22 of 26)

Fail Code	STP Message	Failure Description	
465	465 WINDSHEAR INOP FAIL	Output Discrete Load Failures	Windshear Inop Discrete Load Failure
466	466 WINDSHEAR WARN-1 FAIL		Windshear Warning-1 Discrete Load Failure
467	467 WINDSHEAR CAUT-1 FAIL		Windshear Caution-1 Discrete Load Failure
468	468 WINDSHEAR WARN-2 FAIL		Windshear Warning-2 Discrete Load Failure
469	469 WINDSHEAR CAUT-2 FAIL		Windshear Caution-2 Discrete Load Failure
471	471 PUSHER INHIBIT FAIL		Sticker PUsher Inhibit Relay Failure
473	47X CAWS INTER-FACE FAIL		Central Aural Warning System (CAWS) Decreasing Warning Enable Load Fail
474			CAWS Increasing Caution Enable Load Failure
475	47X HUD INTER-FACE FAIL		Head-Up display (HUD) Warning Load Failure
476			HUD Caution Load Failure
477	477 CAWS INTER-FACE FAIL		CAWS WSC Self Test Load Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 23 of 26)

Fail Code	STP Message	Failure Description	
480*	48X WINDSHEAR COMPUTER FAIL	Inter-processor compare Failures	Calculated F/D Pitch Command Comparison Failure
481*			Calculated A/P Pitch Command Comparison Failure
482*			Calculated Fast/Slow Command Comparison Failure
483*			Calculated PLI Command Comparison Failure
484*			Actual F/D Pitch Command Comparison Failure
485*			Actual A/P Pitch Command Comparison Failure
486*			Actual Fast/Slow Command Comparison Failure
487*			Actual PLI Command Comparison Failure
488*			Windshear status Comparison Failure
489*			Other Processor Heartbeat Timeout

NOTE: Fail codes designated with an "*" will be used to light the Windshear Computer front panel LED display.

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 24 of 26)

Fail Code	STP Message	Failure Description	
497	497 DFGC-1 DATA BUS FAIL	Digital Flight Guidance Computer1 (DFGC-1) Alpha Reference Failures	Center/Fast Alpha Reference 1 Update Failure
498	XXX DFGC-1 ALPHA REFERENCE FAIL		Center Alpha Reference 1 Range Failure
501			Fast Alpha Reference 1 Range Failure
505	505 DFGC-2 DATA BUS FAIL	DFGC-2 Alpha Reference Failures	Center/Fast Alpha Reference 2 Update Failure
506	50X DFGC-2 ALPHA REFERENCE FAIL		Center Alpha Reference 2 Range Failure
509			Fast Alpha Reference 2 Range Failure

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WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 25 of 26)

Fail Code	STP Message	Failure Description	
512	512 DFGC-1 DATA BUS FAIL	Digital Flight Guidance Computer1 (DFGC-1) EPR and G/A EPR Failures	EPR 1 Left-Right Update Failure
513	51X DFGC-1 EPRL SIGNAL FAIL		EPR 1 Left Valid Failure
514			EPR 1 Left Range Failure
515			EPR 1 Left Step Failure
516	51X DFGC-1 EPRR SIGNAL FAIL		EPR 1 Right Valid Failure
517			EPR 1 Right Range Failure
518			EPR 1 Right Step Failure
520	520 DFGC-1 DATA BUS FAIL		G/A EPR 1 Update Failure
522	522 DFGC-1 G/A EPR FAIL		G/A EPR 1 Left Range Failure
528	528 DFGC-2 DATA BUG FAIL	DFGC-2 EPR and G/A EPR Failures	EPR 2 Left-right Update Failure
529	5XX DFGC-2 EPRL SIGNAL FAIL		EPR 2 Left Valid Failure
530			EPR 2 Left Range Failures
531			EPR 2 Left Step Failure
532	53X DFGC-2 EPRR SIGNAL FAIL		EPR 2 Right Valid Failure
533			EPR 2 Right Range Failure
534			EPR 2 Right Step Failure
536	536 DFGC-2 DATA BUS FAIL		G/A EPR 2 Update Failure
538	538 DFGC-2 DATA EPR FAIL		G/A EPR 2 Left Range Failure

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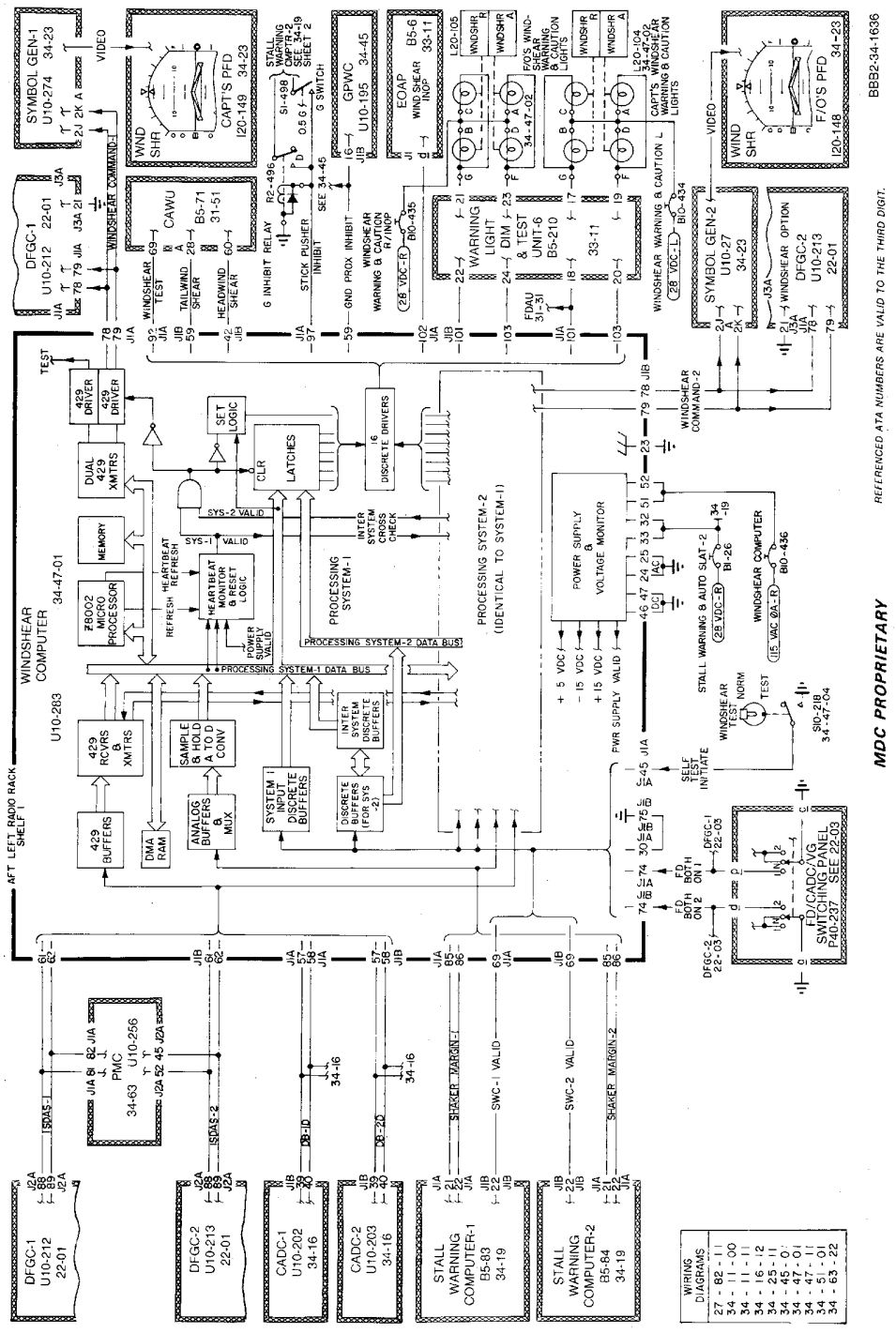
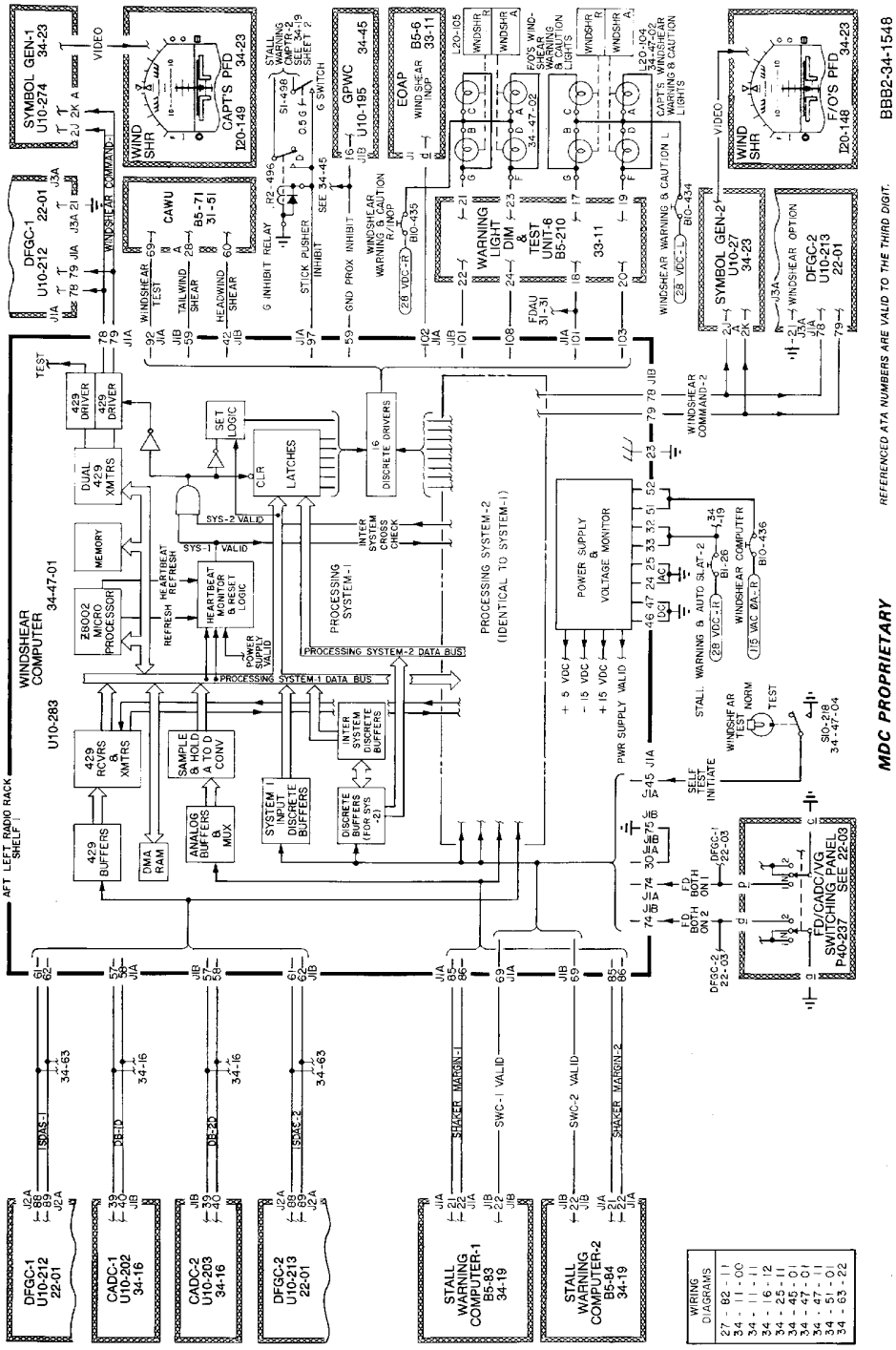
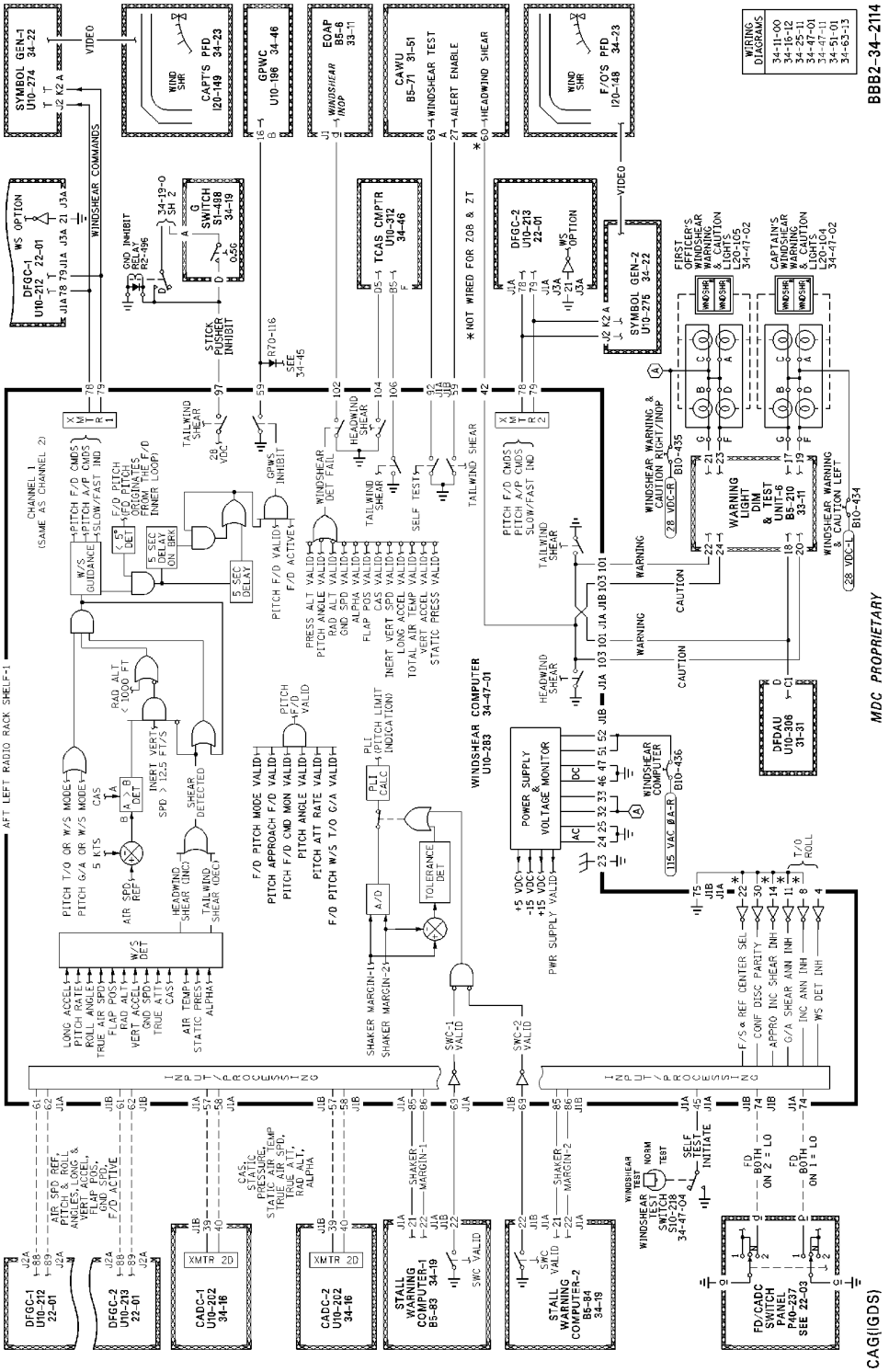
WAGS Fault Code Diagram
Figure 106/34-47-00-990-806 (Sheet 26 of 26)



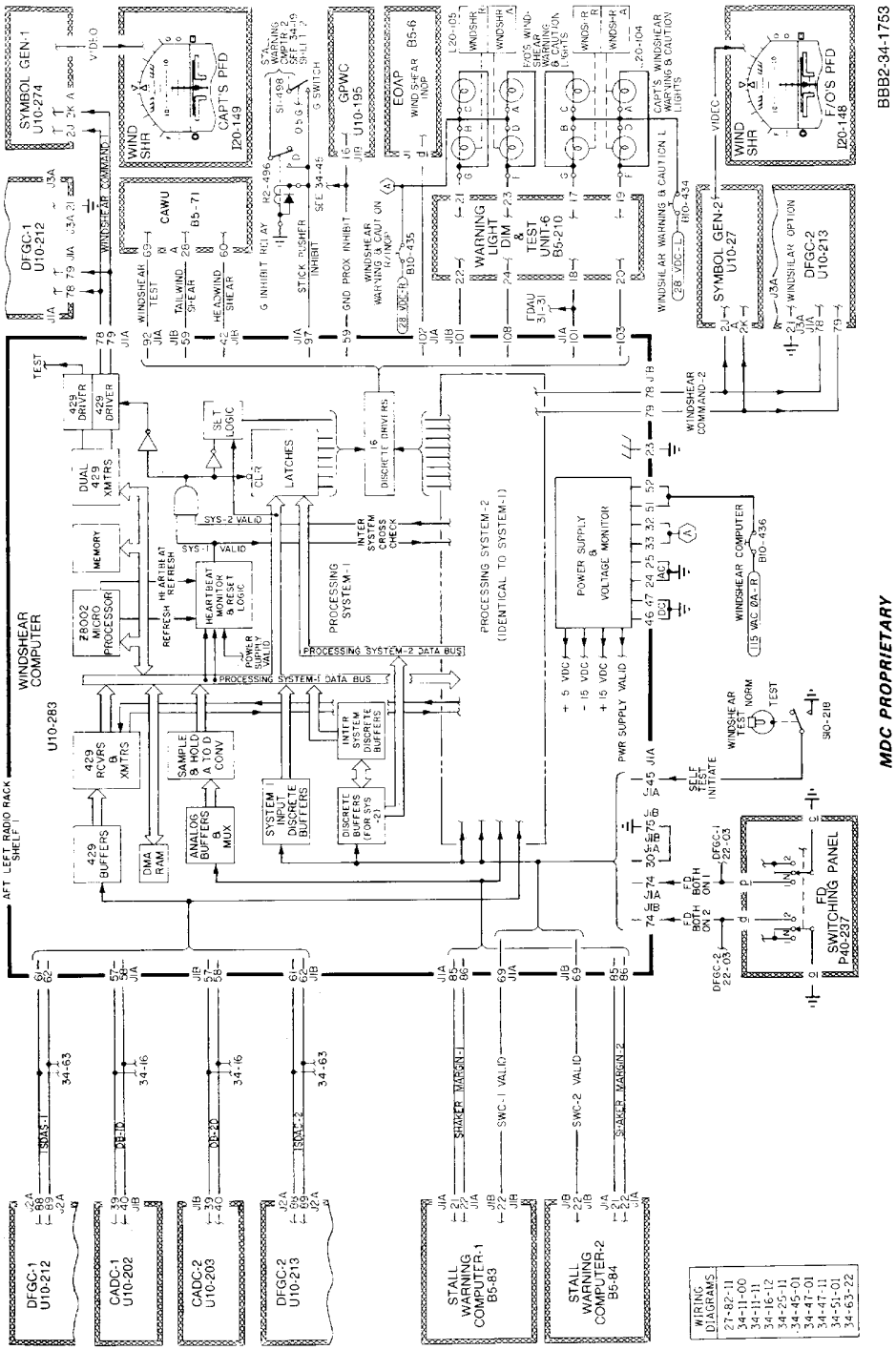
Windshear Alert and Guidance System - Schematic
Figure 107/34-47-00-990-807 (Sheet 1 of 4)



Windshear Alert and Guidance System - Schematic
Figure 107/34-47-00-990-807 (Sheet 2 of 4)



Windshear Alert and Guidance System - Schematic
Figure 107/34-47-00-990-807 (Sheet 3 of 4)



Windshear Alert and Guidance System - Schematic
Figure 107/34-47-00-990-807 (Sheet 4 of 4)

WINDSHEAR ALERT AND GUIDANCE SYSTEM (WAGS) - MAINTENANCE PRACTICES

1. General

A. This section provides adjustment/test procedures to determine the operational status of the Windshear system.

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887

B. The system tests in this section include: self test which exercises all outputs of the windshear computer, and a status test panel test which checks all inputs to the windshear computer.

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872

C. The system tests in this section include: self test which exercises all outputs of the windshear computer, and an MCDU test which checks all inputs to the windshear computer.

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

2. Adjustment/Test Windshear Alert and Guidance System

A. System Self Test

NOTE: Aircraft main gear must be compressed and ground controls in ground mode.

NOTE: The self test will last approximately 8 seconds.

NOTE: Before starting windshear self-test, make sure flap handle agrees with actual flap position. Hydraulic pressure may be required. If flap handle disagrees with flap position, the WINDSHEAR INOP message will come on.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887

Table 201

Step	Operation	Desired Result
(1)	Momentarily place WNDSHR TEST switch on overhead switch panel to TEST position for each of following self test steps.	WNDSHR TEST momentarily to TEST.
(2)	Verify amber WNDSHR lights on Captain's and F/O's glareshield are flashed for three cycles then red WNDSHR lights are flashed for three cycles.	Amber WNDSHR lights cycle three times; red WNDSHR lights cycle three times.
NOTE: On rare occasions, a fourth flash will be observed. When windshear is detected during normal operation in flight, the WNDSHR lights flash three times then remain on. This part of the self test lasts four seconds and occasionally allows enough time for the WNDSHR lights to come on the fourth time. When the self test ends, the WNDSHR lights go off.		
(3)	Verify WINDSHEAR INOP message on overhead annunciator comes on then goes off.	WINDSHEAR INOP comes on then goes off.
WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.		
(4)	Open this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887 (Continued)

Table 201 (Continued)

Step	Operation			Desired Result	
WJE 401-404, 406-408, 410-412, 414, 864, 873-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	UPPER EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	UPPER EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887					
WJE 406					
	Verify 6 cycles of "WINDSHEAR".			Aural "WINDSHEAR" activated 6 cycles.	
WJE 406 POST MD80-34A262					
	Verify 3 cycles of "HEADWIND SHEAR" then 3 cycles of "TAILWIND SHEAR".			Aural "HEADWIND SHEAR" activated 3 cycles, aural "TAILWIND SHEAR" activated 3 cycles.	
WJE 401-404, 407, 408, 410-412, 414, 886, 887					
	Verify 3 cycles of "HEADWIND SHEAR" then 3 cycles of "TAILWIND SHEAR".			Aural "HEADWIND SHEAR" activated 3 cycles, aural "TAILWIND SHEAR" activated 3 cycles.	
WJE 873-879					
	Verify 3 cycles of "TAILWIND SHEAR".			Aural "TAILWIND SHEAR" activated 3 cycles.	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
	Verify 3 cycles of "WINDSHEAR".			Aural "WINDSHEAR" activated 3 cycles.	
WJE 406 POST MD80-34A262					
NOTE: Third “HEADWIND SHEAR” message may not be complete before start of first “TAILWIND SHEAR” message.					
WJE 401-404, 407, 408, 410-412, 414, 886, 887					
NOTE: Third aural "HEADWIND SHEAR" message may not be completed before start of first "TAILWIND SHEAR" message.					
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887					
(5)	Close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 864, 873-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	UPPER EPC	LEFT AC BUS	K/33

WJE 401-404, 406-408, 410-412, 414, 864, 873-879, 886, 887 (Continued)

Table 201 (Continued)

Step	Operation	Desired Result
WJE 417, 419, 421, 423, 865, 869, 871, 872		
	B1–23 LEFT GROUND CONTROL RELAY UPPER EPC LEFT AC BUS K/30	
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887		
WJE 406 POST MD80-34A262		
	Verify 1 cycle of "HEADWIND SHEAR" then 1 cycle of "TAILWIND SHEAR".	
WJE 401-404, 407, 408, 410-412, 414, 886, 887		
	Verify 1 cycle of "HEADWIND SHEAR" then 1 cycle of "TAILWIND SHEAR".	Aural "HEADWIND SHEAR" activated 1 cycle, aural "TAILWIND SHEAR" activated 1 cycle.
WJE 873-879		
	Verify 1 cycle of "TAILWIND SHEAR".	Aural "TAILWIND SHEAR" activated 1 cycle.
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872		
	Verify 1 cycle of "WINDSHEAR".	Aural "WINDSHEAR" activated 1 cycle.
WJE 406		
	Verify 2 cycles of "WINDSHEAR".	Aural "WINDSHEAR" activated 2 cycles.
WJE 406 POST MD80-34A262		
NOTE: "HEADWIND SHEAR" will be heard one time, then "TAILWIND SHEAR" one time.		
WJE 873, 874		
(6)	On aircraft with EFIS, verify PLI bars on PFD's centered up, down, then out of view.	PLI bars centered, up, down, then out of view.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887		
(6)	On Captain's and F/O's PFD verify PLI bars centered, up, down, then out of view.	PLI bars centered, up, down, then out of view.
WJE 406		
NOTE: On CAA certified aircraft, windshear provides detection and alerting only. Steps (6) through (12) do not apply to these aircraft.		
WJE 873, 874		
(7)	On Captain's and F/O's ADI/PFD verify FAST/SLOW displays centered, up, down, then out of view.	F/S centered, up, down, then out of view.
WJE 401-404, 412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 886, 887		
(7)	On Captain's and F/O's PFD verify FAST/SLOW displays out of view.	F/S out of view.

WJE 401-404, 412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 886, 887 (Continued)

Table 201 (Continued)

Step	Operation	Desired Result
WJE 406-408, 410, 411, 875-879		
(7)	On Captain's and F/O's PFD verify FAST/SLOW displays centered, up, down, then out of view.	F/S centered, up, down, then out of view.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887		
(8)	On FGCP, engage applicable autopilot switch to A/P 1 or A/P 2. Repeat WNDSHR TEST and verify column back, forward, back to neutral then A/P disengages.	Column back, forward, neutral, A/P disengages.
(9)	On overhead annunciator panel, verify STALL INDICATION FAILURE light comes on then goes off.	STALL INDICATION FAILURE light comes on then goes off.
(10)	On overhead annunciator panel, verify GPWS FAIL light comes on then goes off.	GPWS FAIL light comes on then goes off.
(11)	On captain's and F/O's FMA, verify WIND SHR, AUT W/S, HDG HLD, WIND SHR.	FMA displays windshear messages.
(12)	Verify Captain's and first officer's pitch bars centered, pitch up, pitch down then go out of view.	F/D pitch bars centered, up, down, out of view.
WJE 406-408, 410, 411, 875-879		
(13)	On captain's and F/O's PFD's, verify amber WIND SHR messages flash three cycles then red WIND SHR messages flash three cycles.	Amber and red WIND SHR messages cycle three times each.
WJE 873, 874		
(13)	On aircraft with EFIS, verify amber WIND SHR messages on PFD's flash three cycles then red WIND SHR messages flash three cycles.	Amber and red WIND SHR messages cycle three times each.
WJE 401-404, 412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 886, 887		
(13)	Verify amber WIND SHR flashes three cycles then red WIND SHR cycle three times each. flashes three cycles.	Amber and red WIND SHR
WJE 407, 408, 411		
(14)	On overhead annunciator panel, verify HUD displays PLI with message WND SHEAR CAUTION for 3 cycles then WND SHEAR WARNING for 2 cycles.	WND SHEAR CAUTION for 3 cycles then WND SHEAR WARNING for 2 cycles.
WJE 401-404, 406, 410, 412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887		
(14)	Verify WINDSHEAR INOP lights all off following self-test.	WINDSHEAR INOP lights off.
WJE 407, 408, 411		
(15)	Verify WINDSHEAR INOP lights all off following self-test.	WINDSHEAR INOP lights off.

WJE 409, 884, 892, 893

Table 202

Step	Operation	Desired Result
(1)	Momentarily place WNDSHR TEST switch on overhead switch panel to TEST position for each of following self test steps.	WNDSHR TEST momentarily to TEST.

WJE 409, 884, 892, 893 (Continued)

Table 202 (Continued)

Step	Operation	Desired Result
(2)	Verify amber WNDSHR lights on Captain's and F/O's glareshield are flashed for three cycles then red WNDSHR lights are flashed for three cycles.	Amber WNDSHR lights cycle three times; red WNDSHR lights cycle three times.
NOTE: On rare occasions, a fourth flash will be observed. When windshear is detected during normal operation in flight, the WNDSHR lights flash three times then remain on. This part of the self test lasts four seconds and occasionally allows enough time for the WNDSHR lights to come on the fourth time. When the self test ends, the WNDSHR lights go off.		
(3)	Verify WINDSHEAR INOP message on overhead annunciator comes on then goes off.	WINDSHEAR INOP comes on then goes off.
WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.		
(4)	Open this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B1–23	LEFT GROUND CONTROL RELAY	UPPER EPC	LEFT AC BUS	K/33

	Verify 3 cycles of "HEADWIND SHEAR" then 3 cycles of "TAILWIND SHEAR".	Aural "HEADWIND SHEAR" activated 3 cycles, aural "TAILWIND SHEAR" activated 3 cycles.
NOTE: Third aural "HEADWIND SHEAR" message may not be completed before start of following "TAILWIND SHEAR" message.		
(5)	Close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B1–23	LEFT GROUND CONTROL RELAY	UPPER EPC	LEFT AC BUS	K/33

	Verify 1 cycle of "HEADWIND SHEAR" then 1 cycle of "TAILWIND SHEAR".	Aural "HEADWIND SHEAR" activated 1 cycle, aural "TAILWIND SHEAR" activated 1 cycle.
(6)	On captain's and F/O's ADI verify FAST/SLOW pointers centered, up, down, then out of view.	F/S centered, up, down, then out of view.
(7)	On FGCP, engage applicable autopilot switch to A/P 1 or A/P 2. Repeat WNDSHR TEST and verify column back, forward, back to neutral then A/P disengages.	Column back, forward, neutral, A/P disengages.
(8)	On overhead annunciator panel, verify STALL INDICATION FAILURE light comes on then goes off.	STALL INDICATION FAILURE light comes on then goes off.

WJE 409, 884, 892, 893 (Continued)

Table 202 (Continued)

Step	Operation	Desired Result
(9)	On overhead annunciator panel, verify GPWS FAIL light comes on then goes off.	GPWS FAIL light comes on then goes off.
(10)	On captain's and F/O's FMA, verify WIND SHR, AUT W/S, HDG HLD, WIND SHR.	FMA displays windshear messages.
(11)	Verify captain's and first officer's pitch bars centered, pitch up, pitch down then go out of view.	F/D pitch bars centered, up, down, out of view.
(12)	Verify WINDSHEAR INOP lights all off following self-test.	WINDSHEAR INOP lights off.

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

B. Status Test Panel Input Test

WJE 401-404, 406-408, 410-412, 414, 873-879, 886, 887, 892, 893

Table 203

Step	Operation	Desired Result
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887, 892, 893		
(1)	Verify EFIS/DFGC switch is in DFGC position.	Switch to DFGC position.
WJE 873, 874		
(1)	Verify EFIS/DFGC switch is in DFGC position (EFIS aircraft).	Switch to DFGC position.
WJE 401-404, 406-408, 410-412, 414, 873-879, 886, 887, 892, 893		
(2)	Press and release power pushbutton (PB) on STP.	DIGITAL FLIGHT GUIDANCE CMPTR?
(3)	Verify DFGC side select switch and STP CMPVLD 1/2 legend correspond to side tested.	DFGC side select and CMPVLD correspond to side tested.
NOTE: If CMPLVLD 1/2 legend does not correspond to desired test side, cycle CMPVLD PB.		
(4)	Cycle forward space PB.	WINDSHEAR COMPUTER?
(5)	Cycle verify PB.	"WINDSHEAR COMPUTER OK" "NO FAILURE"
(6)	Cycle verify PB.	WINDSHEAR FLIGHT FAULT REVIEW?
(7)	Cycle verify PB.	0 CURRENT FAILURES.
(8)	Cycle backspace PB then forward space PB.	REVIEW WINDSHEAR HISTORY DATA?
(9)	Cycle forward space PB.	WINDSHEAR CMPTR MEMORY ERASE?
(10)	Cycle forward space PB.	DISPLAY INPUTS?

WJE 409, 884

Table 204

Step	Operation	Desired Result
(1)	Press and release power pushbutton (PB) on STP.	DIGITAL FLIGHT GUIDANCE COMPUTER?

WJE 409, 884 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
(2)	Verify DFGC side select switch and STP CMPVLD 1/2 legend correspond to side tested.	DFGC side select and CMPVLD correspond to side tested.
NOTE: If CMPLVLD 1/2 legend does not correspond to desired test side, cycle CMPVLD PB.		
(3)	Cycle forward space PB.	WINDSHEAR COMPUTER?
(4)	Cycle verify PB.	WINDSHEAR COMPUTER OK NO FAILURE.
(5)	Cycle verify PB.	WINDSHEAR FLIGHT FAULT REVIEW?
(6)	Cycle verify PB.	0 CURRENT FAILURES.
(7)	Cycle backspace PB then forward space PB.	REVIEW WINDSHEAR HISTORY DATA?
(8)	Cycle forward space PB.	WINDSHEAR CMPTR MEMORY ERASE?
(9)	Cycle forward space PB.	DISPLAY INPUTS?

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884

C. MCDU Test Panel Input Test

Table 205 FMS MCDU Test Panel Input Test

Step	Operation	Desired Result
(1)	On forward pedestal press MENU pushbutton on MCDU-1.	MCDU MENU page appears.
(2)	Press line select key (LSK 6L) and verify DFGC 1 VALID message is displayed on MCDU next to LSK 4L and 5L.	TEST PANEL page appears.
(3)	Select DFGC 1 (LSK 4L) on MCDU.	DIGITAL FLIGHT GUIDANCE COMPUTER?
(4)	Press FWD LSK.	WINDSHEAR COMPUTER?
(5)	Cycle verify PB.	"WINDSHEAR COMPUTER OK" "NO FAILURE"
(6)	Press VERIFY LSK.	WINDSHEAR FLIGHT FAULT REVIEW?
(7)	Press VERIFY LSK.	0 CURRENT FAILURES.
(8)	Press BACK LSK then FWD LSK.	REVIEW WINDSHEAR HISTORY DATA?
(9)	Press FWD LSK.	WINDSHEAR CMPTR MEMORY ERASE?
(10)	Press FWD LSK.	DISPLAY INPUTS?

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

D. Analog Input Test

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

Table 206

Step	Operation	Desired Result
(1)	Cycle verify PB.	ANALOG INPUTS?

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893 (Continued)

Table 206 (Continued)

Step	Operation	Desired Result
(2)	Cycle verify PB.	SWC-L X.XX DEG SWC-R X.XX DEG
NOTE: X.XX can be any number. Verify SWC-L and SWC-R are the same values ±0.4 DEG.		
(3)	Cycle backspace pushbutton.	ANALOG INPUTS?

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884

Table 207

Step	Operation	Desired Result
(1)	Press VERIFY LSK.	ANALOG INPUTS?
(2)	Press VERIFY LSK.	SWC-L X.XX DEG SWC-R X.XX DEG
NOTE: X.XX can be any number. Verify SWC-L and SWC-R are the same values ±0.4 DEG.		
(3)	Press BACK LSK.	ANALOG INPUTS?

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

E. Discrete Inputs Test

Step	Operation			Desired Result	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
(1)	Press FWD LSK.			DISCRETE INPUTS?	
WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893					
(1)	Cycle forward space PB.			DISCRETE INPUTS?	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
(2)	Press VERIFY LSK.			DISC INPUTS 1/4 0000 0000 0011.	
WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893					
(2)	Cycle verify PB.			DISC INPUTS 1/4 0000 0000 0011.	
WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893					
(3)	On overhead switch panel place FD switch to BOTH ON 1 position.			DISC INPUTS 1/4 0100 0000 0011.	
(4)	On overhead switch panel place FD switch to BOTH ON 2 position.			DISC INPUTS 1/4 1000 0000 0011.	
(5)	On overhead switch panel place FD switch to NORM position.			DISC INPUTS 1/4 0000 0000 0011	
(6)	Open this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-589	CAPTAIN'S STALL WARNING	UPPER EPC	LEFT AC BUS	X/23
				DISC INPUTS 1/4 0000 0000 0010.	
(7)	Close this circuit breaker:				

(Continued)

Step	Operation			Desired Result	
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-589	CAPTAIN'S STALL WARNING	UPPER EPC	LEFT AC BUS	X/23
				DISC INPUTS 1/4 0000 0000 0001.	
(8)	Open this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-590	FIRST OFFICER'S STALL WARNING	UPPER EPC	LEFT AC BUS	Z/23
				DISC INPUTS 1/4 0000 0000 0001.	
(9)	Close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-590	FIRST OFFICER'S STALL WARNING	UPPER EPC	LEFT AC BUS	Z/23
				DISC INPUTS 1/4 0000 0000 0011.	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
(10)	Press VERIFY LSK.			DISC INPUTS 2/4 0100 1000 0000.	
WJE 409, 873, 874, 884					
(10)	Cycle verify PB.			DISC INPUTS 2/4 0100 1000 1000.	
WJE 401-404, 406-412, 414, 884, 886, 887, 892, 893					
(10)	Cycle verify PB.			DISC INPUTS 2/4 0000 0000 0000.	
WJE 875-879					
(10)	Cycle verify PB.			DISC INPUTS 2/4 0100 1000 0000.	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
(11)	Press VERIFY LSK.			DISC INPUTS 3/4 0100 0000 0010	
WJE 873, 874					
(11)	Cycle verify PB.			DISC INPUTS 3/4 1010 0000 0010	
WJE 875-879					
(11)	Cycle verify PB.			DISC INPUTS 3/4 0010 0000 0010.	
WJE 401-404, 406-412, 414, 884, 886, 887, 892, 893					
(11)	Cycle verify PB.			DISC INPUTS 3/4 0000 0000 0000.	
WJE 409, 884					
(11)	Cycle verify PB.			DISC INPUTS 3/4 1010 0000 0000	
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872					
(12)	Press VERIFY LSK.			DISC INPUTS 4/4 0000 0010 0000.	

WJE 417, 419, 421, 423, 864, 865, 869, 871, 872 (Continued)

(Continued)

Step	Operation	Desired Result
WJE 401-404, 406-408, 410-412, 414, 873-879, 886, 887, 892, 893		
(12)	Cycle verify PB.	DISC INPUTS 4/4 0000 0010 0000.
WJE 409, 884		
(12)	Cycle verify PB.	DISC INPUTS 4/4 0000 0000 0000.
WJE 417, 419, 421, 423, 864, 865, 869, 871, 872		
(13)	Press VERIFY LSK.	DISCRETE INPUTS?
WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893		
(13)	Cycle verify PB.	DISCRETE INPUTS?
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887		
(14)	Discrete Input option pins (1234 5678 9ABC):	
	DISC INPUTS 1/4	
	1 - Flight Director both on 2	
	2 - Flight Director both on 2	
	3 - Spare	
	4 - Spare	
	5 - Self Test initiate	
	6 - Spare	
	7 - Spare	
	8 - Spare	
	9 - Simulator reset	
	A - Simulator freeze	
	B - Stall Warning Computer-2 valid	
	C - Stall Warning Computer-1 valid	
	DISC INPUTS 2/4	
	(WSC Option pins J1A-1 thru A-12)	
	1 - Approach AutoThrottle Control Inhibit (A-12)	
	2 - TO/GA Aural Caution Inhibit (A-11)	
	3 - Spare (A-10)	
	4 - Auto EPR Guidance Inhibit (A-9)	
	5 - T/O Roll Aural Caution Inhibit (A-8)	
	6 - Automatic AutoThrottle Disengage Enable (A-7)	
	7 - Post Stall Recovery System Not Installed (A-6)	

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887 (Continued)

(Continued)

Step	Operation	Desired Result
	8 - AutoThrottle Automatic Unclamp Inhibit (A-5)	
	9 - T/O Roll Windshear Detection Inhibit (A-4)	
	A - In Burn-in (A-3)	
	B - In Test Set (A-2)	
	C - In Simulator (A-1)	
	DISC INPUTS 3/4	
	(WSC Option pins J1A-13 thru A-24)	
	1 - EFIS Not Installed (A-24)	
	2 - "Windshear" Aural Annunciation (A-23)	
	3 - Fast/Slow Alpha Ref Centering (A-22)	
	4 - HUD Installed (A-21)	
	5 - ISDAS Recorder Select (A-20)	
	6 - DFGC -935 Installed (A-19)	
	7 - MD-87 Installed (A-18)	
	8 - Windshear Guidance Inhibit (A-17)	
	9 - CADC ARINC 429 Select (A-16)	
	A - Autopilot Disconnect at Windshear Warning (A-15)	
	B - Approach Aural Caution Inhibit (A-14)	
	C - Spare (A-13)	
	DISC INPUTS 4/4	
	(WSC Option pins J1A-25 thru A-30)	
	1 - Spare	
	2 - Spare	
	3 - Spare	
	4 - Spare	
	5 - Spare	
	6 - Spare	
	7 - Option Pin Parity (A-30)	
	8 - Spare (A-29)	
	9 - Spare (A-28)	
	A - Spare (A-27)	

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 886, 887 (Continued)

(Continued)

Step	Operation	Desired Result
	B - Spare (A-26)	
	C - Spare (A-25)	
WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893		

F. Digital Input Test

WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893

Table 208

Step	Operation	Desired Result
(1)	Cycle forward space PB.	DIGITAL INPUTS?
(2)	Cycle verify PB.	CADC-1 DATA CADC-2 DATA
(3)	Cycle verify PB again.	ALT-1 XXXXX ALT-2 XXXXX
(4)	Verify ALT-1 and ALT-2 values are same ± 20.	Values same ± 20
(5)	Cycle backspace PB.	CADC-1 DATA CADC-2 DATA
(6)	Cycle forward PB.	ISDAS-1 DATA ISDAS-2 DATA
(7)	Cycle verify PB.	PITCH1-1A ± XX.XX PITCH2-1A ± XX.XX
WJE 892, 893		
NOTE: ± can be either + or - and XX.XX can be any number.		
WJE 401-404, 406-412, 414, 873-879, 884, 886, 887, 892, 893		
(8)	Verify PITCH1-1A and PITCH2-1A values are same.	Values same ± 4.0 °
(9)	Cycle CMPVLD pushbutton and repeat Paragraph 2.B. through Paragraph 2.F. using opposite DFGC side select switch.	Same as for Paragraph 2.B. through Paragraph 2.F..
(10)	Test complete, return aircraft to required configuration.	

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884

Table 209

Step	Operation	Desired Result
(1)	Press FWD LSK.	DIGITAL INPUTS?
(2)	Press VERIFY LSK.	CADC-1 DATA CADC-2 DATA

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884 (Continued)

Table 209 (Continued)

Step	Operation	Desired Result
(3)	Press VERIFY LSK again.	ALT-1 XXXXX ALT-2 XXXXX
(4)	Verify ALT-1 and ALT-2 values are same ± 20.	Values same ± 20
(5)	Press BACK LSK.	CADC-1 DATA CADC-2 DATA
(6)	Press FWD LSK.	ISDAS-1 DATA ISDAS-2 DATA
(7)	Press VERIFY LSK.	PITCH1-1A ± XX.XX PITCH2-1A ± XX.XX
(8)	Verify PITCH1-1A and PITCH2-1A values are same.	Values same ± 4.00.
(9)	Press MENU PB and repeat Paragraph 2.C. through Paragraph 2.F. using opposite DFGC side select switch and MCDU-2.	Same as for Paragraph 2.C. through Paragraph 2.F..
(10)	Test complete, return aircraft to required configuration.	

WINDSHEAR COMPUTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Windshear computer. The computer is installed in the aft left radio rack in the electrical/electronics compartment.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	

3. Removal/Installation Windshear Computer

A. Remove Windshear Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	23	B10-434	WINDSHEAR WARNING & CAUTION LEFT

UPPER EPC, POWER - RIGHT AC BUS

Row	Col	Number	Name
WJE 873-879, 886, 887, 892, 893			
L	7	B10-436	WINDSHEAR COMPUTER
WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884			
L	10	B10-436	WINDSHEAR COMPUTER

WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	11	B10-435	WINDSHEAR WARNING & CAUTION RIGHT/INOP

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

NOTE: Power to the windshear computer is supplied by the WINDSHEAR WARNING & CAUTION RIGHT/INOP circuit breaker. The STALL WARNING AND AUTO SLAT-2 circuit breaker does not need to be opened.

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) If installed, turn driver/extractor handle CCW (Counterclockwise), otherwise pull unit straight out until unit electrical connectors are disengaged from mounting rack support, and remove unit.

(4) Install protective caps on electrical connections.

B. Install Windshear Computer

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	23	B10-434	WINDSHEAR WARNING & CAUTION LEFT

UPPER EPC, POWER - RIGHT AC BUS

Row	Col	Number	Name
WJE 873-879, 886, 887, 892, 893			
L	7	B10-436	WINDSHEAR COMPUTER
WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884			
L	10	B10-436	WINDSHEAR COMPUTER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	11	B10-435	WINDSHEAR WARNING & CAUTION RIGHT/INOP

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

(2) Remove protective caps and visually check unit connector plugs and mating connectors on mounting rack for loose, broken or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW (Clockwise), if installed, otherwise push unit straight in until unit is firmly engaged into rack.

(5) Engage holddown assemblies on unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	23	B10-434	WINDSHEAR WARNING & CAUTION LEFT

UPPER EPC, POWER - RIGHT AC BUS

Row	Col	Number	Name
WJE 873-879, 886, 887, 892, 893			
L	7	B10-436	WINDSHEAR COMPUTER
WJE 406-411, 417, 419, 421, 423, 864, 865, 869, 871, 872, 884			
L	10	B10-436	WINDSHEAR COMPUTER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 864, 865, 869, 871, 872, 875-879, 886, 887, 892, 893			
E	11	B10-435	WINDSHEAR WARNING & CAUTION RIGHT/INOP

WJE 401-404, 406-412, 414, 417, 419, 421, 423, 864, 865, 869, 871-879, 884, 886, 887, 892, 893

(7) Perform Windshear self test. (WINDSHEAR ALERT AND GUIDANCE SYSTEM (WAGS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-47-00/201 Config 1)

DEPENDENT POSITION DETERMINING - DESCRIPTION AND OPERATION

1. General

A. This section describes that portion of equipment which provides position, enroute guidance, and flight safety information to the pilots through operations that are dependent upon ground stations or ground control.

2. VHF Navigation

WJE 873, 874, 892, 893

A. The VHF navigation system uses signals from ground stations to provide visual and aural indications of VOR bearings. The course to be flown to intercept or follow a known VOR radial is selected on the Flight Guidance Control Panel. On non-EFIS aircraft, selected heading, radio course deviation, and to-from data are displayed on the HSI. On EFIS aircraft, these data are displayed on the EFIS Navigation Display (ND). Relative and magnetic bearing to the selected VOR station are displayed on the compass indicator. Frequency selection and switching is controlled from the VHF NAV control panel, adjacent to the flight guidance control panel.

WJE 886, 887

B. The VHF navigation system uses signals from ground stations to provide visual and aural indications of VOR bearings. The course to be flown to intercept or follow a known VOR radial is selected on the Flight Guidance Control Panel. Selected heading, radio course deviation, and to-from data are displayed on the EFIS Navigation Display (ND). Relative and magnetic bearing to the selected VOR station are displayed on the compass indicator. Frequency selection and switching is controlled from the VHF NAV control panel, adjacent to the flight guidance control panel.

WJE 405-411, 880, 881, 883, 884

C. The VHF navigation system uses signals from ground stations to provide visual and aural indications of VOR bearings. The course to be flown to intercept or follow a known VOR radial is selected on the Flight Guidance Control Panel. Selected heading, radio course deviation, and to-from data are displayed on the HSI. On aircraft with EFIS, these data are displayed on the EFIS Navigation Display (ND). Relative and magnetic bearing to the selected VOR station are displayed on the compass indicator/RMI. Frequency selection and switching is controlled from the VHF NAV control on the flight guidance control panel.

WJE 401-404, 412, 414

D. The VHF navigation system uses signals from ground stations to provide visual and aural indications of VOR bearings. The course to be flown to intercept or follow a known VOR radial is selected on the Flight Guidance Control Panel. Selected heading, radio course deviation, and to-from data are displayed on the EFIS Navigation Display (ND). Relative and magnetic bearing to the selected VOR station are displayed on the RMI. Frequency selection and switching is controlled from the VHF NAV control panel, adjacent to the flight guidance control panel.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 891

E. The VHF navigation system uses signals from ground stations to provide visual and aural indications of VOR bearings. The course to be flown to intercept or follow a known VOR radial is selected on the Flight Guidance Control Panel. On non-EFIS aircraft, selected heading, radio course deviation, and to-from data are displayed on the HSI. On EFIS aircraft, these data are displayed on the EFIS Navigation Display (ND). Relative and magnetic bearing to the selected VOR station are displayed on the compass indicator or Radio Distance Magnetic Indicator (RDMI). Frequency selection and switching is controlled from the VHF NAV control panel, adjacent to the flight guidance control panel.

WJE ALL

3. DME

WJE 873, 874, 892, 893

A. The distance measuring equipment (DME) system is a navigational aid which provides the pilots with a digital readout of slant distance from the aircraft to a ground facility. When the system transmits an interrogation signal, a ground transponder sends back a reply. The elapsed time between transmission of the signal and reception of the response is measured, and the distance computed. On non-EFIS aircraft, DME distance is displayed in the DME window on the applicable HSI. On EFIS aircraft, these data are displayed on the EFIS ND.

WJE 886, 887

B. The distance measuring equipment (DME) system is a navigational aid which provides the pilots with a digital readout of slant distance from the aircraft to a ground facility. When the system transmits an interrogation signal, a ground transponder sends back a reply. The elapsed time between transmission of the signal and reception of the reply is measured, and the distance computed. DME distance is displayed on the upper right and left corners of the EFIS ND.

WJE 405-411, 880, 881, 883, 884

C. The distance measuring equipment (DME) system is a navigational aid which provides the pilots with a digital readout of slant distance from the aircraft to a ground facility. When the system transmits an interrogation signal, a ground transponder sends back a reply. The elapsed time is measured and the distance computed. DME distance is displayed in the DME window on the applicable HSI. On aircraft with EFIS, these data are displayed on the EFIS ND.

WJE 401-404, 412, 414

D. The distance measuring equipment (DME) system is a navigational aid which provides the pilots with a digital readout of slant distance from the aircraft to a ground facility. When the system transmits an interrogation signal, a ground transponder sends back a reply. The elapsed time between transmission of the signal and reception of the reply is measured, and the distance computed. DME distance is displayed on the ND and RDMI.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 891

E. The distance measuring equipment (DME) system is a navigational aid which provides the pilots with a digital readout of slant distance from the aircraft to a ground facility. When the system transmits an interrogation signal, a ground transponder sends back a reply. The elapsed time between transmission of the signal and reception of the response is measured, and the distance computed. On non-EFIS aircraft, DME distance is displayed in the DME window on the applicable HSI. On EFIS aircraft, these data are displayed on the EFIS ND and RDMI.

WJE ALL

4. ADF

WJE 873, 874, 892, 893

A. The automatic direction finding (ADF) system uses radio signals in determining the angle between the aircraft heading and a selected ground station. Relative and magnetic bearing to the transmitting station are displayed on the arrow pointers of the applicable compass indicator. On aircraft with EFIS, ADF data is displayed on the EFIS ND's. The system may be used for homing, ADF fix, range orientation, beam bracketing, and time-distance computing. Voice communications from the transmitting station may be routed to the flight crew through the applicable audio control panel.

WJE 886, 887

B. The automatic direction finding (ADF) system uses radio signals in determining the angle between the aircraft heading and a selected ground station. Relative and magnetic bearing to the transmitting station are displayed on the EFIS ND. The system may be used for homing, ADF fix, range orientation, beam bracketing, and time-distance computing. Voice communications from the transmitting station may be routed to the flight crew through the applicable audio control panel.

WJE 405-411, 880, 881, 883, 884

C. The automatic direction finding (ADF) system uses radio signals in determining the angle between the aircraft heading and a selected ground station. Relative and magnetic bearing to the transmitting station are displayed on the arrow pointers of the applicable compass indicator/RMI. On aircraft with EFIS, these data are also displayed on the EFIS ND. The system may be used for homing, ADF fix, range orientation, beam bracketing, and time-distance computing. Voice communications from the transmitting station may be routed to the flight crew through the applicable audio control panel.

WJE 401-404, 412, 414

D. The automatic direction finding (ADF) system uses radio signals in determining the angle between the aircraft heading and a selected ground station. Relative and magnetic bearing to the transmitting station are displayed on the EFIS ND. The system may be used for homing, ADF fix, range orientation, beam bracketing, and time-distance computing. Voice communications from the transmitting station may be routed to the flight crew through the applicable audio control panel.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 875-879, 891

E. The automatic direction finding (ADF) system uses radio signals in determining the angle between the aircraft heading and a selected ground station. Relative and magnetic bearing to the transmitting station are displayed on the arrow pointers of the applicable compass indicator. On aircraft with EFIS, ADF data is displayed on the EFIS ND's. The system may be used for homing, ADF fix, range orientation, beam bracketing, and time-distance computing. Voice communications from the transmitting station may be routed to the flight crew through the applicable audio control panel.

WJE ALL

5. ATC Transponder

A. The air traffic control (ATC) transponder system, when interrogated by a ground radar control station, sends a coded reply that specifically identifies the airplane. The coded reply, allows surface tracking and airplane identification. Altitude reporting is automatically accomplished when the control panel altitude reporting switch is on.

WJE 405-411, 873, 874, 880, 881, 883, 884, 886, 887, 892, 893

6. OMEGA (On aircraft with OMEGA Navigation System)

A. The OMEGA/VLF Navigation System is a very low frequency long range radio navigation system. The system operates on a hyperbolic basis employing eight OMEGA and nine Navy VLF transmitters, strategically located around the earth's surface. The transmitters transmit timed continuous wave (CW) bursts. The CW bursts are compared, by the Omega Receiver Processor Unit (RPU), for phase relationship to each other and to the RPU's internal oscillator. The phase relationship is processed with airplane True Airspeed (TAS) and magnetic heading, to provide accurate position, navigation, and guidance data. Position and navigation data are displayed on the Omega Control Display Units (CDUs) and the Horizontal Situation Indicators (HSIs). Steering commands are provided to the Digital Flight Guidance System (DFGS).

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the airplane in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's HSI, and VOR-1 bearing signals to both compass indicators. VHF NAV-2 provides VOR deviation, to/from, and flag signals to the first officer's HSI, and VOR-2 bearing signals to both compass indicators. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and forward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's HSIs display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the aiplane is to the left of the radial. Flying the airplane so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. An aperture in the course mask displays NAV system - ON. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. A blue-yellow annunciator replaces the to/from display when a localizer is tuned. Each HSI displays heading dial and flag data from magnetic heading of the airplane as read under a lubber line pointer at top of the dial. A flag placarded HDG will come into view, partially obscuring the lubber line, to denote a power failure or unreliable operation of the compass system. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a dagger-shaped pointer, rotating in the center of the heading dial. A pointer opposite the dagger-shaped pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, a servo loop positions the applicable selected course pointer to the desired course.

H. The captain's compass indicator displays the magnetic heading of compass system -2 and the first officer's displays compass system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the HSI. If the airplane is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the Compass indicator pointers as VOR station relative bearing. The heading card reads the magnetic heading of the airplane, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

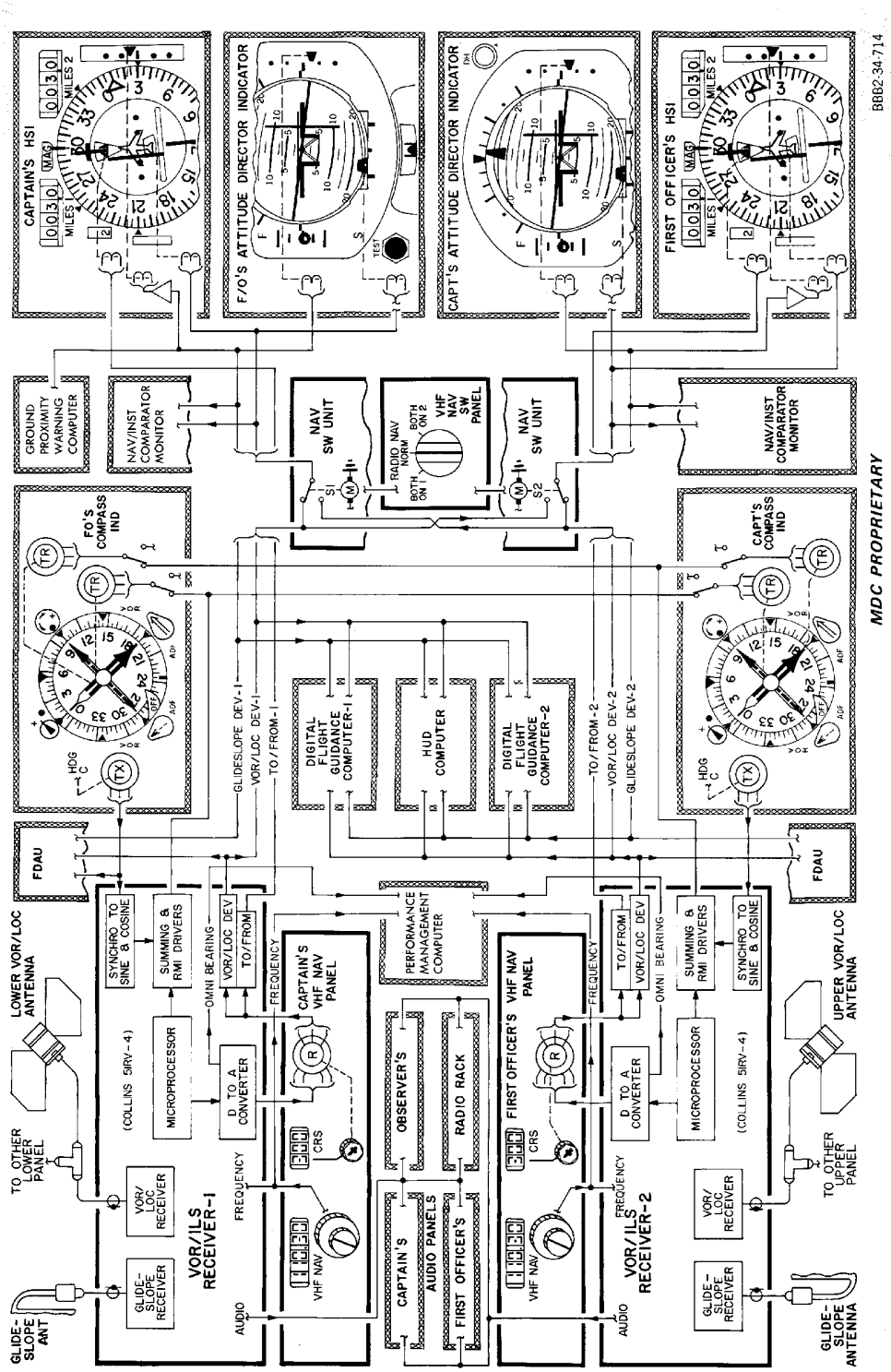
(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both compass indicators, ensure that OFF flag is out of view.

(4) On both HSI's, ensure that HDG flag is not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-802

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the airplane in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, NAV frequency control portion of the flight guidance control panel, and the compass indicators.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's HSI, and VOR-1 bearing signals to both compass indicators. VHF NAV-2 provides VOR deviation, to/from, and flag signals to the first officer's HSI, and VOR-2 bearing signals to both compass indicators. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and forward to the respective VOR/ILS receiver in the electrical/electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's HSIs display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the airplane is to the left of the radial. Flying the airplane so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each HSI displays heading dial and flag data from the compass system. The heading dial rotates to display the magnetic heading of the airplane as read under a lubber line pointer at top of the dial. A flag placarded HDG will come into view, partially obscuring the lubber line, to denote a power failure or unreliable operation of the compass system. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a dagger-shaped pointer, rotating in the center of the heading dial. A pointer opposite the dagger-shaped pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, a servo loop positions the applicable selected course pointer to the desired course.

H. The captain's compass indicator displays the magnetic heading of compass system -2 and the first officer's displays compass system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the HSI. If the airplane is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the Compass indicator pointers as VOR station relative bearing. The heading card reads the magnetic heading of the airplane, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

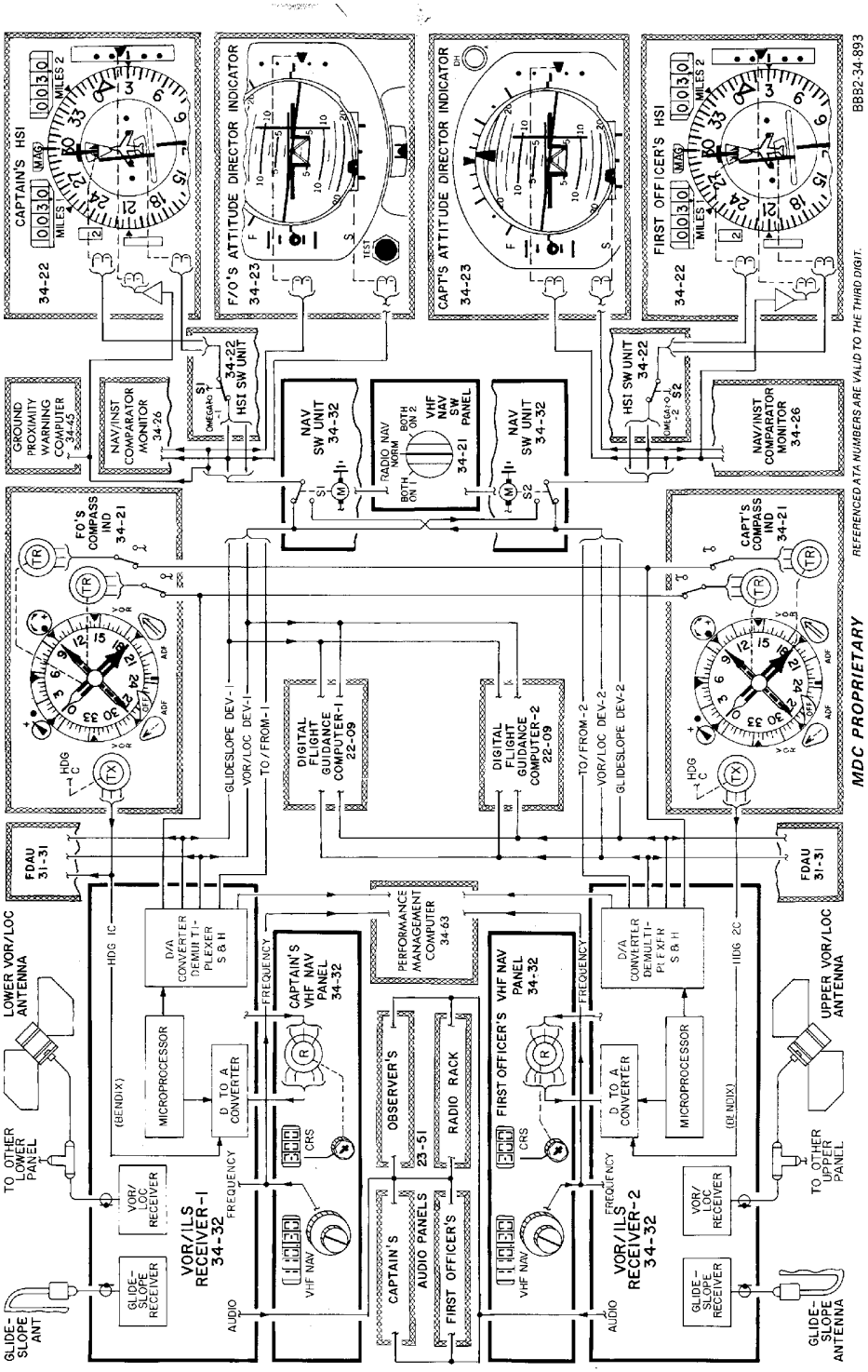
(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

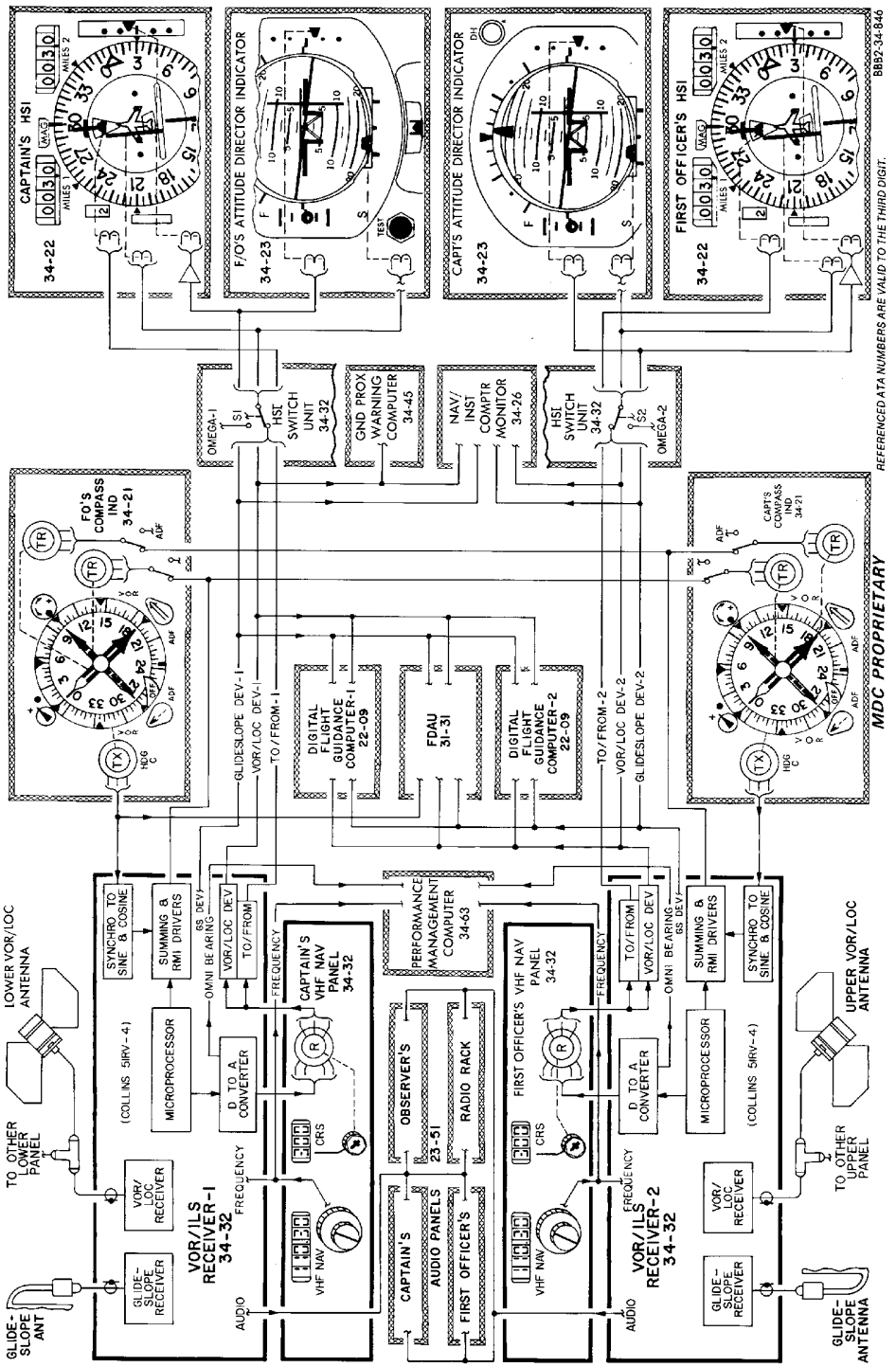
(3) On both compass indicators, ensure that OFF flag is out of view.

(4) On both HSI's, ensure that HDG flag is not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-803



ILS -- Block Diagram
Figure 2/34-51-00-990-804

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's HSI, and VOR-1 bearing signals to both compass indicators. VHF NAV-2 provides VOR deviation, to/from, and flag signals to the first officer's HSI, and VOR-2 bearing signals to both compass indicators. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's HSIs display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the aiplane is to the left of the radial. Flying the airplane so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each HSI displays heading dial and flag data from the compass system. The heading dial rotates to display the magnetic heading of the airplane as read under a lubber line pointer at top of the dial. A flag placarded HDG will come into view, partially obscuring the lubber line, to denote a power failure or unreliable operation of the compass system. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a dagger-shaped pointer, rotating in the center of the heading dial. A pointer opposite the dagger-shaped pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, a servo loop positions the applicable selected course pointer to the desired course.

H. The captain's compass indicator displays the magnetic heading of compass system -2 and the first officer's displays compass system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the HSI. If the airplane is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the compass indicator pointers as VOR station relative bearing. The heading card reads the magnetic heading of the airplane, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

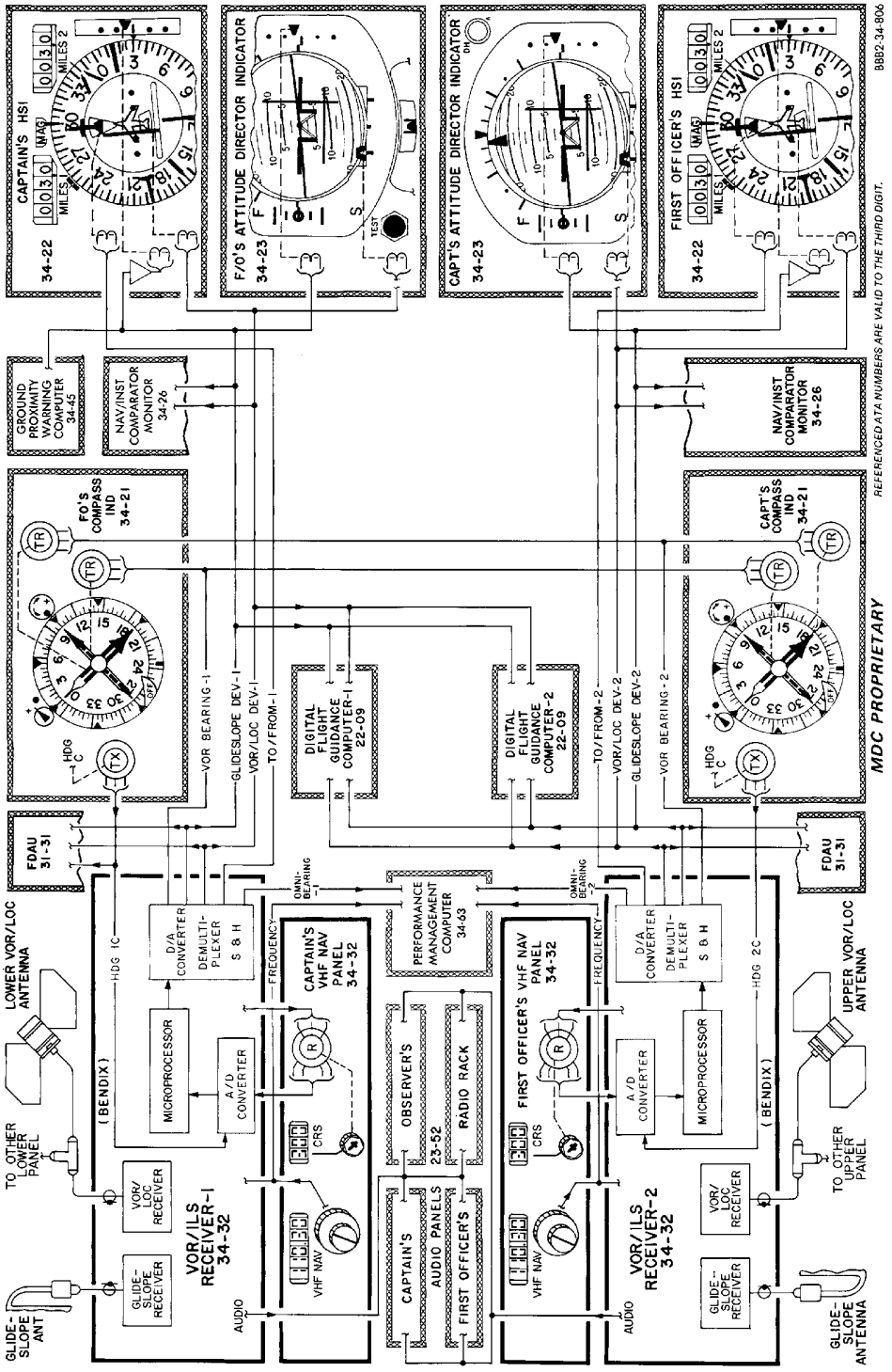
(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both compass indicators, ensure that OFF flag is out of view.

(4) On both HSI's, ensure that HDG flag is not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-807

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's HSI, and VOR-1 bearing signals to both compass indicators. VHF NAV-2 provides VOR deviation, to/from, and flag signals to the first officer's HSI, and VOR-2 bearing signals to both compass indicators. Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

(1) Two HSI switches, placarded RADIO OMEGA are located on the captain's and first officer's instrument panels, respectively. These switches operate the HSI (RAD/INS) switching unit. Placing either switch in the RADIO position, arms the digital flight guidance system for VOR mode and provides VOR inputs to the applicable HSI.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. When the HSI display selector switches are in the RADIO position, an aperture to the right of the course mask displays RAD. The captain's and first officer's HSI's display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the aircraft is to the right of the VOR radial, and to the right when the aircraft is to the left of the radial. Flying the aircraft so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on-the-beam (selected radial) condition. The To-From pointer is displayed to denote flying toward the VOR transmitter, or flying away from the station. A striped navigation warning flag masks the To-From pointer from view when valid VOR input signal is lost or aircraft is directly over VOR station. Each HSI displays heading dial and flag data from magnetic heading of the aircraft as read under a lubber line pointer at top of the dial. A flag placarded HEADING will come into view, partially obscuring the lubber line, to denote a power failure or unreliable operation of the compass system. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a dagger-shaped pointer, rotating in the center of the heading dial. A pointer opposite the dagger-shaped pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, a servo loop positions the applicable selected course pointer to the desired course.

(1) An annunciator window, on the upper right side of the indicator, displays the legend RAD to denote position of the HSI display selector switch. An adjacent window will display the number 1 or 2 to indicate which VOR receiver is selected by the VOR switch on the overhead switch panel.

H. The captain's compass indicator displays the magnetic heading of compass system -2 and the first officer's displays compass system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the aircraft. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the aircraft heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the HSI/ND. If the airplane is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the RMI pointers as VOR station relative bearing. The heading card reads the magnetic heading of the aircraft, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

(1) Energize airplane electrical buses.

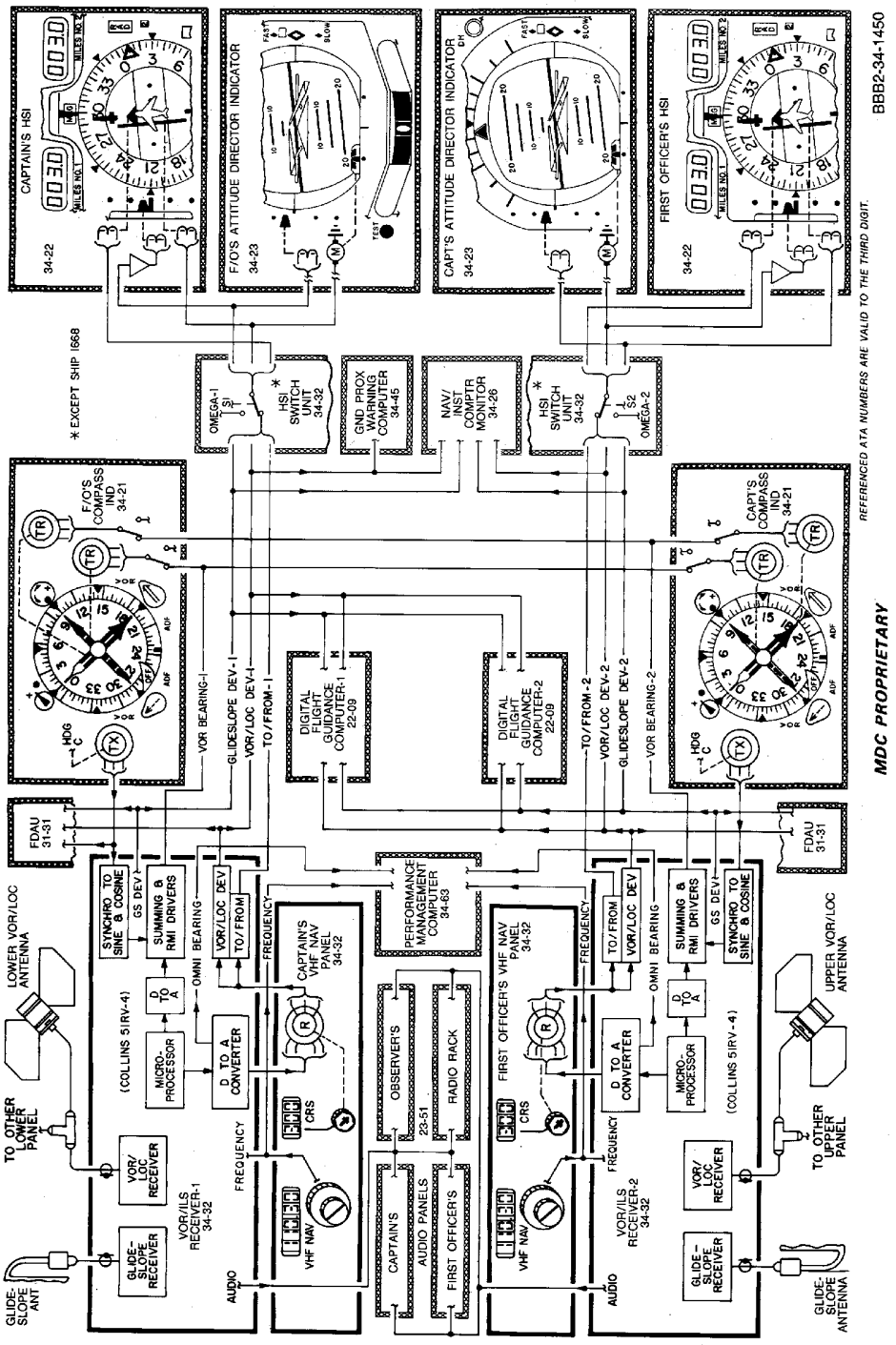
(2) Ensure VHF NAV and AHRS switches are in normal position.

(3) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(4) On both compass indicators, ensure that OFF flag is out of view.

(5) On both HSI's, ensure that HEADING flag is not displayed.

(6) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-809

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, radio magnetic indicators (RMI's) and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's Navigation Display (ND), and VOR-1 bearing signals to both RMI's. VHF NAV-2 provides VOR deviation, to/from, and FAIL signals to the first officer's ND, and VOR-2 bearing signals to both RMI's. VOR deviation, To/From and FAIL flag signals are displayed on the EFIS Navigation Display (ND). Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's ND's display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the airplane is to the left of the radial. Flying the airplane so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each ND displays heading dial and FAIL data from the Attitude and Heading System (AHRS). The heading dial rotates to display the magnetic heading of the aircraft as read under a lubber line pointer at top of the dial. A HDG FAIL will be displayed on the ND if a power failure or unreliable operation of the AHRS system occurs. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a pointer, rotating in the center of the heading dial. A pointer opposite the course pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, it positions the applicable selected course pointer to the desired course.

H. The captain's RMI displays the magnetic heading of attitude and heading reference system -2 and the first officer's displays attitude and heading reference system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the ND. If the aircraft is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the RMI pointers as VOR station relative bearing. The heading card reads the magnetic heading of the airplane, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both RMI's, ensure that OFF flag is out of view.

(4) On both ND's, ensure that HDG FAIL not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's Navigation Display (ND), and VOR-1 bearing signals to both compass indicators. VHF NAV-2 provides VOR deviation, to/from, and FAIL signals to the first officer's ND, and VOR-2 bearing signals to both compass indicators. VOR deviation, To/From and FAIL signals are displayed on the EFIS Navigation Display (ND). Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's ND's display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale rotates in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the aiplane is to the left of the radial. Flying the aircraft so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each ND displays heading dial and FAIL data from the compass system. The heading dial rotates to display the magnetic heading of the aircraft as read under a lubber line pointer at top of the dial. A HDG FAIL will be displayed on the ND if a power failure or unreliable operation of the compass system occurs. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, the selected heading cursor positions to the desired heading. Selected course is displayed on the heading dial by a pointer, rotating in the center of the heading dial. A pointer opposite the course pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, it positions the applicable selected course pointer to the desired course.

H. The captain's compass indicator displays the magnetic heading of compass system -2 and the first officer's displays compass system -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the ND. If the aircraft is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the compass magnetic heading is displayed by the RMI pointers as VOR station relative bearing. The heading card reads the magnetic heading of the airplane, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

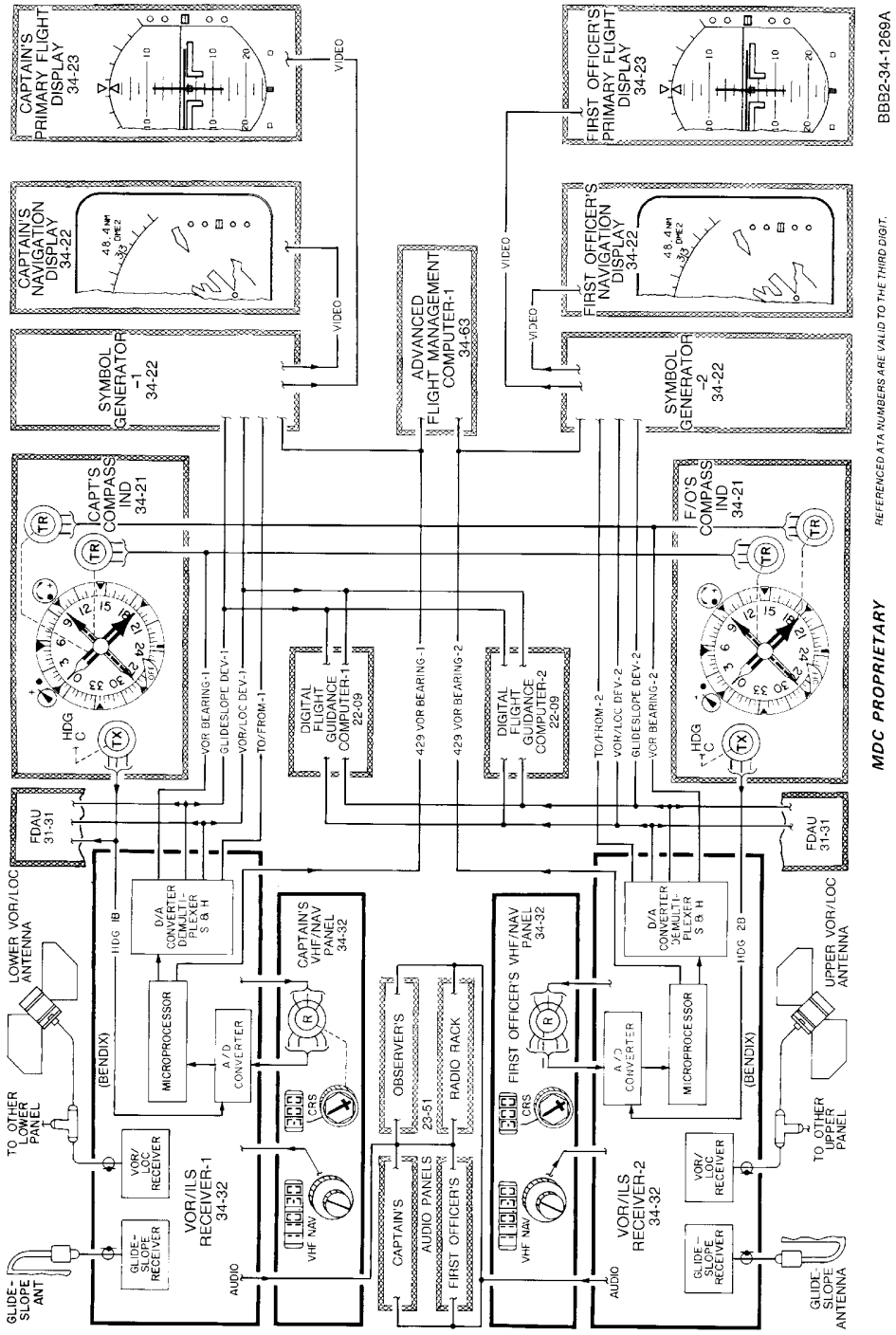
(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both compass indicators, ensure that OFF flag is out of view.

(4) On both NDs, make certain HDG FAIL not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-811

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's Navigation Display (ND), and VOR-1 bearing signals to both radio distance magnetic indicators (RDMI's). VHF NAV-2 provides VOR deviation, to/from, and FAIL signals to the first officer's ND, and VOR-2 bearing signals to both radio distance magnetic indicators (RDMI's). VOR deviation, To/From and FAIL signals are displayed on the EFIS Navigation Display (ND). Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's ND's display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale is printed on a course mask which rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the airplane is to the right of the VOR radial, and to the right when the airplane is to the left of the radial. Flying the airplane so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each ND displays heading dial and FAIL data from the Attitude and Heading System (AHRS). The heading dial rotates to display the magnetic heading of the aircraft as read under a lubber line pointer at top of the dial. A HDG FAIL will be displayed on the ND if a power failure or unreliable operation of the AHRS system occurs. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a pointer, rotating in the center of the heading dial. A pointer opposite the course pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, it positions the applicable selected course pointer to the desired course.

H. The captain's RDMI displays the magnetic heading of AHRS -2 and the first officer's displays AHRS -1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR or ADF bearing information.

(1) The circular inner dial is driven by a servo loop to display airplane heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven by a torque receiver which positions the pointer in response to a 3-wire electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the ND. If the aircraft is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the AHRS magnetic heading is displayed by the RDMI pointers as VOR station relative bearing. The heading card reads the magnetic heading of the aircraft, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both RDMI's, ensure that OFF flag is out of view.

(4) On both NDs, make certain HDG FAIL not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.

VHF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The dual VHF navigation system uses VOR signals transmitted from ground stations to aid in navigation by providing indications of the position of the aircraft in relation to a selected VOR radial. Basic components of each system are: VOR/LOC antenna, VOR/ILS receiver, and the NAV frequency control portion of the flight guidance control panel.

B. VHF NAV-1 provides VOR deviation, to/from, and flag signals to the captain's Navigation Display (ND), and VOR-1 bearing signals to both radio distance magnetic indicators (RDMI's). VHF NAV-2 provides VOR deviation, to/from, and FAIL signals to the first officer's ND, and VOR-2 bearing signals to both radio distance magnetic indicators (RDMI's). VOR deviation, To/From and FAIL signals are displayed on the EFIS Navigation Display (ND). Both systems provide data to the Flight Guidance Control system and audio identification signals to the Flight Interphone System.

C. VOR/LOC Antenna - The VOR/LOC antenna assembly consists of four vertical slot antenna elements, two on the upper and two on the lower side of the vertical stabilizer leading edge. The elements are connected together electrically so each pair will provide omnidirectional reception. Each element is bonded to the inner surface of an antenna panel which is a section of the vertical stabilizer skin. The two upper antennas are inter-connected by a tee connector and provide VOR signals to the VOR/ILS receiver-2. The two lower antenna are interconnected by a tee connector and provide VOR signals to the VOR/ILS receiver-1. From each of the two tee connectors, a coaxial cable is routed down through the vertical stabilizer and for-ward to the respective VOR/ILS receiver in the electrical/ electronics compartment.

D. VOR/LOC Antenna Transformer - One transformer is attached to a bracket on each left and right antenna panels which form a section of the vertical stabilizer skin.

E. VHF NAV Control Panel - Two control panels form a portion of the flight guidance control panel on the glareshield. The captain's (-1) controls are on the left, and the first officer's (-2) controls on the right. Each control panel contains a NAV frequency selector that tunes from 108.00 to 117.95 MHz in 50 KHz steps. This also provides frequency selection for the ILS and DME systems. When a VOR frequency is selected, the ILS portion of the receivers are operating in standby. Each panel also contains a CRS select knob with digital display window.

F. VOR/ILS Receiver - Two VOR/ILS receivers are mounted on the radio rack in the electrical/ electronics compartment. Each receiver is designed to receive and process VHF omnirange signals in frequencies of even-tenth megahertz in the range from 108.00 to 111.80 MHz and any frequency in the range from 112.00 to 117.95 MHz. A magnetic heading signal from the compass coupler is compared with VOR data to provide a relative bearing to the VOR ground station as displayed on the compass indicator pointers.

(1) The desired VOR ground station frequency is selected on the VHF NAV control panel, by positioning the five indicator wheels in the frequency select window to display the correct five digits (i.e. 108.00 MHz).

G. The captain's and first officer's ND's display VOR deviation by movement of a course deviation bar as read against a 4-dot scale. The scale rotates, in conjunction with a heading dial, around a fixed airplane symbol which acts as the center index of the scale. The course deviation bar moves to the left when the aircraft is to the right of the VOR radial, and to the right when the aircraft is to the left of the radial. Flying the aircraft so that the course deviation bar, the airplane symbol, and the course select pointer line up, will indicate an on the beam (selected radial) condition. To/from is displayed to denote flying toward the VOR transmitter, or flying away from the station. Each ND displays heading dial and FAIL data from the Inertial Reference System (IRS). The heading dial rotates to display the magnetic heading of the aircraft as read under a lubber line pointer at top of the dial. A HDG FAIL will be displayed on the ND if a power failure or unreliable operation of the IRS occurs. A heading cursor displays selected heading as read against the heading dial. When the HDG knob on the flight guidance control panel is rotated, a servo loop positions the selected heading cursor to the desired heading. Selected course is displayed on the heading dial by a pointer, rotating in the center of the heading dial. A pointer opposite the course pointer displays the reciprocal of selected course. When the captain's or first officer's CRS knob on the flight guidance control panel is rotated, it positions the applicable selected course pointer to the desired course.

H. The captain's RDMI displays the magnetic heading of IRS-2 and the first officer's displays IRS-1 heading. Each indicator displays VHF NAV-1 and VHF NAV-2 radio bearing. The display consists of a fixed outer dial with a lubber line, reciprocal heading marker, and a 45-degree markings; a rotating inner dial with clockwise graduations from 0 to 360 degrees in 2-degree increments; and a single and double pointer. The rotating dial indicates magnetic heading, and the pointers supply VOR or ADF bearing information.

(1) The circular inner dial is driven by a servo loop to display aircraft heading when read against the lubber line. Single (-1) and double (-2) arrow shaped pointers rotate around the center of the unit. These pointers display magnetic radio bearing as read against the rotating compass card, and relative bearing when read against the lubber line or 45-degree markings on the fixed outer dial. The single and double pointers are each driven in response to an electrical angle signal from VOR receiver.

2. Operation

A. The principle of VOR navigation is phase comparison of two 30 Hz audio signals. The ground station transmits an infinite number of radials in which the phase difference is directly related to the relative bearing of the station from the airplane. The VHF NAV system is also used for communications, with the ground station providing voice transmission and an identifying code to ensure that the desired VOR station is being monitored.

B. The ground station reference phase signal includes an rf carrier and a 9960 Hz subcarrier frequency modulated at a rate of 30 Hz. This signal is omnidirectional and has a constant phase throughout 360 degrees of azimuth. When voice communication or station identification is transmitted, the FM sub-carrier is amplitude modulated.

C. The ground station variable phase signal is an rf carrier modulated and radiated in a figure eight configuration that is rotated through 360 degrees of azimuth at a rate of 1800 revolutions per minute. The phase of the signal varies directly with azimuth and lags the reference phase signal by the bearing (degrees) from the station.

D. In the VOR/ILS receiver, the reference 30 Hz signal is demodulated from the 9960 Hz subcarrier, and a comparator detects the phase difference between the reference 30 Hz and the variable 30 Hz signal. An instrumentation unit compares the phase difference, and provides a synchro output to drive the compass indicator pointers. In order to have the airplane heading considered, the VOR information is compared with either a manually selected course or with the compass system.

(1) The VOR data, as compared with the selected course is displayed by the course deviation bar on the ND. If the aircraft is not on the selected course, the course bar is displayed in the direction of the required corrective maneuver.

(2) VOR data as compared with the IRS heading is displayed by the RDMI pointers as VOR station relative bearing. The heading card reads the magnetic heading of the aircraft, and the pointer reads the angle between the magnetic bearing and the VOR bearing.

3. To Operate System

A. Operate

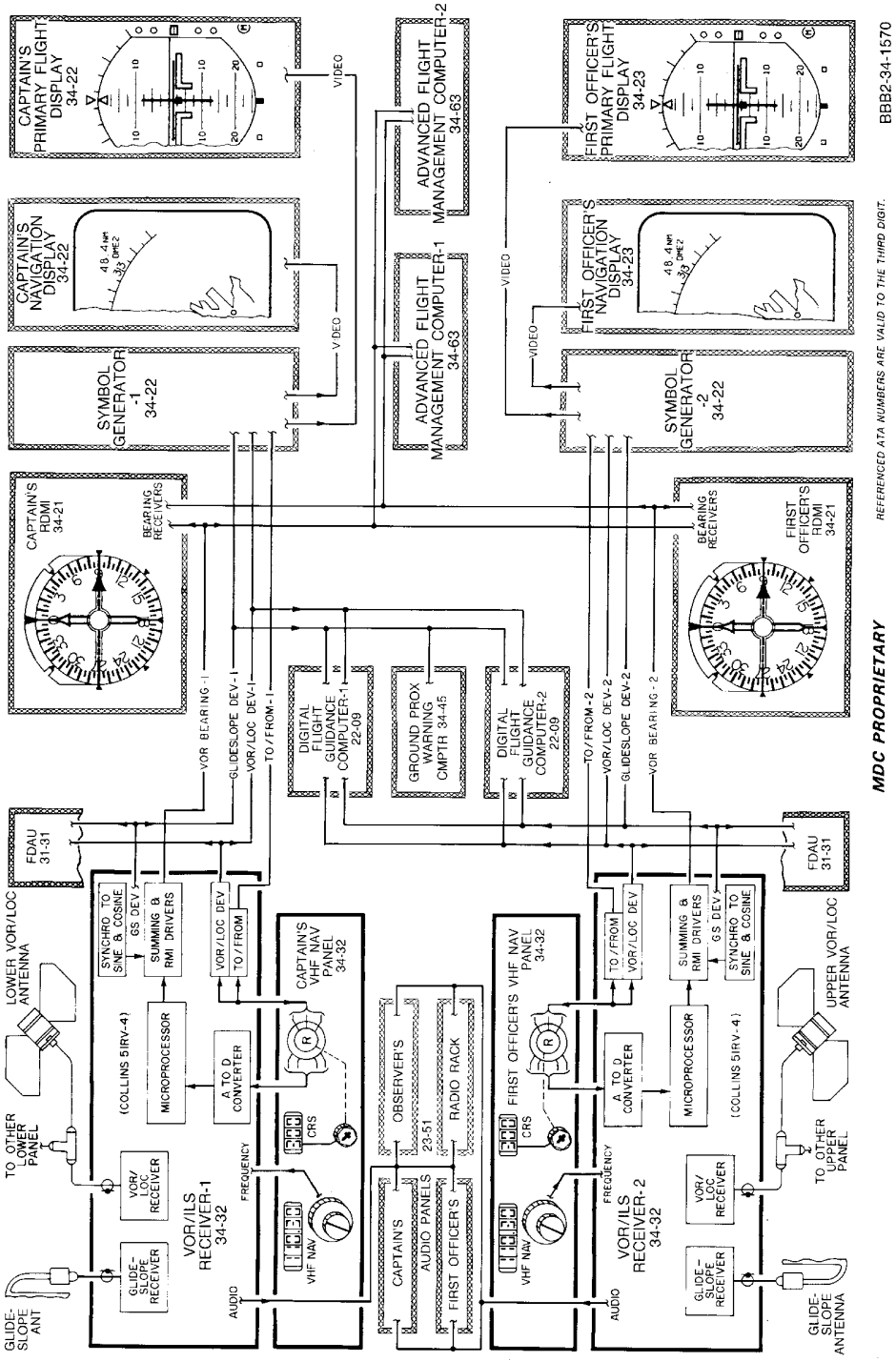
(1) Energize airplane electrical buses.

(2) At the VHF NAV control panel, on the glareshield, select applicable VOR frequency.

(3) On both RDMI's, ensure that OFF flag is out of view.

(4) On both NDs, make certain HDG FAIL not displayed.

(5) Check at audio control panel for audio fidelity and set for comfortable volume. System is ready to operate.



VHF Navigation System -- Block Diagram
Figure 1/34-51-00-990-813

VHF NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty VHF navigation system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the VHF navigation system operation are Captain's and First Officer's Horizontal Situation Indicators, Compass Indicators, Attitude Direction Indicators, VHF Navigation panels, Navigation switching unit and VOR/LOC antenna.

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

E. The VHF Navigation system components are located as follows:

Table 101

Component	Location
Horizontal Situation (HSI)	Captain's and First Officer's Glareshields
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
VHF NAV Control Panels	Flight Guidance Control Panel
Navigation Switching Unit	Electrical/Electronics Compartment
VOR/LOC Antenna	Vertical Stabilizer

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting VHF Navigation System

A. Trouble Shoot

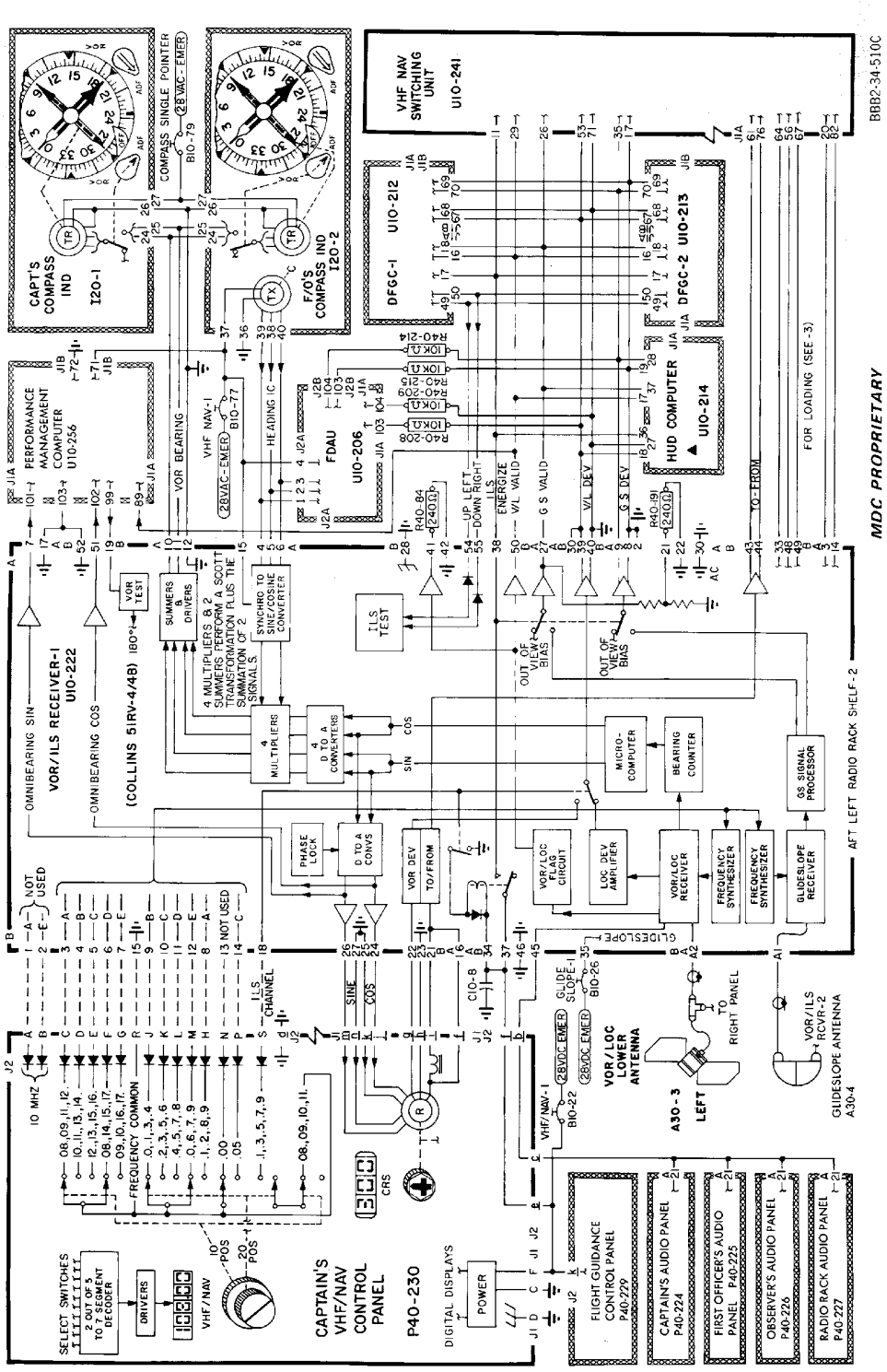
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are HSI, ADI, Compass Indicators, VHF NAV Control Panels, Switching Unit, and VOR/LOC Antenna.

Table 103

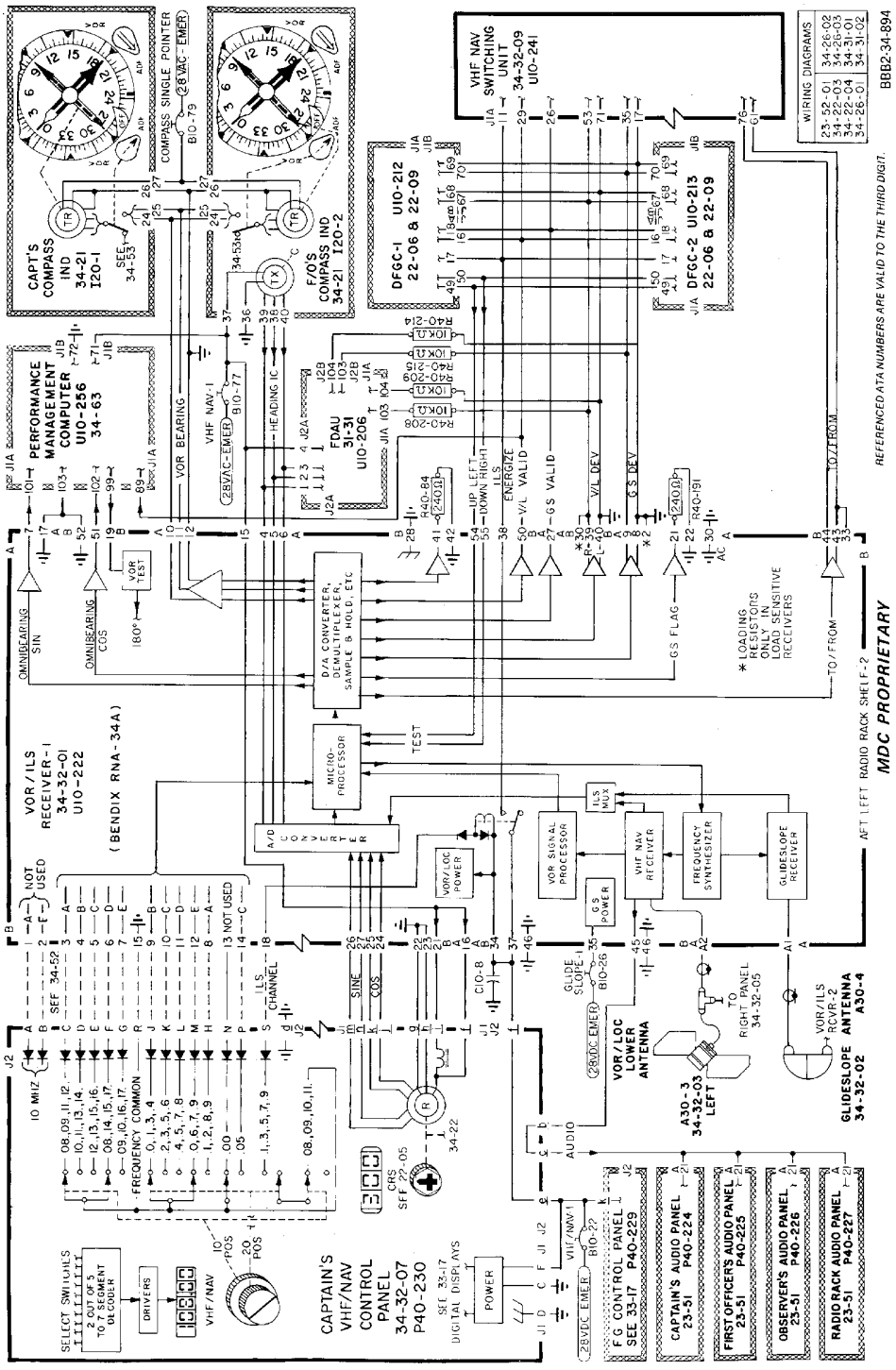
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.

Table 103 (Continued)

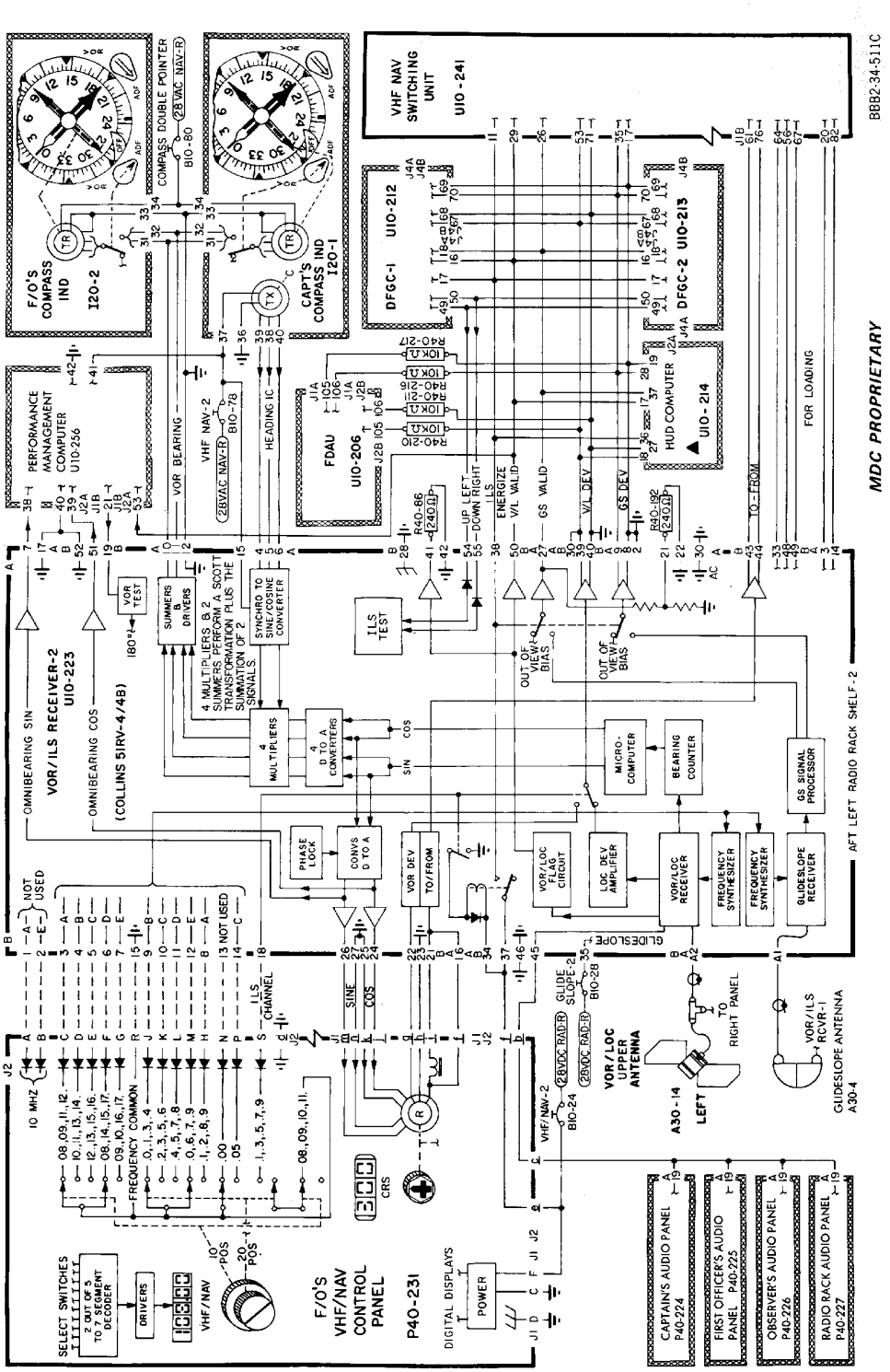
Step	Procedure	Correction
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform system test for VOR LRUs. (SUBJECT 34-51-00)	



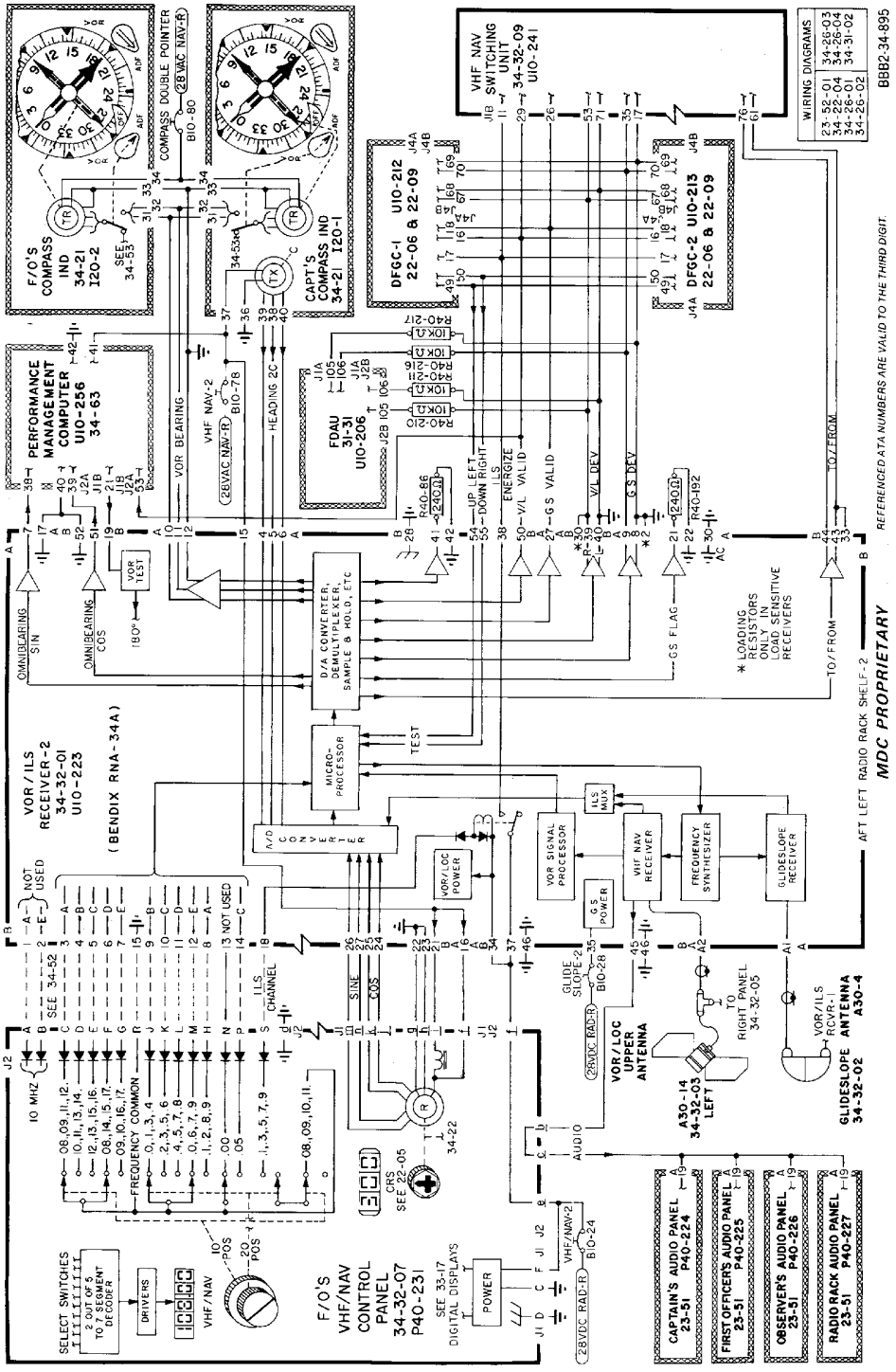
VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-818 (Sheet 1 of 2)



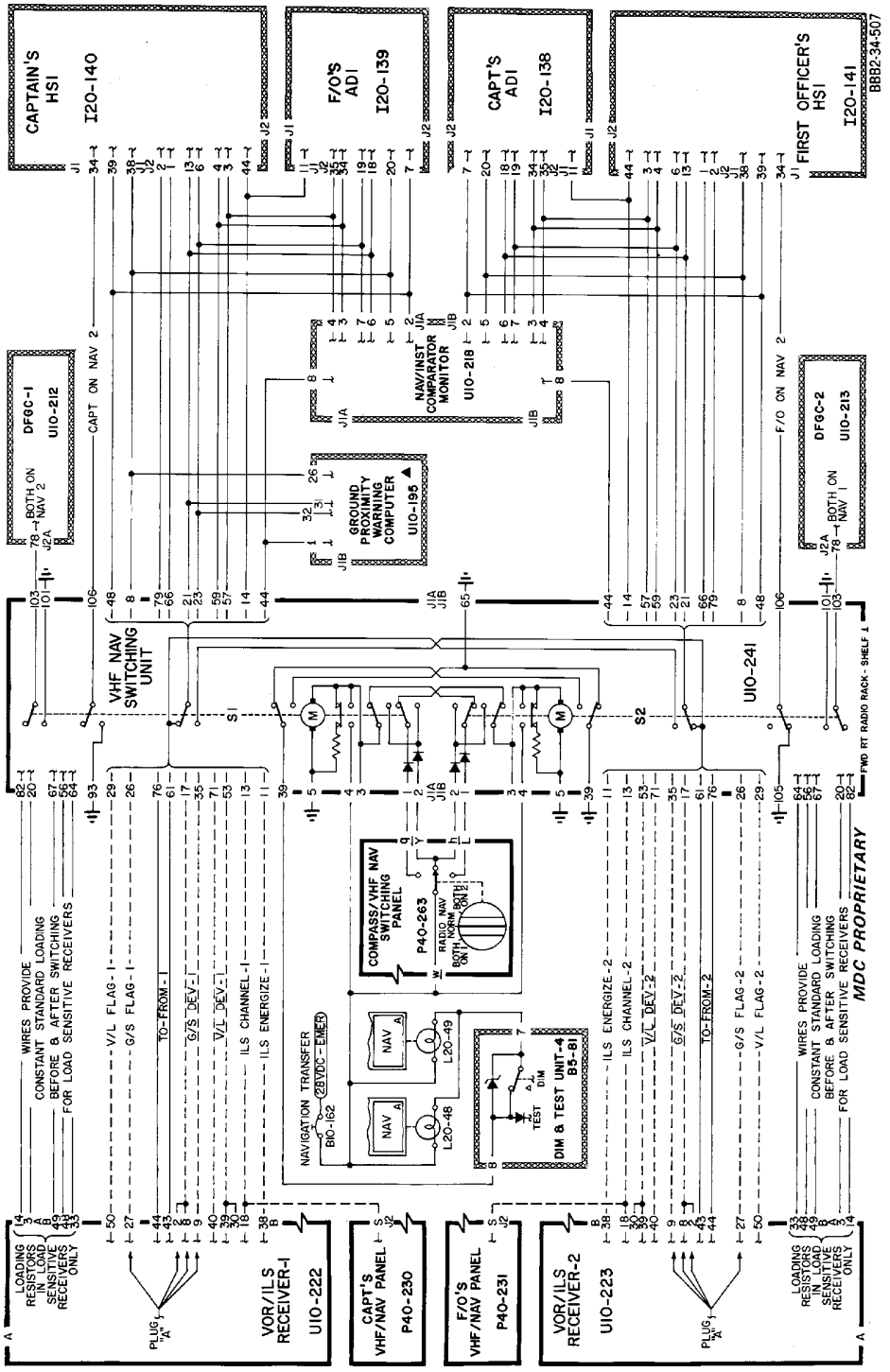
VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-818 (Sheet 2 of 2)



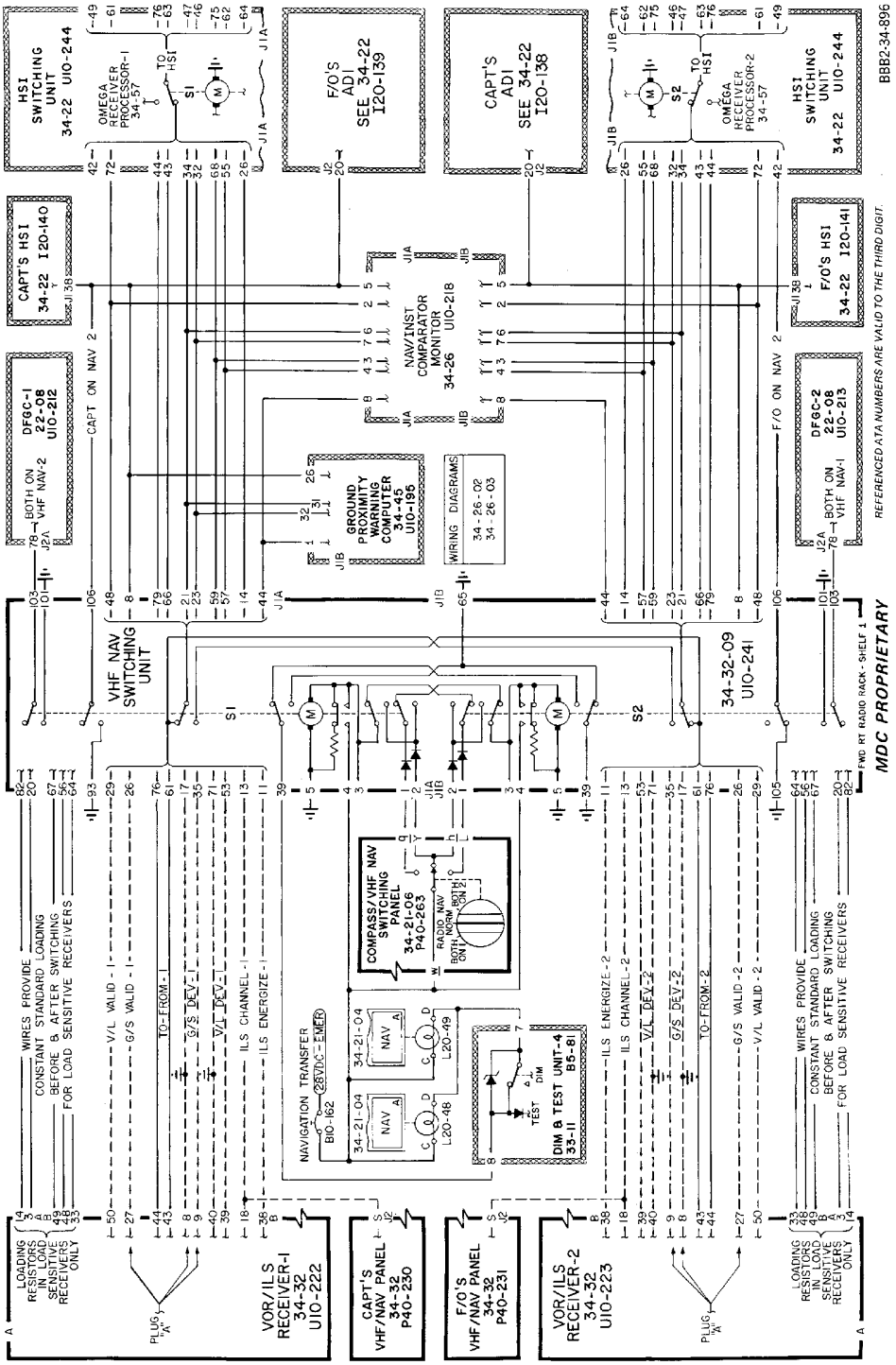
VOR/ILS-2 (VHF NAV) - Schematic
Figure 102/34-51-00-990-819 (Sheet 1 of 2)



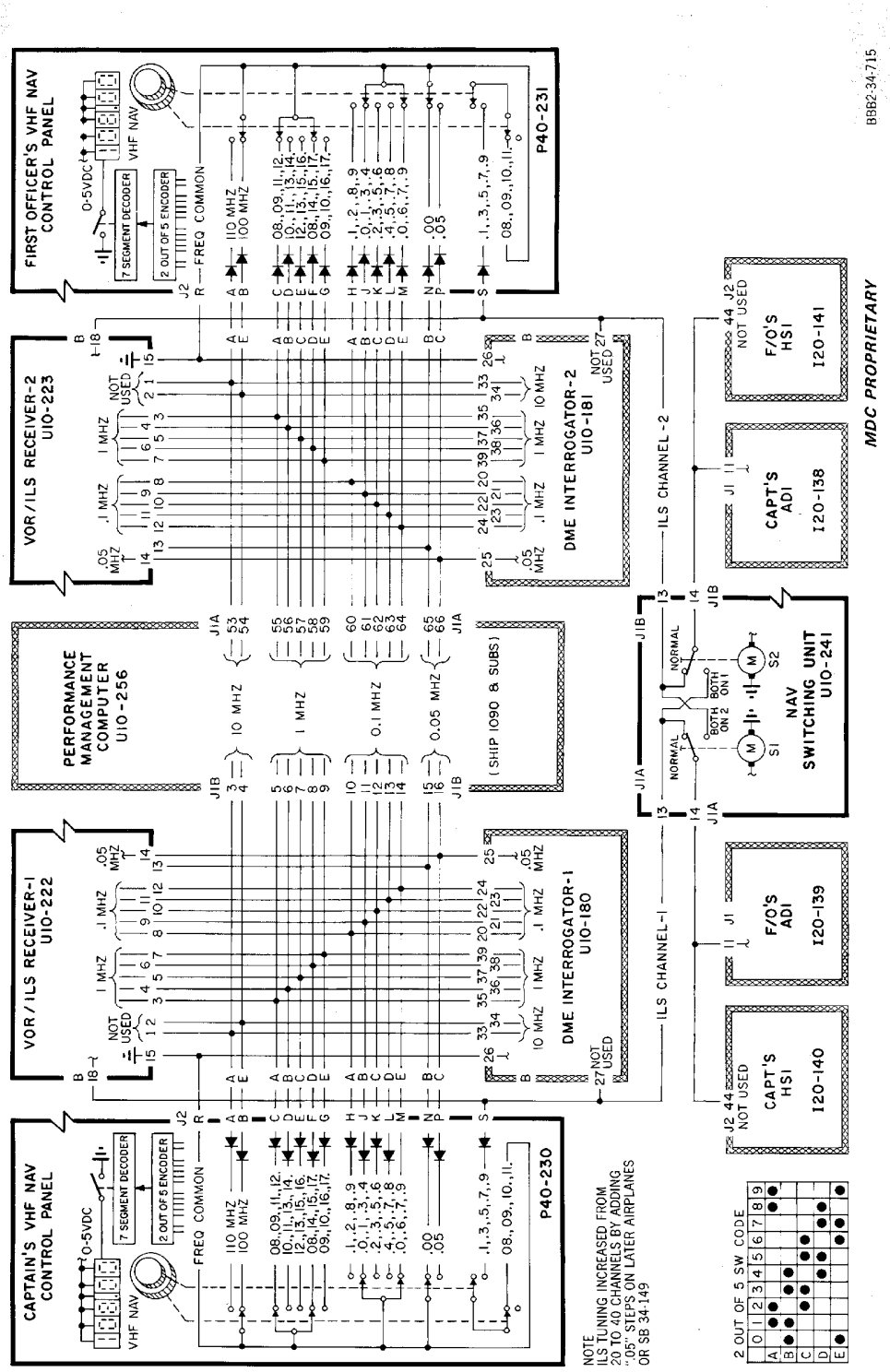
VOR/ILS-2 (VHF NAV) - Schematic
Figure 102/34-51-00-990-819 (Sheet 2 of 2)



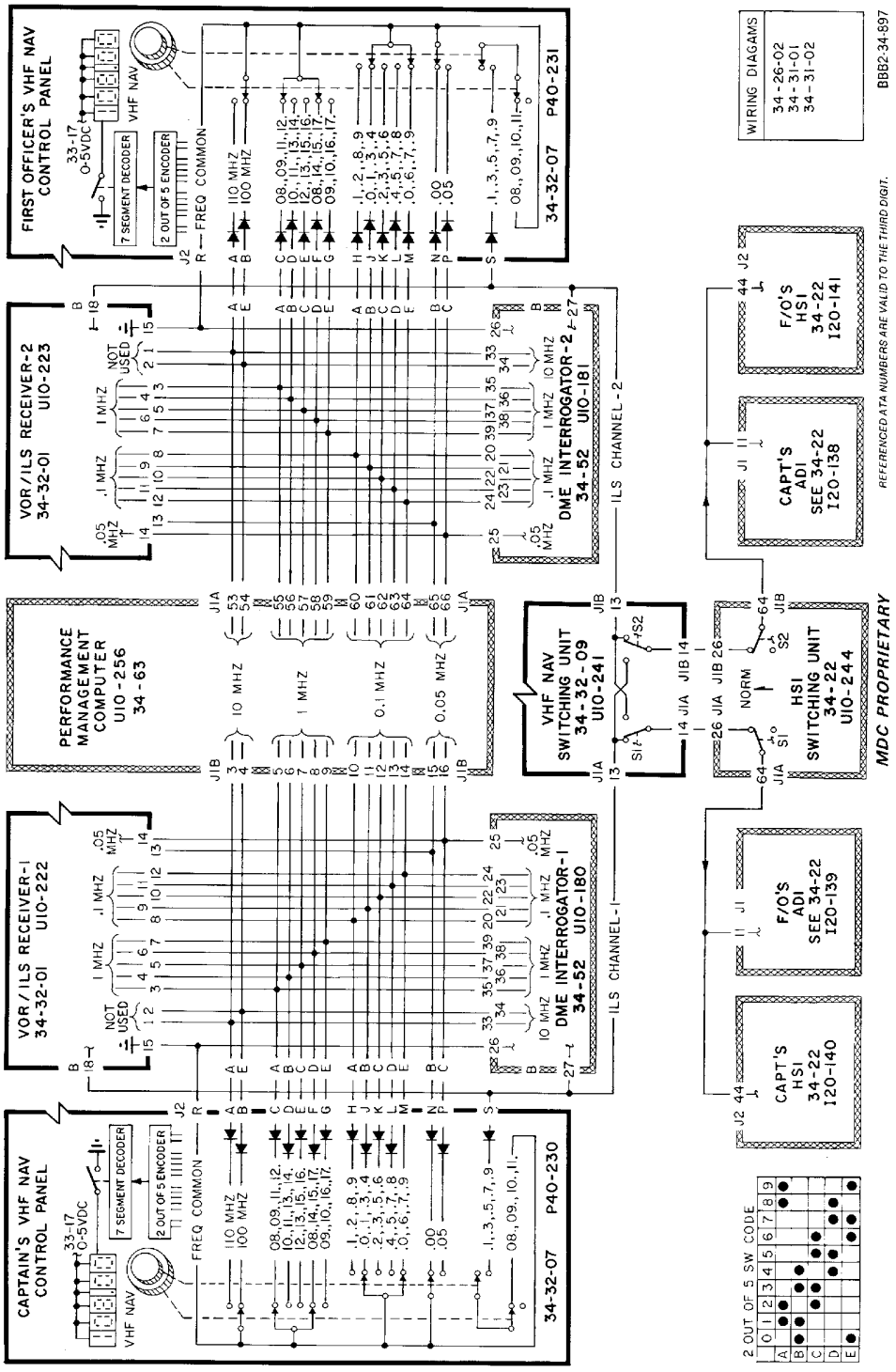
VOR/ILS (VHF NAV) Switching - Schematic
Figure 103/34-51-00-990-820 (Sheet 1 of 2)



VOR/ILS (VHF NAV) Switching - Schematic
Figure 103/34-51-00-990-820 (Sheet 2 of 2)



VHF NAV Tuning - Schematic
Figure 104/34-51-00-990-821 (Sheet 1 of 2)



VHF NAV Tuning - Schematic
Figure 104/34-51-00-990-821 (Sheet 2 of 2)

VHF NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty VHF navigation system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the VHF navigation system operation are Captain's and First Officer's Horizontal Situation Indicators, Compass Indicators, Attitude Direction Indicators, VHF Navigation panels, and VOR/LOC antenna.

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

E. The VHF Navigation system components are located as follows:

Table 101

Component	Location
Horizontal Situation (HSI)	Captain's and First Officer's Glareshields
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
VHF NAV Control Panels	Flight Guidance Control Panel
VOR/LOC Antenna	Vertical Stabilizer

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting VHF Navigation System

A. Trouble Shoot

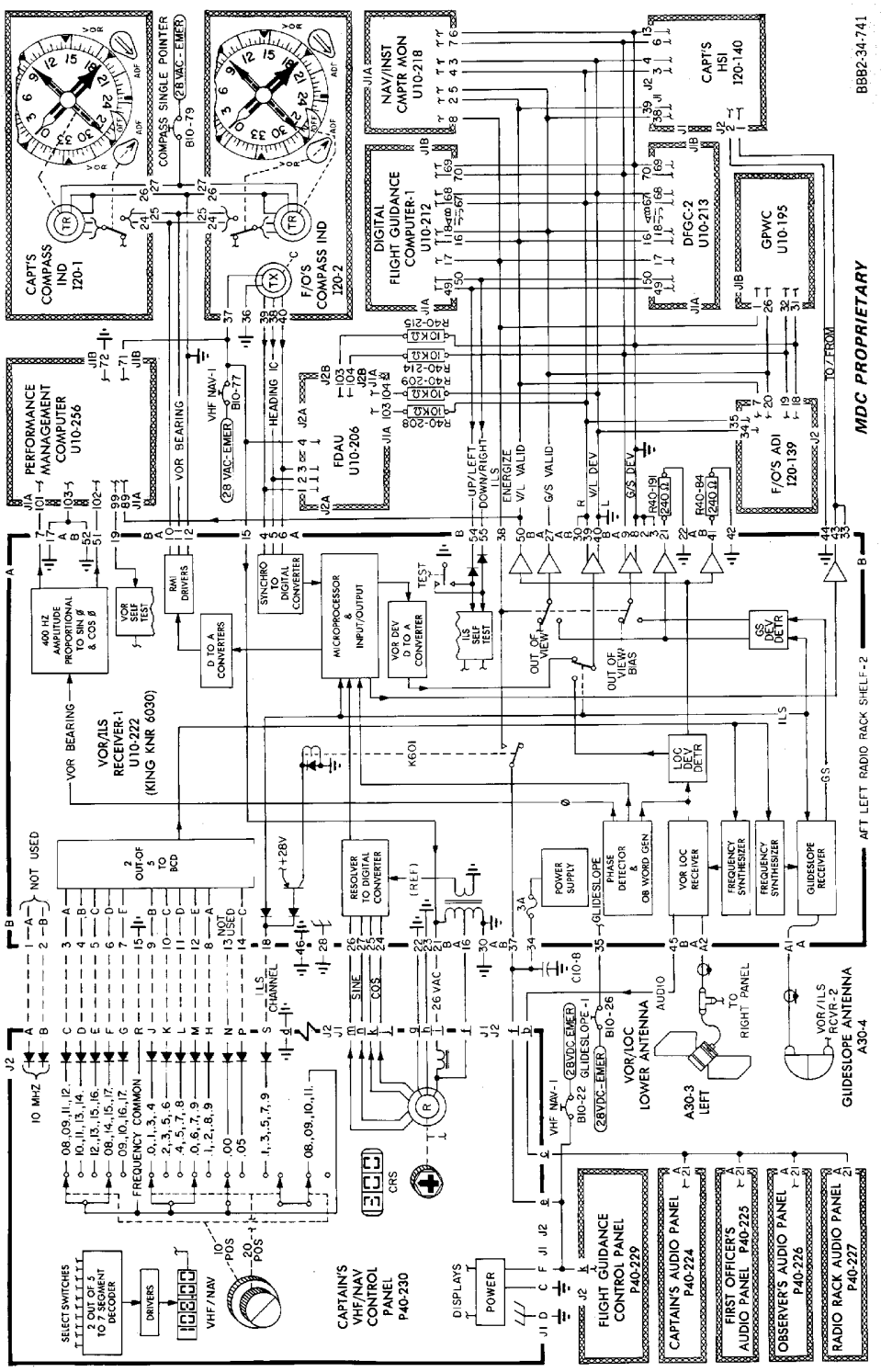
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are HSI, ADI, Compass Indicators, VHF NAV Control Panels, Switching Unit, and VOR/LOC Antenna.

Table 103

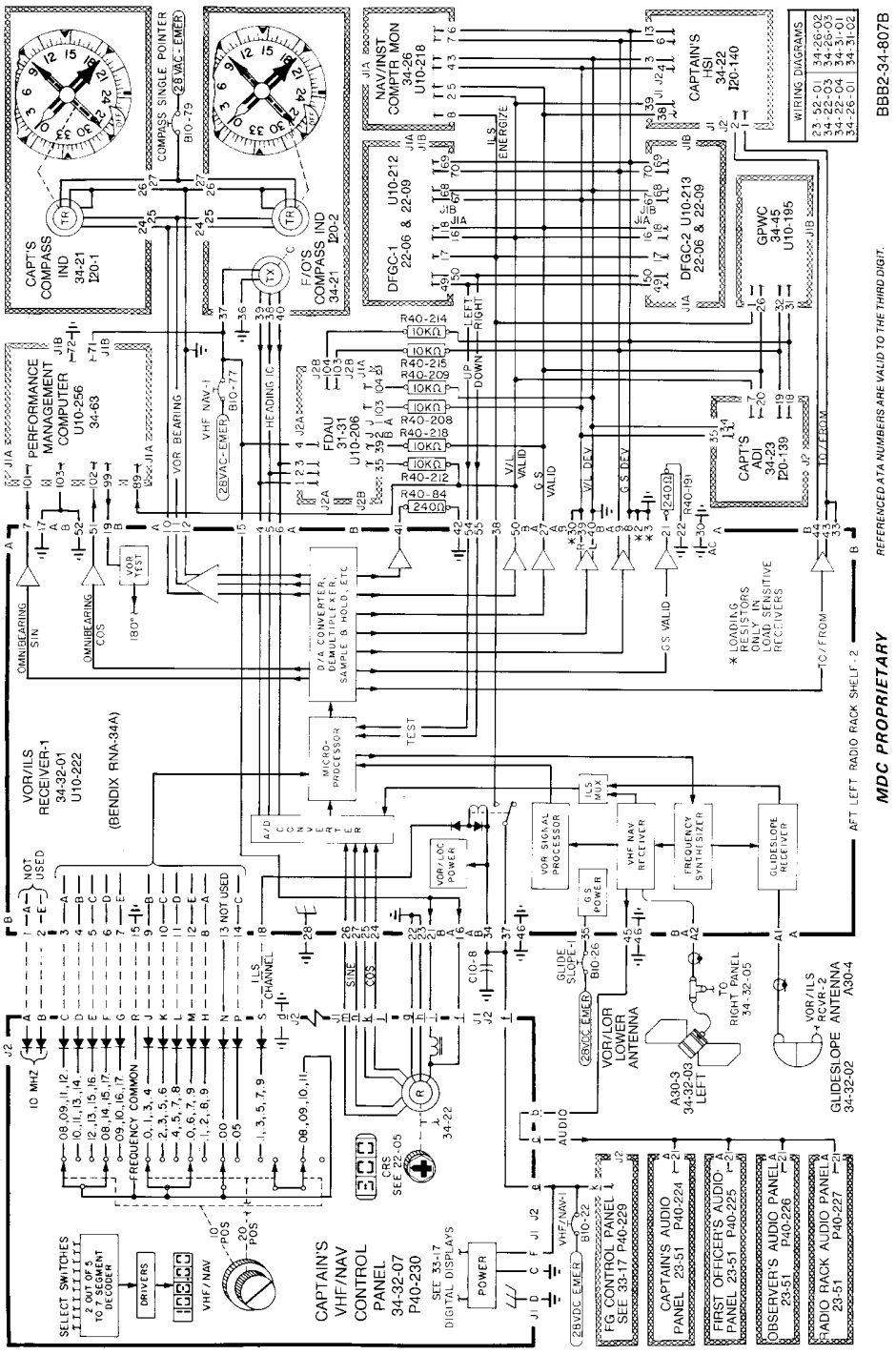
Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.

Table 103 (Continued)

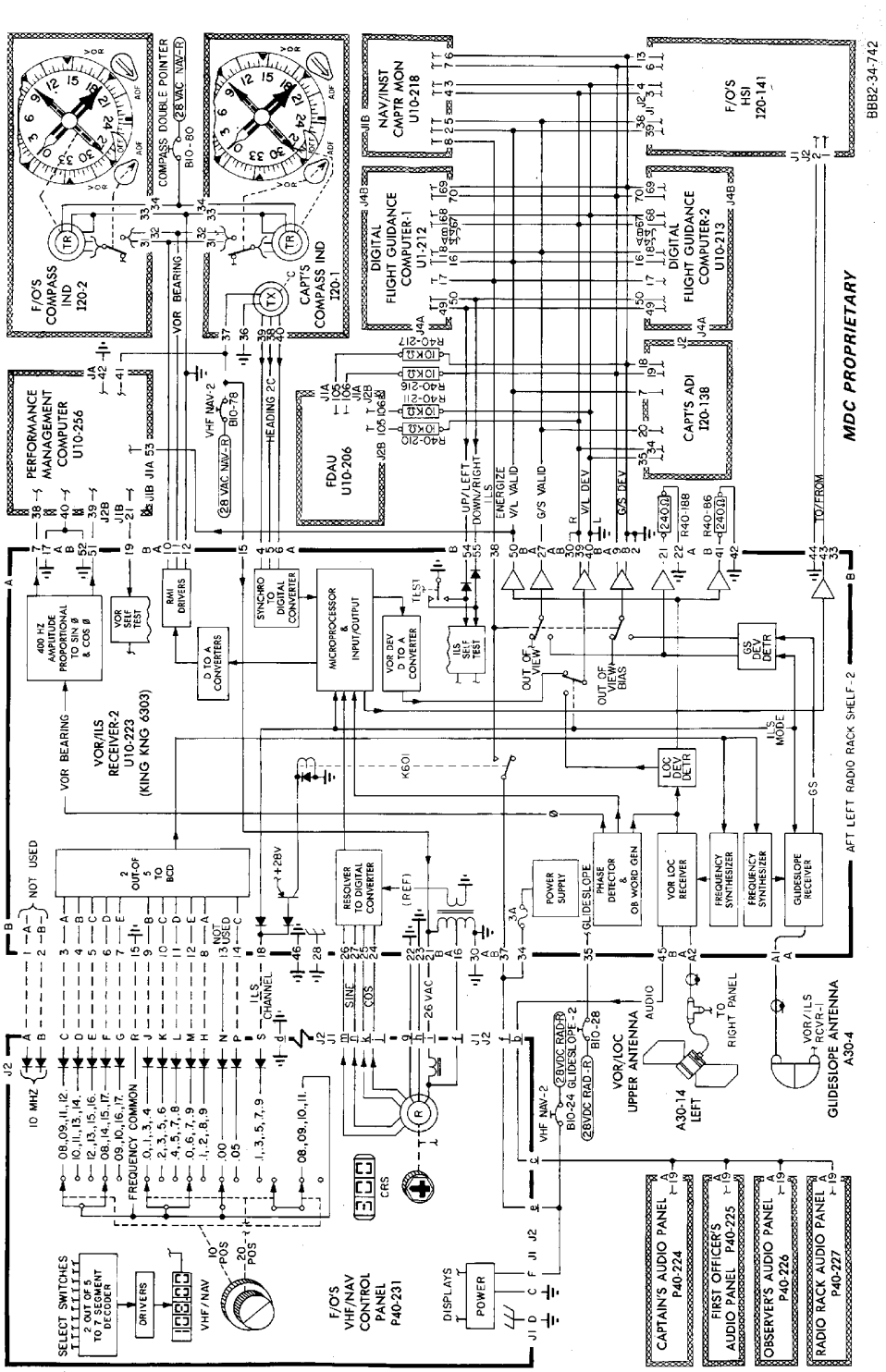
Step	Procedure	Correction
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6)	Perform Return to Service (RTS) test. (SUBJECT 22-01-05)	



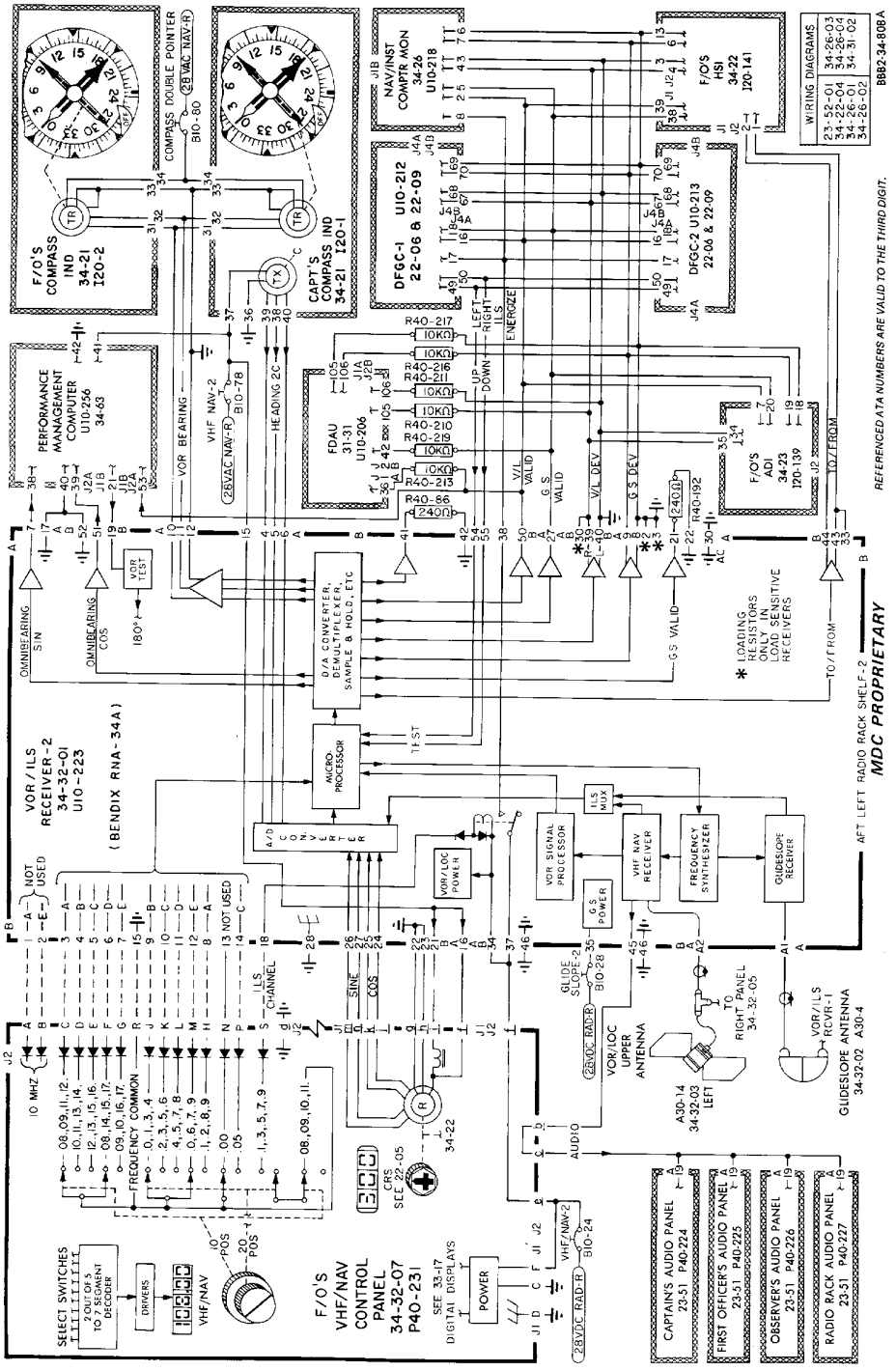
VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-828 (Sheet 1 of 2)



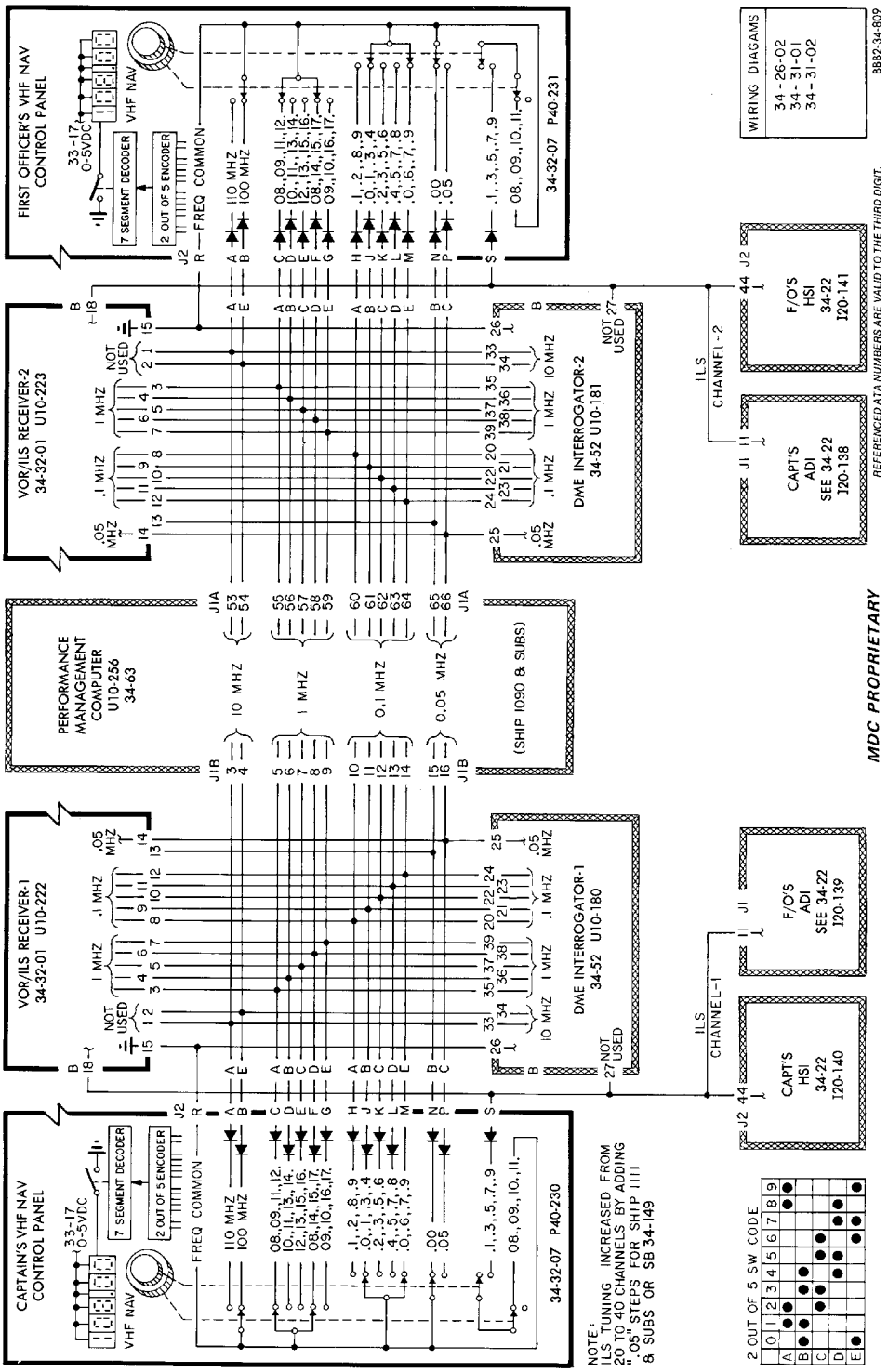
VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-828 (Sheet 2 of 2)



VOR/ILS-2 (VHF NAV) - Schematic
Figure 102/34-51-00-990-829 (Sheet 1 of 2)



VOR/ILS-2 (VHF NAV) - Schematic
Figure 102/34-51-00-990-829 (Sheet 2 of 2)



VHF NAV Tuning - Schematic
Figure 103/34-51-00-990-831

VHF NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty VHF navigation system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the VHF navigation system operation are Captain's and First Officer's Horizontal Situation Indicators, Compass Indicators, Attitude Direction Indicators, VHF Navigation panels, Navigation Switching Unit, VOR/LOC Antenna, and RAD/INS Switching Unit.

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

E. The VHF Navigation system components are located as follows:

Table 101

Component	Location
Horizontal Situation (HSI)	Captain's and First Officer's Glareshields
Attitude Direction Indicators	Captain's and First Officer's Instrument Panels
VHF NAV Control Panels	Flight Guidance Control Panel
Navigation Switching Unit	Electrical/Electronics Compartment
VOR/LOC Antenna	Vertical Stabilizer
RAD/INS Switching Unit	Electrical/Electronics Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting VHF Navigation System

A. Trouble Shoot

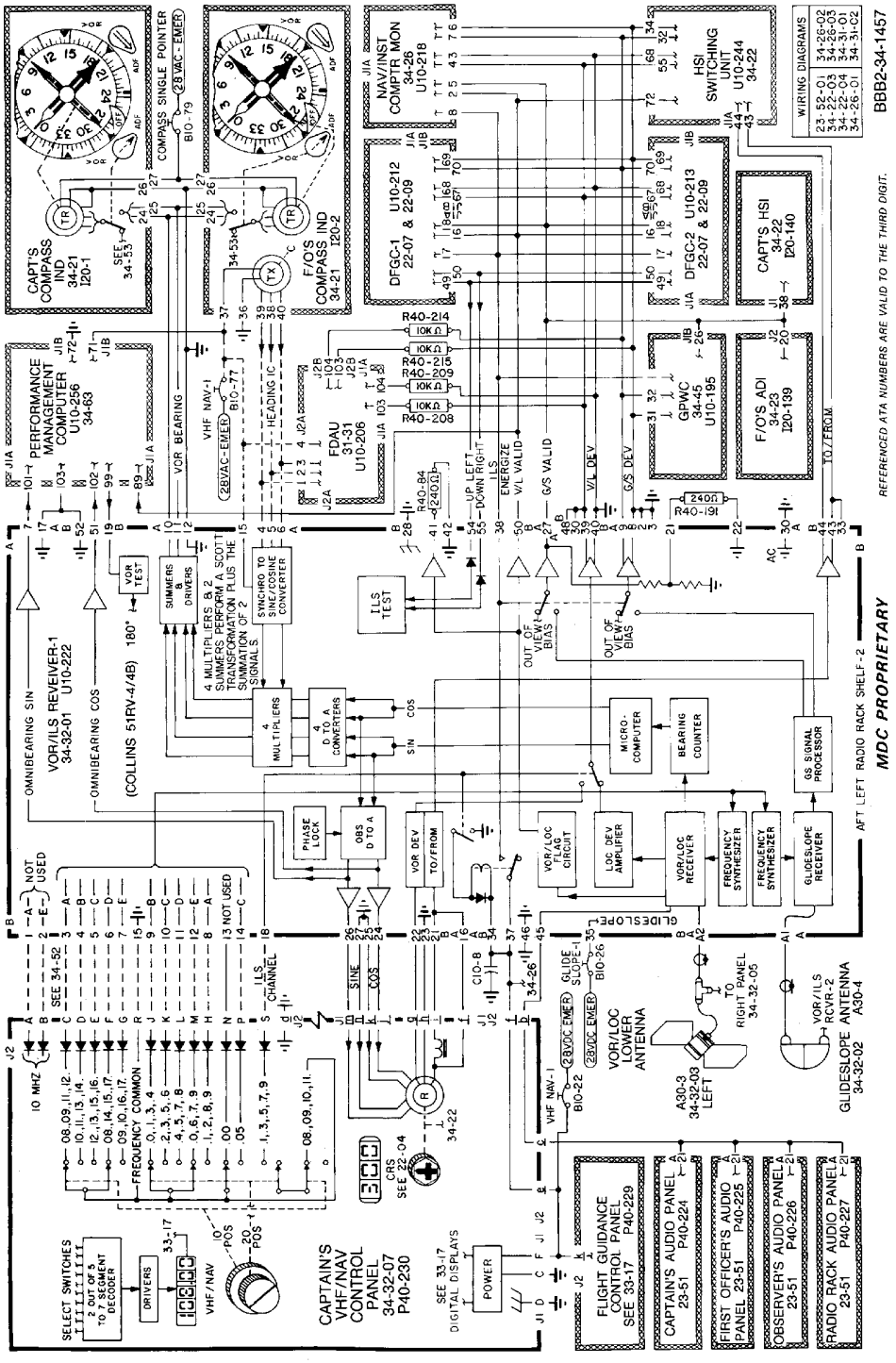
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are HSI, ADI, Compass Indicators, VHF NAV Control Panels, Switching Unit, VOR/LOC Antenna, and RAD/INS Switching Unit.

Table 103

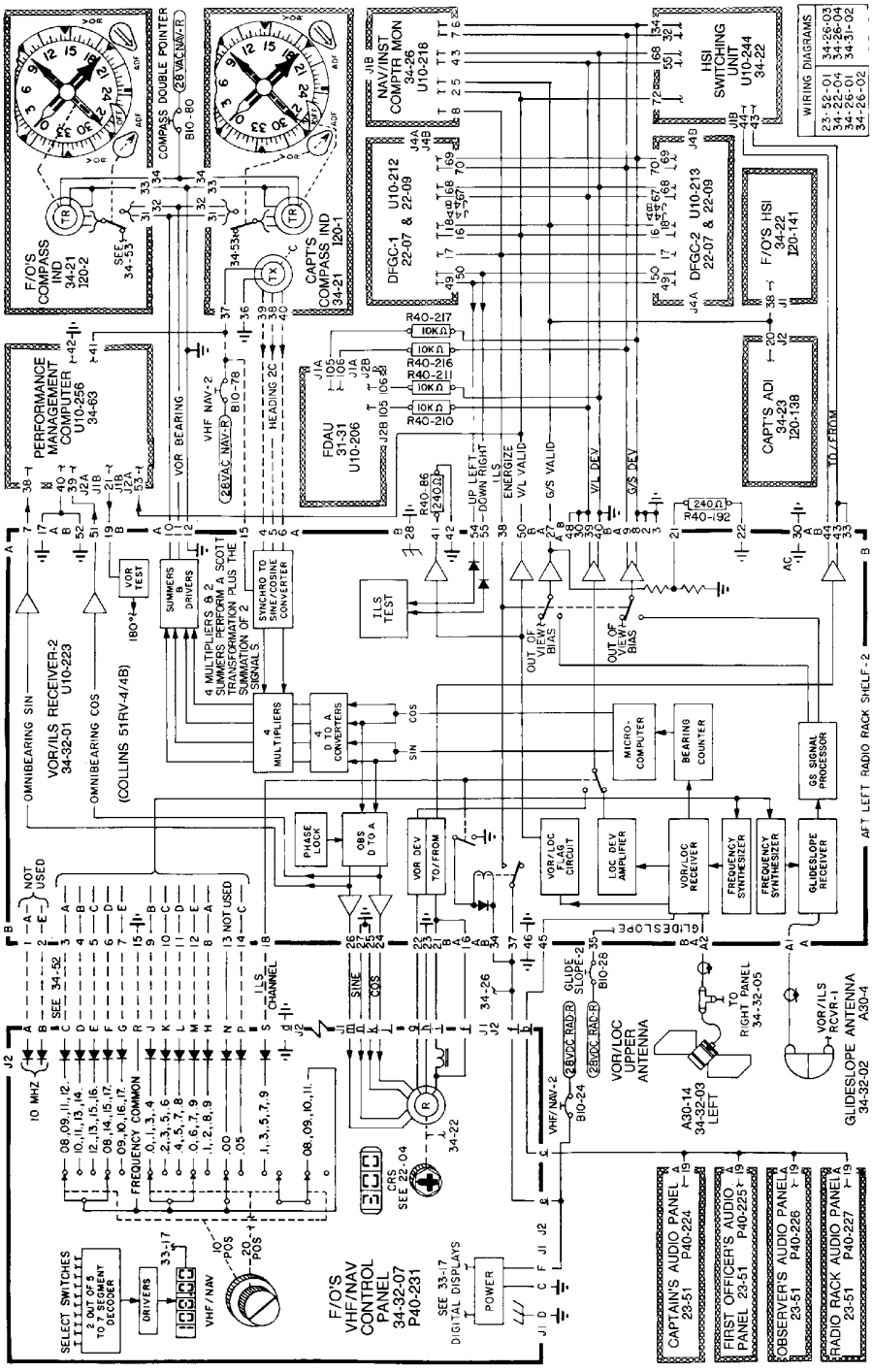
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.

Table 103 (Continued)

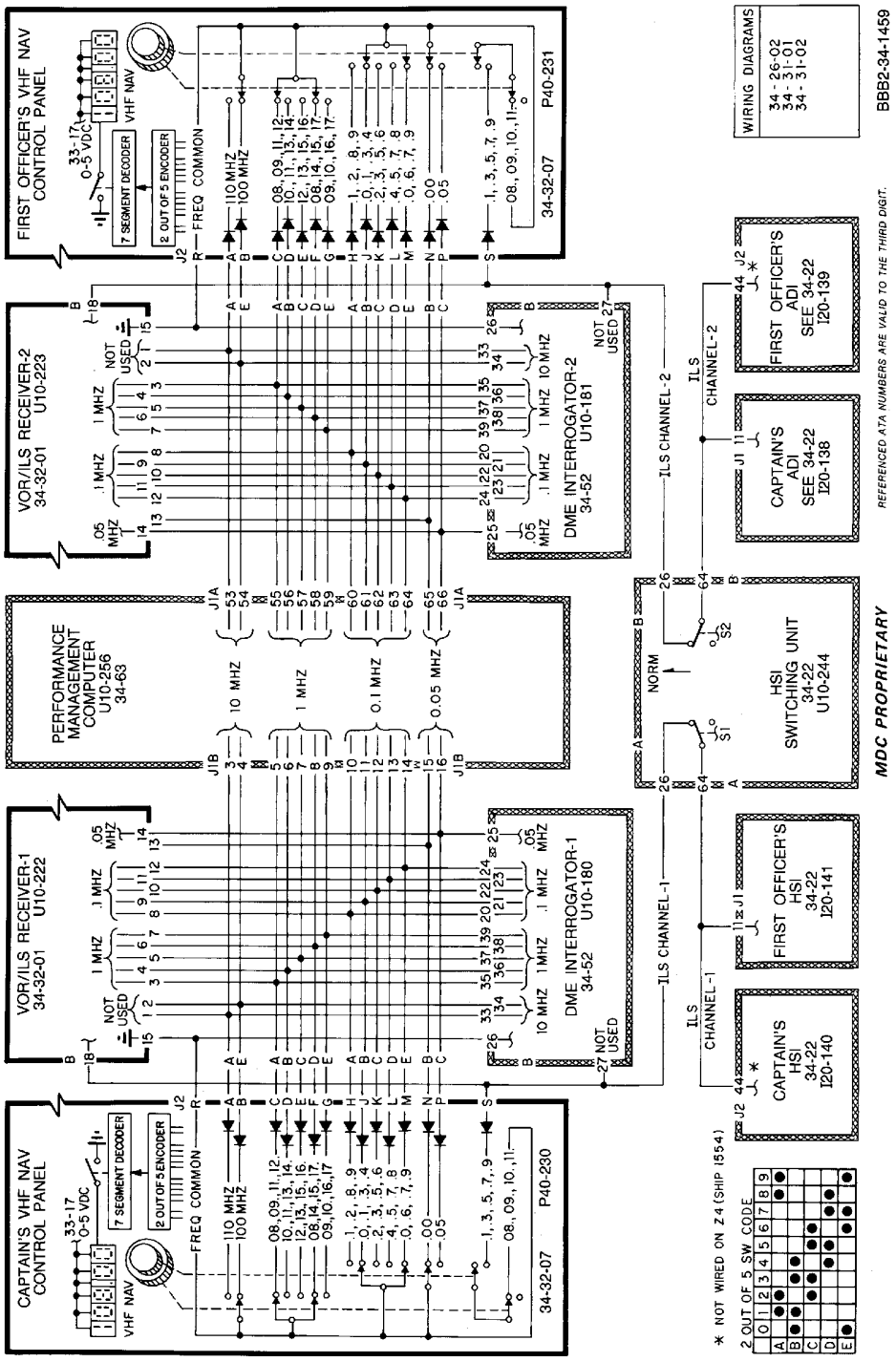
Procedure	Correction
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3) Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6) Perform Return to Service (RTS) test. (SUBJECT 22-01-05)	



VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-842



VOR/ILS-2 (VHF NAV) - Schematic
Figure 102/34-51-00-990-843



VOR/ILS (VHF NAV) Switching - Schematic
Figure 103/34-51-00-990-844

VHF NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty VHF navigation system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 415, 418, 863, 864, 866

D. The basic components of the VHF navigation system operation are Captain's and First Officer's EFIS Primary Flight Displays and Navigation Displays, Compass Indicators, VOR/ILS receivers, VHF Navigation panels, and VOR/LOC antenna. The system interfaces with the EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made (SUBJECT 34-22-00).

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

WJE 406-408, 410, 411

E. The basic components of the VHF navigation system operation are Captain's and First Officer's EFIS Primary Flight Displays and Navigation Displays, Compass/Radio Magnetic Indicator's, VOR/ILS receivers, VHF Navigation panels, and VOR/LOC antenna. The system interfaces with the EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made (SUBJECT 34-22-00).

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

WJE 406-408, 410, 411, 415, 418, 863, 864, 866

F. The VHF Navigation system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
EFIS Navigation Display (ND)	Captain's and First Officer's Instrument Panels
VHF NAV Control Panels	Flight Guidance Control Panel
VOR/ILS Receivers	Electrical/Electronics Compartment
VOR/LOC Antenna	Vertical Stabilizer
WJE 415, 418, 863, 864, 866	
Compass Indicators	Captain's and First Officer's Instrument Panels
WJE 406-408, 410, 411	
Compass/Radio Magnetic Indicator	Captain's and First Officer's Instrument Panels
WJE 406-408, 410, 411, 415, 418, 863, 864, 866	

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter Model 8025A	Fluke

3. Trouble Shooting VHF Navigation System

A. Trouble Shoot

WJE 415, 418, 863, 864, 866

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are PFD, ND, Compass Indicators, VHF NAV Control Panels, VOR/ILS receivers and VOR/LOC Antenna.

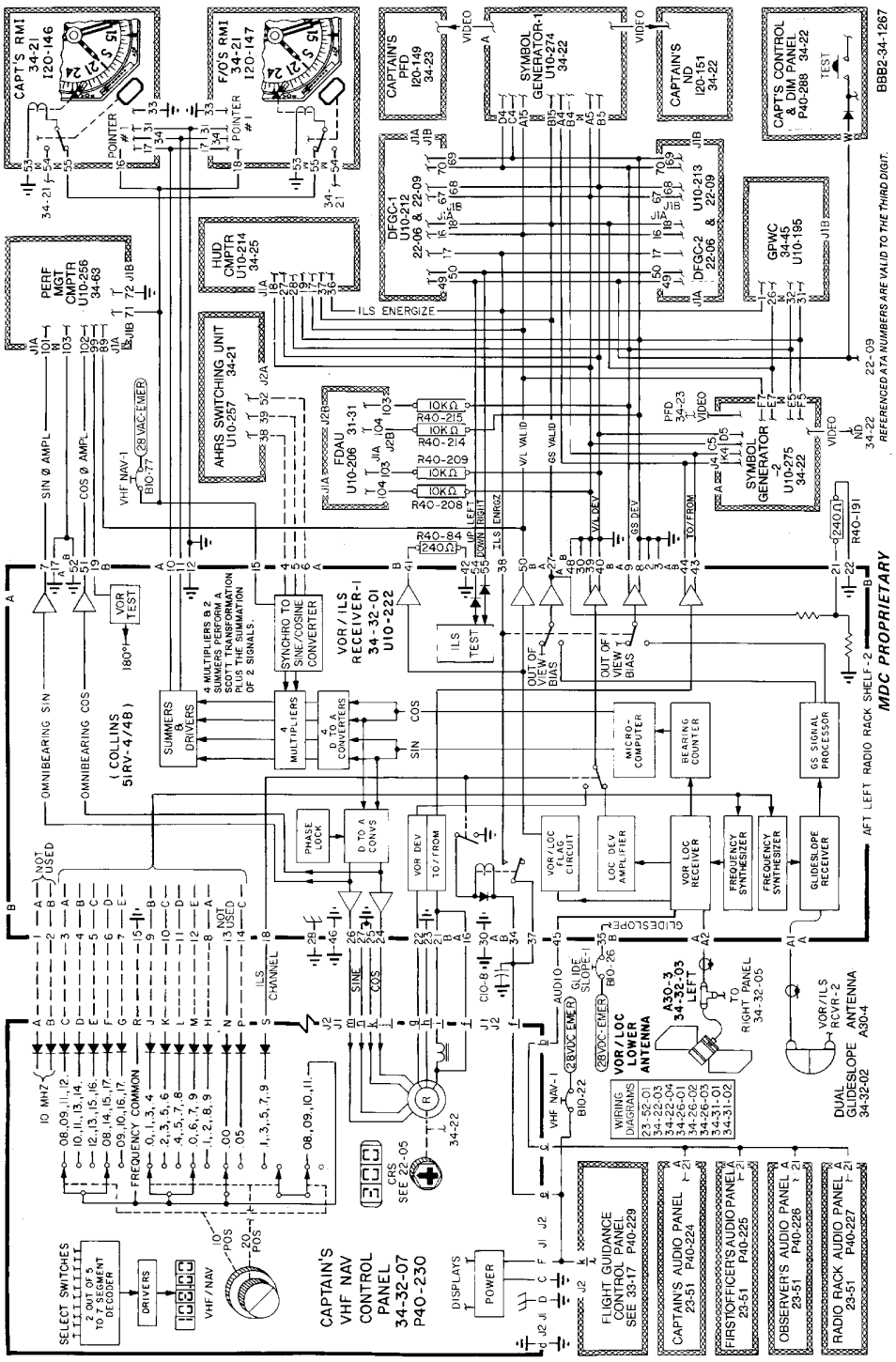
WJE 406-408, 410, 411

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are PFD, ND, CI's/RMI's, VHF NAV Control Panels, VOR/ILS receivers and VOR/LOC Antenna.

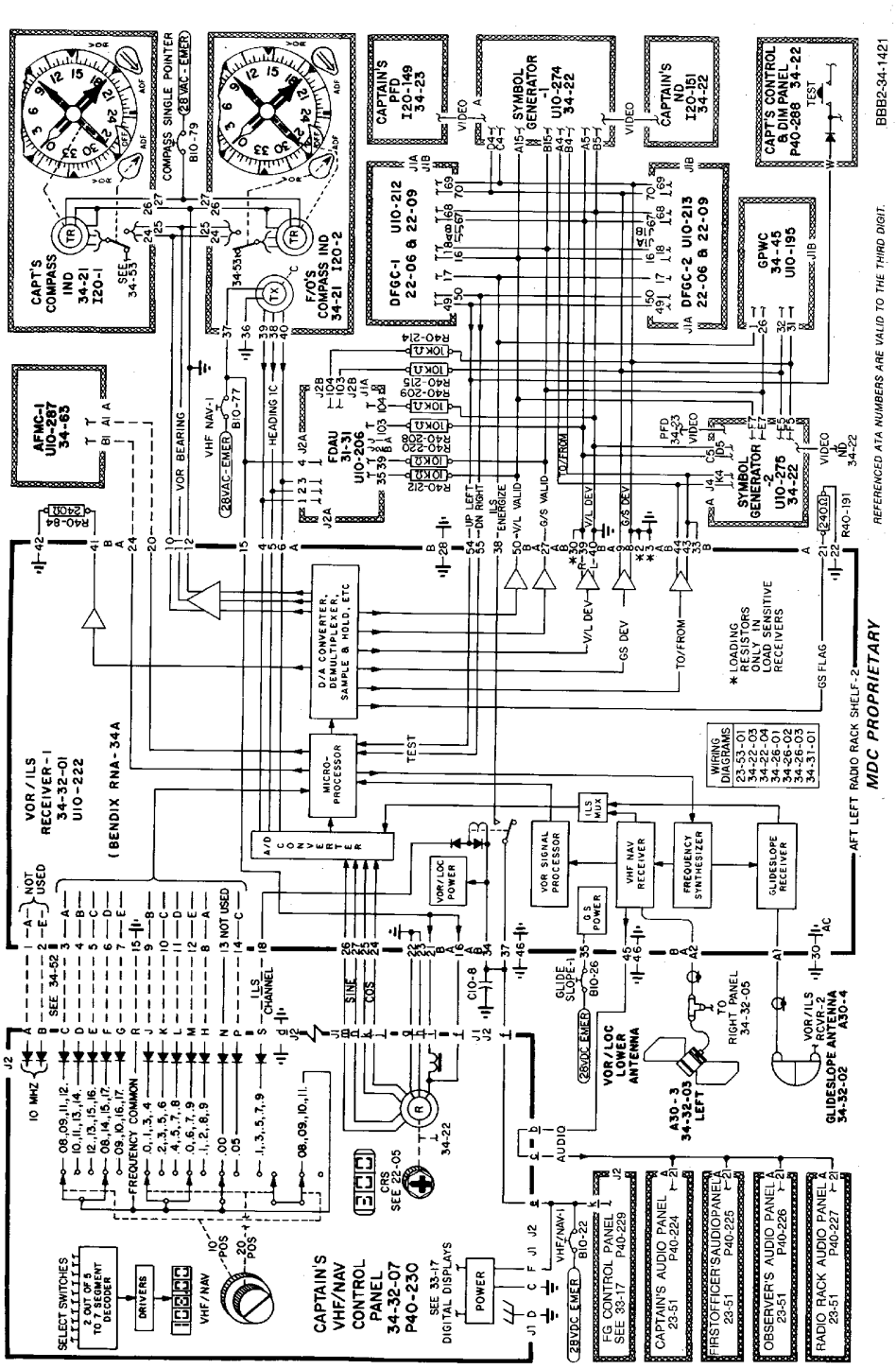
WJE 406-408, 410, 411, 415, 418, 863, 864, 866

Table 103

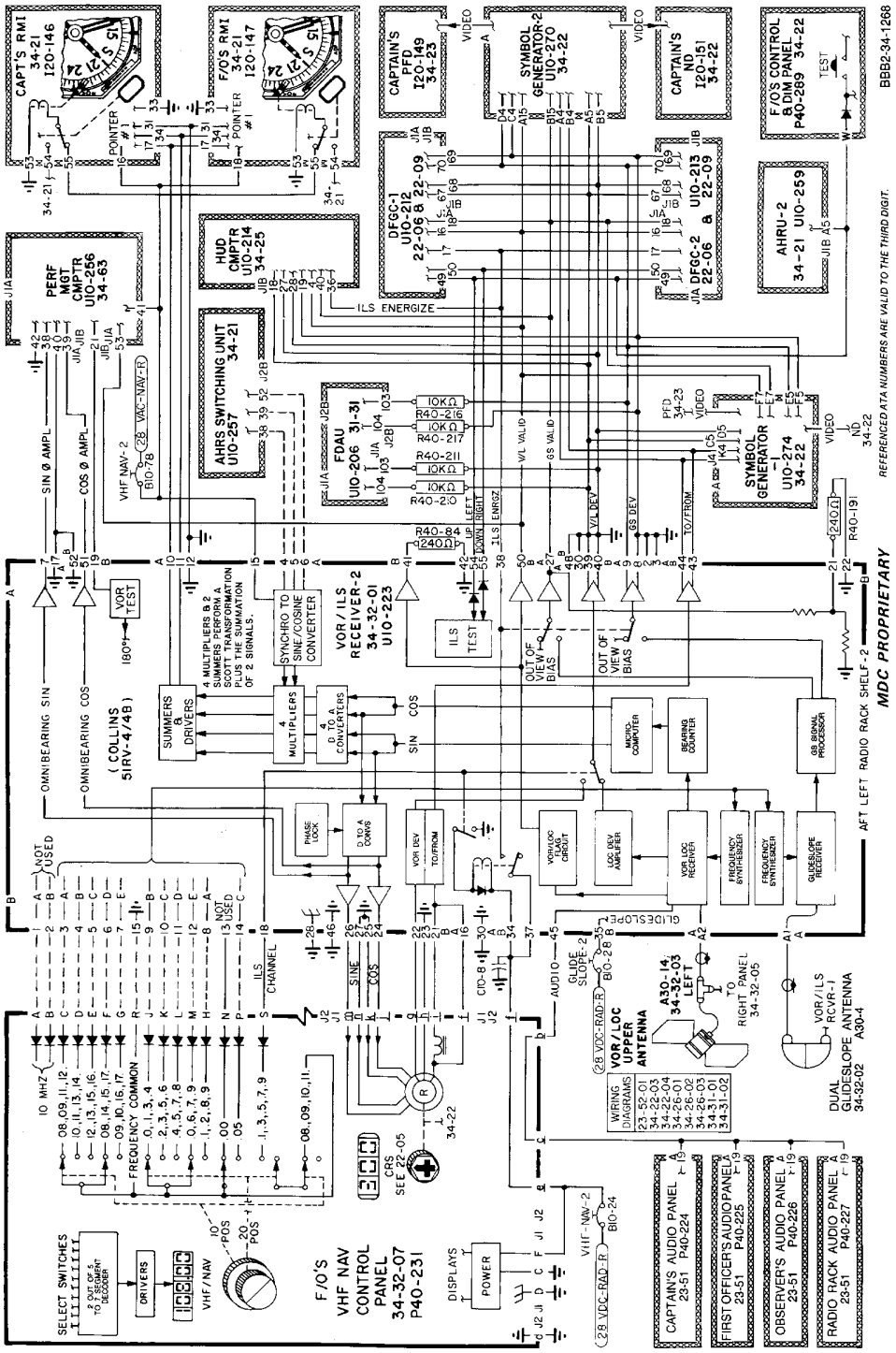
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3) Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6) Perform Return to Service (RTS) test. (SUBJECT 22-01-05)	



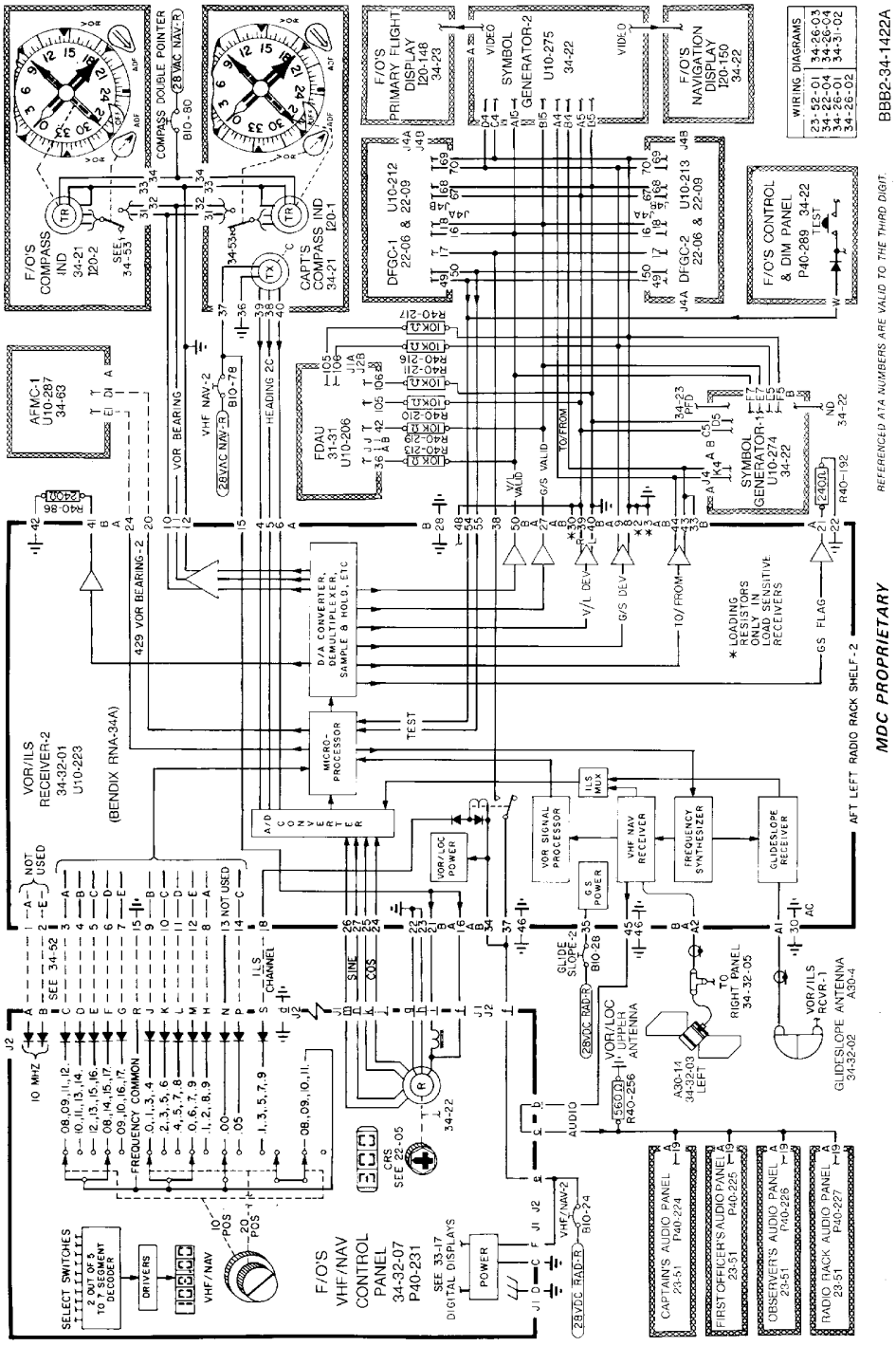
VHF Navigation System -1 Schematic
Figure 101/34-51-00-990-846 (Sheet 1 of 2)



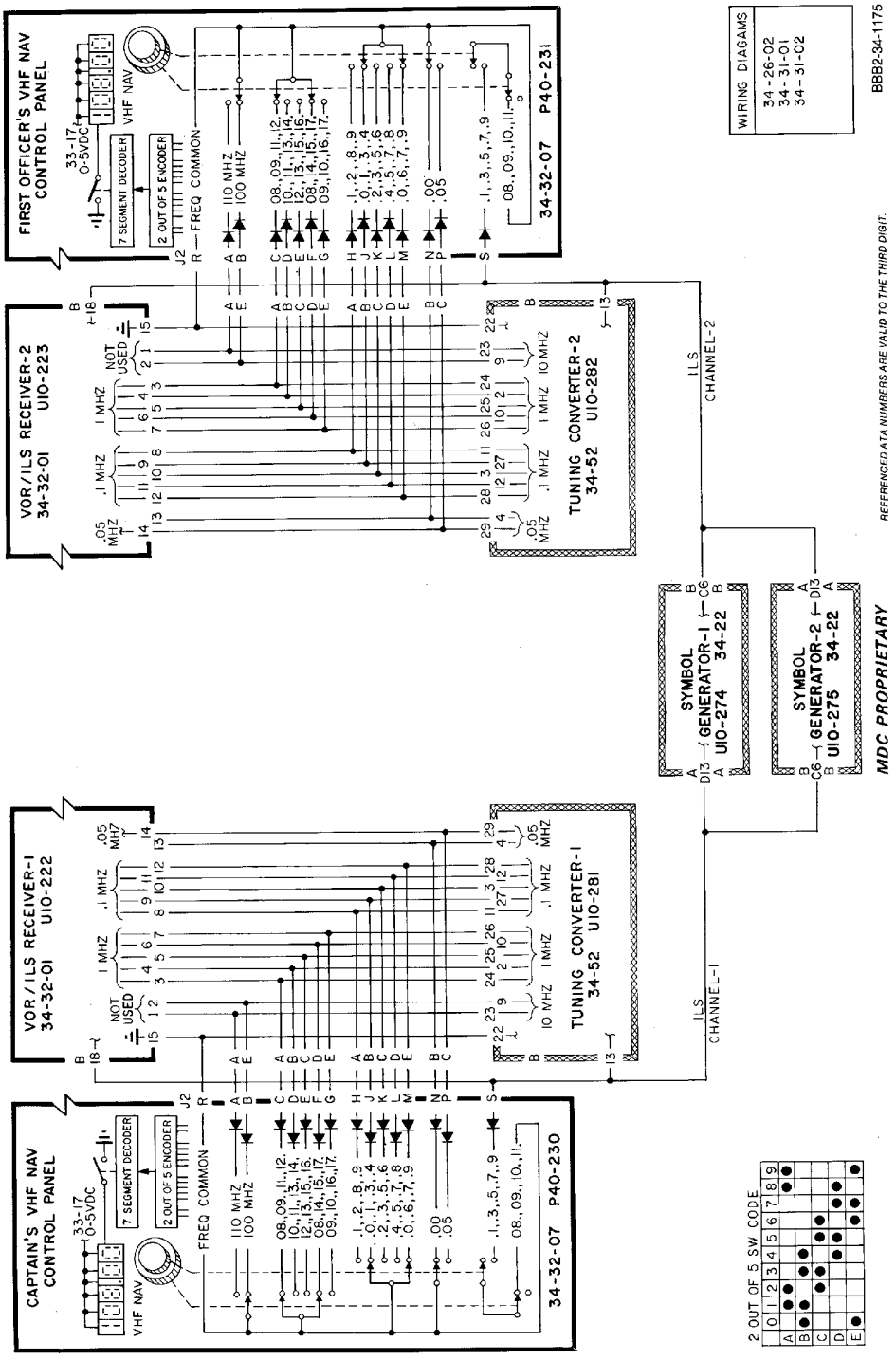
VHF Navigation System -1 Schematic
Figure 101/34-51-00-990-846 (Sheet 2 of 2)



VHF Navigation System -2 Schematic
Figure 102/34-51-00-990-847 (Sheet 1 of 2)



VHF Navigation System -2 Schematic
Figure 102/34-51-00-990-847 (Sheet 2 of 2)



VHF NAV Tuning - Schematic
Figure 103/34-51-00-990-848

VHF NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty VHF navigation system in the airplane.

B. The basic causes of a faulty system operation are generally, faulty airplane wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the VHF navigation system operation are: Captain's and First Officer's EFIS Primary Flight Displays and Navigation Displays, radio distance magnetic indicators, VOR/LOC antenna, VHF NAV panels and VOR/ILS receivers. The system interfaces with the EFIS symbol generators. In trouble shooting, some EFIS system checks may have to be made (SUBJECT 34-22-00).

NOTE: The VHF navigation system interfaces with the ILS system (SUBJECT 34-32-00) as the VOR/ILS receiver provides VOR and ILS data.

E. The VHF Navigation system components are located as follows:

Table 101

Component	Location
EFIS Primary Flight Display (PFD)	Captain's and First Officer's Instrument Panels
EFIS Navigation Display (ND)	Captain's and First Officer's Instrument Panels
RadioDistance Magnetic Indicators (RDMI's)	Captain's and First Officer's Instrument Panels
VHF NAV Control Panels	Flight Guidance Control Panel
VOR/LOC Antenna	Vertical Stabilizer
VOR/ILS Receivers	Electrical/Electronics Compartment

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed item.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

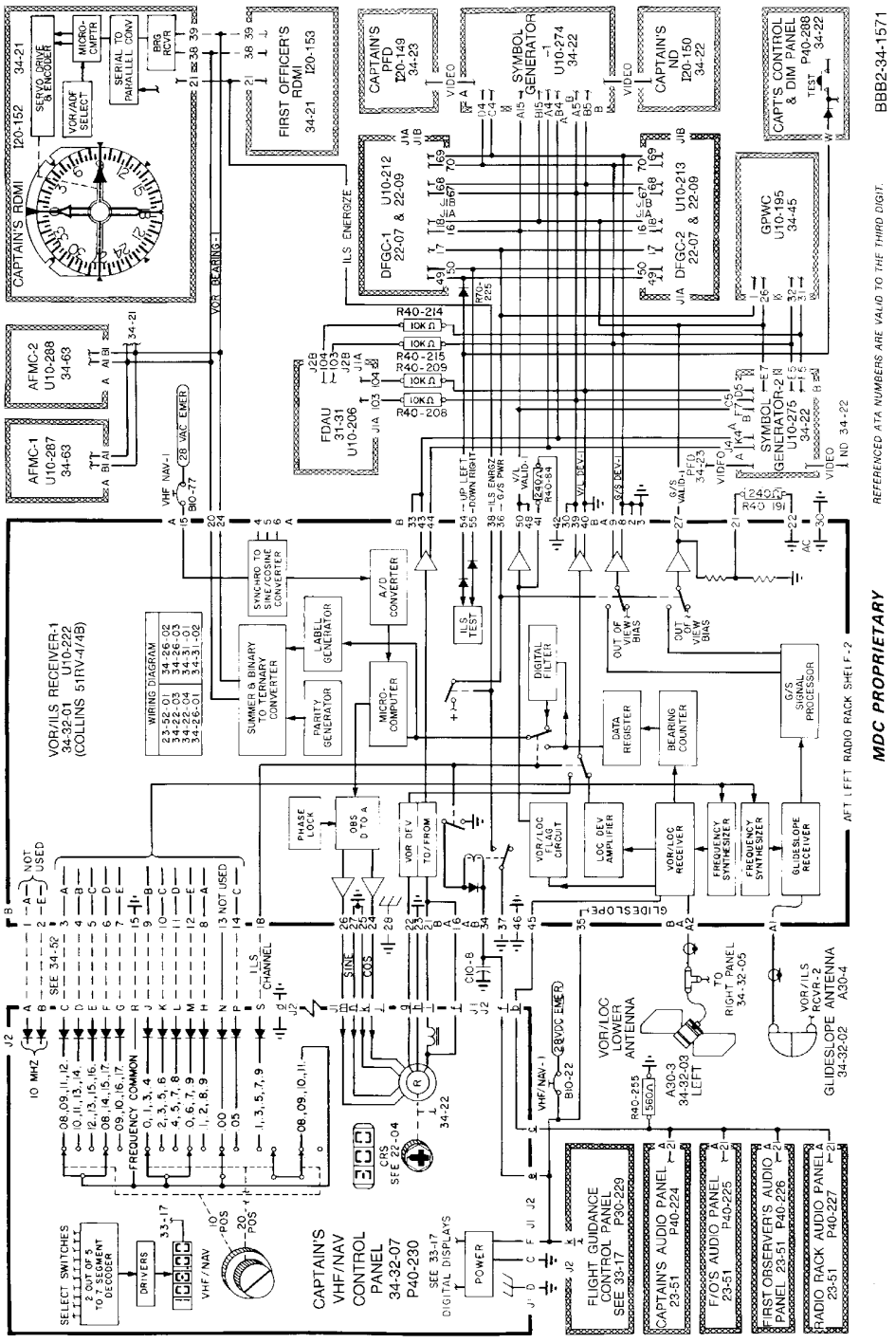
3. Trouble Shooting VHF Navigation System

A. Trouble Shoot

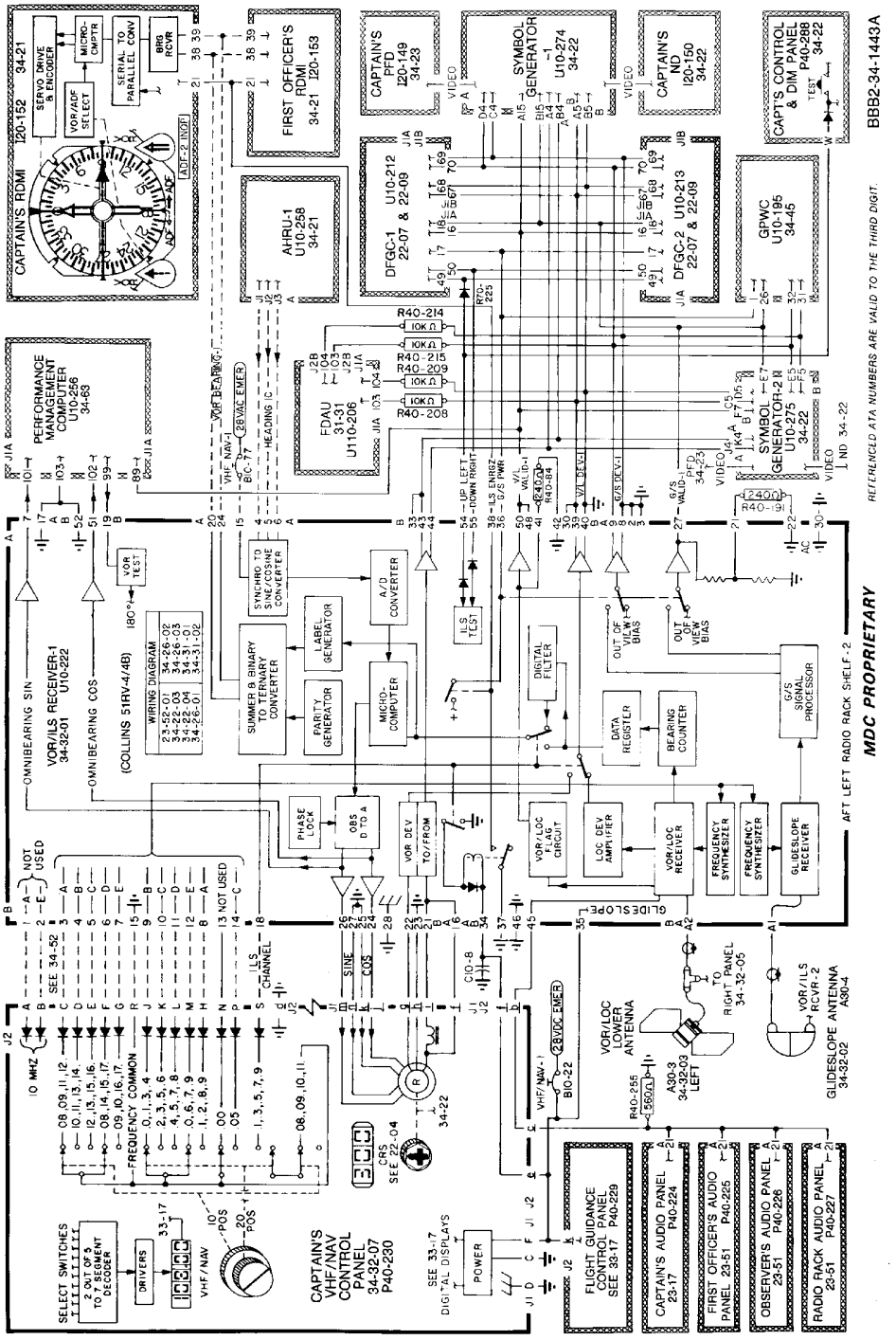
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are PFD, ND, radio distance magnrtic indicator, VHF NAV Control Panels, VOR/ILS receivers and VOR/LOC Antenna.

Table 103

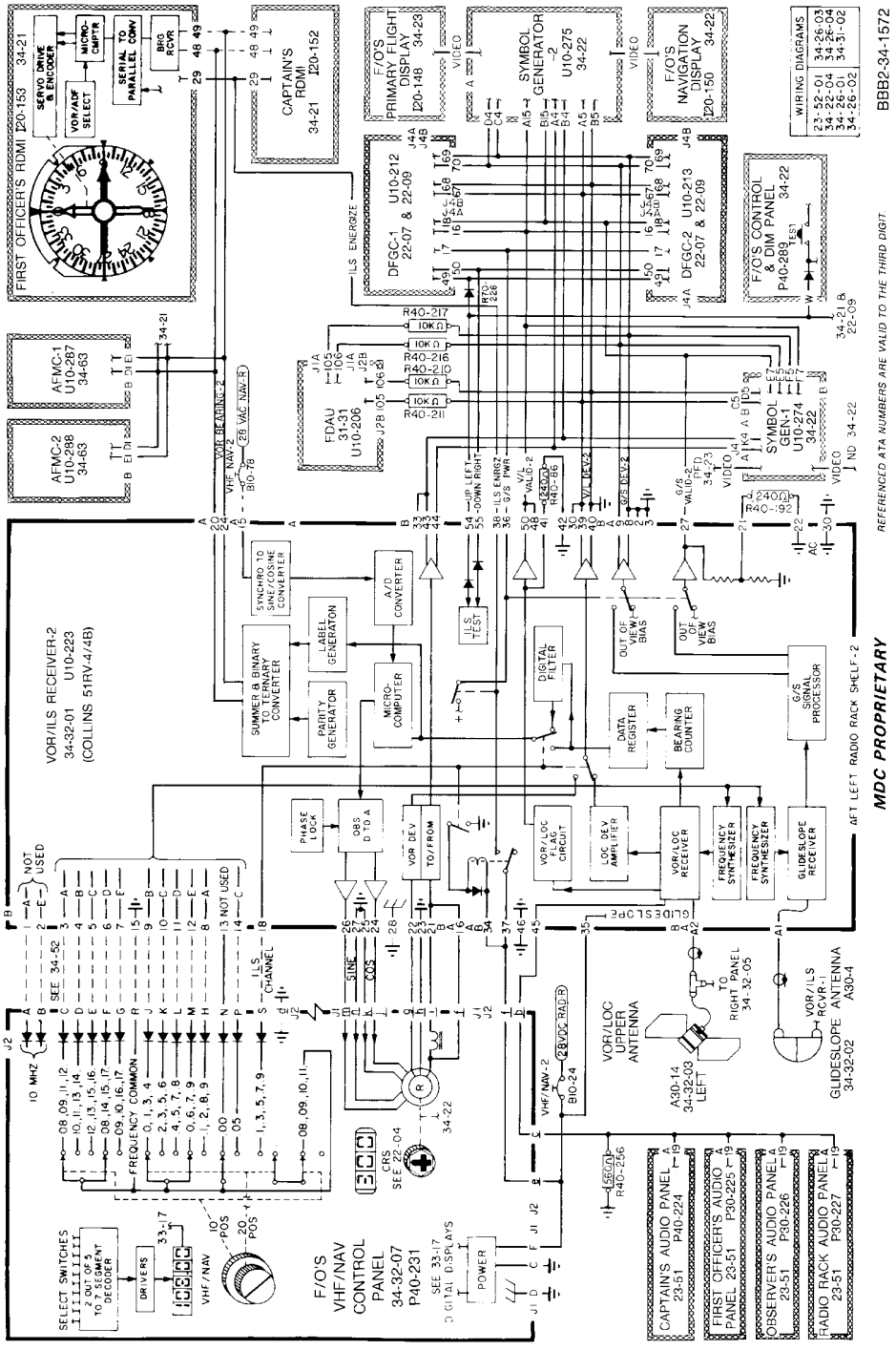
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3) Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.
(6) Perform Return to Service (RTS) test. (SUBJECT 22-01-05)	



VOR/ILS-1 (VHF NAV) - Schematic
Figure 101/34-51-00-990-849



VHF Navigation System - 1 Schematic
Figure 102/34-51-00-990-850



VOR/ILS-2 (VHF NAV) - Schematic
Figure 103/34-51-00-990-851

VHF NAVIGATION SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 873, 874, 892, 893

A. The VHF navigation (VOR) system accepts and processes signals from a ground transmitting station through the aircraft VOR/ILS receiver to provide bearing displays on the aircraft compass indicators (CI's) and displacement information relative to the selected VOR radial which is displayed on the horizontal situation indicators (HSI's).

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

B. The VHF navigation (VOR) system accepts and processes signals from a ground transmitting station through the aircraft VOR/ILS receiver to provide bearing displays on the aircraft compass indicators (CIs) and displacement information relative to the selected VOR radial which is displayed on the horizontal situation indicators (HSIs). On aircraft with EFIS, VOR deviation and TO/FROM indications are displayed on the EFIS Navigation Display (ND).

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

C. The procedures contained in this section tests the VOR navigation system.

D. Localizer and glideslope signals are also processed through the VOR/ILS receiver. These are described and tested in section SUBJECT 34-32-00 of the Maintenance Manual.

E. The lower VOR/LOC antennas on the vertical stabilizer supply signals to the -1 VOR/ILS receiver, and the upper antennas provide signals to the -2 ILS receiver.

F. The VHF NAV frequency control, HDG and CRS knobs are located on the left, Captain's, and right, First Officer's, Flight Guidance Control Panel.

G. During TEST, a local VOR TEST frequency can be used or a signal generator.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Portable signal generator	
479S-6A or	Collins Radio Co.
T30D	Tel-Electronic Instruments Corp.

3. Adjustment/Test VHF Navigation System

A. Test VOR Audio

WJE 405, 407-411, 873, 874, 880, 881, 883, 884, 892, 893

NOTE: Ensure VOR-ADF switches on compass indicators are in VOR position.

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

Table 202

Operation	Desired Result
(1) If utilizing test set equipment set test set to radiate a 1000 cycle per second tone frequency on a designated VOR frequency that does not interfere with local air traffic control, or tune to a local VOR frequency.	
(2) Tune both Captain's and First Officer's VHF NAV control to frequency corresponding to above step (1).	
(3) Set audio control panel switches for applicable NAV(VOR)-1 or -2 audio.	Use headset at audio stations, distinct tone should be heard.
(4) Vary audio volume control.	Should be smooth adjustment of audio tone.
(5) Return audio control panel and test set settings to normal.	

B. Test VOR Function

NOTE: During the following tests, alternately check the Captain's -1 and First Officer's -2 system using the applicable controls and instrument readings.

Table 203 Table 1

Operation	Desired Result
(1) Tune VHF NAV controls to a common frequency with signal generator, or local VOR TEST frequency.	
WJE 405, 407-411, 873, 874, 880, 881, 883, 884, 892, 893	
(1a) On aircraft with OMEGA installed, and no EFIS, place HSI switches (RADIO OMEGA), on captain's and first officer's instrument panels, in RADIO position.	
WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893	
(2)Turn sync knobs on both RDIs until both indicator cards read zero degrees.	

Table 203 Table 1 (Continued)

Operation	Desired Result
(3) If local VOR TEST frequency used.	VOR pointers on RMI should point towards known bearing of VOR station (±4) degrees.
(4) If signal generator is used, perform steps (5) and (6).	
WJE 873, 874, 892, 893	
(5) Set signal generator VOR azimuth control to positions as noted inTable 204.	Both VOR pointers should indicate as noted inTable 204.
WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891	
(5) Set signal generator VOR azimuth control to positions as noted inTable 205.	Both VOR pointers should indicate as noted inTable 205.
WJE 873, 874, 892, 893	
(6) Adjust course control until course deviation bar aligns with course error pointer on HSI's.	To-From arrow should indicate as noted in Table 204.
WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891	
(6) Adjust course control until course deviation bar aligns with course error pointer on HSI's.	To-From arrow should indicate as noted in Table 205..

WJE 873, 874, 892, 893

Table 204 Table 2

T30D or Cossor 555 Signal Generator VOR Azimuth Control	479T-2 Signal Generator VOR Azimuth Control	Radio Magnetic Indicator Pointer	Horizontal Situation Indicator	
			Course Setting	To-From Arrow
0	180	0(±4°)	0(±4°)	Upwards
45	225	45(±4°)	45(±4°)	Upwards
90	270	90(±4°)	90(±4°)	-
135	315	135(±4°)	135(±4°)	Downwards
180	0	180(±4°)	180(±4°)	Downwards
225	45	225(±4°)	225(±4°)	Downwards
270	90	270(±4°)	270(±4°)	-
315	135	315(±4°)	315(±4°)	Upwards

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 880, 881, 883, 884, 891

Table 205 Table 2

T30D or Cossor 555 Signal Generator VOR Azimuth Control	479T-2 Signal Generator VOR Azimuth Control	Compass Indicator or Radio Magnetic Indicator Pointer	Horizontal Situation Indicator (Navigation Display (ND) on EFIS aircraft)	
			Course Setting	To-From Arrow
0	180	0(±4°)	0(±4°)	Upwards
45	225	45(±4°)	45(±4°)	Upwards
90	270	90(±4°)	90(±4°)	-
135	315	135(±4°)	135(±4°)	Downwards
180	0	180(±4°)	180(±4°)	Downwards
225	45	225(±4°)	225(±4°)	Downwards
270	90	270(±4°)	270(±4°)	-
315	135	315(±4°)	315(±4°)	Upwards

WJE 405, 407-411, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(1) Following adjustment to VOR/ILS receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ± 10 percent across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.

VHF NAVIGATION SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 406

A. The VHF navigation (VOR) system accepts and processes signals from a ground transmitting station through the aircraft VOR/ILS receiver to provide bearing displays on the aircraft radio magnetic indicators (RMI's) and displacement information relative to the selected VOR radial which is displayed on the EFIS Navigation Display (ND).

WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B. The VHF navigation (VOR) system accepts and processes signals from a ground transmitting station through the aircraft VOR/ILS receiver to provide bearing displays on the aircraft radio distance magnetic indicators (RDMI's) and displacement information relative to the selected VOR radial which is displayed on the EFIS Navigation Display (ND).

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

C. The procedures contained in this section tests the VOR navigation system.

D. Localizer and glideslope signals are also processed through the VOR/ILS receiver. These are described and tested in section SUBJECT 34-32-00 of the Maintenance Manual.

E. The lower VOR/LOC antennas on the vertical stabilizer supply signals to the -1 VOR/ILS receiver, and the upper antennas provide signals to the -2 ILS receiver.

F. The VHF NAV frequency control, HDG and CRS knobs are located on the left, Captain's, and right, First Officer's, Flight Guidance Control Panel.

G. During TEST, a local VOR TEST frequency can be used or a signal generator.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Portable signal generator	
479S-6A or	Collins Radio Co.
T30D	Tel-Electronic Instruments Corp.

3. Adjustment/Test VHF Navigation System

A. Test VOR Audio

Table 202

Operation	Desired Result
(1) If utilizing test set equipment set test set to radiate a 1000 cycle per second tone frequency on a designated VOR frequency that does not interfere with local air traffic control, or tune to a local VOR frequency.	

Table 202 (Continued)

Operation	Desired Result
(2) Tune both Captain's and First Officer's VHF NAV control to frequency corresponding to above step (1).	
(3) Set audio control panel switches for applicable NAV(VOR)-1 or -2 audio.	Use headset at audio stations, distinct tone should be heard.
(4) Vary audio volume control.	Should be smooth adjustment of audio tone.
(5) Return audio control panel and test set settings to normal.	

B. Test VOR Function

NOTE: During the following tests, alternately check the Captain's -1 and First Officer's -2 system using the applicable controls and instrument readings.

Table 203 Table 1

Operation	Desired Result
(1) Tune VHF NAV controls to a common frequency with signal generator, or local VOR TEST frequency.	
WJE 401-404, 417, 419, 421, 423, 865, 869, 871, 872, 875-879	
(1a) On Captain's and first officer's instrument panels ensure MAG light is on MAG/TRUE switches.	MAG lights are on.
WJE 406	
(2) If local VOR TEST frequency used.	VOR pointers on RMI should point towards known bearing of VOR station (±4) degrees.
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
(2) If local VOR TEST frequency used.	VOR pointers on RDMI should point towards known bearing of VOR station (±4) degrees.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
(3) If signal generator is used, perform steps (4) and (5).	
(4) Set signal generator VOR azimuth control to aircraft compass heading plus values noted inTable 204.	Both VOR pointers should indicate compass heading plus values noted inTable 204.
(5) Adjust course control until course deviation bar aligns with course error pointer on ND's.	To-From arrow should indicate as noted in Table 204.

Table 204 Table 2

T30D or Cossor 555 Signal Generator VOR Azimuth Control	479T-2 Signal Generator VOR Azimuth Control	Compass Indicator or Radio (Distance) Magnetic Indicator Pointer	Navigation display (ND)	
			Course Setting	To-From Arrow
0°	180°	0(±2.5°)	0(±2.5°)	TO
WJE 401-404, 406, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
5°	225°	45(±2.5°)	45(±2.5°)	TO
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
90°	270°	90(±2.5°)	90(±2.5°)	TO
135°	315°	135(±2.5°)	135(±2.5°)	TO
180°	0°	180(±2.5°)	180(±2.5°)	TO
225°	45°	225(±2.5°)	225(±2.5°)	TO
270°	90°	270(±2.5°)	270(±2.5°)	TO
315°	135°	315(±2.5°)	315(±2.5°)	TO
0°	180°	0(±2.5°)	180(±2.5°)	FROM

(1) Following adjustment to VOR/ILS receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ± 10 percent across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.

(2) Remove test equipment and return aircraft to required configuration.

VOR/LOC ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the VHF Omnidirectional Range/ILS Localizer (VOR/LOC) antenna.

B. The VOR/LOC antennas are located on the upper leading edge of the vertical stabilizer. There are four antenna panels, two located on left side of the stabilizer and two on the right side. The two upper antennas are located opposite and inter-connected to provide VOR/LOC signals for the VOR/ILS receiver number 2. The two lower antennas, located opposite and interconnected provide VOR/LOC signals for the VOR/ILS receiver number 1.

C. The VOR/LOC antennas are located on the upper leading edge of the vertical stabilizer. There are four antenna panels, two located on left side of the stabilizer and two on the right side. The two upper antennas are located opposite and inter-connected to provide VOR/LOC signals for the VOR/ILS receiver number 2. The two lower antennas, located opposite and interconnected provide VOR/LOC signals for the VOR/ILS receiver number 1.

D. Each antenna panel, transformer, and interconnecting coaxial cables to the disconnect tee are removed as a unit. Transformer and coaxial cables can be removed from panel. (Figure 201) (Figure 202)

E. Removal/Installation procedures are for the left hand antenna assemblies, procedures are identical for right hand assemblies except where noted.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Signal Generator 479S-6A	Collins Radio Co.
Lockwire .020 copper safety wire	
Standing Wave 415-B	Hewlett-Packard
Standing Wave Detector Indicator 219	PRD Electronics
Multimeter 630A	Triplett
Coaxial Termination 80F	Bird

3. **Removal/Installation VOR/LOC Antenna**

A. Remove VOR/LOC Antenna

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

CAUTION: CARE SHOULD BE TAKEN TO REMOVE BUTT EDGE SEALING AROUND ANTENNA PANELS WITH NON-METALLIC SPATULA TO PREVENT DELAMINATION OF METAL PAN ASSEMBLY.

(2) Remove sealant around antenna edge.

CAUTION: ANTENNA PANEL MUST BE SUPPORTED AFTER PERIPHERY SCREWS ARE REMOVED WHILE DISCONNECTING COAX AND ON RIGHT PANEL, A COAX CLAMP. TO PREVENT DAMAGE TO PANEL OR COAXS, IT IS ADVISABLE TO SUPPORT PANEL TO VERTICAL STABILIZER BY MEANS OF SAFETY WIRE OR LONG SCREW WHILE DISCONNECTING COAXS AND CLAMP.

(3) Remove screws around periphery of antenna panel, carefully remove panel to gain access to coax connection at connector tee on bulkhead.

(4) Disconnect and cap coax assembly connector from connector tee. Remove two coax clamps at bulkhead to free antenna panel.

(5) Disconnect and cap coax assembly disconnect and cap from connector tee. Remove two coax clamps at bulkhead to free antenna panel.

(6) Remove antenna panel from stabilizer.

B. Install VOR/LOC Antenna

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

(2) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Apply applicable faying surface seal to the edge of the antenna assembly. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(4) Install antenna assembly as follows:

CAUTION: TO PREVENT DAMAGE TO PANEL OR COAXS, PANEL SHOULD BE SUPPORTED TO VERTICAL STABILIZER BY MEANS OF SAFETY WIRE OR LONG SCREWS WHEN CONNECTING COAXS AND COAX CLAMP ASSEMBLY.

(a) Support antenna panel in mounting position. Remove protective cap and connect coax assembly to connector tee. Install coax clamps to secure coax to bulkhead.

(b) Safety coax connectors with 0.020 copper lockwire. (LOCKWIRE SAFETYING - MAINTENANCE PRACTICES, PAGEBLOCK 20-10-18/201)

(c) Carefully position panel in mounting position on stabilizer.

(d) Install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws. Follow opposite tightening sequence to prevent warping of panel. (PAGEBLOCK 20-30-01/201)

2) Torque the attachments screws 10 minutes after the initial torque.

(5) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(6) Fill antenna butt joints with sealant. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(7) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

NOTE: You have VHF NAV circuit breakers.

4. Adjustment/Test VOR/LOC Antenna

NOTE: VOR/LOC tests are also accomplished in INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-32-00/201 Config 2 or INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-32-00/201 Config 3 or INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-32-00/201 Config 4 or INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-32-00/201 Config 5 or INSTRUMENT LANDING SYSTEM (ILS) - MAINTENANCE PRACTICES, PAGEBLOCK 34-32-00/201 Config 6.

A. Test Antenna

(1) Energize aircraft electrical buses.

(2) On aircraft with EFIS, place MODE knob on EFIS Mode select panel in ROSE position.

(3) Tune both VHF NAV controls to select local VOR station with known magnetic bearing to aircraft position.

NOTE: If unable to contact a VOR station, set up signal generator for VOR frequency same as VHF NAV control frequency setting and 1000 cps tone.

(4) VHF Omnidirectional Range (VOR) pointers should deflect to indicate magnetic bearing to VOR station test set.

(5) Check for presence of VOR station audio identification signal at audio control panel or 1000 cps signal generator tone.

(6) Position signal generator at rear of aircraft with fully extended antenna broadside to VOR/LOC antenna's and tune for localizer frequency.

(7) Tune VHF NAV control to localizer frequency. Same as signal generator.

(8) On signal generator, rotate LOC-GS control to maximum left position; Captain's and First Officer's course deviation bars on HSI's/ND's move left.

(9) Rotate LOC-GS control to maximum right position; course deviation bars move right.

(10) Set LOC-GS control to center position; course deviation bars center.

(11) Remove test equipment and return aircraft to required configuration.

NOTE: The following check Paragraph 4.B. may be performed at customer's option.

B. Continuity Check

(1) Disconnect VOR-1 and VOR-2 cables at disconnect point located in electrical/electronic compartment.

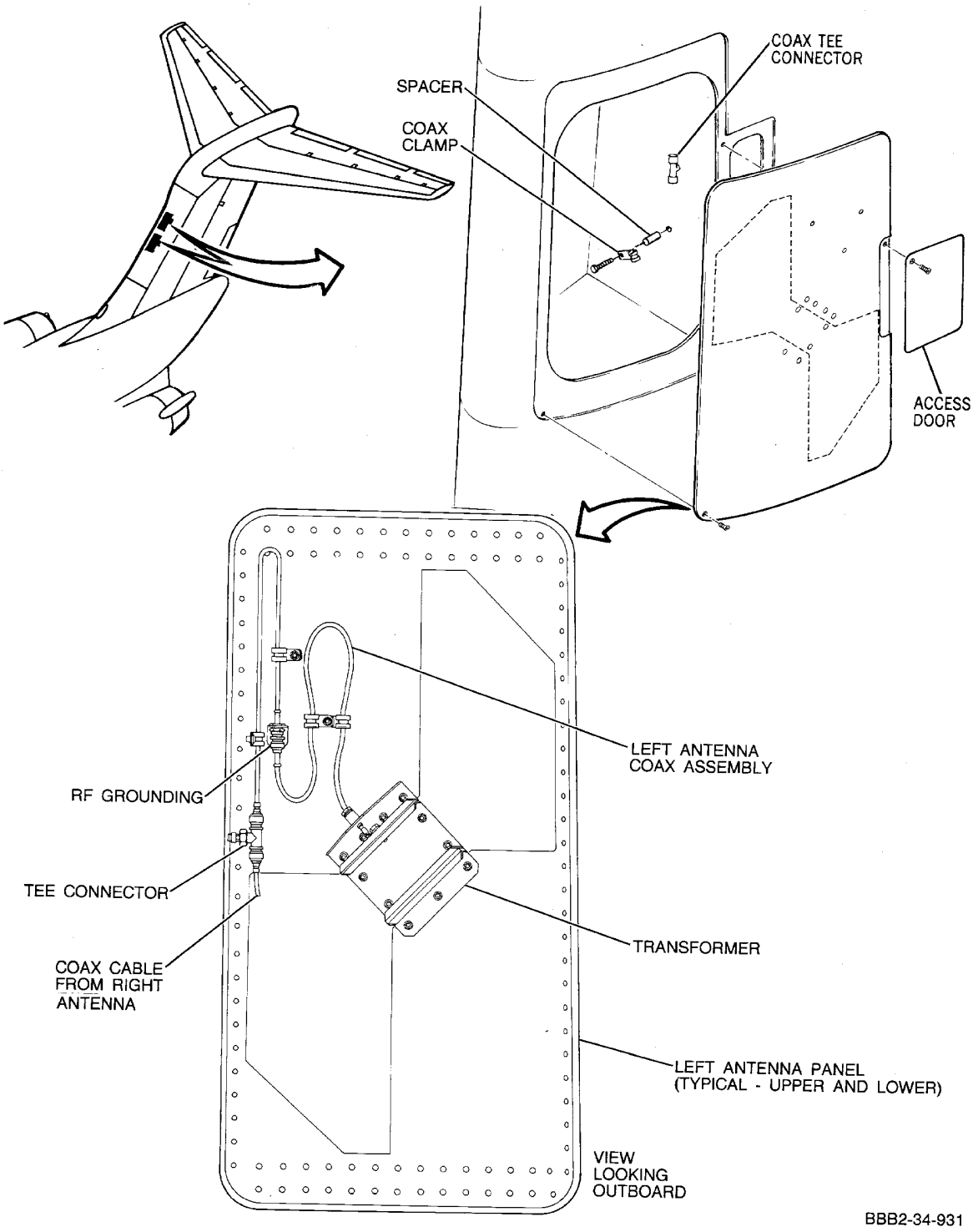
(2) Connect multimeter between center conductor of either VOR cable and ground. No continuity should exist.

C. Standing Wave Ratio (SWR) Check

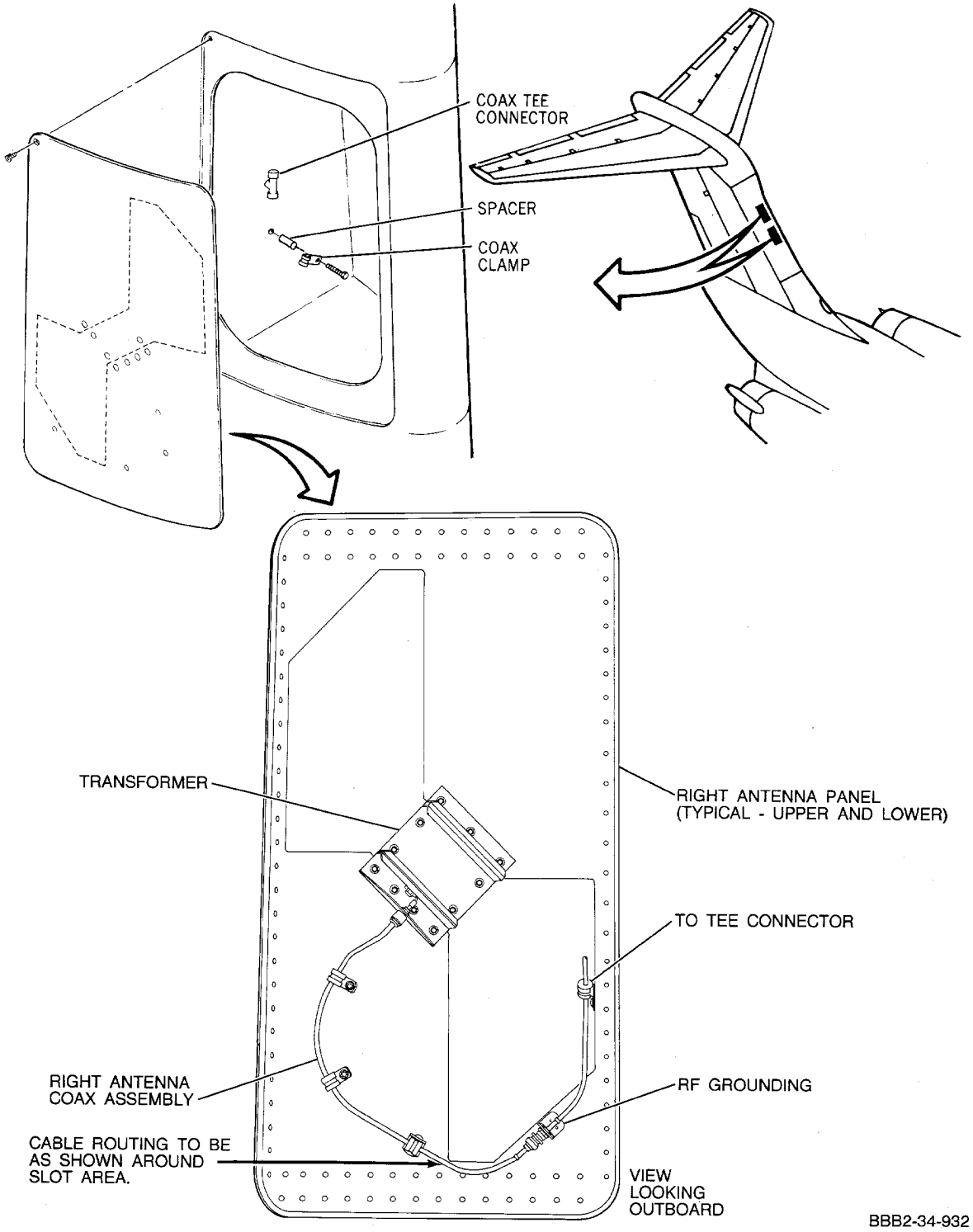
(1) Connect signal generator and VSWR meter to VOR-1 cable at aft cargo disconnect.

(2) Measure VSWR at 108, 113 and 118 mcs (MHz). In all cases VSWR should be a ratio of 5 to 1 or less (if meter at 1).

(3) Repeat Paragraph 4.C.(1) through Paragraph 4.C.(2) for VOR-2.



VOR/LOC Antenna (Left) -- Removal/Installation
Figure 201/34-51-01-990-805



VOR/LOC Antenna (Right) -- Removal/Installation
Figure 202/34-51-01-990-806

VOR/LOC ANTENNA - INSPECTION/CHECK

1. General

A. This procedure contains MSG-3 task card data.

TASK 34-51-01-211-801

2. Detailed Inspection of the VOR/NAV Antenna for Proper Bonding

NOTE: This procedure is a scheduled maintenance task.

A. References

Reference	Title
20-30-01 P/B 201	BOLT TORQUE DATA - MAINTENANCE PRACTICES
20-50-10 P/B 201	COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES

B. Consumable Materials

NOTE: Equivalent replacements are permitted for the items that follow.

NOTE: It is possible that some materials in the Consumable Materials chart cannot be used for some or all of the necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Reference	Description	Specification
A60125	Sealant - Polysulfide Aluminized	
B60101	Solvent, Degreasing (Type 2)	DPM 518 (MIL-PRF-680, Type 2)
C60001	Alodine #1500 Coating, Chem. Film, Premixed Liquid Brush	DPM 5089-1

C. Prepare for the Detailed Inspection of the VOR/NAV Antenna for Proper Bonding

SUBTASK 34-51-01-865-001

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

SUBTASK 34-51-01-020-001

CAUTION: CARE SHOULD BE TAKEN TO REMOVE BUTT EDGE SEALING AROUND ANTENNA PANELS WITH NON-METALLIC SPATULA TO PREVENT DELAMINATION OF METAL PAN ASSEMBLY.

(2) Remove sealant around antenna edge.

CAUTION: ANTENNA PANEL MUST BE SUPPORTED AFTER PERIPHERY SCREWS ARE REMOVED. TO PREVENT DAMAGE TO PANEL OR COAXS, IT IS ADVISABLE TO SUPPORT PANEL TO VERTICAL STABILIZER BY MEANS OF SAFETY WIRE OR LONG SCREW.

(3) Remove screws around periphery of antenna panel, carefully remove panel.

(4) Remove antenna panel from stabilizer and secure with safety wire or long screw.

D. Detailed Inspection of the VOR/NAV Antenna for Proper Bonding

SUBTASK 34-51-01-211-001

(1) Do a detailed inspection of the VOR/NAV antenna for proper bonding.

WARNING: P-D-680 TYPE 1 SOLVENT IS AN AGENT THAT IS FLAMMABLE AND POISONOUS. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN P-D-680 TYPE 1 SOLVENT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET P-D-680 TYPE 1 SOLVENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(WARNING PRECEDES)

WARNING: ALODINE 1500 COATING IS AN AGENT THAT IS POISONOUS, CORROSIVE, CARCINOGENIC, AN OXIDIZER, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN ALODINE 1500 COATING IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET ALODINE 1500 COATING IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE DUST OR MIST.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(a) Clean metal antenna mounting faying surface with Degreasing Solvent, B60101 to ensure a low impedance RF bond.

1) After cleaning, the above surfaces may be treated with brush alodine #1500 coating, C60001 for corrosion prevention.

SUBTASK 34-51-01-914-001

(2) Apply applicable faying surface seal to the edge of the antenna assembly. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

SUBTASK 34-51-01-420-001

(3) Carefully position panel in mounting position on stabilizer.

(4) Install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(5) Torque the attachment screws. Follow opposite tightening sequence to prevent warping of panel. (PAGEBLOCK 20-30-01/201)

(6) Torque the attachment screws again 10 minutes after the initial torque.

(7) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

SUBTASK 34-51-01-914-002

WARNING: POLYSULFIDE ALUMINIZED SEALANT IS AN AGENT THAT IS FLAMMABLE, EXPLOSIVE, POISONOUS, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN POLYSULFIDE ALUMINIZED SEALANT IS USED.

- GAS/AIR MIXTURES MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET POLYSULFIDE ALUMINIZED SEALANT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIER'S MSDS FOR:

- MORE PRECAUTIONARY DATA
- APPROVED SAFETY EQUIPMENT
- EMERGENCY MEDICAL AID.

TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(8) Fill antenna butt joints with polysulfide aluminized sealant, A60125.

(9) Clean excess sealant to provide a flush surface between mating surfaces.

E. Job Close-up

SUBTASK 34-51-01-865-002

(1) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 401-409, 411, 412, 414-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	10	B10-22	VHF NAV-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE ALL			
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2

SUBTASK 34-51-01-942-001

(2) Remove all the tools and equipment from the work area. Make sure the area is clean.

——— END OF TASK ———

DISTANCE MEASURING EQUIPMENT SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The DME system measures the line-of-sight distance from the aircraft to a selected ground station and provides a continuous decimal readout of that distance, in nautical miles. Dual systems are installed: DME-1 and DME-2. Each system consists of a DME (interrogator) and antenna. The VHF/NAV control panel, located on the upper instrument panel, is used for frequency control.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

B. The DME interrogator is the receiver-transmitter component of the system. It normally supplies distance information to the pilots' DME indicators located on the horizontal situation indicators (HSI). On aircraft equipped with EFIS, distance information appears on the Navigation Displays (ND). Aural station identification signals are sent to the audio panels of the flight interphone system.

WJE 405, 407-409, 411, 873, 874, 880, 881, 883, 884, 892, 893

C. The DME, or interrogator, is the receiver-transmitter component of the system. It supplies distance information to the horizontal situation indicators, and to the EFIS Navigation Displays on aircraft depending on equipment installed. Aural station identification signals are sent to the audio panels of the flight interphone system. The DME is of state-of-the-art design, employing solid state circuitry and digital techniques.

WJE 405, 407-409, 411, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

D. The DME system is controlled by the VHF Nav control panel. When a VOR/ILS frequency is selected, the DME is channeled to the related DME frequency.

E. The antenna is a vertically polarized, blade type unit, designed for L-band frequencies between 960 and 1220 megahertz. Two antennas are mounted on the lower fuselage centerline. The forward antenna is used with DME-1 system, the aft with DME-2.

F. DME-1 and DME-2 distance readouts appear in each Captain's and First Officer's HSI/ND (as applicable). On aircraft with HSI's, each HSI displays a DME-1 and a DME-2 readout. A shutter covers the display when the DME is off, in the search mode, or experiences a power failure or loss of valid distance data, i.e., when the flag ground is removed by the interrogator. On aircraft with EFIS, DME readouts appear in the top left and right hand corners of the ND. In the absence of computed data, three dashes will replace the numerical display above the DME1/DME2 annunciations.

2. Operation

A. Whenever power is applied to the DME, the DME starts in the automatic standby or signal-controlled search (SCS) mode. In this mode, the DME transmitter is inhibited and the receiver is operative. The DME will remain in SCS mode until the receiver determines that the antenna is receiving more than 450 squitter pulse pairs per second (pp/s) from a ground station. When this occurs, the DME switches to its search mode.

B. In the search mode, the DME interrogates the ground station by transmitting pulse pairs. After each interrogation, the DME receiver searches the ground station signals for a reply pulse pair that is synchronous with the interrogation pulse pair. The receiver searches during the time a signal would be received from a ground station located between 0 and 200 nmi away. The range computer in the DME counts the time from the interrogation pulse pair to the decoded reply pulse that it locates, and stores this time.

C. Once the DME has located a decoded reply pulse, it waits until the next interrogation pulse pair is transmitted. It then counts out to the time at which the last decoded reply pulse was received and develops a range gate. Presence of a decoded reply pulse in the range gate means that, twice in a row, the DME has found a pulse located at the same time interval after the second interrogation pulse. When this occurs, the DME continues to develop a range gate at this same point in time for consecutive interrogation periods. Location of 7 decoded reply pulses in 15 consecutive interrogation periods is the criterion necessary for the DME to switch to its pretrack mode.

D. Development of the range gate, at 1 point in time for 15 consecutive interrogation periods, can be terminated. This termination will occur if the DME fails to find a decoded reply pulse during three consecutive interrogation periods. When a termination occurs, the DME begins to search outbound from the previous distance to 200 nmi, and then from 0 to 200 nmi, until it finds another decoded reply pulse. When another decoded reply pulse is found, the range gate is then developed at that period of time. This process continues until the DME finds a point in time at which 7 decoded reply pulses occur within 15 consecutive interrogation periods. The DME will then switch to pretrack mode.

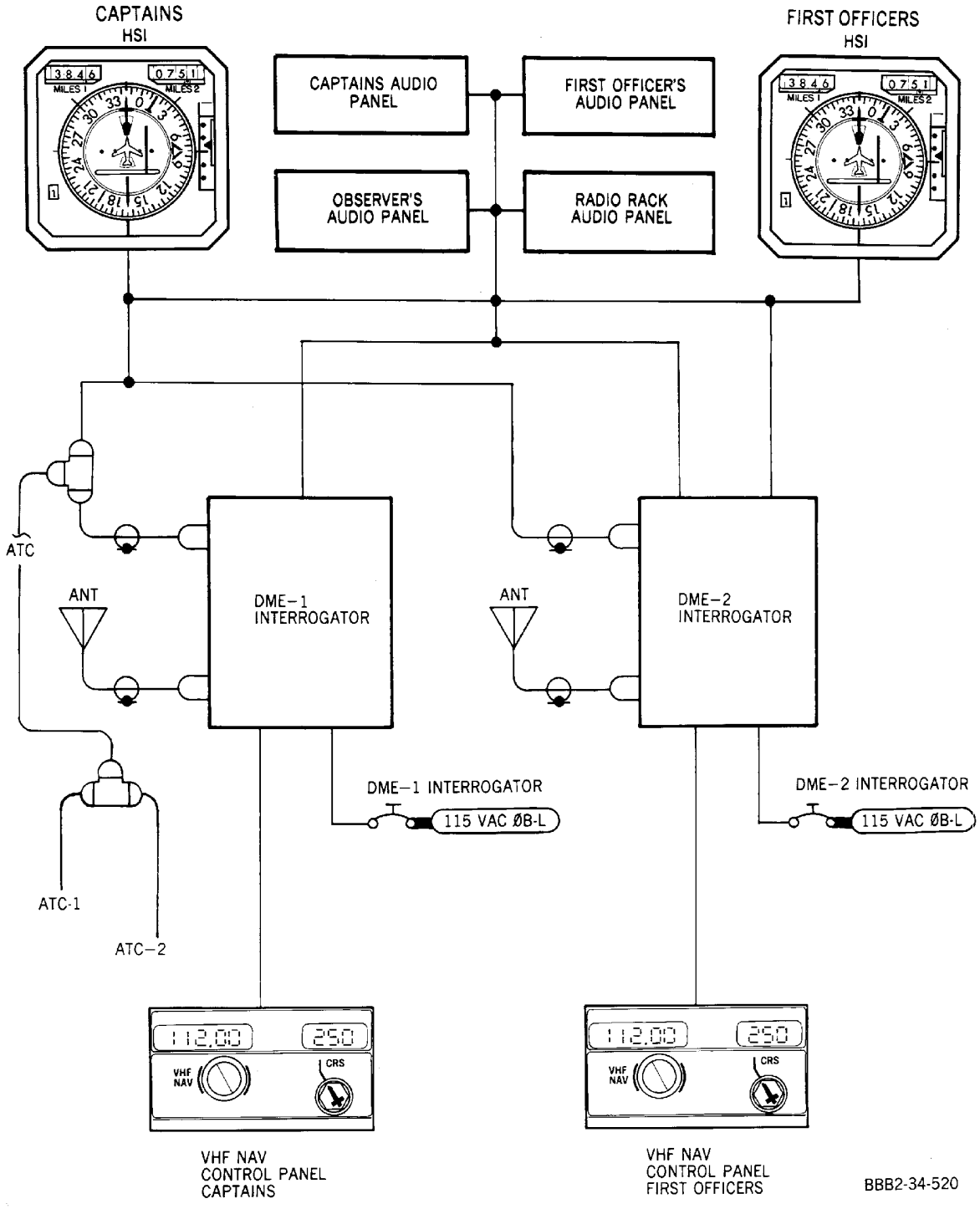
E. In pretrack mode, the DME determines the relative velocity of the aircraft with respect to the ground station. This is accomplished, during the 4-second pretrack mode, by a velocity accumulator which fine-positions the range gate so that the reply pulses are centered within the range gate. The velocity accumulator determines both the direction of range gate movement, either inbound or outbound, and the slew rate of the range gate to track the reply pulses. During pretrack mode, the DME continues to interrogate the ground station at 90 pp/s, and valid data is displayed.

F. In pretrack mode, the DME determines the relative velocity of the aircraft with respect to the ground station. This is accomplished, during the 4-second pretrack mode, by a velocity accumulator which fine-positions the range gate so that the reply pulses are centered within the range gate. The velocity accumulator determines both the direction of range gate movement, either inbound or outbound, and the slew rate of the range gate to track the reply pulses. During pretrack mode, the DME continues to interrogate the ground station and valid data is displayed.

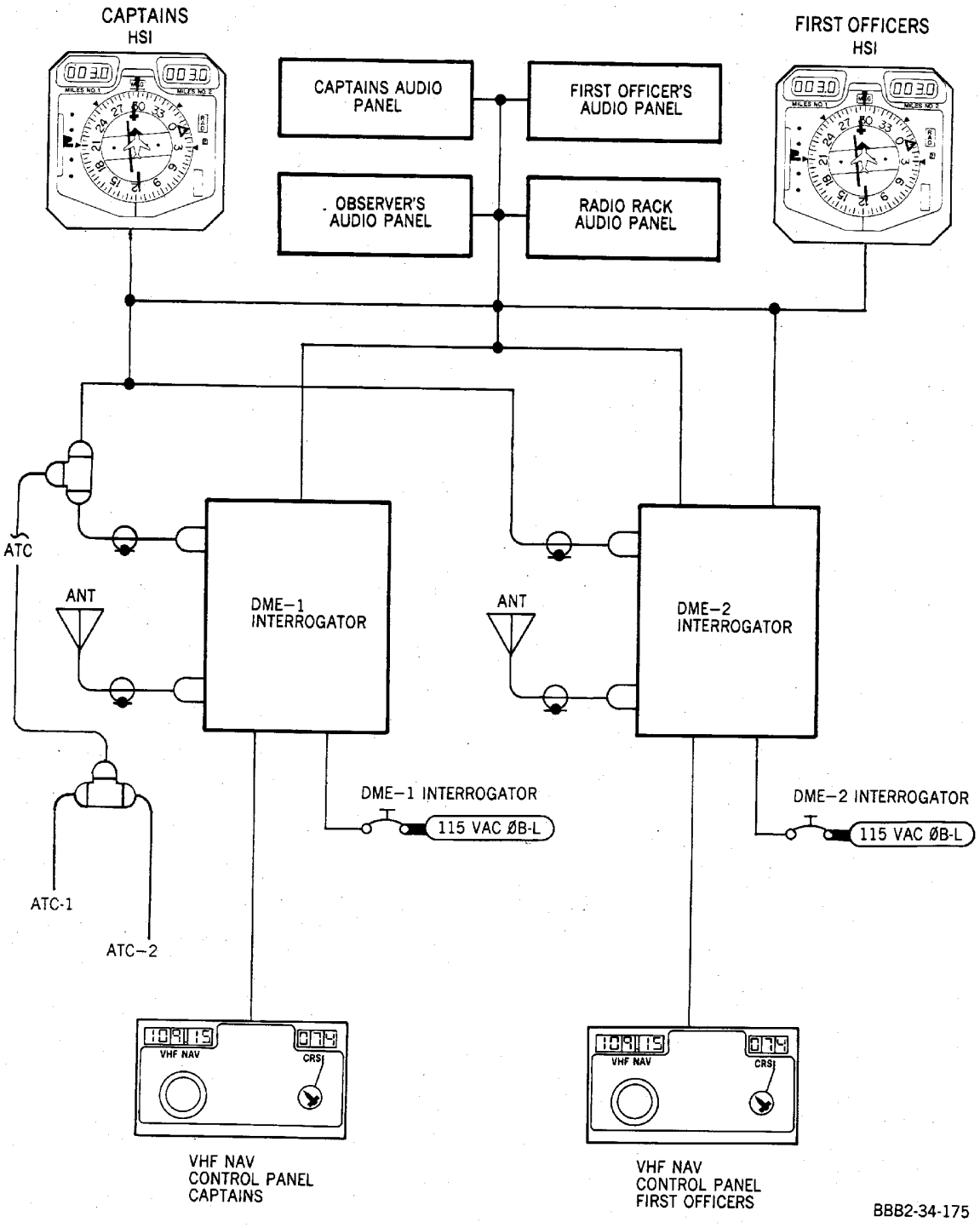
G. After the 4-second pretrack mode, the DME switches to the track mode. There is a delay immediately following the pretrack mode before the distance shutter is lifted. The criterion for maintaining track is that the DME continues to find at least 7 synchronous decoded replies for every 15 interrogation periods. If that criterion is not satisfied, the DME will go into its memory code. Memory will last for 10-14 seconds if track criteria is not established, and will return to search if a 450 pp/s is not received within that period.

H. The nominal memory mode is entered when a temporary or permanent loss of reply signal occurs. During memory mode, the DME continues interrogations and the distance is displayed as if the station were still being tracked. If the signal is reacquired during memory mode, the DME returns to track mode. If the signal is lost for a length of time greater than memory, the DME changes back to the search mode.

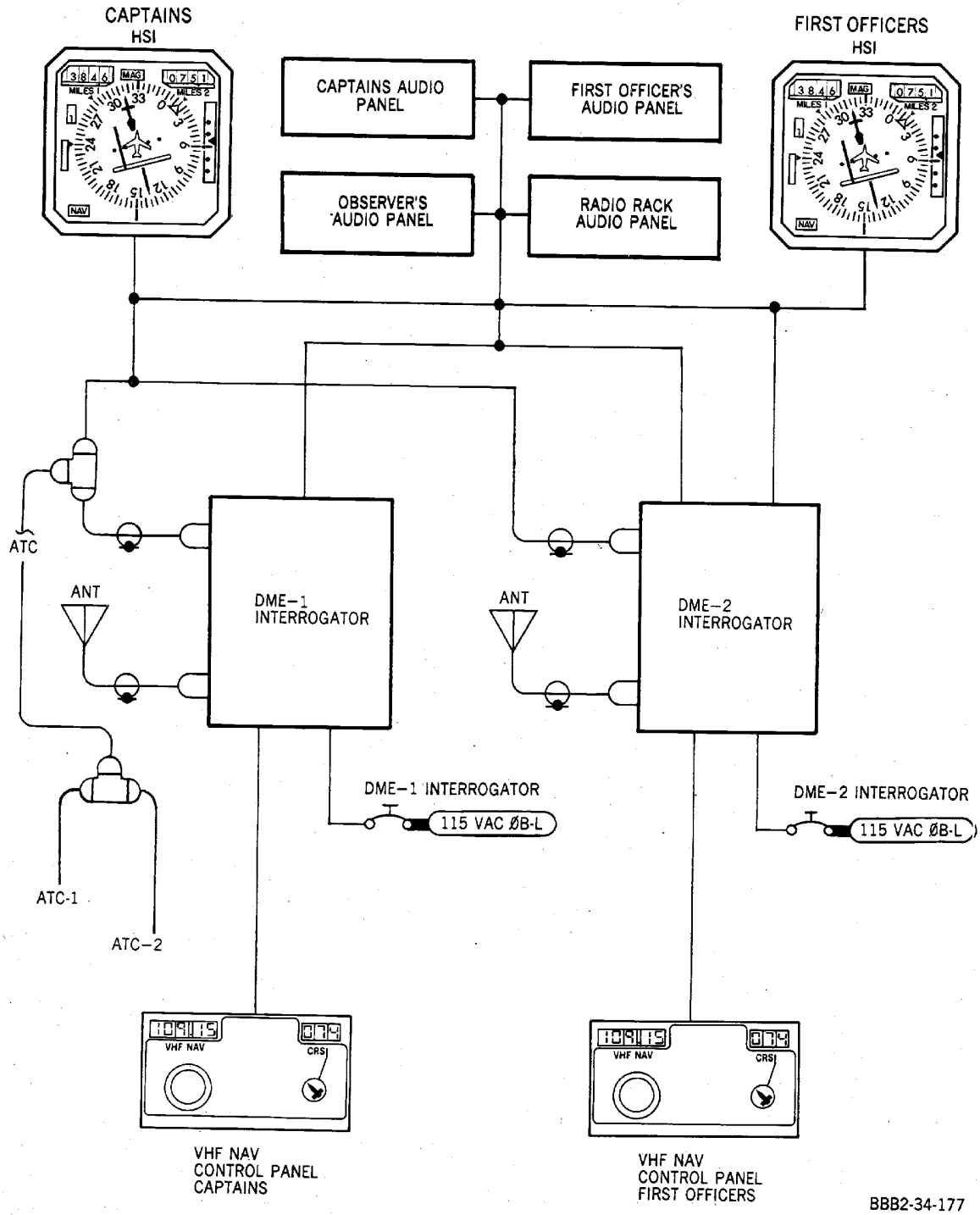
I. If the received squitter rate falls below 450 pp/s when the DME is in search mode, the DME will revert to the SCS or automatic standby mode, the transmitter will then be inhibited, the receiver will be operational, and distance data will not be displayed.



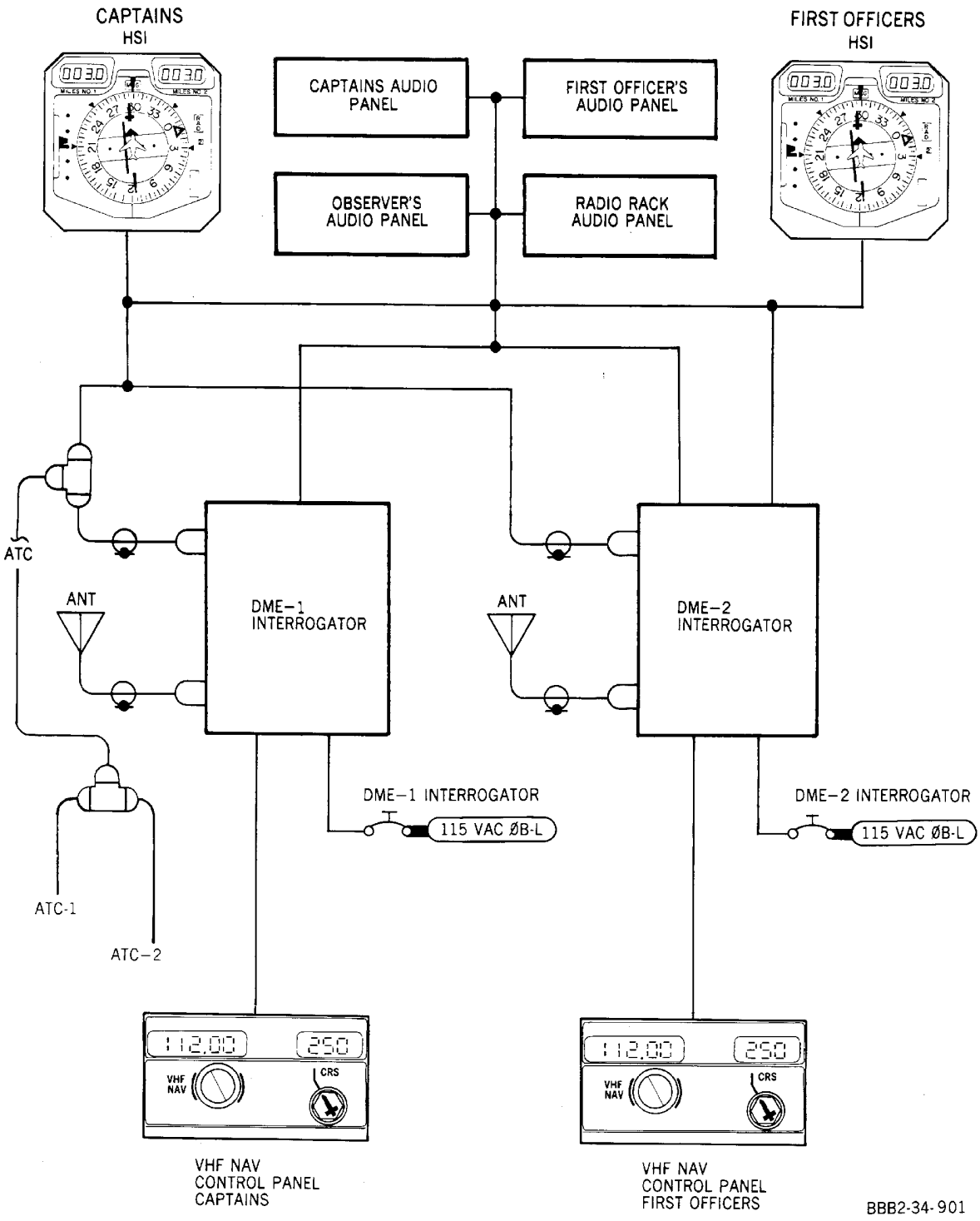
Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-802 (Sheet 1 of 4)



Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-802 (Sheet 2 of 4)



Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-802 (Sheet 3 of 4)



Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-802 (Sheet 4 of 4)

DISTANCE MEASURING SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The DME system measures the line-of-sight distance from the aircraft to a selected ground station, and provides a continuous decimal readout of that distance, in nautical miles, on the RDMI's. The system consists of two DME interrogators (Figure 1). Each interrogator has its own frequency tuning converter, antenna (located at the bottom of the fuselage), navigation control panel, and cockpit decimal readout indicator. A coax cable system connects the DME interrogators to the ATC systems (and TCAS when installed), to suppress operation during the transmit function.

B. A DME tuning converter is installed in the radio rack to provide an interface between each DME system and other aircraft systems. The tuning converter changes the tuning information from the NAV control panel to ARINC 429 digital format. The converter also accepts ARINC 429 tuning information from the Flight Management System, if installed.

C. The ground station, which must be within 350 nautical miles of the system, is automatically selected by tuning the VHF NAV control to its NAV paired frequency. The VHF NAV control is located on the VHF NAV control panel, adjacent to the Flight Guidance Control Panel.

D. The DME receiver-transmitter component supplies distance information to the pilots' DME indicators, and aural station identification signals to the audio panels of the flight interphone system.

E. The antenna is a vertically polarized, blade type unit, designed for L-band frequencies between 960 and 1220 megahertz. Two antennas are mounted on the lower fuselage centerline. The forward antenna is used with DME-1 system, the aft with DME-2.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

F. DME-1 and DME-2 distance is shown on the RDMI's and on the upper left and right corners of the EFIS ND's. If DME data is not present, the ND's and RDMI's will show dashes in place of the DME distance displays.

WJE 410

G. DME-1 and DME-2 distance is shown on the upper left and right corners of the EFIS ND's. If DME data is not present, the ND's will show dashes in place of the DME distance displays.

WJE 401-404, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

2. Operation

A. The DME transmits a pulse-pair signal on any one of 126 frequencies within the range of 1025 and 1150 MHz. These interrogation signals are received by the ground station assigned to the channel frequency selected on the VHF/NAV control panel. After a built-in delay of 50 microseconds, a reply pulse-pair is automatically transmitted from the ground station, on the assigned channel frequency. The reply pulse pair is offset by 63 MHz from the received signal.

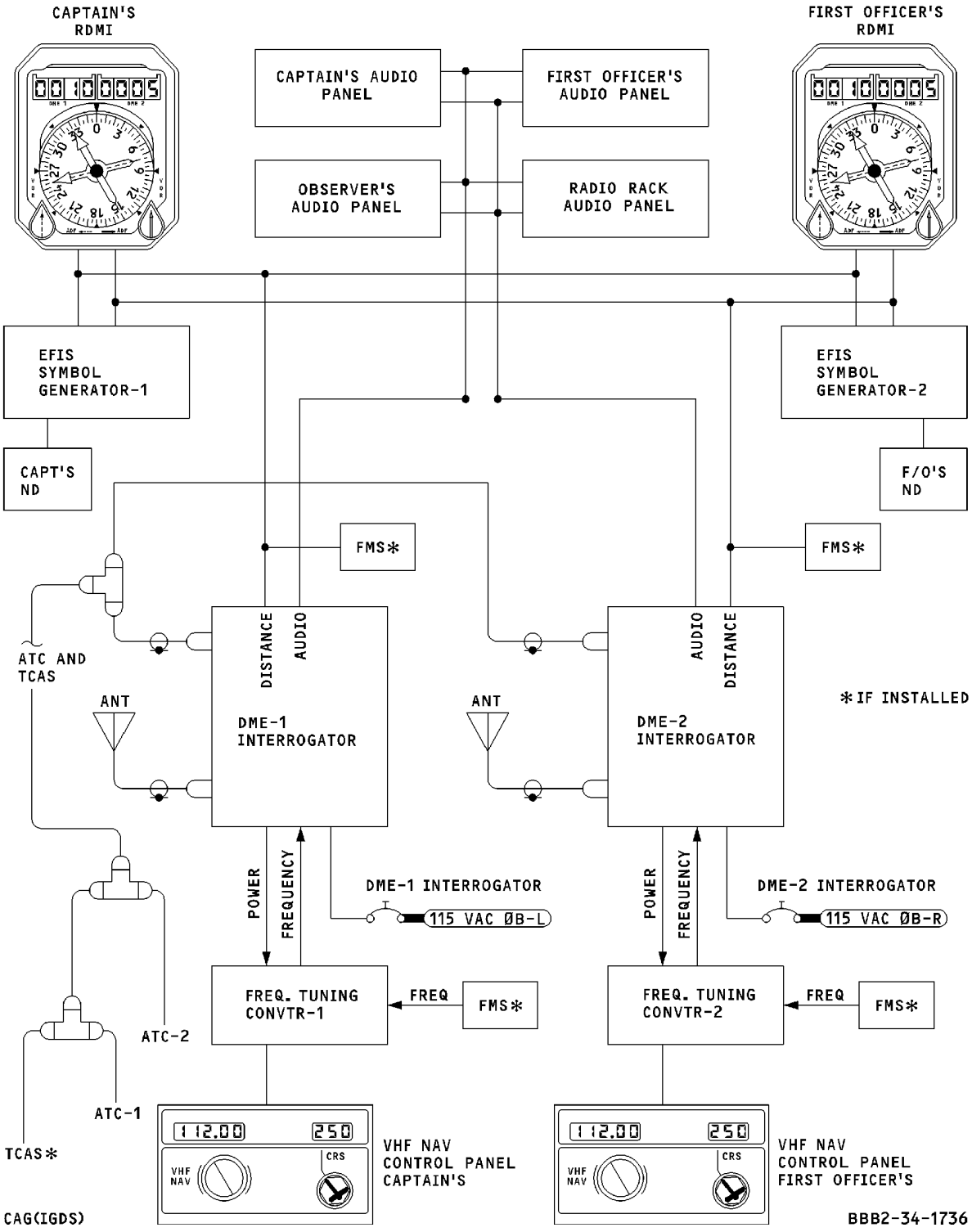
B. The response signals are processed by the DME to determine the precise amount of time that has elapsed between transmission of a pulse pair and reception of the response. The DME then computes the slant-range distance by subtracting the delay and dividing the results by 12.359 microseconds (time required for DME signal to travel to and return from a station that is one mile away). The distance is computed every time a pulse pair is transmitted, so that slant-range distance is updated 30 times a second.

C. There are two modes of DME operation: X-channel and Y-channel. The mode is determined by the hundredth MHz digit of the frequency selected. X-channel frequencies have a zero in the hundredths position (1nn.n0). Y-channel frequencies have a five (1nn.n5). Pulse pair transmissions for the X channel are spaced by 12 microseconds. Y-channel pulse pair transmissions are spaced by 36 microseconds. The pulse spacing of the ground station replay is 12 microseconds for X channels and 30 microseconds for Y channels. The repetition rate for all pulse pairs is 30 times a second.

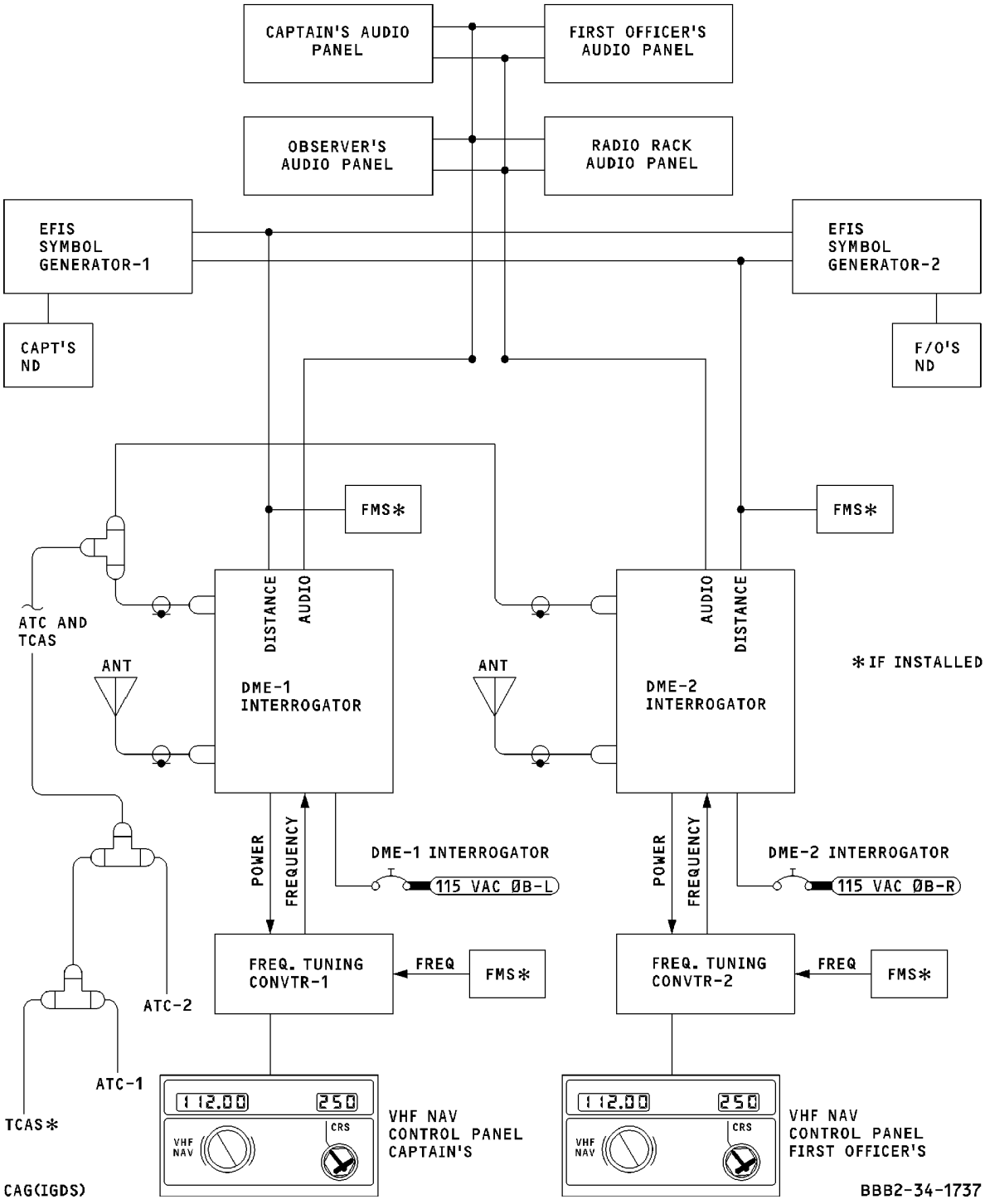
D. Each DME ground station periodically transmits an identification signal along with other data. This identification signal is decoded in the DME and applied to the aircraft audio system when operating in the single channel mode.

E. An operator-initiated self-test feature is included in the DME. The self-test routine is initiated by pressing the TEST pushbutton on the front panel of the unit, and is terminated by releasing the button. The test procedure checks the equipment by activating a 63 MHz oscillator; the test oscillator signal is modulated to produce a pulse pair signal. This signal is processed like a received signal. A malfunction is indicated by the illumination of the LRU-STATUS-FAIL light on the front panel following the lamp test sequence. The green LRU-STATUS-PASS light is illuminated if there is no fault, and if the CONTROL INPUT FAIL light is off. The DME failure warning flag will come into view and remain in view, the distance display will be inhibited, and the DME binary distance display will indicate 0 (+ 0.1) nm when there is a malfunction.

F. An automatic self-test feature is also built into the DME interrogator. This test is initiated automatically every five seconds. The results of the test are monitored and compared against the information stored in memory. Appropriate DME failure flags appears if a malfunction is indicated.



Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-805 (Sheet 1 of 2)



Distance Measuring Equipment -- Block Diagram
Figure 1/34-52-00-990-805 (Sheet 2 of 2)

DISTANCE MEASURING EQUIPMENT - DESCRIPTION AND OPERATION

1. General

A. The DME system measures the line-of-sight distance from the aircraft to a selected ground station and provides a continuous digital readout of that distance, in nautical miles. Dual systems are installed: DME-1 and DME-2. Each system consists of a DME (interrogator) and antenna. The VHF/NAV control panel, located on the upper instrument panel, is used for frequency control.

B. The DME interrogator is the receiver-transmitter component of the system. It supplies distance information to the EFIS symbol generators, to be processed for display on the navigation displays (ND). Aural station identification signals are sent to the audio panels of the flight interphone system.

C. The DME frequency is controlled by the VHF Nav control panel. When a VOR/ILS frequency is selected, the DME is channeled to the related DME frequency.

D. The antenna is a vertically polarized, blade type unit, designed for L-band frequencies between 960 and 1220 megahertz. Two antennas are mounted on the lower fuselage centerline. The forward antenna is used with DME-1 system, the aft with DME-2.

E. DME-1 and DME-2 distance readouts appear in each Captain's and First Officer's ND. DME readouts appear in the top left and right hand corners of the ND. In the absence of computed data, three dashes will replace the numerical display above the DME1/DME2 annunciations.

2. Operation

A. Whenever power is applied to the DME, the DME starts in the automatic standby or signal-controlled search (SCS) mode. In this mode, the DME transmitter is inhibited and the receiver is operative. The DME will remain in SCS mode until the receiver determines that the antenna is receiving more than 450 squitter pulse pairs per second (pp/s) from a ground station. When this occurs, the DME switches to its search mode.

B. In the search mode, the DME interrogates the ground station by transmitting pulse pairs. After each interrogation, the DME receiver searches the ground station signals for a reply pulse pair that is synchronous with the interrogation pulse pair. The receiver searches during the time a signal would be received from a ground station located between 0 and 200 nmi away. The range computer in the DME counts the time from the interrogation pulse pair to the decoded reply pulse that it locates, and stores this time.

C. Once the DME has located a decoded reply pulse, it waits until the next interrogation pulse pair is transmitted. It then counts out to the time at which the last decoded reply pulse was received and develops a range gate. Presence of a decoded reply pulse in the range gate means that, twice in a row, the DME has found a pulse located at the same time interval after the second interrogation pulse. When this occurs, the DME continues to develop a range gate at this same point in time for consecutive interrogation periods. Location of 7 decoded reply pulses in 15 consecutive interrogation periods is the criterion necessary for the DME to switch to its pretrack mode.

D. Development of the range gate, at 1 point in time for 15 consecutive interrogation periods, can be terminated. This termination will occur if the DME fails to find a decoded reply pulse during three consecutive interrogation periods. When a termination occurs, the DME begins to search outbound from the previous distance to 200 nmi, and then from 0 to 200 nmi, until it finds another decoded reply pulse. When another decoded reply pulse is found, the range gate is then developed at that period of time. This process continues until the DME finds a point in time at which 7 decoded reply pulses occur within 15 consecutive interrogation periods. The DME will then switch to pretrack mode.

E. In pretrack mode, the DME determines the relative velocity of the aircraft with respect to the ground station. This is accomplished, during the 4-second pretrack mode, by a velocity accumulator which fine-positions the range gate so that the reply pulses are centered within the range gate. The velocity accumulator determines both the direction of range gate movement, either inbound or outbound, and the slew rate of the range gate to track the reply pulses. During pretrack mode, the DME continues to interrogate the ground station and valid data is displayed.

F. After the 4-second pretrack mode, the DME switches to the track mode. There is a delay immediately following the pretrack mode before the distance shutter is lifted. The criterion for maintaining track is that the DME continues to find at least 7 synchronous decoded replies for every 15 interrogation periods. If that criterion is not satisfied, the DME will go into its memory code. Memory will last for 10-14 seconds if track criteria is not established, and will return to search if a 450 pp/s is not received within that period.

G. The nominal memory mode is entered when a temporary or permanent loss of reply signal occurs. During memory mode, the DME continues interrogations and the distance is displayed as if the station were still being tracked. If the signal is reacquired during memory mode, the DME returns to track mode. If the signal is lost for a length of time greater than memory, the DME changes back to the search mode.

H. If the received squitter rate falls below 450 pp/s when the DME is in search mode, the DME will revert to the SCS or automatic standby mode, the transmitter will then be inhibited, the receiver will be operational, and distance data will not be displayed.

DISTANCE MEASURING (DME) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty DME system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the DME system are: DME Indicators which are located in the Captain's and First Officer's Horizontal Situation Indicators (HSI's) DME Interrogators. The system interfaces with the audio panels and VHF Navigation control panel. For operation of the system, refer to SUBJECT 34-52-00, Page 201. In trouble shooting some checks may have to be made to these interfacing systems. Refer to applicable trouble shooting sections.

E. The DME components are located as follows:

Table 101

Component	Location
DME Indicators	Captain's and First Officer's Horizontal Situation Indicators
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891	
DME Indication on Navigation Displays (ND's) aircraft with EFIS	Captain's and First Officer's instrument panels
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893	
DME Interrogator	Electrical/Electronics compartment
Capt's and F/O's DME-1 and DME-2 Circuit Breakers	Upper EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes may be used in place of the following listed items:

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting DME System

A. Trouble Shoot

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 891

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Horizontal Situation Indicators (non-EFIS aircraft), DME Interrogators, Audio Panels and VHF NAV Control Panel.

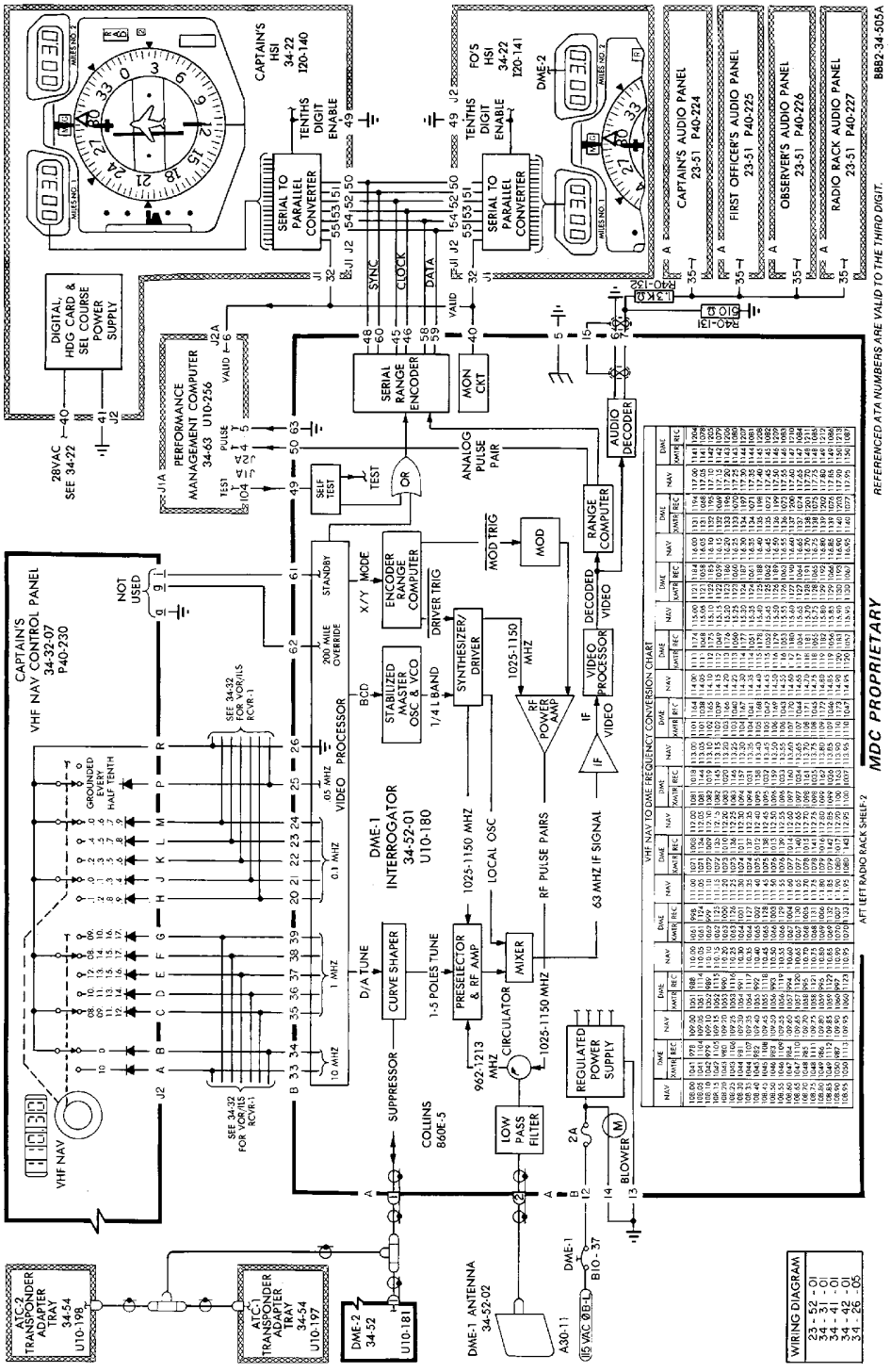
WJE 405, 409, 873, 874, 880, 881, 883, 884, 892, 893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Horizontal Situation Indicators, DME Interrogators, Audio Panels and VHF NAV Control Panel.

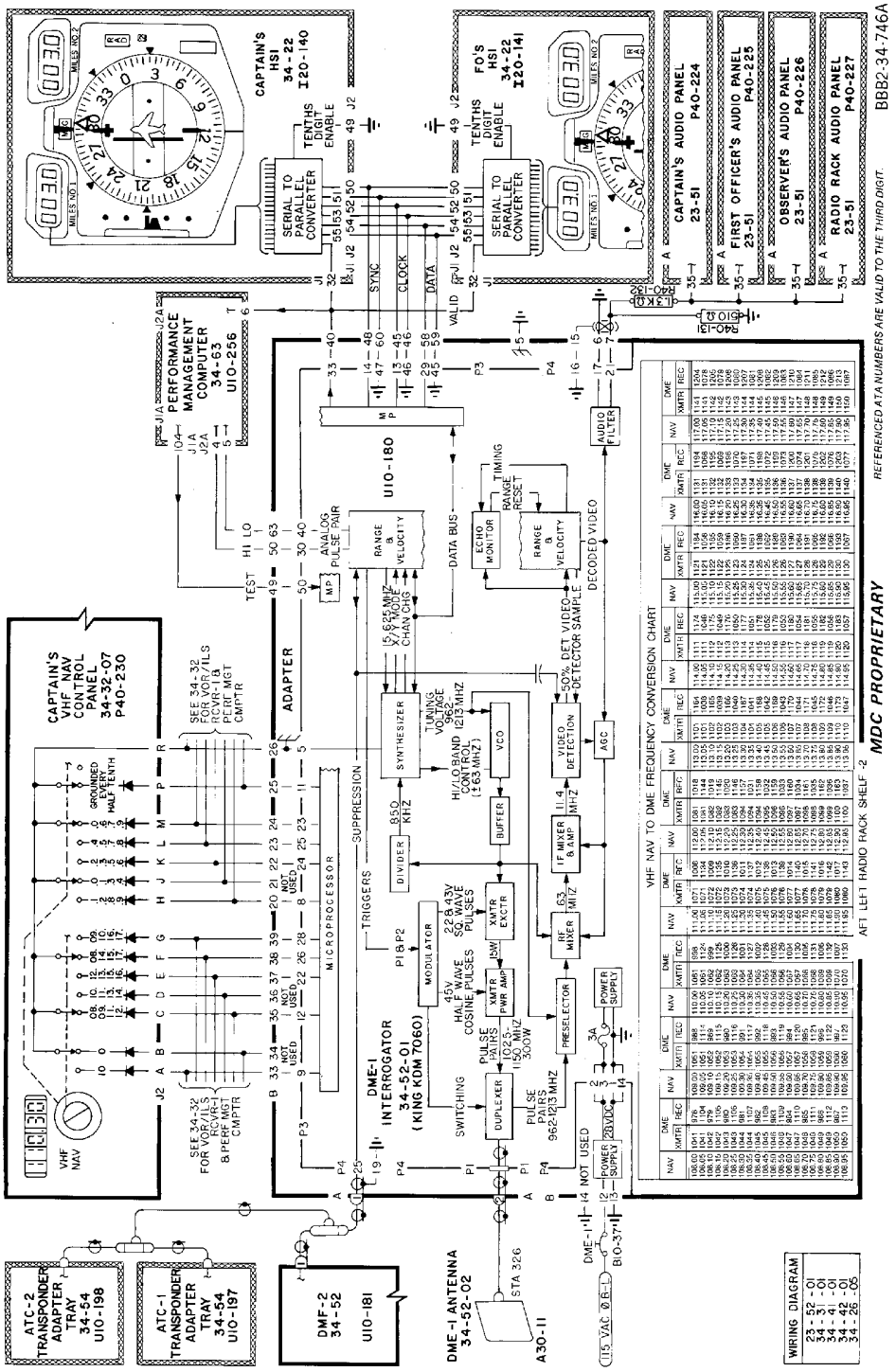
WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

Table 103

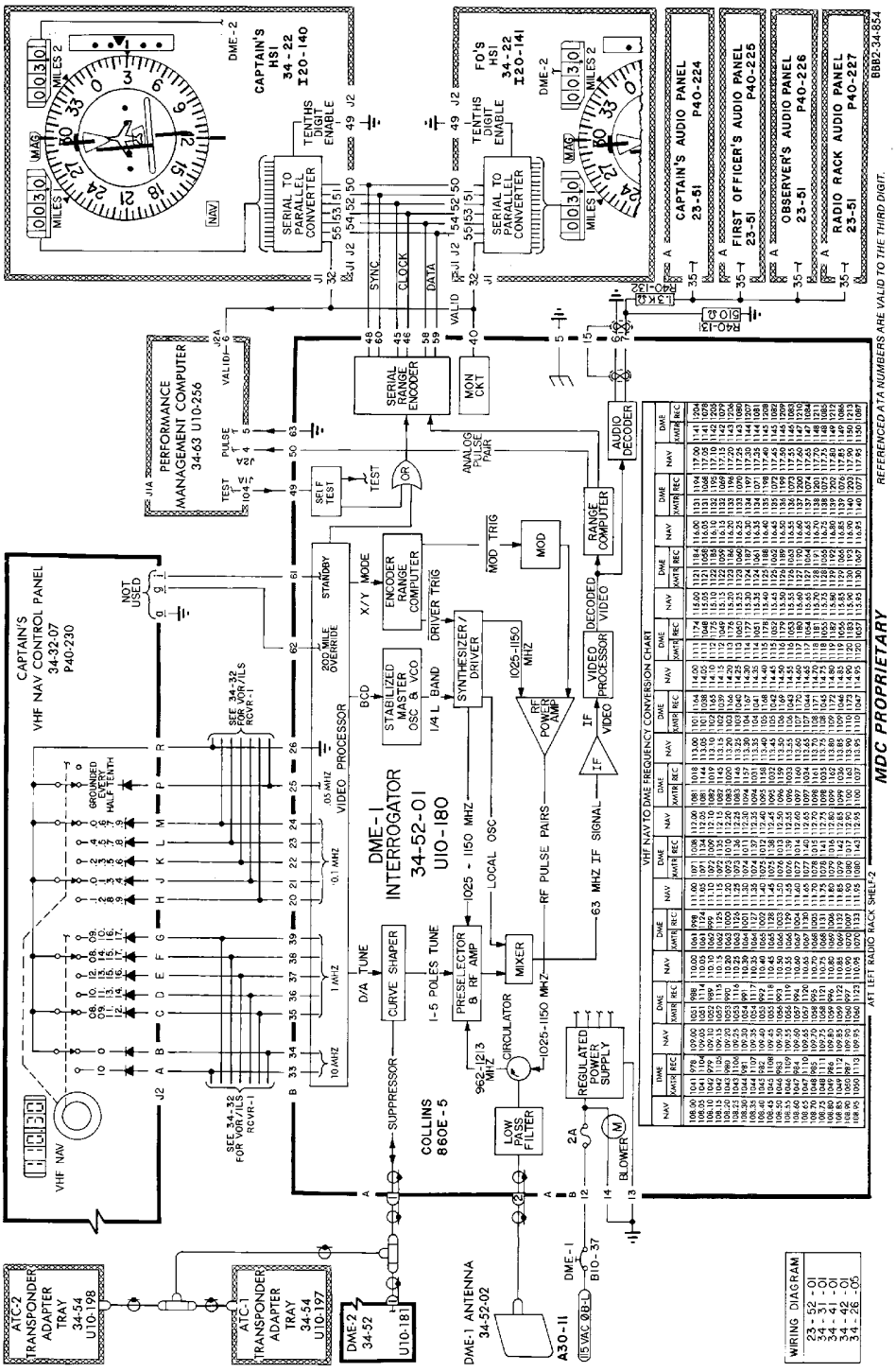
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.



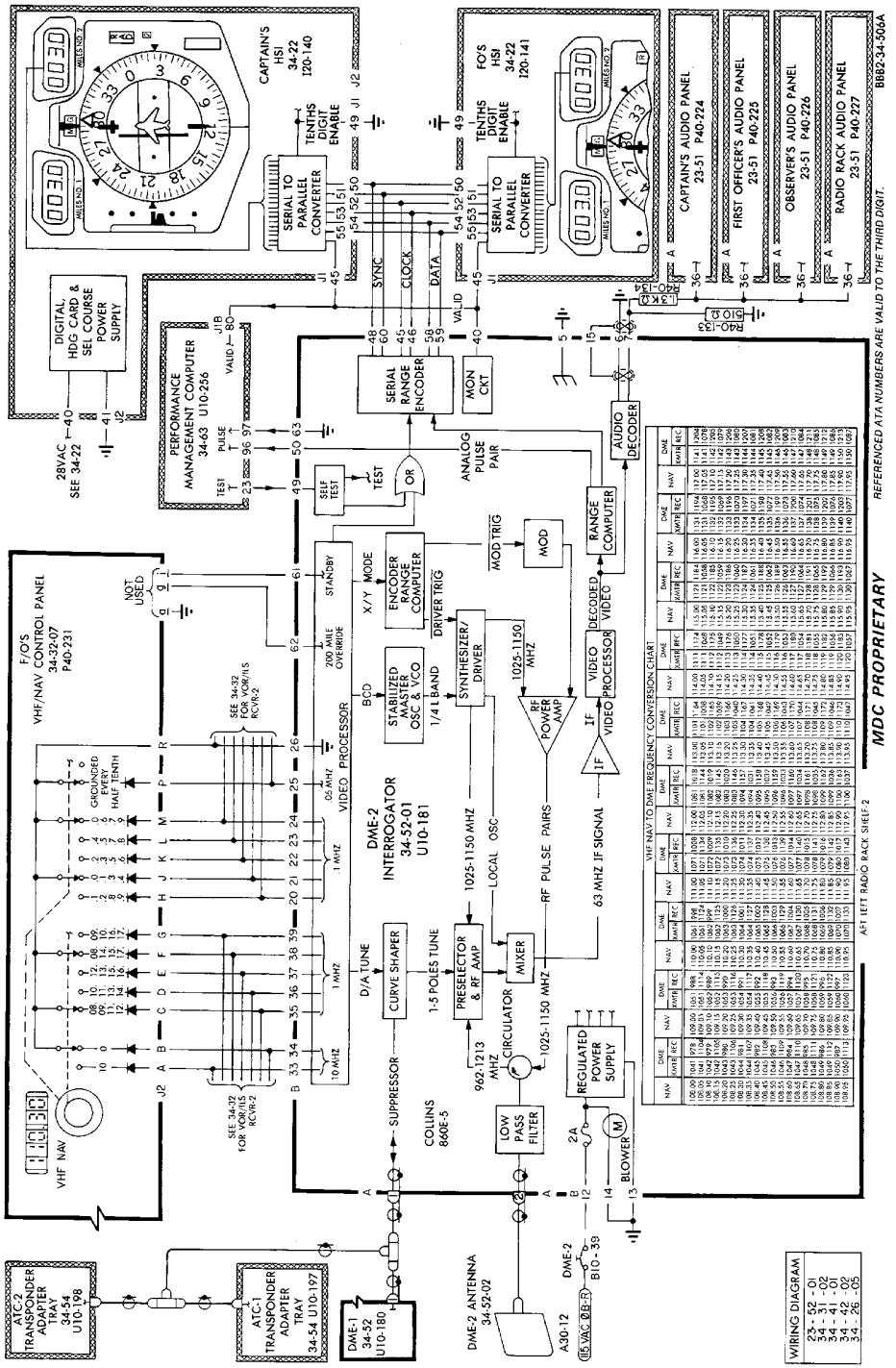
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-810 (Sheet 1 of 3)



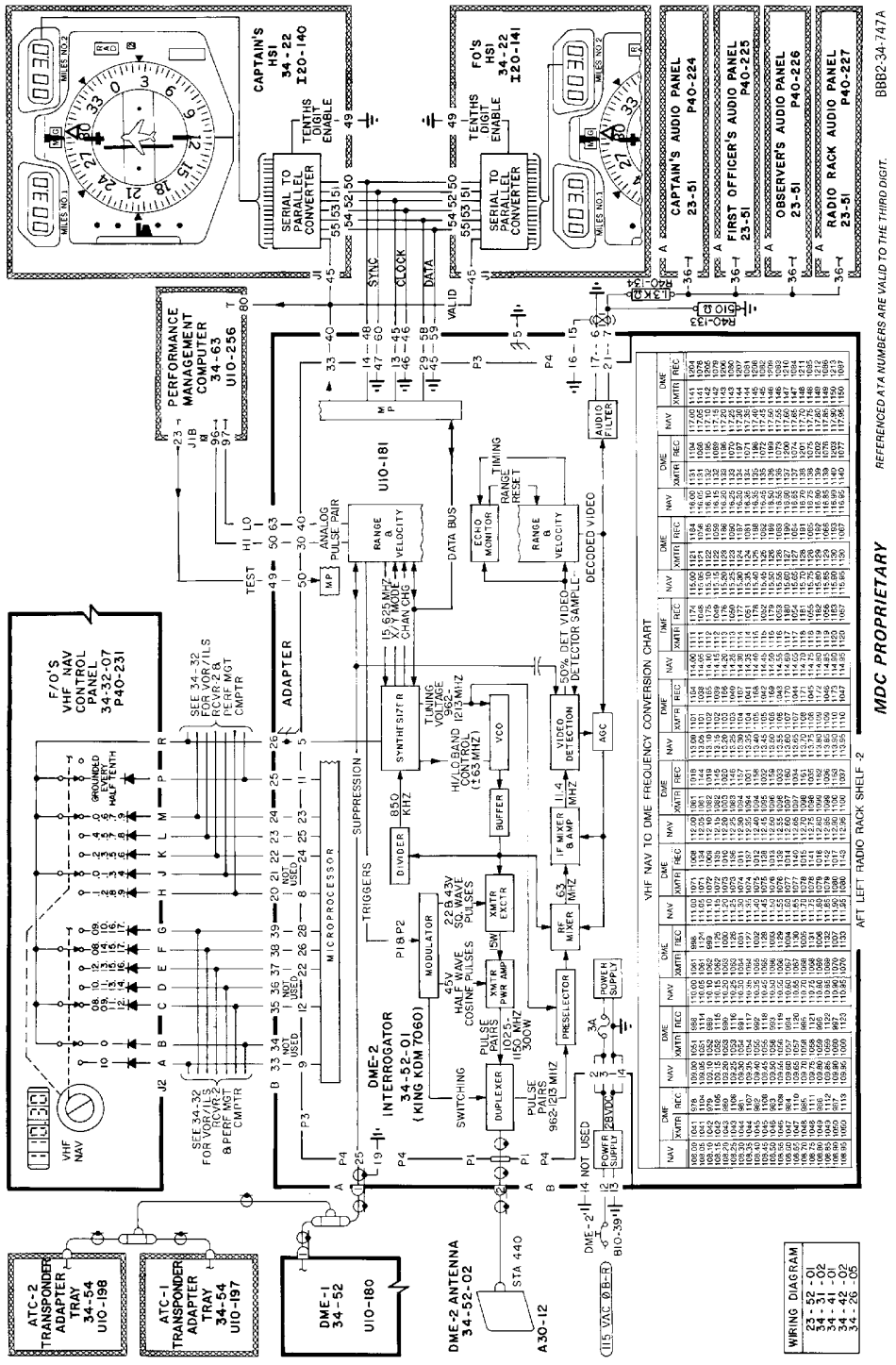
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-810 (Sheet 2 of 3)



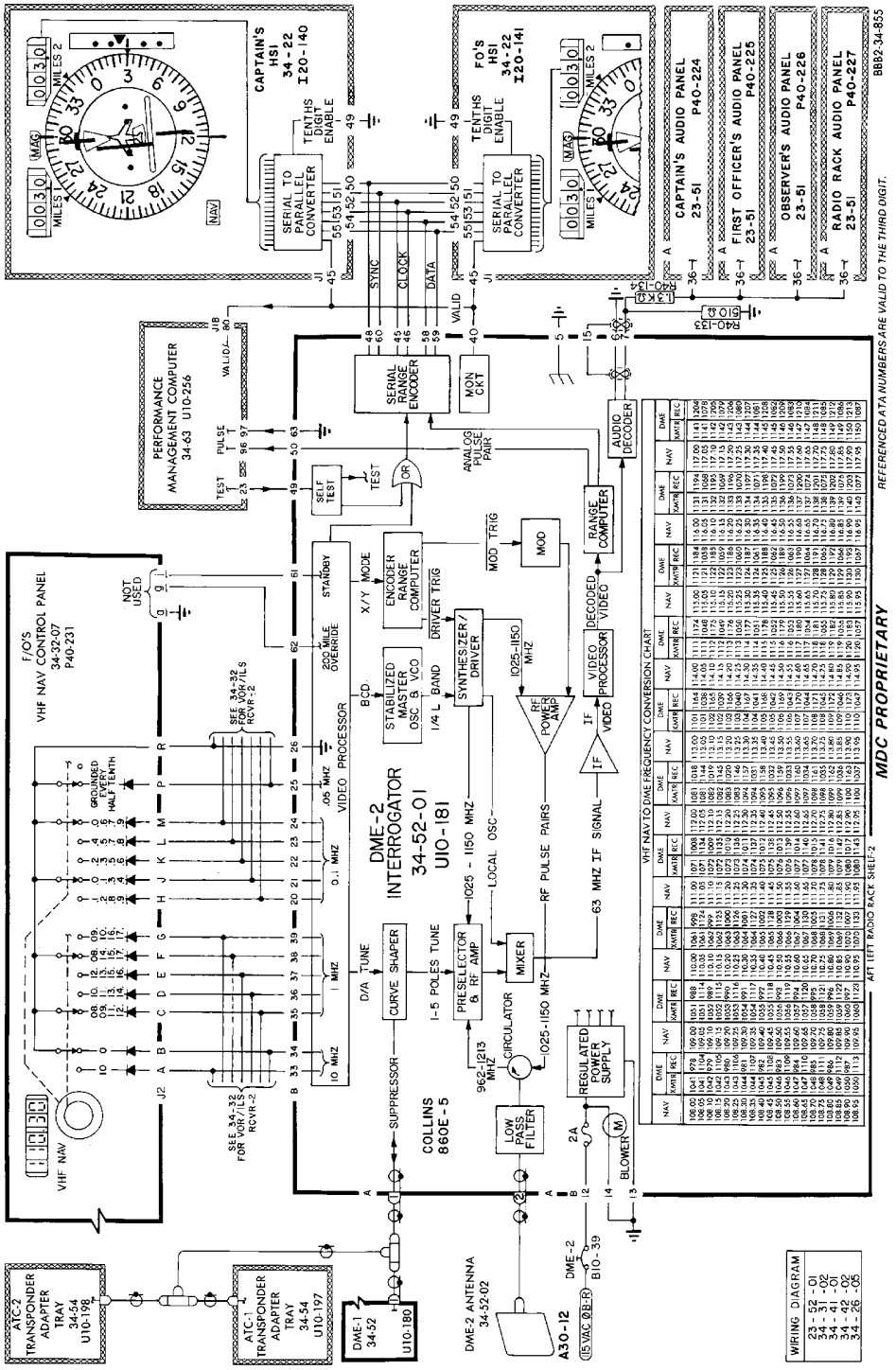
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-810 (Sheet 3 of 3)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-812 (Sheet 1 of 3)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-812 (Sheet 2 of 3)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-812 (Sheet 3 of 3)

EFFECTIVITY
WJE 405, 409, 880, 881, 883, 884, 892, 893

VHF NAV TO DME FREQUENCY CONVERSION CHART

NAV	DME		NAV	DME		NAV	DME		NAV	DME	
	XMTR	REC		XMTR	REC		XMTR	REC		XMTR	REC
108.00	1041	978	110.50	1066	1003	113.00	1101	1164	115.50	1126	1189
108.05	1041	1104	110.55	1066	1129	113.05	1101	1038	115.55	1126	1063
108.10	1042	979	110.60	1067	1004	113.10	1102	1165	115.60	1127	1190
108.15	1042	1105	110.65	1067	1130	113.15	1102	1039	115.65	1127	1064
108.20	1043	980	110.70	1068	1005	113.20	1103	1166	115.70	1128	1191
108.25	1043	1106	110.75	1068	1131	113.25	1103	1040	115.75	1128	1065
108.30	1044	981	110.80	1069	1006	113.30	1104	1167	115.80	1129	1192
108.35	1044	1107	110.85	1069	1132	113.35	1104	1041	115.85	1129	1066
108.40	1045	982	110.90	1070	1007	113.40	1105	1168	115.90	1130	1193
108.45	1045	1108	110.95	1070	1133	113.45	1105	1042	115.95	1130	1067
108.50	1046	983	111.00	1071	1008	113.50	1106	1169	116.00	1131	1194
108.55	1046	1109	111.05	1071	1134	113.55	1106	1043	116.05	1131	1068
108.60	1047	984	111.10	1072	1009	113.60	1107	1170	116.10	1132	1195
108.65	1047	1110	111.15	1072	1135	113.65	1107	1044	116.15	1132	1069
108.70	1048	985	111.20	1073	1010	113.70	1108	1171	116.20	1133	1196
108.75	1048	1111	111.25	1073	1136	113.75	1108	1045	116.25	1133	1070
108.80	1049	986	111.30	1074	1011	113.80	1109	1172	116.30	1134	1197
108.85	1049	1112	111.35	1074	1137	113.85	1109	1046	116.35	1134	1071
108.90	1050	987	111.40	1075	1012	113.90	1110	1173	116.40	1135	1198
108.95	1050	1113	111.45	1075	1138	113.95	1110	1047	116.45	1135	1072
109.00	1051	988	111.50	1076	1013	114.00	1111	1174	116.50	1136	1199
109.05	1051	1114	111.55	1076	1139	114.05	1111	1048	116.55	1136	1073
109.10	1052	989	111.60	1077	1014	114.10	1112	1175	116.60	1137	1200
109.15	1052	1115	111.65	1077	1140	114.15	1112	1049	116.65	1137	1074
109.20	1053	990	111.70	1078	1015	114.20	1113	1176	116.70	1138	1201
109.25	1053	1116	111.75	1078	1141	114.25	1113	1050	116.75	1138	1075
109.30	1054	991	111.80	1079	1016	114.30	1114	1177	116.80	1139	1202
109.35	1054	1117	111.85	1079	1142	114.35	1114	1051	116.85	1139	1076
109.40	1055	992	111.90	1080	1017	114.40	1115	1178	116.90	1140	1203
109.45	1055	1118	111.95	1080	1143	114.45	1115	1052	116.95	1140	1077
109.50	1056	993	112.00	1081	1018	114.50	1116	1179	117.00	1141	1204
109.55	1056	1119	112.05	1081	1144	114.55	1116	1053	117.05	1141	1078
109.60	1057	994	112.10	1082	1019	114.60	1117	1180	117.10	1142	1205
109.65	1057	1120	112.15	1082	1145	114.65	1117	1054	117.15	1142	1079
109.70	1058	995	112.20	1083	1020	114.70	1118	1181	117.20	1143	1206
109.75	1058	1121	112.25	1083	1146	114.75	1118	1055	117.25	1143	1080
109.80	1059	996	112.30	1094	1157	114.80	1119	1182	117.30	1144	1207
109.85	1059	1122	112.35	1094	1031	114.85	1119	1056	117.35	1144	1081
109.90	1060	997	112.40	1095	1158	114.90	1120	1183	117.40	1145	1208
109.95	1060	1123	112.45	1095	1032	114.95	1120	1057	117.45	1145	1082
110.00	1061	998	112.50	1096	1159	115.00	1121	1184	117.50	1146	1209
110.05	1061	1124	112.55	1096	1033	115.05	1121	1058	117.55	1146	1083
110.10	1062	999	112.60	1097	1160	115.10	1122	1185	117.60	1147	1210
110.15	1062	1125	112.65	1097	1034	115.15	1122	1059	117.65	1147	1084
110.20	1063	1000	112.70	1098	1161	115.20	1123	1186	117.70	1148	1211
110.25	1063	1126	112.75	1098	1035	115.25	1123	1060	117.75	1148	1085
110.30	1064	1001	112.80	1099	1162	115.30	1124	1187	117.80	1149	1212
110.35	1064	1127	112.85	1099	1036	115.35	1124	1061	117.85	1149	1086
110.40	1065	1002	112.90	1100	1163	115.40	1125	1188	117.90	1150	1213
110.45	1065	1128	112.95	1100	1037	115.45	1125	1062	117.95	1150	1087

BBB2-34-545

VHF NAV to DME Frequency Conversion Chart
Figure 103/34-52-00-990-814

DISTANCE MEASURING (DME) SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty DME system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 406-408, 410, 411

D. The major components of the DME system are: DME display on the Captain's and First Officer's EFIS Navigation Displays (ND), DME Interrogators, and DME tuning converters. The system interfaces with the audio panels and VHF Navigation control panel. For operation of the system, refer to SUBJECT 34-52-00, Page 201. In trouble shooting, some checks may have to be made to these interfacing systems. Refer to applicable trouble shooting sections.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

E. The major components of the DME system are: DME Indicators which are located in the Captain's and First Officer's Radio Direction Magnetic Indicators (RDMI), DME Interrogators, and DME tuning converters. The system interfaces with the audio panels and VHF Navigation control panel. For operation of the system, refer to SUBJECT 34-52-00, Page 201. In trouble shooting some checks may have to be made to these interfacing systems. Refer to applicable trouble shooting sections.

WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

F. The DME components are located as follows:

Table 101

Component	Location
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872	
DME Indicators (if installed)	Captain's and First Officer's Radio Direction Magnetic Indicators (RDMI)
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
DME Indicators	Captain's and First Officer's Radio Direction Magnetic Indicators (RDMI)
WJE 406-408, 410, 411	
DME Displays on Navigation Displays	Captain's and First Officer's Instrument Panels
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
EFIS Navigation Displays	Captain's and First Officer's instrument panels
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
DME Interrogator	Electrical/Electronics compartment
DME Tuning Coverters	Electrical/Electronics compartment
Capt's and F/O's DME-1 and DME-2 Circuit Breakers	Upper EPC Circuit Breaker Panel

2. Equipment and Materials

NOTE: Equivalent substitutes may be used in place of the following listed items:

Table 102

Name and Number	Manufacturer
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
Multimeter 2000A	Dana
WJE 406-408, 410, 411	
Multimeter Model 8025A	Fluke
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	

3. Trouble Shooting DME System

A. Trouble Shoot

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are Radio Direction Magnetic Indicators (RDMI) (if installed), DME Interrogators, DME Tuning Converters, Audio Panels and VHF NAV Control Panel.

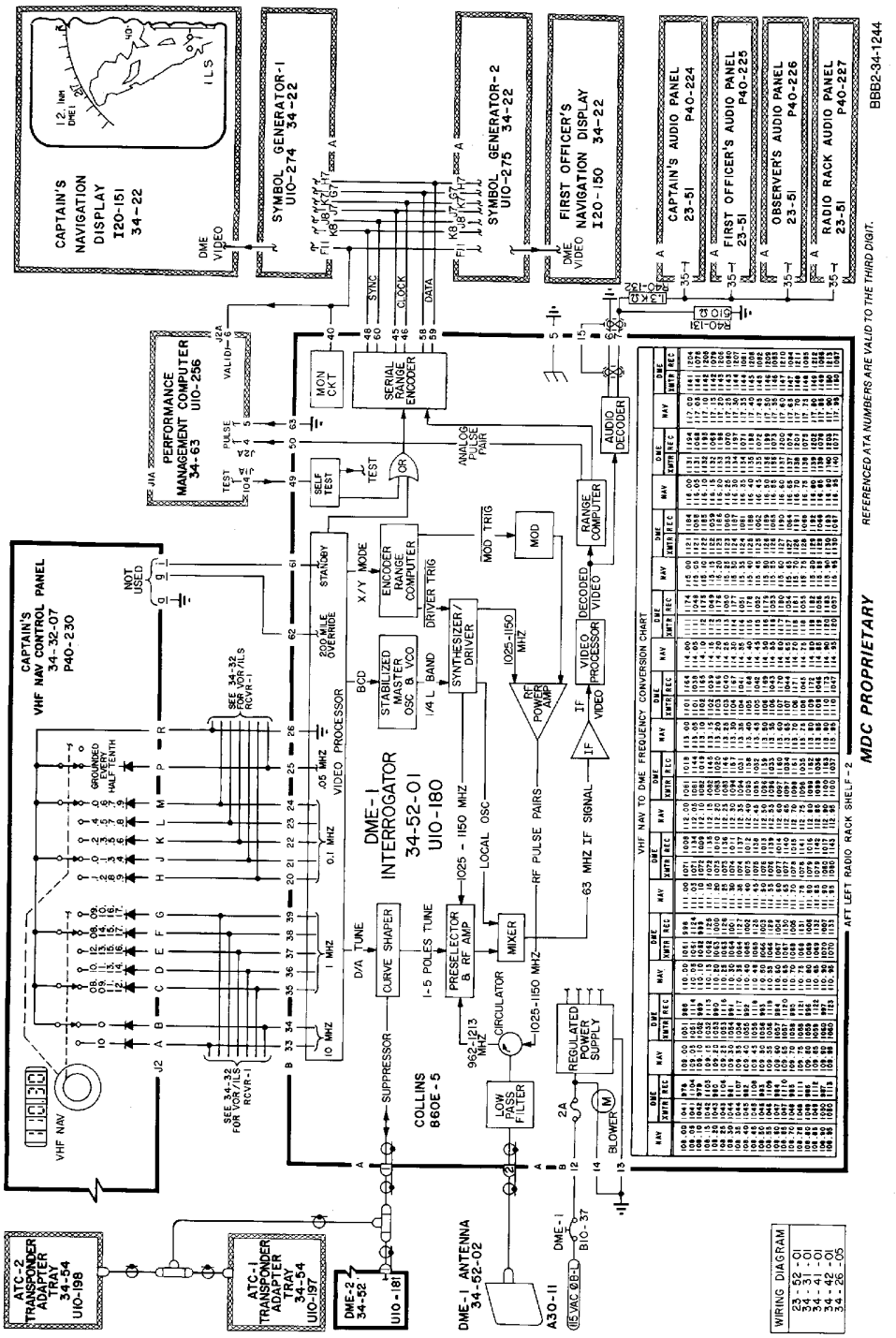
WJE 406-408, 410, 411

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRU's are EFIS symbol generators and Navigation Displays, DME Interrogators, DME Tuning Converters, Audio Panels, and VHF NAV Control Panel.

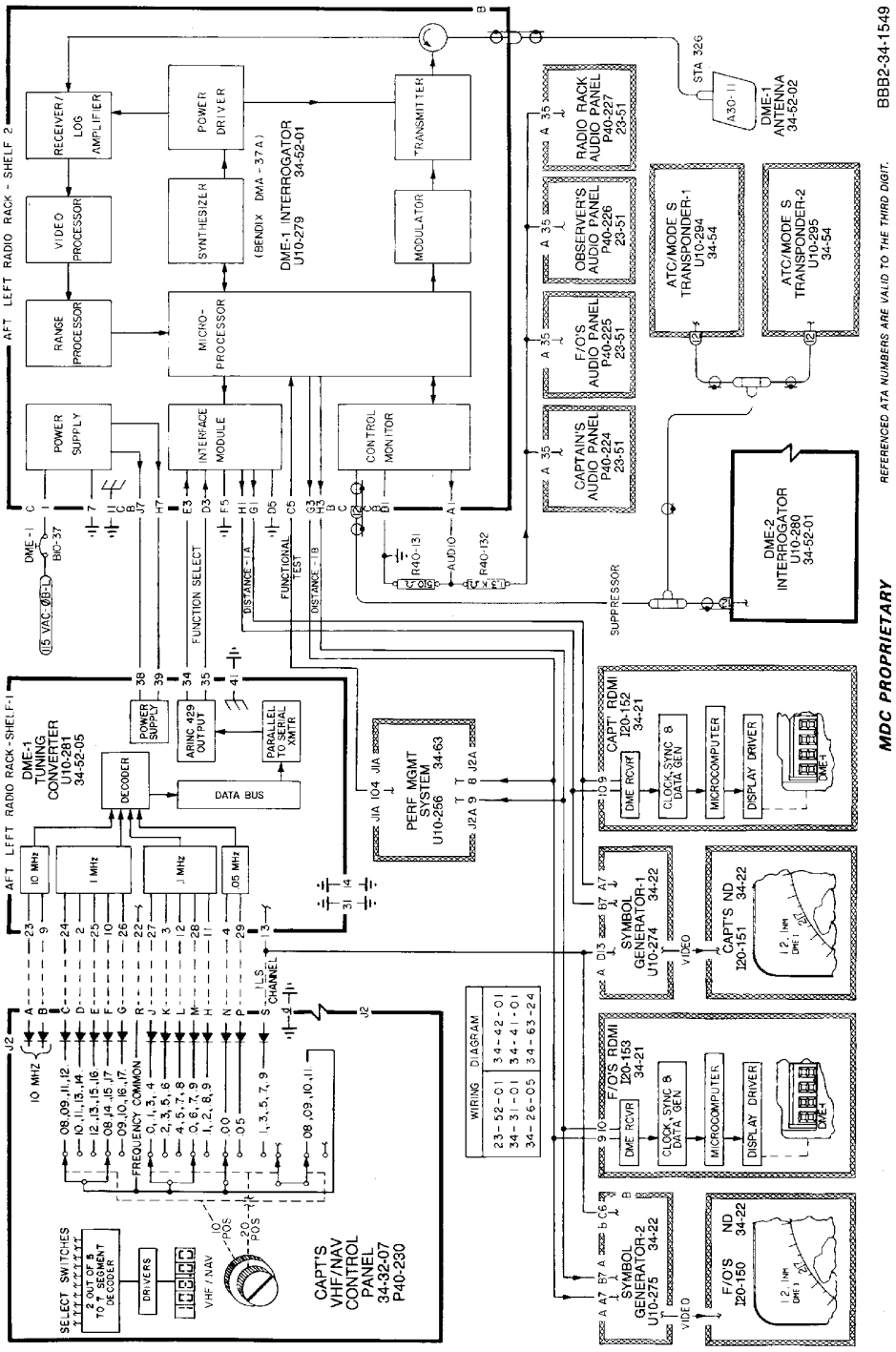
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

Table 103

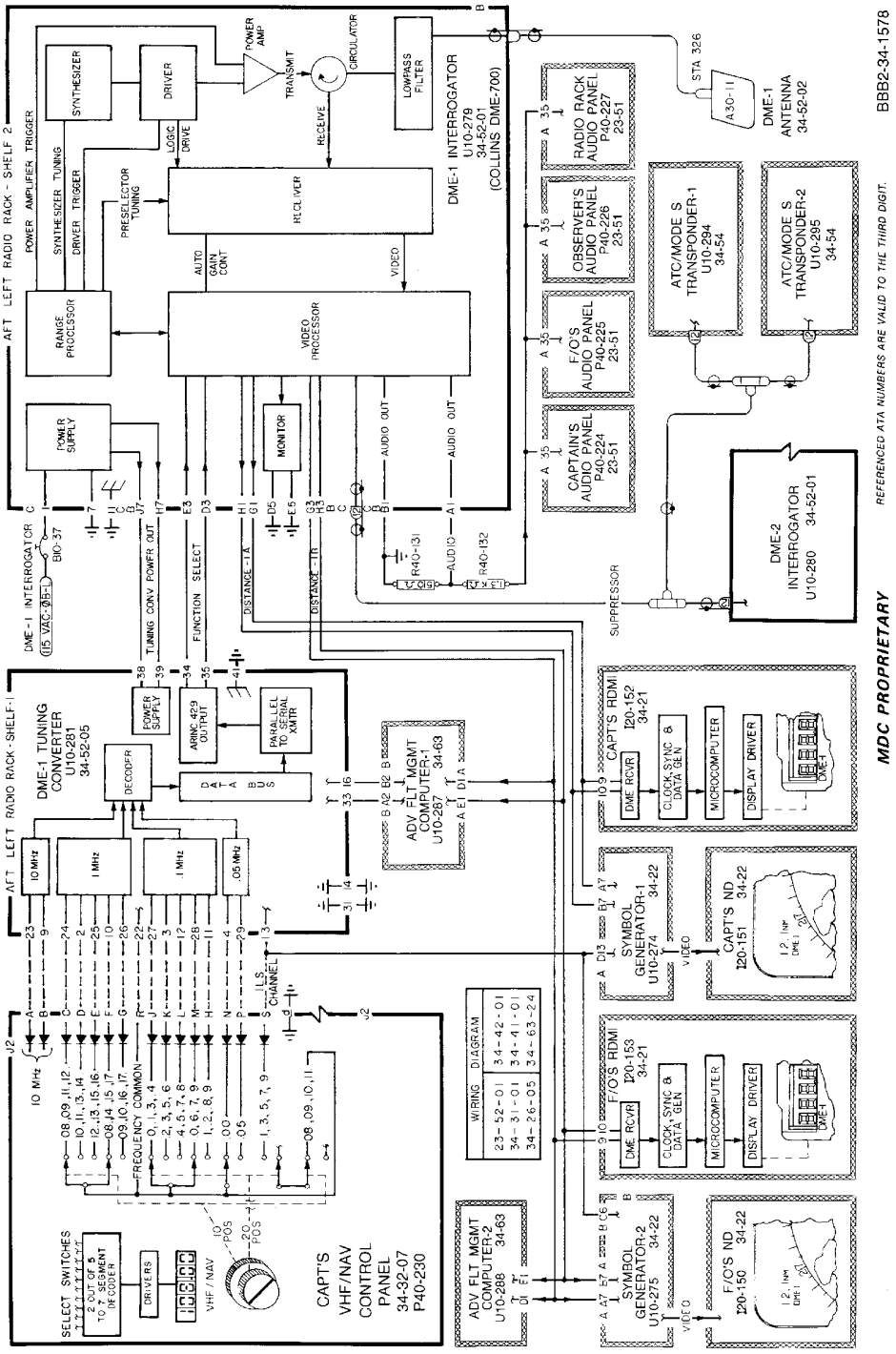
Procedure		Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. Hot continuity check may be required to check operation of relays or other associated actuation components to complete continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	In dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5)	Replace suspected faulty LRUs or component with known operational unit.	Replace faulty LRUs or components.



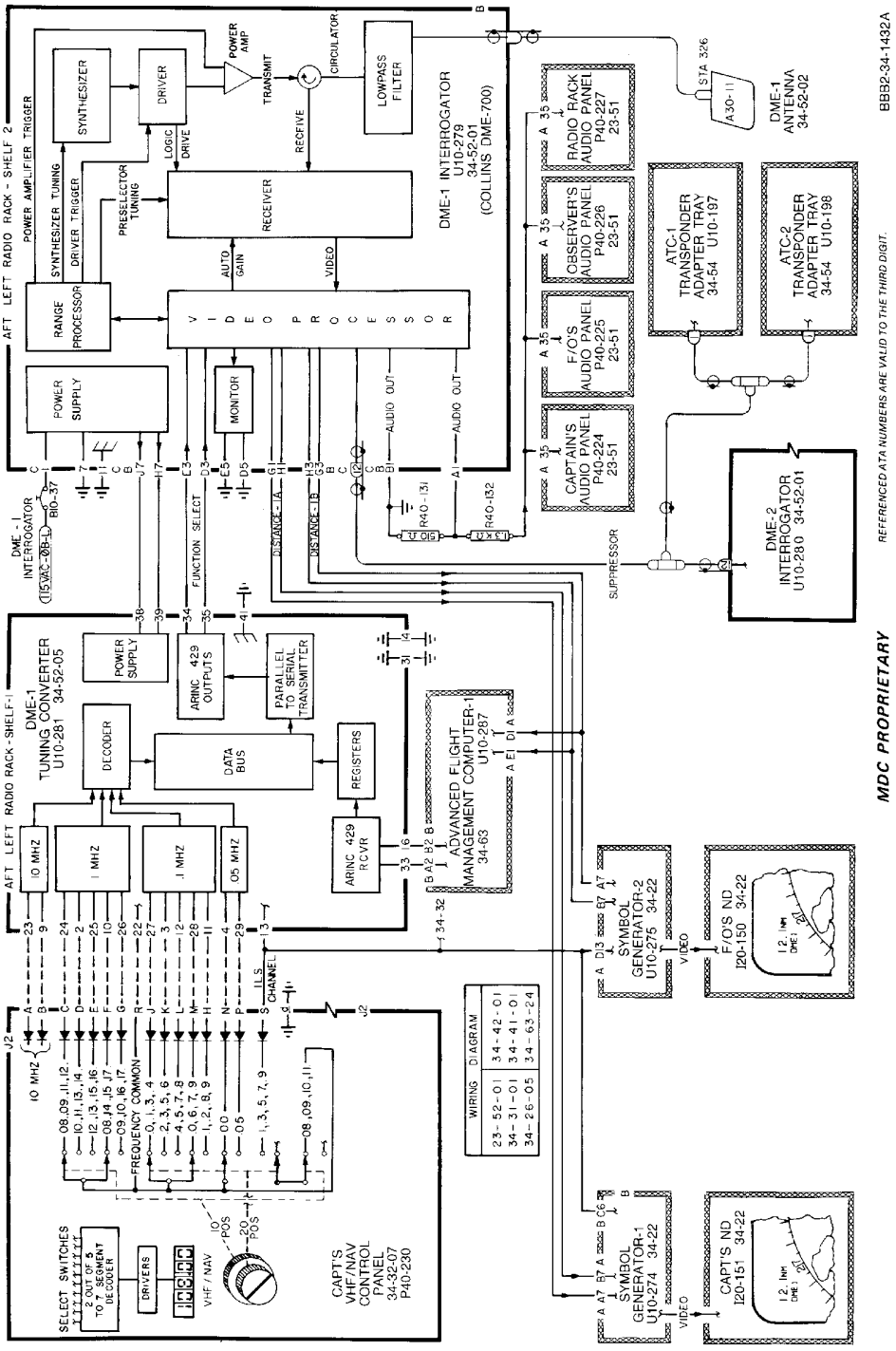
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-818 (Sheet 1 of 4)



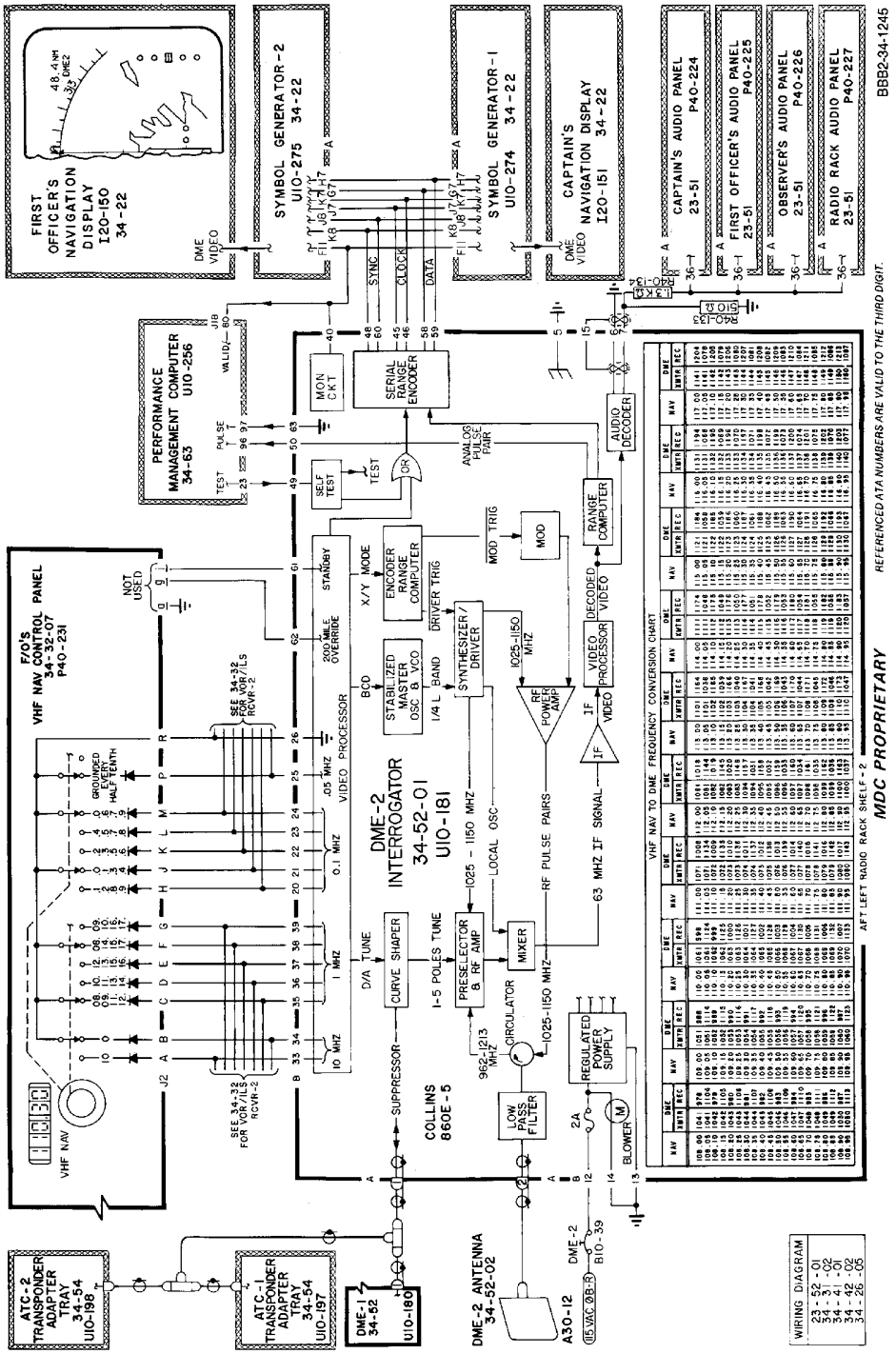
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-818 (Sheet 2 of 4)



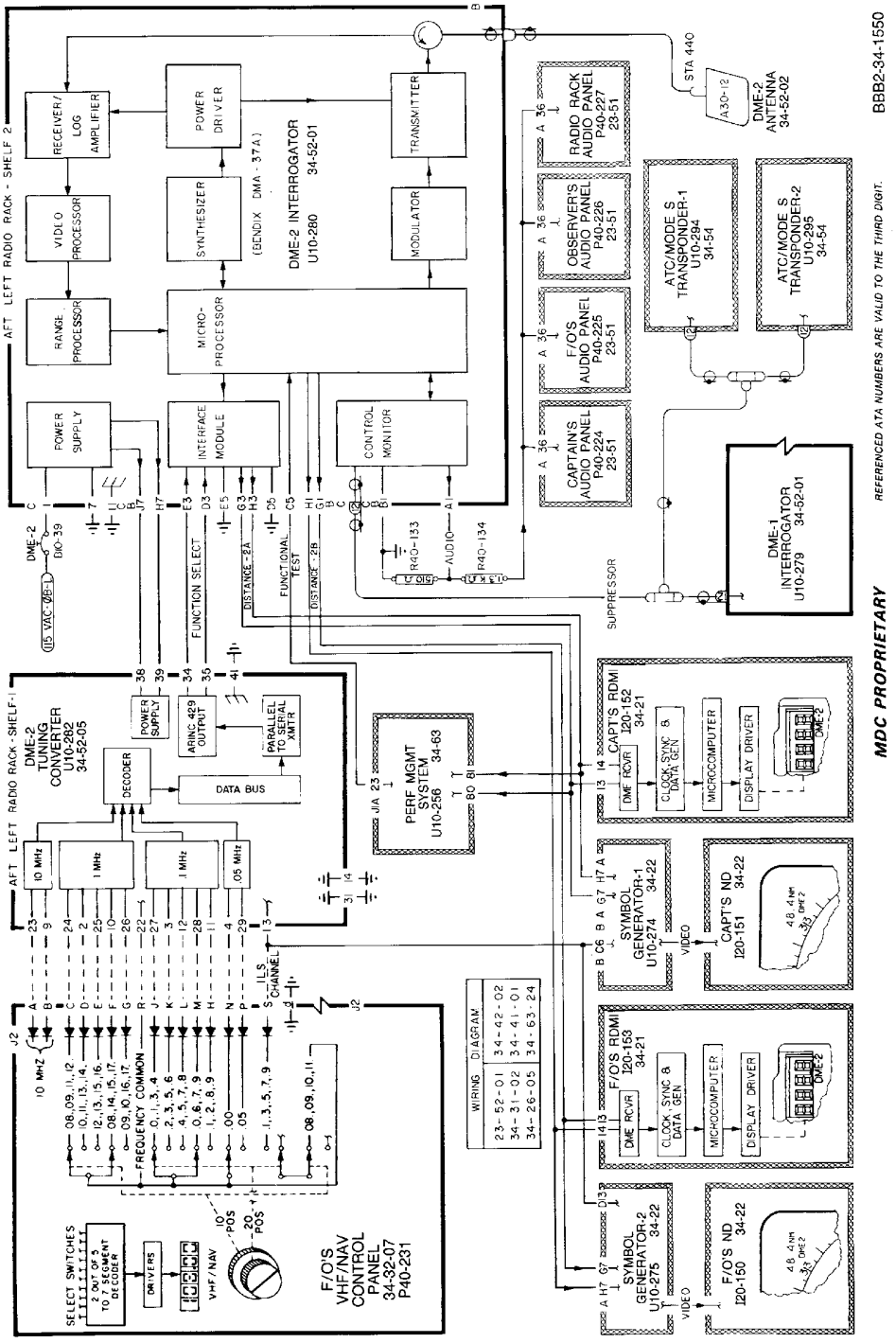
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-818 (Sheet 3 of 4)



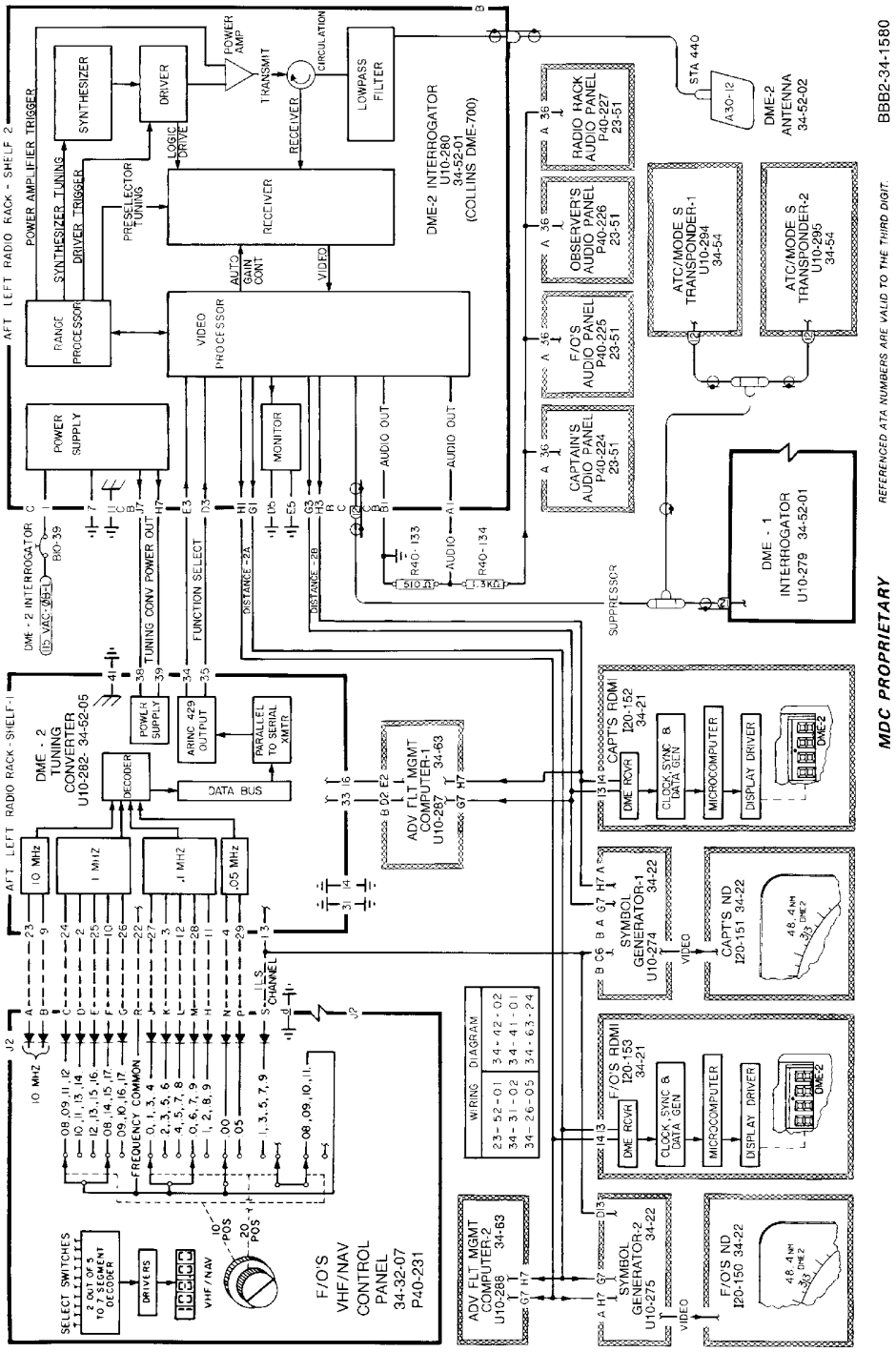
Distance Measuring-1 System - Schematic
Figure 101/34-52-00-990-818 (Sheet 4 of 4)



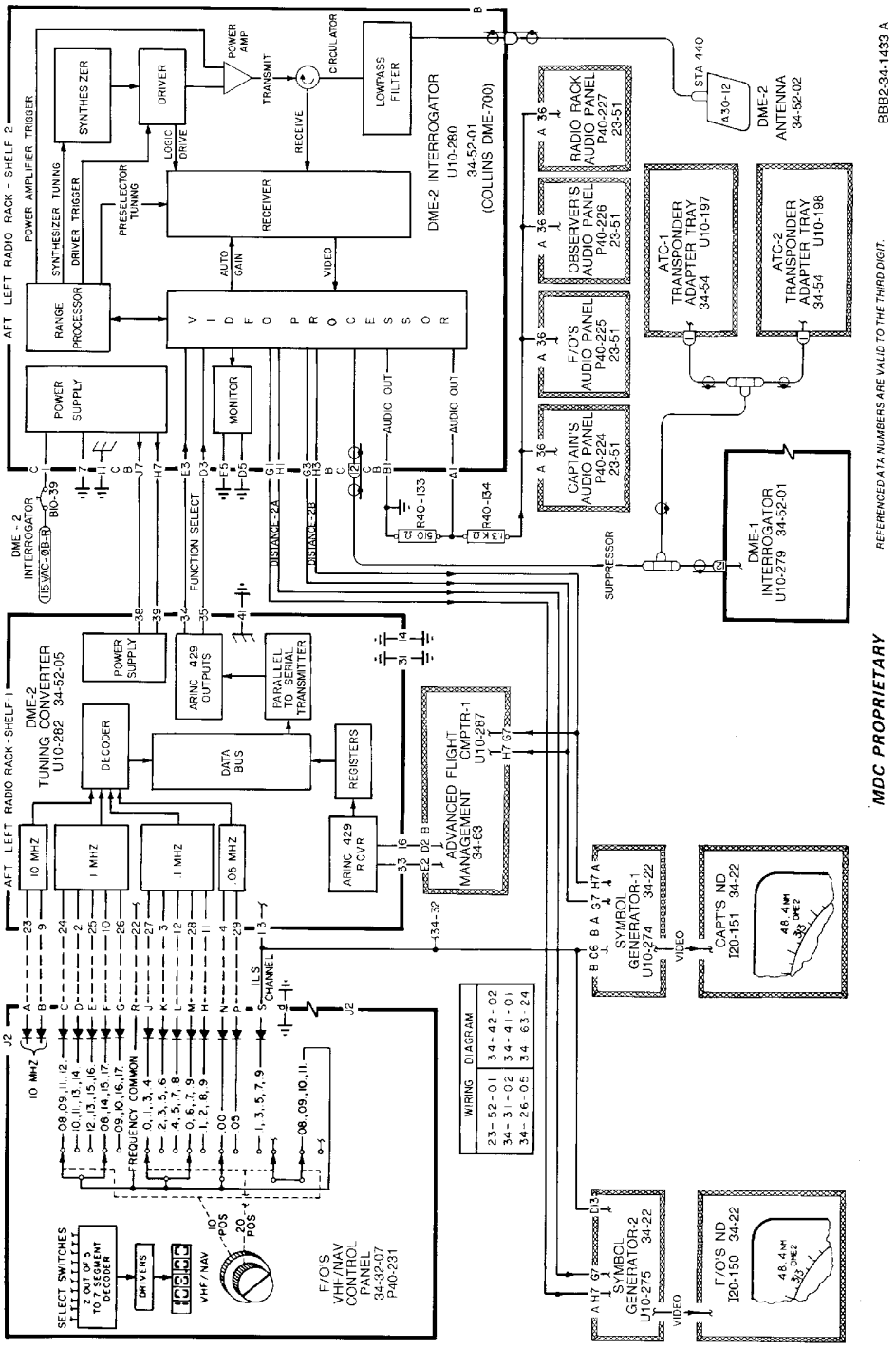
Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-819 (Sheet 1 of 4)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-819 (Sheet 2 of 4)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-819 (Sheet 3 of 4)



Distance Measuring-2 System - Schematic
Figure 102/34-52-00-990-819 (Sheet 4 of 4)

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for Distance Measuring Equipment (DME) 1 and DME 2 systems are similar. The DME 1 and 2 systems are controlled from the VHF NAV control panel located on the glareshield. DME-1 system provides DME-1 readout to the Captain's and First Officer's instruments. DME-2 provides DME-2 readout to the Captain's and First Officer's instruments.

B. Test procedures are provided for use with Collins 475D-1 test set. (Paragraph 3.)

C. Additional test procedures are provided for use with TIC T-24A or T-24B test sets.

D. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
DME ramp test set 475D-1	Collins Radio Company
DME Ramp Test Set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset 710HB or H3370 or 720HB or equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment

NOTE: Test Set 475D-1

A. Setup Test Equipment

NOTE: Test set should include one short-range crystal to cover channels 17 through 56.

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so self-contained antenna is visible from aircraft DME antenna.

(3) Place FUNCTION SELECT to BATT position. Test set meter should indicate in BAT. OK portion or scale. If not, recharge self-contained batteries before proceeding with test.

(4) Turn FUNCTION SELECTOR to RF OUT position.

NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Collins 475-1). Set test set frequency on the NAV control panel.

(5) Adjust RF OUTPUT control for a red line meter indication.

(6) Turn FUNCTION SELECTOR to 5 MI position.

(7) Press SELF-TEST button. Meter should indicate in 5 MI portion of scale.

(8) Turn FUNCTION SELECTOR to 180 MI position.

(9) Press SELF-TEST button. Meter should indicate in 180 MI portion of scale.

(10) Turn FUNCTION SELECTOR to 5 - 180 position. Depress SELF-TEST button. Meter should indicate 5 MI. Release and depress SELF-TEST button, meter should indicate 180 MI after about 8 seconds. Release and depress again. After eight seconds, meter needle should return to 5 MI position.

(11) Turn FUNCTION SELECTOR to 5 MI position.

(12) Set T/R ATTEN DB control to 15.

NOTE: The T/R ATTEN DB control may be set to another position to obtain normal DME operation. In addition, test set may be moved closer to aircraft to obtain normal DME operation.

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Captain's and First Officer's Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Captain's NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Collins 475-1). Set test set frequency on the NAV control panel.		
(4)	Place VOICE-IDENT switch, located on Captain's audio control panels, to IDENT position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6)	If tuned to local DME station over one mile.	DME's should indicate miles to station.
(7)	If local DME station is not available perform following steps:	
(8)	Place Test Set Function Selector in 5 MI position.	DME No. 1 on the captain's and first officer's indicator should lock on at 5(±0.2) miles.
(9)	Place FUNCTION SELECTOR, on Test Set, in 180/270 MI position, and Range Switch in the 180 position.	After approximately 10 seconds DME No. 1 on captain's and first officer's indicators should indicate 180(±1) miles.
NOTE: If 475D-1 Test Set S/N is above No. 135 or is below No. 135 and has had Collins Service Bulletin No. 1 incorporated, step (9) will read as follows: With FUNCTION SELECTOR switch in 180-mile position, the unit simulates tracking inbound approximately 173 miles and outbound approximately 187 miles.		
(10)	Place Test Set RANGE switch in 270 position.	After approximately 10 seconds DME No. 1 on captain's and first officer's indicators should indicate a series of dashes.
(11)	Place Test Set Function Selector in the 5MI position.	DME No. 1 on captain's and first officer's indicator should lock on at 5(±0.2) miles.
(12)	The following adjustment to the DME Interrogator is authorized upon experiencing audio bleed through: Adjust audio output levels for 2.3 volts RMS ± 10% across a 600 ohm load using a VTVM or equivalent voltmeter. Refer to the appropriate equipment overhaul manual for detailed instructions of how to perform the adjustment.	

Table 202 (Continued)

Operation		Desired Results
(13)	Remove test equipment if used.	
(14)	Return aircraft to required configuration.	

Table 203 VOR/ILS Frequency and DME Channel Number

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
17	108.0	37	110.0
18	108.1	38	110.1
19	108.2	39	110.2
20	108.3	40	110.3
21	108.4	41	110.4
22	108.5	42	110.5
23	108.6	43	110.6
24	108.7	44	110.7
25	108.8	45	110.8
26	108.9	46	110.9
27	109.0	47	111.0
28	109.1	48	111.1
29	109.2	49	111.2
30	109.3	50	111.3
31	109.4	51	111.4
32	109.5	52	111.5
33	109.6	53	111.6
34	109.7	54	111.7
35	109.8	55	111.8
36	109.9	56	111.9
		57	112.0

4. Adjustment/Test Distance Measuring Equipment (Test Set T-24A or T-24B)

A. A. Setup Test Equipment

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so that self-contained antenna is visible from aircraft DME antenna.

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries, or operate unit from 115 VAC line.

(4) Set test set controls as follows:

Distance-NMI	004.0 NMI	
EFF	100%	
Function	Distance	(OUT)
Normal	ON	(IN)
Echo	OFF	(OUT)
Squitter	2700	(OUT)
Freq	108.00	(OUT)
Meter	150	(OUT)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 204

Operation		Desired Results
(1)	Plug headset into headset jack at Capt's and F.O.'s stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to local DME station using NAV frequency selector on Capt's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Tel-Instruments T-24A or T-24B). Set test set frequency on the VHF/NAV control panel.		
(4)	Place VOICE/IDENT switch, located on Capt's audio control panels, in IDENT position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6)	If tuned to local DME station over one mile.	DME readout should indicate miles to station.
(7)	If local DME station not available perform following steps.	
(8)	Place Test Set DISTANCE- N.M. selectors in 4.0 mi position.	DME No. 1 on Captain's and First Officer's indicator should lock on at 4.0(±0.2) miles.
(9)	Place DISTANCE-N.M. selectors on Test Set, in 190.0 mi. position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's indicators should read 190.0(±0.2) miles.
(10)	Place DISTANCE-N.M. selectors on Test Set in 290.0 mi. position.	After approximately 10 seconds DME No. 1 on Captain's and First Officer's indicators should show a series of dashes.
(11)	Place DISTANCE-N.M. selectors on Test Set in 4.0 mi. position.	DME No. 1 on the Captain's and First Officer's indicators should lock on at 4.0(±0.2) miles.
(12)	Remove test equipment if used.	
(13)	Return aircraft to required configuration.	

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for DME 1 and DME 2 systems are similar. The DME 1 and 2 systems are controlled from the VHF NAV control panel located on the glareshield. DME-1 system provides DME-1 readout to the Captain's and First Officer's instruments. DME-2 provides DME-2 readout to the Captain's and First Officer's instruments.

B. Test procedures are provided for use with Collins 475D-1 test set (Paragraph 3.). Additional test procedures are provided for use with TIC T-24A or T-24B test sets (Paragraph 4.).

C. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
DME ramp test set 475D-1 (as required) or DME Ramp Test Set T-24A, T-24B or T-48D	Collins Radio Company Tel-Instrument Electronics Corp.
Headset 710HB or H3370 or 720HB or equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment (Test Set 475D-1)

A. Setup Test Equipment (as required, see Paragraph 3.B. step (3))

NOTE: Test set should include one short-range crystal to cover channels 17 through 56.

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so self-contained antenna is visible from aircraft DME antenna.

(3) Place FUNCTION SELECT to BATT position. Test set meter should indicate in BAT. OK portion or scale. If not, recharge self-contained batteries before proceeding with test.

(4) Turn FUNCTION SELECTOR to RF OUT position.

NOTE: For requirement of test set setup, refer to Paragraph 3.B., step (3), NOTE.

(5) Adjust RF OUTPUT control for a red line meter indication.

(6) Turn FUNCTION SELECTOR to 5 MI position.

(7) Press SELF-TEST button. Meter should indicate in 5 MI portion of scale.

(8) Turn FUNCTION SELECTOR to 180 MI position.

(9) Press SELF-TEST button. Meter should indicate in 180 MI portion of scale.

(10) Turn FUNCTION SELECTOR to 5 - 180 position. Depress SELF-TEST button. Meter should indicate 5 MI. Release and depress SELF-TEST button, meter should indicate 180 MI after about 8 seconds. Release and depress again. After eight seconds, meter needle should return to 5 MI position.

(11) Turn FUNCTION SELECTOR to 5 MI position.

(12) Set T/R ATTEN DB control to 15.

NOTE: The T/R ATTEN DB control may be set to another position to obtain normal DME operation. In addition, test set may be moved closer to aircraft to obtain normal DME operation.

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Captain's and First Officer's Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Captain's NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Collins 475D-1). Set test set frequency on the NAV control panel.		
(4)	Place VOICE/IDENT switch, located on Captain's audio control panels, to IDENT position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6)	If tuned to local DME station over one mile.	DME's should indicate miles to station.
(7)	If local DME station is not available, perform following steps:	
(8)	Place Test Set Function Selector in 5 MI position.	DME No. 1 on the Captain's and First Officer's indicator should lock on at 5(±0.2) miles.
(9)	Place FUNCTION SELECTOR on Test Set, in 180/270 MI position, and Range Switch in the 180 position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's indicators should indicate 180(±1) miles.
NOTE: If 475D-1 Test Set S/N is above No. 135 or is below No. 135 and has had Collins Service Bulletin No. 1 incorporated, step (6) will read as follows: With FUNCTION SELECTOR switch in 180-mile position, the unit simulates tracking inbound approximately 173 miles and outbound approximately 187 miles.		

Table 202 (Continued)

Operation		Desired Results
(10)	Place Test Set RANGE switch in 270 position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's indicators should indicate a series of dashes.
(11)	Place Test Set Function Selector in the 5 MI position.	DME No. 1 on Captain's and First Officer's indicator should lock on at 5(±0.2) miles.
(12)	The following adjustment to the VOR/ILS receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ± 10% across a 600 ohm load using a VTVM or equivalent voltmeter. Refer to the appropriate equipment overhaul manual for detailed instructions of how to perform the adjustment.	
(13)	Remove test equipment if used.	
(14)	Return aircraft to required configuration.	

Table 203 VOR/ILS Frequency and DME Channel Number

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
17	108.0	37	110.0
18	108.1	38	110.1
19	108.2	39	110.2
20	108.3	40	110.3
21	108.4	41	110.4
22	108.5	42	110.5
23	108.6	43	110.6
24	108.7	44	110.7
25	108.8	45	110.8
26	108.9	46	110.9
27	109.0	47	111.0
28	109.1	48	111.1
29	109.2	49	111.2
30	109.3	50	111.3
31	109.4	51	111.4
32	109.5	52	111.5
33	109.6	53	111.6
34	109.7	54	111.7
35	109.8	55	111.8
36	109.9	56	111.9
		57	112.0

4. **Adjustment/Test Distance Measuring Equipment (Test Set T-24A or T-24B)**

A. Setup Test Equipment (as required, see Paragraph 4.B. step (3))

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so that self-contained antenna is visible from aircraft DME antenna.

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries, or operate unit from 115 VAC line.

(4) Set test set controls as follows:

Distance-NMI	004.0 NMI	
EFF	100%	
Function	Distance	(OUT)
Normal	ON	(IN)
Echo	OFF	(OUT)
Squitter	2700	(OUT)
Freq	108.00	(OUT)
Meter	150	(OUT)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 204

Operation	Desired Results
(1) Plug headset into headset jack at Capt's and F.O.'s stations.	
(2) Allow DME interrogator to warm up at least one minute.	
(3) Channel interrogator to local DME station using NAV frequency selector on Capt's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Tel-Instruments T-24A or T-24B). Set test set frequency on the VHF/NAV control panel.	
(4) Place VOICE/IDENT switch, located on Capt's audio control panels, in IDENT position.	
(5) Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6) If tuned to local DME station over one mile.	DME readout should indicate miles to station.

Table 204 (Continued)

Operation		Desired Results
(7)	If local DME station is not available, perform following steps.	
(8)	Place Test Set DISTANCE-N.M. selectors in 4.0 mi position.	DME No. 1 on Captain's and First Officer's indicator should lock on at 4.0(±0.2) miles.
(9)	Place DISTANCE-N.M. selectors on Test Set, in 190.0 mi. position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's indicators should read 190.0(±0.2) miles.
(10)	Place DISTANCE-N.M. selectors on Test Set in 290.0 mi. position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's indicators should show a series of dashes.
(11)	Place DISTANCE-N.M. selectors on Test Set in 4.0 mi. position.	DME No. 1 on the Captain's and First Officer's indicators should lock on at 4.0(±0.2) miles.
(12)	Remove test equipment if used.	
(13)	Return aircraft to required configuration.	

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for DME 1 and DME 2 systems are similar. The DME 1 and 2 systems are controlled from the VHF NAV control panel located on the glareshield.

B. DME-1 system provides "DME1" readout on the Captain's and First Officer's EFIS Navigation Displays. DME-2 provides "DME2" readout to the Captain's and First Officer's EFIS Navigation Displays. DME is also displayed on the Capt's and F/O's Radio Distance Magnetic Indicators (RDMI's).

C. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
DME Ramp Test Set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset 710HB or H3370 or 720HB or equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment

A. Setup Test Equipment (as required, see Paragraph 3.B.)

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so self-contained antenna is visible from aircraft DME antenna.

WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries, or operate unit from 115 VAC line.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(4) Set test set controls as follows:

DISTANCE-N.M.	004.0 n.mi	
EFF	100%	
FUNCTION	DISTANCE	(OUT)
NORMAL	ON	(IN)
ECHO	OFF	(OUT)
SQUITTER	2700	(OUT)
FREQ	108.00	(OUT)
METER	150	(DOWN)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Captain's and First Officer's Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Captain's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set, T-24A, T-24B, or T-48D (Paragraph 3. for test equipment setup). Set test set frequency on the NAV control panel to 108.0 MHz.		
WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(4)	Place VOICE-IDENT switch, located on Capt's audio control panels, to IDENT position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(6)	Place MODE selector on EFIS Mode Select Panels in ROSE position.	ROSE mode display appears on both EFIS Navigation Displays (ND).
WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(7)	If tuned to local DME station over one mile.	DME1 display on Capt's/F.O.'s EFIS ND should indicate miles to station.
NOTE: DME will also be displayed on Capt's/F./O.'s Radio Distance Magnetic Indicators (RDMI's).		
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(8)	If local DME station is not available perform steps (9) through (12):	
(9)	Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 display on upper left corner of Capt's and F.O.'s EFIS ND's should show 4(±0.2) miles. (DME2 display will appear in upper right corner of ND.) ILS annunciators should appear on both Capt's and F/O's ND's.
WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(10)	Set Test Set DISTANCE-N.M. selectors to 190.0.	After approximately 10 seconds DME1 on Capt's and F.O.'s ND's should indicate 190(±0.2) miles.
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(11)	Set Test Set DISTANCE-N.M. selectors to 405.0.	After approximately 10 seconds both ND's should show three dashes.
WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(12)	Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 on the Capt's and F.O.'s ND's should show 4(±0.2) miles.

WJE 401-404, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879 (Continued)

Table 202 (Continued)

Operation		Desired Results
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879		
(13)	Remove test equipment if used.	
(14)	Return aircraft to required configuration.	

Table 203 DME Self Test

Operation		Desired Results
(1)	On RADIO NAV test panel, press and hold DME-1 TEST switch.	DME1 on Capt's and F.O.'s ND's show three dashes.
(2)	Release DME-1 TEST switch.	DME1 display blanks.
(3)	On RADIO NAV test panel, press and hold DME-2 TEST switch.	DME2 on Capt's and F.O.'s ND's show three dashes.
(4)	Release DME-2 TEST switch.	DME2 display blanks.
(5)	Return aircraft to required configuration.	

Table 204 VOR/ILS Frequency and DME Channel Number

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
17	108.0	37	110.0
18	108.1	38	110.1
19	108.2	39	110.2
20	108.3	40	110.3
21	108.4	41	110.4
22	108.5	42	110.5
23	108.6	43	110.6
24	108.7	44	110.7
25	108.8	45	110.8
26	108.9	46	110.9
27	109.0	47	111.0
28	109.1	48	111.1
29	109.2	49	111.2
30	109.3	50	111.3
31	109.4	51	111.4
32	109.5	52	111.5
33	109.6	53	111.6
34	109.7	54	111.7

Table 204 VOR/ILS Frequency and DME Channel Number (Continued)

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
35	109.8	55	111.8
36	109.9	56	111.9
		57	112.0

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for DM- 1 and DME -2 systems are similar. The DME-1 and -2 systems are controlled from the VHF NAV control panel located on the glareshield.

B. DME-1 system provides "DME1" readout on the Captain's and First Officer's EFIS Navigation Displays. DME-2 provides "DME2" readout to the Captain's and First Officer's EFIS Navigation Displays.

C. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
DME Ramp Test Set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset 710HB or H3370 or 720HB or equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment System

A. Setup Test Equipment (as required, see Paragraph 3.B., step (3))

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so self-contained antenna is visible from aircraft DME antenna.

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries, or operate unit from 115 VAC line.

(4) Set test set controls as follows:

DISTANCE - N.M.	004.0 nmi	
EFF	100%	
FUNCTION	DISTANCE	(OUT)
NORMAL	ON	(IN)
ECHO	OFF	(OUT)
SQUITTER	2700	(OUT)
FREQ	108.00	(OUT)
METER	150	(DOWN)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Captain's and First Officer's Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Captain's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set, T-24A, T-24B, or T-48D (Paragraph 3. for test equipment setup). Set test set frequency on the NAV control panel.		
(4)	Place VOICE ONLY button, located on Capt's, First Officer's, Observer's and Avionics Compartment's audio control panels (ACP), to OFF position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at Captain's station.
(6)	Place NAV-1 volume control Captain's ACP, in OFF position.	OFF set.
(7)	Repeat steps (5) and (6) for First Officer's, Observer's and Avionics Compartments.	
(8)	If local DME station is not available, perform steps (9) through (12):	
(9)	Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 display on upper left corner of Capt's and F.O.'s EFIS ND's should show 4(±0.2) miles. (DME2 display will appear in upper right corner of ND.) "ILS" annunciation in Rose Mode on Capt's and F/O's NDs.
(10)	Set Test Set DISTANCE-N.M. selectors to 190.0.	After approximately 10 seconds DME1 on Capt's and F.O.'s ND's should indicate 190(±1.0) miles.
(11)	Set Test Set DISTANCE-N.M. selectors to 405.0.	After approximately 10 seconds DME1 on Capt's and F.O.'s ND's should show a series of dashes.
(12)	Set Test Set DISTANCE-N.M. selectors to 004.0.	After approximately 10 seconds DME1 on the Capt's and F.O.'s ND's should show 4.0(±0.2) miles.
(13)	Remove test equipment if used.	

Table 203 DME Self Test

Operation		Desired Results
(1)	On RADIO NAV test panel, press and hold DME-1 TEST switch.	DME1 on Capt's and F.O.'s ND's show three dashes.
(2)	Release DME-1 TEST switch.	DME1 display blanks.
(3)	On RADIO NAV test panel, press and hold DME-2 TEST switch.	DME2 on Capt's and F.O.'s ND's show three dashes.
(4)	Release DME-2 TEST switch.	DME2 display blanks.
(5)	Return aircraft to required configuration.	

Table 204 VOR/ILS Frequency and DME Channel Number

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
17	108.0	37	110.0
18	108.1	38	110.1
19	108.2	39	110.2
20	108.3	40	110.3
21	108.4	41	110.4
22	108.5	42	110.5
23	108.6	43	110.6
24	108.7	44	110.7
25	108.8	45	110.8
26	108.9	46	110.9
27	109.0	47	111.0
28	109.1	48	111.1
29	109.2	49	111.2
30	109.3	50	111.3
31	109.4	51	111.4
32	109.5	52	111.5
33	109.6	53	111.6
34	109.7	54	111.7
35	109.8	55	111.8
36	109.9	56	111.9
		57	112.0

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for DME 1 and DME 2 systems are similar. The DME 1 and 2 systems are controlled from the VHF NAV control panel located on the glareshield.

B. DME-1 system provides DME1 readout on the Captain's and First Officer's instruments. DME-2 provides DME2 readout to the Captain's and First Officer's instruments.

C. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
DME Ramp Test Set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset 710HB or H3370 or 720HB or equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment

A. Setup Test Equipment (as required, see Paragraph 3.B. step (3))

(1) Place test set on ground approximately 50 feet from aircraft DME antenna.

(2) Connect pendant antenna cable to RF jack, and turn test set so self-contained antenna is visible from aircraft DME antenna.

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries, or operate unit from 115 VAC line.

(4) Set test set controls as follows:

DISTANCE - NMI	004.0 NMI	
EFF	100%	
FUNCTION	DISTANCE	(OUT)
NORMAL	ON	(IN)
ECHO	OFF	(OUT)
SQUITTER	2700	(OUT)
FREQ	108.00	(OUT)
METER	150	(OUT)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Capt's and F. O.'s Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Capt's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Tel-Instruments T-24A, T-24B, or T-48D). Set test set frequency on the VHF/ NAV control panel.		
(4)	Place VOICE-IDENT switch, located on Capt's audio control panels, in IDENT position.	
(5)	Adjust VOR-1 (NAV-1) control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6)	If tuned to local DME station over one mile.	DME readout should indicate miles to station.
(7)	If local DME station is not available perform steps (8) through (12):	
(8)	Place Test Set DISTANCE-N.M. selectors in 4.0.	DME1 display on Captain's and First Officer's indicator should lock on at 4.0(±0.2) miles.
(9)	Place DISTANCE-N.M. selectors on Test Set, in 190.0 mi. position.	After approximately 10 seconds DME No. 1 on Captain's and First Officer's indicators should read 190.0(±0.2) miles.
(10)	Place DISTANCE-N.M. selectors on Test Set, to 290.0 mi. position.	After approximately 10 seconds DME No. 1 on Captain's and First Officer's indicators should show a series of dashes.
(11)	Place DISTANCE-N.M. selectors on Test Set in 4.0 mi. position.	DME No. 1 on the Captain's and First Officer's indicators should lock on at 4.0(±0.2) miles.
(12)	Remove test equipment if used.	
(13)	Return aircraft to required configuration.	

Table 203 VOR/ILS Frequency and DME Channel Number

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
17	108.0	37	110.0
18	108.1	38	110.1

Table 203 VOR/ILS Frequency and DME Channel Number (Continued)

DME Channel Number	VOR/ILS Frequency (Mc)	DME Channel Number	VOR/ILS Frequency (Mc)
19	108.2	39	110.2
20	108.3	40	110.3
21	108.4	41	110.4
22	108.5	42	110.5
23	108.6	43	110.6
24	108.7	44	110.7
25	108.8	45	110.8
26	108.9	46	110.9
27	109.0	47	111.0
28	109.1	48	111.1
29	109.2	49	111.2
30	109.3	50	111.3
31	109.4	51	111.4
32	109.5	52	111.5
33	109.6	53	111.6
34	109.7	54	111.7
35	109.8	55	111.8
36	109.9	56	111.9
		57	112.0

DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. Test procedures for DME-1 and DME-2 systems are similar. The DME-1 and -2 systems are controlled from the VHF NAV control panel located on the glareshield.

B. DME-1 system provides DME1 readout to the Captain's and First Officer's RDMI's and EFIS navigation displays (ND's). DME-2 provides DME2 readout to the Captain's and First Officer's RDMI's and ND's.

C. Before proceeding with the following Adjustment/Test, verify that the DME circuit breakers and all associated equipment circuit breakers are closed.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
DME Ramp Test Set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset, 710HB or H3370 equivalent	David Clark

3. Adjustment/Test Distance Measuring Equipment

A. Setup Test Equipment (as required, see Paragraph 3.B. step (3))

(1) Place test set on ground approximately 50 feet (15.24 m) from aircraft DME antenna. Open test set cover.

(2) Connect pendant antenna cable to RF jack, and turn test set so that self-contained antenna is visible from aircraft DME antenna.

(3) Press test set POWER switch. Battery check meter should indicate in white portion of scale. If not, recharge batteries before proceeding with test or operate unit from 115 VAC line.

(4) Set test set controls as follows:

DISTANCE - NMI	004.0 NMI	
EFF	100%	
FUNCTION	DISTANCE	(OUT)
NORMAL	ON	(IN)
ECHO	OFF	(OUT)
SQUITTER	2700	(OUT)
FREQ	BOTH	(OUT)
METER	150	(DOWN)

B. Test Distance Measuring Equipment

NOTE: Following procedural steps checks DME-1 System. DME-2 System can be checked concurrently by substituting DME-2 operations and results for DME-1.

Table 202

Operation		Desired Results
(1)	Plug a headset into headset jack at Captain's and First Officer's Stations.	
(2)	Allow DME interrogator to warm up at least one minute.	
(3)	Channel interrogator to a local DME station using NAV frequency selector on Capt's VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set (Tel-Instruments T-24A, T-24B, or T-48D). Set test set frequency on the NAV control panel.		
(4)	Push in RANGE switch, located on Captain's audio control panels.	
(5)	Adjust DME-1 volume on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(6)	If tuned to local DME station over one mile (1.6 km).	DME readout RDMI's should indicate miles to station.
(7)	If local DME station is not available, perform steps (8) through (12):	
(8)	Place Test Set DISTANCE-N.M. selectors in 4.0 mi. position. On Capt's and F.O.'s Mode Select Panel, place NAV/RAD switch to RAD and Mode Select switch to ROSE.	DME1 on Captain's and First Officer's RDMI and ND should lock on at 4.0(±0.2) miles. ILS annunciators should appear on Capt's and F.O.'s ND's.
(9)	Place DISTANCE-N.M. selectors on Test Set in 190.0 mi. position.	After approximately 10 seconds, DME 1 on Captain's and First Officer's RDMI's and ND's should indicate 190.0(±0.2) miles.
(10)	Place DISTANCE-N.M. selectors on Test Set in 290.0 mi. position.	After approximately 10 seconds, DME No. 1 on Captain's and First Officer's RDMI'S and ND's should indicate a series of dashes.
(11)	Place DISTANCE-N.M. selectors on Test Set in 4.0 mi. position.	DME No. 1 on the Captain's and First Officer's RDMI's and ND's should lock on at 4.0(±0.2) miles.
(12)	Remove test equipment if used.	
(13)	Return aircraft to required configuration.	

DME ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the DME antenna.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B. Each DME antenna is a vertically polarized, blade type antenna mounted on the underside of the forward fuselage.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

C. Each DME antenna is an omni-directional, quarter wave, blade type antenna mounted on the underside of the forward fuselage.

WJE ALL

D. Each antenna (DME-1 forward and DME-2 aft), is mounted to the aircraft and secured by screws that fit into sealed cap nuts. Removal/installation for both antennas is identical, except for circuit breaker placarding.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation DME Antenna

A. Remove Applicable DME Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scrapper.

(3) Remove antenna mounting screws.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(4) Lower antenna; disconnect and cap coaxial cable connector, and remove antenna, retain O-ring installed in base of antenna.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(5) Lower antenna; disconnect and cap coaxial cable connector, and remove antenna and gasket.

WJE ALL

B. Install Applicable DME Antenna

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(2) Make certain O-ring is installed in antenna base O-ring groove.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(3) Position gasket on antenna.

WJE ALL

(4) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(5) Prepare the surface of the antenna for Radio Frequency (RF) bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(6) Apply faying surface seal to the base of the antenna. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(7) Install antenna assembly as follows: (Figure 201)

(a) Remove protective cap and check for damage and unwanted material.

1) Connect antenna coaxial cable connector.

(b) Place antenna in mounting position and install attachment screws.

1) Torque the attachments screws.

a) Torque the attachments screws again 10 minutes after the initial torque.

(c) Remove sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(8) Do the RF bonding check of the antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(9) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

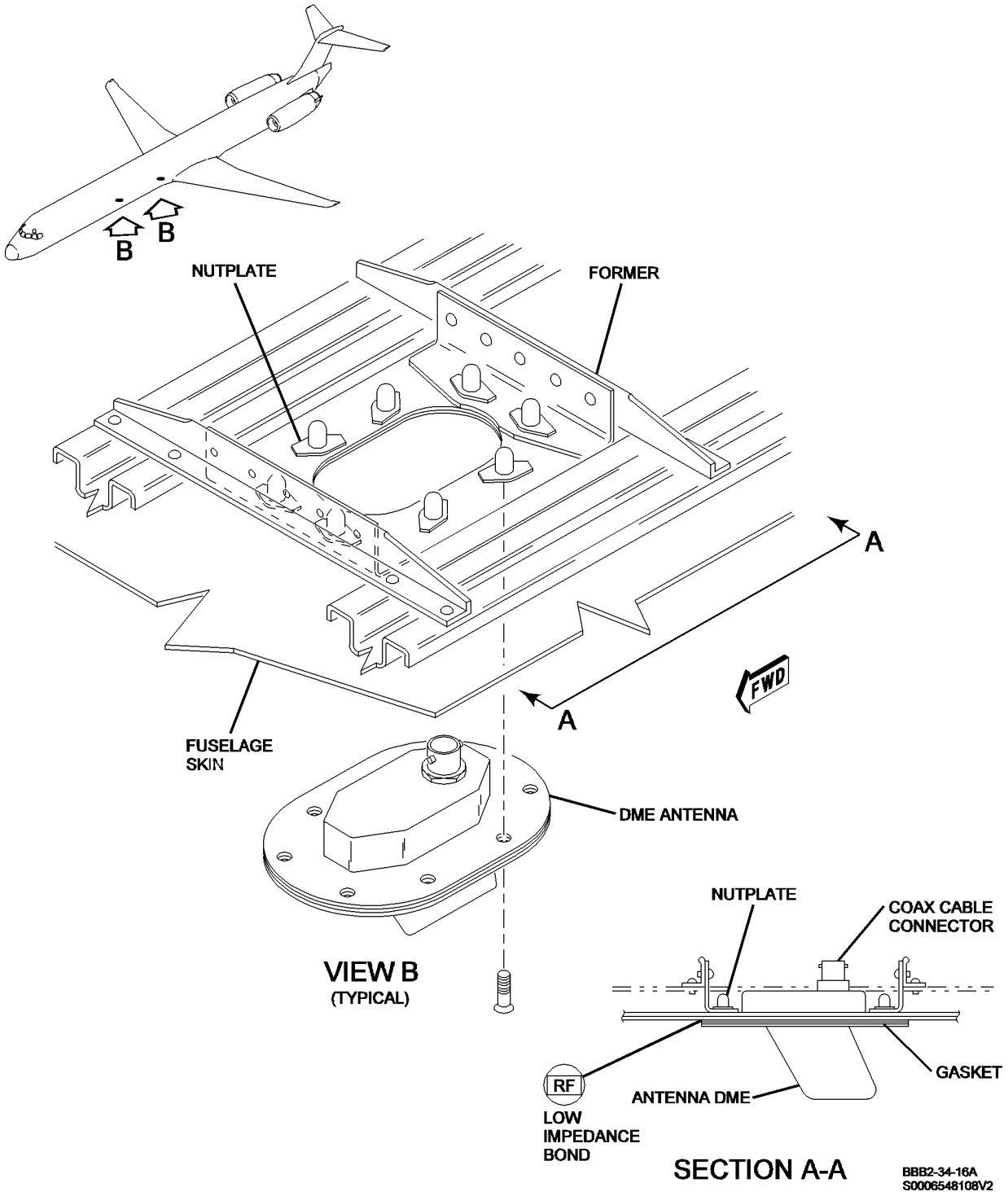
(10) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

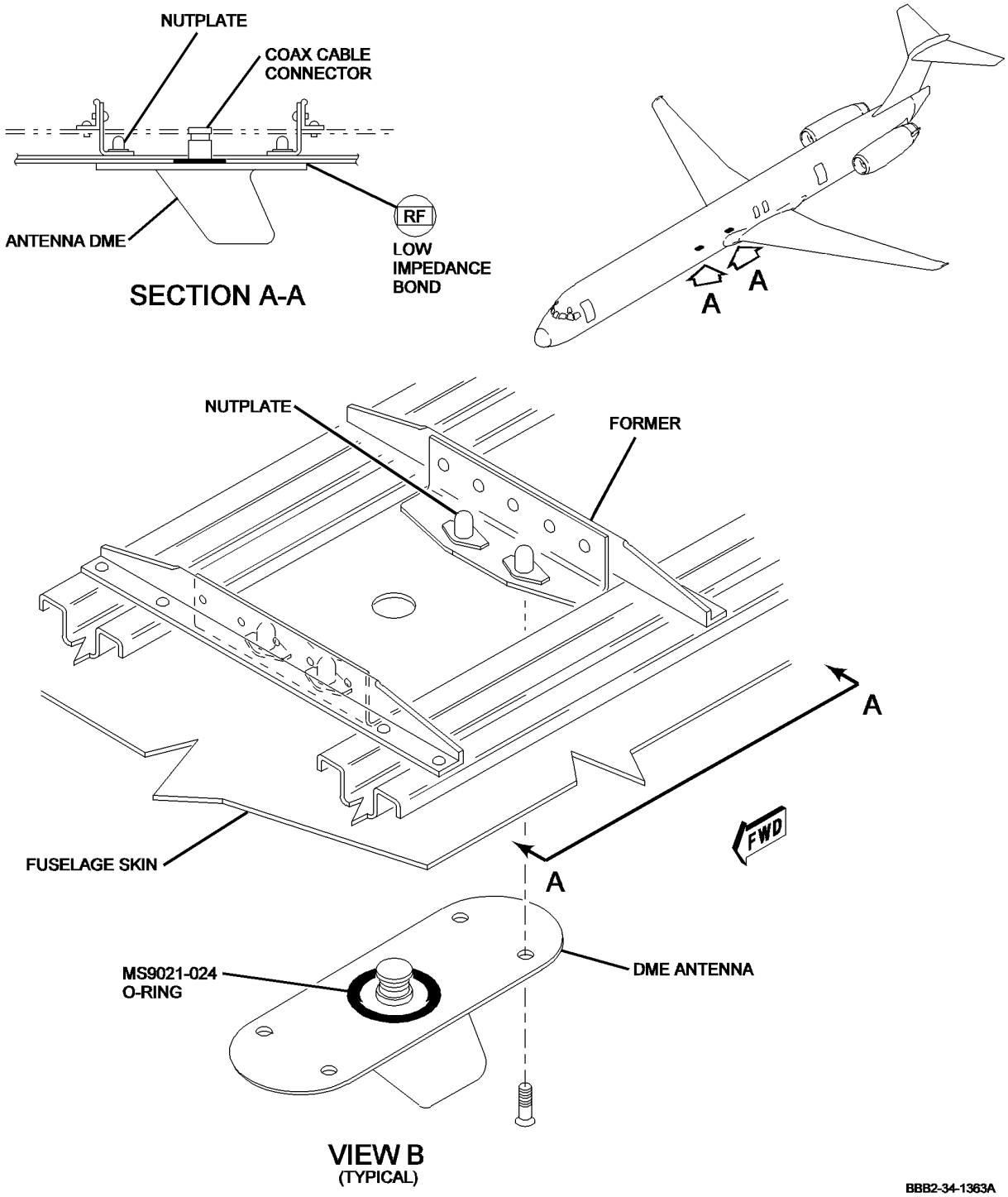
Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2



DME Antenna -- Removal/Installation
Figure 201/34-52-01-990-803 (Sheet 1 of 2)



DME Antenna -- Removal/Installation
Figure 201/34-52-01-990-803 (Sheet 2 of 2)

DME INTERROGATOR - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the DME interrogator. Two interrogators are installed on the radio rack in the electrical/electronics compartment. Operating controls for the interrogators are on the applicable VHF NAV-1, or VHF NAV-2 control panel portion of the flight guidance control panel. DME channel selection occurs automatically when the NAV frequency control is tuned to a matching VOR frequency.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

B. Removal/installation procedures for both units are identical except for circuit breaker placarding. Test procedures are provided for use with Collins 475D-1 test set. (Paragraph 3.C.) Additional test procedures are provided for use with TIC T-24A or T-24B test sets. (Paragraph 3.D.)

WJE 405, 409, 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 880, 881, 883, 884, 891-893

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
DME Ramp Test set 475D-1 or DME ramp test set T-24A, T-24B or T-48D	Collins Radio Company Tel Instrument Electronics Corp.
Headset, 710HB or H3370 or 720HB or equivalent	David Clark

3. Removal/Installation DME Interrogator

A. Remove DME Interrogator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Turn driver/extractor handle CCW until unit electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install DME Interrogator

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW until unit is firmly engaged into rack.

(5) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

C. Test DME Interrogator

Operation	Desired Results
(1) Channel interrogator to a local DME station using NAV frequency selector on Captain's NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set, Collins 475D-1, Ref. (SUBJECT 34-52-00, Page 201). Set test set frequency on the NAV control panel.	
(2) Place VOICE-IDENT switch, located on Captain's, audio control panels, to ON position.	
(3) Adjust VOR volume control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(4) If tuned to local DME station over one mile.	DME's should indicate miles to station.
(5) If local DME station not available perform following steps.	

(Continued)

Operation	Desired Results
(6) Place Test Set Function Selector in 5 MI position.	DME No. 1 on Captain's/First Officer's indicator should lock on at 5(±0.2) miles.
(7) Place FUNCTION SELECTOR, on Test Set, in 180/270 MI position, and Range Switch in 180 position.	After approximately 10 seconds DME No. 1 on Captain's/First Officer's indicator's should indicate between 173 and 187 miles.
NOTE: If complete system test is required, refer to SUBJECT 34-52-00, Page 201.	
(8) The following adjustment to the DME interrogator is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ± 10% across a 600 ohm load using a VTVM or equivalent voltmeter. Refer to the appropriate equipment overhaul manual for detailed instructions of how to perform the adjustment.	
(9) Remove test equipment if used.	
(10) Return aircraft to required configuration.	

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

D. Test DME Interrogator (Test Set T24-A, T24-B or T-48D)

Table 202

Operation	Desired Results
(1) Channel interrogator to local DME station using NAV frequency selector on Capt's/F.O.'s VHF/NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set, T-24A, T-24B or T-48D. (SUBJECT 34-52-00, Page 201, for test equipment set-up) Set test set frequency on the VHF/NAV control panel.	
(2) Place VOICE switch, located on Capt's/F.O.'s audio control panel to ON position.	
(3) Adjust VOR volume control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(4) If tuned to local DME station over one mile.	DME's should indicate miles to station.
(5) If local DME station is not available perform steps (6) through (7):	
(6) Place Test Set DISTANCE-N.M. selector in 4.0 mi. position.	DME No. 1 on Capt's/F.O.'s indicator should lock on at 4.0(±0.2) miles.

WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893 (Continued)

Table 202 (Continued)

Operation	Desired Results
(7) Place DISTANCE-N.M. selector on Test Set, in 190.0 mi. position.	After approximately 10 seconds, DME No. 1 on Capt's/ F.O.'s indicator should indicate 190.0(±0.2) miles.
NOTE: If complete system test is required, refer to SUBJECT 34-52-00, Page 201.	
(8) Remove test equipment, if used.	
(9) Return aircraft to required configuration.	

DME INTERROGATOR - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation procedures for the DME interrogator. Two interrogators are installed on the radio rack in the electrical/electronics compartment. Operating controls for the interrogators are on the applicable VHF NAV-1, or VHF NAV-2 control panel portion of the flight guidance control panel. DME channel selection occurs automatically when the NAV frequency control is tuned to a matching VOR frequency. DME audio level is controlled from the NAV/VOR adjustment on the audio control panel.

B. Removal/installation procedures for both units are identical, except for circuit breaker placarding. Allow interrogators at least one minute to warm up before performing Adjustment/Test.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
DME ramp test set T-24A, T-24B or T-48D	Tel Instrument Electronics Corp.
Headset, 710HB or H3370 or 720HB or equivalent	David Clark

3. Removal/Installation DME Interrogator

A. Remove DME Interrogator

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

(3) Pull unit straight out from mounting rack.

B. Install DME Interrogator

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

C. Test DME Interrogator (Test Set 475D-1)

Operation	Desired Results
(1) Channel interrogator to a local DME station using NAV frequency selector on Captain's/ First Officer's NAV control panel.	
NOTE: If unable to pick up local DME station, use DME Ramp Test Set, T-24A, T-24B or T-48D. (SUBJECT 34-52-00Page 201, for test equipment set-up) Set test set frequency on the VHF/NAV control panel.	
WJE 401-404, 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879	
(2) Place VOICE/IDENT switch, located on Captain's/F.O.'s control panel, to IDENT position.	
WJE 886, 887	
(2) Press RANGE button on Capt's/F/O audio control panel.	
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887	
(3) Adjust NAV/VOR volume control on audio control panel to comfortable listening level.	DME tone signal should be present in headset at audio station.
(4) Place MODE select switch on EFIS Mode Select Panel in ARC position.	

(Continued)

Operation	Desired Results
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879	
(5) If tuned to local DME station over one mile.	DME displays on Capt's/F.O.'s EFIS Navigation Displays (ND) should indicate miles to station.
WJE 401-404, 412, 414, 875-879	
(5) If tuned to local DME station over one mile.	DME displays on Capt's/F.O.'s EFIS Navigation Displays (ND) and RDMI's should indicate miles to station.
WJE 886, 887	
(5) If tuned to local DME station over one mile.	DME displays on EFIS Navigation Displays (ND) and RDMI's should indicate miles to station.
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887	
(6) If local DME station not available perform steps (7) and (8).	
WJE 886, 887	
(7) Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 display on ND's/RDMI's should read 4(±0.2) miles.
WJE 401-404, 412, 414, 875-879	
(7) Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 display on Capt's/F.O.'s ND's and RDMI's should read 4(±0.2) miles.
WJE 406-408, 410, 411, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879	
(7) Set Test Set DISTANCE-N.M. selectors to 004.0.	DME1 display on Capt's/F.O.'s ND's should read 4(±0.2) miles.
(8) Set Test Set DISTANCE-N.M. selectors to 190.0.	After approximately 10 seconds DME1 display on Capt's/F.O.'s ND's should read 190(±0.2) miles.
WJE 886, 887	
(8) Set Test Set DISTANCE-N.M. selectors to 190.0.	After approximately 10 seconds DME1 display on ND's/RDMI's should read 190(±0.2) miles.
WJE 401-404, 412, 414, 875-879	
(8) Set DISTANCE-N.M. selector on Test Set, in 190.0 mi. position.	After approximately 10 seconds, DME No. 1 on Capt's/ F.O.'s ND's and RDMI's should indicate 190.0(±0.2) miles.
WJE 401-404, 406-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887	
NOTE: If complete system test is required, refer to SUBJECT 34-52-00, Page 201.	
(9) Remove test equipment if used.	
(10) Return aircraft to required configuration.	

DME DISPLAY LAMP BLOCKS - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the DME display lamp blocks. These lamp blocks are located on the Horizontal Situation Indicator (HSI), and are labeled MILES NO. 1 and MILES NO. 2. Removal/installation for both displays is identical.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Prying Device (fiberglass)	Collins Division, Rockwell International

3. Removal/Installation of DME Display Lamp Blocks

A. Remove Lamp Blocks (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING

(2) Remove lamp block bezel retaining screws (2). Retain these screws.

CAUTION: PRY LAMP BLOCK FROM UNIT CAREFULLY. POSSIBLE DAMAGE TO UNIT OR LAMP BLOCK COULD OCCUR.

(3) Using prying device, remove lamp block from unit.

(4) Remove mounting plate screws (2) from lamp block. Retain these screws.

(5) Remove mounting plate.

B. Install Lamp Blocks (Figure 201)

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING

(2) Install mounting plate onto replacement lamp block, using 2 screws removed in Paragraph 3.A.(4).

(3) Install replacement lamp block, with mounting plate, into unit.

(4) Install bezel, using 2 screws removed in Paragraph 3.A.(2).

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	1	B10-377	CAPTAIN'S HSI & HEADING 28VAC

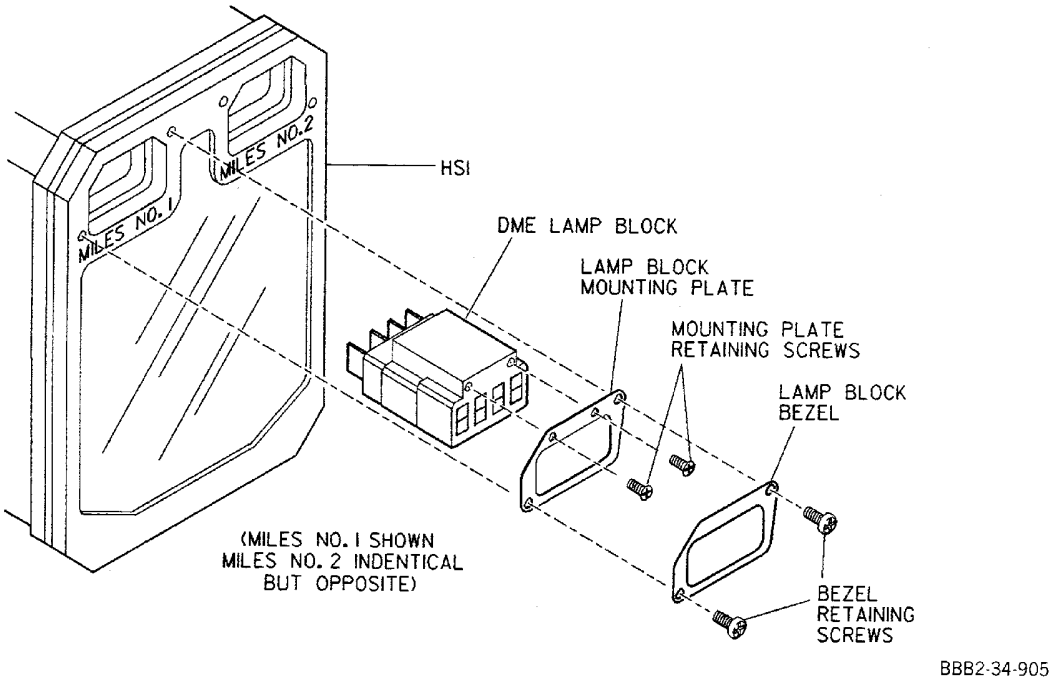
UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	4	B10-378	FIRST OFFICER'S HSI & HEADING

(6) On overhead panel press and hold ANNUN/DIGITAL LTS TEST pushbutton. Check that DME display lamp blocks come on. Release pushbutton.

NOTE: During the ANNUN/DIGITAL LTS test, the HSI must receive a DME valid to observe "8's" in the HSI DME window. This can be accomplished by tuning the DME to a local station, by using a ramp tester, or by initiating a DME self-test.

(7) Return aircraft to required configuration.



DME Display Lamp Blocks -- Removal/Installation
Figure 201/34-52-03-990-801

DME TUNING CONVERTER - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation procedures for the DME tuning converters. Two tuning converters are installed on the aft left radio rack in the electrical/electronics compartment. The tuning converters change the tuning information from the VHF NAV control panels to ARINC 429 digital format and add additional tuning information provided by the FMS. Power is supplied by the DME interrogators.

B. Removal/installation procedures for both units are identical, except for circuit breaker placarding.

2. Removal/Installation DME Tuning Converter

A. Remove DME Tuning Converter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(3) Pull unit straight out from mounting rack.

B. Install DME Tuning Converter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, making sure guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(5) Remove tags and close following applicable circuit breakers:

Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(6) Perform DME adjustment/test. (DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-52-00/201 Config 5)

WJE 410; AFTER SERVICE BULLETIN 34-285 REV 3

(7) Perform DME adjustment/test. (DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-52-00/201 Config 6)

WJE 886, 887

(8) Perform DME adjustment/test. (DISTANCE MEASURING EQUIPMENT SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-52-00/201 Config 8)

WJE 401-404, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 886, 887

(9) Return aircraft to required configuration.

AUTOMATIC DIRECTION FINDING (ADF) - DESCRIPTION AND OPERATION

1. General

A. The Automatic Direction Finding (ADF) system is a navigational aid that uses radio signals in determining the angle between the aircraft heading and a radio transmitting station. The system provides an indication of relative and magnetic bearing to a selected station with respect to the aircraft, and may also be used to receive aural communication and navigation signals. The ADF receiver is tunable, in 0.5 KHz increments, in the frequency range of 190 to 1750 KHz to receive amplitude-modulated, continuous-wave, radio range signals. A single ADF system consisting of a receiver, control panel, D to A converter, and ADF sense/loop antenna are installed.

WJE 873, 874

B. ADF bearing data is displayed on the captain's and first officer's compass indicator. Magnetic heading from the compass system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

WJE 409, 884

C. ADF bearing data is displayed on the captain's and first officer's compass indicator and, if installed, on the EFIS Navigation Displays (ND). Magnetic heading from the compass/heading system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

D. ADF Receiver - The ADF receiver(s) are rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and three LED test annunciators. Depressing and holding the TEST switch causes the LEDs to come on for two to three seconds; then go off for two to three seconds; and then come on as applicable to test results, for 16 seconds or until the TEST button is released. In addition, the single pointer on the captain's and first officer's compass indicators (EFIS ND on aircraft with EFIS) will indicate 135 degrees from the lubber line.

WJE 873, 874

E. ADF Receiver - The ADF receiver(s) are rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and three LED test annunciators. Pressing and holding the TEST button for nine seconds causes the three LEDs to come on for three seconds; go off for three seconds; then the green LED come on for three seconds. When the LED comes on the second time, while button is still pressed, the double pointer on the captain's and first officer's compass indicators will indicate 135 degrees from the lubber line. Also, a tone should be heard in the last second of the test.

WJE 409, 873, 874, 884

F. ADF Control Panel - The ADF control panel, located on the pedestal, provide the following controls and functions:

Table 1

Control	Function
WJE 873, 874	
A1/NORM switch	A1 position provides 1020 Hz modulation for CW reception. NORM position is used for reception ofmodulated signals.
WJE 409, 884	
TONE Switch	Provides 1020 Hz modulation for CW reception. OFF position is used for reception of modulated signals.
WJE 409, 873, 874, 884	
ADF/ANT switch	Selects ADF or ANT mode of operation.
Frequency windows	Display selected receiver frequency in kilohertz.
Frequency select knobs	Simultaneously control rotary position of frequency select switches and frequency display.
TFR switch	Selects either left or right frequency control and display. An annunciator light comes on above selected display.

G. In addition to audio controls for other systems, each audio selector panel contains specific ADF audio selection controls that interlock with the ADF control panel. A voice/range filter is an integral part of each audio control panel. The applicable controls and functions are as follows:

Table 2

Control	Function
ADF-1, ADF-2 switches	Provides the capability of selecting and monitoring the output of the ADF receiver through the flight interphone system and controlling volume of ADF signal. (ADF-2 not used)
VOICE/IDENT switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit. IDENT - Passes both radio range CW and superimposed voice signals to audio integrating circuit.

H. ADF Sense/Loop Antenna - The ADF sense/loop antenna contains, in a single low profile dielectric cover, an omnidirectional sense antenna and two directional loop antennas. The two loop antennas are mounted orthogonally. The ADF sense/loop antenna is located on the top fuselage centerline.

I. The D to A converter, located in the electrical/electronics compartment, converts digital (ARINC 429 data stream) input from the ADF receiver to synchro format, for use in driving the compass indicators ADF pointers.

2. **Operation**

A. The ADF receiver operates in either of two modes as selected by the ADF/ANT switch. In the ADF, or ANT mode, the receiver is tunable from 190 to 1750 KHz.

B. In the ADF mode, signals from both the loop and sense antennas are used simultaneously by the ADF receiver to provide the bearing of a selected radio station to the aircraft, and audio information through the flight interphone system.

(1) The directional characteristics of the loop antenna are used to determine the bearing to a selected ground station. The received signal strength is relative to the position of the antenna with respect to the ground station. The loop antennas are mounted in a fixed position on the aircraft and are physically positioned 90° apart. One antenna is oriented to receive maximum signal strength when the aircraft is on a direct heading to or from the ground station and minimum signal when headed at right angles from the ground station. The signal strength of this loop antenna is proportional to the cosine function of the relative angle between aircraft heading and ground station bearing. The other loop antenna signal strength is maximum at 90° and 270° and minimum at zero and 180° (sine function). The signals received from the loop antennas may appear to be from either of two directions 180° apart. In order to eliminate the 180° ambiguity, the sine and cosine signals are combined with the nondirectional signal from the sense antenna.

(2) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The digitized data is output by way of an ARINC 429 data stream to a digital-to-synchro converter, which drives the ADF pointers on the compass indicators/RMI's. On aircraft with EFIS, the digitized data is also sent to the EFIS Symbol Generator where it is processed for display on the ND. Audio output is applied to the flight interphone system through the applicable audio selector panel.

C. In the ANT mode, the receiver accepts signals only from the sense antenna with the loop antennas disconnected from the circuit. The receiver operates as a low-frequency and standard broadcast band receiver with signals from all directions received equally well. The sense antenna RF signal is heterodyned with a local oscillator signal to yield the intermediate frequency, which is detected and amplified. The resultant audio signal of the selected station is applied to the flight interphone system through the applicable audio selector panel.

3. **To Operate System**

A. Operate

(1) Energize aircraft electrical buses.

(2) Place VOR/ADF switch on compass indicators to ADF position.

WJE 409, 884

(3) On aircraft with EFIS, rotate ADF bearing knobs on EFIS Mode Select Panels (MSP) clockwise, to ON position.

WJE 409, 873, 874, 884

(4) On ADF control panel, set ADF/ANT switch to ANT position.

(5) On ADF control panel, set TFR switch to left or right position and tune in proper frequency of selected station.

(6) On convenient audio control panel, set ADF switch to the on (up) position and adjust for comfortable audio level.

WJE 873, 874

(7) Make positive aural identification of station. It is necessary to set ADF control panel A1/NORM switch to A1 position to aurally receive a CW signal.

WJE 409, 884

(8) Make positive aural identification of station. It is necessary to set control panel IDENT switch to IDENT position to aurally receive a CW signal.

WJE 409, 873, 874, 884

(9) On ADF control panel, set ADF/ANT switch to desired mode of operation.

AUTOMATIC DIRECTION FINDING (ADF) - DESCRIPTION AND OPERATION

1. General

A. The Automatic Direction Finding (ADF) system is a navigational aid that uses radio signals in determining the angle between the aircraft heading and a radio transmitting station. The system provides an indication of relative and magnetic bearing to a selected station with respect to the aircraft, and may also be used to receive aural communication and navigation signals. The ADF receiver is tunable, in 0.5 KHz increments, in the frequency range of 190 to 1750 KHz to receive amplitude-modulated, continuous-wave, radio range signals. Two ADF systems each consisting of a receiver, control panel, D to A converter, and ADF sense/loop antenna are installed.

WJE 406-408, 410, 411, 880

B. On aircraft 126-127, ADF bearing data is displayed on the captain's and first officer's compass indicator. On aircraft 104-109, 128-130, 151, 152, ADF bearing is displayed on the captain's and first officer's RMI's. (It can also be displayed on the EFIS Navigation Display (ND))(NAVIGATION DISPLAYS, SUBJECT 34-22-00). ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Magnetic heading from the compass system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

NOTE: On aircraft 110, ADF bearing data is displayed on the captain's and first officer's EFIS Navigation Display (ND). (SUBJECT 34-22-00, Page 1) On aircraft 131-132, ADF bearing data is displayed on the captain's and first officer's EFIS ND Radio Magnetic compass indicators (SUBJECT 34-22-00, Page 1). For aircraft 110, 131-132 the rest of paragraph 1.B and 1.C. is similar in description and operation.

WJE 886, 887

C. ADF bearing data is displayed on the captain's and first officer's EFIS Navigation Displays (ND) Radio Magnetic compass indicators. (SUBJECT 34-22-00, Page 1) ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass display, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

WJE 401-404, 412, 414

D. ADF bearing data is displayed on the captain's and first officer's EFIS Navigation Displays (ND). (SUBJECT 34-22-00, Page 1) ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass display, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

WJE 401-404, 412, 414, 886, 887

E. ADF Receiver - The ADF receiver(s) are rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and three LED test annunciators. Depressing and holding the TEST switch causes the LEDs to come on for two to three seconds; then go off for two to three seconds; and then come on as applicable to test results, for 16 seconds or until the TEST button is released. In addition, the single pointer on the captain's and first officer's compass indicators will indicate 135 degrees from the lubber line.

WJE 406-408, 410, 411, 880

F. ADF Receiver - The ADF receiver(s) are rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and three LED test annunciators. Depressing and holding the TEST switch causes the LEDs to come on for two to three seconds; then go off for two to three seconds; and then come on as applicable to test results, for 16 seconds or until the TEST button is released. In addition, the single pointer on the captain's and first officer's compass indicators/RMI's will indicate 135 degrees from the lubber line.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

G. ADF Control Panel - The ADF control panel, located on the pedestal, provide the following controls and functions:

Table 1

Control	Function
WJE 401-404, 406, 410, 412, 414	
TONE Switch	TONE position provides 1020 Hz modulation for CW reception. NORM position is used for reception of modulated signals.
WJE 886, 887	
TONE Switch	TONE position provides 1020 Hz modulation for CW reception. OFF position is used for reception of modulated signals.
WJE 407, 408, 411, 880	
A1/NORM Switch	A1 position provides 1020 Hz modulation for CW reception. NORM position is used for reception of modulated signals.
WJE 401-404, 406-408, 410-412, 414, 880, 886, 887	
ADF/ANT switch	Selects ADF or ANT mode of operation.
Frequency windows	Display selected receiver frequency in kilohertz.
Frequency select knobs	Simultaneously control rotary position of frequency select switches and frequency display.
WJE 407, 408, 411, 880, 886, 887	
TFR switch	Selects either left or right frequency control and display. An annunciator light comes on above selected display.
WJE 401-404, 406, 410, 412, 414	
TEST switchs	Initiates system self test.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

H. In addition to audio controls for other systems, each audio selector panel contains specific ADF audio selection controls that interlock with the ADF control panel. A voice/range filter is an integral part of each audio control panel. The applicable controls and functions are as follows:

Table 2

Control	Function
WJE 401-404, 406-408, 410-412, 414, 880	
ADF-1, ADF-2 switches	Provides the capability of selecting and monitoring the output of the ADF receiver through the flight interphone system.
WJE 886, 887	
ADF-1, ADF-2 switches (ADF-2 INOP)	Provides the capability of selecting and monitoring the output of the ADF receiver through the flight interphone system.
WJE 401-404, 406-408, 410-412, 414, 880	
VOICE/IDENT switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit. IDENT - Passes both radio range CW and superimposed voice signals to audio integrating circuit.
WJE 886, 887	
VOICE switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit.
RANGE switch	RANGE - Filters voice audio out of circuit and passes CW range signals to audio integrating circuits. circuit.
VOICE/IDENT switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit. IDENT - Passes both radio range CW and superimposed voice signals to audio integrating circuit.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

I. ADF Sense/Loop Antenna - The ADF sense/loop antenna contains, in a single low profile dielectric cover, an omnidirectional sense antenna and two directional loop antennas. The two loop antennas are mounted orthogonally. The ADF sense/loop antenna is located on the top fuselage centerline.

WJE 406-408, 410, 411, 880

J. The D to A converter, located in the electrical/electronics compartment, converts digital (ARINC 429 data stream) input from the ADF receiver to synchro format, for use in driving the compass indicators ADF pointers.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

2. Operation

A. The ADF receiver operates in either of two modes as selected by the ADF/ANT switch. In the ADF, or ANT mode, the receiver is tunable from 190 to 1750 KHz.

B. In the ADF mode, signals from both the loop and sense antennas are used simultaneously by the ADF receiver to provide the bearing of a selected radio station to the aircraft, and audio information through the flight interphone system.

(1) The directional characteristics of the loop antenna are used to determine the bearing to a selected ground station. The received signal strength is relative to the position of the antenna with respect to the ground station. The loop antennas are mounted in a fixed position on the aircraft and are physically positioned 90° apart. One antenna is oriented to receive maximum signal strength when the aircraft is on a direct heading to or from the ground station and minimum signal when headed at right angles from the ground station. The signal strength of this loop antenna is proportional to the cosine function of the relative angle between aircraft heading and ground station bearing. The other loop antenna signal strength is maximum at 90° and 270° and minimum at zero and 180° (sine function). The signals received from the loop antennas may appear to be from either of two directions 180° apart. In order to eliminate the 180° ambiguity, the sine and cosine signals are combined with the nondirectional signal from the sense antenna.

WJE 406-408, 410, 411, 880

(2) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The digitized data is output by way of an ARINC 429 data stream to a digital-to-synchro converter, which drives the ADF pointers on the compass indicators/RMI's. On aircraft with EFIS, the digitized data is also sent to the EFIS Symbol Generator where it is processed for display on the ND. Audio output is applied to the flight interphone system through the applicable audio selector panel.

WJE 401-404, 412, 414

(3) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The digitized data are sent to the EFIS Symbol Generator where they are processed for display on the ND. Audio output is applied to the flight interphone system through the applicable audio selector panel.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

C. In the ANT mode, the receiver accepts signals only from the sense antenna with the loop antennas disconnected from the circuit. The receiver operates as a low-frequency and standard broadcast band receiver with signals from all directions received equally well. The sense antenna RF signal is heterodyned with a local oscillator signal to yield the intermediate frequency, which is detected and amplified. The resultant audio signal of the selected station is applied to the flight interphone system through the applicable audio selector panel.

WJE 406-408, 410, 411, 880

D. On EFIS aircraft, ADF bearing can be displayed on the EFIS Navigation Display (ND) by turning the two concentric ADF rotary switches on the EFIS Mode Select Panel clockwise, past the detent (OFF) position. ADF bearing will appear on both the ROSE and ARC displays. An "ADF1 FAIL" or "ADF2 FAIL" message will appear on screen when loss of data, loss of valid or invalid data are detected by the Symbol Generator.

WJE 401-404, 406, 410, 412, 414, 886, 887

E. ADF bearing can be displayed on the EFIS Navigation Display (ND) by turning the two concentric ADF rotary switches on the EFIS Mode Select Panel clockwise, past the detent (OFF) position. ADF bearing will appear on both the ROSE and ARC displays. An "ADF1 FAIL" or "ADF2 FAIL" message will appear on screen when loss of data, loss of valid or invalid data are detected by the Symbol Generator.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

3. **To Operate System**

A. Operate

(1) Energize aircraft electrical buses.

WJE 401-404, 406, 410, 412, 414, 886, 887

(2) Rotate ADF bearing knobs on EFIS Mode Select Panels (MSP) clockwise, to ON position.

WJE 407, 408, 411, 880

(3) Place/press VOR/ADF switch on compass indicators/RMI's to ADF position.

(4) On EFIS aircraft, rotate ADF bearing knobs on Mode Select Panel clockwise, to ON position.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

(5) On ADF control panel, set ADF/ANT switch to ANT position.

(6) On ADF control panel, set TFR switch to left or right position and tune in proper frequency of selected station.

WJE 407, 408, 411, 880

(7) On convenient audio control panel, set ADF switch to the on (up) position and adjust for comfortable audio level.

WJE 401-404, 406, 410, 412, 414

(8) On convenient audio control panel, set ADF switch to the on position and adjust for comfortable audio level.

WJE 407, 408, 411, 880

(9) Make positive aural identification of station. It is necessary to set ADF control panel A1/NORM switch to A1 position to aurally receive a CW signal.

WJE 886, 887

(10) Make positive aural identification of station. It is necessary to set control panel RANGE switch to RANGE position to aurally receive a CW signal.

WJE 401-404, 406, 410, 412, 414

(11) Make positive aural identification of station. It is necessary to set control panel IDENT switch to IDENT position to aurally receive a CW signal.

WJE 401-404, 406-408, 410-412, 414, 880, 886, 887

(12) On ADF control panel, set ADF/ANT switch to desired mode of operation.

AUTOMATIC DIRECTION FINDING (ADF) - DESCRIPTION AND OPERATION

1. General

A. The automatic direction finding (ADF) system is a navigational aid that uses radio signals in determining the angle between the aircraft heading and a radio transmitting station. The system provides an indication of relative and magnetic bearing to a selected station with respect to the aircraft, and may also be used to receive aural communication and navigation signals. The ADF operates in the frequency range of 190 to 1749.5 KHz to receive amplitude-modulated, continous-wave, and radio range signals. Two ADF systems are installed, each consisting of receiver, sense antenna, antenna coupler, loop antenna, and dual control panel.

B. On both Horizontal Situation Indicators (HSI), ADF-1 bearing is displayed by a single pointer, and ADF-2 by a triangular pointer, rotating around the inner periphery of the heading dial. The heading dial repeats aircraft heading when read against the lubber line. The ADF pointers display magnetic radio bearing when read against the heading dial and relative bearing when read against the lubber line. On aircraft with EFIS, ADF bearing is displayed on the EFIS navigation displays (ND's) located on the Captain's and First Officer's instrument panels. ADF-1 is displayed by a single arrow pointer and ADF-2 by a double line pointer.

C. ADF Receiver - Each ADF receiver is rack-mounted in the forward right radio rack. A single electrical connector is mounted on the rear panel, and two antenna coax connectors on the front panel. The front panel contains a servo repeater which annunciates the position of the ADF pointers on the indicator. The annunciator is placarded ZERO at the 12 o'clock point, and TEST at the 3 o'clock point. A white dot on dark background rotates around the inside of the annunciator to continously display an analogy of the movement of the servo loop which controls the ADF pointers. A test pushbutton is located adjacent to the annunicator. Activating the test pushbutton results in a simulated 45-degree bearing error signal that is resolved by the receiver to provide a 45-degree test indication on the front panel annunciator and to drive the ADF pointers to seek the left wing position.

(1) Each ADF receiver is tunable in 0.5 KHz increments from 190 to 1749.5 KHz in six bands. Band selection is through a combination logic circuit that converts binary coded decimal (bcd) frequency control information into band information to select one of six bandpass type filters at the output of the RF amplifiers.

D. ADF Control Panel - A dual ADF control panel, located on the pedestal, provide the following controls and functions:

Table 1

Control	Function
A1/NORM switch	Initiates 1020 Hz tone signal. Must be in ON position to provide audio for CW reception.
ADF/ANT switch (if installed)	Selects ADF, or ANT mode of operation.
Frequency windows	Display selected receiver frequency in megahertz.
Frequency select knobs	Simultaneously control rotary position of frequency select switches and frequency display.
TFR switch	Selects either left or right frequency control and display. A yellow bar obscures the readout of the channel not selected by the TFR switch.

E. In addition to audio controls for other systems, each audio selector panel contains specific ADF audio selection controls that interlock with the ADF control panel. A voice/range filter is an integral part of each audio control panel. The applicable controls and functions are as follows:

Table 2

Control	Function
ADF-1, ADF-2 switches	Provides the capability of selecting and monitoring the output of the ADF receivers through the flight interphone system and controlling volume of ADF signal.
VOICE/IDENT switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit. IDENT - Passes both radio range CW and superimposed voice signals to audio integrating circuit.

F. ADF Loop Antenna (aircraft 101-108, 151-158, 175, 176) - The ADF loop antenna is a fixed, cross-loop antenna, flush mounted on the upper center fuselage. Each loop coaxial cable consists of four coaxial cables within a shielded cable. The four cables provide rf input leads from four coils with ferrite cores that constitute the loop antenna. The loop antenna signal is applied to the ADF receiver through a precalibrated quadrantal error corrector which compensates for arriving radio signal deflection by the wings and fuselage of the aircraft.

G. ADF Sense Antenna (aircraft 101-108, 151-158, 175, 176) - The ADF sense antenna array consists of four interconnected elements located in the lower fuselage wing fillet area. The elements are cross connected to form two antennas, ADF-1 and ADF-2. The cables of the interconnected elements are cooled by ram air from the brake cooling system. Each element of the flush mounted array is enclosed and supported by epoxied fiberglass cloth. The sense antennas are omnidirectional, and so located as to provide nearly optimum null characteristics. The sense antenna signals are applied to the ADF receivers through sense antenna couplers. The couplers, along with a predetermined length and type of coaxial cables, ensures a proper input impedance match at the receivers.

H. ADF Sense/Loop Antenna (aircraft 109-137, 159, 161-169, 201-216) - The ADF sense/loop antenna contains, in a single low profile dielectric cover, an omnidirectional sense antenna and two directional loop antennas. The two loop antennas are mounted orthogonally. The ADF sense/loop antenna is located on the top fuselage centerline.

2. Operation

A. The ADF receiver operates in either of two modes as selected by the control panel function switch. In the ADF, or ANT mode, the receiver is tunable from 190 to 1749.5 KHz.

B. In the ADF mode, signals from both the loop and sense antennas are applied to the receiver. An equivalent to the RF signal received at the loop antenna is generated with the same relative direction and magnitude by the stator coils within the receiver RF resolver. Maximum voltage is induced into the loop coil when the signal source is perpendicular to the coil axis, and minimum voltage when the signal is on the coil axis (null points). The resultant signal in the resolver will have the same relative direction as the original signal source. The resolver functions as a miniature rotating loop in receiving the resultant RF signal. The receiving pattern of the rotor is a figure-eight, and the phase of the RF output shifts 180 degrees as the null points are crossed. After amplification and phase shifting, the loop signal from the resolver rotor is balance modulated. The RF signal is then applied to one end of a grounded center-tap transformer primary during half of the cycle and to the opposite end of the primary during the second half. Simultaneously, the RF signal from the sense antenna is induced into the transformer secondary through a third winding. Since the nondirectional sense signal does not shift phase, the sense and loop signals add during half of the modulating cycle, then subtract during the other half cycle. One winding of the two-phase loop servo motor is excited by an amplified 110 Hz reference voltage. The second winding is driven by the detected and amplified signal from the balance modulator. The variable-phase detected voltage either leads or lags the reference voltage by 90 degrees depending on the phase of the loop RF. The variable phase leading or lagging the reference phase determines the direction of rotation of the loop servo motor. As the motor rotates, the resolver is driven toward the null. If the rotor revolves past the null, the loop RF voltage and the phase of the resulting variable phase voltage shifts 180 degrees. The motor then changes direction and drives the rotor back toward the null. The position of the resolver rotor is transferred by a transmitting synchro, geared to the resolver rotor, to a receiving synchro in the RDI to position the ADF pointers.

C. In the ANT mode, the receiver accepts signals only from the sense antenna with the loop antenna disconnected from the circuit. The receiver operates as a low-frequency and standard broadcast band receiver with signals from all directions received equally well. The sense antenna rf signal is heterodyned with a local oscillator signal to yield the intermediate frequency, which is detected and amplified. The resultant audio signal is applied to the flight interphone system through the applicable audio selector panel.

3. **To Operate System**

A. Operate

(1) Energize aircraft electrical buses.

(2) On aircraft with EFIS, rotate ADF knobs on EFIS Mode Select Panel to ON.

(3) On ADF control panel, set ADF/ANT switch, if installed, to desired mode of operation.

(4) On control panel set TFR switch to left or right position and tune in proper frequency of selected station.

(5) On convenient audio control panel, set ADF switch to the on (up) position and adjust for comfortable audio level.

(6) Make positive aural identification of station. It is necessary to set control panel A1/NORM switch to A1 position to aurally receive a CW signal.

(7) On ADF control panel, set ADF/ANT switch, if installed, to desired mode of operation.

AUTOMATIC DIRECTION FINDING (ADF) - DESCRIPTION AND OPERATION

1. General

A. The Automatic Direction Finding (ADF) system is a navigational aid that uses radio signals in determining the angle between the aircraft heading and a radio transmitting station. The system provides an indication of relative and magnetic bearing to a selected station with respect to the aircraft, and may also be used to receive aural communication and navigation signals. The ADF receiver is tunable, in 0.5 KHz increments, in the frequency range of 190 to 1750 KHz to receive amplitude-modulated, continuous-wave, radio range signals. Two ADF systems each consisting of a receiver, control panel, D to A converter, and ADF sense/loop antenna are installed.

WJE 892, 893

B. ADF bearing data is displayed on the captain's and first officer's compass indicator. ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Magnetic heading from the compass system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station.

WJE 875-879

C. ADF bearing data is displayed on the captain's and first officer's compass indicator. ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Magnetic heading from the compass system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station. On aircraft with EFIS, ADF bearing is shown on the Navigation Displays (ND's).

WJE 405, 881, 883

D. ADF bearing data is displayed on the captain's and first officer's compass/radio magnetic indicator. ADF-1 bearing is displayed by a single pointer, and ADF-2 by a double pointer. Magnetic heading from the compass system is repeated by the compass cards. Relative bearing of the transmitting station is indicated by the angular displacement of the pointer from the indicator lubber line. Magnetic bearing indicated by the pointer, as read against the rotating compass card, is the sum of the magnetic heading of the aircraft and the relative bearing of the transmitting station. On aircraft with EFIS, ADF bearing is shown on the Navigation Displays (ND's).

WJE 875-879

E. ADF Receiver - The ADF receiver is rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and LED test annunciators. Pressing and holding the TEST button for nine seconds causes the three LEDs to come on for three seconds; go off for three seconds; then the green LED come on for three seconds. When the LED comes on the second time, while button is still pressed, the pointer on the captain's and first officer's compass indicators/ND's will indicate 135 degrees from the lubber line. Also, a tone should be heard in the last second of the test.

WJE 405, 881, 883

F. ADF Receiver - The ADF receiver is rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and LED test annunciators. Pressing and holding the TEST button for nine seconds causes the three LEDs to come on for three seconds; go off for three seconds; then the green LED come on for three seconds. When the LED comes on the second time, while button is still pressed, the double pointer on the captain's and first officer's compass/radio magnetic indicators/ND's will indicate 135 degrees from the lubber line. Also, a tone should be heard in the last second of the test.

WJE 892, 893

G. ADF Receiver - The ADF receiver is rack mounted in the forward right radio rack, in the electrical/electronics compartment. An ARINC 600 electrical connector is mounted on the rear panel. The front panel contains a momentary contact TEST button and LED test annunciators. Pressing and holding the TEST button for nine seconds causes the three LEDs to come on for three seconds; go off for three seconds; then the green LED come on for three seconds. When the LED comes on the second time, while button is still pressed, the double pointer on the captain's and first officer's compass indicators will indicate 135 degrees from the lubber line. Also, a tone should be heard in the last second of the test.

WJE 405, 881, 883

H. ADF Control Panels - The ADF control panels, located on the pedestal, provide the following controls and functions:

Table 1

Control	Function
TONE Switch	Switch provides 1020 Hz modulation for CW reception. Switch to OFF position to receive modulated signals.
ADF/ANT switchs	Selects ADF or ANT mode of operation.
Frequency windows	Display selected receiver frequency in kilohertz.
Frequency select knobs	Simultaneously control rotary position of frequency select switches and frequency display.
TEST pushbutton	Used to initiate system self-test from the flight compartment; performs same function as receiver TEST pushbutton.

WJE 875-879, 892, 893

I. ADF Control Panel - The dual ADF control panel, located on the pedestal, provides the following controls and functions:

WJE 875-879, 892, 893 (Continued)

Table 2

Control	Function
TONE Switch	Switch provides 1020 Hz modulation for CW reception. Left (L) position for ADF-1 receiver. Right (R) position for ADF-2. Switch to OFF position to receive modulated signals.
ADF/ANT/OFF Switches	Select ADF or ANT mode of operation. Left (L) switch controls ADF-1 receiver. Right (R) switch controls ADF-2.
Frequency windows	Display selected receiver frequency in kilohertz. Left (L) display shows ADF-1 frequency. Right (R) display shows ADF-2.
Frequency select knobs	Simultaneously control rotary position of frequency select switches and frequency display.
TEST pushbutton	Used to initiate system self-test from the flight compartment; performs same function as receiver TEST pushbutton.

WJE 405, 875-879, 881, 883, 892, 893

J. In addition to audio controls for other systems, each audio selector panel contains specific ADF audio selection controls that interlock with the ADF control panel. A voice/range filter is an integral part of each audio control panel. The applicable controls and functions are as follows:

Table 3

Control	Function
ADF-1, ADF-2 switches	Provides the capability of selecting and monitoring the output of the ADF receiver through the flight interphone system and controlling volume of ADF signal.
VOICE/IDENT switch	VOICE - Filters out radio range CW and passes voice signals to audio integrating circuit. IDENT - Passes both radio range CW and superimposed voice signals to audio integrating circuit.

K. ADF Sense/Loop Antenna - The ADF sense/loop antenna contains, in a single low profile dielectric cover, an omnidirectional sense antenna and two directional loop antennas. The two loop antennas are mounted orthogonally. The ADF sense/loop antenna is located on the top fuselage centerline.

L. D to A converter, located in the electrical/electronics compartment, converts digital (ARINC 429 data stream) input from the ADF receiver to synchro format, for use in driving the compass indicators ADF pointers.

2. Operation

A. The ADF receiver operates in either of two modes as selected by the ADF/ANT switch. In the ADF, or ANT mode, the receiver is tunable from 190 to 1750 KHz.

B. In the ADF mode, signals from both the loop and sense antennas are used simultaneously by the ADF receiver to provide the bearing of a selected radio station to the aircraft, and audio information through the flight interphone system.

(1) The directional characteristics of the loop antenna are used to determine the bearing to a selected ground station. The received signal strength is relative to the position of the antenna with respect to the ground station. The loop antennas are mounted in a fixed position on the aircraft and are physically positioned 90° apart. One antenna is oriented to receive maximum signal strength when the aircraft is on a direct heading to or from the ground station and minimum signal when headed at right angles from the ground station. The signal strength of this loop antenna is proportional to the cosine function of the relative angle between aircraft heading and ground station bearing. The other loop antenna signal strength is maximum at 90° and 270° and minimum at zero and 180° (sine function). The signals received from the loop antennas may appear to be from either of two directions 180° apart. In order to eliminate the 180° ambiguity, the sine and cosine signals are combined with the nondirectional signal from the sense antenna.

WJE 892, 893

(2) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The digitized data is output by way of an ARINC 429 data stream to a digital-to-synchro converter, which drives the ADF pointers on the compass indicators. Audio output is applied to the flight interphone system through the applicable audio selector panel.

WJE 405, 881, 883

(3) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The digitized data is output by way of an ARINC 429 data stream to a digital-to-synchro converter, which drives the ADF pointers on the indicators/ ND's. Audio output is applied to the flight interphone system through the applicable audio selector panel.

WJE 875-879

(4) The combined sine, cosine, and sense antenna signals are compared with an internal signal to determine relative bearing which is digitized. The data is sent on an ARINC 429 data bus to a digital-to-analog converter, which drives the ADF pointers on the compass indicators. On aircraft with EFIS, digital bearing data is also sent to the symbol generators for display on the ND's. Audio output is applied to the flight interphone system through the applicable audio selector panel.

WJE 405, 875-879, 881, 883, 892, 893

C. In the ANT mode, the receiver accepts signals only from the sense antenna with the loop antennas disconnected from the circuit. The receiver operates as a low-frequency and standard broadcast band receiver with signals from all directions received equally well. The sense antenna RF signal is heterodyned with a local oscillator signal to yield the intermediate frequency, which is detected and amplified. The resultant audio signal of the selected station is applied to the flight interphone system through the applicable audio selector panel.

3. To Operate System

A. Operate

(1) Energize aircraft electrical buses.

WJE 875-879, 892, 893

(2) Place VOR/ADF switch on compass indicators to ADF position.

WJE 405, 881, 883

(3) Place VOR/ADF switch on compass indicators/RMI's to ADF position.

WJE 405, 875-879, 881, 883

(4) On aircraft with EFIS, rotate ADF knobs on EFIS Mode Select Panel to ON.

WJE 405, 881, 883

(5) On ADF control panel, set ADF/ANT switch to ANT position.

WJE 875-879, 892, 893

(6) On ADF control panel, set ADF/ANT/OFF switch to ANT position.

WJE 405, 875-879, 881, 883, 892, 893

(7) On ADF control panel, rotate frequency select knobs to tune in proper frequency of selected station.

WJE 875-879, 892, 893

(8) On convenient audio control panel, set ADF switch to the on (up) position and adjust for comfortable audio level.

WJE 405, 881, 883

(9) On convenient audio control panel, set ADF switch to the on position and adjust for comfortable audio level.

WJE 405, 875-879, 881, 883, 892, 893

(10) Make positive aural identification of station. TONE switch must be in L or R position to aurally receive a CW signal.

WJE 405, 881, 883

(11) On ADF control panel, set ADF/ANT switch to desired mode of operation.

WJE 875-879, 892, 893

(12) On ADF control panel, set left (ADF-1) and right (ADF-2) ADF/ANT switch to desired mode of operation.

AUTOMATIC DIRECTION FINDING (ADF) - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ADF system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable Units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The major components of the ADF system are: ADF control panels, ADF receivers, loop antenna, and sense antenna. The system interfaces with the horizontal Situation Indicators (HSI), and audio control panels. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

E. The ADF components are located as follows:

Table 101

Component	Location
Control Panels	Flight Compartment Pedestal
ADF Receivers	Radio Rack, Electrical/Electronics Compartment
Loop Antenna	Forward Top Fuselage
Sense Antennas	Lower Wing Fillets
ADF Circuit Breakers	EPC Circuit Breaker Panel
Horizontal Situation Indicators	Captain's and First Officer's Instrument Panels

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name & Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting ADF System

A. Trouble Shoot

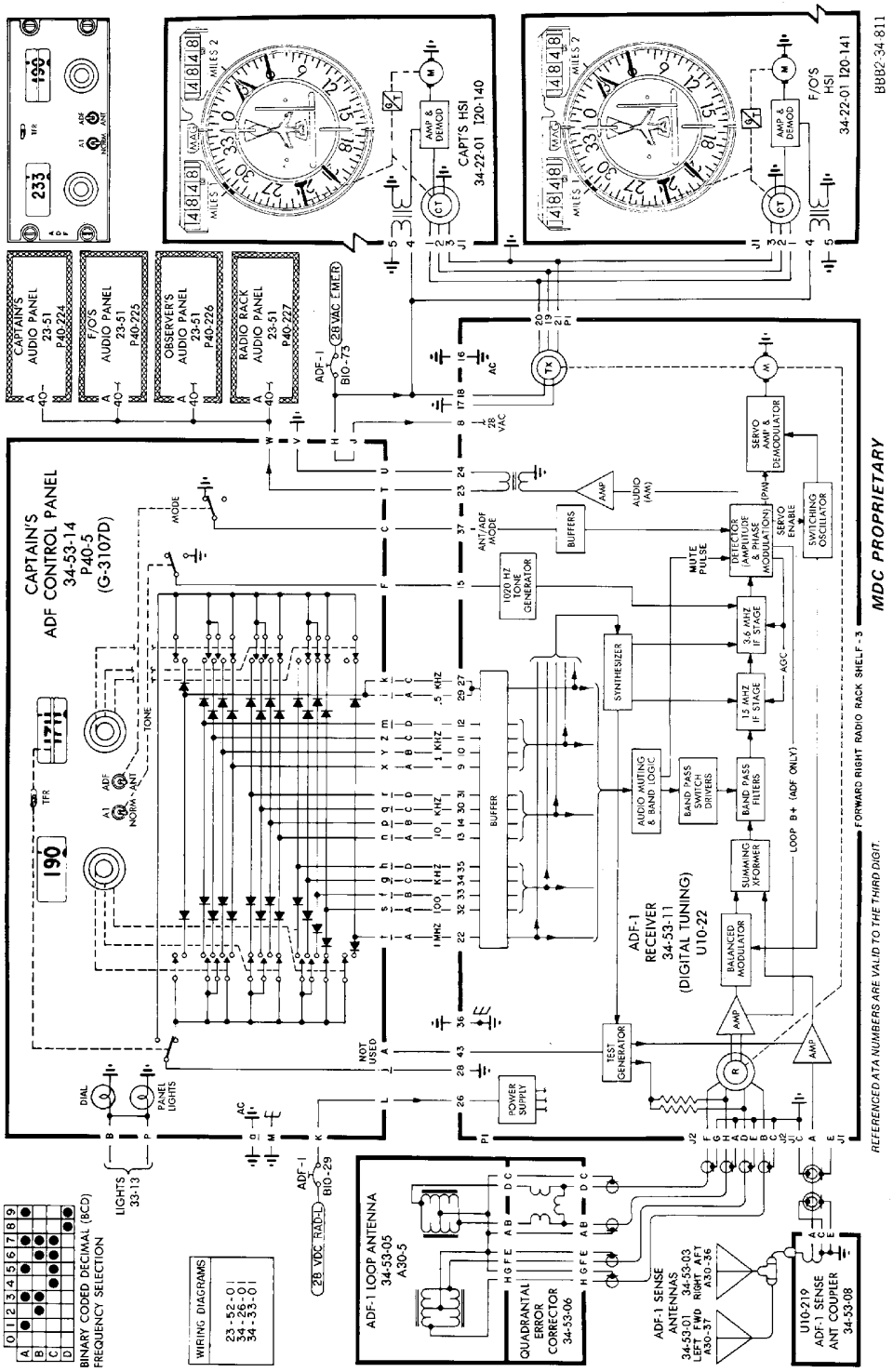
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

Table 103

Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.

Table 103 (Continued)

Procedure	Correction
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



ADF-1 System - Schematic
Figure 101/34-53-00-990-803

AUTOMATIC DIRECTION FINDING (ADF) - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ADF system in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable Units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887

D. The major components of the ADF system are: ADF control panels, ADF receiver(s), ADF sense/loop antenna(s). The system interfaces with the Electronic Flight Instrument System (EFIS), instrument amplifiers, and audio control panels. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

WJE 875-879

E. The major components of the ADF system are: ADF control panels, ADF receiver(s), ADF sense/loop antenna(s). The system interfaces with the Compass Indicators (CI), instrument amplifiers, and audio control panels. The system also interfaces with the Electronic Flight Instrument System (EFIS), if installed. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

WJE 405-411, 873, 874, 880, 881, 883, 884, 892, 893

F. The major components of the ADF system are: ADF control panels, ADF receiver(s), ADF sense/loop antenna(s). The system interfaces with the Compass Indicators/Radio Magnetic Indicators, instrument amplifiers, and audio control panels. The system also interfaces with the Electronic Flight Instrument System (EFIS), if installed. In trouble shooting some checks may have to be made to these interfacing systems. See applicable trouble shooting sections.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893

G. The ADF components are located as follows:

Table 101

Component	Location
Control Panels	Flight Compartment Pedestal
WJE 405-411, 873-881, 883, 884, 892, 893	
ADF Receivers	Radio Rack, Electrical/Electronics Compartment
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
ADF Receivers	Electrical/Electronics Compartment
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893	
Sense/Loop Antenna	Forward Top Fuselage
ADF Circuit Breakers	EPC Circuit Breaker Panel

Table 101 (Continued)

Component	Location
WJE 875-879	
Compass Indicators	Captain's and First Officer's Instrument Panels
WJE 405-411, 873, 874, 880, 881, 883, 884, 892, 893	
Compass Indicators/ Radio Magnetic Indicators	Captain's and First Officer's Instrument Panels
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
EFIS Navigation Displays (ND)	Captain's and First Officer's Instrument Panels
WJE 405-411, 873-881, 883, 884, 892, 893	
D to A Converter(s) (aircraft with EFIS)	Radio Rack, Electrical/Electronics Compartment
EFIS Navigation Displays (ND) (aircraft with EFIS)	Captain's and First Officer's Instrument Panels
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 886, 887	
Primary Flight Displays (PFD's) (EFIS Interface Components)	Captain's and First Officer's Instrument Panels
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893	

2. **Equipment and Materials**

NOTE: Equivalent substitutes can be used in place of the following listed items.

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 892, 893

Table 102

Name & Number	Manufacturer
WJE 401-412, 414, 873-881, 883, 884, 892, 893	
Multimeter 2000A	Dana
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872	
Multimeter Model 8025A	Fluke

WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893

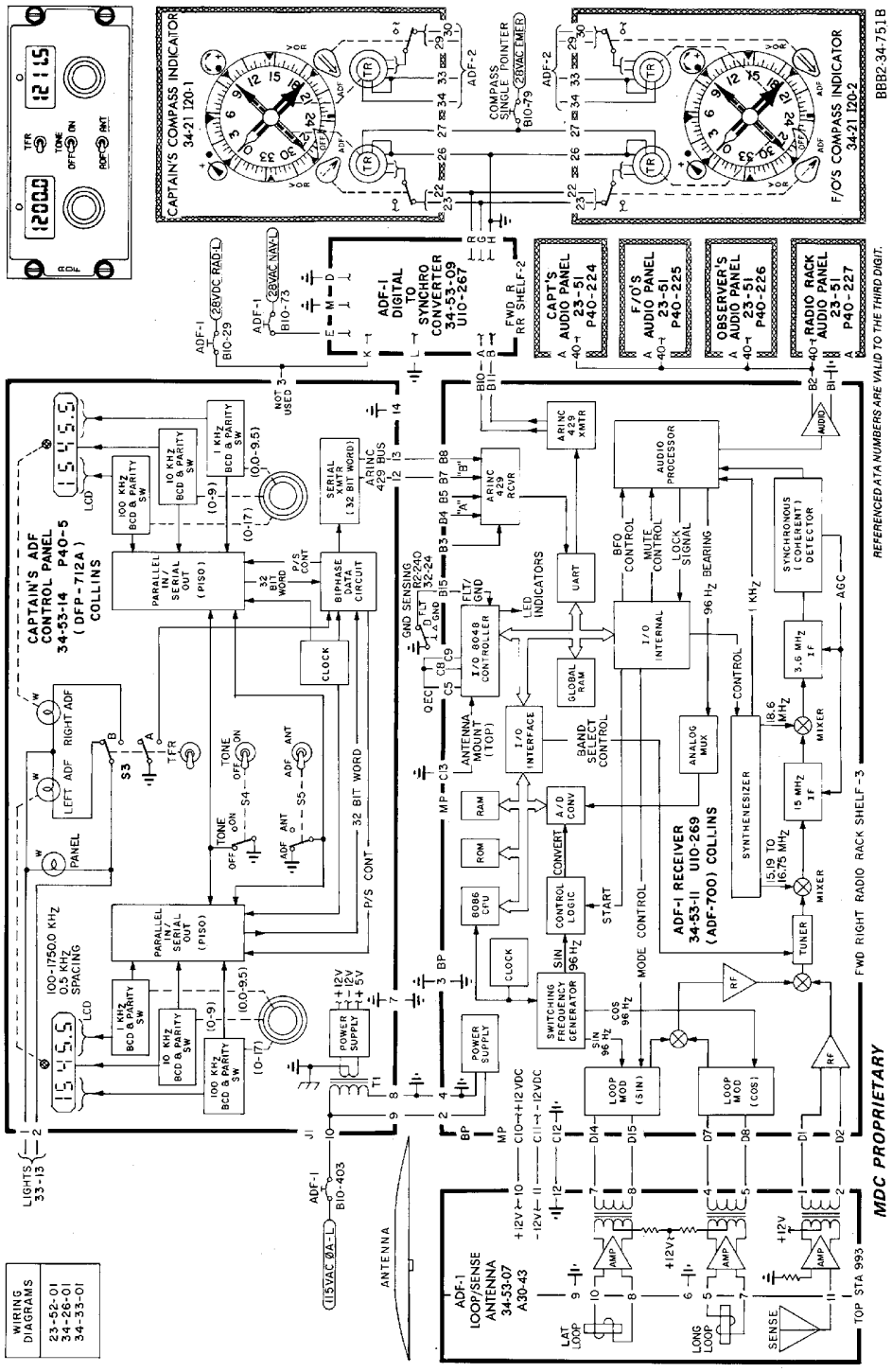
3. **Trouble Shooting ADF System**

A. Trouble Shoot

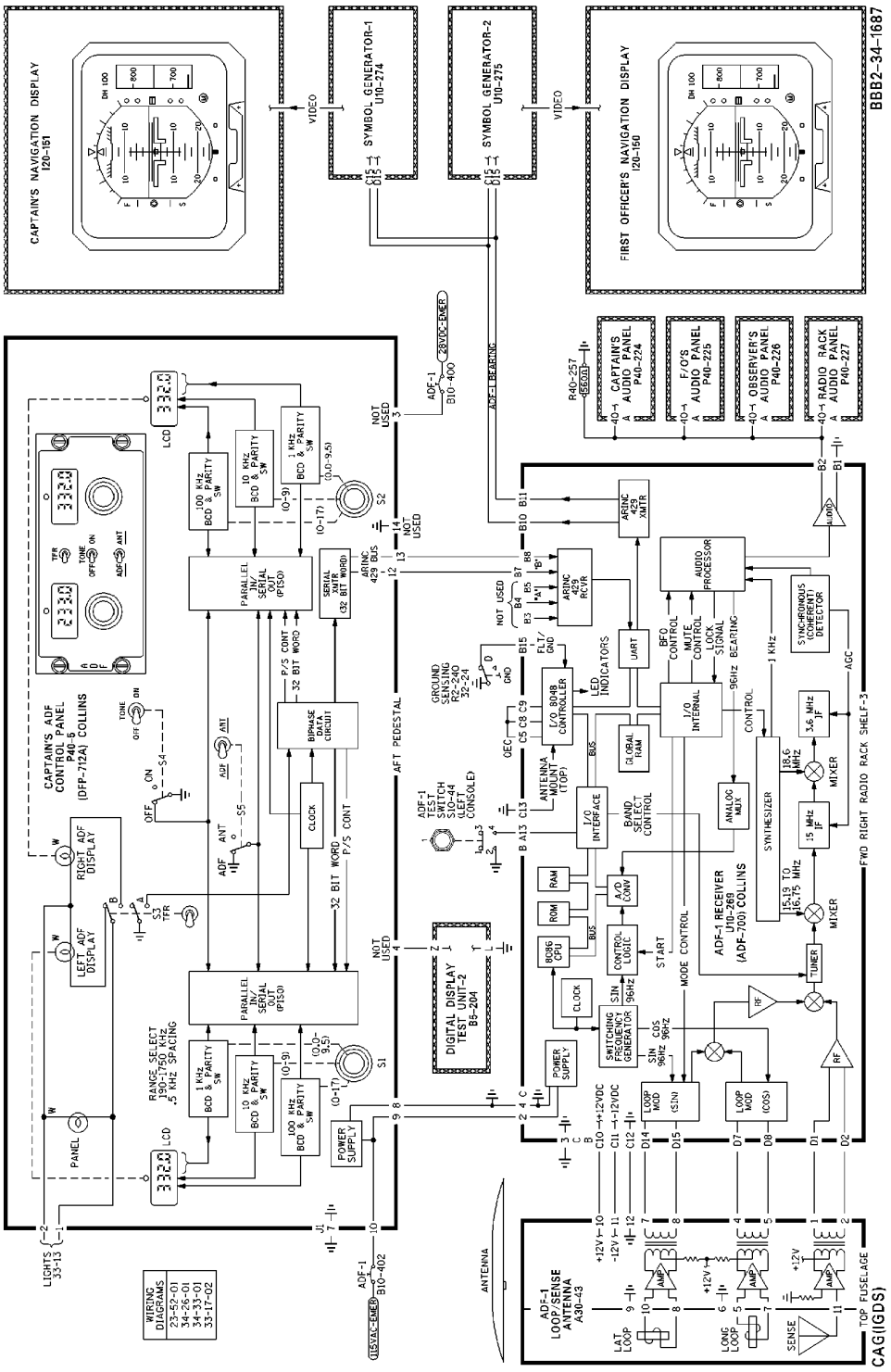
NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

Table 103

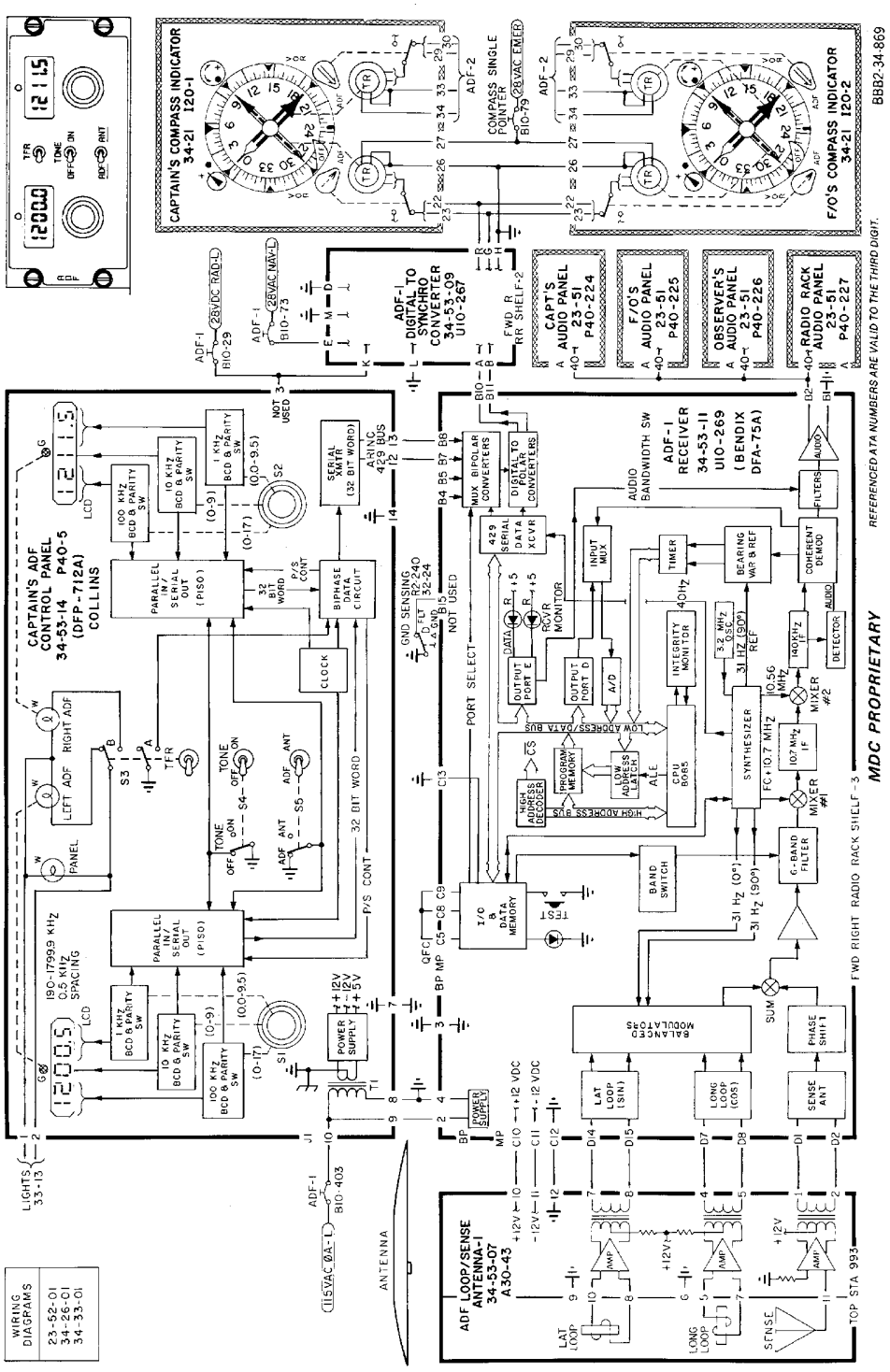
Procedure	Correction
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded. Replace LRUs.
(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4) In a dual system, interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.



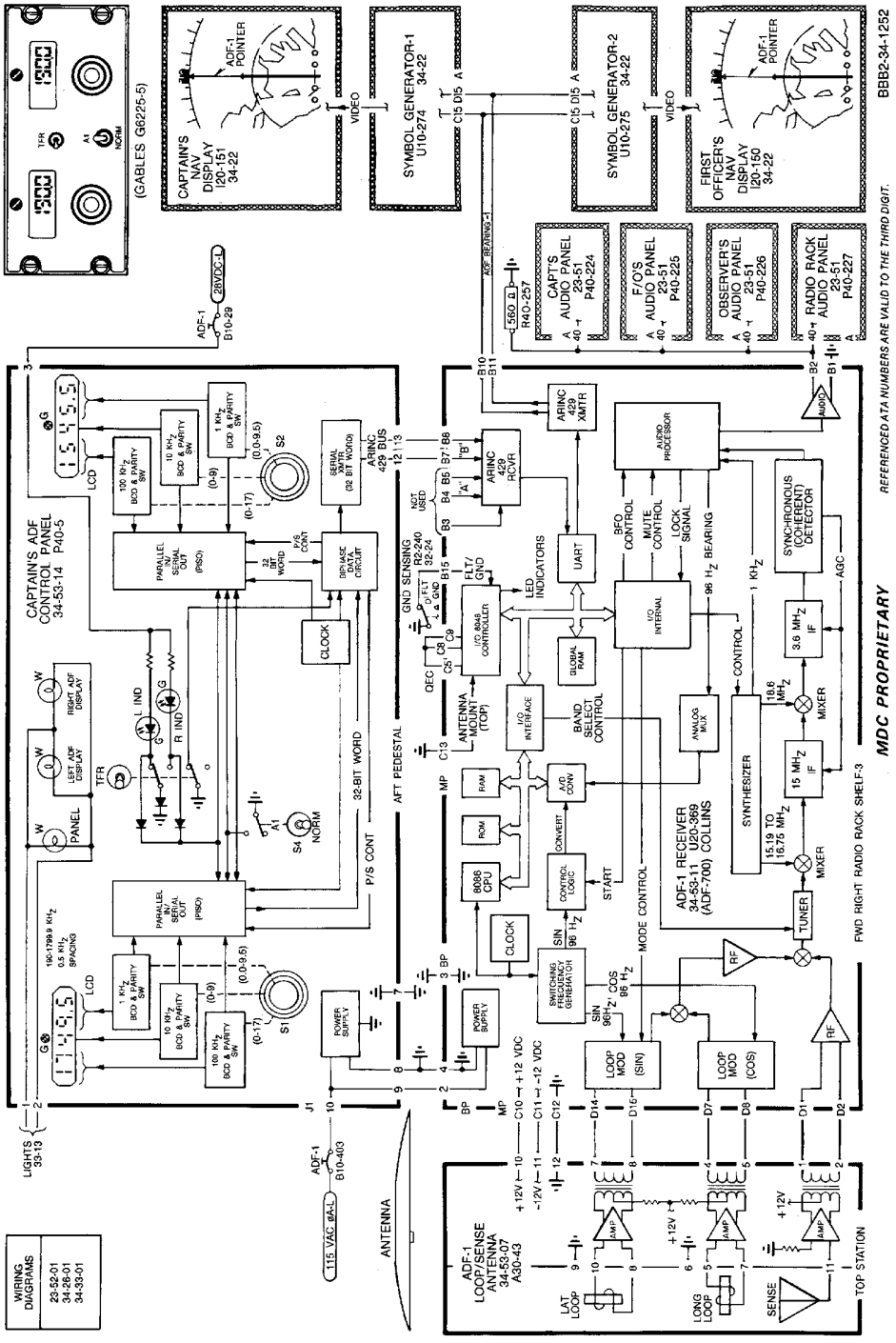
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 1 of 7)



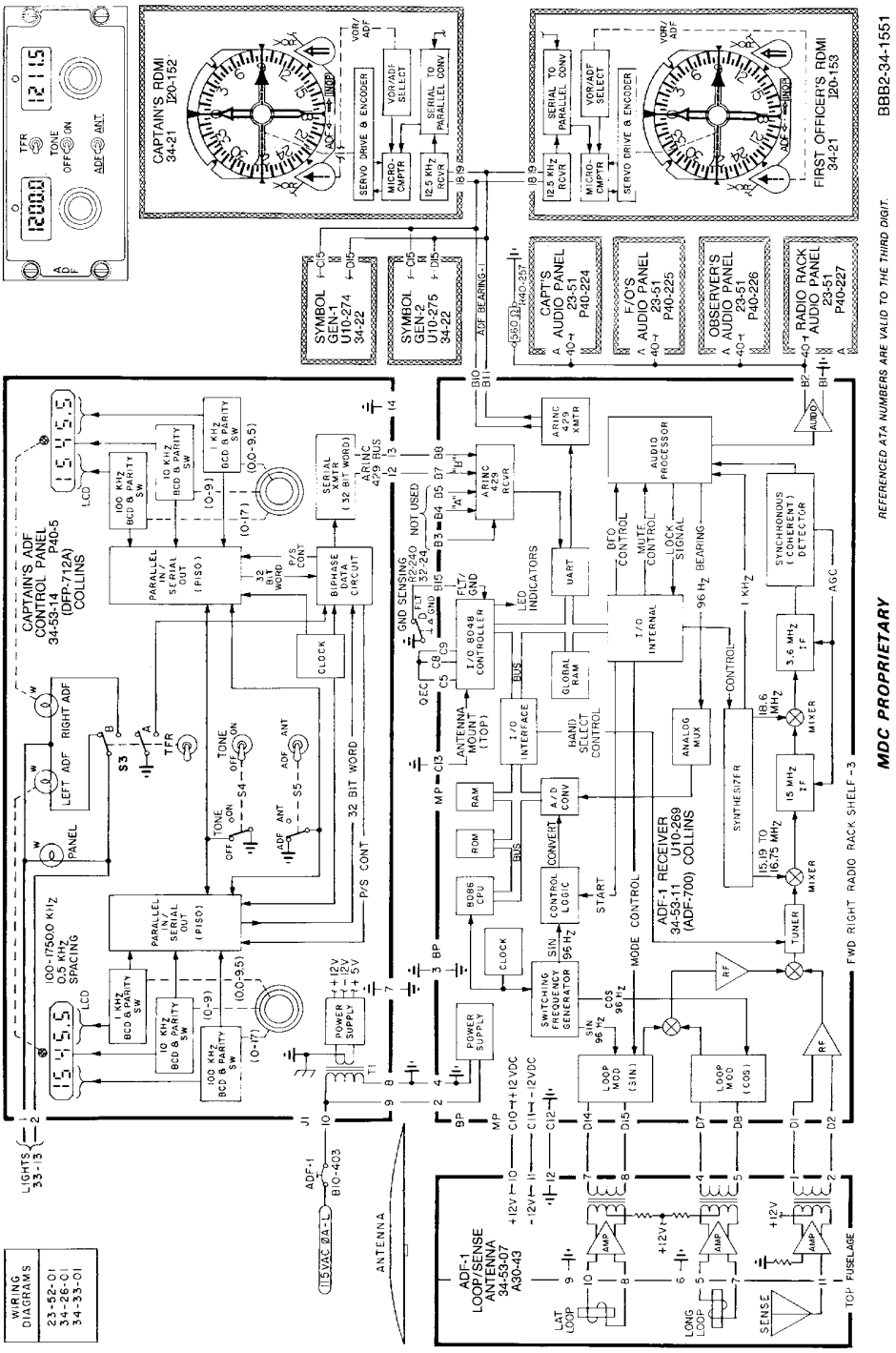
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 2 of 7)



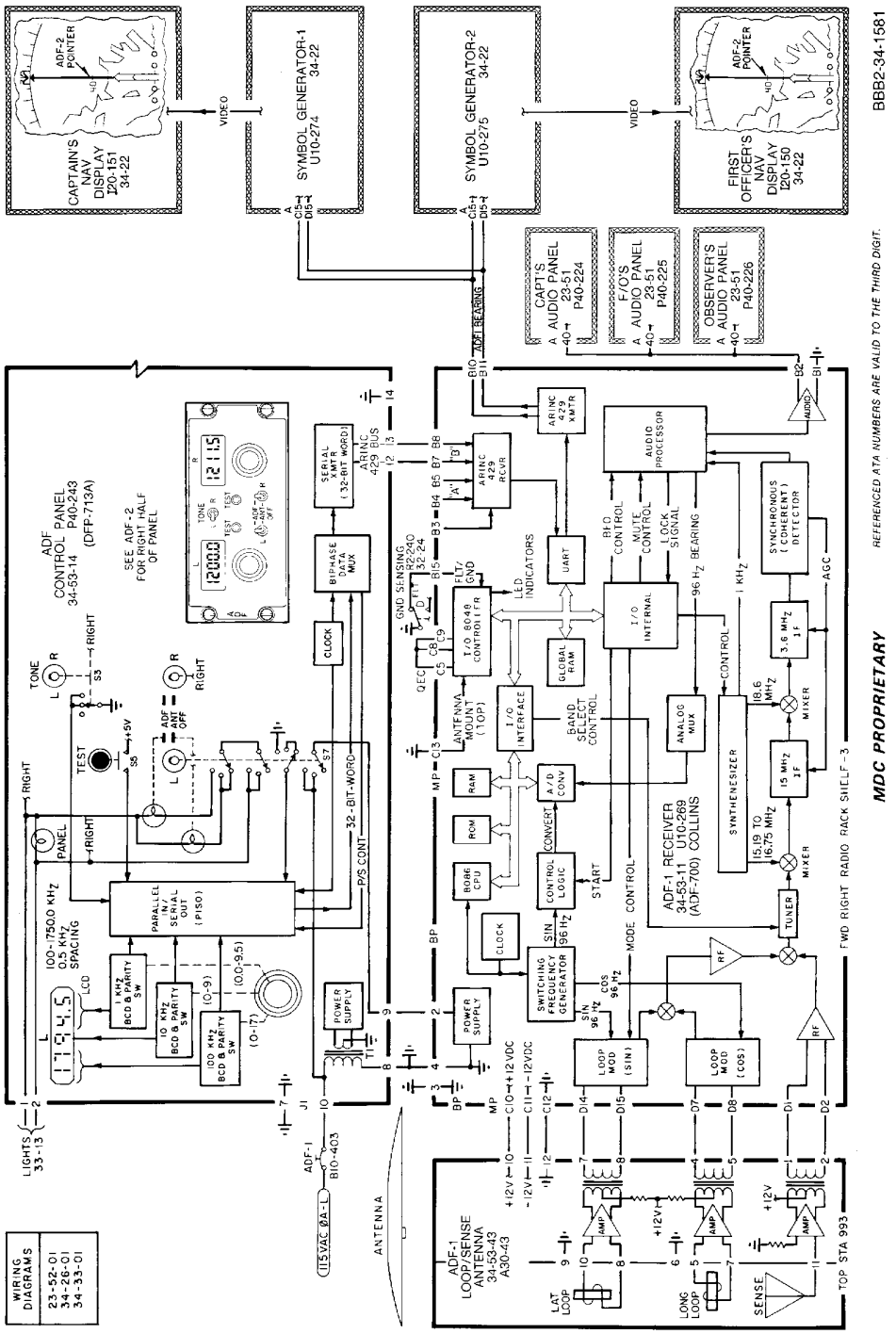
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 3 of 7)



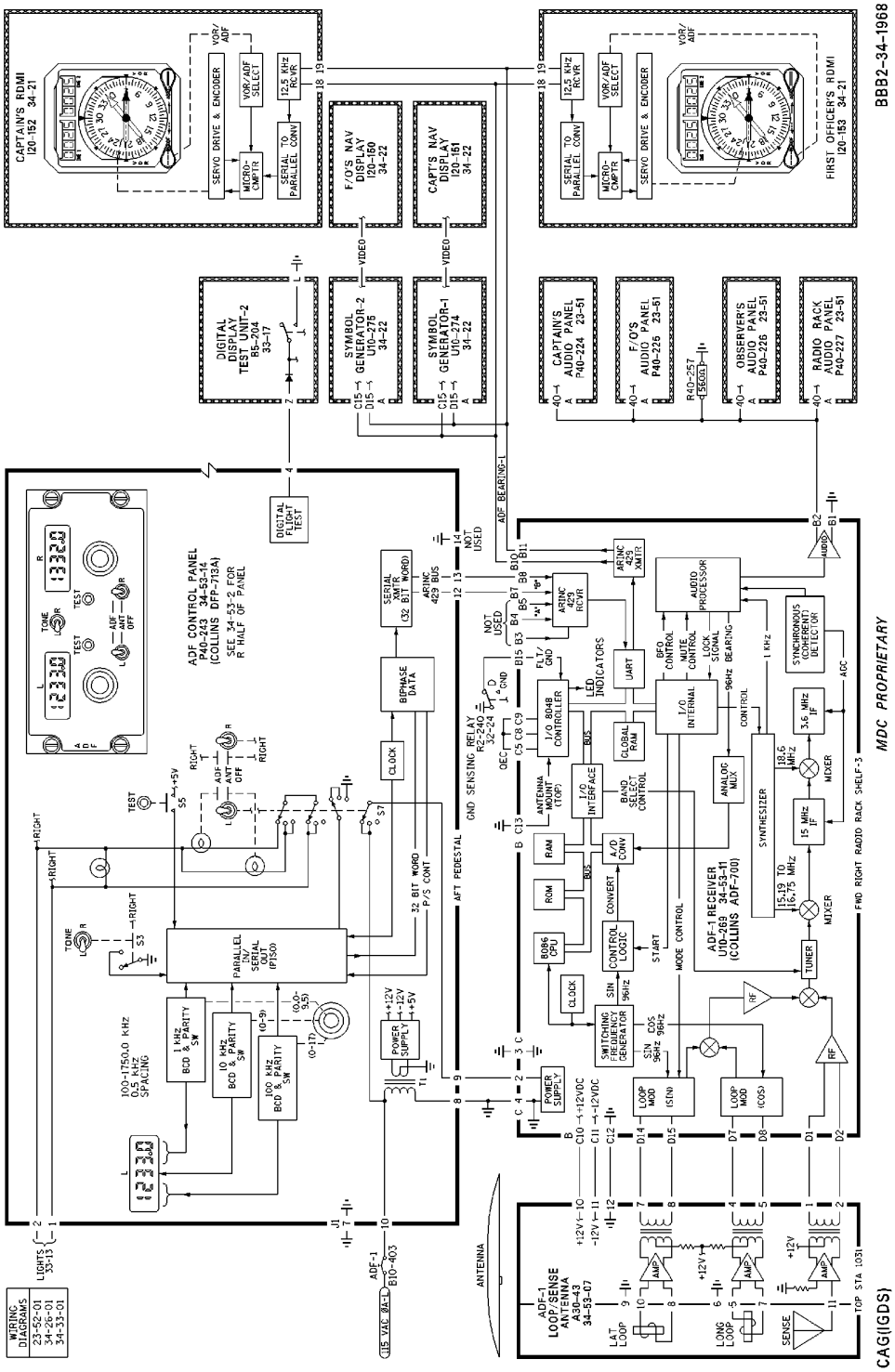
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 4 of 7)



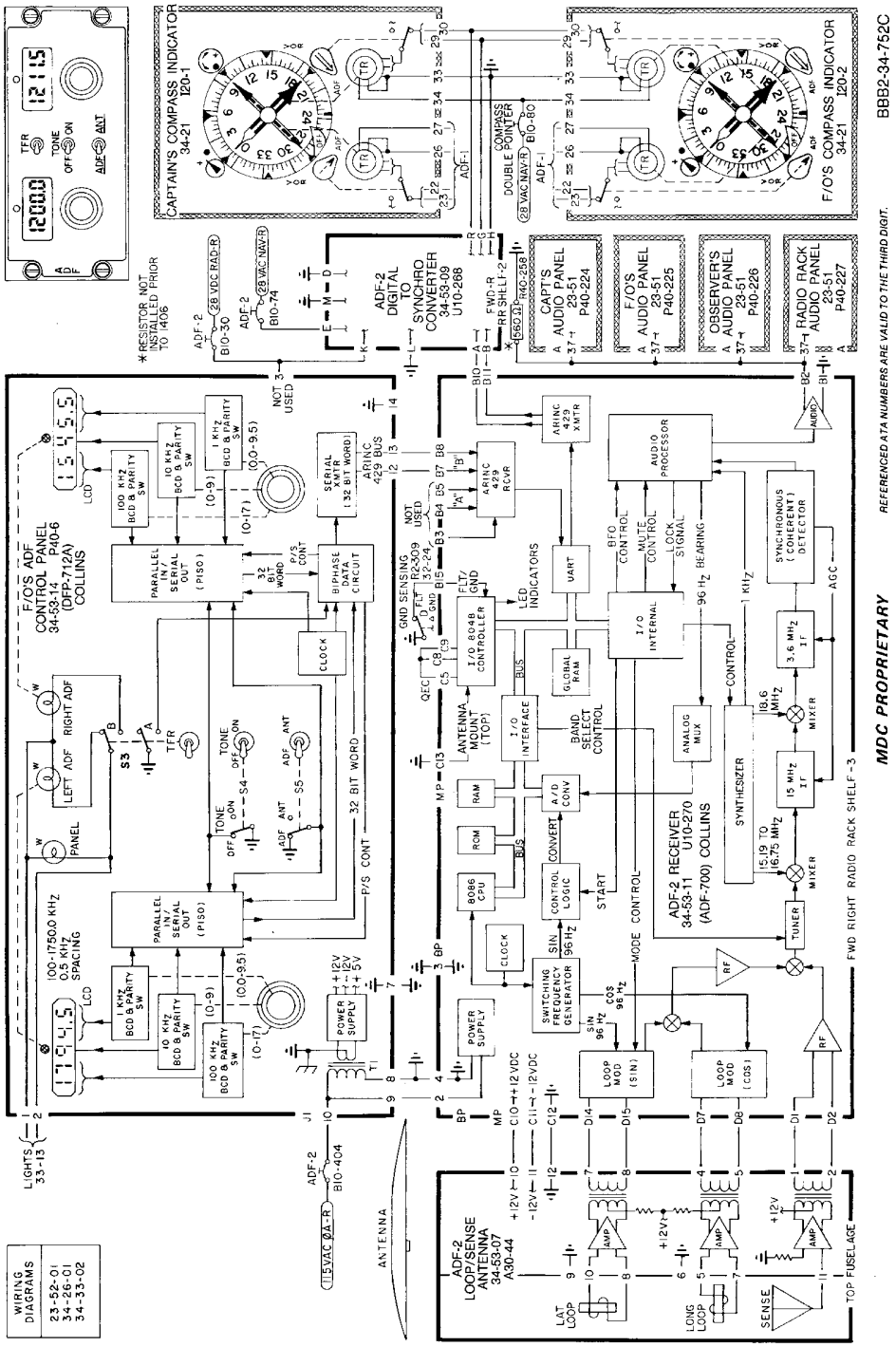
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 5 of 7)



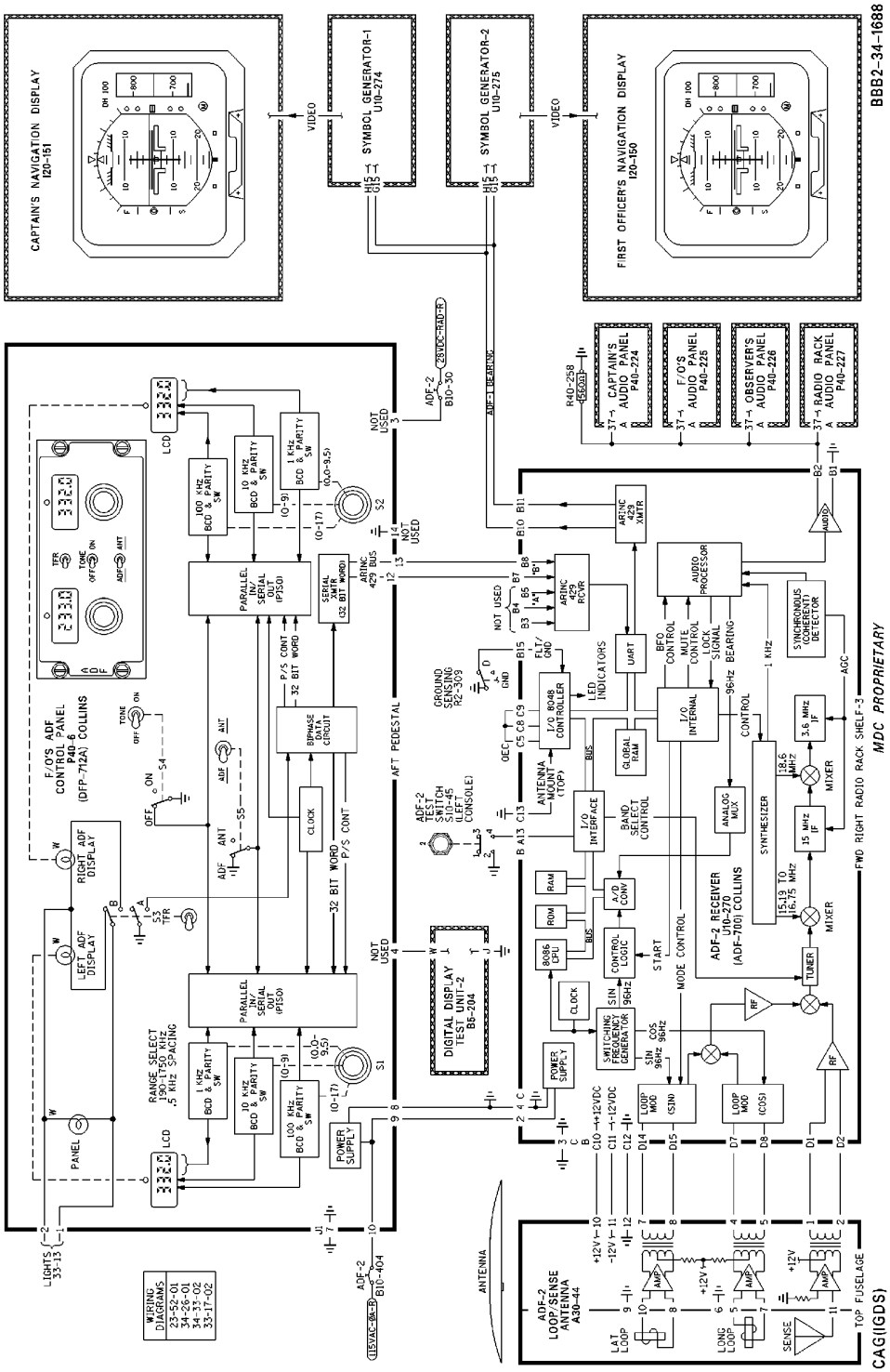
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 6 of 7)



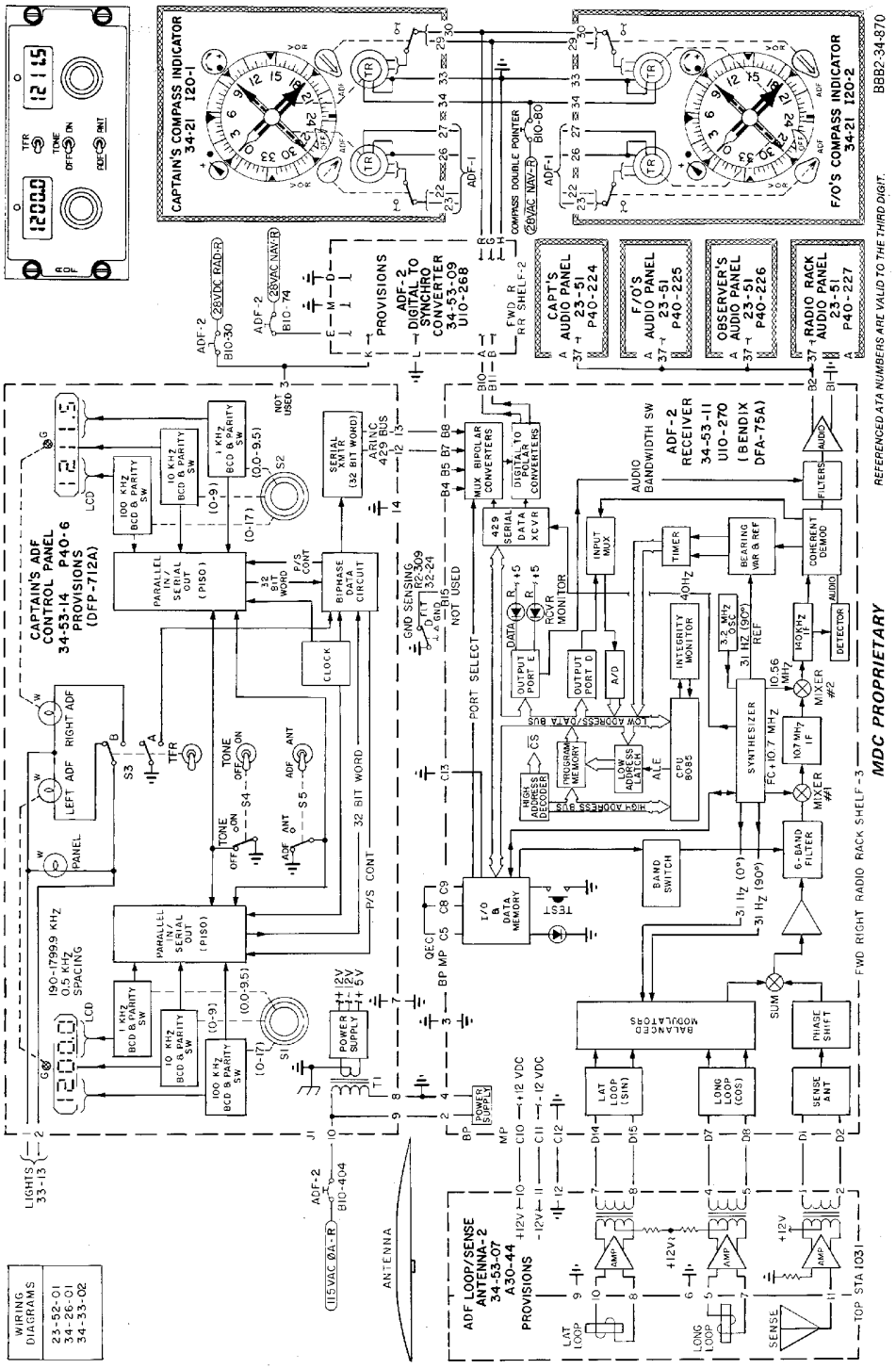
ADF-1 System - Schematic
Figure 101/34-53-00-990-809 (Sheet 7 of 7)



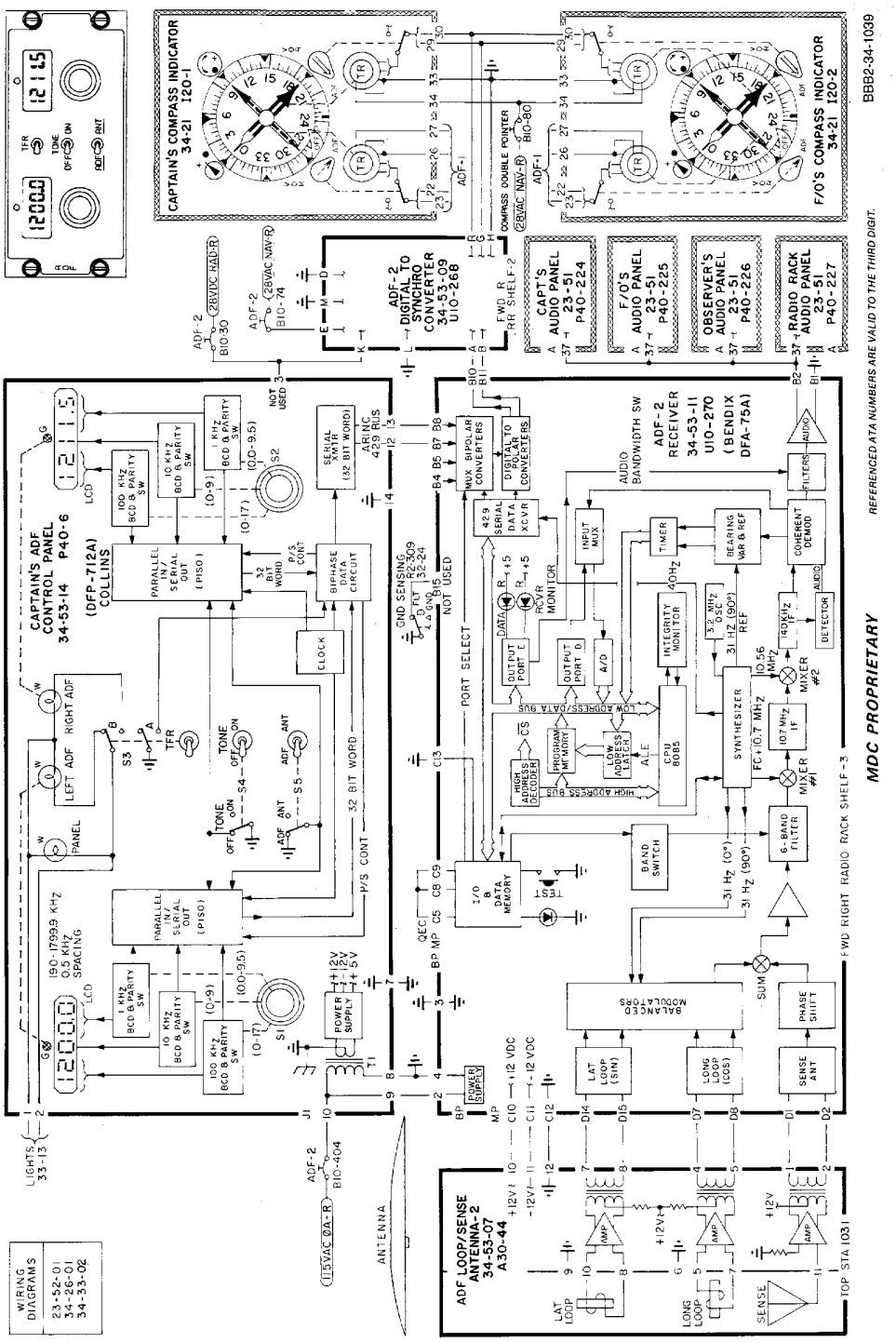
ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 1 of 7)



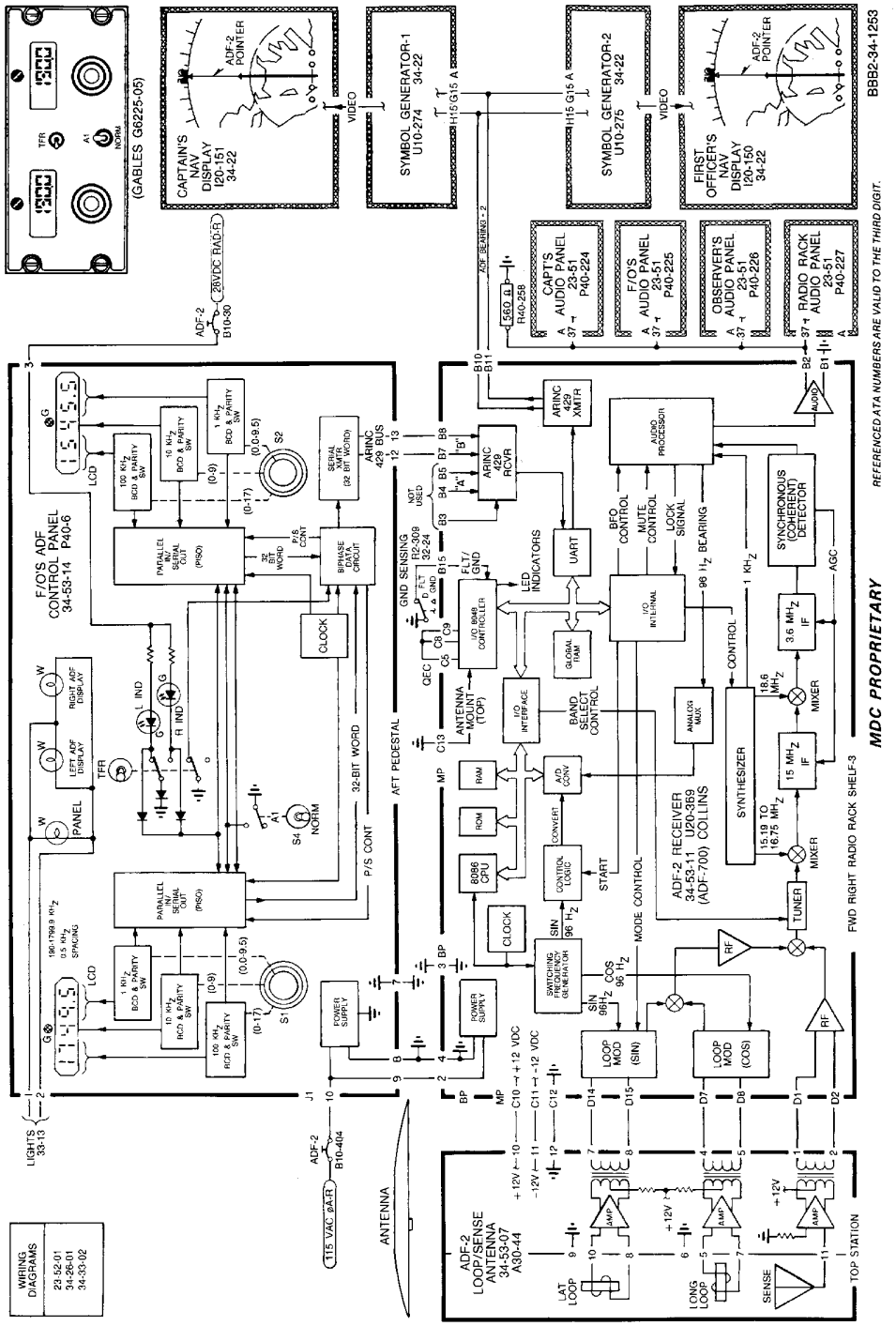
ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 2 of 7)



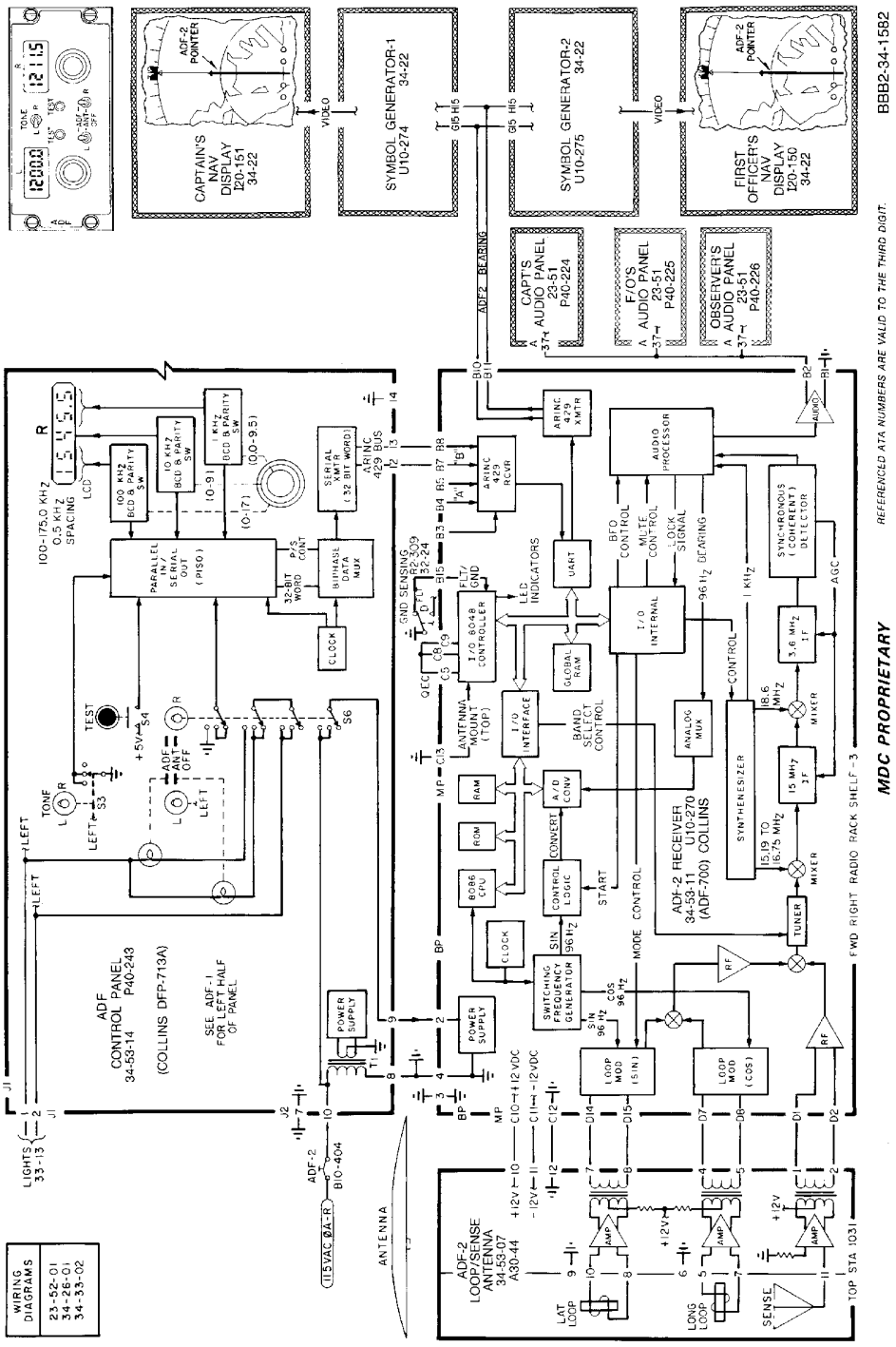
ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 3 of 7)



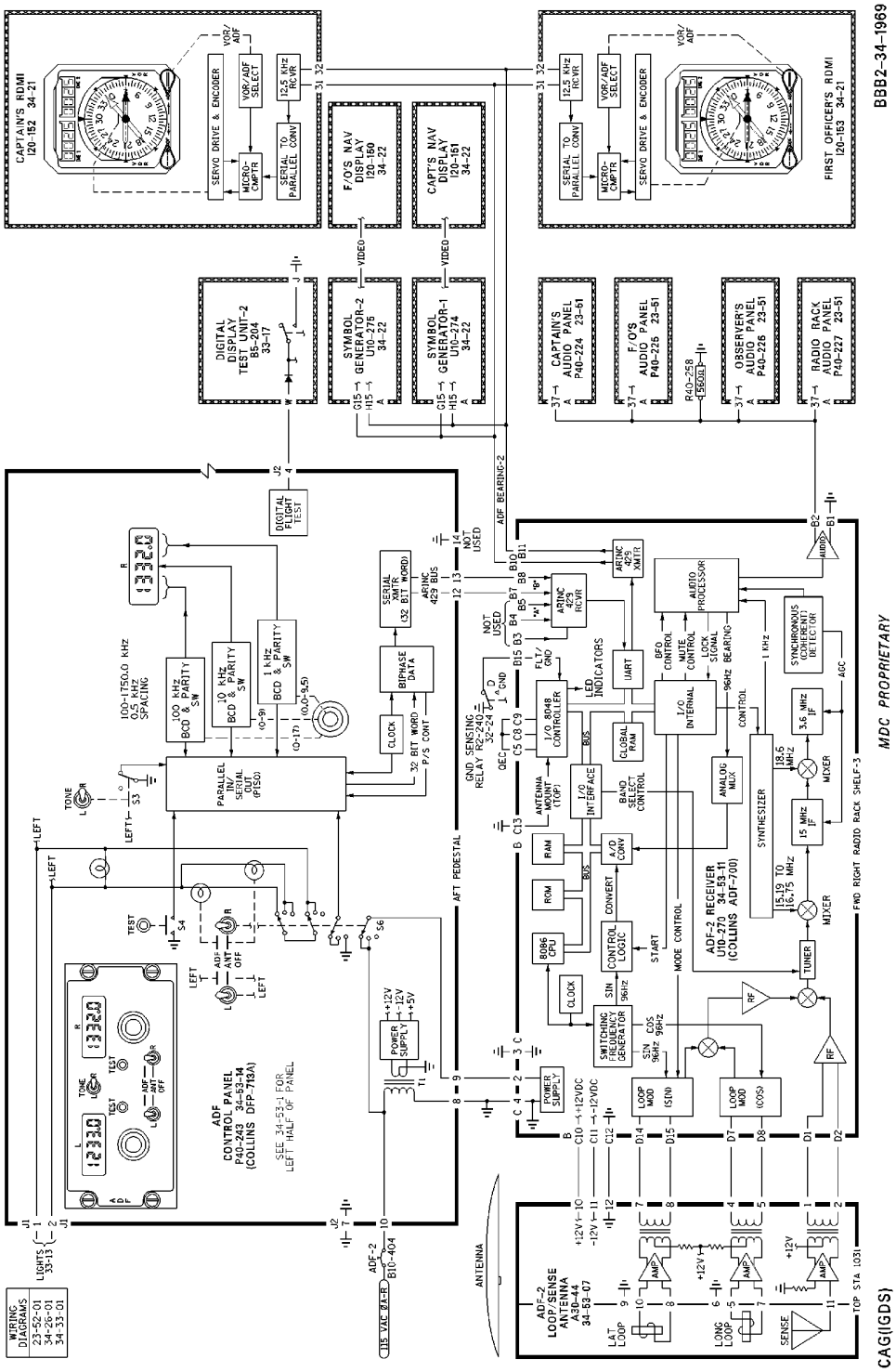
ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 4 of 7)



ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 5 of 7)



ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 6 of 7)



ADF-2 System - Schematic
Figure 102/34-53-00-990-810 (Sheet 7 of 7)

AUTOMATIC DIRECTION FINDING (ADF) - MAINTENANCE PRACTICES

1. General

WJE 407, 408, 411, 880 PRE MD80-34-285

A. The automatic direction finding (ADF) system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. The system is operated from a control panel on the pedestal, with ADF bearing displayed on the captain's and first officer's compass indicator (aircraft 126-127) or RMI (aircraft 104-106, 128-999).

WJE 405, 406, 409, 410, 881, 883, 884 PRE MD80-34-285

B. The automatic direction finding (ADF) system is a navigational aid that uses radio signals to determine the angle between the airplane heading and a selected radio station. The systems are operated from control panels on the pedestal, with ADF bearing displayed on the captain's and first officer's compass/radio magnetic indicators. On aircraft with EFIS, ADF bearing is shown on the Navigation Displays (ND's).

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

C. The automatic direction finding (ADF) system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. The system is operated from a control panel on the pedestal, with ADF bearing displayed on the Captain's and First Officer's navigation displays (ND'S).

WJE 405-411, 880, 881, 883, 884

D. Audio controls that interface with the ADF control panel are contained on the captain's, first officer's, observer's, and radio rack audio selector panels.

2. Adjustment/Test ADF

A. Self Test ADF

WJE 407, 408, 411, 880 PRE MD80-34-285

Table 201

Operation		Desired Result
(1)	Press and hold TEST push- button, on front of ADF receiver, for minimum of ten seconds; and verify following test sequence.	Test sequence verified.
(a)	Three LED test annunciators (CONTROL INPUT FAIL, LRU STATUS PASS, and LRU STATUS FAIL) come on for approximately three seconds.	
(b)	LED test annunciators go off for two to three seconds.	
(c)	LRU STATUS PASS LED comes on; and applicable ADF pointers on compass indicators/RMI's indicate 135°, from lubber line.	
(d)	Release TEST pushbutton; system returns to normal operation.	

WJE 405, 406, 409, 410, 881, 883, 884 PRE MD80-34-285

Table 202

Operation		Desired Result
(1)	Energize airplane electrical buses.	
(2)	Press and hold TEST push- button, on front of ADF-1 receiver, for minimum of ten seconds; and verify following test sequence.	Test sequence verified.
(a)	Three LED test annunciators (CONTROL INPUT FAIL, LRU STATUS PASS, and LRU STATUS FAIL) come on for approximately three seconds.	
(b)	LED test annunciators go off for two to three seconds.	
(c)	LRU STATUS PASS LED comes on; and applicable ADF pointers on compass indicators position at 135°, from lubber line.	
(d)	Release TEST pushbutton; system returns to normal operation.	

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

Table 203

Operation		Desired Result
(1)	Activate self test function on front of ADF-1 control panel to TEST position.	Self test activated.
(2)	Listen to test tone in cockpit.	Tone heard.
(3)	Read ADF-1 bearing on Captain's and First Officer's Navigation Displays (single pointer). Captain's Navigation Display First Officer's Nav. Display	 135° (±5°). 135° (±5°).
(4)	Activate self test function on front of ADF-2 control panel to TEST position.	Self test activated.
(5)	Listen to test tone in cockpit.	Tone heard.
(6)	Read ADF-2 bearing on Captain's and First Officer's Navigation Displays (double pointer). Captain's Navigation Display First Officer's Nav. Display	 135° (±5°). 135° (±5°).
(7)	For aircraft with MODE switch read ADF-1 bearing on Captain's and First Officer's Navigation Displays (single pointer). Captain's Navigation Display First Officer's Nav. Display	 135° (±5°). 135° (±5°).
(8)	Mode switch to TEST selected.	TEST position.
(9)	Read ADF-2 bearing on Captain's and First Officer's Navigation Displays (double pointer).	

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285 (Continued)

Table 203 (Continued)

Operation		Desired Result
	Captain's Navigation Display	135° (±5°).
	First Officer's Nav. Display	135° (±5°).
(10)	MODE switch to ADF position.	TEST OFF.
(11)	Return aircraft to required configuration.	

WJE 405-411, 880, 881, 883, 884

B. Test Radio Reception

WJE 407, 408, 411, 880 PRE MD80-34-285

Table 204

Operation		Desired Result
(1)	Energize aircraft electrical buses.	
(2)	On convenient audio selector panel, set ADF-1 switch to ADF-1 switch to UP position, and VOICE/IDENT switch to VOICE position.	
(3)	On ADF-1 control panel, set ADF/ANT switch to ANT position, and TFR switch to left position.	Annunciator light above left frequency window comes on; and annunciator light over right window is off.
(4)	Tune ADF receiver to local radio station.	Provide rf input signal to system.
(5)	On ADF control panel, set A1/NORM switch to A1 position.	Verify presence of tone at audio selector panel.
(6)	Set A1/NORM switch to NORM position.	
(7)	On ADF-1 control panel, set TFR switch to right hand position.	Annunciator light over left frequency window goes off, and annunciator light over right window comes on.
(8)	On ADF-1 control panel, use right hand frequency selector to tune local ADF station.	
(9)	On audio selector panel, set VOICE/IDENT switch to IDENT position.	Both voice and range signals heard at audio selector panel.
(10) .	Set VOICE/IDENT switch to VOICE position	Range signal should become faint or disappear and voice heard at audio selector panel.
(11)	Repeat steps (2) through (10), using ADF-2 control panel, and ADF-2 switch on audio selector panel.	

WJE 405, 406, 409, 410, 881, 883, 884 PRE MD80-34-285

Table 205

Operation		Desired Result
(1)	On convenient audio control panel set ADF-1 switch to on (up) position.	
(2)	On any audio control panel, set VOICE/IDENT switch to VOICE position.	

WJE 405, 406, 409, 410, 881, 883, 884 PRE MD80-34-285 (Continued)

Table 205 (Continued)

Operation		Desired Result
(3)	Place ADF/ANT switch on ADF-1 control panel to ANT position.	
(4)	Set TFR switch on ADF-1 control panel to left position.	Annunciator light above left frequency window comes on; and annunciator light over right window is off.
(5)	Tune ADF receiver to local radio station, using left hand selector.	Provide rf input signal to system.
(6)	Adjust volume to comfortable level by adjusting ADF-1 control on audio control panel.	Volume adjusted; audio heard.
(7)	Place TONE switch on ADF control panel in ON position.	TONE ON.
(8)	Verify presence of tone.	1000 Hz tone should be clear at audio panels.
(9)	Set TFR switch to right position.	Annunciator light above right frequency window comes on; and annunciator light above left window goes off.
(10)	Place TONE switch in OFF position.	
(11)	Tune ADF-1 receiver to local radio station, using left hand selector.	Provide rf input signal to system.
(12)	Set VOICE/IDENT switch to IDENT position.	Both voice and range tone should be heard at each audio panel.
(13)	Set VOICE/IDENT switch to VOICE position.	Range signal should become faint or disappear and voice heard at audio selector panel.
(14)	Place ADF/VOR switch on compass indicators/RMI's to ADF position. On aircraft with EFIS, select ROSE and ADF modes on EFIS mode select panels.	
NOTE: This test should be made outside in an open area away from metallic objects that might cause variable field distortion. Two or more radio stations of different heading should be selected and the apparent heading of these stations (from the test site) accurately determined. To avoid irregular variations in the earth's magnetic field, these stations should have primarily a ground wave field at the test site. (Low frequency stations have greater ground wave radiations than high frequency stations.)		
NOTE: Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.		
(15)	Place ADF/ANT switch in ADF position.	ADF selected.
(16)	Single pointer on both compass indicators turn in unison.	Pointers turn.
(17)	Note indicated bearing of pointers.	Bearing on both indicators/ND's agrees within ±5°
(18)	Set ADF-1 audio control to off (down) position.	
(19)	Repeat Paragraph 2. using ADF-2 system, if installed.	

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

C. Audio Functional Test

NOTE: The following test is performed to check the aural capabilities of the ADF system for both voice and CW signals. It is recommended to perform this test when the aircraft is outside of the building to achieve better results.

NOTE: If frequencies noted below are not available, tune into any other four frequencies.

Table 206

	Operation	Desired Result
(1)	Set Captain's cockpit speaker volume control to mid-range position. Set First Officer's (F/O's) speaker in OFF position.	Captain's speaker ON, First Officer's speaker OFF.
(2)	On ADF control panel, place ADF/ANT switch to ANT position, A1/NORM switch to NORM, and TFR switch to left hand position.	Tone off, left dial light comes on.
(3)	Set ADF left frequency selector to 640.0. Set ADF right frequency selector to 233.0.	Left Frequency 640.0, Right frequency 233.0.
(4)	On Captain's audio panel: place ADF-1 switch in ON (up) position, place ADF-2 switch in OFF (down) position, push VOICE ONLY button to ON position, push VOICE ONLY button to reset audio panel	ADF-1 ON, ADF-2 OFF, VOICE ONLY light ON, audio heard; VOICE ONLY light OFF audio heard.
(5)	On ADF-1 Control Panel: place A1/NORM switch to A1 position, place TFR switch to right hand position, place A1/NORM switch to NORM position, set right frequency selector to 640.0	Tone present, Light over right dial comes on, NORM selected, TONE off/ID AUDIO, Right frequency 640.0 audio heard.
(6)	Set Captain's cockpit speaker in OFF position, Set First Officer's speaker volume control in mid-range position.	Captain's speaker off, First Officer's speaker on.
(7)	On F/O's audio panel: place ADF-1 switch in ON (up) position, place ADF-2 switch in OFF (down) position, push VOICE ONLY button to ON position, push VOICE ONLY button to reset audio panel.	 ADF-1 ON, ADF-2 OFF, VOICE ONLY light ON, audio heard; VOICE ONLY light OFF,audio heard.
(8)	Plug headset into head set jack at Observer's audio panel.	

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285 (Continued)

Table 206 (Continued)

Operation		Desired Result
(9)	On Observer's audio panel: place ADF-1 switch in ON (up) position, place ADF-2 switch in OFF (down) position, push VOICE ONLY button to ON position, push VOICE ONLY button to reset audio panel	 ADF-1 ON, ADF-2 OFF, VOICE ONLY light ON, audio heard; VOICE ONLY light OFF, audio heard.
(10)	Remove headset from Observer's audio panel.	
(11)	Repeat steps 1 thru 10 for ADF-2.	

D. Directional (Bearing) Test

NOTE: This test should be made outside in an open area, away from metallic objects that might cause variable field distortion. Two or more radio stations of different heading should be selected and the apparent heading of these stations (from the test site) accurately determined. To avoid irregular variations in the earth's magnetic field, these stations should have primarily a ground wave field at the test site. (Low frequency stations have greater ground wave radiations than high frequency stations.)

NOTE: Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.

Table 207

Operation		Desired Result
(1)	Set Captain's cockpit speaker volume control to mid-range position. Set First Officer's (F/O's) speaker in OFF position.	Captain's speaker ON, First Officer's speaker OFF.
(2)	On ADF-1 control panel, place ADF-ANT switch in ADF position, place A1/NORM switch in NORM position.	ADF selected, NORM selected, tone OFF.
(3)	On ADF-1 control panel, set left frequency selector to 640.0.	Left frequency 640.0.
(4)	On Captain's audio panel: place ADF-1 switch in ON (up) position, place ADF-2 switch in OFF (down) position, push VOICE ONLY button to ON position.	ADF-1 ON, ADF-2 OFF, VOICE selected, audio heard.
(5)	Select ROSE mode on Captain's and First Officer's EFIS Mode Select panels.	ROSE mode selected.
(6)	Select ADF-1 mode on Captain's and First Officer's EFIS Mode Select Panels.	ADF-1 mode selected. Check ADF-1 annunciation on each NAV display.
(7)	Note bearing of the single pointers on Captain's and First Officer's Navigation Displays. Pointers must agree within 5°.	Pointers within 5°.

WJE 405-411, 880, 881, 883, 884 POST MD80-34-285 (Continued)

Table 207 (Continued)

Operation		Desired Result
(8)	Select following frequencies using preselect function of control panel. Switch to selected frequency using transfer switch and note that lamp over selected frequency is illuminated. Listen to audio. Note bearing of the single pointers on Navigation Displays (NDs).	
	Frequency Selector 233.0	Pointers within 5°.
	Frequency Selector 690.0	Audio Signal/Pointers within 5°.
	Frequency Selector 1070.0	Audio Signal/Pointers within 5°.
	Frequency Selector 1280.0	Audio Signal/Pointers within 5°.
(9)	On ADF-1 control panel, place ADF-ANT switch to ANT position.	Single pointers blank, Audio is clear.
(10)	On ADF-1 control panel, place ADF-ANT switch to ADF position.	ADF selected. Single pointers within 5°. Audio is clear.
(11)	Repeat steps 1 through 10 for ADF-2.	

WJE 405-411, 880, 881, 883, 884

E. Test Servo Loop

NOTE: This test should be made outside in an open area away from metallic objects that might cause variable field distortion. Two or more radio stations of different heading should be selected and the apparent heading of these stations (from the test site) accurately determined. To avoid irregular variations in the earth's magnetic field, these stations should have primarily a ground wave field at the test site. (Low frequency stations have greater ground wave radiation than high frequency stations.)

WJE 407, 408, 411, 880 PRE MD80-34-285

Table 208

Operation		Desired Result
(1)	Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.	
(2)	On ADF-1 control panel, set ADF/ANT switch to ANT position and tune applicable station frequency.	
(3)	On ADF-2 control panel, set ADF/ANT switch to ANT position and tune frequency of second station.	
(4)	On ADF-1 control panel, set ADF/ANT switch to ADF position.	Narrow ADF-1 pointers on both compass indicators/RMI's must read known bearing of first station within ±5 degrees.
(5)	On ADF-2 control panel, set ADF/ANT switch to ADF position.	Wide ADF-2 pointers on both compass indicators/RMI's must read known bearing of second station within ±5 degrees.
(6)	Return aircraft to required configuration.	

WJE 405-411, 880, 881, 883, 884

F. ADF Pointer Tolerances

(1) In-service ADF pointer tolerances are as follows:

(a) Difference between needles on same station.....Max. 6°

WJE 405, 406, 409, 410, 881, 883, 884 PRE MD80-34-285

(b) Difference between needles on same station.....Max. 5°.

WJE 405-411, 880, 881, 883, 884

(c) ADF needle rotation of 180.....Max. 8 sec.

AUTOMATIC DIRECTION FINDING (ADF) - MAINTENANCE PRACTICES

1. General

WJE 875-879

A. Automatic Direction Finder (ADF) system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. The systems are operated from a dual ADF control panel on the pedestal, with ADF bearing displayed on the captain's and first officer's Radio Distance Magnetic Indicators (RDMI's) and Navigation Display (ND)'s.

WJE 892, 893

B. ADF system is a navigational aid that uses radio signals to determine the angle between the airplane heading and a selected radio station. The systems are operated from a dual control panel on the pedestal, with ADF bearing displayed on the captain's and first officer's compass indicators.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

C. The dual ADF system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. ADF-1 bearing indicated by a single pointer and ADF-2 bearing indicated by double pointer. ADF bearing is displayed on the EFIS ND's located on the Captain's and First Officer's instrument panels.

WJE 873, 874

D. ADF system is a navigational aid that uses radio signals to determine the angle between the airplane heading and a selected radio station. The system is operated from a control panel on the pedestal, with ADF bearing displayed on the Captain's and First Officer's compass indicator.

WJE 401-404, 412, 414

E. ADF system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. The system is operated from a control panel on the pedestal, with ADF bearing displayed on the cCaptain's and First Officer's EFIS ND.

WJE 886, 887

F. ADF system is a navigational aid that uses radio signals to determine the angle between the aircraft heading and a selected radio station. The systems are operated from control panels on the pedestal, with ADF bearing displayed on the Captain's and First Officer's Radio Distance Magnetic indicators, and EFIS ND's.

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 886, 887, 891-893

G. Audio controls that interface with the ADFcontrol panel are contained on the Captain's, First Officer's, Observer's, and radio rack audio selector panels.

2. Adjustment/Test ADF

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

A. Audio Functional Test

NOTE: The following test is performed to check the aural capabilities of the ADF system for both voice and CW signals. It is recommended to perform this test when the aircraft is outside of the building to achieve better results.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891 (Continued)

Table 201

Step	Operation	Desired Result
(1)	Set Captain's cockpit speaker volume control to mid-range position. Set First Officer's (F/O's) speaker in OFF position.	Captain's speaker ON, First Officer's speaker OFF.
(2)	On ADF-1 control panel, A1/NORM switch to NORM position, and TFR switch to left position	Light above left frequency window comes on.
(3)	Set ADF-1 left frequency selector to 640.0. Set ADF-1 right frequency selector to 233.0.	Left Frequency 640.0. Right frequency 233.0.
(4)	On Captain's audio panel: Place VOICE/IDENT switch to VOICE position. Place ADF-2 volume control to OFF position. Place ADF-1 volume control to comfortable listening level. Place VOICE/IDENT switch to IDENT position.	 VOICE selected. ADF-1 volume OFF. Local AM radio KFI audio is heard. IDENT selected.
(5)	On ADF-1 control panel: place A1/NORM switch to A1 position, place TFR switch to right hand position, place A1/NORM switch to NORM position, set right frequency selector to 640.0	 Tone present, Light over right dial comes on, Tone present, Tone off / ID audio, Right frequency 640.0 .
(6)	Set Captain's cockpit speaker in OFF position, Set First Officer's speaker volume control in mid-range position.	Captain's speaker off, First Officer's speaker on.
(7)	On First officer's audio panel: Place VOICE/IDENT switch to VOICE position, Place ADF-2 volume control to OFF position, Place ADF-1 volume control to comfortable listening level, Place VOICE/IDENT switch to IDENT position.	 VOICE selected. ADF-2 volume OFF. Local AM radio KFI audio is heard. IDENT selected.
(8)	Plug headset into head set jack at Observer's audio panel.	
(9)	On Observer's audio panel: Place VOICE/IDENT switch to VOICE position, Place ADF-2 volume control to OFF position. Place ADF-1 volume control to comfortable listening level. Place VOICE/IDENT switch to IDENT position.	 VOICE selected. ADF-2 volume OFF. Local AM radio KFI audio is heard. IDENT selected.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891 (Continued)

Table 201 (Continued)

Step	Operation	Desired Result
(10)	Remove headset from Observer's audio panel.	
(11)	Plug headset into head set jack in avionic compartment.	
(12)	On avionics vompartment audio panel: Place VOICE/IDENT switch to VOICE position. Place ADF-2 volume control to OFF position. Place ADF-1 volume control to comfortable listening level. Place VOICE/IDENT switch to IDENT position.	 VOICE selected. ADF-2 volume OFF. Local AM radio KFI audio is heard. IDENT selected.
(13)	Remove headset from avionic compartment.	
(14)	Repeat steps 1 through 13 for ADF-2.	

B. Directional (Bearing) Test

NOTE: This test should be made outside in an open area, away from metallic objects that might cause variable field distortion. Two or more radio stations of different heading should be selected and the apparent heading of these stations (from the test site) accurately determined. To avoid irregular variations in the earth's magnetic field, these stations should have primarily a ground wave field at the test site. (Low frequency stations have greater ground wave radiations than high frequency stations.)

NOTE: Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.

Table 202

Step	Operation	Desired Result
(1)	Set Captain's cockpit speaker volume control to mid-range position. Set First Officer's (F/O's) speaker in OFF position.	Captain's speaker ON, First Officer's speaker OFF.
(2)	On ADF-1 control panel: place A1/NORM switch in NORM position.	 NORM selected, tone OFF.
(3)	On ADF-1 control panel, set left frequency selector to 640.0.	Left frequency 640.0.
(4)	On Captain's audio panel: Place VOICE/INDENT to VOICE position. ADF-1 volume control to comfortable listening level.	 VOICE selected, Local AM radio station, KFI audio heard.
(5)	Note bearing of double pointers on both indicators. Pointers must agree within 5°.	Pointers within 5°.

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891 (Continued)

Table 202 (Continued)

Step	Operation	Desired Result
(6)	Select following frequencies using preselect function of ADF-1 control panel. Switch to selected frequency using transfer switch and note that indicator to selected frequency is activated. Listen to audio. Note bearing of double pointers on NDs.	
	Frequency Selector 233.0	Pointers within 5°.
	Frequency Selector 690.0	Audio Signal/Pointers within 5°.
	Frequency Selector 1070.0	Audio Signal/Pointers within 5°.
	Frequency Selector 1280.0	Audio Signal/Pointers within 5°.
(7)	Repeat steps 1 through 6 for ADF-2.	

WJE 401-404, 412, 414-427, 429, 861-866, 868, 869, 871-879, 886, 887, 891-893

C. Self Test ADF

Table 203

Step	Operation	Desired Result
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(1)	On ADF-1 or ADF-2 control panel, set function switch to TEST position.	Self test activated.
WJE 401-404, 412, 414, 873-879, 886, 887, 892, 893		
(1)	Energize aircraft electrical buses.	
WJE 875-879		
(1a)	On RDMI's rotate VOR/ADF switches to ADF position.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(2)	Listen to test tone in cockpit.	Tone heard.
WJE 873, 874		
(2)	Press and hold TEST pushbutton, on front of ADF reciever, for 9 seconds; and verify following sequence of events:	Test sequence verified.
WJE 401-404, 412, 414, 875-879, 892, 893		
(2)	Press and hold TEST pushbutton, on left (L) side of ADF control panel.	Test tone heard in flight compartments. ADF pointers on Capt's and F.O.'s point 135* (+-5) from index mark.
WJE 886, 887		
(2)	Press and hold TEST pushbutton, on front of ADF-1 receiver, for minimum of 10 seconds; and verify following test sequence.	Test sequence verified.

WJE 886, 887 (Continued)

Table 203 (Continued)

Step	Operation	Desired Result
		Three LED test annunciators (CONTROL INPUT FAIL, LRU STATUS PASS, and LRU STATUS FAIL) come on for approximately 3 seconds
WJE 873, 874		
		Three LED's on front of ADF reciever come on for 3 seconds.
WJE 873, 874, 886, 887		
		LED test annunciators go off for 2 to 3 seconds.
WJE 886, 887		
		LRU STATUS PASS LED comes on; and applicable ADF pointers on RDMI's position at135°, from lubber line.
WJE 873, 874		
		During last 3 seconds green LED comes on, ADF pointers on Captain's and First Officer's compass indicators indicate 135* (+-5*), from the lubber line and tone is heard.
WJE 401-404, 412, 414, 873-879, 886, 887, 892, 893		
(3)	Release TEST pushbutton; system returns to normal operation.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891		
(3)	Read ADF-1 bearing on Captain's and First Officer's ND's (single pointer). Captain's ND First Officer's ND	 135° (±5°). 135° (±5°).
WJE 401-404, 412, 414, 875-879, 892, 893		
(4)	Repeat steps (1) through (3), using right (R) TEST pushbutton to test ADF-2 system.	

WJE 401-404, 412, 414, 873-879, 886, 887, 892, 893

D. Test Radio Reception

Table 204

Step	Operation	Desired Result
WJE 401-404, 412, 414, 874-879, 892, 893		
(1)	On convenient audio control panel set ADF-1 switch to ON (up) position	
WJE 886, 887		
(1)	Push and rotate ADF-1 switch on audio control panels.	

WJE 886, 887 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
WJE 401-404, 412, 414, 874-879, 892, 893		
(2)	On any audio control panel, set VOICE/IDENT switch to VOICE position.	
WJE 886, 887		
(2)	Push VOICE switch on any audio control panels on.	
WJE 401-404, 412, 414, 875-879, 892, 893		
(3)	Place left ADF/ANT/OFF switch on dual ADF control panel to ANT position.	
WJE 873, 874		
(3)	Place ADF/ANT switch on ADF control panel to ANT position.	
WJE 886, 887		
(3)	Place ADF/ANT switch on ADF-1 control panel to ANT position.	
WJE 401-404, 412, 414, 875-879, 892, 893		
(4)	Set TONE switch on ADF control panel to OFF (center) position.	Tone off.
WJE 873, 874		
(4)	Set TFR switch on ADF control panel to left position.	
WJE 886, 887		
(4)	Tune ADF receiver to local radio station, using -1 hand selector.	Provide rf input signal to system.
(5)	Adjust volume to comfortable level by adjusting gain control on ADF control panel.	Volume adjusted.
(5)	Adjust volume to comfortable level.	Volume adjusted.
WJE 401-404, 412, 414, 873-879, 892, 893		
(5)	Tune ADF receiver to local radio station, using left hand selector.	Provide rf input signal to system.
WJE 875-879, 892, 893		
(6)	Adjust volume to comfortable level by adjusting ADF-1 control on audio control panel.	Volume adjusted; audio heard.
WJE 873, 874		
(6)	Adjust volume to comfortable level by adjusting ADF control on audio control panel.	
WJE 886, 887		
(6)	Place TONE switch on ADF control panel in ON position.	Tone ON.

WJE 886, 887 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
WJE 401-404, 412, 414, 875-879, 892, 893		
(7)	Place TONE switch on ADF control panel in left (L) position.	TONE ON.
WJE 886, 887		
(7)	Verify presence of tone.	Tone present.
WJE 873, 874		
(7)	Place TONE switch on ADF control panel in ON position.	Tone ON.
WJE 401-404, 412, 414, 873-879, 892, 893		
(8)	Verify presence of tone.	1000 Hz tone should be clear at audio panels.
WJE 886, 887		
(8)	Place TONE switch in OFF position.	
WJE 401-404, 412, 414, 875-879, 892, 893		
(9)	Place TONE switch in OFF (center) position.	
WJE 886, 887		
(9)	Push VOICE switch OFF.	
WJE 873, 874		
(9)	Set TFR switch to right position.	Annunciator light above right frequency window comes on; and annunciator light above left window goes off.
WJE 401-404, 412, 414, 875-879, 892, 893		
(10)	Set VOICE/IDENT switch to IDENT position.	Both voice and range tone should be heard at each audio panel.
WJE 873, 874		
(10) .	Place TONE switch in OFF position.	
WJE 886, 887		
(10)	Push RANGE switch on audio control panels to on.	Range tone should be clear with little or no change in volume at each audio panel.
WJE 873, 874		
(11)	Tune ADF receiver to local radio beacon station, using right hand selector.	Provide rf input signal to system.
WJE 401-404, 412, 414, 875-879, 892, 893		
(11)	Set VOICE/IDENT switch to VOICE position.	Range signal should become faint or disappear and voice heard at audio selector panel.

WJE 401-404, 412, 414, 875-879, 892, 893 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
WJE 886, 887		
(11)	Push VOICE switch on audio control panels to on.	Both voice and range tone should be heard at each audio panel.
WJE 873, 874		
(12)	Set VOICE/IDENT switch to IDENT position.	Both voice and range tone should be heard at each audio panel.
WJE 886, 887		
(12)	Push both VOICE and RANGE switches.	Voice and range off.
NOTE: This test should be made outside in an open area away from metallic objects that might cause variable field distortion. Two or more radio stations of different heading should be selected and the apparent heading of these stations (from the test site) accurately determined. To avoid irregular variations in the earth's magnetic field, these stations should have primarily a ground wave field at the test site. (Low frequency stations have greater ground wave radiation than high frequency stations.)		
NOTE: Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.		
WJE 873, 874		
(13)	Set VOICE/IDENT switch to VOICE position.	Range signal should become faint or disappear and voice heard at audio selector panel.
(13a)	Place ADF/VOR switch on Compass Indicators to ADF position.	
WJE 886, 887		
(13)	Place ADF/ANT switch on ADF-1 control panel in ADF position.	ADF selected.
WJE 401-404, 412, 414		
(14)	Note indicated bearing of pointers.	Bearing on both ND's agrees within ±5°.
WJE 875-879		
(14)	Note indicated bearing of pointers.	Bearing on both indicators/ND's agrees within ±5°.
WJE 892, 893		
(14)	Note indicated bearing of pointers.	Bearing on both indicators agrees within ±5°.
WJE 873, 874		
(14)	Place ADF/ANT switch in ADF position.	ADF selected.
WJE 886, 887		
(14)	On EFIS mode select panel, select ROSE and ADF modes.	
WJE 401-404, 412, 414, 875-879, 892, 893		
(15)	Set ADF-1 audio control to off (down) position.	

WJE 401-404, 412, 414, 875-879, 892, 893 (Continued)

Table 204 (Continued)

Step	Operation	Desired Result
WJE 873, 874		
(15)	Single pointer on both compass indicators turn in unison.	Pointers turn.
WJE 886, 887		
(15)	Single pointer on both RDMI's/ND's should turn in unison.	Pointers turn.
WJE 401-404, 412, 414		
(16)	Repeat steps (1) through (15), using ADF-2 controls and double pointers on ND's.	
WJE 875-879, 892, 893		
(16)	Repeat steps (1) through (15), using ADF-2 controls and double pointers.	
WJE 873, 874		
(16)	Note indicated bearing of pointers.	Bearing on both indicators agrees within ±5°.
WJE 886, 887		
(16)	Note indicated bearing of pointers.	Bearing noted.
WJE 873, 874		
(17)	Set ADF audio control to off (down) position.	
WJE 886, 887		
(17)	Rotate ADF-1 audio control to off position.	
(18)	Place ADF-1 function selector switch to OFF position.	Switch set to OFF.
(19)	Repeat steps (1) through (18), using ADF-2 controls and pointers (if ADF-2 installed).	
Return airplane to required configuration.		

WJE 401-404, 412, 414, 873-879, 886, 887, 892, 893

E. ADF Pointer Tolerances

WJE 886, 887

NOTE: The following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across a 600 ohm load using a VTVM or equivalent voltmeter. Refer to the appropriate equipment overhaul manual for detailed instructions of how to perform the adjustment.

WJE 401-404, 412, 414, 873-879, 886, 887, 892, 893

(1) In-service ADF pointer tolerances are as follows:

WJE 401-404, 412, 414, 886, 887

(a) Difference between needles on same station.....Max. 6°

WJE 873-879, 892, 893

(b) Difference between needles on same station.....Max. 5°.

WJE 873-879, 886, 887, 892, 893

(c) ADF needle rotation of 180.....Max. 8 sec.

WJE 401-404, 412, 414

(d) ADF pointer rotation of 180.....Max. 8 sec.

ADF LOOP ANTENNA - MAINTENANCE PRACTICES

1. General

A. This procedure has the removal and installation procedures for ADF-1 and ADF-2 loop antennas. The procedures are the same.

B. The loop antennas are mounted on the upper fuselage surface. The antenna connector mates with the corresponding quadrantal error corrector connector through a hole in the aircraft skin and doubler. Two rubber cork composition gaskets, one bonded to the airplane skin and one bonded to the antenna, provide pressure sealing.

2. Equipment and Materials

NOTE: Equivalent susbtitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation ADF Loop Antenna

A. Remove ADF Loop Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scrapper.

(3) Remove screws securing antenna to fuselage. Lift antenna straight up, taking care not to damage quadrantal error connector.

(4) Disconnect antenna cable connector and install dust caps on the coaxial connector and the antenna receptacle.

(5) If antenna is to be replaced, remove quadrantal error corrector.

(6) Attach the coaxial connector to the fuselage using masking tape.

NOTE: Due to the difficulty of retrieval, ensure coax cable does not fall completely inside fuselage.

B. Install ADF Loop Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Clean area between the antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Prepare the surface of the structure attachment holes for electrical bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(4) Install ADF antenna as follows:

(a) Remove protective dust caps and check for damage and unwanted material.

1) Install quadrantal error corrector on antenna connector.

(b) Place antenna in mounting position.

(c) Install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws.

a) Torque the attachment screws again 10 minutes after the initial torque.

2) Coat screws heads with sealant approximately 0.010 thick. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(5) Do a electrical bond check of the ADF antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(6) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

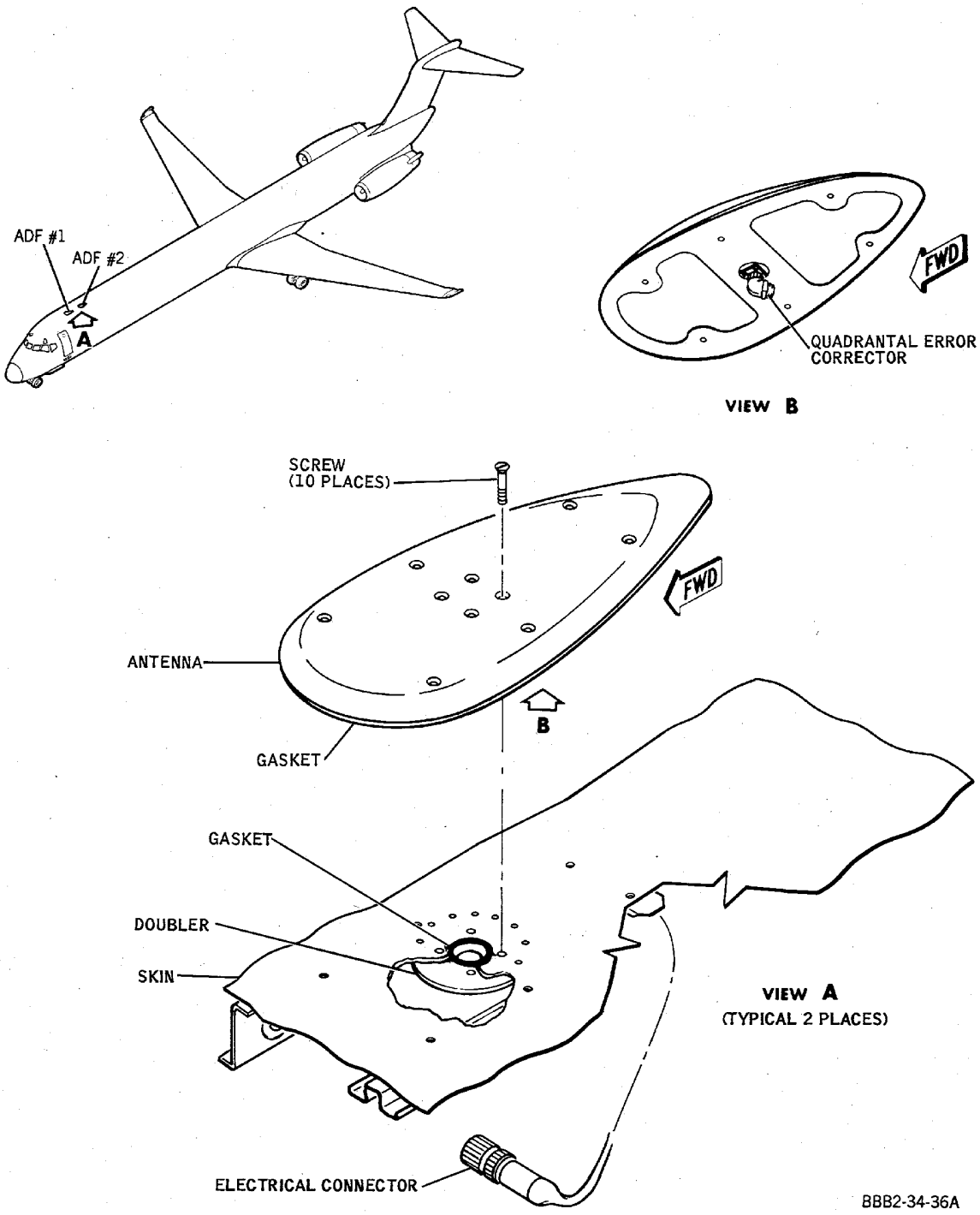
(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2



ADF Loop Antenna -- Removal/Installation
Figure 201/34-53-01-990-801

4. Adjustment/Test ADF Loop Antenna

A. Test Loop Antenna

Table 202

Operation		Desired Result
(1)	Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.	
(2)	Tune ADF-1 and ADF-2 receivers to a strong radio broadcast station using frequency selector on control panel.	Receiver tuned
(3)	Place ADF-ANT switch on ADF control panels in ADF position.	ADF selected
(4)	Note bearings of pointers on Captain's and First Officers HSI's.	Bearings should agree within ±5 degrees.
(4)	Note the bearings of pointers on the Captain's and First Officer's RDI. The desired result should be the same.	Bearings should agree within ±5 degrees.
(5)	Return aircraft to required configuration.	

ADF SENSE ANTENNA - MAINTENANCE PRACTICES

1. General

A. There are four, ADF sense antenna panels, one each flush mounted on the right and left lower wing fillets just aft of the landing gear, and the right and left aft underwing fillets just forward of the landing gear. The left aft sense antenna is connected to the right forward antenna then to the right antenna coupler and provides inputs to the ADF-2 receiver. The right aft sense antenna is connected to the left forward antenna and to the left antenna coupler to provide inputs to the ADF-1 receiver.

B. The antenna element is bonded to the antenna panel and is not replaceable on the aircraft due to processing procedures involved in attaching the antenna element to the panel.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	

3. Removal/Installation ADF Sense Antenna

A. Remove applicable ADF sense antenna.

NOTE: Removal procedures are applicable for all antennas.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Remove access plate from fillet, (provides access to access plate in upper part of antenna cavity).

(3) Remove access plate in top of antenna cavity, (provides access to antenna coax connector).

(4) Disconnect and cap antenna coax connector.

(5) Remove bonding straps from antenna panel assembly, (access from wheelwell).

(6) Remove antenna panel. (WING-TO-FUSELAGE FILLETS - MAINTENANCE PRACTICES, PAGEBLOCK 53-52-00/201 Config 2)

B. Install applicable ADF sense antenna.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Install antenna panel to aircraft. (WING-TO-FUSELAGE FILLETS - MAINTENANCE PRACTICES, PAGEBLOCK 53-52-00/201 Config 2)

(3) Remove dust cap and check for damage or unwanted material.

(a) Connect antenna coax at connector.

(4) Install access plate in top of antenna cavity.

(5) Install access plate in wing fillet.

(6) Prepare bonding straps to antenna panel for electrical bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(7) Connect bonding straps to antenna panel assembly.

(8) Do a electrical bond check of the ADF sense antenna assembly. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(9) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(10) Test ADF antenna. (Paragraph 5.A.)

4. Removal/Installation Lightning Arrester

A. Remove lightning arrester

(1) Remove antenna panel assembly. (WING-TO-FUSELAGE FILLETS - MAINTENANCE PRACTICES, PAGEBLOCK 53-52-00/201 Config 2)

(2) Remove lightning arrester.

B. Install lightning arrester

(1) Install lightning arrester to antenna panel assembly.

(2) Install antenna panel. (WING-TO-FUSELAGE FILLETS - MAINTENANCE PRACTICES, PAGEBLOCK 53-52-00/201 Config 2)

5. Adjustment/Test ADF Sense Antenna

A. Test ADF antenna

(1) Energize aircraft electrical buses.

(2) On applicable audio control panel, set ADF switch to up position and VOICE/IDENT switch to VOICE position.

(3) On ADF control panel, set ADF/ANT to ANT position and TFR switch to applicable system.

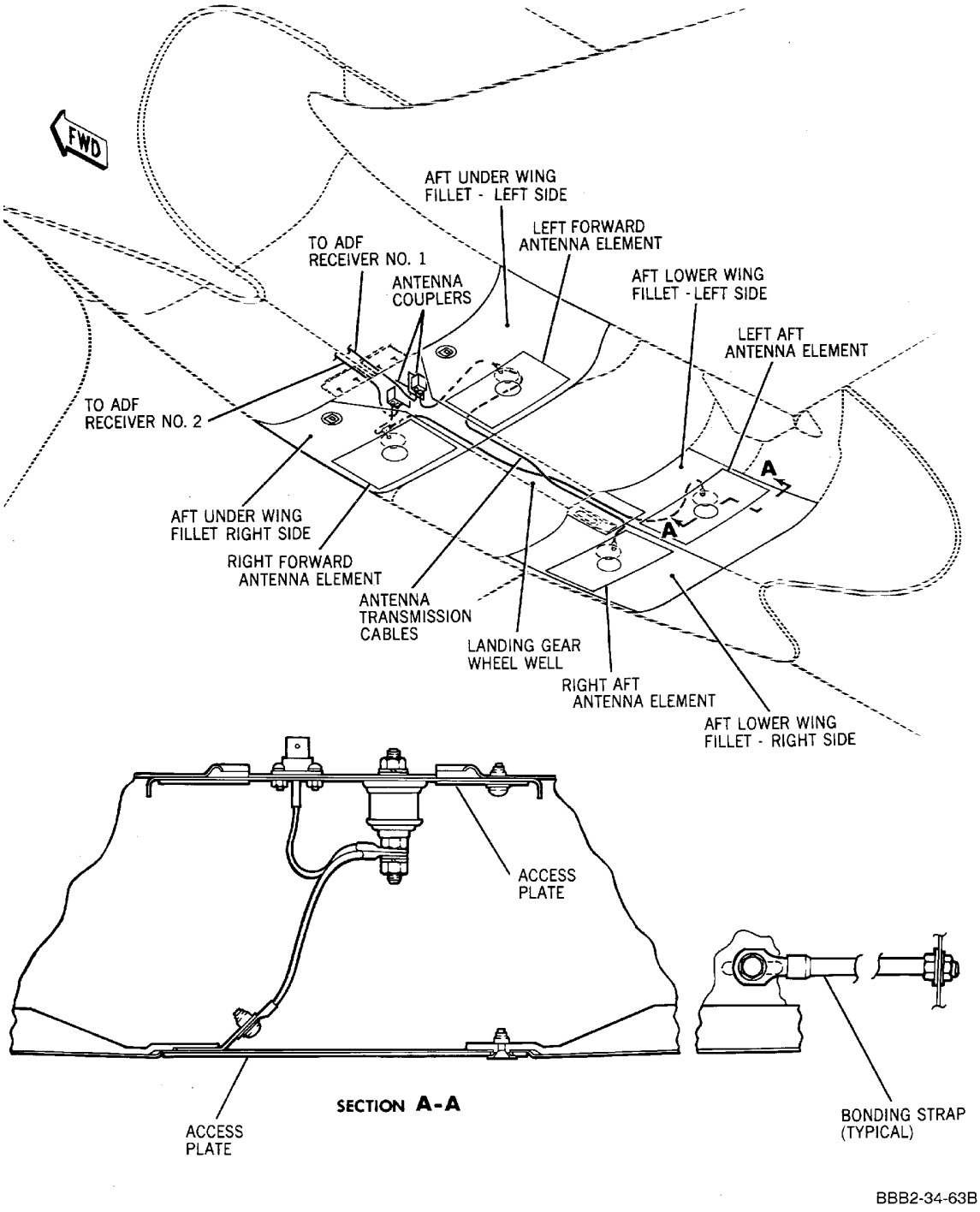
(4) Tune ADF control to local radio station.

(5) On ADF control panel set A1/NORM switch to A1 position, verify presence of tone at an audio station.

(6) Place A1/NORM switch to NORM position.

(7) On audio control panel set VOICE/IDENT switch to IDENT position, both voice and range signals should be heard.

(8) Return aircraft to required configuration.



ADF Sense Antennas
Figure 201/34-53-02-990-801

ADF SENSE ANTENNA COUPLER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF sense antenna coupler. The ADF sense antenna coupler is an impedance matching device. The coupler along with a predetermined length and type of coaxial cable transforms a sense antenna capacity value at the input of the receiver that will permit the receiver to track. The ADF-1 and -2 coupler are located on the center of the aircraft bottom center keel just forward of the landing gear wheelwell. Access to the couplers is through triangular lower fairing panel below couplers. On later aircraft, access to couplers is through quick release doors in the fairing.

2. Equipment and Materials

NOTE: Equivalent substitute may be used instead of the following listed item:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Solvent, cleaning P-D-680, Type 1 DPM 518	Arco Corp.

3. Removal/Installation Sense Antenna Coupler

A. Remove Coupler

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Remove lower fairing to gain access to the coupler through applicable door for right or left coupler. Later aircraft, open quick release doors in fairing.

(3) Disconnect, and cap antenna and receiver coax connectors.

(4) Remove coupler mounting screws, and remove coupler.

B. Install ADF Sense Antenna Coupler

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

WARNING: P-D-680 TYPE 1 SOLVENT IS AN AGENT THAT IS FLAMMABLE AND POISONOUS. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN P-D-680 TYPE 1 SOLVENT IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET P-D-680 TYPE 1 SOLVENT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS MSDS FOR:

- MORE PRECAUTIONARY DATA.
- APPROVED SAFETY EQUIPMENT.
- EMERGENCY MEDICAL AID.
- TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(2) Clean antenna coupler and bracket attach points with solvent, (P-D-680, Type 1 or equivalent) to ensure proper radio frequency (rf) bond.

(3) Place antenna coupler in mounting position with connectors facing down and install mounting screws.

(4) Observe placarding for proper connector; remove caps and connect antenna, and receiver coax connectors to coupler.

(5) Install lower fairing panel. Close quick release access doors (as applicable).

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

C. Test Coupler

(1) Energize aircraft electrical buses.

(2) On applicable audio control panel, set ADF switch to up position and VOICE/IDENT switch to VOICE position.

(3) On ADF control panel, set ADF/ANT switch to ANT position, and TFR switch to applicable system.

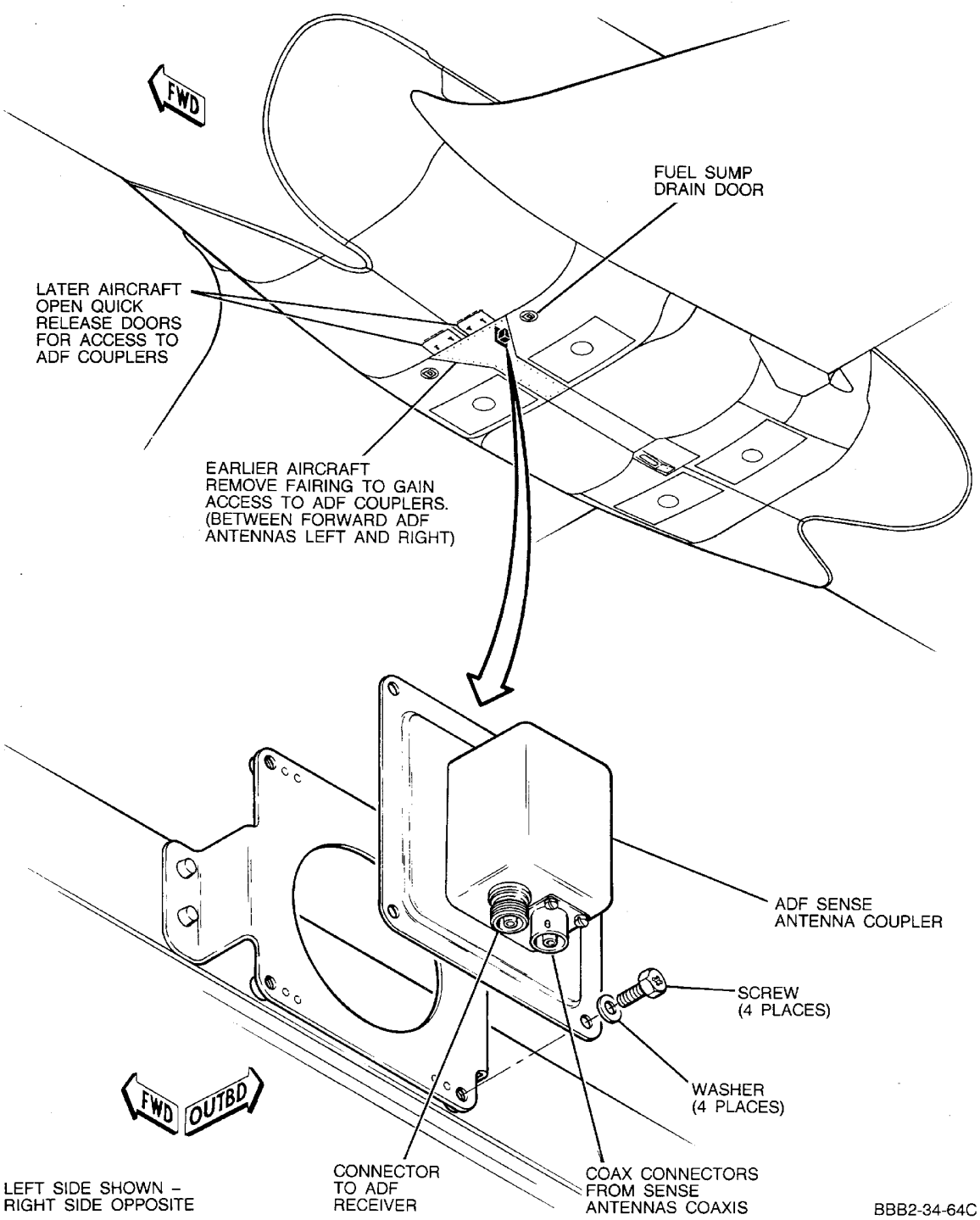
(4) Tune ADF control to a local radio station.

(5) On ADF control panel set A1/NORM switch to A1 position, verify presence of tone at an audio station.

(6) Place A1/NORM switch to NORM position.

(7) On audio control panel set VOICE/IDENT switch to IDENT position, both voice and range signals should be heard.

(8) Return aircraft to required configuration.



ADF Sense Antenna Coupler -- Removal/Installation
Figure 201/34-53-03-990-801

ADF CONTROL PANEL - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF control panel. Two ADF control panels are located on the pedestal. Removal/installation procedures for both control panels are identical except for circuit breaker placarding.

2. Removal/Installation - ADF Control Panel

A. Remove ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	16	B10-83	NAV INST XFMR-1
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Loosen mounting screws and lift control panel out of receptacle.

(3) Disconnect and cap wire harness; remove control panel.

NOTE: Tag wire harness to prevent cross wiring and damage to equipment.

B. Install ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	16	B10-83	NAV INST XFMR-1
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Remove cap and tag from wire harness connector and connect connector to control panel.

(3) Insert control panel into receptacle and tighten mounting screws until panel is secure.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	16	B10-83	NAV INST XFMR-1
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2
F	13	B10-84	NAV INST XFMR-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

3. **Adjustment/Test ADF Control Panel**

A. Test ADF Control Panel

NOTE: Following test applies to either ADF-1 or 2 control panels. TFR switch and audio panel controls should be in applicable positions for panel being tested. Compass Indicator switch must be in ADF position.

Table 201

Operation	Desired Result
(1) On audio panel set ADF switch to UP and VOICE/ IDENT switch to VOICE position.	
(2) Set ADF/ANT switch on ADF control panel to ANT position.	
(3) Tune ADF receiver to local radio station.	
(4) Set A1/NORM switch to A1 position.	Verify presence of tone through selected audio panel.
(5) Set A1/NORM switch to NORM position.	
(6) Set ADF/ANT switch to ADF position.	ADF pointer on Compass Indicator/RMI should read known bearing of station within ±5 degrees.
(7) Return aircraft to required configuration.	

ADF CONTROL PANEL - MAINTENANCE PRACTICES

1. General

WJE 405, 410, 415-427, 429, 861-866, 868, 869, 871, 872, 881, 883, 886, 887, 891

A. This maintenance practice provides removal/installation procedures for the ADF control panel. Two ADF control panels are located on the pedestal. Removal/installation procedures for both control panels are identical except for circuit breaker placarding.

WJE 401-404, 412, 414, 875-879, 892, 893

B. This maintenance practice provides removal/installation procedures for the dual ADF control panel. The ADF-1/ADF-2 control panel is located on the pedestal.

WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893

2. Removal/Installation - ADF Control Panel

A. Remove ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 410, 881, 883			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 410, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 886, 887, 891-893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
D	12	B10-404	ADF-2

WJE 401-405, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893 (Continued)

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 891-893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	5	B10-30	ADF-2

(2) Loosen mounting screws and lift control panel out of receptacle.

(3) Disconnect and cap wire harness; remove control panel.

NOTE: Tag wire harness to prevent cross wiring and damage to equipment.

B. Install ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 410, 881, 883			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 410, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 886, 887, 891-893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 891-893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	5	B10-30	ADF-2

(2) Remove cap and tag from wire harness connector and connect connector to control panel.

(3) Insert control panel into receptacle and tighten mounting screws until panel is secure.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 410, 881, 883			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 410, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 886, 887, 891-893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879, 881, 883, 886, 887, 892, 893			
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 410, 412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 877, 881, 883, 891-893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893			
E	5	B10-30	ADF-2

C. Test ADF Control Panel

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891

NOTE: Following test applies to either ADF-1 or 2 control panels. TFR switch and audio panel controls should be in applicable positions for panel being tested.

WJE 401-405, 410, 412, 414, 881, 883, 886, 887

NOTE: Following test applies to either ADF-1 or 2 control panels. Audio panel controls should be in applicable positions for system being tested.

WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 875-879, 881, 883, 886, 887, 891-893

Table 201

Operation	Desired Result
WJE 401-405, 410, 412, 414, 881, 883	
(1) On audio panel set ADF switch to up (on) and VOICE/ IDENT switch to VOICE position.	
WJE 875-879, 892, 893	
(1) On audio panel set ADF-1 switch to up (on) and VOICE/ IDENT switch to VOICE position.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
(1) On audio panel set ADF switch to UP and VOICE/ IDENT switch to VOICE position.	

WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 886, 887	
(1) On EFIS mode select panels, select ROSE and ADF positions.	
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 881, 883, 891	
(2) Set ADF/ANT switch to ANT position.	
WJE 875-879, 892, 893	
(2) On dual ADF control panel, set left (L) ADF/ANT/OFF switch to ANT position.	
WJE 886, 887	
(2) On audio panel set ADF switch to on and select VOICE.	
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 881, 883, 891	
(3) Tune ADF receiver to local radio station.	
WJE 875-879, 892, 893	
(3) Tune left (L) ADF-1 receiver to local radio station.	Verfiy presence of tone through selected audio panel.
WJE 886, 887	
(3) Set ADF/ANT switch to ANT position.	
(4) Tune ADF receiver to local radio station.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
(4) Set A1/NORM switch to A1 position.	Verify presence of tone through selected audio panel.
WJE 401-405, 410, 412, 414, 881, 883	
(4) Set TONE switch to ON positon.	Verify presence of tone through selected audio panel.
WJE 875-879, 892, 893	
(4) Set TONE switch to left (L) ON position.	Verify presence of tone through selected audio panel.
WJE 886, 887	
(5) Set TONE switch to ON positon.	Verify presence of tone through selected audio panel.

WJE 886, 887 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
(5) Set A1/NORM switch to NORM position.	
WJE 401-405, 410, 412, 414, 881, 883	
(5) Set TONE switch to OFF positon.	
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
(5) Set A1/NORM switch to NORM position.	
WJE 401-405, 410, 412, 414, 881, 883	
(5) Set TONE switch to center (OFF) positon.	Verify presence of tone through selected audio panel.
WJE 886, 887	
(6) Set TONE switch to OFF positon.	
WJE 405, 410, 881, 883	
(6) Set ADF/ANT switch to ADF position.	ADF pointer on compass/radio magnetic indicators and ND's should read known bearing within ±5 degrees.
WJE 401-404, 412, 414	
(6) Set ADF/ANT switch to ADF position and ADF selector switch on mode select panel to ADF position.	ADF pointer on Navigation Display (ND's) indicators should read known bearing within ±5 degrees.
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891	
(6) Set ADF/ANT switch to ADF position and ADF selector switch on mode select panel to ADF position.	ADF pointer on HSI should read known bearing of station within ±5 degrees. On aircraft with EFIS, ADF bearing is displayed by pointers on EFIS Navigation Displays (ND's).
WJE 892, 893	
(6) Set left (L) ADF/ANT/OFF switch to ADF position.	ADF pointer on compass indicator should read known bearing within ±5 degrees.
WJE 875-879	
(6) Set left (L) ADF/ANT/OFF switch to ADF position.	ADF pointer on compass indicator/Navigation Display should read known bearing within ±5 degrees.

WJE 875-879 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 886, 887	
(7) Set ADF/ANT switch to ADF position and ADF selector switch on mode select panel to ADF position.	ADF pointer on Navigation Displays should read known bearing within ±5 degrees.
WJE 875-879, 892, 893	
(7) To test ADF-2 system, repeat steps (1) through (6) using right (R) controls on ADF control panel.	
WJE 401-405, 410, 412, 414-427, 429, 861-866, 868, 869, 871, 872, 881, 883, 891	
(7) Return aircraft to required configuration.	
WJE 875-879, 892, 893	
(8) Return aircraft to required configuration.	
WJE 886, 887	
(8) Return aircraft to required configuration.	

WJE 892, 893

D. Self Test

(1) Press left or right TEST switch on ADF control panel; ADF pointers on applicable compass indicator should display 135 degrees.

WJE 875-879

E. Self Test

(1) Press left or right TEST switch on ADF control panel; ADF pointers on applicable compass indicator/ND should display 135 degrees.

WJE 401-404, 412, 414

F. Self Test

(1) Press left or right TEST switch on ADF control panel; ADF pointers on applicable ND should display 135 degrees.

ADF CONTROL PANEL - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF control panel. The ADF control panel is located on the pedestal.

2. Removal/Installation - ADF Control Panel

A. Remove ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 409, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 409, 873, 874, 884			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Loosen mounting screws and lift control panel out of receptacle.

(3) Disconnect and cap wire harness; remove control panel.

NOTE: Tag wire harness to prevent cross wiring and damage to equipment.

B. Install ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 409, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 409, 873, 874, 884			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Remove cap and tag from wire harness connector and connect connector to control panel.

(3) Insert control panel into receptacle and tighten mounting screws until panel is secure.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 409, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 409, 873, 874, 884			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

C. Test ADF Control Panel

Table 201

Operation	Desired Result
(1) On audio panel set ADF switch to up (on) and VOICE/ IDENT switch to VOICE position.	
(2) Set ADF/ANT switch to ANT position.	
(3) Tune ADF receiver to local radio station.	
(4) Set TONE switch to ON positon.	Verify presence of tone through selected audio panel.
(5) Set TONE switch to OFF positon.	
(6) Set ADF/ANT switch to ADF position.	ADF pointer on compass indicators should read known bearing within ±5 degrees.
(7) Return aircraft to required configuration.	

ADF CONTROL PANEL - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF control panel. Two ADF control panels are located on the pedestal. Removal/installation procedures for both control panels are identical except for circuit breaker placarding.

2. Removal/Installation - ADF Control Panel

A. Remove ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Loosen mounting screws and lift control panel out of receptacle.

(3) Disconnect and cap wire harness; remove control panel.

NOTE: Tag wire harness to prevent cross wiring and damage to equipment.

B. Install ADF Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Remove cap and tag from wire harness connector and connect connector to control panel.

(3) Insert control panel into receptacle and tighten mounting screws until panel is secure.

(4) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

C. Test ADF Control Panel

NOTE: Following test applies to either ADF-1 or 2 control panels. Audio panel controls should be in applicable positions for system being tested.

Table 201

Operation	Desired Result
(1) On audio panel set ADF switch to UP (on) and VOICE/ IDENT switch to VOICE position.	
(2) Set ADF/ANT switch to ANT position.	
(3) Tune ADF receiver to local radio station.	
(4) Set Tone switch to ON position.	Verify presence of tone through selected audio panel.
(5) Set Tone switch to OFF position.	

Table 201 (Continued)

Operation	Desired Result
(6) Set ADF/ANT switch to ADF position and ADF selector switch on mode select panel to ADF position.	ADF pointer on Navigation Display (ND's) indicators should read known bearing within ±5 degrees.
(7) Return aircraft to required configuration.	

ADF RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF receivers. The receivers are installed in the forward right radio rack in the electrical/electronics compartment. Operation of the receivers is controlled by the ADF control panels on the pedestal.

2. Removal/Installation ADF Receiver

A. Remove ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	5	B10-30	ADF-2

(2) Disconnect electrical/coax connectors at ADF receiver front panel.

(3) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(4) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	5	B10-30	ADF-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lug on unit, and tighten hold-down nut.

(5) Connect electrical/coax connectors on ADF receiver front panel.

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872			
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 891			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 415-427, 429, 861-866, 868, 869, 871, 872, 891			
E	5	B10-30	ADF-2

C. Test ADF Receiver

NOTE: Following test applies to either ADF-1 or 2 control panels.

Table 201

Operation	Desired Result
(1) Place TFR switch on ADF panels to left or right position as applicable for system being tested.	ADF pointer on Captain's and First Officer's Horizontal Situation Indicators (HSIs) should agree within ±5 degrees. On aircraft with EFIS, ADF bearing is displayed by the pointers on the EFIS navigation displays (NDs).
(2) Place ADF switch on audio panel in 1 or 2 system being tested.	

Table 201 (Continued)

Operation	Desired Result
(3) On audio panel set ADF switch to UP and VOICE/ IDENT switch to VOICE position.	
(4) Set ADF/ANT switch to ANT position.	
(5) Tune ADF receiver to local radio station.	
(6) Set A1/NORM switch to A1 position.	Verify presence of tone through selected audio panel.
(7) Set A1/NORM switch to NORM position.	
(8) Set ADF/ANT switch to ADF position.	ADF pointer on HSI should read known bearing of station within ±5 degrees. On aircraft with EFIS, ADF bearing is displayed by the pointers on the EFIS Navigation Displays (ND's).
(9) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	
(10) Return aircraft to required configuration.	

ADF RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF receivers. The receivers are installed in the forward right radio rack in the electrical/electronics compartment. Operation of the receivers is controlled by the ADF control panels on the pedestal.

2. Removal/Installation ADF Receiver

A. Remove ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
E	5	B10-30	ADF-2

(2) Disconnect electrical/coax connectors at ADF receiver front panel.

(3) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(4) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
E	5	B10-30	ADF-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(4) Engage holddown assembly with lug on unit, and tighten hold-down nut.

(5) Connect electrical/coax connectors on ADF receiver front panel.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 407, 408, 411, 880, 886, 887			
E	5	B10-30	ADF-2

C. Test ADF Receiver

WJE 886, 887

NOTE: Following test applies to either ADF-1 or 2 control panels.

WJE 407, 408, 411, 880, 886, 887

Table 201

Operation	Desired Result
WJE 886, 887	
(1) Ensure VOR/ADF switches on compass indicators are in ADF position.	ADF pointer on Captain's and First Officer's compass indicators should agree within ±5 degrees.

WJE 886, 887 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 407, 408, 411, 880	
(1) On audio panel set ADF switch to UP and VOICE/IDENT switch to VOICE position.	
(2) Set ADF/ANT switch to ANT position.	
WJE 886, 887	
(2) On audio panel push and rotate applicable ADF switch to ADF position and press VOICE switch.	
WJE 407, 408, 411, 880	
(3) Place TFR switch on ADF panel to left or right position, tune ADF receiver to local radio station.	Verify audio signal through selected audio panel.
WJE 886, 887	
(4) Tune ADFreceiver to local radio station.	
WJE 407, 408, 411, 880	
(4) Set A1/NORM switch to A1 position.	Verify presence of tone through selected audio panel.
(5) Set A1/NORM switch to NORM position.	Verify tone no longer present.
WJE 886, 887	
(5) Set TONE switch to ON position.	Verify presence of tone through selected audio panel.
WJE 407, 408, 411, 880	
(6) Set ADF/ANT switch to ADF position.	ADF double pointers on compass indicators/RMI's should read known bearing of station within ±5 degrees.
WJE 886, 887	
(6) Set TONE switch to OFF position.	
WJE 407, 408, 411, 880	
(7) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	

WJE 407, 408, 411, 880 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 886, 887	
(7) Set function switch to ADF position.	ADF pointer on captain's and first officer's compass indicators should read known bearing within ±5 degrees.
(8) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	
WJE 407, 408, 411, 880	
(8) Return aircraft to required configuration.	
WJE 886, 887	
(9) Return aircraft to required configuration.	

ADF RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF receivers. The receivers are installed in the forward right radio rack in the electrical/electronics compartment. Operation of the receivers is controlled by the ADF control panels on the pedestal.

2. Removal/Installation ADF Receiver

A. Remove ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

CAUTION: THE ADF RECEIVER CONTAINS ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(2) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(3) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Verify mating surfaces of mounting tray and receiver are clean and free of paint and dirt.

(3) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(4) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(5) Engage holddown assembly with lug on unit, and tighten hold-down nut.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

C. Test ADF Receiver

Table 201

Operation	Desired Result
(1) On audio panel set ADF switch to on (up) and VOICE/IDENT switch to VOICE position.	
(2) Set ADF/ANT switch to ANT position.	

Table 201 (Continued)

Operation	Desired Result
(3) Place TFR switch on ADF panel, applicable for system being tested, to left or right position; tune ADF receiver to local radio station.	Verify audio signal through selected audio panel.
(4) Set TONE switch to ON position.	Verify presence of tone through selected audio panel.
(5) Set TONE switch to OFF position.	Verify tone no longer present.
(6) Set ADF/ANT switch to ADF position.	Applicable ADF pointers on compass indicators should read known bearing of station within ±5 degrees.
(7) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	
(8) Return aircraft to required configuration.	

ADF RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF receivers. The receivers are installed in the forward right radio rack in the electrical/electronics compartment. Operation of the receivers is controlled by the ADF control panels on the pedestal.

2. Removal/Installation ADF Receiver

A. Remove ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

CAUTION: THE ADF RECEIVER CONTAINS ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(2) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(3) Pull unit straight out of rack until electrical connector is disengaged from mounting rack support, and remove unit.

B. Install ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Verify mating surfaces of mounting tray and receiver are clean and free of paint and dirt.

(3) Visually check unit connector plugs, and mating connector on mounting rack for loose, broken, or dirty connector pins or wires.

(4) Slide unit straight into rack, ensuring that guide pin bushings and connector are properly aligned with mounting rack guide pins and connectors.

(5) Engage holddown assembly with lug on unit, and tighten hold-down nut.

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

C. Test ADF Receiver

Table 201

Operation	Desired Result
(1) On audio panel set ADF switch to UP and VOICE/IDENT switch to VOICE position.	
(2) Set ADF/ANT switch to ANT position.	
(3) Place TFR switch on ADF panel to left or right position, tune ADF receiver to local radio station.	Verify audio signal through selected audio panel.
(4) Set TONE switch to ON position.	Verify presence of tone through selected audio panel.
(5) Set TONE switch to OFF position.	Verify tone no longer present.
(6) Set ADF/ANT switch to ADF position.	ADF single pointers on compass indicators should read known bearing of station within ±5 degrees.
(7) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	
(9) Return aircraft to required configuration.	

ADF RECEIVER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the ADF receivers. The receivers are installed in the forward right radio rack in the electrical/electronics compartment. Operation of the receivers is controlled by the ADF control panels on the pedestal.

2. Removal/Installation ADF Receiver

A. Remove ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 875-879, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

WJE 405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	5	B10-30	ADF-2

CAUTION: THE ADF RECEIVER CONTAINS ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(2) Unscrew knurled holddown nut at front end of mounting rack and swing assembly down.

(3) Pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install ADF Receiver

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 875-879, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	5	B10-30	ADF-2

(2) Verify mating surfaces of mounting tray and receiver are clean and free of paint and dirt.

(3) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(4) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

(5) Engage holddown assembly with lug on unit, and tighten hold-down nut.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 875-879, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

WJE 405, 409, 410, 412, 414, 877, 881, 883, 884, 892, 893 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893			
E	5	B10-30	ADF-2

C. Test ADF Receiver

WJE 401-404, 412, 414, 875-879

NOTE: On EFIS aircraft, make certain EFIS system is operational and ADF selector switch on mode selector panel is in ADF position.

WJE 401-405, 409, 410, 412, 414, 875-879, 881, 883, 884, 892, 893

Table 201

Operation	Desired Result
WJE 405, 409, 410, 881, 883, 884	
(1) On aircraft 131-132, set, on audio panel, ADF switch to on (up) and VOICE/IDENT switch to VOICE position.	
(1a) On aircraft 133-137, push and turn, on audio panel, ADF switch to on and push VOICE switch to on position.	
WJE 401-404, 412, 414, 875-879, 892, 893	
(1) On audio panel set ADF-1 switch to up (on) and VOICE/IDENT switch to VOICE position.	
WJE 405, 409, 410, 881, 883, 884	
(2) Set ADF/ANT switch to ANT position.	
WJE 401-404, 412, 414, 875-879, 892, 893	
(2) On dual ADF control panel, set left (L) ADF/ANT/OFF switch to ANT position.	
(3) Tune left (L) ADF-1 receiver to local radio station.	
WJE 405, 409, 410, 881, 883, 884	
(3) Place TFR switch on ADF panel, applicable for system being tested, to left or right position; tune ADF receiver to local radio station.	Verify audio signal through selected audio panel.

WJE 405, 409, 410, 881, 883, 884 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 401-404, 412, 414, 875-879, 892, 893	
(4) Set TONE switch to left (L) ON position.	Verify presence of tone through selected audio panel.
WJE 405, 409, 410, 881, 883, 884	
(4) Set TONE switch to ON position.	Verify presence of tone through selected audio panel.
(5) Set TONE switch to OFF position.	
WJE 401-404, 412, 414, 875-879, 892, 893	
(5) Set TONE switch to center (OFF) position.	
(6) Set left (L) ADF/ANT/OFF switch to ADF position.	
WJE 405, 409, 410, 881, 883, 884	
(6) Set ADF/ANT switch to ADF position.	Applicable ADF pointers on compass indicator should read known bearing of station within ±5 degrees.
(7) Following adjustment to ADF receiver is authorized upon experiencing audio bleedthrough: Adjust audio output levels for 2.3 volts RMS ±10% across 600 ohm load using VTVM or equivalent voltmeter. Refer to appropriate equipment overhaul manual for detailed instructions of how to perform adjustment.	
WJE 401-404, 412, 414, 875-879, 892, 893	
(7) To test ADF-2 system, repeat steps (1) through (6) using right (R) controls on ADF control panel.	ADF pointers on horizontal situation indicators should read known bearing of station within ±5 degrees.
(8) Return aircraft to required configuration.	
WJE 405, 409, 410, 881, 883, 884	
(8) Return aircraft to required configuration.	

WJE 401-404, 412, 414, 875-879, 892, 893

D. Self Test

Operation	Desired Results
(1) Press left or right TEST switch on ADF control panel.	ADF panel on applicable indicator display 135 degrees.

ADF SENSE/LOOP ANTENNA - MAINTENANCE PRACTICES

1. General

A. This procedure has the removal/installation of the ADF sense/loop antenna.

B. The ADF sense/loop antennas are mounted on the upper fuselage surface. Each antenna's connector mates with an aircraft cable connector. An O-ring provides pressure sealing.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation ADF Sense/Loop Antenna

A. Remove ADF Sense/Loop Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	6	B10-402	ADF-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 886, 887, 892, 893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	5	B10-30	ADF-2

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scrapper.

(3) Remove the antenna mounting screws and carefully remove the antenna from the fuselage.

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

CAUTION: DO NOT USE FORCE TO REMOVE THE ANTENNA FROM THE AIRCRAFT. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE ANTENNA. TO REMOVE THE ANTENNA, CAREFULLY AND CONTINUOUSLY PULL ON ONE SIDE OF THE ANTENNA. THIS WILL LET THE SEALANT CORRECTLY COME APART AT THE SURFACE.

(a) If necessary, use an approved plastic scraper, to help remove antenna from the fuselage.

(b) Lift antenna straight up, taking care not to damage electrical connector or harness.

(4) Disconnect electrical connector and install caps on exposed contacts.

(5) Attach the coaxial connector to the fuselage using masking tape.

NOTE: Due to the difficulty of retrieval, ensure electrical cable does not fall completely inside fuselage.

B. Install ADF Sense/Loop Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	6	B10-402	ADF-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 886, 887, 892, 893			
C	15	B10-73	ADF-1

WJE 401-405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 886, 887, 892, 893 (Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	5	B10-30	ADF-2

(2) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Check that O-ring is installed on antenna.

(4) Install ADF antenna as follows:

(a) Remove protective cap and check for damage and unwanted material.

1) Connect antenna coaxial cable connector.

(b) Place antenna in mounting position and install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws.

a) Torque the attachment screws again 10 minutes after the initial torque.

(5) Remove excess sealant squeeze out from around screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(6) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(7) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	6	B10-402	ADF-1

WJE 406 (Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
WJE 401-405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 886, 887, 892, 893			
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 407-412, 414, 415, 418, 863, 864, 866, 873, 874, 877, 880, 881, 883, 884, 892, 893			
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893			
E	5	B10-30	ADF-2

4. Removal/Installation Automatic Direction Finder Cover Plate

A. Remove ADF Cover Plate (Figure 202)

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(1) Carefully cut sealant around the outer edge of cover plate with an approved plastic scrapper.

(2) Remove the 4 cover plate mounting screws and carefully remove the cover plate from the fuselage.

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

CAUTION: DO NOT USE FORCE TO REMOVE THE ANTENNA FROM THE AIRCRAFT. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE ANTENNA. TO REMOVE THE ANTENNA, CAREFULLY AND CONTINUOUSLY PULL ON ONE SIDE OF THE ANTENNA. THIS WILL LET THE SEALANT CORRECTLY COME APART AT THE SURFACE.

(a) If necessary, use an approved plastic scraper, to help remove cover plate from the fuselage.

(3) If necessary, remove the set screws.

B. Install Applicable ADF Cover Plate (Figure 202)

(1) Clean area between cover plate and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(2) Prepare the surface of the ADF cover plate for RF bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(3) Apply faying surface seal to the base of the cover plate assembly. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(4) Install cover plate

(a) Place cover plate in mounting position.

(b) Install cover plate mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(c) Torque the attachment screws.

1) Torque the attachment screws again 10 minutes after the initial torque.

(5) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(6) Do the RF bonding check of the cover plate. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(7) Apply periphery (fillet) seal around cover plate edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(8) If necessary, install the set screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

5. Adjustment/Test ADF Sense/Loop Antenna

A. Test ADF antenna

WJE 401-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 892, 893

Table 202

Step	Operation	Desired Result
(1)	Consult appropriate sectional aeronautical charts for frequency of two local stations with known bearing from test site.	
(2)	Tune applicable ADF receiver to a strong radio broadcast station using frequency selector on corresponding ADF control panel.	Receiver tuned.
(3)	Place ADF/ANT switch on ADF control panel in ADF position.	ADF selected.
WJE 873-879, 892, 893		
(4)	Note bearing of pointers on Captain's and First Officer's compass indicators.	Bearings should agree within ±5 degrees.
WJE 401-404, 406, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872		
(4)	Note bearing of pointers on Captain's and First Officer's Navigation Displays.	Bearings should agree within ±5 degrees.
WJE 405, 407, 408, 410, 411, 880, 881, 883		
(4)	Note bearing of pointers on Captain's and First Officer's compass indicators/RMI's.	Bearings should agree within ±5 degrees.
WJE 401-408, 410-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 892, 893		
(5)	Return aircraft to required configuration.	

WJE 409, 884, 886, 887

Table 203

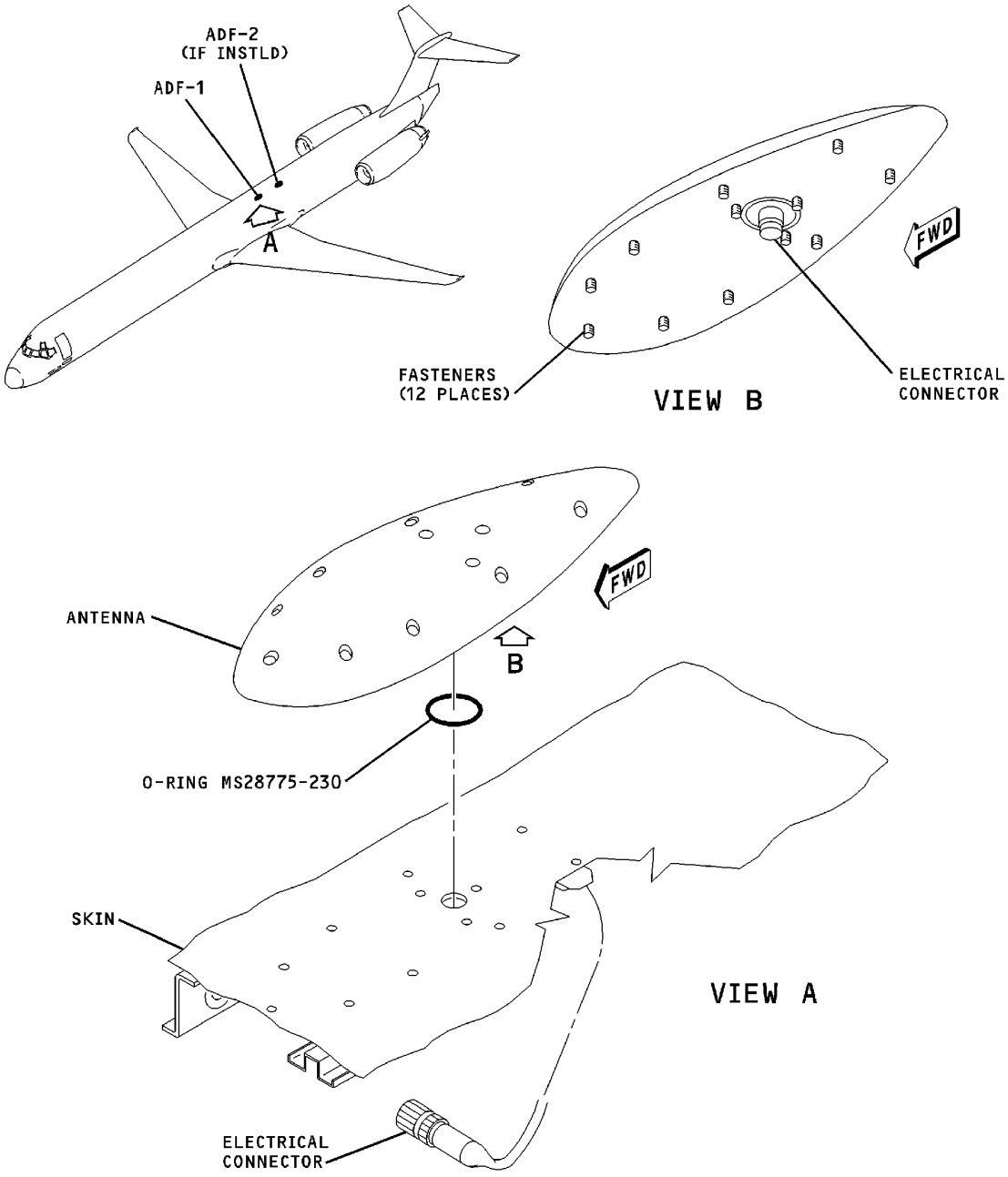
Step	Operation	Desired Result
(1)	Tune applicable ADF receiver to a known strong radio broadcast station using frequency selector on corresponding ADF control panel.	Receiver tuned.
(2)	Place ADF/ANT switch on ADF control panel in ADF position.	ADF selected.
WJE 409, 884		
(3)	Note bearing of pointers on Captain's and First Officer's compass indicators/Navigation Displays (ND's).	Bearings should agree within ±5 degrees.

WJE 409, 884 (Continued)

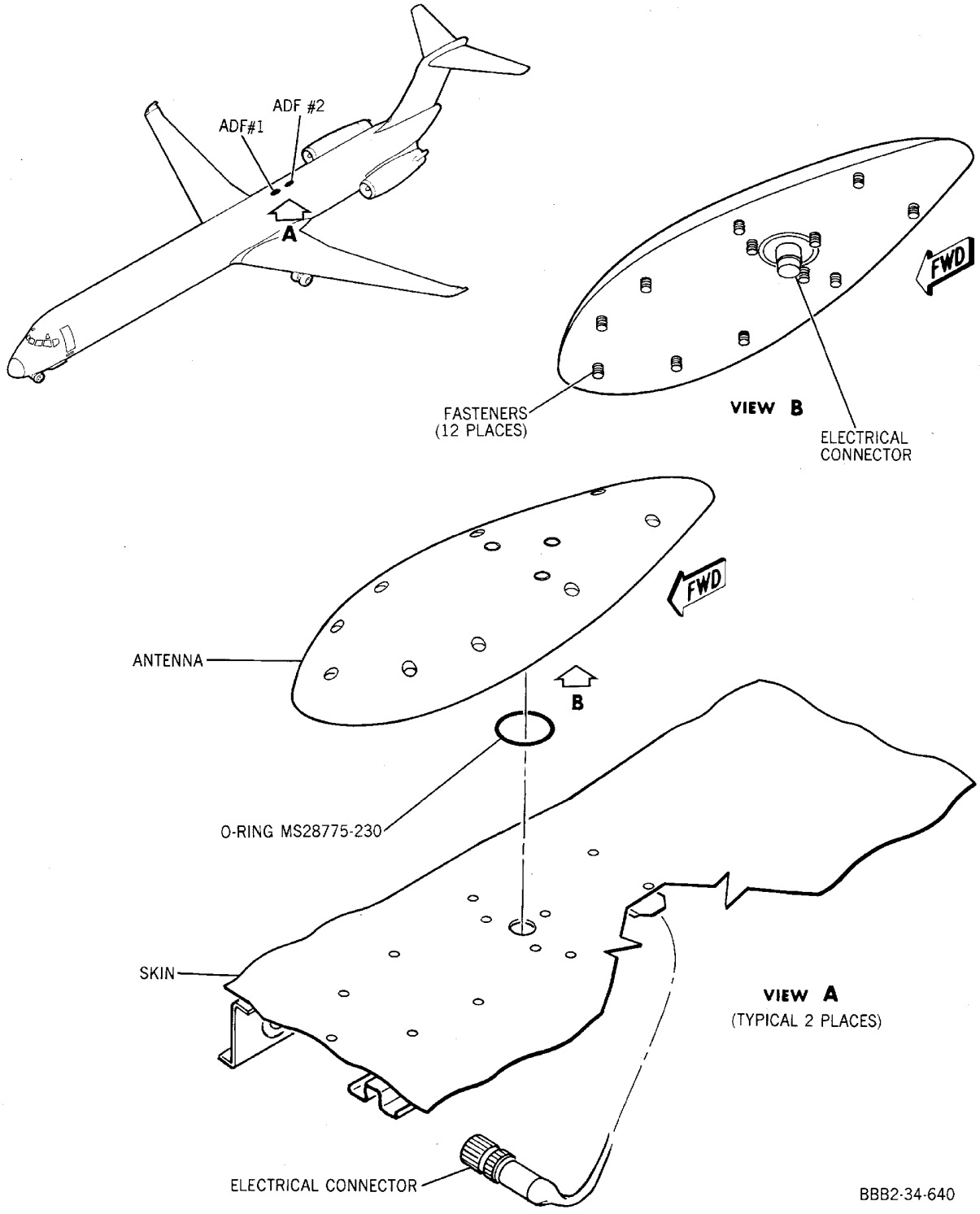
Table 203 (Continued)

Step	Operation	Desired Result
WJE 886, 887		
(3)	Note bearing of pointers on Captain's and First Officer's Navigation Displays (ND's).	Bearings should agree within ±5 degrees.
WJE 409, 884, 886, 887		
(4)	Return aircraft to required configuration.	

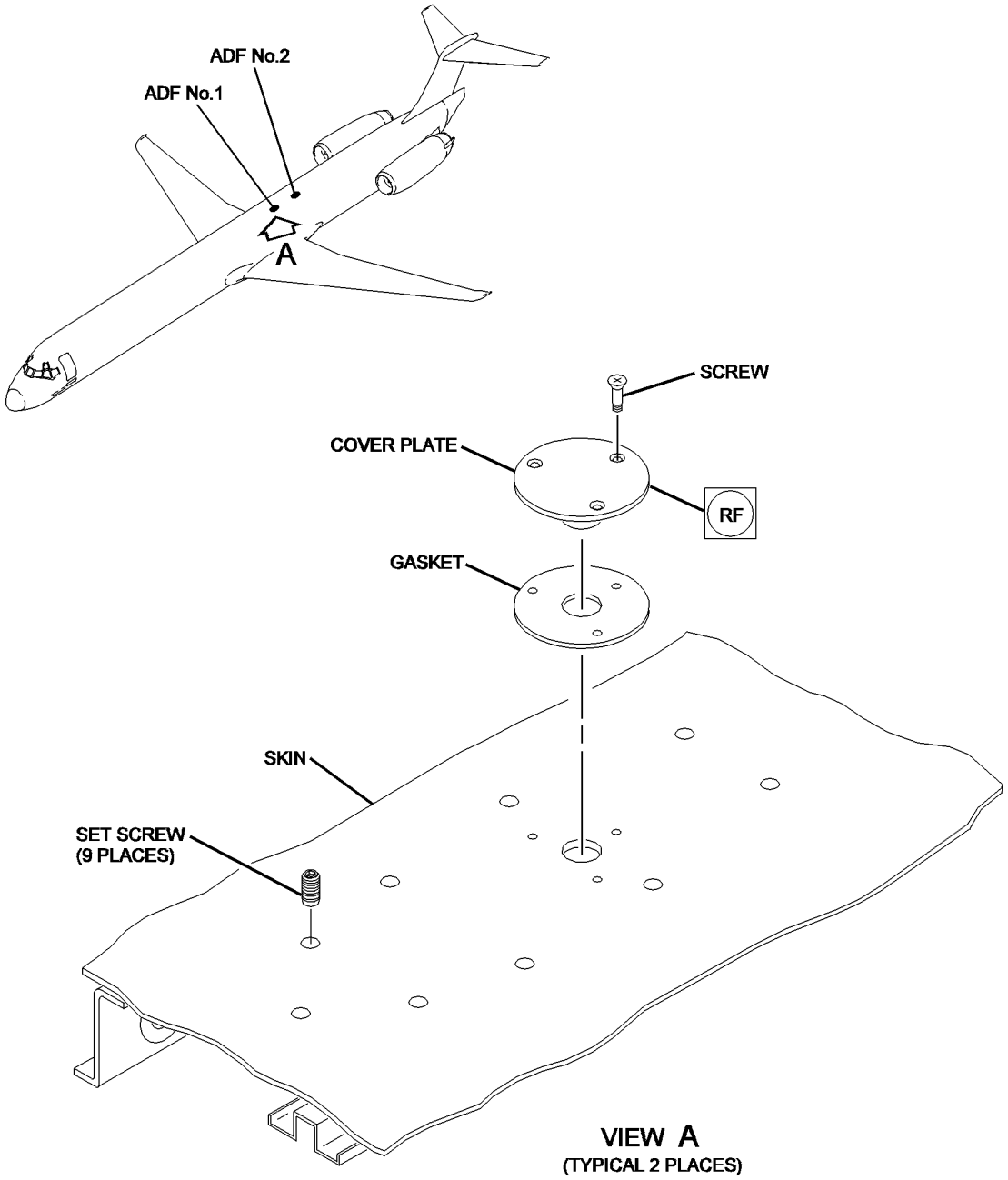
WJE 401-412, 414, 415, 417-419, 421, 423, 863-866, 869, 871-881, 883, 884, 886, 887, 892, 893



ADF Sense/Loop Antenna -- Removal/Installation
Figure 201/34-53-06-990-801 (Sheet 1 of 2)



ADF Sense/Loop Antenna -- Removal/Installation
Figure 201/34-53-06-990-801 (Sheet 2 of 2)



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S0000213489V1

ADF Cover Plate-- Removal/Installation
Figure 202/34-53-06-990-805

DIGITAL TO SYNCHRO CONVERTER - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation procedures for the digital to synchro converters used in conjunction with the ARINC 712 ADF System. The digital to synchro converter accepts serial digital data from the ADF receiver and converts the data into a synchro output capable of driving the torque receiver in the compass indicator. The digital to synchro converters are located in the forward right radio rack. On aircraft with one ADF system, perform procedures for that system only.

2. Removal/Installation Digital to Synchro Converter

A. Remove Digital to Synchro Converter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 418, 863, 864, 866, 873, 874, 880, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Disconnect and cap connector located on top of CONVERTER-1.

(3) Remove and retain mounting screws and washers used to attach base of CONVERTER-1 to radio rack. Remove CONVERTER-1 from rack.

(4) If removing CONVERTER-2 from rack, disconnect and cap connector at top of unit. Remove mounting screws and washers attaching front end of unit to rack. Pull unit forward until rear mounting flange on base of unit is free from retainer plate at back of radio rack. Remove unit from rack.

B. Install Digital to Synchro Converter

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 418, 863, 864, 866, 873, 874, 880, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Place CONVERTER-2 in rear mounting position in radio rack, with connector facing up. Make sure that mounting flange on rear base of converter is under retainer. Install attaching hardware on forward mounting flange of converter.

(3) Remove protective caps and connect electrical connector to top of unit.

(4) Place CONVERTER-1 in forward mounting position in radio rack, with connector facing up. Install attaching hardware.

(5) Remove protective caps and connect electrical connector to top of unit.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 407-411, 880, 881, 883, 884			
A	9	B10-400	ADF-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 407-411, 415, 418, 863, 864, 866, 873, 874, 880, 881, 883, 884, 892, 893			
F	24	B10-403	ADF-1

UPPER EPC, LEFT RADIO BUS

Row	Col	Number	Name
C	15	B10-73	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
C	6	B10-74	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(7) Perform system test. (SUBJECT 34-53-00, Page 201)

DIGITAL SYNCHRO CONVERTER - MAINTENANCE PRACTICES

1. General

A. These maintenance practices provide removal/installation procedures for the digital to synchro converters used in conjunction with the ARINC 712 ADF System. The digital to synchro converter accepts serial digital data from the ADF receiver and converts the data into a synchro output capable of driving the torque receiver in the compass indicator. The digital to synchro converters are located in the forward right radio rack. On aircraft with one ADF system, perform procedures for that system only.

2. Removal/Installation Digital to Synchro Converter

A. Remove Digital to Synchro Converter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Disconnect and cap connector located on top of CONVERTER-1.

(3) Remove and retain mounting screws and washers used to attach base of CONVERTER-1 to radio rack. Remove CONVERTER-1 from rack.

(4) If removing CONVERTER-2 from rack, disconnect and cap connector at top of unit. Remove mounting screws and washers attaching front end of unit to rack. Pull unit forward until rear mounting flange on base of unit is free from retainer plate at back of radio rack. Remove unit from rack.

B. Install Digital to Synchro Converter

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(2) Place CONVERTER-2 in rear mounting position in radio rack, with connector facing up. Make sure that mounting flange on rear base of converter is under retainer. Install attaching hardware on forward mounting flange of converter.

(3) Remove protective caps and connect electrical connector to top of unit.

(4) Place CONVERTER-1 in forward mounting position in radio rack, with connector facing up. Install attaching hardware.

(5) Remove protective caps and connect electrical connector to top of unit.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
B	6	B10-402	ADF-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	17	B10-29	ADF-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	12	B10-404	ADF-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	5	B10-30	ADF-2

(7) Perform system test. (SUBJECT 34-53-00, Page 201)

AIR TRAFFIC CONTROL TRANSPONDER SYSTEM - DESCRIPTION AND OPERATION

1. General

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

A. The air traffic control (ATC) transponder system identifies the airplane on a ground control radarscope by transmitting coded response signals when interrogated by a distinguishing series of coded pulses. When the ground control interrogation is in agreement with the enabled mode in the airplane transponder, an interrogation from the ground station will trigger a response from the transponder. Normal ATC traffic control procedures operate on mode A. The addition of air data system altitude encoding equipment enables the transponder to respond with altitude information when interrogated in mode A&B with ALT/RPTG switch on. The ATC system consists of one antenna, two transponders, and a dual control panel.

B. ATC Antenna - The ATC antenna is omnidirectional, blade-type, designed to radiate and receive signals in the frequency range of 900 to 1220 megahertz. The antenna is mounted on the lower forward fuselage, with a 50 ohm coaxial feed line connecting the antenna through coax relays to the ATC-1 transponder and ATC-2 transponder respectively.

C. ATC Control Panel - The dual ATC control panel is located in the flight compartment on the pedestal. The control panel has controls and functions as follows:

Table 1

Control	Function
ATC/TR-1/-2 Switch	Select transponder -1 or -2
MODE Switch	Select mode A, B or C (D not used)
Code Knobs	Select desired reply code as indicated in viewing window.
IDENT Button	Manually operates to send distinctive reply signal for ATC identification.
Selector Switch	Selects operations OFF, STBY ON, and LO SENS (low sensitivity operation)
NORM-TEST Switch	In TEST, Monitor Light should come on denoting system is operable. In NORM, monitor light comes on when being interrogated by ATC.
ALT RPTG/OFF Switch 1-2	In ALT RPTG position, enables selected system to automatically send altitude code from air data system when interrogated in mode C.
Monitor Light	Comes on when TEST activated, or transponder is being interrogated by ATC.

D. ATC Transponder - The ATC transponder is mounted in the left aft radio rack located in the electrical/electronics compartment. Electrical connection to airplane wiring is made through a double connector on the rear of the case. Each transponder contains a power supply and solid state plug-in module boards to accomplish receiver decoding and transmitter encoding. The receiver section is pretuned and crystal controlled to receive interrogation pulse signals from ground radar on 1030 mega-hertz. The transmitter section is frequency controlled to transmit response pulse signals on 1090 megahertz.

(1) The transponder front panel contains a TEST switch, and ANT and RT fault lights. Depressing the TEST switch activates the self-test oscillator which injects a signal into the transponder preselector. From this point the signal is processed as a valid interrogation signal. If no fault exists, the monitor light on the control panel will come on. The RT fault light will come on if a fault has occurred in the transponder. The ANT fault light will come on if there is an open circuit in the antenna system. The fault lights are reset by a reset switch on the front panel. If lights will not remain off, system trouble-shooting should be performed.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(2) The TEST switch and monitor light on the ATC control panel are wired in parallel with the transponder TEST switch. Either transponder can be tested, depending on the position of the ATC-1/-2 switch on the control panel (-2 when installed).

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E. The air traffic control transponder radar beacon system (ATCRBS) provides the means for identifying an aircraft on a ground control radar scope. This is accomplished by the aircraft transmitting coded response signals when ground control interrogation is in agreement with the aircraft enabled mode.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

F. The number of VHF frequencies used for aircraft communications has increased per AOL 9-2551 dated November 18, 1997. The European air traffic control (ATC) regulatory groups have jointly agreed to reduce VHF channel spacing from 25.00KHz to 8.33KHz. The 8.33KHz channel spacing requirement is for ATC VHF communication only and not VHF navigation.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

2. Description

A. The ATC/MODE S Transponder System is the airborne transponder for the ATCRBS and serves as a data link for air traffic control. The system provides MODE A, MODE C and special identification replies to ATCRBS interrogations for tracking, identification, and altitude reporting of aircraft. The system is also utilized for receiving and sending MODE S message formats required for air traffic control automation. Each aircraft with the ATC/MODE S system is assigned a unique address code so interrogation can be directed to that specific aircraft. The reply also contains the unique address to identify the sending aircraft.

B. The ATC/MODE S system consists of two ATC MODE S Transponders, a dual MODE S Control Panel, and four L band Antennas. The system interfaces with the air data computers, the traffic collision computer unit (when installed), and the data link process units (when installed).

C. The ATC/MODE S Transponder is a solid state airborne air traffic control transponder. The transponder responds to mode A, mode C, and mode select (mode S) interrogations. The MODE S transponder is capable of being discretely addressed from a Mode S station. The ATC transponders are located in the aircraft electrical/electronics compartment and accessible through the electrical/electronics compartment door. The transponder weighs 12 lbs. (5.4 Kg) and is powered by 115 VAC, 400 Hz. The transponder is capable of receiving and transmitting through two antennas, one on the top and one on the bottom.

WJE 410, 412, 414, 875-879

D. The ATC/MODE S Transponder control panel provides the means for control of the ATC/MODE S Transponder System operation. The panel contains two code selector knobs (or a digital keypad), a mode selector switch, a fault light, ident switch, a transponder select switch, altitude source selection switch and a liquid crystal display. Panel lighting is provided by 5 VAC 400 Hz power. The ATC panel also controls the Traffic Alert and Collision Avoidance System (TCAS), if installed. TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM, SUBJECT 34-46-00

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E. The ATC antennas are L band blade type antennas. There are four antennas located two on top and two on bottom of the forward aircraft fuselage section.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

F. Two electrical receptacles are installed on the aft radio rack above the transponders. Each receptacle is assigned to one of the transponders. An electrical plug with a jumper wire installed is connected to each receptacle. The plug jumper wire pin connections determine the mode S code assigned to that aircraft.

G. The number of VHF frequencies used for aircraft communications has increased per AOL 9-2551 dated November 18, 1997. The European air traffic control (ATC) regulatory groups have jointly agreed to reduce VHF channel spacing from 25.00KHz to 8.33KHz. The 8.33KHz channel spacing requirement is for ATC VHF communication only and not VHF navigation.

WJE ALL

3. Operation

A. The ground station setup for air traffic control (ATC) is composed of two types of radar, primary surveillance radar (PSR) and secondary surveillance radar (SSR). They are used together to form an air pattern for air traffic handling. In a typical radar equipped airport, two directional antennas, one belonging to the PSR and the other to the SSR are mounted together (or, if not mounted together, their rotation is synchronized). Near these antennas is a fixed omnidirectional antenna part of the SSR which is used for sidelobe suppression (SLS). The SLS system is used to prevent triggering by the sidelobes of the SSR directional antenna when the airborne transponder is near the ground station. The radar antennas are synchronized so that coded reply signals from the SSR and the echo replies from the PSR can be simultaneously displayed on the ATC ground radarscope. This display allows the air traffic controller to simultaneously handle transponder-equipped aircraft and non-equipped aircraft.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B. Placing the control panel function selector to STBY position applies power to both ATC/mode S transponders, but does not permit them to transmit a reply signal. Placing the function selector to any other position actuates the complete circuitry of the selected transponder, when the aircraft is in flight. An interlock through the ground control relay prevents actuation when on the ground. When actuated, the selected system will then receive and reply to SSR interrogation. The code selector knobs (or digital keypad) are used to select the desired reply code as indicated in the viewing window. The left large (outside) knob selects thousands; the left small (inside) knob selects hundreds; the right small (inside) knob selects tens; and the right large (outside) knob selects units; 4096 codes are thus available.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

C. Placing the control panel function selector to STBY position applies power to both ATC transponders, but does not permit them to transmit a reply signal. Placing the function selector to the -1 or -2 position actuates the complete circuitry of the applicable transponder, when the airplane is in flight. An interlock through the ground control relay prevents actuation when on the ground. When actuated, the selected system will then receive and reply to SSR interrogation. The MODE switch is used to select either mode A, B or C. The code selector knobs are used to select the desired reply code as indicated in the viewing window. The left large (outside) knob selects thousands; the left small (inside) knob selects hundreds; the right small (inside) knob selects tens; and the right large (outside) knob selects units; 4096 codes are thus available.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D. The transponder can be interrogated in mode A or C. The transponder is permanently enabled for mode A and C. The reply signal is composed of a series of pulses 0.45 micro-seconds in duration, within two framing pulses spaced approximately 20 microseconds apart. The number of pulses generated in a mode A reply code is dependent on the code selected at the control panel. An identification pulse is generated when the control panel IDENT button is depressed, and is transmitted 4.35 microseconds after the last framing pulse. Two separate matrices are used to encode the reply, one is used for mode A and the other for mode C. If the interrogation is accepted as valid; the transponder automatically sends a reply signal, and a suppression pulse is coupled out of the transponder to prevent the DME system and the TCAS system (if installed) from transmitting at the same time.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

E. The transponder can be interrogated in mode A, B, or C, (D not used). A mode A or B interrogation accepted as valid by the transponder is determined by the position of the mode selector on the control panel. The transponder is permanently enabled for mode C. The reply signal is composed of a series of pulses 0.45 micro-seconds in duration, within two framing pulses spaced approximately 20 microseconds apart. The number of pulses generated in a mode A or B reply code is dependent on the code selected at the control panel. An identification pulse is generated when the control panel IDENT button is depressed, and is transmitted 4.35 microseconds after the last framing pulse. Two separate matrices are used to encode the reply, one is used for modes A and B and the other for mode C. If the interrogation is accepted as valid; the transponder automatically sends a reply signal, and a suppression pulse is coupled out of the transponder to prevent the DME system from transmitting at the same time.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

F. A mode C interrogation is received as valid regardless of the mode selected on the control panel. If altitude reporting is on, the transponder automatically sends a coded reply signal representing the aircraft actual altitude. If altitude reporting is off, framing pulses only are transmitted. The ATC/Mode S receives altitude information from the Air Data Computers. Either ADC-1 or ADC-2 can be selected by the ATC control panel. The CADC switch in the overhead panel does not affect the routing of these signals. This signal along with a mode trigger, generated in the transponder decoder, is coupled to the mode matrix within the transponder encoder.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

G. A mode C interrogation is received as valid regardless of the mode selected on the control panel. If the control panel altitude reporting is in the ALT RPTG position, the transponder automatically sends a coded reply signal representing the airplane actual altitude. If the switch is in OFF position, framing pulses only are transmitted. An altitude encoder in the air data computer-1 provides an encoded altitude readout signal to the ATC-1 transponder. A similar signal is provided from air data computer-2 to the ATC-2 provisions. The CADC switch in the overhead panel does not affect the routing of these signals. This signal along with a mode trigger, generated in the transponder decoder, is coupled to the mode matrix within the transponder encoder. The coded reply signal output of the encoder is applied to a modulator, with the resultant signal applied to the grid of the transmitter tube. The rf coded reply signal from the transmitter tube is fed through a duplexer to the antenna, and radiated.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

H. The reply signals received from the transponder are displayed on a ground station radarscope that has a superimposed map of the region being scanned. The superimposed map shows the various airways between air terminals and also the boundary of the ATC center area. The aircraft may be displayed on the radarscope in several ways, determined by the reply signal received at the ATC center. If the aircraft has a transponder but the unit is not on the proper reply code, the reply is displayed as a large bright arc on the radarscope. If the aircraft has a transponder and the proper code reply, the reply signal is displayed as two arcs. If the aircraft has a transponder on the proper reply code and the ground controller requests the pilot to identify, the reply signal is displayed as two bright arcs and a "bloom". Range marks are available to aid the ground controller in the estimation of range of an aircraft from the ATC center.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

I. The reply signals received from the transponder are displayed on a ground station radarscope that has a superimposed map of the region being scanned. The superimposed map shows the various airways between air terminals and also the boundary of the ATC center area. The airplanes may be displayed on the radar-scope in several ways, determined by the reply signal received at the ATC center. If the airplane has no transponder, the reply is an echo reply only and is shown as a small arc on the radarscope. If the airplane has a transponder but the unit is not on the proper reply code, the reply is displayed as a large bright arc on the radarscope. If the airplane has a transponder and the proper code reply, the reply signal is displayed as two arcs. If the airplane has a transponder on the proper reply code and the ground controller requests the pilot to identify, the reply signal is displayed as two bright arcs and a "bloom". Range marks are available to aid the ground controller in the estimation of range of an aircraft from the ATC center.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

J. Mode S uses a discrete set of radio pulses (CODE) for each individual aircraft assigned in advance for identification. The assigned code will be automatically transmitted when the transponder is appropriately interrogated by a mode S station. The transponder will transmit the CODE set on the control panel by the pilot as assigned by the controller for ATCRBS interrogation. Mode S is capable of operation in the mode C function and responds to specific ground interrogation by transmitting the aircraft's current altitude in 100 foot increments. The information is received by the ground equipment and displayed on the controller's screen. By being able to identify and locate the aircraft gives the controller the ability to maintain aircraft separation and collision avoidance. This information will be received by aircraft with Traffic Alert and Collision Avoidance System (TCAS) installed to provide traffic and resolution advisories. Mode S adds the capability to provide a data link between the aircraft and the ground as mode S ground stations are installed.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887

K. A self test is accomplished by momentarily pressing the TEST button on the control panel. The FAIL light should come on momentarily to indicate there is no fault in the transponder.

WJE 407, 408, 410, 411

L. A self test is accomplished by rotating the selector switch on the control panel in TEST position for one second. The FAIL light should come on momentarily to indicate there is no fault in the transponder.

WJE 875-879

M. A self test is accomplished by pressing the TEST button on the front of the transponder. The green light should remain on 2-5 seconds after test to indicate there is no fault in the transponder.

WJE ALL

4. To Operate System

A. Operate

(1) Energize electrical buses.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

NOTE: When aircraft electrical buses are energized, electrical power is applied to ATC/Mode S transponders regardless of position of ATC function switch, unless ATC MODE-S-1 or ATC MODE-S-2 circuit breakers are opened.

WJE ALL

(2) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	7	B10-458	MODE-S ATC-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2
WJE 407, 408, 411			
E	1	B10-451	MODE-S ATC INOP

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(3) On control panel, set function switch to STBY position and allow approximately 5 minutes for equipment warmup.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(4) On control panel, set function switch to STBY position and allow approximately 3 minutes for equipment warmup.

WJE 407, 408, 410, 411

(5) On control panel, set function switch to ALT OFF or ALT ON and select desired transponder.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(6) On control panel, set function switch to XPDR position and select desired transponder.

NOTE: When the aircraft is on the ground, actuation of the selected transponder is prevented by a ground control relay interlock, unless the ground control relay is manually placed in the flight mode or the interlock is overridden by actuating the ATC Test Switch control panel.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(7) On control panel, set function switch to -1 or -2 position to select desired transponder.

NOTE: When the aircraft is on the ground, actuation of the selected transponder is prevented by a ground control relay interlock, unless the ground control relay is manually placed in the flight mode or the interlock is overridden by actuating the ATC Test Switch control panel.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

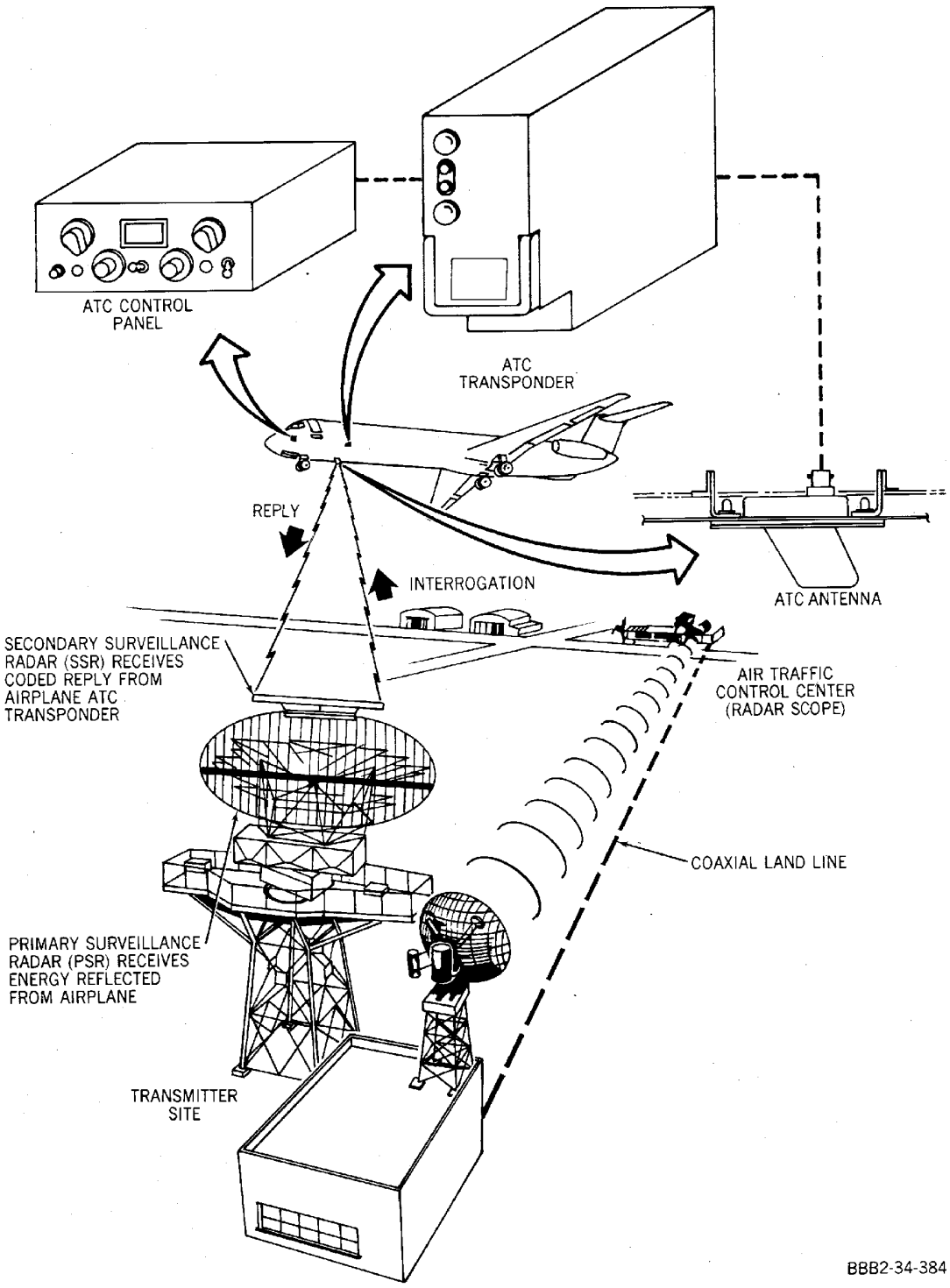
(8) On control panel set up proper reply code.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(9) On control panel, per traffic controller instructions, set MODE switch to desired mode, and set up proper reply code using code selector knobs.

NOTE: When airplane electrical buses are energized, electrical power is applied to ATC transponders regardless of position of ATC function switch, unless ATC-1 or ATC-2 circuit breakers are opened.

WJE ALL



Air Traffic Control (ATC) System
Figure 1/34-54-00-990-801

EFFECTIVITY
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

AIR TRAFFIC CONTROL (ATC) TRANSPONDER SYSTEM - TROUBLE SHOOTING

1. General

WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty ATC system in the aircraft.

B. The basic causes of a faulty system operation are generally: faulty aircraft wiring or faulty line replaceable units (LRU).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

WJE ALL

D. The major components of the ATC system are the control panel, transponder, and antenna. The system interfaces with the air data computers. In Trouble Shooting, some checks may have to be made to air data computers.

E. The ATC system components are located as follows:

Table 101 Table 101

Component	Location
Control Panel	Flight Compartment Pedestal
Transponder	Radio Rack, Electrical/Electronics Compartment
ATC Circuit Breakers	EPC Circuit Breaker Panel
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
Antenna	Forward Top and Bottom Fuselage
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893	
Antenna	Forward Bottom Fuselage
WJE 406	
NOTE: The ATC circuit breakers are located in the EPC and Overhead circuit breaker panels.	
WJE ALL	

2. Equipment and Materials

NOTE: Equivalent substitutes can be used in place of the following listed items.

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shoot ATC System

A. Trouble Shoot

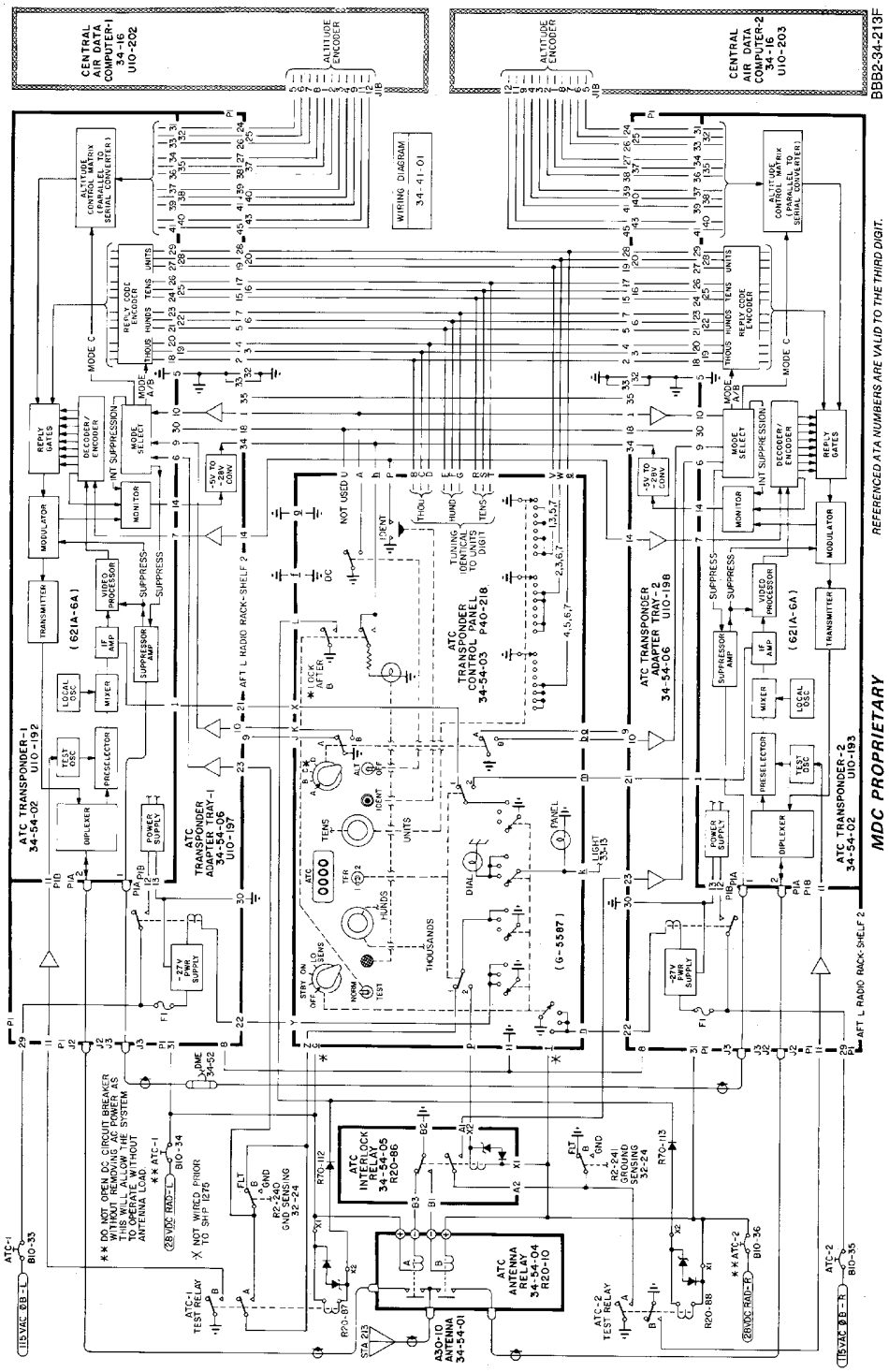
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification.

WJE ALL

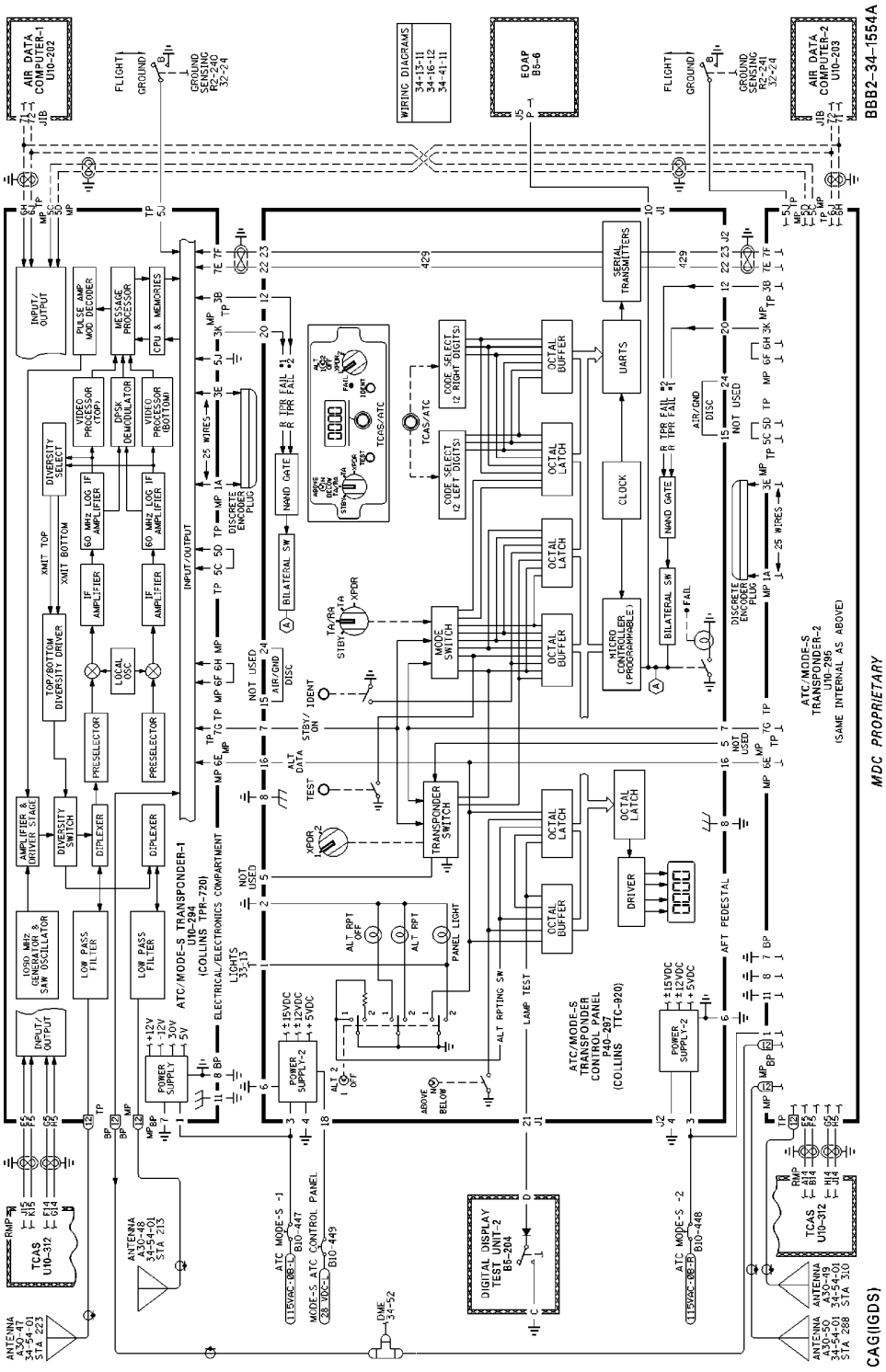
Table 103

Procedure	Correction
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893	
(1) Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses. Replace faulty circuit breakers, wires, or LRUs.
(2) Check for proper grounds at control panel, transponder, antenna relay and air data computers. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make certain ground terminals are tight and properly bonded. Replace LRUs.
WJE ALL	
(3) Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
WJE 401-411, 415-427, 429, 861-866, 868, 869, 871-881, 883, 884, 886, 887, 891-893	
(4) In a dual system, interchange LRUs to isolate of faulty LRUs.	Replace faulty LRUs.
WJE ALL	
(5) Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

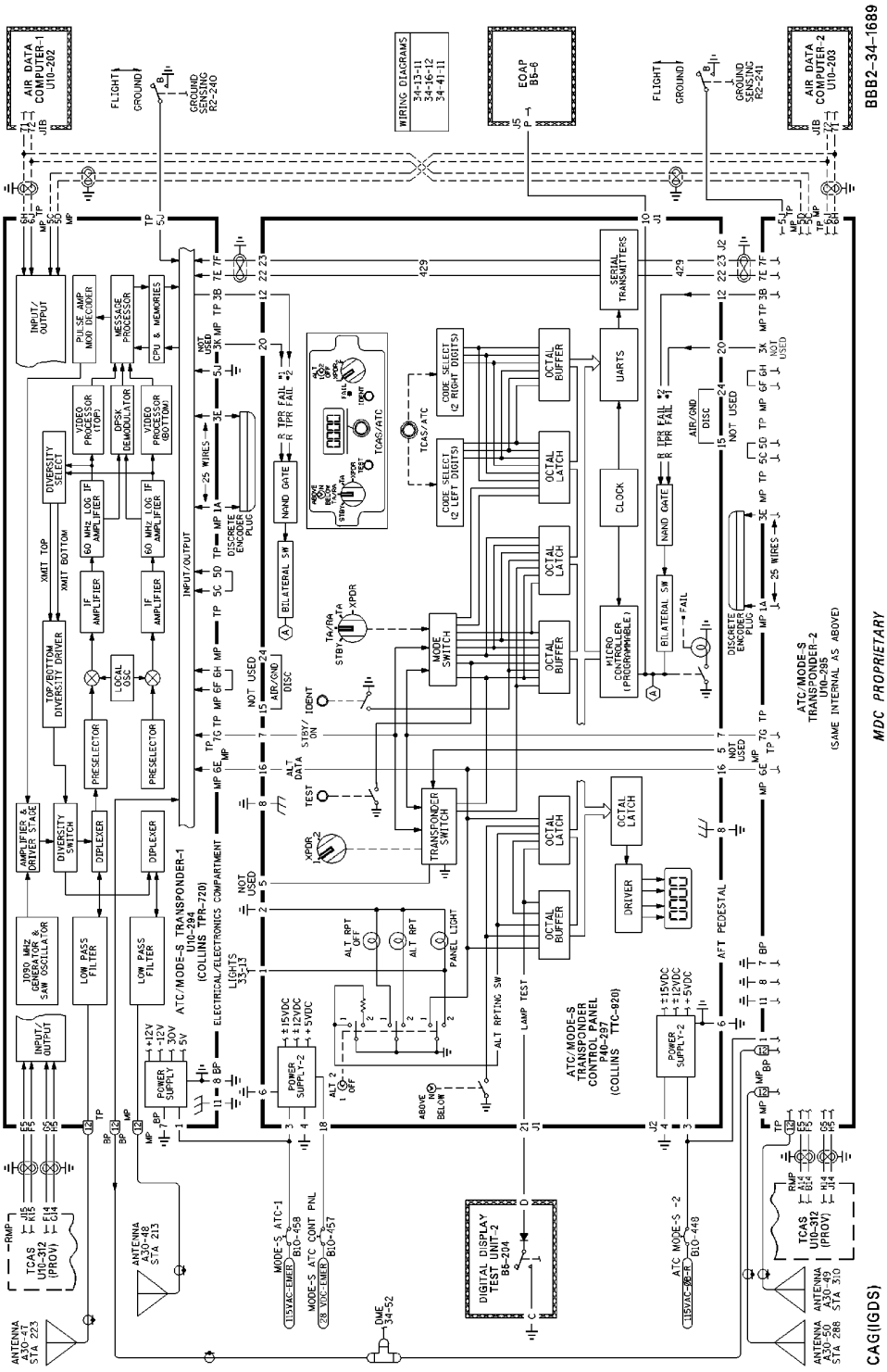


ATC Transponder System - Schematic
Figure 101/34-54-00-990-806

EFFECTIVITY
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893



ATC Mode S System - Schematic
Figure 102/34-54-00-990-807 (Sheet 1 of 2)



ATC Mode S System - Schematic
Figure 102/34-54-00-990-807 (Sheet 2 of 2)

AIR TRAFFIC CONTROL TRANSPONDER SYSTEM - MAINTENANCE PRACTICES

1. General

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

A. The air traffic control (ATC) transponder system identifies the aircraft on a ground radarscope by transmitting coded signals at 1090 megahertz when interrogated with coded signals at 1030 megahertz. The transponder can also receive and send Mode S message formats that will be required for ATC automation. The Mode S transponder can be addressed from a Mode S station or aircraft. Two transponders are installed in the radio rack located in the electrical/electronics compartment. Four L-band blade type antennas are installed on the forward fuselage, two on top and two on the bottom. The system is operated from a dual control panel on the pedestal.

B. When the ATC Mode S system is interrogated during the Adjustment/Test, it sends out coded response signals which could cause a "phantom aircraft" to appear on local air traffic control monitors. Also, aircraft flying in the area may be equipped with a Traffic Alert and Collision Avoidance System (TCAS). When the TCAS in the overhead aircraft receives the Mode S response it could advise the pilot to take evasive action to avoid the "phantom." A TCAS advisory is more likely when the ATC Adjustment/Test is performed at a simulated altitude of 10,000 feet.

C. Consult local air traffic control authorities to find out which simulated altitude to use for this test. Alternate tests are provided for the ATC, one at 10,000 feet and one at 45,000 feet. Either test can be used.

(1) The test in Paragraph 4. uses the remote CADC test adapter which causes the CADC to simulate an altitude of approximately 10,000 feet. The air data tester is not required.

(2) The test in Paragraph 5. uses the air data tester to inject a simulated altitude of 45,000 feet.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

D. The air traffic control (ATC) transponder system identifies the airplane on a ground radarscope by transmitting coded signals at 1090 megahertz when interrogated with coded signals at 1030 megahertz. Two transceivers are mounted in the radio rack located in the electrical/electronics compartment. An omnidirectional antenna is mounted on the lower forward fuselage. The system is turned on and operated from a dual control panel on the pedestal.

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893	
ATC Ramp Test Set TIC T-33B, T-49, T-49C or T-48D	TEL Instruments Corp.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
TCAS/ATC Mode S Ramp Test Set T-49, T-49C or T-48D	Tel-Instrument Electronics Corp.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 201 (Continued)

Name and Number	Manufacturer
Foam, Microwave Absorbing, Eccosorb DMS 2358	Emerson & Cuming Canton, MA
Test Adapter, CADC Remote (5963440-1)	The Boeing Company
NOTE: The remote test adapter is used for the 10,000 foot test.	
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893	
Air Data Tester Milhard 127-1M	Edcliff Instruments
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
Air Data Tester model No. 127-1M	Edcliff Instruments
or	PARTIAL VER E 3
FLMTS Air Data Tester P/N 18910460000	Kollsman
WJE ALL	
Red tape VIP 7331 DPM 850-24	Valley Industrial Products
Adapter, Static Port (33410LH 90-5)	Canadian Aero Inst Co.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	
NOTE: The air data tester and adapters are used for the 45,000 foot test.	
NOTE: The TIC-T-49 TCAS/ATC Mode S ramp test set is used in the following test procedures. If optional test set used, substitute operating instructions in place of T-49 test set. The TCAS/ATC Mode S ramp test set will be the test set called out in procedure.	
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893	
NOTE: The TIC-T-33B test set is used in the following test procedures, if optional test set used, substitute operating instructions in place of T-33B test set.	
WJE ALL	

3. Functional Test of the ATC Mode-S Transponder Power Output

A. Job Set-up - ATC Mode-S Transponder Power Output Functional Test

(1) Make sure that these circuit breakers are closed:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	7	B10-458	MODE-S ATC-1

WJE 406 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE ALL			
C	1	B10-316	AIR DATA CMPTR-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE ALL			
F	12	B10-317	AIR DATA CMPTR -2

WARNING: THE ELECTRICAL POWER SUPPLIED TO MANY AIRCRAFT SYSTEMS CAN CHANGE WHEN THE GROUND SENSING CIRCUIT BREAKERS ARE OPENED. MAKE SURE THE NECESSARY GROUND OPERATIONS CONTINUE. ALSO MAKE SURE THE SWITCHES AND CONTROLS OF THE OTHER AIRCRAFT SYSTEMS ARE IN THE CORRECT POSITIONS TO PREVENT ACCIDENTAL OPERATION WHEN THE CIRCUIT BREAKERS ARE CLOSED. THIS WILL HELP PREVENT INJURY TO PERSONS AND DAMAGE TO THE EQUIPMENT.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Open these circuit breakers and install safety tags:

LOWER EPC, ENGINE - LEFT DC BUS

Row	Col	Number	Name
S	37	B1-45	LEFT ANTI-ICE VALVE CAUTION

LOWER EPC, ENGINE - RIGHT DC BUS

Row	Col	Number	Name
T	37	B1-46	RIGHT ANTI-ICE VALVE CAUTION

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

UPPER EPC, ENGINE - LEFT AC BUS

Row	Col	Number	Name
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	30	B1-43	ANTI-ICING VALVE LEFT ENGINE COWL
K	31	B1-53	ANTI-ICING VALVE LEFT ENGINE LEFT
K	32	B1-55	ANTI-ICING VALVE LEFT ENGINE RIGHT

UPPER EPC, ENGINE - RIGHT AC BUS

Row	Col	Number	Name
L	30	B1-44	ANTI-ICING VALVE RIGHT ENGINE COWL
L	31	B1-54	ANTI-ICING VALVE RIGHT ENGINE LEFT
L	32	B1-56	ANTI-ICING VALVE RIGHT ENGINE RIGHT

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, L DC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	32	B1-999	ANTI-ICING VALVE LEFT ENGINE COWL
K	33	B1-1000	ANTI-ICING VALVE LEFT ENGINE LEFT
K	34	B1-1001	ANTI-ICING VALVE LEFT ENGINE RIGHT

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	30	B1-24	RIGHT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, R DC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
L	32	B1-996	ANTI-ICING VALVE RIGHT ENGINE COWL
L	33	B1-997	ANTI-ICING VALVE RIGHT ENGINE LEFT
L	34	B1-998	ANTI-ICING VALVE RIGHT ENGINE RIGHT

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2

WJE ALL

(3) Install air data tester as follows:

NOTE: A minimum of two maintenance persons is necessary to do the subsequent procedure.

(a) Connect air data test set to the Captains's and F/O's pitot tubes and static ports to provide inputs for both Air Data computers.

(b) Energize air data tester. Let the tester operate for 5 minutes before you use it. The air data tester indications become stable.

(c) On the Captain's and first officer's gusset panels, set the STATIC AIR switches to the NORM position.

(d) On the source select panel on the overhead, put the CADC switch in the NORM position.

(e) On the air data tester, adjust the atmosphere pressure indication to 29.92 Hg.

(4) Install the T-49 ATC tester as follows:

(a) Place T-49 test set under the aircraft below the bottom TCAS directional antenna.

1) Make sure that the test set is in line of sight with the antenna being tested. If test is performed close to large structures, put the test set HI/LO switch to LO to avoid reflected signals.

(b) Connect the sleeve dipole antenna to the test set ANTENNA connector.

NOTE: If the dipole antenna is not available, use the directional antenna provided with the T-49 test set.

(5) Install the T-49C ATC tester as follows:

(a) Connect the antenna coupler to the ATC-1 bottom antenna.

(b) Connect the antenna coupler connector to the antenna jack on the test set.

(6) On the T-49C ATC tester, set the function switch to ATCRBS/MODE S XPDR TEST. On the T-49 ATC tester, set the function switch to XPDR TEST.

(a) Push the INTERROGATE switch. Make sure that the display shows MODE S XPDR COM A/B (NO COMM).

NOTE: If the tester shows BATTERY LOW or NO REPLY FOR XPDR, the internal battery is low or the antenna is not correctly attached.

NOTE: The tester will automatically turn off after 3 minutes operation. Push the REPEAT switch to extend the tester power-on time.

B. Procedure - ATC Mode-S Transponder Power Output Functional Test

CAUTION: THE AIR DATA TESTER CAN CAUSE DAMAGE TO THE AIR DATA COMPUTER AND STANDBY AIRSPEED/ALTIMETER IF NOT OPERATED PROPERLY. DO NOT HAVE MORE THAN 6000 FEET PER MINUTE RATE OF CHANGE ON THE STATIC PORTS. DO NOT SUDDENLY VENT THE LINES TO THE ATMOSPHERE WHILE THE AIR DATA TESTER IS IN OPERATION.

(1) Do the ATC Mode-S transponder power output functional test as follows:

STEP	OPERATION	VISUAL INSPECTION
On the ATC control panel:		
1	Set controls to ALT 1; XPDR 1; and function selector switch to STBY.	Switches set to ALT 1, XPDR 1, and STBY.
On the air data tester:		

(Continued)

STEP	OPERATION	VISUAL INSPECTION
2	Operate the air data tester to set 45 knots airspeed and 45,000 feet altitude.	On the mach airspeed indicator, make sure that the airspeed is 45 ±5 knots. On the altimeter, make sure that altitude is 45,000 ±125 feet.
On the ATC control panel:		
3	Set the function switch to XPDR.	
On the ATC tester:		
4	Push the INTERROGATE switch.	The display shows MODE S XPDR COM A/B (NO COMM).
5	Push and hold down TEST switch until SQUITTER PASS is seen on the display window.	SQUITTER PASS is shown on the display window.
6	Push the TEST switch.	DIVERSITY PASS is shown on the display window.
7	Push the TEST switch.	MAX. TRUE AIRSPEED GT XX & LE XXX KTS is displayed on the tester window.
NOTE: LE means les than or equal to and GT means greater than.		
8	Push the TEST switch.	VS=0 is shown on the tester window.
9	Push the TEST switch.	XXX W -74±3dBm ±1MHZ is shown on the tester window.
NOTE: The XXX shown is the Radio Frequency (RF) Output Power. The minimum RF peak output power is no less than 125 watts and the maximum RF peak output power should not be more than 500 watts.		
10	Push the ON/OFF switch to the OFF position.	
On the ATC control panel:		
11	Set the function switch to STBY.	
On the T-49:		
11A	Set the test set as appropriate to the ATC-1 top antenna.	
On the T-49C:		
12	Connect the antenna coupler to the ATC-1 top antenna.	
13	Do the steps 3 through 11 again.	
On the overhead circuit breaker panel:		
14	Open the circuit breakers that follow:	

	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
	B10-447	ATC MODE-S-1	Upper EPC	LEFT RADIO AC BUS	D/13

WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

(Continued)

	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406					
	B10-458	MODE-S ATC -1	Overhead	EMERGENCY AC BUS	B/7
WJE ALL					
On the EPC circuit breaker panel:					
15	Close the circuit breaker that follows:				
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
	B10-448	ATC MODE-S -2	Upper EPC	RIGHT RADIO AC BUS	D/1
WJE ALL					

STEP	OPERATION	VISUAL INSPECTION
On the ATC control panel:		
16	Set the XPDR switch to 2.	
On the T-49:		
17	Set the test set as appropriate to the ATC-2 bottom antenna.	
On the T-49C:		
18	Connect the antenna coupler to the ATC-2 bottom antenna.	
19	Do the steps 3 through 11 again.	
On the T-49:		
20	Set the test set as appropriate to the ATC-2 top antenna.	
On the T-49C:		
21	Connect the antenna coupler to the ATC-2 top antenna.	
22	Do steps 3 through 11 again.	
On the T-49:		
23	Disconnect the test set.	
On the T-49C:		
24	Disconnect the antenna coupler.	
On the ATC control panel:		
25	Set the XPDR switch to 1.	

(Continued)

STEP	OPERATION	VISUAL INSPECTION
CAUTION: THE AIR DATA TESTER CAN CAUSE DAMAGE TO THE AIR DATA COMPUTER AND STANDBY AIRSPEED/ALTIMETER IF NOT OPERATED PROPERLY. DO NOT HAVE MORE THAN 6000 FEET PER MINUTE RATE OF CHANGE ON THE STATIC PORTS. DO NOT SUDDENLY VENT THE LINES TO THE ATMOSPHERE WHILE THE AIR DATA TESTER IS IN OPERATION.		
On the Air Data Tester:		
26	Slowly set the airspeed and altitude controls back to atmospheric pressure.	

C. Job Close-up - ATC Mode-S Transponder Power Output Functional Test

(1) Remove the air data tester from the pitot tubes and static ports.

(2) Remove the safety tags and close these circuit breakers:

LOWER EPC, ENGINE - LEFT DC BUS

Row	Col	Number	Name
S	37	B1-45	LEFT ANTI-ICE VALVE CAUTION

LOWER EPC, ENGINE - RIGHT DC BUS

Row	Col	Number	Name
T	37	B1-46	RIGHT ANTI-ICE VALVE CAUTION

LOWER EPC, MISCELLANEOUS LEFT DC BUS

Row	Col	Number	Name
P	35	B1-487	STALL WARNING AND AUTO SLAT-1

LOWER EPC, MISCELLANEOUS RIGHT DC BUS

Row	Col	Number	Name
R	35	B1-26	STALL WARNING AND AUTO SLAT-2

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	7	B10-458	MODE-S ATC-1

UPPER EPC, ENGINE - LEFT AC BUS

Row	Col	Number	Name
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	30	B1-43	ANTI-ICING VALVE LEFT ENGINE COWL
K	31	B1-53	ANTI-ICING VALVE LEFT ENGINE LEFT
K	32	B1-55	ANTI-ICING VALVE LEFT ENGINE RIGHT

WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893 (Continued)

UPPER EPC, ENGINE - RIGHT AC BUS

Row	Col	Number	Name
L	30	B1-44	ANTI-ICING VALVE RIGHT ENGINE COWL
L	31	B1-54	ANTI-ICING VALVE RIGHT ENGINE LEFT
L	32	B1-56	ANTI-ICING VALVE RIGHT ENGINE RIGHT

UPPER EPC, L AC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	30	B1-23	LEFT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, L DC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
K	32	B1-999	ANTI-ICING VALVE LEFT ENGINE COWL
K	33	B1-1000	ANTI-ICING VALVE LEFT ENGINE LEFT
K	34	B1-1001	ANTI-ICING VALVE LEFT ENGINE RIGHT

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	30	B1-24	RIGHT GROUND CONTROL RELAY
WJE 401-412, 414-416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873-881, 883, 884, 886, 887, 891-893			
L	33	B1-24	RIGHT GROUND CONTROL RELAY

UPPER EPC, R DC BUS

Row	Col	Number	Name
WJE 417, 419, 421, 423, 865, 869, 871, 872			
L	32	B1-996	ANTI-ICING VALVE RIGHT ENGINE COWL
L	33	B1-997	ANTI-ICING VALVE RIGHT ENGINE LEFT
L	34	B1-998	ANTI-ICING VALVE RIGHT ENGINE RIGHT

WJE ALL

(3) Remove all the tools and equipment from the work area. Make sure that the area is clean.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

4. Adjustment/Test ATC System (10,000 foot test with remote CADC test adapter)

A. Test Preparation

Table 202

Operation		Desired Result
(1) Connect the sleeve dipole antenna to the test set ANTENNA connector.		
NOTE: If the dipole antenna is not available, use the TAP antenna coupler provided with the T-49 test set. The TAP antenna coupler slides onto the ATC blade antenna.		
(2)	Place TCAS/ATC Mode S ramp test set under the aircraft below the bottom TCAS directional antenna.	
(3)	On test set, put mode select knob in XPDR TEST position. Press the LIGHTS/OFF switch to OFF position to make sure test set is off.	
(4)	Lift dust cover on front of CADC connector and connect CADC remote test adapter to the front of CADC connector.	

B. Functional Test ATC/Mode S-1

Table 203

Operation			Desired Result		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(1)	Open, safety and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKERS	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(2)	On ATC/TCAS control panel, place function selector switch to STBY and allow three minutes warm up.		Function selector to STBY.		

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 203 (Continued)

Operation			Desired Result		
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(3)	Place function selector to XPDR, and XPDR switch to 1, and ALT switch to 1 position.		XPDR, XPDR 1, and ALT 1 selected.		
WJE 875-879					
(3)	Place function selector to XPDR ON, XPDR switch to 1, and ALT RPTG switch to 1 position.		XPDR ON, XPDR 1, and ALT RPTG 1 selected.		
WJE 407, 408, 410, 411					
(3)	Place function selector to ALT ON, ATC switch to 1, and ALT switch to 1 position.		ALT ON, ATC 1, and ALT 1 selected.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(4)	On test set, press and release TEST button to turn on test set.		On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.		
CAUTION: AVOID USING ANY CODE COMBINATION STARTING WITH "77" IN THE FIRST TWO DIGITS. THIS IS AN EMERGENCY CODE.					
(5)	On ATC control panel, set code selector to 1200.		1200 selected.		
(6)	On test set, press and release TEST button.		Test set shows ATCRBS/A 1200 95(±5)% REPLY.		
(7)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.				
(8)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(9)	On test set, press and release STORE/REPEAT button.				
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(10)	Open, safety and tag the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 203 (Continued)

Operation			Desired Result	
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887				
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872				
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
WARNING: WHEN FLIGHT GUIDANCE SYSTEM IS ENERGIZED, UNDER CERTAIN CONDITIONS, CADC SELF TEST FUNCTION CAN CAUSE MOVEMENT OF FLIGHT CONTROL SURFACES.				
(11)	On flight guidance control panel, make sure autopilot is disengaged.		Autopilot disengaged.	
(12)	On overhead panel, set CADC switch to NORM.			
(13)	Connect CADC Remote Test Adapter to Air Data Computer1.		Test adapter connected.	
(14)	On remote test adapter, select 9900(±20) feet by setting No. 1 switch to ON, No. 2 and 3 switches to OFF.		1 ON; 2 and 3 OFF.	
(15)	On Capt's and F/O's alti- meters, set barometric pressure to 29.92 inches.		Barometric pressure at 29.92(±.01) inches. Captain and F/O altimeters show 9900(±125) feet.	
(16)	On test set, press and release TEST button.		Test set shows ATCRBS/C 9,900(±125) 95(±5)% REPLY.	
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.				
(17)	Open, safety and tag the circuit breaker that follows:			
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA / ROW/COL
	B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS / C/1
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887				
(18)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY. On ATC control panel, ATC FAIL light comes on. On OAP, TRANSPONDER INOP comes on.	
WJE 407, 408, 410, 411				
(18)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY.	

WJE 407, 408, 410, 411 (Continued)

Table 203 (Continued)

Operation			Desired Result		
WJE 875-879					
(18)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY. On ATC control panel, XPDR FAIL light comes on. On OAP, TRANSPONDER INOP comes on.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(19)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
			ATC FAIL and TRANSPONDER INOP lights go off.		
WJE 875-879					
			XPDR FAIL and TRANSPONDER INOP lights go off.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(20)	On ATC control panel, put the ALT switch to 2.		ALT 2 selected.		
(21)	Connect CADC Remote Test Adapter to Air Data Computer-2.		Test adapter connected.		
(22)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C 9,900(±125) 95(±5)% REPLY.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(23)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10–317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(24)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY. On ATC control panel, ATC FAIL light comes on. On OAP, TRANSPONDER INOP comes on.		
WJE 407, 408, 410, 411					
(24)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY.		
WJE 875-879					
(24)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/C NO ALT 100% REPLY. On ATC control panel, XPDR FAIL light comes on. On OAP, TRANSPONDER INOP comes on.		

WJE 875-879 (Continued)

Table 203 (Continued)

Operation			Desired Result		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(25)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10–317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
			ATC FAIL and TRANSPONDER INOP lights go off.		
WJE 875-879					
			XPDR FAIL and TRANSPONDER INOP lights go off.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(26)	On test set, press and release TEST button.		Test set shows ATCRBS/A MODE S ALL XXXXXX 95(±5)% REPLY.		
NOTE: XXXXXX is the aircraft Mode S address code.					
(27)	On test set, press and release TEST button.		Test set shows ATCRBS/C MODE S ALL XXXXXX 95(±5)% REPLY.		
NOTE: XXXXXX is the aircraft Mode S address code.					
WJE 875-879					
(28)	Delete				
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(28)	On ATC control panel, press TEST button for one second and release.		On control panel, ATC FAIL light comes on for approximately 3 seconds. Display shows 8888. On OAP, TRANSPONDER INOP light comes on momentarily.		
WJE 407, 408, 410, 411					
(28)	On ATC control panel, rotate function switch to TEST for one second then back to ALT OFF position.		On control panel, ATC FAIL light comes on for approximately 3 seconds. Display shows 8888, ATC 1 2 and R.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(29)	Remove the safety tags and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30

WJE 417, 419, 421, 423, 865, 869, 871, 872 (Continued)

Table 203 (Continued)

Operation			Desired Result		
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(30)	On front panel of ATC-1 transponder, press and hold TEST button for approximately 6 seconds.		On transponder, all red lights and the green light come on momentarily, then red lights go off. Green light stays on for a few seconds then goes off.		
WJE 407, 408, 410, 411, 875-879					
(30)	On front panel of ATC-1 transponder, press and hold TEST button for approximately 6 seconds.		On transponder, all red lights and the green light come on momentarily then go off. Green light comes on again for 2-5 seconds after TEST button is released.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(31)	Open, safety and tag these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(32)	On test set, press and release TEST button until maximum true airspeed is shown.		Test set shows MAX TRUE AIRSPEED GT 300 & LE 600 KTS.		
(33)	Place "C" band absorbent material over the ATC-1 bottom antenna.				

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 203 (Continued)

Operation		Desired Result
(34)	Move T-49 test set to side of aircraft in line of sight with upper ATC antennas.	Test set antenna pointed at upper ATC antennas.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(35)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR NO COMM INTERROGATE TO TEST comes on.
WJE 407, 408, 410, 411, 875-879		
(35)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(36)	Press and release TEST button.	Test set shows ATCRBS/A 1200 95(±5)% REPLY.
(37)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.	Test set shows ATCRBS/A IDENT 1200 95(±5)% REPLY.

(38)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(39)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/A NO REPLY FROM XPDR.			

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(40)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	K/30

WJE 417, 419, 421, 423, 865, 869, 871, 872 (Continued)

Table 203 (Continued)

Operation	Desired Result
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887	

C. Functional Test ATC/Mode S-2

Table 204

Operation					Desired Result
(1)	On ATC control panel, place XPDR switch to 2.				ATC 2 selected.
(2)	Remove "C" band absorbent from ATC-1 bottom antenna. Place "C" band absorbent material over the ATC-2 bottom antenna.				
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(3)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.				On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR NO COMM INTERROGATE TO TEST comes on.
WJE 407, 408, 410, 411, 875-879					
(3)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.				On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(4)	Press and release TEST button.				Test set shows ATCRBS/A 1200 95(±5)% REPLY.
(5)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.				Test set shows ATCRBS/A IDENT 1200 95(±5)% REPLY.
(6)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(7)	On test set, press and release STORE/REPEAT button.				Test set shows ATCRBS/A NO REPLY FROM XPDR.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 204 (Continued)

Operation			Desired Result		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(8)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(9)	Remove "C" band absorbent from ATC-2 bottom antenna.				
(10)	Place T-49 test set under the aircraft below the bottom TCAS directional antenna.				
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(11)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.		On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR NO COMM INTERROGATE TO TEST comes on.		
WJE 407, 408, 410, 411, 875-879					
(11)	On test set, press the LIGHTS/OFF switch to OFF, then press and release TEST button.		On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(12)	Press and release TEST button.		Test set shows ATCRBS/A 1200 95(±5)% REPLY.		
(13)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.		Test set shows ATCRBS/A IDENT 1200 95(±5)% REPLY.		
(14)	Remove safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 204 (Continued)

Operation			Desired Result		
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(15)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/A NO REPLY FROM XPDR.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(16)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
WJE 875-879					
(17)	On ATC control panel, place ALT RPTG switch to 1.		ALT RPTG 1 selected.		
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(17)	On ATC control panel, place ALT switch to 1.		ALT 1 selected.		
WJE 407, 408, 410, 411					
(17)	On ATC control panel, place ALT RPTG switch to 1.		ALT RPTG 1 selected.		

WJE 407, 408, 410, 411 (Continued)

Table 204 (Continued)

Operation		Desired Result
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
WARNING: WHEN FLIGHT GUIDANCE SYSTEM IS ENERGIZED, UNDER CERTAIN CONDITIONS, CADC SELF TEST FUNCTION CAN CAUSE MOVEMENT OF FLIGHT CONTROL SURFACES.		
(18)	On flight guidance control panel, make sure autopilot is disengaged.	Autopilot disengaged.
(19)	Connect CADC Remote Test Adapter to Air Data Computer-1.	Test adapter connected.
(20)	On remote test adapter, select 9900(±20) feet by putting No. 1 switch to ON; No. 2 and No. 3 switches to OFF.	1 ON; 2 and 3 OFF.
(21)	On Capt's and F/O's altimeters, set barometric pressure to 29.92 inches.	Barometric pressure at 29.92(±.01) inches. Capt's altimeter show 9900(±125) feet.
(22)	On test set, press and release TEST button.	Test set shows ATCRBS/C 9,900(±125) 95(±5)% REPLY.
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.		
(23)	Open, safety and tag this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(24)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C NO ALT 100% REPLY. On ATC control panel, ATC/XPDR FAIL light comes on. On OAP, TRANSPONDER INOP comes on.
WJE 407, 408, 410, 411		
(24)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C NO ALT 100% REPLY.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(25)	Remove the safety tag and close this circuit breaker:	

REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/3

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 204 (Continued)

Operation			Desired Result		
	B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
			ATC/XPDR FAIL and TRANSPONDER INOP lights go off.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(26)	On test set, press and release TEST button.		Test set shows ATCRBS/A MODE S ALL XXXXXX 95(±5)% REPLY.		
NOTE: XXXXXX is the aircraft Mode S address code.					
(27)	On test set, press and release TEST button.		Test set shows ATCRBS/C MODE S ALL XXXXXX 95(±5)% REPLY.		
NOTE: XXXXXX is the aircraft Mode S address code.					
WJE 875-879					
(28)	Deleted.				
WJE 407, 408, 410, 411					
(28)	On ATC control panel, rotate function switch to TEST for one second then back to ALT OFF position.		On control panel, ATC FAIL light comes on for approximately 3 seconds. Display shows 8888, ATC 1 2 and R.		
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(28)	On ATC control panel, press TEST button for one second and release.		On control panel, XPDR FAIL light comes on for approximately 3 seconds, then display shows PASS for approximately 3 seconds. On OAP, TRANSPONDER INOP comes on momentarily.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(29)	Remove the safety tags and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33

WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887 (Continued)

Table 204 (Continued)

Operation			Desired Result		
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(30)	On front panel of ATC-1 transponder, press and hold TEST button for approximately 6 seconds.		On transponder, all red lights and the green light come on momentarily, then red lights go off. Green light stays on for a few seconds then goes off.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(31)	Open, safety and tag these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(32)	On test set, press and release TEST button until maximum true airspeed is shown.		Test set shows MAX TRUE AIRSPEED GT 300 & LE 600 KTS.		
(33)	Remove the safety tags and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 204 (Continued)

Operation			Desired Result	
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887				
B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872				
B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887				
B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872				
B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
(34)	Remove test equipment and return aircraft to required configuration.			

5. Adjustment/Test ATC System (45,000 foot test with air data tester)

A. Test Preparation

Table 205

Operation		Desired Result
(1)	Connect the sleeve dipole antenna to the test set ANTENNA connector.	
NOTE: If the dipole antenna is not available, use the TAP antenna coupler provides with the T-49 test set. The TAP antenna coupler slides onto the ATC blade antenna.		
(2)	Place T-49 test set under the aircraft below the bottom TCAS directional antenna.	
(3)	On test set, put mode select knob in XPDR TEST position. Press the LIGHTS/OFF switch to OFF position to make sure test set is off.	
(4)	On overhead panel, set CADC switch to NORM. On gusset panels, set Capt's and F/O's static air selector switches to NORM.	
(5)	Seal Capt's and F/O's pitot tube drain holes with tape or other suitable device.	
(6)	Connect Air Data Tester to Capt's and F/O's pitot tube and static port with suitable adapter.	

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 205 (Continued)

Operation		Desired Result
(7)	Seal opposite static ports with tape or other suitable device.	
NOTE: When Air Data Tester is connected to only one static port, only corresponding port on opposite side of aircraft should be sealed.		
CAUTION: THE AIR DATA TESTER CAN DAMAGE THE INSTRUMENTATION SENSING DEVICES IF NOT PROPERLY OPERATED. DO NOT EXCEED 6,000 FEET PER MINUTE ON STATIC PORTS OR 100 KNOTS PER MINUTE ON PITOT TUBES, DO NOT SUDDENLY VENT LINES TO ATMOSPHERE WHILE AIR DATA TESTER IS CONNECTED, AND DO NOT EXCEED 12 INCHES OF MERCURY DIFFERENTIAL PRESSURE BETWEEN PITOT AND STATIC SYSTEMS AT ANY TIME. DO NOT PERMIT STATIC PRESSURE TO EXCEED PITOT PRESSURE.		
(8)	Adjust Air Data Tester for 29.92 inches Hg (if applicable)*	*Adjusting air data tester may not be applicable for different testers.
(9)	Set Air Data Tester airspeed for 300(±30) knots.	Applies air pressure to pitot system.
(10)	Set Air Data Tester altitude for 45,000(±100) feet.	Applies vacuum to static system.
WJE 875-879		
(11)	On ATC/TCAS control panel, select ALT RPTG 1, XPDR 1, and XPDR ON.	ALT RPTG 1, XPDR 1 and XPDR ON selected.
WJE 407, 408, 410, 411		
(11)	On ATC/TCAS control panel, place function switch to STBY, ALT switch to 1, and ATC switch to 1.	STBY, ALT 1, and ATC 1 selected.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(11)	On ATC/TCAS control panel, set function switch to 1 and ALT RPTG switch to 1.	Function switch to 1, ALT RPTG 1 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		

B. Self Test ATC-1 and ATC-2 Systems

Table 206

	Operation	Desired Result
(1)	Allow three minutes for system warmup.	
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(2)	On front panel of ATC-1 transponder, press the TEST button.	On transponder, all red lights and the green light come on momentarily, then the red lights go off. Green light stays on for a few seconds then goes off.

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887 (Continued)

Table 206 (Continued)

	Operation	Desired Result
WJE 407, 408, 410, 411		
(2)	On front panel of ATC-1 transponder, press and hold the TEST button for approximately 6 seconds.	On transponder, all red lights and the green light come on approximately 3 seconds, then go off. Green TPR light comes on again momentarily to indicate pass.
WJE 875-879		
(2)	On front panel of ATC-1 transponder, press and hold the TEST button for approximately 6 seconds.	On transponder, all red lights and the green light come on momentarily then go off. Green light comes on again for 2–5 seconds after TEST button is released.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(3)	On front panel of ATC-2 transponder, press the TEST button.	On transponder, all red lights and the green light come on momentarily, then the red lights go off. Green light stays on for a few seconds then goes off.
WJE 407, 408, 410, 411		
(3)	On front panel of ATC-2 transponder, press and hold the TEST button for approximately 6 seconds.	On transponder, all red lights and the green light come on approximately 3 seconds, then go off. Green TPR light comes on again momentarily to indicate pass.
WJE 875-879		
(3)	On front panel of ATC-2 transponder, press and hold the TEST button for approximately 6 seconds.	On transponder, all red lights and the green light come on momentarily then go off. Green light comes on again for 2–5 seconds after TEST button is released.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

C. Lower Antenna Test

Table 207

Operation					Desired Result
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(1)	Open, safety and tag these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30

WJE 417, 419, 421, 423, 865, 869, 871, 872 (Continued)

Table 207 (Continued)

Operation		Desired Result		
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887				
B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872				
B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
WJE 407, 408, 410, 411, 875-879				
(2)	On test set, press and release TEST button to turn on test set.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.		
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887				
(2)	On test set, press and release TEST button to turn on test set.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR NO COMM INTERROGATE TO TEST comes on.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
WARNING: WHEN FLIGHT GUIDANCE SYSTEM IS ENERGIZED, UNDER CERTAIN CONDITIONS, CADC SELF TEST FUNCTION CAN CAUSE MOVEMENT OF FLIGHT CONTROL SURFACES.				
(3)	On flight guidance control panel, make sure autopilot is disengaged.	Autopilot disengaged.		
WJE 875-879				
(4)	On ATC control panel, set ALT RPTG switch to OFF.	ALT RPTG OFF selected.		
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887				
(4)	On ATC control panel, set ALT switch to OFF.	ALT OFF selected.		
WJE 407, 408, 410, 411				
(4)	On ATC control panel, set function switch to ALT OFF.	ALT OFF selected.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887				
(5)	On Capt's and F/O's altimeters, set BARO knobs to make altimeters agree with air data tester display altitude.	Altimeters show 45,000(±400) feet.		
CAUTION: AVOID USING ANY CODE COMBINATION STARTING WITH "77" IN THE FIRST TWO DIGITS. THIS IS AN EMERGENCY CODE.				

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 207 (Continued)

Operation			Desired Result		
(6)	On ATC control panel, set code selector to 1200.		1200 selected.		
(7)	On test set, press and release TEST button.		Test set shows ATCRBS/A 1200 75(±25)% REPLY.		
(8)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.		Test set shows ATCRBS/A IDENT 1200 75(±25)% REPLY.		
(1)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(10)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/A NO REPLY FROM XPDR.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(11)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(12)	On ATC control panel, set the XPDR switch to 2.		XPDR switch to 2.		

WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 207 (Continued)

Operation			Desired Result		
WJE 407, 408, 410, 411					
(12)	On ATC control panel, set the ATC switch to 2.		ATC 2 selected.		
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(13)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.		Test set shows ATCRBS/A IDENT 1200 75(±25)% REPLY.		
(14)	Remove the safety tag and close this circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(15)	On test set, press and release STORE/REPEAT button.		Test set shows ATCRBS/A NO REPLY FROM XPDR.		
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(16)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D. Air Data Computer/ATC Interface Test

Table 208

Operation		Desired Result
(1)	On test set, press and release TEST button.	Test set shows ATCRBS/C NO ALT 75(±25)% REPLY.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 208 (Continued)

Operation					Desired Result
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887					
(2)	On ATC control panel, set the ALT switch to 1.				ALT 1 selected.
WJE 407, 408, 410, 411					
(2)	On ATC control panel, set function switch to ALT ON.				ALT ON selected.
WJE 875-879					
(2)	On ATC control panel, set the ALT RPTG switch to 1.				ALT RPTG 1 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(3)	On test set, press and release STORE/REPEAT button.				Test set shows ATCRBS/C 45,000(±300) 75(±25)% REPLY.
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.					
(4)	Open, safety and tag this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Circuit breaker open.		
(5)	On test set, press and release STORE/REPEAT button.				Test set shows ATCRBS/C NO ALT 75(±25)% REPLY.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(6)	On ATC control panel, set the XPDR switch to 1.				XPDR 1 selected.
WJE 407, 408, 410, 411					
(6)	On ATC control panel, set the ATC switch to 1.				ATC 1 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(7)	On test set, press and release STORE/REPEAT button.				Test set shows ATCRBS/C NO ALT 75(±25)% REPLY.
(8)	Remove the safety tag and close this circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10–316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Circuit breaker closed.		

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Table 208 (Continued)

Operation		Desired Result
(9)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C 45,000(±300) 75(±25)% REPLY.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(10)	On ATC control panel, set the ALT switch to 2.	ALT 2 selected.
WJE 875-879		
(10)	On ATC control panel, put the ALT RPTG switch to 2.	ALT RPTG 2 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(11)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C 45,000(±300) 75(±25)% REPLY.
WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.		
(12)	Open, safety and tag this circuit breaker:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B10–317 / AIR DATA CMPTR-2 / Overhead / RIGHT AC BUS / F/12	
		Circuit breaker open.
(13)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C NO ALT 75(±25)% REPLY.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(14)	On ATC control panel, put the XPDR switch to 2.	XPDR 2 selected.
WJE 407, 408, 410, 411		
(14)	On ATC control panel, set the ATC switch to 2.	ATC 2 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(15)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C NO ALT 75(±25)% REPLY.
(16)	Remove the safety tag and close this circuit breaker:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B10–317 / AIR DATA CMPTR-2 / Overhead / RIGHT AC BUS / F/12	
		Circuit breaker closed.
(17)	On test set, press and release STORE/REPEAT button.	Test set shows ATCRBS/C 45,000(±300) 75(±25)% REPLY.

E. Upper Antenna Test

Table 209

Operation		Desired Result
(1)	Move T-49 test set to side of aircraft in line of sight with upper ATC antennas.	Test set antenna pointed at upper ATC antennas.
(2)	Place "C" band absorbent material over the ATC-2 bottom antenna.	
WJE 407, 408, 410, 411, 875-879		
(3)	On test set, press the LIGHTS/OFF switch to OFF, wait for 5 seconds, then press and release TEST button.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.
WJE 401-404, 406, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 886, 887		
(3)	On test set, press the LIGHTS/OFF switch to OFF, wait for 5 seconds, then press and release TEST button.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR NO COMM INTERROGATE TO TEST comes on.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(4)	On test set, press and release TEST button.	Test set shows ATCRBS/A 1200 75(±25)% REPLY.
(5)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.	Test set shows ATCRBS/A IDENT 1200 75(±25)% REPLY.
(6)	On ATC control panel, set the XPDR switch to 1.	XPDR 1 selected.
WJE 407, 408, 410, 411		
(6)	On ATC control panel, set the ATC switch to 1.	ATC 1 selected.
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887		
(7)	Remove "C" band absorbent from ATC-2 bottom antenna. Place "C" band absorbent material over the ATC-1 bottom antenna.	
(8)	On test set, press the LIGHTS/OFF switch to OFF, wait for 5 seconds, then press and release TEST button.	On test set display, TEL INSTRUMENT T-49 REV XXX comes on and goes off. MODE S XPDR COM A/B INTERROGATE TO TEST comes on.
(9)	On test set, press and release TEST button.	Test set shows ATCRBS/A 1200 75(±25)% REPLY.
(10)	On ATC control panel, press IDENT button, then press STORE/REPEAT button on test set.	Test set shows ATCRBS/A IDENT 1200 75(±25)% REPLY.
(11)	Verify that the Mode S Transponder generates a correct squitter.	Approximately between 0.8 to 1.2 seconds each period.
(12)	Check Mode S diversity test. The power output transmitted from selected antenna must exceed the power transmitted from the nonselected antenna.	Should be by at least 20dB.

F. Test Termination

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

Operation			Desired Result		
(1)	Remove the safety tags and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
WJE 417, 419, 421, 423, 865, 869, 871, 872					
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/30
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/30
WJE 401-404, 406-408, 410-412, 414, 875-879, 886, 887					
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887					
(2)	Remove test equipment and return aircraft to required configuration.				

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

6. Adjustment/Test ATC System

A. Preliminary

(1) Set ATC control panel switch to ATC 2 STBY position and allow 5 minute warm up period.

(2) Place ATC ramp test set in a position such that test set antenna is in view of aircraft antenna.

(3) Set transponder test set controls as follows:

Table 210

RCVR SENS	MAX CW
1090 MHZ	zero
REPLY/SLS	LEVEL/-9db
MODE	A
READOUT	PILOT

(4) Turn test set on and note that battery check meter pointer is in white portion of scale.

NOTE: It is permissible to operate test set while battery is being charged.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: MAKE CERTAIN METER SEL & HEAT SWITCH ON OVERHEAD PANEL IS IN OFF POSITION. WITH GROUND CONTROL RELAY CIRCUIT BREAKERS OPEN, HEATER CIRCUITS ARE ENERGIZED.

(5) Open these circuit breakers and install safety tags:

UPPER EPC, L AC BUS

Row	Col	Number	Name
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

CAUTION: DO NOT USE ANY COMBINATION STARTING WITH DIGITS 77. THE USE OF ANY CODE COMBINATION STARTING WITH THE DIGITS “77” ASSUMES AN “EMERGENCY” CONDITION AND WILL ALERT GROUND STATION ALARMS.

B. Test ATC System

	Operation	Desired Result
(1)	Set transponder code selectors to 1200.	
(2)	Set control panel ATC/TR switch to 1 and ATC function selector to ON.	
(3)	Set ATC mode selector to A.	
NOTE: Adjust the location of the T-33B or equivalent to obtain maximum deflection of the microammeter to determine if the transponder is being interrogated. Meter readings of less than full scale indicate that the T-33B antenna is in a weak signal area. Erratic meter readings indicate that the transponder is not replying to every interrogation of the T-33B and the transponder is receiving a weak signal. This can be verified by throwing the REPLY LEVEL switch to the 100% position. Readings under 100% indicate that the transponder is not replying to every interrogation of the T-33B. It may be necessary to change the position of the T-33B to achieve sufficient signal strength. The T-33B meter must read at least full scale for proper operation of the decoder circuitry.		
(4)	With REPLY/SLS switch in LEVEL position adjust RECEIVER/SENSITIVITY control so that meter deflection is about 1/4 scale. Adjust 1090 MHZ control on T-33B for maximum meter deflection. Maximum error permissible is ±3 MHZ.	1090 MHZ (±3 MHZ).
(5)	Place REPLY/SLS switch to 100% position. Transponder must reply with rate of 90% or greater.	Test set indicate 90% or greater.
(6)	Place REPLY/SLS switch to 10%/0 dB position. Meter, with full scale equal to 10%, should read 1.3% or less.	Test set indicate 1.3% or less.
NOTE: That the T-33B readout extinguishes indicating correct operation of the transponder.		

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(Continued)

Operation		Desired Result
(7)	Place REPLY/SLS switch to LEVEL position. Observe framing pulse indications and a 1200 code reading in test set readout window.	FR1, FR2, 1200 reading observed.
(8)	Observe that TEST lamp is on.	TEST Lamp ON.
(9)	Set test set MODE selector and ATC mode selector to B.	
(10)	Set ATC code selectors to 6577.	6577 reading in test set window.
(11)	Actuate ATC IDENT button.	IDENT indications observed in test set readout window.
(12)	Place control panel ATC/TR switch in -2 position.	
(13)	Repeat test for ATC-2.	Same as test for -1 system.

WARNING: THE FUNCTIONING OF SYSTEMS USED AS SENSORS FOR THE AUTOPILOT MAY RESULT IN CONTROL SURFACE MOVEMENT IF THE AUTOPILOT IS IN OPERATION AND ENGAGED. FOR THIS REASON, VERIFY THAT THE AUTOPILOT SWITCH ON THE GLARESHIELD IS IN THE DISENGAGE POSITION. THIS WILL PREVENT DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL.

C. Test Altitude Reporting

Operation		Desired Result
(1)	Connect air data calibrator to Captain and First Officer pitot and static system. (PITOT STATIC, SUBJECT 34-11-00, Page 201)	
(2)	Set CADC switch, on overhead panel, to center position.	
(3)	Adjust air data tester to obtain 200(±20) knots airspeed on captain's mach airspeed indicator.	
(4)	On ATC control panel, set ATC/TR switch to -1.	
(5)	Adjust Captain altimeter to a barometric pressure of 29.92 in Hg.	
NOTE: Set ATC code selectors to any code not starting with "77" in the first two digits.		
(6)	Set ATC code selectors to any code not starting with "77" in first two digits.	
(7)	Set ATC altitude reporting switch to OFF.	
(8)	Set test set MODE selector to C and readout switch to ALTITUDE.	
(9)	Observe framing pulse indications and a 4007 reading in test set readout window.	FR1, FR2, and 4007 reading observed.
(10)	Set ATC ALT RPTG switch to 1.	

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(Continued)

Operation		Desired Result
(11)	Gradually adjust air data tester (increase altitude) to obtain ATC test set reading of 101.	Altitude readout of 101 and Grey Code numeric of 6530 observed on ATC test set. Captain's altimeter reads 10,050(±75) feet.
(12)	Adjust air data tester so that ATC test set reads 326.	
(13)	Gradually adjust air data tester to obtain ATC test set reading of 327.	Altitude readout of 327 and Grey Code numeric of 1244 observed on ATC test set. Captain's altimeter reads 32,650(±75) feet.
(14)	Place control panel ATC/TR switch in -2 position.	
(15)	Adjust first officer's altimeter to barometric pressure of 29.92 in. Hg.	
(16)	Adjust air data tester (decrease altitude) to obtain ATC test set reading of 326.	
(17)	Gradually adjust air data tester to obtain ATC test set reading of 327.	Altitude readout of 327 and grey code numeric of 1244 observed on ATC test set. First officer's altimeter reads 32,650(±75) feet.
(18)	Adjust air data tester to obtain ATC test set reading of 100.	
(19)	Gradually adjust air data tester to obtain ATC test set reading of 101.	Altitude readout of 101 and grey code numeric of 6530 observed on ATC test set. First officer's altimeter reads 10, 050(±75) feet.
(20)	Repeat steps (10) through (19) with ALT RPTG switch set to 2.	

D. Test Termination

(1) Set ATC selector switch to off.

(2) Remove the safety tags and close these circuit breakers:

UPPER EPC, L AC BUS

Row	Col	Number	Name
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

(3) Remove test equipment.

(4) Return aircraft to required configuration.

ATC TRANSPONDER ANTENNA - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Air Traffic Control (ATC) antenna.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B. The ATC transponder antenna is a lightweight, vertically polarized, blade-type antenna designed to radiate and receive signals in the frequency range from 960 to 1220 megacycles. There are four ATC transponder antennas located on the lower and upper forward surface of the aircraft fuselage.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

C. The ATC transponder antenna is a lightweight, vertically polarized, blade-type antenna designed to radiate and receive signals in the frequency range from 900 to 1220 megacycles. The single ATC transponder antenna is located on the lower forward surface of the fuselage.

WJE ALL

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 201

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Plastic Scraper DPM 6587	Commercial available.

3. Removal/Installation ATC Transponder Antenna

A. Remove ATC Antenna (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 406			
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1

WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

(2) Carefully cut sealant around the outer edge of antenna base with an approved plastic scraper.

(3) Remove antenna mounting screws.

(4) Lower and support antenna and disconnect antenna coaxial cable connector.

(a) Install dust caps.

(b) Attach the coaxial connector to the fuselage using masking tape.

NOTE: Due to the difficulty of retrieval, ensure coax cable does not fall completely inside fuselage.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(5) Remove antenna and gasket. (Figure 201)

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(6) Remove antenna, retain O-ring installed in antenna base. (Figure 201)

WJE ALL

B. Install Applicable ATC Antenna (Figure 201)

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 406			
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

(2) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(3) Prepare the surface of the ATC antenna for RF bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(4) Apply faying surface seal to the base of the antenna. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(5) Position gasket on antenna. (Figure 201)

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(6) Make certain O-ring is installed in antenna base groove. (Figure 201)

WJE ALL

(7) Install antenna as follows:

(a) Remove protective cap and check for damage and unwanted material.

1) Connect antenna coaxial cable connector.

(b) Place antenna in mounting position and install antenna mounting screws using small amount of sealant under screw heads. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

1) Torque the attachment screws.

a) Torque the attachment screws again 10 minutes after the initial torque.

(8) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

(9) Do a RF bond check of the ATC antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

(10) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

C. Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 406			
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

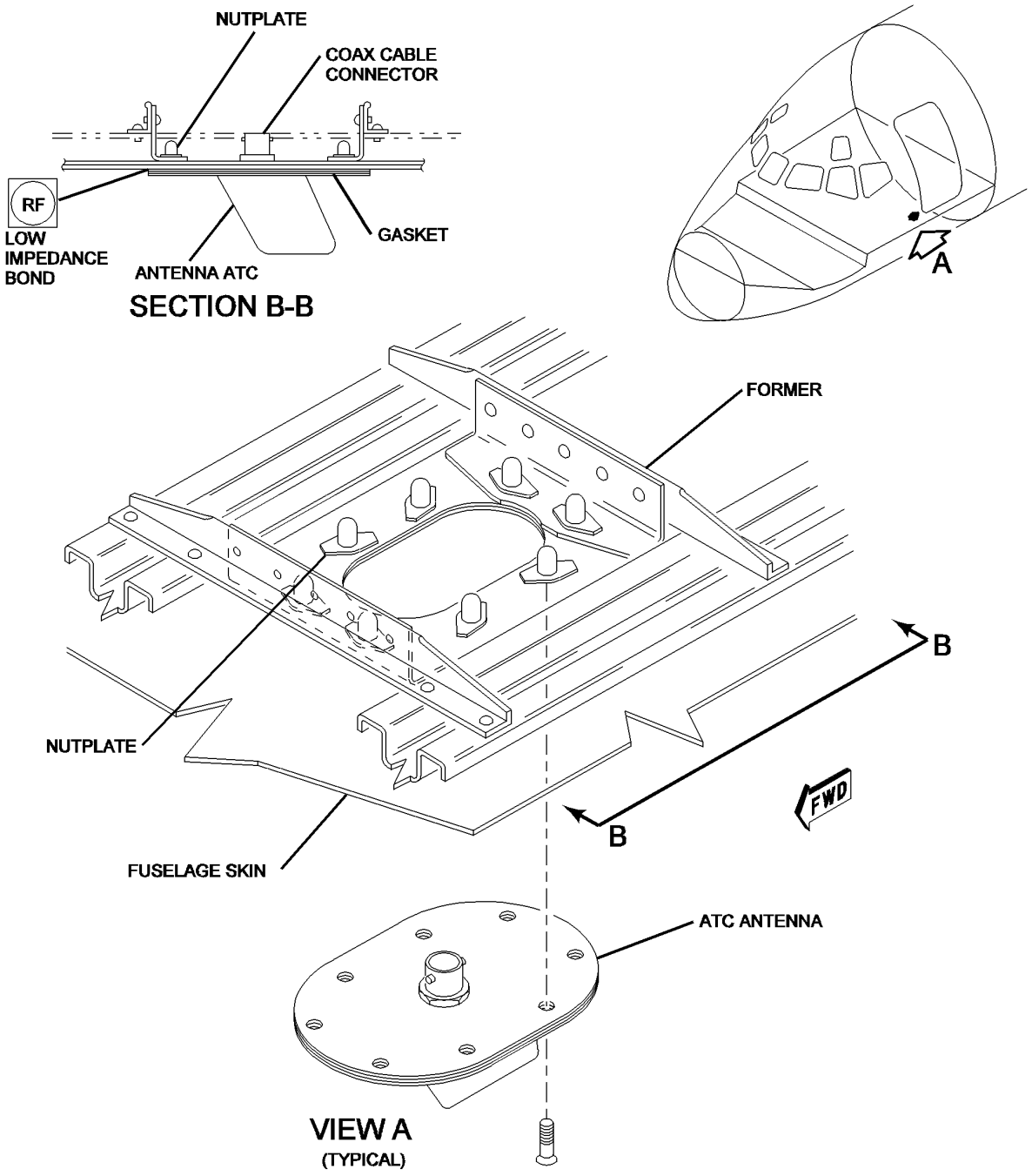
Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

D. Test ATC antenna.

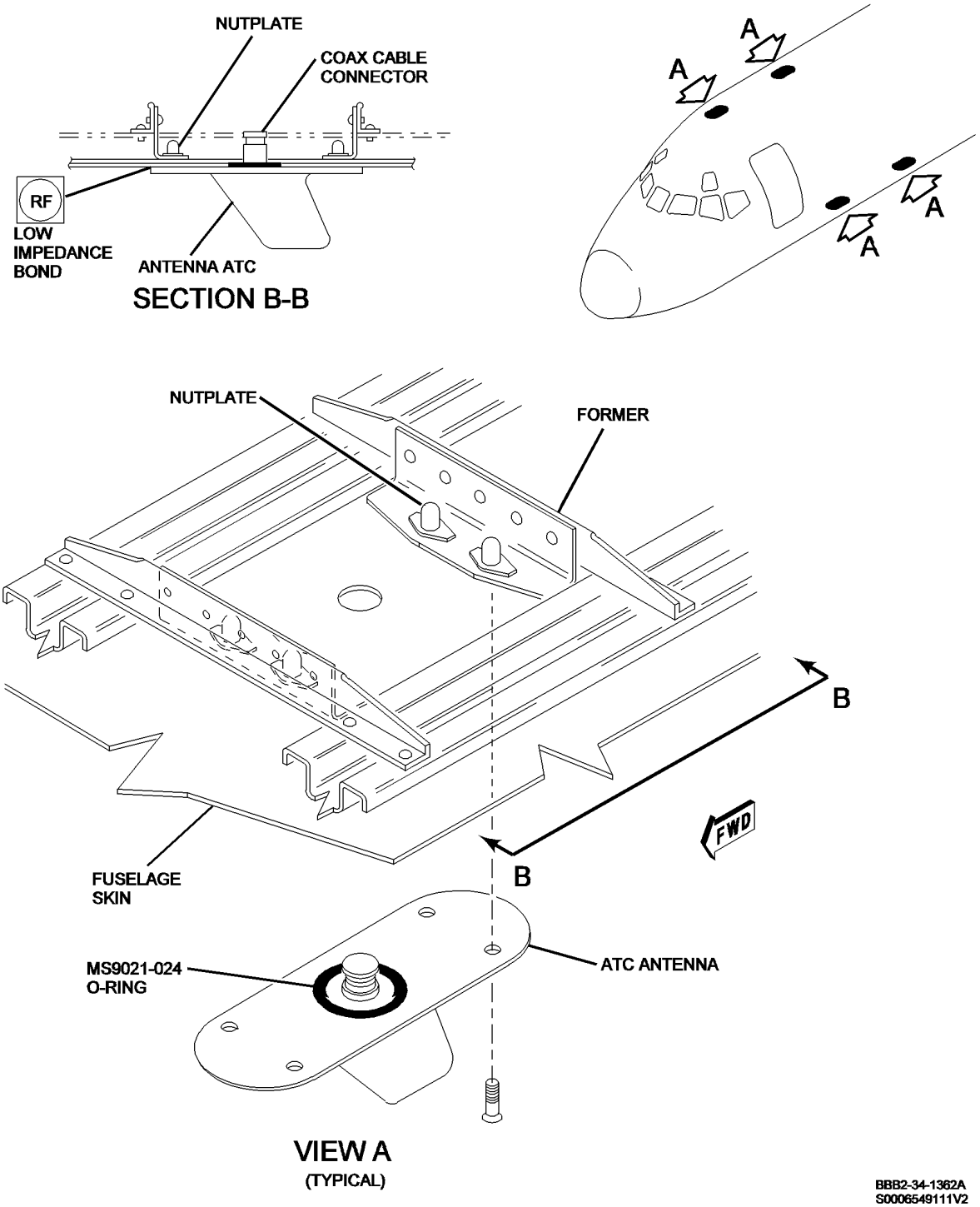
(1) Do ATC self-test. (AIR TRAFFIC CONTROL TRANSPONDER SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-54-00/201 Config 1)

E. Return aircraft to required configuration.



ATC Transponder Antenna -- Removal/Installation, Typical
Figure 201/34-54-01-990-803 (Sheet 1 of 2)

EFFECTIVITY
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893



ATC Transponder Antenna -- Removal/Installation, Typical
Figure 201/34-54-01-990-803 (Sheet 2 of 2)

ATC/TCAS CONTROL PANEL - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

A. This maintenance practice provides removal/installation procedures for the ATC control panel. The dual ATC control panel is located in the flight compartment on the aft pedestal. It contains a function selector, ATC 1/2 switch, ALT RPTG/OFF switch, IDENT button, code select knobs, CODE display window, TEST button, and monitor light.

WJE 401-404, 406-408, 410, 411, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

B. This maintenance practice provides removal/installation procedures for the ATC control panel. The dual ATC control panel is located in the flight compartment on the aft pedestal. It contains a function selector switch, ALT RPTG switch, transponder select switch, IDENT button, code select knobs or digital keypad, and CODE display window.

WJE ALL

2. Equipment and Materials

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

NOTE: Equivalent substitutes may be used instead of the following listed item.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

NOTE: No test equipment is required.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

Table 201

Name and Number	Manufacturer
TCAS/ATC Mode S ramp test set Model TIC T-33B, T-49, T-49C or T-48D	Tel Instrument Electronics Corp.
NOTE: TIC T-33B test set used in following test procedures. If optional test set used, substitute test set operating instructions in place of T-33B instructions.	

WJE ALL

3. Removal/Installation - ATC Control Panel

A. Remove ATC Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D	1	B10-448	ATC MODE-S -2

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

(2) Turn mounting screws counterclockwise approximately 1/4 turn until control panel is loose.

(3) Disconnect and cap wire harness, and remove control panel from pedestal.

B. Install ATC Control Panel

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D	13	B10-447	ATC MODE-S -1

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E	13	B10-449	MODE-S ATC CONTROL PANEL

WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

(2) Remove cap from wire harness connector and connect to ATC control panel.

(3) Insert control panel into cavity and tighten mounting screws until secure.

(4) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE 401-404, 406-408, 410, 411, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(5) Do a return to service test of the applicable air traffic control panel. (Paragraph 3.C.)

WJE 412, 414

WJE (6) Do a return to service test of the applicable ATC/TCAS control panel Paragraph 3.D..

WJE (7) Repeat steps Paragraph 3.D.(1)(a) through Paragraph 3.D.(1)(c) for ATC transponder 2.

WJE (8) Perform TCAS self test TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM,
WJE SUBJECT 34-46-00, Page 201.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(9) Return aircraft to required configuration.

WJE 401-404, 406-408, 410, 411, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

C. Return to Service Test

(1) Do a return to service test as follows:

Table 202

STEP	OPERATION	VISUAL INSPECTION
1	Allow three minutes for system warmup.	
On the front panel of the ATC-1 transponder:		
2	Press and hold the TEST button for a few seconds, then release.	All red lights and the green light come on for approximately 3 seconds, then go off. The green light comes on again to indicate a passed test.
On the front panel of the ATC-2 transponder:		
3	Press and hold the TEST button for a few seconds, then release.	All red lights and the green light come on for approximately 3 seconds, then go off. The green light comes on again to indicate a passed test.

WJE 412, 414

WJE D. ATC/TCAS Control Panel Return To Service Test

WJE (1) Do a return to service test as follows:

WJE (a) On the ATC/TCAS Control Panel, set mode switch to STANDBY mode.

WJE (b) On the ATC/TCAS Control Panel, set TRANSPONDER SELECT switch to Transponder
WJE 1(2).

WJE (c) On the number 1(2) Transponder Front Panel in the E & E, push the PUSH TO TEST
WJE button on the transponder.

WJE 1) All transponder front panel annunciator come on for a 3-second lamp test.

WJE 2) The green XPDR PASS annunciator comes on for a 10-second display period and
WJE then goes off indicating the transponder system is operational.

WJE 3) If a red fault annunciator comes on during the 10-second test a failure is indicated,
WJE refer to troubleshooting section of this manual.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

E. MODE S SYSTEM TEST

(1) Set ATC control panel switch to STBY position and allow 5 minute warm up period.

(2) Place TCAS/ATC Mode S ramp test set in a position such that test set antenna can activate aircraft antenna.

NOTE: Use of remote antenna is acceptable.

(3) Set transponder test set controls as follows:

Table 203

RCVR SENS	MAX CW
1090 MHZ	zero
REPLY/SLS	LEVEL/-9db
MODE	A
READOUT	PILOT

(4) Turn test set on and note that battery check meter pointer is in white portion of scale.

NOTE: It is permissible to operate test set while battery is being charged.

(5) Press TEST button on control panel, monitor light should come on.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: MAKE CERTAIN METER SEL & HEAT SWITCH ON OVERHEAD PANEL IS IN OFF POSITION. WITH GROUND CONTROL RELAY CIRCUIT BREAKERS OPEN, HEATER CIRCUITS ARE ENERGIZED.

(6) Open these circuit breakers and install safety tags:

UPPER EPC, L AC BUS

Row	Col	Number	Name
K	33	B1-23	LEFT GROUND CONTROL RELAY

UPPER EPC, R AC BUS

Row	Col	Number	Name
L	33	B1-24	RIGHT GROUND CONTROL RELAY

CAUTION: DO NOT USE ANY COMBINATION STARTING WITH DIGITS 77. THE USE OF ANY CODE COMBINATION STARTING WITH THE DIGITS “77” ASSUMES AN “EMERGENCY” CONDITION AND WILL ALERT GROUND STATION ALARMS.

F. Test ATC Control Panel

Step	Operation	Desired Result
(1)	Set transponder code selectors to 1200.	
(2)	Turn ATC-TFR switch to 1.	
(3)	Turn ATC-1/-2 switch to 1.	
(4)	Actuate TEST button. Note presence of framing pulses in test set readout window.	Presence of framing pulses FR1, FR2, 1200 reading.
(5)	Set code selector on transponder control to 6577.	
(6)	Set Test set and control panel mode selector to B.	6577 observed.
(7)	Actuate transponder TEST function.	6577 reading observed.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

(Continued)

Step	Operation		Desired Result		
(8)	Altitude reporting switch OFF.				
(9)	Set test set MODE selector to C and the readout switch to ALTITUDE.				
(10)	Actuate the TEST button. While the button is depressed, observe framing pulse indications and a 4007 reading in the test set readout window.		TEST actuated FR1, FR2, 4007 reading observed.		
(11)	Set the ATC altitude reporting switch to ALT RPTG.				
(12)	Actuate TEST button. While button is depressed, observe that the test set reading (with two zeroes added) and the Captain's altimeter reading correspond with 125 ft.		Altitude readings equal. ±125 ft.		
(13)	Place ATC/TR switch to 2 and repeat test.				
(14)	Remove safety tags and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1–23	LEFT GROUND CONTROL RELAY	Upper EPC	LEFT AC BUS	K/33
	B1–24	RIGHT GROUND CONTROL RELAY	Upper EPC	RIGHT AC BUS	L/33
(15)	Remove test equipment and return airplane to required configuration.				

ATC TRANSPONDER - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

A. This maintenance practice provides removal/installation procedures for the ATC transponders. The transponders are installed on the radio rack in the electrical/electronics compartment. Operation of the transponders is controlled by the ATC control panels on the pedestal.

B. The transponders are installed to a transponder adapter in the mounting rack. For removal/installation of adapter.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

C. This maintenance practice provides removal/installation procedures for the ATC transponders. The transponders are installed on the left aft radio rack in the electrical/electronics compartment. Operation of the transponders is controlled by the ATC control panel on the pedestal.

WJE ALL

2. Removal/Installation ATC Transponder

A. Remove ATC Transponder

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	7	B10-458	MODE-S ATC-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

(2) Unscrew knurled holddown nuts at front end of mounting rack and swing assemblies down.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(3) Pull transponder straight out until unit electrical connectors are disengaged from mounting adapter, and remove unit.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(4) If installed, turn driver/extractor handle CCW otherwise pull unit straight out until unit electrical connectors are disengaged from mounting rack support, and remove unit.

WJE ALL

B. Install ATC Transponder

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 406			
B	7	B10-458	MODE-S ATC-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	11	B10-457	MODE-S ATC CONT PNL

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893 (Continued)

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

D	1	B10-448	ATC MODE-S -2

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE ALL

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Slide unit straight into rack, ensuring that guide pin bushings and connectors are properly aligned with mounting rack guide pins and connectors.

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(4) With bottom edge of unit front panel seated in extractor slot, turn driver/extractor handle CW, if installed, otherwise push unit straight in until unit is firmly engaged into rack.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(5) Push transponder in until unit is firmly engaged into rack.

WJE ALL

(6) Engage holddown assembly with lugs on unit, and tighten holddown nuts.

(7) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name

WJE 406

B	7	B10-458	MODE-S ATC-1

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
A	11	B10-457	MODE-S ATC CONT PNL

WJE 406 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 410, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	13	B10-447	ATC MODE-S -1
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1
WJE 401-404, 408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
E	13	B10-449	MODE-S ATC CONTROL PANEL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887			
D	1	B10-448	ATC MODE-S -2
WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893			
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

WJE 401-404, 406-408, 410-412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879, 886, 887

(8) Perform ATC Transponder test. (SUBJECT 34-54-00, Page 201)

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

(9) Place function selector switch on applicable ATC control panel in STBY position and allow 5 minutes for system warm-up.

(10) RT and ANT fault lights should not be on. If on, push reset switch, lights should remain off.

(11) Place function selector switch on applicable ATC control panel in ON position.

(12) Place mode selector switch in either A or B position.

(13) Depress TEST switch on front panel of ATC transponder.

(14) Test light on control panel should come on, denoting system is operable.

NOTE: A complete system test is required for aircraft with Mode-S. For aircraft with Mode-C a complete system test is only necessary when system wiring is affected. (SUBJECT 34-54-00, Page 201)

NOTE: For Mode-C aircraft, if ATC transponder is restricted only to removal and installation, a self test is acceptable instead of complete system test. (SUBJECT 34-54-00, Page 201)

WJE ALL

(15) Return aircraft to required configuration.

WJE 405, 409, 415, 416, 418, 420, 422, 424-427, 429, 861-864, 866, 868, 873, 874, 880, 881, 883, 884, 891-893

C. Remove Transponder Adapter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

(2) Remove transponder. (Paragraph 2.A.)

(3) Unscrew knurled holddown nut at front of adapter and swing down.

(4) Pull adapter straight out of rack until electrical connectors are disengaged and remove adapter.

D. Install Transponder Adapter

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

(2) Visually check adapter connector plugs and mating connectors in rack for dirty or damaged pins.

(3) Slide adapter straight into mounting rack and carefully mate adapter electrical connectors with rack connectors.

(4) Push adapter into rack until it is firmly engaged.

(5) Engage knurled holddown nut with adapter lug and tighten holddown nut.

(6) Connect coax cables with connectors on front of adapter.

(7) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	13	B10-33	ATC-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	13	B10-34	ATC-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	1	B10-35	ATC-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	1	B10-36	ATC-2

OMEGA / VLF NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Omega/VLF Navigation System (ONS) is a fully automatic, computerized navigation system which determines aircraft position changes by utilizing very low frequency radio signals (VLF). The radio signals are provided by eight Omega transmitters and seven Navy VLF transmitters located throughout the world to provide reliable signal reception from several stations regardless of aircraft position. Each Omega station transmits three primary continuous wave signals at frequencies of 10.2 kHz, 13.6 kHz and 11.33 kHz. Each frequency transmission lasts a fixed period of time, between 0.9 seconds and 1.2 seconds depending upon the station, and is repeated in a fixed format once every 10 seconds. The transmitting sequence is synchronized to universal time by the use of a very high accuracy atomic clock. (Figure 1) (Figure 2)

B. The airborne receivers use one or both of two methods for position fixing. In the first method, hyperbolic navigation, the phase difference between two stations' transmissions is measured to locate the aircraft along a hyperbolic isophase Line of Position (LOP). By measuring the phase differences between another two stations, a second LOP is defined. The aircraft's position is at the intersection of these two LOP's. This is called ABSOLUTE mode. In the second method, range or range-range navigation, the phase of a single station is measured. The phase and range to the station are then used to fix the aircraft position on a circular LOP about the station. This is called RELATIVE mode. Aircraft position is determined using the phase of two stations (RHO-RHO navigation) or three stations (RHO-RHO-RHO navigation).

WJE 405, 409, 410, 874, 881, 883, 884, 892

C. Two OMEGA systems are installed in the aircraft . Each system consists of a Receiver Processor Unit (RPU), located in the main radio rack in the avionics compartment; a Control Display Unit (CDU), located on the forward pedestal in the flight compartment; and an Antenna Coupler Unit (ACU), located in the upper aft tip of the vertical stabilizer. The RPU provides continuous self-test monitoring of the system to provide warning signals and system performance status indications. System 1 utilizes a True Airspeed (TAS) signal from CADC-1 and compass heading from the F/O's compass indicator. System 2 utilizes a TAS signal from CADC-2 and compass heading from the Captains's compass indicator. System electrical power is supplied by the 28 VAC EMERGENCY AC BUS, 28 VAC RIGHT RADIO BUS, and 115 VAC RIGHT and LEFT RADIO AC BUS. Following primary power interruptions to the ONS of not more than seven (7) seconds, system operation resumes automatically.(Figure 3)

WJE 886, 887

D. A single OMEGA system is installed in the aircraft (Figure 3). It consists of a Receiver Processor Unit (RPU), located in the main radio rack in the avionics compartment; a Control Display Unit (CDU), located on the aft pedestal in the flight compartment; and an Antenna Coupler Unit (ACU), located in the upper aft tip of the vertical stabilizer. The RPU provides continuous self-test monitoring of the system to provide warning signals and system performance status indications. The system utilizes a True Airspeed (TAS) signal from CADC-1 and compass heading from the F/O's compass indicator.

System electrical power is supplied by the 28 VAC EMERGENCY AC BUS VDC EMERGENCY DC BUS, and 115 VAC LEFT RADIO AC BUS. Following primary power interruptions to the ONS of not more than seven (7) seconds, system operation resumes automatically.

WJE 405, 409, 410, 874, 881, 883, 884, 886, 887, 892

E. The CAPT's and F/O's HSI's/ND's receive inputs from the Omega system when the applicable HSI display selector switch (placarded RADIO/OMEGA on the CAPT's and F/O's instrument panels) is in the OMEGA position. NAV selection is annunciated on the appropriate HSI. A remote OMEGA MESSAGE annunciator, mounted on the CAPT's and F/O's instrument panels, calls the operator's attention to any ONS status change. The system Control Display Unit (CDU) provides display of present position in latitude and longitude coordinates, bearing and distance, crosstrack distance and track angle error, desired track and track angle, heading and drift angle, groundspeed and estimated time enroute, wind velocity, waypoint display, and Greenwich Mean Time and date. (Figure 4)

2. Description

A. The Omega system consists of three components, as follows:

Receiver Processor Unit (RPU)

Control Display Unit (CDU)

Antenna Coupler Unit (ACU)

B. Receiver Processor Unit (RPU) - The RPU is a 3/4 ATR long box mounted in the main radio rack in the avionics compartment. It contains the major Omega system electronics. Power is provided to the RPU from the equipment rack via the unit's rear connector. The front connector links the RPU to the ACU. Two hold-down hooks are provided on the front of the RPU to ensure proper mounting and connection. The RPU receives RF signals from the Antenna Coupler Unit, airspeed information from the Central Air Data Computers and heading information from the compass system. This input is processed to provide various navigational steering information to the HSI, CDU and autopilot. The RPU receives control and selection of modes from the CDU which, in turn, displays present position, navigation, steering, and other information processed by the RPU. (Figure 3)

C. Control Display Unit (CDU) - The CDU is a panel-mounted unit installed on the forward pedestal. It is provided with four captive dzus fasteners for console mounting. The unit contains all operating controls for the Omega system. The front of the unit is functionally divided into upper and lower display windows, a 9-key Display Mode Selection (DMS) keyboard and a 12-key Data Entry keyboard. The CDU has two basic modes of operation: Display Mode and Entry Mode. In Display Mode, the Display Mode Selection keyboard is used to select the navigational data to be displayed on the CDU. It is not possible to affect or control the basic system navigation while in this mode. In Entry Mode, the Data Entry keyboard is used to feed data into the ONS to control system operation/ navigation. The displays, controls and annunciations on the face of the CDU are as follows: (Figure 5)

(1) Display Mode Selection (DMS) keyboard - Used to select data to be presented on upper numeric display windows. Each key has its own integral mode annunciator which comes on when mode is activated.

Table 1

MODE	Function
POS (Present Position)	Upper left display reads Latitude of present aircraft position. Upper right dis play reads Longitude of present aircraft position.
	Lower display shows either the TO waypoint identifier (alphanumeric) or the FROM/ TO waypoint numbers as selected using the IDENT key.
BRG-DIS (Bearing and Distance)	Upper left display reads bearing from present position to active TO waypoint. Upper right display reads distance to active waypoint.

Table 1 (Continued)

MODE	Function
XTK-TKE (Crosstrack Distance and Track Angle Error)	Upper left display reads crosstrack distance in nautical miles. L or R annunciator beneath display shows relative position of aircraft to track (left or right). Upper right display shows track angle error in degrees. L or R annunciator beneath display indicates present track is left/right of desired track angle.
	Lower display shows either the TO waypoint identifier or FROM/TO waypoint numbers.
WPT (Waypoint)	Upper left and right displays show waypoint coordinates in latitude and longitude respectively.
	Lower display shows associated identifier or waypoint numbers.
FLT-PLN (Flight Plan)	Allows storage of flight routes into ONS memory banks and recall of routes to form an active flight plan.
DATA DTK-TK HDG-DA GS-ETE WIND GMT-DT	Pressing DATA key successively causes the following Data to appear: Desired Track and Track Angle, Head ing and Drift Angle, Ground speed and Estimated Time Enroute, Wind Velocity, Greenwich Mean Time and Date.
	Lower display identifies type of Data in upper numerical display.
IDNT (Identifier)	Allows selection of either alphanumeric or numeric identifiers for waypoints. Identifiers appear in lower display.
FMS (Flight Management System)	Provides supplementary functions such as fuel management, search pattern capability and vertical navigation.
STS-PWR (Status Power)	Turns system primary power ON, triggering automatic initialization sequence.

(2) Lower Alphanumeric Display Window - Identifies data appearing in upper display windows; displays waypoint numbers/identifiers; displays messages associated with MSG annunciator.

(3) Upper Numeric Display Windows - Provide numeric readouts of data selected via DMS keyboard.

(4) Data Entry keyboard - Allows entry of numeric and alphanumeric data, such as position and waypoint coordinates and identifiers. The 0 (DIM) key may be used to adjust intensity of displays.

Table 2

KEY	Function
CLR-BK (Clear and Backspace)	Allows data entry to be back spaced one digit at a time to delete entry errors, clears frozen position (POS) display, cancels certain message annunciators.
ENT (Enter)	Used to select display window for data entry and to complete entry operation, transferring data to RPU.

(5) Left (N,S,L,R) Annunciators - Indicate north or south, left or right, in association with upper left display window.

(6) Right (E,W,L,R) Annunciators - Indicate east or west, left or right, in association with upper right display window.

(7) Message (MSG) Annunciator - Calls operator's attention to any change in ONS operational status (system failures, dead reckoning (DR) mode navigation or position ambiguity (AMB)).

D. Antenna Coupler Unit (ACU) - The ACU consists of an orthogonal loop antenna ("H" field) with an integral active pre-amplifier. The antenna receives radio frequency transmissions from Omega and VLF transmitters. The ACU is located in the upper aft tip of the vertical stabilizer.

3. Operation

A. The ONS is an automatic, computerized, earth-oriented navigation system. The system uses Very Low Frequency radio signals, aircraft heading and airspeed inputs to provide continuous position and navigation information. In Hyperbolic (ABSOLUTE) mode, the ONS relies on Omega communication signals only in determining aircraft position. If usable signals are not available from at least three Omega stations, the ONS automatically switches to Relative mode operation. In Relative mode, the best available combination of Omega and VLF signals is used. If both Omega and VLF signals should become unreliable, the ONS will revert to Dead Reckoning mode. In this mode, windspeed or drift angle and ground speed must be entered manually along with position updates.

B. At system initialization, the operator enters present position (latitude and longitude), confirms Greenwich Mean Time and Date, and calls up the intended route (Active Route) from the ONS computer data bank. The ONS then automatically navigates from waypoint (WPT) to waypoint. The operator may bypass waypoints, change waypoints, or insert new waypoints to allow for flight plan changes.

C. The two "H" field antennas continuously receive 10.2, 11.3 and 13.6 kHz Omega signals and VLF signals from all directions. The signals are amplified in the ACU built-in preamplifier and fed into the Receiver Processor Unit (RPU). The signals are processed and used to:

(1) Identify the stations being received.

(2) Determine the stations to be used to provide a position fix (based on signal-to-noise ratio and distance).

(3) Calculate navigational steering information (based on pre-stored waypoints) for display on the CDU and HSI and as input to the autopilot.

D. The ONS communicates with various navigation instruments in the following ways: (Figure 3)

(1) The ONS provides a steering signal (roll command) for the aircraft's Digital Flight Guidance System. This is a composite signal made up of Track Angle Error (TKE), Crosstrack (XTK) and Groundspeed (GS).

(2) The HSI receives crosstrack deviation, TO/FROM, desired track indication and warning flag signals from the ONS.

(3) Heading synchronization input is derived from the aircraft's compass system. This input is also used as a heading reference source when operating in Dead Reckoning mode.

(4) The True Airspeed Signal (TAS) input is derived from the aircraft's Central Air Data Computers.

(5) HDG and TAS valid signals and various selectable programming inputs are processed by the ONS to provide proper system operation.

E. ONS continuously performs an end-to-end self-test routine during the 0.2 sec. gap between station transmissions. A pulse signal, injected at the input to the antenna switching matrix, is used by the RPU to verify that the signals are being processed correctly by the receiver circuits.

F. System memory contents can be called up on the CDU display to allow the operator to slew through the stored system parameters. Table 4

G. Signal quality readings for all Omega (three frequencies) and VLF stations can be displayed on the CDU.

(1) Signal quality parameters are indicated on the lower display as follows:

Table 3

(1)	SNR-10	for Omega signals on 10.2 kHz
(2)	SNR-11	for Omega signals on 11.3 kHz
(3)	SNR-13	for Omega signals on 13.6 kHz
(4)	SNRVLH	for VLF upper side band signals
(5)	SNRVLL	for VLF lower side band signals.

(2) The eight digits on the upper display show signal quality readings on a scale from zero to nine. Each digit is assigned to a particular Omega or VLF station. Normally, a quality reading of 2 or greater is considered satisfactory.

4. To Operate ONS System:

A. The following steps bring the system to operational status:

(1) Close all relevant circuit breakers.

(2) Press the STS PWR key on the Data Mode Selection (DMS) keyboard, located on the lower left portion of the CDU. The system automatically initiates a synchronization sequence and displays the Program Number and primary operating mode on the CDU. After 10 seconds, an automatic lamp test sequence is initiated.

(3) When the DATA annunciator on the DMS keyboard comes on, enter present position (latitude and longitude), GMT and date. The active Flight Plan (waypoints) may now be called up from memory.

Table 4 Omega System Memory Contents

MEMORY CONTENTS	NOTES AND COMMENTS
OLDGMT	GMT AT LAST POWER OFF
SNR-10	DISPLAY OF SIGNAL TO NOISE RATIOS FOR 10.2 KHZ
SNR-13	DISPLAY OF SIGNAL TO NOISE RATIOS FOR 13.6 KHZ
SNR-11	DISPLAY OF SIGNAL TO NOISE RATIOS FOR 11.33 KHZ
SNRVLF	DISPLAY OF SIGNAL TO NOISE RATIOS FOR VLF
DSIP13	DISCRETE INPUT 13
DSIP14	DISCRETE INPUT 14
DSIP15	DISCRETE INPUT 15
DSOP11	DISCRETE OUTPUT 11
DSOP15	DISCRETE OUTPUT 15
ANLTST	ANALOG OUTPUT TEST WORD
DISTST	DISCRETE OUTPUT TEST WORD
HWYOP1	DIGITAL HIGHWAY OUTPUT TEST WORD 1
HWYOP2	DIGITAL HIGHWAY OUTPUT TEST WORD 2
HW1IP1	DIGITAL INPUT 1 WORD 1
HW1IP2	DIGITAL INPUT 1 WORD 2

Table 4 Omega System Memory Contents (Continued)

MEMORY CONTENTS	NOTES AND COMMENTS	
HW2IP1	DIGITAL INPUT 2 WORD 1	
HW2IP2	DIGITAL INPUT 2 WORD 2	
HW3IP1	DIGITAL INPUT 3 WORD 1	
FALDSL	FAILURE DESELECT	
BITE	BITE (SEE BELOW)	
SBITE	SYNCHRO BITE (SEE BELOW)	
MBITE	MEMORY BITE	
REBITE	RECEIVER BITE	
ANTYPE	ANTENNA TYPE (SEE BELOW)	
OSCDRF	OSCILLATOR DRIFT	
FRSW	FREQUENCY SWITCH	
NODIUR	DIURNAL CANCEL FLAG	
TAS	TRUE AIRSPEED	
MAGVAR	MAGNETIC VARIATION	
HDG	HEADING	
10SN-X		
13SN-X	DISPLAY OF SIGNAL TO NOISE RATIOS (SN) AND	
11SN-X	PHASES (PH) ON 10.2 (10) kHz, 13.6 (13) kHz,	
VLSN-X	11.33 (11) kHz AND VLF CHANNELS. X DENOTES	
10PH-X	OPERATOR INPUT. AS SHOWN BELOW, THE ALLOWABLE	
13PH-X	RANGE OF INPUT IS FROM 1 THROUGH 8 CORRESPONDING	
11PH-X	TO THE 8 OMEGA AND 7 VLF STATINS. FOR VLF STA-	
VLPH-X	TION 8 IS THE TEST SIGNAL.	
	OMEGA STATION CODES	VLF STATION CODES
	1 = Norway	1 = Australia
	2 = Liberia	2 = Japan
	3 = Hawaii	3 = England
	4 = N. Dakota	4 = Maine
	5 = Reunion	5 = Hawaii
	6 = Argentina	6 = Maryland
	7 = Australia	7 = Washington
	8 = Japan	8 = Test Signal

Table 4 Omega System Memory Contents (Continued)

MEMORY CONTENTS	NOTES AND COMMENTS	
ANTYPE	1 is for Loop Antenna	
	0 is for WHIP	
BITE	0	= NO FAILURE
	1	= A/D FAILURE
	2	= TAS FAILURE
	4	= HDG FAILURE
	10	= I/P HIGHWAY FAILURE (NO.1)
	20	= EXCESSIVE OSC. DRIFT
	40	= BATTERY BACKUP IS USE
	100	= RCVR SELF TEST FAILURE
	200	= I/P HIGHWAY FAILURE (NO. 2)
	400	= PROC/MEM FAILURE
	1000	= ANTENNA SELF TEST FAILURE
	2000	= #1 INS NO VALID DATA
	4000	= #2 INS NO VALID DATA
SBITE	0	= NORMAL
	2	= TAS DISCRETE FAILURE
	4	= HDG DISCRETE FAILURE
	6	= TAS & HDG DISCRETE FAILURE
	12	= TAS SYNCHRO FAILURE
	24	= HDG SYNCHRO FAILURE
	36	= TAS & HDG SYNCHRO FAILURE
	42	= DIGITAL TAS INVALID
MAGVAR	READ IN DEGREES 0 to 359	
WJE 405, 409, 410, 881, 883, 884, 892		
ANLTST	Used during detailed HSI/ND interface test to check Autopilot output (crosstrack, course pointer, etc.) against given test values.	
DISTST	Used during detailed HSI/ND interface test to check ONS Output Discretes (From/To pointer, NAV flag, Alert Light, etc.).	
WJE 886, 887		
ANLTST	Used during detailed ND interface test to check Autopilot output (crosstrack, course pointer, etc.) against given test values.	

WJE 886, 887 (Continued)

Table 4 Omega System Memory Contents (Continued)

MEMORY CONTENTS	NOTES AND COMMENTS
DISTST	Used during detailed ND interface test to check ONS Output Discretes (From/To pointer, NAV flag, Alert Light, etc.).
WJE 405, 409, 410, 874, 881, 883, 884, 886, 887, 892	

OMEGA STATIONS

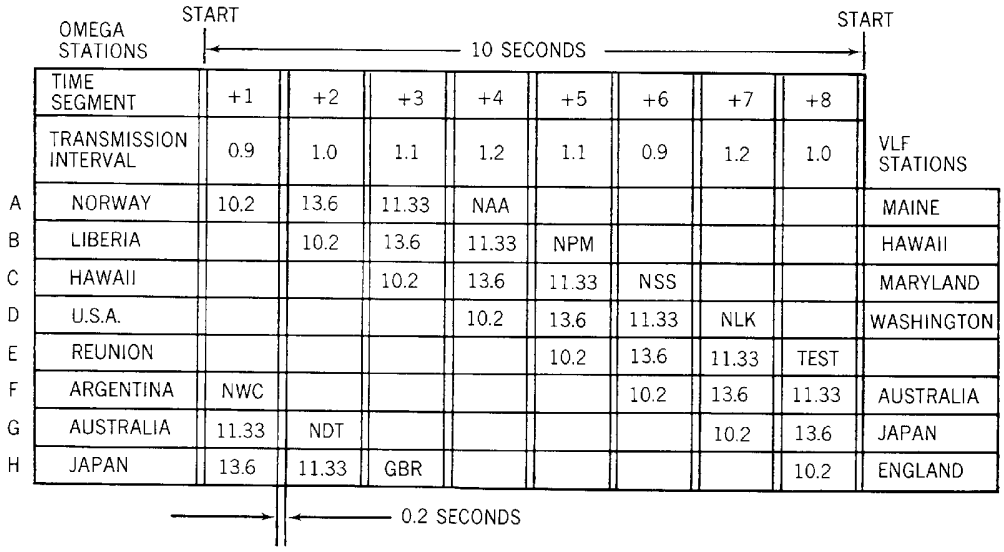
STATION NO.	STATION LOCATION	LATITUDE	LONGITUDE
1	NORWAY (A)	66°25'15.00"N	13°09'10.00"E
2	LIBERIA (B)	6°18'19.39"N	10°39'44.21"W
3	HAWAII (C)	21°24'20.67"N	157°49'47. 5"W
4	NORTH DAKOTA (D)	46°21'57.20"N	98°20'08.77"W
5	LA REUNION (E)	20°58'26.47"S	55°17'24.25"E
6	ARGENTINA (F)	43°03'12.53"S	65°11'27.29"W
7	AUSTRALIA (G)	38°28'52.53"S	146°56'06.61"E
8	JAPAN (H)	34°36'53.26"N	129°27'12.49"E

VLF COMM STATIONS
(LOCATIONS NOT SHOWN ON MAP)

STATION NO.	STATION LOCATION	LATITUDE	LONGITUDE	(KHz)	(KW)
1	AUSTRALIA	21° 49' S	114° 10' E	22.3	989
2	JAPAN	34° 58' N	137° 01' E	17.4	48
3	GREAT BRITAIN	52° 22' N	001° 11' W	16.0	650
4	MAINE	44° 39' N	67° 17' W	24.0	1026
5	PUERTO RICO	18° 23' N	67° 11' W	28.5	50
6	MARYLAND	38° 60' N	76° 27' W	21.4	588
7	WASHINGTON	48° 12' N	121° 55' W	24.8	124

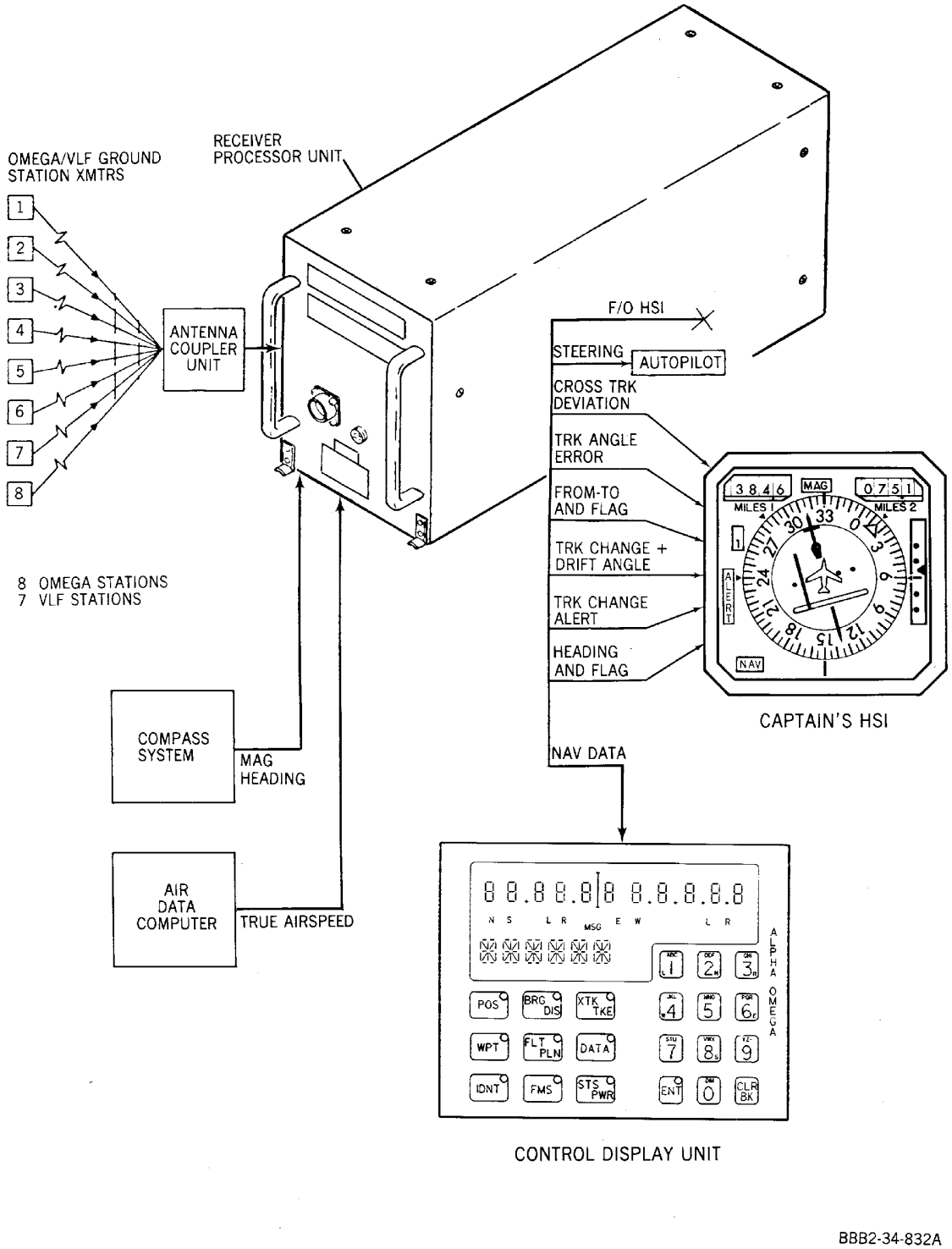
BBB2-34-830

Locations of Omega/VLF Transmitters
Figure 1/34-55-00-990-801

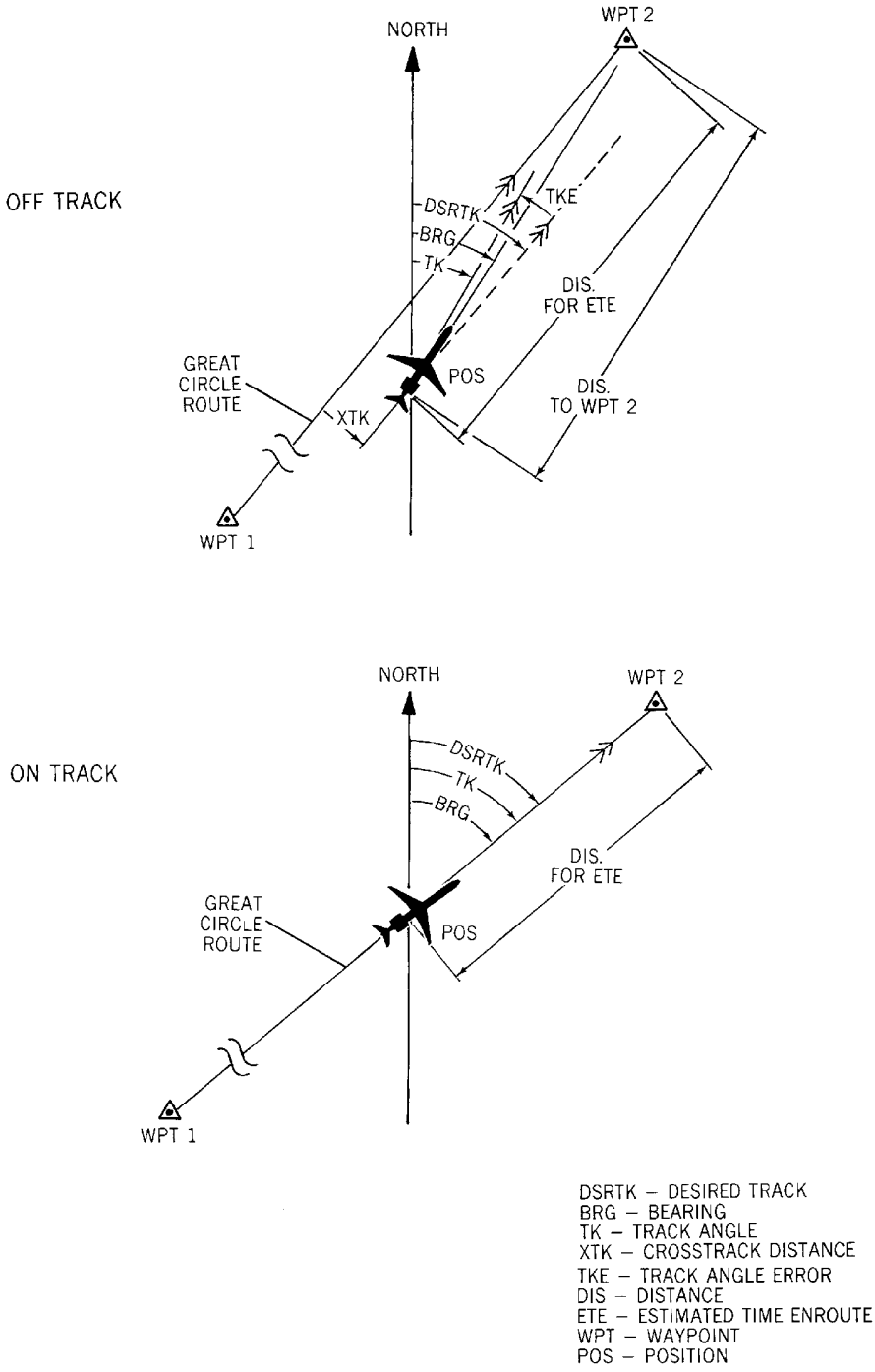


BBB2-34-831

OMEGA Transmitting Format
Figure 2/34-55-00-990-802



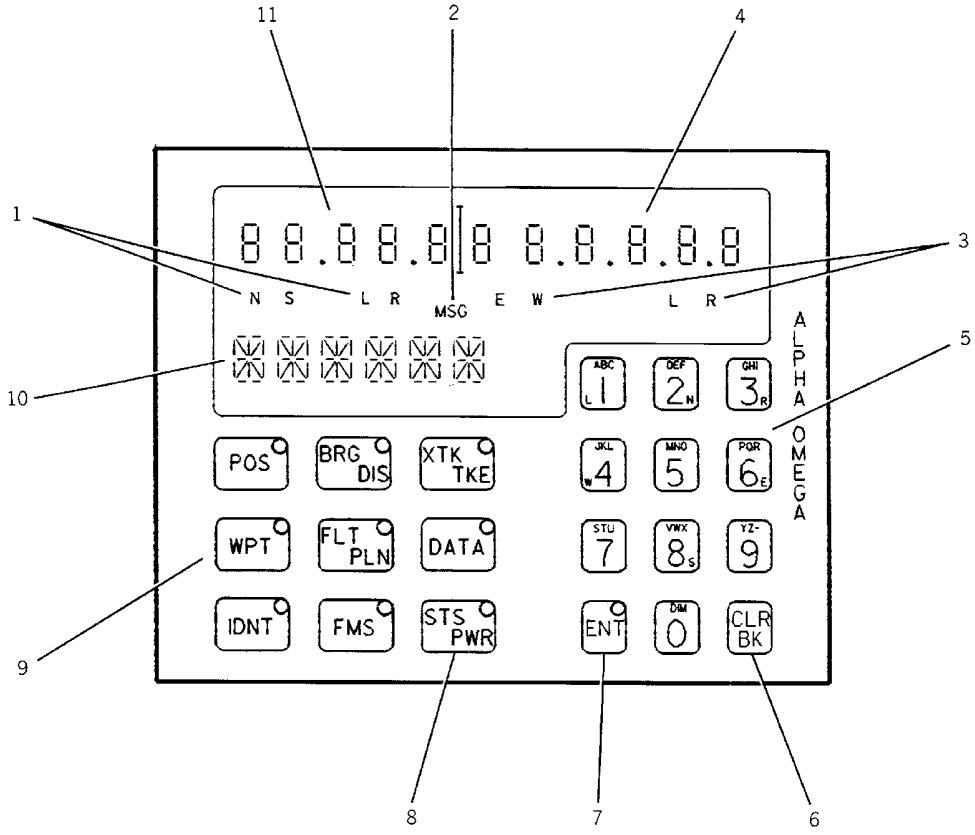
OMEGA System - Block Diagram
Figure 3/34-55-00-990-803



DSRTK – DESIRED TRACK
BRG – BEARING
TK – TRACK ANGLE
XTK – CROSSTRACK DISTANCE
TKE – TRACK ANGLE ERROR
DIS – DISTANCE
ETE – ESTIMATED TIME ENROUTE
WPT – WAYPOINT
POS – POSITION

BBB2-34-833

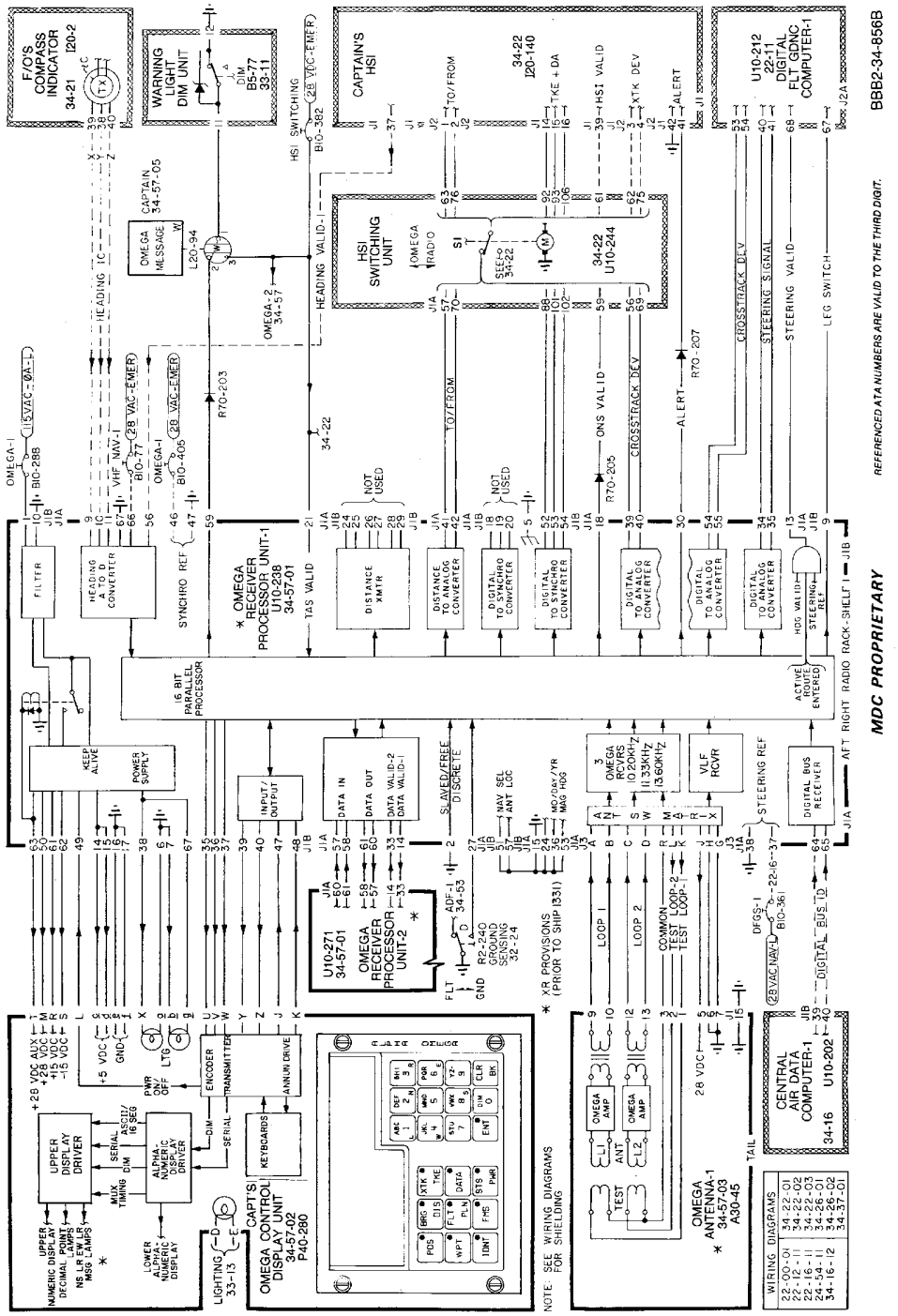
Omega Navigation Relationships
Figure 4/34-55-00-990-804



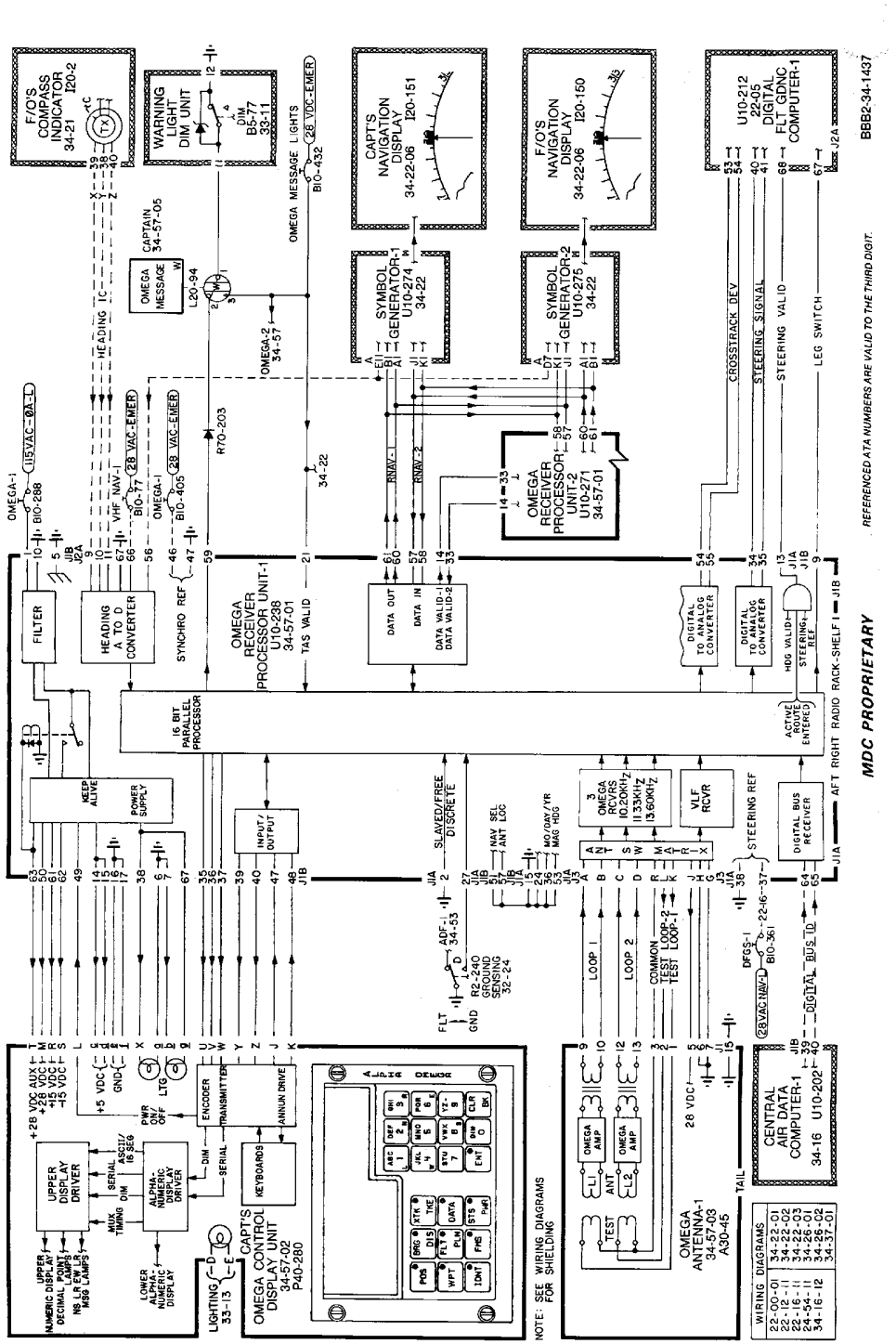
1. LEFT (N, S, L, R) ANNUNCIATORS
2. MESSAGE ANNUNCIATOR
3. RIGHT (E, W, L, R) ANNUNCIATORS
4. UPPER RIGHT NUMERIC DISPLAY WINDOW
5. DATA ENTRY KEYBOARD
6. CLEAR/BACKSPACE KEY
7. ENTER KEY
8. STATUS/POWER KEY
9. DISPLAY MODE SELECTION (DMS) KEYBOARD
10. LOWER ALPHANUMERIC DISPLAY WINDOW
11. UPPER LEFT NUMERIC DISPLAY WINDOW

BBB2-34-834

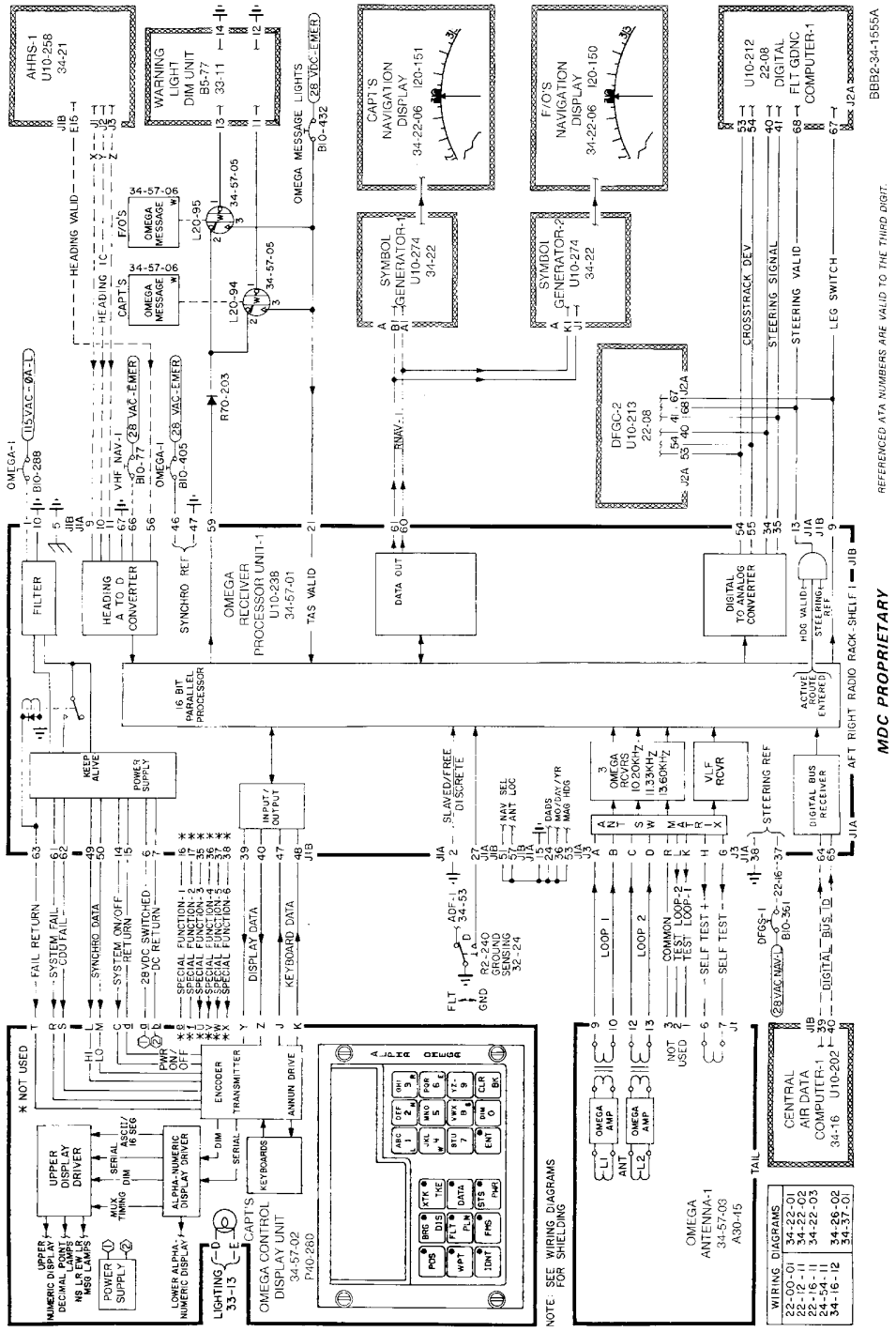
Omega Control Display Unit
Figure 5/34-55-00-990-805



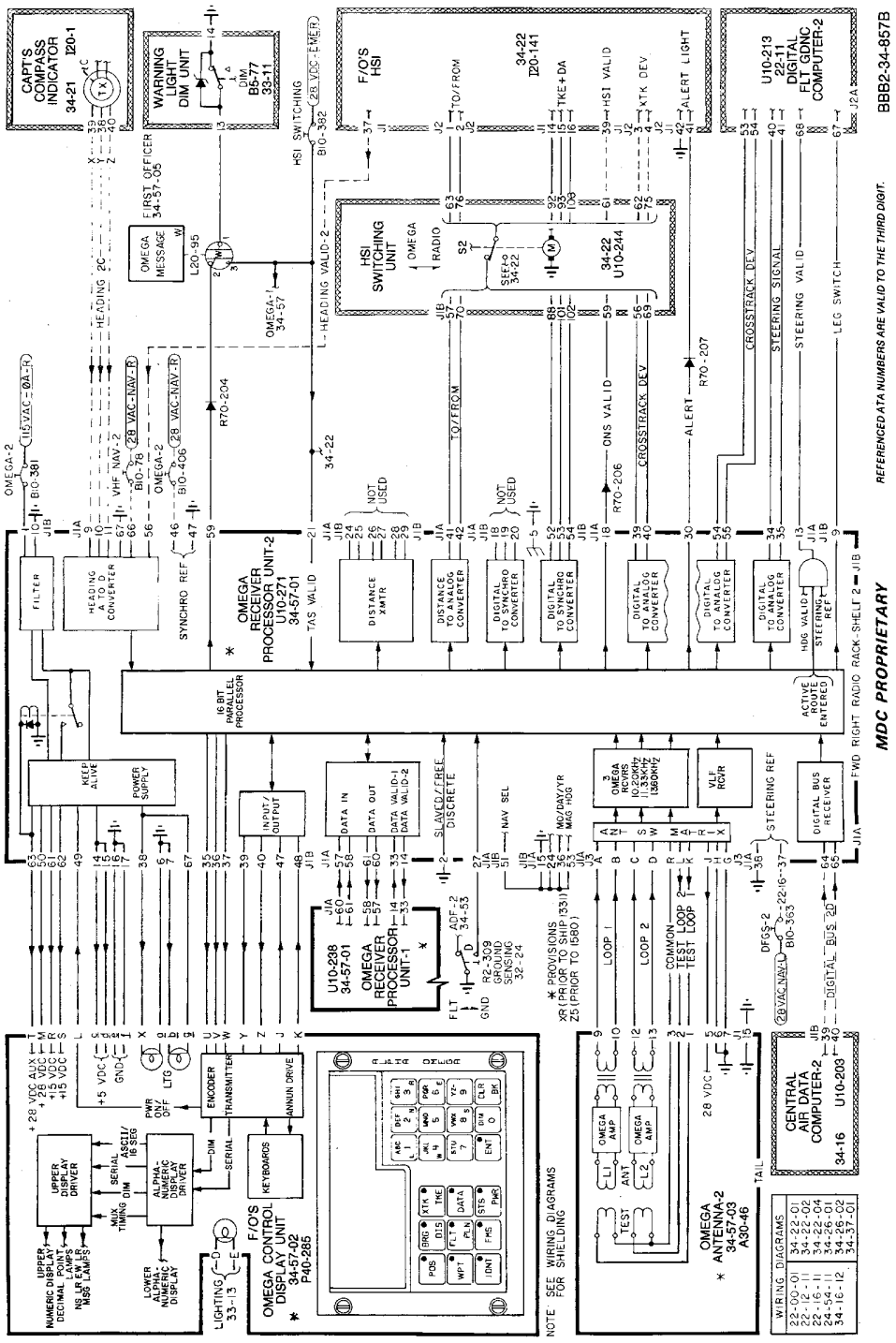
OMEGA System -1 -- Schematic
Figure 6/34-55-00-990-806 (Sheet 1 of 3)



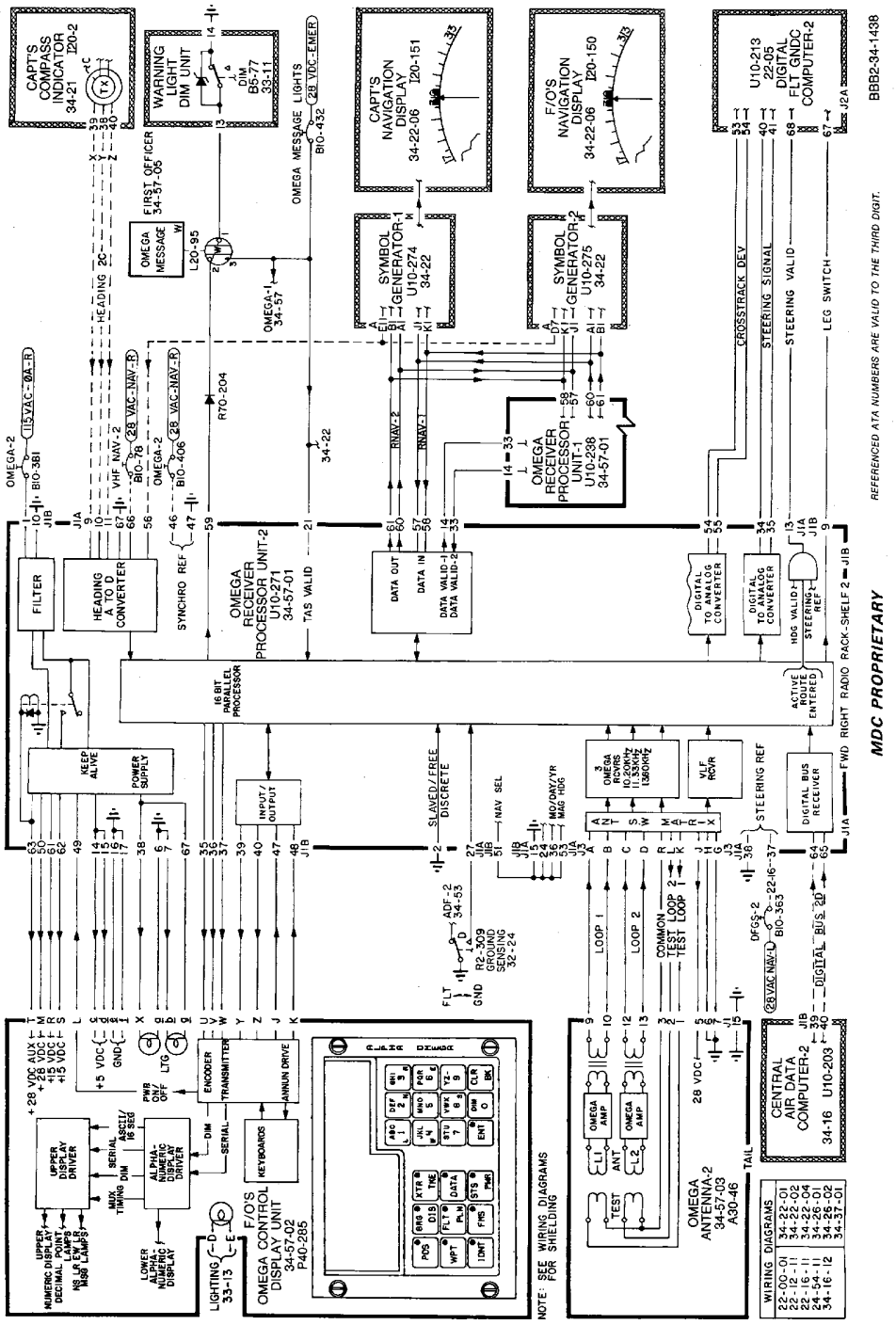
OMEGA System -1 -- Schematic
Figure 6/34-55-00-990-806 (Sheet 2 of 3)



OMEGA System -1 -- Schematic
Figure 6/34-55-00-990-806 (Sheet 3 of 3)



OMEGA System 2 -- Schematic
Figure 7/34-55-00-990-807 (Sheet 1 of 2)



OMEGA System 2 -- Schematic
Figure 7/34-55-00-990-807 (Sheet 2 of 2)

OMEGA/VLF NAVIGATION SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Omega/VLF Navigation System (ONS) Maintenance Practices provides instructions for checking the Omega system operation with the aircraft on the ground. The procedure consists of the following tests:

(1) Preliminary and Control Display Unit (CDU) Test - checks all CDU lamps and indicates system BITE status by displaying malfunction codes.

(2) Initialization and Waypoint Heading Check - checks time, date and local position coordinates; checks bearing and distance between waypoints in sample Active Flight Plan.

(3) System Memory, Air Speed and Heading Check - checks aircraft input interfaces.

(4) HSI Test - checks HSI interface; provides partial test of CDU and RPU.

WJE 405, 409, 410, 881, 883, 884, 892

(5) Cross Fill Test - ensures proper interface between OMEGA-1 system and OMEGA-2 system.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

B. The Control Display Unit (CDU) is the interface between the operator and the Omega system. It contains the controls and indicators used during system checkout procedures.

C. The following procedures require that system installation be complete, and that the aircraft supply all necessary input data to the ONS. Paragraph 2. provide a complete system test. Tests to be performed following removal/installation of individual LRU's are provided in applicable LRU Maintenance Practices sections.

D. The following procedures require that system installation be complete, and that the aircraft supply all necessary input data to the ONS. Paragraphs A. through E. of Adjustment/Test Procedures provide a complete system test. Tests to be performed following removal/installation of individual LRU's are provided in applicable LRU Maintenance Practices sections.

E. If a failure code is displayed on the CDU while carrying out the system test, the failure can be identified.

Table 201 Omega System Failure Codes

FAILURE CODE	FAILURE
0	= NO FAILURE
1 THRU 9	= ANTENNA FAILURE (LOOP ANTENNA ONLY)
10	= TAS FAILURE
100	= HEADING FAILURE
1000	= MINOR RPU FAILURE
10000	= MAJOR RPU FAILURE
100000	= DATA LINK FAILURE FROM INS #1 OR SECOND ONS
200000	= DATA LINK FAILURE FROM INS #2
300000	= DATA LINK FAILURE FROM BOTH INS #1 AND INS #2
8000000	= PRIMARY POWER FAILURE
NOTE: Composite Failure Codes indicate multiple failures, e.g., 1110 = MINOR RPU FAILURE + HEADING FAILURE + TAS FAILURE	

WJE 405, 409, 410, 881, 883, 884, 892

2. Adjustment/Test Omega System

WJE 886, 887

Adjustment/Test Omega / VLF Navigation System

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

A. Preliminary and CDU Display Test (Figure 201)

NOTE: The following test is applicable to ONS-1 and should also be performed for ONS-2.

NOTE: Pressing the STS PWR key on the CDU keyboard will initiate CDU self-test sequence.

Table 202

Operation	Desired Result
(1) Press STS PWR key on CDU keyboard and observe CDU.	(a) STS PWR annunciator comes on.
WJE 405, 409, 881, 883, 884, 892	
	608200 appears in upper RH display of CDU; 004 appears in upper LH display.
WJE 410	
	608200 appears in upper RH display of CDU; 801 appears in upper LH display.
WJE 886, 887	
	608200 appears in upper RH display of CDU; 005 appears in upper LH display.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	REL appears in lower display.
	(b) After 10 seconds, all Display Mode Selector (DMS) annunciators come on in sequence, starting with POS key and ending with ENT key.
	Upper and lower displays alternate between 1) and 2) as follows:
	1) Upper readouts display 8's; MSG annunciator comes on; lower dis play reads TEST.
	2) All 6 decimal points plus N,S,L,R, MSG and E,W,L,R annunciciators come on; snowflakes (all segments illu minated) appear in lower display.
NOTE: Intensity of CDU display may be adjusted by pressing 0 (DIM) key until desired intensity level is achieved.	

B. Initialization and Waypoint Heading Check

WJE 405, 409, 410, 881, 883, 884, 892

NOTE: The following test is applicable to ONS-1 and should also be performed for ONS-2.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

Table 203

Operation	Desired Result
(1) Press POS key on CDU.	POS annunciator flashes; DATA annunciator comes on; GMT-DT identifier appears in lower display; GMT time and date appear on upper display.
(2) If GMT is correct, press ENT key on CDU and proceed to step (3); otherwise, press ENT and insert correct GMT (4 digits, hours and minutes) using Data Entry keyboard.	Correct GMT appears in upper LH display.
(3) If date is correct, press ENT key and proceed to step (4); otherwise, press ENT key and insert date in double digits (month, day, year) using Data Entry keyboard.	Correct date appears in upper RH display.
WJE 886, 887	
(3a) Press ENT key.	DATA annunciator goes out; FMS annunciator comes on; RUNWAY or RAMP appears in lower display.
NOTE: If RUNWAY is displayed, press ENT and zero keys so that RAMP appears in lower display.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(4) Press ENT key.	DATA annunciator goes out; POS annunciator flashes; previously stored position coordinates appear in upper display; LATLON appears in lower display.
(5) If latitude is correct as shown, press ENT and proceed to step (6); otherwise, press ENT, then N(2) or S(7) key and insert local latitude (5 digits; degrees, minutes, tenths of minute).	Local latitude displayed as N or S plus 5 digits on LH display.
(6) If longitude is correct as shown, press ENT and proceed to step (7); otherwise, press ENT, then W(4) or E(6) and insert local longitude (6 digits; degrees, minutes, tenths of minute).	Local longitude displayed as W or E and 6 digits on RH display.
(7) Press ENT key.	POS key annunciator goes out; FLT PLN key comes on; ACT-RT appears in lower display window.
NOTE: Position may drift with time.	
	MSG indicator off or continuously on.
WJE 405, 409, 410, 881, 883, 884, 892	
NOTE: If aircraft is in noisy area, MSG may flash; cancel MSG with CLR BRK key to continue test.	
WJE 886, 887	
NOTE: If aircraft is in noisy area, ONS may revert to DR mode and MSG may flash; cancel MSG with CLR BRK key to continue test.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(8) Press the following keys on Display Mode Selection (DMS) keyboard:	Key annunciator comes on when key is pressed.
(a) FMS	
(b) WPT	

Table 203 (Continued)

Operation	Desired Result
(c) FLT PLN	
(d) DATA	
(e) POS	
(f) BRG DIS	
(g) XTK TKE	
(9) Press WPT key. If IDNT key is on, press to turn off.	WPT key comes on; lower display reads WPT-00.
(10) Sequentially press keys 0 through 9 on Data Entry keyboard.	Upper display shows all 9's. The following sequence of numbers appears in lower display:
	WPT- 0
	WPT-01
	WPT- 2
	WPT-23
	WPT- 4
	WPT-45
	WPT- 6
	WPT-67
	WPT- 8
	WPT-89
(11) Press FLT PLN key on DMS keyboard.	FLT PLN key comes on; ACT-RT appears on lower display.
(12) Press ENT-0-ENT on Data Entry keyboard.	Upper LH and RH displays read zero.
(13) Press WPT key.	WPT key annunciator comes on; WPT-01 appears on lower dis play; upper display reads all 9's.
(14) Press ENT key.	Upper LH display blanks.
(15) Enter local Latitude (Lat) and Longitude (Lon) for WPT-01 (same coordinates as entered in steps (5) and (6).	Lat appears on LH display; Lon appears on RH display.
(16) Press ENT-ENT.	WPT-02 appears on lower display.
(17) Enter Lat and Lon for way- point of known distance and bearing from WPT-01.	WPT-02 Lat and Lon appear on upper displays.
(18) Press ENT-ENT.	WPT-03 appears on lower display.
(19) Enter Lat and Lon for way- point of known distance and bearing from WPT-02.	WPT-03 Lat and Lon appear on upper display.
(20) Press ENT-ENT.	WPT-04 appears on lower display.
(21) Enter Lat and Lon for way- point of known distance and bearing from WPT-03.	WPT-04 Lat and Lon appear on upper display.
(22) Press ENT-ENT.	WPT-05 appears on lower display.
(23) Enter Lat and Lon for way- point of known distance and bearing from WPT-04.	WPT-05 Lat and Lon appear on upper display.

Table 203 (Continued)

Operation	Desired Result
(24) Press ENT.	WPT-06 appears on lower display.
(25) Press POS key on DMS keyboard.	ENT annunciator goes off. FROM-TO WPT numbers (00-01) appear in lower display.
(26) Press BRG DIS key on DMS keyboard.	BRG DIS annunciator light comes on; bearing and distance on WPT-01 appear in LH and RH displays respectively. (In this case, distance should read 0 (zero)).
(27) Press 01; press 02.	Lower display shows 01-02 with flashing arrow; bearing and distance between WPT-01 and WPT-02 appear in upper display.
(28) Repeat step (27) for 02-03 03-04 04-05 or press CLR BK key repeatedly.	Bearing and distance displays for all sequential legs appear in upper display.
(29) Press POS key on DMS keyboard.	BRG DIS key annunciator goes out.

C. Interface Checks - System Memory, TAS and Magnetic Heading

NOTE: This test is performed on ONS-1 and ONS-2 simultaneously.

Table 204

Operation	Desired Result
WJE 405, 409, 410, 881, 883, 884, 892	
On CDU-1 and CDU-2, press and hold STS PWR keys until MAINT appears on lower display.	
WJE 886, 887	
On CDU, press and hold STS PWR key until MAINT appears on lower display.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(2) Press ENT-2-ENT on Data Entry keyboard.	2 appears on RH display.
WJE 405, 409, 410, 881, 883, 884, 892	
(3) Press STS PWR keys until DSIP13 appears on lower display.	RH displays show: 305 for OMEGA-1 105 for OMEGA-2.
WJE 886, 887	
(3) Press STS PWR key until DSIP13 appears on lower display.	RH display shows 307.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(4) Press and hold STS PWR keys until DSIP14 appears on lower displays.	RH displays show 0 (zero).
(5) Press and hold STS PWR keys until DSIP15 appears on lower displays.	RH displays show 3.
(6) On upper EPC, open LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	RH display shows 2.

Table 204 (Continued)

Operation	Desired Result
(7) Close LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	
(8) On CADC-1 and CADC-2, place MODE SELECTOR switches in FUNCTION TEST position.	
NOTE: CADC Remote Self-Test Adapter may be used for installation of Adapter. AIR DATA COMPUTING - MAINTENANCE PRACTICES, PAGEBLOCK 34-16-00/201	
(9) Press and hold CADC-1 and CADC-2 PUSH TO TEST switches.	
(10) On OMEGA CDU-s, press and hold DATA keys until TAS-AM appears on lower display.	TAS values appear on CDU's (458(±5) knots).
(11) Release CADC PUSH TO TEST switches.	
(12) On CDU's, press and hold DATA keys until HDG-DA appears on lower displays.	Heading value displayed on RH CDU displays agree with heading values displayed on Compass Indicators (±4 degrees).

WJE 405, 409, 410, 881, 883, 884, 892

D. HSI Check (aircraft without EFIS)

NOTE: This test is performed on ONS-1 and ONS-2 simultaneously.

NOTE: Left/right indications in the following check are relative to the course pointer on the HSI.

Operation	Desired Result
Ensure OMEGA system is not in DR mode (flashing MSG annunciator; DR in lower display).	
Place FD switches on Flight Guidance Control Panel (FGCP) to FD position.	
Press NAV pushbutton on FGCP.	
On Captains's and F/O's instrument panels, select OMEGA on RADIO/OMEGA switches.	OMEGA switches on.
On CDU's, press STS PWR keys until MAINT appears in lower displays.	
(6) On CDU's, press ENT-2-ENT, then press STS PWR key until ANLTST appears in lower display.	
(7) On CDU's, press ENT-ENT-1-ENT.	Both CDU LH displays read 0 (zero); RH displays read 1.
	HSI cross track deviation bars centered (±1/4 dot); course pointers at 3 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate no turn.
	NAV TRK displayed on FMA's.
(8) On CDU's press ENT-ENT- 2-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 2000.

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

(Continued)

Operation	Desired Result
	HSI cross track deviation bars right 1 dot (±1/4 dot); course pointers at 6 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate left turn.
	NAV CAP displayed on FMA's.
(9) ON CDU's, press ENT-ENT- 1-7-4-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 174000.
	HSI cross track deviation bars left 2 dots (±1/4 dot); course pointers at 9 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate right turn.
	NAV CAP displayed on FMA's.
(10) On CDU's press ENT-ENT- 1-7-6-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 176000.
	HSI cross track deviation bars left 1 dot (±1/4 dot); course pointers at 12 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate right turn.
	NAV CAP displayed on FMA's.
(11) On CDU's press ENT-ENT- 4-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 4000.
	HSI cross track deviation bars right 2 dots (±1/4 dot); course pointers at 3 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate left turn.
	NAV CAP displayed on FMA's.
(12) On CDU's, press ENT-ENT-1-ENT.	
(13) On CDU's, press STS PWR key until DISTST appears in lower displays.	
(14) On CDU's press ENT-ENT-5- ENT.	Both CDU LH displays read 0 (zero); RH display reads 5.
	HSI FROM/TO flags indicate TO.
(15) On CDU's, press ENT-ENT-4- ENT.	HSI FROM/TO flags indicate FROM.
(16) On CDU's, press ENT-ENT-10- ENT.	On Captain's and F/O's instrument panels, OMEGA MESSAGE annunciator comes on.
	HSI NAV flags in view.
(17) On FGCP, press NAV pushbutton.	FMA's annunciate NAV TRK or NAV CAP.
(18) On CDU's pres ENT-ENT-6-ENT.	HSI track change ALERT light comes on; FROM/TO flag indi cates FROM; NAV flag out of view.

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

(Continued)

Operation	Desired Result
	OMEGA MESSAGE annunciator goes out.
	FMA NAV message (NAV TRK or NAV CAP) goes out.

WJE 886, 887, 892

WJE 886, 887

E. EFIS Check - Navigation Display (ND) and Primary Flight Display (PFD) Check

WJE 892

EFIS Check (aircraft with EFIS) - Navigation Display (ND) and Primary Flight Display (PFD) Check

WJE 886, 887, 892

NOTE: Make certain system is not in DR mode before performing following tests.

Table 205

Operation	Desired Result
(1) Place flight director ON. Press NAV button on digital flight guidance panel. Select ROSE mode on EFIS Mode Select Panels.	Switch on FD.
(2) On Capt. and F/O Mode Select Panel (MSP) select NAV position to display Omega on the EFIS. ON CDU press STS PWR key until MAINT appears in lower display. Press ENT-2-ENT. Press STS PWR key until ANL TST appears in lower display.	NAV selected. MAINT dis played, ANL TEST displayed.
(3) Press ENT-ENT-1-ENT. Upper LH and RH displays indicate 0 and 1. Check both ND's for following:	0 on LH display, 1 on RH display.
(a) Cross track deviation bar will be centered.	Bar centered (±1/4 dot).
(b) Course pointer is equal to aircraft heading.	(±2°).
(c) Command bars on PFD's will indicate no turns.	No turns.
(d) Words NAV TRK will appear in both FMAs.	NAV TRK displayed.
(e) No NAV or HDG failure messages displayed.	No failure messages.
(4) Press ENT-ENT-2000-ENT. Verify upper LH and RH dis- plays indicate 0 and 2000.	0 on LH display, 2000 on RH display.
(5) Check both PFD's for following:	
(a) Command bars will indicate a left turn.	Left turn indicated.
(b) Both FMA's will display NAV CAP.	NAV CAP displayed.
(6) Press ENT-ENT-1-7-4-0-0- -0-ENT. Verify upper LH and RH displays indicate 0 and 174000 respectively.	0 on LH display, 174000 on upper RH display.
(7) Check both PFD's for following:	
(a) Command bars will indicate a right turn.	Right turn indicated.
(b) Both Flight Mode Annuncia- tors (FMA's) wll display NAV CAP.	NAV CAP displayed.
(8) Select MAP mode on EFIS Mode Select Panels.	MAP selected.

WJE 886, 887, 892 (Continued)

Table 205 (Continued)

Operation	Desired Result
(9) ON CDU's press DATA key until DTK-TK appears in lower display.	DTK-TK displayed.
(10) On keyboard of CDU press and hold STS PWR key until DISTST appears in lower display.	DISTST on lower display.
(11) Select ROSE mode on EFIS Mode Select Panels.	Rose selected.
(12) On keyboard press ENT-ENT -10-ENT, OMEGA MESSAGE annunciators will come on.	OMEGA MESSAGE comes on.
(13) Press NAV button on Flight Guidance Control Panel (FGCP), and check both FMA's will display NAV TRK or NAV CAP.	Verified.
(14) On keyboard press ENT-ENT-6-ENT.	
(a) Check NAV message on both Flight Mode Annunciators (FMA's) is no longer displayed.	Verified.
(b) OMEGA MESSAGE annunciators go off.	OMEGA MESSAGE off.

WJE 405, 409, 410, 881, 883, 884, 892

F. Flight Plan Cross Fill Check

NOTE: For the following procedure, ONS-1 acts as the transmitting system, and ONS-2 acts as the receiving system. Once completed, this procedure should be repeated with the ONS system roles reversed.

Table 206

Operation	Desired Result
(1) On CDU-2, press FLT PLN key until ACT-RT appears in lower display.	
(2) On CDU-2, press ENT-0-ENT.	CDU-2 upper displays read all zeroes.
(3) On CDU-2, press WPT key.	CDU-2 WPT key annunciator comes on; WP-01 appears in lower display; upper display reads all 9's.
(4) On CDU-2, press and hold FLT-PLN key until XLD-RX appears in lower display.	
(5) On CDU-1, press FLT-PLN key until ACT-RT appears in lower display.	CDU-1 LH display reads 5; RH display reads 0 (zero).
(6) On CDU-1, press FLT-PLN key until XLD-TX appears on lower display.	
(7) On CDU-2, press ENT-1-ENT.	CDU-2 RH display reads 9.
(8) On CDU-1, press ENT-1-ENT.	When all WPT's transferred, both CDU-1 and CDU-2 LH and RH displays read zero.
(9) On CDU-2, press WPT key.	LAT-LON of WPT-01 displayed.
(10) Repeat step (9) for all WPT's.	All WPT's verified.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

G. Test Termination

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884			
A	11	B10-382	HSI SWITCHING

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

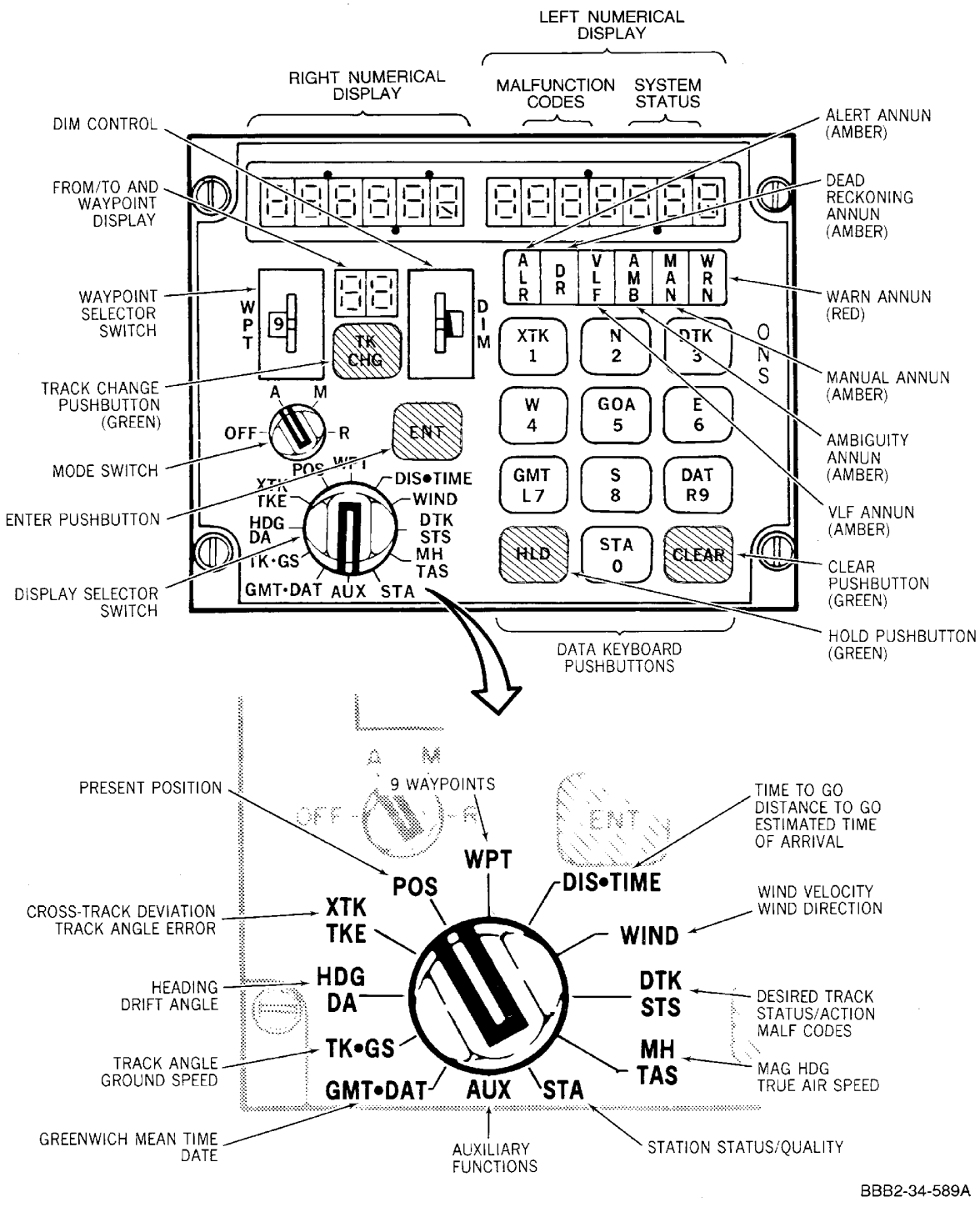
UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

NOTE: Circuit breakers are opened to turn system power off and clear test input data.

(2) Return aircraft controls and systems to required configuration.



OMEGA Control Display Unit - Test Display
Figure 201/34-55-00-990-853

OMEGA RECEIVER PROCESSOR UNIT - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 410, 881, 883, 884, 892

A. Two receiver processor units (RPUs) are located in the main radio rack in the avionics compartment.

WJE 886, 887

B. The Omega receiver processor unit (RPU) is located in the main radio rack in the avionics compartment.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

C. The following Maintenance Practices provide removal/ installation procedures for the RPU's.

WJE 886, 887

D. The following Maintenance Practices provide removal/ installation procedures for the RPU.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

2. Removal/Installation RPU

A. Remove RPU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
A	11	B10-432	OMEGA MESSAGE LIGHTS
WJE 410			
A	12	B10-432	OMEGA MESSAGE LIGHTS

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

WJE 405, 409, 410, 884, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Loosen and disengage locking nuts at RPU mounting rack from RPU lugs.

(3) Remove RPU from mounting by carefully pulling RPU straight out of rack to disengage RPU electrical connector from rack electrical receptacle.

(4) Install protective covers over RPU and mounting rack electrical connectors.

B. Install RPU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
A	11	B10-432	OMEGA MESSAGE LIGHTS
WJE 410			
A	12	B10-432	OMEGA MESSAGE LIGHTS

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

WJE 405, 409, 410, 884, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Remove protective covers from RPU electrical connector and mounting rack electrical receptacle; check electrical connectors for damaged pins, corrosion and dirt.

(3) Place RPU in mounting rack and carefully push RPU straight into rack exercising care to engage electrical connectors so as not to damage connector pins.

(4) Engage mounting rack locking nuts to RPU lugs and tighten fingertight.

(5) Recheck RPU installation in rack to make certain RPU is fully engaged in rack to make certain electrical connectors are firmly engaged.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
A	11	B10-432	OMEGA MESSAGE LIGHTS
WJE 410			
A	12	B10-432	OMEGA MESSAGE LIGHTS

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

WJE 405, 409, 410, 884, 886, 887 (Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

3. **Adjustment/Test RPU**

A. Test RPU

NOTE: Pressing the STS PWR key on the CDU keyboard will initiate CDU self-test sequence.

Table 201

Operation	Desired Result
(1) Press STS PWR key on CDU keyboard and observe CDU.	(a) STS PWR annunciator comes on.
WJE 405, 409, 410, 881, 883, 884, 892	
	608200 appears in upper RH display of CDU; 004 appears in upper LH display.
WJE 886, 887	
	608200 appears in upper RH display of CDU; 801 appears in upper LH display.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	REL appears in lower display.
	(b) After 10 seconds, all Display Mode Selector (DMS) annunciators come on in sequence, starting with POS key and ending with ENT key.
	Upper and lower displays alternate between 1) and 2) as follows:
	1) Upper readouts display 8's; MSG annunciator comes on; lower display reads TEST.
	2) All 6 decimal points plus N,S,L,R, MSG and E,W,L,R annunciators come on; snowflakes (all segments illuminated) appear in lower display.

Table 201 (Continued)

Operation	Desired Result
	(c) After lamp test, POS annunciator flashes; DATA annunciator comes on; GMT-DT identifier appears in lower display; GMT time and date appear on upper display.
NOTE: Intensity of CDU display may be adjusted by pressing 0 (DIM) key until desired intensity level is achieved.	
(2) If GMT is correct, press ENT key on CDU and proceed to step (3); otherwise, press ENT and insert correct GMT (4 digits, hours and minutes) using Data Entry keyboard.	Correct GMT appears in upper LH display.
(3) If date is correct, press ENT key and proceed to step (4); otherwise, press ENT key and insert date in double digits (month, day, year) using Data Entry keyboard.	Correct date appears in upper RH display.
WJE 886, 887	
(3a) Press ENT key.	DATA annunciator goes out; FMS annunciator comes on; RUNWAY or RAMP appears in lower display.
NOTE: If RUNWAY is displayed, press ENT and zero keys so that RAMP appears in lower display.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(4) Press ENT key.	DATA annunciator goes out; POS annunciator flashes; previously stored position coordinates appear in upper display; LATLON appears in lower display.
(5) If latitude is correct as shown, press ENT and proceed to step (6); otherwise, press ENT, then N(2) or S(8) key and insert local latitude (5 digits; degrees, minutes, tenths of minute).	Local latitude displayed as N or S plus 5 digits on LH display.
(6) If longitude is correct as shown, press ENT and proceed to step (7); otherwise, press ENT, then W(4) or E(6) and insert local longi tude (6 digits; degrees, minutes, tenths of minute).	Local longitude displayed as W or E and 6 digits on RH display.
(7) Press ENT key.	POS key annunciator goes out; FLT PLN key comes on; ACT-RT appears in lower display window.
NOTE: Position may drift with time.	
	MSG indicator off or continu ously on.
NOTE: If aircraft is in noisy area, ONS may revert to DR mode and MSG may flash; cancel MSG with CLR BRK key to continue test.	
(8) Press ENT-0-ENT on Data Entry keyboard.	Upper LH and RH displays read zero.
(9) Press WPT key.	WPT key annunciator comes on; WPT-01 appears on lower display; upper display reads all 9's.
(10) Press ENT key.	Upper LH display blanks.
(11) Enter local Latitude (Lat), press ENT key, enter local Longitude (Lon) for WPT-01 (same coordinates as entered in steps (5) and (6).	Lat appears on LH display; Lon appears on RH display.
(12) Press ENT-ENT.	WPT-02 appears on lower display.
(13) Enter Lat and Lon for way- point of known distance and bearing from WPT-01.	WPT-02 Lat and Lon appear on upper displays.

Table 201 (Continued)

Operation	Desired Result
(14) Press ENT-ENT.	WPT-03 appears on lower display.
(15) Enter Lat and Lon for way- point of known distance and bearing from WPT-02.	WPT-03 Lat and Lon appear on upper display.
(16) Press ENT.	WPT-04 appears on lower display.
(17) Press BRG DIS key on DMS keyboard.	BRG DIS annunciator light comes on; bearing and distance to WPT-01 appear in LH and RH displays respectively. (Distance should read 0 (zero)).
(18) Press 01; press 02.	Lower display shows 01-02 with flashing arrow; bearing and distance between WPT-01 and WPT-02 appear in upper display.
(19) Repeat step (18) for: 02-03	Bearing and distance displays for all sequential legs appear in upper display.
WJE 405, 409, 410, 881, 883, 884, 892	
(20) On CDU-1 and CDU-2, press and hold STS PWR keys until MAINT appears on lower display.	
WJE 886, 887	
(20) On CDU, press and hold STS PWR key until MAINT appears on lower display.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(21) Press ENT-2-ENT on Data Entry keyboard.	2 appears on RH display.
WJE 405, 409, 410, 881, 883, 884, 892	
(22) Press STS PWR keys until DSIP13 appears on lower display.	RH displays show: 305 for OMEGA-1 105 for OMEGA-2.
WJE 886, 887	
(22) Press STS PWR keys until DSIP13 appears on lower display.	RH displays shows 307
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(23) Press and hold STS PWR keys until DSIP14 appears on lower displays.	RH displays show 0 (zero).
(24) Press and hold STS PWR keys until DSIP15 appears on lower displays.	RH displays show 3.
(25) On upper EPC, open LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	RH display shows 2.
(26) Close LEFT and RIGHT GROUND CONTROL RELAY circuit breakers.	
WJE 405, 409, 410, 881, 883, 884, 892	
(27) On CDU's, press and hold STS PWR keys until HDG appears on lower displays.	Heading value displayed on RH CDU displays agree with heading values displayed on Compass Indicators (±4 degrees).

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 886, 887	
(27) On CDU, press and hold DATA key until HDG-DA appears on lower display.	Heading value shown on LH CDU display agrees with heading values displayed on RDMI's (±4 degrees).
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(28) Make sure that OMEGA system is not in DR mode (flashing MSG annunciator; DR in lower display).	
(29) Place FD switches on Flight Guidance Control Panel (FGCP) to FD position.	
(30) Press NAV pushbutton on FGCP.	
WJE 405, 409, 410, 881, 883, 884, 892	
(31) On Captain's and F/O's instrument panels, select OMEGA on RADIO/OMEGA switches.	OMEGA switches on.
WJE 886, 887	
(31) On Captain's and F/O's EFIS mode select NAV on RAD/NAV switches. Select ROSE mode.	NAV and ROSE selected.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(32) On CDU's, press STS PWR keys until MAINT appears in lower displays.	
(33) On CDU's, press ENT-2-ENT, then press STS PWR key until ANLTST appears in lower display.	
(34) On CDU's, press ENT-ENT-1- ENT.	Both CDU LH displays read 0 (zero); RH displays read 1.
WJE 886, 887	
	PFD command bars indicate no turn.
WJE 405, 409, 410, 881, 883, 884, 892	
	HSI cross track deviation bars centered (±1/4 dot); course pointers at 3 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate no turn.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	NAV TRK displayed on FMA's.
(35) On CDU's, press ENT-ENT- 2-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 2000.
WJE 886, 887	
	PFD command bars indicate left turn.
WJE 405, 409, 410, 881, 883, 884, 892	
	HSI cross track deviation bars right 1 dot (±1/4 dot); course pointers at 6 o'clock position (±2°); NAV and HDG flags retracted.

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

Table 201 (Continued)

Operation	Desired Result
	ADI command bars indicate left turn.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	NAV CAP displayed on FMA's.
(36) On CDU's, press ENT-ENT- 1-7-4-0-0-0-ENT.	Both CDU LH displays read 0 (zero); RH displays read 174000.
WJE 886, 887	
	PFD command bars indicate right turn.
WJE 405, 409, 410, 881, 883, 884, 892	
	HSI cross track deviation bars left 2 dots (±1/4 dot); course pointers at 9 o'clock position (±2°); NAV and HDG flags retracted.
	ADI command bars indicate right turn.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	NAV CAP displayed on FMA's.
(37) On CDU, press ENT-ENT-1-ENT.	
(38) On CDU, press STS PWR key until DISTST appears in lower displays.	
WJE 886, 887	
(39) Deleted.	
WJE 405, 409, 410, 881, 883, 884, 892	
(39) On CDU's, press ENT-ENT- 5-ENT.	Both CDU LH displays read 0 (zero); RH display reads 5.
	HSI FROM/TO flags indicate TO.
(40) On CDU's, press ENT-ENT- 4-ENT.	HSI FROM/TO flags indicate FROM.
WJE 886, 887	
(40) Deleted.	
WJE 405, 409, 410, 881, 883, 884, 892	
(41) On CDU's, press ENT-ENT- 10-ENT.	On Captain's and F/O's instrument panels, OMEGA MESSAGE annunciator comes on.
	HSI NAV flags in view.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(42) On FGCP, press NAV pushbutton.	FMA's annunciate NAV TRK or NAV CAP.
WJE 405, 409, 410, 881, 883, 884, 892	
(43) On CDU's, press ENT-ENT- 6-ENT.	HSI track change ALERT light comes on; FROM/TO flag indicates FROM; NAV flag out of view.

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	OMEGA MESSAGE annunciator goes out.
	FMA NAV message (NAV TRK or NAV CAP) goes out.
WJE 405, 409, 410, 881, 883, 884, 892	
NOTE: For the following procedure, ONS-1 acts as the transmitting system, and ONS-2 acts as the receiving system. Once completed, this procedure should be repeated with the ONS system roles reversed.	
(44) On CDU-2, press FLT PLN key until ACT-RT appears in lower display.	
(45) On CDU-2, press ENT-0-ENT.	CDU-2 upper displays read all zeroes.
(46) On CDU-2, press WPT key.	CDU-2 WPT key annunciator comes on; WPT-01 appears in lower display; upper display reads all 9's.
(47) On CDU-2, press and hold FLT-PLN key until XLD-RX appears in lower display.	
(48) On CDU-1, press FLT-PLN key until ACT-RT appears in lower display.	CDU-1 LH display reads 5; RH display reads 0 (zero).
(49) On CDU-1, press FLT-PLN key until XLD-TX appears on lower display.	
(50) On CDU-2, press ENT-1-ENT.	CDU-2 RH display reads 9.
(51) On CDU-1, press ENT-1-ENT.	When all WPT's transferred, both CDU-1 and CDU-2 LH and RH displays read zero.
(52) On CDU-2, press WPT key.	LAT-LON of WPT-01 displayed.
(53) Repeat step (52) for all WPT's.	All WPT's verified.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	

(1) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC
WJE 405, 409, 881, 883, 884, 892			
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 410			
B	7	B10-10	FIRST OFFICER'S COMPASS

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 886, 887			
A	11	B10-432	OMEGA MESSAGE LIGHTS
WJE 410			
A	12	B10-432	OMEGA MESSAGE LIGHTS

WJE 410 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 881, 883, 884, 892			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 886, 887

NOTE: Circuit breakers are opened to turn system power off and clear test input data.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Return aircraft to required configuration.

WJE 405, 409, 410, 881, 883, 884, 892

(3) Verify installation by complete System Test (OMEGA/VLF NAVIGATION SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-55-00/201 Config 1).

OMEGA ANTENNA COUPLER UNIT - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 410, 881, 883, 884, 892

A. This Maintenance Practices section provides removal/ installation procedures for the Omega Antenna Coupler Units (ACUs). Two Antenna Coupler Units (ACUs) are located in the upper aft tip of the vertical stabilizer. Removal/installation procedures are typical for both units.

WJE 886, 887

B. This Maintenance Practices section provides removal/ installation procedures for the Omega Antenna Coupler Units (ACUs). The Antenna Coupler Unit (ACU) is located in the upper aft tip of the vertical stabilizer.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

2. Removal/Installation Omega ACU

A. Remove ACU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Support vertical stabilizer tip radome and remove screws and washers attaching radome to aircraft. Remove radome.

(3) Disconnect coax connector from applicable antenna.

(4) Protect connectors by installing caps or approved covering.

(5) Support antenna and remove screws and washers attaching antenna to aircraft. Remove antenna.

B. Install ACU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Move antenna into mounting position and secure to aircraft structure with the attaching screws and washers.

(3) Remove protective covers from coax connectors and check connectors for any damage, contamination, or dirt. Make sure antenna cable #1 goes to top antenna and antenna cable #2 goes to bottom antenna.

(4) Connect coax to antenna receptacle.

(5) Move vertical stabilizer tip radome into mounting position and secure to aircraft with attaching screws and washers.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

WJE 405, 409, 881, 883, 884, 886, 887 (Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

3. **Adjustment/Test Omega ACU**

A. Test ACU

NOTE: Pressing the STS PWR key on the CDU keyboard will initiate CDU self-test sequence.

Table 201

Operation	Desired Result
(1) Press STS PWR key on CDU keyboard and observe CDU.	(a) STS PWR annunciator comes on.
WJE 405, 409, 410, 881, 883, 884, 892	
	608200 appears in upper RH display of CDU: 004 appears in upper LH display.
WJE 886, 887	
	608200 appears in upper RH display of CDU; 801 appears in upper LH display.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	REL appears in lower display.
	(b) After 10 seconds, all Display Mode Selector (DMS) annunciator come on in sequence, starting with POS key and ending with ENT key.
	Upper and lower displays alternate between 1) and 2) as follows:
	1) Upper readouts display 8's; MSG annunciator comes on; lower display reads TEST.

Table 201 (Continued)

Operation	Desired Result
	2) All 6 decimal points plus N,S,L,R, MSG and E,W,L,R annunciators come on; snowflakes (all segments illuminated) appear in lower display.
NOTE: Intensity of CDU display may be adjusted by pressing 0 (DIM) key until desired intensity level is achieved.	
(2) Press and hold STS PWR key on CDU until MAINT appears in lower display.	
(3) Press ENT-1-ENT on CDU.	Upper RH display reads 1; ENT annunciator goes out.
(4) Press and hold STS PWR key until SNR-10 appears in lower display.	Eight digits in upper display show Omega signal quality readings at 10.2 kHz.
NOTE: Each digit in upper display represents Omega or VLF stations in predefined order. (Table 202)	
Eighth digit for VLF stations (7 total) is blank.	
(5) Press and hold STS PWR key until SNR-11 appears in lower display.	Eight digits in upper display show Omega signal quality readings at 11.3 kHz.
(6) Press and hold STS PWR key until SNR-13 appears in lower display.	Eight digits in upper display show Omega signal quality readings at 13.6 kHz.
(7) Press and hold STS PWR key until SNRVLH appears in lower display.	Seven digits in upper display show Omega signal quality readings for VLF upper side band signals.
(8) Press and hold STS PWR key until SNRVLL appears in lower display.	Seven digits in upper display show Omega signal quality readings for VLF lower side band signals.
(9) On CDU-1 and CDU-2, press and hold STS PWR keys until MAINT appears on lower display.	
(10) Press ENT-2-ENT on Data Entry keyboard.	2 appears on RH display.
(11) Press STS PWR keys until DSIP13 appears on lower display.	RH displays show: 305 for OMEGA-1 105 for OMEGA-2.
(12) Press and hold STS PWR keys until DSIP14 appears on lower displays.	RH displays show 0 (zero).
(13) Press and hold STS PWR keys until DSIP15 appears on lower displays.	RH displays show 3.

B. Return aircraft to required configuration.

C. Verify installation by complete System Test. (OMEGA/VLF NAVIGATION SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-55-00/201 Config 1)

Table 202 Signal Quality Readings - Omega/VLF Station Order

UPPER DISPLAY DIGIT NUMBER	OMEGA STATIONS	VLF STATIONS
1	NORWAY	NWC AUSTRALIA
2	LIBERIA	NDT JAPAN
3	HAWAII	GBR ENGLAND
4	NORTH DAKOTA	NAA MAINE
5	LA REUNION	NAU PUERTO RICO

Table 202 Signal Quality Readings - Omega/VLF Station Order (Continued)

UPPER DISPLAY DIGIT NUMBER	OMEGA STATIONS	VLF STATIONS
6	ARGENTINA	NSS MARYLAND
7	AUSTRALIA	NLK WASHINGTON STATE
8	JAPAN	NOT USED

OMEGA CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General

WJE 405, 409, 410, 881, 883, 884, 892

A. The OMEGA control display units (CDUs) are located in the forward pedestal in the flight compartment.

WJE 886, 887

B. The Omega Control Display Unit (CDU) is located in the aft pedestal in the flight compartment.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

C. The Manintenance Practices section provides typical removal/ installation and test procedures for the CDU.

2. Removal/Installation Omega Control Display Unit

A. Remove CDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Unlock CDU fasteners.

(3) Pull CDU straight out of pedestal sufficiently to gain access to electrical wiring connector.

(4) Disconnect electrical connector from CDU and remove CDU.

(5) Install protective covers on aircraft electrical connector and CDU electrical receptacle.

B. Install CDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

(2) Check CDU receptacle and aircraft electrical connector for damaged, corroded, or dirty electrical contacts.

(3) Place CDU in position at pedestal and connect aircraft electrical connector to CDU electrical receptacle.

(4) Insert CDU in pedestal and lock fasteners into place.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892			

UPPER EPC, LIGHTS - LEFT AC BUS

Row	Col	Number	Name
K	19	B1-309	INTEGRAL LIGHTS PEDESTAL

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

3. Adjustment/Test Omega CDU

WJE 886, 887

NOTE: Before doing Adjustment/Test, make sure that all Omega system circuit breakers are closed, and that aircraft is supplying all necessary inputs to the ONS.

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

A. Test CDU

NOTE: Pressing the STS PWR key on the CDU keyboard will initiate CDU self-test sequence.

Table 201

Operation	Desired Result
(1) Press STS PWR key on CDU keyboard and observe CDU.	(a) STS PWR annunciator comes on.
WJE 405, 409, 410, 881, 883, 884, 892	
	608200 appears in upper RH display of CDU: 004 appears in upper LH display.

WJE 405, 409, 410, 881, 883, 884, 892 (Continued)

Table 201 (Continued)

Operation	Desired Result
WJE 886, 887	
	608200 appears in upper RH display of CDU: 801 appears in upper LH display.
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
	REL appears in lower display.
	(b) After 10 seconds, all Display Mode Selector (DMS) annunciators come on in sequence, starting with POS key and ending with ENT key.
	Upper and lower displays alternate between 1) and 2) as follows:
	1) Upper readouts display 8's; MSG annunciator comes on; lower display reads TEST.
	2) All 6 decimal points plus N,S,L,R, MSG and E,W,L,R annunciators come on; snowflakes (all segments illuminated) appear in lower display.
NOTE: Intensity of CDU display may be adjusted by pressing 0 (DIM) key until desired intensity level is achieved.	
(2) Press POS key on CDU.	POS annunciator flashes; DATA annunciator comes on; GMT-DT identifier appears in lower display; GMT time and date appear on upper display.
(3) If GMT is correct, press ENT key on CDU and proceed to step (4); otherwise, press ENT and insert correct GMT (4 digits, hours and minutes) using Data Entry keyboard.	Correct GMT appears in upper LH display.
(4) If date is correct, press ENT key and proceed to step (5); otherwise, press ENT key and insert date in double digits (month, day, year) using Data Entry keyboard.	Correct date appears in upper RH display.
WJE 886, 887	
(4a) Press ENT Key.	DATA annunciator goes out; FMS annunciator comes on; RUNWAY or RAMP appears in lower display.
NOTE: If RUNWAY is displayed, press ENT and zero keys so that RAMP appears in lower display.	
WJE 405, 409, 410, 881, 883, 884, 886, 887, 892	
(5) Press ENT Key.	FMS annunciator goes out; POS annunciator flashes; previously stored position coordinates appear in upper display; LATLON appears in lower display.
(6) If latitude is correct as shown, press ENT and proceed to step (7); otherwise, press ENT, then N(2) or S(7) key and insert local latitude (5 digits; degrees, minutes, tenths of minute).	Local latitude displayed as N or S plus 5 digits on LH display.
(7) If longitude is correct as shown, press ENT and proceed to step (8); otherwise, press ENT, then W(4) or E(6) and insert local longitude (6 digits; degrees, minutes, tenths of minute).	Local longitude displayed as W or E and 6 digits on RH display.

Table 201 (Continued)

Operation	Desired Result
(8) Press ENT key.	POS key annunciator goes out; FLT PLN key comes on; ACT-RT appears in lower display window.
NOTE: Position may drift with time.	
	MSG indicator off or continuously on.
NOTE: If aircraft is in noisy area, ONS may revert to DR mode and MSG may flash; cancel MSG with CLR BRK key to continue test.	
(9) Press the following keys on Display Mode Selection (DMS) keyboard:	Key annunciator comes on when key is pressed.
(a) FMS	
(b) WPT	
(c) FLT PLN	
(d) DATA	
(e) POS	
(f) BRG DIS	
(g) XTK TKE	
(10) Press WPT Key. If IDNT key is on, press to turn off.	WPT key comes on; lower display reads WPT-00.
(11) Sequentially press keys 0 through 9 on Data Entry keyboard.	Upper display shows all 9's. The following sequence of numbers appears in lower display:
	WPT- 0
	WPT-01
	WPT- 2
	WPT-23
	WPT- 4
	WPT-45
	WPT- 6
	WPT-67
	WPT- 8
	WPT-89

B. Open and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884, 886, 887			
A	2	B10-405	OMEGA-1 28 VAC

WJE 405, 409, 881, 883, 884, 886, 887 (Continued)

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405, 409, 881, 883, 884			
A	11	B10-382	HSI SWITCHING

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 884, 886, 887			
F	25	B10-288	OMEGA-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 405, 409, 884			
F	11	B10-381	OMEGA-2
WJE 410			
F	15	B10-381	OMEGA-2

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
WJE 405, 409, 884			
B	8	B10-406	OMEGA-2

WJE 405, 409, 410, 881, 883, 884, 886, 887, 892

NOTE: Circuit breakers are opened to turn system power off and clear test input data.

C. Return aircraft to required configuration.

WJE 405, 409, 410, 881, 883, 884, 892

D. Verify installation by complete System Test. (OMEGA/VLF NAVIGATION SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-55-00/201 Config 1)

GLOBAL NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The global navigation system (GNS) uses navigation satellites to supply accurate aircraft position information to aircraft systems and flight crew. The GNS is able to calculate:

- Latitude
- Longitude
- Altitude
- True track angle
- UTC time
- Groundspeed

B. There are two GNS antennas and two global navigation system sensor units (GNSSUs). The GNS-1 antenna receives satellite signals and sends them to the GNSSU-1. The GNS-2 antenna receives satellite signals and sends them to the GNSSU-2. (Figure 1)

C. The GNS related components are as follows:

- Two GNS antennas
- Two global navigation system sensor units (GNSSUs).

2. Global Navigation System Antenna

A. The GNS antennas are located on the upper forward fuselage in close proximity to the GNSSUs to reduce RF signal loss. The GNS antennas receive L-band frequency signals and send them to the GNSSUs.

3. Global Navigation System Sensor Unit

A. The GNSSUs are located in the forward cargo compartment left hand tunnel, under the floor.

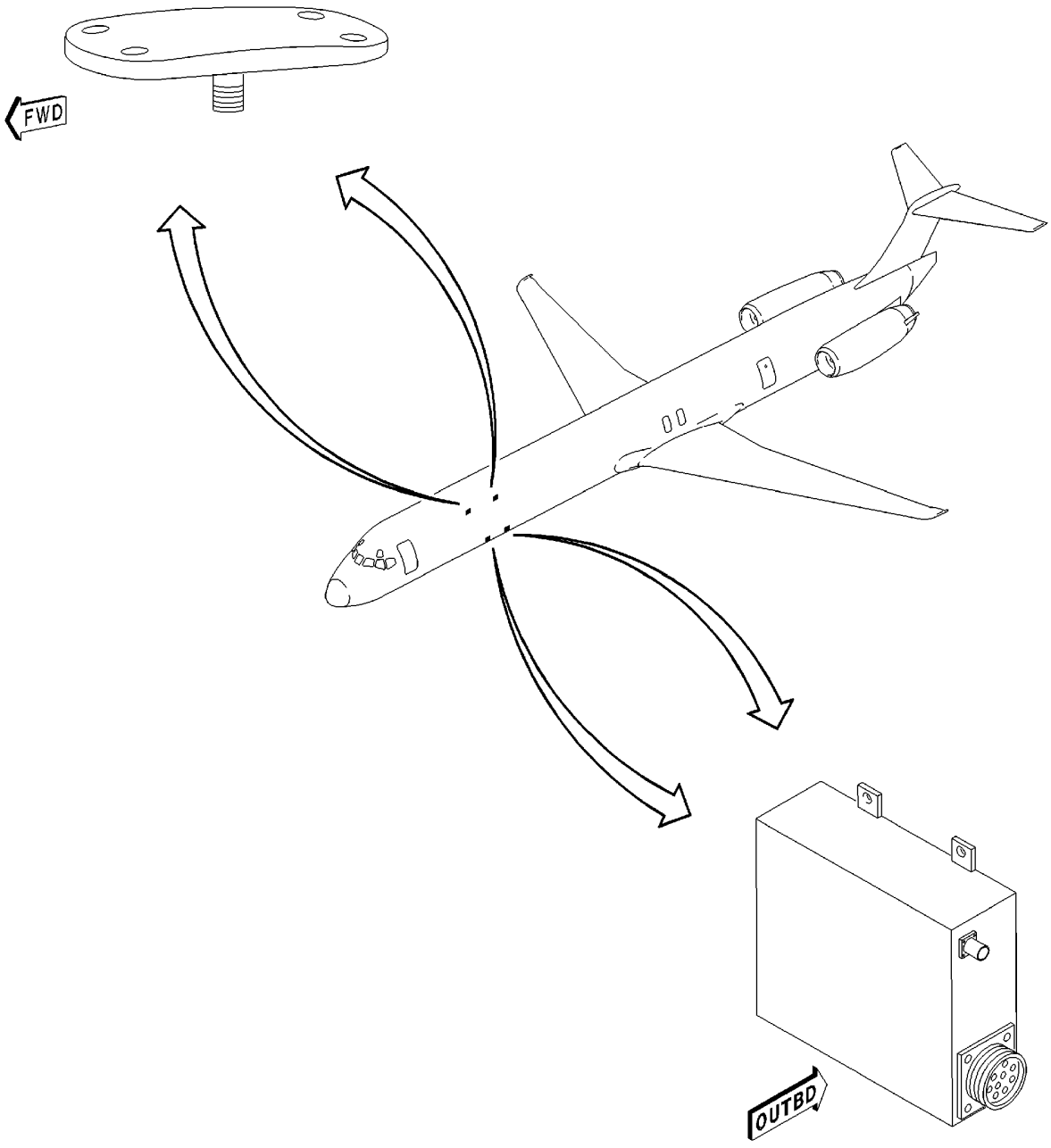
B. The GNSSU is a twelve channel GNS receiver that receives L1 transmissions from the NAVSTAR GPS satellite constellation. The primary function of the GNSSU is to receive the satellite RF signals from the GNS antenna, find the signal code phase and carrier phase and by using these signals, compute the antenna position and then output data to aircraft systems. The output data includes three dimensional aircraft position and velocities, satellite positions, pseudo ranges and delta ranges.

C. The GNSSUs receive navigation satellite signals to calculate GNS data. The GNSSU is an L-band receiver, each sensor unit has its own circuit breaker and uses 28 VDC for operation.

D. The GNSSUs interface with these devices or systems:

- Global Navigation System (GNS) Antenna
- Global Positioning System (GPS) satellite constellation
- Flight Management Computers (FMCs)

E. The GNS system gives an accurate position of the aircraft. This helps check the accuracy of the other systems that give a position of the aircraft. The other systems that give a position of the aircraft are the Attitude Heading Reference System (AHRS) or directional gyros in older aircraft.



Global Navigation System
Figure 1/34-58-00-990-806

GLOBAL NAVIGATION SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Global Navigation System (GNS) in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic, quick isolation and correction of the problem can be accomplished.

D. The basic components of the GNS operation are: two GNS antennas and two global navigation system sensor units (GNSSUs).

NOTE: The GNS interfaces with Global Positioning System (GPS) Antenna, Global Positioning System (GPS) satellite constellation, and Flight Management Computers (FMCs).

E. The GNS components are located as follows:

Table 101

Component	LOCATION
Global Navigation System Sensor Units (GNSSUs)	Forward Cargo Compartment
Global Navigation System Antennas	Upper Forward Fuselage

2. Equipment and Materials

NOTE: Equivalent substitute may be used instead of following listed item.

Table 102

Name and Number	Manufacturer
Multimeter	

3. Procedure - Global Navigation Trouble Shooting

A. Do trouble shooting of global navigation system (GNS) as follows:

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are GNS global navigation system sensor units (GNSSUs) and GNS antennas.

Table 103

STEP	ISOLATION PROCEDURE	CORRECTIVE ACTION
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of aircraft wiring. A hot continuity check may be required to check operation of relays or other associated actuation components.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in aircraft wiring.
(4)	Interchange LRUs to establish isolation of faulty LRUs.	Replace faulty LRUs.

Table 103 (Continued)

STEP	ISOLATION PROCEDURE	CORRECTIVE ACTION
(5)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

UNIT, GLOBAL NAVIGATION SATELLITE SENSOR - REMOVAL/INSTALLATION

1. General

A. This procedure has the removal and installation instructions for the global navigation satellite sensor units (GNSSUs).

B. The GNSSUs are accessed through the forward cargo compartment. Both units are mounted to a bracket that is attached to the fuselage structure GNSSU-1 at (station 427.000) and GNSSU-2 at (station 408.000).

C. The two GNSSUs are interchangeable. Other than component location the procedures are the same for both GNSSUs.

2. Equipment and Materials

NOTE: Equivalent substitute may be used instead of the following listed item.

Table 401

Name and Number	Manufacturer
Dust caps MS90376	

3. Global Navigation Satellite Sensor Unit Removal/Installation

A. GNSSU Removal

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

(2) Open access door to forward cargo compartment.

(3) Remove applicable sensor unit as follows: (Figure 401)

(a) Disconnect electrical connector and antenna connector.

(b) Put protective dust caps on connectors and on sensor unit receptacles.

(c) Remove screws and washers that attach sensor unit to bracket assembly. Remove sensor unit.

B. GNSSU Installation

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

(2) Make sure that access panel in forward cargo compartment is open.

(3) Install applicable sensor unit as follows: (Figure 401)

(a) Place sensor unit on WSP0649-509 panel.

(b) Install screws and washers.

(c) Remove dust caps on connectors and on sensor unit receptacles.

(d) Inspect connectors for bent or broken pins, dirt, and damage.

(e) Connect cable to electrical connector on sensor unit.

(f) Connect cable to antenna connector on sensor unit.

(4) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

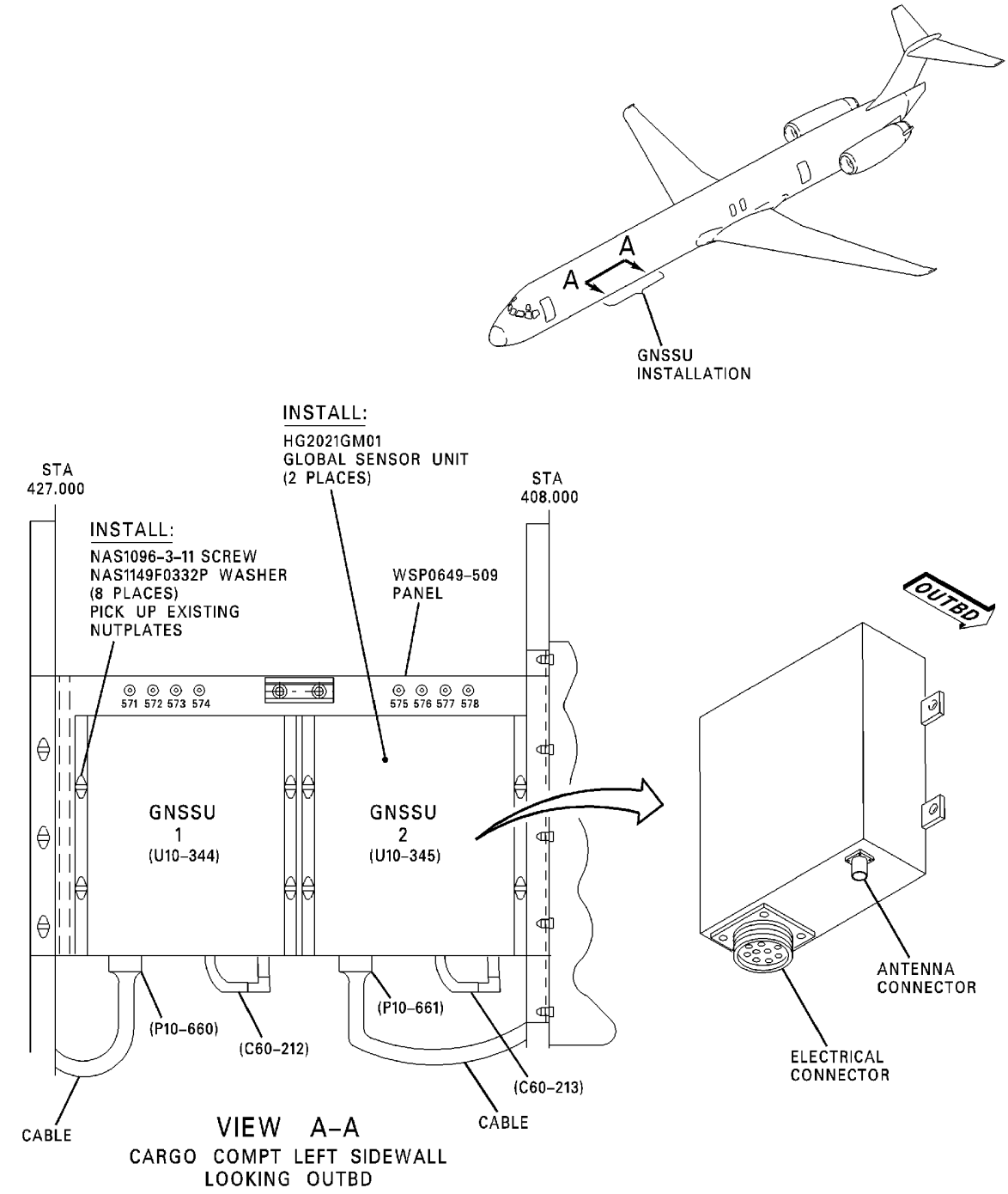
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

C. Do an operational test of the Flight Management System. (FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-00/201 Config 6)

D. Remove all tools and equipment from work area. Make sure area is clean.

E. Close access panel in forward cargo compartment.



CAG(IGDS)

BBB2-34-2149

GNSSU -- Removal/Installation
Figure 401/34-58-01-990-801

ANTENNA, GLOBAL NAVIGATION SYSTEM - REMOVAL/INSTALLATION

1. General

A. This procedure has the removal and installation instructions for the global navigation system (GNS) antenna.

B. There are two antennas, both are located on the upper forward fuselage.

C. The two antennas are interchangeable. Other than component location the procedures that follow are the same for both antennas.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

NOTE: It is possible that some materials in the Equipment and Material chart cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

Table 401

Name and Number	Manufacturer
Dust caps MS90376	
Scraper, nonmetallic	
Torque wrench , 0-50 in-lb (0-5.6 N·m)	
Solvent (1,1,1 Trichloroethane) MIL-T-81533 (DPM 5792)	
Sealant, aluminized polysulfide MC-632 (DMS QPL 1819)	
Sealant PS870 B2 (DPM 5896-2)	
Mold release, fluorocarbon MS-122N/CO_2 (DPM 3494)	
Cloth (low lint) MIL-C-85043 (Type II)	

3. Global Navigation System Antenna Removal/Installation

A. GNS Antenna Removal

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

(2) Remove global navigation system (GNS) antenna as follows: (Figure 401)

(a) Remove screws from GNS antenna.

(b) Carefully pull antenna minimal amount necessary to get access to coaxial connector.

NOTE: If necessary, use a nonmetallic scraper to break the seal around the antenna.

(c) Disconnect and put cap on coaxial cable connector.

(d) Remove antenna and o-ring.

NOTE: Make sure that the coaxial cable connector does not fall into the aircraft fuselage.

B. Global Navigation System Antenna Installation

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

(2) Remove dust cap. Examine GNS antenna coaxial cable for loose, dirty, or damaged connector. Repair all damage before antenna is installed. Make sure connector is clean and place dust cap back on connector.

WARNING: 1,1,1-TRICHLOROETHANE IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN 1,1,1-TRICHLOROETHANE IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET 1,1,1-TRICHLOROETHANE IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS MSDS FOR:

- MORE PRECAUTIONARY DATA.
- APPROVED SAFETY EQUIPMENT.
- EMERGENCY MEDICAL AID.
- TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(WARNING PRECEDES)

(3) Use clean low lint cloth moist with MIL-T-81533 solvent to clean antenna and faying surface on aircraft. Dry antenna and aircraft surface with clean cloth. This causes correct low-impedance radio frequency bond.

NOTE: If necessary, use a nonmetallic scraper to remove the unwanted sealant from the skin of the aircraft.

(4) Install global navigation system (GNS) antenna as follows: (Figure 401)

WARNING: FLUOROCARBON MOLD RELEASE IS AN AGENT THAT IS POISONOUS, AN ASPHYXIANT, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN FLUOROCARBON MOLD RELEASE IS USED.

- DO NOT USE IN AREAS WHERE THERE IS HIGH HEAT, SPARKS, OR FLAMES.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET FLUOROCARBON MOLD RELEASE IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS MSDS FOR:

- MORE PRECAUTIONARY DATA.
- APPROVED SAFETY EQUIPMENT.
- EMERGENCY MEDICAL AID.
- TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(a) Make sure there is dust cap on coaxial cable connector. Apply two coats of MS-122 fluorocarbon mold release to antenna surface. Stop for 15 minutes to permit first coat of mold release to dry. Apply second coat. Stop for 15 minutes to permit second coat of mold release to dry.

(b) Make sure that o-ring is correctly installed in groove around base of antenna.

NOTE: A new o-ring is supplied with the new antenna.

(c) Remove dust cap and install coaxial cable connector on antenna.

WARNING: FAYING SURFACE SEALANT IS AN AGENT THAT IS FLAMMABLE, POISONOUS, AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY THE PRECAUTIONS WHEN FAYING SURFACE SEALANT IS USED.

- GAS/AIR MIXTURES MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET FAYING SURFACE SEALANT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

(WARNING PRECEDES)

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS MSDS FOR:

- MORE PRECAUTIONARY DATA.
- APPROVED SAFETY EQUIPMENT.
- EMERGENCY MEDICAL AID.
- TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(d) Apply PS870 sealant to antenna and aircraft surface where antenna is installed.

(e) Remove protective cap from coaxial cable connector.

(f) Connect coaxial cable connector to antenna.

(g) Put antenna in position. Install screws. Use small quantity of PS870 sealant below head of each screw.

(h) Tighten screws by hand.

(i) After 10 minutes torque antenna screws to 25(±2) in-lb.

(j) Remove excess sealant from around antenna base.

WARNING: LOW VISCOSITY POLYSULFIDE SEALANT IS AN AGENT THAT IS POISONOUS AND AN IRRITANT. MAKE SURE ALL PERSONS OBEY ALL OF THE PRECAUTIONS WHEN LOW VISCOSITY POLYSULFIDE SEALANT IS USED.

- GAS/AIR MIXTURE MORE THAN THE LOWER EXPLOSIVE LIMIT (LEL) CAN CAUSE AN EXPLOSION IF HIGH HEAT, SPARKS, OR FLAMES SUPPLY IGNITION.
- USE IN AN AREA OPEN TO THE AIR.
- CLOSE THE CONTAINER WHEN NOT USED.
- DO NOT GET LOW VISCOSITY POLYSULFIDE SEALANT IN THE EYES, ON THE SKIN, OR ON YOUR CLOTHES.
- DO NOT BREATHE THE GAS.

WARNING: REFER TO THE APPLICABLE MANUFACTURER'S OR SUPPLIERS MSDS FOR:

- MORE PRECAUTIONARY DATA.
- APPROVED SAFETY EQUIPMENT.
- EMERGENCY MEDICAL AID.
- TALK WITH THE LOCAL SAFETY DEPARTMENT OR AUTHORITIES FOR THE PROCEDURES TO DISCARD THIS HAZARDOUS AGENT.

(k) Apply bead of MC-632 aluminized sealant around antenna outer edge to create aerodynamic fillet seal between antenna and aircraft skin. Cover all of unpainted area.

(l) Apply small quantity of sealant over mount screws and smooth in relation to antenna surface.

C. Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO DC BUS

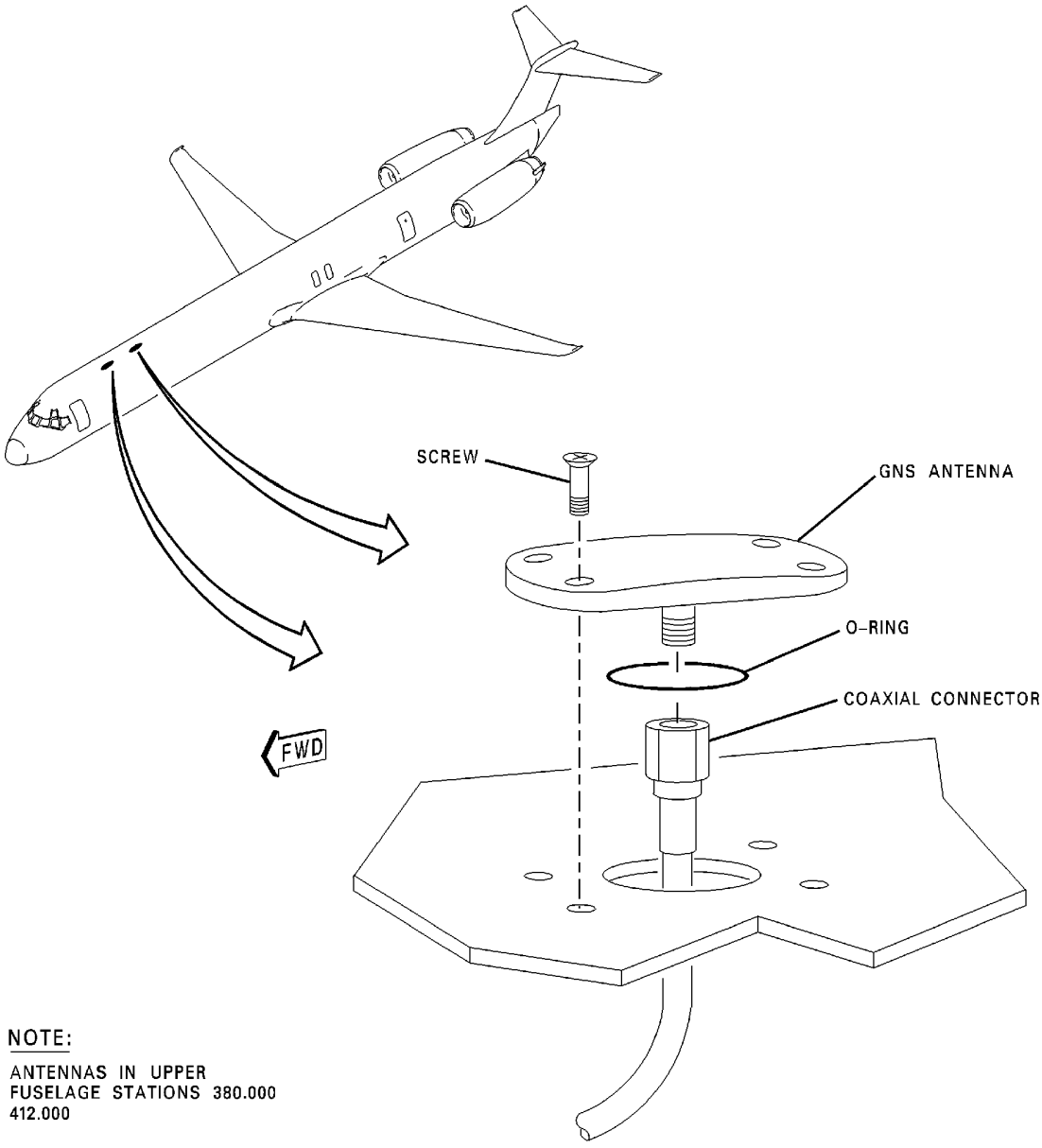
Row	Col	Number	Name
E	14	B10-496	GLOBAL POSITION SYSTEM 1

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
E	4	B10-497	GLOBAL POSITION SYSTEM 2

D. Do FMS system Maintenance Practices. (FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-00/201 Config 6)

E. Remove all tools and equipment from work area. Make sure area is clean.



GNS Antenna -- Removal/Installation
Figure 401/34-58-02-990-801

EFFECTIVITY
WJE 405-411, 880, 881, 883, 884 POST MD80-34-285

WJE

ANTENNA, GLOBAL POSITIONING SYSTEM (GPS) REMOVAL/INSTALLATION

WJE

1. General

WJE A. This procedure has the removal and installation instructions for the Global Positioning System (GPS) antenna.

WJE B. There is one GPS antenna installed on the forward upper fuselage.

WJE C. The receiver for the GPS is part of the Enhanced Ground Proximity Warning System (EGPWS) computer. (GROUND PROXIMITY WARNING SYSTEM, SUBJECT 34-45-00)

WJE

2. Equipment and Material

WJE NOTE: Equivalent substitutes may be used instead of the following listed items:

WJE NOTE: It is possible that some materials in the Equipment and Materials List cannot be used for some or all of their necessary applications. Before you use the materials, make sure the types, quantities, and applications of the materials necessary are legally permitted in your location. All persons must obey all applicable federal, state, local, and provincial laws and regulations when it is necessary to work with these materials.

WJE

Table 401

WJE

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	
Platform, High Maintenance 15-30 ft. (4.57-9.14m)	
Plastic Scraper DPM 6587	Commercial available.
Tape, Masking, Pressure Sensitive	Commercial available.

WJE

3. Removal/Installation - EGPWS Global Positioning System (GPS) Antenna

WJE A. Remove EGPWS GPS Antenna

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Open this circuit breaker and install safety tag:

WJE

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE (2) Position a maintenance platform near the forward upper fuselage.

WJE **CAUTION:** MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

WJE **CAUTION:** DO NOT USE METAL TOOLS TO REMOVE THE SEALANT. AN APPROVED TOOL WILL PREVENT DAMAGE TO THE SKIN OF THE AIRCRAFT.

WJE (3) Carefully cut sealant around the outer edge of antenna with an approved plastic scrapper.

WJE (4) Remove the four screws from the antenna.

WJE (5) Disconnect coaxial connector and install dust caps.

WJE (6) Attach the coaxial connector to the fuselage using masking tape.

WJE NOTE: Due to the difficulty of retrieval, ensure coax cable does not fall completely inside fuselage.

WJE (7) Remove the antenna.

WJE B. Install EGPWS GPS Antenna

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (1) Make sure that this circuit breaker is open and has safety tag:

WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE (2) Position a maintenance platform near the forward upper fuselage.

WJE (3) Clean area between antenna and fuselage surface. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

WJE (4) Prepare the surface of the antenna for RF bond. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

WJE (5) Apply faying surface seal to the base of the antenna. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

WJE (6) Install antenna as follows:

WJE (a) Install new O-ring (part number MS28775-142) in antenna base groove.

WJE (b) Remove dust cap and check for damage and unwanted material.

WJE 1) Connect coaxial cable connector to antenna.

WJE (c) Place antenna in mounting position and install screws.

WJE 1) Torque the attachment screws to 25 ±2 in-lb (3 ±0 N·m).

WJE 2) Torque the attachment screws again 10 minutes after the initial torque.

WJE (7) Remove excess sealant squeeze out. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

WJE (8) Do the RF bonding check of the antenna. (ELECTRICAL BONDING - MAINTENANCE PRACTICES, SWPM 20-50-01)

WJE (9) Apply periphery (fillet) seal around antenna edge at fuselage skin. (COMMUNICATION / NAVIGATION ANTENNAS SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 20-50-10/201)

WJE **WARNING:** TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE
WJE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO
WJE PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

WJE (10) Remove the safety tag and close this circuit breaker:

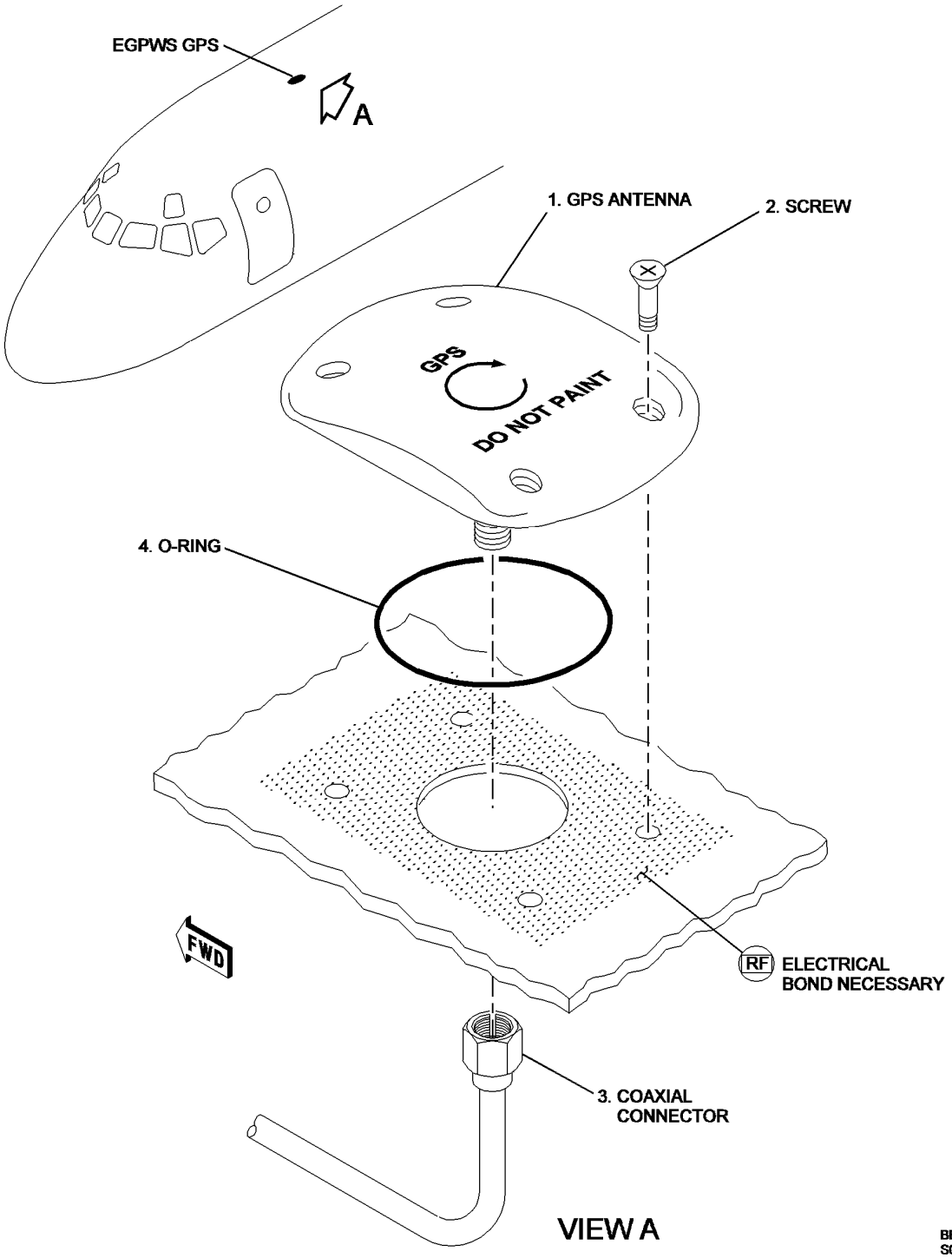
WJE
WJE **UPPER EPC, LEFT RADIO AC BUS**

Row	Col	Number	Name
F	20	B10-302	GROUND PROXIMITY WARNING COMPUTER

WJE (11) Do the Enhanced Ground Proximity Warning Test and Self-Test Level 2: Current Faults test.

WJE (12) Remove all tools and equipment from work area. Make sure area is clean.

WJE



WJE
WJE

EGPWS Global Positioning System Antenna - Removal/Installation
Figure 401/34-58-02-990-804

EFFECTIVITY
WJE 412, 414

PERFORMANCE MANAGEMENT SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Performance Management System (PMS) operates as a fully integrated selectable mode of the digital flight guidance system. PMS provides automatic control and coordination of pitch and thrust during climb, cruise, and descent phases of flight, and also provides an advisory display of numerous flight parameters, on a full time real time basis.

B. PMS consists of a Performance Management Control Display Unit (CDU), Performance Management Computer Unit (PCU), CDU MESSAGE annunciator, and VERTICAL ALERT annunciator.

C. The CDU is located in the pedestal, and provides the flight crew with the selectable controls and displays necessary for the operation of the PMS.

D. The PCU is located in the electrical/electronics (E/E) compartment. The PCU makes all performance computations and provides this information to the CDU for message and data displays, and to the DFGC's for flight guidance interface.

E. The PMS annunciators, CDU MESSAGE and VERTICAL ALERT, are located on the Captain's and First Officer's instrument panels. The annunciators, respectively, advise the flight crew that a message is being displayed in the CDU or that a vertical path change is imminent.

2. Description

A. Control Display Unit (CDU)

(1) The Performance Management Control Display Unit (CDU) provides the flight crew with the necessary control function and displays for operation of the PMS. (Figure 1)

(2) CDU display, controls, and indicators include the following:

(a) Data Display

(b) Function Keys

(c) Data Entry Keys

(d) Mode Annunciators

(e) Warning Annunciator

(f) Line Select Keys

(g) Slew Switch

NOTE: On some aircraft the slew switch is called slew keys.

(h) Dim Control

(i) Ambient Light Sensor.

(3) Data Display

(a) Data display is a 4 line x 24 character display, with each character formatted within a 5 x 7 LED dot matrix.

1) The top line of the display is a combination title page and scratch pad. The remaining three lines are used for data entry and display, or in conjunction with the line select keys for the call-up of sub-pages.

2) The top line first twelve characters are used to relate the display page to the function key calling up that page.

3) Top line characters 13 through 24 are used as a combination display, alert/advisory message, and scratch pad area.

(4) Function Keys

(a) The following function keys are provided:

1) PLAN (Planning)
2) CLB (Climb)
3) CRZ (Cruise)
4) DES (Descent)
5) VERT WPTS (Vertical Waypoints)
6) CLEAR
7) STS/TEST (Status/Test)

(b) PLAN key calls up data pages relevant to preflight and enroute planning.

(c) CLB, CRZ, and DES keys allow selection of their respective flight mode display pages and permits display of performance and related data associated with the respective modes.

(d) VERT WPTS key provides for display of data related to vertical waypoints (top of climb, top of descent, etc.).

(e) CLEAR key is used to clear data loaded into the scratch pad; clear alert/advisory messages; and in conjunction with the slash key (/) and/or a line select key, to clear previously entered data from a data line.

(f) STS/TEST key functions as a combination lamp test command and status display select key.

(5) Data Entry Keys

(a) Data entry keys are used to load data into the scratch pad area of the data display.

1) Data entry keys include numeric keys 0-9 (eight of which are dual function), a decimal point (.), slash (/), and an alternate function key.

a) The alternate function key is used to select the alternate character of the next data key pressed.

(6) Mode Annunciators

(a) Mode annunciators, labeled CLB, CRZ, and DES, are white in color and come on to indicate the current mode of PMS operation.

1) The annunciated mode is not necessarily related to the display mode selected.

(7) The warning annunciator labeled PMS is amber in color and comes on to indicate PMS failure.

(8) Line select keys are used to transfer data entries from the scratch pad to a data line in the display, arm and/or select PMS submodes, and call up additional data relevant to a specific line in the display.

(9) In cases where multiple display pages are available under the same title, operation of the slew keys (up or down arrow) displays those pages.

(a) A cue symbol consisting of an arrow, pointing up or down or both, appears in the last two characters of the scratch pad to indicate which slew key to operate, to obtain display of the additional pages.

(10) The dimming control knob is used to adjust the brightness of the LED display, line select keys, and the mode annunciators about a brightness reference level.

(11) A built-in light sensor senses the ambient light level and together with its associated circuitry adjusts the brightness reference level.

B. Performance Management Computer Unit (PCU)

(1) The PCU is contained in a 1/2 ATR long package and features a magnetic bubble memory. The PCU is programmed to compute a cost efficient flight path profile while considering fuel and time costs, airplane performance, and flight crew inputs. It also processes data for input to the DFGC's and for display on the CDU.

(2) Inherent in the computer program are engine limits and airplane maximum/minimum speeds. Based upon the programmed limits, the PCU provides automatic protection against overboost, overspeed, and minimum speed.

(3) Included in the computer program are data input reasonableness tests and an automatic longitudinal speed restriction of 250 Kts. at altitudes below 10,000 feet.

(a) Reasonableness tests applied to input data include the following:

1) Comparison of entered gross weight (GWT) to airplane maximum and minimum limits.

2) Comparison of entered fuel to maximum limit and GWT minus zero fuel.

3) Comparison of computed bottom of descent (BOD) GWT and maximum GWT for landing.

4) Computed BOD fuel less than 2000 lb.

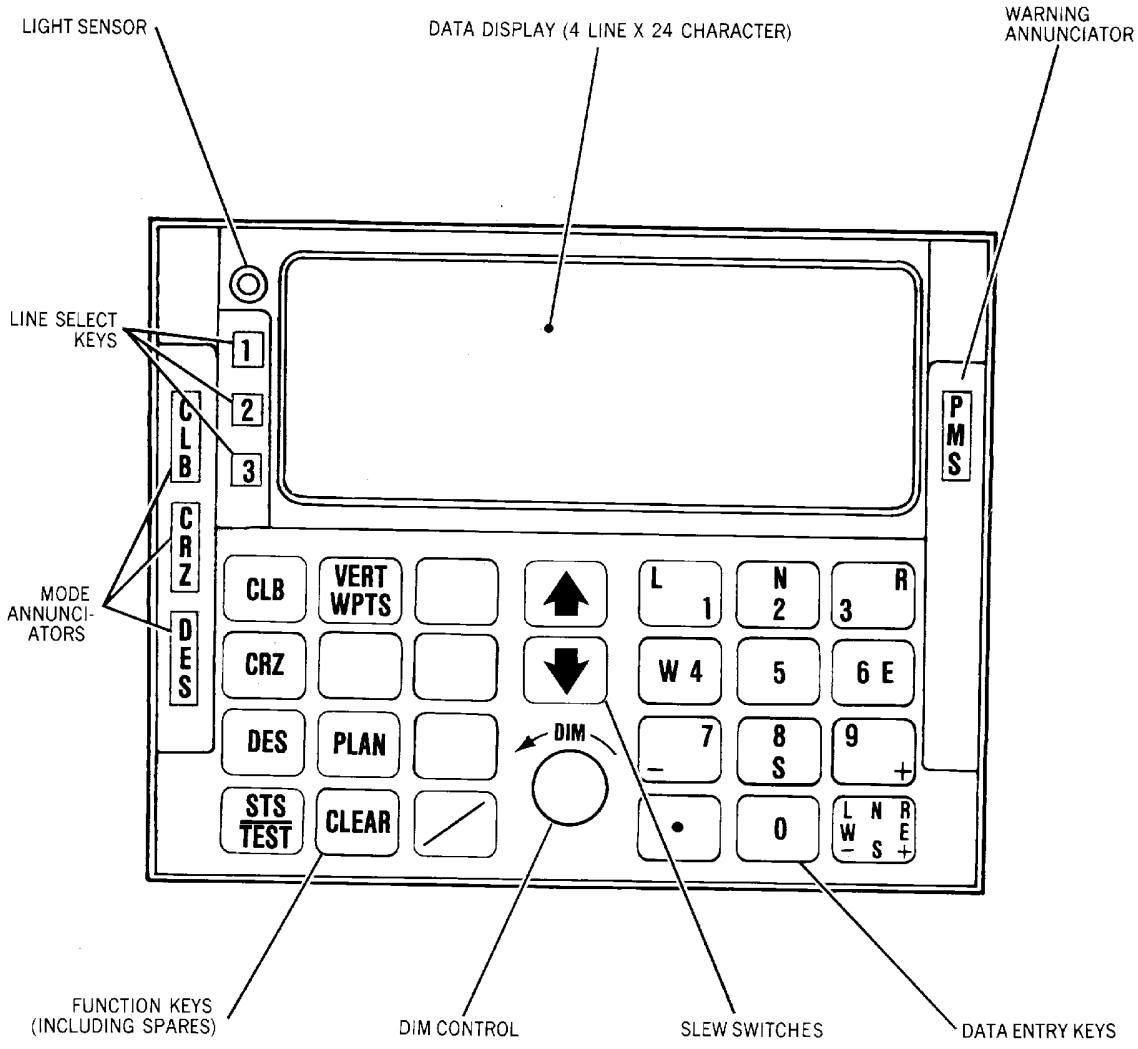
(b) The 250 kt longitudinal speed restriction can be overridden by use of the CLEAR key and Line Select Key 1.

C. PMS Annunciators

(1) The PMS annunciators (CDU MESSAGE and VERTICAL ALERT) advise the flight crew of messages that are being displayed in the CDU and of an impending vertical event.

(a) The CDU MESSAGE annunciator, which is white in color, comes on to advise the crew that a message is being displayed in the scratch pad of the CDU. The annunciator goes off when the message is cleared.

(b) The VERTICAL ALERT annunciator, which is amber in color, comes on when a vertical path change is to take place within 15 seconds. The annunciator goes off at the path change.



BBB2-34-1043

CDU Front Panel
Figure 1/34-63-00-990-860

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 886, 887, 891-893

3. Operation

A. Data inputs required for PMS operation are received from three primary sources.

(1) Preprogrammed data of airplane performance characteristics, cost index, and engine and airplane speed limits.

(2) Continuous inputs from VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, R/H & L/H engine fuel flow indicators, digital flight guidance computers 1 & 2, and the landing gear control relay.

(3) Manual data entered through the control display unit.

B. PLAN mode is used for entry of preflight data. This mode can be selected manually by operation of the PLAN function key or by automatic selection following a flight. Automatic selection of PLAN takes place following a flight when the airplane is on the ground and both engines are shut down. Selection of PLAN always results in the display of PLAN Page 1.

(1) Data to be entered on PLAN page 1 includes airplane Gross Weight (GWT), fuel weight, and the distance to the Bottom of Descent (BOD). Based upon these entries, the PMS computes and displays an estimate of GWT at BOD and fuel remaining at BOD.

(a) The entry of all PLAN Page 1 data is prerequisite to system engagement.

(b) The CDU scratch pad displays up and down arrows, with "up" arrow flashing as a cue to slew to PLAN Page 2 for further data entry.

(2) Planning data entires are accomplished by loading the desired data into the scratch pad using the data entry keys, then entering the data into the display field by operation of the appropriate line select key.

(a) The use of the slash key (/) may be required if the data line contains more than one parameter.

(3) Data entries on PLAN Pages are subjected to reasonableness tests. (Table 1) In the event that an entry fails to pass the tests, the CDU MESSAGE annunciator comes on and an alert message appears in the scratch pad. The message remains until a new entry has been made, or the message has been cleared.

(4) PLAN Page 2, cruise planning, is obtained from PLAN Page 1 by operation of the slew switch. This page provides for the entry of planned cruising altitude(s), the net trip wind component of the planned cruise altitude(s), and the temperature of the initial cruise altitude.

(a) Data entries are accomplished by the same method as for PLAN Page 1.

(b) Entries on Page 2 revise BOD estimates displayed by PLAN Page 1.

(c) Altitudes are loaded in flight level format separated by a / as necessary.

(d) Entry of the initial cruise altitude is a prerequisite to the entry of wind and temperature data.

(e) Zero wind is the default value if no wind is loaded, and head wind is loaded as a minus value.

(f) The temperature loaded is the temperature of the initial cruise altitude. Temperature is loaded as actual static air temperature (SAT) or deviation from the international standard atmosphere (ISA). The entry of either SAT or deviation from ISA results in the computation of the value not entered and the display of both values. Computation of the temperature for succeeding cruise altitudes is based upon the entered temperature for the initial cruise altitude and application of the standard lapse rate.

Table 1 PMS Reasonableness Limits

Parameter	Maximum Value	Minimum Value
Entered GWT	150 KLB	100 KLB
Entered Fuel	40 KLB	10 KLB
Computed BOD GWT	133 KLB	0
Computed BOD Fuel	0 -	5 KLB
Entered Landing Elevation	15000 FT	
Entered Wind Speeds	250 KT	
Altitude	42000 FT	
Entered Temperatures	STD + 40°C	STD - 40°C
	(or ±40°C ISA deviation)	
Entered Trip Distance	2600 NM	50 NM

C. The PMS mode of the digital flight guidance system (DFGS) is engaged by operation of the PERF pushbutton located on the flight guidance control panel. In order for a successful system engagement to take place, the following conditions must be met: Flaps less than 26 degrees; Thrust Rating Indicator (TRI) in CLB, CRZ, or MCT; flight director on or autopilot engaged; autothrottles engaged; PMS valid; and flight plan loaded.

(1) At the time that the PERF mode of the DFGS is selected, the PMS automatically enters the appropriate mode of operation, CLB, CRZ, or DES. (Table 2)

Table 2 PERF Mode Entry at PMS Engagement

CURRENT ALTITUDE CURRENT VERTICAL SPEED (SEE NOTE 1)	MORE THAN 512 FT BELOW SELECTED ALTITUDE	WITHIN +/- 512 FT OF SELECTED ALTITUDE	MORE THAN 512 FT ABOVE SELECTED ALTITUDE
CLB greater than 240 fpm	CLB to selected altitude	CRZ at selected altitude	See NOTE 2
Between +/-240 fpm	CLB to selected altitude	CRZ at selected altitude	CRZ at current altitude
DES greater than 240 fpm	See NOTE 3	CRZ at selected altitude	DES to selected altitude (See NOTE 4)

NOTE: 1. Change from one state to another requires new state to exist for 1.2 seconds.
2. PMS computes altitude 30 seconds ahead at current climb rate; captures that altitude.
3. Level off and climb to altitude that existed at time of PERF selection.
4. PERF inhibited unless projected BOD miss distance less than or equal to 5 NM.

D. The only CLB mode available is the OPT mode (optimum output of the performance optimization algorithm).

(1) The format for the CLB display is as follows:

Table 3

Top Line	Title	
Data Line 1	Target Longitudinal Speed	Target EPR
Data Line 2	Target Vertical Speed	TRI Mode Computed EPR Limit

Table 3 (Continued)

Data Line 3	Next Vertical Event (NVE) (SPD change, ARMed ALT, TOC, STEP)	Distance and Time to NVE

(a) Below an altitude (ALT) of 10,000 feet, the target longitudinal speed (SPD) is 250 Kts. (displayed in brackets). The NVE displays (data line 3) indicate a SPD change at 10,000 feet, to the optimum speed. This reflects ATC restrictions and can be overridden by entering "CLEAR" into data line 1.

(b) Longitudinal speed is normally displayed as IAS below an altitude of 27,000 feet and as MACH at and above 27,000 feet.

E. CRZ is automatically selected whenever a transition is made from climb or descent to cruise, or can be selected through automatic system moding at PMS engagement. The display page corresponds with the entered mode. Operation of the CRZ key during climb or descent results in the display of the armed or default CRZ mode. Operation of the CRZ key while in cruise displays the current CRZ mode operation.

(1) Two cruise modes are provided. These modes are OPT (cost factor optimized longitudinal speed) and NON OPT (pilot defined speed).

(a) OPT display is available by operation of the CRZ key, if NON OPT has not been armed; or by operation of the CRZ key and slew switch, if NON OPT has been armed.

(b) NON OPT display is available by editing longitudinal speed (SPD) on the OPT page.

(2) OPT is the default mode of operation and is automatically selected for cruise, whenever a transition is made from climb or descent to the planned cruise altitude.

(3) NON OPT mode is obtained through a flight crew edit of SPD on the OPT page or through automatic system moding whenever a transition is made from climb or descent to cruise at an altitude other than the planned cruise altitude (existing climb or descent airspeed at time of transition will be maintained).

(4) NON OPT mode can be armed prior to PMS engagement or while in CLB by following the same procedures as those employed for a specific mode engagement during CRZ operation.

(5) The basic cruise display is as follows:

Table 4

Top Line	Title	
Data Line 1	Target Longitudinal Speed	Flight Level Target EPR
Data Line 2		TRI Mode Computed EPR Limit
Data Line 3	Next Vertical Event (NVE)	Distance and Time to NVE

(a) NVE data, displayed on data line 3, is for either a STEP climb to a new flight level or for the Top of Descent (TOD). In the event that the NVE is TOD, data line 3 displays the predicted fuel remaining at TOD.

F. Two basic DES modes are available for display or selection, either by operation of the DES Function Key or through automatic system moding at PMS engagement. These modes are OPT (cost factor optimized speed to a bottom of descent point) and NON OPT (pilot specified speed to a bottom of descent point).

(1) The basic display format is the same as that for CLB mode, except that TOD fuel weight replaces TOC flight level.

(2) OPT is the default mode of operation for all descents, unless manually changed by the flight crew.

G. The VERT WPTS fuction key provides for the display of those vertical waypoints (events) that will be experienced during the course of the flight. Those waypoints displayed include: present position (PPOS), start of STEP climb, speed changes, top of climb (TOC), top of descent (TOD), bottom of descent (BOD), and armed altitude (if different than planned cruise altitudes). These vertical waypoints (Vert. Wpts.) are displayed sequentially from top to bottom.

(1) The basic VERT WPTS display format is as follows:

Table 5

Top Line	TO			
Data Line 1	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.
Data Line 2	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.
Data Line 3	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.

(a) This format uses one data line per event, with the next event displayed in data line 1. As events occur, the data in line 1 is replaced by what was in line 2 and line 2 is replaced by the contents of line 3, etc. This same "scrolling" is obtained by operation of the slew switch, such that, depending on direction of operation, additional upcoming or past events can be viewed.

(b) The distance and time estimates are computed from present position and take into account the current and armed modes of operation.

(2) Operation of the line select key adjacent to a Vert. Wpt. calls up a waypoint data page (expanded BOD page is also available by slewing from the expanded PPOS page). The waypoint data page provides for entry of an expanded definition of the waypoint. This definition consists of a VOR (DME) frequency, bearing and distance to the VOR station, SPD at the waypoint, wind direction and velocity, and temperature. The expanded BOD page also displays, on the top line, an estimate of fuel remaining at BOD.

(a) Entry of the "expanded definition data" increases the precision of the time and distance estimates displayed in all modes of operation. The default displays for SPD, wind, and temperature at the waypoint are the PMS estimates, based on the available data.

(3) The expanded PPOS page is obtained by pressing the line select key adjacent to PPOS on the vertical waypoints page or slewing from the expanded BOD page. The expanded PPOS page displays current true airspeed, static air temperature, wind component, ground speed, track angle, heading, and drift angle.

(a) The expanded PPOS display can be frozen at any time by operation of line select key 1. The display will remain static until line select key 1 is operated a second time, or selection of another page and return to the expanded PPOS page.

H. The STS (status)/TEST key is a combination lamp test command and status display select key. When the key is pressed and held, it functions as a lamp/display test. All CDU annunciators and LED elements are illuminated. While the STS/TEST key is being held, all other keys/switches can be operated to generate specific characters, as verification of proper key/switch operation and CDU decoding. When the STS/TEST key is released, the STS menu page is displayed. The STS page is formatted as follows:

Table 6

Top Line	STS	Airplane Type, Model, and Configuration
Data Line 1	FAULT STATUS?	Cost Factor
Data Line 2		Program Part Number

Table 6 (Continued)

Data Line 3	TESTS?	

NOTE: Cost Factor will be displayed as a number between 0 (most fuel efficient) and 255 (least fuel efficient).

(1) The FAULT STATUS page is obtained by operation of line select key 1. This page provides a display of active, PMS and interfacing system, faults. The presence of an arrow in the top line of the display indicates that there are additional faults to be displayed. Display of the additional faults is accomplished through operation of the slew switch. In the event that there are no active faults, data line 1 displays "NO FAULTS". As faults are cleared or corrected, they are removed from the display.

(2) The TESTS menu display page is obtained through operation of line select key 3. This page allows selection of: return to service checks; a display of real time inputs to the PMS; and a flight fault review. TESTS display page format is as follows:

Table 7

Top Line	TESTS
Data Line 1	INPUT DATA?
Data Line 2	FAULT REVIEW?
Data Line 3	SERVICE TEST?

NOTE: Desired function is obtained by operation of the corresponding line select key.

(a) INPUT DATA pages display inputs to the PMS from interfacing airplane systems. They are intended primarily as a trouble shooting tool, but can be called up at any time. VOR, DME, and fuel flow inputs are displayed with the indication that the data is VALID or INVALID. DFGS have VALID, INVALID, and NOT SELECTED indications. Gear up/down and ice protection status is also displayed.

(b) The FLIGHT FAULT REVIEW page provides a display of all monitored faults for the 25 previous flights in which PMS faults occurred. Provisions are also made for clearing the fault memory. The FLIGHT FAULT REVIEW display page format is as follows:

Table 8

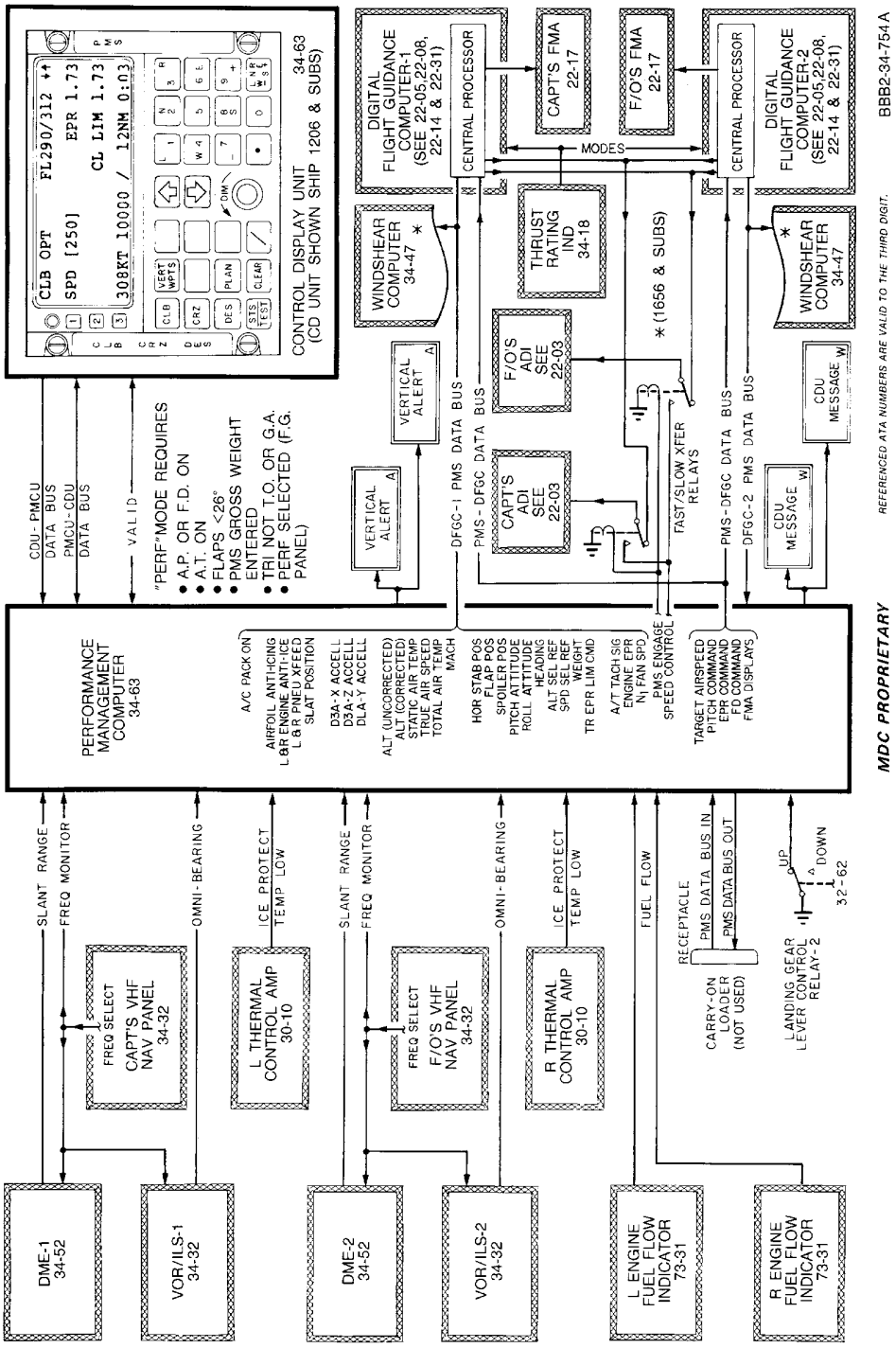
Top Line	FAULT REVIEW
Data Line 1	RECALL FAULTS?
Data Line 2	ERASE FAULTS?
Data Line 3	(Blanked)

1) A display of the faults of the previous 25 flights, in which PMS faults occurred, is obtained by operation of line select key 1. The display indicates the title of the page, the flight number, and the faults that occurred. The first display will be for the last flight where a PMS fault was detected. If no faults were detected during the first four flights, for example, but a fault was detected on the fifth flight, the top line would display FAULTS-FLT 5. Only flights where the PMS detected faults will be displayed so that a complete review might display flight 5, 43, 98, 160,...999. Should 999 flights be flown without removing a PCU or erasing the faults, any additional flights with PMS detected faults would be shown as flight 999. The slew switch is used to review the flights and faults.

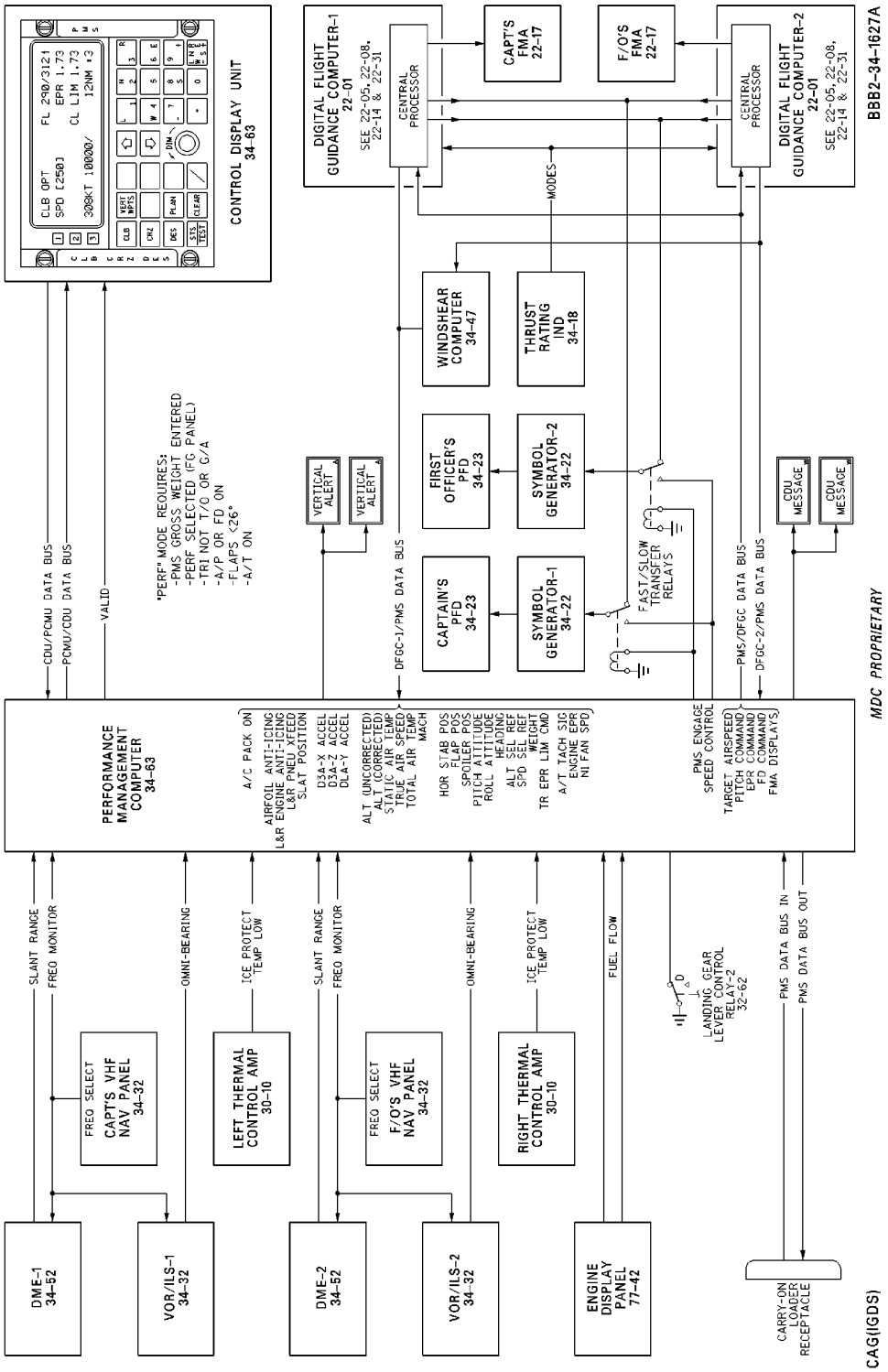
2) Line select key 2 is used to erase the fault memory. Operation of line select key 2 causes, "CONFIRM" to alternate flashing with "ERASE FAULTS" and line select key 2 to illuminate. A second operation of the key erases the memory and extinguishes the key. The ERASE FAULTS option is available only on the ground.

(c) SERVICE TEST is a ground test which verifies the interfaces of the PMS with other airplane systems. The test displays a series of pages, each of which requires a response by the operator. The response is verified by the operator by pressing a line select key. Failures are displayed at the end of the test.

1) The Service Test is initiated by pressing line select key 3 on the TESTS page. If no PMS detected faults are present, the Service Test is immediately displayed. If faults are present, the FAULT STATUS page is displayed. To enter the Service Test, the fault list must be slewed to the end. Following the last fault message, the message ENABLE SERVICE TEST? is displayed and the adjacent line select key comes on. Pressing the lighted line select key causes the Service Test to be displayed.



Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-861 (Sheet 1 of 2)



Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-861 (Sheet 2 of 2)

FLIGHT MANAGEMENT SYSTEM - DESCRIPTION AND OPERATION

1. General

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

A. The Flight Management System (FMS) provides the means for the Captain or First Officer to initiate airplane control in automatic navigation, lateral and vertical guidance commands, Electronic Flight Instrument System (EFIS) MAP OR PLAN display information and the most advantageous airplane flight performance.

B. The FMS is integrated with the Digital Flight Guidance System (DFGS) to provide the automatic pitch, roll and thrust during climb, cruise and descent airplane operations. The coordination of pitch, roll and thrust during lateral and vertical navigation effects efficient fuel consumption and cost efficiency within the limitations of the commanded flight plan, altitude clearance limits and airplane performance limits.

C. The FMS consists of two Multipurpose Control Display Units (MCDU) and an Advanced Flight Management Computer (AFMC). The MCDUs are located one each on the left and right sides of the forward pedestal in the flight compartment. The (AFMC) is located in the electrical/electronics (E/E) compartment on the aft left radio rack.

WJE 401-404, 412, 414

D. The Flight Management System (FMS) provides the means for the Captain or First Officer to initiate aircraft control in automatic navigation, lateral and vertical guidance commands, Electronic Flight Instrument System (EFIS) MAP OR PLAN display information and the most advantageous aircraft flight performance.

E. The FMS is integrated with the Digital Flight Guidance System (DFGS) to provide the automatic pitch, roll and thrust during climb, cruise and descent aircraft operations. The coordination of pitch, roll and thrust during lateral and vertical navigation effects efficient fuel consumption and cost efficiency within the limitations of the commanded flight plan, altitude clearance limits and airplane performance limits.

F. The FMS consists of two Multipurpose Control Display Units (MCDU), two Advanced Flight Management Computers (AFMC) and an FMS source select switch. The MCDUs are located one each on the left and right sides of the forward pedestal in the flight compartment. The AFMCs are located in the electrical/ electronics (E/E) compartment on the aft left and right radio racks. The FMS source select switch is located on the overhead, and allows either MCDU to operate from the cross-side AFMC in the event of an on-side failure.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

G. Navigation data (software) is usually loaded into the AFMC by a data loader every 28 days by the ground crew. The data loader provides for the down loading of a cartridge of updated navigation data as required by the operating airline. A data loader connector receptacle provides the necessary connection between the data loader and the AFMC. The data loader connector receptacle is located at the Captain's briefcase holder area. The data loader is not a part of the aircraft equipment.

2. Description

A. The FMS utilizes data from aircraft systems to accomplish the functions of airplane control in automatic navigation, lateral and vertical guidance commands, EFIS MAP OR PLAN display and the most optimum flight performance. (Figure 1)

WJE 401-404, 412, 414

B. Navigation aids (NAVAIDS), distance measuring equipment (DME), very high frequency (VHF) omni range (VOR) and instrument landing system data are supplied to the AFMC for FMS inflight. The NAVAIDS are initiated through frequency tuning at the CAPT/FO VHF/NAV control panel or the AFMC has the capability of DME autotuning, activated by the AFMC navigation data base (NDB). The central air data computers supply pressure altitude, Mach, calibrated air speed (CAS) and true air speed (TAS) to the AFMC for vertical guidance and speed control through autothrottle operation. The Inertial Reference System (IRS) provides attitude, heading, validity velocities, and acceleration data to the AFMC. This data is processed by the AFMC to provide navigation, guidance and performance functions by the FMS. The CAPTs electronic clock supplies current Greenwich Mean Time (GMT) to the AFMC for FMS navigation functions.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

C. Navigation aids (NAVAIDS), distance measuring equipment (DME), very high frequency (VHF) omni range (VOR) and instrument landing system data are supplied to the AFMC for FMS inflight. The NAVAIDS are initiated through frequency tuning at the CAPT/FO VHF/NAV control panel or the AFMC has the capability of DME autotuning, activated by the AFMC navigation data base (NDB). The central air data computers supply pressure altitude, Mach, calibrated air speed (CAS) and true air speed (TAS) to the AFMC for vertical guidance and speed control through autothrottle operation. The vertical and directional gyros (VG/DGs) or Inertial Reference Systems (IRS), if installed, provide attitude and heading data to the AFMC. This data is processed by the AFMC to provide navigation, guidance and performance functions by the FMS. The CAPTs electronic clock supplies current Greenwich Mean Time (GMT) to the AFMC for FMS navigation functions.

WJE 875-879

D. Navigation aids (NAVAIDS), distance measuring equipment (DME), very high frequency (VHF) omni range (VOR) and instrument landing system data are supplied to the AFMC for FMS inflight. The NAVAIDS are initiated through frequency tuning at the CAPT/FO VHF/NAV control panel or the AFMC has the capability of DME autotuning, activated by the AFMC navigation data base (NDB). The central air data computers supply pressure altitude, Mach, calibrated air speed (CAS) and true air speed (TAS) to the AFMC for vertical guidance and speed control through autothrottle operation. The Inertial Reference System (IRS) provides attitude and heading, validity velocities, and acceleration data to the AFMC. This data is processed by the AFMC to provide navigation, guidance and performance functions by the FMS. The CAPTs electronic clock supplies current Greenwich Mean Time (GMT) to the AFMC for FMS navigation functions.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

E. The engine displays provide fuel flow and engine pressure ratio data to the AFMC for FMS optimum aircraft performance functions.

F. The Electronic Flight Instrument System (EFIS) symbol generators receive navigation data from the AFMC and generates the symbology for the MAP or displays on the EFIS Navigation Display (ND).

G. The multipurpose control display unit is the interface between the AFMC and the CAPT/F/O. CAPT/F/O data entered into the MCDU is provided to the AFMC. The AFMC in turn supplies the necessary processed information to the MCDU for display on the MCDU. Refer to Paragraph 5. for MCDU alert messages.

WJE 401-404, 412, 414

H. The AFMC's are integrated with the Digital Flight Guidance Computers (DFGC) to process mode logic and selection data, thrust settings, EPR ratings, CADC data, attitude/heading, localizer data, flaps/slats and radio data for all navigation, guidance and performance functions and MCDU displays. The AFMC's process data from only one DFGC at a time. The DFGC data selected for processing depends on the status of the DFGS. In general the selection is based on the following criteria, given in the order of descending priority: autopilot engagement, autothrottle engagement, and flight director engagement.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

I. The AFMC is integrated with the Digital Flight Guidance Computer (DFGC) to process mode logic and selection data, thrust settings, EPR ratings, CADC data, attitude/heading, localizer data, flaps/slats and radio data for all navigation, guidance and performance functions and MCDU displays.

J. The FMS data loader receptacle provides the airplane connection between the data loader and the AFMC for loading the current airline navigation data into the AFMC.

WJE 401-404, 412, 414

K. The FMS data loader receptacle provides the airplane connection between the data loader and the AFMC for loading the current airline navigation data into the AFMC. Data from AFMC 1 is cross loaded to AFMC via the MCDU NAV DATA CROSSLOAD page.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

L. The proximity switch electronics unit provides a weight on wheels (WOW) discrete signal to the AFMC for airplane inflight or on ground determination.

M. The thermal control AMPs provide temperature information regarding the airfoil anti-ice system.

N. The ACARS (automatic communications addressing and reporting system) interface is a growth option for future integration with the AFMC.

O. MCDU - The MCDU is the interface unit between the Captain/First Officer and the AFMC. The MCDU provides the means for the Captain/First Officer to manually insert system control parameters and select modes of operation. The MCDU also provides AFMC readout capability as well as verification of data entered. Flight plan and advisory data are continuously available for display on the MCDU.

P. The MCDU consists of the following controls and indicators and their function. (Figure 2)

(1) Cathode Ray Tube (CRT) - AFMC generated data, command entries and performance data are displayed on the CRT. The bottom line of the CRT is the scratchpad. Typed alphanumeric characters and AFMC generated messages are displayed on this line.

(2) Line Select Keys (LSK) - The LSKs provide for entry of data from the scratchpad into selected line and field. When field is selectable, pressing key with scratchpad empty will enter content of that line and field into scratchpad. Also provides access to data or function identified by that field. There are six line select keys on each side of the CRT. The left side keys are identified as L1, L2, L3, L4, L5 and L6. The right side keys are identified as R1, R2, R3, R4, R5 and R6.

(3) Bright Adjust (BRT) provides control for increasing or decreasing brightness of CRT display.

(4) Annunciators

- MENU - Comes on whenever any non-active system has a request pending.
- MSG (Message) - Comes on when an AFMC generated message is displayed in the scratchpad.
- DSPY (Display) - Comes on when current display is not related to active flight plan leg or the current operational performance mode.

- OFST (Offset) - Comes on when a parallel offset is in use.

(5) CLR (Clear) - Single brief presses of the key will cause a message or the last character in the scratchpad to be erased. A longer press of key will erase entire contents of scratchpad.

(6) DEL (Delete) - Pressing the key inserts DELETE Into scratchpad. Line selection into a deletable field deletes data in the field.

(7) ALPHA KEYS - Pressing the key enters the selected alphabetic character into the scratchpad.

(8) NUMERIC KEYS - Pressing the key enters the selected number in scratchpad.

(9) FUNCTION AND MODE KEYS

- EXEC (Execute) - The EXEC key is the command key of the AFMC. The key activates changes to the active flight plan and/or to the vertical guidance mode. Such changes require a two step keyboard procedure: Entry and review of data and pressing the EXEC key to activate the change. The key contains a light bar that comes on whenever the displayed page contains data defining a modification. Pressing the key while the light bar is on results in the execution of the modification.
- NEXT PAGE - Pressing the key causes the MCDU to display the next page of a multiple page display.
- PREV PAGE (Previous Page) - Pressing the key causes the MCDU to display the previous page of a multiple page display.

WJE 401-404, 412, 414, 875-879

- INIT/REF (Initialization/Reference) - Provides access to pages of data required for initialization of the FMS and inertial reference system (IRS) for flight plus various categories of reference data.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

- INIT/REF (Initialization/Reference) - Provides access to pages of data required for initialization of the FMS, IRS (if installed), and various categories of reference data.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

- RTE (route) - Provides clearance language access to both routes entered.
- DIR/INTC (Direct/Intercept) - Provides for development of a guidance path to fly aircraft from present position direct to any designated geographic reference point (waypoint) or to intercept a designated course to a specified waypoint.
- HOLD - Provides for definition of a holding pattern at any designated waypoint or present position.
- LEGS - Provides detailed data concerning all legs of a flight plan. Allows for detailed data entry of each leg of flight plan.
- DEP/ARR (Departure/Arrival) - Provides for selection of departure and/or arrival procedures and runways.
- PROG (Progress) - Displays current dynamic flight information such as distance to go, fuel weight, wind, etc.
- FIX - Allows the creation of waypoint fixes from the intersection points between the present route and selected radials from known waypoints.
- CLB (Climb) - Pressing key will display current or planned climb mode. Evaluation and selection of other climb modes as the commanded climb mode can be made.
- CRZ (Cruise) - Pressing key will display current or planned cruise mode. Evaluation and selection of other cruise modes as the commanded cruise mode can be made.

- DES (Descent) - Pressing key will display current or planned descent mode. Evaluation and selection of other descent modes as the commanded descent mode can be made.
- MENU (MCDU Main Menu) - Provides a menu for selecting MCDU subsystems.

Q. AFMC - The AFMC receives and processes information from the following sources (Figure 3):

Table 1

SOURCE	DATA
WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872	
Compass and Attitude Reference Systems (VG/DG) or Inertial Reference System (IRS, if installed)	Attitude, Heading Attitude, Heading, Velocities, Accelerations
WJE 401-404, 412, 414, 875-879	
Inertial Reference System (IRS)	Attitude, Heading, Velocities, Accelerations
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879	
Air Data Computers (ADC)	Altitude, Mach, CAS, TAS
VHF Omnirange (VOR)	VOR Bearing, Frequency
Distance Measuring Equipment (DME)	Range, Frequency
Multipurpose Control Display Unit	Keyboard, Mode Key Data, Status
EFIS Symbol Generator	Display Data & Control (Navigation Display)
Digital Flight Guidance Computer	Mode Logic and Selection Data, Thrust Setting, EPR/N1 Ratings, ADC Data, Attitude/Heading Data, Localizer/Data, Flap/Slats Data
Electronic Clock	Greenwich Mean Time (GMT)
Fuel Flow (DC Signal)	Fuel Flow
Navigation Data Loader	Navigation Data

NOTE: The above AFMC processed data along with the Captain/First Officer entered data via the MCDU initiates the following functions:

- Navigation
- Performance
- Guidance
- AFMC Data Base
- EFIS Interface

R. A simplified description of the AFMC functions are as follows:

(1) Navigation Functions

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(a) Horizontal navigation programs combine data from the navigation data base (NDB), attitude and heading from VG/DG's or IRS, range and bearing from VOR/DME stations and altitude and true airspeed from central air data computer to generate aircraft position, velocity, track angle and wind vector data.

WJE 401-404, 412, 414, 875-879

(b) Horizontal navigation programs combine data from the navigation data base (NDB), attitude and heading from inertial reference system (IRS), range and bearing from VOR/DME stations and altitude and true airspeed from central air data computer to generate aircraft position, velocity, track angle and wind vector data.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(c) The twenty closest navaids within 200 nautical miles of the AFMC computed aircraft position are compiled from the navigation data base every two minutes. Navigation selects from this list a collated VOR/DME or two DME stations that will yield the most accurate estimate of the aircraft position.

(d) A terminal area position update function is available if the ILS frequency matches the frequency specified for the selected approach procedure or runway. The ILS LOC deviation updates position in a direction normal to the final approach path.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872

(e) VG (IRS, if installed) and CADC altitude processing filters the CAPT/F/O entered barometer correction to prevent undesirable vertical maneuvers which can result when baro correction is allowed to change suddenly.

WJE 401-404, 412, 414, 875-879

(f) IRS and CADC altitude processing filters the CAPT/F/O entered barometer correction to prevent undesirable vertical maneuvers which can result when baro correction is allowed to change suddenly.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879 POST MD80-34-293

(g) The Global Positioning System (GPS) and Satellite Communications System (SATCOM) can be connected and used by the AFMC.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(2) Performance Functions - The AFMC computes the aircraft most advantageous vertical profile as described in the following:

(a) Optimal Speed Computation - This computation relates to speed targets which result in the most advantageous aircraft performance. The available profile modes are: maximum angle of climb, engine-out climb, economy climb, economy cruise, long range cruise, engine-out cruise, engine-out driftdown, minimum drag holding and economy descent.

(b) Economy Climb Speed - The economy climb speed target is a constant calibrated air speed (CAS), constant Mach schedule to obtain the minimum airplane operating cost per mile traveled enroute.

(c) Maximum Angle Climb Speed - The maximum angle climb speed target is a variable CAS versus gross weight speed schedule stored in the AFMC data base.

(d) Engine-Out Climb Speed - The engine-out climb speed target is a CAS value that corresponds to maximum engine-out lift-over-drag (L/D) ratio.

(e) Economy Cruise Speed - The economy cruise speed target is a Mach value which results in minimum operating cost per mile traveled enroute at the specified altitude.

(f) Long Range Cruise (LRC) Speed - The LRC speed is a Mach target which is optimized to provide 99 percent of the airplanes maximum still air range at the specified cruise altitude. The speed gives the lowest cruise speed which can be flown.

(g) Engine-Out Cruise & Driftdown Speeds - The engine-out cruise speed targets are driftdown speeds and engine-out long range cruise. Driftdown speed is a CAS value which corresponds to the maximum engine-out L/D. Engine-out long range cruise speed is a Mach value which is optimized to provide 99 percent of the airplanes maximum still air range in the engine-out configuration.

(h) Economy Descent Speed - The economy descent speed target is a constant Mach, constant CAS schedule which is optimized to obtain the minimum airplane operating cost per mile traveled enroute.

(i) Minimum Drag Holding - Minimum drag holding target is the CAS value which corresponds to maximum L/D with flaps up. The best hold speeds are computed in the same manner as engine-out climb and driftdown speeds using best L/D coefficient of lift and Mach cutoff values stored in the data base.

(j) Speed Envelope - The speed envelope function of the AFMC computes the maximum operating speeds for any given altitude, weight and configuration constraint such as flaps position, maneuver load factor and VMO/MMO.

(k) Minimum Speed Limits - Minimum speed limits are established by considering low speed initial buffet boundary at a specified maneuver margin with flaps up and the minimum flaps extended speeds which meet maneuver criteria for operation at V/REF (Approach Reference Speed).

(l) Buffet Bank Angle - Buffet bank angle is established by the AFMC as the bank angle which increases load factor by a value which is less than the specified maneuvering load factor margin with respect to initial buffet.

(m) Maximum Altitude - Maximum altitude is established by the AFMC as the highest altitude to which the airplane can climb where neither the planned climb speed or the selected cruise speed will be affected by the speed envelope and where sufficient excess thrust is available to provide a specified rate of climb capability.

(n) Engine OUT Drift Down Altitude - Engine-out driftdown altitude is the maximum altitude that can be maintained with single engine operation generating maximum continuous thrust at a speed corresponding to maximum L/D.

(o) Engine Out Maximum Altitude - Engine-out maximum altitude is maximum altitude than can be maintained with single engine operation generating maximum continuous thrust at a speed corresponding to single engine long range cruise.

(p) Optimum Cruise Altitude - Optimum cruise altitude is established by the AFMC at that altitude which provides the lowest operating cost for the economy cruise speed mode or best fuel mileage for the LRC (long range cruise) and speed select modes. The calculated optimum altitude considers trip length so a specified minimum cruise time will be obtained.

(q) Flight Path Predictions - Flight path predictions are computed by the AFMC using an origin to destination trajectory which is based on gross weight, cost index and MCDU entered specified modes for climb at CLB thrust cruise and flight idle descent plus allowances for takeoff approach and acceleration requirements between the legs of the vertical profile. The predications are updated periodically as the flight progresses to account for winds, route modifications, actual fuel remaining and actual times of arrival at waypoints.

(r) Descent Path Synthesis - Descent path synthesis predicts the descent path by assuming flight idle thrust. The computation starts at the bottom of the descent point and integrates in reverse direction to intersect the cruise altitude at top of descent.

(s) Step Climb - Step climb function computes the best point along the route to start a limit climb thrust segment to a higher cruising altitude which will result in a minimum trip cost for the economy cruise mode or minimum trip fuel consumption for the LRC and selected speed cruise modes.

(t) Approach Speed - Approach speed targets (V/REF) are extracted from the data base as a function of calculated gross weight and the various flap settings.

(u) AFMC Current Fuel/Weight - AFMC current fuel/weight calculation is a prerequisite for all other performance computations. It is initiated and displayed as the sum of a Captain/ First Officer entry of zero fuel weight and fuel quantity weight on the MCDU before engine start. This data is displayed on the MCDU and stored for all future calculations.

(v) With Service Bulletin 34-254 incorporated, an improvement in the cruise to descend speed propagation, enhanced "Hold" exit display, EFIS, MCDU displays, altitude captures, and Flight Guidance Computer Panel window control logic is met. The AFMCs part numbers 4052504-921, -922, -923 and -924 are upgraded to 4052504-925 and meet the FAA requirements.

(3) Guidance Function Lateral

(a) The lateral guidance function compares the airplanes actual position with the desired flight path and generates steering commands to the autopilot and flight director systems to cause the airplane to fly along the desired path. Great circle paths join the route waypoints and circular transition arcs are formed between the route legs by the AFMC. The airplane progress along each path segment is continuously monitored to determine when a path transition should be initiated.

(b) The lateral guidance function mode is initiated by pressing the NAV key on the flight guidance control panel (FGCP). The ARM annunciation will come on the flight mode annunciator (FMA) if the digital flight guidance computer (DFGC) determines NAV engagement parameters have been met.

(4) Guidance Function Vertical

(a) Vertical guidance functions are the climb, cruise and descent phases of the flight plan. The AFMC flight planning capability provides entering of published departure, arrival and approach segments and individual waypoints that include altitude constraints. These constraints as well as the entered cruise altitude and cost index, define the vertical profile for which the AFMC provides guidance.

(b) In the climb portion of the profile, the autothrottle portion of the DFGC will control thrust while speed is maintained by the vertical navigation pitch commands from the AFMC. The aircraft will climb at climb limit thrust to each altitude constraint, fly level at cruise thrust until past the restraining waypoint and then resume the climb at climb limit thrust. The speed schedule is determined by the speed transition altitude which is stored in the data base with the origin airport. Below the transition altitude, the speed is limited to 250 knots in climb. Above the speed transition altitude, the system defaults to any economy climb schedule which is a function of gross weight at top of the climb, entered cruise altitude and the entered cost index. After reaching cruise altitude, vertical navigation will maintain an economy cruise or Captain/First Officer entered speed through the MCDU until the descent phase is reached.

(c) In the descent portion of the profile, VNAV guidance controls aircraft pitch in a manner similar to the tracking of a glide slope on an ILS beam except the path (plane) is internally generated. When flying the descent path, VNAV pitch commands to the DFGC hold the path while the throttle or speed brake is used to maintain speed if a significant acceleration occurs that was not anticipated such as weather disturbances.

(d) The vertical guidance function is selected by pressing the VNAV key located on the digital flight guidance control panel on the main instrument panel in the flight compartment.

(e) All profile changes should end up with pressing the VNAV key to start the maneuver.

(5) AFMC Data Base

(a) The information stored in the AFMC is the operation program and two data bases. The data bases contain, performance related data and navigation related data. The performance data base information reduces the need for the Captain/First Officer to refer to a performance manual during flight and provides the AFMC that data required to transmit pitch and thrust commands to the DFGC. The performance data base in the AFMC also provides detail predictions along the entire aircraft flight path.

(b) The AFMC navigation data base includes most of the information that the Captain/First Officer would normally need by referring to navigation charts. The information can be displayed on the MCDU or Electronic flight Instrument System (EFIS) navigation display (ND).

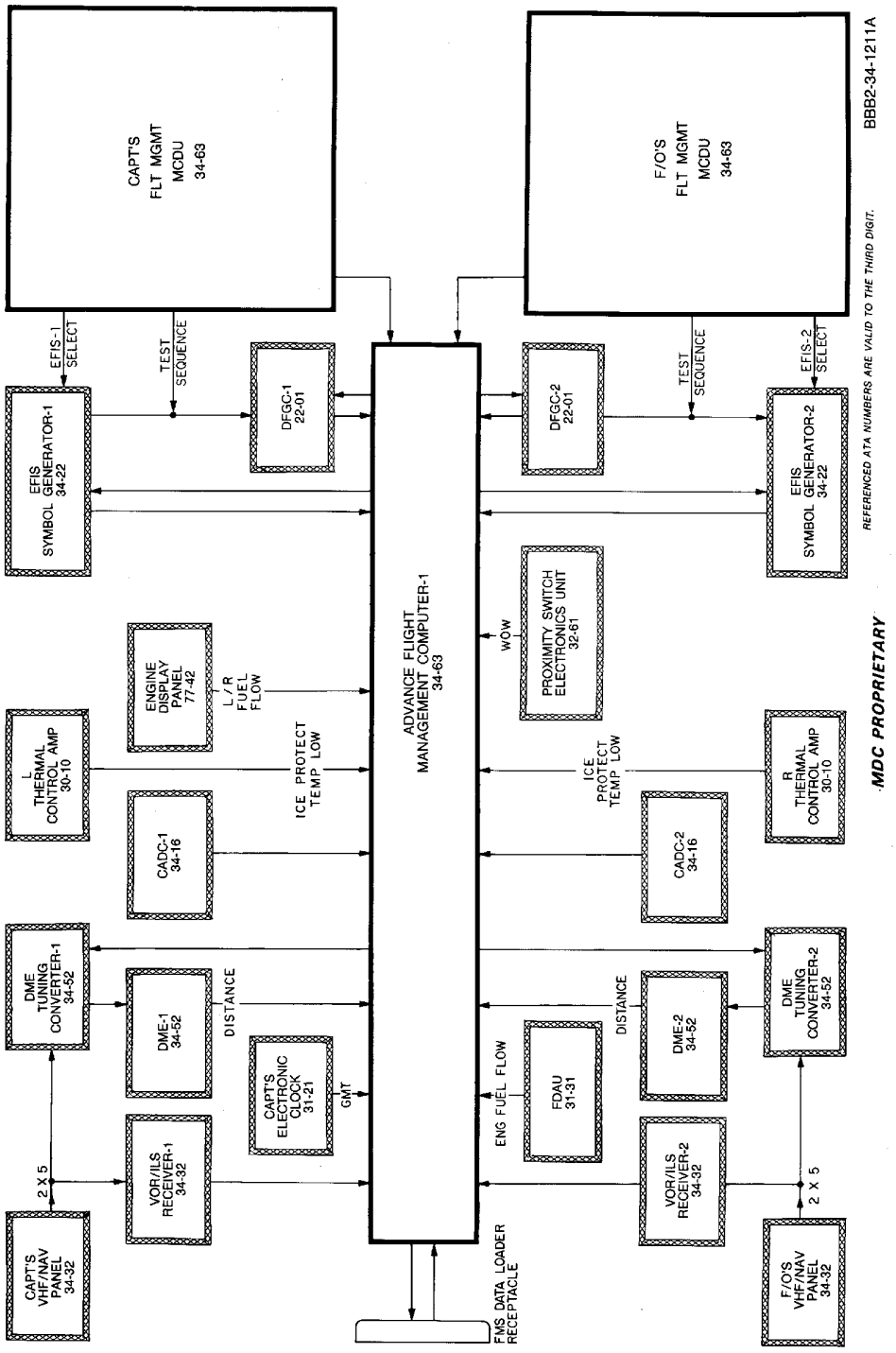
(c) The navigation base is tailored to a specific airline. The stored data includes location of VHF navigation aids, airports, runways, geographical reference points and other airline selected information such as standard instrument departures (SID), standard terminal arrival routes (STAR), approaches and company routes. The contents of the navigation data base is usually updated every 28 days. This is accomplished by the maintenance crew through use of the data base loader.

(6) EFIS Interface

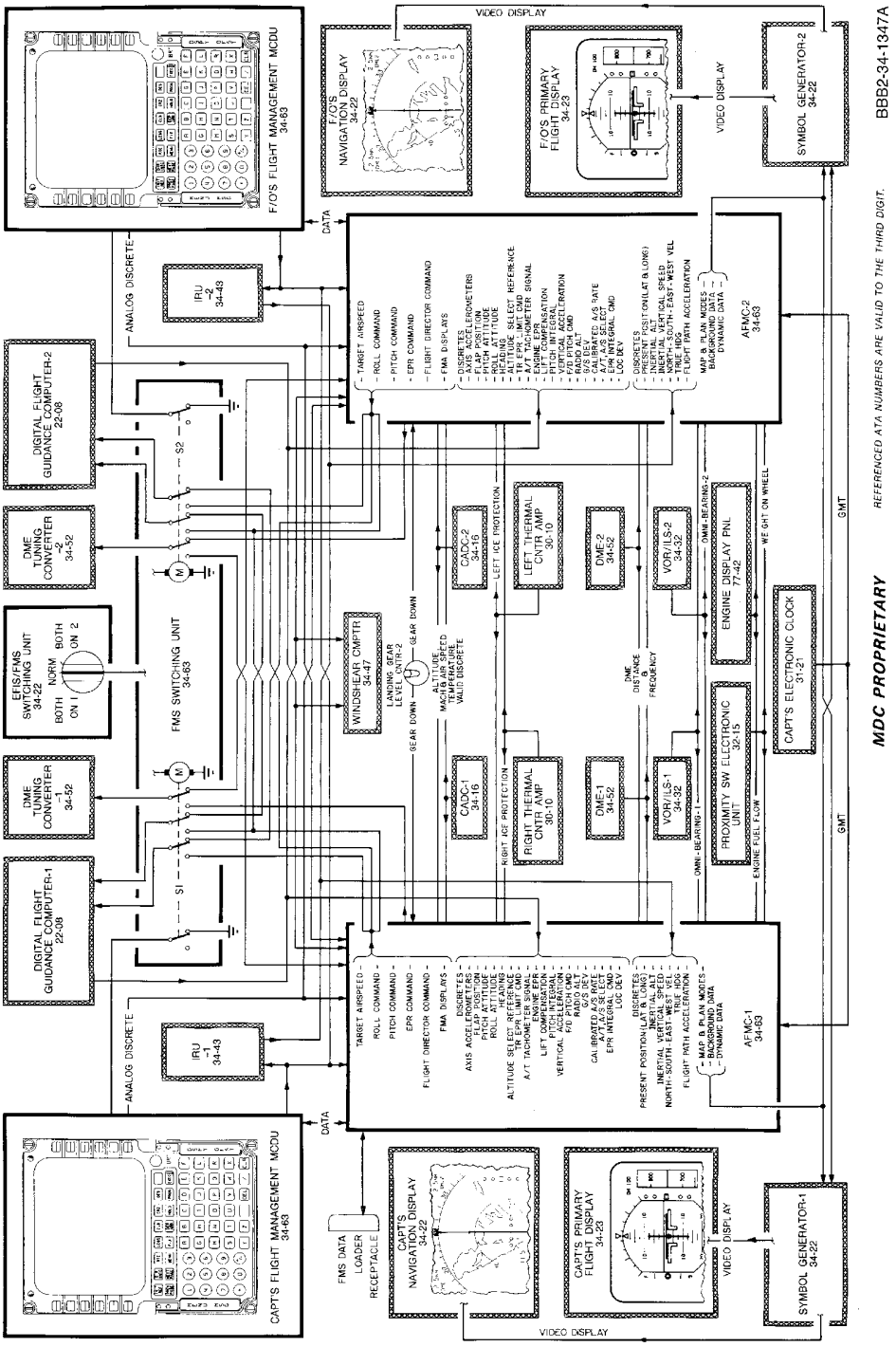
(a) The FMS interfaces with the Electronic Flight Instrument System (EFIS) to provide a MAP or PLAN display on the EFIS Navigation Display (ND). THE AFMC is the primary source of data for the EFIS ND when the EFIS mode selector panel MODE selector is set to MAP or PLAN position. The mode selector control panel (Figure 4) provides the means for selection of MODE, RANGE and background data selections. The background selections are pushbuttons designated N-AID (navigational aids), ARPT (airport), DATA (WPT data) and WPT (waypoint). Pressing the N-AID button will cause display of the navaids that are in the data base within the current range. Pressing the ARPT button will cause display of the airports that are in the data base within the current range. Pressing the DATA button will cause the display of constraint altitudes and ETA (estimated time of arrival) of all waypoints defined in the displayed active route. Pressing the WPT button will cause display of the data base waypoints not on the active route when the range of the display is 40 nautical miles or less. To remove (declutter) unwanted data, press the pertinent pushbutton a second time.

(b) The AFMC EFIS interface provides navigation data to the EFIS symbol generators which initiate a MAP or PLAN mode, as selected and displayed on the EFIS navigation display (ND). The difference between the MAP and PLAN mode displays is the MAP display is dynamic, oriented track or heading up and shows the aircraft position relative to the active or inactive flight plan and other earth referenced data. The PLAN mode display is oriented north up and used by the Captain/First Officer to look ahead in the flight plan and review what a portion of the flight plan looks like. The reference point for the PLAN mode is the center of the ND, as selected on the MCDU. (Figure 5) and (Figure 6)

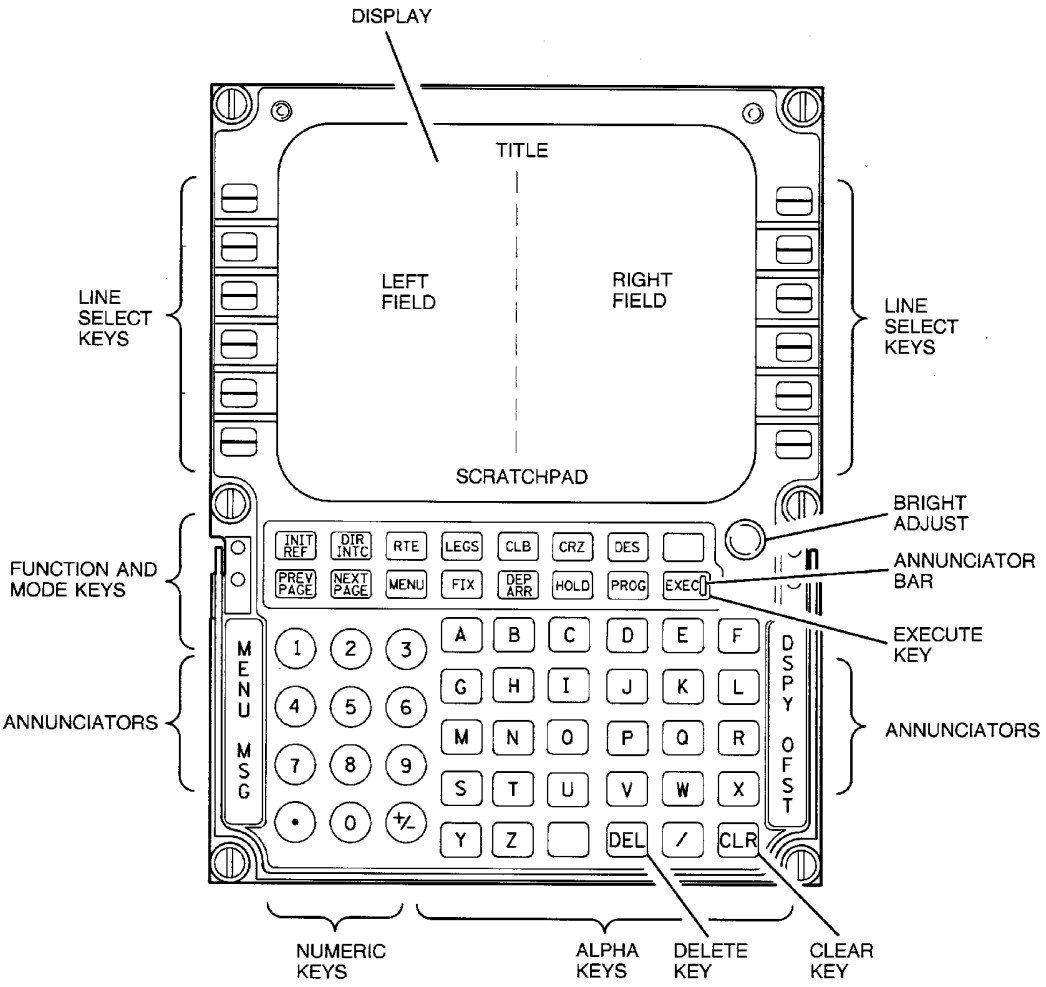
(7) Data Loader - The data loader (Figure 7) is a portable device used to transfer the current navigation data into the AFMC. The data is transferred from a diskette in the data loader to mass memory in the AFMC. A data loader connector cable is used to connect the data loader to the AFMC via a connector receptacle located in the CAPTs briefcase holder area. Power to the data loader is supplied from the aircraft through the cable. The diskette is updated periodically for transfer of current data to the AFMC. This update is every 28 days. The data loader is not part of the aircraft on-board equipment. For operating instructions of the Data Loader, see Paragraph 3..



Flight Management System
Figure 1/34-63-00-990-850 (Sheet 1 of 2)



Flight Management System
Figure 1/34-63-00-990-850 (Sheet 2 of 2)

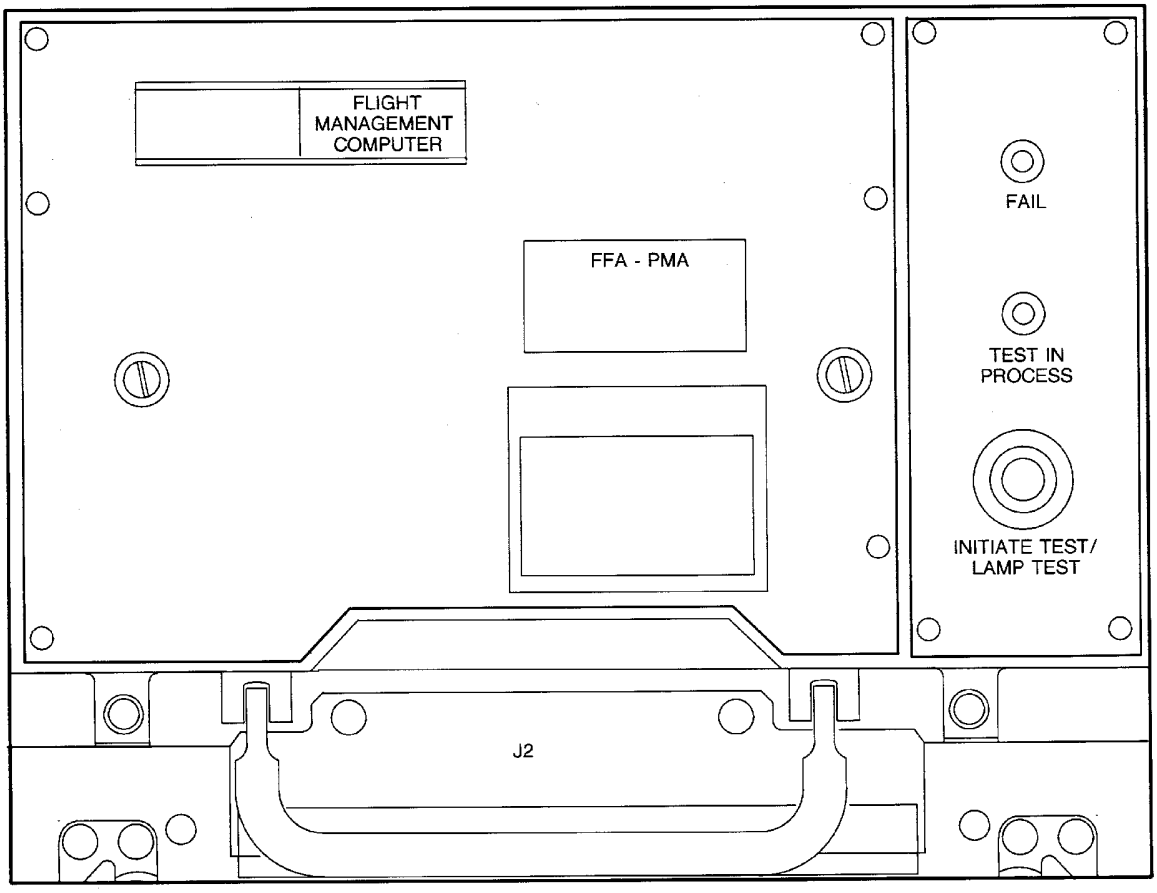


CAG(IGDS)

BBB2-34-1109

Multipurpose Control Display Unit (MCDU)
Figure 2/34-63-00-990-851

EFFECTIVITY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

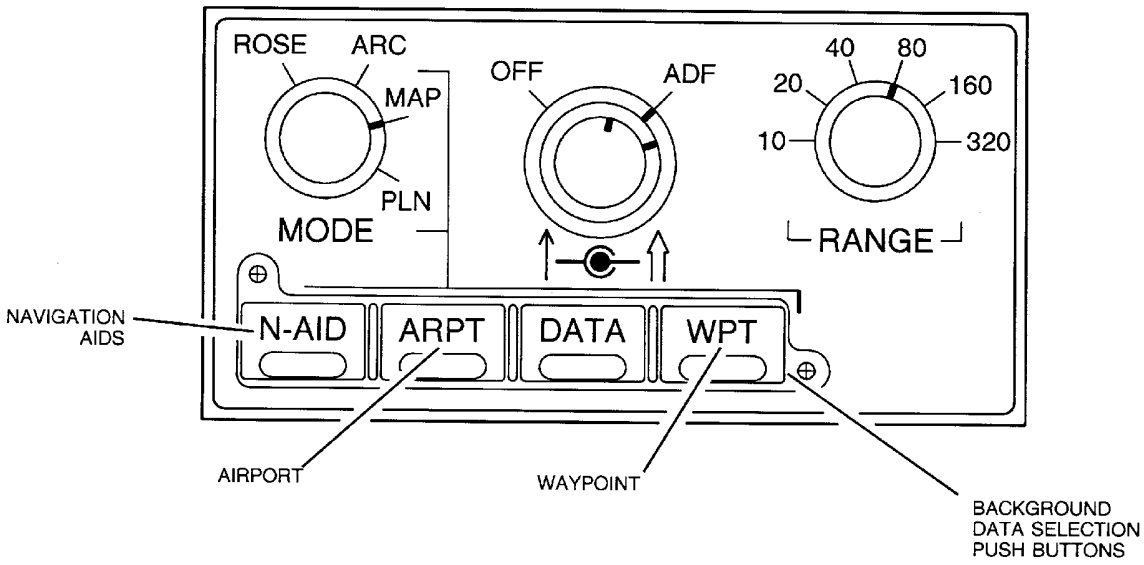


CAG(IGDS)

BBB2-34-1110

Advanced Flight Management Computer (AFMC)
Figure 3/34-63-00-990-852

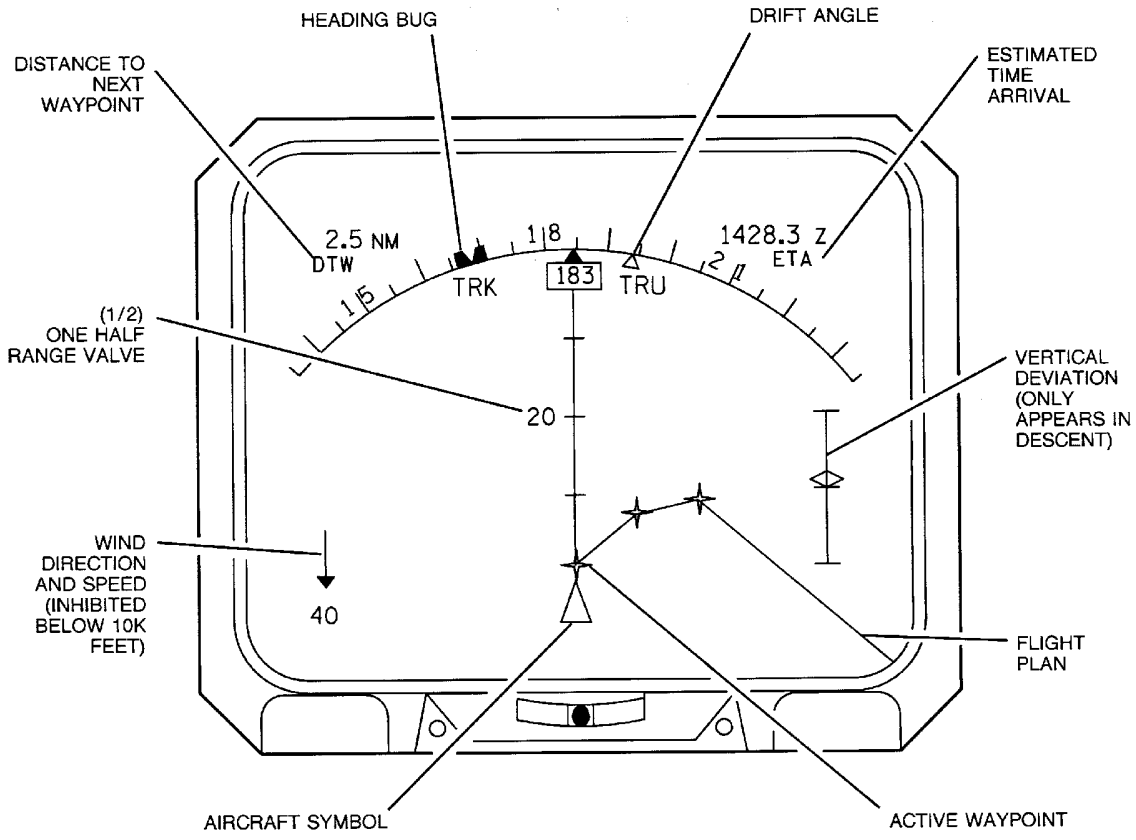
EFFECTIVITY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879



CAG(IGDS)

BBB2-34-1111

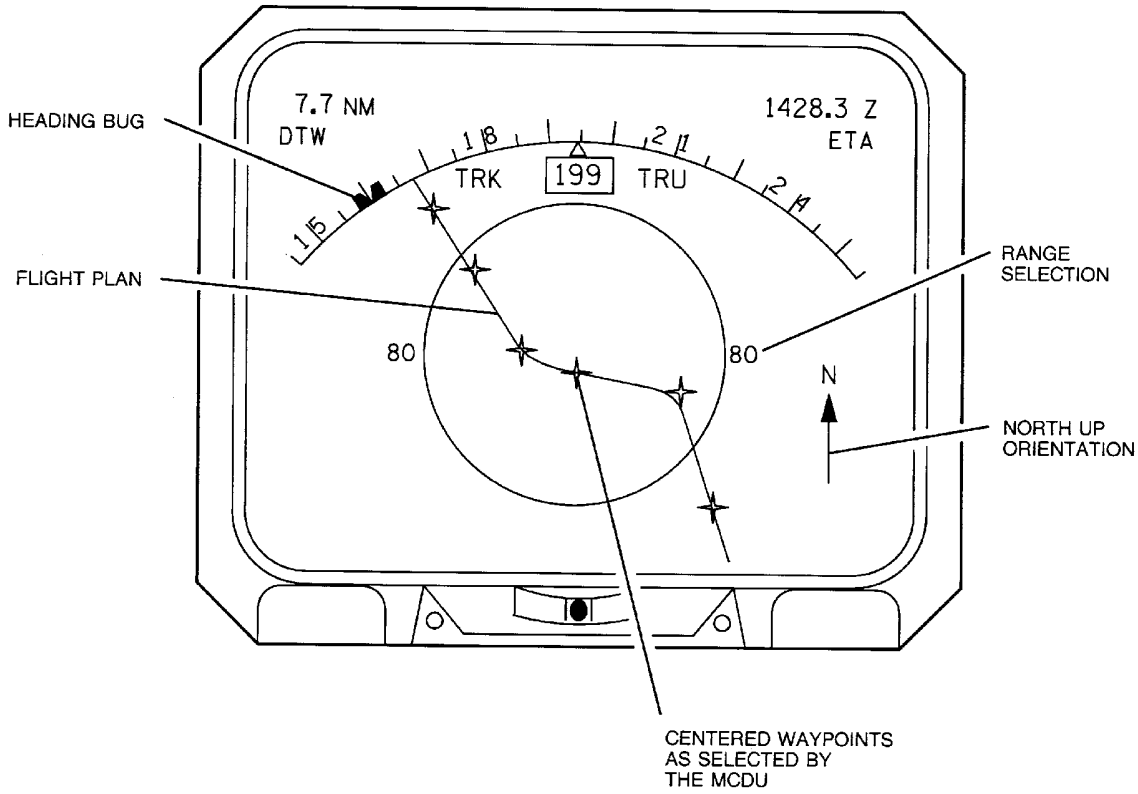
Mode Selector Control Panel (MSP)
Figure 4/34-63-00-990-853



CAG(IGDS)

BBB2-34-1112

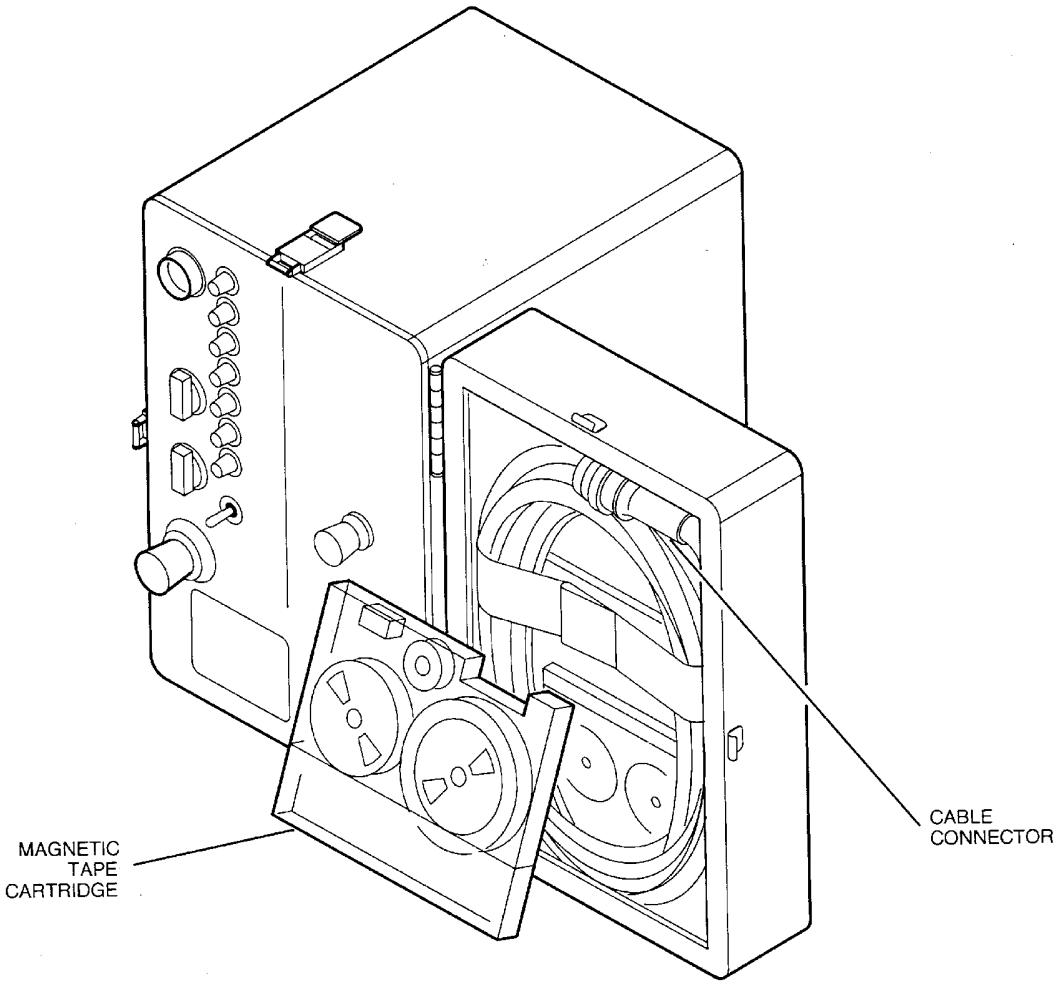
EFIS MAP Mode Display
Figure 5/34-63-00-990-854



CAG(IGDS)

BBB2-34-1113

EFIS PLAN Mode Display
Figure 6/34-63-00-990-855



CAG (IGDS)

BBB2-34-1114

Data Loader
Figure 7/34-63-00-990-856

EFFECTIVITY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

3. Operation

A. When the FMS is powered up, the FMS executes an internal self test. Upon successful completion of the self test, the MCDU displays the first page of the highest priority subsystem on the MCDU unless unable to establish communication with that subsystem. The AFMC is the primary subsystem therefore the FMS IDENT page is displayed. (Figure 9)

B. The following text and associated art describes the functions of the FMS through use of the MCDU line select keys (LSK) and the MCDU function and mode keys. The subtitles, Page Access, Purpose and Use are applicable to the operational description as follows:

(1) Page Access - The page access denotes the MCDU LSK or MCDU function and mode keys to use for access to the pertinent page displayed from another page or by use of the MCDU function and mode keys.

(2) Purpose - The purpose denotes the functional program of the page.

(3) Use - The use describes the function of the LSKs.

(4) The S, E and D designations beside the LSKs on page displays denote the LSKs as select, enter or delete keys. They can be designated in combination. The designations do not appear on the MCDU.

(5) The ALPHA/NUMERICS displayed on the MCDU pages are not necessarily the true display; as an example, Longitude and Latitudes and Greenwich Mean Time (GMT) are picked at random for display purposes.

C. Initialization Reference Index

Table 2

Page Access: (Figure 8)

6L on IDENT page	6L on TAKEOFF page
6L on POS INIT page	6L on REF NAV DATA page
6L on POS REF page	6L on APPROACH REF page
6L on PERF INIT page	6L on MAINT INDEX page

Purpose:

This page provides access to all initialization and reference pages.

Use:

Only selection is allowed on the page.
To display one of the initialization or reference pages, press the line select key adjacent to the desired title.

NOTE: To gain access to the MAINT INDEX page, a secret code must be entered into the scratchpad and then line selected to 6R on this page.

D. Identification

Page Access: (Figure 9)

Automatically displayed after 20 second time delay on power up 1L on INDEX page.

Purpose:

Provides a means of reviewing the AFMC data base and operational program configuration. If blanks are displayed in 1L, 2L, or 1R, then this page is frozen and all line select and mode keys are ignored.

Use:

(Continued)

1L - Displays the aircraft model as determined from the airframe/engine program pins. These program pins are read only on a long term power up while on the ground. If they do not match the stored performance data base, then blank will be displayed.

2L - Displays the navigation data base number. If the data base load complete bit is not set (indicating a bad data base load), blanks will be displayed.

4L - Displays the operational program serial number.

5L - Displays the drag factor which has been entered on the PERF FACTORS page.

6L - Displays INDEX prompt for selecting the INIT/REF INDEX page by pressing this key.

1R - Displays the engine identification number as determined from the airframe/engine program pins. These pins are only read on a long term power up while on the ground. If they do not match the stored performance data base, then blanks are displayed.

2R - Displays the active navigation data base cycle effective date.

CAUTION: CHANGING THE ACTIVE NAVIGATION DATA BASE WILL ERASE ANY FLIGHT PLAN AND ANY DATA WHICH MADE USE OF THE NAVIGATION DATA BASE.

3R - Displays the active navigation data base cycle effective date. Line selecting this field enters the gata into the scratchpad for selection into 2R.

5R - Displays the fuel flow factor which has been entered on the PERF FACTORS page.

6R - Displays the POS INIT prompt for selecting that page by pressing this key.

E. Position Initialize

Page Access: (Figure 10)

2L on INIT REF INDEX page

6R on IDENT page

4L on TAKEOFF REF page

PREV or NEXT page on POS REF page (2/2)

INIT REF mode key when position has not been entered

Purpose:

Provides a means of initializing the AFMC Greenwich to present ground position and setting the displayed Greenwich Mean Time (GMT) time.

Use:

2L - Dashes are displayed until a valid airport identifier is entered or the aircraft goes airborne. Valid entries, 4 character alphanumeric, must be in the data base. Valid entry causes airport reference Latitude/Longitude (LAT/LON) to be displayed in 2R. When a REF AIRPORT is entered on the POS INIT page, the REF AIRPORT is automatically transferred to ORIGIN or RTE 1 page, unless ORIGIN has already been entered.

3L - Displays blanks until 2L has valid entry, then displays dashes. Valid entries are gate identifiers contained in the data base, causing gate LAT/LON to be displayed in 3R. New entry into 2L deletes any previous 3L entry.

5L - Displays current GMT as read from the aircraft clock or blanks if the clock is not valid. Only the hours digits can be changed. Minutes are changed by resetting the Captain's clock (First Officer's clock for AFMC-2 if dual FMS installed).

(Continued)

6L -	Displays the INDEX prompt to allow selection of INIT REF INDEX page.
1R -	Displays the last computed AFMC position. Data is retained on power down.
2R -	Displays airport reference LAT/LON when valid airport identifier is entered in 2L.
3R -	Displays gate reference LAT/LON when valid gate identifier is entered in 3L.
4R -	Displays prompt boxes when aircraft is on the ground and IRS is in ALIGN MODE. If IRS is not installed, prompt boxes will be displayed until a position has been entered. Valid entries can be data selected from 1R, 2R, 3R, or entered directly into the scratchpad as N4726.2W12218.5 where leading zeros are required on the degrees. Valid entries can be without minutes and seconds as N47W122. Also entries can be Place, Bearing, and Distance as XXXXX NNN.N/ ZZZ.Z where XXXXX is the place, NNN.N is the bearing, and ZZZ.Z is the distance. Place, Bearing, Distance - (PBD) entries will be displayed in 4R as LAT/LON. Entered data is displayed until the aircraft transitions to airborne; then blanks are displayed.
5R -	Header displays SET IRS HDG if at least one IRS is in attitude mode. Dashes displayed in 5R before and after heading is entered. If IRS is not installed, 5R will be blank.
6R -	Displays the ROUTE prompt. Selection displays the active route or, if no active route, route 1 is displayed with the first page shown.

F. Position Reference

Page Access: (Figure 11)

Purpose:

This page displays the current AFMC computed position and GROUND SPEED (airborne).

Use:

1L -	Displays the computed AFMC position based on attitude, heading, and radio inputs. If the AFMC position is invalid, blanks are displayed. Data is selectable to the scratchpad.
2L -	Displays IRS-1 position (blank if IRS not installed).
3L -	Displays IRS-2 position (blank if IRS not installed).
4L -	No display.
6L -	Displays the INDEX prompt. Selecting this prompt displays the INIT REF INDEX page.
1R -	Displays AFMC ground speed.
2R -	Displays IRS-1 ground speed.
3R -	Displays IRS-2 ground speed.
4R -	Blank.

NOTE: 1R, 2R, 3R fields are blank if IRS not installed.

6R -	Displays route prompt, same as Page 1/2.

G. Route

Page Access: (Figure 12)

4R of TAKEOFF page

6R on POS INIT page

6R on DEPARTURE page

6R on ARRIVALS page

(Continued)

RTE mode key

The route page displayed (RTE 1 or RTE 2) will depend on whether a route is active or which route was being worked with. In most cases, with an inactive route, RTE 1 will be displayed.

Purpose:

Provides a means of entering a desired route into the AFMC for guidance and reference.

Use:

1L - Displays the origin when entered. Valid entries are 4 character International Civil Aviation Organization (ICAO) airport identifiers contained in the navigation data base (NDB).

2L - Displays dashes until a company route is entered. A company route is a Navigation Data Base (NDB) stored airline route. Entry of a company route identifier will build the route which may or may not contain the departure and/or arrivals.

3L - Displays the selected runway as entered by the Captain/First Officer (CAPT/F/O) or as selected on the DEPARTURE page and must be compatible with the selected Standard Instrument Departure (SID) if one is selected.

4L - Displays the selected airway or DIRECT to the first waypoint displayed in 4R (selecting a SID inserts data into this area). If a waypoint is entered into 4R with dashes in 4L, DIRECT is automatically inserted into 4L.

5L - Displays the entered airway or DIRECT if no airway is entered and waypoint selection is made in 5R.

6L - Displays RTE 2 prompt (if on RTE 1). If the route is pending activation or a modification to the active route is pending, then the ERASE prompt is displayed and the EXEC annunciator is lit. Pressing the ERASE prompt erases all modifications or cancels the activation and turns off the EXEC annunciator light.

1R - Displays the destination as entered by the pilot or as selected by a company route that contains a destination. Entering a new destination over a previously entered one deletes all approach procedures associated with it.

2R - Is blank.

3R - Is blank.

4R - Displays the first waypoint in the flight plan as entered by the CAPT/F/O or from the company route.

5R - Displays the next selected waypoint.

6R - Displays the ACTIVATE prompt initially. Pressing the ACTIVATE prompt causes the EXEC annunciator to light. Pressing the EXEC key activates the flight plan. After activation, 6R displays PERF INIT, if the performance page is not completed, or TAKE OFF, if perfomance initialization is complete, and pressing 6R displays the corresponding page. If airborne, 6R will have a header for OFFSET and dashes are displayed. An offset of up to 99 nautical miles to the left or right can be entered (as Rxx or Lxx) providing the active leg is not part of an approach or a certain leg type and modification is not being made. In these cases the header is dashed and the data field is blank. Entering an offset causes the EXEC and DSPY annunciators to light. Pressing the EXEC key activates the offset, extinguishes the EXEC and DSPY annunciators and lights the OFST annunciator. Entry of O or DELETE into 6R cancels the offset.

If the flight plan is being manually entered and the present page is full, pressing the next page key displays a blank route page with the VIA header over 1L and the TO header over 1R, allowing 5 more entries. 6L and 6R remain the same.

H. Select Desired Waypoint

Page Access: (Figure 13)

Automatically whenever a non-unique identifier is entered.

Purpose:

Allows selection of the desired waypoint from the list of up to 6 waypoint which have the same identifier.

Use:

The header for each waypoint is the waypoint identifier. If the waypoint is a navaid, the frequency is displayed along with the latitude and longitude. If the waypoint is not a navaid, blanks are displayed where the frequency is normally displayed and the latitude and longitude after. Once the desired waypoint is identified, pressing the line select key beside it returns to the page which brought up this page and the desired waypoint is inserted into the flight plan.

I. Route Data

Page Access: (Figure 14)

6R on ACT RTE LEGS page with Electronic Flight Instrument System (EFIS) not in plan mode.

Purpose:

Displays the same waypoints as the displayed RTE LEGS page with additional leg data on the right side.

Use:

1L through 5L -	Display is the same as the RTE LEGS page.
6L -	Displays the ERASE prompt when the EXEC key is lighted. Selection erases any modifications made.
1C through 5Z -	Displays Estimated Time of Arrival (ETA) to the waypoints based on performance flight plan predictions and cannot be changed.
1R through 5R -	Displays the forecast wind for each cruise waypoint in the form of XXX/YYY, where XXX is wind direction from 0 to 359 and YYY is wind magnitude from 0 to 250. If the cruise segment is not defined, blanks are displayed except for entered winds. AFMC predicted winds appear in small font and CAPT/F/O entered winds in large font. Only CAPT/F/O entered winds can be deleted.
6R -	Displays the LEGS prompt for selection to return to the RTE LEGS page.

J. Legs

Page Access: (Figure 15)

LEGS mode key on MCDU

6R when RTE DATA page is displayed

6L when the other RTE LEGS page is displayed

Purpose:

Displays details of each leg in the route and provides a means entering or modifying the data. (Maximum number of legs is 2 times the number of legs in the largest route plus the number of legs in the smallest route not to exceed 146.)

Use:

1L through 5L -	Displays the waypoint identifiers for each leg with a header for each leg. The header is leg direction or procedure information depending on leg type.
1C through 5C -	Displays the computed leg distance. Blanks are displayed if the waypoint is active and some leg types.

(Continued)

1R through 5R -	Displays the speed/altitude for the waypoint opposite. These may be speed/altitude constraints from the data base or pilot entered. Predicted values are displayed in small font and constraints (Navigation Data Base or CAPT/F/O entered) are in large font.
6L -	Displays RTE 2 LEGS (if on RTE 1) for selection or ERASE if modification or pending activation is in progress.
6R -	Display depends on conditions. If the on-side EFIS is in the plan mode, 6R header displays MAP CTR and the data field displays STEP prompt. In this case CTR in brackets is displayed in the center of the page starting at the first waypoint. The STEP prompt steps the CTR down through the page, causing that waypoint to be the center of the display on the EFIS. The EFIS will be in a north up display. If the inactive RTE LEGS is displayed, 6R displays ACTIVATE to allow activation of the inactive route, if possible. If there is an active flight plan and the EFIS is not in the plan mode, then RTE DATA will be displayed. In a single AFMC installation both EFIS control panels feed the AFMC and the AFMC has two independent EFIS output buses. In a dual AFMC installation each AFMC handles its on-side EFIS displays.

K. Direct/Intercept

Page Access: (Figure 16)

DIR/INTC mode key when a route is active

Purpose:

Provides a means of flying direct to or intercepting a course to any waypoint in the NDB or line selectable waypoint in the active route.

Use:

1L/1R through 5L/5R -	These are the same as the normal RTE LEGS page. Use of the DIR/INTC function will not display the ERASE prompt in 6L, however, displaying another page without pressing the EXEC key will erase the modification.
6L -	DIRECT TO is displayed to solicit an entry for the desired waypoint. The waypoint can be entered through the keyboard or line selected from any RTE LEGS page. Entry of a waypoint not contained in the active flight plan causes the DIRECT TO waypoint to be in 1L and a discontinuity to appear in 2L. Waypoints between present position and the DIRECT TO waypoint will be deleted upon EXECution.
6R -	INTC LEG TO is displayed to solicit a waypoint entry. Entry of a valid waypoint causes 6R header to change to INTC CRS with 3 prompt boxes and the entered waypoint is displayed in 1L with the default course displayed in the 1L header. Any valid course entry will overwrite the default value.

L. Hold

Page Access: (Figure 17)

HOLD mode key

Purpose:

Allows display of preplanned holding patterns and/or creating holding patterns in the route and provides the means of exiting a holding pattern.

Use:

(Continued)

If no hold page has been entered, line 6 (Page B) displays HOLD AT with prompt boxes in 6L for the waypoint and 6R has PPOS prompt for present position. Entering a waypoint in 6L or selecting 6R displays the RTE HOLD page (Page A) for entering the holding pattern information.

1L - Displays the hold fix (selected waypoint or present position).

2L - For entering the holding quadrant and radial in the form xx/nnn where xx can be N, NE, E, SE, S, SW, W, or NW and nnn is from 0 to 359, with leading zeros, which is the reciprocal of the inbound course.

3L - For entering the inbound course and turn direction. The inbound course is from 0 to 359, with leading zeros, and the turn direction is L or R separated by a slash.

4L - Used to enter the leg time in minutes as x.x with the range of 0.1 to 9.9. This can be CAPT/F/O entered or from a predefined holding pattern in the NDB. The default value depends on the altitude at the holding fix. 1.0 minutes is used for altitudes at or below 14,000 feet and 1.5 minutes above 14,000 feet.

5L - Displays leg distance, if entered, for holding pattern as NN.N nm or N.N nm. The range is 0.1 to 99.9 nm. The default display will be --.- nm.

6L - Displays '<ERASE' whenever a route activation, hold exit, or a flight plan modification is pending. At all other times, '<NEXT HOLD' will be displayed. If '<ERASE' is displayed, selection will result in the clearing of the pending route activation, hold exit, or flight plan modification. If '<NEXT HOLD' is displayed, selection results in the display of the RTE LEGS HOLD AT page.

1R - Displays the same speed/altitude as on the RTE LEGS page for the hold leg. Invalid values are displayed as dashes. The format for the display will be NNN/MMMMMX, beginning in column 15, where NNN is a Calibrated Airspeed (CAS) value, MMMMM is an altitude in either Mean Sea Level (MSL) or Flight Level (FL) format, and X is blank for 'at' constraints for predicted values, A for 'at or above' constraints, or B for 'at or below' constraints. Altitude WINDOW constraints will be displayed, beginning in column 8, in the format NNN/MMMMMA LLLLLB where MMMMMM is the lower altitude of the window, and LLLLL is the upper altitude.

2R - Displays the predicted time that the aircraft will next cross the holding fix. Display format is NNNN.N in large font. If value is not valid blanks will be displayed.

3R - Dashes will be displayed until the Expected Further Clearance Time is entered by the CAPT/F/O. Valid entries will be in the form HHMM in the range 0000 to 2359. For entries less than 1000, leading zeros must be used.

4R - Displays the holding time available before an exit is required in order to reach the destination with specified fuel reserves. Display format will be HH+MM, where HH is between 0 and 23 hours, and MM is between 00 and 59 minutes. If value is not valid, dashes will be displayed.

5R - Displays the best speed (speed at which left/drag is maximum) for current altitude and conditions. Format is a 3-digit CAS value in knots. If the holding speed is invalid, dashes will be displayed.

6R - Displays "EXIT HOLD' if the hold is the active lateral leg and if the exit criteria have not been met. Once the exit criteria are met, the display changes to 'EXIT ARMED" and the aircraft will sequence out of the hold on the next crossing of the fix.

M. Performance Initialization

Page Access: (Figure 18)

3L on INIT REF INDEX page

6R on ACT RTE page

5L on TAKEOFF page if PERF INIT is not complete

INIT/REF mode key when on the ground and position has been initialized.

Purpose:

(Continued)

Allows entry of gross weight or zero fuel weight, fuel, cost, index, reserves, cruise altitude, cruise wind, and International Standard Atmosphere (ISA) deviation or top of climb outside air temperature. All weight entries are in thousands of pounds (or thousands of kilograms if kilogram discrete is enabled) to the nearest 100 pounds (kilograms). Prompt boxes indicate mandatory entries.

Use:

1L - Displays prompt boxes unless zero fuel weight has been entered with valid fuel weight. Entering gross weight with valid fuel weight results in zero fuel weight being computed. After entry, displays AFMC computed gross weight.

2L - Displays prompt boxes which require pilot input. The fuel weight can be suffixed by, "MANUAL", or "CALC" depending on the condition.

Prior to engine start with FQ invalid and FF valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (entered value).

After engine start with FQ invalid and FF valid:

Displays prompt boxes.

Input manual entry, display "MANUAL" (calculated value).

Prior to or after engine start with FQ & FF invalid:

Displays blanks, manual and gross weight entries non-operational; VNAV (vertical navigation) guidance not allowed.

Prior to engine start with FQ invalid and FF transitions from invalid to valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (entered value).

After engine start with FQ invalid and FF transitions from invalid to valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (calculated value).

3L - Displays prompt boxes until CAPT/F/O enters gross weight with valid fuel weight or enters the zero fuel weight.

4L - Displays prompt boxes until CAPT/F/O entry. Entries less the 10.0 may include a hundreds digit. This is the required reserve fuel to be on board at destination.

5L - Displays the cost index which can be input by the CAPT/F/O or entered by route activation if the company route contained the cost index information. The cost index is an airline derived figure consisting of the cost of airline operation in dollars per hour divided by the cost of fuel in cents per pound.

6L - Displays the INDEX prompt to allow displaying the INIT REF INDEX page.

1R - Displays prompt boxes until CAPT/F/O entry or a company route is activated containing a stored cruise altitude. These will be in flight level format above the transition altitude and in mean sea level format below the transition altitude.

2R - Displays dashes until CAPT/F/O entry. Entry is wind bearing followed by a / and wind magnitude. Entries can be changed by entering bearing followed by a / or magnitude by its self.

(Continued)

3R -	Displays dashes until CAPT/F/O entry of ISA deviation or Top of Climb (T/C) Outside Air Temperature (OAT) is entered with a cruise altitude displayed in 1R. The ISA deviation is the deviation in temperature from the International Standard Atmosphere which is defined as being at sea level with a temperature of 15 degrees C. Entry of ISA deviation with a displayed cruise altitude causes the Top of Climb Outside Air Temperature (T/C OAT) to be computed.
4R -	Displays dashes until CAPT/F/O entry of ISA DEV is entered with a cruise altitude displayed in 1R. Entry of T/C OAT with a cruise altitude displayed in 1R causes the ISA DEV value to be computed and displayed.
5R -	Display 18,000 feet as the default transition altitude. If the airport or departure procedure contains a different transition altitude, it will be displayed providing the CAPT/F/O has not previously entered a transition altitude.
6R -	Displays the TAKEOFF prompt for selection of the TAKEOFF page.

N. Takeoff

Page Access: (Figure 19)

4L on the INIT REF INDEX page

6R on the PERF INIT page

6R on the ACT RTE page providing PERF INIT page is complete and the aircraft is on the ground.

Purpose:

To display the preflight status and other takeoff information for reference purposes.

Use:

1L -	Displays the total air temperature (TAT) as received from the Digital Flight Guidance Computer (DFGC).
1C -	Displays the assumed temperature which is selected on the Thrust Rating Panel only if the mode selected is T.O. FLX.
2L -	Displays the takeoff EPR value for takeoff depending on the engines installed and can be preceded by FLX if the mode is T.O. FLX. This is received from the DFGC.
1C -	Displays the assumed temperature which is selected on the Thrust Rating Panel only if the mode selected is TAKEOFF FLEX.
2L -	Displays the takeoff EPR value for takeoff depending on the engines installed and can be preceded by FLX if the mode is TAKEOFF FLEX. This is received from the DFGC.
3L -	Displays the dynamic gross weight.
4L -	Displays the POS INIT prompt if the position has not been initialized, otherwise it is blank. If displayed, pressing the 4L line select key causes the POS INIT page to be displayed.
5L -	Displays the PERF INIT prompt if all mandatory entries are not complete on the PERF INIT page, otherwise it is blank. If displayed, pressing the 5L key displays the PERF INIT page.
6L -	Displays the prompt for the INIT REF INDEX page.
1R -	Used for displaying of CAPT/F/O entered value of Decision Takeoff Speed (V1) for reference purposes.
2R -	Used for displaying of pilot entered value of Takeoff Rotation Speed (VR) for reference purposes.
3R -	Used for displaying of pilot entered value of Takeoff Safety Speed (V2) for reference purposes.
4R -	Displays the ROUTE prompt when no active route exists. If a route is active, this field is blank. Selection when prompt is displayed results in displaying page 1 of RTE 1.

(Continued)

5R -	Displays the DEPARTURE prompt when no departure has been selected, otherwise it is blank. Selecting this prompt when displayed causes the origin airport DEPARTURE page to be displayed unless there is no active route. In that case, the departure/arrival (DEP/ARR) INDEX page is displayed.
6R -	The RUNWAY UPDATE prompt allows reestablishing the AFMC position based on the runway threshold latitude and longitude of the runway as displayed in 3L of the ACT RTE page.

O. Approach

Page Access: (Figure 20)

5L on INIT REF INDEX page

INIT/REF mode key when airborne

Purpose:

Provides for the display of reference information relative to the approach.

Use:

1L -	Displays the dynamic gross weight if valid; otherwise boxes are displayed. CAPT/F/O may enter a gross weight but leaving this page and returning to it causes the dynamic gross weight to be redisplayed. (In a dual MCDU system, if both MCDU's are displaying the APPROACH page when an entry is made, the entry will appear on both MCDU's and will only clear when both MCDU's leave the APPROACH page.)
4L -	Displays the runway length of the origin or destination. If there is no active route, this field is blank. Destination is displayed if there is no origin or if the aircraft is over 50 nautical miles from origin or more than half way to the destination, whichever is less. The origin is displayed if there is no destination specified or the aircraft is less than 50 nautical miles from the origin or less than half way to the destination, whichever is less.
5L -	Displays the ILS, LOC, or BAC frequency for the runway in 4L if one exists. (Backcourse will not be displayed for the origin.)
6L -	Displays the INDEX prompt for selecting the INIT REF INDEX page.
1R through 2R -	Displays the Approach Reference Speed (VREF) speeds for the 1L displayed gross weight. These values are obtained from the performance data base and will change with a changed displayed gross weight. Landing flap setting for the displayed VREF speeds are displayed in 1C through 2C and also come from the performance data base.
4R -	Blank but provides for customer selected flap position/VREF display.
5R -	Displays the front course heading of the runway or approach in 5L. If 5L is blank, this will also be blank.

P. Reference Navigation Data

Page Access: (Figure 21)

1R on INIT REF INDEX page

Purpose:

Displays data of selected waypoint, navaid, airport, or destination runway contained in the data base or flight plan route.

Use:

(Continued)

1L - Displays dashes until a waypoint identifier is entered. Acceptable entries are any data base waypoint or course intersection, LAT/LON, Place, Bearing, Distance Waypoint (PBD), or along track route waypoint. Any entry longer than 5 characters or any entry containing a slash will be rejected. Any non-unique identifier entry will cause the SELECT DESIRED WPT page to be displayed with from 2 to 6 choices for the Capt/F/O to choose from.

2L - Displays the latitude of the entered waypoint to the nearest tenth of a degree.

3L - Displays the frequency if the entered waypoint is a navaid. If it is not a navaid, the header and data field will be blanked.

4L - Displays the magnetic variation of an entered navaid which has an associated VOR; header and data field are blanked if it is not a navaid or a DME only. Displayed with an E for positive variation or W for negative.

5L - Dashes are displayed initially. Provides for entry of VOR or DME identifier for exclusion in the auto tune function. This is referred to as a "blackballed" navaid. ILS or LOC entries result in an "INVALID ENTRY" message. Two entries are allowed, one into 5L and one into 5R. Overwriting of an existing entry makes the existing entry available for auto tune and the new entry is blackballed. Any non-unique navaid identifier entered results in the SELECT DESIRED WPT page being displayed for CAPT/F/O selection of the correct one. The blackball status of these navaids are retained on power down. They can be cleared by using the DELETE function. Also they will be cleared when a new navigation data base is loaded.

6L - Displays the INDEX prompt for selection of the INIT REF INDEX page.

2R - Displays the longitude of the entered waypoint to the nearest tenth of a degree.

3R - Displays the elevation when the entered waypoint is a runway, airport, or a navaid which has a DME; otherwise blanks are displayed. Elevations are to the nearest 10 feet.

4R - Displays runway length to the nearest foot when a runway identifier is entered; otherwise blanks are displayed.

5R - See 5L description.

Q. Maintenance Index

Page Access: (Figure 22)

6R on INIT REF INDEX page upon entry of password

Purpose:

Provides access to all maintenance pages.

Use:

Pressing the line select key adjacent to the desired field causes that page to be displayed.

2R - On aircraft with IRS, displays the IRS MONITOR page. This line is blank when IRS is not installed.

R. Sensor Status

Page Access: (Figure 23)

2L on MAINTENANCE INDEX page

NEXT or PREV key when on AFMC DATA STATUS page 2/2

Purpose:

Displays current sensor status of sensors providing data to the AFMC.

Use:

(Continued)

No selection, deletion, or entry is allowed. Dashes are displayed where no sensor is input to this side. The status is one of three states: FAIL, TEST, or OK.

FAIL can be caused by one of two conditions. If the sensor is not transmitting for whatever reason (power off, bad transmitter, etc.), there is an activity failure. If the sensor is capable of transmitting valid labels but the Sign Status Matrix (SSM) is coded as FAIL WARNING, the sensor is also declared failed.

TEST will be displayed as the sensor status when any valid label is received with the SSM coded as TEST.

OK will be displayed if all valid labels are received with the SSM coded as normal operation or no computed data.

In the event that a sensor input is received containing more than one type of SSM in the data words, display priority will be FAIL, TEST, and then OK in that order.

S. Analog Discretes

Page Access: (Figure 24)

3L on MAINTENANCE INDEX page

NEXT or PREV key when on AFMC ANALOG DISCR page 2/2

Purpose:

Displays the condition in the AFMC of the changeable discretes.

Use:

When a discrete comes in from the left or right side, such as ENGINE ANTI ICE, the state of each discrete is listed under the header 1 or 2, whichever is appropriate. All others are listed singularly between 1 and 2.

In a single AFMC configuration, the MDCU source selects discrete is not displayed.

T. Performance Factors

Page Access: (Figure 25)

1R on MAINTENANCE INDEX page

Purpose:

Provides display and entry of performance data applicable to individual airline policy or aircraft characteristics. Before data can be entered into this page, it must be armed by typing the letters ARM into the scratchpad and line selecting it to 6R.

Use:

1L - Displays the 4 performance program pins configuration as a binary code. This data is for display only, it cannot be changed.

2L - Displays the drag factor. The drag factor is a correction factor, expressed as a percentage, for AFMC internal drag computations. If no value has been entered, it will display +0.0. Entries can range from -5.0 to +9.9. Entries are propagated to the IDENT page and also to the off-side AFMC in a dual configuration.

3L - Displays the fuel flow factor. The fuel flow factor, expressed as a percentage, is for AFMC internal fuel flow computations. Display and entry range is the same as for drag factor.

4L - Displays the maneuver margin for use by flight envelope computations in the AFMC. The default value is 1.30 and can range from 1.25 to 1.60.

5L - Displays the minimum time the aircraft has to be in the cruise phase during a flight. The default value is 1 and can range from 1 to 20 minutes.

(Continued)

6L - Displays the prompt for the MAINTENANCE INDEX page.

1R - Displays the policy speed for descent. Defaults to 300 if no other value has been entered previously. Allowable range is from 240 to 330 knots.

2R - Displays the minimum rate of climb header for 3R and 4R.

3R - Displays the minimum rate of climb margin for flight envelope calculations at climb speed and maximum climb thrust in feet per minute. Entry range is from 0 to 999 with the default value of 100.

4R - Displays the minimum rate of climb at cruise speed and maximum cruise thrust in feet per minute. Range is from 0 to 999 with a default value of 0.

6R - Displays dashes until ARM is selected to this line. Leaving this page and returning requires the page to be armed again for data entry.

U. IRS Monitor Page (Aircraft with IRS)

Page Access: (Figure 26)

2R on MAINTENANCE INDEX page

Purpose:

Displays the present and previous flight position error rate for each IRS.

IRS position error in nautical miles is calculated by subtracting the IRS position from the AFMC position. Position error is calculated at flight start and at flight completion. If the AFMC-1 or IRS-1 position is invalid, the IRS-1 error rate displays will be blank. If the AFMC-2 or IRS-2 position is invalid, the IRS-2 display will be blank.

IRS error rate is the difference between position error at flight start and flight completion, divided by the total flight time. Error rate is calculated at flight completion and displayed on the IRS MONITOR page. Error rate display rang is 0.0 to 99.9 NM/hr.

Total flight time is the elapsed GMT between flight start and flight completion, calculated from the Capt's clock input. Clock must be valid at flight start and flight completion. If total time cannot be calculated, IRS error rate displays will be blank.

After flight completion, the IRS error rate display will not change until another flight completion. Display lines cannot be selected by pressing line select key, and information cannot be manually entered. Error rate display can be cleared by pressing MCDU delete key (DEL), then the LSK next to the display line. Display should becleared when an IRS is replaced.

Use:

2L - Displays present drift error and time of flight for IRS-1.

3L - Displays present drift error and time of flight for IRS-2.

4L - Blank if IRS-3 not installed.

6L - Displays the MAINTENANCE INDEX page when selected.

2R - Displays previous drift error and time of flight for IRS-1.

3R - Displays previous drift error and time of flight for IRS-2.

4R - Blank if IRS-3 not installed.

V. Menu

Page Access: (Figure 27)

MENU mode key on MCDU

6L on CONFIGURATION INDEX page

(Continued)

Purpose:

Allows interfacing between the CAPT/F/O and multiple systems, one at a time. 1L through 3L are ARINC 739 protocol subsystems while 5L and 6L are non-ARINC 739 protocol subsystems.

Use:

1L - Displays AFMC #1 as active to the MCDU.

5L - Displays IRS INIT/REF (aircraft with IRS).

6L - Displays the TEST PANEL prompt. Pressing 6L displays the TEST PANEL page. This field will be blank if the TEST PANEL OPTION is deactivated on the CONFIGURATION INDEX page.

6R - Displays RETURN for selection to return to the active system.

The current active system is annunciated by "(ACT)" (active) being displayed after the subsystem name. Any other self-formatting subsystems having requested communication with the MCDU is annunciated by "(REQ)" after the subsystem name, and the illumination of the "MENU" annunciator.

When the MCDU MENU page is not displayed, the illuminated "MENU" annunciator is the only indicator that another subsystem is requesting communication. To establish communication with a new subsystem the MCDU MENU page must be accessed. Once displayed, the operator should select the line key adjacent to the subsystem identifier to establish communication. If no line key is selected within 60 seconds after accessing the MCDU MENU page, the MCDU reverts to the last active system (if an active system exists). Also, the active system can be immediately returned to by selecting 6R "<RETURN". Following section of a subsystem, an indication is provided to inform the operator that the selection of the subsystem is acknowledged. This is accomplished by displaying a subsystem page indicating that the MCDU is waiting for a response from the selected subsystem.

W. MCDU CONFIG INDEX

Page access:

This page is directly accessible from the main MCDU MENU page by depressing the NEXT PAGE function key.

Purpose:

Provides the ability to activate or deactivate the non-self formatting subsystems for each MCDU, independently. In addition, it is used to specify how many Inertial Reference Units (IRU) are in the aircraft when the IRS subsystem is activated. This page is not intended for general operator use but can be accessed as a reference.

Use:

2L - Displays flashing ACTIVATED or DEACTIVATED to show current IRS configuration.

3L - Displays flashing number of IRUs installed into the aircraft.

4L - Displays flashing ACTIVATED or DEACTIVATED to show whether the MCDU is being used as the STP.

6L - Used to exit back to MENU page.

X. IRS INIT/REF (Aircraft with IRS).

Page access:

5L MCDU MENU page

Purpose:

This page allows flight crew to initialize the IRU, via the MCDUs, in the event of an AFMC failure. Additionally, IRS data is displayed on the MCDU. The IRS INIT/REF page is intended as a backup feature, and functions regardless of the operational status of the AFMCs. The primary purpose of this page is to provide for the entry of IRS set position and heading data.

(Continued)

Use:

1L - Displays present position from IRU-1. If no present position data is received or the data is invalid, this field is blank.

2L - Displays present position from IRU-2. If no present position data is received or the data is invalid, this field is blank.

3L - Data fields immediately below line select keys 3L and 3R display the true heading values from the IRUs that are configured to the MCDU. If no true heading is received from an IRU or the heading is invalid, the associated data field is blank.

Y. Set IRS Position (Aircraft with IRS)

(1) Line select key 5R provides for the entry of IRS set position data. The field adjacent to 5L displays prompt boxes, entered data, or is blank. Blank fields indicate that none of the IRUs communicating with the MCDU are in the align mode. Prompt boxes are displayed whenever any of the IRUs communicating with the MCDU are in the align mode. Data is accepted in this field when either prompt boxes or previously entered data is displayed. Entries are nonoperational if made while this field is blank, and a blank field will continue to be displayed. Valid accepted entries will allow data to be transmitted to the IRUs. The input data remains displayed until either new data is entered or all of the IRUs have been removed from the align mode.

Z. Set IRS Position Data Entry (Aircraft with IRS)

(1) IRS set position data is entered in the format of the displayed position data in the fields adjacent to 1L and 2L, without the degree symbol; for example, N4038.1W07346.0. Valid entries include data without minutes or seconds; for example N40W074. Values not specified in this format are assumed to be zero. Data is entered by typing it into the scratchpad and then line selecting it to 5R. Refer to Figure 28 for a complete table of data entry options. Alternatively, position data is also entered by selecting the displayed position at either 1L or 2L (by pressing the appropriate line select key), which copies that position into the scratchpad, and then selecting 5R. The data displayed in the scratchpad after line selecting either 1L or 2L is in the format specified for manual entry, but always includes minute and second values.

(a) Invalid entries result in the display of the message INVALID ENTRY in the scratchpad, and the entry rejected. Data cannot be entered over this message. Selecting the CLR key while this message is displayed results in the redisplay of rejected data in the scratchpad.

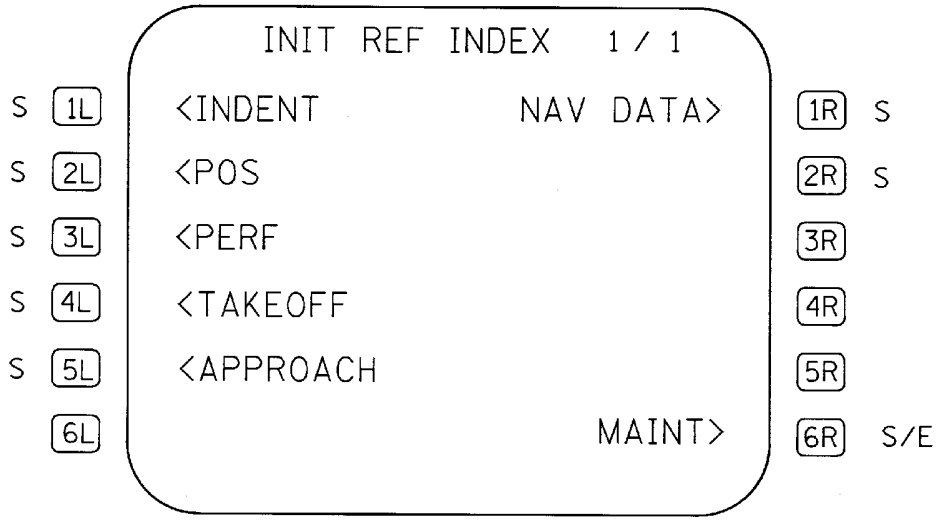
(b) The scratchpad displays message RE-ENTER IRS POSITION if the IRU returned position and MCDU entered position differ by more than 0.1 degree after 5 seconds, or the position entered on the MCDU is not sent back from any IRU currently in align mode.

AA. Set IRS Heading (Aircraft with IRS)

(1) The field at line 6R provides for the entry of IRS set heading data. This field displays dashes, entered data or remains blank. A blank field indicates that none of the IRUs communicating with the MCDU are in attitude mode. Dashes are displayed whenever any of the IRUs communicating with the MCDU are in attitude mode. Dashes are replaced by data during transmission of data entry two to four seconds after data entry. After transmission is complete and the dashes are redisplayed, additional entries are allowed. Data is accepted in this field only when dashes are displayed.

AB. Set IRS Heading Data Entry (Aircraft with IRS)

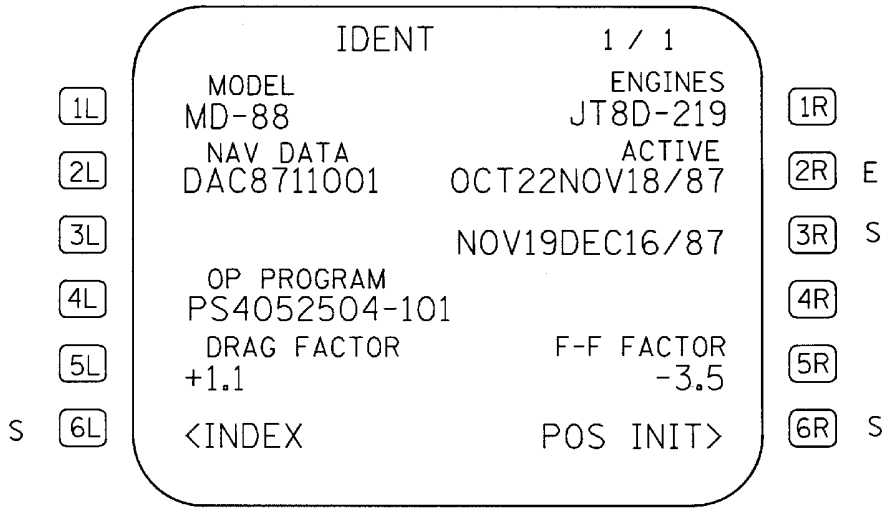
(1) Valid IRS set heading data consists of three numeric characters with a value between 000 and 360, inclusive; however, 360 is displayed as 000. Data is entered by typing it into the scratchpad and then line selecting it to 6R. Entry is not allowed while the previous entry is being displayed. Invalid entries will result in display of the scratchpad message INVALID ENTRY, and the entry is rejected. The SET IRS HDG is only displayed when any of the IRUs communicating with the MCDU are in attitude mode.



CAG(IGDS)

BBB2-34-1115

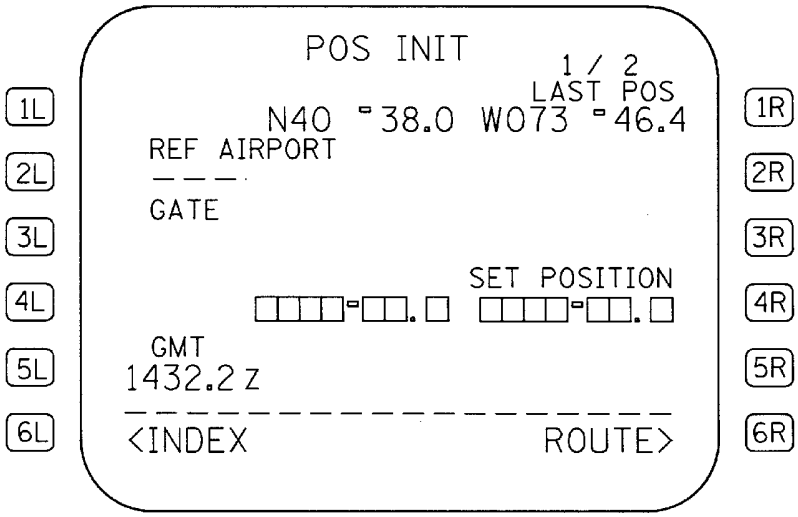
Initialization Reference Index
Figure 8/34-63-00-990-830



CAG(IGDS)

BBB2-34-1116

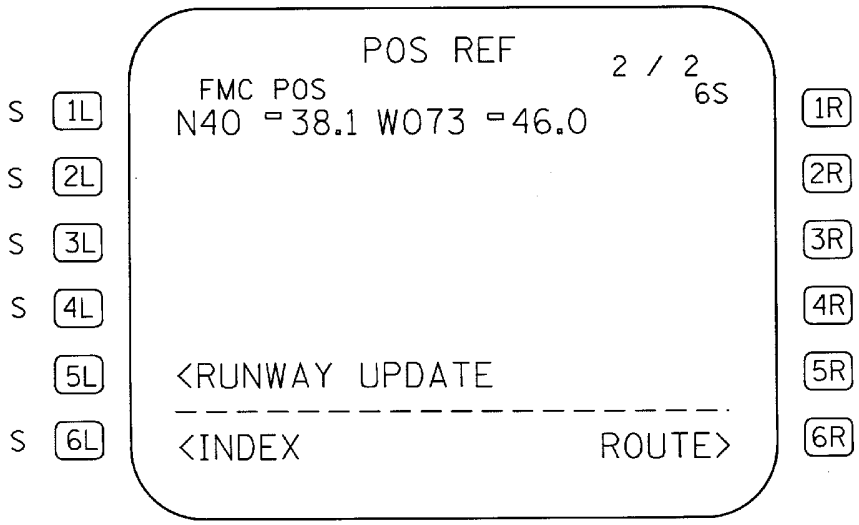
Identification
Figure 9/34-63-00-990-831



CAG(IGDS)

BBB2-34-1117

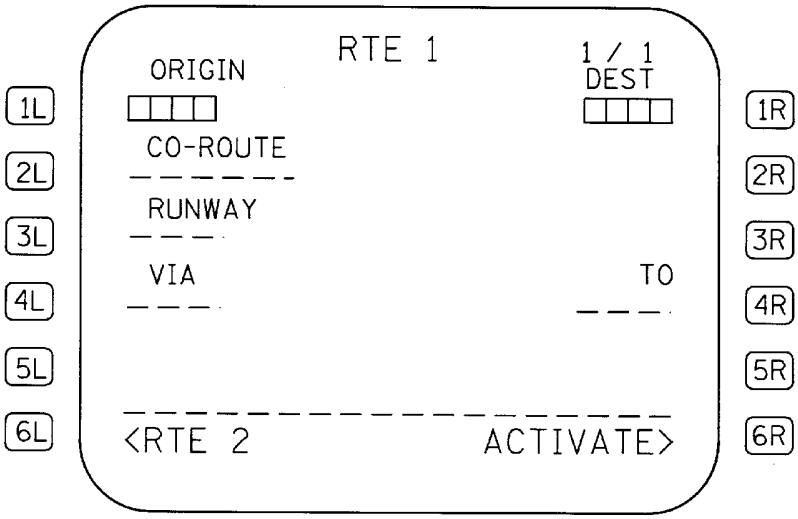
Position Initialize
Figure 10/34-63-00-990-832



CAG(IGDS)

BBB2-34-1118

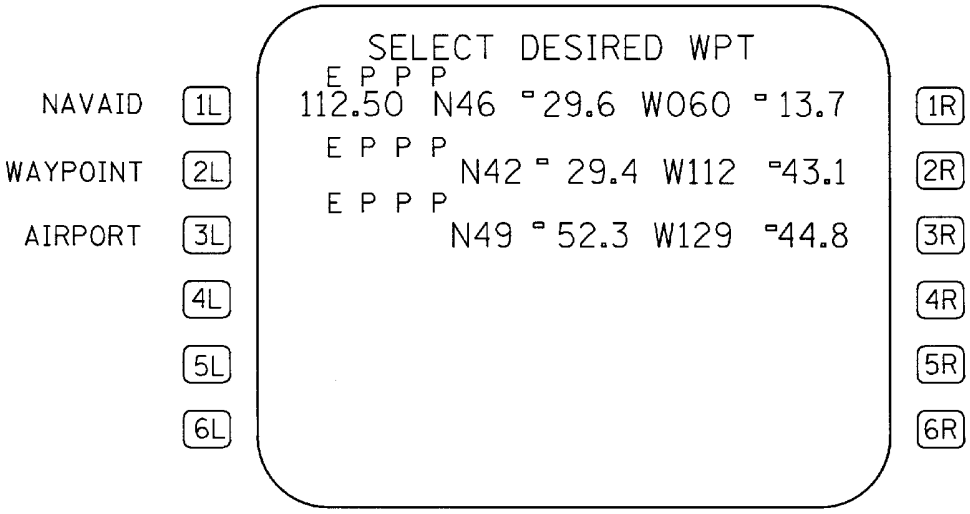
Position Reference
Figure 11/34-63-00-990-833



CAG(IGDS)

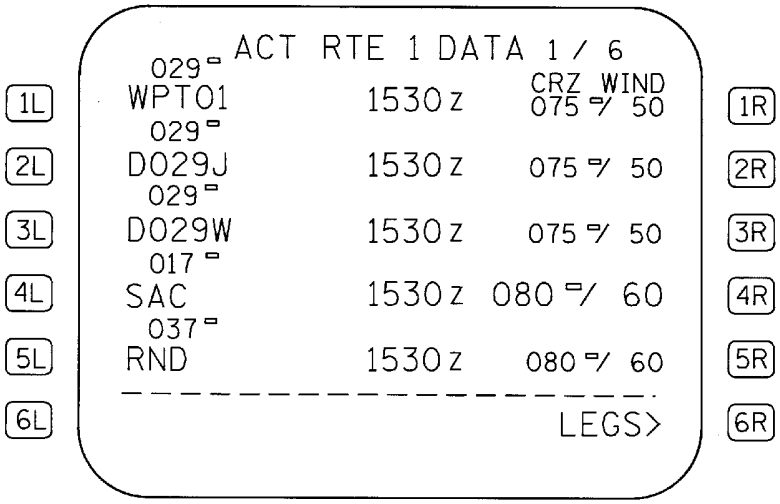
BBB2-34-1119

Route
Figure 12/34-63-00-990-834



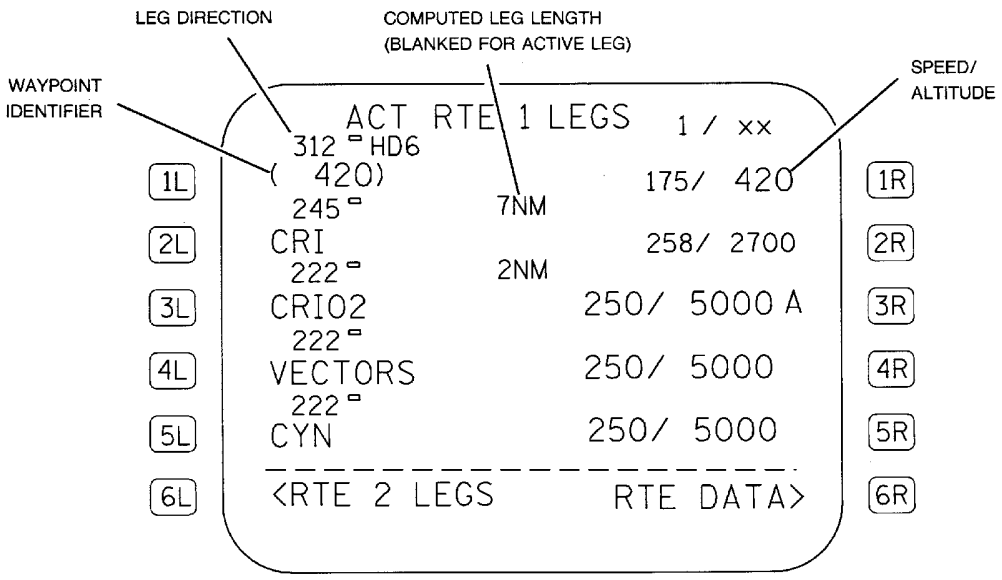
CAG(IGDS) BBB2-34-1120

Select Desired Waypoint
Figure 13/34-63-00-990-835

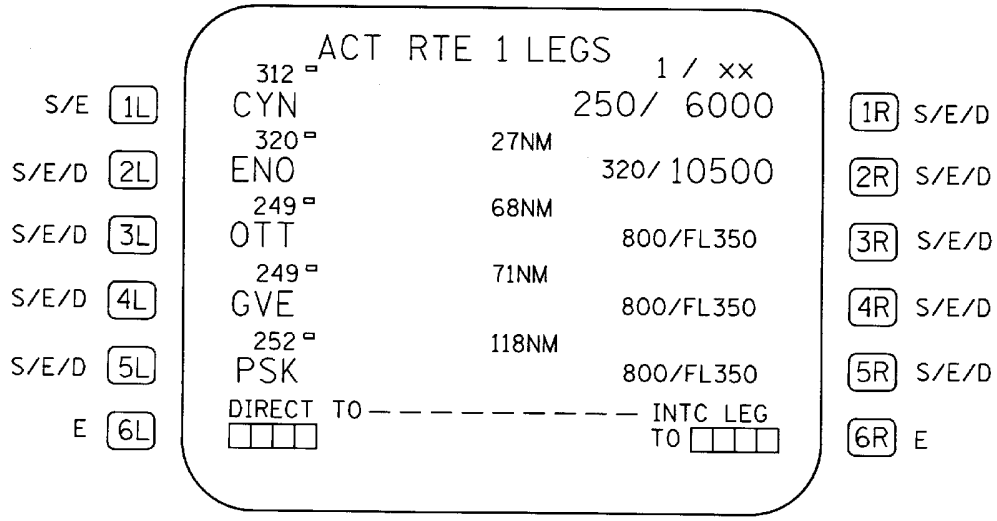


CAG(IGDS) BBB2-34-1121

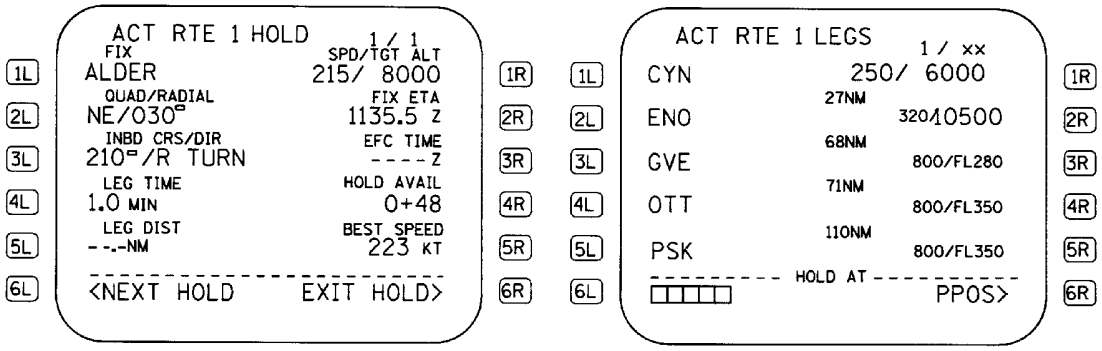
Route Data
Figure 14/34-63-00-990-836



Legs
Figure 15/34-63-00-990-837



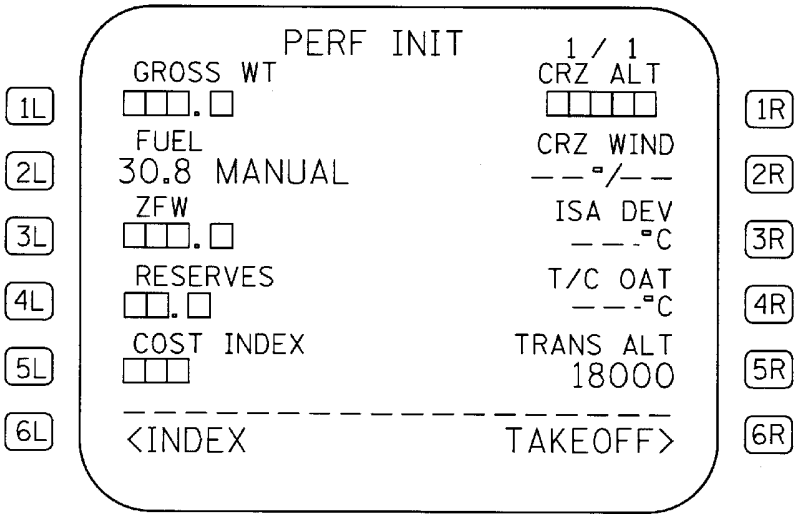
Direct / Intercept
Figure 16/34-63-00-990-838



CAG(IGDS)

BBB2-34-1124

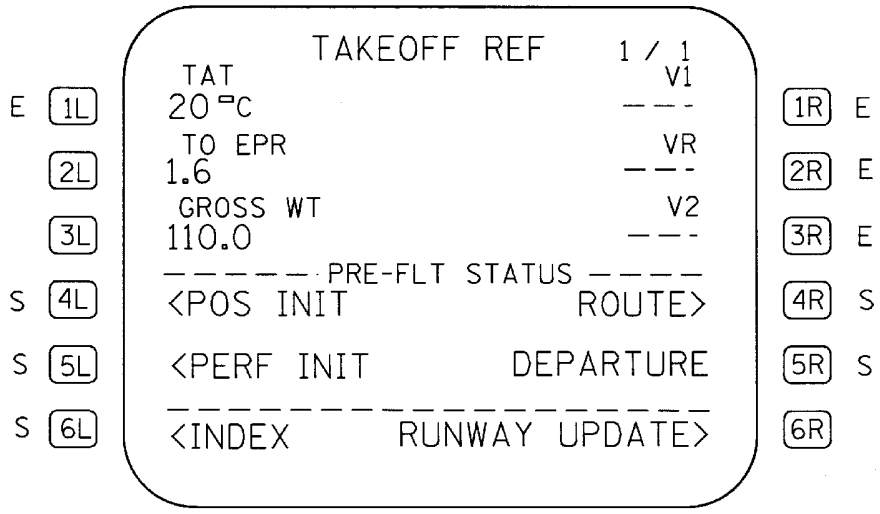
Hold
Figure 17/34-63-00-990-839



CAG(IGDS)

BBB2-34-1125

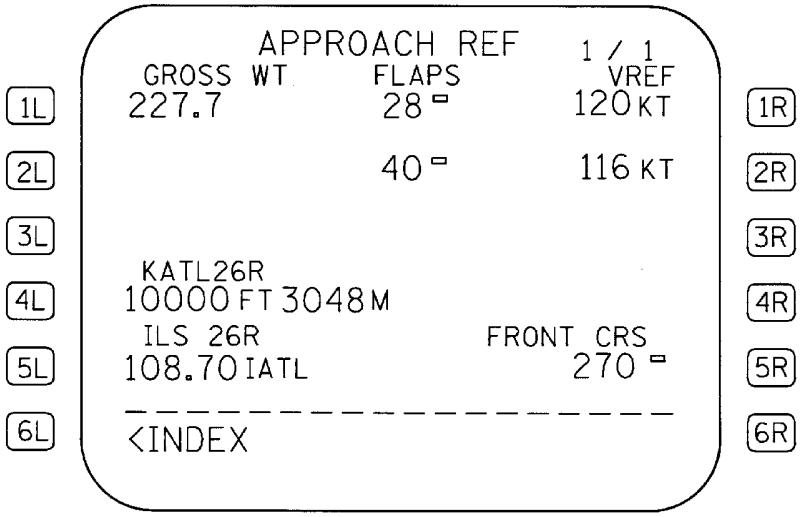
Performance Initialization
Figure 18/34-63-00-990-840



CAG(IGDS)

BBB2-34-1126

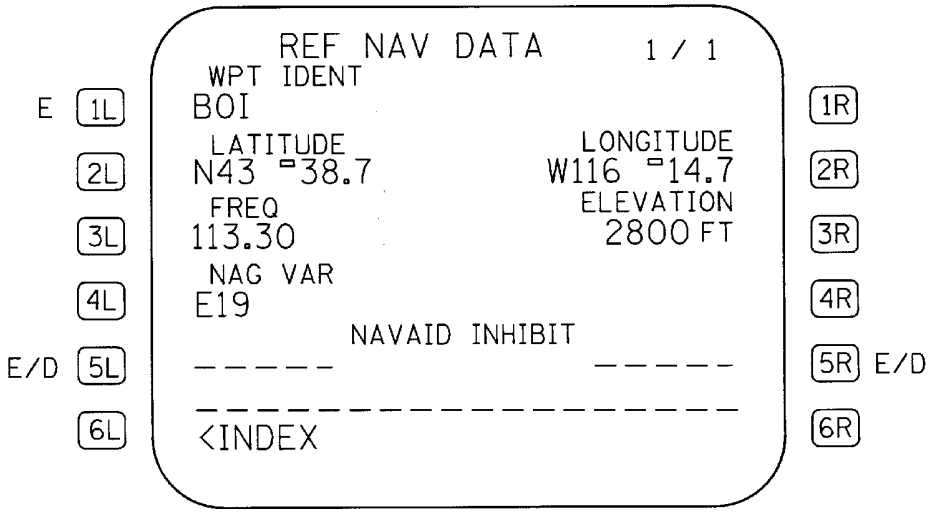
Takeoff
Figure 19/34-63-00-990-841



CAG(IGDS)

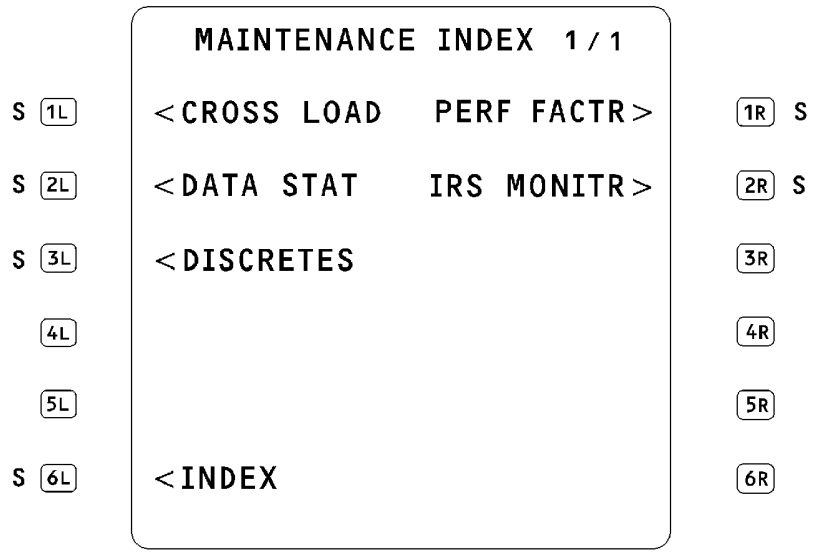
BBB2-34-1127

Approach
Figure 20/34-63-00-990-842



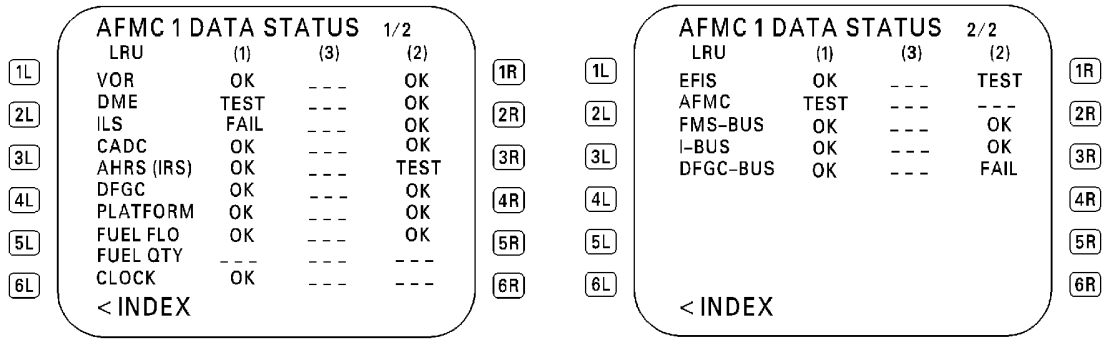
CAG(IGDS) BBB2-34-1128

Reference Navigation Data
Figure 21/34-63-00-990-843



CAG(IGDS) BBB2-34-1129A

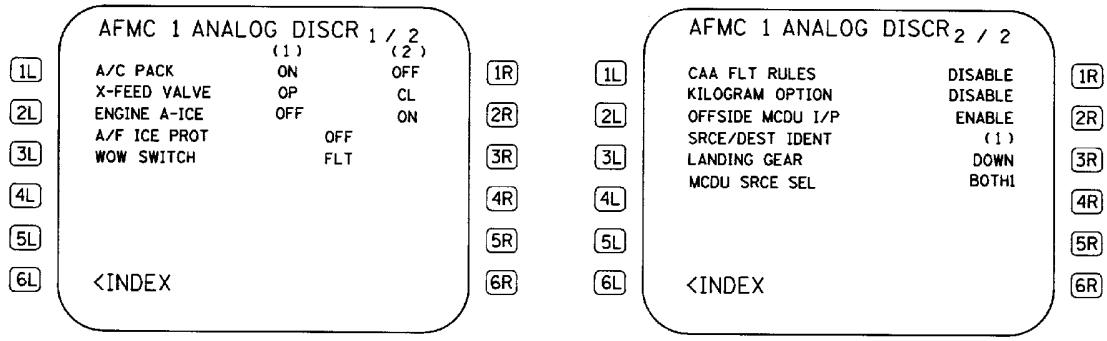
Maintenance Index
Figure 22/34-63-00-990-844



CAG(IGDS)

BBB2–34–1130A

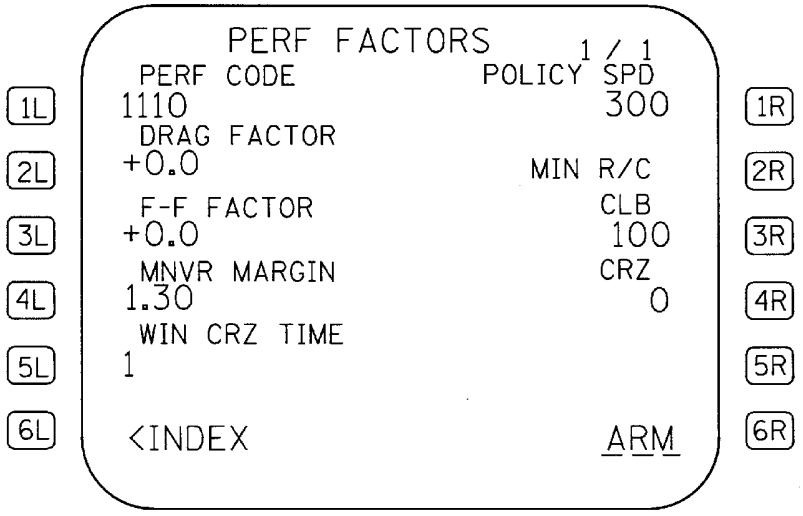
Sensor Status
Figure 23/34-63-00-990-845



CAG(IGDS)

BBB2-34-1131

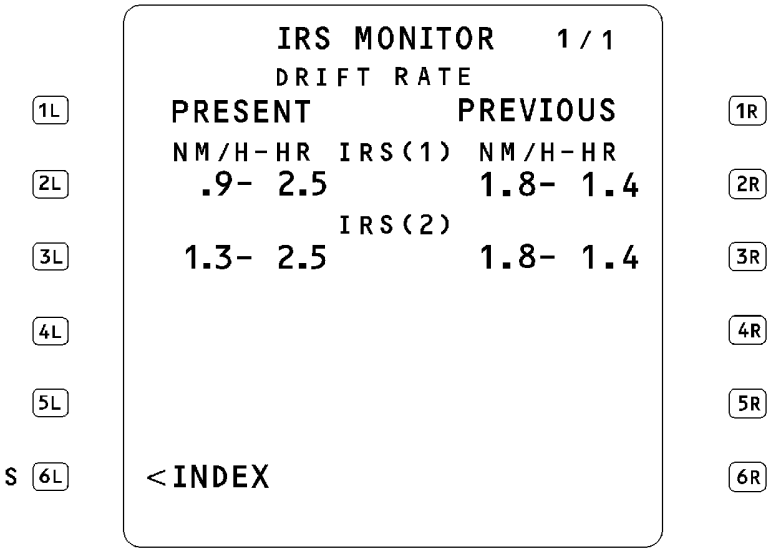
Analog Discretes
Figure 24/34-63-00-990-846



CAG(IGDS)

BBB2-34-1132

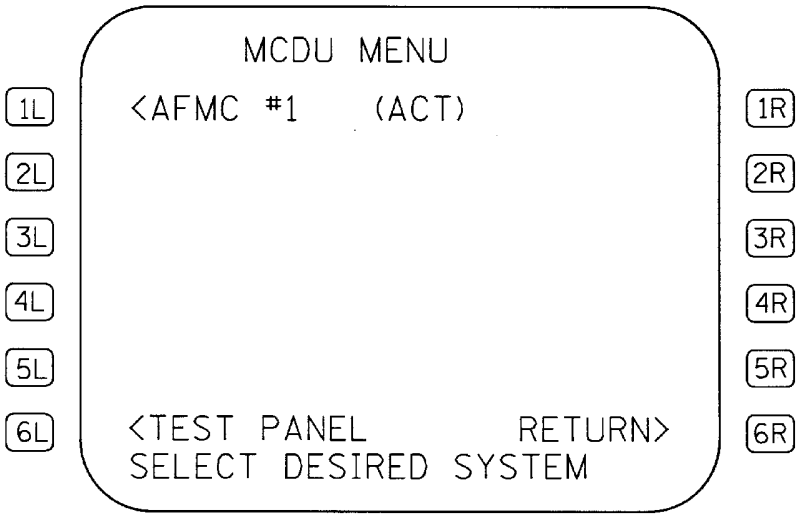
Performance Factors
Figure 25/34-63-00-990-847



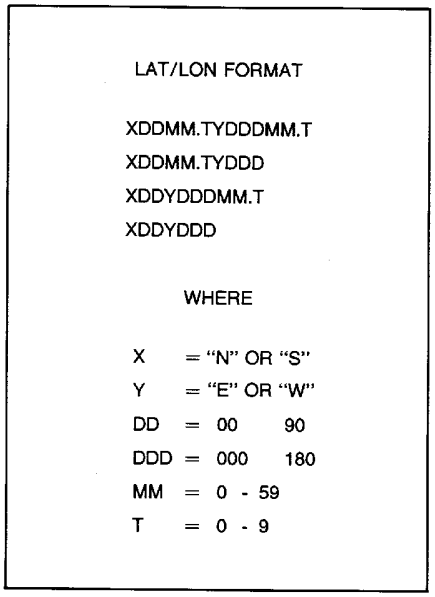
CAG(IGDS)

BBB2-34-1754

IRS Monitor
Figure 26/34-63-00-990-848



Menu
Figure 27/34-63-00-990-849



Acceptable Position Entry Formats For IRS/REF
Figure 28/34-63-00-990-875

4. **Operating Instructions - FMS Data Loader**

A. Load Data

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

(2) Connect one end of cable (stored in data loader case), to J1 of data loader, and other end to aircraft data loader receptacle.

(3) Place function SELECT switch on data loader to 1 position.

(4) Insert tape cartridge into mounting slot of tape drive with metal plate toward EJECT control. Push cartridge in until locked in place.

NOTE: Data cartridge is keyed and can be installed only one way. It should slide in easily.

(5) Remove the safety tag and close this circuit breaker:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

(6) Place POWER switch on data loader to ON position.

(7) Wait for XFR COMPL or DATA XFR FAIL indicator to come on.

NOTE: If DATA FAIL indicator comes on, data loader must be powered down, then powered up. XFR COMPL indicator denotes data transfer complete.

(8) When data transfer complete, place power on data loader to OFF.

(9) Push EJECT control on data loader in until cartridge is ejected, half way.

(10) Pull data cartridge straight out.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(11) Open this circuit breaker and install safety tag:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

(12) Remove cable from data loader and aircraft receptacle and store in data loader cover.

(13) Remove the safety tag and close this circuit breaker:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

(14) Power up flight management system and make certain new data base appears on MCDU IDENT page opposite line select key 3R.

NOTE: For aircraft with dual AFMC's, refer to PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201, paragraph 4., for crossload procedures.

(15) Return aircraft to required configuration.

5. MCDU Alert Messages

Table 3

Message	Cause
AHRS (1) FAIL	Either AHRS (1) has stopped sending data to the AFMC or it is sending data that is not valid.
AHRS (2) FAIL	Either AHRS (2) has stopped sending data to the AFMC or it is sending data that is not valid.
ALT CONSTRAINT ALTERED	When a constraint or part of a constraint is not applied due to cruise altitude comparison.
CADC (1) DATA FAIL	The AFMC has determined that CADC (1) data is NOT valid.
CADC (2) DATA FAIL	The AFMC has determined that CADC (2) data is NOT valid.
CHECK ALT TGT	VNAV is engaged and the aircraft is between the FGCP and AFMC target altitude. Engine Out mode is EXECuted and the aircraft has slowed to the E/O speed + 5 knots, and the aircraft is level at the FGCP window altitude which is higher than E/O maximum altitude (amber MCDU MSG on PFD).
CHECK MAX ALT	VNAV is engaged and Engine Out mode is EXECuted and the E/O maximum altitude drops below the cruise altitude (amber MCDU MSG on PFD).
CLOCK FAIL	Either CLOCK has stopped sending data to the AFMC or it is sending data that is not valid.
DEAD RECKONING *[1]	AFMC in DEAD RECKONING mode for navigation (amber D/R on PFD).
DESCENT PATH DELETED	VNAV is engaged and all waypoint altitude constraints defining descent path are deleted.
DESCENT PATH INHIBITED	VNAV is engaged and in descent, NAV is disengaged, the vertical guidance has not been terminated, and either the track angle error is greater than 90 degrees and the roll command error is greater than 20 degrees or the crosstrack error is greater than 21 nautical miles (amber MCDU MSG on the PFD).
DFGC (1) BUS FAIL	No data has come from the DFGC (1) for more than 1 second.
DFGC (2) BUS FAIL	No data has come from the DFGC (2) for more than 1 second.
DFGC MISC DATA (1) FAIL	The DFGC has determined that miscellaneous data from the No. 1 side is NOT valid. The miscellaneous DFGC data consists of EPR data, THROTTLE data, ALT SEL, FLAPS, SLATS, and EPR LIM.
DFGC MISC DATA (2) FAIL	The DFGC has determined that miscellaneous data from the No. 2 side is NOT valid. The miscellaneous DFGC data consists of EPR data, THROTTLE data, ALT SEL, FLAPS, SLATS, and EPR LIM.

Table 3 (Continued)

Message	Cause
DISCONTINUITY	NAV is engaged and aircraft entered route discontinuity. NAV will disengage in a DISCONTINUITY if the current track does not intercept the active leg (amber MCDU MSG in PFD).
DME (1) FAIL	Either DME (1) has stopped sending data to the AFMC or it is sending data that is not valid.
DME (2) FAIL	Either DME (2) has stopped sending data to the AFMC or it is sending data that is not valid.
DRAG REQUIRED	VNAV is engaged and additional drag is required to track descent path and maintain commanded speed (amber MCDU MSG on PFD).
END OF OFFSET	NAV is engaged and end of active route offset overflown. NAV will disengage at END OF OFFSET if not on intercept track (amber MCDU MSG on PFD)
END OF ROUTE	NAV is engaged and end of active route overflown. NAV will disengage at END OF ROUTE (amber MCDU MSG on PFD).
FUEL QTY ERROR- PROG 2/2	Fuel totalizer and calculated values disagree by 3000 lb (1360 kg).
FUEL FLOW (1) DATA FAIL	The data computed by the AFMC for fuel flow from FUEL FLOW SENSOR (1) is either out of bounds for the reasonableness check or has exceeded the delta check limit.
FUEL FLOW (2) DATA FAIL	The data computed by the AFMC for fuel flow from FUEL FLOW SENSOR (2) is either out of bounds for the reasonableness check or has exceeded the delta check limit.
FUEL QTY SENSOR FAIL	Either the FQS has stopped sending data to the AFMC or it is sending data that is not valid.
ILS (1) DATA FAIL	The DFGC has determined that the data from ILS (1) is NOT valid, or the SSM for the ILS FREQUENCY indicates FAIL.
ILS (2) DATA FAIL	The DFGC has determined that the data from ILS (2) is NOT valid, or the SSM for the ILS FREQUENCY indicates FAIL.
INSUFFICIENT FUEL	Estimated fuel at destination is less than RESERVES value (amber MCDU MSG on PFD).
INVALID DFGC CONFIG	One or both of the DFGCs are not -970 or later. This message will flash in the scratchpad and prevents any data entry (amber MCDU MSG on PFD).
IRS (1) FAIL *[2]	Either IRU (1) has stopped transmitting data or the data transmitted is not valid.
IRS (2) FAIL *[2]	Either IRU (2) has stopped transmitting data or the data transmitted is not valid.
IRS NAV ONLY *[2]	AFMC has been navigating without radio updating for more than 12 minutes above or 10 minutes below 15,000 feet.
LIMIT ALT FLNNN	VNAV engagement is attempted and aircraft altitude is approaching or exceeding the VNAV maneuver limit altitude.
LONG RANGE VOR *[1]	NAV is engaged and the FMS is in the DME-VOR mode of navigation and the VOR navaid being tuned is more than 150 nautical miles from the aircraft (amber MCDU MSG on PFD).

Table 3 (Continued)

Message	Cause
LOW TEMP CONDITION	VNAV is engaged and airfoil anti-ice is required and engine EPR at upper limit (amber MCDU MSG on PFD).
NO ACTIVE ROUTE	NAV selected, but no route is activated.
NOT ON INTERCEPT TRACK	NAV selected and aircraft outside active leg capture criteria and current track will not intercept the active leg (amber MCDU MSG on PFD).
PERF/NAV UNAVAILABLE	NAV selected without gross weight, cost index, and cruise altitude entry.
PERF/VNAV UNAVAILABLE	VNAV selected without gross weight, cost index, and cruise altitude entry.
PLATFORM (1) DATA FAIL	The DFGC has determined that platform (1) data is NOT valid. The platform data consists of NORM ACC, LONG ACC, MAG HDG, PITCH, ROLL, and VERT ACC.
NOTE: The failure of R2-47 can also cause this message PLATFORM (1) DATA FAIL or PLATFORM (2) DATA FAIL.	
PLATFORM (2) DATA FAIL	The DFGC has determined that platform (2) data is NOT valid. The platform data consists of NORM ACC, LONG ACC, MAG HDG, PITCH, ROLL, and VERT ACC.
NOTE: The failure of R2-47 can also cause this message PLATFORM (1) DATA FAIL or PLATFORM (2) DATA FAIL.	
RADIO ONLY	AFMC in RADIO ONLY mode for navigation. Note: This message will be displayed only if radio data is valid and IRS or AHRS has failed. At this point, the FMS will drop out of NAV and VNAV.
RE-ENTER IRS POSITION *[2]	Position entered though the MCDU does not correspond to the internal (or previously entered) IRU position.
RESET FGCP ALT	VNAV is engaged and approaching T/D point with FGCP set at or above cruise altitude (amber MCDU MSG on PFD).
RESYNC FAIL- SINGLE AFMC	Resynchronization is unsuccessful and one AFMC is shut down (amber MCDU MSG on PFD - split message).
RESYNCING OTHER AFMC	One AFMC is being resynchronized by the other AFMC (split message).
SELECT MCT	Engine Out mode is selected with a thrust mode other than MCT selected (amber MCDU MSG on PFD).
SELECT TRUE HDG *[2]	MAG/TRUE switch selected to MAG state and the aircraft is approaching a latitude in which the magnetic heading becomes invalid (73 degrees North latitude and 60 degrees South latitude - amber MCDU MSG on PFD).
SIMSOFT ENGAGED	SimSoft becomes operational.
SINGLE AFMC OPERATION	One AFMC is inoperative (amber MCDU MSG on PFD - split message).
TUNE NAV - XXXX	RNAV or VOR approach procedure requires a specific navaid to be tuned, and it is either not tuned or a valid signal is not being received (amber MCDU MSG on PFD).
UNABLE NEXT ALT	VNAV is engaged and climb gradient not great enough to comply with waypoint altitude constraint.
VERIFY IRS POSITIONS *[2]	Position and velocity data from the two IRUs exceed the comparison threshold (4+3t up to 25 nautical miles for position and 20 knots for velocity (amber MCDU MSG on PFD).

Table 3 (Continued)

Message	Cause
VERIFY POSITION	When the radio position is more than 12 nautical miles from the AFMC position, or two AFMC positions are more than 4 nautical miles apart.
VOR (1) FAIL	Either VOR (1) has stopped sending data to the AFMC, or it is sending invalid data.
VOR (2) FAIL	Either VOR (2) has stopped sending data to the AFMC, or it is sending invalid data.
ARRIVAL N/A FOR RUNWAY	Selected arrival and runway are incompatible.
CRS REVERSAL AT FA FIX	Entered route contains a course reversal at final approach fix.
INVALID DELETE	Delete function attempted where not allowed.
INVALID ENTRY	The entry has an incorrect format and/or range.
NOT IN DATA BASE	Data not in navigation data base.
ROUTE FULL	AFMC route is filled to allowable waypoint capacity.
RUNWAY N/A FOR SID	Runway not compatible with SID.
RUNWAY NOT SPECIFIED	Runway update prompt on TAKEOFF REF page was depressed when a runway had not been specified.
STANDBY ONE	The AFMC requires more than 6 seconds to complete requested flight plan operation.
DELETE	DEL key pushed.
MAX ALT FLNNN	Entered cruise altitude greater than AFMC computed maximum altitude for specified vertical modes.
NNNNN	VNAV is engaged, CLIMB or CRUISE page displayed, and new cruise altitude set in FGCP (NNNNN).
NO ACTIVE ROUTE	DIR/INTC key pushed without active route.
NOT ON AIRWAY	Attempting to close an airway with a waypoint that is not on that airway.
RW/ILS FREQ ERROR	LOC captured and ILS frequency does not match frequency for runway in active route.
UNABLE CRZ ALT	Entered cruise altitude results in a zero cruise time prediction.

*[1] Denotes Non-IRS-equipped aircraft only.

*[2] Denotes IRS-equipped aircraft only.

FLIGHT MANAGEMENT SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Flight Management System (FMS) provides the means for the Captain or First Officer to initiate aircraft control in automatic navigation, lateral and vertical guidance commands, Electronic Flight Instrument System (EFIS) MAP OR PLAN display information and the most advantageous aircraft flight performance.

B. The dual FMS is integrated with the Digital Flight Guidance System (DFGS) to provide the automatic pitch, roll and thrust during climb, cruise and descent aircraft operations. The coordination of pitch, roll and thrust during lateral and vertical navigation effects efficient fuel consumption and cost efficiency within the limitations of the commanded flight plan, altitude clearance limits and airplane performance limits.

C. The dual FMS consists of two Multipurpose Control Display Units (MCDU), two Advanced Flight Management Computers (AFMC) and an FMS source select switch. The MCDUs are located one each on the left and right sides of the forward pedestal in the flight compartment. The AFMCs are located in the electrical/electronics (E/E) compartment on the aft left and right radio racks. The FMS source select switch is located on the overhead, and allows either MCDU to operate from the cross-side AFMC in the event of an on-side failure.

D. Navigation data (software) is usually loaded into the AFMC by a data loader every 28 days by the ground crew. The data loader provides for the down loading of a floppy diskette of updated navigation data as required by the operating airline. An airborne data loader, located below the First Officer's briefcase stowage rack, is connected to the AFMC.

2. Description

A. The FMS utilizes data from aircraft systems to accomplish the functions of airplane control in automatic navigation, lateral and vertical guidance commands, EFIS MAP OR PLAN display and the most optimum flight performance. (Figure 1)

B. GPS position, navigation aids (NAVAIDS), distance measuring equipment (DME), very high frequency (VHF) omni range (VOR) and instrument landing system data are supplied to the AFMC for FMS inflight control. The NAVAIDS are initiated through frequency tuning at the CAPT/FO VHF/NAV control panel or the AFMC has thecapability of DME autotuning, activated by the AFMC navigation data base (NDB). The central air data computers supply pressure altitude, Mach, calibrated air speed (CAS) and true air speed (TAS) to the AFMC for vertical guidance and speed control through autothrottle operation. The attitude/heading reference system (AHRS) provides attitude, heading, validity velocities, and acceleration data to the AFMC. This data is processed by the AFMC to provide navigation, guidance and performance functions by the FMS. The CAPTs electronic clock supplies current Greenwich Mean Time (GMT) to the AFMC for FMS navigation functions.

C. The engine displays provide fuel flow and engine pressure ratio data to the AFMC for FMS optimum aircraft performance functions.

D. The Electronic Flight Instrument System (EFIS) symbol generators receive navigation data from the AFMC and generates the symbology for the MAP or displays on the EFIS Navigation Display (ND).

E. The multipurpose control display unit is the interface between the AFMC and the CAPT/F/O. CAPT/F/O data entered into the MCDU is provided to the AFMC. The AFMC in turn supplies the necessary processed information to the MCDU for display on the MCDU. Refer to Paragraph 5. for MCDU alert messages.

F. The AFMC's are integrated with the Digital Flight Guidance Computers (DFGC) to process mode logic and selection data, thrust settings, EPR ratings, CADC data, attitude/heading, localizer data, flaps/slats and radio data for all navigation, guidance and performance functions and MCDU displays. The AFMC's process data from only one DFGC at a time. The DFGC data selected for processing depends on the status of the DFGS. In general the selection is based on the following criteria, given in the order of descending priority: autopilot engagement, autothrottle engagement, and flight director engagement.

G. The airborne data loader receptacle provides the capability for loading the current airline navigation data into the AFMC. Data from AFMC 1 is cross loaded to AFMC via the MCDU NAV DATA CROSSLOAD page.

H. The proximity switch electronics unit provides a weight on wheels (WOW) discrete signal to the AFMC for airplane inflight or on ground determination.

I. The thermal control AMPs provide temperature information regarding the airfoil anti-ice system.

J. The ACARS (automatic communications addressing and reporting system) interface is a growth option for future integration with the AFMC.

K. MCDU - The MCDU is the interface unit between the Captain/First Officer and the AFMC. The MCDU provides the means for the Captain/First Officer to manually insert system control parameters and select modes of operation. The MCDU also provides AFMC readout capability as well as verification of data entered. Flight plan and advisory data are continuously available for display on the MCDU.

L. The MCDU consists of the following controls and indicators and their function. (Figure 2)

(1) Cathode Ray Tube (CRT) - AFMC generated data, command entries and performance data are displayed on the CRT. The bottom line of the CRT is the scratchpad. Typed alphanumeric characters and AFMC generated messages are displayed on this line.

(2) Line Select Keys (LSK) - The LSKs provide for entry of data from the scratchpad into selected line and field. When field is selectable, pressing key with scratchpad empty will enter content of that line and field into scratchpad. Also provides access to data or function identified by that field. There are six line select keys on each side of the CRT. The left side keys are identified as L1, L2, L3, L4, L5 and L6. The right side keys are identified as R1, R2, R3, R4, R5 and R6.

(3) Bright Adjust (BRT) provides control for increasing or decreasing brightness of CRT display.

(4) Annunciators

- MENU - Comes on whenever any non-active system has a request pending.
- MSG (Message) - Comes on when an AFMC generated message is displayed in the scratchpad.
- DSPY (Display) - Comes on when current display is not related to active flight plan leg or the current operational performance mode.
- OFST (Offset) - Comes on when a parallel offset is in use.

(5) CLR (Clear) - Single brief presses of the key will cause a message or the last character in the scratchpad to be erased. A longer press of key will erase entire contents of scratchpad.

(6) DEL (Delete) - Pressing the key inserts DELETE Into scratchpad. Line selection into a deletable field deletes data in the field.

(7) ALPHA KEYS - Pressing the key enters the selected alphabetic character into the scratchpad.

(8) NUMERIC KEYS - Pressing the key enters the selected number in scratchpad.

(9) FUNCTION AND MODE KEYS

- EXEC (Execute) - The EXEC key is the command key of the AFMC. The key activates changes to the active flight plan and/or to the vertical guidance mode. Such changes require a two step keyboard procedure: Entry and review of data and pressing the EXEC key to activate the change. The key contains a light bar that comes on whenever the displayed page contains data defining a modification. Pressing the key while the light bar is on results in the execution of the modification.
- NEXT PAGE - Pressing the key causes the MCDU to display the next page of a multiple page display.
- PREV PAGE (Previous Page) - Pressing the key causes the MCDU to display the previous page of a multiple page display.
- INIT/REF (Initialization/Reference) - Provides access to pages of data required for initialization of the FMS, AHRS (or IRS, if installed) and various categories of reference data.
- RTE (route) - Provides clearance language access to both routes entered.
- DIR/INTC (Direct/Intercept) - Provides for development of a guidance path to fly aircraft from present position direct to any designated geographic reference point (waypoint) or to intercept a designated course to a specified waypoint.
- HOLD - Provides for definition of a holding pattern at any designated waypoint or present position.
- LEGS - Provides detailed data concerning all legs of a flight plan. Allows for detailed data entry of each leg of flight plan.
- DEP/ARR (Departure/Arrival) - Provides for selection of departure and/or arrival procedures and runways.
- PROG (Progress) - Displays current dynamic flight information such as distance to go, fuel weight, wind, etc.
- FIX - Allows the creation of waypoint fixes from the intersection points between the present route and selected radials from known waypoints.
- CLB (Climb) - Pressing key will display current or planned climb mode. Evaluation and selection of other climb modes as the commanded climb mode can be made.
- CRZ (Cruise) - Pressing key will display current or planned cruise mode. Evaluation and selection of other cruise modes as the commanded cruise mode can be made.
- DES (Descent) - Pressing key will display current or planned descent mode. Evaluation and selection of other descent modes as the commanded descent mode can be made.
- MENU (MCDU Main Menu) - Provides a menu for selecting MCDU subsystems.

M. AFMC - The AFMC receives and processes information from the following sources (Figure 3):

Table 1

SOURCE	DATA
Attitude/Heading Reference System (AHRS)	Attitude, Heading, Velocities, Accelerations
Air Data Computers (ADC)	Altitude, Mach, CAS, TAS
Global Navigation System Sensor Unit (GNSSU)	GPS Position, UTC Time
VHF Omnirange (VOR)	VOR Bearing, Frequency
Distance Measuring Equipment (DME)	Range, Frequency
Multipurpose Control Display Unit	Keyboard, Mode Key Data, Status

Table 1 (Continued)

SOURCE	DATA
EFIS Symbol Generator	Display Data & Control (Navigation Display)
Digital Flight Guidance Computer	Mode Logic and Selection Data, Thrust Setting, EPR/N1 Ratings, ADC Data, Attitude/Heading Data, Localizer/Data, Flap/Slats Data
Electronic Clock	Greenwich Mean Time (GMT)
Engine Display Panel	Fuel Flow, EPR
Airborne Data Loader	Navigation Data

NOTE: The above AFMC processed data along with the Captain/First Officer entered data via the MCDU initiates the following functions:

- Navigation
- Performance
- Guidance
- AFMC Data Base
- EFIS Interface

N. A simplified description of the AFMC functions are as follows:

(1) Navigation Functions

(a) Horizontal navigation programs combine data from the navigation data base (NDB), attitude and heading from AHRS position data from the optional Global Navigation System Sensor Units (GNSSU's), range and bearing from VOR/DME stations and altitude and true airspeed from central air data computer to generate aircraft position, velocity, track angle and wind vector data.

(b) The twenty closest navaids within 200 nautical miles of the AFMC computed aircraft position are compiled from the navigation data base every two minutes. Navigation selects from this list a collated VOR/DME or two DME stations that will yield the most accurate estimate of the aircraft position.

(c) A terminal area position update function is available if the ILS frequency matches the frequency specified for the selected approach procedure or runway. The ILS LOC deviation updates position in a direction normal to the final approach path.

(d) AHRS and CADC altitude processing filters the CAPT/F/O entered barometer correction to prevent undesirable vertical maneuvers which can result when baro correction is allowed to change suddenly.

(2) Performance Functions - The AFMC computes the aircraft most advantageous vertical profile as described in the following:

(a) Optimal Speed Computation - This computation relates to speed targets which result in the most advantageous aircraft performance. The available profile modes are: maximum angle of climb, engine-out climb, economy climb, economy cruise, long range cruise, engine-out cruise, engine-out driftdown, minimum drag holding and economy descent.

(b) Economy Climb Speed - The economy climb speed target is a constant calibrated air speed (CAS), constant Mach schedule to obtain the minimum airplane operating cost per mile traveled enroute.

(c) Maximum Angle Climb Speed - The maximum angle climb speed target is a variable CAS versus gross weight speed schedule stored in the AFMC data base.

(d) Engine-Out Climb Speed - The engine-out climb speed target is a CAS value that corresponds to maximum engine-out lift-over-drag (L/D) ratio.

(e) Economy Cruise Speed - The economy cruise speed target is a Mach value which results in minimum operating cost per mile traveled enroute at the specified altitude.

(f) Long Range Cruise (LRC) Speed - The LRC speed is a Mach target which is optimized to provide 99 percent of the airplanes maximum still air range at the specified cruise altitude. The speed gives the lowest cruise speed which can be flown.

(g) Engine-Out Cruise & Driftdown Speeds - The engine-out cruise speed targets are driftdown speeds and engine-out long range cruise. Driftdown speed is a CAS value which corresponds to the maximum engine-out L/D. Engine-out long range cruise speed is a Mach value which is optimized to provide 99 percent of the airplanes maximum still air range in the engine-out configuration.

(h) Economy Descent Speed - The economy descent speed target is a constant Mach, constant CAS schedule which is optimized to obtain the minimum airplane operating cost per mile traveled enroute.

(i) Minimum Drag Holding - Minimum drag holding target is the CAS value which corresponds to maximum L/D with flaps up. The best hold speeds are computed in the same manner as engine-out climb and driftdown speeds using best L/D coefficient of lift and Mach cutoff values stored in the data base.

(j) Speed Envelope - The speed envelope function of the AFMC computes the maximum operating speeds for any given altitude, weight and configuration constraint such as flaps position, maneuver load factor and VMO/MMO.

(k) Minimum Speed Limits - Minimum speed limits are established by considering low speed initial buffet boundary at a specified maneuver margin with flaps up and the minimum flaps extended speeds which meet maneuver criteria for operation at V/REF (Approach Reference Speed).

(l) Buffet Bank Angle - Buffet bank angle is established by the AFMC as the bank angle which increases load factor by a value which is less than the specified maneuvering load factor margin with respect to initial buffet.

(m) Maximum Altitude - Maximum altitude is established by the AFMC as the highest altitude to which the airplane can climb where neither the planned climb speed or the selected cruise speed will be affected by the speed envelope and where sufficient excess thrust is available to provide a specified rate of climb capability.

(n) Engine OUT Drift Down Altitude - Engine-out driftdown altitude is the maximum altitude that can be maintained with single engine operation generating maximum continuous thrust at a speed corresponding to maximum L/D.

(o) Engine Out Maximum Altitude - Engine-out maximum altitude is maximum altitude than can be maintained with single engine operation generating maximum continuous thrust at a speed corresponding to single engine long range cruise.

(p) Optimum Cruise Altitude - Optimum cruise altitude is established by the AFMC at that altitude which provides the lowest operating cost for the economy cruise speed mode or best fuel mileage for the LRC (long range cruise) and speed select modes. The calculated optimum altitude considers trip length so a specified minimum cruise time will be obtained.

(q) Flight Path Predictions - Flight path predictions are computed by the AFMC using an origin to destination trajectory which is based on gross weight, cost index and MCDU entered specified modes for climb at CLB thrust cruise and flight idle descent plus allowances for takeoff approach and acceleration requirements between the legs of the vertical profile. The predications are updated periodically as the flight progresses to account for winds, route modifications, actual fuel remaining and actual times of arrival at waypoints.

(r) Descent Path Synthesis - Descent path synthesis predicts the descent path by assuming flight idle thrust. The computation starts at the bottom of the descent point and integrates in reverse direction to intersect the cruise altitude at top of descent.

(s) Step Climb - Step climb function computes the best point along the route to start a limit climb thrust segment to a higher cruising altitude which will result in a minimum trip cost for the economy cruise mode or minimum trip fuel consumption for the LRC and selected speed cruise modes.

(t) Approach Speed - Approach speed targets (V/REF) are extracted from the data base as a function of calculated gross weight and the various flap settings.

(u) AFMC Current Fuel/Weight - AFMC current fuel/weight calculation is a prerequisite for all other performance computations. It is initiated and displayed as the sum of a Captain/ First Officer entry of zero fuel weight and fuel quantity weight on the MCDU before engine start. This data is displayed on the MCDU and stored for all future calculations.

WJE 405-411, 880, 881, 883, 884

(v) With Service Bulletin 34-277 incorporated, GPS Navigation is provided as well as an expanded 1 Meg format navigation data base. In addition, the -926 AFMC corrects a number of timeout related problems. The AFMCs part numbers 4052504-921, -922, -923, -924, and -925 are upgraded to 4052504-926 and meet the FAA requirements.

WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD

(3) Guidance Function Lateral

(a) The lateral guidance function compares the airplanes actual position with the desired flight path and generates steering commands to the autopilot and flight director systems to cause the airplane to fly along the desired path. Great circle paths join the route waypoints and circular transition arcs are formed between the route legs by the AFMC. The airplane progress along each path segment is continuously monitored to determine when a path transition should be initiated.

(b) The lateral guidance function mode is initiated by pressing the NAV key on the flight guidance control panel (FGCP). The ARM annunciation will come on the flight mode annunciator (FMA) if the digital flight guidance computer (DFGC) determines NAV engagement parameters have been met.

(4) Guidance Function Vertical

(a) Vertical guidance functions are the climb, cruise and descent phases of the flight plan. The AFMC flight planning capability provides entering of published departure, arrival and approach segments and individual waypoints that include altitude constraints. These constraints as well as the entered cruise altitude and cost index, define the vertical profile for which the AFMC provides guidance.

(b) In the climb portion of the profile, the autothrottle portion of the DFGC will control thrust while speed is maintained by the vertical navigation pitch commands from the AFMC. The aircraft will climb at climb limit thrust to each altitude constraint, fly level at cruise thrust until past the restraining waypoint and then resume the climb at climb limit thrust. The speed schedule is determined by the speed transition altitude which is stored in the data base with the origin airport. Below the transition altitude, the speed is limited to 250 knots in climb. Above the speed transition altitude, the system defaults to any economy climb schedule which is a function of gross weight at top of the climb, entered cruise altitude and the entered cost index. After reaching cruise altitude, vertical navigation will maintain an economy cruise or Captain/First Officer entered speed through the MCDU until the descent phase is reached.

(c) In the descent portion of the profile, VNAV guidance controls aircraft pitch in a manner similar to the tracking of a glide slope on an ILS beam except the path (plane) is internally generated. When flying the descent path, VNAV pitch commands to the DFGC hold the path while the throttle or speed brake is used to maintain speed if a significant acceleration occurs that was not anticipated such as weather disturbances.

(d) The vertical guidance function is selected by pressing the VNAV key located on the digital flight guidance control panel on the main instrument panel in the flight compartment.

(e) All profile changes should end up with pressing the VNAV key to start the maneuver.

(5) AFMC Data Base

(a) The information stored in the AFMC is the operation program and two data bases. The data bases contain, performance related data and navigation related data. The performance data base information reduces the need for the Captain/First Officer to refer to a performance manual during flight and provides the AFMC that data required to transmit pitch and thrust commands to the DFGC. The performance data base in the AFMC also provides detail predictions along the entire aircraft flight path.

(b) The AFMC navigation data base includes most of the information that the Captain/First Officer would normally need by referring to navigation charts. The information can be displayed on the MCDU or Electronic flight Instrument System (EFIS) navigation display (ND).

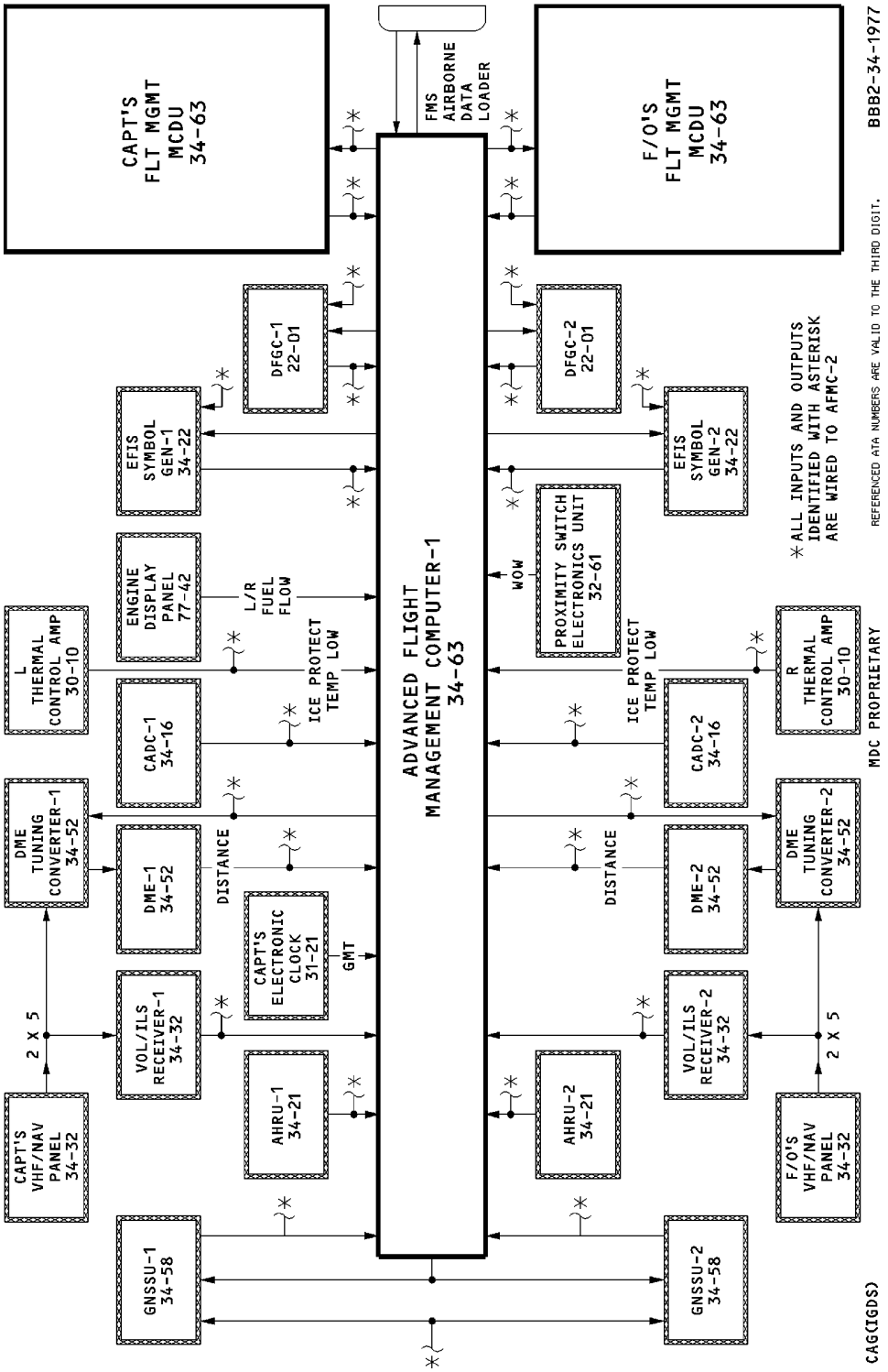
(c) The navigation base is tailored to a specific airline. The stored data includes location of VHF navigation aids, airports, runways, geographical reference points and other airline selected information such as standard instrument departures (SID), standard terminal arrival routes (STAR), approaches and company routes. The contents of the navigation data base is usually updated every 28 days. This is accomplished by the maintenance crew through use of the airborne data base loader.

(6) EFIS Interface

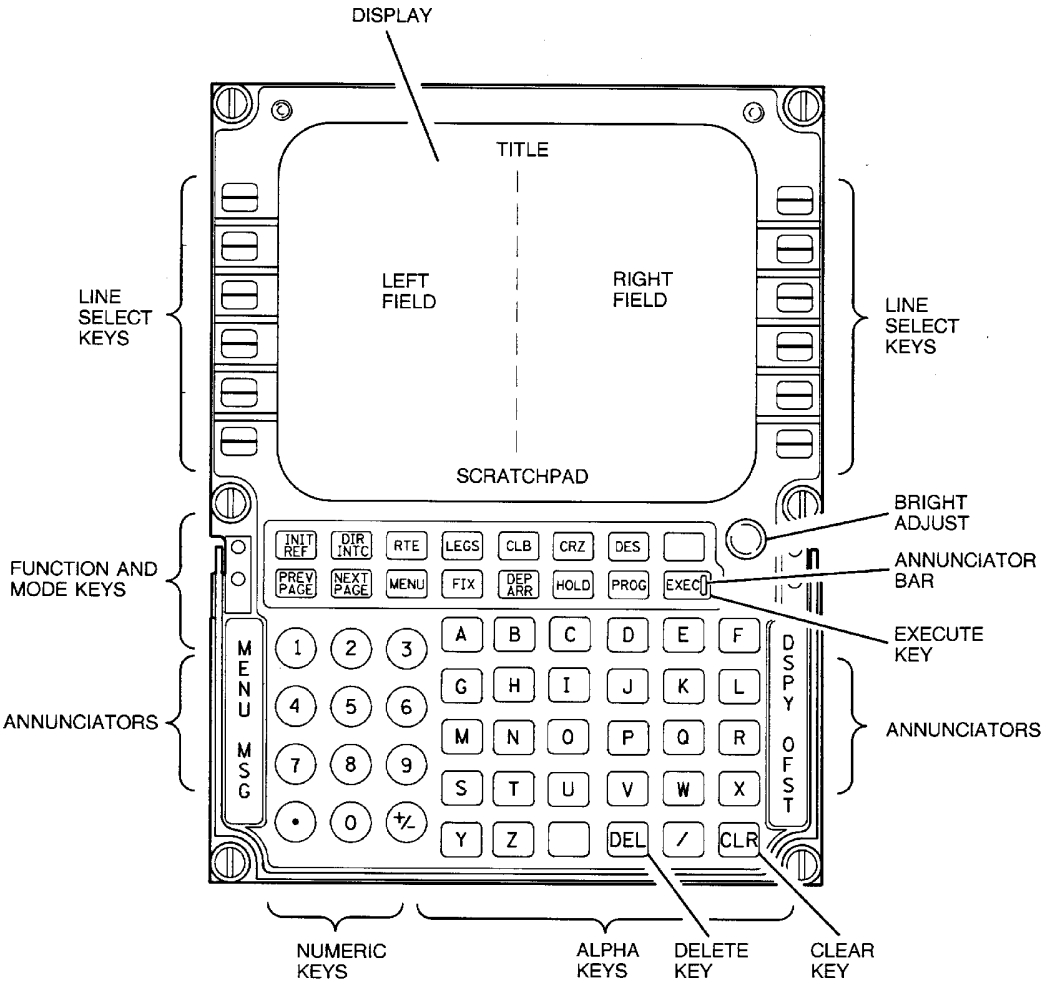
(a) The FMS interfaces with the Electronic Flight Instrument System (EFIS) to provide a MAP or PLAN display on the EFIS Navigation Display (ND). THE AFMC is the primary source of data for the EFIS ND when the EFIS mode selector panel MODE selector is set to MAP or PLAN position. The mode selector control panel (Figure 4) provides the means for selection of MODE, RANGE and background data selections. The background selections are pushbuttons designated N-AID (navigational aids), ARPT (airport), DATA (WPT data) and WPT (waypoint). Pressing the N-AID button will cause display of the navaids that are in the data base within the current range. Pressing the ARPT button will cause display of the airports that are in the data base within the current range. Pressing the DATA button will cause the display of constraint altitudes and ETA (estimated time of arrival) of all waypoints defined in the displayed active route. Pressing the WPT button will cause display of the data base waypoints not on the active route when the range of the display is 40 nautical miles or less. To remove (declutter) unwanted data, press the pertinent pushbutton a second time.

(b) The AFMC EFIS interface provides navigation data to the EFIS symbol generators which initiate a MAP or PLAN mode, as selected and displayed on the EFIS navigation display (ND). The difference between the MAP and PLAN mode displays is the MAP display is dynamic, oriented track or heading up and shows the aircraft position relative to the active or inactive flight plan and other earth referenced data. The PLAN mode display is oriented north up and used by the Captain/First Officer to look ahead in the flight plan and review what a portion of the flight plan looks like. The reference point for the PLAN mode is the center of the ND, as selected on the MCDU. (Figure 5) and and (Figure 6)

(7) Airborne Data Loader - The airborne data loader (Figure 7) used to transfer the current navigation data or op-program into the AFMC. The data is transferred from a diskette in the data loader to mass memory in the AFMC. Power to the data loader is supplied from the aircraft. The NDB diskette is updated periodically for transfer of current data to the AFMC. This update is every 28 days. The data loader is part of the aircraft on-board equipment. For operating instructions of the Data Loader, (Paragraph 3.). Bite download from either AFMC to the ADL is accomplished by inserting a special "BITE Download" diskette into the ADL with the ADL selector switch in either the AFMC-1 or AFMC-2 position for each respective BITE download.



Flight Management System
Figure 1/34-63-00-990-805

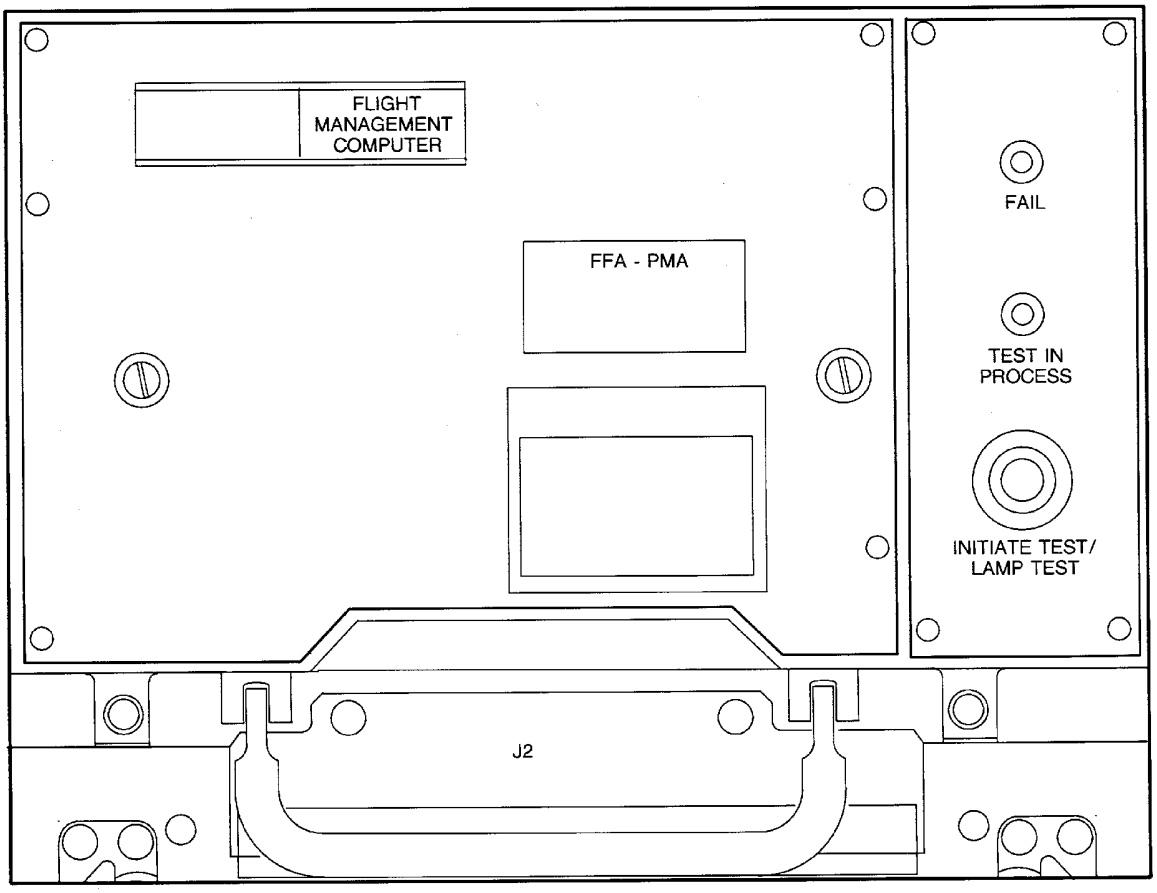


CAG(IGDS)

BBB2-34-1109

Multipurpose Control Display Unit (MCDU)
Figure 2/34-63-00-990-806

EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD

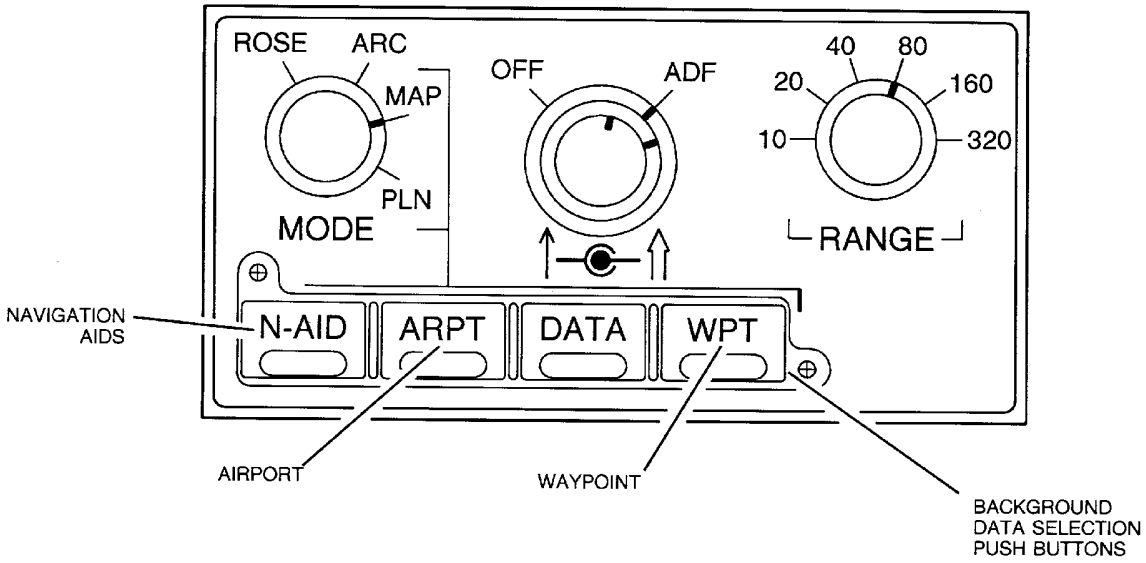


CAG(IGDS)

BBB2-34-1110

Advanced Flight Management Computer (AFMC)
Figure 3/34-63-00-990-807

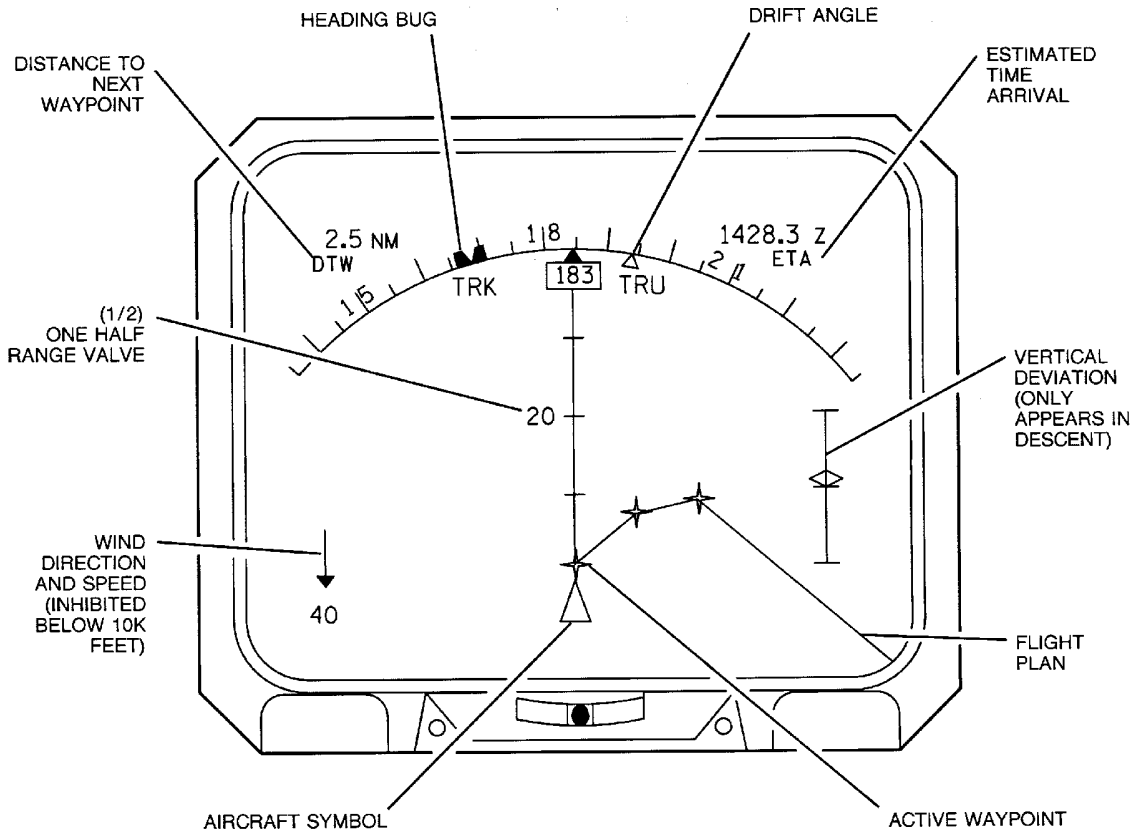
EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD



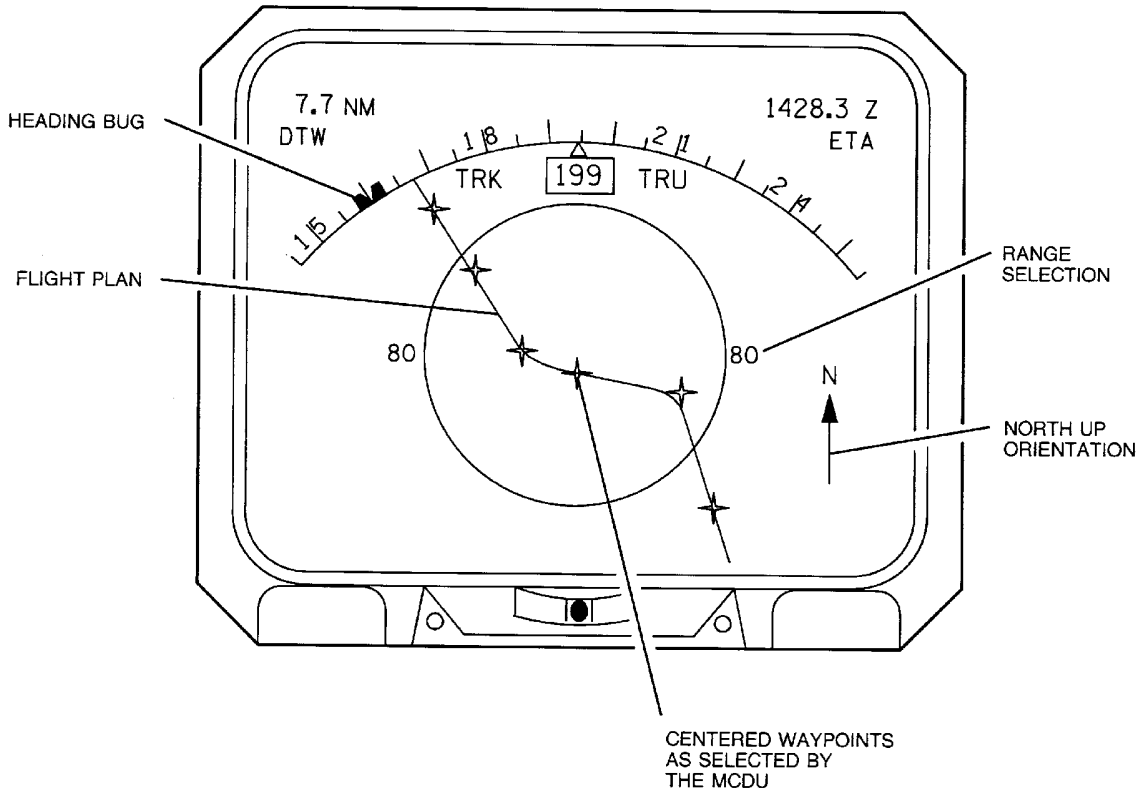
CAG(IGDS)

BBB2-34-1111

Mode Selector Control Panel (MSP)
Figure 4/34-63-00-990-808



EFIS MAP Mode Display
Figure 5/34-63-00-990-809

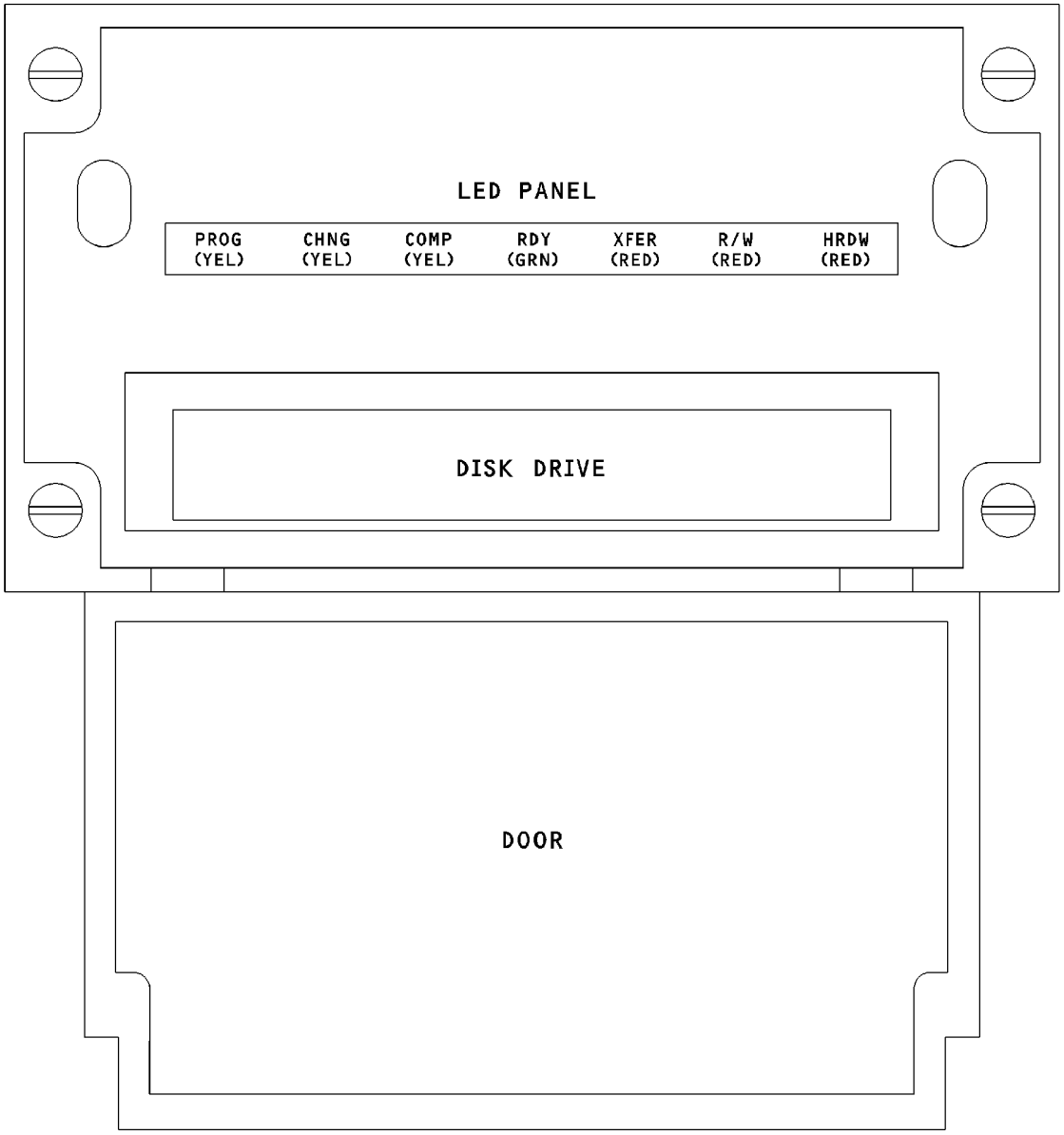


CAG(IGDS)

BBB2-34-1113

EFIS PLAN Mode Display
Figure 6/34-63-00-990-810

EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD



Airborne Data Loader
Figure 7/34-63-00-990-811

3. Operation

A. When the FMS is powered up, the FMS executes an internal self test. Upon successful completion of the self test, the MCDU displays the first page of the highest priority subsystem on the MCDU unless unable to establish communication with that subsystem. The AFMC is the primary subsystem therefore the FMS IDENT page is displayed. (Figure 9)

B. The following text and associated art describes the functions of the FMS through use of the MCDU line select keys (LSK) and the MCDU function and mode keys. The subtitles, Page Access, Purpose and Use are applicable to the operational description as follows:

(1) Page Access - The page access denotes the MCDU LSK or MCDU function and mode keys to use for access to the pertinent page displayed from another page or by use of the MCDU function and mode keys.

(2) Purpose - The purpose denotes the functional program of the page.

(3) Use - The use describes the function of the LSKs.

(4) The S, E and D designations beside the LSKs on page displays denote the LSKs as select, enter or delete keys. They can be designated in combination. The designations do not appear on the MCDU.

(5) The ALPHA/NUMERICS displayed on the MCDU pages are not necessarily the true display; as an example, Longitude and Latitudes and Greenwich Mean Time (GMT) are picked at random for display purposes.

C. Initialization Reference Index

Table 2

Page Access: (Figure 8)

6L on IDENT page	6L on TAKEOFF page
6L on POS INIT page	6L on REF NAV DATA page
6L on POS REF page	6L on APPROACH REF page
6L on PERF INIT page	6L on MAINT INDEX page

Purpose:

This page provides access to all initialization and reference pages.

Use:

Only selection is allowed on the page.
To display one of the initialization or reference pages, press the line select key adjacent to the desired title.

NOTE: To gain access to the MAINT INDEX page, a secret code must be entered into the scratchpad and then line selected to 6R on this page.

D. Identification

Page Access: (Figure 9)

Automatically displayed after 20 second time delay on power up 1L on INDEX page.

Purpose:

Provides a means of reviewing the AFMC data base and operational program configuration. If blanks are displayed in 1L, 2L, or 1R, then this page is frozen and all line select and mode keys are ignored.

Use:

(Continued)

1L - Displays the aircraft model as determined from the airframe/engine program pins. These program pins are read only on a long term power up while on the ground. If they do not match the stored performance data base, then blank will be displayed.

2L - Displays the navigation data base number. If the data base load complete bit is not set (indicating a bad data base load), blanks will be displayed.

4L - Displays the operational program serial number.

5L - Displays the drag factor which has been entered on the PERF FACTORS page.

6L - Displays INDEX prompt for selecting the INIT/REF INDEX page by pressing this key.

1R - Displays the engine identification number as determined from the airframe/engine program pins. These pins are only read on a long term power up while on the ground. If they do not match the stored performance data base, then blanks are displayed.

2R - Displays the active navigation data base cycle effective date.

CAUTION: CHANGING THE ACTIVE NAVIGATION DATA BASE WILL ERASE ANY FLIGHT PLAN AND ANY DATA WHICH MADE USE OF THE NAVIGATION DATA BASE.

3R - Displays the active navigation data base cycle effective date. Line selecting this field enters the gata into the scratchpad for selection into 2R.

5R - Displays the fuel flow factor which has been entered on the PERF FACTORS page.

6R - Displays the POS INIT prompt for selecting that page by pressing this key.

E. Position Initialize

Page Access: (Figure 10)

2L on INIT REF INDEX page

6R on IDENT page

4L on TAKEOFF REF page

PREV or NEXT page on POS REF page (2/2)

INIT REF mode key when position has not been entered

Purpose:

Provides a means of initializing the AFMC Greenwich to present ground position and setting the displayed Greenwich Mean Time (GMT) time.

Use:

2L - Dashes are displayed until a valid airport identifier is entered or the aircraft goes airborne. Valid entries, 4 character alphanumeric, must be in the data base. Valid entry causes airport reference Latitude/Longitude (LAT/LON) to be displayed in 2R. When a REF AIRPORT is entered on the POS INIT page, the REF AIRPORT is automatically transferred to ORIGIN or RTE 1 page, unless ORIGIN has already been entered.

3L - Displays blanks until 2L has valid entry, then displays dashes. Valid entries are gate identifiers contained in the data base, causing gate LAT/LON to be displayed in 3R. New entry into 2L deletes any previous 3L entry.

5L - Displays current GMT as read from the aircraft clock or blanks if the clock is not valid. Only the hours digits can be changed. Minutes are changed by resetting the Captain's clock (First Officer's clock for AFMC-2 if dual FMS installed).

(Continued)

6L -	Displays the INDEX prompt to allow selection of INIT REF INDEX page.
1R -	Displays the last computed AFMC position. Data is retained on power down.
2R -	Displays airport reference LAT/LON when valid airport identifier is entered in 2L.
3R -	Displays gate reference LAT/LON when valid gate identifier is entered in 3L.
4R -	Displays prompt boxes when aircraft is on the ground and IRS is in ALIGN MODE. If IRS is not installed, prompt boxes will be displayed until a position has been entered. Valid entries can be data selected from 1R, 2R, 3R, or entered directly into the scratchpad as N4726.2W12218.5 where leading zeros are required on the degrees. Valid entries can be without minutes and seconds as N47W122. Also entries can be Place, Bearing, and Distance as XXXXX NNN.N/ ZZZ.Z where XXXXX is the place, NNN.N is the bearing, and ZZZ.Z is the distance. Place, Bearing, Distance - (PBD) entries will be displayed in 4R as LAT/LON. Entered data is displayed until the aircraft transitions to airborne; then blanks are displayed.
5R -	Header displays SET IRS HDG if at least one IRS is in attitude mode. Dashes displayed in 5R before and after heading is entered. If IRS is not installed, 5R will be blank.
6R -	Displays the ROUTE prompt. Selection displays the active route or, if no active route, route 1 is displayed with the first page shown.

F. Position Reference

(1) POS REF (Page 2 of 3)

Page Access: (Figure 11)

Purpose:

This page displays the current AFMC computed position and GROUND SPEED (airborne).

Use:

1L -	Displays the computed AFMC position based on attitude, heading, and radio inputs. If the AFMC position is invalid, blanks are displayed. Data is selectable to the scratchpad.
2L -	No display.
3L -	Displays Required Navigation Performance (RNP) and Actual Navigation Performance in nautical miles.
4L -	Displays GNS (UTC) time.
6L -	Displays the INDEX prompt. Selecting this prompt displays the INIT REF INDEX page.
1R -	Displays AFMC ground speed.
2R -	No display.
3R -	No display.
4R -	Displays date (Month/Day).
5R -	Displays INHIBIT when GNS NAV is enabled. Pressing this line select key inhibits GNS NAV. Displays ENABLE when GNS NAV is inhibited. Pressing this line select key enables GNS NAV.
6R -	Displays route prompt, same as page 1/3.

(2) POS REF (Page 3 of 3)

Page Access: (Figure 11)

Purpose:

(Continued)

This page displays the current GNS 1 and GNS 2 positions and the bearing/distance from each GNS position to the current AFMC computed position.

Use:

1L - Displays the current GNS-1 position.

2L - Displays the current GNS-2 position.

3L - No display.

4L - No display.

5L - No display.

6L - Displays the INDEX prompt. Selecting this prompt displays the INIT REF INDEX page.

1R - No display.

2R - No display.

3R - No display.

4R - No display.

5R - No display.

6R - Displays route prompt, same as page 2/3.

G. Route

Page Access: (Figure 12)

4R of TAKEOFF page

6R on POS INIT page

6R on DEPARTURE page

6R on ARRIVALS page

RTE mode key

The route page displayed (RTE 1 or RTE 2) will depend on whether a route is active or which route was being worked with. In most cases, with an inactive route, RTE 1 will be displayed.

Purpose:

Provides a means of entering a desired route into the AFMC for guidance and reference.

Use:

1L - Displays the origin when entered. Valid entries are 4 character International Civil Aviation Organization (ICAO) airport identifiers contained in the navigation data base (NDB).

2L - Displays dashes until a company route is entered. A company route is a Navigation Data Base (NDB) stored airline route. Entry of a company route identifier will build the route which may or may not contain the departure and/or arrivals.

3L - Displays the selected runway as entered by the Captain/First Officer (CAPT/F/O) or as selected on the DEPARTURE page and must be compatible with the selected Standard Instrument Departure (SID) if one is selected.

4L - Displays the selected airway or DIRECT to the first waypoint displayed in 4R (selecting a SID inserts data into this area). If a waypoint is entered into 4R with dashes in 4L, DIRECT is automatically inserted into 4L.

(Continued)

5L - Displays the entered airway or DIRECT if no airway is entered and waypoint selection is made in 5R.

6L - Displays RTE 2 prompt (if on RTE 1). If the route is pending activation or a modification to the active route is pending, then the ERASE prompt is displayed and the EXEC annunciator is lit. Pressing the ERASE prompt erases all modifications or cancels the activation and turns off the EXEC annunciator light.

1R - Displays the destination as entered by the pilot or as selected by a company route that contains a destination. Entering a new destination over a previously entered one deletes all approach procedures associated with it.

2R - Is blank.

3R - Is blank.

4R - Displays the first waypoint in the flight plan as entered by the CAPT/F/O or from the company route.

5R - Displays the next selected waypoint.

6R - Displays the ACTIVATE prompt initially. Pressing the ACTIVATE prompt causes the EXEC annunciator to light. Pressing the EXEC key activates the flight plan. After activation, 6R displays PERF INIT, if the performance page is not completed, or TAKE OFF, if perfomance initialization is complete, and pressing 6R displays the corresponding page. If airborne, 6R will have a header for OFFSET and dashes are displayed. An offset of up to 99 nautical miles to the left or right can be entered (as Rxx or Lxx) providing the active leg is not part of an approach or a certain leg type and modification is not being made. In these cases the header is dashed and the data field is blank. Entering an offset causes the EXEC and DSPY annunciators to light. Pressing the EXEC key activates the offset, extinguishes the EXEC and DSPY annunciators and lights the OFST annunciator. Entry of O or DELETE into 6R cancels the offset.

If the flight plan is being manually entered and the present page is full, pressing the next page key displays a blank route page with the VIA header over 1L and the TO header over 1R, allowing 5 more entries. 6L and 6R remain the same.

H. Select Desired Waypoint

Page Access: (Figure 13)

Automatically whenever a non-unique identifier is entered.

Purpose:

Allows selection of the desired waypoint from the list of up to 6 waypoint which have the same identifier.

Use:

The header for each waypoint is the waypoint identifier. If the waypoint is a navaid, the frequency is displayed along with the latitude and longitude. If the waypoint is not a navaid, blanks are displayed where the frequency is normally displayed and the latitude and longitude after. Once the desired waypoint is identified, pressing the line select key beside it returns to the page which brought up this page and the desired waypoint is inserted into the flight plan.

I. Route Data

Page Access: (Figure 14)

6R on ACT RTE LEGS page with Electronic Flight Instrument System (EFIS) not in plan mode.

Purpose:

Displays the same waypoints as the displayed RTE LEGS page with additional leg data on the right side.

Use:

(Continued)

1L through 5L -	Display is the same as the RTE LEGS page.
6L -	Displays the ERASE prompt when the EXEC key is lighted. Selection erases any modifications made.
1C through 5Z -	Displays Estimated Time of Arrival (ETA) to the waypoints based on performance flight plan predictions and cannot be changed.
1R through 5R -	Displays the forecast wind for each cruise waypoint in the form of XXX/YYY, where XXX is wind direction from 0 to 359 and YYY is wind magnitude from 0 to 250. If the cruise segment is not defined, blanks are displayed except for entered winds. AFMC predicted winds appear in small font and CAPT/F/O entered winds in large font. Only CAPT/F/O entered winds can be deleted.
6R -	Displays the LEGS prompt for selection to return to the RTE LEGS page.

J. Legs

Page Access: (Figure 15)

LEGS mode key on MCDU

6R when RTE DATA page is displayed

6L when the other RTE LEGS page is displayed

Purpose:

Displays details of each leg in the route and provides a means entering or modifying the data. (Maximum number of legs is 2 times the number of legs in the largest route plus the number of legs in the smallest route not to exceed 146.)

Use:

1L through 5L -	Displays the waypoint identifiers for each leg with a header for each leg. The header is leg direction or procedure information depending on leg type.
1C through 5C -	Displays the computed leg distance. Blanks are displayed if the waypoint is active and some leg types.
1R through 5R -	Displays the speed/altitude for the waypoint opposite. These may be speed/altitude constraints from the data base or pilot entered. Predicted values are displayed in small font and constraints (Navigation Data Base or CAPT/F/O entered) are in large font.
6L -	Displays RTE 2 LEGS (if on RTE 1) for selection or ERASE if modification or pending activation is in progress.
6R -	Display depends on conditions. If the on-side EFIS is in the plan mode, 6R header displays MAP CTR and the data field displays STEP prompt. In this case CTR in brackets is displayed in the center of the page starting at the first waypoint. The STEP prompt steps the CTR down through the page, causing that waypoint to be the center of the display on the EFIS. The EFIS will be in a north up display. If the inactive RTE LEGS is displayed, 6R displays ACTIVATE to allow activation of the inactive route, if possible. If there is an active flight plan and the EFIS is not in the plan mode, then RTE DATA will be displayed. In a dual AFMC installation each AFMC controls its on-side EFIS displays.

K. Direct/Intercept

Page Access: (Figure 16)

DIR/INTC mode key when a route is active

Purpose:

Provides a means of flying direct to or intercepting a course to any waypoint in the NDB or line selectable waypoint in the active route.

Use:

1L/1R through 5L/5R -	These are the same as the normal RTE LEGS page. Use of the DIR/INTC function will not display the ERASE prompt in 6L, however, displaying another page without pressing the EXEC key will erase the modification.
6L -	DIRECT TO is displayed to solicit an entry for the desired waypoint. The waypoint can be entered through the keyboard or line selected from any RTE LEGS page. Entry of a waypoint not contained in the active flight plan causes the DIRECT TO waypoint to be in 1L and a discontinuity to appear in 2L. Waypoints between present position and the DIRECT TO waypoint will be deleted upon EXECution.
6R -	INTC LEG TO is displayed to solicit a waypoint entry. Entry of a valid waypoint causes 6R header to change to INTC CRS with 3 prompt boxes and the entered waypoint is displayed in 1L with the default course displayed in the 1L header. Any valid course entry will overwrite the default value.

L. Hold

Page Access: (Figure 17)

HOLD mode key

Purpose:

Allows display of preplanned holding patterns and/or creating holding patterns in the route and provides the means of exiting a holding pattern.

Use:

If no hold page has been entered, line 6 (Page B) displays HOLD AT with prompt boxes in 6L for the waypoint and 6R has PPOS prompt for present position. Entering a waypoint in 6L or selecting 6R displays the RTE HOLD page (Page A) for entering the holding pattern information.

1L -	Displays the hold fix (selected waypoint or present position).
2L -	For entering the holding quadrant and radial in the form xx/nnn where xx can be N, NE, E, SE, S, SW, W, or NW and nnn is from 0 to 359, with leading zeros, which is the reciprocal of the inbound course.
3L -	For entering the inbound course and turn direction. The inbound course is from 0 to 359, with leading zeros, and the turn direction is L or R separated by a slash.
4L -	Used to enter the leg time in minutes as x.x with the range of 0.1 to 9.9. This can be CAPT/F/O entered or from a predefined holding pattern in the NDB. The default value depends on the altitude at the holding fix. 1.0 minutes is used for altitudes at or below 14,000 feet and 1.5 minutes above 14,000 feet.
5L -	Displays leg distance, if entered, for holding pattern as NN.N nm or N.N nm. The range is 0.1 to 99.9 nm. The default display will be --.- nm.
6L -	Displays '<ERASE' whenever a route activation, hold exit, or a flight plan modification is pending. At all other times, '<NEXT HOLD' will be displayed. If '<ERASE' is displayed, selection will result in the clearing of the pending route activation, hold exit, or flight plan modification. If '<NEXT HOLD' is displayed, selection results in the display of the RTE LEGS HOLD AT page.

(Continued)

1R - Displays the same speed/altitude as on the RTE LEGS page for the hold leg. Invalid values are displayed as dashes. The format for the display will be NNN/MMMMMX, beginning in column 15, where NNN is a Calibrated Airspeed (CAS) value, MMMMM is an altitude in either Mean Sea Level (MSL) or Flight Level (FL) format, and X is blank for 'at' constraints for predicted values, A for 'at or above' constraints, or B for 'at or below' constraints. Altitude WINDOW constraints will be displayed, beginning in column 8, in the format NNN/MMMMMA LLLLLB where MMMMMM is the lower altitude of the window, and LLLLL is the upper altitude.

2R - Displays the predicted time that the aircraft will next cross the holding fix. Display format is NNNN.N in large font. If value is not valid blanks will be displayed.

3R - Dashes will be displayed until the Expected Further Clearance Time is entered by the CAPT/F/O. Valid entries will be in the form HHMM in the range 0000 to 2359. For entries less than 1000, leading zeros must be used.

4R - Displays the holding time available before an exit is required in order to reach the destination with specified fuel reserves. Display format will be HH+MM, where HH is between 0 and 23 hours, and MM is between 00 and 59 minutes. If value is not valid, dashes will be displayed.

5R - Displays the best speed (speed at which left/drag is maximum) for current altitude and conditions. Format is a 3-digit CAS value in knots. If the holding speed is invalid, dashes will be displayed.

6R - Displays "EXIT HOLD' if the hold is the active lateral leg and if the exit criteria have not been met. Once the exit criteria are met, the display changes to 'EXIT ARMED" and the aircraft will sequence out of the hold on the next crossing of the fix.

M. Performance Initialization

Page Access: (Figure 18)

3L on INIT REF INDEX page

6R on ACT RTE page

5L on TAKEOFF page if PERF INIT is not complete

INIT/REF mode key when on the ground and position has been initialized.

Purpose:

Allows entry of gross weight or zero fuel weight, fuel, cost, index, reserves, cruise altitude, cruise wind, and International Standard Atmosphere (ISA) deviation or top of climb outside air temperature. All weight entries are in thousands of pounds (or thousands of kilograms if kilogram discrete is enabled) to the nearest 100 pounds (kilograms). Prompt boxes indicate mandatory entries.

Use:

1L - Displays prompt boxes unless zero fuel weight has been entered with valid fuel weight. Entering gross weight with valid fuel weight results in zero fuel weight being computed. After entry, displays AFMC computed gross weight.

2L - Displays prompt boxes which require pilot input. The fuel weight can be suffixed by, "MANUAL", or "CALC" depending on the condition.

Prior to engine start with FQ invalid and FF valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (entered value).

After engine start with FQ invalid and FF valid:

Displays prompt boxes.

(Continued)

Input manual entry, display "MANUAL" (calculated value).

Prior to or after engine start with FQ & FF invalid:

Displays blanks, manual and gross weight entries non-operational; VNAV (vertical navigation) guidance not allowed.

Prior to engine start with FQ invalid and FF transitions from invalid to valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (entered value).

After engine start with FQ invalid and FF transitions from invalid to valid:

Displays prompt boxes.

Input manual entry, displays "MANUAL" (calculated value).

3L - Displays prompt boxes until CAPT/F/O enters gross weight with valid fuel weight or enters the zero fuel weight.

4L - Displays prompt boxes until CAPT/F/O entry. Entries less the 10.0 may include a hundreds digit. This is the required reserve fuel to be on board at destination.

5L - Displays the cost index which can be input by the CAPT/F/O or entered by route activation if the company route contained the cost index information. The cost index is an airline derived figure consisting of the cost of airline operation in dollars per hour divided by the cost of fuel in cents per pound.

6L - Displays the INDEX prompt to allow displaying the INIT REF INDEX page.

1R - Displays prompt boxes until CAPT/F/O entry or a company route is activated containing a stored cruise altitude. These will be in flight level format above the transition altitude and in mean sea level format below the transition altitude.

2R - Displays dashes until CAPT/F/O entry. Entry is wind bearing followed by a / and wind magnitude. Entries can be changed by entering bearing followed by a / or magnitude by its self.

3R - Displays dashes until CAPT/F/O entry of ISA deviation or Top of Climb (T/C) Outside Air Temperature (OAT) is entered with a cruise altitude displayed in 1R. The ISA deviation is the deviation in temperature from the International Standard Atmosphere which is defined as being at sea level with a temperature of 15 degrees C. Entry of ISA deviation with a displayed cruise altitude causes the Top of Climb Outside Air Temperature (T/C OAT) to be computed.

4R - Displays dashes until CAPT/F/O entry of ISA DEV is entered with a cruise altitude displayed in 1R. Entry of T/C OAT with a cruise altitude displayed in 1R causes the ISA DEV value to be computed and displayed.

5R - Display 18,000 feet as the default transition altitude. If the airport or departure procedure contains a different transition altitude, it will be displayed providing the CAPT/F/O has not previously entered a transition altitude.

6R - Displays the TAKEOFF prompt for selection of the TAKEOFF page.

N. Takeoff

Page Access: (Figure 19)

4L on the INIT REF INDEX page

6R on the PERF INIT page

6R on the ACT RTE page providing PERF INIT page is complete and the aircraft is on the ground.

(Continued)

Purpose:

To display the preflight status and other takeoff information for reference purposes.

Use:

1L - Displays the total air temperature (TAT) as received from the Digital Flight Guidance Computer (DFGC).

1C - Displays the assumed temperature which is selected on the Thrust Rating Panel only if the mode selected is T.O. FLX.

2L - Displays the takeoff EPR value for takeoff depending on the engines installed and can be preceded by FLX if the mode is T.O. FLX. This is received from the DFGC.

1C - Displays the assumed temperature which is selected on the Thrust Rating Panel only if the mode selected is TAKEOFF FLEX.

2L - Displays the takeoff EPR value for takeoff depending on the engines installed and can be preceded by FLX if the mode is TAKEOFF FLEX. This is received from the DFGC.

3L - Displays the dynamic gross weight.

4L - Displays the POS INIT prompt if the position has not been initialized, otherwise it is blank. If displayed, pressing the 4L line select key causes the POS INIT page to be displayed.

5L - Displays the PERF INIT prompt if all mandatory entries are not complete on the PERF INIT page, otherwise it is blank. If displayed, pressing the 5L key displays the PERF INIT page.

6L - Displays the prompt for the INIT REF INDEX page.

1R - Used for displaying of CAPT/F/O entered value of Decision Takeoff Speed (V1) for reference purposes.

2R - Used for displaying of pilot entered value of Takeoff Rotation Speed (VR) for reference purposes.

3R - Used for displaying of pilot entered value of Takeoff Safety Speed (V2) for reference purposes.

4R - Displays the ROUTE prompt when no active route exists. If a route is active, this field is blank. Selection when prompt is displayed results in displaying page 1 of RTE 1.

5R - Displays the DEPARTURE prompt when no departure has been selected, otherwise it is blank. Selecting this prompt when displayed causes the origin airport DEPARTURE page to be displayed unless there is no active route. In that case, the departure/arrival (DEP/ARR) INDEX page is displayed.

6R - The RUNWAY UPDATE prompt allows reestablishing the AFMC position based on the runway threshold latitude and longitude of the runway as displayed in 3L of the ACT RTE page.

O. Approach

Page Access: (Figure 20)

5L on INIT REF INDEX page

INIT/REF mode key when airborne

Purpose:

Provides for the display of reference information relative to the approach.

Use:

1L - Displays the dynamic gross weight if valid; otherwise boxes are displayed. CAPT/F/O may enter a gross weight but leaving this page and returning to it causes the dynamic gross weight to be redisplayed. (In a dual MCDU system, if both MCDU's are displaying the APPROACH page when an entry is made, the entry will appear on both MCDU's and will only clear when both MCDU's leave the APPROACH page.)

(Continued)

4L -	Displays the runway length of the origin or destination. If there is no active route, this field is blank. Destination is displayed if there is no origin or if the aircraft is over 50 nautical miles from origin or more than half way to the destination, whichever is less. The origin is displayed if there is no destination specified or the aircraft is less than 50 nautical miles from the origin or less than half way to the destination, whichever is less.
5L -	Displays the ILS, LOC, or BAC frequency for the runway in 4L if one exists. (Backcourse will not be displayed for the origin.)
6L -	Displays the INDEX prompt for selecting the INIT REF INDEX page.
1R through 2R -	Displays the Approach Reference Speed (VREF) speeds for the 1L displayed gross weight. These values are obtained from the performance data base and will change with a changed displayed gross weight. Landing flap setting for the displayed VREF speeds are displayed in 1C through 2C and also come from the performance data base.
4R -	Blank but provides for customer selected flap position/VREF display.
5R -	Displays the front course heading of the runway or approach in 5L. If 5L is blank, this will also be blank.

P. Reference Navigation Data

Page Access: (Figure 21)

1R on INIT REF INDEX page

Purpose:

Displays data of selected waypoint, navaid, airport, or destination runway contained in the data base or flight plan route.

Use:

1L -	Displays dashes until a waypoint identifier is entered. Acceptable entries are any data base waypoint or course intersection, LAT/LON, Place, Bearing, Distance Waypoint (PBD), or along track route waypoint. Any entry longer than 5 characters or any entry containing a slash will be rejected. Any non-unique identifier entry will cause the SELECT DESIRED WPT page to be displayed with from 2 to 6 choices for the Capt/F/O to choose from.
2L -	Displays the latitude of the entered waypoint to the nearest tenth of a degree.
3L -	Displays the frequency if the entered waypoint is a navaid. If it is not a navaid, the header and data field will be blanked.
4L -	Displays the magnetic variation of an entered navaid which has an associated VOR; header and data field are blanked if it is not a navaid or a DME only. Displayed with an E for positive variation or W for negative.
5L -	Dashes are displayed initially. Provides for entry of VOR or DME identifier for exclusion in the auto tune function. This is referred to as a "blackballed" navaid. ILS or LOC entries result in an "INVALID ENTRY" message. Two entries are allowed, one into 5L and one into 5R. Overwriting of an existing entry makes the existing entry available for auto tune and the new entry is blackballed. Any non-unique navaid identifier entered results in the SELECT DESIRED WPT page being displayed for CAPT/F/O selection of the correct one. The blackball status of these navaids are retained on power down. They can be cleared by using the DELETE function. Also they will be cleared when a new navigation data base is loaded.
6L -	Displays the INDEX prompt for selection of the INIT REF INDEX page.
2R -	Displays the longitude of the entered waypoint to the nearest tenth of a degree.

(Continued)

3R - Displays the elevation when the entered waypoint is a runway, airport, or a navaid which has a DME; otherwise blanks are displayed. Elevations are to the nearest 10 feet.

4R - Displays runway length to the nearest foot when a runway identifier is entered; otherwise blanks are displayed.

5R - See 5L description.

Q. Maintenance Index

Page Access: (Figure 22)

6R on INIT REF INDEX page upon entry of password

Purpose:

Provides access to all maintenance pages.

Use:

Pressing the line select key adjacent to the desired field causes that page to be displayed.

2R - On aircraft with IRS, displays the IRS MONITOR page. This line is blank when IRS is not installed.

R. Sensor Status

Page Access: (Figure 23)

2L on MAINTENANCE INDEX page

NEXT or PREV key when on AFMC DATA STATUS page 2/2

Purpose:

Displays current sensor status of sensors providing data to the AFMC.

Use:

No selection, deletion, or entry is allowed. Dashes are displayed where no sensor is input to this side. The status is one of three states: FAIL, TEST, or OK.

FAIL can be caused by one of two conditions. If the sensor is not transmitting for whatever reason (power off, bad transmitter, etc.), there is an activity failure. If the sensor is capable of transmitting valid labels but the Sign Status Matrix (SSM) is coded as FAIL WARNING, the sensor is also declared failed.

TEST will be displayed as the sensor status when any valid label is received with the SSM coded as TEST.

OK will be displayed if all valid labels are received with the SSM coded as normal operation or no computed data.

In the event that a sensor input is received containing more than one type of SSM in the data words, display priority will be FAIL, TEST, and then OK in that order.

S. Analog Discretes

Page Access: (Figure 24)

3L on MAINTENANCE INDEX page

NEXT or PREV key when on AFMC ANALOG DISCR page 2/2

Purpose:

Displays the condition in the AFMC of the changeable discretes.

Use:

(Continued)

When a discrete comes in from the left or right side, such as ENGINE ANTI ICE, the state of each discrete is listed under the header 1 or 2, whichever is appropriate. All others are listed singularly between 1 and 2.

T. Performance Factors

Page Access: (Figure 25)

1R on MAINTENANCE INDEX page

Purpose:

Provides display and entry of performance data applicable to individual airline policy or aircraft characteristics. Before data can be entered into this page, it must be armed by typing the letters ARM into the scratchpad and line selecting it to 6R.

Use:

1L - Displays the 4 performance program pins configuration as a binary code. This data is for display only, it cannot be changed.

2L - Displays the drag factor. The drag factor is a correction factor, expressed as a percentage, for AFMC internal drag computations. If no value has been entered, it will display +0.0. Entries can range from -5.0 to +9.9. Entries are propagated to the IDENT page and also to the off-side AFMC in a dual configuration.

3L - Displays the fuel flow factor. The fuel flow factor, expressed as a percentage, is for AFMC internal fuel flow computations. Display and entry range is the same as for drag factor.

4L - Displays the maneuver margin for use by flight envelope computations in the AFMC. The default value is 1.30 and can range from 1.25 to 1.60.

5L - Displays the minimum time the aircraft has to be in the cruise phase during a flight. The default value is 1 and can range from 1 to 20 minutes.

6L - Displays the prompt for the MAINTENANCE INDEX page.

1R - Displays the policy speed for descent. Defaults to 300 if no other value has been entered previously. Allowable range is from 240 to 330 knots.

2R - Displays the minimum rate of climb header for 3R and 4R.

3R - Displays the minimum rate of climb margin for flight envelope calculations at climb speed and maximum climb thrust in feet per minute. Entry range is from 0 to 999 with the default value of 100.

4R - Displays the minimum rate of climb at cruise speed and maximum cruise thrust in feet per minute. Range is from 0 to 999 with a default value of 0.

6R - Displays dashes until ARM is selected to this line. Leaving this page and returning requires the page to be armed again for data entry.

U. Menu

Page Access: (Figure 26)

MENU mode key on MCDU

6L on CONFIGURATION INDEX page

Purpose:

Allows interfacing between the CAPT/F/O and multiple systems, one at a time. 1L through 3L are ARINC 739 protocol subsystems while 5L and 6L are non-ARINC 739 protocol subsystems.

Use:

(Continued)

1L - Displays AFMC #1 as active to the MCDU.

5L - Displays IRS INIT/REF (aircraft with IRS).

6L - Displays the TEST PANEL prompt. Pressing 6L displays the TEST PANEL page. This field will be blank if the TEST PANEL OPTION is deactivated on the CONFIGURATION INDEX page.

6R - Displays RETURN for selection to return to the active system.

The current active system is annunciated by "(ACT)" (active) being displayed after the subsystem name. Any other self-formatting subsystems having requested communication with the MCDU is annunciated by "(REQ)" after the subsystem name, and the illumination of the "MENU" annunciator.

When the MCDU MENU page is not displayed, the illuminated "MENU" annunciator is the only indicator that another subsystem is requesting communication. To establish communication with a new subsystem the MCDU MENU page must be accessed. Once displayed, the operator should select the line key adjacent to the subsystem identifier to establish communication. If no line key is selected within 60 seconds after accessing the MCDU MENU page, the MCDU reverts to the last active system (if an active system exists). Also, the active system can be immediately returned to by selecting 6R "<RETURN". Following section of a subsystem, an indication is provided to inform the operator that the selection of the subsystem is acknowledged. This is accomplished by displaying a subsystem page indicating that the MCDU is waiting for a response from the selected subsystem.

V. MCDU CONFIG INDEX

Page access:

This page is directly accessible from the main MCDU MENU page by depressing the NEXT PAGE function key.

Purpose:

Provides the ability to activate or deactivate the non-self formatting subsystems for each MCDU, independently. In addition, it is used to specify how many Inertial Reference Units (IRU) are in the aircraft when the IRS subsystem is activated. This page is not intended for general operator use but can be accessed as a reference.

Use:

2L - Displays flashing ACTIVATED or DEACTIVATED to show current IRS configuration.

3L - Displays flashing number of IRUs installed into the aircraft.

4L - Displays flashing ACTIVATED or DEACTIVATED to show whether the MCDU is being used as the STP.

6L - Used to exit back to MENU page.

W. Fault Detection and Exclusion (FDE) (Figure 27)

Preflight FDE algorithm is used primarily to detect any exclusion zeroes in the flight plan prior to departure.

(1) The requirements for FDE algorithm are:

(a) Active route.

(b) Origin and Destination airport.

(c) UTC entered for expected departure time.

(d) A/C on ground.

(2) Select the GNS PRED prompt (4R) on INIT/REF INDEX 1/1 page. This takes you to the FDE AVAILABILITY 1/2 page.

(3) Enter:

- ORIG/DEST (1L)

- Expected departure time (1R)
- BEG WPT (2L)
- END WPT (3L)
- RTE RNP (2R)

(4) After all required entries are input, A "XX% COMPLETE" message will appear in line 4. At end of computation, this header will change to either "ROUTE AVAILABLE" or "ROUTE UNAVAILABLE" in 4R.

X. PREDICTIVE RAIM (Figure 28)

Predictive RAIM algorithm is used to check for satellite coverage relative to a destination and ETD.

(1) Select the GNS PRED prompt (4R) on the INIT/REF INDEX 1/1 page.

(2) Enter Estimated Time of Departure (ETD) into 1L.

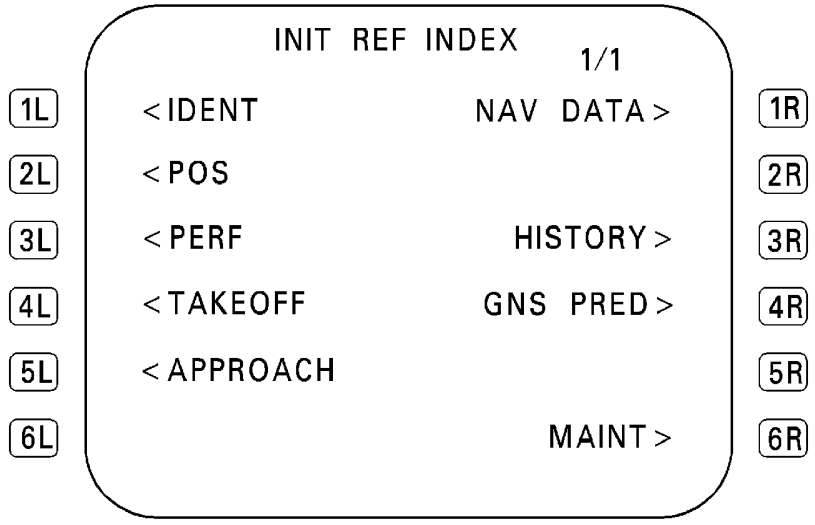
(3) * Enter satellite out of service into 2L (up to 4 satellites).

(4) Enter destination identifier into 3L.

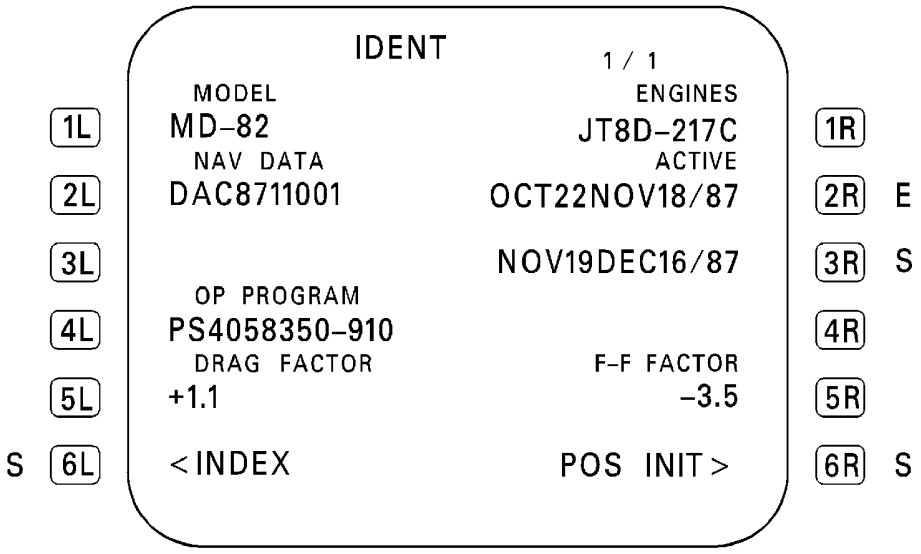
(5) Observe the initial RAIM predictions returned by the GNSSU on line 5.

(6) * Enter the RAIM limit into 1R (Default is 0.3 Nm).

NOTE: * = Optional Entries



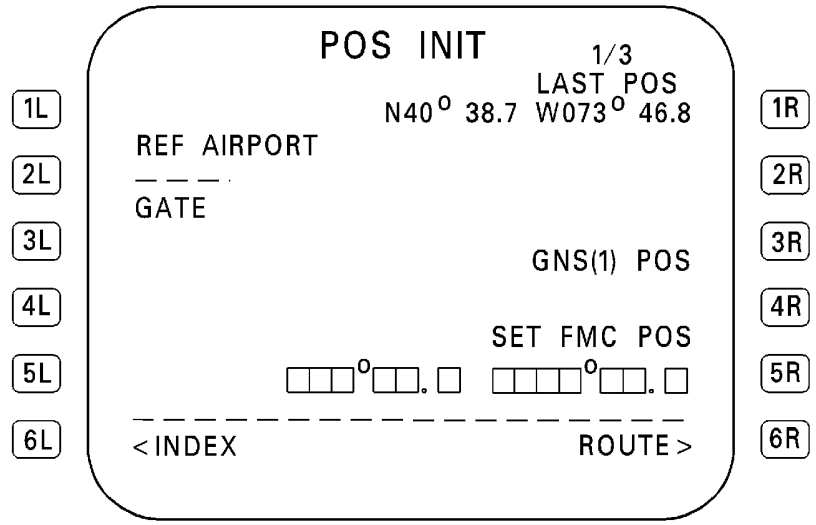
Initialization Reference Index
Figure 8/34-63-00-990-812



CAG(IGDS)

BBB2-34-2004

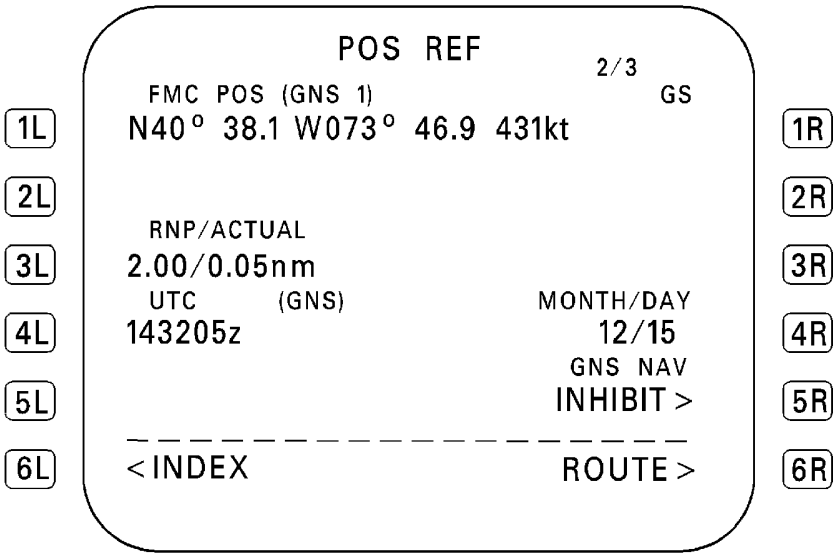
Identification
Figure 9/34-63-00-990-813

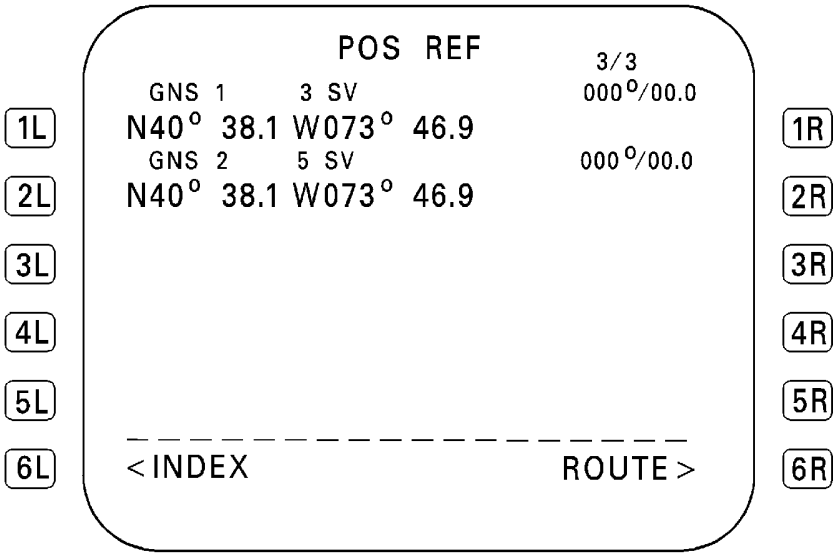


CAG(IGDS)

BBB2-34-1980

Position Initialize
Figure 10/34-63-00-990-814



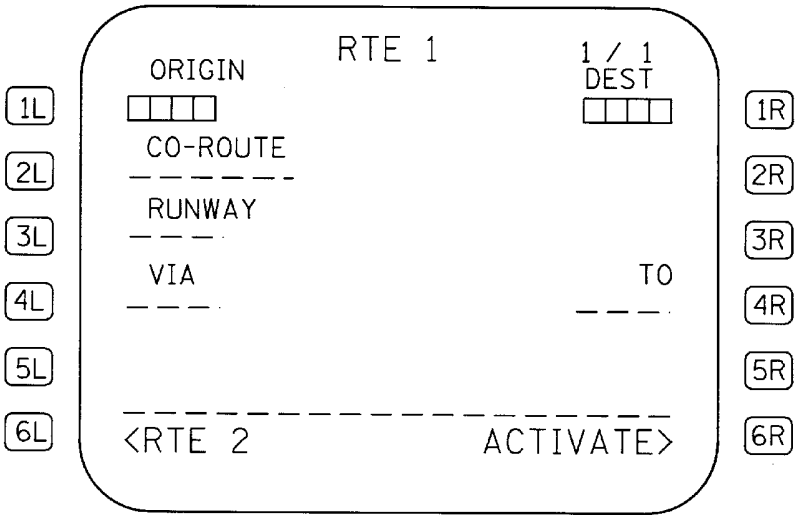


CAG(IGDS)

BBB2-34-1981

Position Reference
Figure 11/34-63-00-990-873

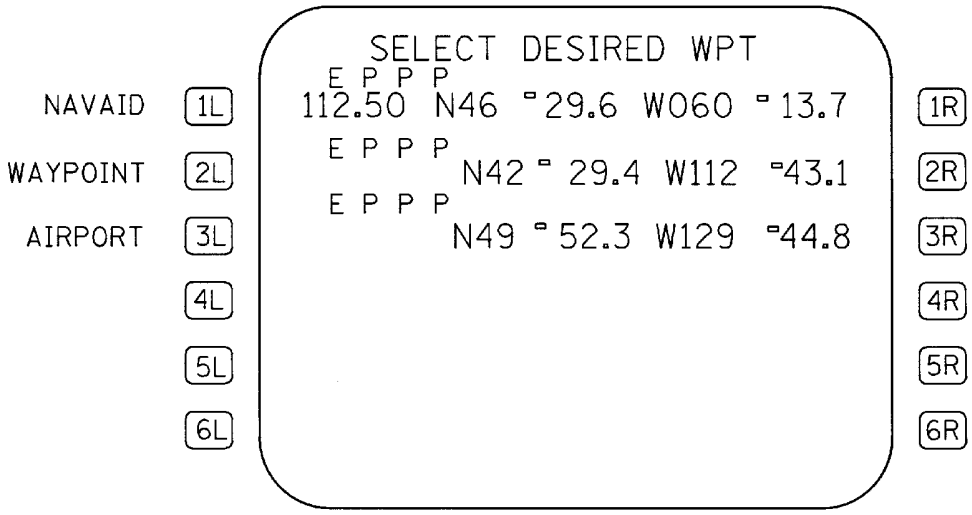
EFFECTIVITY
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD



CAG(IGDS)

BBB2-34-1119

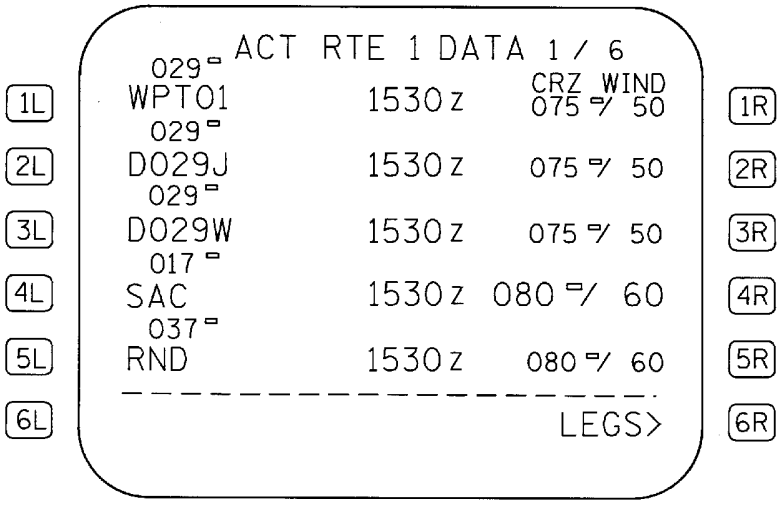
Route
Figure 12/34-63-00-990-815



CAG(IGDS)

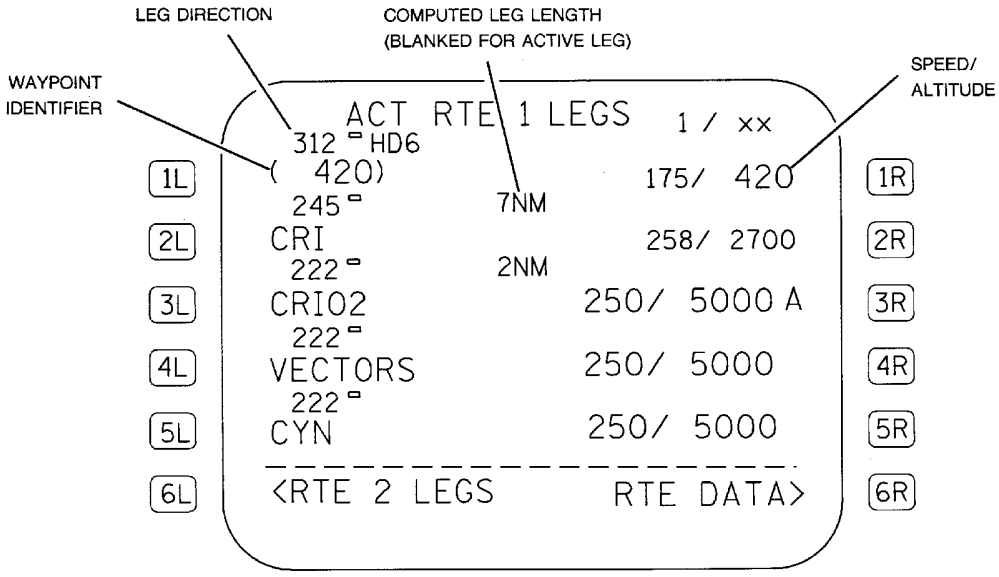
BBB2-34-1120

Select Desired Waypoint
Figure 13/34-63-00-990-816



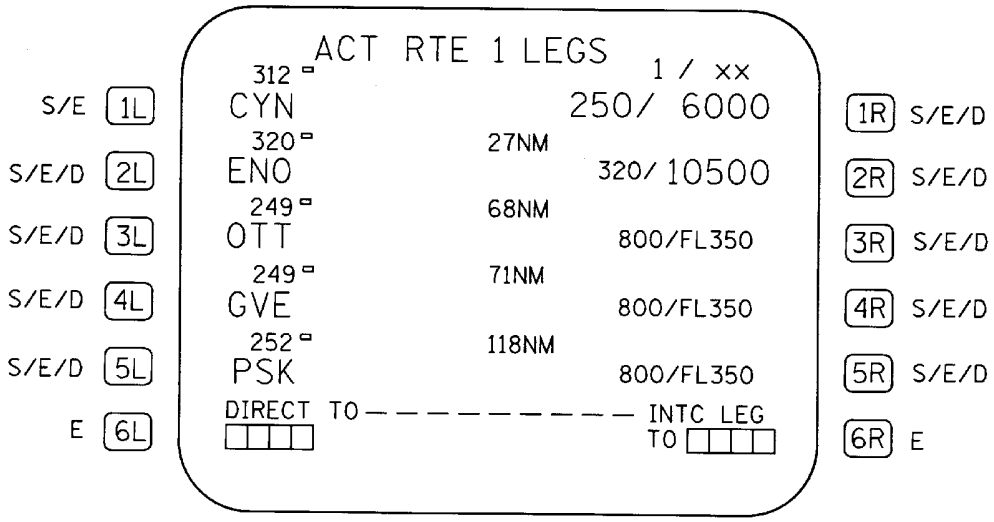
CAG(IGDS) BBB2-34-1121

Route Data
Figure 14/34-63-00-990-817



CAG(IGDS) BBB2-34-1122

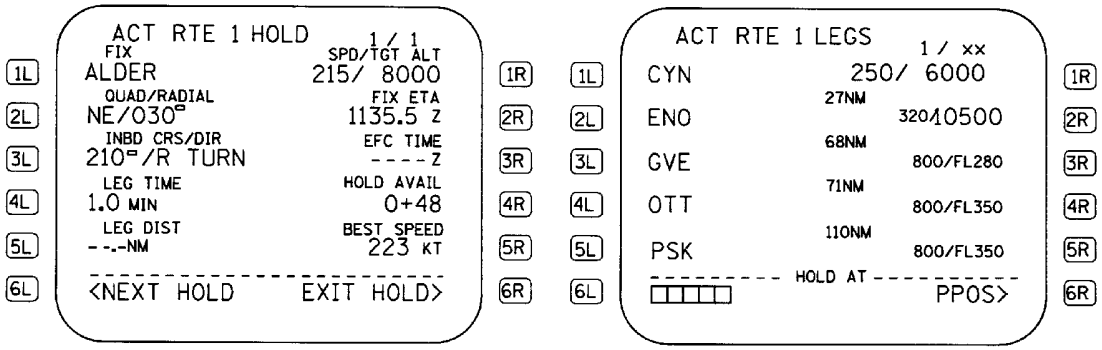
Legs
Figure 15/34-63-00-990-818



CAG(IGDS)

BBB2-34-1123

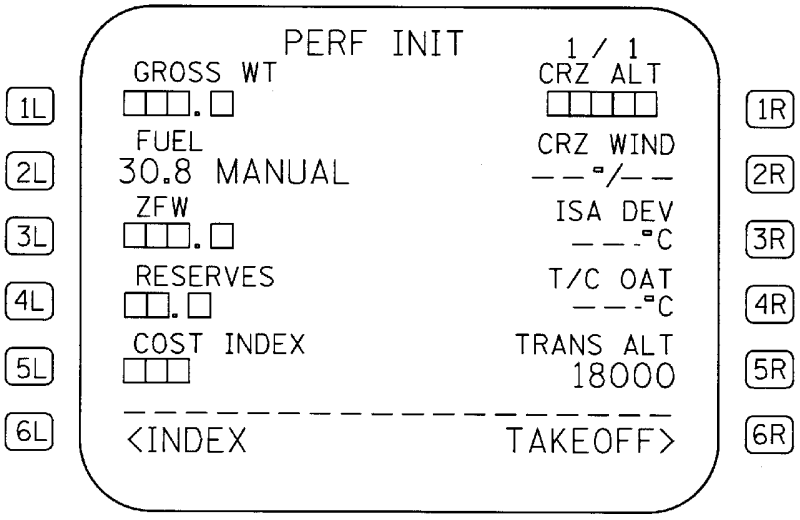
Direct / Intercept
Figure 16/34-63-00-990-819



CAG(IGDS)

BBB2-34-1124

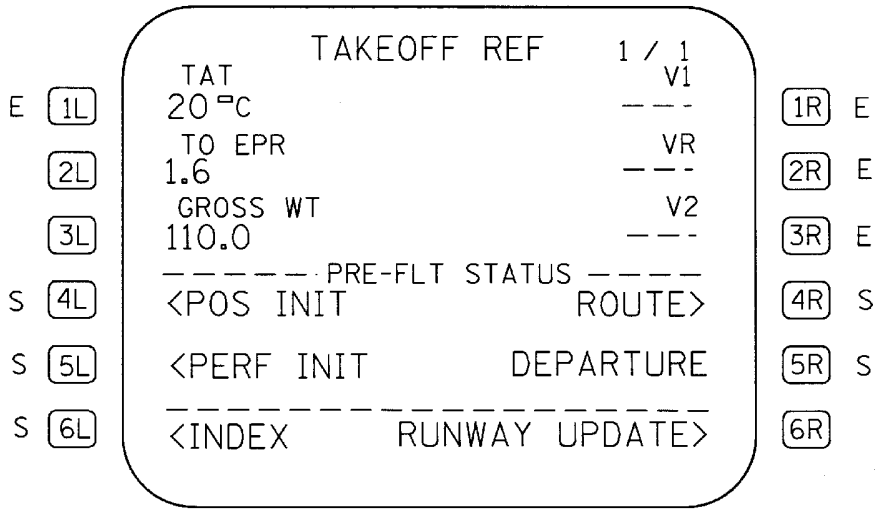
Hold
Figure 17/34-63-00-990-820



CAG(IGDS)

BBB2-34-1125

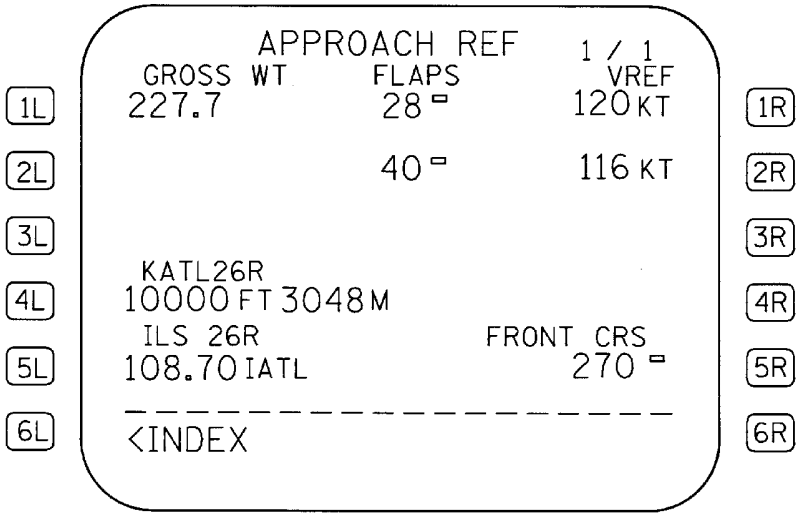
Performance Initialization
Figure 18/34-63-00-990-821



CAG(IGDS)

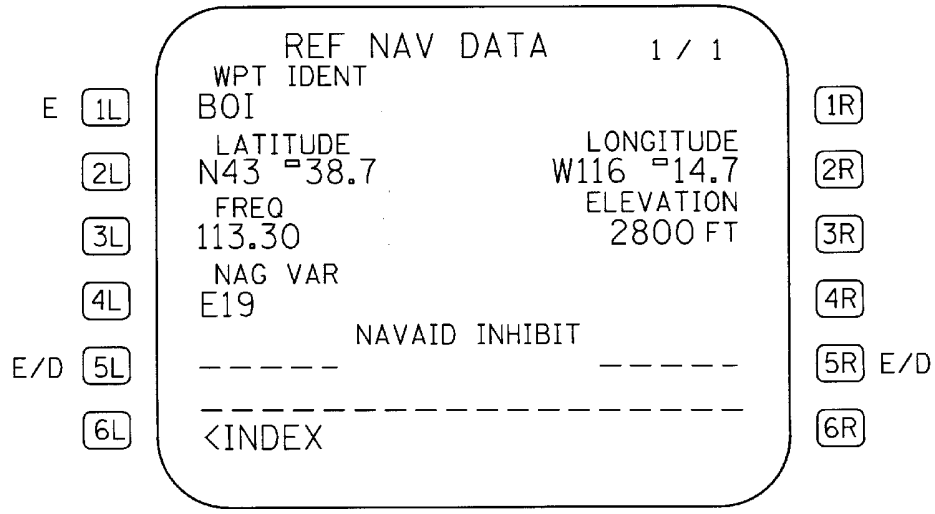
BBB2-34-1126

Takeoff
Figure 19/34-63-00-990-822



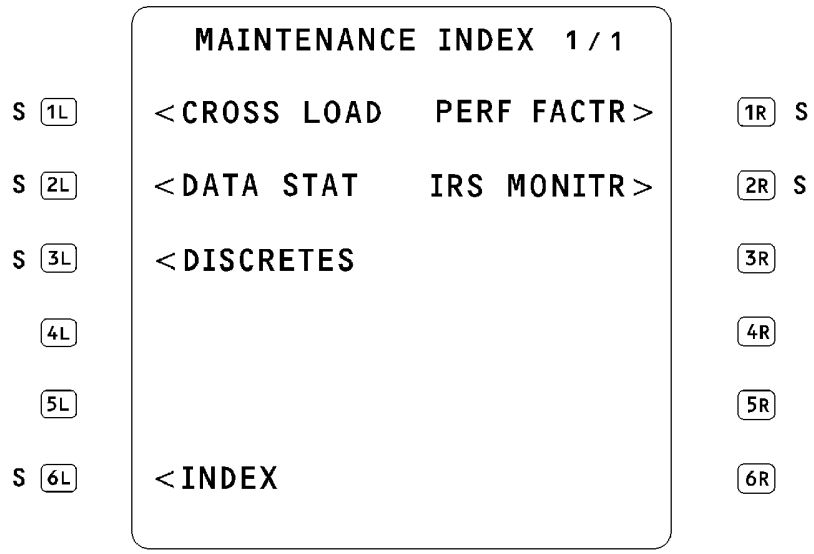
CAG(IGDS) BBB2-34-1127

Approach
Figure 20/34-63-00-990-823

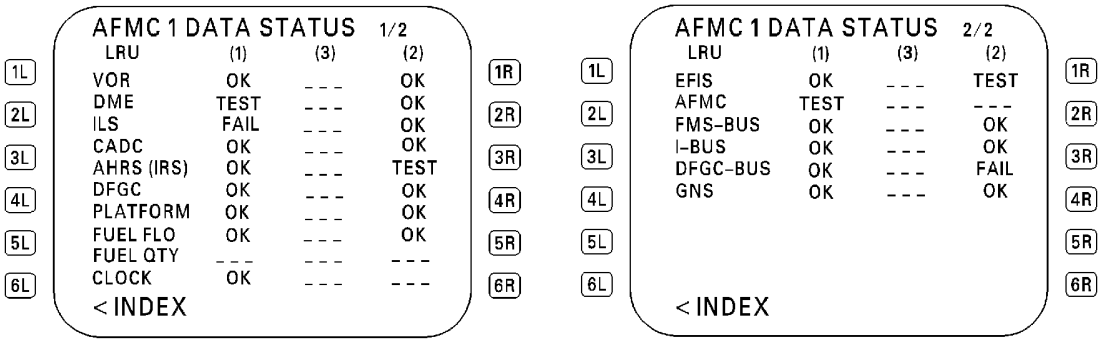


CAG(IGDS) BBB2-34-1128

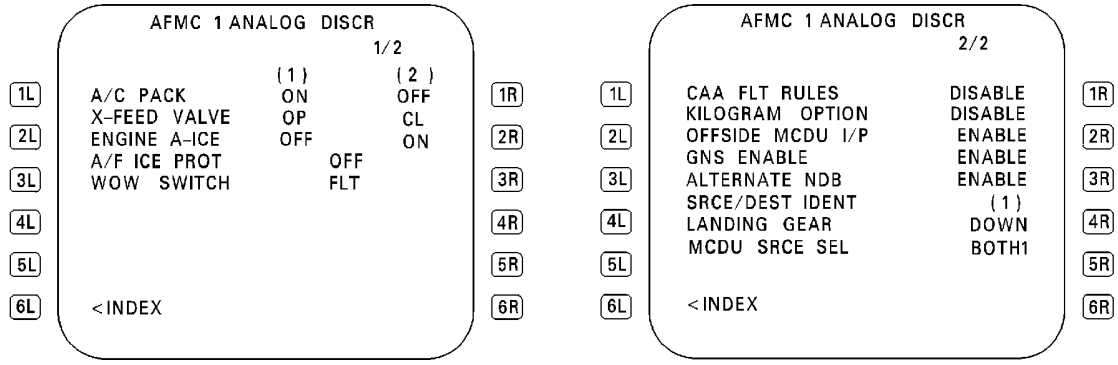
Reference Navigation Data
Figure 21/34-63-00-990-824



Maintenance Index
Figure 22/34-63-00-990-825



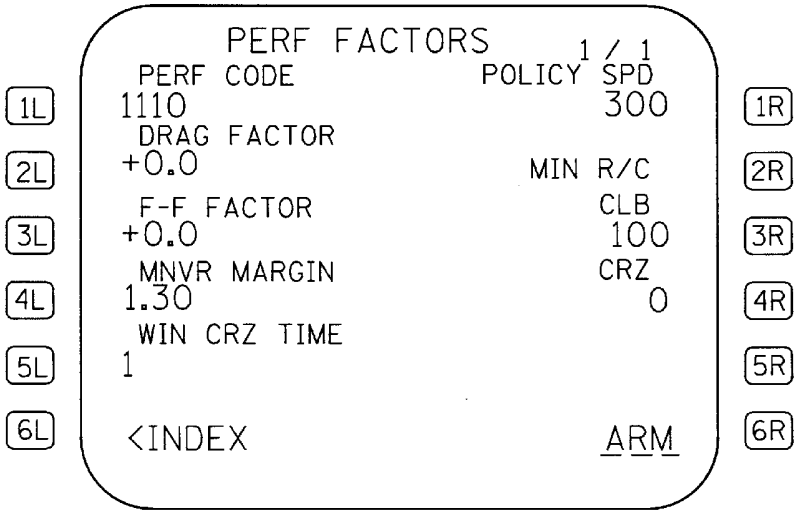
Sensor Status
Figure 23/34-63-00-990-826



CAG(IGDS)

BBB2-34-1983

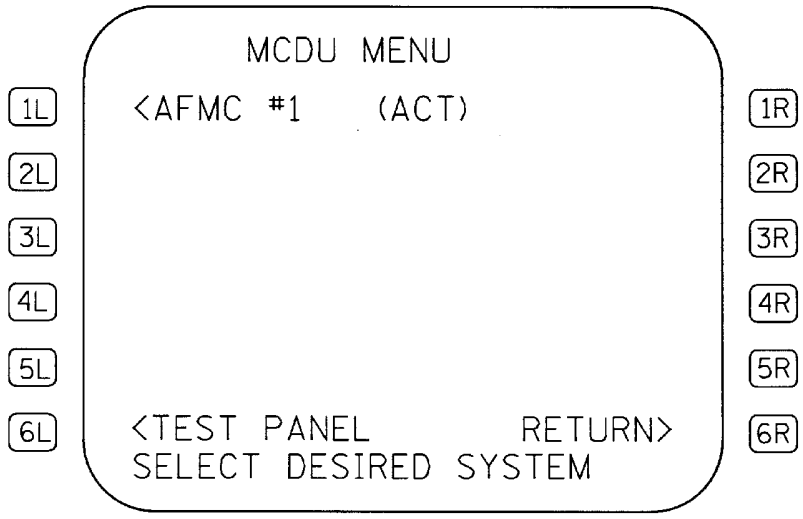
Analog Discretes
Figure 24/34-63-00-990-827



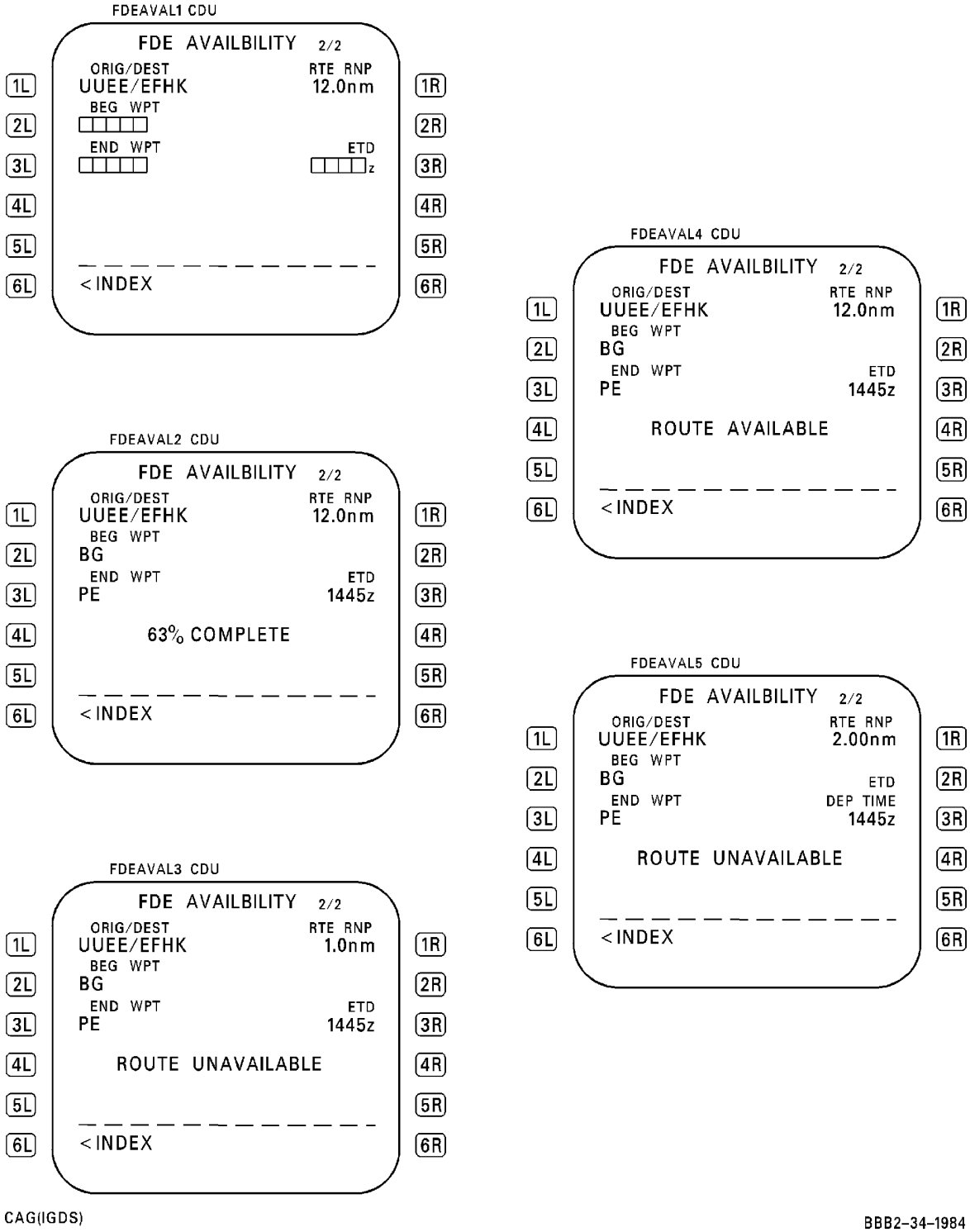
CAG(IGDS)

BBB2-34-1132

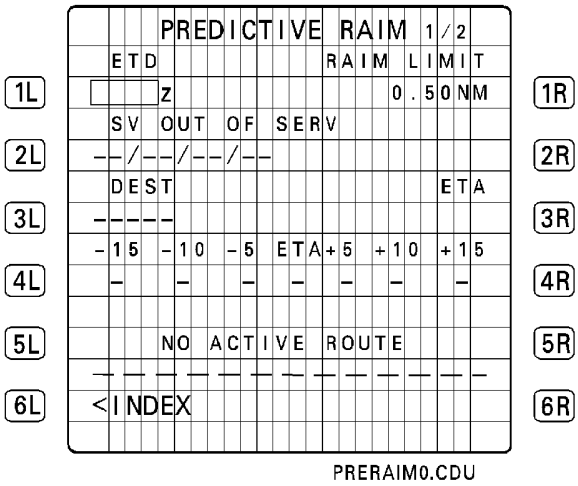
Performance Factors
Figure 25/34-63-00-990-828



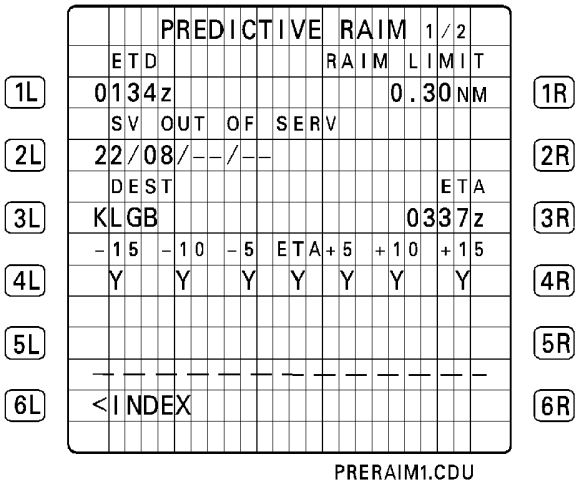
Menu
Figure 26/34-63-00-990-829



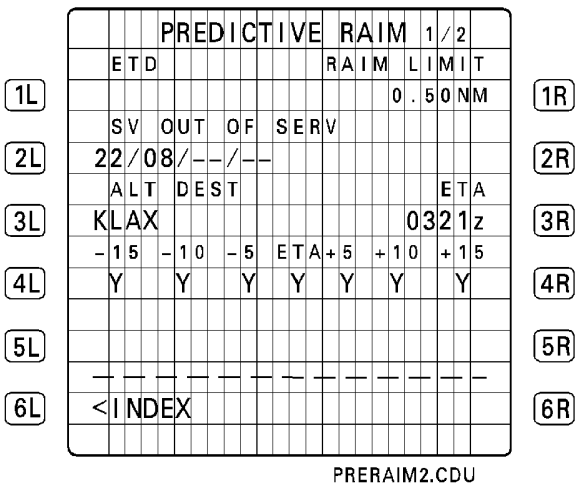
FDE Availability
Figure 27/34-63-00-990-858



PRERAIM0.CDU



PRERAIM1.CDU



PRERAIM2.CDU

CAG(IGDS)

BBB2-34-1985

Predictive RAIM
Figure 28/34-63-00-990-859

4. Operating Instructions - Allied Signal Airborne Data Loader (ADL) P/N 964-0401-036

A. Upload of Data from ADL to AFMC:

(1) Navigation Data Base (NDB):

(a) Open cover to F/O briefcase stowage rack. Swivel up ADL and lock into upright position.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(b) Open this circuit breaker and install safety tag:

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

(c) Close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

(d) Place ADL selector switch in "OFF" position.

(e) On both MCDUs, press MCDU MENU key.

(f) On either MCDU, select AFMC#1 prompt (1L).

(g) On the IDENT 1/1 page, verify display of current data base P/N in 2L and effective dates on line 3R.

(h) Insert NDB disk into ADL. Wait for green RDY status indicator, then rotate ADL Selector switch from "OFF" to "AFMC-1" position.

(i) At this point, verify ADL indicates RDY (Green) followed by PROG (AMBER) status indicators.

(j) AFMC-1 MCDU will be in TIMEOUT state during the load.

(k) At load completion, the ADL status indicator "COMP" will illuminate to indicate that data upload is complete.

(l) Eject NDB disk from ADL. Select AFMC(#1) prompt (1L) on MCDU. Verify correct NDB P/N and cycle date as in Paragraph 4.A.(1)(g).

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(m) Open this circuit breaker and install safety tag:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

(n) Remove the safety tag and close this circuit breaker:

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

(o) Repeat Paragraph 4.A.(1)(d) to Paragraph 4.A.(1)(l).

(p) Remove power to ADL, unlock from upright position, stow in horizontal position and close stowage rack cover.

(2) Operational Program (Op-Prog):

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(a) Open this circuit breaker and install safety tag:

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

(b) Close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

(c) Place ADL selector switch in "OFF" position.

(d) On both MCDUs, press MCDU MENU key.

(e) On either MCDU, select AFMC#1 prompt (1L).

(f) On the IDENT 1/1 page, verify display of current Op-prog P/N (4L).

(g) Insert Op-prog disk into ADL. Wait for green RDY status indicator, then rotate ADL Selector switch from "OFF" to "AFMC-1" position.

(h) At this point, verify ADL indicates RDY (Green) followed by PROG (AMBER) status indicators.

(i) AFMC-1 MCDU will be in TIMEOUT state during the load.

(j) At load completion, the ADL status indicator "COMP" will illuminate to indicate that data upload is complete.

(k) Eject Op-prog disk from ADL. Select AFMC(#1) prompt (1L) on MCDU. Verify correct Op-prog P/N as in Paragraph 4.A.(2)(f).

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(l) Open this circuit breaker and install safety tag:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

(m) Remove the safety tag and close this circuit breaker:

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

(n) Repeat Paragraph 4.A.(2)(c) to Paragraph 4.A.(2)(k) for AFMC-2.

(o) Remove power to ADL, unlock from upright position, stow in horizontal position and close stowage rack cover.

B. BITE Download from AFMC to ADL:

(1) Open cover to F/O briefcase stowage rack. Swivel up ADL and lock into upright position.

(2) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

(3) Place ADL selector switch in "OFF" position.

(4) On both MCDUs, press MCDU MENU key.

(5) On either MCDU, select AFMC#1 prompt (1L).

(6) Verify INIT/REF INDEX 1/1 page is displayed.

(7) Insert BITE download disk into ADL.

(8) Rotate ADL selector Switch from "OFF" to "AFMC-1" position.

(9) Verify ADL status indicator goes from RDY (Green) to PROG (Amber) to COMP (Amber).

(10) Eject newly written to BITE Download disk. ASCII file MD80AFMC.BDL has been created.

(11) Repeat Paragraph 4.B.(3) to Paragraph 4.B.(10) for AFMC-2 with a different BITE download disk.

(12) Verify that the file referenced in Paragraph 4.B.(10) was created for each AFMC BITE download.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(13) Open this circuit breaker and install safety tag:

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

(14) Unlock from upright position, stow in horizontal position and close stowage rack cover.

5. MCDU Alert Messages

Table 3

Message	Cause
AHRS (1) FAIL	Either AHRS (1) has stopped sending data to the AFMC or it is sending data that is not valid.
AHRS (2) FAIL	Either AHRS (2) has stopped sending data to the AFMC or it is sending data that is not valid.
ALT CONSTRAINT ALTERED	When a constraint or part of a constraint is not applied due to cruise altitude comparison.
CADC (1) DATA FAIL	The AFMC has determined that CADC (1) data is NOT valid.
CADC (2) DATA FAIL	The AFMC has determined that CADC (2) data is NOT valid.
CHECK ALT TGT	VNAV is engaged and the aircraft is between the FGCP and AFMC target altitude. Engine Out mode is EXECuted and the aircraft has slowed to the E/O speed + 5 knots, and the aircraft is level at the FGCP window altitude which is higher than E/O maximum altitude (amber MCDU MSG on PFD).
CHECK MAX ALT	VNAV is engaged and Engine Out mode is EXECuted and the E/O maximum altitude drops below the cruise altitude (amber MCDU MSG on PFD).
CLOCK FAIL	Either CLOCK has stopped sending data to the AFMC or it is sending data that is not valid.
DEAD RECKONING *[1]	AFMC in DEAD RECKONING mode for navigation (amber D/R on PFD).
DESCENT PATH DELETED	VNAV is engaged and all waypoint altitude constraints defining descent path are deleted.
DESCENT PATH INHIBITED	VNAV is engaged and in descent, NAV is disengaged, the vertical guidance has not been terminated, and either the track angle error is greater than 90 degrees and the roll command error is greater than 20 degrees or the crosstrack error is greater than 21 nautical miles (amber MCDU MSG on the PFD).
DFGC (1) BUS FAIL	No data has come from the DFGC (1) for more than 1 second.
DFGC (2) BUS FAIL	No data has come from the DFGC (2) for more than 1 second.
DFGC MISC DATA (1) FAIL	The DFGC has determined that miscellaneous data from the No. 1 side is NOT valid. The miscellaneous DFGC data consists of EPR data, THROTTLE data, ALT SEL, FLAPS, SLATS, and EPR LIM.

Table 3 (Continued)

Message	Cause
DFGC MISC DATA (2) FAIL	The DFGC has determined that miscellaneous data from the No. 2 side is NOT valid. The miscellaneous DFGC data consists of EPR data, THROTTLE data, ALT SEL, FLAPS, SLATS, and EPR LIM.
DISCONTINUITY	NAV is engaged and aircraft entered route discontinuity. NAV will disengage in a DISCONTINUITY if the current track does not intercept the active leg (amber MCDU MSG in PFD).
DME (1) FAIL	Either DME (1) has stopped sending data to the AFMC or it is sending data that is not valid.
DME (2) FAIL	Either DME (2) has stopped sending data to the AFMC or it is sending data that is not valid.
DRAG REQUIRED	VNAV is engaged and additional drag is required to track descent path and maintain commanded speed (amber MCDU MSG on PFD).
END OF OFFSET	NAV is engaged and end of active route offset overflown. NAV will disengage at END OF OFFSET if not on intercept track (amber MCDU MSG on PFD)
END OF ROUTE	NAV is engaged and end of active route overflown. NAV will disengage at END OF ROUTE (amber MCDU MSG on PFD).
FUEL QTY ERROR- PROG 2/2	Fuel totalizer and calculated values disagree by 3000 lb (1360 kg).
FUEL FLOW (1) DATA FAIL	The data computed by the AFMC for fuel flow from FUEL FLOW SENSOR (1) is either out of bounds for the reasonableness check or has exceeded the delta check limit.
FUEL FLOW (2) DATA FAIL	The data computed by the AFMC for fuel flow from FUEL FLOW SENSOR (2) is either out of bounds for the reasonableness check or has exceeded the delta check limit.
FUEL QTY SENSOR FAIL	Either the FQS has stopped sending data to the AFMC or it is sending data that is not valid.
ILS (1) DATA FAIL	The DFGC has determined that the data from ILS (1) is NOT valid, or the SSM for the ILS FREQUENCY indicates FAIL.
ILS (2) DATA FAIL	The DFGC has determined that the data from ILS (2) is NOT valid, or the SSM for the ILS FREQUENCY indicates FAIL.
INSUFFICIENT FUEL	Estimated fuel at destination is less than RESERVES value (amber MCDU MSG on PFD).
INVALID DFGC CONFIG	One or both of the DFGCs are not -970 or later. This message will flash in the scratchpad and prevents any data entry (amber MCDU MSG on PFD).
IRS (1) FAIL *[2]	Either IRU (1) has stopped transmitting data or the data transmitted is not valid.
IRS (2) FAIL *[2]	Either IRU (2) has stopped transmitting data or the data transmitted is not valid.
IRS NAV ONLY *[2]	AFMC has been navigating without radio updating for more than 12 minutes above or 10 minutes below 15,000 feet.
LIMIT ALT FLNNN	VNAV engagement is attempted and aircraft altitude is approaching or exceeding the VNAV maneuver limit altitude.

Table 3 (Continued)

Message	Cause
LONG RANGE VOR *[1]	NAV is engaged and the FMS is in the DME-VOR mode of navigation and the VOR navaid being tuned is more than 150 nautical miles from the aircraft (amber MCDU MSG on PFD).
LOW TEMP CONDITION	VNAV is engaged and airfoil anti-ice is required and engine EPR at upper limit (amber MCDU MSG on PFD).
NO ACTIVE ROUTE	NAV selected, but no route is activated.
NOT ON INTERCEPT TRACK	NAV selected and aircraft outside active leg capture criteria and current track will not intercept the active leg (amber MCDU MSG on PFD).
PERF/NAV UNAVAILABLE	NAV selected without gross weight, cost index, and cruise altitude entry.
PERF/VNAV UNAVAILABLE	VNAV selected without gross weight, cost index, and cruise altitude entry.
PLATFORM (1) DATA FAIL	The DFGC has determined that platform (1) data is NOT valid. The platform data consists of NORM ACC, LONG ACC, MAG HDG, PITCH, ROLL, and VERT ACC.
NOTE: The failure of R2-47 can also cause this message PLATFORM (1) DATA FAIL or PLATFORM (2) DATA FAIL.	
PLATFORM (2) DATA FAIL	The DFGC has determined that platform (2) data is NOT valid. The platform data consists of NORM ACC, LONG ACC, MAG HDG, PITCH, ROLL, and VERT ACC.
NOTE: The failure of R2-47 can also cause this message PLATFORM (1) DATA FAIL or PLATFORM (2) DATA FAIL.	
RADIO ONLY	AFMC in RADIO ONLY mode for navigation. Note: This message will be displayed only if radio data is valid and IRS or AHRS has failed. At this point, the FMS will drop out of NAV and VNAV.
RE-ENTER IRS POSITION *[2]	Position entered though the MCDU does not correspond to the internal (or previously entered) IRU position.
RESET FGCP ALT	VNAV is engaged and approaching T/D point with FGCP set at or above cruise altitude (amber MCDU MSG on PFD).
RESYNC FAIL- SINGLE AFMC	Resynchronization is unsuccessful and one AFMC is shut down (amber MCDU MSG on PFD - split message).
RESYNCING OTHER AFMC	One AFMC is being resynchronized by the other AFMC (split message).
SELECT MCT	Engine Out mode is selected with a thrust mode other than MCT selected (amber MCDU MSG on PFD).
SELECT TRUE HDG *[2]	MAG/TRUE switch selected to MAG state and the aircraft is approaching a latitude in which the magnetic heading becomes invalid (73 degrees North latitude and 60 degrees South latitude - amber MCDU MSG on PFD).
SIMSOFT ENGAGED	SimSoft becomes operational.
SINGLE AFMC OPERATION	One AFMC is inoperative (amber MCDU MSG on PFD - split message).
TUNE NAV - XXXX	RNAV or VOR approach procedure requires a specific navaid to be tuned, and it is either not tuned or a valid signal is not being received (amber MCDU MSG on PFD).
UNABLE NEXT ALT	VNAV is engaged and climb gradient not great enough to comply with waypoint altitude constraint.

Table 3 (Continued)

Message	Cause
VERIFY IRS POSITIONS *[2]	Position and velocity data from the two IRUs exceed the comparison threshold (4+3t up to 25 nautical miles for position and 20 knots for velocity (amber MCDU MSG on PFD).
VERIFY POSITION	When the radio position is more than 12 nautical miles from the AFMC position, or two AFMC positions are more than 4 nautical miles apart.
VOR (1) FAIL	Either VOR (1) has stopped sending data to the AFMC, or it is sending invalid data.
VOR (2) FAIL	Either VOR (2) has stopped sending data to the AFMC, or it is sending invalid data.
ARRIVAL N/A FOR RUNWAY	Selected arrival and runway are incompatible.
CRS REVERSAL AT FA FIX	Entered route contains a course reversal at final approach fix.
INVALID DELETE	Delete function attempted where not allowed.
INVALID ENTRY	The entry has an incorrect format and/or range.
NOT IN DATA BASE	Data not in navigation data base.
ROUTE FULL	AFMC route is filled to allowable waypoint capacity.
RUNWAY N/A FOR SID	Runway not compatible with SID.
RUNWAY NOT SPECIFIED	Runway update prompt on TAKEOFF REF page was depressed when a runway had not been specified.
STANDBY ONE	The AFMC requires more than 6 seconds to complete requested flight plan operation.
DELETE	DEL key pushed.
MAX ALT FLNNN	Entered cruise altitude greater than AFMC computed maximum altitude for specified vertical modes.
NNNNN	VNAV is engaged, CLIMB or CRUISE page displayed, and new cruise altitude set in FGCP (NNNNN).
NO ACTIVE ROUTE	DIR/INTC key pushed without active route.
NOT ON AIRWAY	Attempting to close an airway with a waypoint that is not on that airway.
RW/ILS FREQ ERROR	LOC captured and ILS frequency does not match frequency for runway in active route.
UNABLE CRZ ALT	Entered cruise altitude results in a zero cruise time prediction.

*[1] Denotes Non-IRS-equipped aircraft only.

*[2] Denotes IRS-equipped aircraft only.

PERFORMANCE MANAGEMENT SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The Performance Management System (PMS) operates as a fully integrated selectable mode of the digital flight guidance system. PMS provides automatic control and coordination of pitch and thrust during climb, cruise, and descent phases of flight, and also provides an advisory display of numerous flight parameters, on a full time real time basis.

B. PMS consists of a Performance Management Control Display Unit (CDU), Performance Management Computer Unit (PCU), CDU MESSAGE annunciator, and VERTICAL ALERT annunciator.

C. The CDU is located in the pedestal, and provides the flight crew with the selectable controls and displays necessary for the operation of the PMS.

D. The PCU is located in the electrical/electronics (E/E) compartment. The PCU makes all performance computations and provides this information to the CDU for message and data displays, and to the DFGC's for flight guidance interface.

E. The PMS annunciators, CDU MESSAGE and VERTICAL ALERT, are located on the Captain's and First Officer's instrument panels. The annunciators, respectively, advise the flight crew that a message is being displayed in the CDU or that a vertical path change is imminent.

2. Description

A. Control Display Unit (CDU)

(1) The Performance Management Control Display Unit (CDU) provides the flight crew with the necessary control function and displays for operation of the PMS. (Figure 1)

(2) CDU display, controls, and indicators include the following:

(a) Data Display

(b) Function Keys

(c) Data Entry Keys

(d) Mode Annunciators

(e) Warning Annunciator

(f) Line Select Keys

(g) Slew Switch

NOTE: On some aircraft the slew switch is called slew keys.

(h) Slew Keys

(i) Dim Control

(j) Ambient Light Sensor.

(3) Data Display

(a) Data display is a 4 line x 24 character display, with each character formatted within a 5 x 7 LED dot matrix.

1) The top line of the display is a combination title page and scratch pad. The remaining three lines are used for data entry and display, or in conjunction with the line select keys for the call-up of sub-pages.

2) The top line first twelve characters are used to relate the display page to the function key calling up that page.

3) Top line characters 13 through 24 are used as a combination display, alert/advisory message, and scratch pad area.

(4) Function Keys

(a) The following function keys are provided:

1) PLAN (Planning)

2) CLB (Climb)

3) CRZ (Cruise)

4) DES (Descent)

5) VERT WPTS (Vertical Waypoints)

6) CLEAR

7) STS/TEST (Status/Test)

(b) PLAN key calls up data pages relevant to preflight and enroute planning.

(c) CLB, CRZ, and DES keys allow selection of their respective flight mode display pages and permits display of performance and related data associated with the respective modes.

(d) VERT WPTS key provides for display of data related to vertical waypoints (top of climb, top of descent, etc.).

(e) CLEAR key is used to clear data loaded into the scratch pad; clear alert/advisory messages; and in conjunction with the slash key (/) and/or a line select key, to clear previously entered data from a data line.

(f) STS/TEST key functions as a combination lamp test command and status display select key.

(5) Data Entry Keys

(a) Data entry keys are used to load data into the scratch pad area of the data display.

1) Data entry keys include numeric keys 0-9 (eight of which are dual function), a decimal point (.), slash (/), and an alternate function key.

a) The alternate function key is used to select the alternate character of the next data key pressed.

(6) Mode Annunciators

(a) Mode annunciators, labeled CLB, CRZ, and DES, are white in color and come on to indicate the current mode of PMS operation.

1) The annunciated mode is not necessarily related to the display mode selected.

(7) The warning annunciator labeled PMS is amber in color and comes on to indicate PMS failure.

(8) Line select keys are used to transfer data entries from the scratch pad to a data line in the display, arm and/or select PMS submodes, and call up additional data relevant to a specific line in the display.

(9) In cases where multiple display pages are available under the same title, operation of the slew switch in either the up or down direction displays those pages.

NOTE: On some aircraft the operation of the slew keys (up or down arrows) displays the pages.

(a) A cue symbol consisting of an arrow, pointing up or down or both, appears in the last two characters of the scratch pad to indicate which direction to operate the switch to obtain display of the additional pages.

(10) In cases where multiple display pages are available under the same title, operation of the slew keys (up or down arrow) displays those pages.

(a) A cue symbol consisting of an arrow, pointing up or down or both, appears in the last two characters of the scratch pad to indicate which slew key to operate, to obtain display of the additional pages.

(11) The dimming control knob is used to adjust the brightness of the LED display, line select keys, and the mode annunciators about a brightness reference level.

(12) A built-in light sensor senses the ambient light level and together with its associated circuitry adjusts the brightness reference level.

B. Performance Management Computer Unit (PCU)

(1) The PCU is contained in a 1/2 ATR long package and features a magnetic bubble memory. The PCU is programmed to compute a cost efficient flight path profile while considering fuel and time costs, airplane performance, and flight crew inputs. It also processes data for input to the DFGC's and for display on the CDU.

(2) Inherent in the computer program are engine limits and airplane maximum/minimum speeds. Based upon the programmed limits, the PCU provides automatic protection against overboost, overspeed, and minimum speed.

(3) Included in the computer program are data input reasonableness tests and an automatic longitudinal speed restriction of 250 Kts. at altitudes below 10,000 feet.

(a) Reasonableness tests applied to input data include the following:

1) Comparison of entered gross weight (GWT) to airplane maximum and minimum limits.

2) Comparison of entered fuel to maximum limit and GWT minus zero fuel.

3) Comparison of computed bottom of descent (BOD) GWT and maximum GWT for landing.

4) Computed BOD fuel less than 2000 lb.

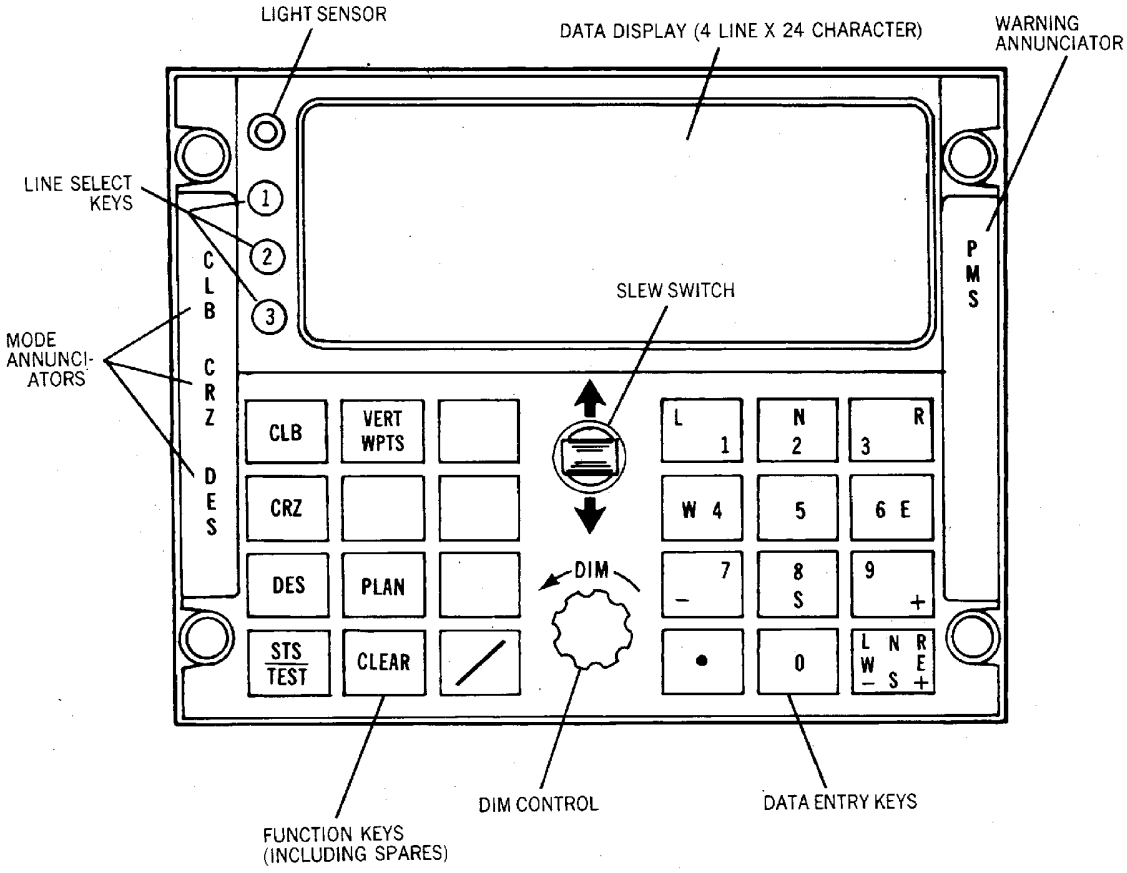
(b) The 250 kt longitudinal speed restriction can be overridden by use of the CLEAR key and Line Select Key 1.

C. PMS Annunciators

(1) The PMS annunciators (CDU MESSAGE and VERTICAL ALERT) advise the flight crew of messages that are being displayed in the CDU and of an impending vertical event.

(a) The CDU MESSAGE annunciator, which is white in color, comes on to advise the crew that a message is being displayed in the scratch pad of the CDU. The annunciator goes off when the message is cleared.

(b) The VERTICAL ALERT annunciator, which is amber in color, comes on when a vertical path change is to take place within 15 seconds. The annunciator goes off at the path change.



BBB2-34-422

CDU Front Panel
Figure 1/34-63-00-990-864

3. Operation

A. Data inputs required for PMS operation are received from three primary sources.

(1) Preprogrammed data of airplane performance characteristics, cost index, and engine and airplane speed limits.

(2) Continuous inputs from VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, R/H & L/H engine fuel flow indicators, digital flight guidance computers 1 & 2, and the landing gear control relay.

(3) Manual data entered through the control display unit.

B. PLAN mode is used for entry of preflight data. This mode can be selected manually by operation of the PLAN function key or by automatic selection following a flight. Automatic selection of PLAN takes place following a flight when the airplane is on the ground and both engines are shut down. Selection of PLAN always results in the display of PLAN Page 1.

(1) Data to be entered on PLAN page 1 includes airplane Gross Weight (GWT), fuel weight, and the distance to the Bottom of Descent (BOD). Based upon these entries, the PMS computes and displays an estimate of GWT at BOD and fuel remaining at BOD.

(a) The entry of all PLAN Page 1 data is prerequisite to system engagement.

(b) The CDU scratch pad displays up and down arrows, with "up" arrow flashing as a cue to slew to PLAN Page 2 for further data entry.

(2) Planning data entires are accomplished by loading the desired data into the scratch pad using the data entry keys, then entering the data into the display field by operation of the appropriate line select key.

(a) The use of the slash key (/) may be required if the data line contains more than one parameter.

(3) Data entries on PLAN Pages are subjected to reasonableness tests (Table 1). In the event that an entry fails to pass the tests, the CDU MESSAGE annunciator comes on and an alert message appears in the scratch pad. The message remains until a new entry has been made, or the message has been cleared.

(4) PLAN Page 2, cruise planning, is obtained from PLAN Page 1 by operation of the slew switch. This page provides for the entry of planned cruising altitude(s), the net trip wind component of the planned cruise altitude(s), and the temperature of the initial cruise altitude.

(a) Data entries are accomplished by the same method as for PLAN Page 1.

(b) Entries on Page 2 revise BOD estimates displayed by PLAN Page 1.

(c) Altitudes are loaded in flight level format separated by a / as necessary.

(d) Entry of the initial cruise altitude is a prerequisite to the entry of wind and temperature data.

(e) Zero wind is the default value if no wind is loaded, and head wind is loaded as a minus value.

(f) The temperature loaded is the temperature of the initial cruise altitude. Temperature is loaded as actual static air temperature (SAT) or deviation from the international standard atmosphere (ISA). The entry of either SAT or deviation from ISA results in the computation of the value not entered and the display of both values. Computation of the temperature for succeeding cruise altitudes is based upon the entered temperature for the initial cruise altitude and application of the standard lapse rate.

Table 1 PMS Reasonableness Limits

Parameter	Maximum Value	Minimum Value
Entered GWT	150 KLB	100 KLB
Entered Fuel	40 KLB	10 KLB
Computed BOD GWT	133 KLB	0
Computed BOD Fuel	0 -	5 KLB
Entered Landing Elevation	15000 FT	
Entered Wind Speeds	250 KT	
Altitude	42000 FT	
Entered Temperatures	STD + 40°C	STD - 40°C
	(or ±40°C ISA deviation)	
Entered Trip Distance	2600 NM	50 NM

C. The PMS mode of the digital flight guidance system (DFGS) is engaged by operation of the PERF pushbutton located on the flight guidance control panel. In order for a successsful system engagement to take place, the following conditions must be met: Flaps less than 26 degrees; Thrust Rating Indicator (TRI) in CLB, CRZ, or MCT; flight director on or autopilot engaged; autothrottles engaged; PMS valid; and flight plan loaded.

(1) At the time that the PERF mode of the DFGS is selected, the PMS automatically enters the appropriate mode of operation, CLB, CRZ, or DES. (Table 2)

Table 2 PERF Mode Entry at PMS Engagement

CURRENT ALTITUDE CURRENT VERTICAL SPEED (SEE NOTE 1)	MORE THAN 512 FT BELOW SELECTED ALTITUDE	WITHIN +/- 512 FT OF SELECTED ALTITUDE	MORE THAN 512 FT ABOVE SELECTED ALTITUDE
CLB greater than 240 fpm	CLB to selected altitude	CRZ at selected altitude	See NOTE 2
Between +/-240 fpm	CLB to selected altitude	CRZ at selected altitude	CRZ at current altitude
DES greater than 240 fpm	See NOTE 3	CRZ at selected altitude	DES to selected altitude (See NOTE 4)

NOTE: 1. Change from one state to another requires new state to exist for 1.2 seconds.
2. PMS computes altitude 30 seconds ahead at current climb rate; captures that altitude.
3. Level off and climb to altitude that existed at time of PERF selection.
4. PERF inhibited unless projected BOD miss distance less than or equal to 5 NM.

D. The only CLB mode available is the OPT mode (optimum output of the performance optimization algorithm).

(1) The format for the CLB display is as follows:

Table 3

Top Line	Title	
Data Line 1	Target Longitudinal Speed	Target EPR
Data Line 2	Target Vertical Speed	TRI Mode Computed EPR Limit

Table 3 (Continued)

Data Line 3	Next Vertical Event (NVE) (SPD change, ARMed ALT, TOC, STEP)	Distance and Time to NVE

(a) Below an altitude (ALT) of 10,000 feet, the target longitudinal speed (SPD) is 250 Kts. (displayed in brackets). The NVE displays (data line 3) indicate a SPD change at 10,000 feet, to the optimum speed. This reflects ATC restrictions and can be overridden by entering "CLEAR" into data line 1.

(b) Longitudinal speed is normally displayed as IAS below an altitude of 27,000 feet and as MACH at and above 27,000 feet.

E. CRZ is automatically selected whenever a transition is made from climb or descent to cruise, or can be selected through automatic system moding at PMS engagement. The display page corresponds with the entered mode. Operation of the CRZ key during climb or descent results in the display of the armed or default CRZ mode. Operation of the CRZ key while in cruise displays the current CRZ mode operation.

(1) Two cruise modes are provided. These modes are OPT (cost factor optimized longitudinal speed) and NON OPT (pilot defined speed).

(a) OPT display is available by operation of the CRZ key, if NON OPT has not been armed; or by operation of the CRZ key and slew switch, if NON OPT has been armed.

(b) NON OPT display is available by editing longitudinal speed (SPD) on the OPT page.

(2) OPT is the default mode of operation and is automatically selected for cruise, whenever a transition is made from climb or descent to the planned cruise altitude.

(3) NON OPT mode is obtained through a flight crew edit of SPD on the OPT page or through automatic system moding whenever a transition is made from climb or descent to cruise at an altitude other than the planned cruise altitude (existing climb or descent airspeed at time of transition will be maintained).

(4) NON OPT mode can be armed prior to PMS engagement or while in CLB by following the same procedures as those employed for a specific mode engagement during CRZ operation.

(5) The basic cruise display is as follows:

Table 4

Top Line	Title	
Data Line 1	Target Longitudinal Speed	Flight Level Target EPR
Data Line 2		TRI Mode Computed EPR Limit
Data Line 3	Next Vertical Event (NVE)	Distance and Time to NVE

(a) NVE data, displayed on data line 3, is for either a STEP climb to a new flight level or for the Top of Descent (TOD). In the event that the NVE is TOD, data line 3 displays the predicted fuel remaining at TOD.

F. Two basic DES modes are available for display or selection, either by operation of the DES Function Key or through automatic system moding at PMS engagement. These modes are OPT (cost factor optimized speed to a bottom of descent point) and NON OPT (pilot specified speed to a bottom of descent point).

(1) The basic display format is the same as that for CLB mode, except that TOD fuel weight replaces TOC flight level.

(2) OPT is the default mode of operation for all descents, unless manually changed by the flight crew.

G. The VERT WPTS fuction key provides for the display of those vertical waypoints (events) that will be experienced during the course of the flight. Those waypoints displayed include: present position (PPOS), start of STEP climb, speed changes, top of climb (TOC), top of descent (TOD), bottom of descent (BOD), and armed altitude (if different than planned cruise altitudes). These vertical waypoints (Vert. Wpts.) are displayed sequentially from top to bottom.

(1) The basic VERT WPTS display format is as follows:

Table 5

Top Line	TO			
Data Line 1	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.
Data Line 2	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.
Data Line 3	Vert. Wpt.	Altitude of Vert. Wpt.	Distance to Vert. Wpt.	Time to Vert. Wpt.

(a) This format uses one data line per event, with the next event displayed in data line 1. As events occur, the data in line 1 is replaced by what was in line 2 and line 2 is replaced by the contents of line 3, etc. This same "scrolling" is obtained by operation of the slew switch, such that, depending on direction of operation, additional upcoming or past events can be viewed.

(b) The distance and time estimates are computed from present position and take into account the current and armed modes of operation.

(2) Operation of the line select key adjacent to a Vert. Wpt. calls up a waypoint data page (expanded BOD page is also available by slewing from the expanded PPOS page). The waypoint data page provides for entry of an expanded definition of the waypoint. This definition consists of a VOR (DME) frequency, bearing and distance to the VOR station, SPD at the waypoint, wind direction and velocity, and temperature. The expanded BOD page also displays, on the top line, an estimate of fuel remaining at BOD.

(a) Entry of the "expanded definition data" increases the precision of the time and distance estimates displayed in all modes of operation. The default displays for SPD, wind, and temperature at the waypoint are the PMS estimates, based on the available data.

(3) The expanded PPOS page is obtained by pressing the line select key adjacent to PPOS on the vertical waypoints page or slewing from the expanded BOD page. The expanded PPOS page displays current true airspeed, static air temperature, wind component, ground speed, track angle, heading, and drift angle.

(a) The expanded PPOS display can be frozen at any time by operation of line select key 1. The display will remain static until line select key 1 is operated a second time, or selection of another page and return to the expanded PPOS page.

H. The STS (status)/TEST key is a combination lamp test command and status display select key. When the key is pressed and held, it functions as a lamp/display test. All CDU annunciators and LED elements are illuminated. While the STS/TEST key is being held, all other keys/switches can be operated to generate specific characters, as verification of proper key/switch operation and CDU decoding. When the STS/TEST key is released, the STS menu page is displayed. The STS page is formatted as follows:

Table 6

Top Line	STS	Airplane Type, Model, and Configuration	
Data Line 1	FAULT STATUS?		Cost Factor
Data Line 2			Program Part Number

Table 6 (Continued)

Data Line 3	TESTS?		

NOTE: Cost Factor will be displayed as a number between 0 (most fuel efficient) and 255 (least fuel efficient).

(1) The FAULT STATUS page is obtained by operation of line select key 1. This page provides a display of active, PMS and interfacing system, faults. The presence of an arrow in the top line of the display indicates that there are additional faults to be displayed. Display of the additional faults is accomplished through operation of the slew switch. In the event that there are no active faults, data line 1 displays "NO FAULTS". As faults are cleared or corrected, they are removed from the display.

(2) The TESTS menu display page is obtained through operation of line select key 3. This page allows selection of: return to service checks; a display of real time inputs to the PMS; and a flight fault review. TESTS display page format is as follows:

Table 7

Top Line	TESTS
Data Line 1	INPUT DATA?
Data Line 2	FAULT REVIEW?
Data Line 3	SERVICE TEST?

NOTE: Desired function is obtained by operation of the corresponding line select key.

(a) INPUT DATA pages display inputs to the PMS from interfacing airplane systems. They are intended primarily as a trouble shooting tool, but can be called up at any time. VOR, DME, and fuel flow inputs are displayed with the indication that the data is VALID or INVALID. DFGS have VALID, INVALID, and NOT SELECTED indications. Gear up/down and ice protection status is also displayed.

(b) The FLIGHT FAULT REVIEW page provides a display of all monitored faults for the 25 previous flights in which PMS faults occurred. Provisions are also made for clearing the fault memory. The FLIGHT FAULT REVIEW display page format is as follows:

Table 8

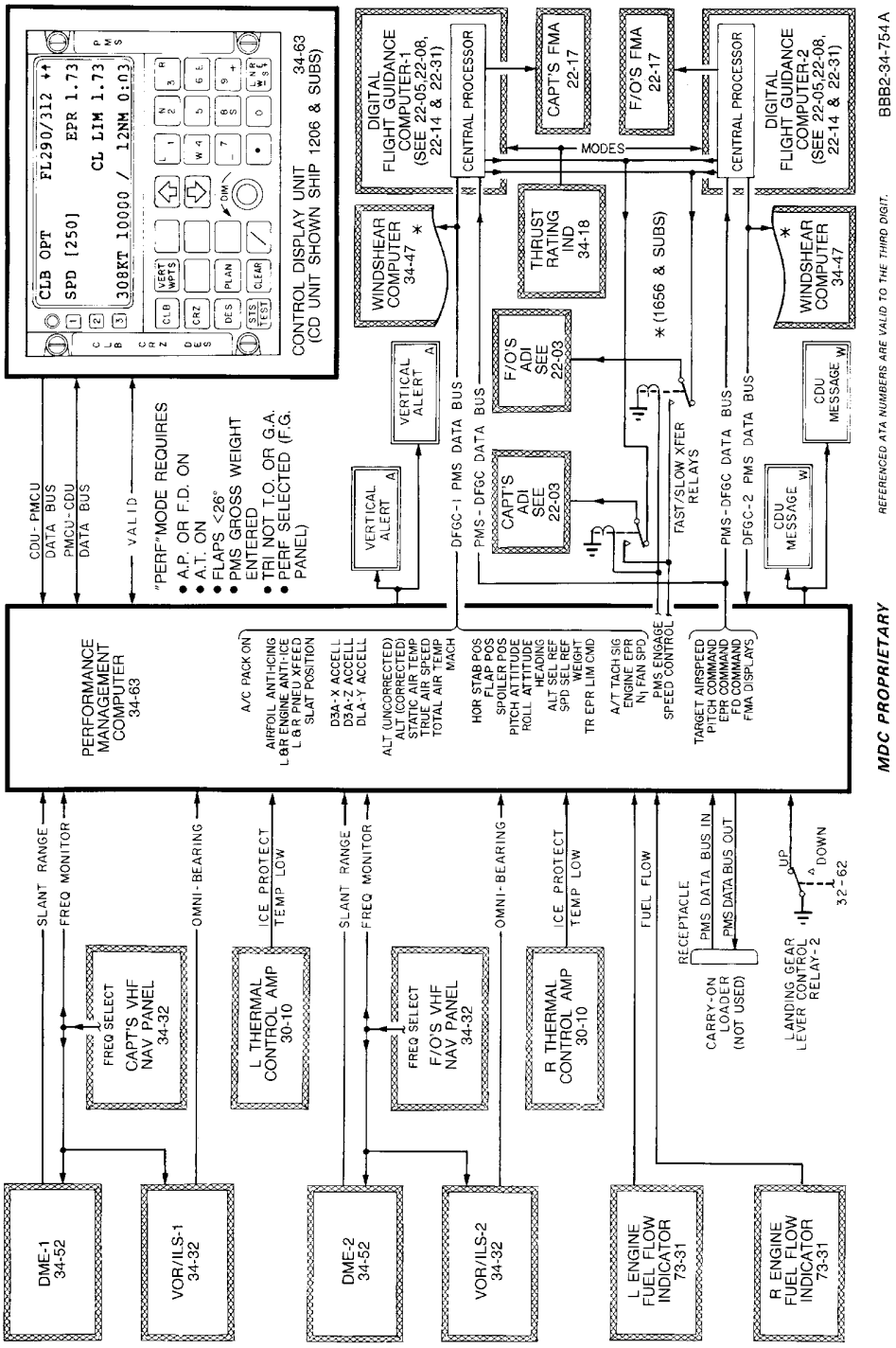
Top Line	FAULT REVIEW
Data Line 1	RECALL FAULTS ?
Data Line 2	ERASE FAULTS ?
Data Line 3	(Blanked)

1) A display of the faults of the previous 25 flights, in which PMS faults occurred, is obtained by operation of line select key 1. The display indicates the title of the page, the flight number, and the faults that occurred. The first display will be for the last flight where a PMS fault was detected. If no faults were detected during the first four flights, for example, but a fault was detected on the fifth flight, the top line would display FAULTS-FLT 5. Only flights where the PMS detected faults will be displayed so that a complete review might display flight 5, 43, 98, 160,...999. Should 999 flights be flown without removing a PCU or erasing the faults, any additional flights with PMS detected faults would be shown as flight 999. The slew switch is used to review the flights and faults.

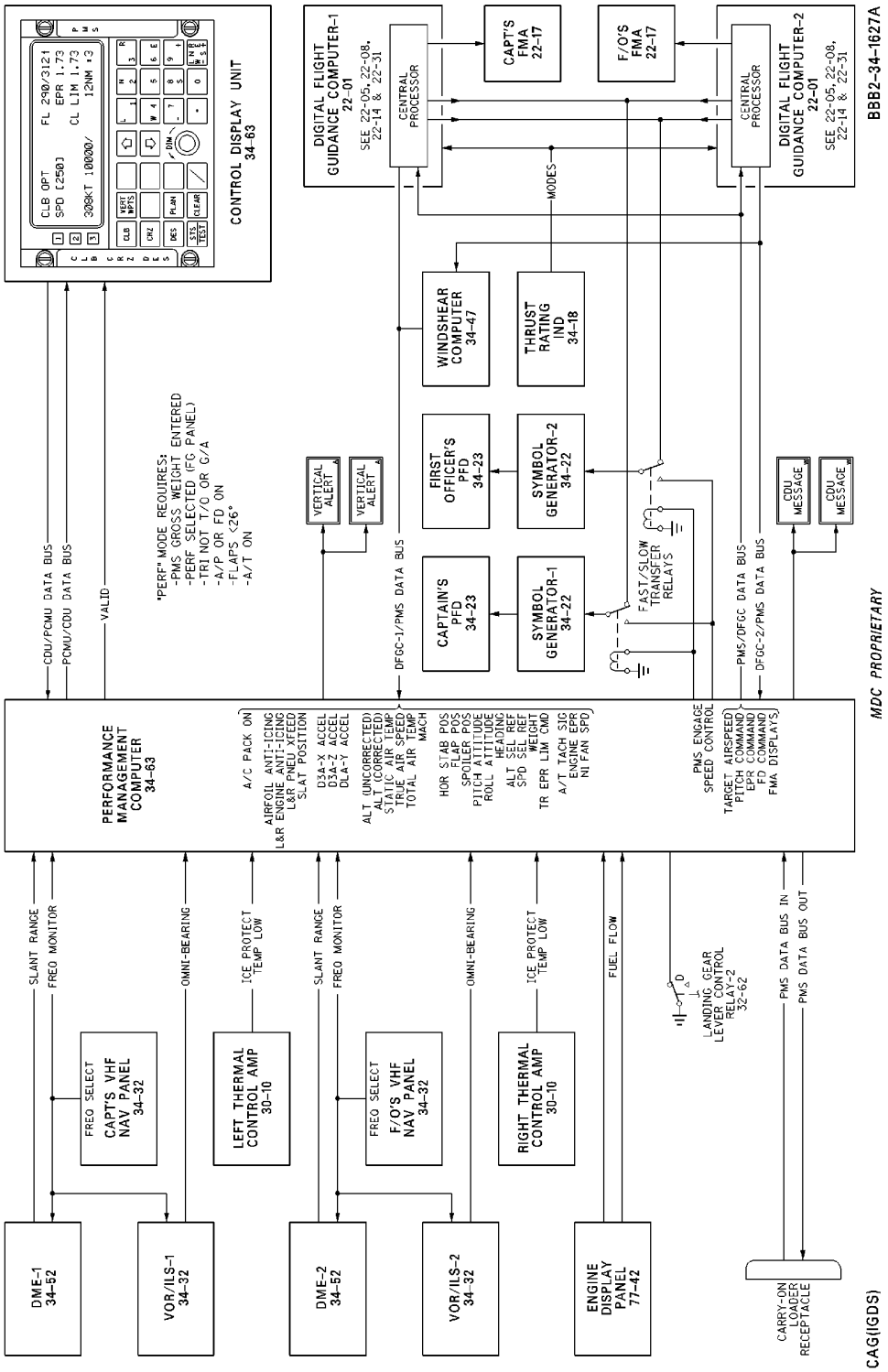
2) Line select key 2 is used to erase the fault memory. Operation of line select key 2 causes, "CONFIRM" to alternate flashing with "ERASE FAULTS" and line select key 2 to illuminate. A second operation of the key erases the memory and extinguishes the key. The ERASE FAULTS option is available only on the ground.

(c) SERVICE TEST is a ground test which verifies the interfaces of the PMS with other airplane systems. The test displays a series of pages, each of which requires a response by the operator. The response is verified by the operator by pressing a line select key. Failures are displayed at the end of the test.

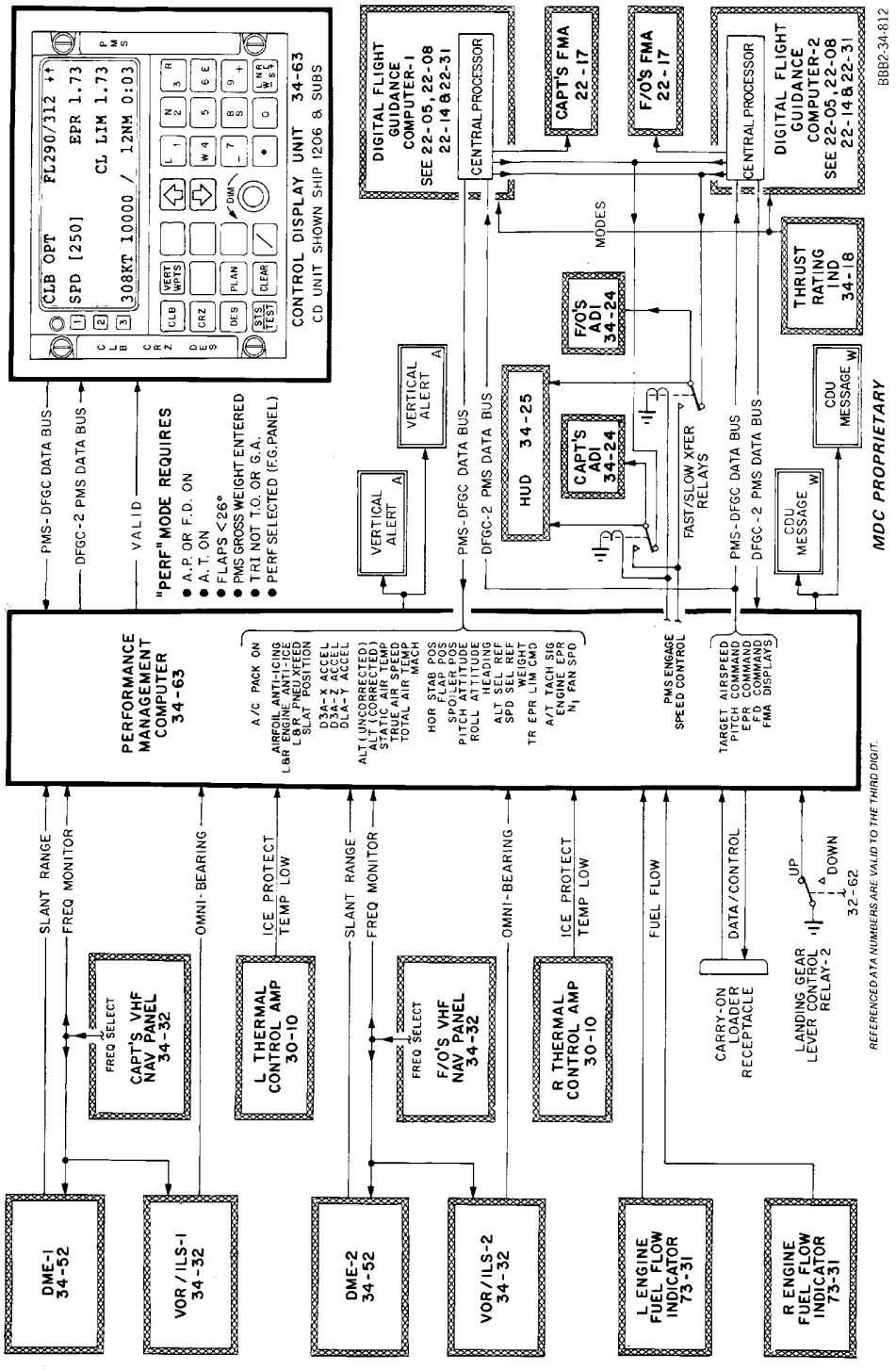
1) The Service Test is initiated by pressing line select key 3 on the TESTS page. If no PMS detected faults are present, the Service Test is immediately displayed. If faults are present, the FAULT STATUS page is displayed. To enter the Service Test, the fault list must be slewed to the end. Following the last fault message, the message ENABLE SERVICE TEST ? is displayed and the adjacent line select key comes on. Pressing the lighted line select key causes the Service Test to be displayed.



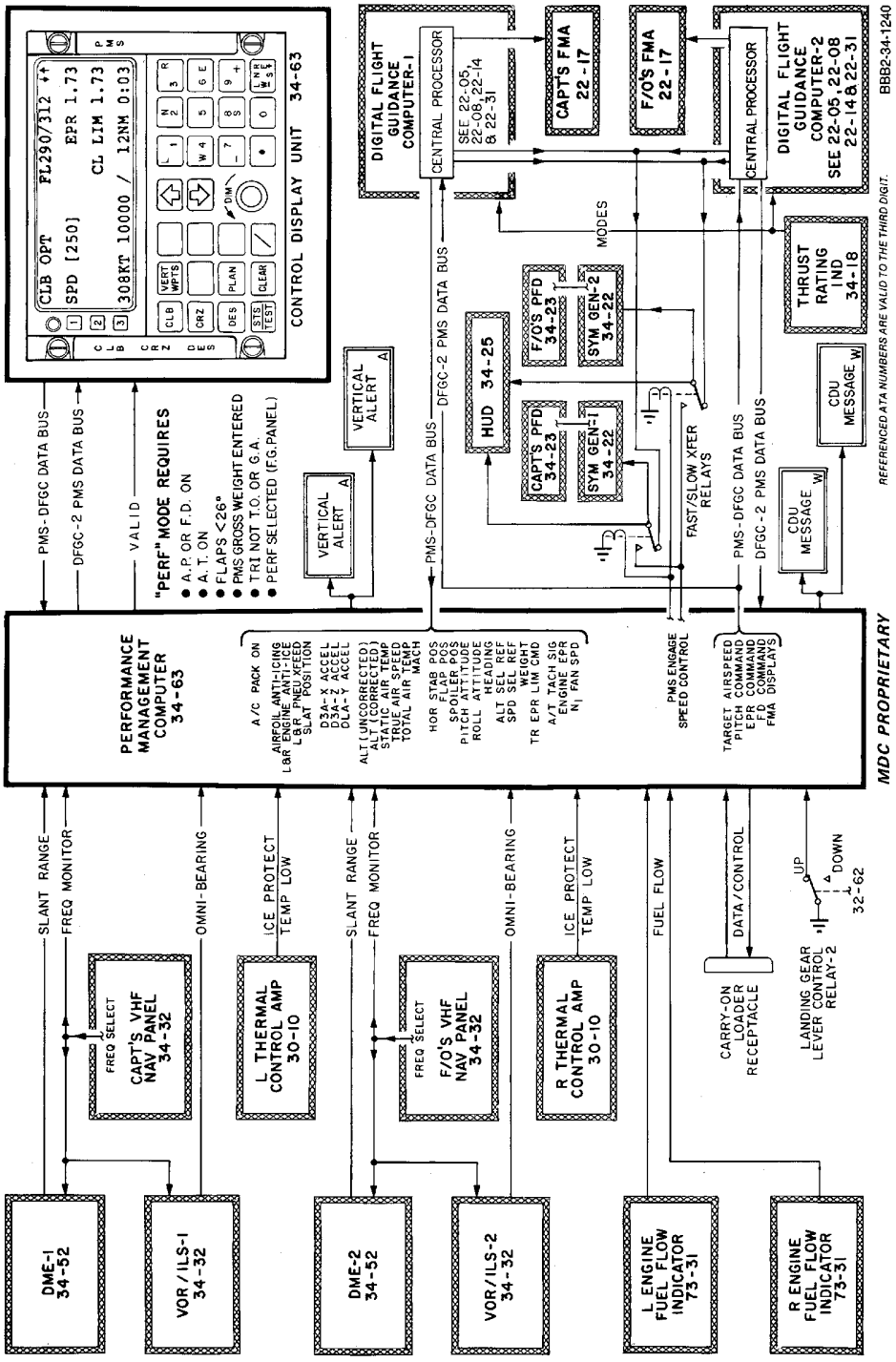
Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-801 (Sheet 1 of 5)



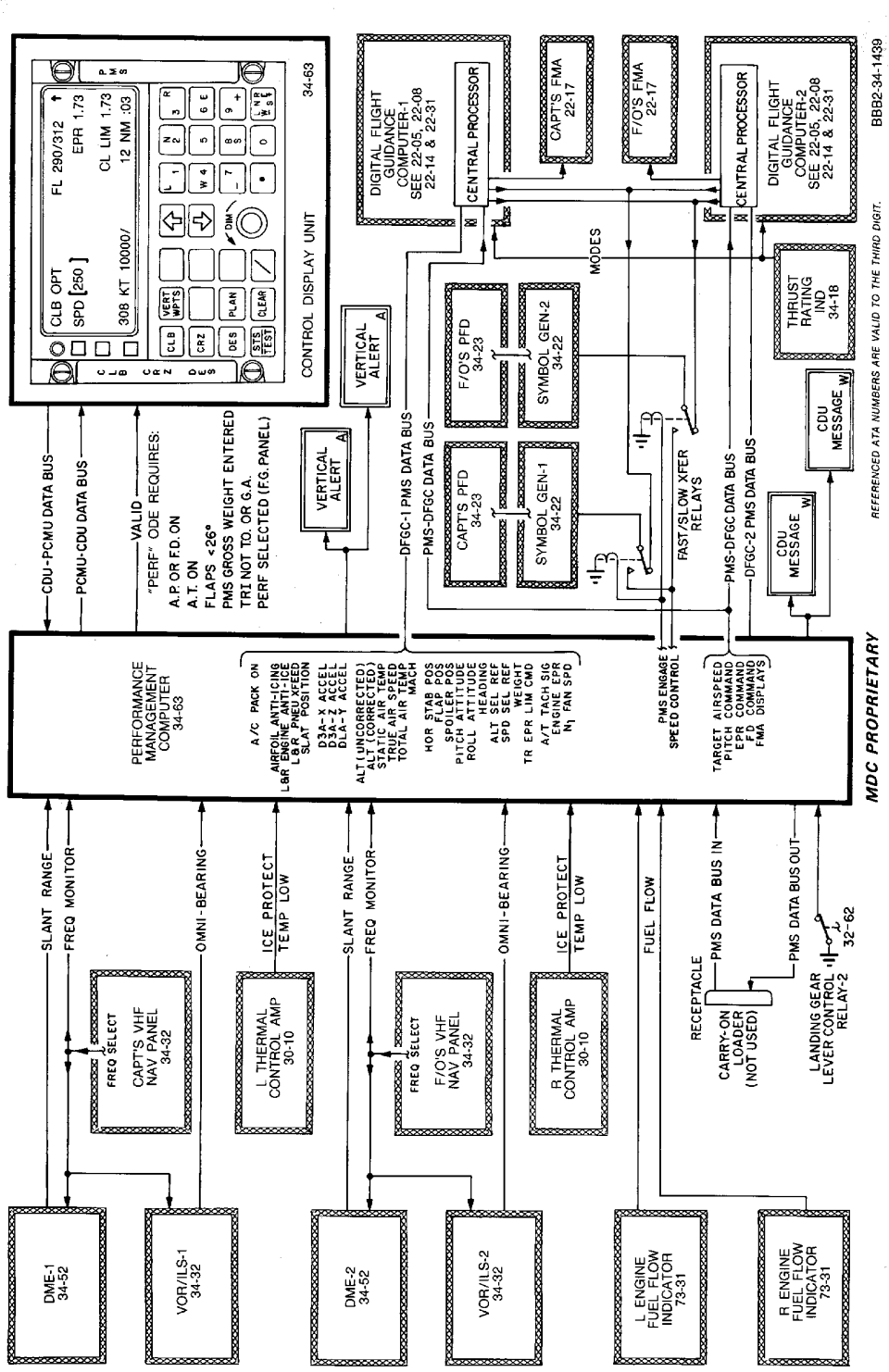
Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-801 (Sheet 2 of 5)



Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-801 (Sheet 3 of 5)



Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-801 (Sheet 4 of 5)



Performance Management System -- Simplified Schematic
Figure 2/34-63-00-990-801 (Sheet 5 of 5)

PERFORMANCE MANAGEMENT SYSTEM - TROUBLE SHOOTING

1. General

A. PMS offers a complement of tests and checks to ensure that it is functioning properly. A review of inputs to PMS is helpful in isolating a malfunction. (Figure 101) CDU self-test, Input Data Pages, Fault Review and the Service Test are dynamic indicators of PMS status. Figure 102 offers the flight line maintenance technician a detailed explanation of the checks for each input.

2. CDU Self-Test

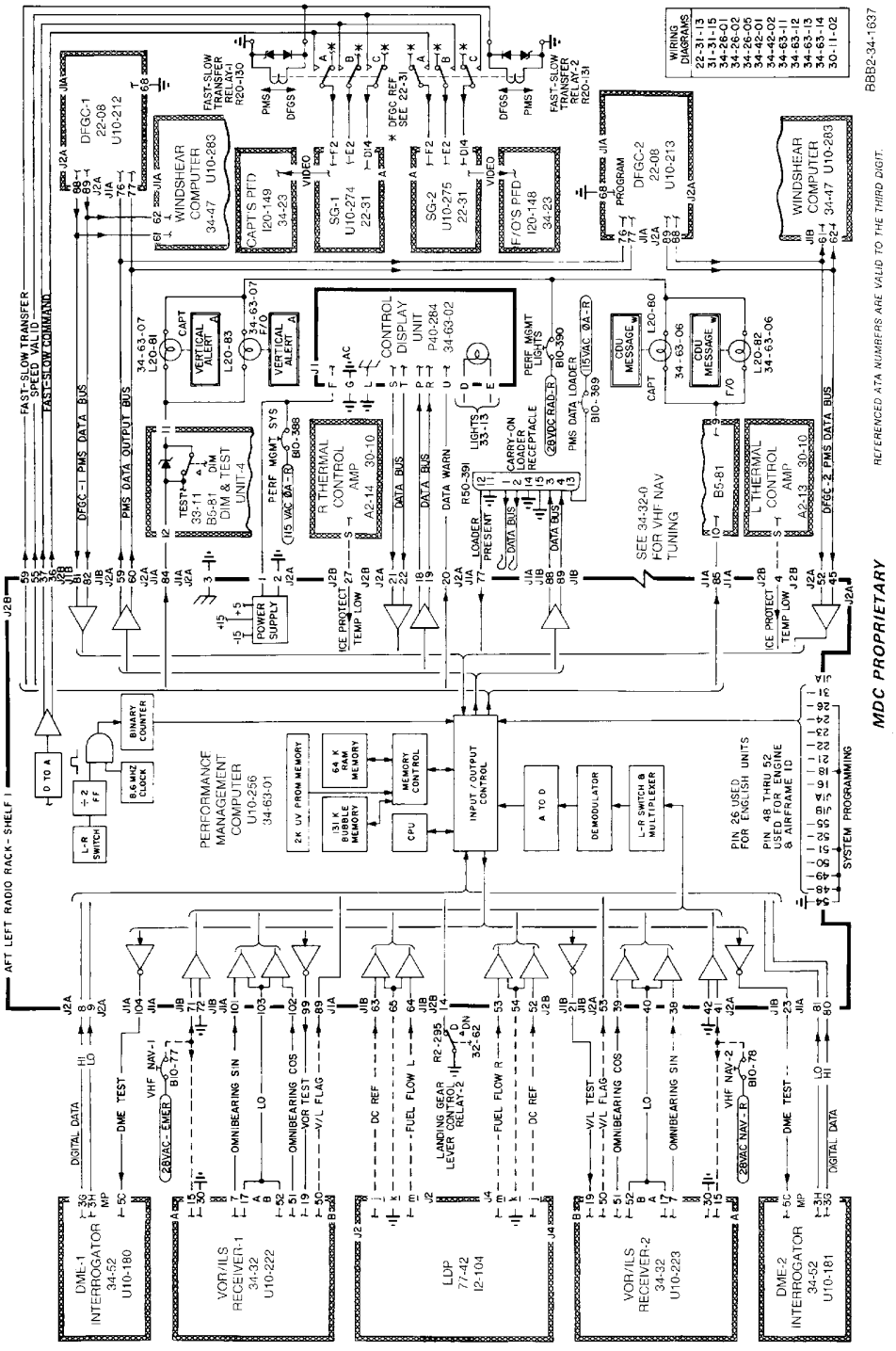
A. The CDU has a self test capability which provides a closed-loop to verify all front panel switches. Simultaneously pressing the STS TEST key and any other key at the same time will result in the 5 x 7 matrix being replaced by an alpha character assigned to the individual key. (Table 106)

3. System Line Fault Monitoring

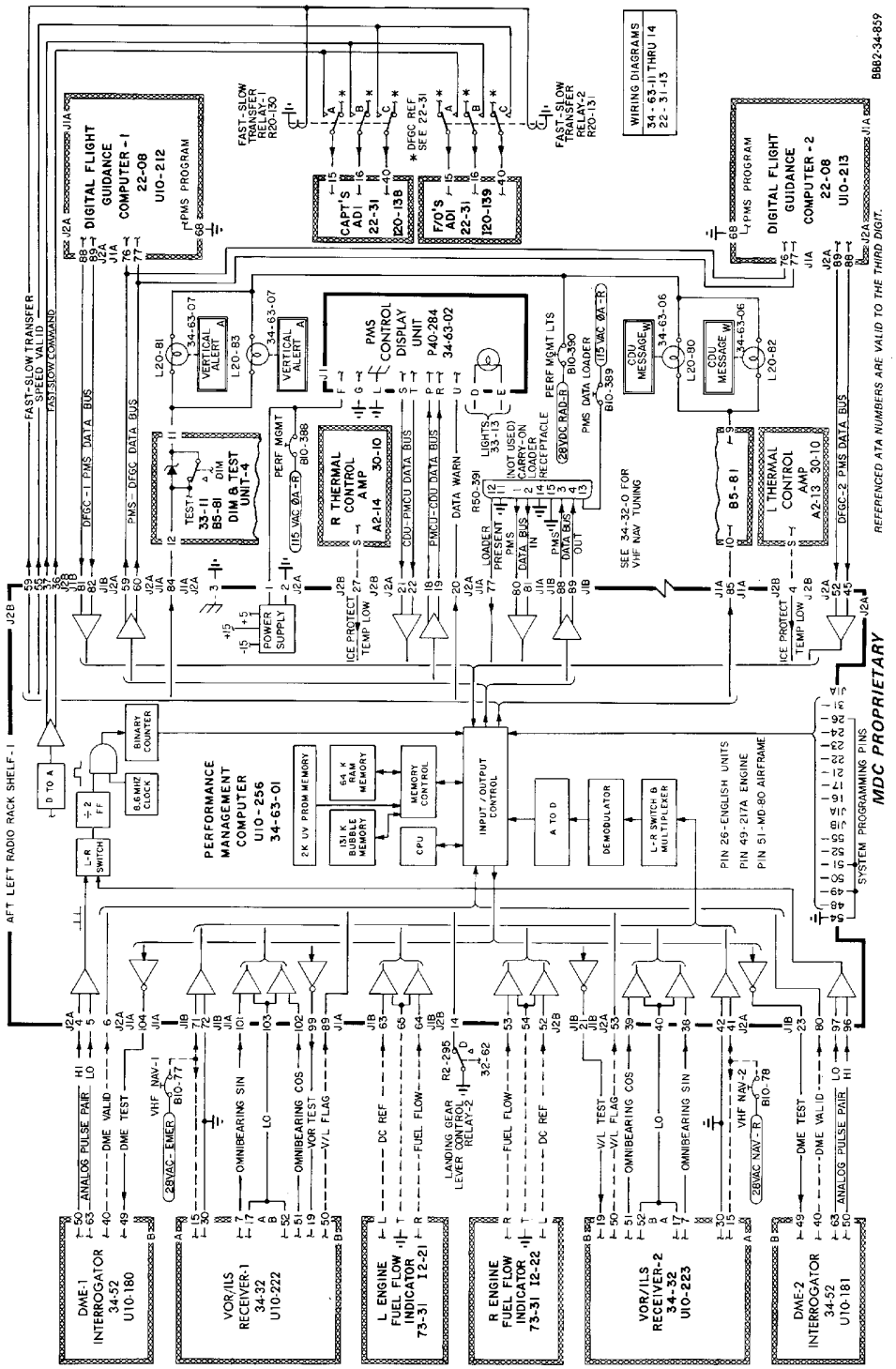
A. The PMS software and hardware provide fault monitoring to ensure that input data is valid, computer operation is normal and output data is valid. When a fault is detected, the PMS provides CDU display messages, invalid output flag voltages and/or lights the amber PMS warning annunciator on the CDU. The tests performed, display messages, and additional Fault Isolation actions are shown Figure 102.

B. The fault STS messages are displayed on the CDU fault status pages only while the faults are being detected. These messages are also available for display on the fault review test pages which will display all faults detected for previous flights. (Paragraph 5., Fault Review) The scratchpad messages are displayed on all pages except status pages in the scratchpad area of the display. Only one fault will be displayed while multiple faults are detected. When a detected fault does not prevent valid operation of PMS, such as one DFGS failure, the scratchpad failure message can be cleared by pressing the clear key. The instrument panel CDU message annunciators are lighted when a scratchpad fault message is being displayed and the PMS is engaged.

C. The discrete flag voltages and CDU PMS annunciator control voltage are output through specific pins on the PMCU. The PMS annunciator is only lighted when an internal PMCU hardware or software fault is detected. These faults are not resettable. When a non-resettable fault which affects thrust or pitch control occurs, the PMCU drops the PERF READY bit which causes the DFGS to disregard PMS outputs. The PERF selected discrete also drops reverting control of the Fast/Slow pointer to the DFGS.



Performance Management System -- Schematic
Figure 101/34-63-00-990-867 (Sheet 1 of 2)



Performance Management System -- Schematic
Figure 101/34-63-00-990-867 (Sheet 2 of 2)

EFFECTIVITY
WJE 416, 420, 422, 424-427, 429, 861, 862, 868, 873, 874, 891-893

CDU Message		CDU/PMS Annunciator Lighted	Digital Data Valid Discrete Set Invalid	PERF Ready Discrete Set Not Ready		
FAULT STATUS & FAULT REVIEW Pages	Scratchpad				Test Type	Test Description
75 MS	75 MS FAIL	X	X	X	75 ms Loop Test	75 ms task not completed in 75 msec.
150 MS	150 MS FAIL	X	X	X	150 ms Loop Test	150 ms task not completed in 150 msec.
600 MS	600 MS FAIL	X	X	X	600 ms Loop Test	600 ms task not completed in 600 msec.
6 SEC	6 SEC FAIL	X	X	X	Outer Timing Loop Test	6 second task not completed in 6 seconds.
SUMCHECK (PGM's -007, -008 & -010 only) (Note 1)	SUMCHECK (PGM's -007, -008 & -010 only) (Note 1)	X	X	X	Memory Sum Check	Groups of non-variable 64K RAM memory words are summed and must equal predetermined values.
N/A	MEM FAIL XXXXXX (Note 1)	X	X	X	Bulk Storage Memory Check	Uncorrectable errors encountered during bulk storage memory read.
N/A	PMCU FAIL PROM SUM CHECK (Note 1)	X	X	X	2K UVPROM Sumcheck	Sumcheck error of UVPROM firmware at turn-on.

BBB2-34-2808
S0000241281V1

PMS Fault Monitoring
Figure 102/34-63-00-990-876 (Sheet 1 of 5)

CDU Message		CDU/PMS Annunciator Lighted	Digital Data Valid Discrete Set Invalid	PERF Ready Discrete Set Not Ready		
FAULT STATUS & FAULT REVIEW Pages	Scratchpad				Test Type	Test Description
N/A	PMCU BUBBLE FAIL, ERROR CODE XX (Note 1)	X	X	X	Bulk Storage Memory Checks	Bulk storage memory failure due to 11 possible faults identified by ERROR CODE 1 THROUGH 11.
N/A	FAIL TEMP HI (Note 1)	X	X	X	Bubble Memory Temp Check	Bubble memory temperature exceeds high limit, or bulk storage memory bank 1 commanded.
N/A	FAIL TEMP LO (Note 1)	X	X	X	Bubble Memory Check	Bubble memory temperature exceeds low limit.
MEMORY (PGM -006 only)	MEMORY FAIL (PGM -006 only)	X	X	X	Memory Sum Check	Non-variable RAM memory words are summed and must equal a predetermined value.
N/A	N/A	X	X	X	Computer Operations (COP) Check	Program is "lost" as detected by hardware check.
PARITY displayed only on Fault Review page (PGM -010 only)	PERF AVAIL-RESTRT COMPL (PGM -010 only)	X	X	X	64K RAM Memory Parity Check	Parity is not odd for 64K RAM memory location data as detected by hardware check on location being executed. Program reloads entire 64K RAM from bulk memory.
	N/A	X	X	X	Computer Operations (COP) Check	Program is lost as detected by hardware check.
SEU displayed only on Fault Review page (PGM -010 only)	N/A				64K RAM Memory Parity Check	Parity is not odd for 64K RAM memory location data as detected by hardware check on location being summed for sumcheck purposes. Program reloads block of memory containing parity fail from bulk memory.

BBB2-34-2809
S0000241375V1

PMS Fault Monitoring
Figure 102/34-63-00-990-876 (Sheet 2 of 5)

CDU Message		CDU/PMS Annunciator Lighted	Digital Data Valid Discrete Set Invalid	PERF Ready Discrete Set Not Ready		
FAULT STATUS & FAULT REVIEW Pages	Scratchpad				Test Type	Test Description
FF-L	FF-L FAIL			X	Fuel Flow 1 Input	References A/D conversion, $\lvert V_{REF} - 5V \rvert$ <0.5 volt Signal: A/D conversion, $0 > V_{SIG} > REF$ Fail = Ref or Signal fail If Ref or Signal fail, Fuel Flow = 0
FF-R	FF-R FAIL			X	Fuel Flow 2 Input	Same as Fuel Flow No. 1 Input
DME1 (PGM's -008 & -010 only)	DME1 FAIL (PGM's -008 & -010 only)				DME Input	Digital DME ● No DME input ● Invalid selected frequency ● Parity fail ● SSM = FAIL (0, 0) ● SSM = NCD (0,1) ● SSM = TEST (1, 0) & NOT DM1TST ● No corresponding distance data ● Invalid distance data ● Parity ● SSM = FAIL (0, 0) ● SSM = TEST (1, 0) & NOT DM1TST ● 304NM<DME<-0.0NM Analog DME ● NOT DM1VLD

BBB2-34-2810
S0000241376V1

PMS Fault Monitoring
Figure 102/34-63-00-990-876 (Sheet 3 of 5)

CDU Message		CDU/PMS Annunciator Lighted	Digital Data Valid Discrete Set Invalid	PERF Ready Discrete Set Not Ready		
FAULT STATUS & FAULT REVIEW Pages	Scratchpad				Test Type	Test Description
DME2 (PGM's -008 & -010 only)	DME2 FAIL (PGM's -008 & -010 only)				DME Input	Digital DME Same as DME1 Analog DME Same as DME1
VOR1	VOR1 FAIL				VOR1 Resolver Input	A/D conversion, Resolver Format
VOR2	VOR2 FAIL				VOR2 Resolver Input	Same as VOR1 Input
TUNE 1	TUNE 1 FAIL				NAV TUNE 1	Analog DME ● Illegal 2 x 5 code on units or tenths of MHz inputs. ● Outside range 108.00 thru 117.95 MHz. ● Sets FREQ = 0 if FAIL. Digital DME (PGM's -008 & -009 only) ● No selected frequency data. ● Invalid BCD digit. ● Outside range 108.00 thru 117.95 MHz. ● Sets FREQ = 0 if FAIL.
TUNE 2	TUNE 2 FAIL				NAV TUNE 2	Same as TUNE 1

BBB2-34-2811
S0000241377V1

PMS Fault Monitoring
Figure 102/34-63-00-990-876 (Sheet 4 of 5)

CDU Message		CDU/PMS Annunciator Lighted				
		Digital Data Valid Discrete Set Invalid				
		PERF Ready Discrete Set Not Ready				
FAULT STATUS & FAULT REVIEW Pages	Scratchpad				Test Type	Test Description
DFGS1 FAIL (Note 4)	DFGS1 DATA			X	DFGS1 Input data	Illegal combination of DATA GOOD and DATA VALID bits in the DFGS word.
DFGS1 FAIL (Note 4)	DFGS1 FAIL			X	DFGS1 Input Bus	Complete failure of DFGS Input bus detected through lowering of a valid bit in the DFGS word.
DFGS2 DATA (Note 4)	DFGS2 DATA			X	DFGS2 Input data	Same as DFGS1.
DFGS2 FAIL (Note 4)	DFGS2 FAIL			X	DFGS2 Input Bus	Same as DFGS1.
HEADING COMP	HEADING COMP			X	DFGS1 and 2 magnetic heading	Difference in magnetic heading from selected DFGS and DFGS1 or DFGS2 greater than 81 degrees.

Note 1: No other data can be displayed when fault is detected. Fault may be resettable by cycling power.
Note 2: In -010 PGM fail must exist for 3 seconds before annunciated.
Note 3: Test is performed in 600 msec loop but Fail must occur for 5 consecutive passes before it is logged, therefore test interval is 3 sec.
Note 4: Fault messages set only when specific DFGS is selected.

BBB2-34-2812
S0000241378V1

PMS Fault Monitoring
Figure 102/34-63-00-990-876 (Sheet 5 of 5)

4. Input Data Checks

A. The input data pages are intended as a trouble shooting tool that can be called up at any time to display inputs to the PMS from interfacing aircraft systems. These pages are accessible by:

(1) Pressing STS/TEST function key to display STS/TEST page.

XXX Denotes type airplane

YYY Denotes type engine

ZZZ Denotes PMS Program

Table 101

STS	XXXX-XX	YYYY-YYYY	P/N - ZZZ
FAULT	STATUS ?	COST	0
		KD + .0 / KF + .0	
TESTS ?		DES M. 72 / 280	

(2) Pressing line select key 3 displays a TESTS page.

	TESTS		
1	INPUT	DATA	?
2	FAULT	REVIEW	?
3	SERVICE	TEST	?

(3) Pressing line select key 1 displays Input Data Page 1.

Table 102 Input Data Displays

	INPUT			DATA		*
1	DFGS	1	INVALID	DATA		
2	DFGS	2	NOT	SELECTED		
3	GEAR		DOWN	PROG	PINS	-01280
	INPUT		DATA			#*
1						
2	VOR1		1XX.XX	XXX°		INVALID
3	DME1			XXXNM		VALID
	INPUT		DATA			#*
1						
2	VOR2		1XX.XX	XXX°		INVALID
3	DME2			XXXNM		VALID
	INPUT		DATA			#*
1	FF	L	XX.XX		VALID	
2	FF	R	--.--	INVALID		
3	ICE	PROT	TEMP		NORM	LOW

# Indicates "down" arrow in display.

Table 102 Input Data Displays (Continued)

* Indicates "up" arrow in display.

5. Fault Review

A. These pages display a list of faults from previous flights in reverse chronological order. Each flight is numbered sequentially and faults are logged from takeoff to landing, along with the number of occurrences of each.

(1) Entry to the sequence of display pages is by operating line key 2 on the TESTS page, which then calls up this page: (Ground operation only, in flight this page is not available).

Table 103

	FAULT	REVIEW	
1	RECALL	FAULTS	?
2	ERASE	FAULTS	?
3			
NOTE: Previously recorded faults can be erased by a double push of line key 2.			

(2) Pressing line key 1 gives access to the entire list of recorded faults and the number of occurrences, up to 7. A typical page would be:

Table 104

	FAULTS-FLT 1	*
1	DFGS1 DATA	2
2	FF 2	3
3	TUNE 1	4
* Indicates "up" arrow in display.		
NOTE: If more than 3 faults are present for a given flight, slew arrows are displayed.		

(a) The list may be slewed until all flights with stored faults have been displayed.

Current flight is 1 only if a fault has been detected, and only flights with faults are recorded. The fault review could be:

1 (last flight)

5 (5th previous flight)

999 (999th previous flight)

(b) The largest number that could be displayed is 999, which would only be displayed if there were no more than 25 flights with detected faults out of the last 999 flights.

Flights with no faults are not displayed. A maximum of 25 flights with faults may be stored/displayed. Table 105 lists all Flight Fault Review messages.

Table 105 Fault Messages

SCRATCHPAD	FAULT STATUS PAGE	FLIGHT FAULT REVIEW PAGE
25 MS FAIL	25 MS	25 MS
MEMORY FAIL	MEMORY	MEMORY

Table 105 Fault Messages (Continued)

SCRATCHPAD	FAULT STATUS PAGE	FLIGHT FAULT REVIEW PAGE
150 MS FAIL	150 MS	150 MS
600 MS FAIL	600 MS	600 MS
75 MS FAIL	75 MS	75 MS
FF L FAIL	FF L	FF L
FF R FAIL	FF R	FF R
	DME 1	
	DME 2	
VOR1	VOR1	VOR1
VOR2	VOR2	VOR2
	VOR1 FLAG	
	VOR2 FLAG	
TUNE 1 FAIL	TUNE 1	TUNE 1
TUNE 2 FAIL	TUNE 2	TUNE 2
DFGS1 DATA	DFGS1 DATA	DSGS1 DATA
DFGS1 BUS	DFGS1 BUS	DFGS1 BUS
DFGS2 DATA	DFGS2 DATA	DSGS2 DATA
DFGS2 BUS	DFGS2 BUS	DFGS2 BUS
SLAT POS FAIL	SLAT POS	SLAT POS

Table 106 CDU Self-Test Patterns

Key or Switch Pressed	Display For Each Line																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CLEAR Key	A				A				A				A				A				A			
/Key	B				B				B				B				B				B			
CLB Key	C				C				C				C				C				C			
VERT WPTS Key	D				D				D				D				D				D			
Spare #3 Key	E				E				E				E				E				E			
CRZ Key	F				F				F				F				F				F			
Spare #4 Key	G				G				G				G				G				G			
Spare #1 Key	H				H				H				H				H				H			
DES Key	I				I				I				I				I				I			
PLAN Key	J				J				J				J				J				J			
Spare #2 Key	K				K				K				K				K				K			

Table 106 CDU Self-Test Patterns (Continued)

Key or Switch Pressed	Display For Each Line																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Line Select 1 Switch	M				M				M				M				M			
Line Select 2 Switch	N				N				N				N				N			
Line Select 3 Switch	O				O				O				O				O			
· Key		A				A				A				A				A		
LNR Key		B				B				B				B				B		
0 Key		C				C				C				C				C		
1 Key		D				D				D				D				D		
2 Key		E				E				E				E				E		
3 Key		F				F				F				F				F		
4 Key		G				G				G				G				G		
5 Key		H				H				H				H				H		
6 Key		I				I				I				I				I		
7 Key		J				J				J				J				J		
8 Key		K				K				K				K				K		
9 Key		L				L				L				L				L		
Slew Switch (up)		M				M				M				M				M		
Slew Switch (down)		N				N				N				N				N		

FLIGHT MANAGEMENT SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Flight Management System in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the Flight Management System operation are: Advanced Flight Management Computer (AFMC) and the Multipurpose Control Display Units (MCDU).

E. The Flight Management System components are located as follows:

Table 101

Component	Location
Advanced Flight Management Computer (AFMC)	Electrical/Electronics Compartment Aft Radio Rack Shelf 1
Multipurpose Control Display Units (MCDU)	Pedestal

2. Equipment and Materials

NOTE: Equivalent substitutes can be used instead of the following listed item:

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Flight Management

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are AFMC and MCDU.

Table 103

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

Table 103 (Continued)

Step	Procedure	Correction
(5)	The DISCRETES page displays the condition in the AFMC of the changeable discretes. When a discrete comes in from the left or right side, such as ENGINE ANTI ICE, the state of each discrete is listed under the header 1 or 2, whichever is appropriate, all others are listed singularly between 1 and 2. The following will be displayed on the DISCRETES page: A/C PACK, X-FEED VALVE, ENGINE A/ICE, A/F ICE PROT, WOW SWITCH, CAA FLIGHT RULES, KILOGRAM OPTION, SRCE/DEST IDENT, and LANDING GEAR.	
(6)	The PERF FACTR page provides display and entry of performance data applicable to individual airline policy or aircraft characteristics. Before data can be entered into this page, it must be armed by typing the letters ARM into the scratchpad and line selecting it to 6R.	

4. Intermittent AFMC Timeouts Reported - Maintenance Procedure

A. Check the FAIL LED on the front of the related AFMC. If it is on (red), then replace the AFMC per ADVANCED FLIGHT MANAGEMENT COMPUTER, SUBJECT 34-63-03 , Removal/Installation, and continue with Paragraph 4.C. that follows. If it is off, continue with Paragraph 4.B. that follows.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

B. Open these circuit breakers for 30 seconds, then close these circuit breakers.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name

WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879

F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

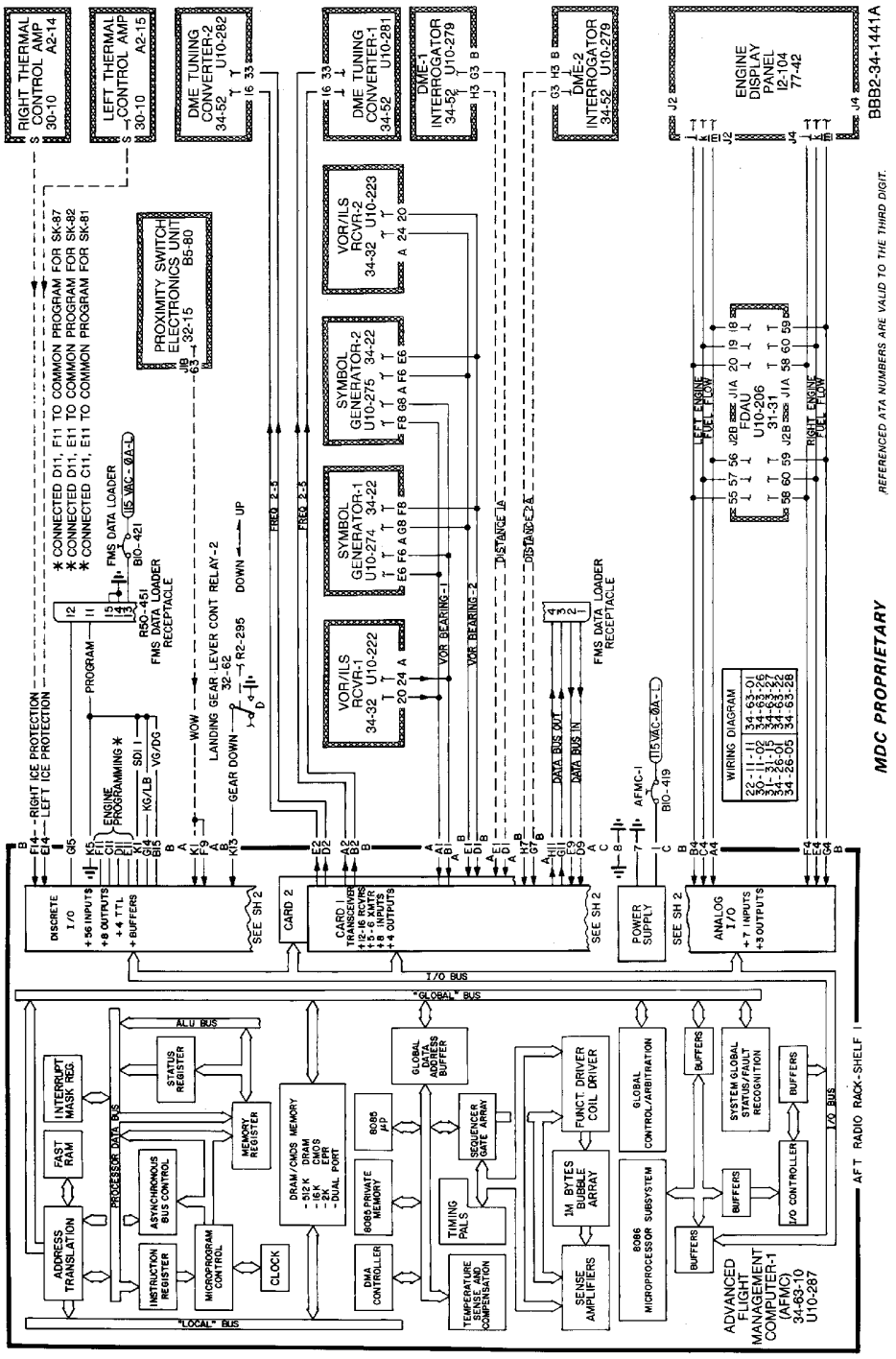
NOTE: The FLIGHT MANAGEMENT SYSTEM-2 AFMC circuit breaker may not be on some aircraft or it is used provisionally.

(1) After at least 1 minute, look at the FAIL light on the front of the AFMC.

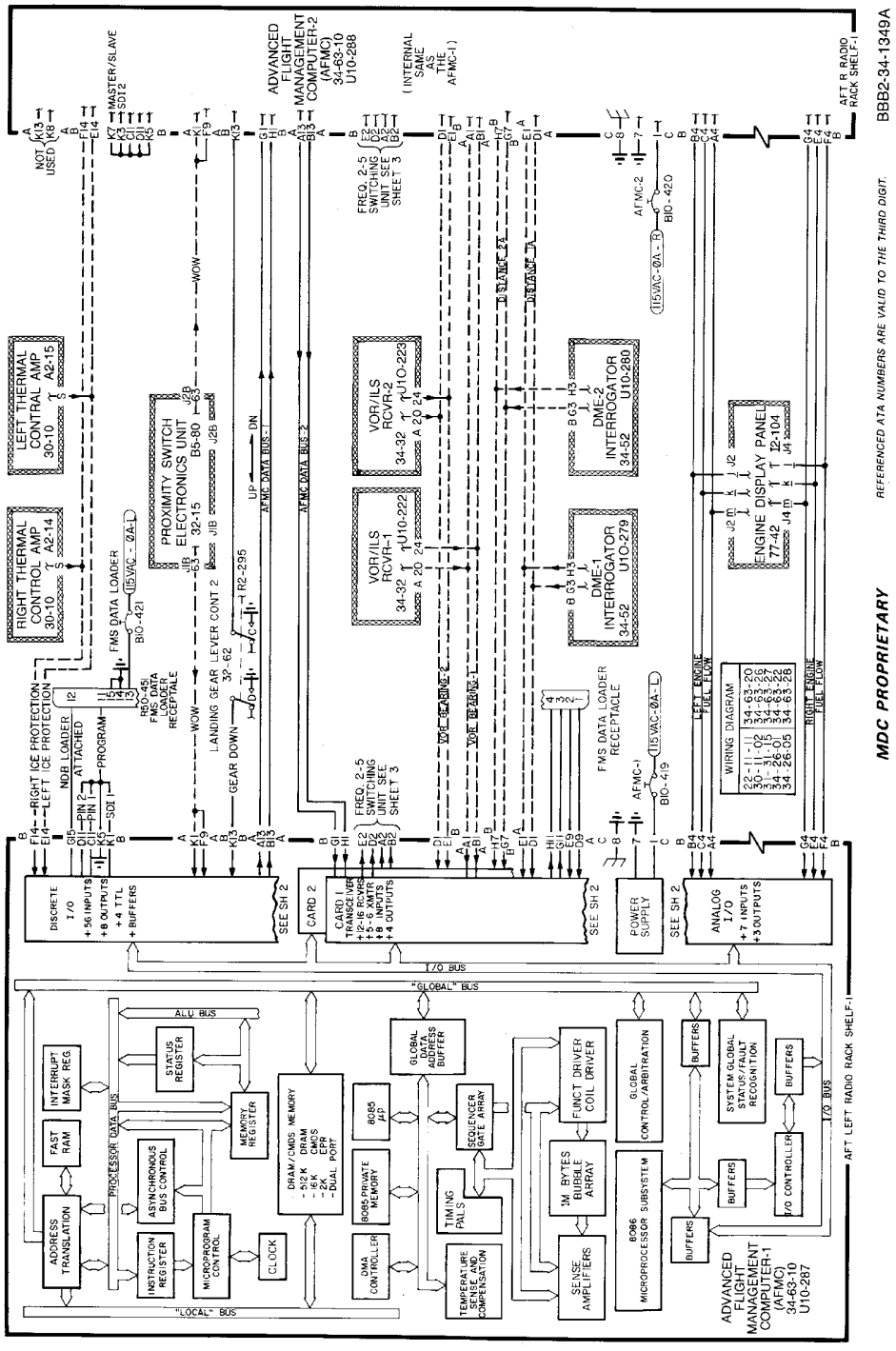
(2) If it is on, replace the AFMC per ADVANCED FLIGHT MANAGEMENT COMPUTER, SUBJECT 34-63-03, Removal/Installation and continue with Paragraph 4.C. that follows.

(3) If it is off, continue with Paragraph 4.C. that follows.

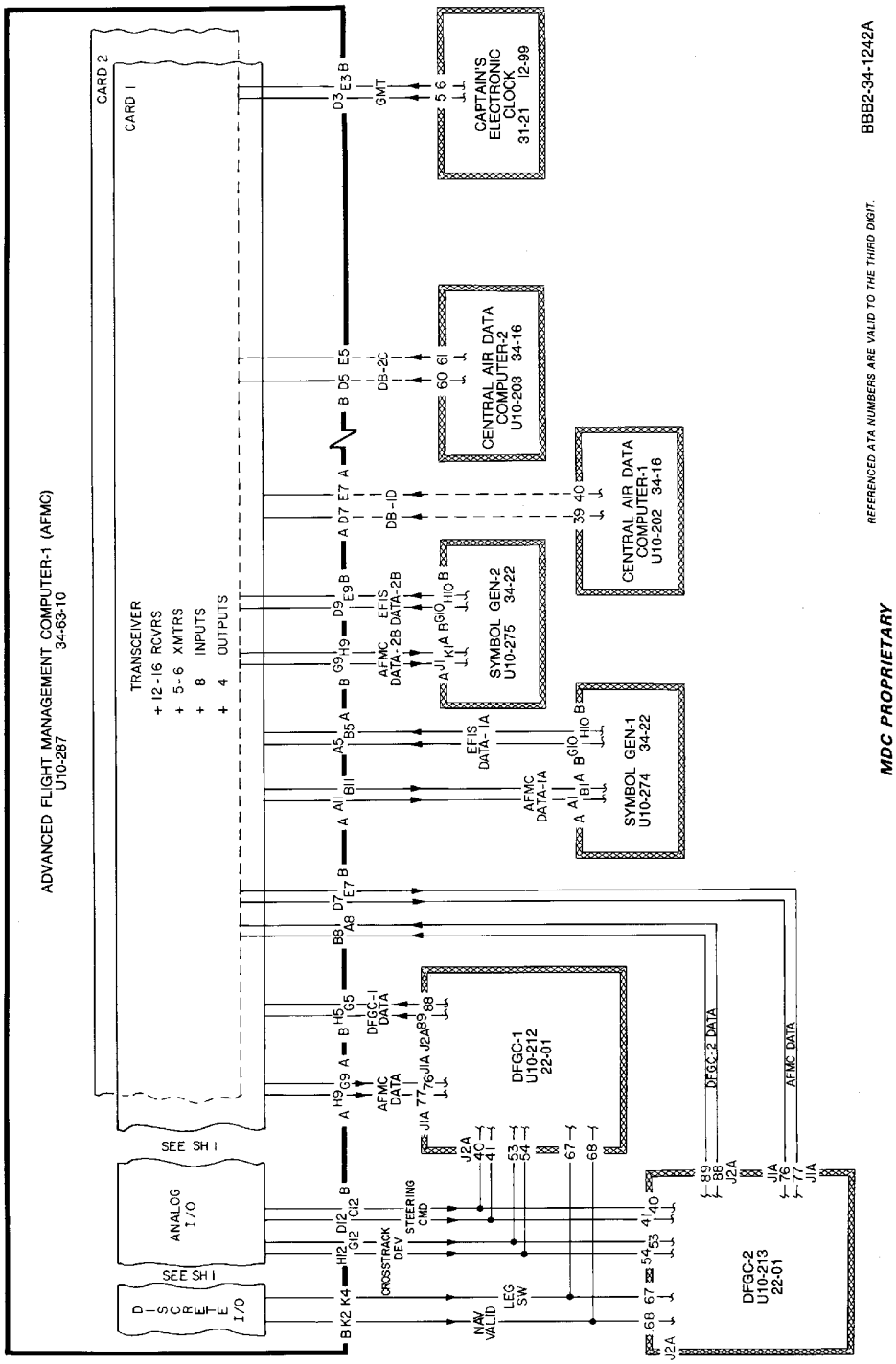
C. Run the R-T-S test per MULTIPURPOSE CONTROL DISPLAY UNIT, SUBJECT 34-63-04, Return To Service Test. If the AFMC fails, replace the AFMC. If the AFMC passes, the AFMC is OK.



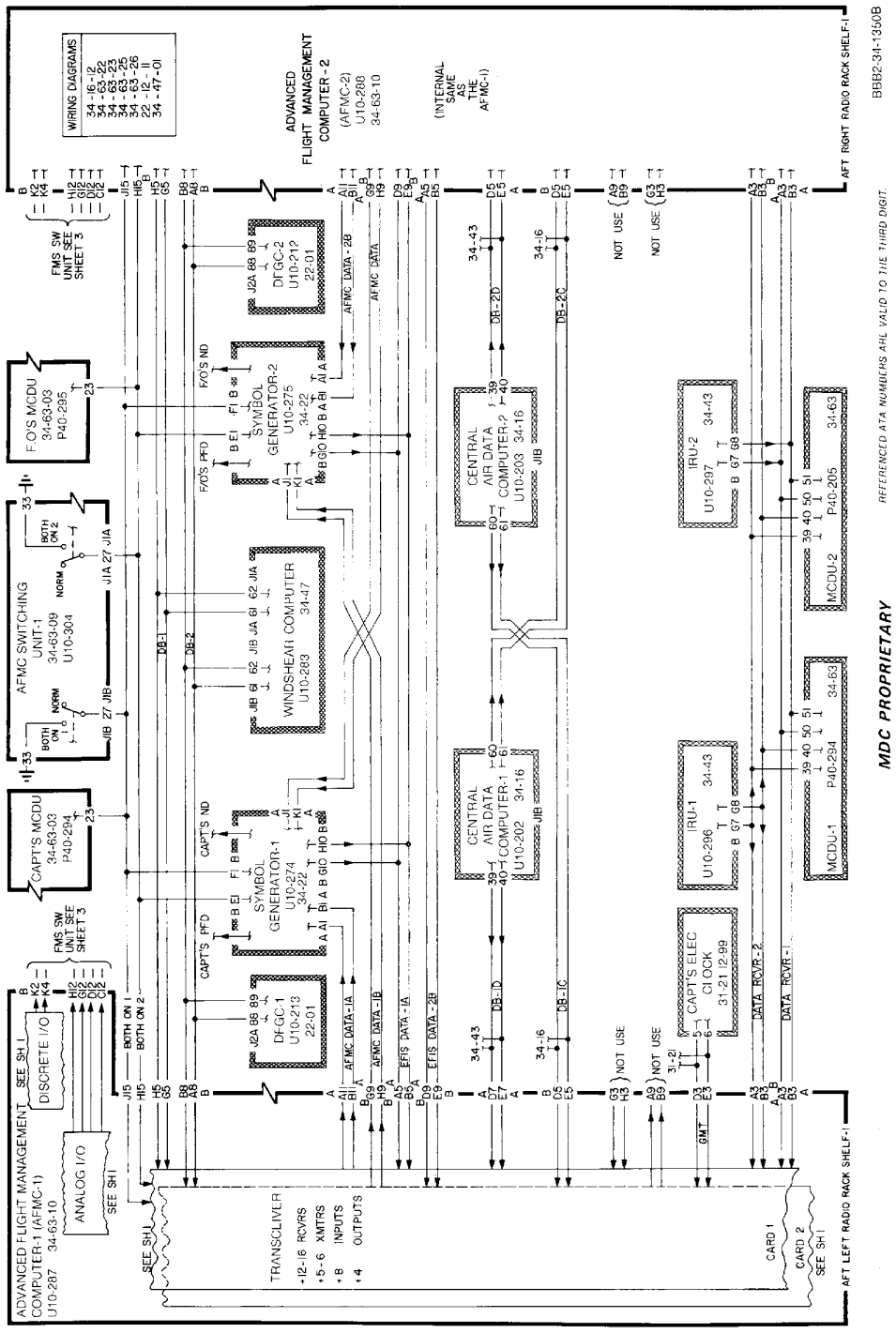
Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 1 of 6)



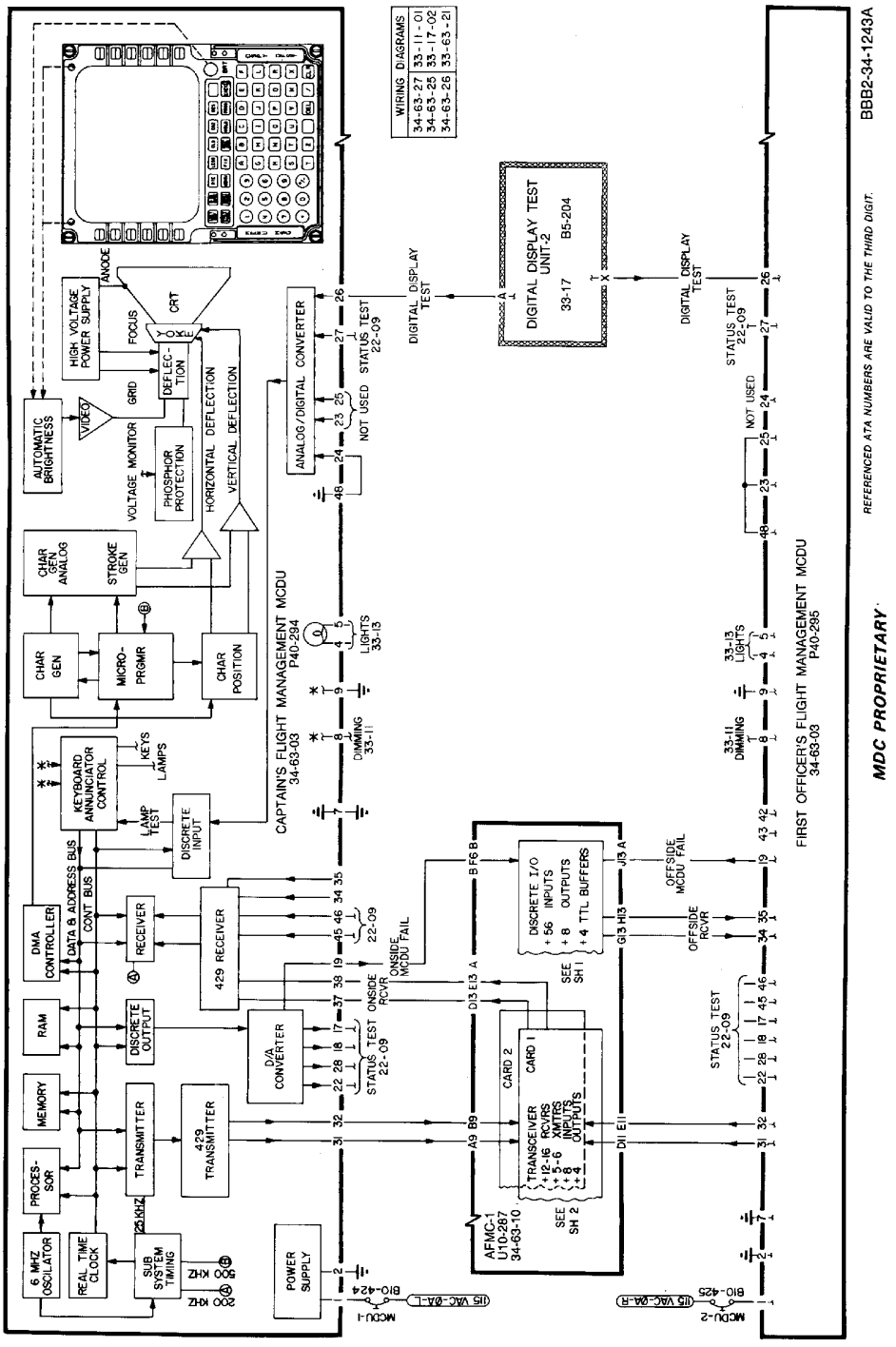
Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 2 of 6)



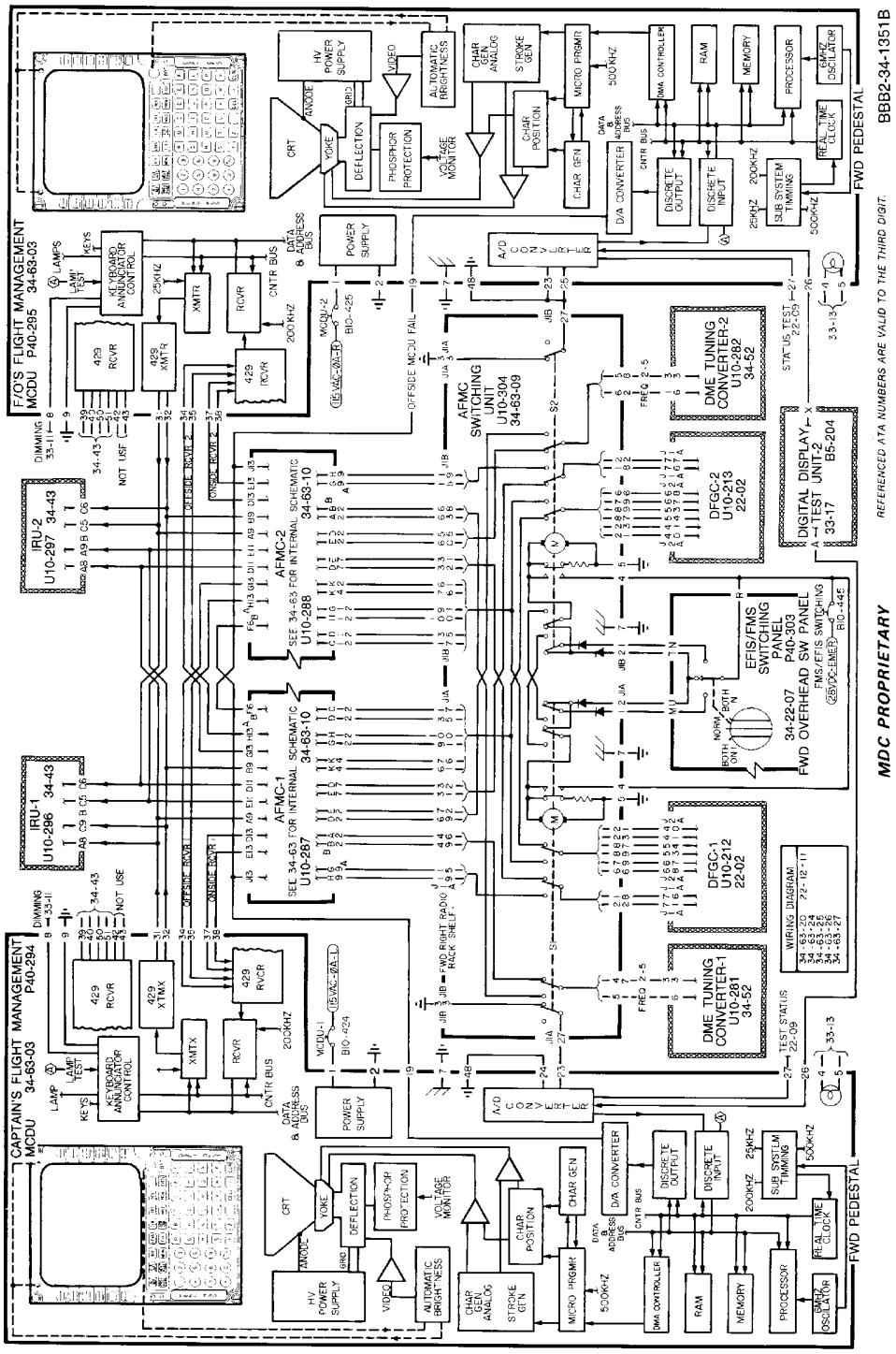
Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 3 of 6)



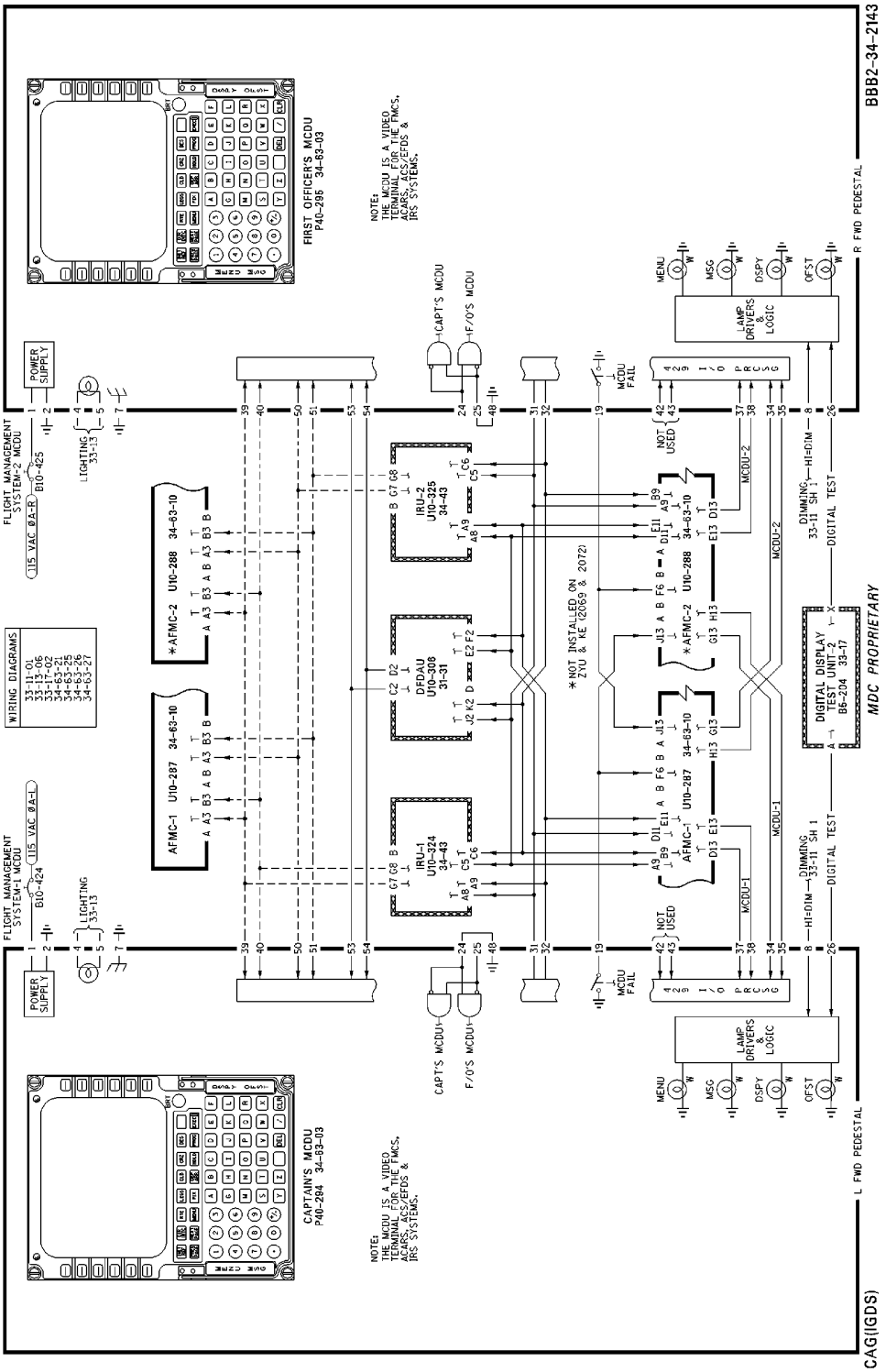
Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 4 of 6)



Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 5 of 6)



Flight Management System -- Schematic
Figure 101/34-63-00-990-865 (Sheet 6 of 6)



Flight Management System MCDUs -- Schematic
Figure 102/34-63-00-990-874

PERFORMANCE MANAGEMENT SYSTEM - TROUBLE SHOOTING

1. General

A. PMS offers a complement of tests and checks to ensure that it is functioning properly. A review of inputs to PMS is helpful in isolating a malfunction. Figure 101. CDU self-test, Input Data Pages, Fault Review and the Service Test are dynamic indicators of PMS status. PMS Fault Isolation Chart, Figure 102 offers the flight line maintenance technician a detailed explanation of the checks for each input.

2. CDU Self-Test

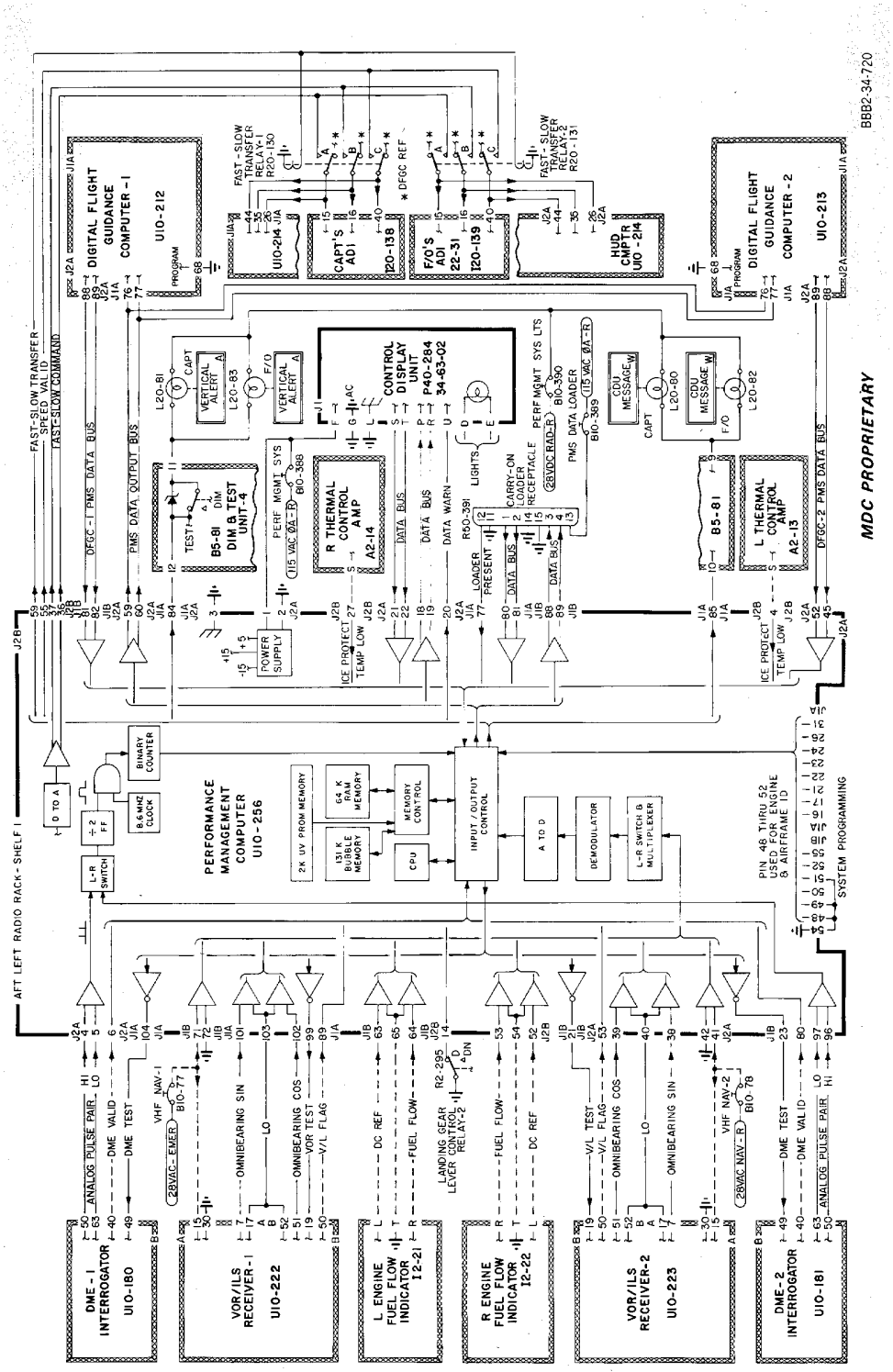
A. The CDU has a self test capability which provides a closed-loop to verify all front panel switches. Simultaneously pressing the STS TEST key and any other key at the same time will result in the 5 x 7 matrix being replaced by an alpha character assigned to the individual key. (Table 108)

3. System Line Fault Monitoring

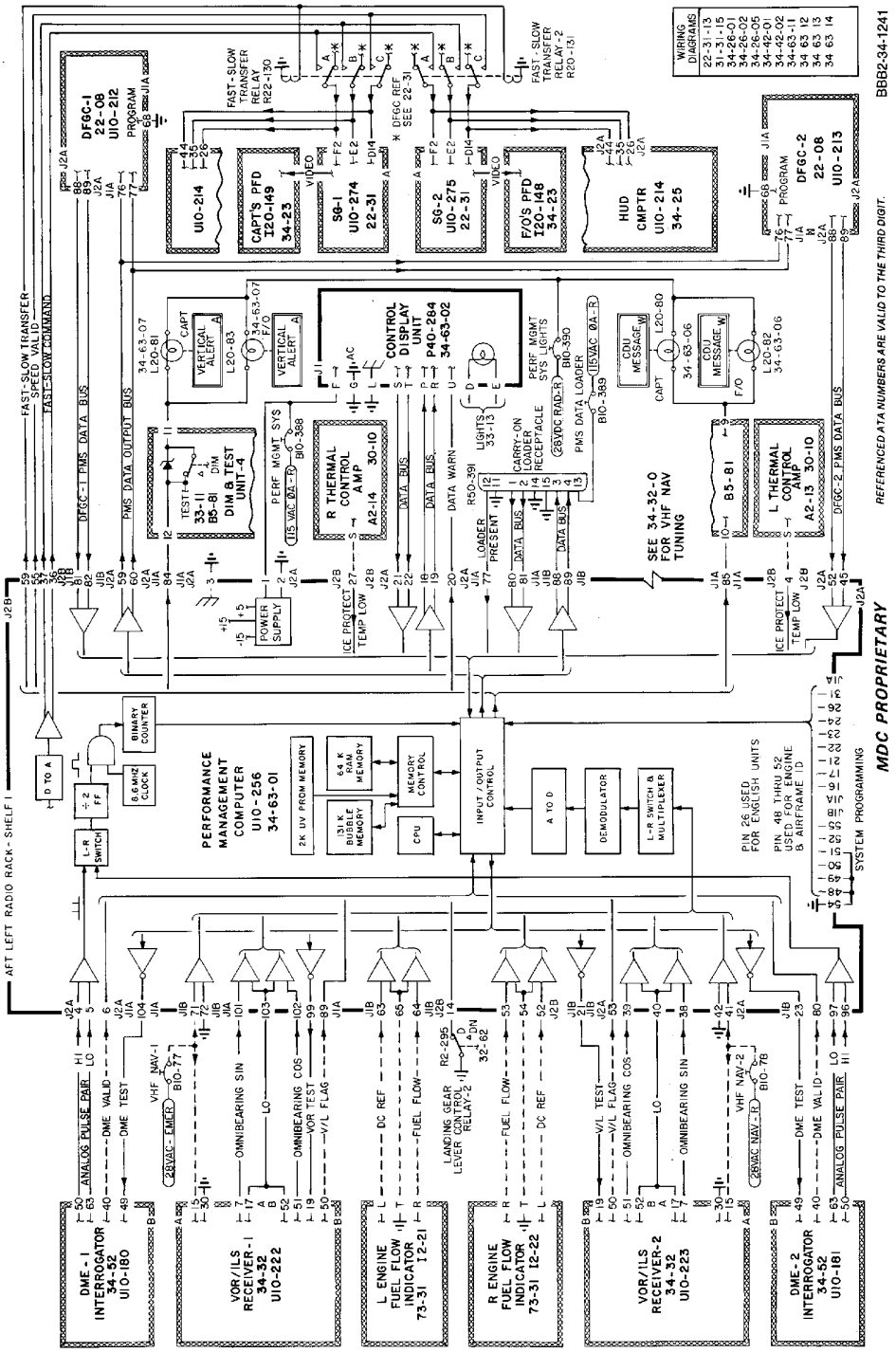
A. The PMS software and hardware provide fault monitoring to ensure that input data is valid, computer operation is normal and output data is valid. When a fault is detected, the PMS provides CDU display messages, invalid output flag voltages and/or lights the amber PMS warning annunciator on the CDU. The tests performed, display messages, and additional Fault Isolation actions are shown Figure 102.

B. The fault STS messages are displayed on the CDU fault status pages only while the faults are being detected. These messages are also available for display on the fault review test pages which will display all faults detected for previous flights. (Paragraph 5., Fault Review). The scratchpad messages are displayed on all pages except status pages in the scratchpad area of the display. Only one fault will be displayed while multiple faults are detected. When a detected fault does not prevent valid operation of PMS, such as one DFGS failure, the scratchpad failure message can be cleared by presing the clear key. The instrument panel CDU message annnciators are lighted when a scratchpad fault message is being displayed and the PMS is engaged.

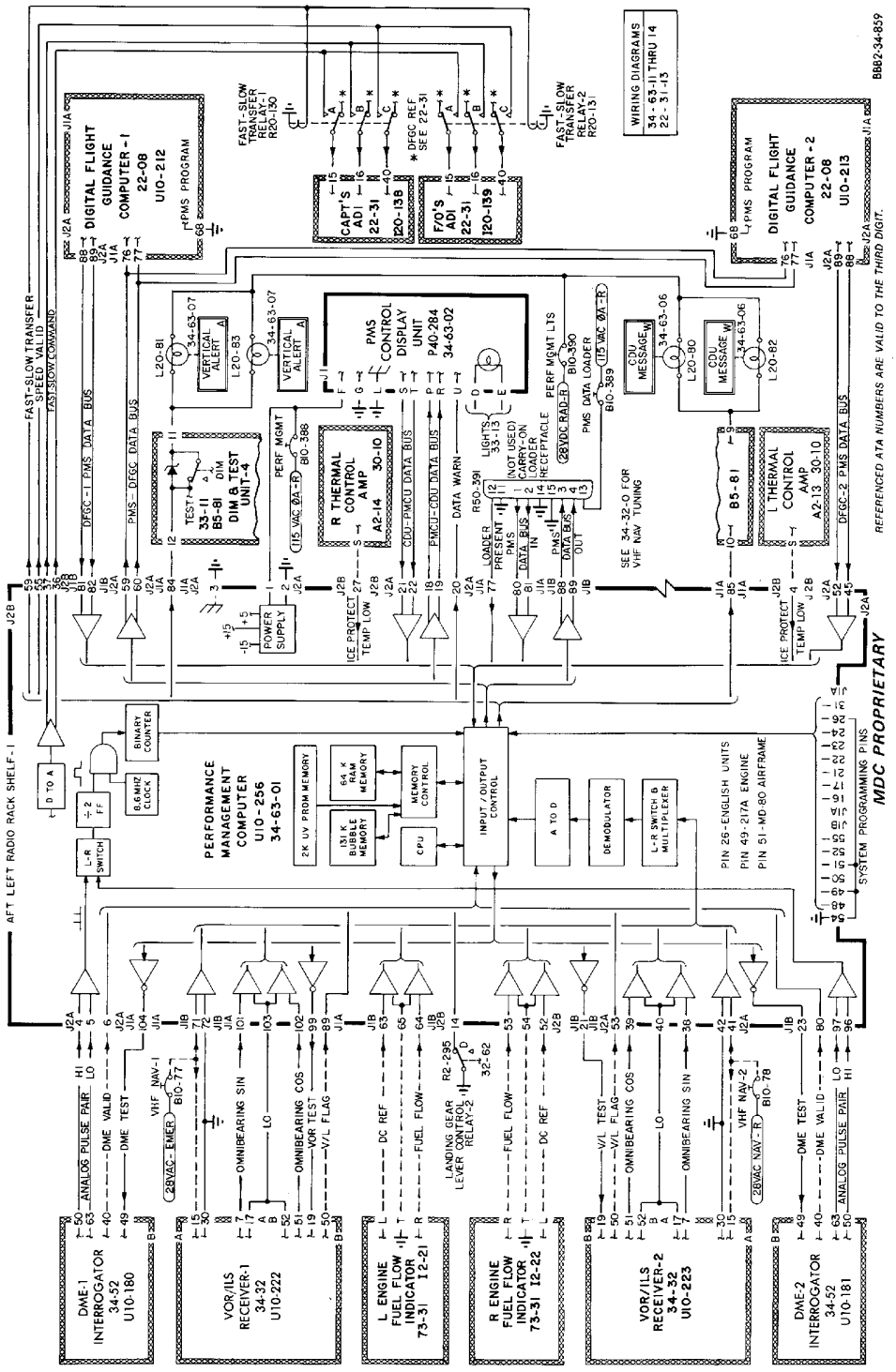
C. The discrete flag voltages and CDU PMS annunciator control voltage are output through specific pins on the PMCU. The PMS annunciator is only lighted when an internal PMCU hardware or software fault is detected. These faults are not resettable. When a non-resettable fault which affects thrust or pitch control occurs, the PMCU drops the PERF READY bit which causes the DFGS to disregard PMS outputs. The PERF selected discrete also drops reverting control of the Fast/Slow pointer to the DFGS.



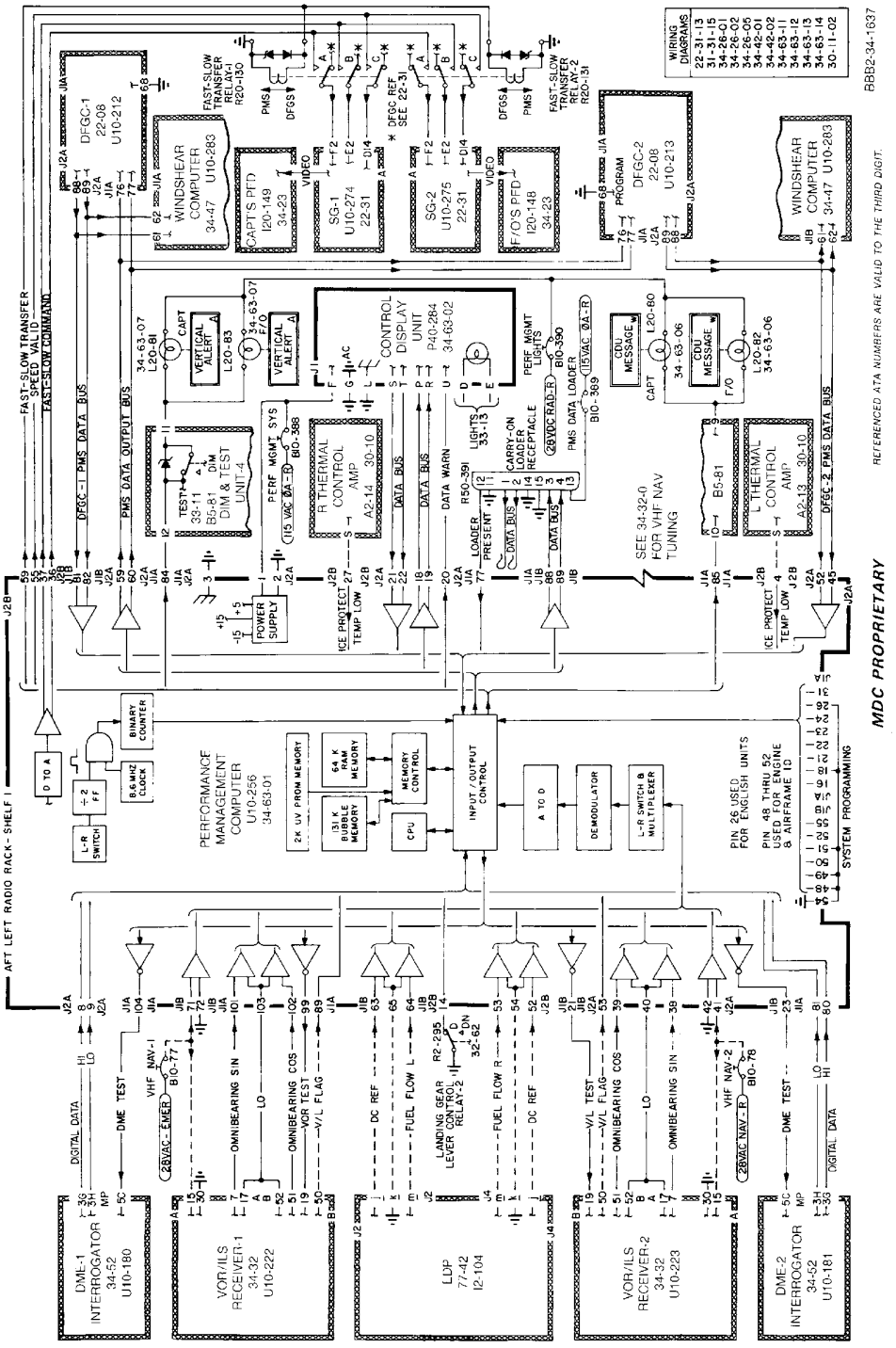
Performance Management System -- Schematic
Figure 101/34-63-00-990-870 (Sheet 1 of 5)



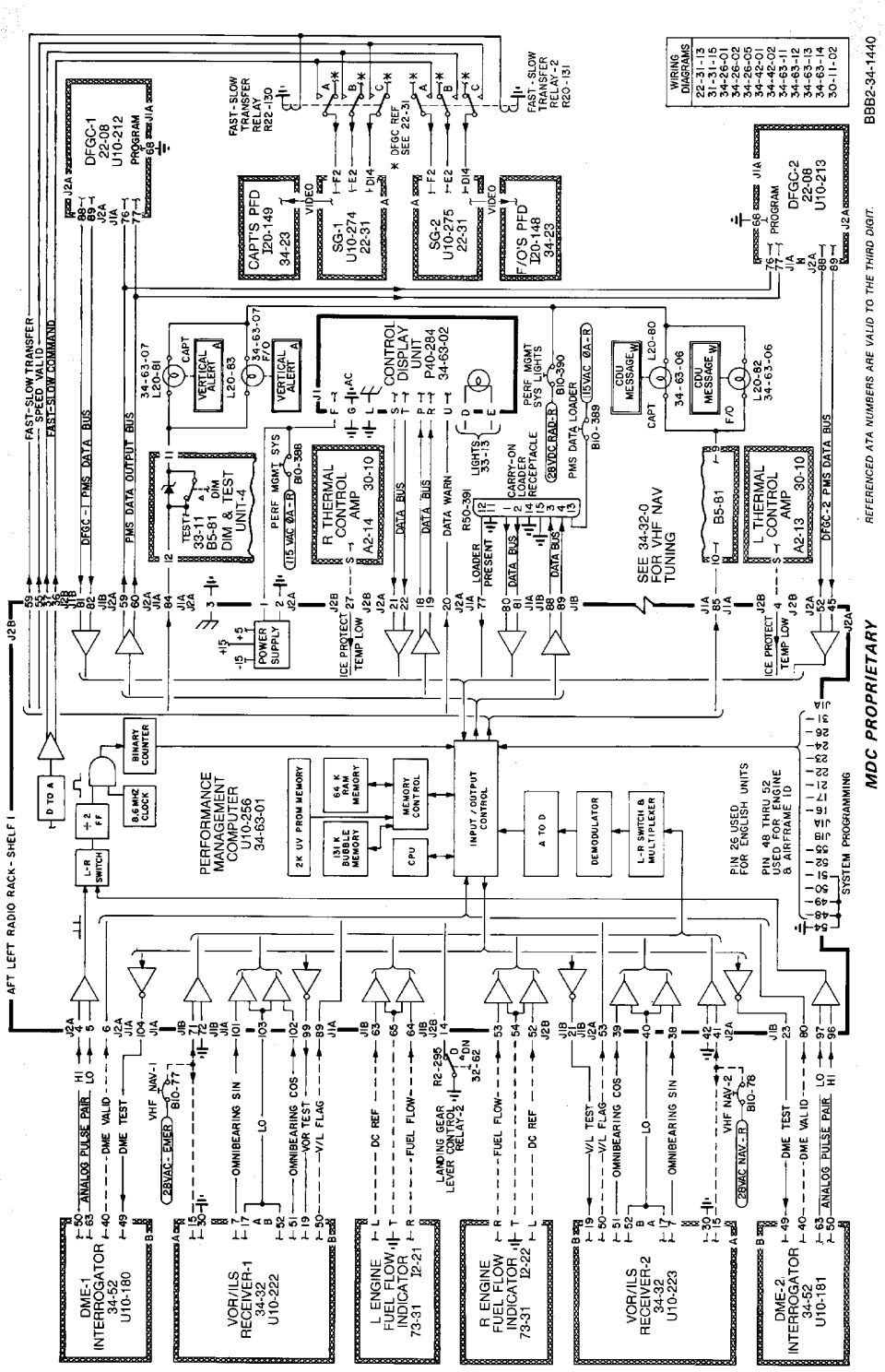
Performance Management System -- Schematic
Figure 101/34-63-00-990-870 (Sheet 2 of 5)



Performance Management System -- Schematic
Figure 101/34-63-00-990-870 (Sheet 3 of 5)



Performance Management System -- Schematic
Figure 101/34-63-00-990-870 (Sheet 4 of 5)



Performance Management System -- Schematic
Figure 101/34-63-00-990-870 (Sheet 5 of 5)

CDU MESSAGE		PMS CDU ANNUN	INVALID DIGITAL DATA TO DFS	NO 'PERF' ENGAGE	TEST TYPE	ADDITIONAL FAULT ISOLATION ACTION REQUIRED
FAULT STS	SCRATCHPAD					
FFL	FFL FAIL			X	FUEL FLOW 1 INPUT	CHECK FF BREAKER CLOSED. CHECK FOR CORECT FF PANEL INDICATION
FFR	FFR FAIL			X	FUEL FLOW 2 INPUT	SAME AS FF 1 #1 INPUT
DME1					DME1 INPUT	CHECK DME CIRCUIT BREAKERS CLOSED. CHECK FOR CORRECT DME PANEL DISPLAY
DME2					DME2 INPUT	SAME AS DME1
VOR1	VOR1			—	VOR1 RESOLVER INPUT	CHECK FOR ALL VHF NAV CIRCUIT BREAKERS CLOSED. CHECK OPERATION OF COMPASS IND.
VOR2	VOR2				VOR2 RESOLVER INPUT	SAME AS VOR1
25 MS	25 MS FAIL	X	X	X	25 MS LOOP TEST	REMOVE PCU IF PMS WARN IS ILLUMINATED.
75 MS	75 MS FAIL	X	X	X	75 MS LOOP TEST	REMOVE PCU IF PMS WARN IS ILLUMINATED.
150 MS	150 MS FAIL	X	X	X	150 MS LOOP	REMOVE PCU IF PMS WARN IS ILLUMINATED.
600 MS	600 MS FAIL	X	X	X	600 MS LOOP	REMOVE PCU IF PMS WARN IS ILLUMINATED.
MEMORY	MEMORY FAIL	X	X	X	MEMORY SUM CHECK HARDWARE MEMORY PARITY	REMOVE PCU IF PMS WARN IS ILLUMINATED.

BBB2-34-573

Fault Isolation Chart
Figure 102/34-63-00-990-869 (Sheet 1 of 2)

CDU MESSAGE		PMS CDU ANINUM	INVALID DIGITAL DATA TO DFS	NO 'PERF' ENGAGE	TEST TYPE	ADDITIONAL FAULT ISOLATION ACTION REQUIRED
FAULT STS	SCRATCHPAD					
VOR1 FLAG					VOR 1 FLAG INPUT	CHECK ALL VHF NAV CIRCUIT BREAKERS CLOSED. CHECK FOR NAV FLAG ON COMPASS INDICATOR.
VOR2 FLAG					VOR 2 FLAG INPUT	SAME AS VOR 1 FLAG.
TUNE 1	TUNE 1 FAIL				NAV TUNE 1	CHECK ALL VHF NAV CIRCUIT BREAKERS CLOSED. CHECK FOR LEGAL VOR FREQUENCY TUNED.
TUNE2	TUNE 2 FAIL				NAV TUNE 2	SAME AS TUNE 1 FAIL.
DFGS 1 DATA	DFGS 1 DATA			X	DFGS 1 INPUT DATA	CHECK ALL DFGS CIRCUIT BREAKERS CLOSED. CHECK FOR VALID DFGS OPERATION.
DFGS 1 BUS FAIL	DFGS 1 BUS			X	DFGS 1 INPUT BUS	CHECK ALL DFGS CIRCUIT BREAKERS CLOSED. CYCLE PMS CU CIRCUIT BREAKERS.
DFGS 2 DATA	DFGS 2 DATA			X	DFGS 2 INPUT DATA	SAME AS DFGS 1 DATA.
DFGS 2 BUS FAIL	DFGS 2 BUS			X	DFGS 2 INPUT BUS	SAME AS DFGS 1 BUS FAIL.
MEMORY TEMP LO	TEMP LO	X	X	X	MEMORY TEMP	CHECK ELECTRICAL/ELECTRONICS BAY TEMPERATURE.
MRMORY TEMP HI	TEMP HI	X	X	X	MEMORY TEMP	CHECK AVIONIC RACK COOLING FAN FOR PROPER OPERATION.
PRGM PIN CONFIG ERR	PRGM PIN CONFIG ERR	X	X	X	PIN CONFIG	CHECK FOR VALID PROGRAM PIN COMBINATION.
ERATIC OR BLANK CDU DISPLAY					CDU	DEPRESS CDU STS/TEST. CHECK FOR STUCK CDU KEYS OF SWITCHES.
INVALID PROGRAM LOADED		X			DATA LOAD	LAST COL BUBBLE MEMORY LOAD ATTEMPT FAILED IN PROCESS.

CAG(IGDS)

BBB2-34-574A

Fault Isolation Chart
Figure 102/34-63-00-990-869 (Sheet 2 of 2)

4. Input Data Checks

A. The input data pages are intended as a trouble shooting tool that can be called up at any time to display inputs to the PMS from interfacing aircraft systems. These pages are accessible by:

(1) Pressing STS/TEST function key to display STS/TEST page.

XXX Denotes type airplane

YYY Denotes type engine

ZZZ Denotes PMS Program

Table 101

	STS	XXXX-XX	YYYY-YYYY	
1	FAULT	STATUS?	COST	0
2			PRGM P/N-ZZZ	
3	TESTS ?			

(2) Pressing line select key 3 displays a TESTS page.

Table 102

	TESTS			
1	INPUT	DATA ?		
2	FAULT	REVIEW	?	
3	SERVICE	TEST	?	

(3) Pressing line select key 1 displays Input Data Page 1.

NOTE: See Table 103.

Table 103 Input Data Displays

	INPUT	DATA			*
1	DFGS 1	INVALID		DATA	
2	DFGS 2	NOTSELECTED			
3	GEAR	DOWN	PROG	PINS-01280	
	INPUT	DATA			#*
1					
2	VOR1	1XX.XX		XXX°	INVALID
3	DME1			XXXNM	VALID
	INPUT	DATA			#*
1					
2	VOR2	1XX.XX		XXX°	INVALID
3	DME2			XXXNM	VALID

Table 103 Input Data Displays (Continued)

	INPUT		DATA			#*
1	FF	L	XX.XX		VALID	
2	FF	R	--.--	INVALID		
3	ICE	PROT	TEMP		NORM	LOW
# Indicates "down" arrow in display.						
* Indicates "up" arrow in display.						

5. Fault Review

A. These pages display a list of faults from previous flights in reverse chronological order. Each flight is numbered sequentially and faults are logged from takeoff to landing, along with the number of occurrences of each.

(1) Entry to the sequence of display pages is by operating line key 2 on the TESTS page, which then calls up this page: (Ground operation only, in flight this page is not available).

Table 104

	FAULT	REVIEW	
1	RECALL	FAULTS	?
2	ERASE	FAULTS	?
3			
Previously recorded faults can be erased by a double push of line key 2.			

(2) Pressing line key 1 gives access to the entire list of recorded faults and the number of occurrences, up to 7. A typical page would be:

Table 105

	FAULTS-FLT	1	*
1	DFGS1	DATA	2
2	FF 2		3
3	TUNE	1	4
* Indicates "up" arrow in display.			
If more than 3 faults are present for a given flight, slew arrows are displayed.			

(a) The list may be slewed until all flights with stored faults have been displayed. Current flight is 1 only if a fault has been detected, and only flights with faults are recorded. The fault review could be:

Table 106

1	(last flight)
5	(5th previous flight)
999	(999th previous flight)

(b) The largest number that could be displayed is 999, which would only be displayed if there were no more than 25 flights with detected faults out of the last 999 flights. Flights with no faults are not displayed. A maximum of 25 flights with faults may be stored/displayed. Table 107 lists all Flight Fault Review messages.

Table 107 Fault Messages

SCRATCHPAD	FAULT STATUS PAGE	FLIGHT FAULT REVIEW PAGE
25 MS FAIL	25 MS	25 MS
MEMORY FAIL	MEMORY	MEMORY
150 MS FAIL	150 MS	150 MS
600 MS FAIL	600 MS	600 MS
75 MS FAIL	75 MS	75 MS
FF L FAIL	FF L	FF L
FF R FAIL	FF R	FF R
	DME 1	
	DME 2	
VOR1	VOR1	VOR1
VOR2	VOR2	VOR2
	VOR1 FLAG	
	VOR2 FLAG	
TUNE 1 FAIL	TUNE 1	TUNE 1
TUNE 2 FAIL	TUNE 2	TUNE 2
DFGS1 DATA	DFGS1 DATA	DSGS1 DATA
DFGS1 BUS	DFGS1 BUS	DFGS1 BUS
DFGS2 DATA	DFGS2 DATA	DSGS2 DATA
DFGS2 BUS	DFGS2 BUS	DFGS2 BUS
SLAT POS FAIL	SLAT POS	SLAT POS

Table 108 CDU Self-Test Patterns

Key or Switch Pressed	Display For Each Line																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CLEAR Key	A				A				A				A				A				A			
/Key	B				B				B				B				B				B			
CLB Key	C				C				C				C				C				C			
VERT WPTS Key	D				D				D				D				D				D			
Spare #3 Key	E				E				E				E				E				E			
CRZ Key	F				F				F				F				F				F			
Spare #4 Key	G				G				G				G				G				G			
Spare #1 Key	H				H				H				H				H				H			
DES Key	I				I				I				I				I				I			
PLAN Key	J				J				J				J				J				J			
Spare #2 Key	K				K				K				K				K				K			

Table 108 CDU Self-Test Patterns (Continued)

Key or Switch Pressed	Display For Each Line																			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Line Select 1 Switch	M				M				M				M				M				M			
Line Select 2 Switch	N				N				N				N				N				N			
Line Select 3 Switch	O				O				O				O				O				O			
· Key		A				A				A				A				A				A		
LNR Key		B				B				B				B				B				B		
0 Key		C				C				C				C				C				C		
1 Key		D				D				D				D				D				D		
2 Key		E				E				E				E				E				E		
3 Key		F				F				F				F				F				F		
4 Key		G				G				G				G				G				G		
5 Key		H				H				H				H				H				H		
6 Key		I				I				I				I				I				I		
7 Key		J				J				J				J				J				J		
8 Key		K				K				K				K				K				K		
9 Key		L				L				L				L				L				L		
Slew Switch (up)		M				M				M				M				M				M		
Slew Switch (down)		N				N				N				N				N				N		

FLIGHT MANAGEMENT SYSTEM - TROUBLE SHOOTING

1. General

A. Trouble Shooting provided in this section are basic procedures for isolating and correcting a faulty Flight Management System in the aircraft.

B. The basic causes of a faulty system operation are generally, faulty aircraft wiring or faulty Line Replaceable units (LRUs).

C. By using the basic check procedures, coordinated with the system schematic contained in this section, quick isolation and correction of the problem can be accomplished.

D. The basic components of the Flight Management System operation are: Advanced Flight Management Computer (AFMC) and the Multipurpose Control Display Units (MCDU).

E. The Flight Management System components are located as follows:

Table 101

Component	Location
Advanced Flight Management Computer (AFMC)	Electrical/Electronics Compartment Aft Radio Rack Shelf 1
Multipurpose Control Display Units (MCDU)	Pedestal

2. Equipment and Materials

NOTE: Equivalent substitutes can be used instead of the following listed item:

Table 102

Name and Number	Manufacturer
Multimeter 2000A	Dana

3. Trouble Shooting Flight Management

A. Trouble Shoot

NOTE: During continuity, power, and ground checks, it may be necessary to refer to wiring diagram manual for terminal board connections and wire identification. LRUs are AFMC and MCDU.

Table 103

Step	Procedure	Correction
(1)	Check for proper power sources at main buses, circuit breakers, and input and output at LRUs.	Correct main power supply to buses, replace faulty circuit breakers, wires, or LRUs.
(2)	Check for proper grounds at LRUs. This may require operation of relays in units to contact ground.	Repair or replace wiring. Make sure ground terminals are tight and properly bonded: replace LRUs.
(3)	Perform continuity check of airplane wiring. A hot continuity check may be required to check operation of relays or other associated actuation components to complete a continuity.	Repair or replace faulty wiring, terminal junctions, relays, or associated items in airplane wiring.
(4)	Replace suspected faulty LRUs or component with a known operational unit.	Replace faulty LRUs or components.

Table 103 (Continued)

Step	Procedure	Correction
(5)	The DISCRETES page displays the condition in the AFMC of the changeable discretes. When a discrete comes in from the left or right side, such as ENGINE ANTI ICE, the state of each discrete is listed under the header 1 or 2, whichever is appropriate, all others are listed singularly between 1 and 2. The following will be displayed on the DISCRETES page: A/C PACK, X-FEED VALVE, ENGINE A/ICE, A/F ICE PROT, WOW SWITCH, CAA FLIGHT RULES, KILOGRAM OPTION, SRCE/DEST IDENT, LANDING GEAR, GNS ENABLE, and ALTERNATE NDB.	
(6)	The PERF FACTR page provides display and entry of performance data applicable to individual airline policy or aircraft characteristics. Before data can be entered into this page, it must be armed by typing the letters ARM into the scratchpad and line selecting it to 6R.	

4. Intermittent AFMC Timeouts Reported - Maintenance Procedure

A. Check the FAIL LED on the front of the related AFMC. If it is on (red), then replace the AFMC per ADVANCED FLIGHT MANAGEMENT COMPUTER, SUBJECT 34-63-03, Removal/Installation, and continue with Paragraph 4.C. that follows. If it is off, continue with Paragraph 4.B. that follows.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

B. Open the related AFMC circuit breakers on the upper EPC that follow for 30 seconds, then close the circuit breakers.

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2

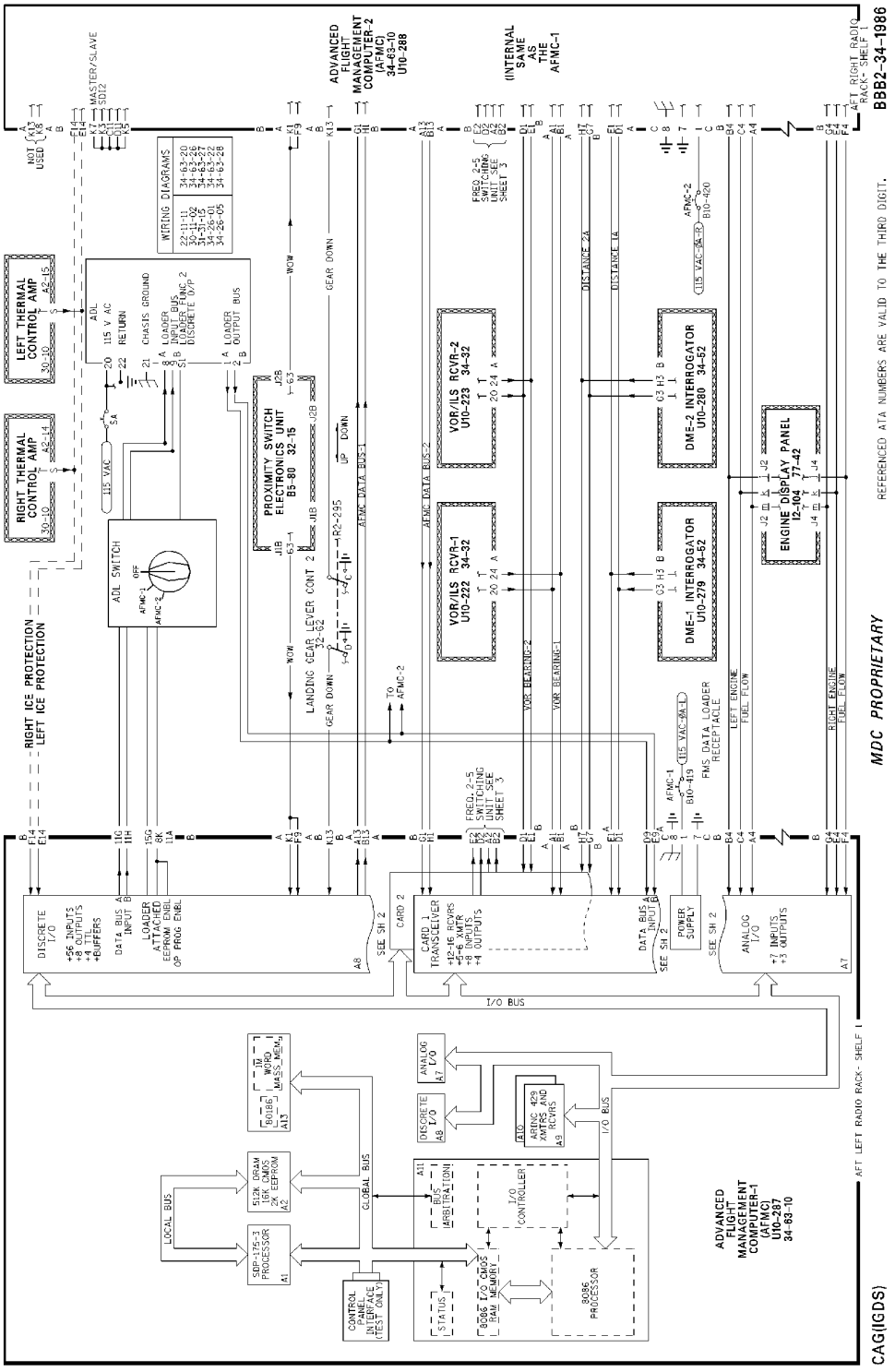
NOTE: The FLIGHT MANAGEMENT SYSTEM-2 AFMC circuit breaker may not be on some aircraft or it is used provisionally.

(1) After at least 1 minute, look at the FAIL light on the front of the AFMC.

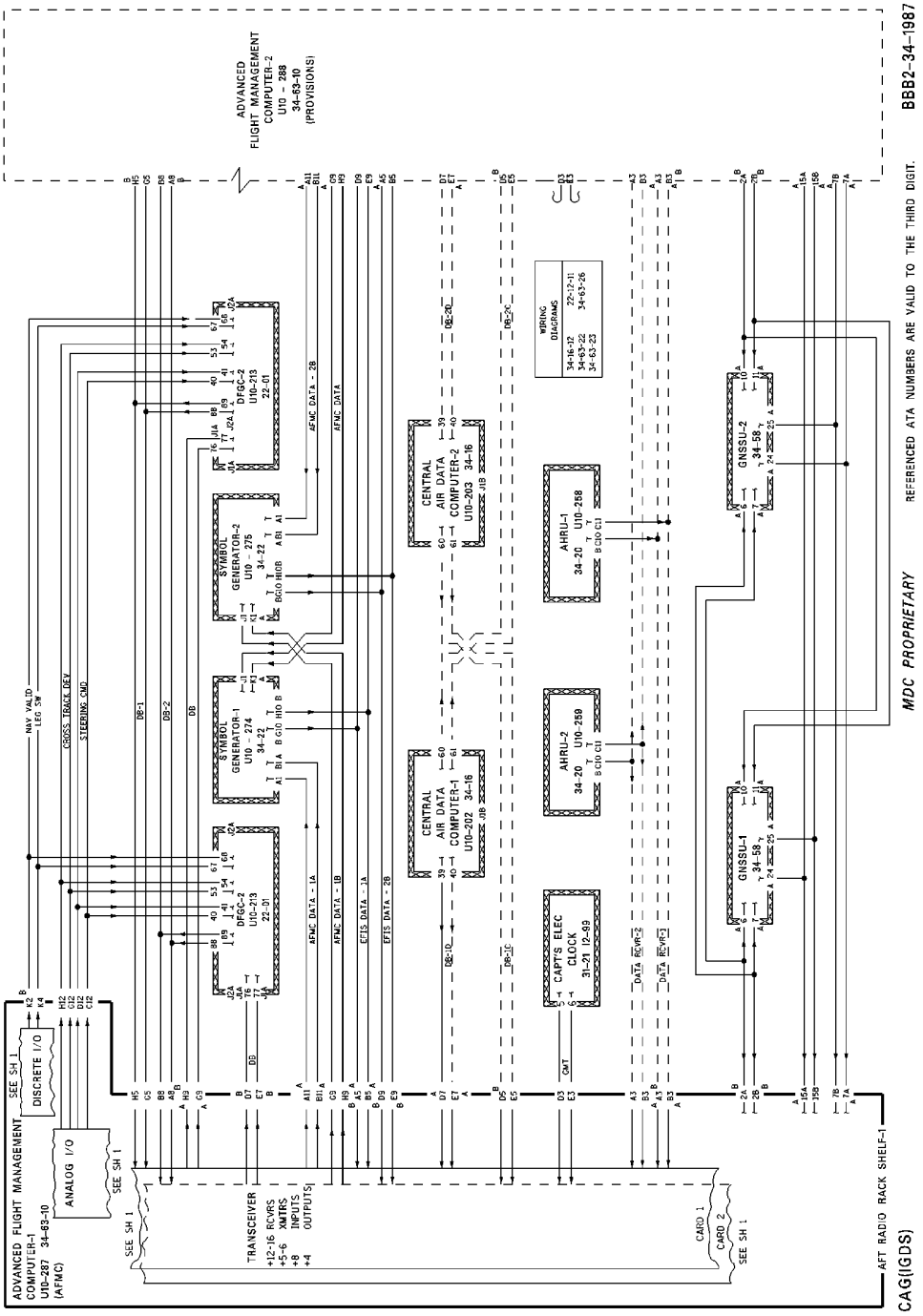
(2) If it is on, replace the AFMC per ADVANCED FLIGHT MANAGEMENT COMPUTER, SUBJECT 34-63-03, Removal/Installation, and continue with Paragraph 4.C. that follows.

(3) If it is off, continue with Paragraph 4.C. that follows.

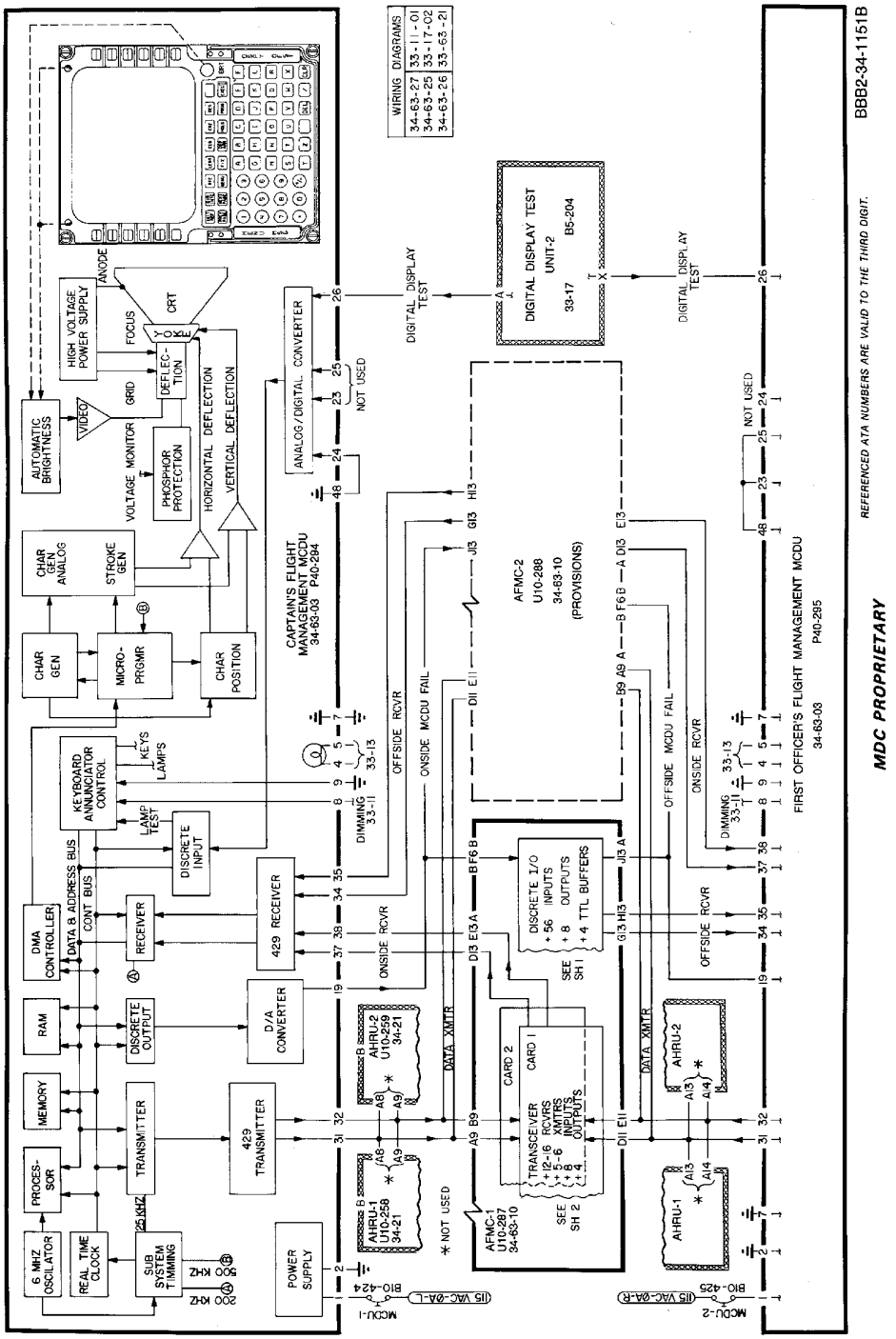
C. Run the R-T-S test per MULTIPURPOSE CONTROL DISPLAY UNIT, SUBJECT 34-63-04, Return To Service Test. If the AFMC fails, replace the AFMC. If the AFMC passes, the AFMC is OK.



Flight Management System -- Schematic
Figure 101/34-63-00-990-866 (Sheet 1 of 3)



Flight Management System -- Schematic
Figure 101/34-63-00-990-866 (Sheet 2 of 3)



Flight Management System -- Schematic
Figure 101/34-63-00-990-866 (Sheet 3 of 3)

PERFORMANCE MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Performance Management System (PMS) operates as a fully selectable mode of the digital flight guidance system. PMS provides automatic control and coordination of pitch and thrust during climb, cruise, and descent phases of flight, and also provides an advisory display of numerous flight parameters, on a full time real time basis.

B. PMS consists of a Performance Management Control Display Unit (CDU), Performance Management Computer Unit (PCU), CDU MESSAGE annunciator, and VERTICAL ALERT annunciator.

C. Primary interfacing units are VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, digital flight guidance computers 1 & 2, R/H & L/H engine fuel flow indicators, and the landing gear control lever relay.

2. Service Tests

A. Test CDU Lamps

Table 201

Operation		Desired Result
(1)	On CDU, rotate DIM knob fully clockwise.	DIM knob rotated.
(2)	On Flight Guidance Control Panel, set altitude preselect to 10000.	Altitude preselect set.
NOTE: Flicker of display in step (3) is normal.		
(3)	On CDU, press and hold STS/TEST key.	On the CDU, all LEDs; Line Select Keys 1, 2, and 3; CLB, CRZ, and DES mode annunciators; and PMS annunciator come on.
(4)	Release STS/TEST key.	STS page displayed on CDU. Line Select Keys 1, 2, and 3; CRZ and DES mode annunciators; and PMS annunciator goes off.

B. Service Test

Table 202

Operation		Desired Result
(1)	On CDU, momentarily press STS/TEST key. ZZZ denotes PMS program.	STS page displayed on CDU. Top display line displays appropriate aircraft and engine type. Data line 2 displays PROGRAM P/N-ZZZ
(2)	Momentarily press Line Select Key 1 (FAULT STATUS ?).	FAULT STATUS page displayed on CDU.
(3)	Review faults listed on CDU (if any) and clear faults by normal maintenance action.	Faults cleared.
(4)	Momentarily press STS/TEST key.	STS page displayed on CDU.
(5)	Momentarily press Line Select Key 3 (TESTS ?).	TESTS page displayed on CDU.
(6)	Momentarily press Line Select Key 3 (SERVICE TEST ?).	SERVICE TEST page displayed on CDU.

Table 202 (Continued)

Operation		Desired Result
NOTE: The PMS Service Test verifies the interfaces with other aircraft systems. Generally, failures in the Service Test are caused by aircraft systems not transmitting or receiving data from the PMS. Check the interfacing aircraft system for normal operation before suspecting the PMS. A steady amber PMS warn light is the only positive indication of a PMS Computer Unit failure.		
(7)	Respond appropriately to each requested action on SERVICE TEST list, displayed on CDU. Following response to each request, momentarily press Line Select Key 2 (to verify response).	All requested actions responded to and verified. Following selection of PERF on FGCP, FMAs, on captain's and first officer's instrument panels, display PERF CLB in throttle and pitch windows. Observe ADI/PFD Fast/Slow indicator shows 1 dot (±1/4) dot fast. Following completion of last step on SERVICE TEST list, FAULT/FAIL RECAP page is displayed on CDU, with message NO FAULTS/FAILS.
(8)	If it is necessary to rerun SERVICE TEST, momentarily press STS/TEST key and repeat steps (6) and (7).	

3. Supplementary Tests

A. Test Anti-Ice Temp Low

Table 203

Operation			Desired Result		
CAUTION: OPENING THE GROUND CONTROL RELAY CIRCUIT BREAKERS WILL STOP EQUIPMENT COOLING AIRFLOW. THE FOLLOWING TEST MUST BE COMPLETED AS QUICKLY AS POSSIBLE.					
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(2)	On CDU, momentarily press STS/TEST key.		STS page is displayed on CDU.		
(3)	Momentarily press Line Select Key 3 (TESTS ?).		TESTS page displayed on CDU.		
(4)	Momentarily press Line Select Key 1 (INPUT DATA ?).		INPUT DATA page displayed on CDU.		
(5)	On overhead panel, verify L SYS and R SYS AIRFOIL ice protection switches are in OFF position.		Airfoil ice protection off.		
NOTE: Some aircraft have a single AIRFOIL ice protection switch.					
(6)	On CDU, use slew switch (or slew keys) to obtain display of ICE PROT TEMP.		ICE PROT TEMP reads NORM NORM.		
(7)	Place L SYS AIRFOIL ice protection switch to ON position.		Left airfoil ice protection on CDU displays LOW NORM.		
NOTE: On aircraft with single AIRFOIL ice protection switch, CDU will display LOW LOW when switch is ON.					

Table 203 (Continued)

Operation			Desired Result		
(8)	Place R SYS AIRFOIL ice protection switch to ON position.		Right airfoil ice protection on CDU displays LOW LOW.		
(9)	Place L SYS and R SYS AIRFOIL ice protection switches to OFF position.		Airfoil ice protection off.		
(10)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33

B. Test PMS Annunciators

Table 204

OPERATION		DESIRED RESULTS
(1)	On overhead panel, press and hold ANNUN/DIGITAL LTS TEST switch.	On captain's and first officer's instrument panels, VERTICAL ALERT and CDU MESSAGE annunciators come on.
(2)	Release test switch.	VERTICAL ALERT and CDU MESSAGE annunciators go off.

FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Flight Management System (FMS) is integrated with the Digital Flight Guidance System (DFGS) to provide automatic pitch, roll and thrust control during climb, cruise and descent. The coordination of pitch, roll and thrust during lateral and vertical navigation provides efficient fuel usage or cost efficiency within the constraints of the commanded flight plan, altitude clearance limits and airplane performance limits.

B. The FMS consists of two Multipurpose Control Display Units (MCDU) and an Advanced Flight Management Computer (AFMC). The MCDUs are located one each on the forward pedestal left and right sides. The AFMC is located in the electrical/electronics (E/E) compartment. An ARINC 429 data loader is used for loading software (navigational data base) into the AFMC using a connector accessible in the cockpit in the captains briefcase holder area.

C. The FMS receives input data via serial data buses from the DFGCs. Additional inputs are received from the following:

(1) CADC 1,2

(2) DME interrogators 1, 2

(3) VOR receivers 1,2

(4) Engine Fuel Flow Indicators 1, 2

(5) VG/DG 1, 2 (aircraft with VG/DG)

(6) IRS 1, 2 (aircraft with IRS)

(7) Landing Gear Lever Control Relay (Discrete)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Air Data Tester model No. 127-1M	Edcliff Instruments
Red Tape VIP 7331 DPM 850-24	Valley Industrial Products
33410LH-90-5 Static Port Adapters	Canadian Aero Inst. Co.
7131A-1 Pitot Head Adapter	Edcliff Instruments
Portable Data Loader	
964-0400-006	Sundstrand
30100 Rev. A	Demo Systems
2230915-01B	Teledyne

3. FMS Data Base Loading Operation

A. Data Loading

NOTE: In the -924 and previous FMS versions, data base loading operation automatically erases all performance factors from memory. If desired, record performance factors prior to data base loading for re-entry after loading operation is complete. In the -925 FMS, all performance factors are retained after data base loading operation.

Table 202

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.		Cable connected.		
(3)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(4)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.		IDENT page displayed on MCDU.		
(5)	Turn on data loader power.		Data loader power light on.		
(6)	Insert Navigation Data Base (NDB) diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE or XFR COMPL.		NDB diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.		
(7)	Press EJECT button to eject NDB diskette.		NDB diskette removed.		
(8)	Turn data loader power off.		Power light off.		
(9)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(10)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(11)	Remove tags and close the circuit breakers that follow:				

Table 202 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

B. BITE Download from AFMC

NOTE: This procedure applies to aircraft with -926 AFMC or greater.

Table 203

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.		Cable connected.		
(3)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(4)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.		INIT/REF INDEX 1/1 page is shown on MCDU.		
(5)	Turn on data loader power.		Data loader power light on.		
(6)	Insert BITE DOWNLOAD diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE.		Diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.		
(7)	Press EJECT button to eject diskette.				
(8)	Turn data loader power off.		Power light off.		
(9)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

Table 203 (Continued)

Operation			Desired Result		
(10)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(11)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

4. Power Up Operation

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

NOTE: When scratchpad messages appear, press and hold CLR pushbutton until all messages clear.

A. Power Up Transient Test

Table 204

Operation		Desired Result
(1)	Return To Service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.	Verify SELECT DESIRED SYSTEM appears in scratchpad.
(2)	Press line select key 1L adjacent to AFMC prompt.	Verify IDENT appears on title page in upper left hand corner.

B. Maintenance Index Test

Table 205

Operation		Desired Result
(1)	Press line select key 6L adjacent to the INDEX prompt.	Verify INIT/REF index page is displayed.
(2)	Type DAC into scratchpad.	Verify DAC is entered into scratchpad.
(3)	Press line select key 6R adjacent to MAINT prompt.	Verify maintenance index page 1/1 is displayed.
(4)	Press line select key 3L adjacent to DISCRETES prompt.	Verify AFMC 1 ANALOG DISCRETE page 1/2 is displayed.
(5)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed.
(6)	Press line select key 1R adjacent to PERF FACTORS prompt.	Verify PERF FACTORS page is displayed.
(7)	Enter ARM into scratchpad and press line select key 6R.	Verify ARM is displayed next to line select key 6R.
(8)	On MCDU-1, enter 3 into scratchpad, then press line select key 2L.	Verify 3.0 displayed next to line select key 2L on both MCDU's.

Table 205 (Continued)

Operation		Desired Result
(9)	On MCDU-2, enter 0 into scratchpad, then press line select key 2L.	Verify 0.0 displayed next to line select key 2L on both MCDU's.
(10)	On MCDU-1, enter -3.5 into scratchpad, then press line select key 3L.	Verify -3.5 displayed next to line select key 3L on both MCDU's.
(11)	On MCDU-2, enter 1.3 into scratchpad, then press line select key 4L.	Verify 1.3 displayed next to line select key 4L on both MCDU's.
(12)	On MCDU-1, enter 2 into scratchpad, then press line select key 5L.	Verify 2 displayed next to line select key 5L on both MCDU's.
(13)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed on MCDU's.

C. AFMC-1 Analog Discretes Test

Table 206

Operation			Desired Result		
(1)	Press line select key 3L adjacent to DISCRETES prompt.		Verify AFMC-1 ANALOG DISCRETES page 1/2 is displayed.		
(2)	Check A/C PACK LEFT and RIGHT status.		Verify OFF OFF displayed.		
(3)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
			After ten seconds, check A/C pack LEFT and RIGHT status and verify ON OFF is displayed.		
(4)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			After ten seconds, check A/C LEFT and RIGHT status and verify ON ON is displayed.		
(5)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14

Table 206 (Continued)

Operation			Desired Result		
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			Check A/C PACK LEFT and RIGHT status and verify OFF OFF is displayed.		
(6)	Place crossfeed valve LEFT and RIGHT on aft pedestal in closed position.		Verify closed CL CL is displayed.		
(7)	Place LEFT and RIGHT crossfeed valve on pedestal to OPEN position.		Verify open OP OP is displayed.		
(8)	Place LEFT and RIGHT crossfeed valve back to CLOSED position.		Verify closed CL CL is displayed.		
(9)	Check engine ANTI-ICE LEFT and RIGHT status.		Verify OFF OFF is displayed.		
(10)	Place LEFT and RIGHT engine ANTI-ICE to ON position.		Verify ON ON is displayed.		
(11)	Place LEFT and RIGHT engine ANTI-ICE switch to OFF position.		LEFT and RIGHT engine ANTI ICE switch to OFF.		
(12)	Verify air foil ice protection switch to OFF position.		Verify OFF is displayed.		
(13)	Make sure the circuit breakers that follow are closed:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-222	L SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION LEFT DC BUS	M/22
	B1-221	R SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/22
	B1-251	L SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	U/26
	B1-252	R SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	W/26
(14)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33

Table 206 (Continued)

Operation			Desired Result		
(15)	Place LEFT & RIGHT AIRFOIL ANTI-ICE switches to ON position; place CROSSFEED VALVE LEFT & RIGHT in OPEN position.		Breakers and valves open; check air foil anti-ice protection status and verify ON is displayed on MCDU.		
(16)	Place LEFT & RIGHT AIRFOIL ANTI-ICE to OFF position; place CROSSFEED VALVE LEFT & RIGHT in closed position.		Check air foil anti-ice protection status and verify OFF is displayed on MCDU.		
(17)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
			Check WOW switch status and verify GND is displayed on MCDU.		
(18)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify FLT is displayed on MCDU.		
(19)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify GND is displayed on MCDU.		
(19a)	Perform steps (19b) through (19f) on aircraft with Inertial Reference Systems (IRS).				
(19b)	Check MAG/TRUE STATUS.		Verify MAG is displayed on MCDU.		
(19c)	On Capt's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		
(19d)	On F/O's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		
(198e)	On F/O's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		
(19f)	On Capt's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		

Table 206 (Continued)

Operation			Desired Result		
(20)	Press NEXT PAGE key on MCDU.		Verify AFMC-1 ANALOG DISCRETE PAGE 2/2 displayed.		
(21)	Check CAA FLT RULES status.		Verify DISABLE is displayed.		
(22)	Check KILOGRAM OPTION status.		Verify ENABLE is displayed.		
(23)	Check offside MCDU ENABLE status.		Verify ENABLE is displayed.		
(24)	Check SRCE/DEST IDENT status.		Verify 1 is displayed.		
(25)	Check LANDING GEAR status.		Verify DOWN is displayed.		
(26)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify UP is displayed.		
(27)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify DOWN is displayed.		
(28)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

D. AFMC-1 Data Status Test

NOTE: Each sensor input is displayed under the LRU heading. The status of the 1, 3 and 2 sensors (where applicable) are also displayed under subtitles. 3 should display dashes if no center LRU exists. A typical example for all three fields would be: FAIL --- OK.

Table 207

Operation			Desired Result		
(1)	Verify that MAINTENANCE INDEX page is displayed.		MAINTENANCE INDEX page displayed.		
(2)	Press line select key 2L adjacent to DATA STAT prompt.		Verify AFMC-1 DATA STATUS page 1/2 is displayed.		
(3)	Set up TIC 30B signal generator and tune TIC 30B generator (or equivalent), VHF NAV-1 and VHF NAV-2 to 108.0 MHz.		Generator, VHF NAV-1 and VHF NAV-2 control panels tuned to 108.0 MHz.		
(4)	Check VOR-1 and VOR- 2 status on MCDU.		Verify OK or TEST is displayed on MCDU.		
(5)	On EFIS control panel located outboard to briefcase lights, select ROSE mode.		ROSE mode selected.		
(6)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4

Table 207 (Continued)

Operation			Desired Result		
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
	Check VOR-1 and VOR-2 status on MCDU.		Verify FAIL --- OK displayed on MCDU.		
(7)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(8)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check VOR-1 and VOR-2 status and verify OK or TEST is displayed.		
(9)	Check DME-1 and DME-2 status.		Verify OK or TEST is displayed.		
(10)	Check RDMI DME windows.		Verify dashes or numbers in DME windows.		
(11)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Check DME-1 and DME-2 status and verify FAIL --- OK is displayed.		
(12)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
			Verify FAIL --- FAIL is displayed.		
(13)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2

Table 207 (Continued)

Operation			Desired Result		
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Verify OK or TEST is displayed.		
(14)	Tune TIC 30B generator or equivalent to 108.10; tune VHF-1 and VHF-2 to 108.10.		TIC generator, VHF-1 and VHF-2 tuned to 108.10.		
(15)	Check ILS-1 and ILS-2 status.		Verify OK or TEST is displayed on MCDU.		
(16)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check ILS-1 and ILS-2 status and verify FAIL --- OK displayed.		
(17)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Verify TEST or OK is displayed.		
(19)	Remove TIC 30B generator.		Generator removed.		
(20)	Check CADC-1 and CADC-2 status.		Verify OK --- OK is displayed.		
(21)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Verify FAIL --- OK is displayed.		

Table 207 (Continued)

Operation			Desired Result		
(22)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
			Verify FAIL --- FAIL is displayed.		
(23)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Verify OK --- OK is displayed.		
(24)	Perform steps (24a) through (24k) on aircraft with IRS.				
(24a)	On IRS mode select panels, place IRS-1 and -2 switches to OFF; check IRS-1 and IRS-2 status.		Verify FAIL --- FAIL is displayed.		
(24b)	Check platform status.		Verify FAIL --- FAIL is displayed.		
(24c)	Place IRS-1 mode select switch to NAV.				
(24d)	On MCDU-2, press LSK 6L, LSK 6L, and LSK 2L. Leave MCDU-1 on DATA STATUS page.		Verify POS INIT page is displayed.		
(24e)	Enter local station code, then press LSK 2L.		Verify local station position displayed.		
(24f)	Press LSK 2R (position to scratchpad), then LSK 4R (scratchpad to set position).		Verify present position is displayed in 4R.		
(24g)	On IRS-1 mode select panel, wait for ALIGN light to go out (approx. 2-10 minutes).		ALIGN light goes out.		
(24h)	Check platform status.		Verify OK --- FAIL is displayed.		
(24i)	Place IRS-2 mode select switch to NAV; repeat steps (24f) and (24g) on MCDU-2.		ALIGN light goes out.		
(24j)	Check platform status.		Verify OK --- OK is displayed.		
(24k)	On MCDU-2, press LSK 6L, type DAC into scratchpad and press LSK 6R. Press LSK 2L.		Verify AFMC-1 DATA STATUS page is displayed.		
(25)	Select T.O. mode on Thrust Rating Panel (TRP); select autopilot side 2.		T.O. mode and autopilot side 2 selected.		
(26)	Check DFGC-1, DFGC-2 and platform status.		Verify OK --- OK is displayed.		
(27)	Check platform status.		Verify OK --- OK is displayed.		
(28)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1

Table 207 (Continued)

Operation			Desired Result		
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	Check DFGC-1 and DFGC-2 status.		Verify FAIL --- OK is displayed.		
(29)	On MCDU, press NEXT PAGE pushbutton.		Verify AFMC-1 DATA STATUS page 2/2.		
(30)	Check DFGS-BUS status.		Verify FAIL --- OK is displayed.		
(31)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify FAIL --- FAIL is displayed.		
(32)	On MCDU, press PREVIOUS PAGE pushbutton.		Verify AFMC-1 DATA STATUS page 1/2 is displayed.		
(33)	Check platform status and verify FAIL --- FAIL is displayed.		FAIL --- FAIL is displayed.		
(34)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8

Table 207 (Continued)

Operation			Desired Result		
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(35)	Check platform status.		Verify OK --- OK is displayed.		
(36)	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(37)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
			Verify FAIL --- OK is displayed.		
(38)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
			Verify FAIL --- FAIL is displayed.		
(39)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(40)	Check fuel quantity status and verify dashes are displayed.		Dashes are displayed.		
(41)	Check clock-1 status.		Verify OK or TEST is displayed.		
(42)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17

Table 207 (Continued)

Operation			Desired Result		
			Verify FAIL --- --- is displayed.		
(43)	Set GMT knob on captain's and first officer's to F.S. position.		GMT knob set to F.S. position.		
(44)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify OK or TEST is displayed.		
(45)	On MCDU, press next page button.		Verify AFMC 1 DATA STATUS page 2/2 is displayed.		
(46)	Check EFIS-1 and EFIS-2 status.		Verify OK or TEST is displayed.		
(47)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify FAIL --- OK is displayed.		
(48)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
			Verify FAIL --- FAIL is displayed.		
(49)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify OK or TEST is displayed.		
(50)	Check AFMC 1 and 2 status.		Verify OK --- --- is displayed.		
(51)	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(52)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS status on opposite MCDU.		Verify FAIL --- OK is displayed.		
(53)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 (Continued)

Operation			Desired Result		
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10
			Verify both MCDUs are blanked.		
(54)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10
	Check FMS-BUS status.		Verify FAIL --- OK is displayed.		
(55)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(56)	Check I-BUS-1 1 and 2 status.		Verify dashes are displayed.		
(57)	Check DFGC-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(58)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- FAIL is displayed.		
(59)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9

Table 207 (Continued)

Operation			Desired Result		
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
			Verify FAIL --- FAIL is displayed.		
(60)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(61)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

5. System Service Test

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

A. EFIS Map and Plan Mode Test

Table 208

Operation		Desired Result
(1)	On MCDU, press ROUTE function key.	RTE pressed.
(2)	On EFIS control panel, select MAP mode, then set range 160 nautical miles.	Verify MAP selected and 160 NM displayed.
(3)	Enter company route number in line 2L. Press ACTIVATE button, then EXEC button.	On EFIS ND verify a route is displayed.

Table 208 (Continued)

Operation		Desired Result
(4)	On EFIS control panel, select PLAN mode.	Verify PLAN mode is being displayed on EFIS NAV display.

B. Annunciator/Digital Lights Test

Table 209

Operation		Desired Result
(1)	On overhead console, press and hold ANNUNCIATOR/DIGITAL LIGHTS test button and observe MCDU.	Verify that annunciators and exec keys are brightly lit.
(2)	On overhead console, pull out PULL TO DIM knob.	Verify that annunciators and exec keys dim.
(3)	Release ANNUNCIATOR/DIGITAL LIGHTS test button, then turn pedestal panel lighting knob to right.	Observe that MCDU and instrument lights increased in brightness.
(4)	Turn pedestal panel lighting knob back to original position.	Verify that MCDU and instrument lights dim.

C. Auto Brightness Test of Display Units

NOTE: This test is performed to verify that the automatic light sensors will provide brightness boost to the multipurpose control display units (MCDUs) in high intensity light circumstances.

Table 210

Operation		Desired Result
(1)	Shine a flashlight on each of EFIS photocells.	Verify MCDUs increase in brightness.

D. Test Termination

(1) Remove test equipment and return aircraft to required configuration.

FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Flight Management System (FMS) is integrated with the Digital Flight Guidance System (DFGS) to provide automatic pitch, roll and thrust control during climb, cruise and descent. The coordination of pitch, roll and thrust during lateral and vertical navigation provides efficient fuel usage or cost efficiency within the constraints of the commanded flight plan, altitude clearance limits and airplane performance limits.

B. The FMS consists of two Multifunction Control Display Unit (MCDU) and two Advanced Flight Management Computers (AFMC). The MCDUs are located one each on the forward pedestal left and right sides. The AFMC is located in the Electrical/Electronics (E/E)compartment. An ARINC 429 data loader is used for loading software (navigational data base) into the AFMC using a connector accessible in the cockpit in the captains briefcase holder area.

C. The FMS receives input data via serial data buses from the DFGSs. Additional inputs are received from the following:

(1) CADC 1,2

(2) DME interrogators 1, 2

(3) VOR receivers 1,2

(4) Engine Fuel Flow Indicators 1, 2

(5) IRS 1, 2

(6) Landing Gear Lever Control Relay (Discrete)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Air Data Tester model No. 127-1M	Edcliff Instruments
Red Tape VIP 7331 DPM 850-24	Valley Industrial Products
33410LH-90-5 Static Port Adapters	Canadian Aero Inst. Co.
7131A-1 Pitot Head Adapter	Edcliff Instruments
Portable Data Loader	
964-0400-006	Sundstrand
30100 Rev. A	Demo Systems
2230915-01B	Teledyne

3. FMS Data Base Loading Operation

A. Data Loading

NOTE: In the -924 and previous FMS versions, data base loading operation automatically erases all performance factors from memory. If desired, record performance factors prior to data base loading for re-entry after loading operation is complete. In the -925 FMS, all performance factors are retained after data base loading operation.

Table 202 Data Loading

Step	Operation		Desired Result		
(1)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.		Cable connected.		
(3)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(4)	On overhead panel, put FMS switch in NORM position.		FMS switch in NORM.		
(5)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.		IDENT page displayed on MCDU.		
(6)	Turn on data loader power.		Data loader power light on.		
(7)	Insert Navigation Data Base (NDB) diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE.		NDB diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.		
(8)	Press EJECT button to eject NDB diskette.		NDB diskette removed.		
(9)	Turn data loader power off.		Power light off.		
(10)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(11)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(12)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21

Table 202 Data Loading (Continued)

Step	Operation		Desired Result		
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
NOTE: Data base crossloading is required if AFMC-2 data base is different than AFMC-1, or if AFMC-2 has not been loaded yet. If crossloading is required perform steps (12) through (26), otherwise proceed to Paragraph 4.B. .					
(13)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
(14)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
(15)	On MCDU-1, press the MENU key.		MCDU MENU page displayed.		
(16)	Press the line select key (LSK) 1L next to AFMC#1 prompt, then press LSK 6L next to INDEX prompt.		INIT/REF INDEX page displayed.		
(17)	Type DAC into scratchpad, then press LSK 6R next to MAINT prompt.		MAINTENANCE INDEX page displayed.		
(18)	Press LSK 1L next to CROSS LOAD prompt.		NAV DATA CROSSLOAD page displayed on MCDU-1.		
(19)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
(20)	On MCDU-2, press the MENU key.		MCDU MENU page displayed on MCDU-2.		
(21)	On MCDU-2, press LSK 1L next to the AFMC#2 (REQ) prompt.		NAV DATA CROSSLOAD page displayed on MCDU-2.		
(22)	On both MCDU's, type ARM into scratchpad, then press LSK 6R.		ARM displayed on both MCDUs, next to LSK 6R.		
(23)	On MCDU-1, press LSK 3L next to TRANSMIT prompt. On MCDU-2, press LSK 3R next to RECEIVE prompt.		SUBSYSTEM page displayed on MCDU-2. AFMC#2 (TIMEOUT) shown next to LSK 1L. On MCDU-1, TRANSFER IN PROGRESS shown in line 4. After approximately 5 minutes, TRANSFER COMPLETE is shown.		
NOTE: If data base transfer fails, then TRANSFER ABORTED will be displayed on MCDU.					
(24)	On MCDU-1, press LSK 6L next to INDEX prompt, then press LSK 6L next to INDEX prompt on MAINTENANCE INDEX page.		INIT/REF INDEX page displayed on MCDU-1.		
(25)	Press LSK 1L next to IDENT prompt.		IDENT page displayed on MCDU-1.		

Table 202 Data Loading (Continued)

Step	Operation	Desired Result
(26)	On MCDU-2, press MENU button, then press LSK 1L next to AFMC#2 (REQ) on MCDU MENU page.	IDENT page displayed on MCDU-2.
(27)	On both MCDU's, check ACTIVE date next to LSK 2R.	ACTIVE date is the same on both MCDU's.

B. BITE Download from AFMC

NOTE: This procedure applies to aircraft with -926 AFMC or greater.

Table 203 BITE Download from AFMC

Step	Operation	Desired Result
(1)	Open the circuit breakers that follow:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL B10-419 / FLIGHT MANAGEMENT SYSTEM-1 AFMC / Upper EPC / LEFT RADIO AC BUS / D/21 B10-421 / FMS DATA LOADER / Upper EPC / FUEL - LEFT AC BUS / H/15	
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.	Cable connected.
(3)	Close the circuit breakers that follow:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL B10-419 / FLIGHT MANAGEMENT SYSTEM-1 AFMC / Upper EPC / LEFT RADIO AC BUS / D/21 B10-421 / FMS DATA LOADER / Upper EPC / FUEL - LEFT AC BUS / H/15	
(4)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.	INIT/REF INDEX 1/1 page is shown on MCDU.
(5)	Turn on data loader power.	Data loader power light on.
(6)	Insert BITE DOWNLOAD diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE.	Diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.
(7)	Press EJECT button to eject diskette.	
(8)	Turn data loader power off.	Power light off.
(9)	Remove AFMC-1 from its mount rack and install AFMC-2 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 1)	
(10)	Repeat steps (4) through (8) for AFMC-2.	

Table 203 BITE Download from AFMC (Continued)

Step	Operation		Desired Result		
(11)	Reinstall AFMC-2 into its mount rack and reinstall AFMC-1 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 1)				
(12)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(13)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(14)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

4. Power Up Operation

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

NOTE: When scratchpad messages appear, press and hold CLR pushbutton until all messages clear.

A. Power Up Transient Test

Table 204 Power Up Transient Test

Step	Operation		Desired Result		
(1)	Open and close these circuit breakers:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
(2)	Return To Service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.		Verify MCDU MENU displayed on both MCDU's. SELECT DESIRED SYSTEM appears in scratchpads.		
(3)	On overhead panel, place FMS selector switch to BOTH ON 1.		Verify both MCDU's display AFMC #1 prompt.		
(4)	Place FMS selector switch to BOTH ON 2.		Verify both MCDU's display AFMC #2 prompt.		
(5)	Place FMS selector switch to NORM position		Verify MCDU-1 displays AFMC #1 and MCDU-2 displays AFMC #2 prompts.		

Table 204 Power Up Transient Test (Continued)

Step	Operation	Desired Result
(6)	Press line select key 1L adjacent to AFMC-1 prompt on MCDU-1 and AFMC-2 prompt on MCDU-2.	Verify IDENT page is displayed on both MCDU's.

B. Maintenance Index Test

Table 205 Maintenance Index Test

Step	Operation	Desired Result
(1)	Press line select key 6L adjacent to the INDEX prompt.	Verify INIT/REF index page is displayed.
(2)	Type DAC into scratchpad.	Verify DAC is entered into scratchpad.
(3)	Press line select key 6R adjacent to MAINT prompt.	Verify maintenance index page 1/1 is displayed.
(4)	Press line select key 3L adjacent to DISCRETES prompt.	Verify AFMC 1 ANALOG DISCRETE page 1/2 is displayed.
(5)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed.
(6)	Press line select key 1R adjacent to PERF FACTORS prompt.	Verify PERF FACTORS page is displayed.
(7)	Enter ARM into scratchpad and press line select key 6R.	Verify ARM is displayed next to line select key 6R.
(8)	On MCDU-1, enter 3 into scratchpad, then press line select key 2L.	Verify 3.0 displayed next to line select key 2L on both MCDU's.
(9)	On MCDU-2, enter 0 into scratchpad, then press line select key 2L.	Verify 0.0 displayed next to line select key 2L on both MCDU's.
(10)	On MCDU-1 enter -3.5 into scratchpad, then press line select key 3L.	Verify -3.5 displayed next to line select key 3L on both MCDU's.
(11)	On MCDU-2, enter 1.3 into scratchpad, then press line select key 4L.	Verify 1.3 displayed next to line select key 4L on both MCDU's.
(12)	On MCDU-1, enter 2 into scratchpad, then press line select key 5L.	Verify 2 displayed next to line select key 5L on both MCDU's.
(13)	Open and close the circuit breaker:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B10-420 / FLIGHT MANAGEMENT SYSTEM-2 AFMC / Upper EPC / RIGHT RADIO AC BUS / F/9	
		Verify MCDU-2 displays TIMEOUT. Verify MCDU-1 displays SINGLE AFMC OPERATION then RESYNCING OTHER AFMC.
(14)	On MCDU-2, press MENU.	After resyncing complete, verify MCDU-2 displays same data as MCDU-1.
(15)	Open and close the circuit breaker:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	

Table 205 Maintenance Index Test (Continued)

Step	Operation	Desired Result
	B10-419 FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC LEFT RADIO AC BUS D/21
		Verify MDCU-1 displays TIMEOUT. Verify MCDU-2 displays SINGLE AFMC OPERATION then RESYNCING OTHER AFMC.
(16)	On MCDU-1, press MENU.	After resyncing is complete, verify MCDU-1 displays same data as MCDU-2.
(17)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed.

C. Analog Discretes Test

Table 206 Analog Discretes Test

Step	Operation	Desired Result
(1)	Press line select key 3L adjacent to DISCRETES prompt.	Verify AFMC-1 (2) ANALOG DISCRETES page 1/2 is displayed.
(2)	Check A/C PACK LEFT and RIGHT status.	Verify OFF OFF displayed.
(3)	Open the circuit breakers that follow:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B1-335 / AIR CONDITION REGULATOR VALVE LEFT / Overhead / EMERGENCY DC BUS / B/13	
	B1-189 / AIR CONDITION FLOW CONTROL VALVE LEFT / Overhead / EMERGENCY DC BUS / C/13	
		After 10 seconds check A/C pack LEFT and RIGHT status and verify ON OFF is displayed.
(4)	Open the circuit breakers that follow:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B1-336 / AIR CONDITION REGULATOR VALVE RIGHT / Overhead / EMERGENCY DC BUS / B/14	
	B1-190 / AIR CONDITION FLOW CONTROL VALVE RIGHT / Overhead / EMERGENCY DC BUS / C/14	
		After 10 seconds check A/C LEFT and RIGHT status and verify ON ON is displayed.
(5)	Close the circuit breakers that follow:	
	REF DES / CIRCUIT BREAKER / LOCATION / PANEL AREA / ROW/COL	
	B1-335 / AIR CONDITION REGULATOR VALVE LEFT / Overhead / EMERGENCY DC BUS / B/13	
	B1-336 / AIR CONDITION REGULATOR VALVE RIGHT / Overhead / EMERGENCY DC BUS / B/14	

Table 206 Analog Discretes Test (Continued)

Step	Operation		Desired Result		
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			Check A/C PACK LEFT and RIGHT status and verify OFF OFF is displayed.		
(6)	Place crossfeed valve LEFT and RIGHT on aft pedestal in CLOSED position.		Verify closed CL CL is displayed.		
(7)	Place LEFT and RIGHT crossfeed valve on pedestal to OPEN position.		Verify open OP OP is displayed.		
(8)	Place LEFT and RIGHT crossfeed valve back to CLOSED position.		Verify closed CL CL is displayed.		
(9)	Check engine ANTI-ICE LEFT and RIGHT status.		Verify OFF OFF is displayed.		
(10)	Place LEFT and RIGHT engine ANTI-ICE switch to ON position.		Verify ON ON is displayed.		
(11)	Place LEFT and RIGHT engine ANTI-ICE switch to OFF position.		LEFT and RIGHT engine ANTI ICE switch to OFF.		
(12)	Check air foil ice protection status.		Verify OFF is displayed.		
(13)	Make sure the circuit breakers that follow are closed:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-222	L SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION LEFT DC BUS	M/22
	B1-221	R SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/22
	B1-251	L SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	U/26
	B1-252	R SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	W/26
WARNING: NORMAL ELECTRICAL POWER TO VARIOUS SYSTEMS MAY BE INTERRUPTED WHEN GROUND CONTROL RELAY CIRCUIT BREAKERS ARE OPENED. IF GROUND CONTROL RELAY CIRCUIT BREAKERS ARE TO BE OPENED WHILE PERFORMING PROCEDURES, MAKE CERTAIN SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITION TO PREVENT INADVERTENT OPERATION OF EQUIPMENT.					
(14)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33

Table 206 Analog Discretes Test (Continued)

Step	Operation		Desired Result		
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(15)	Place AIRFOIL ANTI-ICE switch to ON position; place CROSSFEED VALVES LEFT & RIGHT to OPEN position.		Check air foil anti-ice protection status and verify ON is displayed on MCDU.		
(16)	Close left and right crossfeed valves.		Valves closed.		
(17)	Place AIRFOIL ANTI-ICE switch to OFF position.		Check air foil anti-ice protection status and verify OFF is displayed on MCDU.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
			Check WOW switch status and verify GND is displayed on MCDU.		
(19)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify FLT is displayed on MCDU.		
(20)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify GND is displayed on MCDU.		
(21)	Check MAG/TRUE STATUS.		Verify MAG is displayed on MCDU.		
(22)	On Capt's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		
(23)	On F/O's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		
(24)	On F/O's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		

Table 206 Analog Discretes Test (Continued)

Step	Operation		Desired Result		
(25)	On Capt's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		
(26)	Press NEXT PAGE key on MCDU.		Verify AFMC-1 (2) ANALOG DISCRETE PAGE 2/2 displayed.		
(27)	Check CAA FLT RULES status.		Verify DISABLE is displayed.		
(28)	Check KILOGRAM OPTION status.		Verify DISABLE is displayed.		
(29)	Check offside MCDU ENABLE status.		Verify ENABLE is displayed.		
(30)	Check SRCE/DEST IDENT status.		Verify 1 (2) is displayed.		
(31)	Check LANDING GEAR status.		Verify DOWN is displayed.		
(32)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify UP is displayed.		
(33)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify DOWN is displayed.		
(34)	Check MCDU SRCE SEL STATUS.		Verify NORM is displayed.		
(35)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

D. Data Status Test

NOTE: Each sensor input is displayed under the LRU heading. The status of the 1, 3 and 2 sensors (where applicable) are also displayed under subtitles. 3 should display dashes if no center LRU exists. A typical example for all three fields would be: FAIL --- OK.

Table 207 Data Status Test

Step	Operation	Desired Result
(1)	Verify that MAINTENANCE INDEX page is displayed.	MAINTENANCE INDEX page displayed.
(2)	Press line select key 2L adjacent to DATA STAT prompt.	Verify AFMC-1 (2) DATA STATUS page 1/2 is displayed.
(3)	Set up TIC 30B signal generator and tune TIC 30B generator (or equivalent), VHF NAV-1 and VHF NAV-2 to 108.0 MHz.	Generator, VHF NAV-1 and VHF NAV-2 control panels tuned to 108.0 MHz.
(4)	Check VOR-1 and VOR- 2 status on MCDU.	Verify OK or TEST is displayed on MCDU.
(5)	On EFIS control panel located outboard to briefcase lights, select ROSE mode.	ROSE mode selected.
(6)	Open the circuit breakers that follow:	

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
(7)	Check VOR-1 and VOR-2 status on MCDU.		Verify FAIL --- OK displayed on MCDU.		
(8)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(9)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check VOR-1 and VOR-2 status and verify OK or TEST is displayed.		
(9)	Check DME-1 and DME-2 status.		Verify OK or TEST is displayed.		
(10)	Check RDMI DME windows.		Verify dashes or numbers in RMDI DME windows.		
(11)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Check DME-1 and DME-2 status and verify FAIL --- OK is displayed.		
(12)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
			Verify FAIL --- FAIL is displayed.		
(13)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Verify OK or TEST is displayed.		
(14)	Tune TIC 30B generator or equivalent to 108.10; tune VHF-NAV-1 and VHF-NAV-2 to 108.10.		TIC generator, VHF-NAV-1 and VHF-NAV-2 tuned to 108.10.		
(15)	Check ILS-1 and ILS-2 status.		Verify OK or TEST is displayed on MCDU.		
(15a)	Do steps (16) through (18) and continue at step (19).				
(16)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check ILS-1 and ILS-2 status and verify FAIL --- OK displayed.		
(17)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Verify TEST or OK is displayed.		
(19)	Remove TIC 30B generator.		Generator removed.		
(20)	Check CADC-1 and CADC-2 status.		Verify OK --- OK is displayed.		
(21)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/3
			Verify FAIL --- OK is displayed.		
(22)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
			Verify FAIL --- FAIL is displayed.		
(23)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/3
			Verify OK --- OK is displayed.		
(24)	On IRS mode select panels, place IRS-1 and -2 switches to OFF; check IRS-1 and IRS-2 status.		Verify FAIL --- FAIL is displayed.		
(25)	Check platform status.		Verify FAIL --- FAIL is displayed.		
(26)	Place IRS-1 mode select switch to NAV.				
(27)	On MCDU-2, press LSK 6L, LSK 6L, and LSK 2L. Leave MCDU-1 on DATA STATUS page.		Verify POS INIT page is displayed.		
(28)	Enter local station code, then press LSK 2L.		Verify local station position displayed.		
(29)	Press LSK 2R (position to scratchpad), then LSK 4R (scratchpad to set position).		Verify present position is displayed in 4R.		
(30)	On IRS-1 mode select panel, wait for ALIGN light to go out (approx. 2-10 minutes).		ALIGN light goes out.		
(31)	Check platform status.		Verify OK --- FAIL is displayed.		
(32)	Place IRS-2 mode select switch to NAV; repeat steps (29) and (30) onMCDU-2.		ALIGN light goes out.		
(33)	Check platform status.		Verify OK --- OK is displayed.		
(34)	On MCDU-2, press LSK 6L, type DAC into scratchpad and press LSK 6R. Press LSK 2L.		Verify AFMC-2 DATA STATUS page is displayed.		
(35)	Select T.O. mode on Thrust Rating Panel (TRP); select autopilot side 2.		T.O. mode selected, autopilot side 2 selected.		
(36)	Check DFGC-1, DFGC-2 and platform status.		Verify OK --- OK is displayed.		
(37)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	Check DFGC-1 and DFGC-2 status.		Verify FAIL --- OK is displayed.		
(38)	On MCDU, press NEXT PAGE pushbutton.		Verify AFMC-1 (2) data status page 2/2.		
(39)	Check DFGS-BUS status.		Verify FAIL --- OK is displayed.		
(40)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify FAIL --- FAIL is displayed.		
(41)	On MCDU, press PREVIOUS PAGE pushbutton.		Verify AFMC-1 (2) data status page 1/2 is displayed.		
(42)	Check platform status and verify FAIL --- FAIL is displayed.		FAIL --- FAIL is displayed.		
(43)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(44)	Check platform status.		Verify OK --- OK is displayed.		
(45)	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(46)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
			Verify FAIL --- OK is displayed.		
(47)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
			Verify FAIL --- FAIL is displayed.		
(48)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(49)	Check fuel quantity status and verify dashes are displayed.		Dashes are displayed.		
(50)	Check clock-1 status.		Verify OK or TEST is displayed.		
(51)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify FAIL --- --- is displayed.		
(52)	Set GMT knob on captain's and first officer's to F.S. position.		GMT knob set to F.S. position.		
(53)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify OK or TEST is displayed.		
(54)	On MCDU, press next page button.		Verify AFMC 1 (2) DATA STATUS page 2/2 is displayed.		
(55)	Check EFIS-1 and EFIS-2 status.		Verify OK or TEST is displayed.		
(56)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify FAIL --- OK is displayed.		
(57)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
			Verify FAIL --- FAIL is displayed.		
(58)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify OK or TEST is displayed.		
(59)	Check AFMC 1 and 2 status.		Verify OK --- OK is displayed.		
(60)	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(61)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS status on opposite MCDU.		Verify FAIL --- OK is displayed.		
(62)	Open the circuit breaker that follows:				

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10
			Verify both MCDUs are blanked.		
(63)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10
	Check FMS-BUS status.		Verify FAIL --- OK is displayed.		
(64)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(65)	Check I-BUS-1 1 and 2 status.		Verify dashes are displayed.		
(66)	Check DFGC-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(67)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- FAIL is displayed.		
(68)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9

Table 207 Data Status Test (Continued)

Step	Operation		Desired Result		
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
			Verify FAIL --- FAIL is displayed.		
(69)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(70)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

5. System Service Test

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

A. EFIS Map and Plan Mode Test

Table 208 EFIS Map and Plan Mode Test

Step	Operation	Desired Result
(1)	On MCDU, press ROUTE function key.	RTE pressed.
(2)	On EFIS control panel, select MAP mode, then set range 160 nautical miles.	Verify MAP selected and 160 NM displayed.
(3)	Enter company route number in line 2L. Press ACTIVATE button, then EXEC button.	On EFIS ND, verify a route is displayed.

Table 208 EFIS Map and Plan Mode Test (Continued)

Step	Operation	Desired Result
(4)	On EFIS control panel, select PLAN mode.	Verify PLAN mode is being displayed on EFIS NAV display.

B. Annunciator/Digital Lights Test

Table 209 Annunciator/Digital Lights Test

Step	Operation	Desired Result
(1)	On overhead console, press and hold ANNUNCIATOR/DIGITAL LIGHTS test button and observeMCDU .	Verify that annunciators and exec keys are brightly lit.
(2)	On overhead console, pull out PULL TO DIM knob.	Verify that annunciators and exec keys dim.
(3)	Release ANNUNCIATOR/DIGITAL LIGHTS test button, then turn pedestal panel lighting knob to right.	Observe that MCDU and instrument lights increased in brightness.
(4)	Turn pedestal panel lighting knob back to original position.	Verify that MCDU and instrument lights dim.

C. Auto Brightness Test of Display Units

NOTE: This test is performed to verify that the automatic light sensors will provide brightness boost to the MCDUs in high intensity light circumstances.

Table 210 Auto Brightness Test of Display Units

Step	Operation	Desired Result
(1)	Shine a flashlight on each of EFIS photocells.	Verify MCDUs increase in brightness.

D. Test Termination

(1) Remove test equipment and return aircraft to required configuration.

FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Flight Management System (FMS) is integrated with the Digital Flight Guidance System (DFGS) to provide automatic pitch, roll and thrust control during climb, cruise and descent. The coordination of pitch, roll, and thrust during lateral and vertical navigation provides efficient fuel usage or cost efficiency within the constraints of the commanded flight plan, altitude clearance limits, and aircraft performance limits.

B. The FMS consists of two Multipurpose Control Display Units (MCDU) and two Advanced Flight Management Computers (AFMC). The MCDUs are located one each on the forward pedestal left and right sides. The AFMCs are located in the electrical/ electronics (E/E) compartment. An Airborne Data Loader (ADL) is used for loading software (navigational data base and operational program) into the AFMC and for downloading BITE data from the AFMC to the ADL.

C. The FMS receives input data via serial data buses from the DFGCs. Additional inputs are received from the following:

(1) CADC 1,2

(2) DME interrogators 1, 2

(3) VOR receivers 1,2

(4) Engine Fuel Flow Indicators 1, 2

(5) AHRS 1, 2

(6) Landing Gear Lever Control Relay (Discrete)

(7) GNSSU 1, 2

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Air Data Tester model No. 127-1M	Edcliff Instruments
Red Tape VIP 7331 DPM 850-24	Valley Industrial Products
33410LH-90-5 Static Port Adapters	Canadian Aero Inst. Co.
7131A-1 Pitot Head Adapter	Edcliff Instruments

3. FMS Data Base Loading Operation

A. Navigation Data Base Loading

NOTE: In the -924 and previous FMS versions, data base loading operation automatically erases all performance factors from memory. If desired, record performance factors prior to data base loading for re-entry after loading operation is complete. In the -925 FMS and subsequent, all performance factors are retained after data base loading operation.

Table 202

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-420	FMC-2	Upper EPC	RT AC	B/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(2)	Select "NORM" on FMS selector switch in overhead.				
(3)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(4)	On both MCDUs, press MCDU MENU key.		"MCDU MENU" page shows on MCDU.		
(5)	On either MCDU, press line select key (LSK) 1L next to "<AFMC #2 (REQ)" prompt.		"IDENT 1/1" page appears.		
(6)	Record dates on LSK 2R and 3R on MCDU-2.				
(7)	Open and tag the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(8)	Connect one end of cable (stored in cover of portable data loader) to data loader and other end to data loader receptacle R50-451 located under CAPT's briefcase stowage area.				
(9)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(10)	Check "MCDU MENU" page is shown on MCDU-1.		MCDU MENU page is shown.		
(11)	Press LSK 1L next to "<AFMC #1 (REQ)" prompt on MCDU-1.		"IDENT 1/1" page is shown.		
(12)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 202 (Continued)

Operation			Desired Result		
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(13)	Get 3 1/2 NDB diskette with different date than recorded in step (6).				
(14)	Turn on data loader power.		Data loader power light is ON.		
(15)	Insert NDB diskette into data loader drive unit with diskette label facing up.		Diskette is inserted.		
(16)	Wait for "LOAD COMPLETE" to be shown in data loader window. This takes up to 10 minutes to load data.		"LOAD COMPLETE" is shown.		
(17)	Eject diskette by pressing EJECT button on drive cover.		Diskette is EJECTED.		
(18)	Open and tag the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(19)	Open and tag the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(20)	Remove cables installed in step (8).				
(21)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(22)	Press MENU key on MCDU-1.		"MCDU MENU" page is shown.		
(23)	Press LSK 1L next to "<AFMC #1 (REQ)" prompt on MCDU-1.		IDENT 1/1 page is shown.		

B. NDB Cross Loading (AFMC-1 TO AFMC-2)

Table 203

Operation		Desired Result
(1)	Press LSK 6L next to "<INDEX" prompt on MCDU-1.	"INIT/REF INDEX 1/1" page is shown on MCDU-1.
(2)	Type "DAC" into scratchpad on MCDU-1, then press LSK 6R next to "MAINT >" prompt.	"MAINTENANCE INDEX 1/1" page is shown.

Table 203 (Continued)

Operation			Desired Result		
(3)	Press LSK 1L next to "<CROSS LOAD" prompt on MCDU-1.		"NAV DATA CROSSLOAD 1/1" page is shown on MCDU-1.		
(4)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-420	FMC-2	Upper EPC	RT AC	B/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(5)	Press MENU key on MCDU-2.		"MCDU MENU" page is shown on MCDU-2.		
(6)	Press LSK 1L next to "AFMC #2 (REQ)" prompt on MCDU-2.		"NAV DATA CROSSLOAD 1/1" page is shown on MCDU-2.		
(7)	On MCDU-1 and MCDU-2, type "ARM" into scratchpad, then press LSK 6R.		"ARM" is at LSK 6R.		
(8)	Press LSK 3L next to "<TRANSMIT" prompt on MCDU-1.				
(9)	Press LSK 3R next to "RECEIVE>" prompt on MCDU-2.		"SUBSYSTEM" page with "AFMC #2 (TIMEOUT)" at LSK 1L is shown.		
(10)	Check line 4 on MCDU-1.		"TRANSFER IN PROGRESS" is shown.		
(11)	Check line 4 on MCDU-1. (Wait up to 5 minutes)		"TRANSFER COMPLETE" is shown.		
(12)	Press LSK 6L next to "<INDEX" prompt on MCDU-1.		"MAINTENANCE INDEX 1/1" page is shown.		
(13)	Press LSK 6L next to "<INDEX" prompt on MCDU-1.		"INIT/REF INDEX 1/1" page is shown.		
(14)	Press LSK 1L next to "<IDENT" prompt on MCDU-1.		"IDENT 1/1" page is shown.		
(15)	Press MENU key on MCDU-2.		"MCDU MENU" page is shown.		
(16)	Press LSK 1L next to "<AFMC #2 (REQ)" prompt on MCDU-2.		"NAV DATA CROSSLOAD 1/1" page is shown on MCDU-2.		
(17)	Press LSK 6L next to "<INDEX" prompt on MCDU-2.		"MAINTENANCE INDEX 1/1" page is shown.		
(18)	Press LSK 6L next to "<INDEX" prompt on MCDU-2.		"INIT/REF INDEX 1/1" page is shown.		
(19)	Press LSK 1L next to "<IDENT" prompt on MCDU-2.		"IDENT 1/1" page is shown.		
(20)	Verify that "ACTIVE" date at LSK 2R is same on both MCDUs.		"ACTIVE" date is same on both MCDUs.		

C. BITE Download from AFMC

NOTE: This procedure applies to aircraft with -926 AFMC or greater.

Table 204

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.		Cable connected.		
(3)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(4)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.		INIT/REF INDEX 1/1 page is shown on MCDU.		
(5)	Turn on data loader power.		Data loader power light on.		
(6)	Insert BITE DOWNLOAD diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE.		Diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.		
(7)	Press EJECT button to eject diskette.				
(8)	Turn data loader power off.		Power light off.		
(9)	Remove AFMC-1 from its mount rack and install AFMC-2 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 4)				
(10)	Repeat steps (4) through (8) for AFMC-2.				
(11)	Reinstall AFMC-2 into its mount rack and reinstall AFMC-1 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 4)				
(12)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 204 (Continued)

Operation			Desired Result		
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(13)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(14)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
WJE 405-411, 880, 881, 883, 884					
	B10-421	FMS DATA LOADER	Upper EPC	RT AC	J/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					

4. Power Up Operation

NOTE: Unless otherwise indicated, the following steps should be performed on both MCDU-1 and MCDU-2. Verify responses on both MCDU's.

NOTE: When scratchpad messages appear, press and hold CLR pushbutton until all messages clear.

A. Power Up Transient Test

Table 205

Operation			Desired Result		
(1)	Open and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-420	FMC-2	Upper EPC	RT AC	B/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B10-419	FMC-1	Upper EPC	LEFT RADIO AC BUS	D/21
(2)	Return To Service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.		Verify MCDU MENU displayed on both MCDU's. SELECT DESIRED SYSTEM appears in scratchpads.		
(3)	On overhead panel, place FMS selector switch to BOTH ON 1.		Verify both MCDU's display AFMC #1 prompt.		
(4)	Place FMS selector switch to BOTH ON 2.		Verify both MCDU's display AFMC #2 prompt.		
(5)	Place FMS selector switch to NORM position		Verify MCDU-1 displays AFMC #1 and MCDU-2 displays AFMC #2 prompts.		

Table 205 (Continued)

	Operation	Desired Result
(6)	Press line select key 1L adjacent to AFMC-1 prompt on MCDU-1 and AFMC-2 prompt on MCDU-2.	Verify IDENT page is displayed on both MCDU's.
(7)	Check that engine type is shown to left of LSK 1R on both MCDUs.	JT8D-219.
(8)	Check that Model Type is shown to right of LSK 1L.	MD-82: LMN, LMO, LMP, LMT, LMW, LMX, LMY, LMZ, LMH, and LMC. MD-83: LMS, LMR, LPE, LPF, LPH, LMG, LPD, LPG, LMU, LMV, LPC, and LPB. MD-87: LMA, LMB, and LMC.

B. Maintenance Index Test

Table 206

	Operation	Desired Result
(1)	Press line select key 6L adjacent to INDEX prompt.	Verify INIT/REF index page is displayed.
(2)	Type DAC into scratchpad.	Verify DAC is entered into scratchpad.
(3)	Press line select key 6R adjacent to MAINT prompt.	Verify maintenance index page 1/1 is displayed.
(4)	Press line select key 3L adjacent to DISCRETES prompt.	Verify AFMC 1 ANALOG DISCRETE page 1/2 is displayed.
(5)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed.
(6)	Press line select key 1R adjacent to PERF FACTORS prompt.	Verify PERF FACTORS page is displayed.
(7)	Enter ARM into scratchpad and press line select key 6R.	Verify ARM is displayed next to line select key 6R.
(8)	On MCDU-1, enter 3 into scratchpad, then press line select key 2L.	Verify 3.0 displayed next to line select key 2L on both MCDU's.
(9)	On MCDU-2, enter 0 into scratchpad, then press line select key 2L.	Verify 0.0 displayed next to line select key 2L on both MCDU's.
(10)	On MCDU-1, enter -3.5 into scratchpad, then press line select key 3L.	Verify -3.5 displayed next to line select key 3L on both MCDU's.
(11)	On MCDU-2, enter 1.3 into scratchpad, then press line select key 4L.	Verify 1.3 displayed next to line select key 4L on both MCDU's.
(12)	On MCDU-1, enter 2 into scratchpad, then press line select key 5L.	Verify 2 displayed next to line select key 5L on both MCDU's.
(13)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is displayed on MCDU.

C. AFMC-1 Analog Discretes Test

Table 207

	Operation	Desired Result
(1)	Press line select key 3L adjacent to DISCRETES prompt on MCDU-1 and MCDU-2.	Verify AFMC-1 ANALOG DISCRETES page 1/2 is displayed on MCDU-1 and MCDU-2.

Table 207 (Continued)

Operation			Desired Result		
(2)	Check A/C PACK LEFT and RIGHT status (after approximately 10 seconds).		Verify OFF OFF displayed.		
(3)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-409, 411, 880, 881, 883, 884					
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
WJE 410					
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/14
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
			After ten seconds, check A/C pack LEFT and RIGHT status and verify ON OFF is displayed.		
(4)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-409, 411, 880, 881, 883, 884					
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14
WJE 410					
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			After ten seconds, check A/C LEFT and RIGHT status and verify ON ON is displayed.		
(5)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-409, 411, 880, 881, 883, 884					
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
WJE 410					
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/14

WJE 410 (Continued)

Table 207 (Continued)

Operation			Desired Result		
WJE 405-409, 411, 880, 881, 883, 884					
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14
WJE 410					
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/15
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			Check A/C PACK LEFT and RIGHT status and verify OFF OFF is displayed.		
(6)	Place crossfeed valve LEFT and RIGHT on aft pedestal in CLOSED position.		Verify closed CL CL is displayed.		
(7)	Place LEFT and RIGHT crossfeed valve on pedestal to OPEN position.		Verify open OP OP is displayed.		
(8)	Place LEFT and RIGHT crossfeed valve back to CLOSED position.		Verify closed CL CL is displayed.		
(9)	Check engine ANTI-ICE LEFT and RIGHT status.		Verify OFF OFF is displayed.		
(10)	Place LEFT and RIGHT engine ANTI-ICE to ON position.		Verify ON ON is displayed.		
(11)	Place LEFT and RIGHT engine ANTI-ICE switch to OFF position.		Verify OFF OFF is displayed.		
(12)	Verify air foil ice protection status.		Verify OFF is displayed.		
(13)	Make sure the circuit breakers that follow are closed:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-222	L SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION LEFT DC BUS	M/22
	B1-221	R SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/22
	B1-251	L SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	U/26
	B1-252	R SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	W/26
(14)	Open the circuit breakers that follow:				

Table 207 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(15)	Place left and right AIRFOIL ANTI-ICE switches to ON position; place CROSSFEED VALVES LEFT & RIGHT to OPEN position.		Check air foil anti-ice protection status and verify ON is displayed on MCDU.		
(16)	Close left and right airfoil switches to OFF.		Switches are OFF.		
(17)	Close left and right crossfeed valves and check airfoil anti-ice protection status.		Check air foil anti-ice protection status and verify OFF is displayed on MCDU.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
			Check WOW switch status and verify GND is displayed on MCDU.		
(19)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify FLT is displayed on MCDU.		
(20)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify GND is displayed on MCDU.		
(21)	Check MAG/TRUE STATUS.		Verify MAG is displayed on MCDU.		
(22)	Press NEXT PAGE key on MCDU.		Verify AFMC-1 ANALOG DISCRETE PAGE 2/2 displayed.		
(23)	Check CAA FLT RULES status.		Verify DISABLE is displayed.		
(24)	Check KILOGRAM OPTION status.		Verify "ENABLE" is displayed.		

Table 207 (Continued)

Operation			Desired Result		
(25)	Check offside MCDU ENABLE status.		Verify ENABLE is displayed.		
(26)	Check GNS ENABLE status.		Verify ENABLE is displayed.		
(27)	Check ALTERNATE NDB status.		Verify ENABLE is displayed.		
(28)	Source Destination Identifier and MCDU Source Select Status				
(a)	Verify that FMS source select switch on overhead panel is in "NORM" position.		Set in "NORM" position.		
(b)	Select "MAP" mode on both Captain's and First Officer's mode select panel.		Set in "MAP" mode.		
(c)	Check "SRCE/DEST IDENT" status on MCDU-1.		"1" is shown.		
(d)	Check "SRCE/DEST IDENT" status on MCDU-2.		"2" is shown.		
(e)	Check "MCDU SRCE SEL" status.		"NORM" is shown.		
(f)	Place FMS source select switch to "BOTH ON 1" position and check "MCDU SRCE SEL" status on MCDU-1 and MCDU-2.		"BOTH 1" is shown.		
(g)	Check Captain's and First Officer's Navigation Display (ND) on main instrument panel for "NAV 1" enclosed in amber box.		"NAV 1" is shown.		
(h)	Place FMS source select switch to "BOTH ON 2" position and check "MCDU SRCE SEL" status on MCDU-1 and MCDU-2.		"BOTH 2" is shown.		
(i)	Check NDs for "NAV 2" enclosed in amber box.		"NAV 2" is shown.		
(j)	Set FMS source select switch on overhead panel is in "NORM" position.		Set in "NORM" position.		
(k)	Check NDs for "NAV".		"NAV" is shown.		
(26)	Check LANDING GEAR status.		Verify DOWN is displayed.		
(27)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify UP is displayed.		
(28)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify DOWN is displayed.		
(29)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

D. AFMC-1 Data Status Test

NOTE: Each sensor input is displayed under the LRU heading. The status of the 1, 3 and 2 sensors (where applicable) are also displayed under subtitles. 3 should display dashes if no center LRU exists. A typical example for all three fields would be: FAIL --- OK.

Table 208

Operation			Desired Result		
(1)	Verify that MAINTENANCE INDEX page is displayed.		MAINTENANCE INDEX page displayed.		
(2)	Press line select key 2L adjacent to DATA STAT prompt.		Verify AFMC-1 DATA STATUS page 1/2 is displayed.		
(3)	Set up TIC 30B signal generator and tune TIC 30B generator (or equivalent), VHF NAV-1 and VHF NAV-2 to 108.0 MHz.		Generator, VHF NAV-1 and VHF NAV-2 control panels tuned to 108.0 MHz.		
(4)	Check VOR-1 and VOR- 2 status on MCDU.		Verify OK or TEST is displayed on MCDU.		
(5)	On EFIS control panel located outboard to briefcase lights, select ROSE mode.		ROSE mode selected.		
(6)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-409, 411, 880, 881, 883, 884					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
WJE 410					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/5
WJE 405-409, 411, 880, 881, 883, 884					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
WJE 410					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/10
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	Check VOR-1 and VOR-2 status on MCDU.		Verify FAIL --- OK displayed on MCDU.		
(7)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(8)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 208 (Continued)

Operation			Desired Result		
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
WJE 405-409, 411, 880, 881, 883, 884					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
WJE 410					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/5
WJE 405-409, 411, 880, 881, 883, 884					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
WJE 410					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/10
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Check VOR-1 and VOR-2 status and verify OK or TEST is displayed.		
(9)	Check DME-1 and DME-2 status.		Verify OK or TEST is displayed.		
(10)	Check RDMI DME windows.		Verify dashes or numbers in RDMI DME windows.		
(11)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Check DME-1 and DME-2 status and verify FAIL --- OK is displayed.		
(12)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
			Verify FAIL --- FAIL is displayed.		
(13)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Verify OK or TEST is displayed.		

Table 208 (Continued)

Operation			Desired Result		
(14)	Tune TIC 30B generator or equivalent to 108.10; tune VHF-1 and VHF-2 to 108.10.		TIC generator, VHF-1 and VHF-2 tuned to 108.10.		
(15)	Check ILS-1 and ILS-2 status.		Verify OK or TEST is displayed on MCDU.		
(16)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-409, 411, 880, 881, 883, 884					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
WJE 410					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/5
WJE 405-409, 411, 880, 881, 883, 884					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
WJE 410					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/10
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Check ILS-1 and ILS-2 status and verify FAIL --- OK displayed.		
(17)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
WJE 405-409, 411, 880, 881, 883, 884					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
WJE 410					
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/5

WJE 410 (Continued)

Table 208 (Continued)

Operation			Desired Result		
WJE 405-409, 411, 880, 881, 883, 884					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
WJE 410					
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/10
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify TEST or OK is displayed.		
(19)	Remove TIC 30B generator.		Generator removed.		
(20)	Check CADC-1 and CADC-2 status.		Verify OK --- OK is displayed.		
(21)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify FAIL --- OK is displayed.		
(22)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
			Verify FAIL --- FAIL is displayed.		
(23)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
WJE 405-411, 880, 881, 883, 884					
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify OK --- OK is displayed.		
(24)	Check AHRS-1 and AHRS-2 status.		Verify OK or TEST is displayed.		
(25)	Check AHRS-1 and AHRS-2 status.		OK -- OK is shown.		
(26)	Check platform status.		Verify OK --- OK is displayed.		
(27)	Open the circuit breakers that follow:				

Table 208 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-394	AHRS-1	Overhead	EMERGENCY AC BUS	B/5
			Verify FAIL --- OK is displayed.		
(28)	Place AHRS source select switch to "L on AUX".		Switch position is on "L on AUX".		
(29)	Check AHRS status.		Verify "OK --- OK" is displayed.		
(30)	Place AHRS source select switch to NORM.		Switch position is at NORM.		
(31)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406-408, 411					
	B10-396	AHRS-2	Upper EPC	RIGHT RADIO AC BUS	F/2
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify FAIL --- FAIL is displayed.		
(32)	Place AHRS source select switch to "R on AUX".		Switch position is at R on AUX.		
(33)	Check AHRS-1 and AHRS-2 status.		Verify FAIL --- OK is displayed.		
(34)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406-408, 411					
	B10-397	AHRS-3	Upper EPC	RIGHT RADIO AC BUS	F/1
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	Inspect AHRS status.		Verify FAIL --- FAIL is displayed.		
(35)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406-408, 411					
	B10-397	AHRS-3	Upper EPC	RIGHT RADIO AC BUS	F/1
	B10-396	AHRS-2	Upper EPC	RIGHT RADIO AC BUS	F/2
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	B10-394	AHRS-1	Overhead	EMERGENCY AC BUS	B/5
	Check AHRS status.		Verify OK or TEST is displayed.		
(36)	Place AHRS source select switch to NORM position.		Switch in NORM position.		

Table 208 (Continued)

Operation			Desired Result		
(37)	Select T.O. mode on Thrust Rating Panel (TRP); select autopilot side 2.		T.O. mode selected, autopilot side 2 selected.		
(38)	Check DFGC-1, DFGC-2 and platform status.		Verify OK --- OK is displayed.		
(39)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	Check DFGC-1 and DFGC-2 status.		Verify FAIL --- OK is displayed.		
(40)	On MCDUs, press NEXT PAGE pushbutton.		Verify AFMC-1 data status page 2/2 on MCDUs.		
(41)	Check DFGS-BUS status.		Verify FAIL --- OK is displayed.		
(42)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify FAIL --- FAIL is displayed.		
(43)	On MCDUs, press PREVIOUS PAGE pushbutton.		Verify AFMC-1 data status page 1/2 is displayed on MCDUs.		
(44)	Check platform status and verify FAIL --- FAIL is displayed.		FAIL --- FAIL is displayed.		
(45)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1

Table 208 (Continued)

Operation			Desired Result		
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(46)	Check platform status.		Verify OK --- OK is displayed.		
(47)	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(48)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
			Verify FAIL --- OK is displayed.		
(49)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
			Verify FAIL --- FAIL is displayed.		
(50)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
	Check fuel flow left and right status.		Verify OK --- OK is displayed.		

Table 208 (Continued)

Operation			Desired Result		
(51)	Check fuel quantity status and verify dashes are displayed.		Dashes are displayed.		
(52)	Check clock-1 status.		Verify OK or TEST is displayed.		
(53)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify FAIL --- --- is displayed.		
(54)	Set GMT knob on captain's and first officer's to F.S. position.		GMT knob set to F.S. position.		
(55)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify OK or TEST is displayed.		
(56)	On MCDUs, press next page button.		Verify AFMC 1 DATA STATUS page 2/2 is displayed on MCDUs.		
(57)	Check EFIS-1 and EFIS-2 status.		Verify OK or TEST is displayed.		
(58)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-408, 410, 411, 880, 881, 883					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
WJE 409, 884					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	B/4
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify EFIS FAIL --- OK is displayed.		
(59)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406-408, 411					
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7

WJE 406-408, 411 (Continued)

Table 208 (Continued)

Operation			Desired Result		
WJE 405, 409, 881, 883, 884					
	B10-413	SYMBOL GENERATOR -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify EFIS FAIL --- FAIL is displayed.		
(60)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 406-408, 411					
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/7
WJE 405, 409, 881, 883, 884					
	B10-413	SYMBOL GENERATOR -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/10
WJE 410					
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/14
WJE 405-408, 410, 411, 880, 881, 883					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
WJE 409, 884					
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	B/4
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify OK or TEST is displayed.		
(61)	Check AFMC 1 and 2 status.		Verify OK --- OK is displayed.		
(62)	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(63)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	MCDU-1	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS status on opposite MCDU.		Verify FAIL --- OK is displayed.		
(64)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 208 (Continued)

Operation			Desired Result		
WJE 405-411, 880, 881, 883, 884					
	B10-425	MCDU-2	Upper EPC	RT AC	B/16
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
			Verify both MCDUs are blanked.		
(65)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-425	MCDU-2	Upper EPC	RT AC	B/16
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
	Check FMS-BUS status.		Verify FAIL --- OK is displayed.		
(66)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	MCDU-1	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(67)	Check I-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(68)	Check DFGC-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(69)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- FAIL is displayed.		
(70)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10

Table 208 (Continued)

Operation			Desired Result		
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
			Verify FAIL --- FAIL is displayed.		
(71)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		

5. **Global Navigation System (GNS) Test**

NOTE: 1. The GNS test needs to be performed outside of the hangar.

2. The GNS position may take up to 10 minutes to acquire.

3. Perform the following steps on MCDU-1 and MCDU-2 simultaneously.

Table 209

Operation		Desired Result
(1)	Verify that MAINTENANCE INDEX page is shown.	Maintenance index page is shown.

Table 209 (Continued)

Operation			Desired Result		
(2)	Press LSK 2L adjacent to data stat prompt on MCDU-1.		Verify "AFMC-1 DATA STATUS 1/2" page is shown.		
(3)	Press LSK 2L adjacent to data stat prompt on MCDU-2.		Verify "AFMC-2 DATA STATUS 1/2" page is shown.		
(4)	Press NEXT PAGE button on MCDU-1.		Verify "AFMC-1 DATA STATUS 2/2" page is shown.		
(5)	Press NEXT PAGE button on MCDU-2.		Verify "AFMC-2 DATA STATUS 2/2" page is shown.		
(6)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-497	GLOBAL POSITION SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/4
WJE 405-411, 880, 881, 883, 884					
	B10-496	GLOBAL POSITION SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/14
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(7)	Check GNS status.		Verify FAIL --- FAIL is shown.		
(8)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
WJE 405-411, 880, 881, 883, 884					
	B10-496	GLOBAL POSITION SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/14
WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MOD					
(9)	Check GNS status.		Verify OK --- FAIL is shown.		
(10)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-497	GLOBAL POSITION SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/4
(11)	Check GNS status.		Verify OK --- OK is shown.		
(12)	Press LSK 6L next to "<INDEX" prompt.		"MAINTENANCE INDEX" page is shown.		
(13)	Press LSK 6L next to "<INDEX" prompt.		"INIT/REF INDEX" page is shown.		
(14)	Press LSK 2L next to "<POS" prompt.		Verify "POS INIT" page is shown.		
(15)	Press PREV PAGE button.		Verify "POS REF 3/3" is shown.		
(16)	Verify that GNS 1 position is shown to right of LSK 1L key.		Verify GNS 1 position is shown.		
(17)	Verify that GNS 2 position is shown to right of LSK 2L key.		Verify GNS 2 position is shown.		

6. **System Service Test**

NOTE: The following applies to MCDU-1 and MCDU-2.

A. Annunciator/Digital Lights Test

Table 210

Operation		Desired Result
(1)	Push in "PULL TO DIM" knob on overhead console.	
(2)	Press and hold in "ANNUN/DIGITAL LTS TEST" button on overhead console.	
	(a) Check "EXEC" key.	Brightly lit.
	(b) Check "MENU" annunciation.	Brightly lit.
	(c) Check "MSG" annunciation.	Brightly lit.
	(d) Check "DSPY" annunciation.	Brightly lit.
	(e) Check "OFST" annunciation.	Brightly lit.
(3)	Pull out "PULL TO DIM" knob on overhead console.	
	(a) Check "EXEC" key.	Dim.
	(b) Check "MENU" annunciation.	Dim.
	(c) Check "MSG" annunciation.	Dim.
	(d) Check "DSPY" annunciation.	Dim.
	(e) Check "OFST" annunciation.	Dim.
(4)	Release ANNUN/DIGITAL LTS TEST button. (Push in PULL TO DIM knob.)	
(5)	Turn "PANEL" knob on "CTR INSTR & PED LTS" located on pedestal clockwise.	MCDUs and instrument lights increase in brightness.
(6)	Turn "PANEL" knob back to original position.	MCDUs and instrument lights dim.

B. MCDU Auto Brightness Test

NOTE: This test is to be performed to verify that remote light sensors will provide adequate brightness on the MCDUs.

Table 211

Operation		Desired Result
(1)	Shine light on each of two photocells on both MCDUs.	MCDUs increase in brightness.

C. Test Termination

(1) Remove test equipment and return aircraft to required configuration.

FLIGHT MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Flight Management System (FMS) is integrated with the Digital Flight Guidance System (DFGS) to provide automatic pitch, roll and thrust control during climb, cruise and descent. The coordination of pitch, roll and thrust during lateral and vertical navigation provides efficient fuel usage or cost efficiency within the constraints of the commanded flight plan, altitude clearance limits and airplane performance limits.

B. The FMS consists of two Multipurpose Control Display Units (MCDU) and an Advanced Flight Management Computer (AFMC). The MCDUs are located one each on the forward pedestal left and right sides. The AFMC is located in the electrical/electronics (E/E) compartment. An ARINC 429 data loader is used for loading software (navigational data base) into the AFMC using a connector accessible in the cockpit in the captains briefcase holder area.

C. The FMS receives input data via serial data buses from the DFGCs. Additional inputs are received from the following:

(1) CADC 1,2

(2) DME interrogators 1, 2

(3) VOR receivers 1,2

(4) Engine Fuel Flow Indicators 1, 2

(5) IRS 1, 2

(6) Landing Gear Lever Control Relay (Discrete)

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Air Data Tester model No. 127-1M	Edcliff Instruments
Red Tape VIP 7331 DPM 850-24	Valley Industrial Products
33410LH-90-5 Static Port Adapters	Canadian Aero Inst. Co.
7131A-1 Pitot Head Adapter	Edcliff Instruments
Portable Data Loader	
964-0400-006	Sundstrand
30100 Rev. A	Demo Systems
2230915-01B	Teledyne

3. FMS Data Loading Operation

A. Data Loading

NOTE: In the -924 and previous FMS versions, data base loading operation automatically erases all performance factors from memory. If desired, record performance factors prior to data base loading for re-entry after loading operation is complete. In the -925 FMS, all performance factors are retained after data base loading operation.

Table 202

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(2)	Connect one end of the cable (stored in data loader cover) to J1 of data loader and other end to data loader receptacle R50-451.		Cable connected.		
(3)	Set function select switch to "1".		Switch set to "1".		
(4)	Insert data cartridge with with old NAV data base into mounting slot of tape drive with metal plate toward eject control and push in firmly until locked in place.		Cartridge inserted.		
(5)	Turn on data loader power.		Data loader power on.		
(6)	Wait for "XFR COMPL" light to be shown.		"XFR COMPL" is shown.		
(7)	Turn data loader power off.		Data loader power off.		
(8)	Open and tag the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
(9)	Remove AFMC-1 and install it in AFMC-2 position; remove AFMC-2 and install it in AFMC-1 position. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 1)		Verify AFMC-1 is exchanged with AFMC-2.		
(10)	Remove tag and close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
(11)	Repeat steps (2) through (7) with new NAV data base.		Verify.		
(12)	Remove cable from data loader and data loader receptacle and store in data loader cover.		Cable removed.		
(13)	Remove tag and close the circuit breaker that follows:				

Table 202 (Continued)

Operation			Desired Result		
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
(14)	Press MENU key on MCDU-1 and MCDU-2.		Verify "MCDU MENU" is shown on MCDU-1, and MCDU-2.		
(15)	Place FMS selector switch in NORM position; press LSK 1L adjacent to AFMC-1 prompt on MCDU-1; press LSK 1L adjacent to AFMC-2 prompt on MCDU-2.		Switch to NORM. Verify IDENT page is shown on MCDU-1 and crossload page shown on MCDU-2.		
(16)	Press LSK 6L adjacent to INDEX prompt on MCDU-1; enter "DAC" into scratchpad and press LSK 6R adjacent to MAINT prompt.		Verify MAINTENANCE index page is shown.		
(17)	Press line select key 1L adjacent to "CROSS LOAD" prompt on MCDU-1.		Verify NAV DATA CROSSLOAD page is shown.		
(18)	Type "ARM" into scratchpad of MCDU-1, MCDU-2, and press line select key 6R.		Verify "ARM" is shown next to LSK 6R.		
(19)	Press line select key 3L adjacent to "TRANSMIT" prompt on MCDU-1.		Verify "RECEIVE" is removed from 3R on left MCDU.		
(20)	Press line select key 3R adjacent to "RECEIVE" prompt on MCDU-2.		Verify right MCDU blanks and and times out.		
(21)	Inspect LSK 4L and 4R on MCDU-1 (if data base transfer is aborted, then "TRANSFER ABORTED" will be shown).		Verify "TRANSFER IN PROGRESS" is shown.		
(22)	Inspect LSK 4L and 4R on MCDU-1.		Verify "TRANSFER COMPLETE" is shown.		
NOTE: Allow 10 minutes for the transfer.					
(23)	Press MENU key on MCDU-2, then press LSK 1L next to AFMC-2 prompt.		Verify NAV DATA CROSSLOAD 1/1 page is shown.		
(24)	Press line select key 6L adjacent to INDEX prompt on MCDU-1 and MCDU-2.		Verify MAINTENANCE INDEX page is shown.		

B. BITE Download from AFMC

NOTE: This procedure applies to aircraft with -926 AFMC or greater.

Table 203

Operation			Desired Result		
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

Table 203 (Continued)

Operation			Desired Result		
(2)	Connect one end of cable stored in data loader cover to J1 of data loader and other end to data loader receptacle located in cockpit under the captain's brief case holder.		Cable connected.		
(3)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(4)	On MCDU-1, press MENU button, then press line select key (LSK) 1L next to AFMC#1 prompt.		INIT/REF INDEX 1/1 page is shown on MCDU.		
(5)	Turn on data loader power.		Data loader power light on.		
(6)	Insert BITE DOWNLOAD diskette into data loader with diskette label facing up. Wait for LOAD COMPLETE.		Diskette inserted. After approximately 10 minutes, LOAD COMPLETE is shown in data loader window.		
(7)	Press EJECT button to eject diskette.				
(8)	Turn data loader power off.		Power light off.		
(9)	Remove AFMC-1 from its mount rack and install AFMC-2 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 1)				
(10)	Repeat steps (4) through (8) for AFMC-2.				
(11)	Reinstall AFMC-2 into its mount rack and reinstall AFMC-1 in its place. (ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES, PAGEBLOCK 34-63-03/201 Config 1)				
(12)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15
(13)	Remove cable from data loader and data loader receptacle, then store in data loader cover.		Cable removed.		
(14)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 203 (Continued)

Operation			Desired Result		
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
	B10-421	FMS DATA LOADER	Upper EPC	FUEL - LEFT AC BUS	H/15

4. Power Up Operation

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

NOTE: When scratchpad messages appear, press and hold CLR pushbutton until all messages clear.

A. Power Up Transient Test

Table 204

Operation		Desired Result
(1)	Press MENU key on MCDU-1 and MCDU-2.	"MCDU MENU" is shown. Verify "SELECT DESIRED SYSTEM" appears in scratchpad.
(2)	Place FMS selector switch on overhead panel in BOTH ON 1 position.	Verify both MCDU's show AFMC #1 prompt.
(3)	Place FMS selector switch on overhead panel in BOTH ON 2 position.	Verify both MCDU's show AFMC #2 prompt.
(4)	Place FMS selector switch in NORM position.	Verify MCDU-1 shows AFMC #1 prompt and MCDU-2 shows AFMC #2 prompt.
(5)	Press LSK 1L adjacent to AFMC-1 prompt on MCDU-1 and AFMC-2 prompt on MCDU-2; "IDENT" will appear on title page of both MCDU's.	Verify IDENT page is shown on MCDU-1 and MCDU-2.

B. Maintenance Index Test

Table 205

Operation		Desired Result
(1)	Press line select key 6L adjacent to the INDEX prompt.	Verify INIT/REF index page is displayed.
(2)	Type DAC into scratchpad.	Verify DAC is entered into scratchpad.
(3)	Press line select key 6R adjacent to MAINT prompt.	Verify maintenance index page 1/1 is displayed.
(4)	Press line select key 3L adjacent to DISCRETES prompt.	Verify AFMC 1 ANALOG DISCRETE page 1/2 is displayed.
(5)	Press line select key 3L adjacent to DISCRETES prompt on MCDU-2 only.	Verify AFMC 2 ANALOG DISCRETE page 1/2 is shown on MCDU-2.
(6)	Turn auxiliary hydraulic switch (located on First Officer's main instrument panel) to ON.	Auxiliary hydraulic pump on.
(7)	Inspect AFMC-1 ANALOG DISCRETE page. Verify that display remains same as before turning on auxiliary hydraulic pump switch. Turn auxiliary hydraulic pump OFF.	Verify that display remains same and auxiliary hydraulic pump OFF.

Table 205 (Continued)

Operation					Desired Result
(8)	Turn auxiliary hydraulic pump switch (located on First Officer's main instrument panel) to ON.				Auxiliary hydraulic pump on.
(9)	Inspect AFMC-2 ANALOG DISCRETE page. Verify that display remains same as before turning on auxiliary hydraulic pump switch. Turn auxiliary hydraulic pump OFF.				Verify that display remains same and auxiliary hydraulic pump OFF.
(10)	Press line select key 6L adjacent to INDEX prompt.				Verify MAINTENANCE INDEX page is displayed.
(11)	Press line select key 1R adjacent to PERF FACTORS prompt.				Verify PERF FACTORS page is displayed.
(12)	Enter ARM into scratchpad and press line select key 6R.				Verify ARM is displayed next to line select key 6R.
(13)	On MCDU-1, enter 3 into scratchpad, then press line select key 2L.				Verify 3.0 displayed next to line select key 2L on both MCDU's.
(14)	On MCDU-2, enter 0 into scratchpad, then press line select key 2L.				Verify 0.0 displayed next to line select key 2L on both MCDU's.
(15)	On MCDU-1 enter -3.5 into scratchpad, then press line select key 3L.				Verify -3.5 displayed next to line select key 3L on both MCDU's.
(16)	On MCDU-2, enter 1.3 into scratchpad, then press line select key 4L.				Verify 1.3 displayed next to line select key 4L on both MCDU's.
(17)	On MCDU-1, enter 2 into scratchpad, then press line select key 5L.				Verify 2 displayed next to line select key 5L on both MCDU's.
(18)	Press line select key 6L adjacent to INDEX prompt.				Verify MAINTENANCE INDEX page is displayed on MCDU's.
(19)	Open and close the circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC	Upper EPC	RIGHT RADIO AC BUS	F/9
			Verify MCDU-2 shows "TIMEOUT". Verify MCDU-1 shows "SINGLE AFMC OPERATION" then "RESYNCING OTHER AFMC".		
(20)	Press MENU key on MCDU-2, then press LSK 1L adjacent to AFMC-2 prompt on MCDU-2.				After resyncing is complete, verify MCDU-2 shows same page as MCDU-1.
(21)	Open and close the circuit breaker:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC	Upper EPC	LEFT RADIO AC BUS	D/21
			Verify MCDU-1 shows "TIMEOUT". Verify MCDU-2 shows "SINGLE AFMC OPERATION" then "RESYNCING OTHER AFMC".		
(22)	Press MENU key on MCDU-1, then press LSK 1L adjacent to AFMC-1 prompt on MCDU-1.				After resyncing is complete, verify MCDU-1 shows same page as MCDU-2.

Table 205 (Continued)

Operation		Desired Result
(23)	Press line select key 6L adjacent to INDEX prompt.	Verify MAINTENANCE INDEX page is shown on MCDU's.

C. AFMC-1 Analog Discretes Test

Table 206

Operation			Desired Result		
(1)	Press line select key 3L adjacent to DISCRETES prompt on MCDU-1.		Verify AFMC-1 ANALOG DISCRETES page 1/2 is displayed on MCDU-1.		
(2)	Press line select key 3L adjacent to DISCRETES prompt on MCDU-2.		Verify ANALOG DISCRETES Page 1/2 shows on MCDU-2.		
(3)	Check A/C PACK LEFT and RIGHT status.		Verify OFF OFF displayed.		
(4)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
			After ten seconds, check A/C pack LEFT and RIGHT status and verify ON OFF is displayed.		
(5)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			After ten seconds, check A/C LEFT and RIGHT status and verify ON ON is displayed.		
(6)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-335	AIR CONDITION REGULATOR VALVE LEFT	Overhead	EMERGENCY DC BUS	B/13
	B1-336	AIR CONDITION REGULATOR VALVE RIGHT	Overhead	EMERGENCY DC BUS	B/14
	B1-189	AIR CONDITION FLOW CONTROL VALVE LEFT	Overhead	EMERGENCY DC BUS	C/13
	B1-190	AIR CONDITION FLOW CONTROL VALVE RIGHT	Overhead	EMERGENCY DC BUS	C/14
			Check A/C PACK LEFT and RIGHT status and verify OFF OFF is displayed.		

Table 206 (Continued)

Operation			Desired Result		
(7)	Place crossfeed valve LEFT and RIGHT on aft pedestal in CLOSED position.		Verify closed CL CL is displayed.		
(8)	Place LEFT and RIGHT crossfeed valve on pedestal to OPEN position.		Verify open OP OP is displayed.		
(9)	Place LEFT and RIGHT crossfeed valve back to CLOSED position.		Verify closed CL CL is displayed.		
(10)	Check engine ANTI-ICE LEFT and RIGHT status.		Verify OFF OFF is displayed.		
(11)	Place LEFT and RIGHT engine ANTI-ICE to ON position.		Verify ON ON is displayed.		
(12)	Place LEFT and RIGHT engine ANTI-ICE switch to OFF position.		LEFT and RIGHT engine ANTI ICE switch to OFF.		
(13)	Verify air foil ice protection switch to OFF position.		Verify OFF is displayed.		
(14)	Make sure the circuit breakers that follow are closed:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-222	L SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION LEFT DC BUS	M/22
	B1-221	R SUPPLY AIR TEMP & PRESS HIGH CAUTION	Lower EPC	ICE PROTECTION RIGHT DC BUS	N/22
	B1-251	L SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	U/26
	B1-252	R SUPPLY AIR TEMP HIGH CAUTION	Lower EPC	DC AIR CONDITIONING & MISCELLANEOUS	W/26
(15)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(16)	Place AIRFOIL ANTI-ICE switches to ON position; place CROSSFEED VALVE LEFT & RIGHT in OPEN position.		Breakers and valves open; check air foil anti-ice protection status and verify ON is displayed on MCDU.		
(17)	Close left and right crossfeed valves.		Valves closed.		
(18)	Place AIRFOIL ANTI-ICE switches to OFF position.		Check air foil anti-ice protection status and verify OFF is displayed on MCDU.		
(19)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33

Table 206 (Continued)

Operation			Desired Result		
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
			Check WOW switch status and verify GND is displayed on MCDU.		
(20)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify FLT is displayed on		
(21)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-827	LEFT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/39
	B1-828	RIGHT PROXIMITY SWITCH CONTROL	Lower EPC	MISCELLANEOUS RIGHT DC BUS	R/39
			Check WOW switch status and verify GND is displayed on MCDU.		
(22)	Check MAG/TRUE STATUS.		Verify MAG is displayed on MCDU.		
(23)	On Capt's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		
(24)	On F/O's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		
(25)	On F/O's instrument panel, press MAG/TRUE switch.		Verify TRUE is displayed on MCDU.		
(26)	On Capt's instrument panel, press MAG/TRUE switch.		Verify MAG is displayed on MCDU.		
(27)	Press NEXT page button on MCDU-1.		Verify AFMC-1 ANALOG DISCRETE page 2/2 is shown.		
(28)	Press NEXT page button on MCDU-2.		Verify AFMC-2 ANALOG DISCRETE page 2/2 is shown.		
(29)	Check CAA FLT RULES status.		Verify DISABLE is displayed.		
(30)	Check KILOGRAM OPTION status.		Verify ENABLE is displayed.		
(31)	Check offside MCDU ENABLE status.		Verify ENABLE is displayed.		
(32)	Check SRCE/DEST IDENT status.		Verify 1 is displayed.		
(33)	Check LANDING GEAR status.		Verify DOWN is displayed.		
(34)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26

Table 206 (Continued)

Operation			Desired Result		
			Verify UP is displayed.		
(35)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-187	LANDING GEAR WARNING	Lower EPC	MISCELLANEOUS LEFT DC BUS	P/26
			Verify DOWN is displayed.		
(36)	Inspect MCDU SRCE SEL status.		Verify NORM is shown.		
(37)	Place FMS selector switch in BOTH ON 1 position.		Verify BOTH 1 is shown on MCDU-1 and MCDU-2.		
(38)	Place FMS selector switch in BOTH ON 2 position.		Verify BOTH 2 is shown on MCDU-1 and MCDU-2.		
(39)	Place FMS selector switch in NORM position.				
(40)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

D. AFMC-1 Data Status Test

NOTE: Each sensor input is displayed under the LRU heading. The status of the 1, 3 and 2 sensors (where applicable) are also displayed under subtitles. 3 should display dashes if no center LRU exists. A typical example for all three fields would be: FAIL --- OK.

Table 207

Operation			Desired Result		
(1)	Verify that MAINTENANCE INDEX page is displayed.		MAINTENANCE INDEX page displayed.		
(2)	Press line select key 2L adjacent to DATA STAT prompt on MCDU-1 and MCDU-2.		Verify AFMC-1 DATA STATUS page 1/2 is displayed and AFMC-2 DATA STATUS page 1/2 is shown.		
(3)	Set up TIC 30B signal generator and tune TIC 30B generator (or equivalent), VHF NAV-1 and VHF NAV-2 to 108.0 MHz.		Generator, VHF NAV-1 and VHF NAV-2 control panels tuned to 108.0 MHz.		
(4)	Check VOR-1 and VOR- 2 status on MCDU.		Verify OK or TEST is displayed on MCDU.		
(5)	On EFIS control panel located outboard to briefcase lights, select ROSE mode.		ROSE mode selected.		
(6)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
	Check VOR-1 and VOR-2 status on MCDU.		Verify FAIL --- OK displayed on MCDU.		
(7)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 (Continued)

Operation			Desired Result		
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(8)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check VOR-1 and VOR-2 status and verify OK or TEST is displayed.		
(9)	Check DME-1 and DME-2 status.		Verify OK or TEST is displayed.		
(10)	Check RDMI DME windows.		Verify dashes or numbers in DME windows.		
(11)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Check DME-1 and DME-2 status and verify FAIL --- OK is displayed.		
(12)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
			Verify FAIL --- FAIL is displayed.		
(13)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-39	DME -2	Upper EPC	RIGHT RADIO AC BUS	D/2
	B10-37	DME -1	Upper EPC	LEFT RADIO AC BUS	D/14
			Verify OK or TEST is displayed.		
(14)	Tune TIC 30B generator or equivalent to 108.10; tune VHF-1 and VHF-2 to 108.10.		TIC generator, VHF-1 and VHF-2 tuned to 108.10.		
(15)	Check ILS-1 and ILS-2 status.		Verify OK or TEST is displayed on MCDU.		
(16)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL

Table 207 (Continued)

Operation			Desired Result		
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Check ILS-1 and ILS-2 status and verify FAIL --- OK displayed.		
(17)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
			Verify FAIL --- FAIL is displayed.		
(18)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-78	VHF NAV -2	Upper EPC	RIGHT RADIO BUS	B/5
	B10-24	VHF NAV -2	Upper EPC	RIGHT RADIO DC BUS	G/7
	B10-77	VHF NAV -1 28 VAC	Overhead	EMERGENCY AC BUS	A/4
	B10-22	VHF NAV -1	Overhead	EMERGENCY DC BUS	B/9
			Verify TEST or OK is displayed.		
(19)	Remove TIC 30B generator.		Generator removed.		
(20)	Check CADC-1 and CADC-2 status.		Verify OK --- OK is displayed.		
(21)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Verify FAIL --- OK is displayed.		
(22)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12
			Verify FAIL --- FAIL is displayed.		
(23)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-317	AIR DATA CMPTR-2	Upper EPC	RIGHT RADIO AC BUS	F/12

Table 207 (Continued)

Operation			Desired Result		
	B10-316	AIR DATA CMPTR-1	Overhead	EMERGENCY AC BUS	C/1
			Verify OK --- OK is displayed.		
(24)	On IRS mode select panels, place IRS-1 and -2 switches to OFF; check IRS-1 and IRS-2 status.		Verify FAIL --- FAIL is displayed.		
(25)	Check platform status.		Verify FAIL --- FAIL is displayed.		
(26)	Place IRS-1 mode select switch to NAV.				
(27)	On MCDU-2, press LSK 6L, LSK 6L, and LSK 2L. Leave MCDU-1 on DATA STATUS page.		Verify POS INIT page is displayed.		
(28)	Enter local station code, then press LSK 2L.		Verify local station position displayed.		
(29)	Press LSK 2R (position to scratchpad), then LSK 4R (scratchpad to set position).		Verify present position is displayed in 4R.		
(30)	On IRS-1 mode select panel, wait for ALIGN light to go out (approx. 2-10 minutes).		ALIGN light goes out.		
(31)	Check platform status.		Verify OK --- FAIL is displayed.		
(32)	Place IRS-2 mode select switch to NAV; repeat steps (29) and (30) on MCDU-2.		ALIGN light goes out.		
(33)	Check platform status.		Verify OK --- OK is displayed.		
(34)	On MCDU-2, press LSK 6L, type DAC into scratchpad and press LSK 6R. Press LSK 2L.		Verify AFMC-2 DATA STATUS page is displayed.		
(35)	Select T.O. mode on Thrust Rating Panel (TRP); select autopilot side 2.		T.O. mode and autopilot side 2 selected.		
(36)	Check DFGC-1, DFGC-2 and platform status.		Verify OK --- OK is displayed.		
(37)	Check platform status.		Verify OK --- OK is displayed.		
(38)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	Check DFGC-1 and DFGC-2 status.		Verify FAIL --- OK is displayed.		
(39)	On MCDU-1, press NEXT PAGE pushbutton.		Verify AFMC-1 DATA STATUS page 2/2.		
(40)	On MCDU-2, press NEXT PAGE pushbutton.		Verify AFMC-2 DATA STATUS page 2/2.		

Table 207 (Continued)

Operation			Desired Result		
(41)	Check DFGS-BUS status.		Verify FAIL --- OK is displayed.		
(42)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify FAIL --- FAIL is displayed.		
(43)	On MCDU-1, press PREVIOUS PAGE pushbutton.		Verify AFMC-1 DATA STATUS page 1/2 is displayed.		
(44)	On MCDU-2, press PREVIOUS PAGE pushbutton.		Verify AFMC-2 DATA STATUS page 1/2 is shown.		
(45)	Check platform status and verify FAIL --- FAIL is displayed.		FAIL --- FAIL is displayed.		
(46)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20

Table 207 (Continued)

Operation			Desired Result		
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(47)	Check platform status.		Verify OK --- OK is displayed.		
(48)	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(49)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
			Verify FAIL --- OK is displayed.		
(50)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
			Verify FAIL --- FAIL is displayed.		
(51)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-75	LEFT FUEL FLOW	Upper EPC	ENGINE - LEFT AC BUS	K/27
	B1-76	RIGHT FUEL FLOW	Upper EPC	ENGINE - RIGHT AC BUS	L/27
	Check fuel flow left and right status.		Verify OK --- OK is displayed.		
(52)	Check fuel quantity status and verify dashes are displayed.		Dashes are displayed.		
(53)	Check clock-1 status.		Verify OK or TEST is displayed.		
(54)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17
			Verify FAIL --- --- is displayed.		
(55)	Set GMT knob on captain's and first officer's to F.S. position.		GMT knob set to F.S. position.		
(56)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-911	ELECTRONIC CLOCKS	Lower EPC	ENGINE - LEFT DC BUS	S/38
	B1-913	ELECTRONIC CLOCK	Overhead	BATT DIR BUS	B/17

Table 207 (Continued)

Operation			Desired Result		
			Verify OK or TEST is displayed.		
(57)	On MCDU-1, press next page button.		Verify AFMC 1 DATA STATUS page 2/2 is displayed.		
(58)	On MCDU-2, press next page button.		Verify AFMC 2 DATA STATUS page 2/2 is shown.		
(59)	Check EFIS-1 and EFIS-2 status.		Verify OK or TEST is displayed.		
(60)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify FAIL --- OK is displayed.		
(61)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
			Verify FAIL --- FAIL is displayed.		
(62)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-413	SYMBOL GEN -2 POWER	Upper EPC	RIGHT RADIO AC BUS	F/4
	B10-412	SYMBOL GENERATOR-1 POWER	Overhead	EMERGENCY AC BUS	C/3
			Verify OK or TEST is displayed.		
(63)	Check AFMC 1 and 2 status.		Verify OK --- --- is displayed.		
(64)	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(65)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS status on opposite MCDU.		Verify FAIL --- OK is displayed.		
(66)	Open the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10
			Verify both MCDUs are blanked.		
(67)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU	Upper EPC	RIGHT RADIO AC BUS	F/10

Table 207 (Continued)

Operation			Desired Result		
	Check FMS-BUS status.		Verify FAIL --- OK is displayed.		
(68)	Close the circuit breaker that follows:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU	Upper EPC	LEFT RADIO AC BUS	D/22
	Check FMS-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(69)	Check I-BUS-1 1 and 2 status.		Verify dashes are displayed.		
(70)	Check DFGC-BUS 1 and 2 status.		Verify OK --- OK is displayed.		
(71)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- FAIL is displayed.		
(72)	Open the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
			Verify FAIL --- FAIL is displayed.		
(73)	Close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B10-360	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO BUS	C/1

Table 207 (Continued)

Operation			Desired Result		
	B10-362	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO BUS	C/2
	B10-361	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO BUS	C/10
	B10-363	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO BUS	C/11
	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO AC BUS	D/8
	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO AC BUS	D/20
	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	RIGHT RADIO DC BUS	E/8
	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	RIGHT RADIO DC BUS	E/9
	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1	Upper EPC	LEFT RADIO DC BUS	E/20
	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2	Upper EPC	LEFT RADIO DC BUS	E/21
			Verify OK --- OK is displayed.		
(74)	On MCDU, press line select key 6L adjacent to INDEX prompt.		Verify MAINTENANCE INDEX page is displayed.		

5. System Service Test

NOTE: Unless otherwise indicated, the following steps can be performed on MCDU-1 or MCDU-2. Verify responses on both MCDU's.

A. EFIS Map and Plan Mode Test

Table 208

Operation		Desired Result
(1)	On MCDU, press ROUTE function key.	RTE pressed.
(2)	On EFIS control panel, select MAP mode, then set range 160 nautical miles.	Verify MAP selected and 160 NM displayed.
(3)	Enter company route number in line 2L. Press ACTIVATE button, then EXEC button.	On EFIS ND, verify a route is displayed.
(4)	On EFIS control panel, select PLAN mode.	Verify PLAN mode is being displayed on EFIS NAV display.

B. Annunciator/Digital Lights Test

Table 209

Operation		Desired Result
(1)	On overhead console, press and hold ANNUNCIATOR/DIGITAL LIGHTS test button and observe MCDU.	Verify that annunciators and exec keys are brightly lit.
(2)	On overhead console, pull out PULL TO DIM knob.	Verify that annunciators and exec keys dim.
(3)	Release ANNUNCIATOR/DIGITAL LIGHTS test button, then turn pedestal panel lighting knob to right.	Observe that MCDU and instrument lights increased in brightness.
(4)	Turn pedestal panel lighting knob back to original position.	Verify that MCDU and instrument lights dim.

C. Auto Brightness Test of Display Units

NOTE: This test is performed to verify that the automatic light sensors will provide brightness boost to the multipurpose control display units (MCDUs) in high intensity light circumstances.

Table 210

Operation		Desired Result
(1)	Shine a flashlight on each of EFIS photocells.	Verify MCDUs increase in brightness.

D. Test Termination

(1) Remove test equipment and return aircraft to required configuration.

PERFORMANCE MANAGEMENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. The Performance Management System (PMS) operates as a fully selectable mode of the digital flight guidance system. PMS provides automatic control and coordination of pitch and thrust during climb, cruise, and descent phases of flight, and also provides an advisory display of numerous flight parameters, on a full time real time basis.

B. PMS consists of a Performance Management Control Display Unit (CDU), Performance Management Computer Unit (PCU), CDU MESSAGE annunciator, and VERTICAL ALERT annunciator.

C. Primary interfacing units are VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, digital flight guidance computers 1 & 2, R/H & L/H engine fuel flow indicators, and the landing gear control lever relay.

2. Service Tests

A. Test CDU Lamps

Table 201

Operation		Desired Result
(1)	On CDU, rotate DIM knob fully clockwise.	DIM knob rotated.
(2)	On Flight Guidance Control Panel, set altitude preselect to 10000.	Altitude preselect set.
NOTE: Flicker of display in step (3) is normal.		
(3)	On CDU, press and hold STS/TEST key.	On the CDU, all LEDs; Line Select Keys 1, 2, and 3; CLB, CRZ, and DES mode annunciators; and PMS annunciator come on.
(4)	Release STS/TEST key.	STS page displayed on CDU. Line Select Keys 1, 2, and 3; CRZ and DES mode annunciators; and PMS annunciator goes off.

B. Service Test

Table 202

Operation		Desired Result
(1)	On CDU, momentarily press STS/TEST key. ZZZ denotes PMS program.	STS page displayed on CDU. Top display line displays appropriate aircraft and engine type. Data line 2 displays PROGRAM P/N-ZZZ
(2)	Momentarily press Line Select Key 1 (FAULT STATUS ?).	FAULT STATUS page displayed on CDU.
(3)	Review faults listed on CDU (if any) and clear faults by normal maintenance action.	Faults cleared.
(4)	Momentarily press STS/TEST key.	STS page displayed on CDU.
(5)	Momentarily press Line Select Key 3 (TESTS ?).	TESTS page displayed on CDU.
(6)	Momentarily press Line Select Key 3 (SERVICE TEST ?).	SERVICE TEST page displayed on CDU.

Table 202 (Continued)

Operation		Desired Result
NOTE: The PMS Service Test verifies the interfaces with other aircraft systems. Generally, failures in the Service Test are caused by aircraft systems not transmitting or receiving data from the PMS. Check the interfacing aircraft system for normal operation before suspecting the PMS. A steady amber PMS warn light is the only positive indication of a PMS Computer Unit failure.		
(7)	Respond appropriately to each requested action on SERVICE TEST list, displayed on CDU. Following response to each request, momentarily press Line Select Key 2 (to verify response).	All requested actions responded to and verified. Following selection of PERF on FGCP, FMAs, on captain's and first officer's instrument panels, display PERF CLB in throttle and pitch windows. Observe ADI/PFD Fast/Slow indicator shows 1 dot (±1/4) dot fast. Following completion of last step on SERVICE TEST list, FAULT/FAIL RECAP page is displayed on CDU, with message NO FAULTS/FAILS.
(8)	If it is necessary to rerun SERVICE TEST, momentarily press STS/TEST key and repeat steps (6) and (7).	

3. Supplementary Tests

A. Test Anti-Ice Temp Low

Table 203

Operation			Desired Result		
CAUTION: OPENING THE GROUND CONTROL RELAY CIRCUIT BREAKERS WILL STOP EQUIPMENT COOLING AIRFLOW. THE FOLLOWING TEST MUST BE COMPLETED AS QUICKLY AS POSSIBLE.					
(1)	Open and tag the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33
(2)	On CDU, momentarily press STS/TEST key.		STS page is displayed on CDU.		
(3)	Momentarily press Line Select Key 3 (TESTS ?).		TESTS page displayed on CDU.		
(4)	Momentarily press Line Select Key 1 (INPUT DATA ?).		INPUT DATA page displayed on CDU.		
(5)	On overhead panel, verify L SYS and R SYS AIRFOIL ice protection switches are in OFF position.		Airfoil ice protection off.		
NOTE: Some aircraft have a single AIRFOIL ice protection switch.					
(6)	On CDU, use slew switch (or slew keys) to obtain display of ICE PROT TEMP.		ICE PROT TEMP reads NORM NORM.		
(7)	Place L SYS AIRFOIL ice protection switch to ON position.		Left airfoil ice protection on CDU displays LOW NORM.		
NOTE: On aircraft with single AIRFOIL ice protection switch, CDU will display LOW LOW when switch is ON.					

Table 203 (Continued)

Operation			Desired Result		
(8)	Place R SYS AIRFOIL ice protection switch to ON position.		Right airfoil ice protection on CDU displays LOW LOW.		
(9)	Place L SYS and R SYS AIRFOIL ice protection switches to OFF position.		Airfoil ice protection off.		
(10)	Remove tags and close the circuit breakers that follow:				
	REF DES	CIRCUIT BREAKER	LOCATION	PANEL AREA	ROW/COL
	B1-23	LEFT GROUND CONTROL RELAY	Upper EPC	L AC BUS	K/33
	B1-24	RIGHT GROUND CONTROL RELAY	Upper EPC	R AC BUS	L/33

B. Test PMS Annunciators

Table 204

OPERATION		DESIRED RESULTS
(1)	On overhead panel, press and hold ANNUN/DIGITAL LTS TEST switch.	On captain's and first officer's instrument panels, VERTICAL ALERT and CDU MESSAGE annunciators come on.
(2)	Release test switch.	VERTICAL ALERT and CDU MESSAGE annunciators go off.

PERFORMANCE MANAGEMENT CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Performance Management Control Display Unit (CDU), mounted on the pedestal, and approved repairs of the CDU. The CDU provides the flight crew with the necessary controls, indicators, and display for the operation of the performance management system. The CDU receives manual inputs from the flight crew and automatic digital and discrete inputs from the performance management computer unit.

B. Approved repairs consist of replacement of CDU lamps and caps. These repairs can be accomplished on the airplane, without removal of the CDU.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
Lens cap and lamp replacement tool 7892088-011	Delco Electronics

3. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove CDU (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(2) On flight compartment pedestal, turn mounting fasteners counterclockwise approximately 1/4 turn until CDU is loose.

(3) Carefully lift CDU out, and disconnect and cap wire harness connector.

B. Install CDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(2) Remove cap from wire harness connector and connect to CDU.

(3) Carefully insert CDU into cavity and rotate mounting fasteners until secure.

(4) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(5) Return airplane to required configuration.

4. Approved Repairs

A. Removal/Installation Line Select Cap

(1) Removal/Installation Line Select Cap

(a) To remove cap, pull cap from switch base using fingertips.

NOTE: The lamp will not be extracted when the cap is removed. The lamp must be centered on the switch base before the cap can be installed.

(b) To install cap, carefully install cap over lamp and press cap to seat both cap and lamp on switch base.

(2) Removal/Installation Key Cap

(a) To remove cap from any key switch, place tangs of special tool into grooves on sides of cap and pull cap from key switch. (Figure 202)

(b) To install cap, place cap over key switch, being sure that placarding is right side up, and press it onto the key switch.

(3) Removal/Installation Line Select Lamp

(a) Remove line select cap as described in Paragraph 4.A.(1)(a).

(b) Use barrel end of special tool to remove lamp from front panel recess. (Figure 202)

(c) Insert replacement lamp in front panel recess so that it is centered on the switch base. Use special tool for insertion and positioning.

(d) Install cap as described in Paragraph 4.A.(1)(b).

(4) Removal/Installation Key Lamp

(a) Remove key cap as described in Paragraph 4.A.(2)(a).

(b) Use barrel end of special tool to grasp and pull lamp from key switch. (Figure 202)

(c) Grasp replacement lamp at junction between glass and plastic base with the special tool and carefully insert lamp leads into their sockets in the key switch.

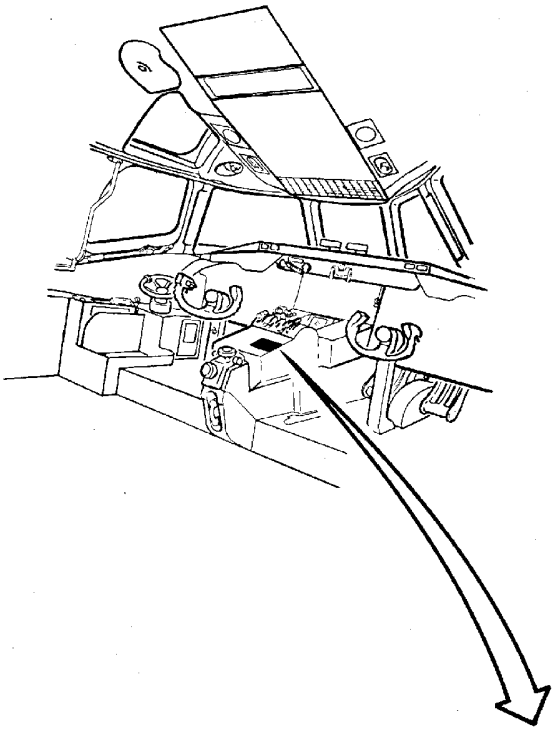
(d) Install key cap as described in Paragraph 4.A.(2)(b).

5. Test CDU

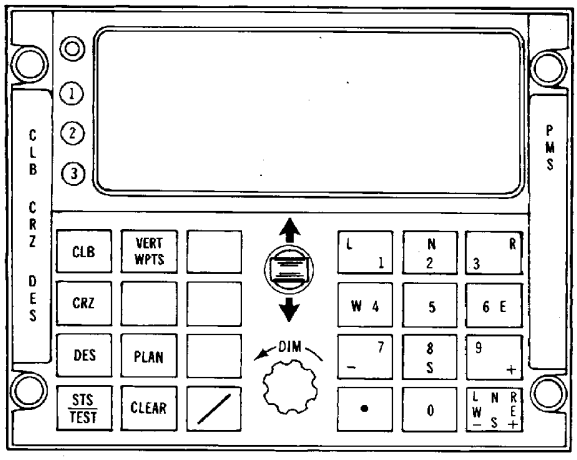
A. Test CDU Lamps

Table 202

Operation		Desired Results
(1)	On CDU, rotate DIM knob fully clockwise.	DIM knob rotated.
(2)	On CDU, press and hold STS/TEST key.	On CDU, all LEDs; Line Select Keys 1, 2, and 3; CLB, CRZ, and DES mode annunciators; and PMS annunciator come on.
NOTE: Flicker of display in step (2) is normal.		
(3)	Release STS/TEST key.	STS page displayed on CDU. Line Select Keys 1, 2, and 3; CRZ and DES mode annunciators; and PMS annunciator goes off.
NOTE: If necessary, refer to PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201, for complete system test.		
(4)	Return airplane to required configuration.	



PMS CONTROL DISPLAY UNIT



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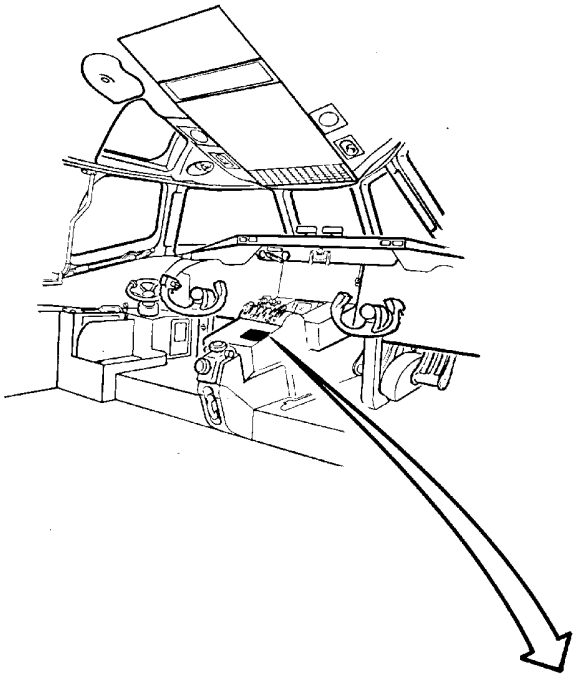
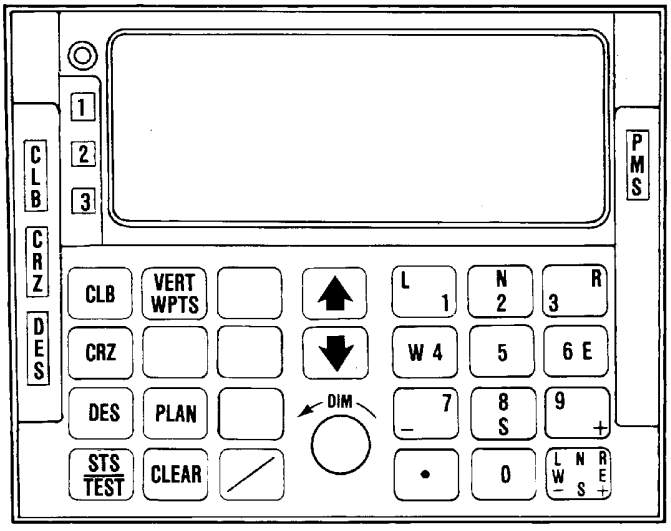
CDU -- Removal/Installation
Figure 201/34-63-01-990-801 (Sheet 1 of 2)



PMS CONTROL DISPLAY UNIT



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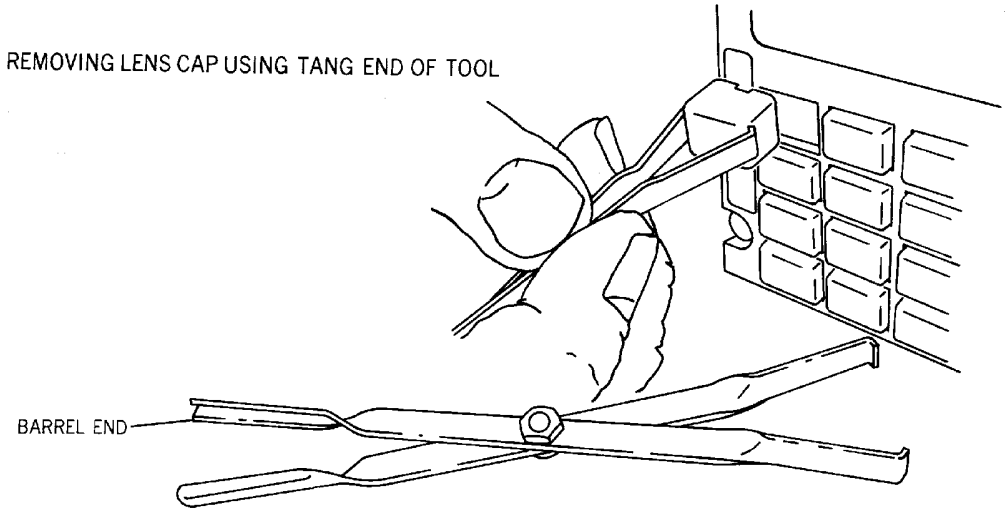
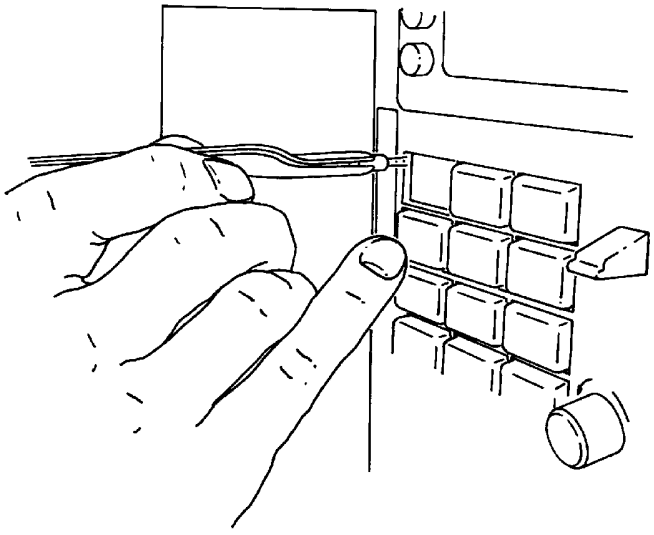
CDU -- Removal/Installation
Figure 201/34-63-01-990-801 (Sheet 2 of 2)



BULB ASSEMBLY AND REMOVAL TOOL
P/N 7892088-011



INSTALLING OR REMOVING LAMP
USING BARREL END OF TOOL

BBB2-34-576

CDU Lens Cap and Lamp -- Removal/Installation
Figure 202/34-63-01-990-802

PERFORMANCE MANAGEMENT CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Performance Management Control Display Unit (CDU), mounted on the pedestal, and approved repairs of the CDU. The CDU provides the flight crew with the necessary controls, indicators, and display for the operation of the performance management system. The CDU receives manual inputs from the flight crew and automatic digital and discrete inputs from the performance management computer unit.

B. Approved repairs consist of replacement of CDU lamps and caps. These repairs can be accomplished on the airplane, without removal of the CDU.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items.

Table 201

Name and Number	Manufacturer
Lens cap and lamp replacement tool 792088-011	Delco Electronics

3. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove CDU (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(2) On flight compartment pedestal, turn mounting fasteners counterclockwise approximately 1/4 turn until CDU is loose.

(3) Carefully lift CDU out, and disconnect and cap wire harness connector.

B. Install CDU (Figure 201)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(2) Remove cap from wire harness connector and connect to CDU.

(3) Carefully insert CDU into cavity and rotate mounting fasteners until secure.

(4) Remove the safety tags and close these circuit breakers:

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	10	B10-390	PERF MGMT LIGHTS

(5) Return airplane to required configuration.

4. Approved Repairs

A. Removal/Installation Line Select Cap

(1) Removal/Installation Line Select Cap

(a) To remove cap, pull cap from switch base using fingertips.

NOTE: The lamp will not be extracted when the cap is removed. The lamp must be centered on the switch base before the cap can be installed.

(b) To install cap, carefully install cap over lamp and press cap to seat both cap and lamp on switch base.

(2) Removal/Installation Key Cap

(a) To remove cap from any key switch, place tangs of special tool into grooves on sides of cap and pull cap from key switch. (Figure 202)

(b) To install cap, place cap over key switch, being sure that placarding is right side up, and press it onto the key switch.

(3) Removal/Installation Line Select Lamp

(a) Remove line select cap as described in Paragraph 4.A.(1)(a).

(b) Use barrel end of special tool to remove lamp from front panel recess. (Figure 202)

(c) Insert replacement lamp in front panel recess so that it is centered on the switch base. Use special tool for insertion and positioning.

(d) Install cap as described in Paragraph 4.A.(1)(b).

(4) Removal/Installation Key Lamp

(a) Remove key cap as described in Paragraph 4.A.(2)(a).

(b) Use barrel end of special tool to grasp and pull lamp from key switch. (Figure 202))

(c) Grasp replacement lamp at junction between glass and plastic base with the special tool and carefully insert lamp leads into their sockets in the key switch.

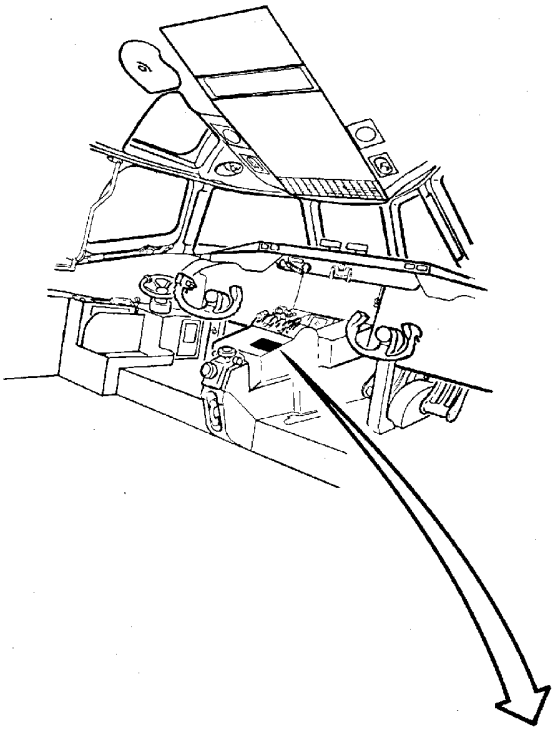
(d) Install key cap as described in Paragraph 4.A.(2)(b).

5. Test CDU

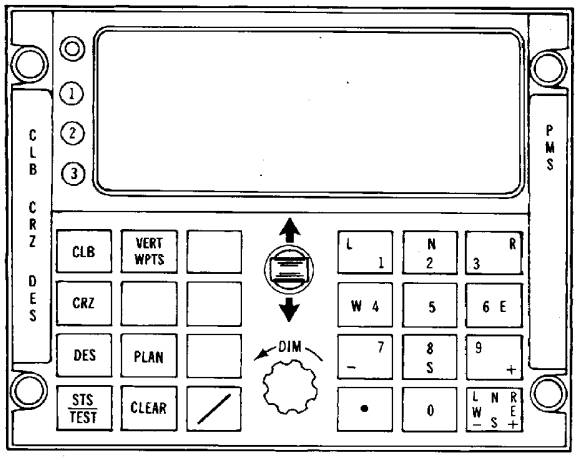
A. Test CDU Lamps

Table 202

Operation		Desired Results
(1)	On CDU rotate DIM knob fully clockwise.	DIM knob rotated.
(2)	On CDU, press and hold STS/TEST key.	On CDU, all LEDs; Line Select Keys 1, 2, and 3; CLB, CRZ, and DES mode annunciators; and PMS annunciator come on.
NOTE: Flicker of display in step (2) is normal.		
(3)	Release STS/TEST key.	STS page displayed on CDU. Line Select Keys 1, 2, and 3; CRZ and DES mode annuncia tors; and PMS annunciator goes off.
NOTE: If necessary, PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201, for complete system test.		
(4)	Return airplane to required configuration.	

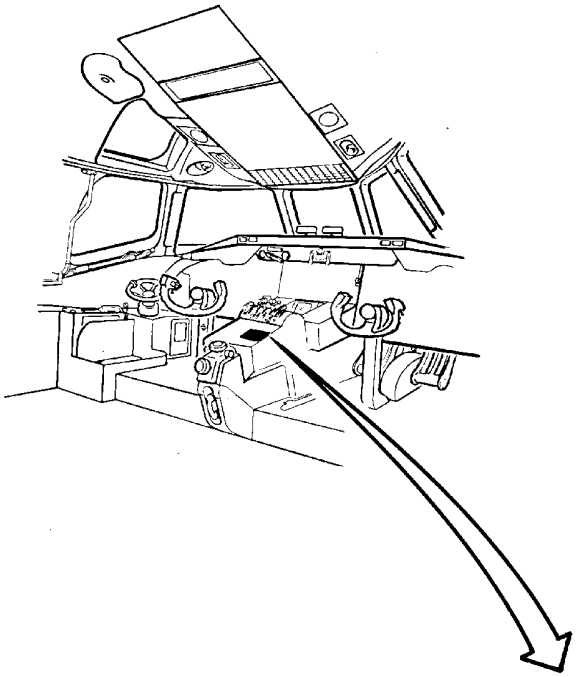


PMS CONTROL DISPLAY UNIT

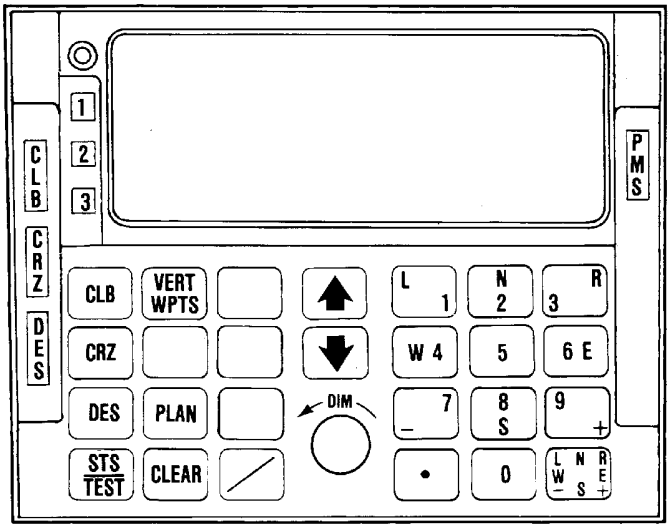


BBB2-34-426

CDU -- Removal/Installation
Figure 201/34-63-01-990-803 (Sheet 1 of 2)

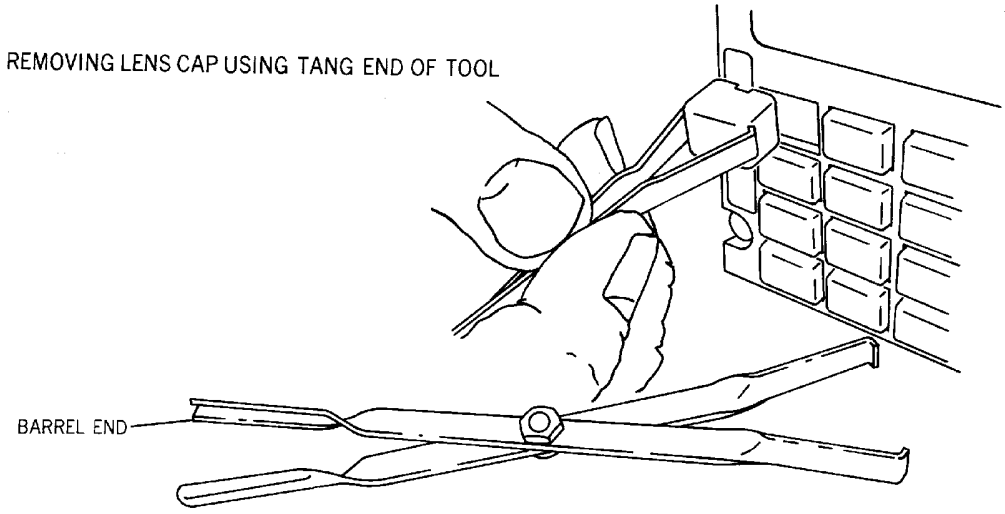


PMS CONTROL DISPLAY UNIT

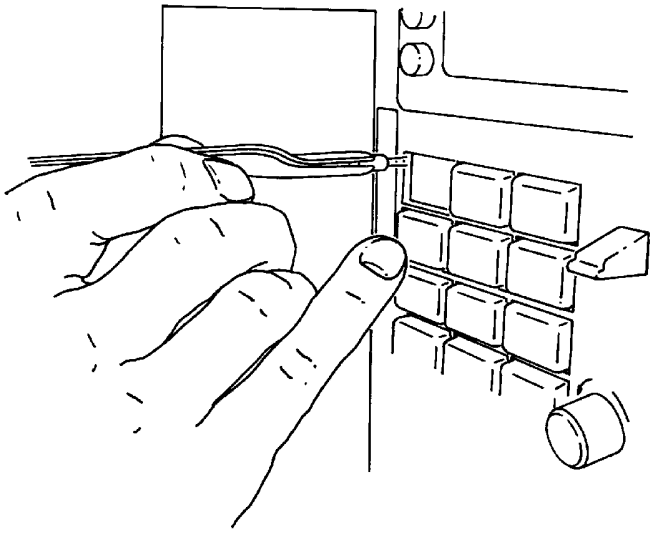


BBB2-34-1044

CDU -- Removal/Installation
Figure 201/34-63-01-990-803 (Sheet 2 of 2)



BULB ASSEMBLY AND REMOVAL TOOL
P/N 7892088-011



INSTALLING OR REMOVING LAMP
USING BARREL END OF TOOL

BBB2-34-576

CDU Lens Cap and Lamp -- Removal/Installation
Figure 202/34-63-01-990-805

PERFORMANCE MANAGEMENT COMPUTER UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Performance Management Computer Unit (PCU). The PCU is installed on the aft left radio rack in the electrical/electronics compartment. The PCU receives analog and discrete inputs from VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, digital flight guidance computers 1 & 2, R/H & L/H engine fuel flow indicators, landing gear control lever relay, and the performance management control display unit.

2. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove PCU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(2) Press release button at top of handles; pull inner portion of handles out and down to release locking pins. (Figure 201)

CAUTION: THE PCU CONTAIN ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(3) Carefully pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install PCU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Carefully slide unit straight into rack, ensuring that connectors are properly aligned, and that latch handles engage on keeper pins.

(4) Close locking handles and press firmly until securely locked in place.

NOTE: Handles should lock in place with a firm snap without excessive force. Computer should not have any looseness.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
A	4	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
B	9	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

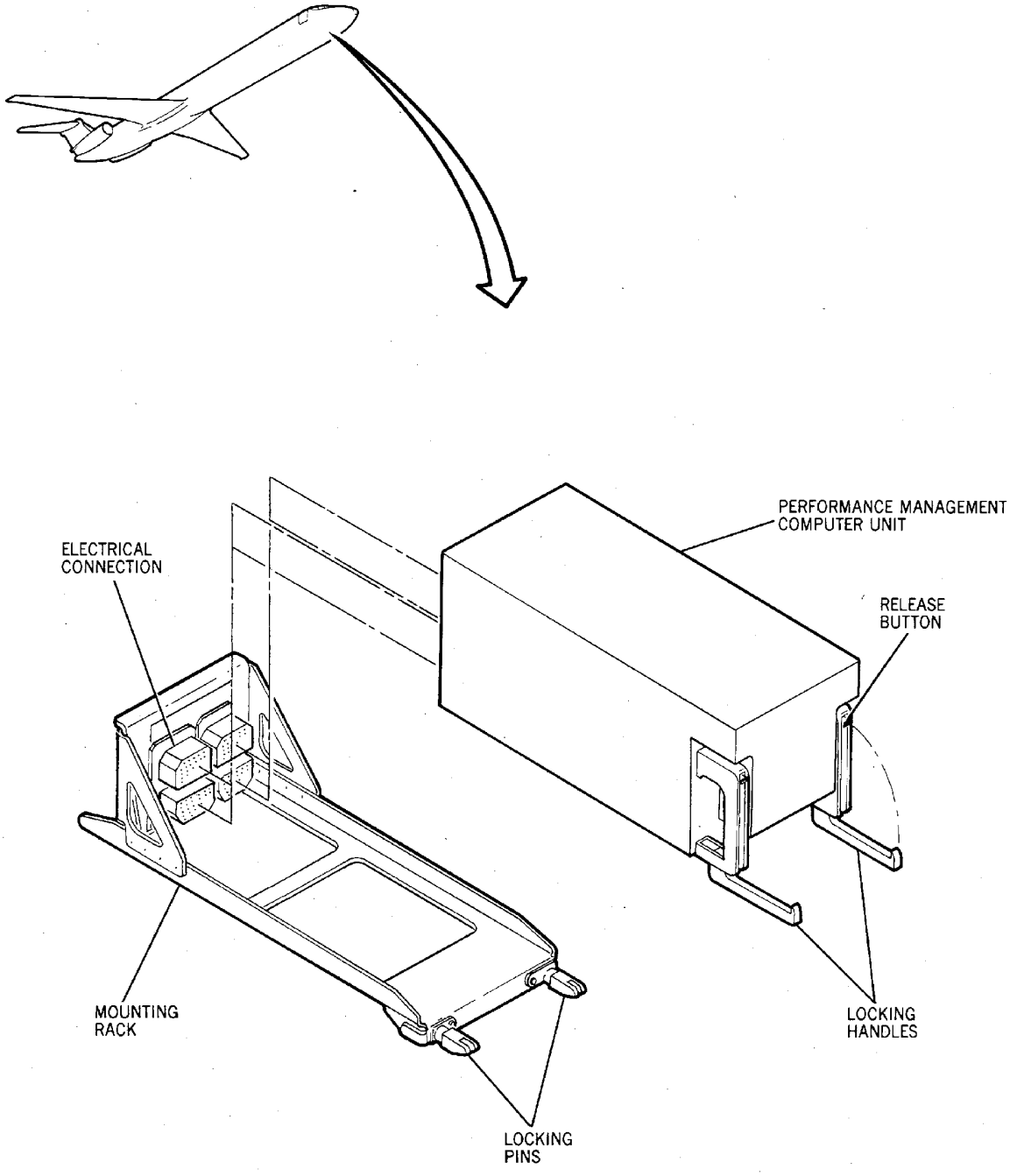
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(6) Return airplane to required configuration.

3. Test PCU

A. Perform system tests (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201)



PCU -- Removal/Installation
Figure 201/34-63-02-990-801

PERFORMANCE MANAGEMENT COMPUTER UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Performance Management Computer Unit (PCU). The PCU is installed on the aft left radio rack in the electrical/electronics compartment. The PCU receives analog and discrete inputs from VOR/ILS receivers 1 & 2, DME interrogators 1 & 2, digital flight guidance computers 1 & 2, R/H & L/H engine fuel flow indicators, landing gear control lever relay, and the performance management control display unit.

2. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove PCU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; BEFORE AVIONICS UPGRADE MODIFICATION			
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(2) Press release button at top of handles; pull inner portion of handles out and down to release locking pins. (Figure 201)

CAUTION: THE PCU CONTAIN ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(3) Carefully pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install PCU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; BEFORE AVIONICS UPGRADE MODIFICATION			
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Carefully slide unit straight into rack, ensuring that connectors are properly aligned, and that latch handles engage on keeper pins.

(4) Close locking handles and press firmly until securely locked in place.

NOTE: Handles should lock in place with a firm snap without excessive force. Computer should not have any looseness.

(5) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
A	4	B10-77	VHF NAV-1 28 VAC
WJE 410			
A	5	B10-77	VHF NAV-1 28 VAC

OVERHEAD EMERGENCY DC BUS

Row	Col	Number	Name
WJE 405-409, 411, 880, 881, 883, 884			
B	9	B10-22	VHF NAV-1
WJE 410			
B	10	B10-22	VHF NAV-1

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; BEFORE AVIONICS UPGRADE MODIFICATION			
D	14	B10-37	DME-1

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	2	B10-39	DME-2
F	10	B10-388	PERFORMANCE MGMT SYSTEM

UPPER EPC, RIGHT RADIO BUS

Row	Col	Number	Name
B	5	B10-78	VHF NAV-2

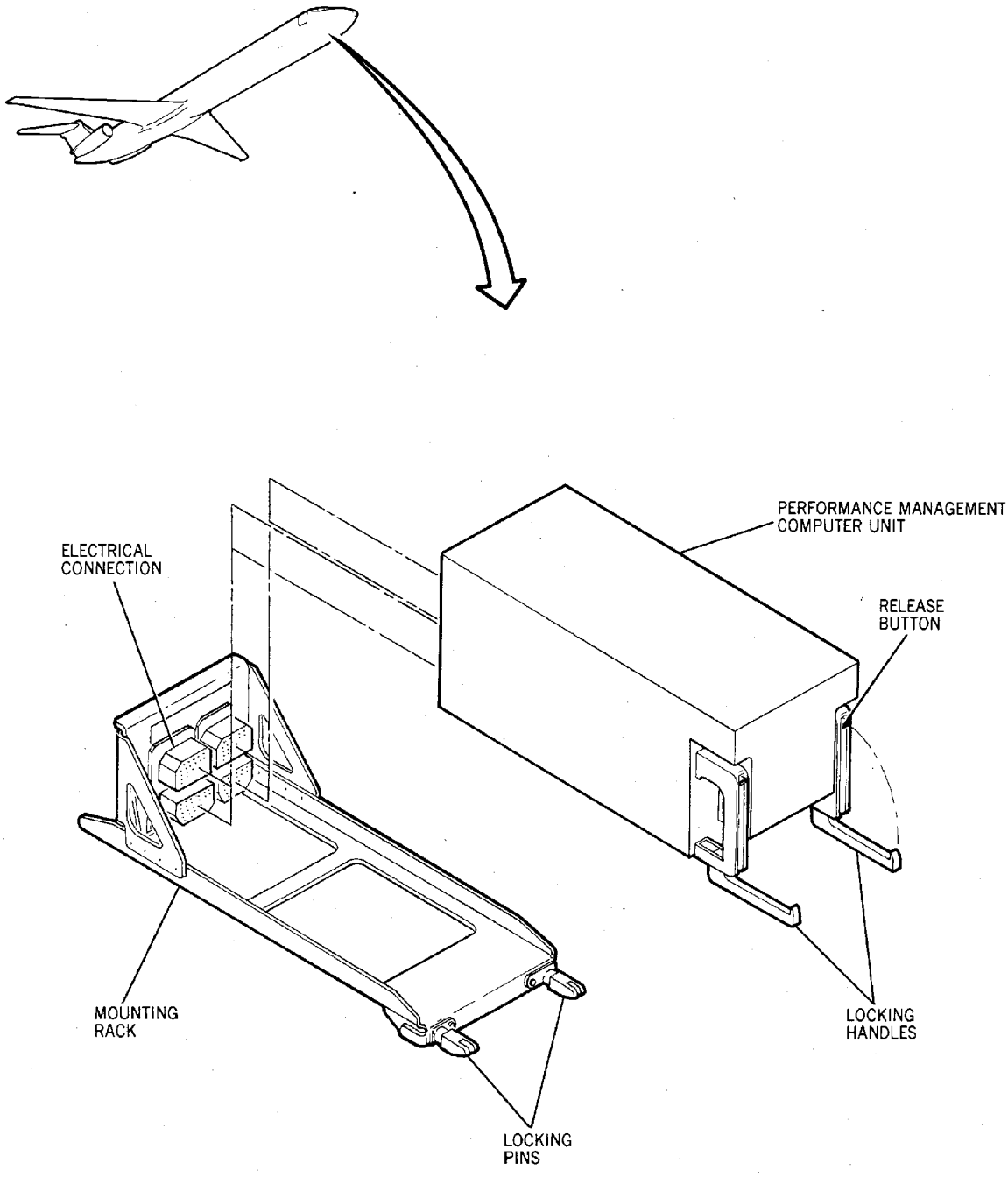
UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
G	7	B10-24	VHF NAV-2
G	10	B10-390	PERF MGMT LIGHTS

(6) Return airplane to required configuration.

3. **Test PCU**

   A. Perform system tests (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201)



PCU -- Removal/Installation
Figure 201/34-63-02-990-802

ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES

1. General

WJE 415, 418, 863, 864, 866

A. This maintenance practice provides removal/installation procedures for the Advanced Flight Management Computer (AFMC). The AFMC is located on the aft left radio rack in the electrical/electronics compartment. The AFMC receives analog and discrete inputs from VOR/ILS receivers 1 and 2, DME interrogators 1 and 2, digital flight guidance computers 1 and 2 (serial data buses), engine fuel flow indicators 1 and 2, landing gear lever control relay (discrete), VG/DG 1 and 2 and the multipurpose control display unit (MCDU).

WJE 417, 419, 421, 423, 865, 869, 871, 872, 875-879

B. This maintenance practice provides removal/installation procedures for the Advanced Flight Management Computer (AFMC). The AFMC is located on the aft left radio rack in the electrical/electronics compartment. The AFMC receives analog and discrete inputs from VOR/ILS receivers 1 and 2, DME interrogators 1 and 2, digital flight guidance computers 1 and 2 (serial data buses), engine fuel flow indicators 1 and 2, landing gear lever control relay (discrete), IRS 1 and 2 and the multipurpose control display unit (MCDU).

WJE 401-404, 412, 414

C. This maintenance practice provides removal/installation procedures for the Advanced Flight Management Computers (AFMC). The AFMC's are located on the aft left and aft right radio rack in the electrical/electronics compartment. The AFMC receives analog and discrete inputs from VOR/ILS receivers 1 and 2, DME interrogators 1 and 2, digital flight guidance computers 1 and 2 (serial data buses), engine fuel flow indicators 1 and 2, landing gear lever control relay (discrete), IRS 1 and 2 and the multipurpose control display units (MCDU).

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

2. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove AFMC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	05	B10-19	VERTICAL GYRO-1
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU
WJE 877			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 877			
F	2	B10-396	AHRS-2
WJE 415, 418, 863, 864, 866			
F	2	B10-20	VERTICAL GYRO-2
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 415, 418, 863, 864, 866			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

(2) Loosen hold-down nuts at lower front end of AFMC.

(3) Swing hold-down nuts down to clear AFMC.

CAUTION: AFMC CONTAINS ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(4) Carefully pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install AFMC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	05	B10-19	VERTICAL GYRO-1
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU
WJE 877			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 877			
F	2	B10-396	AHRS-2
WJE 415, 418, 863, 864, 866			
F	2	B10-20	VERTICAL GYRO-2

WJE 415, 418, 863, 864, 866 (Continued)

(Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 415, 418, 863, 864, 866			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Place AFMC on mounting rack and carefully push unit straight back to engage connectors.

CAUTION: DAMAGE TO CONNECTORS MAY OCCUR IF ENGAGEMENT BECOMES DIFFICULT BEFORE CONNECTORS ARE COMPLETELY ENGAGED AND EXTREME FORCE IS APPLIED. CHECK FOR FOREIGN OBJECTS, PIN ALIGNMENT, AND DAMAGE.

(4) Press AFMC home until unit connectors are completely engaged.

(5) Raise hold-down nuts, mate with AFMC hold-down lugs, and tighten securely.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 415, 418, 863, 864, 866			
B	05	B10-19	VERTICAL GYRO-1
B	6	B10-10	FIRST OFFICER'S COMPASS
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 877			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	14	B10-440	IRS-1 BATTERY
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
G	18	B10-443	IRS-1 ANN

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 877			
F	2	B10-396	AHRS-2
WJE 415, 418, 863, 864, 866			
F	2	B10-20	VERTICAL GYRO-2
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
F	4	B10-413	SYMBOL GEN -2 POWER
WJE 415, 418, 863, 864, 866			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875-879			
E	4	B10-441	IRS-2 BATTERY
WJE 401-404, 412, 414, 417, 419, 421, 423, 865, 869, 871, 872, 875, 876, 878, 879			
G	4	B10-444	IRS-2 ANN
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879			
G	12	B10-444	MACH TRIM-2

WJE 401-404, 412, 414

3. Adjustment/Test

A. Return To Service Test

(1) Return to service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.

(2) Verify SELECT DESIRED SYSTEM appears in scratchpad area of MCDU.

(3) Return aircraft to required configuration.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

4. Adjustment/Test

A. Self Test

(1) Return to service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.

(2) Verify SELECT DESIRED SYSTEM appears in scratchpad area of MCDU.

(3) Return aircraft to required configuration.

ADVANCED FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Advanced Flight Management Computers (AFMC). The AFMC's are located on the aft left and aft right radio rack in the electrical/electronics compartment. The AFMC receives analog and discrete inputs from VOR/ILS receivers 1 and 2, DME interrogators 1 and 2, digital flight guidance computers 1 and 2 (serial data buses), engine fuel flow indicators 1 and 2, landing gear lever control relay (discrete), AHRS 1 and 2 and the multipurpose control display units (MCDU).

NOTE: On aircraft equipped with JT8D-217A engines with 4052504-925 FMC's installed, install placard "VNAV NOT AUTHORIZED" on cockpit instrument panel. (FIRST OFFICER'S INSTRUMENT PANEL, SUBJECT 31-11-02, Figure 1) and (CENTER INSTRUMENT PANEL, SUBJECT 31-11-03, Figure 1).

NOTE: On aircraft with engine intermix of one JT8D-217A engine and one JT8D-217C engine with 4052504-925 FMC's installed, install placard "VNAV NOT AUTHORIZED" on cockpit instrument panel. (FIRST OFFICER'S INSTRUMENT PANEL, SUBJECT 31-11-02, Figure 1) and (CENTER INSTRUMENT PANEL, SUBJECT 31-11-03, Figure 1).

2. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove AFMC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 409, 884			
B	4	B10-412	SYMBOL GENERATOR-1 POWER
WJE 406-408			
B	5	B10-394	AHRS-1
WJE 405, 409, 880, 881, 883, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 405-408, 410, 411, 880, 881, 883			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1

(Continued)

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1
D	22	B10-424	MCDU-1
WJE 406-408			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	14	B10-496	GLOBAL POSITION SYSTEM 1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2
WJE 405, 409, 410, 880, 881, 883, 884			
F	2	B10-20	VERTICAL GYRO-2
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 405, 409, 410, 880, 881, 883, 884			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 881, 883, 884			
F	10	B10-413	SYMBOL GENERATOR-2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	4	B10-497	GLOBAL POSITION SYSTEM 2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2
B	16	B10-425	MCDU-2

(2) Loosen hold-down nuts at lower front end of AFMC.

(3) Swing hold-down nuts down to clear AFMC.

CAUTION: AFMC CONTAINS ELECTROSTATIC SENSITIVE DEVICES WHICH CAN BE DAMAGED IF ELECTRICAL CONNECTORS ARE EXPOSED TO STATIC ELECTRICITY.

(4) Carefully pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install AFMC

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open and have safety tags:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 409, 884			
B	4	B10-412	SYMBOL GENERATOR-1 POWER
WJE 406-408			
B	5	B10-394	AHRS-1
WJE 405, 409, 880, 881, 883, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 405-408, 410, 411, 880, 881, 883			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
D	21	B10-419	FMC-1
D	22	B10-424	MCDU-1
WJE 406-408			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	14	B10-496	GLOBAL POSITION SYSTEM 1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2

(Continued)

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2
WJE 405, 409, 410, 880, 881, 883, 884			
F	2	B10-20	VERTICAL GYRO-2
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 405, 409, 410, 880, 881, 883, 884			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 881, 883, 884			
F	10	B10-413	SYMBOL GENERATOR-2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	4	B10-497	GLOBAL POSITION SYSTEM 2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2
B	16	B10-425	MCDU-2

(2) Visually check unit connector plugs, and mating connectors on mounting rack for loose, broken, or dirty connector pins or wires.

(3) Place AFMC on mounting rack and carefully push unit straight back to engage connectors.

CAUTION: DAMAGE TO CONNECTORS MAY OCCUR IF ENGAGEMENT BECOMES DIFFICULT BEFORE CONNECTORS ARE COMPLETELY ENGAGED AND EXTREME FORCE IS APPLIED. CHECK FOR FOREIGN OBJECTS, PIN ALIGNMENT, AND DAMAGE.

(4) Press AFMC home until unit connectors are completely engaged.

(5) Raise hold-down nuts, mate with AFMC hold-down lugs, and tighten securely.

(6) Remove the safety tags and close these circuit breakers:

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 410, 880, 884			
B	2	B10-380	F/O COMPASS BOTH ON 2 28 VAC
WJE 409, 884			
B	4	B10-412	SYMBOL GENERATOR-1 POWER
WJE 406-408			
B	5	B10-394	AHRS-1

WJE 406-408 (Continued)

(Continued)

OVERHEAD EMERGENCY AC BUS

Row	Col	Number	Name
WJE 405, 409, 880, 881, 883, 884			
B	05	B10-19	VERTICAL GYRO-1
WJE 410			
B	06	B10-19	VERTICAL GYRO-1
WJE 406-408			
C	1	B10-398	AHRS-3
WJE 405-408, 410, 411, 880, 881, 883			
C	3	B10-412	SYMBOL GENERATOR-1 POWER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
D	20	B10-351	DIGITAL FLIGHT GUIDANCE SYSTEM-1
D	21	B10-419	FMC-1
D	22	B10-424	MCDU-1
WJE 406-408			
F	15	B10-395	AHRS-1

UPPER EPC, LEFT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	14	B10-496	GLOBAL POSITION SYSTEM 1
E	20	B10-349	DIGITAL FLIGHT GUIDANCE SYSTEM-1
E	21	B10-348	DIGITAL FLIGHT GUIDANCE SYSTEM-2

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
D	8	B10-352	DIGITAL FLIGHT GUIDANCE SYSTEM-2
WJE 406-408, 411			
F	1	B10-397	AHRS-3
F	2	B10-396	AHRS-2
WJE 405, 409, 410, 880, 881, 883, 884			
F	2	B10-20	VERTICAL GYRO-2
WJE 406-408, 411			
F	7	B10-413	SYMBOL GEN -2 POWER
WJE 405, 409, 410, 880, 881, 883, 884			
F	08	B10-9	CAPTAIN'S COMPASS
WJE 405, 409, 881, 883, 884			
F	10	B10-413	SYMBOL GENERATOR-2 POWER
WJE 410			
F	14	B10-413	SYMBOL GEN -2 POWER

WJE 410 (Continued)

UPPER EPC, RIGHT RADIO DC BUS

Row	Col	Number	Name
WJE 405-411, 880, 881, 883, 884; AFTER AVIONIC UPGRADE MODIFICATION			
E	4	B10-497	GLOBAL POSITION SYSTEM 2
E	8	B10-350	DIGITAL FLIGHT GUIDANCE SYSTEM-2
E	9	B10-347	DIGITAL FLIGHT GUIDANCE SYSTEM-1

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2
B	16	B10-425	MCDU-2

3. **Adjustment/Test**

A. Return To Service Test

(1) Return to service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.

(2) Verify SELECT DESIRED SYSTEM appears in scratchpad area of MCDU.

(3) Return aircraft to required configuration.

FLIGHT MANAGEMENT SYSTEM MULTIPURPOSE CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Flight Management System Multipurpose Control Display Unit (MCDU). The MCDU's are located on the forward pedestal, left and right sides. The MCDU provides the flight crew with the necessary controls, indicators, and display for the operation of the Flight Management System. The MCDU receives manual inputs from the flight crew and automatic digital and discrete inputs from the Flight Management Computer.

NOTE: It has been recommended that the MCDU cooling inlets periodically be cleaned. The cleaning process should be done at least twice a year. Honeywell, the manufacturer, has said that the MCDU repair reports has "not" shown any case of overheating. Vacuum out the bucket areas and the cooling inlet holes of the MCDU.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Non-ammoniated mild window cleaner	
Lens paper	VWR Science Co. Cat No. S68

3. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove MCDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

CAUTION: EXERCISE CAUTION IN REMOVING MCDU TO PREVENT DAMAGE TO KNOBS ON ENGINE FLAT PANEL DISPLAY.

(2) Prior to removal of right hand MCDU, remove landing gear handle and fuel quantity indicator. (COCKPIT DISPLAY UNIT, SUBJECT 28-40-07, Page 201)

NOTE: Aircraft with hinged landing gear handle, handle can be rotated out of way for MCDU removal.

(3) Before removal of left hand MCDU: remove Engine Display Panel (ENGINE DISPLAY PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 77-42-00/201). On some aircraft, the standby altimeter/airspeed indicator (STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-02/201), standby horizon indicator ((STANDBY HORIZON INDICATOR - MAINTENANCE PRACTICES, PAGEBLOCK 34-28-01/201), and speed brake arming switch cover (SPEEDBRAKE CONTROL LEVER ARMING SWITCHES - MAINTENANCE PRACTICES, PAGEBLOCK 27-62-08/201) must also be removed.

(4) On flight compartment pedestal, turn two lower mounting fasteners counterclockwise approximately 1/4 turn; this will loosen attached MCDU handle for removal of the MCDU. Loosen remaining two fasteners in same fashion.

(5) Using extreme caution to avoid breaking wire or pins, grasp attached MCDU handle and carefully pull MCDU out of its cavity

B. Install MCDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(2) Remove cap from connector. Ensure cavity is clear of any foreign material that may damage mating connectors.

(3) Carefully insert MCDU into its cavity exercising caution not to damage engine flat plate display knobs. Lower MCDU attached handle before securing fasteners. Rotate four fasteners in clockwise direction until secured.

WJE 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(4) Install landing gear handle (rotate handle to normal position, aircraft with hinged handle), indicators and displays as applicable.

WJE 401-404, 412, 414

(5) Rotate landing gear handle back to normal position and install indicators and displays as applicable.

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

(6) Remove the safety tags and close these circuit breakers:

UPPER EPC, FUEL - LEFT AC BUS

Row	Col	Number	Name
H	15	B10-421	FLT MGMT SYSTEM DATA LOADER

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC
D	22	B10-424	FLIGHT MANAGEMENT SYSTEM-1 MCDU

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
WJE 401-404, 412, 414, 415, 418, 863, 864, 866, 875, 876, 878, 879			
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC
WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875, 876, 878, 879			
F	10	B10-425	FLIGHT MANAGEMENT SYSTEM-2 MCDU

WJE 401-404, 412, 414, 415, 417-419, 421, 423, 863-866, 869, 871, 872, 875-879

4. Adjustment/Test

A. Check MCDU Configuration

NOTE: Whenever a new MCDU is installed, the CONFIG INDEX page must be checked to verify proper configuration of the MCDU.

(1) Access CONFIG INDEX page by pressing NEXT PAGE function key from the main MENU page.

(2) Type "DAC" into the scratch pad and press LSK 6R.

(3) Press the appropriate Line Select keys for the particular aircraft configuration.

(4) Press MENU key to return to main MENU page.

(5) Perform the Return-To-Service Test.

B. Return to Service Test

(1) Return to service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.

(2) On overhead console, press and hold ANNUNCIATOR/DIGITAL LIGHTS test button and observe MCDU. Verify that annunciators and exec keys are brightly lit.

(3) On overhead console, pull out PULL TO DIM knob and verify that annunciators and exec keys dim.

(4) Release ANNUNCIATOR/DIGITAL LIGHTS test button then turn pedestal panel lighting knob to right. Observe that MCDU and instrument lights increase in brightness.

(5) Rotate pedestal panel lighting knob back to original position and verify that MCDU and instrument lights dim.

(6) Return aircraft to required configuration.

5. Cleaning/Painting FMS MCDU Display Screen

A. Clean FMS MCDU Display Screen

(1) Moisten lens paper with window cleaner, then lightly wipe off surface to be cleaned in one pass.

(2) Obtain fresh piece of lens paper, moisten, then wipe again. Continue this procedure until all marks have been completely removed, taking fresh piece of lens paper each time in order not to scratch optical parts with dust collected on lens paper.

(3) Wipe screen with dry, clean lens paper, again replacing paper after each pass.

NOTE: Always moisten lens paper with window cleaner and not screen. Do not press hard when wiping. It is advisable to mist surface to be wiped before wiping with lens paper to avoid scratches. The more often lens paper is replaced, the faster and more efficient the cleaning.

FLIGHT MANAGEMENT SYSTEM MULTIPURPOSE CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General

A. This maintenance practice provides removal/installation procedures for the Flight Management System Multipurpose Control Display Unit (MCDU). The MCDU's are located on the forward pedestal, left and right sides. The MCDU provides the flight crew with the necessary controls, indicators, and display for the operation of the Flight Management System. The MCDU receives manual inputs from the flight crew and automatic digital and discrete inputs from the Flight Management Computer.

NOTE: It has been recommended that the MCDU cooling inlets periodically be cleaned. The cleaning process should be done at least twice a year. Honeywell, the manufacturer, has said that the MCDU repair reports has "not" shown any case of overheating. Vacuum out the bucket areas and the cooling inlet holes of the MCDU.

2. Equipment and Materials

NOTE: Equivalent substitutes may be used instead of the following listed items:

Table 201

Name and Number	Manufacturer
Non-ammoniated mild window cleaner	
Lens paper	VWR Science Co. Cat No. S68

3. Removal/Installation

CAUTION: EXCESSIVE OUTPUT VOLTAGE SPIKES MAY CAUSE DAMAGE TO UNIT AND ASSOCIATED EQUIPMENT IF UNIT IS REMOVED WITH POWER APPLIED.

A. Remove MCDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	22	B10-424	MCDU-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

UPPER EPC, RT AC

Row	Col	Number	Name
B	16	B10-425	MCDU-2

CAUTION: EXERCISE CAUTION IN REMOVING MCDU TO PREVENT DAMAGE TO KNOBS ON ENGINE FLAT PANEL DISPLAY.

(2) Before removal of right hand MCDU: rotate landing gear handle out of the way and remove fuel quantity indicator. (COCKPIT DISPLAY UNIT - MAINTENANCE PRACTICES, PAGEBLOCK 28-40-07/201)

WJE 407-409, 411, 880, 881, 883, 884

(3) Before removal of left hand MCDU: On some aircraft, the standby altimeter/airspeed indicator (STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-02/201), standby horizon indicator (STANDBY HORIZON INDICATOR - MAINTENANCE PRACTICES, PAGEBLOCK 34-28-01/201), and speed brake arming switch cover (SPEEDBRAKE CONTROL LEVER ARMING SWITCHES - MAINTENANCE PRACTICES, PAGEBLOCK 27-62-08/201) must also be removed.

WJE 405, 406, 410

(4) Before removal of left hand MCDU: remove Engine Display Panel (ENGINE DISPLAY PANEL - MAINTENANCE PRACTICES, PAGEBLOCK 77-42-00/201). On some aircraft, the standby altimeter/airspeed indicator (STANDBY ALTIMETER/AIRSPEED INDICATOR (PNEUMATIC) - MAINTENANCE PRACTICES, PAGEBLOCK 34-13-02/201), standby horizon indicator (STANDBY HORIZON INDICATOR - MAINTENANCE PRACTICES, PAGEBLOCK 34-28-01/201), and speed brake arming switch cover (SPEEDBRAKE CONTROL LEVER ARMING SWITCHES - MAINTENANCE PRACTICES, PAGEBLOCK 27-62-08/201) must also be removed.

WJE 405-411, 880, 881, 883, 884; AFTER AVIONICS UPGRADE MODIFICATION

(5) On flight compartment pedestal, turn two lower mounting fasteners counterclockwise approximately 1/4 turn; this will loosen attached MCDU handle for removal of the MCDU. Loosen remaining two fasteners in same fashion.

(6) Using extreme caution to avoid breaking wire or pins, grasp attached MCDU handle and carefully pull MCDU out of its cavity.

B. Install MCDU

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Make sure that these circuit breakers are open:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1
D	22	B10-424	MCDU-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2
B	16	B10-425	MCDU-2

(2) Remove cap from connector. Ensure cavity is clear of any foreign material that may damage mating connectors.

(3) Carefully insert MCDU into its cavity exercising caution not to damage mating connectors. Lower MCDU handle before securing fasteners. Rotate four fasteners in clockwise direction until secured.

(4) Rotate landing gear handle back to normal position and install indicators and displays as applicable.

(5) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
D	21	B10-419	FMC-1
D	22	B10-424	MCDU-1

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

UPPER EPC, RT AC

Row	Col	Number	Name
B	15	B10-420	FMC-2
B	16	B10-425	MCDU-2

4. Adjustment/Test

A. Check MCDU Configuration

NOTE: Whenever a new MCDU is installed, the CONFIG INDEX page must be checked to verify proper configuration of the MCDU.

(1) Access CONFIG INDEX page by pressing NEXT PAGE function key from the main MENU page.

(2) Type "DAC" into the scratch pad and press LSK 6R.

(3) Press the appropriate Line Select keys for the particular aircraft configuration.

(4) Press MENU key to return to main MENU page.

(5) Perform the Return-To-Service Test.

B. Return to Service Test

(1) Return to service self test is activated upon power up. If self test is satisfactory, MCDU MENU appears on title page at top line.

(2) On overhead console, press and hold ANNUNCIATOR/DIGITAL LIGHTS test button and observe MCDU. Verify that annunciators and exec keys are brightly lit.

(3) On overhead console, pull out PULL TO DIM knob and verify that annunciators and exec keys dim.

(4) Release ANNUNCIATOR/DIGITAL LIGHTS test button then turn pedestal panel lighting knob to right. Observe that MCDU and instrument lights increase in brightness.

(5) Rotate pedestal panel lighting knob back to original position and verify that MCDU and instrument lights dim.

(6) Return aircraft to required configuration.

5. Cleaning/Painting FMS MCDU Display Screen

A. Clean FMS MCDU Display Screen

(1) Moisten lens paper with window cleaner, then lightly wipe off surface to be cleaned in one pass.

(2) Obtain fresh piece of lens paper, moisten, then wipe again. Continue this procedure until all marks have been completely removed, taking fresh piece of lens paper each time in order not to scratch optical parts with dust collected on lens paper.

(3) Wipe screen with dry, clean lens paper, again replacing paper after each pass.

NOTE: Always moisten lens paper with window cleaner and not screen. Do not press hard when wiping. It is advisable to mist surface to be wiped before wiping with lens paper to avoid scratches. The more often lens paper is replaced, the faster and more efficient the cleaning.

AIRBORNE DATA LOADER - REMOVAL/INSTALLATION

1. General

A. This procedure has the removal and installation instructions for the airborne data loader (ADL).

B. The ADL is located under the first officer's briefcase stowage compartment.

2. Equipment and Materials

NOTE: Equivalent substitute may be used instead of the following listed item:

Table 401

Name and Number	Manufacturer
Dust caps, electrical connector MS90376	

3. Removal/Installation

A. Remove Airborne Data Loader (Figure 401)

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and install safety tag:

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

(2) Unlock the four dzus fasteners.

(3) Carefully remove the ADL.

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(4) Disconnect the electrical connector. Install dust caps.

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(5) Make sure that this circuit breaker is open and has safety tag:

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

B. Install Airborne Data Loader (Figure 401)

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(1) Remove the dust caps. Connect the electrical connector.

(2) Install the ADL in the mount.

(3) Lock the four dzus fasteners.

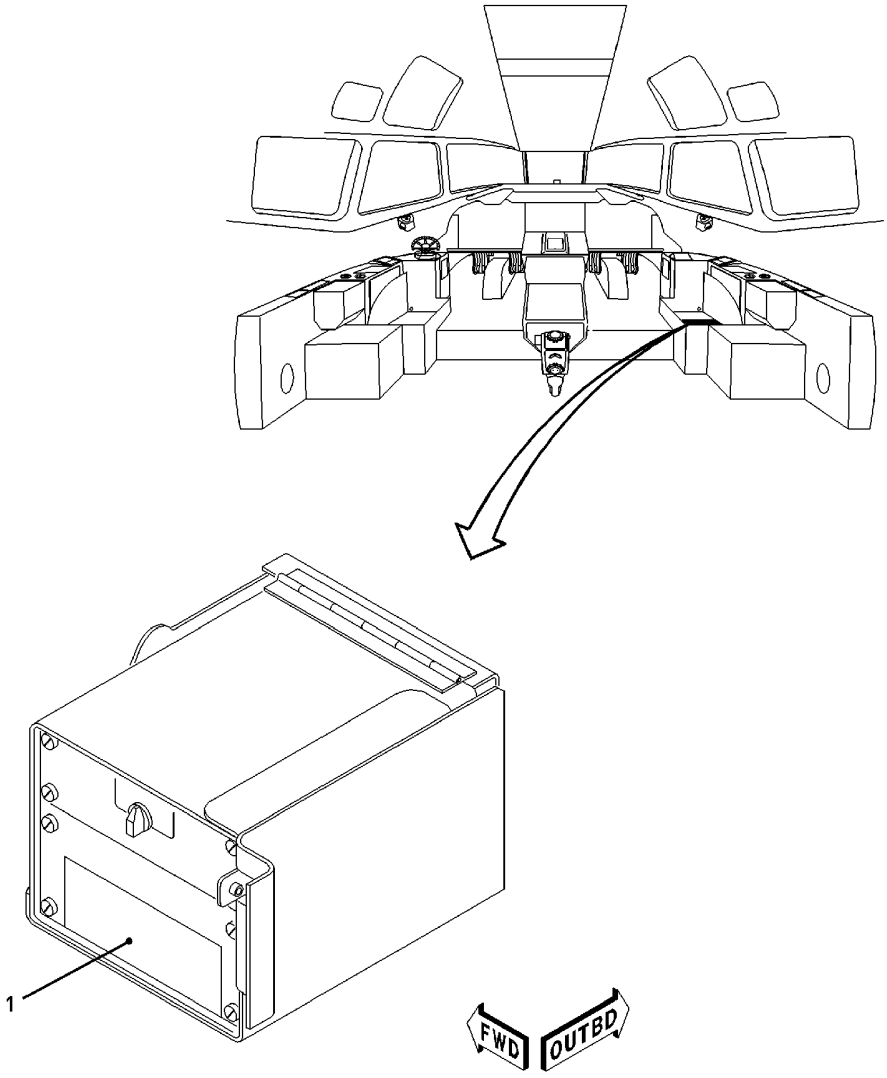
(4) Remove the safety tag and close this circuit breaker:

UPPER EPC, R AC BUS

Row	Col	Number	Name
J	15	B10-421	FMS DATA LOADER

(5) Do the up-loading of the flight management system navigation data base Op-program or down-loading of AFMC BITE data to the ADL. Refer to FMS with Airborne Data Loading of the Flight Management System Navigation Data Base. (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00, Page 201)

(6) Remove all the tools and equipment from the work area. Make sure that area is clean.



LEGEND:
1. AIRBORNE DATA LOADER

CAG(IGDS)

BBB2-34-1989

Airborne Data Loader -- Removal/Installation
Figure 401/34-63-11-990-801

ADVANCED FLIGHT MANAGEMENT SYSTEM (AFMC) SWITCHING UNIT - REMOVAL/INSTALLATION

1. General

A. This procedure has the removal and installation instructions for the Advanced Flight Management System (AFMC) Switching Unit.

B. The Advanced Flight Management System (AFMC) Switching Unit is located in the forward right radio rack.

2. Removal/Installation

A. Remove the Advanced Flight Management System (AFMC) Switching Unit

WARNING: TAG AND USE SAFETY CLIPS TO SAFETY THE CIRCUIT BREAKERS. IF THE CIRCUIT BREAKERS ARE NOT OPENED, TAGGED, AND SAFETIED, INJURY TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open these circuit breakers and install safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC

WJE 875-879

(2) Remove the AFMC Switching Unit as follows:

(a) Loosen hold-down nuts at lower front end of AFMC switching unit.

(b) Swing hold-down nuts down to clear AFMC switching unit.

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTOR CONTACT PINS. STATIC ELECTRICAL CHARGES THAT COLLECT ON THE SKIN CAN CAUSE DAMAGE TO THE ELECTROSTATIC SENSITIVE COMPONENTS INSTALLED IN THIS DEVICE.

(c) Carefully pull unit straight out of rack until electrical connectors are disengaged from mounting rack support, and remove unit.

B. Install the Advanced Flight Management System (AFMC) Switching Unit

Make sure that these circuit breakers are open and have safety tags:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC

WJE 875-879

(1) Install the AFMC switching unit as follows:

(a) Visually check unit and mounting rack connectors for loose, broken or dirty connector pins or wires.

CAUTION: MAKE SURE THAT THE PINS ARE ALIGNED CORRECTLY BEFORE CONNECTING THE ELECTRICAL CONNECTOR. IF THE PINS ARE NOT ALIGNED CORRECTLY, DAMAGE TO THE CONNECTOR CAN OCCUR.

(b) Place AFMC switching unit on mounting rack and carefully push unit straight back to engage connectors.

(c) Raise hold-down nuts, mate with AFMC switching unit hold-down lugs and tighten securely.

(2) Remove the safety tags and close these circuit breakers:

UPPER EPC, LEFT RADIO AC BUS

Row	Col	Number	Name
WJE 875, 876, 878, 879			
D	21	B10-419	FLIGHT MANAGEMENT SYSTEM-1 AFMC

UPPER EPC, RIGHT RADIO AC BUS

Row	Col	Number	Name
F	9	B10-420	FLIGHT MANAGEMENT SYSTEM-2 AFMC

WJE 875-879

C. Do a Return to Service (RTS) test. (PERFORMANCE/FLIGHT MANAGEMENT SYSTEM, SUBJECT 34-63-00)

D. Remove all the tools and equipment from the work area. Make sure that area is clean.