BOEING 757

AIRCRAFT MAINTENANCE MANUAL

CHAPTER 34 - NAVIGATION

THOMSON AIRWAYS CUSTOMISATIONS

Monarch *BOEING 757*

AIR 2000

757-2Y0

MAINTENANCE MANUAL

CHAPTER 34 - NAVIGATION

Traffic Alert and Collision Avoidance System (TCAS II) - Description and Operation

1. General

   A. The traffic Alert and Collision Avoidance System, or TCAS II, is a system that is designed to forewarn the pilot of any potential collision with other transponder equipped aircraft. This is accomplished by interrogating the Mode 'C' and Mode 'S' transponders of latent threat aircraft, tracking their responses and providing advisories to the flight crew to assure vertical separation.

   B. Two levels of advisories are provided:
      (i) Traffic Advisories (TA) which indicate the range, bearing and relative altitude to the intruder to aid in visual acquisition of the intruder.
      (ii) Resolution advisories (RA) which indicate what vertical manoeurve is to be performed or avoided in order to assure safe separation.

NOTE: It should be noted that; An intruder not equipped with a transponder of any kind will be invisible to TCAS II.

   C. Directional Antennas mounted on top and on the underside of the aircraft fuselage in conjunction with four receivers in the TCAS Computer Unit (CU) provide the capability to determine the bearing of an intruder within the pattern limits of the antennas

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D. Communications with another TCAS equipped aircraft is provided via an on board Mode 'S' Transponder to ensure that complementary RA's are posted when both TCAS's issue simultaneous RA's. Only one on-board Mode 'S' Transponder is required for TCAS operation, however, the TCAS II will operate with either of two on board Mode 'S' Transponders, one of which operates as a cold spare. The Transponder in use is selectable from the cockpit.

E. Mode selection and operation of the TCAS II and the Mode 'S' Transponder is accomplished from a TCAS Control Panel which is in place of the existing ATCRBS Control Panel.

F. Several forms of displays can be used with the TCAS II. Monarch, Air 2000 and Canada 3000 extended range aircraft use the Vertical Speed Indicator (VSI) for traffic advisory displays.

G. The TCAS system has a theoretical range of 67 nautical miles for nominal power and antenna gains. Thus, to allow for antenna pattern vibrations, antenna gains and receiver minimum trigger levels, a decrease in signal level of about 4 decibels must be permitted. Therefore, considering this reduction of 4 decibels, the theoretical range would be 42 nautical miles.

2. Component Details

A. TCAS Computer Unit

i) The TCAS Computer Unit is the heart of the TCAS II system. It contains the RF transmitter and receivers to perform the interrogation of other transponders. Dual microprocessors are utilized to implement the surveillance and collision avoidance system (CAS) algorithms to decide whether a transponder response should be considered a threat and then determine the appropriate vertical response to avoid mid-air or near mid-air collision.

ii) In addition, output data is provided to drive displays to inform the flight crew as to what action to take or avoid. An interface is provided with an on-board Mode 'S' Transponder in order to communicate with other TCAS II equipped aircraft.

B. Mode 'S' Transponder

i) The Mode 'S' Transponder has been specifically designed for use in Commercial Transport Type Aircraft, and includes, as standard, an interface for TCAS. The transponder receives ATCRBS or Mode 'S' RF interrogations on 1030MHz from either ground station interrogators or TCAS equipped aircraft and replies with either ATCRBS or Mode 'S' replies on 1090MHz.

ii) The Mode 'S' portion of the transponder is a cooperative surveillance and communications system which is an evolutionary addition to the Air Traffic Control (ATC) systems. The Mode 'S' system differs from the ATCRBS system principally in that aircraft are assigned discrete Mode 'S' address codes. This enables interrogations to be directed to particular aircraft and allows their replies to be unabiguously identified

C. Control Panel

- i) The Control Panel for the TCAS II provides for mode control for the Mode 'S' Transponders and TCAS II
- ii) Control Panel functions include 4096 ident code selection and display, altitude source and reporting inhibit selection and selection between two on-board transponders. Switches are also provided to enable TCAS and the display modes associated with TCAS.

D. Directional Antenna

- i) The TCAS Directional Antenna is a four-element, vertically polarized, monopole array which is capable of transmitting in four selectable directions at 1030 MHz and receiving omnidirectional with bearing at 1090 MHz using amplitude monopulse techniques.
- ii) The antenna contains such features as Electronic Sidelobe Suppression and Amplitude Radio Tracking which can actually compensate for on-aircraft pattern distortions
- iii) These exclusive features, along with the amplitude monopulse direction finding techniques used in the TCAS system, provide on-aircraft system accuracies that cannot be acheived in phase-based TCAS systems

E. Vertical Speed Indicator

- i) The Vertical Speed Indicator (VSI) is used to display current vertical speed and TCAS traffic/warning information. The display consists of a full colour active matrix liquid crystal display panel. The display quality compares favourably to CRT displays but requires less power, weight and volume than CRT with similar display area.

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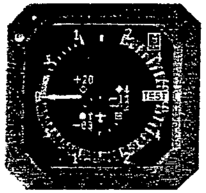
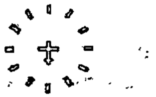
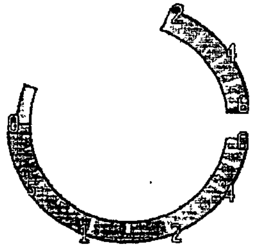


VSI Display (example)
P/No. 457400UA1311

SYMBOL	NAME	REMARKS
	Range Ring	White Range Ring indicates area of range of a pre-determined distance. This specific ring corresponds to a 6-nautical mile range. This is the only available range.
	Red Avoid Band Green Go-to Band	Red Avoid Band indicates the immediate avoid-ance area, anywhere within the limits of this red band is prohibited. Green Go-to Band indicates the immediate safearea, anywhere in the green band is sanctioned. An un-banded area of the display indicates an acceptable area of flight. The aural "Monitor Vertical Speed" is heard when a resolution advisory is in range but the present vertical speed is not within the Red band. The aural "Climb Climb Climb" is heard when the VSI shows Red band from negative to +1500 FPM and Green band from +1500 FPM to +2000 FPM. The aural "Descend Descend Descend" is heard when the VSI shows Red and from positive to -1500 FPM and Green band from -1500 FPM to -2000 FPM. The aural "Descend Crossing Descend" is the same as ("Descend" x3) but indicates that own flight path will cross the intruders altitude. The aural "Climb Crossing Climb is the same as ("Climb" x3) but indicates that own flight path will cross the intruders altitude

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SYMBOL	NAME	REMARKS
■	Red Square, Solid. Traffic Symbol	A red solid square indicates an intruder aircraft entering the Warning Area, 20-30 seconds from the TCAS Collision Area. This is usually coupled with a number indicating distance (see Data Tag). This is known as a Resolution Advisory.
●	Amber Circle, Solid. Traffic Symbol	An amber solid circle indicates an intruder entering the Caution Area, 35-45 seconds from the TCAS Collision Area. This is usually coupled with a number indicating distance (see Data Tag). This is known as a Traffic Advisory.
◆	Cyan Diamond ,Solid. Traffic Symbol	A cyan diamond indicates aircraft within 6 nautical miles ±1200 feet vertically. This is usually coupled with a number indicating distance (see Data Tag). This is known as Proximate Traffic.
◇	Cyan Diamond ,Hollow	A hollow cyan diamond indicates any transponder-replying aircraft not classified as an intruder or Proximate Traffic and within ±2700 feet vertically. This is known as Other Traffic.
↓ ↑	Up Arrow, Down Arrow All Three Colours	An UP arrow indicates an aircraft/intruder is climbing, a DOWN arrow indicates an aircraft/intruder is descending - in excess of 500 feet per minute.
+ 20 (Typical)	Data Tag	The two digits represent the relative altitude difference, in hundreds of feet . For an intruder above the TCAS aircraft, the two digits will be placed above the traffic symbol, and be preceded by a + sign.
-03 (Typical)	Data Tag	The two digits represent the relative altitude difference, in hundreds of feet . For an intruder below the TCAS aircraft, the two digits will be placed below the traffic symbol, and be preceded by a - sign.
TCAS OFF	Tcas Off White Flag	The TCAS OFF flag appears when the ATC/TCAS Control Panel is in the STBY position. VSI function is not affected.
TA ONLY	TA Only White Flag	The TA ONLY flag appears when TA ONLY is selected on the ATC/TCAS Control Panel. RA information is not displayed.
TEST	Test White Flag	The TEST flag appears when the TEST button is depressed on the ATC/TCAS Control Panel and will show for about 8 seconds while the test is in process.
RA FAIL	RA Fail Amber Flag	The RA FAIL flag appears when a failure is detected with the Resolution Advisory Display Bus.
TCAS FAIL	TCAS Fail Amber Flag	The TCAS FAIL flag appears upon any detected Hard Failure (refer to self test of TCAS Computer Unit 34-45-00 page MON 501)
"REDUCE DESCENT - REDUCE DECENT" *"REDUCE CLIMB - REDUCE CLIMB"*	Aural RA Advisories	Both aurals "Reduce decent...." & "Reduce climb...." refer to own vertical speed are at that moment in the Red band, therefore vertical speed should be appropriately reduced.
"CLIMB CLIMB NOW" *"DESCEND DESCEND NOW"* *"INCREASE CLIMB"* *"INCREASE DESCENT"*	Aural RA Advisories	"Climb Climb Now" is the same as ("Climb" x3 see Red & Green Band Descriptions) but this is followed by a "Descend" when circumstances require a reversal of vertical direction to ensure adequate vertical seperation. "Descend Descend Now" is the same as ("Descend" x3) but this is followed by a "climb" when circumstances require a reversal of vertical direction to ensure adequate separation. "Increase Climb" is heard when the vertical speed MUST BE INCREASED to ensure vertical separation. "Increase Descent" is heard when the vertical speed MUST BE INCREASED to ensure vertical separation.

E. (cont)

ii) The VSI is controlled by a microprocessor. Analog and digital inputs are read, processed and bufferered by the microprocessor. The display is continuously created and updated by the microprocessor software. Power (±15V DC at 2 W maximum) is provided for a remote pressure sensor if required.

F. Pressure Transducer Module

The Pressure Transducer Module converts static pressure to a low speed output which is then used by the VSI to compute altitude rate.

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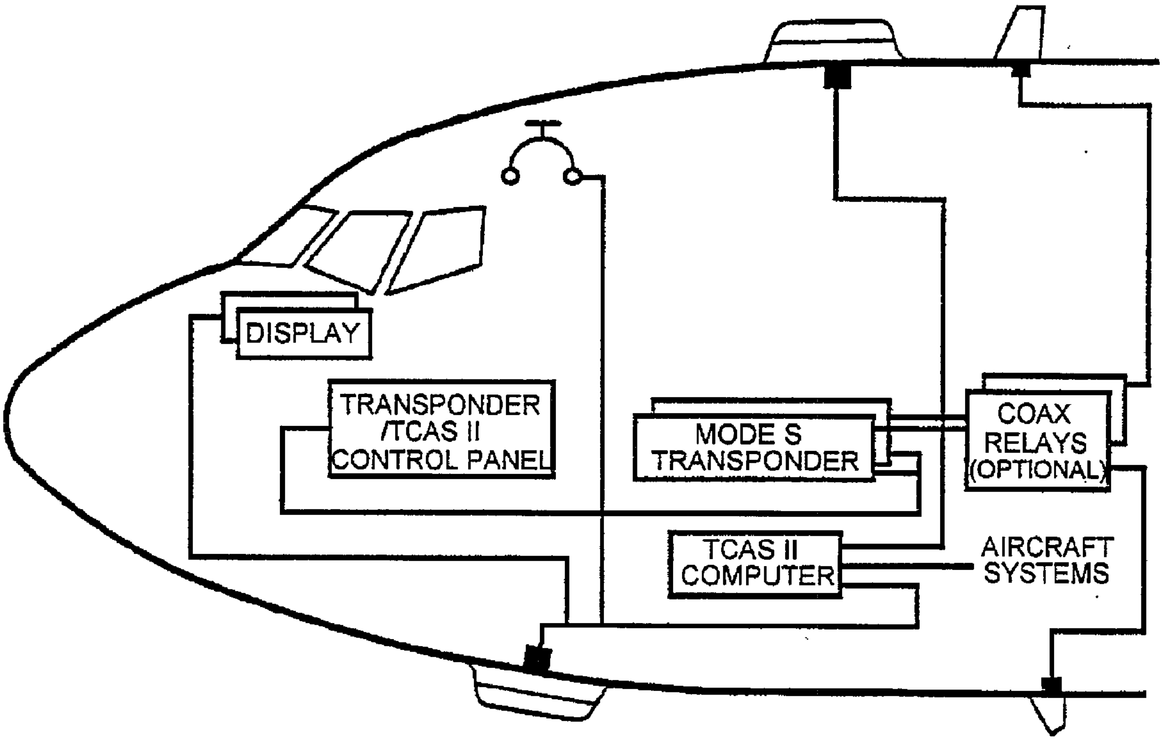

TCAS II SYSTEM

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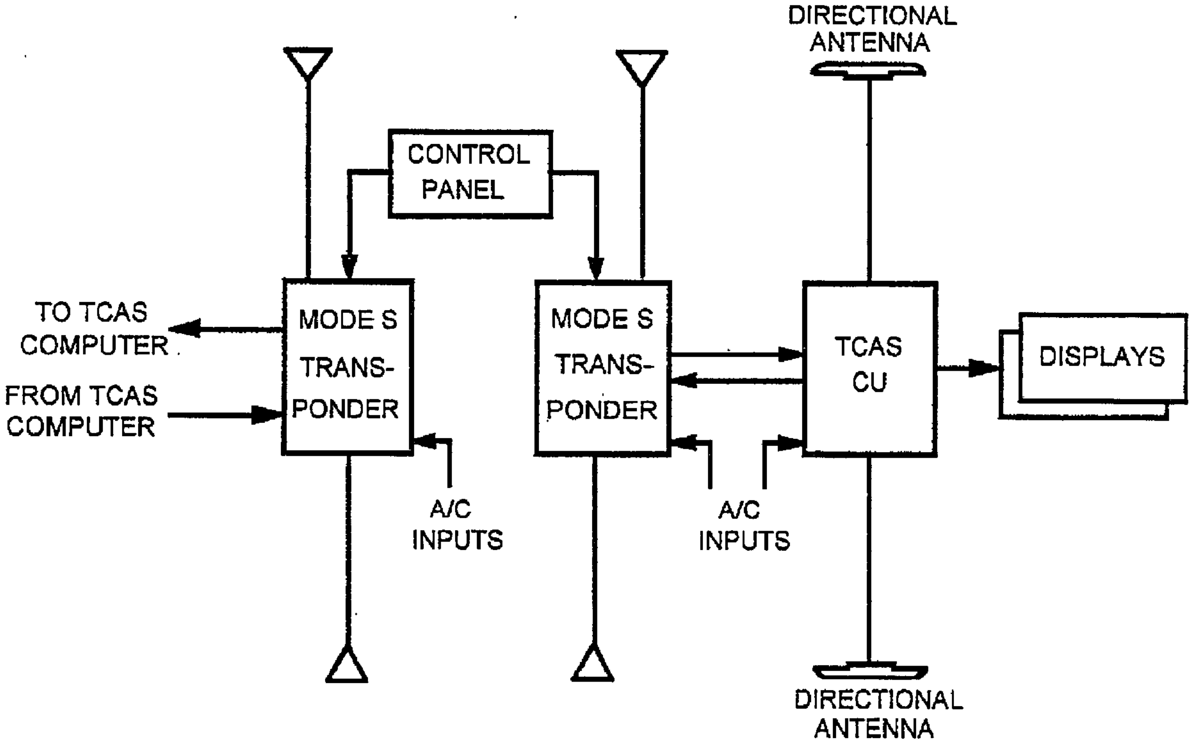

Monarch Dual Mode 'S'/Bottom Directional Antenna Installation

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Traffic Alert And Avoidance System (TCAS) - Adjustment/Test

1. General
   A. This procedure has two tasks. One is an operational test and the other is a system test. The operational test is a fast test of the TCAS system. The system test uses the operational test, then does a test of the system functions using additional test equipment.

2. Operational Test - TCAS
   A. General
      (1) This test is to make sure the TCAS is operating properly. It uses only the system's Built In Test Equipment (BITE) functions and special test or ground equipment is not necessary.
   B. References
      (1) 24-22-00/201, Electrical power - control.
      (2) 31-41-00/501, Engine Indication Crew Alerting System (EICAS)
      (3) 32-09-02/201, Air/Ground Relays
      (4) 34-12-00/501, Air Data System (ADS)
      (5) 34-21-00/501, Inertial Reference System (IRS)
      (6) 34-22-00/501, Electronic Flight Instrument System (EFIS)
      (7) 34-33-00/501, Low Range Radio Altimeter (LRRA)
      (8) 34-46-00/501, Ground Proximity Warning System (GPWS)
      (9) 34-53-00/501, Air Traffic Control System (ATC)
   C. Access
      (1) Location Zones

119/120	Main Equipment Centre
211/212	Flight Compartment

   D. Prepare for Operational Test

      (1) Supply electrical power (Ref 24-22-00/201)

      (2) Make sure these systems are serviceable:
         (a) Air Data System (Ref 34-12-00/501)
         (b) Air Traffic Control System (Ref 34-53-00/501)
         (c) Electronic Flight Instrument System (Ref 34-22-00/501)
         (d) Engine Indication Crew Alerting System (Ref 31-41-00/501)
         (e) Ground Proximity Warning System (Ref 34-46-00/501)
         (f) Inertial Reference System (Ref 34-21-00/501)
         (g) Low Range Radio Altimeter (Ref 34-33-00/501)

(3) Make sure these circuit breakers are closed.
  (a) Overhead Circuit Breaker Panel, P11;
    1) 11E7, TCAS
    2) 11S15, LANDING GEAR AIR/GND SYS 1
    3) 11S19, LANDING GEAR AIR/GND SYS 2

(4) Align all the IRS (Ref 34-21-00/201).

(5) Set the transponder select switch on the ATC Control Panel (referred to as the control unit for the rest of the section) to the L position.
  (a) Make sure the ATC FAIL lamp on the control unit is off.

(6) Set the mode switch on the control unit to the STBY position.
  (a) Make sure the IVSI shows the TCAS OFF indication.

(7) Set the mode switch on the control unit to the TA ONLY position.
  (a) Make sure TA ONLY shows on the IVSI.

(8) Set the mode switch on the control unit to the TA/RA position.
  (a) Make sure the IVSI continues to show the TA ONLY indication.

E. Procedure

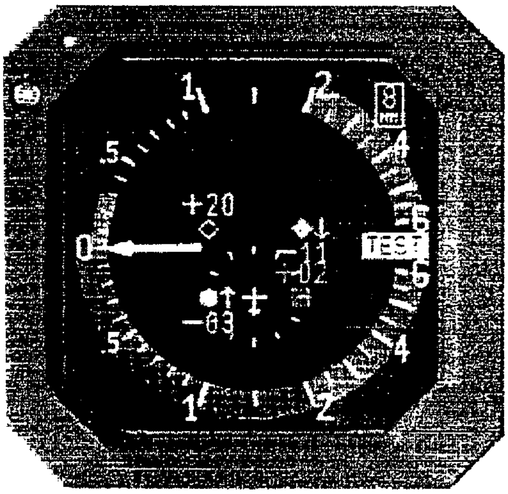
(1) Do the self test as follows:
  (a) Push the TEST switch on the control unit.

  (b) Make sure these results occur:
    1) The control unit shows these indications:
      a) The IDENT CODE window shows 8888
    2) The IVSI shows the test pattern below (Fig 501)
      a) TEST shows on the right side of the IVSI
      b) An R/A (red square) at 3 o'clock, range of 6 nautical miles, 200 feet above and flying level.
      c) A T/A (solid amber circle) at 9 o'clock, range of 6 nautical miles, 300 feet below and climbing.
      d) Proximity Traffic (solid cyan diamond) at 2 o'clock, range of 6.5 nautical miles, 1100 feet below and descending.

e) Non-Threat Traffic (hollow cyan diamond) at 11 o'clock, range of 6.5 nautical miles, 2000 feet above flying level.
f) Monitor Vertical Speed (red outer band) showing "do not descend and do not climb greater than 2000 feet" resolution advisories.
g) A green 'fly to' band showing safe area at present positon up to 300 feet above.

3) A TCAS SYSTEM PASS synthesized voice announcment is heard at the end of the test if the test passes.

NOTE : A TCAS SYSTEM FAIL synthesized voice announcment is heard at the end of the test if the test fails.



IVSI Self Test Display
Figure 501

(2) Do the self test again with the transponder select switch in the R position on the control unit.

(3) Remove the electrical power if it is not necessary (Ref 24-22-02/201).

3. System Test - TCAS

A. General

The objective of the test is to verify satisfactory installation and operation of the Honeywell TCAS II system. The tests will verify:

(1) Proper TCAS and IVSI/TRA system performance on-ground environments.
(2) Non-interference with aircraft systems operation.
(3) Proper operation of previously approved equipment whose installation was affected by the installation of the TCAS system.
(4) Proper Mode 'S' Transponder system performance on-ground environments.

B. Equipment

(1) TCAS Ramp Test Set - IFR Model TCAS-201
(2) Transponder Ramp Test Set - IFR Model ATC-601
(3) Radio Altimeter test set.
(4) Pitot/Static test set.

C. References

(1) 24-22-01/201, Electrical Power - Control.
(2) 32-09-02/201, Air/Ground Relays.

D. Prepare for System Test

CAUTION: DO NOT OPERATE TEST SET WHEN TEST SET ANTENNA IS WITHIN 15 INCHES OF AIRPLANE ANTENNA. DAMAGE TO THE TEST SET MAY OCCUR.

(1) Set up TCAS-201 test set antenna in an appropriate location (about 50 feet from the bottom TCAS antenna) forward of the airplane at 45 degrees off of the centreline to send signals to the TCAS directional antenna.

NOTE: Make sure there is no obstruction between the TCAS antenna and the test set antenna. Face the test set antenna in the direction so that the TCAS antenna under test receives the strongest signal. Use the antenna stand to prevent movements to the test set antenna which can cause TCAS to loose tracking. If ground equipment, walkways or other objects that could cause a signal obstruction or a multipath problem, choose a more suitable location for the test set and change the setup in the test set accordingly.

(2) Push the POWER switch to supply power to the TCAS-201 test set.

(3) Push the SET/CONT key on the TCAS-201 test set.

(4) Enter the distance, ± 5 feet, from the test set antenna and the bottom TCAS antenna in the HORIZ field.

(5) Enter the height difference, ± 3 feet, between the test set antenna and the bottom TCAS antenna in the VERT field.

(6) Enter the gain of the test set antenna in the GAIN field.

NOTE: The antenna gain should be listed on the test set antenna.

(7) Enter the loss of the cable in the LOSS field.

NOTE: The cable loss values should be listed on the cable.

E. Test The TCAS System

(1) Supply electrical power (Ref 24-22-00/201)

(2) Do the Operational Test.

(3) Do the TCAS Bearing Accuracy Test as follows:
   (a) Set the mode switch on the control unit to the TA ONLY position.
   (b) Push the SCEN key on the TCAS test set to show the scenario menu.
   (c) Set up this scenario:
      1) INTRUDER TYPE: ATCRBS ALT: OFF
      2) RANGE: 8.0 nm RATE: 0 kt
   (d) Use the test set to interrogate the four quadrants of the TCAS antenna at bearings of 0, 90, 180, and 270 degrees.

NOTE: Shield the bottom TCAS antenna with an antenna shield. This is the test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

   (e) Push the RUN/STOP key to start the test.
      1) Make sure the IVSI shows the intruder's bearing ± 15 degrees.

   (f) Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna.

NOTE: This is to test the bottom TCAS antenna. If you moved the test set, you must change the test set setup accordingly.

WARNING: MAKE SURE THE GROUND LOCKS ARE INSTALLED ON ALL THE LANDING GEAR (BEFORE YOU MOVE THE CONTROL LEVER). WITHOUT THE GROUND LOCKS, THE LANDING GEAR CAN RETRACT AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(4) Make sure the ground locks are installed on the nose and main landing gear (AMM 32-00-01/201).

(5) Put the landing gear lever in the OFF position.
   (a) Do the steps in the Bearing Accuracy Test again for the bottom antenna.

WARNING: **YOU MUST CAREFULLY FOLLOW THE STEPS IN THE REFERENCED TASK TO PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE. FAILURE TO FOLLOW THE STEPS CORRECTLY CAN CAUSE THE AUTOMATIC OPERATION OF THE AIRPLANE SYSTEMS. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.**

(6) Do the Prepare Safety-Sensitive Systems for Air Mode Simulation task (Ref 32-09-02/201)

(7) Simulate aircraft "In Air" by opening these circuit breakers and attach DO-NOT-CLOSE tags:
   (a) P11 Overhead Circuit Breaker Panel;
      1) 11S15, LANDING GEAR AIR/GND SYS 1
      2) 11S19, LANDING GEAR AIR/GND SYS 2

(8) Connect the radio altimeter tests et to the airplane.

(9) Set the radio altitude to 2400 feet.

NOTE: **Increase the radio altitude by 600 feet per minute (fpm) or less.**

   (a) Make sure the IVSI does not show the TA ONLY indication when the radio altitude is greater than 600 feet.

(10) Set the mode select switch on the TCAS Control Panel to TA/RA position

(11) Set the transponder select switch on the TCAS Control Panel to L

(12) Connect a pitot/static test set to the airplane so that both air data computers be pressurized (Ref 34-11-00/201).

(13) Use the pitot/static test set to apply an altitude of 48,000 feet.

NOTE: **The 48,000 feet barometric altitude is chosen to minimise false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting of the ATC temporarily off or put the ATC system on standby during this procedure and then reset to on when 48,000 is reached.**

(14) Push the SCEN key to display scenario menu.

(15) Set up this scenario:
   (a) INTRUDER TYPE: ATCRBS   ALT: ON
   (b) RANGE: 8.0 nm   RATE: +500 kt
   (c) ALTITUDE: 47,900 ft   RATE: 0 fpm

NOTE: **Make sure the intruder's altitude is less than 100 feet below your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.**

(16) Push the RUN/STOP key to start the scenario.
  (a) Make sure this sequence shows on the IVSI display:
    1) The intruder moves down the 45-degree bearing mark to the airplane symbol.
    2) The intruder has the correct relative altitude.

    NOTE: The relative altitude shown can be -00 or -01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.

    3) The intruder begins as Non-threat Traffic (hollow cyan diamond).
    4) The intruder changes to Proximate Traffic (solid cyan diamond).
    5) The intruder changes to a Traffic Advisory (solid amber circle).
    6) The TCAS system gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
    7) The intruder changes to a Resolution Advisory (solid red square)
    8) The TCAS system gives a " CLIMB, CLIMB, CLIMB" voice announcement on the flight compartment speaker.
    9) The IVSI shows a resolution advisory to climb to a verified safe area (green outer band).
    10) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "INCREASE CLIMB" voice announcement on the flight compartment speaker.
  (b) Shortly after the intruder reaches the airplane symbol on the IVSI, TCAS system gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speaker.

  NOTE: The "CLEAR OF CONFLICT" announcement sometimes may not be given.

(17) Push the SCEN key to display scenario menu.

(18) Set up this scenario:
  (a) INTRUDER TYPE: Mode S
  (b) RANGE: 8.0 nm RATE: +500 kt
  (c) ALTITUDE: 48,100 ft RATE: 0 fpm

  NOTE: Make sure the intruder's altitude is less than 100 feet above your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

(19) Push the RUN/STOP key to start the scenario.
  (a) Make sure this sequence shows on the IVSI display:
    1) The intruder moves down the 45 degree bearing mark to the airplane symbol.
    2) The intruder has the correct relative altitude.

NOTE: **The relative altitude shown can be +00 or +01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.**

3) The intruder begins as Non-threat Traffic (hollow cyan diamond).
4) The intruder changes to Proximate Traffic (solid cyan diamond).
5) The intruder changes to a Traffic Advisory (solid amber circle).
6) The TCAS system gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
7) The intruder changes to a Resolution Advisory (solid red square) and gives a "DESCEND, DESCEND, DESCEND" voice announcement on the flight compartment speaker.
8) The IVSI shows a resolution advisory to descend to a verified safe area (green outer band).
9) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "INCREASE DESCENT" voice announcement on the flight compartment speaker.

(b) Shortly after the intruder reaches the airplane symbol on the IVSI, TCAS system gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speaker.

NOTE: **The "CLEAR OF CONFLICT" announcement sometimes may not be given.**

(20) Return the airplane back to field level altitude.

(21) Set the radio altimeter to 0 feet.

NOTE: **Decrease the radio altitude by 600 feet per minute (fpm) or less.**

(a) Make sure the IVSI shows the TA ONLY indication when the radio altitude is less than 400 feet.

F. Put the Airplane Back to its Usual Condition

(1) Put the landing gear lever back to the down position.

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  (a) P11 Overhead Circuit Breaker Panel;
    1) 11S15, LANDING GEAR AIR/GND SYS 1
    2) 11S19, LANDING GEAR AIR/GND SYS 2

(3) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

4. TCAS Interface Test

A. General

(1) This interface test is a check of the interface between TCAS and other systems that interface with TCAS. The interface check on the ATC is done in the TCAS system test.

B. References

(1) AMM 31-41-00/501, Engine Indication Crew Altering System (EICAS).
(2) AMM 34-12-00/501, Air Data System (ADS).
(3) AMM 34-21-00/501, Inertial Reference System (IRS).
(4) AMM 34-22-00/501, Electronic Flight Instrument System (EFIS).
(5) AMM 34-33-00/501, Low Range Radio Altimeter (LRRA).
(6) AMM 34-46-00/501, Ground Proximity Warning System (GPWS).
(7) AMM 34-53-00/501, Air Traffic Control (ATC).

C. Access

(1) Location Zones

119/120	Main Equipment Centre
211/212	Flight Compartment

D. Prepare for the Test

(1) Make sure these systems are operational:
   (a) Air Data System (Ref 34-12-00/501)
   (b) Air Traffic Control System (Ref 34-53-00/501)
   (c) Electronic Flight Instrument System (Ref 34-22-00/501)
   (d) Inertial Reference System (Ref 34-21-00/501)
   (e) Low Range Radio Altimeter (Ref 34-33-00/501)
   (f) Ground Proximity Warning System (Ref 34-46-00/501)

(2) Make sure these circuit breakers are closed:
   (a) P11 Overhead Circuit Breaker Panel;
      1) 11F3, TCAS
      2) 11S15, LANDING GEAR AIR/GND SYS 1
      3) 11S19, LANDING GEAR AIR/GND SYS 2

E. GPWS Interface Test

(1) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501)

<u>NOTE:</u> **The Ground Proximity Test will cycle through the three aural warnings "GLIDESLOPE", "WHOOP-WHOOP PULL-UP", and "WINDSHEAR, WINDSHEAR" with a slight delay between each warning. This is to make sure TCAS aurals are inhibited whenever these Ground Proximity warnings are annunciated.**

(2) During the "GLIDESLOPE" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "GLIDESLOPE" aural message occurs.

(3) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501).

(4) During the "WHOOP-WHOOP PULL-UP" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WHOOP-WHOOP PULL-UP" aural message occurs.

(5) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501)

(6) During the "WINDSHEAR, WINDSHEAR" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WINDSHEAR, WINSHEAR" aural message occurs.

F. IRS Interface Test

(1) Make sure the captain's IRS instrument source select switch is set to normal.

(2) Push the TEST switch on the front of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is not on.

(3) Set the left IRMP mode switch to ALIGN.

(4) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is on.

(5) Set the captain's IRS instruments source select switch to alternate.

(6) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is not on.

(7) Set the centre IRMP mode switch to ALIGN

(8) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is on.

(9) Set the captain's IRS instruments source select switch to normal.

(10) Set the IRMP mode switches to NAV

G. Low Range Radio Altimeter Interface Test

(1) Make sure the two EADI's show a radio altitude between 0 and -10 feet.

(2) Push the TEST switch on the front panel of the TCAS computer.
    (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(3) Open this circuit breaker.
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F5, LEFT RAD ALTM

(4) Push the TEST switch on the front panel of the TCAS computer.
    (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(5) Open this circuit breaker.
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F26, RIGHT RAD ALTM

(6) Push the TEST switch on the front panel of the TCAS computer.
    (a) Make sure you hear the "TCAS SYSTEM TEST FAIL" annunciation.

(7) Close this circuit breaker.
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F5, LEFT RAD ALTM

(8) Open and then close the TCAS circuit breaker to clear the latched fail state of the TCAS computer, if necessary.

(9) Push the TEST switch on the front panel of the TCAS computer.
    (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(10) Close this circuit breaker.
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F26, RIGHT RAD ALTM

(11) Open these circuit breakers and attach DO-NOT-CLOSE tags:
    (a) P11 Overhead Circuit Breaker Panel;
        1) 11S15, LANDING GEAR AIR/GND SYS 1
        2) 11S19, LANDING GEAR AIR/GND SYS 2

(12) Use the radio altimeter test set to simulate a radio altitude of 350 feet
    (a) Make sure the EADI shows the radio altitude at 350 feet.
    (b) Make sure the IVSI shows the TA ONLY indication.

(13) Use the radio altimeter test set to make a radio altitude of 1000 feet.
  (a) Make sure the EADI shows the radio altitude at 1000 feet.
  (b) Make sure the IVSI does not show a TA ONLY, TCAS FAIL, or TCAS OFF message.

(14) Close these circuit breakers.
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11S15, LANDING GEAR AIR/GND SYS 1
    2) 11S19, LANDING GEAR AIR/GND SYS 2

H. Put the Airplane Back to its Usual Condition

(1) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

APPENDIX "A"

TCAS II SYSTEM
GROUND TEST PROCEDURE

for

AIR 2000 B757-200

5140-1208
REV -

HONEYWELL INC.
COMMERCIAL FLIGHT SYSTEMS GROUP
PHOENIX, ARIZONA

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TCAS SYSTEM

GROUND TEST PROCEDURE

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TCAS SYSTEM

GROUND TEST PROCEDURE

1.0 INTRODUCTION

1.1 Scope

This document specifies the ground and flight test requirements in support of 'Follow-On' certifications of the Honeywell TCAS II System, for Monarch B757-200 series aircraft. The tests will satisfy the requirements outlined in FAA Draft AC 20-131A, Paragraph 7.g., First of Type Approvals.

1.2 Objectives

The objective of the tests specified in this document is to provide system performance data which will verify satisfactory installation and operation of the Honeywell TCAS (-903) system. The data will support application for an STC.

The tests will verify:

a. Proper TCAS and VSI/TRA system performance on-ground environments.

b. Non-interference with aircraft systems operation.

c. Proper operation of previously approved equipment whose installation was affected by the installation of the TCAS System.

d. Proper Mode S transponder system performance on-ground environments.

2.0 REFERENCE DOCUMENTS

The following documents shall be considered a part of this certification test plan to the extent specified herein. In the event of a conflict between the referenced document and this certification test plan, this certification test plan shall take precedence. Documents referenced within documents shall not be applicable unless specified as such in this test plan.

2.1 FAA DOCUMENTS

FAA/DRAFT AC 20-131A April, 1990	Airworthiness and Operational Approval of Traffic Alert And Collision Avoidance System (TCAS II) and Mode S transponders DOT, FAA, Washington D.C.
FAR: Part 25	Federal Aviation Regulations, Part 25 - Airworthiness Standards - Transport Category Airplanes. DOT, FAA, Washington D.C
ARINC 718-4 Dec 15 1989	Air Traffic Control Transponder (ATCRBS/Mode S)
ARINC 735 thru Draft 1 of Supplement 2 11 Dec 1989	Traffic Alert and Collision Avoidance System (TCAS)

3.0 Ground Tests

3.1 Mode S Ground Tests

Unless otherwise noted, all of the following tests are to be conducted with an IFR ATC-601 or equivalent, transponder ramp test set.

Configure the TCAS/Mode S Control Panel settings as follows:

Select "TA/RA", on function mode select switch.
Select "XPDR 1"*, on the transponder select switch.

Apply power to the aircraft avionic systems.
Make sure the a/c is 'on the ground'.

Verify that the "TA Only", is annunciated on the VSI/TRA displays, and that the Vertical Speed Indicator is indicating 0 FPM rate.

Simulate aircraft 'In Air', by de-activating the Air/Ground and Landing gear circuit breakers.

The operating procedure for running of the tests shall be as per th instructions in the appropriate operators manual.

The ramp test set will display 'TEST PASSED' or 'TEST FAILED' indications as appropriate, on analyzing the measured parameters.

Activate the Mode S ramp test set.

* Transponder 1 = L Transponder
  Transponder 2 = R Transponder

3.1.1 Pressure Altitude (ADC) Interface Tests

Verify proper interface to the altitude sources and the TCAS system by exercising the aircraft pitot/static system with an altitude tester. Verify the altitude interface up to 45,000 feet at 5,000 feet intervals.

The altitude decoded by the ramp test set, should be within ± 100 feet of the expected altitude, as indicated by the Captains's or Flight Officer's altimeters.

Note:
#1 = Left Transponder
#2 = Right Transponder
System 1= S1= Altitude Source 1
System 2= S2= Altitude Source 2

3.1.1 DATA

Altitude Tester		System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
Ground	#1/S1	____	________	________	________
Ground	#2/S1	____	________	________	________
Ground	#1/S2	____	________	________	________
Ground	#2/S2	____	________	________	________
5000	#1/S1	____	________	________	________
5000	#2/S1	____	________	________	________
5000	#1/S2	____	________	________	________
5000	#2/S2	____	________	________	________

Observer:__________

3.1.1 DATA cont.

Altitude Tester	System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
10000 #1/S1				
10000 #2/S1				
10000 #1/S2				
10000 #2/S2				
15000 #1/S1				
15000 #2/S1				
15000 #1/S2				
15000 #2/S2				
20000 #1/S1				
20000 #2/S1				
20000 #1/S2				
20000 #2/S2				
25000 #1/S1				
25000 #2/S1				
25000 #1/S2				
25000 #2/S2				

3.1.1 DATA cont.

Altitude Tester	System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
30000 #1/S1	______	____________	__________	___________
30000 #2/S1	______	____________	__________	___________
30000 #1/S2	______	____________	__________	___________
30000 #2/S2	______	____________	__________	___________
35000 #1/S1	______	____________	__________	___________
35000 #2/S1	______	____________	__________	___________
35000 #1/S2	______	____________	__________	___________
35000 #2/S2	______	____________	__________	___________
40000 #1/S1	______	____________	__________	___________
40000 #2/S1	______	____________	__________	___________
40000 #1/S2	______	____________	__________	___________
40000 #2/S2	______	____________	__________	___________
45000 #1/S1	______	____________	__________	___________
45000 #2/S1	______	____________	__________	___________
45000 #1/S2	______	____________	__________	___________
45000 #2/S2	______	____________	__________	___________

Observer:____________

SELECT TRANSPONDER #1 ON THE TCAS/MODE S CONTROL PANEL

3.1.2.1 Altitude Request Test - Intruder Surveillance

Make sure that altitude reporting is 'ON'.

Interrogate with Mode S UF4.

Verify that the reply has the correct altitude and format.

3.1.2.1 DATA

____ Correct UF-4 Reply (Test Passed)

3.1.2.2 Mode S UF5: ID Request Test

Interrogate Mode S transponder with UF5.

Verify that the reply has the correct ID code, correct address and correct format.

3.1.2.2 DATA

____ Correct UF-5 Reply (Test Passed)
____ Correct ID Code
____ Correct Address

3.1.2.3 Mode S Squitter Txmt Test

Verify that Squitter signals are received from the Mode S transponder, every 1 (+/- 0.2) sec.

3.1.2.3 DATA

______ Period (seconds)
______ Squitter signals (Test Passed)

Observer:__________

3.1.2.4 Reply Frequency Test

Interrogate the system and verify the reply frequency of the transponder is 1090 (+/- 1) MHz.

3.1.2.4 DATA

______ Frequency (MHz)
______ Reply Frequency (Test Passed)

3.1.2.5 Transmit Power/Receiver Sensitivity Test

Follow the specific directions in the ramp test set operator's manual, to conduct the transmit power/receiver sensitivity test. Monitor the Mode S transponders interrogations and reply signals.

Verify that the peak power output from the transponder is between 54 (+/- 3) dBm ERP. Verify that the MTL of the system is: -74 (+/- 3) dBm.

3.1.2.5 DATA

______ Transmit Power: Top (dBm)
______ Transmit Power: Bottom (dBm)
______ Receive Sensitivity (MTL): Top (dBm)
______ Receive Sensitivity (MTL): Bottom (dBm)

3.1.2.6 Mode S Address Test

Verify that the Mode S transponder replies to interrogations using Own Mode S Address.

Next verify that NO reply is received from the transponder when interrogated with a Mode S, non All-Call, address of which is different from Own Mode S Address.

3.1.2.6 DATA

All Call Address __________ All Call Address __________
DF4 Reply Address __________ DF4 Reply Address __________

_____ Replies to correct address
_____ Does not reply to incorrect address

Observer:_________

3.1.2.7 ATCRBS Reply Test

Interrogate with Modes A and C and verify that replies are received by the ramp test set.

3.1.2.7 DATA

____ Mode S (Mode A)
____ Mode S (Mode C)

3.1.2.8 Transponder Parameter Selection Test

Verify that when the 'IDNT' button on the TCAS/ Mode S Control Panel is activated, the ident code is displayed at the ramp test set and that it remains valid for 15 to 20 seconds.

3.1.2.8 DATA

____ IDNT Verified (Mode S UF4: FS = 4)
____ Duration (seconds)

3.1.2.9 Discretes Verification Test

Verify the status of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Check for correct discrete configuration setting for AIR/GND, by verifying that no ATCRBS replies are received while the aircraft is on the ground.

3.1.2.9 DATA

____ (Mode S UF0: RI = C)

____ Aircraft On Ground (Mode S UF4: FS = 1)

____ No ATCRBS replies on ground (ATCRBS Reply Test = Fail)

Simulate aircraft 'In Air'.

SELECT MODE S TRANSPONDER #2, ON THE CONTROL PANEL

Observer:__________

3.1.3.1 Altitude Request Test - Intruder Surveillance

Interrogate with Mode S UF4.

Verify that the reply has the correct altitude and format.

Select "ALT/R OFF" on the TCAS/Mode S Control Panel and verify that the altitude information is no longer being decoded at the ramp test set.

3.1.3.1 DATA

____ Correct UF-4 Reply (Test Passed)
____ ALT RPTG OFF (AC = 0 FT)

Return the altitude reporting to 'ON'.

3.1.3.2 Mode S UF5: ID Request Test

Interrogate Mode S transponder with UF5.

Verify that the reply has the correct ID code, correct address and correct format.

3.1.3.2 DATA

____ Correct UF-5 Reply (Test Passed)
____ Correct ID Code
____ Correct Address

3.1.3.3 Mode S Squitter Txmt Test

Verify that Squitter signals are received from the Mode S transponder, every 1 (+/- 0.2) sec.

3.1.3.3 DATA

______ Period (seconds)
______ Squitter signals (Test Passed)

Observer:__________

3.1.3.4 Reply Frequency Test

Interrogate the system and verify the reply frequency of the transponder is 1090 (+/- 1) MHz.

3.1.3.4 DATA

_______ Frequency (MHz)
_______ Reply Frequency (Test Passed)

3.1.3.5 Transmit Power/Receiver Sensitivity Test

Follow the specific directions in the ramp test set operator's manual, to conduct the transmit power/receiver sensitivity test. Monitor the Mode S transponders interrogations and reply signals.

Verify that the peak power output from the transponder is between 54 (+/- 3) dBm ERP. Verify that the MTL of the system is: -74 (+/- 3) dBm.

3.1.3.5 DATA

_______ Transmit Power: Top (dBm)
_______ Transmit Power: Bottom (dBm)
_______ Receive Sensitivity (MTL): Top (dBm)
_______ Receive Sensitivity (MTL): Bottom (dBm)

3.1.3.6 Mode S Address Test

Verify that the Mode S transponder replies to interrogations using Own Mode S Address.

Next verify that NO reply is received from the transponder when interrogated with a Mode S, non All-Call, address of which is different from Own Mode S Address.

3.1.3.6 DATA

All Call Address ____________ All Call Address ____________
DF4 Reply Address ____________ DF4 Reply Address ____________

_____ Replies to correct address
_____ Does not reply to incorrect address

Observer:__________

3.1.3.7 ATCRBS Reply Test

Interrogate with Modes A and C and verify that replies are received by the ramp test set.

3.1.3.7 DATA

____ Mode S (Mode A)
____ Mode S (Mode C)

3.1.3.8 Transponder Parameter Selection Test

Verify that when the IDENT button on the TCAS/ Mode S Control Panel is activated, the ident code is displayed at the ramp test set and that it remains valid for 15 to 20 seconds.

3.1.3.8 DATA

____ IDENT Verified (Mode S UF4: FS = 4)
____ Duration (seconds)

3.1.3.9 Discretes Verification Test

Verify the status of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Check for correct discrete configuration setting for AIR/GND, by verifying that no ATCRBS replies are received while the aircraft is on the ground.

3.1.3.9 DATA

____ (Mode S UF0: RI = C)

____ Aircraft On Ground (Mode S UF4: FS = 1)

____ No ATCRBS replies on ground (ATCRBS Reply Test = Fail)

Simulate aircraft 'In Air'.

Observer:__________

3.2 VSI Ground Tests

3.2.1 VSI Climb and Descend Rate Indications

Evaluate the pilot's and first officer's VSI/TRA displays for vertical speed operation. The test is performed by using a ground based static source test unit to maintain a constant FPM indication on the VSI, and timing the rate of altitude indication change on the captain's and first officer's altimeters.

Verify that altitude rates indicated on the VSI displays CORRESPOND to the rates induced by the static altitude test equipment. The test must be conducted for verification of both the climb and the descend senses.

Induce climb rates of: 500, 1000 and 2000 feet per minute (FPM) and descend rates of: 500, 1000 and 2000 feet per minute (FPM).

3.2 DATA

VSI Indication (Climb - FPM)	Start Altitude (ft)	End Altitude (ft)	Time Interval (seconds)	Climb Rate (FPM)

_______ Climb Rates Verified (Pass/Fail)

VSI Indication (Descend - FPM)	Start Altitude (ft)	End Altitude (ft)	Time Interval (seconds)	Climb Rate (FPM)

_______ Climb Rates Verified (Pass/Fail)

Observer:__________

3.2.2 VSI (ADC Source) Fail Indication

Verify that when the circuit breaker of the altitude source (ADC), for the VSI/TRA display, is 'opened', that "VSI FAIL" and "TCAS OFF" messages are annunciated on the corresponding VSI/TRA display. Note: Do not open circuit breaker for either IRS, only associated ADC's. This will accomplish the same result without requiring a realignment of the IRS's.

3.2.2 DATA

____ "VSI FAIL" and "TCAS OFF"- Indication verified on Captains VSI.

____ "VSI FAIL" and "TCAS OFF"- Indication verified on Flight Officers VSI.

Observer:__________

3.3 TCAS System Ground Tests

These tests will be performed utilizing a TCAS ramp test equipment (IFR TCAS-201 or equivalent). A TCAS data recording system may be used for auxiliary data analysis.

3.3.1 Self Test Check

Activate the TCAS Self Test function by pressing and momentarely holding the 'TEST' switch in the 'TEST' position on the TCAS/ Mode S Control Panel.

Verify the TCAS Self Test feature by confirming that the expected TCAS test display: four intruders in a square formation, along with the red and green bands for Resolution Advisory are displayed, and the test aural annunciations are generated. The self test should terminate with the aural annunciation of: "TCAS TEST PASS".

3.3.1 DATA

______Self Test (Pass/Fail)

3.3.2 Extended Test Functions Check

Verify the access to the TCAS extended test mode on the Sextant VSI.

The extended test mode will be activated by setting the control Panel display function select switch to 'STBY', and pushing and holding the 'TEST' button on the Control Panel TCAS/ Mode S Selector Switch for at least eight (8) seconds.

The TCAS systems' "GEAR DOWN" and "AIR/ GND" logic indicators must indicate aircraft gear to be extended and the aircraft to be on ground, in order for the Extended Test function to be activated.

3.3.2 DATA

______ Extended Test (Pass/Fail)

Observer:__________

3.3.3 Radio Altimeter Source Test

3.3.3.1 Radio Altitude No. 1

Verify proper interface of the Radio Altimeters to the TCAS II system, by exercising the Radio Altimeter with a suitable tester.

Use the Radio Altitude tester to obtain the desired altitude level -indicated on the Captain's radio altimeter.

3.3.3.1 DATA

Altitude Level	Captain's Radio Altimeter (ft)	Captain's VSI
Ground	0	TA
300	300	TA
700	700	TA indication disappears

Observer:__________

3.3.3.2 Radio Altitude No. 2

Pull circuit breaker for Radio Altitude No. 1. Verify that the Radio Altitude No. 1 is inactive.

Use the Radio Altitude tester to obtain the desired altitude level -indicated on the First Officer's radio altimeter.

3.3.3.2 DATA

Altitude Level (ft)	First Officer's Radio Altimeter (ft)	First Officer's VSI
Ground	0	TA
300	300	TA
700	700	TA indication disappears

RESET THE RADIO ALTITUDE NO. 1 CIRCUIT BREAKER

Observer:__________

3.3.4 Bearing Tests

Verify the surveillance operation of the TCAS system and directional antennas. Configure the TCAS/Mode S Control Panel settings as follows:

Select "TA/RA", on function mode select switch.
Select "XPDR 1", on the transponder select switch.

3.3.4.1 Top Directional Antenna Test

Use the IFR TCAS-201 ramp test set to simulate a stationary Mode C intruder at 2.0 nm and with an altitude of 500 feet above the aircrafts' baro altitude. Position the ramp test set at the front of the aircraft (0 degrees) and then move it around the aircraft, pausing approximately every 90° position to allow the display of the intruder on the VSIs to stabilize.

Coverage at all four of the quadrants will be verified.

3.3.4.1 DATA

Nominal Position	Relative Bearing (Approximate)	Observed Intruder Bearing	Comment
0	________	________	________
90	________	________	________
180*	________	________	________
270	________	________	________

Observer:__________

* Position of the ramp test set may have to be offset slightly from th 180° position due to obstruction by the tail structure.

3.3.4.2 Bottom Directional Antenna Test

Use a dummy antenna load to terminate the TCAS outputs to the top directional antenna during the bottom directional antenna test. This will ensure that there is no interference from the top direction antenna during this test.

Simulate the aircraft "in air" and "gear up" condition, to the inputs to the TCAS CU.

Use the IFR TCAS-201 ramp test set to simulate a stationary Mode C intruder at 2.0 mn. and with an altitude of 500 feet above the aircrafts' baro altitude. Position the tester at the front of the aircraft (0 degrees) and then move it around the aircraft, pausing approximately 90° position to allow the display of the intruder on the VSIs to stabilize.

Coverage at all four of the quadrants will be verified.

3.3.4.2 DATA

Nominal Position	Relative Bearinge (Approximate)	Observed Intruder Bearing	Comment
0*	________	________	________
90	________	________	________
180	________	________	________
270	________	________	________

Observer:__________

* Position of the ramp test set may have to be offset slightly from the 0° position due to obstruction by the nose gear.

3.3.5 TCAS Aural Advisory Audibility

Verify the intelligibility of the TCAS aural advisories using the test sequence initiated through the TCAS/Mode S Control Panel.

Initiate a TCAS self test sequence followed immediately by a GPWS self sequence. Verify the following:

i> That the TCAS aural warnings are approximately as loud as the GPWS warnings.
ii> That the TCAS aural warnings are interrupted by GPWS aural warnings.
iii> That the TCAS System goes into "TA ONLY" mode.*

* With weight OFF wheels/gear and RAD ALT at > 600'.

Repeat the above sequence with the Windshear warning system, if installed.

3.3.5 DATA

____ Aural advisories intelligible
____ GPWS warning priority
____ Windshear warning priority
____ TA Only Mode

Observer:__________

3.3.6 Traffic/ Resolution Advisory Check

Demonstrate the operation of the TCAS system by programming the TCAS ramp test set to simulate a Mode C intruder approaching the aircraft, from a distance greater than 4.0 nm, and at an altitude of 200 feet above the aircrafts' baro altitude.

Verify that this scenario results in causing a TA and RA to be generated, with proper bearing, distance, and relative altitude.

Verify that the appropriate aural advisories, TRAFFIC-TRAFFIC, DESCEND-DESCEND-DESCEND, and CLEAR-OF-CONFLICT, are annunciated.

Aircraft configuration:

Radio Altimeter:	> 2000 ft.
Barometric Altitude:	> 5000 ft.
Aircraft	- in Air
Landing Gear	- Down

Failure criteria shall be unacceptable TA or RA display or TCAS operation during the encounter with the test equipment.

3.3.6 DATA

____ TA Display Operation Acceptable
____ RA Display Operation Acceptable

Observer:__________

3.3.7 Control Panel Functions Evaluations

3.3.7.1 TCAS Mode Controls Evaluations

Activate each of the selectable TCAS modes available on the TCAS/ Mode S Control Panel. Verify proper operation in each mode by observing the appropriate changes in the TCAS display.

TCAS MODE	TCAS DISPLAY MESSAGE
STBY (Standby)	TCAS OFF
XPDR (Transponder only)	TCAS OFF
TA (TA Only)	TA/ONLY*
RA/TA	(none)*
ALT/R OFF	TCAS OFF

* With weight OFF wheels/gear and RAD ALT at > 600'.

With the use of the TCAS ramp test set, simulate an RA encounter scenario (Test 3.3.8) and verify that:

a) No aural advisories are annunciated and no Traffic is indicated on the display, while the TCAS system is in "STBY", "XPDR" or "ALT/R OFF" modes, and that the display indicates "TCAS OFF".

b) Only the "TRAFFIC TRAFFIC" aural advisories are annunciated and the intruder is displayed only as a "TA" on the IVSI, while TCAS is in the "TA Only" mode.

c) The system annunciates the normal "TRAFFIC TRAFFIC", and the appropriate resolution advisories, and the intruder is displayed as a "TA" or as an "RA", as appropriate, while the TCAS is in the "TA/RA" mode.

3.3.7.1 DATA

_____ STBY Mode
_____ XPDR Mode
_____ ALT/R OFF

_____ TA Only Mode
_____ RA/TA Mode

3.3.8 Sensor Failure and Self Test

Conduct a subsystem failure test. Activate TCAS SELF TEST function prior to each failure, after inducing the failure, and after the failure is corrected.

Simulate failure of each of the equipment called out in Table 1, by pulling its circuit breaker.

Note: The TCAS II System should be placed in "TA ONLY" or "RA/TA" Mode for these tests.

Failures should generate 'TCAS FAIL' messages on the VSI/TRA's as appropriate, and should generate 'TCAS TEST FAIL' aural messages when SELF TEST function is active after the failure.

Verify that the system behavior is as expected per Table 1.

Failures of the following equipment will be simulated:

- Air Data Computers
- Radio Altimeters
- Mode S Transponders
- VSI/TRAs
- TCAS Computer Unit

3.3.8 DATA

_____ Altitude Source 1
_____ Altitude Source 2
_____ Radio Altimeter 1
_____ Radio Altimeter 2
_____ Mode S Transponder 1
_____ Mode S Transponder 2
_____ Mode S Transponder 1 and 2
_____ Cockpit VSI/TRA 1
_____ Cockpit VSI/TRA 2
_____ Cockpit VSI/TRA 1 and 2
_____ TCAS CU

Table 1

Sensor Failure Matrix

Sensor	VSI/TRA Indication	Self Test Indication
Alt Source 1 (Note 1)	TCAS OFF	TCAS TEST PASS
Alt Source 2 (Note 1)	TCAS OFF	TCAS TEST PASS
Radio Altimeter 1	(none)	TCAS TEST PASS
Radio Altimeter 2	(none)	TCAS TEST PASS
Radio Altimeter 1 and 2	TCAS FAIL	TCAS TEST FAIL
Mode S Transponder 1 Note 1	TCAS OFF	TCAS TEST PASS
Mode S Transponder 2 Note 1	TCAS OFF	TCAS TEST PASS
Mode S Transponder 1 and 2	TCAS FAIL	(none)
Cockpit VSI/TRA 1 *	#1 OFF #2 none	TCAS TEST PASS
Cockpit VSI/TRA 2 *	#1 none #2 OFF	TCAS TEST PASS
Cockpit VSI/TRA 1 and 2 *	#1 and #2 OFF	TCAS TEST FAIL
TCAS CU	TCAS FAIL	(none)

NOTE: 1. Transponder No.1 selected on the TCAS/Mode S Control Panel.

2. "VSI FAIL" will be displayed on indicator which has selected its Altitude Source Fail. (No VSI rate data due to loss of baro altitude to the associated IRS.

* When the VSI's are 'OFF', the displays are without power and are blank.

3.3.9 Electromagnetic Non-Interference (EMI)

Conduct a flight deck EMI survey on the ground.

Verify that the installed TCAS equipment does not generate any unacceptable interference to any of the other on-board equipment, and that non of the other on-board equipment in operation, generates unacceptable interference to the installed TCAS system.

The following equipment will be operated and evaluated for interference to/ from TCAS equipment:

VHF Comm #1 and #2
VHF Nav/ILS #1, #2, and #3
Marker Beacon Receiver #1
Weather Radar
DME #1 and #2
Public Address system
Ground Interphone
HF Radio #1 and #2

3.3.9 DATA

______ VHF Comm #1 and #2
______ VHF Nav/ILS #1, #2, and #3
______ Marker Beacon Receiver #1
______ Weather Radar
______ DME #1 and #2
______ Public Address system
______ Ground Interphone
______ HF Radio #1 and #2

Observer:________

3.3.10 Configuration Discrete

Verify the status (using the First Officer's VSI) of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Pull the TCAS circuit breaker and remove the lru from the rack. Using an ohmmeter measure the resistance at the rack connector on the following pins:

i.	Air/ Ground discrete	RMP Pin 5K
ii.	Gear status discrete	RMP Pin 13F
iii.	Max. Climb Altitude	RMP Pins 6E, 6F, 6G, 6H, 6J

3.3.10 DATA

Reading

_____ Air/ Ground discrete Air = 100 Kohm ; Gnd = 100 ohm

_____ Gear status Discrete G up = 100 Kohm ; G down = 100 ohm

_____ Maximum Climb Altitude (ALT LIMIT = 48,000 ft)

Connector	Pins	Reading
RMP	6H	100 ohm
	6J	100 ohm
RMP	6E	100 Kohm
	6F	100 Kohm
	6G	100 Kohm

Observer:__________

Monarch *BOEING 757*

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CHAPTER 34 - NAVIGATION

Traffic Alert and Collision Avoidance System (TCAS) Computer Removal/Installation

1. General
   A. This procedure has two tasks. One is the removal of the TCAS Computer; the other is the installation of the TCAS Computer.
   B. The TCAS Computer, M09001 (P/No. 4066010-903), is installed on the E2-1 rack in the main equipment centre. (Fig 401)

2. TCAS Computer Removal
   A. References
      (1) 20-10-01/401, E/E Mounted Components
      (2) 20-41-01/201, Electrostatic Sensitive Devices

   B. Access
      (1) Location zones
         119/120 Main Equipment Centre

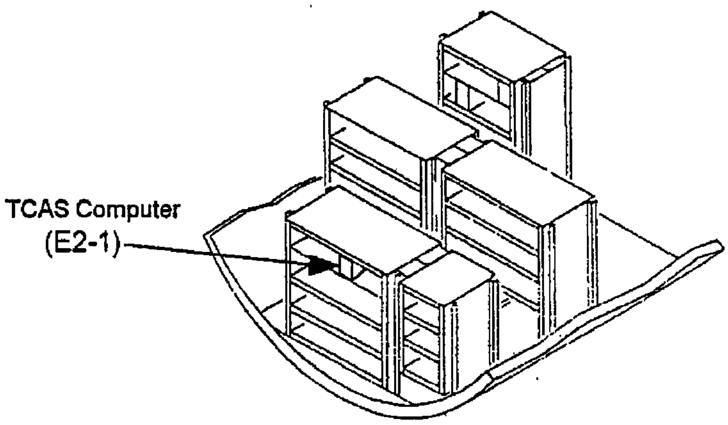
      (2) Access Panels
         119BL Main Equipment Centre Access Door

   C. Procedure

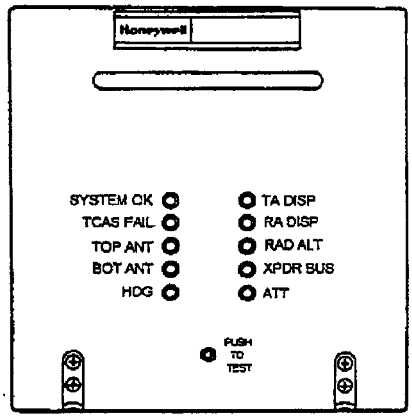
      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
         (a) P11, Overhead Circuit Breaker Panel
            1) 11F3, TCAS

      CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTRO-STATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

      (2) Remove the TCAS Computer (Ref 20-10-01/401)



MAIN EQUIPMENT CENTRE



TCAS Computer

figure 401

(3) Install dust caps on the electrical connectors.

3. TCAS Computer Installation
   A. Reference
      (1) 20-10-01/401, E/E Rack Mounted Components
      (2) 24-22-00/201, Electrical Power - Control
      (3) 34-45-00/MON 501, TCAS Test

   B. Access
      (1) Location Zones
         119/120 Main Equipment Centre

      (2) Access Panels
         119BL Main Equipment Centre Access Door

   C. Procedure
      (1) Make sure these circuit breakers are open:
         (a) P11, Overhead Circuit Breaker Panel
            1) 11F3, TCAS

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

      (2) Install the TCAS Computer (Ref 20-10-01/401)

   D. TCAS Computer Test
      (1) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
         (a) P11, Overhead Circuit Breaker Panel
            1) 11F3, TCAS

      (2) Supply electrical power (Ref 24-22-00/201)
      (3) Do the TCAS Operational test (Ref 34-45-00/MON 501)

   E. Put the Airplane Back to its Usual Condition

      (1) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

Dual Air Traffic Control (ATC) Control Panel - Removal/Installation

1. General
   A. This procedure has two tasks. One is the removal of the ATC Control Panel; the other is the installation of the ATC Control Panel.
   B. The ATC Control Panel, G6992-12, is installed on the Aisle Control Stand, P8. Electrical connections are at the rear of the control panel.

2. Remove the ATC Control Panel
   A. Access
      (1) Location Zones
      211/212 Flight Compartment

   B. Prepare for removal

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11F7, ATC LEFT
         (b) 11F28, ATC RIGHT

   C. Procedure

      (1) Loosen and remove the screws on the Control Panel.

      (2) Move the Control Panel out to get access to the electrical cable.

      (3) Disconnect the two electrical connectors.

      (4) Remove the ATC Control Panel.

3. Install the ATC Control Panel
   A. References
      (1) 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones
      211/212 Flight Compartment

C. Prepare for Installation

   (1) Make sure these circuit breakers on the P11 panel are open:
      (a) 11F7, ATC LEFT
      (b) 11F28, ATC RIGHT

D. Procedure

   (1) Connect the two electrical connectors to the Control Panel.

   (2) Install the ATC Control Panel.

   (3) Tighten the screws on the Control Panel.

   (4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
      (a) 11F7, ATC LEFT
      (b) 11F28, ATC RIGHT

E. ATC Control Panel Test

   (1) Supply electrical power (Ref 24-22-00/201).

   (2) Make sure the Control Panel lights come on.

   (3) Set the Transponder select switch on the ATC Control Panel to the L or 1 position.

(4) Push and hold the Test switch on the front panel of the left ATC Transponder.
   (a) Make sure the sequence that follows occurs:
      1) All LEDS come on.
      2) All LEDS go off.
      3) The green LED comes on and stays on.

(5) Release the TEST switch on the ATC Transponder.
(6) Set the Transponder select switch on the ATC Control Panel to the R or 2 position.
(7) Push and hold the TEST switch on the front panel of the right ATC Transponder.
   (a) Make sure the sequence that follows occurs:
      1) All LEDS come on.
      2) All LEDS go off.
      3) The green LED comes on and stays on.
(8) Release the TEST switch on the ATC Transponder.
(9) Push and hold the TEST switch on the ATC Control Panel.
   (a) Make sure the sequence that follows occurs:
      1) On the VSI's, four 'intruders' appear in a square formation, along with Red and Green bands denoting RA's.
      2) A aural annunciation is heard stating either "TCAS TEST PASS" or "TCAS TEST FAIL".
      3) On the VSI's, a visual display stating either "TCAS TEST PASS" or "TCAS TEST FAIL".

F. Put the Airplane back to its usual condition

(1) Set the Transponder select switch to the STBY position.

(2) Remove electrical power if it is not necessary (Ref 24-22-00/201).

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CHAPTER 34 - NAVIGATION

Traffic Alert and Collision Avoidance System (TCAS II) - Description and Operation

1. General
   A. The traffic Alert and Collision Avoidance System, or TCAS II, is a system that is designed to forewarn the pilot of any potential collision with other transponder equipped aircraft. This is accomplished by interrogating the Mode 'C' and Mode 'S' transponders of latent threat aircraft, tracking their responses and providing advisories to the flight crew to assure vertical separation.

   B. Two levels of advisories are provided:
      (i) Traffic Advisories (TA) which indicate the range, bearing and relative altitude to the intruder to aid in visual acquisition of the intruder.
      (ii) Resolution advisories (RA) which indicate what vertical manoeurve is to be performed or avoided in order to assure safe separation.

NOTE: It should be noted that; An intruder not equipped with a transponder of any kind will be invisible to TCAS II.

   C. Directional Antennas mounted on top and on the underside of the aircraft fuselage in conjunction with four receivers in the TCAS Computer Unit (CU) provide the capability to determine the bearing of an intruder within the pattern limits of the antennas

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D. Communications with another TCAS equipped aircraft is provided via an on board Mode 'S' Transponder to ensure that complementary RA's are posted when both TCAS's issue simultaneous RA's. Only one on-board Mode 'S' Transponder is required for TCAS operation, however, the TCAS II will operate with either of two on board Mode 'S' Transponders, one of which operates as a cold spare. The Transponder in use is selectable from the cockpit.

E. Mode selection and operation of the TCAS II and the Mode 'S' Transponder is accomplished from a TCAS Control Panel which is in place of the existing ATCRBS Control Panel.

F. Several forms of displays can be used with the TCAS II. Monarch, Air 2000 and Canada 3000 extended range aircraft use the Vertical Speed Indicator (VSI) for traffic advisory displays.

G. The TCAS system has a theoretical range of 67 nautical miles for nominal power and antenna gains. Thus, to allow for antenna pattern vibrations, antenna gains and receiver minimum trigger levels, a decrease in signal level of about 4 decibels must be permitted. Therefore, considering this reduction of 4 decibels, the theoretical range would be 42 nautical miles.

2. <u>Component Details</u>

A. TCAS Computer Unit

i) The TCAS Computer Unit is the heart of the TCAS II system. It contains the RF transmitter and receivers to perform the interrogation of other transponders. Dual microprocessors are utilized to implement the surveillance and collision avoidance system (CAS) algorithms to decide whether a transponder response should be considered a threat and then determine the appropriate vertical response to avoid mid-air or near mid-air collision.

ii) In addition, output data is provided to drive displays to inform the flight crew as to what action to take or avoid. An interface is provided with an on-board Mode 'S' Transponder in order to communicate with other TCAS II equipped aircraft.

B. Mode 'S' Transponder

i) The Mode 'S' Transponder has been specifically designed for use in Commercial Transport Type Aircraft, and includes, as standard, an interface for TCAS. The transponder receives ATCRBS or Mode 'S' RF interrogations on 1030MHz from either ground station interrogators or TCAS equipped aircraft and replies with either ATCRBS or Mode 'S' replies on 1090MHz.

ii) The Mode 'S' portion of the transponder is a cooperative surveillance and communications system which is an evolutionary addition to the Air Traffic Control (ATC) systems. The Mode 'S' system differs from the ATCRBS system principally in that aircraft are assigned discrete Mode 'S' address codes. This enables interrogations to be directed to particular aircraft and allows their replies to be unabiguously identified

C. Control Panel

i) The Control Panel for the TCAS II provides for mode control for the Mode 'S' Transponders and TCAS II

ii) Control Panel functions include 4096 ident code selection and display, altitude source and reporting inhibit selection and selection between two on-board transponders. Switches are also provided to enable TCAS and the display modes associated with TCAS.

D. Directional Antenna

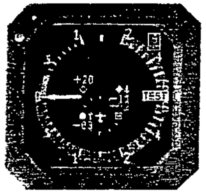
i) The TCAS Directional Antenna is a four-element, vertically polarized, monopole array which is capable of transmitting in four selectable directions at 1030 MHz and receiving omnidirectional with bearing at 1090 MHz using amplitude monopulse techniques.

ii) The antenna contains such features as Electronic Sidelobe Suppression and Amplitude Radio Tracking which can actually compensate for on-aircraft pattern distortions

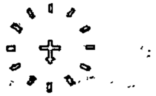
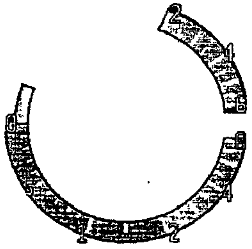
iii) These exclusive features, along with the amplitude monopulse direction finding techniques used in the TCAS system, provide on-aircraft system accuracies that cannot be acheived in phase-based TCAS systems

E. Vertical Speed Indicator

i) The Vertical Speed Indicator (VSI) is used to display current vertical speed and TCAS traffic/warning information. The display consists of a full colour active matrix liquid crystal display panel. The display quality compares favourably to CRT displays but requires less power, weight and volume than CRT with similar display area.



VSI Display (example)
P/No. 457400UA1311

SYMBOL	NAME	REMARKS
	Range Ring	White Range Ring indicates area of range of a pre-determined distance. This specific ring corresponds to a 6-nautical mile range. This is the only available range.
	Red Avoid Band Green Go-to Band	Red Avoid Band indicates the immediate avoid-ance area, anywhere within the limits of this red band is prohibited. Green Go-to Band indicates the immediate safearea, anywhere in the green band is sanctioned. An un-banded area of the display indicates an acceptable area of flight. The aural "Monitor Vertical Speed" is heard when a resolution advisory is in range but the present vertical speed is not within the Red band. The aural "Climb Climb Climb" is heard when the VSI shows Red band from negative to +1500 FPM and Green band from +1500 FPM to +2000 FPM. The aural "Descend Descend Descend" is heard when the VSI shows Red and from positive to -1500 FPM and Green band from -1500 FPM to -2000 FPM. The aural "Descend Crossing Descend" is the same as ("Descend" x3) but indicates that own flight path will cross the intuders altitude. The aural "Climb Crossing Climb is the same as ("Climb" x3) but indicates that own flight path will cross the intruders altitude

SYMBOL	NAME	REMARKS
■	Red Square, Solid. Traffic Symbol	A red solid square indicates an intruder aircraft entering the Warning Area, 20-30 seconds from the TCAS Collision Area. This is usually coupled with a number indicating distance (see Data Tag). This is known as a Resolution Advisory.
●	Amber Circle, Solid. Traffic Symbol	An amber solid circle indicates an intruder entering the Caution Area, 35-45 seconds from the TCAS Collision Area. This is usually coupled with a number indicating distance (see Data Tag). This is known as a Traffic Advisory.
◆	Cyan Diamond ,Solid. Traffic Symbol	A cyan diamond indicates aircraft within 6 nautical miles ±1200 feet vertically. This is usually coupled with a number indicating distance (see Data Tag). This is known as Proximate Traffic.
◇	Cyan Diamond ,Hollow	A hollow cyan diamond indicates any transponder-replying aircraft not classified as an intruder or Proximate Traffic and within ±2700 feet vertically. This is known as Other Traffic.
↓ ↑	Up Arrow, Down Arrow All Three Colours	An UP arrow indicates an aircraft/intruder is climbing, a DOWN arrow indicates an aircraft/intruder is descending - in excess of 500 feet per minute.
+ 20 (Typical)	Data Tag	The two digits represent the relative altitude difference, in hundreds of feet . For an intruder above the TCAS aircraft, the two digits will be placed above the traffic symbol, and be preceded by a + sign.
-03 (Typical)	Data Tag	The two digits represent the relative altitude difference, in hundreds of feet . For an intruder below the TCAS aircraft, the two digits will be placed below the traffic symbol, and be preceded by a - sign.
TCAS OFF	Tcas Off White Flag	The TCAS OFF flag appears when the ATC/TCAS Control Panel is in the STBY position. VSI function is not affected.
TA ONLY	TA Only White Flag	The TA ONLY flag appears when TA ONLY is selected on the ATC/TCAS Control Panel. RA information is not displayed.
TEST	Test White Flag	The TEST flag appears when the TEST button is depressed on the ATC/TCAS Control Panel and will show for about 8 seconds while the test is in process.
RA FAIL	RA Fail Amber Flag	The RA FAIL flag appears when a failure is detected with the Resolution Advisory Display Bus.
TCAS FAIL	TCAS Fail Amber Flag	The TCAS FAIL flag appears upon any detected Hard Failure (refer to self test of TCAS Computer Unit 34-45-00 page MON 501)
"REDUCE DESCENT - REDUCE DECENT" *"REDUCE CLIMB - REDUCE CLIMB"*	Aural RA Adviscries	Both aurals "Reduce decent...." & "Reduce climb...." refer to own vertical speed are at that moment in the Red band, therefore vertical speed should be appropriately reduced.
"CLIMB CLIMB NOW" *"DESCEND DESCEND NOW"* *"INCREASE CLIMB"* *"INCREASE DESCENT"*	Aural RA Adviscries	"Climb Climb Now" is the same as ("Climb" x3 see Red & Green Band Descrptions) but this is followed by a "Descend" when circumstances require a reversal of vertical direction to ensure adequate vertical seperation. "Descend Descend Now" is the same as ("Descend" x3) but this is followed by a "climb" when circumstances require a reversal of vertical direction to ensure adequate separation. "Increase Climb" is heard when the vertical speed MUST BE INCREASED to ensure vertical separation. "Increase Descent" is heard when the vertical speed MUST BE INCREASED to ensure vertical separation.

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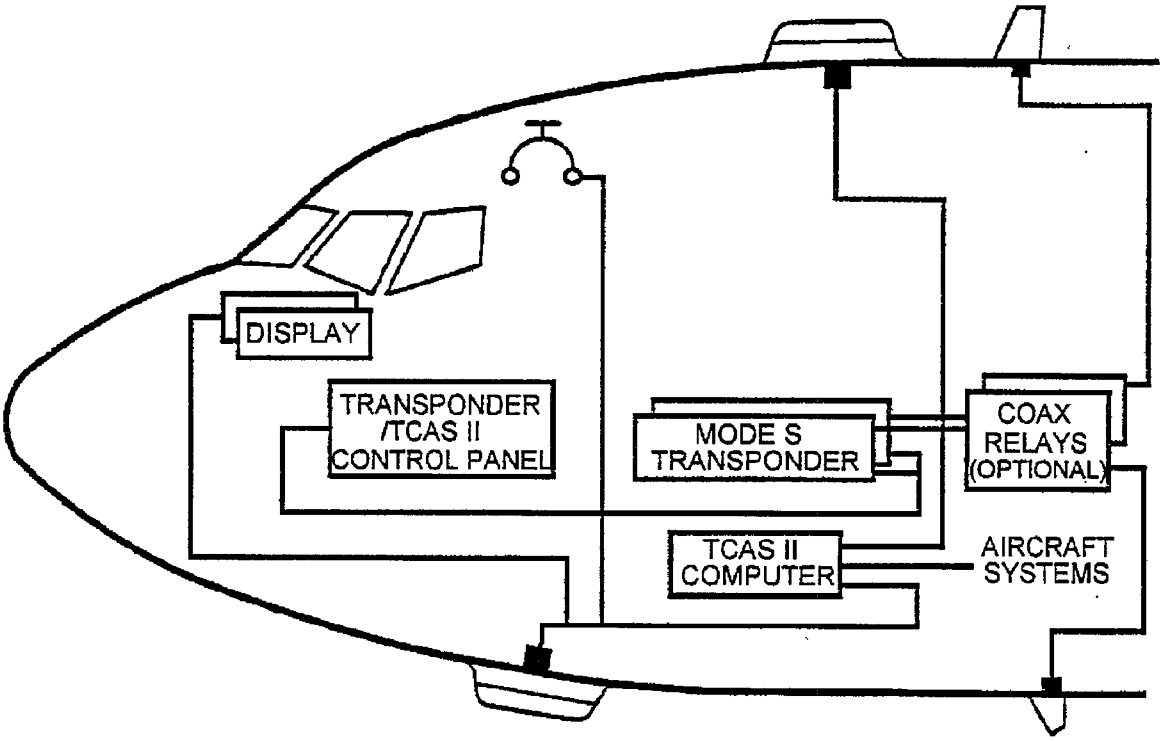
E. (cont)

ii) The VSI is controlled by a microprocessor. Analog and digital inputs are read, processed and bufferered by the microprocessor. The display is continuously created and updated by the microprocessor software. Power (±15V DC at 2 W maximum) is provided for a remote pressure sensor if required.

F. Pressure Transducer Module

The Pressure Transducer Module converts static pressure to a low speed output which is then used by the VSI to compute altitude rate.



TCAS II SYSTEM

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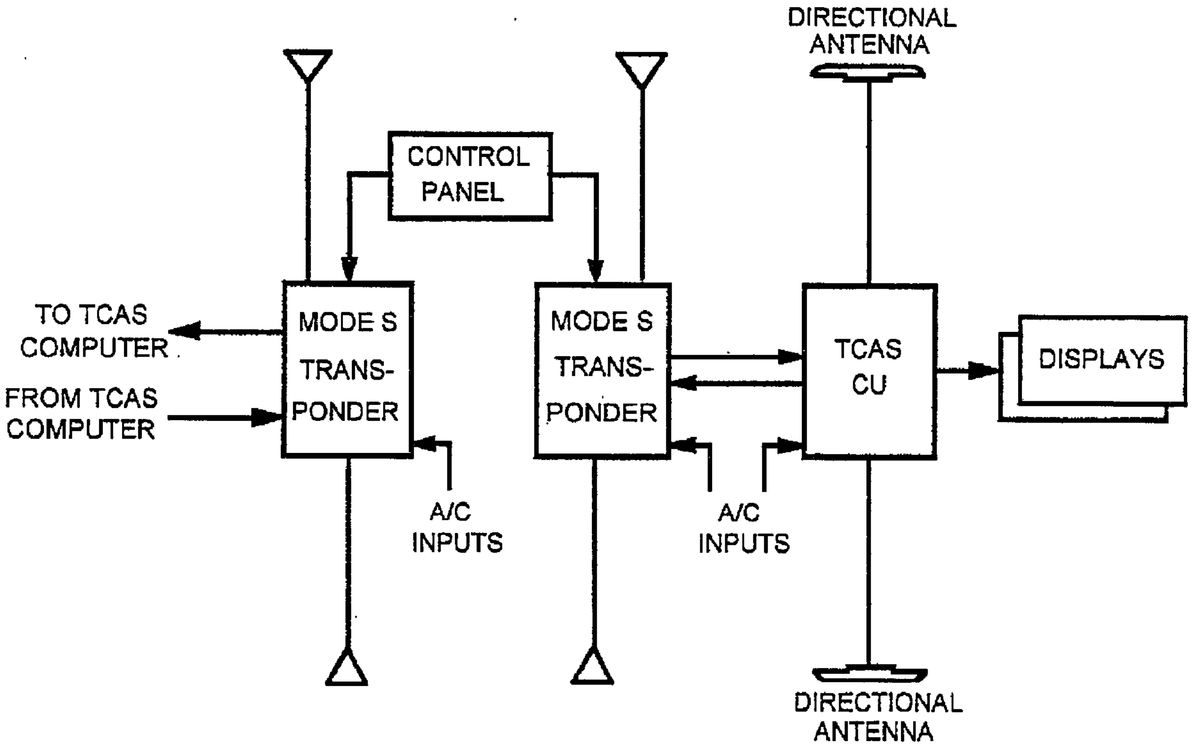

Monarch Dual Mode 'S'/Bottom Directional Antenna Installation

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Traffic Alert And Avoidance System (TCAS) - Adjustment/Test

1. General
   A. This procedure has two tasks. One is an operational test and the other is a system test. The operational test is a fast test of the TCAS system. The system test uses the operational test, then does a test of the system functions using additional test equipment.

2. Operational Test - TCAS
   A. General
      (1) This test is to make sure the TCAS is operating properly. It uses only the system's Built In Test Equipment (BITE) functions and special test or ground equipment is not necessary.
   B. References
      (1) 24-22-00/201, Electrical power - control.
      (2) 31-41-00/501, Engine Indication Crew Alerting System (EICAS)
      (3) 32-09-02/201, Air/Ground Relays
      (4) 34-12-00/501, Air Data System (ADS)
      (5) 34-21-00/501, Inertial Reference System (IRS)
      (6) 34-22-00/501, Electronic Flight Instrument System (EFIS)
      (7) 34-33-00/501, Low Range Radio Altimeter (LRRA)
      (8) 34-46-00/501, Ground Proximity Warning System (GPWS)
      (9) 34-53-00/501, Air Traffic Control System (ATC)
   C. Access
      (1) Location Zones

119/120	Main Equipment Centre
211/212	Flight Compartment

   D. Prepare for Operational Test

      (1) Supply electrical power (Ref 24-22-00/201)

      (2) Make sure these systems are serviceable:
         (a) Air Data System (Ref 34-12-00/501)
         (b) Air Traffic Control System (Ref 34-53-00/501)
         (c) Electronic Flight Instrument System (Ref 34-22-00/501)
         (d) Engine Indication Crew Alerting System (Ref 31-41-00/501)
         (e) Ground Proximity Warning System (Ref 34-46-00/501)
         (f) Inertial Reference System (Ref 34-21-00/501)
         (g) Low Range Radio Altimeter (Ref 34-33-00/501)

(3) Make sure these circuit breakers are closed.
  (a) Overhead Circuit Breaker Panel, P11;
    1) 11E7, TCAS
    2) 11S15, LANDING GEAR AIR/GND SYS 1
    3) 11S19, LANDING GEAR AIR/GND SYS 2

(4) Align all the IRS (Ref 34-21-00/201).

(5) Set the transponder select switch on the ATC Control Panel (referred to as the control unit for the rest of the section) to the L position.
  (a) Make sure the ATC FAIL lamp on the control unit is off.

(6) Set the mode switch on the control unit to the STBY position.
  (a) Make sure the IVSI shows the TCAS OFF indication.

(7) Set the mode switch on the control unit to the TA ONLY position.
  (a) Make sure TA ONLY shows on the IVSI.

(8) Set the mode switch on the control unit to the TA/RA position.
  (a) Make sure the IVSI continues to show the TA ONLY indication.

E. Procedure

(1) Do the self test as follows:
  (a) Push the TEST switch on the control unit.

  (b) Make sure these results occur:
    1) The control unit shows these indications:
      a) The IDENT CODE window shows 8888
    2) The IVSI shows the test pattern below (Fig 501)
      a) TEST shows on the right side of the IVSI
      b) An R/A (red square) at 3 o'clock, range of 6 nautical miles, 200 feet above and flying level.
      c) A T/A (solid amber circle) at 9 o'clock, range of 6 nautical miles, 300 feet below and climbing.
      d) Proximity Traffic (solid cyan diamond) at 2 o'clock, range of 6.5 nautical miles, 1100 feet below and descending.

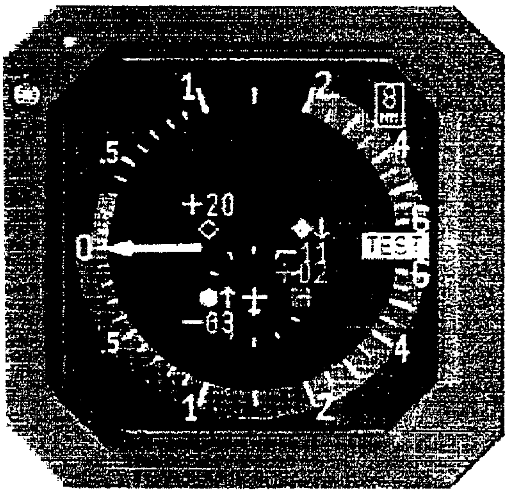
e) Non-Threat Traffic (hollow cyan diamond) at 11 o'clock, range of 6.5 nautical miles, 2000 feet above flying level.

f) Monitor Vertical Speed (red outer band) showing "do not descend and do not climb greater than 2000 feet" resolution advisories.

g) A green 'fly to' band showing safe area at present positon up to 300 feet above.

3) A TCAS SYSTEM PASS synthesized voice announcment is heard at the end of the test if the test passes.

NOTE : A TCAS SYSTEM FAIL synthesized voice announcment is heard at the end of the test if the test fails.



IVSI Self Test Display
Figure 501

(2) Do the self test again with the transponder select switch in the R position on the control unit.

(3) Remove the electrical power if it is not necessary (Ref 24-22-02/201).

3. System Test - TCAS

A. General

The objective of the test is to verify satisfactory installation and operation of the Honeywell TCAS II system. The tests will verify:

(1) Proper TCAS and IVSI/TRA system performance on-ground environments.
(2) Non-interference with aircraft systems operation.
(3) Proper operation of previously approved equipment whose installation was affected by the installation of the TCAS system.
(4) Proper Mode 'S' Transponder system performance on-ground environments.

B. Equipment

(1) TCAS Ramp Test Set - IFR Model TCAS-201
(2) Transponder Ramp Test Set - IFR Model ATC-601
(3) Radio Altimeter test set.
(4) Pitot/Static test set.

C. References

(1) 24-22-01/201, Electrical Power - Control.
(2) 32-09-02/201, Air/Ground Relays.

D. Prepare for System Test

CAUTION: DO NOT OPERATE TEST SET WHEN TEST SET ANTENNA IS WITHIN 15 INCHES OF AIRPLANE ANTENNA. DAMAGE TO THE TEST SET MAY OCCUR.

(1) Set up TCAS-201 test set antenna in an appropriate location (about 50 feet from the bottom TCAS antenna) forward of the airplane at 45 degrees off of the centreline to send signals to the TCAS directional antenna.

NOTE: Make sure there is no obstruction between the TCAS antenna and the test set antenna. Face the test set antenna in the direction so that the TCAS antenna under test receives the strongest signal. Use the antenna stand to prevent movements to the test set antenna which can cause TCAS to loose tracking. If ground equipment, walkways or other objects that could cause a signal obstruction or a multipath problem, choose a more suitable location for the test set and change the setup in the test set accordingly.

(2) Push the POWER switch to supply power to the TCAS-201 test set.

(3) Push the SET/CONT key on the TCAS-201 test set.

(4) Enter the distance, ± 5 feet, from the test set antenna and the bottom TCAS antenna in the HORIZ field.

(5) Enter the height difference, ± 3 feet, between the test set antenna and the bottom TCAS antenna in the VERT field.

(6) Enter the gain of the test set antenna in the GAIN field.

<u>NOTE:</u> The antenna gain should be listed on the test set antenna.

(7) Enter the loss of the cable in the LOSS field.

<u>NOTE:</u> The cable loss values should be listed on the cable.

E. Test The TCAS System

(1) Supply electrical power (Ref 24-22-00/201)

(2) Do the Operational Test.

(3) Do the TCAS Bearing Accuracy Test as follows:
  (a) Set the mode switch on the control unit to the TA ONLY position.
  (b) Push the SCEN key on the TCAS test set to show the scenario menu.
  (c) Set up this scenario:
    1) INTRUDER TYPE: ATCRBS   ALT: OFF
    2) RANGE: 8.0 nm   RATE: 0 kt
  (d) Use the test set to interrogate the four quadrants of the TCAS antenna at bearings of 0, 90, 180, and 270 degrees.

<u>NOTE:</u> Shield the bottom TCAS antenna with an antenna shield. This is the test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

  (e) Push the RUN/STOP key to start the test.
    1) Make sure the IVSI shows the intruder's bearing ± 15 degrees.

  (f) Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna.

<u>NOTE:</u> This is to test the bottom TCAS antenna. If you moved the test set, you must change the test set setup accordingly.

<u>WARNING:</u> MAKE SURE THE GROUND LOCKS ARE INSTALLED ON ALL THE LANDING GEAR (BEFORE YOU MOVE THE CONTROL LEVER). WITHOUT THE GROUND LOCKS, THE LANDING GEAR CAN RETRACT AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(4) Make sure the ground locks are installed on the nose and main landing gear (AMM 32-00-01/201).

(5) Put the landing gear lever in the OFF position.
  (a) Do the steps in the Bearing Accuracy Test again for the bottom antenna.

WARNING: YOU MUST CAREFULLY FOLLOW THE STEPS IN THE REFERENCED TASK TO PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE. FAILURE TO FOLLOW THE STEPS CORRECTLY CAN CAUSE THE AUTOMATIC OPERATION OF THE AIRPLANE SYSTEMS. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(6) Do the Prepare Safety-Sensitive Systems for Air Mode Simulation task (Ref 32-09-02/201)

(7) Simulate aircraft "In Air" by opening these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel;
    1) 11S15, LANDING GEAR AIR/GND SYS 1
    2) 11S19, LANDING GEAR AIR/GND SYS 2

(8) Connect the radio altimeter tests et to the airplane.

(9) Set the radio altitude to 2400 feet.

NOTE: Increase the radio altitude by 600 feet per minute (fpm) or less.

  (a) Make sure the IVSI does not show the TA ONLY indication when the radio altitude is greater than 600 feet.

(10) Set the mode select switch on the TCAS Control Panel to TA/RA position

(11) Set the transponder select switch on the TCAS Control Panel to L

(12) Connect a pitot/static test set to the airplane so that both air data computers be pressurized (Ref 34-11-00/201).

(13) Use the pitot/static test set to apply an altitude of 48,000 feet.

NOTE: The 48,000 feet barometric altitude is chosen to minimise false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting of the ATC temporarily off or put the ATC system on standby during this procedure and then reset to on when 48,000 is reached.

(14) Push the SCEN key to display scenario menu.

(15) Set up this scenario:
  (a) INTRUDER TYPE: ATCRBS ALT: ON
  (b) RANGE: 8.0 nm RATE: +500 kt
  (c) ALTITUDE: 47,900 ft RATE: 0 fpm

NOTE: Make sure the intruder's altitude is less than 100 feet below your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

(16) Push the RUN/STOP key to start the scenario.
   (a) Make sure this sequence shows on the IVSI display:
      1) The intruder moves down the 45-degree bearing mark to the airplane symbol.
      2) The intruder has the correct relative altitude.

      NOTE: **The relative altitude shown can be -00 or -01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.**

      3) The intruder begins as Non-threat Traffic (hollow cyan diamond).
      4) The intruder changes to Proximate Traffic (solid cyan diamond).
      5) The intruder changes to a Traffic Advisory (solid amber circle).
      6) The TCAS system gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
      7) The intruder changes to a Resolution Advisory (solid red square)
      8) The TCAS system gives a " CLIMB, CLIMB, CLIMB" voice announcement on the flight compartment speaker.
      9) The IVSI shows a resolution advisory to climb to a verified safe area (green outer band).
      10) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "INCREASE CLIMB" voice announcement on the flight compartment speaker.

   (b) Shortly after the intruder reaches the airplane symbol on the IVSI, TCAS system gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speaker.

   NOTE: **The "CLEAR OF CONFLICT" announcement sometimes may not be given.**

(17) Push the SCEN key to display scenario menu.

(18) Set up this scenario:
   (a) INTRUDER TYPE: Mode S
   (b) RANGE: 8.0 nm RATE: +500 kt
   (c) ALTITUDE: 48,100 ft RATE: 0 fpm

   NOTE: **Make sure the intruder's altitude is less than 100 feet above your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.**

(19) Push the RUN/STOP key to start the scenario.
   (a) Make sure this sequence shows on the IVSI display:
      1) The intruder moves down the 45 degree bearing mark to the airplane symbol.
      2) The intruder has the correct relative altitude.

NOTE: The relative altitude shown can be +00 or +01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.

3) The intruder begins as Non-threat Traffic (hollow cyan diamond).
4) The intruder changes to Proximate Traffic (solid cyan diamond).
5) The intruder changes to a Traffic Advisory (solid amber circle).
6) The TCAS system gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
7) The intruder changes to a Resolution Advisory (solid red square) and gives a "DESCEND, DESCEND, DESCEND" voice announcement on the flight compartment speaker.
8) The IVSI shows a resolution advisory to descend to a verified safe area (green outer band).
9) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "INCREASE DESCENT" voice announcement on the flight compartment speaker.

(b) Shortly after the intruder reaches the airplane symbol on the IVSI, TCAS system gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speaker.

NOTE: The "CLEAR OF CONFLICT" announcement sometimes may not be given.

(20) Return the airplane back to field level altitude.

(21) Set the radio altimeter to 0 feet.

NOTE: Decrease the radio altitude by 600 feet per minute (fpm) or less.

(a) Make sure the IVSI shows the TA ONLY indication when the radio altitude is less than 400 feet.

F. Put the Airplane Back to its Usual Condition

(1) Put the landing gear lever back to the down position.

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
(a) P11 Overhead Circuit Breaker Panel;
1) 11S15, LANDING GEAR AIR/GND SYS 1
2) 11S19, LANDING GEAR AIR/GND SYS 2

(3) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

4. TCAS Interface Test
   A. General
      (1) This interface test is a check of the interface between TCAS and other systems that interface with TCAS. The interface check on the ATC is done in the TCAS system test.

   B. References
      (1) AMM 31-41-00/501, Engine Indication Crew Altering System (EICAS).
      (2) AMM 34-12-00/501, Air Data System (ADS).
      (3) AMM 34-21-00/501, Inertial Reference System (IRS).
      (4) AMM 34-22-00/501, Electronic Flight Instrument System (EFIS).
      (5) AMM 34-33-00/501, Low Range Radio Altimeter (LRRA).
      (6) AMM 34-46-00/501, Ground Proximity Warning System (GPWS).
      (7) AMM 34-53-00/501, Air Traffic Control (ATC).

   C. Access
      (1) Location Zones

119/120	Main Equipment Centre
211/212	Flight Compartment

   D. Prepare for the Test
      (1) Make sure these systems are operational:
         (a) Air Data System (Ref 34-12-00/501)
         (b) Air Traffic Control System (Ref 34-53-00/501)
         (c) Electronic Flight Instrument System (Ref 34-22-00/501)
         (d) Inertial Reference System (Ref 34-21-00/501)
         (e) Low Range Radio Altimeter (Ref 34-33-00/501)
         (f) Ground Proximity Warning System (Ref 34-46-00/501)

      (2) Make sure these circuit breakers are closed:
         (a) P11 Overhead Circuit Breaker Panel;
            1) 11F3, TCAS
            2) 11S15, LANDING GEAR AIR/GND SYS 1
            3) 11S19, LANDING GEAR AIR/GND SYS 2

   E. GPWS Interface Test

      (1) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501)

<u>NOTE:</u> **The Ground Proximity Test will cycle through the three aural warnings "GLIDESLOPE", "WHOOP-WHOOP PULL-UP", and "WINDSHEAR, WINDSHEAR" with a slight delay between each warning. This is to make sure TCAS aurals are inhibited whenever these Ground Proximity warnings are annunciated.**

(2) During the "GLIDESLOPE" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "GLIDESLOPE" aural message occurs.

(3) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501).

(4) During the "WHOOP-WHOOP PULL-UP" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WHOOP-WHOOP PULL-UP" aural message occurs.

(5) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501)

(6) During the "WINDSHEAR, WINDSHEAR" aural, press the TEST button on the TCAS control panel.
   (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WINDSHEAR, WINSHEAR" aural message occurs.

F. IRS Interface Test

(1) Make sure the captain's IRS instrument source select switch is set to normal.

(2) Push the TEST switch on the front of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is not on.

(3) Set the left IRMP mode switch to ALIGN.

(4) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is on.

(5) Set the captain's IRS instruments source select switch to alternate.

(6) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is not on.

(7) Set the centre IRMP mode switch to ALIGN

(8) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure the HDNG fail light on the TCAS computer is on.

(9) Set the captain's IRS instruments source select switch to normal.

(10) Set the IRMP mode switches to NAV

G. Low Range Radio Altimeter Interface Test

(1) Make sure the two EADI's show a radio altitude between 0 and -10 feet.

(2) Push the TEST switch on the front panel of the TCAS computer.
(a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(3) Open this circuit breaker.
(a) P11 Overhead Circuit Breaker Panel:
1) 11F5, LEFT RAD ALTM

(4) Push the TEST switch on the front panel of the TCAS computer.
(a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(5) Open this circuit breaker.
(a) P11 Overhead Circuit Breaker Panel:
1) 11F26, RIGHT RAD ALTM

(6) Push the TEST switch on the front panel of the TCAS computer.
(a) Make sure you hear the "TCAS SYSTEM TEST FAIL" annunciation.

(7) Close this circuit breaker.
(a) P11 Overhead Circuit Breaker Panel:
1) 11F5, LEFT RAD ALTM

(8) Open and then close the TCAS circuit breaker to clear the latched fail state of the TCAS computer, if necessary.

(9) Push the TEST switch on the front panel of the TCAS computer.
(a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

(10) Close this circuit breaker.
(a) P11 Overhead Circuit Breaker Panel:
1) 11F26, RIGHT RAD ALTM

(11) Open these circuit breakers and attach DO-NOT-CLOSE tags:
(a) P11 Overhead Circuit Breaker Panel;
1) 11S15, LANDING GEAR AIR/GND SYS 1
2) 11S19, LANDING GEAR AIR/GND SYS 2

(12) Use the radio altimeter test set to simulate a radio altitude of 350 feet
(a) Make sure the EADI shows the radio altitude at 350 feet.
(b) Make sure the IVSI shows the TA ONLY indication.

(13) Use the radio altimeter test set to make a radio altitude of 1000 feet.
   (a) Make sure the EADI shows the radio altitude at 1000 feet.
   (b) Make sure the IVSI does not show a TA ONLY, TCAS FAIL, or TCAS OFF message.

(14) Close these circuit breakers.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11S15, LANDING GEAR AIR/GND SYS 1
      2) 11S19, LANDING GEAR AIR/GND SYS 2

H. Put the Airplane Back to its Usual Condition

(1) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

APPENDIX "A"

TCAS II SYSTEM
GROUND TEST PROCEDURE

for

AIR 2000 B757-200

5140-1208
REV -

HONEYWELL INC.
COMMERCIAL FLIGHT SYSTEMS GROUP
PHOENIX, ARIZONA

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TCAS SYSTEM

GROUND TEST PROCEDURE

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TCAS SYSTEM

GROUND TEST PROCEDURE

1.0 INTRODUCTION

1.1 Scope

This document specifies the ground and flight test requirements in support of 'Follow-On' certifications of the Honeywell TCAS II System, for Monarch B757-200 series aircraft. The tests will satisfy the requirements outlined in FAA Draft AC 20-131A, Paragraph 7.g., First of Type Approvals.

1.2 Objectives

The objective of the tests specified in this document is to provide system performance data which will verify satisfactory installation and operation of the Honeywell TCAS (-903) system. The data will support application for an STC.

The tests will verify:

a. Proper TCAS and VSI/TRA system performance on-ground environments.

b. Non-interference with aircraft systems operation.

c. Proper operation of previously approved equipment whose installation was affected by the installation of the TCAS System.

d. Proper Mode S transponder system performance on-ground environments.

2.0 REFERENCE DOCUMENTS

The following documents shall be considered a part of this certification test plan to the extent specified herein. In the event of a conflict between the referenced document and this certification test plan, this certification test plan shall take precedence. Documents referenced within documents shall not be applicable unless specified as such in this test plan.

2.1 FAA DOCUMENTS

FAA/DRAFT AC 20-131A April, 1990	Airworthiness and Operational Approval of Traffic Alert And Collision Avoidance System (TCAS II) and Mode S transponders DOT, FAA, Washington D.C.
FAR: Part 25	Federal Aviation Regulations, Part 25 - Airworthiness Standards - Transport Category Airplanes. DOT, FAA, Washington D.C
ARINC 718-4 Dec 15 1989	Air Traffic Control Transponder (ATCRBS/Mode S)
ARINC 735 thru Draft 1 of Supplement 2 11 Dec 1989	Traffic Alert and Collision Avoidance System (TCAS)

3.0 Ground Tests

3.1 Mode S Ground Tests

Unless otherwise noted, all of the following tests are to be conducted with an IFR ATC-601 or equivalent, transponder ramp test set.

Configure the TCAS/Mode S Control Panel settings as follows:

Select "TA/RA", on function mode select switch.
Select "XPDR 1"*, on the transponder select switch.

Apply power to the aircraft avionic systems.
Make sure the a/c is 'on the ground'.

Verify that the "TA Only", is annunciated on the VSI/TRA displays, and that the Vertical Speed Indicator is indicating 0 FPM rate.

Simulate aircraft 'In Air', by de-activating the Air/Ground and Landing gear circuit breakers.

The operating procedure for running of the tests shall be as per th instructions in the appropriate operators manual.

The ramp test set will display 'TEST PASSED' or 'TEST FAILED' indications as appropriate, on analyzing the measured parameters.

Activate the Mode S ramp test set.

* Transponder 1 = L Transponder
  Transponder 2 = R Transponder

3.1.1 Pressure Altitude (ADC) Interface Tests

Verify proper interface to the altitude sources and the TCAS system by exercising the aircraft pitot/static system with an altitude tester. Verify the altitude interface up to 45,000 feet at 5,000 feet intervals.

The altitude decoded by the ramp test set, should be within ± 100 feet of the expected altitude, as indicated by the Captains's or Flight Officer's altimeters.

Note:
#1 = Left Transponder
#2 = Right Transponder
System 1= S1= Altitude Source 1
System 2= S2= Altitude Source 2

3.1.1 DATA

Altitude Tester		System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
Ground	#1/S1				
Ground	#2/S1				
Ground	#1/S2				
Ground	#2/S2				
5000	#1/S1				
5000	#2/S1				
5000	#1/S2				
5000	#2/S2				

Observer:___________

3.1.1 DATA cont.

Altitude T ster	System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
10000 #1/S1	______	__________	________	_________
10000 #2/S1	______	__________	________	_________
10000 #1/S2	______	__________	________	_________
10000 #2/S2	______	__________	________	_________
15000 #1/S1	______	__________	________	_________
15000 #2/S1	______	__________	________	_________
15000 #1/S2	______	__________	________	_________
15000 #2/S2	______	__________	________	_________
20000 #1/S1	______	__________	________	_________
20000 #2/S1	______	__________	________	_________
20000 #1/S2	______	__________	________	_________
20000 #2/S2	______	__________	________	_________
25000 #1/S1	______	__________	________	_________
25000 #2/S1	______	__________	________	_________
25000 #1/S2	______	__________	________	_________
25000 #2/S2	______	__________	________	_________

3.1.1 DATA cont.

Altitude Tester	System (#1/#2)	Capt. Alt.	F/O Alt.	Ramp Test Set
30000 #1/S1				
30000 #2/S1				
30000 #1/S2				
30000 #2/S2				
35000 #1/S1				
35000 #2/S1				
35000 #1/S2				
35000 #2/S2				
40000 #1/S1				
40000 #2/S1				
40000 #1/S2				
40000 #2/S2				
45000 #1/S1				
45000 #2/S1				
45000 #1/S2				
45000 #2/S2				

Observer:___________

SELECT TRANSPONDER #1 ON THE TCAS/MODE S CONTROL PANEL

3.1.2.1 Altitude Request Test - Intruder Surveillance

Make sure that altitude reporting is 'ON'.

Interrogate with Mode S UF4.

Verify that the reply has the correct altitude and format.

3.1.2.1 DATA

____ Correct UF-4 Reply (Test Passed)

3.1.2.2 Mode S UF5: ID Request Test

Interrogate Mode S transponder with UF5.

Verify that the reply has the correct ID code, correct address and correct format.

3.1.2.2 DATA

____ Correct UF-5 Reply (Test Passed)
____ Correct ID Code
____ Correct Address

3.1.2.3 Mode S Squitter Txmt Test

Verify that Squitter signals are received from the Mode S transponder, every 1 (+/- 0.2) sec.

3.1.2.3 DATA

______ Period (seconds)
______ Squitter signals (Test Passed)

Observer:__________

3.1.2.4 Reply Frequency Test

Interrogate the system and verify the reply frequency of the transponder is 1090 (+/- 1) MHz.

3.1.2.4 DATA

______ Frequency (MHz)
______ Reply Frequency (Test Passed)

3.1.2.5 Transmit Power/Receiver Sensitivity Test

Follow the specific directions in the ramp test set operator's manual, to conduct the transmit power/receiver sensitivity test. Monitor the Mode S transponders interrogations and reply signals.

Verify that the peak power output from the transponder is between 54 (+/- 3) dBm ERP. Verify that the MTL of the system is: -74 (+/- 3) dBm.

3.1.2.5 DATA

______ Transmit Power: Top (dBm)
______ Transmit Power: Bottom (dBm)
______ Receive Sensitivity (MTL): Top (dBm)
______ Receive Sensitivity (MTL): Bottom (dBm)

3.1.2.6 Mode S Address Test

Verify that the Mode S transponder replies to interrogations using Own Mode S Address.

Next verify that NO reply is received from the transponder when interrogated with a Mode S, non All-Call, address of which is different from Own Mode S Address.

3.1.2.6 DATA

All Call Address __________ All Call Address __________
DF4 Reply Address __________ DF4 Reply Address __________

_____ Replies to correct address
_____ Does not reply to incorrect address

Observer:_________

3.1.2.7 ATCRBS Reply Test

Interrogate with Modes A and C and verify that replies are received by the ramp test set.

3.1.2.7 DATA

____ Mode S (Mode A)
____ Mode S (Mode C)

3.1.2.8 Transponder Parameter Selection Test

Verify that when the 'IDNT' button on the TCAS/ Mode S Control Panel is activated, the ident code is displayed at the ramp test set and that it remains valid for 15 to 20 seconds.

3.1.2.8 DATA

____ IDNT Verified (Mode S UF4: FS = 4)
____ Duration (seconds)

3.1.2.9 Discretes Verification Test

Verify the status of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Check for correct discrete configuration setting for AIR/GND, by verifying that no ATCRBS replies are received while the aircraft is on the ground.

3.1.2.9 DATA

____ (Mode S UF0: RI = C)

____ Aircraft On Ground (Mode S UF4: FS = 1)

____ No ATCRBS replies on ground (ATCRBS Reply Test = Fail)

Simulate aircraft 'In Air'.

SELECT MODE S TRANSPONDER #2, ON THE CONTROL PANEL

Observer:__________

3.1.3.1 Altitude Request Test - Intruder Surveillance

Interrogate with Mode S UF4.

Verify that the reply has the correct altitude and format.

Select "ALT/R OFF" on the TCAS/Mode S Control Panel and verify that the altitude information is no longer being decoded at the ramp test set.

3.1.3.1 DATA

____ Correct UF-4 Reply (Test Passed)
____ ALT RPTG OFF (AC = 0 FT)

Return the altitude reporting to 'ON'.

3.1.3.2 Mode S UF5: ID Request Test

Interrogate Mode S transponder with UF5.

Verify that the reply has the correct ID code, correct address and correct format.

3.1.3.2 DATA

____ Correct UF-5 Reply (Test Passed)
____ Correct ID Code
____ Correct Address

3.1.3.3 Mode S Squitter Txmt Test

Verify that Squitter signals are received from the Mode S transponder, every 1 (+/- 0.2) sec.

3.1.3.3 DATA

______ Period (seconds)
______ Squitter signals (Test Passed)

Observer:__________

3.1.3.4 Reply Frequency Test

Interrogate the system and verify the reply frequency of the transponder is 1090 (+/- 1) MHz.

3.1.3.4 DATA

______ Frequency (MHz)
______ Reply Frequency (Test Passed)

3.1.3.5 Transmit Power/Receiver Sensitivity Test

Follow the specific directions in the ramp test set operator's manual, to conduct the transmit power/receiver sensitivity test. Monitor the Mode S transponders interrogations and reply signals.

Verify that the peak power output from the transponder is between 54 (+/- 3) dBm ERP. Verify that the MTL of the system is: -74 (+/- 3) dBm.

3.1.3.5 DATA

______ Transmit Power: Top (dBm)
______ Transmit Power: Bottom (dBm)
______ Receive Sensitivity (MTL): Top (dBm)
______ Receive Sensitivity (MTL): Bottom (dBm)

3.1.3.6 Mode S Address Test

Verify that the Mode S transponder replies to interrogations using Own Mode S Address.

Next verify that NO reply is received from the transponder when interrogated with a Mode S, non All-Call, address of which is different from Own Mode S Address.

3.1.3.6 DATA

All Call Address ____________ All Call Address ____________
DF4 Reply Address ____________ DF4 Reply Address ____________

_____ Replies to correct address
_____ Does not reply to incorrect address

Observer:__________

3.1.3.7 ATCRBS Reply Test

Interrogate with Modes A and C and verify that replies are received by the ramp test set.

3.1.3.7 DATA

____ Mode S (Mode A)
____ Mode S (Mode C)

3.1.3.8 Transponder Parameter Selection Test

Verify that when the IDENT button on the TCAS/ Mode S Control Panel is activated, the ident code is displayed at the ramp test set and that it remains valid for 15 to 20 seconds.

3.1.3.8 DATA

____ IDENT Verified (Mode S UF4: FS = 4)
____ Duration (seconds)

3.1.3.9 Discretes Verification Test

Verify the status of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Check for correct discrete configuration setting for AIR/GND, by verifying that no ATCRBS replies are received while the aircraft is on the ground.

3.1.3.9 DATA

____ (Mode S UF0: RI = C)

____ Aircraft On Ground (Mode S UF4: FS = 1)

____ No ATCRBS replies on ground (ATCRBS Reply Test = Fail)

Simulate aircraft 'In Air'.

Observer:__________

3.2 VSI Ground Tests

3.2.1 VSI Climb and Descend Rate Indications

Evaluate the pilot's and first officer's VSI/TRA displays for vertical speed operation. The test is performed by using a ground based static source test unit to maintain a constant FPM indication on the VSI, and timing the rate of altitude indication change on the captain's and first officer's altimeters.

Verify that altitude rates indicated on the VSI displays CORRESPOND to the rates induced by the static altitude test equipment. The test must be conducted for verification of both the climb and the descend senses.

Induce climb rates of: 500, 1000 and 2000 feet per minute (FPM) and descend rates of: 500, 1000 and 2000 feet per minute (FPM).

3.2 DATA

VSI Indication (Climb - FPM)	Start	End	Time Interval (seconds)	Climb Rate (FPM)
	Altitude (ft)			

________ Climb Rates Verified (Pass/Fail)

VSI Indication (Descend - FPM)	Start	End	Time Interval (seconds)	Climb Rate (FPM)
	Altitude (ft)			

________ Climb Rates Verified (Pass/Fail)

Observer:__________

3.2.2 VSI (ADC Source) Fail Indication

Verify that when the circuit breaker of the altitude source (ADC), for the VSI/TRA display, is 'opened', that "VSI FAIL" and "TCAS OFF" messages are annunciated on the corresponding VSI/TRA display. Note: Do not open circuit breaker for either IRS, only associated ADC's. This will accomplish the same result without requiring a realignment of the IRS's.

3.2.2 DATA

____ "VSI FAIL" and "TCAS OFF"- Indication verified on Captains VSI.

____ "VSI FAIL" and "TCAS OFF"- Indication verified on Flight Officers VSI.

Observer:__________

3.3 TCAS System Ground Tests

These tests will be performed utilizing a TCAS ramp test equipment (IFR TCAS-201 or equivalent). A TCAS data recording system may be used for auxiliary data analysis.

3.3.1 Self Test Check

Activate the TCAS Self Test function by pressing and momentarely holding the 'TEST' switch in the 'TEST' position on the TCAS/ Mode S Control Panel.

Verify the TCAS Self Test feature by confirming that the expected TCAS test display: four intruders in a square formation, along with the red and green bands for Resolution Advisory are displayed, and the test aural annunciations are generated. The self test should terminate with the aural annunciation of: "TCAS TEST PASS".

3.3.1 DATA

______Self Test (Pass/Fail)

3.3.2 Extended Test Functions Check

Verify the access to the TCAS extended test mode on the Sextant VSI.

The extended test mode will be activated by setting the control Panel display function select switch to 'STBY', and pushing and holding the 'TEST' button on the Control Panel TCAS/ Mode S Selector Switch for at least eight (8) seconds.

The TCAS systems' "GEAR DOWN" and "AIR/ GND" logic indicators must indicate aircraft gear to be extended and the aircraft to be on ground, in order for the Extended Test function to be activated.

3.3.2 DATA

______ Extended Test (Pass/Fail)

Observer:__________

3.3.3 Radio Altimeter Source Test

3.3.3.1 Radio Altitude No. 1

Verify proper interface of the Radio Altimeters to the TCAS II system, by exercising the Radio Altimeter with a suitable tester.

Us the Radio Altitude tester to obtain the desired altitude level -indicated on the Captain's radio altimeter.

3.3.3.1 DATA

Altitude L vel	Captain's Radio Altimeter (ft)	Captain's VSI
Ground	0	TA
300	300	TA
700	700	TA indication disappears

Observer:__________

3.3.3.2 Radio Altitude No. 2

Pull circuit breaker for Radio Altitude No. 1. Verify that the Radio Altitude No. 1 is inactive.

Use the Radio Altitude tester to obtain the desired altitude level -indicated on the First Officer's radio altimeter.

3.3.3.2 DATA

Altitude Level (ft)	First Officer's Radio Altimeter (ft)	First Officer's VSI
Ground	0	TA
300	300	TA
700	700	TA indication disappears

RESET THE RADIO ALTITUDE NO. 1 CIRCUIT BREAKER

Observer:__________

3.3.4 Bearing Tests

Verify the surveillance operation of the TCAS system and directional antennas. Configure the TCAS/Mode S Control Panel settings as follows:

Select "TA/RA", on function mode select switch.
Select "XPDR 1", on the transponder select switch.

3.3.4.1 Top Directional Antenna Test

Use the IFR TCAS-201 ramp test set to simulate a stationary Mode C intruder at 2.0 nm and with an altitude of 500 feet above the aircrafts' baro altitude. Position the ramp test set at the front of the aircraft (0 degrees) and then move it around the aircraft, pausing approximately every 90° position to allow the display of the intruder on the VSIs to stabilize.

Coverage at all four of the quadrants will be verified.

3.3.4.1 DATA

Nominal Position	Relative Bearing (Approximate)	Observed Intruder Bearing	Comment
0	________	________	________
90	________	________	________
180*	________	________	________
270	________	________	________

Observer:__________

* Position of the ramp test set may have to be offset slightly from th 180° position due to obstruction by the tail structure.

3.3.4.2 Bottom Directional Antenna Test

Use a dummy antenna load to terminate the TCAS outputs to the top directional antenna during the bottom directional antenna test. This will ensure that there is no interference from the top direction antenna during this test.

Simulate the aircraft "in air" and "gear up" condition, to the inputs to the TCAS CU.

Use the IFR TCAS-201 ramp test set to simulate a stationary Mode C intruder at 2.0 mn. and with an altitude of 500 feet above the aircrafts' baro altitude. Position the tester at the front of the aircraft (0 degrees) and then move it around the aircraft, pausing approximately 90° position to allow the display of the intruder on the VSIs to stabilize.

Coverage at all four of the quadrants will be verified.

3.3.4.2 DATA

Nominal Position	Relative Bearinge (Approximate)	Observed Intruder Bearing	Comment
0*	________	________	________
90	________	________	________
180	________	________	________
270	________	________	________

Observer:__________

* Position of the ramp test set may have to be offset slightly from the 0° position due to obstruction by the nose gear.

3.3.5 TCAS Aural Advisory Audibility

Verify the intelligibility of the TCAS aural advisories using the test sequence initiated through the TCAS/Mode S Control Panel.

Initiate a TCAS self test sequence followed immediately by a GPWS self sequence. Verify the following:

i> That the TCAS aural warnings are approximately as loud as the GPWS warnings.
ii> That the TCAS aural warnings are interrupted by GPWS aural warnings.
iii> That the TCAS System goes into "TA ONLY" mode.*

* With weight OFF wheels/gear and RAD ALT at > 600'.

Repeat the above sequence with the Windshear warning system, if installed.

3.3.5 DATA

____ Aural advisories intelligible
____ GPWS warning priority
____ Windshear warning priority
____ TA Only Mode

Observer:__________

3.3.6 Traffic/ Resolution Advisory Check

Demonstrate the operation of the TCAS system by programming the TCAS ramp test set to simulate a Mode C intruder approaching the aircraft, from a distance greater than 4.0 nm, and at an altitude of 200 feet above the aircrafts' baro altitude.

Verify that this scenario results in causing a TA and RA to be generated, with proper bearing, distance, and relative altitude.

Verify that the appropriate aural advisories, TRAFFIC-TRAFFIC, DESCEND-DESCEND-DESCEND, and CLEAR-OF-CONFLICT, are annunciated.

Aircraft configuration:

Radio Altimeter:	> 2000 ft.
Barometric Altitude:	> 5000 ft.
Aircraft	- in Air
Landing Gear	- Down

Failure criteria shall be unacceptable TA or RA display or TCAS operation during the encounter with the test equipment.

3.3.6 DATA

____ TA Display Operation Acceptable
____ RA Display Operation Acceptable

Observer:__________

3.3.7 Control Panel Functions Evaluations

3.3.7.1 TCAS Mode Controls Evaluations

Activate each of the selectable TCAS modes available on the TCAS/ Mode S Control Panel. Verify proper operation in each mode by observing the appropriate changes in the TCAS display.

TCAS MODE	TCAS DISPLAY MESSAGE
STBY (Standby)	TCAS OFF
XPDR (Transponder only)	TCAS OFF
TA (TA Only)	TA/ONLY*
RA/TA	(none)*
ALT/R OFF	TCAS OFF

* With weight OFF wheels/gear and RAD ALT at > 600'.

With the use of the TCAS ramp test set, simulate an RA encounter scenario (Test 3.3.8) and verify that:

a) No aural advisories are annunciated and no Traffic is indicated on the display, while the TCAS system is in "STBY", "XPDR" or "ALT/R OFF" modes, and that the display indicates "TCAS OFF".

b) Only the "TRAFFIC TRAFFIC" aural advisories are annunciated and the intruder is displayed only as a "TA" on the IVSI, while TCAS is in the "TA Only" mode.

c) The system annunciates the normal "TRAFFIC TRAFFIC", and the appropriate resolution advisories, and the intruder is displayed as a "TA" or as an "RA", as appropriate, while the TCAS is in the "TA/RA" mode.

3.3.7.1 DATA

_____ STBY Mode
_____ XPDR Mode
_____ ALT/R OFF

_____ TA Only Mode
_____ RA/TA Mode

3.3.8 Sensor Failure and Self Test

Conduct a subsystem failure test. Activate TCAS SELF TEST function prior to each failure, after inducing the failure, and after the failure is corrected.

Simulate failure of each of the equipment called out in Table 1, by pulling its circuit breaker.

Note: The TCAS II System should be placed in "TA ONLY" or "RA/TA" Mode for these tests.

Failures should generate 'TCAS FAIL' messages on the VSI/TRA's as appropriate, and should generate 'TCAS TEST FAIL' aural messages when SELF TEST function is active after the failure.

Verify that the system behavior is as expected per Table 1.

Failures of the following equipment will be simulated:

- Air Data Computers
- Radio Altimeters
- Mode S Transponders
- VSI/TRAs
- TCAS Computer Unit

3.3.8 DATA

____ Altitude Source 1
____ Altitude Source 2
____ Radio Altimeter 1
____ Radio Altimeter 2
____ Mode S Transponder 1
____ Mode S Transponder 2
____ Mode S Transponder 1 and 2
____ Cockpit VSI/TRA 1
____ Cockpit VSI/TRA 2
____ Cockpit VSI/TRA 1 and 2
____ TCAS CU

Table 1

Sensor Failure Matrix

Sensor	VSI/TRA Indication	Self Test Indication
Alt Source 1 (Note 1)	TCAS OFF	TCAS TEST PASS
Alt Source 2 (Note 1)	TCAS OFF	TCAS TEST PASS
Radio Altimeter 1	(none)	TCAS TEST PASS
Radio Altimeter 2	(none)	TCAS TEST PASS
Radio Altimeter 1 and 2	TCAS FAIL	TCAS TEST FAIL
Mode S Transponder 1 Note 1	TCAS OFF	TCAS TEST PASS
Mode S Transponder 2 Note 1	TCAS OFF	TCAS TEST PASS
Mode S Transponder 1 and 2	TCAS FAIL	(none)
Cockpit VSI/TRA 1 *	#1 OFF #2 none	TCAS TEST PASS
Cockpit VSI/TRA 2 *	#1 none #2 OFF	TCAS TEST PASS
Cockpit VSI/TRA 1 and 2 *	#1 and #2 OFF	TCAS TEST FAIL
TCAS CU	TCAS FAIL	(none)

NOTE: 1. Transponder No.1 selected on the TCAS/Mode S Control Panel.

2. "VSI FAIL" will be displayed on indicator which has selected its Altitude Source Fail. (No VSI rate data due to loss of baro altitude to the associated IRS.

* When the VSI's are 'OFF', the displays are without power and are blank.

3.3.9 Electromagnetic Non-Interference (EMI)

Conduct a flight deck EMI survey on the ground.

Verify that the installed TCAS equipment does not generate any unacceptable interference to any of the other on-board equipment, and that non of the other on-board equipment in operation, generates unacceptable interference to the installed TCAS system.

The following equipment will be operated and evaluated for interference to/ from TCAS equipment:

VHF Comm #1 and #2
VHF Nav/ILS #1, #2, and #3
Marker Beacon Receiver #1
Weather Radar
DME #1 and #2
Public Address system
Ground Interphone
HF Radio #1 and #2

3.3.9 DATA

______ VHF Comm #1 and #2
______ VHF Nav/ILS #1, #2, and #3
______ Marker Beacon Receiver #1
______ Weather Radar
______ DME #1 and #2
______ Public Address system
______ Ground Interphone
______ HF Radio #1 and #2

Observer:________

3.3.10 Configuration Discrete

Verify the status (using the First Officer's VSI) of applicable discrete inputs to the TCAS CU, used to define the configuration and capabilities of the aircraft, with the TCAS test equipment.

Put the aircraft to normal 'on ground' status.

Pull the TCAS circuit breaker and remove the lru from the rack. Using an ohmmeter measure the resistance at the rack connector on the following pins:

i.	Air/ Ground discrete	RMP Pin 5K
ii.	Gear status discrete	RMP Pin 13F
iii.	Max. Climb Altitude	RMP Pins 6E, 6F, 6G, 6H, 6J

3.3.10 DATA

Reading

_____ Air/ Ground discrete Air = 100 Kohm ; Gnd = 100 ohm

_____ Gear status Discrete G up = 100 Kohm ; G down = 100 ohm

_____ Maximum Climb Altitude (ALT LIMIT = 48,000 ft)

Connector	Pins	Reading
RMP	6H	100 ohm
	6J	100 ohm
RMP	6E	100 Kohm
	6F	100 Kohm
	6G	100 Kohm

Observer:__________

Monarch *BOEING 757*

AIR 2000

757-2Y0

MAINTENANCE MANUAL

CHAPTER 34 - NAVIGATION

Traffic Alert and Collision Avoidance System (TCAS) Computer Removal/Installation

1. General
   - A. This procedure has two tasks. One is the removal of the TCAS Computer; the other is the installation of the TCAS Computer.
   - B. The TCAS Computer, M09001 (P/No. 4066010-903), is installed on the E2-1 rack in the main equipment centre. (Fig 401)

2. TCAS Computer Removal
   - A. References
     - (1) 20-10-01/401, E/E Mounted Components
     - (2) 20-41-01/201, Electrostatic Sensitive Devices

   - B. Access
     - (1) Location zones
       - 119/120 Main Equipment Centre

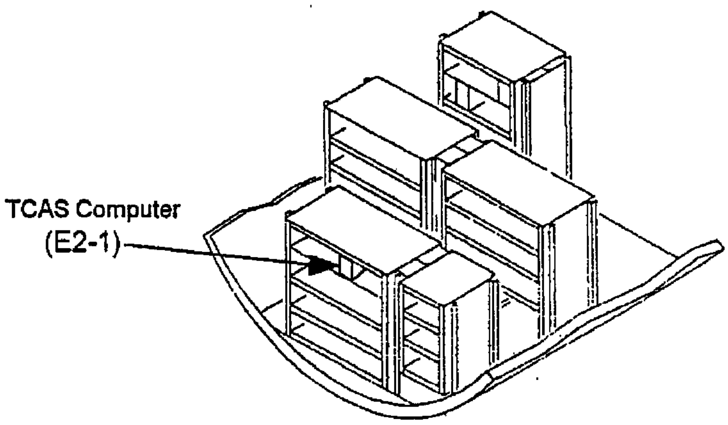
     - (2) Access Panels
       - 119BL Main Equipment Centre Access Door

   - C. Procedure

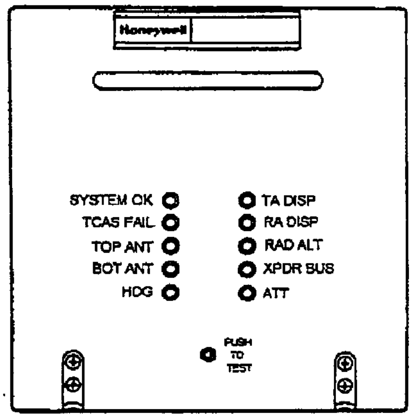
     - (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
       - (a) P11, Overhead Circuit Breaker Panel
         - 1) 11F3, TCAS

     CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTRO-STATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

     - (2) Remove the TCAS Computer (Ref 20-10-01/401)



MAIN EQUIPMENT CENTRE



TCAS Computer

figure 401

(3) Install dust caps on the electrical connectors.

3. TCAS Computer Installation
   A. Reference
      (1) 20-10-01/401, E/E Rack Mounted Components
      (2) 24-22-00/201, Electrical Power - Control
      (3) 34-45-00/MON 501, TCAS Test

   B. Access
      (1) Location Zones
         119/120 Main Equipment Centre

      (2) Access Panels
         119BL Main Equipment Centre Access Door

   C. Procedure
      (1) Make sure these circuit breakers are open:
         (a) P11, Overhead Circuit Breaker Panel
            1) 11F3, TCAS

<u>CAUTION:</u> DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

      (2) Install the TCAS Computer (Ref 20-10-01/401)

   D. TCAS Computer Test
      (1) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
         (a) P11, Overhead Circuit Breaker Panel
            1) 11F3, TCAS

      (2) Supply electrical power (Ref 24-22-00/201)
      (3) Do the TCAS Operational test (Ref 34-45-00/MON 501)

   E. Put the Airplane Back to its Usual Condition

      (1) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

Dual Air Traffic Control (ATC) Control Panel - Removal/Installation

1. General
   - A. This procedure has two tasks. One is the removal of the ATC Control Panel; the other is the installation of the ATC Control Panel.
   - B. The ATC Control Panel, G6992-12, is installed on the Aisle Control Stand, P8. Electrical connections are at the rear of the control panel.

2. Remove the ATC Control Panel
   - A. Access
     - (1) Location Zones
       - 211/212 Flight Compartment
   - B. Prepare for removal
     - (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
       - (a) 11F7, ATC LEFT
       - (b) 11F28, ATC RIGHT
   - C. Procedure
     - (1) Loosen and remove the screws on the Control Panel.
     - (2) Move the Control Panel out to get access to the electrical cable.
     - (3) Disconnect the two electrical connectors.
     - (4) Remove the ATC Control Panel.

3. Install the ATC Control Panel
   - A. References
     - (1) 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones
         211/212   Flight Compartment

C. Prepare for Installation

   (1) Make sure these circuit breakers on the P11 panel are open:
      (a) 11F7, ATC LEFT
      (b) 11F28, ATC RIGHT

D. Procedure

   (1) Connect the two electrical connectors to the Control Panel.

   (2) Install the ATC Control Panel.

   (3) Tighten the screws on the Control Panel.

   (4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
      (a) 11F7, ATC LEFT
      (b) 11F28, ATC RIGHT

E. ATC Control Panel Test

   (1) Supply electrical power (Ref 24-22-00/201).

   (2) Make sure the Control Panel lights come on.

   (3) Set the Transponder select switch on the ATC Control Panel to the L or 1 position.

(4) Push and hold the Test switch on the front panel of the left ATC Transponder.
  (a) Make sure the sequence that follows occurs:
    1) All LEDS come on.
    2) All LEDS go off.
    3) The green LED comes on and stays on.

(5) Release the TEST switch on the ATC Transponder.
(6) Set the Transponder select switch on the ATC Control Panel to the R or 2 position.
(7) Push and hold the TEST switch on the front panel of the right ATC Transponder.
  (a) Make sure the sequence that follows occurs:
    1) All LEDS come on.
    2) All LEDS go off.
    3) The green LED comes on and stays on.
(8) Release the TEST switch on the ATC Transponder.
(9) Push and hold the TEST switch on the ATC Control Panel.
  (a) Make sure the sequence that follows occurs:
    1) On the VSI's, four 'intruders' appear in a square formation, along with Red and Green bands denoting RA's.
    2) A aural annunciation is heard stating either "TCAS TEST PASS" or "TCAS TEST FAIL".
    3) On the VSI's, a visual display stating either "TCAS TEST PASS" or "TCAS TEST FAIL".

F. Put the Airplane back to its usual condition

(1) Set the Transponder select switch to the STBY position.

(2) Remove electrical power if it is not necessary (Ref 24-22-00/201).

aes aerospace engineering solutions	MODIFICATION TITLE: INTRODUCTION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM [EGPWS]	MODIFICATION No. **AES-757-165** **ISSUE 4, PT A & B** **Page 1 of 13**

www.aesglobal.com **JAR21 APPR: CAA.JA.02304**	A/C TYPE:. B757	A/C VARIANT:. SEE SECTION 2	A/C REG:. SEE SECTION 2	A/C SERIAL No:. SEE SECTION 2

Retro. Action: **SEE SHT. ~~YES~~/NO**	Certificate of Airworthiness Category: **PUBLIC TRANSPORT - PASSENGER**	JAA Class: **MAJOR/~~MINOR~~**
Project No.: 0107	Performance Group: **TURBINE JET**	ATA: 34

Reason for Modification: **FACILITATE OPERATOR COMPLIANCE WITH JAR-OPS 1.665**	Reports: AES-TR-0030, AES-TR-0031, AES-TR-0032, AES-TR-0033, AES-TR-0034, AES-TR-0045, AES-TR-0046

WEIGHT CHANGE **SEE SECTION 5.5.1**	ELECTRICAL LOAD **SEE SECTION 5.5.2**	NOISE **SEE SECTION 5.3**	DOCUMENTS **SEE SECTION 11.0**

CERTIFICATE OF DESIGN

I hereby certify that this modification defines all the changes associated with this certificate.

The technical information contained in this document has been approved under the authority of JAA Design Organisation Approval No CAA.JA.02304
I further certify that, with the exceptions listed below, the design of this modification complies with the requirements specified by the CAA as the certification basis for this type of aircraft and with any additional requirements notified by the CAA in respect of the particular modification.

EXCEPTIONS

NONE – FOR LIMITATIONS REFER TO SECTION 6 AND 8

APPROVAL STATUS **COMPLETE/~~INCOMPLETE~~ (see section 10)**	**CAA STC No.: CAA.21NE2.00039** **JAA STC No.: NOT APPLICABLE**

ISSUE	**DRAFT**	**1**	**2**	**3**	**4**		
DRN No.	**-**	**0484**	**0523**	**0556**	**0694**		
APPROVAL DATE	**-**	**MAE** **24.10.03**	**MAE** **26.11.03**	**MAE** **24.12.03**	**MAE** **05.05.04**		

ISSUE	RAISE ISSUE DETAIL	SHEETS AFFECTED
4	PARA 2.2.2, 2.8.4.2, 2.9.1 & 2.9.2 AMENDED PARA 5.5.3.1 AMENDED PARA 11.1.1 AMENDED PARA 11.1.2 & 11.3.1 AMENDED PARA 11.3.2 AMENDED CHANGES HIGHLIGHTED WITH VERTICAL MARGINAL LINES.	2, 3 & 4 7 8 9 10

ISSUE	DATE	COMPILED	CVE / APP STRUCTURES	CVE / APP DESIGN	CVE / APP SYSTEMS	DOCUMENTS AFFECTED	SEE SHT
1	**20.10.03**	**A TEMPLETON**	**M A E**	**M A E**	**A L H**	MMEL* MAINT MANUAL	6 6
2	**25.11.03**	**M IRVINE**	**M A E**	**M A E**	**A L H**	WDM ~~REPAIR MANUAL~~	6
3	**18.12.03**	**M IRVINE**	**M A E**	**A M D**	**A L H**	FLIGHT MANUAL CREW MANUAL*	6 6
4	**26.04.04**	**R.KENNY**	**M A E**	**A M D**	**A L H**	~~MAINT. SCHEDULE~~ PART CATALOGUE	6
						* OPERATORS RESPONSIBILITY	

DETAILS OF MODIFICATION

1.0 Introduction

1.1 The subject aircraft are installed from build with a Ground Proximity Warning System providing aural and visual warnings of aircraft closeness to terrain for various flight conditions.

1.2 This modification replaces the existing GPWS with an Enhanced GPWS and installs additional aircraft system interfaces and hardware to provide the following additional modes for compliance with the requirements of JAR-OPS 1.665.

1.3 This modification must be embodied concurrently with AES modification AES-757-081 – 'INTRODUCTION OF GPS ANTENNA'.

1.4 This modification is split into two parts A & B. AES-757-165 Part A is **only** applicable to aircraft equipped with EFIS Symbol Generator part numbers 622-9436-101 and Operational Performance software P/N 995-0491-011 or later (section 2.9.1 refers). AES-757-165 Part B is applicable to aircraft **not equipped** with EFIS Symbol Generator part numbers 622-9436-101 and Operational Performance software P/N 995-0491-011 (Section 2.9.2 refers).

2.0 Modification Definition

2.1 The existing GPWS Computer located in the Main Equipment Bay shelf E2-3 is replaced with an Enhanced GPWS Computer (P/N 965-0976-020-212-212). The new unit is installed into the existing mounting tray assembly.

2.2.1 **AES-757-165 Part A Only:** The existing Captains and First officer's EFIS control panels are replaced with panels incorporating a Terrain Display select switch.

2.2.2 **AES-757-165 Part B Only:** The existing Captains and First officer's instrument panels P1 and P3 are modified to incorporate a separate Terrain Display and Weather Radar select switch. The existing Weather Radar select switch located on the EFIS control panel is re-idented WXR/TERR.

2.3 A new GPS antenna is installed at STA690 on the aircraft fuselage crown by concurrent modification AES-757-081. A new co-axial feeder is installed between the antenna and the EGPWS unit on shelf E2-3.

2.4 The existing flight deck aural warning speakers are retained as existing.

2.5.1 **AES-757-165 Part A Only:** A new Terrain Override Switch is installed in the First Officer's instrument panel P3-1.

2.5.2 **AES-757-165 Part B Only:** A new combined Terrain Override Switch and Terrain Fail annunciator is installed in the First Officer's instrument panel P3-1.

2.6 Additional wiring for ARINC 429 data system inputs into the GPWS are introduced from the Left and Right EFIS Symbol Generators, Right and Centre Radio Altimeters, Right FMC, Right Air Data system, Right ILS and Right IRS.

2.7 Additional relays are introduced in the P36 panel to facilitate the ARINC 453 Terrain Display/Weather Radar bus switching to the EFIS symbol generators.

2.8 Functionality

2.8.1 The Enhanced Ground Proximity Warning Computer receives digital databus signals from the following systems to develop the warning and alerting modes. The existing GPWS modes 1 through 6 are retained unaffected.

1.) Air Data System (DADC)
2.) Flight Management System (FMS)
3.) Inertial Reference System (IRS)
4.) Instrument Landing System (ILS)
5.) Radio Altimeter System
6.) Stall Warning System

2.8.2 The following existing discretes in the computer logic used for the warning and alerting modes are retained unaltered:

1.) Ground Proximity Test Switch
2.) Gear Override Switch
3.) Flap Override Switch
4.) G/S Inhibit Switch
5.) Air/Ground System
6.) TCAS

2.8.3 Additional positional data is introduced by the addition of a GPS antenna to supply the internal GPS card within the EGPWS computer.

2.8.4.1 **AES-757-165 Part A**: The following new discrete is introduced as part of the Enhanced system capabilities:

1.) Terrain Override Switch

2.8.4.2 **AES-757-165 Part B**: The following new discretes are introduced as part of the Enhanced system capabilities:

1.) Terrain Override Switch / Fail annunciator
2.) WXR/TERRAIN Mode Select Switches

2.8.5 The ground proximity computer outputs the following digital databus signals to the following LRU's:

1.) EFIS Symbol generators (Terrain Display [**Part A & B**] / Warning messages [**Part A only**])
2.) EICAS Computers

3.) Digital Flight Data Acquisition unit (DFDAU)

2.8.6 The EGPWS also provides an analog audio output to the Warning Electronic Unit (WEU) for amplification and output to the flight deck warning speakers.

2.9 APPLICABILITY

2.9.1 **AES-757-165 PART A**: Part A of this modification is applicable to the following aircraft:

Reg	**Type**	**Var #**	**MSN**
G-CPEP	B757-2YO	NB322	25268
G-OOOY	B757-28A	NT232	28203
G-OOOZ	B757-236	NA352	25593
G-OOOK	B757-236	NA346	25054
G-OOOX	B757-2YO	NB329	26158
G-OOBI	B757-2B7	NB506	27146
G-OOBJ	B757-2B7	NB507	27147

2.9.2 **AES-757-165 PART B**: Part B of this modification is applicable to the following aircraft:

Reg	**Type**	**Var #**	**MSN**
G-OOOB	B757-28A	NA442	23822
G-OOOC	B757-28A	NA443	24017
~~G-OOOD~~	~~B757-28A~~	~~NA447~~	~~24235~~
G-OOOG	B757-23A	NB134	24292

3.0 Approval Procedures

3.1 This modification certification/approval/validation has been carried out in accordance with JAR 21.

4.0 Basis of Certification/Validation/Approval

4.1 CAA Certification/Validation/Approval Basis For The Aircraft/Modification

4.1.1 The certification basis of the aircraft type is FAR 25, UK Type Certificate Data Sheet FA28 refers.

4.1.2 The design requirements addressed by this modification are detailed within the Project Specific Certification Plan (PSCP). AES Technical Report AES-TR-0030 refers.

4.2 Design Requirements For Certificate Of Airworthiness

4.2.1 Not applicable.

4.3 Environmental Requirements

4.3.1 The aircraft noise requirements are detailed in CAA Noise Type Certificate No. 58 & 77, UK TCDS FA28 refers.

4.4 Design Requirements Associated With operational Approvals

4.4.1 The following JAR OPS-1 design requirements are addressed within this modification.

Requirement	**Description**
JAR OPS 1.665	Ground Proximity Warning Systems

5.0 Compliance with the Basis of Certification/Validation/Approval

5.1 Compliance with the Certification/Validation/Approval Basis for the Aircraft/Modification.

5.1.1. Embodiment of this modification does not affect the certification basis of the aircraft.

5.1.2 **AES-757-165 Part A**: EGPWS System Safety Hazard Assessment and certification compliance statements are detailed within AES Technical Report AES-TR-0033.

5.1.3 **AES-757-165 Part B**: EGPWS System Safety Hazard Assessment and certification compliance statements are detailed within AES Technical Report AES-TR-0045.

5.1.4 The EGPWS computer unit is UK CAA approved under CAA Accessory Approval Number VC01107 and has been previously been certified on Boeing aircraft.

5.1.5 Post embodiment the system shall be function tested in accordance with AES Technical Report AES-TR-0031 [**AES-757-165 PT A**] / AES-TR-0046 [**AES-757-165 PT B**].

5.2 Compliance With Design Requirements For Certificate Of Airworthiness

5.2.1 Not Applicable.

5.3 Compliance with Environmental Requirements

5.3.1 Embodiment of this modification does not affect the existing noise certificate.

5.4 Compliance with Design Requirements Associated with Operational Approvals

5.4.1 Post embodiment of this modification the subject aircraft will meet the requirements contained in JAR OPS-1.665 with respect to carriage of a ground proximity warning system that includes a forward looking terrain avoidance function (Terrain Awareness and Warning System – TAWS)

5.5 Required (Amendments to) Manuals and other Documents Including Mandatory Placards.

5.5.1 Weight

5.5.1.1 The increase in weight attributable to this modification is approximately 20.0lbs at Fuse Station 400.

5.5.1.2 It is the operator’s responsibility to amend the aircraft weight and balance manual.

5.5.2 Electrical Load Analysis

5.5.2.1 The electrical load increase attributable to the new EGPWS LRU is 22 Watts on the 115VAC Left Bus. The electrical load increase attributable to the new relays is less than 0.25 A on the Left 28VDC source. The electrical load increase attributable to the new lightplate is 0.24 A

5.5.2.2 The emergency flight times are not affected and the aircraft maintains positive reserves of generator capacity during all phases of flight.

5.5.3 Aircraft Flight Manual

5.5.3.1 The aircraft flight manual is affected by this modification. A supplement will be produced for the respective Boeing Flight Manual as follows and submitted to the UK CAA for approval:

Aircraft Variant	Boeing AFM Doc No.	AES Supplement No.	Issue
B757-2YO (G-CPEP)	D631N005.2Y01	AES SUPPLEMENT No 1	1
B757-28A	D631N005.28A	AES SUPPLEMENT No 1	1
B757-236	D631N005.2S3	AES SUPPLEMENT No 2	1

Aircraft Variant	Boeing AFM Doc No.	AES Supplement No.	Issue
B757-2YO (G-OOOX)	D631N005.2Y0UK	AES SUPPLEMENT No 1	1
B757-23A (G-OOOG)	D631N005.23A	AES SUPPLEMENT No 1	1
B757-2B7 (G-OOBI & G-OOBJ)	TBC	AES SUPPLEMENT No 1	1

5.5.4 Minimum Equipment List (MEL)

It is the operator's responsibility to amend the Minimum Equipment List.

5.5.5 SFAR 88 Compliance

This modification maintains compliance with SFAR 88.

5.5.6 Continued Airworthiness

Supplemental revisions to the Maintenance Manual (AMM), Illustrated Parts Catalogue (IPC) and Wiring Diagram Manual (WDM) shall be provided to the operator. AES Technical Publication Supplement AES-TP-0003 refers.

6.0 Conditions Affecting This Approval

6.1 The compatibility of this modification with other previously approved modifications installed on the particular aircraft must be verified by the installer. Where the potential for interactions between modifications exists, the advice of the Design Organisation/CAA shall be sought.

6.2 For the first installation only, a flight evaluation shall be carried out to ensure correct system functionality. Upon completion the report shall be submitted to the authority for review. AES Technical Report AES-TR-0032 refers.

7.0 Continued Airworthiness

7.1 The influence of the modification on Airworthiness Directive, Service Bulletin eligibility and other data must be considered and the publications monitored accordingly. The maintenance schedule for the aircraft should include reference to this material additional to the original design. Co-ordination is the responsibility of the operator.

8.0 Survey

8.1 This Major modification is subject to an aircraft survey post embodiment by the Authority prior to release to service.

9.0 Authorisation of Release to Service

9.1 In addition to the actions required by the procedures for release to service following maintenance or modification, the following actions must be completed prior to signing the Certificate of Release to Service:

a) All actions and ground test procedures specified by the modification instructions must be completed satisfactorily.

b) It must be verified that the documents or amendments to documents, above are as specified, including any changes specified under Section 8 above.

10.0 Approval

10.1 This Major modification AES-757-165 (MCA-AES-757-165) and related instructions will be approved by the Authority.

11. Documents Required

11.1.1 **AES-757-165 PART A**: New Drawings Introduced

Drawing Number	Issue	Title	Effectivity
0528-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-CPEP G-OOOY
0655-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-OOOZ, G-OOOK, G-OOOX
0793-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-OOBI, G-OOBJ
0555-346-757	1	TERRAIN OVERRIDE SWITCH INSTALLATION	AES-757-165 PT A
0563-113-757	1	P11 CIRCUIT BREAKER PANEL MODIFICATION	AES-757-165 PT A
0595-344-757	1	CO-AXIAL CABLE CONNECTOR INSTALLATION (E2-3)	AES-757-165 PT A
0597-331-757	1	W/D: REWORK OF FIRST OFFICERS INST & PANEL LIGHTS	G-CPEP G-OOOY
0571-344-757	1	ILLUMINATED PANEL - TERRAIN OVERRIDE SWITCH	AES-757-165 PT A
0797-113-757	1	P11 CIRCUIT BREAKER PANEL MODIFICATION	G-OOBI, G-OOBJ

11.1.2 **AES-757-165 PART B**: New Drawings Introduced

Drawing Number	Issue	Title	Effectivity
0770-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-OOOG
0614-346-757	1	INSTALLATION OF EGPWS SWITCHES [FLIGHT DECK]	G-OOOB, G-OOOC, G-OOOG
0778-113-757	1	P11 CIRCUIT BREAKER PANEL MODIFICATION	G-OOOB, G-OOOC
0595-344-757	1	CO-AXIAL CABLE CONNECTOR INSTALLATION (E2-3)	G-OOOB, G-OOOC, G-OOOG
~~0658-331-757~~	~~1~~	~~W/D: REWORK OF FIRST OFFICERS INST & PANEL LIGHTS~~	~~AES-757-165 PT B~~
0571-344-757	1	ILLUMINATED PANEL - TERRAIN OVERRIDE SWITCH	G-OOOB, G-OOOC, G-OOOG
0779-113-757	1	P11 CIRCUIT BREAKER PANEL MODIFICATION	G-OOOG
0794-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-OOOB
0795-344-757	1	W/D: INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS) B757	G-OOOC

11.2 Concurrent Modifications Also Required

Document Number	Issue	Title
AES-757-081	2	MODIFICATION SUMMARY TITLE: INTRODUCTION OF GPS ANTENNA

11.3.1 **AES-757-165 PART A**: Reports/Documents

Document Number	Issue	Title	Effectivity
MEI-090	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-CPEP G-OOOY
MEI-268	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-OOOZ, G-OOOK, G-OOOX
MEI-390	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-OOBI, G-OOBJ
AES-TR-0030	1	INTRODUCTION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM [EGPWS] – PROJECT SPECIFIC CERTIFICATION PLAN (PSCP)	AES-757-165 PT A
AES-TR-0031	2	EGPWS GROUND TEST PROCEDURE B757 AIRCRAFT	AES-757-165 PT A

Document Number	Issue	Title	Effectivity
AES-TR-0032	1	EGPWS FLIGHT EVALUATION SCHEDULE B757 AIRCRAFT	G-OOOY ONLY
AES-TR-0033	2	SYSTEM SAFETY ASSESSMENT AND CERTIFICATION COMPLIANCE FOR A HONEYWELL ENHANCED GROUND PROXIMITY WARNING SYSTEM (FOR A/C FITTED **WITH** EFIS SG P/N 622-9436-101 AND OPS SOFTWARE 995-0491-011 OR LATER)	AES-757-165 PT A

11.3.2 **AES-757-165 PART B**: Reports/Documents

Document Number	Issue	Title	Effectivity
MEI-384	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-OOOG
MEI-391	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-OOOB
MEI-392	1	INSTALLATION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	G-OOOC
AES-TR-0030	1	INTRODUCTION OF ENHANCED GROUND PROXIMITY WARNING SYSTEM [EGPWS] – PROJECT SPECIFIC CERTIFICATION PLAN (PSCP)	AES-757-165 PT B
AES-TR-0046	1	EGPWS GROUND TEST PROCEDURE B757 AIRCRAFT	AES-757-165 PT B
AES-TR-0045	1	SYSTEM SAFETY ASSESSMENT AND CERTIFICATION COMPLIANCE FOR A HONEYWELL ENHANCED GROUND PROXIMITY WARNING SYSTEM (FOR A/C **NOT FITTED WITH** EFIS SG P/N 622-9436-101 AND OPS SOFTWARE 995-0491-011 OR LATER)	AES-757-165 PT B
AES-TR-0032	2	EGPWS FLIGHT EVALUATION SCHEDULE B757 AIRCRAFT	G-OOOG ONLY

11.4 Design Organisations Instructions and Query Note's. (G-CPEP NB322)

Document Number	Issue	Title
DOI-0152	2	ADDITIONAL WIRING INSTALLATION FOR G-CPEP AND G-OOOY EGPWS MODIFICATION (QN-757-165-14)
DOI-0156	1	INSTALLATION OF ADDITION WEATHER RADAR CONTROL PANEL WIRING.
DOI-0168	1	INSTALLATION OF ADDITION WIRING TO RECTIFY WEATHER RADAR RANGE PROBLEMS
DOI-0169	1	EFIS PIN PROGRAMMING TO ENABLE WXR MODE ANNUNCIATION
QN-AES-757-165-02	1	INCORRECT CONTACT P/N CALL-OUT
QN-AES-757-165-03	1	MISSING CONTACT P/N CALL-OUT
QN-AES-757-165-04	1	MISSING CONTACT P/N CALL-OUT

Document Number	Issue	Title
QN-AES-757-165-05	1	EXISTING UTILISED MODULE BLOCK ALLOCATION.
QN-AES-757-165-06	1	EGPWS BACK CONNECTOR PIN ALLOCATION.
QN-AES-757-165-07	1	RELOCATION OF RELAYS AES-K9007 & AES-K9008
QN-AES-757-165-08	2	ROUTING OF CABLES IN THE P3-1 PANEL.
QN-AES-757-165-09	1	AMENDMENT FROM PINS TO SOCKETS
QN-AES-757-165-10	1	REFITTING OF WIRE W1175-0615-22
QN-AES-757-165-11	1	DRAWING ERROR ON DOI-152
QN-AES-757-165-12	1	MEI-090 PG 79 DUPLICATION OF PINS 28,29 & 30
QN-AES-757-165-13	1	WIRE W9001 AES-0081-20 (PIN CONTACT BACC47DE1A)
QN-AES-757-165-14	1	TERMINAL BLOCKS FULL.
QN-AES-757-165-15	1	CAP AND STOW SPARE WIRE
QN-AES-757-165-24	1	CONNECTOR REPOSITIONING
QN-AES-757-165-25	1	CANCELLATION OF QN-AES-757-165-24 @ BASCO REQUEST
QN-AES-757-165-32	1	WIRE IDENT ERROR ON QN-AES-757-165-14
QN-AES-757-165-35	1	EGPWS FUNCTION TEST QUERY (WEATHER RADAR)
QN-AES-757-165-36	1	EGPWS FUNCTION TEST QUERY (TERRAIN DISPLAY)

11.5 Design Organisations Instructions and Query Note’s. (G-OOOY NT232)

Document Number	Issue	Title
DOI-0152	2	ADDITIONAL WIRING INSTALLATION FOR G-CPEP AND G-OOOY EGPWS MODIFICATION (QN-757-165-14)
DOI-0156	1	INSTALLATION OF ADDITION WEATHER RADAR CONTROL PANEL WIRING.
DOI-0168	2	INSTALLATION OF ADDITION WIRING TO RECTIFY WEATHER RADAR RANGE PROBLEMS
DOI-0169	1	EFIS PIN PROGRAMMING TO ENABLE WXR MODE ANNUNCIATION
QN-AES-757-165-02	1	INCORRECT CONTACT P/N CALL-OUT
QN-AES-757-165-03	1	MISSING CONTACT P/N CALL-OUT
QN-AES-757-165-04	1	MISSING CONTACT P/N CALL-OUT
QN-AES-757-165-05	1	EXISTING UTILISED MODULE BLOCK ALLOCATION.
QN-AES-757-165-07	1	RELOCATION OF RELAYS AES-K9007 & AES-K9008
QN-AES-757-165-09	1	AMENDMENT FROM PINS TO SOCKETS
QN-AES-757-165-16	1	WIRE QUANTITY SHORTAGE **(GAMCO 004)**
QN-AES-757-165-17	1	ADDITION OF THERMAX WIRE TO PARTS LIST **(GAMCO 006)**
QN-AES-757-165-18	1	WIRE GAUGE ALLOCATION **(GAMCO 003)**
QN-AES-757-165-19	1	EXISTING ANTENNA CO-AXIAL CABLE **(GAMCO 001)**
QN-AES-757-165-20	1	P11 LIGHPLATE **(GAMCO 002)**
QN-AES-757-165-21	1	REDUNDANT GROUND WIRE **(GAMCO 007)**
QN-AES-757-165-22	1	MODULE BLOCK REPOSITION **(GAMCO 009)**
QN-AES-757-165-23	1	GROUND BLOCK RELOCATION **(GAMCO 005)**
QN-AES-757-165-26	1	VALIDATION OF EXISTING QN's FOR G-OOOY **(GAMCO 014)**

Document Number	Issue	Title
QN-AES-757-165-27	1	EGPWS BACK CONNECTOR PIN ALLOCATION. **(GAMCO 008)**
QN-AES-757-165-28	1	IRU-R CONNECT CONFIRMATION **(GAMC0 010)**
QN-AES-757-165-29	1	LIGHTPLATE QUERY **(GAMCO 013)**
QN-AES-757-165-30	1	DRAWING ERROR [PIN D7 MIDDLE PLUG] **(GAMCO 011)**
QN-AES-757-165-31	1	REF ERROR IN MEI **(GAMCO 012)**
QN-AES-757-165-33	1	ROUTING OF CABLES IN THE P3-1 PANEL. **(GAMCO 015)**
QN-AES-757-165-34	1	VALIDATION OF EXISTING QN's FOR G-OOOY **(GAMCO 016)**
QN-DOI-168-01	1	ALTERNATE PINS ALLOCATION
QN-DOI-168-02	1	TYPO ERROR ON DOI
QN-DOI-168-03	1	TYPO ERROR ON DOI
QN-DOI-168-04	1	ALTERNATE PINS ALLOCATION
QN-DOI-169-01	1	ALTERNATE GROUND

11.6 Design Organisations Instructions and Query Note's. (G-OOOK NA346)

Document Number	Issue	Title
QN-AES-757-165-62	1	15 PIN CONNECTOR
QN-AES-757-165-63	1	CONFLICT OF WIRE ROUTING
QN-AES-757-165-64	1	SPLICE SIZE QUERY
QN-AES-757-165-65	1	WIRE LENGTH SHORT
QN-AES-757-165-66	1	WIRE DELETION/RE-ROUTE QUERY
QN-AES-757-165-67	1	PIGTAIL LENGTH SHORT
QN-AES-757-165-68	1	GROUND TERMINAL SHORTAGE
QN-AES-757-165-69	1	WRONG CONNECTOR IDENT
QN-AES-757-165-70	1	FLAG NOTE AMENDMENT
QN-AES-757-165-71	1	CONNECTOR POSITION QUERY
QN-AES-757-165-72	1	GROUND POSITIONS FULL
QN-AES-757-165-73	1	FLAG NOTE AMENDMENT FOR SKTS/PINS
QN-AES-757-165-74	1	GROUND POINTS FULL
QN-AES-757-165-75	1	MEI 268,PG 79, 81 & 121 NO WIRE CODE
QN-AES-757-165-76	1	OMMISSION OF CONNECTOR IDENT
QN-AES-757-165-77	1	QUERY ON WIRE GAUGE
QN-AES-757-165-78	1	PIN DUPLICATION
QN-AES-757-165-79	1	PIN IDENT DUPLICATION
QN-AES-757-165-80	1	PIN IDENT DUPLICATION
QN-AES-757-165-81	1	PIN IDENT DUPLICATION
QN-AES-757-165-82	1	PIN IDENT DUPLICATION
QN-AES-757-165-83	1	CAPPING & STOWING WIRE W2352-063
QN-AES-757-165-84	1	POSITIONING OF RELAY BASES
QN-AES-757-165-85	1	WIRE DUPLICATION
QN-AES-757-165-86	1	CAPPING & STOWING WIRE W2352-063
QN-AES-757-165-87	1	TYPO ERROR

Document Number	Issue	Title
QN-AES-757-165-88	1	LINK WIRE DELETION
QN-AES-757-165-89	1	SPLICE QUERY
QN-AES-757-165-90	1	GROUND QUERY
QN-AES-757-165-91	1	SOLDER SLEEVE QUERY
QN-AES-757-165-92	1	CONN’R PIN NO. QUERY
QN-AES-757-165-93	1	SOLDER SLEEVE QUERY
QN-AES-757-165-94	1	GROUND QUERY
QN-AES-757-165-95	1	ANTENNA CO-AXIAL ROUTING QUERY
QN-AES-757-165-96	1	CONTACT P/N QUERY
QN-AES-757-165-97	1	CONN’R IDENT CLARIFICATION QUERY
QN-AES-757-165-98	1	DWG 0595-344-757 QUERY
QN-AES-757-165-99	1	DECAL CLARIFICATION QUERY
QN-AES-757-165-100	1	METAL WORK ADJUSTMENT QUERY
QN-AES-757-165-101	1	PIN ALLOCATION QUERY
QN-AES-757-165-102	1	CAP & STOW SPARE WIRE QUERY
QN-AES-757-165-103	1	REDUNDANT WIRE QUERY
QN-AES-757-165-104	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-105	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-106	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-107	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-108	1	GROUND ALLOCATION QUERY
QN-AES-757-165-109	1	TERMINAL BLOCK ALLOCATION QUERY
QN-AES-757-165-110	1	ANCHOR NUT P/N QUERY
QN-AES-757-165-111	1	CAP & STOW SPARE WIRE QUERY
QN-AES-757-165-112	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-113	1	CONN’R PIN ALLOCATION QUERY
QN-AES-757-165-114	1	RIVET LENGTH QUERY
QN-AES-757-165-115	1	CAP & STOW SPARE WIRE QUERY
QN-AES-757-165-116	1	CAP & STOW SPARE WIRE QUERY
QN-AES-757-165-117	1	REDUNDANT WIRE QUERY

aes aerospace engineering solutions www.aesglobal.com **EUROPEAN AVIATION SAFETY AGENCY** **PART21 APPR: EASA.21J.036**	MODIFICATION TITLE: **INTRODUCTION OF REMOVABLE MODE-S ADDRESS CODING PLUGS**	MODIFICATION No. **AES-757-427** **PART A & B** **ISSUE 2** **Page 1 of 6**

A/C TYPE:.	A/C VARIANT:	A/C REG:.	A/C SERIAL No:.
B757	-200	SEE SECTION 2	SEE SECTION 2

Retro. Action: **SEE SHT.** **~~YES~~/NO**	Certificate of Airworthiness Category: **LARGE AEROPLANE**	EASA Class: **~~MAJOR~~/MINOR**
Project No.: **0404**	Performance Group: **TURBINE JET**	ATA: 34
Reason for Modification: TO SUIT THE OPERATORS REQUIREMENTS (FIRST CHOICE AIRWAYS Ltd)		Reports: NONE

WEIGHT CHANGE	ELECTRICAL LOAD	NOISE	DOCUMENTS
SEE SECTION 5.5.1	**SEE SECTION 5.5.2**	**SEE SECTION 5.3.1**	**SEE SECTION 11.0**

CERTIFICATE OF DESIGN

I hereby certify that this modification defines all the changes associated with this certificate.

The technical information contained in this document has been approved under the authority of EASA Design Organisation Approval No EASA.21J.036.
I further certify that, with the exceptions listed below, the design of this modification complies with the requirements specified by the Agency as the certification basis for this type of aircraft and with any additional requirements notified by the Agency in respect of the particular modification.

EXCEPTIONS

NONE

APPROVAL STATUS **COMPLETE/~~INCOMPLETE~~ (see section 10)**	**~~CAA STC No.:~~** **EASA STC No.:** **NOT APPLICABLE**

ISSUE	**1**	**2**					
DRN No.	**1276**	**1364**					
APPROVAL DATE	**MAE** **03-07-05**	**MAE** **12.09.05**					

ISSUE	RAISE ISSUE DETAIL	SHEETS AFFECTED
1	NEW ISSUE	
2	DETAILS OF C-FLEU INCLUDED DOCUMENT ISSUE NUMBERS AMENDED CHANGES INDICATED BY A MARGINAL VERTICAL LINE	2 6

ISSUE	DATE COMPILED		CVE / APP STRUCTURES	CVE / APP DESIGN	CVE / APP SYSTEMS	DOCUMENTS AFFECTED	SEE SHT
1	**04.07.05**	**T HAWKINS**	**M EVANS**	**A DOLBY**	**A HEISSIG**	~~MMEL~~ ~~MAINT MANUAL~~ WDM* ~~REPAIR MANUAL~~ ~~FLIGHT MANUAL~~ ~~CREW MANUAL~~ ~~MAINT. SCHEDULE~~ ~~PART CATALOGUE~~	4
2	**18.08.05**	**A MADDY**	**M EVANS**	**A DOLBY**	**A HEISSIG**		
						* OPERATORS RESPONSIBILITY	

DETAILS OF MODIFICATION

1.0 Introduction

1.1 This modification introduces a new wiring configuration for the aircraft left and right ATC/Mode-S transponders to facilitate installation of a removable 24-bit Mode-S address coding plug.

1.2 This modification is written in two parts A & B to facilitate progressive embodiment. Part A of this modification enables manufacture of a 24-bit Mode-S address coding plug. Part B of this modification enables rework of the Left and Right Transponder coding bundle to allow installation of the removable 24-bit Mode-S address coding plug.

2.0 Modification Definition

2.1 Applicability: This modification is applicable to the following aircraft:
NOTE: Registrations shown in brackets [ ] represent sub-lease registrations

Aircraft Registration	Variable No.	Hexadecimal Code
G-OOBH [C-FOBH]	NT407	400A8A [C0251A]
G-OOBG [C-FUBG]	NT405	40078A [C034F1]
G-OOOK [C-FLOK]	NA346	400488 [C01E83]
G-OOOZ [C-GOOZ]	NA352	40051C [C06B26]
G-OOBB [C-GTBB]	NT246	40090E [C076F0]
G-CPEP	NB322	400699
G-CPEU [C-FLEU]	NT404	400788 [C01D89]
G-CPEV	NT406	400789
G-OOBA	NT245	40090D
G-OOBI	NB506	400AEE
G-OOBJ	NB507	400AED
G-OOOX	NB329	400533
G-OOOY	NT232	4006B5

2.1 AES-757-427 Part A: Removable Plug Manufacture

2.1.1 The component kit associated with Part B of this modification is manufactured in accordance with the instruction documents detailed in Section 11. These documents are not required for direct work on an aircraft and are shown herein for design traceability purposes only. The applicable Hexadecimal codes are shown for reference.

2.2 AES-757-427 Part B: Mode-S Coding Bundle Rework & Installation of Removable coding plug

2.2.1 The Left and Right transponder coding bundle and plugs located on the E3-3 and E3-2 shelves are reworked to allow installation of the removable 24-bit Mode-S address coding plug. AES drawing 1178-345-757 refers.

2.2.2 The new 24-bit Mode-S coding plug manufactured by Part A of this modification is installed to the Left and Right mode-S transponders.

3.0 Approval Procedures

3.1 This modification certification/approval/validation has been carried out in accordance with EASA Part 21.

4.0 Basis of Certification/Validation/Approval

4.1 Certification/Validation/Approval Basis For The Aircraft/Modification

4.1.1 The certification basis of the aircraft (B757) is FAR 25 (state of design is U.S.A.) with Amendment 25-1 through 25-45 and additional amendments applicable as defined in the FAA TCDS A2NM Rev 24.

4.1.2 The following CS25 (initial issue) design requirements, which meet or exceed the applicable FAR's determined from the type certification basis, are addressed within this modification.

Requirement Description	
CS/FAR 25.869 (a)(4)	Fire Protection: Systems
CS/FAR 25.1301	Function and Installation
CS/FAR 25.1309 (b)	Equipment, Systems and Installations
CS/FAR 25.1353 (a)(b)(d)	Electrical Equipment and Installations

4.2 Design Requirements For Certificate Of Airworthiness

4.2.1 Not Applicable

4.3 Environmental Requirements

4.3.1 The aircraft noise requirements are detailed in CAA Noise Certificate No. 126. Environmental requirements are contained within Chapter 1 of Annex 16, Volume 1, Part II of the Chicago convention.

4.4 Design Requirements Associated With operational Approvals

4.4.1 Not Applicable

5.0 Compliance with the Basis of Certification/Validation/Approval

5.1 Compliance with the Certification/Validation/Approval Basis for the Aircraft/Modification.

5.1.1. Embodiment of this modification does not affect the certification basis of the aircraft.

5.1.2 **CS/FAR 25.869(a)(4):** All new wiring used is of a type approved for use on the aircraft type by the constructor (BMS13-48) and meets the applicable smoke and flammability requirements.

5.1.3 **CS/FAR 25.1301, 25.1309 (b):** The functionality of the transponder system will remain unaffected by this modification. A ground test in accordance with the relevant maintenance manual chapter post modification will verify correct Mode-S address pin coding MEI-564 refers.

5.1.4 **CS/FAR 25.1353 (a)(b)(d):** All wiring changes are carried out in accordance with the constructor standard wiring practices ref D6-54446.

5.2 Compliance With Design Requirements For Certificate Of Airworthiness

5.2.1 Not Applicable.

5.3 Compliance with Environmental Requirements

5.3.1 Embodiment of this modification does not affect the existing noise certificate or environmental requirements.

5.4 Compliance with Design Requirements Associated with Operational Approvals

5.4.1 Not Applicable.

5.5 Required (Amendments to) Manuals and other Documents Including Mandatory Placards.

5.5.1 Weight: The weight change attributable to this modification is negligible.

5.5.2 Electrical Load Demand: This modification does not affect the aircraft electrical load demand. Emergency Flight times and battery discharge times are not adversely affected

5.5.3 The Aircraft Flight Manual is not affected by this modification.

5.5.4 A supplement to the existing Wiring Diagram Manual (WDM) may be produced at the operator’s discretion, or this data attached to the existing manuals.

6.0 Conditions Affecting This Approval

6.1 The compatibility of this modification, with other previously approved modifications installed on the particular aircraft, must be verified by the installer. Where the potential for interactions between modifications exists, the advice of the Design Organisation/Agency shall be sought.

7.0 Continued Airworthiness

7.1 The influence of the modification on Airworthiness Directive, Service Bulletin eligibility and other data must be considered and the publications monitored accordingly. The maintenance schedule for the aircraft should include reference to this material additional to the original design. Co-ordination is the responsibility of the operator.

8.0 Survey

8.1 No further survey required.

9.0 Authorisation of Release to Service

9.1 In addition to the actions required by the procedures for release to service following maintenance or modification, the following actions must be completed prior to signing the Certificate of Release to Service:

a) All actions and ground test procedures specified by the modification instructions must be completed satisfactorily.

b) It must be verified that the documents or amendments to documents, above are as specified, including any changes specified under Section 8 above.

10.0 Approval

10.1 This Minor modification AES-757-427 (MCA-AES-757-427) and related instructions has been approved under the authority of EASA Design Organisation Approval no. EASA.21J.036.

11. Documents Required

11.1 AES-757-427 Part A

11.1.1 New Documents Required: [Associated document required for production purposes only]

THESE DOCUMENTS ARE NOT REQUIRED FOR DIRECT WORK ON AN AIRCRAFT AND ARE SHOWN HEREIN FOR DESIGN TRACEABILITY PURPOSES ONLY.

Drawing Number	Issue	Title
1164-345-757	2	MANUFACTURE OF MODE-S ADDRESS CODING PLUGS
MEI-565	2	MANUFACTURE OF MODE-S ADDRESS CODING PARTS

11.2 AES-757-427 Part B

11.2.1 New Documents Required:

Drawing Number	Issue	Title
1178-345-757	1	INSTALLATION OF REMOVABLE MODE-S ADDRESS CODING PLUG SYSTEM
MEI-564	2	REWORK OF LEFT AND RIGHT MODE-S TRANSPONDER CODING BUNDLE AND INSTALLATION OF REMOVABLE MODE S CODING PLUG

1164-345-757

SHEET 1 OF 2 SHEETS
DRAWING SIMILAR TO
N/A

REVISIONS

DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1292	04.07.2005	NEW	ALH
2	DRN 1364	08.09.2005	DCN 0465	ALH

NOTES:

1. THIS DRAWING DETAILS THE MANUFACTURE OF A MODE-S ADDRESS CODING PLUG. READ IN CONJUNCTION WITH MODIFICATION AES-757-427 PART A.
2. X-XXXX = AIRCRAFT REGISTRATION. USE HEAT SHRINK SLEEVING, ITEM 43, AND PRINT ON AIRCRAFT REGISTRATION AS APPLICABLE AND EQUIPMENT IDENT NUMBER.
3. USE WIRE TYPE BMS13-60T01C01G024 FOR ALL JUMPER WIRES. MAX LENGTH 6". INSTALL ALL WIRING IN ACCORDANCE WITH SWPM CHAPTER 20-61-11.
4. CRIMP TWO (2) 24 AWG WIRES INTO EACH PIN MARKED 'X' (EXCEPT PINS 27-29, SEE NOTE 9), USING ITEM 45 AND CRIMP TOOL P/N: M22520/1-01 LOCATOR M22520/1-02. COLOUR RED AND DIAL POSITION 2.
5. PART MARK USING BLACK INDELIBLE INK AS SHOWN.
6. USE BACKSHELL ITEM 41 AND TY-WRAP WIRES TO LEG CLAMP. USE SUITABLE INSULATION TAPE (E.G. SCOTCH 70) TO PROTECT WIRES AS REQUIRED.
7. FOR WIRING CONFIGURATION, REFER TO TABLE A:
   LOGIC - : LEAVE PIN POSITION EMPTY
   LOGIC X: CONNECT THE WIRE PER DIAGRAM
8. FILL ALL UNUSED PLUG CAVITIES WITH SEAL CONTACT ITEM 47.
9. LINK PINS 27, 28 AND 29 BY CRIMPING TWO (2) 24 AWG WIRES INTO EACH PIN (TOTAL 3 WIRES), USING ITEM 45 AND CRIMP TOOL P/N: M22520/1-01 LOCATOR M22520/1-02. COLOUR RED DIAL POSITION 2. ENSURE WIRES IN PINS 27, 28 & 29 ARE KEPT SEPERATE FROM PINS 1-25.
10. PERMANENTLY AND LEGIBLY MARK THE LETTERS 'EPA' (EUROPEAN PART APPROVAL) USING BLACK INDELIBLE INK AS SHOWN.
11. CARRY OUT CONTINUITY AND RESISTANCE CHECKS ON ALL NEWLY INSTALLED WIRES.

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DATE: 13.09.05
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1164-345-757-037	1164-345-757-035	1164-345-757-033	1164-345-757-031	1164-345-757-029	1164-345-757-027	1164-345-757-025	1164-345-757-023	1164-345-757-021	1164-345-757-019	1164-345-757-017	1164-345-757-015	1164-345-757-013	1164-345-757-011	1164-345-757-009	1164-345-757-007	1164-345-757-005	1164-345-757-003	1164-345-757-001	PART NUMBER	ITEM No.	PART NUMBER	ITEM ISS	KEYWORD / DESCRIPTION	MATERIAL	SPECIFICATION	DIMENSIONS	TREATMENT
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		51	TY23M		TIE-WRAP	◭ OR EQUIVALENT			
10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT	10FT		49	BMS13-60T01C01G024		WIRE SINGLE CORE 24AWG	◭ BOEING CODE GA			
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50		47	MS27488-20		SEAL CONTACT	◭ PYLE NATIONAL No. BA-4020-59P			
20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20		45	BACC47CN1A		CONTACT - PIN	◭ ALTN P/N BACC47CN1S			
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		43	TMS3/8-4		HEAT SHRINK SLEEVE				
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		41	BACC10GH22		SINGLE STRAIGHT LEG BACK CLAMP				
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		39	BACC45FT22-55PN		CONNECTOR, PLUG				
●																				37	-037	1	MODE-S ADDRESS PLUG ASSY (C-FLEU)				
	●																			35	-035	1	MODE-S ADDRESS PLUG ASSY (C-GOOZ)				
		●																		33	-033	1	MODE-S ADDRESS PLUG ASSY (C-FLOK)				
			●																	31	-031	1	MODE-S ADDRESS PLUG ASSY (C-FUBG)				
				●																29	-029	1	MODE-S ADDRESS PLUG ASSY (C-FOBH)				
					●															27	-027	1	MODE-S ADDRESS PLUG ASSY (G-OOOZ)				
						●														25	-025	1	MODE-S ADDRESS PLUG ASSY (G-OOOY)				
							●													23	-023	1	MODE-S ADDRESS PLUG ASSY (G-OOOX)				
								●												21	-021	1	MODE-S ADDRESS PLUG ASSY (G-OOOK)				
									●											19	-019	1	MODE-S ADDRESS PLUG ASSY (G-OOBJ)				
										●										17	-017	1	MODE-S ADDRESS PLUG ASSY (G-OOBI)				
											●									15	-015	1	MODE-S ADDRESS PLUG ASSY (G-OOBH)				
												●								13	-013	1	MODE-S ADDRESS PLUG ASSY (G-OOBG)				
													●							11	-011	1	MODE-S ADDRESS PLUG ASSY (G-OOBB)				
														●						9	-009	1	MODE-S ADDRESS PLUG ASSY (G-OOBA)				
															●					7	-007	1	MODE-S ADDRESS PLUG ASSY (G-CPEV)				
																●				5	-005	1	MODE-S ADDRESS PLUG ASSY (G-CPEU)				
																	●			3	-003	1	MODE-S ADDRESS PLUG ASSY (G-CPEP)				
																		●		1	-001	1	MODE-S ADDRESS PLUG ASSY (C-GTBB)				
No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	No. OFF	MAP REF	ITEM No.	PART NUMBER	ITEM ISS	KEYWORD / DESCRIPTION	MATERIAL	SPECIFICATION	DIMENSIONS	TREATMENT
A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	A/D	HAND								
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	ISS								

◭ OR REMARKS

DRAWN BY: T HAWKINS	DATE: 04 JUNE 2005	MODIFICATION No: AES-757-427-PT-A
CHECKED BY: A HEISSIG	SCALE: 1:1 AT A3 U.O.S.	EASA APP.: EASA.21J.036
STRESS: N/A	LIMITS: N/A U.O.S.	THIRD ANGLE PROJECTION:
APPROVED: A HEISSIG	SURFACE FINISH:	DIMENSIONS IN: INCHES

TITLE: MANUFACTURE OF MODE-S ADDRESS CODING PLUGS

IN 1.5 1.0 0.5 0
MM 40 30 20 10 0

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PT No	NHA	No. OFF	EFFECTIVITY
-001 - -037	AES-757-427-PTA	2	SEE MOD (SEE TABLE A)

1164-345-757

SHEET 1 OF 2 SHEETS

1164-345-757

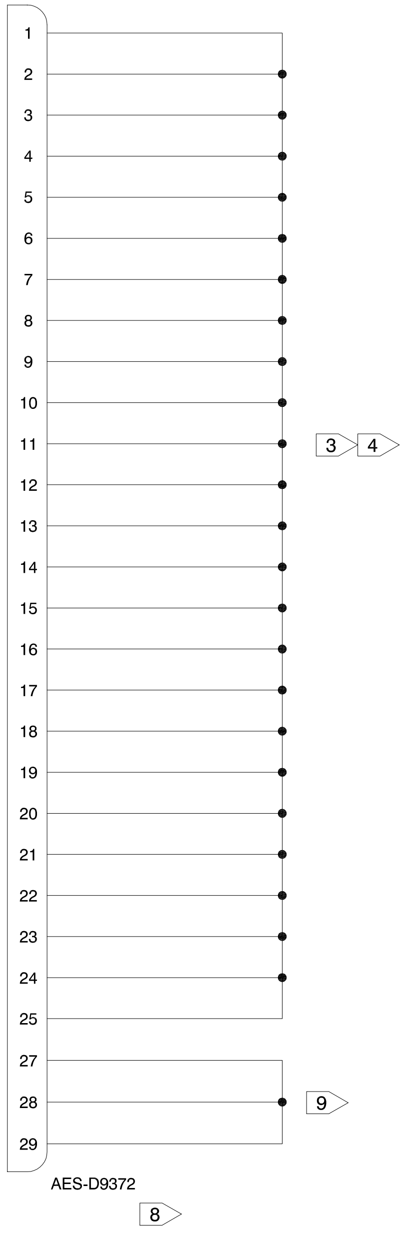
SHEET 2 OF 2 SHEETS
DRAWING SIMILAR TO
N/A

REVISIONS

DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1292	04.07.2005	NEW	ALH
2	DRN 1364	08.09.2005	DCN 0465	ALH

7 MODE-S ADDRESS HOOKUP MATRIX (TABLE A)

CABLE ASSY 1164-345-757-( )	AIRCRAFT REG'N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	HEX CODE
-001	C-GTBB	X	X								X	X	X		X	X		X	X	X	X					X	C076F0
-003	G-CPEP		X												X	X		X			X	X			X	X	400699
-005	G-CPEU		X												X	X	X	X				X				X	400788
-007	G-CPEV		X												X	X	X	X				X			X	X	400789
-009	G-OOBA		X											X			X					X	X		X	X	40090D
-011	G-OOBB		X											X			X					X	X	X		X	40090E
-013	G-OOBG		X												X	X	X	X				X		X		X	40078A
-015	G-OOBH		X											X		X		X				X		X		X	400A8A
-017	G-OOBI		X											X		X		X	X	X		X	X	X		X	400AEE
-019	G-OOBJ		X											X		X		X	X	X		X	X		X	X	400AED
-021	G-OOOK		X												X			X				X				X	400488
-023	G-OOOX		X												X		X			X	X			X	X	X	400533
-025	G-OOOY		X												X	X		X		X	X		X		X	X	4006B5
-027	G-OOOZ		X												X		X				X	X	X			X	40051C
-029	C-FOBH	X	X									X			X		X				X	X		X		X	C0251A
-031	C-FUBG	X	X									X	X		X			X	X	X	X				X	X	C034F1
-033	C-FLOK	X	X										X	X	X	X		X						X	X	X	C01E83
-035	C-GOOZ	X	X								X	X		X		X	X			X			X	X		X	C06B26
-037	C-FLEU	X	X										X	X	X		X	X				X			X	X	C01D89



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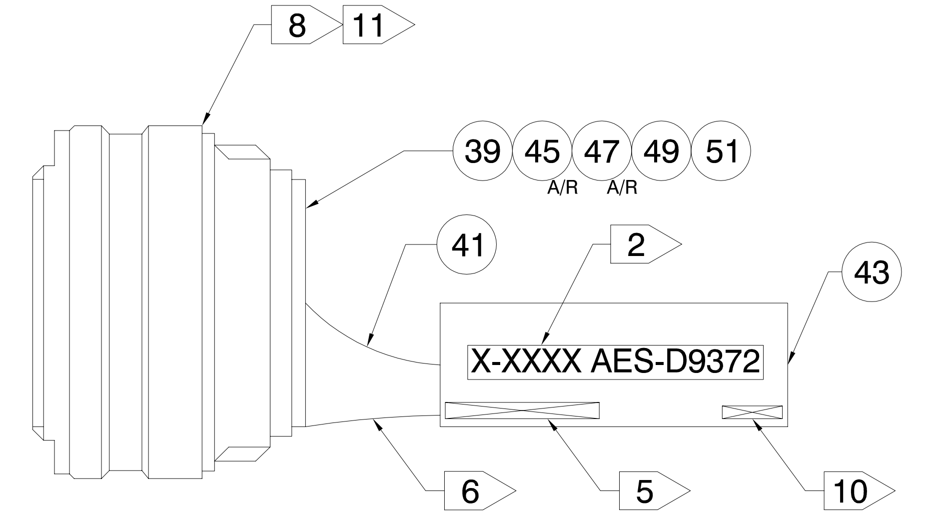
DATE: 13.09.05
COPY



MODE-S ADDRESS CODING PLUG ASSY -001 TO -037 1 11

(SCALE 1:1)

SEE SHEET 1

No. OFF			PART NUMBER
No. OFF	A/D	1	1164-345-757-037
No. OFF	A/D	1	1164-345-757-035
No. OFF	A/D	1	1164-345-757-033
No. OFF	A/D	1	1164-345-757-031
No. OFF	A/D	1	1164-345-757-029
No. OFF	A/D	1	1164-345-757-027
No. OFF	A/D	1	1164-345-757-025
No. OFF	A/D	1	1164-345-757-023
No. OFF	A/D	1	1164-345-757-021
No. OFF	A/D	1	1164-345-757-019
No. OFF	A/D	1	1164-345-757-017
No. OFF	A/D	1	1164-345-757-015
No. OFF	A/D	1	1164-345-757-013
No. OFF	A/D	1	1164-345-757-011
No. OFF	A/D	1	1164-345-757-009
No. OFF	A/D	1	1164-345-757-007
No. OFF	A/D	1	1164-345-757-005
No. OFF	A/D	1	1164-345-757-003
No. OFF	A/D	1	1164-345-757-001
MAP REF	HAND	ISS	PART NUMBER

ITEM No.	PART NUMBER	ITEM ISS	KEYWORD / DESCRIPTION

MATERIAL	SPECIFICATION	DIMENSIONS	TREATMENT

OR REMARKS

DRAWN BY: T HAWKINS
DATE: 04 JUNE 2005
MODIFICATION No: AES-757-427-PT-A
CHECKED BY: A HEISSIG
SCALE: 1:1 AT A3 U.O.S.
EASA APP.: EASA.21J.036
STRESS: N/A
LIMITS: N/A U.O.S.
THIRD ANGLE PROJECTION:
APPROVED: A HEISSIG
SURFACE FINISH:
DIMENSIONS IN: INCHES
TITLE: MANUFACTURE OF MODE-S ADDRESS CODING PLUGS

1.5 1.0 0.5 IN 0
40 30 20 10 MM 0

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PT No	NHA	No. OFF	EFFECTIVITY
-001 - -037	AES-757-427-PTA	2	SEE MOD (SEE TABLE A)

1164-345-757

SHEET 2 OF 2 SHEETS

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Essex
CM22 6JX

MEI-565

ISSUE 2, SEPTEMBER 2005

MODIFICATION EMBODIMENT INSTRUCTIONS

A. TITLE PAGE

TITLE: MANUFACTURE OF MODE-S ADDRESS CODING PARTS

DATE COMPILED: 04.07.2005

MODIFICATION NO.: AES-757-427 PTA

PROJECT NO.: 0404

EFFECTIVITY:

A/C TYPE	REG.	INDICATE AS APPLICABLE	SERIAL NO.
NOT APPLICABLE			

This document is issued for production engineering purposes.

The definitive design requirements are shown in mod AES-757-427 PTA, the contents of which override information contained in this MEI.

Differences resulting from existing repairs, variation in build standard or corrosion to be reported to AES Ltd Design Department.

Manufacturing processes and inspection and installation procedures are the responsibility of FIRST CHOICE AIRWAYS LTD.

ISSUE	1 2		3	4 5		6
DRN:	1292	1364				
DATE	04.07.2005	09.05.09				
COMPILED BY:	T HAWKINS	A MADDY				
CHECKED BY:	A HEISSIG	A HEISSIG				
DESIGN APP:	A HEISSIG	A HEISSIG				

B. REVISION DETAILS

WRITE BELOW A BRIEF SUMMARY OF THE CHANGES WHICH HAVE BEEN INTRODUCED AT THE STATED REVISION:

ISSUE	DESCRIPTION
1	NEW ISSUE
2	Table H: Note at bottom of table amended to reflect 2off assy's required per aircraft - ie TOTAL 2 x 19 = 38 assy's Changes indicated by a vertical marginal line

C. CONTENTS

D1. ACCOMPLISHMENT INSTRUCTIONS – MANUFACTURE OF MODE-S ADDRESS CODING PLUGS

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

		MECH SIG.	**INSP STAMP**
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]		N/A N/A	
D1.1	Ref AES Dwg 1164-345-757: Making reference to AES drawing 1164-345-757 sheet 1, ensure all related parts to facilitate the manufacture of harness part No. 1164-345-757-( ) are in place.		
D1.2	Ref AES Dwg 1164-345-757: Manufacture coding plug assemblies I.A.W reference drawing, ensuring all notes are complied with.		
D1.3	Ref AES Dwg 1178-345-757: Carry out continuity and IR/OR checks on the assembled plug.		
D1.4	Protect exposed connector using a dust cap. Label and secure coding plug into sealed plastic bag for aircraft installation.		
END			

E. DOCUMENTS REQUIRED

THE FOLLOWING DOCUMENTS ARE REQUIRED FOR EMBODIMENT OF MODIFICATION AES-757-427 PTA. **NOTE: REFER TO MODIFICATION SHEET FOR LATEST DRAWING ISSUE.**

The following existing drawings/documents are required for embodiment:

Drawing No Title	SOURCE	
1164-345-757	MANUFACTURE OF MODE-S ADDRESS CODING PLUGS	AES

F. SPECIAL TOOLS REQUIRED

PART NUMBER	DESCRIPTION	VENDOR	COMMENTS
M22520/1-01	CRIMP TOOL	QPL	
M22520/1-02	LOCATOR	QPL	

G. ESTIMATED TIME REQUIRED

It is estimated that this modification will take approximately 30 man-hours.

This is based on the direct labour cost to do the work. The estimated assume that the work will be done by experienced personal, and may need to be revised upwards to suit operators' circumstances. The estimates do not include the time to prepare, plan or inspect the work. Manufacture and procurement of parts and tools' drying time for paints sealants, etc and general administration work are also not included.

H. PARTS REQUIRED LIST KIT NUMBER MEI-565 (MOD. NUMBER: AES-757-427 PTA)

ITEM NO	PART NUMBER	QTY RQD	DESCRIPTION	USED ON	ADD/	REMARKS / VENDOR	ALT PART NUMBER	OWNER	REVISION
1	BACC45FT22-55PN	1	CONNECTOR - PLUG	1164-345-757	**ADD**	AES-D9372		FCA	1
2	BACC10GH22	1	CONNECTOR BACKSHELL	1164-345-757	**ADD**			FCA	1
3 T	MS3/8-4	1	HEAT-SHRINKABLE SLEEVING	1164-345-757	**ADD**			FCA	1
4	BACC47CN1A	20	CONTACT – PIN	1164-345-757	**ADD**	BACC47CN1S		FCA	1
5	MS27488-20	50	SEAL CONTACTS	1164-345-757	**ADD**		PYLE NATIONAL No. BA-4020-59P	FCA 1	
6	BMS13-60T 01C01G024	10 FT	WIRE SINGLE CORE 24AWG	1164-345-757	**ADD**	BOEING CODE GA	FCA		1
7 T	Y23M	1	TIE WRAP	1164-345-757	**ADD**	OR EQUIVALENT		FCA	1

*** Quantities shown above are per ELT coding plug assy. There are 38 assemblies required per drawing 1164-345-757.**

MODIFICATION EMBODIMENT INSTRUCTIONS

I. PARTS REMOVED LIST

ITEM NO	PART NUMBER	QTY RQD	DESCRIPTION	USED ON	ADD/ REMOVE/ REWORK	REMARKS / VENDOR	ALT PART NUMBER	OWNER	REVISION
1					**REMOVE**			FCA	1

<u>NONE</u>

J. WIRE LIST

WIRE IDENT	WIRE CODE	GAUGE	LENGTH	WIRE TYPE	USED ON

NONE

K. WIRING DIAGRAMS

NONE

L. MEI - REPORT SHEET

THE MEI REPORT SHEET IS PROVIDED FOR THE PURPOSE OF COMMUNICATING TO AES DESIGN OFFICE ANY IMPROVEMENTS / SUGGESTIONS ARISING FROM THE EMBODIMENT OF THE MODIFICATION.

REPORT SHEET	**MEI No: MEI-565** **MOD No: AES-757-427 PTA**
AIRCRAFT TYPE:	
REGISTRATION AND SERIAL NUMBER:	
LOCATION:	
COMMENTS: PREPARED BY / DATE:________________________________	

APPENDIX A **FIRST CHOICE AIRLINES RE-CERTIFICATION CONTROL SHEET** **A/C REG.**

PART NUMBER	**DESCRIPTION**	**SERIAL NO.**	**LOCATION**	**QTY.**	**COMMENTS** I.E. SERVICEABLE / UNSERVICEABLE	**DATE / INSPECTION STAMP**

APPENDIX B: - ADDITIONAL WORK CARD INDEX SHEET

(Photocopy additional sheets as required)

Item	Work card REF	Description	MECH SIG.	INSP STAMP

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FAX: 44 (0)1279 647683

AES Limited
28 Golds Nurseries Business Park
Elsenham
Essex
CM22 6JX

QUERY NOTE

AES REF No:.
QN-AES-…...-…...-…...
(COMPLETED BY AES STAFF ONLY)

AIRCRAFT TYPE:…………………………………	APPLICANTS NAME:……………………………
REGISTRATION:…………………………………. DATE	………………………………………………
LOCATION:………………………………………..	APPLICANTS FAX No:…………………………..
DRAWING (S) / P/N AFFECTED: ……………………………………………………….	APPLICANTS TEL No:…………………………..

GIVE FULL DETAILS, INCLUDE OR ATTACH RELEVANT SKETCHES

DESIGN RESPONSE TO QUERY NOTE

DRAWING (S) TO BE AMENDED YES / NO	DATE AMENDED:

(AEROSPACE ENGINEERING SOLUTIONS LIMITED DESIGN OFFICE USE ONLY)

COMPILED BY:	APPROVED BY:

REVISIONS

DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH

NOTES:

1. THIS DIAGRAM DETAILS THE REWORK OF THE MODE-S ADDRESS CODING BUNDLE WIRING FOR THE LEFT AND RIGHT TRANSPONDER UNITS.
2. ASSEMBLE ELECTRICAL CONNECTORS & TERMINATIONS PER THE APPLICABLE SECTION OF CHAPTER 20, STANDARD WIRING PRACTICES MANUAL, BOEING DOC REF D6-54446.
3. CARRY OUT CONTINUITY & RESISTANCE CHECKS ON ALL NEW AND DISTURBED WIRING.
4. ROUTE ALL NEW WIRES PER EXISTING WIRE BUNDLE ROUTES & I.A.W THE REQUIREMENTS DETAILED IN STANDARD WIRING PRACTICES MANUAL D6-54446 CHAPTER 20-10-11, 20-10-19 & WDM CHAPTER 91.
5. CARRY OUT CHANGES IN THIS DRAWING I.A.W MEI-564.

AIRCRAFT REG'N	AIRCRAFT VAR	EFFECTIVE SHEET					
		2	3	4	5	6	7
C-FLOK / G-OOOK	NA346			●	●		
C-GOOZ / G-OOOZ	NA352	●				●	
G-CPEP	NB322		●			●	
G-OOOX	NB329		●			●	
G-OOBI	NB506		●			●	
G-OOBJ	NB507		●			●	
G-OOOY	NT232			●	●		
G-OOBA	NT245		●			●	
C-GTBB / G-OOBB	NT246		●			●	
G-CPEU	NT404			●			●
G-FUBG / G-OOBG	NT405			●			●
G-CPEV	NT406			●			●
C-FOBH / G-OOBH	NT407			●			●

AES LTD
OFFICIAL ISSUE
DATE: 05.07.2005
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MODIFICATION No: AES-757-427-PT-B	PART 21 APPR: EASA.21J.00036	
DRAWN BY: T HAWKINS	DATE: 23 JUNE 05	NHA: AES-757-427-PT-B
CHECKED BY: A HEISSIG	DATE: 23.06.2005	EFFECTIVITY: SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005	
TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING		1178-345-757 SHEET 1 OF 7 SHEETS

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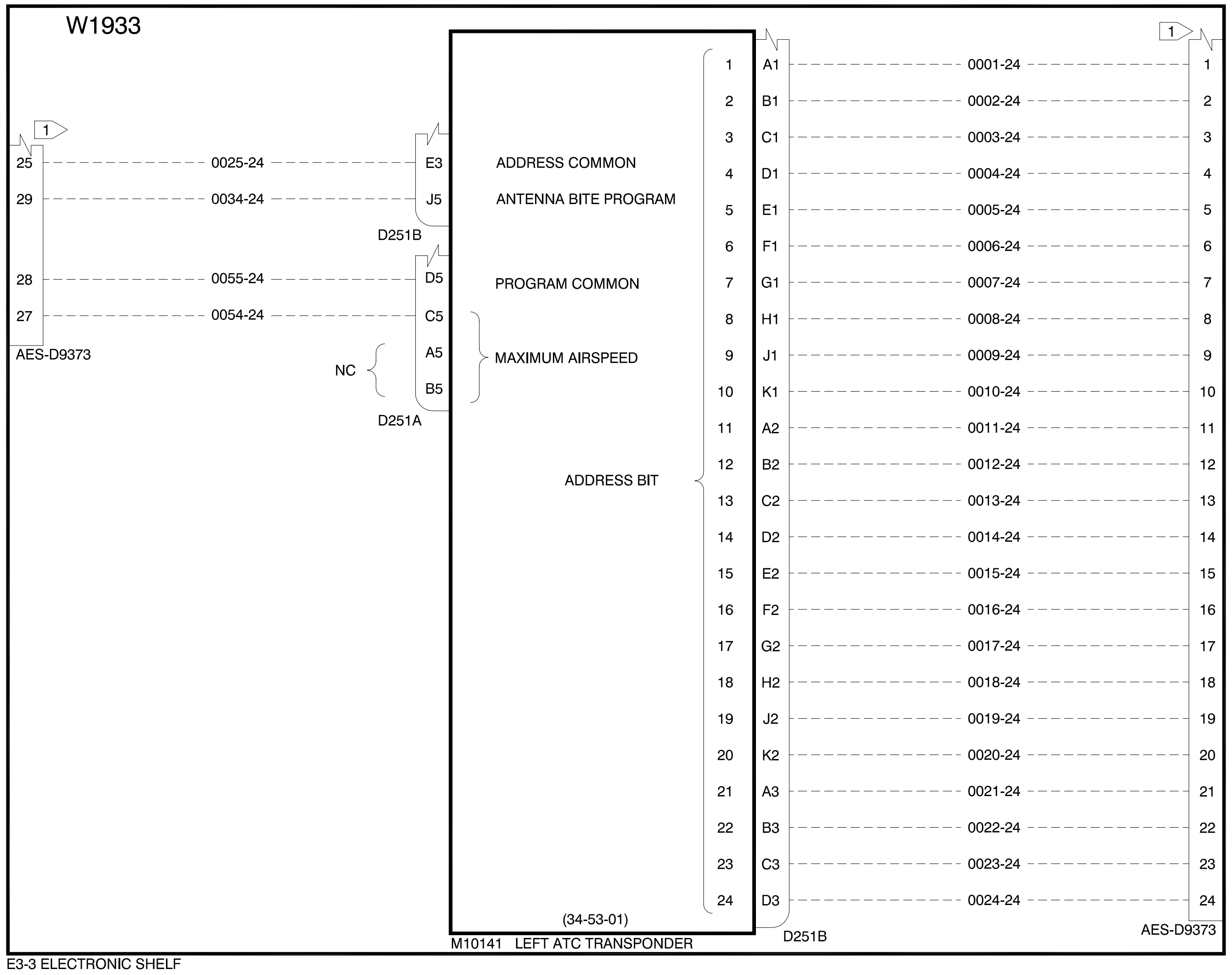
REVISIONS				
DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



NA352	MODE S TRANSPONDER - LEFT ADDRESS AND AIRSPEED CODING

34-53-12
PAGE 1A
JUNE / 2005

34-53-12
PAGE 1A
JUNE / 2005

NOTES:

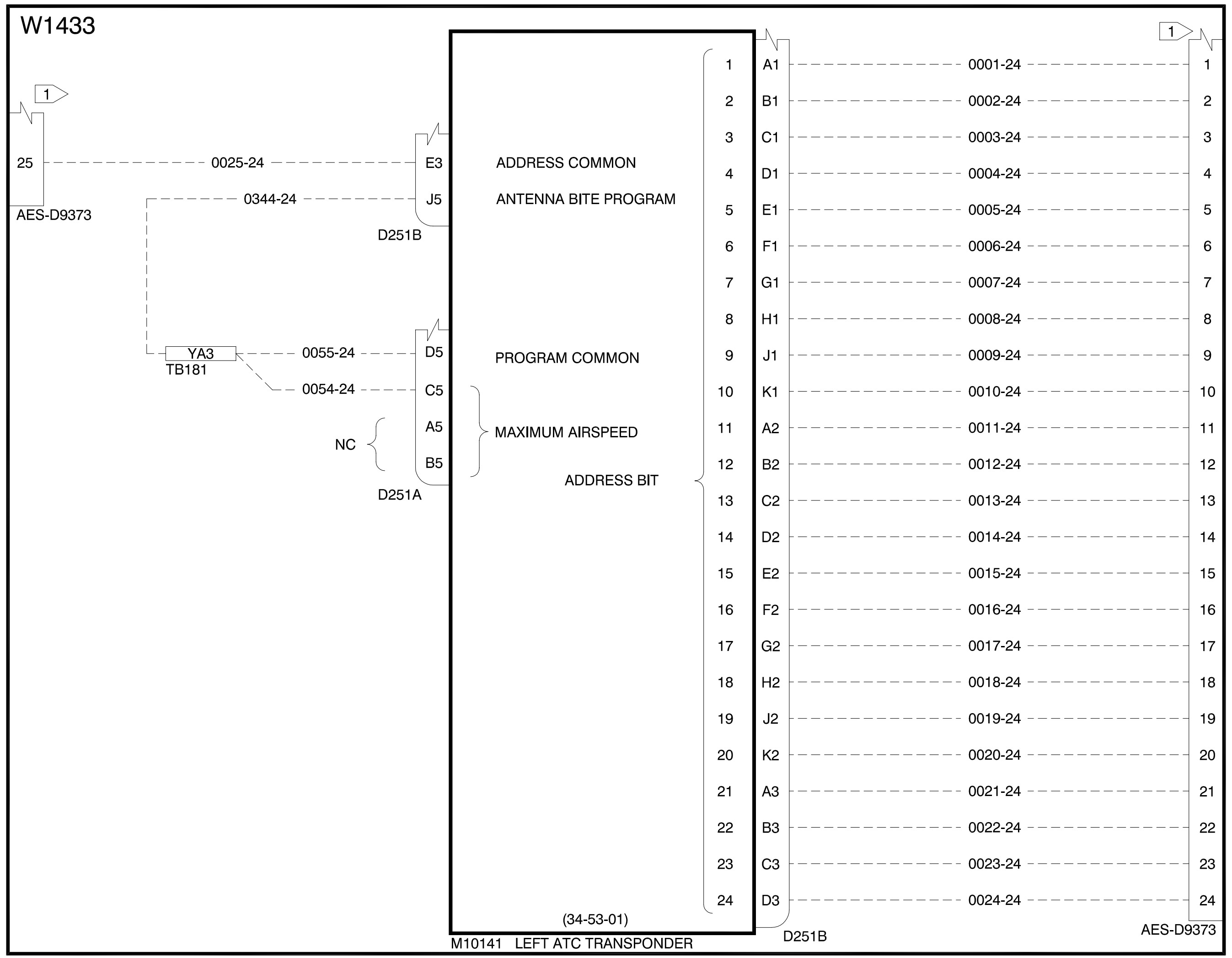
1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

MODIFICATION No: AES-757-427-PT-B	PART 21 APPR: EASA.21J.00036	aes aerospace engineering solutions	©2005 ALL RIGHTS RESERVED. THE INFORMATION CONTAINED HEREIN IS PROPRIETARY TO AEROSPACE ENGINEERING SOLUTIONS LTD AND SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT THE OWNERS WRITTEN PERMISSION.
DRAWN BY: T HAWKINS	DATE: 23 JUNE 05	NHA	EFFECTIVITY
CHECKED BY: A HEISSIG	DATE: 23.06.2005	AES-757-427-PT-B	SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005		

TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING

REVISIONS

DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



E3-3 ELECTRONIC SHELF

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DATE: 05.07.2005

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NB322, NB329, NB506, NB507, NT245, NT246	MODE S TRANSPONDER - LEFT ADDRESS AND AIRSPEED CODING

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NOTES:

1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

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APPROVED: A HEISSIG	DATE: 23.06.2005		

TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING

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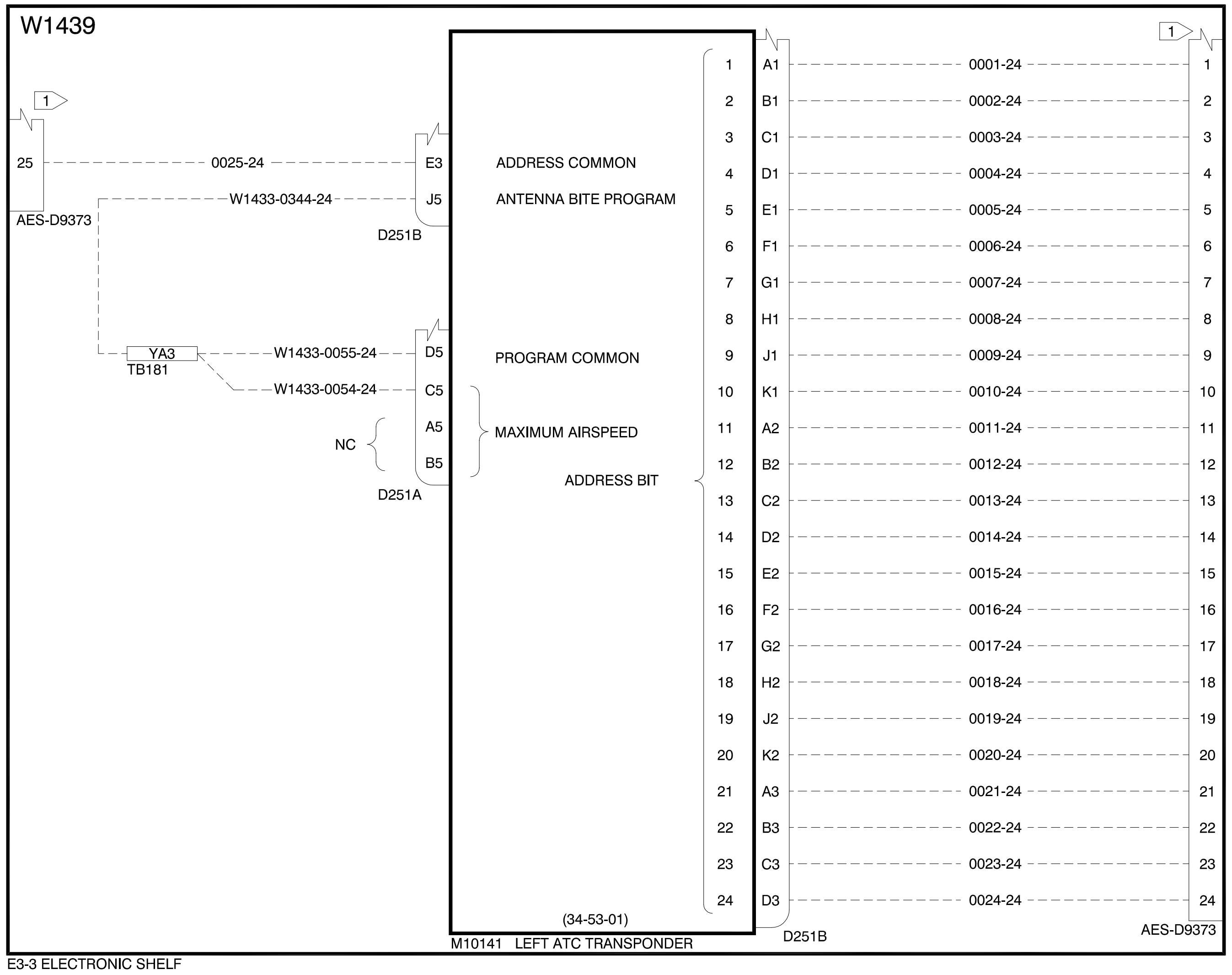
SHEET 4 OF 7 SHEETS

REVISIONS				
DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



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DATE: 05.07.2005

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NA346, NT232, NT404, NT405, NT406, NT407	MODE S TRANSPONDER - LEFT ADDRESS AND AIRSPEED CODING

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NOTES:

1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

MODIFICATION No: AES-757-427-PT-B	PART 21 APPR: EASA.21J.00036	aes aerospace engineering solutions
DRAWN BY: T HAWKINS	DATE: 23 JUNE 05	NHA / EFFECTIVITY
CHECKED BY: A HEISSIG	DATE: 23.06.2005	AES-757-427-PT-B / SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005	
TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING		1178-345-757 SHEET 4 OF 7 SHEETS

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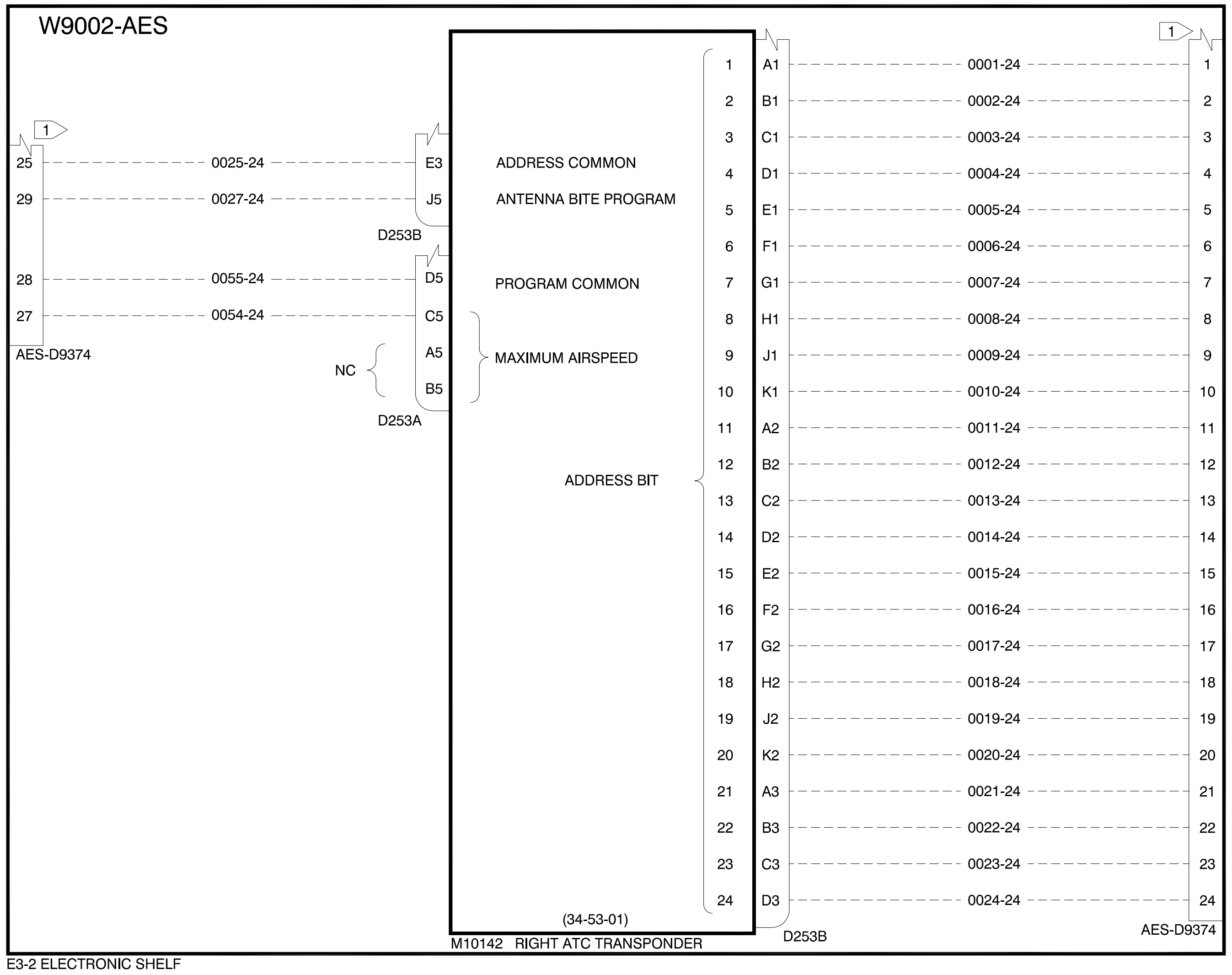
SHEET 5 OF 7 SHEETS

REVISIONS				
DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



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DATE: 05.07.2005

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NA346, NT232	MODE S TRANSPONDER - RIGHT ADDRESS AND AIRSPEED CODING

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NOTES:

1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

MODIFICATION No: AES-757-427-PT-B	PART 21 APPR: EASA.21J.00036	aes aerospace engineering solutions	
DRAWN BY: T HAWKINS	DATE: 23 JUNE 05	NHA	EFFECTIVITY
CHECKED BY: A HEISSIG	DATE: 23.06.2005	AES-757-427-PT-B	SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005		
TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING		1178-345-757 SHEET 5 OF 7 SHEETS	

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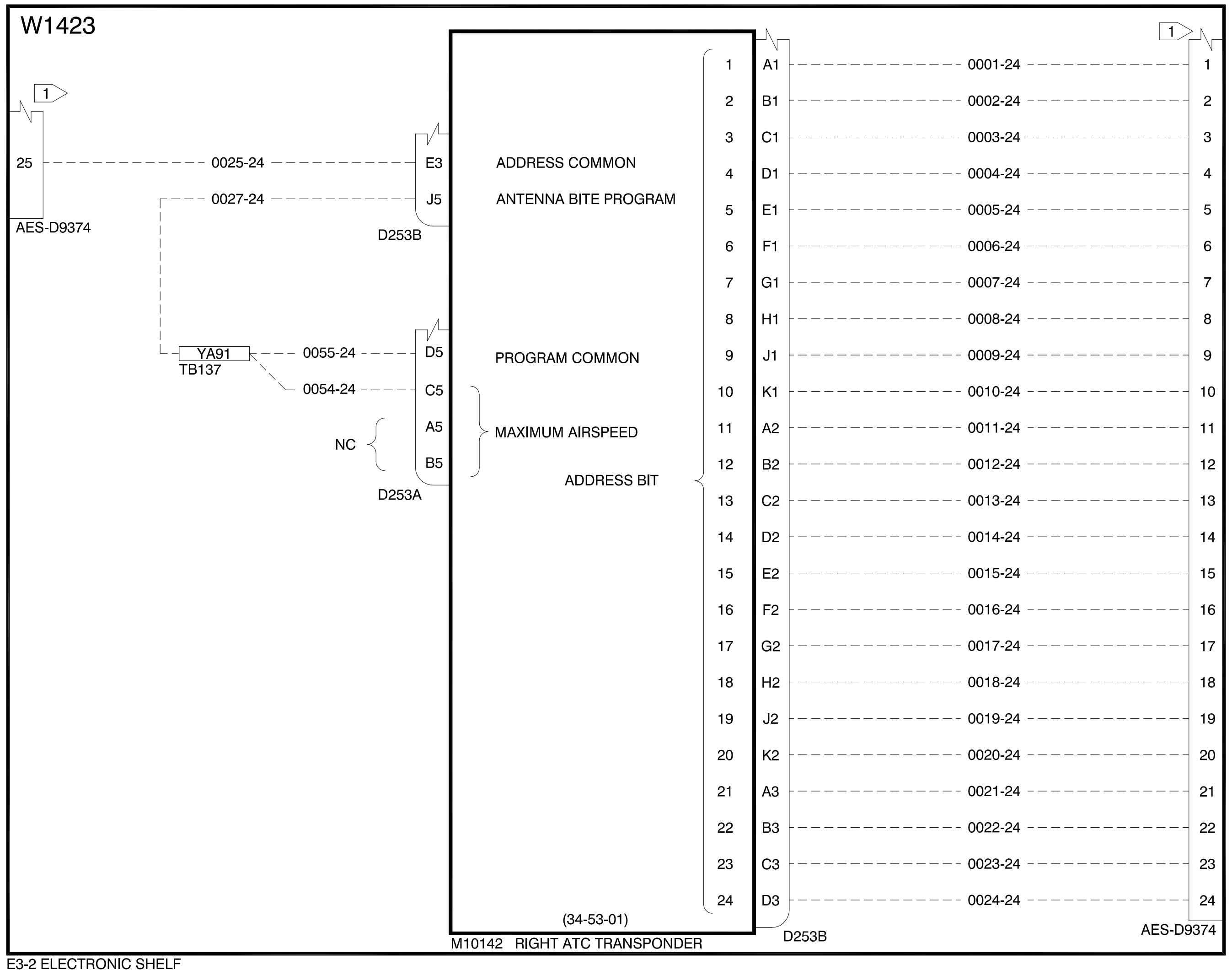
SHEET 6 OF 7 SHEETS

REVISIONS				
DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



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NA352, NB322, NB329, NT245, NT246, NB506, NB507	MODE S TRANSPONDER - RIGHT ADDRESS AND AIRSPEED CODING

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JUNE / 2005

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NOTES:

1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

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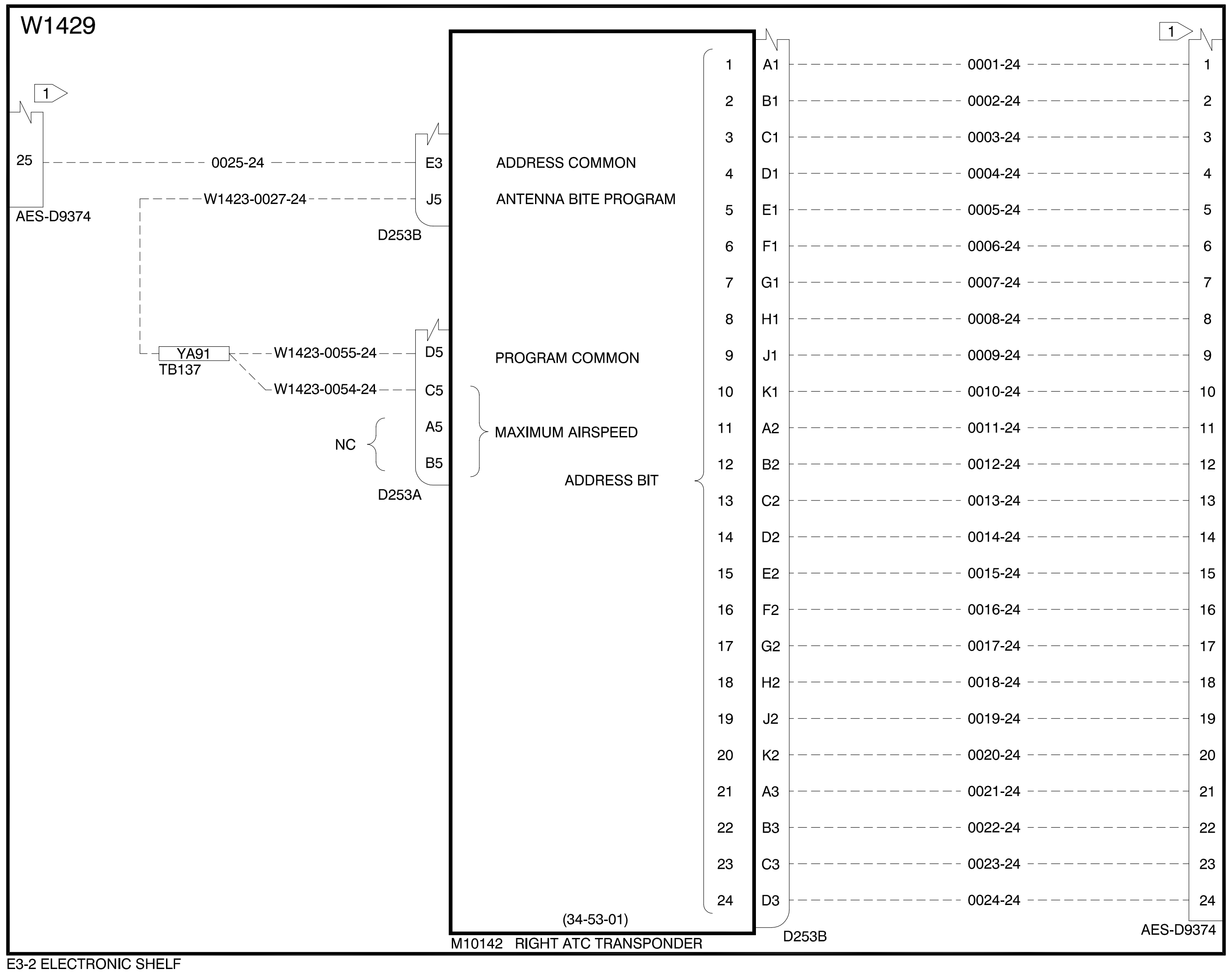
CHECKED BY: A HEISSIG	DATE: 23.06.2005	AES-757-427-PT-B	SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005		

TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING

1178-345-757

SHEET 6 OF 7 SHEETS

REVISIONS				
DRG ISS No.	RELEASE DOC.	ISSUE DATE:	DRG CHANGE	APP BY:
1	DRN 1276	JUNE 2005	NEW	ALH



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DATE: 05.07.2005

COPY

NT404, NT405, NT406, NT407	MODE S TRANSPONDER - RIGHT ADDRESS AND AIRSPEED CODING

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NOTES:

1 RECEPTACLE CONNECTOR P/N: BACC45FN22-55SN

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DRAWN BY: T HAWKINS	DATE: 23 JUNE 05	NHA	EFFECTIVITY
CHECKED BY: A HEISSIG	DATE: 23.06.2005	AES-757-427-PT-B	SEE MOD
APPROVED: A HEISSIG	DATE: 23.06.2005		
TITLE: REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING		1178-345-757 SHEET 7 OF 7 SHEETS	

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Elsenham
Essex
CM22 6JX

MEI-564
ISSUE 2, AUGUST 2005
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MODIFICATION EMBODIMENT INSTRUCTIONS

A. TITLE PAGE

TITLE: REWORK OF LEFT AND RIGHT MODE-S TRANSPONDER CODING BUNDLE AND INSTALLATION OF REMOVABLE MODE S CODING PLUG

DATE COMPILED: 04.07.2005

MODIFICATION NO.: AES-757-427-PT B

PROJECT NO.: 0404

EFFECTIVITY:

A/C TYPE	REG.	INDICATE AS APPLICABLE	SERIAL NO.

REFER TO SECTION D0 FOR AIRCRAFT EFFECTIVITIES

This document is issued for production engineering purposes.

The definitive design requirements are shown in mod AES-757-427-PT B, the contents of which override information contained in this MEI.

Differences resulting from existing repairs, variation in build standard or corrosion to be reported to AES Ltd Design Department.

Manufacturing processes and inspection and installation procedures are the responsibility of FIRST CHOICE AIRWAYS LTD.

ISSUE	1 2		3	4 5		6
DRN:	1276	1364				
DATE	04.07.2005	18.08.2005				
COMPILED BY:	T HAWKINS	A MADDY				
CHECKED BY:	A HEISSIG	A HEISSIG				
DESIGN APP:	A HEISSIG	A HEISSIG				

B. REVISION DETAILS

WRITE BELOW A BRIEF SUMMARY OF THE CHANGES WHICH HAVE BEEN INTRODUCED AT THE STATED REVISION:

ISSUE	DESCRIPTION
1	NEW ISSUE
2	D0: C-FLEU ADDED TO TABLE OF EFFECTIVITIES D2.5: C-FLEU ADDED TO PART NUMBER TABLE D3.5: C-FLEU ADDED TO PART NUMBER TABLE FIGURE 1 - AIRCRAFT REG / HEX CODE APPLICABILITY C-FLEU DETAILS ADDED TO TABLE ALL CHANGES INDICATED BY A MARGINAL VERTICAL LINE

C. CONTENTS

D0. AIRCRAFT EFFECTIVITIES

AIRCRAFT REG	AIRCRAFT S/N	AIRCRAFT VAR	AIRCRAFT TYPE
C-GTBB 32447		NT246	B757
C-FUBG 29942		NT405	B757
C-FOBH 29944		NT407	B757
C-FLOK 25054		NA346	B757
C-GOOZ 25593		NA352	B757
G-CPEP 25268		NB322	B757
G-CPEU 29941		NT404	B757
G-CPEV 29943		NT406	B757
G-OOBA 32446		NT245	B757
G-OOBB 32447		NT246	B757
G-OOBG 29942		NT405	B757
G-OOBH 29944		NT407	B757
G-OOBI 27146		NB506	B757
G-OOBJ 27147		NB507	B757
G-OOOK 25054		NA346	B757
G-OOOX 26158		NB329	B757
G-OOOY 28203		NT232	B757
G-OOOZ 25593		NA352	B757
C-FLEU 29941		NT404	B757

D1. ACCOMPLISHMENT INSTRUCTIONS – PREPARATION

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

		MECH SIG.	**INSP STAMP**
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]		N/A N/A	
D1.1	Remove electrical power from the airplane per 24-22-00 P201		
D1.2	Open all circuit breakers relevant to equipment fitted to E3-2 and E3-3 electronic shelves and attach ‘DO-NOT-CLOSE’ tags.		
D1.3	Locate the following circuit breakers on the P11 panel. Open and attach ‘DO-NOT-CLOSE’ tags: a) 11F07 ATC-L b) 11F28 ATC-R		
D1.4	Gain access to the E/E Bay.		
END			

D2. ACCOMPLISHMENT INSTRUCTIONS – E3-2 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	
D2.1 Gain access to E/E bay shelf E3-2. The following units may be removed to gain better access to the back of the rack.		

E3-2			
IDENT	DESCRIPTION	REMOVAL	SERIAL NO.
M187	VOR/MKR R	34-51-01 P401	____________
M153	HF COMM R	23-11-03 P401	____________
M186	VOR/MKR L	34-51-01 P401	____________
M127	PACK TEMP CONT R	21-51-14 P401	____________
M168	MCDP	22-41-01 P401	____________
M124	DME R	34-55-01 P401	____________
M10142	ATC R	34-53-01 P401	____________

Check for serviceability and tag all removed units. Route to safe storage.

Remove E3-2 rack if required for access and route to workshop for rework.

D2. ACCOMPLISHMENT INSTRUCTIONS – E3-2 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	
D2.2 <u>Ref AES W/D 1178-345-757:</u> Locate existing connector D753 on AE0302 disconnect panel and replace with new connector AES-D9373 (P/N BACC45FN22-55SN). Install removed wires in accordance with wiring diagram 1178-345-757. Refer to drawing page 1 for applicable aircraft sheets.		
D2.3 Insert contact sealing plugs (P/N MS27488-20) in all remaining vacant contact positions. Carry out resistance and continuity checks on all new and disturbed wiring.		
D2.4 Re-install the following LRU's if removed for access:		

E3-2		
IDENT	DESCRIPTION	INSTL'N
M187	VOR/MKR R	34-51-01 P401
M153	HF COMM R	23-11-03 P401
M186	VOR/MKR L	34-51-01 P401
M127	PACK TEMP CONT R	21-51-14 P401
M168	MCDP	22-41-01 P401
M124	DME R	34-55-01 P401
M10142	ATC R	34-53-01 P401

D2. ACCOMPLISHMENT INSTRUCTIONS – E3-2 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	

D2.5 Ref AES W/D 1164-345-757:

Locate from stores 2off coding plug assembly manufactured I.A.W the applicable aircraft registration imprinted on the coding plug sleeving. (Retain 1off assy for E3-3 shelf – Section D3.5)

Install 1off coding plug on mating connector AES-D9373 located on E3-2 disconnect panel AE0302.

Select P/N I.A.W table below:

AIRCRAFT REGISTRATION	CODING PLUG P/N
C-GTBB	1164-345-757-001
G-CPEP	1164-345-757-003
G-CPEU	1164-345-757-005
G-CPEV	1164-345-757-007
G-OOBA	1164-345-757-009
G-OOBB	1164-345-757-011
G-OOBG	1164-345-757-013
G-OOBH	1164-345-757-015
G-OOBI	1164-345-757-017
G-OOBJ	1164-345-757-019
G-OOOK	1164-345-757-021
G-OOOX	1164-345-757-023
G-OOOY	1164-345-757-025
G-OOOZ	1164-345-757-027
C-FOBH	1164-345-757-029
C-FUBG	1164-345-757-031
C-FLOK	1164-345-757-033
C-GOOZ	1164-345-757-035
C-FLEU	1164-345-757-037

D2. ACCOMPLISHMENT INSTRUCTIONS – E3-2 SHELF

INDICATE
A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	**INSP STAMP**
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	
END		

D3. ACCOMPLISHMENT INSTRUCTIONS – E3-3 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	
D3.1 Gain access to E/E bay shelf E3-3. The following units may be removed to gain better access to the back of the rack.		

E3-3

IDENT	DESCRIPTION	REMOVAL	SERIAL NO.
M123	DME L	34-55-01 P401	________________
M195	ZONE TEMP CONT	21-61-03 P401	________________
M10389	STBY PACK TEMP CONT	21-51-14 P401	________________
M126	PACK TEMP CONT L	21-51-14 P401	________________
M138	DFDAU	31-31-03 P401	________________
M10141	ATC L	34-53-01 P401	________________

Check for serviceability and tag all removed units. Route to safe storage.

Remove E3-3 rack if required for access and route to workshop for rework.

D3. ACCOMPLISHMENT INSTRUCTIONS – E3-3 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	**INSP STAMP**
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	
D3.2 <u>Ref AES W/D 1178-345-757:</u> Locate existing connector D751 on AE0303 disconnect panel and replace with new connector AES-D9374 (P/N BACC45FN22-55SN). Install removed wires in accordance with wiring diagram 1178-345-757. Refer to drawing page 1 for applicable aircraft sheets.		
D3.3 Insert contact sealing plugs (P/N MS27488-20) in all remaining vacant contact positions. Carry out resistance and continuity checks on all new and disturbed wiring.		
D3.4 Re-install the following LRU's if removed for access:		

E3-3		
<u>IDENT</u>	<u>DESCRIPTION</u>	<u>INSTL'N</u>
M123	DME L	34-55-01 P401
M195	ZONE TEMP CONT	21-61-03 P401
M10389	STBY PACK TEMP CONT	21-51-14 P401
M126	PACK TEMP CONT L	21-51-14 P401
M138	DFDAU	31-31-03 P401
M10141	ATC L	34-53-01 P401

D3. ACCOMPLISHMENT INSTRUCTIONS – E3-3 SHELF

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	

D3.5 Ref AES W/D 1164-345-757:

Install 1off coding plug on mating connector AES-D9374 located on E3-3 disconnect panel AE0303.

Select P/N I.A.W table below:

AIRCRAFT REGISTRATION	CODING PLUG P/N
C-GTBB	1164-345-757-001
G-CPEP	1164-345-757-003
G-CPEU	1164-345-757-005
G-CPEV	1164-345-757-007
G-OOBA	1164-345-757-009
G-OOBB	1164-345-757-011
G-OOBG	1164-345-757-013
G-OOBH	1164-345-757-015
G-OOBI	1164-345-757-017
G-OOBJ	1164-345-757-019
G-OOOK	1164-345-757-021
G-OOOX	1164-345-757-023
G-OOOY	1164-345-757-025
G-OOOZ	1164-345-757-027
C-FOBH	1164-345-757-029
C-FUBG	1164-345-757-031
C-FLOK	1164-345-757-033
C-GOOZ	1164-345-757-035
C-FLEU	1164-345-757-037

END

D4. ACCOMPLISHMENT INSTRUCTIONS – FUNCTION TESTING

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

		MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]		N/A N/A	
D4.1	Restore electrical power to the airplane per 24-22-00 P201		
D4.2	Close all circuit breakers opened in Section D1.2.		
D4.3	Locate the following circuit breakers on the P11 panel. Remove ‘DO-NOT-CLOSE’ tags and close: c) 11F07 ATC-L d) 11F28 ATC-R		

D4. ACCOMPLISHMENT INSTRUCTIONS – FUNCTION TESTING

INDICATE A/C REG:

CERTIFICATE OF RELEASE TO SERVICE:

Certifies that the work specified, except as otherwise stated, was carried out in accordance with PART 145 and in respect to that work the aircraft/aircraft component is considered ready for Release to Service.

	MECH SIG.	INSP STAMP
[All instructions stated within this section of the embodiment instructions are to be carried out in accordance with the relevant sections of the Aircraft Maintenance and Structural Repair Manual]	N/A N/A	

D4.4 Carry out re-racking tests of the following units as follows:

IDENT	DESCRIPTION	TEST
M187	VOR/MKR R	34-51-01 P401
M153	HF COMM R	23-11-03 P401
M186	VOR/MKR L	34-51-01 P401
M127	PACK TEMP CONT R	21-51-14 P401
M168	MCDP	22-41-01 P401
M124	DME R	34-55-01 P401
M123	DME L	34-55-01 P401
M195	ZONE TEMP CONT	21-61-03 P401
M10389	STBY PACK TEMP CONT	21-51-14 P401
M126	PACK TEMP CONT L	21-51-14 P401
M138	DFDAU	31-31-03 P401
M10141	ATC L	34-53-01 P401
M10142	ATC R	34-53-01 P401

		MECH SIG.	INSP STAMP
D4.5	Using IFR ATC-601 test set, ensure Left and Right Mode-S ATC transponder address code are correct for the applicable aircraft registration in accordance with Figure 1.		
D4.6	If no longer required, Remove electrical power from the airplane per 24-22-00 P201.		
END			

Aircraft Registration	Variable No.	Hexadecimal Code
G-OOBH	NT407	400A8A
G-OOBG	NT405	40078A
G-OOOK	NA346	400488
G-OOOZ	NA352	40051C
G-OOBB	NT246	40090E
G-CPEP	NB322	400699
G-CPEU	NT404	400788
G-CPEV	NT406	400789
G-OOBA	NT245	40090D
G-OOBI	NB506	400AEE
G-OOBJ	NB507	400AED
G-OOOX	NB329	400533
G-OOOY	NT232	4006B5
C-FOBH	NT407	C0251A
C-FUBG	NT405	C034F1
C-FLOK	NA346	C01E83
C-GOOZ	NA352	C06B26
C-GTBB	NT246	C076F0
C-FLEU	NT404	C01D89

FIGURE 1 - AIRCRAFT REG / HEX CODE APPLICABILITY

E. DOCUMENTS REQUIRED

THE FOLLOWING DOCUMENTS ARE REQUIRED FOREMBODIMENT OF MODIFICATION AES-757-427-PT B. **NOTE: REFER TO MODIFICATION SHEET FOR LATEST DRAWING ISSUE.**

The following existing drawings/documents are required for embodiment:

Drawing No Title	____ SOURCE	________
1164-345-757	MANUFACTURE OF MODE-S ADDRESS CODING PLUGS	AES
1178-345-757	REWORK OF MODE-S ADDRESS CODING BUNDLE WIRING	AES

F. SPECIAL TOOLS REQUIRED

PART NUMBER	DESCRIPTION	VENDOR	COMMENTS
M22520/1-01	CRIMP TOOL	DMC	
M22520/1-02	LOCATOR	DMC	

G. ESTIMATED TIME REQUIRED

It is estimated that this modification will take approximately 25 man-hours.

This is based on the direct labour cost to do the work. The estimated assume that the work will be done by experienced personal, and may need to be revised upwards to suit operators' circumstances. The estimates do not include the time to prepare, plan or inspect the work. Manufacture and procurement of parts and tools' drying time for paints sealants, etc and general administration work are also not included.

H. PARTS REQUIRED LIST KIT NUMBER MEI-564 (MOD. NUMBER: AES-757-427-PT B)

ITEM NO	PART NUMBER	QTY RQD	DESCRIPTION	USED ON	ADD/	REMARKS / VENDOR	ALT PART NUMBER	OWNER	REVISION
1	BACC45FN22-55SN	2	CONN'R - RECEPTACLE	1178-345-757	**ADD**			FCA	1
2	MS27488-20	25	CONTACT SEALING PLUGS	1178-345-757	**ADD**			FCA	1
3	1164-345-757-(*)	2	MODE-S CODING PLUG	MEI-564 / 1164-345-757	**ADD**	***REFER TO MEI SECTION D2.5 / D3.5 AND REFERENCE DRAWING FOR CORRECT P/N**	FCA		1

I. PARTS REMOVED LIST

ITEM NO	PART NUMBER	QTY RQD	DESCRIPTION	USED ON	ADD/ REMOVE/ REWORK	REMARKS / VENDOR	ALT PART NUMBER	OWNER	REVISION
1	BACC45FT22A55S	1	CONNECTOR - PLUG	34-53-22 E3-2 SHELF	**REMOVE**	D751		FCA	1
2	BACC45FT22A55S	1	CONNECTOR - PLUG	34-53-12 E3-3 SHELF	**REMOVE**	D753		FCA	1

J. WIRE LIST

WIRE IDENT	WIRE CODE	GAUGE	LENGTH	WIRE TYPE	USED ON

NONE

K. WIRING DIAGRAMS

NONE

REF AES W/D: 1178-345-757

L. MEI - REPORT SHEET

THE MEI REPORT SHEET IS PROVIDED FOR THE PURPOSE OF COMMUNICATING TO AES DESIGN OFFICE ANY IMPROVEMENTS / SUGGESTIONS ARISING FROM THE EMBODIMENT OF THE MODIFICATION.

REPORT SHEET	**MEI No: MEI-564** **MOD No: AES-757-427-PT B**

AIRCRAFT TYPE:

REGISTRATION AND SERIAL NUMBER:

LOCATION:

COMMENTS:

PREPARED BY / DATE:______________________________

MODIFICATION EMBODIMENT INSTRUCTIONS

APPENDIX A **FIRST CHOICE AIRLINES RE-CERTIFICATION CONTROL SHEET** **A/C REG.**

PART NUMBER	**DESCRIPTION**	**SERIAL NO.**	**LOCATION**	**QTY.**	**COMMENTS** I.E. SERVICEABLE / UNSERVICEABLE	**DATE / INSPECTION STAMP**

APPENDIX B: - ADDITIONAL WORK CARD INDEX SHEET

(Photocopy additional sheets as required)

Item	Work card REF	Description	MECH SIG.	INSP STAMP

aes
aerospace engineering solutions
www.aesglobal.com
TEL: 44 (0)1279 818010
FAX: 44 (0)1279 647683

AES Limited
28 Golds Nurseries Business Park
Elsenham
Essex
CM22 6JX

QUERY NOTE

AES REF No:.
QN-AES-…...-…...-…...
(COMPLETED BY AES STAFF ONLY)

AIRCRAFT TYPE:…………………………………

APPLICANTS NAME:……………………………

REGISTRATION:…………………………………. DATE ……………………………………………

LOCATION:………………………………………..

APPLICANTS FAX No:…………………………..

DRAWING (S) / P/N AFFECTED:
……………………………………………………….

APPLICANTS TEL No:…………………………..

GIVE FULL DETAILS, INCLUDE OR ATTACH RELEVANT SKETCHES

DESIGN RESPONSE TO QUERY NOTE

DRAWING (S) TO BE AMENDED YES / NO

DATE AMENDED:

(AEROSPACE ENGINEERING SOLUTIONS LIMITED DESIGN OFFICE USE ONLY)

COMPILED BY:

APPROVED BY:

Form No: AES-031 (Issue 1)

AES Limited

PUBLICATION REVISION

Document No. AES-TP-0031

TRANSMITTAL SHEET
THE TECHNICAL INFORMATION CONTAINED IN THIS DOCUMENT HAS BEEN APPROVED UNDER THE AUTHORITY OF EASA DESIGN ORGANISATION APPROVAL No. EASA.21J.036

Project No.: 0909
DRN: 2517
Revision No.: Issue 1

Reason for Issue: **To introduce supplements to the aircraft technical publications listed in the introduction. This is the Introduction of an enhanced mode S transponder under cover of AES modifications AES-757-300, AES-757-345 and AES-757-434 .**

AIRCRAFT TECHNICAL PUBLICATION SUPPLEMENT - CERTIFICATION

Manual & Chapter	*Prepared by*	*Responsible for design*	*Date*	*Compliance Verification Engineer / Approval*		
				Stress	*Design*	*Systems*
Aircraft Maintenance Manual **34-53**	T N Gaunt		4/10/07			
Illustrated Parts Catalog **34-53**	T N Gaunt		4/10/07			
Wiring Diagram Manual **34-53**	T N Gaunt		4/10/07			

EFFECTIVITY

24017 (NA443), 24292 (NT405), 25054 (NA346), 25268 (NB322), 25593 (NA352), 26158 (NB329), 27146 (NB506), 27147 (NB507), 28203 (NT232), 29941 (NT404), 29942 (NT405), 29943 (NT406), 29944 (NT407), 32446 (NT245), 32447 (NT246), 33098 (NJ001), 33099 (NJ002), 33100 (NJ003)

INTRODUCTION - GENERAL

1 This modification introduces an enhanced mode S transponder to the subject aircraft. This technical publication supplement describes the installed equipment, and gives the removal, installation and test procedures for the equipment.

2 The only technical publications which are affected and which should be used with this supplement are the:

- Aircraft maintenance manual
- Wiring diagram manual
- Illustrated parts catalogue.

3 Aircraft effectivity details are given in the table below.

Manufacturer's Serial Number (MSN)	Registration	Variable Number	Customer Effectivity Code
24017	C-FTDV	NA443	003
24292	G-OOOG	NT405	004
25054	G-OOOK	NA346	115
25268	G-CPEP	NB322	952
25593	G-OOOZ	NA352	121
26158	G-000X	NB329	009
27146	G-OOBI	NB506	006
27147	G-OOBJ	NB507	002
28203	G-OOOY	NT232	010
29941	G-CPEU	NT404	504
29942	G-OOBG	NT405	505
29943	G-CPEV	NT406	506
29944	G-OOBH	NT407	507
32446	G-OOBA	NT245	950
32447	C-GTBB	NT246	951
33098	G-OOBC	NJ001	098
33099	G-OOBD	NJ002	099
33100	G-OOBE	NJ003	100

AIRCRAFT MAINTENANCE MANUAL

LIST OF EFFECTIVE PAGES

CHAP-SECT-UNIT	PAGE No.	DATE	CHAP-SECT-UNIT	PAGE No.	DATE
EFFECTIVE PAGES	i	Oct 04/2007	34-53-01	402	Oct 04/2007
REVISIONS	ii	Oct 04/2007	34-53-02	401	Oct 04/2007
INTRODUCTION	iii	Oct 04/2007	34-53-02	402	Oct 04/2007
CONTENTS	iv	Oct 04/2007	34-53-02	403	Oct 04/2007
34-53-00	1	Oct 04/2007			
34-53-00	2	Oct 04/2007			
34-53-00	3	Oct 04/2007			
34-53-00	4	Oct 04/2007			
34-53-00	101	Oct 04/2007			
34-53-00	102	Oct 04/2007			
34-53-00	103	Oct 04/2007			
34-53-00	104	Oct 04/2007			
34-53-00	501	Oct 04/2007			
34-53-00	502	Oct 04/2007			
34-53-00	503	Oct 04/2007			
34-53-00	504	Oct 04/2007			
34-53-00	505	Oct 04/2007			
34-53-00	506	Oct 04/2007			
34-53-00	507	Oct 04/2007			
34-53-00	508	Oct 04/2007			
34-53-00	509	Oct 04/2007			
34-53-00	510	Oct 04/2007			
34-53-00	511	Oct 04/2007			
34-53-00	512	Oct 04/2007			
34-53-00	513	Oct 04/2007			
34-53-00	514	Oct 04/2007			
34-53-00	505	Oct 04/2007			
34-53-01	401	Oct 04/2007			

AIRCRAFT MAINTENANCE MANUAL

RECORD OF REVISIONS

REV No.	INSERTION DATE	BY	REV No.	INSERTION DATE	BY	REV No.	INSERTION DATE	BY

AIRCRAFT MAINTENANCE MANUAL

INTRODUCTION

1 This section supplements the manufacturer's aircraft maintenance manual. It only relates to the specific components which are replaced by this modification. For all other data, refer to the manufacturer's documentation.

2 Aircraft effectivity details are given in the table below.

Manufacturer's Serial Number (MSN)	Registration	Variable Number	Customer Effectivity Code
24017	C-FTDV	NA443	003
24292	G-OOOG	NT405	004
25054	G-OOOK	NA346	115
25268	G-CPEP	NB322	952
25593	G-OOOZ	NA352	121
26158	G-OOOX	NB329	009
27146	G-OOBI	NB506	006
27147	G-OOBJ	NB507	002
28203	G-OOOY	NT232	010
29941	G-CPEU	NT404	504
29942	G-OOBG	NT405	505
29943	G-CPEV	NT406	506
29944	G-OOBH	NT407	507
32446	G-OOBA	NT245	950
32447	C-GTBB	NT246	951
33098	G-OOBC	NJ001	098
33099	G-OOBD	NJ002	099
33100	G-OOBE	NJ003	100

AIRCRAFT MAINTENANCE MANUAL

TABLE OF CONTENTS

TRANSPONDER SYSTEM - SPECIFIC COMPONENTS

DESCRIPTION AND OPERATION

1 General

A This modification replaced two components in the transponder system. This supplement therefore only describes these components. Consult the manufacturer's Aircraft Maintenance Manual (AMM) for all other details of the system.

B The components which were replaced are:

- two enhanced mode S transponders.
- the ATC control panel.

2 Transponder

A Description (Ref. Fig 1)

(1) The transponder units are the airborne receiver-transmitter part of the ATC radar beacon system. The units are located in rack E3 of the main equipment center, where the racks and connectors are original equipment. They are therefore not detailed in this supplement.

B Operation

Operation

(1) The transponder sends a coded identification signal in reply, when a ground-based radar station send a signal to interrogate the transponder. This reply gives the identity, location and altitude of the aircraft. It is used to generate a display for the air traffic control system.

(2) The mode S function of the transponder is used to transmit Traffic alert and Collision Avoidance System (TCAS)-related data between TCAS-equipped aircraft. It can also transmit data to suitably equipped ground stations.

(3) The interrogation and reply signals are pulse-signals, where the data which is transmitted controls the number and spacing of the pulses.

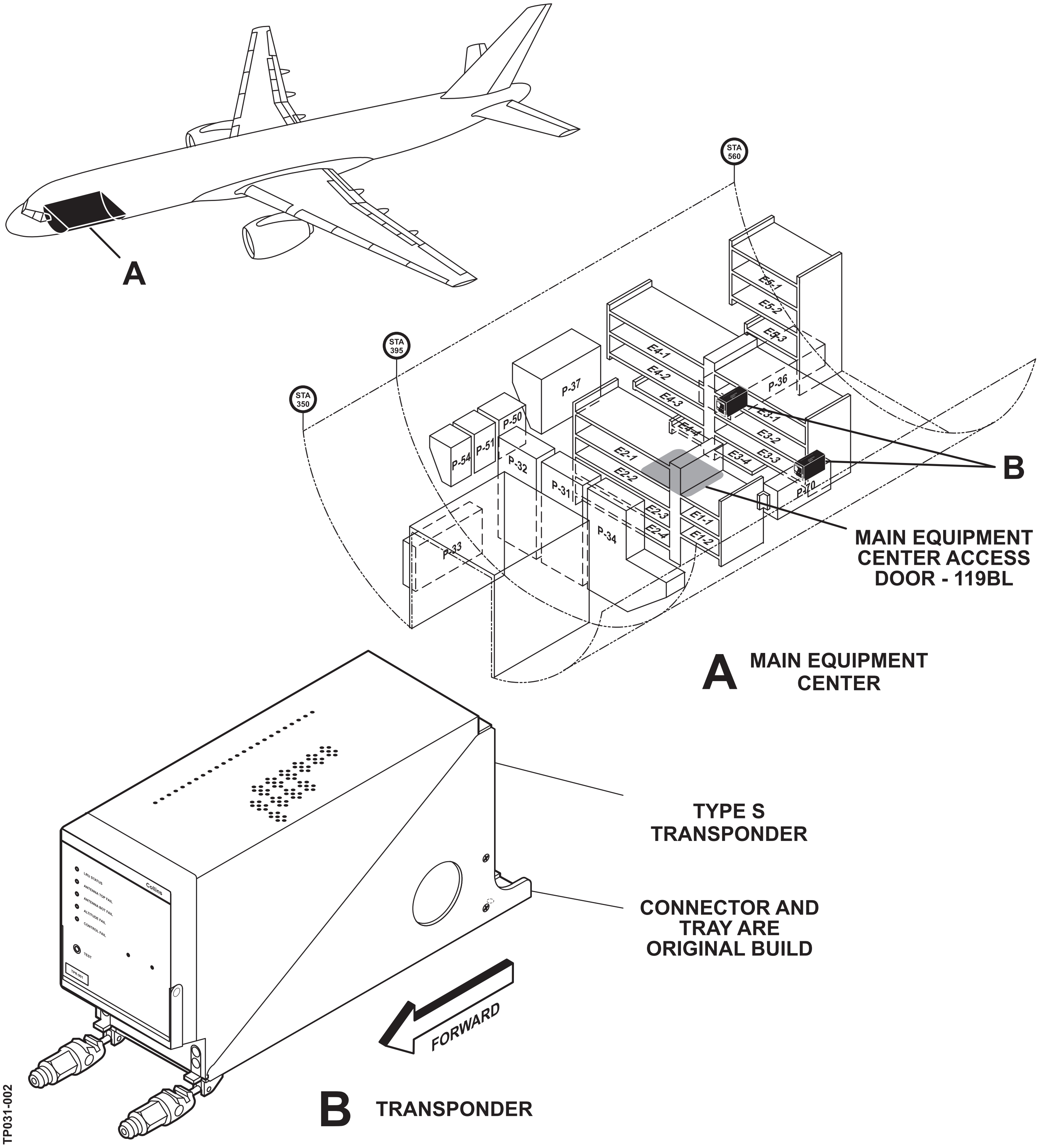


Fig 1 Transponders - location

EFFECTIVITY

24017 (NA443), 24292 (NT405), 25054 (NA346), 25268 (NB322), 25593 (NA352), 26158 (NB329), 27146 (NB506), 27147 (NB507), 28203 (NT232), 29941 (NT404), 29942 (NT405), 29943 (NT406), 29944 (NT407), 32446 (NT245), 32447 (NT246), 33098 (NJ001), 33099 (NJ002), 33100 (NJ003)

3 ATC control panel

A Description (Ref. Fig 2)

(1) The ATC control panel is used to control the two transponders. It is installed in the center pedestal in the flight compartment.

(2) Controls and indicators on the ATC control panel are:

- the XPNDR (transponder) selector switch
- an alpha-numeric keypad
- a liquid-crystal display (display)
- the IDENT push button
- a function selector
- a TEST push button.

B Operation

(1) The XPNDR selector is used to select the transponder in use.

(2) Flight identification data is entered through the keypad and confirmed on the display.

(3) When the IDENT button is pushed, the data is sent to the transponder and transmitted.

(4) The function selector switch is used to select the operational mode of the system.

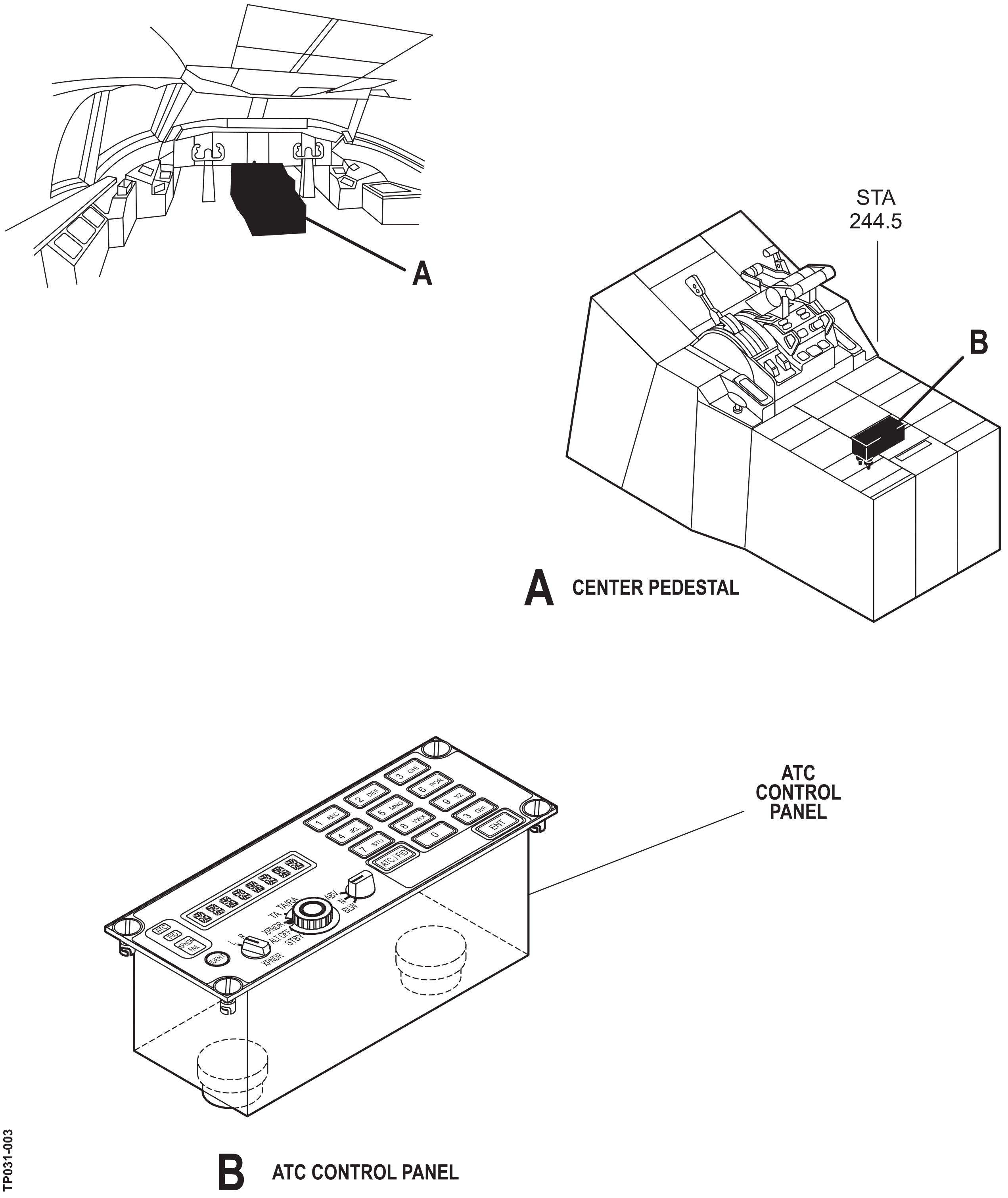


Fig 2 ATC control panel - location

TRANSPONDER SYSTEM - SPECIFIC COMPONENTS

COMPONENT LOCATION

1 General

A The table of component locations are given on the next page.

COMPONENT	QTY	ACCESS/AREA	REFERENCE AMM
TRANSPONDER	2	119BL, MAIN ELECTRONICS CENTER.	AMM SUP 34-53-01
ATC CONTROL PANEL	1	FLIGHT COMPARTMENT, CENTER PEDESTAL	AMM SUP 34-53-02
NOTE: ALL OTHER COMPONENTS OF THE TRANSPONDER SYSTEM REMAIN AS PER ORIGINALBUILD STANDARD. REFER TO THE AIRCRAFT MANUFACTURER'S DOCUMENTATION FOR DETAILS.			

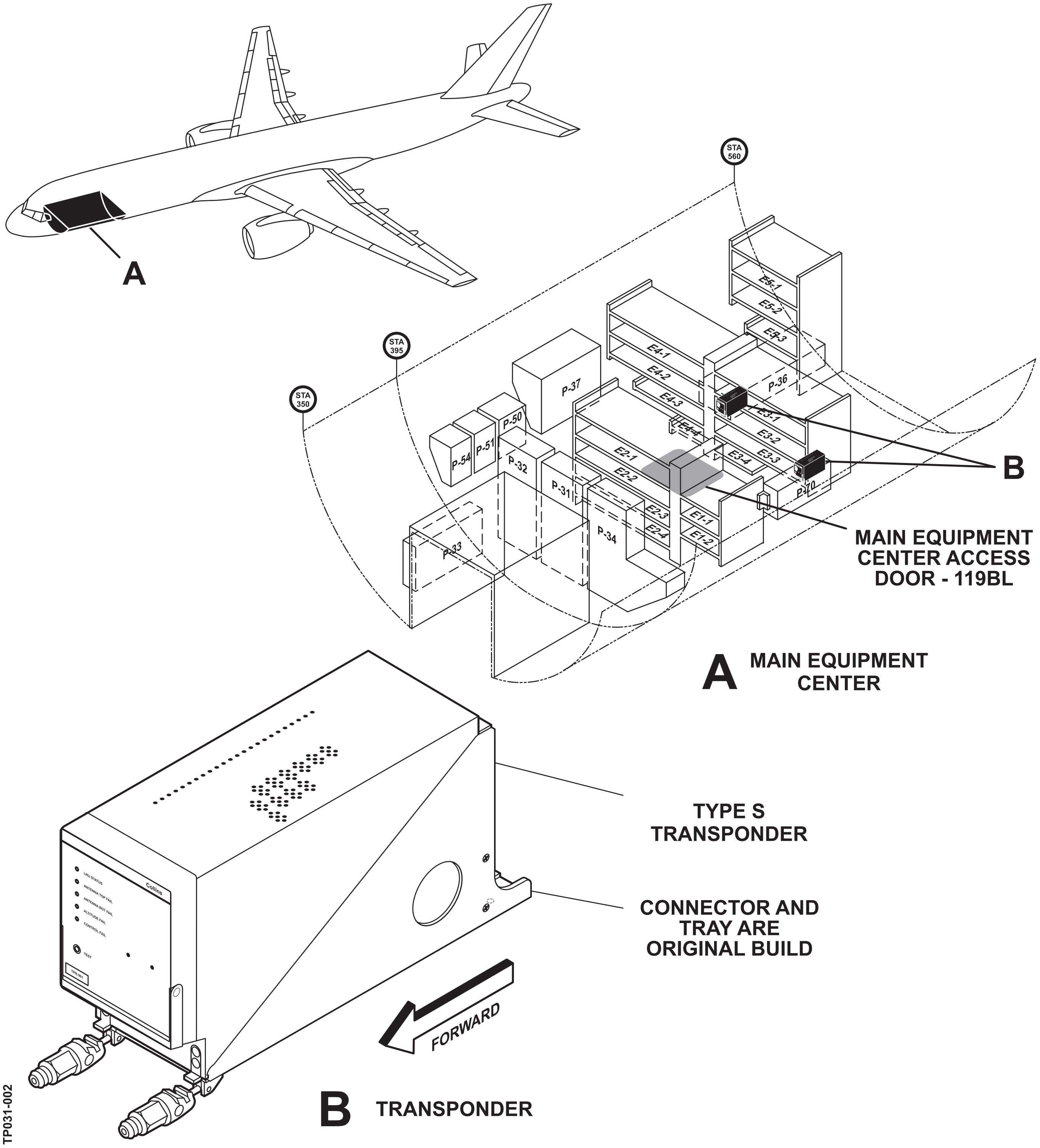
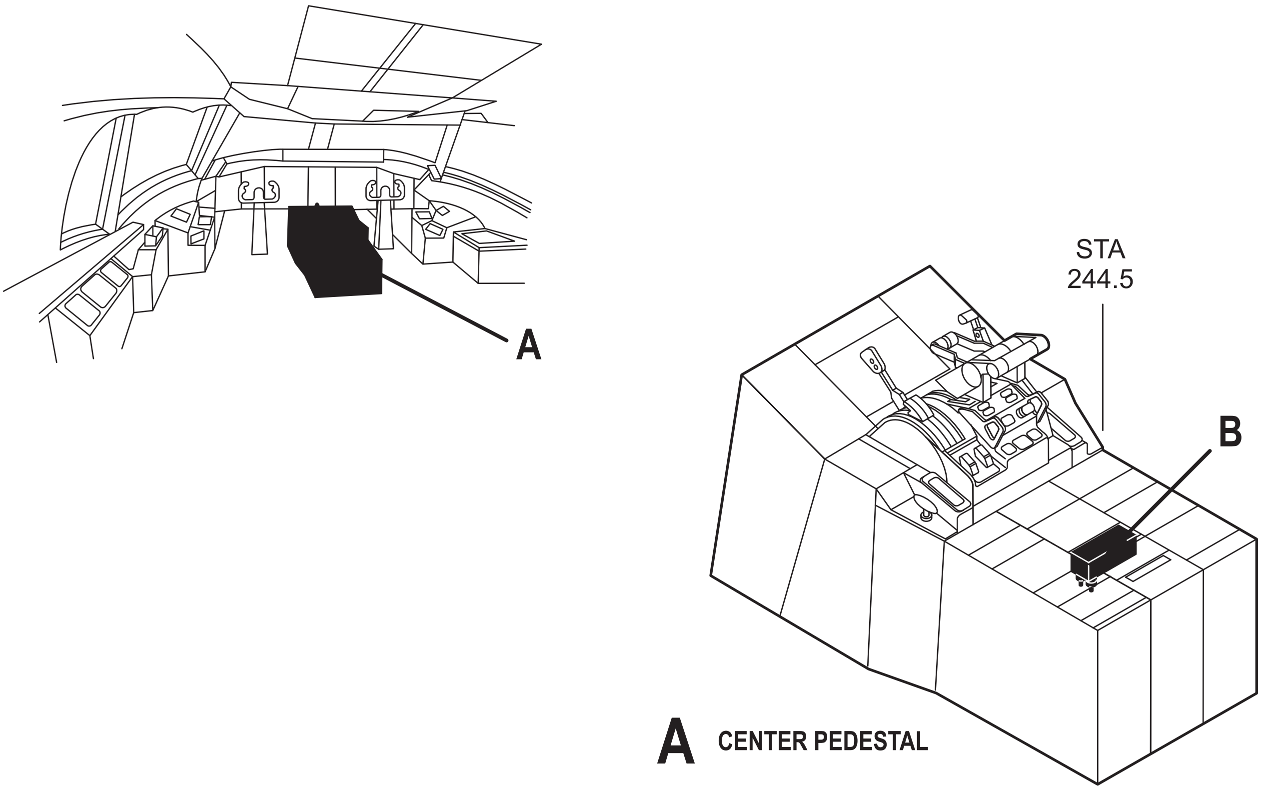


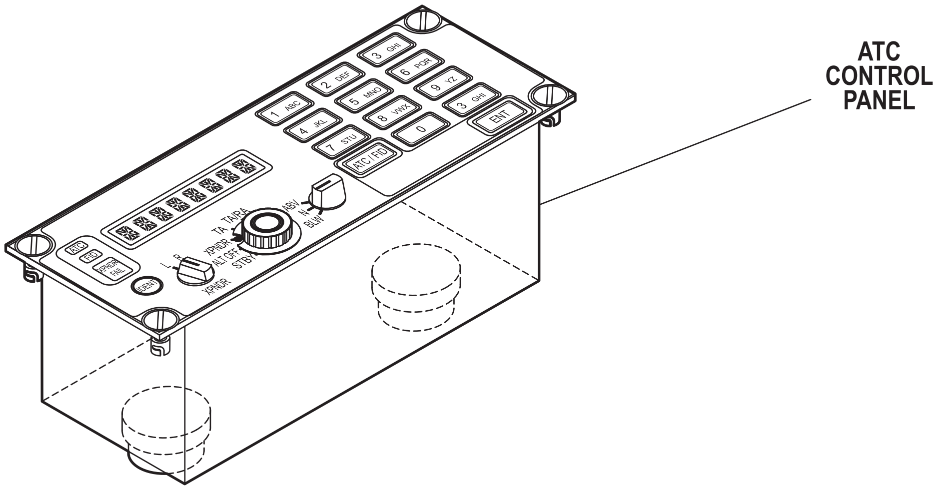
Fig 101 Transponder system components (sheet 1 of 2)

EFFECTIVITY

24017 (NA443), 24292 (NT405), 25054 (NA346), 25268 (NB322), 25593 (NA352), 26158 (NB329), 27146 (NB506), 27147 (NB507), 28203 (NT232), 29941 (NT404), 29942 (NT405), 29943 (NT406), 29944 (NT407), 32446 (NT245), 32447 (NT246), 33098 (NJ001), 33099 (NJ002), 33100 (NJ003)



A **CENTER PEDESTAL**



B **ATC CONTROL PANEL**

Fig 101 Transponder system components (sheet 2 of 2)

TRANSPONDER SYSTEM

ADJUSTMENT/TEST

1 General

A This pageblock contains these tests of the transponder system:

(1) An operational test.

(2) A system test.

2 Operational test

A General

(1) This test examines the ATC system for correct operation. It uses only the system's BITE function, and no special test or ground equipment is necessary.

B Referenced Information

REFERENCE	DESIGNATION
AMM 24-22-00/201	Electrical Power – Control

C Location and Access

ZONE	DESCRIPTION	ACCESS
119/120	Main equipment center	119BL
211/212	Flight compartment	Not applicable

D Preparation

(1) Supply electrical power (AMM 24-22-00/201).

(2) In the flight compartment, on the overhead equipment panel P11, make sure these circuit breakers are closed:

- 11A10, AIR DATA CMPTR LEFT
- 11A11, AIR DATA AOA SENSOR LEFT
- 11A12, AIR DATA BARO CORRECT LEFT
- 11E28, ATC ANT SWITCH
- 11E2, ALTM LEFT
- 11E23, ALTM RIGHT
- 11F7, ATC LEFT
- 11F28, ATC RIGHT
- 11F30, AIR DATA CMPTR RIGHT

- 11F31, AIR DATA AOA SENSOR RIGHT
- 11F32, AIR DATA BARO CORRECT RIGHT
- EICAS (6 locations)

(3) On the ATC control panel, set the XPNDR selector to L.

E Procedure

(1) Make sure the EICAS message, ATC FAULT, does not show on the top display.

NOTE: If it is necessary, push the CANCEL switch on the EICAS DISPLAY select panel to see more messages.

(2) In the main equipment center, push and hold the TEST switch on the left ATC transponder.

(3) Make sure this sequence occurs:

(a) All the red LEDs come on.

(b) All the red LEDs go off.

(4) The green LED comes on and stays on.

(5) Release the TEST switch on the ATC transponder.

(6) In the flight compartment, on the ATC control panel, set the XPNDR selector to R.

(7) Do the self-test procedure again for the right ATC transponder.

F Close up

(1) Remove the electrical power from the aircraft if not required (AMM 24-22-00/201).

3 System test

A Fixtures, Tools, Test and Support Equipment

REFERENCE	DESIGNATION
ATC-601-2	Ramp Test Set - with software 3.04 (or later) installed
Alternatives:	
ATC-601-1	Ramp Test Set - with software 3.04 (or later) installed
ATC 600	Ramp test unit (only required for IDENT test)

REFERENCE	DESIGNATION
429EBP	Data Bus Analyzer (recommended) JcAIR Instrumentation 400 Industrial Parkway Industrial Airport, KS 66031
Alternatives: 429-2	Data Bus Analyzer Interface Technology 150 E. Arrow Highway San Dimas, CA 91773
A34011-1	Breakout Box (recommended)
Alternative: A34011-112	Breakout Box

B Referenced Information

REFERENCE	DESIGNATION
AMM 24-22-00/201	Electrical Power – Control
AMM 32-09-02/201	Air/Ground Relay System
AMM 33-13-00/501	Integral Panel Light Test
AMM 34-45-01/501	TCAS Operational Test
AMM 34-53-00/501	Air Traffic Control System
1002-8105-200 Issue 3	Ramp Test Set ATC-601-2 Operation Manual

C Location and Access

ZONE	DESCRIPTION	ACCESS
119/120	Main equipment center	119BL
211/212	Flight compartment	Not applicable

D Procedure

(1) Preparation

(a) Supply electrical power to the aircraft (Ref. AMM 24-22-00/201).

CAUTION: DO NOT PUT THE ANTENNA OF THE REMOTE TEST SET LESS THAN 15 INCHES (0.40 METERS) FROM THE AIRCRAFT ANTENNA WHEN THE TEST SET ON. THIS WILL CAUSE DAMAGE TO THE TEST SET.

(b) Put the test antenna for the Ramp Test Set at a convenient bearing and distance from the aircraft ATC antennae. The test antenna must be:

- facing towards the aircraft ATC antennae
- in line of sight of the aircraft ATC antennae.

(c) Connect the coaxial cable between the remote test set antenna and the ramp test set.

(d) Make sure the Left, Right and Center IRU’s are powered and aligned.

(e) Make sure the Left and Right ADC system are operating normally.

(f) Make sure the Left and Right FMC is operating correctly and is initialized.

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(g) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

(h) Set the Captain’s and First Officer’s altimeters to 29.92 inches of mercury.

(i) On the overhead equipment panel P11, open these circuit breakers and attach DO-NOT-CLOSE tags:

- 11C19 [or 11D25], LANDING GEAR POS SYS 2 ALTN
- 11S15, AIR/GND SYS 1
- 11S19, LDG GR POS AIR/GND SYS 2

E Integral panel lights test

(1) Do a test of integral panel lighting (AMM 33-13-00/501).

(a) Make sure that the lighting on the transponder control panel operates correctly from full bright to full dim.

F Mode-S functional test

(1) In the flight compartment, at the ATC control panel:

(a) Set the rotary mode selector switch to STBY.

(b) Set the XPNDR selector to L and make sure that the display does not show a FAIL message.

(c) Allow one minute for the transponder to warm-up, then make sure that:

- ATC or Flight ID is shown in the display
- the XPNDR FAIL indicator is not on.

(2) In the main equipment center, on shelf E3-3 at the left transponder (M10141) make sure that:

(a) All the LED test indicators are off.

(b) Press and hold the TEST push button and make sure that:

1 All five LED indicators show red for approximately five seconds.

2 After five seconds the:

- top LED indicator changes to green
- lower four LED indicators go off.

(c) Release the TEST push button, and make sure the top LED indicator goes off.

(3) In the flight compartment, at the ATC control panel:

(a) Set the XPNDR selector to R and make sure that the display does not show a FAIL message.

(4) In the main equipment center, on shelf E3-2 at the right transponder (M10142) make sure that:

(a) All the LED test indicators are off.

(b) Press and hold the TEST push button and make sure that:

1 All five LED indicators show red for approximately five seconds.

2 After five seconds the:

- top LED indicator changes to green
- lower four LED indicators go off.

(c) Release the TEST push button, and make sure the top LED indicator goes off.

(5) In the flight compartment:

(a) At the ATC control panel:

1 Set the XPNDR selector to L.

2 Press and release the TEST push button, and make sure the display shows a ‘PASS’ message.

NOTE: This indicates that the self-test was completed successfully.

(b) On the overhead equipment panel P11, remove the DO-NOT-CLOSE tags and close these circuit breakers:

– 11C19 [or 11D25], LANDING GEAR POS SYS 2 ALTN
– 11S15, AIR/GND SYS 1
– 11S19, LDG GR POS AIR/GND SYS 2

(c) Do a TCAS operational test (AMM 34-45-00/501).

(d) On the overhead equipment panel P11, open these circuit breakers and attach DO-NOT-CLOSE tags:

– 11C19 [or 11D25], LANDING GEAR POS SYS 2 ALTN
– 11S15, AIR/GND SYS 1
– 11S19, LDG GR POS AIR/GND SYS 2

(e) If local procedures require it, tell Air Traffic Control (ATC) that an ATC transponder test is to be done.

(f) On the ATC control panel make sure the display shows the four digit ATC code.

1 If the display does not show the ATC code, press and release the ATC/FID button until the ATC code is shown and the ATC indicator comes on.

(g) Do a test of the alpha-numeric keypad. Do not use codes 7500, 7600 or 7700. These are emergency codes

1 Push four alpha-numeric keypad numbers 0 thru 7.

2 Make sure the four numbers are shown in display locations three thru six. Locations one, two, seven and eight are blank.

3 Push the CLR push button and make sure the present location in the display changes to an underscore (_).

4 Push the CLR push button again and make sure the present position in the display moves one position to the left.

5 Push keypad numbers 8 and 9 and make sure the display shows INVALID.

6 Push the ATC/FID push button switch until the FID indicator comes on.

7 Make sure all the alpha-numeric keypad numbers display numeric and alpha characters in the display. At keys 1 thru 8:

a Push a keypad alpha-numeric push button two times and make sure a letter is shown in the display.

b Push the same keypad alpha-numeric push button again and make sure the next letter on that push button is shown in the display.

(h) Do a test of the IDENT push button switch.

NOTE: When the IDENT push button switch is pushed, the ATC code that is shown on the display is sent to the selected transponder.

1 Make sure the ATC indicator is on.

2 Use the alpha-numeric keypad to enter a valid ATC code.

3 Outside the aircraft, at the ATC 600 ramp test unit (or alternative), push the IDENT push button switch. Make sure the IDENT indicator comes on, on the test set.

4 In the flight compartment, at the ATC control panel, set the XPNDR selector to R, then do Para 3F(5)(h)1 thru Para 3F(5)(h)3 again for the right transponder.

(i) Do a test of the function selector.

1 Set the function selector to STBY and make sure the TCAS display shows TCAS OFF or TCAS STBY for the selected transponder (L or R).

a Make sure that any alpha-numeric input changes the value shown in the display.

2 Set the XPNDR selector to select the second transponder.

a Make sure the TCAS display shows TCAS OFF or TCAS STBY for that transponder.

3 Set the function selector to TA/RA.

a Make sure the EHSI display shows TA ONLY.

4 Set the XPNDR selector to L.

5 Push the ATC/FID push button.

a If the airline code shown is not a First Choice Airways code use the CLR push button to clear the display.

b Use the keypad to enter a valid test or current FLT ID code.

(6) Use the ATC-601-2 Ramp Test Set to do a test (Test Set Operation Manual Section 4.3.1).

The test set is a source of interference for radio and L-band radar equipment operating on the airplane and located near the test set. Turn the test set off as soon as the test is completed or when you must perform other radio checks on the aircraft.

(a) On the test set, set the PWR switch to ON.

(b) Do the start-up procedure for the ramp test set in accordance with the manufactures operation manual.

NOTE: The aircraft must be in AIR MODE for the test to function correctly.

(c) Make sure that the correct version of software configuration is installed in the ramp test set. It must be version 3.04 or later approved revision.

(d) Push the SELF TEST and then the RUN/STOP key.

1 Make sure the display on the test set shows PASSED.

(e) Push the SETUP key then enter this data:

1 In the RANGE field enter the distance from the test set antenna to the aircraft antenna for the TOP and BOTTOM antennae.

2 In the HEIGHT field enter 21 feet for the TOP antenna and 8 feet for the BOTTOM antenna.

3 Choose the BOTTOM antenna on the SELECTED field.

4 In the GAIN_1030 and GAIN_1090 field enter the gain listed on the test set antenna.

5 In the LOSS field enter the cable loss listed on the test cable.

NOTE:

1 Use the SLEW keys to change the values.

2 Use the SELECT keys to change the items.

3 Use the SELECT keys to select the antenna which you must test.

(f) Do the auto test procedure (Test Set Operation Manual Section 4.3.1).

1 The AUTO test will run until it is finished.

2 The results are stored in the tester memory for review.

3 These test screens will show as failed because the transponder is currently not wired for ADS-B modes:

Test	Description
29	Airborne Position BDS 0,5
30	Surface Position BDS 0,6
31	Ident and Category BDS 0,8
32	Airborne Velocity BDS 0,9 Part 1
33	Airborne Velocity BDS 0,9 Part 2
34	Airborne Velocity BDS 0,9 Part 3
35	Ext Squitter Status BDS 0,7
38	Aircraft Status BDS 6,1

4 Reply Delay Test (Test Set Operation Manual Section 4.4.1(1) and Fig. 12)

a Make sure the reply delay is 128.00us (±0.25us) for Mode-S.

b Make sure the reply delay is 128.00us (±0.5 us) for ITM.

c Make sure the reply delay is 3.00us (±0.5us) for ATC A and C.

5 Reply Jitter Test (Test Set Operation Manual Section 4.4.1(2) and Fig. 13)

- a Make sure the reply jitter is ≥ 0.05us for Mode-S.
- b Make sure the reply jitter is ≥ 0.06us for ITM A and C.
- c Make sure the reply jitter is ≥ 0.1us for ATC A and C.

6 ATCRBS Replay Test (Test Set Operation Manual Section 4.4.1(3) and Fig. 14)

- a Make sure the spacing of the F1 to F2 pulse is 20.3us (±0.10us).
- b Make sure the duration of the F1, F2 pulse is 0.45us (±0.10us).

7 SLS Level Test (Test Set Operation Manual Section 4.4.1(4) and Fig.15).

- a Do this test less than 95 feet (28.96 meters) from the UUT antenna.
- b Make sure the reply is received when the SLS pulse is -9dB and no reply is received when the SLS pulse is 0dB.

8 ATCRBS Only All-Call Test (Test Set Operation Manual Section 4.4.1(5) and Fig. 16)

- a Make sure the Mode-S transponder did not reply to the interrogation (PASSED TEST).

9 Mode-S All Call Test [(est Set Operation Manual Section 4.4.1(6) and Fig. 17)

- a Make sure the test set shows PASSED and the aircraft's Mode-S address.

10 Invalid Mode-S Address Test (Test Set Operation Manual Section 4.4.1(7) and Fig. 18)

- a Make sure the Mode-S transponder did not reply (PASSED TEST).

11 SPR On/Off Test (Test Set Operation Manual Section 4.4.1(8) and Fig. 19)

a Make sure a reply is received when SPR is ON and no reply is received when SPR is OFF.

12 Mode-S UF0 Test (Test Set Operation Manual Section 4.4.1(9) and Fig. 20)

a Make sure (Down-link format) DF=0, AC=(airplane's altitude) and ADDRESS=(airplane's Mode-S address). The reported altitude must be within ±125 feet of the altitude shown on the captain's and first officer's altimeter (this is applicable for all the altitude reporting checks).

NOTE: The aircraft's Mode-S address is displayed in hexadecimal form.

13 Mode-S UF4 Test (Test Set Operation Manual Section 4.4.1(10) and Fig. 21)

a Make sure DF=4, AC= (airplane's altitude) and ADDRESS= (airplane's mode address).

14 Mode-S UF5 Test (Test Set Operation Manual Section 4.4.1(11) and Fig. 22)

a Make sure DF=5, ID= (selected ATC ID code on the ATC control panel) and ADDRESS= (airplane's Mode-S address)

NOTE: The aircraft's Mode-S address is displayed in hexadecimal form.

15 Mode-S UF11 Test (Test Set Operation Manual Section 4.4.1(12) and Fig. 23)

a Make sure DF=11 and AA= (airplane's address).

b Make sure the CA field is not void.

NOTE: The manufacturer gives the value of the CA field.

16 Mode-S UF16 Test (Test Set Operation Manual Section 4.4.1(13) and Fig. 24)

a Make sure DF=16, AC= (airplane's altitude) and ADDRESS= (airplane's Mode-S address).

NOTE: No reply to the UF16 test is not a failure of the ATC system.

17 Mode-S UF20 Test (Test Set Operation Manual Section 4.4.1(14) and Fig. 25)

a Make sure DF=20, AC= (airplane's altitude) and ADDRESS= (airplane's Mode-S address).

NOTE: No reply to the UF20 test is not a failure of the ATC system.

18 Mode-S UF21 Test (Test Set Operation Manual Section 4.4.1(15) and Fig. 26)

a Make sure DF=21, ID= (selected ATC ID code on the ATC control panel) and ADDRESS= (airplane's Mode-S address).

NOTE: No reply to the UF21 test is not a failure of the ATC system.

19 Squitter Test (Test Set Operation Manual Section 4.4.1(16) and Fig. 27)

a Make sure the squitter's period is between 0.8 and 1.2 seconds.

NOTE: If the test set antenna is in line of sight with only one of the ATC antennae, the squitter period will be between 1.6 and 2.4 seconds.

20 Frequency Test (Test Set Operation Manual Section 4.4.1(17) and Fig. 28)

a Make sure the reply frequency of the transponder is 1090 MHz ±1MHz.

b Move the test set to less than 50 feet from the top ATC antenna.

Make sure the top ATC antenna is not in the line of sight of the test set antenna. Follow the test set operator's guide to reduce multi-path errors. Repeat the test several times with the test set at different locations until you get valid results.

c Push the SETUP key on the test set and enter the appropriate range for the top and bottom antenna.

21 Diversity Test (Test Set Operation Manual Section 4.4.1(21) and Fig. 32)

a Make sure the power level difference is ≥ 20dB between 'on' antenna squitters and 'off' antenna squitters. To make sure the dynamic range is ≥ 20dB, a diversity test must be run at a distance of less than 50 feet (15.2 meters) from the airplane antenna.

22 MTL Difference Test (Test Set Operation Manual Section 4.4.1(22) and Fig. 33)

a Make sure the Minimum Threshold Level (MTL) difference between Mode-A and Mode-C is ≤ 1.0dBm.

23 Power Test (Test Set Operation Manual Section 4.6.2 and Fig. 58, 59 and 60)

a Push the PWR TEST key on the test set.

b Use the SELECT key on the test set and select the bottom antenna.

Make sure the top ATC antenna is not in the line of sight of the test set antenna during the POWER TEST.

c Push the antenna push button switch.

d Slowly lift the test set antenna 6 ft (1.8 m) vertically from the ground at a rate of less than 1 ft/sec (30 cm/sec).

e Push the antenna push button switch a second time to stop the test when the test set antenna is approximately 6 ft (1.8 m) high.

24 Do a check of the POWER TEST.

a Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBm) and 500W (ERP = 57.0 dBm).

NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

b Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).

c Make sure the test set shows PASSED for the BOT AVG (dBm).

25 Power Test (continued)

a Put the antenna shield over the bottom ATC antenna.

b Move the test set so that it is in the line of sight of the top ATC antenna.

c Push the SETUP key on the test set.

- Enter the appropriate range for the top antenna.
- Choose the top antenna on the SELECTED field.

d Push the PWR TEST key on the test set.

e Use the SELECT key on the test set and select the top antenna.

26 Flight ID Test (Test Set Operation Manual Section 4.4.1(18) and Fig. 29)

a Make sure that the Flight ID shown is the same as the value selected in Para 3F(5)(i)5a.

27 UELM Test (Test Set Operation Manual Section 4.4.1(19) and Fig. 30)

a If not NOT AVAIL is displayed for the UELM test, this is not a failure of the ATC system.

28 DELM Test (Test Set Operation Manual Section 4.4.1(20) and Fig. 31)

a If not NOT AVAIL is displayed for the DELM test, this is not a failure of the ATC system.

29 Selected VERT Intent Report BDS 4,0 Pt.1 Test (Test Set Operation Manual Section 4.4.1(23) and Fig. 34)

a Make sure DF=20, BDS=4,0 and AA=(airplane's Mode-S address).

b Make sure **SEL VERT INTENT RPT#1 - PASSED** is shown.

30 Selected VERT Intent Report BDS 4,0 Pt.2 Test (Test Set Operation Manual Section 4.4.1(24) and Fig. 35)

a Make sure DF=20, BDS=4,0 and AA=(airplane's Mode-S address).

b Make sure **SEL VERT INTENT RPT#2 - PASSED** is shown.

31 Track & Turn Report BDS 5,0 Test (Test Set Operation Manual Section 4.4.1(27) and Fig. 38)

a Make sure DF=20, BDS=5,0 and AA=(airplane's Mode-S address).

b Make sure **TRACK & TURN REPORT - PASSED** is shown.

32 Data Link Capability Report Part 1 BDS 1,0 Test (Test Set Operation Manual Section 4.4.1 (25) and Fig. 36)

a Make sure DF=20, BDS=1,0 and AA=(airplane's Mode-S address).

b Make sure **DATA LINK CAP REPORT #1 - PASSED** is shown.

33 Data Link Capability Report Part 2 BDS 1,0 Test (Test Set Operation Manual Section 4.4.1 (26) and Fig. 37)

a Make sure DF=20, BDS=1,0 and AA=(airplane's Mode-S address).

b Make sure **DATA LINK CAP REPORT #2 - PASSED** is shown.

34 Heading & Speed Report BDS 6,0 Test (Test Set Operation Manual Section 4.4.1(28) and Fig. 39)

a Make sure DF=20, BDS=6,0 and AA=(airplane's Mode-S address).

b Make sure **HEADING & SPEED REPORT - PASSED** is shown.

35 In the flight compartment, at the ATC control panel, set the XPNDR selector to R.

36 Do Para 3F(6)(f) thru Para 3F(6)(f)34b again for the right transponder.

(7) Close up

(a) When the test is completed:

1 Shut down the test set and remove all the test equipment from the aircraft.

2 Return aircraft to usual configuration.

3 Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

4 On the overhead equipment panel P11, remove the DO-NOT-CLOSE tags and close these circuit breakers:

- 11C19 [or 11D25], LANDING GEAR POS SYS 2 ALTN
- 11S15, AIR/GND SYS 1
- 11S19, LDG GR POS AIR/GND SYS 2

5 Remove the electrical power from the aircraft if not required (AMM 24-22-00/201).

6 Close all the panels and/or access doors.

TRANSPONDER

REMOVAL/INSTALLATION

1 General

A The left (M10141) and right (M10142) ATC transponders are installed in the E3 rack in the main equipment center.

2 Removal

A Fixtures, Tools, Test and Support Equipment

None.

B Referenced Information

REFERENCE	DESIGNATION
AMM 20-10-01/401	E/E Rack-Mounted Components

C Location and Access

ZONE	DESCRIPTION	ACCESS
119/120	Main equipment center	119BL
211/212	Flight compartment	Not applicable

D Procedure

(1) Preparation

(a) In the flight compartment, on the overhead equipment panel P11, open these circuit breakers and attach DO-NOT-CLOSE tags:

- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(2) Removal

(a) Remove the ATC transponder (AMM 20-10-01/401).

3 Installation

A Fixtures, Tools, Test and Support Equipment

None.

B Referenced Information

REFERENCE	DESIGNATION
AMM 20-10-01/401	E/E Rack-Mounted Components

C Location and Access

ZONE	DESCRIPTION	ACCESS
119/120	Main equipment center	119BL
211/212	Flight compartment	Not applicable

D Procedure

(1) Preparation

(a) In the flight compartment, on the overhead equipment panel P11, make sure these circuit breakers are open and DO-NOT-CLOSE tags are attached:

- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(2) Installation

(a) Install the ATC transponder (AMM 20-10-01/401).

(3) Close up

(a) In the flight compartment, on the overhead equipment panel P11, remove the DO-NOT-CLOSE tags and close these circuit breakers:

- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(b) Do an operational test of the transponder system (AMM SUPP 34-53-00/501).

ATC CONTROL PANEL

REMOVAL/INSTALLATION

1 General

A The ATC control panel (M10140) is installed on the aisle control stand P8. Electrical connections are at the rear of the control panel.

2 Removal

A Fixtures, Tools, Test and Support Equipment

None.

B Referenced Information

None.

C Location and Access

ZONE	DESCRIPTION	ACCESS
211/212	Flight compartment	Not applicable

D Procedure

(1) Preparation

(a) In the flight compartment, on the overhead equipment panel P11, make sure these circuit breakers are open and DO-NOT-CLOSE tags are attached:

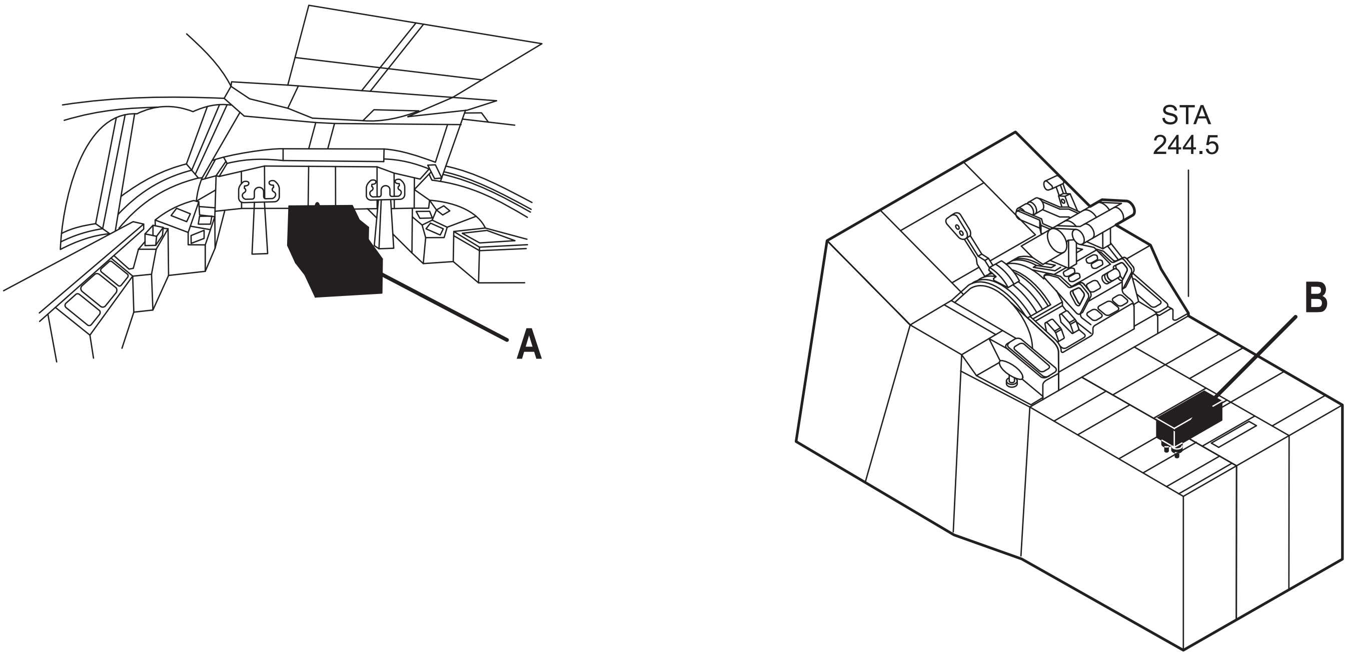
- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(2) Removal (Ref. Fig 401)

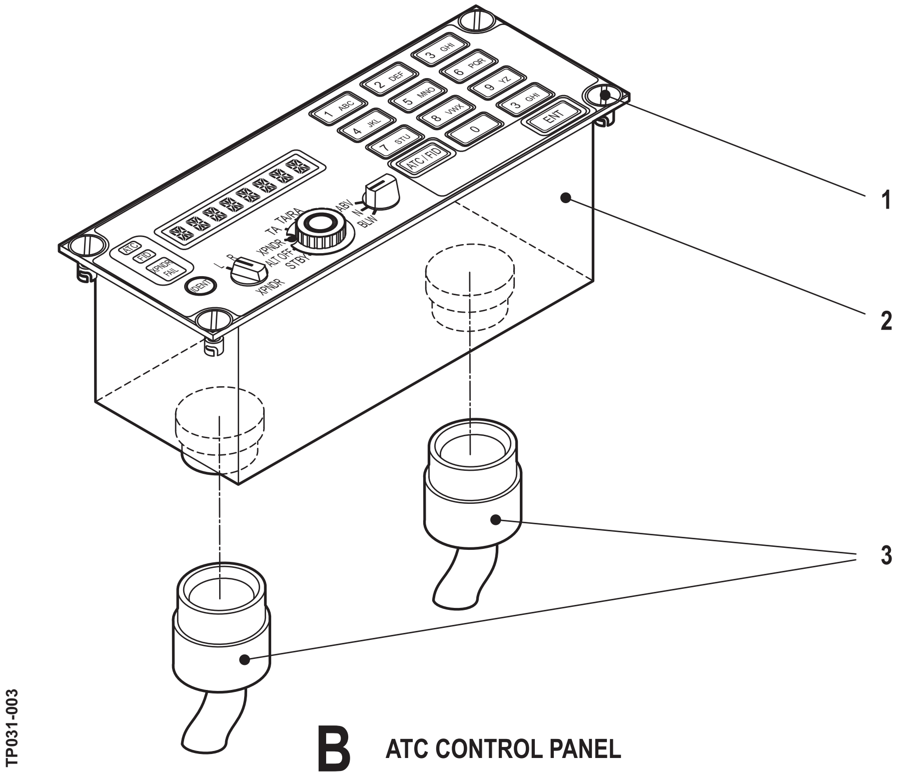
(a) Remove the ATC control panel.

1 Release the fasteners (1) on the control panel (2).

2 Lift the control panel (2) for access to the connectors (3). Release the connectors and remove the control panel.



A CENTER PEDESTAL



B ATC CONTROL PANEL

Fig 401 ATC control panel installation

3 Installation

A Fixtures, Tools, Test and Support Equipment

None.

B Referenced Information

REFERENCE	DESIGNATION
AMM 24-22-00/201	Electrical Power Control

C Location and Access

ZONE	DESCRIPTION	ACCESS
211/212	Flight compartment	Not applicable

D Procedure

(1) Preparation

(a) In the flight compartment, on the overhead equipment panel P11, make sure these circuit breakers are open and DO-NOT-CLOSE tags are attached:

- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(2) Installation

(a) Connect the two electrical connectors (3) to the control panel (2) and put it in position in the control stand.

(b) Attach the control panel (2) with the fasteners (1).

(3) Close up

(a) In the flight compartment, on the overhead equipment panel P11, remove the DO-NOT-CLOSE tags and close these circuit breakers:

- 11F7, ATC LEFT
- 11F28, ATC RIGHT

(b) Do an operational test of the transponder system (AMM SUPP 34-53-00/501).

B757 MANUAL SUPPLEMENT - ATP 3510
SECTION 1 CHAPTER 34
CONTROL PAGE - ISSUE 7

A. File the attached Temporary Revision/Alerts in the Manual Supplement in ATA Chapter/Section/Subject/Page sequence

B. File this Control Page in front of the Chapter TRs/Alerts.

C. The following list shows active TRs/Alerts together with TRs/Alerts added by this control page.

Chapter Section Subject	Page	TR/Alert No.
34-11-00-2	201	Alert 34-665
34-11-00-2	201	Alert 34-661
34-13-01	401	* 34-700
34-13-02	401	* 34-702
34-21-02	201	* 34-715
34-24-01	201	* 34-709
34-24-01	401	* 34-706
34-22-00	518 & 525	34-652
34-24-01	402	34-671
34-31-00	504	34-675
34-33-00	5	34-657
34-46-00	4	34-656
34-46-00 Config 2	505	34-658
34-46-00 Config 2	506	34-659
34-46-00-5-2	503	34-651
34-51-02	201	* 34-712
34-61-00	201	34-653
34-61-00	213	34-655
34-61-02	201	* 34-697
34-61-02-2	208	34-663

D. Remove and Destroy the following TRs/Alerts:

* Indicates TRs/Alerts issued with this control page

ATP ALERT

NB322

ALERT Page 1 of 1
4 March, 1998

B757
MAINTENANCE MANUAL
ALERT No. 34-665

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA) AND COMPLIES WITH BCAR'S CHAPTER A5-3, B5-3 AND/OR TSS No. 0-2 AS REQUIRED. CAA DESIGN APPROVAL No. DAI/8566/78.

For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-11-00-2 Page 201

REASON FOR REVISION

To communicate CAA requirement detailed in Airworthiness Notice No.12, Appendix 57, issue 1.

ACTION

CAA AIRWORTHINESS NOTICE 12
CONTROL OF PITOT AND STATIC VENT BLANKING COVERS

Airworthiness Notice 12 , Appendix 57, issue 1, refers to a serious incident where half of an aircraft's primary reference flight instruments were lost during take off. The reason for the malfunction was that 2 of the 4 pitot head blanking covers had not been removed before flight.

The pre-departure check carried out before the aircraft was returned to service occurred at night when it was raining. Two pitot head covers were missed during the check and not removed. It is very probable that weather and darkness contributed to the incident.

Reliance on warning or attention getting flags attached to blanks or covers is not by itself sufficient to ensure the covers are identified and removed before flight, particularly in darkness or adverse weather conditions.

To comply with the requirements of Notice 12 Appendix 57, issue 1, whenever pitot or static ports are covered there must be a clear unambiguous entry in the Technical Log saying that the aircraft's pitot and/or static ports are covered and the aircraft is no longer airworthy as a result of the installation.

Persons performing a supervisory function are responsible for informing their appropriate staff of the substance of this ATP Alert.

Originator: A.E.MORGAN
Reference: ESA.104.AEM.753
Workbook: CC 34-028

ATP
ALERT

BRITISH AIRWAYS

TR Page 1 of 1
13 October, 1997

B757 **(NB322)**
MAINTENANCE MANUAL
ALERT 34-661

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA) AND COMPLIES WITH BCAR'S CHAPTER A5-3, B5-3 AND/OR TSS No. 0-2 AS REQUIRED. CAA DESIGN APPROVAL No. DAI/8566/78.

For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-11-00-2 Page 201

REASON FOR REVISION

This Alert is intended to increase awareness of the possible consequences of not removing protective covers from Pitot probes or Static port prior to flight and increase awareness that air data ports are covered by introducing a warning label.

ACTION

ACTION

The primary cause of a recent accident where another operators aircraft crashed into the Pacific Ocean was loss of air data sensing, due to blockage of the aircraft's Static ports. The ports had been covered with adhesive tape during the aircraft's previous maintenance input, but the tape had inadvertently not been removed prior to service. This accident reaffirmed that it is imperative that aircraft are not returned to service with their Pitot or Static ports covered. The following warning note applies whenever Pitot or Static probes or ports are covered during any form of maintenance activity.

WARNING: WHEN PITOT PROBES/ STATIC PORTS ARE COVERED ENSURE THAT THIS CONDITION IS VISIBLE FROM THE GROUND. IN ADDITION, ATTACH A LABEL TO THE LEFT CONTROL WHEEL AS A REMINDER THAT THE PITOT PROBES/ STATIC PORTS ARE COVERED. FAILURE TO REMOVE THESE COVERINGS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED AND ALTITUDE SENSOR OUTPUTS WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

As stated in the above warning note, a red paper label, part number 2000S, must be attached to the left control wheel whenever Pitot or Static ports are covered. Write on the label PITOT PROBES COVERED and/or STATIC PORTS COVERED as applicable.

Persons performing a supervisory function are responsible for informing their appropriate staff of the substance of this ATP Alert.

Originator: A Morgan
Reference: ESA.104.AEM.512
Workbook: CC 34-008

ATP TEMPORARY REVISION

A/C NB322

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12 August, 1999

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-700

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA).
CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-13-01 Page 401 para 2 and 3

(Tasks 34-13-01-004-001 and 34-13-01-404-004)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 2.C.(3) and before 2.C.(4) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

Before the existing paragraph 3.C.(2) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Remove the existing paragraph 3.D.(3) and insert the following:

3.D(3)(a) Make sure the altimeter panel lights come on.
3.D(3)(b) Do the Operational Test of the Air Data Computing System (**AMM 34-12-00/501**).

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-514
Workbook: JS 34-070

ATP TEMPORARY REVISION

A/C NB322

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12 August, 1999

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-702

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA).
CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-13-02 Page 401 para 2 and 3

(Tasks 34-13-02-004-001 and 34-13-02-404-004)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 2.C.(3) and before 2.C.(4) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

Before the existing paragraph 3.C.(2) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Remove the existing paragraph 3.D.(3) and insert the following:

3.D(3)(a) Make sure the panel lights on the Mach Airspeed Indicator come on.

3.D(3)(b) Do the Operational Test of the Air Data Computing System (**AMM 34-12-01/501**).

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-513
Workbook: JS 34-069

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ATP TEMPORARY REVISION

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12 August, 1999

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-715

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CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-21-02 Page 201 para 4 and 5

(Tasks 34-21-02-002-015 AND 34-21-02-402-018)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 4.C.(6) and before 4.C.(7) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

After the existing paragraph 5.C.(3) and before the existing paragraph 5.C.(4) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-445
Workbook: JS 34-067

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ATP TEMPORARY REVISION

BRITISH AIRWAYS

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MAINTENANCE MANUAL

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24 August, 1997

TEMPORARY REVISION No. 34-652

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA) AND COMPLIES WITH BCAR'S CHAPTER A5-3, B5-3 AND/OR TSS No. 0-2 AS REQUIRED. CAA DESIGN APPROVAL No. DAI/8566/78.

For CHIEF ENGINEER QUALITY AND TRAINING

Manual References 34-22-00 Page 518 and Page 525.

REASON FOR REVISION

EFIS reconfiguration to BA Standard.

Action:

After Mod 34G227 make sure that the EFIS program pin hex codes that follow show in the right position of the EADI display

Upper Code	Middle Code	Lower Code
0000056	00002A	C080000

Originator: A GRAHAM
Reference: 34G227
Workbook: CV 34-202

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12 August, 1999

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-706

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA).
CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-24-01 Page 401 para 2 and 3

(Tasks 34-24-01-004-001 and 34-24-01-404-008)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 2.C.(5) and before 2.C.(6) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

After the existing paragraph 3.C.(1)(b) and before the existing paragraph 3.C.(2) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-435
Workbook: JS 34-063

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-709

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA).
CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-22-02 Page 201 para 3 and 4

(Tasks 34-22-02-002-012 and 34-22-02-402-020)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 3.C.(3) and before 3.D.(1) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

After the existing paragraph 4.C.(4) and before the existing paragraph 4.C.(5) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Remove the existing paragraph 4.C.(8) and insert the following:

(8) Check the following:
  (a) Make sure the panel lights come on.
  (b) Rotate the ILS/VOR/PLAN(or APP/VOR/PLAN as applicable) knob. Verify that the EHSI associated with the control panel changes accordingly.

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-440
Workbook: JS 34-065

ATP TEMPORARY REVISION

AIRPLANE

NB322

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17 April, 1998

757 MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-671

THIS TEMPORARY REVISION IS ISSUED BY BRITISH AIRWAYS ENGINEERING (TECHNICAL INFORMATION SERVICES, G2, TBA, S401, P. O. BOX 10, HEATHROW AIRPORT, HOUNSLOW, MIDDLESEX TW6 2JA) AND COMPLIES WITH BCAR'S CHAPTER A5-3, B5-3 AND/OR TSS No. 0-2 AS REQUIRED. CAA DESIGN APPROVAL No. DAI/8566/78.

For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-24-01 Page 402

REASON FOR REVISION

Addition of operational test for Standby Attitude System

ACTION

Ref task 34-24-01-404-008 Para 3.C:

Add new item 3.C (8) Carry out standby attitude reference system operational test (ref 34-24-00-5) Task 34-24-00-715-001.

Originator: D.Treeves
Reference: 757/W/MCR/DT/980271
Workbook: CC 34-029

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ATP TEMPORARY REVISION

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21 April, 1998

MAINTENANCE MANUAL

TEMPORARY REVISION No. 34-675

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-31-00 Page 504

REASON FOR REVISION

To correct functional test indications

ACTION

Ref Task 34-31-00-715-001 para 2.E.(1)(c):

Replace existing text of 2.E.1.C.2) with :- "For approximately 3 seconds, the G/S and LOC deviation pointers move to one dot down and right."

Add new item 2.E.1.C.3) to read :- "Make sure the G/S and LOC deviation pointers go out of view."

Originator: D.TREEVES
Reference: 757/W/MCR/DT/980279
Workbook: CC 34-30

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TEMPORARY REVISION No. 34-657

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-33-00 Page 5

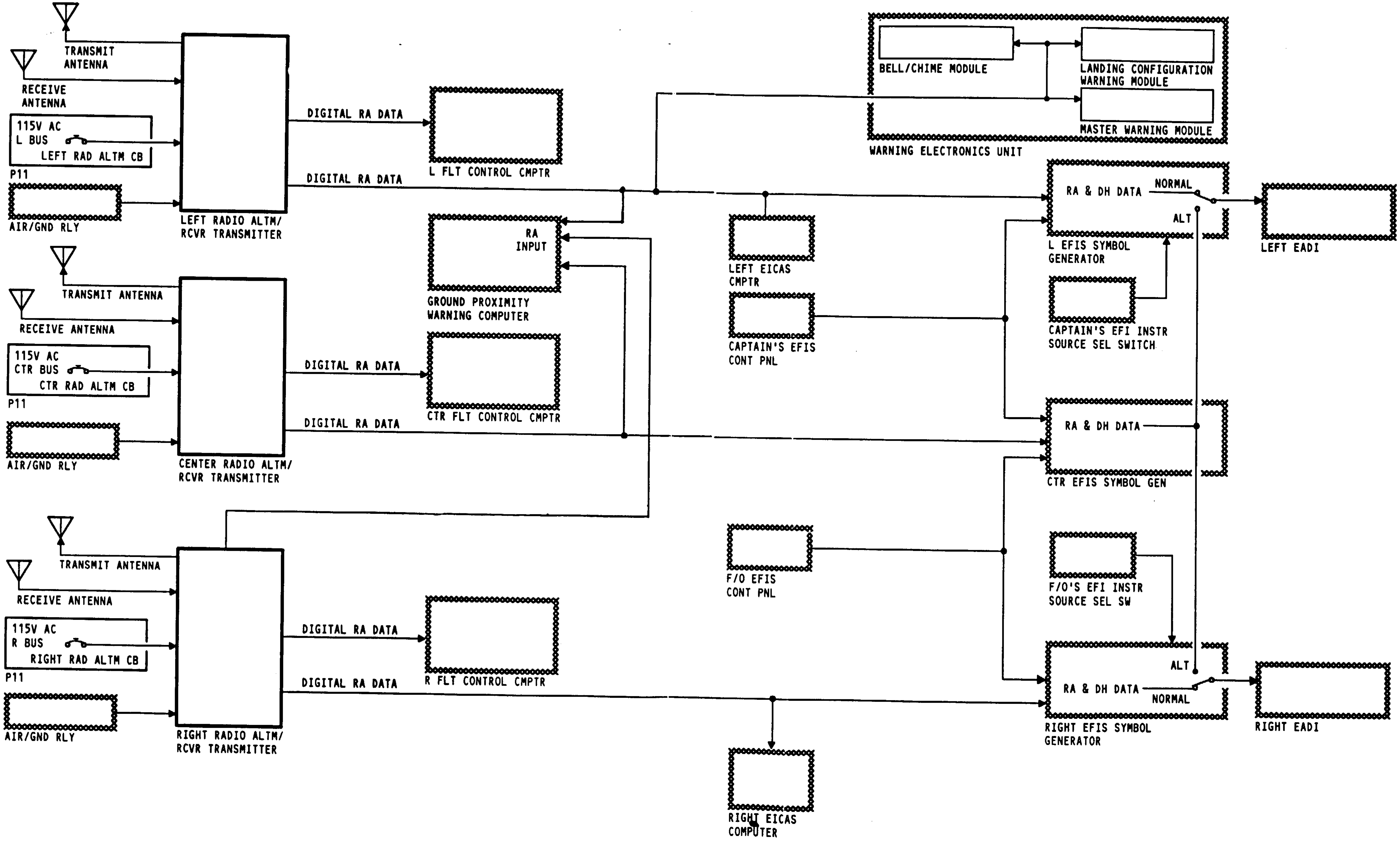
REASON FOR REVISION

Mod 34G224 hard wires the Radio Altimeters to the GPWC. The block schematic reflects the changes.

ACTION

The following block diagram reflects that the RA\GPWS Source Select Switch on P61 panel pilot's right hand side, is no longer used. The Ground Prox Warn System is now directly connected to the three radio altimeter transmitters.

Originator: GARY KERR
Reference: 757-W-MCR-GK-97-838
Workbook: CV 34-225



Radio Altimeter System Block Diagram

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-46-00 Page 4

REASON FOR REVISION

Mod 34G224 hard wires the Radio Altimeters to the GPWC.

ACTION

After Mod 34G224 the Rad Alt ARINC 429 data busses from all three Radio Altimeters (Rad Alts) are hard wired to the GPWS Computer.
RA Source Select switch (on P61, Service Interpfone Panel) has been disconnected and labelled 'inop'.
The GPWS can analyse the inputs and uses the most suitable Rad Alt Signal.
If all three Rad Alt signals are valid, the left Rad Alt is selected. If this deviates from the other 2 Rad Alts by more than 500 ft, then the center Rad Alt is selected. If then the center Rad Alt deviates from the right Rad Alt by more than 500 ft, then the Right Rad Alt is selected.
If only one or two Rad Alt sources are valid, then the order of priority is left, center, then right.

Originator: GARY KERR
Reference: 757-W-MCR-GK-97-838
Workbook: CV 34-225

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-46-00 Config 2 Page 505

REASON FOR REVISION

Mod 34G224 hard wires the Radio Altimeters to the GPWC. The test reflects the changes.

ACTION

Refer to Para 3. F.(3) & (4) Interface Test, and replace with the following paras.

(3.1) Open the RAD ALTM LEFT and CENTRE circuit breakers on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, does not show on the bottom display.
(3.2) Open the RAD ALTM RIGHT circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, shows on the bottom display in less than 12 seconds.
(3.3) Close the RAD ALTM CENTRE circuit breaker on the P11 panel
  (a) Make sure the EICAS message, GND PROX BITE, does not show on the bottom display.
(3.4) Open the RAD ALTM CENTRE circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, shows on the bottom display in less than 12 seconds.
(3.5) Close the RAD ALTM LEFT circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, does not show on the bottom display.
(4) Close the RAD ALTM RIGHT and CENTRE circuit breakers on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, does not show on the bottom display.

Originator: GARY KERR
Reference: 34G224
Workbook: CV 34-225

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-46-00 Config 2 Page 506

REASON FOR REVISION

Paragraph 3.F steps (11) and (12) only apply to A/C which have windshear active.

ACTION

Read the following before step (11)

S865-121-002
Note: Steps (11) and (12) only apply to A/C with windshear active.

(11) Open the WARN ELEX A etc.

Originator: GARY KERR
Reference: 757-W-MCR-GK-97-838
Workbook: CV 34-225

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-46-00-5-2 Page 503

REASON FOR REVISION

To bring GPWS to the BA standard. The GPWS Aural Standard is reproduced below. Mod 34G224 refers.

GPWS AURALS	WARNING LIGHTS	EADI MSG	EICAS MSG *
GLIDESLOPE	GND PROX (A)		
WHOOP WHOOP PULL UP	MASTER (R)	PULL-UP (R)	GND PROX BITE
SIREN	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
SINKRATE			GND PROX BITE
WHOOP WHOOP PULL UP			GND PROX BITE
TERRAIN			GND PROX BITE
WHOOP WHOOP PULL UP			GND PROX BITE
DON'T SINK			GND PROX BITE
TOO LOW TERRAIN			GND PROX BITE
TOO LOW GEAR			GND PROX BITE
TOO LOW FLAPS			GND PROX BITE
TOO LOW TERRAIN			GND PROX BITE
GLIDE SLOPE			GND PROX BITE
BANK ANGLE			GND PROX BITE
BANK ANGLE			GND PROX BITE
RADIO ALTIMETER			GND PROX BITE
ONE THOUSAND			GND PROX BITE
FIVE HUNDRED			GND PROX BITE
ONE HUNDRED			GND PROX BITE
FIFTY			GND PROX BITE
THIRTY			GND PROX BITE
TWENTY			GND PROX BITE
TEN			GND PROX BITE
SIREN			GND PROX BITE
WINDSHEAR,			GND PROX BITE
WINDSHEAR,			GND PROX BITE
WINDSHEAR			GND PROX BITE

* GND PROX BITE may not display for up to 12 seconds

Originator: P WIVELL
Reference: 34G224
Workbook: CV 34-203

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TEMPORARY REVISION No. 34-712

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Manual Reference 34-51-02 Page 201 para 3 and 4

(Tasks 34-51-02-002-022 AND 34-51-02-422-043)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

Remove the existing paragraph 3.C.(2) and 3.C.(3), add the following:

(2) Pull out the VOR control panel to get to the connectors.

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

(3) Disconnect the connectors at the VOR control panel.

Remove the existing paragraph 4.D.(1),add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

SUBTASK 432-029

(1) Connect the connectors to the control panel.

After Paragraph 4.E.(2) add the following:

(3) Operate the AUTO/MAN switch.
    (a) Verify that the legend changes.
(4) Operate the AUTO/MAN switch so that AUTO is displayed.

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-442
Workbook: JS 34-066

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TEMPORARY REVISION No. 34-653

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual References 34-61-00 Page 201.

REASON FOR REVISION

To provide data loader part numbers used within BA.

Action:

Where Data Base Loader, Sundstrand part number 964-0400-010 is specified, data loaders 964-0400-011, 964-0400-021 or 964-0400-025 may be used.

Originator: G KERR
Reference: 757-W-MCR-97-561
Workbook: CV 34-221

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For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-61-00 Page 213

REASON FOR REVISION

To provide the current drag/fuel flow figures used on the 757 aircraft.

ACTION

Refer to Para 4.D.

Performance factors for PS4052970-954 and subsequent Operational Software.

MNVR MARGIN	1.3
MIN CRZ TIME	1
MIN R/C CLIMB	300
MIN R/C CRZ	100
DRAG/F-F	+0.0+0*

* These figures are a default value. The actual drag/fuel flow figures are inserted by the Flight Crew via the SWORD flight plan.

Originator: G KERR
Reference: 757-W-MCR-97-562
Workbook: CV 34-222

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TEMPORARY REVISION No. 34-697

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CAA DESIGN APPROVAL No. DAI/8566/78.

Manual Reference 34-61-02 Page 201 para 2, 3 and 4

(Tasks 34-61-02-022-001, 34-61-02-422-035 and 34-61-02-712-036)

REASON FOR REVISION

To carry out the requirements of the Safety and Technical Strategy Board Cross-Connection Project G/38/98.

ACTION

After the existing paragraph 2.D.(3) and before 2.D.(4) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. CLEARLY IDENTIFY CONNECTIONS UPON DISCONNECTION AND FUNCTION CHECK UPON RECONNECTION.

After the existing paragraph 3.C.(4) and before 3.C.(5) add the following:

CAUTION: CROSS CONNECTION POSSIBILITY WHEN WORKING WITH THIS COMPONENT. POSITIVELY IDENTIFY CONNECTIONS PRIOR TO RECONNECTION.

Delete the existing paragraph 4.D.(1) and insert the following:
(1) Remove the DO-NOT-CLOSE tags and close these breakers on the P11 panel:
    (a) 11E8, FMCS CDU LEFT
        1) After a few seconds verify that the left CDU screen is operative.
    (b) 11E29, FMCS CDU RIGHT
        1) After a few seconds verify that the right CDU screen is operative.

Originator: Gary Kerr
Reference: 757-W-MCR-34-GK-99-505
Workbook: JS 34-068

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G Litchfield

For CHIEF ENGINEER QUALITY AND TRAINING

Manual Reference 34-61-02-2 Page 208

REASON FOR REVISION

To add a Caution to ensure that an insulator is fitted on replacement of the EXEC key.

ACTION

Please add the following to task 34-61-02-902-059

7.D.(3) Install the EXEC key assembly as follows:

CAUTION: Ensure that when an EXEC key assembly or its PCB (P/N 565-000227-1) is being replaced, an insulator P/N 365-000437-1 is fitted.

Originator: D Treeves
Reference: 757/W/MCR/DT/970810
Workbook: CC 34-022

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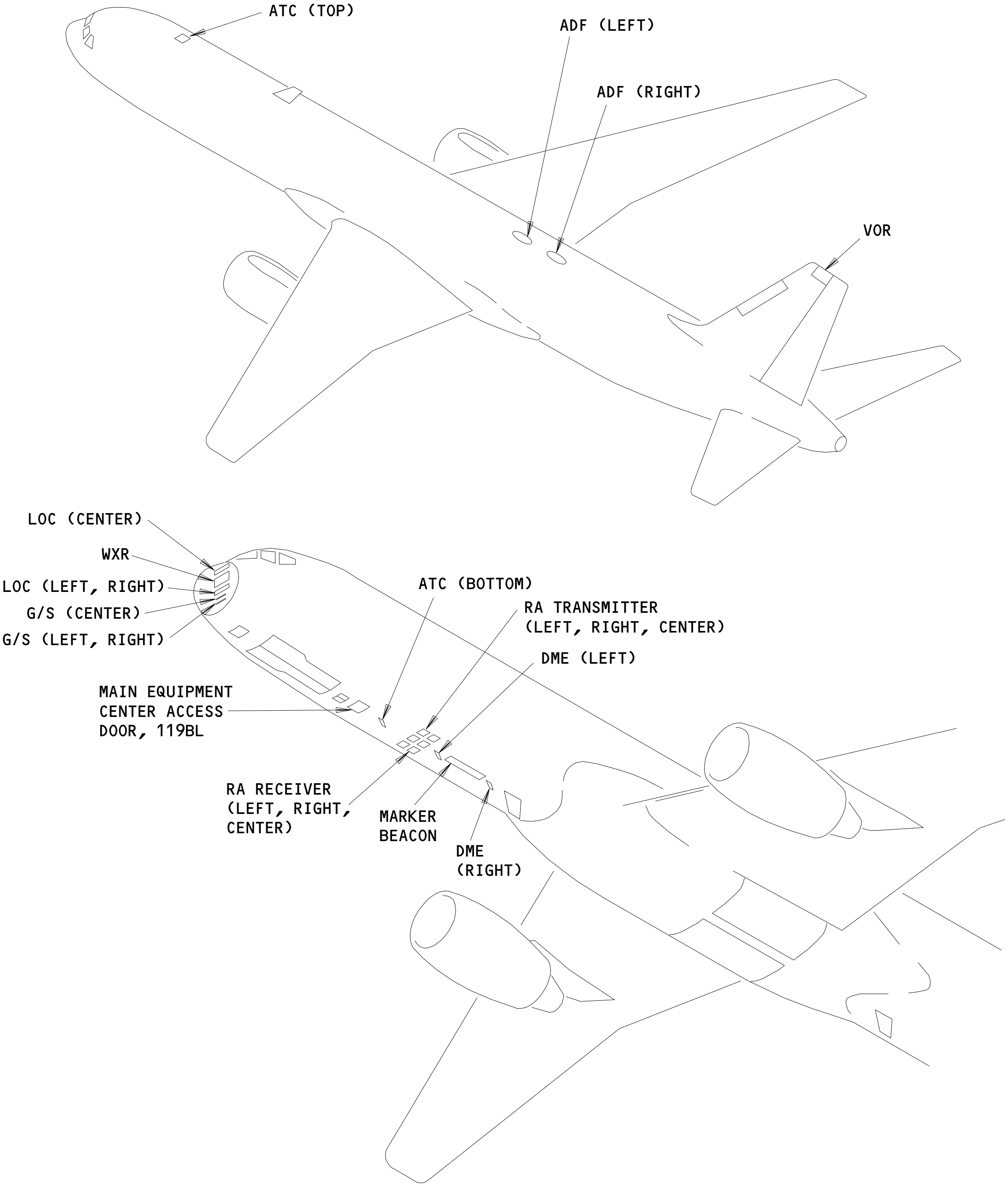
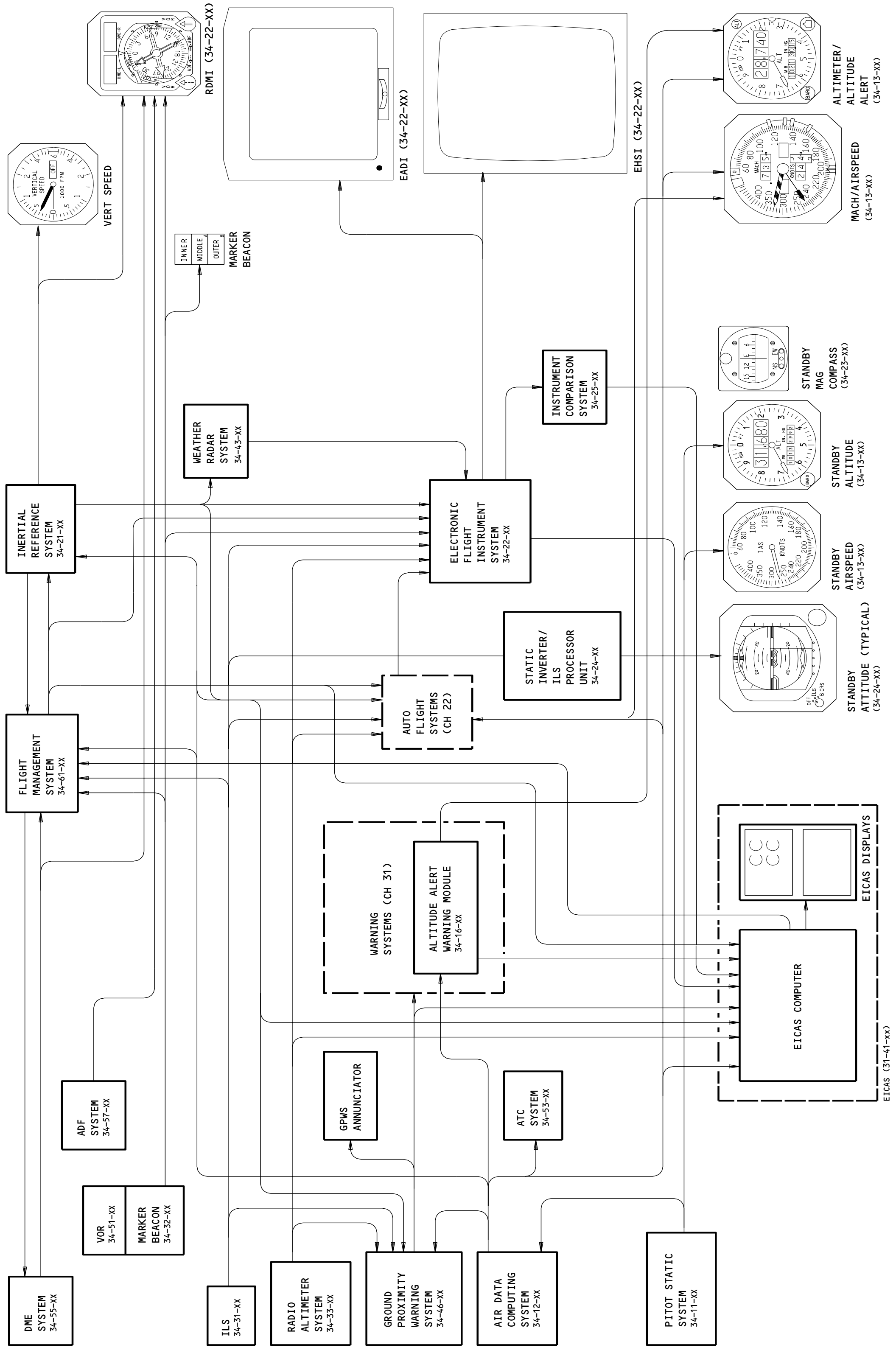
NAVIGATION - GENERAL - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The navigation systems are used to compute and display attitude, altitude, and position of the airplane with respect to the earth's surface. These systems acquire data from other airplane systems, ground stations, and/or environmental conditions about the airplane. The displayed data consists of movement, speed, and direction of travel in all three axis. Also, present position and future position are computed and displayed.
   B. The navigation systems fall in the following general categories:
      (1) Those systems which sense and display flight environmental data.
      (2) Those systems which determine airplane attitude and direction.
      (3) Those systems which provide landing and taxiing aids.
      (4) Those systems which are self-contained and independent of ground based equipment.
      (5) Those systems which are dependent upon and operate in conjunction with ground based equipment.
2. System Description
   A. Component Locations
      (1) The various navigation units are located in three main equipment centers. They are remotely controlled from and their information is displayed in the flight compartment. The equipment centers are the forward equipment center, the main equipment center, and the mid equipment center.
      (2) Receiving and/or transmitting antennas for the navigation systems are externally mounted as shown.
   B. Systems (Fig. 2)
      (1) Pitot-Static System (34-11-00)
         (a) The pitot-static system senses the dynamic (pitot) and ambient (static) air pressure external to the airplane. It supplies these pressures to systems which determine and/or indicate airspeed, mach number, or altitude. It also supplies data for determining true airspeed (TAS), static air temperature (SAT), and total air temperature (TAT).
      (2) Air Data Computing System (34-12-00)
         (a) The air data computing system provides digital air data to interfacing systems. It computes altitude, airspeed, mach number, and air temperature from the pitot-static system input. This data is sent to the air data instruments, EICAS, and FMS for display. It is also sent to other airplane systems for computing flight parameters.



Navigational Systems - Antenna Locations
Figure 1



Navigational Systems Block Diagram
Figure 2

(3) Air Data Instruments (34-13-00)
   (a) The air data instruments display airplane speed and altitude based upon atmospheric inputs. They are classified in two categories: electrical and pneumatic displays. The electrical displays receive digital data from the air data computing system. The pneumatic displays receive inputs directly from the pitot-static system.

(4) Altitude Alert System (34-16-00)
   (a) The altitude alert system provides aural and visual alert signals when the airplane approaches or departs from a selected altitude. Its prime source of data is the air data computing system.

(5) Inertial Reference System (34-21-00)
   (a) The inertial reference system (IRS) determines and provides angular rates and acceleration. It also computes attitude, true and magnetic headings, velocity, and present position. It is the primary reference source for the main navigation indicators. It is also the main reference for the autoflight systems (Chapter 22) and the other navigation systems which require this data.

(6) Flight Instrument System (34-22-00)
   (a) GUI 001-114, 116-999;
   The flight instrument system is the primary navigation display system. It includes the radio distance magnetic indicators (RDMI), the vertical speed indicators (VSI), and the electronic flight instrument system (EFIS). The EFIS receives flight data from most of the navigation systems. The EFIS symbol generator converts this data into CRT symbology for the electronic horizontal situation (EHSI) and electronic attitude director (EADI) indicators. The symbol generator memory circuits contain all the standard symbology used for display.
   (b) GUI 115;
   The flight instrument system is the primary navigation display system. It includes the radio magnetic indicators (RMI), the vertical speed indicators (VSI), and the electronic flight instrument system (EFIS). The EFIS receives flight data from most of the navigation systems. The EFIS symbol generator converts this data into CRT symbology for the electronic horizontal situation (EHSI) and electronic attitude director (EADI) indicators. The symbol generator memory circuits contain all the standard symbology used for display.

(7) Standby Magnetic Compass (34-23-00)
   (a) The standby magnetic compass provides quick directional reference as an auxiliary compass. It receives no inputs and provides no outputs.

(8) Standby Attitude Reference System (34-24-00)
   (a) The standby attitude reference system provides a backup pitch and roll attitude display. The system also provides standby instrument landing system (ILS) data. The data is displayed on the standby attitude indicator.

(9) Instrument Comparison System (34-25-00)
   (a) The instrument comparision system provides automatic comparing and monitoring of various airplane flight data parameters. It compares the input data to the EFIS symbol generators and provides warning outputs if NCD, Invalid, or out of tolerance data conditions exist. The warnings are displayed by EICAS.

(10) ILS Navigation System (34-31-00)
   (a) The instrument landing system (ILS) determines lateral (localizer) and vertical (glideslope) deviations of the airplane, relative to the runway during landing approaches. It provides this data to many of the airplane navigation systems. The main ILS display is provided by the EFIS.

(11) Marker Beacon System (34-32-00)
   (a) The marker beacon system provides visual and aural indications when the airplane flies over marker beacon stations.

(12) Radio Altimeter System (34-33-00)
   (a) The radio altimeter system supplies vertical position data to the airplanes systems. It transmits a continuous radio signal to the ground. This signal is reflected back to the airplane. The radio altitude is then computed and sent to the EFIS for display on the EADI.

(13) Weather Radar System (34-43-00)
   (a) The weather radar system is used to determine weather conditions ahead of the airplane. Location and intensity of storm areas is displayed on the EHSI. A ground mapping mode is also included for presentation of terrain features.

(14) Ground Proximity Warning System (34-46-00)
   (a) The ground proximity warning system provides the pilots with aural and visual warnings of airplane closeness to the terrain for various flight conditions. The warnings are determined by comparing the actual flight conditions and computed flight path relative to the ground.
   (b) The ground proximity warning system is also part of the wind shear system. It calculates the vertical and horizontal components of the wind and determines if a wind shear condition exists. Aural and visual warnings alert the pilot of the wind shear condition.

(15) VOR System (34-51-00)
   (a) GUI 001-114, 116-999;
   The VHF omnirange navigation (VOR) system determines the airplane's position with respect to ground-based VOR transmitting stations. It determines lateral and horizontal deviation from the desired flight path. This data is displayed by the RDMIs and EHSIs.

(b) GUI 115;
The VHF omnirange navigation (VOR) system determines the airplane's position with respect to ground-based VOR transmitting stations. It determines lateral and horizontal deviation from the desired flight path. This data is displayed by the RMIs and EHSIs.

(16) ATC System (34-53-00)

(a) The air traffic control (ATC) system, when interrogated by a ground station, automatically transmits airplane parameters to a ground receiver. The parameters include airplane altitude and identification data for ground based personnel to monitor airplane traffic.

(17) DME System (34-55-00)

(a) GUI 001-114, 116-999;
The distance measuring equipment (DME) system determines the distance from the airplane to selected ground stations. The distance is displayed on the RDMI.

(b) GUI 115;
The distance measuring equipment (DME) system determines the distance from the airplane to selected ground stations. The distance is displayed on the dual distance indicators.

(18) ADF System (34-57-00)

(a) GUI 001-114, 116-999;
The automatic direction finder (ADF) system determines airplane bearing from conventional broadcast or low range radio stations. This is displayed as the bearing, relative to the airplane heading, on the RDMI.

(b) GUI 115;
The automatic direction finder (ADF) system determines airplane bearing from conventional broadcast or low range radio stations. This is displayed as the bearing, relative to the airplane heading, on the RMI and EHSI.

(19) Flight Management Computer System (34-61-00)

(a) The flight management computer system (FMCS) provides navigation, guidance, and performance management data to the autoflight systems (Ref Chapter 22) and the flight instrument system (34-22-00). The flight management computer (FMC) contains the main data base for all stored airplane performance and related navigation route data. The control display unit (CDU) provides a means for the crew to program flight plan data. This includes all lateral (L NAV) and vertical (V NAV) commands in a flight plan. The system also continuously calculates and executes optimum airplane performance paths. All faults detected are reported to the Maintenance Control and Display Panel (MCDP).

NAVIGATION - GENERAL - MAINTENANCE PRACTICES

TASK 34-00-00-702-003

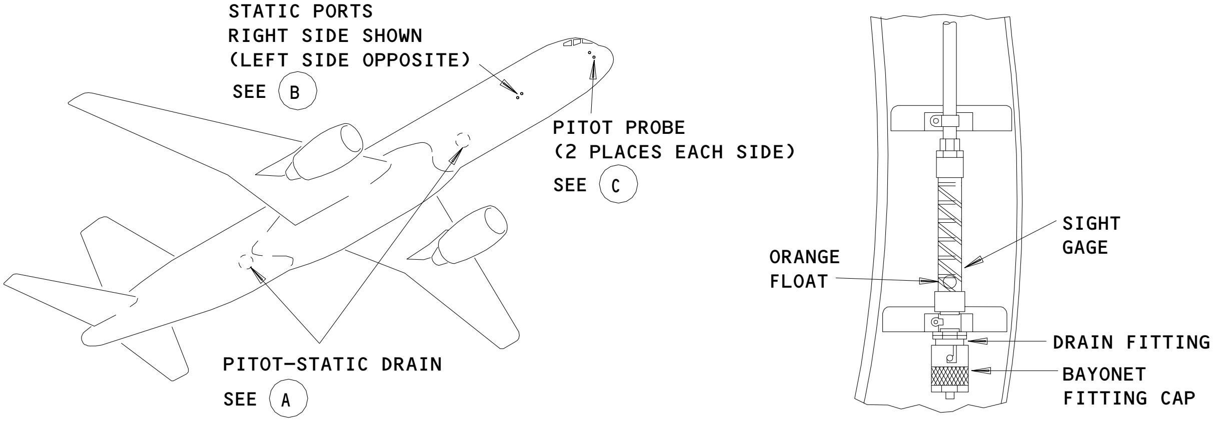
1. Coaxial Cable Test

A. General

(1) This task has been moved to AMM 20-10-32/201.

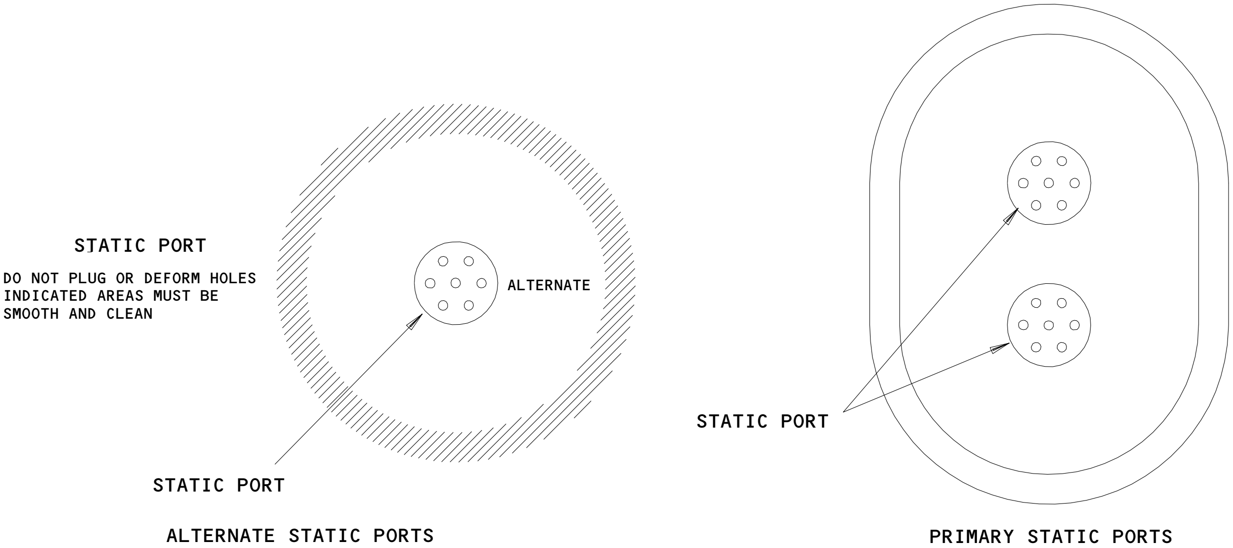
PITOT-STATIC SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   - A. The pitot-static system senses the dynamic (pitot) and ambient (static) air pressure external to the airplane. It supplies these two pressures to various systems for determining airplane altitude and motion through the air mass.
   - B. The system consists of pitot probes, static ports, drain fittings, and pneumatic tubes and hoses.
     The pitot and/or static pressures are supplied to the standby altimeter, standby airspeed indicator, differential pressure sensor, air data computers and elevator feel computers.
   - C. Electrical power is required only for the pitot probe anti-icing heaters (Ref 30-31-00).
2. Component Details (Fig. 1)
   - A. Pitot Probe
     - (1) Two pitot probes are installed on the left upper nose section at station 210, and two pitot probes are installed on the opposite location.
     - (2) Each pitot probe provides one dynamic pressure input to various pitot-static subsystems. Pitot pressure is sensed through a single pitot opening at the tip of the probe.
     - (3) Each probe is installed with mounting screws. A gasket is installed between the probe base and the airplane structure to form a pressure seal. The probes are interchangeable between all four positions. The mounting bases are unique for each location and are not interchangeable.
     - (4) The pitot probes are heated for anti-icing (Ref 30-31-00).
   - B. Static Port
     - (1) The static ports are flush mounted of each side of the lower forward fuselage. The primary static ports are located at station 466, and the alternate static ports are located at station 535. Anti-icing heaters are not provided on the ports.
     - (2) Each port is an independent sensor of external ambient pressure and is cross connected with the ports on the opposite side. At the port, pressure is sensed through small holes open to the static line tubing.
   - C. Pitot-Static System Drain
     - (1) The pitot-static system drains are located at the left and right crawlways by nose wheel well area, at the electronic equipment compartment, and aft of the pressurized bulkhead.
     - (2) The system drain acts as a sump to remove condensation collected from the pitot-static lines. The drain fittings other than those located at aft of the pressurized area has a reinforced transparent section of tubing with an orange float. This forms a sight gage to indicate the level of liquid accumulated in the sump.



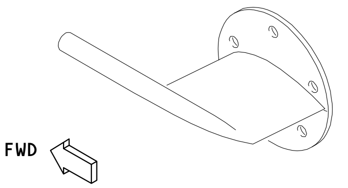
PITOT STATIC SYSTEM DRAIN (TYPICAL)

A



STATIC PORTS

B



PITOT PROBE (TYPICAL)

C

Pitot-Static System Components
Figure 1

(3) The lower portion of the drain contains a poppet valve covered by a bayonet cap. To drain the pitot static line, the cap is removed and the valve depressor on the cap is inserted into the poppet valve. Accumulated liquid in the sump is drained by gravity flow as the valve is depressed.

3. <u>Operation</u> (Fig. 2)

A. The pitot-static system consists of four independent pitot systems and three static systems. The function of each of the systems is similar.

B. Pitot Pressure Sensing

(1) A pitot probe is provided for each pitot system. The dynamic or ram pressure created by the forward motion of the airplane pressurizes the entire pitot portion of each subsystem.

(2) Each probe provides a single isolated source of dynamic pressure to interfacing equipment. The four pitot systems are referred to as captain's, first officer's, No. 1 and No. 2 auxiliary pitot systems.

C. Static Pressure Sensing

(1) The static ports are located at the lower forward fuselage. The surface at the ports provides an accurate sensing of ambient air pressure as independent as possible of airspeed.

(2) The static pressure inputs are equalized by cross connecting sets of static ports on opposite side of the airplane, to reduce any error caused by a localized pressure anomaly. This results in three independent static systems which are referred to as captain's, first officer's and alternate static systems.

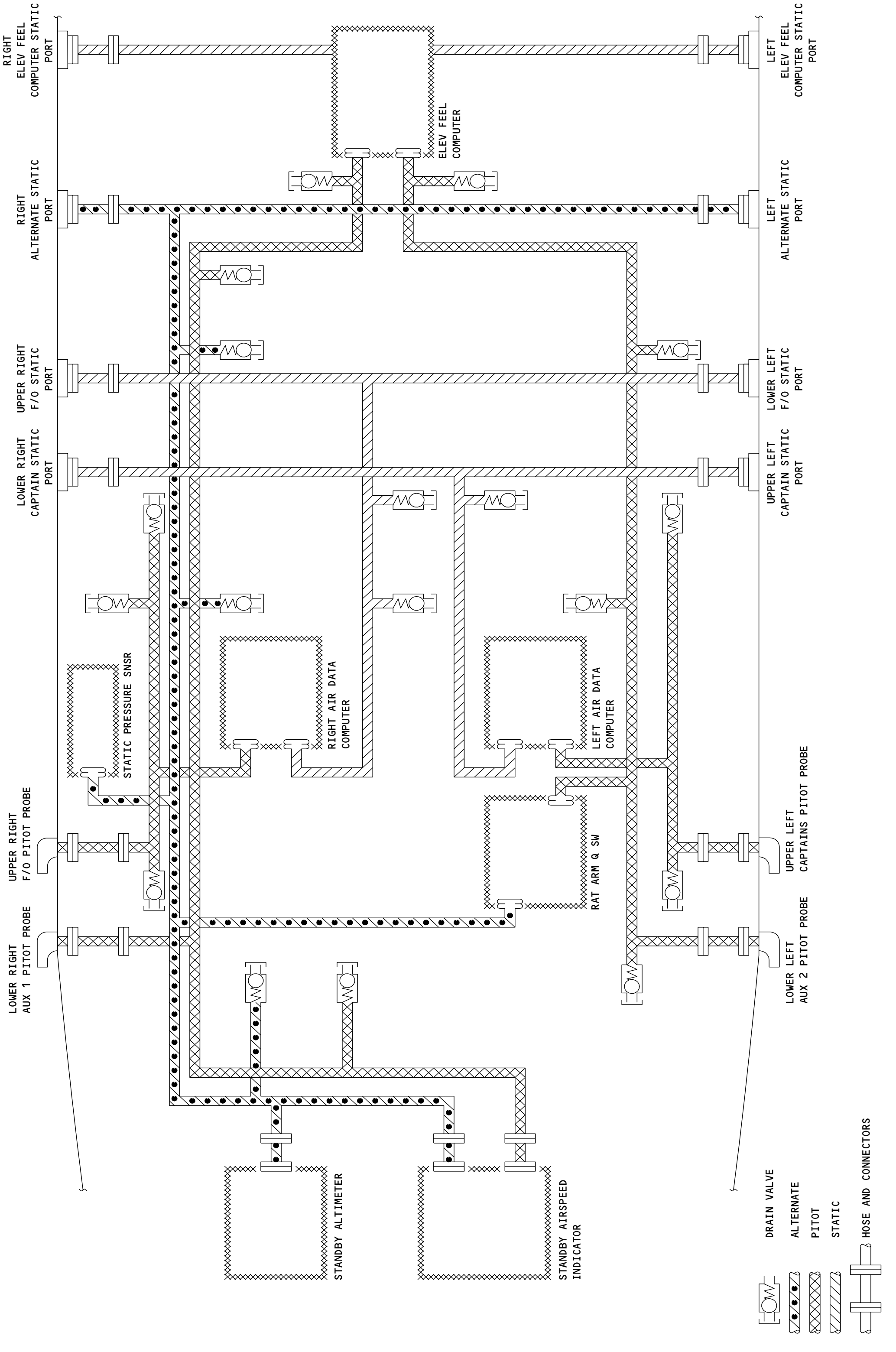
D. Sensed pressures are distributed throughout the airplane in metal tubing. The tubing is mounted on walls and bulkheads with brackets. Unions and tee fittings are used for connection and branching of the tubing. Flexible hoses, quick-disconnects, or threaded fittings connect the pressure lines to interfacing components.

E. AIRPLANES WITH AIR DATA COMPUTERS;

F. The captain's pitot system provides pressure to the left air data computer. The first officer's pitot system provides pressure to the right air data computer. The Auxiliary pitot system No. 1 provides pressure to the standby airspeed indicator and to the elevator feel computer. Auxiliary pitot system No. 2 provides pressure to the ram air turbine (ARM Q) switch and to the elevator feel computer.

G. The captain's static system provides pressure to the left ADC. The first officer's static system provides pressure to the right ADC. The alternate static system provides pressure to the standby altimeter, standby airspeed indicator, differential pressure transducer, and the ram air turbine (ARM Q) switch.

H. The pitot-static system requires periodic draining, dependent upon the amount of liquid accumulated in each drain. Refer to the Maintenance Planning Document for draining schedule.



Pitot-Static System Schematic
Figure 2

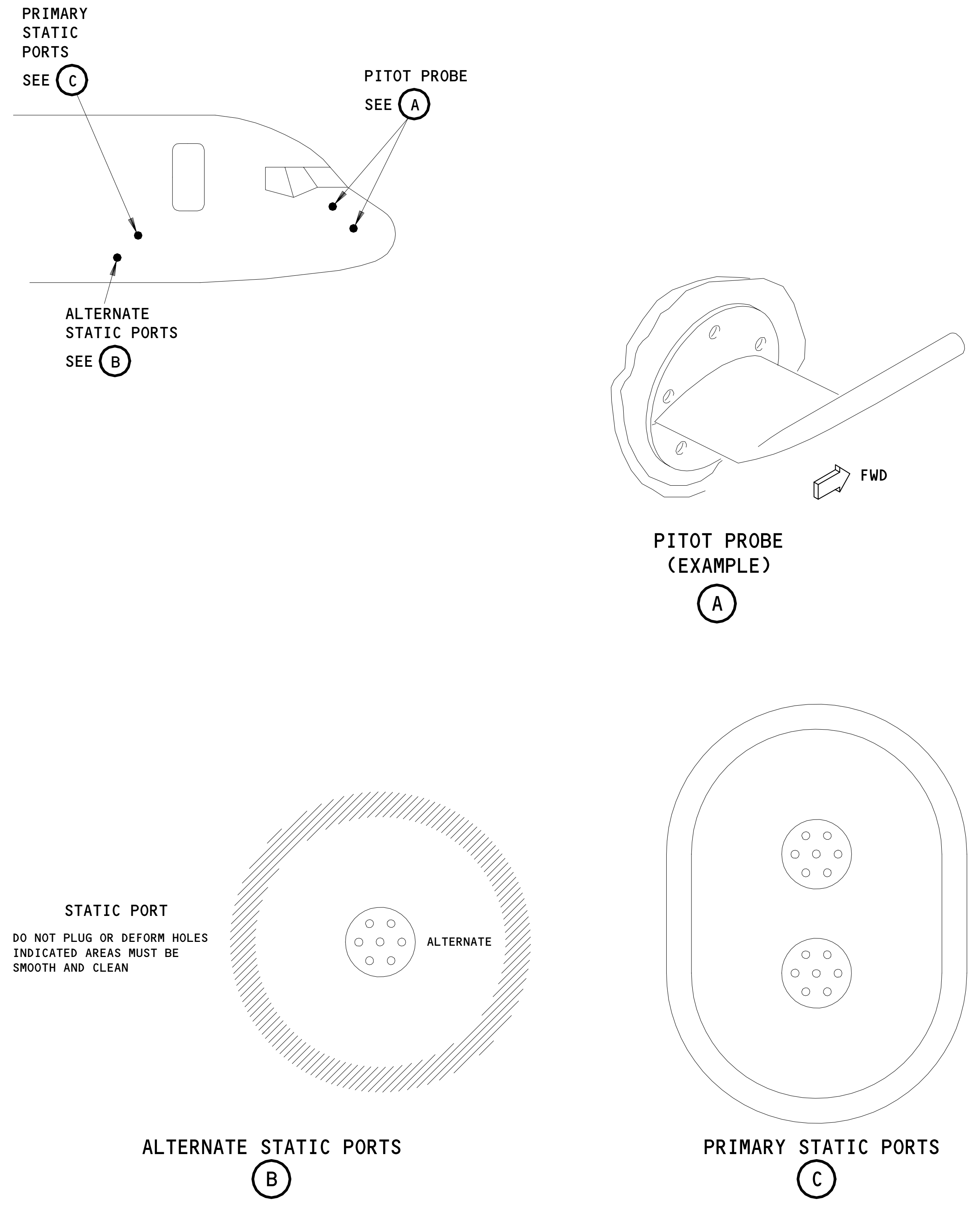
320049

PITOT-STATIC SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
PORT - CAPTAIN'S STATIC	--	2	FWD FUSELAGE, L UPPER AND R LOWER	34-11-03
PORT - F/O'S STATIC	--	2	FWD FUSELAGE, L LOWER AND R UPPER	34-11-03
PORT - STATIC, ALTERNATE	--	2	FWD FUSELAGE, 1 EACH SIDE	34-11-03
PROBE - AUX 1 PITOT, B27	--	1	NOSE SECTION, R SIDE - LOWER PROBE	34-11-01
PROBE - AUX 2 PITOT, B29	--	1	NOSE SECTION, L SIDE - LOWER PROBE	34-11-01
PROBE - CAPTAIN'S PITOT, B26	--	1	NOSE SECTION, L SIDE - UPPER PROBE	34-11-01
PROBE - F/O'S PITOT, B28	--	1	NOSE SECTION, R SIDE - UPPER PROBE	34-11-01
PROBE HEATER - (FIM 30-31-00/101)				

* SEE THE WDM EQUIPMENT LIST

Pitot-Static System - Component Index
Figure 101



PITOT PROBE
(EXAMPLE)
A

STATIC PORT

DO NOT PLUG OR DEFORM HOLES
INDICATED AREAS MUST BE
SMOOTH AND CLEAN

ALTERNATE STATIC PORTS
B

PRIMARY STATIC PORTS
C

Pitot-Static System - Component Location
Figure 102

PITOT-STATIC SYSTEM (PRESSURIZATION) - MAINTENANCE PRACTICE

1. General
    A. This procedure shows how to pressurize each of the pitot-static systems independently. The procedure shows how to supply air pressure when it is necessary to do a test of other airplane systems.

TASK 34-11-00-862-008

2. Pressurization of the Pitot-Static System
    A. Equipment
        (1) Adapters
            (a) The NAV-AIDS LTD equipment that follows:
                NAV-AIDS, 2955 Diab St., Montreal, Quebec,
                Canada, H45 1M1:
                1) Air Data Accessory Kit - P/N ADA 757-612
        (2) Pneumatic Test Set
            (a) The Smith Industries equipment that follows:
                Smith Industries Aerospace and Defense
                Systems Co., Basingstoke DIV., Winchester
                Rd., Basingstoke, Hants RG22 6HP, England:
                1) Pressure Controller - P/N 3006KTQ1 or equivalent
                2) Air Data Tester - P/N 3207KTQ1 or equivalent
        (3) Gages
            (a) Pitot system test gage - necessary to show a precision of ± 0.16 (you can read it to ± 0.03) inch of mercury or ± 5 (you can read it to ± 1) knots.
            (b) Static system test gage - necessary to show a precision of ± 0.1 (you can read it to ± 0.01) inch of mercury or ± 200 (you can read it to ± 20) feet.

(c) Differential pressure gage - necessary to show 10 inches of mercury differential pressure (minimum) with a precision of ± 0.010 inch of mercury.

(4) Flow restrictors, control valves, cut off valves, tape and port seals as necessary.

B. Consumable Materials

(1) G02219 Tape, Yellow Vinyl Adhesive - 3M Scotch Brand No. 471, 3 inches wide, BAC 5034-4

C. References

(1) AMM 34-11-01/601, Pitot-Static Probe

D. Access

(1) Location Zones

119/120	Main Equipment Center (External)
211/212	Control Cabin (External)

E. Precautions

S 862-013

(1) The rate that you apply or release the vacuum to a static system must be less than 5000 feet.

S 862-014

(2) The rate that you apply or release the pressure to a pitot system must be less than 300 knots.

S 862-015

(3) The absolute pressure in the pitot system must be the same as or larger than the pressure in the static system.

S 862-016

(4) The difference between the pitot and the static pressures must not be larger than 10.9 inches of mercury.

S 862-017

(5) The absolute pressure applied to the static system must not be larger than the ambient pressure when an instrument is connected to that static system.

S 862-018

(6) Make sure the seals used on the static ports do not extend into the static ports.

S 862-019

(7) Make sure the seals do not damage or change the surface in the area when you remove the seals.

S 862-020

(8) Make sure the flow restrictors are installed between the cutoff valve and the pitot-static system.

S 862-021

(9) Make sure the autopilot is off.

S 862-022

(10) Make sure the pitot probe heat is off during pressurization.

S 862-023

(11) You must set the left and right AOA vanes to 0 degrees +/-2 degrees if you are performing an accuracy test of the air data instruments.

F. Prepare to Pressurize the Pitot-Static System

S 862-029

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) On the power distribution panel, P6:
    1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
    2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
    3) 6L21, PITOT HEAT R AUX
    4) 6L22, PITOT HEAT F/O MAIN

G. Pressurize the Pitot and Static System

S 862-001

(1) Pressurize the Captain's Pitot and Static System.
  (a) Prepare for Pressurization
    1) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
      a) 11C6, CSEU 1L AC or
         FLT CONT ELEC 1L AC

b) 11C8, CSEU 2L AC or
FLT CONT ELEC 2L AC
c) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or
FSEU-1 PWR
d) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT or
FSEU-1 CONT

CAUTION: SUPPORT THE TEST HOSES AND THE ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND TO BE DAMAGED.

2) Install the pitot probe test adapter to the upper left pitot probe.
3) Set the Left and Right AOA vanes to 0 degrees +/-2 degrees.

NOTE: The AOA vanes must be set only if you are doing an accuracy test of the air data instruments.

4) Connect the pitot inlet of the test adapter to the pitot cutoff valve through the pitot system test gage and flow restrictor.
5) Connect the pitot pressure source in the pneumatic test set through the pitot control valve to the pitot cutoff valve.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: DO NOT EXTEND THE SEALS INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SURFACE IN THE AREA WHEN YOU REMOVE THE SEALS.

6) Put vinyl adhesive tape over the lower right primary static port.

CAUTION: SUPPORT THE TEST HOSES AND THE ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND/OR TO BE DAMAGED.

7) Install the static port test adapter on the top left primary static port.

8) Connect the static port adapter to the static cutoff valve through the static system test gage and flow restrictor.

9) Connect the static pressure source in the pneumatic test set through the static control valve to the static cutoff valve.

(b) Pressurize the Captain's Pitot and Static System

1) Make sure the equipment installation is completed and ready for pressurization.

2) For pressures below ambient, operate the pitot vacuum source and control valve such that the pressure in the pitot system does not start to decrease until after the static systems have started to decrease.

3) Monitor the pitot system vacuum continuously during pump down.

4) For pressures above ambient, operate the pitot pressure source and control valve such that the pressure in the pitot system starts to increase before the static systems start to pressurize.

5) Monitor the instruments continuously.

<u>CAUTION</u>: PITOT PRESSURE MUST ALWAYS EQUAL OR BE LARGER THAN THE STATIC LINE PRESSURE. DIFFERENCE (DIFFERENTIAL PRESSURE) MUST NOT EXCEED 10.00 INCHES OF MERCURY OR 420 KNOTS. DIFFERENTIAL PRESSURE MUST NOT FALL BELOW ZERO. FAILURE TO MEET THESE REQUIREMENTS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

6) Operate the pneumatic test set and the control valves to apply the necessary pressure or vacuum to the pitot and static systems as shown on the test gages.

7) Keep the differential pressure between 0 and 10 inches of mercury or 420 knots.

<u>CAUTION</u>: RELEASE THE PRESSURE OR VACUUM CONTINUOUSLY AND AT THE SAME TIME FOR THE PITOT AND STATIC SYSTEMS. FAILURE TO DO SO COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

8) When you complete the test, release the pressure or vacuum on the pitot and static system to ambient.

(c) Put the systems back to their usual condition.
  1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
    a) 11C6, CSEU 1L AC or
       FLT CONT ELEC 1L AC
    b) 11C8, CSEU 2L AC or
       FLT CONT ELEC 2L AC
    c) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or
       FSEU-1 PWR
    d) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT or
       FSEU-1 CONT

<u>WARNING</u>: FAILURE TO REMOVE VINYL ADHESIVE TAPE FROM STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: MAKE SURE THAT YOU REMOVE ALL OF THE PIECES OF TAPE FROM EACH STATIC PRESSURE PORT. THE SYSTEM WILL NOT OPERATE CORRECTLY WHEN THE TAPE IS IN ITS POSITION.

  2) Remove the vinyl adhesive tape and adapters from the pitot probe and the static ports.

S 862-003
(2) Pressurize the First Officer's Pitot and Static System
(a) Prepare for Pressurization
  1) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
    a) 11G17, CSEU 1R AC or
       FLT CONT ELEC 1R AC
    b) 11G27, CSEU 2R AC or
       FLT CONT ELEC 2R AC

<u>CAUTION</u>: SUPPORT THE TEST HOSES AND THE ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND/OR TO BE DAMAGED.

  2) Install the pitot probe test adapter to the top right pitot probe.

3) Set the Left and Right AOA vanes to 0 degrees +/-2 degrees.
4) Connect the pitot inlet of the test adapter to the pitot cutoff valve through the pitot system test gage and the flow restrictor.
5) Connect the pitot pressure source in the pneumatic test set through the pitot control valve to the pitot cutoff valve.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: DO NOT EXTEND THE SEALS INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SURFACE IN THE AREA WHEN YOU REMOVE THE SEALS.

6) Put vinyl adhesive tape over the top right primary static port.

CAUTION: SUPPORT THE TEST HOSES AND THE ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND TO BE DAMAGED.

7) Install the static port test adapter on the lower left primary static port.
8) Connect the static port adapter to the static cutoff valve through the static system test gage and the flow restrictor.
9) Connect the static pressure source in the pneumatic test set through the static control valve to the static cutoff valve.

(b) Pressurize the First Officer's Pitot and Static System

1) Make sure the equipment installation is completed and ready for pressurization.
2) For pressures below ambient, operate the pitot vacuum source and control valve so the pressure in the pitot system does not start to decrease until after the static systems have started to be removed.
3) Monitor the pitot system vacuum continuously during pump down.
4) For pressures above ambient, operate the pitot pressure source and control valve such that the pressure in pitot system begins to increase before the static systems start to pressurize.
5) Monitor the instruments continously.

CAUTION: PITOT PRESSURE MUST ALWAYS BE EQUIVALENT OR BE LARGER THAN THE STATIC LINE PRESSURE. THE DIFFERENCE IN PRESSURE MUST NOT BE LARGER THAN 10.00 INCHES OF MERCURY OR 420 KNOTS. DIFFERENTIAL PRESSURE MUST NOT FALL BELOW ZERO. FAILURE TO MEET THESE REQUIREMENTS COULD CAUSE EQUIPMENT DAMAGE.

6) Operate the pneumatic test set and control valves to apply the necessary pressure or vacuum to the pitot and static systems as shown on the test gages.
7) Keep the differential pressure between 0 and 10 inches of mercury or 420 knots.

CAUTION: RELEASE THE PRESSURE OR VACUUM CONTINUOUSLY AT THE SAME TIME FOR THE PITOT AND STATIC SYSTEMS. FAILURE TO DO SO COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

8) When you complete the test, release the pressure or vacuum on the pitot and static system to ambient.

(c) Put the Systems back to their Usual Conditions

1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   a) 11G17, CSEU 1R AC or
      FLT CONT ELEC 1R AC
   b) 11G27, CSEU 2R AC or
      FLT CONT ELEC 2R AC

<u>WARNING</u>: FAILURE TO REMOVE VINYL ADHESIVE TAPE FROM STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: MAKE SURE THAT YOU REMOVE ALL OF THE PIECES OF TAPE FROM EACH STATIC PRESSURE PORT. THE SYSTEM WILL NOT OPERATE CORRECTLY WHEN THE TAPE IS IN ITS POSITION.

2) Remove the vinyl adhesive tape and adapters from the pitot probe and static ports.

S 862-007

(3) Pressurize the Auxiliary Pitot System No. 1, No. 2, and the Alternate Static System

(a) Prepare for Pressurization

<u>WARNING</u>: OPEN THE HYDRAULIC RAT AUTO CIRCUIT BREAKER BEFORE YOU DO THE PITOT-STATIC TEST. IF THE CIRCUIT BREAKER IS NOT OPENED, AND THE ALTERNATIVE PITOT-STATIC DIFFERENTIAL PRESSURE EQUIVALENT TO 80 KNOTS IS APPLIED WITH BOTH ENGINES OFF, THE RAT WILL DEPLOY. THIS COULD CAUSE INJURY TO PERSONS.

(b) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:

1) 11D27, HYDRAULIC RAT AUTO or
HYDRAULIC RAT AUTO PWR

<u>CAUTION</u>: THE RATE THAT YOU APPLY OR RELEASE THE VACUUM TO A STATIC SYSTEM MUST BE LESS THAN 5000 FEET. THE RATE THAT YOU APPLY OR RELEASE THE PRESSURE TO A PITOT SYSTEM MUST BE LESS THAN 300 KNOTS. DAMAGE TO ELEVATOR FEEL COMPUTER MAY RESULT.

<u>CAUTION</u>: SUPPORT THE TEST HOSES AND ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND TO BE DAMAGED.

2) Install the pitot probe test adapter to the lower right pitot probe.
3) Connect the pitot inlet of the test adapter to the pitot cutoff valve through the pitot system test gage.
4) Connect the flow restrictor to pressurize the auxiliary pitot system No. 1 and alternate static system.

5) Install the pitot probe test adapter to the lower left pitot probe.
6) Connect the pitot inlet of the test adapter to the pitot cutoff valve through the pitot system test gage.
7) Connect the flow restrictor to pressurize the Auxiliary Pitot System No. 2.
8) Connect the pitot pressure source in the pneumatic test set through the pitot control valve to the pitot cutoff valve.

<u>WARNING</u>: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: DO NOT EXTEND THE SEALS INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SURFACE IN THE AREA WHEN YOU REMOVE THE SEALS.

9) Put vinyl adhesive tape over the right alternate static port.

<u>CAUTION</u>: SUPPORT THE TEST HOSES AND ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND TO BE DAMAGED.

10) Install the static port test adapter on the left alternate static port.
11) Connect the static port adapter and the static cutoff valve through the static system test gage and flow restrictor.
12) Connect the static pressure source in the pneumatic test set through the static control valve to the static cutoff valve.

(c) Pressurize the Auxiliary Pitot System No. 1, No. 2 and Alternate Static System
1) Make sure the equipment installation is completed and ready for pressurization.
2) For the pressures below ambient, operate the pitot vacuum source and the control valve so the pressure in the pitot system does not start to decrease until after the static systems have started to be removed.
3) Monitor the pitot system vacuum continuously during the pump down.
4) For pressures above ambient, operate the pitot pressure source and control valve so the pressure in the pitot system starts to increase before the static systems start to pressurize.
5) Monitor the instruments continuously.

CAUTION: PITOT PRESSURE MUST ALWAYS EQUAL OR BE LARGER THAN THE STATIC LINE PRESSURE. DIFFERENCE (DIFFERENTIAL PRESSURE) MUST NOT EXCEED 10.00 INCHES OF MERCURY OR 420 KNOTS. DIFFERENTIAL PRESSURE MUST NOT FALL BELOW ZERO. FAILURE TO MEET THESE REQUIREMENTS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

6) Operate the pneumatic test set and control valves to apply the necessary pressure or vacuum to the pitot and static systems as shown on the test gages. Keep the differential pressure between 0 and 10 inches of mercury or 420 knots.

CAUTION: RELEASE THE PRESSURE OR VACUUM CONTINUOUSLY AND AT THE SAME TIME FOR THE PITOT AND STATIC SYSTEMS. FAILURE TO DO SO COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(d) When you complete the test, release the pressure or vacuum on the pitot and static system to ambient.
(e) Restore the System to its Usual Condition
   1) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
      a) 11D27, HYDRAULIC RAT AUTO or
         HYDRAULIC RAT AUTO PWR

WARNING: FAILURE TO REMOVE VINYL ADHESIVE TAPE FROM STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: MAKE SURE THAT YOU REMOVE ALL OF THE PIECES OF TAPE FROM EACH STATIC PRESSURE PORT. THE SYSTEM WILL NOT OPERATE CORRECTLY WHEN THE TAPE IS IN ITS POSITION.

2) Remove the vinyl adhesive tape and adapters from the pitot probes and static ports.

S 862-009
(4) Pressurize the Elevator Feel Computer Pitot Systems
(a) General
   1) This test shows how to pressurize the Auxiliary Pitot No. 1 and No. 2 Systems at the same time.
   2) The procedure keeps the pitot systems connected to the elevator feel computer.
   3) The pressure applied to the pitot systems must be the same as or larger than the ambient pressure.
(b) Prepare for Pressurization

<u>WARNING</u>: OPEN THE RAT CIRCUIT BREAKERS BEFORE YOU DO THE PITOT- STATIC TEST. IF THE CIRCUIT BREAKERS ARE NOT OPENED, AND PITOT-STATIC DIFFERENTIAL PRESSURE EQUIVALENT TO 80 KNOTS IS APPLIED WITH ENGINES NOT POWERED, THE RAT WILL DEPLOY. THIS COULD CAUSE INJURY TO PERSONS.

1) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
    a) 11D27, HYDRAULIC RAT AUTO or
       HYDRAULIC RAT AUTO PWR

<u>CAUTION</u>: SUPPORT THE TEST HOSES AND ADAPTER SO THEY ADD NO WEIGHT ON THE PITOT PROBES. FAILURE TO DO SO COULD CAUSE THE PITOT PROBES TO NOT BE ALIGNED AND TO BE DAMAGED.

2) Install the pitot probe test adapter on the lower right pitot probe.
3) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
    a) A control valve
    b) A cutoff valve
    c) A flow restrictor
    d) A test gage.

(c) Install the pitot probe test adapter on the lower left pitot probe.
(d) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
    1) A control valve
    2) A cutoff valve
    3) A flow restrictor
    4) A test gage.
(e) Pressurize the Auxiliary Pitot No. 1 and No. 2 Systems
    1) Make sure the equipment installation is completed and ready for pressurization.
    2) Monitor the instruments continuously.

CAUTION: PITOT PRESSURE MUST ALWAYS EQUAL OR BE LARGER THAN AMBIENT PRESSURE. DIFFERENCE (DIFFERENTIAL PRESSURE) MUST NOT EXCEED 10.00 INCHES OF MERCURY OR 420 KNOTS. DIFFERENTIAL PRESSURE MUST NOT FALL BELOW ZERO. FAILURE TO MEET THESE REQUIREMENTS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

3) Operate the pneumatic test set and control valves to apply the necessary pressure to the pitot systems as shown on the test gages. Keep the differential pressure between 0 and 10 inches of mercury or 420 knots.

(f) When you complete the test, release the pressure on the pitot system to ambient.

(g) Restore the System to its Usual Condition

1) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:

a) 11D27, HYDRAULIC RAT AUTO or
HYDRAULIC RAT AUTO PWR

2) Remove the adapters from the pitot probes.

H. Put the Pitot-Static System back to its Usual Condition

S 212-011

WARNING: FAILURE TO REMOVE VINYL ADHESIVE TAPE FROM EACH PITOT PROBE AND STATIC PORT BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: MAKE SURE THAT YOU REMOVE ALL OF THE PIECES OF TAPE FROM EACH STATIC PRESSURE PORT. THE SYSTEM WILL NOT OPERATE CORRECTLY WHEN THE TAPE IS IN ITS POSITION.

(1) Make sure the vinyl adhesive tape and adapters are removed from the pitot probes and static ports.

S 212-033

(2) Examine the dain holes and static pressure ports for unwanted materials and rough locations on the inner and outher surfaces (AMM 34-11-01/601).

S 212-034

(3) Examine the pitot-static probes for signs of damage to the pitot tips and to the static ports (AMM 34-11-01/601).

S 082-005

(4) Remove the pneumatic test set.

S 432-006

(5) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  (a) On the P6 panel:
    1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
    2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
    3) 6L21, PITOT HEAT R AUX
    4) 6L22, PITOT HEAT F/O MAIN

PITOT-STATIC SYSTEM - SERVICING

1. General
   A. This procedure has two tasks to service the pitot-static system. One is to drain the system to remove liquid from the pitot-static lines. The other is to flush the system to remove all unwanted material in the pitot-static lines.

TASK 34-11-00-683-001

2. Drain the Pitot-Static System (Fig. 301)
   A. General
      (1) This procedure is applicable to these systems:
         - the Captain's Pitot and Static Systems
         - the First Officer's Pitot and Static Systems
         - the No. 1 and Alternate Static Systems
         - the No. 1 and No. 2 Auxiliary Pitot Systems
         - the First Observer's Pitot System

      (2) The pitot-static drains are found in the left and right crawlways, the E/E compartment, aft of the aft cargo compartment, and aft of the pressurized bulkhead.
   B. Equipment
      (1) Container and absorbent cloth to collect the small amount of liquid from each drain.
   C. Access
      (1) Location Zones

119	Main Equipment Center
153/154	Aft of Aft Cargo Compartment
311/312	Aft of Pressurized Bulkhead

   D. Drain the Pitot-Static System

S 863-002

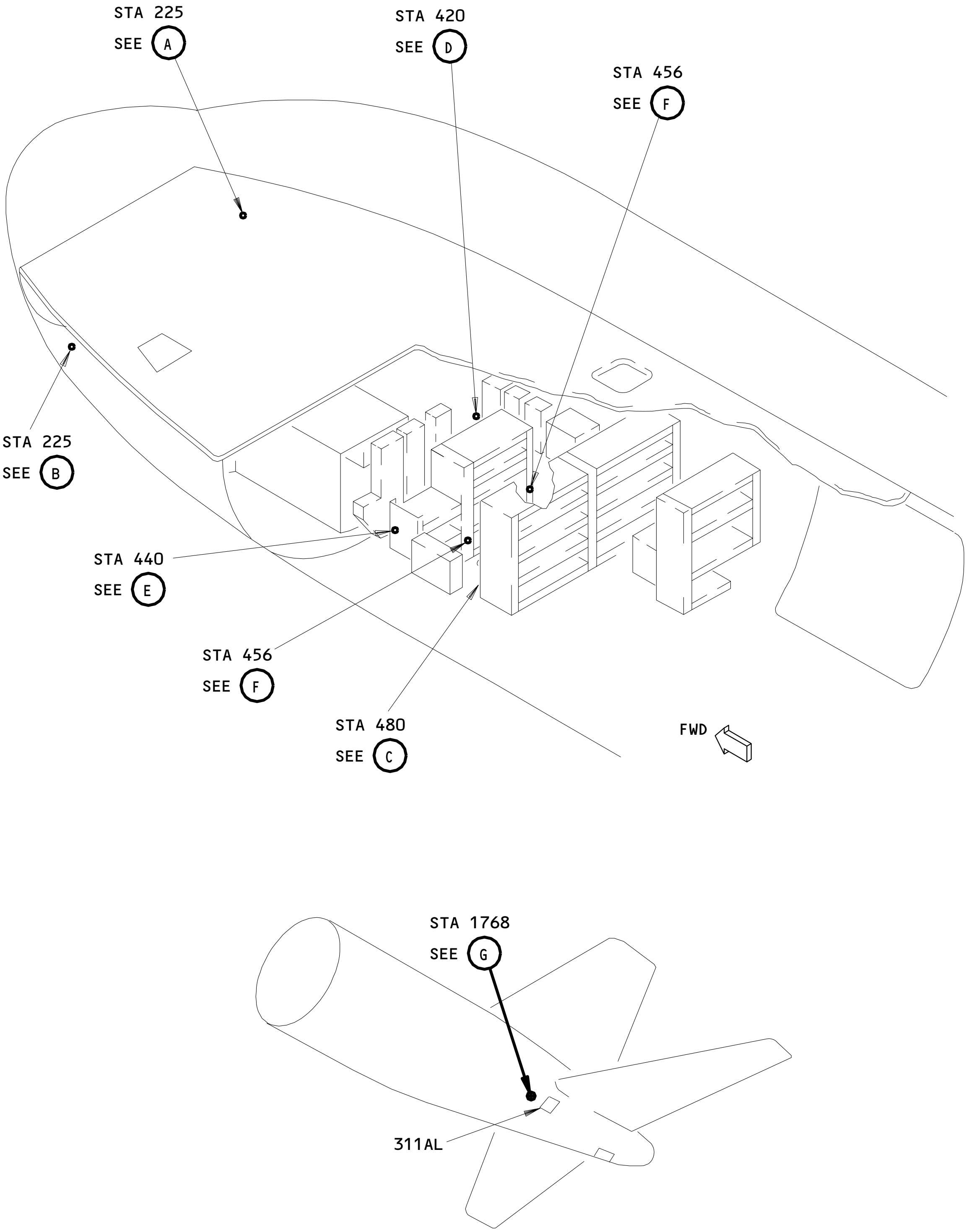
(1) Find each drain fitting.

NOTE: If no liquid is seen in the drain sight gage, you do not have to drain the system.

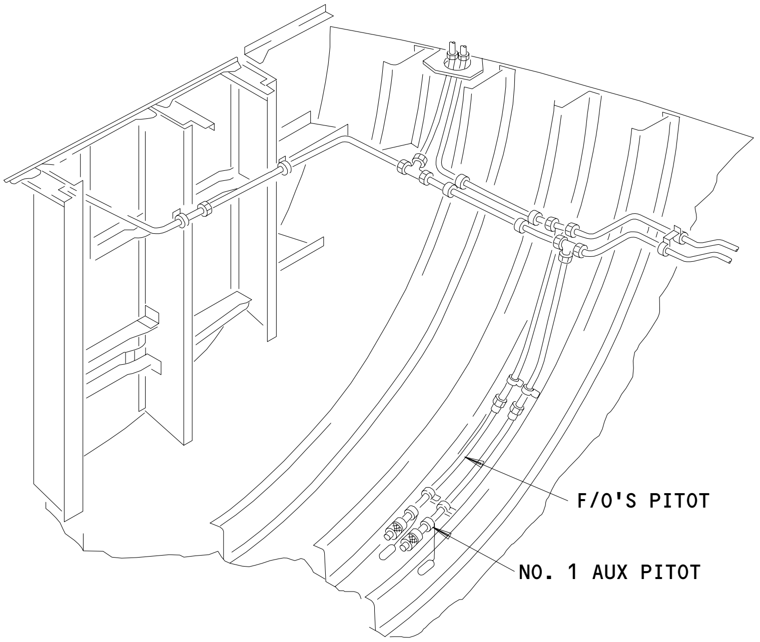
S 863-041

WARNING: THERE CAN BE HYDRAULIC FLUID WHEN YOU DRAIN THE STATIC SYSTEM. IF THE HYDRAULIC FLUID TOUCHES YOUR SKIN, FLUSH THE SKIN WITH WATER. IF THE HYDRAULIC FLUID TOUCHES YOUR EYES, FLUSH THE EYES WITH WATER AND GET MEDICAL AID.

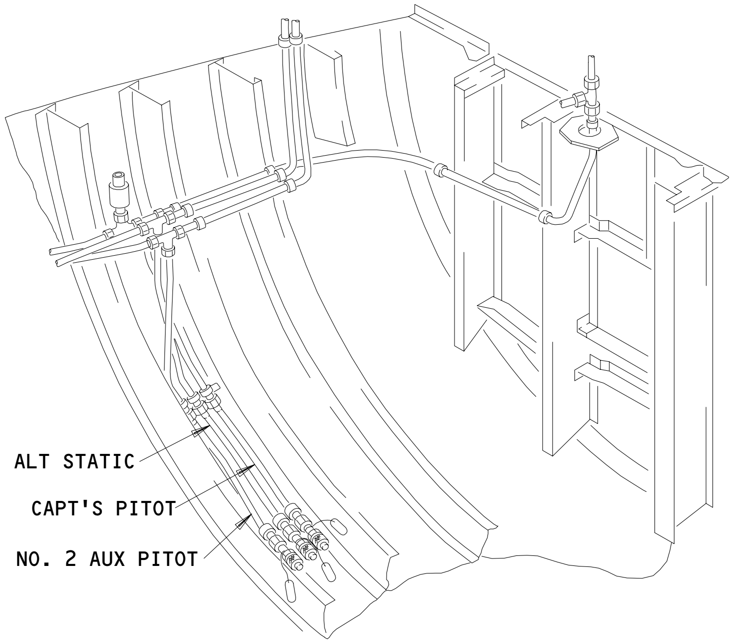
(2) Push up on the drain cap and turn to release the cap from the bayonet pins. The drain cap is on the lower body of the drain.



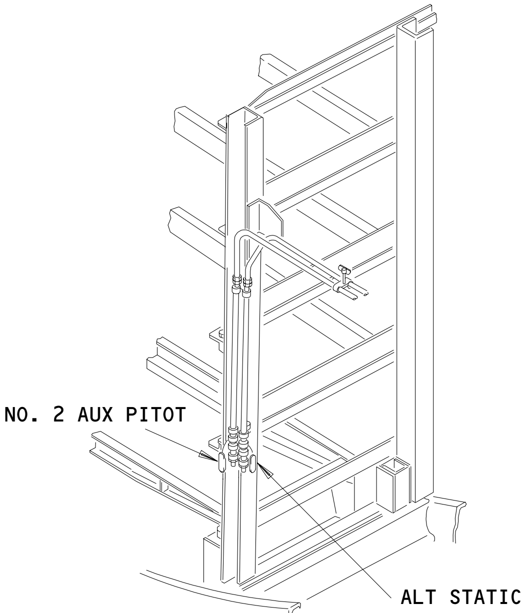
Pitot-Static System Drain Locations
Figure 301 (Sheet 1)



DRAIN VALVE
(LOWER LOBE SIDEWALLS)
STA 225
Ⓐ

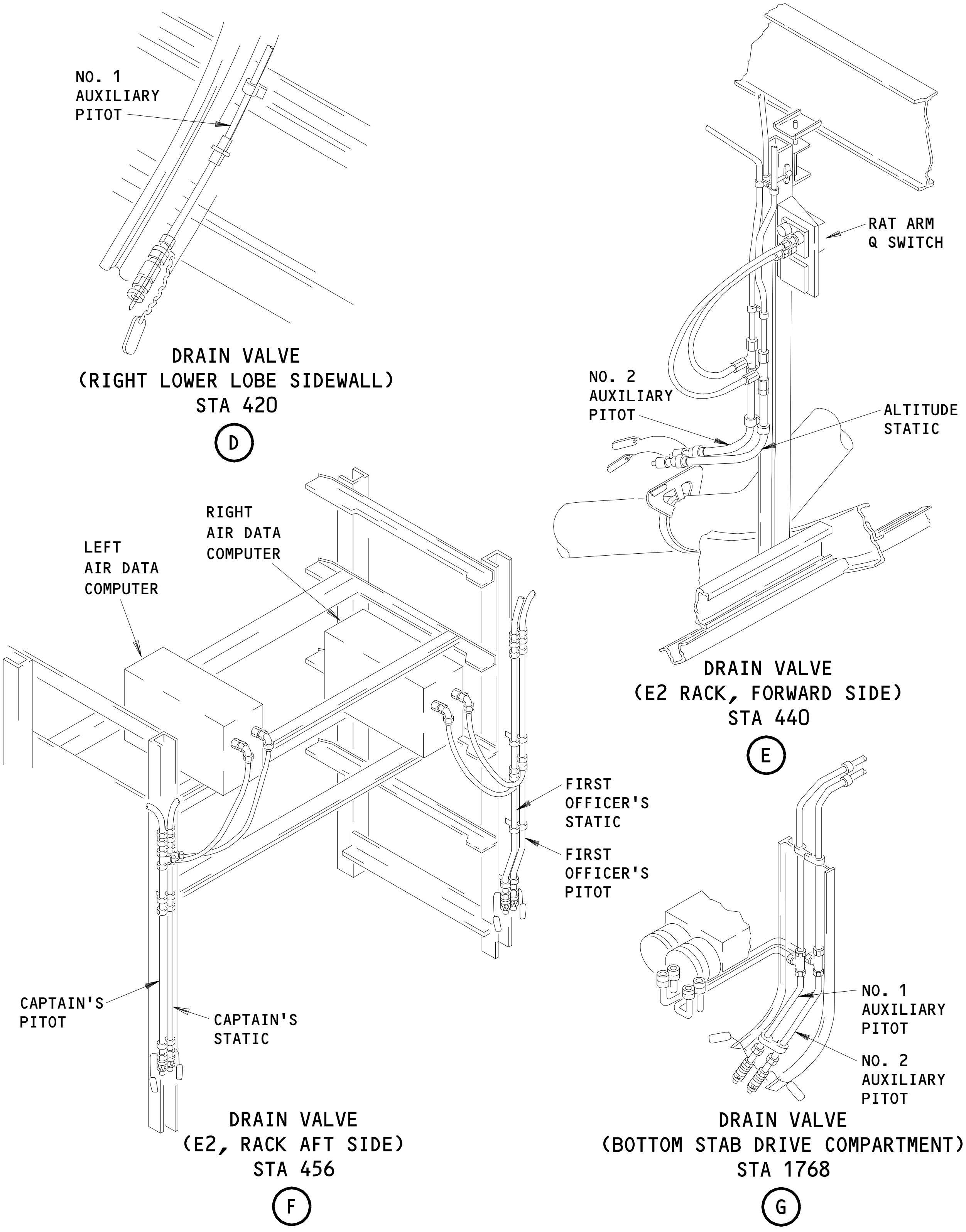


DRAIN VALVE
(LOWER LOBE SIDEWALLS)
STA 225
Ⓑ



DRAIN VALVE
(E3 RACK FWD SIDE)
STA 480
Ⓒ

Pitot-Static System Drain Locations
Figure 301 (Sheet 2)



DRAIN VALVE
(RIGHT LOWER LOBE SIDEWALL)
STA 420
D

DRAIN VALVE
(E2 RACK, FORWARD SIDE)
STA 440
E

DRAIN VALVE
(E2, RACK AFT SIDE)
STA 456
F

DRAIN VALVE
(BOTTOM STAB DRIVE COMPARTMENT)
STA 1768
G

Pitot-Static System Drain Locations
Figure 301 (Sheet 3)

S 013-004
(3) Remove the drain cap.

S 863-005
(4) Turn the drain cap in.

S 863-006
(5) Put the pin into the opening in the bottom of the drain body.

S 863-007
(6) Push the cap into the drain body with hand pressure and allow the liquid in the sump to drain.

S 963-008
(7) Install the cap on the drain body in its initial position.

TASK 34-11-00-173-009

3. Flush the Pitot-Static System

A. Equipment
- (1) Dry air pressure source, 0-15 psig with filter and gage to measure pressure

B. References
- (1) AMM 21-33-04/401, Differential Pressure Transducer
- (2) AMM 27-31-19/401, Elevator Feel Computer
- (3) AMM 29-21-01/401, RAT Assembly
- (4) AMM 34-11-00/501, Pitot-Static System
- (5) AMM 34-11-01/401, Pitot Probe
- (6) AMM 34-11-03/401, Static Port
- (7) AMM 34-12-01/401, Air Data Computer (ADC)
- (8) AMM 34-13-05/401, Standby Airspeed Indicator
- (9) AMM 34-13-06/401, Standby Altimeter

C. Access
- (1) Location Zones

119	Main Equipment Center
153/154	Aft of Aft Cargo Compartment
311/312	Aft of Pressurized Bulkhead

D. Prepare to Flush the Pitot-Static System

S 033-010

(1) Disconnect the pitot-static system lines and cap each hose or tube.

S 033-011

(2) As you do the steps that follow, remove the quick-disconnect halves which are installed on the hoses.

S 863-012

(3) Hold all the hoses so they do not move.

S 863-013

(4) In the flight compartment, disconnect these instruments from the pitot-static system:

S 093-014

(5) In the left lower lobe area, disconnect the differential pressure transducer from the static system (AMM 21-33-04/401).

S 093-015

(6) In the main equipment center, disconnect this equipment from the pitot-static system (two inputs each):
   (a) RAT ARM Q switch (S10334)
   (b) Left and right air data computers (two inputs each) (AMM 34-12-01/401).

S 033-016

(7) In section 48 of the airplane, disconnect the elevator feel computer from the pitot system (Two inputs).

S 033-042

WARNING: THERE CAN BE HYDRAULIC FLUID WHEN YOU DRAIN THE STATIC SYSTEM. IF THE HYDRAULIC FLUID TOUCHES YOUR SKIN, FLUSH THE SKIN WITH WATER. IF THE HYDRAULIC FLUID TOUCHES YOUR EYES, FLUSH THE EYES WITH WATER AND GET MEDICAL AID.

(8) Remove all the drain assemblies from the pitot-static system, and cap each hose at these locations:
   (a) In the forward equipment area (3 drains on the left side, 2 drains on the right side)

(b) Two drains on the left outboard corner of the E3 electronic rack
(c) Two drains on the left and right outboard corner of the E2 electronic rack
(d) Two drains on the left forward corner of the E1 electronic rack
(e) One drain on the left side of the the P54 panel
(f) Two drains aft of the pressurized bulkhead (section 48, forward of the elevator feel computer).

S 033-018
(9) Remove the hoses from each static port.

S 173-034
(10) Cap each hose.

E. Flush the Pitot-Static System

<u>NOTE</u>: The pitot and static drain fittings are identified by color and each drain fitting is attached with a system identification tag.

S 173-020
(1) Flush the pitot-static lines with dry, filtered air, not more than 15 psi.

S 033-021
(2) Remove the caps one at a time and flush from the location given below to the outlet shown for 3 minutes.

S 213-022
(3) Make sure air comes out of each outlet that is flushed. This shows that no lines are cross-connected.

S 433-023
(4) Install the cap after you flush each line before you do the next line.

S 173-024
(5) Flush the captain's Pitot System
(a) Flush from the upper left pitot probe to:
1) The pitot line that is disconnected from the drain found on the left side at approximately STA 225, WL 160

2) The pitot hose that is disconnected from the left ADC
3) The pitot line that is disconnected from the drain found on the left below the left ADC on the E2 rack.

S 173-025

(6) Flush the First Officer's Pitot System
- (a) Flush from the upper right pitot probe to:
  1) The pitot hose that is disconnected from the drain found on the right side at approximately STA 225, WL 160
  2) The pitot hose that is disconnected from the right ADC
  3) The pitot hose that is disconnected from the drain found below the right ADC on the E2 rack.

S 173-026

(7) Flush the Auxiliary Pitot System No. 1
- (a) Flush from the lower right pitot probe to:
  1) The pitot hose that is disconnected from the standby airspeed indicator.
  2) The pitot line that is disconnected from the drain found on the right side at approximately STA 225, WL 160
  3) The pitot line that is disconnected from the drain found on the right side at approximately STA 420, WL 170
  4) The pitot line that is disconnected from the drain found on the right side at approximately STA 1768, WL 190
  5) The pitot hose that is disconnected from the right side of the elevator feel computer.

S 173-027

(8) Flush the Auxiliary Pitot System No. 2
- (a) Flush from the hose that is disconnected from the lower left pitot probe to:
  1) The pitot line that is disconnected from the drain found on the left side at approximately STA 225, WL 160
  2) The pitot hose that is disconnected from the RAT ARM Q switch (S10334)
  3) The pitot line that is disconnected from the drain found on the left side at approximately STA 480, WL 170
  4) The pitot line that is disconnected from the drain found on the left side at approximately STA 1768, WL 190
  5) The pitot hose that is disconnected from the left side of the elevator feel computer.

S 173-028

(9) Flush the Captain's Static System
- (a) Flush from the static hose that is disconnected from the top left primary static port at STA 490, WL 180 to:
  1) The static hose that is disconnected from the lower right primary static port at STA 490, WL 178

2) The static hose that is disconnected from the drain found on the left side at approximately STA 456, WL 160
3) The static hose that is disconnected from the left ADC.

S 173-029

(10) Flush the First Officer's Static System
  (a) Flush from the static hose that is disconnected from the lower left primary static port at STA 490, WL 180 to:
    1) The static hose that is disconnected from the upper right primary static port
    2) The static hose that is disconnected from the right air data computer
    3) The static line that is disconnected from the drain found on the right stanchion of the E2 rack at approximately STA 456, WL 160
    4) The static line that is disconnected from the drain found on the left stanchion of the E2 rack at approximately STA 440, WL 160
    5) AIRPLANES WITH TWO RAT AIRSPEED SWITCHES (PRE-SB 29A32); The static hose that is disconnected from the RAT MNL Q switch (S10335)

S 173-030

(11) Flush the Alternate Static System
  (a) Flush from the static hose disconnected from the right alternate static port to the locations that follow:
    1) The static hose that is disconnected from the left alternate static port
    2) The static hose that is disconnected from the drain RAT ARM Q switch (S10334)
    3) The static line that is disconnected from the drain found on the left stanchion of the E1 rack
    4) The static line that is disconnected from the drain found on the left stanchion of the E3 rack
    5) The static line that is disconnected from the drain found on the left side at approximately STA 225, WL 160
    6) The static hose that is disconnected from the cabin differential pressure transducer at STA 223, WL 180
    7) The static hose that is disconnected from the standby altimeter
    8) The static hose that is disconnected from the standby airspeed indicator.

F. Put the Pitot-Static System Back to Its Usual Condition

S 093-031

(1) Remove the caps on the pitot and static hoses and lines.

S 433-032

(2) Connect the hoses and lines to the correct components.

S 793-043

(3) Do the leakage test on the pitot-static system (AMM 34-11-00/501).

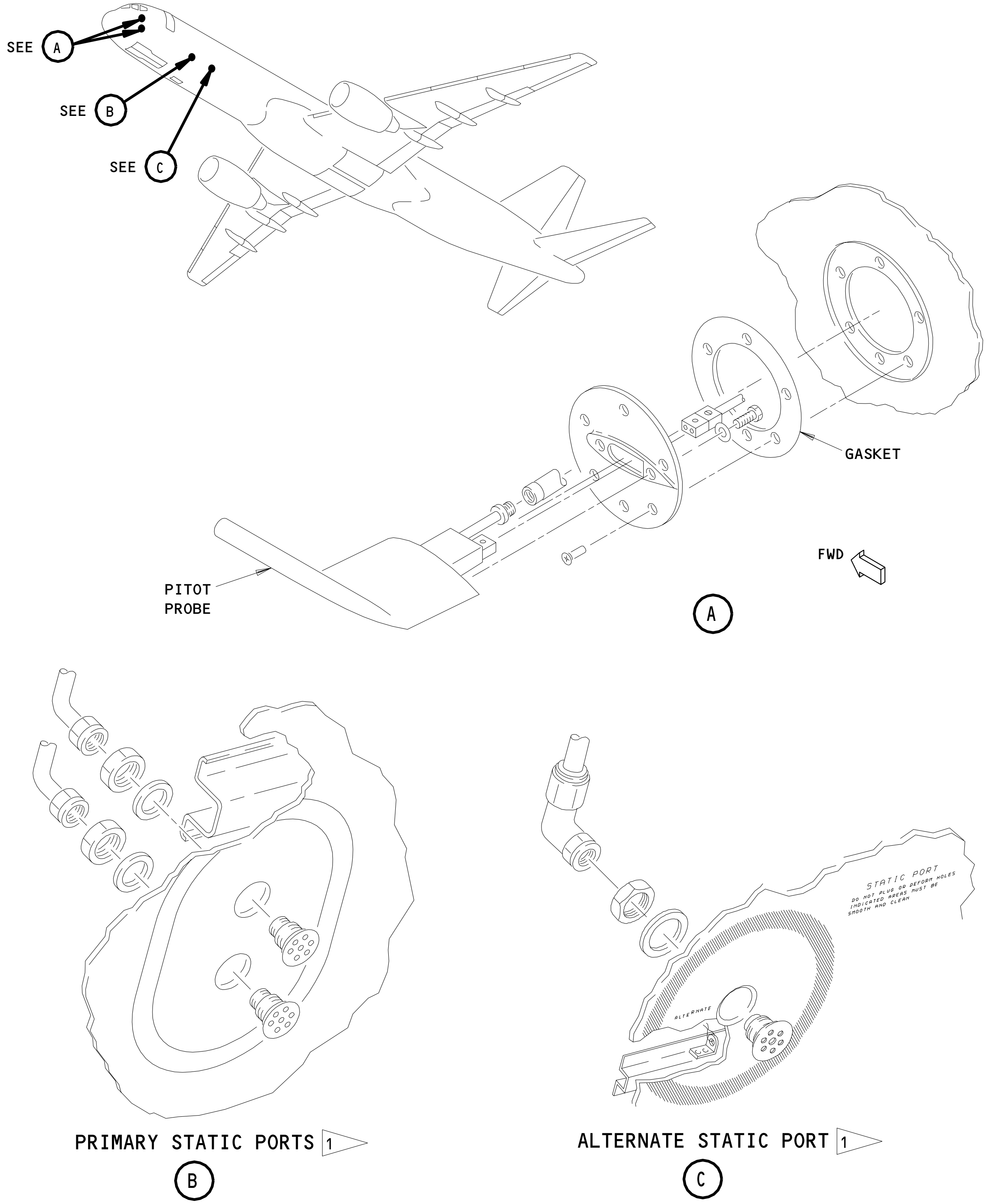
PITOT-STATIC SYSTEM - ADJUSTMENT/TEST

1. General
   A. Make sure the ATC transponders are not in an altitude reporting mode.
   B. The pitot-static system test contains procedures for both full range and low range leakage tests. These leakage tests cannot be done as pre-flight tests because they require a source of air as input to the pitot-static system. A check of the air data instrument indications is the only test that can be done as a pre-flight check.
   C. It is not necessary to perform a pitot-static leak check when replacing a component that is equipped with a quick-disconnect fitting or for quick disconnects that are reconnected. It is only necessary to see that the fitting connection is locked and sealed.
   D. The low range leakage test is done for the conditions that follow:

      - if a pitot-static system connection is broken to replace fittings, hoses or tubing
      - if the pitot-static system is flushed
      - if the air data instrument indications show that a leak is possible
      - after a major airplane overhaul.

TASK 34-11-00-735-001

2. System Test - Low Range Pitot-Static
   A. Equipment
      (1) Adapters
         (a) The NAV-AIDS LTD equipment, NAV-AIDS, 2955 Diab St., Montreal, Quebec Canada H4S 1M1 that follows:
            1) Air Data Accessory Kit - ADA 757-612
      (2) Angular displacement measuring tool, J34002-1
      (3) Pneumatic Test Set
         (a) The Smith Industries equipment; Smith Industries Aerospace and Defence System Co., Basingstoke Div., Winchester Rd., Basingstoke, Hants RG22 6HP England, that follows:
            1) Pressure Controller - P/N 3006KTQ1 or equivalent
            2) Air Data Tester - P/N 3207KTQ1 or equivalent

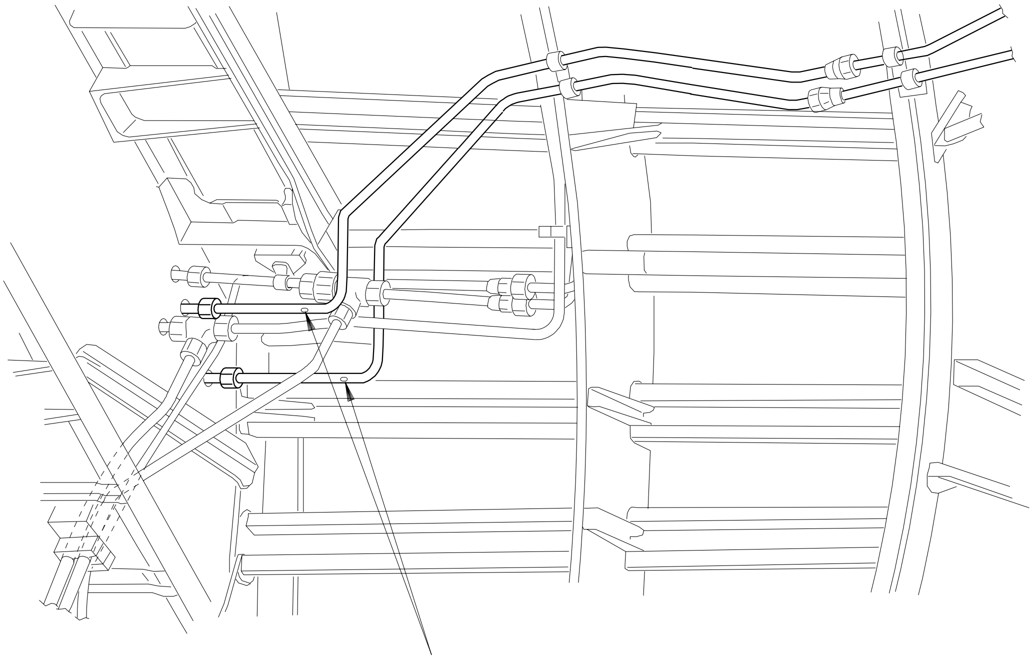


PRIMARY STATIC PORTS 1

ALTERNATE STATIC PORT 1

1 LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE

Pitot-Static System Component Location
Figure 501



Elevator Feel Computer Static Lines
Figure 502

C26053

(4) Gages

NOTE: The gages that follow are included in the pneumatic test set above. Only one set of gages is necessary. The list that follows can be referred to if a different pneumatic test set is used that does not have gages included.

(a) Pitot system test gage - with a precision of +/-0.16 inch of mercury (in increments of 0.03 inches or smaller) or +/-5 knots (in increments of 1.0 knots or smaller).
(b) Static system test gage - with a precision of +/-0.1 inch of mercury (in increments of .01 or smaller) or +/-200 feet (in increments of 20 feet or smaller).
(c) Differential pressure gage - with a precision of +/-0.01 inches of mercury that can measure a minimum differential pressure of 10 inches.
(5) Flow restrictors, control valves, cutoff valves

B. Consumable Materials
(1) G02219 Tape, Yellow Vinyl Adhesive - 3M Scotch Brand No. 471, 3 inches wide, BAC 5034-4

C. References
(1) 22-10-00/501, Autopilot (Flight Control) System

D. Access
(1) Location Zones

113	Area Fwd of NLG Wheel Well, Left (External)
114	Area Fwd of NLG Wheel Well, Right (External)
119	Main Equipment Center (External)
211	Control Cabin, Left (External)
212	Control Cabin, Right (External)

E. Prepare for Test

S 865-074

WARNING: MAKE SURE THAT THE PITOT PROBE HEATERS ARE OFF DURING THE TEST. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(1) Open these circuit breakers on the main power distribution circuit breaker panel, P6, and attach DO-NOT-CLOSE tags:
(a) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
(b) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
(c) 6L21, PITOT HEAT R AUX
(d) 6L22, PITOT HEAT F/O MAIN

S 865-078

WARNING: OPEN THE RAT AUTO CIRCUIT BREAKER BEFORE YOU DO THE PITOT-STATIC TEST. IF THE CIRCUIT BREAKER IS NOT OPENED, AND THE ALTERNATE PITOT-STATIC DIFFERENTIAL PRESSURE EQUIVALENT TO 80 KNOTS IS APPLIED WITH BOTH ENGINES NOT POWERED, THE RAT WILL DEPLOY. THIS COULD CAUSE INJURY TO PERSONS.

(2) Open these circuit breakers on the P11 overhead panel and attach DO-NOT-CLOSE tags:
  (a) 11C6, CSEU 1L AC or FLT CONT ELECT 1L AC
  (b) 11C8, CSEU 2L AC or FLT CONT ELEC 2L AC
  (c) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR
  (d) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or FSEU-1 PWR
  (e) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT FSEU-1 CONT
  (f) 11G17, FLT CONT ELEC 1R AC or CSEU 1R AC
  (g) 11G27, CSEU 2R AC or FLT CONT ELEC 2R AC

S 865-005

(3) Set the left and right AOA vanes to 0°±2°.

S 865-049

CAUTION: MAKE SURE THAT THE AUTOPILOT SYSTEM IS OFF DURING THE TEST. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE AIRPLANE.

(4) Remove all power from the autopilot flight director system (AFDS) (AMM 22-10-00/501).

F. Captain's Pitot Test

S 845-007

(1) Prepare for Test

S 845-177

WARNING: MAKE SURE THAT YOU FLUSH THE PROBE ADAPTER WITH WATER BEFORE YOU ATTACH THE ADAPTER TO THE PROBE. YOU CAN CAUSE DAMAGE TO THE PROBE OR THE ADAPTER.

(2) Flush the adapter for the pitot probe with water before you install it on the probe.

NOTE: Use a solution that has equal parts of ethylene glycol and water in temperatures between 32 degrees F and -40 degrees F.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(a) Install the pitot probe test adapter on the upper left pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
   1) A control valve
   2) A cutoff valve
   3) A flow restrictor
   4) A test gage.
(c) Put vinyl adhesive tape on the drain holes for the pitot chamber on the top left probe.

S 735-008
(3) Do the test of the captain's pitot system as follows:
(a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Pressurize the captain's pitot system to 1.959 (±0.16) inches of mercury (gage) or 200 (±5) knots. Measure the pressure on either the pitot system test gage or the captain's Mach airspeed indicator.
(c) When the pressure is stable, close the pitot cutoff valve.

(d) Read and write the value shown on either the test gage or the captain's Mach airspeed indicator.

(e) After 1 minute, make sure that the pressure has not decreased by more than 0.03 inches of mercury or 1.5 knots.

(f) Slowly release all the pressure in the captain's pitot system.

<u>CAUTION</u>: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

(g) Remove the vinyl adhesive tape and the pitot probe test adapter from the pitot probe.

G. First Officer's Pitot Test

S 845-009

(1) Prepare for Test

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(a) Install the pitot probe test adapter on the upper right pitot probe.

<u>CAUTION</u>: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

(c) Put vinyl adhesive tape on the drain holes for the pitot chamber on the top right probe.

S 735-010

(2) Do the test of the first officer's pitot system as follows:

(a) Make sure that the test equipment is installed correctly.

<u>CAUTION</u>: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Pressurize the first officer's pitot system to 1.959 (±0.16) inches of mercury (gage) or 200 (±5) knots. Measure the pressure on either the pitot system test gage or the first officer's Mach airspeed indicator.
(c) When the pressure is stable, close the pitot cutoff valve.
(d) Read and write the value shown on either the test gage or the first officer's Mach airspeed indicator.
(e) After 1 minute, make sure that the pressure has not decreased by more than 0.03 inches of mercury or 1.5 knots.
(f) Slowly release all the pressure in the first officer's pitot system.

<u>CAUTION</u>: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

(g) Remove the vinyl adhesive tape and the pitot probe test adapter from the pitot probe.

H. Auxiliary Pitot System No. 1 Test

S 845-011

(1) Prepare for Test

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(a) Install the pitot probe test adapter on the lower right pitot probe.

<u>CAUTION</u>: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
    1) A control valve
    2) A cutoff valve
    3) A flow restrictor
    4) A test gage.
(c) Put vinyl adhesive tape on the drain holes for the pitot chamber on the bottom right probe.

S 735-012

(2) Do the test of the auxiliary pitot system No. 1 as follows:
   (a) Make sure that the test equipment is installed correctly.

<u>CAUTION</u>: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

   (b) Pressurize the auxiliary pitot system No. 1 to 1.959 (±0.16) inches of mercury (gage) or 200 (±5) knots. Measure the pressure on either the pitot system test gage or the standby airspeed indicator.
   (c) When the pressure is stable, close the pitot cutoff valve.
   (d) Read and write the value shown on either the test gage or the standby airspeed indicator.
   (e) After 1 minute make sure that the pressure has not decreased by more than 0.03 inches of mercury or 1.5 knots.
   (f) Slowly release all the pressure in the auxiliary pitot system No. 1.

<u>CAUTION</u>: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

   (g) Remove the vinyl adhesive tape and the pitot probe test adapter from the pitot probe.

I. Auxiliary Pitot System No. 2 Test

S 845-013

(1) Prepare for Test

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

   (a) Install the pitot probe test adapter on the lower left pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
   1) A control valve
   2) A cutoff valve
   3) A flow restrictor
   4) A test gage.

(c) Put vinyl adhesive tape on the drain holes for the pitot chamber on the bottom left probe.

S 735-014

(2) Do the test of the auxiliary pitot system No. 2 as follows:
   (a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

   (b) Pressurize the auxiliary pitot system No. 2 to 1.959 (±0.16) inches of mercury (gage) or 200 (±5) knots. Measure the pressure on the pitot system test gage.
   (c) When the pressure is stable, close the pitot cutoff valve.
   (d) Read and write the value shown on the test gage.
   (e) After 1 minute make sure that the pressure has not decreased by more than 0.03 inches of mercury or 1.5 knots.
   (f) Slowly release all the pressure in the auxiliary pitot system No. 2.

CAUTION: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

   (g) Remove the vinyl adhesive tape and the pitot probe test adapter from the pitot probe.

J. Captain's Static System Test

S 845-015

(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(a) Install the static port test adapter on the upper left primary static port.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(b) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
  1) A control valve
  2) A cutoff valve
  3) A flow restrictor
  4) A test gage.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: MAKE SURE THAT THE SEALS DO NOT EXTEND INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SYSTEM.

(c) Put vinyl adhesive tape over the lower right primary static port.

S 735-016

(2) Do the test of the captain's static system as follows:
(a) Make sure the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS . FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Apply a vacuum to the upper left primary static port equivalent to 5.25 (±0.25) inches of mercury (gage pressure) or 5,000 feet above airport altitude. Measure the pressure on the test gage.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) When the vacuum is stable, close the static cutoff valve.

(d) Read and write the value shown on the test gage.

(e) After 1 minute, make sure that the vacuum has not decreased by more than 0.07 inches of mercury or 80 feet of altitude.

(f) Slowly release all of the pressure in the captain's static system.

<u>WARNING</u>: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SEN SING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: EXAMINE THE STATIC PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE STATIC PORT DAMAGE.

(g) Remove the static port test adapter and the vinyl adhesive tape from the static ports.

K. First Officer's Static System Test

S 845-017

(1) Prepare for Test

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(a) Install the static port test adapter on the lower left primary static port.

<u>CAUTION</u>: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(b) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
1) A cutoff valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

<u>WARNING</u>: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: MAKE SURE THAT THE SEALS DO NOT EXTEND INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SYSTEM.

(c) Put vinyl adhesive tape over the upper right primary static port.

S 735-018

(2) Do the test of the first officer's static system as follows:

(a) Make sure the test equipment is installed correctly.

<u>CAUTION</u>: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Apply a vacuum to the lower left primary static port equivalent to 5.25 (±0.25) inches of mercury (gage pressure) or 5,000 feet above airport altitude. Measure the pressure on the test gage.

<u>CAUTION</u>: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) When the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute, make sure that the vacuum has not decreased by more than 0.07 inches of mercury or 80 feet of altitude.
(f) Slowly release all of the pressure in the first officer's static system.

<u>WARNING</u>: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: EXAMINE THE STATIC PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE STATIC PORT DAMAGE.

(g) Remove the static port test adapter and vinyl adhesive tape from the static ports.

L. Alternate Static System Test

S 845-019

(1) Prepare for Test

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(a) Install the static port test adapter on the left alternate static port.

<u>CAUTION</u>: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(b) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
1) A cutoff valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

<u>WARNING</u>: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

<u>CAUTION</u>: MAKE SURE THAT THE SEALS DO NOT EXTEND INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SYSTEM.

(c) Put vinyl adhesive tape over the right alternate static port.

S 735-020

(2) Do the test of the alternate static system as follows:
(a) Make sure the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Apply a vacuum to the left alternate static port equivalent to 5.25 (±0.25) inches of mercury (gage pressure) or 5,000 feet above airport altitude. Measure the pressure on the test gage.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) When the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute, make sure that the vacuum has not decreased by more than 0.07 inches of mercury or 80 feet of altitude.
(f) Slowly release all of the pressure in the alternate static system.

WARNING: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: EXAMINE EACH PROBE AND STATIC PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PROBE AND PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE STATIC PORT DAMAGE.

(g) Remove the static port test adapter and vinyl adhesive tape from the pitot probe and static ports.

M. Elevator Feel Computer Static System Test

S 845-021

(1) Prepare for Test

CAUTION: DISCONNECT THE LEFT STATIC LINE FROM THE ELEVATOR FEEL COMPUTER BEFORE THE SYSTEM TEST IS DONE. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(a) Disconnect the left static line from the elevator feel computer and allow the static cavity to drain.

(b) Wait until the static drains and elevator feel computer static ports stop dripping.
(c) Wipe any residual hydraulic fluid from static drains and static ports.
(d) Seal the end of the static line with a cap.
(e) Put a temporary seal over the drain hole located approximately at sta 1727.5 WL 193.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(f) Install the static port test adapter on the left elevator feel computer static port.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(g) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
    1) A control valve
    2) A cutoff valve
    3) A flow restrictor
    4) A test gage.

S 735-022

(2) Do the test of the elevator feel computer static system as follows:
(a) Make sure that the test equipment is installed correctly.
(b) Apply a vacuum equivalent to 5.25 (±0.25) inches of mercury (gage pressure) or 5,000 feet above airport altitude to the left elevator feel computer static line.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) After the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute make sure that the vacuum has not decreased by more than 0.07 inches of mercury or 80 feet of altitude.
(f) Slowly release the vacuum in the static line.

CAUTION: MAKE SURE THAT YOU REMOVE ALL OF THE PIECES OF TAPE FROM EACH PITOT PROBE AND STATIC PORT. THE SYSTEM WILL NOT OPERATE CORRECTLY WHEN THE TAPE IS IN ITS POSITION.

(g) Remove all adapters and seals from the static ports.

(h) Remove the temporary seal over the drain hole.
(i) Remove the seal cap from the end of the static line.
(j) Connect the left static line with the elevator feel computer.
(k) Do a low range leak test for the auxiliary pitot No. 1 and No. 2 systems (AMM 34-11-00/501).
(l) If you found large amount of hydraulic fluid and suspect the elevator feel computer, do the elevator feel computer operational test (AMM 27-31-00/501).
(m) Do the same test for the elevator feel computer right static line.

N. Put the Airplane Back to Its Usual Condition

S 865-023

(1) Close these circuit breakers on the main power distribution circuit breaker panel, P6, and remove the DO-NOT-CLOSE tags:
  (a) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
  (b) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
  (c) 6L21, PITOT HEAT R AUX
  (d) 6L22, PITOT HEAT F/O MAIN

S 865-024

(2) Close these circuit breakers on the P11 overhead panel and remove the DO-NOT-CLOSE tags:
  (a) 11C6, CSEU 1L AC or FLT CONT ELECT 1L AC
  (b) 11C8, CSEU 2L AC or FLT CONT ELEC 2L AC
  (c) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR
  (d) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or FSEU-1 PWR
  (e) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT FSEU-1 CONT
  (f) 11G17, CSEU 1R AC or FLT CONT ELEC 1R AC
  (g) 11G27, CSEU 2R AC or FLT CONT ELEC 2R AC

TASK 34-11-00-735-002

3. <u>System Test - Full Range Pitot-Static</u>

A. Equipment

(1) Adapters
  (a) The NAV-AIDS LTD equipment, NAV-AIDS, 2955 Diab St., Montreal, Quebec Canada H4S 1M1 that follows:
    1) Air Data Accessory Kit - ADA 757-612
(2) Angular displacement measuring tool, J34002-1
(3) Pneumatic Test Set
  (a) The Smith Industries equipment; Smith Industries Aerospace and Defence System Co., Basingstoke Div., Winchester Rd., Basingstoke, Hants RG22 6HP England, that follows:
    1) Pressure Controller - P/N 3006KTQ1 or equivalent
    2) Air Data Tester - P/N 3207KTQ1 or equivalent

(4) Gages

NOTE: The gages that follow are included in the pneumatic test set above. Only one set of gages is necessary. The list that follows can be referred to if a different pneumatic test set is used that does not have gages included.

(a) Pitot system test gage - with a precision of +/-0.16 inch of mercury (in increments of 0.03 inches or smaller) or +-5 knots (in increments of 1.0 knots or smaller).
(b) Static system test gage - with a precision of +/- 0.1 inch of mercury (in increments of .01 or smaller) or +/- 200 feet (in increments of 20 feet or smaller).
(c) Differential pressure gage - with a precision of +/-0.01 inches of mercury that can measure a minimum differential pressure of 10 inches.

(5) Flow restrictors, control valves, cutoff valves

B. Consumable Materials
(1) G02219 Tape, Yellow Vinyl Adhesive - 3M Scotch Brand No. 471, 3 inches wide, BAC 5034-4.

C. References
(1) AMM 22-10-00/501, Autopilot (Flight Control) System

D. Access
(1) Location Zones

119	Main Equipment Center (External)
211/212	Control Cabin (External)

E. Prepare for Test

S 865-056

WARNING: MAKE SURE THAT THE PITOT PROBE HEATERS ARE OFF DURING THE TEST. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(1) Open these circuit breakers on the main power distribution circuit breaker panel, P6, and attach DO-NOT-CLOSE tags:
(a) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
(b) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
(c) 6L21, PITOT HEAT R AUX
(d) 6L22, PITOT HEAT F/O MAIN

S 865-058

WARNING: OPEN THE RAT AUTO CIRCUIT BREAKER BEFORE YOU DO THE PITOT-STATIC TEST. IF THE CIRCUIT BREAKER IS NOT OPENED, AND THE ALTERNATE PITOT-STATIC DIFFERENTIAL PRESSURE EQUIVALENT TO 80 KNOTS IS APPLIED WITH BOTH ENGINES NOT POWERED, THE RAT WILL DEPLOY. THIS COULD CAUSE INJURY TO PERSONS.

(2) Open these circuit breakers on the P11 overhead panel and attach DO-NOT-CLOSE tags:
   (a) 11C6, CSEU 1L AC or FLT CONT ELECT 1L AC
   (b) 11C8, CSEU 2L AC or FLT CONT ELEC 2L AC
   (c) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR
   (d) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or FSEU-1 PWR
   (e) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT or FSEU-1 CONT
   (f) 11G17, CSEU 1R AC or FLT CONT ELEC 1R AC
   (g) 11G27, CSEU 2R AC or FLT CONT ELEC 2R AC

S 865-062

(3) Set the left and right AOA vanes to 0°±2°.

S 865-051

CAUTION: MAKE SURE THAT THE AUTOPILOT SYSTEM IS OFF DURING THE TEST. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE AIRPLANE.

(4) Remove all power from the autopilot (flight control) system (Ref 22-10-00).

F. Captain's Pitot Test

S 845-029

(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

   (a) Install the pitot probe test adapter on the upper left pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

S 735-030

(2) Do the test of the captain's pitot system as follows:
(a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Pressurize the captain's pitot system to 4.53 (±0.16) inches of mercury (gage) or 300 (±5) knots. Measure the pressure on either the pitot system test gage or the captain's Mach airspeed indicator.
(c) When the pressure is stable, close the pitot cutoff valve.
(d) Read and write the value shown on either the test gage or the captain's Mach airspeed indicator.
(e) After 1 minute, make sure that the pressure has not decreased by more than 0.16 inches of mercury or 5 knots.
(f) Slowly release all the pressure in the captain's pitot system.

CAUTION: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

(g) Remove the pitot probe test adapter from pitot probe.

G. First Officer's Pitot Test

S 845-031

(1) Prepare for Test
(a) Install the pitot probe test adapter on the upper right pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

S 735-032

(2) Do the test of the first officer's pitot system as follows:
(a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Pressurize the first officer's pitot system to 4.53 (±0.16) inches of mercury (gage) or 300 (±5) knots. Measure the pressure on either the pitot system test gage or the first officer's Mach airspeed indicator.
(c) When the pressure is stable, close the pitot cutoff valve.
(d) Read and write the value shown on either the test gage or the first officer's Mach airspeed indicator.
(e) After 1 minute, make sure that the pressure has not decreased by more than 0.16 inches of mercury or 5 knots.
(f) Slowly release all the pressure in the first officer's pitot system.

CAUTION: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

(g) Remove the pitot probe test adapter from pitot probe.

H. Auxiliary Pitot System No. 1 Test

S 845-033

(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(a) Install the pitot probe test adapter on the lower right pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

S 735-034
(2) Do the test of the auxiliary pitot system No. 1 as follows:
(a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

(b) Pressurize the auxiliary pitot system No. 1 to 4.53 (±0.16) inches of mercury (gage) or 300 (±5) knots. Measure the pressure on either the pitot system test gage or the standby airspeed indicator.
(c) When the pressure is stable, close the pitot cutoff valve.
(d) Read and write the value shown on either the test gage or the standby airspeed indicator.
(e) After 1 minute make sure that the pressure has not decreased by more than 0.16 inches of mercury or 5 knots.
(f) Slowly release all the pressure in the auxiliary pitot system No. 1.

CAUTION: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

(g) Remove the pitot probe test adapter from the pitot probe.

I. Auxiliary Pitot System No. 2 Test

S 845-035
(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(a) Install the pitot probe test adapter on the lower left pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(b) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
  1) A control valve
  2) A cutoff valve
  3) A flow restrictor
  4) A test gage.

S 735-036

(2) Do the test of the auxiliary pitot system No. 2 as follows:
  (a) Make sure that the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF PITOT PRESSURE CHANGE BELOW 300 KNOTS PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN 0 AND 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT/EQUIPMENT DAMAGE.

  (b) Pressurize the auxiliary pitot system No. 2 to 4.53 (±0.16) inches of mercury (gage) or 300 (±5) knots. Measure the pressure on the pitot system test gage.
  (c) When the pressure is stable, close the pitot cutoff valve.
  (d) Read and write the value shown on the test gage.
  (e) After 1 minute make sure that the pressure has not decreased by more than 0.16 inches of mercury or 5 knots.
  (f) Slowly release all the pressure in the auxiliary pitot system No. 2.

CAUTION: EXAMINE THE PITOT PROBE TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PITOT PROBE. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE DAMAGE.

  (g) Remove the pitot probe test adapter from the pitot probe.

J. Captain's Static System Test

S 845-037

(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

  (a) Install the static port test adapter on the top left primary static port.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(b) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(c) Install the pitot probe test adapter on the top left pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(d) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
1) A control valve
2) A cutoff valve
3) A flow restrictor
4) A test gage.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: MAKE SURE THAT THE SEALS DO NOT EXTEND INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SYSTEM.

(e) Put vinyl adhesive tape over the lower right primary static port.

S 735-038

(2) Do the test of the captain's static system as follows:
(a) Make sure the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN THE PITOT AND STATIC SYSTEM LESS THAN 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT OR EQUIPMENT DAMAGE.

CAUTION: KEEP THE ABSOLUTE PRESSURE OF THE PITOT SYSTEM THE SAME AS OR GREATER THAN THE PRESSURE IN THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO INSTRUMENTS OR EQUIPMENT.

CAUTION: DO NOT MAKE THE STATIC PRESSURE LESS THAN 4 IN.HG. STATIC PRESSURE LESS THAN 4 IN.HG. CAN CAUSE DAMAGE TO THE AIR DATA COMPUTER.

(b) Use the test set to supply a vacuum of 18.82 in.Hg. but do not make the static pressure less than 4.3 in.Hg. absolute, as follows:
   1) Always keep the pressure in the static system lower than the pitot system.
   2) Do not let the pressure differential between the pitot and static system to be greater than 10 inches of mercury.
   3) First apply a vacuum to the top left primary static port and then to the top left pitot probe.
   4) Increase the vacuum in the pitot and static system lines until the static line vacuum is at the full value.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) When the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute make sure that the vacuum has not decreased by more than 0.20 inches of mercury or 400 feet of altitude.
(f) Slowly release the vacuum in the pitot and static lines.

WARNING: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: EXAMINE EACH PROBE AND PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PROBE OR PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE OR STATIC PORT DAMAGE.

(g) Remove all adapters and vinyl adhesive tape from the pitot probe and static ports.

K. First Officer's Static System Test

S 845-039

(1) Prepare for Test

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(a) Install the static port test adapter on the lower left primary static port.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(b) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
  1) A control valve
  2) A cutoff valve
  3) A flow restrictor
  4) A test gage.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(c) Install the pitot probe test adapter on the top right pitot probe.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(d) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
  1) A control valve
  2) A cutoff valve
  3) A flow restrictor
  4) A test gage.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

(e) Put vinyl adhesive tape over the top right primary static port.

S 735-040

(2) Do the test of the first officer's static system as follows:
(a) Make sure the test equipment is installed correctly.

CAUTION: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN THE PITOT AND STATIC SYSTEM LESS THAN 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT OR EQUIPMENT DAMAGE.

CAUTION: KEEP THE ABSOLUTE PRESSURE OF THE PITOT SYSTEM THE SAME AS OR GREATER THAN THE PRESSURE IN THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO INSTRUMENTS OR EQUIPMENT.

CAUTION: DO NOT MAKE THE STATIC PRESSURE LESS THAN 4 IN.HG. STATIC PRESSURE LESS THAN 4 IN.HG. CAN CAUSE DAMAGE TO THE AIR DATA COMPUTER.

(b) Use the test set to supply a vacuum of 18.82 in.Hg. but do not make the static pressure less than 4.3 in.Hg. absolute, as follows:
  1) Always keep the pressure in the static system lower than the pitot system.
  2) Do not let the pressure differential between the pitot and static system to be greater than 10 inches of mercury or 420 knots.

3) First apply a vacuum to the lower left primary static port and then to the top right pitot probe.
4) Increase the vacuum in the pitot and static system lines until the static line vacuum is at the full value.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) When the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute make sure that the vacuum has not decreased by more than 0.20 inches of mercury or 400 feet of altitude.
(f) Slowly release the vacuum in the pitot and static lines.

WARNING: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SEN SING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: EXAMINE EACH PROBE AND PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PROBE OR PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE OR STATIC PORT DAMAGE.

(g) Remove all adapters and vinyl adhesive tape from the pitot probe and static ports.

L. Alternate Static System Test

S 845-063

(1) Prepare for Test

CAUTION: DISCONNECT THE AUXILIARY PITOT NO. 1 AND NO. 2 LINES FROM THE ELEVATOR FEEL COMPUTER BEFORE THE ALTERNATE STATIC SYSTEM TEST IS DONE. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(a) Disconnect the auxiliary pitot No. 1 and No. 2 lines from the elevator feel computer.
(b) Seal the ends of the auxiliary pitot No. 1 and No. 2 lines with caps.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(c) Install the static port test adapter on the left alternate static port.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(d) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
   1) A control valve
   2) A cutoff valve
   3) A flow restrictor
   4) A test gage.

CAUTION: BE CAREFUL WITH THE TEST HOSES. INSTALL THE PITOT PROBE TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE PITOT PROBES. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT PROBES OR PUT THEM OUT OF ADJUSTMENT.

(e) Install pitot probe test adapters on the lower left and the lower right pitot probes.

CAUTION: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE PITOT-STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE PITOT-STATIC SYSTEM.

(f) From the pitot pressure source on the pneumatic test set to the pitot inlet of the pitot probe test adapter, connect in-line these items:
   1) A control valve
   2) A cutoff valve
   3) A flow restrictor
   4) A test gage.

WARNING: WHEN THE STATIC PORTS ARE COVERED, MAKE SURE THAT CONDITION IS VISIBLE FROM THE GROUND. FAILURE TO OBSERVE AND REMOVE COVERINGS OVER STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SENSING AND ALTITUDE SENSING SIGNALS, WHICH MAY LEAD TO LOSS OF SAFE FLIGHT.

CAUTION: MAKE SURE THAT THE SEALS DO NOT EXTEND INTO THE STATIC PORTS. YOU CAN CAUSE DAMAGE TO THE SYSTEM.

(g) Put vinyl adhesive tape over the right alternate static port.

S 735-064

(2) Do the test of the alternate static system as follows:

CAUTION: KEEP THE RATE OF STATIC CHANGE BELOW 5000 FEET PER MINUTE, AND THE DIFFERENTIAL PRESSURE BETWEEN THE PITOT AND STATIC SYSTEM LESS THAN 10 INCHES OF MERCURY OR 420 KNOTS. FAILURE TO DO THIS COULD CAUSE INSTRUMENT OR EQUIPMENT DAMAGE.

CAUTION: KEEP THE ABSOLUTE PRESSURE OF THE PITOT SYSTEM THE SAME AS OR GREATER THAN THE PRESSURE IN THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO INSTRUMENTS OR EQUIPMENT.

CAUTION: DO NOT MAKE THE STATIC PRESSURE LESS THAN 4 IN.HG. STATIC PRESSURE LESS THAN 4 IN.HG. CAN CAUSE DAMAGE TO THE AIR DATA COMPUTER.

(a) Use the test set to supply a vacuum of 18.82 in.Hg. but do not make the static pressure less than 4.3 in.Hg. absolute, as follows:
    1) Always keep the pressure in the static system lower than the pitot system.
    2) Do not let the pressure differential between the pitot and static system to be greater than 10 inches of mercury or 420 knots.
    3) First apply a vacuum to the left alternate static port and then to the lower left and lower right pitot probe.
    4) Increase the vacuum in the pitot and static system lines until the static line vacuum is at the full value.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(b) When the vacuum is stable, close the static cutoff valve.
(c) Read and write the value shown on the test gage.
(d) After 1 minute make sure that the vacuum has not decreased by more than 0.20 inches of mercury or 400 feet of altitude.
(e) Slowly release the vacuum in the pitot and static lines.

CAUTION: EXAMINE EACH PROBE AND PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PROBE OR PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE PITOT PROBE OR STATIC PORT DAMAGE.

(f) Connect the auxiliary pitot No. 1 and No. 2 lines to the elevator feel computer.
(g) Do a full range system test of the auxiliary pitot No. 1 and No. 2 systems.

<u>WARNING</u>: FAILURE TO REMOVE THE VINYL ADHESIVE TAPE FROM THE STATIC PORTS BEFORE FLIGHT MAY CAUSE LARGE ERRORS IN AIRSPEED SEN SING AND ALTITUDE SENSING SIGNALS, MAY LEAD TO LOSS OF SAFE FLIGHT.

(h) Remove all adapters and vinyl adhesive tape from the pitot probes and static ports.

M. Elevator Feel Computer Static System Test

S 845-043

(1) Prepare for Test

<u>CAUTION</u>: DISCONNECT THE LEFT STATIC LINE FROM THE ELEVATOR FEEL COMPUTER BEFORE THE SYSTEM TEST IS DONE. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(a) Disconnect the left static line from the elevator feel computer.
(b) Seal the end of the static line with a cap.
(c) Put a temporary seal over the drain hole.

<u>CAUTION</u>: BE CAREFUL WITH THE TEST HOSES. INSTALL THE STATIC PORT TEST ADAPTER AND TEST HOSES SO NO WEIGHT IS ADDED TO THE STATIC PORTS. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC PORTS.

(d) Install the static port test adapter on the left elevator feel computer static port.

<u>CAUTION</u>: MAKE SURE THAT FLOW RESTRICTORS ARE INSTALLED BETWEEN CUTOFF VALVES AND THE STATIC SYSTEM. FAILURE TO DO THIS COULD CAUSE DAMAGE TO THE STATIC SYSTEM.

(e) From the static pressure source in the pneumatic test set to the static port test adapter, install these items in-line:
  1) A control valve
  2) A cutoff valve
  3) A flow restrictor
  4) A test gage.

S 735-044

(2) Do the test of the elevator feel computer static system as follows:
(a) Make sure that the test equipment is installed correctly.
(b) Apply a vacuum equivalent to 11.10 (±0.10) inches of mercury (gage pressure) or 25,000 feet above airport altitude to the left elevator feel computer static line.

CAUTION: CONTINUE TO APPLY THE VACUUM BEHIND THE CUTOFF VALVE AFTER THE CUTOFF VALVE IS CLOSED. FAILURE TO DO THIS MAY CAUSE DAMAGE TO EQUIPMENT WHEN THE CUTOFF VALVE IS OPENED.

(c) After the vacuum is stable, close the static cutoff valve.
(d) Read and write the value shown on the test gage.
(e) After 1 minute make sure that the vacuum has not decreased by more than 0.20 inches of mercury or 400 feet of altitude.
(f) Slowly release the vacuum in the static line.

CAUTION: EXAMINE THE STATIC PORT TO MAKE SURE THAT NO PIECES OF TAPE STAY ON THE PORT. FAILURE TO REMOVE THE TAPE COULD CAUSE STATIC PORT DAMAGE.

(g) Remove all adapters and seals from the static ports.
(h) Remove the temporary seal over the drain hole.
(i) Remove the seal cap from the end of the static line.
(j) Connect the left static line with the elevator feel computer.
(k) Do the same test for the elevator feel computer right static line.

N. Put the Airplane Back to Its Usual Condition

S 865-161

(1) Close these circuit breakers on the main power distribution circuit breaker panel, P6, and remove the DO-NOT-CLOSE tags:
(a) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
(b) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
(c) 6L21, PITOT HEAT R AUX
(d) 6L22, PITOT HEAT F/O MAIN

S 865-162

(2) Close these circuit breakers on the P11 overhead panel and remove DO-NOT-CLOSE tags:
(a) 11C6, CSEU 1L AC or FLT CONT ELECT 1L AC
(b) 11C8, CSEU 2L AC or FLT CONT ELEC 2L AC
(c) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR
(d) 11G12, FLAP/SLAT ELEC UNIT 1 POWER or FSEU-1 PWR
(e) 11C17 or 11G13, FLAP/SLAT ELEC UNIT 1 CONT or FSEU-1 CONT
(f) 11G17, CSEU 1R AC or FLT CONT ELEC 1R AC
(g) 11G27, CSEU 2R AC or FLT CONT ELEC 2R AC

PITOT PROBE - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the pitot probe; the other is the installation of the pitot probe.

TASK 34-11-01-024-044

2. Remove the Pitot Probe (Fig. 401)
   A. General
      (1) You should take special care when you touch the pitot probes. You must not drop, scratch or bend them.
      (2) There are four pitot probes on the airplane. They are found on the nose of the airplane. The captain's probe is on the top left. The first officer's is on the top right. The auxiliary 1 probe is on the bottom right. The auxiliary 2 probe is on the bottom left.
   B. Access
      (1) Location Zones

119/120	Main Equipment Center
153/154	Aft Cargo Compartment
311/312	Aft of Pressurized Bulkhead

   C. Procedure

S 864-039

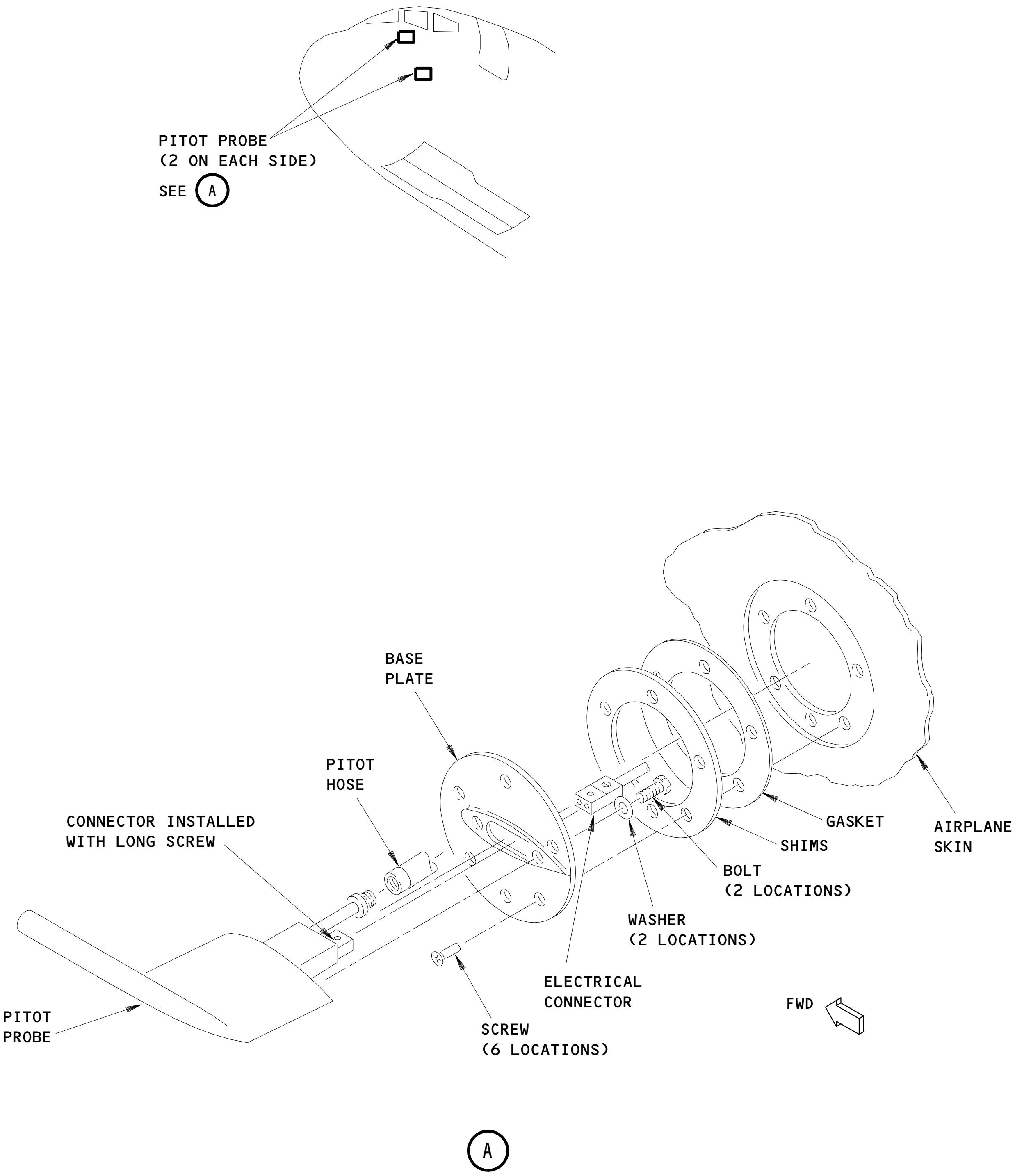
WARNING: DO NOT TOUCH THE PROBE IF THE HEATER POWER WAS ON. THE PROBE CAN CAUSE INJURY TO PERSONS IF TOUCHED.

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
   (a) On the power distribution panel, P6:
      1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
      2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
      3) 6L21, PITOT HEAT R AUX
      4) 6L22, PITOT HEAT F/O MAIN

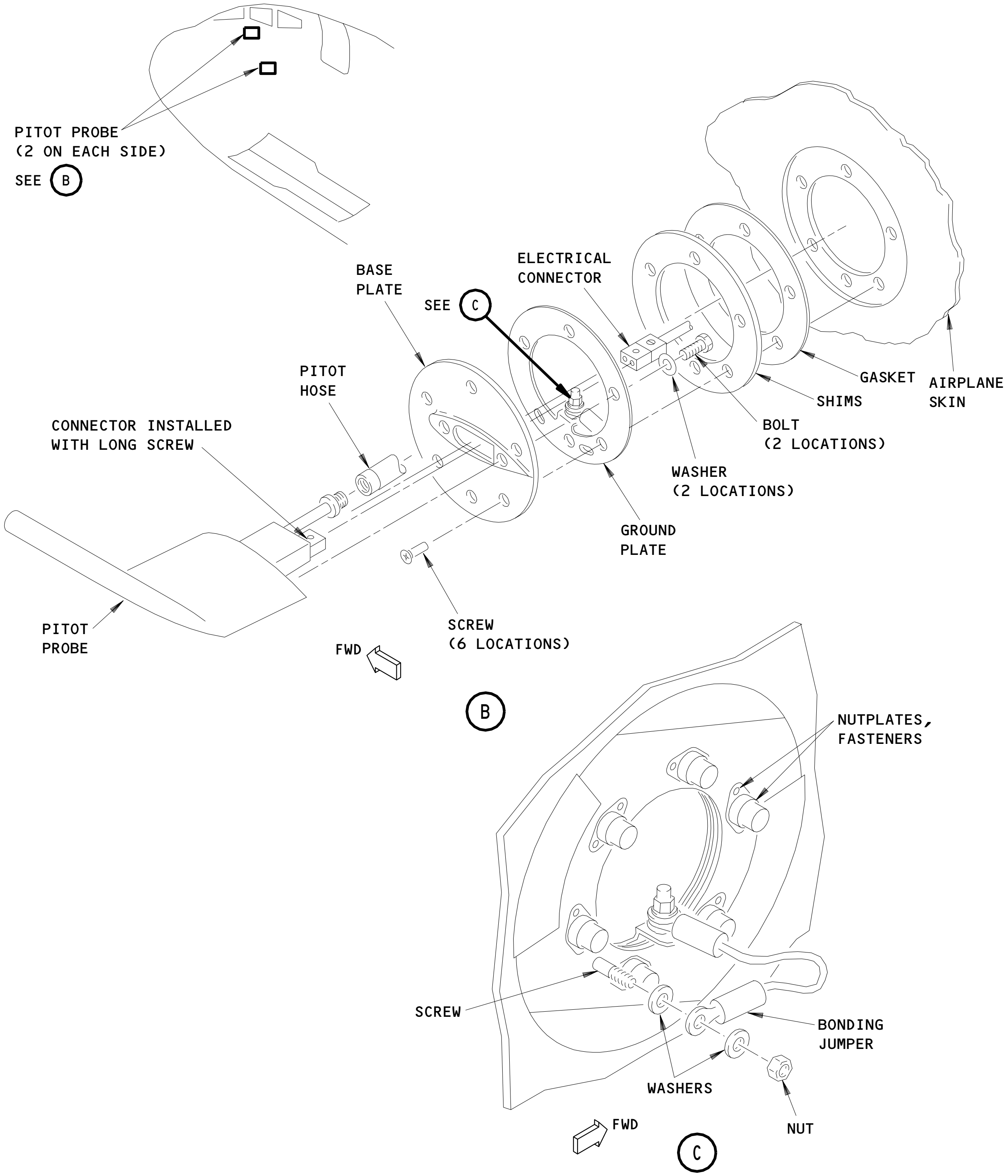
S 094-061

CAUTION: BE CAREFUL WHEN YOU TOUCH THE PITOT PROBE. DO NOT PUT TOO MUCH WEIGHT ON THE PROBE. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PROBE CAN OCCUR.

(2) Remove the screws from the probe baseplate.



Pitot Probe Installation
Figure 401 (Sheet 1)



Pitot Probe Installation
Figure 401 (Sheet 2)

S 024-003

(3) While you hold the probe strut, loosen the gasket and shim and carefully pull the probe out from the airplane skin until you can access the fittings on the base of the probe.

S 034-040

CAUTION: USE WRENCHES TO APPLY COUNTER PRESSURE ON EACH SIDE OF THE FITTING DURING DISASSEMBLY. THIS WILL PREVENT TUBE OR FITTING DAMAGE.

(4) Loosen the hose fitting.

S 094-005

(5) Remove the long screw on the connector.

S 034-006

(6) Disconnect the electrical cable.

S 024-007

(7) Remove the probe assembly.

S 494-008

(8) Install the long screw in the connector.

S 864-009

(9) Hold the cable and hoses so they do not fall back inside the fuselage.

S 864-010

(10) Cap the hose ends that remain on the airplane to keep out foreign material unless a probe will be immediately installed.

S 034-036

(11) Remove the lockwires on the baseplate.

S 094-011

(12) Remove the bolts and the probe from the baseplate.

NOTE: Hardened sealant can be softened with heat for easier removal. The baseplate and probe may be heated in an oven, 150 degrees F (65.5 C) for 20 minutes to soften the sealant.

S 864-037

(13) Hold the baseplate for a different installation.

NOTE: The baseplates are not interchangeable between different positions.

S 024-012

(14) Remove the gasket and discard it.

TASK 34-11-01-024-041

3. Install Pitot Probe (Fig. 401)

A. General

(1) You should take special care when you touch the pitot probes. You must not drop, scratch or bend them.

(2) There are four pitot probes on the airplane. They are found on the nose of the airplane. The captain's probe is on the top left. The first officer's is on the top right. The auxiliary 1 probe is on the bottom right. The auxiliary 2 probe is on the bottom left.

B. Equipment

(1) Electrical Bonding Meter - (Commercially available) capable of measuring 0.010 ohm plus or minus 0.001 ohm.

C. Consumable Materials

(1) A00091 Compound-Sealing -- Dow Corning 93-006
(Prefered)
A00247 BMS 5-95 (Alternative)

(2) B00184 Solvent - BMS 11-7

D. References

(1) AMM 20-10-22/701, Metal Surfaces
(2) AMM 20-10-23/401, Lockwires
(3) AMM 30-31-00/501, Pitot Probe Anti-Icing
(4) AMM 34-11-01/501, Pitot Probe
(5) AMM 51-31-01/201, Seals and Sealing

E. Access

(1) Location Zones

119/120	Main Equipment Center
153/154	Aft Cargo Compartment
311/312	Aft of Pressurized Bulkhead

F. Procedure

S 094-042

CAUTION: MAKE SURE THERE ARE NO UNWANTED MATERIALS IN THE PITOT PROBE BEFORE INSTALLATION. THIS WILL PREVENT CONTAMINATION OF THE SYSTEM.

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(1) Remove the sealant on the baseplate (AMM 51-31-01/201).

S 104-014

(2) Clean the surface of the baseplate (AMM 20-10-22/701).

S 424-015

(3) Put the probe on the baseplate.

S 434-034
(4) Install the bolts on the baseplate.

S 434-035
(5) Install the lockwires (AMM 20-10-23/401).

S 394-066
(6) Seal the probe and baseplate with sealant.

NOTE: It is not neccessary to apply the sealant immediately, if the cure time will cause a flight delay. But, you must apply the sealant as soon as possible to keep moisture out of the area between the probe and the airplane skin.

S 864-056
(7) Make sure that these circuit breakers are open with DO-NOT-CLOSE tags attached:
  (a) On the P6 panel:
    1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
    2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
    3) 6L21, PITOT HEAT R AUX
    4) 6L22, PITOT HEAT F/O MAIN

S 094-016
(8) Remove the protective covers from the pitot hose on the airplane.

S 424-017
(9) Put the new gasket in position.

S 424-018
(10) Put the shims in position.

S 424-069
(11) POST-SB 34-0265
Put the ground plate in position.

S 434-019

CAUTION: USE WRENCHES TO APPLY COUNTER PRESSURE ON EACH SIDE OF THE FITTING DURING ASSEMBLY. THIS WILL PREVENT TUBING OR FITTING DAMAGE.

(12) Connect the hose fitting at the probe base.

S 094-020
(13) Remove the long screw from the probe side of the electrical connector.

S 864-021
(14) Insert the connector fully into the probe with the other screw head up.

S 424-022
(15) Insert the long screw through the probe housing.

S 864-023
(16) Tighten the screw.

S 864-024
(17) While you hold the probe strut, carefully insert the pneumatic hose and electrical cable into the hole in the support plate so the baseplate is in the airplane skin cutout.

S 214-025
(18) Make sure the baseplate is in line with airplane skin.

S 494-026
(19) Install the screws in the probe base.

S 864-027
(20) Tighten the screws.

S 764-059
(21) Measure the resistance between the strut of the pitot probe and the airplane skin with a milliohm/bonding meter.

S 764-064
(22) If the resistance is more than 0.010 Ohms, do these steps:
  (a) Remove the pitot static probe.
  (b) Clean the bonding surfaces, including the counter sunk holes in the pitot-static probe (SWPM 20-20-00).
  (c) Replace the existing screws with new screws.
  (d) Re-install the pitot-static probe.
  (e) Measure the resistance between the strut of the pitot-static probe and the airplane skin with the milliohm/ bonding meter.
  (f) If the resistance is more than 0.010 Ohms, do these steps:
    1) Remove the pitot-static probe.
    2) Replace the nutplates and rivets that attach the pitot-static probe (SRM 51-40-02).
    3) Re-install the pitot-static probe and make sure the bonding resistance is not more than 0.010 Ohms.

S 394-067

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO APPLY THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(23) Apply a fillet of sealant around the baseplate, to fill the gap between the baseplate and the skin with sealant (AMM 51-31-01/201).

NOTE: It is not neccessary to apply the sealant immediately, if the cure time will cause a flight delay. But, you must apply the sealant as soon as possible to keep moisture out of the area between the probe and the airplane skin.

S 094-038

CAUTION: FAILURE TO REMOVE THE PROTECTIVE COVER WILL CAUSE DAMAGE TO THE PITOT-STATIC WHEN THE PROBE HEATER POWER IS APPLIED.

(24) Remove the protective cover from the pitot-static probe.

S 864-052

(25) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  (a) On the P6 panel:
    1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
    2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
    3) 6L21, PITOT HEAT R AUX
    4) 6L22, PITOT HEAT F/O MAIN

S 754-032

(26) Do a test on the probe heater circuit of the installed pitot probe (AMM 30-31-00/501).

S 754-063

(27) Do the pitot probe leakage test (AMM 34-11-01/501).

PITOT PROBE - ADJUSTMENT/TEST

1. General

A. You must do a leakage test on the changed subsystems after each pitot probe installation. You do not usually have to flush the system. You must flush the system only if you think unwanted material got into the pitot system hoses or tubes during disassembly/assembly.

B. Precautions

(1) When you do a test of the auxiliary No. 2 pitot system and the alternate static system, you must open the HYDRAULICS RAT AUTO or HYDRAULICS RAT AUTO PWR (11D27) circuit breaker on overhead circuit breaker panel, P11. This will prevent RAT (Ram Air Turbine) operation.

(2) When you apply or release pressure to a pitot system, the rate must be less than 300 knots for each minute.

(3) Absolute pressure in the pitot system must be equal to or greater than the pressure in the static system. The difference between pitot and static pressures must never be more than 10.9 inches of mercury.

(4) The absolute pressure for all static systems must never be more than the ambient pressure when an instrument is connected to that static system.

(5) Make sure that flow restrictors are installed between the cutoff valve and the pitot system.

TASK 34-11-01-755-033

2. Pitot Probe Test

A. Equipment

(1) Adapter

(a) Pitot probe test adapter - P/N P75701-4:
NAV-AIDS, 2955 Diab St., Montreal, Quebec
Canada 4HS 1M1:

(2) Pneumatic Test Set

(a) Dry air pressure source (1 required), 0 to 5 inches of mercury (absolute)

(3) Gages

(a) Pitot system test gage - accurate to -0.16 (able to read to ± 0.03) inch of mercury or ± 5 (able to read to ± 1) knots

(b) Static system test gage - accurate to -0.1 (able to read to ± 0.01) inch of mercury or ± 200 (able to read to ± 20) feet

(c) Differential pressure gage - able to show 10 inches of mercury differential pressure (minimum) and accurate to ± 0.010 inch of mercury.

(4) Flow restrictors, control valves, and cutoff valves as necessary

B. Access

(1) Location Zones

119/120	Main Equipment Center
153/154	Aft Cargo Compartment
211/212	Flight Compartment
311/312	Aft of Pressurized Bulkhead

C. Prepare for the Pitot Probe Test

S 865-034

WARNING: OPEN THE RAT CIRCUIT BREAKERS BEFORE YOU DO THE PITOT-STATIC TEST. IF AN ALTERNATIVE PITOT-STATIC DIFFERENTIAL PRESSURE EQUAL TO 80 KNOTS IS APPLIED WITH BOTH ENGINES OFF, THE RAT CAN OPERATE. INJURY TO PERSONS CAN OCCUR.

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) On the overhead circuit breaker panel, P11:
    1) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR

S 865-037

(2) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) On the power distribution panel, P6:
    1) 6L13, 6L14, or 6L15, PITOT HEAT CAP MAIN
    2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
    3) 6L21, PITOT HEAT R AUX
    4) 6L22, PITOT HEAT F/O MAIN
  (b) On the overhead circuit breaker panel, P11:
    1) 11A10, AIR DATA CMPTR LEFT
    2) 11F30, AIR DATA CMPTR RIGHT

S 485-011

(3) Connect the pitot pressure source in the pneumatic test set through the pitot control valve to the pitot cutoff valve.

S 865-012

(4) If you must do a check for leakage on the captain's main pitot probe (upper left), do the steps that follow:

CAUTION: IT IS NECESSARY TO HOLD THE TEST HOSES AND ADAPTERS TO PREVENT ADDED WEIGHT ON THE PITOT PROBES. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PITOT PROBE CAN OCCUR.

  (a) Install the pitot probe test adapter on the upper left pitot probe.
  (b) Connect the test adapter to the cutoff valves through the system test gage and flow restrictors.

S 865-013

(5) If you must do a check for leakage on the first officer's main pitot probe (upper right), do the steps that follow:

<u>CAUTION</u>: IT IS NECESSARY TO HOLD THE TEST HOSES AND ADAPTER TO PREVENT ADDED WEIGHT ON THE PITOT PROBES. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PITOT PROBE CAN OCCUR.

(a) Install the pitot probe test adapter on the upper right pitot probe.
(b) Connect the test adapter to the cutoff valves through the system test gage and flow restrictors.

S 865-014

(6) If you must do a check for leakage on the auxiliary No. 1 pitot probe (lower right), do the steps that follow:

<u>CAUTION</u>: IT IS NECESSARY TO HOLD THE TEST HOSES AND ADAPTERS TO PREVENT ADDED WEIGHT ON THE PITOT PROBES. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PITOT PROBE CAN OCCUR.

(a) Install the pitot probe test adapter on the lower right pitot probe.
(b) Connect the test adapter to the cutoff valves through the system test gage and flow restrictors.

S 865-015

(7) If you must do a check for leakage on the auxiliary No. 2 pitot probe (lower left), do the steps that follow:

<u>CAUTION</u>: IT IS NECESSARY TO HOLD THE TEST HOSES AND ADAPTERS TO PREVENT ADDED WEIGHT ON THE PITOT PROBES. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PITOT PROBE CAN OCCUR.

(a) Install the pitot probe test adapter on the lower left pitot probe.
(b) Connect the test adapter to the cutoff valves through the system test gage and flow restrictors.

D. Pitot Probe Leakage Test

S 945-016

(1) Use the pneumatic test set and control valve to apply a pressure of 4.53 (±0.16) inches of mercury or 300 (±5) knots to the pitot system. Use the pitot system test gage to measure pressure.

S 415-018

(2) When the system becomes stable, close the pitot cutoff valve.

S 215-017

(3) Read and write down the value shown on the test gage.

S 215-019

(4) After one minute, make sure the pressure does not decrease by more than 0.16 inch of mercury or 5 knots.

E. Put the Airplane Back to Its Usual Condition

S 845-020

(1) Slowly decrease the pitot system to ambient.

S 085-021

(2) Remove the probe test adapters and all the seals on the pitot probe.

S 865-030

(3) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
    (a) On the P6 panel:
        1) 6L13, 6L14, or 6L15, PITOT HEAT CAPT MAIN
        2) 6L14, 6L15, or 6L16, PITOT HEAT L AUX
        3) 6L21, PITOT HEAT R AUX
        4) 6L22, PITOT HEAT F/O MAIN
    (b) On the P11 panel:
        1) 11A10, AIR DATA CMPTR LEFT
        2) 11D27, HYDRAULIC RAT AUTO or HYDRAULIC RAT AUTO PWR
        3) 11F30, AIR DATA CMPTR RIGHT

PITOT PROBE - INSPECTION/CHECK

1. General

A. This procedure has one task. The task is to visually examine the pitot-static probe, static ports, pitot opening, and pitot drain hole for damage and unwanted materials. This procedure gives limits for damage to the inlet of the pitot probes. If there is more damage than these limits, you must replace the probe (AMM 34-11-01/401).

B. Fly Back Limits
  (1) Replace the pitot probe for one or more of the conditions that follow:
    (a) The pitot probe is out of the inspection tolerance
    (b) There is mechanical damage.
  (2) Do these steps when you see deterioration of the pitot probe:
    (a) You can dispatch the airplane from a base without maintenance facilities until one of the conditions that follow occur:
      1) 24 hours elapse
      2) The airplane gets to a maintenance base.

TASK 34-11-01-226-012

2. Examine the Pitot Probe

NOTE: All the limits given below include a tolerance because of measurement procedures.

A. Equipment
  (1) Different gages or wires - 0.025 to 0.470 inch, optical micrometer; or a different applicable instrument to measure nicks, dents or scratches in or around the opening of the probe.

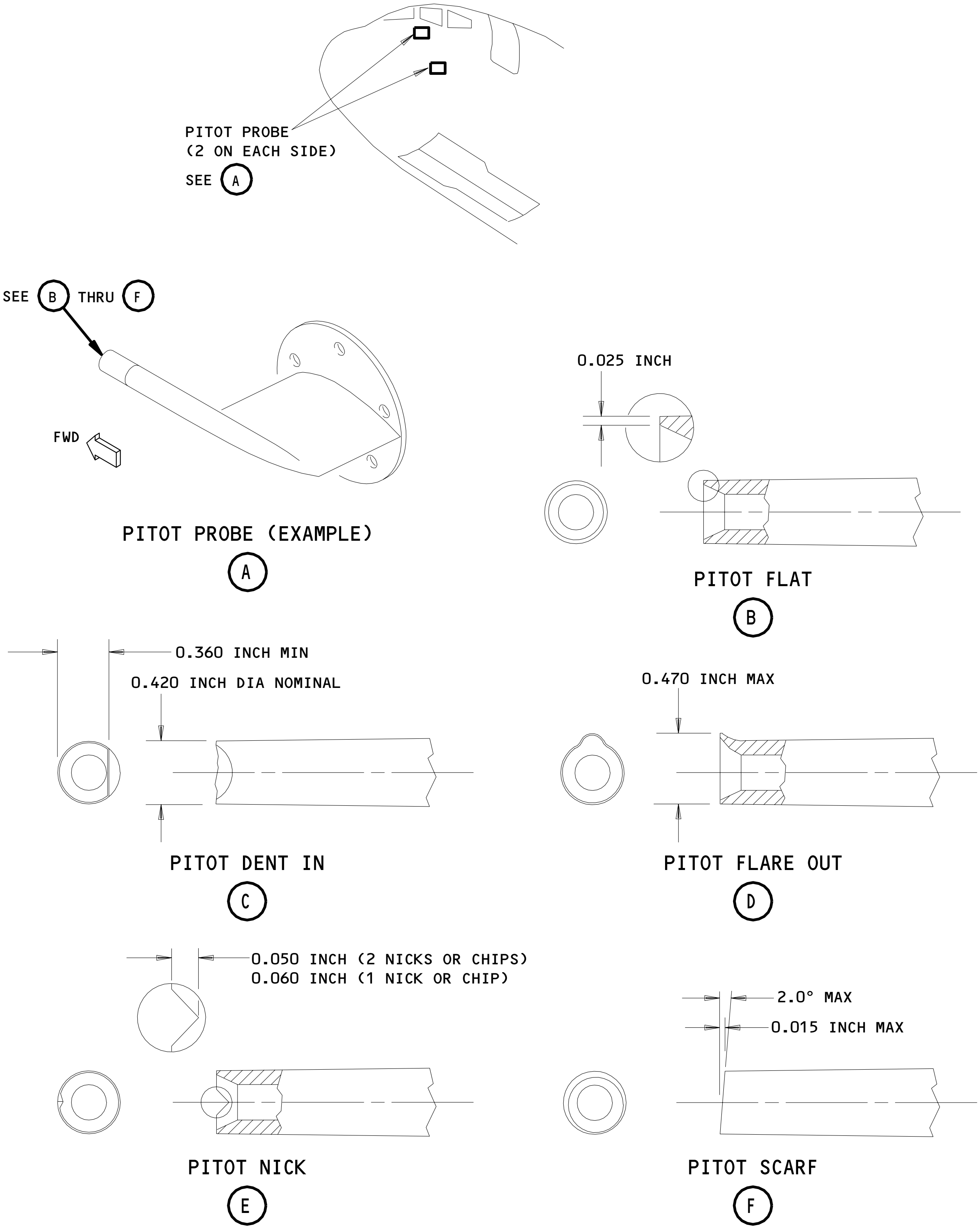
B. References
  (1) AMM 34-11-00/301, Pitot-Static System

C. Access
  (1) Location Zones
    211/212   Control Cabin (external)

D. Procedure

S 216-001

  (1) Visually examine the pitot probe for damage or unwanted material in the drain holes, the pitot opening, or the contour of the probe.



Pitot Probe - Inspection/Check
Figure 601

S 216-014

(2) If material is present in the pitot openings, static ports or drain holes, drain and flush the pitot-static system (AMM 34-11-00/301).

S 216-002

(3) Make sure the edge of the pitot opening is sharp. New probes are sharpened to 0.010 maximum flat.

S 026-003

(4) Remove the probe if the lip is damaged so that the outer flat edge of the lip is more than 0.025 inch (View B, Fig. 601).

S 216-004

(5) Make sure the inner surface of the probe tip is smooth and rounded.

S 026-005

(6) Remove the probe if the dent is more than 0.060 inch from the correct tip diameter of 0.420 inch. The dent can be at a location around the opening, but must not affect more than 1/5 (20%) of the lip area (View C, Fig. 601).

S 216-006

(7) Make sure the outer surface of the probe tip is smooth and rounded. The tip cannot flare out more than 0.050 inch. You can find this condition if you slide your fingernail along the outer surface at the tip.

S 026-007

(8) Remove the probe if this condition exists and the maximum measured tip diameter is more than 0.470 inch (View D, Fig. 601).

S 216-008

(9) Make sure the probe lip has no nicks.

S 026-009

(10) Replace the probe if there are two or more nicks between 0.050 and 0.060 inch deep.

S 026-010

(11) Replace the probe if there is one nick more than 0.060 inch deep (View E, Fig. 601).

S 216-011

(12) Make sure the surface of the pitot tip is vertical to the probe axis. This is a maximum side to side difference of 0.015 inch (View F, Fig. 601).

PITOT PROBE - CLEANING/PAINTING

1. General
   A. This procedure shows how to clean the inside and the outside parts of the pitot probe.

TASK 34-11-01-167-004

2. Clean the Pitot Probe
   A. General
      (1) The pitot probe should not be painted. The data from the pitot probe can be affected if you paint the pitot probe.
      (2) Two pitot probes are found on each side of the airplane at Station 200.

CAUTION: BE CAREFUL WHEN YOU TOUCH THE PITOT PROBE. DO NOT PUT TOO MUCH WEIGHT ON THE PROBE. DAMAGE TO OR INCORRECT ALIGNMENT OF THE PROBE CAN OCCUR.

      (3) Make sure there is no damage to the pitot probes before you clean them (AMM 34-11-01/601).
   B. Equipment
      (1) Drill rods of 0.026 inches and 0.031 inches.
      (2) Dry air pressure source.
   C. References
      (1) AMM 34-11-01/401, Pitot Probe
      (2) AMM 34-11-01/601, Pitot Probe
   D. Access
      (1) Location Zones

119/120	Main Equipment Center
153/154	Aft Cargo Compartment
311/312	Aft of Pressurized Bulkhead

   E. Clean the Inside of the Pitot Probe

S 167-001

      (1) Disconnect the pitot probe pressure lines and force compressed, dry air through the line and out the ports. This will remove the unwanted material in the pitot opening or drain holes. The maximum air pressure you can use is 60 psi.

S 027-002

      (2) If the forced air method does not remove the unwanted material, remove the pitot probe from the airplane (AMM 34-11-01/401), and do the steps that follow:
         (a) Soak or flush the unit with clean water

CAUTION: DO NOT USE FLUIDS THAT CONTAIN SODIUM CHLORIDE OR SULFUR COMPOUNDS TO CLEAN THE PROBE. SODIUM CHLORIDE AND SULFUR CAN CAUSE PREMATURE FAILURE OF THE PROBE.

(b) Drain the unit
(c) Do these steps until the probe is clean.

S 147-005

CAUTION: MAKE SURE YOU DO NOT MAKE THE DRAIN HOLE LARGER WHEN YOU CLEAN IT (THE DRAIN HOLE DIAMETER IS 0.031 ±.001 INCHES). DAMAGE TO THE DRAIN CAN OCCUR.

(3) If the forced air and soak methods do not clean the drain hole you can clean the drainhole manually. Insert a 0.026-inch drill rod and then a 0.031-inch drill rod into the drain hole.

S 417-008
(4) Install the pitot probe (AMM 34-01-01/401).

S 867-009
(5) Connect the pitot probe pressure lines (AMM 34-11-00/001).

S 717-010
(6) Do the pitot/static system leak check (AMM 34-11-00/501).

F. Clean the Outside of the Pitot Probe

S 867-006

CAUTION: DO NOT LET SOLVENTS, OIL, OR GREASE GET ON THE PITOT PROBE. DO NOT RUB THE SURFACE OF THE PROBE TO CLEAN IT. DAMAGE TO THE PITOT PROBE CAN OCCUR.

(1) To remove the unwanted material from the external surfaces, clean the probe with clean water and then dry it with a soft cloth.

STATIC PORT - REMOVAL/INSTALLATION

1. General
   A. The static ports are installed on the left and right side of the fuselage. The primary static ports are found outboard and aft of the P70 panel, and outboard of the right EICAS computer on the E4-2 electronic rack. The left alternate static port is found outboard and below the Air Supply Fan No. 2 (B11). The right alternate static port is found forward and outboard of the E5-2 electronic rack.

TASK 34-11-03-024-001

2. Remove the Static Port (Fig. 401)
   A. References
      (1) AMM 20-10-23/401, Lockwires
      (2) AMM 51-31-01/201, Seals and Sealing
   B. Procedure

S 094-037

(1) Remove the hard liner (AMM 25-50-02/401).

S 094-002

(2) Remove the guard bracket if it is necessary to remove the right primary static ports.

S 034-004

(3) Loosen the fitting that connects the hose to the static port.

S 094-003

CAUTION: DO NOT TWIST OR CAUSE THE STATIC HOSE TO HAVE KINKS DURING REMOVAL. A KINKED HOSE CAN MAKE THE ALTERNATE STATIC SYSTEM SO IT DOES NOT OPERATE.

(4) Remove the hose.

S 434-005

(5) Cap the hose to prevent entry of unwanted materials.

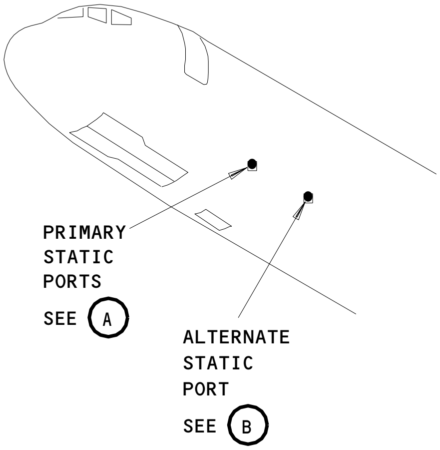
S 164-040

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

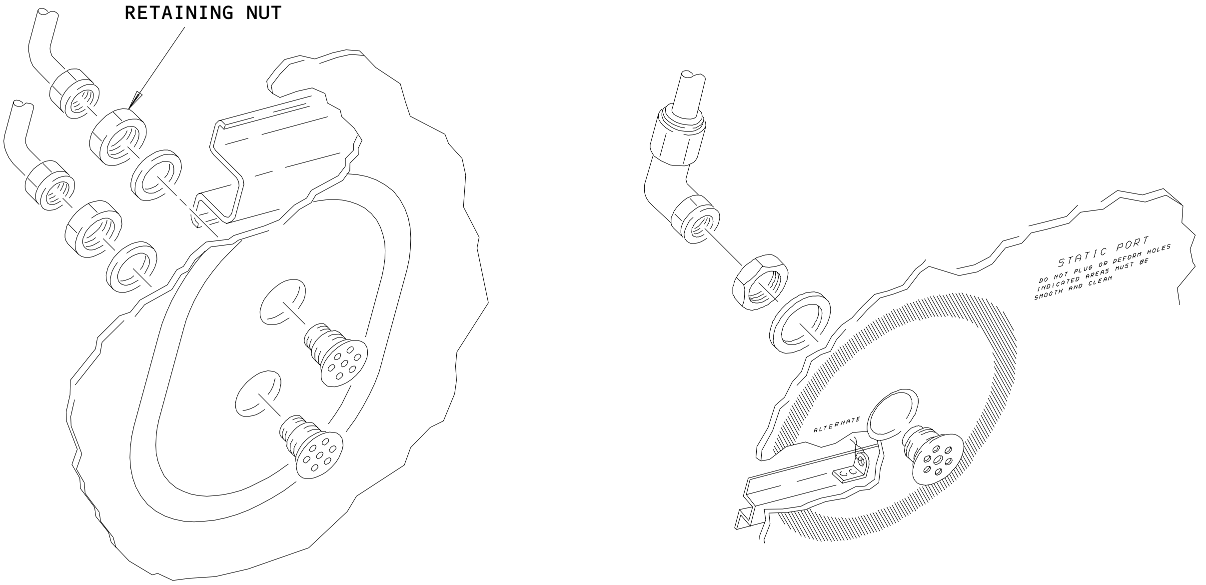
(6) Clean away the sealant around the static port and the retaining nut (AMM 51-31-01/201).

S 094-007

(7) Remove the lockwire on the retaining nut (AMM 20-10-23/401).



STATIC PORT LOCATIONS



PRIMARY STATIC PORTS
A 1

ALTERNATE STATIC PORT
B 1

1 LEFT SIDE SHOWN
RIGHT SIDE OPPOSITE

Static Ports Installation
Figure 401

<u>CAUTION</u>: DO NOT MAKE A MARK ON OR CAUSE DAMAGE TO THE OUTER SURFACE OF THE AIRPLANE SKIN. BE VERY CAREFUL IN THE AREA IN THE PAINTED CIRCLE. THIS KEEPS ACCURATE PRESSURE SENSING TO THE SYSTEMS. DAMAGE TO THE AIRPLANE SKIN CAN OCCUR.

(a) Remove the retaining nut and washer.
(b) Remove the static port from its mounting hole.

TASK 34-11-03-424-032

3. <u>Install the Static Port</u> (Fig. 401)
   A. Equipment
      (1) Adapters
         (a) The NAV-AIDS LTD equipment that follows, NAV AIDS, 2955 Diab St., Montreal, Quebec, Canada H4S 1M1:
            1) Pitot probe test adapter - P/N P75701-4
            2) Static port test adapter - P/N 33410LH - 125-4
      (2) Pneumatic Test Set
         (a) Dry air pressure source (1 required) - To 5 inches of mercury (absolute)
         (b) Vacuum sources (2 required), 0 to 20 inches of mercury (absolute)
      (3) Gages
         (a) Pitot system test gage - Necessary to show a precision of ± 0.16 (you can read it to ± 0.03) inch of mercury or ± 5 (you can read to ± 1) knots
         (b) Static system test gage - Necessary to show a precision of ± 0.1 (you can read it to ± 0.01) inch of mercury or ± 200 (you can read to ± 20) feet
         (c) Differential pressure gage - Necessary to indicate 10 inches of mercury differential pressure (minimum) with a precision of ± 0.010 inch of mercury
      (4) Flow restrictors, control valves, cutoff valves, tape and port seals as necessary
   B. Consumable Materials
      (1) A00626 Compound - Sealing, BMS 5-95
      (2) C00426 Coating - Surface Treatment, MIL-C-5541, Type II class B Alodizing
      (3) B00184 Solvent - BMS 11-7
   C. References
      (1) AMM 20-10-23/401, Lockwires

(2) AMM 20-30-03/201, Finishing Materials
(3) AMM 25-50-02/401, Sidewall Lining Panel
(4) AMM 27-31-19/401, Elevator Feel Computer
(5) AMM 34-11-00/501, Pitot-Static System
(6) AMM 51-21-04/701, Alodizing
(7) AMM 51-31-01/201, Seals and Sealing
(8) SRM 51-10-01/101, Aerodynamic Smoothness

D. Procedure

S 164-012

(1) Clean away all remaining sealant.

S 844-041

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(2) Prepare the area so you can apply the new sealant (AMM 51-31-01/201).

S 434-016

(3) Insert the static port in the mounting hole.

S 864-015

(4) Adjust the static port until the face of the port is as in line with the airplane skin as possible.

S 864-014

(5) Hold the static port in position.

S 494-017

(6) Install the retaining nut and washer from the inner side of the airplane.

S 494-018

(7) Use the double twist method to install the lockwire (AMM 20-10-23/401).

S 864-019

(8) Make the external surface of the static port smooth until it is in line with the airplane skin to +0.003/-0.00 inch (SRM 51-10-01).

S 214-038

(9) Make sure that there are no scratches, burrs, or deformations on the static port finish and around the sensing holes in the static port.

S 214-039

(10) Make sure that there is no unwanted material in the holes of the static port.

S 864-022

(11) Apply alodine on the external surface of the static port (AMM 20-30-03/201, AMM 51-21-04/701).

S 214-023

(12) Make sure all the inlet holes on the static port are not blocked or damaged.

S 394-042

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO APPLY THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(13) Apply sealant all around the static port and the retaining nut (AMM 51-31-01/201).

S 434-025

CAUTION: DO NOT TWIST OR MAKE A KINK IN THE STATIC HOSE. DAMAGE TO THE HOSE OR FITTING CAN OCCUR.

(14) Connect the hose and fitting to the static port.

S 494-026

(15) Install the guard bracket over the right primary static ports.

S 494-027

(16) Install the hard liner (AMM 25-50-02/401).

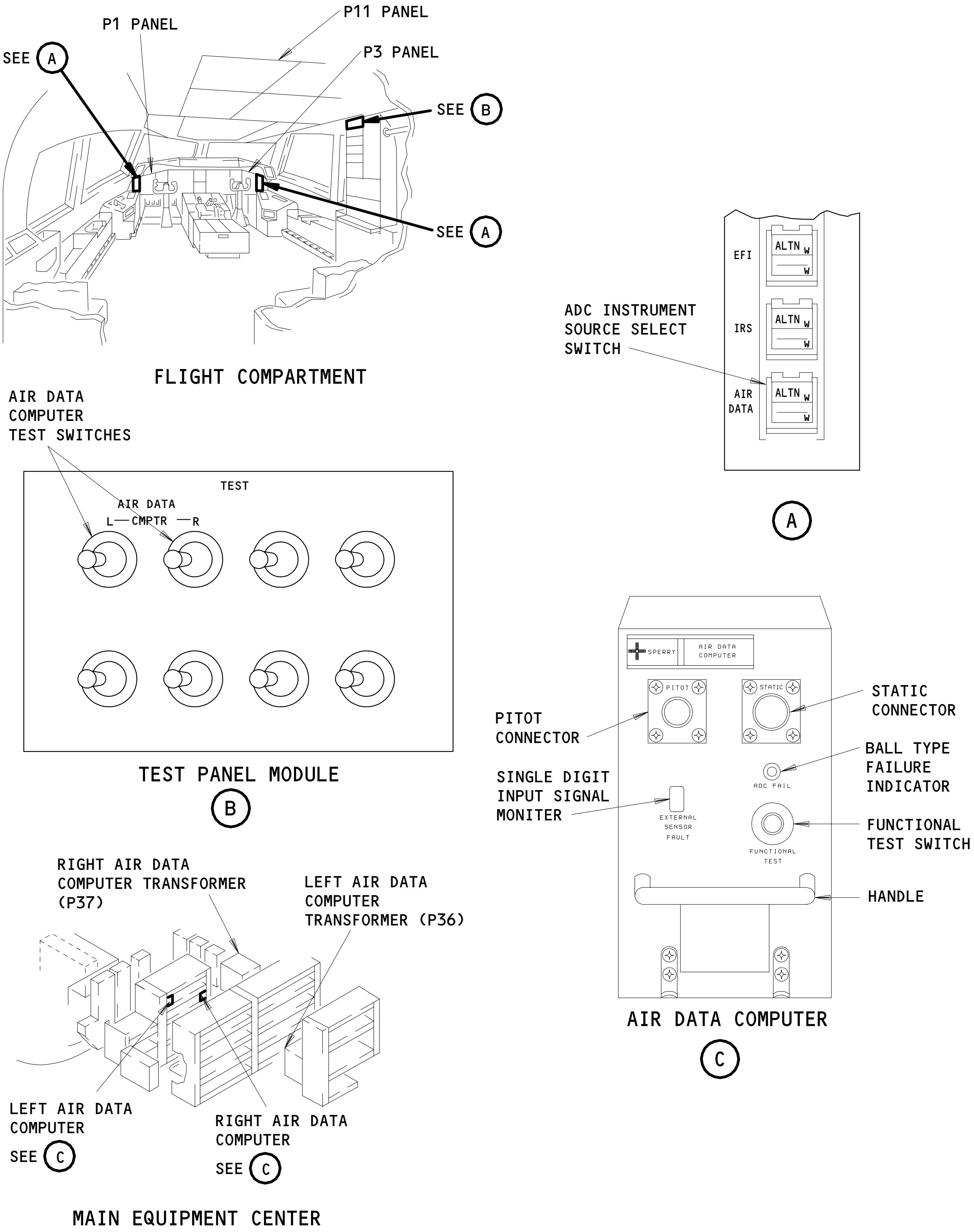
E. Static Port Test

S 864-030

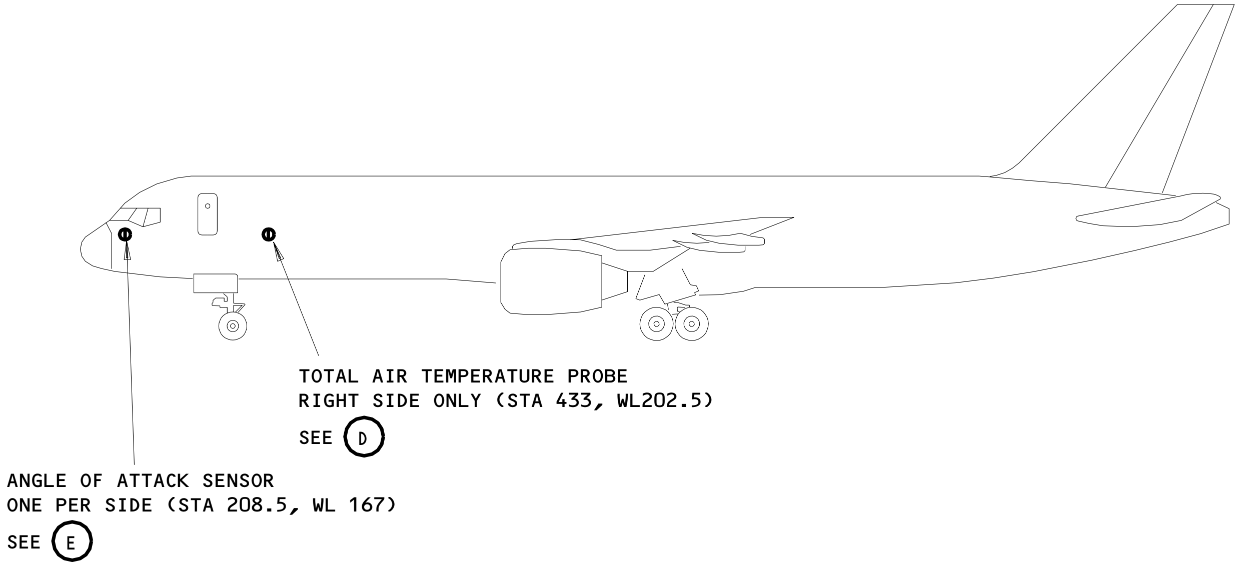
(1) Do the low-range leakage test for the applicable static system (AMM 34-11-00/501).

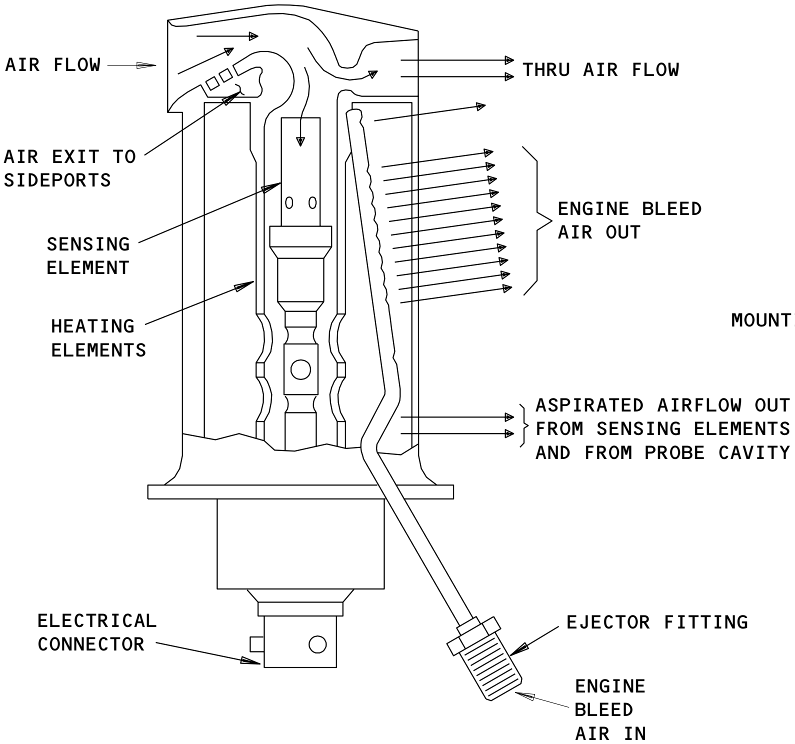
AIR DATA COMPUTING SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The air data computing system provides air data outputs to the air data instruments and other interfacing systems. The system consists of one total air temperature (TAT) probe, two air data computers (ADCs), two angle of attack (AOA) sensors. It also has two external test switches.
   B. The air data system uses pneumatic and electric signals as input data. Pitot and static air pressure from the pitot-static system (Ref 34-11-00) is applied to the ADC's. Total air temperature (TAT) is provided from a TAT probe. Angle of attack (AOA) and BARO correction are sent to the ADC by resolver voltages. The two ADC's are the central processing units of the system.
   C. Four identical ARINC 429 serial data buses from each ADC transmit output data to interfacing systems. The output data includes altitude, airspeed, air temperature, air pressure, and angle of attack data. An overspeed discrete line is connected to the warning system (Ref 31-51-00) and the EICAS.
2. Component Details (Fig. 1)
   A. Air Data Computer
      (1) The air data computers process all the air data inputs and provide computed air data outputs. Outputs are derived from three types of data sensed from the external ambient air. Pitot and static air pressures are provided from the pitot static system. Air temperature of the atmosphere is sensed by the total air temperature probe. Angle of attack information is provided by angle of attack sensors. Baro correction is supplied from the altimeters.
      (2) The ADC front panel provides pitot and static air pressure input connectors. It also provides an external sensor fault LED display, an ADC fail annunciator, and a functional test pushbutton switch.
      (3) The ADC fail annunciator indicates whether or not the ADC had a failure during the last flight. The annunciator shows black for no failures and yellow for a failure.
      (4) The external sensor fault LED display is only operational during the system self-test and is only activated by the test switch on the front of the ADC. The display identifies input sensor failures. It displays a 0-9 single digit number corresponding to specific failures on input sensors. When the test switch is pressed, a dash (-) appearing in the LED indicates no external sensor faults.



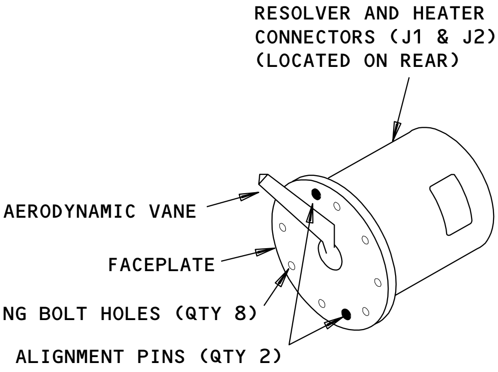
Air Data Computing System - Component Location
Figure 1 (Sheet 1)





TOTAL AIR TEMPERATURE PROBE

D



ANGLE OF ATTACK SENSOR

E

Air Data Computing System - Component Location
Figure 1 (Sheet 2)

(5) The left and right ADC's are located in the main equipment center at racks E2-1 and E2-2, respectively.

B. ADC Test Switches

(1) The ADC (AIR DATA COMPTR) remote test switch is located on the P61 panel. The ADC test switch is wired in parallel with the functional test switch on the front of ADC's. However, this remote test switch is disabled in flight by the air/gnd relay. When the L AIR DATA COMPTR test switch is held in the up position, the left ADC enters a self-test mode. When the R AIR DATA COMPTR test switch is held in the up position, the right ADC enters a self-test mode. Outputs are provided to the interfacing system. However, the external sensor fault indicator on the front of each ADC is not activated by the corresponding L or R ADC test switch. The test is terminated when the switch is released and returns to the center (OFF) position.

C. Angle of Attack (AOA) Sensor

(1) The AOA sensor measures the direction of airflow relative to the fuselage. The sensor vane aligns itself with the prevailing airstream, rotating a central shaft. At the opposite end of the shaft, a gear drives position resolvers. The resolvers are powered by 26V, 400 Hz current and transform rotational position into an electrical output. This electrical output is proportional to the angle of attack. A viscous damper in the AOA vane stabilizes vane movements and reduces the effects of turbulence.

(2) The sensor has a solid-state vane heater which provides continuous de-icing/anti-icing. The AOA sensor also has a case heater which prevents condensation and reduces changes in damper fluid viscosity (Ref 30-31-00).

(3) The right and left sensors are physically and electrically interchangeable. They are located on both sides of the airplane at station 208.50, water line 167.

D. Total Air Temperature Probe

(1) The total air temperature probe is a small metal strut mounted external to the airplane skin. It senses the temperature of airflow passing through cavities within the strut. Air enters an inlet port at the top and exits through several outlet ports on the side and aft surfaces. The TAT probe converts temperature to an analog output signal. It provides this output to the ADC. The TAT temperature is displayed on the EICAS display (Ref 31-41-00).

(2) The probe contains two temperature sensitive wire elements. Airflow around these sensing elements causes the resistance of the wire to vary as a function of total air temperature.

(3) Bleed air provided by the engine bleed air distribution manifold (Ref 36-11-00) into the ejector fitting creates a negative pressure which draws outside air across the sensing elements at such a rate that the anti-ice heaters have a negligible effect. This feature permits accurate TAT readings to be displayed while the airplane is on the ground or in-flight at low airspeeds.

(4) The TAT probe is located on the right side of the airplane. Heating elements provide anti-icing for the probe (Ref 30-31-00).

E. ADC Transformers

(1) Each ADC transformer converts 115 Vac to 26 Vac. This stepdown voltage is used as a reference for barometric correction and AOA sensor resolver excitation.

(2) The left and right transformers are mounted on the left and right miscellaneous equipment panels P36 and P37.

F. ADC Instrument Source Select Switch.

(1) Both the captain and F/O have an ADC instrument source select switch. This allows either pilot to switch over his instruments to operate off of the opposite ADC.

(2) The instrument source select switches are located on the capt's P1 panel and the F/O's P3 panel.

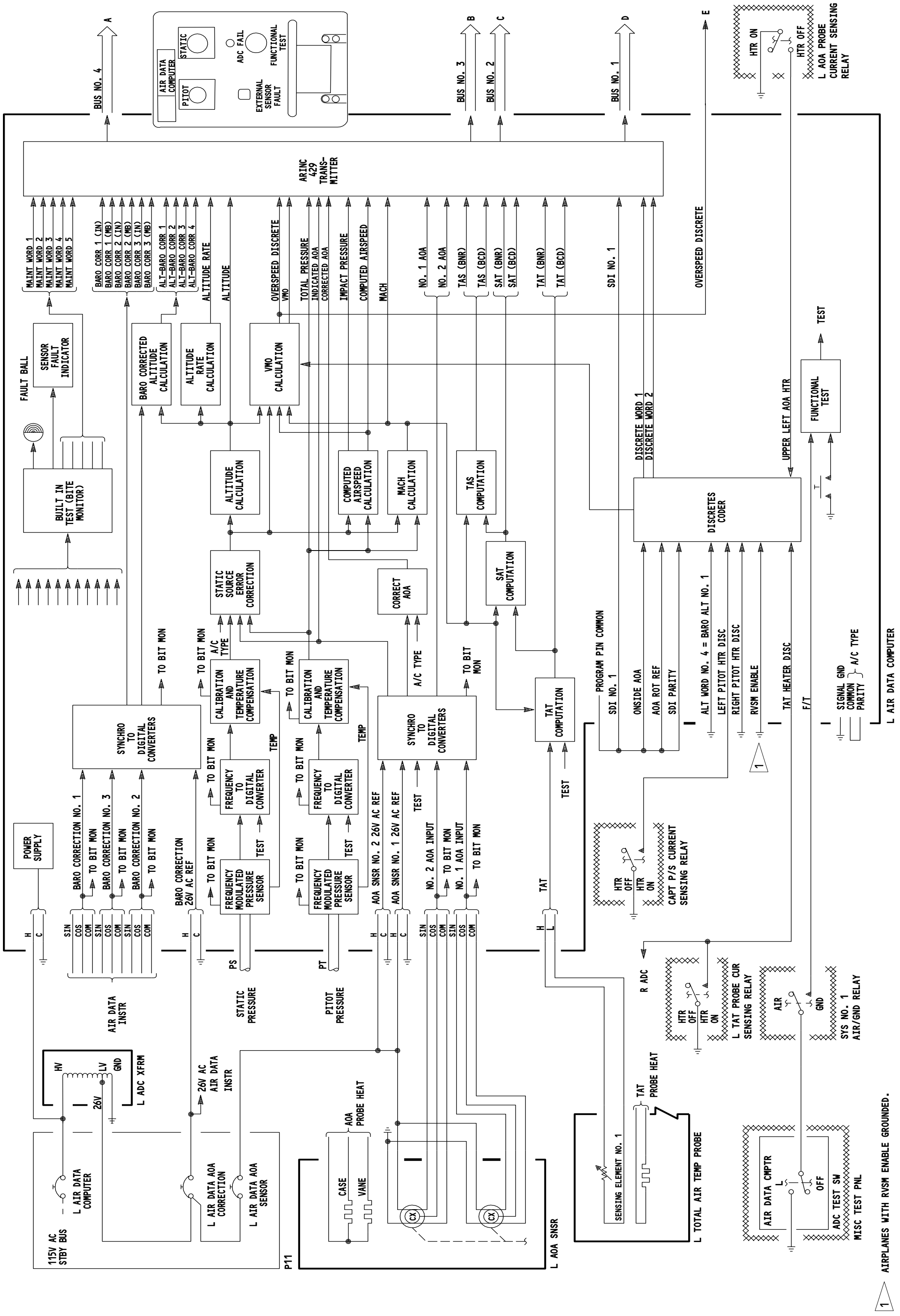
(3) AIRPLANES WITH POST-SB 34-0222;
The captain's and the first officer's ADC instrument source select switch each respectively controls the captain's and the first officer's ADC instrument source select relay. The relays supply more switches for added functions.

3. Operation (Fig. 2)

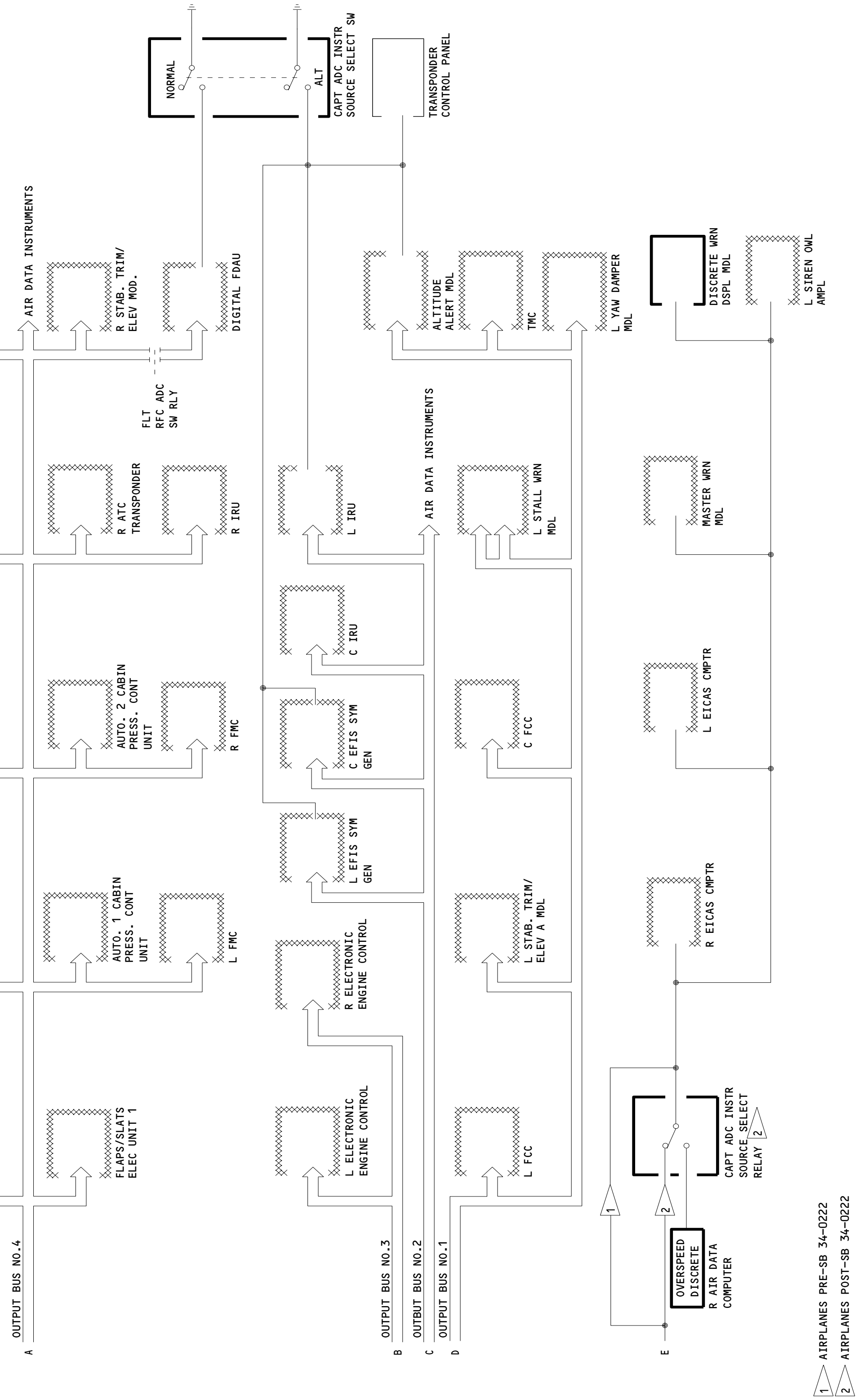
A. Functional Description

(1) The left air data computing system is shown on the schematic and is covered in the following write-up. The right system is similar so the coverage for the left system applies.

(2) Power is supplied to the air data computing systems from the left and right 115 Vac 400 Hz buses. This power is rectified, filtered and regulated by the ADC power supplies to output dc voltages. The ADC transformer converts the 115 Vac to 26 Vac. This stepdown voltage is applied through the BARO correction circuit breakers to the ADC, AOA sensors, and air data instruments. It is used for reference and excitation voltage. P11 circuit breakers protect the 26 Vac circuit breakers from overcurrents.



Air Data Computing System Schematic (Example)
Figure 2 (Sheet 1)



Air Data Computing System Schematic (Typical)
Figure 2 (Sheet 2)

D76952

(3) For a left power bus failure (occurs when the bus voltage is less than 104 ±2 Vac for greater than 400 ms), the left ADC, which is on the standby power bus, receives power from the hot battery bus via the static inverter. When the left bus returns to greater than 106 ±2 Vac for more than 1.2 seconds, the left ADC resumes it's normal power flow from the left bus. For a right power bus failure, the right ADC which operates off the right flight instrument transfer bus, receives power from the left bus. When the right bus returns to normal, the right ADC resumes its normal power flow from the right bus.

(4) The ADCs use pneumatic and electric signals as input data. This data is converted to digital data for use by the central processing unit (CPU). The CPU controls all operations and performs the required computations. It outputs the proper data to the output transmitters. The CPU is represented by the compensation, computation, correction and calculation circuits.

(5) Pitot and static air pressures are applied directly to the ADC. The ADC uses two identical pressure sensors to convert the pressures to frequencies that are proportional to pressure. These frequencies are converted to digital data for use by the CPU. The data is calibrated and temperature compensated and then corrected for static source error. The ADCs computer program provides correction of static source error as a function of indicated AOA. Static source error is the ratio of pressure error to static pressure. Correction factors are stored in the CPU memory and used to make the required compensation.

(6) The functional test switch on the front panel initiates a self-test of the internal circuits of the respective ADC. Outputs are provided to the interfacing systems and the external sensor fault LED display is activated. The test switch is also used to reset the ADC fault ball once the ADC fault has been corrected.

(7) GUI 001-114, 116-999;
For the left ADC, baro corrections 1 and 3 come from the Captain's altimeter and 2 from the F/O's altimeter. For the right ADC, baro correction 1 comes from the Captain's altimeter and 2 and 3 come from the F/O's altimeter (Ref 24-13-00).

(8) GUI 115;
BARO correction 1 comes from the captain's altimeter, 2 from the F/O's altimeter and 3 from the standby altimeter (Ref 34-13-00).

(9) These BARO correction signals are analog signals that are determined by the BARO pressure correction settings. The sin and cos signals are sampled at the peak value of the 26 Vac reference voltage. They are converted to digital angular data. This data is then computed to develop the BARO correction factors.

(10) The resolver voltage signals from the AOA sensors are converted to digital angular information and computed with respect to AOA rotation angle. The indicated AOA data is then in binary digital form for ADC output and further ADC calculations.

(11) The variable resistance in the TAT probe provides an analog input to the TAT computation circuit. Here, the signals are converted to digital form and output to the CPU.

(12) Several discretes are coded to inform the ADC and interfacing systems of sensor heater status.

(13) The ADC is set for either a right or left system by shorting the SDI (source/destination identifier) pin to common.

(14) The AIR DATA CMPTR remote test switch is paralleled with the FUNCTIONAL TEST switch on the front of the ADC. The air/ground relay prevents a system test from being initiated from the remote test switch during flight.

(15) Each ADC has four ARINC 429 digital data buses transmitting identical data. A fault on one bus does not affect data on other buses. The following data is output on each bus.

   (a) Pressure altitude is derived from the static pressure input which is compensated for ambient temperature and corrected for static pressure source errors. The range is from -1000 to +50,000 feet.

   (b) The altitude rate is derived from pressure altitude. Its range is from -20,000 fpm to +20,000 fpm.

   (c) Computed airspeed is computed from a combination of calibrated pitot and static pressure inputs that have been compensated for ambient temperature. The static pressure has also been corrected for static pressure source errors. Computed airspeed range is from 30 to 450 knots.

   (d) MACH number is computed from the same inputs as computed airspeed. Range is from 0.1 to 1.0 MACH.

   (e) True airspeed is computed from a combination of MACH and static air temperature (SAT). Range is from 100 to 599 knots.

   (f) Static air temperature is computed from a combination of MACH and total air temperature. It ranges from -99°C to +60°C.

(g) Total air temperature is computed from the analog output of the TAT probe. TAT ranges from -60°C to +99°C.

(h) Impact pressure is derived from the difference between total pitot pressure and indicated static pressure. Its range is from 0 to 372.5 millibars.

(i) Total pressure is derived from the calibrated pitot pressure input that has been compensated for ambient temperature. The range is from 135.5 to 1354.5 millibars.

(j) GUI 115;
Two discrete lines from the AFCS mode control panel (MM 22-11-00) control the BARO No. 4 output. A pushbutton on the control panel selects either BARO No. 4 equal Baro No. 1 or No. 2.

(k) GUI 001-114, 116-999;
The BARO corrected altitudes are computed from pressure altitude and the BARO correction inputs (range -1000 to +50,000 feet). BARO corrected altitude No. 4 is provided for the autopilot and repeats BARO No. 3. Grounding pin D8 sets No. 4 BARO corrected altitude to use No. 3 BARO correction.

(l) BARO corrections No. 1, 2, and 3 are repeats of the BARO corrections received from the altimeters. Their range is from 745 to 1050 millibars or 22.00 to 31.00 in.

(m) The indicated angle of attack is either unique or averaged depending upon a program pin jumper. For unique AOA the No. 1 resolver input is used primarily for computation. The No. 2 resolver is used as a secondary input, in case of a No. 1 resolver failure. For averaged AOA the inputs are averaged from both No. 1 and No. 2 resolvers. The range is ±60°.

(n) Corrected angle of attack is not used on the airplane.

(o) Maximum allowable airspeed (Vmo) (display output) is computed from altitude, airspeed, MACH data, and stored Vmo reference data. Reference data for 16 airplane types is stored in memory. Selection of the correct reference data is made by the program jumper. Mmo is derived from Vmo reference data. The Vmo range is 150 to 450 knots.

(p) ADC maintenance words include BITE test fail/OK data.

(q) The overspeed discrete provides a switch closure when computed airspeed or MACH is greater than the maximum allowed. Detailed switch characteristics are covered later.

(16) BIT Fault Monitoring

(a) The ADC built-in-test (BIT) equipment uses software tests in combination with BIT hardware to detect ADC and input sensor failures. BIT tests are performed during the operational program.

(b) The BIT checks all input data, internal circuits, CPU operations and memory. It uses wrap-around tests to check the transmitter output. If the latter test fails for more than 2 seconds, ARINC transmissions are halted. After a failure and halt, one ARINC transmission is made every 5 seconds thereafter to do another wrap-around test. If any of these tests pass, ARINC transmissions are resumed.

(c) The results of the BIT tests are reported in maintenance words on the ADC output data bus. The results also set the sign status matrix in the binary outputs and inhibit the BCD output when a failure occurs. For detected ADC internal failures, the fault ball on the front of the ADC changes from black to yellow. In addition, the BIT logic will store in-flight failures into a fault memory. This information is used for bench maintenance.

(d) The BIT also checks that the operational program has executed all of the program that it should. If the program is not operating properly, the fault ball on the front of the ADC will turn to yellow. This fault will fail all outputs from the ADC.

(e) Once the fault ball is set, it cannot be reset until the fault causing the set condition has been corrected. Once that fault is cleared, the fault ball is reset by pressing the test button on the ADC front panel.

(17) Self-Test

(a) The self-test provides a confidence check of the ADC. The test can be initiated by pressing the functional test switch on the ADC or the AIR DATA CMPTR test switch on the P61 panel. To prevent erroneous test results, the self-test function cannot be initiated in flight by the AIR DATA CMPTR test switch on the P61 panel due to the air/ground logic.

(b) Caution must be exercised while using the ADC self test. If the pitot-static system is pressurized when the self test is activated, the ADC will enter an erroneous failure mode. The fault ball will show yellow and components receiving ADC data will display ADC failure. The failure mode can be correctecd by first returning the pitot-static system to ambient pressure, the fault is then cleared by pressing the ADC functional test button.

(c) The self-test indicates faults and sends canned outputs to the flight deck displays as shown in the ADC TEST INDICATIONS table.

NOTE: The external sensor fault indicator on the ADC front panel is not activated by the ADC test switch on the P61 panel.

(d) The following indications occur on the air data instruments during the ADC self-test.

NOTE: If the IRS is off, the vertical speed indicator (VSI) shows 0 FPM. If the IRS is on, the VSI fault flag shows after 3 seconds.

ADC TEST INDICATIONS			
TIME	OVERSPEED WARNINGS		
0-2 Sec	Half of the red OVERSPEED light comes on. The aural warnings sound and both master WARNING lights on the glareshield come on. A level A red OVERSPEED message is shown on the upper EICAS display.		
	AIRSPEED AND ALTITUDE INDICATIONS		
	MASI	ALTIMETER	EADI *[1]
	Airspeed pointer and counter, and MACH counter will drive up.	Drives up scale to 10,000 ft.	CAS drives to 419 knots. MACH drives to 0.75.
2-7 Sec	Airspeed pointer drives down scale. Airspeed and MACH flags are shown.		SPD and MACH flags are shown.
After 7 Sec	AS and MACH flags are retracted. AS pointer shows 137 knots. MACH drives below 0.4.	ALT shows 10,000 ft. (May take more than 7 sec.)	SPD and MACH flags are removed. MACH display drives below 0.38.

*[1] GUI 001-008, 010-114, 116-999

(e) The TAT display on the EICAS appears as follows during the ADC self-test:

NOTE: The thrust management computer (TMC) must be off. The EICAS computer selected must correspond (L or R) to the ADC being tested for the TAT display to appear during the ADC test.

1) During the first three seconds, the TAT display shows +35°C.
2) During the third to seventh seconds, the TAT display is blanked.
3) After seven seconds, the TAT display again reads +35°C.

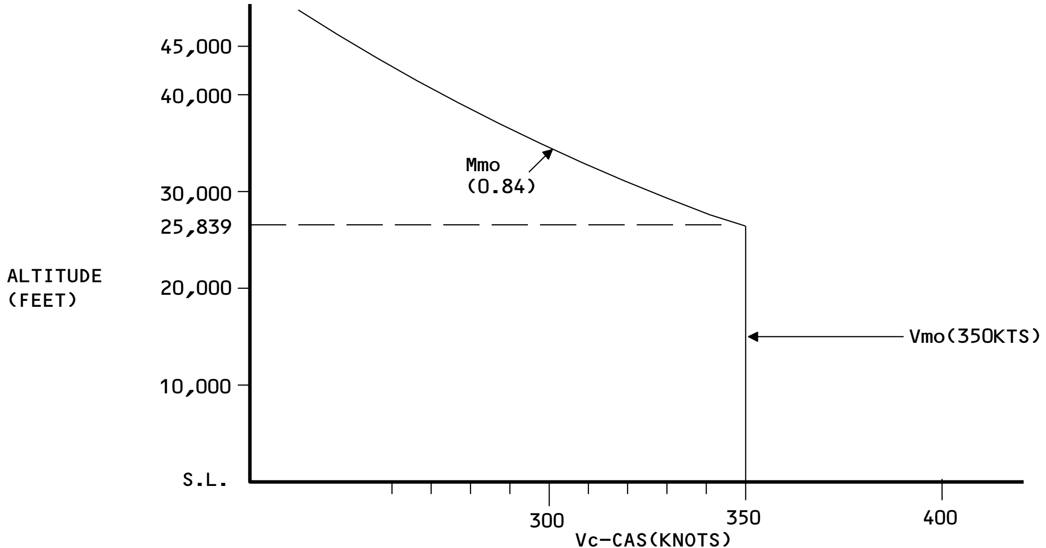
(f) A numeric display on the ADC front panel indicates external sensor failures, which do not set the ADC fault ball. It is activated when the self-test button on the front of the ADC is pushed. The readout indicates a BIT detected failure of external sensor data. Each digit represents a failure as shown.

0 - Spare
1 - No. 1-AOA synchro input
2 - No. 2-AOA synchro input
3 - SDI parity
4 - Spare
5 - TAT probe sensor resistance
6 - No. 1 Baro-correction synchro
7 - No. 2 Baro-correction synchro
8 - No. 3 Baro-correction synchro
9 - Aircraft type program
"-" - No fault detected

(g) If multiple faults should occur, the LED display will indicate the faults in numerical sequence, such as a 1 would be displayed first and a 9 last. When the first fault is corrected, then the next fault in numerical sequence will be displayed.

(18) MACH/Airspeed Warning Curve Characteristics (Fig. 3)

(a) The graph shows maximum allowed operating velocity and MACH. Unsafe operations are to the right of the curve.



NORMAL Vmo/Mmo OVERSPEED DISCRETE ACTIVATION POINTS
Vc≥356 ± 0.25 KNOTS
Mc≥0.8500 ± 0.0005 MACH

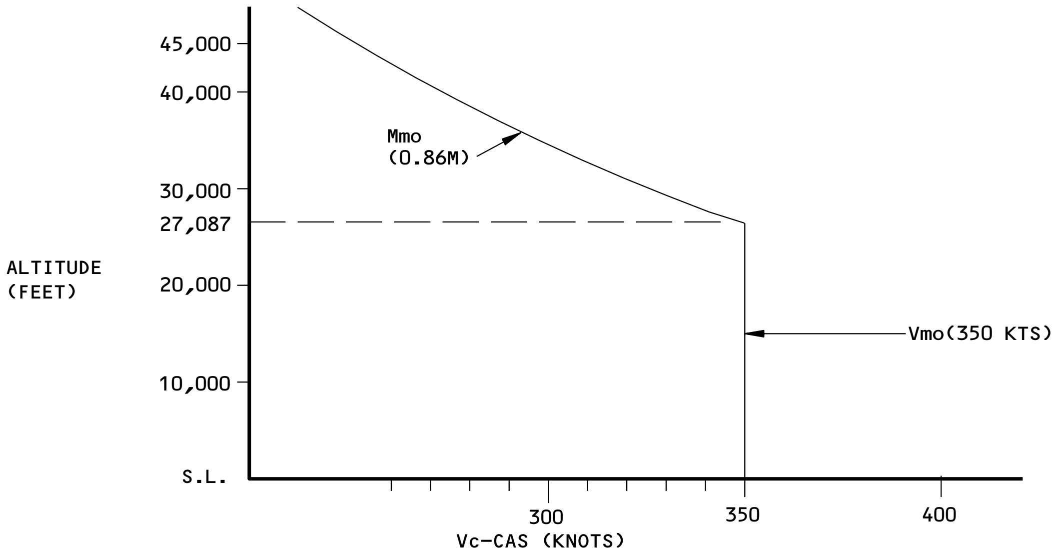
Vmo = MAX OPERATING AIRSPEED
Vc = COMPUTED AIRSPEED OUTPUT, OF ACTUATION POINT, KNOTS
Mc = MACH NUMBER OUTPUT OF ACTUATION POINT
Mmo = MAX OPERATING MACH

Maximum Operating Speed Schedule
Figure 3 (Sheet 1)

(b) Vmo/Mmo is a function of altitude and MACH number. The curve values are stored in computer memory and compared with computed airspeed and MACH.

(c) GUI 001-008, 010-999;
The airplane is MACH limited to .86M above 27,087 ft. For constant Mach, airspeed must decrease as altitude increases.

(d) GUI 009;
The airplane is MACH limited to .84M above 25,839 ft. For constant Mach, airspeed must decrease as altitude increases.



NORMAL Vmo/Mmo OVERSPEED DISCRETE ACTIVATION POINTS
Vc≥352 ± 0.25 KNOTS
Mc≥0.8630 ± 0.0005 MACH

Vmo = MAX OPERATING AIRSPEED
Vc = COMPUTED AIRSPEED OUTPUT, OF ACTUATION POINT, KNOTS
Mc = MACH NUMBER OUTPUT OF ACTUATION POINT
Mmo = MAX OPERATING MACH

Maximum Operating Speed Schedule
Figure 3 (Sheet 2)

(e) The ADC outputs an overspeed discrete when the computed airspeed reaches Vc +/-0.25 knots or Mach reaches Mc +/-0.0005 mach whichever is applicable. The overspeed discrete causes the siren aural warning to come on. The red master WARNING lights on the glareshield come on and the red OVSPD discrete warning indicator on the captain's panel lights. An overspeed message will also appear on the upper EICAS display.

(f) AIRPLANES POST SB 31-0068;
When a real or nuisance overspeed event occurs there is an an aural warning. To make the flight deck better for thought and communication during a long event, the flight crew may want to reset this warning.

(g) Once the ADC outputs an overspeed discrete, it will continue until the speed is reduced to Vmo ±0.25 kts, or Mmo ±0.0005 M, whichever is applicable.

B. Control

(1) There is no on-off switch for the ADCs. They are always on, provided their circuit breakers are closed.

(2) To check the ADC's do the following:

(a) Provide electrical power (Ref 24-22-00).

(b) Close the following overhead panel P11 circuit breakers:

1) 11A10, AIR DATA CMPTR LEFT
2) 11A11, AIR DATA AOA SENSOR LEFT
3) 11A12, AIR DATA BARO CORRECT LEFT
4) 11F30, AIR DATA CMPTR RIGHT
5) 11F31, AIR DATA AOA SENSOR RIGHT
6) 11F32, AIR DATA BARO CORRECT RIGHT

(c) Ensure that pitot-static system is at ambient (Ref 34-11-00).

(d) Press FUNCTIONAL TEST button on front of each ADC.

1) Check that a " - " appears in the EXTERNAL SENSOR FAULT display.
2) Check that ADC FAIL indicator shows black.

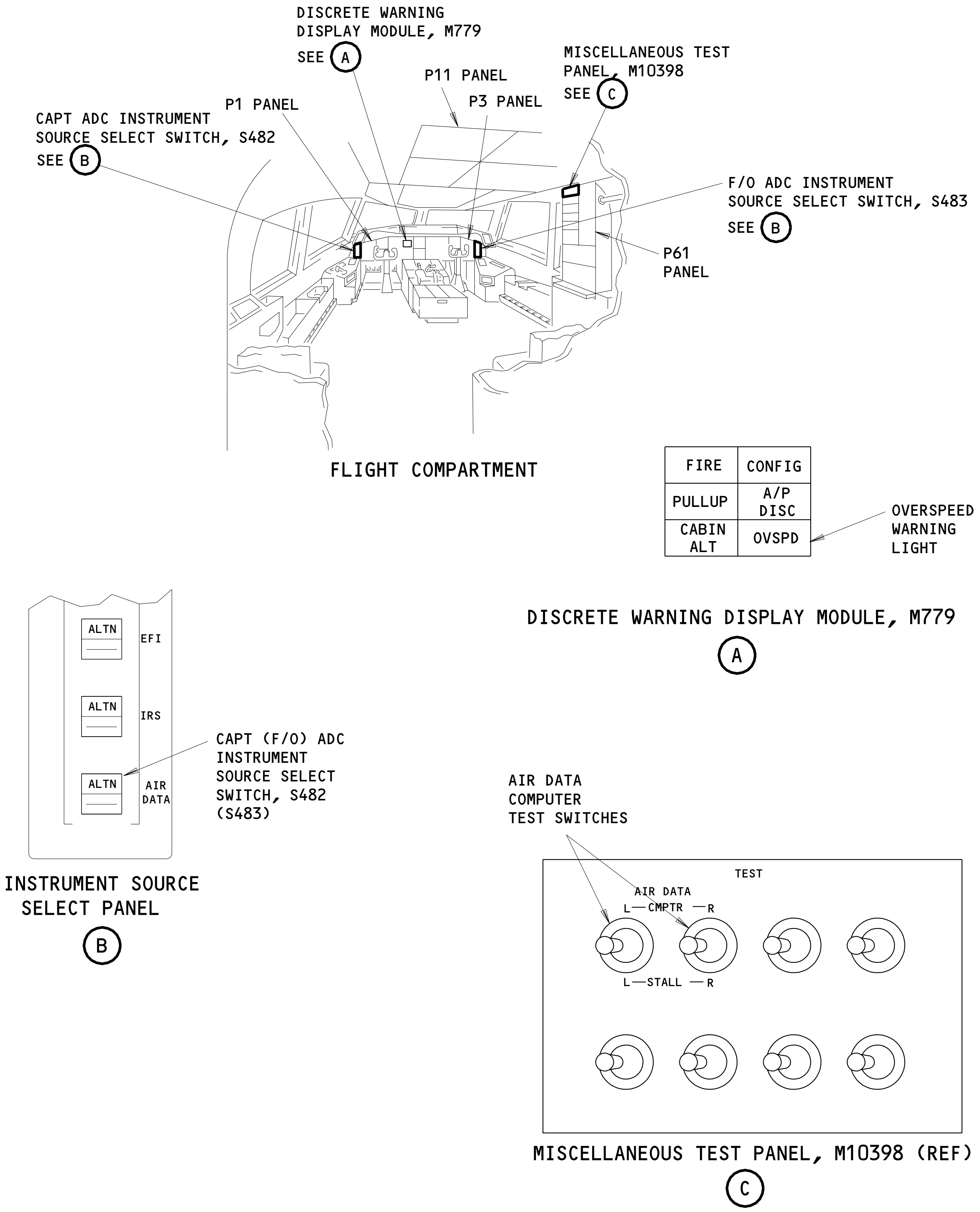
AIR DATA COMPUTING SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKERS	1		FLIGHT COMPARTMENT, P11	
AIR DATA AOA SENSOR LEFT, C1		1	11A11	*
AIR DATA AOA SENSOR RIGHT, C3		1	11F31	*
AIR DATA BARO CORRECT LEFT, C2		1	11A12	*
AIR DATA BARO CORRECT RIGHT, C4		1	11F32	*
AIR DATA CMPTR LEFT, C625		1	11A10	*
AIR DATA CMPTR RIGHT, C626		1	11F30	*
AIR DATA SOURCE SEL RELAY LEFT, C4664 [1]		1	11B4	*
AIR DATA SOURCE SEL RELAY RIGHT, C4665 [1]		1	11B5	*
COMPUTER - AIR DATA L, M100	2	1	119BL, MAIN EQUIPMENT CENTER, E2-1	34-12-01
COMPUTER - AIR DATA R, M101	2	1	119BL, MAIN EQUIPMENT CENTER, E2-2	34-12-01
MODULE - DISCRETE WARNING DISPLAY, M779	1	1	FLIGHT COMPARTMENT, P1-3	*
PANEL - (FIM 30-32-00/101) MISCELLANEOUS TEST, M10398				
PROBE - TOTAL AIR TEMPERATURE, TS5001	2	1	L SIDE FORWARD FUSELAGE	34-12-02
RELAY - LEFT AIR DATA SOURCE SELECT, K10802 [1]	2	1	119BL, MAIN EQUIPMENT CENTER, E2-4	
RELAY - RIGHT AIR DATA SOURCE SELECT, K10803 [1]	2	1	119BL, MAIN EQUIPMENT CENTER, E2-4	
RELAY - (FIM 31-01-36/101) SYS 1 AIR/GROUND, K148				
RELAY - (FIM 31-01-37/101) SYS 2 AIR/GROUND, K207				
SENSOR - ANGLE OF ATTACK L, TS12	2	1	L SIDE FUSELAGE NOSE	34-12-03
SENSOR - ANGLE OF ATTACK R, TS13	2	1	R SIDE FUSELAGE NOSE	34-12-03
SWITCH - CAPT ADC INSTR SOURCE SELECT, S482	1	1	FLIGHT COMPARTMENT, P1-1	*
SWITCH - F/O ADC INSTR SOURCE SELECT, S483	1	1	FLIGHT COMPARTMENT, P3-3	*
TRANSFORMER - (FIM 31-01-36/101) AIR DATA COMPUTER L, T139				
TRANSFORMER - (FIM 31-01-37/101) AIR DATA COMPUTER R, T140				

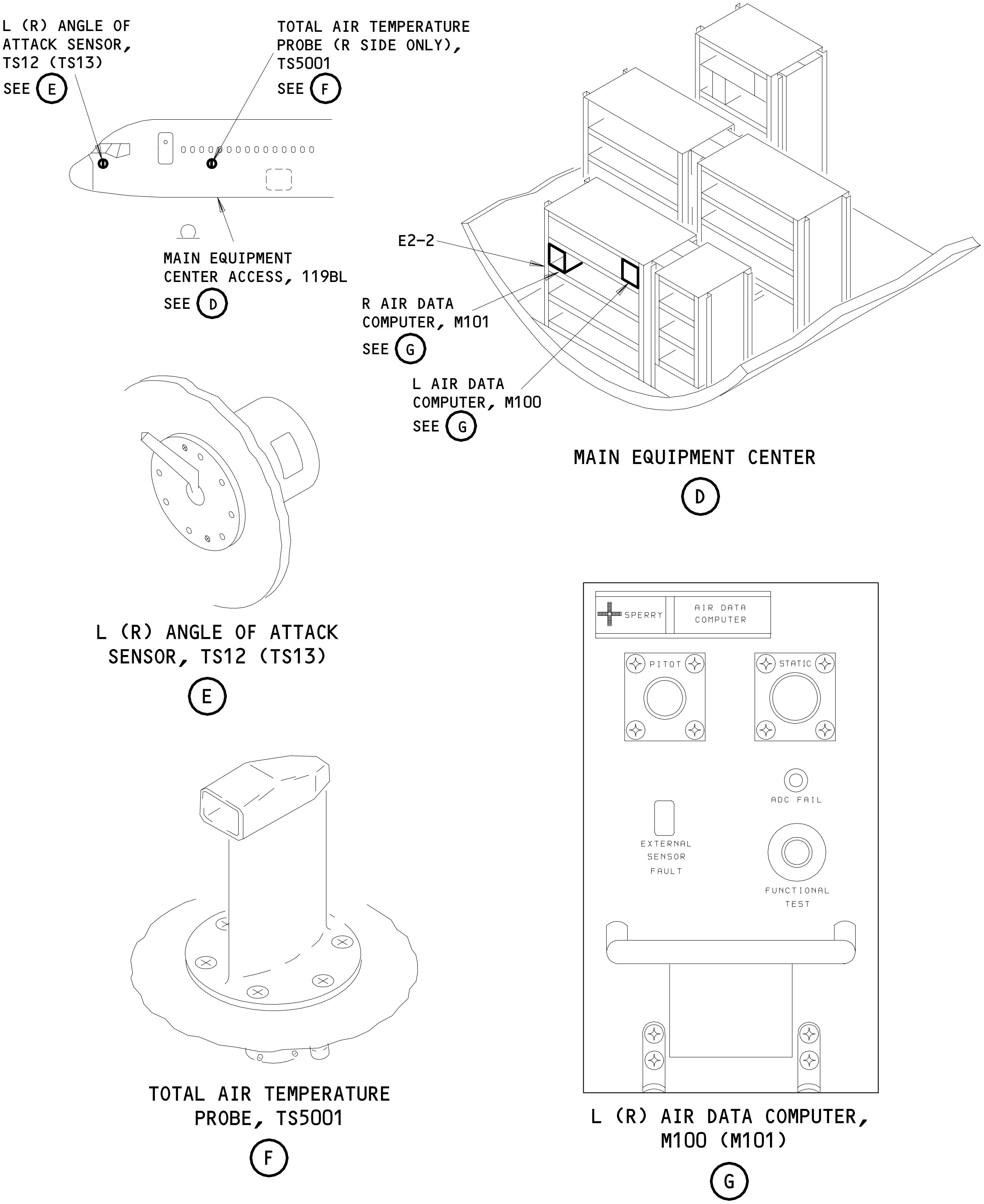
* SEE THE WDM EQUIPMENT LIST

[1] AIRPLANES POST-SB 34-0222

Air Data Computing System - Component Index
Figure 101



Component Location
Figure 102 (Sheet 1)



MAIN EQUIPMENT CENTER
D

L (R) ANGLE OF ATTACK SENSOR, TS12 (TS13)
E

TOTAL AIR TEMPERATURE PROBE, TS5001
F

L (R) AIR DATA COMPUTER, M100 (M101)
G

Component Location
Figure 102 (Sheet 2)

AIR DATA COMPUTING SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure contains two tasks. The first procedure is an operational test and the second procedure is a system test. The operational test uses the air data computer (ADC) bite test to make sure the basic air data system operates. The system test is done after the operational test is completed and it is necessary to use external equipment.
   B. The operational and system tests also make sure the electric air data instruments (34-13-00) operate. While the test is run, these devices show the output. The total function and precision of the system from input to output is tested at one time.

TASK 34-12-00-715-001

2. Operational Test - Air Data Computing System
   A. General
      (1) The operational test is the self-test mode of air data computer system. This test will make sure of the conditions that follow:
         - the air data computer modules function correctly.
         - the interface and failure warning system between computers and air data instruments operates correctly.
         - the air data instruments operate from input signals without internal failures.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   C. Access
      (1) Location Zones
         211/212 Flight Compartment

   D. Prepare for Test

      S 865-002
      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-003
      (2) Make sure the two F/D switches on the MCP are in the OFF position.

      S 865-004
      (3) Make sure these circuit breakers on the overhead panel P11 are closed:
         (a) 11A8, STBY ALTM VIB
         (b) 11A10, AIR DATA CMPTR LEFT
         (c) 11A11, AIR DATA AOA SENSOR LEFT
         (d) 11A12, AIR DATA BARO CORRECT LEFT
         (e) 11A32, INDICATOR LIGHTS 1
         (f) 11A33, INDICATOR LIGHTS 2
         (g) 11A34, INDICATOR LIGHTS 3
         (h) 11B16, AURAL WARN SPKR LEFT
         (i) 11B18, WARN ELEX B
         (j) 11C30, LANDING GEAR POS SYS 1
         (k) 11E1, IAS MACH LEFT

(l) 11E2, ALTM LEFT
(m) 11E5, VSI LEFT
(n) 11E8, FMCS CDU LEFT
(o) 11E9, FMCS CMPTR LEFT
(p) 11E22, IAS MACH RIGHT
(q) 11E23, ALTM RIGHT
(r) 11E26, VSI RIGHT
(s) 11E29, FMCS CDU RIGHT
(t) 11E30, FMCS CMPTR RIGHT
(u) 11F30, AIR DATA CMPTR RIGHT
(v) 11F31, AIR DATA AOA SENSOR RIGHT
(w) 11F32, AIR DATA BARO CORRECT RIGHT
(x) 11H35, AURAL WARN SPKR RIGHT
(y) 11J2, EICAS CMPTR LEFT
(z) 11J3, EICAS UPPER DISPLAY
(aa) 11J29, EICAS CMPTR RIGHT
(ab) 11J30, EICAS LOWER DISPLAY
(ac) 11J31, EICAS DSPL SW
(ad) 11J32, EICAS DISPLAY SELECT
(ae) 11J33, WARN ELEX A
(af) 11S15, AIR/GND SYS 1
(ag) 11S19, AIR/GND SYS 2
(ah) 11S23, POS SYS 2

S 865-005

(4) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
(a) 11F14, TMC AC
(b) 11F15, TMC DC

S 865-006

(5) On the select panel of the EICAS display, (P9), set the COMPUTER select switch to the L position.

E. Procedure

S 865-007

(1) Make sure the fault ball indicator, ADC FAIL, on the front panel of each ADC shows black.

S 725-008

(2) Push the FUNCTIONAL TEST button on the front panel of each ADC. Make sure the numeric display on each ADC front panel shows a dash (-) when the test switch is pushed.

NOTE: Do not push the ADC test switch(es) while the pitot-static system is pressurized. The ADC will go into a fault condition in error and report this incorrect fault condition to its interface systems. To clear this fault, do the steps that follow:
- Put the pitot-static system to ambient pressure.
- Push the ADC test switch to reset the ADC.

S 865-009

(3) Make sure the ADC alternate select switches on the capt's and F/O's instrument panel are not set to ALTN.

S 705-010

(4) On the P61 miscellaneous test panel, set the AIR DATA CMPTR - L test switch to the up position and hold. Make sure of the indications given in the table that follows. Use the left half of the OVERSPEED light and use the Captain's instruments.

<u>NOTE</u>: If the IRS is off, make sure the vertical speed indicator (VSI) shows 0 FPM. If the IRS is on, make sure the VSI fault flag shows after 3 seconds.

ADC TEST INDICATIONS			
TIME	OVERSPEED WARNINGS		
0-2 Sec	Half of the red OVERSPEED light comes on. The aural warnings sound and both master WARNING lights on the glareshield come on. A level A red OVERSPEED message is shown on the upper EICAS display.		
	AIRSPEED AND ALTITUDE INDICATIONS		
	MASI	ALTIMETER *[2]	EADI *[1]
	Airspeed pointer and counter, and MACH counter will drive up.	Drives up scale to 10,000 ft.	CAS drives to 419 knots. MACH drives to 0.75.
2-7 Sec	Airspeed pointer drives down scale. Airspeed and MACH flags are shown.		SPD and MACH flags are shown.
After 7 Sec	AS and MACH flags are retracted. AS pointer shows 137 knots. MACH drives below 0.4.	ALT shows 10,000 ft. (May take more than 7 sec.)	SPD and MACH flags are removed. MACH display drives below 0.38.

*[1] GUI 001-008, 010-114, 116-999

*[2] GUI 010, 011 POST-SB 34-166;
Metric altimeter will drive to 3048 meters.

(a) The TAT display on the EICAS shows as follows during the ADC self-test:

NOTE: The thrust management computer (TMC) must be off. The EICAS computer must agree with (L or R) the ADC. Open the TMC CBs to turn off the TMC (Ref step 2.C.(3)).

1) During the first three seconds, the TAT display shows +35°C.
2) Between the third to seventh seconds, the TAT display goes out of view.
3) After seven seconds, the TAT display again shows +35-C.

(b) If the IRS is off, make sure the vertical speed indicator (VSI) shows 0 FPM. If the IRS is on, make sure the VSI fault flag shows after 3 seconds. The VSI fault flag must be shown on the VSI until the test switch is released.
(c) Release the switch.

S 705-011

(5) Do the test on the F/O's system as follows:
(a) On the EICAS display select panel, set the COMPUTER select switch to R.
(b) On the P11 panel, open the AIR DATA CMPTR-LEFT (11A10) circuit breaker.

NOTE: The left ADC must be off to permit the values of the R ADC to show.

(c) On the P61 miscellaneous test panel, set the AIR DATA CMPTR - R test switch to the up position and hold.
1) Make sure of the indications given in the ADC TEST INDICATIONS table. Use the right half of the OVERSPEED light and use the F/O's instruments.

F. Put the Airplane Back to Its Usual Condition

S 865-098

(1) Close these circuit breakers on the P11 panel and remove DO-NOT-CLOSE tags (where applicable):
(a) 11A10, AIR DATA CMPTR LEFT
(b) 11F14, TMC AC
(c) 11F15, TMC DC

S 865-099

(2) On the EICAS display select panel, set the COMPUTER switch to AUTO.

S 865-100

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-12-00-735-013

3. System Test - Air Data Computing System

A. General

- (1) The system test makes sure of the conditions that follow:
  - (a) AIRPLANES WITH POST-SB 34-0222;
    The IAS DISAGREE and ALT DISAGREE EICAS caution messages are correctly switched and displayed.
  - (b) The two temperature sensing systems are accurate for at least one temperature.
  - (c) The air data instruments give accurate values of computed and raw air data over a range of data points.
  - (d) The pressure transducers in the computers and air data instruments function accurately.
- (2) The main equipment center and the flight compartment must have an air temperature of 25°C ±5°C and relative humidity of less than 85%. Use equipment cooling air (Ref 21-58-00) and flight deck temperature control (Ref 21-61-00) to get these conditions.

B. Equipment

- (1) Angular displacement measuring tool, J34002-1
- (2) Pitot Static Pressure Controller, Smiths Industries 3006KTQ1 or equivalent
- (3) Air Data Tester, Smith Industries 3207KTQ1 or equivalent, or EPR Test Set, Smiths Industries 3204KTQ1
- (4) Air Data Accessory Kit, Navaids ADA757-612
- (5) Data Bus Analyzer
  - (a) 429EB JcAIR Instrumentation (preferred)
    400 Industrial Parkway,
    Industrial Airport, KS 66031
  - (b) 429-2, Interface Technology (optional)
    150 E. Arrow Highway,
    San Dimas, CA 91773
- (6) Thermometer - 10° to +40°C ±0.5°C, Wekslar
- (7) Angular displacement measuring tool, A34012-24 (Prefered).

(8) Angular displacement measuring tool - J34002-1 (Alternative).

C. References
  (1) AMM 24-22-00/201, Electrical Power - Control
  (2) AMM 34-11-00/201, Pitot Static System
  (3) AMM 49-11-00/201, Auxiliary Power Unit

D. Access
  (1) Location Zones
    211/212 Flight Compartment

E. Prepare for Test

S 865-014
(1) Supply electrical power (AMM 24-22-00/201).

S 865-015
(2) Make sure these circuit breakers on the P11 panel are closed:
  (a) 11A8, STBY ALTM VIB
  (b) 11A10, AIR DATA CMPTR LEFT
  (c) 11A11, AIR DATA AOA SENSOR LEFT
  (d) 11A12, AIR DATA BARO CORRECT LEFT
  (e) 11A32, INDICATOR LIGHTS 1
  (f) 11A33, INDICATOR LIGHTS 2
  (g) 11A34, INDICATOR LIGHTS 3
  (h) 11C30, LANDING GEAR POS SYS 1
  (i) 11E1, IAS MACH LEFT
  (j) 11E2, ALTM LEFT
  (k) 11E5, VSI LEFT
  (l) GUI 010, 011 POST-SB 34-166;
      11E7, METRIC ALTM
  (m) 11E8, FMCS CDU LEFT
  (n) 11E9, FMCS CMPTR LEFT
  (o) 11E22, IAS MACH RIGHT
  (p) 11E23, ALTM RIGHT
  (q) 11E26, VSI RIGHT
  (r) 11E29, FMCS CDU RIGHT
  (s) 11E30, FMCS CMPTR RIGHT
  (t) 11F14, TMC AC
  (u) 11F15, TMC DC
  (v) 11F30, AIR DATA CMPTR RIGHT
  (w) 11F31, AIR DATA AOA SENSOR RIGHT
  (x) 11F32, AIR DATA BARO CORRECT RIGHT
  (y) 11J2, EICAS CMPTR LEFT
  (z) 11J3, EICAS UPPER DISPLAY
  (aa) 11J29, EICAS CMPTR RIGHT
  (ab) 11J30, EICAS LOWER DISPLAY
  (ac) 11J31, EICAS DSPL SW
  (ad) 11J32, EICAS DISPLAY SELECT
  (ae) 11S15, AIR GND SYS 1
  (af) 11S19, AIR/GND SYS 2
  (ag) 11S23, POS SYS 2

S 865-125

(3) AIRPANES WITH POST-SB 34-0222;
Make sure these circuit breakers on the P11 panel are closed:
- (a) 11B4, AIR DATA SOURCE SEL RELAY RIGHT
- (b) 11B5, AIR DATA SOURCE SEL RELAY LEFT

S 865-130

(4) AIRPLANES WITH POST-SB 34-0222;
Open these circuit breakers on the P11 panel and install DO-NOT-CLOSE tags:
- (a) 11F5, RAD ALTM L
- (b) 11F20, RAD ALTM C
- (c) 11F26, RAD ALTM R

S 865-019

WARNING: MAKE SURE YOU OPEN THE RAT AUTO PWR CIRCUIT BREAKER BEFORE YOU DO THE PITOT-STATIC TEST. IF YOU DO NOT AND A PITOT-STATIC DIFFERENTIAL PRESSURE EQUAL TO 80 KNOTS IS APPLIED WITH BOTH ENGINES OFF, THE RAT WILL DEPLOY. THIS COULD CAUSE INJURY TO PERSONS.

(5) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
- (a) 11D27, HYDRAULIC RAT AUTO PWR

S 865-023

WARNING: MAKE SURE ALL PITOT, TAT AND AOA PROBE HEAT IS OFF. THIS WILL PREVENT BAD BURNS.

(6) Open these circuit breakers on the panel P6 and install DO-NOT-CLOSE tags:
- (a) PITOT PROBE HEAT (8)
- (b) 6L17, L AOA HEAT
- (c) 6L23, R AOA HEAT
- (d) 6L24, TAT PROBE HEAT

S 735-025

(7) Do the ADC System Operational Test (Ref paragraph 2).

S 865-027

(8) Set the left AOA vane to 0 degrees ± 0.5.

S 865-028

(9) Set the right AOA vane to 0 degrees ± 0.5.

S 865-031

(10) Make sure the Capt's and F/O's ADC select switches on capt's and F/O's instrument panels are not set to ALTN.

F. ADC System Test (Fig. 501)

S 705-032

(1) To test the capt's (left) ADC system do the steps that follow,
   - (a) Open this circuit breaker on the P11 panel:
     - 1) 11A10, AIR DATA CMPTR LEFT
   - (b) Make sure the Capt's altimeter and mach airspeed indicator have their failure flags in view.
   - (c) GUI 001-008, 010-114, 116-999;
     Make sure the Capt's EADI has its failure flag in view.
   - (d) Push the Capt's ADC select switch to ALTN. Make sure the ALTN display is in view on the switch. Also make sure the failure flags do not show.
   - (e) Close this circuit breaker on the P11 panel:
     - 1) 11A10, AIR DATA CMPTR LEFT
   - (f) Set capt's ADC select switch to normal and see that no failure flags are in view. Make sure that no VMO barber poles on the mach airspeed indicator point to 347 ±2 Kts.

S 705-033

(2) To do a test of the F/O's (right) ADC system, do the steps that follow:
   - (a) Open this circuit breaker on the P11 panel:
     - 1) 11F30, AIR DATA CMPTR RIGHT
   - (b) Make sure the F/O's altimeter and mach airspeed indicator have their failure flags in view.
   - (c) GUI 001-008, 010-114, 116-999;
     Make sure the F/O's EADI has its failure flag in view.
   - (d) Push the F/O's ADC select switch to ALTN. Make sure the ALTN display is in view on the switch. Also make sure the failure flags do not show.
   - (e) Close this circuit breaker on the P11 panel:
     - 1) 11F30, AIR DATA CMPTR RIGHT
   - (f) Set F/O's ADC select switch to normal and make sure that no failure flags are in view. Make sure the VMO barberpoles on the mach airspeed indicator point to 347 -2 Kts.

S 865-127

(3) AIRPLANES WITH POST-SB 34-0222;
Do these steps to test the IAS DISAGREE and the ALT DISAGREE EICAS messages:

(a) Set the BARO correction knobs to 29.92 inches Hg on the captain's and first officer's altimeters.
(b) Make sure the ADC select switches on the captain's and first officer's instrument panels are not set to ALTN.
(c) Set the static and pitot pressures equivalent to these altitudes and airspeeds (AMM 34-11-00/201):
    1) 5000 feet and 250 knots for the captain's air data computer.
    2) 5210 feet and 256 knots for the first officer's air data computer.
(d) Make sure the EICAS messages IAS DISAGREE and ALT DISAGREE are shown.
(e) Set the captain's ADC select switch to ALTN.
    1) Make sure ALTN is shown on the switch.
    2) Make sure the EICAS messages IAS DISAGREE and ALT DISAGREE are not shown.
(f) Set the captain's ADC select switch to normal.
    1) Make sure ALTN is not shown on the switch.
(g) Set the first officer's ADC select switch to ALTN.
    1) Make sure ALTN is shown on the switch.
    2) Make sure the EICAS messages IAS DISAGREE and ALT DISGREE are not shown.
(h) Set the captain's air data source select switch to ALTN.
    1) Make sure ALTN is shown on the switch.
    2) Make sure the EICAS messages IAS DISAGREE and ALT DISAGREE are shown.
(i) Set the static and pitot pressures equivalent to 5150 feet and 252 knots to the first officer's air data computer.
(j) Set the captain's air data source select switch to normal.
    1) Make sure ALTN is not shown on the switch.
(k) Set the first officer's air data source select switch to normal.
    1) Make sure ALTN is not shown on the switch.
    2) Make sure the EICAS messages IAS DISAGREE and ALT DISAGREE are not shown.

S 865-034

(4) Set the pressure to 20.452 in. Hg. for the Captain's and F/O's Ps (Static) lines. Set the pressure to 23.067 in. Hg. for the Captain and F/O's Pt (pitot) lines (AMM 34-11-00/201).

S 865-107

(5) Set BARO set knob on captain's and first officer's altimeters to the values that follow. Make sure the altitude, airspeed, MACH, and Vmo shown on the altimeters, EADIs (as applicable), and mach/airspeed indicators are as shown below.

BARO SETTING (in Hg)	ALTITUDE (ft)	MACH	Vmo	COMPUTED AIRSPEED (Kts)
30.71	10,721 +/- 30	.407+/-.01	347+/-2.5	225+/-3
29.92	10,000 +/- 30	.407+/-.01	347+/-2.5	225+/-3
29.12	9,251 +/- 30	.407+/-.01	347+/-2.5	225+/-3

S 705-037

(6) To do a test of the capt's (left) ADC system, do the step that follows:
  (a) Keep the captain's BARO set control at 29.12 and set the first officer's BARO set control at 29.92.

S 705-038

(7) To do a test of the F/O's (right) ADC system, do the step that follows:
  (a) Keep the first officer's BARO set control at 29.12 and set the captain's BARO set control at 29.92.

S 865-103

(8) GUI 115;
set the baro set control on the standby altimeter to 30.99 in Hg.

S 865-041

(9) Apply pneumatic air to the TAT probe as follows:

NOTE: Bleed air cooling is required for this test only if the TAT probe casing is in the sunlight.

  (a) Turn on the APU (AMM 49-11-00/201).

WARNING: DO NOT TOUCH THE TAT PROBE WHEN PNEUMATIC POWER IS APPLIED TO THE TAT PROBE. THIS WILL PREVENT BAD BURNS.

  (b) Push the APU VALVE switch light to ON on the P-5 overhead panel.

S 705-043

(10) To do a test of the Captain's system, do the steps that follow:
  (a) Attach probe A of the ARINC 429 data/bus reader to the Burndy block Z118, TB201 on the E2-1 shelf.
  (b) Attach probe B to the Burndy block Z117, TB201 on the E2-1 shelf.
  (c) Make sure the data bus reader shows the values on the table that follows in decimal format.

S 705-044

(11) To do a test of the first officer's system, do the steps that follow:

(a) Attach probe A of the ARINC 429 receiver/bus reader to the Burndy block Z114, TB203 on the E2-2 shelf.

(b) Attach probe B to the Burndy block Z113, TB203 on the E2-2 shelf.

(c) Make sure the data bus reader shows the values on the table that follows in decimal format.

(d) GUI 001-114, 116-999;
Refer to the table that follows:

PARAMETER	OCTAL LABEL		DATA
	CAPTAIN ADC OUTPUT	FIRST OFFICER ADC OUTPUT	
Baro Altitude No. 1	N.A.	204	10,000 ±30
Baro Altitude No. 2	220	N.A.	10,000 ±30
Baro Altitude No. 3	251*[2]	251*[2]	9,251 ±30
Baro Altitude No. 4	252*[2]	252*[2]	9,251 ±30
Total Air Temp	211	211	*[1]

*[1] Put a thermometer adjacent to each total temperature probe, and keep wind and sunlight away. After the thermometer has become stable, measure the temperature. Make sure the data is ±3.0°C of the measured ambient air temperature for the left TAT probe.

*[2] If octal labels 251 and 252 are read as "Distance to go" and "Time to go", these labels must be read in binary. Then Binary to decimal conversion is necessary to get the decimal value in feet. Refer to Fig. 501.

N.A. = Not Applicable

BINARY TO DECIMAL CONVERSION TABLE

DECIMAL VALUE (Ft)	SSM 31	30	SIGN 29	BINARY FORMAT DATA FIELD 28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	SDI 10	9 BIT NO.
11,005	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	1	0	1	D	D	D
11,004	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	1	0	0	D	D	D
11,003	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	0	1	1	D	D	D
11,002	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	0	1	0	D	D	D
11,001	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	0	0	1	D	D	D
11,000	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	D	D	D
10,999	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	1	1	1	D	D	D
10,998	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	1	1	0	D	D	D
10,997	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	1	0	1	D	D	D
10,996	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	1	0	0	D	D	D
10,995	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	1	1	D	D	D
10,994	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	1	0	D	D	D
10,993	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	0	1	D	D	D
10,992	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	0	0	D	D	D
10,991	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	1	1	D	D	D
10,990	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	1	0	D	D	D
10,989	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	0	1	D	D	D
10,988	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	0	0	D	D	D
10,987	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	0	1	1	D	D	D
10,986	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	0	1	0	D	D	D
10,985	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	0	0	1	D	D	D
10,984	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	0	0	0	D	D	D
10,983	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	1	1	1	D	D	D
10,982	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	1	1	0	D	D	D
10,981	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	1	0	1	D	D	D
10,980	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	1	0	0	D	D	D
10.979	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	0	1	1	D	D	D
10,978	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	0	1	0	D	D	D
10,977	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	1	D	D	D
10,976	D	D	0	0	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	0	D	D	D
10,975	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	1	1	1	D	D	D
10,974	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	1	1	0	D	D	D
10.973	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	1	0	1	D	D	D
10,972	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	1	0	0	D	D	D
10,971	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	0	1	1	D	D	D
10,970	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	0	1	0	D	D	D
10,969	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	D	D	D
10,968	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	1	0	0	0	D	D	D
10,967	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	1	1	1	D	D	D
10,966	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	1	1	0	D	D	D
10,965	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	1	0	1	D	D	D
10,964	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	1	0	0	D	D	D
10,963	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	1	1	D	D	D
10,962	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	1	0	D	D	D
10,961	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	0	1	D	D	D
10,960	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	0	0	D	D	D
10,959	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	1	D	D	D
10,958	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	D	D	D
10,957	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	1	D	D	D
10,956	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	D	D	D
10,955	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	1	1	D	D	D
10,954	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	1	0	D	D	D
10,953	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	1	D	D	D
10,952	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	D	D	D

ADC Adjustment Test - Binary to Decimal Conversion Table
Figure 501 (Sheet 1)

BINARY TO DECIMAL CONVERSION TABLE

DECIMAL VALUE	SSM		SIGN	BINARY FORMAT DATA FIELD																		SDI		
(Ft)	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	BIT NO.
10,951	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	1	1	1	D	D	D	
10,950	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	1	1	0	D	D	D	
10,949	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	1	0	1	D	D	D	
10,948	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	1	0	0	D	D	D	
10,947	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	0	1	1	D	D	D	
10,946	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	0	1	0	D	D	D	
10,945	D	D	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	D	D	D	
10,030	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	1	1	0	0	D	D	
10,029	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	1	D	D	D	
10,028	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	D	D	D	
10,027	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	0	1	1	D	D	D	
10,026	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	0	1	0	D	D	D	
10,025	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	0	0	1	D	D	D	
10,024	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	0	0	0	D	D	D	
10,023	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	1	1	1	D	D	D	
10,022	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	1	1	0	D	D	D	
10,021	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	1	0	1	D	D	D	
10,020	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	1	0	0	D	D	D	
10,019	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	0	1	1	D	D	D	
10,018	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	0	1	0	D	D	D	
10,017	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	0	0	1	D	D	D	
10,016	D	D	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	0	0	0	D	D	D	
10,015	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	1	1	1	D	D	D	
10,014	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	1	1	0	D	D	D	
10,013	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	1	0	1	D	D	D	
10,012	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	1	0	0	D	D	D	
10,011	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	0	1	1	D	D	D	
10,010	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	0	1	0	D	D	D	
10,009	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	0	0	1	D	D	D	
10,008	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	1	0	0	0	D	D	D	
10,007	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	1	1	D	D	D	
10,006	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	1	0	D	D	D	
10,005	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	0	1	D	D	D	
10,004	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	0	0	D	D	D	
10,003	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	1	1	D	D	D	
10,002	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	1	0	D	D	D	
10,001	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	1	D	D	D	
10,000	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	D	D	D	
9,999	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	D	D	D	
9,998	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	1	0	D	D	D	
9,997	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	1	D	D	D	
9,996	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	0	D	D	D	
9,995	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0	1	1	D	D	D	
9.994	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0	1	0	D	D	D	
9,993	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0	0	1	D	D	D	
9,992	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	D	D	D	
9,991	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	1	1	D	D	D	
9,990	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	1	0	D	D	D	
9,989	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	0	1	D	D	D	
9,988	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	0	0	D	D	D	
9,987	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	1	D	D	D	
9,986	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	0	D	D	D	
9,985	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	D	D	D	

ADC Adjustment Test - Binary to Decimal Conversion Table
Figure 501 (Sheet 2)

BINARY TO DECIMAL CONVERSION TABLE

DECIMAL VALUE (Ft)	SSM		SIGN	BINARY FORMAT DATA FIELD																		SDI	
BIT NO.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
9,984	D	D	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	D	D	D
9,983	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	1	D	D	D
9,982	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0	D	D	D
9,981	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	0	1	D	D	D
9,980	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	0	0	D	D	D
9,979	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	1	D	D	D
9,978	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0	D	D	D
9,977	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	0	1	D	D	D
9,976	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	0	0	D	D	D
9,975	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	1	1	1	D	D	D
9,974	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	1	1	0	D	D	D
9,973	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	1	0	1	D	D	D
9,972	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	1	0	0	D	D	D
9,971	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	0	1	1	D	D	D
9,970	D	D	0	0	0	0	1	0	0	1	1	0	1	1	1	1	0	0	1	0	D	D	D
9,281	D	D	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	D	D	D
9,280	D	D	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	D	D	D
9,279	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	1	1	D	D	D
9,278	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0	D	D	D
9,277	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	1	D	D	D
9,276	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	0	D	D	D
9,275	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	1	1	D	D	D
9,274	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	1	0	D	D	D
9,273	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	1	D	D	D
9,272	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	D	D	D
9,271	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	1	1	D	D	D
9,270	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	1	0	D	D	D
9,269	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	1	D	D	D
9,268	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	D	D	D
9,267	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	1	D	D	D
9,266	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	D	D	D
9,265	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	1	D	D	D
9,264	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	D	D	D
9,263	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	1	1	D	D	D
9,262	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	1	0	D	D	D
9,261	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	1	D	D	D
9,260	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	D	D	D
9,259	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	1	1	D	D	D
9,258	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	1	0	D	D	D
9,257	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	1	D	D	D
9,256	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	D	D	D
9,255	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	1	D	D	D
9,254	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	0	D	D	D
9,253	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	D	D	D
9,252	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	D	D	D
9,251	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	1	D	D	D
9,250	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	D	D	D

ADC Adjustment Test - Binary to Decimal Conversion Table
Figure 501 (Sheet 3)

BINARY TO DECIMAL CONVERSION TABLE

DECIMAL VALUE	SSM		SIGN	BINARY FORMAT DATA FIELD																		SDI	
(Ft)	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9 BIT NO.
9,249	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	D	D	D
9,248	D	D	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	D	D	D
9,247	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	D	D	D
9,246	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	0	D	D	D
9,245	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1	D	D	D
9,244	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	D	D	D
9,243	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1	D	D	D
9,242	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	D	D	D
9,241	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	1	D	D	D
9,240	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	D	D	D
9,239	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1	1	D	D	D
9,238	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1	0	D	D	D
9,237	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	1	D	D	D
9,236	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	D	D	D
9,235	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	D	D	D
9,234	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	D	D	D
9,233	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	D	D	D
9,232	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	D	D	D
9,231	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	D	D	D
9,230	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	0	D	D	D
9,229	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	D	D	D
9,228	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	D	D	D
9,227	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	1	D	D	D
9,226	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	0	D	D	D
9,225	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	D	D	D
9,224	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	D	D	D
9,223	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	D	D	D
9,222	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	D	D	D
9,221	D	D	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	D	D	D

D = DO NOT CARE

<u>INSTRUCTIONS</u>: FIND THE BINARY VALUE IN THE "BINARY FORMAT" SECTION THAT IS DISPLAYED ON THE TEST SET. READ ACROSS TO OBTAIN ITS DECIMAL EQUIVALENCE.

ADC Adjustment Test - Binary to Decimal Conversion Table
Figure 501 (Sheet 4)

(e) GUI 115;
Refer to the table that follows:

PARAMETER	OCTAL LABEL		DATA
	CAPTAIN ADC OUTPUT	FIRST OFFICER ADC OUTPUT	
Baro Altitude No. 1	N.A.	204	10,000 ±30
Baro Altitude No. 2	220	N.A.	10,000 ±30
Baro Altitude No. 3	251*[2]	251*[2]	10,975 ±30
Total Air Temp	211	211	*[1]

*[1] Put a thermometer adjacent to each total temperature probe, and keep wind and sunlight away. After the thermometer has become stable, measure the temperature. Make sure the data is -3.0-C of the measured ambient air temperature for the left TAT probe.

*[2] If octal label 251 is read as "distance to go" the label must be read in binary. Then binary to decimal conversion is necessary to get the decimal value in feet. Refer to Fig. 501.

N.A. = Not Applicable

S 865-095
(12) GUI 115;
Set the Baro select switch on the autopilot mode control in the BARO L position.

S 705-096
(13) GUI 115;
To do a test of the Captain's system, do the steps that follow:
(a) Attach probe A of the ARINC 429 data/bus reader to the Burndy block Z118, TB201 on the E2-1 shelf.
(b) Attach probe B to Burndy block Z117, TB201 on the E2-1 shelf.
(c) Make sure the data/bus reader shows the values on the table the that follows in decimal format.

S 705-105
(14) GUI 115;
To do a test of the first officer's system, do the steps that follow:
(a) Attach probe A of the ARINC 429 data/bus reader to the Burndy block Z114, TB203 on the E2-2 shelf.
(b) Make sure the data/bus reader shows the values on the table that follows in decimal format.

PARAMETER	OCTAL LABEL	DATA		TOLERANCE
		CAPTAIN	F/O	
Baro Altitude No. 1	204	9,251	10,000	±30 Feet
Baro Altitude No. 4	252 *[1]	9,251	10,000	±30 Feet

*[1] If the octal label 252 is read as "Time to go", the label must be read in binary. Then binary to decimal conversion is necessary to get the decimal value in feet. Refer to Fig. 501.

S 865-050

(15) If pneumatic air has been applied to the TAT probe for this test do the steps that follow:
- (a) Push the APU VALVE switch to OFF on the overhead panel P-5.
- (b) Turn the APU off.

S 865-051

(16) Connect the data bus reader to the left and right ADC data buses.

S 825-052

(17) Use an angular displacement measuring tool to position the angle of attack (AOA) vanes to the values that follow:

S 205-053

(18) Use the data bus reader to make sure the right and left ADC output values agree with the values listed below.

<u>NOTE</u>: A positive angle of attack is produced when the trailing edge of the AOA sensor is above the horizontal axis of the AOA vane.

RIGHT ADC TEST	
RIGHT VANE POSITION	OCTAL LABEL 221, 222, and 223 OUTPUT
0°	0° ± .75°
+10°	+10° ± .75°
-10°	-10° ± .75°

LEFT ADC TEST	
LEFT VANE POSITION	OCTAL LABEL 221, 222, and 223 OUTPUT
0° +10° -10°	0° ± .75° +10° ± .75° -10° ± .75°

S 705-056

(19) To do a test of the Captain's system, do the steps that follow:
   - (a) Keep probe A of the ARINC 429 data/bus reader connected to the Burndy block Z118, TB201 on the E2-1 shelf.
   - (b) Keep probe B of ARINC 429 data/bus reader connected to the Burndy block Z117, TB201 on the E2-1 shelf.

S 865-057

CAUTION: MAKE SURE THE COVER ON THE PITOT-STATIC PROBE IS REMOVED. THIS PREVENTS DAMAGE TO THE PROBE.

(20) Make sure no test equipment or covers are installed on pitot-static probes.

S 865-059

(21) Make sure these circuit breakers on the panel P11 are closed:
   - (a) 11C21, PITOT PROBE HEAT IND R
   - (b) 11D4, PROBE HEAT IND PITOT LEFT
   - (c) 11D5, PROBE HEAT IND AOA LEFT
   - (d) 11R25, PITOT HEAT IND TAT
   - (e) 11R27, PROBE HEAT IND AOA R

S 865-062

(22) Open these circuit breakers on the right Misc. Electrical Equipment Panel P37:
  (a) 37E3, WINDOW HTR 2L
  (b) 37E4, WINDOW HTR 3L
  (c) 37J2, WINDOW HTR 1R

S 865-063

(23) Open these circuit breakers on the Misc. Electrical Equipment Panel P70:
  (a) 70A3, WINDOW HTR 2R
  (b) 70A4, WINDOW HTR 3R
  (c) 70C13, WINDOW HTR L

S 865-064

<u>CAUTION</u>: REMOVE SHIPPING CAPS, TEST HOSES, AND ADAPTERS FROM ALL PROBES. MAKE SURE PROBE HEAT POWER IS NOT ON LONGER THAN 2 MINUTES. THIS CAN CAUSE DAMAGE TO THE PROBE.

(24) Set the ARINC 429 data bus reader to read label 270 and to show it in the binary format.

S 705-067

(25) Do the steps that follow to do a test of the capt's (left) system.
  (a) Make sure bits 14, 16, 17, and 18 are in the "zero" state and that bit 15 is in the "one" state.
  (b) Close this circuit breaker on the P6 panel:
    1) 6L15, PITOT HEAT CAPT MAIN
  (c) Hold down on the WINDOW/PROBE HEAT test switch, found on the P61 miscellaneous test panel.
  (d) Make sure bit 14 is in the "one" state.
  (e) Release the WINDOW/PROBE HEAT switch.
  (f) Open this circuit breaker on the P6 panel:
    1) 6L15, PITOT HEAT CAPT MAIN

(g) Close this circuit breaker on the P6 panel:
  1) 6L17, L AOA HEAT
(h) Hold down on the WINDOW/PROBE HEAT switch.
(i) Make sure bit 17 is in the "one" state.
(j) Release the WINDOW/PROBE HEAT switch.
(k) Open this circuit breaker on the P6 panel:
  1) 6L17, L AOA HEAT
(l) Close this circuit breaker on the P6 panel:
  1) 6L23, R AOA HEAT
(m) Hold down on the WINDOW/PROBE HEAT switch.
(n) Make sure bit 18 is in the "zero" state.
(o) Release the WINDOW/PROBE HEAT switch.
(p) Open this circuit breaker on the P6 panel:
  1) 6L23, R AOA HEAT
(q) Close this circuit breaker on the P6 panel:
  1) 6L24, TAT PROBE HEAT
(r) Hold down on the WINDOW/PROBE HEAT switch.
(s) Make sure bit 16 is in the "one" state.
(t) Release the WINDOW/PROBE HEAT switch.
(u) Open this circuit breaker on the P6 panel:
  1) 6L24, TAT PROBE HEAT

S 705-068

(26) To test the F/O's (right) system, do the steps that follow:
(a) Attach probe A of the ARINC 429 receiver/bus reader to the Burndy block Z114, TB203 on the E2-2 shelf.
(b) Attach probe B of the ARINC 429 receiver/bus reader to the Burndy block Z113, TB203 found on the E2-2 shelf.
(c) Set the ARINC 429 data bus reader to read Label 270 in binary.
(d) Make sure bits 15, 16, 17, and 18 are in the "zero" state and that bit 14 is in the "one" state.
(e) Close this circuit breaker on the P6 panel:
  1) 6L22, PITOT HEAT F/O MAIN
(f) Hold down on the WINDOW/PROBE HEAT test switch, found on the P61 miscellaneous test panel.

(g) Make sure bit 15 is in the one state.
(h) Release the WINDOW/PROBE HEAT switch.
(i) Open this circuit breaker on the P6 panel:
    1) 6L22, PITOT HEAT CAPT MAIN
(j) Close these circuit breakers on the P6 panel:
    1) 6L23, R AOA HEAT
(k) Hold down on the WINDOW/PROBE HEAT switch.
(l) Make sure bit 18 is in the "one" state.
(m) Release the WINDOW/PROBE HEAT switch.
(n) Open this circuit breaker on the P6 panel:
    1) 6L23, R AOA HEAT
(o) Close this circuit breaker on the P6 panel:
    1) 6L17, L AOA HEAT
(p) Hold down on the WINDOW/PROBE HEAT switch.
(q) Make sure bit 17 is in the "zero" state.
(r) Release the WINDOW/PROBE HEAT switch.
(s) Open this circuit breaker on the P6 panel:
    1) 6L17, L AOA HEAT
(t) Close this circuit breaker on the P6 panel:
    1) 6L24, TAT PROBE HEAT
(u) Hold down on the WINDOW/PROBE HEAT switch.
(v) Make sure bit 16 is in the "one" state.
(w) Release the WINDOW/PROBE HEAT switch.
(x) Open this circuit breaker on the P6 panel:
    1) 6L24, TAT PROBE HEAT

S 865-093

(27) Set the BARO set knob on the captain's and F/O's altimeter to 29.92 in. Hg.

S 865-094

(28) Set the left AOA vane to 0 degree +/-0.5 and the right AOA vane to 0 degree +/-0.5.

S 805-069

CAUTION: MAKE SURE THE STATIC PRESSURE DOES NOT EXCEED 31.1 IN. HG MAKE SURE THE DIFFERENCE BETWEEN THE STATIC PRESSURE AND THE TOTAL PRESSURE DOES NOT EXCEED 10.0 IN. HG. DO NOT APPLY OR RELEASE THE VACUUM AT A RATE OF CLIMB OR DESCENT ABOVE 5,000 FEET PER MINUTE. THIS WILL PREVENT DAMAGE TO THE PITOT/STATIC SYSTEM.

(29) Set the pressures in the Captain's and F/O's pitot (Pt) and static (Ps) lines to the values that follow. (AMM 34-11-00/201).
    (a) Make sure the captain's and F/O's instruments read the values given for altitude, MACH, airspeed, TAS, SAT and Vmo.

(b) Read the TAS and SAT values on the progress page 1 and 2 of the FMC-CDU (AMM 34-61-00/501).

FAA Non-RVSM							
INPUT		OUTPUT					
Ps	Pt	Altitude	Mach	Airspeed	TAS	SAT	Vmo Barberpole
29.860	31.012	0 ± 25 Delta=38 *[1]		150 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
20.476	22.536	10,000 ± 30 Delta=45 *[1]		200 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
13.517	18.284	20,000 ± 40 Delta=60 *[1]		300 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
8.699	12.904	30,000 ± 60 Delta=90 *[1]	.75 ± .006 Delta=.009		*[2]	*[3]	326 ± 2.5
6.883	10.732	35,000 ± 70 Delta=105 *[1]	.8 ± .005 Delta=.008		*[2]	*[3]	292 ± 2.5
5.415	8.881	40,000 ± 80 Delta=120 *[1]	.85 ± .005 Delta=.008		*[2]	*[3]	260 ± 2.5

*[1] "Delta" shows the maximum difference permitted between the Captain and First Officer's instruments.

*[2] The true airspeed on the TAS indicator should agree with the values in Fig. 502 in less than ± 6 knots. To find the ambient temperature, use the test thermometer.

*[3] The static air temperature on the SAT indicator should agree with the values in Fig. 503 in less than ± 3 degrees. Use the test thermometer to find the ambient temperature.

CAA Non-RVSM							
INPUT		OUTPUT					
Ps	Pt	Altitude	Mach	Airspeed	TAS	SAT	Vmo Barberpole
29.860	31.012	0 ± 25 Delta=38 *[1]		150 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2
20.476	22.536	10,000 ± 30 Delta=45 *[1]		200 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2
13.517	18.284	20,000 ± 40 Delta=60 *[1]		300 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2
8.699	12.904	30,000 ± 60 Delta=90 *[1]	.75 ± .006 Delta=.009		*[2]	*[3]	318 ± 2
6.883	10.732	35,000 ± 70 Delta=105 *[1]	.8 ± .005 Delta=.008		*[2]	*[3]	284 ± 2
5.415	8.881	40,000 ± 80 Delta=120 *[1]	.85 ± .005 Delta=.008		*[2]	*[3]	253 ± 2

*[1] "Delta" shows the maximum difference permitted between the Captain and First Officer's instruments.
*[2] The true airspeed on the TAS indicator should agree with the values in Fig. 502 in less than ± 6 knots. To find the ambient temperature use the test thermometer.
*[3] The static air temperature on the SAT indicator should agree with the values in Fig. 503 in less than ± 3 degrees. Use the test thermometer to find the ambient temperature.

(c) Use this table for airplanes with RVSM installed:

FAA RVSM							
INPUT		OUTPUT					
Ps	Pt	Altitude	Mach	Airspeed	TAS	SAT	Vmo Barberpole
29.860	31.012	0 ± 25 Delta=38 *[1]		150 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
20.474	22.536	10,000 ± 30 Delta=45 *[1]		200 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
13.491	18.259	20,000 ± 40 Delta=60 *[1]		300 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
8.669	12.859	30,000 ± 60 Delta=90 *[1]	.75 ± .006 Delta=.009		*[2]	*[3]	326 ± 2.5
6.851	10.683	35,000 ± 70 Delta=105 *[1]	.8 ± .005 Delta=.008		*[2]	*[3]	292 ± 2.5
5.385	8.832	40,000 ± 80 Delta=120 *[1]	.85 ± .005 Delta=.008		*[2]	*[3]	260 ± 2.5

*[1] "Delta" shows the maximum difference permitted between the Captain and First Officer's instruments.
*[2] The true airspeed on the TAS indicator should agree with the values in Fig. 502 in less than ± 6 knots. To find the ambient temperature, use the test thermometer.
*[3] The static air temperature on the SAT indicator should agree with the values in Fig. 503 in less than ± 3 degrees. Use the test thermometer to find the ambient temperature.

CAA RVSM							
INPUT		OUTPUT					
Ps	Pt	Altitude	Mach	Airspeed	TAS	SAT	Vmo Barberpole

CAA RVSM							
INPUT		OUTPUT					
Ps	Pt	Altitude	Mach	Airspeed	TAS	SAT	Vmo Barberpole
29.860	31.012	0 ± 25 Delta=38 *[1]		150 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.5
20.474	22.536	10,000 ± 30 Delta=45 *[1]		200 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.0
13.491	18.257	20,000 ± 40 Delta=60 *[1]		300 ± 2.0 Delta=3.0	*[2]	*[3]	347 ± 2.0
8.669	12.859	30,000 ± 60 Delta=90 *[1]	.75 ± .006 Delta=.009		*[2]	*[3]	318 ± 2.0
6.851	10.683	35,000 ± 70 Delta=105 *[1]	.8 ± .005 Delta=.008		*[2]	*[3]	284 ± 2.0
5.385	8.832	40,000 ± 80 Delta=120 *[1]	.85 ± .005 Delta=.008		*[2]	*[3]	253 ± 2.0

*[1] "Delta" shows the maximum difference permitted between the Captain and First Officer's instruments.
*[2] The true airspeed on the TAS indicator should agree with the values in Fig. 502 in less than ± 6 knots. To find the ambient temperature, use the test thermometer.
*[3] The static air temperature on the SAT indicator should agree with the values in Fig. 503 in less than ± 3 degrees. Use the test thermometer to find the ambient temperature.

G. Put the Airplane Back to Its Usual Condition

S 865-086

(1) Put the pitot-static system back to normal (AMM 34-11-00/201).

TABLE 2

Measured Temp (Deg C)	TRUE AIRSPEED (KTS)					
	CAS= 150 Kts	CAS= 200 Kts	CAS= 300 Kts	MACH =0.75	MACH =0.80	MACH =0.85
-10	142.8	226.5	395.3	449.5	476.1	502.2
-9	143.0	226.9	396.0	450.3	477.0	503.2
-8	143.3	227.4	396.8	451.2	477.9	504.1
-7	143.6	227.8	397.5	452.0	478.8	505.1
-6	143.8	228.2	398.3	452.9	479.7	506.0
-5	144.1	228.6	399.0	453.7	480.6	507.0
-4	144.4	229.1	399.8	454.6	481.5	507.9
-3	144.6	229.5	400.5	455.4	482.4	508.9
-2	144.9	229.9	401.2	456.3	483.3	509.8
-1	145.2	230.3	402.0	457.1	484.2	510.8
0	145.5	230.8	402.7	457.9	485.1	511.7
1	145.7	231.2	403.4	458.8	486.0	512.6
2	146.0	231.6	404.2	459.6	486.9	513.6
3	146.2	232.0	404.9	460.4	487.8	514.5
4	146.5	232.4	405.7	461.3	488.6	515.4
5	146.8	232.9	406.4	462.1	489.5	516.4
6	147.0	233.3	407.1	462.9	490.4	517.3
7	147.3	233.7	407.8	463.8	491.3	518.2
8	147.6	234.1	408.6	464.6	492.2	519.1
9	147.8	234.5	409.3	465.4	493.0	520.1
10	148.1	234.9	410.0	466.2	493.9	521.0
11	148.3	235.4	410.7	467.1	494.8	521.9
12	148.6	235.8	411.5	467.9	495.6	522.8
13	148.9	236.2	412.2	468.7	496.5	523.7
14	149.1	236.6	412.9	469.5	497.4	524.6
15	149.4	237.0	413.6	470.3	498.2	525.6
16	149.6	237.4	414.3	471.2	499.1	526.5
17	149.9	237.8	415.1	472.0	500.0	527.4
18	150.2	238.2	415.8	472.8	500.8	528.3
19	150.4	238.6	416.5	473.6	501.7	529.2
20	150.7	239.1	417.2	474.4	502.5	530.1
21	150.9	239.5	417.9	475.2	503.4	531.0
22	151.2	239.9	418.6	476.0	504.3	531.9
23	151.4	240.3	419.3	476.8	505.1	532.8
24	151.7	240.7	420.0	477.6	506.0	533.7
25	152.0	241.1	420.7	478.4	506.8	534.6
26	152.2	241.5	421.4	479.2	507.7	535.4
27	152.5	241.9	422.1	480.0	508.5	536.4
28	152.7	242.3	422.9	480.8	509.4	537.3
29	153.0	242.7	423.6	481.6	510.2	538.2
30	153.2	243.1	424.3	482.4	511.0	539.1
31	153.5	243.5	425.0	483.2	511.9	539.9
32	153.7	243.9	425.6	484.0	512.7	540.8
33	154.0	244.3	426.3	484.8	513.6	541.7
34	154.2	244.7	427.0	485.6	514.4	542.6
35	154.5	245.1	427.7	486.4	515.2	543.5
36	154.7	245.5	428.4	487.2	516.1	544.4
37	155.0	245.9	429.1	488.0	516.9	545.2
38	155.2	246.3	429.8	488.8	517.7	546.1
39	155.5	246.7	430.5	489.5	518.6	547.0
40	155.7	247.1	431.2	490.3	519.4	547.9

ADC Adjustment Test - True Airspeed (TAS) Chart
Figure 502

TABLE 3
*STATIC AIR TEMPERATURE (DEG C)

Measured Temp (Deg C)	CAS= 150 Kts	CAS= 200 Kts	CAS= 300 Kts	MACH =0.75	MACH =0.80	MACH =0.85
-10	-12.7	-16.8	-30.6	-36.6	-39.9	-43.2
-9	-11.7	-15.8	-29.6	-35.7	-39.0	-42.4
-8	-10.7	-14.8	-28.7	-34.8	-38.1	-41.5
-7	-9.7	-13.8	-27.8	-33.9	-37.2	-40.6
-6	-8.7	-12.9	-26.9	-33.0	-36.2	-39.7
-5	-7.7	-11.8	-26.0	-32.1	-35.4	-38.9
-4	-6.7	-10.8	-25.0	-31.2	-34.5	-38.0
-3	-5.8	-9.9	-24.1	-30.3	-33.7	-37.1
-2	-4.8	-9.0	-23.2	-29.4	-32.8	-36.2
-1	-3.8	-8.0	-22.3	-28.5	-31.9	-35.4
0	-2.8	-7.0	-21.3	-27.6	-31.0	-34.5
1	-1.8	-6.0	-20.4	-26.7	-30.1	-33.6
2	-0.8	-5.1	-19.5	-25.8	-29.2	-32.7
3	-0.2	-4.1	-18.6	-24.9	-28.3	-31.9
4	1.2	-3.1	-17.7	-24.0	-27.4	-31.0
5	2.2	-2.1	-16.7	-23.1	-26.6	-30.1
6	3.2	-1.2	-15.8	-22.2	-25.7	-29.2
7	4.1	-0.2	-14.9	-21.3	-24.8	-28.4
8	5.1	0.8	-14.0	-20.4	-23.9	-27.5
9	6.1	1.8	-13.0	-19.5	-23.0	-26.6
10	7.1	2.7	-12.1	-18.6	-22.1	-25.7
11	8.1	3.7	-11.2	-17.7	-21.2	-24.9
12	9.1	4.7	-10.3	-16.8	-20.4	-24.0
13	10.1	5.7	-9.4	-15.9	-19.5	-23.1
14	11.1	6.6	-8.4	-15.0	-18.6	-22.3
15	12.1	7.6	-7.5	-14.1	-17.7	-21.4
16	13.1	8.6	-6.6	-13.2	-16.8	-20.5
17	14.0	9.5	-5.7	-12.3	-15.9	-19.6
18	15.0	10.5	-4.7	-11.4	-15.0	-18.8
19	16.0	11.5	-3.8	-10.5	-14.2	-17.9
20	17.0	12.5	-2.9	-9.6	-13.3	-17.0
21	18.0	13.4	-2.0	-8.7	-12.4	-16.1
22	19.0	14.4	-1.1	-7.8	-11.5	-15.3
23	20.0	15.4	-0.1	-6.9	-10.6	-14.4
24	21.0	16.4	0.8	-6.0	-9.7	-13.5
25	22.0	17.3	1.7	-5.2	-8.8	-12.6
26	22.9	18.3	2.6	-4.3	-7.9	-11.8
27	23.9	19.3	3.5	-3.4	-7.1	-10.9
28	24.9	20.3	4.5	-2.5	-6.2	-10.0
29	25.9	21.2	5.4	-1.6	-5.3	-9.1
30	26.9	22.2	6.3	-0.7	-4.4	-8.3
31	27.9	23.2	7.2	0.2	-3.5	-7.4
32	28.9	24.2	8.2	1.1	-2.6	-6.5
33	29.9	25.1	9.1	2.0	-1.7	-5.7
34	30.9	26.1	10.0	2.9	-0.9	-4.8
35	31.9	27.1	10.9	3.8	0.0	-3.9
36	32.8	28.1	11.8	4.7	0.9	-3.0
37	33.8	29.0	12.8	5.6	1.8	-2.2
38	34.8	30.0	13.7	6.5	2.7	-1.3
39	35.8	31.0	14.6	7.4	3.6	-0.4
40	36.8	32.0	15.5	8.3	4.5	0.5

ADC Adjustment Test - Static Air Temperature (SAT) Chart
Figure 503

S 085-087
(2) Remove the test equipment.

S 865-088
(3) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
  (a) 11D27, HYDRAULIC RAT AUTO PWR

S 865-089
(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
  (a) PITOT PROBE HEAT (8)
  (b) 6L17, L AOA HEAT
  (c) 6L23, R AOA HEAT
  (d) 6L24, TAT PROBE HEAT

S 865-128
(5) AIRPLANES WITH POST-SB 34-0222;
Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11F5, RAD ALTM L
  (b) 11F20, RAD ALTM C
  (c) 11F26, RAD ALTM R

S 865-090
(6) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AIR DATA COMPUTING SYSTEM - INSPECTION/CHECK

1. General
   A. The Air Data Computing System Inspection/Check procedure is a check of the items that follow:
      - Air Data Computer (ADC) operation and isolation
      - Overspeed Annunciation with aural warnings
      - Altimeter
      - MACH Airspeed Indicator (MASI)
      - Electronic Attitude Direction Indicator (EADI)

TASK 34-12-00-716-016

2. Air Data Computer Check
   A. Reference
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Prepare for Check

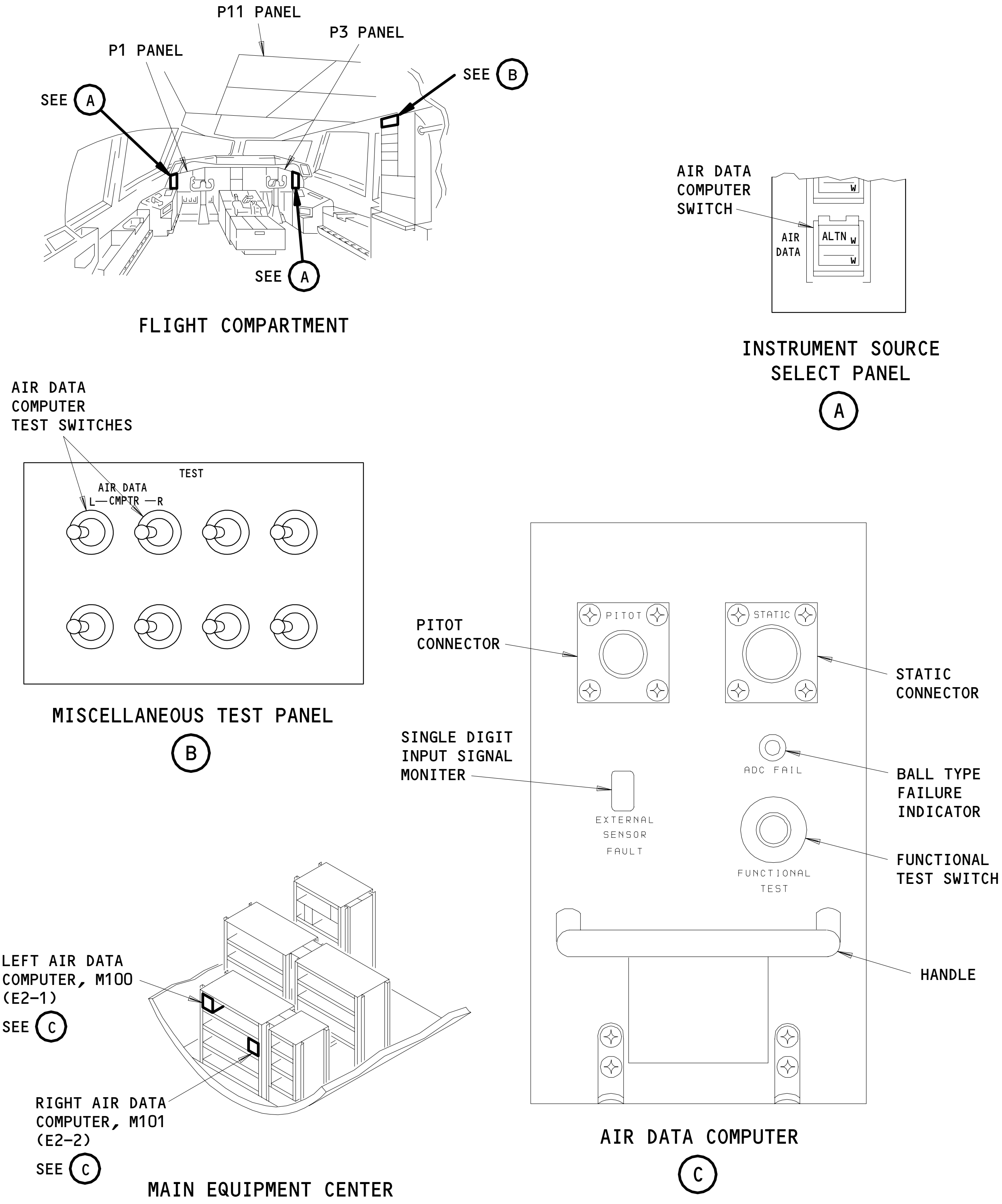
      S 866-001
      (1) Supply electrical power (AMM 24-22-00/201).
   C. Left Air Data Computer Check (Fig. 601)

      S 866-003
      (1) On the P61 panel, put the L AIR DATA CMPTR test switch in the AIR DATA CMPTR position.

      S 756-006
      (2) Make sure you hear an aural warning for 2 seconds.

      S 756-008
      (3) Make sure the airspeed and MACH indications move up-scale on the captain's altimeter and MASI.

      S 756-019
      (4) AIRPLANES WITH AIRSPEED TAPE;
      Make sure the airspeed and MACH indications move up-scale on the captain's EADI.



Air Data Computing System
Figure 601

S 866-010
(5) Release the L AIR DATA CMPTR test switch.

D. Right Air Data Computer Check (Fig. 601)

S 866-011
(1) On the P61 panel, put the R AIR DATA CMPTR test switch in the AIR DATA CMPTR position.

S 756-012
(2) Make sure the same results occur as during the Left Air Data Computer Check but on the F/O's displays.

S 756-013
(3) Release the R AIR DATA CMPTR test switch.

E. Put the Airplane Back to Its Usual Condition

S 866-014
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AIR DATA COMPUTER - REMOVAL/INSTALLATION

1. General
   - A. The left, M100, and right, M101, Air Data Computers (ADC) are located on the E-2 rack in the main equipment center. All electrical connections are made through connectors at the rear of the unit.

TASK 34-12-01-024-001

2. Remove Air Data Computer
   - A. References
     - (1) AMM 20-10-01/401, E/E Rack-Mounted Components
   - B. Access
     - (1) Location Zones
       - 119/120 Main Equipment Center
     - (2) Access Panel
       - 119BL Main Equipment Center
   - C. Procedure

     S 864-002
     - (1) Set the two F/D switches on the MCP to off.

     S 864-003
     - (2) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
       - (a) For the left ADC:
         - 1) 11A10, AIR DATA CMPTR LEFT
         - 2) 11A11, AIR DATA AOA SENSOR LEFT
         - 3) 11A12, AIR DATA BARO CORRECT LEFT
       - (b) For the right ADC:
         - 1) 11F30, AIR DATA CMPTR RIGHT
         - 2) 11F31, AIR DATA AOA SENSOR RIGHT
         - 3) 11F32, AIR DATA BARO CORRECT RIGHT

     S 034-004
     - (3) Operate the quick-disconnect fittings to disconnect the pitot-static system hoses from the ADC's front panel.

     S 024-005
     - (4) Remove the ADC (AMM 20-10-01/401).

TASK 34-12-01-424-006

3. Install Air Data Computer
   - A. General
     - (1) You do not have to do a leak test when you connect a quick-disconnect fitting. A visual examination of the quick-disconnect for a complete seal is necessary. You must do a leak test when you cannot make sure that the quick-disconnect has a complete seal.
   - B. References
     - (1) AMM 20-10-01/401, E/E Rack-Mounted Components

(2) AMM 22-00-02/201, Autoflight BITE
(3) AMM 24-22-00/201, Electrical Power - Control
(4) AMM 34-11-00/501, Pitot Static System

C. Access

(1) Location Zones

119/120 Main Equipment Center

(2) Access Panel

119BL Main Equipment Center

D. Procedure

S 414-016

(1) Connect the pitot-static system hoses to the ADC front panel.
   (a) Make sure the quick-disconnect fitting is fully mated and that the connection is locked in a sealed position.

S 864-009

(2) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
   (a) For the left ADC:
      1) 11A10, AIR DATA CMPTR LEFT
      2) 11A11, AIR DATA AOA SENSOR LEFT
      3) 11A12, AIR DATA BARO CORRECT LEFT
   (b) For the right ADC:
      1) 11F30, AIR DATA CMPTR RIGHT
      2) 11F31, AIR DATA AOA SENSOR RIGHT
      3) 11F32, AIR DATA BARO CORRECT RIGHT

E. Air Data Computer Test

S 864-010

(1) Supply electrical power (AMM 24-22-00/201).

S 864-011

(2) Push the ADC FUNCTIONAL TEST switch on the ADC front panel.

S 204-012

(3) Make sure a dash (-) shows in the EXTERNAL SENSOR FAULT display on the ADC front panel.

S 204-013

(4) Make sure the ADC FAIL indicator shows black.

S 744-014

(5) Do the MCDP Test-30 CURRENT FAULT REPORT (AMM 22-00-02/201).

S 864-015

(6) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TOTAL AIR TEMPERATURE PROBE - REMOVAL/INSTALLATION

1. General
   - A. The TAT probe is located on the right side of the airplane.

TASK 34-12-02-024-033

2. Total Air Temperature Probe Removal (Fig. 401)

   A. Consumable Materials
      (1) A00144 - Solvent, BMS 11-7
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 34-12-00/501, Air Data Computing System
      (3) AMM 36-00-00/201, Pneumatic General
      (4) AMM 51-31-01/201, Seals and Sealing
   C. Access
      (1) Location Zone
            118   Area outboard and above NLG wheel well (Right) (Exterior)

   D. Procedure

S 864-001

WARNING: MAKE SURE THE PROBE HEAT IS NOT ON. THIS WILL PREVENT BAD BURNS.

(1) Open this circuit breaker on the main power distribution panel, P6, and attach a DO-NOT-CLOSE tag:
    (a) 6L24, TAT PROBE HEAT

S 864-031

(2) Make sure the two F/D switches on the MCP are in the OFF position.

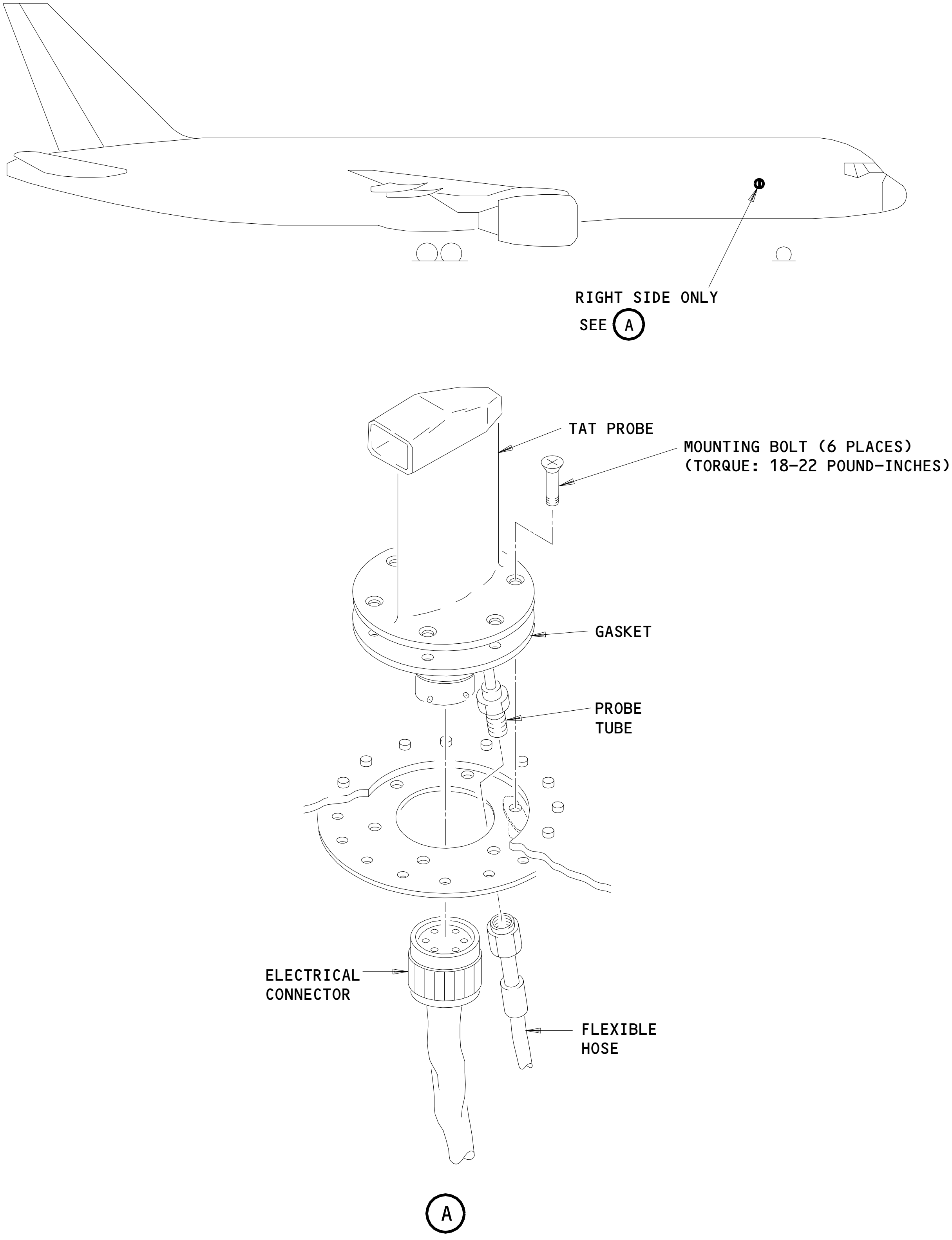
S 864-002

(3) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
    (a) 11A10, AIR DATA CMPTR LEFT
    (b) 11F30, AIR DATA CMPTR RIGHT

S 864-003

WARNING: MAKE SURE PNEUMATIC POWER IS NOT ON. THIS WILL PREVENT BAD BURNS.

(4) Make sure pneumatic power is not applied to the TAT probe (AMM 36-00-00/201).



Total Air Temperature Probe Installation
Figure 401

S 024-038

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(5) Remove the sealant from around the probe base (AMM 51-31-01/201).

S 034-005

(6) Remove the screws from the probe mounting flange.

S 014-006

CAUTION: MORE FORCE ON THE PROBE BASE CAN BE USED TO BREAK THE GASKET SEAL. DO NOT LET THE PROBE PULL AWAY FROM THE AIRPLANE WITH A FORCE THAT WOULD DAMAGE THE CABLE.

(7) Pull the probe out from the airplane skin until the electrical cable comes into view.

S 034-007

(8) Disconnect the electrical cable and hose from the probe and put a cover on the two sides of the fittings. Do not let the cable and hose fall back inside fuselage.

TASK 34-12-02-404-008

3. Total Air Temperature Probe Installation (Fig. 401)

A. Equipment

(1) Resistance measuring bridge or milliohmeter to measure .010 ohm with a precision of ±.001 ohm.

B. Consumable Materials

(1) A00679 Compound Sealing - BMS 5-95, Class B 1/2
(2) A00144 Solvent - BMS 11-7
(3) B00184 Gasket - BMS 1-57

C. References

(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 34-12-00/501, Air Data Computing System
(3) AMM 36-00-00/201, Pneumatic, General
(4) AMM 51-31-01/201, Seals and Sealing

D. Access

(1) Location Zone

118 Area outboard and above NLG wheel well (Right) (Exterior)

E. Procedure

S 864-032

(1) Make sure the two F/D switches on the MCP are in the OFF position.

S 864-010

<u>WARNING</u>: MAKE SURE PNEUMATIC POWER IS NOT ON. THIS WILL PREVENT BAD BURNS.

(2) Make sure pneumatic power is not applied to the TAT probe hose (AMM 36-00-00/201).

S 034-012

(3) Remove and discard old gasket, if it is there.

S 104-041

(4) Remove old sealant from mounting hole.

S 104-040

<u>CAUTION</u>: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(5) Clean and prepare surface and sides of mounting hole (AMM 51-31-01/201).

S 434-015

(6) Install the new gasket.

S 864-016

(7) Remove protective covers from electrical connectors and hose fittings.

S 434-017

(8) Connect electrical cable and flexible hose to probe base.

S 864-018

(9) Move the cable and flexible hose inside the airplane while you put the probe base into the mounting hole.

S 824-019

(10) Position the probe and gasket so that the wide intake of the probe points forward. The exit holes along the back of the strut point aft.

S 434-020

(11) Make sure the probe base makes a continuous surface with the skin. Install the screws and tighten to 18-22 pound-inches.

S 764-036

(12) Measure the resistance between the TAT probe body and the airplane skin with a resistance measuring bridge or a milliohm meter.

S 764-037

(13) If the resistance is more than 0.010 Ohms, do these steps:
  (a) Remove the TAT probe.
  (b) Clean the bonding surfaces, including the counter sunk holes in the TAT probe (SOPM 20-20-00).
  (c) Replace the existing screws with new screws.
  (d) Re-install the TAT probe.
  (e) Measure the resistance between the strut of the TAT probe and the airplane skin with the resistance measurement bridge/milliohm meter.
  (f) If the resistance is more than 0.010 Ohms, do these steps:
    1) Remove the TAT probe.
    2) Replace the nutplates and rivets that attach the TAT probe (SRM 51-40-02).
    3) Re-install the TAT probe and make sure the bonding resistamce is not more than 0.010 Ohms.

S 394-042

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO APPLY THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(14) Fill the empty space around the probe base with sealant (AMM 51-31-01/201). Water, BMS 11-7 or tape can be used as an aid to make the sealant smooth.

S 864-023

(15) Cure the sealant until the sealant cannot be pushed in. Cure time can be faster if heat is applied (AMM 51-31-01/201).

S 864-024

(16) Remove DO-NOT-CLOSE tag and close this circuit breaker on the P6 panel:
  (a) 6L24, TAT PROBE HEAT

S 864-025

(17) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
  (a) 11A10, AIR DATA CMPTR LEFT
  (b) 11F30, AIR DATA CMPTR RIGHT

F. Total Air Temperature Probe Test

S 844-034

(1) Supply electrical power (AMM 24-22-00/201).

S 724-027

(2) Push the FUNCTIONAL TEST switch on the front panel of the left ADC (rack E2-1) and right ADC (Rack E2-2).

<u>NOTE</u>: Do not push the ADC test switch(es) while pitot-static system is pressurized. The ADC will go into an incorrect fault condition and tell this condition to its interface systems. Special procedures will have to be done to clear this fault (AMM 34-12-00/501).

S 214-028

(3) Make sure the numeric display on the ADC front panel shows a (-).

S 714-030

(4) Do a test of the bleed air operation of the total air temperature probe (AMM 36-00-00/201).
    (a) Make sure there is Bleed Airflow at the TAT probe airflow ejector.

S 864-029

(5) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ANGLE OF ATTACK SENSOR - REMOVAL/INSTALLATION

1. General
   A. The left (TS 12) and right (TS 13) Angle of Attack (AOA) sensors are on each side of the airplane. Connection is made by an electrical connector at the rear of each sensor.

TASK 34-12-03-004-001

2. Angle of Attack Sensor Removal

   A. Consumable Materials
      (1) B00184 Solvent - BMS 11-7
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 51-31-01/201, Seals and Sealing
   C. Access
      (1) Location Zones

117/118	Area outboard and above NLG wheel well (Exterior)

   D. Procedure

S 864-034

(1) Make sure the two F/D switches on the MCP are in the OFF position.

S 864-002

(2) Open these circuit breakers on the main distribution panel, P6, and attach DO-NOT-CLOSE tag:
   (a) For the left AOA sensor:
      1) 6L17, L AOA HEAT
   (b) For the right AOA sensor:
      1) 6L23, R AOA HEAT

S 864-036

(3) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) For the left AOA sensor:
      1) 11A10, AIR DATA CMPTR LEFT
      2) 11A11, AIR DATA AOA SENSOR LEFT
      3) 11A12, AIR DATA BARO CORRECT LEFT
   (b) For the right AOA sensor:
      1) 11F30, AIR DATA CMPTR RIGHT
      2) 11F31, AIR DATA AOA SENSOR RIGHT
      3) 11F32, AIR DATA BARO CORRECT RIGHT

S 014-004

(4) Remove the eight mounting screws that hold the AOA sensor.

S 024-073

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(5) Remove the sealant that is around the AOA sensor (AMM 51-31-01/201).

S 024-006

CAUTION: DO NOT APPLY A FORCE TO THE SENSOR VANE. THIS WILL PREVENT DAMAGE TO THE VANE.

(6) Lightly move the sensor body to break the sealant, then remove the sensor and gaskets.

S 034-007
(7) Disconnect the electrical connector from the AOA sensor.

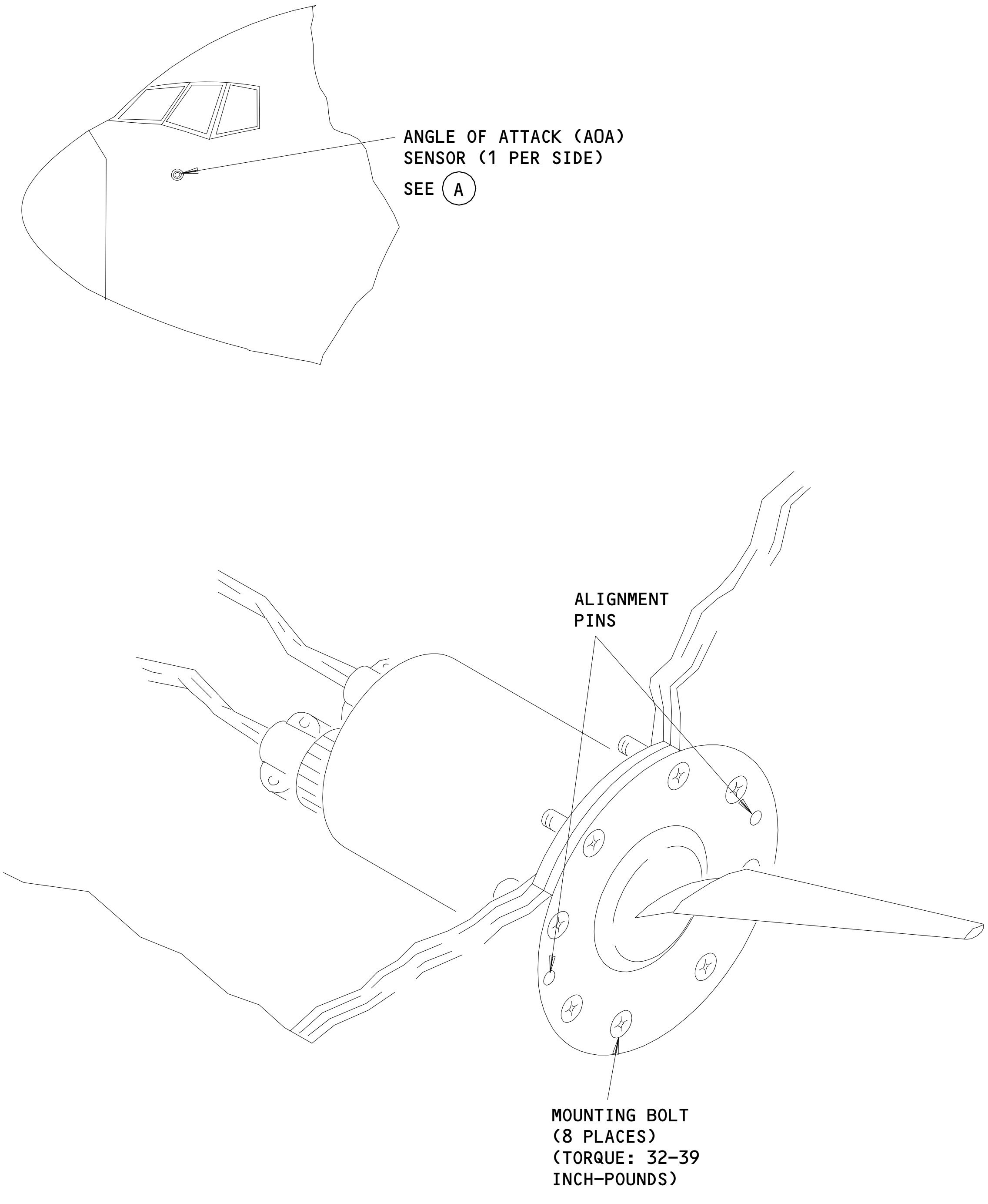
S 034-008
(8) Remove the sealant from the sensor hole (AMM 51-31-01/201).

TASK 34-12-03-404-002

3. Angle of Attack Sensor Installation

A. Equipment
  (1) ARINC 429 Databus Analyzer
    (a) 429EB JcAIR Instrumentation (preferred)
    400 New Century Parkway,
    New Century, KS 66031-0009
    (b) 429-2, Interface Technology (optional)
    150 E. Arrow Highway,
    San Dimas, CA 91773
  (2) Angular displacement measuring tool, J34002-1
  (3) Milliohm/bonding meter (commercially available) - measures 0.010 ohms with a precision of plus/minus 0.001 ohm

B. Consumable Materials
  (1) G02313 Gasket - BMS 1-57
  (2) A00144 - Compound, Sealing, BMS 5-79 Class B 1/2
  (3) D50180 - Grease, BMS 3-33 (Preferred)



Angle of Attack Sensor Installation
Figure 401

(4) D00015 - Grease, BMS 3-24 (Alternate)

C. References
- (1) AMM 34-12-00, Air Data Computing System
- (2) AMM 24-22-00/201, Electrical Power - Control
- (3) AMM 51-31-01/201, Seals and Sealing

D. Access
- (1) Location Zones

117/118	Area outboard and above NLG wheel well (Exterior)

E. Installation Procedure

S 864-035

(1) Make sure the two F/D switches on the MCP are in the OFF position.

S 434-012

(2) Install the gasket.

S 624-013

(3) Apply a thin coat of corrosive preventive grease (BMS 3-33, preferred or BMS 3-24, alternate) on the surface of the alignment pins on the sensor faceplate.

S 434-014

(4) Connect the electrical connectors to the sensor.

S 864-015

(5) Carefully put the sensor through the hole in the skin.

S 414-016

(6) Install the eight mounting screws and tighten to 32-39 inch-pounds.

S 864-017

(7) Make sure the face of the sensor makes a continuous surface within 0.04 inch with the outside of fuselage skin.

S 764-069

(8) Use a milliohm/bonding meter to measure the resistance between the base of the AOA sensor and the airplane skin.

S 764-072

(9) If the resistance is more than than 0.010 Ohms, do these steps:
- (a) Remove the AOA vane.
- (b) Clean the bonding surfaces, including the counter sunk holes in the AOA vane (SOPM 20-20-00).
- (c) Replace the existing screws with new screws.
- (d) Re-install the AOA vane.
- (e) Measure the resistance between the AOA vane and the airplane skin with the milliohm/bonding meter.
- (f) If the resistance is more than 0.010 Ohms, do these steps:
  - 1) Remove the AOA vane.

2) Replace the nutplates and rivets that attach the AOA vane (SRM 51-40-02).
3) Re-install the AOA vane and make sure the bonding resistamce is not more than 0.010 Ohms.

(g) Make sure the resistance is not more than 0.010 ohm.

S 394-074

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO APPLY THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(10) Put sealant in the space between the sensor and the airplane skin. Make sure the sealant makes a continuous surface with the airplane skin (AMM 51-31-01/201).

S 864-019

(11) Supply electrical power (AMM 24-22-00/201).

S 864-020

(12) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
(a) 11A10, AIR DATA CMPTR LEFT
(b) 11A11, AIR DATA AOA SENSOR LEFT
(c) 11A12, AIR DATA BARO CORRECT LEFT
(d) 11F30, AIR DATA CMPTR RIGHT
(e) 11F31, AIR DATA AOA SENSOR RIGHT
(f) 11F32, AIR DATA BARO CORRECT RIGHT

F. Angle of Attack Sensor Test (Recommended)

S 864-021

WARNING: MAKE SURE THE AOA PROBE HEAT IS OFF BEFORE YOU TOUCH THE AOA PROBE. THIS WILL PREVENT BAD BURNS.

(1) Set the AOA sensor you replaced to the 0° ±5° position.

S 744-064

(2) Push the FUNCTIONAL TEST switch on the front panel of the left ADC if the left AOA sensor was replaced.

S 744-066

(3) Push the FUNCTIONAL TEST switch on the front panel of the right ADC if the right AOA sensor was replaced.

NOTE: Do not push the ADC test switches while the pitot-static system is pressurized. The ADC will go into an incorrect fault condition and report this to its interface systems. Special procedures will have to be done to remove this type of fault (AMM 34-12-00/501).

S 744-067

(4) Make sure the numeric display on the front panel of the ADC shows a (-).

S 864-068

(5) Do this test if you replaced the left (Captain's) AOA sensor:
  (a) Set up the ARINC 429 Databus Analyzer as follows:
    1) Set the RX SPEED switch to LO.
    2) Set the DISPLAY switch to ENG.
    3) Set the ON switch to ON.
    4) Attach probe A of the ARINC 429 Databus Analyzer to the Burndy block Z118, TB201 on the E2-1 shelf.
    5) Attach probe B to the Burndy block Z117, TB201 on the E2-1 shelf.
  (b) Connect the ARINC 429 Databus Analyzer to probe A and probe B.
  (c) Use an angular displacement measuring tool to move the angle of attack (AOA) vanes to the values that follow:
  (d) Use the ARINC 429 Databus Analyzer to make sure the left ADC output values agree with the values listed below.

<u>NOTE</u>: A positive angle of attack is produced When the trailing edge of the AOA vane is above the horizontal axis.

LEFT ADC TEST	
LEFT VANE POSITION	OCTAL LABEL 221, 222, and 223 OUTPUT
0°	0° ± 0.75°
+10°	10° ± 0.75°
-10°	350° ± 0.75° or -10°

S 704-045

(6) Do this test if you replaced the right (First Officer's) AOA sensor:
  (a) Set up the ARINC 429 Databus Analyzer:
    1) Set the RX SPEED switch to LO.
    2) Set the DISPLAY switch to ENG.
    3) Set the ON switch to ON.
  (b) Attach probe A of the ARINC 429 Databus Analyzer to the Burndy block Z114, TB203 on the E2-2 shelf.
  (c) Attach probe B to the Burndy block Z113, TB203 on the E2-2 shelf.
  (d) Connect the ARINC 429 Databus Analyzer to probe A and probe B.

(e) Use an angular displacement measuring tool to move the angle of attack (AOA) vanes to the values that follow:

(f) Use the ARINC 429 Databus Analyzer to make sure the right ADC output values agree with the values listed below.

NOTE: A positive angle of attack is produced When the trailing edge of the AOA vane is above the horizontal axis.

RIGHT ADC TEST	
RIGHT VANE POSITION	OCTAL LABEL 221, 222, and 223 OUTPUT
0° +10° -10°	0° ± 0.75° 10° ± 0.75° 350° ± 0.75° or -10°

S 864-027

(7) Remove DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
   (a) 6L17, L AOA HEAT
   (b) 6L23, R AOA HEAT

G. Angle of Attack Sensor Test (Alternative)

NOTE: Use the alternative test only when the recommended calibrator tool is unavailable.

S 714-075

(1) Use the ARINC 429 databus analyzer to make sure that the left and right ADC output values agree with the values below:

ADC TEST	
RIGHT VANE POSITION	OCTAL LABEL 221, 222, and 223 OUTPUT
0° +10° -10°	0° ± 0.75° 10° ± 0.75° 350° ± 0.75° or -10°

S 714-062

(2) Do this test if you replaced the left (Captains) AOA sensor:

WARNING: MAKE SURE THE AOA PROBE HEAT IS OFF BEFORE YOU TOUCH THE AOA PROBE. THIS WILL PREVENT BAD BURNS.

(a) Set the left AOA Sensor to the 0° ±5° position with reference to the index pins.
(b) Push the FUNCTIONAL TEST switch on the front panel of the left ADC.

NOTE: Do not push the ADC test switches while the pitot-static system is pressurized. The ADC will go into an incorrect fault condition and report this to its interface systems. Special procedures will have to be done to remove this type of fault (AMM 34-12-00/501).

(c) Make sure the numeric display on the front panel of the ADC shows a (-).
(d) Set up the ARINC 429 Databus Analyzer as follows:
    1) Set the RX SPEED switch to LO.
    2) Set the DISPLAY switch to ENG.
    3) Set the ON switch to ON.
(e) Attach probe A of the ARINC 429 Databus Analyzer to the Burndy block Z118, TB201 on the E2-1 shelf.
(f) Attach probe B of the ARINC 429 Databus Analyzer to the Burndy block Z117, TB201 on the E2-1 shelf.
(g) Attach probes A and B to the ARINC 429 Databus Analyzer.
(h) Make sure the ARINC 429 Databus Analyzer shows 0° ±5°.
(i) Move the left AOA Sensor (trailing edge up) to the maximum upper stop.
(j) Make sure the ARINC 429 Databus Analyzer shows 90° ±5°.
(k) Move the left AOA sensor (trailing edge down) to the maximum lower stop.
(l) Make sure the ARINC 429 Databus Analyzer shows 270° or -90° ±5°.

(m) Make a record of the left AOA sensor values.
(n) If the left sensor angles are not satisfactory, replace the left AOA sensor.

S 714-071

(3) Do this test if you replaced the right (First Officer's) AOA Sensor:

WARNING: MAKE SURE THE AOA PROBE HEAT IS OFF BEFORE YOU TOUCH THE AOA PROBE. THIS WILL PREVENT BAD BURNS.

(a) Set the right AOA Sensor to the 0° ±5° position with reference to the index pins.
(b) Push the FUNCTIONAL TEST switch on the front panel of the right ADC.

NOTE: Do not push the ADC test switches while the pitot-static

system is pressurized. The ADC will go into an incorrect fault condition and report this to its interface systems. Special procedures will have to be done to remove this type of fault (AMM 34-12-00/501).

(c) Make sure the numeric display on the front panel of the ADC shows a (-).
(d) Set up the ARINC 429 Databus Analyzer as follows:
  1) Set the RX SPEED switch to LO.
  2) Set the DISPLAY switch to ENG.
  3) Set the ON switch to ON.
(e) Attach probe A of the ARINC 429 Databus Analyzer to the Burndy block Z114, TB203 on the E2-2 shelf.
(f) Attach probe B of the ARINC 429 Databus Analyzer to the Burndy block Z113, TB203 on the E2-2 shelf.
(g) Attach probes A and B to the ARINC 429 Databus Analyzer.
(h) Make sure the ARINC 429 Databus Analyzer shows 0° ±5°.
(i) Move the right AOA sensor (trailing edge up) to the maximum upper stop.
(j) Make sure the ARINC 429 Databus Analyzer shows 90° ±5°.
(k) Move the right AOA Sensor (trailing edge down) to the maximum lower stop.
(l) Make sure the ARINC 429 Databus Analyzer shows 270° or -90° ±5°.
(m) Make a record of the right AOA sensor values.
(n) If the right sensor angles are not satisfactory, replace the right AOA sensor.

ANGLE OF ATTACK SENSOR - INSPECTION/CHECK

1. General
   A. This procedure does an inspection for the AOA sensor stuck against a vane end stop.

TASK 34-12-03-216-014

2. Angle of Attack Sensor - Inspection
   A. Reference
      (1) AMM 34-12-03/401, Angle of Attack Sensor
   B. Equipment
      (1) Gram guage
          Jonard Model GD-30 or equivalent
          Range: 40 - 350 grams
          Manufacturer : Jonard Industry Corp. N.Y.10707
   C. Access
      (1) Location Zones
          117/118 Area outboard and above NLG wheel well (exterior)

   D. Prepare for Inspection

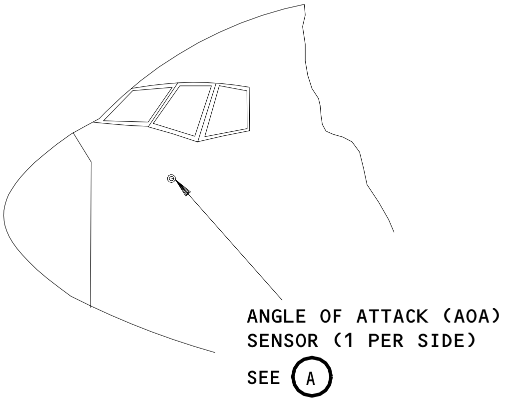
      S 866-001
      (1) Open these circuit breakers on the main distribution panel P6 and attach DO-NOT-CLOSE tags:
          (a) 6L17, L AOA HEAT
          (b) 6L23, R AOA HEAT
   E. Inspection Procedure

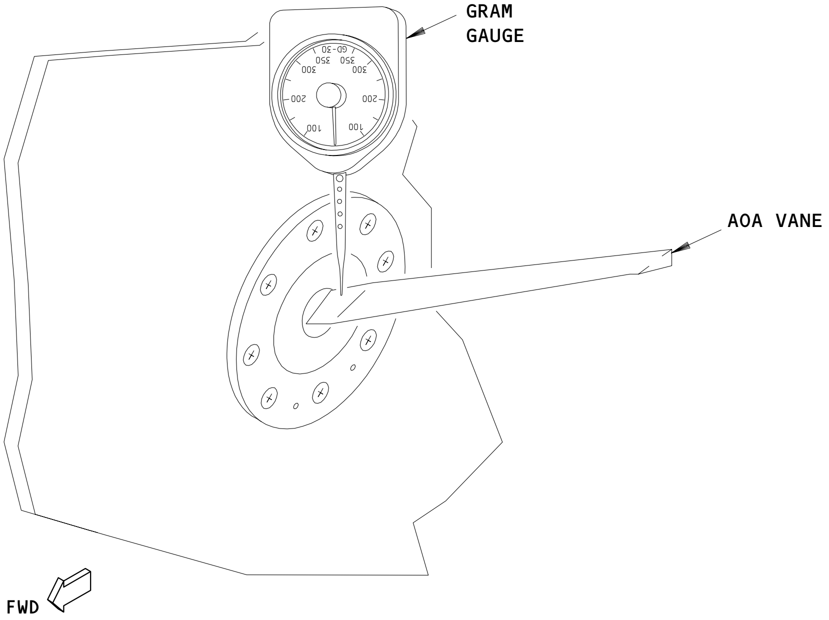
      S 866-002

      WARNING: AOA PROBE HEAT MUST BE OFF. THIS WILL PREVENT BAD BURNS.

      (1) Make sure AOA probe heat is off.

      S 866-019
      (2) Do these steps to identify AOA sensor with movement problem which the vane counterweight may stick against the vane end stop.
          (a) Turn the vane in an upward direction and put it against the upper vane end stop.
          (b) Hold the vane firmly against the vane end stop by hand for 3 seconds, then release.
          (c) Put the gram guage measurement arm against the AOA vane at the base of the trailing edge as shown in Fig. 601.
          (d) As slowly as possible, move the vane away from the vane end stop position.





ANGLE OF ATTACK SENSOR (AOA)
(EXAMPLE)
A

AOA Sensor - Inspection/Check
Figure 601

- (e) Record the results.
  - 1) Make sure that the gram gauge reading is less than 170 grams; otherwise, remove the sensor from the airplane for service.
- (f) Turn the vane downward and put it against the lower vane end stop.
- (g) Repeat steps (b), (c) and (d).
- (h) Record the results.
  - 1) Make sure that the gram gauge reading is less than 170 grams; otherwise, remove the sensor from the airplane for service.
- (i) Return the vane to a horizontal position.

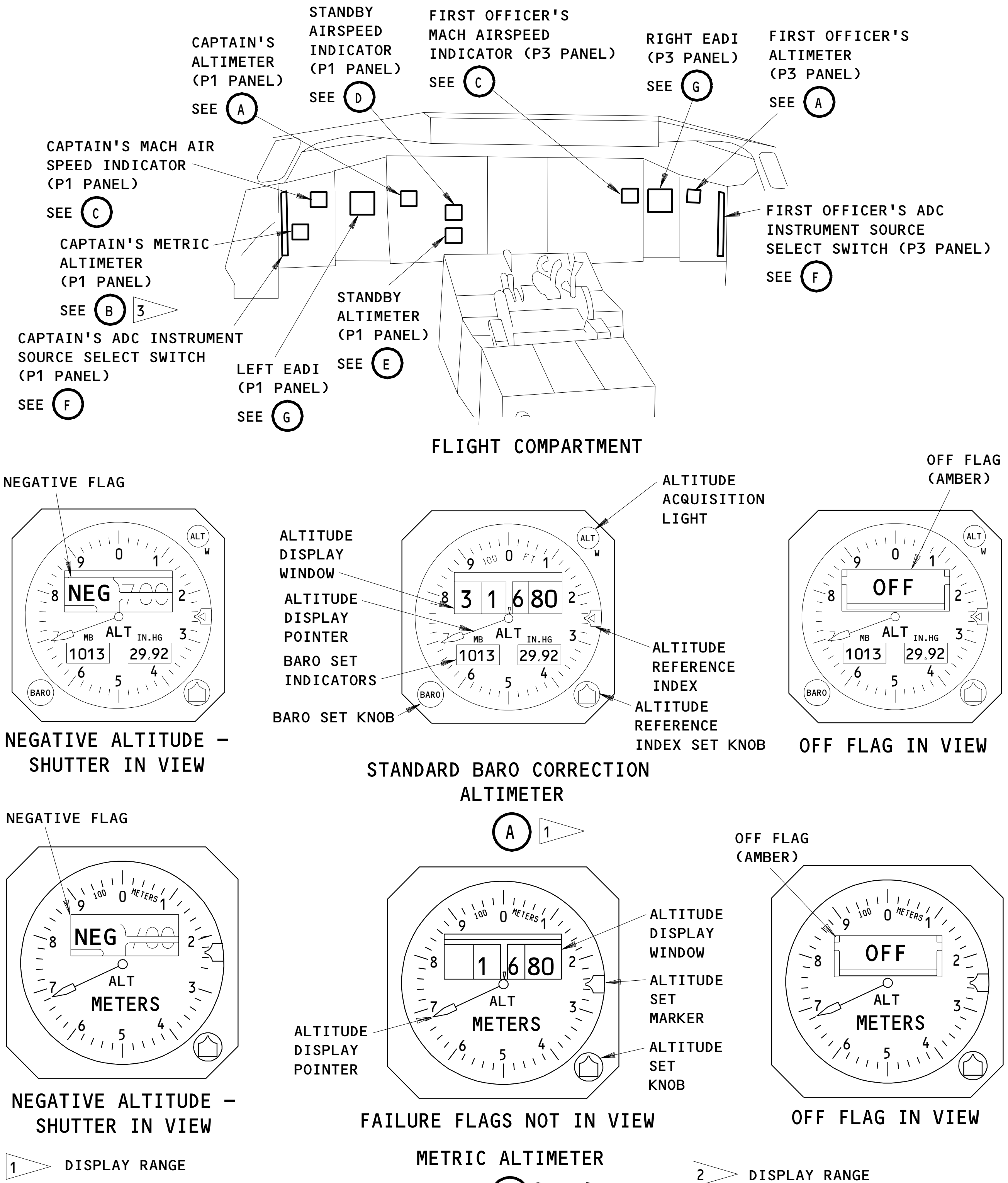
F. Put the Airplane Back to Its Usual Condition.

S 866-006

(1) Remove DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
- (a) 6L17, L AOA HEAT
- (b) 6L23, R AOA HEAT

AIR DATA INSTRUMENTS - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The air data instruments display airplane speed and altitude based upon inputs from the atmosphere. These instruments are classified as either electric or pneumatic displays. The pneumatic displays receive inputs from the pitot and static systems. The electric displays receive inputs from other units through ARINC 429 data buses.
   B. The pneumatic instruments include the standby airspeed indicator and standby altimeter. The airspeed display receives input pressure from the alternate static system and input pressure from the No. 1 auxiliary pitot system. The standby altimeter receives static inputs from the alternate static system.
   C. The electric instruments include the captain's and F/O's altimeters and MACH airspeed indicators. They receive inputs from the air data computer (ADC).
   D. GUI 001-008, 010-114, 116-999;
   The Electronic Attitude Direction Indicators (EADIs) also display airspeed data and are part of the Electronic Flight Instrument System (EFIS) (Ref 34-22-00). The EADI's display computed airspeed and MACH. The airspeed data is provided by the ADC's which feed the EFIS Symbol Generators via ARINC 429 data buses. The EFIS Symbol Generators convert this data into video signals and transmit them for display on the EADI's.
   E. True airspeed/static air temperature (TAS/SAT) and total air temperature (TAT), usually part of air data instruments, are displayed elsewhere. TAS/SAT is displayed on the FMC control display unit (Ref 34-61-00). TAT is displayed on the EICAS indicator (Ref 31-41-00).
2. Component Details (Fig. 1)
   A. MACH Airspeed Indicator
      (1) The MACH airspeed indicator displays the computed airspeed, commanded airspeed, MACH number, and maximum allowable airspeed. The indicator has a 4-inch face.
      (2) GUI 001-114, 116-999;
      Computed airspeed is displayed by a white pointer read against a numbered dial. The dial is divided into 2-knot increments from 60 to 250 knots. From 250 to 450 knots, it is divided into 10-knot increments. Airspeed is also displayed by a 3-digit display window. Airspeed is displayed in 1-knot increments from 60 to 450 knots in conjunction with the pointer.

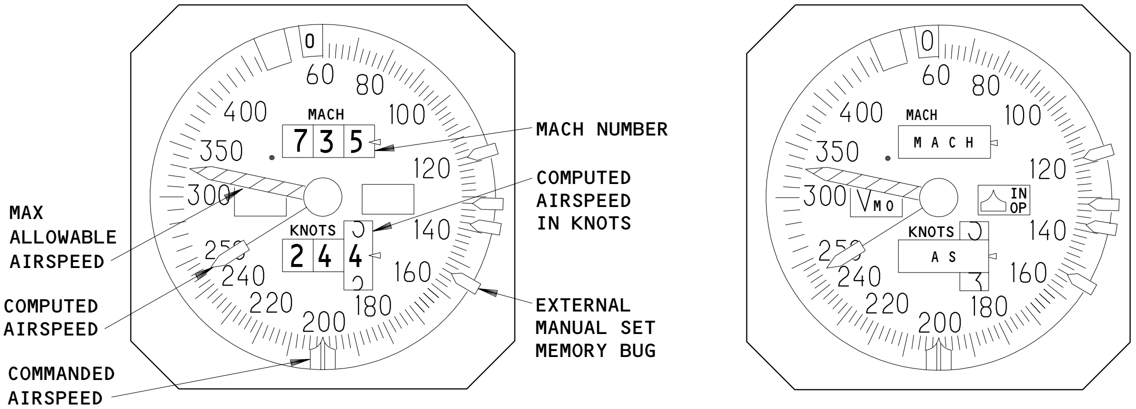


1 DISPLAY RANGE
ALTITUDE: -1000 TO 50,000 FT
BARO SET: 22.00 IN HG (745MB) TO 31.00 IN HG (1049MB)

2 DISPLAY RANGE
-300 TO +15,700 METERS

3 GUI 010,011 POST-SB 34-166

Air Data Instruments - Component Location
Figure 1 (Sheet 1)

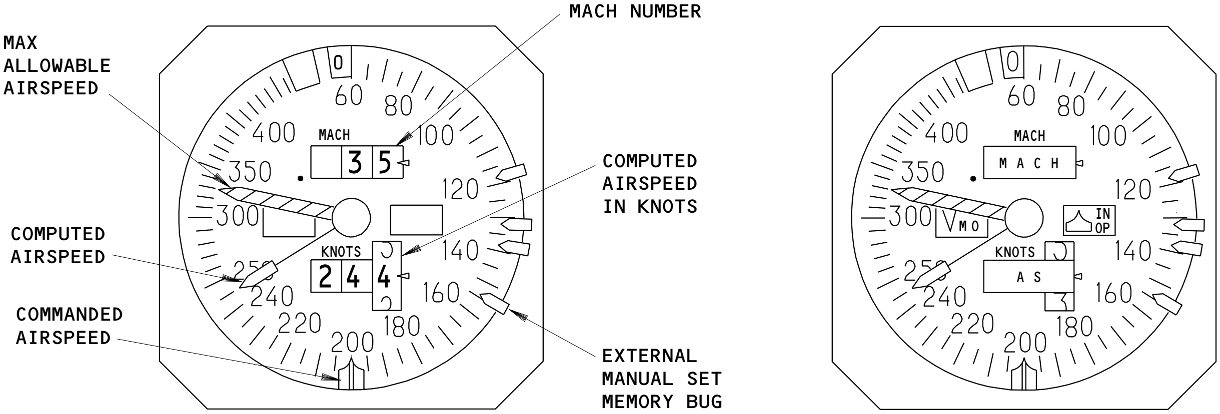


FAILURE FLAGS NOT IN VIEW

FAILURE FLAGS IN VIEW

MACH AIRSPEED INDICATOR

C 4



FAILURE FLAGS NOT IN VIEW

FAILURE FLAGS IN VIEW

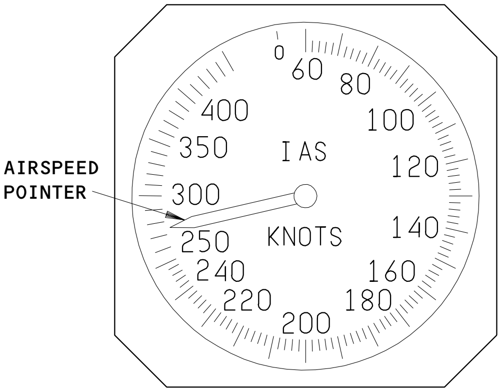
MACH AIRSPEED INDICATOR

C 5

4 GUI 001-114,116-999

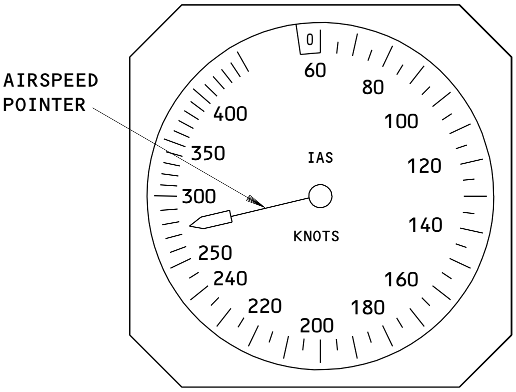
5 GUI 115

Air Data Instruments - Component Location
Figure 1 (Sheet 2)



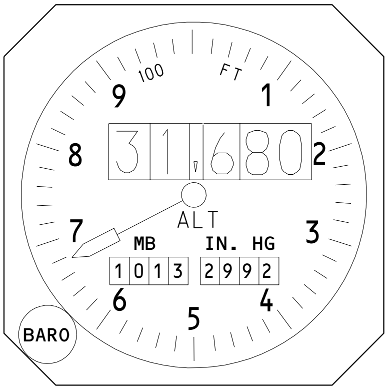
STANDBY AIRSPEED INDICATOR

D 4



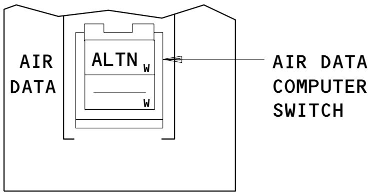
STANDBY AIRSPEED INDICATOR

D 5



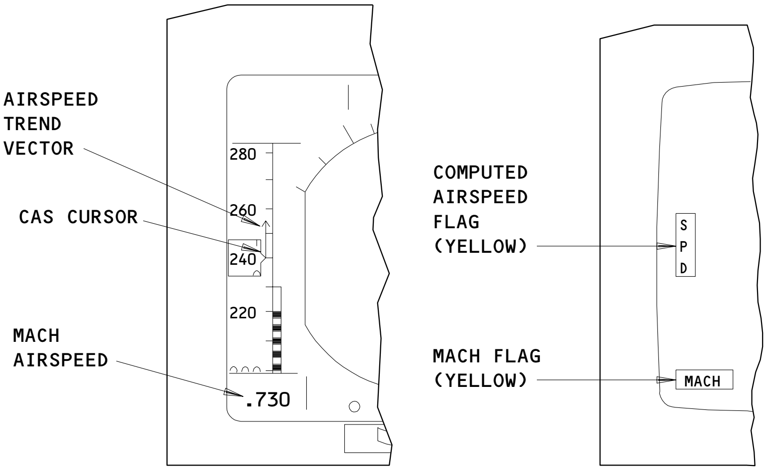
STANDBY ALTIMETER

E



INSTRUMENT SOURCE
SELECT PANEL

F



VALID DISPLAY

INVALID DATA

EADI

G 6

6 GUI 001-008,010-114,116-999

Air Data Instruments - Component Location
Figure 1 (Sheet 3)

(3) GUI 115;
Computed airspeed is displayed by a white pointer read against a numbered dial. The dial is divided into 5-knot increments from 60 to 250 knots. From 250 to 450 knots, it is divided into 10-knot increments. Airspeed is also displayed by a 3-digit display window. Airspeed is displayed in 1-knot increments from 60 to 450 knots in conjunction with the pointer.

(4) MACH number is indicated by three magnetic wheels in the range of .400 to .999 mach. The decimal point is fixed on the indicator face. MACH indications below .4 are masked by a black shutter.

(5) The commanded airspeed is displayed by a cursor moving around the periphery of the airspeed scale. The cursor is electrically positioned from a remote selector on the autopilot mode control panel.

(6) The maximum allowable airspeed (VMO/MMO) is displayed by a red and white striped pointer. The VMO/MMO is read against the computed airspeed scale.

(7) Four indices may be manually set around the face of the indicator. They are used for reference as chosen by the pilot.

(8) Failure warning flags within the indicator come into view in event of input signal and/or indicator circuit failure. Failure and indications are listed in the table below.

SIGNAL	INDICATOR FAILURE	INPUT SIGNAL FAILURE
Computed Airspeed	AS Flag	AS Flag, Pointer Indicates 0
Commanded Airspeed	INOP Flag	Index driven behind mask
Maximum Allowable Airspeed	VMO Flag	VMO Flag, Pointer indicates 260 Knots
Mach	MACH Flag	MACH Flag

(9) One MACH/Airspeed indicator is installed on the captain's main instrument panel. One is installed on the pilots' center instrument panel.

B. Altimeter

(1) The altimeter displays corrected pressure altitude from -1000 to +50,000 feet. It also displays barometric correction from 22.0 to 30.99 inches of mercury and 745 to 1049 millibars. It also contains a set altitude marker and an altitude alert light.

(2) Altitude is displayed by a pointer and a drum counter. The pointer is read against a dial which indicates altitude between thousand-foot levels in 20-foot increments. The counter is a 5-digit, 4-drum mechanical counter. It has a range of -1000 to +50,000 feet displayed in 20-foot increments. The left digit drum is colored green to alert the pilots that the altitude is less than 10,000 feet. A NEG shutter covers the counter digits when negative altitude is displayed.

(3) The indicator may be adjusted to local barometric pressure by means of the BARO set knob on the indicator. Two counters indicate the barometric setting. One reads in inches of mercury from 22.00 to 30.99 in. Hg. The other reads in millibars from 745 to 1049 mbs.

(4) The altitude reference index is located on the outer edge of the indicator. The marker is manually set by the altitude reference set knob located on the lower right corner.

(5) An altitude acquisition (ALT) light is located on the upper right corner. The light comes on when the altitude alert system is activated.

(6) If the altimeter is defective, if the input signal to the altimeter is bad, or if electrical power is removed, the OFF flag will show in front of the counter, and the counter and the pointer will stop. If there is a large difference between the altitude on the display and the altitude of the airplane, the OFF flag will show until the altimeter's pointer and counter agree with the altitude of the airplane.

(7) One altimeter is installed in the pilots' center instrument panel. One is installed in the F/O's main instrument panel.

C. Standby Altimeter

(1) The standby altimeter displays uncorrected altitude and serves as a backup to the pilots' electric altimeters. It is driven by the alternate static system.

(2) Altitude is displayed by a pointer and a drum counter. The pointer is read against a dial which indicates altitude between thousand-foot levels in 100-foot increments. The counter is a 5-digit, 3-drum mechanical counter. It has a range of -1000 to +50,000 feet displayed in 100-foot increments. The left digit drum is colored green to alert the pilots that the altitude is less than 10,000 feet. A NEG shutter covers the counter digits when negative altitude is displayed.

(3) The indicator may be adjusted to local barometric pressure by means of the BARO set knob on the indicator. Two counters indicate the barometric setting. One reads in inches of mercury from 22.00 to 30.99 in. Hg. The other reads in millibars from 745 to 1049 mbs.

(4) The Standby Altimeter is located on the pilot's center instrument panel.

D. Standby Airspeed Indicator

(1) GUI 001-114, 116-999;
The standby airspeed indicator provides a visual display of the indicated airspeed in the range of 60 to 450 knots. Airspeed is indicated by a pointer read against a graduated scale . The scale is divided into 2-knot increments from 60 to 250 knots, and 10-knot increments from 250 to 450 knots.

(2) GUI 115;
The standby airspeed indicator provides a visual display of the indicated airspeed in the range of 60 to 450 knots. Airspeed is indicated by a pointer read against a graduated scale. The scale is divided into 5-knot increments from 60 to 250 knots, and 10-knot increments from 250 to 450 knots.

(3) The standby airspeed indicator is installed in the pilot's center instrument panel.

E. GUI 001-008, 010-114, 116-999;
EADI (Interface)

(1) The EADI's display computed airspeed and MACH. Computed airspeed is displayed on the left side of the EADI's. MACH data is displayed in the lower left corner.

(2) Computed airspeed is indicated by a white airspeed tape that moves against a fixed green pointer. Speed scale numbers are also in white. When the speed is equal to or less than 30 knots or NCD, the tape indicates 30 knots. Speed scale below 30 knots is blank. Invalid data is annunciated by replacing the normal display with the letters SPD in a yellow box (Ref 34-22-00).

(3) MACH is indicated by white numerics and is displayed for MACH values greater than or equal to .400. Invalid data is annunciated by replacing the normal display with the letters MACH in yellow outlined by a yellow box (Ref 34-22-00). For MACH NCD, three dashes are displayed.

(4) Airspeed trend vector, a green symbol placed alongside the airspeed tape, indicates the airspeed acceleration or deceleration. For acceleration, the arrow points upward and for deceleration, the arrow points downward. The symbol is displayed if the trend is greater than 4.5 knots and is removed when the trend is less than 3.5 knots.

F. GUI 010, 011 WITH SB 34-166;
Metric Altimeter

(1) The metric altimeter also displays corrected altitude. It contains an altitude set knob which provides a means of manually controlling a settable altitude marker.

(2) Altitude is displayed by a pointer and a drum counter. The pointer is read against a dial which indicates altitude between 1000-foot levels in 20-foot increments. It has a range of -300 to +15,700 meters (-1000 to +51,500 ft).

(3) The counter is a five-digit, four-drum mechanically driven counter. The least significant altitude drum is in 20-foot increments. The other three drums display 100 meter, 1000 meter, and 10,000 meter increments of altitude. The 10,000 meter drum shall be green for altitudes less than 10,000 meters.

(4) Negative altitudes are displayed with the two most significant counter drums (10,000 and 1000) covered by a NEG flag.

(5) In event of a metric altimeter input signal failure or on electrical power failure, an amber-colored OFF flag will come into view. The flag covers the altitude drum counter and the altitude pointer returns to zero. If a failure occurs within the metric altimeter, the OFF flag comes into view and the pointer remains at its present position.

(6) The metric altimeter pointer and counter are mechanically linked and driven by the same servo loop. The input signal displays altitude accurate to within ±5 meters and the counter-pointer difference should also not exceed 5 meters.

(7) One metric altimeter is installed on the captain's main instrument panel.

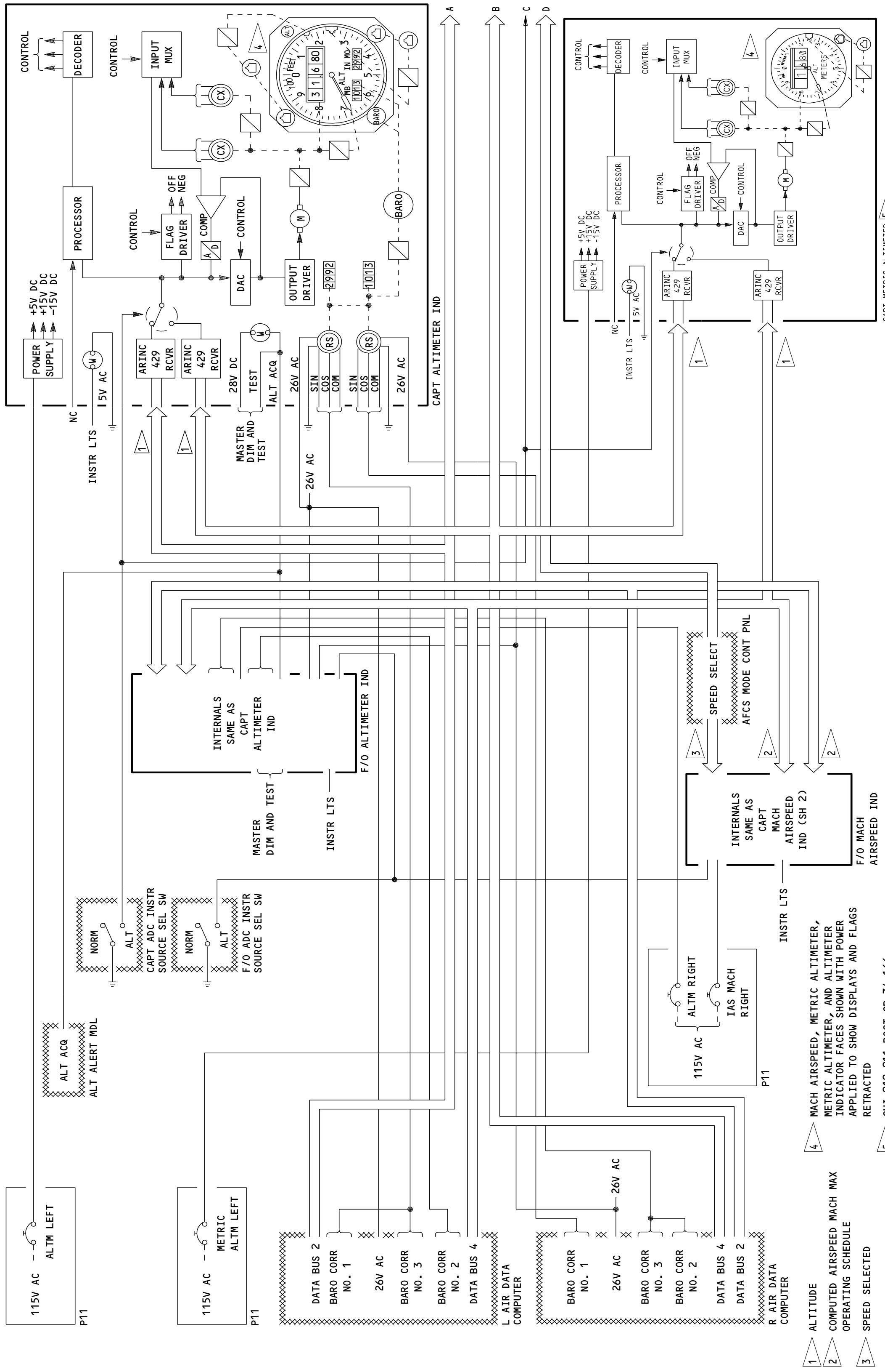
G. AIR DATA Instrument Source Select Switch

(1) The AIR DATA instrument source select switches select which ADC supplies data to the captain's and F/O's instruments. The switches are located on the captain's and F/O's main instrument panel.

3. Operation (Fig. 2)

A. AIR DATA Instrument Source Select Switch

(1) GUI 009, 115;
The MACH airspeed indicator and the altimeter both receive data from both air data computers. The captain's instruments normally run off the left ADC and the F/O's instrument off the right ADC. When either the captain or F/O AIR DATA switch is set to ALTN, a discrete is sent to the respective MACH airspeed indicator and altimeter. This causes these instruments to switch over to the alternate ADC.



1 ALTITUDE

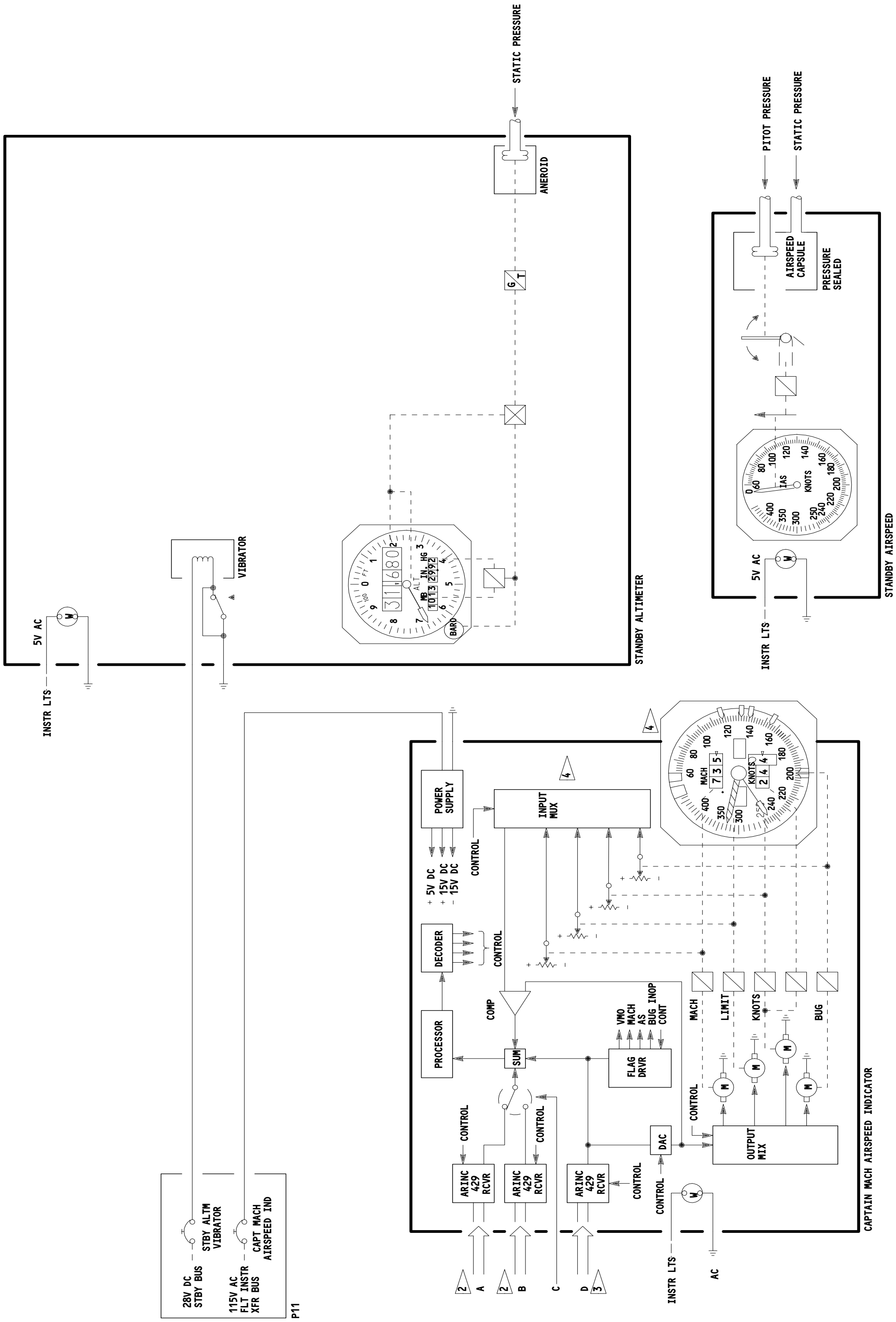
2 COMPUTED AIRSPEED MACH MAX OPERATING SCHEDULE

3 SPEED SELECTED

4 MACH AIRSPEED, METRIC ALTIMETER, METRIC ALTIMETER, AND ALTIMETER INDICATOR FACES SHOWN WITH POWER APPLIED TO SHOW DISPLAYS AND FLAGS RETRACTED

5 GUI 010,011 POST-SB 34-166

Left and Right Air Data Instruments Schematic
Figure 2 (Sheet 1)



Left And Right Air Data Instruments Schematic
Figure 2 (Sheet 2)

(2) GUI 001-008, 010-114, 116-999;
The EFIS Symbol Generator, MACH airspeed indicator, and the altimeter all receive data from both air data computers. The captain's instruments normally run off the left ADC and the F/O's instrument off the right ADC. When either the captain or F/O AIR DATA switch is set to ALTN, a discrete is sent to the respective EFIS Symbol Generator, MACH airspeed indicator, and altimeter. This causes these instruments to switch over to the alternate ADC.

B. MACH Airspeed Indicator

(1) Computed Airspeed Display

(a) The MACH airspeed indicator receives computed airspeed data from the ADC on an ARINC 429 digital data bus. Provisions and switching for a second ADC input are provided but not implemented at this time. The airspeed data is buffered and then transferred to the processor. The processor controls operation of the indicator by execution of its stored program. It also performs data calculations, storage, and failure monitoring.

(b) After the airspeed data is processed, it is converted to an analog voltage (D/A). The analog signal is output to both the comparator and to the output driver. The motor, controlled by the drive circuit, drives the airspeed pointer and three drum counter. The motor also positions the two speed resolver which sends course and fine position feedback signals to the multiplexer (MUX). The MUX output is compared with the original drive signal to null out servo error until the display equals the airspeed input.

(c) The processor monitors the airspeed circuits and incoming data. Detected failures cause the airspeed (AS) flag to come into view. For internal circuit failures or loss of power, only the AS flag appears. For detected airspeed input data faults, the AS flag comes into view and the pointer indicates zero. A time delay in the processor prevents nuisance tripping of the flags.

(2) Mach Display

(a) The MACH number data input and processing are identical to the airspeed signal. The MACH number is displayed on a 3-digit magnetic wheel and is not servoed, but is directly monitored by the multiplexer.

(b) For detected MACH input data faults, the MACH failure shutter comes into view and covers the 3-digit readout. A time delay in the processor prevents nuisance tripping of flags.

(3) Maximum Allowable Airspeed (VMO/MMO)

(a) The maximum allowable airspeed (VMO/MMO) data input and processing are identical to the airspeed signals. VMO/MMO is displayed by a servoed, stripped pointer rotating adjacent to the airspeed dial scale. The VMO flag comes into view in event of indicator circuit failure. The flag comes in view and the pointer indicates 260 knots in the event of input signal failure.

(4) Commanded/Selected Airspeed Display

(a) The selected airspeed signal is supplied from the autopilot mode control panel. Signal processing is identical to the airspeed signal. The selected airspeed is displayed by a servoed bug rotating about the periphery of the airspeed dial scale. An INOP flag comes into view in the event of indicator circuit failures. The index is driven behind the mask in event of input signal failures.

C. Altimeter

(1) The following description is common to both the captain's and F/O's altimeters.

(2) Power

(a) The altimeter receives 115 volts ac from the altimeter circuit breaker for its power supply. It receives 26 volts ac from the ADC for resolver excitation. It also receives 28 volts dc from the lighting circuits for the ALT acquisition light.

(3) Altitude Display

(a) The altimeter receives altitude data or an ARINC 429 digital data bus from the ADC. Provisions and switching for a second ADC input are not used at this time. The altitude data is buffered and then transferred to the processor. The processor controls all operations by execution of its stored program. It also performs data calculations, storage, and failure monitoring.

(b) After the data is processed, it is routed to the digital-to-analog converter (DAC). The analog signal is output to both the comparator and to the output driver. The analog signal drives the pointer and drum display through the servo motor and driver. They are driven to the position determined by the ADC input.

(c) The motor also drives the two-speed resolver. The resolver pick-off sends position feedback signals to the input MUX. The MUX output or display position is compared with the desired position. Any error signal is processed and routed to the servo loop. The servo error is reduced to a null when the displayed altitude equals the ADC input.

(d) The processor monitors all operations of the altitude display and the incoming data. If any indicator fault is detected, or there is a loss of input power, the failure warning OFF flag will come into view. If an incorrect data word is detected or there is an absence of input data, the OFF flag will come into view. The pointer will also indicate zero. The negative altitude NEG flag will come into view when the displayed altitude is negative.

(4) BARO Correction

(a) The BARO set knob on the front panel is used to correct for variations in local barometric pressure. It is mechanically linked to the front panel BARO counters. Two resolvers are linked to the counters. They transmit the barometric correction to the interfacing ADC.

(5) Altitude Acquisition Light
   (a) The altitude acquisition light comes on when within 900 feet of the selected altitude (Ref 34-16-00). It will go off when within 300 feet of this altitude.

(6) Altitude Reference Index
   (a) The altitude reference index is manually driven by the reference index knob. The index moves around the outer edge of the display and can be set anywhere on the dial. This system is independent of any other system in the indicator.

D. Standby Altimeter

(1) Operation
   (a) The standby altimeter receives static pressure from the alternate static system. The altimeter mechanism is housed in an airtight case into which static air enters. Two aneroid diaphragms expand or contract in response to the static pressure change. The aneroid diaphragms drive the altitude gear train. The gear train links mechanically to the altitude counter and pointer.
   (b) GUI 115;
   Rotation of the BARO set knob on the front panel provides correction for local changes in barometric pressure. The knob drives the spiral gear and linkage. This changes the operation of the mechanical drive system to correct for pressure variations. It also drives the two BARO counters and two resolvers which transmit the BARO correction to the interfacing ADC.
   (c) GUI 001-114, 116-999;
   Rotation of the BARO set knob on the front panel provides correction for local changes in barometric pressure. The knob drives the spiral gear and linkage. This changes the operation of the mechanical drive system to correct for pressure variations.
   (d) A vibrator is mounted on the instrument frame to reduce friction errors in the mechanical linkage and to improve indicator response. The vibrator receives 28 volts dc power from the 28-volt dc standby bus. Power is controlled by the STBY ALTM VIBRATOR circuit breaker on the P11 panel.

E. GUI 010, 011 WITH SB 34-166;
Metric Altimeter

(1) The captain's metric altimeter operates identically to the captain's and F/O's altimeters as described above. However, the metric altimeter does not have an altitude acquisition light and does not provide BARO correction.

F. Standby Airspeed Indicator

(1) The indicator mechanism is contained in a hermetically sealed case with two pressure ports. One port is for static pressure which is supplied to the case interior. The other port is connected to the aneroid diaphragm and supplies pitot pressure. The diaphragm expands and contracts in response to changes in the pitot-static pressure. This deflection is transmitted by the rocking shaft sector gear to the pinion drive gear. This gear converts the linear motion to rotary movement of the pointer shaft and airspeed pointer. The hairspring removes backlash from the mechanism.

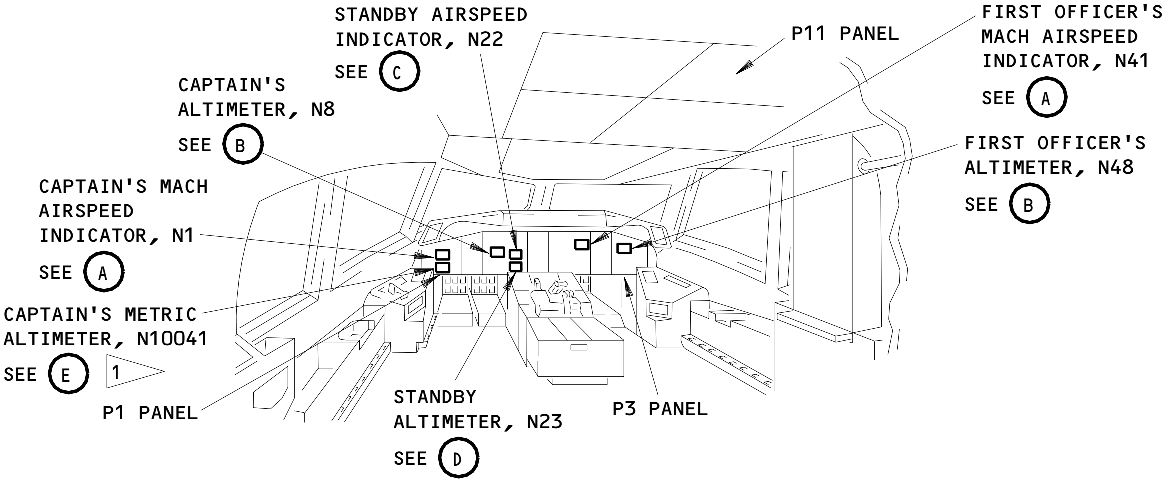
AIR DATA INSTRUMENTS

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ALTIMETER - CAPT, N8	2	1	FLIGHT COMPARTMENT, P1	34-13-01
ALTIMETER - F/O, N48	2	1	FLIGHT COMPARTMENT, P3	34-13-01
ALTIMETER - STANDBY, N23	2	1	FLIGHT COMPARTMENT, P1	34-13-06
CIRCUIT BREAKER -	1	1	FLIGHT COMPARTMENT, P11	
ALTM LEFT, C584		1	11E2	*
ALTM RIGHT, C585		1	11E23	*
IAS MACH LEFT, C580		1	11E1	*
IAS MACH RIGHT, C581		1	11E22	*
METRIC ALTM LEFT, C4499 [1]		1	11E7	*
STBY ALTM VIB, C591		1	11A8	*
INDICATOR - CAPT MACH AIRSPEED, N1	2	1	FLIGHT COMPARTMENT, P1	34-13-02
INDICATOR - F/O MACH AIRSPEED, N41	2	1	FLIGHT COMPARTMENT, P3	34-13-02
INDICATOR - STANDBY AIRSPEED, N22	2	1	FLIGHT COMPARTMENT, P1	34-13-05
METRIC ALTIMETER - CAPT, N10041 [1]		1	FLIGHT COMPARTMENT, P1	34-13-08
SWITCH - (FIM 34-12-00/101)				
CAPT ADC INSTR SOURCE SELECT, S482				
F/O ADC INSTR SOURCE SELECT, S483				

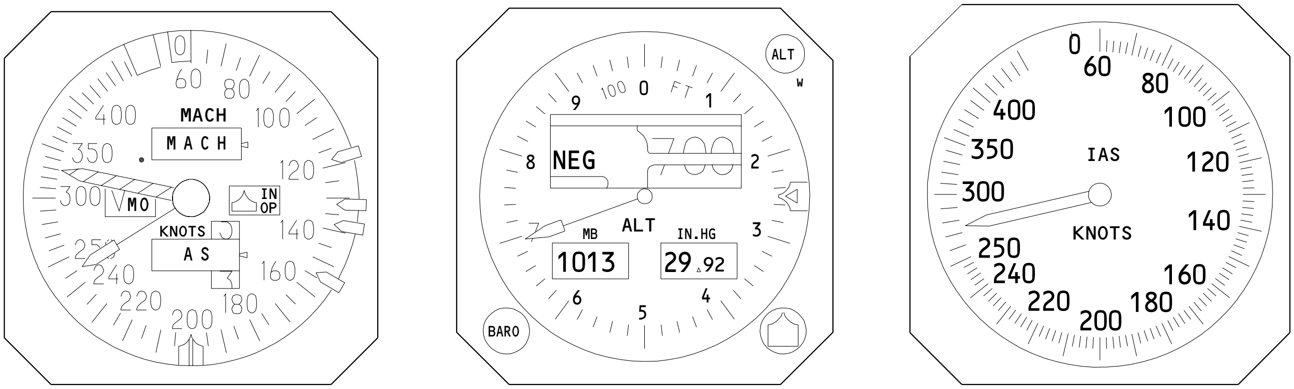
* SEE THE WDM EQUIPMENT LIST

[1] GUI 010,011 POST SB 34-166

Air Data Instruments - Component Index
Figure 101



FLIGHT COMPARTMENT



MACH AIRSPEED INDICATOR (WITH FLAGS), N1 OR N41

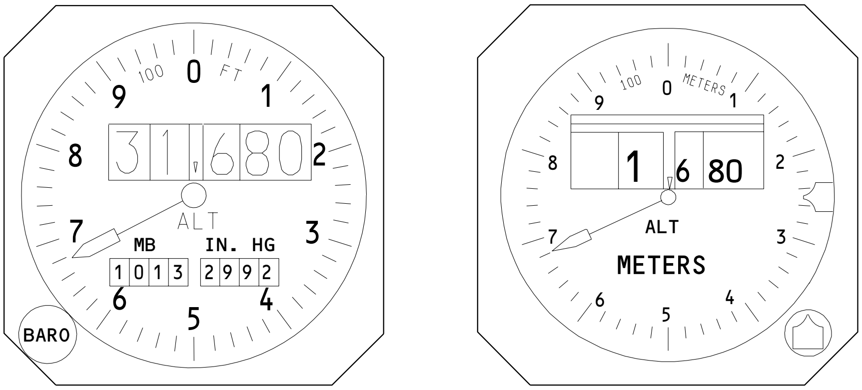
A

ALTIMETER (WITH OFF FLAG), N8 OR N48

B

STANDBY AIRSPEED INDICATOR, N22

C



STANDBY ALTIMETER, N23

D

METRIC ALTIMETER, N10041

E 1

1 GUI 010,011
POST-SB 34-166

Air Data Instruments - Component Location
Figure 102

AIR DATA INSTRUMENTS - ADJUSTMENT/TEST

1. General
   A. This procedure contains one task. This task is the System Test of the Air Data Instruments.

TASK 34-13-00-735-001

2. System Test - Air Data Instruments
   A. General
      (1) The operational and system tests for the electric air data instruments are done in the air data computer system adjustment/test (AMM 34-12-00/501). This procedure does the test for the air data instruments that get inputs directly from the pitot and/or static system. These instruments are the Standby Airspeed Indicator and the Standby Altimeter. This test uses the pitot-static system to give indication of airspeed and altitude for these two instruments. Equipment used, operation, and setup are included in the Pitot and Static Systems Pressurization (AMM 34-11-00/501).
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 34-11-00/501, Pitot and Static Systems
   C. Access
      (1) Location Zones
         211/212 Flight Compartment

   D. Procedure

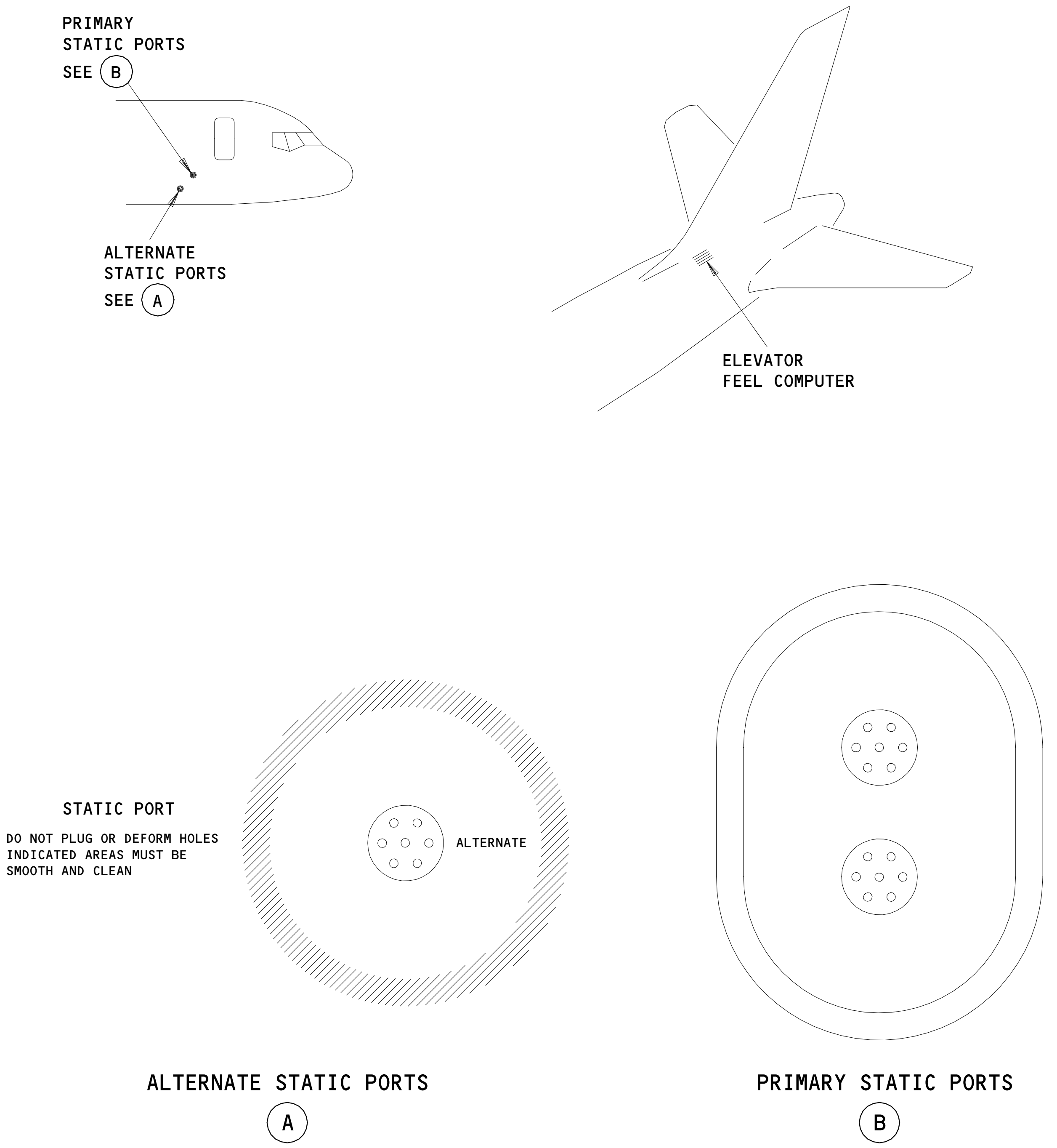
S 865-026

(1) Supply electrical power (AMM 24-22-00/201).

S 865-034

WARNING: MAKE SURE THE RAT AUTO PWR CIRCUIT BREAKER IS OPEN BEFORE YOU TEST THE PITOT-STATIC SYSTEM. IF YOU DO NOT AND DIFFERENTIAL PRESSURE EQUAL TO 80 KNOTS IS APPLIED WITH BOTH ENGINES OFF, THE RAT WILL DEPLOY. THIS CAN CAUSE INJURY TO PERSONS.

(2) Open this circuit breaker on the overhead P11 panel and attach a DO-NOT-CLOSE tag:
   (a) 11D27, HYDRAULIC RAT AUTO PWR



Component Location
Figure 501

S 865-036

(3) Open these circuit breakers and attach DO-NOT-CLOSE tags:

(a) On the power distribution panel, P6:

1) 6L13, 6L14, or 6L15, CAPT MAIN PITOT HEAT
2) 6L14, 6L15, or 6L16, L AUX PITOT HEAT
3) 6L21, R AUX PITOT HEAT
4) 6L22, F/O MAIN PITOT HEAT

S 705-011

(4) Standby Airspeed Indicator Test

CAUTION: THE NO. 1 AUXILIARY PITOT LINE CONNECTED TO THE ELEVATOR FEEL COMPUTER MUST BE DISCONNECTED AND CAPPED. THIS WILL PREVENT DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(a) Disconnect and cap the No. 1 Auxiliary Pitot Line at the elevator feel computer.
(b) Pressurize the alternate static system and the No. 1 auxiliary pitot system (AMM 34-11-00/201).
(c) Apply 29.921 in. Hg. to the alternate static system.
(d) Apply pressure to the Auxiliary No. 1 (lower RHS) pitot probe to get the test airspeeds in the table that follows. Make sure the values on the standby airspeed indicator are within tolerances shown for each airspeed value.

AIRSPEED (KNOTS)	PRESSURE (PITOT MINUS STATIC) (INCHES MERCURY)	TOLERANCES (KNOTS)
120	.695	±5
180	1.580	±5
250	3.100	±5
280	3.924	±5
300	4.534	±5

(e) Put the pitot and static systems to ambient pressure (AMM 34-11-00/201).

(f) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  1) On the P6 panel:
    a) 6L13, 6L14, or 6L15, CAPT MAIN PITOT HEAT
    b) 6L14, 6L15, or 6L16, L AUX PITOT HEAT
    c) 6L21, PITOT HEAT R AUX
    d) 6L22, PITOT HEAT F/O MAIN

(g) Remove the cap and connect the No. 1 Auxiliary Pitot Line to the elevator feel computer.

S 705-027

(5) Standby Altimeter Test

(a) Make sure these circuit breakers on the P11 panel are closed:
  1) 11A8, STBY ALTM VIB

(b) Seal these static port(s) (AMM 34-11-00/201).
  1) Opposite RHS (STA 535 WL 173.5).

(c) Make sure the vibrator in the standby altimeter operates.

NOTE: To do this, touch the standby altimeter casing.

(d) Set BARO scale to 29.92 inches of mercury on standby altimeter.

CAUTION: THE NO. 1 AUXILIARY PITOT LINE CONNECTED TO THE ELEVATOR FEEL COMPUTER MUST BE DISCONNECTED AND CAPPED. THIS WILL PREVENT DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(e) Disconnect and cap the No. 1 Auxiliary Pitot Line from the elevator feel computer.

(f) Disconnect the alternate static line from the RAT airspeed switch (AMM 29-21-53) and seal the end of the disconnected pipe with a suitable plug.

CAUTION: DO NOT PERMIT THE RATE OF PRESSURE CHANGE TO BE MORE THAN 5,000 FT/MIN. KEEP THE DIFFERENTIAL PRESSURE BETWEEN THE PITOT AND STATIC SYSTEMS LESS THAN 10 INCHES OF MERCURY. MAKE SURE THAT THE PRESSURE IN THE PITOT SYSTEM IS ALWAYS GREATER THAN OR EQUAL TO THE PRESSURE IN THE STATIC SYSTEM. THIS WILL PREVENT INSTRUMENT DAMAGE.

(g) Pressurize the alternate static system (AMM 34-11-00/201).

(h) Apply absolute pressures to the alternate static and the auxiliary pitot #1 systems equivalent to altitudes shown in the table that follows. Make sure the values shown on the standby altimeter are within the tolerance shown for each test point. At each test point, decrease pressure slowly to the correct level without overshoot.

(i) Make sure the vibrator turns on.

(j) Stop the vacuum between the airplane's systems and the test source after the system has become stable at each test altitude.

ALTITUDE (FEET)	PRESSURE (STATIC) INCHES MERCURY	ALTIMETER VALUE (FEET)
0	29.921	0 ±25
5,000	24.896	5,000 ±45
10,000	20.577	10,000 ±60
20,000	13.750	20,000 ±100
25,000	11.104	25,000 ±120
40,000	5.538	40,000 ±200

S 865-029

(6) Put the alternate static and pitot systems to ambient pressure (AMM 34-11-00/201).

S 865-031

(7) Remove DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
    (a) 11D27, HYDRAULIC RAT AUTO PWR

S 865-087

(8) Remove cap and connect No. 1 Auxiliary Pitot Line to elevator feel computer.

S 865-088

(9) Remove the plug from and reconnect the alternate static line to the RAT airspeed switch (AMM 29-21-53).

S 795-017

(10) Do a leak test of the auxiliary No. 1 pitot system (AMM 34-11-00/501).

S 795-096

(11) Do a leak test of the alternate static line (AMM 34-11-00/501).

S 865-030

(12) Remove the pitot-static test equipment and seals from static ports and probes (AMM 34-11-00/501).

S 865-028

(13) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-13-00-735-008

3. System Test - Air Data Instruments

NOTE: This is a scheduled maintenance task.

A. General

(1) The operational and system tests for the electric air data instruments are done in the air data computer system adjustment/test (AMM 34-12-00/501). This procedure does the test for the air data instruments that get inputs directly from the pitot and/or static system. These instruments are the Standby Airspeed Indicator and the Standby Altimeter. This test uses the pitot-static system to give indication of airspeed and altitude for these two instruments. Equipment used, operation, and setup are included in the Pitot and Static Systems Pressurization (AMM 34-11-00/201).

B. References

(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 34-11-00/501, Pitot and pitot Static Systems
(3) AMM 34-11-00/201, Pitot and Static Systems

C. Access

(1) Location Zones

211/212 Flight Compartment

D. Prepare for the test

S 865-059

(1) Supply electrical power (AMM 24-22-00/201).

S 865-060

WARNING: OPEN 11D27 RAT AUTO PWR CIRCUIT BREAKER ON PANEL P11 AND 6F1 RAT MAN PWR CIRCUIT BREAKER ON PANEL P6. IF SIMULATED PITOT-STATIC DIFFERENTIAL PRESSURE EQUAL TO 80 KNOTS IS APPLIED WITH BOTH ENGINES OFF, THE RAT WILL DEPLOY WHICH COULD CAUSE INJURY TO PERSONNEL.

(2) Open this circuit breaker on the overhead P11 panel and attach DO-NOT-CLOSE tag:
    (a) 11D27, RAT AUTO PWR

S 865-061

(3) Open this circuit breakers on the P6 panel and attach DO-NOT-CLOSE identifier:
   (a) 6F1, RAT MAN PWR

S 865-076

(4) Open these circuit breakers and attach DO-NOT-CLOSE tags:
   (a) On the P6 panel:
      1) 6L13, 6L14, or 6L15, CAPT MAIN PITOT HEAT
      2) 6L14, 6L15, or 6L16, L AUX PITOT HEAT
      3) 6L21, PITOT HEAT R AUX
      4) 6L22, PITOT HEAT F/O MAIN

E. Standby Altimeter Test

S 705-095

(1) Do the test for Standby Altimeter as follows:
   (a) Make sure these circuit breakers on the P11 panel are closed:
      1) 11A8, STBY ALTM VIB
   (b) Seal these static port(s) (AMM 34-11-00/201).
      1) Opposite RHS (STA 535 WL 173.5).
   (c) Make sure the vibrator in the standby altimeter operates.

      <u>NOTE</u>: To do this, touch the standby altimeter casing.

   (d) Set BARO scale to 29.92 inches of mercury on standby altimeter.

<u>CAUTION</u>: THE NO. 1 AUXILIARY PITOT LINE CONNECTED TO THE ELEVATOR FEEL COMPUTER MUST BE DISCONNECTED AND CAPPED. THIS WILL PREVENT DAMAGE TO THE ELEVATOR FEEL COMPUTER.

   (e) Disconnect and cap the No. 1 Auxiliary Pitot Line from the elevator feel computer.
   (f) Disconnect the alternate static line for the RAT airspeed switch (AMM 29-21-53) and seal the end of the disconnected pipe with a suitable plug.

<u>CAUTION</u>: DO NOT PERMIT THE RATE OF PRESSURE CHANGE TO BE MORE THAN 5,000 FT/MIN. KEEP THE DIFFERENTIAL PRESSURE BETWEEN THE PITOT AND STATIC SYSTEMS LESS THAN 10 INCHES OF MERCURY. MAKE SURE THAT THE PRESSURE IN THE PITOT SYSTEM IS ALWAYS GREATER THAN OR EQUAL TO THE PRESSURE IN THE STATIC SYSTEM. THIS WILL PREVENT INSTRUMENT DAMAGE.

   (g) Pressurize the alternate static system (AMM 34-11-00/201).
   (h) Apply absolute pressures to the alternate static and the auxiliary pitot #1 systems equivalent to altitudes shown in the table that follows. Make sure the values shown on the standby altimeter are within the tolerance shown for each test point. At each test point, decrease pressure slowly to the correct level without overshoot.

(i) Make sure the vibrator turns on.

(j) Stop the vacuum between the airplane's systems and the test source after the system has become stable at each test altitude.

ALTITUDE (FEET)	PRESSURE (STATIC) INCHES MERCURY	ALTIMETER VALUE (FEET)
0	29.921	0 ±25
5,000	24.896	5,000 ±45
10,000	20.577	10,000 ±60
20,000	13.750	20,000 ±100
25,000	11.104	25,000 ±120
40,000	5.538	40,000 ±200

S 865-049

(2) Put the alternate static and pitot systems to ambient pressure (AMM 34-11-00/201).

S 865-051

(3) Remove DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
- (a) 11D27, HYDRAULIC RAT AUTO PWR

S 865-053

(4) Remove DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
- (a) 6F1, RAT MAN PWR
- (b) 6L13, 6L14, or 6L15, CAPT MAIN PITOT HEAT
- (c) 6L14, 6L15, or 6L16, L AUX PITOT HEAT
- (d) 6L21, PITOT HEAT R AUX
- (e) 6L22, PITOT HEAT F/O MAIN

S 865-055

(5) Remove cap and connect No. 1 Auxiliary Pitot Line to elevator feel computer.

S 865-086

(6) Remove the plug from and reconnect the alternate static line to the RAT airspeed switch (AMM 29-21-53).

S 865-065

(7) Do an auxiliary pitot system #1 leak check (AMM 34-11-00/501).

S 865-056

(8) Remove the pitot-static test equipment and seals from static ports and probes (AMM 34-11-00/501).

S 865-057

(9) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-13-00-735-009

4. System Test - Air Data Instruments

NOTE: This is a scheduled maintenance task.

A. General

(1) The operational and system tests for the electric air data instruments are done in the air data computer system adjustment/test (AMM 34-12-00/501). This procedure does the test for the air data instruments that get inputs directly from the pitot and/or static system. These instruments are the Standby Airspeed Indicator and the Standby Altimeter. This test uses the pitot-static system to give indication of airspeed and altitude for these two instruments. Equipment used, operation, and setup are included in the Pitot and Static Systems Pressurization (AMM 34-11-00/201).

B. References

(1) AMM 24-22-00/201, Electrical Power-Control
(2) AMM 34-11-00/201, Pitot and static Static Systems
(3) AMM 34-11-00/501, Pitot and static Static Systems

C. Procedure

S 865-045

(1) Supply electrical power (AMM 24-22-00/201).

S 865-046

WARNING: MAKE SURE THAT THE 11D27 CB AND THE 6F1 CB ARE OPEN WHEN YOU APPLY A DIFFERENTIAL PRESSURE EQUAL TO 80 KNOTS WITH THE ENGINES OFF. THE RAT WILL DEPLOY WHICH COULD CAUSE INJURY TO PERSONNEL.

(2) Open this circuit breaker on the overhead P11 panel and attach DO-NOT-CLOSE tag:
  (a) 11D27, HYDRAULIC RAT AUTO PWR

S 865-047

(3) Open this circuit breakers on the P6 panel and attach DO-NOT-CLOSE identifier:
  (a) 6F1, RAT MAN PWR

S 865-079

(4) Open these circuit breakers on P6 panel and attach DO-NOT-CLOSE tags:
  (a) 6L13, 6L14, or 6L15, CAPT MAIN PITOT HEAT
  (b) 6L14, 6L15, or 6L16, L AUX PITOT HEAT
  (c) 6L21, PITOT HEAT R AUX
  (d) 6L22, PITOT HEAT F/O MAIN

D. Standby Airspeed Indicator Test

S 865-093

(1) Do the test of Standby Airspeed Indicator as follows:

<u>CAUTION</u>: THE NO. 1 AUXILIARY PITOT LINE CONNECTED TO THE ELEVATOR FEEL COMPUTER MUST BE DISCONNECTED AND CAPPED. THIS WILL PREVENT DAMAGE TO THE ELEVATOR FEEL COMPUTER.

(a) Disconnect and cap the No. 1 Auxiliary Pitot Line at the elevator feel computer.
(b) Pressurize the alternate static system and the No. 1 auxiliary pitot system (AMM 34-11-00/201).
(c) Apply 29.921 in. Hg. to the alternate static system.
(d) Apply pressure to the Auxiliary No. 1 (lower RHS) pitot probe to get the test airspeeds in the table that follows. Make sure the values on the standby airspeed indicator are within tolerances shown for each airspeed value.

AIRSPEED (KNOTS)	PRESSURE (PITOT MINUS STATIC) INCHES MERCURY	TOLERANCES (KNOTS)
120	.695	±5
180	1.580	±5
250	3.100	±5
280	3.924	±5
300	4.534	±5

(e) Put the pitot—static system to ambient pressure (AMM 34—11—00/201).
(f) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
    1) 6F1, RAT MAN PWR
    2) 6L15, PITOT HEAT CAPT MAIN
    3) 6L16, PITOT HEAT L AUX
    4) 6L21, PITOT HEAT R AUX
    5) 6L22, PITOT HEAT F/O MAIN

S 865-094

(2) Remove the cap and connect the No. 1 Auxiliary Pitot Line to the elevator feel computer.

S 205-017

(3) Do an auxiliary pitot system No. 1 leak check (AMM 34-11-00/501).

S 865-041

(4) Remove the pitot-static test equipment and seals from static ports and probes (AMM 34-11-00/201).

S 865-042

(5) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ALTIMETER - REMOVAL/INSTALLATION

1. General
   A. There are two altimeters (N8-Left and N48-Right). These procedures give instructions for the removal and installation.

TASK 34-13-01-004-001

2. Remove the Altimeter
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones
         211/212 Flight Compartment
   C. Procedure

      S 864-009

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) For the captain's altimeter:
            1) 11E2, ALTM LEFT
            2) 11N2, INSTRUMENT AND PANEL CAPT
         (b) For the first officer's altimeter:
            1) 11E23, ALTM RIGHT
            2) 11N28, INSTRUMENT AND PANEL F/O

      S 034-010

      (2) Loosen the clamp screws on the front panel adjacent to the indicator.

      S 024-019

      (3) Move the indicator out of the instrument panel.

      S 034-011

      (4) Disconnect the electrical cable.

TASK 34-13-01-404-004

3. Install Altimeter
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones
    211/212 Flight Compartment

C. Procedure

S 864-012

(1) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are open:

S 434-013

(2) Connect the electrical cable.

S 424-014

(3) Move the indicator into the instrument panel and tighten the mounting clamp screws.

D. Altimeter Test

S 864-015

(1) Supply electrical power (AMM 24-22-00/201).

S 864-016

(2) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
  (a) For the captain's altimeter:
    1) 11E2, ALTM LEFT
    2) 11N2, INSTRUMENT AND PANEL CAPT
  (b) For the first officer's altimeter:
    1) 11E23, ALTM RIGHT
    2) 11N28, INSTRUMENT AND PANEL F/O

S 214-017

(3) Make sure the altimeter panel lights come on.

S 864-018

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

MACH AIRSPEED INDICATOR - REMOVAL/INSTALLATION

1. General
   A. There are two mach airspeed indicators (N1-left, N41-right). These procedures give instruction for removal and installation.

TASK 34-13-02-004-001

2. Mach Airspeed Indicator Removal
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zone

211/212	Flight Compartment

   C. Procedure

S 864-012

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) For the captain's indicator:
      1) 11E1, IAS MACH LEFT
      2) 11N2, INSTRUMENT AND PANEL CAPT
   (b) For the first officer's indicator:
      1) 11E22, IAS MACH RIGHT
      2) 11N28, INSTRUMENT AND PANEL F/O

S 034-009

(2) Loosen the clamp screws on the front panel adjacent to the indicator.

S 024-020

(3) Move the indicator out of the instrument panel.

S 034-011

(4) Disconnect the electrical cable on the rear of the indicator case.

TASK 34-13-02-404-004

3. Mach Airspeed Indicator Installation
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control

B. Access
(1) Location Zones
211/212 Flight Compartment

C. Procedure

S 434-014
(1) Connect the electrical cable on the rear of the indicator case.

S 424-015
(2) Move the indicator into the instrument panel and tighten the mounting clamp screws.

D. MACH Airspeed Indicator Test

S 864-016
(1) Supply electrical power (AMM 24-22-00/201).

S 864-017
(2) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
  (a) For the captain's indicator:
    1) 11E1, IAS MACH LEFT
    2) 11N2, INSTRUMENT AND PANEL CAPT
  (b) For the first officer's indicator:
    1) 11E22, IAS MACH RIGHT
    2) 11N28, INSTRUMENT AND PANEL F/O

S 754-018
(3) Make sure the panel lights on the Mach Airspeed Indicator come on and all failure flags are retracted.

S 864-019
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

STANDBY AIRSPEED INDICATOR - REMOVAL/INSTALLATION

TASK 34-13-05-004-004

1. Standby Airspeed Indicator Removal
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones
          211/212 Flight Compartment

   C. Procedure

      S 864-008
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
          (a) 11B7, LIGHTS STBY INSTR
          (b) 11N1, INSTRUMENT AND PANEL AISLE STAND

      S 024-022
      (2) Loosen the two larger mounting clamp screws adjacent to the indicator.

      S 024-005

      CAUTION: CAREFULLY MOVE INDICATOR OUT OF INSTRUMENT PANEL. THIS WILL PREVENT DAMAGE TO CABLE AND PNEUMATIC HOSE AT REAR OF CASE.

      (3) Move the indicator out of the instrument panel.

      S 034-009
      (4) Disconnect the electrical cable.

      S 034-002

      CAUTION: THE PITOT-STATIC SYSTEM MUST BE AT AMBIENT PRESSURE BEFORE DISCONNECTING HOSES. THIS WILL PREVENT INSTRUMENT DAMAGE.

      (5) Operate the quick disconnects to disconnect the pitot and static pressure hoses.

TASK 34-13-05-404-003

2. Standby Airspeed Indicator Installation
   A. General
      (1) You do not have to do a leak test when you connect a quick-disconnect fitting. A visual examination of the quick-disconnect for a complete seal is necessary. You must do a leak test when you cannot make sure that the quick-disconnect has a complete seal.

B. References
   (1) 24-22-00/201, Electrical Power - Control
   (2) 34-11-00/501, Pitot - Static System

C. Access
   (1) Location Zones

211/212	Flight Compartment

D. Procedure

S 864-012

(1) If the replacement indicator does not have the quick-disconnects installed, remove the quick-disconnects from the unit you removed.

S 214-013

(2) Inspect the O-rings for damage.

S 864-014

(3) Replace the O-rings if necessary and install quick-disconnects on the replacement indicator.

S 424-030

(4) Tighten the quick-disconnect with a torque wrench to 65 pound-inches.

S 424-025

(5) If you installed the quick-disconnect fittings on the indicator, do a low-range leakage test (AMM 34-11-00/501) after you connect the pressure hoses to the indicator.

S 434-015

(6) Connect the electrical cable.

S 434-003

CAUTION: PITOT-STATIC SYSTEM MUST BE AT AMBIENT PRESSURE BEFORE YOU CONNECT THE HOSES. THIS WILL PREVENT DAMAGE TO THE INSTRUMENTS.

(7) Connect the pitot-static hoses. Visually make sure the quick-disconnect fittings are fully mated and that the connections are locked.

S 864-023

(8) If you installed the quick-disconnect fittings on the replacement indicator, do the step that follows:
  (a) Do a low range leakage test on the other static and auxiliary No. 1 pitot systems (AMM 34-11-00/501).

S 424-007

<u>CAUTION</u>: CAREFULLY PUT INDICATOR INTO PANEL. THIS WILL PREVENT DAMAGE TO THE CABLE AND PNEUMATIC HOSES AT THE REAR OF THE CASE.

(9) Move the indicator into position in the instrument panel and tighten the mounting clamp screws.

S 864-019

(10) Remove DO-NOT-CLOSE tags and close these circuit breakers on the overhead circuit breaker panel, P11:
  (a) 11B7, LIGHTS STBY INSTR
  (b) 11N1, INSTRUMENT AND PANEL AISLE STAND

S 864-020

(11) Supply electrical power (AMM 24-22-00/201).

S 754-021

(12) Make sure the indicator light is on.

S 864-022

(13) Remove electrical power if it is not necessary (AMM 24-22-00/201).

STANDBY ALTIMETER - REMOVAL/INSTALLATION

1. General
   A. There is one standby altimeter, N23. These procedures give instructions for removal, installation, and a check of the new standby altimeter.

TASK 34-13-06-004-005

2. Standby Altimeter Removal
   A. Access
      (1) Location Zones

211/212	Flight Compartment

   B. Procedure

S 864-007

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   - (a) 11B7, LIGHTS STBY INSTR
   - (b) 11N1, INSTRUMENT AND PANEL AISLE STAND
   - (c) 11A8, STBY ALTM VIB

S 034-007

(2) Loosen the two larger mounting clamp screws adjacent to the indicator.

S 024-008

CAUTION: CAREFULLY MOVE THE INDICATOR OUT OF INSTRUMENT PANEL. THIS WILL PREVENT DAMAGE TO THE CABLE AND THE PNEUMATIC HOSE AT THE BACK OF THE INDICATOR.

(3) Move the indicator out of the instrument panel.

S 034-008

(4) Disconnect the electrical cable.

S 034-006

CAUTION: MAKE SURE THE PITOT-STATIC SYSTEM IS AT AMBIENT PRESSURE BEFORE YOU DISCONNECT THE PNEUMATIC HOSE. THIS WILL PREVENT DAMAGE TO THE INSTRUMENTS.

(5) Use the quick disconnect to disconnect the static pressure hose.

TASK 34-13-06-404-002

3. Standby Altimeter Installation

A. General

(1) You do not have to do a leak test when you connect a quick-disconnect fitting. A visual examination of the quick-disconnect for a complete seal is necessary. You must do a leak test when you cannot make sure that the quick-disconnect has a complete seal.

B. References

(1) AMM 24-22-00/201, Electrical Power - Control

(2) AMM 34-11-00/501, Pitot-Static System

C. Access

(1) Location Zones

211/212	Flight Compartment

D. Procedure

S 434-003

(1) If the new indicator does not have a quick-disconnect installed on it, remove the quick-disconnect from the old indicator.

S 434-004

(2) Inspect the O-ring for damage and replace if necessary.

S 434-005

(3) Install the quick-disconnect on the new indicator.

S 424-020

(4) Tighten the quick-disconnect with a torque wrench to 65 pound-inches.

S 434-006

(5) Connect the electrical cable to the indicator.

S 434-007

CAUTION: MAKE SURE THE PITOT-STATIC SYSTEM IS AT AMBIENT PRESSURE BEFORE YOU CONNECT THE PNEUMATIC HOSE. THIS WILL PREVENT DAMAGE TO THE INSTRUMENTS.

(6) Connect the static hose to indicator.

S 754-009

(7) Visually make sure the quick-disconnect fittings are fully mated and the connection is locked in a sealed position.

S 794-011

(8) If you installed the quick-disconnect fitting on the new indicator, do a low range leakage test on the alternate static system (AMM 34-11-00/501).

S 424-004

CAUTION: CAREFULLY PUT THE INDICATOR INTO THE INSTRUMENT PANEL. THIS WILL PREVENT DAMAGE TO THE CABLE AND PNEUMATIC HOSE AT THE BACK OF THE INDICATOR.

(9) Put the indicator into position in the instrument panel and tighten the mounting clamp screws.

S 864-005

(10) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11B7, LIGHTS STBY INSTR
  (b) 11N1, INSTRUMENT AND PANEL AISLE STAND
  (c) 11A8, STBY ALTM VIB

S 864-012

(11) Supply electrical power (AMM 24-22-00/201).

S 754-013

(12) Make sure the indicator light is on.

S 864-014

(13) Remove electrical power if it is not necessary (AMM 24-22-00/201).

METRIC ALTIMETER - REMOVAL/INSTALLATION

1. General
   A. This procedure gives instructions for the removal and installation of the metric altimeter.

TASK 34-13-08-004-001

2. Metric Altimeter Removal
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones

211/212	Flight Compartment

   C. Procedure

S 864-002

(1) Make sure the two F/D switches on the MCP are in the OFF position.

S 864-019

(2) Make sure the AIR DATA switches on the INSTR SOURCE SEL panels are in their usual positions.

S 864-004

(3) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) For the captain's metric altimeter:
      1) 11A10, AIR DATA CMPTR L
      2) 11A11, AIR DATA AOA SENSOR L
      3) 11A12, AIR DATA BARO CORRECT L
      4) 11E7, METRIC ALTM LEFT
      5) 11P2, LIGHTING INSTRUMENT & PANEL CAPT

S 034-005

(4) Loosen the clamp screws on the front panel adjacent to the indicator.

S 034-006

(5) Move the indicator out of the instrument panel.

S 024-007

(6) Disconnect the electrical cable.

EFFECTIVITY
AIRPLANES WITH METRIC ALTIMETER
(POST SB 34-166)

TASK 34-13-08-404-008

3. Metric Altimeter Installation

A. References

(1) AMM 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

211/212	Flight Compartment

C. Procedure

S 864-009

(1) Make sure the two F/D switches on the MCP are in the OFF position.

S 434-011

(2) Connect the electrical cable.

S 424-012

(3) Move the indicator into the instrument panel.

S 434-013

(4) Tighten the clamp screws.

D. Metric Altimeter Test

S 864-014

(1) Supply electrical power (AMM 24-22-00/201).

S 864-015

(2) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
   (a) For the captain's metric altimeter:
      1) 11A10, AIR DATA CMPTR L
      2) 11A11, AIR DATA AOA SENSOR L
      3) 11A12, AIR DATA BARO CORRECT L
      4) 11E7, METRIC ALTM LEFT
      5) 11P2, LIGHTING INSTRUMENT & PANEL CAPT

S 754-016

(3) Make sure the metric altimeter OFF flag does not show.

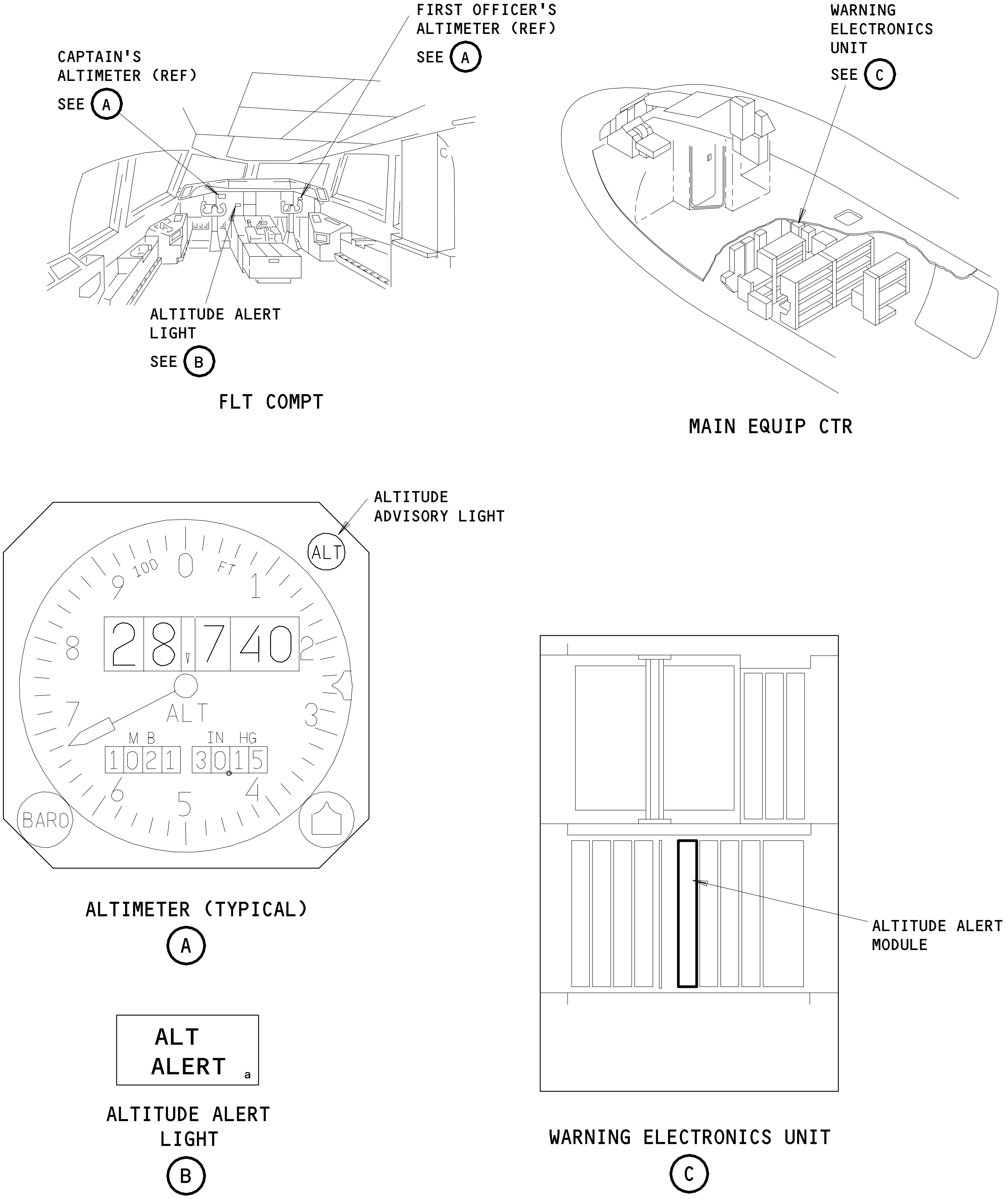
E. Put the Airplane Back to Its Usual Condition

S 864-017

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ALTITUDE ALERT SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   - A. The altitude alert system provides the pilots with aural and visual alert signals, when the airplane approaches or deviates from a selected altitude. The selected altitude is set on the autopilot mode select panel. It is compared with the airplane altitude as displayed on the altimeter.
   - B. The altitude alert system is comprised of an altitude alert module and display lights. The selected altitude is set by the pilots on the autopilot mode select panel. Input signals are supplied by other airplane sensors and systems. These signals are processed by the altitude alert module under microprocessor control to provide an output alert signal. The altitude alert system is inhibited when the landing gear is down and locked.
2. Component Details (Fig. 1)
   - A. Altitude Alert Module
     - (1) The altitude alert module is located in the warning electronics unit on the P51 panel.
     - (2) The altitude alert module is a microprocessor controlled circuit board. It receives and processes the input signals to the system. It also provides alert signals when the airplane approaches or deviates from the selected altitude.
   - B. Altitude Advisory Light
     - (1) An ALT advisory light is located on the top right corner of the captain's and first officer's altimeter.
     - (2) GUI 010, 011 PRE-SB 34-167;
       GUI 001-009;
       The white altitude advisory (ALT) light is turned on by the altitude alert module. This occurs when the airplane approaches the selected altitude at less than 900 feet but greater than 300 feet.
     - (3) GUI 115;
       The white altitude advisory (ALT) light is turned on by the altitude alert module. This occurs when the airplane approaches the selected altitude at less than 750 feet but greater than 300 feet.
     - (4) GUI 010, 011 POST-SB 34-167;
       GUI 012-114, 116-999;
       The white altitude advisory (ALT) light is turned on by the altitude alert module. This occurs when the airplane approaches the selected altitude at less than 500 feet but greater than 200 feet.
   - C. Altitude Alert Light
     - (1) The altitude alert (ALT ALERT) light is located on the center instrument panel.



Altitude Alert System Components
Figure 1

(2) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
The altitude alert light displays the amber message ALT ALERT. The light is turned on by the altitude alert module when the airplane deviates more than 300 feet but less than 900 feet from the selected altitude.

(3) GUI 115;
The altitude alert light displays the amber message ALT ALERT. The light is turned on by the altitude alert module when the airplane deviates more than 300 feet but less than 750 feet from the selected altitude.

(4) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
The altitude alert light displays the amber message ALT ALERT. The light is turned on by the altitude alert module when the airplane deviates more than 200 feet but less than 500 feet from the selected altitude.

3. <u>Operation</u> (Fig. 2)

A. The altitude alert module receives ±12 volts dc and +5 volts dc power from the power supply modules A and B. The power supplies receive their power through the WARN ELEX A and B circuit breakers on the P11 panel.

B. The following input signals are required by the altitude alert module to check altitude alert conditions:

(1) The actual airplane altitude input is supplied from either the left or right ADC.

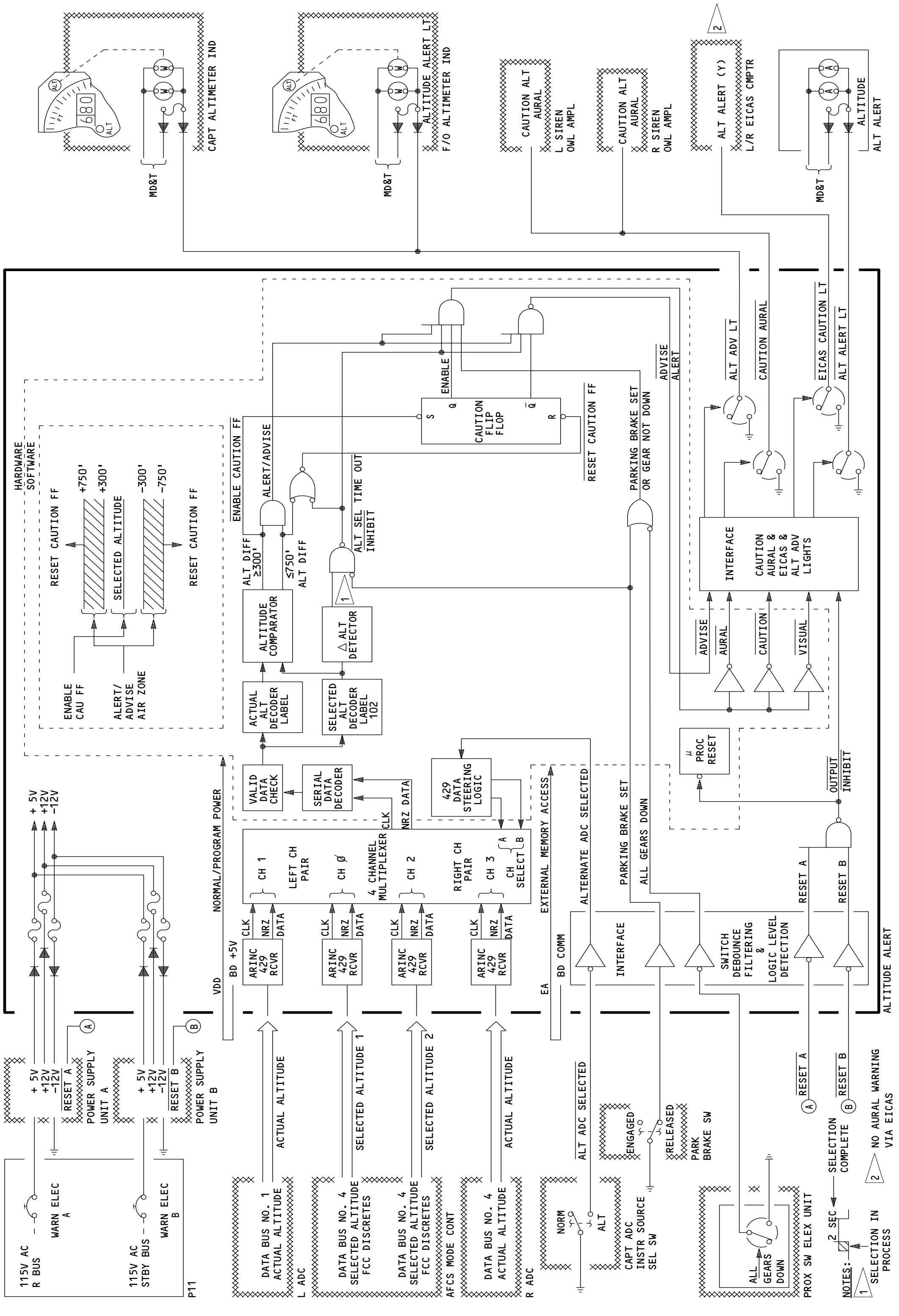
(2) Selected altitude is set on the autopilot mode control panel which provides 2 selected altitude and FCC discretes inputs to the alert module.

(3) Altitude information to the Altitude Alert System is taken from either the left or right ADC dependent upon the operation of the Flight Control Computers (FCC's).

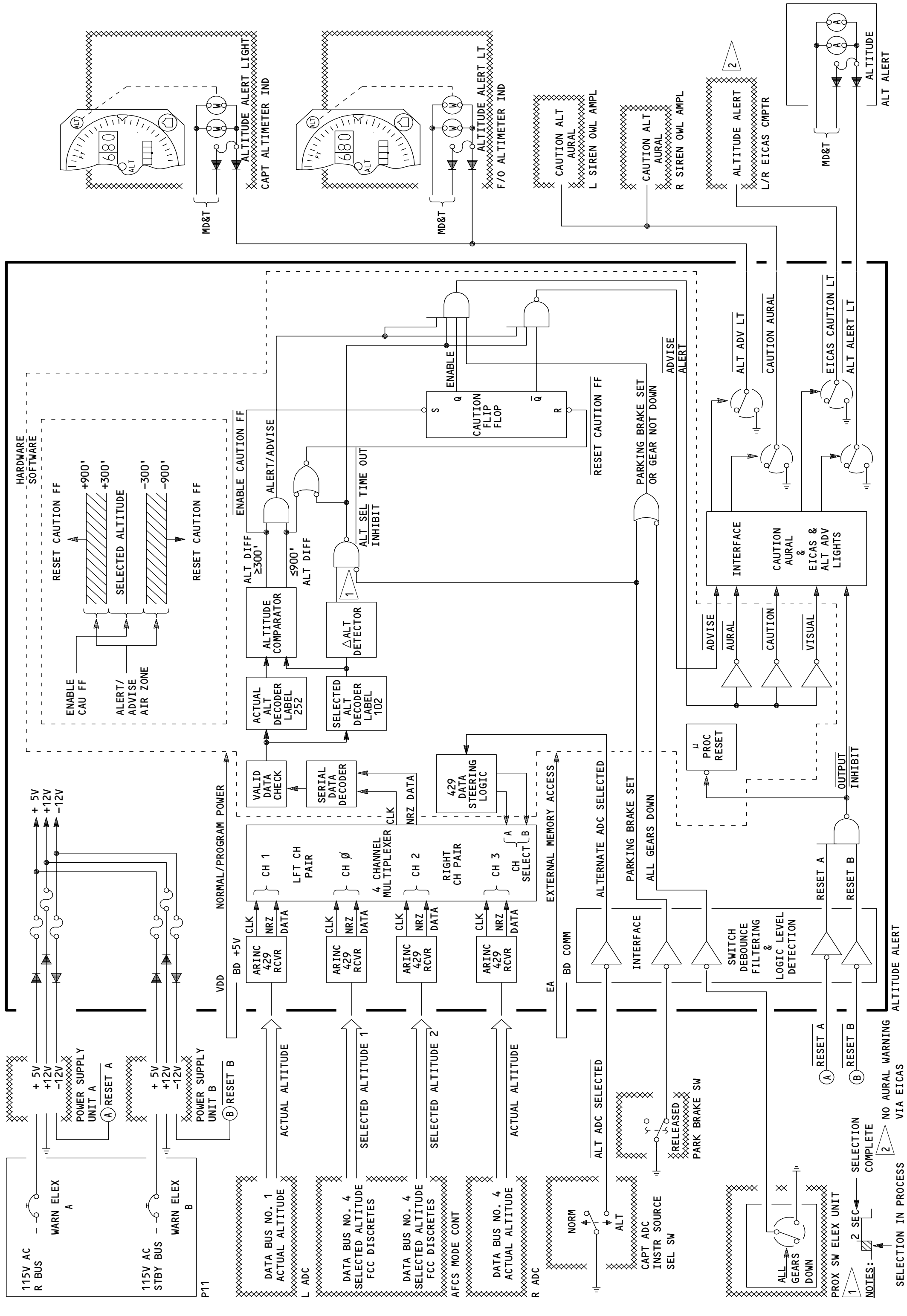
(4) When no FCC is in command or when more than one FCC is in command, the setting of the Captain's ADC instrument source select switch determines which ADC will be used by the Altitude Alert System. When the switch is in NORM, the left ADC is used by the system and when in ALT, the right ADC is used by the system.

(5) When only one FCC is in command, then the Altitude Alert System will use the same ADC that is driving the FCC in command. The left and center FCCs use the left ADC and the right FCC uses the right ADC.

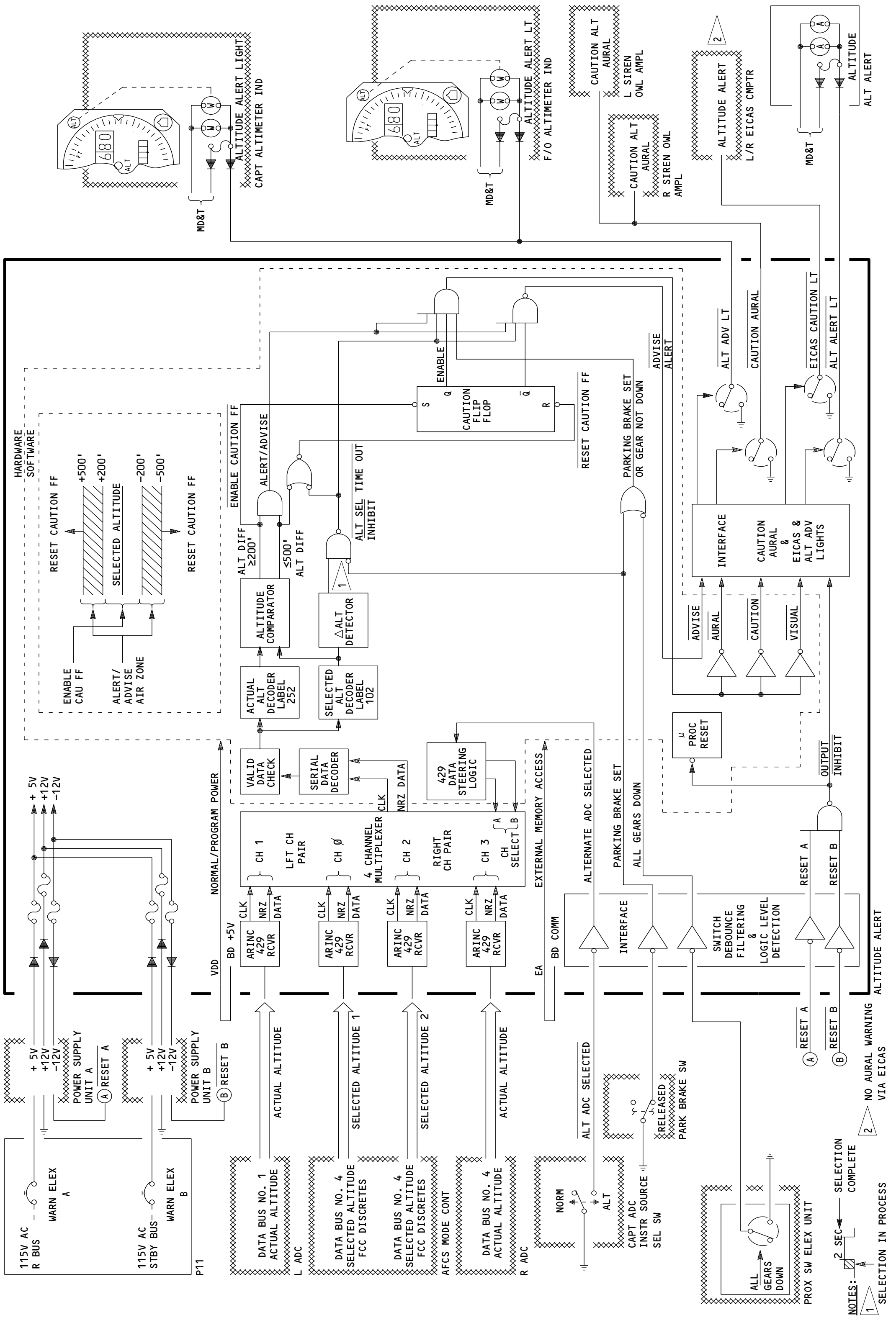
(6) A parking brake discrete is provided from the parking brake switch. A landing gear not down and locked discrete is provided by the proximity switch electronic unit. The landing gear not down and locked discrete enables the altitude alert system when the airplane is in the air and the landing gear is retracted. The parking brake discrete is used to prevent the altitude alert system from entering test mode unless the parking brake is set.



Altitude Alert System Schematic
Figure 2 (Sheet 1)



Altitude Alert System Schematic
Figure 2 (Sheet 2)



Altitude Alert System Schematic
Figure 2 (Sheet 3)

C. GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
The selected altitude input is first decoded and then compared with the ADC altitude. The difference is used to set up the output logic and to provide the output signals. Output signals are provided for three different categories. These are differences of less than 900 but greater than 300 feet, less than 300 feet, and greater than 900 feet.

D. GUI 115;
The selected altitude input is first decoded and then compared with the ADC altitude. The difference is used to set up the output logic and to provide the output signals. Output signals are provided for three different categories. These are differences of less than 750 but greater than 300 feet, less than 300 feet, and greater than 750 feet.

E. GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
The selected altitude input is first decoded and then compared with the ADC altitude. The difference is used to set up the output logic and to provide the output signals. Output signals are provided for three different categories. These are differences of less than 500 but greater than 200 feet, less than 200 feet, and greater than 500 feet.

F. GUI 001-114, 116-999;
When the airplane first approaches within 900 feet of the selected altitude, the ALT light on each of the altimeters comes on. When the airplane is within 300 feet of the selected altitude, the ALT light is turned off. The altitude alert caution logic is also armed. When the airplane deviates more than 300 feet from the selected altitude, the Altitude Alert Module turns on the amber ALT ALERT light. It also provides a ground discrete to the EICAS computers to turn on the master CAUTION lights and the ALTITUDE ALERT caution message. A ground is also sent to the aural warning module to generate the caution aural (electronic owl).

G. GUI 115;
When the airplane first approaches within 750 feet of the selected altitude, the ALT light on each of the altimeters comes on. When the airplane is within 300 feet of the selected altitude, the ALT light is turned off. The altitude alert caution logic is also armed. When the airplane deviates more than 300 feet from the selected altitude, the Altitude Alert Module turns on the amber ALT ALERT light. It also provides a ground discrete to the EICAS computers to turn on the master CAUTION lights and the ALTITUDE ALERT caution message. A ground is also sent to the aural warning module to generate the caution aural (electronic owl).

H. The caution signals are reset, the alert caution cancelled, and the microprocessor is reset to the approach mode after any one of the following actions:
   (1) The airplane returns to the selected altitude.
   (2) The airplane deviates more than 900 feet from the selected altitude.
   (3) A new altitude is selected on the mode control panel.

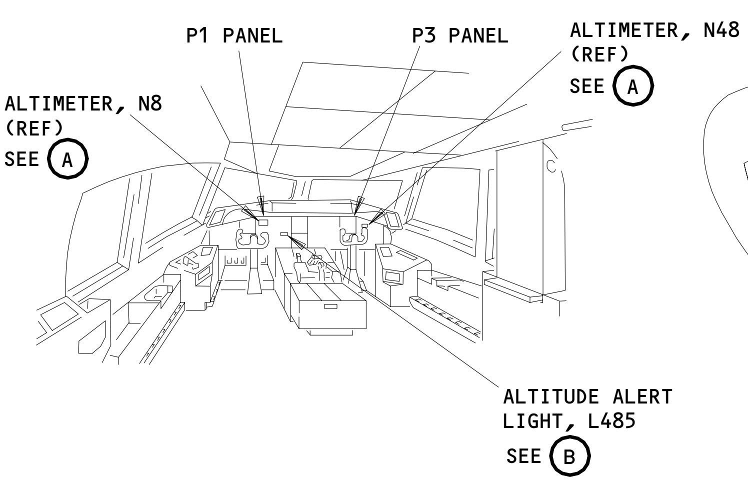
I. The altitude alert cautions are inhibited when the landing gear is down and locked and the parking brake is released. This prevents nuisance cautions from occurring during landing.

ALTITUDE ALERT SYSTEM

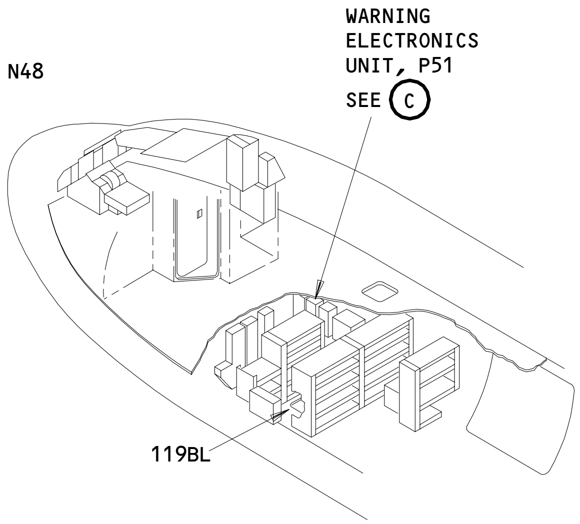
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
ALTIMETER - (REF 34-13-00, FIG. 101)				
CAPT, N8				
F/O, N48				
CIRCUIT BREAKERS			FLT COMPT, P11	
AURAL WARN SPKR LEFT, C567	--	1	11B16	*
AURAL WARN SPKR RIGHT, C568	--	1	11H35	*
WARN ELEX A, C565	--	1	11J33	*
WARN ELEX B, C566	--	1	11B18	*
LIGHT - ALTITUDE ADVISORY	--	2	FLT COMPT, P1,P3, ALTIMETER N8, N48	*
LIGHT - ALTITUDE ALERT, L485	--	1	FLT COMPT, P1	*
MODULE - ALTITUDE ALERT, M617	--	1	119BL, MAIN EQUIP CTR, P51	34-16-01
MODULE - (REF 32-09-03, FIG. 101)				
PSEU, M162				
SWITCH - (REF 34-12-00, FIG. 101)				
CAPT ADC, S482				
SWITCH - (REF 32-44-00, FIG.101)				
PARKING BRAKE, S459				

* SEE THE WDM EQUIPMENT LIST

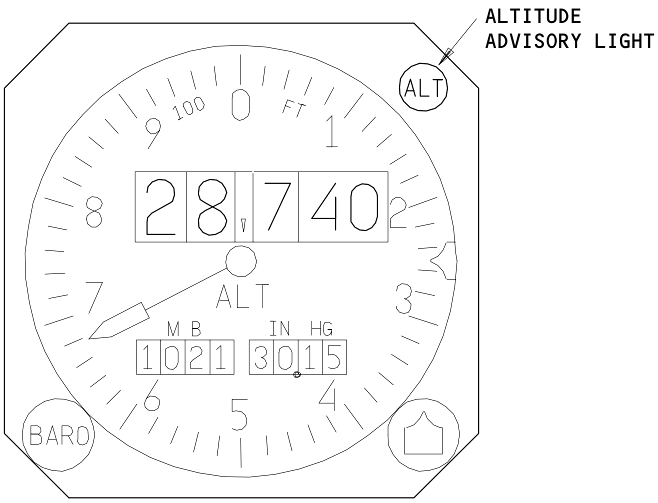
Altitude Alert System - Component Index
Figure 101



FLIGHT COMPARTMENT



MAIN EQUIPMENT CENTER



ALTIMETER, N8 OR N48 (REF)

Ⓐ

ALTITUDE ALERT
LIGHT, L485

Ⓑ

WARNING ELECTRONICS UNIT, P51

Ⓒ

Component Location
Figure 102

ALTITUDE ALERT SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure tests to make sure that the altitude alert system is operational.

TASK 34-16-00-735-001

2. Altitude Alert System - System Test
   A. Equipment
      (1) Sensor Actuator, 4130 Carbon Steel 1.5" x .75" x .05" - Proximity Sensor Set, A27092-84
      (2) Sensor deactuator, Aluminum 1.5" x .75" x .05" - Proximity Sensor Set, A27092-84
   B. References
      (1) AMM 22-10-00/501, Autopilot (Flight Control) System
      (2) AMM 24-22-00/201, Electrical Power - Control
      (3) AMM 31-41-00/201, Engine Indication and Crew Alert System (EICAS)
      (4) AMM 32-09-02/201, Air/Ground Relays
      (5) AMM 34-12-00/501, Air Data Computing System
   C. Access
      (1) Location Zones

211/212	Flight Compartment
711	Nose Landing Gear (NLG)
731	Left Main Landing Gear (MLG)
741	Right Main Landing Gear (MLG)

   D. Prepare for the System Test

      S 865-002
      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-003
      (2) Set the parking brake to the on position.

      S 865-216
      (3) Set the FUEL CONTROL switch for the LEFT engine to RUN.

      S 865-004
      (4) Open these circuit breakers on the main power distribution panel, P6, and attach DO-NOT-CLOSE tags:
         (a) 6E1, FUEL VALVE L SPAR
         (b) 6E2, FUEL VALVE R SPAR

      S 735-005
      (5) Make sure the air data computing system operates correctly (AMM 34-12-00/501).

      S 865-006
      (6) Make sure the autopilot flight director system operates correctly (AMM 22-10-00/501).

S 865-007
(7) Make sure these circuit breakers on the P11 panel are closed:
    (a) 11B16, AURAL WARN SPKR LEFT
    (b) 11H35, AURAL WARN SPKR RIGHT
    (c) 11J33, WARN ELEX A
    (d) EICAS (six places)

S 865-008
(8) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
    (a) 11B18, WARN ELEX B

S 865-009
(9) Do the EICAS procedure for engine shutdown input removal (AMM 31-41-00/201).

S 865-010
(10) Make sure the ADC switches on the instrument source select panels are set to the NORM position.

S 865-085
(11) GUI 115;
Set the BARO SELECT switch on the mode control panel (MCP) for the Auto-Flight Control System to the LEFT position.

E. Procedure

S 745-083
(1) Push the IND LIGHTS TEST switch on the pilots' overhead panel, P5.

S 755-012
(2) Make sure the lights come on as follows:
    (a) Make sure these lights come on:
        1) The ALT light on the captain's and first officer's altimeters
        2) The ALT ALERT light on the instrument panel
        3) The master CAUTION lights on the glareshield.

S 745-084
(3) Push the IND LIGHTS TEST switch again to stop the test.

S 865-014
(4) Adjust the BARO switches on the captain's and first officer's altimeters to the nearest thousand ± 40 feet.

S 865-097
(5) GUI 115;
Also adjust the BARO switch on the standby altimeter to the nearest thousand ± 40 feet.

S 865-016
(6) Set the MCP ALT display to 10,000 feet.

S 755-017
(7) Make sure these indicators are off:
  (a) The two altimeter ALT lights
  (b) The ALT ALERT light
  (c) The master CAUTION lights
  (d) The EICAS message, ALTITUDE ALERT, on the top display.

S 865-088
(8) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
set the MCP ALT display to 600 ±200 feet above the altimeter altitude.

S 865-089
(9) GUI 115;
Set the MCP ALT display to 500 ±200 feet above the altimeter altitude.

S 865-166
(10) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to 300 ±50 feet above the altimeter altitude.

S 755-021
(11) Make sure the altimeter ALT lights come on.

S 865-168

(12) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to less than 300 feet above the altimeter altitude.

S 865-170

(13) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to less than 200 feet above the altimeter altitude.

S 755-024

(14) Make sure the two altimeter ALT lights go off.

S 865-090

(15) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
set the MCP ALT display to 600 ±200 feet above the altimeter altitude.

S 865-091

(16) GUI 115;
Set the MCP ALT display to 500 ±200 feet above the altimeter altitude.

S 865-173

(17) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to 300 ±50 feet above the altimeter altitude.

S 755-028

(18) Make sure these indicators are on:
(a) The ALT ALERT light
(b) The master CAUTION lights
(c) The EICAS message, ALTITUDE ALERT, on the top display
(d) An owl aural tone for 1 second.

S 865-092

(19) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
set the MCP ALT display to greater than 900 feet above the altimeter altitude.

S 865-093

(20) GUI 115;
Set the MCP ALT display to greater than 750 feet above the altimeter altitude.

S 865-176

(21) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to greater than 500 feet above the altimeter altitude.

S 755-031

(22) Make sure these indicators are off:
   (a) The ALT ALERT light
   (b) The master CAUTION lights
   (c) The owl aural tone
   (d) The EICAS message, ALTITUDE ALERT, on the top display.

S 865-032

(23) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
   (a) 11J33, WARN ELEX A

S 865-033

(24) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
   (a) 11B18, WARN ELEX B

S 865-236

(25) Set the MCP ALT display to 10,000 feet.

S 755-237

(26) Make sure these indicators are off:
   (a) The two altimeter ALT lights
   (b) The ALT ALERT light
   (c) The master CAUTION lights
   (d) The EICAS message, ALTITUDE ALERT, on the top display.

S 865-242

(27) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to 600 ±200 feet above the altimeter altitude.

S 865-245
(28) GUI 115;
Set the MCP ALT display to 500 ±200 feet above the altimeter altitude.

S 865-249
(29) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to 300 ±50 feet above the altimeter altitude.

S 755-250
(30) Make sure the altimeter ALT lights come on.

S 865-254
(31) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to less than 300 feet above the altimeter altitude.

S 865-258
(32) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to less than 200 feet above the altimeter altitude.

S 755-259
(33) Make sure the two altimeter ALT lights go off.

S 865-264
(34) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to 600 ±200 feet above the altimeter altitude.

S 865-267
(35) GUI 115;
Set the MCP ALT display to 500 ±200 feet above the altimeter altitude.

S 865-271
(36) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to 300 ±50 feet above the altimeter altitude.

S 755-272
(37) Make sure these indicators are on:
- (a) The ALT ALERT light
- (b) The master CAUTION lights

(c) The EICAS message, ALTITUDE ALERT, on the top display
(d) An owl aural tone for 1 second.

S 865-277
(38) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to greater than 900 feet above the altimeter altitude.

S 865-281
(39) GUI 115;
Set the MCP ALT display to greater than 750 feet above the altimeter altitude.

S 865-284
(40) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to greater than 500 feet above the altimeter altitude.

S 755-285
(41) Make sure these indicators are off:
(a) The ALT ALERT light
(b) The master CAUTION lights
(c) The owl aural tone
(d) The EICAS message, ALTITUDE ALERT, on the top display.

S 865-094
(42) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the MCP ALT display to less than 250 feet, then to 600 ±200 feet above the altimeter altitude.

S 865-095
(43) GUI 115;
Set the MCP ALT display to less than 250 feet, then to 500 ±200 feet above the altimeter altitude.

S 865-179

(44) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the MCP ALT display to less than 200 feet, then to 300 ±50 feet above the altimeter altitude.

S 865-287

(45) Make sure the EICAS message, ALTITUDE ALERT, is shown on the top display.

S 755-288

(46) Release the parking brake.

S 865-289

(47) Make sure the EICAS message, ALTITUDE ALERT, is not shown on the top display.

S 865-039

(48) Turn off these GEAR DOWN and LOCKED switches:

<u>NOTE</u>: Put the deactuator between the switch sensor and the target to turn off the switch. The deactuator can touch the target but not the sensor.

(a) S10057 - Right Gear Down and Locked
(b) S10070 - Right Gear Down and Locked

S 755-041

(49) Make sure the EICAS message, ALTITUDE ALERT, is shown on the top display.

S 865-042

(50) Remove the GEAR DOWN and LOCKED deactuators installed above.

S 755-043

(51) Make sure these indicators are off:
(a) The two altimeter ALT lights

(b) The ALT ALERT light
(c) The master CAUTION lights
(d) The EICAS message, ALTITUDE ALERT, on the top display.

S 865-044

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE SPOILERS OR MOVE ALL PERSONS AND EQUIPMENT AWAY FROM THE SPOILERS. THE SPOILERS CAN RETRACT QUICKLY AND CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

(52) Do the deactivation procedure for the spoilers (AMM 27-61-00) or move all persons and equipment away from the spoilers.

S 865-045

WARNING: MAKE SURE YOU DO THE FLIGHT MODE SIMULATION CORRECTLY. IF THE PROCEDURE IS NOT DONE CORRECTLY, INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

(53) Do the Flight Mode Simulation procedure for the two air/ground systems (AMM 32-09-02/201).

S 865-046

(54) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:

NOTE: Make sure the correct system 1 and system 2 circuit breakers are open. There are two system 1 and two system 2 circuit breakers for the landing gear.

(a) 11C30, LANDING GEAR POS SYS 1
(b) 11S23, POS SYS 2
(c) GUI 001, 002, 115 POST-SB 78-32;
GUI 003-114, 116-999;
11C19, LDG GEAR POS SYS 2 ALTN

S 755-047

(55) Make sure the ALTITUDE ALERT message is shown on EICAS.

S 865-048

(56) Open the WARN ELEX B (11B18) circuit breaker for 5 seconds and then close it.

S 865-049

(57) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
  (a) 11E34, MODE CONT PNL RIGHT
  (b) 11F30, AIR DATA CMPTR RIGHT

S 755-050

(58) Make sure the altimeter ALT lights are on.

S 865-060

(59) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11E34, MODE CONT PNL RIGHT
  (b) 11F30, AIR DATA CMPTR RIGHT

S 865-061

(60) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
  (a) 11A10, AIR DATA CMPTR LEFT
  (b) 11E16, MODE CONT PNL LEFT

S 755-062

(61) Make sure the altimeter ALT lights are off.

S 865-127

(62) Set the captain's ADC switch on the instrument source select panel to the ALTN position.

S 755-128

(63) Make sure the altimeter ALT lights come on.

S 865-129

(64) Set the captain's ADC switch on the instrument source select panel to the NORM position.

F. Put the Airplane Back to Its Usual Condition

S 865-073

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11A10, AIR DATA CMPTR LEFT
  (b) 11C30, LANDING GEAR POS SYS 1
  (c) GUI 001, 002, 115 POST-SB 78-32;
      GUI 003-114, 116-999;
      11C19, LDG GEAR POS SYS 2 ALTN
  (d) 11E16, MODE CONT PNL LEFT
  (e) 11J33, WARN ELEX A
  (f) 11S23, POS SY 2

S 865-080

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P6 panel:
  (a) 6E1, FUEL VALVE L SPAR
  (b) 6E1, FUEL VALVE R SPAR

S 865-081

(3) Put the airplane back to the ground mode (AMM 32-09-02/201).

S 865-082

(4) Do the activation procedure for the spoilers if you did the deactivation procedure (AMM 27-61-00).

S 865-075

(5) Remove the actuators and deactuators on the landing gear switches.

S 865-076

(6) Set the captain's and first officer's altimeters to the correct barometric value.

S 865-096

(7) GUI 115;
Also set the standby altimeter to the correct barometric value.

S 865-079

(8) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ALTITUDE ALERT MODULE - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the altitude alert module and the other is the installation of the altitude alert module.
   B. The altitude alert module is installed in the warning electronics unit (WEU). The WEU is installed to the right and forward of the main electronic equipment compartment.

TASK 34-16-01-004-001

2. Remove the Module (Fig. 401)
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components
      (2) AMM 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zone
            120 Main Equipment Center (Right)

   C. Procedure

      S 864-003

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11B18, WARN ELEX B
         (b) 11J33, WARN ELEX A

      S 014-004

      (2) Open the access door to the WEU.

      S 914-005

      CAUTION: DO NOT TOUCH THE ALTITUDE ALERT MODULE BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE ALTITUDE ALERT MODULE.

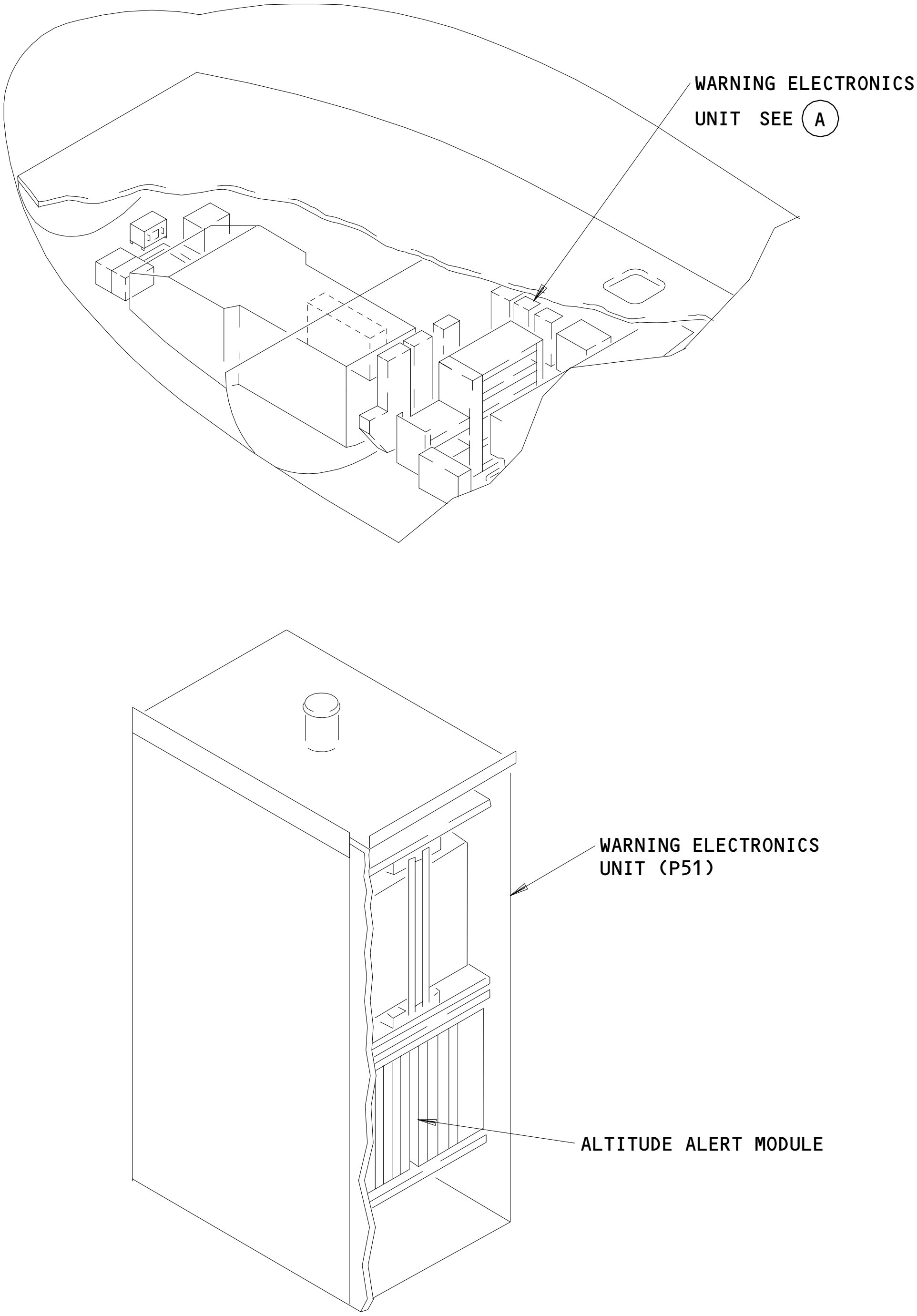
      (3) Do the procedure for electrostatic discharge sensitive devices (AMM 20-41-01/201).

      S 024-006

      (4) Remove the altitude alert module (AMM 20-10-01/401).

TASK 34-16-01-404-007

3. Install the Module (Fig. 401)
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components



Altitude Alert Module Installation
Figure 401

(2) AMM 20-41-01/201, Electrostatic Sensitive Devices
(3) AMM 22-10-00/501, Autopilot Flight Director System
(4) AMM 24-22-00/201, Electrical Power - Control
(5) AMM 34-12-00/501, Air Data Computing System

B. Access

(1) Location Zones

120	Main Equipment Center (Right)
211/212	Flight Compartment

C. Procedure

S 864-008

(1) Make sure these circuit breakers on the P11 panel are open:
  (a) 11B18, WARN ELEX B
  (b) 11J33, WARN ELEX A

S 914-025

<u>CAUTION</u>: DO NOT TOUCH THE ALTITUDE ALERT MODULE BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE ALTITUDE ALERT MODULE.

(2) Do the procedure for electrostatic discharge sensitive devices (AMM 20-41-01/201).

S 424-009

(3) Install the altitude alert module (AMM 20-10-01/401).

S 414-010

(4) Close the access door to the WEU.

D. Altitude Alert Module Test

S 864-011

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11B18, WARN ELEX B
  (b) 11J33, WARN ELEX A

S 714-012

(2) Make sure the autopilot flight director system operates correctly (AMM 22-10-00/501).

S 714-013
(3) Make sure the air data computing system operates correctly (AMM 34-12-00/501).

S 864-014
(4) Set the parking brake to the on position.

S 864-015
(5) Adjust the BARO switch on the captain's and first officer's altimeters to the nearest thousand ±40 feet.

S 864-037
(6) GUI 115;
Also adjust the standby altimeter to the nearest thousand ±40 feet.

S 864-030
(7) GUI 010, 011 PRE-SB 34-167;
GUI 001-009;
Set the mode control panel ALT display for the Auto-Flight Control System to 600 ±200 feet above the altimeter altitude.

S 864-031
(8) GUI 115;
Set the mode control panel ALT display for the Auto-Flight Control System to 500 ±200 feet above the altimeter altitude.

S 864-055
(9) GUI 010, 011 POST-SB 34-167;
GUI 012-114, 116-999;
Set the mode control panel ALT display for the Auto-Flight Control System to 300 ±50 feet above the altimeter altitude.

S 754-021
(10) Make sure the ALT lights on the captain's and first officer's altimeters come on.

E. Put the Airplane Back to Its Usual Condition

S 864-023
(1) Remove electrical power from the autopilot flight director system (AMM 22-10-00/501).

S 864-027

(2) Adjust the BARO switch on the captain's and first officer's altimeters back to the correct position.

S 864-033

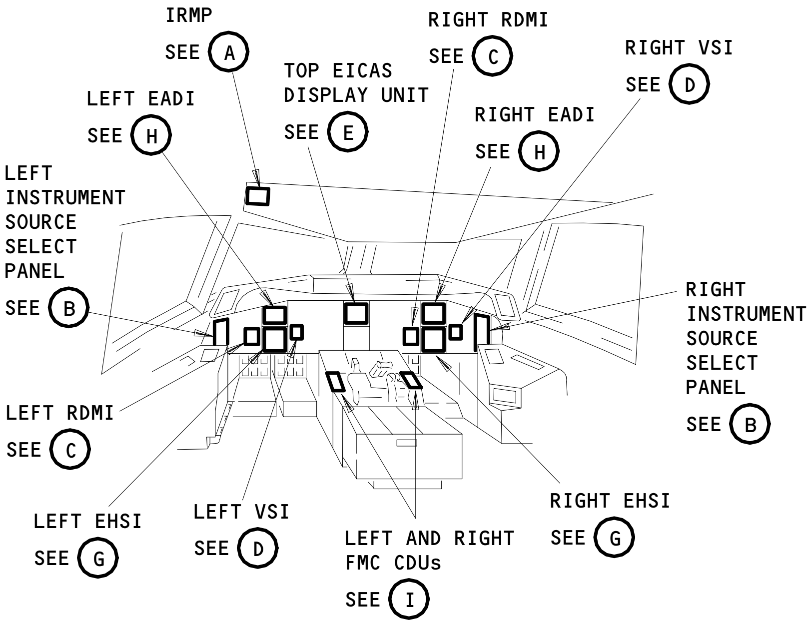
(3) GUI 115;
Also adjust the BARO switch on the standby altimeter back to the correct position.

S 864-024

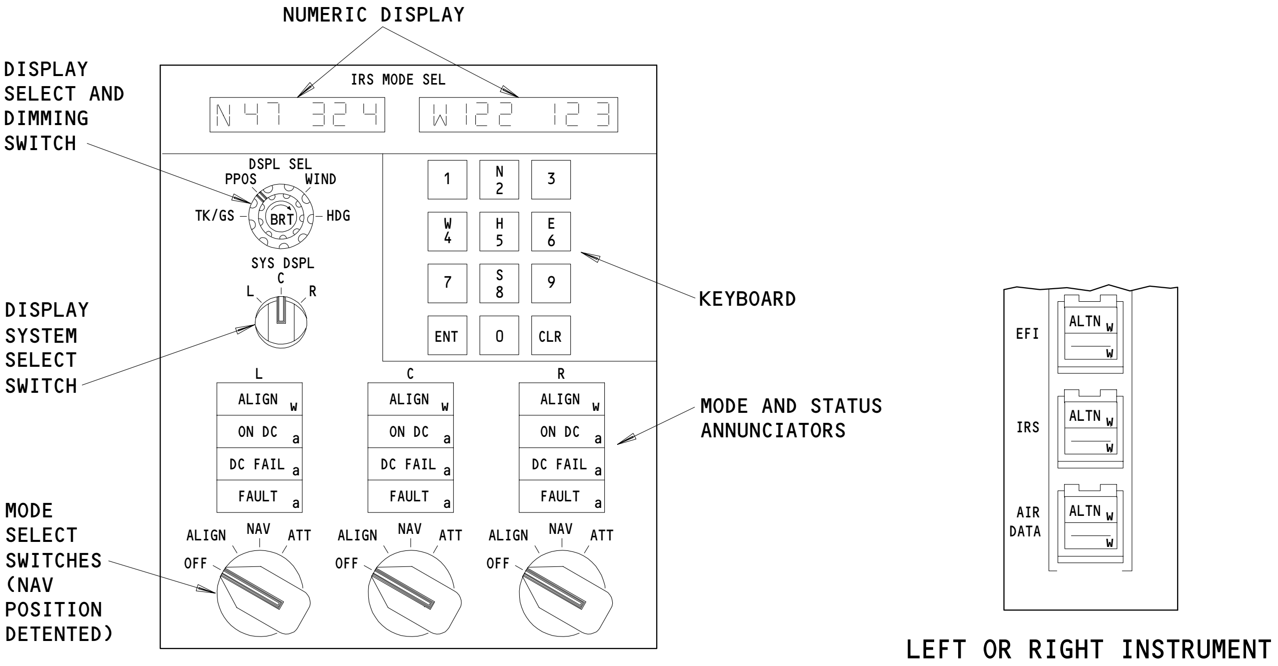
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

INERTIAL REFERENCE SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The inertial reference system (IRS) provides inertial navigation data to user systems. It uses ring laser gyro instead of the conventional rate gyro to sense angular rate about the roll, pitch and yaw axes. The system is termed strapdown since its sensors are, in effect, directly mounted to the airframe.
   B. The inertial reference system (IRS) includes three inertial reference units (IRU). One common mode control panel (IRS MODE SELECT) is used to control the three IRUs. The system provides inertial navigation and flight control data to other systems.
   C. The main function of each IRU is to sense and compute linear accelerations and angular turning rates about the airplane's pitch, roll, and yaw axes. This data is used for pitch and roll displays and navigational computations.
   D. Each IRU contains three laser gyros and three accelerometers. These sense angular rates and linear accelerations, respectively. The sensed data is resolved to local vertical coordinates and combined with air data inputs to compute the following:
      (1) position (latitude, longitude)
      (2) attitude (pitch, roll, yaw)
      (3) true and magnetic heading
      (4) windspeed, direction, and drift angle
      (5) velocity
      (6) accelerations
      (7) angular rate data
      (8) altitude
   E. The IRS outputs are displayed on the flight instrument system displays (AMM 34-22-00). They are also displayed on the flight management computer control display unit (FMC-CDU) (AMM 34-61-00).
2. Component Details (Fig. 1)
   A. IRS Mode Select Panel (IRMP)
      (1) The IRS Mode Select Panel is used to control the three IRUs. It provides individual mode selection, displays align status, displays fault annunciation for each IRU, and provides a display and keyboard for IRU initialization. The IRMP is located on the pilot's overhead panel.



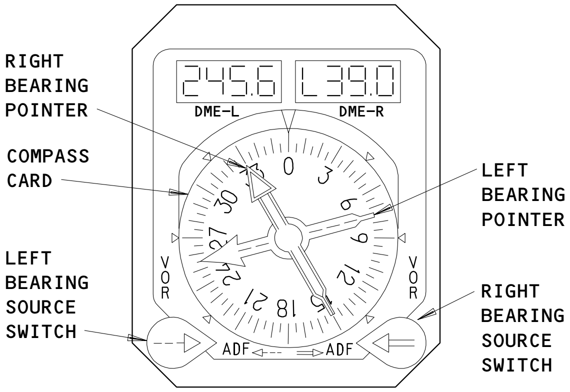
FLIGHT COMPARTMENT



INERTIAL REFERENCE MODE PANEL (IRMP)
A

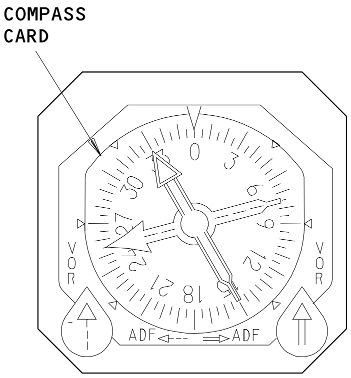
LEFT OR RIGHT INSTRUMENT
SOURCE SELECT PANEL
B

Inertial Reference System - Component Location
Figure 1 (Sheet 1)



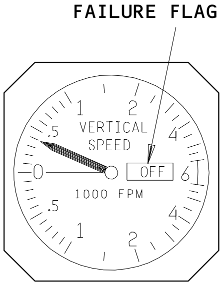
RADIO DISTANCE MAGNETIC INDICATOR (RDMI)

C 1



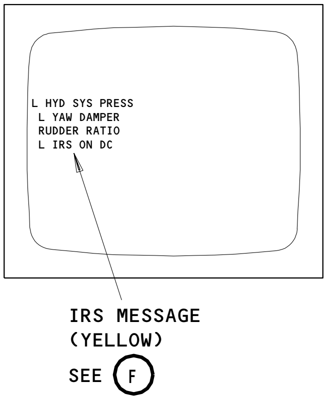
RADIO MAGNETIC INDICATOR (RMI)

C 2



VERTICAL SPEED INDICATOR (VSI)

D



TOP EICAS DISPLAY UNIT

E

EICAS LEVEL C IRS ADVISORIES

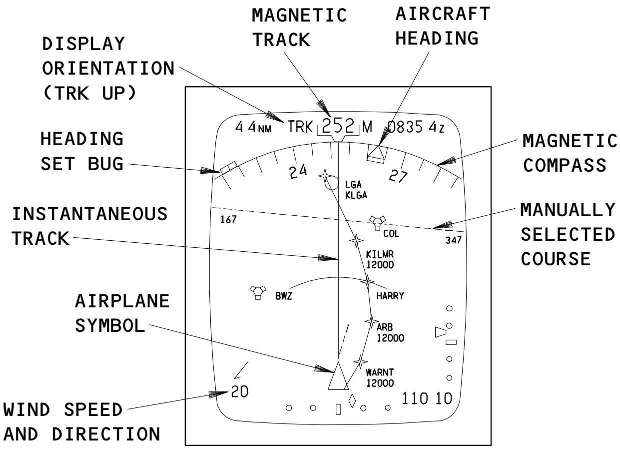
L IRS ON DC
L IRS DC FAIL
L IRS FAULT
C IRS ON DC
C IRS DC FAIL
C IRS FAULT
R IRS ON DC
R IRS DC FAIL
R IRS FAULT

IRS MESSAGES

F

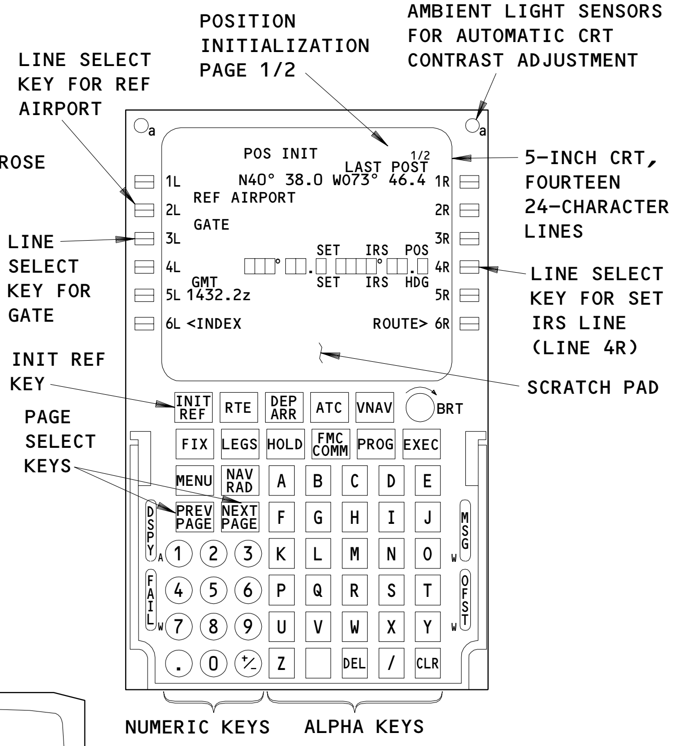
1 GUI 001-114,116-999
2 GUI 115

Inertial Reference System - Component Location
Figure 1 (Sheet 2)



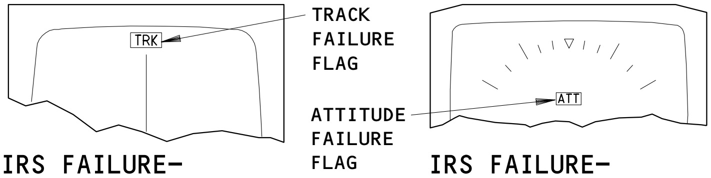
LEFT OR RIGHT ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

G



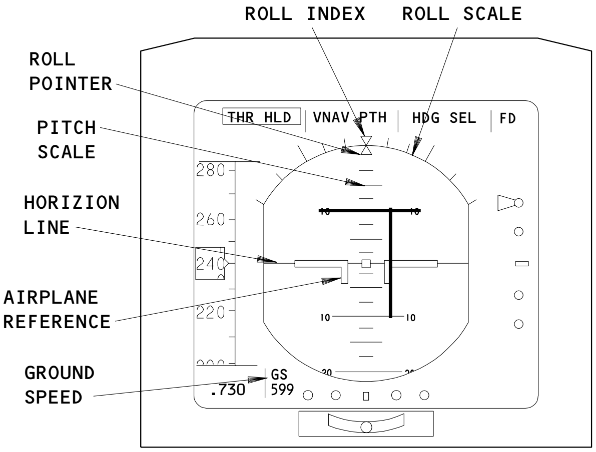
LEFT OR RIGHT FMC CDU

I



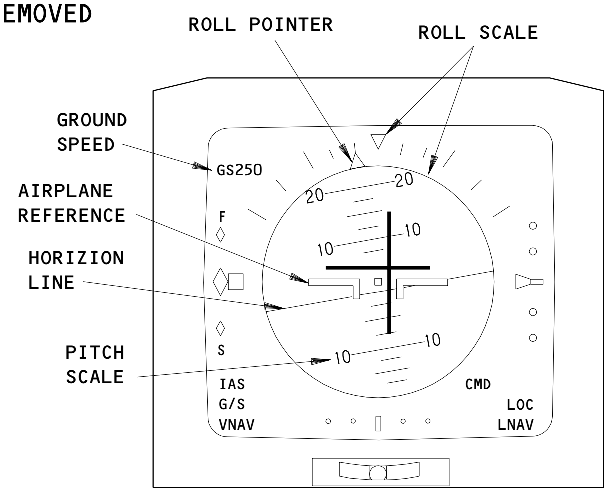
IRS FAILURE-
IRS SYMBOLOGY REMOVED

IRS FAILURE-
IRS SYMBOLOGY REMOVED



LEFT OR RIGHT ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

H 1



LEFT OR RIGHT ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

H 2

Inertial Reference System - Component Location
Figure 1 (Sheet 3)

(2) The IRMP has three rotary switches for selecting the following operational modes of each IRU:
  (a) OFF - IRS is off.
  (b) ALIGN (alignment) - During the ALIGN mode, the IRU is initialized. The position information given to the IRS is checked for accuracy in the IRU. This process, when properly completed, allows the IRU to advance to the NAV mode.
  (c) NAV (navigation) - The NAV mode is the normal operating mode for the IRS. In this mode, the IRS performs inertial navigation functions and outputs normal IRS data to be displayed or used by other system.
  (d) ATT (attitude) - The ATT mode is used as a backup mode when a failure is detected or when both AC and DC power loss occurs in the NAV mode. In this mode, only attitude data is output to the user systems.

(3) The ALIGN, NAV, ATT, and OFF modes are entered using the following mode sequences. The corresponding IRU operation and ALIGN annunciator status are as follows:

MODE SEQUENCE	IRU OPERATION	ALIGN LIGHT
OFF TO ALIGN *[1]	REMAINS IN ALIGN MODE AND CONTINUES FINE LEVELING AND EARTH RATE ESTIMATION.	REMAINS ON
OFF TO ALIGN TO NAV *[1]	PERFORMS 10-MINUTE ALIGNMENT AND AUTOMATICALLY SEQUENCES TO NAV MODE.	ON DURING ALIGNMENT
OFF OR NAV TO ATT	FULL SUPPORT OF ATTITUDE - RELATED AND BODY ACCELERATION OUTPUTS IN 30 SECONDS.	ON FOR 30 SECONDS
NAV TO ALIGN *[1]	SETS VELOCITIES TO ZERO AND CONTINUES TO REFINE LEVELING AND HEADING DETERMINATION (NAV MAY BE RE-ENTERED IN APPROXIMATELY 30 SECONDS).	REMAINS ON, FLASHES IF MOVEMENT
NAV TO ALIGN TO NAV *[1]	SETS VELOCITIES TO ZERO.	ON FOR 30 SEC, FLASHES IF MOVEMENT WHILE ON
ATT TO NAV OR ALIGN	REMAINS IN ATT MODE UNTIL SWITCHED OFF.	OFF
ALIGN TO NAV	IF ALIGN TIME GREATER THAN 10 MINUTES, IRU SEQUENCES TO NAV.	ON DURING ALIGNMENT
ATT OR NAV OR ALIGN TO OFF	30 SECOND POWER-OFF COUNTDOWN, BITE INFORMATION, PPOS, AND AUTOCAL TRANSFER TO NVM.	ON FOR 30 SECONDS

*[1] Reference paragraph 3.A.(1)(g) for details of mode sequences to ALIGN mode.

(4) Each mode select switch has a detented NAV position which prevents accidental movement of the switch out of the NAV mode. When the switch is in the NAV position, it must first be pulled out of detent before selecting a new position to prevent damage to the switch.

(5) Three sets of four annunciators provide system status and fault indication. ALIGN (white when lit), ON DC, DC FAIL, and FAULT (amber when lit) annunciators are provided for each IRU and operate as follows:

(a) The ALIGN annunciator indicates that the IRU is in the align mode and is running an initial position determination, is in initial attitude mode erection, or is powering down.

(b) The ON DC annunciator lights when the IRU has switched to backup battery power.

(c) If battery power fails, the DC FAIL light will come on.

(d) The FAULT annunciator indicates when a BITE detected failure has occurred. The FAULT light also comes on if certain alignment tests fail. These tests are covered in detail in the operation section.

(6) The IRMP also has two displays, a keyboard, and two select switches for IRU initialization and data display.

(a) The SYS DSPL switch selects the IRU, for on-line interface with the IRMP. The IRMP can only display data from the IRU which has been selected on the SYS DSPL switch.

(b) The DSPL SEL switch selects the type of data to be shown on the IRMP numeric displays. The IRU selected by the SYS DSPL switch, supplies the data. The four switch positions and the data shown for each position is as follows:

1) TK/GS - Track angle (TK) is shown in the left display and the ground speed (GS) in the right display.

2) PPOS - Present position latitude shows in the left display and the longitude in the right display.

3) WIND - Wind angle is shown in the left display and the wind velocity in the right display.

4) HDG - True heading is shown in the left display and the right display remains blank.

(c) There are two numeric displays on the IRMP. When the IRMP is receiving IRU data, the DSPL SEL switch determines the data on the display. When the IRMP keyboard is used to initialize an IRU, the data entered is shown on the two displays. For invalid data from an IRU, both displays are blanked. A brightness control for the displays is located concentric within the DSPL SEL switch.

(d) The keyboard consists of twelve lighted keys. To change the numeric display from the IRU receive mode to a keyboard display mode, you must push one of these keys : N(2), S(8), H(5), E(6), or W(4). Any other initial key is ignored.

1) When you push N(2) or S(8) once, a N or S shows in the left display. These represent north and south and are used to initialize latitude in the IRU.

2) When you push W(4) or E(6) once, a W or E shows in the right display. These represent west and east and are used to initialize longitude in the IRU.

3) When you push H(5) once, this also changes the IRMP from an IRU receive mode to the keyboard display mode. This is used to enter magnetic heading in the ATT mode.

4) Numeric data can be entered after one of the five letter keys is pushed. It will be shown in the numeric display as it is entered.

5) Keys with letters and numbers on them represent the letter value when they are the initially pushed key in a program sequence.

6) When you push the ENT key, the IRMP transfers data to the IRU. Also, when the ENT key is pushed, the display is first blanked and then returned to the IRU receive mode.

7) The CLR key clears the display, then returns the IRMP to the IRU receive mode.

(7) AIRPLANES WITH -203 IRMP;
The IRMP also has a Time to NAV (TTN) display and a maintenance fault code display.

(8) The IRMP also has a Time to NAV (TTN) display and a maintenance fault code display.

(a) The Time to NAV (TTN) feature counts down the minutes to alignment completion. The IRU must be in the ALIGN mode, the IRMP mode select switch must be set to ALIGN or NAV, and the DSPL SEL switch must be set to HDG. A single digit will appear on the right side of the IRMP display to indicate minutes remaining as follows:

MINUTES REMAINING	NUMBER DISPLAYED
10	7
9	7
8	7
7	7
6	6
5	5
4	4
3	3
2	2
1	1
0	0

1) The TTN zero will not be visible with the mode select switch set to NAV. The display will blank as the IRS sequences to NAV and the ALIGN annunciator goes off.

2) When ALIGN mode is selected again, the TTN will show a 7 and count toward 0 in 30 seconds.

(b) The maintenance fault code display mode provides access to some IRU faults without external test equipment. Faults are classified as either critical, noncritical, or BITE memory only. The maintenance fault code display mode will display critical and noncritical faults, but external test equipment is required to read faults stored in BITE memory. Regardless of fault classification, all faults are stored in BITE memory when the IRU is turned off.

1) To enter the maintenance code display mode, first select the desired IRU with the SYS DSPL switch. Next, set the DSPL SEL switch to the HDG position. Enter a 0 on the keyboard, followed within five seconds by a 1. The highest priority code will be displayed in the two right digits of the IRMP display. Record the code, press CLR to display the next priority code, and repeat to cycle through the remaining codes.
2) If the IRS was navigating, the last value shown for true heading stays on the display.
3) If the TTN display was shown, the last value is kept in memory when the maintenance code mode is entered. The internal clock continues to run and a new TTN value will show after all maintenance codes are shown.
4) The following table shows the related fault for each IRMP code:

IRMP CODE AND PRIORITY	IRU FAULT
01	POWER SUPPLY CRITICAL
02	DIGITAL I/O WRAP-AROUND
03	RAM/NVM/PROM MEMORY
04	LSIC
05	DISCRETE INPUT
06	PROCESSOR
07	GYRO
08	ALIGN/SYSTEM
09	A/D MUX DATA TRANSFER
11	POWER SUPPLY
12	ADC DISCRETE OUT
13	NOT USED
14	CALIBRATION PROM
15	INA/OTA
16	ANALOG PITCH RATE
17	GYRO
18	GYRO CONFIGURATION
19	TEMPERATURE SENSOR
20	NOT USED

5) Codes 01 thru 09 are critical faults. When a critical fault occurs, it turns on the IRMP fault annunciator and sets the IRU fault ball immediately.

6) Codes 11 thru 20 are noncritical faults and are indicated as follows:

a) During initialization, align, align downmode, or navigate mode, a noncritical fault sets the IRU faultball immediately upon detection of the fault. If a noncritical fault is detected on the ground, the IRMP fault annunciator turns on. If a noncritical fault is detected in the air, the IRMP fault annunciator turns on below a set groundspeed after touchdown.

b) During attitude mode, no failure indication is given by the IRMP fault annunciator. A fault detected prior to entering attitude mode is indicated as previously described. Entering attitude mode causes the IRMP fault annunciator to go out, but the IRU faultball remains set.

B. FMC-CDU IRS Functions

(1) CDU - IRS Initialization Functions

(a) The IRS is initialized (present position entered) by selecting IRS pages on the FMC-CDU keyboard. For detailed operation of the FMC-CDU, refer to 34-61-00. The FMC-CDUs are located in the forward electronics panel, P9.

(2) IRS Related CDU Displays (Fig. 3)

(a) The INIT/REF INDEX page provides access to pages of data required for initializing and monitoring the IRS.

(b) The POS INIT page is selected to enter the initial reference position for IRS alignment.

(c) The POS REF 2/2 page displays current position and ground speed, as computed by the FMC and each IRU.

(d) The MAINTENANCE INDEX provides access to two pages of data from which maintenance personnel can check IRU status and performance.

1) The SENSOR STATUS page shows the current status of each IRU (OK, TEST, or FAIL).

2) The IRS MONITOR page shows the FMC computed position error rate for each IRS. This rate is calculated by subtracting the final position deviation from the initial position deviation and dividing by the total time of the previous flight segment. All error rates are shown in nautical miles per hour and are available at the completion of each flight segment.

(3) The FMC CDU RTE 1 LEGS page can be used to do an actual position error check. You must enter the actual and IRS positions as waypoints and compare their difference in nautical miles to a deviation criterion.

C. Instrument Source Select Panels
  (1) The IRS switches on the instrument source select panels let the captain and first officer switch between the normal and alternate (ALTN) IRUs. The switch is lit (white) in the ALTN position (AMM 34-22-00). The switches are on the captains and F/O's instrument panels.

D. Radio Distance Magnetic Indicator (RDMI)
  (1) The RDMIs show magnetic heading supplied by the IRS. The HEADING failure flag shows on the instrument face if the IRS is off or the data shown is invalid (AMM 34-22-00). The RDMI's are on the captains and F/O's instrument panels.

E. Vertical Speed Indicator (VSI)
  (1) The VSIs show vertical speed supplied by the IRS. The OFF failure flag is shown on the instrument face if the IRS is off or the IRS data is invalid (AMM 34-22-00). The VSI's are on the captain's and F/O's instrument panels.

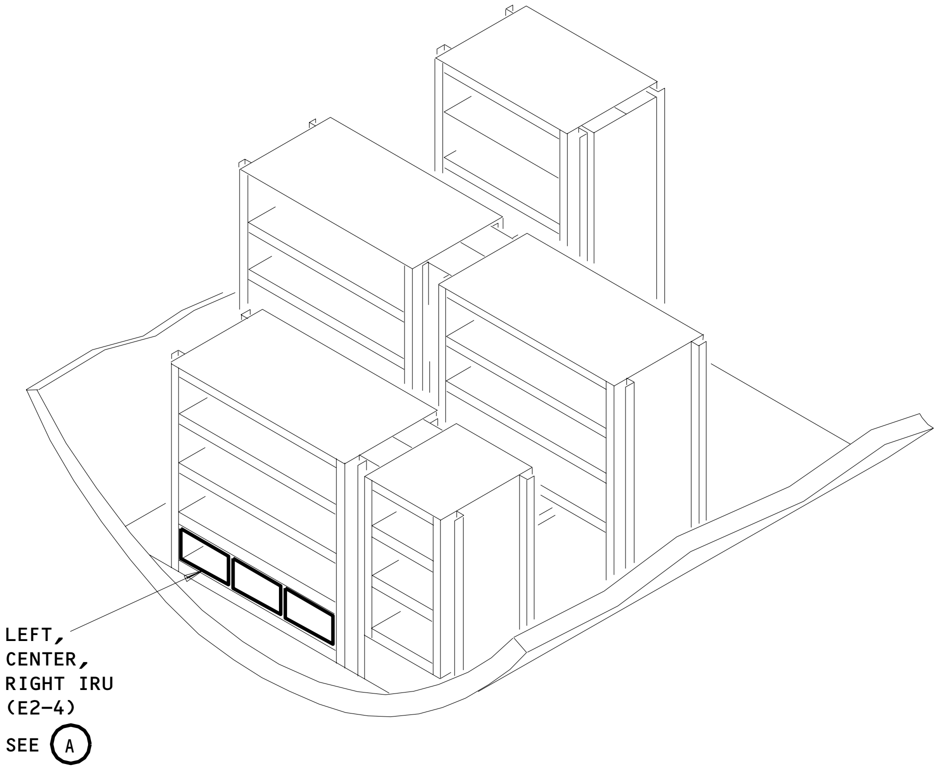
F. Electronic Horizontal Situation Indicator (EHSI)
  (1) The EHSIs show IRS generated track and heading. IRS failures cause removal of IRS related symbology and display of the TRK failure flag (AMM 34-22-00). The EHSIs are on the captain's and F/O's instrument panels.

G. Electronic Attitude Director Indicator (EADI)
  (1) The EADIs display pitch, roll, and ground speed supplied by the IRS. IRS failures cause removal of IRS related symbology and display of the ATT failure flag (AMM 34-22-00). The EADIs are located on the captain's and F/O's instrument panels.

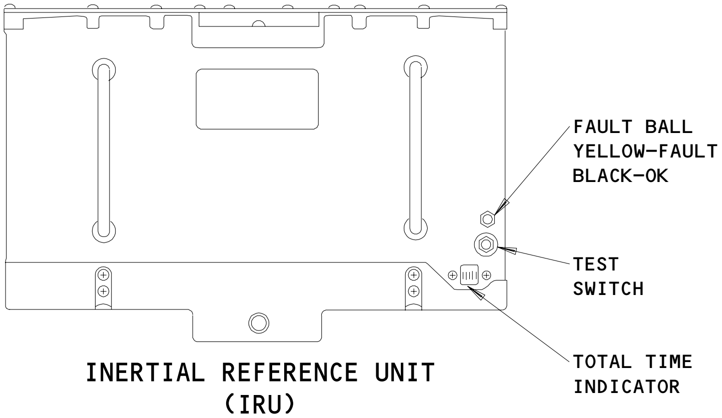
H. EICAS Display Units
  (1) The top EICAS display unit provides nine IRS level C advisory messages which include IRS ON DC, DC FAIL, and FAULT for each IRU (AMM 31-41-00). These same messages are also displayed on the IRMP. The EICAS display units are located on the center instrument panel, P2.

I. Heading Reference Switch
  (1) The HDG REF switch is used to manually select either magnetic (NORM position) or true (TRUE position) north reference on the EHSIs and RDMIs. It is located on panel P3.

J. Inertial Reference Unit (IRU) (Fig. 2)
  (1) Each IRU provides the guidance reference for the airplane by sensing airplane angular rate and linear acceleration. Position, velocity, attitude, heading, acceleration and body angular rates are compiled from the sensor data. A digital computer in each IRU performs all the calculations for IRS.
  (2) The IRU consists of three laser gyros, three accelerometers, circuit cards, a sensor assembly, a power supply, and a chassis assembly.
  (3) The front panel of the IRU has a fault ball indicator, interface test switch, and a total time indicator.
    (a) The BITE fault ball indicator shows black for an operational IRU and yellow for a failed IRU. The fault ball indicates a failure that could cause irregular outputs. Other failures detected by BITE, which do not have an effect on the outputs are stored in BITE memory.



MAIN EQUIPMENT CENTER



INERTIAL REFERENCE UNIT
(IRU)
A

Inertial Reference System - IRU Location
Figure 2

(b) Pushing the test switch turns on the IRMP annunciator lights for 2 seconds, then the IRU sends digital failure words for 8 seconds. After 10 seconds and until the switch is released, the IRU outputs canned test data for observation in the flight deck. The test can be done in the NAV or ALIGN mode. The test operation is prevented in the NAV mode whenever the ground speed is greater than 20 knots, and in the ATT mode. Some of the test outputs are:

1)	AIRPLANES WITH FULL VOR AND ILS MODES; Drift Angle	-10° (L)
2)	Ground Speed *[1]	200 Kts
3)	Inertial Vertical Speed	-600 ft/min
4)	Magnetic Heading	15°
5)	Pitch Angle	5° UP
6)	Present Position (Lat, Long) *[2]	N22°30', E22°30'
7)	Roll Angle	45° RIGHT
8)	True Heading	10°
9)	Wind Direction as follows: a) 30 degrees on the IRMP b) 30 degrees on the EHSI if TRU is shown above the compass card c) 36 degrees on the EHSI if M is shown above the compass card	
10)	Wind Speed	100 Kts

*[1] During the functional test, ground speed is not displayed on the FMC CDU. A ground speed of 200 knots can be read on both the IRMP and EADI. It flashes for only about 1/2 second at the tenth second of the test.

*[2] For the functional test, present position must be read on the IRMP. The FMC CDU does not display IRU test values of present position; rather, it displays a blank for the associated IRU.

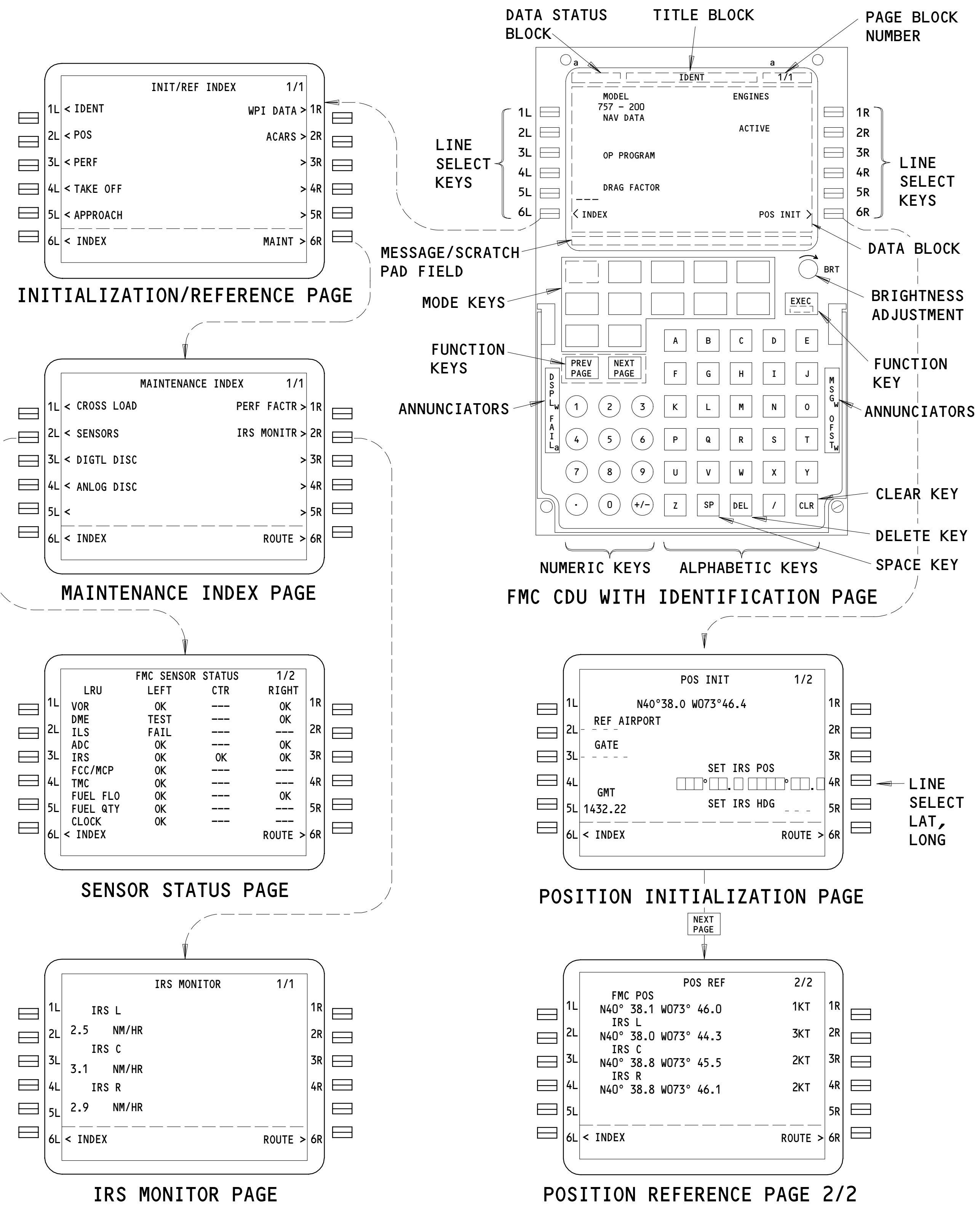
(c) The total time indicator displays accumulated operating time.

3. Operation

A. Functional Description (Fig. 3)

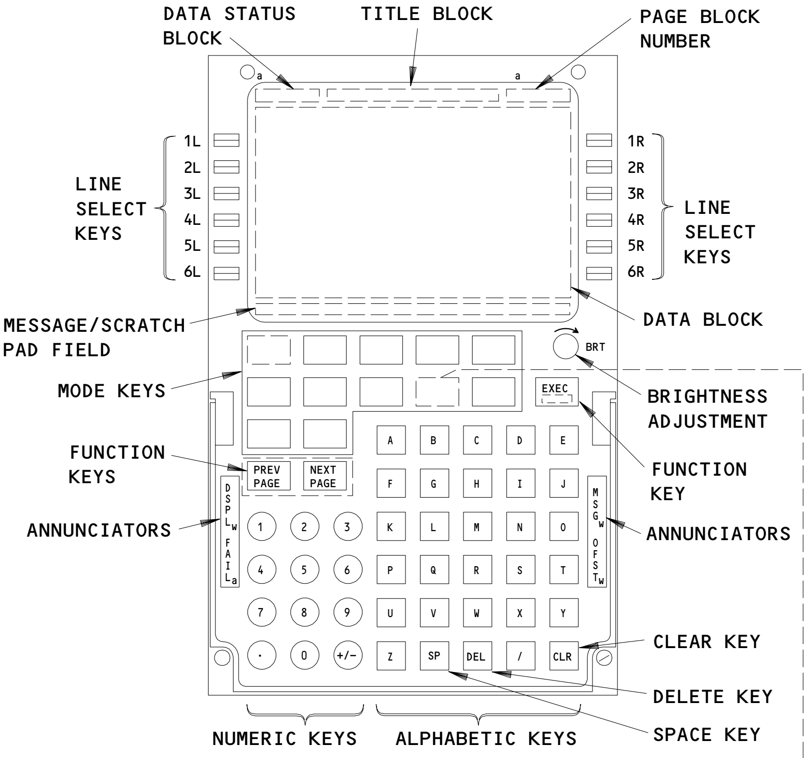
(1) IRS Alignment

(a) The IRS can be initialized by the FMC-CDU or IRMP whenever the IRU is in the alignment (ALIGN) mode. When a mode select switch on the IRMP is switched to ALIGN or NAV, the respective IRU enters the alignment mode. In the alignment mode, the IRU reference axis is aligned to the local vertical. The IRU calculates latitude by estimating the horizontal earth rate components. While in the alignment mode, the IRU outputs a discrete signal to light the ALIGN annunciator on the IRMP. When the mode select switch is switched to ALIGN or NAV from OFF, initial latitude and longitude (lat/long) must be entered to complete the alignment process. Initial latitude and longitude are not required when switching from NAV to ALIGN.

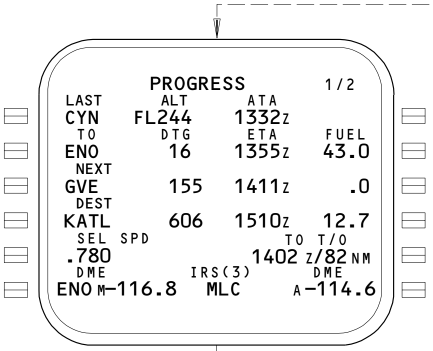


LRU	LEFT	CTR	RIGHT
VOR	OK	---	OK
DME	TEST	---	OK
ILS	FAIL	---	---
ADC	OK	---	OK
IRS	OK	OK	OK
FCC/MCP	OK	---	---
TMC	OK	---	---
FUEL FLO	OK	---	OK
FUEL QTY	OK	---	---
CLOCK	OK	---	---

IRS Related FMC CDU Pages
Figure 3 (Sheet 1)

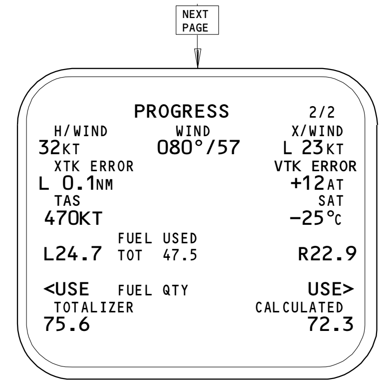


FMC CDU



```
          PROGRESS          1/2
LAST      ALT       ATA
CYN      FL244     1332z
 TO       DTG       ETA       FUEL
ENO        16      1355z      43.0
 NEXT
GVE       155      1411z        .0
 DEST
KATL      606      1510z      12.7
 SEL  SPD                TO  T/O
.780                   1402 z/82NM
 DME          IRS(3)        DME
ENO M-116.8    MLC       A-114.6
```

PROGRESS PAGE 1/2



```
            PROGRESS              2/2
 H/WIND        WIND            X/WIND
32KT         080°/57           L 23KT
  XTK ERROR                 VTK ERROR
L 0.1NM                         +12AT
 TAS                              SAT
470KT                           -25°C
            FUEL  USED
L24.7       TOT   47.5          R22.9

<USE        FUEL  QTY            USE>
 TOTALIZER                 CALCULATED
75.6                             72.3
```

PROGRESS PAGE 2/2

IRS Related FMC CDU Pages
Figure 3 (Sheet 2)

(b) Position initialization by the FMC-CDU is accomplished by accessing the POS INIT page on the FMC-CDU by one of four methods:
  1) Pressing the INIT/REF mode select key (when on the ground and when the IRS position has not been initialized).
  2) Pressing the POS line select key when the INDEX page is displayed.
  3) Pressing the POS INIT line select key when the IDENT page is displayed.
  4) Pressing the PREV PAGE or NEXT PAGE key when the POS REF 2/2 page is displayed.

(c) The POS REF page 2/2 displays ground speed (GS) and current position as computed by the FMC and each IRU. The GS displays are frozen at flight completion and retained until power down or takeoff.

(d) Prompt Boxes (FMC CDU)
  1) Prior to the entry of present position LAT/LONG into the FMC-CDU, box prompts may appear in the SET IRS POS line. Box prompts are necessary for the original entry of data into this line. Re-entry or overwriting of data does not require box prompts. Box prompts appear when the IRMP mode select switch is turned from OFF to ALIGN or NAV. They will also appear if the IRMP mode select switch is turned from NAV to ALIGN after the IRU's have completed an alignment.
  2) In certain situations, box prompts will appear in the SET IRS POS line even though the insertion of data is not required. This is a normal feature of the system. It does not require operator action, and does not indicate system malfunction. Box prompts will disappear after an alignment is completed, or if the IRUs are OFF and power is temporarily removed from the FMC.

(e) One of the following three methods is used to enter present position lat/long into the SET IRS POS line of the POS INIT page on the CDU.
  1) LAT/LONG is entered into the scratch pad using the keyboard, then line selected into the SET IRS POS line.
  2) LAT/LONG is transferred from the LAST POS line to the SET IRS POS line via the scratch pad.
  3) REF AIRPORT or REF AIRPORT and GATE is entered, the resultant lat/long is line selected to the SET IRS POS line.

(f) Initialization at the IRMP is done as follows:
  1) Set DSPL SEL in the PPOS position.
  2) Enter the present position (latitude and longitude) by pressing in proper sequence, two of the following keys: N(2), W(4), E(6), or S(8) and the present position.
  3) Press ENT key to transmit the data displayed to the IRU.

4) The displayed data is sent to all three IRUs simultaneously. Correct data reception by an IRU can be verified by setting SYS DSPLY to the appropriate IRU (L, C, R) and reading the IRMP display.

(g) The alignment mode can be entered by turning the mode select switch in any of four sequences: OFF to ALIGN, OFF to ALIGN to NAV, NAV to ALIGN, or NAV to ALIGN to NAV.

1) OFF to ALIGN. Switching from OFF to ALIGN requires that the initial position (latitude and longitude) be entered in order to complete the alignment satisfactorily. This requires that initialization of the IRU be performed and that the airplane is not moving. If left in the ALIGN position, the system will continue to perform the alignment process.

2) OFF to ALIGN to NAV. Switching from OFF to ALIGN to NAV requires that the initial position be entered during the alignment period, and that the airplane is not moving. Once the alignment process is complete, the align annunciator will go out and the IRU will enter the navigate mode.

3) NAV to ALIGN. Switching from NAV to ALIGN will zero the system residual velocity errors and level the system. If the ground speed is greater than 20 knots, the IRU will remain in the NAV mode of operation. A maximum of 30 seconds is required to complete the platform releveling part of alignment. It is permissible to enter a more accurate latitude and longitude to improve the system alignment. Updates to latitude and longitude are allowed only during the ALIGN mode. The system will enter the navigation mode when selected manually.

4) NAV to ALIGN to NAV. This sequence, when completed in less than 30 seconds, will zero the system residual velocity errors and level the system. The system will automatically revert to the NAV mode after the 30 second releveling process is complete. The above sequence can only be performed when the airplane is not moving.

(2) Alignment Conditions and Indications (Fig. 4)

(a) The table lists annunciation for both good alignment and alignment problems.

(b) The IRU compares entered longitude with the last known longitude stored in BITE memory. If the difference is greater than one degree, the ALIGN annunciator flashes. This could legitimately occur (i.e. the entry is correct) if the IRU was newly installed. In this case, a re-entry of the same (correct) position will be accepted.

<u>NOTE</u>: Latitude and longitude are not compared to the present position stored in memory after the IRU is powered down from the attitude mode or due to a power loss or after the IRU is returned from a repair center.

ALIGNMENT CONDITIONS TABLE

ACTION	RESULTS		
	ALIGN ANNUNCIATOR	FAULT ANNUNCIATOR	OPERATIONAL MODE
MODE SELECT SWITCH MOVED TO ALIGN OR NAV FROM OFF.	ON	OFF	ALIGN
ELAPSED TIME = 0:			
LATITUDE DATA ENTERED.	ON	OFF	ALIGN (DATA STORED)
LONGITUDE DATA ENTERED IS NOT WITHIN 1 DEGREE OF PREVIOUS ENTRY OR MISCOMPARES WITH STORED VALUE.	FLASHING	OFF	ALIGN (DATA STORED)
SAME LONGITUDE DATA ENTERED SECOND CONSECUTIVE TIME (IDENTICAL DATA).	ON	OFF	ALIGN (DATA ACCEPTED)
ACCEPTABLE LONGITUDE DATA ENTERED.	ON	OFF	ALIGN (DATA ACCEPTED)
ELAPSED TIME = 10 MINUTES:			
NO LATITUDE AND/OR LONGITUDE DATA HAS BEEN ACCEPTED.	FLASHING	OFF	ALIGN (AWAITING DATA)
INVALID LATITUDE DATA ENTERED.	FLASHING	OFF	ALIGN (DATA IGNORED)
MARGINALLY BAD LATITUDE DATA ENTERED FOR FIRST TIME, MISCOMPARES WITH COMPUTED LATTITUDE.	FLASHING	OFF	ALIGN (DATA STORED)
DIFFERENT LAT ENTERED MISCOMPARES WITH COMPUTED LATITUDE.	FLASHING	OFF	ALIGN
SAME LATITUDE DATA ENTERED SECOND CONSECUTIVE TIME (IDENTICAL DATA).	ON	ON	ALIGN
LONGITUDE DATA INVALID, NOT WITHIN 1 DEG OF PREVIOUS ENTRY OR MISCOMPARES WITH STORED VALUE.	FLASHING	OFF	ALIGN (DATA STORED)
AIRPLANE WAS MOVED DURING 10-MINUTE INTERVAL. ALIGNMENT AUTOMATICALLY RESTARTS AFTER 30 SECONDS USING PREVIOUS ENTRY.	ON	OFF	ALIGN (DATA ACCEPTED)
SAME BAD LONGITUDE DATA ENTERED SECOND CONSECUTIVE TIME (IDENTICAL DATA).	ON	OFF	ALIGN (DATA ACCEPTED)
SOME OTHER DIFFICULTY IS PREVENTING PROPER ALIGNMENT (IRS FAULT).	ON/FLASH	ON/OFF	ALIGN
LATITUDE AND LONGITUDE DATA HAVE BEEN ACCEPTED, AIRPLANE WAS NOT MOVED, NO OTHER PROBLEMS ARE PREVENTING ALIGNMENT, AND MODE SELECT SWITCH IS IN NAV POSITION.	OFF	OFF	NAV
MODE SELECT NAV-ALIGN-NAV CONDITION. ZEROES RESIDUAL VELOCITY ERRORS.	OFF	OFF	ALIGN

IRS Alignment Conditions
Figure 4

(c) Entered latitude is compared with an IRU computed latitude during alignment. A difference in latitude Sine/Cosine of greater than .15/.01234 causes a flashing ALIGN light.

<u>NOTE</u>: The latitude sin/cos test will be performed only once per latitude entry and once prior to entering NAV mode.

(3) Laser Gyro Operation (Fig. 5)

(a) The ring laser gyro uses laser light to measure angular rotation. It is contained in a triangular cavity filled with helium-neon gas. Mirrors are mounted at each corner, and high voltage electrodes are mounted in each leg. The cavity and mirrors form a positive feedback, resonant system required for laser action.

(b) When a high voltage is applied between the cathode and anodes, the helium-neon gas ionizes, producing a clockwise and counterclockwise beam of laser light. The two light beams are reflected around the cavity by the mirrors.

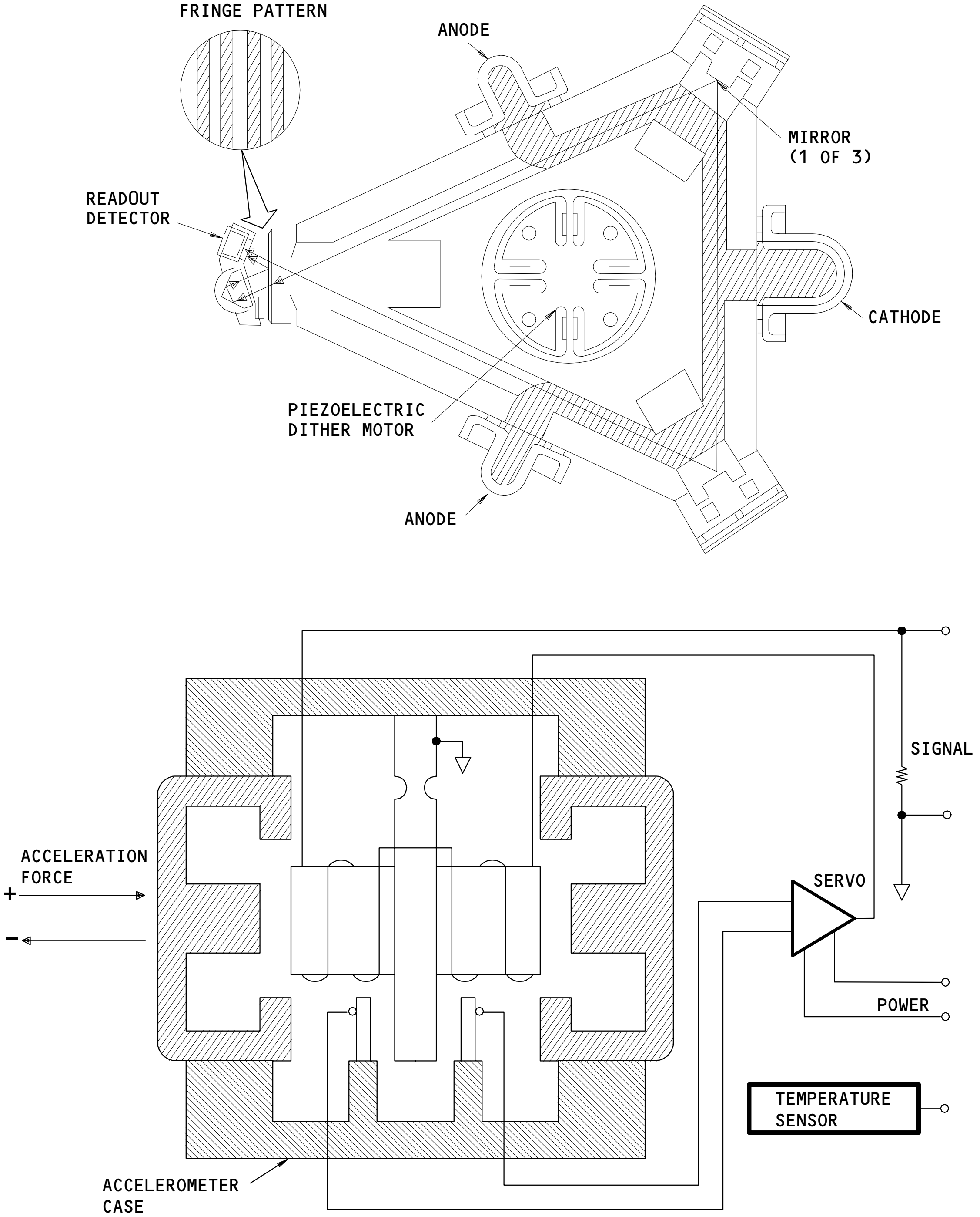
(c) The path length around the cavity is carefully monitored and adjusted so that it is an integral multiple of the peak power laser wavelength.

(d) When the laser gyro is at rest, the frequencies of the two opposite travelling laser beams are equal. When the laser gyro is rotated about an axis perpendicular to the lasing plane, a frequency difference between the two laser beams results. The frequency difference is created because the speed of light is constant. One laser beam will thus have a greater apparent distance to travel than the other laser beam in completing one pass around the cavity.

(e) A small amount of light from the two laser beams passes through one of the mirrors (less than .2%). The beams are combined by optical means. If there is an input angular rate, the two different light frequencies produce a beat frequency. This takes the form of a fringe (interference) pattern. This beat frequency of light compares to two different audio frequencies combining to produce a third difference frequency.

(f) When the laser beam frequencies differ, a fringe pattern of alternate dark and light stripes is created. Photodiodes sense the fringe pattern rate and direction of movement. The frequency and relative phase of the two diode outputs indicate magnitude and the direction of the gyro's rotation.

(g) At low rotation rates, the small frequency difference between the laser beams leads to beam coupling. This locks the frequencies together at a single false value. To compensate for this effect a piezoelectric dither motor is used to vibrate the laser block through the lock-in region. Dither vibration has a net zero average. It produces no net inertial rotation. The dither motor vibration can be felt on the IRU case and produces an audible hum.



Laser Gyro and Accelerometer Operation
Figure 5

(4) Accelerometer Operation
- (a) The accelerometer senses acceleration (changes in velocity). A proof mass is mounted on a pivot between two capacitor plates. The proof mass suspends a common capacitor plate forming two capacitances, C1 and C2. During an acceleration, the proof mass begins to pivot causing the capacitances to become unequal.
- (b) A servo loop senses the unequal capacitances. As a result, it forces current through an electromagnetic torque coil which drives the proof mass to null (C1=C2). The changing servo current is proportional to acceleration. It provides a continuous measure of static and dynamic acceleration.
- (c) A temperature sensor is provided for each axis (X, Y, Z) to improve accelerometer accuracy. Each sensor provides a signal proportional to temperature. This signal is used by the IRU for compensation and correction of sensor data.

B. IRS Block Diagram (Fig. 6)

(1) Normal system power is 115v ac from circuit breakers in P11 with 28v dc from the hot battery bus providing a backup power source. For system startup, both ac and dc power must be available.

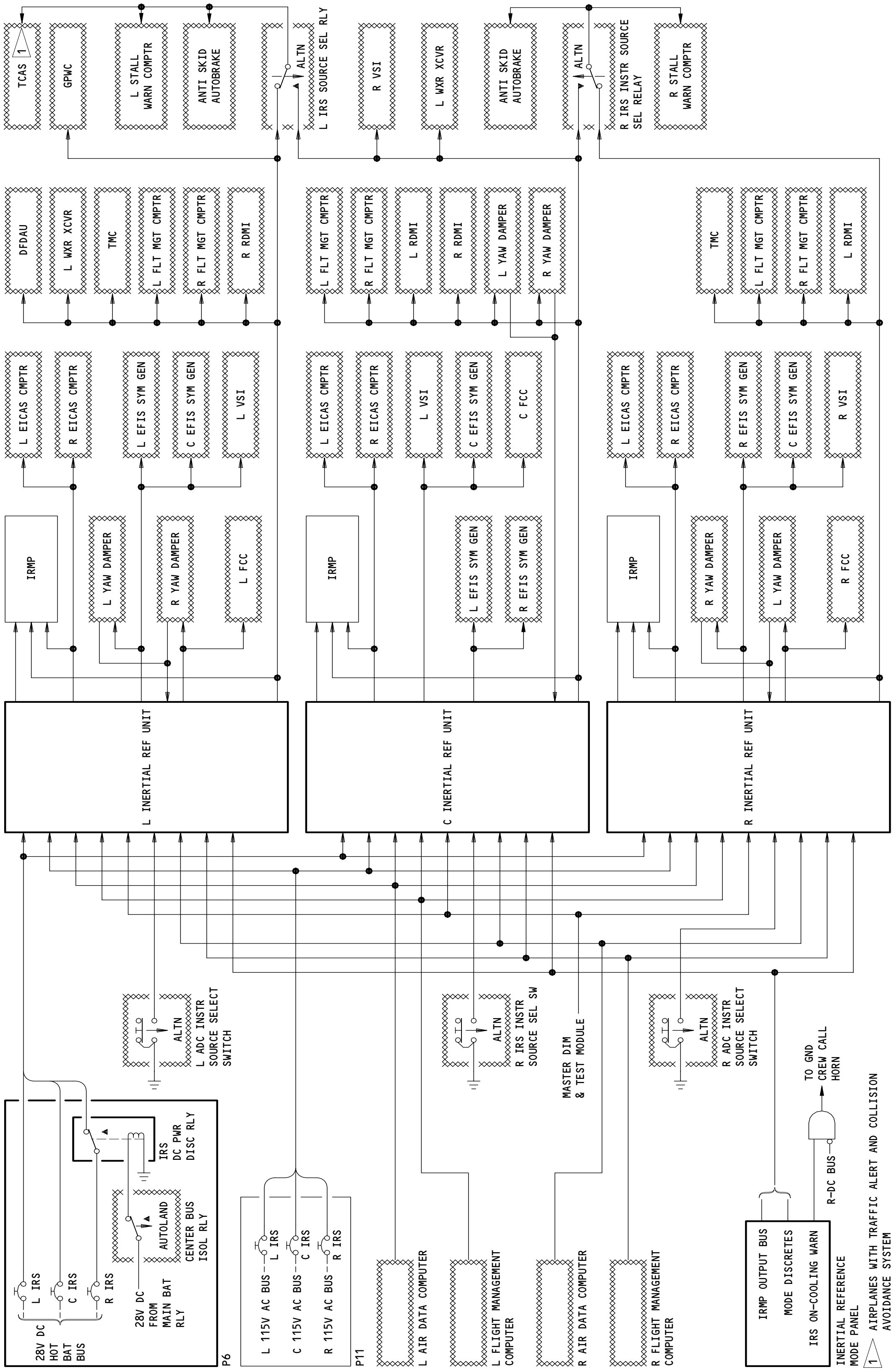
(2) Switching to 28v dc is accomplished automatically by the IRUs when loss of 115v ac is sensed. Five minutes after 28v dc is supplied from the main battery relay, the backup hot battery bus 28v dc is removed from the right IRU by the IRS DC power disconnect relay. The center and left IRU's remain powered from the airplane battery to supply heading to the captain's RDMI. During autoland, the center bus isolation relay, K123, inhibits the IRS DC power disconnect relay.

(3) The IRMP supplies system mode discretes from the mode select switch and digital data from keyboard entries to the IRUs.

(4) The left and right air data computers provide altitude, altitude rate, and true airspeed. For the left and right IRUs, the ADC is selected by the ADC switch on the onside instrument source select panel. The center IRU receives a switching discrete from the first officer's IRS switch to control which (left or right) ADC input it utilizes: in normal, the left ADC supplies the center IRU, in ALTN (alternate) the right ADC supplies the center IRU.

(5) The flight management computers supply initialization. The IRU looks for initialization data from either flight management computer or the IRMP.

(6) The ground-crew call horn will sound during either of the conditions that follow:
- (a) An IRU is on and there is no power to the over-temperature protection circuits (AC and HMG DC power has failed or pilot selected equipment cooling override).
- (b) AC and HMG DC power are lost and on IRU is on (powered from the main battery).



1 AIRPLANES WITH TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM

IRS Block Diagram
Figure 6

(7) Each IRU transmits data related to airplane heading, attitude, inertial velocities, position, acceleration, angular rates, and wind velocity and direction to various airplane systems. Status discretes are transmitted to the inertial reference mode panel and to the EICAS computers for display on the upper EICAS display unit.

(8) The data transmitted to the IRS instrument source select relays is routed to the stall warning computers and the antiskid/autobrake system. The antiskid/autobrake system monitors IRU calculated ground speeds to maintain the optimum deceleration rate while the autobrake system is in use.

(9) If either yaw damper is placed in self-test, all three IRUs will be given a self-test discrete input.

(10) System Operation (Fig. 7)

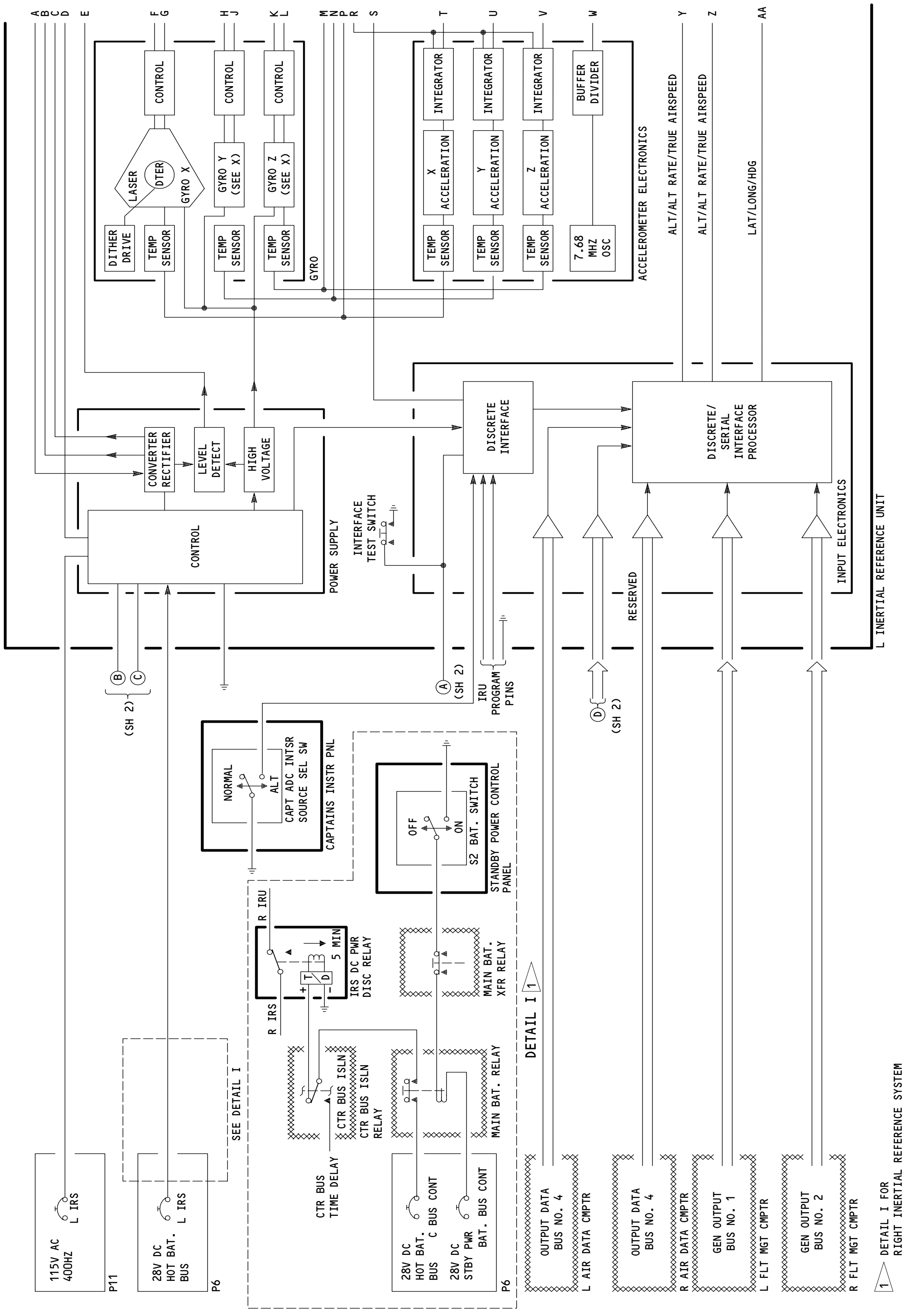
 (a) The left IRS is shown on the schematic. The right and center systems are similar, so the left IRS description applies to these systems also.

 (b) The IRMP and the FMCs supply initialization data and the ADCs furnish required air data inputs to the system. The IRMP also supplies mode selection discretes to the IRU. A remote test discrete directs IRS to output canned data for checks of the yaw damper system and inter-system wiring.

 (c) When airplane power fails, the IRU automatically switches to battery power. The right system stays on battery power for a maximum of 5 minutes. The left and center systems stay on battery power indefinitely. All three systems stay on battery power during autoland.

 (d) Power Supply - The power supply furnishes the control currents and voltages for the IRU and IRS mode select panel. The main supply provides two drive signals for the HV power supply, two status indication signals for the IRS mode select panel, two mode selection signals to the input electronics, and a power-up initialization signal for the entire IRS.

 (e) The power supply receives 115 V, 400 Hz power and 28 V dc back-up power from the airplane. MODE 1 and MODE 2 mode select discretes from the IRS mode select panel control the on/off condition of the main power supply.



1 DETAIL I FOR RIGHT INERTIAL REFERENCE SYSTEM

Inertial Reference System Schematic (Typical)
Figure 7 (Sheet 1)

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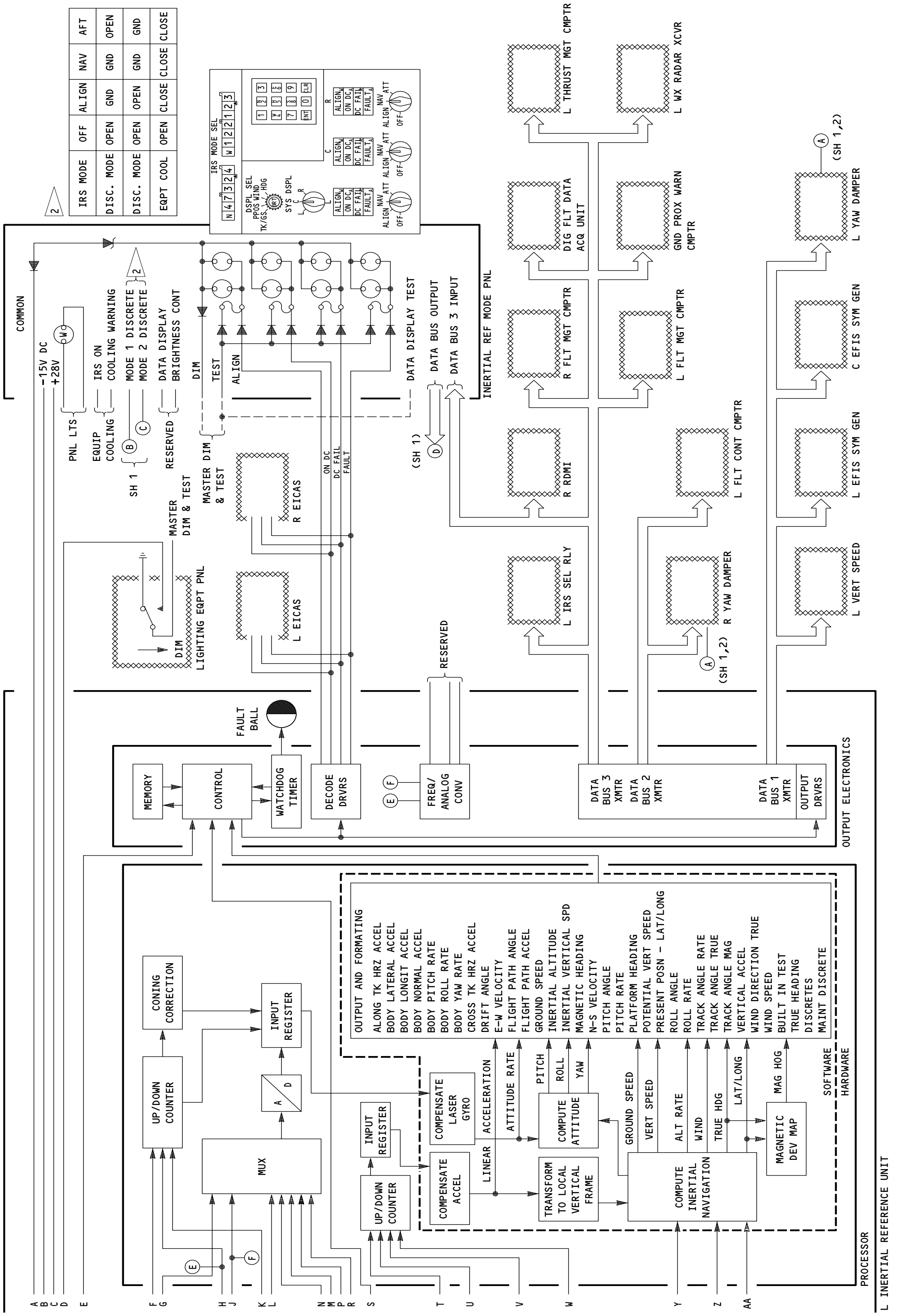

IRS MODE	OFF	ALIGN	NAV	AFT
DISC. MODE	OPEN	GND	GND	OPEN
DISC. MODE	OPEN	OPEN	GND	GND
EQPT COOL	OPEN	CLOSE	CLOSE	CLOSE

Inertial Reference System Schematic (Example)
Figure 7 (Sheet 2)

T62051

IRU DATA BUS OUTPUTS •

IRU DATA BUS INPUTS +

	OUTPUT SIGNALS / IRU OUTPUT TO	R IRS SEL	L IRS SEL	IRMP	L,R FMC	DFDAU	L FLT CONT CMPTR	C FLT CONT CMPTR	R FLT CONT CMPTR	GND PROX CMPTR	L EFIS SYM GEN	C EFIS SYM GEN	R EFIS SYM GEN	THRUST MGMT CMPTR	L WXR RCVR	L,R YAW DAMPER	L SWC	R SWC	L RDMI	L VSI	R RDMI	R VSI	L AIR DATA CMPTR	R AIR DATA CMPTR	IRU INPUT FROM / INPUT DATA
	L IRU		•	• +	• +	•	•			•	•	•		•	•	•	•			•	•		+		L IRU
	R IRU	•		• +	• +				•			•	•	•		•		•	•		•	•	+	+	R IRU
	C IRU	•	•	• +	• +			•			•	•	•		•	•	•	•	•	•		•		+	C IRU
	ALONG TK HRZ ACCEL			+	• +		•	•	•																SET LATITUDE
	BODY LATERAL ACCEL			+	• +		•	•	•							•									SET LONGITUDE
	BODY LONGIT ACCEL	•	•	+	• +		•	•	•								•	•							SET MAGNETIC HDG
	BODY NORMAL ACCEL						•	•	•					•			•	•					+	+	ALTITUDE (29.92)
	BODY PITCH RATE						•	•	•					•			•	•					+	+	ALTITUDE RATE
	BODY ROLL RATE						•	•	•							•							+	+	TRUE AIRSPEED
	BODY YAW RATE						•	•	•					•		•									
	CROSS TK HRZ ACCEL				•		•	•	•		•	•	•												
	DRIFT ANGLE					•					•	•	•												
	E-W VELOCITY				•																				
	FLIGHT PATH ACCEL				•		•	•	•		•	•	•	•											
	FLIGHT PATH ANGLE					•					•	•	•												
	GROUND SPEED	•	•		•		•	•	•		•	•	•	•		•									
	GROUND SPEED-D			•							•	•	•												
	INERTIAL ALTITUDE				•		•	•	•					•											
	INERTIAL VERT SPD				•	•	•	•	•					•						•		•			
	MAGNETIC HEADING				•		•	•	•		•	•	•						•		•				
	MAGNETIC HEADING-D									•															
	N-S VELOCITY				•																				
	PITCH ANGLE				•		•	•	•		•	•	•	•	•		•	•							
	PITCH ATT RATE						•	•	•																
	PRESENT POS LAT-D			•																					
	PRESENT POS LONG-D			•																					
	PRESENT POS-LAT				•	•																			
	PRESENT POS-LONG				•	•																			
	ROLL ANGLE				•		•	•	•		•	•	•	•	•	•									
	TRACK ANGLE TRUE						•	•	•		•	•	•												
	TRACK ANGLE TRUE-D			•																					
	TRACK ANGLE-MAG						•	•	•		•	•	•												
	TRUE HEADING				•		•	•	•		•	•	•						•		•				
	TRUE HEADING-D			•																					
	VERTICAL ACCEL				•		•	•	•																
	WIND DIRECT TRUE					•					•	•	•												
	WIND DIRECT TRUE-D			•																					
	WIND SPEED					•					•	•	•												
	WIND SPEED-D			•																					
DISCRETES	ALIGN MODE/NR				•																				
	REV ATTITUDE MODE				•																				
	NAV MODE				•																				
	SET HEADING				•																				
	ATTITUDE INVALID				•																				
	DC FAIL				•																				
	ON DC				•																				
	ADC FAULT				•																				
	IRU FAULT				•																				
	DC FAIL ON DC				•																				
	ALIGN FAULT				•		•	•	•					•											
	NO IRS INITIAL				•		•	•	•					•											
	EXCESS MOTION ERR				•		•	•	•					•											
	ADC/IRU FAULT				•		•	•	•					•											

Inertial Reference Data Bus Schematic
Figure 8

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(f) If 115 V ac is not available from the airplane, the IRU automatically switches to 28 V dc battery power. It also provides a signal to light the ON DC annunciator on the IRMP. If the battery voltage drops below 18 V, the IRU will generate a DC FAIL discrete which is displayed at the IRS mode select panel.

(g) After 5 minutes on battery power or termination of autoland, the DC power disconnect relay (K137) opens to remove battery power from the right IRU. The left and center IRU's stay on battery power until the voltage drops below 18 V. The center bus isolation relay (K123) maintains triple system operation during autoland (AMM 24-00-00).

(h) When the IRMP's mode select switch is moved from OFF to ALIGN, or NAV, a self-test BITE signal disables the 115 V ac input and inserts the 28 V dc battery as the power source for 5 sec. This tests the battery and associated power switching circuits. The ON DC annunciator lights during this test.

(i) Gyro electronics - Each laser sensor assembly contains a laser gyro fringe pattern detector, and control circuits. The main function of each laser gyro assembly is to produce pulsers indicating CW/CCW rotation.

(j) The laser gyro detects pitch, roll, and yaw rates and provides this data to the IRU computer for computation and navigation. A temperature sensor provides a signal that is used for correction of thermal drifts. Each gyro has correction values stored in a PROM which details the gyro's unique bias, thermal, and alignment characteristics. The PROM data is routed to the CPU at turn-on. It is used to provide error correction of laser gyro outputs.

(k) The laser gyro is started by -950 V dc and +3500 V dc levels from the HV power supply. Once laser action starts, the +3500 V dc is turned off and operation is sustained on the -950 V dc supply. Control signals standardize the path length for each gyro such that gyro operation efficiency is maximized. A dither drive circuit controls the operation of the dither motor. The dither motor develops a vibration to keep the gyro out of the lock-in region during low rotation rates.

(l) Accelerometer electronics - These circuits consist of three accelerometers, temperature sensors and wave-shaping circuits. This portion of the IRU outputs analog and digitized acceleration. The output of each accelerometer is an analog current proportioned to acceleration. The current is integrated and digitized and the digital counts are stored. They are then used to produce a component of velocity and change in velocity (acceleration) for each axis.

(m) The accelerometer electronics also contains a 7.68 MHz precision system clock. The clock outputs are divided down to 3.84 MHz and 640 kHz. The clock signals control the timing of data transfer and computer program execution.

(n) Sensor electronics and A/D multiplexer - The A/D multiplexer converts analog input signals from the sensors into digital words. The input signals are accelerometer analog currents and sample and hold signals, pitch rate, temperature sensor signals, and BITE monitor signals.

(o) Acceleration and gyro data are received under timing control of a clock signal. The accelerometer pulses are accumulated as velocity and change in velocity. The gyro pulses are summed as changes in angular rate and direction. Coning circuits correct the gyro data for errors developed by the cone-shaped motion of the gyros. Sensor data is then routed to the common CPU bus.

(p) IRU sensor data is supplied by the laser gyros, accelerometers, and their temperature sensors. Signal outputs of these devices are formatted into data words for manipulation by the IRU computer. A microprocessor is used in the IRU computer of the central processing unit (CPU). A common data bus links the following blocks of the IRU.

1) Input electronics.
2) Sensor electronics and A/D multiplexor.
3) CPU
4) Output electronics.
5) BITE electronics.

(q) Input Electronics - The IRU receives altitude, altitude rate, and true airspeed (TAS) from the air data computer (ADC). The IRMP and flight management computers (FMCs) send initial latitude/longitude and heading (in the ATT mode only) to the IRU. This data is transferred to the IRU memory. It is then placed on the CPU input bus for use by the CPU computer program. Mode 1 and Mode 2 discretes, switched from the IRS mode select panel, select the operating mode using open/ground logic as shown on the schematic. IRU on/off discretes alert the equipment cooling system that the IRU is on/off.

(r) CPU - The IRU computer is controlled by a stored program. The computer uses the sensor data to perform calculations.

(s) A 16-bit microprocessor is used as the central processing unit (CPU) for each IRU. Input control signals direct the CPU to perform specific tasks with the aid of software. The program is run at the system clock frequency of 3.84 MHz. The sensor inputs are compensated for inherent drifts, bias, and misalignments. The program uses stored coefficients to perform this function. The inputs are used to compute airplane attitude. This attitude is referenced to the local level navigational coordinates. The angular rate of the airplane over the surface of the earth is also included in the computation. This rate accounts for the airplanes velocity and the earth's rotation. This provides for rotation of the local vertical. Attitude data is also used to resolve acceleration data into the local level coordinate frame. Acceleration is used to compute the airplane's horizontal and vertical velocity. It is also used to compute the airplanes present position.

(t) A magnetic deviation table stored in memory is used to compute magnetic heading. As the result, heading is computed as a function of present position latitude and longitude. This computed data is added to true heading and true track to produce magnetic referenced data. In areas beyond latitude 60 degrees South and 73 degrees North, the IRS transmits NO COMPUTED DATA (NCD) for magnetic heading. The IRS uses inputs from the ADC to compute windspeed and direction. It also uses these inputs to smooth out the vertical velocity and altitude computations.

(u) When the mode select switch on the IRMP is placed in the ALIGN position, the respective IRU enters the alignment mode. The IRU reference axis is aligned to the local vertical. It computes latitude by estimating the horizontal earth rate components. True north is computed from the vector sum of these earth rate components. While in the alignment mode, the IRU will output a signal to light the ALIGN display on the IRMP.

(v) Ten minutes are required to complete the alignment for any latitude between ±73°. For latitudes greater than ±73°, the alignment time can be greater than ten minutes. The system can engage the NAV mode at any time after a satisfactory alignment as determined by the following:

1) The total time in the ALIGN mode is 10 minutes or greater.
2) The quality-of-alignment index is less than 1. (This is a measurement of how fast the computed earth rate is reaching a steady state value).
3) For latitude, the cosine of the entered amount equals the computed cosine amount within 0.01234.
4) For latitude, the sine of the entered amount equals the computed sine amount within 0.15.
5) The longitude in memory equals the input longitude within one degree.

6) Latitude and longitude are not compared to the present position stored in memory after any of the following conditions:
   a) The IRU is powered down from the attitude mode.
   b) The IRU is powered down due to a power loss.
   c) The IRU is returned from a repair center.

(w) If during the alignment process the criteria outlined is not met, several indications occur. If the quality-of-align index is greater than one at 10 minutes, the IRU transmits a signal to the IRS mode select panel. The signal lights the FAULT annunciator and sets the fault ball on the IRU. This fault is also stored in BITE memory.

(x) If the entered latitude fails the sin/cos test, the ALIGN annunciator will flash. If the same latitude is entered a second time, the flashing ALIGN annunciator will go steady and the FAULT annunciator will light. If the second latitude entry does not agree with the first entry, the ALIGN annunciator will continue to flash or will extinguish. A FAULT is annunciated only after the same latitude is entered twice and fails the sin/cos test after the second entry. However, a latitude may be entered at anytime during the alignment process. If it passes the tests, the system will enter the NAV mode providing that the IRMP switch is in the NAV position.

NOTE: The latitude sin/cos test will be performed only once per latitude entry and once prior to entering NAV mode.

(y) The entered longitude is compared to the last computed longitude stored in the IRU memory. If the difference is greater than 1 degree, the ALIGN annunciator will flash and the test failure is stored in memory. If the second longitude entry is identical to the first it is then taken as correct, the ALIGN annunciator goes out. The IRU enters the NAV mode. If the remaining tests pass, conditions are satisfied. Once in the NAV mode, no further updates are accepted to the latitude or longitude by the IRU.

(z) When the mode select switch is in NAV position (ALIGN mode), updating of the present position latitude and longitude is allowed from the IRMP or FMC, but not when the IRS has entered the NAV mode. In the NAV mode, the IRS performs inertial navigation. It provides data on airplane attitude. It outputs body rates and accelerations. It also provides true and magnetic heading along with velocity vectors. Latitude and longitude are also output. The IRS accepts the latitude and longitude entered during the alignment mode as the starting point for the dead-reckoning computation.

(aa) The attitude mode provides a rapid attitude/heading restart capability. The ATT mode is used if the IRS has had a total power shutdown for more than .010 second. ATT mode outputs are attitude/heading, rate, acceleration and vertical velocity.

(ab) The attitude mode is selected by switching the mode select switch to the ATT position. Magnetic heading inputs from the IRMP or FMC are only accepted by the IRU while the mode select switch is in the ATT position.

(ac) If the attitude mode is selected, the magnetic heading changes will track the platform heading changes after heading is entered.

(ad) The bus transmitters format and transfer CPU data to the ARINC 429 busses. The ARINC 429 busses supply identical information to the interface systems and the IRMP.

(ae) Status discretes are sent to the IRMP status annunciators and EICAS system.

C. BITE

(1) Fault Monitoring

(a) IRU BITE automatically monitors unit performance. It also initiates self-tests. It detects failures that could cause erroneous outputs of heading, attitude, angular rates, or accelerations. If BITE detects any of these failures, it will cause the IRS valid output discrete to be set invalid. It will also light the FAULT indicator on the IRS mode select panel and set the IRU fault ball. All outputs are transmitted with a failure warning sign/status matrix if a critical fault is detected. BCD data is removed from the data bus upon detection of a critical failure.

(b) BITE monitors and tests the following:

1) Power supply
2) Laser gyros and accelerometers
3) Pitch rate output
4) Discrete Input/Output
5) Sensor/electronics
6) Computer clock/interfaces
7) Input receiver and output transmitters
8) Alignment, air data input, and computed data reasonableness
9) Derived latitude compared to entered latitude
10) Keyed in longitude compared to stored longitude
11) Memory operation
12) Instruction execution
13) Internal temperature

(c) The watch dog timer (WDT) monitors and detects failures that prevent the CPU from executing its program. The CPU is programmed to reset the WDT every 20 ms (50 Hz rate). If the CPU is unable to reset the WDT because of a computer failure, hangup, or memory failure, the WDT will time out. This will set the fault ball and light the FAULT annunciator. In addition, the analog pitch rate will be invalidated, and a fault word will be written into BITE memory.

(d) Non-volatile BITE memory states the latest calculated longitude and accumulated BITE status record of the last two power-on periods. It also stores a summary of IRS discrete message words for the last 6 power-on periods.

(e) When BITE detects a failure, the analog pitch rate invalid discrete is set. The fault annunciator on the IRS mode select panel is also lit and the fault ball is set.

(2) Interface Test

(a) The Interface Test may be initiated from the IRU self-test button or the miscellaneous test panel L or R YAW DAMPER test switch.

(b) Either switch will provide the following test output:

1) For 0 - 2 seconds - BCD output data with SSM set to functional test and all display segments illuminated. BNR output data with SSM set to functional test and data set at the pre-determined values. IRMP annunciator discretes illuminated.

2) For 2 - 10 seconds - No BCD output data. BNR output data with SSM set to failure warning and data set to the pre-determined values. IRMP annunciator discretes indicate proper status. Pitch Rate Validity discrete set invalid.

3) After 10 seconds - BCD output data with SSM set to functional test and data set to pre-determined values. BNR output data with SSM set to functional test and data set to pre-determined values. IRMP annunciator discretes indicate proper status. Pitch rate validity discrete indicates proper status.

4) The analog pitch rate output remains at the test value for the duration of the test.

(c) The interface test mode is inhibited whenever the indicated ground speed exceeds 20 knots or the IRU is in the attitude mode. Some of the test outputs are:

1)	AIRPLANES WITH FULL VOR AND ILS MODES; Drift Angle	-10° (L)
2)	Ground Speed *[1]	200 Kts
3)	Vertical Speed	-600 ft/min
4)	Magnetic Heading	15°
5)	Pitch Angle	5° UP
6)	Present Position (Lat, Long) *[2]	N 22° 30.0' 45 E 22° 30.0'
7)	Roll Angle	45° (RIGHT)
8)	True Heading	10°
9)	Wind Speed	100 Kts

10) Wind Direction as follows:
  a) 30 degrees on the IRMP
  b) 30 degrees on the EHSI if TRU is shown above the compass card
  c) 35 degrees on the EHSI if "M" is shown above the compass card

*[1] During the functional test, ground speed is not displayed on the FMC CDU. A ground speed of 200 knots can be read on both the IRMP and EADI, but it flashes for only about 1/2 second at the tenth second of the test.

*[2] For the functional test, present position must be read on the IRMP. The FMC CDU does not display IRU test values of present position (latitude and longitude); rather, it displays a blank for the associated IRU.

D. Control

(1) To activate the IRS, do the following:
  - (a) Provide electrical power (MM 24-22-00).
  - (b) Close the following overhead panel P11 circuit breakers:
    - 1) 11F1, IRS LEFT
    - 2) 11F21, IRS CENTER
    - 3) 11F22, IRS RIGHT
  - (c) Close the following overhead panel P6 circuit breakers:
    - 1) 6D3, IRS L
    - 2) 6D4, IRS C
    - 3) 6D5, IRS R
  - (d) Turn mode select switch on IRMP, to the NAV position.
  - (e) Enter the present longitude and latitude at the FMC-CDU (AMM 34-61-00) or the IRMP.
  - (f) Check that after 10 minutes, the ALIGN light on the IRMP goes out. Re-entry of present position as in step (d) above, is necessary if the align light flashes.

INERTIAL REFERENCE SYSTEM

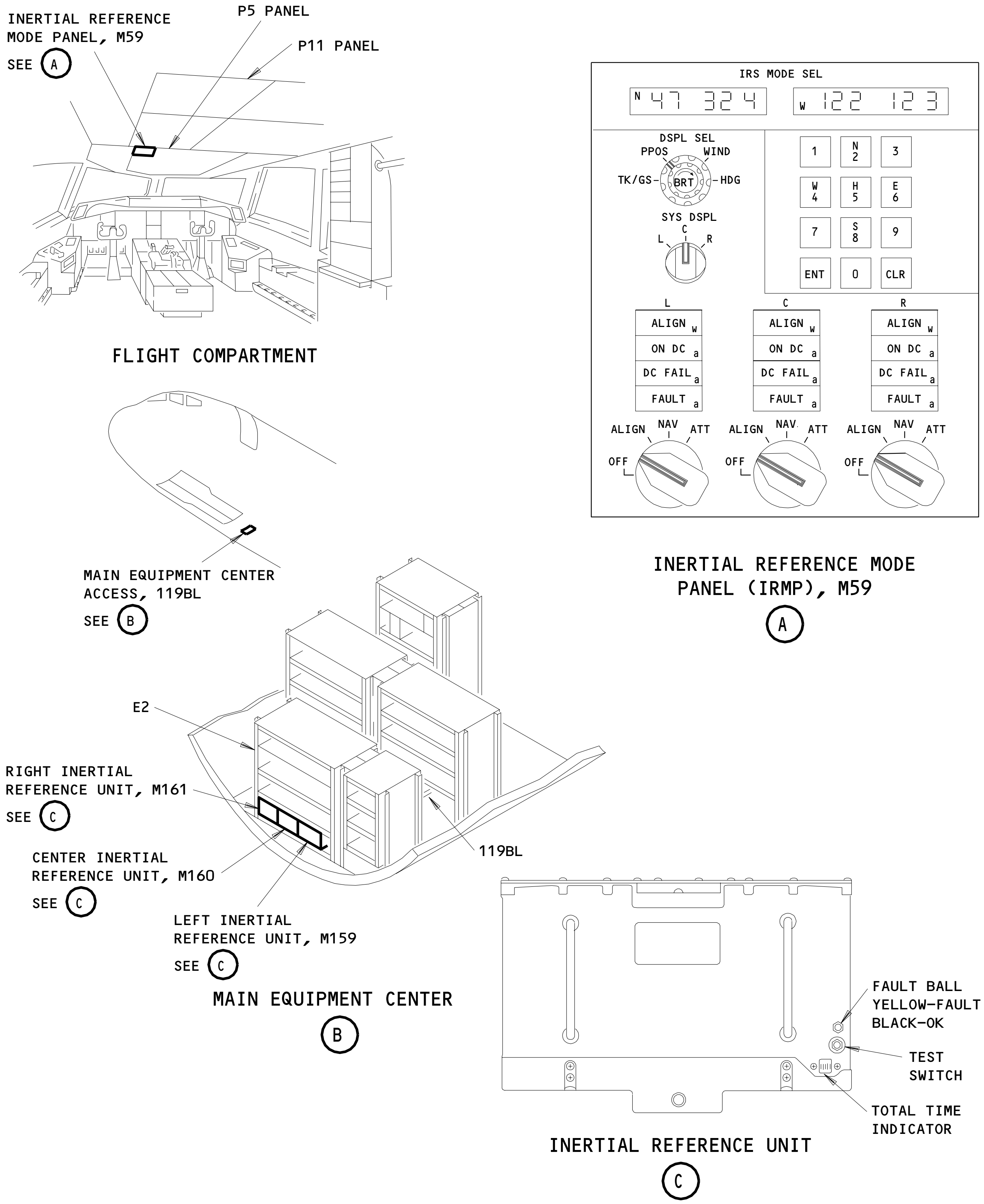
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -			FLT COMPT, P6	
BATTERY XFR CONT, C814		1	6D2	*
CENTER BUS CONT, C880		1	6G6	*
IRS C, C621		1	6D4	*
IRS L, C611		1	6D3	*
IRS R, C620		1	6D5	*
CIRCUIT BREAKER -			FLT COMPT, P11	
IRS CENTER, C613		1	11F21	*
IRS LEFT, C611		1	11F1	*
IRS RIGHT, C612		1	11F22	*
COMPUTER - AIR DATA (FIM 34-12-00/101)				
ADC L, M100				
ADC R, M101				
INDICATOR - (FIM 34-22-00/101)				
RDMI L, N3 [1]				
RDMI R, N43 [1]				
RMI L, N10024 [2]				
RMI R, N10026 [2]				
VSI L, N9				
VSI R, N49				
PANEL - (FIM 24-33-00/101)				
STANDBY POWER CONTROL, M10062				
PANEL - INERTIAL REFERENCE MODE, M59	--	1	FLT COMPT, P5	34-21-02
RELAY - (FIM 31-01-06/101)				
CENTER BUS ISOLATION, K123				
MAIN BATTERY, K104				
MAIN BATTERY TRANSFER, K106				
RELAY - IRS DC PWR DISCONNECT, K137	--	1	FLT COMPT, P6	*
SWITCH - BATTERY, S2	--	1	FLT COMPT, P5, STANDBY POWER CONTROL PANEL, M10062	24-33-01
SWITCH - CAPT ADC INSTR SOURCE SEL, S482	--	1	FLT COMPT, P1	*
SWITCH - F/O ADC INSTR SOURCE SEL, S483	--	1	FLT COMPT, P3	*
UNIT - INERTIAL REFERENCE C, M160	--	1	119BL, MAIN EQUIP CTR, E2-4	34-21-01
UNIT - INERTIAL REFERENCE L, M159	--	1	119BL, MAIN EQUIP CTR, E2-4	34-21-01
UNIT - INERTIAL REFERENCE R, M161	--	1	119BL, MAIN EQUIP CTR, E2-4	34-21-01

* SEE THE WDM EQUIPMENT LIST

[1] GUI 001-114,116-999

[2] GUI 115

Inertial Reference System - Component Index
Figure 101



FLIGHT COMPARTMENT

INERTIAL REFERENCE MODE PANEL (IRMP), M59
A

MAIN EQUIPMENT CENTER
B

INERTIAL REFERENCE UNIT
C

Inertial Reference System - Component Location
Figure 102

INERTIAL REFERENCE SYSTEM - MAINTENANCE PRACTICES

1. General

A. This procedure contains one task. That task is the alignment of the inertial reference system (IRS).

B. There are two types of alignments: regular and high latitude.

C. A regular alignment is used between latitudes 70.2 degrees south and 70.2 degrees north. A regular alignment takes 10 minutes.

D. A high latitude alignment is used between latitudes 70.2 degrees north and 78.2 degrees north and from 70.2 degrees south to 78.2 degrees south. A high latitude alignment takes 17 minutes.

E. Above 78.2 degrees north latitude and below 78.2 degrees south latitude you can not align the IRS.

F. You can align the IRS from any flight management computer (FMC) control display unit (CDU) or the inertial reference mode panel (IRMP). You do not have to align the IRS from both the IRMP and a CDU. You only have to align the IRS from a single source.

G. There are three IRS alignment messages that can show on the FMC CDU. Push the clear key to remove the message from the CDU.
   (1) IRS MOTION (the airplane moved during alignment)
   (2) CYCLE IRS OFF-NAV (an IRS alignment problem makes it necessary to turn the mode switch to OFF and then to NAV)
   (3) ENTER IRS POSITION (the FMC finds a problem that makes it necessary to put the position in again).

H. You can not move the airplane while you align the IRS.

I. The local latitude and longitude are necessary to align the IRS.

TASK 34-21-00-822-039

2. IRS - Alignment

A. References
   (1) 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zone

211	Control Cabin - Left
212	Control Cabin - Right

C. Procedure

S 862-007

(1) Make sure that these circuit breakers are closed:
   (a) P11 Overhead Circuit Breaker Panel
      1) 11E4, EFIS CONT PNL LEFT
      2) 11E8, FMCS CDU LEFT
      3) 11E9, FMCS CMPTR LEFT
      4) 11E25, EFIS CONT PNL RIGHT
      5) 11E29, FMCS CDU RIGHT
      6) 11E30, FMCS CMPTR RIGHT

7) 11F1, IRS LEFT
8) 11F8, EFIS SYM GEN L
9) 11F9, EFIS SYM GEN C
10) 11F21, IRS CENTER
11) 11F22, IRS RIGHT
12) 11F29, EFIS SYM GEN RIGHT

(b) P6 Main Power Distribution Panel
1) 6D3, IRS L
2) 6D4, IRS C
3) 6D5, IRS R

S 862-017
(2) Make sure that the EQUIP COOLING switch on the P5 panel is set to the AUTO position.

S 862-038
(3) Make sure that the captain's and first officer's F/D switches on the mode control panel are set to the OFF position.

S 862-018
(4) Supply the electrical power (Ref 24-22-00/201).

S 822-009
(5) Do these steps to align the IRS from a CDU.

NOTE: You can align the IRS from a CDU or the IRMP. You do not have to align the IRS from both the IRMP and a CDU. You only have to align the IRS from a single source.

CAUTION: THE MODE SELECT SWITCHES ON THE IRMP MUST FIRST BE PULLED AND THEN TURNED TO LEAVE THE NAV POSITION. IN THE NAV POSITION, IF YOU TRY TO TURN THESE SWITCHES BEFORE YOU PULL THEM, YOU CAN DAMAGE THE IRMP.

(a) To start a high latitude alignment,
set the switches on the IRMP to the ALIGN position from the OFF position.

NOTE: You can find the IRMP on the P5 overhead panel.
A high latitude alignment takes 17 minutes. Note the present time for later use in this procedure.

(b) To start a regular alignment,
set the switches on the IRMP to the NAV position from the OFF position.

NOTE: You can find the IRMP on the P5 overhead panel.
A regular alignment takes 10 minutes.

(c) Make sure that the ON DC lights on the IRMP come on for a short time.
(d) Make sure that the ALIGN lights on the IRMP come on.
(e) Push the INIT REF key on the CDU.
(f) Push the line select key adjacent to the <INDEX prompt.
  1) Make sure that the CDU shows the INIT/REF INDEX page.
(g) Push the line select key adjacent to the <POS prompt.
  1) Make sure that the CDU shows the first POS INIT page.
(h) Push the CLR key to erase the scratch pad.
(i) Put the latitude and the longitude into the scratch pad line of the CDU.

NOTE: Do not put a space between the latitude and the longitude. Example N1234.5W01234.5

(j) Push the line select key adjacent to SET IRS POS.

NOTE: The ALIGN lights on the IRMP may flash. If they flash, check the position on the SET IRS POS line to be sure it is correct. If correct, then reenter the exact same position.

  1) Make sure that the CDU shows the latitude and the longitude below SET IRS POS.
(k) Push the PREV PAGE key to show the POS REF page.
  1) Make sure that you can see the position you just entered on the IRS L, C, and R lines.
(l) To complete the regular alignment,
after 10 minutes, make sure that the ALIGN lights on the IRMP go out.

NOTE: The IRS is now aligned and in the navigation mode.

(m) To complete a high latitude alignment, after 17 minutes, set the switches on the IRMP to the NAV position from the ALIGN position.
  1) Make sure that the ALIGN lights on the IRMP go out.

  NOTE: The IRS is now aligned and in the navigation mode.

S 822-031
(6) Do these steps to align the IRS from the IRMP.

NOTE: You can align the IRS from the IRMP or a CDU. You do not have to align the IRS from both the IRMP and a CDU. You only have to align the IRS from a single source.

CAUTION: THE MODE SELECT SWITCHES ON THE IRMP MUST FIRST BE PULLED AND THEN TURNED TO LEAVE THE NAV POSITION. IN THE NAV POSITION, IF YOU TRY TO TURN THESE SWITCHES BEFORE YOU PULL THEM, YOU CAN DAMAGE THE IRMP.

(a) To start a high latitude alignment, set the switches on the IRMP to the ALIGN position from the OFF position.
(b) To start a regular alignment, set the switches on the IRMP to the NAV position from the OFF position.

  NOTE: You can find the IRMP on the P5 overhead panel. A regular alignment takes 10 minutes.

(c) Make sure that the ON DC lights on the IRMP come on for a short time.
(d) Make sure that the ALIGN lights on the IRMP come on.
(e) Set the DSPL SEL switch on the IRMP to the PPOS position.

  NOTE: You can find the IRMP on the P5 overhead panel.

(f) Push the N or S key on the IRMP.
(g) Put in the degrees and minutes of the local latitude on the IRMP.
  1) Make sure that the local latitude shows on the left side of the IRMP.

(h) Push the ENT key to transmit the local latitude to the inertial reference units (IRU).

(i) Push W or E on the IRMP.

(j) Put in the degrees and minutes of the local longitude on the IRMP.
   1) Make sure that the local longitude shows on the right side of the IRMP.

(k) Push the ENT key to transmit the local longitude to the IRUs.

   NOTE: The ALIGN lights on the IRMP may flash. If they flash, check the position on the IRMP to be sure it is correct. If correct, then reenter the exact same position.

(l) Set the SYS DSPL switch on the IRMP to the L position.
   1) Make sure that the position displayed on the IRMP is correct.

(m) Set the SYS DSPL switch on the IRMP to the C position.
   1) Make sure that the position displayed on the IRMP is correct.

(n) Set the SYS DSPL switch on the IRMP to the R position.
   1) Make sure that the position displayed on the IRMP is correct.

(o) To complete a regular alignment,
after 10 minutes, make sure that the ALIGN lights on the IRMP go out.

   NOTE: The IRS is now aligned and in the navigation mode.

(p) To complete a high latitude alignment,
after 17 minutes, set the switches on the IRMP to the NAV position from the ALIGN position.
   1) Make sure that the ALIGN lights on the IRMP go out.

      NOTE: The IRS is now aligned and in the navigation mode.

INERTIAL REFERENCE SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure has three tasks. The first task aligns the inertial reference system (IRS). The second task does an operational test of the IRS. The operational test uses the built-in-test equipment (BITE) of the IRS. The third task does a full test of the IRS. It also tests the interface between the IRS and other systems.

TASK 34-21-00-825-001

2. Inertial Reference System - Alignment
   A. General

      (1) You can align the IRUs from the Flight Management Computer Control Display Unit (FMC-CDU).
      (2) You can also align the IRUs from the IRS Mode Select panel (IRMP).
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 29-11-00/201, Main Hydraulic Systems
   C. Access
      (1) Location Zones
         211/212 Flight Compartment

      (2) Access Panel
         119BL Main Equipment Center

   D. Prepare to Align the IRUs

      S 865-002
      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-003
      (2) Make sure that these circuit breakers on the overhead circuit breaker panel, P11, are closed:
         (a) 11E9, FMCS CMPTR LEFT

(b) 11E30, FMCS CMPTR RIGHT
(c) 11E8, FMCS CDU LEFT
(d) 11E29, FMCS CDU RIGHT
(e) GUI 001-114, 116-999;
 11A6, RDMI LEFT
(f) GUI 115;
 11A7, RMI L
(g) 11E3, ADI LEFT
(h) GUI 115;
 11C4, EFIS DSPL SW LEFT
(i) GUI 001-114, 116-999;
 11A7, EFIS DSPL SW LEFT
(j) 11E4, EFIS CONT PNL LEFT
(k) 11E5, VSI LEFT
(l) 11E6, HSI LEFT
(m) 11E24, ADI RIGHT
(n) 11E25, EFIS CONT PNL RIGHT
(o) 11E26, VSI RIGHT
(p) 11E27, HSI RIGHT
(q) 11F8, EFIS SYM GEN LEFT
(r) 11F9, EFIS SYM GEN CENTER
(s) 11F24, EFIS DSPL SW RIGHT
(t) 11F29, EFIS SYM GEN RIGHT
(u) 11F1, IRS LEFT
(v) 11F21, IRS CENTER
(w) 11F22, IRS RIGHT
(x) GUI 115;
 11F23, RMI R
(y) GUI 001-114, 116-999;
 11F25, RDMI RIGHT
(z) EICAS (6 locations)

S 865-004

(3) Make sure that these circuit breakers on the main power distribution panel, P6, are closed:
(a) 6D3, IRS L

(b) 6D4, IRS C
(c) 6D5, IRS R

S 755-008

(4) Make sure that the faultball on each IRU is black.

E. Align the IRUs with the FMC-CDU

S 865-149

CAUTION: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(1) Set each IRMP mode select switch to OFF.

NOTE: Do not move the airplane during the align procedure. The align procedure will automatically start again 30 seconds after the airplane movement.

(a) After 30 seconds, do the steps that follow:
  1) Make sure the IRS annunciator lights on the IRMP stay off.
  2) Make sure that the IRS Engine Indication and Crew Alerting System (EICAS) messages do not show on the EICAS displays.

S 755-010

(2) Set each IRMP mode select switch to the NAV position.

NOTE: The box prompts on the line below the SET IRS POS are to enter the latitude and longitude values. They show when the IRMP mode select switch goes from OFF to NAV, or OFF to ALIGN.

(a) Make sure that all ON DC lights on the IRMP come on and then go off.
(b) Make sure that the EICAS (L, C, R) IRS ON DC messages show and then go off.
(c) Make sure that the ALIGN lights on the IRMP come on and stay on.
(d) Make sure that the box prompts show on the line below the SET IRS POS of the left FMC-CDU.

S 865-011

(3) Do the steps that follow on the left FMC-CDU:

(a) Push the INIT REF switch on the left FMC-CDU.

NOTE: You can align the IRUs from the left or the right FMC-CDU. The steps are the same. You must enter the local latitude and longitude data less than ten minutes after the IRMP mode select switches goes to NAV or to ALIGN.

(b) Use the PREV PAGE or NEXT PAGE switch to find the POS INIT page.

(c) Enter the local latitude and longitude data.

(d) Make sure the correct data shows on the scratch pad of the left FMC-CDU.

(e) Push the line select key (LSK) adjacent to the SET IRS POS to move the data to the box prompts.

(f) Make sure the data shows on the box prompts.

NOTE: Latitude and longitude data will stay on line 4 until the IRU is aligned and fully in the NAV mode (approximately ten minutes).

S 755-013

(4) Make sure that the IRMP ALIGN lights stay on and all other lights are off on the IRMP.

S 865-012

(5) If the ALIGN lights flash, do the steps that follow on the FMC-CDU:

(a) Enter the latitude and longitude data again into the scratch pad.

(b) Push the line select key (SLK) adjacent to the SET IRS POS to move the data from the scratch pad to to the box prompts.

NOTE: If you put in the wrong position, it is possible that you must put in the correct position two times to stop the flash of the ALIGN lights. Do not move the IRMP mode selector switch out of the NAV mode if you must put in the data again.

S 865-014

(6) If the ALIGN lights continue to flash, you must do the full 10-minute align procedure again.

NOTE: You must do a full 10-minute alignment if one or more of these conditions occur:
- airplane movement occurs during preflight alignment
- the ALIGN lights flash during an align downmode (30-second alignment) after two of the same position entries
- the mode selector switch is accidentally moved from the NAV to the ATT position
- the mode selector switch is accidentally moved from the NAV to the OFF position

S 865-109

(7) You can use the IRS codes that show in the maintenance code display mode to show the cause of the flash of the IRS ALIGN lights.
  (a) To go into the maintenance code display mode, do the steps that follow:
    1) Set the IRU SYS DSPL switch to the applicable IRU.
    2) Set the DSPL SEL switch to the HDG position.
    3) Put in a 0 on the keyboard, and in less than five seconds, a 1 (The highest priority code will show in the two right digits of the IRMP display).
    4) Make a record of the code.
    5) Push the CLR switch to show the next priority code.
    6) Do the steps again to see the other codes.
  (b) If code 08 shows, there was airplane movement.
  (c) If code 08 does not show, only a position entry is necessary.

NOTE: If code 08 does not show while in align downmode (30-second realignment) and the ALIGN light continues to flash after you put in two of the same positions, a full 10-minute alignment is necessary.

S 755-017

(8) Make sure that all three IRMP ALIGN lights go off at 10 minutes ±20 seconds after the IRMP mode select switches are set to NAV. (This shows that the alignment is complete).

NOTE: If the alignment data is not accepted by an IRU, a caution signal "RE-ENTER IRS POSITION" will show on line six of the left FMC-CDU.

S 755-018

(9) Push the NEXT PAGE switch on the left FMC-CDU.
  - (a) Make sure that the latitude and longitude show on lines 2, 3, and 4 of the left FMC-CDU display.

    NOTE: If the position data is not accepted by an IRU, the left FMC-CDU display will show no data for that IRU.

S 755-019

(10) Push the NEXT PAGE switch on the right FMC-CDU.
  - (a) Make sure that the latitude and longitude show on lines 2, 3, and 4 of the right FMC-CDU display.

    NOTE: If the position data is not accepted by an IRU, the right FMC-CDU display will show no data for that IRU.

F. Align the IRUs with the IRMP

S 755-020

(1) Set all three mode select switches on the IRMP to the NAV position.
  - (a) Make sure that the L-ALIGN light on the IRMP comes on and stays on.
  - (b) Make sure that the ON DC light on the IRMP comes on momentarily.
  - (c) Make sure that the ON DC message shows on the EICAS momentarily.

S 865-021

(2) Set the DSPL SEL switch to PPOS.

S 865-110

(3) Put in the local latitude data.
  - (a) Make sure that the position data shows on the IRMP display.

S 865-022

(4) Push the IRMP ENT switch to put the latitude data into all three IRUs.

NOTE: You must put in the local latitude and longitude data in less than ten minutes after the IRMP mode select switches move to NAV or ALIGN. You must put in the latitude and longitude data separately.

S 865-023

(5) Put in the local longitude data.
  - (a) Make sure the data shows on the IRMP display.

S 865-024

(6) Push the IRMP ENT switch to put the data into all three IRUs.

NOTE: If the longitude data that was put in during alignment does not agree with the longitude kept in the IRU memory, the ALIGN light will flash immediately. To stop the flash of the light, put in the same longitude data again. (DO NOT move the IRMP mode select switch to the OFF position.)

(a) After approximately 11 minutes, make sure that all ALIGN lights go off.

NOTE: If the latitude data put in during alignment does not agree with the latitude calculated during alignment by an IRU, the ALIGN light for that IRU will flash after the 10 minute cycle for that IRU is complete. To stop the flash of the light, put in the correct current latitude data. If the ALIGN light is on but does not flash and the fault light is on, the IRU is possibly defective.

G. Alignment procedure with the IRMP and a constant flash of the ALIGN light

S 865-025

(1) Put the latitude and longitude data in again.

S 865-026

(2) After 30 seconds, if the ALIGN light continues to flash, set the mode select switch to OFF.

NOTE: The alignment automatically starts again after 30 seconds if there was airplane movement. If it starts again, the ALIGN light will be on and not flash.

(a) After 30 seconds, make sure the ALIGN light goes off.

S 865-027

(3) Set the mode select switch to the NAV position.
  (a) After the ALIGN light comes on, make sure that line 4R of the FMC-CDU contains prompt boxes.

S 865-028

(4) Put in the correct latitude and longitude data.

S 865-029

(5) Do the steps that follow to make sure that the data was received correctly:
  (a) Set the DSPL SEL switch in the PPOS position.
  (b) Set the SYS DSPL switch to the applicable system.
  (c) Make sure the data that shows in the display is the same as the data you put in.

S 865-030

(6) If the data is not the same, put in the data again.

S 865-032

(7) Do the steps that follow to make sure that the data was received correctly:
  (a) Set the DSPL SEL switch in the PPOS position.
  (b) Set the SYS DSPL switch to the applicable system.
  (c) Make sure the data that shows in the display is the same as the data you put in.

S 865-031

(8) If the ALIGN light flashes, put in the correct data again.

S 865-033

(9) Do the steps that follow to make sure that the data was received correctly:
  (a) Set the DSPL SEL switch in the PPOS position.

(b) Set the SYS DSPL switch to the applicable system.

(c) Make sure the data that shows in the display is the same as the data you put in.

H. IRS alignment and heading update with the IRMP

S 865-034

(1) Set the mode select switch to the ATT (attitude) position.

S 865-035

(2) Set the display selector switch to the HDG (heading) position.

S 865-036

(3) Push the H5 key and put in the magnetic heading.

S 865-037

(4) Push the ENT key.

S 755-038

(5) Make sure that the correct heading shows on the EHSI and the RDMI.

I. IRS alignment and heading update with the FMC-CDU

S 865-039

(1) Set the IRMP mode select switch to the ATT (attitude) position.

<u>NOTE</u>: The IRMP display does not show data during the ATT mode alignment and heading update with the FMC-CDU.

S 865-041

(2) Put in the correct magnetic heading in the scratch pad area of the POS INIT page of the FMC-CDU.

S 865-042

(3) Push the line 5R switch on the FMC-CDU to move the data into the SET IRS HDG line.

S 755-043

(4) Make sure that the correct heading shows on the RDMI and the EHSI.

TASK 34-21-00-715-044

3. Inertial Reference System - Operational Test

A. References

(1) AMM 24-22-00/201, Electrical Power - Control

(2) AMM 29-11-00/201, Main Hydraulic Systems

B. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

(2) Access Panel

119BL	Main Equipment Center

C. Procedure

S 865-005

(1) Supply electrical power (AMM 24-22-00/201).

S 865-006

(2) Make sure that these circuit breakers on the overhead circuit breaker panel, P11, are closed:

(a) 11E9, FMCS CMPTR LEFT

(b) 11E30, FMCS CMPTR RIGHT

(c) 11E8, FMCS CDU LEFT

(d) 11E29, FMCS CDU RIGHT

(e) GUI 001-114, 116-999;
11A6, RDMI LEFT

(f) GUI 115;
11A7, RMI L

(g) GUI 115;
11C4, EFIS DSPL SW LEFT

(h) GUI 001-114, 116-999;
11A7, EFIS DSPL SW LEFT
(i) 11E3, ADI LEFT
(j) 11E4, EFIS CONT PNL LEFT
(k) 11E5, VSI LEFT
(l) 11E6, HSI LEFT
(m) 11E24, ADI RIGHT
(n) 11E25, EFIS CONT PNL RIGHT
(o) 11E26, VSI RIGHT
(p) 11E27, HSI RIGHT
(q) 11F8, EFIS SYM GEN LEFT
(r) 11F9, EFIS SYM GEN CENTER
(s) 11F24, EFIS DSPL SW RIGHT
(t) 11F29, EFIS SYM GEN RIGHT
(u) 11F1, IRS LEFT
(v) 11F21, IRS CENTER
(w) 11F22, IRS RIGHT
(x) GUI 115;
11F23, RMI R
(y) GUI 001-114, 116-999;
11F25, RDMI RIGHT
(z) EICAS (6 locations)

S 865-007

(3) Make sure that these circuit breakers on the main power distribution panel, P6, are closed:
(a) 6D3, IRS L
(b) 6D4, IRS C
(c) 6D5, IRS R

S 865-045

(4) Make sure that all IRMP mode select switches are in the ALIGN or NAV position.

NOTE: For the IRS self-test, ground speed must be less than 20 knots.

S 865-046

(5) Set the left and right FMC-CDUs to the POS REF 2/2 page.

S 865-047

(6) Set the IRMP SYS DSPL select switch to L.

S 715-048

(7) To do a self-test for the left IRU, push and hold the test switch on the left IRU.

<u>NOTE</u>: You can also do the IRU self-test from the flight compartment with the YAW DAMPER test switch on the miscellaneous test panel. If you use this procedure, make sure that hydraulic power is off, or obey the applicable safety precautions (AMM 29-11-00/201). The L or R YAW DAMPER test switch starts the test for all three IRUs at the same time. You must do the test again for each selection (L, C, R) of the IRMP SYS DSPL select switch. For the center IRU, you must make the ALTN IRS selection. With the YAW DAMPER test switch, the instrument indications stay on the displays only a short time. With the IRU test switch, some indications stay on the displays as long as you hold the test switch in.

S 755-049

(8) Make sure the sequence of indications that follows occurs:

(a) <u>Seconds 0-2</u>:
  1) IRMP four left annunciator lights come on
  2) IRMP shows the number "8" in all display areas for all selections of the DSPL SEL switch.
  3) UPPER EICAS display flashes the level C messages that follow for approximately 1/2 second:
    a) L IRS ON DC
    b) L IRS DC FAIL
    c) L IRS FAULT

(b) <u>Seconds 3-10</u>:
  1) Left IRMP annunciator lights show the correct indication.
  2) IRMP display shows no data for all selections of the DSPL SEL switch.
  3) OFF fault flag shows on the captain's VSI.

4) HDG fault flag shows on the F/O's RDMI (or RMI).

5) Left and right FMC-CDUs show no data for the IRS L PPOS on line 2L of the POS REF 2/2 page.

(c) After 10 seconds:
For the left IRU, make sure that the indications that follow show on the Captain's and F/O's instruments:

NOTE: The outputs with the *[1] flash for only 1/2 second at approximately the tenth second. You must do the test again as many times as necessary to view all the outputs. The YAW DAMPER test switch is the easiest to use to do this. Make sure that the hydraulic power is OFF, or obey the applicable safety precautions (AMM 29-11-00).

1) IRMP *[1]	TRACK	0.0°
	GROUND SPEED	200 Kts
	PPOS (LAT)	N22° 30.0'
	PPOS (LONG)	E 22° 30.0'
	WIND DIRECTION	30°
	WIND SPEED	100 Kts
	HDG	10.0°
2) CAPT VSI	VERTICAL SPEED	-600 ft/min
3) CAPT EHSI *[1]	DRIFT ANGLE	-10° LEFT *[2]
	MAGNETIC HEADING	15°
	WIND DIRECTION	*[3]
	WIND SPEED	100 Kts

*[2] FULL VOR OR FULL ILS MODES ONLY. -10° LEFT WILL DISPLAY WHEN A TRUE POSITION IS SELECTED WITH THE HEADING REFERENCE SWITCH.

*[3] IF "TRU" SHOWS ABOVE THE EHSI COMPASS CARD, WIND DIRECTION IS 30° (NOT CORRECTED FOR MAGNETIC DECLINATION).
IF "M" SHOWS ABOVE THE EHSI COMPASS CARD, WIND DIRECTION IS 35° (CORRECTED FOR MAGNETIC DECLINATION OF 5°).

4) CAPT EADI	PITCH ANGLE	5° UP
	ROLL ANGLE	45° RIGHT
5) F/O RDMI (or RMI)	MAGNETIC HEADING	15°

S 865-050

(9) Release the test switch on the left IRU.
   - (a) Make sure that all IRMP annunciator lights go off.
   - (b) Make sure the IRMP shows the latitude and longitude data put in during the alignment.
   - (c) Make sure that the L and R FMC-CDUs show the latitude and longitude data put in during the alignment.

S 865-051

(10) Set the SYS DSPL switch on the IRMP to R.

S 715-052

(11) Do the same test for the right IRU as done for the left IRU except as follows:
   - (a) Use the test switch on the right IRU.
   - (b) Use the right annunciator lights on the IRMP.
   - (c) Use the R IRS message on the EICAS.
   - (d) Use the F/O's EADI, EHSI, VSI.
   - (e) Use the left RDMI (or RMI).

S 865-100

(12) Set the captain's and F/O's IRS INSTR SOURCE SEL switches to ALTN IRS.

S 865-101

(13) Set the SYS DSPL switch on the IRMP to C.

S 715-053

(14) Do the same test for the center IRU as done for the left IRU except as follows:
   - (a) Use the test switch on the center IRU.
   - (b) Use the center annunciator lights on the IRMP.
   - (c) Use the C IRS messages on the EICAS.
   - (d) Use the captain's and F/O's instruments.

D. Put the Airplane Back to Its Usual Condition

S 865-054

(1) Set the captain's and F/O's INSTR SOURCE SEL switches for the IRS to the usual positions.

S 865-055

CAUTION: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(2) Turn the IRS mode select switches on the IRMP to OFF.

S 865-056

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-21-00-735-057

4. Inertial Reference System - System Test

A. General

(1) The IRS system test makes sure the VSI, the IRU alignment, the IRS system, and the IRS system interfaces are correct. It gives information to the IRS through the FMC-CDU, the ADC test switch, the IRMP, and the INSTR SOURCE SEL panel.

B. References

(1) AMM 24-22-00/201, Electrical Power - Control

C. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

(2) Access Panel

119BL	Main Equipment Center

D. Procedure

S 865-102

(1) Supply electrical power (AMM 24-22-00/201).

S 865-058

(2) Make sure that these circuit breakers on the P11 panel are closed:
- (a) 11E9, FMCS CMPTR LEFT
- (b) 11E30, FMCS CMPTR RIGHT
- (c) 11E8, FMCS CDU LEFT
- (d) 11E29, FMCS CDU RIGHT
- (e) GUI 001-114, 116-999;
  11A6, RDMI LEFT
- (f) GUI 115;
  11A7, RMI L
- (g) GUI 115;
  11C4, EFIS DSPL SW LEFT
- (h) GUI 001-114, 116-999;
  11A7, EFIS DSPL SW LEFT
- (i) 11E3, ADI LEFT
- (j) 11E4, EFIS CONT PNL LEFT
- (k) 11E5, VSI LEFT
- (l) 11E6, HSI LEFT
- (m) 11E24, ADI RIGHT
- (n) 11E25, EFIS CONT PNL RIGHT
- (o) 11E26, VSI RIGHT
- (p) 11E27, HSI RIGHT
- (q) 11F8, EFIS SYM GEN LEFT
- (r) 11F9, EFIS SYM GEN CENTER
- (s) 11F24, EFIS DSPL SW RIGHT

- (t) 11F29, EFIS SYM GEN RIGHT
- (u) 11F1, IRS LEFT
- (v) 11F21, IRS CENTER
- (w) 11F22, IRS RIGHT
- (x) GUI 115;
  11F23, RMI R
- (y) GUI 001-114, 116-999;
  11F25, RDMI RIGHT
- (z) Air Data (6 places)
- (aa) EICAS (6 locations)

S 865-059

(3) Make sure that these circuit breakers on the P6 panel are closed:
- (a) 6D3, IRS L
- (b) 6D4, IRS C
- (c) 6D5, IRS R

S 865-060

(4) Set the IRS switch on the captain's and F/O's INSTR SOURCE SEL panels to the usual position.
- (a) Make sure that all the IRMP lights stay off.

S 865-061

(5) Set the two Flight Director (F/D) switches on the Mode Control Panel (MCP) to off.

S 865-062

(6) Open these circuit breakers on the P6 panel and attach DO-NOT-CLOSE tags:
- (a) 6D3, IRS L
- (b) 6D4, IRS C
- (c) 6D5, IRS R

S 755-056

(7) Set all three IRS mode select switches on the IRMP to ALIGN.
- (a) Make sure that all three ALIGN lights are on.
- (b) Make sure that all three FAULT lights are off.
- (c) Make sure that all three DC FAIL lights are on.
- (d) Make sure that the IRS DC FAIL messages show on the EICAS display for the L, C, and R IRUs.

S 755-057

<u>CAUTION</u>: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(8) Set all three IRMP mode select switches to OFF.
- (a) Make sure that all IRMP lights and EICAS IRS messages are off.

S 865-064

(9) Remove the DO-NOT-CLOSE tags and close these P6 panel circuit breakers:
   (a) 6D3, IRS L
   (b) 6D4, IRS C
   (c) 6D5, IRS R

S 865-148

(10) Make sure that the IRMP lights stay off.

S 865-066

(11) Set all three IRMP mode select switches to NAV.

S 755-067

(12) Make sure the conditions that follow occur:
   (a) All three ON DC lights come on momentarily on the IRMP.
   (b) The message IRS ON DC shows momentarily on the EICAS display unit for the L, R, and C IRUs.
   (c) All three ALIGN lights come on, on the IRMP.
   (d) All other lights are off on the IRMP.
   (e) EICAS DISAGREE does not show on the top EICAS display.

S 865-067

CAUTION: WHEN THE IRU MODE SELECT SWITCH IS IN THE "NAV" POSITION, YOU MUST PULL AND TURN IT TO SET IT TO A NEW POSITION. THIS PREVENTS DAMAGE TO THE SWITCH.

(13) Turn the R and C IRMP mode select switches to the OFF position.

S 865-069

(14) Set the DSPL SEL switch to the PPOS position.

S 865-070

(15) Set the SYS DSPL switch to the L position.

S 735-071

(16) Do the left IRS-IRMP test as follows:
   (a) Put in the local latitude and longitude with the IRMP keyboard. (You must do this less than ten minutes after you turn the L mode select switch to NAV.)
   (b) Make sure that the IRMP display shows the latitude and longitude data.
   (c) Make sure that only the L ALIGN light is on.
   (d) If the L ALIGN light flashes, put in the longitude again.
      1) Make sure the L ALIGN light does not flash and stays on.

(e) In less than 11 minutes after the IRU was energized, make sure that the L ALIGN light goes off.
(f) Make sure that all other annunciator lights are off on the IRMP.

CAUTION: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(g) Set the L IRMP mode select switch to the OFF position.
(h) After one minute, make sure the conditions that follow occur:
    1) All annunciator lights on the IRMP are off.
    2) There are no IRS FAULT messages on the EICAS display.

S 865-150

(17) Set the SYS DSPL switch to the R position.

S 865-073

(18) Set the R mode select switch to the NAV position.
    (a) Make sure that ON DC shows momentarily on the EICAS display.
    (b) Make sure that the R ON DC light on the IRMP comes on momentarily.
    (c) Make sure the R IRMP ALIGN light comes on and stays on.

S 735-074

(19) Do the right IRS-IRMP test the same as the LEFT IRS-IRMP test except as follows:
    (a) Use the R IRMP mode select switch.
    (b) Use the R IRMP lights.
    (c) Use the right IRS EICAS messages.

S 865-075

(20) Set the SYS DSPL switch to the C position.

S 865-068

CAUTION: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(21) Set the C mode select switch to the NAV position.
    (a) Make sure that ON DC shows momentarily on the EICAS display.

(b) Make sure that the C ON DC light on the IRMP comes on momentarily.
(c) Make sure that the C IRMP ALIGN light comes on and stays on.

S 735-077

(22) Do the center IRS-IRMP test the same as the left IRS-IRMP test except as follows:
(a) Use the C IRMP mode select switch.
(b) Use the C IRMP lights.
(c) Use the center IRS EICAS messages.

S 715-081

(23) Do the L FMC-CDU IRS test as follows:

<u>CAUTION</u>: DO NOT TURN THE IRU MODE SELECTOR SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(a) Set all three IRMP mode selector switches to the OFF position.
(b) After one minute, make sure that all IRMP lights and EICAS IRS messages are off.
(c) Set all three IRMP mode select switches to the NAV position.
(d) Make sure the conditions that follow occur:
    1) All three IRMP ON DC lights come on momentarily.
    2) The message IRS ON DC appears momentarily on the EICAS display unit for the L, R, and C IRUs.
    3) All three IRMP ALIGN lights come on and all other IRMP lights are off.
(e) Push the INIT REF switch found on the L FMC-CDU.
(f) Put in the local longitude and latitude.
(g) Make sure the data shows correctly on line six of the L FMC-CDU.
(h) Push the line 4R switch to move the data to line four.
(i) Make sure the conditions that follow occur:
    1) The latitude and longitude show on line four of the L FMC-CDU.

2) On the IRMP, all three ALIGN lights stay on and all other lights stay off.
3) All three IRMP ALIGN lights go off at 10 minutes ± 20 seconds after the IRMP mode select switches were set to the NAV position. (This shows the alignment is complete.)

<u>NOTE</u>: If one of the IRUs does not accept the data, a caution signal, "RE-ENTER IRS POSITION", will show on line six of the L FMC-CDU.

(j) Push the NEXT PAGE switch on the L FMC-CDU.
(k) Make sure that the latitude and longitude appear on lines 2, 3 and 4 of the L FMC-CDU.

<u>NOTE</u>: If one of the IRUs does not accept the data, the L FMC-CDU display will show no data for that IRU.

S 715-082
(24) Do the R FMC-CDU IRS test the same as the L FMC-CDU IRS test except use the R FMC-CDU.

S 865-083
(25) Keep all three IRMP mode select switches in the NAV position with all three IRUs aligned.
(a) Make sure that all lights on the IRMP are off.

S 865-106
(26) Make sure the IRS switch on the Capt's INSTR SOURCE SEL panel is set to the ALTN position.

S 865-107
(27) Make sure the F/O's INSTR SOURCE SEL panel is set as usual.

S 865-108
(28) Make sure that the ADC switch on the Capt's and F/O's INSTR SOURCE SEL panels is set to the ALTN position.

S 715-084

(29) Do the L-ADC interface test as follows:
- (a) On the P61 miscellaneous test panel, push up and hold the L-ADC test switch for approximately ten seconds.
  - 1) Make sure the L Vertical Situation Indicator (VSI) and R VSI flags come into view.
- (b) Release the L-ADC test switch and make sure the flags go out of view on the L and R VSI.
- (c) On the INSTR SOURCE SEL panel, set the F/O's ADC switch to the NORM position.
- (d) On the INSTR SOURCE SEL panel, set the Capt's IRS switch to the NORM position.
- (e) Make sure that all IRMP lights stay off.

S 715-085

(30) Do the R-ADC interface test the same as the L-ADC interface test except use the R-ADC test switch.

S 865-086

(31) Set the Capt's ADC switch to the usual position.

S 865-087

(32) Set the IRS switch on F/O's INSTR SOURCE SEL panel to the ALTN position.
- (a) Make sure that all the IRMP lights stay off.

S 715-088

(33) Do the L-ADC interface test again except use only the L VSI.

S 715-089

(34) Do the R-ADC interface test again except use only the R-VSI.

S 865-090

(35) Set the IRS switch on the F/O's INSTR SOURCE SEL panel to the usual position.
- (a) Make sure that all IRMP lights are off.

S 865-091

(36) Set the IRMP DSPL SEL switch to HDG.

S 865-092

(37) Set the SYS DSPL switch to L, C, and R.
   (a) Examine the headings and make sure they all have the same value ±1 degree.

S 865-104

(38) Set the Capt's IRS INSTR SOURCE SEL switch to the usual position.

S 865-093

(39) Set the HDG REF switch to the TRUE position.
   (a) Make sure the heading card on the L-RDMI (or L-RMI) and the R-RDMI (or R-RMI) changes from the MAG heading to the TRUE heading.

S 715-094

(40) Do the Equipment Cooling Ground-Warning Test through the IRS as follows:

<u>CAUTION</u>: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

   (a) Set the IRMP mode select switches to OFF.
   (b) Make sure that the P6 panel circuit breaker that follows is closed:
      1) 6D6, EQUIP COOL GND WARN AND TEST
   (c) Set the L IRMP mode select switch to ALIGN.
   (d) Open the P11 panel circuit breaker that follows:
      1) 11N13, EQUIP COOLING LOW FLOW DET
   (e) After approximately 30 seconds, make sure you hear the ground warning horn.
   (f) Set the L IRMP mode select switch to the OFF position.

(g) Make sure that you do not hear the ground warning horn.
(h) Close the P11 panel circuit breaker that follows:
    1) 11N13, EQUIP COOLING LOW FLOW DET

S 715-095
(41) Do the "Equipment Cooling Ground-Warning Test" again except use the C IRMP mode select switch.

S 715-105
(42) Do the "Equipment Cooling Ground-Warning Test" again except use the R IRMP mode select switch.

S 715-096
(43) Do the Five Minute Time-Delay Test as follows:
(a) Set all the IRMP mode select switches to the ALIGN position.
    1) Make sure that all three ON DC lights come on momentarily.
    2) Make sure that all three ALIGN lights come on and stay on.
(b) Open the P11 panel circuit breakers that follow and attach DO-NOT-CLOSE tags:
    1) 11F1, IRS LEFT
    2) 11F21, IRS CENTER
    3) 11F22, IRS RIGHT
(c) Make sure that all three ALIGN lights are on.
(d) Make sure that all three ON DC lights are on.
(e) On the P5 Overhead Panel, set the BAT switch to the ON position.
(f) On the P5 Overhead Panel, set the STBY PWR switch to the BAT position.
(g) After approximately five minutes, make sure the conditions that follow occur:
    1) The R ALIGN and ON DC lights go off.
    2) The L and C ALIGN and ON DC lights stay on.
(h) Set the BAT switch and the STBY PWR switch on the P5 panel to their initial positions.
(i) Remove the DO-NOT-CLOSE tags and close the P11 panel circuit breakers that follow:
    1) 11F1, IRS LEFT

2) 11F21, IRS CENTER
3) 11F22, IRS RIGHT

E. IRU Nuisance Non-critical Fault Test.

S 865-158

(1) If a "FAULT" light is illuminated on the IRMP, do nuisance non-critical fault test.

S 865-159

(2) AIRPLANES WITH P/N S242T101-201 AND -202 IRMPS;
On the IRMP, turn the applicable IRU mode select switch to the OFF position. Wait approximately 30 seconds, then turn the mode select switch to the NAV position.
   (a) Enter present position to initialize the IRU.
   (b) Make sure that the electrical power is applied to the ADC system and the FMC system.
   (c) Wait approximately 10 minutes until the IRMP "ALIGN" annunciator extinguishes and the IRU is operating in the nav mode.
   (d) If the IRMP "FAULT" annunciator extinguished after transaction to the NAV mode, then the IRU does not require replacement. If the annunciator remains illuminated, then the IRU should be replaced.

S 865-160

(3) AIRPLANES WITH P/N S242T101-203, -204 OR -206 IRMPS;
On the IRMP, turn the "SYS DSPL" knob to the "L" or "C" or "R" position corresponding to the IRU that has the fault.
   (a) On the IRMP, place the "DSPL SEL" knob to the "HDG" position. Enable display of IRU fault codes by pressing "0" and then "1" within five seconds.
   (b) If fault code 15 is displayed, then continue. Otherwise, turn the applicable IRU off via the mode select switch and replace the unit.
   (c) On the IRMP, turn the applicable IRU off by the mode select switch. Wait approximately 30 seconds until the IRMP "ALIGN" annunciator extinguishes, then select the mode select switch to the "NAV" position.
   (d) Enter present position to initialize the IRU.
   (e) Make sure that the electrical power is applied to the ADC system and the FMC System.

(f) Wait approximately 10 minutes until the IRMP "ALIGN" annunciator extinguishes and the IRU is operating in the nav mode.

(g) If the IRMP "FAULT" annunciator extinguished after transaction to the NAV mode, then the IRU does not require replacement. If the annunciator remains illuminated, then the IRU should be replaced.

F. Put the Airplane Back to Its Usual Condition

S 845-063

(1) Set all IRS INSTR SOURCE SEL switches to their usual positions.

S 845-064

<u>CAUTION</u>: DO NOT TURN THE IRU MODE SELECT SWITCH OUT OF THE "NAV" POSITION UNLESS YOU PULL THE SWITCH KNOB BEFORE YOU TURN IT. IF YOU TURN THE IRU MODE SELECT SWITCH BEFORE YOU PULL THE SWITCH KNOB, YOU CAN CAUSE DAMAGE TO THE INTERNAL SAFETY DETENT.

(2) Turn all three IRMP mode select switches to the OFF position.

S 865-098

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

INERTIAL REFERENCE UNIT (IRU) - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes an IRU. The second task installs an IRU.
   B. The left (M159), center (M160), and right (M161) IRUs are found in the main equipment center rack, E2. All electrical connections are made through connectors at the rear of the units.

TASK 34-21-01-024-001

2. IRU Removal
   A. References
      (1) AMM 20-10-01/401, E/E Rack Mounted Components
      (2) AMM 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones

119/120	Main Equipment Center

   C. Procedure

S 864-002

(1) Set the two F/D switches on the Mode Control Panel (MCP) to OFF.

S 864-003

(2) Open these circuit breakers (as applicable) on the main power distribution panel, P6, and attach DO-NOT-CLOSE tags:
   (a) 6D3, IRS L
   (b) 6D4, IRS C
   (c) 6D5, IRS R

S 864-004

(3) Open these circuit breakers (as applicable) on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11F1, IRS LEFT
   (b) 11F21, IRS CENTER
   (c) 11F22, IRS RIGHT

S 864-005

CAUTION: DO NOT OPERATE THE "MASTER DIM AND TEST" SWITCH FOR MORE THAN FIVE MINUTES WITH THE "IND LTS" SWITCH IN THE DIM POSITION IF ONE OR MORE OF THE THREE IRUS IS REMOVED. THIS CAN CAUSE DAMAGE TO THE IRS MODE SELECT PANEL.

(4) Attach a tag by the Master Dim and Test switch which reads: Caution, one IRU is removed. Do not operate the Master Dim and Test switch for more than 5 minutes with the IND LTS switch in the Dim position. This can cause damage to the IRS Mode Select panel (IRMP).

S 864-006

CAUTION: DO NOT MOVE THE IRU BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE IRU.

(5) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

S 024-007

WARNING: BE CAREFUL WHEN YOU MOVE THE IRU. BECAUSE THE IRU WEIGHS 47 POUNDS (21 KG), INJURY CAN OCCUR.

(6) Remove the IRU (AMM 20-10-01).

TASK 34-21-01-424-026

3. IRU Installation

A. References
  (1) AMM 20-10-01/401, E/E Rack Mounted Components
  (2) AMM 20-41-01/201, Electrostatic Sensitive Devices
  (3) AMM 22-00-02/201, Autoflight BITE
  (4) AMM 24-22-00/201, Electrical Power - Control
  (5) AMM 34-21-00/501, Inertial Reference System

B. Access
  (1) Location Zones
      119/120 Main Equipment Center

C. Procedure

S 864-008

(1) Make sure these circuit breakers (as applicable) on the P6 panel are open:
  (a) 6D3, IRS L
  (b) 6D4, IRS C
  (c) 6D5, IRS R

S 864-009

(2) Make sure that these circuit breakers (as applicable) on the P11 panel are open:
  (a) 11F1, IRS LEFT
  (b) 11F21, IRS CENTER
  (c) 11F22, IRS RIGHT

S 864-010

CAUTION: DO NOT MOVE THE IRU BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE IRU.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 424-011

WARNING: BE CAREFUL WHEN YOU MOVE THE IRU. BECAUSE THE IRU WEIGHS 47 POUNDS (21 KG), INJURY CAN OCCUR.

(4) Install the IRU (AMM 20-10-01/401).

S 434-012

(5) If all three IRUs are installed, remove the caution tag at the Master Dim and Test switch.

S 864-013

(6) Remove the DO-NOT-CLOSE tags and close these circuit breakers (as applicable) on the P6 panel:
  (a) 6D3, IRS L
  (b) 6D4, IRS C
  (c) 6D5, IRS R

S 864-014

(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers (as applicable) on the P11 panel:
  (a) 11F1, IRS LEFT
  (b) 11F21, IRS CENTER
  (c) 11F22, IRS RIGHT

D. IRU Test

S 864-015

(1) Supply electrical power (AMM 24-22-00/201).

S 864-016

(2) Set the IRMP mode select switch to ALIGN or NAV for the applicable IRU.

S 754-017
(3) Make sure that only the ALIGN annunciator on the IRMP stays on.

S 864-018
(4) Put in the longitude and latitude of your position (AMM 34-21-00/501). (If the ALIGN light flashes, put the same position in again.)

S 754-019
(5) Make sure that 10 minutes after you set the IRMP mode select switch to ALIGN or NAV, the ALIGN light goes out.

S 754-020
(6) AIRPLANES WITH -107 IRUs OR PREVIOUS;
make sure that the IRU fault ball shows black.

S 714-021
(7) Do the Maintenance Control Display Panel (MCDP) Test - 30 CURRENT FAULT REPORT (AMM 22-00-02/201).

S 864-022
(8) Set the IRMP mode select switch to OFF.

S 864-023
(9) Remove electrical power if it is not necessary (AMM 24-22-00/201).

IRS MODE SELECT PANEL (IRMP) - MAINTENANCE PRACTICES

1. General

A. This procedure has four tasks for the IRS Mode Select Panel (IRMP). The first task replaces the lights in the IRMP annunciators. The second task replaces the incandescent display lights. The third task removes the IRMP. The fourth task installs the IRMP.

B. The lights in the annunciator are replaced from the front of the panel. The lights are at the rear of the annunciator.

C. The IRMP is installed on the overhead panel. There are electrical connectors at the rear of the panel.

TASK 34-21-02-962-001

2. Annunciator Light Replacement (Fig. 201)

A. Access

(1) Location Zones

211/212	Flight Compartment

B. Procedure

S 962-002

(1) Push the annunciator in until you feel a detent position, then release it. (The annunciator will extend out from the assembly.)

S 962-003

(2) Carefully pull the annunciator from the assembly until it does not move freely.

S 962-004

(3) Continue to pull the annunciator lightly and turn the annunciator down as shown in C. (A retaining clip holds the annunciator to the assembly.)

S 962-005

(4) At the base of the annunciator, lift the light from the annunciator by the lip on the light base as shown in D.

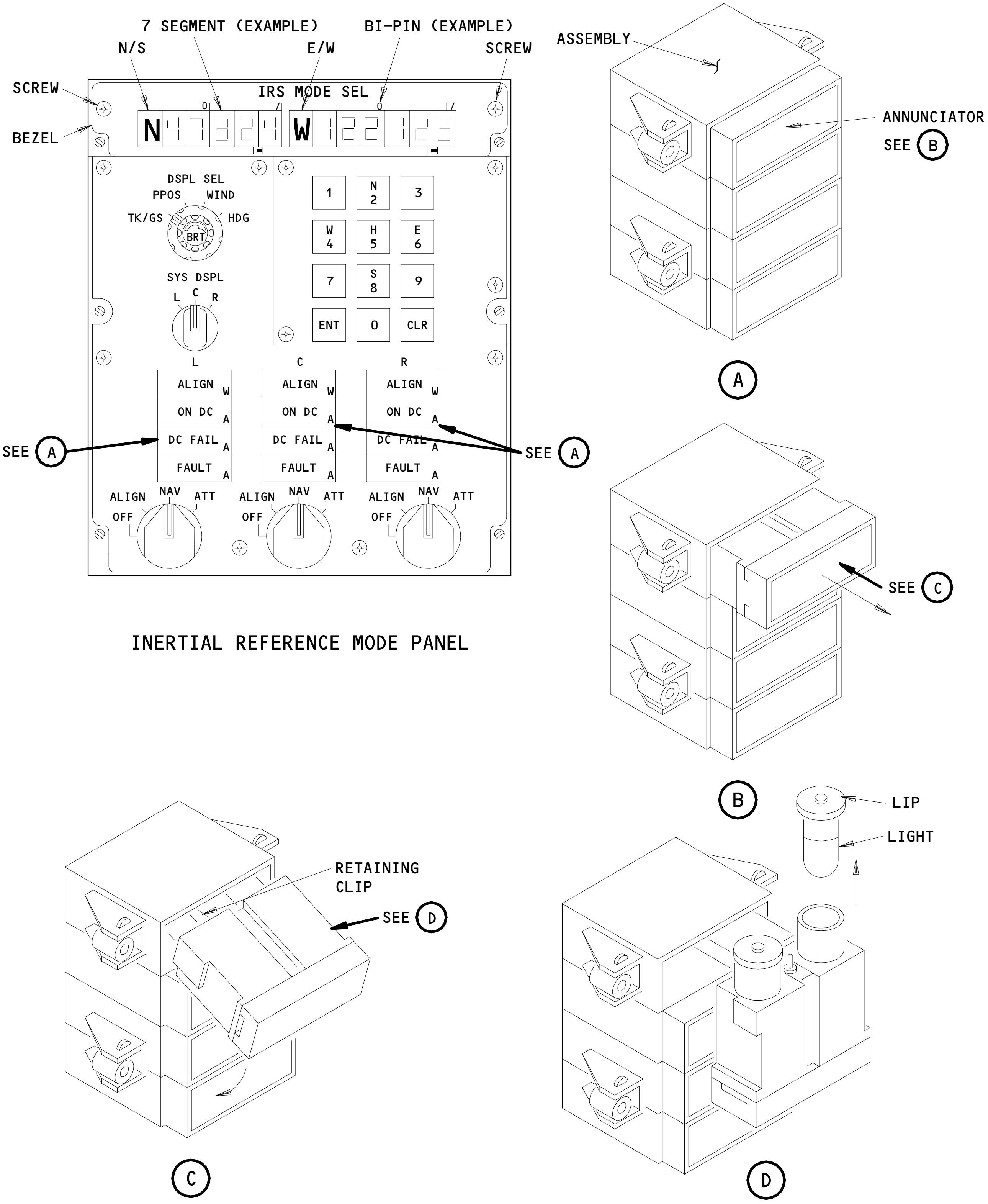
S 962-006

(5) Replace the light.

S 962-007

CAUTION: BE CAREFUL WHEN YOU MOVE THE ANNUNCIATOR. DO NOT CAUSE DAMAGE TO THE RETAINING CLIP.

(6) Turn the annunciator up until it is in the position shown in B.



IRMP Light Replacement
Figure 201

177568

S 962-008

(7) Push the annunciator in until you feel a detent position, then release it.
  (a) Make sure the annunciator is smooth with the other annunciators as shown in A.

TASK 34-21-02-962-009

3. Incandescent Light Replacement (Fig. 201)
  A. Access
    (1) Location Zones
        211/212 Flight Compartment

  B. Procedure

S 962-011

(1) Loosen the two screws on the bezel.

S 962-033

(2) Remove the bezel.

S 962-010

(3) Remove the light that does not work. (Use needle-nose pliers to remove a display light and tweezers to remove a bi-pin light if necessary.)

S 962-038

(4) Replace the light. (Align the seven segment, N/S, and E/W display light so the small mark on the face of the bulb is toward the bottom of the IRMP. Put a white plastic spacer on replacement bi-pin lights.)

S 962-012

(5) Attach the bezel and tighten the two screws.

TASK 34-21-02-002-015

4. IRMP Removal
  A. References
    (1) AMM 20-41-01/201, Electrostatic Sensitive Devices
    (2) AMM 24-22-00/201, Electrical Power - Control
  B. Access
    (1) Location Zones
        211/212 Flight Compartment

  C. Procedure

S 862-013

(1) Set all three mode select switches on the IRMP to OFF.

S 862-014

(2) Open these circuit breakers on the main power distribution panel, P6, and attach DO-NOT-CLOSE tags:
   (a) 6D3, IRS L
   (b) 6D4, IRS C
   (c) 6D5, IRS R

S 862-015

(3) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11F1, IRS LEFT
   (b) 11F21, IRS CENTER
   (c) 11F22, IRS RIGHT

S 032-031

CAUTION: DO NOT MOVE THE IRMP BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE IRMP.

(4) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

S 032-036

(5) Loosen the screws on the control panel that hold it in position.

S 032-016

(6) Lower the control panel.

S 032-034

(7) Disconnect the electrical cables.

S 022-017

(8) Remove the IRMP.

TASK 34-21-02-402-018

5. Install the IRMP

A. References
   (1) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
   (2) AMM 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones
      211/212 Flight Compartment

C. Procedure

S 862-019

(1) Make sure that these circuit breakers on the P6 panel are open:
   (a) 6D3, IRS L
   (b) 6D4, IRS C

(c) 6D5, IRS R

S 862-020

(2) Make sure that these circuit breakers on the P11 panel are open:
   (a) 11F1, IRS LEFT
   (b) 11F21, IRS CENTER
   (c) 11F22, IRS RIGHT

S 432-032

CAUTION: DO NOT MOVE THE IRMP BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE IRMP.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 432-037

(4) Connect the electrical cables to the rear of the IRMP.

S 422-021

(5) Install the control panel and tighten the screws.

S 862-022

(6) Remove the DO-NOT-CLOSE tags and close these P6 panel circuit breakers:
   (a) 6D3, IRS L
   (b) 6D4, IRS C
   (c) 6D5, IRS R

S 862-023

(7) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
   (a) 11F1, IRS LEFT
   (b) 11F21, IRS CENTER
   (c) 11F22, IRS RIGHT

D. IRMP Test

S 862-024

(1) Supply electrical power (AMM 24-22-00).

S 712-025

(2) Set the three mode select switches to ALIGN.
   (a) Make sure that the three ALIGN annunciators come on after approximately ten seconds.

S 712-026

(3) Keep the IRU mode select switches in ALIGN.

S 712-035

(4) Put in your position on the IRMP.

S 712-027

(5) Push the ENT key.

S 712-028

(6) Set the DSPL SEL switch to PPOS.
  (a) Make sure that the IRMP shows the present position.

S 712-029

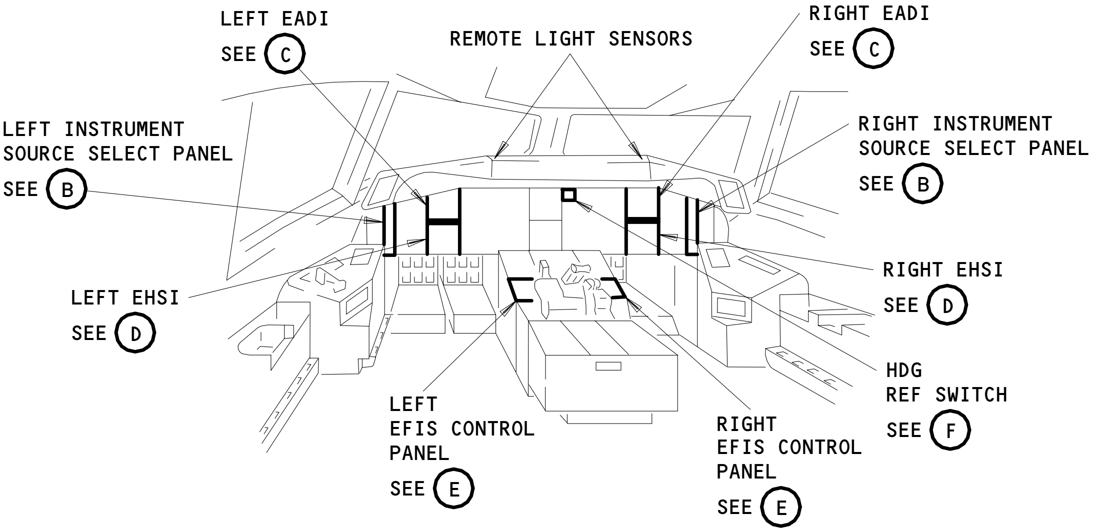
(7) Set the IRMP mode select switches to the OFF position.

S 862-030

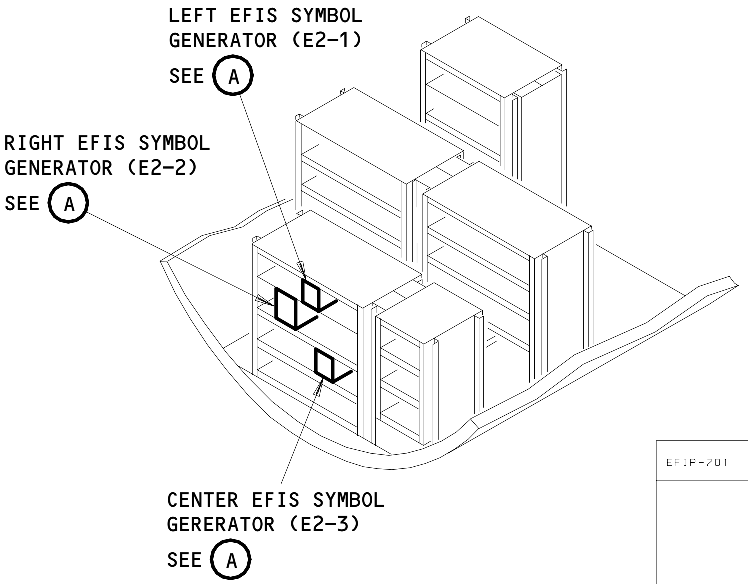
(8) Remove electrical power if it is not necessary (AMM 24-22-00).

ELECTRONIC FLIGHT INSTRUMENT SYSTEM - DESCRIPTION AND OPERATION

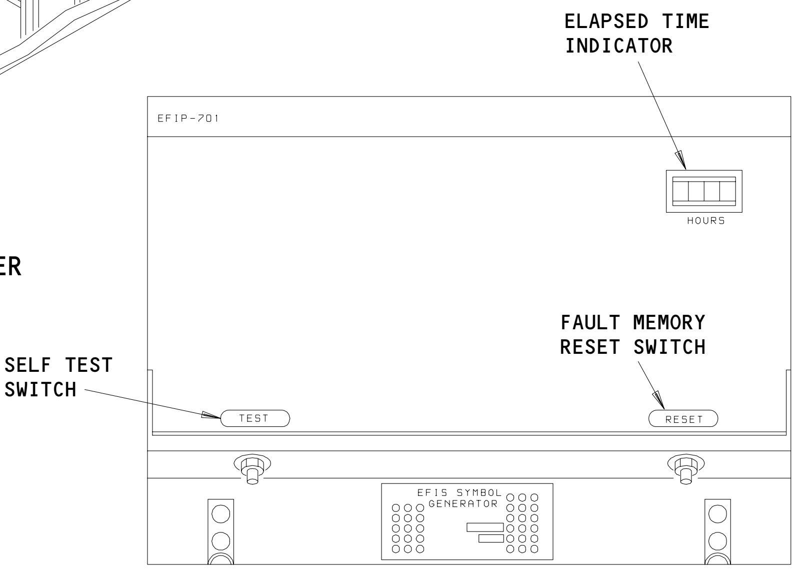
1. General (Fig. 1)
   - A. The electronic flight instrument system (EFIS) provides the main displays for most of the airplane's navigation systems. The EFIS also includes the switches on the instrument source select panels.
   - B. GUI 001-114, 116-999;
     It also includes the radio distance magnetic indicators (RDMI) and the vertical speed indicators (VSI).
   - C. GUI 115;
     It also includes the radio magnetic indicators (RMI), the RMI bearing source annunciators, and the vertical speed indicators (VSI).
   - D. The EFIS uses CRT indicators to provide multicolor navigation displays. The system displays the following:
     - (1) Pitch, roll, and directional data; map displays and flight path data; weather radar data; altitude and decision height; autopilot mode data; and input system fault annunciations.
     - (2) GUI 001-008, 010-114, 116-999;
       Airspeed data.
   - E. The two indicators associated with the EFIS are the EHSI and the EADI. Two units of each display are installed, and each set operates independently under normal conditions. Each display set has a dedicated control panel, remote light sensor, and a symbol generator. A third symbol generator is installed, as a backup, for either display set.
   - F. The switches on the instrument source select panels provide selection for backup data sources in the event of a main data source failure.
   - G. Normally, the left and right symbol generators supply the corresponding display information. If a fault is detected by the operating symbol generator, either display can be switched to the center symbol generator. The RDMIs (RMIs) and VSIs can be switched to the center IRU if a source fault is detected.
   - H. If the Capt and F/O both select the center EFIS at the same time, a level B caution message - INSTR SWITCH, will appear on the EICAS display.
   - I. The RDMIs (RMIs) provide heading and bearing displays. They display the airplanes present heading and directional bearing to selected reference points.



FLIGHT COMPARTMENT



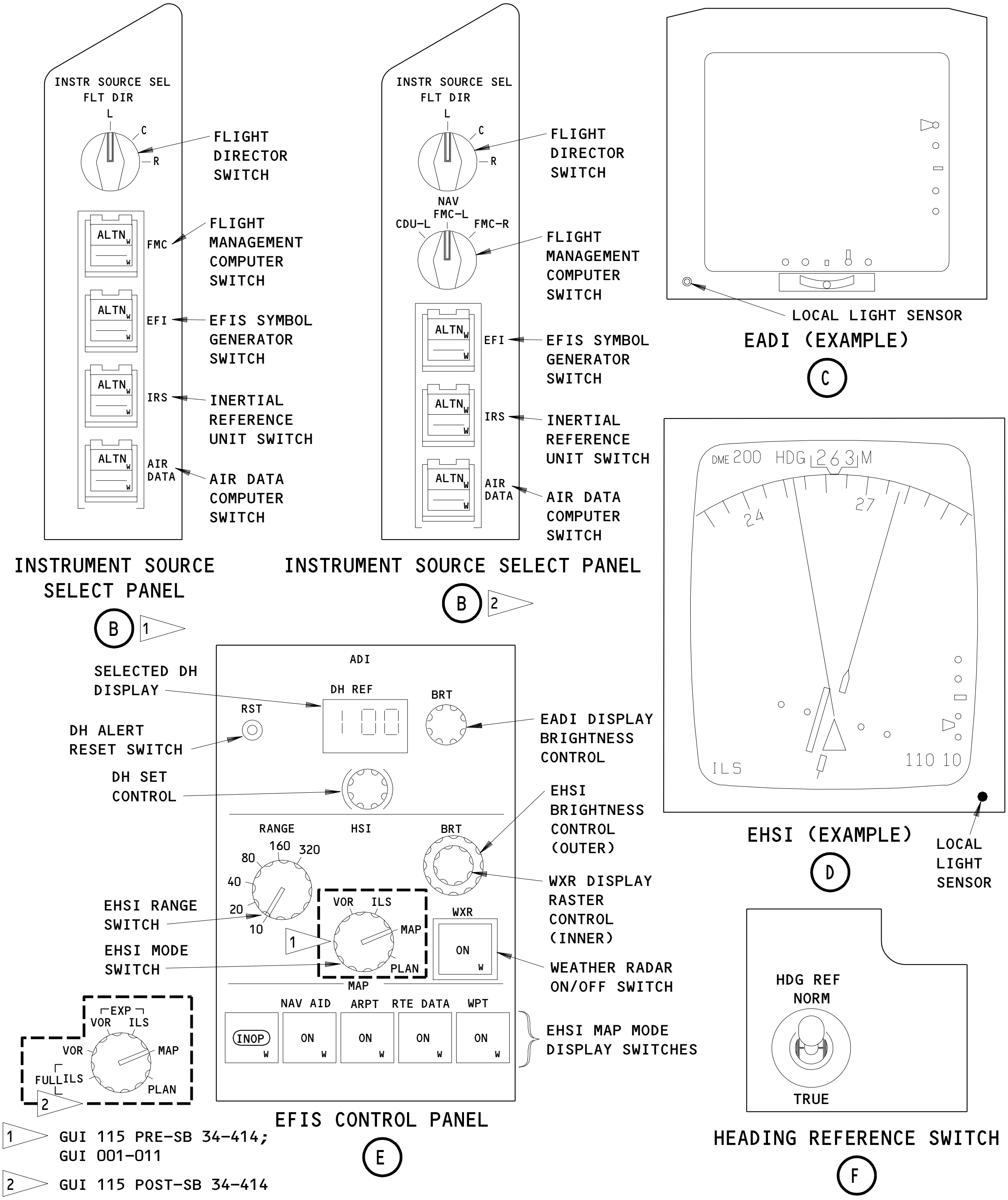
MAIN EQUIPMENT CENTER



EFIS SYMBOL GENERATOR

A

EFIS - Component Detail
Figure 1 (Sheet 1)



1 GUI 115 PRE-SB 34-414;
GUI 001-011

2 GUI 115 POST-SB 34-414

EFIS - Component Detail
Figure 1 (Sheet 2)

J. The RDMIs (RMIs) receive data from the IRS, VOR, and ADF systems.

K. GUI 115;
The RMI bearing source annunciator displays which data source is being displayed by the RMI as selected on the respective ADF/VOR switch.

L. The VSIs provide vertical rate-of-climb and descent display. They receive data from the inertial reference system.

NOTE: The component details and operation of the RDMIs, RMIs, RMI bearing source annunciator, and VSIs are covered following the EFIS operation section.

M. Configuration

(1) EFIS Symbol Generator

	-420	-421
GUI 001, 002, 115	BASIC	
GUI 003-114, 116-999		BASIC

2. Component Details - EFIS (Fig. 1)

A. EFIS Symbol Generator

(1) The left, right, and center EFIS symbol generators are located in the main equipment center on rack E2.

(2) The front panel of the symbol generator has two push switches. One is a self-test switch which, when pressed, causes the symbol generator's BITE circuits to run a system self-test. The symbol generator will check the operation of the control panel, the display units, and itself. Any detected faults are stored in a non-volatile memory. The other switch is a BITE memory reset switch. When this is pressed, all stored faults in the BITE memory are erased. The symbol generator stores faults for the past two flights.

B. EFIS Control Panel

(1) The left and right EFIS control panels are located on the aisle control stand (P10).

(2) The EADI control functions are as follows:

(a) The EADI display brightness control is a rotary potentiometer control for manual EADI brightness adjust.

(b) The DH readout is a three-digit, LCD display representing selected DH in feet.

(c) The DH set control is a ten-turn rotary switch used to select DH. It drives the selected DH readout.

(d) The DH reset switch is a push switch used to manually reset the DH alert.

(3) The EHSI controls and their functions are as follows:
   (a) The range switch is a six position rotary switch used to select display range. It also controls the range processing in the WXR XCVR (AMM 34-43-00/001). The knob selects 10, 20, 40, 80, 160, or 320 nmi display range.
   (b) The EHSI brightness control and WXR display brightness control are two concentric rotary controls. The outer control is for the overall EHSI brightness. The inner control is for the WXR raster brightness.
   (c) The EHSI map mode display switches are a set of five push-on/push-off switches (far left switch is inoperative). They illuminate in the ON position and call up display data in the Map Mode. When in the ON position, the following data will be included in the map display:
      1) The NAVAID - displays all VOR, VORTAC, and NAVAIDS, with identifiers, in the displayed range.
      2) The ARPT - displays all airports and identifiers in the displayed range.
      3) The RTE DATA - displays altitude and ETA next to all flight path waypoints.
      4) The WPT - displays all waypoints, with identifiers, not on the flight path and within display range.
   (d) The weather radar ON/OFF switch is used to turn on the WXR system (AMM 34-43-00/001) and WXR display on the EHSI.
   (e) GUI 115;
   The EHSI mode switch is a six position rotary switch. It is used to select either the MAP, PLAN, Expanded (EXP) VOR, EXP ILS, FULL VOR, or FULL ILS display modes for the EHSI.
   (f) GUI 001-114, 116-999;
   The EHSI mode switch is a four position rotary switch. It is used to select either the MAP, PLAN, VOR, or ILS display modes for the EHSI.

C. Instrument Source Select Panel

(1) Both instrument source select panels contain one flight director and four normal/alternate source select switches. These are used to switch from a normal to an alternate data source, in the event of a failure. All switching is done within the displaying system components (ex. EFIS symbol generator, RDMI, VSI). The left and right instrument source select panels are located on the captain's instrument panel (P1) and first officer's instrument panel (P3), respectively.

(2) The flight director three-position rotary switch is used to select either the left, right, or center flight control computer (FCC).

(3) The flight management computer (FMC) switch selects which FMC provides flight parameter data for display on the EHSI. This is switched by a relay within the symbol generator.

(4) The four normal/alternate source select switches are pushed once for alternate and again for normal. They are lighted when in the alternate mode.

(5) The electronic flight instrument (EFI) switch selects which symbol generator supplies the display units. The switching is done by relays in the left and right symbol generators. The left and right EFI switches are electronically interlocked.

(6) The air data source select (AIR DATA) switch is used to select which ADC provides data to its interfacing systems (AMM 34-12-00/001).

(7) The inertial reference system (IRS) switch selects which IRU supplies pitch, roll, heading, and track data. This is supplied to and switched within the EFIS symbol generators, the RDMIs (RMIs), the VSIs, and the digital flight data acquisition units (DFDAU).

(8) The air data source select (AIR DATA) switch selects which ADC gives airspeed data to its interfacing systems. This is supplied to and switched inside the symbol generators.

D. EFIS Remote Light Sensor

(1) The remote light sensors detect the amount of ambient light coming through the windshield and are used for automatic intensity control of the display units. The left and right remote light sensors are located on the glareshield (P7).

(2) The light passes through a lens and is sensed by the photo diode light sensor. This causes the diode to produce a voltage which corresponds to the amount of detected light. The voltage is sent to the display units to automatically adjust their brightness.

E. Heading Reference Switch

(1) The HDG REF Switch is used to manually select either magnetic (NORM position) or true (TRUE position) north reference on the EHSIs. It is located on panel P3.

(2) GUI 001-114, 116-999;
the HDG REF switch is also used to select magnetic or true north reference on the RDMIs.

(3) GUI 115;
the HDG REF switch is also used to select magnetic or true north reference on the RMIs.

F. Normal Displays

(1) The purpose of the EADIs and EHSIs is to display basic attitude and navigation data. The displays are color CRTs which receive symbol data from the symbol generator. Navigational format and content are mainly supplied by the FMC. Attitude data comes from the IRS. Both indicators are also capable of displaying text information such as flight parameters and system status.

(2) The colors used on the displays generally have the following meanings:

(a) GREEN - indicates engaged flight mode annunciations, dynamic conditions

(b) WHITE - indicates present status situation, scales, flight mode annunciations

(c) MAGENTA - Indicates command information, pointers, symbols, fly-to condition
(d) CYAN (Light Blue) - Indicates non active background information (i.e. EADI sky)
(e) RED - indicates warning.
(f) YELLOW - indicates cautionary information, faults flags (i.e. EADI ground)
(g) BLACK - indicates blank areas

(3) The following figures and tables describe the display symbols and their parameters on the EADIs and EHSIs under normal conditions.

G. Electronic Attitude Director Indicator (EADI) (Fig. 2)

(1) The EADIs display basic attitude information, ILS data, radio altitude, and autopilot mode data.

(2) GUI 001-008, 010-114, 116-999;
The EADIs also display airspeed data.

(3) The EADIs display fault data for the input systems in the event of a failure. The display consists of a standard attitude display centered on the screen. Text, which represents various flight parameters, is located in each corner of the screen. The left and right EADIs are located in the captains (P1) and first officers (P3) instrument panels, respectively.

(4) The display is a shadow masked vertical raster CRT with three color guns (red, blue, green). It utilizes magnetic deflection and electrostatic focus control. Failure of one of the color guns will result in a monochromatic display. The three colors are used to generate other color combinations such as magenta, cyan, yellow, and white.

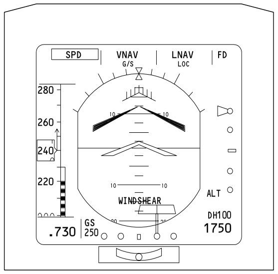
(5) The internal circuit operation and unit temperature are monitored by the symbol generator BITE circuits. Any detected faults are displayed on the screen.

(6) The front panel includes the screen, an inclinometer, and a light sensor. The light sensor detects cabin lighting intensity and varies the display brightness accordingly. The inclinometer is a standard ball-type and is used as an attitude backup. The display area is approximately 5 inches square.

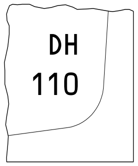
H. Electronic Horizontal Situation Indicator (EHSI)

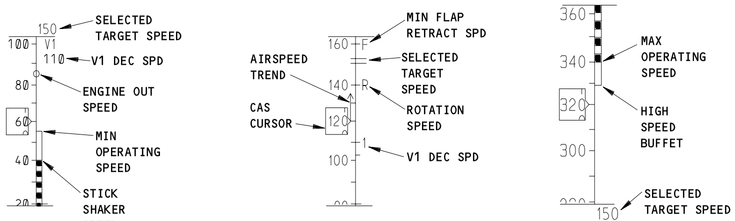
(1) The EHSI displays flight information in a horizontal format. It displays standard type HSI information and many other flight parameters in modified formats.

(2) GUI 115;
The EHSI is also used for the WXR display in the MAP, VOR-EXP, and ILS-EXP modes.

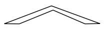
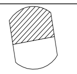
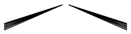
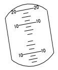


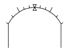
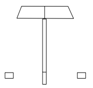
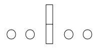
EADI DISPLAY (EXAMPLE)



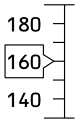
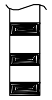
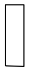
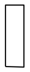
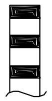
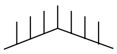


AIRSPEED DISPLAY SYMBOLS

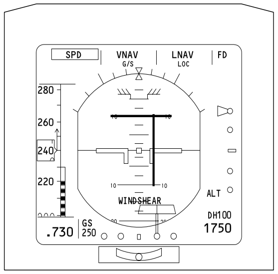
SYMBOL	NAME	REMARKS
	AIRPLANE	WHITE AIRPLANE ATTITUDE REFERENCE PRODUCED BY EFIS SYMBOL GENERATOR.
	SKY/GROUND/HORIZON LINE	CYAN SKY AND YELLOW GROUND PRODUCED BY EFIS SYMBOL GENERATOR. SKY/GROUND MOVEMENT AND WHITE HORIZON LINE PRODUCED BY IRS DATA.
	FILLED INTEGRATED CUE FLIGHT DIRECTOR	MAGENTA SYMBOL PRODUCED BY FCC DATA. DISPLAYED WITH FD SWITCH ON AND VALID STEERING COMMANDS AVAILABLE. ALSO DISPLAYED WHEN T/O GO AROUND SW ACTIVATED IN WINDSHEAR CONDITION, EVEN WITH FD SWITCH OFF.
	PITCH SCALE	WHITE (±90°) PRODUCED BY IRS DATA. 0° INDICATED BY HORIZON LINE

SYMBOL	NAME	REMARKS
	ROLL SCALE, POINTER AND INDEX	WHITE SCALE (±60°), POINTER AND INDEX POINTER MOVEMENT PRODUCED FROM IRS DATA. SCALE AND INDEX PRODUCED BY EFIS SYMBOL GENERATOR.
	EXPANDED LOC SCALE AND POINTER AND RISING RUNWAY	WHITE SCALE, MAGENTA POINTER AND STEM, AND GREEN RISING RUNWAY. FOR VALID ILS DATA, THE STANDARD LOC DISPLAY WILL APPEAR UNTIL THE FOLLOWING CONDITIONS ARE MET: 1. LOC DEVIATION <5/8 DOT; 2. AFDS LOC OR ROLLOUT MODE IS ENGAGED/OPERATIVE. THESE CONDITIONS CAUSE THE EXPANDED LOC SCALE TO APPEAR. THE SYMBOL WILL REVERT BACK TO THE STANDARD DISPLAY IF BOTH AFDS MODES ARE DISENGAGED AND THE GROUND SPEED <30 KNOTS OR RA >200 FT. LOC SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING. THE RISING RUNWAY DISPLAYS A REPRESENTATIVE RA OF 0 TO 200 FT. VERTICAL MOVEMENT IS CONTROLLED BY THE RA SYSTEM. LATERAL MOVEMENT IS CONTROLLED BY THE ILS. ZERO FT RA IS INDICATED WHEN THE RUNWAY TOUCHES THE AIRPLANE SYMBOL.
	STANDARD LOC SCALE AND POINTER	
	GLIDESLOPE SCALE AND POINTER	WHITE SCALE AND MAGENTA POINTER. SCALE PRODUCED BY EFIS SYMBOL GENERATOR. POINTER DISPLAYED WHEN VALID ILS DATA IS RECEIVED. POINTER REMOVED FOR NCD AND FOR BACK COURSE OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS >90°. SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING (ILS).
DH100 1750	NUMERICAL DECISION HEIGHT AND RA DISPLAY	GREEN DECISION HEIGHT SELECTED ON EFIS CONTROL PANEL. WHITE RA (-20 TO +2500 FT) FROM RADIO ALTIMETER SYSTEM (EFIS CP/RA)
DH 110	DH ALERT	YELLOW ALERT WHEN RA≤DH. DISPLAY FLASHES FOR INITIAL 3 SECONDS OF ALERT. ALERT CAN BE CANCELLED MANUALLY FROM EFIS CP OR CANCELS AUTOMATICALLY WHEN RA=0 OR RA=DH+75 (EFIS CP/RA).
GS 250	GROUND SPEED	WHITE DISPLAY OF CALCULATED GROUND SPEED (KNOTS) (FMC, IRS)
FD	AFDS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE (AFDS)
LOC	ROLL MODE ARMED	WHITE DISPLAY FOR ARMED ROLL MODE (AFDS)
G/S	PITCH MODE ARMED	WHITE DISPLAY FOR ARMED PITCH MODE (AFDS)
LNAV	ROLL MODE ENGAGED	GREEN DISPLAY FOR ENGAGED ROLL MODE (AFDS)
VNAV	PITCH MODE ENGAGED	GREEN DISPLAY FOR ENGAGED PITCH MODE (AFDS)
SPD	A/T MODE	GREEN DISPLAY FOR A/T MODE (TMS)
▭	MODE CHANGE HIGHLIGHT	GREEN BOX AROUND MODE ANNUNCIATION FOR TEN SEC AFTER CHANGE TO VALID MODE
ALT	H ALERT	WHITE DISPLAY AT 500 FT < RA ≤ 2500 FT

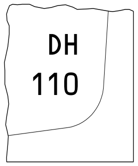
EFIS EADI Display - Component Detail
Figure 2 (Sheet 1)

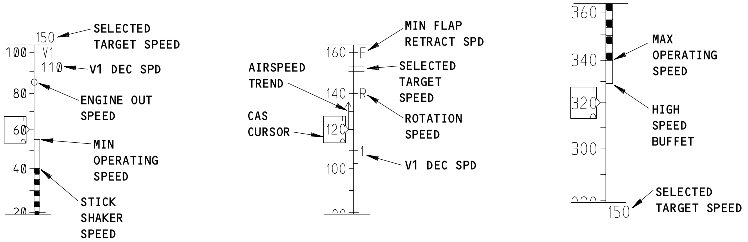
SYMBOL	NAME	REMARKS
	AIRSPEED TAPE AND ROLLING DIGIT CAS CURSOR	WHITE AIRSPEED TAPE MOVES AGAINST FIXED WHITE CAS CURSOR WITH ROLLING DIGITS. SPEED SCALE NUMBERS ALSO ARE IN WHITE. SPEED SCALE BELOW 30 KTS IS BLANK. WHEN THE SPEED IS EQUAL TO OR LESS THAN 30 KTS (OR NCD), THE TAPE INDICATES 30 KTS. (ADC)
.765	MACH DISPLAY	CURRENT MACH NUMBER COMPUTED BY ADC, DISPLAYED BY WHITE NUMERICS. DISPLAYED FOR MACH ≥ 0.400.
=	SELECTED TARGET SPEED	MAGENTA INDEX PLACED AGAINST RESPECTIVE READING ON AIRSPEED TAPE. REPLACED BY MAGENTA THREE-DIGIT DISPLAY WHEN SELECTED TARGET SPEED IS OFF-SCALE. DIGITAL DISPLAY IS PLACED IMMEDIATELY BELOW AIRSPEED TAPE FOR A VALUE LESS THAN THE CURRENT SPEED AND ABOVE AIRSPEED TAPE FOR A VALUE GREATER THAN THE CURRENT SPEED. MOTION CONTROL IS FROM AFDS-MCP.
250		
	MAXIMUM OPERATING SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE INDICATES MAX. OPERATING SPEED. (SWC)
	HIGH SPEED BUFFET	YELLOW BAND PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE REPRESENTS THE SPEED WHERE THE AIRPLANE WOULD ENCOUNTER BUFFETING OR THE FLAPS SHOULD BE EXTENDED (SWC)
-1	DECISION SPEED (V1)	GREEN SYMBOL "-1" IS PLACED AGAINST AIRSPEED TAPE. IF OFF SCALE, THIS INDICATION IS REPLACED BY DISPLAY "V1" AND V1 SPEED VALUE ON THE LINE BELOW, INSIDE THE TOP OF THE AIRSPEED TAPE. (FMC)
V1 140		
-F	MINIMUM FLAP RETRACTION SPEED	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE. (SWC)
-R	ROTATION SPEED (VR)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE (FMC)
-R	APPROACH REFERENCE SPEED (V REF)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE DURING LANDING. (FMC)
	MINIMUM OPERATING SPEED	YELLOW BAND PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. UPPER EDGE INDICATES MIN OPERATING SPEED. (SWC)
	STICK SHAKER SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. TOP EDGE INDICATES STICK SHAKER SPEED. (SWC)
	ENGINE OUT OPERATING SPEED	CYAN SYMBOL PLACED ACROSS AIRSPEED TAPE. (SWC)
	AIRSPEED TREND	GREEN SYMBOL PLACED LEFT AND ALONGSIDE OF AIRSPEED TAPE. LENGTH OF SYMBOL IS PROPORTIONAL TO TREND VALUE. ARROWHEAD TIP INDICATES PROJECTED AIRSPEED AFTER 10 SEC. ARROW POINTS UPWARD FOR ACCELERATION, DOWNWARD FOR DECELERATION. IF TREND IS < 3.5 KTS, SYMBOL IS REMOVED. IF TREND IS > 4.5 KTS, SYMBOL IS DISPLAYED. IF TREND IS ≥ 42 KTS, 42 KT TREND IS INDICATED.
	PITCH LIMIT	YELLOW SYMBOL. READOUT AGAINST PITCH SCALE. BOTTOM EDGE OF SYMBOL INDICATES PITCH MARGIN TO STICKSHAKER. (SWC)
WINDSHEAR	WINDSHEAR WARN	RED DISPLAY FOR DETECTED WINDSHEAR CONDITION (GPWS)

EFIS EADI Display - Component Detail
Figure 2 (Sheet 2)

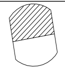
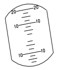


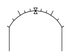
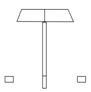
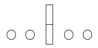
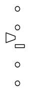
EADI DISPLAY (EXAMPLE)





AIRSPEED DISPLAY SYMBOLS

SYMBOL	NAME	REMARKS
	AIRPLANE	WHITE AIRPLANE ATTITUDE REFERENCE PRODUCED BY EFIS SYMBOL GENERATOR.
	SKY/GROUND/HORIZON LINE	CYAN SKY AND YELLOW GROUND PRODUCED BY EFIS SYMBOL GENERATOR. SKY/GROUND MOVEMENT AND WHITE HORIZON LINE PRODUCED BY IRS DATA.
	SPLIT AXIS FLIGHT DIRECTOR	MAGENTA SYMBOL PRODUCED BY FCC DATA. DISPLAYED WITH FD SWITCH ON AND VALID STEERING COMMANDS AVAILABLE. ALSO DISPLAYED WHEN T/O GO AROUND SW ACTIVATED IN WINDSHEAR CONDITION, EVEN WITH FD SWITCH OFF.
	PITCH SCALE	WHITE (±90°) PRODUCED BY IRS DATA. 0° INDICATED BY HORIZON LINE

SYMBOL	NAME	REMARKS
	ROLL SCALE, POINTER AND INDEX	WHITE SCALE (±60°), POINTER AND INDEX POINTER MOVEMENT PRODUCED FROM IRS DATA. SCALE AND INDEX PRODUCED BY EFIS SYMBOL GENERATOR.
	EXPANDED LOC SCALE AND POINTER AND RISING RUNWAY	WHITE SCALE, MAGENTA POINTER AND STEM, AND GREEN RISING RUNWAY. FOR VALID ILS DATA, THE STANDARD LOC DISPLAY WILL APPEAR UNTIL THE FOLLOWING CONDITIONS ARE MET: 1. LOC DEVIATION <5/8 DOT; 2. AFDS LOC OR ROLLOUT MODE IS ENGAGED/OPERATIVE. THESE CONDITIONS CAUSE THE EXPANDED LOC SCALE TO APPEAR. THE SYMBOL WILL REVERT BACK TO THE STANDARD DISPLAY IF BOTH AFDS MODES ARE DISENGAGED AND THE GROUND SPEED <30 KNOTS OR RA >200 FT. LOC SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING. THE RISING RUNWAY DISPLAYS A REPRESENTATIVE RA OF 0 TO 200 FT. VERTICAL MOVEMENT IS CONTROLLED BY THE RA SYSTEM. LATERAL MOVEMENT IS CONTROLLED BY THE ILS. ZERO FT RA IS INDICATED WHEN THE RUNWAY TOUCHES THE AIRPLANE SYMBOL.
	STANDARD LOC SCALE AND POINTER	
	GLIDESLOPE SCALE AND POINTER	WHITE SCALE AND MAGENTA POINTER. SCALE PRODUCED BY EFIS SYMBOL GENERATOR. POINTER DISPLAYED WHEN VALID ILS DATA IS RECEIVED. POINTER REMOVED FOR NCD AND FOR BACK COURSE OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS >90°. SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING (ILS).
DH100 1750	NUMERICAL DECISION HEIGHT AND RA DISPLAY	GREEN DECISION HEIGHT SELECTED ON EFIS CONTROL PANEL. WHITE RA (-20 TO +2500 FT) FROM RADIO ALTIMETER SYSTEM (EFIS CP/RA)
DH 110	DH ALERT	YELLOW ALERT WHEN RA≤DH. DISPLAY FLASHES FOR INITIAL 3 SECONDS OF ALERT. ALERT CAN BE CANCELLED MANUALLY FROM EFIS CP OR CANCELS AUTOMATICALLY WHEN RA=0 OR RA=DH+75 (EFIS CP/RA).
GS 250	GROUND SPEED	WHITE DISPLAY OF CALCULATED GROUND SPEED (KNOTS) (FMC, IRS)
FD	AFDS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE (AFDS)
LOC	ROLL MODE ARMED	WHITE DISPLAY FOR ARMED ROLL MODE (AFDS)
G/S	PITCH MODE ARMED	WHITE DISPLAY FOR ARMED PITCH MODE (AFDS)
LNAV	ROLL MODE ENGAGED	GREEN DISPLAY FOR ENGAGED ROLL MODE (AFDS)
VNAV	PITCH MODE ENGAGED	GREEN DISPLAY FOR ENGAGED PITCH MODE (AFDS)
SPD	A/T MODE	GREEN DISPLAY FOR A/T MODE (TMS)
▭	MODE CHANGE HIGHLIGHT	GREEN BOX AROUND MODE ANNUNCIATION FOR TEN SEC AFTER CHANGE TO VALID MODE
ALT	H ALERT	WHITE DISPLAY AT 500 FT < RA ≤ 2500 FT

EFIS EADI Display - Component Detail
Figure 2A (Sheet 1)

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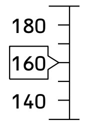
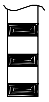
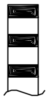
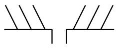
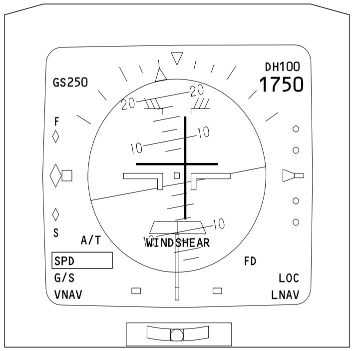
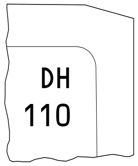
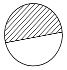
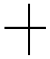
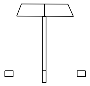
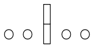
SYMBOL	NAME	REMARKS
	AIRSPEED TAPE AND ROLLING DIGIT CAS CURSOR	WHITE AIRSPEED TAPE MOVES AGAINST FIXED WHITE CAS CURSOR WITH ROLLING DIGITS. SPEED SCALE NUMBERS ALSO ARE IN WHITE. SPEED SCALE BELOW 30 KTS IS BLANK. WHEN THE SPEED IS EQUAL TO OR LESS THAN 30 KTS (OR NCD), THE TAPE INDICATES 30 KTS. (ADC)
.765	MACH DISPLAY	CURRENT MACH NUMBER COMPUTED BY ADC, DISPLAYED BY WHITE NUMERICS. DISPLAYED FOR MACH ≥ 0.400.
═	SELECTED TARGET SPEED	MAGENTA INDEX PLACED AGAINST RESPECTIVE READING ON AIRSPEED TAPE. REPLACED BY MAGENTA THREE-DIGIT DISPLAY WHEN SELECTED TARGET SPEED IS OFF-SCALE. DIGITAL DISPLAY IS PLACED IMMEDIATELY BELOW AIRSPEED TAPE FOR A VALUE LESS THAN THE CURRENT SPEED AND ABOVE AIRSPEED TAPE FOR A VALUE GREATER THAN THE CURRENT SPEED. MOTION CONTROL IS FROM AFDS-MCP.
250		
	MAXIMUM OPERATING SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE INDICATES MAX. OPERATING SPEED. (SWC)
	HIGH SPEED BUFFET	YELLOW BAND PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE REPRESENTS THE SPEED WHERE THE AIRPLANE WOULD ENCOUNTER BUFFETING OR THE FLAPS SHOULD BE EXTENDED (SWC)
-1	DECISION SPEED (V1)	GREEN SYMBOL "-1" IS PLACED AGAINST AIRSPEED TAPE. IF OFF SCALE, THIS INDICATION IS REPLACED BY DISPLAY "V1" AND V1 SPEED VALUE ON THE LINE BELOW, INSIDE THE TOP OF THE AIRSPEED TAPE. (FMC)
V1 140		
-F	MINIMUM FLAP RETRACTION SPEED	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE. (SWC)
-R	ROTATION SPEED (VR)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE (FMC)
-R	APPROACH REFERENCE SPEED (V REF)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE DURING LANDING. (FMC)
	MINIMUM OPERATING SPEED	YELLOW BAND PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. UPPER EDGE INDICATES MIN OPERATING SPEED. (SWC)
	STICK SHAKER SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. TOP EDGE INDICATES STICK SHAKER SPEED. (SWC)
○	ENGINE OUT OPERATING SPEED	CYAN SYMBOL PLACED ACROSS AIRSPEED TAPE. (SWC)
	AIRSPEED TREND	GREEN SYMBOL PLACED LEFT AND ALONGSIDE OF AIRSPEED TAPE. LENGTH OF SYMBOL IS PROPORTIONAL TO TREND VALUE. ARROWHEAD TIP INDICATES PROJECTED AIRSPEED AFTER 10 SEC. ARROW POINTS UPWARD FOR ACCELERATION, DOWNWARD FOR DECELERATION. IF TREND IS < 3.5 KTS, SYMBOL IS REMOVED. IF TREND IS > 4.5 KTS, SYMBOL IS DISPLAYED. IF TREND IS ≥ 42 KTS, 42 KT TREND IS INDICATED.
	PITCH LIMIT	YELLOW SYMBOL. READOUT AGAINST PITCH SCALE. BOTTOM EDGE OF SYMBOL INDICATES PITCH MARGIN TO STICKSHAKER. (SWC)
WINDSHEAR	WINDSHEAR WARN	RED DISPLAY FOR DETECTED WINDSHEAR CONDITION (GPWS)

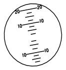
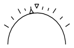
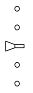
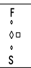
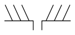
EFIS EADI Display - Component Detail
Figure 2A (Sheet 2)



EADI DISPLAY (EXAMPLE)

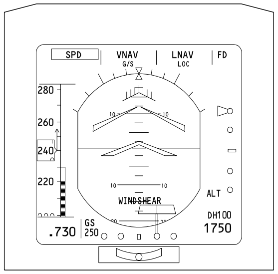


SYMBOL	NAME	REMARKS
	AIRPLANE	WHITE AIRPLANE ATTITUDE REFERENCE PRODUCED BY EFIS SYMBOL GENERATOR
	SKY/GROUND/HORIZON LINE	CYAN SKY AND YELLOW GROUND PRODUCED BY EFIS SYMBOL GENERATOR. SKY/GROUND MOVEMENT AND WHITE HORIZON LINE PRODUCED BY IRS DATA
	SPLIT AXIS FLIGHT DIRECTOR	MAGENTA SYMBOL PRODUCED BY FCC DATA. DISPLAYED W/ FD SWITCH ON AND VALID STEERING COMMANDS AVAILABLE. ALSO DISPLAYED WHEN T/O GO AROUND SW ACTIVATED IN WINDSHEAR CONDITION, EVEN WITH FD SWITCH OFF.
	EXPANDED LOC SCALE AND POINTER AND RISING RUNWAY	WHITE SCALE, MAGENTA POINTER AND STEM, AND GREEN RISING RUNWAY. FOR VALID ILS DATA, THE STANDARD LOC DISPLAY WILL APPEAR UNTIL THE FOLLOWING CONDITIONS ARE MET: 1. LOC DEVIATION <5/8 DOT 2. AFDS LOC OR ROLLOUT MODE IS ENGAGED/OPERATIVE 3. L,R, AND/OR C-A/P OR FLT DIRECTOR ENGAGE.
	STANDARD LOC SCALE AND POINTER	THESE CONDITIONS CAUSE THE EXPANDED LOC SCALE TO APPEAR. THE SYMBOL WILL REVERT BACK TO THE STANDARD DISPLAY IF BOTH AFDS MODES ARE DISENGAGED AND THE GROUND SPEED <30 KNOTS OR RA> 200 FT. LOC SCALE CHANGES TO YELLOW AND POINTER FLASHES DURING ILS DEVIATION WARNING. THE RISING RUNWAY DISPLAYS A REPRESENTATIVE RA OF 0 TO 200 FT. VERTICAL MOVEMENT IS CONTROLLED BY THE RA SYSTEM. LATERAL MOVEMENT IS CONTROLLED BY THE ILS. ZERO FT RA IS INDICATED WHEN THE RUNWAY TOUCHES THE AIRPLANE SYMBOL (ILS, RA).

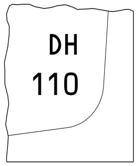
SYMBOL	NAME	REMARKS
	PITCH SCALE	WHITE (±90°) PRODUCED BY IRS DATA. 0° INDICATED BY HORIZON LINE
	ROLL SCALE, POINTER AND INDEX	WHITE SCALE (±60°), POINTER AND INDEX POINTER MOVEMENT PRODUCED FROM IRS DATA. SCALE AND INDEX PRODUCED BY EFIS SYMBOL GENERATOR.
	G/S SCALE AND POINTER	WHITE SCALE AND MAGENTA POINTER. SCALE PRODUCED BY EFIS SYMBOL GENERATOR. POINTER DISPLAYED WHEN VALID ILS DATA IS RECEIVED. POINTER REMOVED FOR NCD AND FOR BACK COURSE OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS >90°. SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING (ILS).
	SPEED DEVIATION SCALE AND POINTER	WHITE SCALE (±10 KNOTS) AND MAGENTA POINTER DISPLAYS DEVIATION FROM SELECTED TMS LIMITED AIRSPEED. THE POINTER GOES OUT OF VIEW DURING GO AROUND.
DH100 1750	NUMERICAL DECISION HEIGHT AND RA DISPLAY	GREEN DECISION HEIGHT SELECTED ON EFIS CONTROL PANEL. WHITE RA (-20 TO +2500 FT) FROM RADIO ALTIMETER SYSTEM
DH 110	DH ALERT	YELLOW ALERT WHEN RA≤DH. DISPLAY FLASHES FOR INITIAL 3 SEC OF ALERT. ALERT CANCELLED MANUALLY FROM EFIS CP OR CANCELS AUTOMATICALLY WHEN RA=0 OR RA=DH+75 (EFIS CP/RA).
GS250	GROUND SPEED	WHITE DISPLAY OF CALCULATED GROUND SPEED (KNOTS) (FMC, IRS)
FD	AFDS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE (AFDS)
LOC	ROLL MODE ARMED	WHITE DISPLAY FOR ARMED ROLL MODE (AFDS)
G/S	PITCH MODE ARMED	WHITE DISPLAY FOR ARMED PITCH MODE (AFDS)
LNAV	ROLL MODE ENGAGED	GREEN DISPLAY FOR ENGAGED ROLL MODE (AFDS)
VNAV	PITCH MODE ENGAGED	GREEN DISPLAY FOR ENGAGED PITCH MODE (AFDS)
SPD	A/T MODE	GREEN DISPLAY FOR A/T MODE (TMS)
A/T	TMS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE (TMS)
▭	MODE CHANGE HIGHLIGHT	GREEN BOX AROUND MODE ANNUNCIATION FOR TEN SEC AFTER CHANGE TO VALID MODE
	PITCH LIMIT	YELLOW SYMBOL. READOUT AGAINST PITCH SCALE. BOTTOM EDGE OF SYMBOL INDICATES PITCH MARGIN TO STICKSHAKER. (SWC).
WINDSHEAR	WINDSHEAR WARN	RED DISPLAY FOR DETECTED WINDSHEAR CONDITION (GPWS)

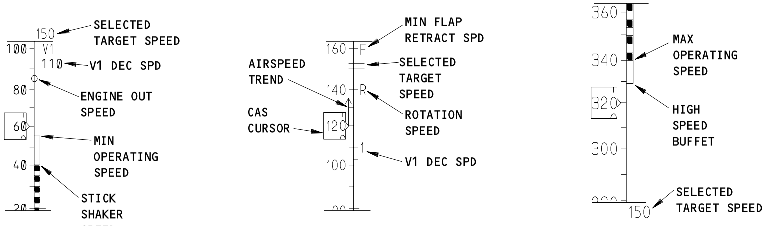
EFIS EADI Display - Component Detail
Figure 2B

A76162

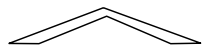
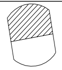
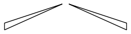
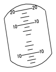


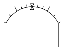
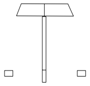
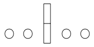
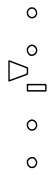
EADI DISPLAY (EXAMPLE)



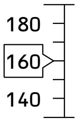
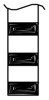
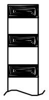
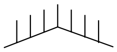


AIRSPEED DISPLAY SYMBOLS

SYMBOL	NAME	REMARKS
	AIRPLANE	WHITE AIRPLANE ATTITUDE REFERENCE PRODUCED BY EFIS SYMBOL GENERATOR.
	SKY/GROUND/HORIZON LINE	CYAN SKY AND YELLOW GROUND PRODUCED BY EFIS SYMBOL GENERATOR. SKY/GROUND MOVEMENT AND WHITE HORIZON LINE PRODUCED BY IRS DATA.
	INTEGRATED CUE FLIGHT DIRECTOR	MAGENTA SYMBOL PRODUCED BY FCC DATA. DISPLAYED WITH FD SWITCH ON AND VALID STEERING COMMANDS AVAILABLE. ALSO DISPLAYED WHEN T/O GO-AROUND SW ACTIVATED IN WINDSHEAR CONDITION, EVEN WITH FD SWITCH OFF.
	PITCH SCALE	WHITE (±90°) PRODUCED BY IRS DATA. 0° INDICATED BY HORIZON LINE

SYMBOL	NAME	REMARKS
	ROLL SCALE, POINTER AND INDEX	WHITE SCALE (±60°), POINTER AND INDEX POINTER MOVEMENT PRODUCED FROM IRS DATA. SCALE AND INDEX PRODUCED BY EFIS SYMBOL GENERATOR.
	EXPANDED LOC SCALE AND POINTER AND RISING RUNWAY	WHITE SCALE, MAGENTA POINTER AND STEM, AND GREEN RISING RUNWAY. FOR VALID ILS DATA, THE STANDARD LOC DISPLAY WILL APPEAR UNTIL THE FOLLOWING CONDITIONS ARE MET: 1. LOC DEVIATION <5/8 DOT; 2. AFDS LOC OR ROLLOUT MODE IS ENGAGED/OPERATIVE. THESE CONDITIONS CAUSE THE EXPANDED LOC SCALE TO APPEAR. THE SYMBOL WILL REVERT BACK TO THE STANDARD DISPLAY IF BOTH AFDS MODES ARE DISENGAGED AND THE GROUND SPEED <30 KNOTS OR RA >200 FT. LOC SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING. THE RISING RUNWAY DISPLAYS A REPRESENTATIVE RA OF 0 TO 200 FT. VERTICAL MOVEMENT IS CONTROLLED BY THE RA SYSTEM. LATERAL MOVEMENT IS CONTROLLED BY THE ILS. ZERO FT RA IS INDICATED WHEN THE RUNWAY TOUCHES THE AIRPLANE SYMBOL.
	STANDARD LOC SCALE AND POINTER	
	GLIDE SLOPE SCALE AND POINTER	WHITE SCALE AND MAGENTA POINTER. SCALE PRODUCED BY EFIS SYMBOL GENERATOR. POINTER DISPLAYED WHEN VALID ILS DATA IS RECEIVED. POINTER REMOVED FOR NCD AND FOR BACK COURSE OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS >90°. SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING (ILS).
DH100 1750	NUMERICAL DECISION HEIGHT AND RA DISPLAY	GREEN DECISION HEIGHT SELECTED ON EFIS CONTROL PANEL. WHITE RA (-20 TO +2500 FT) FROM RADIO ALTIMETER SYSTEM (EFIS CP/RA)
DH 110	DH ALERT	YELLOW ALERT WHEN RA≤DH. DISPLAY FLASHES FOR INITIAL 3 SECONDS OF ALERT. ALERT CAN BE CANCELLED MANUALLY FROM EFIS CP OR CANCELS AUTOMATICALLY WHEN RA=0 OR RA=DH+75 (EFIS CP/RA).
GS 250	GROUND SPEED	WHITE DISPLAY OF CALCULATED GROUND SPEED (KNOTS) (FMC, IRS)
FD	AFDS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE (AFDS)
LOC	ROLL MODE ARMED	WHITE DISPLAY FOR ARMED ROLL MODE (AFDS)
G/S	PITCH MODE ARMED	WHITE DISPLAY FOR ARMED PITCH MODE (AFDS)
LNAV	ROLL MODE ENGAGED	GREEN DISPLAY FOR ENGAGED ROLL MODE (AFDS)
VNAV	PITCH MODE ENGAGED	GREEN DISPLAY FOR ENGAGED PITCH MODE (AFDS)
SPD	A/T MODE	GREEN DISPLAY FOR A/T MODE (TMS)
▭	MODE CHANGE HIGHLIGHT	GREEN BOX AROUND MODE ANNUNCIATION FOR TEN SEC AFTER CHANGE TO VALID MODE
ALT	H ALERT	WHITE DISPLAY AT 500 FT < RA ≤ 2500 FT

EFIS EADI Display - Component Detail
Figure 2C (Sheet 1)

SYMBOL	NAME	REMARKS
	AIRSPEED TAPE AND ROLLING DIGIT CAS CURSOR	WHITE AIRSPEED TAPE MOVES AGAINST FIXED WHITE CAS CURSOR WITH ROLLING DIGITS. SPEED SCALE NUMBERS ALSO ARE IN WHITE. SPEED SCALE BELOW 30 KTS IS BLANK. WHEN THE SPEED IS EQUAL TO OR LESS THAN 30 KTS (OR NCD), THE TAPE INDICATES 30 KTS. (ADC)
.765	MACH DISPLAY	CURRENT MACH NUMBER COMPUTED BY ADC, DISPLAYED BY WHITE NUMERICS. DISPLAYED FOR MACH ≥ 0.400.
 250	SELECTED TARGET SPEED	MAGENTA INDEX PLACED AGAINST RESPECTIVE READING ON AIRSPEED TAPE. REPLACED BY MAGENTA THREE-DIGIT DISPLAY WHEN SELECTED TARGET SPEED IS OFF-SCALE. DIGITAL DISPLAY IS PLACED IMMEDIATELY BELOW AIRSPEED TAPE FOR A VALUE LESS THAN THE CURRENT SPEED AND ABOVE AIRSPEED TAPE FOR A VALUE GREATER THAN THE CURRENT SPEED. MOTION CONTROL IS FROM AFDS-MCP.
	MAXIMUM OPERATING SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE INDICATES MAX. OPERATING SPEED. (SWC)
	HIGH SPEED BUFFET	YELLOW BAND PLACED ALONGSIDE UPPER PORTION OF AIRSPEED TAPE. BOTTOM EDGE REPRESENTS THE SPEED WHERE THE AIRPLANE WOULD ENCOUNTER BUFFETING OR THE FLAPS SHOULD BE EXTENDED (SWC)
-1 V1 140	DECISION SPEED (V1)	GREEN SYMBOL "-1" IS PLACED AGAINST AIRSPEED TAPE. IF OFF SCALE, THIS INDICATION IS REPLACED BY DISPLAY "V1" AND V1 SPEED VALUE ON THE LINE BELOW, INSIDE THE TOP OF THE AIRSPEED TAPE. (FMC)
-F	MINIMUM FLAP RETRACTION SPEED	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE. (SWC)
-R	ROTATION SPEED (VR)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE (FMC)
-R	APPROACH REFERENCE SPEED (V REF)	GREEN SYMBOL PLACED AGAINST AIRSPEED TAPE DURING LANDING. (FMC)
	MINIMUM OPERATING SPEED	YELLOW BAND PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. UPPER EDGE INDICATES MIN OPERATING SPEED. (SWC)
	STICK SHAKER SPEED	RED/BLACK SYMBOL PLACED ALONGSIDE LOWER PORTION OF AIRSPEED TAPE. TOP EDGE INDICATES STICK SHAKER SPEED. (SWC)
	ENGINE OUT OPERATING SPEED	CYAN SYMBOL PLACED ACROSS AIRSPEED TAPE. (SWC)
	AIRSPEED TREND	GREEN SYMBOL PLACED LEFT AND ALONGSIDE OF AIRSPEED TAPE. LENGTH OF SYMBOL IS PROPORTIONAL TO TREND VALUE. ARROWHEAD TIP INDICATES PROJECTED AIRSPEED AFTER 10 SEC. ARROW POINTS UPWARD FOR ACCELERATION, DOWNWARD FOR DECELERATION. IF TREND IS < 3.5 KTS, SYMBOL IS REMOVED. IF TREND IS > 4.5 KTS, SYMBOL IS DISPLAYED. IF TREND IS ≥ 42 KTS, 42 KT TREND IS INDICATED.
	PITCH LIMIT	YELLOW SYMBOL. READOUT AGAINST PITCH SCALE. BOTTOM EDGE OF SYMBOL INDICATES PITCH MARGIN TO STICKSHAKER. (SWC)
WINDSHEAR	WINDSHEAR WARN	RED DISPLAY FOR DETECTED WINDSHEAR CONDITION (GPWS)

EFIS EADI Display - Component Detail
Figure 2C (Sheet 2)

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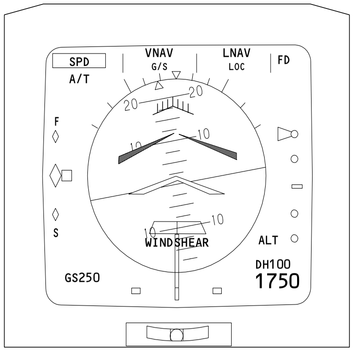
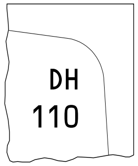
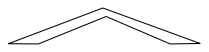
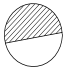
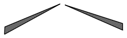
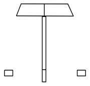
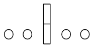
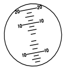
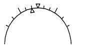
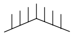


EADI DISPLAY (EXAMPLE)



SYMBOL	NAME	REMARKS
	AIRPLANE	WHITE AIRPLANE ATTITUDE REFERENCE PRODUCED BY EFIS SYMBOL GENERATOR.
	SKY/GROUND/HORIZON LINE	CYAN SKY AND YELLOW GROUND PRODUCED BY EFIS SYMBOL GENERATOR. SKY/GROUND MOVEMENT AND WHITE HORIZON LINE PRODUCED BY IRS DATA.
	FILLED INTEGRATED CUE FLIGHT DIRECTOR	MAGENTA SYMBOL PRODUCED BY FCC DATA. DISPLAYED W/ FD SWITCH ON AND VALID STEERING COMMANDS AVAILABLE. ALSO DISPLAYED WHEN T/O GO AROUND SW ACTIVATED IN WINDSHEAR CONDITION, EVEN WITH FD SWITCH OFF.
	EXPANDED LOC SCALE AND POINTER AND RISING RUNWAY	WHITE SCALE, MAGENTA POINTER AND STEM, AND GREEN RISING RUNWAY. FOR VALID ILS DATA, THE STANDARD LOC DISPLAY WILL APPEAR UNTIL THE FOLLOWING CONDITIONS ARE MET: 1. LOC DEVIATION <5/8 DOT; 2. AFDS LOC OR ROLLOUT MODE IS ENGAGED/OPERATIVE. THESE CONDITIONS CAUSE THE EXPANDED LOC SCALE TO APPEAR. THE SYMBOL WILL REVERT BACK TO THE STANDARD DISPLAY IF BOTH AFDS MODES ARE DISENGAGED AND THE GROUND SPEED <30 KNOTS OR RA >200 FT. LOC SCALE CHANGES TO YELLOW AND POINTER FLASHES DURING ILS DEVIATION WARNING. THE RISING RUNWAY DISPLAYS A REPRESENTATIVE RA OF 0 TO 200 FT. VERTICAL MOVEMENT IS CONTROLLED BY THE RA SYSTEM. LATERAL MOVEMENT IS CONTROLLED BY THE ILS. ZERO FT RA IS INDICATED WHEN THE RUNWAY TOUCHES THE AIRPLANE SYMBOL (ILS, RA)
	STANDARD LOC SCALE AND POINTER	
	PITCH SCALE	WHITE (±90°) PRODUCED BY IRS DATA. 0° INDICATED BY HORIZON LINE
	ROLL SCALE, POINTER AND INDEX	WHITE SCALE (±60°), POINTER AND INDEX POINTER MOVEMENT PRODUCED FROM IRS DATA. SCALE AND INDEX PRODUCED BY EFIS SYMBOL GENERATOR.

SYMBOL	NAME	REMARKS
	G/S SCALE AND POINTER	WHITE SCALE AND MAGENTA POINTER. SCALE PRODUCED BY EFIS SYMBOL GENERATOR. POINTER DISPLAYED WHEN VALID ILS DATA IS RECEIVED. POINTER REMOVED FOR NCD AND FOR BACK COURSE OPERATION OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNNING HEADING IS >90°. SCALE CHANGES TO YELLOW AND THE POINTER FLASHES DURING ILS DEVIATION WARNING
	SPEED DEVIATION SCALE AND POINTER	WHITE SCALE (±10 KNOTS) AND MAGENTA POINTER DISPLAYS DEVIATION FROM SELECTED TMS LIMITED AIRSPEED. THE POINTER GOES OUT OF VIEW DURING GO AROUND.
DH100 1750	NUMERICAL DECISION HEIGHT AND RA DISPLAY	GREEN DECISION HEIGHT SELECTED ON EFIS CONTROL PANEL. WHITE RA (+1000 TO +2500 FT) FROM RADIO ALTIMETER SYSTEM. (EFIS CP/RA)
DH 110	DH ALERT	YELLOW ALERT WHEN RA ≤DH. DISPLAY FLASHES FOR INITIAL 3 SEC OF ALERT. ALERT CANCELLED MANUALLY FROM EFIS CP OR CANCELS AUTOMATICALLY WHEN RA = 0 OR RA = DH+75 (EFIS CP/RA)
GS250	GROUND SPEED	WHITE DISPLAY OF CALCULATED GROUND SPEED. (KNOTS) (FMC, IRS)
FD	AFDS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE. (AFDS)
LOC	ROLL MODE ARMED	WHITE DISPLAY FOR ARMED ROLL MODE. (AFDS)
G/S	PITCH MODE ARMED	WHITE DISPLAY FOR ARMED PITCH MODE. (AFDS)
LNAV	ROLL MODE ENGAGED	GREEN DISPLAY FOR ENGAGED ROLL MODE. (AFDS)
VNAV	PITCH MODE ENGAGED	GREEN DISPLAY FOR ENGAGED PITCH MODE. (AFDS)
SPD	A/T MODE	GREEN DISPLAY FOR A/T MODE. (TMS)
A/T	TMS STATUS MODE	GREEN DISPLAY FOR ENGAGED MODE. (TMS)
☐	MODE CHANGE HIGHLIGHT	GREEN BOX AROUND MODE ANNUNCIATION FOR TEN SEC AFTER CHANGE TO VALID MODE.
ALT	H ALERT	WHITE DISPLAY AT 500 FT < RA ≤ 2500 FT
	PITCH LIMIT	YELLOW SYMBOL. READOUT AGAINST PITCH SCALE. BOTTOM EDGE OF SYMBOL INDICATES PITCH MARGIN TO STICKSHAKER (SWC)
WINDSHEAR	WINDSHEAR WARN	RED DISPLAY FOR DETECTED WINDSHEAR CONDITION (GPWS)

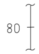
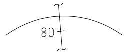
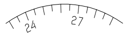
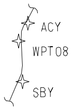
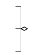
EFIS EADI Display - Component Detail
Figure 2D

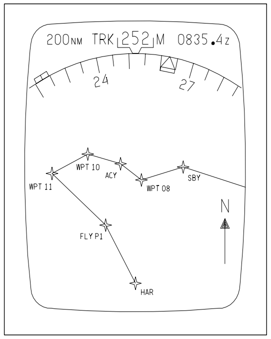
(3) GUI 001-114, 116-999;
The EHSI is also used for the WXR display in the MAP, VOR, and ILS modes.

(4) The left and right EHSIs are located on the captain's (P1) and first officer's (P3) instrument panels, respectively. The EHSI has a display area of approximately 5 x 6 inches.

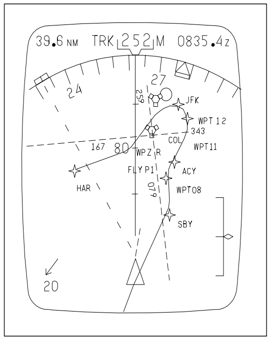
(5) MAP and PLAN Modes (Fig. 3)
- (a) The PLAN mode is used in conjunction with the FMC CDU for flight path planning. This mode is displayed in a north up presentation. It can be utilized for inflight changes in a planned route. Generally though, it is used in pre-flight route planning.
- (b) The MAP mode is used to display present position of the airplane during flight. It displays, in a map format, active flight plan, ground stations (waypoints, VOR stations, airports, navigation aids, etc.), and other flight parameters. It also displays heading, track, windspeed and direction, and other selectable data.
- (c) GUI 001-114, 116-999;
  This mode is displayed in a track-up presentation.
- (d) GUI 115;
  This mode is displayed in a heading-up presentation.

(6) VOR and ILS Modes (Fig. 4)
- (a) The VOR mode is used when flying to VOR ground stations. This mode displays heading-up orientation from desired flight path. It also displays heading data, track data, and flight data text.
  - 1) GUI 001-114, 116-999;
    The VOR mode displays about 70 degrees of arc and WXR when selected.
  - 2) GUI 115;
    The EXP-VOR mode displays about 70 degrees of arc and WXR when selected. The FULL-VOR mode displays a full 360 degrees of arc and no WXR data.
- (b) The ILS mode is used during ILS landing approaches. The display is similar to the VOR mode. It displays heading-up ILS deviations, heading information, track information and flight parameters in text.
  - 1) GUI 001-114, 116-999;
    The ILS mode displays about 70 degrees of arc and WXR when selected.
  - 2) GUI 115;
    The EXP-ILS mode displays about 70 degrees of arc and WXR when selected. The FULL-ILS mode displays a full 360 degrees of arc and no WXR data.

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	MAP	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	CURVED TREND VECTOR	WHITE	MAP	THE THREE SEGMENT CURVE PREDICTS DIRECTIONAL TREND. IT IS BASED ON PRESENT POSITION, GROUND SPEED AND CROSSTRACK ACCELERATION AT THE END OF 30, 60 AND 90 SECOND INTERVALS. [IRS/EFIS/FMC]
	PRESENT TRACK, STRAIGHT TREND, AND RANGE SCALE	WHITE	MAP	MAGNETIC TRACK WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. DISPLAYED RANGE IS ONE-HALF THE ACTUAL SELECTED RANGE. [EFIS/FMC]
TRK 252 M	TRACK - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (TRK, TRU AND M) WHITE - (TRK BOX, TRU BOX, AND NUM.) AMBER - (TRU BOX)	MAP, PLAN	NUMBER UNDER POINTER IS A TRACK. BOX DISPLAYS ACTUAL TRACK. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG AT TYPICAL OPERATIONAL LATITUDES, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
TRK 252 TRU	TRACK - ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
39.6 NM	DISTANCE DISPLAY	WHITE	MAP, PLAN	DISTANCE TO NEXT FMC WAYPOINT (NM). [FMC]
0835.4Z	ETA DISPLAY	WHITE	MAP, PLAN	INDICATES TIME TO NEXT ACTIVE WAYPOINT. [FMC]
	RANGE-TO-ALTITUDE ARC (NOT SHOWN)	GREEN	MAP	CURVED ARC REPRESENTS THE POINT WHERE THE REFERENCE ALTITUDE WILL BE REACHED IF CURRENT VERTICAL & LATERAL FLIGHT PATH ANGLES ARE MAINTAINED. [FMC]
	EXPANDED COMPASS ROSE	WHITE	MAP, PLAN	COMPASS DATA IS PROVIDED BY THE SELECTED FMC. 360° ARE AVAILABLE BUT APPROXIMATELY 70° ARE DISPLAYED. [FMC/IRS]
	SELECTED HEADING MARKER AND LINE	MAGENTA	MAP, PLAN	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. [FCC]
	PRESENT HEADING MARKER	WHITE	MAP, PLAN	DISPLAYED WHEN SELECTED MODE HAS TRK UP ORIENTATION. [IRS]
	WINDSPEED AND DIRECTION	WHITE	MAP	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE MAP DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	ROUTE	ACTIVE - MAGENTA INACTIVE - WHITE CHANGES - CYAN	MAP, PLAN	THE ACTIVE ROUTE IS DISPLAYED WITH CONTINUOUS LINES BETWEEN WAYPOINTS. INACTIVE ROUTES ARE DISPLAYED WITH LONG DASHES BETWEEN WAYPOINTS. CHANGES TO THE ACTIVE ROUTE ARE DISPLAYED WITH SHORT DASHES BETWEEN WAYPOINTS. WHEN A CHANGE IS ACCEPTED IN THE FMC, THE SHORT DASHES ARE REPLACED WITH A CONTINUOUS LINE. [FMC].
	WAYPOINT	—	MAP, PLAN	CONDITIONAL WAYPOINTS - WHITE. ACTIVE WAYPOINTS - MAGENTA. IDENTIFIER LISTED BELOW - RIGHT [FMC]
	VERTICAL DEVIATION SCALE AND POINTER	WHITE - SCALE MAGENTA - POINTER	MAP	DISPLAYS VERTICAL DEVIATION FROM SELECTED VERTICAL PROFILE IN MAP MODE. FULL SCALE EQUALS 400 FEET DEVIATION. [FMC]

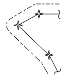
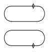
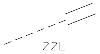
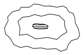
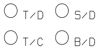


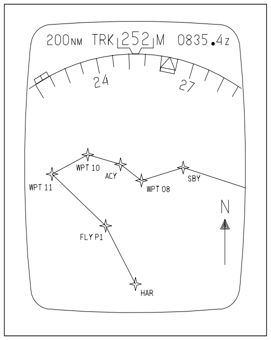
EHSI DISPLAY (PLAN MODE)



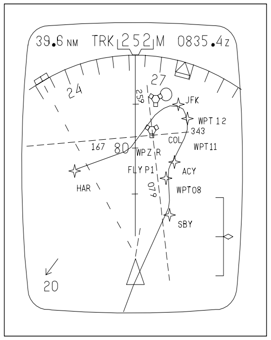
EHSI DISPLAY (MAP MODE)

EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3 (Sheet 1)

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	OFFSET PATH (NOT SHOWN)	MAGENTA	MAP, PLAN	WHEN AN OFFSET PATH AND AFFECT DISTANCE IS SELECTED ON THE FMC CDU, A DOT-DASH LINE IS DISPLAYED PARELLEL TO AND OFFSET BY THE DESIRED DISTANCE FROM THE ACTIVE FLIGHT PLAN. [FMC]
	MARKER BEACON (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	NONDIRECTIONAL BEACON (NDB) (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	HOLDING PATTERN (NOT SHOWN)	[2]	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A HOLDING PATTERN. [FMC]
	PROCEDURE TURN (NOT SHOWN)	[2]	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A PROCEDURE FORM. [FMC]
	AIRPORT AND RUNWAY (NOT SHOWN)	WHITE	MAP, PLAN	SELECTED ON FMC CDU; WHEN EHSI RANGE IS 80,160, OR 320 NM. [FMC]
		WHITE		SELECTED ON FMC CDU; WHEN EHSI RANGE IS 10,20, OR 40 NM. [FMC]
	WEATHER RADAR RETURNS (NOT SHOWN)	GREEN YELLOW RED	MAP	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR] [1]
	ALTITUDE PROFILE POINTS (NOT SHOWN)	GREEN	MAP	CALCULATED BY FMC T/D (TOP-OF-DESCENT), T/C (TOP-OF-CLIMB) S/C (STEP CLIMB), B/D (BOTTOM-OF-DESCENT. [FMC]
	NORTH-UP POINTER	GREEN	PLAN	NOTES PLAN MODE IS NORTH UP PRESENTATION. [EFIS]
	AIRPORT	WHITE	MAP	SUITABLE AIRPORTS DISPLAYED WHEN APRT SWITCH IS ON. [FMC] [1]
	ROUTE DATA (NOT SHOWN)	WHITE	MAP	ALT AND ETA FOR ACTIVE WAYPOINTS DISPLAYED WHEN RTE DATA SWITCH ON [FMC] [1]
	NAVAIDS, VOR, DME/TACAN, VOR TAC	WHITE	MAP	NONFLIGHT PLAN NAVAIDS DISPLAYED WHEN NAV AID SWITCH ON. [FMC] [1]
	WAYPOINT (NOT SHOWN)	WHITE	MAP	NONFLIGHT PLAN WAYPOINTS DISPLAYED WHEN WPT SWITCH ON. [FMC] [1]
	SELECTED REFERENCE POINT (NOT SHOWN)	GREEN	MAP	DISPLAYED AS A SELECTED REFERENCE POINT (FIX) VIA THE FMC CDU FIX KEY. CAN BE WITH ANY NUMBER OF SPECIAL MAP SYMBOLS (i.e. VOR,VORTAC, AIRPOINT OR WAYPOINT, ETC.). [FMC]



EHSI DISPLAY (PLAN MODE)



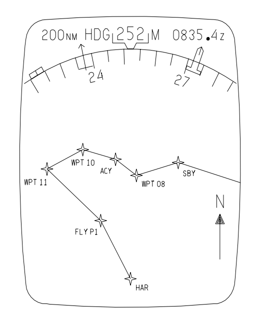
EHSI DISPLAY (MAP MODE)

[1] WXR ON, ARPT, RTE DATA, NAVAID, AND WPT SELECT SWITCHES LOCATED ON EFIS CONTROL PANEL

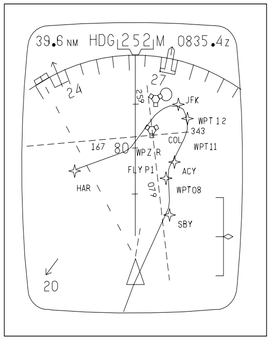
[2] COLORS MATCH ROUTE COLORS (SEE SHEET 1)

EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3 (Sheet 2)

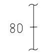
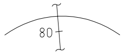
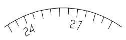
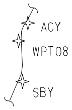
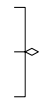
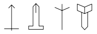
141184



EHSI DISPLAY (PLAN MODE)

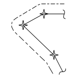
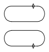
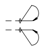
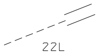
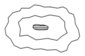
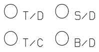


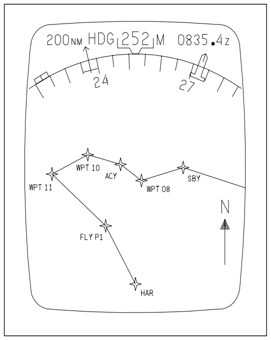
EHSI DISPLAY (MAP MODE)

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	MAP	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	CURVED TREND VECTOR	WHITE	MAP	THE THREE SEGMENT CURVE PREDICTS DIRECTIONAL TREND. IT IS BASED ON PRESENT POSITION, GROUND SPEED AND CROSSTRACK ACCELERATION AT THE END OF 30, 60 AND 90 SECOND INTERVALS. [IRS/EFIS/FMC]
	PRESENT TRACK, STRAIGHT TREND, AND RANGE SCALE	WHITE	MAP	MAGNETIC TRACK WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. DISPLAYED RANGE IS ONE-HALF THE ACTUAL SELECTED RANGE. [EFIS/FMC]
HDG 252 M	HEADING - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (HDG, TRU AND M) WHITE - (HDG BOX, TRU BOX, AND NUM.) AMBER - (TRU BOX)	MAP, PLAN	NUMBER UNDER POINTER IS A HEADING. BOX DISPLAYS ACTUAL HEADING. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG BETWEEN 70 DEGREES N AND 60 DEGREES S, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
HDG 252 TRU	HEADING - ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
39.6 NM	DISTANCE DISPLAY	WHITE	MAP, PLAN	DISTANCE TO NEXT FMC WAYPOINT (NM). [FMC]
0835.4Z	ETA DISPLAY	WHITE	MAP, PLAN	INDICATES TIME TO NEXT ACTIVE WAYPOINT. [FMC]
	RANGE-TO-ALTITUDE ARC (NOT SHOWN)	GREEN	MAP	CURVED ARC REPRESENTS THE POINT WHERE THE REFERENCE ALTITUDE WILL BE REACHED IF CURRENT VERTICAL & LATERAL FLIGHT PATH ANGLES ARE MAINTAINED. [FMC]
	EXPANDED COMPASS ROSE	WHITE	MAP, PLAN	COMPASS DATA IS PROVIDED BY THE SELECTED FMC. 360° ARE AVAILABLE BUT APPROXIMATELY 70° ARE DISPLAYED. [FMC/IRS]
	SELECTED HEADING MARKER AND LINE	MAGENTA	MAP, PLAN	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. [FCC]
	WINDSPEED AND DIRECTION	WHITE	MAP	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE MAP DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	ROUTE	ACTIVE - MAGENTA INACTIVE - WHITE CHANGES - CYAN	MAP, PLAN	THE ACTIVE ROUTE IS DISPLAYED WITH CONTINUOUS LINES BETWEEN WAYPOINTS. INACTIVE ROUTES ARE DISPLAYED WITH LONG DASHES BETWEEN WAYPOINTS. CHANGES TO THE ACTIVE ROUTE ARE DISPLAYED WITH SHORT DASHES BETWEEN WAYPOINTS. WHEN A CHANGE IS ACCEPTED IN THE FMC, THE SHORT DASHES ARE REPLACED WITH A CONTINUOUS LINE. [FMC].
	WAYPOINT	—	MAP, PLAN	CONDITIONAL WAYPOINTS - WHITE. ACTIVE WAYPOINTS - MAGENTA. IDENTIFIER LISTED BELOW - RIGHT [FMC]
	VERTICAL DEVIATION SCALE AND POINTER	WHITE - SCALE MAGENTA - POINTER	MAP	DISPLAYS VERTICAL DEVIATION FROM SELECTED VERTICAL PROFILE IN MAP MODE. FULL SCALE EQUALS 400 FEET DEVIATION. [FMC]
	ADF BEARING POINTERS L,R,L(RECIP),R(RECIP)	GREEN	MAP, PLAN	DIRECTION TO/FROM SELECTED L(R) ADF STATION (ADF)

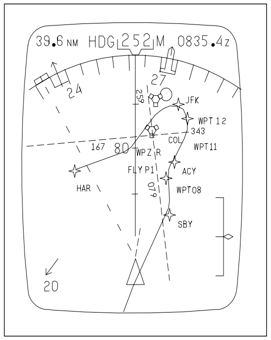
EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3A (Sheet 1)

A75408

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	OFFSET PATH (NOT SHOWN)	MAGENTA	MAP, PLAN	WHEN AN OFFSET PATH AND AFFECT DISTANCE IS SELECTED ON THE FMC CDU, A DOT-DASH LINE IS DISPLAYED PARELLEL TO AND OFFSET BY THE DESIRED DISTANCE FROM THE ACTIVE FLIGHT PLAN. [FMC]
	MARKER BEACON (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	NONDIRECTIONAL BEACON (NDB) (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	HOLDING PATTERN (NOT SHOWN)	[2]	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A HOLDING PATTERN. [FMC]
	PROCEDURE TURN (NOT SHOWN)	[2]	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A PROCEDURE FORM. [FMC]
	AIRPORT AND RUNWAY (NOT SHOWN)	WHITE	MAP, PLAN	SELECTED ON FMC CDU; WHEN EHSI RANGE IS 80,160, OR 320 NM. [FMC]
		WHITE		SELECTED ON FMC CDU; WHEN EHSI RANGE IS 10,20, OR 40 NM. [FMC]
	WEATHER RADAR RETURNS (NOT SHOWN)	GREEN YELLOW RED	MAP	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR] [1]
	ALTITUDE PROFILE POINTS (NOT SHOWN)	GREEN	MAP	CALCULATED BY FMC T/D (TOP-OF-DESCENT), T/C (TOP-OF-CLIMB) S/C (STEP CLIMB), B/D (BOTTOM-OF-DESCENT. [FMC]
	NORTH-UP POINTER	GREEN	PLAN	NOTES PLAN MODE IS NORTH UP PRESENTATION. [EFIS]
	AIRPORT	WHITE	MAP	SUITABLE AIRPORTS DISPLAYED WHEN APRT SWITCH IS ON. [FMC] [1]
	ROUTE DATA (NOT SHOWN)	WHITE	MAP	ALT AND ETA FOR ACTIVE WAYPOINTS DISPLAYED WHEN RTE DATA SWITCH ON [FMC] [1]
	NAVAIDS, VOR, DME/TACAN, VOR TAC	WHITE	MAP	NONFLIGHT PLAN NAVAIDS DISPLAYED WHEN NAV AID SWITCH ON. [FMC] [1]
	WAYPOINT (NOT SHOWN)	WHITE	MAP	NONFLIGHT PLAN WAYPOINTS DISPLAYED WHEN WPT SWITCH ON. [FMC] [1]
	SELECTED REFERENCE POINT (NOT SHOWN)	GREEN	MAP	DISPLAYED AS A SELECTED REFERENCE POINT (FIX) VIA THE FMC CDU FIX KEY. CAN BE WITH ANY NUMBER OF SPECIAL MAP SYMBOLS (i.e. VOR,VORTAC, AIRPOINT OR WAYPOINT, ETC.). [FMC]



EHSI DISPLAY (PLAN MODE)



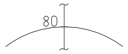
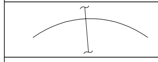
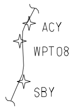
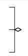
EHSI DISPLAY (MAP MODE)

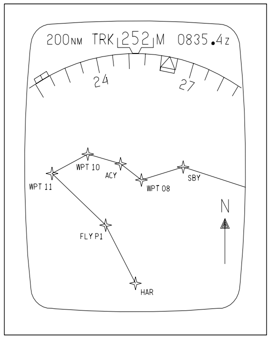
[1] WXR ON, ARPT, RTE DATA, NAVAID, AND WPT SELECT SWITCHES LOCATED ON EFIS CONTROL PANEL

[2] COLORS MATCH ROUTE COLORS (SEE SHEET 1)

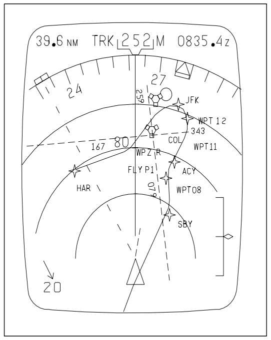
EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3A (Sheet 2)

A75413

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	MAP	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	CURVED TREND VECTOR	WHITE	MAP	THE THREE SEGMENT CURVE PREDICTS DIRECTIONAL TREND. IT IS BASED ON PRESENT POSITION, GROUND SPEED AND CROSSTRACK ACCELERATION AT THE END OF 30, 60 AND 90 SECOND INTERVALS. [IRS/EFIS/FMC]
	PRESENT TRACK, STRAIGHT TREND, AND RANGE ARCS AND SCALE	WHITE	MAP	MAGNETIC TRACK WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. DISPLAYED RANGE IS ONE-HALF THE ACTUAL SELECTED RANGE. [EFIS/FMC]
	TRACK - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (TRK, TRU AND M) WHITE - (TRK BOX, TRU BOX, AND NUM.) AMBER - (TRU BOX)	MAP, PLAN	NUMBER UNDER POINTER IS A TRACK. BOX DISPLAYS ACTUAL TRACK. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG BETWEEN 70 DEGREES N AND 60 DEGREES S, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
	TRACK - ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
39.6 NM	DISTANCE DISPLAY	WHITE	MAP, PLAN	DISTANCE TO NEXT FMC WAYPOINT (NM). [FMC]
0835.4z	ETA DISPLAY	WHITE	MAP, PLAN	INDICATES TIME TO NEXT ACTIVE WAYPOINT. [FMC]
	RANGE-TO-ALTITUDE ARC (NOT SHOWN)	GREEN	MAP	CURVED ARC REPRESENTS THE POINT WHERE THE REFERENCE ALTITUDE WILL BE REACHED IF CURRENT VERTICAL & LATERAL FLIGHT PATH ANGLES ARE MAINTAINED. [FMC]
	EXPANDED COMPASS ROSE	WHITE	MAP, PLAN	COMPASS DATA IS PROVIDED BY THE SELECTED FMC. 360° ARE AVAILABLE BUT APPROXIMATELY 70° ARE DISPLAYED. [FMC/IRS]
	SELECTED HEADING MARKER AND LINE	MAGENTA	MAP, PLAN	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. [FCC]
	PRESENT HEADING MARKER	WHITE	MAP, PLAN	DISPLAYED WHEN SELECTED MODE HAS TRK UP ORIENTATION. [IRS]
	WINDSPEED AND DIRECTION	WHITE	MAP	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE MAP DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	ROUTE	ACTIVE - MAGENTA INACTIVE - WHITE CHANGES - CYAN	MAP, PLAN	THE ACTIVE ROUTE IS DISPLAYED WITH CONTINUOUS LINES BETWEEN WAYPOINTS. INACTIVE ROUTES ARE DISPLAYED WITH LONG DASHES BETWEEN WAYPOINTS. CHANGES TO THE ACTIVE ROUTE ARE DISPLAYED WITH SHORT DASHES BETWEEN WAYPOINTS. WHEN A CHANGE IS ACCEPTED IN THE FMC, THE SHORT DASHES ARE REPLACED WITH A CONTINUOUS LINE. [FMC].
	WAYPOINT	—	MAP, PLAN	CONDITIONAL WAYPOINTS - WHITE. ACTIVE WAYPOINTS - MAGENTA. IDENTIFIER LISTED BELOW - RIGHT [FMC]
	VERTICAL DEVIATION SCALE AND POINTER	WHITE - SCALE MAGENTA - POINTER	MAP	DISPLAYS VERTICAL DEVIATION FROM SELECTED VERTICAL PROFILE IN MAP MODE. FULL SCALE EQUALS 400 FEET DEVIATION. [FMC]

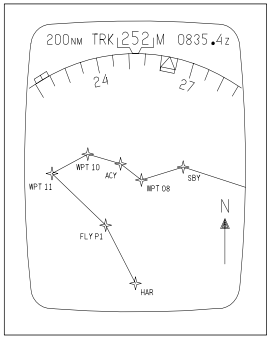


EHSI DISPLAY (PLAN MODE)

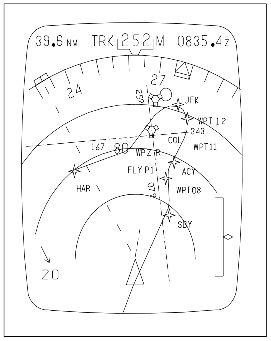


EHSI DISPLAY (MAP MODE)

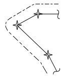
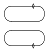
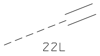
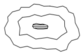
EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3B (Sheet 1)



EHSI DISPLAY (PLAN MODE)



EHSI DISPLAY (MAP MODE)

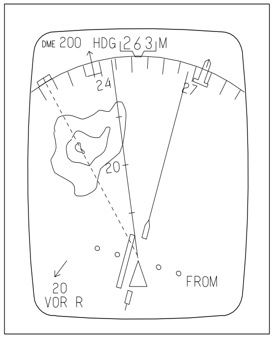
SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	OFFSET PATH (NOT SHOWN)	MAGENTA	MAP, PLAN	WHEN AN OFFSET PATH AND AFFECT DISTANCE IS SELECTED ON THE FMC CDU, A DOT-DASH LINE IS DISPLAYED PARALLEL TO AND OFFSET BY THE DESIRED DISTANCE FROM THE ACTIVE FLIGHT PLAN. [FMC]
	MARKER BEACON (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	NONDIRECTIONAL BEACON (NDB) (NOT SHOWN)	GREEN	MAP, PLAN	NAVIGATION [FMC]
	HOLDING PATTERN (NOT SHOWN)	2	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A HOLDING PATTERN. [FMC]
	PROCEDURE TURN (NOT SHOWN)	2	MAP, PLAN	DISPLAYED WHEN FMC IS ACTIVELY ENGAGED TO FOLLOW A PROCEDURE FORM. [FMC]
 KABC 22L	AIRPORT AND RUNWAY (NOT SHOWN)	WHITE	MAP, PLAN	SELECTED ON FMC CDU; WHEN EHSI RANGE IS 80,160, OR 320 NM. [FMC]
 22L		WHITE		SELECTED ON FMC CDU; WHEN EHSI RANGE IS 10,20, OR 40 NM. [FMC]
	WEATHER RADAR RETURNS (NOT SHOWN)	GREEN YELLOW RED	MAP	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR] 1
VAR/WX +12	WEATHER RADAR MODE, GAIN, AND TILT (NOT SHOWN)	GREEN	MAP	DISPLAYS WXR MODE, GAIN, AND ANTENNA TILT ANGLE WHEN WXR ON SWITCH IS PUSHED. [WXR] 1
○T/D ○S/D ○T/C ○B/D	ALTITUDE PROFILE POINTS (NOT SHOWN)	GREEN	MAP	CALCULATED BY FMC T/D (TOP-OF-DESCENT), T/C (TOP-OF-CLIMB) S/C (STEP CLIMB), B/D (BOTTOM-OF-DESCENT). [FMC]
 N	NORTH-UP POINTER	GREEN	PLAN	NOTES PLAN MODE IS NORTH UP PRESENTATION. [EFIS]
○KTEB	AIRPORT	WHITE	MAP	SUITABLE AIRPORTS DISPLAYED WHEN APRT SWITCH IS ON. [FMC] 1
 KILMR 12000 08352	ROUTE DATA (NOT SHOWN)	WHITE	MAP	ALT AND ETA FOR ACTIVE WAYPOINTS DISPLAYED WHEN RTE DATA SWITCH ON [FMC] 1
	NAVAIDS, VOR, DME/TACAN, VOR TAC	WHITE	MAP	NONFLIGHT PLAN NAVAIDS DISPLAYED WHEN NAV AID SWITCH ON. [FMC] 1
△ MLF	WAYPOINT (NOT SHOWN)	WHITE	MAP	NONFLIGHT PLAN WAYPOINTS DISPLAYED WHEN WPT SWITCH ON. [FMC] 1
 ABC	SELECTED REFERENCE POINT (NOT SHOWN)	GREEN	MAP	DISPLAYED AS A SELECTED REFERENCE POINT (FIX) VIA THE FMC CDU FIX KEY. CAN BE WITH ANY NUMBER OF SPECIAL MAP SYMBOLS (i.e. VOR,VORTAC, AIRPOINT OR WAYPOINT, ETC.). [FMC]

1 WXR ON, APRT, RTE DATA, NAVAID, AND WPT SELECT SWITCHES LOCATED ON EFIS CONTROL PANEL

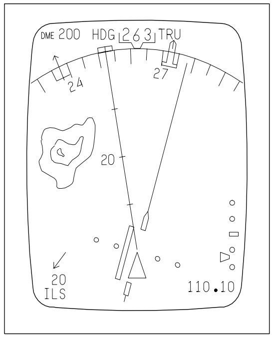
2 COLORS MATCH ROUTE COLORS (SEE SHEET 1)

EFIS EHSI (Map and Plan Modes) - Component Detail
Figure 3B (Sheet 2)

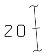
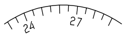
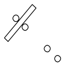
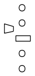
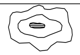
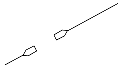
C26968



EHSI VOR-EXP MODE
(EXAMPLE)

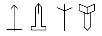
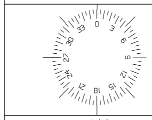
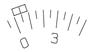
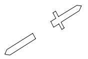


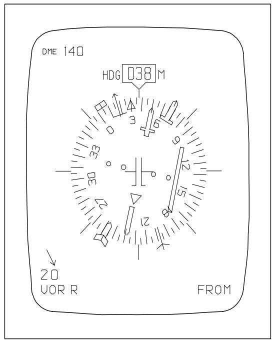
EHSI ILS-EXP MODE
(EXAMPLE)

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	VOR (EXP) ILS (EXP)	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	PRESENT TRACK LINE AND RANGE SCALE	WHITE	VOR (EXP) ILS (EXP)	MAGNETIC COURSELINE WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. [FMC,IRS]
				DISPLAYED RANGE IS ONE-HALF SELECTED RANGE. [FMC,WXR,EFIS]
HDG 263 M	HEADING - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (HDG,TRU, AND M) WHITE - (HDG BOX,TRU BOX AND NUM.) AMBER- (TRU BOX)	VOR, ILS	NUMBER UNDER POINTER IS A HEADING. BOX DISPLAYS ACTUAL HEADING. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG BETWEEN 70 DEGREES N AND 60 DEGREES S, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
HDG 263 TRU	HEADING ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
DME 200	DISTANCE DISPLAY	WHITE	VOR, ILS	DISPLAYS DISTANCE TO NEXT TUNED NAVAID [DME]
	EXPANDED COMPASS ROSE	WHITE	VOR (EXP) ILS (EXP)	COMPASS DATA IS PROVIDED BY THE SELECTED IRS. 360° ARE AVAILABLE BUT ONLY 70° ARE DISPLAYED. [IRS]
	SELECTED HEADING MARKER	MAGENTA	VOR (EXP) ILS (EXP)	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. AUTOMATICALLY REPOSITIONED TO SELECTED LOCALIZER COURSE UPON LOCALIZER CAPTURE (ILS MODE). [FCC]
	COURSE DEVIATION	WHITE - (SCALE)	VOR	WHEN THE VOR MODE IS SELECTED, VOR COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 5° DEVIATION. [VOR]
	LOCALIZER DEVIATION	MAGENTA - (BAR)	ILS	WHEN THE ILS MODE IS SELECTED, ILS COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 1-1/4° DEVIATION. [ILS]
	GLIDESLOPE DEVIATION	WHITE - (SCALE) MAGENTA - (POINTER)	ILS	DISPLAYS GLIDESLOPE DEVIATION IN ILS MODE. ONE DOT EQUALS APPROXIMATELY 0.35 DEGREES. GS POINTER REMOVED FOR BACK COURSE OPERATION OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS GREATER THAN 90 DEGREES [ILS]
	WEATHER RADAR DISPLAY	GREEN YELLOW RED	VOR (EXP) ILS (EXP)	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR]
	COURSE SELECT POINTER	MAGENTA - (LINE)	VOR (EXP)	INDICATES SELECTED VOR COURSE. [VOR]
	RUNWAY HEADING POINTER	WHITE - (POINTER)	ILS (EXP)	INDICATES SELECTED RUNWAY HEADING FOR FRONT COURSE APPROACH. [ILS]
VOR R<L>	SELECTED NAV RADIO	GREEN	VOR	DISPLAYS SELECTED NAV RADIO BASED ON EFIS CP SELECTION. [EFIS]
ILS		GREEN	ILS	
110.10	ILS FREQUENCY DISPLAY	GREEN	ILS	DISPLAYED WHEN VALID ILS FREQUENCY DATA IS BEING RECEIVED AND THE ILS PARK SIGNAL IS NOT BEING RECEIVED. [ILS]
FROM <TO>	TO/FROM ANNUNCIATOR	WHITE	VOR (EXP)	INDICATES AIRPLANE FLYING TO OR FROM THE SELECTED VOR STATION. [VOR]

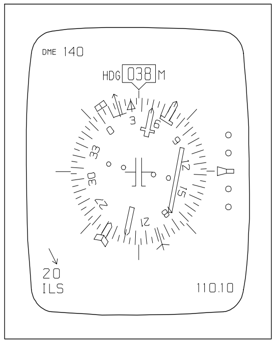
EFIS EHSI (VOR and ILS Modes) - Component Detail
Figure 4 (Sheet 1)

290411

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	WINDSPEED AND DIRECTION	WHITE	VOR, ILS	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	ADF BEARING POINTERS L,R,L(RECIP),R(RECIP)	GREEN	VOR, ILS	DIRECTION TO/FROM SELECTED L(R) ADF STATION. [ADF]
	AIRPLANE SYMBOL	WHITE	VOR (FULL) ILS (FULL)	AIRPLANE POSITION IS INDICATED BY THE SYMBOL. THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE DYNAMIC SYMBOLS. [EFIS]
	FULL COMPASS ROSE DISPLAY	WHITE	VOR (FULL) ILS (FULL)	DISPLAYS 360° OF IRS COMPASS DATA. [IRS]
	DRIFT ANGLE POINTER	WHITE	VOR (FULL) ILS (FULL)	INDICATES FMC/IRS COMPUTED DRIFT ANGLE. [FMC/IRS]
	SELECTED HEADING MARKER	MAGENTA	VOR (FULL) ILS (FULL)	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. AUTOMATICALLY REPOSITIONED TO SELECTED LOCALIZER COURSE UPON LOCALIZER CAPTURE (ILS MODE). [FCC]
	COURSE SELECT POINTER	WHITE	VOR (FULL)	INDICATES SELECTED VOR COURSE. [VOR]
	RUNWAY HEADING POINTER		ILS (FULL)	INDICATES SELECTED RUNWAY HEADING FOR FRONT COURSE APPROACH. [ILS]
▽ (△) FROM (TO)	TO/FROM ANNUNCIATOR	WHITE	VOR (FULL)	INDICATES AIRPLANE FLYING TO OR FROM THE SELECTED VOR STATION. [VOR]



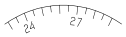
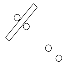
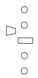
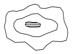
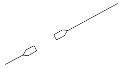
EHSI VOR-FULL MODE
(EXAMPLE)

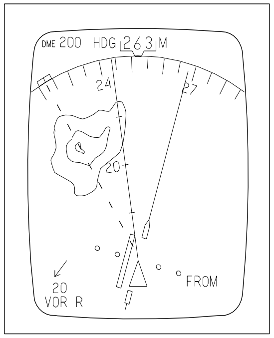


EHSI ILS-FULL MODE
(EXAMPLE)

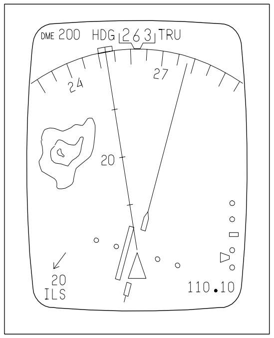
EFIS EHSI (VOR and ILS Modes) - Component Detail
Figure 4 (Sheet 2)

783070

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	VOR, ILS	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	PRESENT TRACK LINE AND RANGE SCALE	WHITE	VOR, ILS	MAGNETIC COURSELINE WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. [FMC,IRS]
				DISPLAYED RANGE IS ONE-HALF SELECTED RANGE. [FMC,WXR,EFIS]
HDG 263 M	HEADING - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (HDG,TRU, AND M) WHITE - (HDG BOX,TRU BOX AND NUM.) AMBER- (TRU BOX)	VOR, ILS	NUMBER UNDER POINTER IS A HEADING. BOX DISPLAYS ACTUAL HEADING. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG BETWEEN 70 DEGREES N AND 60 DEGREES S, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
HDG 263 TRU	HEADING ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
DME 200	DISTANCE DISPLAY	WHITE	VOR, ILS	DISPLAYS DISTANCE TO NEXT TUNED NAVAID [DME]
	EXPANDED COMPASS ROSE	WHITE	VOR, ILS	COMPASS DATA IS PROVIDED BY THE SELECTED IRS. 360° ARE AVAILABLE BUT ONLY 70° ARE DISPLAYED. [IRS]
	SELECTED HEADING MARKER	MAGENTA	VOR, ILS	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. AUTOMATICALLY REPOSITIONED TO SELECTED LOCALIZER COURSE UPON LOCALIZER CAPTURE (ILS MODE). [FCC]
	WINDSPEED AND DIRECTION	WHITE	VOR, ILS	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	COURSE DEVIATION	WHITE - (SCALE)	VOR	WHEN THE VOR MODE IS SELECTED, VOR COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 5° DEVIATION. [VOR]
	LOCALIZER DEVIATION	MAGENTA - (BAR)	ILS	WHEN THE ILS MODE IS SELECTED, ILS COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 1-1/4° DEVIATION. [ILS]
	GLIDESLOPE DEVIATION	WHITE - (SCALE) MAGENTA - (POINTER)	ILS	DISPLAYS GLIDESLOPE DEVIATION IN ILS MODE. ONE DOT EQUALS APPROXIMATELY 0.35 DEGREES. GS POINTER REMOVED FOR BACK COURSE OPERATION OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS GREATER THAN 90 DEGREES. [ILS]
	WEATHER RADAR DISPLAY	GREEN YELLOW RED	VOR, ILS	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR]
	COURSE SELECT POINTER	MAGENTA - (LINE) WHITE - (POINTER)	VOR	INDICATES SELECTED VOR COURSE. [VOR]
	RUNWAY HEADING POINTER		ILS	INDICATES SELECTED RUNWAY HEADING FOR FRONT COURSE APPROACH. [ILS]
VOR R(L)	SELECTED NAV RADIO	GREEN	VOR	DISPLAYS SELECTED NAV RADIO BASED ON EFIS CP SELECTION. [EFIS]
ILS		GREEN	ILS	
110.10	ILS FREQUENCY DISPLAY	GREEN	ILS	DISPLAYED WHEN VALID ILS FREQUENCY DATA IS BEING RECEIVED AND THE ILS PARK SIGNAL IS NOT BEING RECEIVED. [ILS]
FROM (TO)	TO/FROM ANNUNCIATOR	WHITE	VOR	INDICATES AIRPLANE FLYING TO OR FROM THE SELECTED VOR STATION. [VOR]



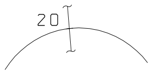
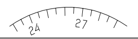
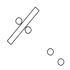
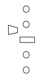
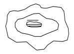
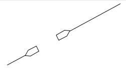
EHSI VOR MODE
(EXAMPLE)

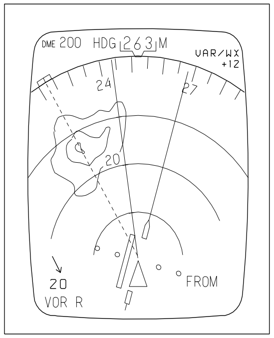


EHSI ILS MODE
(EXAMPLE)

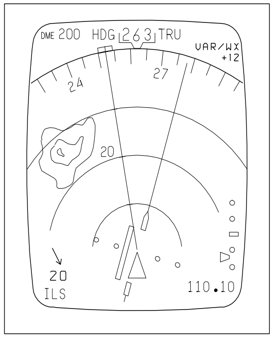
EFIS EHSI (VOR and ILS Modes) - Component Detail
Figure 4 (Sheet 3)

A75446

SYMBOL	NAME	COLOR	APPLICABLE MODE	REMARKS [SYMBOL DATA SOURCE]
	AIRPLANE SYMBOL	WHITE	VOR, ILS	AIRPLANE POSITION IS INDICATED BY THE APEX OF THE TRIANGLE. THE APEX OF THE AIRPLANE SYMBOL IS THE CENTER OF ROTATION AND TRANSLATION FOR ALL THE BACKGROUND AND DYNAMIC SYMBOLS. [EFIS]
	PRESENT TRACK LINE AND RANGE ARCS AND SCALE	WHITE	VOR ILS	MAGNETIC COURSELINE WHICH WILL RESULT WITH PRESENT HEADING AND WINDS. [FMC,IRS] RANGE ARS AND SCALE DISPLAYED WHEN WXR ON SWITCH IS PUSHED. DISPLAYED RANGE IS ONE-HALF SELECTED RANGE. [FMC,WXR,EFIS]
HDG 263 M	HEADING - ORIENTATION INDICATOR AND REFERENCE (MAG HEADING)	GREEN - (HDG,TRU, AND M) WHITE - (HDG BOX,TRU BOX AND NUM.) AMBER- (TRU BOX)	VOR, ILS	NUMBER UNDER POINTER IS A HEADING. BOX DISPLAYS ACTUAL HEADING. COMPASS HEADING IS AUTOMATICALLY SWITCHED TO MAG BETWEEN 70 DEGREES N AND 60 DEGREES S, AND TRUE AT GREATER LATITUDE. THE HEADING CAN BE MANUALLY SWITCHED TO TRUE WITH THE HDG REF SWITCH. THE M/TRU STATUS CHANGE SHOWS FOR TEN SECONDS AFTER THE CHANGE. [IRS/FMC/EFIS]
HDG 263 TRU	HEADING ORIENTATION INDICATOR AND REFERENCE (TRUE HEADING)			
DME 200	DISTANCE DISPLAY	WHITE	VOR, ILS	DISPLAYS DISTANCE TO NEXT TUNED NAVAID [DME]
	EXPANDED COMPASS ROSE	WHITE	VOR, ILS	COMPASS DATA IS PROVIDED BY THE SELECTED IRS. 360° ARE AVAILABLE BUT ONLY 70° ARE DISPLAYED. [IRS]
	SELECTED HEADING MARKER	MAGENTA	VOR, ILS	MANUALLY POSITIONED BY HEADING SELECTOR ON MCP. AUTOMATICALLY REPOSITIONED TO SELECTED LOCALIZER COURSE UPON LOCALIZER CAPTURE (ILS MODE). [FCC]
	WINDSPEED AND DIRECTION	WHITE	VOR, ILS	INDICATES WIND SPEED IN KNOTS AND WIND DIRECTION WITH RESPECT TO THE DISPLAY REFERENCE (MAGNETIC OR TRUE NORTH REFERENCE). [FMC OR IRS]
	COURSE DEVIATION	WHITE - (SCALE)	VOR	WHEN THE VOR MODE IS SELECTED, VOR COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 5° DEVIATION. [VOR]
	LOCALIZER DEVIATION	MAGENTA - (BAR)	ILS	WHEN THE ILS MODE IS SELECTED, ILS COURSE DEVIATION IS DISPLAYED. ONE DOT EQUALS 1-1/4° DEVIATION. [ILS]
	GLIDESLOPE DEVIATION	WHITE - (SCALE) MAGENTA - (POINTER)	ILS	DISPLAYS GLIDESLOPE DEVIATION IN ILS MODE. ONE DOT EQUALS APPROXIMATELY 0.35 DEGREES. GS POINTER REMOVED FOR BACK COURSE OPERATION OR WHEN THE DIFFERENCE BETWEEN AIRPLANE TRACK ANGLE AND SELECTED RUNWAY HEADING IS GREATER THAN 90 DEGREES. [ILS]
	WEATHER RADAR DISPLAY	GREEN YELLOW RED	VOR, ILS	MULTICOLORED RETURNS ARE PRESENTED WHEN EITHER WXR ON SWITCH IS PUSHED. MOST INTENSE AREAS ARE DISPLAYED IN RED. [WXR]
VAR/WX +12	WEATHER RADAR MODE, GAIN, AND TILT	GREEN	VOR, ILS	DISPLAYS WXR MODE, GAIN, AND ANTENNA TILT ANGLE WHEN WXR ON SWITCH IS PUSHED. [WXR]
	COURSE SELECT POINTER	MAGENTA - (LINE) WHITE - (POINTER)	VOR	INDICATES SELECTED VOR COURSE. [VOR]
	RUNWAY HEADING POINTER		ILS	INDICATES SELECTED RUNWAY HEADING FOR FRONT COURSE APPROACH. [ILS]
VOR R(L)	SELECTED NAV RADIO	GREEN	VOR	DISPLAYS SELECTED NAV RADIO BASED ON EFIS CP SELECTION. [EFIS]
ILS		GREEN	ILS	
110.10	ILS FREQUENCY DISPLAY	GREEN	ILS	DISPLAYED WHEN VALID ILS FREQ DATA IS BEING RECEIVED AND THE ILS PARK SIGNAL IS NOT BEING RECEIVED. [ILS]
FROM (TO)	TO/FROM ANNUNCIATOR	WHITE	VOR	INDICATES AIRPLANE FLYING TO OR FROM THE SELECTED VOR STATION. [VOR]



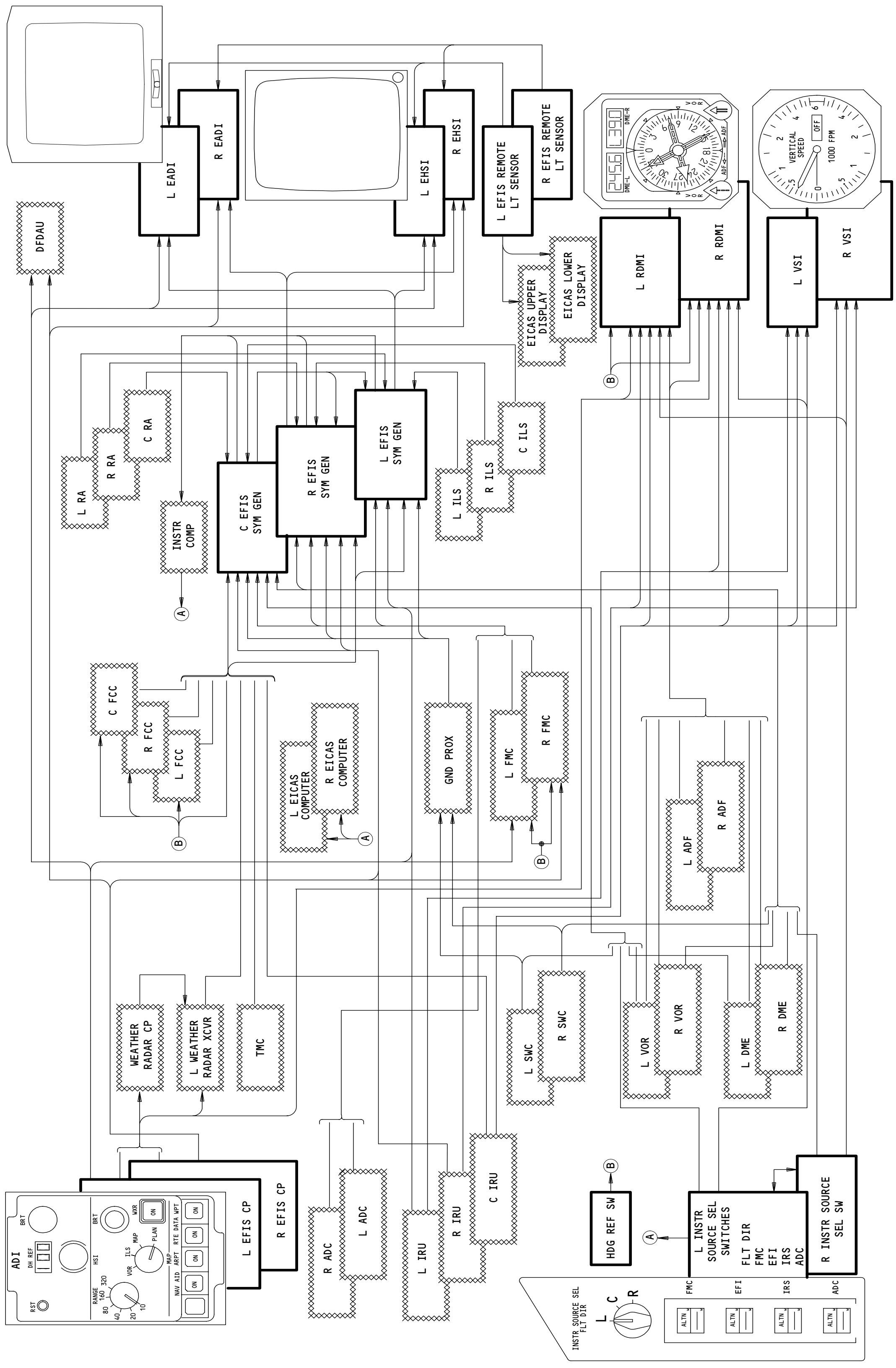
EHSI VOR-EXP MODE
(EXAMPLE)



EHSI ILS-EXP MODE
(EXAMPLE)

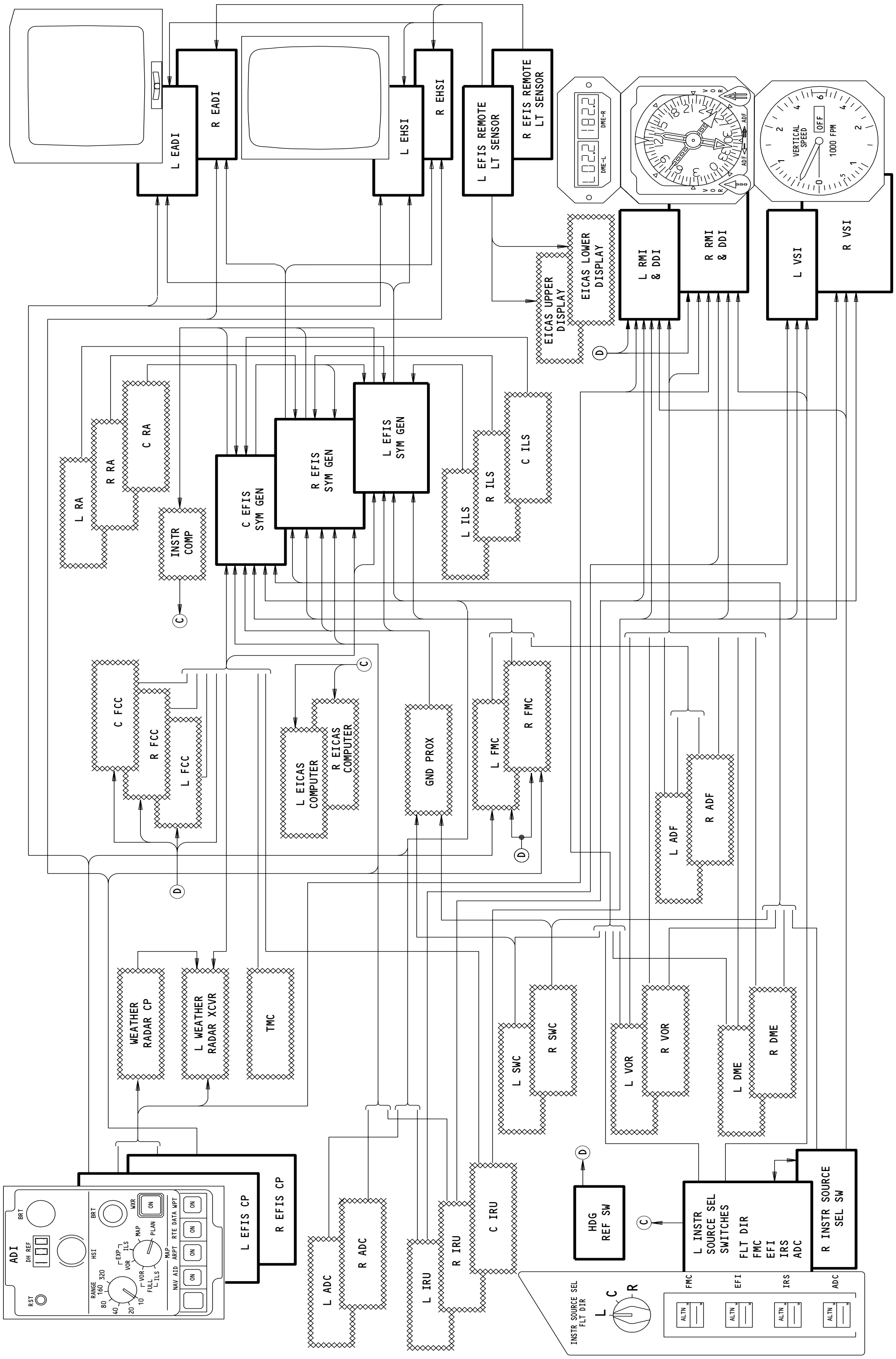
EFIS EHSI (VOR and ILS Modes) - Component Detail
Figure 4 (Sheet 4)

3. Operation
   A. Functional Description
      (1) Flight Instrument System - Block Diagram (Fig. 5)
         (a) The EFIS symbol generator receives digital navigation and sensor data from many of the airplane's navigation systems. This is converted into digital video data and sent to the displays. The display content and format is controlled by the data and the EFIS control panel.
         (b) The EFIS control panels provide display control and selection of mode, range, symbology, DH, brightness, and WXR data.
         (c) The symbol generators provide all character input data to the displays. The symbol generators also provide all system monitoring for the EFIS. The symbol generators receive flight control, flight management, inertial, and air data information. Single inputs of ILS, radio altitude, and thrust management data are received by all the symbol generators. A single input for the left and right, and a dual input to the center symbol generator of stall warning, VOR, and DME data are received. Where more than one source feeds a symbol generator, the switches on the instrument source select panels provide selection.
         (d) The EADIs and EHSIs display different types of information. Electronically though, the two types of indicators are essentially the same. Display contrast and brightness is controlled by two means. The intensity can be varied manually by the ADI and HSI brightness knobs on the EFIS control panel. The intensity is also automatically controlled. As the cabin lighting changes, the EFIS light sensors cause the display brightness to change accordingly. Under normal conditions, the left display set is driven by the left symbol generator and the right display set is driven by the right symbol generator. Either can be driven by the center symbol generator. In the event of a main symbol generator fault, the EFI switches on the instrument source select panels are used to switch the displays to the center unit.
      (2) Flight Instrument System - Input Data (Fig. 5A)



Flight Instrument System Block Diagram
Figure 5 (Sheet 1)

A75628



Flight Instrument System Block Diagram
Figure 5 (Sheet 2)

A75635

TABLE I - FLIGHT INSTRUMENT SYSTEM - INPUT DATA

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
EFIS CONTROL PANEL	SELECTED DH	D	EADI
	DH RESET	Dd	EADI
	BRIGHTNESS CONTROL	D	EADI/EHSI
	RANGE SELECT	D	EHSI
	MODE SELECT	D	EHSI
		Dd	RDMI
	MAP AID SELECTIONS	D	EHSI
	WXR ON	D	EHSI
AIR DATA COMPUTER	COMPUTED AIRSPEED	D	EADI
	MACH	D	EADI
	TRUE AIRSPEED	D	NOT USED
DISTANCE MEASURING EQUIPMENT	DME DISTANCE	D	EHSI
		D	RDMI
FLIGHT CONTROL COMPUTER	AFDS MODE STATUS	D	EADI
	FLT DIR-PITCH	D	EADI
	FLT DIR-ROLL	D	EADI
	SELECTED HEADING	D	EHSI
	AFDS STATUS MODES	Dd	EADI
	AFDS ROLL MODES ARMED	Dd	EADI
	AFDS ROLL MODES ENGAGED	Dd	EADI
	AFDS PITCH MODES ENGAGED	D	EADI
	AFDS PITCH MODES ARMED/LIMIT	Dd	EADI
FLIGHT MANAGEMENT COMPUTER	CROSS TRACK DISTANCE	D	EHSI
	DESIRED TRACK	D	EHSI
	DISTANCE-TO-GO	D	EHSI
	DRIFT ANGLE (I)	D	EADI/EHSI
	MAP BACKGROUND DATA	D	EHSI
	ETA	D	EHSI
	FLIGHT PATH ANGLE (I)	D	EADI
	GROUND SPEED (I)	D	EADI
	PRESENT POS - LAT	D	EHSI
	PRESENT POS - LONG	D	EHSI
	RANGE TO ALTITUDE	D	EHSI
	TRACK ANGLE (I)	D	EHSI
	VERTICAL DEVIATION (= NCD)	D	EHSI
	WIND DIRECTION (I)	D	EHSI
	WIND SPEED (I)	D	EHSI

Flight Instrument System - Input Data
Figure 5A (Sheet 1)

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
GROUND PROXIMITY WARNING COMPUTER	WINDSHEAR WARN	Ad	EADI
INSTRUMENT LANDING SYSTEM	ILS PARK	Ad	EADI/EHSI
	GLIDESLOPE DEV	D	EADI/EHSI
	ILS FREQUENCY	D	EHSI
	LOCALIZER DEV	D	EADI/EHSI
	SELECTED RNWY HDG	D	EHSI
INERTIAL REF SYSTEM	CROSS TRK HRZ ACCEL	D	EHSI
	DRIFT ANGLE (II)	D	EADI/EHSI
	FLT PATH ACCEL	D	EADI
	FLT PATH ANGLE (II)	D	EADI
	GROUNDSPEED (II)	D	EADI
	MAG HEADING	D	EHSI
	PITCH ANGLE	D	EADI
	ROLL ANGLE	D	EADI
	TRACK ANGLE (II)	D	EHSI
	TRUE HEADING	D	EHSI
	WIND DIRECTION (II)	D	EHSI
	WIND SPEED (II)	D	EHSI
	TRUE HEADING	D	RDMI
	VERT SPEED	D	VSI
RADIO ALTIMETER	RADIO HEIGHT	D	EADI
STALL WARNING COMPUTER	PITCH LIMIT (PLI)	D	EADI
	ENGINE OUT SPEED	D	EADI
	HIGH SPEED BUFFET	D	EADI
	MAX OP SPEED	D	EADI
	MIN OP SPEED	D	EADI
	STICK SHAKER SPEED	D	EADI
	MIN A/S - FLAP RETRACTION	D	EADI
THRUST MGMT SYSTEM	SPEED DEVIATION	D	EADI
	TMS FMA STATUS	D	EADI
VOR SYSTEM	SELECTED COURSE	D	EHSI
	VOR FREQUENCY	D	EHSI
	VOR OMNIBEARING	D	EHSI
	L/R SYS	Ad	EHSI
	VOR OMNIBEARING	D	RDMI
WEATHER RADAR	WXR DATA	D	EHSI
INSTRUMENT SOURCE SELECT PANEL	FLT DIR SELECT	Ad	EADI
	FMC SELECT	Ad	EADI/EHSI/RDMI
	IRS SELECT	Ad	EADI/EHSI/RDMI/VSI
	EFI SELECT	Ad	EADI/EHSI
	ADC SELECT	Ad	EADI
AUTOMATIC DIRECTION FINDER SYSTEM	ADF BEARING	D	RDMI

Flight Instrument System - Input Data
Figure 5A (Sheet 2)

TABLE I - FLIGHT INSTRUMENT SYSTEM - INPUT DATA

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
EFIS CONTROL PANEL	SELECTED DH	D	EADI
	DH RESET	Dd	EADI
	BRIGHTNESS CONTROL	D	EADI/EHSI
	RANGE SELECT	D	EHSI
	MODE SELECT	D	EHSI
		D	DDI
	MAP AID SELECTIONS	D	EHSI
	WXR ON	D	EHSI
AIR DATA COMPUTER	COMPUTED AIRSPEED	D	NOT USED
	MACH	D	NOT USED
	TRUE AIRSPEED	D	NOT USED
DISTANCE MEASURING EQUIPMENT	DME DISTANCE	D	EHSI
		D	DDI
FLIGHT CONTROL COMPUTER	AFDS MODE STATUS	D	EADI
	FLT DIR-PITCH	D	EADI
	FLT DIR-ROLL	D	EADI
	SELECTED HEADING	D	EHSI
	AFDS STATUS MODES	Dd	EADI
	AFDS ROLL MODES ARMED	Dd	EADI
	AFDS ROLL MODES ENGAGED	Dd	EADI
	AFDS PITCH MODES ENGAGED	D	EADI
	AFDS PITCH MODES ARMED/LIMIT	Dd	EADI
FLIGHT MANAGEMENT COMPUTER	CROSS TRACK DISTANCE	D	EHSI
	DESIRED TRACK	D	EHSI
	DISTANCE-TO-GO	D	EHSI
	DRIFT ANGLE (I)	D	EADI/EHSI
	MAP BACKGROUND DATA	D	EHSI
	ETA	D	EHSI
	FLIGHT PATH ANGLE (I)	D	EADI
	GROUNDSPEED (I)	D	EADI
	PRESENT POS - LAT	D	EHSI
	PRESENT POS - LONG	D	EHSI
	RANGE TO ALTITUDE	D	EHSI
	TRACK ANGLE (I)	D	EHSI
	VERTICAL DEVIATION (= NCD)	D	EHSI
	WIND DIRECTION (I)	D	EHSI
	WIND SPEED (I)	D	EHSI

Flight Instrument System - Input Data
Figure 5A (Sheet 3)

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
GROUND PROXIMITY WARNING COMPUTER	WINDSHEAR WARN	Ad	EADI
INSTRUMENT LANDING SYSTEM	ILS PARK	Ad	EADI/EHSI
	GLIDESLOPE DEV	D	EADI/EHSI
	ILS FREQUENCY	D	EHSI
	LOCALIZER DEV	D	EADI/EHSI
	SELECTED RNWY HDG	D	EHSI
INERTIAL REFERENCE SYSTEM	CROSS TRK HRZ ACCEL	D	EHSI
	DRIFT ANGLE (II)	D	EADI/EHSI
	FLT PATH ACCEL	D	EADI
	FLT PATH ANGLE (II)	D	EADI
	GROUND SPEED (II)	D	EADI
	MAG HEADING	D	EHSI
	PITCH ANGLE	D	EADI
	ROLL ANGLE	D	EADI
	TRACK ANGLE (II)	D	EHSI
	TRUE HEADING	D	EHSI
	WIND DIRECTION (II)	D	EHSI
	WIND SPEED (II)	D	EHSI
	TRUE HEADING	D	RMI
	VERT SPEED	D	VSI
RADIO ALTIMETER	RADIO HEIGHT	D	EADI
STALL WARNING COMPUTER	PITCH LIMIT (PLI)	D	EADI
THRUST MANAGEMENT SYSTEM	SPEED DEVIATION	D	EADI
	TMS FMA STATUS	D	EADI
VOR SYSTEM	SELECTED COURSE	D	EHSI
	VOR FREQUENCY	D	EHSI
	VOR OMNIBEARING	D	EHSI
	L/R SYS	Ad	EHSI
	VOR OMNIBEARING	D	RMI
WEATHER RADAR	WXR DATA	D	EHSI
INSTRUMENT SOURCE SELECT PANEL	FLT DIR SELECT	Ad	EADI
	FMC SELECT	Ad	EADI/EHSI/DDI
	IRS SELECT	Ad	EADI/EHSI/RMI/VSI
	EFI SELECT	Ad	EADI/EHSI
	ADC SELECT	Ad	EADI
AUTOMATIC DIRECTION FINDER SYSTEM	ADF BEARING	D	RMI/EHSI

Flight Instrument System - Input Data
Figure 5A (Sheet 4)

TABLE I - FLIGHT INSTRUMENT SYSTEM - INPUT DATA

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
EFIS CONTROL PANEL	SELECTED DH	D	EADI
	DH RESET	Dd	EADI
	BRIGHTNESS CONTROL	D	EADI/EHSI
	RANGE SELECT	D	EHSI
	MODE SELECT	D	EHSI
		Dd	RDMI
	MAP AID SELECTIONS	D	EHSI
	WXR ON	D	EHSI
AIR DATA COMPUTER	COMPUTED AIRSPEED	D	NOT USED
	MACH	D	NOT USED
	TRUE AIRSPEED	D	NOT USED
DISTANCE MEASURING EQUIPMENT	DME DISTANCE	D	EHSI
		D	RDMI
FLIGHT CONTROL COMPUTER	AFDS MODE STATUS	D	EADI
	FLT DIR-PITCH	D	EADI
	FLT DIR-ROLL	D	EADI
	SELECTED HEADING	D	EHSI
	AFDS STATUS MODES	Dd	EADI
	AFDS ROLL MODES ARMED	Dd	EADI
	AFDS ROLL MODES ENGAGED	Dd	EADI
	AFDS PITCH MODES ENGAGED	D	EADI
	AFDS PITCH MODES ARMED/LIMIT	Dd	EADI
FLIGHT MANAGEMENT COMPUTER	CROSS TRACK DISTANCE	D	EHSI
	DESIRED TRACK	D	EHSI
	DISTANCE-TO-GO	D	EHSI
	DRIFT ANGLE (I)	D	EADI/EHSI
	MAP BACKGROUND DATA	D	EHSI
	ETA	D	EHSI
	FLIGHT PATH ANGLE (I)	D	EADI
	GROUND SPEED (I)	D	EADI
	PRESENT POS - LAT	D	EHSI
	PRESENT POS - LONG	D	EHSI
	RANGE TO ALTITUDE	D	EHSI
	TRACK ANGLE (I)	D	EHSI
	VERTICAL DEVIATION (= NCD)	D	EHSI
	WIND DIRECTION (I)	D	EHSI
	WIND SPEED (I)	D	EHSI

Flight Instrument System - Input Data
Figure 5A (Sheet 5)

INPUT SOURCE	INPUT DATA	TYPE	DISPLAY
GROUND PROXIMITY WARNING COMPUTER	WINDSHEAR WARN	Ad	EADI
INSTRUMENT LANDING SYSTEM	ILS PARK GLIDESLOPE DEV ILS FREQUENCY LOCALIZER DEV SELECTED RNWY HDG	Ad D D D D	EADI/EHSI EADI/EHSI EHSI EADI/EHSI EHSI
INERTIAL REFERENCE SYSTEM	CROSS TRK HRZ ACCEL DRIFT ANGLE (II) FLT PATH ACCEL FLT PATH ANGLE (II) GROUND SPEED (II) MAG HEADING PITCH ANGLE ROLL ANGLE TRACK ANGLE (II) TRUE HEADING WIND DIRECTION (II) WIND SPEED (II) TRUE HEADING VERT SPEED	D D D D D D D D D D D D D D	EHSI EADI/EHSI EADI EADI EADI EHSI EADI EADI EHSI EHSI EHSI EHSI RDMI VSI
RADIO ALTIMETER	RADIO HEIGHT	D	EADI
STALL WARNING COMPUTER	PITCH LIMIT (PLI)	D	EADI
THRUST MANAGEMENT SYSTEM	SPEED DEVIATION TMS FMA STATUS	D D	EADI EADI
VOR SYSTEM	SELECTED COURSE VOR FREQUENCY VOR OMNIBEARING L/R SYS VOR OMNIBEARING	D D D Ad D	EHSI EHSI EHSI EHSI RDMI
WEATHER RADAR	WXR DATA	D	EHSI
INSTRUMENT SOURCE SELECT PANEL	FLT DIR SELECT FMC SELECT IRS SELECT EFI SELECT ADC SELECT	Ad Ad Ad Ad Ad	EADI EADI/EHSI/RDMI EADI/EHSI/RDMI/VSI EADI/EHSI EADI
AUTOMATIC DIRECTION FINDER SYSTEM	ADF BEARING	D	RDMI

Flight Instrument System - Input Data
Figure 5A (Sheet 6)

(a) The flight instrument systems receive flight data which they process for display. The following table describes the data which each input system provides and how it is used for display (under normal conditions). For fault data displays, see EFIS-, RDMI- (RMI-), or VSI-BITE in the operation areas of this section.

<u>NOTE</u>: In Table I, the type of data transmission will be noted in the column under TYPE as follows: D - digital data, Dd - digital discrete, or Ad - analog discrete.

(b) Under normal conditions, the EFIS will display FMC generated data (noted by I). With the exception of track angle, if the FMC data is determined to be invalid, the EFIS will automatically switch to the inertial generated data (noted by II).

(c) When the airplane is stationary, the EFIS will display inertial heading data as a direct substitute for FMC/inertial track data.

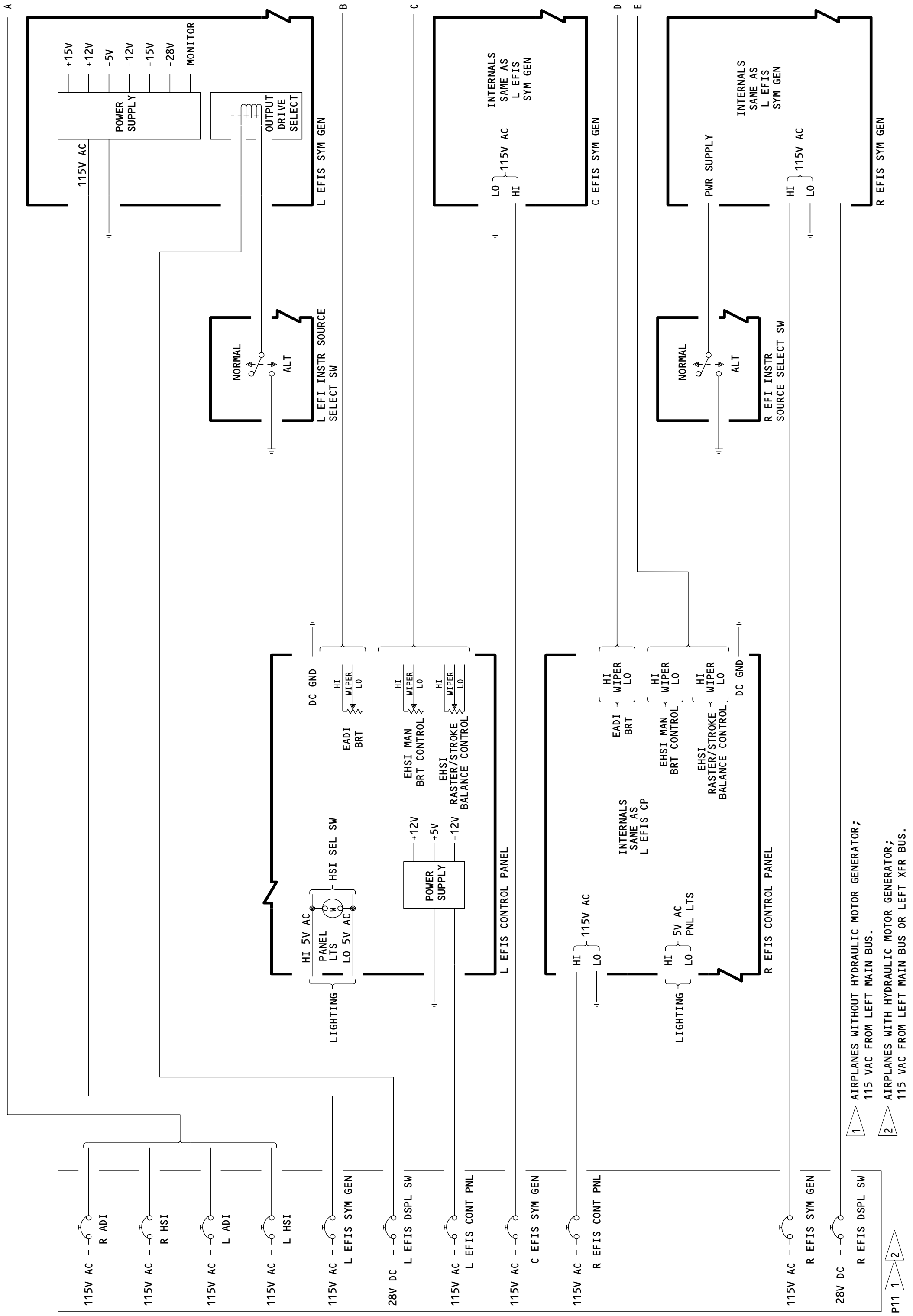
(d) If the FMC/inertial ground speed is greater than or equal to 50 knots and subsequently not less than or equal to 40 knots, EFIS will select FMC/inertial track data. If the above condition is not satisfied, EFIS will then select inertial heading information in place of track information.

(e) When FMC/inertial track data is selected, EFIS will select FMC data if FMC is valid (noted by I). If FMC data is determined to be invalid, EFIS will automatically switch to inertial generated track data (noted by II).

(3) EFIS-Power Distribution and Instrument Lighting (Fig. 6)

(a) The left (right) EFIS control panel receives 115Vac, 400 Hz, single phase power from the main AC power bus. It also receives 5Vac for panel lighting from the master dim and test circuits (AMM 33-16-00/001). The control panel power supply converts the input power into ± 12Vdc and +5Vdc for internal operation.

(b) Each EHSI map mode display switch illuminates an internal switch light in the ON position. The ADI BRT potentiometer controls the EADI display intensity by a variable dc voltage. The HSI STROKE/RASTER BRT potentiometer controls the stroke/raster balance of the EHSI by a variable dc voltage.



1 AIRPLANES WITHOUT HYDRAULIC MOTOR GENERATOR; 115 VAC FROM LEFT MAIN BUS.

2 AIRPLANES WITH HYDRAULIC MOTOR GENERATOR; 115 VAC FROM LEFT MAIN BUS OR LEFT XFR BUS.

EFIS Power Distribution and Instrument Lighting Schematic
Figure 6 (Sheet 1)

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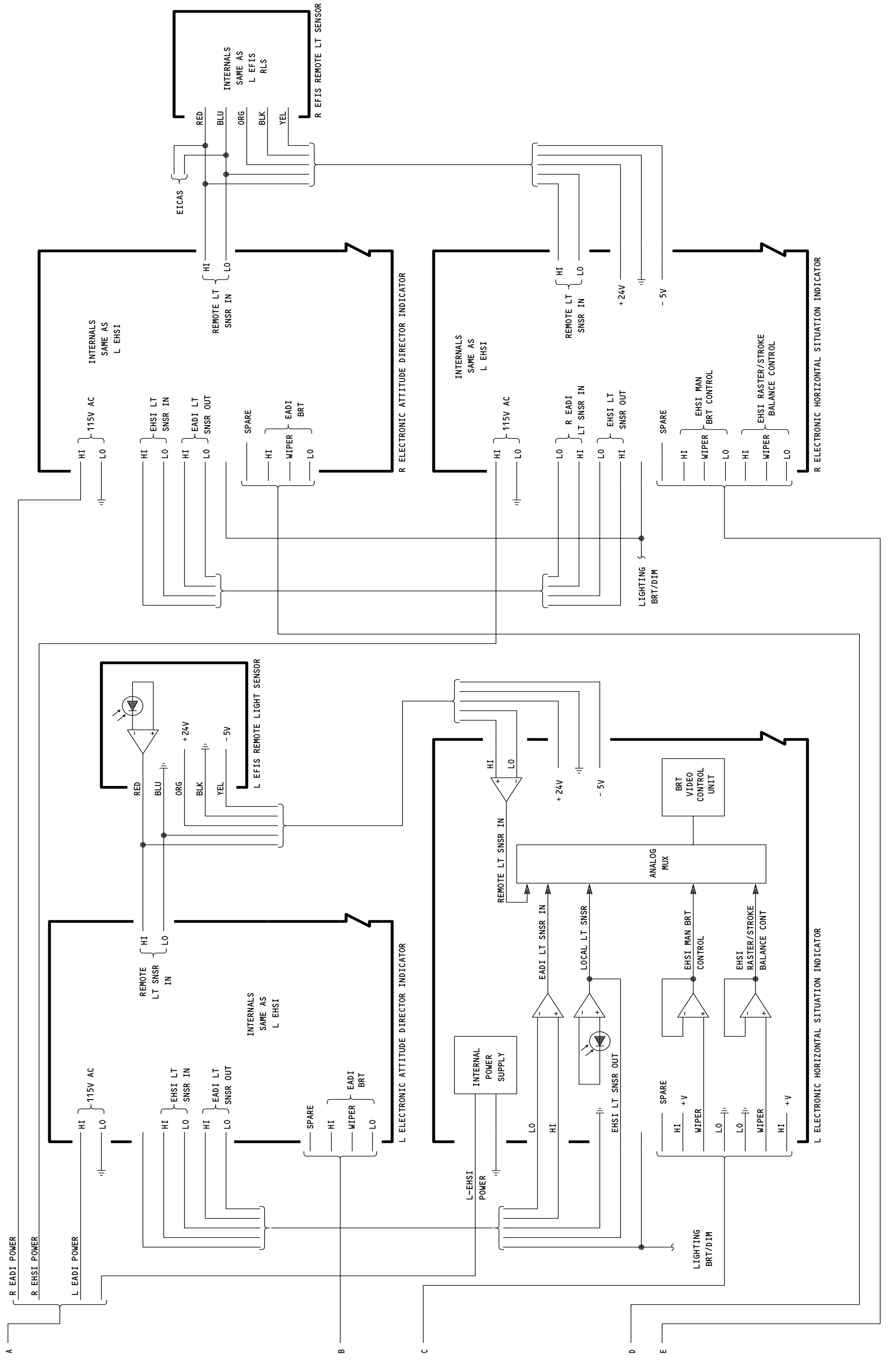

EFIS Power Distribution and Instrument Lighting Schematic
Figure 6 (Sheet 2)

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(c) The HSI BRT potentiometer controls the overall EHSI brightness by a variable dc voltage.

(d) The EFIS symbol generator receives 115Vac, 400 Hz, single phase power from the main AC power bus. It also receives +28Vdc for the output drive select relay. This relay is energized when the EFI switch on the instrument source select panel is in the ALTN position. (The center symbol generator does not require this switching voltage.) The symbol generator converts the 115Vac into ±15Vdc, ±12Vdc, -5Vdc, and -28Vdc for internal circuit operation.

(e) The display units each receive 115Vac, 400 Hz, single phase power from the main power bus. They convert this into dc power for internal operation.

(f) In the event of a left power bus failure, the left EADI and the left and center EFIS symbol generators will automatically switch to the right power bus. This will occur when the left bus drops below 97 ±2 Vac for more than 180 ms. They will automatically switch back to the left bus when the left bus power increases to greater than 106 ±2 Vac for more than 1.2 seconds (AMM 24-51-00/001).

(g) The remote light sensors each receive -24Vdc and -5Vdc from the EHSIs for internal operation.

(h) The EADI receives the variable dc voltage, from the control panel for manual brightness control. The EHSI receives two variable dc voltages, from the control panel, for manual brightness control and raster/stroke balance control.

(i) Both the EADI and EHSI receive automatic brightness control from the remote and local light sensors. In addition, they receive a day/night discrete from the master dim and test circuits.

(j) A display set consists of one EADI, one EHSI and one remote light sensor. Each display set combines and processes all of the automatic brightness control inputs for that set. This is done within the individual CRTs. The combined automatic brightness control inputs maintain the intensity ratio of the sets' displays. As cabin light conditions change, the displays' intensities will change in equal amounts.

(k) The display brightness control signals, both manual and automatic, are converted into digital data by the analog mux. This data is then processed by the BRT CPU for a single display intensity control signal.

(4) EFIS - Program Pin Options (Fig. 6A)

(a) The EFIS symbol generators contain selectable program pins. These pins can be grounded or left open to set the applicable EFIS options. Each option is assigned a binary number, 0 (open) or 1 (grounded), that represents its state. These options are arranged to form a specified sequence of binary numbers. A binary to hexadecimal conversion of this sequence makes a hex code.

1) The hex code is shown on the EADI during self-test.

(5) EFIS - EHSI Control (Fig. 7)

(a) The lower portion of the control panel is used to control the EHSI and the symbol generator's EHSI circuits. All of the controls utilize ground discrete circuits which send their information to the input select level shifter. The unit is microprocessor controlled and provides both digital and discrete data to other systems.

(b) Each of the range switch settings (10, 20, 40, 80, 160, and 320 nmi) and the VOR/ILS orient program pin provides a ground discrete, when selected. These are sent to the input select level shifter. The VOR/ILS orient program pin causes the EHSI display to be a heading-up orientation in the VOR and ILS modes. The display is track-up, in the MAP and PLAN modes, when the map orient program pin is open.

(c) Each of the map mode display switches and the WXR on/off switch sends a ground discrete to the input select level shifter, in the ON position. Each of these switches also turns on an indicator lamp beneath the switch when selected. The lamps all receive parallel inputs from the panel lighting control circuits (AMM 33-13-00/001). The WXR ON/OFF discrete output is also sent to the right EFIS control panel and the WXR control panel. This provides for WXR system initiation by either EFIS control panel (AMM 34-43-00/001).

EFIS HEX CODE BIT ASSIGNMENT

FIRST LINE

LEFTMOST DIGIT

	CONN	PIN
DME SOURCE	B	A03
G/S SOURCE	B	B03
RA SOURCE	B	C03
ADF SOURCE	B	D03
A/P SEL1	B	E03
A/P SEL2	B	F03
ADF INSTALL1	B	D12
ADF INSTALL2	B	E12
SPD TREND VECTOR - DISABLE	B	J03
MIN OP SPEED - DISABLE	B	K03
SINGLE CH ANN	B	A04
PRODUCT IMPROVEMENTS	B	B04
FMC INSTALL (1/2)	B	E04
ILS FLAG MONITOR	B	F04
NAV MON LIMITS	B	C02
NAV COMP MONITOR	B	D02
EHSI DA DSPLY-DISABLE	B	D09
FD DSPLY SEL1	B	E11
FD DSPLY SEL2	B	F11
H ALERT SEL1	B	F09
H ALERT SEL2	B	G09
RA DSPLY SEL1	B	D10
RA DSPLY SEL2	B	E10
FPM DSPLY	B	D11
PROGRAM PIN PARITY	B	J06
ILS DEV WARN	B	E08
LOC DEV SCALE - CAA	B	E09
BK CRS LOC REV - DISABLE	B	C05

RIGHTMOST DIGIT

HEX	BINARY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

SECOND LINE

LEFTMOST DIGIT

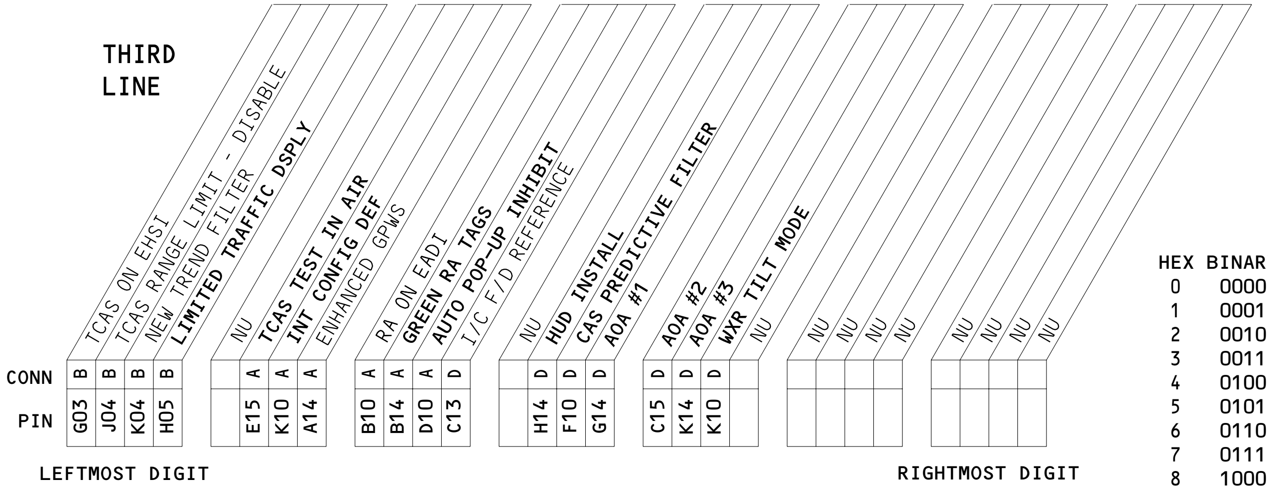
	CONN	PIN
SPD TAPE	B	D05
TAS DSPLY ON EADI	B	E05
HD CUE (INOP)	B	F05
F/S - G/S REVERSAL	B	G05
WXR MODE DSPLY SEL2	A	G14
COMPARATOR DSPLY	B	J05
CENTER MAP - FULL ROSE	B	K05
ANALOG ILS FLAGS	B	D07
CAA COMPARATOR	B	G10
POS DIFF DSPLY SEL1	B	G02
POS DIFF DSPLY SEL2	B	H02
WXR TURB COLOR - MAGENTA	B	E06
EADI FORMAT - EUROPEAN	B	F06
WXR MODE DSPLY SEL1	B	G06
RANGE ARCS	B	H06
ADF POINTERS (MAP) - DISABLE	A	D12
EHSI SYMBOLOGY - ALTERNATE	A	A13
GS AND TAS DISPLAY	A	B13
F/S DURING G/A - DISABLE	D	D12
FILLED AIRPLANE SYMBOL	D	A13
DO NOT GROUND THIS PIN	D	B13
SPD TAPE REVERSAL	D	K13
ROLLING DIGIT CURSOR - DISABLE	D	C14
ADF COLOR	D	D14
ALT PLACEMENT	B	B02
OFF SCALE TARGET SYMBOL	B	G12
RANGE RING - DISABLE	B	H03
MAP SOURCE ANNUN	B	J02

RIGHTMOST DIGIT

<u>NOTES</u>: PIN GROUNDED = 1
PIN OPEN = 0
NU = 0

EFIS - Program Pin Options
Figure 6A (Sheet 1)

EFIS HEX CODE BIT ASSIGNMENT

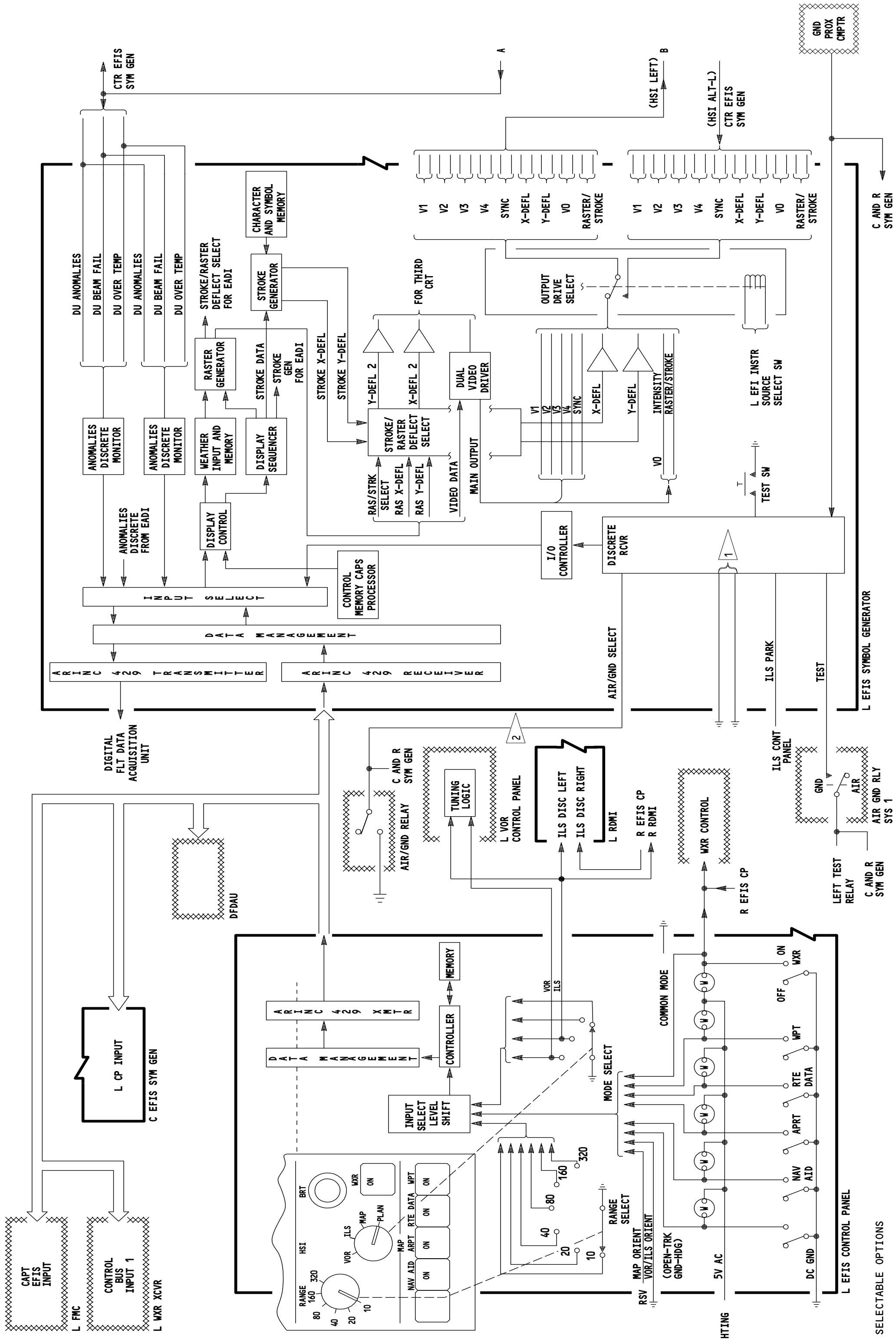


Bit	CONN	PIN
TCAS ON EHSI	B	G03
TCAS RANGE LIMIT - DISABLE	B	J04
NEW TREND FILTER	B	K04
LIMITED TRAFFIC DSPLY	B	H05
NU		
TCAS TEST IN AIR	A	E15
INT CONFIG DEF	A	K10
ENHANCED GPWS	A	A14
RA ON EADI	A	B10
GREEN RA TAGS	A	B14
AUTO POP-UP INHIBIT	A	D10
I/C F/D REFERENCE	D	C13
NU		
HUD INSTALL	D	H14
CAS PREDICTIVE FILTER	D	F10
AOA #1	D	G14
AOA #2	D	C15
AOA #3	D	K14
WXR TILT MODE	D	K10
NU		
NU		
NU		
NU		
NU		
NU		
NU		
NU		
NU		

HEX	BINARY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

NOTES:
PIN GROUNDED = 1
PIN OPEN = 0
NU = 0

Program Pin Options
Figure 6A (Sheet 2)



1 PIN SELECTABLE OPTIONS

2 CONNECTED ON GUI 001-008,010-114,116-999

EFIS - EHSI Schematic (Example)
Figure 7 (Sheet 1)

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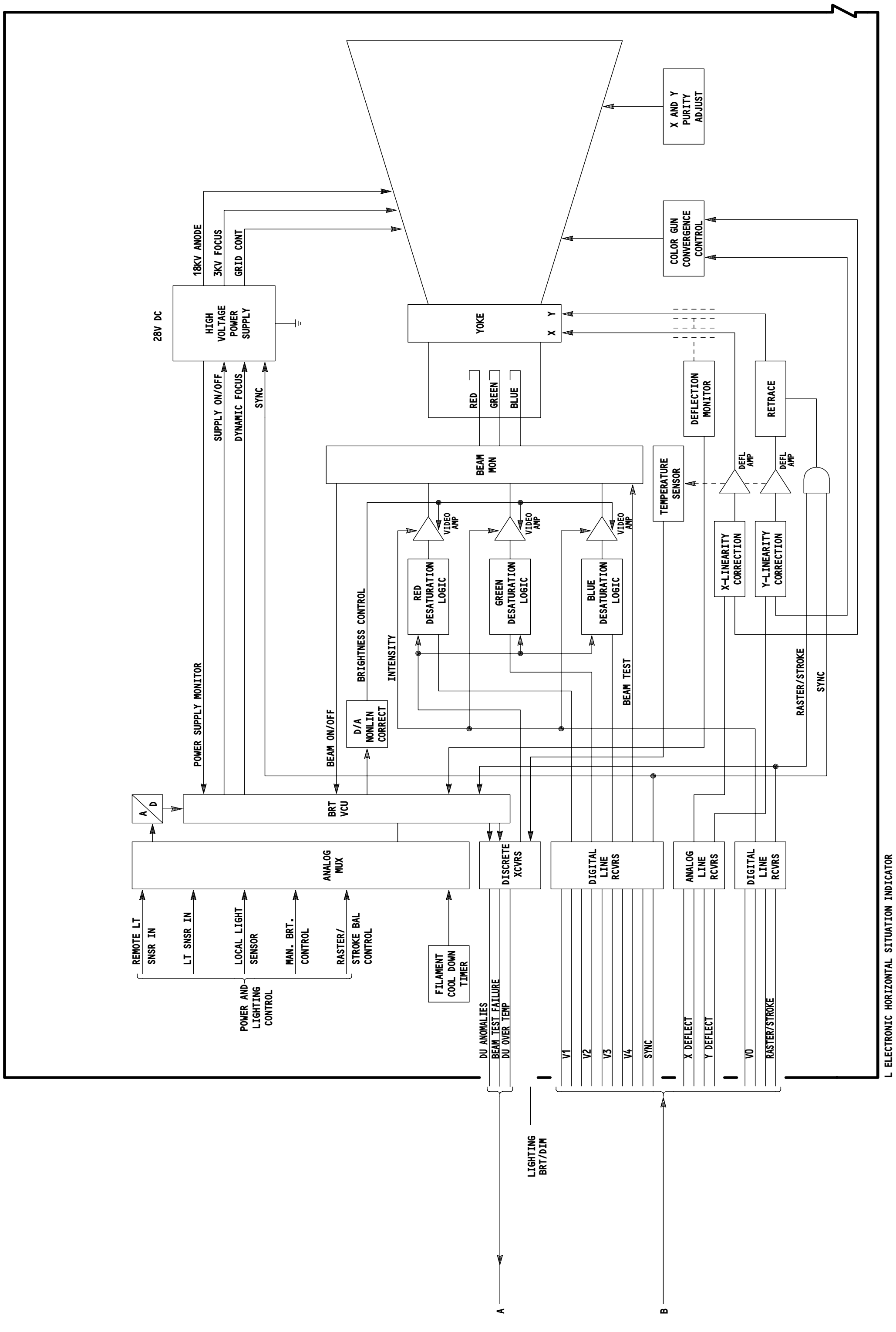

EFIS - EHSI Schematic (Example)
Figure 7 (Sheet 2)

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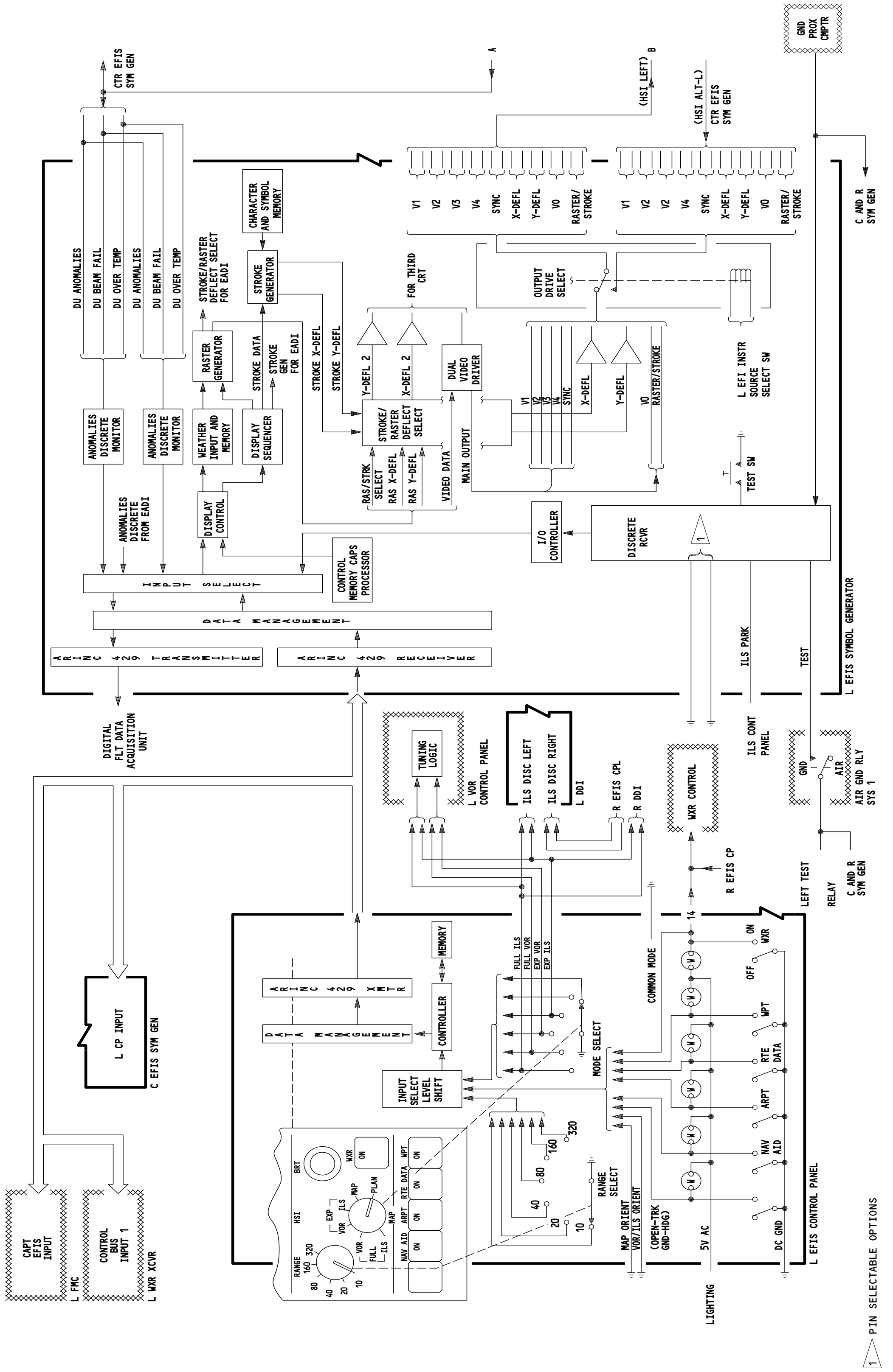

EFIS - EHSI Schematic (Example)
Figure 7A (Sheet 1)

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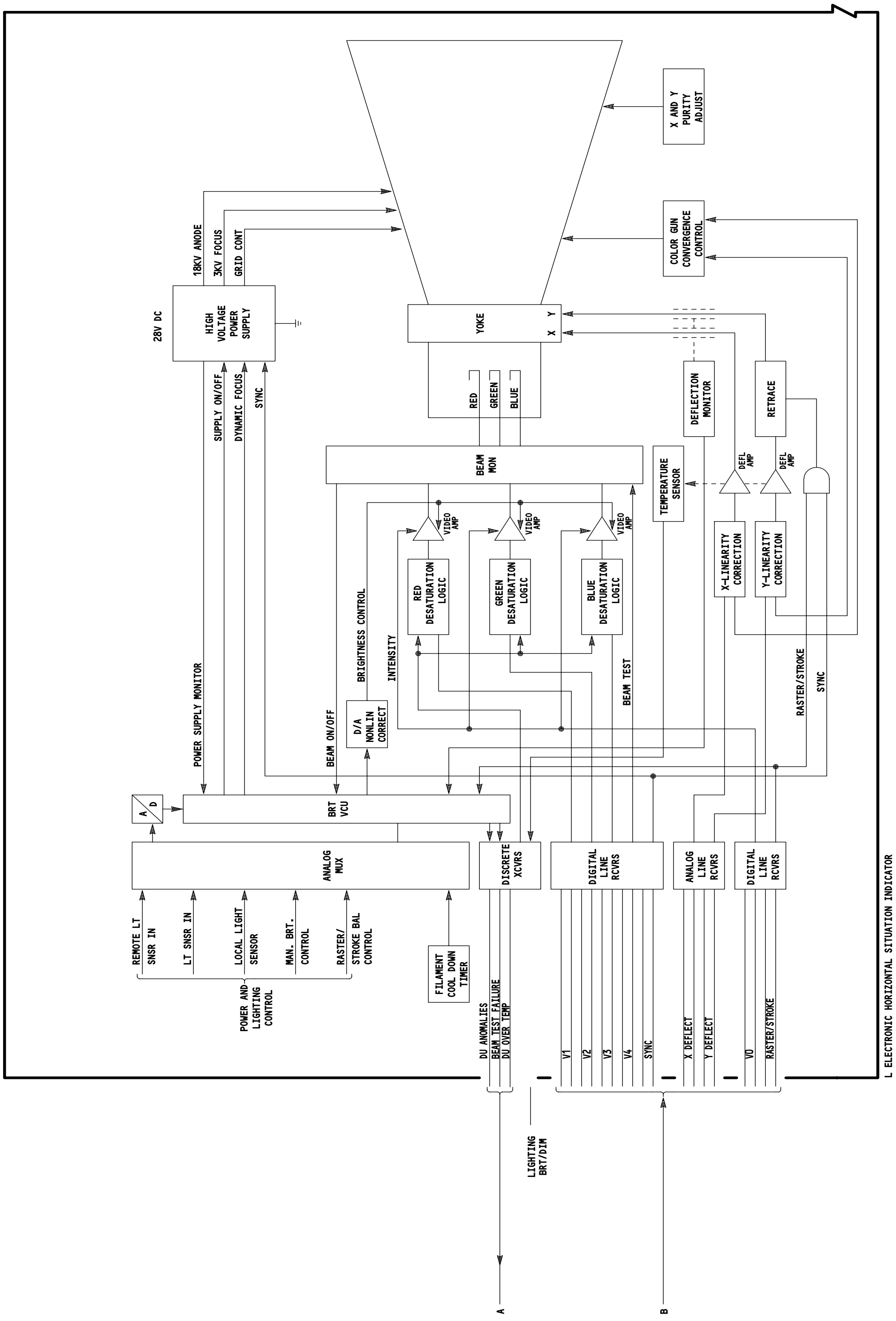


EFIS - EHSI Schematic (Example)
Figure 7A (Sheet 2)

(d) GUI 001-114, 116-999;
Each EHSI mode switch position sends a ground discrete to the input select level shifter. It also sends ground discretes to the VOR control panels, and the RDMIs. In the VOR and ILS position(s) a ground discrete is sent to the left VOR control panel for manual VOR tuning (AMM 34-51-00/001). It also sends the ILS mode discrete to the RDMIs which will display the letter L ahead of the left DME displays and display the VOR bearing to the selected VOR station (see RDMI section, this chapter).

(e) GUI 115;
Each EHSI mode switch position sends a ground discrete to the input select level shifter. It also sends ground discretes to the VOR control panels and the DDIs. In the VOR and ILS position(s) a ground discrete is sent to the left VOR control panel for manual VOR turning (AMM 34-51-00/001). It also sends the ILS mode discrete to the DDIs which will display the letter L ahead of the left DME displays (AMM 34-55-00/001).

(f) The control data is converted from parallel to serial and sent to the data management circuits. Here, the data is arranged and labeled by information from the controller and memory circuits. The final control data is sent to the 429 transmitter. It is then routed, by an ARINC 429 digital data bus, to the left symbol generator. This data is also sent to the WXR XCVR(s) (AMM 34-43-00/001), the left FMC (AMM 34-61-00/001) and the center EFIS symbol generator.

(g) The left symbol generator receives digital control data from the left EFIS control panel. It receives digital display source data from many other navigation systems.

(h) All control and display source data (except WXR) is routed to the symbol generator by ARINC 429 digital data busses. The WXR data is sent by two very high speed, ARINC 453, digital data buses. The digital data is accepted by corresponding 429 and 453 RCVRS. It is then sent to the input select circuits. The selected data is routed to the data management circuits. The information is decoded and converted into parallel data. All digital inputs are monitored by the symbol generator for validity and presence. Any detected errors are flagged on the display units and stored in the BITE memory circuits for later reference.

(i) The symbol generator receives discrete inputs from the program pins on the unit. It also receives discrete inputs from the master annunciator light test circuits. The program pins ground arrangement determines the display format for the specific airplane. This is routed through an I/O controller to the input select switching circuits. The program pins provide the formatting of the following displayed data:

1) ILS Deviation Warning on EADI.
2) Decision Height + Δ Height Alert.

   NOTE: This does not effect the EADI display. However, a discrete is sent to the warning electronics unit siren/owl aural warning modules for a siren at DH +50 feet (AMM 31-51-00/001).

3) GUI 001-114, 116-999;
   European EADI format.
4) Standard EHSI symbology.
5) Magnetic HDG/TRK on EHSI between 70°N and 60°S latitude.
6) Numeric RA and DH on EADI.
7) Rising Runway on EADI.
8) GUI 001-114, 116-999;
   Altitude alert at 2500 ft. on EADI.
9) GUI 115;
   No altitude alert on EADI.
10) Windshear Warn on EADI.
11) Pitch Limit Indication on EADI.
12) GUI 001-008, 010-114, 116-999;
    Speed Tape display on EADI.
13) GUI 002-006, 010-999;
    Split Axis flight director command display on EADI.
14) GUI 007, 008;
    Integrated Cue flight director command display on EADI.
15) GUI 001, 009;
    Filled Integrated Cue flight director command display on EADI.
16) GUI 115;
    Drift Angle pointer on the full compass rose of the EHSI.

17) GUI 010-114, 116-999;
Weather Radar Gain, Mode, and Tilt display on the EHSI.
18) GUI 115;
ADF bearing indication on EHSI.
19) GUI 010-114, 116-999;
Range Arcs on the EHSI.

(j) The input select switching circuits also receive fault data from the display units. This data includes display unit anomalies, beam fail, and over temperature discretes. Any detected display faults are stored in the symbol generators BITE memory circuits.

(k) The digital flight data acquisition unit (DFDAU) acquires pitch roll and heading data from the symbol generator by ARINC 429 digital data bus (AMM 31-31-00/001).

(l) The input select circuits are used to select input data to the display control circuits. This provides the main interface for all I/O functions between the control memory and caps processor. The control memory and caps processor provide the main control, data processing and memory for the system.

(m) WXR data is sent from the display control to the weather memory and control circuits. This provides all control of the raster, refresh, input, rotate/translate, and standby functions of the WXR input data. The memory controls the WXR output data to the raster generator.

(n) The display controller sends all other display data to the display sequencer. Here the raster and stroke data are separated and sent to the respective generators.

(o) The raster generator provides master timing signals for raster, stroke, EADI and EHSI functions. It also generates X-raster data for raster rotation. It provides this to the stroke/raster deflect select circuits in three forms of data. These are raster/stroke select, raster X-deflection, and raster Y-deflection. It also sends video data to the dual video driver. This is processed and sent in the form of digital data. This data includes red, green, blue, beam test, sync, intensity, and raster/stroke signals. The dual video driver outputs are applied to the output drive select relay.

(p) The stroke generator produces all single characters, special symbols, and character strings. It also generates all arcs, and straight and curved lines. The character and symbol memory provides the stroke generator with the standard symbol data. This data is sent to the stroke/raster deflect select circuits in the form of X and Y stroke deflection signals.

(q) The stroke/raster deflect circuits also receive a raster/stroke select signal from the raster generator. The circuit alternates the stroke and raster deflection signals. This produces a single set of analog X and Y deflection signals. The WXR raster display field is built from two combined frames of vertical scale lines. Each frame is updated at an 80 Hz rate. This results in the complete raster display field being updated at a 40 Hz rate. The X and Y deflection signals are then amplified and applied to the output drive select relay.

(r) The relay also receives data from the dual video driver. It receives an identical set of signals from the center symbol generator. The relay is controlled by the EFI switch on the left instrument source select panel. This allows the left EHSI to receive video data from either the left or center symbol generator. (See digital and discrete switching section, this chapter.)

(s) The EHSI display is generated by control and drive signals from the left or center symbol generator. Two analog deflection input signals (X-horizontal, Y-vertical) drive the CRT. Four digital video inputs (red, green, blue, and beam test) provide amplitude control of the electron guns. Three digital mode inputs (raster/stroke, sync, and intensity) provide the following:

1) The raster/stroke signal is provided at the beginning of each raster frame. This ensures the EHSI is in the raster mode.
2) The sync signal maintains the power supply stability with respect to the display.
3) The intensity signal controls the high/low intensity of the raster and stroke signals.

(t) The EHSI also receives brightness/contrast inputs from the control panel, and the remote and local light sensors.

(u) The deflection circuits receive the analog X/Y deflect data. The data is corrected for linearity, amplified, and sent to the yoke circuit. The input raster/stroke and sync signals are used to synchronize the scanning patterns between the stroke and raster scans. The corrected data is also sent to the CRT for color gun convergence control. In the circuit, the deflection amplifiers are monitored for overtemperature conditions. If the temperature exceeds 88°C, a DU overtemp. discrete is sent to the symbol generator. This first causes the raster display to shut down. If the temperature continues to rise to 128°C, the entire display will shut down. However, if the temperature cools to less than 82°C (usually 4 to 6 minutes) the raster display will return.

(v) The color control circuits provide the various colors needed for the display symbols. The three main colors' (red, blue, and green) intensities can be varied and combined to produce cyan (light blue), yellow, white, and magenta. The input signals are received, amplified, monitored, and then sent to the electron guns in the CRT. The video amplifiers receive control from two sources. They receive the intensity signal from the symbol generator. This controls the high or low intensity display of certain symbols (ex. the range scale is displayed in low intensity). The other control signal is the brightness control. This data comes from the combined light sensor inputs and the manual BRT (stroke) and raster/stroke balance controls. The beam monitor circuit provides for continuous beam test and monitoring.

(w) Periodically a test is initiated by the beam test discrete. This causes all three guns to come on, resulting in a white beam which is deflected off of the screen. The cathode currents of three guns are monitored and checked for correct values. If incorrect values are detected, the beam test failure discrete is sent to the symbol generator. This causes the display to become monochromatic. The failing gun will turn off and the remaining guns will stay on.

(x) The CRT control circuits provide convergence control, purity adjust, and high voltage power supply signals to the CRT. The color gun convergence control assures that the three main color beams are properly aligned. It ensures that when the three guns are on, at the same intensity, the display is pure white. This portion of the circuit receives its input data from the X and Y linearity correction circuits. The X and Y purity adjust circuit provides for even color contrast over the entire area of the display.

(y) The automatic and manual analog brightness/contrast signals are input to an analog multiplexer. Here, they are converted to digital and sent to the brightness VCU.

(z) The VCU provides control signals to the high voltage power supply and the filament control circuits. It monitors the power supply, the beam, the deflecton amp temperature, and other display unit anomolies. The high voltage power supply receives dynamic focus and an ON/OFF signal from the VCU. The ON/OFF signal originates in the filament control circuit. This circuit ensures that the filament is up to temperature before turn-on of the high voltage power supply. The high voltage power supply also receives a digital sync signal to ensure correct internal switching. The power supply provides 18KV anode beam acceleration, 3KV focus, and grid control voltages to the CRT. In the event of a fault, the filament control circuit turns the filaments off for at least 30 seconds.

(aa) The VCU monitors the power supplies, the filament current monitor, and the filament cool-down timer. If a fault is detected in any of these, the display will shut down. Also, a DU anomolies discrete is sent to the symbol generator and the DFDAU.

(6) Right EFIS EHSI Control

(a) The right EFIS control panel, right and center symbol generators, and right EHSIs operate in the same manner as the left. The analog mode outputs are output to the right VOR and the RDMIs (RMIs). The digital control signals are routed to the right and center EFIS symbol generators. They are also routed to the right FMC and the WXR XCVR.

(b) The center symbol generator provides back-up video and deflection data to the left and right symbol generators. (This is controlled by the EFI switches on the instrument source select panels). Both left and right EHSIs provide the anomalies discretes to the center symbol generator.

(7) EFIS - EADI Control (Fig. 8)

(a) The EADI utilizes the same control panel as the EHSI. The EADI control circuits are described in the following paragraphs.

(b) The DH set switch controls the DH display setting on the control panel. Turning the knob quickly changes the setting four feet per detent. Turning the knob slowly changes the setting one foot per detent. The selected DH is also sent to the symbol generator. It is transmitted on an ARINC 429 digital data bus, for processing and display on the EADI.

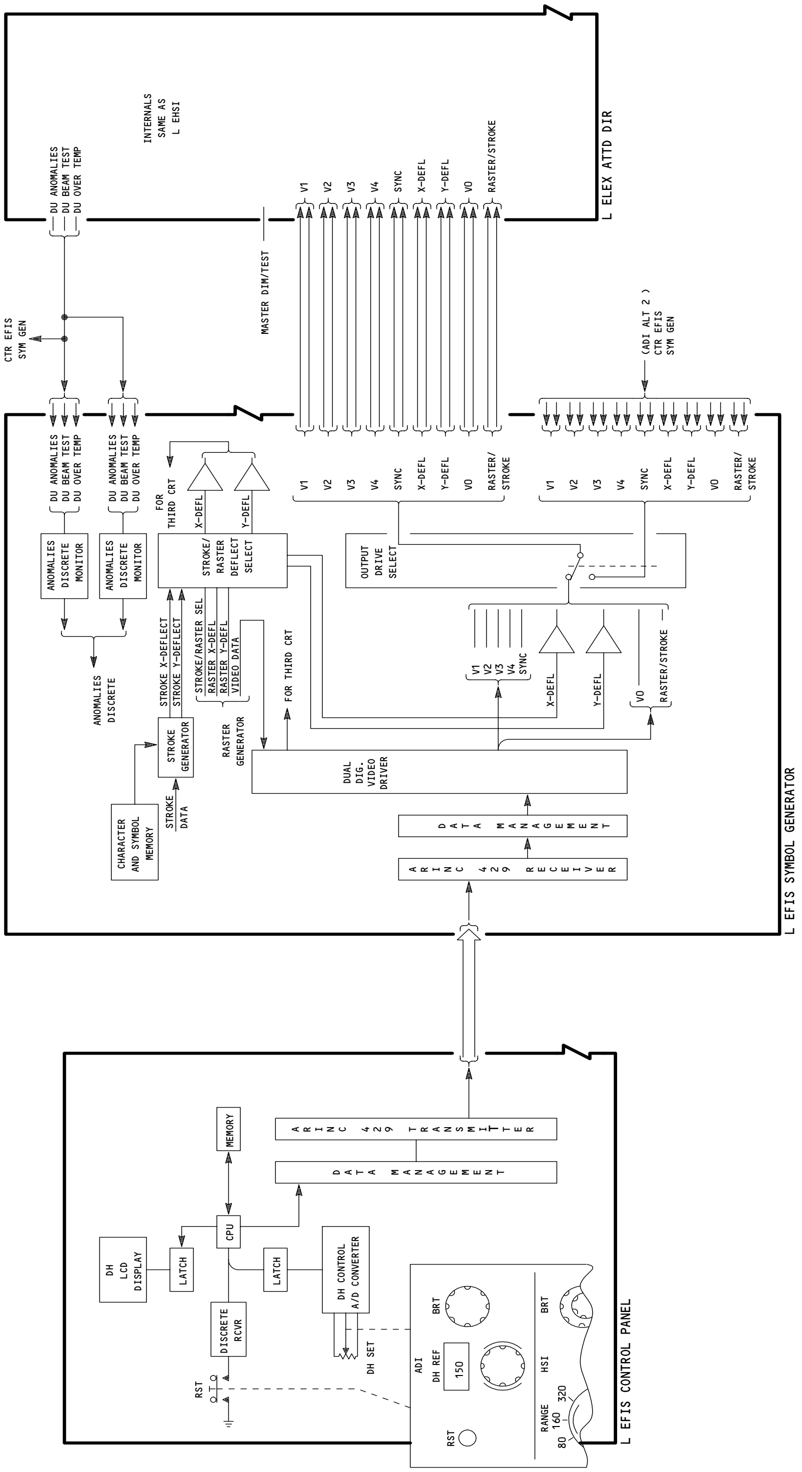
(c) The DH reset switch sends a digital discrete to the symbol generator on the same ARINC 429 bus. This signal causes the symbol generator to reset the DH alert.

(d) GUI 009;
The DH alert is provided by the decision height aural warning module (AMM 31-51-00/001).

(e) GUI 001-008, 010-999;
The DH alert is provided by the siren owl module (AMM 31-51-00 001).

(f) The EADI uses the same symbol generator as the EHSI. Most of the circuits are used by both displays. The EADI utilizes some independent circuits. Whether common or independent, the basic theory of symbol generation is the same. The main differences are the types of input, the symbol/character memory, and the output data. Symbol generator circuits which are shared by the EADI and EHSI are as follows:

1) Input processing and switching circuits.
2) BITE circuits
3) Display Control Circuits
4) Control Memory/CAPS Processor Circuits
5) Display sequencer
6) Raster generator (used on EADI for sky/ground display; on EHSI for WXR display)
7) Output switching relay



EFIS - EADI Schematic (Example)
Figure 8

(g) The circuits which are duplicated for EADI use, are as follows:
   1) Stroke generator
   2) Stroke/Raster Deflection Select circuits
   3) Display Driver circuits
   4) Symbol Generator display output pins.

(h) The EADI is electrically identical to the EHSI. The theory of operation is also the same. The EADI does have raster circuits but, rather than WXR data they provide the sky/ground display.

(8) Right EFIS EADI Control

(a) The EADI portion of the right control panel operates in the same manner as the left.

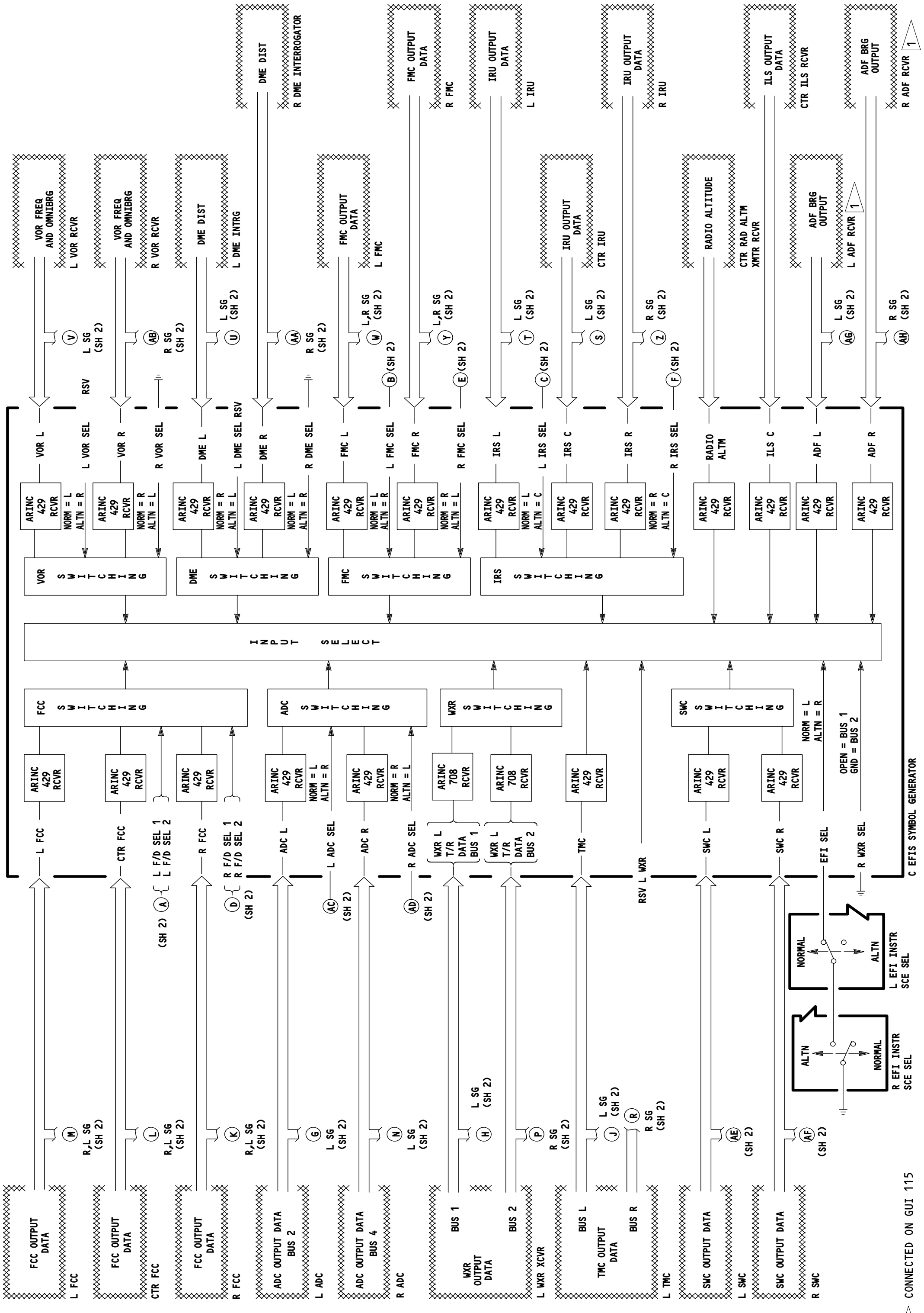
(b) The right symbol generator operates in the same manner as the left.

(c) Normally, the right symbol generator supplies data to the right EADI. The EFI switch on the right instrument source select panel, in the ALTN position, switches the right EADI to the center symbol generator. The left EADI provides DU anomilies discretes to the center symbol generator.

(d) The right EADI operates in the same manner as the left.

(9) EFIS - Digital Data Bus Switching (Fig. 9)

(a) The EFIS symbol generators receive input data from the airplane's navigation systems on digital data buses. All the data except WXR, is transmitted on ARINC 429 digital data buses. The WXR data is transmitted on ARINC 453, very high speed, digital data buses. In most cases due to system redundancy, each symbol generator receives a system's input data from more than one system component. Selection of a normal or alternate system component is controlled by the switches on the instrument source select panels. The actual switching however, is executed by relays within the symbol generators. The two general categories of input data are non-switched and switched. The non-switched data is defined as, data that the symbol generator receives from only one system component, (ex. the left symbol generator receives radio altitude from only the left RA R/T unit). The switched data occurs when one of two system components can be selected (ex. the left symbol generator receives nav data from either the left or right FMC).



Flight Instrument Data Bus Switching Schematic
Figure 9 (Sheet 1)

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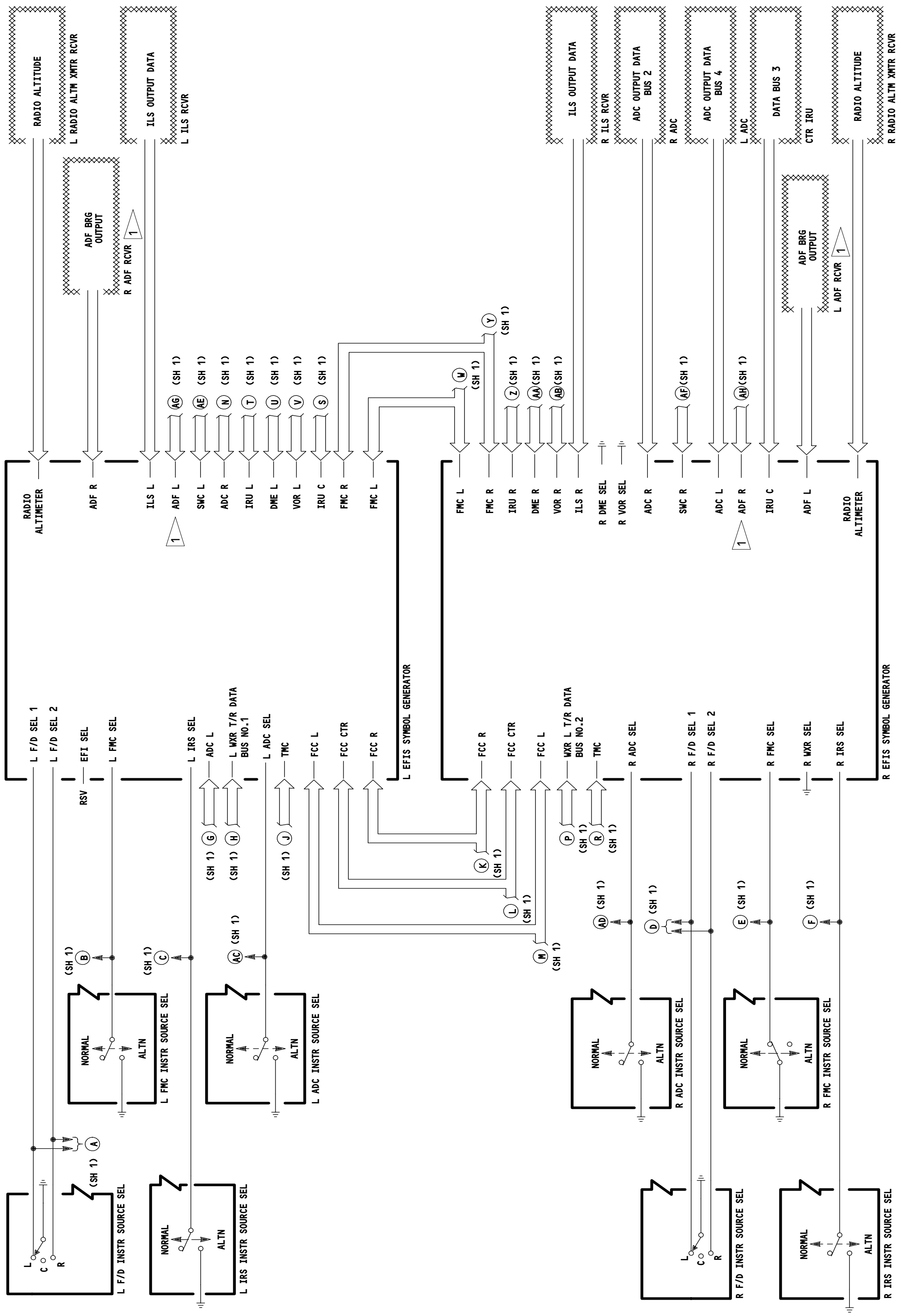

Flight Instrument Data Bus Switching Schematic
Figure 9 (Sheet 2)

(10) L&R EFIS SG Data Buses - Non-Switched
   (a) The left EFIS symbol generator receives non-switched data from the following system components:
      1) The left radio altimeter (RA) provides radio altitude and RA status (AMM 34-33-00/001).
      2) The left ILS or multi-mode receiver provides LOC and G/S deviation data and ILS status (AMM 34-31-00/001).
      3) The left VOR provides selected VOR course and frequency, VOR bearing, and VOR status (AMM 34-51-00/001).
      4) The left DME provides computed distance and DME status (AMM 34-55-00/001).
      5) GUI 115;
      The left and right ADF receivers provide ADF bearing and ADF status.
      6) The left SWC provides pitch limit data and SWC status (AMM 27-32-00/001).
      7) The TMC provides auto throttle fast/slow command data and TMC status discretes (AMM 22-32-00/001).
      8) The WXR XCVR provides weather and ground return data, antenna azimuth, and WXR status (AMM 34-43-00/001).
   (b) The right EFIS symbol generator receives the same system data from the right system components. Only one TMC is installed and provides the same data to both symbol generators.

(11) L & R EFIS S.G. Data Busses - Switched (Fig. 9A)
   (a) Under normal conditions the left symbol generator receives input data from left system components. Some systems, however, transmit more than one independent output to the symbol generator. Selection of an alternate source input, from these systems, is controlled by the switches on the instrument source select panels. Each switchable system has a dedicated switch. The following table lists these systems and their input data. It also lists the sources, and their controlling switch and its location.
   (b) The right EFIS symbol generator normally receives information from the right components of the above systems. The systems, input data, and components are the same. The controlling switches are on the right instrument source select panel.

(12) EFIS Center Symbol Generator Input (Fig. 9B).
   (a) The center symbol generator provides back-up capability in the event the left or right symbol generator fails. It is selected as a back-up by either EFI switch on the instrument source select panels. If the captain selects the alternate (center) symbol generator, the left navigation systems will still provide input. The right systems will feed the center symbol generator if it is selected by the F/O. If both select the alternate symbol generator, the left systems will provide input and the captain's instruments will provide control. Table III relates system input to instrument source select switch position, for the center symbol generator.

System (AMM Ref)	Input Data	Source	Controlling Switch (Normal Component)	Switch Location
Flight Director (F/D) (22-11-00)	ADFD Mode status, F/D pitch and roll, selected heading, and TMS Mode Status.	Left, right, and center FCC	Captain's F/D instrument source select switch (L)	Left instrument source select panel
Flight Management Computer (FMC) (34-61-00)	Nav data such as: • Position, speed, drift angle, track data, windspeed and direction, display symbology.	Left and right FMCs	Captain's FMC instrument source select switch (L)	Left instrument source select panel
Inertial Reference System (IRS) (34-21-00)	Position data such as: • Pitch and roll, mag heading, ground speed track angle, flight path angle and accel, and wind speed and angle.	Left, right and center IRUs.	Captain's IRS instrument source select switch (L)	Left instrument source select panel
Air Data Computer (ADC) (34-12-00)	Computed Airspeed, MACH, True Airspeed, and ADC status	Left and right ADCs	Capt's ADC instrument source select switch (L)	Left instrument source select panel

LEFT SYMBOL GENERATOR - SWITCHED INPUT DATA BUSSES
TABLE II

EFIS - Left Symbol Generator Input
Figure 9A

TABLE III - EFIS CENTER SYMBOL GENERATOR INPUT

INPUTS TO CENTER SYMBOL GENERATOR		LEFT EFI SWITCHED TO ALTERNATE								RIGHT EFI SWITCHED TO ALTERNATE							
		OTHER LEFT SWITCHES IN NORMAL				OTHER LEFT SWITCHES IN ALTERNATE				OTHER RIGHT SWITCHES IN NORMAL				OTHER RIGHT SWITCHES IN ALTERNATE			
		F/D	FMC	IRS	ADC	F/D	FMC	IRS	ADC	F/D	FMC	IRS	ADC	F/D	FMC	IRS	ADC
FCC	SWITCHED	L	N/C	N/C	N/C	R OR C	N/C	N/C	N/C	R	N/C	N/C	N/C	L OR C	N/C	N/C	N/C
FMC		N/C	L	N/C	N/C	N/C	R	N/C	N/C	N/C	R	N/C	N/C	N/C	L	N/C	N/C
IRU		N/C	N/C	L	N/C	N/C	N/C	C	N/C	N/C	N/C	R	N/C	N/C	N/C	C	N/C
ADC		N/C	N/C	N/C	L	N/C	N/C	N/C	R	N/C	N/C	N/C	R	N/C	N/C	N/C	L
VOR RCVR	NON SWITCHED	LEFT VOR RECEIVER								RIGHT VOR RECEIVER							
DME INTER-ROGATOR		LEFT DME INTERROGATOR								RIGHT DME INTERROGATOR							
SWC		LEFT STALL WARNING COMPUTER								RIGHT STALL WARNING COMPUTER							
WXR		WEATHER RADAR TRANSCEIVER															
TMC		THRUST MANAGEMENT COMPUTER															
RA RCVR-XMTR		CENTER RADIO ALTIMETER RECEIVER/TRANSMITTER															
ILS RCVR		CENTER ILS RECEIVER															
ADF RCVR 1		LEFT AND RIGHT ADF RECEIVERS															

L - LEFT UNIT
C - CENTER UNIT
R - RIGHT UNIT
N/C - NO CHANGE WHEN SWITCHED
1 CONNECTED ON GUI 115

EFIS - Center Symbol Generator Input
Figure 9B

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(13) Digital Data Bus - Signal Processing

(a) Within the three symbol generators, the digital data buses are all accepted by ARINC 429 receivers. The received data is routed to the internal switching circuits. These receive one bus for each of the input system components. The switching circuits are controlled by program pins and/or they are controlled by the IRS, FMC or NAV, AIR DATA, and F/D instrument source switches. The program pin arrangements determine whether the symbol generator operates as a left, right, or center component. This programs the symbol generator to use the correct input data. In the left and right symbol generators, this circuit is permanently programmed. The center symbol generator input select circuit is controlled by the EFI switches on the instrument source select panels. This enables the center symbol generator to operate as a left or right symbol generator. The EFI switches are connected in series. This causes the center symbol generator to operate as a left symbol generator when selected by both the Captain and F/O. The selected input data is then processed, for display, as previously discussed.

(14) EFIS - Flight Instrument System Switching (Fig. 10)

(a) The switches on the instrument source select panels provide switching capability for critical NAV systems. In the event of a failure the crew can switch from a primary (normal) to a back-up (alternate) system.

(b) If the captain and F/O both select the center EFIS symbol generator, a Level B caution message will be shown on the EICAS.

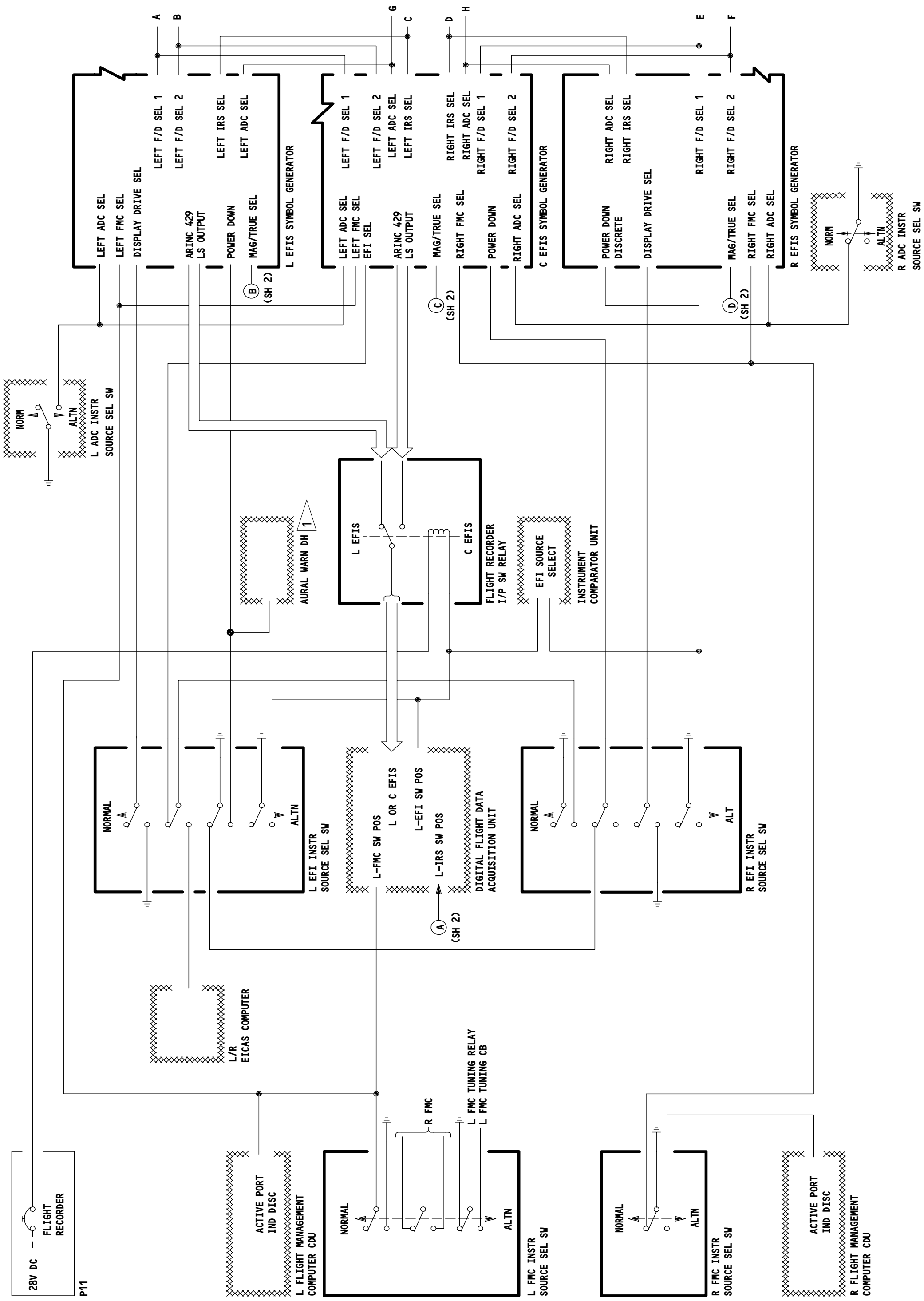
(c) If both EFI switches are in the ALTN position, the captain and F/O both on relay will energize. This provides the captain with complete control of the EFIS.

(d) Table IV describes the conditions which exist for the EFI and FMC switches in the normal and alternate positions (Fig. 10A).

(e) Table V describes the conditions which exist for the IRS and F/D switches in normal and alternate positions (Fig. 10B).

B. BITE (Fig. 11)

(1) If a fault is detected in the data from an interfacing system, the EADIs and EHSIs will display a fault annunciation. They will also annunciate any detected faults within the EFIS system. Most faults from interfacing systems are detected in the respective system. In this case a message is then transmitted to the symbol generator as a digital fault word. The symbol generator also checks the data for parity, presence, and correct labels. EFIS faults can be detected in the symbol generators, control panels, or the display units.



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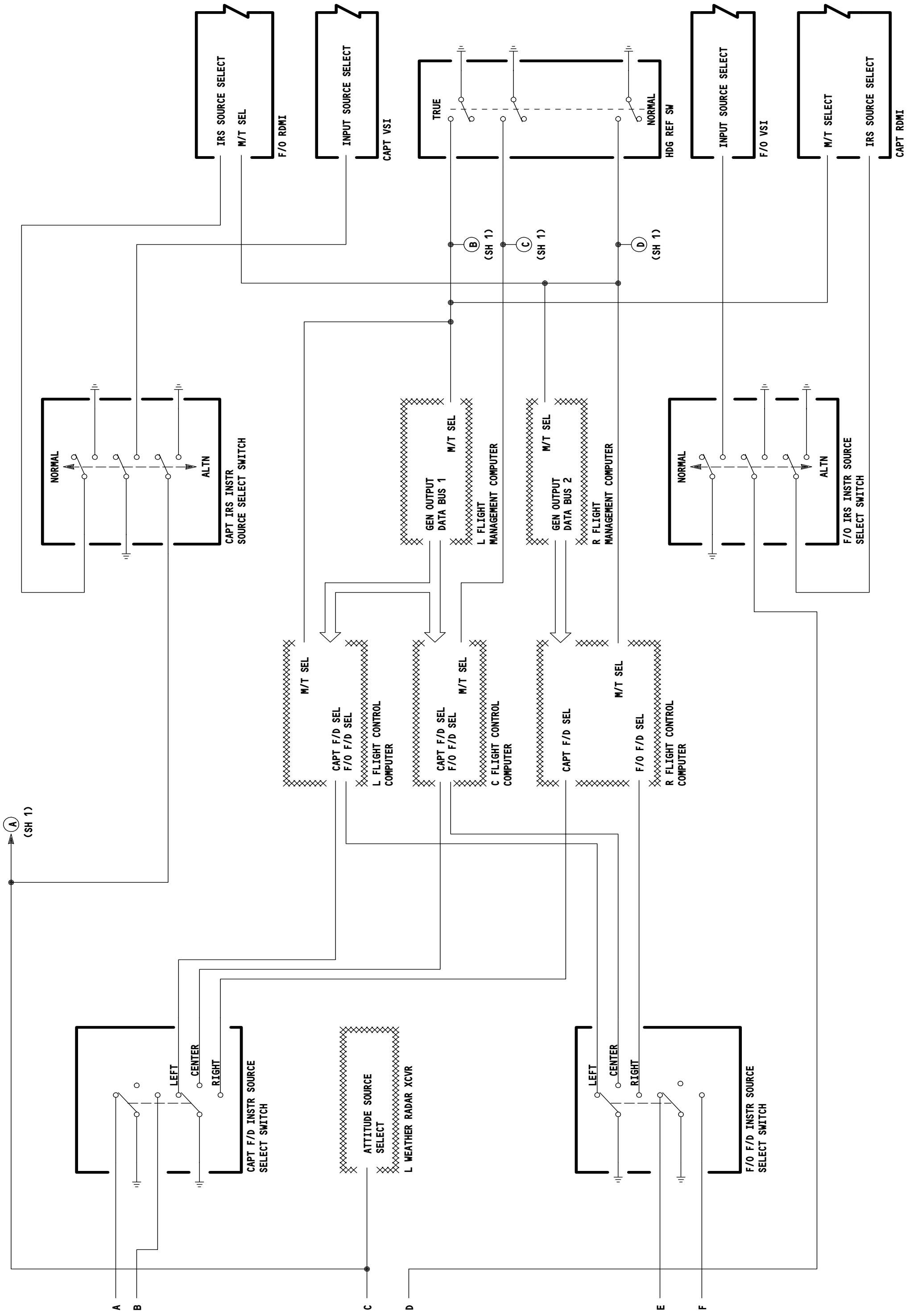
Flight Instrument Switching Schematic
Figure 10 (Sheet 1)



Flight Instrument Switching Schematic
Figure 10 (Sheet 2)

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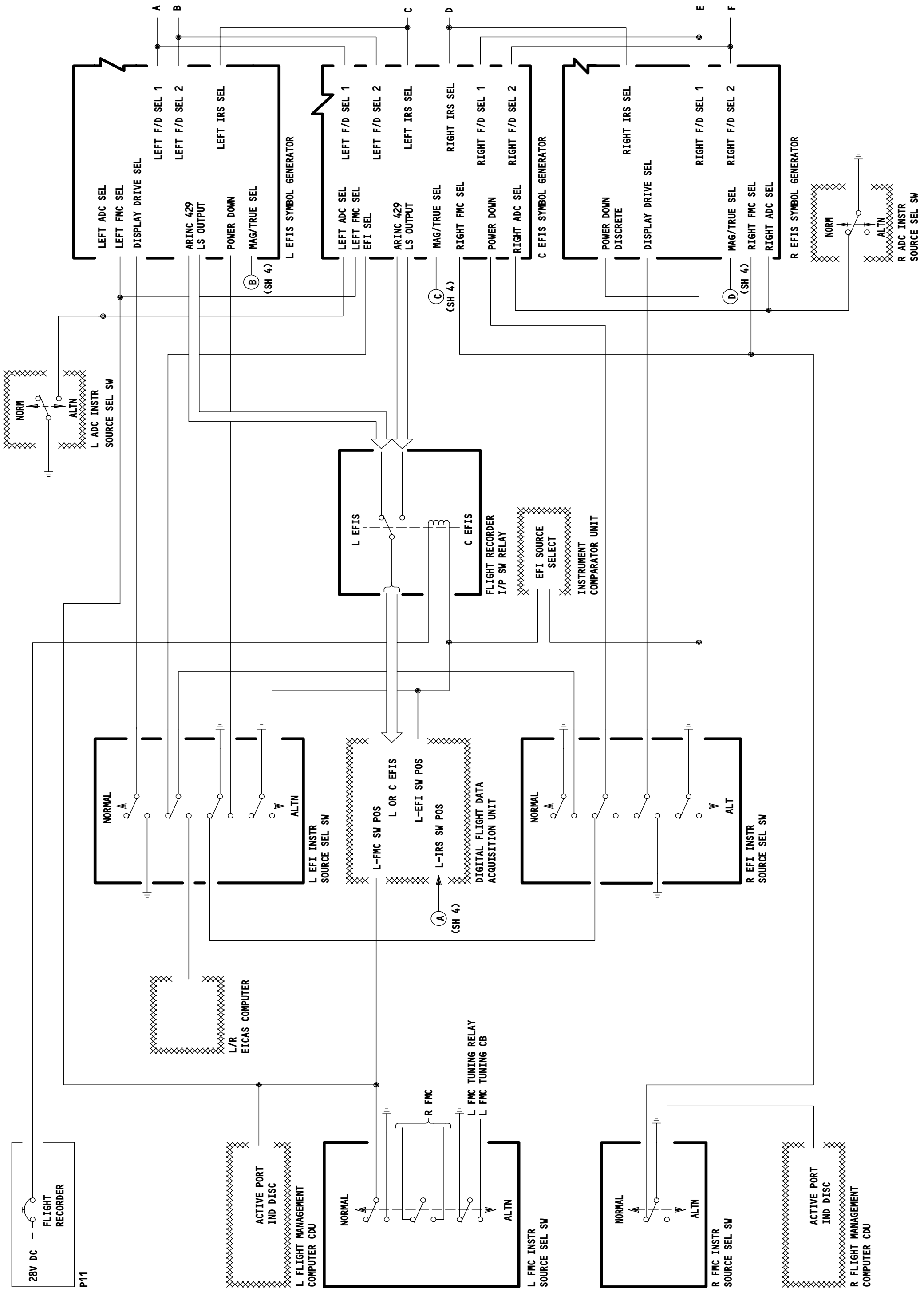
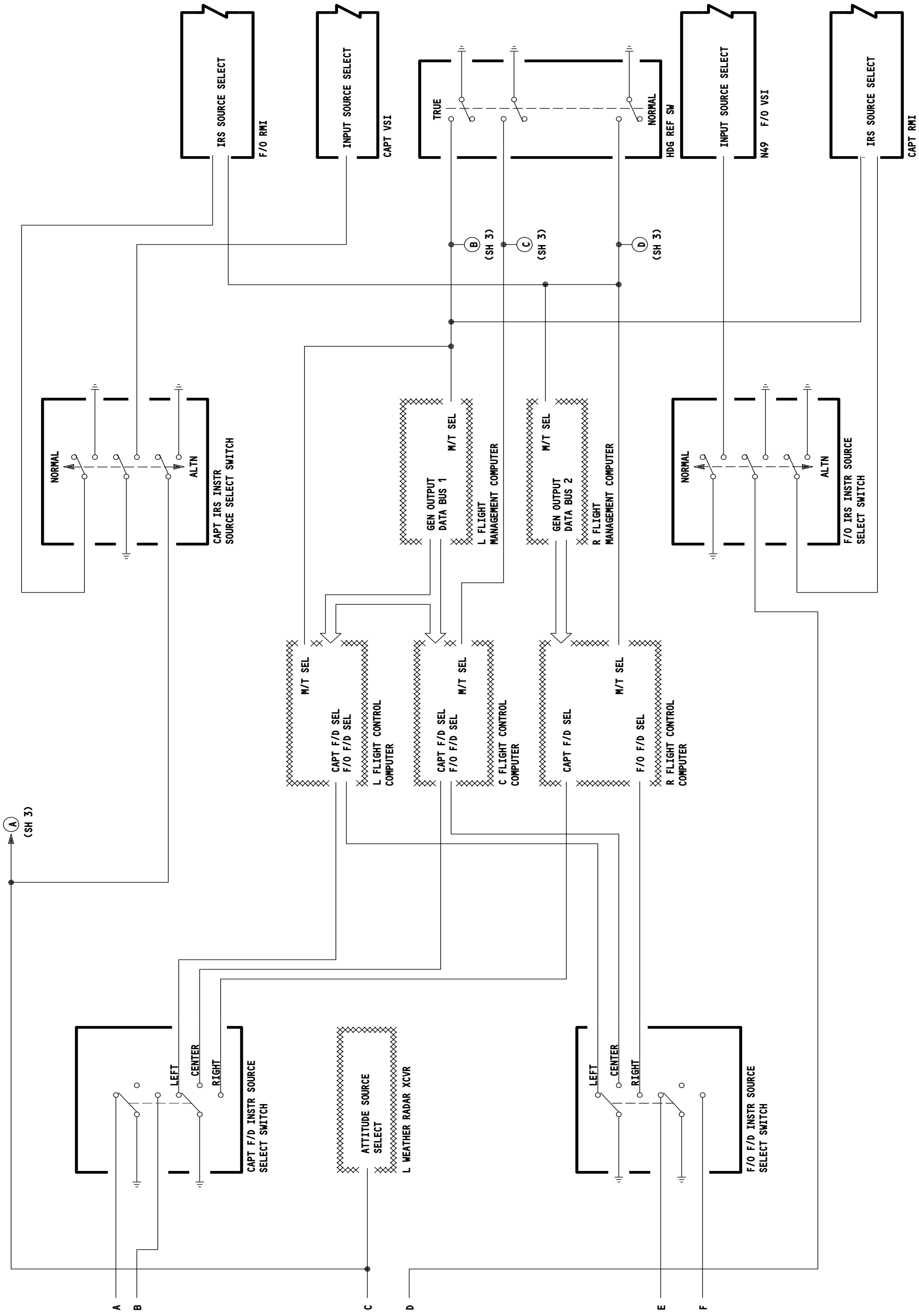


Flight Instrument Switching Schematic
Figure 10 (Sheet 3)



Flight Instrument Switching Schematic
Figure 10 (Sheet 4)

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TABLE IV - FMC AND EFI INSTRUMENT SOURCE SELECT SWITCHES

Instrument Source Select Switch	Normal Position Conditions	Alternate Position Conditions
Left FMC	Left FMC bus 1 supplied to left VOR and left DME and bus 2 supplied to right VOR and right DME. (Hi discrete sent to left and center EFIS S.G.s, left FMC CDU and L FMC TUNING RELAY)	Right FMC, bus 1 supplied to left VOR and left DME and bus 2 supplied to right VOR and right DME. (lo discrete sent to same components).
Right FMC	Lo discrete sent to right and center EFIS S.G.s. Hi discrete sent to right FMC CDU.	Hi discrete sent to right and center EFIS S.G.s. Lo discrete sent to right FMC CDU.
Left EFI	Hi discrete sent to left EFIS S.G. display drive select (left EFIS S.G. drives left displays) Hi discrete sent to center EFIS S.G. EFI select (switch to left inputs and left S.G. output). Hi discrete sent to DFDAU and Flt Rec EFIS I/P relay (left EFIS S.G. output to DFDAU). Lo discrete to center EFIS S.G. power down (C-S.G. off).	Lo discrete sent to left EFIS S.G. display drive select (center EFIS S.G. drives displays). Hi discrete sent to center EFIS S.G. EFI select (switch to left inputs and left S.G. outputs). Lo discrete sent to DFDAU and Flt Rec EFIS I/P relay (center EFIS S.G. output to DFDAU). Lo discrete to left EFIS S.G. power down (L-S.G. off).
Right EFI	Hi discrete sent to center EFIS S.G. EFI select (switch to left inputs and left S.G. output). Lo discrete sent to center EFIS S.G. power down (C-S.G. off). Hi discrete sent to right EFIS S.G. display drive sel. (right EFIS S.G. drives right displays)	Lo discrete sent to center EFIS S.G. EFI select (switch to right inputs and right S.G. output. Hi discrete sent to center EFIS S.G. power down (C-S.G. on). Lo discrete sent to right EFIS S.G. display drive sel. (center EFIS S.G. drives right displays).

<u>NOTE</u>: The information in the table assumes that both switches are not in the same position. If they are, the conditions for the left switch alternate position will occur.

EFIS - Instrument Source Select Switches
Figure 10A

TABLE V - IRS AND F/D INSTRUMENT SOURCE SELECT SWITCHES

Instrument Source Select Switch	Normal Position Conditions	Alternate Position Conditions
Left IRS	Lo discrete sent to right RDMI (RMI) - IRS select. Hi discrete sent to left VSI - IRS select. Hi discrete sent to left and center EFIS S.G., and WXR XCVR - IRS select. Hi discrete sent to Antiskid/Autobrake system - IRS select. (All use L-IRS Data).	Hi discrete sent to right RDMI (RMI) - IRS select. Lo discrete sent to left VSI - IRS select. Lo discrete sent to left and center EFIS S.G., and WXR XCVR - IRS select. Lo discrete sent to Antiskid/Autobrake system - IRS select. (All use C-IRS Data).
Right IRS	Hi discrete sent to Antiskid/ Autobrake system - IRS select. Lo discrete sent to center IRU for left or right ADC select. Hi discrete sent to right VSI - IRS select. Hi discrete sent to right and center EFIS S.G., and WXR XCVR - IRS select. Lo discrete sent to left RDMI (RMI) - IRS select. (All use R-IRS Data).	Lo discrete sent to Antiskid/ Autobrake system - IRS selct. Hi discrete sent to center IRU for left or right ADC select. lo discrete sent to right VSI - IRS select. Lo discrete sent right and center EFIS S.G., and WXR XCVR - IRS select. Hi discrete sent to to left RDMI (RMI) - IRS select. (All use C-IRS Data).
Left F/D	Lo discrete to selected (L,R or C) FCC. Lo discrete to left and center EFIS S.G. - F/D select.	Same as Normal
Right F/D	Lo discrete to selected (L,R, or C) FCC. Lo discrete to right and center EFIS S.G. - F/D select.	Same as Normal

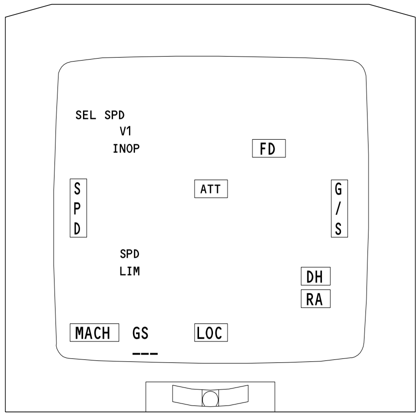
NOTE: The information in the table assumes that both switches are not in the same position. If they are, the conditions for the left switch alternate position will occur.

EFIS - Instrument Source Select Switches
Figure 10B

EADI - FAULT DISPLAYS

SEE A

REMOVED DATA	FLAG	COLOR	CONDITION
HORIZON LINE, PITCH LINES, ROLL POINTER, SKY/GROUND, AND PITCH LIMIT.	ATT	YELLOW	INVALID PITCH AND/OR ROLL DATA FROM IRS.
	NONE	---	NCD PITCH AND/OR ROLL DATA FROM IRS.
FLIGHT DIRECTOR COMMAND BARS	FD	YELLOW	INVALID PITCH AND/OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.
	NONE	---	NCD PITCH AND/OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.
SINGLE FLIGHT DIRECTOR COMMAND BAR [2]	NONE	---	INVALID OR NCD PITCH OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.



A

REMOVED DATA	FLAG	COLOR	CONDITION
GLIDE SLOPE POINTER AND SCALE.	G/S	YELLOW	INVALID GLIDE SLOPE DATA FROM ILS.
GLIDE SLOPE POINTER	NONE	---	NCD GLIDE SLOPE DATA FROM ILS.
LOCALIZER POINTER AND SCALE.	LOC	YELLOW	INVALID LOCALIZER DATA FROM ILS.
LOCALIZER POINTER	NONE	---	NCD LOCALIZER DATA FROM ILS. ALSO FOR LOSS OF PRESENT TRACK FROM IRS OR SELECTED RUNWAY HEADING FROM ILS.
RA DISPLAY	RA	YELLOW	INVALID RADIO ALTITUDE FROM RA.
	NONE	---	NCD RADIO ALTITUDE FROM RA
DECISION HEIGHT NUMERICS AND CHARACTERS	DH	YELLOW	INVALID OR NCD SELECTED DH FROM EFIS CONTROL PANEL. FLAG NOT DISPLAYED IF RA >999.
RISING RUNWAY AND STEM	LOC	YELLOW	INVALID LOCALIZER FROM ILS.
	NONE	---	NCD LOCALIZER FROM ILS.
RISING RUNWAY REMOVED, STEM USED FOR LOCALIZER	NONE	---	INVALID OR NCD RADIO ALTITUDE FROM RA.
GROUNDSPEED NUMERICS CHARACTERS	NONE	---	INVALID GROUNDSPEED FROM FMS AND IRS.
GROUNDSPEED NUMERICS	GS ---	WHITE	NCD GROUNDSPEED FROM FMS AND IRS.
AFDS OR TMS CHARACTERS	NONE	---	INVALID OR NCD FLIGHT MODE ANN FROM AFDS OR TMS.
LINE THROUGH AFDS OR TMS CHARACTERS	~~LNAV~~	YELLOW	FMA FAULT BIT SET IN DISCRETE WORD FROM AFDS OR TMS.
PITCH LIMIT SYMBOL	NONE	---	INVALID OR NCD PITCH LIMIT FROM SWC.
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL (NOT SHOWN)	WHITE	SYMBOL GENERATOR FAILURE [1]

[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY

[2] GUI 002-006,010-114,116-999

EFIS - Fault Displays
Figure 11 (Sheet 1)

985866

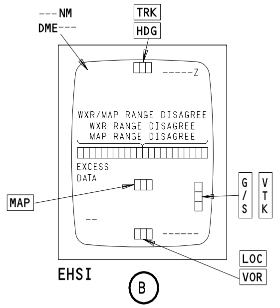
REMOVED DATA	FLAG	COLOR	CONDITION
MIN FLAP RETRACTION SPEED SYMBOL (-F)	NONE	N/A	MIN FLAP RETRACTION SPD INVALID OR NCD
ALL AIRSPEED TAPE SYMBOLOGY	S P D	YELLOW	COMPUTED AIRSPEED INVALID. WHEN "SPD" FLAG DISPLAYED, "MACH" "SPD LIM", "SEL SPD", AND "V1 INOP" FLAGS ARE NOT DISPLAYED (AS LISTED BELOW)
NORMAL AIRSPEED DISPLAY WITH INDICATION OF 30 KTS.	N/A	N/A	COMPUTED AIRSPEED NCD
MACH NUMBER	MACH	YELLOW	INVALID MACH
	————	WHITE	MACH NCD
DECISION SPEED V1 SYMBOL (-1)	V1 INOP	YELLOW	V1 INVALID OR NCD
MIN OPERATING SPEED SYMBOL (BAR)	NONE	N/A	MINIMUM OPER SPD INVALID
ROTATION SPEED VR SYMBOL (-R)	NONE	N/A	ROTATION SPD INVALID OR NCD
STICK SHAKER SPEED SYMBOL (BARBER POLE)	SPD LIMIT	YELLOW	STICK SHAKER SPEED INVALID
	NONE	N/A	STICK SHAKER SPEED NCD
MAX OPERATING SPEED SYMBOL (BARBER POLE)	SPD LIMIT	YELLOW	MAX OPER SPD INVALID OR NCD
ENGINE-OUT SPEED SYMBOL (CIRCLE)	NONE	N/A	ENG-OUT SPD INVALID OR NCD
SELECTED TARGET SPEED POINTER	SEL SPD	YELLOW	SEL TARGET SPD INVALID
	NONE	N/A	SEL TARGET SPD NCD
HIGH-SPEED BUFFET SYMBOL (BAR)	NONE	N/A	HIGH SPEED BUFFET INVALID OR NCD
AIRSPEED TREND	NONE	N/A	INVALID OR NCD AIRSPEED TREND

EFIS - Fault Displays
Figure 11 (Sheet 2)

EHSI - FAULT DISPLAYS

SEE (B)

REMOVED DATA	FLAG	COLOR	CONDITION
LOC DEVIATION BAR AND SCALE	LOC	YELLOW	INVALID LOC FROM ILS
LOC DEVIATION BAR	NONE	---	NCD LOC FROM ILS
LATERAL DEVIATION BAR AND SCALE	VOR	YELLOW	INVALID LATERAL DEV DATA FROM VOR
LATERAL DEVIATION BAR	NONE	---	NCD LATERAL DEV FROM VOR
GLIDE SLOPE DEVIATION BAR AND SCALE	G / S	YELLOW	INVALID G/S FROM ILS
GLIDE SLOPE DEVIATION POINTER	NONE	---	NCD G/S FROM ILS
RNWY HDG POINTER AND LINE, G/S DEVIATION POINTER (LOC DEVIATION BAR ORIENTED VERTICALLY).	NONE	---	INVALID OR NCD SELECTED RUNWAY HEADING FROM ILS
COURSE POINTER AND LINE, LATERAL DEVIATION POINTER	NONE	---	INVALID OR NCD SELECTED COURSE HEADING FROM VOR
DISTANCE NUMERICS AND DME CHARACTERS	NONE	---	INVALID DISTANCE FROM DME OR TUNED DME FREQUENCY DOES NOT CORRESPOND TO SELECTED ILS OR VOR STATION
DISTANCE NUMERICS	DME---	WHITE	NCD DISTANCE FROM DME
ILS FREQUENCY NUMERICS	NONE	---	INVALID ILS FREQUENCY
ILS FREQUENCY NUMERICS	------	GREEN	NCD ILS FREQUENCY
HEADING TAPE AND NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS, HDG AND MAG/TRUE, WINDSPEED AND ARROW	HDG	YELLOW	INVALID HDG FROM IRS (TRK FROM FMC - VALID OR INVALID)
HEADING TAPE NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS, WINDSPEED AND POINTER	---	WHITE	NCD HDG FROM IRS (TRK FROM FMC - VALID OR INVALID)



REMOVED DATA	FLAG	COLOR	CONDITION
TRACK LINE	NONE	---	INVALID OR NCD TRACK FROM FMC (HDG FROM FMC VALID)
ALL MAP DATA	MAP	YELLOW	INVALID OR NCD MAP DATA FROM FMC
ALL NON-ACTIVE FLIGHT PLAN DATA	EXCESS DATA	YELLOW	MORE INPUT (SELECTED) DATA THAN CAN BE DISPLAYED
NONE (REF 34-43-00 AND 34-61-00)	WXR/MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) RANGE DISAGREES W/BOTH WXR AND FMC COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	WXR RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND FMC RANGE DISAGREE W/WXR COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND WXR RANGE DISAGREE W/FMC COMPUTED RANGE
TRACK TAPE AND NUMERICS, SELECTED HEADING MARKER AND LINE, PRESENT HEADING MARKER, TRK READOUT NUMERICS, TRK, MAG/TRUE, WINDSPEED ARROW AND NUMERICS (WXR DISPLAY REMAINS, HDG UP)	TRK	YELLOW	INVALID TRACK DATA FROM FMC (IRS HDG DATA - VALID OR INVALID) AND IRS TRACK INVALID
TRACK TAPE NUMERICS, SELECTED HEADING MARKER AND LINE, PRESENT HEADING MARKER, TRACK READOUT NUMERICS REPLACE W/3 DASHES, WINDSPEED REPLACE W/2 DASHES, WINDSPEED ARROW (WXR DISPLAY REMAINS, HDG UP)	---	WHITE	NCD TRACK DATA FROM FMC (IRS HDG DATA - VALID OR INVALID) AND IRS TRACK NCD OR INVALID
PRESENT HEADING MARKER	NONE	---	INVALID OR NCD HEADING FROM IRS (FMC TRACK VALID)
RANGE SCALE MARKS	NONE	---	INVALID OR NCD RANGE FROM EFIS CONTROL PANEL
Z CHARACTER AND ETA NUMERICS	NONE	---	INVALID ETA FROM FMC
ETA NUMERICS	------Z	WHITE	NCD ETA FROM FMC
NM CHARACTERS AND DISTANCE NUMERICS	NONE	---	INVALID DISTANCE FROM FMC
DISTANCE NUMERICS	---NM	WHITE	NCD DISTANCE FROM FMC
VERTICAL DEVIATION POINTER AND SCALE	V T K		INVALID VERTICAL DEVIATION FROM FMC
	NONE	---	NCD VERTICAL DEVIATION FROM FMC
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL	WHITE	SYMBOL GENERATOR FAILURE [1]

[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY

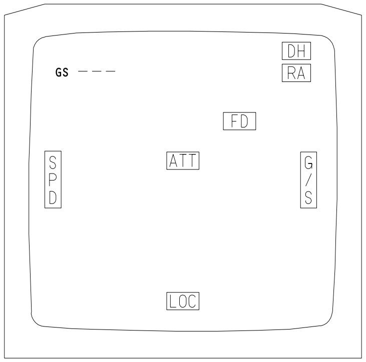
EFIS - Fault Displays
Figure 11 (Sheet 3)

830902

EADI - FAULT DISPLAYS

SEE (A)

REMOVED DATA	FLAG	COLOR	CONDITION
HORIZON LINE, PITCH LINES, ROLL POINTER, SKY/GROUND, AND PITCH LIMIT.	ATT	YELLOW	INVALID PITCH AND/OR ROLL DATA FROM IRS.
	NONE	---	NCD PITCH AND/OR ROLL DATA FROM IRS.
FLIGHT DIRECTOR COMMAND BARS	FD	YELLOW	INVALID PITCH AND ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.
	NONE	---	NCD PITCH AND ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.
SINGLE FLIGHT DIRECTOR COMMAND BAR	NONE	---	INVALID OR NCD PITCH OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.



NAV FLAGS (YELLOW)

(A)

REMOVED DATA	FLAG	COLOR	CONDITION
GLIDE SLOPE POINTER AND SCALE.	G / S	YELLOW	INVALID GLIDE SLOPE DATA FROM ILS.
GLIDE SLOPE POINTER	NONE	---	NCD GLIDE SLOPE DATA FROM ILS.
LOCALIZER POINTER AND SCALE.	LOC	YELLOW	INVALID LOCALIZER DATA FROM ILS.
LOCALIZER POINTER	NONE	---	NCD LOCALIZER DATA FROM ILS. ALSO FOR LOSS OF PRESENT TRACK FROM IRS OR SELECTED RUNWAY HEADING FROM ILS.
SPEED DEVIATION POINTER AND SCALE.	S P D	YELLOW	INVALID SPEED DEVIATION FROM TMS.
SPEED DEVIATION POINTER	NONE	---	NCD SPEED DEVIATION FROM TMS.
RA DISPLAY	RA	YELLOW	INVALID RADIO ALTITUDE FROM RA.
	NONE	---	NCD RADIO ALTITUDE FROM RA
DH CHARACTERS AND NUMERICS.	DH	YELLOW	INVALID OR NCD SELECTED DH FROM EFIS CONTROL PANEL. FLAG NOT DISPLAYED IF RA >999.
RISING RUNWAY AND STEM	LOC	YELLOW	INVALID LOCALIZER FROM ILS.
	NONE	---	NCD LOCALIZER FROM ILS.
RISING RUNWAY REMOVED, STEM USED FOR LOCALIZER	NONE	---	INVALID OR NCD RADIO ALTITUDE FROM RA.
GS CHARACTERS AND NUMERICS	NONE	---	INVALID GROUNDSPEED FROM FMS AND IRS.
GS NUMERICS	GS---	WHITE	NCD GROUNDSPEED FROM FMS AND IRS.
AFDS OR TMS CHARACTERS	NONE	---	INVALID OR NCD FLIGHT MODE ANN FROM AFDS OR TMS.
LINE THROUGH AFDS OR TMS CHARACTERS	~~LNAV~~	YELLOW	FMA FAULT BIT SET IN DISCRETE WORD FROM AFDS OR TMS.
PITCH LIMIT SYMBOL	NONE	---	INVALID OR NCD PITCH LIMIT FROM SWC.
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL (NOT SHOWN)	WHITE	SYMBOL GENERATOR FAILURE [1]

[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY

EFIS - Fault Displays
Figure 11A (Sheet 1)

862837

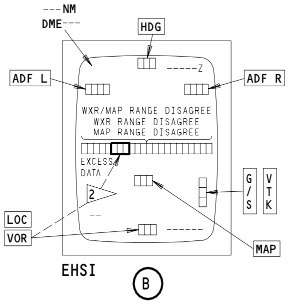
EHSI - FAULT DISPLAYS

SEE (B)

REMOVED DATA	FLAG	COLOR	CONDITION
LOC DEVIATION BAR AND SCALE	LOC	YELLOW	INVALID LOC FROM ILS
LOC DEVIATION BAR	NONE	---	NCD LOC FROM ILS
LATERAL DEVIATION BAR AND SCALE	VOR	YELLOW	INVALID LATERAL DEV DATA FROM VOR
LATERAL DEVIATION BAR	NONE	---	NCD LATERAL DEV FROM VOR
GLIDE SLOPE DEVIATION BAR AND SCALE	G/S	YELLOW	INVALID G/S FROM ILS
GLIDE SLOPE DEVIATION POINTER	NONE	---	NCD G/S FROM ILS
RNWY HDG POINTER AND LINE, G/S DEVIATION POINTER (LOC DEVIATION BAR ORIENTED VERTICALLY).	NONE	---	INVALID OR NCD SELECTED RUNWAY HEADING FROM ILS
COURSE POINTER AND LINE, LATERAL DEVIATION POINTER	NONE	---	INVALID OR NCD SELECTED COURSE HEADING FROM VOR
DISTANCE NUMERICS AND DME CHARACTERS	NONE	---	INVALID DISTANCE FROM DME OR TUNED DME FREQUENCY DOES NOT CORRESPOND TO SELECTED ILS OR VOR STATION
DISTANCE NUMERICS	DME---	WHITE	NCD DISTANCE FROM DME
ILS FREQUENCY NUMERICS	NONE	---	INVALID ILS FREQUENCY
ILS FREQUENCY NUMERICS	------	GREEN	NCD ILS FREQUENCY
HEADING TAPE AND NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS, HDG AND MAG/TRUE, WINDSPEED AND ARROW	HDG	YELLOW	INVALID HDG FROM IRS (TRK FROM FMC - VALID OR INVALID)
HEADING TAPE NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS, WINDSPEED AND POINTER	---	WHITE	NCD HDG FROM IRS (TRK FROM FMC - VALID OR INVALID)
TRACK LINE	NONE	---	INVALID OR NCD TRACK FROM FMC (HDG FROM FMC VALID)
ALL MAP DATA	MAP	YELLOW	INVALID OR NCD MAP DATA FROM FMC
ALL NON-ACTIVE FLIGHT PLAN DATA	EXCESS DATA	YELLOW	MORE INPUT (SELECTED) DATA THAN CAN BE DISPLAYED
NONE (REF 34-43-00 AND 34-61-00)	WXR/MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) RANGE DISAGREES W/BOTH WXR AND FMC COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	WXR RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND FMC RANGE DISAGREE W/WXR COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND WXR RANGE DISAGREE W/FMC COMPUTED RANGE
RANGE SCALE MARKS	NONE	---	INVALID OR NCD RANGE FROM EFIS CONTROL PANEL
Z CHARACTER AND ETA NUMERICS	NONE	---	INVALID ETA FROM FMC
ETA NUMERICS	------Z	WHITE	NCD ETA FROM FMC
NM CHARACTERS AND DISTANCE NUMERICS	NONE	---	INVALID DISTANCE FROM FMC
DISTANCE NUMERICS	---NM	WHITE	NCD DISTANCE FROM FMC
VERTICAL DEVIATION POINTER AND SCALE	VTK		INVALID VERTICAL DEVIATION FROM FMC
	NONE	---	NCD VERTICAL DEVIATION FROM FMC
ADF BEARING POINTER(S)	ADF L ADF R	YELLOW	INVALID BEARING FROM ADF
	NONE	---	NCD BEARING FROM ADF
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL (NOT SHOWN)	WHITE	SYMBOL GENERATOR FAILURE [1]

[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY.

[2] LOCATION OF LOC/VOR FLAG WHEN EFIS IS IN FULL ILS OR FULL VOR MODES



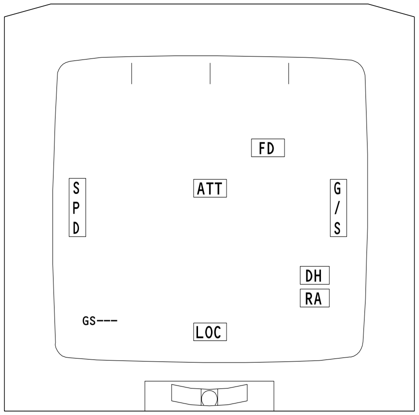
EFIS - Fault Displays
Figure 11A (Sheet 2)

EADI - FAULT DISPLAYS

SEE (A)

REMOVED DATA	FLAG	COLOR	CONDITION
HORIZON LINE, PITCH LINES, ROLL POINTER, SKY/GROUND, AND PITCH LIMIT	ATT	YELLOW	INVALID PITCH AND/OR ROLL DATA FROM IRS.
	NONE	---	NCD PITCH AND/OR ROLL DATA FROM IRS.
FLIGHT DIRECTOR COMMAND BARS	FD	YELLOW	INVALID PITCH AND/OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.
	NONE	---	NCD PITCH AND/OR ROLL FLIGHT DIRECTOR COMMANDS FROM FCC.

REMOVED DATA	FLAG	COLOR	CONDITION
GLIDE SLOPE POINTER AND SCALE	G/S	YELLOW	INVALID GLIDE SLOPE DATA FROM ILS.
GLIDE SLOPE POINTER	NONE	---	NCD GLIDE SLOPE DATA FROM ILS.
LOCALIZER POINTER AND SCALE	LOC	YELLOW	INVALID LOCALIZER DATA FROM ILS.
LOCALIZER POINTER	NONE	---	NCD LOCALIZER DATA FROM ILS. ALSO FOR LOSS OF PRESENT TRACK FROM IRS OR SELECTED RUNWAY HEADING FROM ILS.
RA DISPLAY	RA	YELLOW	INVALID RADIO ALTITUDE FROM RA.
	NONE	---	NCD RADIO ALTITUDE FROM RA
DH CHARACTERS AND NUMERICS	DH	YELLOW	INVALID OR NCD SELECTED DH FROM EFIS CONTROL PANEL. FLAG NOT DISPLAYED IF RA >999.
RISING RUNWAY AND STEM	LOC	YELLOW	INVALID LOCALIZER FROM ILS.
	NONE	---	NCD LOCALIZER FROM ILS.
RISING RUNWAY REMOVED, STEM USED FOR LOCALIZER	NONE	---	INVALID OR NCD RADIO ALTITUDE FROM RA.
GROUND SPEED NUMERICS CHARACTERS	NONE	---	INVALID GROUND SPEED FROM FMS AND IRS.
GROUND SPEED NUMERICS	GS---	WHITE	NCD GROUND SPEED FROM FMS AND IRS.
SPEED DEVIATION POINTER AND SCALE	SPD	YELLOW	INVALID SPEED DEVIATION FROM TMS.
SPEED DEVIATION POINTER	NONE	---	NCD SPEED DEVIATION FROM TMS.
AFDS OR TMS CHARACTERS	NONE	---	INVALID OR NCD FLIGHT MODE AND FROM AFDS OR TMS.
LINE THROUGH AFDS OR TMS CHARACTERS	~~LNAV~~	YELLOW	FMA FAULT BIT SET IN DISCRETE WORD FROM AFDS OR TMS.
PITCH LIMIT SYMBOL	NONE	N/A	PITCH LIMIT INVALID OR NCD
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL (NOT SHOWN)	WHITE	SYMBOL GENERATOR FAILURE [1]



(A)

[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY.

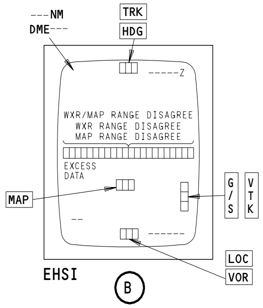
EFIS - Fault Displays
Figure 11B (Sheet 1)

C31217

EHSI - FAULT DISPLAYS

SEE (B)

REMOVED DATA	FLAG	COLOR	CONDITION
LOC DEVIATION BAR AND SCALE	LOC	YELLOW	INVALID LOC FROM ILS
LOC DEVIATION BAR	NONE	---	NCD LOC FROM ILS
LATERAL DEVIATION BAR AND SCALE	VOR	YELLOW	INVALID LATERAL DEV DATA FROM VOR
LATERAL DEVIATION BAR	NONE	---	NCD LATERAL DEV FROM VOR
GLIDE SLOPE DEVIATION BAR AND SCALE	G/S	YELLOW	INVALID G/S FROM ILS
GLIDE SLOPE DEVIATION POINTER	NONE	---	NCD G/S FROM ILS
RNWY HDG POINTER AND LINE, G/S DEVIATION POINTER (LOC DEVIATION BAR ORIENTED VERTICALLY)	NONE	---	INVALID OR NCD SELECTED RUNWAY HEADING FROM ILS
COURSE POINTER AND LINE, LATERAL DEVIATION POINTER	NONE	---	INVALID OR NCD SELECTED COURSE HEADING FROM VOR
DISTANCE NUMERICS AND DME CHARACTERS	NONE	---	INVALID DISTANCE FROM DME OR TUNED DME FREQUENCY DOES NOT CORRESPOND TO SELECTED ILS OR VOR STATION
DISTANCE NUMERICS	DME---	WHITE	NCD DISTANCE FROM DME
ILS FREQUENCY NUMERICS	NONE	---	INVALID ILS FREQUENCY
	------	GREEN	NCD ILS FREQUENCY
HEADING TAPE AND NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS, HDG AND MAG/TRUE, WINDSPEED AND ARROW	HDG	YELLOW	INVALID HDG FROM IRS (TRK FROM FMC - VALID, NCD, OR INVALID)
HEADING TAPE NUMERICS, SELECTED HDG MARKER, TRACK LINE (ORIENT COURSE POINTER AND DEV BAR VERTICALLY), HEADING READOUT NUMERICS REPLACE W/3 DASHES, WINDSPEED REPLACE W/3 DASHES, WINDSPEED ARROW	---	WHITE	NCD HDG FROM IRS (TRK FROM FMC - VALID, NCD, OR INVALID)
TRACK LINE	NONE	---	INVALID OR NCD TRACK FROM FMC (HDG FROM FMC VALID)
ALL MAP DATA	MAP	YELLOW	INVALID OR NCD MAP DATA FROM FMC
ALL NON-ACTIVE FLIGHT PLAN DATA	EXCESS DATA	YELLOW	MORE INPUT (SELECTED) DATA THAN CAN BE DISPLAYED
NONE (REF 34-43-00 AND 34-61-00)	WXR/MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) RANGE DISAGREES W/ BOTH WXR AND FMC COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	WXR RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND FMC RANGE DISAGREE W/ WXR COMPUTED RANGE
NONE (REF 34-43-00 AND 34-61-00)	MAP RANGE DISAGREE	YELLOW	DISPLAYED (SELECTED) AND WXR RANGE DISAGREE W/ FMC COMPUTED RANGE
TRACK TAPE AND NUMERICS, SELECTED HEADING MARKER AND LINE, PRESENT HEADING MARKER, TRK READOUT NUMERICS, TRK, MAG/TRUE, WINDSPEED ARROW AND NUMERICS (WXR DISPLAY REMAINS, HDG UP)	TRK	YELLOW	INVALID TRACK DATA FROM FMC (IRS HDG DATA - VALID, NCD, OR INVALID) AND IRS TRK NOT VALID
TRACK TAPE NUMERICS, SELECTED HEADING MARKER AND LINE, PRESENT HEADING MARKER, TRACK READOUT NUMERICS REPLACE W/3 DASHES, WINDSPEED REPLACE W/3 DASHES, WINDSPEED ARROW (WXR DISPLAY REMAINS, HDG UP)	---	WHITE	NCD TRACK DATA FROM FMC (IRS HDG DATA - VALID, NCD, OR INVALID) AND IRS TRK NCD OR INVALID
PRESENT HEADING MARKER	NONE	---	INVALID OR NCD HEADING FROM IRS (FMC TRACK VALID)
RANGE SCALE MARKS	NONE	---	INVALID OR NCD RANGE FROM EFIS CONTROL PANEL
Z CHARACTER AND ETA NUMERICS	NONE	---	INVALID ETA FROM FMC
ETA NUMERICS	------Z	WHITE	NCD ETA FROM FMC
NM CHARACTERS AND DISTANCE NUMERICS	NONE	---	INVALID DISTANCE FROM FMC
DISTANCE NUMERICS	---NM	WHITE	NCD DISTANCE FROM FMC
VERTICAL DEVIATION POINTER AND SCALE	VTK		INVALID VERTICAL DEVIATION FROM FMC
	NONE	---	NCD VERTICAL DEVIATION FROM FMC
ALL DATA (BOTH EHSI AND EADI BLANK)	SG FAIL	WHITE	SYMBOL GENERATOR FAILURE [1]



[1] FAULT CODES THAT MAY APPEAR WITH SG FAIL DISPLAY ARE INTERNAL SYMBOL GENERATOR FAULTS AND ARE FOR SHOP USE ONLY.

EFIS - Fault Displays
Figure 11B (Sheet 2)

C31219

(2) The two major categories of anomalies are invalid data and no computed data (NCD). Invalid data occurs when a system BITE detects a fault and determines a hardware cause. This usually causes the corresponding symbol(s) to blank and for primary display data, a yellow flag to appear. NCD occurs when a system BITE detects a lack of input data, but finds no hardware cause (ex. a transmitting ground station is out of range). This usually causes the corresponding symbol(s) to simply blank or be replaced by dashes.

(3) The figure relates the symbols and the corresponding displays for these conditions.

<u>NOTE</u>: WXR and FMC disagree conditions are described in WXR (AMM 34-43-00/001) and FMC (AMM 34-61-00/001).

C. EFIS Test Patterns (Fig. 12)

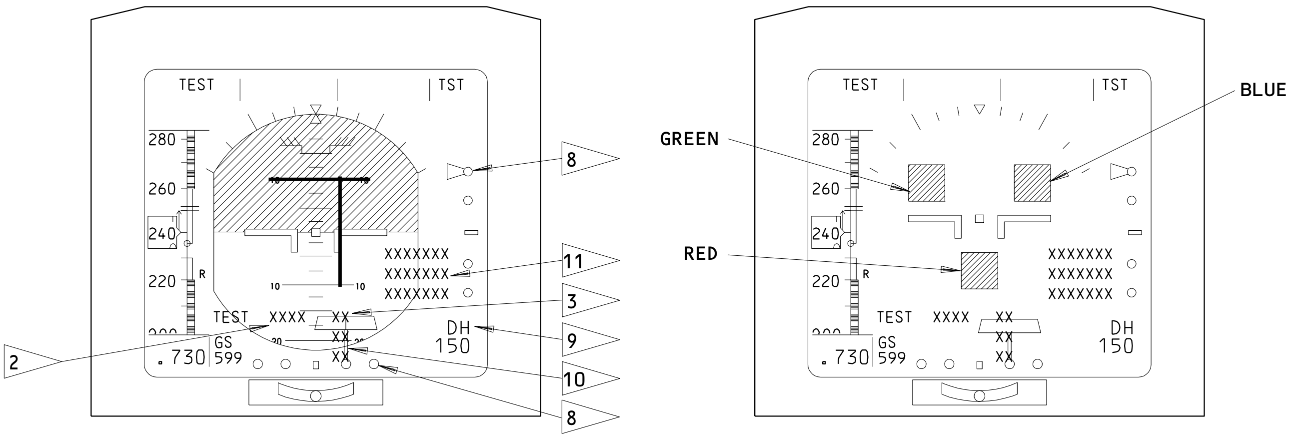
(1) When an EFIS self-test is run, the symbol generator injects a test signal into the major system components. A test pattern and the test results are displayed on the corresponding EHSIs and EADIs. The components tested and their failure indications are control panel (CP), display unit (DU), and symbol generator (SG). Each symbol generator will test itself and the corresponding DU and CP as selected by the EFI switches on the instrument source select panels.

(2) GUI 115;
The EADI displays the test pattern with the word TEST appearing in three places. Two appear in the bottom left corner and one in the bottom right corner. At the end of the test, if all parameters pass, the word OK appears beside TEST in the bottom left corner. If the test fails the word FAIL appears and listed next to the annunciation will be any faulty LRU(s) (CP, DU, or SG).

(3) GUI 001-008, 010-114, 116-999;
The EADI shows the test pattern with the word TEST shown in three places. One is shown in the bottom left corner and one is shown in the upper left corner. The third is shown as TST in the upper right corner. At the end of the test, if all parameters pass, the word OK is displayed beside TEST in the bottom left corner. If the test fails the word FAIL is shown, and listed next to the annunciation will be any faulty LRU(s) (CP, DU, or SG).

(4) GUI 009;
The EADI shows the test pattern with the word TEST shown in four places. Two are shown in the bottom left corner and one is shown in the upper left corner. The fourth is shown as TST in the upper right corner. At the end of the test, if all parameters pass, the word OK is displayed beside the highest TEST in the bottom left corner. If the test fails the word FAIL is shown, and listed next to the annunciation will be any faulty LRU(s) (CP, DU, or SG).

(5) The EADI also displays the program pin configuration. The readout will consist of three lines of hexidecimal digits and will be at the lower right side of the attitude ball in white characters.



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

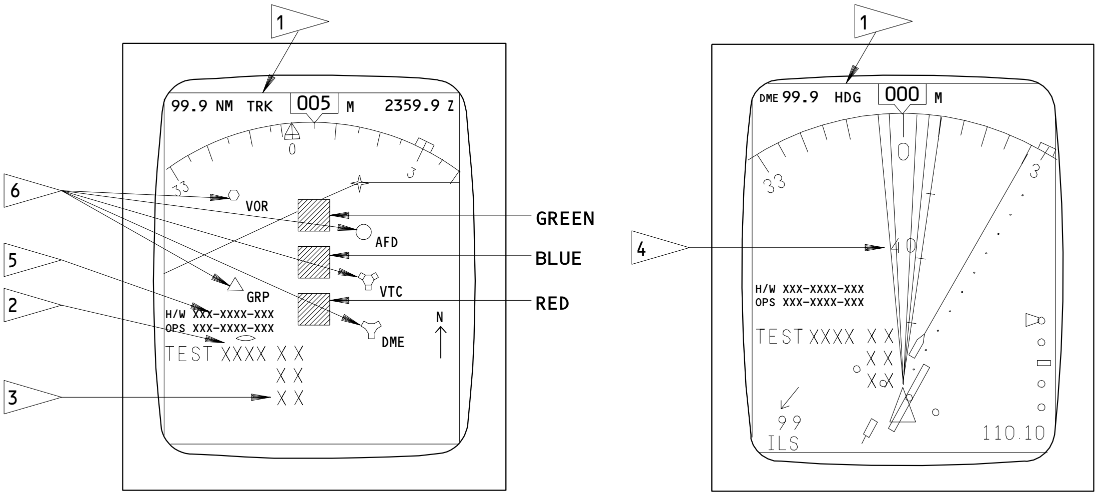
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

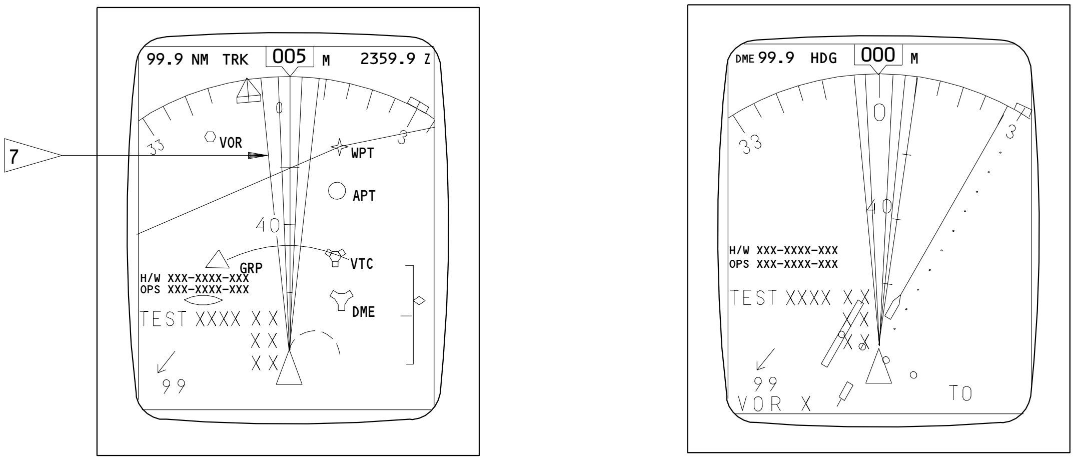
EFIS Test Patterns
Figure 12 (Sheet 1)



PLAN MODE

ILS MODE

EHSI

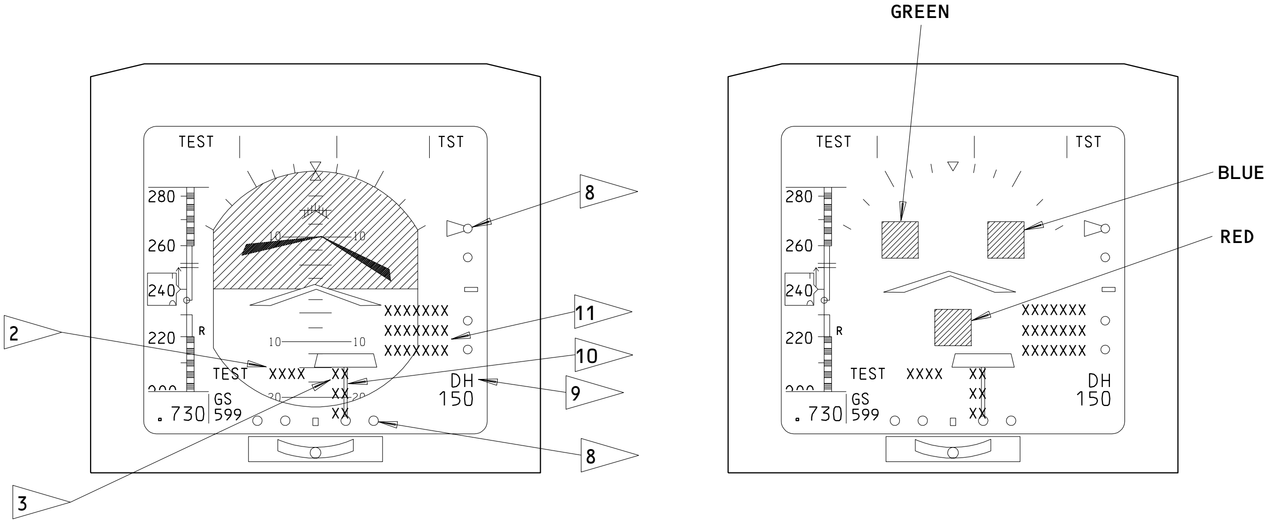


MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12 (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

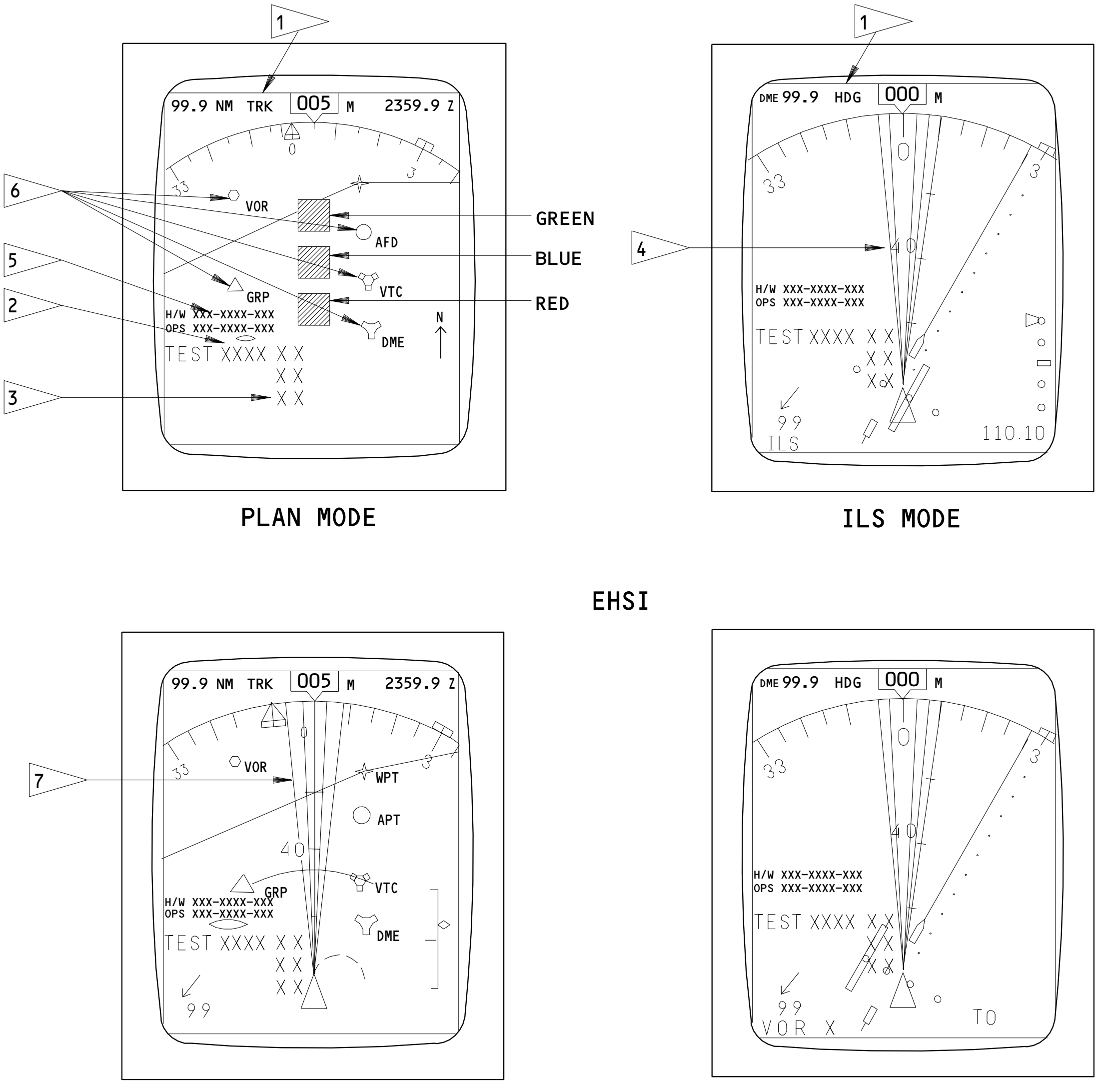
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 12A (Sheet 1)



PLAN MODE

ILS MODE

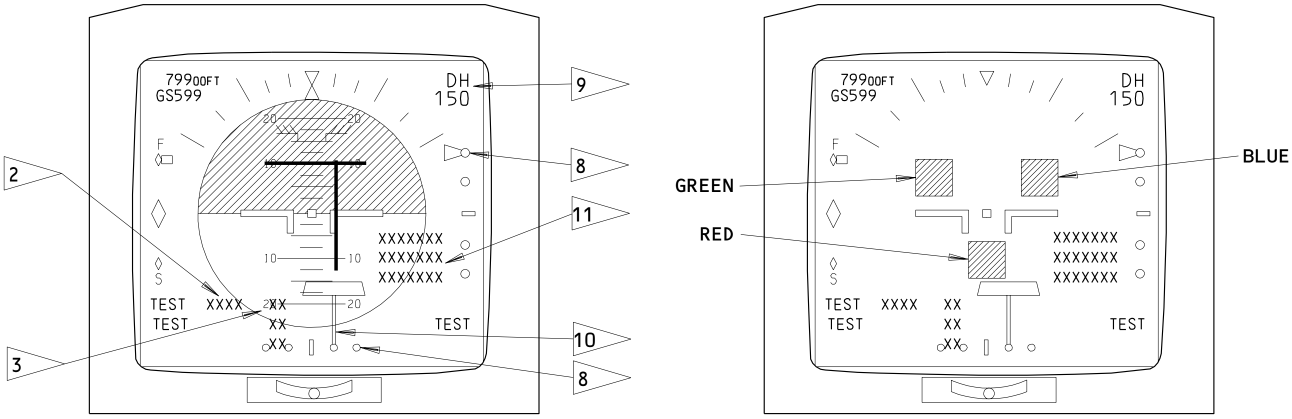
EHSI

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12A (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

<u>NOTE</u>: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

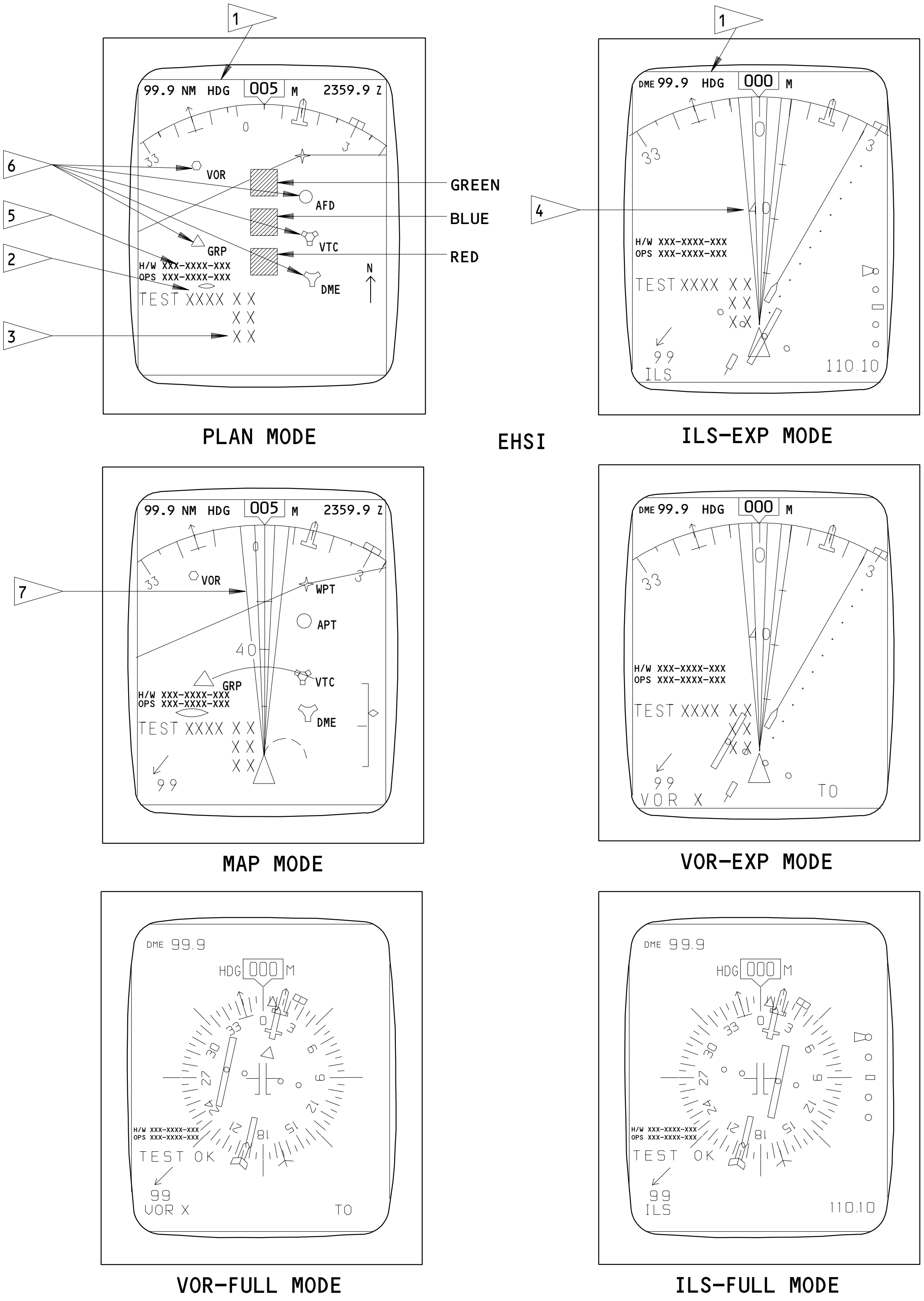
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

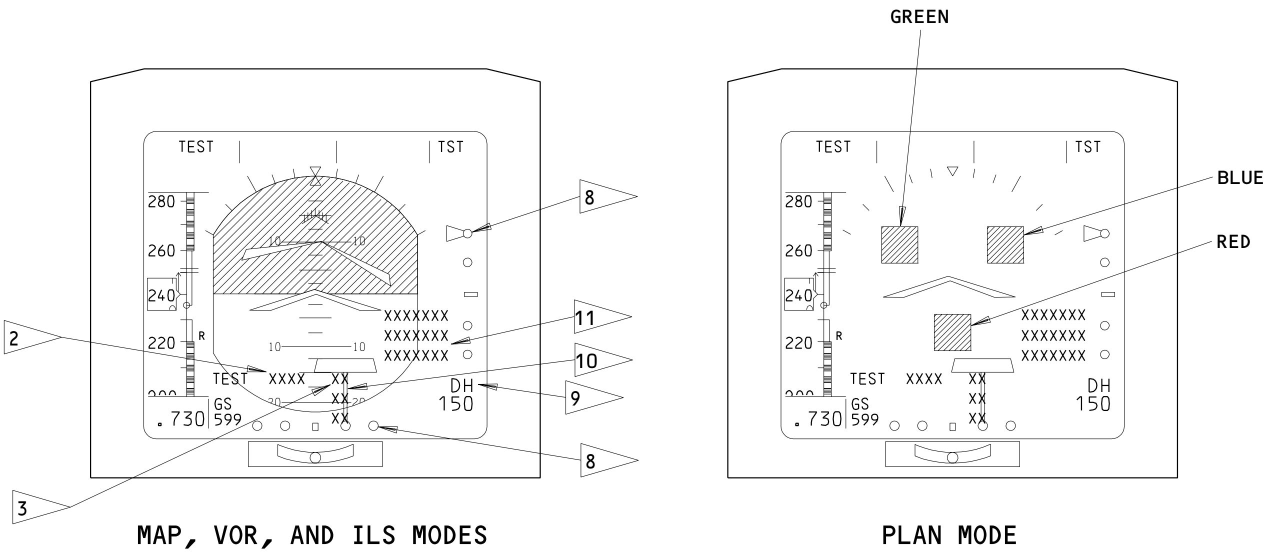
11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 12B (Sheet 1)



THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12B (Sheet 2)



EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

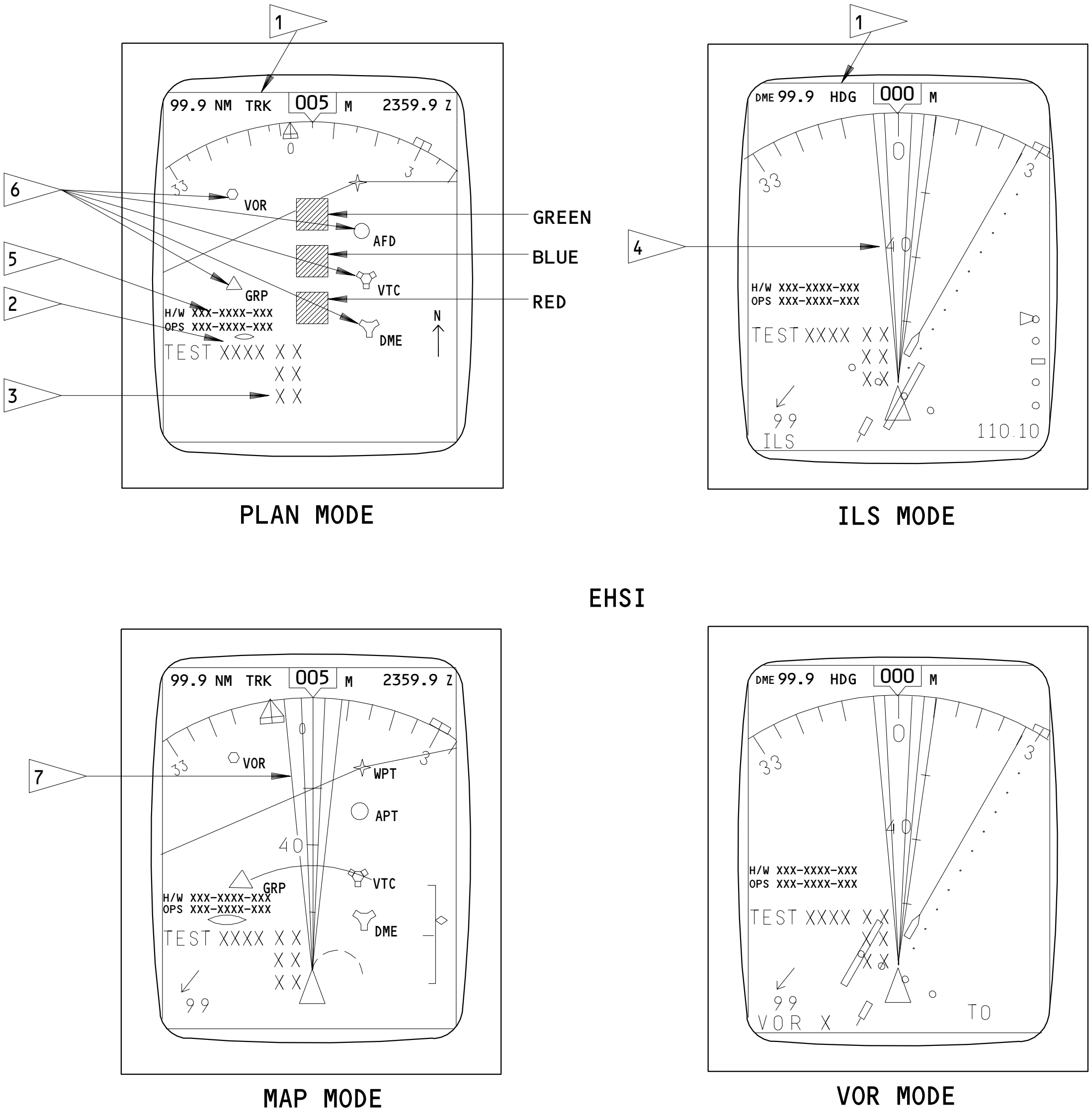
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

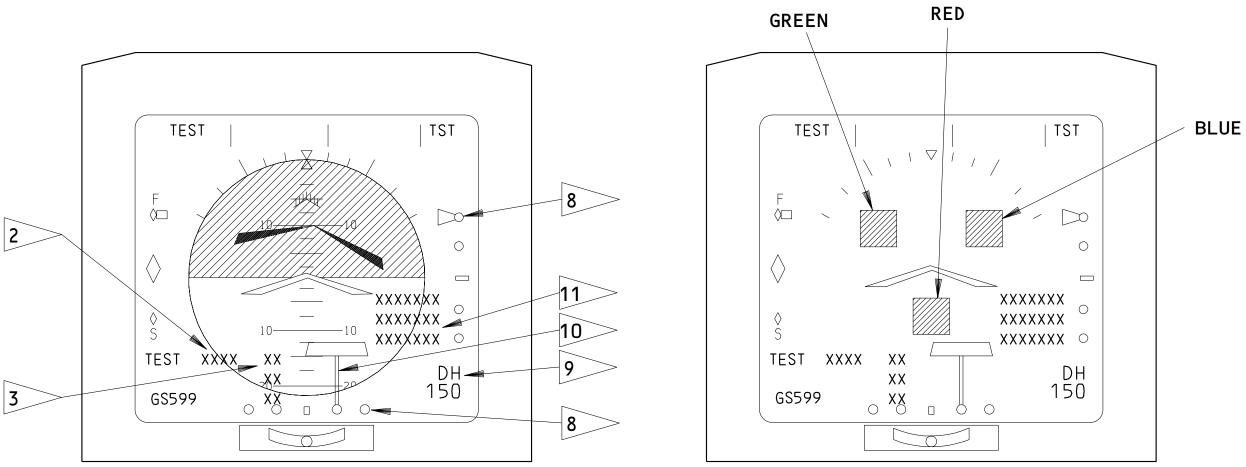
11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 12C (Sheet 1)



THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12C (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

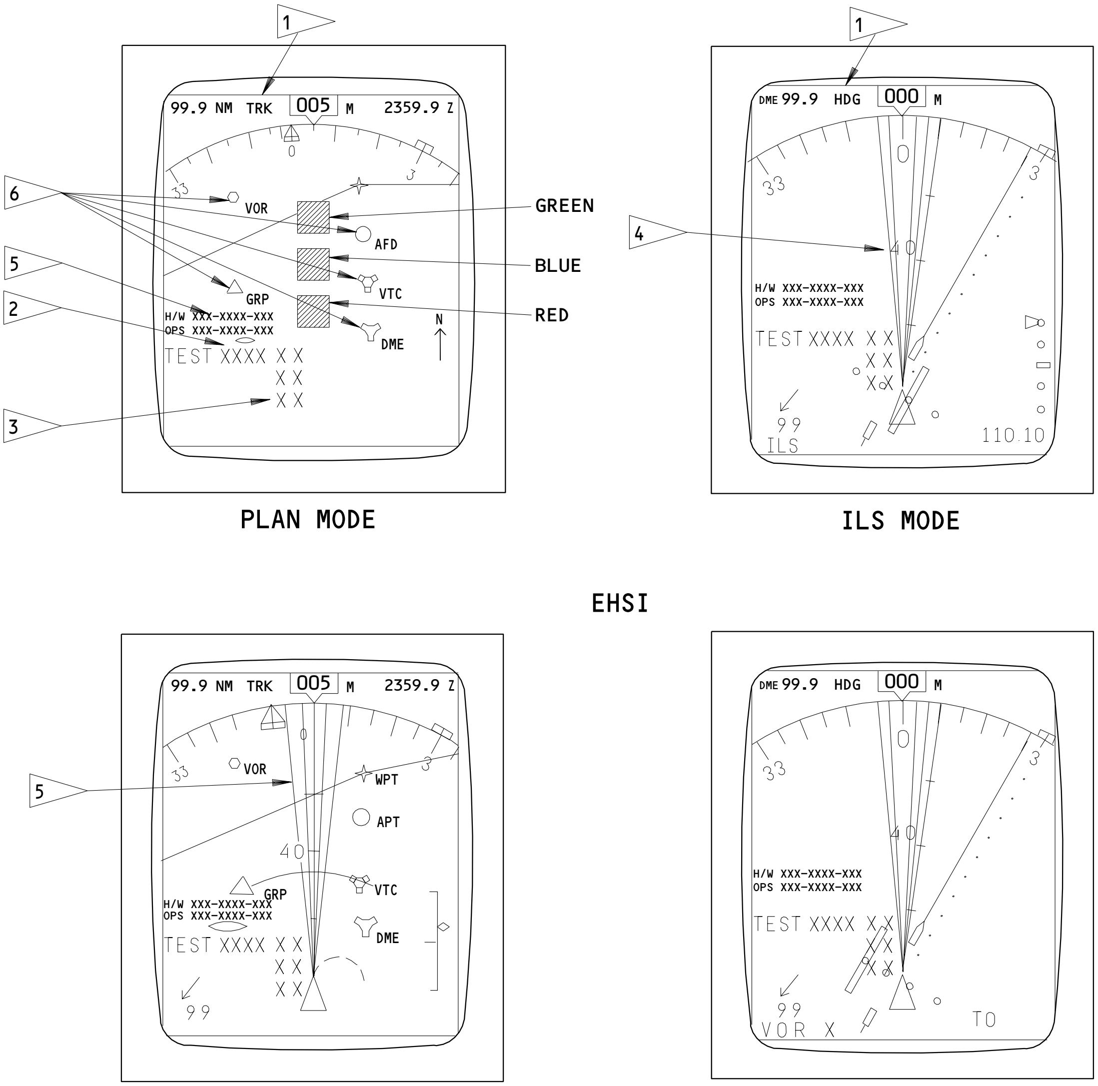
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 12D (Sheet 1)



PLAN MODE

ILS MODE

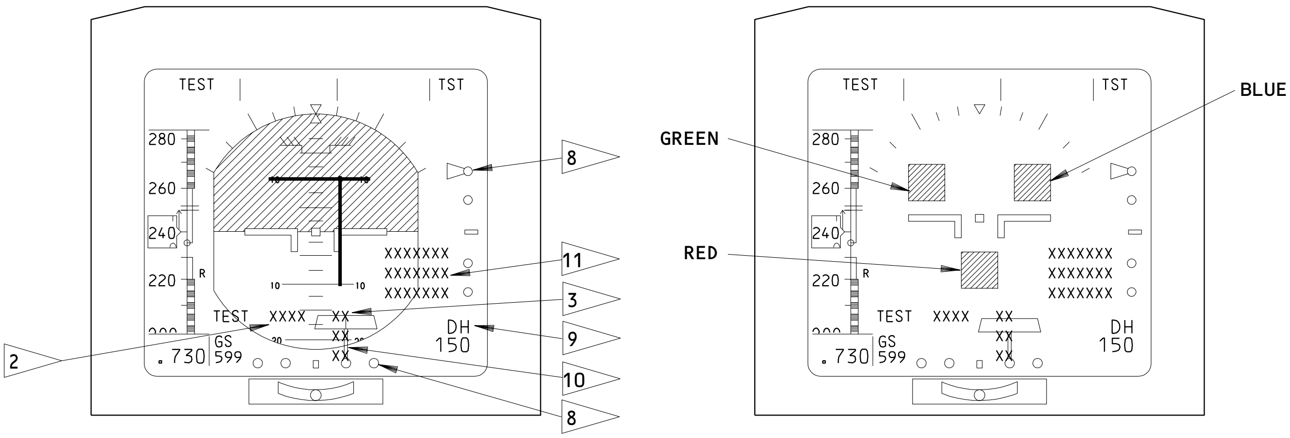
EHSI

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12D (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

<u>NOTE</u>: SYMBOLOGY IS SET BY THE STATE OF THE OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

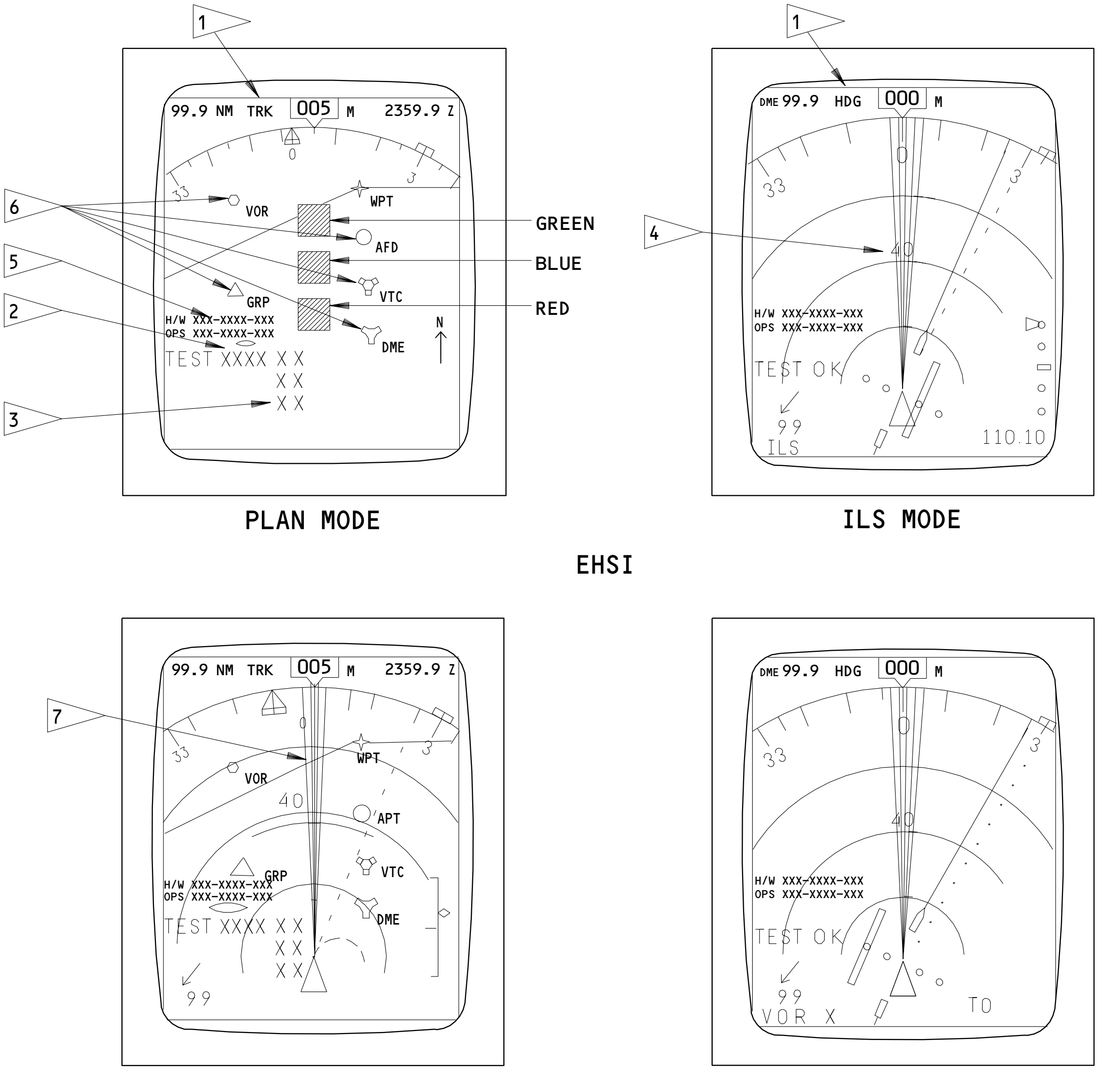
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 12E (Sheet 1)



PLAN MODE

ILS MODE

EHSI

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 12E (Sheet 2)

(6) Each EHSI mode has a separate test pattern. The test annunciations however, are located in the same position for each mode. The word TEST is located in the bottom left corner of the display. The same test result annunciations (OK, FAIL, CP, DU, SG) will appear as on the EADI. The relative position and conditions for test messages display are also the same as on the EADI.

(7) The symbols, colors, and data displayed in the test modes, are the same as for those discussed previously in the normal operation. A weather radar test pattern will appear in the MAP, VOR (VOR-EXP), and ILS (ILS-EXP) modes. The test pattern is not the same as a weather radar self-test (AMM 34-43-00/001).

(8) The test pattern will be a three color (red, yellow, and green) radial arc segment.

(9) The arc segment extends from the airplane reference symbol to the track line.

D. Control

(1) To place EFIS in operation, close the following overhead panel P11 circuit breakers:
 (a) GUI 001-114, 116-999;
  11A7, EFIS DSPL SW LEFT
 (b) GUI 115;
  11C4, EFIS DSPL SW LEFT
 (c) 11E3, ADI LEFT
 (d) 11E4, EFIS CONT PNL LEFT
 (e) 11E6, HSI LEFT
 (f) 11E24, ADI RIGHT
 (g) 11E25, EFIS CONT PNL RIGHT
 (h) 11E27, HSI RIGHT
 (i) 11F8, EFIS SYM GEN LEFT
 (j) 11F9, EFIS SYM GEN CENTER
 (k) 11F24, EFIS DSPL SW RIGHT
 (l) 11F29, EFIS SYM GEN RIGHT

(2) Set the left and right EFIS control panel switches and the switches on the two instrument source select panels as desired.

4. GUI 001-114, 116-999;
<u>Component Details - RDMI</u> (Fig. 13)

5. GUI 115;

Component Details - RMI (Fig. 13)

A. The two RDMIs (RMIs) are located on the main instrument panel. The Captain's is located on the P-1 panel and the F/O's is located on the P-3 panel.

B. GUI 001-114, 116-999;

The RDMIs display magnetic or true heading, VOR and/or ADF bearing, and DME/VOR or DME/ILS distance information.

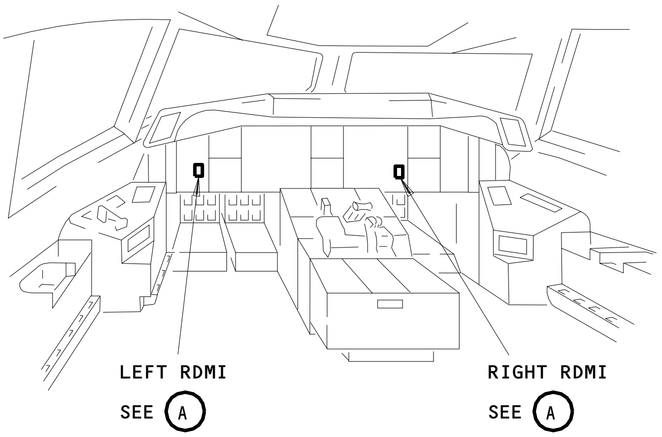
(1) The display includes the heading dial, the bearing pointers, and the DME displays. The heading dial is a 360°, mechanical, compass card display. It rotates within the display and the heading is marked by a fixed lumbar line. There are also six fixed index marks and a heading reciprocal marker, for reference. Two bearing pointers rotate independently on the face of the heading dial. The pointers mark the relative VOR and/or ADF bearing to the selected station. The two ADF/VOR bearing source switches are used to select the data source for the respective pointer.

(2) The heading card reads magnetic heading at typical operational latitudes. At higher latitudes, true heading can be displayed by switching the heading reference switch (if installed) to the TRUE position. The DME is displayed (for left and right systems) by two three-digit LCD displays. The displays represent the distance, in nautical miles, to the selected station (VOR or ILS). Each display is independantly driven by the left or right DME interrogator. The mode of each interrogator is controlled by the respective (left or right) EFIS control panel. The space before the three digits is reserved for the tuning system, DME annunciation. These may be blank for VOR tuning or L for ILS tuning.

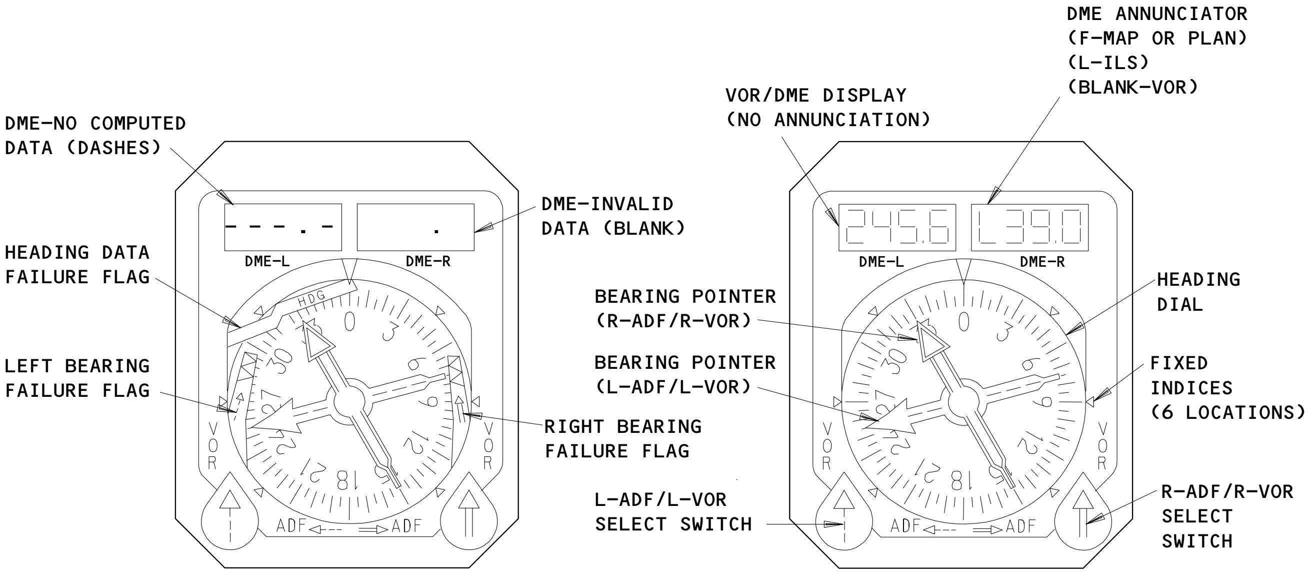
C. GUI 115;

the RMIs display magnetic or true heading and VOR and/or ADF bearing.

(1) The RMIs display magnetic or true heading and VOR and/or ADF bearing. The display includes the heading dial and two bearing pointers. The heading dial is a 360° mechanical compass card display. It rotates within the display and the heading is marked by a fixed lumbar line. There are also six fixed index marks and a heading reciprocal marker for reference. Two bearing pointers rotate independently on the face of the heading dial. The pointers mark the relative VOR and/or ADF bearing to the selected station. The two ADF/VOR bearing source switches are used to select the data source for the respective pointer. The heading dial displays magnetic heading at typical operational latitudes. At higher latitudes, true heading can be displayed by switching the heading reference switch (if installed) to the TRUE position.



FLIGHT COMPARTMENT



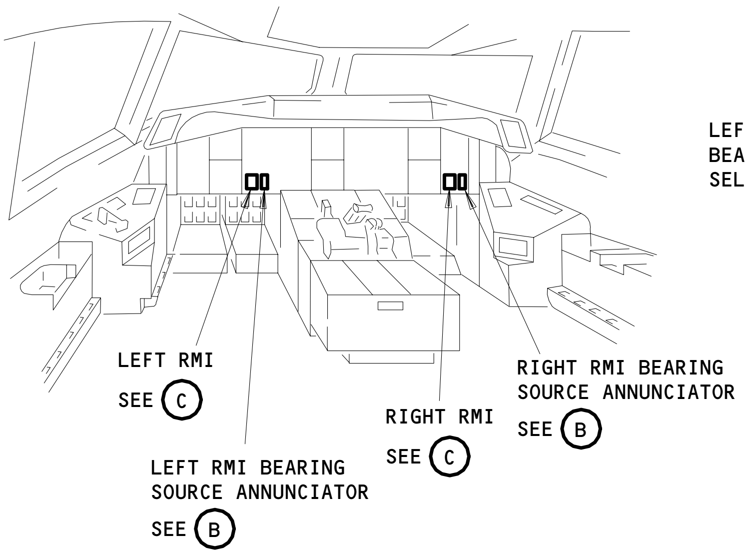
FAULT DISPLAY

NORMAL DISPLAY

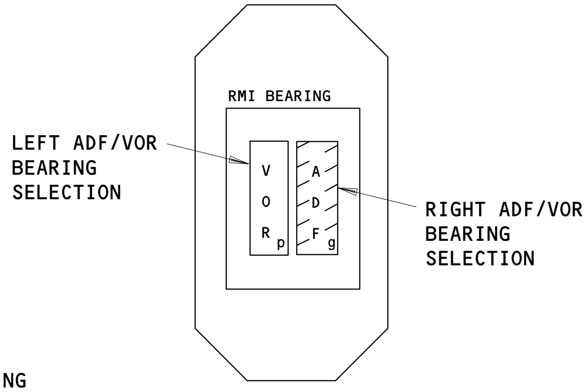
RDMI

A

RDMI - Component Location
Figure 13 (Sheet 1)

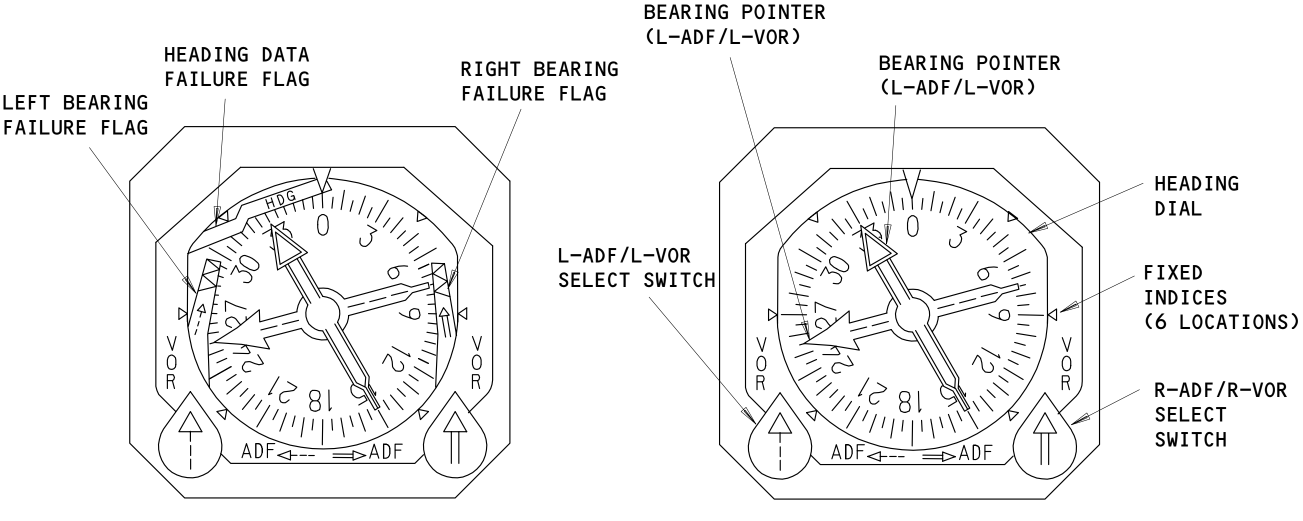


FLIGHT COMPARTMENT



RMI BEARING SOURCE ANNUNCIATOR

B



FAULT DISPLAY

NORMAL DISPLAY

RMI

C

RMI - Component Location
Figure 13 (Sheet 2)

(2) The RMI bearing source annunciator contains two-three sided prisms. Each prism displays its respective ADF/VOR switch position. The sides of the prisms are labeled ADF, VOR, and (blank). The blank side indicates that the ADF is in the ANT mode. The left prism is pink and the right prism is green.

6. GUI 001-114, 116-999;

Operation - RDMI

7. GUI 115;

Operation - RMI

A. Functional Description (Fig. 14)

(1) GUI 001-114, 116-999;

The RDMIs operate as follows:

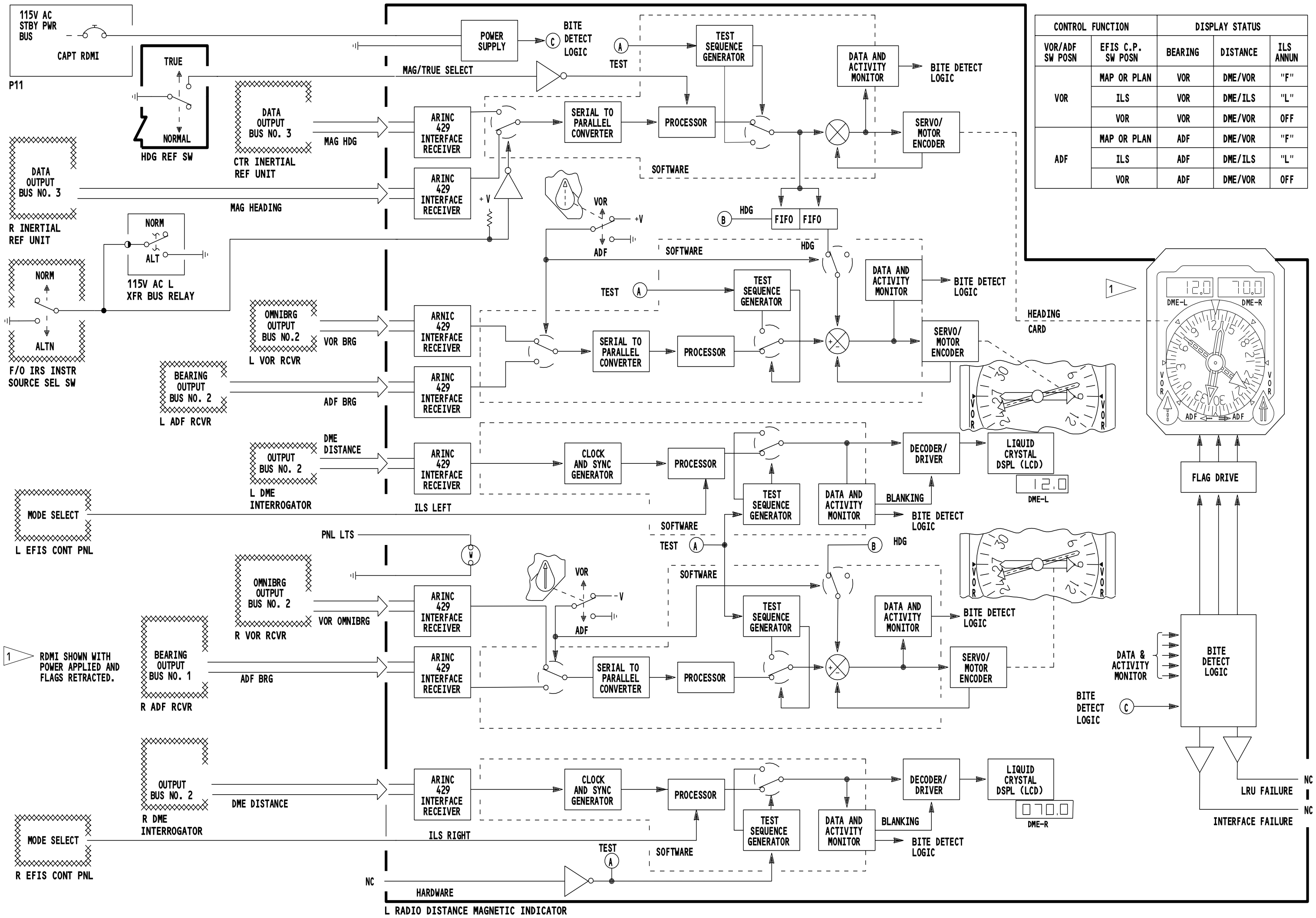
(a) The left RDMI receives 115v ac, 400 Hz power from the standby power bus. The right RDMI receives 115v ac, 400 Hz power from the right main power bus.

(b) The left and right RDMI operation is electrically the same. Only the left RDMI will be discussed.

(c) The RDMI receives all heading, bearing, and distance data on ARINC 429 digital data buses. Switching control data is received as discrete signals from the instrument source select switches.

(d) The left RDMI receives heading data from the right and center IRUs. The desired data source is routed to the processing circuits by the source select relay which is controlled by the IRS switch on the right instrument source select panel. This source/display crossfeeding allows both the Captain and F/O to compare left and right IRU operation. The data is then processed, monitored, and sent to the heading servo/motor circuits for display drive.

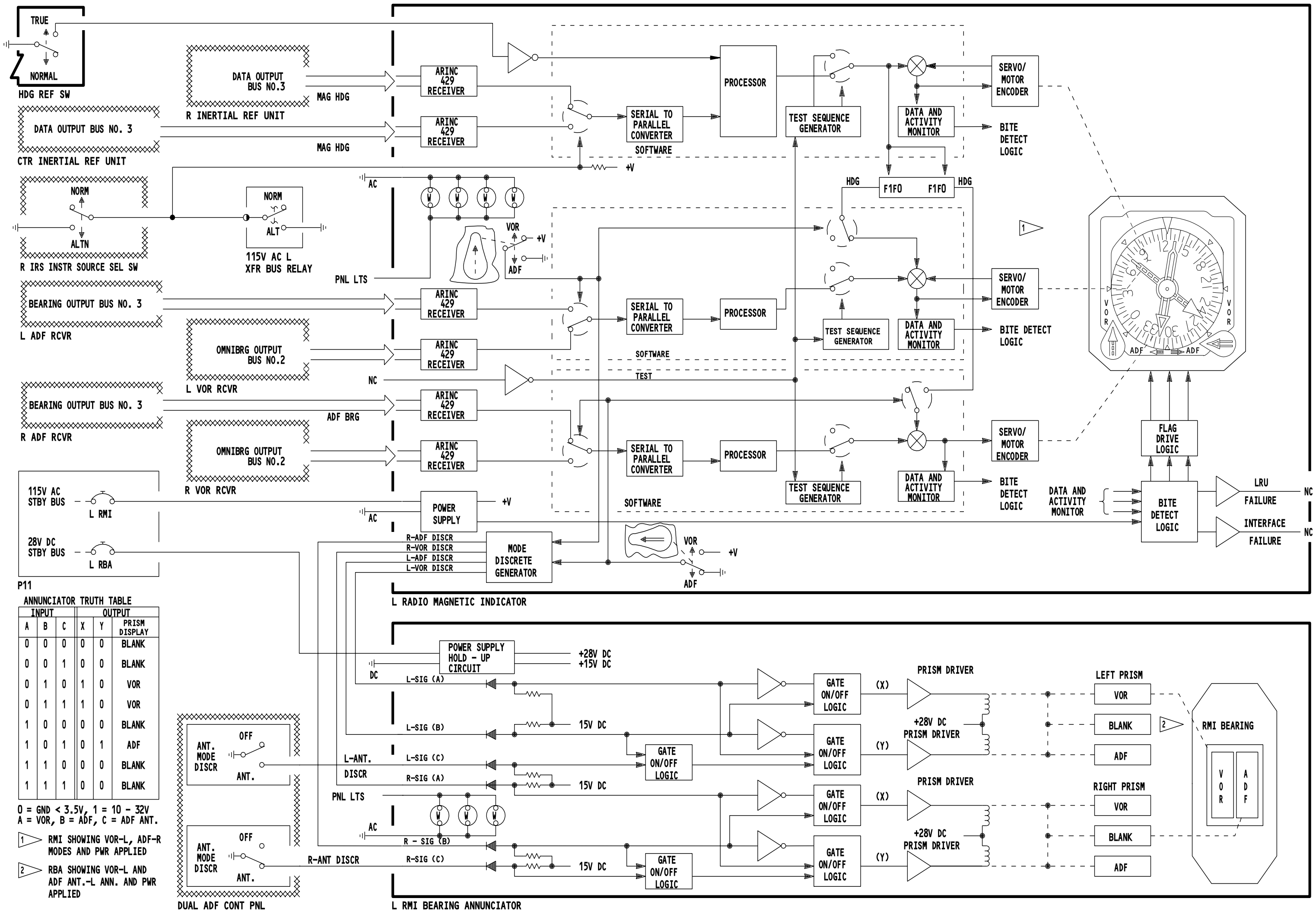
(e) The left RDMI receives bearing data from the left and right VOR receivers and the left and right ADF receivers. The desired data source is routed to the processing circuits by the source select relays. The right needle can be driven by the right VOR or right ADF system. The left needle can be driven by the left VOR or left ADF system.



CONTROL FUNCTION		DISPLAY STATUS		
VOR/ADF SW POSN	EFIS C.P. SW POSN	BEARING	DISTANCE	ILS ANNUN
VOR	MAP OR PLAN	VOR	DME/VOR	"F"
	ILS	VOR	DME/ILS	"L"
	VOR	VOR	DME/VOR	OFF
ADF	MAP OR PLAN	ADF	DME/VOR	"F"
	ILS	ADF	DME/ILS	"L"
	VOR	ADF	DME/VOR	OFF

RDMI Schematic (Example)
Figure 14 (Sheet 1)

A76516



ANNUNCIATOR TRUTH TABLE

INPUT			OUTPUT		
A	B	C	X	Y	PRISM DISPLAY
0	0	0	0	0	BLANK
0	0	1	0	0	BLANK
0	1	0	1	0	VOR
0	1	1	1	0	VOR
1	0	0	0	0	BLANK
1	0	1	0	1	ADF
1	1	0	0	0	BLANK
1	1	1	0	0	BLANK

0 = GND < 3.5V, 1 = 10 - 32V
A = VOR, B = ADF, C = ADF ANT.

1 RMI SHOWING VOR-L, ADF-R MODES AND PWR APPLIED

2 RBA SHOWING VOR-L AND ADF ANT.-L ANN. AND PWR APPLIED

RMI and RBA Schematic (Example)
Figure 14 (Sheet 2)

A76537

(f) The ADF/VOR switches select between the navigation inputs (VOR and/or ADF).

(g) The distance display's data source selection is controlled by the EHSI mode switch. In the VOR mode(s), the DME display represents paired DME/VOR distance. This is the distance to the tuned VOR station. In the ILS mode(s), the DME display represents paired DME/ILS distance. This is the distance to the tuned ILS station. In the ILS mode the letter L appears before the distance readout. In the map or plan mode, the FMC drives the display and the letter F appears before the distance readout.

(h) The EFIS symbol generator monitors the DME to verify that the tuned DME frequency corresponds with the ILS or VOR station selected. If the tuned DME frequency does not correspond with the selected ILS or VOR station, the DME display will blank in both the RDMI and EHSI.

(2) GUI 115;
The RMIs operate as follows:

(a) The left RMI receives 115v ac, 400 Hz power from the standby power bus. The right RMI receives 115v ac, 400 Hz power from the right main power bus. The left RMI bearing source annunciator receives 28v dc from the standby power bus. The right RMI bearing source annunciator receives 28v dc from the right power bus.

(b) The left and right RMI operation is electrically the same. Only the left RMI will be discussed.

(c) The RMI receives all heading and bearing data on ARINC 429 digital data buses. The DDI receives all distance data on ARINC 429 digital data buses (Ref 34-55-00). Switching control data is received as discrete signals from the switches on the instrument source select panels.

(d) The left RMI receives heading data from the right and center IRUs. The desired data source is routed to the processing circuits by the source select relay which is controlled by the IRS switch on the right instrument source select panel. This source/display crossfeeding allows both the Captain and F/O to compare left and right IRU operation. The data is then processed, monitored, and sent to the heading servo/motor circuits for display drive.

(e) The left RMI receives bearing data from the left and right ADF and VOR receivers. The ADF/VOR switches on the indicator select which bearing is displayed. For each bearing mode (ADF and VOR), a discrete is sent to the RMI bearing source annunciator. This drives the display to ADF or VOR. In the ADF mode, the annunciator will blank if the ADF system is placed in the ANT mode. This is initiated by a discrete from the ADF control panel (Ref 34-57-00).

B. GUI 001-114, 116-999;
BITE

(1) For system self-test displays, refer to the corresponding system (IRS, VOR, ADF, or DME) chapter.

(2) The RDMI's internal failure monitor circuits continuously check the five display circuits. A failure in any circuit will cause the applicable fault display to appear.

(3) The left and right bearing failure flags indicate either invalid input data, or a fault within the RDMIs respective bearing circuits. The heading data failure flag indicates either invalid input data or a fault in the RDMI heading circuits. For NCD the heading card remains at the last valid position.

(4) The DME displays warning (invalid) data by going blank. NCD is displayed by four dashes in place of the numerics.

(5) The DME display will also go blank if the tuned DME frequency does not correspond with the ILS or VOR station selected.

C. GUI 115;
BITE

(1) For system self-test displays, refer to the corresponding system (IRS, VOR, ADF, or DME) chapter.

(2) The RMIs internal failure monitor circuits continuously check the five display circuits. A failure in any circuit will cause the applicable fault display to appear.

(3) The left and right bearing failure flags indicate either invalid input data, or a fault within the RMIs respective bearing circuits. The heading data failure flag indicates either invalid input data or a fault in the RMI heading circuits. For NCD the heading card remains at the last valid position.

D. Control

(1) To place the applicable RDMIs or RMIs in operation, close the following P11 panel circuit breakers:

(a) GUI 001-114, 116-999;
11A6, RDMI LEFT

(b) GUI 115;
11A6, RBA L

(c) GUI 115;
11A7, RMI L
(d) GUI 115;
11F23, RMI R
(e) GUI 001-114, 116-999;
11F25, RDMI RIGHT
(f) GUI 115;
11F25, RBA R

8. Component Details - VSI (Fig. 15)

A. Normal Displays

(1) The two VSIs are located on the main instrument panel. The captain's is located on the P1 panel and the F/O's is located on the P3 panel.

(2) The VSI shows the inertial rate of climb and descent (in feet per minute X 1000). This data is shown on a mechanical display as sensed by the IRS.

(3) When there is invalid or NCD data from the IRS, the OFF flag will show.

9. Operation - VSI

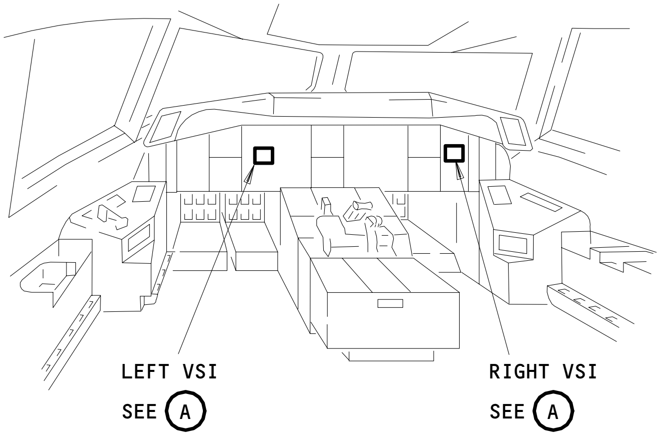
A. Functional Description (Fig. 16)

(1) The operation of the left and right VSIs is electrically identical. Only the left system will be discussed in this manual.

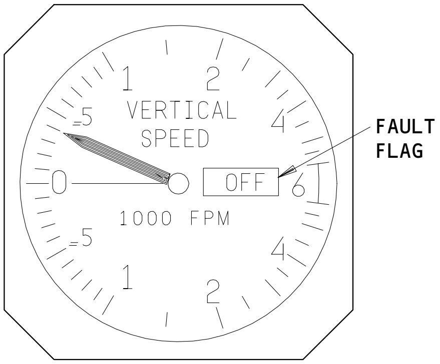
(2) The left VSI is powered by 115v ac, 400 Hz, single phase voltage, from the left main power bus.

(3) In the event of a left power bus failure, the captain's VSI will automatically switch to the right power bus. This will occur when the left bus drops below 97 ±2v ac for more than 180 ms. It will automatically switch back to the left bus when the left bus power increases to greater than 106 ±2v ac for more than 1.2 seconds (AMM 24-51-00/001).

(4) The left VSI receives vertical speed data from the left and center IRUs on ARINC 429 digital data buses. The data is received and passes through the internal switching circuits. A ground discrete, from the IRS switch on the left instrument source select panel, will cause the relay to switch from the left to the center IRU. A high discrete causes the relay to switch to the left IRU. The selected digital input data is processed, monitored, and converted to analog data. This data drives the VSI pointer.

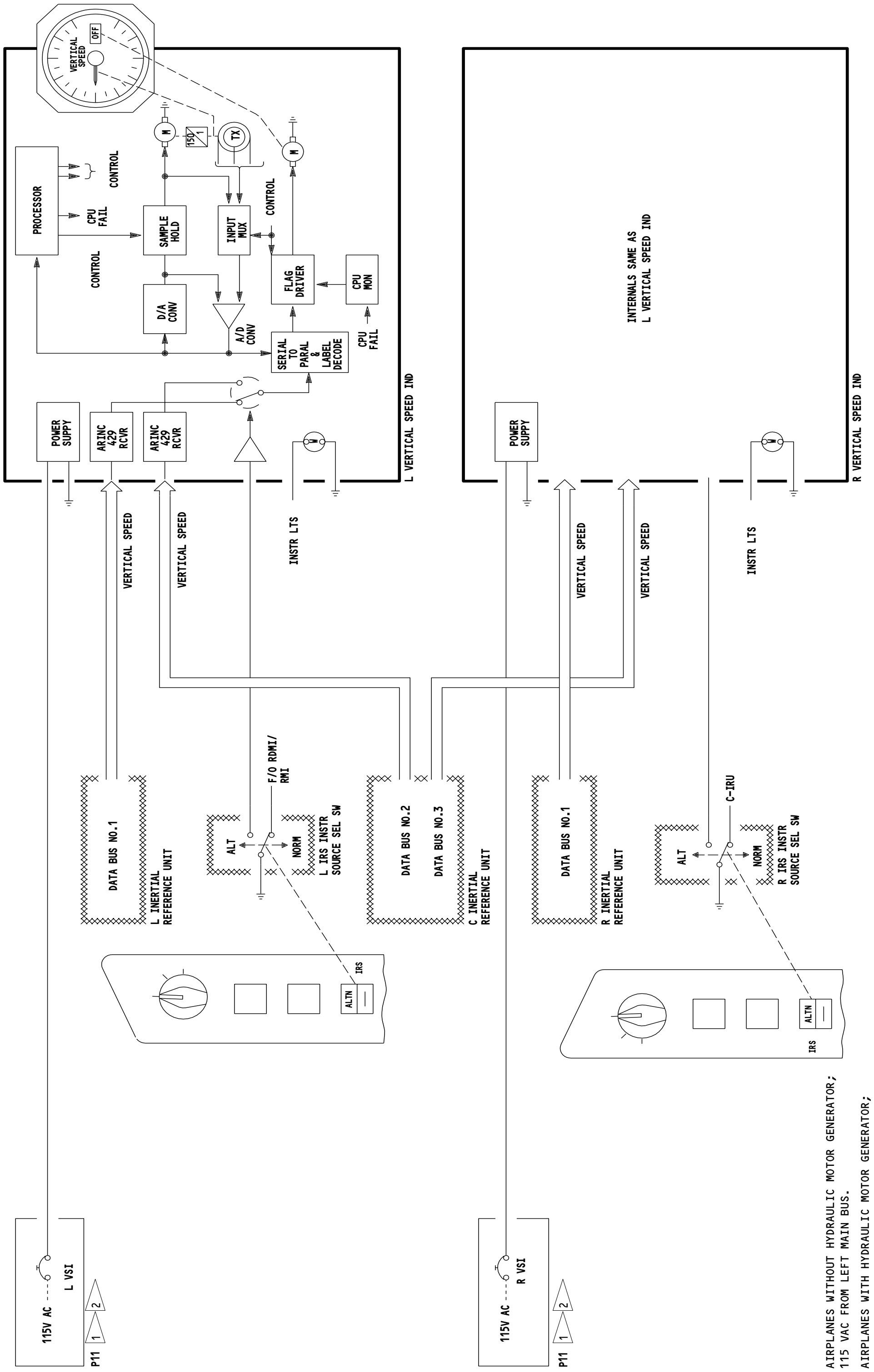


FLIGHT COMPARTMENT



VERTICAL SPEED INDICATOR
A

VSI - Component Details
Figure 15



1 AIRPLANES WITHOUT HYDRAULIC MOTOR GENERATOR; 115 VAC FROM LEFT MAIN BUS.

2 AIRPLANES WITH HYDRAULIC MOTOR GENERATOR; 115 VAC FROM LEFT MAIN BUS OR LEFT XFR BUS.

VSI Schematic
Figure 16

43065

B. BITE
   (1) The monitor circuits continuously check the input data for presence and validity. In the event of a failure, the OFF flag will show.
   (2) A display test is initiated by an IRS system self-test (AMM 34-21-00/001). This causes the OFF flag to show for 10 seconds, followed by a 600 fpm rate of descent display for the duration of the test.

C. Control
   (1) To place the VSIs in operation, close the following P11 panel circuit breakers:
      (a) 11E5, VSI LEFT
      (b) 11E26, VSI RIGHT

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -	2		FLT COMPT, P11	
ADI LEFT, C593		1	11E3	*
ADI RIGHT, C594		1	11E24	*
EFIS CONT PNL LEFT, C633		1	11E4	*
EFIS CONT PNL RIGHT, C634		1	11E25	*
EFIS DSPL SW LEFT, C622		1	11A7	*
EFIS DSPL SW RIGHT, C623		1	11F24	*
EFIS SYM GEN CENTER, C639		1	11F9	*
EFIS SYM GEN LEFT, C637		1	11F8	*
EFIS SYM GEN RIGHT, C638		1	11F29	*
FLIGHT RECORDER DC, C578		1	11J8	*
HSI LEFT, C588		1	11E6	*
HSI RIGHT, C589		1	11E27	*
RDMI LEFT, C635		1	11A6	*
RDMI RIGHT, C636		1	11F25	*
VSI LEFT, C586		1	11E5	*
VSI RIGHT, C587		1	11E26	*
GENERATOR - CENTER EFIS SYMBOL, M149	1	1	119BL, MAIN EQUIP CTR, E2-3	34-22-01
GENERATOR - LEFT EFIS SYMBOL, M148	1	1	119BL, MAIN EQUIP CTR, E2-1	34-22-01
GENERATOR - RIGHT EFIS SYMBOL, M150	1	1	119BL, MAIN EQUIP CTR, E2-2	34-22-01
INDICATOR - LEFT ELECTRONIC ATTITUDE DIRECTOR, N4	2	1	FLT COMPT, P1-1	34-22-03
INDICATOR - LEFT ELECTRONIC HORIZONTAL SITUATION, N5	2	1	FLT COMPT, P1-1	34-22-04
INDICATOR - LEFT RADIO DISTANCE MAGNETIC, N3	2	1	FLT COMPT, P1-1	34-22-05
INDICATOR - LEFT VERTICAL SPEED, N9	2	1	FLT COMPT, P1-3	34-22-06
INDICATOR - RIGHT ELECTRONIC ATTITUDE DIRECTOR, N44	2	1	FLT COMPT, P3-3	34-22-03
INDICATOR - RIGHT ELECTRONIC HORIZONTAL SITUATION, N45	2	1	FLT COMPT, P3-3	34-22-04
INDICATOR - RIGHT RADIO DISTANCE MAGNETIC, N43	2	1	FLT COMPT, P3-1	34-22-05
INDICATOR - RIGHT VERTICAL SPEED, N49	2	1	FLT COMPT, P3-3	34-22-06
PANEL - (FIM 34-51-00/101)				
LEFT VOR/DME CONTROL, M91				
RIGHT VOR/DME CONTROL, M92				
PANEL - LEFT EFIS CONTROL, M94	2	1	FLT COMPT, P10	34-22-02
PANEL - RIGHT EFIS CONTROL, M93	2	1	FLT COMPT, P10	34-22-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K141				
SYS NO. 1 AIR/GND, K167				
SYS NO. 1 AIR/GND, K170				
SYS NO. 1 AIR/GND, K177				
RELAY - (FIM 31-01-37/101)				
FLIGHT RECORDER I/P SW, K15				

* SEE THE WDM EQUIPMENT LIST

Electronic Flight Instrument System (EFIS) - Component Index
Figure 101 (Sheet 1)

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
SENSOR - LEFT EFIS REMOTE LIGHT, TS187		1	FLT COMPT, P7	34-22-08
SENSOR - RIGHT EFIS REMOTE LIGHT, TS188		1	FLT COMPT, P7	34-22-08
SWITCH - HEADING REFERENCE, S616	2	1	FLT COMPT, P3-1	*
SWITCH - LEFT EFI, S3	1	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT F/D, S1	1	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT FMC, S2 3	1	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT IRS, S4	1	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT NAV, S2 4	1	1	FLT COMPT, P1-1	33-13-00
SWITCH - RIGHT EFI, S11	1	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT F/D, S9	1	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT FMC, S10 3	1	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT IRS, S12	1	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT NAV, S10 4	1	1	FLT COMPT, P3-3	33-13-00

* SEE THE WDM EQUIPMENT LIST

3 ATZ 003 PRE-SB 34-414;
ATZ 001, 002, 007

4 ATZ 003 POST-SB 34-414;
ATZ 101-999

Electronic Flight Instrument System (EFIS) - Component Index
Figure 101 (Sheet 2)

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -	4		FLT COMPT, P11	
ADI LEFT, C593		1	11E3	*
ADI RIGHT, C594		1	11E24	*
EFIS CONT PNL LEFT, C633		1	11E4	*
EFIS CONT PNL RIGHT, C634		1	11E25	*
EFIS DSPL SW LEFT, C622		1	11C4	*
EFIS DSPL SW RIGHT, C623		1	11F24	*
EFIS SYM GEN LEFT, C637		1	11F8	*
EFIS SYM GEN RIGHT, C638		1	11F29	*
EFIS SYM GEN CENTER, C639		1	11F9	*
FLIGHT RECORDER DC, C578		1	11J8	*
HSI LEFT, C588		1	11E6	*
HSI RIGHT, C589		1	11E27	*
RBA L, C4239		1	11A6	*
RBA R, C4240		1	11F25	*
RMI L, C635		1	11A7	*
RMI R, C636		1	11F23	*
VSI LEFT, C586		1	11E5	*
VSI RIGHT, C587		1	11E26	*
GENERATOR - LEFT EFIS SYMBOL, M148	3	1	119BL, MAIN EQUIP CTR, E2-1	34-22-01
GENERATOR - CENTER EFIS SYMBOL, M149	3	1	119BL, MAIN EQUIP CTR, E2-3	34-22-01
GENERATOR - RIGHT EFIS SYMBOL, M150	3	1	119BL, MAIN EQUIP CTR, E2-2	34-22-01
INDICATOR - LEFT ELECTRONIC ATTITUDE DIRECTOR, N4	4	1	FLT COMPT, P1-1	34-22-03
INDICATOR - LEFT ELECTRONIC HORIZONTAL SITUATION, N5	4	1	FLT COMPT, P1-1	34-22-04
INDICATOR - LEFT RADIO MAGNETIC, N10024	4	1	FLT COMPT, P1-3	34-22-07
INDICATOR - LEFT RMI BEARING SOURCE ANNUNCIATOR, N10025	4	1	FLT COMPT, P1-3	34-22-07
INDICATOR - LEFT VERTICAL SPEED, N9	4	1	FLT COMPT, P1-3	34-22-06
INDICATOR - RIGHT ELECTRONIC ATTITUDE DIRECTOR, N44	4	1	FLT COMPT, P3-3	34-22-03
INDICATOR - RIGHT ELECTRONIC HORIZONTAL SITUATION, N45	4	1	FLT COMPT, P3-3	34-22-04
INDICATOR - RIGHT RADIO MAGNETIC, N10026	4	1	FLT COMPT, P3-3	34-22-07
INDICATOR - RIGHT RMI BEARING SOURCE ANNUNCIATOR, N10027	4	1	FLT COMPT, P3-3	34-22-07
INDICATOR - RIGHT VERTICAL SPEED, N49	4	1	FLT COMPT, P3-3	34-22-06
PANEL - (FIM 34-51-00/101)				
LEFT VOR/DME CONTROL, M91				
RIGHT VOR/DME CONTROL, M92				
PANEL - LEFT EFIS CONTROL, M94	4	1	FLT COMPT, P10	34-22-02
PANEL - RIGHT EFIS CONTROL, M93	4	1	FLT COMPT, P10	34-22-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K141				
SYS NO. 1 AIR/GND, K170				
SYS NO. 1 AIR/GND, K177				
RELAY - (FIM 31-01-37/101)				
FLIGHT RECORDER I/P SW, K15				

* SEE THE WDM EQUIPMENT LIST

Electronic Flight Instrument System (EFIS) - Component Index
Figure 101 (Sheet 3)

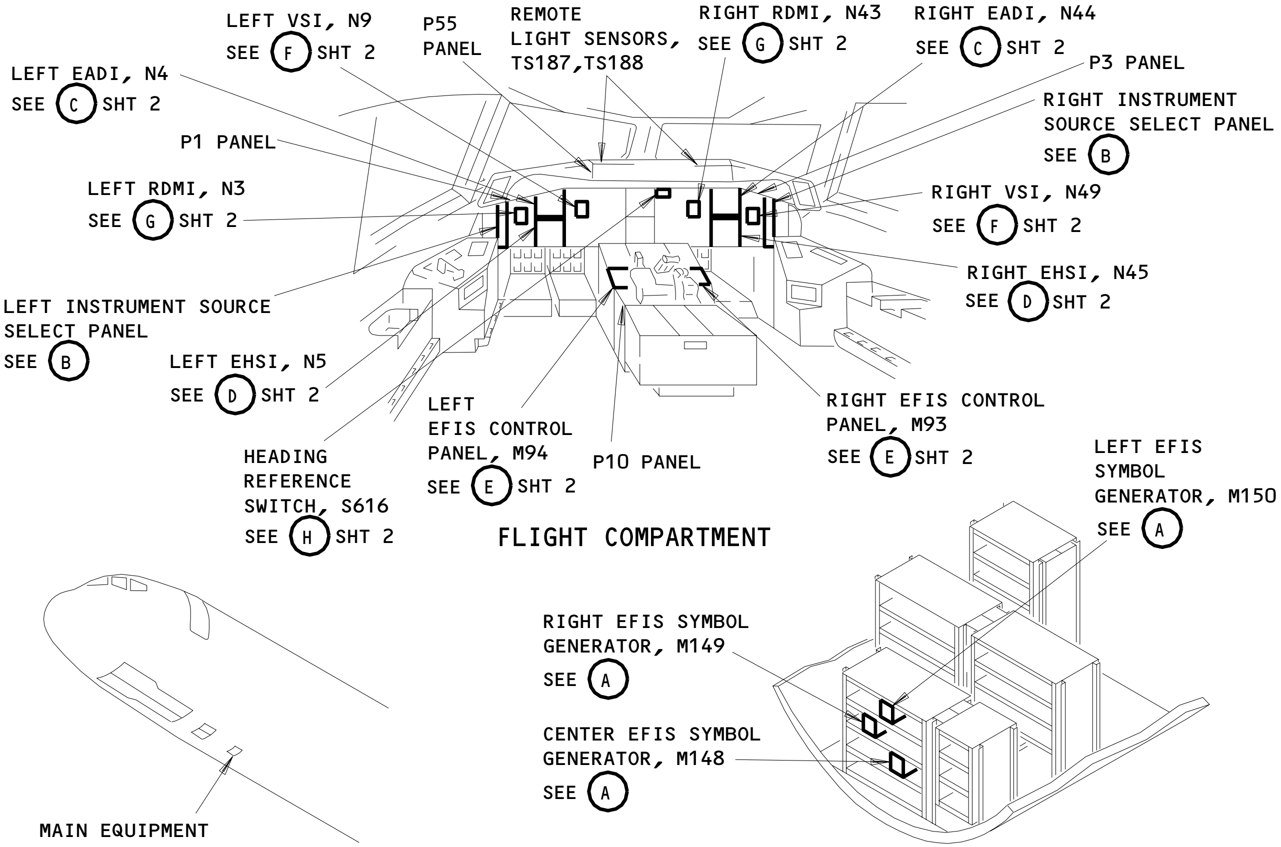
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
SENSOR - LEFT EFIS REMOTE LIGHT, TS187		1	FLT COMPT, P7	34-22-08
SENSOR - RIGHT EFIS REMOTE LIGHT, TS188		1	FLT COMPT, P7	34-22-08
SWITCH - HEADING REFERENCE, S616	4	1	FLT COMPT, P3-1	*
SWITCH - LEFT EFI, S3	3	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT F/D, S1	3	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT FMC, S2 [1]	3	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT IRS, S4	3	1	FLT COMPT, P1-1	33-13-00
SWITCH - LEFT NAV, S2 [1]	3	1	FLT COMPT, P1-1	33-13-00
SWITCH - RIGHT EFI, S11	3	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT F/D, S9	3	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT FMC, S10 [2]	3	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT IRS, S12	3	1	FLT COMPT, P3-3	33-13-00
SWITCH - RIGHT NAV, S10 [2]	3	1	FLT COMPT, P3-3	33-13-00

* SEE THE WDM EQUIPMENT LIST

[1] GUI 115 PRE-SB 34-414;
GUI 001-011

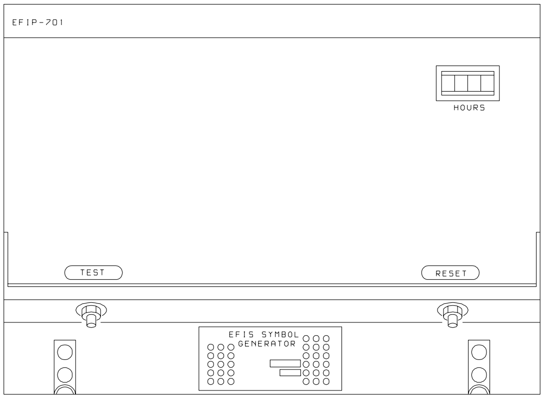
[2] GUI 115 POST-SB 34-414;

Electronic Flight Instrument System (EFIS) - Component Index
Figure 101 (Sheet 4)

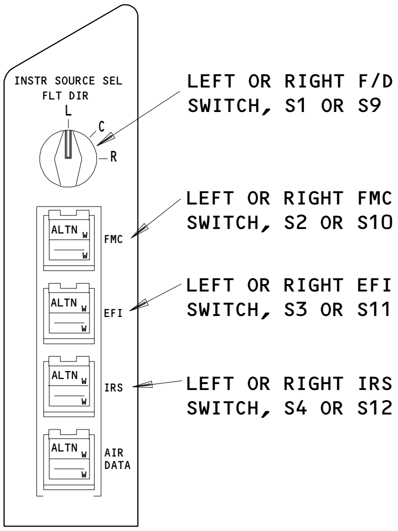


FLIGHT COMPARTMENT

MAIN EQUIPMENT CENTER

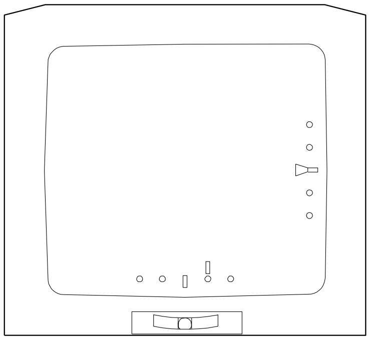


EFIS SYMBOL GENERATOR (EXAMPLE)
A



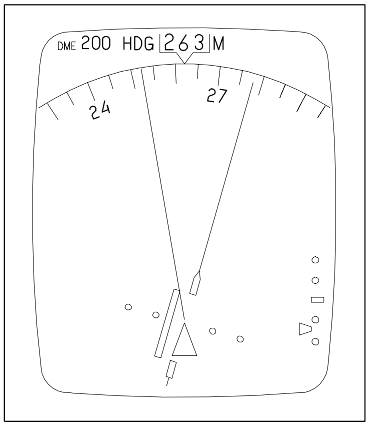
LEFT OR RIGHT INSTRUMENT SOURCE SELECT PANEL (EXAMPLE)
B

EFIS - Component Location
Figure 102 (Sheet 1)



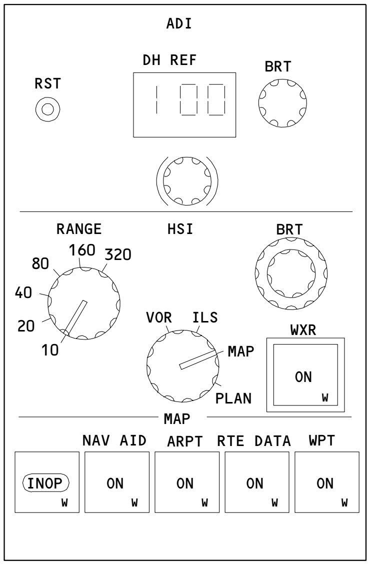
LEFT OR RIGHT EADI,
N4 OR N44

C



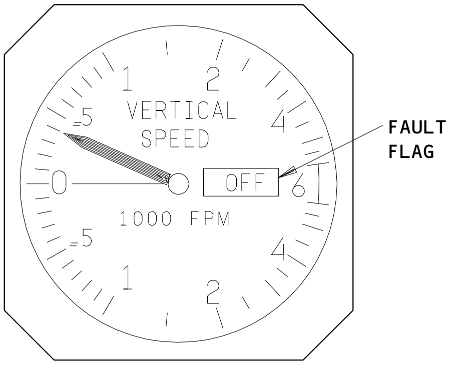
LEFT OR RIGHT EHSI,
N5 OR N45

D



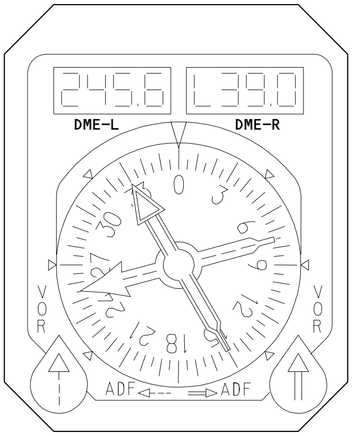
LEFT OR RIGHT EFIS CONTROL
PANEL, M94 OR M93

E



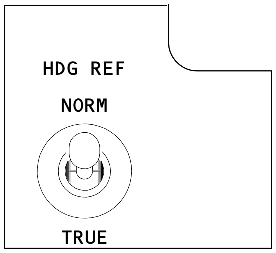
LEFT OR RIGHT VERTICAL SPEED
INDICATOR, N9 OR N49

F



LEFT OR RIGHT RDMI, N3 OR N43

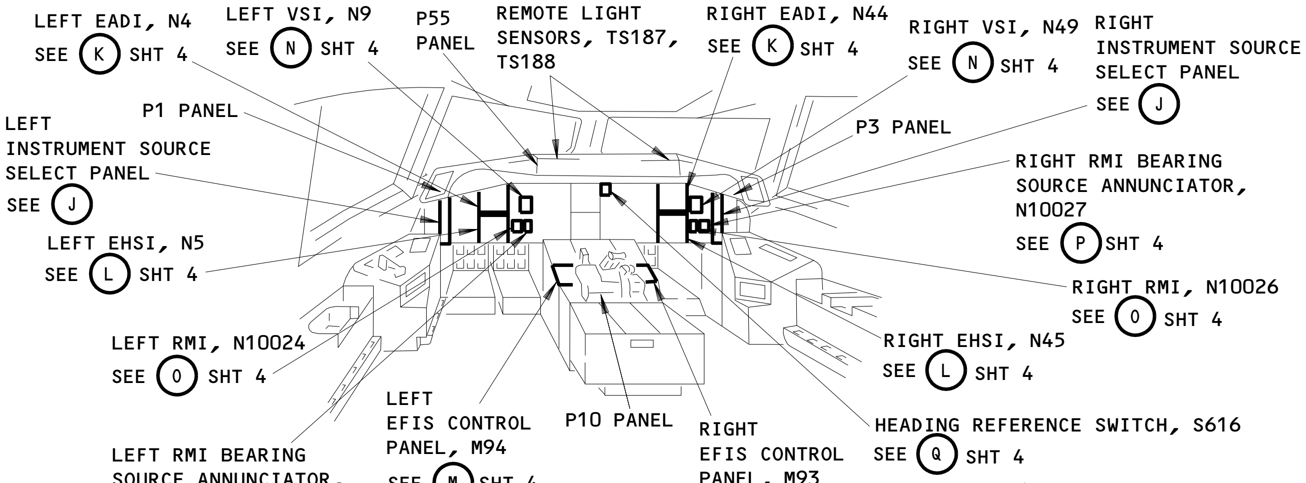
G



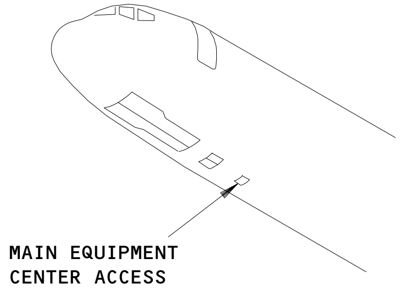
HEADING REFERENCE
SWITCH, S616

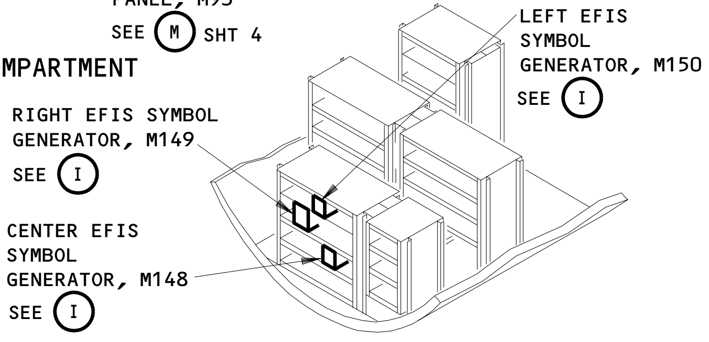
H

EFIS - Component Location (Details from Sht 1)
Figure 102 (Sheet 2)

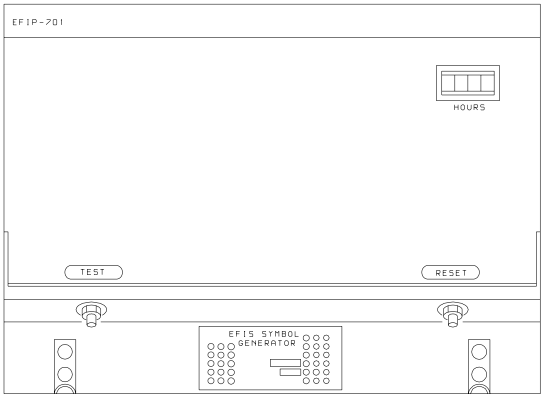


FLIGHT COMPARTMENT



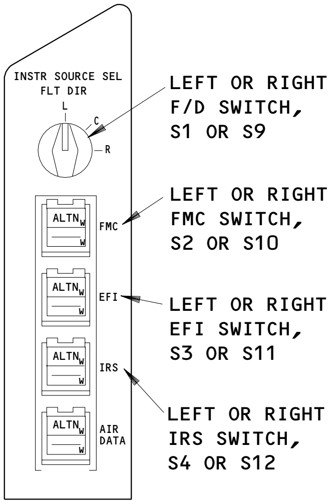


MAIN EQUIPMENT CENTER



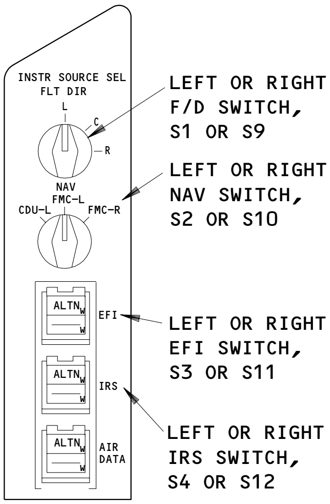
EFIS SYMBOL GENERATOR (EXAMPLE)

I



LEFT OR RIGHT INSTRUMENT SOURCE SELECT PANEL (EXAMPLE)

J 1



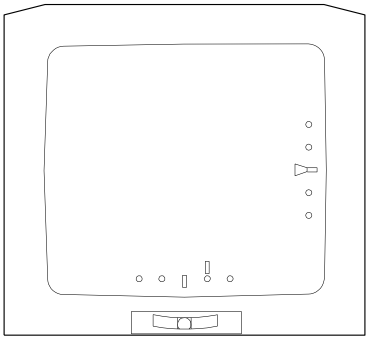
LEFT OR RIGHT INSTRUMENT SOURCE SELECT PANEL (EXAMPLE)

J 2

1 GUI 115 PRE SB 34-414;
GUI 001-011

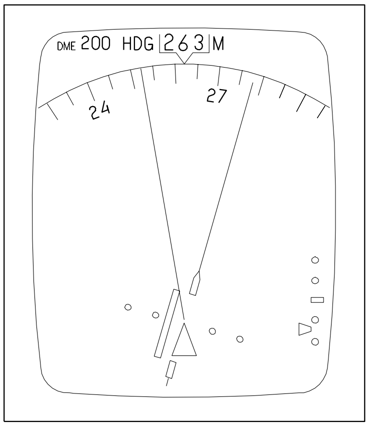
2 GUI 115 POST SB 34-414;

Electronic Flight Instrument System (EFIS) - Component Location
Figure 102 (Sheet 3)



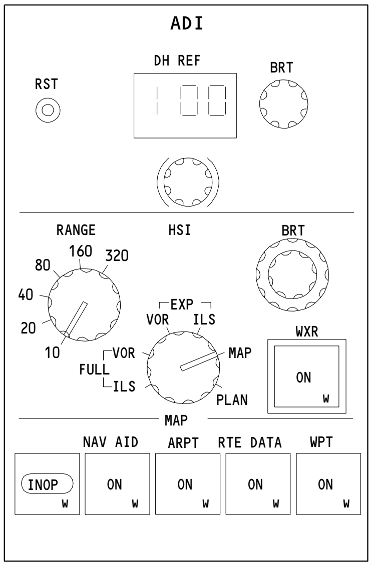
LEFT OR RIGHT EADI,
N4 OR N44

K



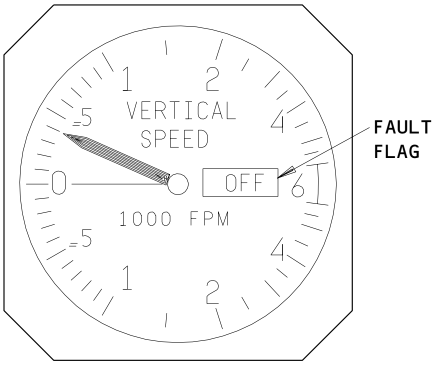
LEFT OR RIGHT EHSI,
N5 OR N45

L



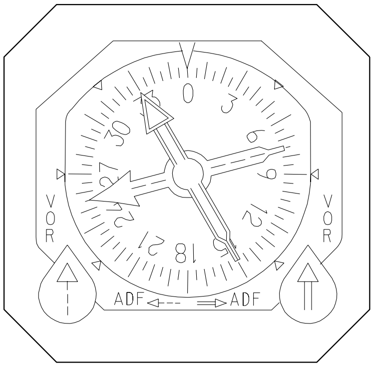
LEFT OR RIGHT EFIS CONTROL
PANEL, M94 OR M93

M



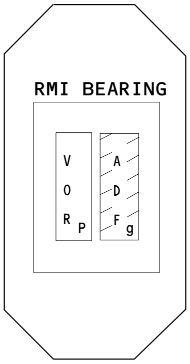
LEFT OR RIGHT VERTICAL SPEED
INDICATOR, N9 OR N49

N



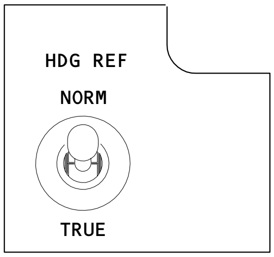
LEFT OR RIGHT RMI,
N10024 OR N10026

O



LEFT OR RIGHT RMI BEARING
SOURCE ANNUNCIATOR,
N10025 OR N10027

P



HEADING REFERENCE
SWITCH, S616

Q

EFIS - Component Location (Details from Sht 3)
Figure 102 (Sheet 4)

ELECTRONIC FLIGHT INSTRUMENT SYSTEM - MAINTENANCE PRACTICES

1. General
   A. The procedures that follow are the maintenance practices for the electronic flight instrument system (EFIS). They include:

      CRT Face - Cleaning
      CRT Brightness - Adjustment/Test
      EADI Inclinometer - Adjustment/Seal
      EFIS Symbol Generator - Software Loading

   B. Software Installation
      (1) This procedure has these tasks for software installation.
         (a) An installation of EFIS software with an airborne data loader (ADL) on the flight deck.
         (b) An installation of EFIS software with a portable data loader (PDL) on the flight deck.
         (c) An installation of the EFIS software using a portable data loader (PDL) and a data loader adapter. This is done in the electronic bay, directly into the EFIS symbol generator.
      (2) To install software in the EFIS symbol generator on the flight deck, these are the requirements:
         (a) There is a data loader control panel on the P61 panel.
         (b) There are EFIS switch positions on the data loader control panel.
         (c) There is an airborne data loader or a connector panel for a portable data loader on the P61 panel.
      (3) If you cannot install the software from the flight deck, then you can install the software directly into the EFIS symbol generator with the use of a portable data loader and an adapter tray.

TASK 34-22-00-102-035

2. CRT Face - Cleaning
   A. Equipment
      (1) Brush - Soft bristle (commercially available)
   B. Consumable Materials
      (1) B50012 Cleaner, Optical Cleaning, Calotherm
          Solution - Supaspray (use with Supacloth)

(2) B50013 Cloth, Calocoat Hi-Tech Lenscloth - Supacloth (use with Supaspray)
(3) G02457 Cleaner, Wet/Dry Anti-static Sachet - ALGLAS Visial ALG/CR 215

C. Access
(1) Location Zones

211/212	Flight Compartment

D. Procedure

S 102-116

CAUTION: DO NOT USE ABRASIVE MATERIALS OR SOLVENTS WHEN YOU CLEAN THE DISPLAY SURFACE. ABRASIVE MATERIALS AND SOLVENTS WILL CAUSE DAMAGE TO THE DISPLAY SURFACE.

(1) Remove all particles from the display surface with a clean, soft, natural-bristle brush.

S 102-117
(2) Carefully clean the display surface with the Supaspray and Supacloth or the wet/dry sachets:
    (a) Apply 2 or 3 sprays of the Supaspray to the Supacloth, or open the wet sachet.
    (b) Use the moist cloth or wet sachet to carefully clean the display surface in a straight line from top to bottom.
    (c) Gradually move from one side of the display surface to the other side while you clean from top to bottom.
    (d) When the display surface is clean, use a clean, dry area of the cloth or the dry sachet in a straight line from top to bottom to carefully dry the display surface.

TASK 34-22-00-702-007

3. CRT Brightness - Adjustment/Test (Fig. 201)

A. General
(1) In the Prepare for Test and Return Airplane to Its Usual Condition sections, procedures are provided for an EICAS CRT and an EFIS CRT.

B. Equipment
(1) Hand-held Photometer, Photo Research PR504
(2) Microreader Probe, Photo Research MR500

C. References
(1) 24-22-00/201, Electrical Power - Control

D. Access
(1) Location Zones

211/212	Flight Compartment

E. Prepare for Test

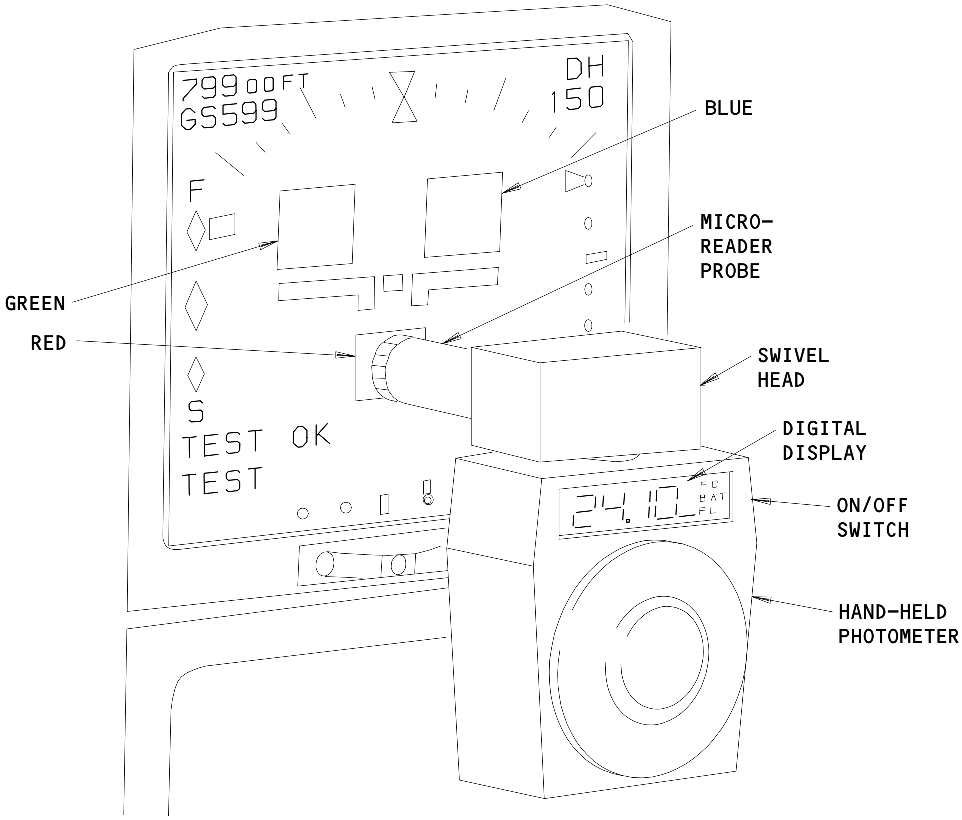
S 862-004
(1) Supply electrical power (Ref 24-22-00).

S 112-005
(2) Remove unwanted materials from the CRT face.

S 712-006
(3) EFIS DISPLAY UNITS;
Do these steps:
(a) Make sure that these circuit breakers on the overhead circuit breaker panel, P11, are closed:
1) GUI 001-114, 116-999;
11A7, EFIS DSPL SW LEFT
2) GUI 115;
11C4, EFIS DSPL SW LEFT
3) 11E3, ADI LEFT
4) 11E4, EFIS CONT PNL LEFT
5) 11E6, HSI LEFT
6) 11E24, ADI RIGHT
7) 11E25, EFIS CONT PNL RIGHT
8) 11E27, HSI RIGHT
9) 11F8, EFIS SYM GEN LEFT
10) 11F9, EFIS SYM GEN CENTER
11) 11F24, EFIS DSPL SW RIGHT
12) 11F29, EFIS SYM GEN RIGHT
(b) Permit 10 minutes for the CRT to become warm.
(c) On the left and right EFIS control panels, put the mode switches in the PLAN position.
(d) On the left and right EFIS control panels, turn the four BRT controls in the fully clockwise position.
(e) On the overhead light control panel, push the TEST switch.
(f) Make sure that the applicable PLAN mode test pattern shows on the EADI and EHSI displays.

S 712-008
(4) EICAS DISPLAY UNITS;
Do these steps:
(a) Make sure that these P11 panel circuit breakers are closed:
1) EICAS (six locations)
(b) Permit 10 minutes for the CRT to become warm.
(c) On the EICAS MAINT panel, push the TEST switch.
(d) On the EICAS control panel, adjust the BRT control so that the EICAS displays are at maximum intensity.
(e) Make sure that the EICAS test pattern shows on the two displays.

F. CRT Brightness Test



EADI (EXAMPLE)

CRT Brightness Test
Figure 201

S 862-033

CAUTION: DO NOT ALLOW THE PHOTOMETER TEMPERATURE TO BECOME MORE THAN 150°F. DO NOT PUT THE PHOTOMETER DIRECTLY IN THE SUNLIGHT. THE PHOTOMETER IS SENSITIVE TO HEAT AND LIGHT. EQUIPMENT DAMAGE CAN OCCUR.

(1) Energize the hand-held photometer.
  (a) Make sure that the battery operates correctly.
  (b) Make sure that the meter is adjusted for a correct meter-zero value.

S 862-010

(2) Attach the micro-reader probe to the photometer.

S 862-011

(3) Turn the swivel head so that the probe and digital display point in opposite directions.

S 862-012

(4) Hold the probe against the CRT face so that it is in the center of the area to be measured.

S 862-013

(5) Push the ON switch for 15 seconds or until the digital display value becomes stable.

S 862-014

(6) With the ON switch pushed in, move the probe around the area to be tested until there is a maximum stable value.

NOTE: Make sure that the CRT face is not in the direct sunlight.

S 972-015

(7) Write the value on Table I.

S 862-016

(8) Repeat this procedure until there are three values for each area to be tested.

S 972-017

(9) Write the micro-reader probe multiplier value on Table I.

S 972-018

(10) Do the calculations.

S 862-019

(11) Make sure that the calculated values are not less than these values for each color:

BLUE	5.0	FOOT-LAMBERTS
GREEN	30.0	FOOT-LAMBERTS
RED	14.0	FOOT-LAMBERTS

G. Put the Airplane Back to Its Usual Condition

S 112-020

(1) Remove unwanted materials from the CRT face.

S 862-021

(2) For the EFIS displays, do this step:
   (a) On the overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 862-022

(3) For the EICAS displays, do this step:
   (a) On the EICAS MAINT panel, push the TEST switch to remove the electrical power from the test circuits.

S 862-023

(4) Remove electrical power if it is not necessary (Ref 24-22-00).

TABLE I
CRT BRIGHTNESS TEST

DATE ______________________________

PHOTOMETER NO. ____________________

CRT _______________________________

AIRPLANE NO. ______________________

GREEN VALUES ______________________

____

____

AVERAGE (AVG) GREEN ________________

__________AVG GREEN X__________________________METER COEF = _____________FL
(> 30 FL)

RED VALUES ________________________

____

____

AVG RED ______________________

__________AVG RED X____________________________METER COEF = _____________FL
(> 14 FL)

BLUE VALUES _______________________

____

____

AVG BLUE __________________________

__________AVG BLUE X___________________________METER COEF = _____________FL
(> 5.0 FL)

COMMENTS:

TASK 34-22-00-822-024

4. EADI Inclinometer - Adjustment/Seal

A. General

(1) This procedure is to be done each time that a new EADI is installed or each time that there is a difference between the inclinometers. When there is a difference and it is not known which inclinometer is correct, the airplane must be made level. The incorrect inclinometer should then be adjusted by this procedure.

B. Equipment

(1) Scraper - wood or plastic

C. Consumable Materials

(1) A00247 Sealant - BMS 5-95 Class B-1/2
(2) B00184 Solvent - BMS 11-7

D. References

(1) 08-21-00/201, Leveling
(2) 20-30-01/201, Adhesives, Cements, and Sealers
(3) 20-30-02/201, Cleaners and Polishes
(4) 20-30-05/201, Strippers
(5) 51-31-01/201, Seals and Sealing

E. Access

(1) Location Zones

211/212 Flight Compartment

F. Adjust the Inclinometer (Fig. 202)

S 862-025

(1) If necessary, make the airplane level to find the incorrect inclinometer.

S 912-026

(2) Remove the sealant from the zero-adjustment screws on the applicable inclinometer (Ref 51-31-01).

S 032-027

(3) Loosen the zero-adjustment screws.

S 862-028

(4) If the plane was made level, adjust the incorrect inclinometer so that the slip ball is between the two vertical lines.

S 862-029

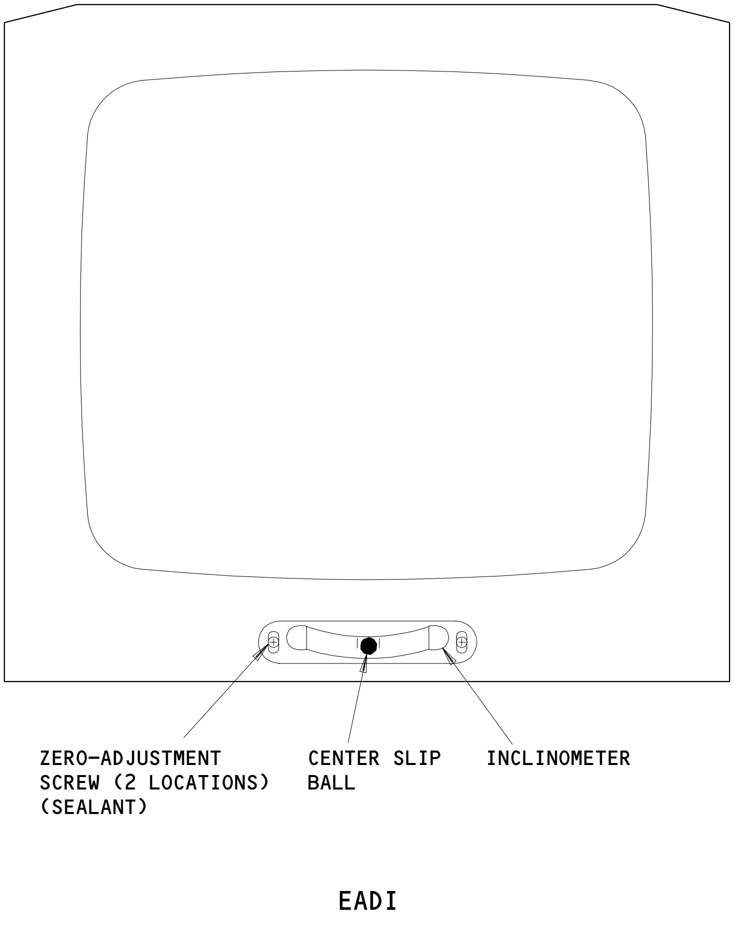
(5) If the plane was not made level, adjust the incorrect inclinometer until the slip ball is within .03 inches of the indication on the correct inclinometer.

S 432-030

(6) Tighten the zero-adjustment screws.

S 912-031

(7) Apply the sealant, BMS 5-95, over the zero-adjustment screw heads (Ref 51-31-01).



EADI Inclinometer Adjustment and Sealing
Figure 202

S 912-032
(8) Remove any unwanted sealant (Ref 51-31-01).

TASK 34-22-00-472-048

5. EFIS Symbol Generator - Software Installation with an ADL

A. General
- (1) This procedure shows you how to install operational program software (OPS) in the EFIS symbol generator.
- (2) An airborne data loader (ADL) and a data loader control panel are necessary for this procedure. The data loader control panel is installed above the airborne data loader on the P61 panel.
- (3) There must be an EFIS position on the data loader control panel. If there is not an EFIS position on the data loader control panel, then do the procedure to load the software directly into the EFIS signal generator using the PDL in the EE bay.
- (4) The airplane must be on the ground with the engines shut down before you can install the software.
- (5) To read about software installation times and data loaders, do this task: On-Airplane Software Installation (AMM 20-15-11/201).
- (6) Some airlines keep the circuit breaker for the data loader open when the data loader is not necessary. This increases the length of time that the data loader is serviceable.

B. References
- (1) AMM 20-15-11/201, On-Airplane Software Installation
- (2) AMM 24-22-00/201, Electrical Power - Control
- (3) AMM 34-21-00/201, Inertial Reference System

C. Access
- (1) Location Zones

211	Flight Compartment
212	Flight Compartment

D. Procedure

S 862-049
(1) Do this task: Supply Electrical Power (AMM 24-22-00/201).

S 862-092
(2) Do this task: Alignment of the IRS (AMM 34-21-00/201).

S 862-094
(3) Make sure the left and right EFI instrument source select switches are in the normal position.

S 862-050
(4) Use an ADL to install software in the EFIS symbol generator.

NOTE: You must know the correct software part numbers for the EFIS symbol generator. For the EFIS symbol generator to be an approved installation, software with the correct part numbers must be installed.

S 862-095

(5) If you will install the software in the center EFIS symbol generator, then set the EFI instrument source select switch on the P1-1 panel to ALTN.

S 862-051

(6) Do these steps to prepare for the software installation:
  - (a) Make sure the system select switch on the data loader control panel (P61) is set to NORM or NORMAL.
  - (b) Make sure that this circuit breaker is closed:
    - 1) P11 Circuit Breaker Panel:
      - a) 11F23, DATA LOADER
  - (c) Select the EFIS signal generator being loaded:
    - 1) AIRPLANES WITH ONE SWITCH ON THE DATA LOADER CONTROL PANEL; Set the switch to EFIS-L, EFIS-C, or EFIS-R.
    - 2) AIRPLANES WITH TWO SWITCHES ON THE DATA LOADER CONTROL PANEL; Do these steps at the data loader control panel:
      - a) Set the upper switch to L, C, or R.
      - b) Set the system select switch to EFIS.

S 472-052

(7) Do these steps to install the software:
  - (a) Put the correct disk in the disk drive.

    NOTE: When software is installed in the left or center EFIS SG, then the left EADI and EHSI will go blank. When software is installed in the right EFIS SG, then the right EADI and EHSI will go blank. This can take 30 to 40 seconds.

  - (b) Follow the prompts on the data loader to complete the installation.

    NOTE: When the data transfer starts, OPS TRANSFER IN PROGRESS will show on the EHSI that is not blank.

  - (c) When the installation is completed, make sure the correct OPS part number shows on the EHSI, adjacent to the applicable letter (L, C or R) for the EFIS symbol generator.

    NOTE: COMP, LOAD COMPLETE, and TRANSF COMPLETE are examples of data loader prompts for a completed installation.

  - (d) Remove the disk from the disk drive.

S 862-053

(8) Set the system select switch to NORM or NORMAL.

E. Put the Airplane Back to Its Usual Condition

S 862-069

(1) Remove electrical power if it is not necessary, (AMM 24-22-00/201).

TASK 34-22-00-472-055

6. EFIS Symbol Generator - Software Installation with a PDL in the Flight Deck

A. General

(1) This procedure shows you how to install operational program software (OPS) in the EFIS symbol generator.

(2) A portable data loader (PDL) is necessary for this procedure. A data loader control panel and a PDL interface connector are also necessary for this procedure (P61).

(3) There must be an EFIS position on the data loader control panel. If there is not an EFIS position on the data loader control panel, then do the procedure to load the software directly into the EFIS signal generator using the PDL in the EE bay.

(4) A PDL is not a Boeing supplied part. Refer to the PDL supplier for instructions for operation. PDLs have a disk drive for software installation from disks. Some PDLs have an internal mass storage device. If the software is stored in the PDL, then disks are not necessary.

(5) The airplane must be on the ground with the engines shut down before you can install software.

(6) To read about software installation times and data loaders, do this task: On-Airplane Software Installation (AMM 20-15-11/201).

B. References

(1) AMM 20-15-11/201, On-Airplane Software Installation

(2) AMM 24-22-00/201, Electrical Power - Control

(3) AMM 34-21-00/201, Inertial Reference System

C. Equipment

(1) Data Loader (or alternative tool)

(a) 11615-02 Loader - Data, Portable, ARINC 615-3 (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(b) 11615-20 Loader - Data, Portable, ARINC 615-3, Includes Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(c) 18000-02 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(d) 2231560-1-B Loader - Data, Portable, ARINC 615, with Two 3.5 Inch Disk Drives (alternative)
Teledyne Controls (Vendor Code 98571)
12333 W. Olympic Blvd., Los Angeles, CA 90064-1021

(e) 30100 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(f) 465130-01-01 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Litton Systems, Inc. (Vendor Code 30782)
6101 Condor Drive, Moorpark, CA 93021-2602

(g) 80000-03-01010203 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(h) 964-0400-024 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(i) 964-0400-025 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(j) YV68A110 Loader - Data, Portable, ARINC 615 (alternative)
SFIM (Vendor Code F6158)
SA 13 AV Marcel Ramofo Garmier, Massy, 91301 France

D. Access

(1) Location Zones

211/212 Flight Compartment

E. Procedure

S 862-064

(1) Do this task: Supply Electrical Power (AMM 24-22-00/201).

S 862-096

(2) Do this task: Alignment of the IRS (AMM 34-21-00/201).

S 862-097

(3) Use a Portable Data Loader (PDL) to install software in the applicable EFIS Symbol Generator.

NOTE: You must know the correct software part numbers for the EFIS signal generators. For the EFIS symbol generators to be an approved installation, software with the correct part numbers must be installed.

S 862-098

(4) Do these steps to prepare for the software installation:

(a) Make sure the left and right EFI instrument source select switches are in the normal position.

(b) Make sure the system select switch on the data loader control panel (P61) is set to NORM or NORMAL.

CAUTION: MAKE SURE THE CIRCUIT BREAKER FOR THE DATA LOADER IS OPEN BEFORE YOU CONNECT OR REMOVE THE INTERFACE CABLE FOR THE PORTABLE DATA LOADER. IF THE CIRCUIT BREAKER IS NOT OPEN, DAMAGE TO EQUIPMENT CAN OCCUR.

(c) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
  1) P11 Circuit Breaker Panel:
    a) 11F23, DATA LOADER

CAUTION: MAKE SURE THE POWER SWITCH FOR THE PDL IS SET TO OFF BEFORE YOU CONNECT OR REMOVE THE INTERFACE CABLE. IF THE POWER SWITCH IS NOT OFF, DAMAGE TO THE PDL CAN OCCUR.

(d) Set thw power switch on the PDL to the off position.
(e) Connect the interface cable from the PDL to the DATA TRANSFER UNIT RECEPTACLE on the P61 panel.
(f) Remove the DO-NOT-CLOSE tag and close this circuit breaker:
  1) P11 Circuit Breaker Panel:
    a) 11F23, DATA LOADER
(g) If you will install the software in the center EFIS symbol generator, then set the EFI instrument source select switch on the P1-1 panel to ALTN.
(h) Select the EFIS symbol generator being loaded:
  1) AIRPLANES WITH ONE SWITCH ON THE DATA LOADER CONTROL PANEL; Set the switch to EFIS-L, EFIS-C, or EFIS-R.
  2) AIRPLANES WITH TWO SWITCHES ON THE DATA LOADER CONTROL PANEL;
     Do these steps at the data loader control panel:
    a) Set the upper switch to L, C, or R.
    b) Set the system select switch to EFIS.

S 472-061

(5) SOFTWARE INSTALLATION WITH A PDL DISK DRIVE;
Do these steps to install the software:

NOTE: For more information on how to use the PDL, refer to the supplier's instructions for the PDL.

(a) Set the power switch on the PDL to the on position.
(b) Put the correct disk in the disk drive.

NOTE: When software is installed in the left or center EFIS SG, then the left EADI and EHSI will go blank. When software is installed in the right EFIS SG, then the right EADI and EHSI will go blank. This can take 30 to 40 seconds.

(c) Follow the prompts on the data loader to complete the installation.

NOTE: When the data transfer starts, OPS TRANSFER IN PROGRESS will show on the EHSI that is not blank.

(d) When the installation is completed, make sure the correct OPS part number shows on the EHSI, adjacent to the applicable letter (L, C or R) for the EFIS symbol generator.

NOTE: COMP, LOAD COMPLETE, and TRANSF COMPLETE are examples of data loader prompts for a completed installation.

(e) Remove the disk from the disk drive.

S 472-112

(6) SOFTWARE INSTALLATION WITH A PDL MASS STORAGE DEVICE; Follow the PDL supplier instructions to install the software.

NOTE: When software is installed in the left or center EFIS SG, then the left EADI and EHSI will go blank.

When software is installed in the right EFIS SG, then the right EADI and EHSI will go blank.

This can take 30 to 40 seconds.

When the data transfer starts, OPS TRANSFER IN PROGRESS will show on the EHSI that is not blank.

(a) When the installation is complete, make sure that OPS TRANSFER COMPLETE shows on the EHSI that is not blank.

(b) Make sure the correct OPS part number shows on the EHSI, adjacent to the applicable letter (L, C or R) for the EFIS symbol generator.

S 862-111

(7) Set the system select switch on the data loader control panel to NORM or NORMAL.

S 862-110

(8) Set the power switch on the data loader to the off position.

F. Put the Airplane Back to its Usual Condition

S 862-099

CAUTION: MAKE SURE THE CIRCUIT BREAKER FOR THE DATA LOADER IS OPEN BEFORE YOU CONNECT OR REMOVE THE INTERFACE CABLE FOR THE PORTABLE DATA LOADER. IF THE CIRCUIT BREAKER IS NOT OPEN, DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
  (a) P11 Circuit Breaker Panel:
    1) 11F23, DATA LOADER

S 862-071

(2) Remove the interface cable from the PDL and the DATA TRANSFER UNIT RECEPTACLE.

S 862-100

(3) Remove the DO-NOT-CLOSE tag and close this circuit breaker:
  (a) P11 Circuit Breaker Panel:
    1) 11F23, DATA LOADER

S 862-077

(4) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-22-00-472-079

7. EFIS Symbol Generator - Software Installation with a PDL in the EE Bay

A. General
  (1) This procedure tells you how to install software directly into an EFIS signal generator.
  (2) A portable data loader (PDL) is necessary for this procedure.
  (3) A PDL is not a Boeing supplied part. Refer to the PDL supplier for instructions for operation. PDLs have a disk drive for software installation from disks. Some PDLs have an internal mass storage device. If the software is stored in the PDL, then disks are not necessary.
  (4) A tray adapter is used to provide the connections between the EFIS Symbol Generator and the Portable Data Loader.
  (5) To read about software installation times and data loaders, do this task: On-Airplane Software Installation - Maintenance Practices (AMM 20-15-11/201).

B. References
  (1) AMM 20-15-11/201 On-Airplane Software Installation
  (2) AMM 24-22-00/201, Supply Electrical Power
  (3) AMM 34-22-01/401, EFIS Symbol Generator

C. Equipment
  (1) Tray Adapter (or alternative tool)
    (a) C34006-58 Adapter, Tray - EFIS SYMBOL GENERATOR software loading (alternative)
    (b) C34006-54 Adapter, Tray - EFIS SYMBOL GENERATOR software loading (alternative)

(c) C34006-2 Adapter, Tray - EFIS SYMBOL GENERATOR software loading (alternative)

(2) Data Loader (or alternative tool)

(a) 11615-02 Loader - Data, Portable, ARINC 615-3 (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(b) 11615-20 Loader - Data, Portable, ARINC 615-3, Includes Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(c) 18000-02 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(d) 2231560-1-B Loader - Data, Portable, ARINC 615, with Two 3.5 Inch Disk Drives (alternative)
Teledyne Controls (Vendor Code 98571)
12333 W. Olympic Blvd., Los Angeles, CA 90064-1021

(e) 30100 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(f) 465130-01-01 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Litton Systems, Inc. (Vendor Code 30782)
6101 Condor Drive, Moorpark, CA 93021-2602

(g) 80000-03-01010203 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(h) 964-0400-024 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(i) 964-0400-025 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(j) YV68A110 Loader - Data, Portable, ARINC 615 (alternative)
SFIM (Vendor Code F6158)
SA 13 AV Marcel Ramofo Garmier, Massy, 91301 France

D. Access

(1) Location Zones

211/212	Flight Compartment

E. Procedure

S 862-090

(1) Do this task: Supply Electrical Power (AMM 24-22-00/201).

S 862-089

(2) Make sure these circuit breakers are open:
- (a) P11 Circuit Breaker Panel:
  - 1) 11F8, EFIS SYM GEN LEFT
  - 2) 11F9, EFIS SYM GEN CENTER
  - 3) 11F29, EFIS SYM GEN RIGHT

S 902-086

(3) Remove the EFIS symbol generator from its tray in the electronics bay (AMM 34-22-01/401).

S 902-087

(4) Put the tray adapter into the empty EFIS symbol generator tray.
- (a) Make sure the tray adapter is fully seated in the tray.

S 902-088

(5) Put the EFIS symbol generator into the tray adapter.
- (a) Make sure the EFIS symbol generator is fully seated in the tray adapter.

S 862-101

CAUTION: MAKE SURE THE CIRCUIT BREAKER FOR THE EFIS SIGNAL GENERATOR IS OPEN, AND THE POWER SWITCH FOR THE PDL IS OFF. THE POWER MUST BE OFF BEFORE YOU CONNECT OR REMOVE THE INTERFACE CABLE FOR THE PDL. DAMAGE TO EQUIPMENT CAN OCCUR.

(6) Set the power switch on the PDL to the off position.

S 862-102

(7) Connect the interface cable from the PDL to the tray adapter.

S 862-083

(8) Set the EFI instrument source select switch as follows:
- (a) To select the left EFIS symbol generator:
  - 1) Set the left EFI source select switch (located left of the left EFIS display) to the normal (out) position.
- (b) To select the right EFIS symbol generator:
  - 1) Set the right EFI source select switch (located right of the right EFIS display) to the normal (out) position.
- (c) To select the center EFIS symbol generator:
  - 1) Set the left EFI source select switch (located left of the left EFIS display) to the alternate (in) position.

S 862-115

(9) Close the circuit breaker for the applicable EFIS symbol generator:
- (a) P11 Circuit Breaker Panel:
  - 1) LEFT EFIS SYMBOL GENERATOR;
    11F8, EFIS SYM GEN LEFT

2) CENTER EFIS SYMBOL GENERATOR;
11F9, EFIS SYM GEN CENTER
3) RIGHT EFIS SYMBOL GENERATOR;
11F29, EFIS SYM GEN RIGHT

S 472-103

(10) SOFTWARE INSTALLATION WITH A PDL DISK DRIVE;
Do these steps to install the software:

(a) Set the power switch on the PDL to the on position.

NOTE: For more information on how to use the PDL, refer to the supplier' s instructions for the PDL.

(b) Put the correct disk in the disk drive.
(c) Follow the prompts on the PDL to complete the installation.
(d) Remove the disk from the disk drive when the software installation is completed.

NOTE: COMP, LOAD COMPLETE, and TRANSF COMPLETE are examples of data loader prompts for a completed installation.

(e) Make sure the software part number that shows on the EHSI is the same part number that is on the disk.

S 472-113

(11) SOFTWARE INSTALLATION WITH A PDL MASS STORAGE DEVICE;
Follow the PDL supplier instructions to install the software.

NOTE: When software is installed in the left or center EFIS SG, then the left EADI and EHSI will go blank.

When software is installed in the right EFIS SG, then the right EADI and EHSI will go blank.

This can take 30 to 40 seconds.

When the data transfer starts, OPS TRANSFER IN PROGRESS will show on the EHSI that is not blank.

(a) When the installation is complete, make sure that OPS TRANSFER COMPLETE shows on the EHSI that is not blank.
(b) Make sure the correct OPS part number shows on the EHSI, adjacent to the applicable letter (L, C or R) for the EFIS symbol generator.

S 862-114

(12) Set the power switch on the PDL to the off position.

F. Put the Airplane Back to its Usual Condition.

S 862-104

(1) Open the circuit breaker for the applicable EFIS symbol generator:
  (a) P11 Circuit Breaker Panel:
    1) LEFT EFIS SYMBOL GENERATOR;
    11F8, EFIS SYM GEN LEFT
    2) CENTER EFIS SYMBOL GENERATOR;
    11F9, EFIS SYM GEN CENTER
    3) RIGHT EFIS SYMBOL GENERATOR;
    11F29, EFIS SYM GEN RIGHT

S 862-105

CAUTION: MAKE SURE THE CIRCUIT BREAKER FOR THE EFIS SIGNAL GENERATOR IS OPEN, AND THE POWER SWITCH FOR THE PDL IS OFF. THE POWER MUST BE OFF BEFORE YOU CONNECT OR REMOVE THE INTERFACE CABLE FOR THE PDL. DAMAGE TO EQUIPMENT CAN OCCUR.

(2) Disconnect the interface cable from the tray adapter and the PDL.

S 022-106

(3) Remove the EFIS symbol generator from the tray adapter.

S 022-107

(4) Remove the tray adapter from the EFIS symbol generator tray.

S 422-108

(5) Install the EFIS symbol generator into the tray (AMM 34-22-01/401).

S 862-109

(6) Close these circuit breakers:
  (a) P11 Circuit Breaker Panel:
    1) LEFT EFIS SYMBOL GENERATOR;
    11F8, EFIS SYM GEN LEFT
    2) CENTER EFIS SYMBOL GENERATOR;
    11F9, EFIS SYM GEN CENTER
    3) RIGHT EFIS SYMBOL GENERATOR;
    11F29, EFIS SYM GEN RIGHT

S 862-093

(7) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ELECTRONIC FLIGHT INSTRUMENT SYSTEM - ADJUSTMENT/TEST

1. General
   A. There are two tasks in this procedure. They are the operational and system tests for the electronic flight instrument system (EFIS).

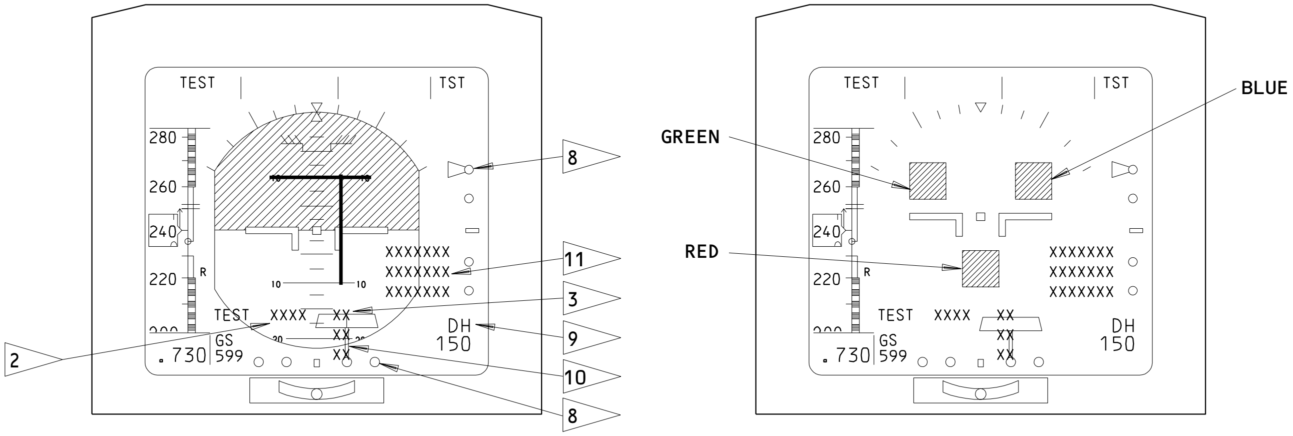
      NOTE: In the operational and system tests, the EADI and EHSI displays will momentarily go blank. This is not a failure condition.

   B. The acronyms that are used in the Electronic Flight Instrument System are as follows:

      ADC - Air Data Computer
      AFDS - Autopilot Flight Director System
      CDU - Control Display Unit
      DME - Distance Measuring Equipment
      EADI - Electronic Attitude Director Indicator
      EFIS - Electronic Flight Instrument System
      EHSI - Electronic Horizontal Situation Indicator
      EICAS - Engine Indication and Crew Alerting System
      FMC - Flight Management Computer
      ILS - Instrument Landing System
      IRMP - Inertial Reference Mode Panel
      MASI - Mach Airspeed Indicator
      MCDP - Maintenance Control Display Panel
      RA - Radio Altimeter
      VOR - Very High Frequency (VHF) Omnidirectional Range
      WXR - Weather Radar

TASK 34-22-00-715-001

2. Electronic Flight Instrument System - Operational Test (Fig. 501)
   A. General
      (1) The Flight Instrument System operational test is done to make sure that all of the components in the system operate correctly.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 34-21-00/201, Inertial Reference System



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY IS SET BY THE STATE OF THE OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

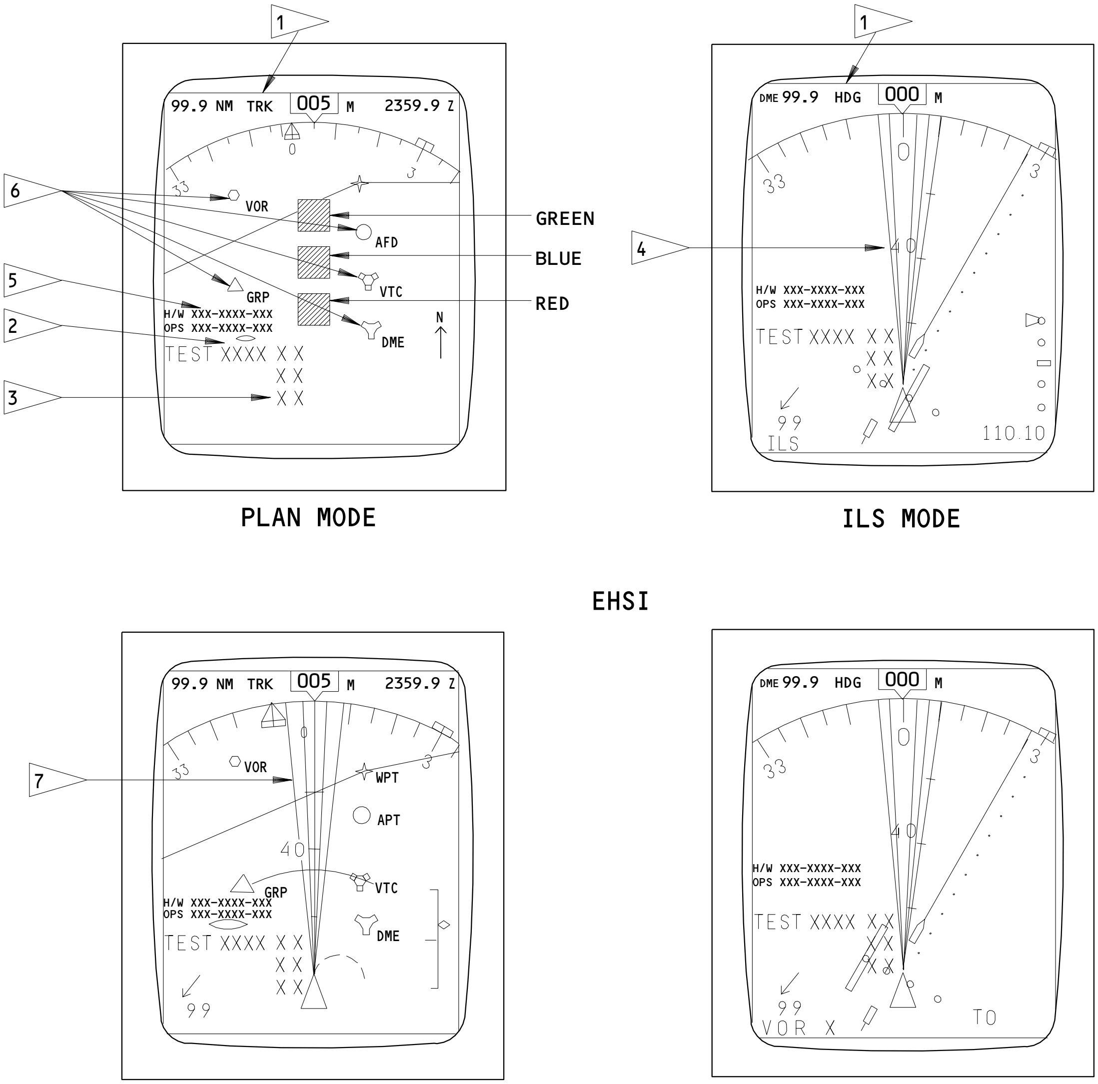
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 501 (Sheet 1)



PLAN MODE

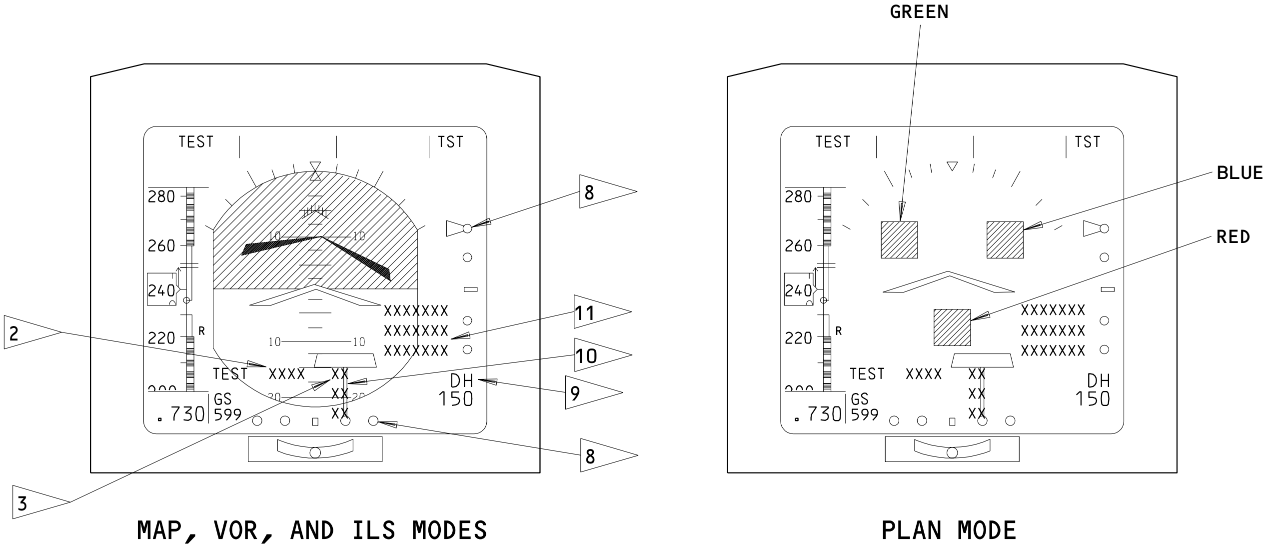
ILS MODE

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501 (Sheet 2)



EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

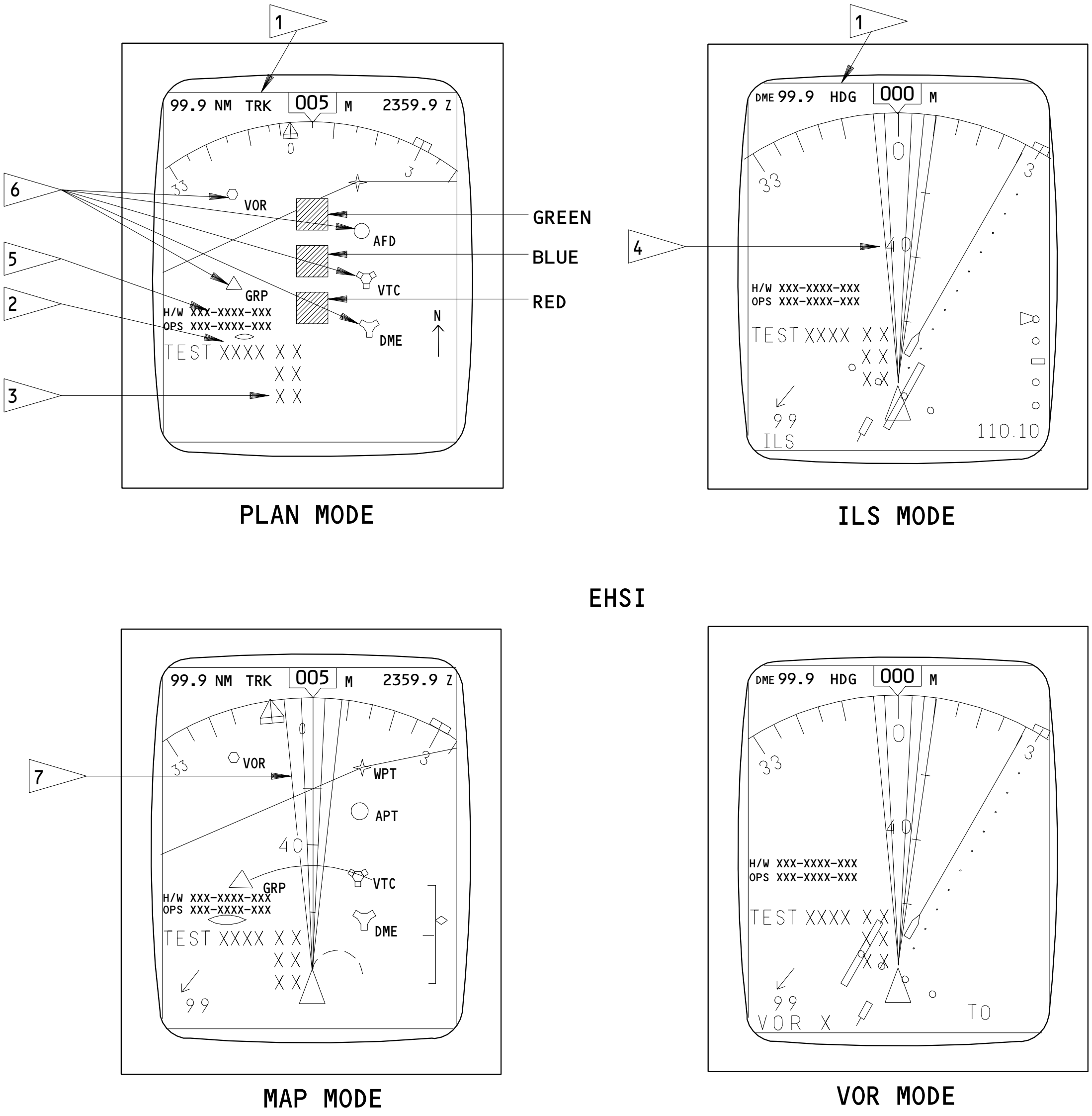
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 501A (Sheet 1)



PLAN MODE

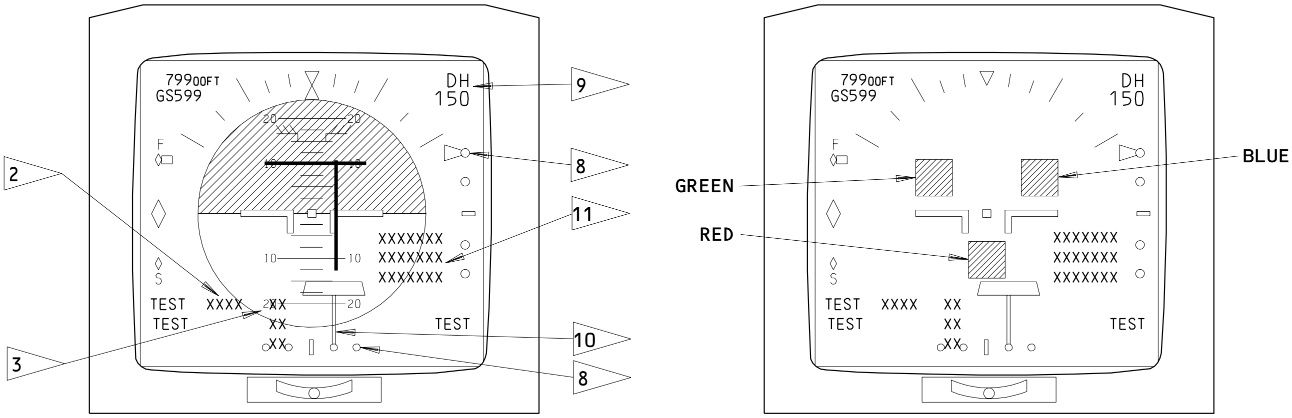
ILS MODE

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501A (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

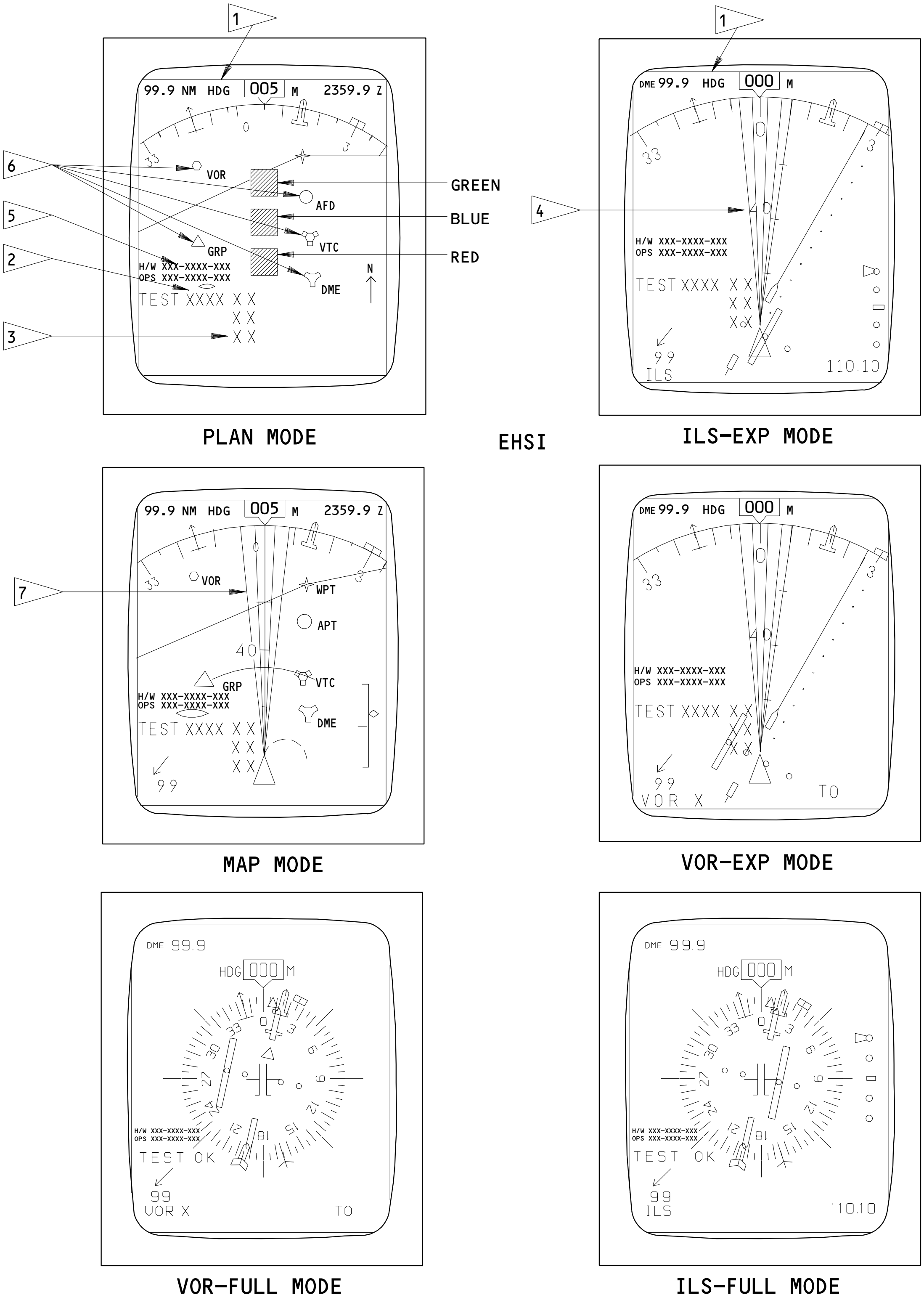
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

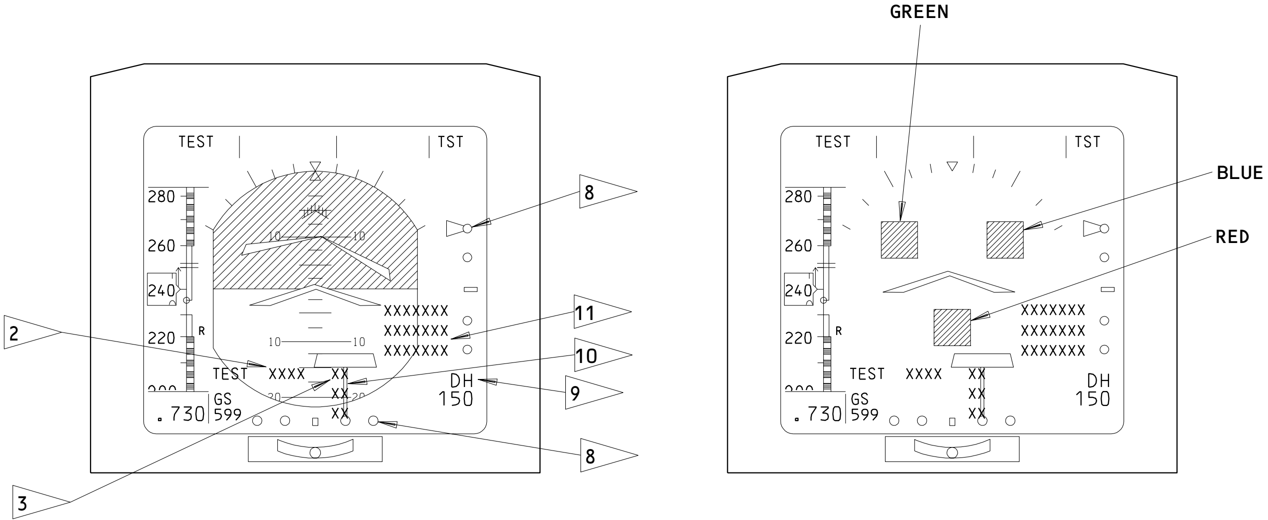
11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 501B (Sheet 1)



THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501B (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

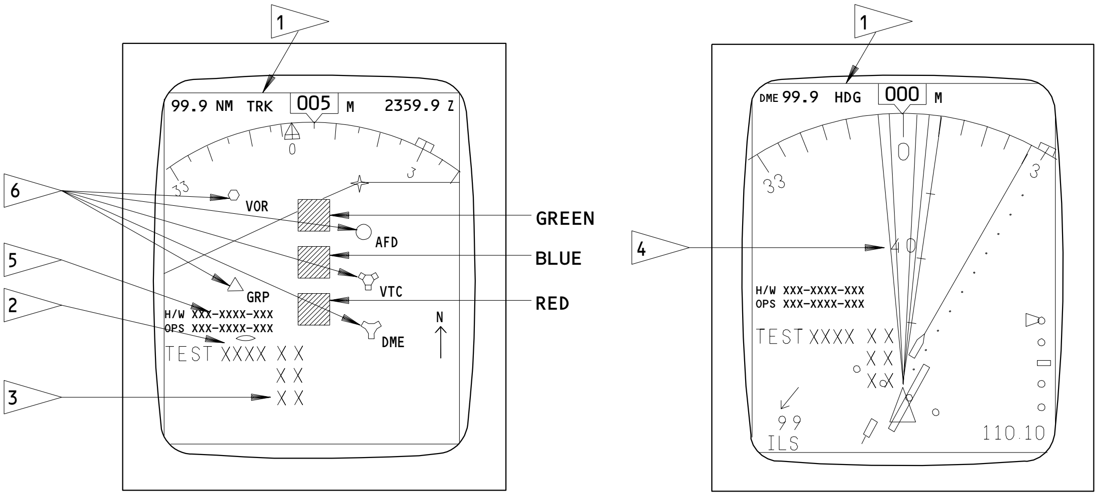
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

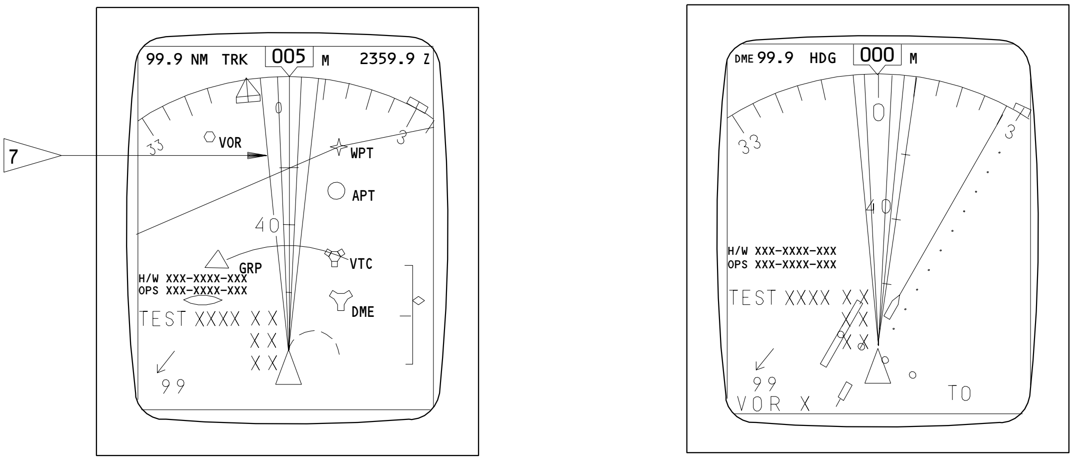
EFIS Test Patterns
Figure 501C (Sheet 1)



PLAN MODE

ILS MODE

EHSI

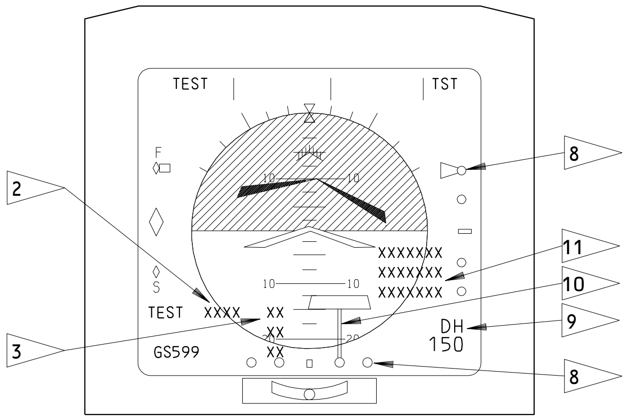


MAP MODE

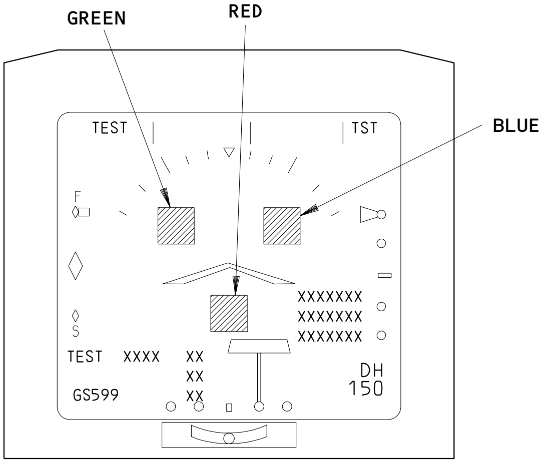
VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501C (Sheet 2)



MAP, VOR, AND ILS MODES



PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY COLORS SAME AS FOR NORMAL OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

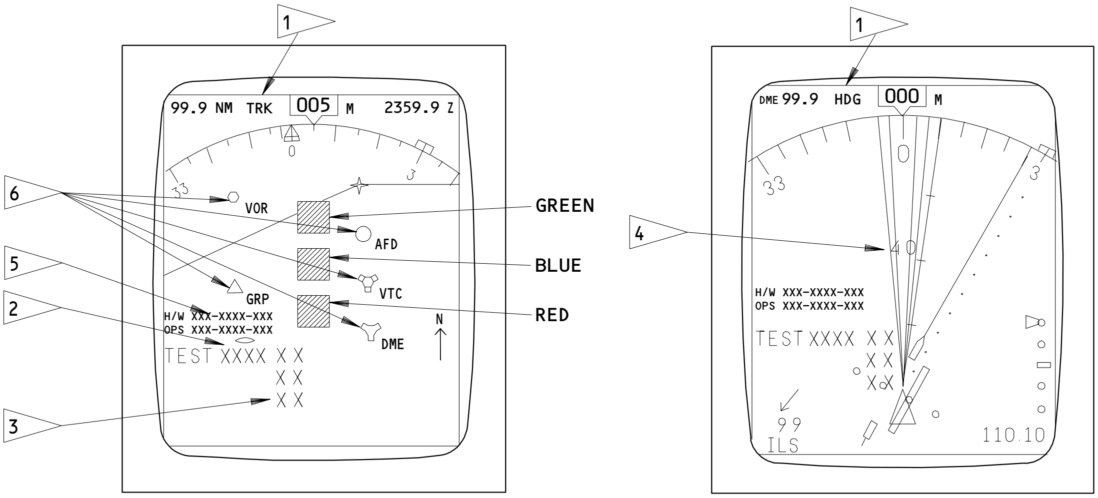
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

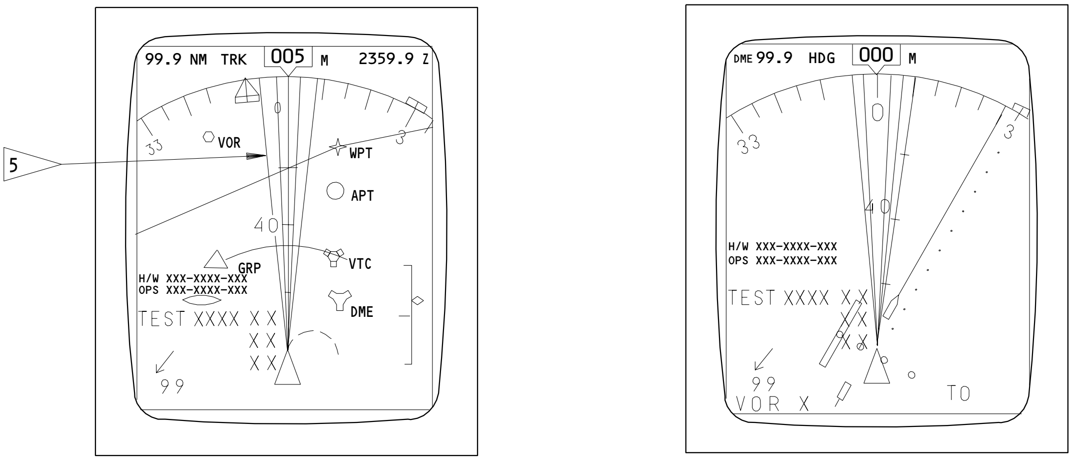
EFIS Test Patterns
Figure 501D (Sheet 1)



PLAN MODE

ILS MODE

EHSI

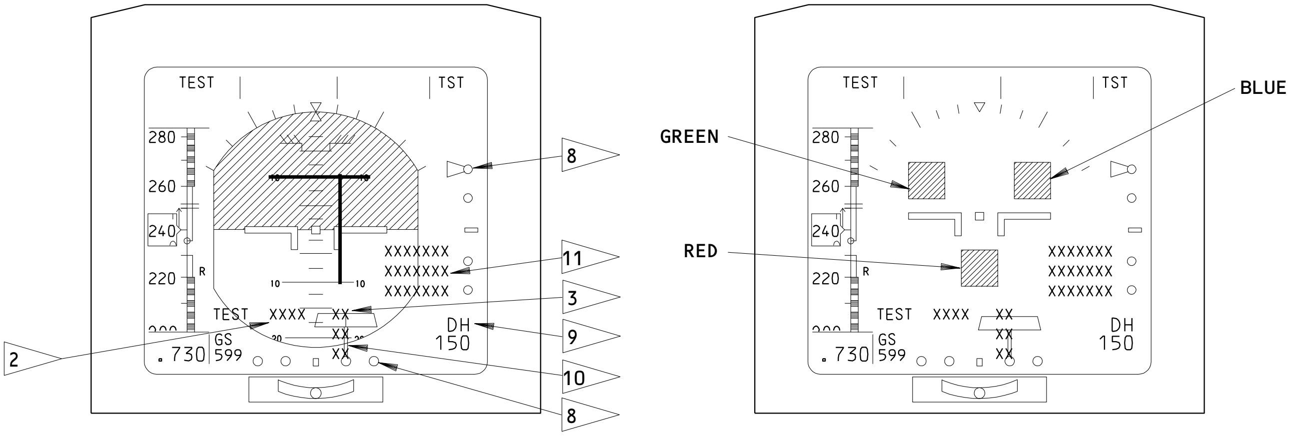


MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501D (Sheet 2)



MAP, VOR, AND ILS MODES

PLAN MODE

EADI

THIS UNIT IS ELECTROSTATIC SENSITIVE

NOTE: SYMBOLOGY IS SET BY THE STATE OF THE OPERATION.

1 PRESENTATION IS SET BY THE STATE OF THE PROGRAM PIN AND/OR DIGITAL DISCRETE INPUT

2 TEST MESSAGE "OK" OR "FAIL"

3 FAILURE MESSAGE-CP (CONTROL PANEL); DU (DISPLAY UNIT); AND SG (SYMBOL GENERATOR)

4 NUMERIC VALUE SHOWS THE EFIS CONTROL PANEL RANGE SELECTION

5 SOFTWARE VERSION

6 SHOWS THE HSI MAP DATA SELECTED ON THE EFIS CONTROL PANEL

7 RED-YELLOW-GREEN WXR TEST PATTERN

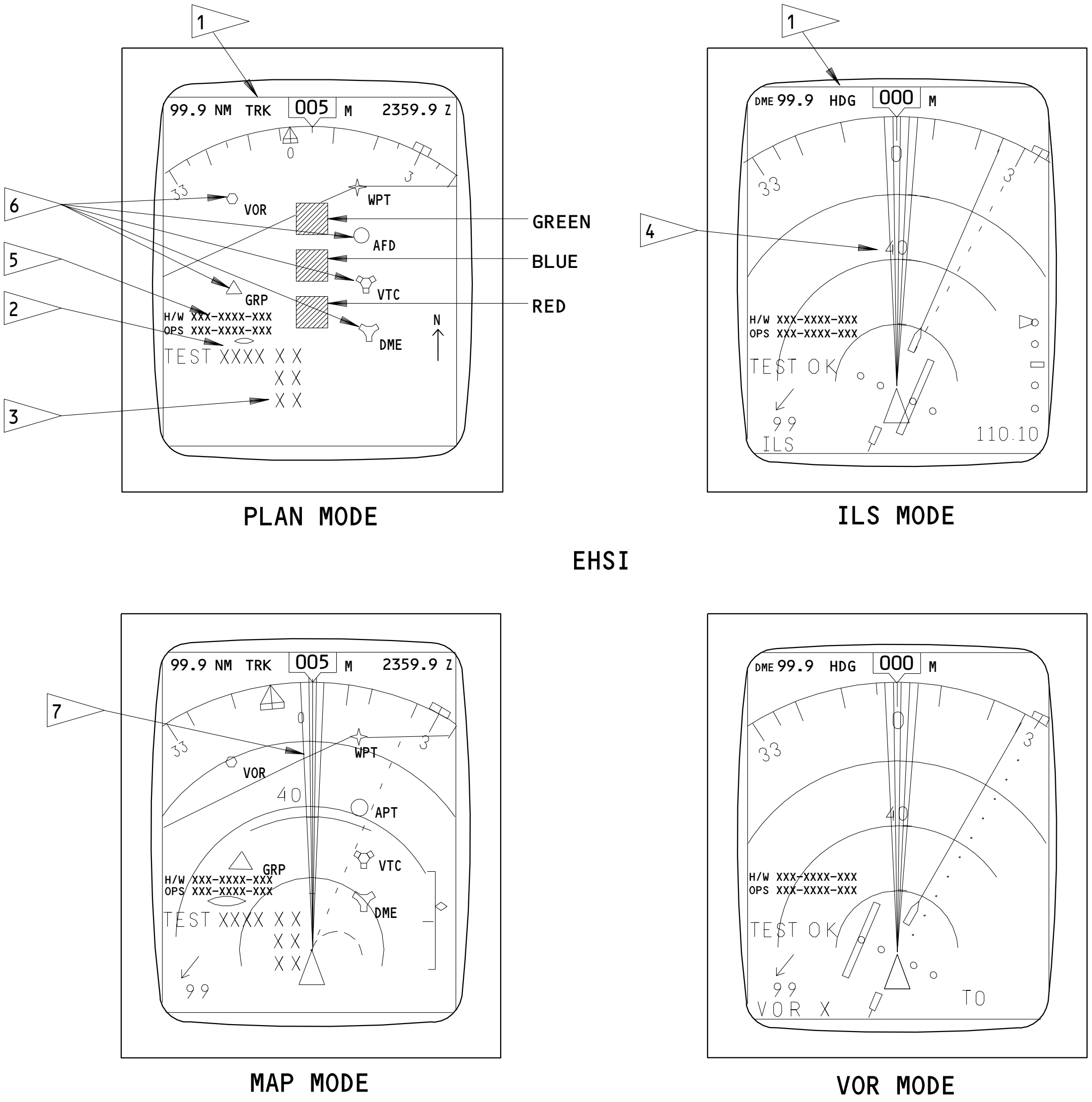
8 THE G/S AND LOC SCALES AND POINTERS WILL NOT SHOW IF THE FREQUENCY ON THE ILS CONTROL PANEL IS IN THE "PK" POSITION

9 "DH" WILL SHOW FOR DH ALERT CONDITIONS; OTHERWISE, THE DECISION HEIGHT FROM THE EFIS CONTROL PANEL WILL SHOW

10 BAR FLASHES FOR ILS DEVIATION WARNING

11 PROGRAM PIN HEX CODES

EFIS Test Patterns
Figure 501E (Sheet 1)



PLAN MODE

ILS MODE

EHSI

MAP MODE

VOR MODE

THIS UNIT IS ELECTROSTATIC SENSITIVE

EFIS Test Patterns
Figure 501E (Sheet 2)

C. Access

(1) Location Zones

211/212 Flight Compartment

D. Prepare for Test

S 865-857

(1) Supply electrical power (AMM 24-22-00/201).

S 865-003

(2) On the left and right EFIS control panels, put the switches and controls in the positions indicated:

- (a) Range Select - 80 NM
- (b) GUI 001-114, 116-999;
  HSI Mode Select - VOR
- (c) GUI 115;
  HSI Mode Select - EXP VOR
- (d) WXR Select - OFF (out)
- (e) MAP NAVAID - ON (in)
- (f) MAP APRT - ON (in)
- (g) MAP RTE DATA - ON (in)
- (h) MAP WPT - ON (in)
- (i) ADI BRT - Equal distance between fully clockwise and fully counterclockwise.
- (j) HSI BRT - Equal distance between fully clockwise and fully counterclockwise.

S 865-004

(3) On the left and right instrument source select panels, put the switches and controls in the positions indicated:

- (a) FLT DIR - L position (left panel)/ R position (right panel)
- (b) GUI 115 PRE-SB 34-414;
  GUI 001-011;
  FMC - NORM (out)
- (c) GUI 115 POST-SB 34-414;
  NAV - FMC-L (left panel)/ FMC-R (right panel)
- (d) EFI - NORM (out)
- (e) IRS - NORM (out)

S 865-005

(4) On the P3 panel, put the HDG REF switch in the NORM position.

S 865-493

(5) On the AFDS mode control panel, set the two F/D switches to the OFF position.

S 865-006

(6) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
  (a) 11A2, VOR MKR LEFT
  (b) 11A3, ILS CENTER or MMR C
  (c) GUI 001-114, 116-999;
      11A7, EFIS DSPL SW LEFT
  (d) GUI 115;
      11C4, EFIS DSPL SW LEFT
  (e) 11E3, ADI LEFT
  (f) 11E4, EFIS CONTROL PNL LEFT
  (g) 11E6, HSI LEFT
  (h) 11E9, FMCS CMPTR LEFT
  (i) 11E10, ILS L or MMR L
  (j) 11E11, DME LEFT
  (k) 11E16, MODE CONT PNL LEFT
  (l) 11E17, FLT CONT COMPUTER POWER LEFT
  (m) 11E20, FLIGHT CONT CMPTR PWR CENTER
  (n) 11E24, ADI RIGHT
  (o) 11E25, EFIS CONT PNL RIGHT
  (p) 11E27, HSI RIGHT
  (q) 11E30, FMCS CMPTR RIGHT
  (r) 11E31, ILS RIGHT or MMR R
  (s) 11E32, DME RIGHT
  (t) 11E33, VOR RIGHT
  (u) 11E34, MODE CONT PNL RIGHT
  (v) 11E35, FLT CONT CMPTR PWR RIGHT
  (w) 11F1, IRS LEFT
  (x) 11F2, WX RADAR
  (y) 11F5, RADIO ALTM LEFT
  (z) GUI 115;
      11F6, ADF LEFT
  (aa) 11F8, EFIS SYM GEN LEFT
  (ab) 11F9, EFIS SYM GEN CENTER
  (ac) 11F10, EFIS INSTR COMPARATOR
  (ad) 11F15, TMC DC
  (ae) 11F20, RADIO ALTM CENTER
  (af) 11F21, IRS CENTER
  (ag) 11F22, IRS RIGHT
  (ah) 11F24, EFIS DSPL SW RIGHT
  (ai) 11F26, RADIO ALTM RIGHT
  (aj) GUI 115;
      11F27, ADF RIGHT
  (ak) 11F29, EFIS SYM GEN RIGHT
  (al) GUI 001-008, 010-114, 116-999;
      11S19, LANDING GEAR AIR/GND SYS 2

S 865-007

(7) Open these circuit breakers on the miscellaneous circuit breaker panel, P6, and attach DO-NOT-CLOSE tags:
   (a) 6D3, IRS L
   (b) 6D4, IRS C
   (c) 6D5, IRS R

S 865-008

(8) On the IRMP, set the left, right, and center mode controls to the OFF position.

S 865-009

(9) Make sure that these P11 panel circuit breakers are closed:
   (a) 11C30, LANDING GEAR POS SYS 1
   (b) 11F14, TMC AC
   (c) 11F16, TMC SERVO
   (d) 11S15, AIR/GND SYS 1

E. Left and Right EFIS Test

S 755-010

(1) On the left and right EFIS control panels, make sure that the NAVAID, APRT, RTE DATA, and WPT switch lights are on.

<u>NOTE</u>: The control panel light intensity is adjusted by the AISLE STAND control on the left overhead light control panel, P5.

S 865-011

(2) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
   (a) 11A3, ILS CENTER or MMR C
   (b) 11E4, EFIS CONT PNL LEFT
   (c) 11E10, ILS L or MMR L
   (d) 11E25, EFIS CONT PNL RIGHT

(e) 11E31, ILS RIGHT or MMR R

S 755-012

(3) On the left and right EFIS control panels, make sure that the NAVAID, APRT, RTE DATA, and WPT switch lights stay on.

S 865-013

(4) On the ILS control panel, set the frequency to 110.10.

S 865-014

(5) On the left and right EFIS control panels, set the DH REF control to 50.

S 865-015

(6) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
   (a) GUI 001-114, 116-999;
       11A7, EFIS DSPL SW LEFT
   (b) GUI 115;
       11C4, EFIS DSPL SW LEFT
   (c) 11E3, ADI LEFT
   (d) 11E6, HSI LEFT
   (e) 11E24, ADI RIGHT
   (f) 11E27, HSI RIGHT
   (g) 11F8, EFIS SYM GEN LEFT
   (h) 11F9, EFIS SYM GEN CENTER
   (i) 11F24, EFIS DSPL SW RIGHT
   (j) 11F29, EFIS SYM GEN RIGHT

S 865-016

(7) On the left, center, and right EFIS symbol generators, momentarily push the RESET switch.

S 865-017

(8) Permit 30 seconds for the EFIS to become warm.

S 865-018

(9) On the right overhead light control panel, push the TEST switch.

S 755-019

(10) On the two EADIs, make sure that the displays are equivalent to the EADI VOR mode in Figure 501.
   (a) Make sure that the TEST OK indication shows in the lower left position of the display.
   (b) Make sure that the glide slope and localizer indicators momentarily go out of view.
   (c) GUI 115;
       Make sure that the digital radio altitude display shows in the top right position.

(d) GUI 001-114, 116-999;
Make sure that the digital radio altitude display shows in the lower right position.

(e) Make sure that the airplane symbol shows in the center position.

(f) GUI 002-006, 010-999;
Make sure the split-axis flight director command bar shows.

(g) GUI 007, 008;
Make sure the integrated cue flight director command bar shows.

(h) GUI 001, 009;
Make sure the filled integrated cue flight director command bar shows.

(i) Make sure that the rising runway display shows.

(j) GUI 001-008, 010-114, 116-999;
Make sure that the speed tape display shows.

(k) Make sure that the pitch limit indicator shows.

(l) Make sure that the EFIS program pin hex codes that follow show in the lower right position of the EADI display:

Airplanes	Upper Code	Middle Code	Lower Code
GUI 001	00003B4	8008200	2000000
GUI 002-006	00001B4	8008200	2000000
GUI 007, 008	00005B4	8008200	2000000
GUI 009	00003B4	0008200	2000000
GUI 010-114, 116-999	00001B4	800E200	2000000
GUI 115	0200036	0000200	0000000

S 865-020

(11) On the left and right EFIS control panels, put the WXR switches in the ON position.

(a) Make sure that the WXR switch lights come on.

S 755-744

(12) GUI 001-114, 116-999;
On the two EHSIs, make sure that the displays are equivalent to the EHSI VOR mode in Figure 501.

S 755-745

(13) GUI 115;
On the two EHSIs, make sure that the displays are equivalent to the EHSI VOR-EXP mode in Figure 501.

S 755-619

(14) Left and right EHSIs:

(a) Make sure that the TEST OK indication shows in the lower left position of the display.

(b) Make sure that the glide slope and localizer indicators momentarily go out of view.
(c) Make sure that the VOR L flag shows in the lower left position of the left display.
(d) Make sure that the VOR R flag shows in the lower left position of the right display.
(e) Make sure that the red, yellow, and green weather radar test lines show in the center position.
(f) Make sure that the wind speed display of 99 shows in the lower left position.

S 865-746
(15) GUI 001-114, 116-999;
On the left and right EFIS control panels, set the HSI MODE control to the ILS position.

S 865-747
(16) GUI 115;
On the left and right EFIS control panels, set the HSI MODE control to the EXP-ILS position.

S 755-748
(17) GUI 001-114, 116-999;
On the two EHSIs, make sure that the displays are equivalent to the EHSI ILS mode in Figure 501.

S 755-749
(18) GUI 115;
On the two EHSIs, make sure that the displays are equivalent to the EHSI EXP-ILS mode in Figure 501.

S 755-629
(19) Left and right EHSIs:
(a) Make sure that the TEST OK indication shows in the lower left position of the display.

(b) Make sure that the ILS indication shows in the lower left position.
(c) Make sure that the weather radar test lines show in the center position.

S 865-750

(20) GUI 115;
On the left and right EFIS control panels, set the HSI MODE control to the EHSI FULL-VOR position.

S 755-752

(21) GUI 115;
On the two EHSIs, make sure that the displays are equivalent to the EHSI FULL-VOR mode in Figure 501.

S 755-G96

(22) Left and right EHSIs:
(a) Make sure that the TEST OK indication shows in the lower left position.
(b) Make sure that the VOR L flag shows in the lower left position of the left display.
(c) Make sure that the VOR R flag shows in the lower left position of the right display.
(d) Make sure that the weather radar test lines do not show.

S 865-753

(23) GUI 115;
On the left and right EFIS control panels, set the HSI MODE control to the EHSI FULL-ILS position.

S 755-755

(24) GUI 115;
On the two EHSIs, make sure that the displays are equivalent to the EHSI FULL-ILS mode in Figure 501.

S 755-H64

(25) Left and right EHSIs:
(a) Make sure that the TEST OK indication shows in the lower left position of the display.
(b) Make sure that the ILS indication shows in the lower left position.

(c) Make sure that the weather radar test lines do not show.

S 865-051

(26) On the left and right EFIS control panels, set the HSI MODE control to the MAP position.

S 755-052

(27) On the two EHSIs, make sure that the displays are equivalent to the EHSI MAP mode in Figure 501.
   (a) Make sure that the TEST OK indication shows in the lower left position of the display.
   (b) Make sure that the weather radar test lines show in the center position.
   (c) Make sure that the NAVAID indications show.
   (d) Make sure that the ARPT indications show.
   (e) Make sure that the RTE DATA indications show.
   (f) Make sure that the WPT indications show.

S 865-053

(28) On the left and right EFIS control panels, set the HSI RANGE control to 40.
   (a) Make sure that the MAP indications move away from the airplane indicator.
   (b) Make sure that the range shown changes from 40 to 20.

S 865-E45

(29) On the left and right EFIS control panels, set the HSI RANGE control to 80.

S 865-054

(30) On the left and right EFIS control panels, set the HSI MODE control to the PLAN position.

S 755-055

(31) On the two EHSIs, make sure that the displays are equivalent to the EHSI PLAN mode in Figure 501.
   (a) Make sure that the TEST OK indication shows in the lower left position of the display.
   (b) Make sure that the weather radar test lines do not show.

S 865-056

(32) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

F. Center EFIS Symbol Generator Test

S 865-057

(1) Make sure that these P11 panel circuit breakers are closed:
   (a) GUI 001-114, 116-999;
       11A7, EFIS DSPL SW LEFT
   (b) GUI 115;
       11C4, EFIS DSPL SW LEFT
   (c) 11E3, ADI LEFT
   (d) 11E4, EFIS CONT PNL LEFT
   (e) 11E6, HSI LEFT
   (f) 11E24, ADI RIGHT
   (g) 11E25, EFIS CONT PNL RIGHT
   (h) 11E27, HSI RIGHT
   (i) 11F8, EFIS SYM GEN LEFT
   (j) 11F9, EFIS SYM GEN CENTER
   (k) 11F24, EFIS DSPL SW RIGHT
   (l) 11F29, EFIS SYM GEN RIGHT

S 865-058

(2) On the right EFIS control panel, put the switches and controls in the positions indicated:
   (a) Range Select - 80 NM
   (b) HSI Mode Select - MAP
   (c) WXR Select - ON (in)
   (d) Map Mode Select Switches (4) - ON (in)
   (e) ADI BRT and HSI BRT - Fully clockwise.

S 865-059

(3) Push the TEST switch on the right overhead light control panel.

S 755-495

(4) Make sure that the right EADI and EHSI displays are equivalent to the MAP mode in Figure 501.
   (a) Make sure that the EHSI display has an indicated range of 80 NM.

S 865-061

(5) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-062

(6) Open this P11 panel circuit breaker:
    (a) 11F29, EFIS SYM GEN RIGHT

S 755-063

(7) Make sure that the right EADI and EHSI displays go out of view.

S 865-064

(8) Set the right EFI instrument source select switch to ALTN.

S 865-065

(9) Push the TEST switch on the right overhead light control panel.

S 755-066

(10) Make sure that the right EADI and EHSI displays are equivalent to the MAP mode in Figure 501.
    (a) Make sure that the EHSI display has an indicated range of 80 NM.

S 865-067

(11) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-069

(12) Close this P11 panel circuit breaker:
    (a) 11F29, EFIS SYM GEN RIGHT

S 865-068

(13) Set the right EFI instrument source select switch to NORM.

S 755-070

(14) Make sure that the right EADI and EHSI displays are correct.

S 865-071
(15) On the left and right EFIS control panels, put the switches and controls in the positions indicated.
  (a) GUI 001-114, 116-999;
  HSI Mode Select - VOR
  (b) GUI 115;
  HSI Mode Select - EXP VOR
  (c) WXR Select - OFF (out)
  (d) ADI BRT - Equal distance between fully clockwise and fully counterclockwise.
  (e) HSI BRT - Equal distance between fully clockwise and fully counterclockwise.

S 865-072
(16) On the center EFIS symbol generator, momentarily push the RESET switch.

S 865-073
(17) On the right instrument source select panel, put the EFI switch to ALTN.

S 865-074
(18) On the right overhead light control panel, push the TEST switch.

S 755-075
(19) On the right EADI, make sure that the display is equivalent to the EADI VOR mode in Figure 501.
  (a) Make sure that the TEST OK indication shows in the lower left position of the display.
  (b) Make sure that the glide slope and localizer indicators momentarily go out of view.
  (c) GUI 115;
  Make sure that the digital radio altitude display shows in the top right position.

(d) GUI 001-114, 116-999;
Make sure that the digital radio altitude display shows in the lower right position.

(e) Make sure that the airplane symbol shows in the center position.

(f) GUI 002-006, 010-999;
Make sure the split-axis flight director command bar shows.

(g) GUI 007, 008;
Make sure the integrated cue flight director command bar shows.

(h) GUI 001, 009;
Make sure the filled integrated cue flight director command bar shows.

(i) Make sure that the rising runway display shows.

(j) GUI 001-008, 010-114, 116-999;
Make sure that the speed tape display shows.

(k) Make sure that the pitch limit indicator shows.

(l) Make sure that the EFIS program pin hex codes that follow show in the lower right position of the EADI display:

Airplanes	Upper Code	Middle Code	Lower Code
GUI 001	00003B4	8008200	2000000
GUI 002-006	00001B4	8008200	2000000
GUI 007, 008	00005B4	8008200	2000000
GUI 009	00003B4	0008200	2000000
GUI 010-114, 116-999	00001B4	800E200	2000000
GUI 115	0200036	0000200	0000000

S 865-076

(20) On the right EFIS control panel, put the WXR switch in the ON position.

(a) Make sure that the WXR switch light comes on.

S 755-757

(21) GUI 001-114, 116-999;
On the right EHSI, make sure that the display is equivalent to the EHSI VOR mode in Figure 501.

S 755-758

(22) GUI 115;
On the right EHSI, make sure that the display is equivalent to the EHSI VOR-EXP mode in Figure 501.

S 755-G55

(23) Right EHSI:
- (a) Make sure that the TEST OK indication shows in the lower left position of the display.
- (b) Make sure that the glide slope and localizer indicators momentarily go out of view.
- (c) Make sure that the VOR R flag shows in the lower left position of the display.
- (d) Make sure that the red, yellow, and green weather radar test lines show in the center position.
- (e) Make sure that the wind speed display of 99 shows in the lower left position.

S 865-759

(24) GUI 001-114, 116-999;
On the right EFIS control panel, set the HSI MODE control to the ILS position.

S 865-760

(25) GUI 115;
On the right EFIS control panel, set the HSI MODE control to the EXP-ILS position.

S 755-761

(26) GUI 001-114, 116-999;
On the right EHSI, make sure that the display is equivalent to the EHSI ILS mode in Figure 501.

S 755-762

(27) GUI 115;
On the right EHSI, make sure that the display is equivalent to the EHSI EXP-ILS mode in Figure 501.

S 755-098

(28) Right EHSI:
- (a) Make sure that the TEST OK indication shows in the lower left position of the display.
- (b) Make sure that the ILS indication shows in the lower left position.
- (c) Make sure that the weather radar test lines show in the center position.

S 865-763

(29) GUI 115;
On the right EFIS control panel, set the HSI MODE control to the EHSI FULL-VOR position.

S 755-764

(30) GUI 115;
On the right EHSI, make sure that the display is equivalent to the EHSI FULL-VOR mode in Figure 501.

S 755-I07

(31) Right EHSI:
- (a) Make sure that the TEST OK indication shows in the lower left position.
- (b) Make sure that the VOR R flag shows in the lower left position of the display.
- (c) Make sure that the weather radar test lines do not show.

S 865-767

(32) GUI 115;
On the right EFIS control panel, set the HSI MODE control to the EHSI FULL-ILS position.

S 755-769

(33) GUI 115;
On the right EHSI, make sure that the display is equivalent to the EHSI FULL-ILS mode in Figure 501.

S 755-H65

(34) Right EHSI:
  - (a) Make sure that the TEST OK indication shows in the lower left position of the display.
  - (b) Make sure that the ILS indication shows in the lower left position.
  - (c) Make sure that the weather radar test lines do not show.

S 865-105

(35) On the right EFIS control panel, set the HSI MODE control to the MAP position.

S 755-106

(36) On the right EHSI, make sure that the display is equivalent to the EHSI MAP mode in Figure 501.
  - (a) Make sure that the TEST OK indication shows in the lower left position of the display.
  - (b) Make sure that the weather radar test lines show in the center position.
  - (c) Make sure that the NAVAID indications show.
  - (d) Make sure that the ARPT indications show.
  - (e) Make sure that the RTE DATA indications show.
  - (f) Make sure that the WPT indications show.

S 865-107

(37) On the right EFIS control panel, set the HSI RANGE control to 40 NM.
  - (a) Make sure that the MAP indications move away from the airplane indicator.
  - (b) Make sure that the range shown changes from 40 to 20.

S 865-E46

(38) On the right EFIS control panel, set the HSI RANGE control to 80 NM.

S 865-108

(39) On the right EFIS control panel, set the HSI MODE control to the PLAN position.

S 755-109

(40) On the right EHSI, make sure that the display is equivalent to the EHSI PLAN mode in Figure 501.
  - (a) Make sure that the TEST OK indication shows in the lower left position of the display.

(b) Make sure that the weather radar test lines do not show.

S 865-110

(41) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

G. EFIS Manual Brightness Control Test

S 865-111

(1) On the left and right EFIS control panels, make sure that the switches and controls are in the positions indicated:
   (a) Range Select - 80 NM
   (b) GUI 001-114, 116-999;
       HSI Mode Select - VOR
   (c) GUI 115;
       HSI Mode Select - EXP VOR
   (d) WXR Select - OFF (out)
   (e) MAP NAVAID - ON (in)
   (f) MAP APRT - ON (in)
   (g) MAP RTE DATA - ON (in)
   (h) MAP WPT - ON (in)
   (i) ADI BRT - Equal distance between fully clockwise and fully counterclockwise.
   (j) HSI BRT - Equal distance between fully clockwise and fully counterclockwise.

S 865-112

(2) On the left and right instrument source select panels, put the switches and controls in the positions indicated:
   (a) FLT DIR - L position (left panel)/ R position (right panel)
       FMC - NORM (out)
   (b) GUI 115 POST-SB 34-414;
       NAV - FMC-L (left panel)/ FMC-R (right panel)
   (c) EFI - NORM (out)
   (d) IRS - NORM (out)

S 865-113

(3) On the right overhead light control panel, push the TEST switch.

S 755-676

(4) On the two EADIs, make sure that the displays are equivalent to the EADI VOR mode in Figure 501.

S 755-771

(5) GUI 001-114, 116-999;
On the two EHSIs, make sure that the displays are equivalent to the EHSI VOR mode in Figure 501.

S 755-772

(6) GUI 115;
On the two EHSIs, make sure that the displays are equivalent to the EHSI VOR-EXP mode in Figure 501.

NOTE: The weather radar test lines will not show.

S 865-121

(7) On the left and right EFIS control panels, turn the ADI BRT controls fully clockwise.
   (a) Make sure that the two EADI displays become brighter.

S 865-122

(8) On the left and right EFIS control panels, turn the ADI BRT controls fully counterclockwise.
   (a) Make sure that the two EADI displays become dimmer.

S 865-123

(9) Turn the ADI BRT controls an equal distance between fully clockwise and fully counterclockwise.

S 865-124

(10) On the left and right EFIS control panels, turn the outer HSI BRT controls fully clockwise.
   (a) Make sure that the two EHSI displays become brighter.

S 865-125

(11) On the left and right EFIS control panels, turn the outer HSI BRT controls fully counterclockwise.
  (a) Make sure that the two EHSI displays become dimmer.

S 865-126

(12) Turn the outer HSI BRT controls an equal distance between fully clockwise and fully counterclockwise.

S 865-127

(13) On the left and right EFIS control panels, put the WXR switches in the ON position.
  (a) Make sure that the WXR switch lights come on.
  (b) On the two EHSI displays, make sure that the weather radar test lines show.

S 865-128

(14) On the left and right EFIS control panels, turn the inner HSI BRT controls fully clockwise.
  (a) Make sure that the weather radar test lines become brighter.

S 865-129

(15) On the left and right EFIS control panels, turn the inner HSI BRT controls fully counterclockwise.
  (a) Make sure that the weather radar test lines become dimmer.

S 865-130

(16) Turn the inner HSI BRT controls an equal distance between fully clockwise and fully counterclockwise.

S 865-961

(17) On the left and right EFIS control panels, put the WXR switches in the off position.

S 865-131

(18) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-132

(19) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
  (a) 11A2, VOR MKR LEFT

(b) 11E11, DME LEFT
(c) 11E16, MODE CONT PNL LEFT
(d) 11E17, FLT CONT COMPUTER POWER LEFT
(e) 11E30, FMCS CMPTR RIGHT
(f) 11E32, DME RIGHT
(g) 11E33, VOR RIGHT
(h) 11E34, MODE CONT PNL RIGHT
(i) 11E35, FLT CONT CMPTR PWR RIGHT
(j) 11F1, IRS LEFT
(k) 11F2, WX RADAR
(l) 11F5, RADIO ALTM LEFT
(m) GUI 115;
11F6, ADF LEFT
(n) 11F10, EFIS INSTR COMPARATOR
(o) 11F15, TMC DC
(p) 11F20, RADIO ALTM CENTER
(q) 11F21, IRS CENTER
(r) 11F22, IRS RIGHT
(s) 11F26, RADIO ALTM RIGHT
(t) GUI 115;
11F27, ADF RIGHT

S 865-133

(20) Remove the DO-NOT-CLOSE tags and close these P6 panel circuit breakers:
(a) 6D3, IRS L
(b) 6D4, IRS C
(c) 6D5, IRS R

H. Instrument Source Select Switch Test

S 865-134

(1) Open this P11 panel circuit breaker and attach a DO-NOT-CLOSE tag:
(a) 11E21, FLT CONT CMPTR SERVO CENTER

S 865-135

(2) Make sure that these P11 panel circuit breakers are open:
(a) 11E9, FMCS CMPTR LEFT

(b) 11E20, FLT CONT CMPTR PWR CENTER

S 865-136

(3) Make sure that these P11 panel circuit breakers are closed:
  (a) EICAS (6 locations)

S 865-137

<u>CAUTION</u>: DO NOT OPEN THE AIR DATA CMPTR RIGHT CIRCUIT BREAKER WITH THE PITOT-STATIC SYSTEM PRESSURIZED. THIS CAN CAUSE DAMAGE TO THE EQUIPMENT.

(4) Open this P11 panel circuit breaker and attach a DO-NOT-CLOSE tag:
  (a) 11F30, AIR DATA CMPTR RIGHT

S 865-138

(5) On the left and right EFIS control panels, set the HSI MODE control to the MAP position.

S 865-139

(6) On the AFDS mode control panel, set the two F/D switches to the ON position.

S 865-140

(7) On the IRMP, set the left and right mode switches to the NAV position.

<u>NOTE</u>: Make sure you permit time for the alignment.

S 865-141

(8) On the IRMP, make sure the center mode switch is in the OFF position.

S 865-142

(9) Put the left and right instrument source select switches and controls in the positions indicated:

<u>NOTE</u>: Make sure that the non-rotary switches are illuminated when they are in the ALTN position.

  (a) FLT DIR - L position (left panel)/ R position (right panel)

(b) GUI 115 PRE-SB 34-414;
GUI 001-011;
FMC - NORM (out)
(c) GUI 115 POST-SB 34-414;
NAV - FMC-L (left panel)/ FMC-R (right panel)
(d) EFI - NORM (out)
(e) IRS - NORM (out)
(f) AIR DATA - NORM (out)

S 755-143

(10) Make sure that these displays have the indications that follow while in the MAP mode.
- (a) Left and right EADIs:
  - 1) GUI 115;
    Make sure that the flight director mode annunciation, FD, shows in the bottom right position.
  - 2) GUI 001-114, 116-999;
    Make sure that the flight director mode annunciation, FD, shows in the top right position.
- (b) Left EHSI:
  - 1) Make sure that the top left and right positions are blank.
- (c) Right EHSI:
  - 1) Make sure that three horizontal lines and the letters NM show in the top left position.
  - 2) Make sure that six horizontal lines and the letter Z show in the top right position.
- (d) EICAS Display:
  - 1) Make sure that the INSTR SWITCH message does not show.
- (e) Left altimeter and MASI:
  - 1) Make sure that the failure flags do not show.
- (f) Right altimeter and MASI:
  - 1) Make sure that the failure flags show.

<u>NOTE</u>: In the steps that follow, only the display changes that are necessary to make sure of correct switch operation are given.

S 865-480

(11) Put the left FLT DIR switch in the C position.
- (a) Left EADI:
  - 1) Make sure the FD mode annunciation goes out of view.

S 865-145
(12) Put the right FLT DIR switch in the C position.
  (a) Right EADI:
    1) Make sure the FD mode annunciation goes out of view.

S 865-144
(13) Put the left FLT DIR switch in the R position.
  (a) Left EADI:
    1) Make sure the FD mode annunciation shows.

S 865-146
(14) Put the right FLT DIR switch in the L position.
  (a) Right EADI:
    1) Make sure the FD mode annunciation shows.

S 865-147
(15) Put the left FLT DIR switch in the L position.

S 865-148
(16) Put the right FLT DIR switch in the R position.

S 865-K56
(17) GUI 115 PRE-SB 34-414;
GIU 001-011;
Put the left and right FMC switches in the ALTN position.

S 865-K61
(18) GUI 115 POST-SB 34-414;
Put the left NAV switch in the FMC-R position and the right NAV switch in the FMC-L position.

S 755-843
(19) Left EHSI:
  (a) Make sure that three horizontal lines and the letters NM show in the top left position.
  (b) Make sure that six horizontal lines and the letter Z show in the top right position.

S 755-844
(20) Right EHSI:
  (a) Make sure the top left and right positions are blank.

S 865-153
(21) Remove the DO-NOT-CLOSE tag and close this P11 panel circuit breaker:
  (a) 11E9, FMCS CMPTR LEFT

S 865-154

(22) Put the left and right FMC switches in the NORM position.

S 865-K65

(23) GUI 115 PRE-SB 34-414;
GUI 001-011;
Put the left and right FMC switches in the NORM position.

S 865-K70

(24) GUI 115 POST-SB 34-414;
Put the left NAV switch in the FMC-L position and the right NAV switch in the FMC-R position.

S 755-848

(25) Left and right EHSIs:
   - (a) Make sure that three horizontal lines and the letters NM show in the top left position.
   - (b) Make sure that six horizontal lines and the letter Z show in the top right position.

S 865-160

(26) On the left EFIS control panel, set the HSI MODE control to the PLAN position.
   - (a) Left EHSI:
     - 1) Make sure that the PLAN mode shows.

S 865-161

(27) Put the left and right EFI switches in the ALTN position.
   - (a) EICAS Display:
     - 1) Make sure that the INSTR SWITCH message shows.
   - (b) Left and right EHSIs:
     - 1) Make sure that the PLAN mode shows.

S 865-162

(28) Put the right EFI switch in the NORM position.
   - (a) EICAS Display:
     - 1) Make sure that the INSTR SWITCH message does not show.
   - (b) Right EHSI:
     - 1) Make sure that the MAP mode shows.

S 865-163

(29) Put the right EFI switch in the ALTN position.
   - (a) EICAS Display:
     - 1) Make sure that the INSTR SWITCH message shows.
   - (b) Right EHSI:
     - 1) Make sure that the PLAN mode shows.

S 865-164

(30) Put the left EFI switch in the NORM position.
   - (a) EICAS Display:
      - 1) Make sure that the INSTR SWITCH message does not show.
   - (b) Right EHSI:
      - 1) Make sure that the MAP mode shows.

S 865-165

(31) Put the right EFI switch in the NORM position.
   - (a) Make sure that the displays do not change.

S 865-166

(32) On the left EFIS control panel, set the HSI MODE control to the MAP position.
   - (a) Left EHSI:
      - 1) Make sure that the MAP mode shows.

S 865-167

(33) Put the left and right IRS switches in the ALTN position.
   - (a) Left and right EADIs:
      - 1) Make sure that the ATT flag shows.

S 865-168

(34) Put the left and right IRS switches in the NORM position.
   - (a) Left and right EADIs:
      - 1) Make sure that the ATT flag does not show.

S 865-169

(35) Set the left and right AIR DATA switches to the ALTN position.

S 755-I49

(36) Altimeters and MASIs:
   - (a) Left altimeter and MASI:
      - 1) Make sure that the failure flags show.
   - (b) Right altimeter and MASI:
      - 1) Make sure that the failure flags do not show.

S 865-170

(37) Set the left and right AIR DATA switches to the NORM position.

S 755-150

(38) Altimeters and MASIs:
- (a) Left altimeter and MASI:
  - 1) Make sure that the failure flags do not show.
- (b) Right altimeter and MASI:
  - 1) Make sure that the failure flags show.

I. Put the Airplane Back to Its Usual Condition

S 865-171

(1) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
- (a) 11E20, FLT CONT CMPTR PWR CENTER
- (b) 11E21, FLT CONT CMPTR SERVO CENTER
- (c) 11F30, AIR DATA CMPTR RIGHT

S 865-172

(2) On the IRMP, set the left and right mode controls to the OFF position.

S 865-483

(3) On the AFDS mode control panel, set the two F/D switches to the OFF position.

S 865-173

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-22-00-735-174

3. Electronic Flight Instrument System - System Test (Fig. 501)

A. General

(1) The Electronic Flight Instrument System system test is done to make sure that all of the system components and the systems that interface operate correctly.

NOTE: The Electronic Flight Instrument System operational test must be done before the system test to make sure of the correct operation of the components.

B. Equipment

(1) Hand-held light source

(2) GUI 001, 009;
Radio Altimeter Ramp Test Set - AMT-52A, BENDIX 2041595-5201
(3) GUI 002-008, 010-114, 116-999;
Radio Altimeter Test Set - Atlantis Flight Research DRA707

C. Consumable Materials
(1) Black tape

D. References
(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 22-00-02/201, Autoflight Bite

E. Access
(1) Location Zones
211/212 Flight Compartment

F. Prepare for Test

S 865-175
(1) Supply electrical power (AMM 24-22-00/201).

S 715-176
(2) Do the Electronic Flight Instrument System - Operational Test.

S 865-177
(3) On the left and right EFIS control panels, put the switches and controls in the positions indicated:
   (a) Range Select - 80 NM
   (b) GUI 001-114, 116-999;
   HSI Mode Select - VOR
   (c) GUI 115;
   HSI Mode Select - EXP VOR
   (d) WXR Select - OFF (out)
   (e) MAP NAVAID - ON (in)
   (f) MAP APRT - ON (in)
   (g) MAP WPT - ON (in)
   (h) MAP RTE DATA - ON (in)
   (i) ADI BRT - Equal distance between fully clockwise and fully counterclockwise.

(j) HSI BRT - Equal distance between fully clockwise and fully counterclockwise.

S 865-178

(4) On the left and right instrument source select panels, put the switches and controls in the positions indicated:
  - (a) FLT DIR - L position (left panel)/ R position (right panel).
  - (b) FMC - NORM (out)
  - (c) GUI 115 PRE-SB 34-414;
    GUI 001-011;
    FMC - NORM (out)
  - (d) GUI 115 POST-SB 34-414;
    NAV - FMC-L (left panel)/ FMC-R (right panel)
  - (e) EFI - NORM (out)
  - (f) IRS - NORM (out)

G. EFIS Automatic Brightness Control Test

S 865-179

(1) Make sure that these P11 panel circuit breakers are closed:
  - (a) GUI 001-114, 116-999;
    11A7, EFIS DSPL SW LEFT
  - (b) GUI 115;
    11C4, EFIS DSPL SW LEFT
  - (c) 11E3, ADI LEFT
  - (d) 11E4, EFIS CONT PNL LEFT
  - (e) 11E6, HSI LEFT
  - (f) 11E24, ADI RIGHT
  - (g) 11E25, EFIS CONT PNL RIGHT
  - (h) 11E27, HSI RIGHT
  - (i) 11F8, EFIS SYM GEN LEFT
  - (j) 11F9, EFIS SYM GEN CENTER
  - (k) 11F24, EFIS DSPL SW RIGHT
  - (l) 11F29, EFIS SYM GEN RIGHT

S 865-180

(2) On the left, center, and right EFIS symbol generators, momentarily push the RESET switch.

S 865-181

(3) On the right overhead light control panel, push the TEST switch.

S 955-182

(4) On the glareshield cover, put tape on the left EFIS remote light sensor.
   (a) Make sure that the left EADI and EHSI displays become dimmer.

S 955-183

(5) Remove the tape from the left remote light sensor.
   (a) Make sure that the left EADI and EHSI displays become brighter.

S 865-184

(6) On the glareshield cover, put tape on the left EFIS remote light sensor.

S 865-185

(7) On the left EHSI, put tape on the local light sensor.

   NOTE: The EHSI light sensor is on the lower right position of the metal bezel.

S 865-186

(8) Point a light source at the left EADI light sensor.

   NOTE: The EADI light sensor is on the lower left position of the metal bezel.

   (a) Make sure that the left EADI and EHSI displays become brighter.

S 955-187

(9) Remove the tape from the left EHSI light sensor.

S 955-184

(10) Put tape on the left EADI light sensor.

S 865-858

(11) Point a light source at the left EHSI light sensor.
   (a) Make sure that the left EADI and EHSI displays become brighter.

S 955-779

(12) Remove the tape from the left EADI light sensor.

S 955-780

(13) Remove the tape from the left remote light sensor.

S 865-859

(14) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 735-186

(15) Use the right light sensors to do a test of the right system.

H. Right EFIS System Test

S 865-187

(1) Make sure that the left and right EFIS control panel switches and controls are in the positions indicated in the Prepare for Test.

S 865-188

(2) Make sure that the left and right instrument source select panel switches and controls are in the positions indicated in the Prepare for Test.

S 865-484

(3) On the AFDS mode control panel, make sure the two F/D switches are in the OFF position.

S 865-189

(4) Open these P11 panel circuit breakers:
  (a) 11A2, VOR MKR LEFT
  (b) 11B18, WARN ELEX B
  (c) 11E8, FMCS CDU LEFT
  (d) 11E9, FMCS CMPTR LEFT
  (e) 11E10, ILS L or MMR L

(f) 11E11, DME LEFT
(g) 11E16, MODE CONT PNL LEFT
(h) 11E17, FLT CONT COMPUTER POWER LEFT
(i) 11E20, FLT CONT CMPTR PWR CENTER
(j) 11E29, FMCS CDU RIGHT
(k) 11E30, FMCS CMPTR RIGHT
(l) 11E31, ILS RIGHT or MMR R
(m) 11E32, DME RIGHT
(n) 11E33, VOR RIGHT
(o) 11E34, MODE CONT PNL RIGHT
(p) 11E35, FLT CONT CMPTR PWR RIGHT
(q) 11F1, IRS LEFT
(r) 11F2, WX RADAR
(s) 11F5, RADIO ALTM LEFT
(t) GUI 115;
11F6, ADF LEFT
(u) 11F15, TMC DC
(v) 11F20, RADIO ALTM CENTER
(w) 11F22, IRS RIGHT
(x) 11F24, EFIS DSPL SW RIGHT
(y) 11F26, RADIO ALTM RIGHT
(z) GUI 115;
11F27, ADF RIGHT
(aa) 11J33, WARN ELEX A

S 865-190

(5) Make sure that these P11 panel circuit breakers are closed:
(a) 11A3, ILS CENTER or MMR C
(b) 11E24, ADI RIGHT
(c) 11E25, EFIS CONT PNL RIGHT
(d) 11E27, HSI RIGHT
(e) 11F29, EFIS SYM GEN RIGHT

S 865-191

(6) Permit 30 seconds for the EFIS to become warm.

S 755-192

(7) Right EHSI:
  - (a) Make sure that the yellow VOR flag shows in the lower left position.
  - (b) Make sure that the green VOR R indication shows in the lower center position.

S 865-193

(8) Close this P11 panel circuit breaker:
  - (a) 11E33, VOR RIGHT

S 755-194

(9) Right EHSI:
  - (a) Make sure that a white, four-point scale replaces the yellow VOR flag.

S 865-195

(10) Close this P11 panel circuit breaker:
  - (a) 11E32, DME RIGHT

S 755-196

(11) Right EHSI:
  - (a) Make sure that three white lines and the letters DME show in the top left position.

S 865-197

(12) On the ILS control panel, set the frequency to 110.10.

S 865-198

(13) Close this P11 panel circuit breaker:
  - (a) 11E31, ILS RIGHT or MMR R

S 755-199

(14) Right EADI:
  - (a) Make sure that the white, four-point, localizer and glideslope scales show.

S 865-200

(15) On the ILS control panel, set the frequency to the PARK position (------).

S 755-201

(16) Right EADI:
   (a) Make sure that the localizer and glideslope scales go out of view.

S 865-202

(17) On the ILS control panel, set the frequency to 110.10.

S 755-203

(18) Right EADI:
   (a) Make sure that the localizer and glideslope scales come back in to view.
   (b) Make sure that the yellow RA flag shows.

S 865-204

(19) Close this P11 panel circuit breaker:
   (a) 11F26, RADIO ALTM RIGHT

S 755-205

(20) Right EADI:
   (a) Make sure that the RA flag goes out of view and is replaced with an RA value.

S 725-773

(21) GUI 001-114, 116-999;
Do the right radio altimeter test as follows:
   (a) Open this P11 panel circuit breaker and attach a DO-NOT-CLOSE tag:
      1) 11F26, RADIO ALTM RIGHT
   (b) Connect the RA test set to the right RA transceiver.

(c) Remove the DO-NOT-CLOSE tag and close this P11 panel circuit breaker:
    1) 11F26, RAD ALTM RIGHT
(d) On the RA test set, set the controls as indicated:
    1) RA data value - 3000 ft.
    2) Mode Switch - Altitude Select position.
    3) RA data sign status matrix bits - normal operation.
(e) Right EADI:
    1) Make sure that the RA display is out of view.
(f) Slowly decrease the RA value from 3000 feet to 2000 feet at approximately 2000 feet per minute.
(g) Right EADI:
    1) Make sure that the white ALT indication shows in the bottom right position when the test set is at 2500 feet.
(h) Open this P11 panel circuit breaker and attach a DO-NOT-CLOSE tag:
    1) 11F26, RAD ALTM RIGHT
(i) Disconnect the RA test set.
(j) Remove the DO-NOT-CLOSE tag close this P11 panel circuit breaker:
    1) 11F26, RAD ALTM RIGHT

S 865-774
(22) GUI 009, 115;
Do the steps that follow:
(a) Close this P11 panel circuit breaker:
    1) 11F15, TMC DC
(b) Right EADI:
    1) Make sure that the yellow SPD flag is replaced with a white, three-point scale.

S 865-775
(23) GUI 001-008, 010-114, 116-999;
Do the steps that follow:
(a) Close these P11 panel circuit-breakers:
    1) 11F30, AIR DATA CMPTR RIGHT
    2) 11F31, AIR DATA AOA SENSOR RIGHT
    3) 11S19, LANDING GEAR AIR/GND SYS 2
(b) Right EADI:
    1) Make sure that the yellow SPD flag is replaced with the speed tape display.
    2) Make sure that the speed tape shows a value of 30 knots.

S 865-224
(24) Close this P11 panel circuit breaker:
  (a) 11F22, IRS RIGHT

S 865-225
(25) Make sure that this P6 panel circuit breaker is closed:
  (a) 6D5, IRS R

S 865-226
(26) On the IRMP, set the right control to the ALIGN position.

S 755-227
(27) Right EADI:
  (a) Make sure that the yellow ATT flag is out of view.

S 865-228
(28) Close these P11 panel circuit breakers:
  (a) 11E29, FMCS CDU RIGHT
  (b) 11E30, FMCS CMPTR RIGHT

S 865-229
(29) On the right EFIS control panel, set the HSI MODE control to the MAP position.

S 755-230
(30) Right EHSI:
  (a) Make sure that the letters DME are replaced with the letters NM.

S 865-776
(31) GUI 009, 115;
Open this P11 panel circuit breaker:
  (a) 11F15, TMC DC

S 865-861
(32) GUI 001-008, 010-114, 116-999;
Open these P11 panel circuit breakers:
  (a) 11F30, AIR DATA CMPTR RIGHT
  (b) 11F31, AIR DATA AOA SENSOR RIGHT
  (c) 11S19, LANDING GEAR AIR/GND SYS 2

S 865-236

(33) Close these P11 panel circuit breakers:
  (a) 11E34, MODE CONT PNL RIGHT
  (b) 11E35, FLT CONT CMPTR PWR RIGHT

S 865-237

(34) On the AFDS MCP, set the right F/D switch to the ON position.

S 755-238

(35) Right EADI:
  (a) GUI 115;
    Make sure that the letters FD show in the lower right position.
  (b) GUI 001-114, 116-999;
    Make sure that the letters FD show in the top right position.

S 865-239

(36) On the right instrument source select panel, turn the FLT DIR switch to the C, L, and back to the R position.

<u>NOTE</u>: Stop for approximately five seconds at the C and L positions.

S 755-240

(37) Right EADI:
  (a) Make sure that the letters FD show in the R position only.

S 725-777

(38) GUI 115;
  Do the steps that follow:
  (a) Right EHSI:
    1) Make sure that the ADF L and ADF R flags show.
  (b) Close this P11 panel circuit breaker:
    1) 11F27, ADF RIGHT
  (c) Right EHSI:
    1) Make sure that the ADF R flag goes out of view.

(d) Close this P11 panel circuit breaker:
    1) 11F6, ADF LEFT
(e) Right EHSI:
    1) Make sure that the ADF L flag goes out of view.

S 865-248
(39) Close these P11 panel circuit breakers:
    (a) 11B18, WARN ELEX B
    (b) 11F24, EFIS DSPL SW RIGHT
    (c) 11J33, WARN ELEX A

S 865-249
(40) On the IRMP, set the right and center controls to the ATT position.

S 865-250
(41) On the P61 miscellaneous test panel, momentarily set the Stall Warning Computer test switch to the STALL-R position.

S 755-251
(42) Right EADI:
    (a) Make sure that the pitch limit indicator shows at the ten degree line while the switch is held.

S 865-252
(43) On the right instrument source select panel, set the EFI switch to the ALTN position.

S 865-253
(44) On the P61 miscellaneous test panel, momentarily set the Stall Warning Computer test switch to the STALL-R position.

S 865-254
(45) Right EADI:
    (a) Make sure that the pitch limit indicator shows at the ten degree line while the switch is held.

S 865-255

(46) On the right instrument source select panel, set the EFI switch to the NORM position.

S 865-256

(47) On the IRMP, set the right and center controls to the OFF position.

S 865-862

(48) GUI 001-114, 116-999;
On the right EFIS control panel, set the HSI MODE control to the VOR mode.

S 865-779

(49) GUI 115;
On the right EFIS control panel, set the HSI MODE control to the EXP-VOR mode.

I. Left EFIS System Test

S 865-270

(1) Make sure that the left and right EFIS control panel switches and controls are in the positions indicated in the Prepare for Test.

S 865-490

(2) On the AFDS mode control panel, set the right F/D switch to the OFF position.

S 865-271

(3) Open these P11 panel circuit breakers:
   (a) GUI 001-114, 116-999;
       11A7, EFIS DSPL SW LEFT
   (b) 11B18, WARN ELEX B
   (c) GUI 115;
       11C4, EFIS DSPL SW LEFT
   (d) 11E29, FMCS CDU RIGHT

(e) 11E30, FMCS CMPTR RIGHT
(f) 11E31, ILS RIGHT or MMR R
(g) 11E32, DME RIGHT
(h) 11E33, VOR RIGHT
(i) 11E35, FLT CONT CMPTR PWR RIGHT
(j) GUI 115;
    11F6, ADF LEFT
(k) 11F24, EFIS DSPL SW RIGHT
(l) 11F26, RADIO ALTM RIGHT
(m) GUI 115;
    11F27, ADF RIGHT
(n) 11J33, WARN ELEX A

S 865-272

(4) Make sure that these P11 panel circuit breakers are closed:
    (a) 11E3, ADI LEFT
    (b) 11E4, EFIS CONT PNL LEFT
    (c) 11E6, HSI LEFT
    (d) 11F8, EFIS SYM GEN LEFT

S 865-273

(5) Permit 30 seconds for the EFIS to become warm.

S 735-274

(6) Do the Left EFIS System Test the same as the Right EFIS System Test. When you do the procedure, use the left (L) system displays, controls, circuit breakers, and switch positions in place of the right (R) system. The display areas are the same.

J. Center EFIS System Test

S 865-275

(1) Make sure that the left and right EFIS control panel switches and controls are in the positions indicated in the Prepare for Test.

S 865-276

(2) Make sure that the left and right instrument source select panel switches and controls are in the positions indicated in the Prepare for Test.

S 865-277

(3) On the IRMP, make sure that the left, right, and center mode controls are in the OFF position.

S 865-481

(4) Close these P11 panel circuit breakers:
   - (a) 11E29, FMCS CDU RIGHT
   - (b) 11E31, ILS RIGHT or MMR R
   - (c) GUI 009, 115;
     11F15, TMC DC
   - (d) 11F24, EFIS DSPL SW RIGHT

S 865-279

(5) Make sure that this P11 panel circuit breaker is closed:
   - (a) 11F9, EFIS SYM GEN CENTER

S 865-280

(6) On the IRMP, set the right mode control to the ALIGN position.

S 755-281

(7) Right EHSI:
   - (a) Make sure that three white lines in a white rectangle show.

S 865-282

(8) On the right instrument source select panel, set the EFI switch to the ALTN position.

S 755-283

(9) Right EADI and EHSI:
   - (a) Make sure that the displays do not change.

     NOTE: The displays will momentarily go out of view when the switch is turned to ALTN.

S 865-491

(10) On the AFDS mode control panel, set the left F/D switch to the OFF position.

S 865-284

(11) Open these P11 panel circuit breakers:
   - (a) 11E17, FLT CONT COMPUTER POWER LEFT
   - (b) 11F29, EFIS SYM GEN RIGHT

S 865-285

(12) Close these P11 panel circuit breakers:
   - (a) GUI 001-114, 116-999;
     11A7, EFIS DSPL SW LEFT
   - (b) GUI 115;
     11C4, EFIS DSPL SW LEFT
   - (c) 11E30, FMCS CMPTR RIGHT
   - (d) 11E32, DME RIGHT
   - (e) 11E33, VOR RIGHT

- (f) 11E35, FLT CONT CMPTR PWR RIGHT
- (g) 11F20, RADIO ALTM CENTER

S 755-286

(13) Right EADI:
- (a) Make sure that the RA flag is replaced with an RA value.
- (b) Make sure that the white, four-point glideslope and localizer scales show.
- (c) GUI 009, 115;
  Make sure that the white, three point scale shows in the left position.
- (d) GUI 001-008, 010-114, 116-999;
  Make sure that the speed tape display shows in the left position.
- (e) GUI 115;
  Make sure that the green letters FD do not show in the lower right position.
- (f) GUI 001-114, 116-999;
  Make sure that the green letters FD do not show in the top right position.

S 755-287

(14) Right EHSI:
- (a) Make sure that the letters DME show in the top left position.
- (b) Make sure that the white, four-point scale shows in the lower center position.
- (c) Make sure that line segments show in the top center position.

S 865-288

(15) On the right EFIS control panel, set the HSI MODE control to the MAP position.

S 755-289

(16) Right EHSI:
- (a) Make sure that six white lines and the letter Z show in the top right position.

S 865-290

(17) On the ILS control panel, set the frequency to PARK (-----).

S 755-291

(18) Right EADI:
- (a) Make sure that the glideslope and localizer scales go out of view.

S 865-292

(19) On the ILS control panel, set the frequency to 110.10.

S 755-293

(20) Right EADI:
  (a) Make sure that the glideslope and localizer scales come back in to view.

S 865-294

(21) On the EICAS control panel, set the COMPUTER control to the R position.

S 865-295

(22) On the left instrument source select panel, set the EFI switch to the ALTN position.

S 755-296

(23) EICAS Display:
  (a) Make sure that the INSTR SWITCH message shows.

S 755-297

(24) Right EADI and EHSI:
  (a) Make sure that the displays are equivalent to the left EADI and EHSI displays.

S 865-298

(25) On the EICAS control panel, set the COMPUTER control to the L position.

S 865-299

(26) Open these P11 panel circuit breakers:
  (a) 11E33, VOR RIGHT
  (b) 11F8, EFIS SYM GEN LEFT

S 865-300

(27) Close these P11 panel circuit breakers:
  (a) 11E11, DME LEFT

(b) 11F26, RADIO ALTM RIGHT

S 755-301

(28) Left and right EHSIs:
- (a) Make sure that three white lines and the letters DME show in the top left position.
- (b) Make sure that the white, four-point scale shows in the lower center position.

S 755-302

(29) EICAS Display:
- (a) Make sure that the INSTR SWITCH message shows.

S 725-780

(30) GUI 115;
Do the steps that follow:
- (a) Open this P11 panel circuit breaker:
  - 1) 11F27, ADF RIGHT
- (b) Left EHSI:
  - 1) Make sure that the ADF R flag shows.
- (c) Open this P11 panel circuit breaker:
  - 1) 11F6, ADF LEFT
- (d) Left EHSI:
  - 1) Make sure that the ADF L flag shows.
- (e) Close these P11 panel circuit breakers:
  - 1) 11F6, ADF LEFT
  - 2) 11F27, ADF RIGHT

S 865-322

(31) On the IRMP, set the right control to the OFF position.

S 865-323

(32) On the left and right instrument source select panels, set the EFI switches to the NORM position.

S 865-863

(33) GUI 001-114, 116-999;
On the right EFIS control panel, set the HSI MODE control to the VOR position.

S 865-782

(34) GUI 115;
On the right EFIS control panel, set the HSI MODE control to the EXP-VOR position.

K. Instrument Switching System Test

NOTE: In the test, the EFIS displays will momentarily go out of view. This is not a failure condition.

S 865-330

(1) On the left and right EFIS control panels, put the HSI MODE controls to the MAP position.

S 865-332

(2) On the left and right instrument source select panels, make sure that the switches and controls are in the positions indicated:
   (a) FLT DIR - L position (left panel) / R position (right panel)
   (b) GUI 115 PRE-SB 34-414;
       GUI 001-011;
       FMC - NORM (out)
   (c) GUI 115 POST-SB 34-414;
       NAV - FMC-L (left panel) / FMC-R (right panel)
   (d) EFI - NORM (out)
   (e) IRS - NORM (out)

S 865-333

(3) On the ILS control panel, make sure that the frequency is set to 110.10.

S 865-334

(4) On the IRMP, make sure that the three mode switches are in the OFF position.

S 865-335

(5) Open these P11 panel circuit breakers:
   (a) 11E30, FMCS CMPTR RIGHT
   (b) 11E35, FLT CONT CMPTR PWR RIGHT

    (c) 11F9, EFIS SYM GEN CENTER

S 865-336

(6) Close these P11 panel circuit breakers:
    (a) 11E9, FMCS CMPTR LEFT
    (b) 11E20, FLIGHT CONT CMPTR PWR CENTER
    (c) 11F29, EFIS SYM GEN RIGHT

S 865-337

(7) Make sure that this P6 panel circuit breaker is closed:
    (a) 6D4, IRS C

S 865-338

(8) Make sure that this P11 panel circuit breaker is closed:
    (a) 11F21, IRS CENTER

S 865-331

(9) On the AFDS mode control panel, set the two F/D switches to the ON position.

S 865-339

(10) On the IRMP, set the center mode control to the ALIGN position.

S 755-340

(11) Right EADI:
    (a) Make sure that a yellow ATT flag shows.
    (b) GUI 115;
        Make sure that the lower right position is blank.
    (c) GUI 001-114, 116-999;
        Make sure that the top right position is blank.

S 755-341

(12) Right EHSI:
    (a) Make sure that the top left position is blank.

S 865-342

(13) On the right instrument source select panel, set the IRS switch to the ALTN position.

S 755-343

(14) Right EADI:

    (a) Make sure that the yellow ATT flag goes out of view.

S 865-344

(15) On the right instrument source select panel, set the IRS switch to the NORM position.

S 755-345

(16) Right EADI:

    (a) Make sure that the yellow ATT flag comes in to view.

S 865-J82

(17) GUI 115 PRE-SB 34-414;
GUI 001-011;
On the right instrument source select panel, set the FMC switch to the ALTN position.
On the right instrument source select panel, set the NAV switch to the FMC-L position.

S 755-350

(18) Right EHSI:

    (a) Make sure that three white lines and the letters NM show in the top left position.
    (b) Make sure that the letter Z shows in the top right position.

S 865-K79

(19) GUI 115 PRE-SB 34-414;
GUI 001-011;
On the right instrument source select panel, set the FMC switch to the NORM position.

S 865-J88

(20) GUI 115 POST-SB 34-414;
On the right instrument source select panel, set the NAV switch to the FMC-R position.

S 755-355

(21) Right EHSI:

    (a) Make sure that the top left corner is blank.

S 865-356

(22) On the right instrument source select panel, put the FLT DIR switch in the C position.

S 755-357

(23) Right EADI:

    (a) GUI 115;
    Make sure that the green letters FD show in the lower right position.

(b) GUI 001-114, 116-999;
Make sure that the green letters FD show in the top right position.

S 865-358

(24) Close this P11 panel circuit breaker:
  (a) 11E17, FLT CONT COMPUTER POWER LEFT

S 865-359

(25) Open this P11 panel circuit breaker:
  (a) 11E20, FLIGHT CONT CMPTR PWR CENTER

S 755-360

(26) Right EADI:
  (a) Make sure that the letters FD go out of view.

S 755-361

(27) On the right instrument source select panel, put the FLT DIR switch in the L position.

S 755-362

(28) Right EADI:
  (a) Make sure that the green letters FD come back in to view.

S 865-363

(29) Close this P11 panel circuit breaker:
  (a) 11E20, FLIGHT CONT CMPTR PWR CENTER

S 865-364

(30) Open this P11 panel circuit breaker:
  (a) 11E17, FLT CONT COMPUTER POWER LEFT

S 755-365

(31) Right EADI:
  (a) Make sure that the green letters FD go out of view.

S 865-366

(32) Close this P11 panel circuit breaker:
   (a) 11F9, EFIS SYM GEN CENTER

S 865-367

(33) Open this P11 panel circuit breaker:
   (a) 11F29, EFIS SYM GEN RIGHT

S 865-368

(34) On the left instrument source select panel, put the FLT DIR switch in the R position.

S 865-369

(35) On the right instrument source select panel, put the EFI switch in the ALTN position.

S 755-370

(36) Right EADI:
   (a) Make sure that the green letters FD do not show.

S 865-371

(37) On the right instrument source select panel, put the IRS switch in the ALTN position.

S 755-372

(38) Right EADI:
   (a) Make sure that the yellow ATT flag does not show.

S 865-373

(39) On the right instrument source select panel, put the IRS switch in the NORM position.

S 755-374

(40) Right EADI:
   (a) Make sure that the yellow ATT flag comes in to view.

S 865-J92

(41) GUI 115 PRE-SB 34-414;
GUI 001-011;
On the right instrument source select panel, put the FMC switch in the ALTN position.

S 865-J97

(42) GUI 115 POST-SB 34-414;
GUI 001-011;
On the right instrument source select panel, put the NAV switch in the FMC-L position.

S 755-379

(43) Right EHSI:
    (a) Make sure that three white lines and the letters NM show in the top left position.
    (b) Make sure that the letter Z shows in the top right position.

S 865-380

(44) On the right instrument source select panel, put the FMC switch in the NORM position.

S 865-J99

(45) GUI 115 PRE-SB 34-414;
GUI 001-011;

S 865-K04

(46) GUI 115 POST-SB 34-414;
GUI 001-011;
On the right instrument source select panel, put the NAV switch in the FMC-R position.

S 755-384

(47) Right EHSI:
    (a) Make sure that the top right position goes blank.

S 865-385

(48) On the right instrument source select panel, put the FLT DIR switch in the C position.

S 755-386

(49) Right EADI:
    (a) GUI 115;
    Make sure that the green letters FD show in the lower right position.
    (b) GUI 001-114, 116-999;
    Make sure that the green letters FD show in the top right position.

S 865-387

(50) On the left instrument source select panel, put the FLT DIR switch in the L position.

S 865-388

(51) Open these P11 panel circuit breakers:
  - (a) 11E9, FMCS CMPTR LEFT
  - (b) 11F24, EFIS DSPL SW RIGHT
  - (c) 11F29, EFIS SYM GEN RIGHT

S 865-389

(52) Close these P11 panel circuit breakers:
  - (a) 11E30, FMCS CMPTR RIGHT
  - (b) 11F8, EFIS SYM GEN LEFT

S 865-390

(53) On the left instrument source select panel, set the IRS switch to the ALTN position.

S 755-391

(54) Left EADI:
  - (a) Make sure that the yellow ATT flag goes out of view.

S 865-392

(55) On the left instrument source select panel, set the IRS switch to the NORM position.

S 755-393

(56) Left EADI:
  - (a) Make sure that the yellow ATT flag comes in to view.

S 865-394

(57) On the left instrument source select panel, set the FMC switch to the ALTN position.

S 865-K09
(58) GUI 115 PRE-SB 34-414;
GUI 001-011;
On the left instrument source select panel, set the FMC switch to the ALTN position.

S 865-K14
(59) GUI 115 POST SB 34-414;
On the left instrument source select panel, set the NAV switch to the FMC-R position.

S 755-398
(60) Left EHSI:
(a) Make sure that three white lines and the letters NM show in the top left position.
(b) Make sure that the letter Z shows in the top right position.

S 865-399
(61) On the left instrument source select panel, set the FMC switch to the NORM position.

S 865-K19
(62) GUI 115 PRE-SB 34-414;
GUI 001-011;
On the left instrument source select panel, set the FMC switch to the NORM position.

S 865-K24
(63) GUI 115 POST-SB 34-414;
On the left instrument source select panel, set the NAV switch to the FMC-L position.

S 755-403
(64) Left EHSI:
(a) Make sure that the top left corner is blank.

S 865-404
(65) On the left instrument source select panel, put the FLT DIR switch in the C position.

S 755-405
(66) Left EADI:
(a) GUI 115;
Make sure that the green letters FD show in the lower right position.
(b) GUI 001-114, 116-999;
Make sure that the green letters FD show in the top right position.

S 865-406

(67) Close this P11 panel circuit breaker:
 (a) 11E35, FLT CONT CMPTR POWER RIGHT

S 865-407

(68) Open this P11 panel circuit breaker:
 (a) 11E20, FLIGHT CONT CMPTR PWR CENTER

S 755-408

(69) Left EADI:
 (a) Make sure that the letters FD go out of view.

S 865-409

(70) On the left instrument source select panel, put the FLT DIR switch in the R position.

S 755-410

(71) Left EADI:
 (a) Make sure that the green letters FD come back in to view.

S 865-411

(72) Open this P11 panel circuit breaker:
 (a) 11F8, EFIS SYM GEN LEFT

S 865-412

(73) Make sure that this P11 panel circuit breaker is closed:
 (a) GUI 001-114, 116-999;
  11A7, EFIS DSPL SW LEFT
 (b) GUI 115;
  11C4, EFIS DSPL SW LEFT

S 865-413

(74) On the left instrument source select panel, put the EFI switch in the ALTN position.

S 755-414

(75) Left EADI:
 (a) Make sure that the green letters FD show.

S 865-415

(76) On the left instrument source select panel, put the IRS switch in the ALTN position.

S 755-416

(77) Left EADI:
 (a) Make sure that the yellow ATT flag does not show.

S 865-417

(78) On the left instrument source select panel, put the IRS switch in the NORM position.

S 755-418

(79) Left EADI:
  (a) Make sure that the yellow ATT flag comes in to view.

S 865-K29

(80) GUN 1155 PRE-SB 34-414;
GUN 001-011;

S 865-K34

(81) GUI 115 POST-SB 34-414;
On the left instrument source select panel, put the NAV switch in the FMC-R position.

S 755-423

(82) Left EHSI:
  (a) Make sure that three white lines and the letters NM show in the top left position.
  (b) Make sure that the letter Z shows in the top right position.

S 865-424

(83) On the left instrument source select panel, put the FMC switch in the NORM position.

S 865-K39

(84) GUI 115 PRE-SB 34-414;
GUI 001-001;
On the left instrument source select panel, put the FMC switch in the NORM position.

S 865-K44

(85) GUI 115 POST-SB 34-414;
On the left instrument source select panel, put the NAV switch in the FMC-L position.

S 755-428

(86) Left EHSI:
  (a) Make sure that the top right position goes blank.

S 865-429

(87) Open these P11 panel circuit breakers:
  (a) 11E30, FMCS CMPTR RIGHT
  (b) 11E35, FLT CONT CMPTR PWR RIGHT

S 865-430

(88) Close these P11 panel circuit breakers:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E17, FLT CONT COMPUTER POWER LEFT

S 755-431

(89) Left EHSI:
- (a) Make sure that three white lines and the letters NM show in the top left position.
- (b) Make sure that the letter Z shows in the top right position.

S 755-432

(90) Left EADI:
- (a) GUI 115;
  Make sure that the lower right position is blank.
- (b) GUI 001-114, 116-999;
  Make sure that the top right position is blank.

S 865-433

(91) On the left instrument source select panel, put the FLT DIR switch in the L position.

S 755-434

(92) Left EADI:
- (a) Make sure that the letters FD come back in to view.

S 865-435

(93) On the IRMP, turn the center mode control from the ALIGN position to the OFF position.

S 865-436

(94) On the IRMP, turn the left mode control from the OFF position to the ALIGN position.

S 755-437

(95) Left EADI:
- (a) Make sure that the yellow ATT flag goes out of view.

S 865-494

(96) On the AFDS mode control panel, set the two F/D switches to the OFF position.

L. Heading Reference Switch Test

S 865-438

(1) Make sure that the switches and controls on the left and right EFIS control panels are as indicated in the Prepare for Test section.

S 865-439

(2) Close these P11 panel circuit breakers:
- (a) 11E20, FLIGHT CONT CMPTR PWR CENTER

(b) 11E30, FMCS CMPTR RIGHT
(c) 11E35, FLT CONT COMPUTER POWER RIGHT
(d) 11F8, EFIS SYM GEN LEFT
(e) 11F24, EFIS DSPL SW RIGHT
(f) 11F29, EFIS SYM GEN RIGHT

S 865-443

(3) On the left, center, and right EFIS symbol generators, momentarily push the RST buttons.

S 865-444

(4) Push the TEST switch on the right overhead light control panel.

S 755-445

(5) Left and right EHSIs:
    (a) Make sure that the correct test display shows.

S 865-446

(6) On the P3 panel, put the HDG REF switch in the TRUE position.

S 755-449

(7) Left and right EHSIs:
    (a) Make sure that a yellow rectangle shows around the green letters TRU.

S 865-450

(8) On the left instrument source select panel, put the EFI switch in the ALTN position.

S 755-451

(9) Left EHSI:
    (a) Make sure that the TRU display does not change.

S 865-452

(10) On the left instrument source select panel, put the EFI switch in the NORM position.

S 755-453

(11) Left EHSI:
- (a) Make sure that the TRU display does not change.

S 865-454

(12) Put the HDG REF switch in the NORM position.

S 755-457

(13) Left and right EHSIs:
- (a) Make sure that the letter M replaces the letters TRU.
- (b) Make sure that a green rectangle replaces the yellow rectangle for approximately 10 seconds and then goes out of view.

S 865-458

(14) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

M. Wind Shear System Interface Test

S 865-459

(1) Make sure that these P11 panel circuit breakers are closed:
- (a) GUI 001-114, 116-999;
  11A7, EFIS DSPL SW LEFT
- (b) 11B18, WARN ELEX B
- (c) GUI 115;
  11C4, EFIS DSPL SW LEFT
- (d) 11E3, ADI LEFT
- (e) 11E24, ADI RIGHT
- (f) 11F4, GND PROX
- (g) 11F5, RADIO ALTM LEFT
- (h) 11F8, EFIS SYM GEN LEFT
- (i) 11F9, EFIS SYM GEN CENTER
- (j) 11F20, RADIO ALTM CENTER
- (k) 11F24, EFIS DSPL SW RIGHT
- (l) 11F26, RADIO ALTM RIGHT

(m) 11F29, EFIS SYM GEN RIGHT
(n) 11J33, WARN ELEX A

S 865-460
(2) On the IRMP, make sure that the left, right, and center mode controls are in the ALIGN position.

S 865-461
(3) On the left and right instrument source select panels, set the EFI switches to the NORM position.

S 865-462
(4) Push the TEST switch on the right overhead light control panel.

S 865-463
(5) On the P61 miscellaneous test panel, momentarily push the GND PROX test switch.

S 755-464
(6) Left and right EADIs:
   (a) Make sure that the red WINDSHEAR message shows.
   (b) GUI 009, 115;
       Make sure the pointer on the fast/slow scale does not show.

S 755-465
(7) Instrument panel:
   (a) Make sure that the WINDSHEAR light is on.

S 865-466
(8) On the right instrument source select panel, set the EFI switch to the ALTN position.

S 865-467
(9) On the P61 miscellaneous test panel, momentarily push the GND PROX test switch.

S 755-468

(10) Right EADI:
  (a) Make sure that the red WINDSHEAR message shows.
  (b) GUI 009, 115;
    Make sure the pointer on the fast/slow scale does not show.

S 755-469

(11) Instrument panel:
  (a) Make sure that the WINDSHEAR light is on.

S 865-470

(12) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-471

(13) On the right instrument source select panel, set the EFI switch to the NORM position.

N. Put the Airplane Back to Its Usual Condition

S 865-472

(1) Remove the DO-NOT-CLOSE tags and close these P11 panel circuit breakers:
  (a) 11E33, VOR RIGHT
  (b) 11F2, WX RADAR

S 865-473

(2) On the IRMP, place the left, center, and right mode controls to the OFF position.

S 865-475

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-22-00-715-565

4. <u>Instrument Source Select Switching Test</u>

<u>NOTE</u>: This is a scheduled maintenance task.

A. References
   (1) AMM 24-22-00/201, Electrical Power - Control
   (2) AMM 34-21-00/201, Inertial Reference System
B. Access
   (1) Location Zones

211/212	Flight Compartment

C. Prepare for Test

S 865-503
(1) Supply electrical power (AMM 24-22-00/201).

D. Procedure

S 865-504
(1) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
   (a) 11E21, FLT CONT CMPTR SERVO CENTER

S 865-505
(2) Make sure these circuit breakers on the P11 panel are open:
   (a) 11E9, FMCS CMPTR LEFT
   (b) 11E20, FLT CONT CMPTR PWR CENTER

S 865-506
(3) Make sure these circuit breakers on the P11 panel are closed:
   (a) EICAS (6 locations)

S 865-507

<u>CAUTION</u>: DO NOT OPEN THE AIR DATA CMPTR RIGHT CIRCUIT BREAKER WITH THE PITOT-STATIC SYSTEM PRESSURIZED. THIS CAN CAUSE DAMAGE TO THE EQUIPMENT.

(4) Open this circuit breaker on the P11 panel and attach a DO-NOT-CLOSE tag:
   (a) 11F30, AIR DATA CMPTR RIGHT

S 865-508
(5) On the left and right EFIS control panels, set the HSI MODE control to the MAP position.

S 865-509
(6) On the AFDS mode control panel, set the two F/D switches to the ON position.

S 865-510
(7) On the IRMP, set the left and right mode switches to the NAV position (AMM 34-21-00/201).

NOTE: Make sure you permit time for the IRUs to align.

S 865-511
(8) On the IRMP, make sure the center mode switch is in the OFF position.

S 865-512
(9) Put the left and right instrument source select switches and controls in the positions indicated:

NOTE: Make sure that the non-rotary switches are illuminated when they are in the ALTN position.

(a) FLT DIR - L position (left panel)/ R position (right panel)
(b) GUI 115 PRE-SB 34-414;
GUI 001-011;
FMC - NORM (out)
(c) GUI 115 POST-SB 34-414;
GUI 001-011;
NAV - FMC-L (left panel)/ FMC-R (right panel)
(d) EFI - NORM (out)
(e) IRS - NORM (out)
(f) AIR DATA - NORM (out)

S 755-513
(10) Make sure that these displays have the indications that follow while in the MAP mode.
(a) Left and right EADIs:
1) GUI 115;
Make sure that the flight director mode annunciation, FD, shows in the bottom right position.

        2) GUI 001-114, 116-999;
           Make sure that the flight director mode annunciation, FD, shows in the top right position.
    (b) Left EHSI:
        1) Make sure that the top left and right positions are blank.
    (c) Right EHSI:
        1) Make sure that three horizontal lines and the letters NM show in the top left position.
        2) Make sure that six horizontal lines and the letter Z show in the top right position.
    (d) EICAS Display:
        1) Make sure that the INSTR SWITCH message does not show.
    (e) Left altimeter and MASI:
        1) Make sure that the failure flags do not show.
    (f) Right altimeter and MASI:
        1) Make sure that the failure flags show.

NOTE: In the steps that follow, only the display changes that are necessary to make sure of correct switch operation are given.

S 865-514

(11) Put the left FLT DIR switch in the C position.
    (a) Left EADI:
        1) Make sure the FD mode annunciation goes out of view.

S 865-515

(12) Put the right FLT DIR switch in the C position.
    (a) Right EADI:
        1) Make sure the FD mode annunciation goes out of view.

S 865-516

(13) Put the left FLT DIR switch in the R position.
    (a) Left EADI:
        1) Make sure the FD mode annunciation shows.

S 865-517

(14) Put the right FLT DIR switch in the L position.
- (a) Right EADI:
  - 1) Make sure the FD mode annunciation shows.

S 865-518

(15) Put the left FLT DIR switch in the L position.

S 865-519

(16) Put the right FLT DIR switch in the R position.

S 865-520

(17) Put the left and right FMC switches in the ALTN position.

S 865-K86

(18) GUN 115 PRE-SB 34-414;
GUN 001-011;
Put the left and right FMC switches in the ALTN position.
Put the left NAV switch in the FMC-R position and the right NAV switch in the FMC-L position.

S 755-850

(19) Left EHSI:
- (a) Make sure that three horizontal lines and the letters NM show in the top left position.
- (b) Make sure that six horizontal lines and the letter Z show in the top right position.

S 755-851

(20) Right EHSI:
- (a) Make sure the top left and right positions are blank.

S 865-524

(21) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
- (a) 11E9, FMCS CMPTR LEFT

S 865-K96

(22) GUI 115 PRE-SB 34-414;
GUI 001-011;
Put the left and right FMC switches in the NORM position.

S 865-K97

(23) GUI 115 POST-SB 34-414;
Put the left NAV switch in the FMC-L position and the right NAV switch in the FMC-R position.

S 755-855

(24) Left and right EHSIs:
   (a) Make sure that three horizontal lines and the letters NM show in the top left position.
   (b) Make sure that six horizontal lines and the letter Z show in the top right position.

S 865-529

(25) On the left EFIS control panel, set the HSI MODE control to the PLAN position.
   (a) Left EHSI:
      1) Make sure that the PLAN mode shows.

S 865-530

(26) Put the left and right EFI switches in the ALTN position.
   (a) EICAS Display:
      1) Make sure that the INSTR SWITCH message shows.
   (b) Left and right EHSIs:
      1) Make sure that the PLAN mode shows.

S 865-531

(27) Put the right EFI switch in the NORM position.
   (a) EICAS Display:
      1) Make sure that the INSTR SWITCH message does not show.
   (b) Right EHSI:
      1) Make sure that the MAP mode shows.

S 865-532

(28) Put the right EFI switch in the ALTN position.
   (a) EICAS Display:
      1) Make sure that the INSTR SWITCH message shows.
   (b) Right EHSI:
      1) Make sure that the PLAN mode shows.

S 865-533

(29) Put the left EFI switch in the NORM position.
   (a) EICAS Display:
      1) Make sure that the INSTR SWITCH message does not show.
   (b) Right EHSI:
      1) Make sure that the MAP mode shows.

S 865-534

(30) Put the right EFI switch in the NORM position.
  (a) Make sure that the displays do not change.

S 865-535

(31) On the left EFIS control panel, set the HSI MODE control to the MAP position.
  (a) Left EHSI:
    1) Make sure that the MAP mode shows.

S 865-536

(32) Put the left and right IRS switches in the ALTN position.
  (a) Left and right EADIs:
    1) Make sure that the ATT flag shows.

S 865-537

(33) Put the left and right IRS switches in the NORM position.
  (a) Left and right EADIs:
    1) Make sure that the ATT flag does not show.

S 865-538

(34) Set the left and right AIR DATA switches to the ALTN position.

S 755-I05

(35) Altimeters and MASIs:
  (a) Left altimeter and MASI:
    1) Make sure that the failure flags show.
  (b) Right altimeter and MASI:
    1) Make sure that the failure flags do not show.

S 865-539

(36) Set the left and right AIR DATA switches to the NORM position.

S 755-I06

(37) Altimeters and MASIs:
  (a) Left altimeter and MASI:
    1) Make sure that the failure flags do not show.
  (b) Right altimeter and MASI:
    1) Make sure that the failure flags show.

E. Put the Airplane Back to Its Usual Condition

S 865-540

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11E20, FLT CONT CMPTR PWR CENTER
  (b) 11E21, FLT CONT CMPTR SERVO CENTER
  (c) 11F30, AIR DATA CMPTR RIGHT

S 865-541

(2) On the IRMP, set the left and right mode controls to the OFF position.

S 865-542

(3) On the AFDS mode control panel, set the two F/D switches to the OFF position.

S 865-543

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-22-00-715-566

5. Center EFIS Symbol Generator Test

NOTE: This is a scheduled maintenance task.

A. References
  (1) AMM 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones
    211/212 Flight Compartment

C. Prepare for Test

S 865-860

(1) Supply electrical power (AMM 24-22-00/201).

S 865-544

(2) On the left and right instrument source select panels, put the switches and controls in the positions indicated:
  (a) EFI - NORM (out)

S 865-545

(3) On the P3 panel, put the HDG REF switch in the NORM position.

S 865-546

(4) On the AFDS mode control panel, set the two F/D switches to the OFF position.

S 865-547

(5) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
  (a) 11F2, WX RADAR

S 865-548

(6) Make sure these circuit breakers on the P11 panel are closed:
  (a) 11C30, LANDING GEAR POS SYS 1
  (b) 11S15, AIR/GND SYS 1

D. Procedure

S 865-549

(1) Make sure these circuit breakers on the P11 panel are closed:
  (a) GUI 001-114, 116-999;
      11A7, EFIS DSPL SW LEFT
  (b) GUI 115;
      11C4, EFIS DSPL SW LEFT
  (c) 11E3, ADI LEFT
  (d) 11E4, EFIS CONT PNL LEFT
  (e) 11E6, HSI LEFT
  (f) 11E24, ADI RIGHT
  (g) 11E25, EFIS CONT PNL RIGHT
  (h) 11E27, HSI RIGHT
  (i) 11F8, EFIS SYM GEN LEFT
  (j) 11F9, EFIS SYM GEN CENTER
  (k) 11F24, EFIS DSPL SW RIGHT
  (l) 11F29, EFIS SYM GEN RIGHT

S 865-550

(2) On the right EFIS control panel, put the switches and controls in the positions indicated:
  (a) Range Select - 80 NM
  (b) HSI Mode Select - MAP
  (c) WXR Select - ON (in)
  (d) Map Mode Select Switches (4) - ON (in)
  (e) ADI BRT and HSI BRT - Fully clockwise.

S 745-551

(3) Push the TEST switch on the right overhead light control panel.

S 755-552

(4) Make sure that the right EADI and EHSI displays are equivalent to the MAP mode in Figure 501.
  (a) Make sure that the EHSI display has an indicated range of 80 NM.

S 745-553

(5) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-554

(6) Open this circuit breaker on the P11 panel:
  (a) 11F29, EFIS SYM GEN RIGHT

S 755-555

(7) Make sure that the right EADI and EHSI displays go out of view.

S 865-556

(8) Set the right EFI instrument source select switch to ALTN.

S 745-557

(9) Push the TEST switch on the right overhead light control panel.

S 755-558

(10) Make sure that the right EADI and EHSI displays are equivalent to the MAP mode in Figure 501.
  (a) Make sure that the EHSI display has an indicated range of 80 NM.

S 865-559

(11) On the right overhead light control panel, push the TEST switch to remove the electrical power from the test circuits.

S 865-561

(12) Close this circuit breaker on the P11 panel:
  (a) 11F29, EFIS SYM GEN RIGHT

S 865-560

(13) Set the right EFI instrument source select switch to NORM.

S 755-562

(14) Make sure that the right EADI and EHSI displays are correct.

S 865-868

(15) On the right EFIS control panel, set the switches and controls to these positions:
  (a) WXR Select - OFF (out)
  (b) Map Mode Select Switches (4) - OFF (out)

(c) ADI BRT and HSI BRT - Fully counterclockwise.

S 865-563

(16) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:

(a) 11F2, WX RADAR

E. Put the Airplane Back to Its Usual Condition

S 865-564

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ELECTRONIC FLIGHT INSTRUMENT SYSTEM - INSPECTION/CHECK

1. General
   A. There are two electronic attitude director indicators (EADIs) and two electronic horizontal situation indicators (EHSIs) installed on the airplane. The procedures that follow supply instructions for an inspection of the cooling air inlet screens for these display units.

   NOTE: Remove and install only one of the EADIs at a time. If this is not done, then the airplane will have to be made level in order to adjust the inclinometers.

TASK 34-22-00-006-001

2. EADI Cooling Air Inlet Screen Inspection
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 29-11-00/201, Main Hydraulic Systems
      (3) AMM 33-16-00/501, Master Dim and Test
      (4) AMM 34-22-00/201, Cathode Ray Tube (CRT)
   B. Access
      (1) Location Zones

211/212	Flight Compartment

   C. Procedure

      S 866-002

      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
         (a) P11 Circuit Breaker Panel
            1) 11E3, ADI LEFT
            2) 11E24, ADI RIGHT

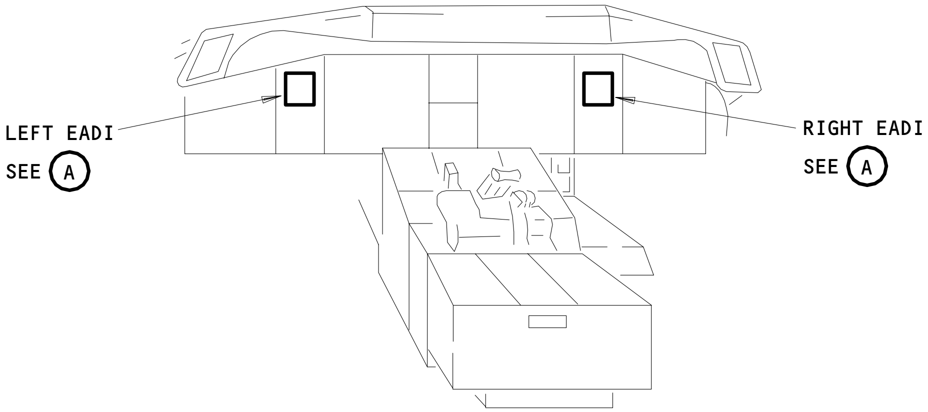
      S 866-003

      (2) Make sure that hydraulic power is removed from the flight controls (AMM 29-11-00/201).

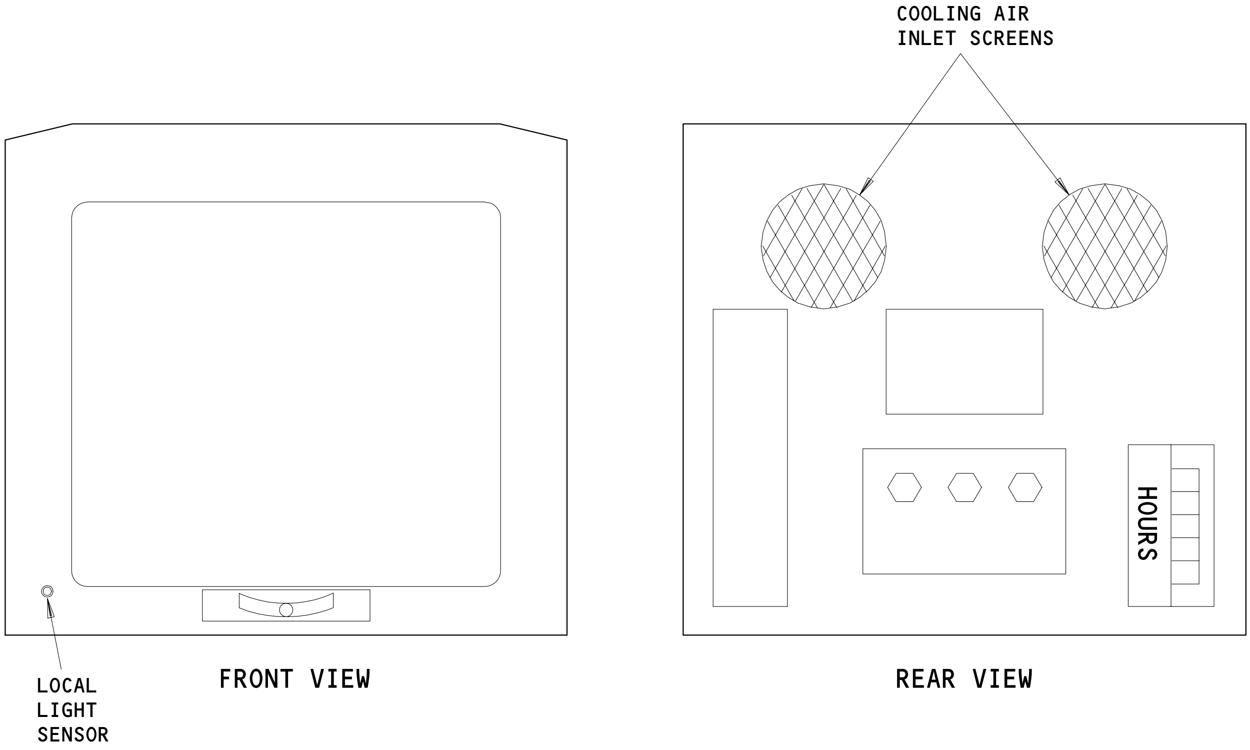
      S 026-064

   CAUTION: DO NOT PULL THE CRT HANDLE. THE HANDLE TURNS OUT AUTOMATICALLY WHEN THE SPRING IS RELEASED. HOLD THE HANDLE UNTIL IT IS COMPLETELY RELEASED FROM THE SCREWS. YOU CAN CAUSE DAMAGE TO THE HANDLE IF YOU TURN IT OUT BEFORE IT IS RELEASED FROM THE SCREWS.

      (3) Hold the CRT handle against the left EADI.



FLIGHT COMPARTMENT



EADI (EXAMPLE)
A

EFIS EADI
Figure 601

S 026-061

(4) Loosen the two screws at the top of the left EADI.

NOTE: Do not completely remove the handle screws.

S 026-063

(5) Pull the the handle out and down.

NOTE: If the handle is not fully extended when you remove the CRT, springs installed in the instrument panel can come out.

S 016-062

(6) Pull the control column rearwards and hold it there.

S 026-008

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EADI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EADI.

(7) Slowly pull the left EADI out from the instrument panel.

S 036-009

(8) Install a dust cap on the electrical connector of the EADI.

S 166-059

(9) Make sure that the inlet screen at the rear of the EADI is clean (Fig. 601).

S 866-011

(10) Make sure these circuit breakers are open:
  (a) P11 Circuit Breaker Panel
    1) 11E3, ADI LEFT
    2) 11E24, ADI RIGHT

S 436-013

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EADI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EADI.

(11) Remove the dust cap from the electrical connector of the EADI.

S 426-014

(12) Slowly push the left EADI into the instrument panel.

NOTE: Make sure that the handle is fully extended out.

S 866-015
(13) Slowly release the control column.

S 866-016
(14) Put the handle in the up and locked position.

S 436-017
(15) While the handle is held, tighten the screws.

S 866-055
(16) Adjust the inclinometer if necessary (AMM 34-22-00/201).

S 216-056
(17) Do this procedure again for the right EADI.

D. EADI Test

S 866-018
(1) Supply electrical power (AMM 24-22-00/201).

S 866-019
(2) Remove the DO-NOT-CLOSE tag and close this circuit breaker:
    (a) P11 Circuit Breaker Panel
        1) 11E3, ADI LEFT
        2) 11E24, ADI RIGHT

S 866-020
(3) Make sure these circuit breakers are closed:
    (a) P11 Circuit Breaker Panel
        1) GUI 001-114, 116-999;
           11A7, EFIS DSPL SW LEFT
        2) GUI 115;
           11C4, EFIS DSPL SW LEFT
        3) 11E4, EFIS CONT PNL LEFT
        4) 11E25, EFIS CONT PNL RIGHT
        5) 11F8, EFIS SYM GEN LEFT
        6) 11F24, EFIS DSPL SW RIGHT
        7) 11F29, EFIS SYM GEN RIGHT

S 866-021
(4) Set the EFI switches on the two instrument source select panels to the NORM position.

S 866-022
(5) On the overhead light control panel, push the TEST switch to start the test (AMM 33-16-00/501).

S 216-023
(6) Make sure the test pattern shows on the EADI display.

S 866-024

(7) On the overhead light control panel, push the TEST switch to stop the test (AMM 33-16-00/501).

S 116-026

(8) Clean the face of the EADI (AMM 34-22-00/201).

E. Put the Airplane Back to Its Usual Condition

S 866-027

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-22-00-006-028

3. EHSI Cooling Air Inlet Screen Inspection

A. References
- (1) AMM 24-22-00/201, Electrical Power - Control
- (2) AMM 29-11-00/201, Main Hydraulic Systems
- (3) AMM 33-16-00/501, Master Dim and Test
- (4) AMM 34-22-00/201, Cathode Ray Tube (CRT)

B. Access

(1) Location Zones

211/212	Flight Compartment

C. Procedure

S 866-029

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
- (a) P11 Circuit Breaker Panel
  - 1) 11E6, HSI LEFT
  - 2) 11E27, HSI RIGHT

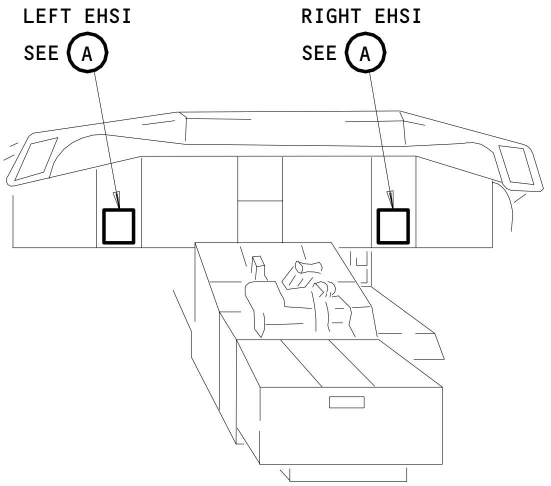
S 866-030

(2) Make sure that hydraulic power is removed from the flight controls (AMM 29-11-00/201).

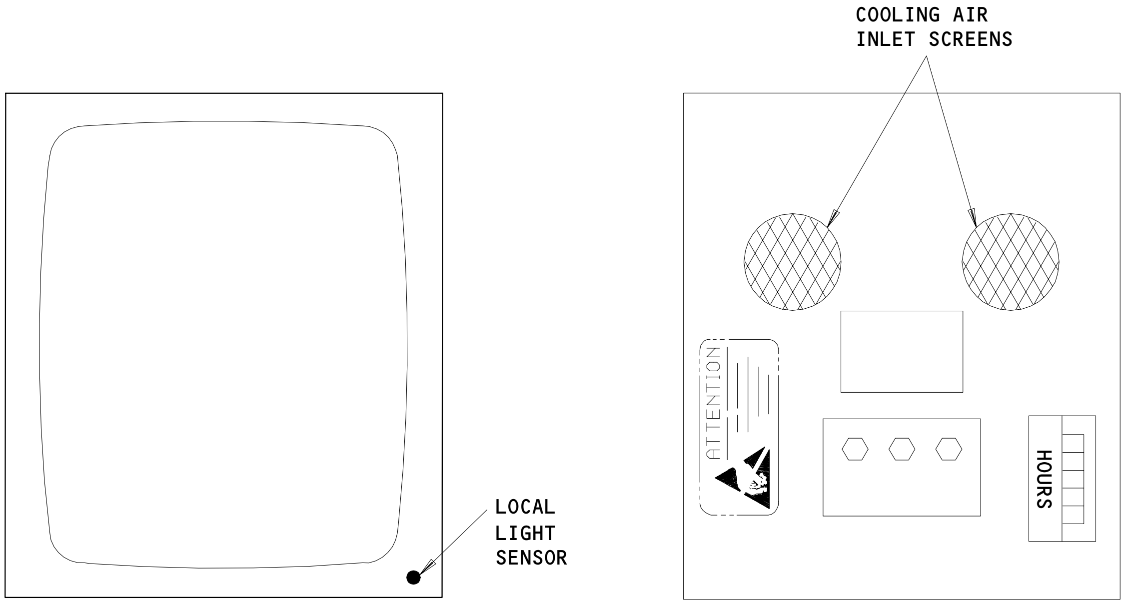
S 026-065

CAUTION: DO NOT PULL THE CRT HANDLE. THE HANDLE TURNS OUT AUTOMATICALLY WHEN THE SPRING IS RELEASED. HOLD THE HANDLE UNTIL IT IS COMPLETELY RELEASED FROM THE SCREWS. YOU CAN CAUSE DAMAGE TO THE HANDLE IF YOU TURN IT OUT BEFORE IT IS RELEASED FROM THE SCREWS.

(3) Hold the CRT handle against the left EHSI.



FLIGHT COMPARTMENT



FRONT VIEW

REAR VIEW

EHSI (EXAMPLE)
A

EFIS EHSI
Figure 602

S 026-066
(4) Loosen the two screws at the top of the left EHSI.

NOTE: Do not completely remove the handle screws.

S 026-067
(5) Pull the handle out and down.

NOTE: If the handle is not fully extended when you remove the CRT, springs installed in the instrument panel can come out.

S 016-068
(6) Pull the control column rearward and hold it there.

S 026-035

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EHSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EHSI.

(7) Slowly pull the left EHSI out from the instrument panel.

S 036-036
(8) Install a dust cap on the electrical connector of the EHSI.

S 166-060
(9) Make sure that the inlet screen at the rear of the EHSI is clean (Fig. 602).

S 866-038
(10) Make sure these circuit breakers are open:
- (a) P11 Circuit Breaker Panel
  - 1) 11E6, HSI LEFT
  - 2) 11E27, HSI RIGHT

S 436-040

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EHSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EHSI.

(11) Remove the dust cap from the electrical connector of the EHSI.

S 426-041
(12) Slowly push the left EHSI into the instrument panel.

NOTE: Make sure that the handle is fully extended out.

S 866-042
(13) Slowly release the control column.

S 416-043
(14) Put the handle in the up and locked position.

S 436-044
(15) While the handle is held, tighten the mounting screws.

S 216-057
(16) Do this procedure again for the right EHSI.

D. EHSI Test

S 866-045
(1) Supply electrical power (AMM 24-22-00/201).

S 866-046
(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
    (a) 11E6, HSI LEFT
    (b) 11E27, HSI RIGHT

S 866-047
(3) Make sure these circuit breakers are closed:
    (a) P11 Circuit Breaker Panel
        1) GUI 001-114, 116-999;
           11A7, EFIS DSPL SW LEFT
        2) GUI 115;
           11C4, EFIS DSPL SW LEFT
        3) 11E4, EFIS CONT PNL LEFT
        4) 11E25, EFIS CONT PNL RIGHT
        5) 11F8, EFIS SYM GEN LEFT
        6) 11F24, EFIS DSPL SW RIGHT
        7) 11F29, EFIS SYM GEN RIGHT

S 866-048
(4) Set the EFI switches on the two instrument source select panels to the NORM position.

S 746-049
(5) On the overhead light control panel, push the TEST switch to start the test (AMM 33-16-00/501).

S 756-050
(6) Make sure the test pattern shows on the EHSI.

S 746-051
(7) On the overhead light control panel, push the TEST switch to stop the test (AMM 33-16-00/501).

S 116-052

(8) Clean the face of the EHSI (AMM 34-22-00/201).

E. Put the Airplane Back to Its Usual Condition

S 866-053

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) SYMBOL GENERATOR - REMOVAL/INSTALLATION

1. General
   A. There are three EFIS symbol generators installed. They are located in the main equipment center on the E2 rack.
   B. The procedures that follow supply instructions for the removal, installation, and test of the symbol generators.

TASK 34-22-01-004-001

2. EFIS Symbol Generator Removal
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components
      (2) AMM 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   C. Prepare for Removal

S 914-002

CAUTION: DO NOT MOVE THE EFIS SYMBOL GENERATOR BEFORE YOU READ THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE SYMBOL GENERATOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 864-003

(2) For the left EFIS symbol generator, open these P11 panel circuit breakers and attach DO-NOT-CLOSE tags:
   (a) GUI 115;
       11C4, EFIS DSPL SW LEFT

(b) GUI 001-114, 116-999;
11A7, EFIS DSPL SW LEFT
(c) 11F8, EFIS SYM GEN LEFT

S 864-004

(3) For the right EFIS symbol generator, open these P11 panel circuit breakers and attach DO-NOT-CLOSE tags:
(a) 11F24, EFIS DSPL SW RIGHT
(b) 11F29, EFIS SYM GEN RIGHT

S 864-005

(4) For the center EFIS symbol generator, open this P11 panel circuit breaker and attach a DO-NOT-CLOSE tag:
(a) 11F9, EFIS SYM GEN CENTER

D. Procedure

S 024-006

(1) Remove the EFIS symbol generator (AMM 20-10-01/401).

TASK 34-22-01-404-007

3. EFIS Symbol Generator Installation

A. References
(1) AMM 20-10-01/401, E/E Rack-Mounted Components
(2) AMM 20-41-01/201, Electrostatic Sensitive Devices
(3) AMM 24-22-00/201, Electrical Power - Control
(4) AMM 34-22-00/201, EFIS Symbol Generator

B. Access
(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

C. Prepare for Installation

S 914-008

CAUTION: DO NOT TOUCH THE EFIS SYMBOL GENERATOR BEFORE YOU READ THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE SYMBOL GENERATOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 864-009

(2) For the left EFIS symbol generator, make sure that these P11 panel circuit breakers are open:
(a) GUI 001-114, 116-999;
11A7, EFIS DSPL SW LEFT
(b) GUI 115;
11C4, EFIS DSPL SW LEFT
(c) 11F8, EFIS SYM GEN LEFT

S 864-010

(3) For the right EFIS symbol generator, make sure that these P11 panel circuit breakers are open:
  (a) 11F24, EFIS DSPL SW RIGHT
  (b) 11F29, EFIS SYM GEN RIGHT

S 864-011

(4) For the center EFIS symbol generator, make sure that these P11 panel circuit breakers are open:
  (a) 11F9, EFIS SYM GEN CENTER

S 214-012

(5) Examine the unit and rack connectors for unwanted materials and loose or damaged pins.
  (a) Use the vacuum cleaner to clean the rear connectors, ventilation holes, installation tray connector(s), cooling air supply and return plenums, mounting fasteners, and mounting surfaces.

S 424-031

(6) Install the EFIS symbol generator (AMM 20-10-01/401).

<u>NOTE</u>: Make sure the correct software version has been installed on the new EFIS symbol generator.

S 864-014

(7) For the left EFIS symbol generator, close these P11 panel circuit breakers and remove the DO-NOT-CLOSE tags:
  (a) GUI 001-114, 116-999;
      11A7, EFIS DSPL SW LEFT
  (b) GUI 115;
      11C4, EFIS DSPL SW LEFT
  (c) 11F8, EFIS SYM GEN LEFT

S 864-015

(8) For the right EFIS symbol generator, close these P11 panel circuit breakers and remove the DO-NOT-CLOSE tags:
  (a) 11F24, EFIS DSPL SW RIGHT
  (b) 11F29, EFIS SYM GEN RIGHT

S 864-016

(9) For the center EFIS symbol generator, close this P11 panel circuit breaker and remove the DO-NOT-CLOSE tag:
  (a) 11F9, EFIS SYM GEN CENTER

D. EFIS Symbol Generator Test

S 864-017

(1) Supply electrical power (AMM 24-22-00/201).

S 864-018

(2) Make sure that these P11 panel circuit breakers are closed:
  - (a) 11E3, ADI LEFT
  - (b) 11E4, EFIS CONT PNL LEFT
  - (c) 11E6, HSI LEFT
  - (d) 11E24, ADI RIGHT
  - (e) 11E25, EFIS CONT PNL RIGHT
  - (f) 11E27, HSI RIGHT

S 864-019

(3) Put the left and right EFI instrument source select switches in the NORM position.

S 864-020

(4) On the left and right EFIS control panels, put the switches and controls in the positions indicated:
  - (a) RANGE - 10
  - (b) MODE - MAP
  - (c) WXR - OFF
  - (d) MAP MODE SELECT SWITCHES (5) - OFF
  - (e) BRIGHTNESS - Fully clockwise

S 864-021

(5) Push the RESET switch on the applicable symbol generator.

S 864-022

(6) On the overhead light control panel, push the TEST switch.

S 214-023

(7) Make sure that the test pattern shows on the EADIs and EHSIs.
  - (a) Make sure that the two EHSI test patterns are in the MAP mode and have an indicated range of 10 nautical miles.
  - (b) Make sure that the letters OPS, followed by a 12 character number are on the left side of the left and right EHSI.
  - (c) Make sure that the OPS software part numbers are correct.
  - (d) If the software part numbers are not correct, then do the software installation task (AMM 34-22-00/201) or replace the EFIS symbol generator with one that has the correct software.

S 864-024

(8) Put the left and right EFI instrument source select switches in the ALTN position.

S 864-025

(9) On the overhead light control panel, push the TEST switch.

S 214-026

(10) Make sure that the test pattern shows on the EADIs and EHSIs.
  - (a) Make sure that the two EHSI test patterns are in the MAP mode and have an indicated range of 10 nautical miles.

E. Put the Airplane Back to Its Usual Condition

S 864-027

(1) Put the left and right EFI instrument source select switches in the NORM position.

S 864-028

(2) Remove electrical power if it is not necessary (AMM 24-22-00/201).

EFIS CONTROL PANEL - MAINTENANCE PRACTICES

1. General
   A. There are two EFIS control panels installed. The procedures that follow include instructions to relamp, remove, and install the control panels.

TASK 34-22-02-962-001

2. EFIS Control Panel Lamp Replacement
   A. General
      (1) The switch-lights on the EFIS control panel are relamped from the front of the panel. The lights are located on the back of the switch lens assembly. The switches must be in the off position to relamp them.
   B. Equipment
      (1) Needle-nose Pliers
   C. References
      (1) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
   D. Access
      (1) Location Zones

211/212	Flight Compartment

   E. Lamp Removal

S 912-032

CAUTION: DO NOT MOVE THE LIGHT-SWITCH ASSEMBLIES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE CONTROL PANEL.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 862-003

CAUTION: DO NOT TRY TO RELAMP THE SWITCHES WITH THE POWER ON. FAILURE TO REMOVE THE POWER COULD RESULT IN DAMAGE TO THE SWITCH.

(2) Open these circuit breakers on the overhead panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11N1, INSTRUMENT AND PANEL AISLE STAND

S 012-005

CAUTION: MAKE SURE THAT THE BAIL WIRE RETAINER IS NOT DAMAGED WHEN THE LENS ASSEMBLY IS REMOVED FROM THE SWITCH HOUSING. MAKE SURE THAT THE LENS ASSEMBLY IS CONNECTED TO THE RETAINER. DAMAGE TO THE SWITCH CAN OCCUR IF A DAMAGED OR DISCONNECTED RETAINER IS PUT INTO THE SWITCH HOUSING.

(3) To remove the assembly, pull the assembly straight out from the housing.

NOTE: The assembly is held by a bail wire retainer to keep it connected to the housing.

S 022-006

(4) Remove the lamp from the lens assembly.

NOTE: If necessary, use a needle-nose pliers to remove the lamp.

F. Lamp Installation

S 422-007

(1) Put the new lamp in the lens assembly.

S 412-033

CAUTION: MAKE SURE THAT THE LENS ASSEMBLY IS CONNECTED TO THE BAIL WIRE RETAINER. IF THE RETAINER IS NOT CONNECTED, INSTALLATION OF LAMP CAN CAUSE THE LAMP POWER TO SHORT-CIRCUIT.

(2) Carefully put the lens assembly in the switch housing.

S 412-009

(3) Slowly push the lens assembly in until the switch engages.

S 862-010

(4) Release the switch.

S 862-011

(5) Remove the DO-NOT-CLOSE tag and close this P11 panel circuit breaker:
   (a) 11N1, INSTRUMENT AND PANEL AISLE STAND

TASK 34-22-02-002-012

3. EFIS Control Panel Removal

A. References
   (1) AMM 20-41-01/201, Electrostatic Sensitive Devices

B. Access
   (1) Location Zones

211/212 Flight Compartment

C. Prepare for Removal

S 912-013

CAUTION: DO NOT MOVE THE EFIS CONTROL PANEL BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EFIS CONTROL PANEL.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 862-014

(2) Open this P11 circuit breaker, as applicable, and attach a DO-NOT-CLOSE tag:
   (a) 11E4, EFIS CONT PNL LEFT
   (b) 11E25, EFIS CONT PNL RIGHT

S 012-016

(3) Remove the left or right access panel, as applicable, on the aisle control stand.

D. Remove the EFIS Control Panel

S 012-017

(1) Disconnect the electrical cable on the rear of the control panel.

S 032-018

(2) Loosen the screws on the control panel.

S 022-019

(3) Remove the control panel.

TASK 34-22-02-402-020

4. EFIS Control Panel Installation

A. References
   (1) AMM 20-41-01/201, Electrostatic Sensitive Devices
   (2) AMM 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones
      211/212 Flight Compartment

C. Install the EFIS Control Panel

S 912-021

CAUTION: DO NOT MOVE THE EFIS CONTROL PANEL BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EFIS CONTROL PANEL.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201)

S 862-022

(2) Make sure that this P11 panel circuit breaker, as applicable, is open:
  (a) 11E4, EFIS CONT PNL LEFT
  (b) 11E25, EFIS CONT PNL RIGHT

S 422-023

(3) Move the control panel into the aisle control stand.

S 432-024

(4) Tighten the screws on the control panel.

NOTE: If there was a blank placard on the range switch of the old EFIS control panel, make sure you put it on the new EFIS control panel.

S 412-025

(5) Connect the electrical cable to the rear of the control panel.

S 862-026

(6) Supply electrical power (AMM 24-22-00/201).

S 862-027

(7) Remove the DO-NOT-CLOSE tag and close this P11 panel circuit breaker, as applicable:
  (a) 11E4, EFIS CONT PNL LEFT
  (b) 11E25, EFIS CONT PNL RIGHT

S 212-028

(8) Make sure that the control panel lights come on.

S 412-029

(9) Replace the applicable aisle control stand access panel.

D. Put the Airplane Back to Its Usual Condition

S 862-031

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI) - REMOVAL/INSTALLATION

1. General
   A. There are two electronic attitude director indicators (refer to as EADIs) installed. The procedures that follow supply instructions for the removal, installation, and test of the EADIs.

      NOTE: If the left and the right EADIs are to be removed, then remove and install only one of the EADIs at a time. If this is not done, then the airplane will have to be made level in order to adjust the inclinometers.

TASK 34-22-03-004-001

2. EADI Removal
   A. References
      (1) 29-11-00/201, Main Hydraulic Systems
   B. Access
      (1) Location Zones
          211/212 Flight Compartment
   C. Procedure

      S 864-003

      (1) Open the applicable circuit breaker and attach a DO-NOT-CLOSE tag:
          (a) P11 Circuit Breaker Panel
              1) 11E3, ADI LEFT
              2) 11E24, ADI RIGHT

      S 864-004

      (2) Make sure that hydraulic power is removed from the flight controls (Ref 29-11-00/201).

      S 024-036

      CAUTION: DO NOT PULL THE CRT HANDLE. THE HANDLE TURNS OUT AUTOMATICALLY WHEN THE SPRING IS RELEASED. HOLD THE HANDLE UNTIL IT IS COMPLETELY RELEASED FROM THE SCREWS. YOU CAN CAUSE DAMAGE TO THE HANDLE IF YOU TURN IT OUT BEFORE IT IS RELEASED FROM THE SCREWS.

      (3) Hold the CRT handle against the EADI.

S 024-033

(4) Loosen the two screws at the top of the EADI display.

NOTE: Do not completely remove the handle screws.

S 024-034

(5) Pull the the handle out and down.

NOTE: If the handle is not fully extended when you remove the CRT, springs installed in the instrument panel can come out.

S 014-035

(6) Pull the control column rearwards and hold it there.

S 024-028

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EADI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EADI.

(7) Slowly pull the EADI out from the instrument panel.

S 034-029

(8) Install a dust cap on the electrical connector of the EADI.

TASK 34-22-03-404-010

3. EADI Installation

A. References
   (1) 24-22-00/201, Electrical Power - Control
   (2) 33-16-00/501, Master Dim and Test
   (3) 34-22-00/201, Cathode Ray Tube (CRT)

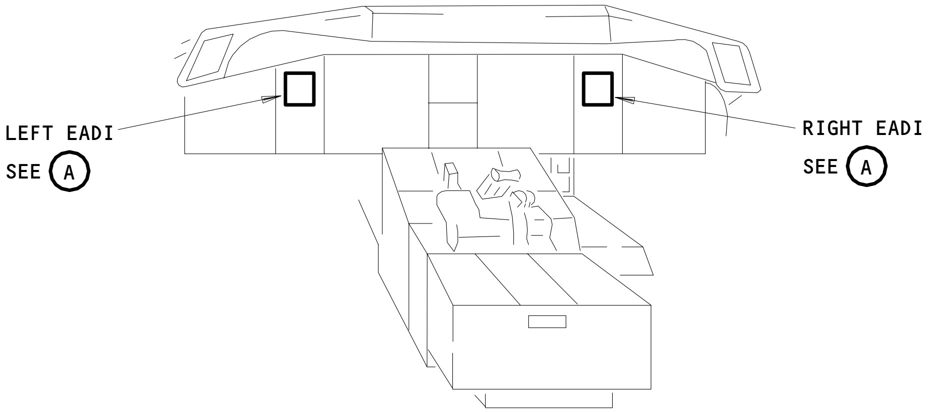
B. Access
   (1) Location Zones

211/212	Flight Compartment

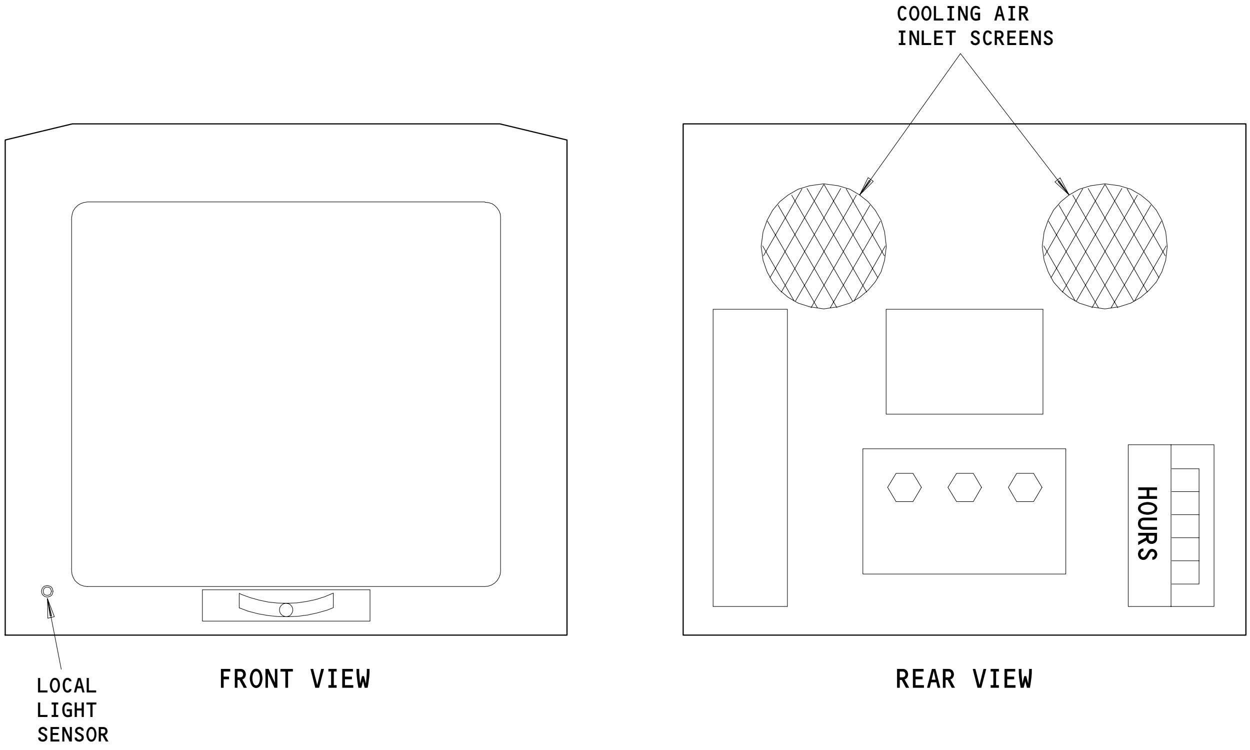
C. Procedure

S 864-012

(1) Make sure the applicable circuit breaker is open:
   (a) P11 Circuit Breaker Panel
      1) 11E3, ADI LEFT
      2) 11E24, ADI RIGHT



FLIGHT COMPARTMENT



EADI (EXAMPLE)
A

EFIS EADI
Figure 401

S 214-027

(2) Make sure that the inlet screen at the rear of the EADI is clean (Fig. 401).

S 434-030

<u>CAUTION</u>: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EADI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EADI.

(3) Remove the dust cap from the electrical connector of the EADI.

S 424-031

(4) Slowly push the EADI into the instrument panel.

<u>NOTE</u>: Make sure that the handle is fully extended out.

S 864-014

(5) Slowly release the control column.

S 864-026

(6) Put the handle in the up and locked position.

S 434-015

(7) While the handle is held, tighten the screws.

S 864-017

(8) Remove the DO-NOT-CLOSE tag and close the applicable circuit breaker:
 (a) P11 Circuit Breaker Panel
  1) 11E3, ADI LEFT
  2) 11E24, ADI RIGHT

D. EADI Test

S 864-032

(1) Supply electrical power (Ref 24-22-00/201).

S 864-018

(2) Make sure these circuit breakers are closed:
 (a) P11 Circuit Breaker Panel
  1) GUI 001-114, 116-999;
   11A7, EFIS DSPL SW LEFT
  2) GUI 115;
   11C4, EFIS DSPL SW LEFT

3) 11E4, EFIS CONT PNL LEFT
4) 11E25, EFIS CONT PNL RIGHT
5) 11F8, EFIS SYM GEN LEFT
6) 11F24, EFIS DSPL SW RIGHT
7) 11F29, EFIS SYM GEN RIGHT

S 864-019

(3) Set the EFI switches on the two instrument source select panels to the NORM position.

S 864-020

(4) On the overhead light control panel, push the TEST switch to start the test (Ref 33-16-00/501).

S 214-021

(5) Make sure the test pattern shows on the EADI.

S 864-022

(6) On the overhead light control panel, push the TEST switch to stop the test (Ref 33-16-00/501).

S 864-023

(7) Adjust the inclinometer if necessary (Ref 34-22-00/201).

S 114-024

(8) Clean the face of the EADI (Ref 34-22-00/201).

E. Put the Airplane Back to Its Usual Condition

S 864-025

(1) Remove electrical power if it is not necessary (Ref 24-22-00/201).

ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI) - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the EHSI; the other is the installation of the EHSI.
   B. Two EHSIs (N5 - left, N45 - right) are installed.

TASK 34-22-04-004-001

2. EHSI Removal
   A. References
      (1) 29-11-00/201, Main Hydraulic Systems
   B. Access
      (1) Location Zones

211/212	Flight Compartment

   C. Procedure

S 864-002

(1) Open the applicable circuit breaker and attach a DO-NOT-CLOSE tag:
   (a) P11 Circuit Breaker Panel
      1) 11E6, HSI LEFT
      2) 11E27, HSI RIGHT

S 864-004

(2) Make sure that hydraulic power is removed from the flight controls (Ref 29-11-00/201).

S 024-034

CAUTION: DO NOT PULL THE CRT HANDLE. THE HANDLE TURNS OUT AUTOMATICALLY WHEN THE SPRING IS RELEASED. HOLD THE HANDLE UNTIL IT IS COMPLETELY RELEASED FROM THE SCREWS. YOU CAN CAUSE DAMAGE TO THE HANDLE IF YOU TURN IT OUT BEFORE IT IS RELEASED FROM THE SCREWS.

(3) Hold the CRT handle against the EHSI.

S 024-031

(4) Loosen the two screws at the top of the EHSI display.

NOTE: Do not completely remove the handle screws.

S 024-032

(5) Pull the handle out and down.

NOTE: If the handle is not fully extended when you remove the CRT, springs installed in the instrument panel can come out.

S 014-033

(6) Pull the control column rearward and hold it there.

S 024-027

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EHSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EHSI.

(7) Slowly pull the EHSI out from the instrument panel.

S 034-028

(8) Install a dust cap on the electrical connector of the EHSI.

TASK 34-22-04-404-009

3. EHSI Installation

A. References
- (1) 24-22-00/201, Electrical Power - Control
- (2) 33-16-00/501, Master Dim and Test
- (3) 34-22-00/201, Cathode Ray Tube (CRT)

B. Access
- (1) Location Zones

  211/212 Flight Compartment

C. Procedure

S 864-011

(1) Make sure the applicable circuit breaker is open:
- (a) P11 Circuit Breaker Panel
  - 1) 11E6, HSI LEFT

        2) 11E27, HSI RIGHT

S 214-012

(2) Make sure that the inlet screen at the rear of the EHSI is clean (Fig. 401).

S 434-029

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE EHSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EHSI.

(3) Remove the dust cap from the electrical connector of the EHSI.

S 424-026

(4) Slowly push the EHSI into the instrument panel.

NOTE: Make sure that the handle is fully extended out.

S 864-013

(5) Slowly release the control column.

S 414-014

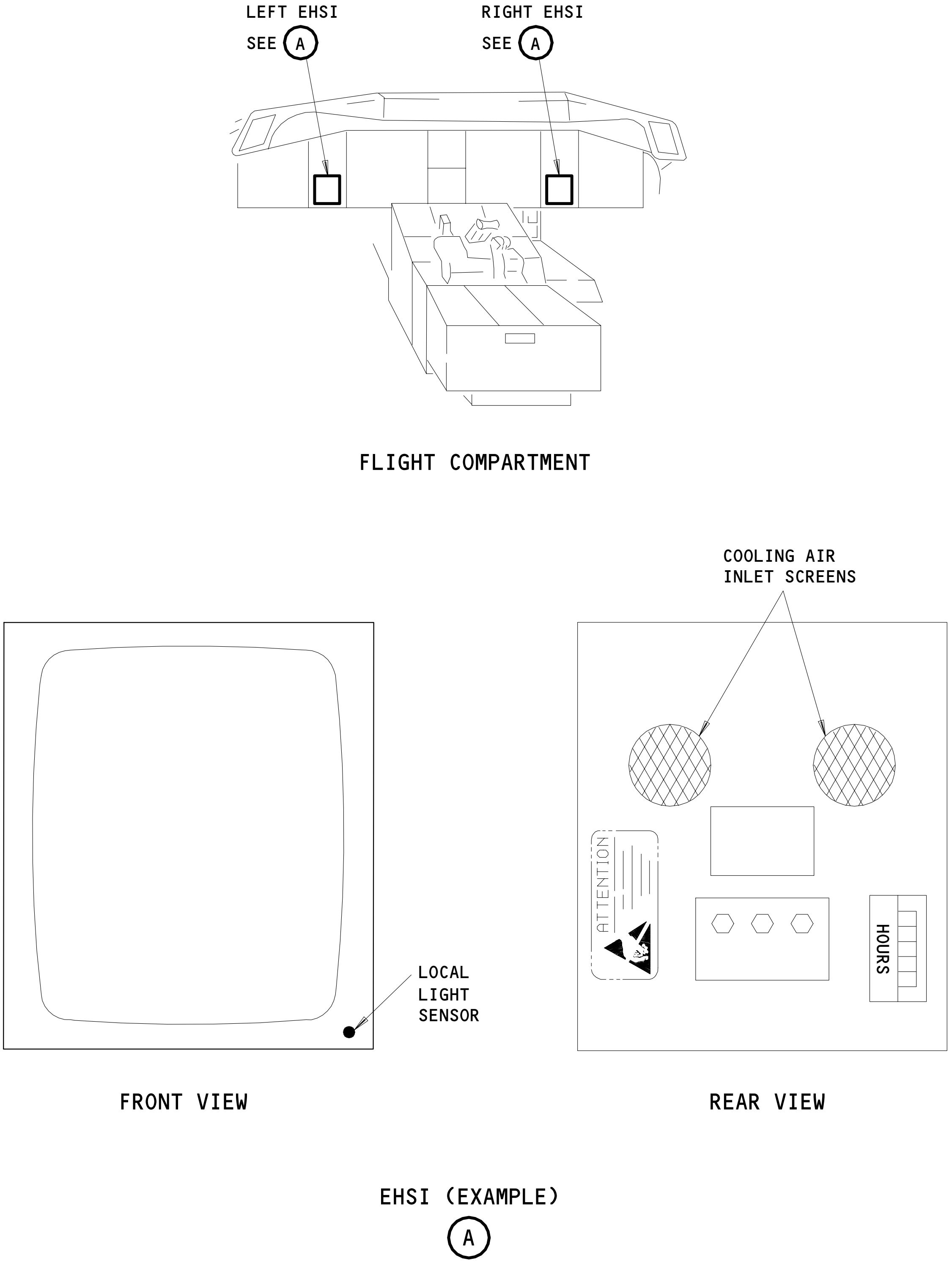
(6) Put the handle in the up and locked position.

S 434-015

(7) While the handle is held, tighten the mounting screws.

S 864-017

(8) Remove the DO-NOT-CLOSE tag and close the applicable circuit breaker:
    (a) P11 Circuit Breaker Panel
        1) 11E6, HSI LEFT
        2) 11E27, HSI RIGHT



EFIS EHSI
Figure 401

D. EHSI Test

S 864-030
(1) Supply electrical power (Ref 24-22-00/201).

S 864-018
(2) Make sure these circuit breakers are closed:
    (a) P11 Circuit Breaker Panel
        1) GUI 001-114, 116-999;
           11A7, EFIS DSPL SW LEFT
        2) GUI 115;
           11C4, EFIS DSPL SW LEFT
        3) 11E4, EFIS CONT PNL LEFT
        4) 11E25, EFIS CONT PNL RIGHT
        5) 11F8, EFIS SYM GEN LEFT
        6) 11F24, EFIS DSPL SW RIGHT
        7) 11F29, EFIS SYM GEN RIGHT

S 864-019
(3) Set the EFI switches on the two instrument source select panels to the NORM position.

S 744-020
(4) On the overhead light control panel, push the TEST switch to start the test (Ref 33-16-00/501).

S 754-021
(5) Make sure the test pattern shows on the EHSI.

S 744-022
(6) On the overhead light control panel, push the TEST switch to stop the test (Ref 33-16-00/501).

S 114-023
(7) Clean the face of the EHSI (Ref 34-22-00/201).

E. Put the Airplane Back to Its Usual Condition

S 864-024
(1) Remove electrical power if it is not necessary (Ref 24-22-00/201).

RADIO DISTANCE MAGNETIC INDICATOR (RDMI) OR RADIO MAGNETIC INDICATOR (RMI) - REMOVAL/INSTALLATION

TASK 34-22-05-004-032

1. Remove the RDMI (RMI)
   A. References
      (1) 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones
          211/212   Flight Compartment

   C. Procedure

S 864-003

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) GUI 001-114, 116-999;
       for the captain's RDMI:
       1) 11A6, RDMI LEFT
   (b) GUI 001-114, 116-999;
       for the first officer's RDMI:
       1) 11F25, RDMI RIGHT
   (c) GUI 115;
       for the captain's RMI:
       1) 11A6, RBA L
       2) 11A7, RMI L
   (d) GUI 115;
       for the first officer's RMI:
       1) 11F23, RMI R
       2) 11F25, RBA R

S 864-026

CAUTION: DO NOT TOUCH THE RDMI (RMI) BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE RDMI (RMI).

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

S 034-004

(3) Loosen the instrument mounting screws on the front panel, adjacent to the indicator.

S 014-005

(4) Pull the indicator out to get access to the electrical cable.

S 034-006

(5) Disconnect the electrical cable.

S 024-027

(6) Remove the RDMI (RMI).

TASK 34-22-05-424-030

2. Install the RDMI (RMI)

A. References

(1) 20-41-01/201, Electrostatic Sensitive Devices

(2) 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

211/212	Flight Compartment

C. Procedure

S 864-012

(1) Make sure these circuit breakers on the P11 panel are open:

- (a) GUI 001-114, 116-999;
  for the captain's RDMI:
  - 1) 11A6, RDMI LEFT
- (b) GUI 001-114, 116-999;
  for the first officer's RDMI:
  - 1) 11F25, RDMI RIGHT
- (c) GUI 115;
  for the captain's RMI:
  - 1) 11A6, RBA L
  - 2) 11A7, RMI L
- (d) GUI 115;
  for the first officer's RMI:
  - 1) 11F23, RMI R
  - 2) 11F25, RBA R

S 864-024

CAUTION: DO NOT TOUCH THE RDMI (RMI) BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE RDMI (RMI).

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

S 434-014

(3) Connect the electrical cable.

S 424-028

(4) Install the RDMI (RMI).

S 434-017

(5) Tighten the mounting screws.

D. Indicator Test

S 864-018

(1) Supply electrical power (AMM 24-22-00).

S 864-019

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) GUI 001-114, 116-999;
      for the captain's RDMI:
      1) 11A6, RDMI LEFT
  (b) GUI 001-114, 116-999;
      for the first officer's RDMI:
      1) 11F25, RDMI RIGHT
  (c) GUI 115;
      for the captain's RMI:
      1) 11A6, RBA L
      2) 11A7, RMI L
  (d) GUI 115;
      for the first officer's RMI:
      1) 11F23, RMI R
      2) 11F25, RBA R

S 754-029

(3) Make sure the RDMI (RMI) panel lights come on.

E. Put the Airplane Back to Its Usual Condition

S 864-022

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

VERTICAL SPEED INDICATOR (VSI) - REMOVAL/INSTALLATION

1. General
   A. The VSIs are installed on the captain's, P1, and first officer's, P3, instrument panels. The electrical connection is at the rear of the unit.

TASK 34-22-06-004-001

2. Remove the VSI
   A. Access
      (1) Location Zones
         211/212 Flight Compartment

   B. Procedure

      S 864-002
      (1) Open these applicable circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) For the captain's VSI:
            1) 11E5, VSI LEFT
         (b) For the first officer's VSI:
            1) 11E26, VSI RIGHT

      S 034-003
      (2) Loosen the instrument mounting screws on the front panel adjacent to the indicator.

      S 014-018

      CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE VSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE VSI.

      (3) Pull the indicator out to get the electrical cable.

      S 034-005
      (4) Disconnect the electrical cable.

S 024-006
(5) Remove the VSI.

S 034-019
(6) Install dust caps on the electrical connectors.

TASK 34-22-06-404-021

3. Install the VSI

A. References
   (1) AMM 24-22-00/201, Electrical Power - Control
   (2) AMM 34-21-00/201, Inertial Reference System

B. Access
   (1) Location Zones
      211/212 Flight Compartment

C. Procedure

S 864-015
(1) Make sure these applicable circuit breakers on the P11 panel are open:
   (a) For the captain's VSI:
      1) 11E5, VSI LEFT
   (b) For the first officer's VSI:
      1) 11E26, VSI RIGHT

S 434-020

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE VSI. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE VSI.

(2) Remove the dust caps from the electrical connectors.

S 434-008
(3) Connect the electrical cable.

S 424-009
(4) Install the VSI.

S 434-010
(5) Tighten the screws.

D. VSI Test

S 864-011
(1) Supply electrical power (AMM 24-22-00/201).

S 864-012
(2) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P11 panel:
  (a) For the captain's VSI:
    1) 11E5, VSI LEFT
  (b) For the first officer's VSI:
    1) 11E26, VSI RIGHT

S 864-023
(3) Make sure the applicable IRU is energized and aligned (AMM 34-21-00/201).

S 714-024
(4) Do this VSI test with the applicable left or right IRS controls and indicators:
  (a) Make sure the IRS switch on the applicable instrument source select panel is in the NORM position.
  (b) Make sure the VSI fault flag does not show.
  (c) Set the applicable mode switch on the IRMP to the ALIGN position.
    1) Make sure the ALIGN light comes on.
    2) Make sure the VSI fault flag shows.
  (d) Push and hold the test switch on the applicable IRU.
  (e) Make sure this sequence of indications occurs for the applicable Inertial Reference System:
    1) <u>Seconds 0-2</u>:
      a) The IRMP annunciator lights come on.

b) The IRMP shows the number "8" in all the display areas.

2) <u>Seconds 2-10</u>:

a) The annunciator light, ALIGN, shows on the IRMP.

b) The VSI fault flag shows.

3) <u>After 10 seconds</u>:

a) The VSI shows -600 ft/min.

(f) Release the test switch on the IRU.

(g) Set the mode switch on the IRMP to the OFF position.

(h) Make sure the annunciator lights on the IRMP are off.

(i) Make sure the VSI fault flag shows.

S 864-025

(5) Set the IRS switch on the applicable instrument source select panel to the ALTN position.

S 714-026

(6) Do the VSI test again on the applicable left or right VSI with the center IRS controls and the center IRU.

E. Put the Airplane Back to Its Usual Condition

S 864-027

(1) Set the IRS switch on the applicable instrument source select panel to the NORM position.

S 864-028

(2) Remove power from the applicable IRU (AMM 34-21-00/201).

S 864-013

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

RADIO MAGNETIC INDICATOR (RMI) BEARING SOURCE ANNUNCIATOR - REMOVAL/INSTALLATION

TASK 34-22-07-004-003

1. Remove the RMI Bearing Source Annunciator
   A. References
      (1) 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones
         211/212 Flight Compartment

   C. Procedure

      S 864-016
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) For the captain's RMI Bearing Source Annunciator:
            1) 11A6, RBA L
            2) 11A7, RMI L
         (b) For the first officer's RMI Bearing Source Annunciator:
            1) 11F23, RMI R
            2) 11F25, RBA R

      S 864-001

      CAUTION: DO NOT TOUCH THE RMI BEARING SOURCE ANNUNCIATOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE RMI BEARING SOURCE ANNUNCIATOR.

      (2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

      S 034-004
      (3) Loosen the instrument mounting screws on the front panel, adjacent to the indicator.

      S 014-005
      (4) Pull out the indicator to get to the electrical cable.

      S 034-006
      (5) Disconnect the electrical cable.

      S 024-007
      (6) Remove the RMI Bearing Source Annunciator.

TASK 34-22-07-404-008

2. Install the RMI Bearing Source Annunciator

A. References
  (1) 20-41-01/201, Electrostatic Sensitive Devices
  (2) 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones
    211/212 Flight Compartment

C. Procedure

S 864-017

(1) Make sure these circuit breakers on the P11 panel are open:
  (a) For the captain's RMI Bearing Source Annunciator:
    1) 11A6, RBA L
    2) 11A7, RMI L
  (b) For the first officer's Bearing Source Annunciator:
    1) 11F23, RMI R
    2) 11F25, RBA R

S 864-002

CAUTION: DO NOT TOUCH THE RMI BEARING SOURCE ANNUNCIATOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE RMI BEARING SOURCE ANNUNCIATOR.

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01).

S 434-009

(3) Connect the electrical cable.

S 424-010

(4) Install the RMI Bearing Source Annunciator.

S 434-011

(5) Tighten the screws.

D. RMI Bearing Source Annunciator Test

S 864-012

(1) Supply electrical power (AMM 24-22-00).

S 864-013

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) For the captain's RMI Bearing Source Annunciator:
    1) 11A6, RBA L
    2) 11A7, RMI L
  (b) For the first officer's RMI Bearing Source Annunciator
    1) 11F23, RMI R
    2) 11F25, RBA R

S 754-014

(3) Make sure the panel lights on the RMI Bearing Source Annunciator come on.

E. Put the Airplane Back to Its Usual Condition

S 864-015

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) REMOTE LIGHT SENSOR - REMOVAL/INSTALLATION

1. General
    A. Two EFIS remote light sensors are installed on the glareshield (P7) panel.

TASK 34-22-08-004-001

2. Remove the EFIS Remote Light Sensor
    A. Equipment
        (1) Removal tool, M524256-R20
    B. References
        (1) 20-41-01/201, Electrostatic Sensitive Devices
        (2) 51-31-01/201, Seals and Sealing
    C. Access
        (1) Location Zones

211/212	Flight Compartment

    D. Prepare for Removal

S 864-003

(1) Open the applicable circuit breaker on the main power distribution panel, P6, and attach a DO-NOT-CLOSE tag:
    (a) For the left remote light sensor:
        1) 6G2, CLOCK TIME BASE L
    (b) For the right remote light sensor:
        1) 6G3, CLOCK TIME BASE R

S 864-002

(2) Open these applicable circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
    (a) For the left remote light sensor:
        1) 11A2, VOR MKR LEFT
        2) 11A34, INDICATOR LIGHTS 3
        3) 11B6, LIGHTS FLOOD MAIN PANEL

4) 11B7, LIGHTS STBY INSTR or
LIGHTS INSTR
5) 11B17, CLOCK IND LEFT
6) 11E3, ADI LEFT
7) 11E6, HSI LEFT
8) 11N2, INSTRUMENT AND PANEL CAPT
9) 11N7, CHART or
CHART TABLE
10) 11N30, INTRUMENT & PANEL GLARESHIELD
11) 11N31, MAP
12) 11N33, FLOOD CAPT PANEL
13) 11P2, L IND LTS 2
14) 11P7, GLARESHIELD FLOOD

(b) For the right remote light sensor:
1) 11A33, INDICATOR LIGHTS 2
2) 11B6, LIGHTS FLOOD MAIN PANEL
3) 11E24, ADI RIGHT
4) 11E27, HSI RIGHT
5) 11E33, VOR RIGHT
6) 11J3, EICAS UPPER DISPLAY or
EICAS UPPER IND
7) 11J30, EICAS LOWER DISPLAY or
EICAS LOWER IND
8) 11J35, CLOCK IND RIGHT
9) 11N6, F/O PANEL FLOOD
10) 11N7, CHART or
CHART TABLE
11) 11N28, INSTRUMENT & PANEL F/O
12) 11N30, INSTRUMENT & PANEL GLARESHIELD
13) 11N31, MAP
14) GUI 115;
11P6, SIDE WALL
15) 11P7, GLARESHIELD FLOOD
16) 11P28, R IND LTS 1

S 864-004

(3) Open these applicable circuit breakers on the equipment lighting panel, P26, and attach DO-NOT-CLOSE tags:

(a) For the left remote light sensor:
1) P26 CENTER ROW, C4166

2) P26 CENTER ROW, C4155

(b) For the right remote light sensor:
   1) P26 BOTTOM ROW, C4167
   2) P26 CENTER ROW, C4160

E. Procedure

S 914-036

CAUTION: DO NOT TOUCH THE LIGHT SENSOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE LIGHT SENSOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-01).

S 034-006

(2) Below the glare shield, disconnect the plug (D40850 or D40854) from the connector receptacle.

S 014-007

(3) Loosen and move the insulation to get access to the wire bundle.

S 034-008

(4) Disconnect the five wires from the connector receptacle with the removal tool.

S 014-009

(5) If it is necessary, remove the connectors and cooling ducts from the rear of the applicable VOR control panel to get access to the remote light sensor.

S 034-010

(6) Loosen the screws on the glare shield, adjacent to the sensor.

S 024-011

(7) Remove the light sensor from below the glare shield.

S 034-012

(8) Remove the wire cable for the remote light sensor from the wire bundle.

S 144-013

(9) Remove the used sealant from below the glare shield (Ref 51-31-01).

TASK 34-22-08-404-014

3. Install the Remote Light Sensor

A. Equipment
  (1) Insertion tool, M524256-A20
  (2) Hand-held light source

B. Consumable Materials
  (1) A00247 Sealant - BMS 5-95
  (2) A00279 Adhesive - Loctite - 222-21
  (3) Black tape

C. References
  (1) 20-41-01/201, Electrostatic Sensitive Devices
  (2) 24-22-00/201, Electrical Power - Control
  (3) 51-31-01/201, Seals and Sealing

D. Access
  (1) Location Zones
      211/212   Flight Compartment

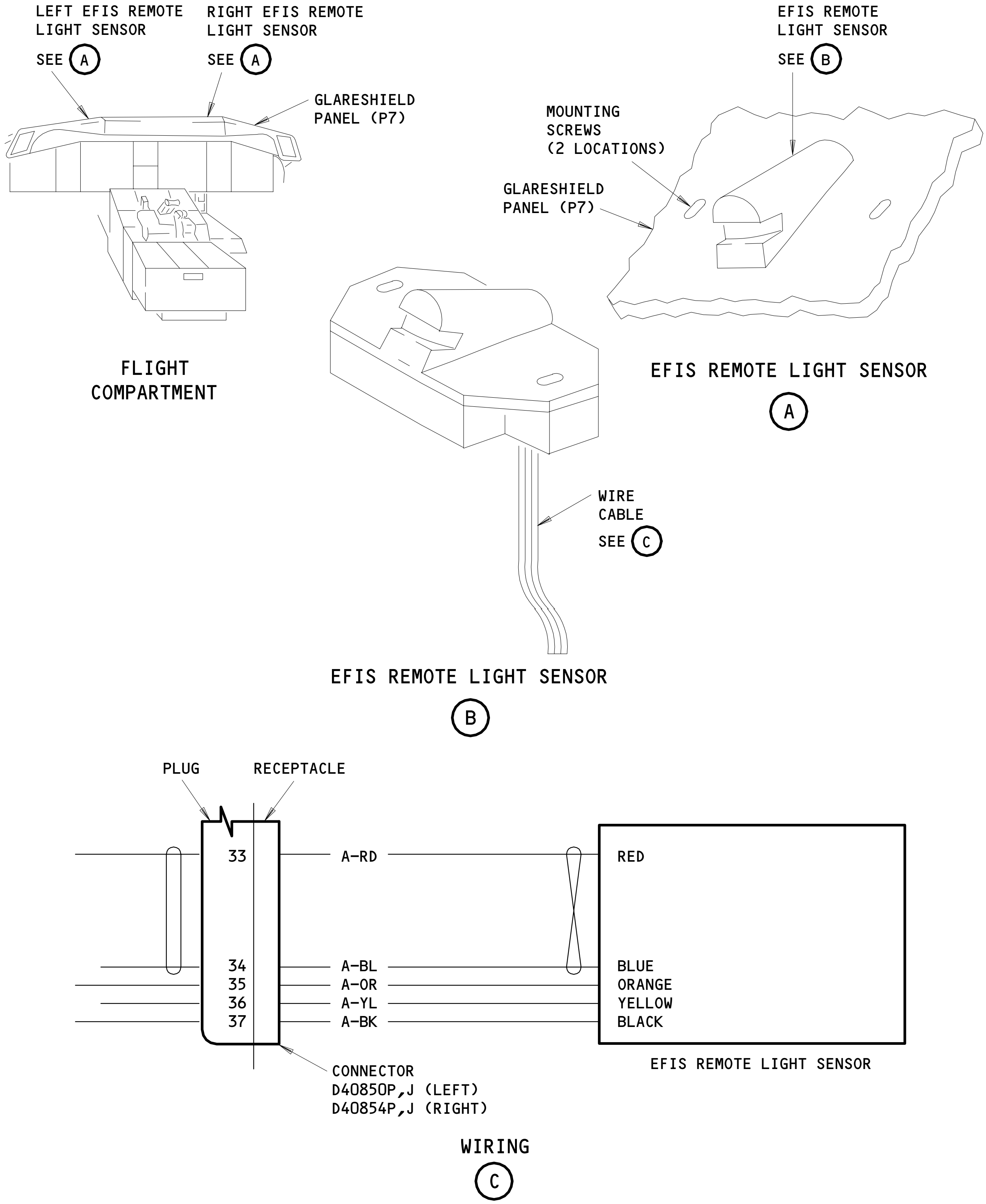
E. Prepare for Installation

S 864-015

(1) Make sure these applicable circuit breakers on the P6 panel are open:
  (a) For the left remote light sensor:
    1) 6G2, CLOCK TIME BASE L
  (b) For the right remote light sensor:
    1) 6G3, CLOCK TIME BASE R

S 864-016

(2) Make sure these applicable circuit breakers on the P11 panel are open:
  (a) For the left remote light sensor:
    1) 11A2, VOR MKR LEFT



EFIS Remote Light Sensor
Figure 401

2) 11A34, INDICATOR LIGHTS 3
3) 11B6, LIGHTS FLOOD MAIN PANEL
4) 11B7, LIGHTS STBY INSTR or
LIGHTS INSTR
5) 11B17, CLOCK IND LEFT
6) 11E3, ADI LEFT
7) 11E6, HSI LEFT
8) 11N2, INSTRUMENT AND PANEL CAPT
9) 11N7, CHART or
CHART TABLE
10) 11N30, INTRUMENT & PANEL GLARESHIELD
11) 11N31, MAP
12) 11N33, FLOOD CAPT PANEL
13) 11P2, L IND LTS 2
14) 11P7, GLARESHIELD FLOOD

(b) For the right remote light sensor:

1) 11A33, INDICATOR LIGHTS 2
2) 11B6, LIGHTS FLOOD MAIN PANEL
3) 11E24, ADI RIGHT
4) 11E27, HSI RIGHT
5) 11E33, VOR RIGHT
6) 11J3, EICAS UPPER DISPLAY or
EICAS UPPER IND
7) 11J30, EICAS LOWER DISPLAY or
EICAS LOWER IND
8) 11J35, CLOCK IND RIGHT
9) 11N6, F/O PANEL FLOOD
10) 11N7, CHART or
CHART TABLE
11) 11N28, INSTRUMENT & PANEL F/O
12) 11N30, INSTRUMENT & PANEL GLARESHIELD
13) 11N31, MAP
14) GUI 115;
11P6, SIDE WALL
15) 11P7, GLARESHIELD FLOOD
16) 11P28, R IND LTS 1

S 864-017

(3) Make sure these applicable circuit breakers on the P26 panel are open:

(a) For the left remote light sensor:

1) P26 CENTER ROW, C4166
2) P26 CENTER ROW, C4155

(b) For the right remote light sensor:

1) P26 BOTTOM ROW, C4167
2) P26 CENTER ROW, C4160

F. Procedure

S 914-018

CAUTION: DO NOT TOUCH THE LIGHT SENSOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE LIGHT SENSOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-01).

S 414-019

(2) Put the light sensor wire cable through the insulation to the connector receptacle.

S 434-020

(3) Install the wires into the correct connector contacts with the insertion tool.

S 434-021

(4) Connect the connector plug to the connector receptacle.

S 424-022

(5) Put the remote light sensor into the hole in the glare shield with the sensor lens face to the front of the airplane.

S 434-023

(6) Install the screws with Loctite 222-21.

S 434-024

(7) Apply the sealant, BMS 5-95, around the light sensor, below the glare shield, to prevent light leakage (Ref 51-31-01).

NOTE: Make sure that the sealant does not have leakage on the glare shield surface.

S 434-025

(8) Attach the connectors and cooling ducts to the VOR control panel.

S 434-026

(9) Tighten the wire bundle insulation.

S 864-027

(10) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P6 panel:
  (a) For the left remote light sensor:
    1) 6G2, CLOCK TIME BASE L
  (b) For the right remote light sensor:
    1) 6G3, CLOCK TIME BASE R

S 864-028

(11) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P11 panel:

(a) For the left remote light sensor:

1) 11A2, VOR MKR LEFT
2) 11A34, INDICATOR LIGHTS 3
3) 11B6, LIGHTS FLOOD MAIN PANEL
4) 11B7, LIGHTS STBY INSTR or
LIGHTS INSTR
5) 11B17, CLOCK IND LEFT
6) 11E3, ADI LEFT
7) 11E6, HSI LEFT
8) 11N2, INSTRUMENT AND PANEL CAPT
9) 11N7, CHART or
CHART TABLE
10) 11N30, INTRUMENT & PANEL GLARESHIELD
11) 11N31, MAP
12) 11N33, FLOOD CAPT PANEL
13) 11P2, L IND LTS 2
14) 11P7, GLARESHIELD FLOOD

(b) For the right remote light sensor:

1) 11A33, INDICATOR LIGHTS 2
2) 11B6, LIGHTS FLOOD MAIN PANEL
3) 11E24, ADI RIGHT
4) 11E27, HSI RIGHT
5) 11E33, VOR RIGHT
6) 11J3, EICAS UPPER DISPLAY or
EICAS UPPER IND
7) 11J30, EICAS LOWER DISPLAY or
EICAS LOWER IND
8) 11J35, CLOCK IND RIGHT
9) 11N6, F/O PANEL FLOOD
10) 11N7, CHART or
CHART TABLE
11) 11N28, INSTRUMENT & PANEL F/O
12) 11N30, INSTRUMENT & PANEL GLARESHIELD
13) 11N31, MAP

14) GUI 115;
    11P6, SIDE WALL
15) 11P7, GLARESHIELD FLOOD
16) 11P28, R IND LTS 1

S 864-029

(12) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P26 panel:
- (a) For the left remote light sensor:
  - 1) P26 CENTER ROW, C4166
  - 2) P26 CENTER ROW, C4155
- (b) For the right remote light sensor:
  - 1) P26 BOTTOM ROW, C4167
  - 2) P26 CENTER ROW, C4160

G. Remote Light Sensor Test

S 864-030

(1) Supply electrical power (Ref 24-22-00).

S 864-031

(2) Make sure these applicable circuit breakers on the P11 panel are closed:
- (a) GUI 001-114, 116-999;
  11A7, EFIS DSPL SW LEFT
- (b) GUI 115;
  11C4, EFIS DSPL SW LEFT
- (c) 11E3, ADI LEFT
- (d) 11E4, EFIS CONT PNL LEFT
- (e) 11E6, HSI LEFT
- (f) 11E24, ADI RIGHT
- (g) 11E25, EFIS CONT PNL RIGHT
- (h) 11E27, HSI RIGHT
- (i) 11F8, EFIS SYM GEN LEFT
- (j) 11F24, EFIS DSPL SW RIGHT
- (k) 11F29, EFIS GYM GEN RIGHT

S 864-032

(3) On the applicable EFIS control panel, set the ADI BRT and HSI BRT controls an equal distance between fully clockwise and fully counterclockwise.

S 864-033

(4) For light conditions, do the steps as follows:
- (a) Put black tape on the applicable remote light sensor.
- (b) On the applicable EHSI and EADI, make sure the display is brighter.
- (c) Remove the tape from the remote light sensor.
- (d) Make sure the display goes back to its usual condition.

S 864-034

(5) For no light conditions, do the steps as follows:
  - (a) Apply a light source to the applicable remote light sensor.
  - (b) On the applicable EHSI and EADI, make sure the display is brighter.
  - (c) Remove the light source from the remote light sensor.
  - (d) Make sure the display goes back to its usual condition.

H. Put the Airplane Back to Its Usual Condition

S 864-035

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

STANDBY MAGNETIC COMPASS - DESCRIPTION AND OPERATION

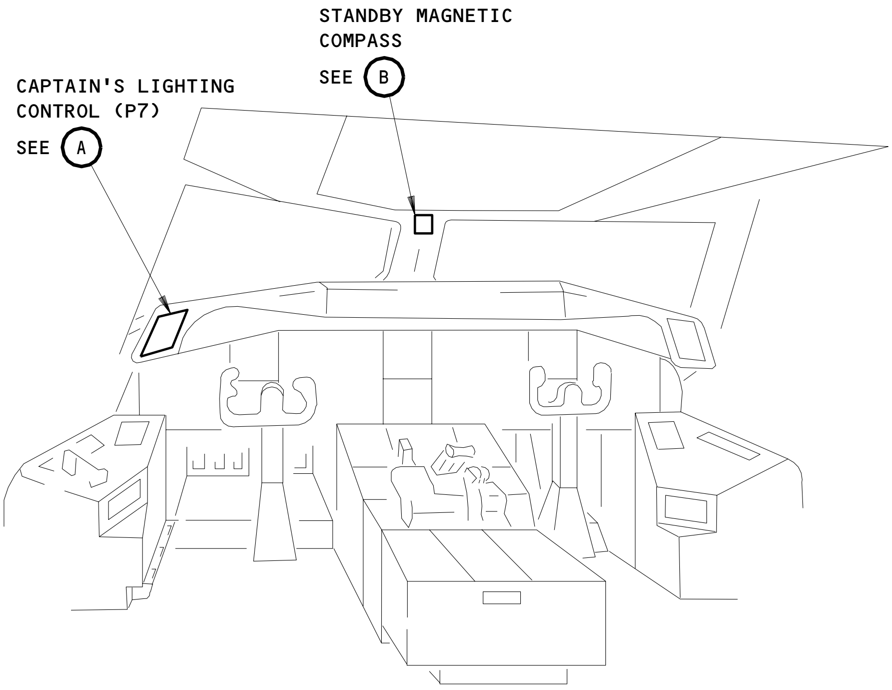
1. General (Fig. 1)
   A. The standby compass is used by the pilots as a quick directional reference and as an auxiliary compass. It is a highly sensitive instrument that is installed in a liquid filled case. The liquid serves to dampen rapid movement and oscillations of the compass.
2. Component Detail (Fig. 1)
   A. Standby Magnetic Compass
      (1) The standby magnetic compass is a single instrument mounted in the control cabin above the center of the left and right windshields. The unit is mounted to the airframe with a nonferrous bracket.
      (2) The compass employs a circular card having two parallel and horizontal magnets attached to indicate magnetic direction. The card is free to rotate and tilt within the liquid filled case. The front panel has E-W and N-S compensator adjusters for alignment of the compass card.
      (3) AIRPLANES WITH STANDBY
      MAGNETIC COMPASS P/N C-5H;

      Rotate the cover screw counter-clockwise and remove the cover to gain acess to the compensator adjustors.
      (4) AIRPLANES WITH STANDBY
      MAGNETIC COMPASS P/N C-5M;

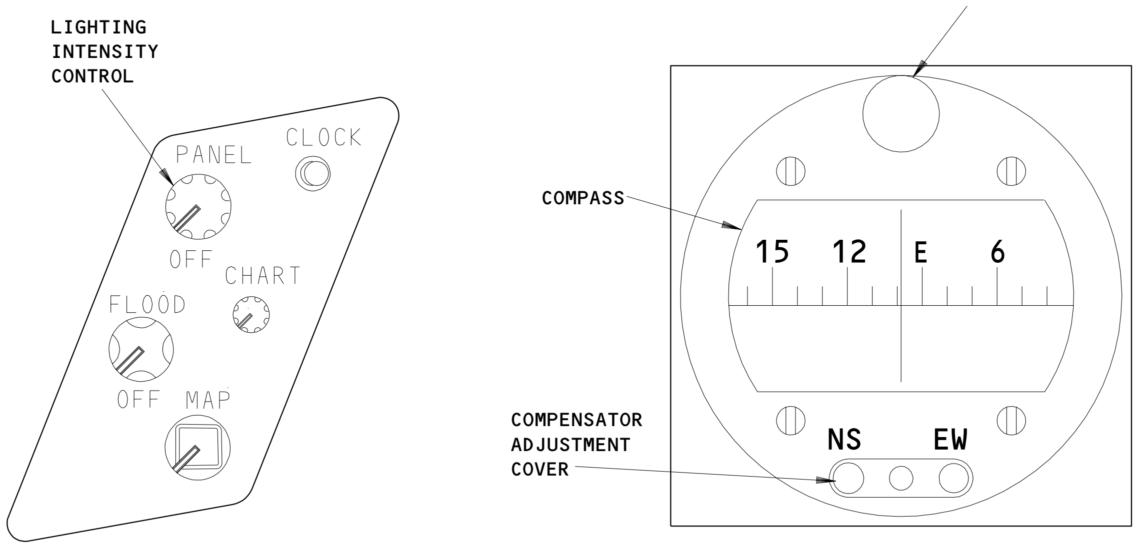
      Rotate the cover screw clockwise to expose the compensator adjustors.
      (5) AIRPLANES WITH STANDBY
      MAGNETIC COMPASS P/N C-5H;

      The indicating card is illuminated by means of a single 5V ac bulb located at the top of the compass. The bulb brightness is controlled by the PANEL lighting intensity control on the captain's lighting control panel (P7). A lamp access cover permits easy replacement of the light bulb.
      (6) AIRPLANES WITH STANDBY
      MAGNETIC COMPASS P/N C-5M;

      The indicating card is illuminated by means of a single 5V ac bulb located at the bottom of the compass. The bulb brightness is controlled by the PANEL lighting intensity control on the captain's lighting control panel (P7). A lamp access cover permits easy replacement of the light bulb.
3. Operation (Fig. 1)
   A. Functional Description
      (1) The magnets attached to the compass card align themselves with the earth's magnetic lines of flux. This rotates the compass card which is calibrated to indicate the airplane heading relative to the earth's field.



FLIGHT COMPARTMENT

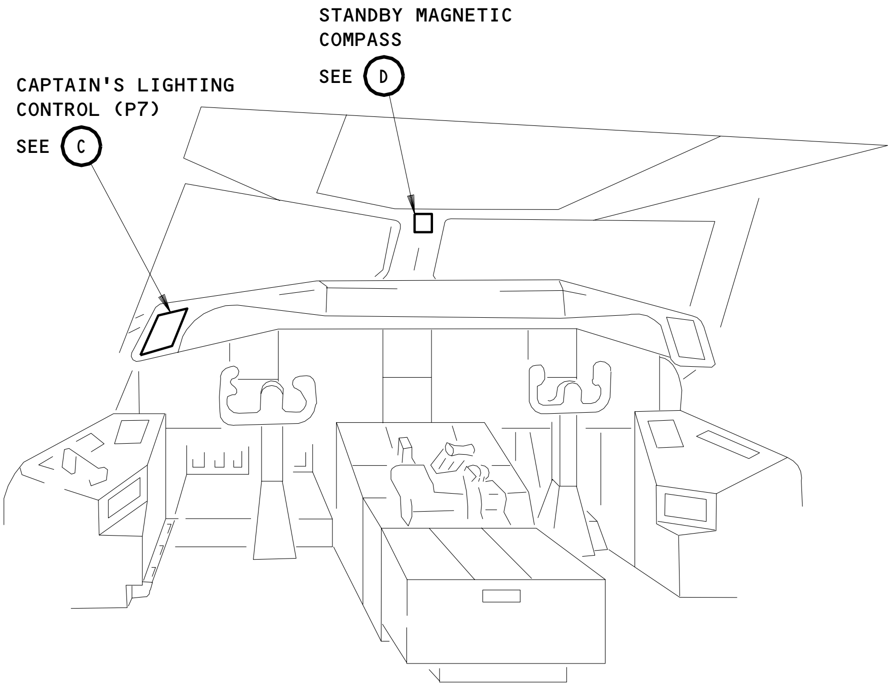


CAPTAIN'S LIGHTING CONTROL
A

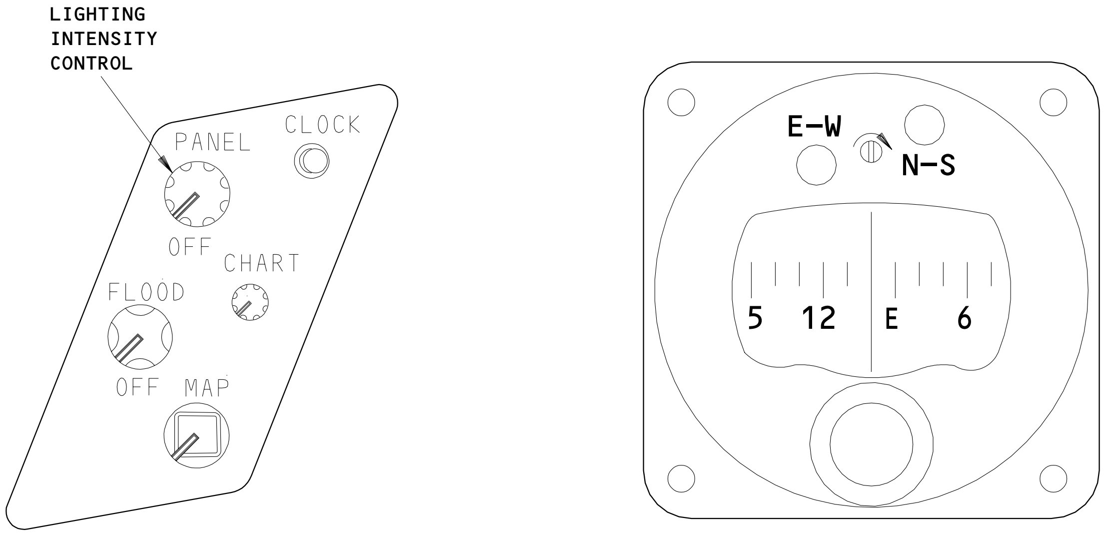
STANDBY MAGNETIC COMPASS
B

Standby Magnetic Compass - Component Location
Figure 1 (Sheet 1)

EFFECTIVITY
AIRPLANES WITH STANDBY MAGNETIC COMPASS
P/N C-5H



FLIGHT COMPARTMENT



CAPTAIN'S LIGHTING CONTROL
C

STANDBY MAGNETIC COMPASS
D

Standby Magnetic Compass - Component Location
Figure 1 (Sheet 2)

(2) The compensators adjust the local magnetic field to correct for deviations produced by airplane components and currents in the airplane wiring. When small errors cannot be removed by the compensators, they are noted on a card mounted near the compass for the pilots' use.

B. Control

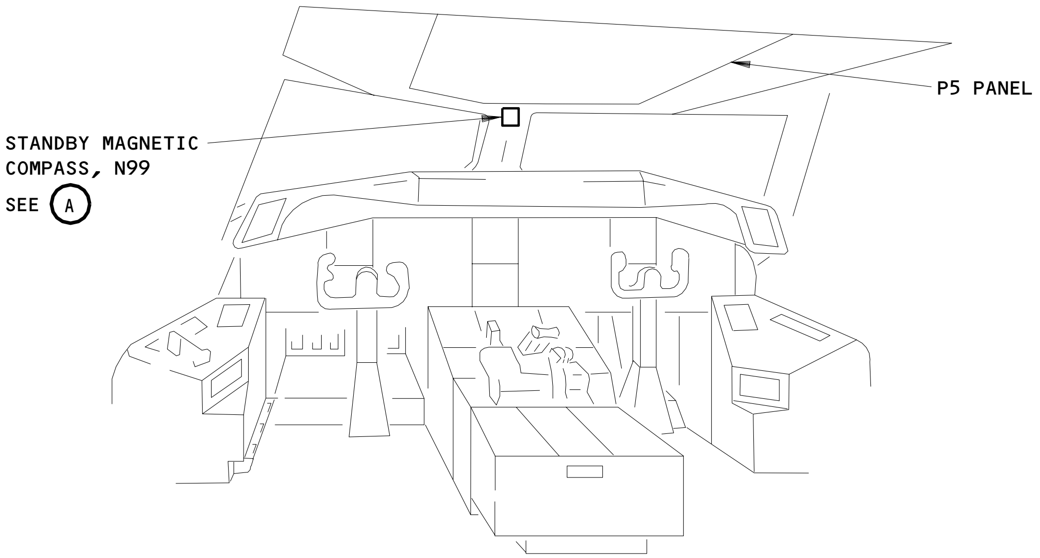
(1) To provide power to compass lighting, perform the following steps:
  (a) Provide electrical power (Ref 24-22-00).
  (b) Close the following overhead panel P11 circuit breaker:
    1) 11N2, INSTRUMENT AND PANEL CAPT
  (c) Adjust compass lighting by rotating the PANEL lighting control knob, located on captain's lighting control panel (P7).

STANDBY MAGNETIC COMPASS

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
COMPASS - STANDBY MAGNETIC, N99	--	1	FLT COMPT, P5	34-23-00

* SEE THE WDM EQUIPMENT LIST

Standby Magnetic Compass - Component Index
Figure 101



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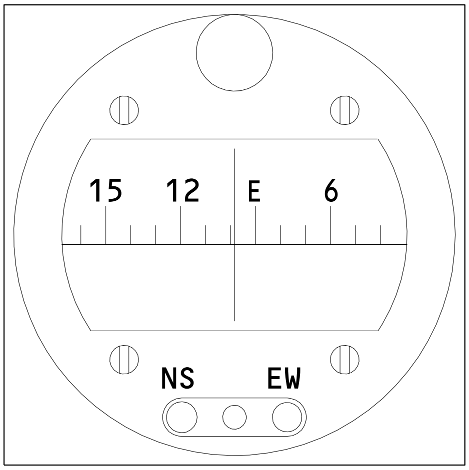
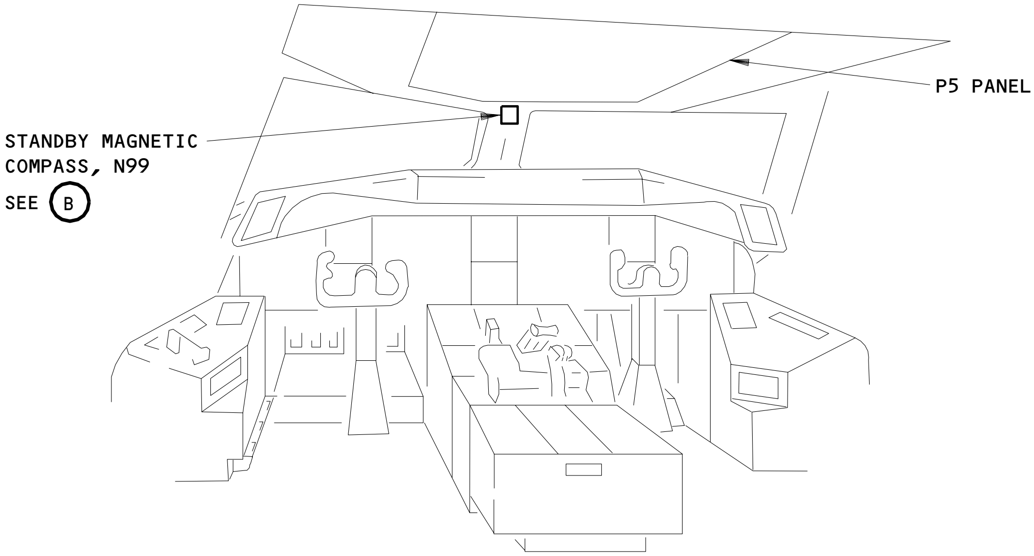


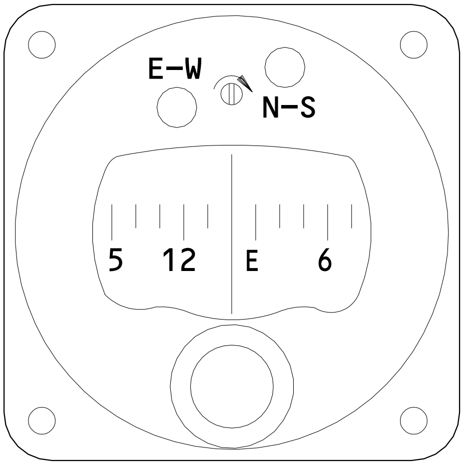
STANDBY MAGNETIC COMPASS, N99

A

Standby Magnetic Compass - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT



STANDBY MAGNETIC COMPASS, N99

B

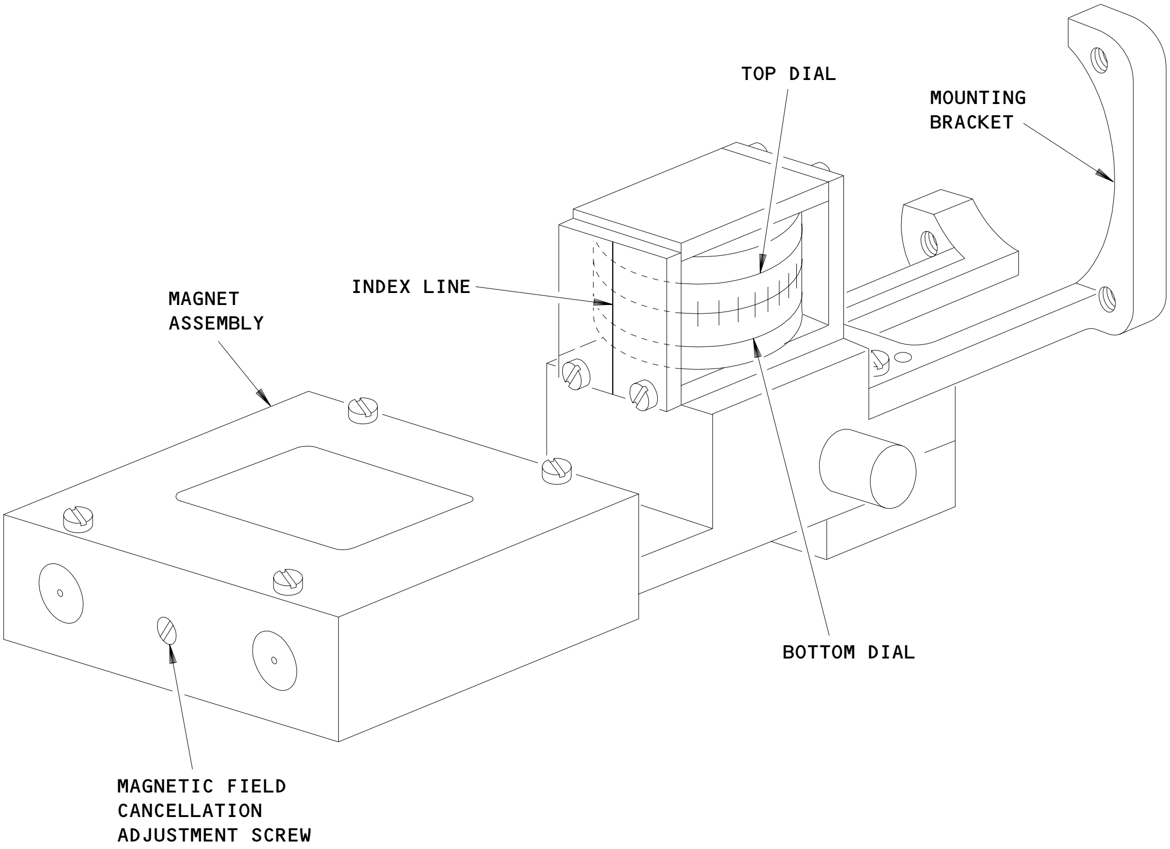
Standby Magnetic Compass - Component Location
Figure 102 (Sheet 2)

STANDBY MAGNETIC COMPASS - MAINTENANCE PRACTICES

1. General
   A. This procedure has these tasks:
      (1) Standby Magnetic Compass - Calibration
      (2) Standby Magnetic Compass Light - Removal
      (3) Standby Magnetic Compass Light - Installation
   B. The Standby Magnetic Compass calibration procedure contains two tasks. Each task is a different procedure that you can use to do a swing of the standby compass. One procedure is to tow the airplane around a compass rose (Tow Around Procedure). The other procedure is to use a standby compass calibrator (Calibrator Procedure). Use only one of these procedures to do a swing of the standby compass.

      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 air bubble is large than 3/8-inch wide and 1/8-inch high, with the glass approximately vertical position, replace the standby compass.

   C. Each task has two parts. The first part is to do a swing of the standby compass through four compass points (N, E, S, W). Use this procedure for compass calibration. The second part is to do a swing of the standby compass through 12 compass points that are approximately 30 degrees apart. Use this procedure to measure the remaining errors and to make sure the standby compass heading is accurate. Use this data to make the compass correction card. This card must stay with the standby compass.
   D. It is not necessary to keep a constant radius or tangency during airplane tow around the compass rose or swing area. Tow direction is optional. These make no difference when you calculate the solutions.
   E. Do not park vehicles less than 250 feet from the airplane during the compass swing.
   F. Make sure the radio receivers are on during the compass swing.
   G. You can use the APU during the compass swing.



Standby Compass Calibrator
Figure 201

H73669

TASK 34-23-00-822-129

2. Standby Magnetic Tow-Around Procedure

A. Equipment
- (1) Tow Tractor
- (2) Non-magnetic tools to adjust the standby magnetic compass.
- (3) One compass correction card - AN5823-1

B. References
- (1) AMM 9-11-00/201, Towing
- (2) AMM 24-22-00/201, Electrical Power - Control
- (3) AMM 34-21-00/201, Inertial Reference System (IRS)
- (4) AMM 34-22-00/501, Electronic Flight Instrument System (EFIS)

C. Access
- (1) Location Zones
  - 211/212 Flight Compartment

D. Procedure

NOTE: Ferromagnetic parts installed near the standby compass can cause compass heading errors. Make sure there are no ferromagnetic parts near the captain's and first officer's window frames. If found, replace the parts with nonmagnetic corrosion resistant steel (CRES) parts.

S 862-126

(1) Supply electrical power (AMM 24-22-00/201).

S 862-006

(2) Initialize and align the IRS (AMM 34-21-00/201).

S 862-007

(3) On the P5 panel, set the three IRS mode select switches to the NAV position.

S 862-008

(4) Make sure that all of the flight compartment equipment is energized and operates as usual.

S 862-127

(5) GUI 115;
Make sure that the autopilot is disengaged or off.

S 862-010

(6) On the P10 panel, set the captain's and the first officer's EFIS mode switches to the VOR or ILS position (AMM 34-22-00/201).

S 862-056

(7) Make sure that the two EHSIs show the same magnetic heading.

S 862-128

(8) GUI 115;
open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
  (a) 11E16, MODE CONT PNL LEFT
  (b) 11E34, MODE CONT PNL RIGHT

<u>NOTE</u>: An energized Autopilot/Flight Director System (AFDS) mode control panel can cause a compass error of ±4 degrees or less.

S 582-059

(9) Tow the airplane to the compass swing area.

<u>NOTE</u>: The Compass Swing Area must be a level area with a smooth surface. It must be sufficiently strong to hold the weight of the airplane. The area must be large enough to tow the airplane. Make sure all vehicles other than the tow vehicle are at least 220 feet from the airplane.

The horizontal component of the earth's magnetic field must be constant (± 1 degree) in the test area. Measure the horizontal component if magnetic material (such as a building) is installed less than 600 feet from the compass rose. Do not use the compass rose if the horizontal component is not constant (± 1 degree).

E. Standby Compass Adjustment

<u>NOTE</u>: The steps that follow are for the four-point calibration swing:

S 582-060

(1) Turn the airplane so that the captain's Electronic Horizontal Situation Indicator (EHSI) shows the north magnetic heading (MH)N ±2 degrees.

S 862-013

(2) Set the left and right IRS instrument source select switches on panels P1 and P3, to the NORM position.

S 862-094

CAUTION: USE TOOLS THAT ARE NOT MAGNETIC. MAGNETIC TOOLS CAN CAUSE COMPASS DIFFERENCES.

(3) Make sure that the N-S and E-W compensations on the standby compass are at neutral.

NOTE: If you use the IRMP to align the airplane to a magnetic heading, the IRMP must show the necessary magnetic heading(MH) + the magnetic variation(MV). This is because the True heading = MH + MV.

S 972-061

(4) Make a record of the EHSI magnetic heading (MH)N and the standby compass heading (CH)N.

S 972-062

(5) Calculate the north heading deviation (DN) and its sign as follows:

DN = (MH)N - (CH)N

S 972-063

(6) Make a record of DN.

S 582-064

(7) Turn the airplane to less than 2 degrees from an east magnetic heading (MH)E as shown on the captain's EHSI.

S 972-065

(8) Make a record of the EHSI magnetic heading (MH)E and the standby compass heading (CH)E.

S 972-066

(9) Calculate the east heading deviation (DE) and its sign as follows:

DE = (MH)E - (CH)E

S 972-067

(10) Make a record of DE.

S 582-068

(11) Turn the airplane to less than 2 degrees from a south magnetic heading (MH)S as shown on the captain's EHSI.

S 972-069

(12) Make a record of the EHSI magnetic heading (MH)S and the standby compass heading (CH)S.

S 972-070

(13) Calculate the south heading deviation (DS) and its sign as follows:

$$DS = (MH)S - (CH)S$$

S 972-071

(14) Make a record of DS.

S 972-072

(15) Calculate the north-south single-cycle error coefficient (C) as follows:

$$C = \frac{DN - DS}{2}$$

S 972-075

(16) Make a record of C.

S 822-076

(17) Turn the N-S compensation screw on the standby magnetic compass (while at the south magnetic heading) to give a compass heading indication of (CH)S - C.

S 582-077

(18) Turn the airplane to less than 2 degrees from a west magnetic heading (MH)W as shown on the captain's EHSI.

S 972-078

(19) Make a record of the EHSI magnetic heading (MH)W and the standby compass heading (CH)W.

S 972-079

(20) Calculate the west heading deviation (DW) and its sign as follows:

$$DW = (MH)W - (CH)W$$

S 972-080

(21) Make a record of DW.

S 972-081

(22) Calculate the east-west single-cycle error coefficient (B) as follows:

$$B = \frac{DE - DW}{2}$$

S 972-082

(23) Make a record of B.

S 822-083

(24) Turn the E-W compensation screw on the standby magnetic compass (while at the west magnetic heading) to give a compass heading indication of (CH)W - B. Make sure the difference between the maximum positive and maximum negative value is 10 degrees or less.

<u>NOTE</u>: For FAA airplane certification, the remaining deviation for the standby magnetic compass must not be more than ± 8 degrees. For CAA certification, the remaining deviation for the standby magnetic compass must not be more than ± 5 degrees.

S 582-086

(25) Turn the airplane to a magnetic heading of 0 degrees as shown by the IRS heading on the IRMP.

<u>NOTE</u>: Make sure the airplane is near the center of the compass swing area.

S 972-130

(26) Make a record of the magnetic heading (MH) and standby compass heading (CH).

S 972-088

(27) Calculate the deviation as follows:

$$D = MH - CH$$

S 972-095

(28) Make a record of D.

S 582-089

(29) Turn the airplane to a magnetic heading of 30 degrees as shown by the IRS heading on the IRMP.

S 972-090
(30) Make a record of the standby compass heading.

S 972-091
(31) Make a record of the heading shown on the EHSI.

S 972-092
(32) Calculate the deviation.

S 972-093
(33) Make a record of the deviation.

S 862-002
(34) Use these values for the magnetic heading (60, 90, 120, 150, 180, 210, 240, 270, 300, 330 degrees) and do the steps that follow:
  (a) Turn the airplane near the center of the compass swing area with the applicable magnetic heading shown on the IRMP.
  (b) Make a record of the standby magnetic compass heading.
  (c) Make a record of the deviation for each heading.

S 862-045
(35) Do the steps that follow to complete the compass correction card:
  (a) Add the deviation values to nominal aircraft magnetic headings.
  (b) Add a note that the calibration was done with the radio equipment on.

F. Put the Airplane Back to Its Usual Condition

S 862-046
(1) Set the three IRS mode select switches to the OFF position.

S 862-131
(2) GUI 115;
remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11E16, MODE CONT PNL LEFT
  (b) 11E34, MODE CONT PNL RIGHT

S 862-050
(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-23-00-822-096

3. Standby Compass Calibrator Procedure

A. Equipment
  (1) Tow Tractor
  (2) Non-magnetic tools to adjust the standby magnetic compass
  (3) One compass correction card - AN5823-1
  (4) Standby Compass Calibrator Kit, Honeywell 2591553-901
  (5) Non-Magnetic Tripod

B. References
  (1) AMM 9-11-00/201, Towing

(2) AMM 24-22-00/201, Electrical Power - Control
(3) AMM 34-21-00/201, Inertial Reference System (IRS)
(4) AMM 34-22-00/501, Electronic Flight Instrument System (EFIS)

C. Access

(1) Location Zones

211/212 Flight Compartment

D. Calibrator Adjustment (Fig. 201)

S 822-097

(1) Do this procedure to calibrate the standby compass calibrator (SCC) to the magnetic field at the location of the compass rose.
  (a) Make sure that there are no vehicles or airplanes less than 250 feet away.
  (b) Make sure that there are no buildings less than 250 feet away.
  (c) Put a nonmagnetic tripod at the center of the compass swing area.
  (d) Remove the magnetic assembly by removing the thumbscrew securing it.
  (e) Remove the knob assembly by loosing the thumbscrew securing it.
  (f) Attach a master magnetic compass to the SCC with two mounting screws.

  <u>NOTE</u>: You can use an accurate standby magnetic compass for a master magnetic compass. Make sure that the N-S and E-W adjustment screws are at neutral.

  (g) Put the SCC/master compass assembly on the tripod.

  <u>NOTE</u>: Make sure the assembly is level.

  (h) Turn the assembly until the master magnetic compass shows an indication of magnetic north (N).
  (i) Reinstall the magnetic assembly.
  (j) Reinstall the knob assembly.
  (k) Turn the top and bottom SCC dials to show an indication of E at the index line.
  (l) Make a record of the heading shown on the master magnetic compass.
  (m) Turn the top and bottom SCC dials to show an indication of W at the index line.
  (n) Make a record of the heading shown on the master magnetic compass.
  (o) Turn the magnetic field cancellation adjustment screw on the SCC to decrease the heading errors in each direction (E and W) to a minimum.

(p) Continue to adjust the SCC dials for each direction (E and W). Then use the field cancellation adjustment screw until the errors are at a minimum.

NOTE: Continue to do this procedure until the error in each direction is at a minimum.

Do not move the field cancellation adjustment screw before the compass swing is completed.

E. Prepare for a Compass Swing of the Standby Compass

S 582-098

(1) Tow the airplane to the compass swing area (AMM 9-11-00/201).

NOTE: The compass swing area must be a level area with a smooth surface. It must be sufficiently strong to hold the weight of the airplane. The area must be large enough to tow the airplane. Make sure all vehicles other than the tow vehicle are not less than 250 feet from the airplane.

The horizontal component of the earth's magnetic field must be constant (± 1 degree) in the test area. Measure the horizontal component if magnetic material (such as a new building) is less than 600 feet from the compass rose. Do not use the compass rose if the horizontal component is not constant (± 1 degree).

S 862-099

(2) Supply electrical power (AMM 24-22-00/201).

S 862-100

(3) Energize all of the electronic equipment, radios, and control cabin lighting for the usual conditions that occur in flight.

S 862-101

(4) On the P10 panel, set the captain's and first officer's EFIS mode switches to the VOR or ILS position (AMM 34-22-00/201).

S 862-102

(5) Align the IRS to the NAV mode (AMM 34-21-00/201).

S 862-103

CAUTION: USE TOOLS THAT ARE NOT MAGNETIC. MAGNETIC TOOLS CAN CAUSE COMPASS DIFFERENCES.

(6) Make sure that the N-S and E-W adjustment screws on the standby compass are at neutral.

S 862-104

(7) Make sure that one EHSI shows a magnetic heading that is less than 1 degree from the other EHSI.

S 752-105

(8) Make sure all vehicles but the tow truck are not less than 250 feet from the airplane.

F. Standby Compass Adjustment

NOTE: The steps that follow are for the four-point calibration swing:

S 582-106

(1) Turn the airplane to a direction where the captain's EHSI shows a magnetic heading of 0 degree.

S 032-107

(2) Remove and keep the lower left and upper right mounting screws on the standby magnetic compass.

S 482-108

(3) Use the two mounting screws to install the SCC on the face of the standby magnetic compass.

S 822-109

(4) Turn the top and bottom SCC dials to show an indication of E at the index line.

S 972-110

(5) Make a record of the heading shown on the standby magnetic compass.

S 822-111

(6) Turn the top and bottom SCC dials to show an indication of W at the index line.

S 972-112

(7) Make a record of the heading shown on the standby magnetic compass.

S 822-113

(8) Turn the E-W adjustment screw on the standby magnetic compass until the error in the last two recorded values is at a minimum.

NOTE: Divide the error in each of the two directions as equally as possible.

S 822-114

(9) Turn the top and bottom SCC dials to show an indication of N at the index line.

S 972-115

(10) Make a record of the heading shown on the standby magnetic compass.

S 822-125

(11) Turn the top and bottom SCC dials to show an indication of S at the index line.

S 972-116

(12) Make a record of the heading shown on the standby magnetic compass.

S 822-117

(13) Turn the N-S adjustment screw on the standby magnetic compass until the error in the last two recorded values is at a minimum.

NOTE: Divide the error in each of the two directions as equally as possible.

S 822-118

(14) Continue to adjust the SCC dials for each pair of directions (E-W, N-S). Then turn the E-W and N-S adjustment screws until the errors are at a minimum.

NOTE: Continue to do this procedure until the error in each pair of directions is at a minimum. Start with E-W and turn the E-W adjustment screw. Then do N-S and turn the N-S adjustment screw.

When the errors are at a minimum, do the steps that follow for the 12-point accuracy swing:

S 582-119

(15) Adjust the SCC dials to indicate these magnetic headings: 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, and 330 degrees.

S 972-120

(16) Make a record of the magnetic heading (MH) and standby compass heading (CH).

S 972-121

(17) Calculate and make a record of the difference for each 30-degree heading in the steer column on the compass correction card as follows:

$$D = MH - CH$$

NOTE: During these steps, make sure that each difference is less than ± 8 degrees. For CAA certification, each difference must be less than ± 5 degrees.

S 972-122

(18) Make sure the difference between the maximum positive and maximum negative value is 10 degrees or less.

G. Put the Airplane Back to Its Usual Condition

S 862-123

(1) Set the mode selector switch for each IRS to OFF.

S 862-124

(2) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-23-00-002-148

4. Standby Magnetic Compass Light - Removal

A. General

(1) The Standby Magnetic Compass Light is located on the face of the Standby Magnetic Compass, which is located above the center of the left and right windshields.

B. Access

(1) Location Zones
    (a) 211 Flight Compartment - Left
    (b) 212 Flight Compartment - Right

C. Procedure

S 862-150

(1) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
    (a) Circuit Breaker Panel, P11:
        1) 11N2, INSTRUMENT AND PANEL CAPT

S 002-158

(2) Do these steps to remove the standby magnetic compass light:
    (a) Remove the lightholder assembly or lamp cap.
    (b) Remove the light.

TASK 34-23-00-402-149

5. Standby Magnetic Compass Light - Installation

A. References

(1) AMM 24-22-00/201, Control (Supply Power)

B. Procedure

S 862-152

(1) Make sure that this circuit breaker is open:
  (a) Circuit Breaker Panel, P11:
    1) 11N2, INSTRUMENT AND PANEL CAPT

S 402-153

(2) Do these steps to install the standby magnetic compass light:
  (a) Insert the light.
  (b) Install the lightholder assembly or lamp cap on the compass.

S 862-154

(3) Remove the DO-NOT-CLOSE tag and close this circuit breaker:
  (a) Circuit Breaker Panel, P11:
    1) 11N2, INSTRUMENT AND PANEL CAPT

S 862-155

(4) Supply Electrical Power (AMM 24-22-00/201).

S 862-156

(5) Make sure the panel light switch is in the ON position.

S 212-157

(6) Make sure the standby magnetic compass internal lights are on.

STANDBY MAGNETIC COMPASS - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the standby magnetic compass. The second task installs the standby magnetic compass.
   B. The standby magnetic compass is found in the flight compartment in the center of the windshield area.

TASK 34-23-01-004-008

2. Remove the Standby Magnetic Compass (Fig. 401)
   A. References
      (1) 34-23-00/201, Standby Magnetic Compass
   B. Access
      (1) Location Zones
          211/212 Flight Compartment

   C. Procedure

      S 034-001
      (1) Disconnect the electrical cable from the rear of the compass.

      S 034-009

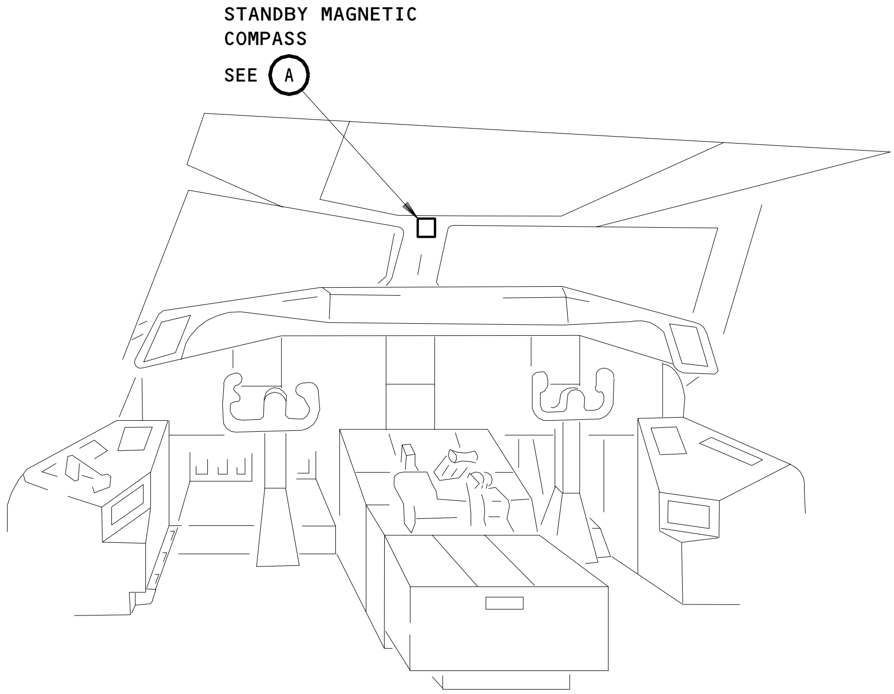
      CAUTION: USE ONLY NONMAGNETIC TOOLS FOR THE REMOVAL/INSTALLATION PROCEDURE. MAGNETIC TOOLS CAN CAUSE DAMAGE TO THE COMPASS.

      (2) Hold the compass in position and remove the screws that hold it to the mounting bracket.

      S 024-003
      (3) Remove the standby magnetic compass.

TASK 34-23-01-404-004

3. Install the Standby Magnetic Compass (Fig. 401)
   A. References
      (1) 34-23-00/201, Standby Magnetic Compass
   B. Access
      (1) Location Zones
          211/212 Flight Compartment



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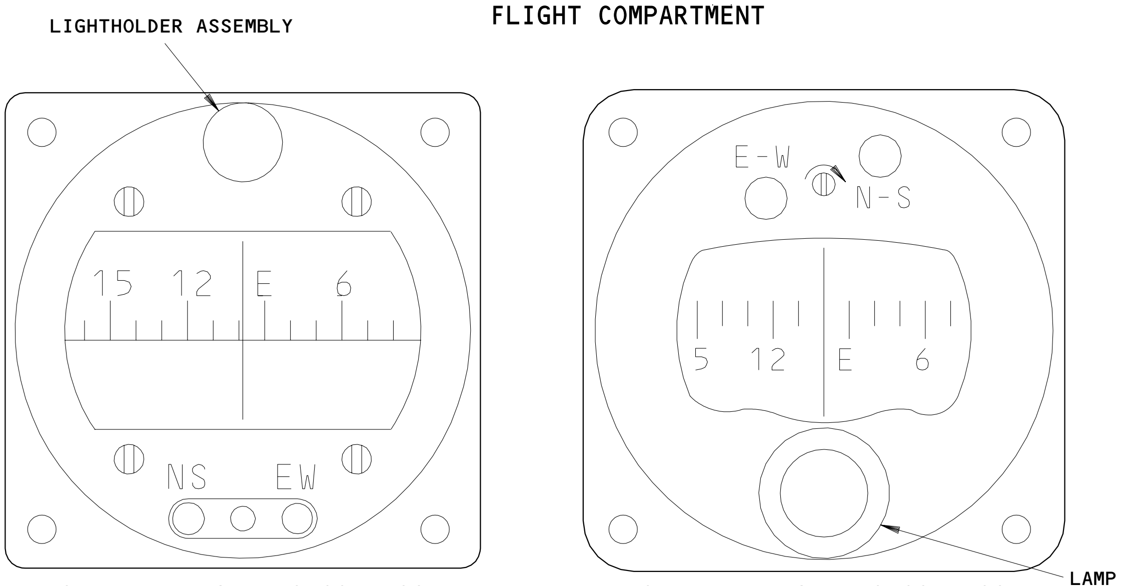


STANDBY MAGNETIC COMPASS
A 1

STANDBY MAGNETIC COMPASS
A 2

1 AIRPLANES WITH STANDBY MAGNETIC COMPASS P/N C-5H
2 AIRPLANES WITH STANDBY MAGNETIC COMPASS P/N C-5M

Standby Magnetic Compass Installation
Figure 401

C. Procedure

S 424-010

CAUTION: USE ONLY NON-MAGNETIC SCREWS TO COMPASS TO PANEL. MAGNETIC SCREWS CAN CAUSE DAMAGE TO THE COMPASS.

(1) Install the compass on the mounting bracket. Use brass screws.

S 864-012

(2) Connect the electrical connector to the rear of the stanby magnetic compass.
   (a) Push the electrical connector until it locks into its position with a click.
   (b) For Airplanes with non-MOD compasses:
   Wind 1 inch wide Scotch No. 24 wire mesh tape around the junction of the electrical connector and standby magnetic compass a minimum of three times.

   NOTE: The tape must touch against the rear of the standby magnetic compass case. Keep sufficient tension on the tape while you wind the junction to make it the shape of the connect. You can use thinner tape, if you wind the connector with a minimum overlap of 50 percent. Wind all parts of the connector within 1 inch of the compass with a minimum of three wrappings.

   (c) Temporarily secure the end of the tape.
   (d) Using a 1 mesh tape a minimum of two times with 1 inch wide Scotch No. 70 or A-A-59163 Type I self fusing silicone rubber tape a minimum of two times.

   NOTE: Keep sufficient tension on the tape while you wind the junction to make it the shape of the connector You can use thinner tape, if you wind the connector with a minimum overlap of 50 percent. Wind all of the wire mesh tape with a minimum of two wrappings of the silicone rubber tape.

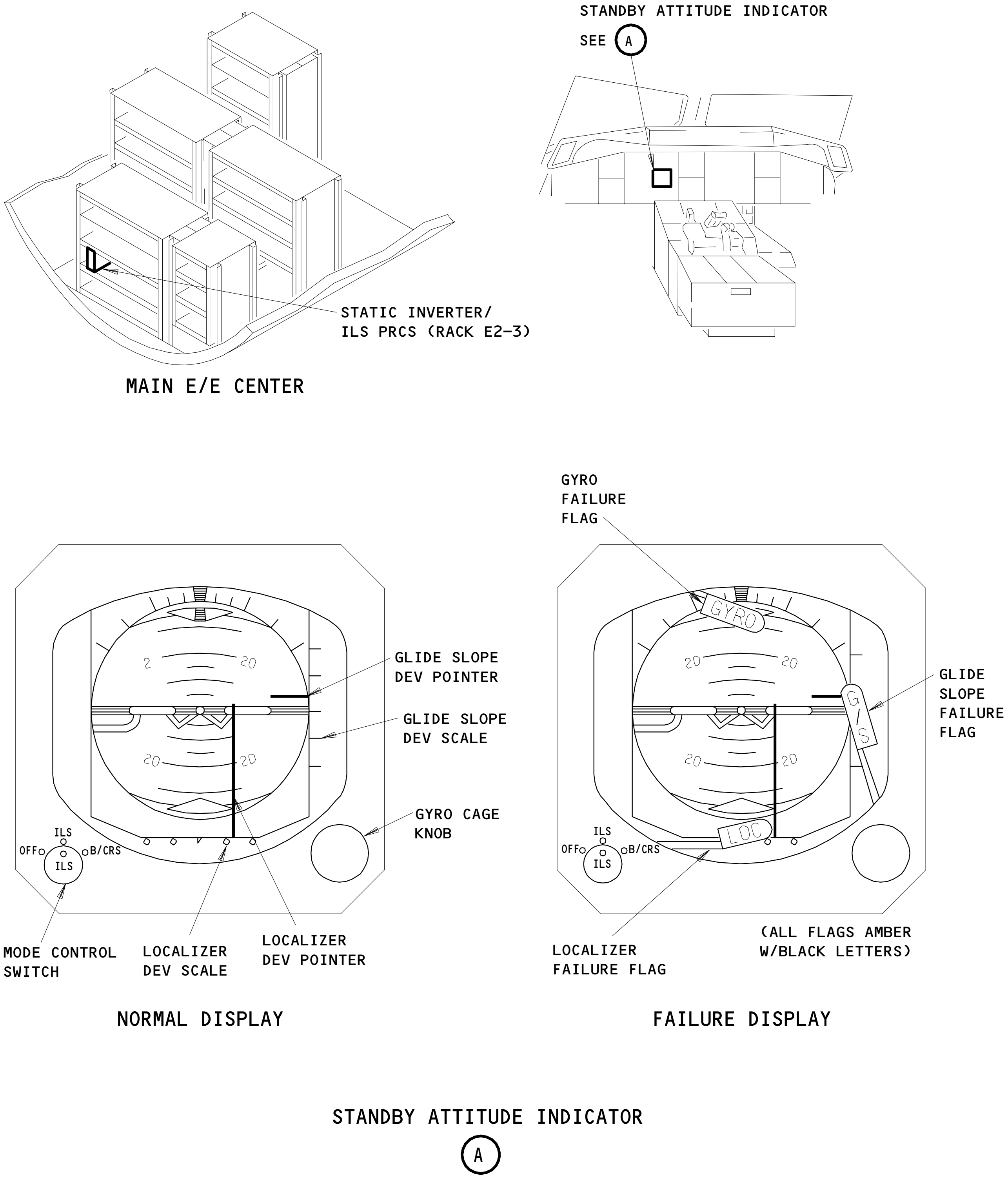
(e) If the connector is removed for any reason, discard all tape and repeat steps a-d above using new tape.

S 864-007

(3) Do the compass calibration procedure (Ref 34-23-00).

STANDBY ATTITUDE REFERENCE SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The standby attitude reference system is a standby navigational aid. It provides a backup display for pitch and roll attitude. The system also displays ILS LOC and G/S deviation. It functions as a backup when the main attitude data source (IRS) or main attitude display (EADI) is inoperative.
   B. The system receives its power from the standby power bus. It receives instrument landing system data from the center ILS/MMR receiver. Attitude display data is generated within the system.
   C. The system includes a standby attitude indicator which contains the attitude and ILS displays. The system also includes a static inverter/ILS processor (PRCS) which provides gyro power and ILS pointer and flag drive voltage to the indicator.
2. Component Detail (Fig. 1)
   A. Standby Attitude Indicator
      (1) The indicator provides the ILS and attitude displays. It is of the conventional mechanical type. The indicator is located on the captain's instrument panel (P1).
      (2) Attitude is provided by a 3-phase vertical gyro suspended in a two degree-of-freedom gimbal system. This system is connected to a drum type roll and pitch attitude display. The system displays approximately 90 degrees variation in climb, 80 degrees of variation in dive, and 360 degrees of variation in roll.
      (3) The gyro system utilizes a spinning ball type device to automatically erect the gyro at turn-on. The caging knob on the front panel is used to mechanically accelerate the erection process. The erection process stabilizes the display drum near the vertical.
      (4) The GYRO fault flag appears when gyro power is lost and during a system test.
      (5) The ILS display consists of the localizer (LOC) and glide slope (G/S) deviation pointers and scales. The pointers indicate deviation from their respective centerline and are driven by the center ILS/MMR receiver (Ref 34-31-00).
      (6) The ILS display is controlled by the rotary mode control switch on its front panel. The switch has three positions which operate as follows:
         (a) OFF - ILS pointers and failure flags (LOC and G/S) retract out of view.
         (b) ILS - ILS operation normal for front course approach
         (c) BCRS - LOC display reversed for back course approaches.



Standby Attitude Reference System - Component Location
Figure 1

(7) The LOC and G/S failure flags come into view for invalid ILS data and/or failures in the standby attitude/ILS system. For no computed data (NCD) conditions, the LOC or G/S deviation pointers and flags are retracted from view.

B. Static inverter/ILS Processor

(1) The static inverter/ILS PRCS provides two functions. The static inverter circuit provides input power to the indicator gyro and control to the gyro fault flag motor. The ILS PRCS circuit uses ILS input data to provide drive for the localizer (LOC) and glideslope (G/S) pointers. The ILS PRCS also provides control for the G/S and LOC fault flag motors. The unit is located in the main elex. equipment center, rack E2.

(2) The static inverter/ILS PRCS has no external adjustments, indicators, or controls.

3. Operation (Fig. 2)

A. Functional Description

(1) Power

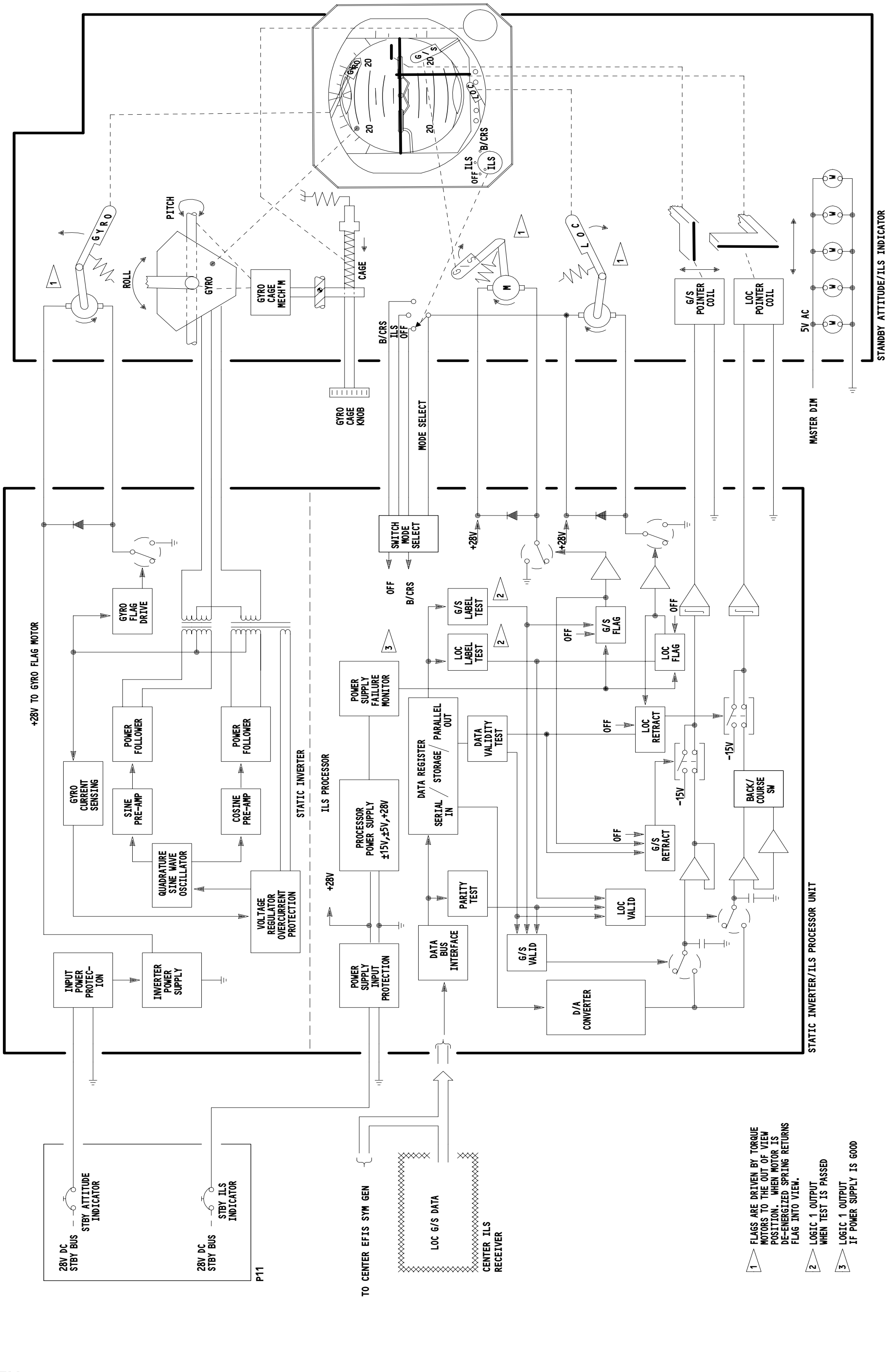
(a) The static inverter/ILS processor receives 28V dc power from the standby power bus. Power to the standby bus is normally supplied by the main dc power. When this power is lost, the standby bus is automatically switched to receive battery power for operation of the system. This same power switching occurs during CAT III Autoland Mode (Ref 24-33-00).

(b) The static inverter converts the 28V dc into 3 phase, 115V ac, 400 Hz power in the power follower network. The static inverter also routes the 28V dc power to the gyro fault flag torque motor for flag operation.

(c) The ILS PRCS power supply produces +28V dc for the LOC and G/S and flag motor operation. It supplies ±15V dc to retract the LOC and G/S pointers. It also supplies voltage for the ILS PRCS internal operation.

(2) Standby Attitude Functions

(a) Both coils of the inverter transformer, supply three phase power to the gyro motor in the indicator. The inverter current sensing circuit, monitors flow in the two transformer coils. Equal coil current flow causes the GYRO flag to be torque out of view. Power loss or an open circuit, in any portion of the gyro power circuit, causes unbalanced coil currents. This unbalance will cause the flag motor to de-energize, allowing a spring to pull the GYRO flag into view.



1 FLAGS ARE DRIVEN BY TORQUE MOTORS TO THE OUT OF VIEW POSITION. WHEN MOTOR IS DE-ENERGIZED SPRING RETURNS FLAG INTO VIEW.

2 LOGIC 1 OUTPUT WHEN TEST IS PASSED

3 LOGIC 1 OUTPUT IF POWER SUPPLY IS GOOD

Standby Attitude Reference System Schematic
Figure 2

27737

(b) When the gyro is turned off, it will assume any position in the gyro mechanism. The display reference marks will not line up with the airplane reference, and the GYRO flag will be in view.

(c) When power is first applied to the gyro, the gyro mechanism precedes causing the drum display to oscillate. The CAGE knob is used to speed up erection and to stabilize the display.

(3) ILS Functions

(a) The OFF mode is selected by placing the indicator switch in the OFF position. In this mode, the mode select circuitry provides gating signals to retract the LOC and G/S pointers and flags. This is the same indication as for no computed data.

(b) When the indicator mode select switch is in the ILS position, the ILS PRCS drives the G/S and LOC pointer for front course approaches.

(c) When the indicator mode select switch is in the BCRS position, the ILS PRCS reverses the polarity of the LOC pointer. The G/S pointer operates as in normal front course approach.

(d) The ILS PROCS circuits receive ARINC 429 digital LOC and G/S data from the center ILS receiver / MMR (Ref 34-31-00). They convert this data into an analog output voltage to drive the LOC and G/S pointers in the indicator. The ILS system also supplies test and fault data (along with the normal data) on the same bus.

(e) In the ILS PROCS the data is first checked for parity. The signal is then converted from serial to parallel data and checked for validity and correct labeling (G/S and LOC). Next, the data is converted to analog data in the D/A converter. If parity, validity and labeling are correct, the analog signals are gated to the G/S and LOC pointer needles in the indicator.

B. BITE

(1) If any of the checks fail on the incoming ILS data, the corresponding G/S or LOC flag will appear. For invalid data, the corresponding pointer will be retracted and flags will be in view. For no computed data (NCD), both the flags and pointers will be retracted out-of-view.

(2) Flag operation is controlled by transistor switches. When there are no faults, the switches are closed completing the circuit. This causes the motors to retract the flags. When a fault occurs, the corresponding switch will open, de-energizing the motor, which allows a spring to pull the flag in view.

(3) If power is lost to the attitude portion of the system, the ATT flag will be pulled into view.

C. Self Test

(1) The self-test for the standby attitude reference system is initiated by pressing the self test button on the center ILS/MMR receiver (Ref 34-31-00). The center ILS receiver / MMR provides test data to the static inverter/ILS PRCS. This causes the following test sequence to appear on the indicator.
    (a) LOC and G/S flags visible for 3 seconds (approx).
    (b) LOC and G/S pointers disappear for 2 seconds (approx).
    (c) Pointers appear at 1 dot UP/LEFT for 3 seconds (approx).
    (d) Pointers move to 1 dot DN/RIGHT position (This takes approximately 2 seconds).
    (e) One dot DN/RIGHT continues until test switch released.

(2) No test is performed on the attitude portion of the display.

D. Control

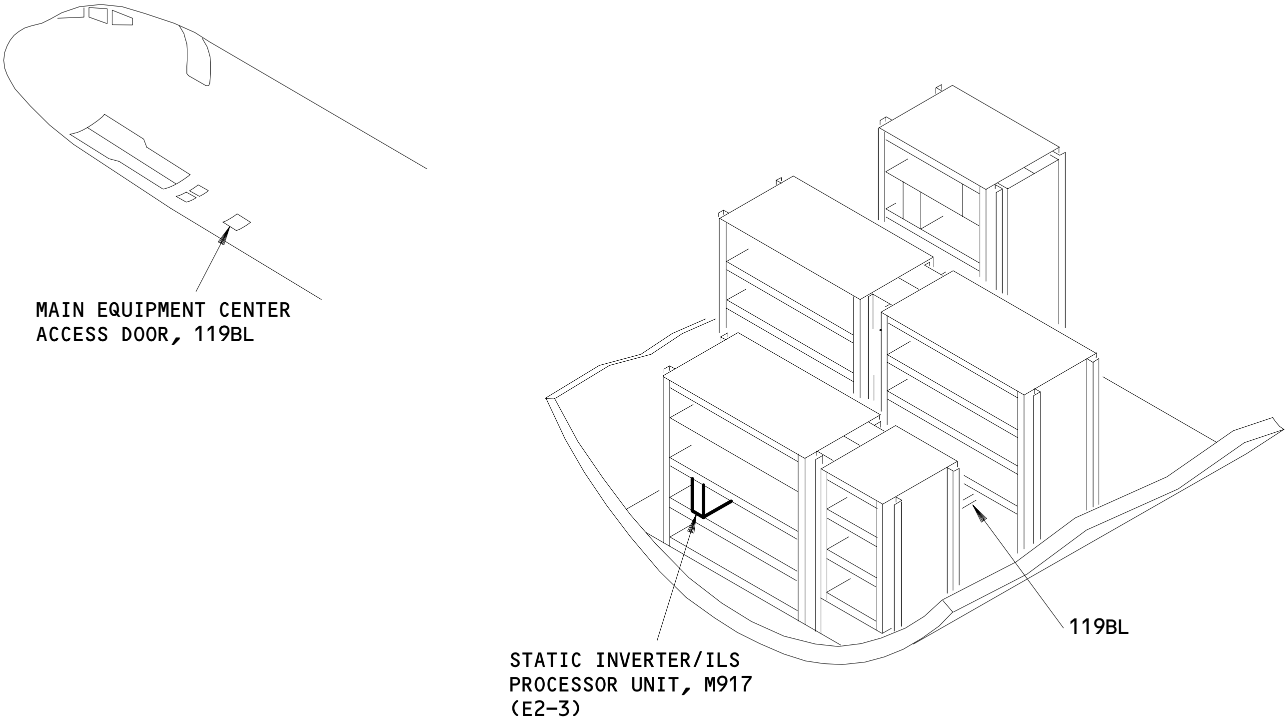
(1) To place the standby attitude reference system in operation, the following steps are required:
    (a) Provide electrical power (Ref 24-22-00).
    (b) Close the following overhead panel P11 circuit breakers:
        1) 11A3, ILS CENTER
        2) 11A5, STBY ATT IND
        3) 11A9, STBY ILS IND
    (c) On standby attitude indicator, place mode switch in ILS.
    (d) Wait 30 seconds, then pull CAGE knob until horizon line is stabilized.
    (e) Gently release CAGE knob.
    (f) Wait six minutes and check that pitch and roll indications are within ± 2 degrees of 0.
    (g) Check that LOC and G/S flags and pointers, are out of view.

STANDBY ATTITUDE REFERENCE SYSTEM

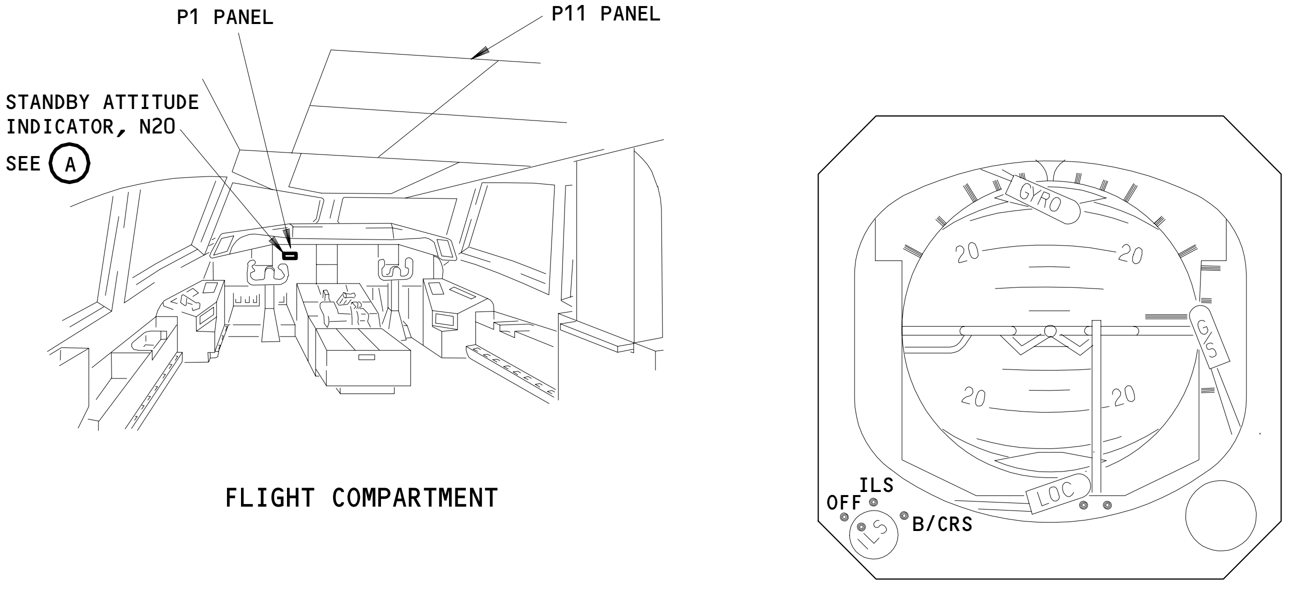
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -	--		FLT COMPT, P11	
STBY ATT IND, C619		1	11A5	*
STBY ILS IND, C604		1	11A9	*
INDICATOR - STANDBY ATTITUDE, N20	--	1	FLT COMPT, P1	34-24-01
UNIT - STATIC INV/ILS PRCS, M917	--	1	119BL, MAIN EQUIP CTR, E2-3	34-24-02

* SEE THE WDM EQUIPMENT LIST

Standby Attitude Reference System - Component Index
Figure 101



MAIN EQUIPMENT CENTER



FLIGHT COMPARTMENT

STANDBY ATTITUDE INDICATOR, N20

A

Standby Attitude Reference System - Component Location
Figure 102

STANDBY ATTITUDE REFERENCE SYSTEM - ADJUSTMENT/TEST

1. General
   - A. This procedure does the operational test for the standby attitude reference system.
   - B. The standby attitude reference system gives standby attitude and standby Instrument Landing System (ILS) displays. The standby attitude part is self-contained. It uses only airplane power for operation. The ILS part receives ILS data from the center ILS receiver. You can do the ILS system adjustment/test at the same time as this test (Ref 34-31-00).

TASK 34-24-00-715-001

2. Operational Test
   - A. Equipment
     - (1) Stopwatch - Commercially Available
   - B. References
     - (1) 24-22-00/201, Electrical Power - Control
     - (2) 34-31-00/501, ILS Navigation System
   - C. Access
     - (1) Location Zones
       211/212 Flight Compartment

   - D. Procedure

     S 865-002
     - (1) Supply electrical power (Ref 24-22-00).

     S 865-003
     - (2) Make sure that these circuit breakers on the overhead circuit breaker panel, P11, are closed:
       - (a) 11A3, ILS CENTER
       - (b) 11A5, STBY ATT IND
       - (c) 11A9, STBY ILS IND

     S 865-004
     - (3) On the standby attitude indicator, set the mode control knob to the ILS position.

     S 755-005
     - (4) After 30 seconds, make sure that the conditions that follow occur if there is no computed data (NCD):
       - (a) The GYRO fault flag goes out of view.

(b) The G/S fault flag goes out of view.
(c) The LOC fault flag goes out of view.
(d) The glide slope deviation pointer goes out of view.
(e) The localizer deviation pointer goes out of view.

NOTE: If the GYRO flag does not retract when power is applied, momentarily pull the caging knob.

S 865-006

(5) On the indicator, pull the caging knob until the horizon line becomes stable, then release it.

S 755-007

(6) After six minutes, make sure that the pitch and roll indications are equal to the airplane attitude ±2 degrees.

S 745-021

(7) Push and release the TEST switch on the ILS control panel.

S 755-009

(8) Make sure the conditions that follow occur on the standby attitude indicator:
   (a) Invalid data shows for three seconds (G/S and LOC flags are in view, G/S and LOC pointers are out of view)
   (b) NCD for two seconds (G/S and LOC pointers and G/S and LOC flags are out of view)
   (c) Localizer deviation pointer moves to one dot left and stays there for three seconds.
   (d) Glide slope deviation pointer moves one dot up and stays there for three seconds.
   (e) Localizer deviation pointer moves one dot right and stays there for three seconds.
   (f) Glide slope deviation pointer moves one dot down and stays there for three seconds.

S 865-010

(9) Set the mode select knob in the B/CRS position.

S 745-022

(10) Push and release the TEST switch on the ILS control panel.

S 755-012

(11) Make sure the conditions that follow occur on the standby attitude indicator.
  - (a) Invalid data shows for three seconds (G/S and LOC flags are in view, G/S and LOC pointers are out of view)
  - (b) NCD for two seconds (G/S and LOC pointers, and G/S and LOC flags are out of view)
  - (c) Localizer deviation pointer moves to one dot right and stays there for three seconds.
  - (d) Glide slope deviation pointer moves one dot up and stays there for three seconds.
  - (e) Localizer deviation pointer moves one dot left and stays there for three seconds.
  - (f) Glide slope deviation pointer moves one dot down and stays there for three seconds.

E. Put the Airplane Back to Its Usual Condition

S 865-015

(1) Set the mode select switch to the OFF position.

S 755-018

(2) Make sure that the GYRO, G/S, and LOC flags do not show.

S 865-017

(3) Remove electrical power if it is not necessary (Ref 24-22-00).

STANDBY ATTITUDE INDICATOR - REMOVAL/INSTALLATION

1. General
    A. This procedure has two tasks. The first task removes the Standby Attitude Indicator. The second task installs the Standby Attitude Indicator.
    B. One Standby Attitude Indicator, N20, is installed on the pilot's main instrument panel.

TASK 34-24-01-004-001

2. Remove the Standby Attitude Indicator
    A. References
        (1) AMM 24-22-00/201, Electrical Power - Control
    B. Access
        (1) Location Zones
            211/212 Flight Compartment

    C. Procedure

S 864-002

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
    (a) 11A5, STBY ATT IND
    (b) 11A9, STBY ILS IND

S 864-003

(2) After 3 minutes, continue. (The gyro will run down during this time.)

S 864-019

CAUTION: INSTALL A DEVICE TO LOCK THE KNOB IN A CAGED POSITION. THIS CAN PREVENT DAMAGE TO THE GYRO WHEN THE INDICATOR IS MOVED.

(3) Pull the cage knob and install a device to lock it in a caged position.

S 034-005

(4) Loosen the screws on the front panel adjacent to the indicator.

S 024-016

(5) Pull the indicator out of the instrument panel.

NOTE: Make sure the shim stays bonded to the forward panel, P1-3.

S 034-007

(6) Disconnect the electrical cable from the indicator.

S 864-018

(7) Put the indicator on a level, soft surface.

TASK 34-24-01-404-008

3. Install the Standby Attitude Indicator

A. References
   (1) AMM 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones

211/212	Flight Compartment

C. Procedure

S 864-009

(1) Make sure that these circuit breakers on the P11 panels are open:
   (a) 11A5, STBY ATT IND
   (b) 11A9, STBY ILS IND

S 434-010

(2) Connect the electrical cable to the indicator.

NOTE: Make sure the shim stays bonded to the forward panel, P1-3.

S 424-011

(3) Push the indicator into the instrument panel and tighten the screws on the front panel adjacent to the indicator.

S 434-012

(4) Remove the device which locks the cage knob in a caged position.

S 864-013

(5) Supply electrical power (AMM 24-22-00/201).

S 864-014

(6) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) 11A5, STBY ATT IND
   (b) 11A9, STBY ILS IND

S 864-015

(7) Make sure that the panel lights on the standby attitude indicator come on.

S 864-024

(8) Do the Standby Attitude Reference System - Operational Test (AMM 34-24-00/501).

D. Put the Airplane Back to Its Usual Condition

S 864-017

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

STATIC INVERTER/ILS PROCESSOR - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the Static Inverter/Instrument Landing System (ILS) processor. The second task installs it.
   B. The static inverter/ILS processor is found on rack E3-3 in the main equipment center. All of the electrical connections are made in the rear of the unit.

TASK 34-24-02-004-011

2. Remove the Static Inverter/ILS Processor
   A. References
      (1) 20-10-01/401, E/E Rack-Mounted Components
      (2) 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones

119/120	Main Equipment Center

      (2) Access Panel

119BL	Main Equipment Center

   C. Procedure

S 864-013

CAUTION: DO NOT MOVE THE STATIC INVERTER/ILS PROCESSOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE STATIC INVERTER/ILS PROCESSOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 864-001

(2) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11A5, STBY ATT IND
   (b) 11A9, STBY ILS IND

S 024-002

(3) Remove the Static Inverter/ILS Processor (Ref 20-10-01).

TASK 34-24-02-404-003

3. Install the Static Inverter/ILS Processor
   A. References
      (1) 20-10-01/401, E/E Rack Mounted Components
      (2) 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

119/120 Main Equipment Center

(2) Access Panel

119BL Main Equipment Center

C. Procedure

S 864-014

<u>CAUTION</u>: DO NOT MOVE THE STATIC INVERTER/ILS PROCESSOR BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE STATIC INVERTER/ILS PROCESSOR.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 864-004

(2) Make sure that these circuit breakers on the P11 panel are open:
  (a) 11A5, STBY ATT IND
  (b) 11A9, STBY ILS IND

S 424-005

(3) Install the Static Inverter/ILS Processor.

S 864-006

(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11A5, STBY ATT IND
  (b) 11A9, STBY ILS IND

D. Static Inverter/ILS Processor Test

S 864-007

(1) Supply electrical power (Ref 24-22-00).

S 864-008

(2) On the aft electronics panel, P8, push and release the TEST switch on the ILS control panel.

S 754-012

(3) On the standby attitude indicator, make sure that the sequence that follows occurs:
  (a) LOC and G/S flags are in view for three seconds.
  (b) LOC and G/S pointers go out of view for two seconds.
  (c) Localizer deviation pointer moves to one dot left and stays there for three seconds.

(d) Glide slope deviation pointer moves one dot up and stays there for three seconds.

(e) Localizer deviation pointer moves one dot right and stays there for three seconds.

(f) Glide slope deviation pointer moves one dot down and stays there for three seconds.

E. Put the Airplane Back to Its Usual Condition

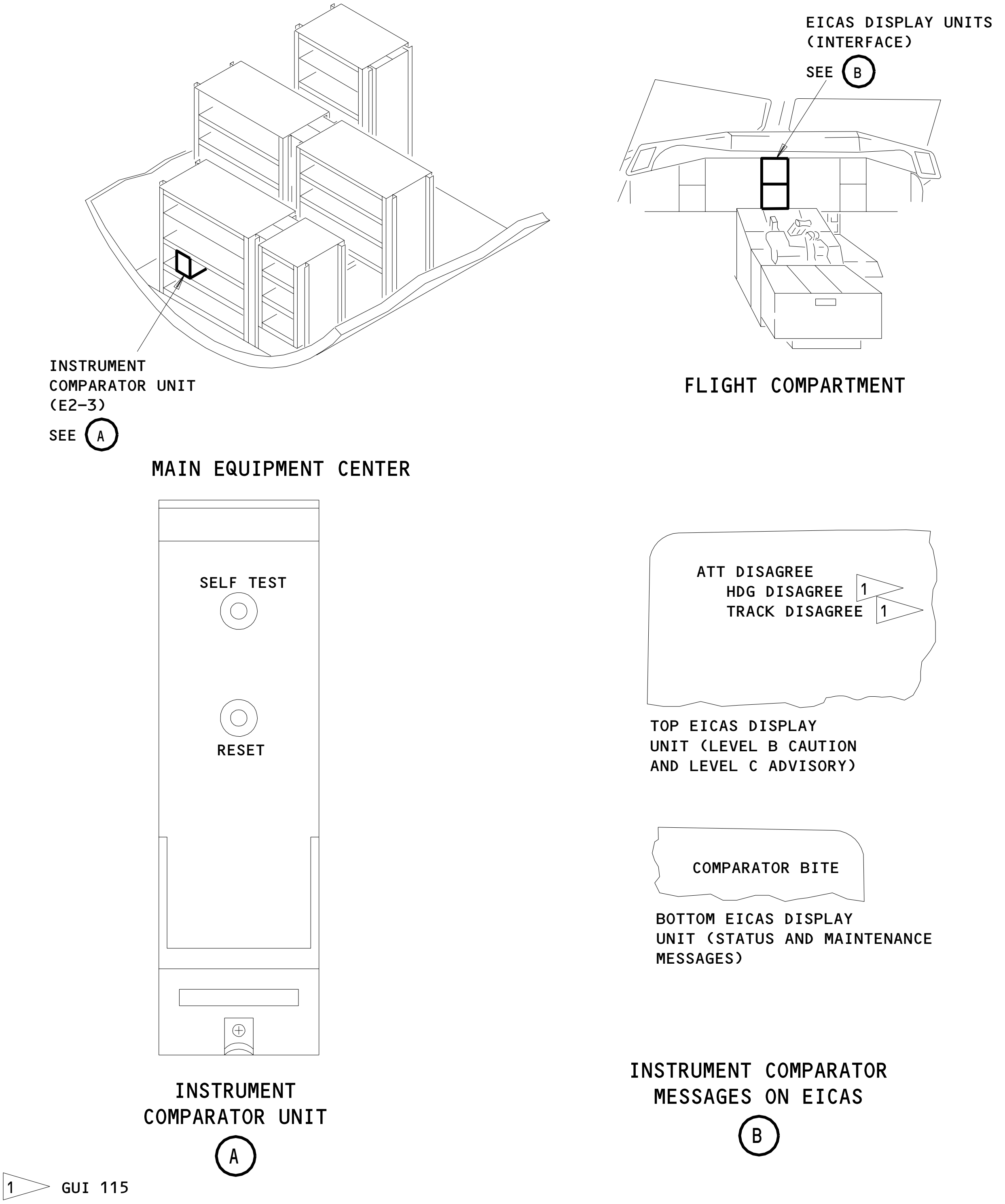
S 864-009

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

INSTRUMENT COMPARISON SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The instrument comparison system monitors and compares the serial data outputs of the two on line electronic flight instrument system (EFIS) symbol generators. Detected faults are sent to the engine indicating and crew alerting system (EICAS) for display.
2. Component Detail (Fig. 1)
   A. Instrument Comparator Unit
      (1) The system includes one instrument comparator unit (ICU) located in the main equipment center rack E2. The instrument comparator unit's front panel has two switches. The SELF TEST switch is used to initiate an end-to-end self-test of the unit. The RESET switch, when pushed, disables all fault monitoring circuits in the unit. In addition, any fault outputs are reset to a no fault condition until the switch is released.
      (2) Any detected faults are shown on the EICAS displays (Ref 31-41-00) as a level B caution or level C advisory. These messages will be shown when their applicable fault is detected:

SYSTEM FAULT	LEVEL	EICAS MESSAGE
GUI 115; Instrument comparator unit senses left and right Heading disagreement	C	HDG DISAGREE
GUI 115; Instrument comparator unit senses left and right Track disagreement	C	TRACK DISAGREE
Instrument comparator unit senses left and right Attitude disagreement	B	ATT DISAGREE
Instrument Comparator Unit (ICU) self-detected fault	S,M	COMPARATOR BITE



Instrument Comparison System - Component Location
Figure 1

(3) These messages are only shown during the BITE procedure:

SYSTEM FAULT	LEVEL	EICAS MESSAGE
Instrument comparator unit senses Invalid Heading data	C	HDG FAIL
Instrument comparator unit senses Invalid Track data	C	TRACK FAIL
Instrument comparator unit senses Invalid Attitude Data	C	ATT FAIL
Instrument comparator unit senses invalid flight Director Command data	C	FD COMMAND FAIL
Instrument comparator unit senses invalid Fast/Slow Command data	C	FAST/SLOW FAIL
GUI 001-114, 116-999; Instrument comparator unit senses left and right Heading disagreement	C	HDG DISAGREE
GUI 001-114, 116-999; Instrument comparator unit senses left and right Track disagreement	C	TRACK DISAGREE
Instrument comparator unit senses invalid Glide Slope data	C	G/S FAIL
Instrument comparator unit senses invalid localizer data	C	LOC FAIL
Instrument comparator unit senses left and right Glide Slope disagreement	C	G/S DISAGREE

Instrument comparator unit senses left and right Localizer disagreement	C	LOC DISAGREE
Instrument comparator unit senses left and right Radio Altitude disagreement	C	RA DISAGREE

3. Operation (Fig. 2)

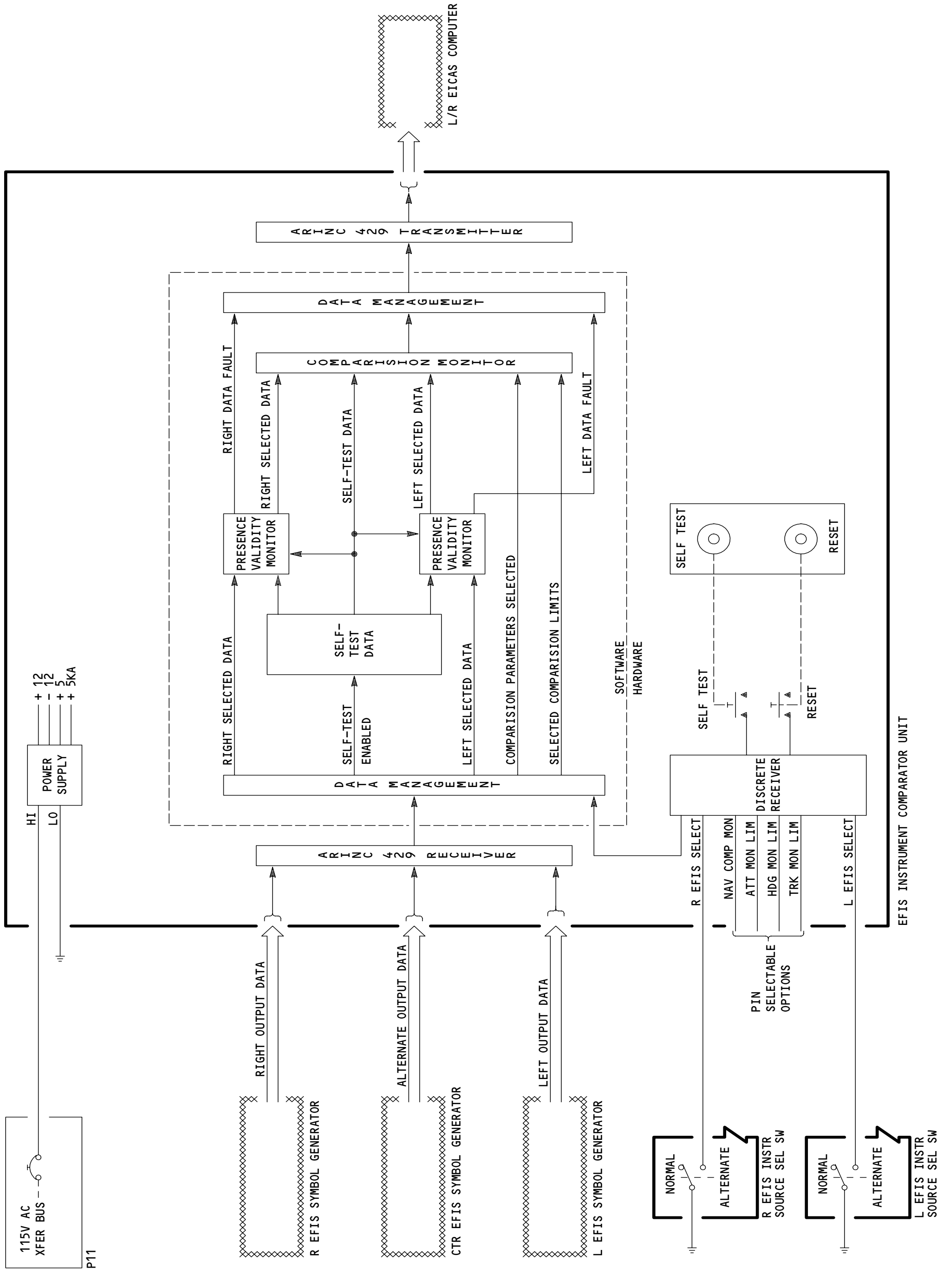
A. Functional Description

(1) The ICU receives 115 Vac from the instrument transfer bus. ICU internal power supply converts this to various DC voltages for system operation. Normally, the instrument transfer bus acquires power from the left main AC bus. In the event of a left system power failure, the instrument transfer bus will automatically switch to the right main AC bus.

(2) The ICU receives digital data on an ARINC 429 data bus from each EFIS symbol generator (3). However, it only checks the data from the two symbol generators which have been selected by the left and right EFI switches on the instrument source select panels.

(3) The ICU receives analog discrete data from the program pins and the EFI switches. The open/ground arrangement of the program pins determine what digital parameters from EFIS the ICU will check. The NORM/ALTN selection of the EFI switches determines which EFIS buses will be checked. When the left and right switches are in the NORM position, the left and right symbol generators' data is checked. If the left EFI switch is in the ALTN position and right EFI switch is in the NORM position, the right and center buses will be checked, and visa versa. If the left and right switches are in the ALT position, comparison monitoring is disabled.

(4) The ICU performs two basic operations. It compares data from the two buses to ensure that related parameters are within tolerance. It also checks the data for validity and presence. If the ICU receives a failure warning sign status matrix, parity errors, no data received, unreasonable data, open circuit, or a shorted or grounded bus; it sends an input FAIL message to EICAS. If two associated input parameters (ex. left and right ATT) deviate from each other by a predetermined amount, the ICU will send an input DISAGREE message to EICAS. If both a FAIL and DISAGREE condition exist, the ICU will send a FAIL message to EICAS.



Instrument Comparison System - Schematic
Figure 2

(5) Due to the program pin arrangement, the ICU will check the following data and provide the associated EICAS message when a fault is detected:

- (a) The ICU continuously monitors selected pitch and roll attitude data. A monitor limit of 3.0 degrees is set by the grounding of the ATT MON LIM program pin. A monitor limit of 5.0 degrees is set by not grounding the ATT MON LIM program pin. If either the two pitch or two roll attitude values deviate by more than the monitor limit (for more than 0.75 ± 0.10 seconds), a fault condition will exist. This will be displayed on EICAS as an ATT DISAGREE message.
- (b) GUI 115;
  the ICU continuously monitors selected heading data due to the grounding of the NAV COMP MONITOR program pin. The monitor limit of 4.0 degrees is set by the grounding of the HDG MON LIM program pin. If either of the two heading values deviate by more than 4.0 degrees (for more than 0.75 ± 0.10 seconds), a fault condition will exist. This will be displayed on EICAS as a HDG DISAGREE message.
- (c) GUI 115;
  the ICU continuously monitors selected track data due to the grounding of the NAV COMP MONITOR program pin. The monitor limit of 6.0 degrees is set by the grounding of the TRK MON LIM program pin. If either of the two track values deviate by more than 6.0 degrees (for more than 0.75 ± 0.10 seconds), a fault condition will exist. This will be displayed on EICAS as a TRK DISAGREE message.

B. BITE and Self-Test

(1) The ICU continuously monitors itself for internal failures. The monitored circuits include the following:

- (a) Input and output digital data circuits.
- (b) Processor activity.
- (c) Memory checksum circuits.
- (d) Power supply circuits.

(2) Failure of a monitored circuit results in the ICU sending an ICU fault output to the EICAS which will display the status/maintenance message COMPARATOR BITE. In addition all data fault/comparison monitoring will be inhibited until the fault condition is removed.

(3) A system self test is initiated by pressing the SELF TEST switch on the front of the ICU. This causes an end-to-end self-test of the ICU and all FAIL and DISAGREE messages to be displayed on EICAS until the SELF TEST switch is released.

C. Control

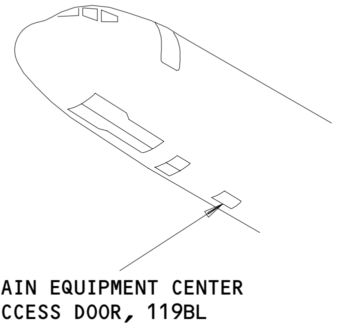
(1) The system is initialized by closing the EFIS INSTR COMPTR circuit breaker on the P11 panel.

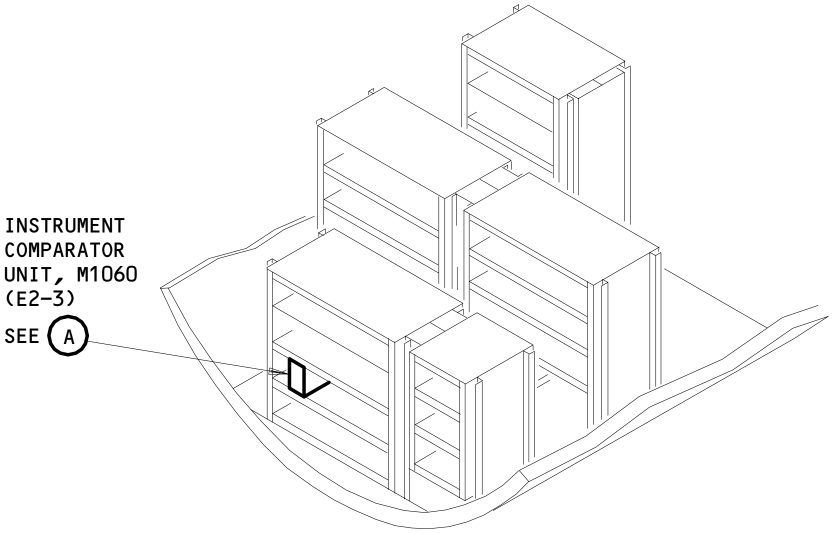
INSTRUMENT COMPARISON SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER - EFIS INSTR COMPTR		1	FLIGHT COMPARTMENT, P11 11F10	*
SWITCH - (FIM 34-22-00/101) LEFT EFIS, S3 RIGHT EFIS, S11				
UNIT - INSTRUMENT COMPARATOR, M1060		1	119BL, MAIN EQUIP CTR, E2-3	34-25-01

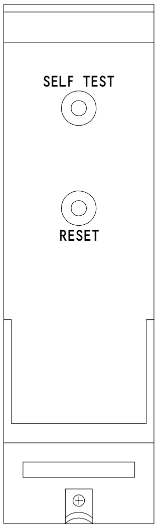
* SEE THE WDM EQUIPMENT LIST

Instrument Comparison System - Component Index
Figure 101





MAIN EQUIPMENT CENTER



INSTRUMENT COMPARATOR
UNIT, M1060

A

Instrument Comparison System - Component Location
Figure 102

INSTRUMENT COMPARISON SYSTEM - ADJUSTMENT/TEST

TASK 34-25-00-715-001

1. Operational Test - Instrument Comparison System

A. General

(1) This procedure is an operational test of the instrument comparison system. No test equipment is necessary.

(2) The Instrument Comparator Unit (ICU) supplies data comparison for data received by the Electronic Flight Instrument System (EFIS). The program pins on the rear of the unit set the compared data and its limits. If the data is more than the limits, a failure message will be shown by the Engine Indicating and Crew Alerting System (EICAS).

B. References

(1) 24-22-00/201, Electrical Power - Control

C. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

D. Prepare for the Operational Test

S 865-002

(1) Supply electrical power (Ref 24-22-00).

S 865-003

(2) Make sure these circuit breakers on the main power distribution panel, P6, are closed:

(a) 6D3, IRS L
(b) 6D4, IRS C
(c) 6D5, IRS R

S 865-004

(3) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:

(a) GUI 001-114, 116-999;
11A7, EFIS DSPL SW LEFT

(b) GUI 115;
11C4, EFIS DSPL SW LEFT
(c) 11E3, ADI LEFT
(d) 11E4, EFIS CONT PNL LEFT
(e) 11E6, HSI LEFT
(f) 11E24, ADI RIGHT
(g) 11E25, EFIS CONT PNL RIGHT
(h) 11E27, HSI RIGHT
(i) 11F1, IRS LEFT
(j) 11F8, EFIS SYM GEN LEFT
(k) 11F9, EFIS SYM GEN CENTER
(l) 11F21, IRS CENTER
(m) 11F22, IRS RIGHT
(n) 11F24, EFIS DSPL SW RIGHT
(o) 11F29, EFIS SYM GEN RIGHT
(p) (6 locations), EICAS

S 865-005

(4) Set the L, R, and C mode select switches on the mode control panel for the Inertial Reference System (IRMP) to the ALIGN position.

E. Procedure

S 865-006

(1) Open this circuit breaker on the P11 panel:
(a) 11F10, EFIS INSTR COMPARATOR

S 865-007

(2) On the EICAS MAINT panel, push the ECS/MSG switch.

S 755-008

(3) Make sure the EICAS message, COMPARATOR BITE, shows on the bottom display.

S 865-009

(4) Close this circuit breaker on the P11 panel:
(a) 11F10, EFIS INSTR COMPARATOR

S 755-015

(5) Make sure the EICAS message, COMPARATOR BITE, does not show.

S 865-016

(6) Push the RESET switch on the ICU.

S 745-017

(7) Push and hold the TEST switch on the ICU.

S 755-020

(8) Make sure these EICAS messages show on the top display:
(a) G/S FAIL (Level C)
(b) LOC FAIL (Level C)
(c) G/S DISAGREE (Level C)

(d) LOC DISAGREE (Level C)
(e) HDG FAIL (Level C)
(f) TRACK FAIL (Level C)
(g) ATT FAIL (Level C)
(h) FD COMMAND FAIL (Level C)
(i) FAST/SLOW FAIL (Level C)
(j) HDG DISAGREE (Level C)
(k) TRACK DISAGREE (Level C)
(l) ATT DISAGREE (Level B)
(m) RA DISAGREE (Level C)

S 745-019
(9) Release the TEST switch on the ICU.

S 755-043
(10) Make sure the Level B and C messages do not show on the top EICAS display.

S 745-021
(11) On the left EFIS symbol generator and the right inertial reference unit (IRU), push and hold the TEST switches.

S 755-022
(12) Make sure the EICAS message, ATT DISAGREE, shows on the top display.

S 745-023
(13) Release the TEST switches on the left EFIS symbol generator and the right IRU.

S 755-024
(14) Make sure the EICAS message, ATT DISAGREE, does not show.

S 865-025
(15) Set the right EFI switch on the instrument source select panel to the ALTN position.

S 865-026
(16) Open this circuit breaker on the P11 panel:
(a) 11F29, EFIS SYM GEN RIGHT

S 745-028
(17) On the left IRU and the center EFIS symbol generator, push and hold the TEST switches.

S 755-029
(18) Make sure the EICAS message, ATT DISAGREE, shows on the top display.

S 745-030
(19) Release the TEST switches on the left IRU and the center EFIS symbol generator.

S 755-031

(20) Make sure the EICAS message, ATT DISAGREE, does not show.

S 755-037

(21) Make sure the EICAS message, COMPARATOR BITE, does not show.

S 755-027

(22) Make sure no instrument comparator messages are shown on the top EICAS display.

F. Put the Airplane Back to Its Usual Condition

S 865-038

(1) Close this circuit breaker on the P11 panel:
    (a) 11F29, EFIS SYM GEN RIGHT

S 865-039

(2) Set the right EFI switch on the instrument source select panel to the NORM position.

S 865-040

(3) Push the RESET switch on the ICU.

S 865-041

(4) On the IRMP, set the L, R, and C mode select switches to the OFF position.

S 865-042

(5) Remove electrical power if it is not necessary (Ref 24-22-00).

INSTRUMENT COMPARATOR UNIT (ICU) - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ICU; the other is the installation of the ICU.
   B. The ICU, M1060, is installed on the E2-3 rack in the main equipment center.

TASK 34-25-01-004-001

2. Remove the Instrument Comparator Unit
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components
      (2) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
   B. Access
      (1) Location Zones
         119/120 Main Equipment Center

   C. Procedure

      S 864-002
      (1) Open this circuit breaker on the overhead circuit breaker panel, P11, and attach a DO-NOT-CLOSE tag:
         (a) 11F10, EFIS INSTR COMPARATOR

      S 864-003

CAUTION: DO NOT TOUCH THE INSTRUMENT COMPARATOR UNIT BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE INSTRUMENT COMPARATOR UNIT.

      (2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

      S 024-004
      (3) Remove the instrument comparator unit (AMM 20-10-01/401).

TASK 34-25-01-404-022

3. Install the Instrument Comparator Unit
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components

(2) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
(3) AMM 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

C. Procedure

S 864-005

(1) Make sure this circuit breaker on the P11 panel is open:
(a) 11F10, EFIS INSTR COMPARATOR

S 864-006

CAUTION: DO NOT TOUCH THE INSTRUMENT COMPARATOR UNIT BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE INSTRUMENT COMPARATOR UNIT.

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 214-007

(3) Make sure the connectors on the unit and the rack are not loose, dirty, or broken.

S 424-008

(4) Install the instrument comparator unit (AMM 20-10-01/401).

S 864-009

(5) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
(a) 11F10, EFIS INSTR COMPARATOR

D. ICU Test

S 864-010

(1) Supply electrical power (AMM 24-22-00/201).

S 864-011

(2) Make sure these circuit breakers on the P11 panel are closed:
  (a) (6 locations), EICAS

S 864-012

(3) Push the RESET switch on the ICU.

S 744-013

(4) Push and hold the TEST switch on the ICU.

S 754-014

(5) Make sure these EICAS messages show on the top display:
  (a) G/S FAIL (Level C)
  (b) LOC FAIL (Level C)
  (c) G/S DISAGREE (Level C)
  (d) LOC DISAGREE (Level C)
  (e) HDG FAIL (Level C)
  (f) TRACK FAIL (Level C)
  (g) ATT FAIL (Level C)
  (h) FD COMMAND FAIL (Level C)
  (i) FAST/SLOW FAIL (Level C)
  (j) HDG DISAGREE (Level C)
  (k) TRACK DISAGREE (Level C)
  (l) ATT DISAGREE (Level B)
  (m) RA DISAGREE (Level C)

S 754-023

(6) Make sure this EICAS message shows on the bottom display:
  (a) COMPARATOR BITE (Status/Maint)

S 744-015

(7) Release the TEST switch on the ICU.

S 754-019

(8) Make sure all the EICAS messages do not show on the displays.

S 864-020

(9) Push the RESET switch on the ICU.

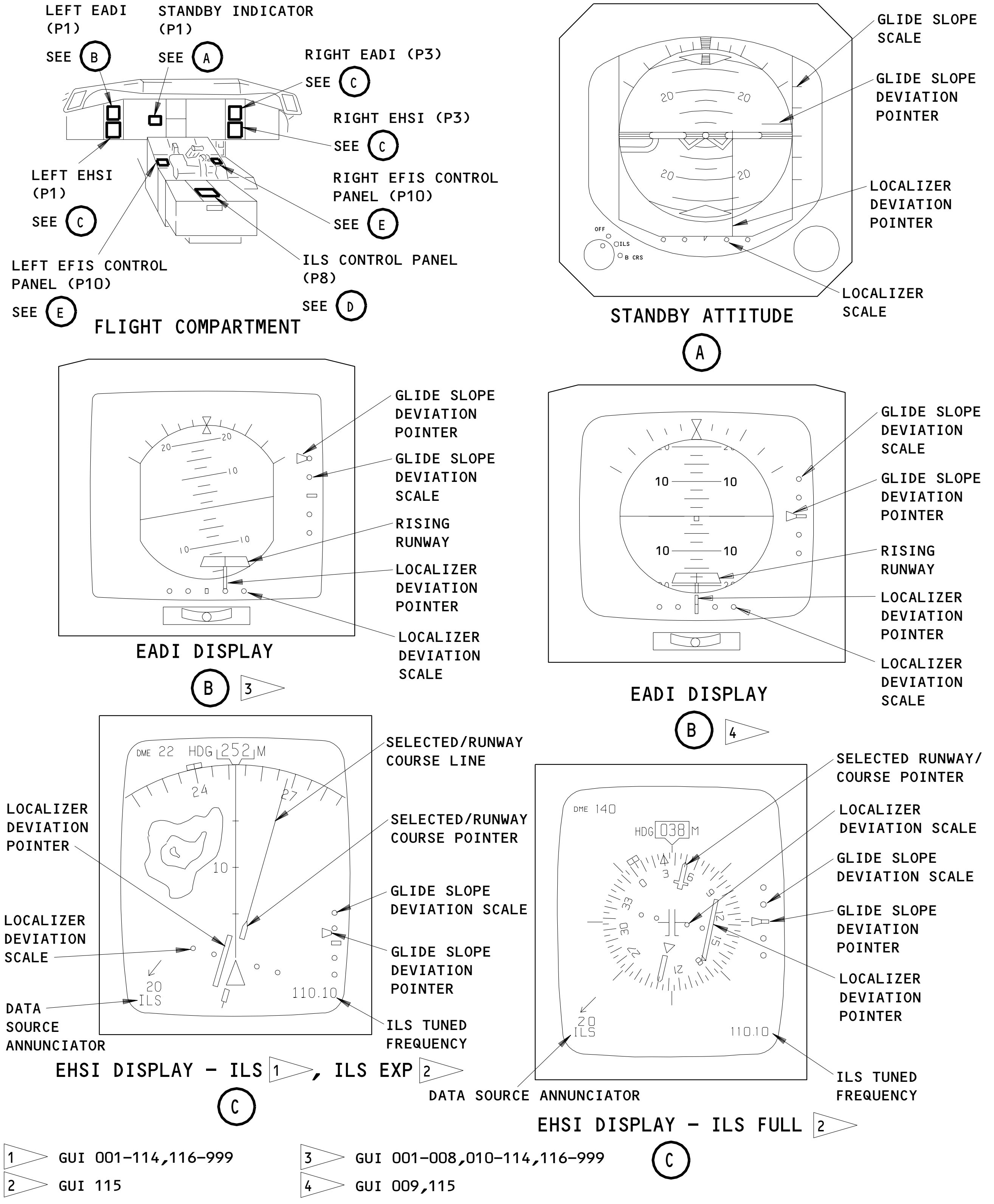
E. Put the Airplane Back to Its Usual Condition

S 864-021

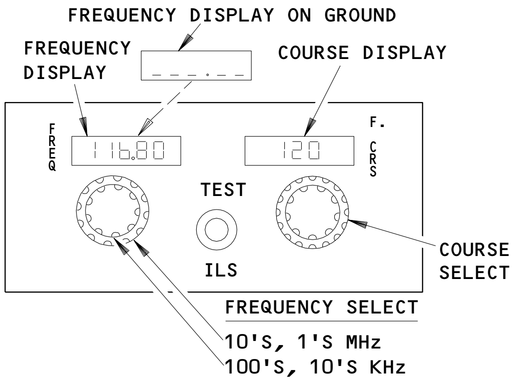
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

INSTRUMENT LANDING SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The instrument landing system (ILS) is a navigational aid. The ILS provides position data of the airplane for landing approaches. It is designed to receive and process localizer and glideslope information. The system outputs this data to interfacing systems for display and navigational use.
   B. Three instrument landing systems are installed and are designated as left, right and center systems. Each system consists of a receiver, a glideslope antenna, and a localizer antenna. One control panel serves all three systems. The left system normally provides information to the captain's EFIS instruments. The right system provides input to the first officer's EFIS instruments. The center system provides inputs to the standby attitude reference system for display on the standby attitude indicator. It also provides input to the center EFIS system for left or right ILS system backup. The EFI instrument source select switch (Ref 34-22-00) is used to select the center EFIS SG as a backup. This is done in the event of a malfunction.
   C. ILS output deviation is displayed on the captain's and first officer's EHSIs and EADIs as well as on the standby attitude display. The system also provides an aural ground station identification output to the flight interphone system. ILS outputs are supplied to the flight control computer (FCC) for control of the airplane during automatic landing (AUTOLAND) (Ref Chapter 22). Outputs are also provided to the ground proximity (GND PROX) warning (AMM 34-46-00) and flight management (FMC) computers (Ref 34-61-00).
   D. AIRPLANES WITH ILS/DFDAU INTERFACE;
      ILS outputs are provided to the digital flight data acquisition unit (AMM 31-31-00).
2. Component Details (Fig. 1)
   A. ILS Antenna
      (1) The system uses two dual channel G/S antennas and two dual channel LOC antennas. Both the top G/S and LOC dual antennas receive signals for the center ILS or multi-mode receiver. One channel of this antenna is not used. The bottom G/S and LOC dual antennas receive signals for the left and right system.
      (2) The antennas are located on the forward pressure bulkhead within the radome. One dual loop LOC antenna is located above and one below the weather radar antenna. The two dual loop G/S antennas are located beneath the lower LOC antenna.
   B. G/S Director Element
      (1) The G/S director element is used to alter the glide slope radiation antenna patterns such that the ILS or multi-mode receivers have maximum glide slope sensitivity.

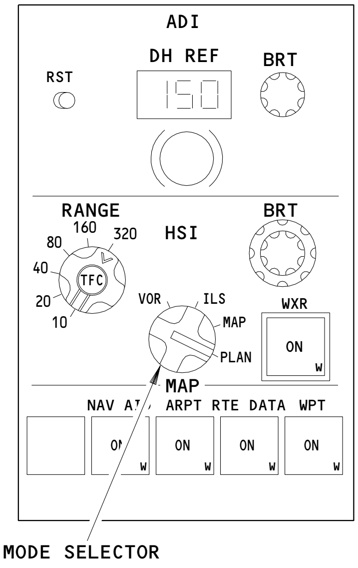


ILS Components
Figure 1 (Sheet 1)



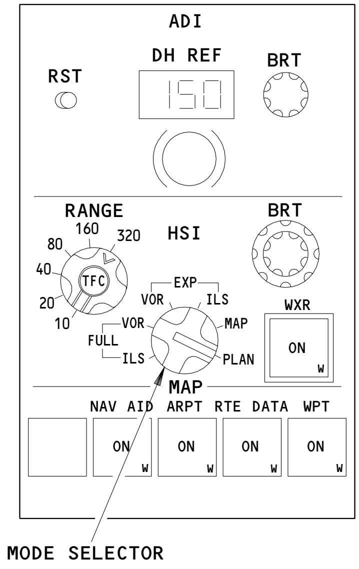
ILS CONTROL PANEL

D



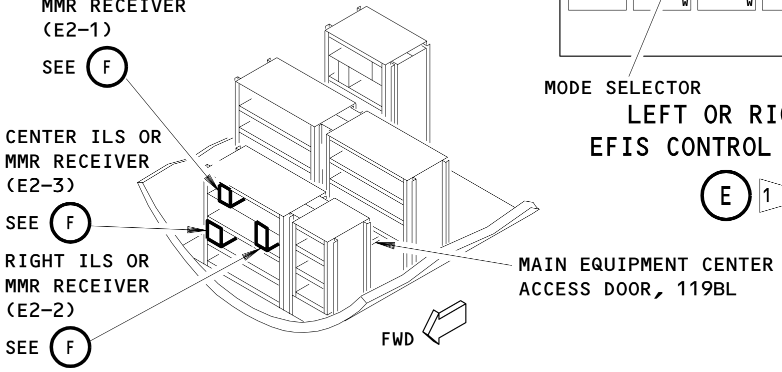
LEFT OR RIGHT EFIS CONTROL PANEL

E 1



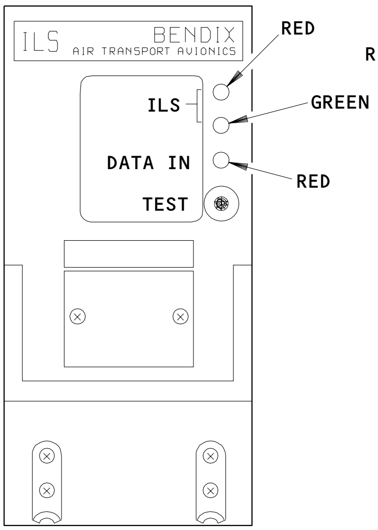
LEFT OR RIGHT EFIS CONTROL PANEL

E 2



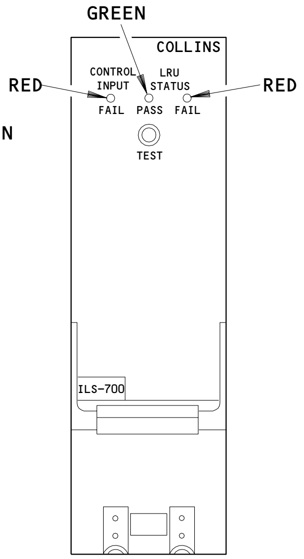
MAIN EQUIPMENT CENTER

1 GUI 001, 009, 115
2 GUI 002-008, 010-114, 116-999
3 GUI 115 POST-SB 34-0400



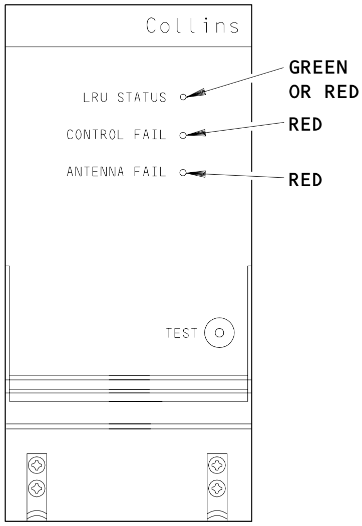
LEFT, RIGHT OR CENTER ILS RECEIVER

F 1



LEFT, RIGHT OR CENTER ILS RECEIVER

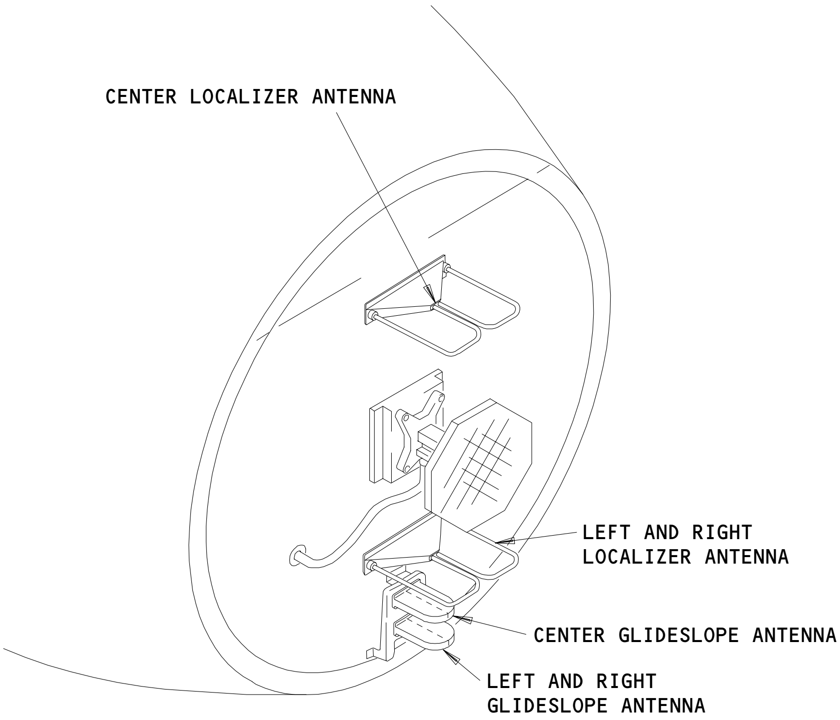
F 2



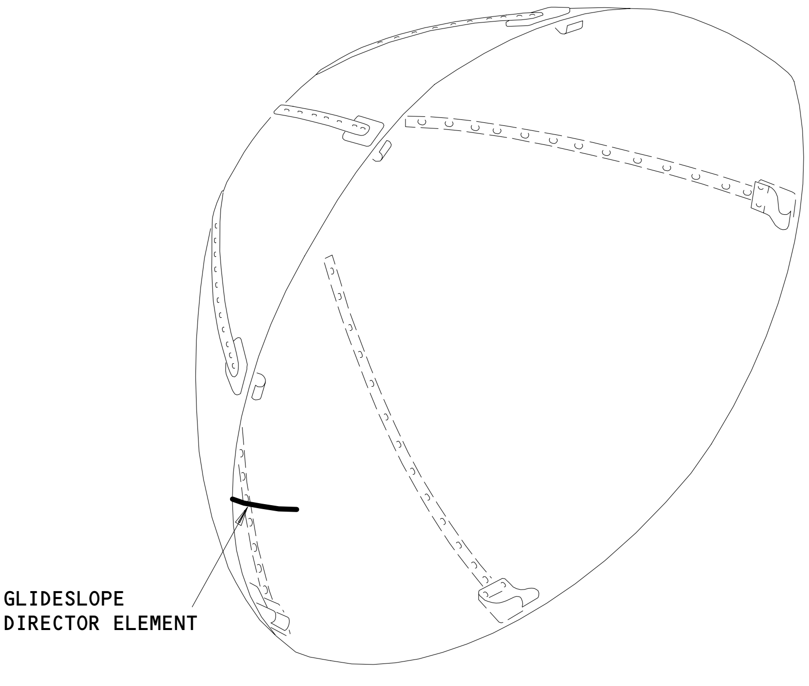
LEFT, RIGHT OR CENTER MULTI-MODE RECEIVER

F 3

ILS Components
Figure 1 (Sheet 2)



FORWARD BULKHEAD



NOSE RADOME

ILS Components
Figure 1 (Sheet 3)

(2) One G/S director element is installed in the nose radome assembly. It is a 12 inch continuous strip of aluminum foil, pressure sensitive tape, positioned horizontally across the center butt line on the inside surface of the radome, about 18 inches from the radome lower edge.

C. ILS or Multi-Mode Receiver

(1) The ILS or multi-mode receiver accepts ILS localizer and glideslope signals from the ground station. It processes these signals to provide digital localizer and glideslope output data to interfacing systems. It also provides station identification audio to the flight interphone system.

(2) The unit provides reception on 40 localizer channels from 108.10 to 111.95 MHz. Glideslope channels are paired with localizer channels and are received from 329.15 to 335.00 MHz with 150 MHz channel spacing.

(3) The receiver has built in test equipment (BITE) which automatically performs self-test procedures as part of an internal program. In addition, a self-test may be manually initiated by the front panel TEST button. The results of the self-test are shown on the front panel of the ILS or multi-mode receiver.

(4) The three ILS or multi-mode receivers are located in rack E2 in the Main E/E Equipment Center.

D. ILS Control Panel

(1) The ILS control panel provides frequency and course selection and a system self-test button.

(2) G/S and LOC frequencies are selected in pairs by the left two concentric knobs. The outer knob selects tens and units of MHz in 1 MHz increments. The inner knob selects tenths and hundredths of MHz in .05 MHz increments. Three ganged wafers provide identical, yet independent, tuning for each ILS system. The left frequency is displayed on the left EHSI, the right on the right EHSI, and the center on the control panel FREQ display.

(3) The ILS FREQ display is a five digit readout that shows the selected localizer frequency with the 100 MHz space fixed at 1. The selected frequency limits are from 108.10 to 111.95 MHz. For the next step past 111.95, the display indicates five dashes. In this position, the ILS control panel sends a NCD ILS frequency word to the receivers, which places them in standby mode. The next selections are 108.10, 108.15, 108.30, 108.35, etc. (odd tenths) back to 111.95.

(4) When the Bendix receiver P/N 2041230-3514 thru -3517 is tuned to 108.XX (odd tenths) or 111.XX (odd tenths) and the park position is selected on the ILS control panel, the receiver will continue to monitor the previously tuned frequency. Therefore, the audio ident for that frequency may be heard.

(5) The control panel TEST switch is pressed for a system self-test and is inhibited during landing approaches by the FCC.

(6) Selected runway heading is selected by the right two concentric knobs. The outer knob is 36 position switch ranging from 00 to 35. It provides selection of the tens and hundreds of the runway heading in degrees. The inner knob is a 20 position switch ranging from 0 to 9. It provides the selection of the units on 1° increments.

(7) The course selection display indicates the runway heading (in degrees) selected on the course selection knob.

(8) The ILS control panel is located on the aft electronics panel (P8).

E. EFIS Control Panel

(1) The EFIS control panel mode selector is used to select the EHSI display mode. When the mode selector is in the ILS position, the DME frequency is paired with the ILS rather than the VOR frequency (AMM 34-55-00).

(a) GUI 001-114, 116-999;
When the mode selector is in the ILS position, the EHSI displays ILS data.

(b) GUI 115;
When the mode selector is in the ILS-FULL position, the EHSI displays ILS data on a full-compass-rose. When set to ILS-EXP, the EHSI displays ILS data in an expanded mode.

F. EHSI

(1) The EHSI is a multifunction indicator which provides displays for several electronic systems. The following paragraphs describe the ILS displays for the EHSI ILS modes. For a more detailed description of the EHSI, refer to 34-22-00, EFIS System.

(a) The localizer and glideslope deviation pointers and scale display deviation from the respective beam. They indicate the direction that the airplane must go in order to reduce the deviation to zero. When the ILS control panel is set to show "-----" on the display, the pointers are removed from the EHSI if the EFIS control panel is in an ILS mode.

(b) Back-course approaches are automatically displayed on the localizer deviation scale. The glide slope deviation pointer is removed from the EHSI during back-course approaches. This occurs when the difference between airplane track angle and selected runway is greater than 90 degrees. The EFIS determines this from airplane/runway heading data sent by the IRS and FMC.

(c) The EHSI displays the runway (course) direction and the ILS tuned frequency selected on the ILS control panel. The ILS frequency is displayed in the lower right corner. When ILS frequency on the control panel is set to PARK (-----), 6 green dashes replace the ILS frequency on the EHSI.

(d) The data source annunciator (ILS) is shown in the lower left corner of the EHSI when ILS is selected on the EFIS control panel.

(e) Absent or improper ILS signals and/or tuning data input to the receiver are defined as a no-computed-data (NCD) condition. For NCD in the receiver G/S channel, the G/S deviation pointer is removed. For NCD in the localizer channel, the runway direction line is removed, and the course pointer is oriented vertically. In either case, 6 green dashes replace the displayed ILS frequency.

(f) Failure warning conditions are defined as detected failures within the ILS or multi-mode receiver itself. For failure warning in either channel, the corresponding pointer and scale are removed, the G/S or LOC flag is displayed, and the ILS frequency display is removed.

G. EADI

(1) The EADI is a multifunction display (AMM 34-22-00). It displays glideslope and localizer deviation which operate the same as the EHSI deviation pointers. When the ILS control panel is in PK, the pointers and scales are removed.

(2) For valid ILS data, the standard (four dot) LOC scale will be displayed until the following conditions are met. For these conditions, the display changes to the expanded (two dot) LOC scale.

(a) LOC deviation is less than 5/8 of one dot.
(b) AFDS LOC or ROLLOUT mode is armed
(c) L, R, and/or C - A/P is engaged.

(3) The display will revert back to the standard LOC scale if:

(a) Ground speed is less than 30 knots or radio altitude is greater than 200 ft.
(b) Neither AFDS mode is engaged

(4) Back-course approaches are automatically displayed on the localizer deviation scale. The glideslope deviation pointer is removed from the EADI during back-course approaches.

(5) For ILS NCD conditions on the EADI, the pointer for the affected channel is removed. For ILS failure warning conditions, the pointer and scale for the affected channel (G/S or LOC) are removed. The corresponding flag (G/S or LOC) also comes into view.

H. Standby Attitude Indicator

(1) The standby attitude indicator displays G/S and localizer deviation from the center ILS system (AMM 34-24-00). These deviation displays operate in the same manner as the EHSI.

(2) On back-course approaches, localizer frequencies are coded opposite from front course approaches. BCRS must be selected on the standby attitude indicator for that display to read correctly.

(3) For ILS failure warning on the standby attitude indicator, the pointer for the invalid channel is removed. The corresponding flag (LOC or G/S) is driven into view.

3. Operation (Fig. 2, Fig. 3)

A. ILS System Block Diagram (Fig. 2)

(1) Three ILS systems are installed, and are designated as left, right and center. Each system consists of a receiver, G/S antenna, and LOC antenna. One control panel serves all three systems.

(2) Each receiver receives power from the 115 volt ac bus through the P11 CB panel, which it then routes to the control panel.

(3) The ILS control panel encodes and outputs the ILS frequency and the front course runway heading, as selected by the pilot, to the left and right VOR control panels and each ILS receiver.

(4) The receiver accepts localizer and glide slope ground station transmission signals, as well as ILS digital frequency data. The receiver processes these signals, and provides digital data to the pilot and automatic flight control system (AFCS) through the interface systems.

(5) The EFIS symbol generators accept ILS digital data and generate video signals for ILS displays on the EHSI and EADI.

(6) GUI 001-114, 116-999;
The digital flight data acquisition unit accepts ILS digital data for the flight data recorder.

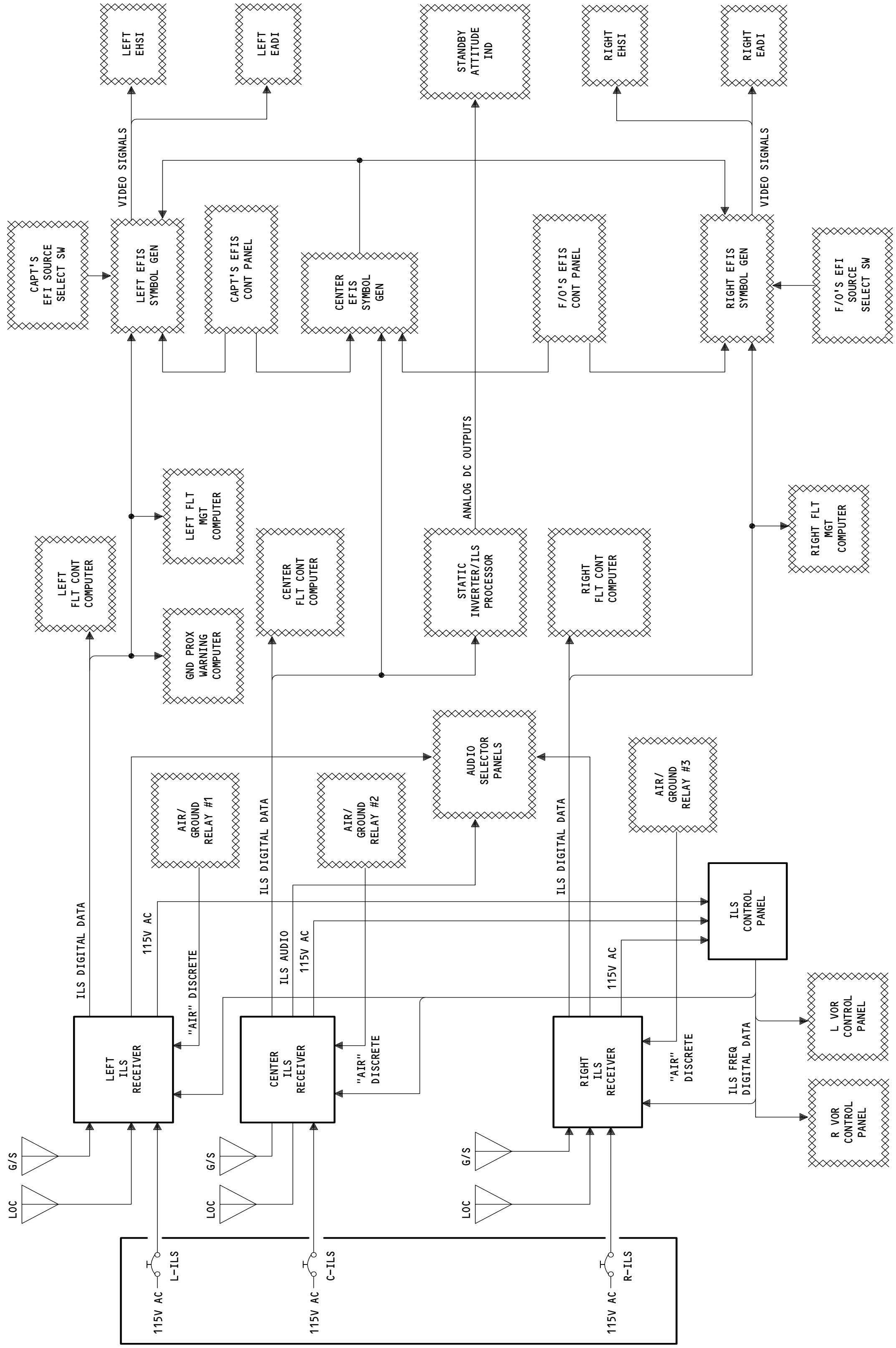
(7) The static inverter/ILS processor accepts center ILS digital data and converts it to analog dc outputs to drive G/S and LOC meter movements on the standby attitude indicator.

(8) The flight management computers accept ILS localizer digital data for position update.

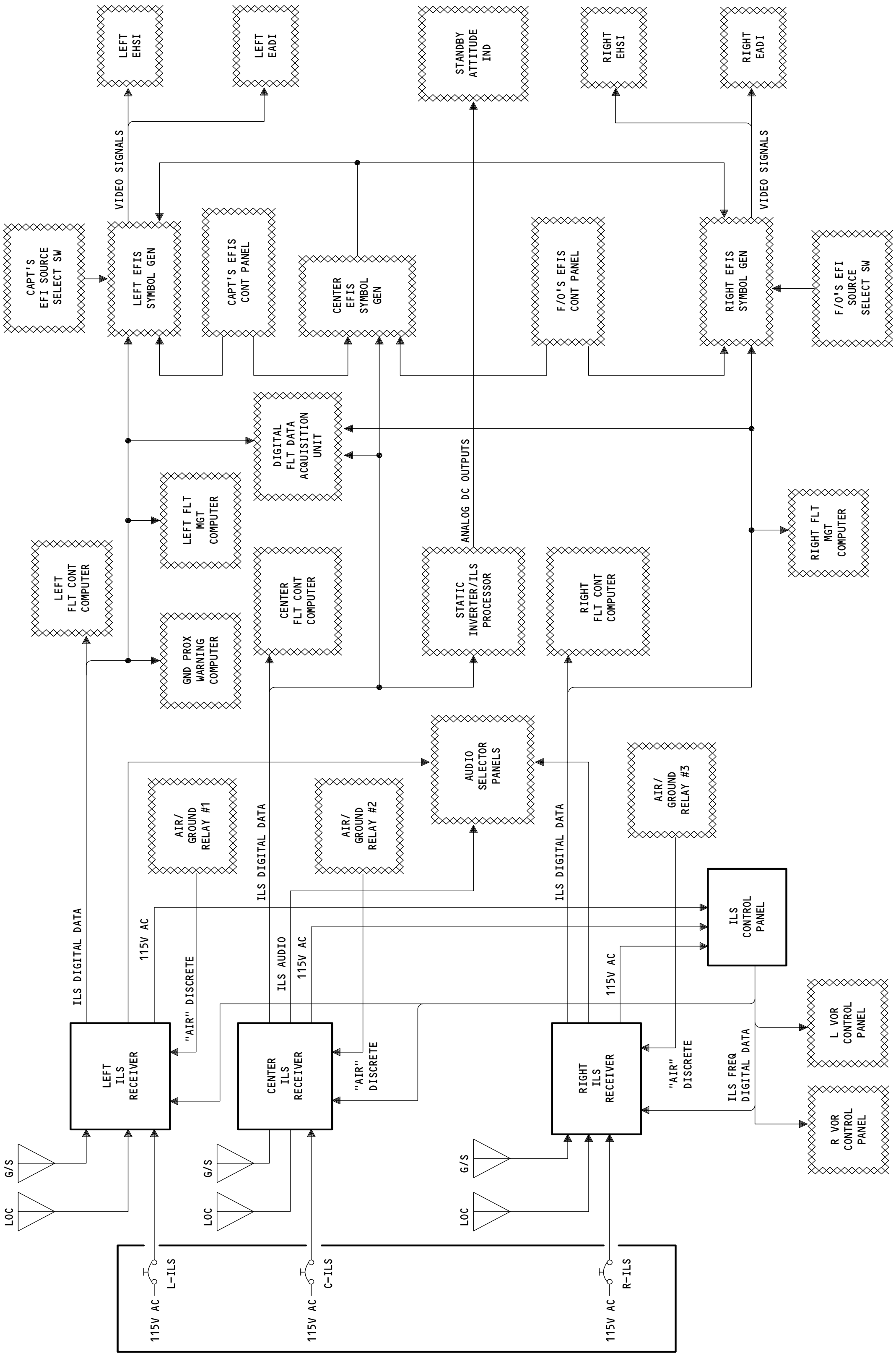
(9) The ground proximity warning computer (GPWC) accepts left ILS digital data to compare actual G/S deviation with calculated admissable G/S deviation. If excessive deviation is detected, the GPWC generates GLIDE SLOPE aural advisory annunciations.

(10) The audio select panels accept ILS audio output which contains ILS station identification in Morse Code, for controlled routing to cockpit speakers, flight crew headsets, and voice recorder.

(11) The air/ground relays provide "air" discrete signals which enable the identification of faults which develop while airborne, to be stored for maintenance purposes.



ILS System Block Diagram
Figure 2 (Sheet 1)



ILS System Block Diagram
Figure 2 (Sheet 2)

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B. Functional Description (Fig. 3)

(1) Three ILS or multi-mode receivers and one control panel are installed. All receiver operations are identical, so only the left system is described.

(2) Each ILS or multi-mode receiver is powered by 115V ac at 400 Hz. Power is received from the corresponding circuit breakers on the P11 panel. The receiver power supply generates dc voltages for internal circuit operation. Each receiver supplies 115V ac, 400 Hz to separate power supplies in the ILS control panel. The control panel indicator lights are supplied by 0-5V ac from the master power and dim circuit.

(3) ILS frequency and course are selected manually on the control panel. The frequency and course signals are processed and routed to the respective output driver. The control signals are sent via an ARINC 429 digital data bus to the ILS or multi-mode receiver for tuning purposes. The frequency data is also routed to the VOR control panel on the same digital data bus for DME tuning.

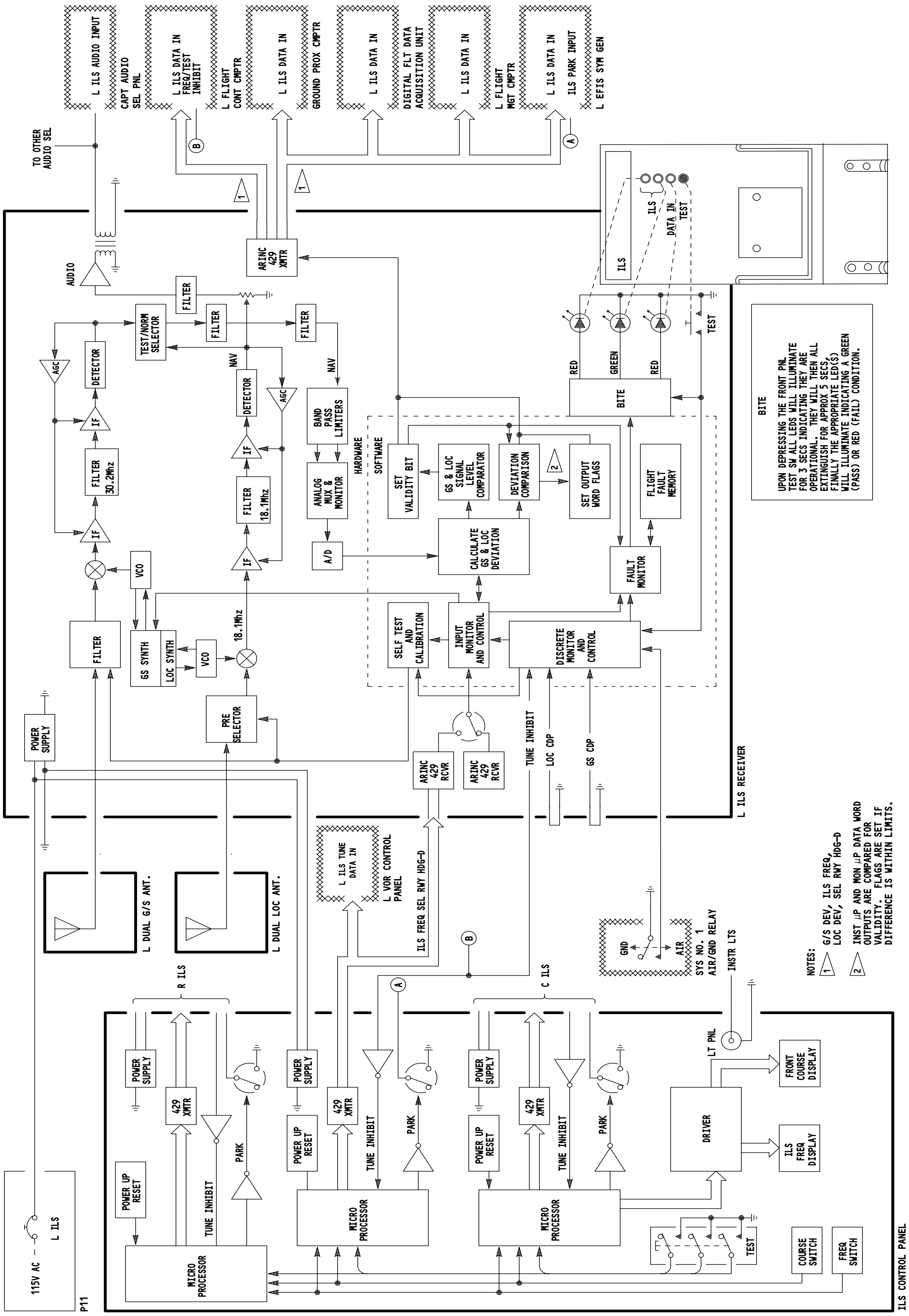
(4) A discrete control signal is received from the flight control computer (FCC). This discrete inhibits self-test and manual tuning during autoland approaches and landing.

(5) The air/ground relay discrete enables the ILS BITE memory to identify flight segments. The BITE memory stores faults by flight segment. A flight segment starts each time the airplane takes off.

(6) The central processor unit (CPU) performs all control, timing, logic, and computations required for system operation. The CPU controls operations of the receiver by means of a stored program in memory (ROM).

(7) Tuning is controlled by the frequency selection on the control panel. This control data is received by the interface module in the receiver and processed by the CPU. The CPU uses this data to provide tuning voltage to the glideslope and localizer synthesizers. It also transmits tuning voltage to the localizer receiver channel.

(8) Each ILS or multi-mode receiver contains separate channels for processing of the LOC and glideslope signals. Operation of the two channels is the same except for the frequency ranges. Frequency range for the localizer channels (40 total) is from 108.10 to 111.95 MHz. The 40 paired glideslope channels range from 329.15 to 335.00 MHz.



BITE

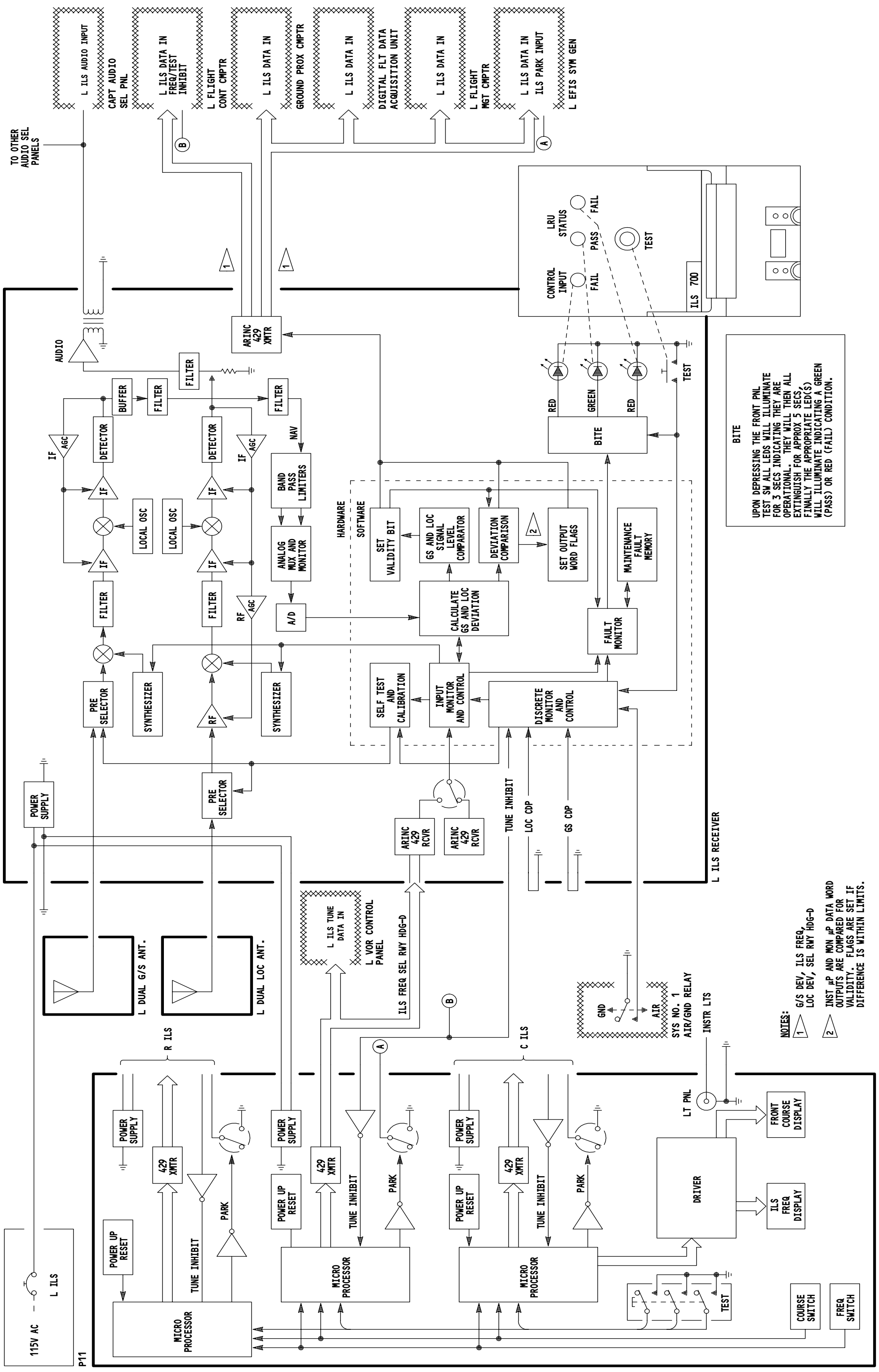
UPON DEPRESSING THE FRONT PNL TEST SW ALL LEDS WILL ILLUMINATE FOR 3 SECS INDICATING THEY ARE OPERATIONAL. THEY WILL THEN ALL EXTINGUISH FOR APPROX 5 SECS, FINALLY THE APPROPRIATE LED(S) WILL ILLUMINATE INDICATING A GREEN (PASS) OR RED (FAIL) CONDITION.

NOTES:

1 G/S DEV, ILS FREQ, LOC DEV, SEL RWY HDG-D

2 INST µP AND MON µP DATA WORD OUTPUTS ARE COMPARED FOR VALIDITY. FLAGS ARE SET IF DIFFERENCE IS WITHIN LIMITS.

ILS System Schematic (Example)
Figure 3 (Sheet 1)



BITE
UPON DEPRESSING THE FRONT PNL TEST SW ALL LEDS WILL ILLUMINATE FOR 3 SECS INDICATING THEY ARE OPERATIONAL. THEY WILL THEN ALL EXTINGUISH FOR APPROX 5 SECS, WILL ILLUMINATE INDICATING A GREEN (PASS) OR RED (FAIL) CONDITION. THEN THE APPROPRIATE LED(S)

NOTES:
1 G/S DEV, ILS FREQ, LOC DEV, SEL RWY HDG-D
2 INST µP AND MON µP DATA WORD OUTPUTS ARE COMPARED FOR VALIDITY. FLAGS ARE SET IF DIFFERENCE IS WITHIN LIMITS.

ILS System Schematic (Example)
Figure 3 (Sheet 2)

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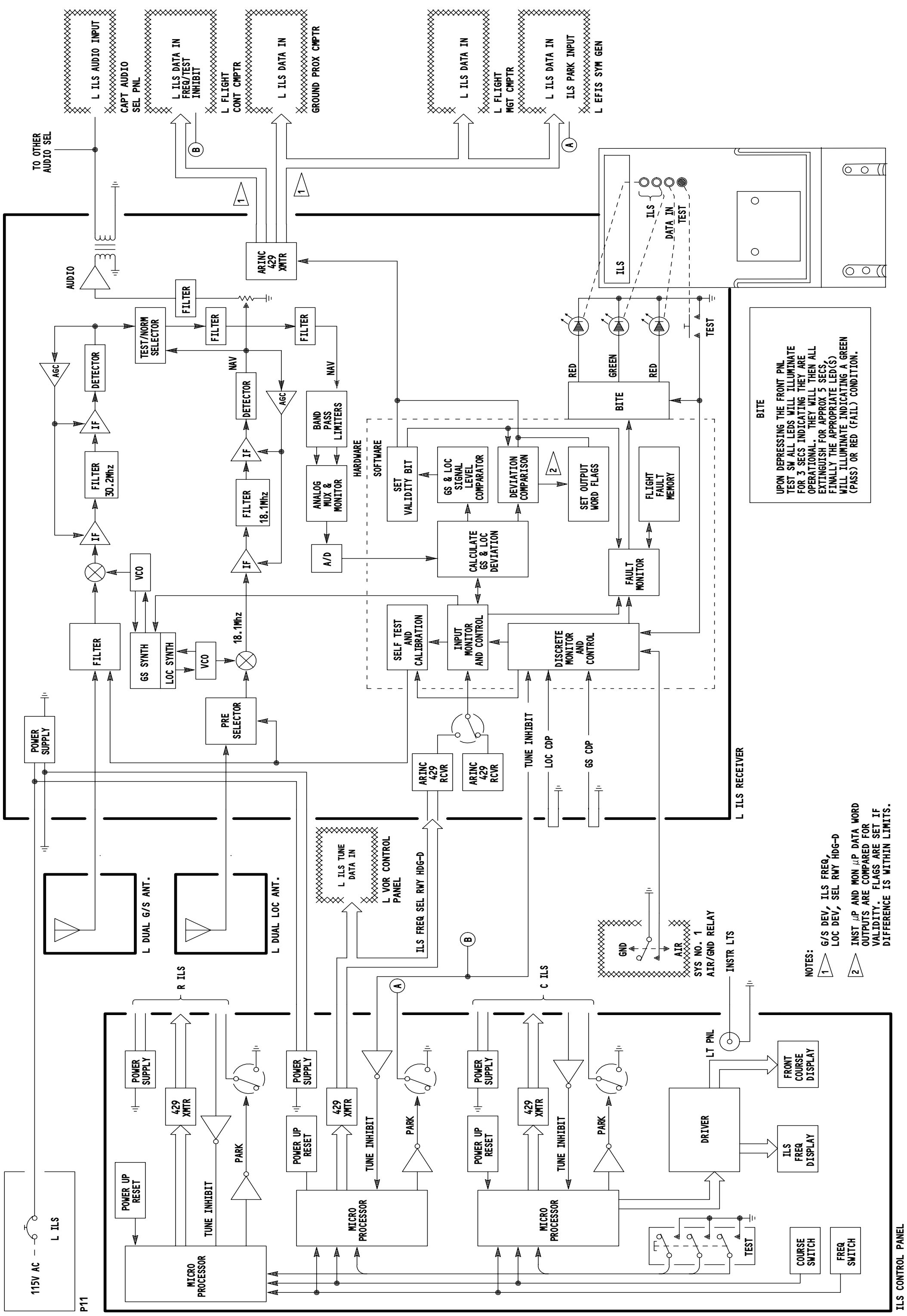


BITE

UPON DEPRESSING THE FRONT PNL TEST SW ALL LEDS WILL ILLUMINATE FOR 3 SECS INDICATING THEY ARE OPERATIONAL. THEY WILL THEN ALL EXTINGUISH FOR APPROX 5 SECS, FINALLY THE APPROPRIATE LED(S) WILL ILLUMINATE INDICATING A GREEN (PASS) OR RED (FAIL) CONDITION.

NOTES:

1 G/S DEV, ILS FREQ, LOC DEV, SEL RWY HDG-D

2 INST µP AND MON µP DATA WORD OUTPUTS ARE COMPARED FOR VALIDITY. FLAGS ARE SET IF DIFFERENCE IS WITHIN LIMITS.

ILS System Schematic (Example)
Figure 3 (Sheet 3)

(9) GUI 002-008, 010-114, 116-999;
ILS receiver operation is as follows:

(a) The LOC signal received at the antenna is modulated with 90 Hz, 150 Hz, and 1020 Hz tones. The 90 Hz and 150 Hz tones contain localizer course information while the 1020 Hz has station code identification. The localizer input signal (RF frequency) is applied to the LOC receiver channel. Using a signal from the localizer synthesizer (21.4 MHz below incoming RF frequency), the LOC receiver converts the RF signal into a 21.4 MHz IF signal.

(b) The IF signal is input into a crystal filter which provides the selectivity for the receiver. The first IF amplifier provides a 25 dB gain to the 21.4 MHz signal. The signal is then mixed with a 21.5685 MHz signal from the local oscillator. The difference frequency of 168.5 KHz is then amplified in three stages with a total gain of 82 dB. The modulated IF signal is applied to an envelope detector that detects modulation peaks from the IF carrier frequency. The resultant modulation waveform is the audio modulation (NAV signal) consisting of 90 Hz, 150 Hz, and 1020 Hz tones.

(c) The output of the envelope detector is applied to the IF AGC amplifier which provides a dc voltage inversely proportional to the amplitude of the IF input. An RF AGC amplifier provides additional RF gain with low-level signal inputs. The RF and IF amplifiers are AGC controlled to provide maximum gain with low signal input.

(d) The NAV signal is applied to the filter and limiter circuits which pass the 1020 Hz signal. This signal is amplified and coupled through a transformer to the audio select panels. A preset output adjustment in the amplifier controls the audio output level. The audio output level is reduced by 10 db when a no computed data (NCD) fault occurs.

(e) The NAV signal is also applied to a buffer in the BITE module. During normal operation, the NAV signal is connected through the buffer to a group of 90/150 Hz low pass filters. These low pass filters pass the 90 and 150 Hz signals and remove the 1020 Hz signal. The filter network also separates each tone from the NAV signal and generates a voltage proportional to the modulation level of each tone. The CPU computes data deviation from this voltage based upon the difference in modulation of the two tones. The data deviation is output to the interface module.

(10) GUI 001, 009, 115;
ILS receiver operation is as follows:

(a) The LOC signal received at the antenna is modulated with 90 Hz, 150 Hz, and 1020 Hz tones. The 90 Hz and 150 Hz tones contain localizer course information while the 1020 Hz has station code identification. The localizer input signal is applied to the NAV receiver preselector. The preselector is tuned to the selected localizer channel by a tuning voltage provided by the CPU module. A local oscillator signal generated by the NAV VCO module and the digital synthesizer module is injected into a balanced mixer. The mixer subtracts the local oscillator frequency from the preselector localizer signal to produce an 18.1 MHz IF signal.

(b) The 18.1 MHz IF signal from the mixer is amplified by the first IF amplifier. The IF signal is then filtered by an 18.1 MHz crystal filter prior to additional amplification by a second IF amplifier. The 90 Hz, 150 Hz, and 1020 Hz audio signals are recovered by a diode detector. This detected audio signal is the NAV composite signal.

(c) Primary and secondary AGC feedback signals are developed by dual AGC circuits to ensure a constant receiver output level with carrier input level variations. The AGC circuits filter the NAV composite signal to remove the audio components. The primary AGC signal is fed back to the input of the second IF amplifier. The secondary AGC signal is fed back to the input of the first IF amplifier.

(d) The NAV signal is applied to the filter and limiter circuits which pass the 1020 Hz signal. This signal is amplified and coupled through a transformer to the audio select panels. A preset output adjustment in the amplifier controls the audio output level. The audio output level is reduced by 10 db when a no computed data (NCD) fault occurs.

(e) The NAV signal is also applied to the test/normal selector in the BITE module. During normal operation, the NAV signal is connected through the test/normal selector to a group of 90/150 Hz low pass filters. These low pass filters pass the 90 and 150 Hz signals and remove the 1020 Hz signal. The filter network also separates each tone from the NAV signal and generates a voltage proportional to the modulation level of each tone. The CPU computes data deviation from this voltage based upon the difference in modulation of the two tones. The data deviation is output to the interface module.

(11) The glideslope signal received at the antenna is also modulated with 90 and 150 Hz tones. These 90 and 150 Hz signals contain glideslope deviation information. Processing of the glideslope 90 and 150 Hz signals is the same as for the LOC signal. The CPU calculates and outputs the glideslope deviation to the interface module.

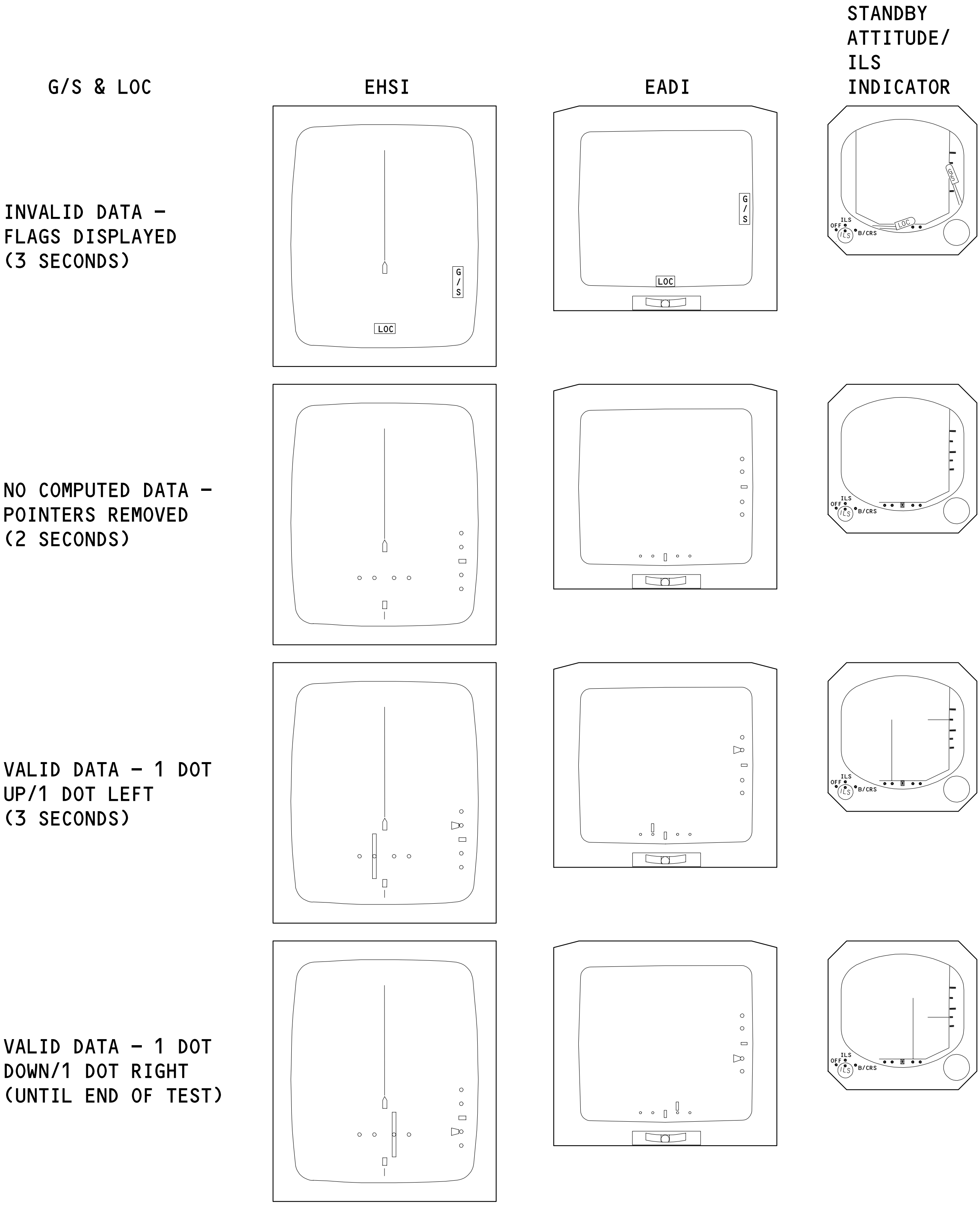
(12) The outputs of the GS and LOC 90/150 Hz filters are also connected to the monitor CPU. The monitor CPU computes localizer and glideslope deviations. It also reads the deviation data output from the data ports. The output data is compared to the computed data. The result is transmitted to the primary CPU. Both the primary CPU and monitor CPU perform comparison of the output data for each transmission.

(13) GUI 115;
Output data is converted from parallel to serial format by the ARINC 429 interface module. The left ILS system sends ILS data over an ARINC 429 bus to the left EFIS symbol generator, the left FMC, and the GPWS. The right system sends data to the right EFIS symbol generator and the right FMC. The center ILS system sends data to the static inverter/ILS processor and to the center EFIS symbol generator. In addition, the left, right, and center ILS receivers send data to the left, right, and center FCCs respectively over a separate dedicated data bus.

(14) GUI 001-114, 116-999;
Output data is converted from parallel to serial format by the ARINC 429 interface module. The left ILS system sends ILS data over an ARINC 429 bus to the left EFIS symbol generator, the left FMC, the GPWS, and the digital flight data acquisition unit (DFDAU). The right system sends data to the right EFIS symbol generator, the right FMC and the DFDAU. The center ILS system sends data to the static inverter/ILS processor, the center EFIS symbol generator and the DFDAU. In addition, the left, right, and center ILS receivers send data to the left, right, and center FCCs respectively over a separate dedicated data bus.

C. BITE and Self Test (Fig. 4)

(1) The ILS built in test equipment (BITE) performs self test procedures on the receiver as part of the CPU stored program. During normal operations, the CPU monitors static signals such as supply voltage and VCO drive signals. It tests G/S and LOC input data at the receiver input and throughout the processing stages to determine low signal level faults. It checks the input tuning data from the control panel for integrity. The BITE also monitors the output data for comparison with the calculated data output from the CPU.



ILS Displays - Self Test Sequence
Figure 4

(2) For detected faults, the receiver will output failure warning codes on the ARINC 429 data bus. For receiver failures, an invalid data code is output. For absent or improper ILS input signals from the antenna and/or tuning data input a no computed data code (NCD) is output.

(3) All receiver faults detected during the BITE program are stored in a non-volatile fault memory. The faults are stored by flight segments for subsequent evaluation in the shop. Each flight segment starts when the airplane takes off as detected by the air/ground relay. The fault memory can store faults for up to 63 flights. The maximum number of faults that can be stored for any flight segment is 13. If a fault exists continuously, it is only stored once. If it exists intermittently, it is stored each time it occurs and remains for 1 second or more. The test data history is available on the ATE connector for shop personnel. In addition, a number corresponding to the failed module is displayed by an internal fault display for shop purposes. This internal display does not show location of intermittent faults. Failure warning codes will be output on the data bus if two or more identical faults are stored in memory from at least two of the last four flight segments, even though the unit currently tests good.

(4) A system self-test is manually initiated by pressing the TEST button on either the receiver front panel or the ILS control panel. When a self-test is run, a G/S and LOC test signal are injected into parts of the receiver. Test signals are injected into either the front end of the receiver or at the NORMAL/TEST circuit in the BITE module as determined by the CPU program. These signals are processed and checked in the same manner as for normal operation. Fault codes are also output and displayed in the same manner. In addition, the lights on the receiver front panel will come on to show pass or fail conditions for the test.

(5) The following test sequence will occur on the ILS receiver during the test.

NOTE: Test button on the receiver front panel must be held in for the entirety of the test (16 seconds).

- (a) All front panel lights come on for about 3 seconds to show that they work.
- (b) All lights go off for about 2 seconds.
- (c) A front panel light then comes back on and stays on until the end of the test cycle. The test results are indicated as follows:
  - 1) GUI 002-008, 010-114, 116-999;
    The following indications occur:
    - a) The green LRU STATUS-PASS light comes on to indicate the test was successful.
    - b) The red LRU STATUS-FAIL light comes on if an internal fault has been detected during the test.
    - c) The red CONTROL INPUT-FAIL light comes on if the digital data word from the ILS control panel was not properly received. It also comes on to indicate a fault in the ARINC 429 receiver.
  - 2) GUI 001, 009, 115;
    The following indications occur:
    - a) The green ILS light comes on to indicate the test was successful.
    - b) The red ILS light comes on if an internal fault has been detected during the test. The red light will come on if two or more identical faults from at least two of the last four flight segments are stored in the flight fault memory.
    - c) The red DATA IN light comes on if the digital data word from the ILS control panel was not properly received.

(6) AIRPLANES WITH COLLINS 822-1821-001 (GLU-925) MULTI-MODE RECEIVER. The following test sequence will occur on the Multi-Mode Receiver during the test.

- (a) All front panel lights come on red
- (b) The LRU STATUS light changes to green in about 2 seconds.
- (c) All lights go off
- (d) After 2 seconds a front panel light will come on to show the test results as follows:
  - 1) The LRU STATUS light comes on green if no internal faults are found.

        2) The LRU STATUS light comes on red if an internal fault is found.
        3) The CONTROL FAIL light comes on red is there is a fault in the data supplied to the receiver.
        4) The ANT FAIL light comes on red if there is a fault found in the antenna connection.
    (7) At the same time as the above sequence, the ILS receiver outputs test data to produce the following patterns on the applicable flight instruments:
        (a) An invalid data display occurs for 3 seconds.
        (b) A NCD condition occurs for the next 2 seconds.
        (c) G/S and localizer pointers move to one dot up and one dot left respectively, for 3 seconds.
        (d) G/S and localizer pointers move to one dot down and one dot right for remainder of the test.

D. Control
    (1) Turn on procedure
        (a) Apply electrical power (AMM 24-22-00).
        (b) Make sure that the following overhead panel P11 circuit breakers are closed:
            1) 11A3, ILS CENTER or MMR C
            2) 11E10, ILS L or MMR L
            3) 11E31, ILS RIGHT or MMR R
        (c) Set frequency select knob on ILS control panel to desired frequency.

INSTRUMENT LANDING SYSTEM

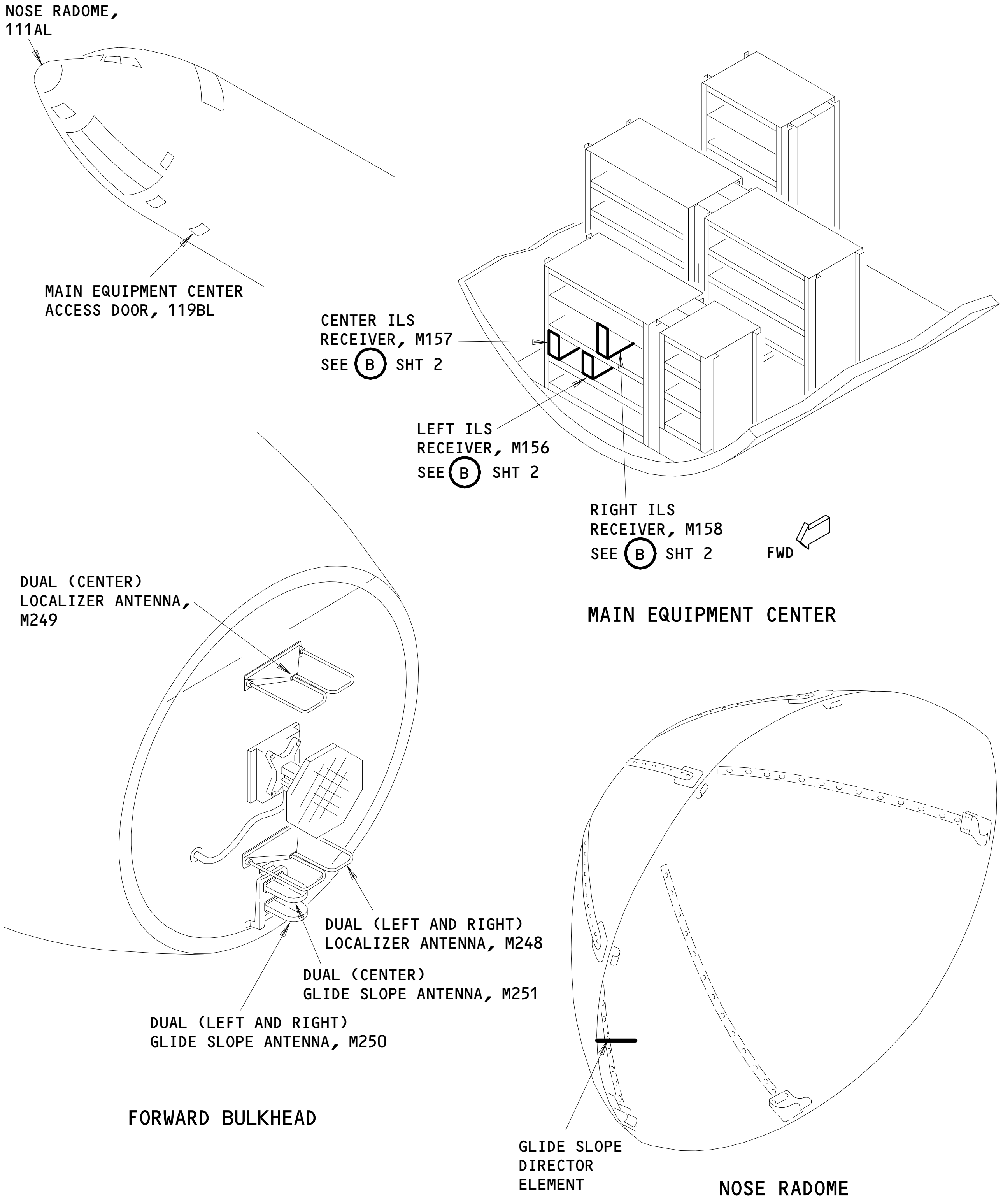
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - CENTER DUAL GLIDE SLOPE, M251	1	1	111AL, NOSE RADOME	34-31-03
ANTENNA - CENTER DUAL LOCALIZER, M249	1	1	111AL, NOSE RADOME	34-31-04
ANTENNA - LEFT/RIGHT DUAL GLIDE SLOPE, M250	1	1	111AL, NOSE RADOME	34-31-03
ANTENNA - LEFT/RIGHT DUAL LOCALIZER, M248	1	1	111AL, NOSE RADOME	34-31-04
CIRCUIT BREAKER -	2		FLT COMPT, P11	
ILS CENTER, C606 1>		1	11A3	*
ILS L, C603 1>		1	11E10	*
ILS RIGHT, C605 1>		1	11E31	*
MMR CENTER, C4602 2>		1	11E31	*
MMR LEFT, C4600 2>		1	11E10	*
MMR RIGHT, C4601 2>		1	11A3	*
PANEL - ILS CONTROL, M87	2	1	FLT COMPT, P8	34-31-02
RECEIVER - CENTER ILS, M157 1>	1	1	119BL, MAIN EQUIP CTR, E2-3	34-31-01
RECEIVER - CENTER MMR, M11251 2>		1	119BL, MAIN EQUIP CTR, E2-3	34-31-02
RECEIVER - LEFT ILS, M156 1>	1	1	119BL, MAIN EQUIP CTR, E2-3	34-31-01
RECEIVER - LEFT MMR, M11249 2>	1	1	119BL, MAIN EQUIP CTR, E2-3	34-31-02
RECEIVER - RIGHT ILS, M158 1>	1	1	119BL, MAIN EQUIP CTR, E2-2	34-31-01
RECEIVER - RIGHT MMR, M11250 2>	1	1	119BL, MAIN EQUIP CTR, E2-2	34-31-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K143				
SYS NO. 1 AIR/GND, K167				
RELAY - (FIM 31-01-37/101)				
SYS NO. 2 AIR/GND, K214				

* SEE THE WDM EQUIPMENT LIST

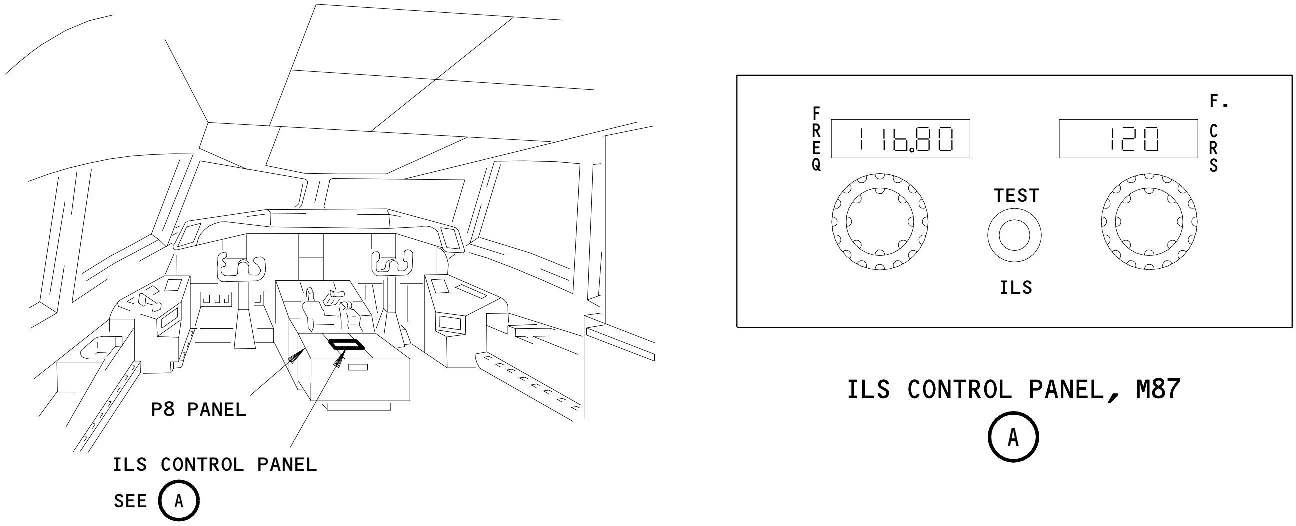
1> AIRPLANES WITH ILS RECEIVERS

2> AIRPLANES WITH MULTI-MODE RECEIVERS (MMR)

Instrument Landing System - Component Index
Figure 101

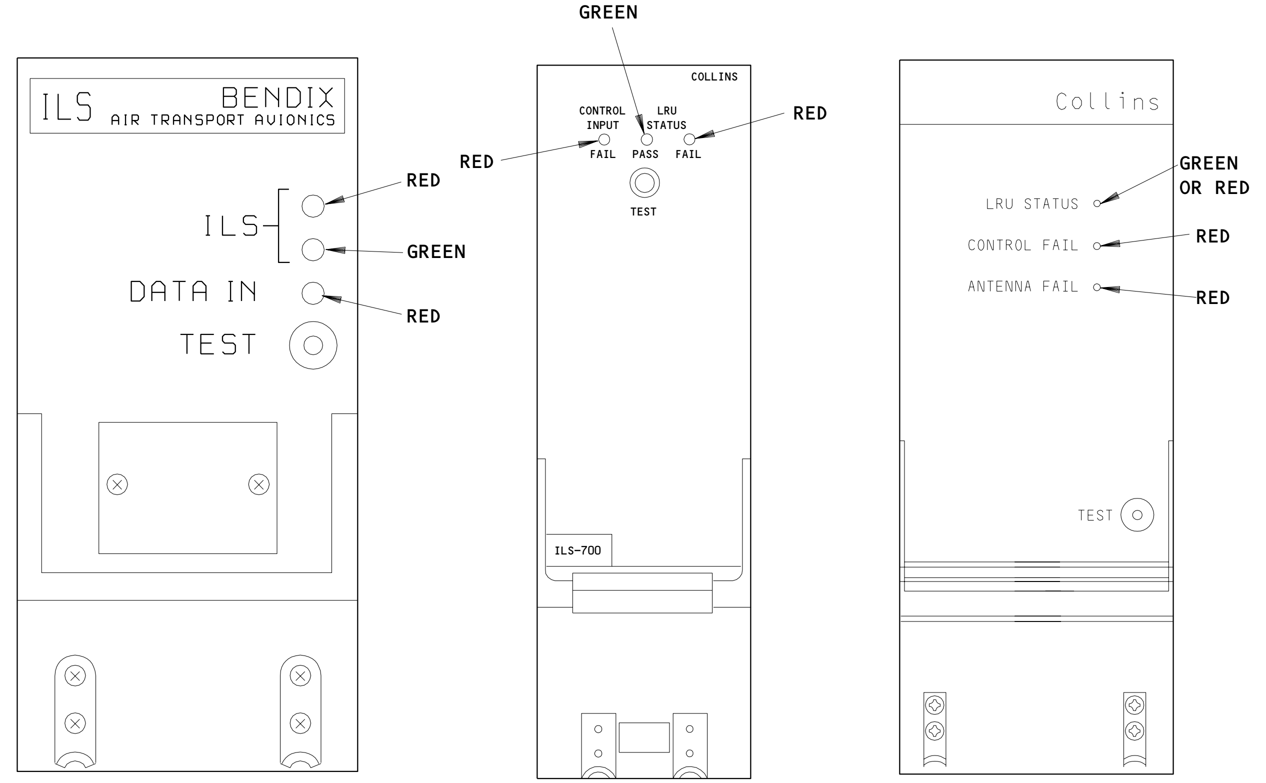


Instrument Landing System - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT

ILS CONTROL PANEL, M87
A



LEFT, RIGHT OR CENTER ILS RECEIVER, M156, M158 OR M157
B 1

LEFT, RIGHT OR CENTER ILS RECEIVER, M156, M158 OR M157
B 2

LEFT, RIGHT OR CENTER MULTI-MODE RECEIVER
B 3

1 GUI 001, 009, 115
2 GUI 002-008, 010-114,116-999

3 GUI 115
(POST SB 34-0400)

Instrument Landing System - Component Location
Figure 102 (Sheet 2)

INSTRUMENT LANDING SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure has two tasks. The Operational Test uses the BITE functions of the system, and no test equipment is necessary. The System Test is a more complete test of the system with a ramp test set.

TASK 34-31-00-715-001

2. ILS - Operational Test
   A. References
      (1) 24-22-00/201, Electrical Power - Control
      (2) 34-21-00/501, Inertial Reference System - Initialization
   B. Access
      (1) Location Zones

211/212	Flight Compartment

   C. Prepare for the Operational Test

S 865-002

(1) Supply electrical power (AMM 24-22-00).

S 865-003

(2) On the left and right EFIS control panels, set the mode select switch to the ILS, APP, ILS-EXP, or ILS-CTR position.

S 865-007

(3) On the standby attitude indicator, set the switch to the ILS mode.

S 755-008

(4) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:
   (a) 11N1, INSTRUMENT AND PANEL AISLE STAND
   (b) 11N2, INSTRUMENT AND PANEL CAPT

S 755-009

(5) Make sure the displays on the ILS control panel and the standby attitude indicator are on.

S 755-010

(6) Make sure these circuit breakers on the P11 panel are closed:
   (a) 11A3, ILS CENTER or MMR C
   (b) 11A9, STBY ILS IND
   (c) 11E4, EFIS CONT PNL LEFT
   (d) 11E6, HSI LEFT

(e) 11E10, ILS L or MMR L
(f) 11F8, EFIS SYM GEN LEFT
(g) 11F9, EFIS SYM GEN CENTER

S 755-011

(7) Make sure the glideslope (G/S) flags, localizer (LOC) flags, and deviation pointers are not in view on the captain's EHSI and standby attitude indicator.

<u>NOTE</u>: If the ILS control panel is set to the local approved ILS frequency, the deviation pointers will be in view.

S 755-012

(8) Make sure these circuit breakers on the P11 panel are closed:
(a) 11E25, EFIS CONT PNL RIGHT
(b) 11E27, HSI RIGHT
(c) 11E31, ILS RIGHT or MMR R
(d) 11F29, EFIS SYM GEN RIGHT

S 755-013

(9) Make sure the G/S and LOC flags and the deviation pointers are not in view on the first officer's EHSI.

<u>NOTE</u>: If the ILS control panel is set to the local approved ILS frequency, the deviation pointers will be in view.

S 755-025

(10) Do these steps to permit the G/S and LOC flags to come into view:
(a) Open these circuit breakers on the P11 panel:
    1) 11E10, ILS L or MMR L
    2) 11E31, ILS RIGHT or MMR R
(b) On the instrument source select panels, make sure the EFI switch is in the NORM position.
(c) Select a frequency between 108.10 and 111.95 MHz on the ILS control panel.
(d) On the EADIs, make sure the G/S and LOC flags are in view.

(e) Close these circuit breakers on the P11 panel:
  1) 11E10, ILS L or MMR L
  2) 11E31, ILS RIGHT or MMR R

(f) On the EADIs, make sure the G/S and LOC flags are out of view.

S 865-026

(11) Energize and align the Inertial Reference System (AMM 34-21-00).

S 865-027

(12) Set the CRS heading display on the ILS control panel to the same airplane heading as shown on the EHSIs.

NOTE: The glideslope pointer is not shown when the difference between the airplane track angle and the runway heading is greater than 90 degrees (backcourse operation).

(a) Make sure the captain's and the first officer's course pointers agree with the CRS heading on the ILS control panel.

(b) Make sure the position of the captain's and the first officer's course pointers are the same.

D. ILS Receiver Self-Test

S 865-072

(1) Make sure the ILS frequency is set to a position other than PK.

S 865-029

(2) Push and hold the TEST switch on the left ILS receiver.

NOTE: Collins ILS receivers P/N 622-5221-102 S/N 4766 and below or P/N 822-0282-102 S/N 4764 and below without Collins service bulletin ILS-700-34-20, dated October 15, 1991, and Collins service bulletin ILS-700/700A-34-23 dated August 22, 1995, can fail the BITE test started from the front panel of the ILS receiver when there is no fault. If this occurs, do the ILS control panel self-test to make sure of the fault.

S 755-030

(3) Make sure the sequence that follows occurs:
  (a) All the LEDs come on
  (b) All the LEDs go off
  (c) The green LED comes on and stays on.

S 745-070

(4) Release the TEST switch on the ILS receiver.

S 745-197

(5) AIRPLANES WITH COLLINS MMR GLU-92X;
Push and release the TEST switch on the left MMR.

(a) Make sure the following sequence occurs:
  1) All three lights come on red.
  2) The LRU STATUS light turns green.
  3) All three lights go off.
  4) A light will then come on and stay on for about 30 seconds to show the result of the test as follows:
  5) FOR COLLINS MMR GLU-920;
    a) The LRU STATUS light comes on green to show the test passed.
    b) The LRU STATUS light comes on red if any fault is detected.
    c) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receiver.
    d) The ANT FAIL light does not come on during the self test because the antenna monitoring discrete program pin is not set.
  6) FOR LEFT/RIGHT COLLINS MMR GLU-925;
    a) The LRU STATUS light comes on green to show the test passed.
    b) The LRU STATUS light comes on red if any fault is detected.
    c) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receiver.
    d) The ANT FAIL light comes on red if a fault is found in the GPS antenna connection.

      NOTE: The GS/LOC antennas are connected to the Left/Right MMR, but the GS/LOC antennas monitoring discrete program pins is not set. Failure of the GS/LOC antennas does not cause the ANT FAIL light to come on, but results in the MMR output of No Computed Data (NCD).

  7) FOR CENTER MMR GLU-925;

    NOTE: It is normal for the self test to end with the red LRU STATUS and ANT FAIL lights on. This is because th GPS antenna is not connected to the center MMR.

NOTE: The GS/LOC antennas are connnected to the Center , but the GS/LOC antennas monitoring discrete program pins is not set. Failure of the GS/LOC antennas does not cause the ANT FAIL light to come on, but results in the MMR ouput of No Computed Data (NCD).

a) The LRU STATUS light comes on red every time because of ANT FAIL.
b) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receicer.
c) The ANT FAIL light comes on red every time because no GPS antenna is connected to the MMR.

S 745-071

(6) Do the procedure again for the center and right ILS or MMR receivers.

E. ILS Control Panel Self-Test

S 745-077

(1) On the ILS control panel, momentarily push and release the TEST switch.
  (a) Make sure these indications occur for approximately three seconds:
    1) On each EHSI, the G/S and LOC deviation scales go out of view. Also, the G/S and LOC deviation pointers stay out of view, and the G/S and LOC flags come into view.
    2) On the standby attitude indicator, the G/S and LOC deviation pointers stay out of view. Also, the G/S and LOC flags come into view.
  (b) Make sure these No Computed Data (NCD) indications occur for approximately two seconds:
    1) On each EHSI, the G/S and LOC deviation scales come into view. Also, the G/S and LOC deviation pointers stay out of view, and the G/S and LOC flags go out of view.

    2) On the standby attitude indicator, the G/S and LOC deviation pointers stay out of view. Also, the G/S and LOC flags go out of view.

  (c) Make sure these functional test indications occur on each EHSI and on the standby attitude indicator:

    1) For approximately three seconds, the G/S and LOC deviation pointers move to one dot up and left.

S 865-032

(2) On the standby attitude indicator, set the switch to the OFF position.

S 745-074

(3) On the ILS control panel, momentarily push and release the TEST switch.

  (a) On the standby attitude indicator, make sure the deviation pointers stay out of view.

S 865-034

(4) On the standby attitude indicator, set the switch to the BCRS position.

S 745-075

(5) On the ILS control panel, momentarily push and release the TEST switch.

  (a) On the standby attitude indicator, make sure these indications occur:

    1) For approximately three seconds, the G/S and LOC deviation pointers stay out of view. Also, the G/S and LOC flags come into view.
    2) For approximately two seconds, the G/S and LOC deviation pointers stay out of view. Also, the G/S and LOC flags go out of view.
    3) For approximately three seconds, the G/S and LOC devation pointers move to one dot up and right.

4) For approximately two seconds, the G/S and LOC devation pointers change position.
5) For approximately three seconds, the pointers move to one dot down and left.
6) Make sure the G/S and LOC deviation pointers go out of view.

S 865-038

(6) On the standby attitude indicator, set the switch to the ILS position.

F. Put the Airplane Back to Its Usual Condition

S 865-040

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

TASK 34-31-00-735-041

3. <u>ILS - System Test</u>

A. General

(1) The first part of the system test is the operational test. Then, you do a test of the localizer and glide slope functions and the audio signal of the localizer.

B. Equipment

(1) VOR/ILS Ramp Test Set, NAV402AP (preferred), NAV401L (optional); Instrument & Flight Research Inc, 10200 West York Street, Wichita, KS, 67215

C. References

(1) AMM 23-42-00/501, Cabin Interphone System
(2) AMM 24-22-00/201, Electrical Power - Control

D. Access

(1) Location Zones

211/212	Flight Compartment

E. Prepare for the System Test

S 865-042

(1) Follow the test set instructions to prepare the test set.

S 865-043

(2) Set the output of the test set as follows:
 - (a) The RF FREQ to the local approved test frequency
 - (b) The RF LEVEL to the middle of the scale
 - (c) The MODULATION to 30 percent at 1020 Hz (audio tone)
 - (d) The DDM to zero for the G/S and the LOC

 NOTE: Turn the control for the master modulation lever fully counterclockwise to get 30% modulation for the IDENT tone. It will supply 20% modulation for the localizer 90 and 150 Hz tones. It will also supply 40% modulation for the glideslope 90 and 150 Hz tones.

 - (e) The MODE switch to the LOC XTL position.

F. Procedure

S 715-044

(1) Do the ILS Operational Test. Do not remove electrical power.

S 865-087

(2) Make sure that the cabin interphone system is serviceable (AMM 23-42-00/501).

S 865-046

(3) Set the ILS control panel to the same frequency as the test set.

S 865-047

(4) Set the CRS heading display on the ILS control panel to the same airplane heading as shown on the EHSIs.

S 865-048

(5) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure these indications occur:
 - (a) The G/S and LOC deviation pointers come into view and are in the middle of their scales.

(b) The frequency shown on the ILS control panel is also shown in the lower right corner of the EHSIs.
(c) The airplane heading and runway heading are the same on the EHSIs.

NOTE: The glideslope pointer is not shown when the difference between the airplane track angle and the runway heading is greater than 90 degrees (backcourse operation).

S 865-049
(6) On the test set, turn the localizer DDM control clockwise to +0.155 DDM.

S 755-050
(7) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the LOC pointers move right two dots.

S 865-051
(8) On the test set, turn the localizer DDM control counterclockwise to -0.155 DDM.

S 755-052
(9) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the LOC pointers move left two dots.

S 865-054
(10) On the captain's audio select panel, set the switch, in sequence, to the L, C, and R ILS positions.

S 755-055
(11) Make sure you hear the ILS ident tone for the test frequency on the flight compartment speakers for each position. If necessary, adjust the volume on the speakers.

S 715-056
(12) Do the same procedure again for the ident tone at the remaining audio select panels.

S 865-058

(13) On the test set, turn the localizer DDM control clockwise to zero position.

S 755-059

(14) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the localizer pointers are in the center.

S 865-176

(15) Set the MODE switch on the test set to the G/S XTL position.

S 865-061

(16) On the test set, turn the glideslope DDM control counterclockwise to +0.175 DDM.

S 755-060

(17) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the glideslope deviation pointers move down two dots.

S 865-062

(18) On the test set, turn the glideslope DDM control clockwise to -0.175 DDM.

S 755-063

(19) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the glideslope deviation pointers move up two dots.

S 865-064

(20) On the test set, turn the glideslope DDM control counterclockwise to zero.

S 755-065

(21) On the captain's EHSI, first officer's EHSI, and standby attitude indicator, make sure the glideslope pointers are in the center.

S 865-067

(22) Remove the test equipment.

G. Put the Airplane Back to Its Usual Condition

S 865-068

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

INSTRUMENT LANDING SYSTEM OR MULTI-MODE RECEIVER - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ILS or multi-mode receiver, the other is the installation of the ILS or multi-mode receiver.
   B. The three ILS or multi-mode receivers are installed on the E2 rack in the main equipment center.

TASK 34-31-01-004-046

2. Remove the ILS or Multi-Mode Receiver
   A. References
      (1) 20-10-01/401, E/E Rack Mounted Components
   B. Access
      (1) Location Zones
          119/120 Main Equipment Center

   C. Prepare for Removal

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
          (a) 11A3, ILS CENTER or MMR C
          (b) 11E10, ILS L or MMR L
          (c) 11E31, ILS RIGHT or MMR R
   D. Procedure

      S 024-045
      (1) Remove the ILS or multi-mode receiver (AMM 20-10-01).

TASK 34-31-01-404-044

3. Install the ILS or Multi-Mode Receiver
   A. References
      (1) AMM 20-10-01/401, E/E Rack Mounted Components
      (2) AMM 22-00-02/201, Autoflight BITE
      (3) AMM 24-22-00/201, Electrical Power - Control

(4) AMM 34-31-00/501, ILS - Adjustment Test

B. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

C. Prepare for Installation

S 754-005

(1) Make sure these circuit breakers on the P11 panel are open:
- (a) 11A3, ILS CENTER or MMR C
- (b) 11E10, ILS L or MMR L
- (c) 11E31, ILS RIGHT or MMR R

D. Procedure

S 424-043

(1) Install the ILS or multi-mode receiver (AMM 20-10-01).

S 864-007

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
- (a) 11A3, ILS CENTER or MMR C
- (b) 11E10, ILS L or MMR L
- (c) 11E31, ILS RIGHT or MMR R

E. ILS Receiver Test

S 864-008

(1) Supply electrical power (AMM 24-22-00).

S 744-062

(2) AIRPLANES WITH COLLINS GLU-92X MULTI-MODE RECEIVERS (MMR);
Push and release the TEST switch on the MMR.
- (a) Make sure that the following sequence occurs:
  - 1) All lights come on red.
  - 2) The LRU STATUS light changes to green.

3) All lights go off.
4) A light will then come on and stay on for about 30 seconds to show the result of the test as follows:
5) FOR COLLINS MMR GLU-920;
    a) The LRU STATUS light comes on green to show the test passed.
    b) The LRU STATUS light comes on red if any fault is detected.
    c) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receiver.
    d) The ANT FAIL light does not come on during the self test because the antenna monitoring discrete program pin is not set.
6) FOR LEFT/RIGHT COLLINS MMR GLU-925;
    a) The LRU STATUS light comes on green to show the test passed.
    b) The LRU STATUS light comes on red if any fault is detected.
    c) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receiver.
    d) The ANT FAIL light comes on red if a fault is found in the GPS antenna connection.

NOTE: The GS/LOC antennas are connected to the Left/Right MMR, but the GS/LOC antennas monitoring discrete program pins is not set. Failure of GS/LOC antennas does not cause the ANT FAIL light to come on, but results in the MMR output of No Computed Data (NCD).

7) FOR CENTER COLLINS MMR GLU-925;

NOTE: It is normal for the self test to end with the red LRU STATUS and ANT FAIL lights on. This is because the GPS antenna is not connected to the center MMR.

NOTE: The GS/LOC antennas are connected to the Center MMR, but the GS/LOC antennas monitoring discrete program pins is not set. Failure of the GS/LOC antennas does not cause the ANT FAIL light to come on, but results in the MMR output of No Computed Data (NCD).

a) The LRU STATUS light comes on red every time because of the ANT FAIL.
b) The CONTROL FAIL light comes on red if a fault is found in the data supplied to the MMR receiver.
c) The ANT FAIL light comes on red every time because no GPS antenna is connected to the MMR.

S 864-009

(3) Push and hold the TEST switch on the applicable ILS receiver.

NOTE: Collins ILS receivers P/N 622-5221-102 S/N 4766 and below or P/N 822-0282-102 S/N 4764 and below without Collins service bulletin ILS-700-34-20, dated October 15, 1991, and Collins service bulletin ILS-700/700A-34-23, dated August 22, 1995, can fail the BITE test started from the front panel of the ILS receiver when there is no fault. If this condition occurs, do the ILS control panel self-test to make sure of the fault (AMM 34-31-00/501).

S 754-010

(4) Make sure the sequence occurs as follows:
  (a) All the LEDs come on
  (b) All the LEDs go off
  (c) The green LED comes on and stays on.

S 734-012

(5) Do the Maintenance Control Display Panel Test - 30 Current Fault Report (AMM 22-00-02).

S 754-014

(6) Make sure there are no ILS fault messages.

NOTE: No GPS Operation Test - AMM 34-58-00/501 is required for center MMR.

F. Put the Airplane Back to Its Usual Condition.

S 864-013

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

INSTRUMENT LANDING SYSTEM (ILS) CONTROL PANEL - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ILS control panel; the other is the installation of the ILS control panel.
   B. The ILS control panel, M87, is installed on the pilots' aft electronics panel, P8. Electrical connections are at the rear of the control panel.

TASK 34-31-02-004-001

2. Remove the ILS Control Panel
   A. Access
      (1) Location Zones
         211/212 Flight Compartment

   B. Prepare for Removal

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11A3, ILS CENTER or MMR C
         (b) 11E10, ILS L or MMR L
         (c) 11E31, ILS RIGHT or MMR R
   C. Procedure

      S 034-003
      (1) Loosen the screws on the control panel.

      S 014-004
      (2) Move the panel out to get access to the electrical connections.

      S 034-005
      (3) Disconnect the electrical cables.

      S 024-006
      (4) Remove the ILS control panel.

TASK 34-31-02-404-007

3. Install the ILS Control Panel
   A. References
      (1) 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones
         211/212 Flight Compartment

C. Prepare for Installation

S 864-008

(1) Make sure these circuit breakers on the P11 panel are open:
    (a) 11A3, ILS CENTER or MMR C
    (b) 11E10, ILS L or MMR L
    (c) 11E31, ILS RIGHT or MMR R

D. Procedure

S 434-009

(1) Connect the electrical cables to the control panel.

S 424-010

(2) Install the control panel.

S 434-011

(3) Tighten the screws on the control panel.

S 864-012

(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
    (a) 11A3, ILS CENTER or MMR C
    (b) 11E10, ILS L or MMR L
    (c) 11E31, ILS RIGHT or MMR R

E. ILS Control Panel Test

S 864-013

(1) Supply electrical power (AMM 24-22-00).

S 754-014

(2) Make sure all the control panel lights come on.

S 754-015

(3) Make sure these circuit breakers on the P11 panel are closed:
    (a) 11E6, HSI LEFT

(b) 11E27, HSI RIGHT
(c) EFIS (7 locations)

S 864-016

(4) Set the mode select switch on the EFIS control panels to the ILS or APP position.

S 864-017

(5) Select a frequency between 108.10 and 111.95 MHz on the ILS control panel.

S 754-018

(6) Make sure the same ILS frequency display value shows on the captain's EHSI, first officer's EHSI, and the ILS control panel.

S 754-021

(7) Make sure that the control panel (CRS) selection display is the same as the EHIS display.

F. Put the Airplane Back to Its Usual Condition.

S 864-019

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

GLIDE SLOPE (G/S) ANTENNA - REMOVAL/INSTALLATION

1. General
   - A. This procedure has two tasks. One is the removal of the G/S antenna; the other is the installation of the G/S antenna.
   - B. Two glide slope antennas (M250 left and right G/S antenna, M251 center G/S antenna) are installed in the nose radome.

TASK 34-31-03-004-001

2. Remove the G/S Antenna
   - A. References
     - (1) AMM 53-12-01/201, Nose Radome
     - (2) AMM 53-12-05/401, G/S Director Element
   - B. Access
     - (1) Location Zone

111	Radome

   - C. Prepare for Removal

S 864-002

     - (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
       - (a) For the left/right antenna:
         - 1) 11E10, ILS L or MMR L
         - 2) 11E31, ILS RIGHT or MMR R
       - (b) For the center antenna:
         - 1) 11A3, ILS CENTER or MMR C
   - D. Procedure

S 014-008

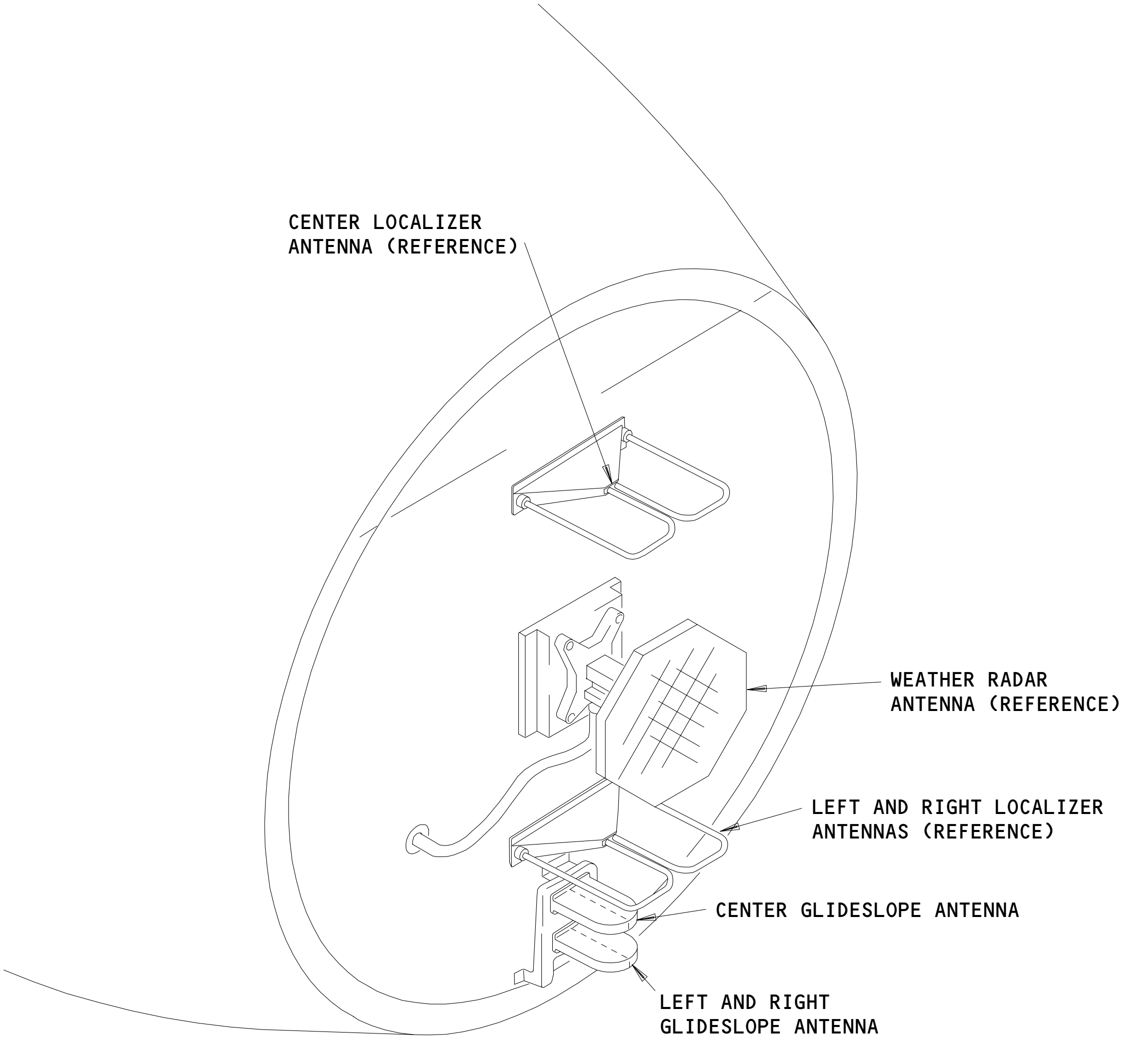
     - (1) Open and lock the nose radome (AMM 53-12-01/201).

NOTE: Inspect the G/S director element before you remove the G/S antenna. It is a 12-inch continuous strip of aluminum foil tape. The strip is located horizontally across the center butt line on the inside surface of the radome. It is approximately 18 inches from the lower edge of the radome.

If the director element is undamaged, go on with the G/S antenna removal. Replace the strip if it is damaged (AMM 53-12-05/401).

S 034-003

     - (2) Loosen the antenna screws.



ILS Dual G/S Antenna Installation
Figure 401

S 034-004
(3) Disconnect the coaxial antenna cable.

S 024-005
(4) Remove the G/S antenna.

TASK 34-31-03-404-006

3. Install the G/S Antenna

A. Equipment
- (1) VOR/ILS Ramp Test Set, NAV402AP (preferred), NAV401L (optional); Instrument & Flight Research Inc, 10200 West York Street, Wichita, KS, 67215
- (2) VOR/ILS Ramp Test Set, T-30-C, D or equivalent
- (3) Resistance measuring bridge or ohmmeter which can measure to .001 ohms

B. Consumable Materials
- (1) B00083 Solvent - TT-N-95 Aliphatic Naphtha.
- (2) G00009 Compound - Corrosion Inhibiting - BMS 3-23

C. References
- (1) AMM 20-10-22/701, Metal Surfaces
- (2) AMM 24-22-00/201, Electrical Power - Control
- (3) AMM 34-21-00/501, Inertial Reference System
- (4) AMM 53-12-01/201, Nose Radome
- (5) SRM 51-20-01, Corrosion Inhibiting Compound

D. Access
- (1) Location Zones

111	Radome
211/212	Flight Compartment

E. Prepare for Installation

S 864-007
(1) Make sure these circuit breakers on the P11 panel are open:
  - (a) For the left/right antenna:
    - 1) 11E10, ILS L or MMR L

2) 11E31, ILS RIGHT or MMR R

(b) For the center antenna:

1) 11A3, ILS CENTER or MMR C

S 214-008

(2) Make sure there is no corrosion on the coaxial connections or the antenna cable.

S 214-009

(3) Make sure the mating surfaces of the antenna and the airplane do not have corrosion.

S 114-010

(4) Clean the mating surfaces with the solvent, TT-N-95 (AMM 20-10-22).

S 624-012

(5) Apply the corrosion inhibiting compound, BMS 3-23, to the faying surfaces of the antenna and the airplane (SRM 51-20-01).

F. Procedure

S 434-013

(1) Connect the coaxial cable to the antenna.

S 424-014

(2) Install the G/S antenna.

S 434-015

(3) Tighten the antenna screws.

S 764-016

(4) Make sure the resistance between the antenna and the airplane is less than .001 ohm.

S 414-017

(5) Unlock and close the nose radome (AMM 53-12-01/201).

S 864-018

(6) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) For the left/right antenna:
    1) 11E10, ILS L or MMR L
    2) 11E31, ILS RIGHT or MMR R
  (b) For the center antenna:
    1) 11A3, ILS CENTER or MMR C

G. G/S Antenna Test

S 864-019

(1) Supply electrical power (AMM 24-22-00/201).

S 754-020

(2) Make sure these applicable circuit breakers on the P11 panel are closed:
  (a) 11A3, ILS CENTER or MMR C
  (b) 11E4, EFIS CONTROL PNL LEFT
  (c) 11E6, HSI LEFT
  (d) 11E10, ILS L or MMR L
  (e) 11E25, EFIS CONTROL PNL RIGHT
  (f) 11E27, HSI RIGHT
  (g) 11E31, ILS RIGHT or MMR R
  (h) 11F8, EFIS SYM GEN LEFT
  (i) 11F9, EFIS SYM GEN CENTER
  (j) 11F29, EFIS SYM GEN RIGHT

S 864-021

(3) Energize and align the IRS system (AMM 34-21-00).

S 864-022

(4) Follow the test set instructions to prepare the test set.

S 864-023

(5) Set the local approved frequency for the test on the ILS control panel.

S 864-024

(6) Set the output of the test set as follows:
  (a) The RF FREQ to the same frequency as on the ILS control panel
  (b) The RF LEVEL to the middle of the scale
  (c) The MODULATION to 30 percent at 1020 Hz (audio tone)
  (d) The DDM to zero for the G/S and the localizer.

S 724-025

(7) Do the left/right antenna test as follows:
  (a) Set the mode select switches on the left and right EFIS control panels in the ILS or APP position.
  (b) Adjust the G/S DDM on the test set to + 0.175 DDM.
  (c) Make sure the G/S deviation pointer on the captain's and first officer's EHSI moves down two dots from the center.

S 724-026

(8) Do the center antenna test as follows:
  (a) Set the mode select switch on the right EFIS control panel in the ILS or APP position.
  (b) Set the EFI switch on the first officer's instrument source select panel to the ALTN position.
  (c) Adjust the G/S DDM on the test set to + 0.175 DDM.
  (d) Make sure the G/S deviation pointer on the first officer's EHSI moves down two dots from the center.
  (e) Set the EFI switch on the first officer's instrument source select panel to the NORM position.

S 864-027

(9) Remove the test set.

H. Put the Airplane Back to Its Usual Condition

S 864-028

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

LOCALIZER (LOC) ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the LOC antenna; the other is the installation of the LOC antenna.
   B. Two localizer antennas (M248 left and right LOC antenna, M249 center LOC antenna) are installed in the nose radome.

TASK 34-31-04-004-001

2. Remove the LOC Antenna
   A. References
      (1) AMM 53-12-01/201, Nose Radome
   B. Access
      (1) Location Zone
         111 Radome

   C. Prepare for Removal

      S 864-002

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) For the left/right antenna:
            1) 11E10, ILS L or MMR L
            2) 11E31, ILS RIGHT or MMR R
         (b) For the center antenna:
            1) 11A3, ILS CENTER or MMR C
   D. Procedure

      S 014-003

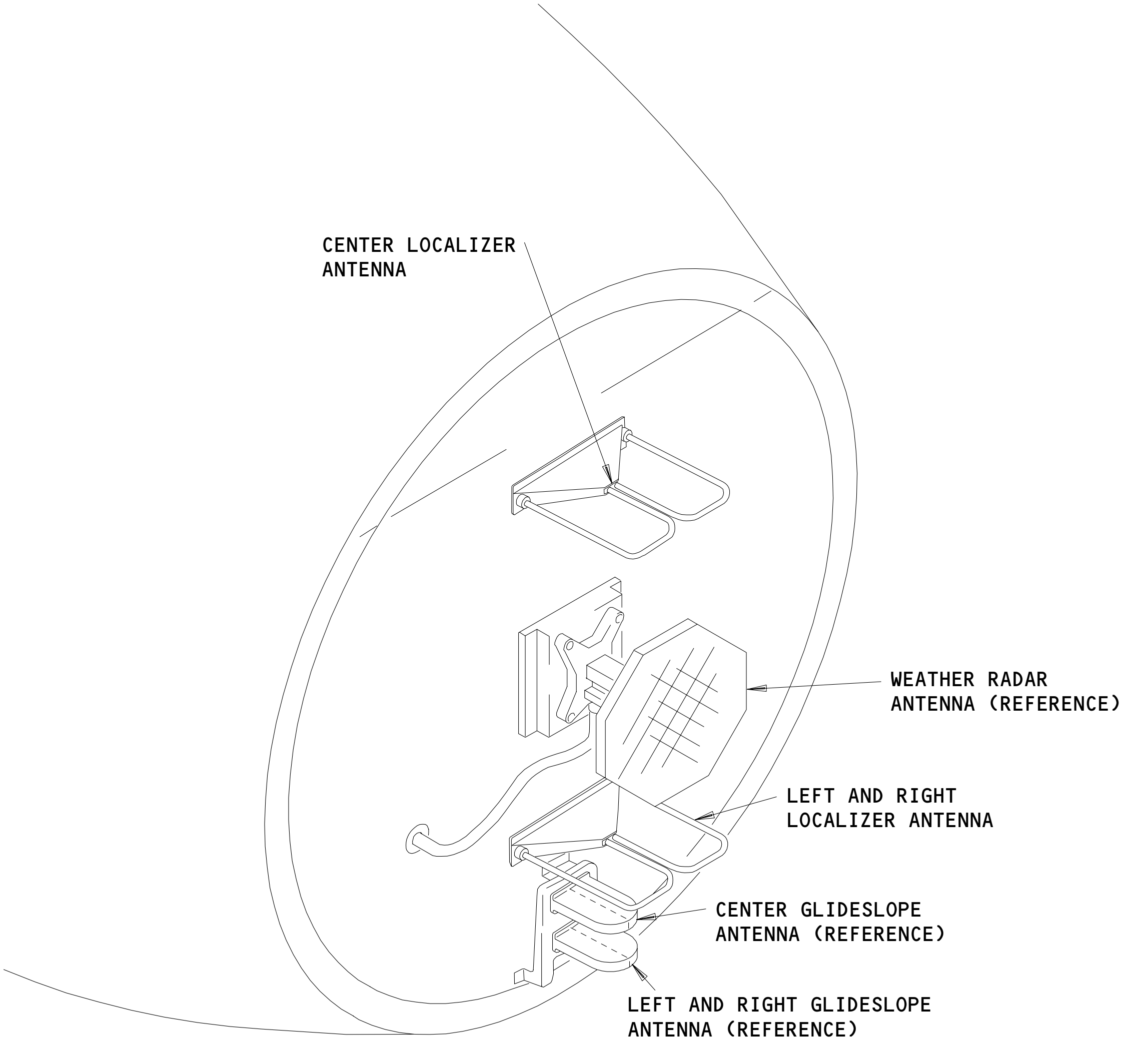
      (1) Open and lock the nose radome (AMM 53-12-01/201).

      S 034-004

      (2) Loosen the antenna screws.

      S 034-005

      (3) Disconnect the coaxial antenna cable.



ILS Dual Loc Antenna Installation
Figure 401

S 024-006

(4) Remove the LOC antenna.

TASK 34-31-04-404-007

3. Install the LOC Antenna

A. Equipment

- (1) VOR/ILS Ramp Test Set, NAV402AP (preferred), NAV401L (optional); Instrument & Flight Research Inc, 10200 West York Street, Wichita, KS, 67215
- (2) VOR/ILS Ramp Test Set, T-30-C, T-30-D or equivalent
- (3) Resistance measuring bridge or ohmmeter which can measure 0.001 ohm

B. Consumable Materials

- (1) B00083 Solvent - TT-N-95 Aliphatic Naphtha.
- (2) G00009 Compound - Corrosion Inhibiting - BMS 3-23

C. References

- (1) AMM 20-10-22/701, Metal Surfaces
- (2) AMM 24-22-00/201, Electrical Power - Control
- (3) AMM 53-12-01/201, Nose Radome
- (4) SRM 51-20-01, Water Displacing Corrosion Prevention Coatings

D. Access

(1) Location Zones

111	Radome
211/212	Flight Compartment

E. Prepare for Installation

S 864-029

(1) Make sure these circuit breakers on the P11 panel are open:
- (a) For the left/right antenna:
  - 1) 11E10, ILS L or MMR L
  - 2) 11E31, ILS RIGHT or MMR R
- (b) For the center antenna:
  - 1) 11A3, ILS CENTER or MMR C

S 214-009
(2) Make sure there is no corrosion on the coaxial connections or the antenna cables.

S 214-010
(3) Make sure the mating surfaces of the antenna and the airplane do not have corrosion.

S 114-011
(4) Clean the mating surfaces with the solvent, TT-N-95 (AMM 20-10-22/701).

S 624-014
(5) Apply the corrosion inhibiting compound, BMS 3-23, to the faying surfaces of the antenna and the airplane (SRM 51-20-01).

F. Procedure

S 434-015
(1) Connect the coaxial cable to the antenna.

S 424-016
(2) Install the LOC antenna.

S 434-017
(3) Tighten the antenna screws.

S 764-018
(4) Make sure the resistance between the antenna and the airplane is less than 0.001 ohm.

S 414-019
(5) Unlock and close the nose radome (AMM 53-12-01/201).

S 864-020
(6) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) For the left/right antenna:
      1) 11E10, ILS L or MMR L
      2) 11E31, ILS RIGHT or MMR R
   (b) For the center antenna:
      1) 11A3, ILS CENTER or MMR C

G. LOC Antenna Test

S 864-021

(1) Supply electrical power (AMM 24-22-00/201).

S 754-022

(2) Make sure these circuit breakers on the P11 panel are closed:
   (a) 11A3, ILS CENTER or MMR C
   (b) 11E10, ILS L or MMR L
   (c) 11E31, ILS RIGHT or MMR R

S 484-030

(3) Put the VOR/ILS Ramp Test Set forward of and close to the nose section.

S 864-023

(4) Follow the test set instructions to prepare the test set.

S 864-024

(5) Set the local approved frequency for the test on the ILS control panel.

S 864-025

(6) Set the output of the test set as follows:
   (a) The RF FREQ to the same frequency as on the ILS control panel
   (b) The RF LEVEL to the middle of the scale
   (c) The MODULATION to 30 percent at 1020 Hz (audio tone)
   (d) The DDM to zero for the LOC and the glide slope.

S 864-031

(7) Set the same test frequency on the ILS control panel that is on the VOR/ILS ramp test set.

S 864-032

(8) On the captain's audio select panel, set the FILTER switch to the BOTH position.

S 724-026

(9) Do the center antenna test as follows:
  (a) On the captain's audio select panel, turn on and adjust the center ILS volume control.
  (b) Adjust the gain control on the captain's flight compartment speaker to get the correct audio signal.

S 724-027

(10) Do the left/right antenna test as follows:
  (a) On the captain's audio select panel, turn on and adjust the left and right ILS volume controls.
  (b) Adjust the gain control on the captain's flight compartment speaker to get the correct audio signal.

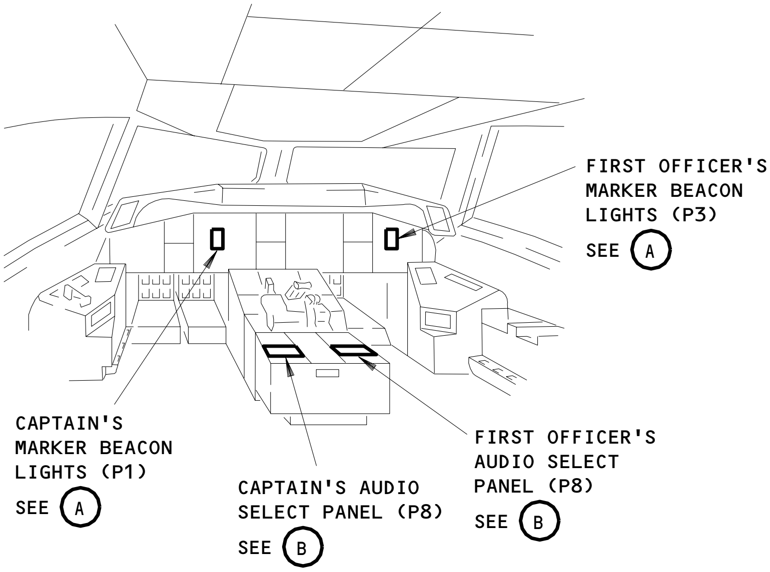
H. Put the Airplane Back to Its Usual Condition

S 864-028

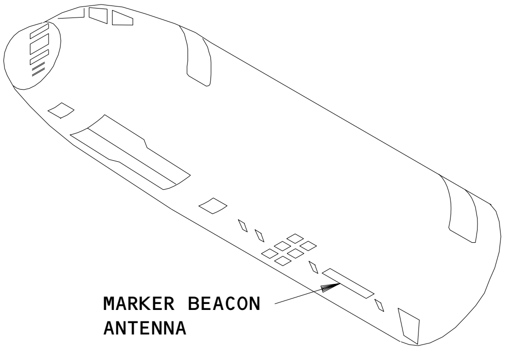
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

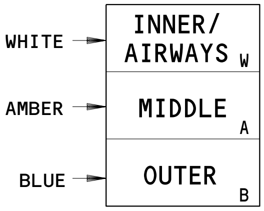
MARKER BEACON SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The marker beacon system provides visual and aural indications when the airplane flies over ground based marker beacon transmitters. The ground stations transmit narrow beams of RF signals modulated with either 400, 1300, or 3000 Hz audio. The signals turn on appropriate lights as the airplane passes over the transmitters. This confirms specific positions during point to point navigation. It also gives positive indication of distance from the runway during a landing approach.
   B. The system consists of a marker beacon receiver module, an antenna, and flight deck marker beacon lights.
2. Component Detail
   A. Marker Beacon Receiver Module
      (1) The active marker beacon module is located in the left VOR receiver (AMM 34-51-00). The VOR receiver is located in the aft equipment center on rack E6-1 or in the main electronic equipment center on rack E3-2. The module in the right VOR receiver is inhibited.
      (2) The marker beacon module receives signals at the standard beacon transmitting frequency of 75 MHz. It detects the audio modulation frequencies of 400 Hz, 1300 Hz, and 3000 Hz. These frequencies indicate passage over the outer, middle and inner markers, respectively. The receiver provides an output signal to drive the appropriate marker beacon light. It also sends the audio signal to the flight interphone system.
   B. The marker beacon system uses dc power provided by the VOR receiver power supply. The VOR receiver is powered by 115 volts ac, 400 Hz from the left VOR/MKR circuit breaker on the P11 panel.
   C. Audio Selector Panel (Interface Component)
      (1) Marker beacon audio tones are routed to all the audio selector panels. The tones are monitored by flight crew headphones or the captain's and F/O's flight deck speakers.
      (2) Marker beacon audio is turned on/off by the MKR switch on the panel.
   D. Antenna
      (1) The marker beacon antenna is shaped like a canoe hull and is flush mounted on the bottom centerline of the fuselage. The antenna receives the 75 MHz marker beacon signal and provides it to the receiver on a 52 ohm coaxial cable.
   E. Marker Beacon Lights
      (1) The marker beacon lights are color coded blue, amber, and white and are labeled OUTER, MIDDLE, and INNER/AIRWAYS, respectively. They come on with detection of the marker audio tones. The blue light comes on with the 400 Hz tone, amber with 1300 Hz, and white with 3000 Hz. Two bulbs light each indicator.
      (2) The two sets of marker beacon lights are located on the captain's panel, P1 and on the first officer's panel, P3.



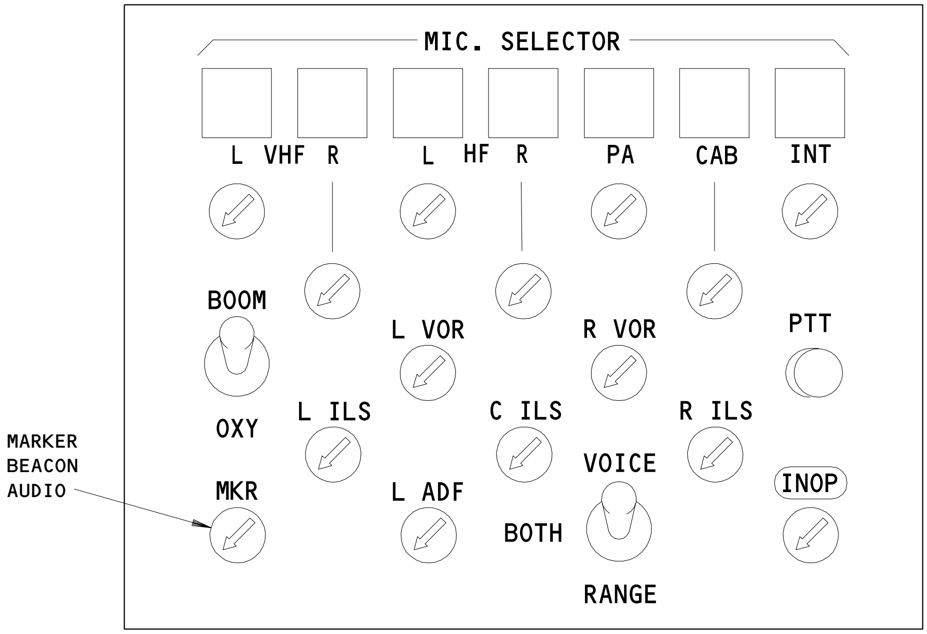
FLIGHT COMPARTMENT





MARKER BEACON LIGHTS

A

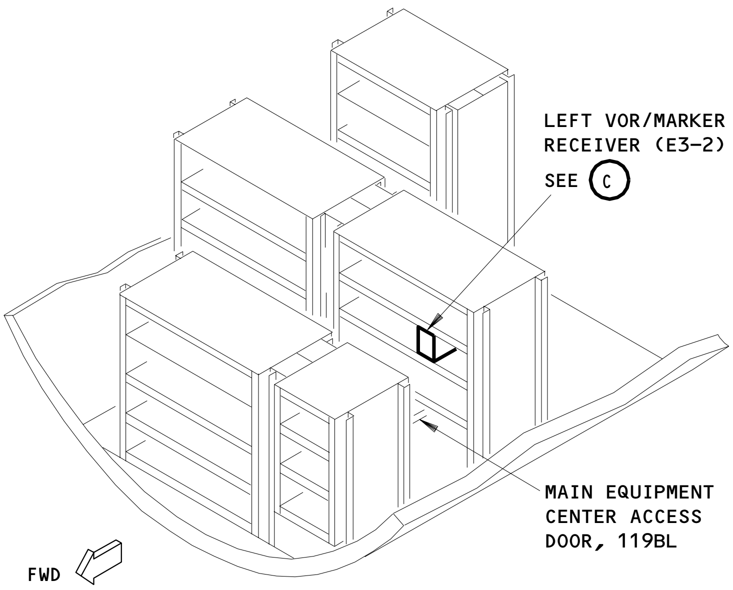


AUDIO SELECTOR PANEL

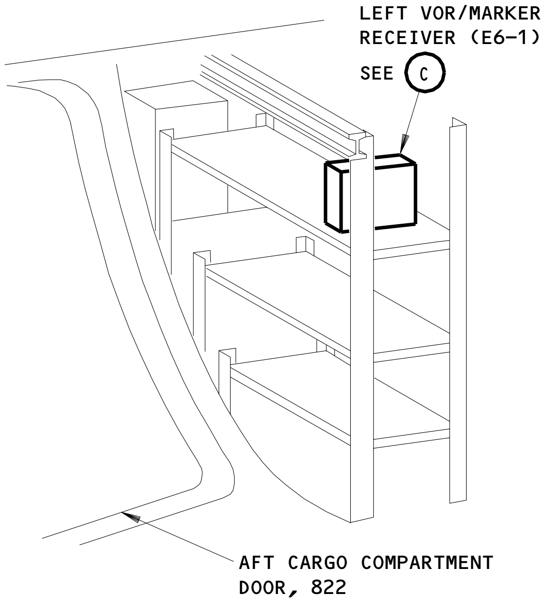
B

Marker Beacon System - Component Location
Figure 1 (Sheet 1)

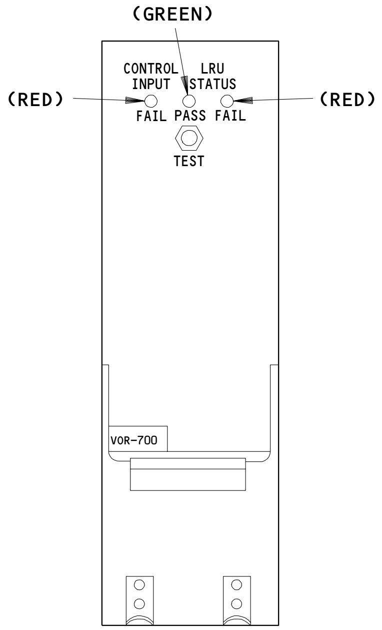
H11512



MAIN EQUIPMENT CENTER 1

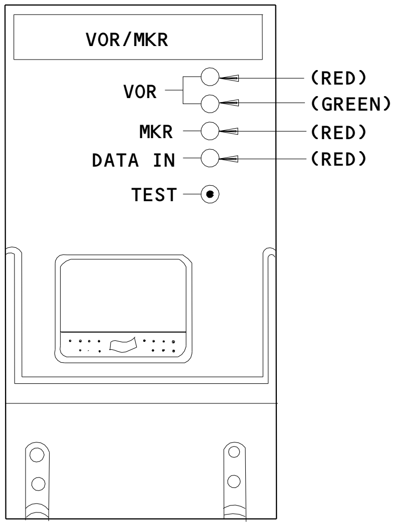


AFT EQUIPMENT CENTER 2



LEFT VOR/MARKER
RECEIVER

C 3



LEFT VOR/MARKER
RECEIVER

C 4

1 AIRPLANES WITH RECEIVER IN MAIN EQUIPMENT CENTER
2 AIRPLANES WITH RECEIVER IN AFT EQUIPMENT CENTER
3 AIRPLANES WITH COLLINS -700 SERIES RECEIVERS
4 AIRPLANES WITH ALLIEDSIGNAL RVA-36A SERIES RECEIVERS

Marker Beacon System - Component Location
Figure 1 (Sheet 2)

3. Operation (Fig. 2)

A. Functional Description

(1) The 75 MHz incoming signal from the antenna is applied to a 75 MHz filter. This filter provides tuning and rejection of unwanted signals. The filter output is applied to a four-stage RF amplifier. A diode detector receives the amplifier output and feeds the demodulated signal to the audio system and the AGC filter. The AGC filter monitors the signal level and maintains a constant output level, through the use of feedback to the RF amplifier.

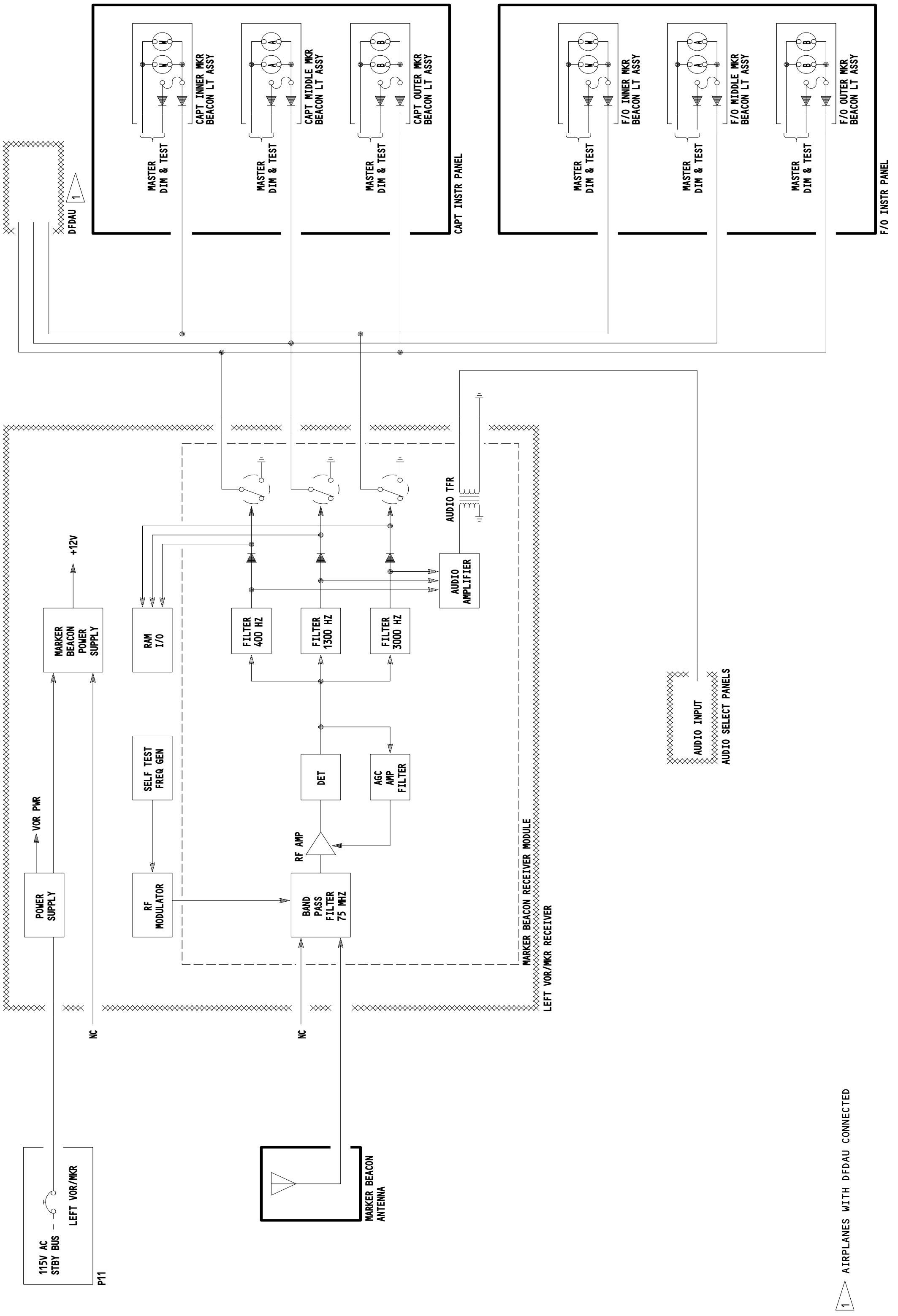
(2) The marker beacon audio system, which receives the signal from the detector, applies the signal to three audio band pass filter circuits. The active filters centered at 400 Hz, 1300 Hz, and 3000 Hz amplify and filter the audio signal and send it to the main audio amplifier, to be output to the audio panels.

(3) The active filters also send the audio signal to diode rectifiers. The dc output from the rectifiers is used to turn on transistor switches. These transistor switches in turn, turn on the appropriate marker beacon lights on the capt's and F/O's panel. The power to the lights is supplied by the master dim and test circuit (Ref 33-16-01).

(4) The 75 MHz incoming signal from the antenna is applied to the marker beacon RF receiver. The signal is applied to a 75 MHz crystal filter at the input to the receiver. The filter provides receiver tuning and rejection of undesired frequencies. The receiver detects the audio modulation present at marker beacon stations.

(5) The RF receiver provides an audio output of 400 Hz, 1300 Hz, or 3000 Hz depending upon whether the outer, middle, inner, or airway marker is being crossed. This output is applied to the threshold sensor. The sensor determines when the amplitude of the output signal is sufficient to light the marker lamps. The threshold sensitivity is adjustable on the bench by the LO SENS ADJ control. The HI SENS ADJ is inoperative.

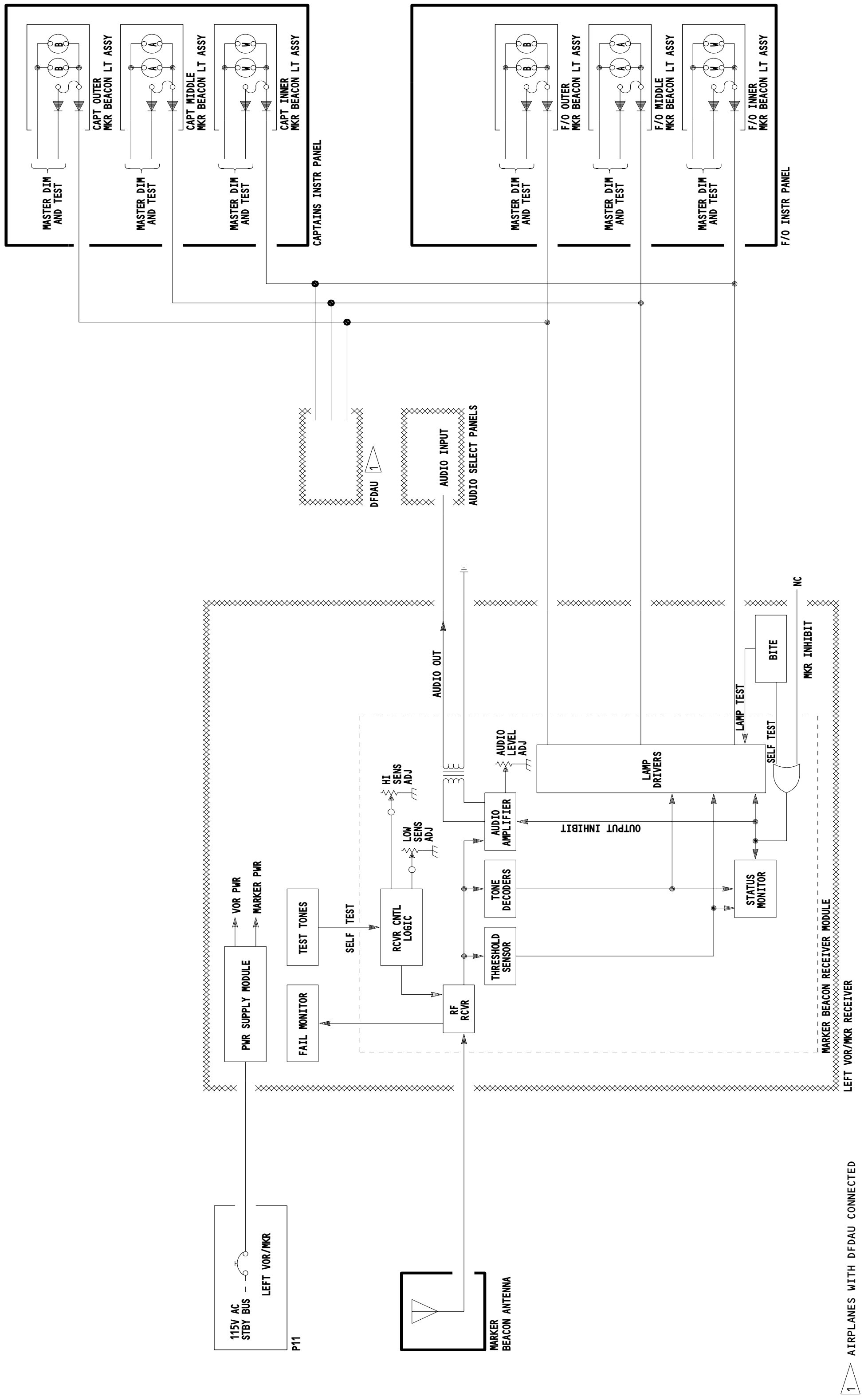
(6) The tone decoders count the audio frequency to find which of the modulation frequencies is present. This is done so that the appropriate light can be illuminated. The outputs of the threshold sensor and tone decoders are applied to the lamp drivers which consists of three transistor switches. Based upon the levels of the threshold sensor and the tone decoder inputs, the appropriate lamp circuit is completed through the associated switch. The lamp power is supplied by the master dim and test circuit. The lamp drivers can be held off by an output inhibit from the OR gate. The OR gate is controlled by the VOR receiver CPU.



1 AIRPLANES WITH DFDAU CONNECTED

Marker Beacon System Schematic
Figure 2 (Sheet 1)

S90640



Marker Beacon System Schematic
Figure 2 (Sheet 2)

F48021

(7) The sensor monitor checks the outputs of the threshold sensor, tone decoders, and OR gate. From these inputs, the monitor develops a digital status signal which is routed to the CPU. This signal informs the CPU of the marker receiver status.

(8) The aural outputs from the RF receiver are filtered by 400, 1300, and 3000 Hz filters prior to further amplification in the final audio amplifier. The audio amplifier provides the gain needed to supply the four audio selector panels. Audio output in adjustable on the bench by the AUDIO LEVEL ADJ control on the module.

(9) For the 400 Hz outer marker, the tone output is continuous dashes (----). For the 1300 Hz middle marker signal, the tone output is alternating dots and dashes (-.-.-.). For the 3000 Hz inner marker, the tone output is continuous dots (....). The airways markers are also 3000 Hz and they are coded with the station identification letters.

B. BITE

(1) The VOR built-in test equipment (BITE) continuously monitors marker beacon module performance. The lights on the receiver front panel will indicate system status.

(2) AIRPLANES WITH VOR-700 OR VOR-900 SERIES RECEIVERS;
This wrap around test simulates receiver operation, turning on the marker beacon lights and audio.

(3) AIRPLANES WITH RVA-36A SERIES RECEIVERS;
This wrap around test simulates receiver operation, turning on the marker beacon lights and audio.

(4) AIRPLANES WITH ALLIEDSIGNAL RVA-36A SERIES MARKER BEACON RECEIVERS;
All LEDs will come on when the TEST switch on the left VOR receiver front panel is first pressed. After 2 to 3 seconds all LEDs will go out. Then after another 2 to 3 seconds, one of the LEDs will come on. The LEDs indicates as follow:
  (a) A green VOR LED indicates no fault.
  (b) A red MKR LED indicates a marker beacon receiver fault.
  (c) A red VOR LED indicates a VOR/MKR receiver fault.
  (d) A red DATA IN LED is relative only to VOR circuitry (Ref 34-51-00). It indicates no data or invalid data from the selected tuning source.

(5) When the front panel TEST switch is pressed, three marker tones are generated sequentially by BITE. They are used to modulate a test carrier in the marker receiver. A feedback path is inserted from the last rf amplifier to the receiver input. This causes the receiver to oscillate at 75 MHz.

(6) AIRPLANES WITH VOR-700 SERIES RECEIVERS;
All LEDS will come on when the TEST switch on the left VOR receiver front panel is first pressed. After 2 to 3 seconds all LEDS will go out. Then after another 2 to 3 seconds, one of the LEDS will come on. The LEDS indicates as follows:
  (a) A green LRU STATUS-PASS LED indicates no fault.
  (b) A red LRU STATUS-FAIL LED indicateds a VOR/MKR receiver failure.
  (c) A red CONTROL INPUT FAIL LED is relative only to VOR circuitry (ref 34-51-00). It indicates invalid data from the selected turning source.

(7) AIRPLANES WITH RVA-36A OR RVA-36B SERIES RECEIVERS;
All faults detected during flight are stored in a flight fault memory (Ref 34-51-00). If a fault exists intermittently, it will not affect status of the receiver lights during the BITE test unless the fault exists during the test. However, if two or more identical faults are stored in the flight fault memory from at least two of the last four flight segments, the front panel lights will show a failed condition.

(8) AIRPLANES WITH COLLINS MARKER BEACON RECEIVERS;
all faults detected during flight are stored in a flight fault memory (Ref 34-51-00). If a fault exists intermittently, it will not effect status of the receiver lights during the BITE test unless the fault exists during the test.
  (a) AIRPLANES WITH VOR-700 OR VOR-900 SERIES RECEIVERS;
  The marker beacon LIGHTS AND audio IN THE COCKPIT also comes on continuously while the test button is pressed.

(9) AIRPLANES WITH RVA-36A SERIES RECEIVERS;
The marker beacon lights in the cockpit come on continuously while the test button is pressed.

C. Control

(1) There are no operating controls for the marker beacon. To turn power on to the receiver, perform the following:
  (a) Provide electrical power (AMM 24-22-00/201).
  (b) Make sure that the following overhead panel P11 circuit breaker is closed:
    1) 11A2, VOR/MKR L

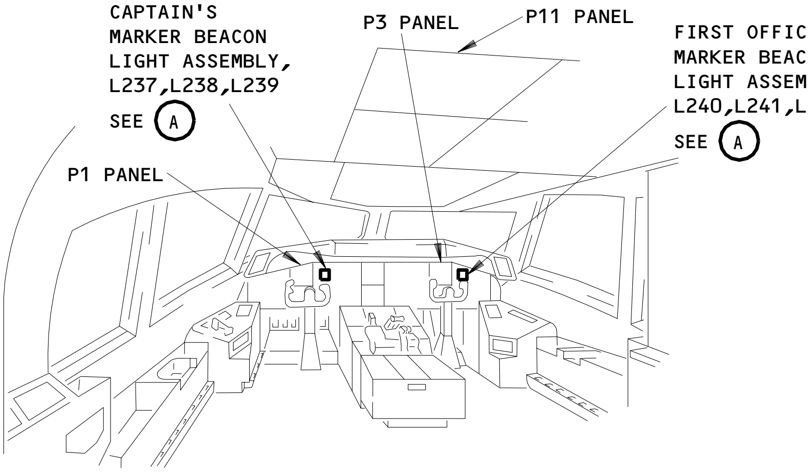
MARKER BEACON SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - MARKER BEACON, M243	1	1	BOTTOM FWD FUSELAGE	34-32-01
CIRCUIT BREAKER -	1		FLT COMPT, P11	
VOR MKR LEFT, C595		1	11A2	*
LIGHT - CAPT INNER MKR BEACON LT ASSY, L237	1	1	FLT COMPT, P1	*
LIGHT - CAPT MIDDLE MKR BEACON LT ASSY, L238	1	1	FLT COMPT, P1	*
LIGHT - CAPT OUTER MKR BEACON LT ASSY, L239	1	1	FLT COMPT, P1	*
LIGHT - F/O INNER MKR BEACON LT ASSY, L240	1	1	FLT COMPT, P3	*
LIGHT - F/O MIDDLE MKR BEACON LT ASSY, L241	1	1	FLT COMPT, P3	*
LIGHT - F/O OUTER MKR BEACON LT ASSY, L242	1	1	FLT COMPT, P3	*
PANEL - (REF 23-51-00, FIG. 101)				
CAPT AUDIO SELECTOR, M70				
F/O AUDIO SELECTOR, M71				
OBS AUDIO SELECTOR, M98				
SUPERNUMERATOR AUDIO SELECTOR, M10216 3				
RECEIVER - VOR/MKR L, M186	2	1	822, AFT CARGO COMPT, E6-1 1 ; 119BL, MAIN EQUIP CTR, E3-2 2	34-51-01
UNIT - (FIM 31-31-00/101)				
DIGITAL FLIGHT DATA ACQUISITION, M138 4				

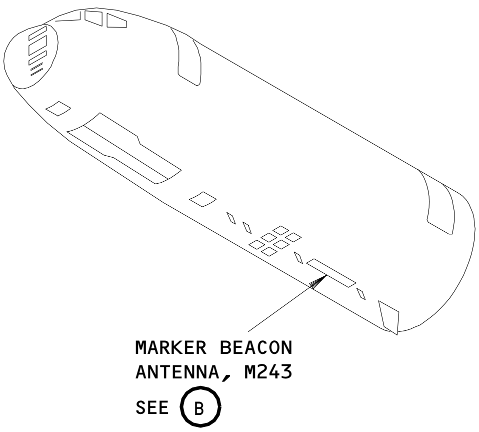
* SEE THE WDM EQUIPMENT LIST

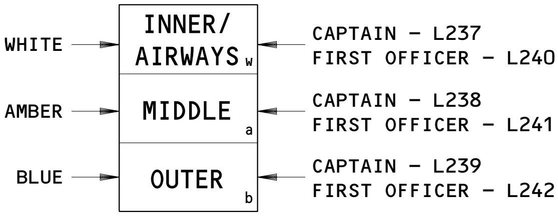
1 AIRPLANES WITH RECEIVER IN AFT EQUIPMENT CENTER
2 AIRPLANES WITH RECEIVER IN MAIN EQUIPMENT CENTER
3 AIRPLANES WITH SUPERNUMERTOR
4 AIRPLANES WITH DFDAU

Marker Beacon System - Component Index
Figure 101



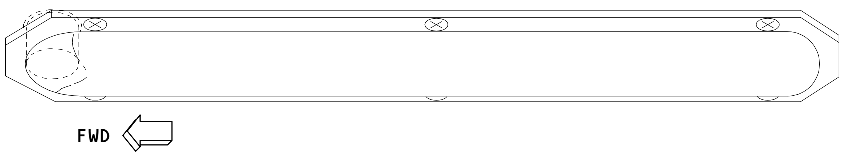
FLIGHT COMPARTMENT





MARKER BEACON LIGHTS

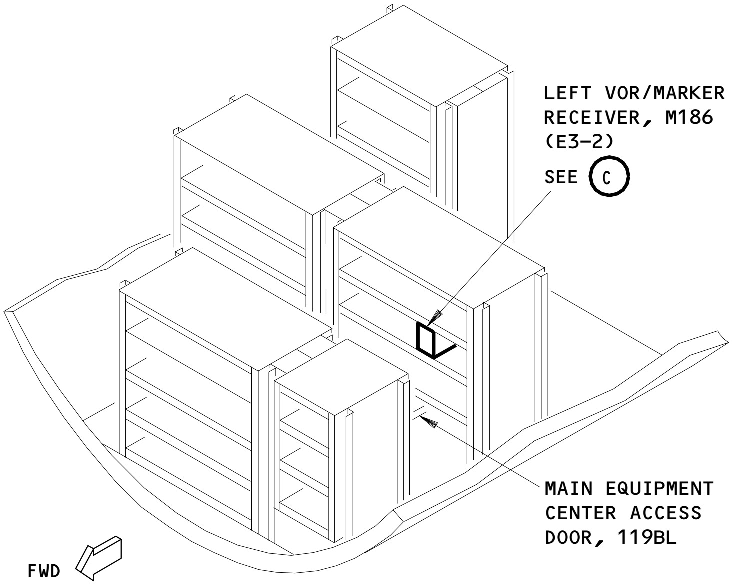
A



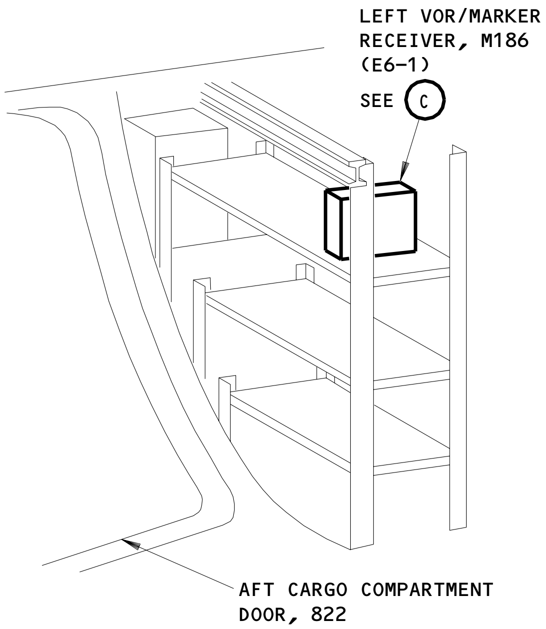
MARKER BEACON ANTENNA, M243

B

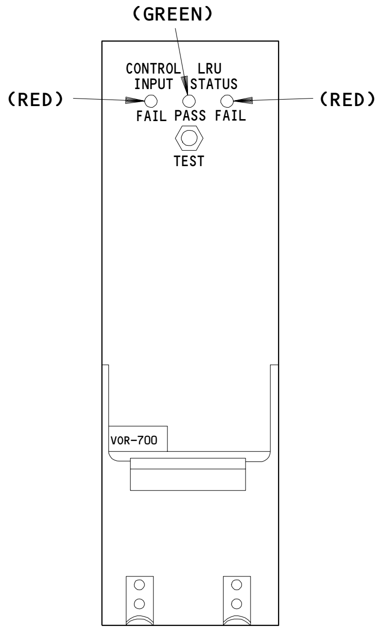
Marker Beacon System - Component Location
Figure 102 (Sheet 1)



MAIN EQUIPMENT CENTER 1

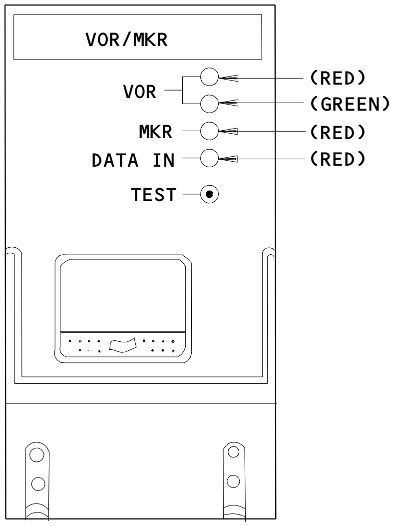


AFT EQUIPMENT CENTER 2



LEFT VOR/MARKER
RECEIVER, M186

C 3



LEFT VOR/MARKER
RECEIVER, M186

C 4

1 AIRPLANES WITH RECEIVER IN MAIN EQUIPMENT CENTER
2 AIRPLANES WITH RECEIVER IN AFT EQUIPMENT CENTER
3 AIRPLANES WITH COLLINS -700 SERIES RECEIVERS
4 AIRPLANES WITH ALLIEDSIGNAL RVA-36A SERIES RECEIVERS

Marker Beacon System - Component Location
Figure 102 (Sheet 2)

MARKER BEACON SYSTEM - ADJUSTMENT/TEST

1. General
   A. The marker beacon adjustment/test procedure has two tasks. One is an operational test; the other is a system test. The operational test is a fast check for proper operation of the system. It uses only the VOR test switch to do the test. The system test uses test equipment and is a full check of the marker beacon system.

TASK 34-32-00-715-026

2. Operational Test - Marker Beacon System
   A. General
      (1) The operational test makes sure the proper indicators come on when the test switch on the VOR receiver is pushed. These indications include the panel lights, the VOR receiver lights, and the self-test audio tone.
   B. Equipment
      (1) Flight Interphone Headset
   C. References
      (1) AMM 23-51-00/501, Flight Interphone System
      (2) AMM 24-22-00/201, Electrical Power - Control
   D. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   E. Prepare for the Operational Test

S 865-001

(1) Supply electrical power (AMM 24-22-00/201).

S 865-039

(2) Make sure the flight interphone system is serviceable (AMM 23-51-00/501).

S 755-002

(3) Make sure this circuit breaker on the overhead circuit breaker panel, P11, is closed:
    (a) 11A2, VOR/MKR L

S 865-003

(4) On the captain's and first officer's audio selector panel, set the controls as follows:
    (a) The MKR control to the ON position

(b) The other switches to the OFF position
(c) The volume control to a minimum
(d) The filter switch to the BOTH position.

S 865-005

(5) Connect the headphones (AMM 23-51-00/501).

F. Procedure

S 745-051

(1) AIRPLANES WITH RVA-36A OR VOR-700 SERIES RECEIVERS;
Push and Hold the TEST switch on the left VOR/MKR receiver.

S 755-057

(2) Make sure this sequence of visual indications occurs:

<u>NOTE</u>: On airplanes with Collins VOR/MKR receivers, the marker beacon audio tone will also comes on.

(a) AIRPLANES WITH RVA-36A SERIES RECEIVERS;
Refer to the table that follows:

TIME(SEC)	VOR RCVR LIGHTS	SIX MKR BEACON LIGHTS
0	OFF	OFF
1-3	ALL ON	ON
4-5	OFF	ON
6-9	GREEN ON	ON
10	OFF	OFF

(b) AIRPLANES WITH VOR-700 SERIES RECEIVERS;
Refer to the table that follows:

TIME(SEC)	VOR RCVR LIGHTS	SIX MKR BEACON LIGHTS
0	OFF	OFF
1-3	ALL ON	ON
4-6	OFF	ON
7-16	GREEN ON	ON
17	OFF	OFF

G. Put the Airplane Back to Its Usual Condition

S 865-007

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-32-00-735-027

3. System Test - Marker Beacon System

A. General

(1) The system test uses a signal generator as a marker beacon ground transmitter during the test.

B. Equipment

(1) VOR/ILS Ramp Test Set, Instrument Flight Research NAV401L
Instruments & Flight Research, Inc.
10200 West York Street
Wichita, KA 67215

(2) VOR/ILS Ramp Test Set, Instrument Flight Research NAV402AP
Instruments & Flight Research, Inc.
10200 West York Street
Wichita, KA 67215

(3) Flight Interphone Headset

C. References

(1) AMM 23-51-00/501, Flight Interphone System
(2) AMM 24-22-00/201, Electrical Power - Control

D. Access

(1) Location Zones

123/124	Area Below Forward Cargo Compartment (Exterior)
211/212	Flight Compartment

E. Prepare for the System Test

S 865-008

(1) Put the signal generator directly beneath the marker beacon antenna.

S 865-009
(2) Activate the signal generator, and permit time for it to become warm.

<u>NOTE</u>: You can put the test antenna as close to the aircraft's antenna as necessary to get the best power transfer.

F. Procedure

S 715-010
(1) Do the Marker Beacon System - Operational Test.

S 485-041
(2) Make sure the flight interphone headset is connected. (AMM 23-51-00/501).

S 745-028
(3) Push and hold the IND LIGHTS test switch on the overhead panel, P5, for at least five seconds.

S 755-012
(4) Make sure the OUTER (blue), MIDDLE (yellow), and INNER/AIRWAYS (white) marker beacon lights on the captain's and first officer's instrument panels come on.

S 745-029
(5) Release the IND LIGHTS test switch.

S 865-014
(6) Apply a 75 MHz signal with 400 Hz modulation from the signal generator.

S 755-015
(7) Make sure the two OUTER marker lights come on.

S 755-016
(8) Make sure a 400 Hz tone is heard through the flight interphone headset.

S 865-017
(9) Change the modulation to 1300 Hz.

S 755-018
(10) Make sure the two MIDDLE marker lights come on.

S 755-019
(11) Make sure a 1300 Hz tone is heard through the flight interphone headset.

S 865-020

(12) Change the modulation to 3000 Hz.

S 755-021

(13) Make sure the two INNER/AIRWAYS marker lights come on.

S 755-022

(14) Make sure a 3000 Hz tone is heard through the flight interphone headset.

G. Put the Airplane Back to Its Usual Condition

S 865-023

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

MARKER BEACON ANTENNA - REMOVAL/INSTALLATION

1. General

A. This procedure has two tasks. One is the removal of the marker beacon antenna; the other is the installation of the marker beacon antenna.

B. The marker beacon antenna is installed on the bottom of the fuselage at station 643.

TASK 34-32-01-004-001

2. Remove the Marker Beacon Antenna

A. Access

(1) Location Zones

123/124	Area Below Forward Cargo Compartment (Exterior)

B. Prepare for Removal

S 864-002

(1) Open this circuit breaker on the overhead circuit breaker panel, P11, and attach a DO-NOT-CLOSE tag:

(a) 11A2, VOR/MKR L

C. Procedure

S 034-003

(1) Remove the screws from the antenna base.

S 034-025

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(2) Use force around the antenna until the seal is fully broken (AMM 51-31-01/201).

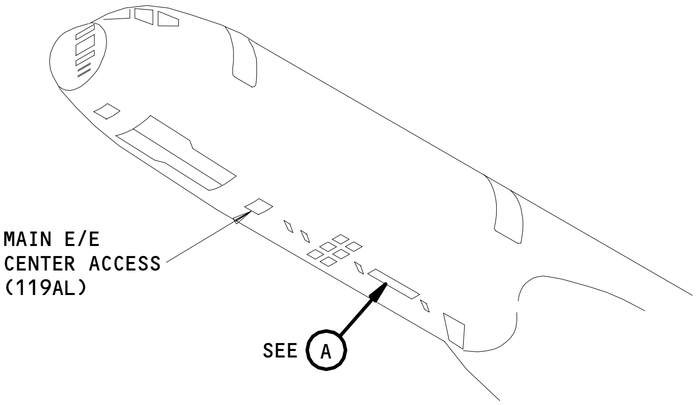
S 014-026

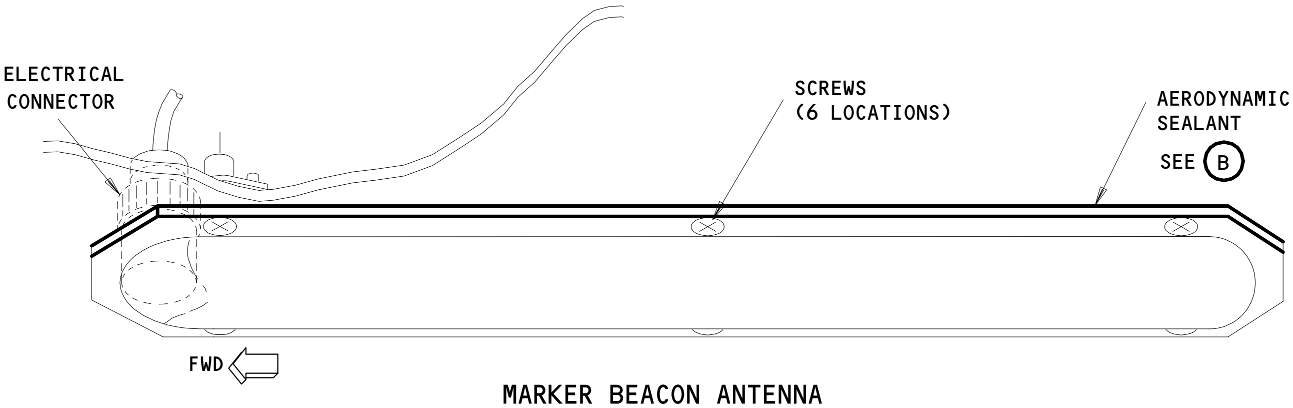
CAUTION: LOWER THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLE. DAMAGE TO THE ANTENNA CABLE CAN OCCUR IF YOU PULL THE CABLE.

(3) Lower the antenna until you can get access to the antenna cable connector.

S 034-006

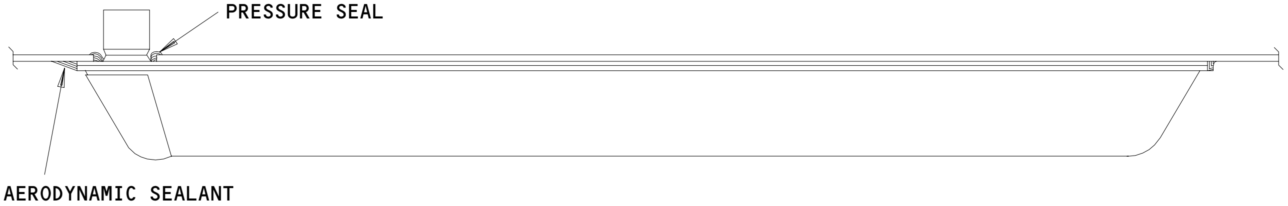
(4) Disconnect the antenna cable.





MARKER BEACON ANTENNA

Ⓐ



AERODYNAMIC SEALANT

Ⓑ

Marker Beacon Antenna Installation
Figure 401

S 024-007

(5) Remove the marker beacon antenna.

TASK 34-32-01-404-008

3. Install the Marker Beacon Antenna (Fig. 401)

A. Equipment

(1) VOR/ILS Ramp Test Set, Instrument Flight Research NAV402AP:
Instrument and Flight Research, Inc.
10200 West York Street
Wichita, KA 67215

(2) VOR/ILS Ramp Test Set, T-30-C, T-30-D or equivalent

B. Consumable Materials

(1) A00247 Sealant - BMS 5-95, Class B 1/2
(2) B00184 Solvent - BMS 11-7
(3) G00034 Cheese Cloth - lint free

C. References

(1) AMM 20-10-22/701, Metal Surfaces
(2) AMM 24-22-00/201, Electrical Power - Control
(3) AMM 51-21-03/701, Corrosion Removal and Control
(4) AMM 51-31-01/201, Seals and Sealing

D. Access

(1) Location Zones
123/124 Area Below Forward Cargo Compartment

E. Prepare for Installation

S 754-009

(1) Make sure this circuit breaker on the P11 panel is open:
(a) 11A2, VOR MKR LEFT

F. Procedure

S 634-049

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO REMOVE THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(1) Remove the sealant from the airplane skin in the antenna area (AMM 20-10-22/701, AMM 51-31-01/201).

S 114-011

(2) Clean the mating surface with the solvent, BMS 11-7, and a clean rag (AMM 51-21-03/701).

S 434-012

(3) Connect the coaxial cable to the antenna.

S 424-027

CAUTION: TIGHTEN THE SCREWS MANUALLY TO THE CORRECT TORQUE VALUE. USE OF POWER OR AIR TOOLS TO TIGHTEN THE SCREWS CAN CAUSE DAMAGE TO THE ANTENNA SURFACE.

(4) Put the new antenna into position on the airplane surface and tighten the screws manually to 15 pound-inches of torque.

S 394-050

CAUTION: OBEY THE INSTRUCTIONS IN THE PROCEDURE TO APPLY THE SEALANT. IF YOU DO NOT OBEY THE INSTRUCTIONS, DAMAGE TO THE AIRPLANE SURFACE CAN OCCUR.

(5) Apply the weather aerodynamic sealant, BMS 5-95, to the outer edge of the antenna (AMM 51-31-01/201).

S 144-015

(6) Remove the unwanted sealant from around the antenna base (AMM 51-31-01/201).

S 014-016

(7) Remove the forward cargo floor panels and the insulation above the antenna to get to the antenna skin.

S 624-017

(8) Apply a fillet seal around the electrical connector as shown in Fig. 401 (AMM 51-31-01/201).

G. Resistance Check

S 764-046

(1) Do a check of the continuity between the antenna and the airplane skin (SWPM 20-20-00).
    (a) Connect the bonding meter between the head of each screw and the airplane skin.
        1) Make sure each measurement of continuity is less than 25 milliohms.

S 624-047

(2) Apply the weather aerodynamic sealant, BMS 5-95, to the head of each screw (AMM 51-31-01/201).

S 864-048

(3) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel:
  (a) 11A2, VOR/MKR L

TASK 34-32-01-344-076

4. Marker Beacon Antenna Test

A. Procedure

S 864-019

(1) Supply electrical power (AMM 24-22-00/201).

S 864-028

(2) Make sure this circuit breaker on the P11 panel is closed:
  (a) 11P2, L IND LTS 2

S 864-020

(3) Put the signal generator approximately 15 feet from the marker beacon antenna.

S 864-021

(4) Activate the signal generator and permit time for it to become warm.

S 864-022

(5) Set the signal generator to a 75 MHz signal with 400 Hz modulation.

S 754-023

(6) Make sure the marker beacon light, OUTER, on the captain's instrument panel comes on.

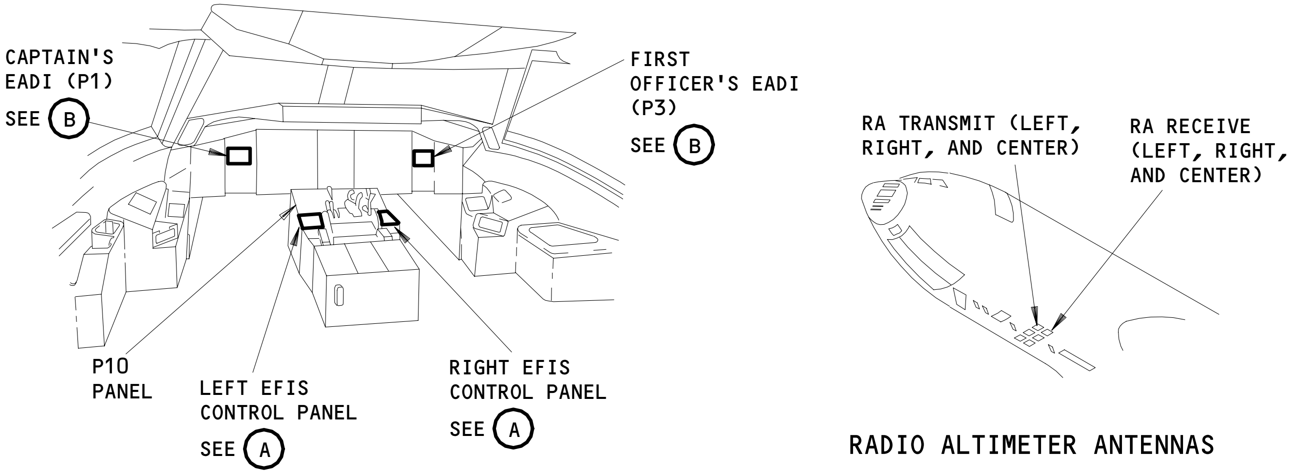
B. Put the Airplane Back to Its Usual Condition

S 864-024

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

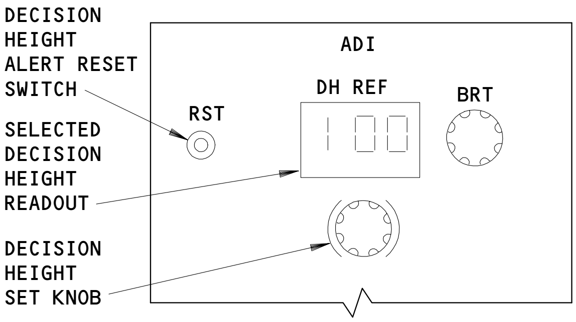
RADIO ALTIMETER - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   - A. The radio altimeter (RA) system supplies vertical position data for use by the pilots for runway approach, landing, and takeoff. The RA system provides accurate measurement of absolute altitude (height above terrain) from 2500 ft. to touchdown. Altitude data is routed to user systems on 429 digital data buses. Altitude data is displayed on the electronic attitude director indicators (EADIs).
   - B. Three complete systems are installed. Each system consists of a receiver/transmitter (R/T), and one transmit and one receive antenna.
2. Component Detail (Fig. 1)
   - A. Receiver/Transmitter
     - (1) The left, center and right R/T units are installed in the main electronic equipment center on rack E5, shelves 1, 2, and 3.
     - (2) The R/T unit transmits and receives a signal to compute height above the terrain. It outputs the computed altitude on an ARINC 429 data bus to the user systems.
     - (3) The R/T front panel monitor lights and manual test switch operate as follows:
       - (a) The TEST switch initiates a self-test which checks the R/T circuits and antennas.
       - (b) The R/T status lights come on for the manual test only. The green light indicates a go condition and the red light a no-go condition.
       - (c) GUI 002-008, 010-114, 116-999;
         When the front panel test switch is pressed, the indicators come on momentarily to show that they all work. At the end of the test, if the green LRU STATUS PASS indicator stays on and the other indicators go out, the R/T has passed the self-test. If the red LRU STATUS FAIL indicator comes on, the R/T is faulty. If the red ANT light comes on, an antenna or the antenna coaxial cable is faulty. The red IND light is not used.
       - (d) GUI 001, 009, 115;
         When the front panel test switch is pressed, the indicators will come on for 3 seconds to show that they work. They will then all extinguish for 3 seconds. After this period, if the green R/T indicator comes on and the red indicators stay off, the R/T has passed the self-test. If either the red R/T or ANT indicator light comes on, the R/T or one of the antennas are faulty. The IND light is disabled.



RADIO ALTIMETER ANTENNAS

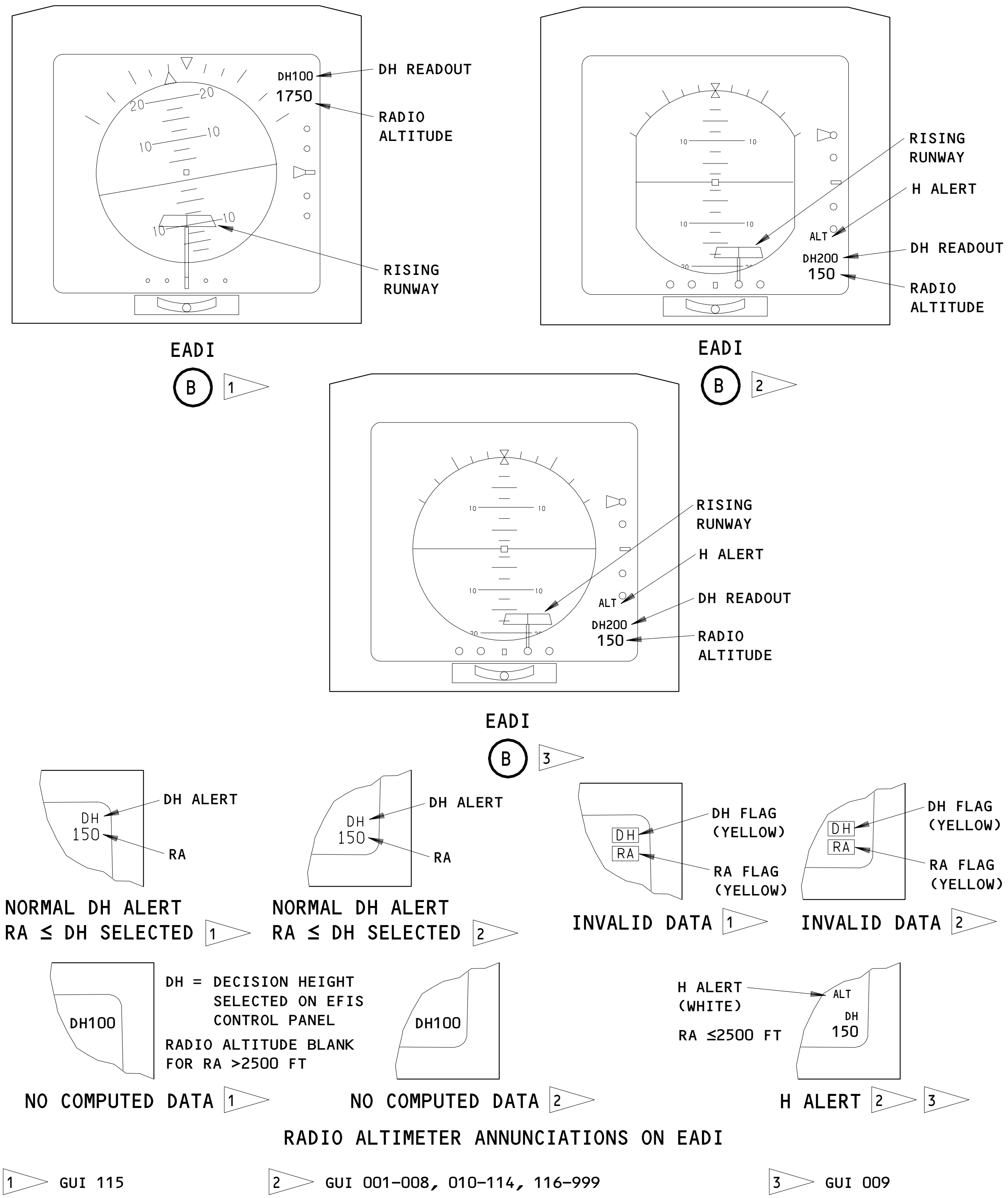
FLIGHT COMPARTMENT



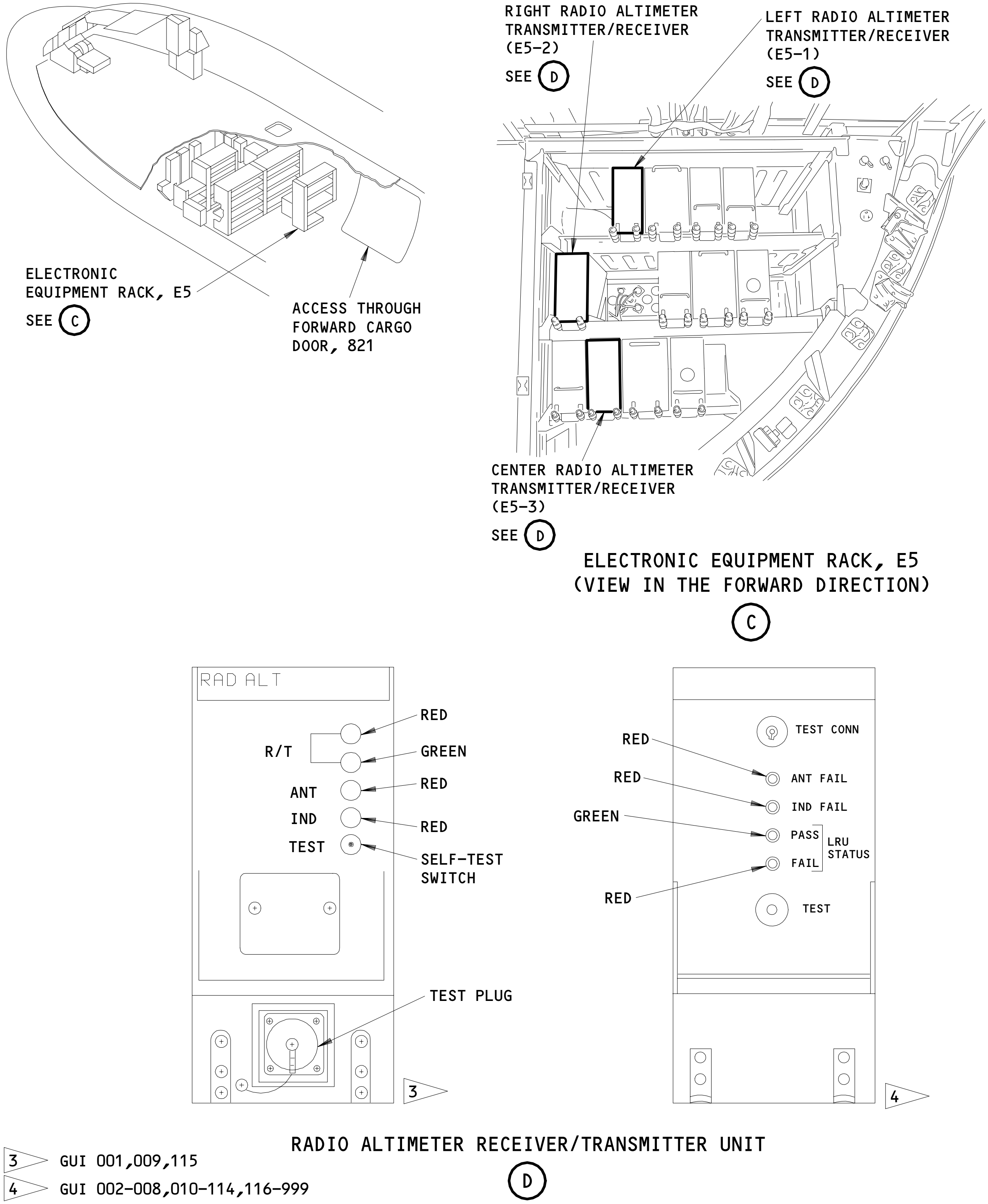
EFIS CONTROL PANEL

A

Radio Altimeter System - Component Location
Figure 1 (Sheet 1)



Radio Altimeter System - Component Location
Figure 1 (Sheet 2)



Radio Altimeter System - Component Location
Figure 1 (Sheet 3)

(4) A line maintenance test connector on the lower portion of the front panel is used to connect a test set for system checks.

B. Antennas

(1) Each R/T has a transmit and receive antenna. They are identical microstrip units with a characteristic impedance of 50 ohms.

(2) The receiver and transmit antennas are installed on the bottom of the fuselage.

C. EFIS Control Panel (RA Related Functions)

(1) The EFIS control panel provides selection of the decision height (DH). DH can be selected from -20 to +999 ft. by turning the DH SELECT knob. DH is read from the 3-digit DH REF LCD display. The RST switch when pressed terminates DH alert. (Ref 34-22-00).

(2) The EFIS control panels are located on the pilots' aft control stand, P10.

D. EADI

(1) GUI 115;
Radio altitude and DH data is displayed in the upper right corner of the EADIs.

(2) GUI 001-114, 116-999;
Radio altitude and DH data is displayed in the lower right corner of the EADIs.

(3) For the radio altitude display, the numerics are white for RA > DH and yellow for RA ≤ DH. A blank space replaces the numerics for altitudes above +2500 and other no computed data conditions. Invalid data is annunciated by replacing the normal display with the letters RA in yellow outlined by a yellow box (Ref 34-22-00).

(4) For the DH display, the DH letters plus the selected DH value are displayed in green above the radio altitude display when RA > DH. When RA equals the selected DH, large yellow DH letters only are displayed. The DH letters will flash for three seconds after they first appear. Yellow DH letters outlined by a yellow box are displayed for invalid conditions. For no computed data conditions, the last valid DH value is displayed (Ref 34-22-00).

(5) GUI 001-114, 116-999;
The white letters ALT are displayed in the lower right corner of the EADI when the EFIS detects a descending RA below 2500 ft (Ref 34-22-00).

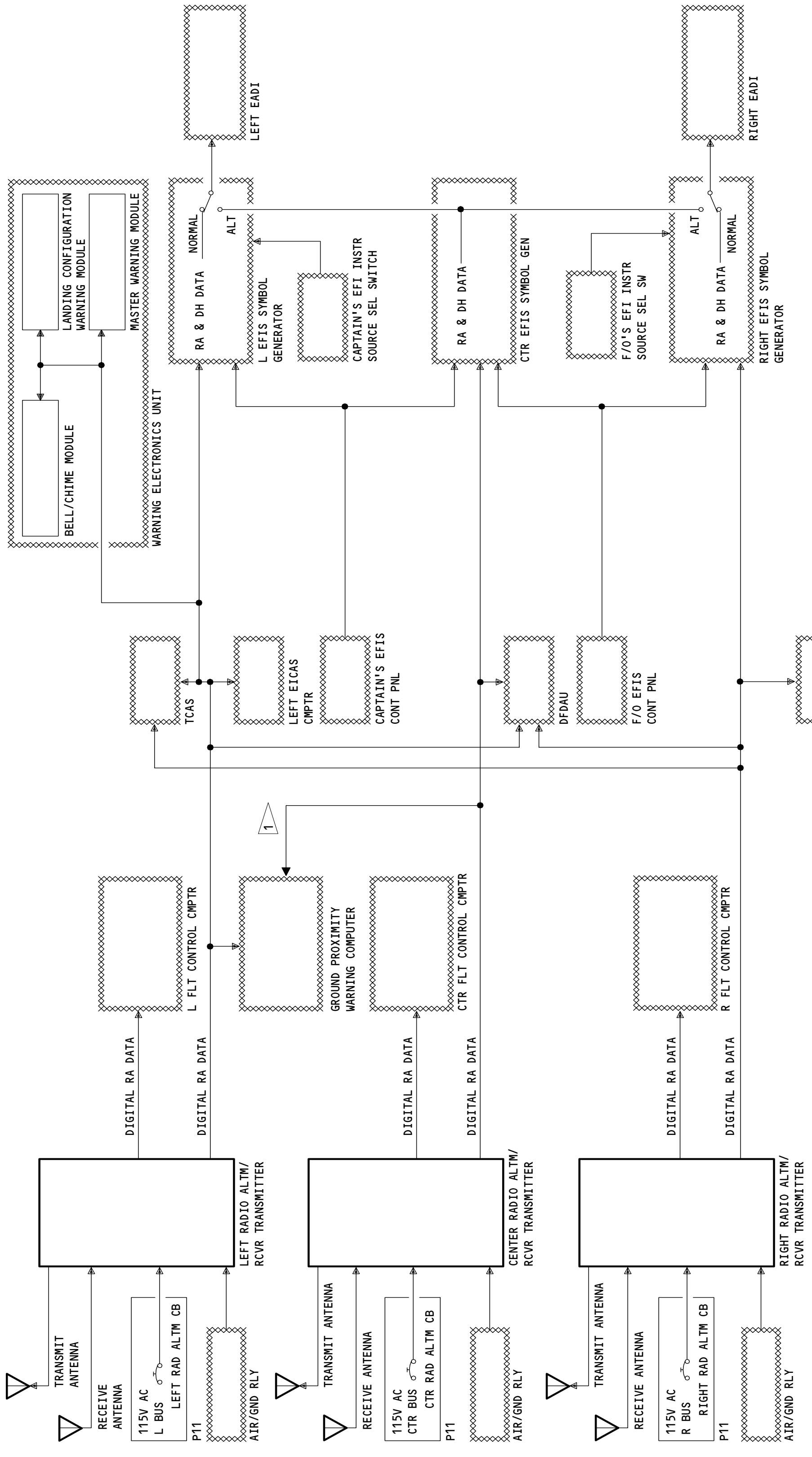
(6) The EADIs are located on the captain's and F/O's instrument panels, P1 and P3, respectively.

3. <u>Operation</u>

A. Functional Description

B. GUI 002-008, 010-114, 116-999;
Functional Description - Collins Radio Altimeters

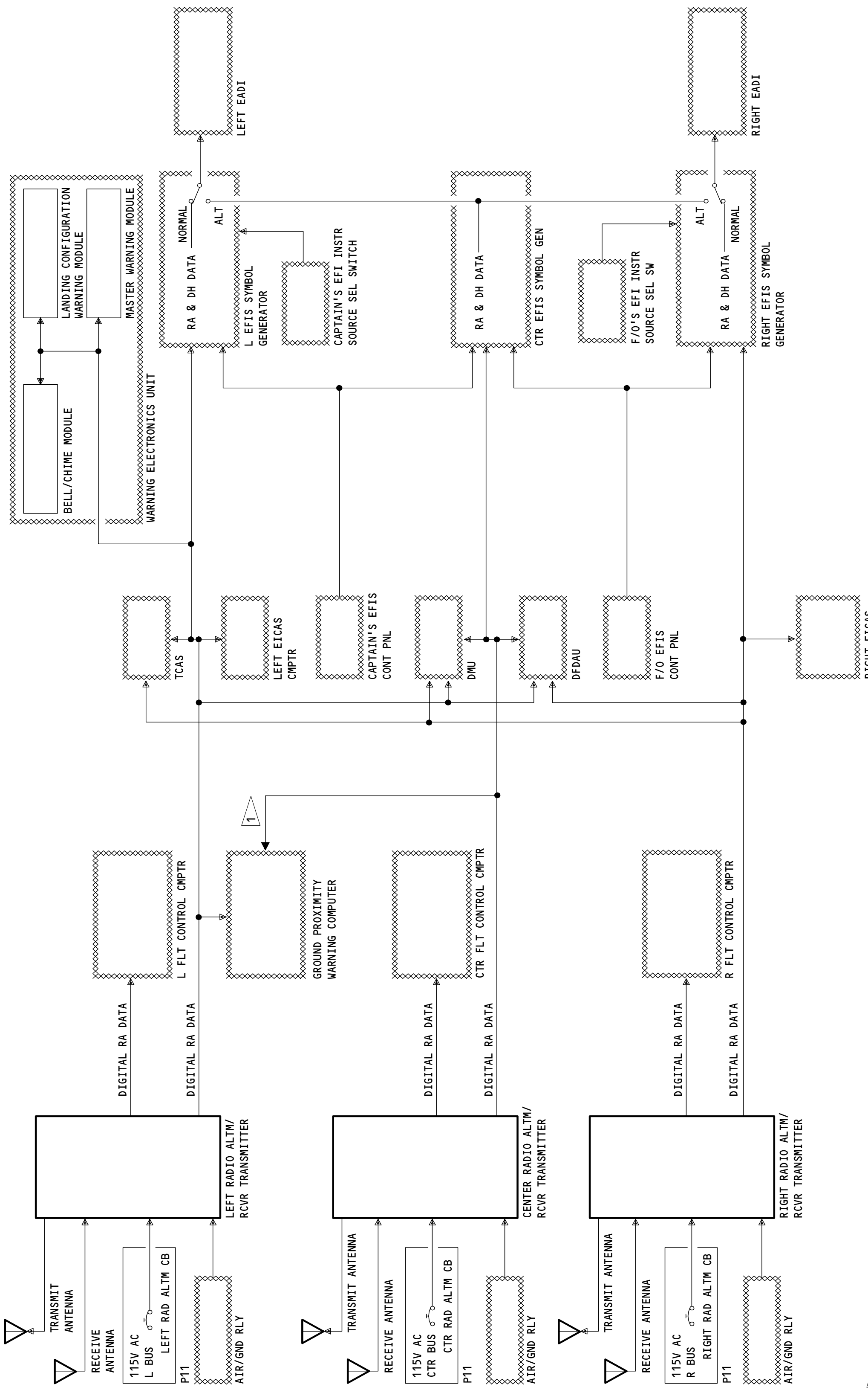
(1) Radio Altimeter Block Diagram (Fig. 2)



1 AIRPLANES WITH GPWC-210 AND SUBSEQUENT GPWC DASH NUMBERS

Radio Altimeter System Block Diagram
Figure 2 (Sheet 1)

A71407



1 AIRPLANES WITH GPWC-210 AND SUBSEQUENT GPWC DASH NUMBERS

Radio Altimeter System Block Diagram
Figure 2 (Sheet 2)

(a) The R/T supplies a FM/CW signal to the transmit antenna. The signal is transmitted, reflected from the terrain, and picked up by the receive antenna. The transmit and receive signals are mixed in the receiver to develop a difference frequency. The difference frequency is proportional to the signal travel time to the terrain and back. This difference is converted to altitude data and output on the 429 data buses.

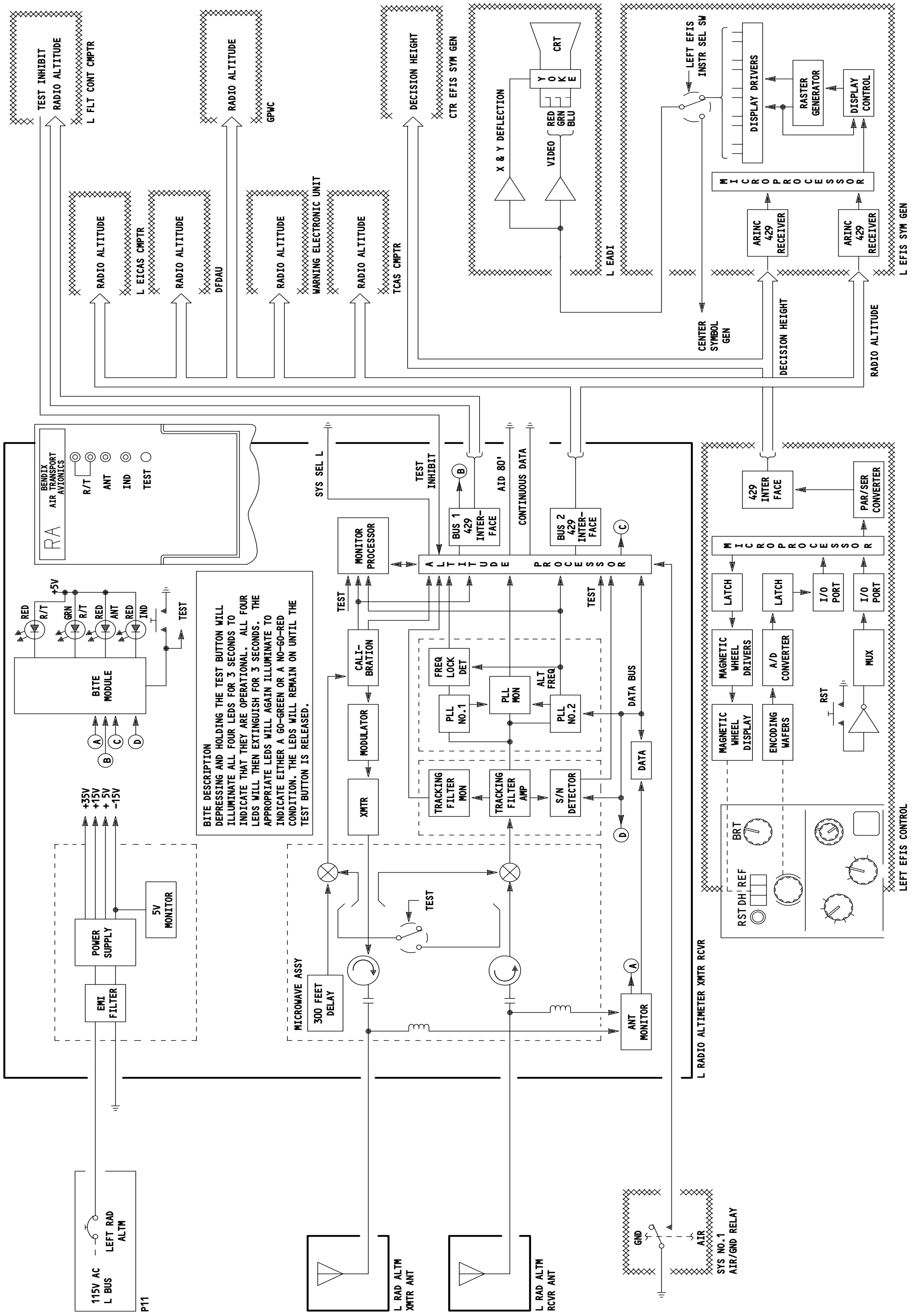
(b) Each R/T provides altitude data in a 32 bit word format via two ARINC 429 digital data buses. These buses supply data to the symbol generators, to the flight control computers, EICAS, ground proximity warning computers, and to the warning electronics units. DH data from the EFIS control panels is supplied to the symbol generators. Setting of the EFIS instrument source select switches selects which symbol generator feeds DH and altitude data to the EADI's.

(2) Signal Processing (Fig. 3)

(a) The R/T units receive 115 V, 400 Hz power from the L, R, and C AC buses via the L, R, and C RAD ALTM circuit breakers on the P11 panel. R/T power supply provides various regulated DC voltages to all circuits in the R/T. The system is turned on as long as the circuit breakers are closed.

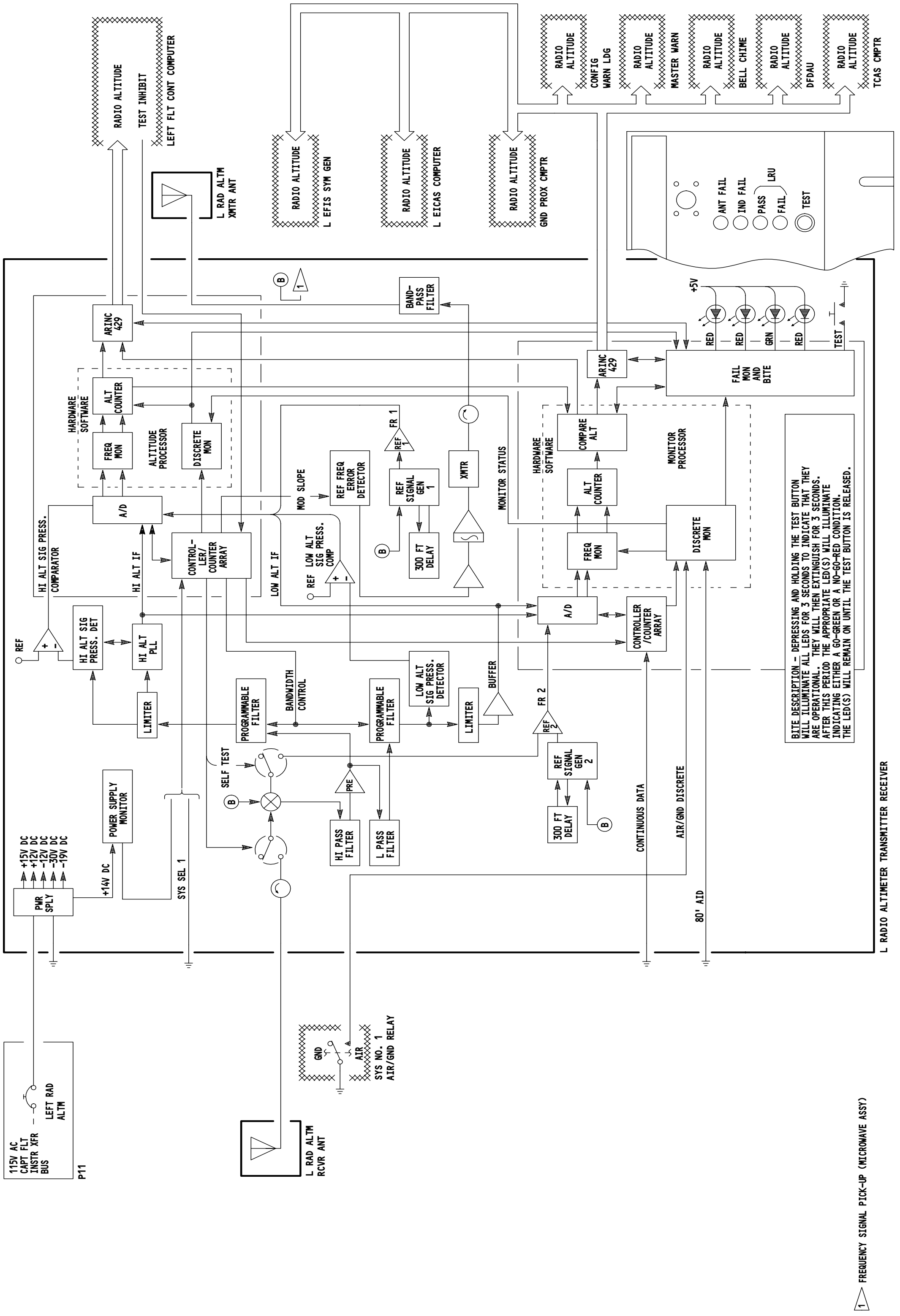
(b) The R/T transmits a carrier wave signal via the transmitter antenna. This signal consists of a CW sweeping linearly from 4.250 to 4.350 GHz 95, 100, and 105 times a second for the left, right and center systems, respectively.

(c) To generate the transmit signal, the R/T transmitter circuit outputs a carrier wave (CW) signal centered at 4.3 GHz. The transmit signal is frequency modulated ±50 MHz by the digital closed loop modulator at the 95, 100, or 105 Hz rate. That is, the signal sweeps from 4.250 to 4.350 GHz and back 95, 100, or 105 times a second. The calibration circuit shapes the transmit signal such that it is a triangular wave linear with time. It uses the 300 ft delay signal as a reference to control the modulation signal amplitude and 95, 100, or 105 Hz rate.



BITE DESCRIPTION
DEPRESSING AND HOLDING THE TEST BUTTON WILL ILLUMINATE ALL FOUR LEDS FOR 3 SECONDS TO INDICATE THAT THEY ARE OPERATIONAL. ALL FOUR LEDS WILL THEN EXTINGUISH FOR 3 SECONDS. THE APPROPRIATE LEDS WILL AGAIN ILLUMINATE TO INDICATE EITHER A GO-GREEN OR A NO-GO-RED CONDITION. THE LEDS WILL REMAIN ON UNTIL THE TEST BUTTON IS RELEASED.

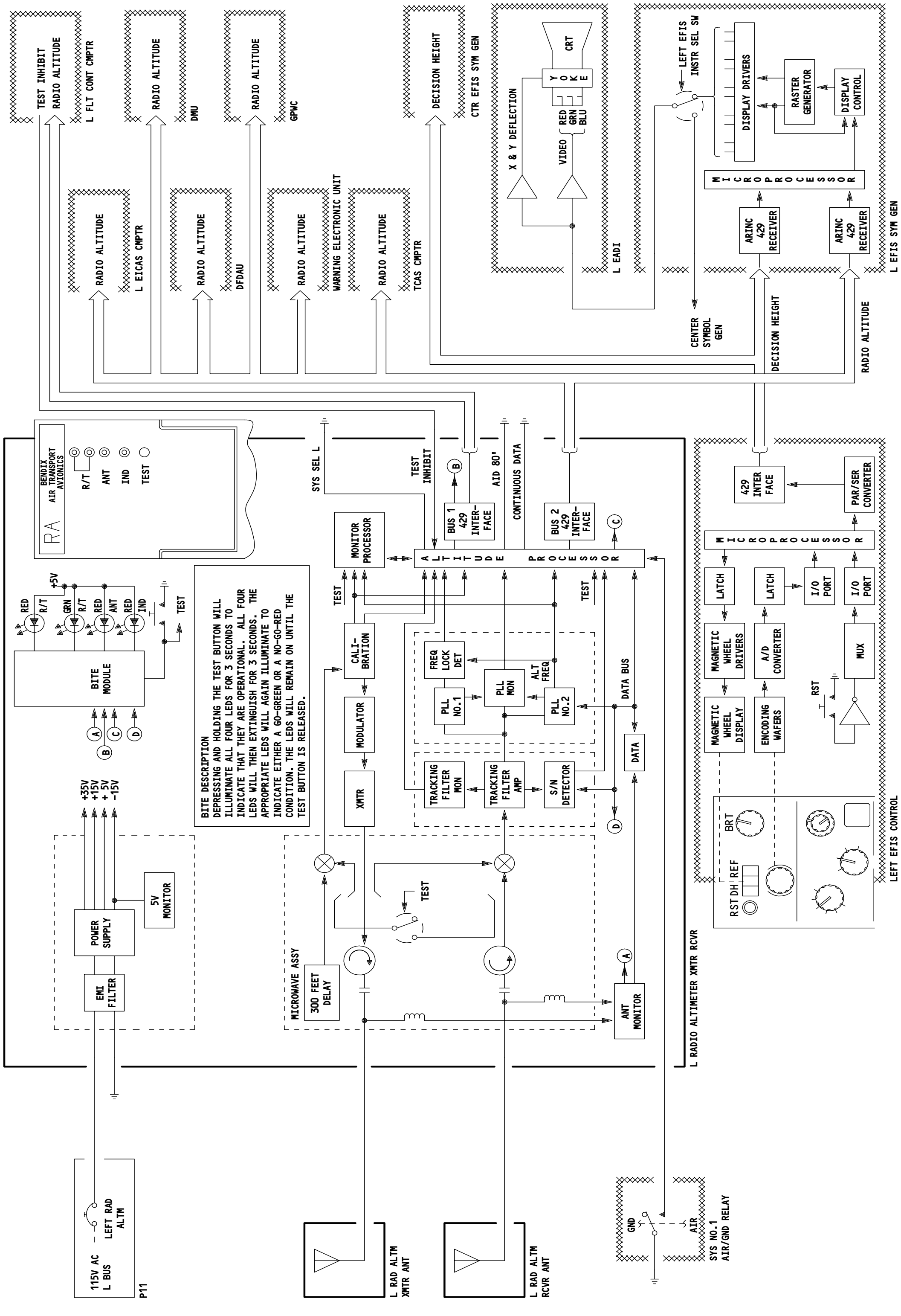
Radio Altimeter Schematic (Example)
Figure 3 (Sheet 1)



BITE DESCRIPTION - DEPRESSING AND HOLDING THE TEST BUTTON WILL ILLUMINATE ALL LEDS FOR 3 SECONDS TO INDICATE THAT THEY ARE OPERATIONAL. THEY WILL THEN EXTINGUISH FOR 3 SECONDS. AFTER THIS PERIOD THE APPROPRIATE LED(S) WILL ILLUMINATE INDICATING EITHER A GO-GREEN OR A NO-GO-RED CONDITION. THE LED(S) WILL REMAIN ON UNTIL THE TEST BUTTON IS RELEASED.

Radio Altimeter Schematic (Example)
Figure 3 (Sheet 2)

A44666



Radio Altimeter Schematic (Example)
Figure 3 (Sheet 3)

(d) The transmit signal is applied through the transmit isolator to the transmit antenna. The signal from the antenna is transmitted to the earth and reflected back to the receive isolator to the mixer. The isolators provide protection for the R/T circuits.

(e) In the mixer, the received signal is beat against a sample of the signal currently being transmitted. The output of the mixer is a difference frequency which is proportional to the distance from the ground (altitude). This mixed frequency output is applied to the low and high altitude IF's.

(f) The low and high altitude IF's supply altitude and presence information to the monitor and altitude processors. The low altitude IF, filters and amplifies the signals from -20 to 450 feet. Altitudes higher than 450 feet are filtered and amplified by the high altitude IF.

(g) The altitude processor computes altitude from the mixed frequency input. It outputs this data in digital format via the ARINC 429 data buses to the interfacing systems. It also outputs status (valid, invalid, test and no-computed data) on the same buses to these systems.

(h) Input program pins select modes of operation of the R/A as follows:

1) The system select input selects the system modulation rate. For the left system, the modulation is set at 95 Hz.

2) The aircraft installation delay (AID) program pins are jumpered for 80 feet. This calibrates the system so that the altitude readout is zero at touchdown. It compensates for the length of the antenna cables plus fuselage to ground distance.

3) The indicator status pins are used for an external display. They are grounded because the system does not use an indicator other than the EADI.

4) The continuous data program pins are jumpered to assure non-interrupted altitude data, regardless of validity, to the flight control computer (FCC).

(i) The test inhibit line from the FCC to the R/T supplies a functional test inhibit signal. This is required if a flight deck functional test switch is used. This would prevent a manual self-test below 1500 ft, during an automatic landing. In this case, TEST pin G5 is reserved.

C. BITE (Fig. 3)

(1) Monitoring

(a) The monitor processor also computes altitude from the input data. It uses this value to verify the value computed by the altitude processor. A hand shake line ties the two processors together for data exchange.

(b) The monitor processor also checks analog voltages such as power supply and reference outputs. It also checks the 429 data bus output words from the R/T. It checks these words for label, parity, altitude, and status. It compares the altitude output data against the values it has computed to determine if the output data is correct.

(c) The altitude processor contains self-test and monitoring features that check for proper operation of the system. This BITE program is conducted as part of the stored software program. During normal transmit/receive operations, the program provides a continuous check of the signal flow through each module of the unit. It also provides a continuous verification of the calibration constants. Complete monitoring is performed at cruise altitude even when there are no ground return signals present.

(d) When no ground return signals are present, the system automatically performs a system self-test. For this condition, the altitude processor provides a test command to the switching circuit. This circuit blocks the incoming signal from the receive antennas and couples the 300-foot delay signal to the signal mixer. The 300-foot delay signal is then processed as a calibrated test signal throughout the R/T. Unit performance is monitored. Monitored data is compared to data stored in memory to verify proper operation.

(e) For detected faults, the altitude processor will output failure warning codes on the ARINC 429 data buses. When computed data is not available for reasons other than equipment failure, a no computed data (NCD) code is output. The type of fault will be indicated on the EADI as described in component details.

(f) All fault information during the BITE program is also sent to the BITE module. The module also contains circuitry that monitors both the receive and transmit antenna paths for an open condition. The BITE module stores all detected faults into a fault memory.

(g) All faults detected during the BITE program are stored in a nonvolatile fault memory. The faults are stored by flight segments for subsequent evaluation during bench level trouble shooting. Each flight segment is initiated when the airplane becomes airborne as detected by the air/ground relay. The fault memory can store faults for up to 254 flights. Only one fault for each of the seven monitored sections (functions) will be stored per flight. The seven monitored sections are: (1) altitude processor, (2) monitor processor, (3) high if amp, (4) low if amp, (5) calibration amps, (6) buses, and (7) antenna monitor. If a fault occurs either continuously or intermittently, it is stored only one time per flight. The test data history is available on the connector for shop personnel.

(2) Self-Test

(a) The self-test is initiated by pressing the TEST switch on the R/T front panel. When this happens, a test command is sent to the switching circuit as in the automatic self-test during normal operation. The incoming signal is blocked and the 300-foot delay signal is coupled to the signal mixer. The 300-foot delay signal is processed and checked in the same manner as for normal operation. The front panel lights indicate status of the R/T self-test.

(b) When the test switch is pressed and held in, the front panel lights (LEDs) will come on for 3 seconds to indicate that they are operative. The lights then extinguish for 3 seconds. After this period, the appropriate light will come on to indicate either a go-green or no-go-red condition. The light will remain on until the test button is released.

(c) Pressing the test button will also cause an altitude of 40 ±2 feet to be indicated on the EADI. This altitude will remain until the test button is released.

(d) The self-test function is inhibited below 1500 feet by a test inhibit discrete received from the flight control computer during a normal automatic landing.

D. GUI 001, 009, 115;
Functional Description - Bendix Radio Altimeters

(1) Radio Altimeter Block Diagram (Fig. 2)

(a) The R/T supplies a FM/CW signal to the transmit antenna. The signal is transmitted, reflected from the terrain, and picked up by the receive antenna. The transmit and receive signals are mixed in the receiver to develop a difference frequency. The difference frequency is proportional to the signal travel time to the terrain and back. This difference is converted to altitude data and output on the 429 data buses.

(b) Each R/T provides altitude data in a 32 bit word format via two ARINC 429 digital data buses. These buses supply data to the symbol generators, to the flight control computers, EICAS, ground proximity warning computers, and to the warning electronics units. DH data from the EFIS control panels is supplied to the symbol generators. Setting of the EFIS instrument source select switches selects which symbol generator feeds DH and altitude data to the EADI's.

(c) The radio altimeter supplies an interlock for the automatic speed brakes (if interfaced). The interlock prevents the automatic activation of the speed brakes above ten feet absolute altitude. The radio altimeter transceiver is connected through the Yaw Damper Stabilizer Trim Module (YSM).

(2) Signal Processing (Fig. 3)

(a) The R/T units receive 115 V, 400 Hz power from the L, R, and C AC buses via the L, R, and C RAD ALTM circuit breakers on the P11 panel. R/T power supply provides various regulated DC voltages to all circuits in the R/T. The system is turned on as long as the circuit breakers are closed.

(b) The R/T transmits a carrier wave signal via the transmitter antenna. This signal consists of a CW sweeping linearly from 4.235 to 4.365 GHz 145, 150, and 155 times a second for the left, right and center systems, respectively.

(c) To generate the transmit signal, the R/T transmitter circuit outputs a carrier wave (CW) signal centered at 4.3 GHz. The transmit signal is frequency modulated ±65 MHz by the digital closed loop modulator at the 145, 150, or 155 Hz rate. That is, the signal sweeps from 4.235 to 4.365 GHz and back 145, 150, or 155 times a second. The calibration circuit shapes the transmit signal such that it is a triangular wave linear with time. It uses the 300 ft delay signal as a reference to control the modulation signal amplitude and 145, 150, or 155 Hz rate.

(d) The transmit signal is applied through the transmit isolator to the transmit antenna. The signal from the antenna is transmitted to the earth and reflected back to the receive isolator to the mixer. The isolators provide protection for the R/T circuits.

(e) The tracking filter tracks only fundamental ground return signals and rejects side bands. To do this, it contains a variable low pass filter which favors low frequencies and thus low altitude. Usually, a large area of the ground reflects the transmitted signal. For each reflecting point, there is a beat frequency. The nearest point produces the smallest beat frequency and other points, higher frequencies. It is desirable for accuracy and airplane safety to measure the nearest point. Therefore, the low pass filter passes the lowest mixed frequency and removes the higher frequency return signals.

(f) In the mixer, the received signal is beat against a sample of the signal currently being transmitted. The output of the mixer is a difference frequency which is proportional to the distance from the ground (altitude). This mixed frequency output is applied to the tracking filter amplifier.

(g) The mixed frequency output, passed by the tracking filter, is sampled by the signal-to-noise (S/N) ratio detector. This circuit will output a S/N ratio voltage to the altitude processor. The processor will use this voltage to decide whether the signal present is greater than or equal to a 6 db S/N ratio. All signals are rejected that have values less than this ratio.

(h) The mixed frequency output of the tracking filter is simultaneously applied to the phase-lock-loop (PLL) circuits. These circuits are tuned to a center frequency by the processor. PLL No. 2 searches the tracking filter output for a match between the center frequency and the mixed frequency input. The direction in which the search takes place is used by the altitude processor to determine if the airplane is going up or down. When a match is sensed, a frequency lock occurs. PLL No. 1 and the frequency lock detector are used to notify the processor of the lock. The mixed frequency at which the match occurs is then sent to both processors from PLL No. 2. This is used to calculate altitude.

(i) The altitude processor computes altitude from the mixed frequency input. It outputs this data in digital format via the ARINC 429 data buses to the interfacing systems. It also outputs status (valid, invalid, test and no-computed data) on the same buses to these systems.

(j) Input program pins select modes of operation of the R/A as follows:

1) The system select input selects the system modulation rate. For the left system, the modulation is set at 145 Hz.

2) The aircraft installation delay (AID) program pins are jumpered for 80 feet. This calibrates the system so that the altitude readout is zero at touchdown. It compensates for the length of the antenna cables plus fuselage to ground distance.

3) The continuous data program pins are jumpered to assure non-interrupted altitude data, regardless of validity, to the flight control computer (FCC).

(k) The test inhibit line from the FCC to the R/T supplies a functional test inhibit signal. This is required if a flight deck functional test switch is used. This would prevent a manual self-test below 1500 ft, during an automatic landing. In this case, TEST pin G5 is reserved.

E. BITE (Fig. 3)

(1) Monitoring

(a) The monitor processor also computes altitude from the input data. It uses this value to verify the value computed by the altitude processor. A hand shake line ties the two processors together for data exchange.

(b) The monitor processor also checks analog voltages such as power supply and reference outputs. It also checks the 429 data bus output words from the R/T. It checks these words for label, parity, altitude, and status. It compares the altitude output data against the values it has computed to determine if the output data is correct.

(c) The altitude processor contains self-test and monitoring features that check for proper operation of the system. This BITE program is conducted as part of the stored software program. During normal transmit/receive operations, the program provides a continuous check of the signal flow through each module of the unit. It also provides a continuous verification of the calibration constants. Complete monitoring is performed at cruise altitude even when there are no ground return signals present.

(d) When no ground return signals are present, the system automatically performs a system self-test. For this condition, the altitude processor provides a test command to the switching circuit. This circuit blocks the incoming signal from the receive antennas and couples the 300-foot delay signal to the signal mixer. The 300-foot delay signal is then processed as a calibrated test signal throughout the R/T. Unit performance is monitored. Monitored data is compared to data stored in memory to verify proper operation.

(e) For detected faults, the altitude processor will output failure warning codes on the ARINC 429 data buses. When computed data is not available for reasons other than equipment failure, a no computed data (NCD) code is output. The type of fault will be indicated on the EADI as described in component details.

(f) All fault information during the BITE program is also sent to the BITE module. The module also contains circuits that monitor the receive and transmit antenna paths for an open condition. The BITE module stores all detected faults into a fault memory.

(g) All faults detected during the BITE program are stored in a nonvolatile fault memory. The faults are stored by flight segments for subsequent evaluation during bench level trouble shooting. Each flight segment is initiated when the airplane becomes airborne as detected by the air/ground relay. The fault memory can store faults for up to 63 flights. The maximum number of faults that can be stored for any flight segment is 13. If a fault exists continuously, it is only stored once. If it exists intermittently, it is stored each time it occurs. The test data history is available on the ATE connector for shop personnel. In addition, an existing fault is displayed by an internal fault display for shop use. The software program determines which fault is displayed.

(2) Self-Test

(a) The self-test is initiated by pressing the TEST switch on the R/T front panel. When this happens, a test command is sent to the switching circuit as in the automatic self-test during normal operation. The incoming signal is blocked and the 300-foot delay signal is coupled to the signal mixer. The 300-foot delay signal is processed and checked in the same manner as for normal operation. The front panel lights indicate status of the R/T self-test.

(b) When the test switch is pressed and held in, the front panel lights (LEDs) will come on for 3 seconds to indicate that they are operative. The lights then extinguish for 3 seconds. After this period, the appropriate light will come on to indicate either a go-green or no-go-red condition. The light will remain on until the test button is released.

(c) A no-go-red condition is caused by either a present fault when the test button is pushed or by two or more identical intermittent faults that have been stored in the flight fault memory from at least two of the last four flights.

(d) Pressing the test button will also cause an altitude of 40 ±2 feet to be indicated on the EADI. This altitude will remain until the test button is released.

(e) The self-test function is inhibited below 1500 feet by a test inhibit discrete received from the flight control computer during a normal automatic landing.

F. Control

(1) Provide electrical power (Ref 24-22-00).

(2) Close L, R, and C RAD ALTM circuit breakers on panel P11.

(3) Close EFIS circuit breakers (7 places) on panel P11.

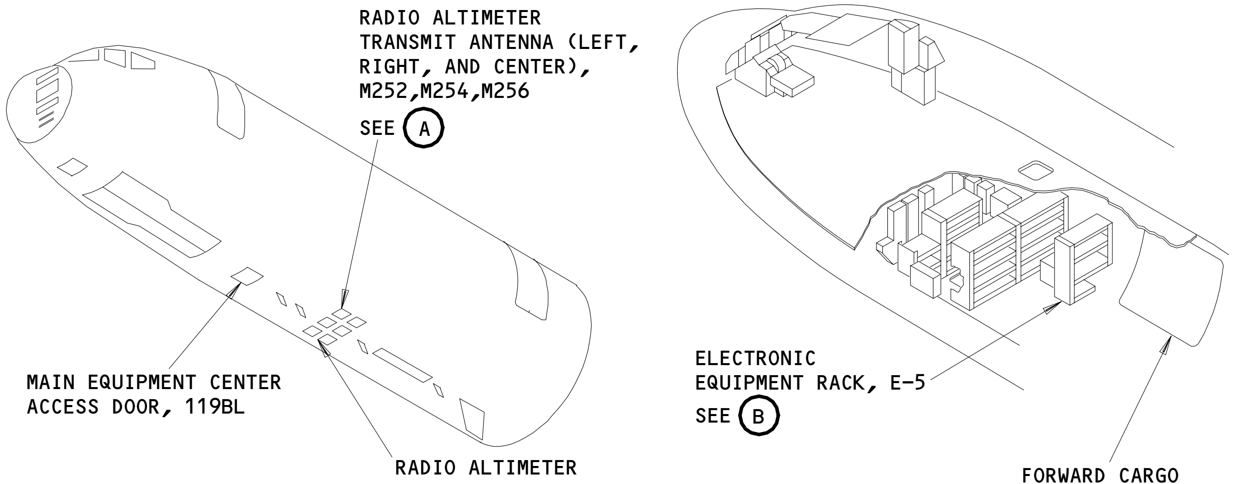
(4) Check that EADI radio altitude display reads -6 ±2 feet.

RADIO ALTIMETER SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
ANTENNA - RADIO ALTIMETER RECEIVER, M253, M255,M257	--	3	BOTTOM FORWARD FUSELAGE	34-33-02
ANTENNA - RADIO ALTIMETER TRANSMITTER, M252,M254,M256	--	3	BOTTOM FORWARD FUSELAGE	34-33-02
CIRCUIT BREAKERS -			FLT COMPT, P11	
RAD ALTM CENTER, C602		1	11F20	*
RAD ALTM LEFT, C600		1	11F5	*
RAD ALTM RIGHT, C601		1	11F26	*
INDICATOR - (REF 34-22-00, FIG. 101)				
LEFT ELEX ATTITUDE DIRECTION, N4				
RIGHT ELEX ATTITUDE DIRECTION, N44				
PANEL - (REF 34-22-00, FIG. 101)				
LEFT EFIS CONTROL, M94				
RIGHT EFIS CONTROL, M93				
RELAY - (REF 31-01-36, FIG. 101)				
SYS NO. 1 AIR/GND, K167				
SYS NO. 2 AIR/GND, K143				
SYS NO. 2 AIR/GND, K214				
SYMBOL GENERATOR - (REF 34-22-00, FIG. 101)				
CENTER EFIS, M149				
LEFT EFIS, M148				
RIGHT EFIS, M150				
TRANSMITTER/RECEIVER - CENTER RAD ALTM, M204	--	1	821, FWD CARGO COMPARTMENT E5 RACK ACCESS PANEL, E5-3	34-33-02
TRANSMITTER/RECEIVER - LEFT RAD ALTM, M202	--	1	821, FWD CARGO COMPARTMENT E5 RACK ACCESS PANEL, E5-1	34-33-02
TRANSMITTER/RECEIVER - RIGHT RAD ALTM, M203	--	1	821, FWD CARGO COMPARTMENT E5 RACK ACCESS PANEL, E5-2	34-33-02

* SEE THE WDM EQUIPMENT LIST

Radio Altimeter System - Component Index
Figure 101



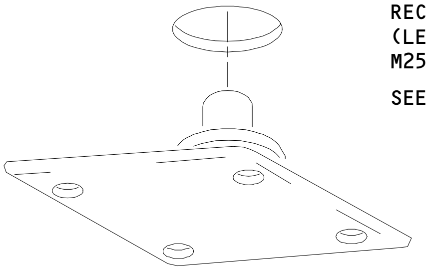
RADIO ALTIMETER TRANSMIT ANTENNA (LEFT, RIGHT, AND CENTER), M252,M254,M256
SEE (A)

MAIN EQUIPMENT CENTER ACCESS DOOR, 119BL

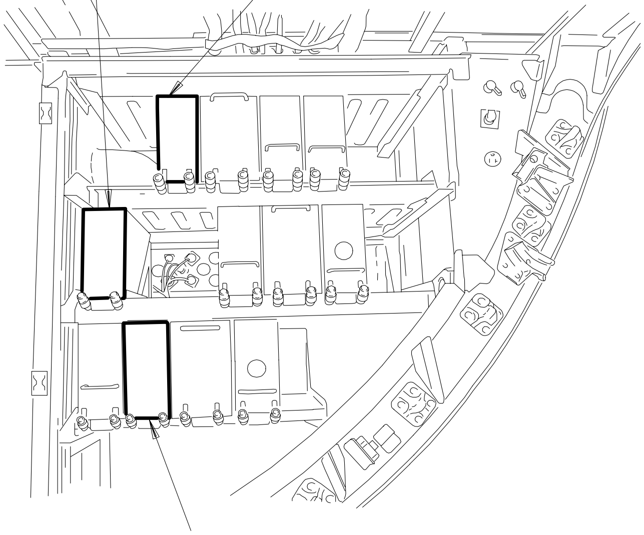
ELECTRONIC EQUIPMENT RACK, E-5
SEE (B)

FORWARD CARGO DOOR, 821 (REF)

RADIO ALTIMETER RECEIVE ANTENNA (LEFT, RIGHT, AND CENTER), M253,M255,M255
SEE (A)



LEFT, RIGHT OR CENTER
RADIO ALTIMETER ANTENNA (EXAMPLE)
(A)

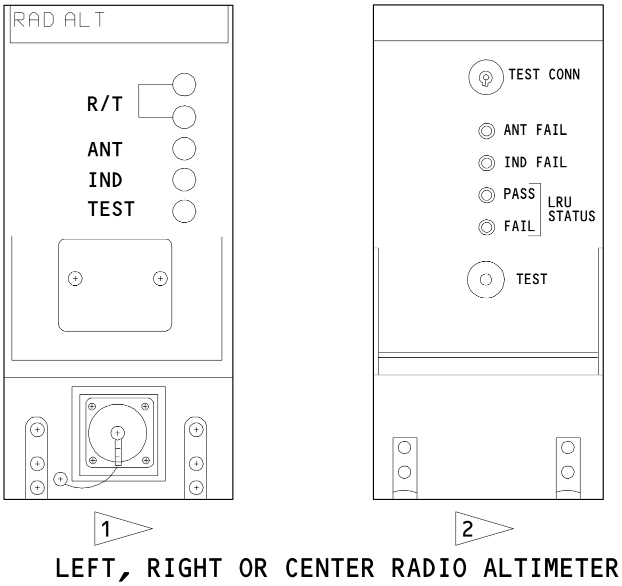


RIGHT RADIO ALTIMETER TRANSMIT/RECEIVE, M203 (E5-2)

LEFT RADIO ALTIMETER TRANSMIT/RECEIVE, M202 (E5-1)
SEE (C)

CENTER RADIO ALTIMETER TRANSMIT/RECEIVE, M204 (E5-3)

ELECTRONIC EQUIPMENT RACK, E-5
(B)



LEFT, RIGHT OR CENTER RADIO ALTIMETER
TRANSMIT/RECEIVE M202,M203 OR M204
(C)

1 GUI 001,009,115
2 GUI 002-008,010-114,116-999

Radio Altimeter System - Component Location
Figure 102

A44560

RADIO ALTIMETER SYSTEM - MAINTENANCE PRACTICES

1. General

A. This subject has two tasks:
   - (1) The first task is a radio altitude simulation test using the Atlantis ramp test set.
   - (2) The second task is a radio altitude simulation test using the Bendix ramp test set.

TASK 34-33-00-722-001

2. Radio Altimeter System Altitude Simulation Test (Using Atlantis Ramp Test Set DRA-707(B))

A. General
   - (1) The DRA-707(B) Ramp Test Set is used for radio altitude simulation with Collins, AlliedSignal or TRT radio altimeters that have 429 bus digital altitude output.
   - (2) To make sure the system interfaces needed for radio altitude simulation are operational, do these procedures in sequence until completion of the Altitude Ramp-Down (Example) later in this section.
   - (3) Refer to AMM 34-46-00/501 for the altitudes and the altitude rates (ramps) necessary to do a test of the GPWS.
   - (4) AIRPLANES WITH PREDICTIVE WINDSHEAR;
     You must open the weather radar (WXR) transceiver circuit breaker(s) to make sure that the WXR system does not come on. The radio altimeter supplies radio altitude data to the WXR transceiver. The WXR transceiver uses the radio altitude data to turn the WXR system on and off.

B. Equipment
   - (1) Ramp Test Set - Atlantis Model DRA-707(B), Atlantis P/N 110-0430-100.

C. References
   - (1) AMM 06-46-00/201, Entry/Service, Emergency Exits, and Cargo Doors (Major Zone 800) Access Doors and Panels
   - (2) AMM 24-22-00/201, Electrical Power - Control
   - (3) AMM 34-22-00/501, Electronic Flight Instrument System
   - (4) AMM 34-33-00/501, Radio Altimeter System
   - (5) AMM 34-46-00/501, Ground Proximity Warning System
   - (6) Technical Manual - Atlantis Ramp Test Set DRA-707, P/N 110-0400-100.

D. Access
   - (1) Location Zones

211/212	Flight Compartment
122	Forward Cargo Compartment, Right (E5 Rack)

   - (2) Access Door

821	Forward Cargo Compartment Door

E. Prepare for the Tests

S 862-002

   - (1) Supply electrical power (AMM 24-22-00/201).

S 712-003

(2) Make sure the electronic flight instrument system (EFIS) operates (AMM 34-22-00/501).

S 712-004

(3) Make sure the radio altimeter system operates (AMM 34-33-00/501).

S 862-005

(4) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) On the overhead equipment panel P11:
    1) 11F2, WX RADAR, or
       WX RADAR LEFT, or
       WX RDR LEFT
    2) 11F5, RAD ALTM LEFT
    3) 11F20, RAD ALTM CENTER
    4) 11F26, RAD ALTM RIGHT

S 012-006

(5) Open the forward cargo compartment door (821) to get access to the radio altimeter R/Ts (AMM 06-46-00/201).

S 862-007

(6) Set the POWER switch on the Ramp Test Set to OFF.

S 482-008

(7) Connect the correct test cable(s) between the TEST connector on the Ramp Test Set and the TEST connector on the R/T(s).

<u>NOTE</u>: You can do a test of each radio altimeter (L, C, or R) seperately, or all together, with the test cables provided with the Ramp Test Set:

Test cable ATLANTIS P/N 110-0440-101 or AY969-00298-001 is used with Collins digital output LRA-700 radio altimeters.

Test cable ATLANTIS P/N AY969-00668-001 is used with Collins digital output LRA-900 radio altimeters.

Test cable ATLANTIS P/N 110-0440-106 is used only with TRT ERT-530 digital output radio altimeters.

S 482-009

(8) Connect the power cable to the correct primary power source shown on the front panel of the Ramp Test Set.

NOTE: If the batteries in the Ramp Test Set have the correct charge, connection to a primary power source is not necessary.

S 862-010

(9) Remove the DO-NOT-CLOSE tags and close the applicable circuit breaker for the R/T(s) to be used for tests:
  (a) On the P11 panel:
    1) 11F5, RAD ALTM LEFT
    2) 11F20, RAD ALTM CENTER
    3) 11F26, RAD ALTM RIGHT

F. Procedure

S 862-318

(1) Prepare the Ramp Test Set for the simulation tests:
  (a) Set the power ON/OFF switch to the ON position.
    1) Make sure the 5 VDC and HOLDING lights come on.
  (b) Set the NO COMPUTED DATA switches to the NORMAL position.
  (c) Push and release the START ALT key.
    1) Make sure START ALT shows on the LEDs.
  (d) Use the keypad to put in a value of +4000 (ft).

  (e) Push and release the ENTER key.
    1) Make sure the radio altitude value shown on the EADIs is blank.

NOTE: The altitude on the radio altimeter 429 busses is limited by program in the radio altimeter R/Ts to the range of +2500 to -20 feet. The R/Ts compute altitudes higher than +2500 feet but inhibit this data on the busses.

S 862-012

(2) Prepare the captain's and the first officer's EFIS control panels for the simulation tests:
  (a) Push and release the RST (reset) button.
  (b) Turn the DH controls to show DH 450 at the captain's EADI and DH 400 at the first officer's EADI.

S 862-189

(3) Set these controls on the Ramp Test Set:
  - (a) Push and release the STOP ALT key.
    - 1) Make sure the LEDs show STOP ALT.
  - (b) On the keypad, put in a value of -20 (ft).
  - (c) Push and release the ENTER key.
    - 1) Make sure the LEDs show STOP ALT -20.
  - (d) Push and release the VERT SPD key.
    - 1) Make sure the LEDs show VERT SPD.
  - (e) On the keypad, put in a value of -4000 (fpm).
  - (f) Push and release the ENTER key.
    - 1) Make sure the LEDs show VERT SPD -4000.

S 722-014

(4) Altitude Ramp-Down Procedure (Example)
  - (a) Push the RAMP/HOLD key on the Ramp Test Set.
    - 1) Make sure the RAMPING light comes on.
  - (b) Look for these displays on the captain's and the first officer's EADIs.
    - 1) The radio altitude goes out of view for approximately 22.5 seconds while the altitude on the Ramp Test Set decreases from 4000 to 2500 feet.
  - (c) After the timeout of 22.5 seconds (previous step), a radio altitude of 2500 feet comes into view on the EADIs and decreases toward zero.

    NOTE: The EADIs display the radio altitudes set on the Ramp Test Set within the limit of +2500 feet to -20 feet.

  - (d) These displays change on the captain's EADI when the radio altitude decreases to 450 feet:
    - 1) The DH value changes to a yellow color and flashes for 3 seconds.
    - 2) The radio altitude continues to decrease toward zero.
  - (e) These displays change on the first officer's EADI when the radio altitude decreases to 400 feet:
    - 1) The DH value changes to a yellow color and flashes for 3 seconds.
    - 2) The radio altitude continues to decrease toward zero.
  - (f) These displays change on the EADIs as the radio altitude decreases to zero feet:
    - 1) The radio altitude value changes to a white color.
    - 2) The DH value changes to the numbers set at the captain's and first officer's EFIS control panels.
  - (g) At this place in the procedure, the simulated altitude from the radio altimeter R/T(s) is proved operational with the EFIS system and the Ramp Test Set.
  - (h) Set the controls on the Ramp Test Set as necessaey for radio altitude tests of the GPWS, autoflight system, and other systems on the airplane.

(i) Go to the next test step when you complete the tests for the other systems.

G. Put the Airplane in its Usual Condition.

S 862-015

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  - (a) On the P11 panel:
    - 1) 11F5, RAD ALTM LEFT
    - 2) 11F20, RAD ALTM CENTER
    - 3) 11F26, RAD ALTM RIGHT

S 862-287

(2) Set the POWER ON/OFF switch on the Ramp Test Set to the OFF position.

S 082-017

(3) Disconnect the Ramp Test Set power cable from the primary power source (if the power cable was used).

S 082-018

(4) Disconnect the test cable(s) from the Ramp Test Set and the applicable R/Ts.

S 862-335

(5) Put the test cable(s) and the power cable in the the Ramp Test Set box.

S 412-020

(6) Install the TEST connector protective cover on the R/T(s).

S 862-021

(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  - (a) On the P11 panel:
    - 1) 11F2, WX RADAR, or
      WX RADAR LEFT, or
      WX RDR LEFT
    - 2) 11F5, RAD ALTM LEFT
    - 3) 11F20, RAD ALTM CENTER
    - 4) 11F26, RAD ALTM RIGHT

S 862-022

(8) Make sure that the EADIs show a radio altitude of -6 ±2 feet.

S 412-023

(9) Close the forward cargo compartment door (821) if access is not necessary (AMM 06-46-00/201).

S 862-024

(10) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-33-00-722-336

3. Radio Altimeter System Altitude Simulation Test (Using Bendix/King AMT-52A Altimeter Test Panel)

A. General

(1) The Bendix/King AMT-52A Altimeter Test Panel is used for radio altitude simulation with Bendix/King ALA-52A radio altimeters that have 429 bus digital altitude output.

(2) To make sure the system interfaces needed for radio altitude simulation are operational, do these procedures in sequence until completion of the Altitude Ramp-Down (Example) later in this section.

(3) Refer to AMM 34-46-00/501 for the altitudes and altitude rates (ramps) used to do a test of the GPWS.

(4) AIRPLANES WITH PREDICTIVE WINDSHEAR;
You must open the weather radar (WXR) transceiver circuit breaker(s) to make sure that the WXR system does not come on. The radio altimeter supplies radio altitude data to the WXR transceiver. The WXR transceiver uses the radio altitude data to turn the WXR system on and off.

B. Equipment

(1) Bendix/King AMT-52A Altimeter Test Panel,
Bendix/King P/N 2041595-5201.

C. References

(1) AMM 06-46-00/201, Entry/Service, Emergency Exits, and Cargo Doors (Major Zone 800) Access Doors and Panels
(2) AMM 24-22-00/201, Manual Control
(3) AMM 34-22-00/501, Electronic Flight Instrument System
(4) AMM 34-33-00/501, Radio Altimeter System
(5) AMM 34-46-00/501, Ground Proximity Warning System
(6) Bendix/King AMT-52A Altimeter Test Panel Component Maintenance Manual, Bendix/King P/N 2041595

D. Access

(1) Location Zones

211/212	Flight Compartment
122	Forward Cargo Compartment, Right (E5 Rack)

(2) Access Door

821	Forward Cargo Compartment Door

E. Prepare for the Tests

S 862-026

(1) Supply electrical power (AMM 24-22-00/201).

S 712-027

(2) Make sure the electronic flight system (EFIS) operates (AMM 34-22-00/501).

S 712-337

(3) Make sure the radio altimeter system operates (AMM 34-33-00/501).

S 862-028
(4) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) On the overhead equipment panel P11:
    1) 11F2, WX RADAR, or
       WX RADAR LEFT, or
       WX RDR LEFT
    2) 11F5, RAD ALTM LEFT
    3) 11F20, RAD ALTM CENTER
    4) 11F26, RAD ALTM RIGHT

S 012-338
(5) Open the forward cargo compartment door (821) to get access to the radio altimeter R/Ts (AMM 06-46-00/201).

S 862-290
(6) Set these controls on the Altimeter Test Panel:
  (a) Set the BCD/BIN switch to the BCD position.
  (b) Set the 429 BUS 1/429 BUS 2 switch to the 429 BUS 1 position.
  (c) Set the FAIL switch to the NORMAL position.
  (d) Set the NOCD switch to the NORMAL position.
  (e) Set the TEST switch to the NORMAL position.
  (f) Set the function selector switch to the NORMAL position.
  (g) Turn the ALTITUDE SELECT control counterclockwise until it stops.

S 482-031
(7) Connect the test cable on the Altimeter Test Panel to the TEST connector on the R/T(s).

<u>NOTE</u>: The three connector test cable on the Altimeter Test Panel connects to one, two, or three radio altimeters.
The programmed RAMPS 1 - 7 in the Altimeter Test Panel go to all three R/Ts if they are connected to the cable. However, others controls on the Altimeter Test Panel operate only with the R/T connected to test cable connector J1.

S 862-032
(8) Remove the DO-NOT-CLOSE tag and close the applicable circuit breaker for the applicable radio altimeter R/T(s).
  (a) On the P11 panel:
    1) 11F5, RAD ALTM LEFT
    2) 11F20, RAD ALTM CENTER
    3) 11F26, RAD ALTM RIGHT

S 862-362
(9) Let the Altimeter Test Panel and the R/T(s) warm up for five minutes.

S 862-365

(10) Make sure that F's do not show on the ALTITUDE readout or on the LABEL readout.

NOTE: The all F's readout shows that power to operate the Altimeter Test Panel is received from the R/T connected to test cable connector J1, but there is no data on the 429 data bus No. 1 from the R/T.

S 862-035

(11) Make sure that a red fault light does not show on the front panel of the R/T(s) connected to the test cable.

S 862-367

(12) Set the 429 BUS 1/429 BUS 2 switch to the 429 BUS 2 position.
  (a) Make sure that the ALTITUDE and the LABEL readouts do not show all F's.

NOTE: All F's shows there is no data on the 429 data bus No. 2 from the R/T connected to test cable connector J1.

F. Procedure

S 862-361

(1) Prepare the Altimeter Test Set for the simulation tests:
  (a) Set the TEST switch to the TEST position.
    1) Make sure the BITE readout is 0.
    2) Make sure the ALTITUDE readout is 40 ±2 feet.
    3) Make sure the STATUS readout is FTST (functional test).
    4) Make sure the ALTITUDE readout shows the self-test altitude of 40 ±2 feet.
    5) Make sure the radio altitude displayed on the EADIs is the self-test altitude of 40 ±2 feet.
  (b) Set the TEST switch to the NORMAL position.
    1) Make sure the ALTITUDE readout on the Altimeter Test Panel shows -6 ±2 feet.

S 862-038

(2) Prepare the captain's and the first officer's EFIS control panels:
  (a) Push and release the RST (reset) button.
  (b) Turn the DH controls to show DH 450 at the captain's EADI and DH 400 at the first officer's EADI.

S 722-039

(3) Do the Altitude Ramp-Down Procedure (Example)

(a) General

1) This procedure is an example of an altitude ramp-down selected on the Altitude Test Panel and displayed on the EADIs. See the list for the ramps you can select on the the Altimeter Test Panel.

ALTITUDE RAMPS LIST

RAMP	RATE FT/MIN	RAMP	RATE FT/MIN
1	600	5	5000
2	1200	6	6000
3	2000	7	7000
4	4000		

(b) Set the function selector switch on the Altimeter Test Panel to RAMP 4 to start the ramp-down.

(c) The ALTITUDE readout on the Altimeter Test Panel shows 4000 and then steadily decreases toward zero at 66.6 fps.

(d) Look for these displays on the captian's and first officer's EADIs.

<u>NOTE</u>: The altitude on the radio altimeter 429 busses is limited by the program in the radio altimeter R/Ts to the altitude range of +2500 to -20 feet. The R/Ts compute altitudes higher than +2500 feet but inhibit this data on the busses.

1) The display shows blank for approximately 22.5 seconds after you selected RAMP 4 (above).
2) The display then shows 2500 (white numerals) and decreases toward 0 (zero).
3) When the display decreases to 450 (feet), the DH flashes (amber) for three seconds on the captain's EADI.
4) When the display decreases to 400 (feet), the DH flashes (amber) for three seconds on the first officer's EADI.
5) The ALTITUDE readout on the Altimeter Test Panel and the radio altitude on the EADIs decrease to 0 (zero) approximately 3 minutes and 20 seconds after start of RAMP 4 (above).

(e) Set the function selector switch on the Altimeter Test Panel to the NORMAL position to stop the RAMP 4 ramp-down.

1) The ALTITUDE readout on the Altimeter Test Panel and the radio altitude displays on the EADIs show -6 ±2 feet.

(f) Use the function selector switch on the Altimeter Test Panel to select ramps needed for test of other systems.

NOTE: When you select a ramp different than the RAMP 4 used in the above example, you will see the same displays on the Altimeter Test Panel and on the EADIs but the times you see them will change.

Refer to the Altitude Ramps List in this procedure for ramp rates available in the Altimeter Test Panel.

(g) Make these control settings at the Altimeter Test Panel when you need a fixed altitude value for a test:
1) Set the function selector switch to the ALT SEL position.
2) Rotate the ALTITUDE SELECT control and look at the ALTITUDE readout for the altitude you require.

NOTE: The EADIs will display the same altitude shown on the ALTITUDE readout if it is within +2500 to -20 feet.

(h) When you complete the tests required for other systems, go to the next test step to remove the test equipment.

G. Put the Airplane in its Usual Condition

S 862-041
(1) Set the function selector switch on the Altimeter Test Panel to the NORMAL position.
(a) The ALTITUDE readout on the Altimeter Test Panel and the radio altitude displays on the EADIs show -6 ±2 feet.

S 862-042
(2) Open these circuit breakers and attach DO-NOT-CLOSE tags:
(a) On the P11 panel:
1) 11F5, RAD ALTM LEFT
2) 11F20, RAD ALTM CENTER
3) 11F26, RAD ALTM RIGHT

S 082-043
(3) Disconnect the test cable(s) from the applicable R/T(s).

S 412-044
(4) Install the TEST connector protective cover on the R/T(s).

S 862-045

(5) Remove the DO-NOT-ClOSE tags and close these circuit breakers:
  (a) On the P11 panel:
    1) 11F2, WX RADAR, or
       WX RADAR LEFT, or
       WX RDR LEFT
    2) 11F5, RAD ALTM LEFT
    3) 11F20, RAD ALTM CENTER
    4) 11F26, RAD ALTM RIGHT

S 862-046

(6) Make sure that the EADIs show a radio altitude of -6 ±2 feet.

S 412-047

(7) Close the forward cargo compartment door (821) if access is not necessary (AMM 06-46-00/201).

S 862-048

(8) Remove electrical power if it is not necessary (AMM 24-22-00/201).

RADIO ALTIMETER SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure contains one task. The task does an operational test of the radio altimeter (RA) system. It uses the altitude shown when the airplane is on the ground and the built-in-test-equipment (BITE).

TASK 34-33-00-715-001

2. Operational Test - Radio Altimeter System
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones

122	Forward Cargo Compartment
211/212	Flight Compartment

   C. Prepare for the Operational Test

S 865-021

      (1) Make sure that this system is serviceable:
         (a) The electronic flight instrument system (EFIS) (AMM 34-22-00/501).

S 865-002

      (2) Supply electrical power (AMM 24-22-00/201).
   D. Procedure

S 865-005

      (1) Set the captain's and F/O's EFI instrument source select switches to the usual positions.
         (a) Make sure that the captain's and first officer's Electronic Attitude Director Indicator (EADI) RA displays show -6 ±2 feet in the top right corner.

S 865-008

      (2) Set the captain's EFI instrument source select switch to ALTN.
         (a) Make sure that the captain's EADI RA display shows -6 ±2 feet.

S 865-009

(3) Set the F/O's EFI instrument source select switch to ALTN.
    (a) Make sure that the F/O's EADI RA display shows -6 ±2 feet.

S 865-010

(4) Set the captain's and F/O's EFI instrument source select switches to the usual positions.

S 745-011

(5) Push and hold the TEST switch on the front panel of the left RA receiver/transmitter (R/T).
    (a) Make sure the conditions that follow occur:
        1) All the monitor lights on the left RA R/T front panel come on for three seconds.
        2) All the monitor lights on the left RA R/T front panel go off for three seconds.
        3) The green monitor light comes on and stays on.
        4) The captain's EADI RA display shows 40 ±2 feet.

S 865-012

(6) Release the left RA R/T test switch.
    (a) Make sure that the green monitor light goes off and that the captain's EADI display shows -6 ±2 feet.

S 745-013

(7) Do the test at the front panel of the R/T again for the right R/T.
    (a) Make sure the indications show on the right R/T and the F/O's display.

S 865-015

(8) Set the captain's EFI instrument source select switch to ALTN.

S 745-077

(9) Do the test at the front panel of the R/T again for the center R/T.
    (a) Make sure the indications show on the center R/T and the captain's displays.

E. Put the Airplane Back to Its Usual Condition

S 865-020

(1) Put the captain's and F/O's EFI instrument source select switches back to the usual positions.

S 865-019

(2) Remove electrical power if it is not necessary (AMM 24-22-00/201).

RADIO ALTIMETER RECEIVER/TRANSMITTER - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the radio altimeter receiver/transmitter (R/T). The second task installs the radio altimeter R/T.
   B. The left, M202, right, M203, and center, M204, radio altimeter R/Ts are found in the main equipment center on the E5 rack. All electrical connections are made through connectors at the rear of the units.

TASK 34-33-01-004-001

2. Remove the Radio Altimeter Receiver/Transmitter (R/T)
   A. References
      (1) 20-10-01/401, E/E Rack-Mounted Components
   B. Access
      (1) Location Zone
          120 Main Equipment Center

   C. Procedure

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
          (a) 11F5, RADIO ALTM LEFT
          (b) 11F20, RADIO ALTM CENTER
          (c) 11F26, RADIO ALTM RIGHT

      S 014-003
      (2) Open the E5 rack door.

      S 024-004
      (3) Remove the applicable radio altimeter R/T (Ref 20-10-01).

TASK 34-33-01-404-005

3. Install the Radio Altimeter Receiver/Transmitter (R/T)
   A. References
      (1) 20-10-01/401, E/E Rack-Mounted Components

(2) 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zone

120	Main Equipment Center

C. Procedure

S 864-006

(1) Make sure that these circuit breakers on the P11 panel are open:
   (a) 11F5, RADIO ALTM LEFT
   (b) 11F20, RADIO ALTM CENTER
   (c) 11F26, RADIO ALTM RIGHT

S 424-007

(2) Install the applicable radio altimeter R/T (Ref 20-10-01).

S 864-008

(3) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) 11F5, RADIO ALTM LEFT
   (b) 11F20, RADIO ALTM CENTER
   (c) 11F26, RADIO ALTM RIGHT

D. Radio Altimeter R/T Test

S 864-015

(1) Make sure that this system is serviceable:
   (a) The electronic flight instrument system (EFIS) (AMM 34-22-00/501).

S 864-010

(2) Supply electrical power (Ref 24-22-00).

S 754-011

(3) Make sure that the radio altitude display on the Electronic Attitude Director Indicator (EADI) shows -6 ±2 feet.

S 754-012

(4) Push and hold the TEST switch on the applicable R/T and make sure the conditions that follow occur:
   (a) All front panel lights come on for three seconds.

(b) All front panel lights go off for three seconds.
(c) The green panel light comes on until the TEST switch is released.
(d) The radio altitude display on the EADI shows 40 ±2 feet.

S 414-013
(5) Close the E5 rack door.

S 864-014
(6) Remove electrical power if it is not necessary (Ref 24-22-00).

RADIO ALTIMETER ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the radio altimeter antenna. The second task installs the radio altimeter antenna.
   B. There are six radio altimeter antennas found on the bottom of the airplane. They are all the same. The left and right radio altimeter antennas have a fairing spacer between the antenna base and the surface of the airplane.

TASK 34-33-02-004-001

2. Remove the Radio Altimeter Antenna
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
      (2) Stainless Steel Brush
   B. References
      (1) AMM 51-31-01/201, Seals and Sealing
   C. Access
      (1) Location Zones
         123/124   Area below forward cargo compartment

   D. Procedure

S 864-002

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11F5, RADIO ALTM LEFT
   (b) 11F20, RADIO ALTM CENTER
   (c) 11F26, RADIO ALTM RIGHT

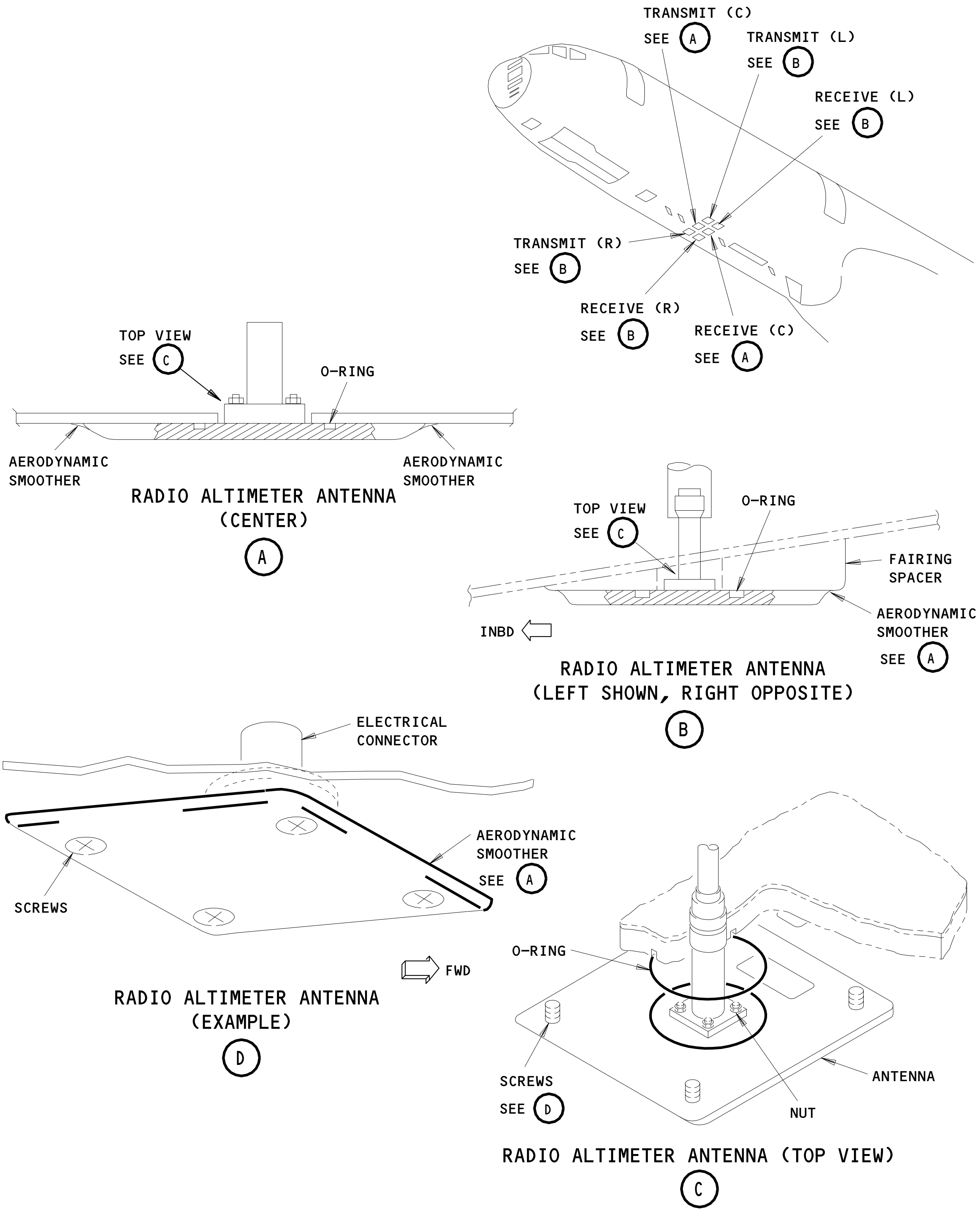
S 034-003

(2) Remove the screws that hold the antenna to the airplane.

S 034-004

CAUTION: BE CAREFUL WITH THE SEALANT REMOVAL TOOL WHEN YOU USE FORCE TO BREAK THE ANTENNA SEAL. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE AIRPLANE SKIN OR THE ELECTRICAL CABLE AT THE ANTENNA BASE.

(3) Use force around the antenna with the sealant removal tool until the seal is fully broken.



Radio Altimeter Installation
Figure 401

S 034-033

CAUTION: DO NOT PULL THE ANTENNA CABLE. THIS CAN CAUSE DAMAGE TO IT. LOWER THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLE FROM THE ANTENNA.

(4) Lower the antenna to get access to the electrical connector.

S 034-007
(5) Disconnect the electrical cable.

S 024-008
(6) Remove the antenna and the O-ring.

S 034-009
(7) Remove the old sealant from the airplane skin (AMM 51-31-01/201).

TASK 34-33-02-404-010

3. Install the Radio Altimeter Antenna

A. Equipment
- (1) Resistance Measuring Bridge or Ohmeter that can measure 0.001 ohm.
- (2) Stainless Steel Brush

B. Consumable Materials
- (1) C00064 Coating, Conversion - Alodine 1000
- (2) A00247 Compound - Sealing - BMS 5-95, Class B 1/2
- (3) B00316 Solvent - Aliphatic Naptha TT-N-95
- (4) D50180 Grease - BMS 3-33 (Preferred)
- (5) D00015 Grease - BMS 3-24 (Alternate)

C. References
- (1) AMM 24-22-00/201, Electrical Power - Control
- (2) AMM 51-21-03/701, Corrosion Removal and Control
- (3) AMM 51-21-04/701, Alodine Coating
- (4) AMM 51-31-01/201, Seals and Sealing
- (5) SRM 51-20-01

D. Procedure

S 864-011

(1) Make sure that these circuit breakers on the P11 panel are open:
   - (a) 11F5, RADIO ALTM LEFT
   - (b) 11F20, RADIO ALTM CENTER
   - (c) 11F26, RADIO ALTM RIGHT

S 754-034

<u>CAUTION</u>: MAKE SURE FAYING SURFACES ARE CLEAN. THE SYSTEM WILL NOT OPERATE CORRECTLY IF THE SURFACES ARE NOT CLEAN.

(2) Visually examine the antenna faying surface on the airplane for corrosion and unwanted material.

S 164-013

(3) Clean the faying surface until the surface has no corrosion and unwanted material (AMM 51-21-03/701).

S 434-014

(4) Apply Alodine 1000 to the faying surfaces (AMM 51-21-04/701).

S 434-015

(5) Apply aliphatic naphtha TT-N-95 solvent or equivalent to the antenna connector base and the nuts (SRM 51-20-01).

S 434-016

(6) Apply aliphatic naphtha TT-N-95 solvent or equivalent to the faying surfaces of the antenna (SRM 51-20-01).

S 434-035

(7) Apply aliphatic naphtha TT-N-95 solvent or equivalent to the faying surfaces of the airplane (SRM 51-20-01).

S 434-017

(8) Make sure that the new O-ring is installed on the new antenna.

S 434-018

(9) Fill the connector base with grease (BMS 3-33, preferred or BMS 3-24, alternate). Confine the grease to the area within the O-ring that surrounds the connector base. Make sure the grease covers the nutplate.

S 434-019

(10) Connect the electrical cable to the antenna.

S 424-020

(11) With the antenna in position, install three screws.

S 424-021

(12) Tighten the screws to 20-25 pound-inches.

S 864-022

(13) Measure the resistance between the antenna mounting screw hole and the antenna mounting surface (fuselage for the center antenna, fairing spacer for the right and left antenna).
    (a) Make sure the resistance is 0.001 ohms or less.

S 424-028

(14) Install the fourth mounting screw.

S 424-027

(15) Tighten the screw to 20-25 pound-inches.

S 434-023

(16) Apply the weather/aerodynamic fillet seal (AMM 51-31-01/201).

S 864-024

(17) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
    (a) 11F5, RADIO ALTM LEFT
    (b) 11F20, RADIO ALTM CENTER
    (c) 11F26, RADIO ALTM RIGHT

E. Antenna Test

S 864-036

(1) Make sure that this system is servicable:
    (a) The electronic flight instrument system (EFIS) (AMM 34-22-00/501).

S 864-025

(2) Supply electrical power (AMM 24-22-00/201).

S 864-061

(3) Make sure the Electronic Flight Instrument System is serviceable (AMM 34-22-00/501).

S 864-029

(4) Set the captain's INSTR SOURCE SEL EFI switch to the out position.
  (a) Make sure that the captain's ADI radio altitude display shows -6 feet ±2 feet.

S 864-030

(5) Set the captain's INSTR SOURCE SEL EFI switch to ALTN (in position).
  (a) Make sure that the captain's ADI radio altitude display shows -6 feet ±2 feet.

S 864-031

(6) Set the first officer's INSTR SOURCE SEL EFI switch to the out position.
  (a) Measure that the first officer's ADI radio altitude display shows -6 feet ±2 feet.

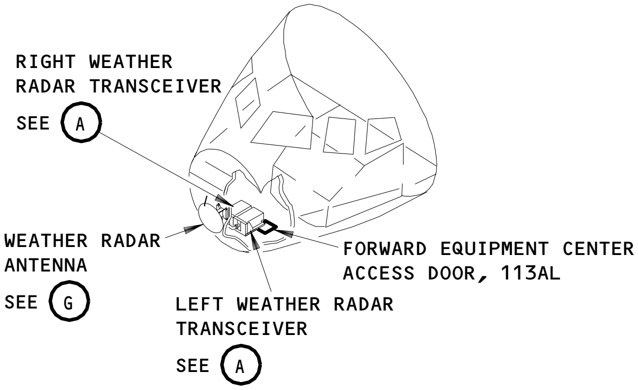
F. Put the Airplane Back to Its Usual Condition

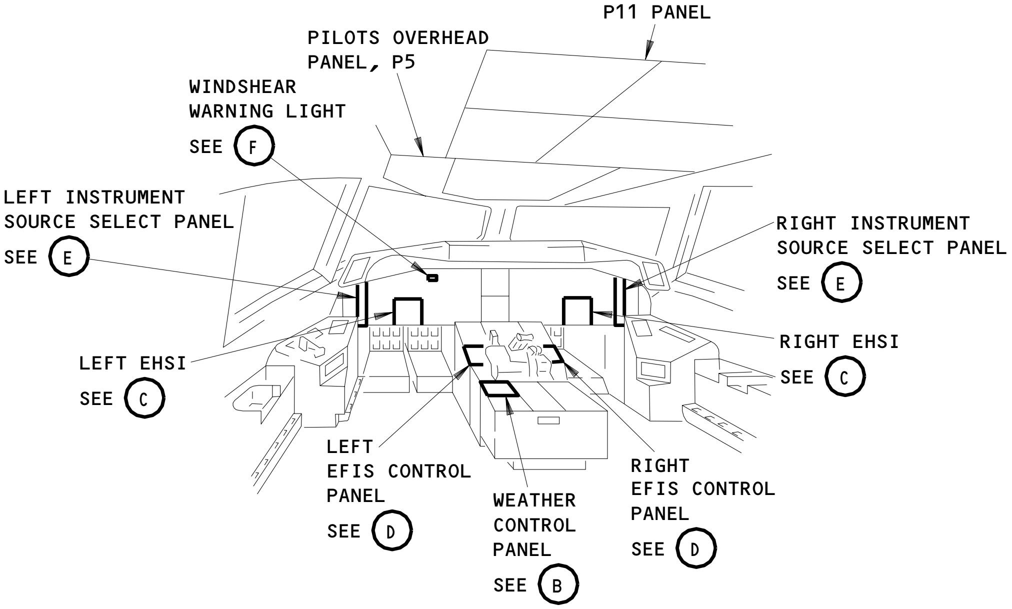
S 864-032

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

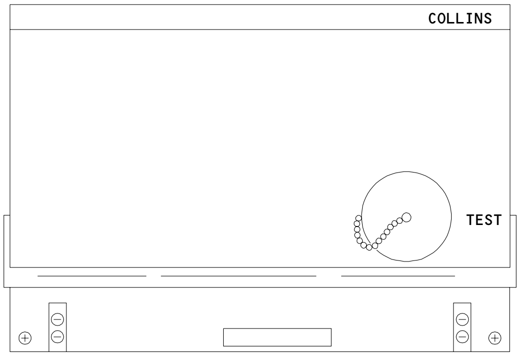
WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The weather radar system is a navigation system which uses the reflective effect of microwave pulses on material substances to obtain a picture of conditions ahead of the airplane. Weather radar operation is based on the fact that water particles present in the air as rainfall (generally associated with storm cells) reflect a radar beam with intensity in proportional to the moisture concentration.
   B. The weather radar operates in the X-band and has a penetration range through relatively light intervening rainfall to detect distant rainfall storm areas at ranges of up to 320 miles. The weather displays permit the pilot to avoid weather storms and the associated turbulence. Strong echoes may also return from other objects (such as mountains). All returns are displayed on the electronic horizontal situation indicator (EHSI) and the dedicated Weather Radar Indicator (if installed).
   C. The receiver/transmitter generates and transmits high energy radio frequency (rf) pulses which are radiated by the antenna. A small portion of the radiated energy is reflected back to the airplane by moisture laden clouds or by major terrain features. The reflected signals are received by the same antenna, processed by the R/T unit and displayed on the EHSI's. The transfer of the RF energy between the R/T unit and the antenna takes place via the waveguide and waveguide switch. Stabilization of the antenna in pitch and roll is provided by the inertial reference system.
   D. While in the MAP Mode of operation the weather radar system presents the pilots with a topographic map type display of moisture laden weather formations or major terrain features such as rivers, coastlines, major mountain peaks, and cities for position fixing. The weather displays permit the pilot to avoid weather storms and the associated turbulence.
   E. The receiver/transmitter(s) and associated waveguide is accessible through the lower access door, forward of the nose wheel well. The antenna and associated waveguide components are accessible by opening the nose radome.
   F. The weather radar system consists of a WXR transceiver (XCVR), transceiver mount, an antenna assembly, waveguide assembly, WXR control panel and a WXR indicator (if installed). The weather radar transceivers receive control data and a power enable signal from the electronic flight instrument system (EFIS) control panel. Weather or map data is displayed on the WXR indicator and the EFIS electronic horizontal situation indicator (EHSI). Equipment location is shown in Figure 1.





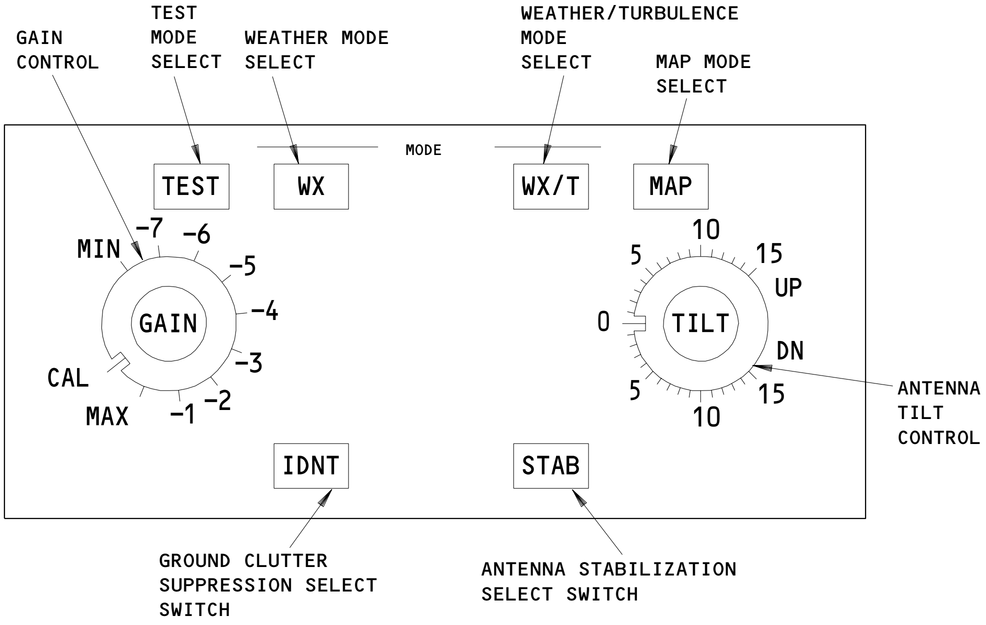
FLIGHT COMPARTMENT



WEATHER RADAR TRANSCEIVER

A

Weather Radar System - Component Location
Figure 1 (Sheet 1)

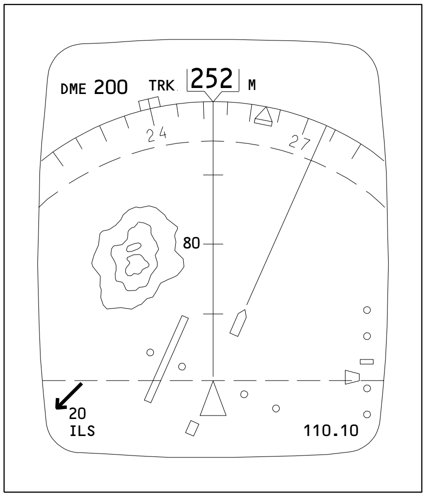


WEATHER RADAR CONTROL PANEL

B

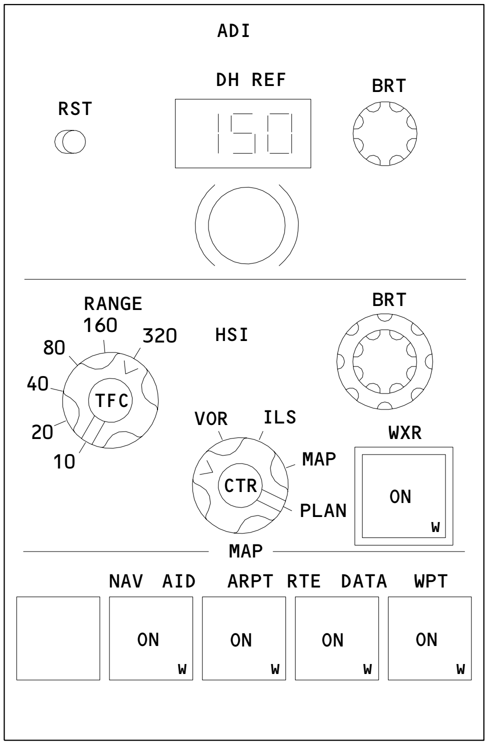
NOTE: A MECHANICAL INTERLOCK PREVENTS THE SELECTION OF MORE THAN ONE MODE (OFF, TEST, WX, MAP)

Weather Radar System - Component Location
Figure 1 (Sheet 2)



ELECTRONIC HORIZONTAL
SITUATION INDICATOR

C



EFIS CONTROL PANEL

D 1

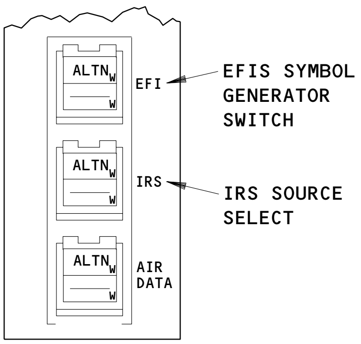
1 GUI 001-008, 010-114

Weather Radar System - Component Location
Figure 1 (Sheet 3)

H69109

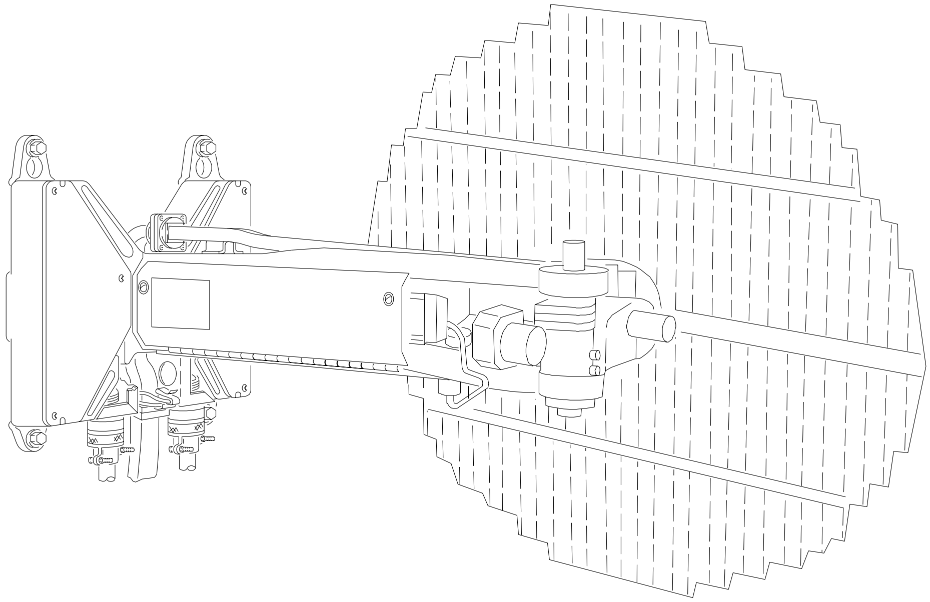
WINDSHEAR WARNING LIGHT

F



CAPTAINS INSTRUMENT SOURCE SELECT PANEL

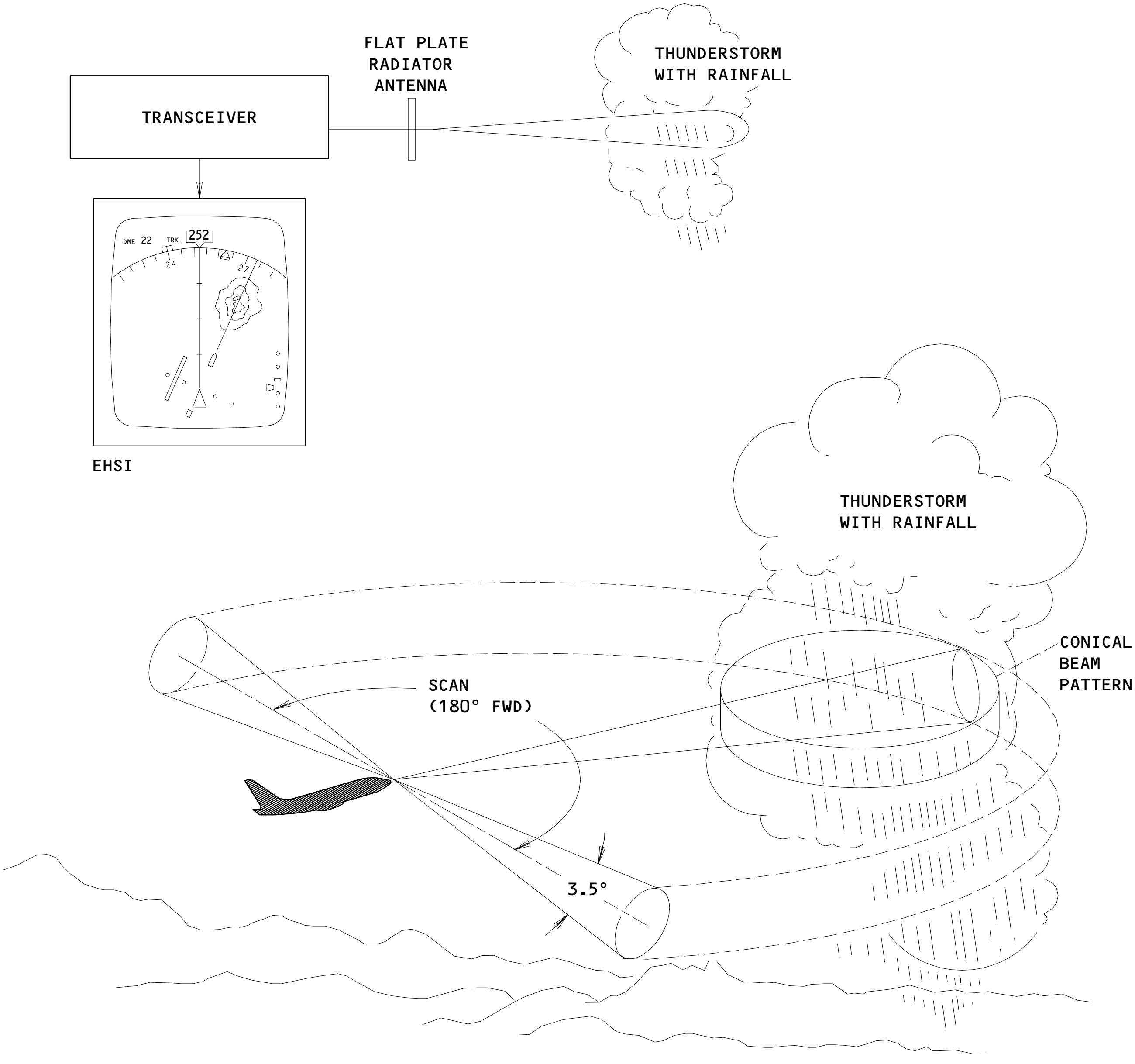
E



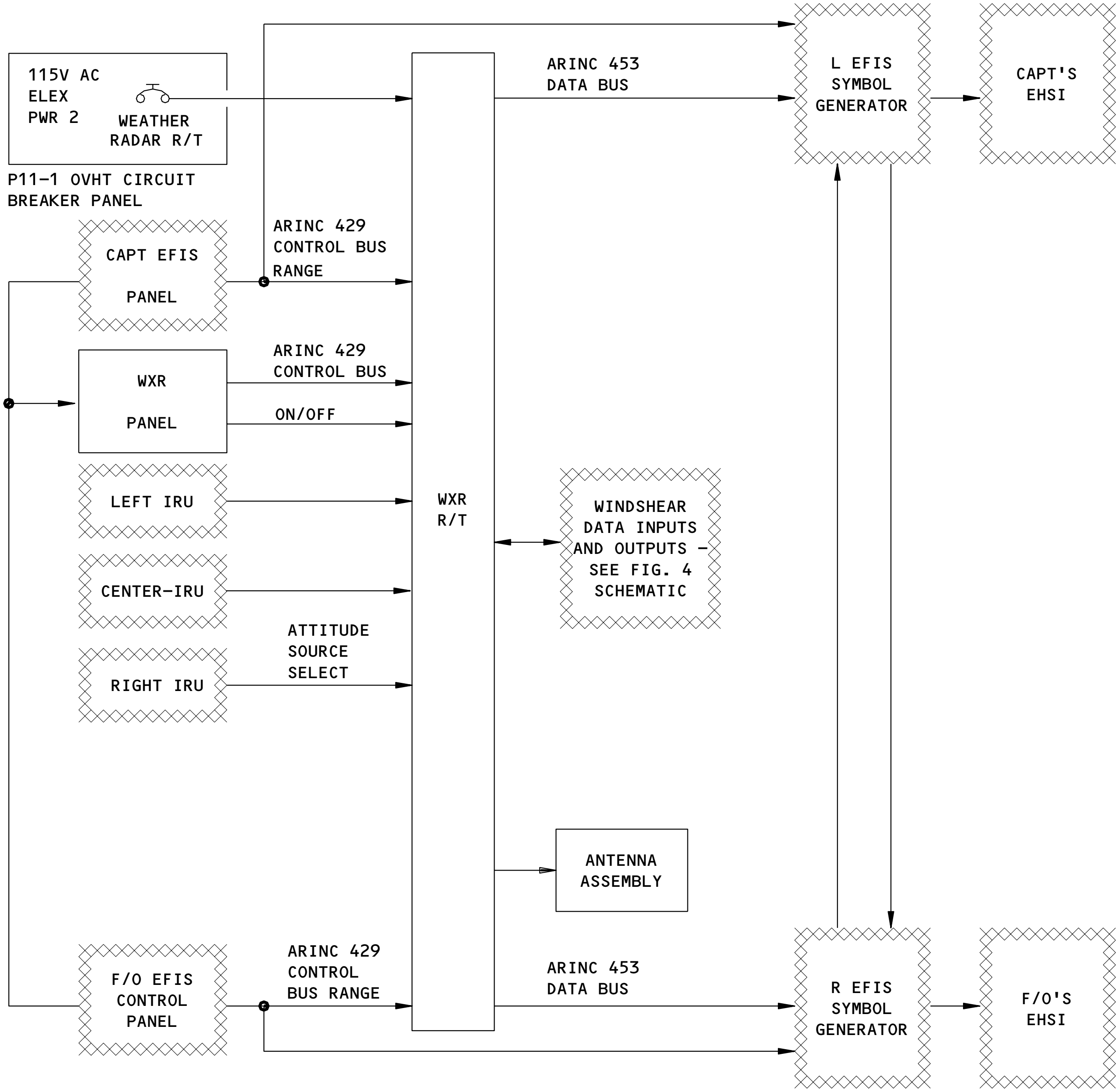
WEATHER RADAR ANTENNA AND WAVEGUIDE

G

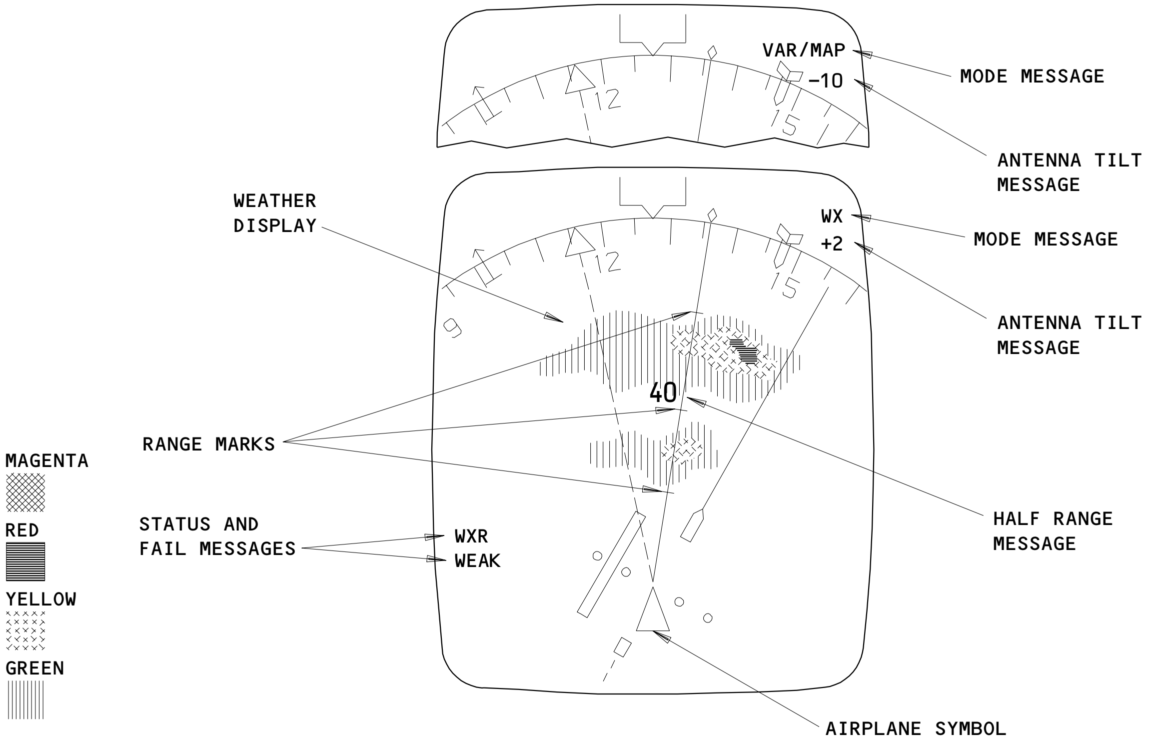
Weather Radar System - Component Location
Figure 1 (Sheet 4)



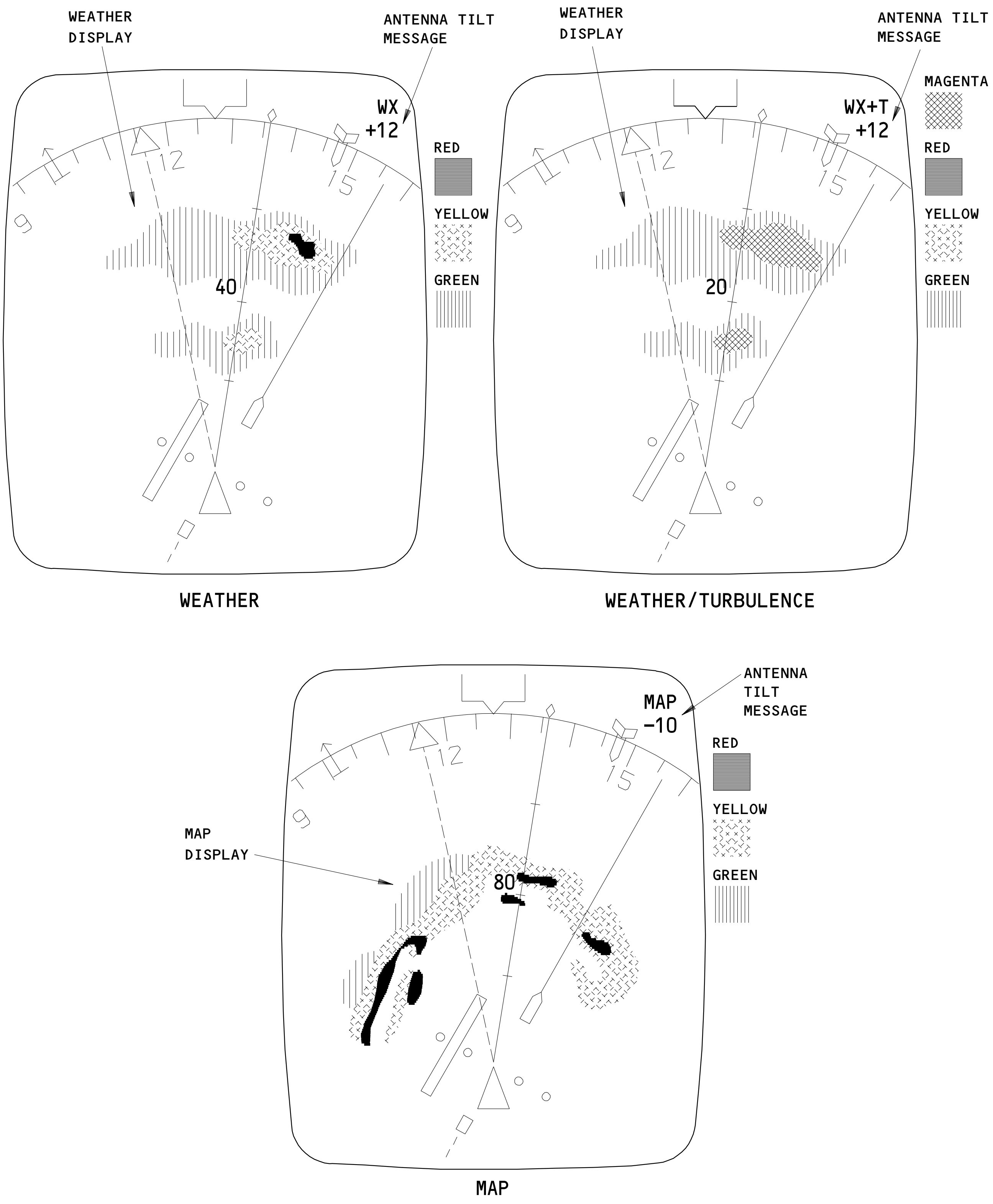
Weather Radar Scan Display and Antenna RF Beam Pattern
Figure 2



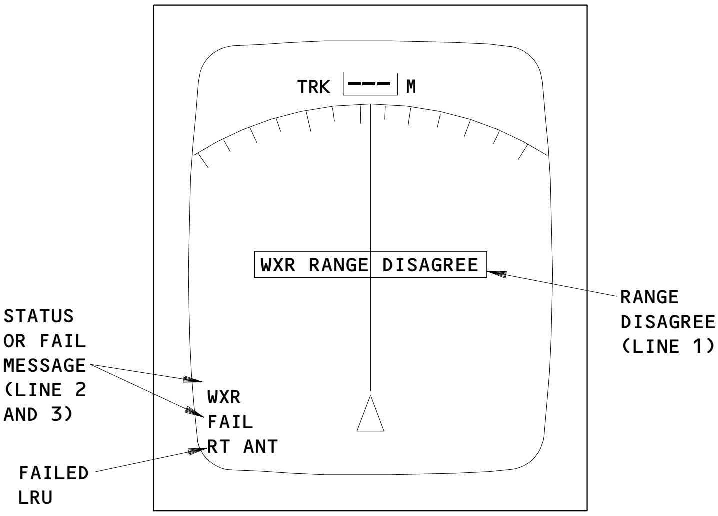
Weather Radar System Block Diagram
Figure 3



EHSI Weather Radar Display
Figure 4



Weather Radar Mode Displays
Figure 5



EHSI - STATUS AND FAULT DISPLAY

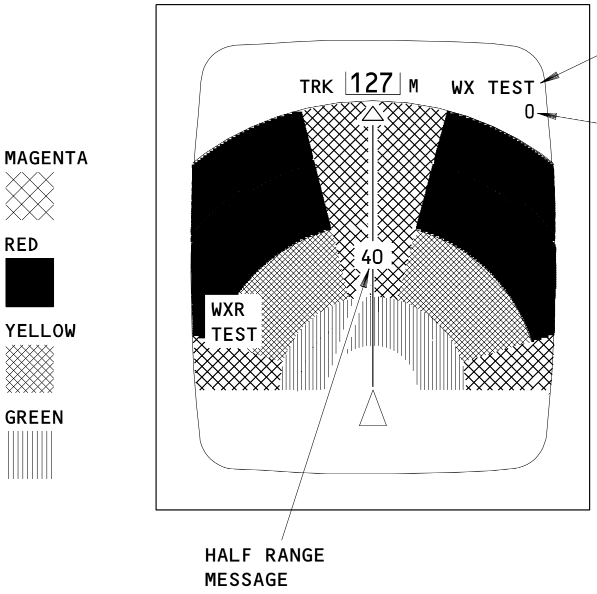
ANNUNCIATION		MEANING OF THE ANNUNCIATION	WXR DATA DISPLAY	ORDER OF PRIORITY OF MESSAGE
LINE 2 (YELLOW)	LINE 3 (YELLOW)			
WXR	WEAK	CALIBRATION FAULT	DISPLAYED	FIRST PRIORTY
WXR	ATT	ATTITUDE INPUT FAULT	DISPLAYED	SECOND PRIORTY
WXR	STAB	STABILIZATION OFF	DISPLAYED	THIRD PRIORTY
WXR	FAIL	RECEIVER/TRANSMITTER FAULT	REMOVED	WXR WEAK, ATT AND STAB MESSAGE INHIBITED
WXR	FAIL	CONTROL FAULT	REMOVED	
WXR	FAIL	ANTENNA FAULT	REMOVED	
WXR	DSPY	EHSI TEMP ABOVE 1ST THRESHOLD (75°C)	REMOVED AFTER 30 SEC	ALL OTHER WXR MESSAGES INHIBITED
BLANK	BLANK	EHSI TEMP ABOVE 2ND THRESHOLD (100°C)	ENTIRE EHSI DISPLAY OFF	

STATUS AND FAULT MESSAGES

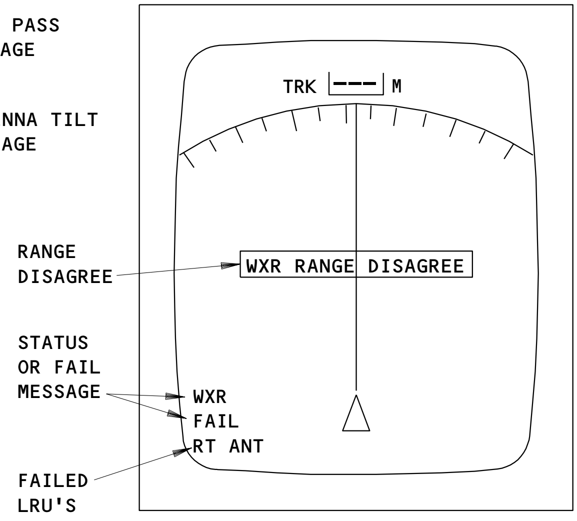
MESSAGE (LINE 1)	COLOR	WXR DATA DISPLAY	CONDITION	EFIS MODE
WXR RANGE DISAGREE	YELLOW	REMOVED	WXR XCVR RANGE PROCESSED DISAGREES WITH EFIS CP SELECTED RANGE	NAV, VOR/ILS MAP, AND CTR MAP
WXR/MAP RANGE DISAGREE	YELLOW	REMOVED	WXR XCVR RANGE PROCESSED AND FMC SELECTED RANGE BOTH DISAGREE WITH EFIS CP SELECTED RANGE	MAP

RANGE DISAGREEMENT MESSAGES

Weather Radar Status and Fault Messages
Figure 6



NORMAL TEST DISPLAY



FAILURE DISPLAY

WX TEST PASS/FAIL (YELLOW)	DEFECTIVE LRU(S) (CYAN)	CONDITION	WXR TEST PATTERN
WX TEST	BLANK	TEST PASS	ON
WX FAIL	RT	RECEIVER/TRANSMITTER FAULT	OFF
WX FAIL	ANT	ANTENNA FAULT	OFF
WX FAIL	CONT	CONTROL FAULT	OFF
WX FAIL	ATT	ATTITUDE INPUT FAULT	OFF
WX FAIL	WEAK	CALIBRATION FAULT	OFF

EHSI TEST PASS/FAIL MESSAGES

Weather Radar Test and Failure Displays
Figure 7

G. The R/T and mounts are located at the following Flight Stations:

Left (R/T No.1)/ - F.S. 0140
Right (R/T No.2) - F.S. 0150 (if installed)

H. During normal ground maintenance the weather radar system on/off control is provided by the WXR switch on the EFIS control panels. The EFIS control panel also enables the weather or map displays on the captain's and first officer's navigation displays (NDs).

2. Component Detail

A. Weather Radar Control Panel

(1) The weather radar control panel is located on the P8 aft electronics panel.

(2) The WXR control panel provides all control data to the transceiver except turn-on and range selection. The control panel also supplies a 28V dc power on discrete to the transceiver. The control panel then receives +28V dc in return from the XCVR for internal processing.

(a) AIRPLANES WITH COLLINS 622-5129-108 WXR CONTROL PANELS; Refer to the data that follows:

1) The MODE controls are as follows:

a) TEST - Activates the test mode for the system. Initially, the transmitter is enabled for less than 1 second and then muted for the remainder of the test. A test pattern is generated containing three concentric arcs with green, yellow and red, displayed from bottom to top. A magenta wedge is in the center and on the two sides. An antenna test sequence is automatically performed. A complete left-to-right scan and up-to-down tilt cycle will occur, with the tilt angle displayed on the EHSIs.

b) WX - activates the weather detection mode within the receiver transmitter.

c) WX/T mode - Selects the normal weather detection and turbulence modes of operation which show areas of significant rainfall and areas where rainfall and winds combine to produce turbulence returns within 50 miles of the airplane. Weather is displayed in green, yellow and red and within 50 Nm turbulence is displayed in magenta.

d) MAP - Depending on the setting of the TILT control, a terrain mapping effect is displayed for identifying terrain features. The colors green, yellow, and red represent increasing levels of return for the radar in the MAP mode. The system gain is selectable in the MAP mode by the use of the GAIN control on the weather radar control panel.

e) IDENT (Identification) - controls the clutter suppression mode of the indicator. Activation of the clutter suppression in the WX modes reduces the intensity of ground clutter.

f) STAB - Provides correct antenna stabilization for changes in airplane attitude. In the OFF position the antenna will rotate around the airplanes centerline axis as opposed to the vertical axis.

g) GAIN control - XVCR gain is controlled in the weather radar WX, WX+T and MAP modes by rotating the GAIN control through its ten detented positions. Counterclockwise rotation of the GAIN control decreases the gain. A VAR message is displayed on the EHSI anytime the GAIN control is in any detent position other than CAL. The VAR message appears to the left of the mode message in the upper right hand corner.

h) TILT control - Tilts the antenna radiator up or down a maximum of 15 degrees from the zero reference position. Antenna tilt in + or - degrees is displayed in the upper RH corner of the EHSI. The tilt control can be adjusted up or down to provide a more accurate EHSI display of the weather conditions in front of the airplane.

B. EFIS Control Panel

C. The captain's and first officer's EFIS control panels are located on the P10 control panel.

(1) The EFIS control panel provides weather radar display turn-on and range selection for the EHSIs. Both the captain's and F/O's EFIS control panels provide independent weather radar control for the respective display.

(2) The WXR power switch provides a power enable signal (ground discrete) to the weather radar transceiver through the weather radar control panel mode switch for system turn on. The switch also sends a discrete to the corresponding EFIS symbol generator for raster display turn-on.

(3) The range selector rotary knob has six range settings which include 10, 20, 40, 80, 160, and 320 nmi. The selected range is sent to the transceiver, the EFIS symbol generator, and the flight management computer (FMC), via a common ARINC 429 data bus. The receiver/transmitter is capable of processing weather radar data for two separate selected ranges.

(4) The mode selector switch will display weather radar data in the following positions: EXP VOR ILS, MAP, CTR MAP and NAV.

D. Receiver/Transmitter

(1) The receiver/transmitter (XCVR) unit(s) are installed on XCVR mounts which has quick-disconnect waveguide fittings. The XCVRs and mounts are located in the pressurized area just aft of the forward pressure bulkhead at station 132.5. Access to the XCVRs is gained through the forward access door of the nose wheel well.

(2) The receiver/transmitter contains the receiver, modulator, TR limiter, duplexer, stabilization, DC power supply, and control circuits. Peak power output from the crystal oscillator is approximately 125 watts at a frequency of 9345 MHz in the X-band. Pulse length is set between 2 to 20 microseconds depending on the range selected. Pulse repetition frequency is 180 or 1440 pps synchronized to the XCVR power supply chopper frequency.

(3) The XCVR is a completely solid-state unit which transmits, receives, processes video, supplies antenna stabilization signals, and provides system monitoring for the weather radar system. The XCVR provides pulse transmission in the X-band frequency range for detection of storm conditions at ranges of up to 320 miles and for terrain mapping. The XCVR contains circuitry which automatically compensates for near and far targets and weakened radar returns due to penetration of weather storm cells. The XCVR contains a microprocessor-controlled antenna stabilization servo loop, which provides antenna line-of-sight stabilization. Microprocessor-controlled system monitoring of key system parameters for fault detection is also an integral part of the XCVR's function. See System Monitoring and Messages in Operation discussion.

E. WXR Receiver/Transmitter Mount

(1) WXR XCVR mount consists of a mounting shelf for the XCVRs, mating quick-disconnect electrical and waveguide fittings, a rotary waveguide switch, and rf feeder waveguides between the switch and XCVRs. Two hold down clamps secure each XCVR to the mount.

(2) Mating quick-disconnect electrical and waveguide fittings. Two hold down clamps secure each XCVR to the mount.

(3) The XCVR mount provides the rf interconnection between the transceivers and antenna and wiring connections between various system components. The XCVR mount is located on a support installation just aft of the forward bulkhead in the forward equipment center.

(4) The XCVR mounts have air conditioning ducts that provide airplane conditioned air to cool the XCVRs.

F. Waveguide

(1) The waveguide connects the selected XCVR to the antenna. The waveguide is X-band, and is pressurized with cabin pressure. A cover flange connects the waveguide to the XCVR and passes through a pressure seal where the waveguide leaves the airplane's pressurized area and enters the nose-cone area. The waveguide connects to the antenna with a choke flange and quick-disconnect clamp.

(2) Waveguide section 3 has a drain hole to allow moisture to go out of the waveguide run from the antenna and the transceiver. The drain hole is located on the bottom side of waveguide section 3 that comes through the forward pressure bulkhead and connects to the waveguide switch.

G. Antenna

(1) The flat plate antenna transmits rf pulses from the weather radar receiver/transmitter, and receives the pulses as the reflect off precipitation formations.

(2) The flat plate antenna is an array of radtiation slots. The rf pulses readiate from each of the slots and combine to make a pencil beam 5.4 degree high and 5.4 degrees wide. The antenna weighs 6 lb. (2.7 kg) and is 23 inches wide.

H. Antenna Pedestal

(1) The antenna pedestal receives 115v ac power from the weather radar receiver/transmitter.

(2) There is a horizontal scan stepper motor to drive the antenna +/- 90 degrees of the airplane centerline. There is also a vertical elevation scan stepper motor to drive the antenna +/- 40 degrees for manual tilt selection from the weather radar control panel. Stepper motors use 26 vdc for operation.

(3) There is a zero position monitor and an incremental monitor for each motor. These monitors send antenna horizontal scan and elevation scan position feedback to the weather radar receiver/tranmitter. There are elecation and azimuth scales that permits a visual measurement of the tilt and scan angles.

(4) There is a horizontal scan and elevation scan disable switch on the antenna pedestal to permit you to remove power to the scan an elevation stepper motors. Use these switches to inhibit movements of the antenna during maintenance. The switches do not stop fr transmissions from the weather radar receiver/transmitter.

(5) A torques spring inside the antenna pedestal counter balances the weight of the antenna. When you remove the antenna, the torque spring moves the elecation drive into the upper position.

I. Electronic Horizontal Situation Indicator (EHSI)

(1) The EHSI is a CRT that provides displays for several electronic systems. The captain's EHSI is located on the captain's instrument panel (P1). The first officer's EHSI is located on the first officer's instrument panel (P3). The following paragraphs describe the displays for the weather radar system:

(a) The weather radar data is displayed on the EHSI's in a low intensity, raster format. The weather and turbulence data is displayed in a four color format. Each color (green, yellow, red, and magenta) represents a range of moisture gradients. Position on the EHSI of the displayed weather radar data corresponds to the actual storm position in relation to the airplane. Display position is also dependent on the selected range.

(b) The ground return data is displayed in a similar manner as the weather data in green, yellow and red. The colors represent the variations in the terrain.

(c) For normal weather radar WXR operation, the EHSI provides the following displays during EFIS operating modes of VOR, ILS and MAP. A four color-coded WXR data display is provided on the EHSIs.

(d) The range arcs are positioned on the course line. Three range arcs are placed on the line at equal distances. Each arc represents one-fourth of the selected range. One-half the selected range (white numerics) is placed beside the center range mark. It equals one-half of the total display range selected on the EFIS control panel. The range arcs are always displayed in the EFIS MAP mode. In the VOR and ILS modes they 1860 are only displayed when the EFIS control panel WXR power switch is in the ON position.

(2) The EHSI is microprocessor controlled. It receives video and control signals from the EFIS symbol generator (Ref 34-22-00/001). Weather radar data is displayed on the EHSI's only when the EFIS control panel WXR power switch is in the ON position.

J. EFI Select Switch

(1) The EFI select switches are an integral part of an instrument source select panels located on the pilots' P1 and P3 panels.

(2) The captain's EFI select switch controls the outputs of the symbol generator to the captain's EHSI. In the normal position, the captain's EHSI is driven by the left symbol generator and the first officer's EHSI is driven by the right symbol generator. When the captain's EFI switch is in the ALTN position, the captain's EHSI is driven by the center symbol generator. The first officer's EFI select switch controls the output of the first officer's symbol generator to the first officer's EHSI.

K. IRS Select Switch

(1) The IRS select switches are an integral part of an instrument source select panels module located on the pilots' P1 and P3 panels.

(2) The captain's IRS select switch controls the inertial reference inputs to the left weather radar transceiver. In the normal position, the left IRS sends inertial reference inputs to the left weather radar. In the ALTN position, the center IRS sends inertial reference inputs to the left weather radar the same as the captains IRS select switch (AMM 34-21-00/001).

(3) The first officer's IRS select switch controls the inertial reference inputs to the right weather radar transceiver.

3. AIRPLANES WITHOUT PREDICTIVE WINDSHEAR;

Operation

A. Functional Description

(1) Electrical Power and Power Control Circuits (Fig. 4)

(a) The receiver/transmitter receives 115-volt, 400 Hz, ac power from the circuit breakers on the P11 overhead circuit breaker panel. The antenna receives 115-volt ac power supplies from the receiver/transmitter.

(2) Weather Radar System Control Functions (Fig. 4)

(a) Several control and data busses send ARINC 429 and 453 data between weather radar and various interfacing systems as shown in Fig. 3. Control bus 0 from the control panel sends ARINC 429 system mode, gain, and tilt data to the left and right XCVRs. Control Bus 1 and 2 is sent from the left and right EFIS control panel data to the respective XCVRs.

(b) The control word is sent to the XCVR. The control information required by the XCVR is assembled by the microcomputer as it examines the control words. The serial data is multiplexed, converted to parallel data and routed to the I/O ports of the XCVR units.

(c) Within the transceiver, the input control data is fed to the timing, control, and monitoring circuits and the antenna stabilization circuits. The timing, control, and monitoring circuits provide timing, control, and monitoring of all functions of the transceiver.

(d) The weather radar control panel microcomputer and its associated components accept the buffered parallel data taken from the control panel switches and controls and converts it into serial data for the ARINC 429 transmitter. Thus, under program control the switch and control inputs are examined and two 32-bit words are assembled. Control word number one from the weather radar control panel is sent to the R/T ARINC 429 interface circuits.

(3) Antenna Functions (Fig. 4)

(a) The radar antenna is a split-axis type mount, having its elevation axis mounted on the scan axis. It is stabilized by a microprocessor-controlled digital servo loop located in the receiver-transmitter unit. 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.

(b) The antenna unit consists of the antenna pedestal and the antenna planar array. The pedestal itself contains circuits for the left and right system which consists of two independent power supplies, motor drivers, receiver/monitor drivers, incremental and zero monitors to provide command signals to the scan and elevation stepper motors.

(c) The flat plate planar array develops the required pencil beam radiation pattern by means of phase reinforcement/cancellation of energy from adjacent slots in the planar array.

1) The motor driver provides an interface with the power supply to pass the binary encoded scan and elevation drive signals from the XCVR to the receiver/monitor driver, and the scan and elevation monitor signals from the receiver/monitor driver to the system XCVR. The receiver/monitor driver buffers and translates the binary encoded scan and elevation drive signals to provide motor positioning control signals to the motor driver. It also buffers the incremental and zero monitor signals and provides a binary encoded output to the XCVR for interpretation. When commanded by the receiver/monitor driver, the motor driver provides drive voltages to incrementally rotate the scan and elevation stepper motors to move the antenna ± 90 degrees in scan and ± 40 degrees in elevation in 0.25-degree steps.

2) Incremental monitors track the motor shaft rotation of the scan and elevation stepper motors from a zero reference point to provide constant monitoring for use by the system receiver-transmitter.
3) Zero monitors provide a reference synchronizing point for the scan and elevation stepper motors from which incremental changes in antenna position can be measured by the incremental monitors.
4) Scan and elevation toggle switches provide a manual means of disabling the input power to the scan and elevation stepper motors. When the pedestal cover is closed, the switches are tripped to ON position by the cover. This prevents the switches from being inadvertently left in OFF position and disabling the antenna drive.

(4) Receiver/Tranmitter Functions (Fig. 4)
  (a) The XCVR unit is a lightweight airborne unit consisting of transmitter, receiver, video processing circuitry, a central processing unit (CPU), input/output circuits, system monitoring circuitry, and power supply.
  (b) The transceiver with predicative windshear capabilities operate as describe below except the windshear circuits are inoperative. The airplane has windshear wiring provisions installed such as wires from the air traffic control and digital air data computers to the weather radar XCVR as shown in Fig 4. Most of the wiring provisions have been installed with the pin connections capped and stowed at their respective connectors.
  (c) The source of the RF transmission is in the XCVR unit driver, where a 777.77 and 777.88 MHz signals are generated and applied to the power amplifier. In the power amplifier, the signal is amplified and split into two separate signals. The multiplier frequency multiplies the signals from the power amplifier in two stages and recombines them to obtain the 125-watt 9333.24 transmitter output signal.
  (d) The duplexer couples the transmitter output signal to the waveguide. The duplexer is monitored by power monitor circuits that develop a loop error signal to correct for output frequency variation and noise. The output signal is transmitted through the waveguide and then radiated out the flat plate antenna.
  (e) The reflected signal is received by the antenna during the interval between transmission pulses, and applied through the duplexer to the receiver circuits of the XCVR. The limiter protects the receiver from power pulses, allowing low power received signals to the mixer.
  (f) The mixer uses a frequency source oscillator to develop the first IF frequency. The first IF amplifier provides a 25 dB gain. The second IF is mixed with frequency source oscillator signals to attain a 13.888 MHz signal. The second IF amplifier gain is controlled by the automatic gain control (AGC) and sensitivity time control (STC) circuits in the azimuth filter.

(g) The reflected signal is routed through the duplexer, limiter and the receiver section, and sent to the range filter. The range filter produces digital range samples and applies them to the azimuth filter and the ground clutter processor.

(h) The range filter is a low pass filter that also digitizes the signal. The low pass function improves the signal-to-noise ratio of the IF signal. The digitized signal is sent to the azimuth filter, which filters and encodes the signal. The encoded signal is sent to the input/output circuits, and formatted into a 1536-bit data word. A 64-bit control word is added to the data word and sent in serial form to the EHSIs.

(i) The azimuth scan filter filters the range samples over multiple PRF samples and averages the returns for each range. It also develops STC and AGC gain control signals for the receiver. Display data is extracted from the returns, filtered, and routed to the displays.

(j) The ground clutter processor determines whether ground clutter is present. If present, a discrete is sent to the signal encoder which removes the ground targets from the display when the ground clutter suppression circuits are operative.

(k) In the signal encoder the processed signals are encoded into 3-bit bin display data, routed to the left and the right ARINC 453 line drivers, and sent serially to the left and the right ARINC 453 data buses 1 and 2 to the captain's and first officer's EHSIs. These data buses transmit data at 1 MHz rate. The ground clutter suppression circuit operates for all ranges in conjunction with any one of the weather radar system modes.

(l) The switches controlling mode, range, tilt, turbulence detection, ground clutter suppression and system selection are applied through the control buses to the control word generator in the central processing unit (CPU) of the XCVR. The CPU uses the control words to configure the operating parameters of the system. The CPU incorporates a microprocessor to perform its various internal functions. The microprocessor executes its control program, which consists of seven major control routines, 180 times a second.

(m) The seven major control routines are:
   1) Attitude routine providing pitch and roll parameters for the stabilization routine.
   2) Stabilization routine providing elevation position to the elevation maintenance routine.
   3) Scan maintenance routine providing antenna scan drive.
   4) Elevation maintenance routine providing antenna elevation drive.
   5) Control bus manager routine determining proper control configuration.
   6) Problem control manager routine programming the internal data collection parameters of the XCVR.
   7) Data bus formatter routine processing and assembling the 64-bit control word of the serial word sent to the indicator.

(n) The video circuits first convert the analog video signals into a digital format. The digital video data is sent to the video processor. It adjusts the signal level with sensitivity timing control (STC). This allows nearby echo signals to be displayed with the same intensity as distant ones. STC is effective to about 70 nm. In the MAP mode, STC is modified to optimize analysis of terrain features.

(o) The video processor also adjusts the overall threshold attenuation and penetration compensation. This compensates for weakened radar returns to intervening targets. Also, the video processor determines the intensity of the weather target and stores this in the video memory. The timing and control circuits sends antenna tilt and scan angle data, selected range data, and any detected fault data to the video memory. The contents of the video memory are formatted and sent to the EFIS symbol generators (Ref 34-22-00) for display. This video memory data is transmitted about every four seconds via ARINC 453 very high speed data buses.

(p) Transceiver Antenna Stabilization Functions

1) The left XCVR receives left or center IRU pitch and roll attitude stabilization inputs. The captain's IRS source select switch in the ALTN position sends a discrete ground to the XCVR to transfer inputs from the left to the center IRU in the left XCVR.

2) The right XCVR receives right or center IRU pitch and roll attitude stabilization inputs. The first officer's IRS source select switch in the ALTN position sends a discrete ground to the XCVR to transfer inputs from the right to the center IRU in the right XCVR.

3) Antenna TILT control changes and antenna scan and elevation monitor signals effect the antenna stabilization circuit computation in the XCVR microcomputer.

4) Stabilization signals from the microcomputer are sent through the I/O ports and elevation and scan line drivers from the XCVR to the antenna.

(q) Transceiver System Monitoring Functions

1) Weather radar system monitoring consists of performance monitoring hardware and built in test equipment (BITE) software within the transceiver. The performance monitor continuously checks for proper transmitter power output and proper receiver operation. If either the transmitter or receiver is operating improperly a WXR, FAIL fault message will be displayed on status and fault lines 2 and 3 as shown in Fig. 6. The weather radar internal BITE continually check for proper operation of the control panel and antenna and valid IRU attitude input data to the transceiver. In addition serial data bus inputs to the transceiver are checked.

(r) Input/output circuits provide the electrical interface circuitry for most of the transceiver rear connector signals. Many of these are routed through the central processing unit. Input/output circuits interface four 12-KHz serial data bus inputs, two 100-KHz serial data bus inputs, and three 1-MHz data bus outputs. Several discrete inputs are used, including the antenna feedback signals and installation program pins.

(5) EFIS Weather Radar Display Functions (Fig. 4)

(a) For normal weather radar operation, the EHSIs provide the weather displays during the EFIS operating modes of VOR, ILS and MAP.

(b) The EHSIs are microprocessor-controlled. The captain's EHSI receives video on the left and right data bus 1. The first officer's EHSI receives video on the left and right data bus 2. Weather radar data is displayed on the EHSIs when the captain's or first officer's EFIS control panel WXR power switch is on. A summary of the input data to the EHSIs is as follows:

Captain's EHSI Signals	From
Video on Left Data Bus 1	XCVR 1
Video on Right Data Bus 1	XCVR 2

First Officer's EHSI Signals	From
Video on Left Data Bus 2	XCVR 1
Video on Right Data Bus 2	XCVR 2

(6) EHSI Weather Radar Alphanumeric Displays (Fig. 5)

(a) AIRPLANES WITH RANGE MARKS;
The selected range and range marks are positioned on the course line. Three range marks are placed on the line at equal distances. The range marks represent one-fourth of the selected range. One-half of the selected range (white numerics) is placed beside the center range mark. It equals one-half of the total display range selected on the EFIS control panel. The range marks are always displayed in the EFIS MAP mode. In the VOR and APP modes the range marks are displayed only when the weather radar data is also represented.

(b) AIRPLANES WITH RANGE ARCS;
The selected range and range marks are positioned on the course line. Three range marks are placed on the line at equal distances. The range marks represent one-fourth of the selected range. One-half of the selected range (white numerics) is placed beside the center range mark. It equals one-half of the total display range selected on the EFIS control panel. The range arcs are always displayed in the EFIS MAP mode. In the VOR and APP modes the range arcs are displayed only when the weather radar data is also represented.

(c) The weather radar mode, tilt and gain messages described below are located in the upper right corner of the EHSI.
1) Mode message - TEST, WX, WX+T and MAP
2) Gain message VAR/MAP is displayed when the GAIN control is in any position other than the calibrate position and the system is in the weather radar MAP mode of operation.
3) Gain message VAR/MAP is displayed when the GAIN control is in any position other than the calibrate position with the system in the WX, WX+T, or MAP modes of operation.
4) Antenna tilt messages of 0 to -15 or +15 are displayed.

(7) Weather Radar Mode Displays (Fig. 6)

(a) The weather radar mode displays are described as follows:
1) WX (weather) - EHSIs show area of heaviest rainfall in red, the next lower level of rainfall in yellow, and the least rainfall in green.
2) WX+T (weather plus turbulence) - the EHSIs display weather the same as in the WX mode. In addition any turbulence return which indicate area of rainfall and winds within 40 miles of the airplane are displayed in magenta.
3) MAP - the EHSIs display terrain mapping returns in red, yellow and green. The WXR indicator displays mapping returns in green an yellow. The most reflective returns are displayed in red, the next lower level in yellow and the least reflective returns are displayed in green.

(8) Weather Radar Status and Fault Message Displays (Fig. 7)
 (a) The EHSI weather radar status, fault messages and range disagreement displays shown in Fig. 7 are described below:
  1) If a calibration fault, attitude input fault, or stabilization off condition is detected, the EFIS symbol generator (SG) generates a WXR on line 2 and WEAK (calibration) ATT (attitude) or STAB (stabilization) on line 3 respectively. If any two or all three conditions occur simultaneously, the symbol generator will prioritize the messages as follows; highest - WEAK, ATT, and lowest - STAB. All three messages will be inhibited whenever a FAIL condition exits. Weather radar data will continue to be sent from the symbol generator and displayed by the EHSIs. If the EFIS symbol generator receives a transmitter fault, antenna fault or control panel fault, the symbol generator will send a status message WXR on line 2 and a FAIL message on line 3 of the EHSI. In a WXR FAIL condition weather radar data will be removed from the EHSIs by the symbol generator.

(9) In the event of an overheat condition on one of the EHSI's the status/fault message would be WXR/DSPY or blank/blank. In either event all weather radar messages would be removed in no longer than 30 seconds.
 (a) When the symbol generator senses a disagreement between the EFIS range and the transceiver range a WXR RANGE DISAGREE message is displayed on line 1 in the center of the EHSI. This message occurs with the EFIS in the NAV, VOR/ILS or MAP modes.
 (b) When both the transceiver range and flight management computer (FMC) range disagree with the EFIS control panel range, a WXR/MAP RANGE DISAGREE message is displayed in the center of the EHSI.
 (c) The weather radar indicator status and fault message displays shown in figure 6 are described below:
  1) A yellow WEAK message in slot 2 indicates an out of calibration condition in the receiver/transmitter. A flashing yellow FAIL message will be present when the system performance monitoring circuits detect a fault. The detected fault will be displayed in message slots 6, 7, 8, or 9 on the left side of the indicator.

B. System Monitoring and Self-Test (Fig. 8)
 (1) Selecting the TEST mode on the weather radar control panel results in a system check of circuits not continually monitored by the performance monitor and BITE as explained in Transceiver Monitor Functions above.
 (2) Self-test is designed to compliment the continuously monitored functions by exercising the system for LRU isolation and operator confidence. The self-test also checks the data bus between the XCVR and the EFIS symbol generator. Self-test of the weather radar system, symbol generators and EHSI is described below.

XCVR - The transmitter transmits for less than 1 second to check proper generation and then is muted for the remainder of the self-test. A proper test pattern verifies correct operation of the weather radar XCVR and EFIS symbol generator and EHSI.

Antenna - The CVR unit automatically exercises the antenna unit to confirm proper operation. It commands a full left sweep followed by a full right sweep to the azimuth limits. Simultaneously, it commands a full up-tilt followed by a full down-tilt to the tilt limits. Upon successful completion of the antenna testing sequence, the CVR unit commands the antenna unit to drive to a dead-ahead azimuth position and to drive to a zero-tilt position, where it stops at the electrical zero positions for the remainder of the test. The antenna test sequence requires less than 8 seconds. Proper antenna tilt operation is verified by observing the tilt readout on the EHSI and WXR indicator. The antenna tilt messages on the EHSIs stops at +15 degrees up, slews to 15 degrees down, and then slews up to 0 degree and stops. On the WXR indicator the operation and antenna tilt messages are the same but use up and down arrows messages.

Antenna - The XCVR unit automatically exercises the antenna unit to confirm proper operation. It commands a full left sweep followed by a full right sweep to the azimuth limits. Simultaneously, it commands a full up-tilt followed by a full down-tilt to the tilt limits. Upon successful completion of the antenna testing sequence, the XCVR unit commands the antenna unit to drive to a dead-ahead azimuth position and to drive to a zero-tilt position, where it stops at the electrical zero positions for the remainder of the test. The antenna test sequence requires less than 8 seconds. Proper antenna tilt operation is verified by observing the tilt readout on the EHSIs and WXR indicator. The tilt readout stops at +15 degrees up, slews to 15 degrees down, and then slews up to 0 degree and stops.

Azimuth - The sweep line on the EHSI is not present during Borescope self-test. Verification of a proper azimuth automatic boresight is accomplished by observing that the sweep line begins its motion from the dead-ahead position after the self-test mode is terminated.

(3) A normal test pattern is shown in Fig. 7. If the test is satisfactorily completed a WX TEST will be present on the EHSIs in the mode message location.

(4) If the test fails a FAIL message will be present on the EHSIs in status message line 3, and the defective LRU or condition will be displayed on fail message line 4 as shown in Fig. 7. The weather radar test pattern will be removed. The following fault conditions will generate the following messages on line 4.

Transceiver	-	RT
Antenna Fault	-	ANT
Control Fault	-	CONT
Attitude Input Fault	-	ATT
Calibration Fault	-	WEAK

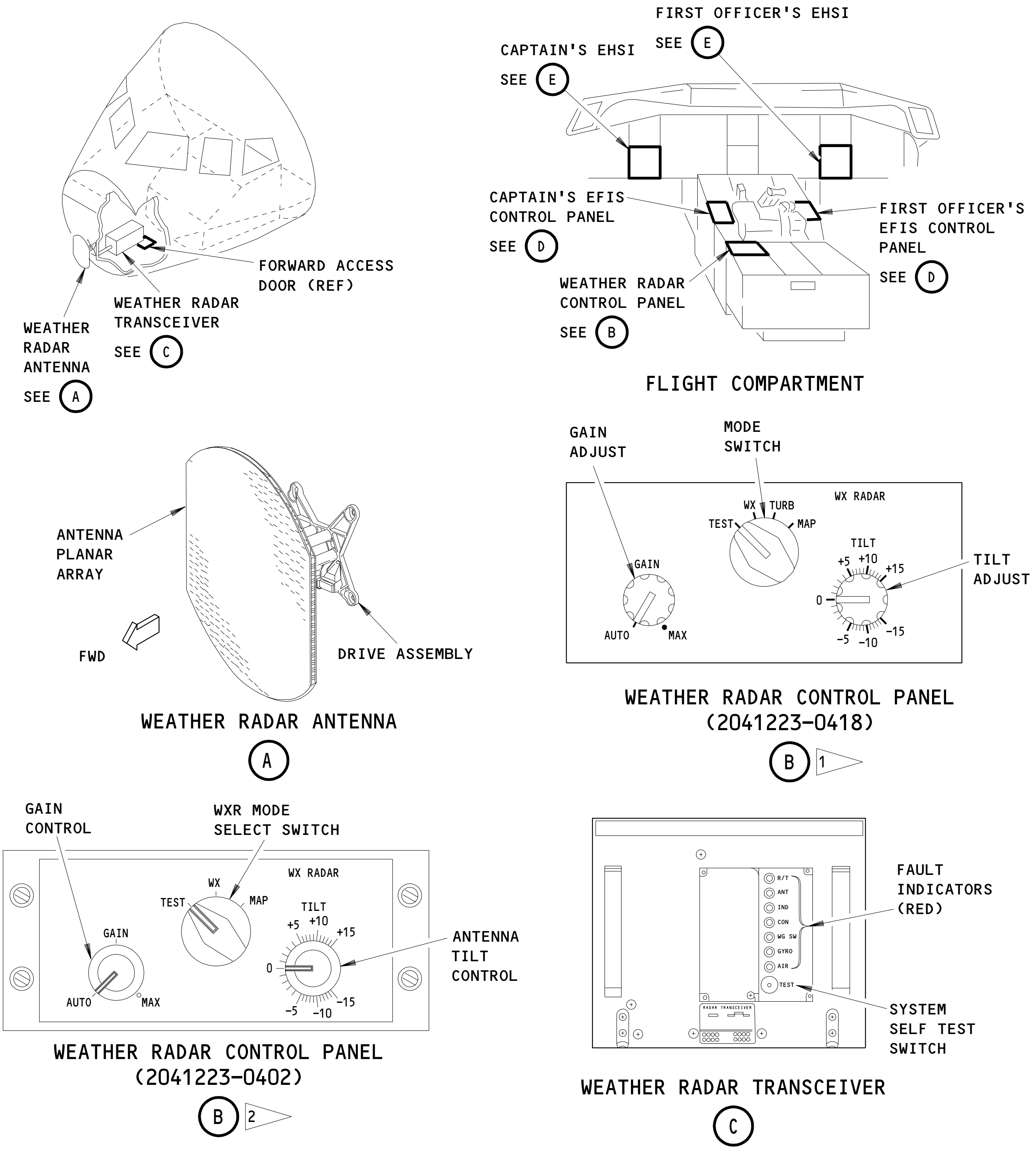
(5) Control
- (a) To initialize the WXR system, the following steps are required:
  - 1) Provide electrical power (AMM 24-22-00/201)
  - 2) On WXR control panel set MODE switch in desired position
  - 3) On IRS mode select panel, place mode switches in ATT.
  - 4) On EFIS control panel, place WXR switch to ON. Place mode-switch in VOR, ILS or MAP
  - 5) Check that weather or ground returns are displayed on EHSIs

WEATHER RADAR SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. Functional Description (Fig. 2)
      (1) The timing and control circuit continuously monitors the XCVR power supply and temperature. It also monitors control panel input and the antenna stabilization circuit. The antenna stabilization circuit continuously monitors IRS input and circuit current. It also monitors the scan and elevation drive. The timing and control circuit periodically (once per transmission period) monitors transmitter output power, the modulator circuit, and the display data bus.
      (2) The rf pre amp, receiver circuits, and antenna stabilization circuits require initiation by the timing and control circuits. If a fault exists, operation will not begin. The rf pre amp and receiver are checked out just prior to transmission. This is done by turning on a diode noise generator at the pre amp. The resulting AGC from the noise injection is measured to determine receiver and pre amp validity. If the antenna stabilization microprocessor detects a fault, it branches into a fault analysis routine. This attempts to drive the antenna through a full scan and full pitch cycle. If the fault is internal to the microprocessor, the timing and control circuits generate a transceiver fault. Otherwise, an antenna fault is generated.
      (3) If a fault is detected during the WX or MAP modes of operation, the fault displays shown in Tables I and II will appear. These will be displayed on the EHSI for the corresponding conditions.

TABLE I
RANGE DISAGREE

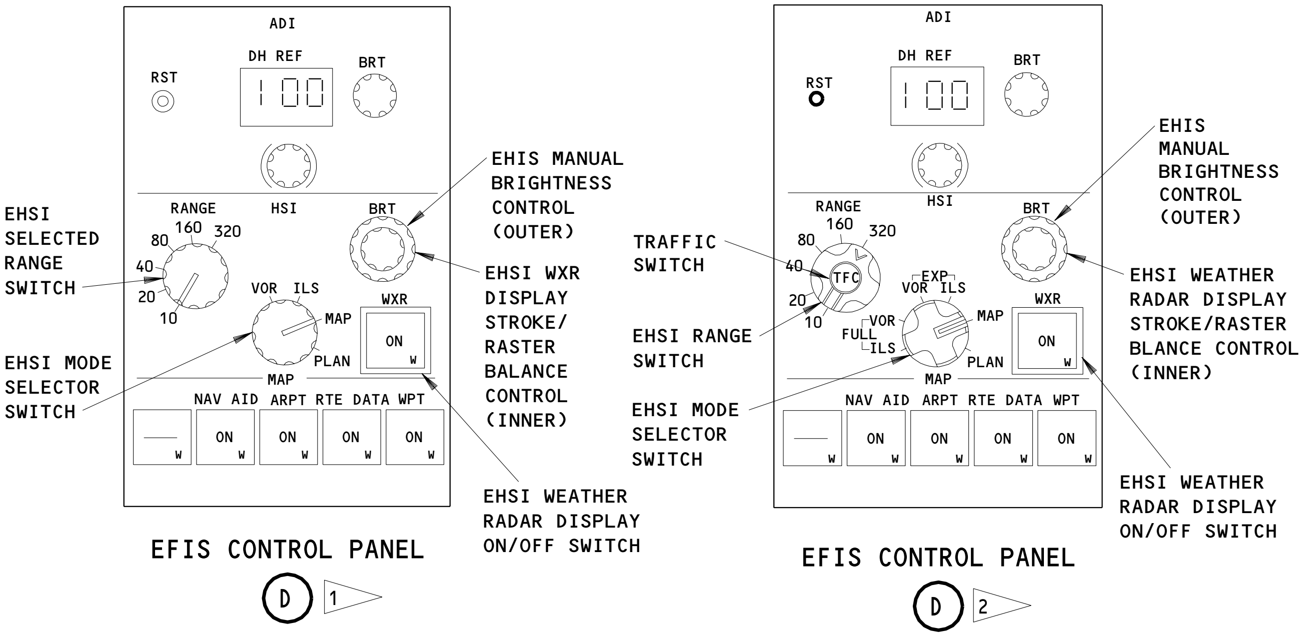
MESSAGE	COLOR	WXR DATA DISPLAY	CONDITION
WXR RANGE DISAGREE	YELLOW	OFF	WXR RANGE DISAGREE WITH CP RANGE IN EFIS MAP MODE
WXR/MAP RANGE DISAGREE	YELLOW	OFF	FMC AND WXR RANGE DISAGREE WITH CP RANGE IN EFIS MAP MODE

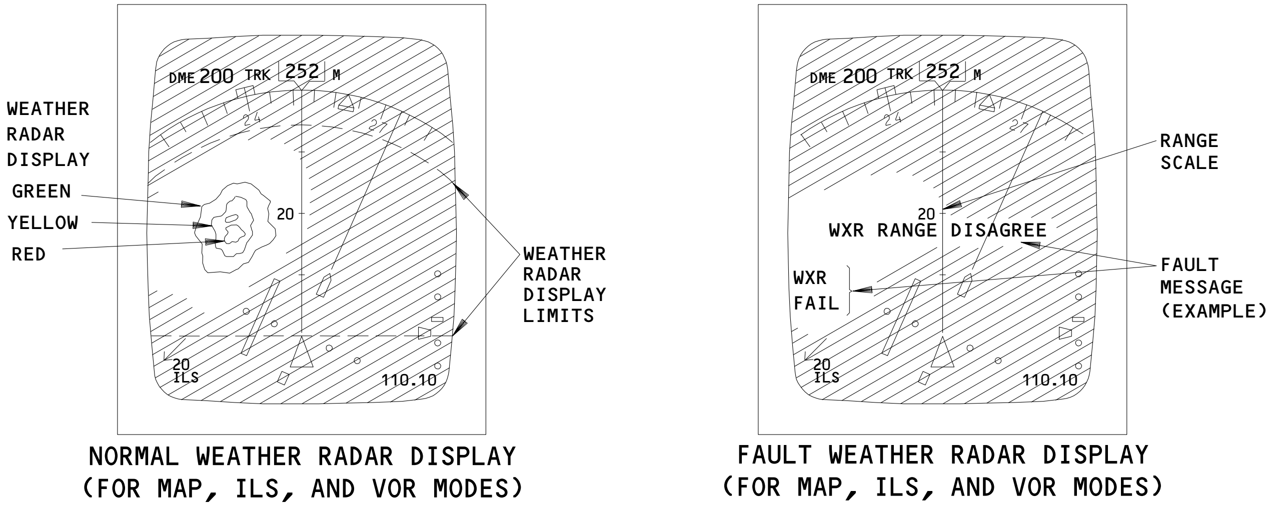


1 GUI 115 POST-SB 34-0394

2 GUI 001, 009, 115 PRE-SB 34-0394

Weather Radar System - Component Location
Figure 1 (Sheet 1)





EHSI - WEATHER DATA
(EXAMPLE)

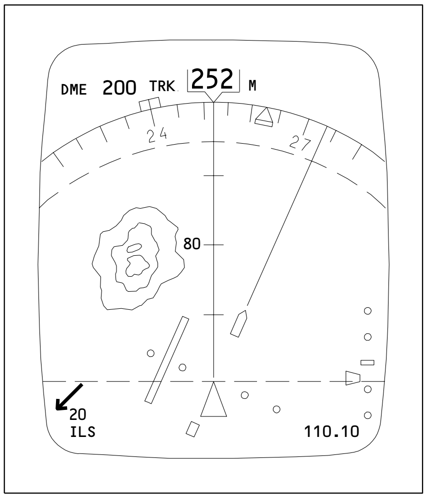
E

COLOR CODE CHART

COLOR	INTENSITY LEVEL	RAIN FALL RATE IN IN/HR OR TURBULENCE LEVEL
BLACK	1	LESS THAN 0.03
GREEN	2	0.03 TO 0.15
YELLOW	3	0.15 TO 0.5
RED	4, 5, 6	MORE THAN 0.5

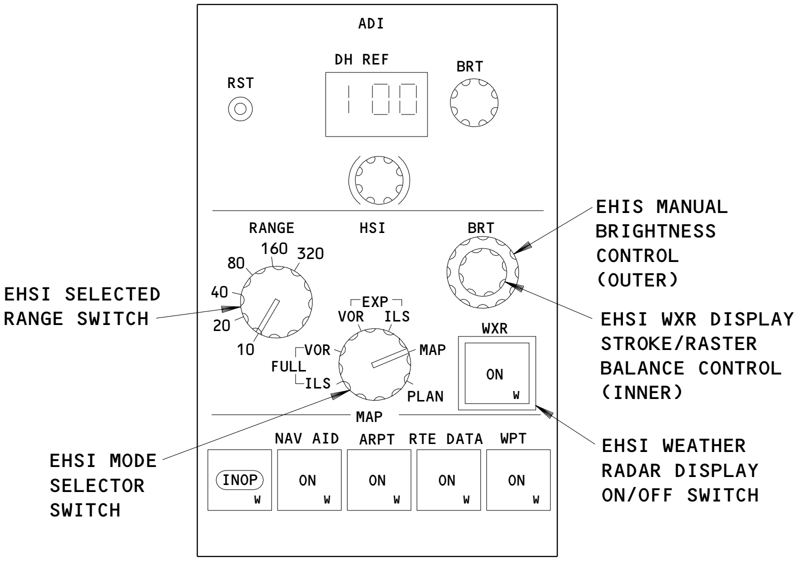
1 GUI 001,009
2 GUI 115

Weather Radar System - Component Location
Figure 1 (Sheet 2)



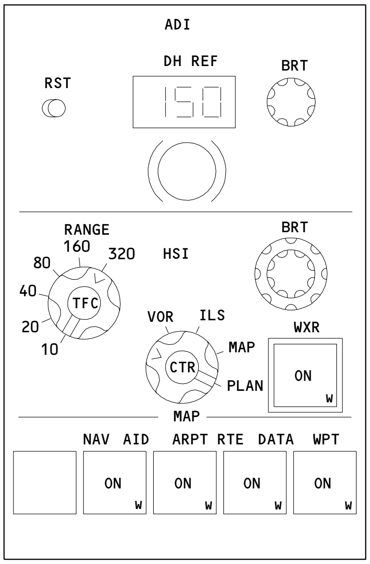
ELECTRONIC HORIZONTAL
SITUATION INDICATOR

C



EFIS CONTROL PANEL

D 1



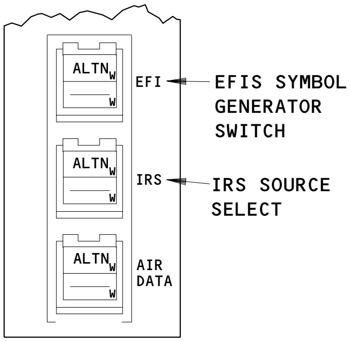
EFIS CONTROL PANEL

D 2

1 GUI 115-999

2 GUI 009

Weather Radar System - Component Location
Figure 1 (Sheet 3)

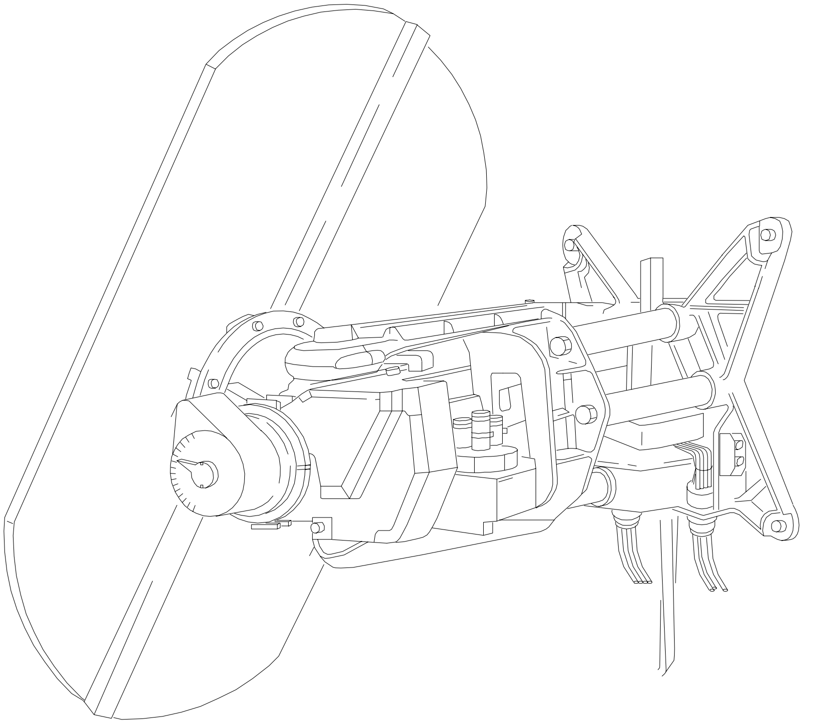


CAPTAINS INSTRUMENT
SOURCE SELECT PANEL

E

WINDSHEAR WARNING LIGHT

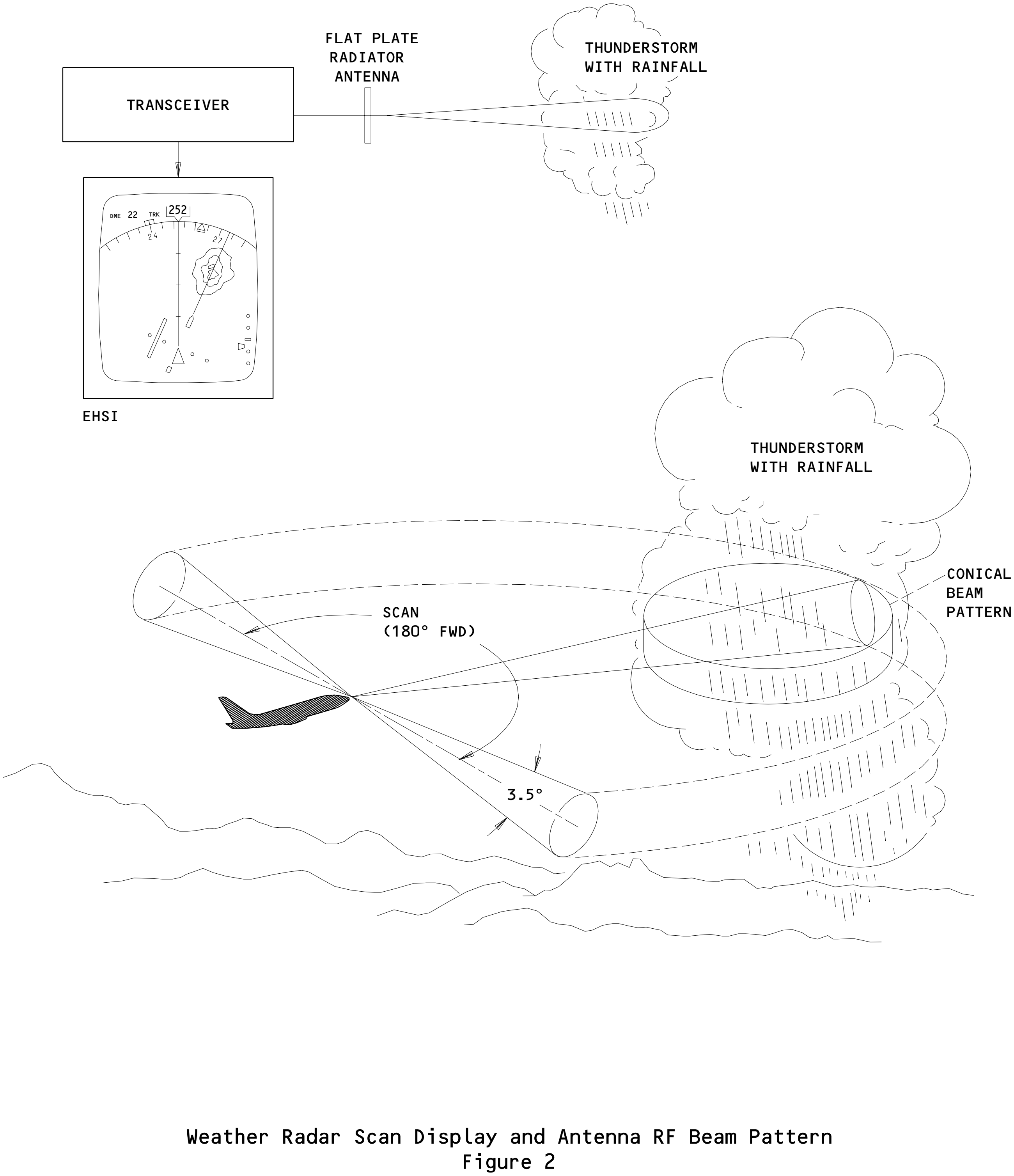
F



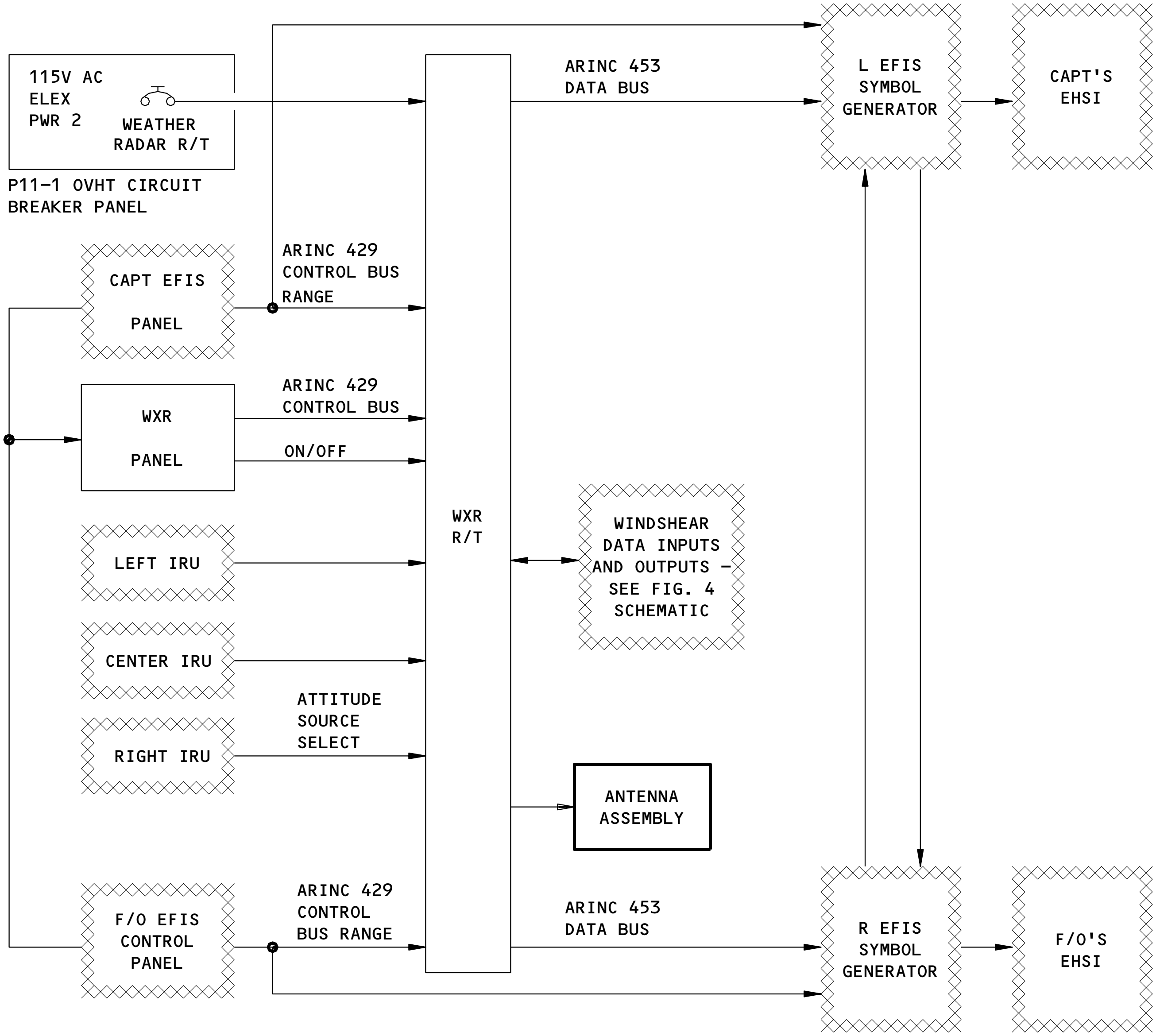
WEATHER RADAR ANTENNA AND WAVEGUIDE

G

Weather Radar System - Component Location
Figure 1 (Sheet 4)



Weather Radar Scan Display and Antenna RF Beam Pattern
Figure 2



Weather Radar System Block Diagram
Figure 3

TABLE II STATUS AND FAIL MESSAGES				
LINE 1 (YELLOW)	LINE 2 (YELLOW)	LINE 3 (CYAN)	CONDITION	WXR DATA DISPLAY
WXR	FAIL	OVERFLOW	SYSTEM FAILURE	OFF
WXR	ATT	OVERFLOW	ATTITUDE INPUT FAULT	ON
WXR	WEAK	OVERFLOW	CALIBRATION FAULT	ON
WXR	STAB	OVERFLOW	STABILIZATION FAULT	ON
WXR	DSPY		EHSI OVERHEAT	OFF AFTER 30 SEC

(4) The system also has manually initiated self test capabilities. During the TEST mode, the system will isolate the fault to the LRU as shown in TABLE III.

TABLE III WXR TEST MESSAGES (EHSI)					
LINE 1 (YELLOW)	LINE 2 (YELLOW)	LINE 3 (CYAN)	LINE 4 (CYAN)	CONDITION	WXR TEST PATTERN
WXR	FAIL	RT	OVERFLOW	TRANSCEIVER FAULT	OFF
WXR	FAIL	ANT	OVERFLOW	ANTENNA FAULT	OFF
WXR	FAIL	CONT	OVERFLOW	CONTROL FAULT	OFF
WXR	FAIL	WEAK	OVERFLOW	CALIBRATION FAULT	OFF
WXR	FAIL	ATT	OVERFLOW	ATTITUDE INPUT FAULT	OFF
WXR	FAIL	STAB	OVERFLOW	STABILIZATION FAULT	OFF

(5) If more than one fault is detected (WX, MAP, or TEST modes), they will be listed according to priority. An OVERHEAT condition is the highest priority and all system messages are inhibited. This is followed by a system failure, ATT, and finally WEAK messages.

(6) During a self test operation, the XCVR transmitter provides several pulses to verify its proper operation. It then turns off. If the self test is initiated on the weather radar control panel, the test result is displayed only on the EHSI (but not on the front panel of the transceiver). If the self test is initiated from the TEST switch on the transceiver, the test result is displayed on the LED fault indicators on the transceiver. No special test signals to drive the antenna to a preset test position are generated; the antenna is driven and monitored as during WX and MAP modes. When a self test is initiated from the XCVR the following display conditions will occur:
- (a) All seven LEDs illuminate on XCVR front panel.
- (b) ALL LEDs turn off, except those which represent detected faults. Also detected faults and appropriate display (see Table III) appear on EHSI. These occur until the test button is released.

(7) Only the EHSI conditions occur when the WXR control panel is placed in the TEST mode.

(8) The seven LEDs on the XCVR and their meanings are:
- (a) R/T - XCVR fault
- (b) ANT - Antenna fault
- (c) IND - Indicator fault (option-not used)
- (d) CON - WXR Control Panel Fault
- (e) WG SW - waveguide switch fault (option-not used).
- (f) GYRO - IRS input fault.
- (g) AIR - XCVR overheat.

B. Control

(1) To initialize the WXR system, the following steps are required:
- (a) Provide electrical power (AMM 24-22-00)
- (b) On WXR control panel set MODE switch in desired postion.
- (c) On panel P11 check that the WX RADAR, all EFIS (7 places), HSI (2 places), and IRS (3 places) circuit breakers are closed.

(d) On panel P6 check that the IRS (3 places) circuit breakers are closed.

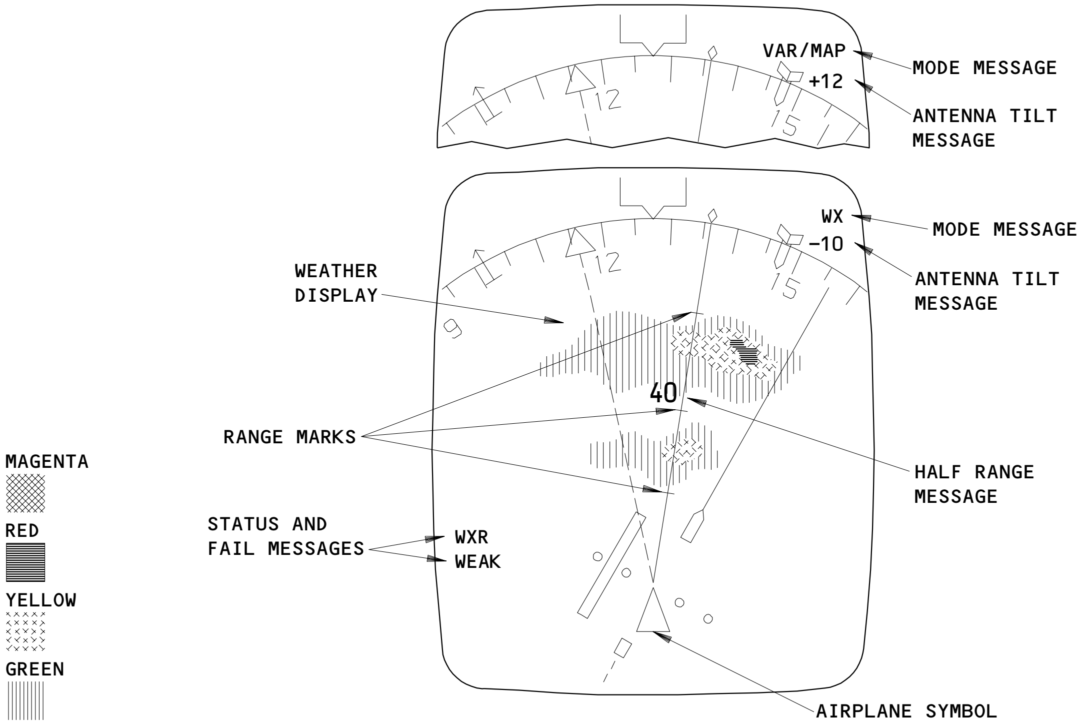
(e) On IRS mode select panel, place mode switches (3 places) in ATT.

(f) On EFIS control panel, place WXR switch to ON. Place mode-switch in EXP-VOR, EXP-ILS or MAP

(g) Check that weather or ground returns are displayed on EHSIs.

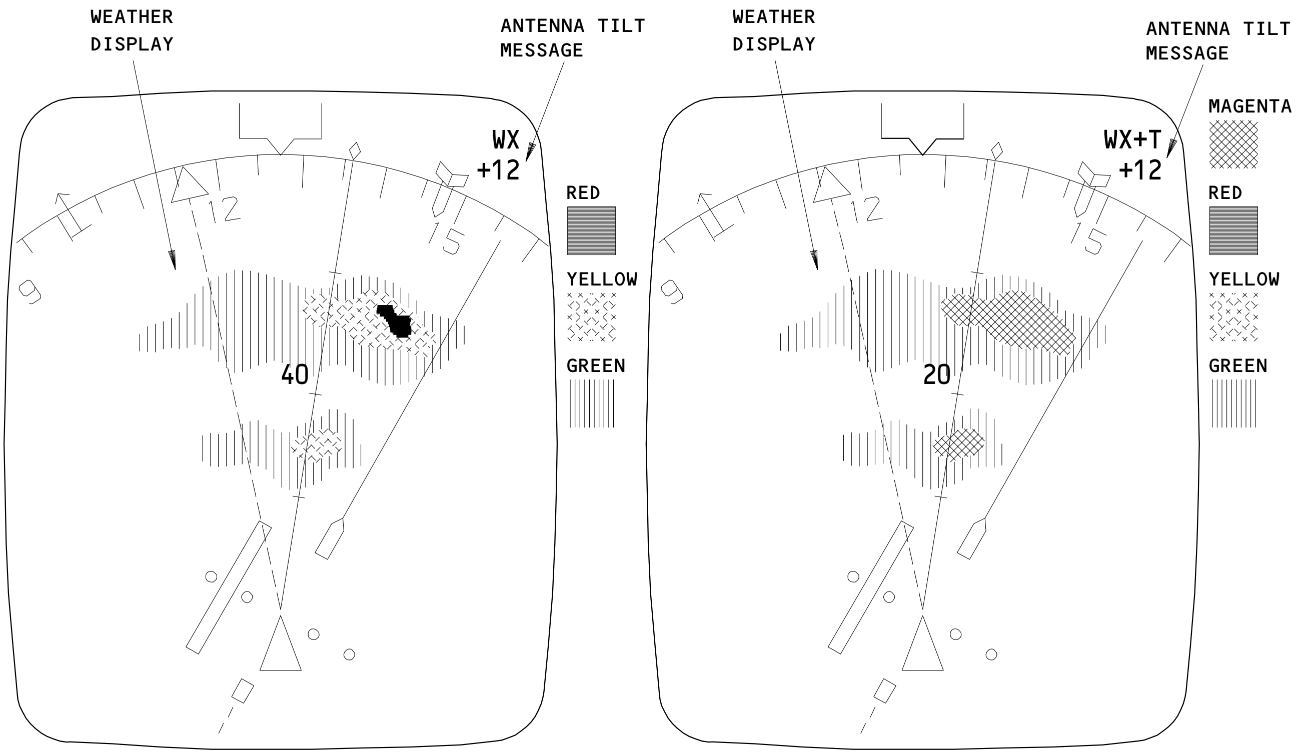
C. The weather radar system uses the reflective effect of microwave pulses on material substances to obtain a picture of conditions ahead of the airplane. The weather radar system presents the pilots with a topographic map type of display of moisture laden weather formations (WX) or major terrain features such as rivers, coastlines, major mountain peaks, and cities for position fixing (MAP). The weather displays permit the pilot to avoid storm penetration and the associated turbulence.

D. The weather radar operates in the X-band and has a penetration range through relatively light intervening rainfall to detect distant rainfall storm areas at ranges of up to 320 miles. The weather displays permit the pilot to avoid weather storms and the associated turbulence. Strong echoes may also return from other objects (such as mountains). All returns are displayed on the electronic horizontal situation indicator (EHSI) and the dedicated Weather Radar Indicator (if installed).



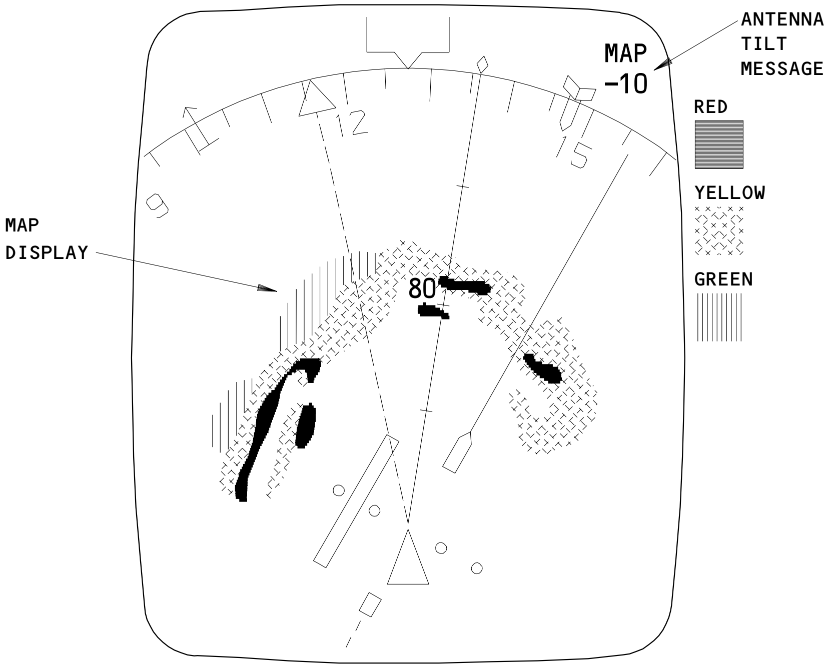
Weather Radar Display
Figure 4

H70385



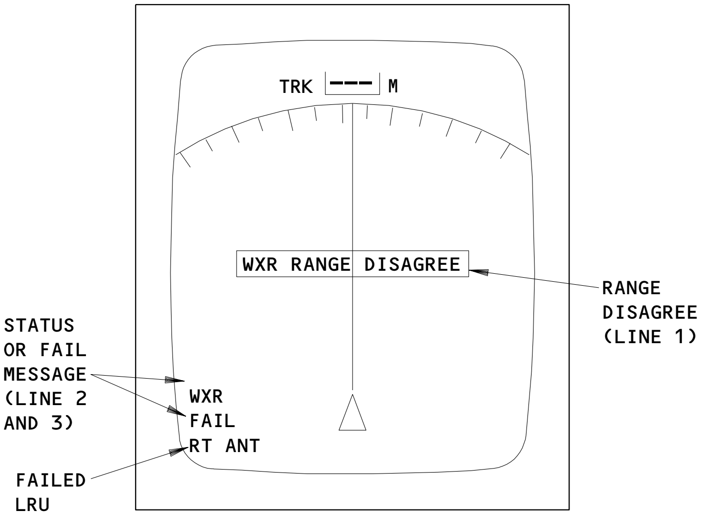
WEATHER

WEATHER/TURBULENCE



MAP

Weather Radar Mode Displays
Figure 5



EHSI - STATUS AND FAULT DISPLAY

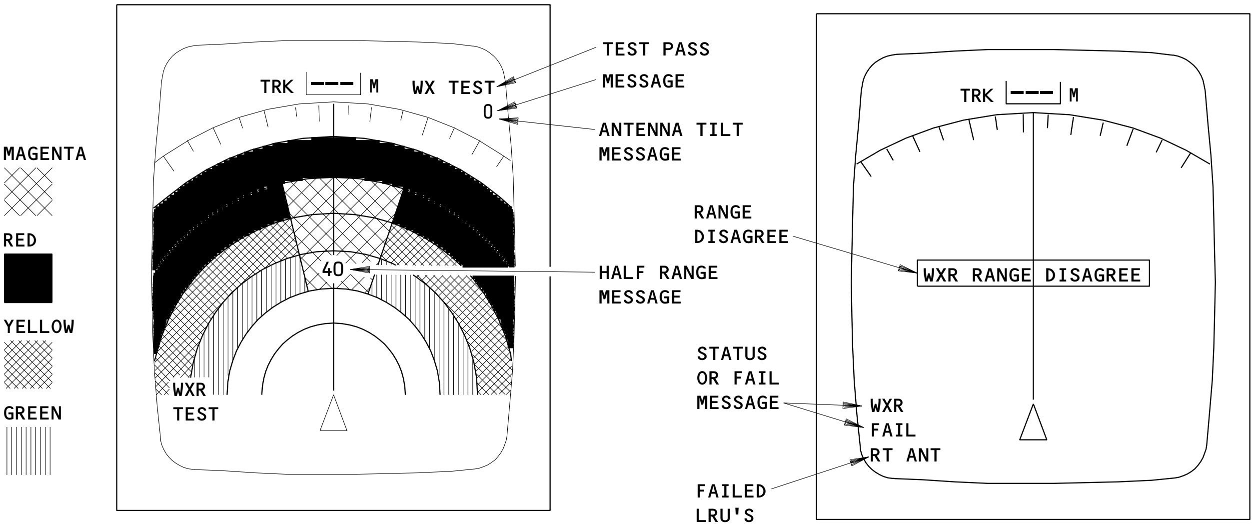
ANNUNCIATION		MEANING OF THE ANNUNCIATION	WXR DATA DISPLAY	ORDER OF PRIORITY OF MESSAGE
LINE 2 (YELLOW)	LINE 3 (YELLOW)			
WXR	WEAK	CALIBRATION FAULT	DISPLAYED	FIRST PRIORTY
WXR	ATT	ATTITUDE INPUT FAULT	DISPLAYED	SECOND PRIORTY
WXR	STAB	STABILIZATION OFF	DISPLAYED	THIRD PRIORTY
WXR	FAIL	RECEIVER/TRANSMITTER FAULT	REMOVED	WXR WEAK, ATT AND STAB MESSAGE INHIBITED
WXR	FAIL	CONTROL FAULT	REMOVED	
WXR	FAIL	ANTENNA FAULT	REMOVED	
WXR	DSPY	EHSI TEMP ABOVE 1ST THRESHOLD (75°C)	REMOVED AFTER 30 SEC	ALL OTHER WXR MESSAGES INHIBITED
BLANK	BLANK	EHSI TEMP ABOVE 2ND THRESHOLD (100°C)	ENTIRE EHSI DISPLAY OFF	

STATUS AND FAULT MESSAGES

MESSAGE (LINE 1)	COLOR	WXR DATA DISPLAY	CONDITION	EFIS MODE
WXR RANGE DISAGREE	YELLOW	REMOVED	WXR XCVR RANGE PROCESSED DISAGREES WITH EFIS CP SELECTED RANGE	NAV, VOR/ILS MAP, AND CTR MAP
WXR/MAP RANGE DISAGREE	YELLOW	REMOVED	WXR XCVR RANGE PROCESSED AND FMC SELECTED RANGE BOTH DISAGREE WITH EFIS CP SELECTED RANGE	MAP

RANGE DISAGREEMENT MESSAGES

Weather Radar Status and Fault Messages
Figure 6



NORMAL TEST DISPLAY

FAILURE DISPLAY

WX TEST PASS/FAIL (YELLOW)	DEFECTIVE LRU(S) (CYAN)	CONDITION	WXR TEST PATTERN
WX TEST	BLANK	TEST PASS	ON
WX FAIL	RT	RECEIVER/TRANSMITTER FAULT	OFF
WX FAIL	ANT	ANTENNA FAULT	OFF
WX FAIL	CONT	CONTROL FAULT	OFF
WX FAIL	ATT	ATTITUDE INPUT FAULT	OFF
WX FAIL	WEAK	CALIBRATION FAULT	OFF

EHSI TEST PASS/FAIL MESSAGES

Weather Radar Test and Failure Displays
Figure 7

E. The receiver/transmitter generates and transmits high energy radio frequency (rf) pulses which are radiated by the antenna. A small portion of the radiated energy is reflected back to the airplane by moisture laden clouds or by major terrain features. The reflected signals are received by the same antenna, processed by the R/T unit and displayed on the EHSI's. The transfer of the RF energy between the R/T unit and the antenna takes place via the waveguide and waveguide switch. Stabilization of the antenna in pitch and roll is provided by the inertial reference system.

F. While in the MAP Mode of operation the weather radar system presents the pilots with a topographic map type display of moisture laden weather formations or major terrain features such as rivers, coastlines, major mountain peaks, and cities for position fixing. The weather displays permit the pilot to avoid weather storms and the associated turbulence.

G. AIRPLANES WITH SINGLE WEATHER RADAR RECEIVER/TRANSMITTERS;
The weather radar system consists of a WXR transceiver (XCVR), transceiver mount, an antenna assembly, waveguide assembly, WXR control panel and a WXR indicator. The weather radar transceivers receive control data and a power enable signal from the electronic flight instrument system (EFIS) control panel. Weather or map data is displayed on the WXR indicator and the EFIS electronic horizontal situation indicator (EHSI). Equipment location is shown in Figure 1.

H. During normal ground maintenance the weather radar system on/off control is provided by the WXR switch on the EFIS control panels. The EFIS control panel also enables the weather or map displays on the captain's and first officer's navigation displays (NDs).

2. <u>Description</u>

A. Weather Radar Control Panel

(1) The control panel is located on the forward electronics control panel P8.

(2) The WXR control panel provides all control data to the transceiver except turn-on and range selection. The control panel also supplies a 28V dc power on discrete to the transceiver. The control panel then receives +28V dc in return from the XCVR for internal processing.

(3) The basic functions of the Control Panel are the following:
  (a) Tilt control knob that will manually adjusted the antenna tilt.
  (b) Mode control enables the user to select various weather (WX) modes, map or test modes.
  (c) Gain control knob that enables the user to manually select the gain for the weather returns shown on the display unit.

B. EFIS Control Panel
  (1) The captain's and first officer's EFIS control panels are located on the P10 control panel.
  (2) The EFIS control panels provide weather radar display turn-on, range and EFIS mode selection for the EHSIs. Both the captain's and F/O's EFIS control panel provides independent weather radar control for the respective display.
  (3) The WXR power switch provides a power enable signal to the weather radar receiver/transmitter when the weather radar mode selector switch is in any operating mode for system turn on. The WXR switch also sends a discrete to the corresponding EFIS symbol generator for raster display turn-on.
  (4) The range selector rotary knob has six range settings which include 10, 20, 40, 80, 160, and 320 nmi. The selected range is sent to the weather radar receiver/transmitter, the EFIS symbol generator, and the flight management computer (FMC), via a common ARINC 429 data bus. The receiver/transmitter is capable of processing WXR data for both separate selected ranges.
  (5) The mode selector switch will display weather radar data in the following positions: EXP VOR/ILS, MAP, CTR MAP and NAV.

C. EFI Select Switch
  (1) The EFI select switch is an integral part of an instrument switching module located on the pilot's forward overhead panel.
  (2) The EFI select switch controls the outputs of the symbol generators to the captain's or first officer's EHSIs. In the NORMAL position, the captain's EHSI is driven by the left symbol generator and the first officer's EHSI is driven by the right symbol generator. When the switch is in the BOTH ON 1 position, both EHSI's are driven by the left symbol generator. In the BOTH ON 2 position, the EHSI's are driven by the right symbol generator.

D. Weather Radar (WXR) Receiver/Transmitter

(1) Receiver/transmitter No. 1 is mounted on an R/T mount in the forward nose compartment at station 140. Access is gained through the lower nose compartment access door. Receiver/transmitter No. 2 (if installed) is mounted on an R/T mount on electronic equipment rack E1 at station 150. Access is gained through the electronics equipment access door. The R/T's have quick-disconnect electrical and waveguide fittings that mate with the R/T mounts.

(2) The R/T is a completely solid state unit which transmits, receives, processes video, supplies antenna stabilization signals, and provides system timing and monitoring for the weather radar system. The R/T provides pulse transmission in the X-band frequency range for detection of storm conditions at ranges of up to 320 miles and for terrain mapping. The R/T contains circuitry which automatically compensates for near and far targets and weakened radar returns due to penetration of weather storm cells. The R/T contains a microprocessor-controlled antenna stabilization servo loop, which provides antenna line-of-sight stabilization.

(3) AIRPLANES WITH ALLIED SIGNAL RDR-4A RECEIVER/TRANSMITTERS;
The front panel of the R/T contains a test switch which is used with seven LED fault annunciators. When the test switch is pressed and held, the fault annunciators will lamp-test momentarily and then go out, unless a fault has been detected. The fault annunciators are as follows:

R/T - receiver/transmitter unit fault annunciator
ANT - antenna drive unit fault annunciator
IND - indicator not installed
CON - control panel fault annunciator
WG SW - waveguide switch fault annunciator
GYRO - attitude inputs fault annunciator
AIR - cooling over temperature annunciator

E. Receiver/Transmitter Mounts

(1) R/T mount No. 1 is located at station 200 in the lower nose compartment. R/T mount No. 1 consists of a shelf with a quick-disconnect electrical and waveguide fittings, an electrical cooling fan, an rf feeder waveguide flange connection and hold down clamps. The hold down clamps secure receiver/transmitter No. 1 to the R/T mount.

(2) R/T mount No. 2 is located on shelf No. 1 in electronic equipment rack E1 at station 307. R/T mount No. 2 consists of quick-disconnect electrical and waveguide fittings, an air hose connection, rf feeder waveguide flange connection and hold down clamps. The hold down clamps secure receiver/transmitter No. 2 to the R/T mount.

(3) The R/T mounts provide the rf waveguide connection between the R/T, antenna and waveguide switch.

F. Waveguide

(1) The X-band waveguide connects the selected R/T from the waveguide switch to the antenna. A choke flange on the antenna and quick-disconnect clamp on the waveguide provide easy removal and installation from the antenna. The waveguide from the antenna is routed aft through the forward pressure bulkhead to the waveguide switch. The waveguide switch connects to R/T mount No. 1. Additional waveguide sections from the waveguide switch, secured to aircraft structure, extend aft to R/T mount No. 2.

(2) Waveguide section 1 has a drain hole to allow moisture to go out of the waveguide run from the antenna and the receiver/transmitter. The drain hole is located on the bottom side of waveguide section 1 just aft of the pressure seal on the forward pressure bulkhead.

(3) The XCVR mounts have air conditioning ducts that provide airplane conditioned air to cool the XCVRs.

G. Antenna

(1) The antenna is mounted on the airplane bulkhead on the forward pressure bulkhead behind the radome in an unpressurized section of the airplane. It is used for both transmitting and receiving.

(2) The antenna system consists of an azimuth drive motor, a tilt drive motor, an azimuth position synchro, an elevation position synchro, and a 30-inch planar array radiating element.

(3) Operation of the TILT control, on the weather radar control panel, up or down from the zero position impresses a fixed angle, as selected on the control, on the stabilized/boresight zero position of the antenna radiator. Maximum compensating movement of the antenna is 45-degree combined pitch and roll plus or minus the TILT angle set at the weather radar control panel.

H. Electronic Horizontal Situation Indicator (EHSI)

(1) The weather radar data is displayed on the EHSI's in a low intensity, raster format. The weather and turbulence data is displayed in a four color format. Each color (green, yellow, red, and magenta) represents a range of moisture gradients. Position on the EHSI of the displayed weather radar data corresponds to the actual storm position in relation to the airplane. Display position is also dependent on the selected range.

(2) The ground return data is displayed in a similar manner as the weather data in green, yellow and red. The colors represent the variations in the terrain.

(3) For normal weather radar operation, the EHSI provides the following displays during the EFIS operating modes of NAV, EXP VOR/ILS, MAP or CTR MAP.

(4) The selected range and range marks are positioned on the course line. Three range marks are placed on the line at equal distances. Each mark represents one-fourth of the selected range. One-half the selected range (white numerics) is placed beside the center range mark. It equals one-half of the total display range and the range selected on the EFIS control panel.

(5) The range marks are always displayed in the EFIS MAP mode. In the NAV and VOR/ILS modes the range marks are displayed only when weather radar data is also presented.

(6) The EHSI is microprocessor controlled. It receives video and control signals from the EFIS symbol generator. Weather radar data is displayed on the EHSI's when the EFIS control panel WXR power switch is ON, weather radar panel mode selector switch is in an operating mode, and the EFIS mode selector is in EXP VOR/ILS, MAP, CTR MAP or NAV.

3. Operation

A. General

(1) The R/T unit will generate the RF pulses for transmission and send them to the antenna via the waveguide. The reflected RF is returned to the R/T for processing.

(2) The video signal received by the radar receiver is digitized and forwarded to the EHSI in binary format.

B. Functional Description.

(1) Electrical Power and Power Control Circuits (Fig. 3)

(a) Weather radar system No. 1 or 2 may be turned on with the captain's or first officer's EFIS control panel WXR switch. The system on/off signal from the EFIS microprocessor goes through the weather radar control panel or WXR indicator mode select switch and system transfer switch to either R/T No. 1 or 2. This discrete ground on/off signal enables the selected R/T which generates power supply voltages of 12 and 28-volts dc for the control panel operation.

(b) Receiver/transmitter No. 1 or 2 provide 12 and 28-volts dc to the weather radar control panel or WXR indicator. The No. 1 system 28-volts dc at the normally closed contacts of the system transfer switch is sent to the R/T microprocessor through the de-energized contacts of the waveguide switch. When R/T No. 2 is selected on the control panel, a discrete ground is sent to R/T No. 1 which stops transmitting. The No. 2 system 28-volts dc de-energizes the waveguide switch to connect the No. 2 R/T to the antenna and send 28-volt s dc to the R/T No. 2 microprocessor to start rf transmission.

(2) Weather Radar System Control Functions (Fig. 3)

(a) The weather radar receiver transmitter acquires control data from the weather radar control panel, EFIS control panels, and inertial reference units. This data is either digital (ARINC 429) or discrete data.

(b) Several control and data buses send ARINC 429 and 453 data between weather radar units and various interfacing systems. Control bus 0 from the control panel sends ARINC 429 system mode, gain, and tilt data to the R/T No 1 or 2. Control bus 1 sends range data from the captain's EFIS control panel to R/T's No. 1 and 2. Control bus 2 sends range data from the first officer's EFIS control panel to R/T's No. 1 and 2.

(c) The WXR power switch (EFIS control panel) and attitude data selection (IRS source select switch) inputs are open/ground discretes. The WXR power switch ground power enable energizes the receiver transmitter power supply. This in turn, provides operating power to the weather radar control panel, antenna, and weather radar for system turn on. The IRS source select switch provides an open discrete (in the NORMAL position) and a ground discrete (in the BOTH ON R position) to the receiver/transmitter data input circuits. This de-energizes (in NORMAL) and energizes (in BOTH ON R) a multiplexer to select between the left or right IRS, respectively.

(d) Within the receiver transmitter, the input control data is fed to the timing, control, and monitoring circuits and the antenna stabilization circuits. The timing, control, and monitoring circuits provide timing, control, and monitoring of all functions of the receiver transmitter.

(3) Weather Radar Control Panel Functions (Fig. 2)

(a) AIRPLANES WITH ALLIED SIGNAL WXR CP 2041223-0418;
The control panels have these functions:

1) The MODE control has the following positions:

a) TEST - Activates the test mode for the system. Initially, the transmitter is enabled for less than 1 second and then muted for the remainder of the test. A test pattern is generated containing three concentric arcs with green, yellow and red, displayed from bottom to top. A magenta wedge is in the center and on the two sides. An antenna test sequence is automatically performed. A complete left-to-right scan and up-to-down tilt cycle will occur, with the tilt angle displayed on the EHSIs.

b) WX - activates the weather detection mode within the receiver transmitter.

c) WX/TURB mode - Selects the normal weather detection and turbulence modes of operation which show areas of significant rainfall and areas where rainfall and winds combine to produce turbulance returns within 50 miles of the airplane. Weather is displayed in green, yellow and red and within 50 Nm turbulence is displayed in magenta.

d) MAP - Depending on the setting of the TILT control, a terrain mapping effect is displayed for identifying terrain features. The colors green, yellow, and red represent increasing levels of return for the radar in the MAP mode. The system gain is selectable in the MAP mode by the use of the GAIN control on the weather radar control panel.

e) TILT control - Tilt settings from the left or right controls are converted by the analog-to-digital converter into digital inputs and sent to the control microprocessor unit. The control microprocessor converts the tilt inputs into serial data and sends tilt commands to the receiver/transmitter on an ARINC 429 control data bus. Tilt settings of 15 degrees up or down from the zero

(b) AIRPLANES WITH ALLIED SIGNAL 2041223-0402 CONTROL PANEL; Refer to the data that follows:

1) GAIN control - XVCR gain is controlled in the weather radar MAP mode by rotating the GAIN control through its ten detented positions. Counterclockwise rotation of the GAIN control decreases the gain. A VAR message is displayed on the EHSI anytime the GAIN control is in any detent position other than AUTO. The VAR message appears to the left of the mode message in the upper right hand corner of the EHSI.
2) TEST - Activates the test mode for the system. Initially, the transmitter is enabled for less than 1 second and then muted for the remainder of the test. A test pattern is generated containing three concentric arcs with green, yellow and red, displayed from bottom to top. A magenta wedge is in the center and on the two sides. An antenna test sequence is automatically performed. A complete test sequence is automatically performed. A complete sequence is automatically performed. A complete left-to-right scan and up-to-down tilt cycle will occur, with the tilt angle displayed on the EHSIs.
3) WX - activates the weather detection mode within the receiver transmitter.
4) MAP - Depending on the setting of the TILT control, a terrain mapping effect is displayed for identifying terrain features. The colors green, yellow, and red represent increasing levels of return for the radar in the MAP mode. The system gain is selectable in the MAP mode by the use of the GAIN control on the weather radar control panel.

5) TILT control - Tilts the antenna radiator up or down a maximum of 15 degrees from the zero reference position. Antenna tilt in + or - degrees is displayed in the upper RH corner of the EHSI. The tilt control can be adjusted up or down to provide a more accurate EHSI display of the weather conditions in front of the airplane.

(4) Antenna Functions

(a) The Radar Antenna is an X-band, line-of-sight antenna, stabilized by a microprocessor-controlled digital servo loop located in the receiver-transmitter unit. The antenna is stabilized in roll up to ±40 degrees and stabilized in pitch up to ±25 degrees. The antenna can be manually tilted ±15 degrees from the horizontal (zero-degree) and is stabilized over a combined tilt, pitch, and roll input of ±45 degrees.

(b) The planar array develops the required pencil beam radiation pattern by means of phase reinforcement/cancellation of energy from adjacent slots in the planar array.

(c) Pitch and roll information from the inertial reference system, tilt information from the manually set tilt control, azimuth angle information from the azimuth (scan) synchro transmitter, and elevation angle information from the elevation synchro transmitter, are processed by the stabilization microprocessor circuitry in the R-T to produce a control phase voltage for the elevation drive motor. The elevation drive motor repositions the antenna to maintain line-of-sight.

(d) The elevation drive motor, is a two-phase servo motor which operates with a reference phase voltage of 115 volts, 400 Hz supplied to one winding and a 400-Hz control phase voltage of varying amplitude applied to the other winding. The reference phase voltage is applied at all times while the control phase is applied only when needed to reposition the antenna planar array in elevation as ordered by the stabilization microprocessor circuitry in the R-T unit. The control voltage is an error voltage supplied by the microprocessor circuitry. The elevation motor repositions the antenna in elevation until the phase of the error voltage induced in the control winding reaches a null. The speed at which this correction is performed is dependent on the error voltage amplitude.

(e) The R-T unit also supplied the azimuth motor drive signal which drives the antenna through the oscillating 180 degrees of azimuth (scan). Controlled by the microprocessor circuitry in the R-T unit, the 115-volt drive signal is applied to one of the dual windings in the azimuth motor. The motor rotation drives the gear train, which in turn drives the antenna to one side of the straight ahead zero-degree heading. The azimuth synchro continuously transmits the antenna angle position to the microprocessor circuitry. When the antenna reaches the 85-degree position, the microprocessor through triac switching removes the 115-volt drive signal from the azimuth motor. The antenna continues to coast in the direction of its movement until the microprocessor circuitry determines the antenna has reached 90 degrees.

(5) AIRPLANES WITH ALLIED SIGNAL RDR-4A RECEIVER/TRANSMITTER; Receiver/Transmitter Functions

(a) The R-T unit is a lightweight airborne unit consisting of a transmitter, receiver, video processing circuitry, digital interfaces, stabilization servo-loop circuitry, system monitoring circuitry, and power supply.

(b) The transmitter consists of a driver stage, which receives its input from crystal-controlled reference oscillator, and a power amplifier output stage. Output of the transmitter is at 9345 MHz and is a nominal 125 watts peak, pulse width alternates between 6 and 18 microseconds. The 6-microsecond pulse echoes are processed to produce the zero to 40 nautical mile targets on the indicator, and the 18-microsecond pulses echoes are processed to produce the targets greater then 100 nautical miles. Echoes from both the 6- and 18-microsecond pulses are processed to produce the targets between 40 and 100 nautical miles.

(c) Because the receiver and transmitter both receive their input from a crystal-controlled reference oscillator, an afc circuit is not necessary. The receiver is a triple-conversion superheterodyne that uses two stages of Gallium-Arsenide FET amplifiers (Ga-As FET) low-noise amplifiers in the front end. The third i-f amplifier is a logarithmic amplifier that has a 60-dB dynamic range, it provides the capability to detect and process weather targets having intensity levels from 0 dBZ to 60 dBZ. The receiver design provides an overall MDS (minimum discernible signal) of -121.9 dB (typical) for the system.

(d) The video circuits first convert the analog video signals into a digital format. The video processor adjusts the signal level with sensitivity timing control (STC). This allows nearby echo signals to be displayed with the same intensity as distant ones. STC is effective to about 70 nm. In the MAP mode, STC is modified to optimize analysis of terrain features.

(e) The video processor also adjusts the overall threshold attenuation and penetration compensation. This compensates for weakened radar returns to intervening targets. Also, the video processor determines the intensity of the weather target and stores this in the video memory. The timing and control circuits sends antenna tilt and scan angle data, selected range data, and any detected fault data to the video memory. The contents of the video memory are formatted and sent to the EFIS symbol generators (AMM 34-22-00) for display. This video memory data is transmitted about every 5.25 milliseconds.

(f) Receiver/Transmitter Antenna Stabilization Functions

1) The antenna stabilization system is a microprocessor-controlled servo loop. The microprocessor receives inputs from: roll and pitch attitude, selected tilt angle, and elevation and azimuth scan angles of the antenna. The microprocessor solves the line-of-sight equation from these inputs and predicts the new position of the antenna elevation. The difference between the predicted position and the desired position is used to derive the elevation motor drive signal. The azimuth drive is an open-loop operation. For this, the microprocessor monitors the position of the antenna and generates signals to reverse the direction of scan when the antenna reaches 90 degrees either side of dead ahead.

2) The R/T's receive continuous No. 1 and No. 2 IRS pitch and roll attitude stabilization inputs. When The ATTITUDE select switch is in the NORMAL position the R/T's receive IRS pitch and roll attitude inputs from the No. 1 IRS. When the ATTITUDE select switch is set to the BOTH ON R position a discrete ground, ATT SOURCE SELECT, is sent to both R/T's. These discrete ground transfers the IRS pitch and roll inputs from the No. 1 to the No. 2 IRS in the R/T's.

(g) System Monitoring

1) The timing control and monitoring module in the R/T performs the system monitoring functions. The module has a timing and control (T&C) microprocessor, power supply monitor, discrete monitor, antenna stabilization, fault memory, data bus, receivers and decoders and various other circuits.

2) Initially after power turn on the power supply monitor checks various dc voltage levels. The monitor also receives a temperature sensor input to detect an overheat condition in the receiver/transmitter mount cooling system. The timing and control microprocessor codes the fault condition and stores it in the fault memory.

3) Normal power supply voltages and temperature causes the timing microprocessor to enable the BITE circuit antenna stabilization microprocessor. When a fault is detected the microprocessor goes through a fault routine to locate the fault condition. Faults are sent by a data bus to the timing microprocessor which codes the fault condition and stores it in the fault memory.

4) The BITE monitoring circuits in the timing control checks each of the weather radar unit functions to determine which replaceable unit or units are faulty. The BITE circuits generate fault messages which are sent through the ARINC 453 data buses No. 1 and 2 to the EHSI's.

5) When a fault is detected the receiver/transmitter T&C microprocessor also stores the fault in the fault memory for display when the R/T front panel TEST switch is pressed. When the TEST pushbutton is pressed (and held), all fault annunciators come on for 1 second to perform a lamp test; then they all go off if no fault is detected. If any of the fault annunciator LEDs stay illuminated, a failure in that unit is indicated. Releasing the pushbutton causes all annunciators to go off and remain off.

C. EHSI Weather Radar Display Functions

(1) Receiver/transmitter No. 1 and 2 supply both EFIS symbol generators with digital weather radar data on data buses 1 and 2. In the symbol generator, the digital data is converted to video data in a X-Y raster format. The signals are separated into analog deflection signals and digital video signals. The information is then routed to the EHSI's.

(2) The EFI select switch in NORMAL sends left symbol generator data to the captain's EHSI and sends right symbol generator data to the first officer's EHSI. In BOTH ON 1 or BOTH ON 2 data to the first officer's EHSI. In BOTH ON 1 or BOTH ON 2 positions the respective symbol generators provide data to both EHSI's.

(a) The EHSI separates the weather radar raster display from the EHSI stroke display symbol generator inputs. The two formats are processed separately. The EHSI then displays the weather radar data in a four color format in a low intensity raster format.

(3) EHSI Weather Radar Alphanumeric Displays

(a) The selected range and range marks are positioned on the course line. Three range marks are placed on the line at equal distances. The range marks and range arcs represent one-fourth of the selected range. One-half the selected range (white numerics) is placed beside the center range mark. It equals one-half of the total display range selected on the EFIS control panel.

(b) The range marks and range arcs are always displayed in the EFIS MAP mode. In the VOR and APP modes, the range marks and arcs are displayed only when weather radar data is also presented.

1) Mode message - TEST, WX, WX+T and MAP

2) Gain message VAR/MAP is displayed when the GAIN control is in any position other than the AUTO (calibrate) position and the system is in the weather radar MAP mode of operation.

3) Antenna tilt messages of 0 to -15 or -15 are displayed.

(4) Weather Radar Mode Displays

(a) The weather radar mode displays are described as follows

1) WX (weather) - EHSIs show area of heaviest rainfall in red, the next lower level of rainfall in yellow, and the least rainfall in green.

2) WX/T (weather plus turbulence) - the EHSIs display weather the same as in the WX mode. In addition any turbulence return which indicate area of rainfall and winds within 40 miles of the airplane are displayed in magenta.

3) MAP - the EHSIs display terrain mapping returns in red, yellow and green. The most reflective returns are displayed in red, the next lower level in yellow and the least reflective returns are displayed in green.

(5) Weather Radar Status and Fault Message Displays

(a) The EHSI weather radar status, fault messages and range disagreement displays

1) If a calibration fault, attitude input fault, or stabilization off condition is detected, the EFIS symbol generator (SG) generates a WXR on line 2 and WEAK (calibration), ATT (attitude) or STAB (stabilization) on line 3 respectively. If any two or all three conditions occur simultaneously, the symbol generator will prioritize the messages as follows; highest - WEAK, ATT, and lowest - STAB. All three messages will be inhibited whenever a FAIL condition exists. Weather radar data will continue to be sent from the symbol generator and displayed by the EHSI's. If the EFIS symbol generator receives a transmitter fault, antenna fault or control panel fault, the symbol generator will send a status

2) In the event of an overheat condition on one of the EHSI's the status/fault message would be WXR/DSPY or blank/blank. In either event all weather radar messages would be removed in no longer than 30 seconds.

3) When the symbol generator senses a disagreement between the EFIS range and the receiver/transmitter range a WXR RANGE DISAGREE message is displayed on line 1 in the center of the EHSI. This message occurs with the EFIS in the NAV, VOR/ILS or MAP modes.

4) When both the receiver/transmitter range and flight management computer (FMC) range disagree with the EFIS control panel range, a WXR/MAP RANGE DISAGREE message is displayed in the center of the EHSI.

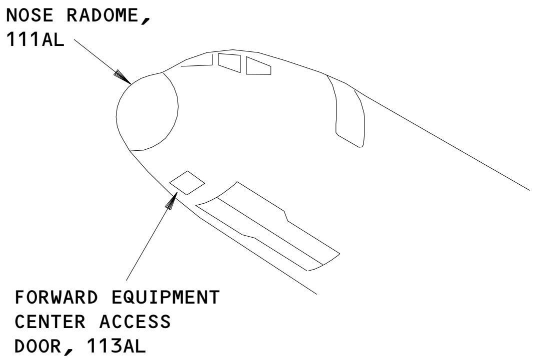
5) The over temperature fault indicator on the front panel of the R/T monitors the cooling provided by the R/T mounts for the receiver/transmitters.

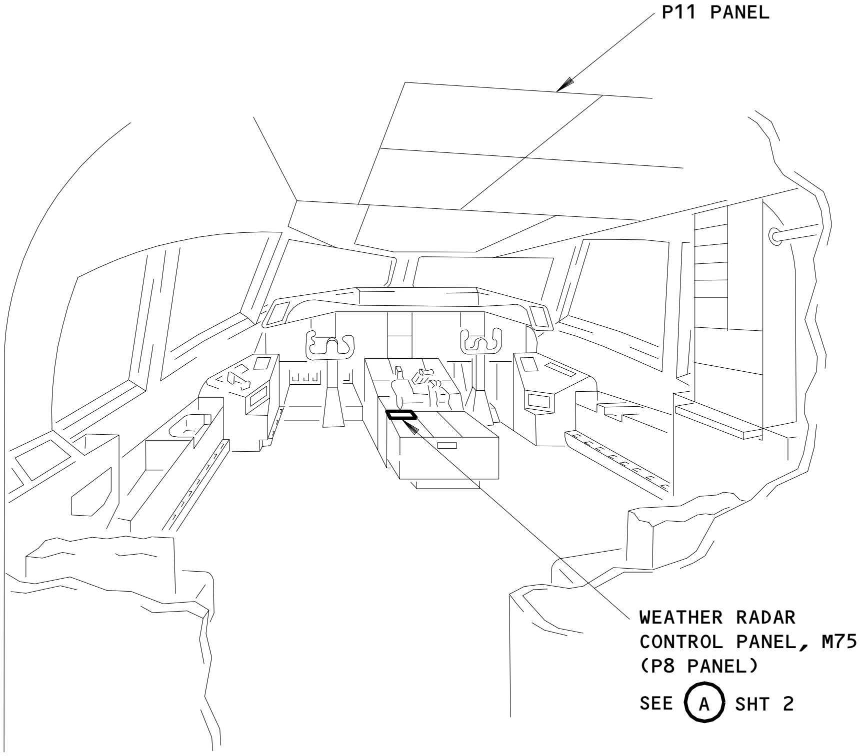
WEATHER RADAR SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - WEATHER RADAR, M269	2	1	111AL, NOSE RADOME	34-43-05
ASSEMBLY - WAVEGUIDE	2	1	113AL, FWD BULKHEAD	34-43-04
CIRCUIT BREAKER -	1		FLT COMPT, P11	
WX RADAR, C615		1	11F2	*
PANEL - WEATHER RADAR CONTROL, M75	1	1	FLT COMPT, P8	34-43-02
PANEL - (FIM 34-22-00/101)				
LEFT EFIS CONT PNL, M94				
RIGHT EFIS CONT PNL, M93				
SWITCH - (FIM 34-22-00/101)				
LEFT IRS, P1				
TRANSCEIVER - WEATHER RADAR, M213	2	1	113AL, FWD EQUIP CTR	34-43-01

* SEE THE WDM EQUIPMENT LIST

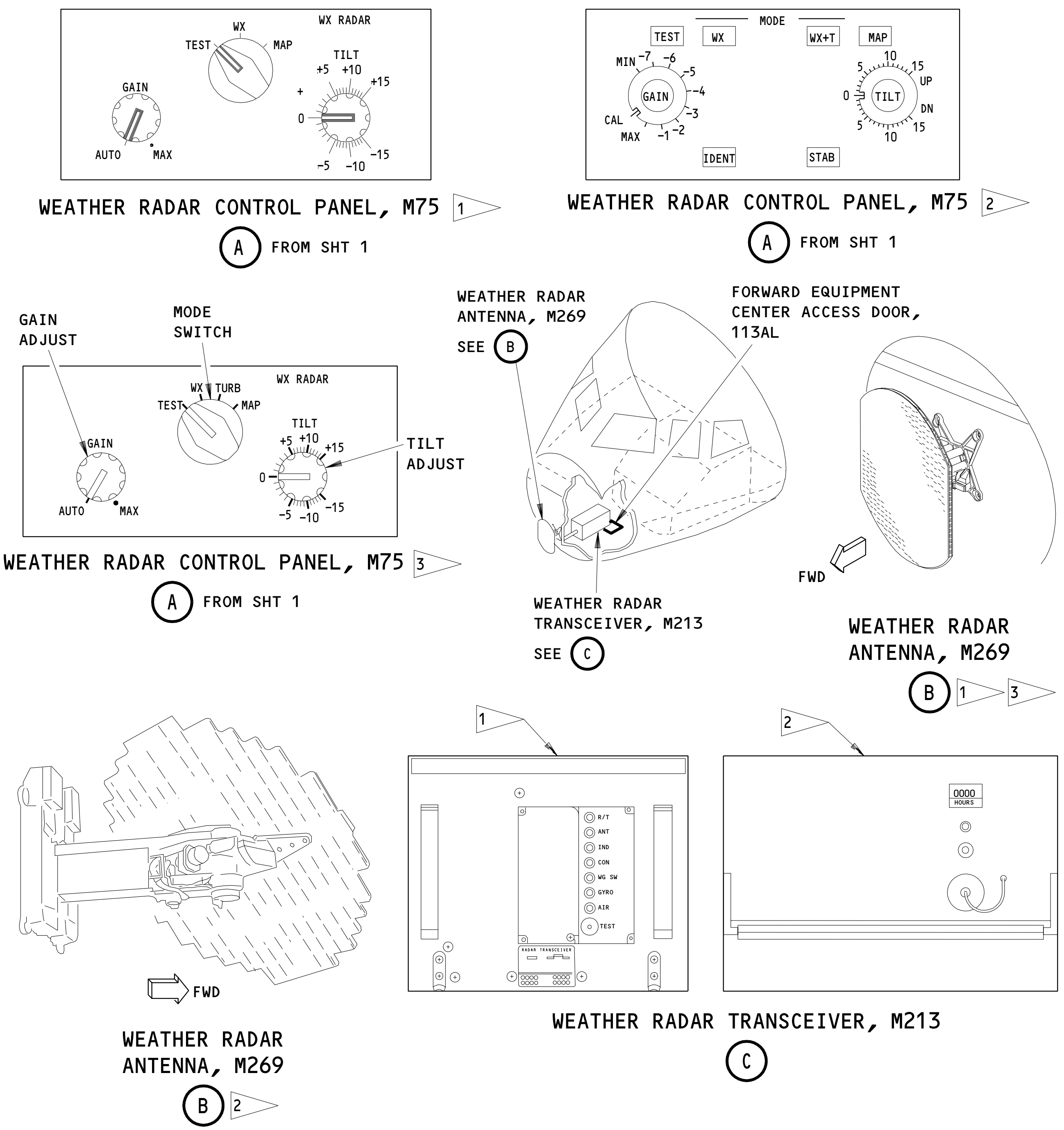
Weather Radar System - Component Index
Figure 101





FLIGHT COMPARTMENT

Weather Radar System - Component Location
Figure 102 (Sheet 1)



1 GUI 001, 009, 115 PRE-SB 34-0394
2 GUI 002-008, 010-114, 116-999
3 GUI 115 POST-SB 34-0394

Weather Radar System - Component Location
Figure 102 (Sheet 2)

WEATHER RADAR SYSTEM - ADJUSTMENT/TEST

1. General
   A. This subject contains these tasks:
      (1) Operational Test
         (a) The operational test uses the self test circuits to make sure all functions of the weather radar system are serviceable.
      (2) System Test
         (a) The system test makes sure all functions of the weather radar operate correctly.

TASK 34-43-00-715-139-001

2. Operational Test - Weather Radar System
   A. General
      (1) The operational test uses the mode selector switch on the WXR control panel in the TEST positsion. In the TEST mode, the self test circuits monitor the performance of the left (right) weather radar systems.
      (2) During the self test the weather radar system operates as follows:
         (a) The transceiver operates for 1 seconds.
         (b) A special test pattern is sent to the EHSIs and the WXR indicator while the system searches for failures.
   B. References
      (1) AMM 06-41-00/201 Access Doors and Panels
      (2) AMM 21-58-00/501, Equipment Cooling
      (3) AMM 24-22-00/201, Electrical Power - Control
      (4) AMM 34-21-00/501, Inertial Reference System
   C. Access
      (1) Location Zones

211	Control Cabin, Left
212	Control Cabin, Right
119	Lower Nose Compartment

   D. Procedure

      S 865-140-001
      (1) Prepare for the weather radar operational test:
         (a) Supply electrical power (AMM 24-22-00/201).

CAUTION: MAKE SURE THE EQUIPMENT COOLING SYSTEM OPERATES BEFORE THE ELECTRONIC SYSTEMS ARE OPERATED. THE EQUIPMENT COOLING SYSTEM MUST BE SET FOR CORRECT COOLING. IF THESE CAUTIONS ARE NOT OBEYED, DAMAGE TO THE ELETRONIC SYSTEMS CAN OCCUR.

         (b) Supply equipment cooling (AMM 21-58-00/501).
         (c) Make sure these circuit breakers on the overhead panel, P11, are closed:
            1) 11F2, WX RADAR L

(d) Make sure the inertial reference system is serviceable in the NAV mode (AMM 34-21-00/501).
   1) Make sure the ATT flags on the captain's and the first officer's EADIs are not in view.

(e) Make sure the flight instrument system (EFIS) is serviceable (AMM 34-22-00/501).

S 865-160-001

(2) Select TEST on the Weather Radar Control Panel
   (a) Select the left (right) system to be tested:

S 865-161-001

(3) Set the control on the captains and first officers EFIS control panel as follows:
   (a) BRT - Mid Scale
   (b) Range - As Necessary
   (c) Mode - VOR (Expanded Scale)

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

   (d) Push the WXR power switch on the captain's and the first officer's EFIS control panels to the ON position.

   <u>NOTE</u>: A test pattern, which appears distorted along a radial line (segmented test pattern) during the first sweep of the weather radar, is normal. An abnormal condition occurs if the above test pattern continues after the second full sweep.

      1) Make sure the weather radar test display on each EHSI is as follows (Fig. 501):
         a) A WXR TEST message shows.
         b) The range arcs (marks) have equal space between them.
         c) The half range message shows in the center.
      2) Make sure the test pattern on the EHSIs is as follows:
         a) The green band shows at the bottom.
         b) The yellow band shows above the green band.
         c) The red band shows above the yellow band.
         d) A magenta wedge is in the center and each side.

3) If failures occur,
these messages will show on the EHSIs:

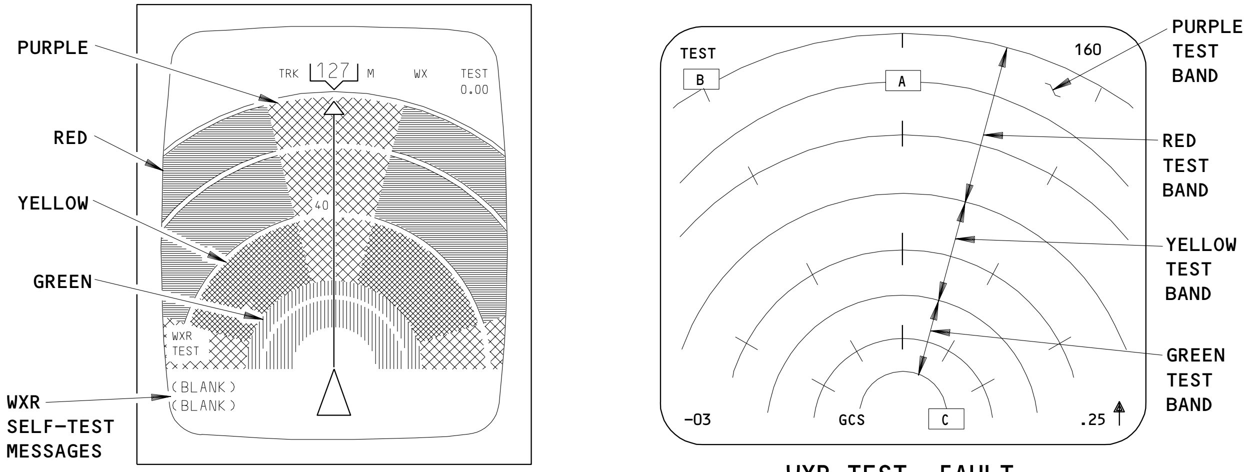
NOTE: For some failures you will not see a test pattern in Fig. 501.

a) An LRU failure message of RT, ANT, CONT, ATT, OR WEAK.
b) Verify that no fault codes are present

S 865-162-001
(4) WXR (EHSI Control Panel) - OFF

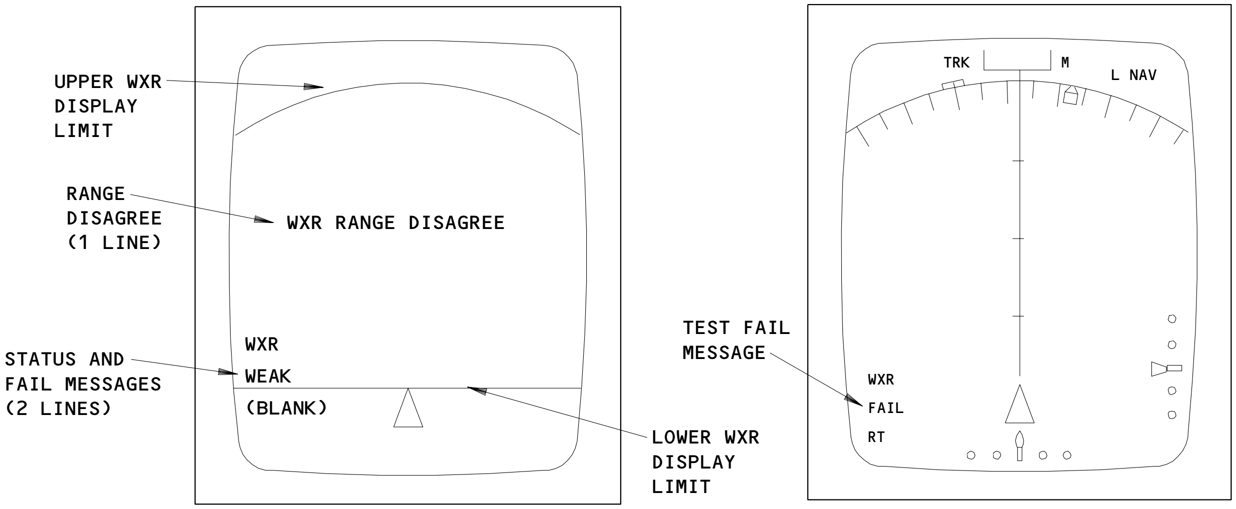
S 865-163-001
(5) Weather Radar Control Panel mode switch - AS NECESSARY

S 865-141-001
(6) If no more tests of the weather radar are necessary,
do the Weather Radar System Shutdown Task.



ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

WXR TEST, FAULT, AND STATUS DISPLAY



ND WXR DISPLAY LIMITS AND STATUS AND FAIL MESSAGES

ND WXR TEST FAIL DISPLAY (EXAMPLE)

Weather Radar Test Pattern
Figure 501

TASK 34-43-00-735-142-001

3. System Test - Weather Radar System

A. General

(1) The system test supplies a full test of the weather radar system but does not include some display tests. These display test are in the operational test. Test that show radar video, the airplane should be pointed so the antenna sector can scan hills, mountains or various height in the distance.

(2) The system test are as follows:

NOTE: A test pattern, which appears distorted along a radial line (segmented test pattern) during the first sweep of the weather radar, is normal. An abnormal condition occurs if the above test pattern continues after the second full sweep.

(a) Weather Radar Display Test
(b) The Mode test
(c) The Indicator Display Test
(d) The Indicator Offset Display Test
(e) The Gain Test
(f) The Antenna Tilt Test
(g) The Stabilization Test.

B. References

(1) AMM 21-58-00/501, Equipment Cooling
(2) 24-22-00/201, Electrical Power - Control
(3) AMM 34-21-00/501, Inertial Reference System

C. Access

(1) Location Zones

211	Control Cabin, Left
212	Control Cabon, Right
119	Main Equipment Center

D. Prepare to do a Weather Radar System test:

S 585-143-001

(1) Point the airplane away from all large metal objects and to an open area. The antenna scan can include hills or mountains at different heights in the distance.

S 865-164-001

(2) The prepare to do a test must be completed before the system test can be done. But, the prepare to do a test procedure does not need to be repeated before each system test part.

S 945-144-001

(3) Set the warning lights around the front of the airplane in an arc 15 feet from the radome.

S 865-145-001

(4) Supply electrical power (AMM 24-22-00/201).

S 865-146-001

CAUTION: MAKE SURE THE EQUIPMENT COOLING SYSTEM OPERATES BEFORE THE ELECTRONIC SYSTEMS ARE OPERATED. THE EQUIPMENT COOLING SYSTEM MUST BE SET FOR CORRECT COOLING. IF THESE CAUTIONS ARE NOT OBEYED, DAMAGE TO THE ELETRONIC SYSTEMS MAY OCCUR.

(5) Make sure these circuit breakers on the overhead panel, P11, are closed:
  (a) 11F2, WX RADAR L
  (b) 11F27, WX RADAR R

S 865-165-001
(6) Supply equipment cooling (AMM 21-58-00/501).

S 865-166-001
(7) Make sure the inertial reference system is serviceable (AMM 34-21-00/501).

S 865-167-001
(8) Make sure the captain's and first officer's IRS and EFI select switches are set to the normal position.

S 865-169-001
(9) Set the controls on the weather radar control panel as follows:
  (a) Mode - TEST
  (b) GAIN control to CAL.
  (c) TILT control to 0 .
  (d) IDENT - OFF
  (e) STAB - OFF

S 865-172-001
(10) Position controls on the captain's and the first officer's EFIS control panel as follows:
  (a) BRT control mid scale.
  (b) RANGE switch to 40.
  (c) Select mode VOR, ILS, MAP, or APP
  (d) Push WXR power switch - OFF

S 865-173-001
(11) Set the switches on the captain's and first officer's instrument source select panel:
  (a) EFI switch - normal
  (b) IRS switch - normal

E. Weather Radar Display Test

S 865-174-001
(1) To complete the display test do the following:

S 865-179-001

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

WARNING: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(2) Push the WXR power switch on the captain's and the first officer's EFIS control panels to the ON position.
  (a) Make sure the weather radar test display on each EHSI is as shown in Figure 501:
    1) The tilt angle in the lower left-hand corner of the EHSI will read 0 .
    2) The range arcs (marks) have equal space between them.
    3) The half range message shows in the center.
    4) If failures occur, these messages will show on the EHSIs:
      a) An LRU failure message of RT, ANT, CONT, ATT, OR WEAK.

S 865-176-001

(3) Push the WXR switch on the captain's EFIS control panel to the off position.

NOTE: These steps make sure the correct operation of the WXR power switch on the first officer's EFIS control panel.

  (a) Make sure the weather radar data on the captain's EHSI is removed.
  (b) Make sure the test pattern stays on the first officer's EHSI
  (c) Push the WXR switch on the captain's EFIS control panel to the On position.
  (d) Make sure the weather radar data on the captain's EHSI comes back on.

F. Mode Test

S 735-147-001

(1) Do the weather radar mode test.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(a) Select these modes on the weather radar control panel:
  1) WX MODE - WX EHSI mode message
  2) WX+T MODE - WX+T EHSI mode message
  3) MAP MODE - MAP EHSI mode message
  4) IDENT - Make sure that STAB shows on the bottom left of both EHSI's
  5) STAB - Make sure that the ground target intensity increases.

(b) If no more tests of weather radar are necessary, do the Weather Radar System Shutdown Procedures.

G. Gain Test

<u>NOTE</u>: The full gain test will not be possible when there are no radar targets from weather, mountains or large buildings. When there are no targets only the gain message part of this test will be done.

S 865-177-001

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(1) Do the gain test as follows:
  (a) Set the WXR control panel into the MAP mode.
  (b) Turn the GAIN control between MIN and MAX to get a middle level of radar targets.
    1) Make sure the gain mode data shows VAR/MAP on each EHSIs.
  (c) Turn the GAIN control to the MIN position.
    1) Make sure the radar returns on each EHSI decreases in intensity.
  (d) Turn the GAIN control to the MAX position.
    1) Make sure the radar returns on each EHSI increase in intensity.

(e) Set the GAIN control to the CAL (AUTO) position.
(f) If no more tests the of the weather radar are necessary, do the Weather Radar System Shutdown Procedures.

H. Antenna Tilt Test

S 735-149-001

(1) Do the antenna tilt test for the left (Right) system.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(a) SET the WXR control panel to the WX mode.
(b) Set the range switch on each EFIS control panel to move the radar targets to the center of each EHSI.
(c) Turn the TILT control on the WXR control panel to 0 degrees.
    1) Make sure the tilt message on the EHSIs show the correct tilt angle ± 1.0 degree.
(d) Turn the antenna TILT control on the WXR control panel in steps from 0 to plus 4.75 degrees.
    1) Make sure the tilt messages on the EHSIs show the correct tilt angle ± 1 degree.
    2) Make sure the close in targets on the EHSIs decrease in intensity.
(e) Turn the antenna TILT control on the WXR control panel in steps from plus 5 to 15.00 degrees.
    1) Make sure the tilt messages on the EHSIs shows the correct tilt angle ± 2 degree.
(f) Turn the antenna TILT control on the WXR control panel in steps from 0 to minus 4.75 degrees.
    1) Make sure the tilt messages on the EHSIs, show the correct tilt angle ± 1 degree.
    2) Make sure the intensity of the targets on the EHSIs near the airplane increase.
(g) Turn the antenna TILT control on the WXR control panel in steps from minus 5 to 15.00 degrees.
    1) Make sure the tilt messages on the EHSIs show the correct tilt angle ± 2 degree.
(h) Turn the antenna TILT control on the WXR control panel to 0 degrees.

I. Stabilization Test

S 735-154-001

(1) Do the stabilization test.

(a) Make sure the inertial reference system is aligned in the NAV mode (AMM 34-21-00/501).

1) Make sure the ATT flags on the captain's and the first officer's EADIs are not in view.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(b) Set the WXR control panel to the WX mode.

(c) Set the IRS switch on the L and R instrument source select panels to the normal position.

(d) Set the SYS DSPL switch on the inertial reference mode panel (IRMP) to the L position.

(e) Push and hold the test switch on the left IRU located on the E2-4 rack in the main equipment center.

1) Make sure the WXR ATT message shows on the EHSIs.

(f) Release the test switch on the left IRU.

1) Make sure the WXR ATT message is removed from the EHSIs.

(g) Set the IRS switch on the L instrument source select panel to the ALTN position.

(h) Set the SYS DSPL switch on the IRMP to the C position.

(i) Push and hold the test switch on the center IRU located on the E2-4 rack in the main equipment center.

1) Make sure the WXR ATT message shows on the EHSIs.

(j) Release the test switch on the center IRU.

1) Make sure the WXR ATT message is removed from the EHSIs.

(k) Set the SYS DSPL switch on the inertial reference mode panel (IRMP) to the R position.

(l) Push and hold the test switch on the right IRU located on the E2-4 rack in the main equipment center.

1) Make sure the WXR ATT message shows on the EHSIs.

(m) Release the test switch on the right IRU.

1) Make sure the WXR ATT message is removed from the EHSIs.

(n) Set the IRS switch on the R instrument source select panel to the ALTN position.

(o) Set the SYS DSPL switch on the IRMP to the C position.

(p) Push and hold the test switch on the center IRU located on the E2-4 rack in the main equipment center.

1) Make sure the WXR ATT message shows on the EHSIs.

(q) Release the test switch on the center IRU.
  1) Make sure the WXR ATT message is removed from the EHSIs.

(r) Set the IRS switch on the L and R instrument source select panels to the normal position.

(s) If no more tests of the weather radar are necessary, do the Weather Radar System Shutdown Procedure.

J. Put the Airplane Back to Its Usual Condition

S 865-155-001

(1) Put the switches on the EFIS control panel as follows:
  - (a) BRT control - midscale
  - (b) RANGE switch - 80
  - (c) WXR power switch - off.

S 865-156-001

(2) Weather Radar Mode Control - AS NECESSARY

S 865-157-001

(3) Remove the equipment cooling if it is not necessary (AMM 21-58-00/501).

S 865-158-001

(4) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

S 865-159-001

(5) Make sure these circuit breakers on the overhead panel, P11, are open:
  - (a) 11F2, WX RADAR L

WEATHER RADAR SYSTEM - ADJUSTMENT/TEST

1. General

   A. This subject contains these tasks:
      (1) Operational Test
         (a) The operational test uses the self test circuits to make sure all functions of the weather radar system are serviceable.
      (2) System Test
         (a) The system test makes sure all functions of the weather radar operate correctly.

TASK 34-43-00-715-095-002

2. Operational Test - Weather Radar System
   A. General
      (1) The operational test uses the mode selector switch on the WXR control panel in the TEST positsion. In the TEST mode, the self test circuits monitor the performance of the left (right) weather radar systems.
      (2) During the self test the weather radar system operates as follows:

      NOTE: A test pattern, which appears distorted along a radial line (segmented test pattern) during the first sweep of the weather radar, is normal. An abnormal condition occurs if the above test pattern continues after the second full sweep.

         (a) The transceiver operates for 1 seconds.
         (b) A special test pattern is sent to the EHSIs while the system searches for failures.
   B. References
      (1) AMM 06-41-00/201, Fuselage (Major Zones 100 AND 200) Access Doors and Panels
      (2) AMM 21-58-00/501, Equipment Cooling
      (3) AMM 24-22-00/201, Manual Control
      (4) AMM 34-22-00/501, Electronic Flight Instrument System
      (5) AMM 34-21-00/501, Inertial Reference System
   C. Access
      (1) Location Zones

101	Control Cabin, Left
102	Control Cabin, Right
202	Lower Nose Compartment

D. Procedure

S 845-162-002

(1) Supply electrical power (AMM 24-22-00/201).

S 865-155-002

CAUTION: MAKE SURE THE EQUIPMENT COOLING SYSTEM OPERATES BEFORE THE ELECTRONIC SYSTEMS ARE OPERATED. THE EQUIPMENT COOLING SYSTEM MUST BE SET FOR CORRECT COOLING. IF THESE CAUTIONS ARE NOT OBEYED, DAMAGE TO THE ELETRONIC SYSTEMS CAN OCCUR.

(2) Supply equipment cooling (AMM 21-58-00/501).

S 845-157-002

(3) Open the forward access door 113AL to get access to the weather radar receiver/transmitter (AMM 06-41-00/201).

S 845-124-002

(4) Make sure these circuit breakers on the overhead panel, P11, are closed:
    (a) 11F2, WEATHER RADAR LEFT

S 845-125-002

(5) Make sure the inertial reference system is serviceable (AMM 34-21-00/501).
    (a) Make sure the ATT flags on the captain's and the first officer's EADIs are not in view.

S 845-122-002

(6) Select TEST on the Weather Radar Control Panel

S 845-123-002

(7) Make sure the flight instrument system (EFIS) is serviceable (AMM 34-22-00/501)
    (a) EHSI Mode selector - Expanded Scale
    (b) WXR (EHSI Control Panel) - ON

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WARNING: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

(c) Make sure the test pattern on the EHSI (See Figure 501)
(d) Make sure that no fault codes are present
(e) WXR (EHSI Control Panel) - OFF
(f) Weather Radar Control Panel mode switch - AS DESIRED

TASK 34-43-00-735-101-002

3. System Test - Weather Radar System

A. General

(1) The system test has these parts:

NOTE: A test pattern, which appears distorted along a radial line (segmented test pattern) during the first sweep of the weather radar, is normal. An abnormal condition occurs if the above test pattern continues after the second full sweep.

(a) Weather Radar Display Test
(b) The Mode test
(c) The Indicator Display Test
(d) The Indicator Offset Controls Test
(e) The Gain Test
(f) Antenna Tilt Test
(g) The Ground Clutter Suppression Test
(h) The Split Function Control Panel Test

B. References

(1) AMM 21-58-00/501, Equipment Cooling
(2) AMM 24-22-00/201, Electrical Control
(3) AMM 34-21-00/501, Inertial Reference System (IRS)

C. Access

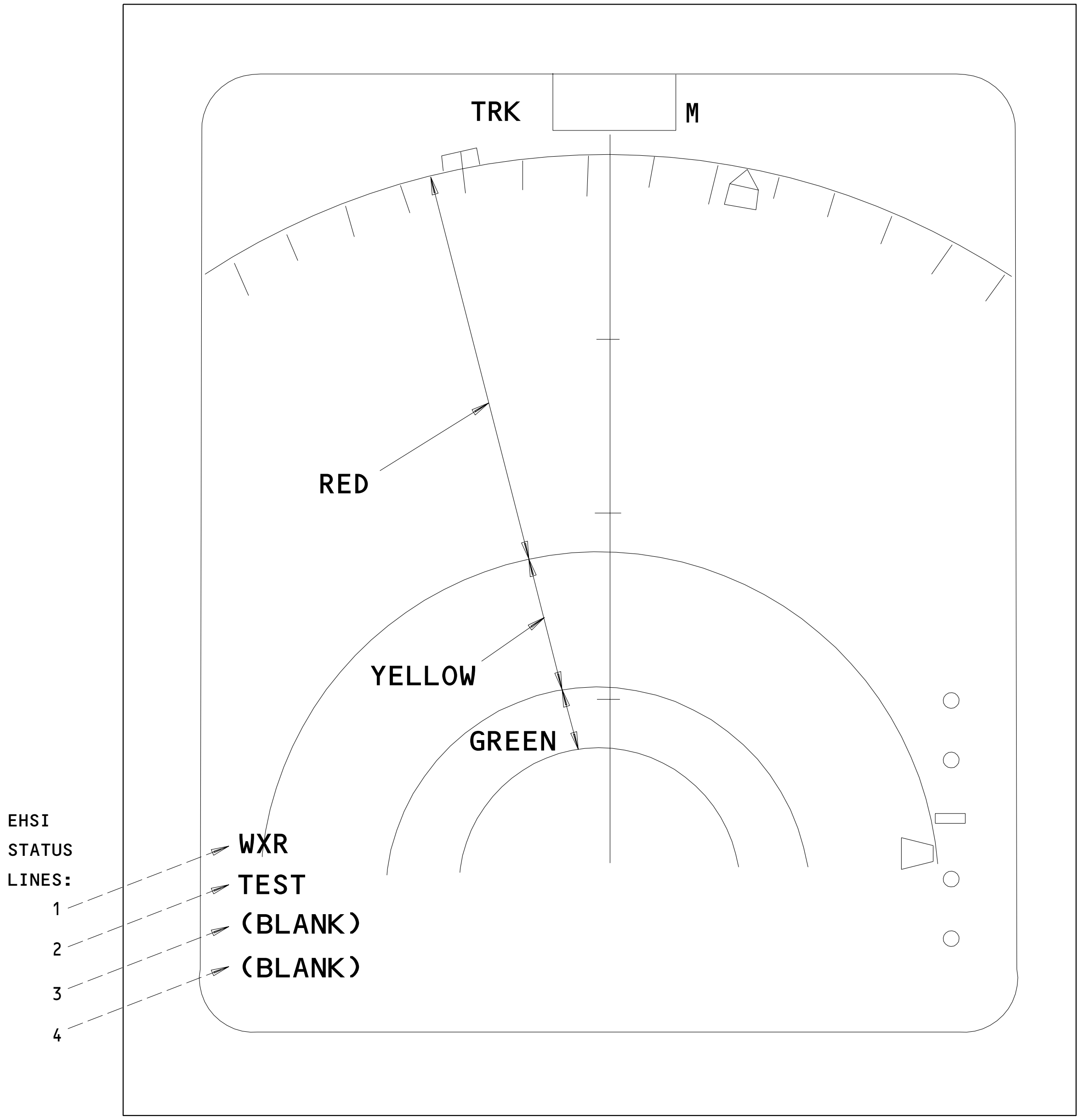
(1) Location Zones

101	Control Cabin, Left
102	Control Cabon, Right

D. Prepare to do a Weather Radar System Test:

S 845-130-002

(1) The prepare to do a test must be completed before the system test can be done. But, the prepare to do a test procedure does not need to be repeated before each system test part.



ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

Weather Radar Test Pattern
Figure 501

S 845-129-002

(2) Point the airplane away from all large metal objects and to an open area. The antenna scan can include hills or mountains at different heights in the distance.

S 845-128-002

(3) Set the warning lights around the front of the airplane in an arc 15 feet from the radome.

S 845-127-002

(4) Supply electrical power (AMM 24-22-00/201).

S 845-126-002

(5) Make sure these circuit breakers on the overhead panel, P11, are closed:
   (a) 11F2, WX RADAR L
   (b) 11F27, WX RADAR R

S 865-105-002

<u>CAUTION</u>: MAKE SURE THE EQUIPMENT COOLING SYSTEM OPERATES BEFORE THE ELECTRONIC SYSTEMS ARE OPERATED. THE EQUIPMENT COOLING SYSTEM MUST BE SET FOR CORRECT COOLING. IF THESE CAUTIONS ARE NOT OBEYED, DAMAGE TO THE ELETRONIC SYSTEMS MAY OCCUR.

(6) Supply equipment cooling (AMM 21-58-00/501).

S 845-131-002

(7) Make sure the inertial reference system is serviceable (AMM 34-21-00/501).

S 845-132-002

(8) Make sure the captain's and first officer's IRS and EFI select switches are set to the normal position.

S 845-134-002

(9) Position controls on EFIS control panel as follows:
   (a) BRT - AS NECESSARY
   (b) RANGE switch to 40.
   (c) Select mode VOR, ILS or MAP.
   (d) Push WXR power switch - OFF

S 845-135-002

(10) Set the switches on the captain's instrument source select panel:
   (a) EFI switch - normal
   (b) IRS switch - normal
   (c) IRS switch - normal

S 845-136-002

(11) Set the switches on the first officer's instrument source select panel:
   (a) EFI switch - normal
   (b) IRS switch - normal

S 845-158-002

(12) AIRPLANES WITH ALLIEDSIGNAL 2041223-0402 CONTROL PANELS;
Set the controls on the weather radar control panel as follows:
   (a) Mode - TEST
   (b) GAIN control to AUTO
   (c) TILT control to 0 .

S 845-169-002

(13) AIRPLANES WITH ALLIED SIGNAL 2041223-0418;
Set the controls on the weather radar control panel as follows:
   (a) Mode - TEST
   (b) GAIN control to AUTO
   (c) TILT control to 0 .

E. Weather Radar Display Test

S 865-137-002

(1) To complete the display test do the following:

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<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

   (a) Push the WXR power switch on the captain's and the first officer's EFIS control panels to the ON position.
   (b) Make sure the weather radar test display on each EHSI is as shown in Figure 501
      1) The tilt angle in the lower left-hand corner of the EHSI will read 0.
      2) A WXR TEST message shows.
      3) The range arcs (marks) have equal space between them.
      4) The half range message shows in the center.
   (c) If failures occur, these messages will show on the EHSIs:

NOTE: For some failures you will not see a test pattern (Fig. 501).

      1) A WXR FAIL message.

2) An LRU failure message of RT, ANT, CONT, ATT, OR WEAK.

(d) Push the WXR switch on the captain's EFIS control panel to the off position.

<u>NOTE</u>: These steps make sure the correct operation of the WXR power switch on the first officer's EFIS control panel.

1) Make sure the weather radar data on the captain's EHSI is removed.
2) Make sure the test pattern stays on the first officer's EHSI.

F. Mode Test

S 735-107-002

(1) Do the weather radar mode test.

(a) Push the WXR switch on the captain's EFIS control panel to the ON position.

1) Make sure the weather radar data on the captain's EHSI comes back on.

(b) AIRPLANES WITH ALLIEDSIGNAL 2041223-0402 CONTROL PANELS;
Turn the mode control through the positions that follow. Make sure that the messages are shown on the EHSI as shown below:

WXR CONTROL PANEL SWITCH POSITION	EHSI DISPLAY MESSAGE
TEST	WXR TEST
WX	WX
MAP	MAP

WEATHER RADAR TRANSCEIVER - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the weather radar (WXR) transceiver. The second task installs the WXR transceiver.
   B. The left WXR transceiver (M213) is found aft of the forward bulkhead. Get access to it through the forward access door, 113AL (AMM 06-41-00).

TASK 34-43-01-004-001

2. Remove the Weather Radar Transceiver
   A. Equipment
      (1) Dry air pressure source (1 required), 25 to 38 psi.
   B. Consumable Materials
      (1) B00541 Cleaner, Detergent Soap - Commercially available
   C. References
      (1) AMM 06-41-00/201, Access Doors and Panels
      (2) AMM 20-10-01/401, E/E Rack Mounted Components
      (3) AMM 20-41-01/201, Electrostatic Sensitive Devices
   D. Access
      (1) Location Zones

113/114	Area Forward of NLG Wheel Well

      (2) Access Panel

113AL	Forward Equipment Center

   E. Procedure

S 864-002

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11F2, WX RADAR

S 414-061

(2) Open the access door to the 113AL forward equipment center to get to the transceivers (AMM 06-41-00/201).

S 914-003

CAUTION: DO NOT TOUCH THE WEATHER RADAR TRANSCEIVER BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE WEATHER RADAR TRANSCEIVER.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 024-062

(4) Do this task to remove the XCVR from the mount: Rack Mounted Electrical/Electronic Module - Removal (AMM 20-10-01/401).
   (a) Put a dust cap on the electrical connector/waveguide flange on the transceiver mount.

S 034-051

(5) GUI 001, 009, 115;
remove the air filter (if installed) from the mounting tray.

NOTE: It is recommended that the air filter be removed and discarded. The air filter is not required for WXR transceivers installed on the 757.

S 164-052

(6) GUI 001, 009, 115;
If you continue to use the air filter, clean the air filter as follows:
   (a) Wash the filter in a container of detergent soap and hot water.
   (b) Dry the filter with clean, dry, compressed air at a pressure between 25 and 38 psi.

TASK 34-43-01-404-008

3. Install the Weather Radar Transceiver

A. References
   (1) AMM 06-41-00/201, Fuselage Access Doors and Panels
   (2) AMM 20-10-01/401, E/E Rack Mounted Components
   (3) AMM 20-41-01/201, Electrostatic Sensitive Devices
   (4) AMM 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones

113/114	Area Forward of NLG Wheel Well
211/212	Flight Compartment

   (2) Access Panel

113AL	Forward Equipment Center

C. Procedure

S 864-009

(1) Make sure that these circuit breakers on the P11 panel are open:
   (a) 11F2, WX RADAR

S 414-096

(2) Open the access door to the 113AL forward equipment center to get to the transceivers (AMM 06-41-00/201).

S 164-053

(3) GUI 001, 009, 115;
make sure the air filter in the R/T mounting tray (if installed) is clean.

S 914-004

CAUTION: DO NOT TOUCH THE WEATHER RADAR TRANSCEIVER BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE WEATHER RADAR TRANSCEIVER.

(4) Do this task for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 014-075

(5) Remove the dust cap on the electrical connector/waveguide flange on the transceiver mount.

S 414-066

(6) Do this task to install the transceiver in the R/T mount: EE Rack Mounted Components (AMM 20-10-01/401).

S 864-012

(7) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) 11F2, WX RADAR

D. Transceiver Test

S 864-057

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

<u>CAUTION</u>: MAKE SURE NO LARGE METALLIC OBJECTS ARE CLOSER THAN 300 FEET FOR THE 180-DEGREE AREA IN FRONT OF THE AIRPLANE WHEN THE RADAR OPERATES. LARGE METALLIC OBJECTS CAN INCLUDE HANGARS, TRUCKS, OR OTHER AIRPLANES. DAMAGE TO THE TRANSCEIVER COULD OCCUR IF OBJECTS ARE IN THIS AREA. WHEN THE WEATHER RADAR OPERATES IN THE STANDBY OR TEST MODE, THIS DOES NOT APPLY.

(1) Supply electrical power (AMM 24-22-00).

S 864-015

(2) Make sure that these circuit breakers on the main distribution panel, P6, are closed:
  (a) 6D3, IRS L
  (b) 6D4, IRS C
  (c) 6D5, IRS R
  (d) 6L9, HOT BAT BUS

S 864-016

(3) Make sure that these circuit breakers on the P11 panel are closed:
  (a) 11A7, EFIS DSPL SW LEFT
  (b) 11E4, EFIS CONT PNL LEFT
  (c) 11E6, HSI LEFT
  (d) 11F8, EFIS SYM GEN LEFT
  (e) 11F21, IRS CENTER
  (f) 11F22, IRS RIGHT

S 864-017

(4) On the IRS control panel, set the IRS mode select switches to NAV.

S 864-018

(5) Load the present position.

S 864-019

(6) On the WXR control panel, set the switches to the positions that follow:
  (a) MODE in WX position
  (b) TILT to 0 degrees

S 864-021
(7) On the captain's instrument source select panel, set the EFI switch to NORM.

S 864-022
(8) On the EFIS control panel, set the switches in the positions that follow:
    (a) RANGE to 10
    (b) MODE to MAP
    (c) WXR to ON

S 754-026
(9) On the captain's EHSI, make sure weather or ground returns show.

S 754-027
(10) Make sure the WX mode message shows on the display.

S 844-030
(11) On the EFIS control panel, set the WXR switch to OFF.

S 414-067
(12) Close the 119BL access door to the electronics compartment (AMM 06-41-00/201).

S 864-033
(13) Remove electrical power if it is not necessary (AMM 24-22-00/201).

WEATHER RADAR CONTROL PANEL - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the weather radar (WXR) control panel. The second task installs the WXR control panel.

TASK 34-43-02-004-001

2. Remove the Weather Radar Control Panel
   A. References
      (1) AMM 20-41-01/201, Electrostatic Sensitive Devices.
   B. Access
      (1) Access Panels
         211/212 Flight Compartment

   C. Procedure

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11F2, WX RADAR

      S 034-015

CAUTION: DO NOT TOUCH THE WEATHER RADAR CONTROL PANEL BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE WEATHER RADAR CONTROL PANEL.

      (2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

      S 034-003
      (3) Loosen the mounting screws on the control panel.

      S 034-004
      (4) Move the control panel out.

      S 034-005
      (5) Disconnect the electrical connectors D163 and D1517 from the control panel.

      S 024-006
      (6) Remove the control panel.

TASK 34-43-02-404-007

3. Install the Weather Radar Control Panel
   A. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 20-41-01/201, Electrostatic Sensitive Devices.

B. Access
   (1) Access Panels
   211/212 Flight Compartment

C. Procedure

S 864-008

(1) Make sure that these circuit breakers on the P11 panel are open with DO-NOT-CLOSE tags attached:
   (a) 11F2, WX RADAR

S 434-016

CAUTION: DO NOT TOUCH THE WEATHER RADAR CONTROL PANEL BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE WEATHER RADAR CONTROL PANEL.

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 434-009

(3) Connect the electrical cable to the control panel.

S 424-010

(4) Install the control panel and tighten the screws.

S 864-011

(5) Remove the DO-NOT-CLOSE tags and close the circuit breakers that follow on the P11 panel:
   (a) 11F2, WX RADAR

S 864-012

(6) Supply electrical power (AMM 24-22-00/201).

S 754-013

(7) Make sure that the control panel lights come on.

S 864-014

(8) Remove electrical power if it is not necessary (AMM 24-22-00/201).

WEATHER RADAR (WXR) WAVEGUIDE - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task removes the WXR waveguide assembly. The second task installs the WXR waveguide assembly.
   B. A dummy load is not necessary to remove or do a test of the assembly components.

TASK 34-43-04-004-002

2. Remove the Waveguide Assembly (Fig. 401)
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
   B. Consumable Materials
      (1) B00184 Solvent - BMS 11-7
   C. References
      (1) AMM 06-41-00/201, Fuselage Access Door and Panels
      (2) AMM 20-10-22/701, Metal Surfaces
      (3) AMM 24-22-00/201, Electrical Power - Control
      (4) AMM 51-31-01/201, Seals and Sealing
      (5) AMM 53-12-01/201, Nose Radome
   D. Access
      (1) Location Zones

111	Radome
113/114	Area Forward of NLG Wheel Well

      (2) Access Panel

113AL	Forward Equipment Center

   E. Procedure

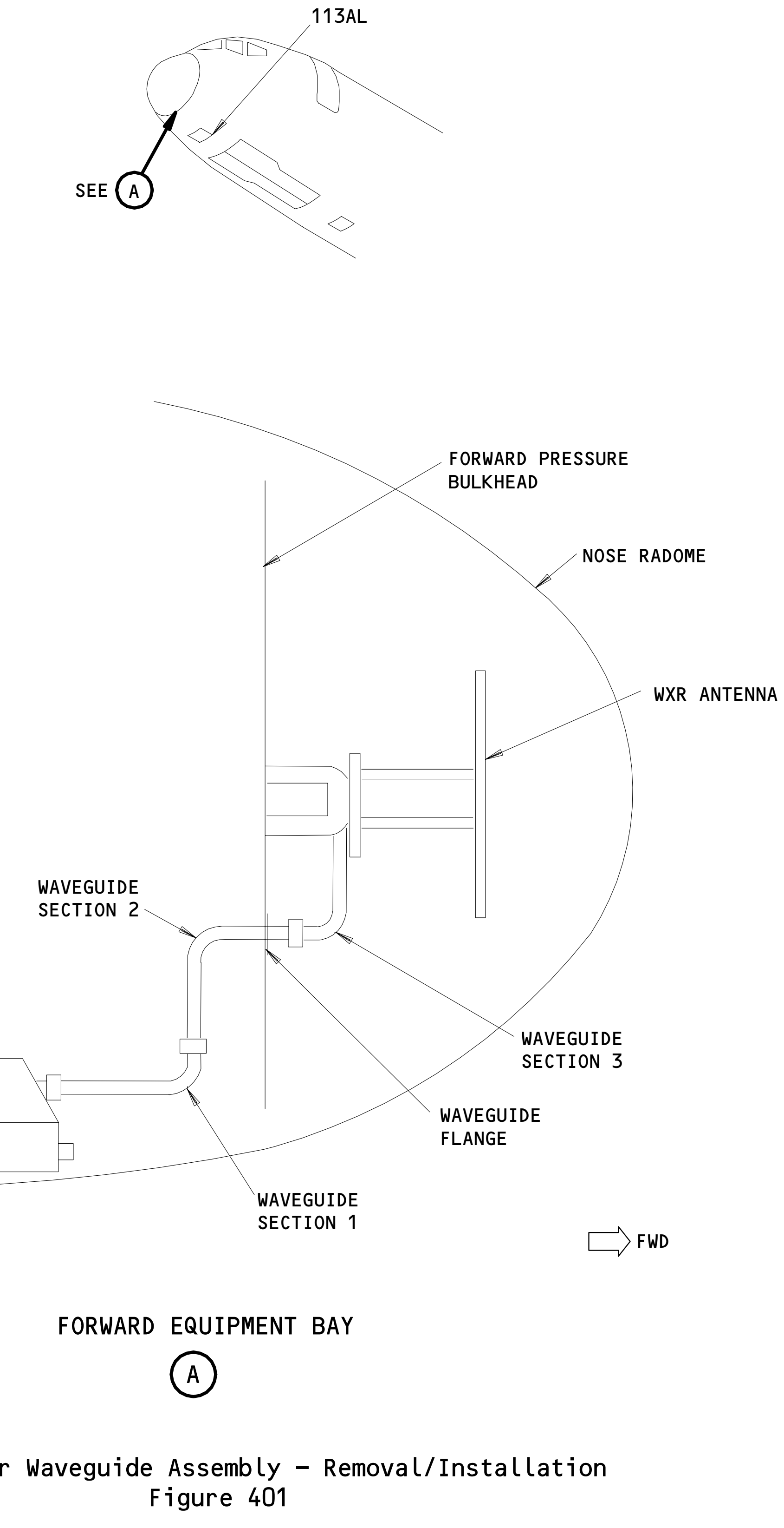
      S 864-003
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11F2, WX RADAR

      S 864-004
      (2) Go into the forward equipment center through the forward access door, 113AL (AMM 06-41-00).

      S 034-012
      (3) Remove the screws for waveguide section 1 from the WXR transceiver.

      S 034-013
      (4) Remove all the straps that hold waveguide sections 1 and 2.

      S 024-014
      (5) Remove waveguide section 1 from waveguide section 2.



Weather Radar Waveguide Assembly - Removal/Installation
Figure 401

S 034-015
(6) Put a cap on the transceiver waveguide connector.

S 864-033
(7) Open the nose radome and lock it in the position (AMM 53-12-01).

S 024-025
(8) Do the steps that follow to remove the waveguide assembly:
  (a) Remove all the straps that hold waveguide section 3.
  (b) Remove the connector on waveguide section 3 from waveguide section 2.
  (c) Remove the connector on waveguide section 3 at the base of the WXR antenna.
  (d) Remove the bolts that hold the waveguide flange to the bulkhead.
  (e) Use the sealant removal tool around the waveguide flange until you break the seal.
  (f) Remove waveguide section 2 from the forward bulkhead.
  (g) Remove the used sealant from the bulkhead (AMM 51-31-01).
  (h) Clean the area with solvent and a clean rag (AMM 20-10-22).
  (i) Put a cap on the WXR antenna connector.

TASK 34-43-04-404-044

3. <u>Install the Waveguide Assembly</u> (Fig. 401)

A. General
  (1) The clear plastic window in the antenna waveguide is to keep dirt, moisture, or other contaminents from entering the waveguide. It is not mandatory to replace the clear plastic window if it has been removed, however it is recommended.

B. Equipment
  (1) Sealant removal tool - hardwood or plastic

C. Consumable Materials
  (1) A00247 Compound - Sealing - BMS 5-95 Type B or C

D. References
  (1) AMM 06-41-00/201, Fuselage Access Door and Panels
  (2) AMM 20-10-22/701, Metal Surfaces
  (3) AMM 24-22-00/201, Electrical Power - Control
  (4) AMM 51-31-01/201, Seals and Sealing
  (5) AMM 53-12-01/201, Nose Radome

E. Access
  (1) Location Zones

111	Radome
113/114	Area Forward of NLG Wheel Well
211/212	Flight Compartment

  (2) Access Panel

113AL	Forward Equipment Center

F. Procedure

S 424-043

(1) Do the steps that follow:

<u>NOTE</u>: The clear plastic window in the antenna waveguide is to keep dirt, moisture, or other contaminents from entering the waveguide.

(a) Remove the cap from the WXR antenna connector.
(b) Connect waveguide section 3 to section 2.
(c) Apply sealant on the new waveguide flange.

<u>NOTE</u>: Do not get sealant in the waveguide hole (Ref 51-31-01).

(d) Put waveguide sections 2 and 3 on the bulkhead.
(e) Replace the flange support bolts and tighten them.
(f) Remove the unwanted sealant from the bulkhead (AMM 51-31-01).
(g) Connect waveguide section 3 to the WXR antenna.
(h) In the forward equipment center, remove the cap from the WXR transceiver.
(i) Connect waveguide section 1 to section 2.
(j) Connect waveguide section 1 to the WXR transceiver.
(k) Replace all of the support clamps in their usual positions.
(l) Make sure that all connections are tight and in the correct position.

G. Weather Radar Test

S 864-048

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
(a) 11F2, WX RADAR

S 864-691

<u>WARNING</u>: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

(2) Supply electrical power (AMM 24-22-00).

S 864-050
(3) Make sure that these circuit breakers on the P11 panel are closed:
  (a) 11A7, EFIS DSPL SW LEFT
  (b) 11E4, EFIS CONT PNL LEFT
  (c) 11E6, HSI LEFT
  (d) 11F8, EFIS SYM GEN LEFT

S 864-051
(4) On the WXR control panel, set the switches to the positions that follow:
  (a) MODE in WX position.
  (b) TILT to 0 degrees
  (c) Set all other controls in the necessary positions.

S 864-053
(5) On the capt's and F/O's instrument source-select panel, set the EFI switch to NORM.

S 864-054
(6) On the EFIS control panels, set the switches to the positions that follow:
  (a) RANGE to 10
  (b) MODE to MAP
  (c) WXR to ON

S 754-058
(7) On the capt's and F/O's EHSIs, make sure weather or ground returns show.

H. Put the Airplane Back to Its Usual Condition

S 864-063
(1) On the EFIS control panel, set the WXR switch to off.

S 864-067
(2) Close and lock the nose radome.

S 864-068
(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

WEATHER RADAR ANTENNA - REMOVAL/INSTALLATION

1. General
   - A. This procedure has five tasks, two removal tasks, two installation tasks, and a test task.
   - B. The weather radar antenna is made up of two parts; the antenna flat plate and the antenna pedestal. The first task removes the full antenna from the base assembly. The second task removes the flat plate from the antenna pedestal. You can use the first procedure to remove the pedestal and flat plate at the same time, or to remove the pedestal only if the flate plate has already been removed.
   - C. The third task installs the flat plate on the antenna pedestal and the fourth task installs the full antenna on the base assembly (either the pedestal and flat plate together, or the pedestal separately).
   - D. The fifth task is a test of the antenna after it is installed on the base assembly.
   - E. The antenna is found in the nose radome.
   - F. It is necessary to put pins in the two lock holes in the antenna pedestal when the full antenna is removed. You do this to prevent movement of the flat plate.

   - G. Clear plastic windows can be used on pedestal waveguide connections. These windows are used to prevent contamination and are not part of a waveguide pressure system. These windows keep unwanted material out of the waveguide during transport and installation. They are transparent to radar energy and are not intended to be removed before installation. Existence or absence of windows will not affect radar operation.

TASK 34-43-05-024-042-001

2. Weather Radar Antenna Removal
   - A. References
     - (1) AMM 53-12-01/401, Nose Radome
   - B. Access
     - (1) Location Zone

111	Radome

   - C. Procedure

S 864-043-001

     - (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
       - (a) P11 Overhead Circuit Breaker Panel
         - 1) 11F2, WX RADAR

S 014-044-001

CAUTION: DO NOT LET THE WORKSTANDS OR EQUIPMENT HIT OR TOUCH THE ANTENNA. THIS CAN CAUSE DAMAGE TO THE ANTENNA.

CAUTION: DO NOT OPEN THE RADOME DURING THE RAINY CONDITION. IF WATER REMAINS ON THE FLAT PLATE ANTENNA, WIPE OFF THE WATER COMPLETELY BEFORE RADOME IS CLOSED.

(2) Open the nose radome and lock it in the open position (AMM 53-12-01/401).

S 494-045-001

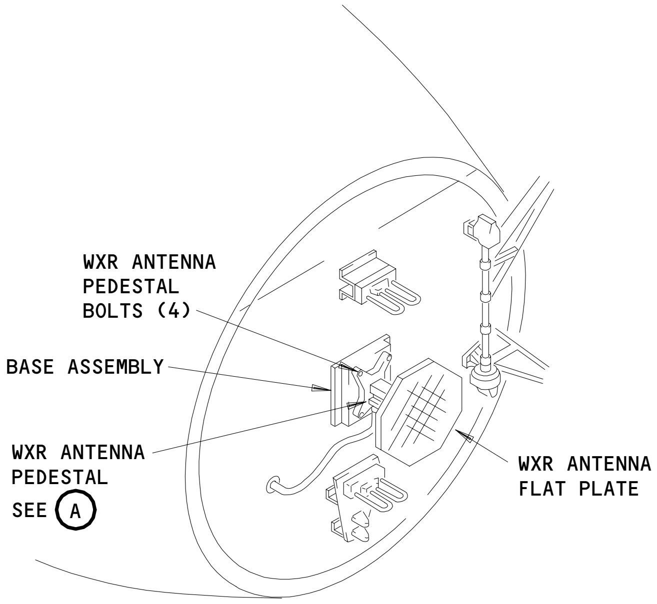
(3) If the flate plate is installed, do the steps that follow (Fig. 401):
   (a) Align the flat plate so it points directly forward.
   (b) Install the two lock pins in the antenna pedestal.

S 024-046-001

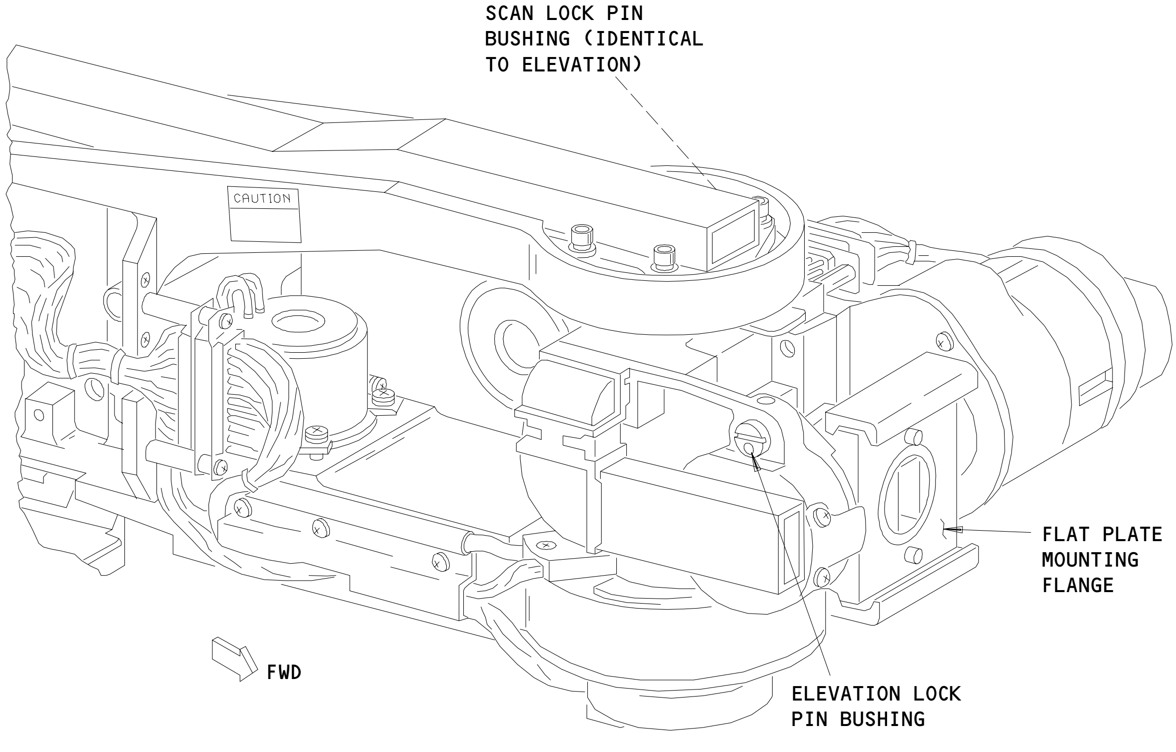
(4) Remove the weather radar antenna:
   (a) Remove the electrical cables from the antenna.
   (b) Remove the screws and washers from the flanges between waveguide section 1 and the antenna pedestal.

   CAUTION: DO NOT LOOSEN THE BOLTS ON THE CASTING OR THE BASE ASSEMBLY. THESE ARE ALIGNED AT THE FACTORY. IF THE BOLTS ARE ACCIDENTALLY LOOSENED, OR IF THE BASE IS LOOSE OR NOT ALIGNED, SPECIAL ALIGNMENT PROCEDURES MUST BE DONE BY A BOEING SPECIALTY TEAM. CONTACT BOEING SEATTLE A.O.G. OFFICE, TECHNICAL ASSISTANCE TEAM.

   (c) Remove the bottom two bolts that hold the antenna to the base assembly.



FORWARD BULKHEAD



WXR ANTENNA LOCK PIN LOCATIONS
(EXAMPLE)
A

Weather Radar Antenna Installation
Figure 401

A44129

(d) Loosen the top two bolts that hold the antenna to the base assembly.

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND TO REMOVE THE ANTENNA. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE ANTENNA.

CAUTION: OBEY THE NO-HANDHOLD PLACARD ON THE ANTENNA PEDESTAL WAVEGUIDE. DAMAGE TO THE ANTENNA WILL OCCUR WHEN THE PEDESTAL WAVEGUIDE IS USED TO HOLD THE ANTENNA.

(e) Lift the antenna up and above the top two bolts that hold the antenna to the base assembly.

S 214-047-001
(5) Make sure the base assembly is not cracked or damaged (fig. 401).

S 034-048-001
(6) Put protective dust caps on the electrical connectors and the waveguide flanges.

TASK 34-43-05-024-049-001
3. Weather Radar Antenna Flat Plate Removal
A. References
(1) AMM 53-12-01/401, Nose Radome
B. Access
(1) Location Zone
111 Radome

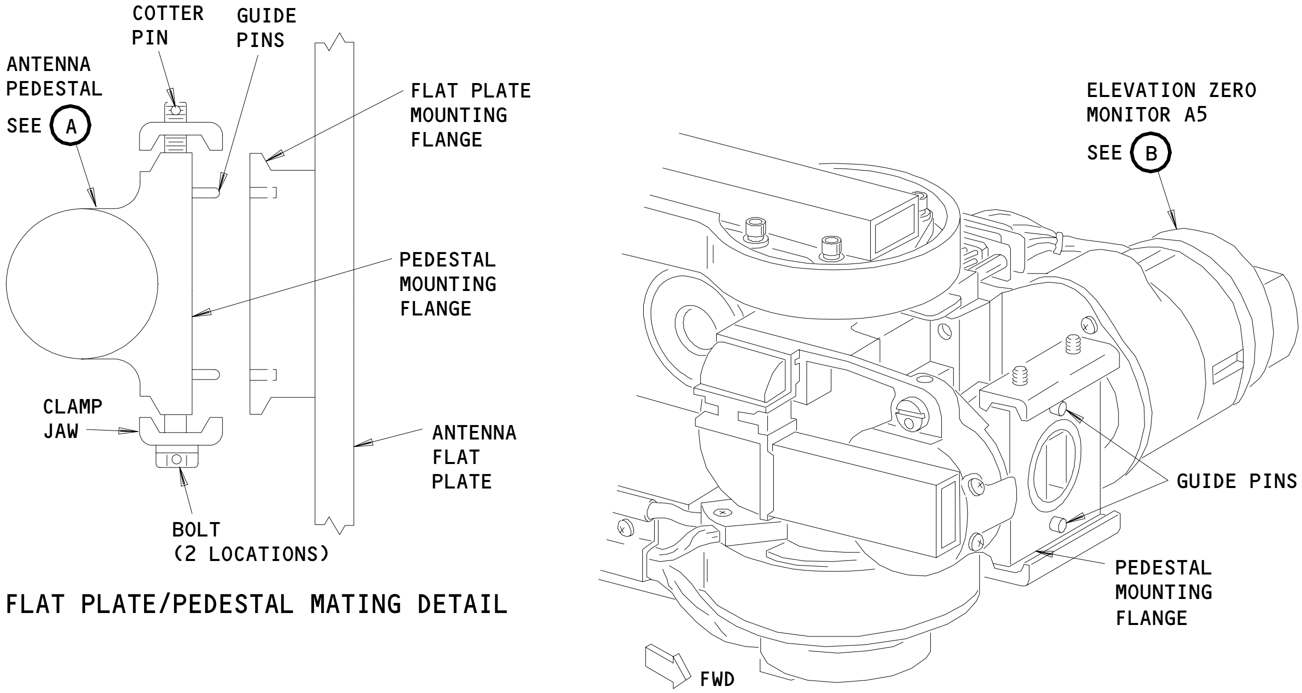
C. Procedure

S 014-050-001
(1) If the antenna pedestal is installed on the airplane, do the steps that follow:
(a) Open these circuit breakers and attach DO-NOT-CLOSE tags:
1) P11 Overhead Circuit Breaker Panel
a) 11F2, WX RADAR

CAUTION: DO NOT LET WORKSTANDS OR EQUIPMENT HIT OR TOUCH THE ANTENNA. THIS CAN CAUSE DAMAGE TO THE ANTENNA.

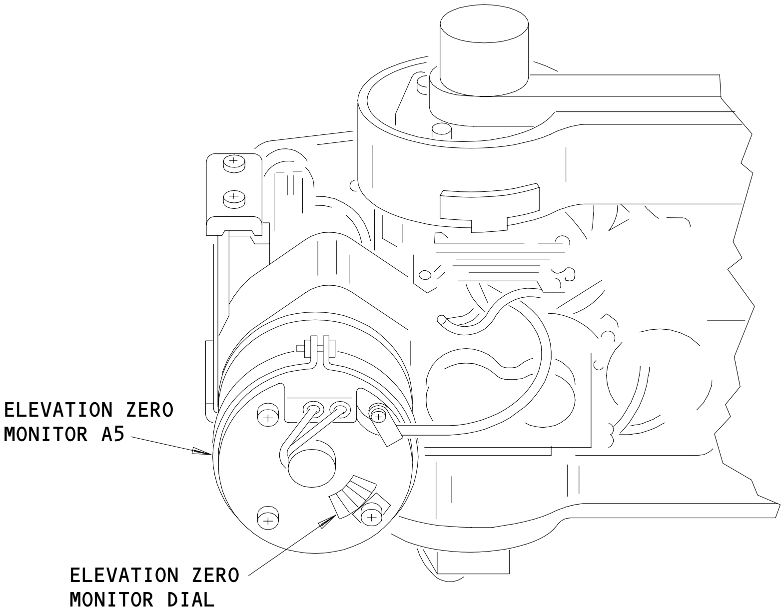
(b) Open the nose radome and lock it in the open position (AMM 53-12-01/401).

S 024-051-001
(2) Remove the flat plate from the antenna pedestal (Fig. 402):
(a) Remove all lock wire from the clamp jaw bolts on the antenna pedestal.



FLAT PLATE/PEDESTAL MATING DETAIL

WXR ANTENNA PEDESTAL
(EXAMPLE)
A



ELEVATION ZERO MONITOR A5
B

Weather Radar Flat Plate Installation
Figure 402

(b) Turn the two bolts on the antenna pedestal counterclockwise to open the jaws.

NOTE: Make sure the A5 ring clamp on the elevator zero monitor does not block or touch the flat plate.

Do not move the ring clamp. Make sure the monitor dial continues to show 0 degrees.

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE FLAT PLATE.

(c) Carefully lift the flat plate away from the antenna pedestal.

S 034-052-001

(3) Put dust caps on the waveguide flanges between the antenna pedestal and the antenna flat plate.

S 034-053-001

(4) If it is necessary to remove the antenna pedestal after you removed the flat plate, do the antenna removal task.

TASK 34-43-05-424-054-001

4. Weather Radar Flat Plate Installation

A. References

(1) AMM 53-12-01/401, Nose Radome

B. Access

(1) Location Zone

111	Radome

C. Procedure

S 414-055-001

(1) If the antenna pedestal is installed on the airplane, do the steps that follow:

(a) Make sure these circuit breakers are open:

1) P11 Overhead Circuit Breaker Panel

a) 11F2, WX RADAR

(b) Open the nose radome and lock it in the open position (AMM 53-12-01/401).

S 434-056-001

(2) Remove the dust caps from the waveguide flanges on the antenna pedestal and the antenna flat plate.

S 424-057-001

(3) Install the weather radar flat plate (Fig. 402):

CAUTION: DO NOT MOVE THE RING CLAMP ON THE ELEVATION ZERO MONITOR. THIS CAN CAUSE THE ANTENNA TO OPERATE INCORRECTLY.

(a) Turn the two bolts on the antenna pedestal counterclockwise to open the jaws.

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE FLAT PLATE.

(b) Carefully set the mounting flange of the flat plate on the mounting flange of the antenna pedestal.

NOTE: Make sure the guide pins on the pedestal mounting flange engage the holes on the flat plate mounting flange. Also, make sure the ring clamp on the elevation zero monitor A5 does not block or touch the flat plate.

(c) Tighten each bolt to approximately 20 pounds-inches.
(d) Attach a lock wire from one bolt head to the other bolt head.
(e) Make sure the elevation zero monitor continues to show 0 degrees.

TASK 34-43-05-424-058-001

5. Weather Radar Antenna Installation

A. References
  (1) AMM 53-12-01/401, Nose Radome

B. Access
  (1) Location Zone

111	Radome

C. Procedure

S 864-059-001

(1) Make sure these circuit breakers are open:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11F2, WX RADAR

S 434-060-001

(2) Remove the dust caps from the electrical connectors and waveguide flanges.

S 424-061-001

(3) Install the weather radar antenna:

<u>WARNING</u>: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE ANTENNA.

<u>CAUTION</u>: OBEY THE NO-HANDHOLD PLACARD ON THE ANTENNA PEDESTAL WAVEGUIDE. DAMAGE TO THE ANTENNA WILL RESULT WHEN THE PEDESTAL WAVEGUIDE IS USED TO HOLD THE ANTENNA.

(a) Put the antenna on the two top boltheads that hold the antenna to the base assembly.
(b) Lower the antenna until it is on the top bolts.
(c) Put the two bottom bolts through the antenna and the base assembly.
(d) Tighten all four bolts that hold the antenna to the base assembly.
(e) Connect waveguide section 1 to the antenna waveguide flanges with the screws and washers.
(f) Connect the electrical connectors to the antenna.

S 434-062-001

<u>CAUTION</u>: DO NOT OPERATE THE WEATHER RADAR SYSTEM WHILE THE LOCK PINS ARE INSTALLED IN THE PEDESTAL. YOU CAN CAUSE DAMAGE TO THE ANTENNA.

(4) Remove the lock pins from the antenna pedestal (Fig. 401).

TASK 34-43-05-714-063-001

6. <u>Weather Radar Antenna Test</u>

A. References
  (1) AMM 24-22-00/201, Manual Control
  (2) AMM 53-12-01/401, Radome
B. Access
  (1) Location Zone
    211/212 Control Cabin

C. Procedure

S 864-064-001
  (1) Supply electrical power (AMM 24-22-00/201).

S 864-065-001

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

WARNING: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

CAUTION: DO NOT OPERATE THE WEATHER RADAR WHEN THERE ARE LARGE METAL OBJECTS IN FRONT OF THE AIRPLANE. AIRPLANES, HANGERS, AND TRUCKS ARE EXAMPLES OF LARGE METAL OBJECTS. KEEP LARGE METAL OBJECTS OUT OF THE AREA THAT IS IN A 300 FOOT RADIUS IN A 180-DEGREE ARC IN FRONT OF THE AIRPLANE. (YOU CAN OPERATE THE WEATHER RADAR IN THE STANDBY OR TEST MODE AND THIS WILL NOT CAUSE TRANSCEIVER DAMAGE.) DAMAGE TO THE TRANSCEIVER COULD OCCUR IF LARGE METAL OBJECTS ARE IN THIS AREA.

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11F2, WX RADAR

S 864-068-001

(3) Make sure these circuit breakers are closed:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11A7, EFIS DSPL SW L
    2) 11E4, EFIS CONT PNL LEFT
    3) 11E6, HSI LEFT
    4) 11F8, EFIS SYM GEN LEFT

S 864-069-001

(4) On the WXR control panel, set the switches in the positions that follow:
  (a) Put the MODE switch in the WX position.
  (b) Put the TILT switch to the 0 degree position.

S 864-082-001
(5) Set all other controls as necessary.

S 864-070-001
(6) On the captain's instrument source select panel, set the EFI switch to the NORM position.

S 864-071-001
(7) On the L-EFIS control panel, set the switches in the positions that follow:
  (a) Set the RANGE to 160.
  (b) Put the MODE switch in the MAP position.
  (c) Put all of the MAP DATA switches to the OFF (out) position.
  (d) Push the WXR button to ON.

S 714-074-001
(8) On the captain's EHSI, make sure weather or ground targets show.

NOTE: Adjust the TILT and the RANGE controls as necessary.

S 714-075-001
(9) On the captain's EHSI, make sure the WXR FAIL message does not show.

D. Put the Airplane Back to Its Usual Condition

S 864-076-001
(1) On the EFIS control panel, set the WXR switch to the OFF position.

S 414-079-001
(2) Close the nose radome (AMM 53-12-01/401).

S 864-080-001
(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

WEATHER RADAR ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has five tasks, two removal tasks, two installation tasks, and a test task.
   B. The weather radar antenna is made up of two parts; the antenna planar array and the antenna drive assembly. The first task removes the full antenna from the base assembly. The second task removes the planar array from the antenna drive assembly. You can use the first procedure to remove the drive assembly and the planar array at the same time, or to remove the drive assembly only, if the planar array has already been removed.
   C. The third task installs the planar array on the antenna drive assembly and the fourth task installs the full antenna on the base assembly (either the drive assembly and planar array together, or the drive assembly separately).
   D. The fifth task is a test of the antenna after it is installed on the base assembly.
   E. The antenna is found in the nose radome.
   F. It is necessary to remove power from the antenna when the antenna is removed or installed. You do this to prevent movement of the planar array.

TASK 34-43-05-024-042-002

2. Weather Radar Antenna Removal
   A. References
      (1) AMM 53-12-01/201, Nose Radome
   B. Access
      (1) Location Zone
          111 Radome

   C. Procedure

      S 864-043-002

      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
          (a) P11 Overhead Circuit Breaker Panel
              1) 11F2, WX RADAR

S 014-044-002

CAUTION: DO NOT LET THE WORKSTANDS OR EQUIPMENT HIT OR TOUCH THE ANTENNA. THIS CAN CAUSE DAMAGE TO THE ANTENNA.

CAUTION: DO NOT OPEN THE RADOME DURING THE RAINY CONDITION. IF THE ANTENNA FLAT PLATE IS WET, WIPE OFF THE WATER COMPLETELY BEFORE RADOME IS CLOSED.

(2) Open the nose radome and lock it in the open position (AMM 53-12-01/201).

S 024-045-002

(3) Remove the weather radar antenna:
  (a) Remove the electrical cables from the antenna.
  (b) Remove the screws and washers from the flanges between waveguide section 1 and the antenna drive assembly.

  CAUTION: DO NOT LOOSEN THE BOLTS ON THE CASTING OR THE BASE ASSEMBLY. THESE ARE ALIGNED AT THE FACTORY. IF THE BOLTS ARE ACCIDENTALLY LOOSENED, OR IF THE BASE IS LOOSE OR NOT ALIGNED, SPECIAL ALIGNMENT PROCEDURES MUST BE DONE BY A BOEING SPECIALTY TEAM. CONTACT BOEING SEATTLE A.O.G. OFFICE, TECHNICAL ASSISTANCE TEAM.

  (c) Remove the bottom two bolts that hold the antenna to the base assembly.
  (d) Loosen the top two bolts that hold the antenna to the base assembly.

  WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND TO REMOVE THE ANTENNA. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE ANTENNA.

  CAUTION: OBEY THE NO-HANDHOLD PLACARD ON THE DRIVE ASSEMBLY WAVEGUIDE. DAMAGE TO THE ANTENNA WILL OCCUR WHEN THE DRIVE ASSEMBLY WAVEGUIDE IS USED TO HOLD THE ANTENNA.

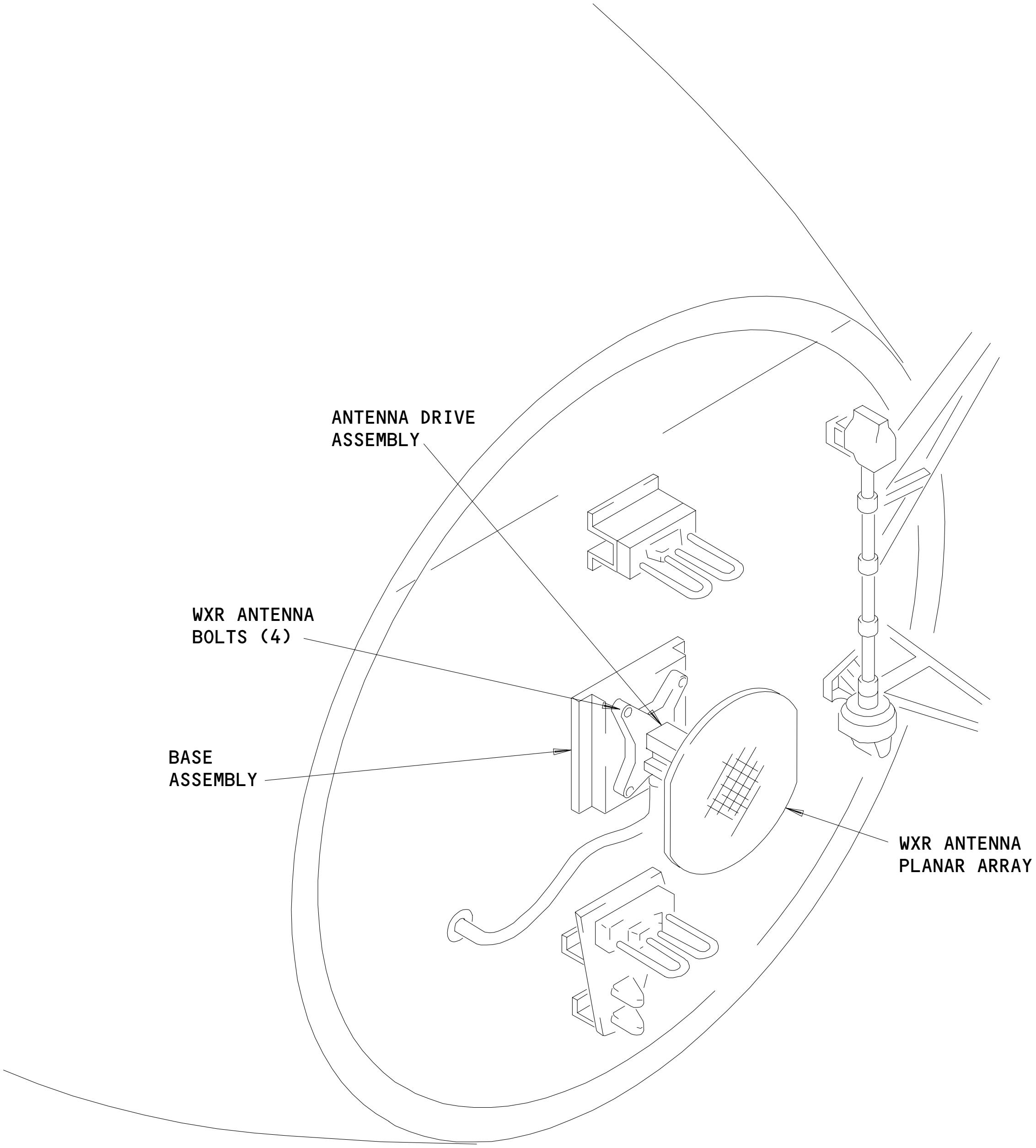
  (e) Lift the antenna up and above the top two bolts that hold the antenna to the base assembly.

S 214-046-002

(4) Make sure the base assembly is not cracked or damaged (Fig. 401).

S 034-047-002

(5) Put protective dust caps on the electrical connectors and the waveguide flanges.



FORWARD BULKHEAD

Weather Radar Antenna Installation
Figure 401

TASK 34-43-05-024-048-002

3. Weather Radar Antenna Planar Array Removal

A. References

(1) AMM 53-12-01/201, Nose Radome

B. Access

(1) Location Zone

111	Radome

C. Procedure

S 014-049-002

(1) If the antenna drive assembly is installed on the airplane, do the steps that follow:

(a) Open these circuit breakers and attach DO-NOT-CLOSE tags:

1) P11 Overhead Circuit Breaker Panel

a) 11F2, WX RADAR

CAUTION: DO NOT LET WORKSTANDS OR EQUIPMENT HIT OR TOUCH THE ANTENNA. THIS CAN CAUSE DAMAGE TO THE ANTENNA.

(b) Open the nose radome and lock it in the open position (AMM 53-12-01/201).

S 024-050-002

(2) Remove the planar array from the antenna drive assembly (Fig. 402):

(a) Remove all lock wire from the clamp jaw bolts on the antenna drive assembly.

(b) Turn the two bolts on the antenna drive assembly counterclockwise to open the jaws.

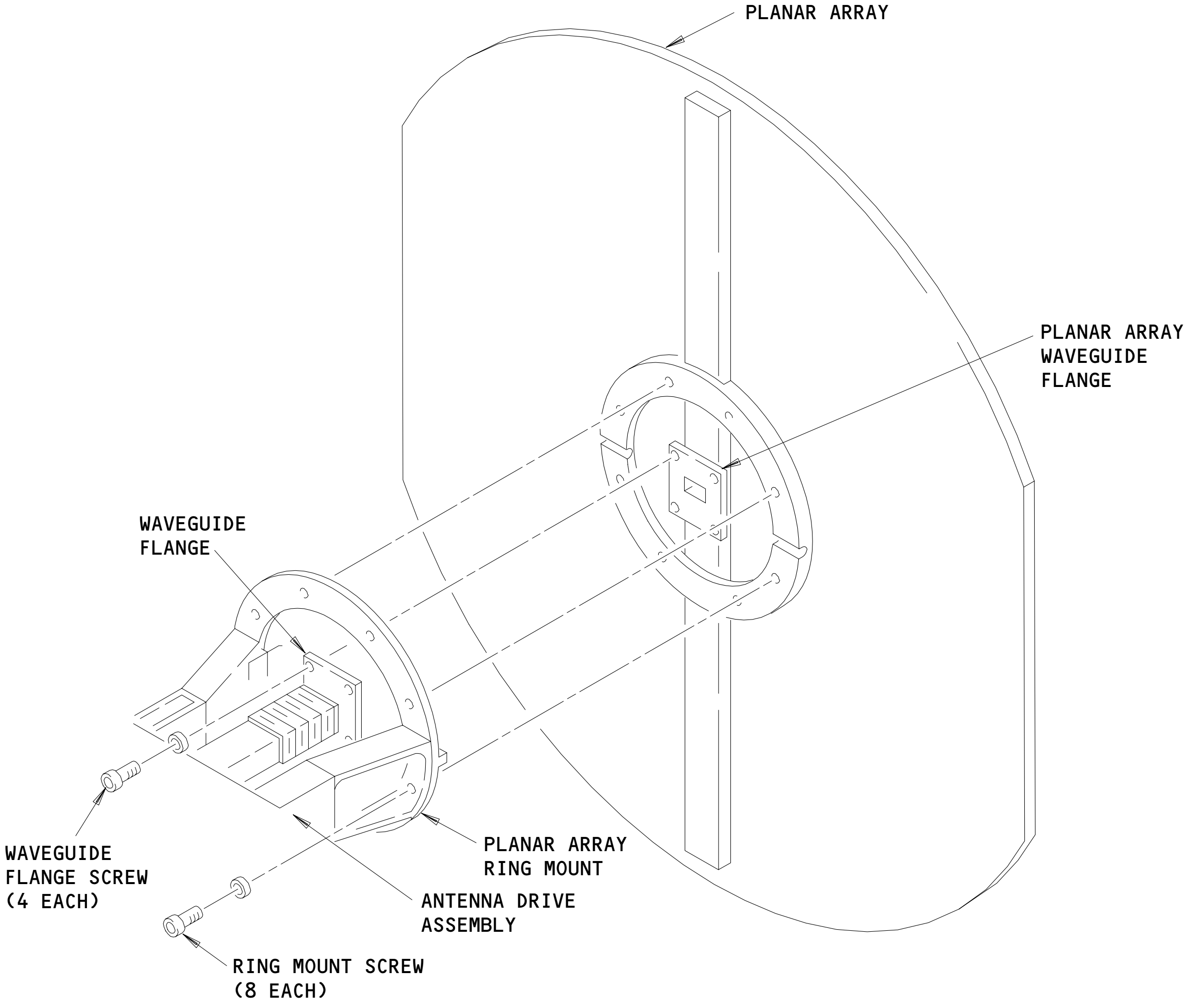
NOTE: Make sure the A5 ring clamp on the elevator zero monitor does not block or touch the planar array.

Do not move the ring clamp. Make sure the monitor dial continues to show 0 degrees.

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE PLANAR ARRAY.

(c) Carefully lift the planar array away from the antenna drive assembly.

CAUTION: PLANAR ARRAY IS COUNTERBALANCED BY A TORQUE SPRING. RESTRICT ROTOR ASSEMBLY MOVEMENT WHEN REMOVING PLANAR ARRAY FROM ROTOR ASSEMBLY.



NOTE: TIGHTEN SCREWS TO 24-33 INCH-POUNDS.

Weather Radar Antenna Array Installation
Figure 402

S 034-051-002

(3) Put dust caps on the waveguide flanges between the antenna drive assembly and the antenna planar array.

S 034-052-002

(4) If it is necessary to remove the antenna drive assembly after you removed the planar array, do the antenna removal task.

TASK 34-43-05-424-053-002

4. Weather Radar Planar Array Installation

A. References
   (1) AMM 53-12-01/201, Nose Radome

B. Access
   (1) Location Zone
         111   Radome

C. Procedure

S 414-054-002

(1) If the antenna drive assembly is installed on the airplane, do the steps that follow:
   (a) Make sure these circuit breakers are open:
      1) P11 Overhead Circuit Breaker Panel
         a) 11F2, WX RADAR

   (b) Open the nose radome and lock it in the open position (AMM 53-12-01/201).

S 434-055-002

(2) Remove the dust caps from the waveguide flanges on the antenna drive assembly and the antenna planar array.

S 424-056-002

(3) Install the weather radar planar array (Fig. 402):

CAUTION: DO NOT MOVE THE RING CLAMP ON THE ELEVATION ZERO MONITOR. THIS CAN CAUSE THE ANTENNA TO OPERATE INCORRECTLY.

   (a) Turn the two bolts on the antenna drive assembly counterclockwise to open the clamp jaws.

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE PLANAR ARRAY.

(b) Carefully set the mounting flange of the planar array on the mounting flange of the antenna drive assembly.

NOTE: Make sure the guide pins on the drive assembly mounting flange engage the holes on the planar array mounting flange. Also, make sure the ring clamp on the elevation zero monitor A5 does not block or touch the planar array.

(c) Tighten each bolt to approximately 20 pounds-inches.
(d) Attach a lock wire from one bolt head to the other bolt head.
(e) Make sure the elevation zero monitor continues to show 0 degrees.

TASK 34-43-05-424-057-002

5. Weather Radar Antenna Installation

A. References
- (1) AMM 53-12-01/201, Nose Radome

B. Access
- (1) Location Zone

111	Radome

C. Procedure

S 864-058-002

(1) Make sure these circuit breakers are open:
- (a) P11 Overhead Circuit Breaker Panel
  - 1) 11F2, WX RADAR

S 434-059-002

(2) Remove the dust caps from the electrical connectors and waveguide flanges.

S 424-060-002

(3) Install the weather radar antenna:

WARNING: USE TWO PERSONS AND A SAFELY INSTALLED WORKSTAND. THIS WILL PREVENT INJURY TO YOU OR DAMAGE TO THE ANTENNA.

CAUTION: OBEY THE NO-HANDHOLD PLACARD ON THE DRIVE ASSEMBLY WAVEGUIDE. DAMAGE TO THE ANTENNA WILL RESULT WHEN THE DRIVE ASSEMBLY WAVEGUIDE IS USED TO HOLD THE ANTENNA.

(a) Put the antenna on the two top boltheads that hold the antenna to the base assembly.
(b) Lower the antenna until it is on the top bolts.
(c) Put the two bottom bolts through the antenna and the base assembly.
(d) Tighten all four bolts that hold the antenna to the base assembly.
(e) Connect waveguide section 1 to the antenna waveguide flanges with the screws and washers.
(f) Connect the electrical connectors to the antenna.

TASK 34-43-05-714-061-002

6. Weather Radar Antenna Test

A. References
   (1) AMM 24-22-00/201, Manual Control
   (2) AMM 53-12-01/201, Radome

B. Access
   (1) Location Zone

211/212	Control Cabin

C. Procedure

S 864-062-002
   (1) Supply electrical power (AMM 24-22-00/201).

S 864-063-002

WARNING: DO NOT OPERATE THE WEATHER RADAR IN A HANGAR OR WITHIN 50 FEET OF ANY PERSONNEL. THESE CONDITIONS CAN CAUSE INJURY TO PERSONNEL.

WARNING: DO NOT OPERATE THE WEATHER RADAR WITHIN 50 FEET OF A FUEL SPILL OR OPEN FUEL CELLS. OPERATION OF THE WEATHER RADAR WITHIN THE 50 FT LIMIT CAN CAUSE A FIRE OR EXPLOSION. A FIRE OR EXPLOSION CAN CAUSE SERIOUS INJURY OR DEATH TO PERSONS AND CAUSE DAMAGE TO EQUIPMENT.

CAUTION: DO NOT OPERATE THE WEATHER RADAR WHEN THERE ARE LARGE METAL OBJECTS IN FRONT OF THE AIRPLANE. AIRPLANES, HANGARS, AND TRUCKS ARE EXAMPLES OF LARGE METAL OBJECTS. KEEP LARGE METAL OBJECTS OUT OF THE AREA THAT IS IN A 300 FOOT RADIUS IN A 180-DEGREE ARC IN FRONT OF THE AIRPLANE. (YOU CAN OPERATE THE WEATHER RADAR IN THE STANDBY OR TEST MODE AND THIS WILL NOT CAUSE TRANSCEIVER DAMAGE.) DAMAGE TO THE TRANSCEIVER COULD OCCUR IF LARGE METAL OBJECTS ARE IN THIS AREA.

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
    (a) P11 Overhead Circuit Breaker Panel
        1) 11F2, WX RADAR

S 864-066-002

(3) Make sure these circuit breakers are closed:
    (a) P11 Overhead Circuit Breaker Panel
        1) 11A7, EFIS DSPL SW L
        2) 11E4, EFIS CONT PNL LEFT
        3) 11E6, HSI LEFT
        4) 11F8, EFIS SYS GEN L

S 864-067-002

(4) On the WXR control panel, set the switches in the positions that follow:
  (a) Put the MODE switch in the WX position.
  (b) Put the TILT switch to the 0 degree position.
  (c) Set all other controls as necessary.

S 864-068-002

(5) On the captain's instrument source select panel, set the EFI switch to the NORM position.

S 864-069-002

(6) On the L-EFIS control panel, set the switches in the positions that follow:
  (a) Set the RANGE to 10.
  (b) Put the MODE switch in the MAP position.
  (c) Put all of the MAP DATA switches to the OFF (out) position.
  (d) Push the WXR button to ON.

S 714-071-002

(7) On the captain's EHSI, make sure weather or ground targets show.

NOTE: Adjust the TILT and the RANGE controls as necessary.

S 714-072-002

(8) On the captain's EHSI, make sure the WXR FAIL message does not show.

D. Put the Airplane Back to Its Usual Condition

S 864-073-002

(1) On the EFIS control panel, set the WXR switch to the OFF position.

S 414-075-002

(2) Close the nose radome (AMM 53-12-01/201).

S 864-076-002

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

WEATHER RADAR ANTENNA MOUNT - MAINTENANCE PRACTICES

1. General
   A. This subject has three tasks:
      (1) Weather Radar Antenna Mount Removal
      (2) Weather Radar Antenna Mount Installation
      (3) Weather Radar Antenna Mount Adjustment.

TASK 34-43-07-002-003

2. Weather Radar Antenna Mount Removal (Fig. 201)
   A. General
      (1) Do not remove the weather radar (WXR) antenna mount unless the approved tools are available to do the antenna mount alignment.
   B. References
      (1) AMM 34-43-05/401, Weather Radar Antenna
      (2) AMM 53-12-01/201, Nose Radome
      (3) AIPC 34-43-03
   C. Access
      (1) Location Zone
          111 Radome

   D. Procedure

      S 862-046

      (1) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
         (a) On the overhead circuit breaker panel P11:
            1) 11F2, WX RADAR L

      S 012-029

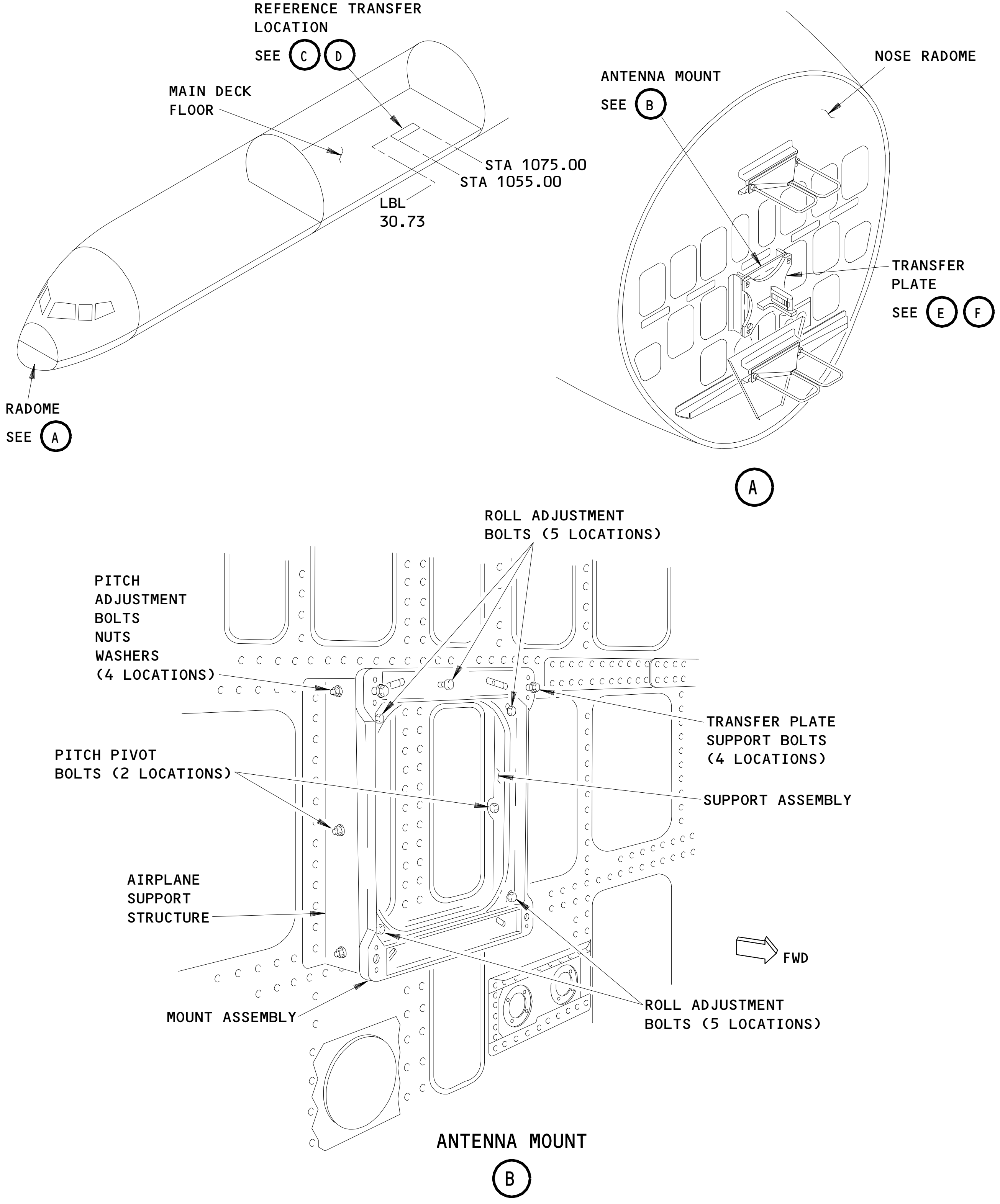
      (2) Open the nose radome (AMM 53-12-01/201).

      S 012-005

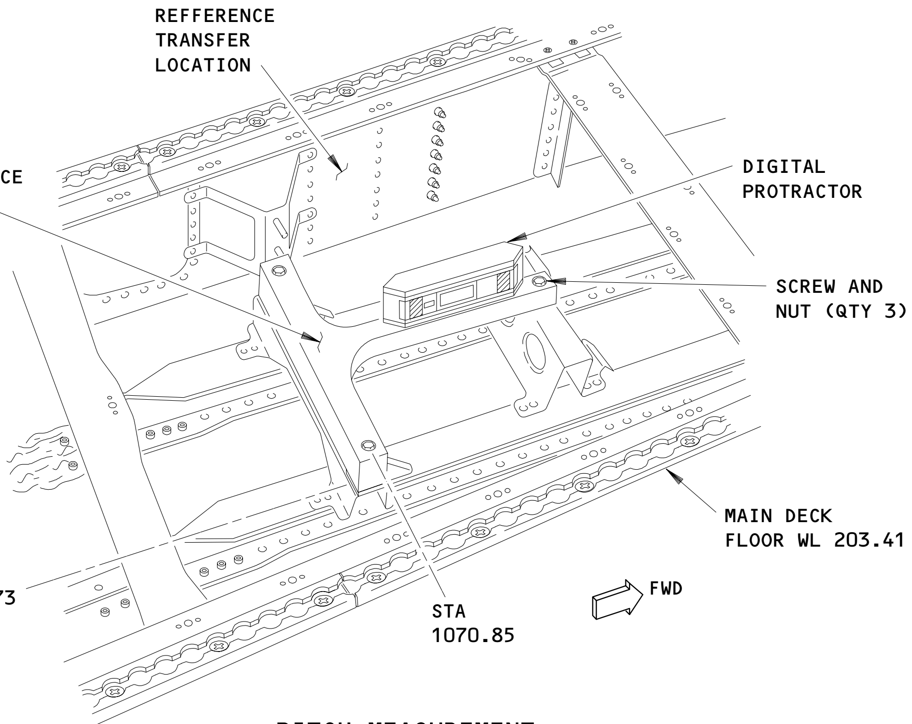
      (3) Remove the WXR antenna (AMM 34-43-05/401).

      S 022-006

      (4) Remove the WXR antenna mount:
         (a) Remove the four pitch adjustment bolts, nuts and washers that hold the WXR antenna mount to the airplane support structure.
         (b) Remove the two pitch pivot bolts, nuts and washers that hold the WXR antenna mount to the airplane support structure.
         (c) Remove the WXR antenna mount from the airplane support structure.
         (d) Keep the bolts, nuts and washers for installation of the WXR antenna mount.

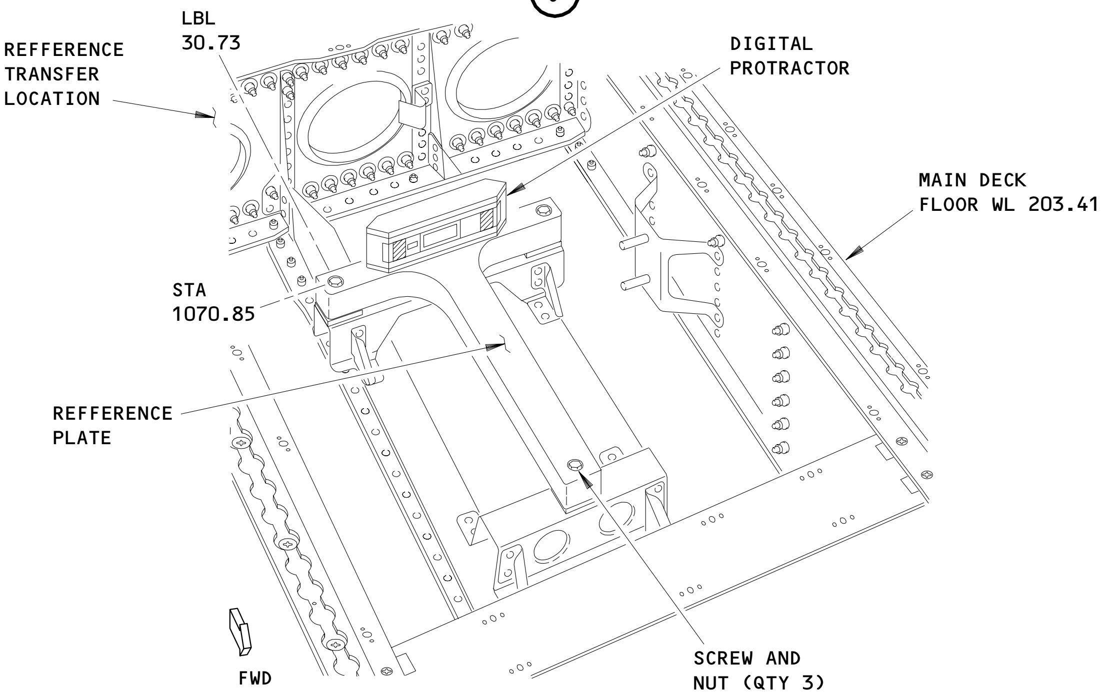


Weather Radar Antenna Mount Maintenance Practice
Figure 201 (Sheet 1)



PITCH MEASUREMENT

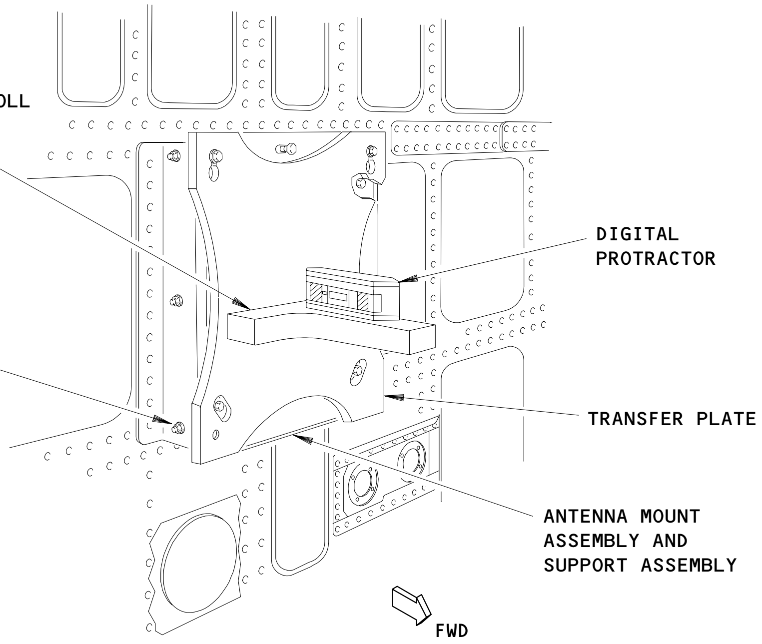
C



ROLL MEASUREMENT

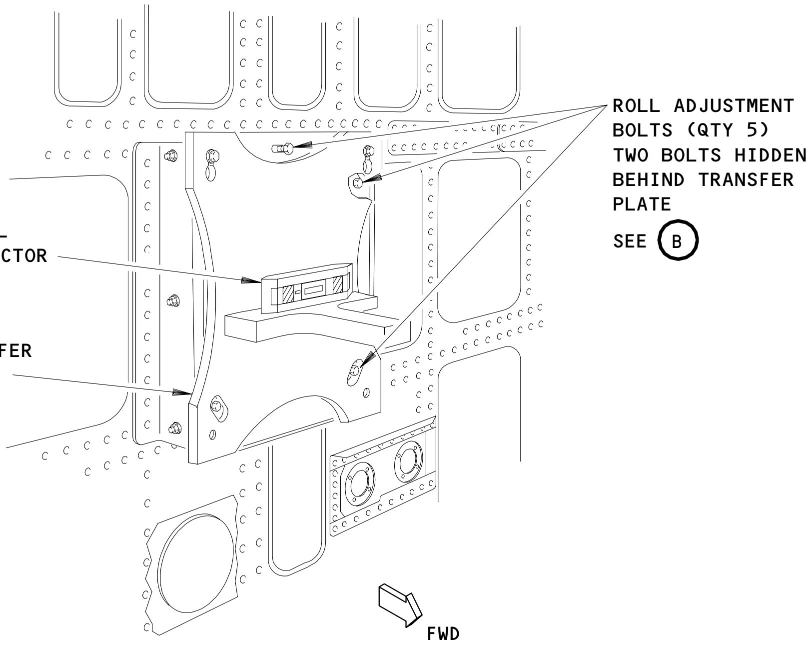
D

Weather Radar Antenna Mount Maintenance Practice
Figure 201 (Sheet 2)



PITCH TRANSFER

E



ROLL TRANSFER

F

Weather Radar Antenna Mount Maintenance Practice
Figure 201 (Sheet 3)

TASK 34-43-07-402-007

3. Weather Radar Antenna Mount Installation (Fig. 201)

A. Reference
   (1) AMM 34-43-05/401, Weather Radar Antenna
   (2) AMM 53-12-01/201, Nose Radome
   (3) AIPC 34-43-03

B. Access
   (1) Location Zone
        111 Radome

C. Procedure

S 862-006
(1) Make sure this circuit breaker is open and a DO-NOT-CLOSE tag is attached:
   (a) On the overhead circuit breaker panel P11:
      1) 11F2, WX RADAR L

S 012-030
(2) Open the nose radome (AMM 53-12-01/201) if it is necessary.

S 212-008
(3) Examine the mount and support assemblies of the WXR antenna mount for cracks or damage.

S 422-009
(4) Install the WXR antenna mount:
   (a) Make sure that six sets of pitch adjustment and pitch pivot bolts, nuts and washers are available.
   (b) Make sure the five roll adjustment bolts and washers are correctly installed on the WXR antenna mount.
   (c) Install the WXR antenna mount on the airplane support structure.
   (d) Install the four pitch adjustment bolts with washers and nuts through the support assembly and the airplane support structure.
   (e) Install the two pivot bolts with washers and nuts through the support assembly and airplane support structure.
   (f) Lightly tighten the six-pitch bolts.

S 722-010
(5) Do the weather radar antenna mount adjustment task (AMM 34-43-07/201).

S 412-011
(6) Install the WXR antenna (AMM 34-43-05/401).

S 412-012
(7) Close the nose radome (AMM 53-12-01/201).

TASK 34-43-07-732-031

4. Weather Radar Antenna Mount Adjustment (Fig. 201)

A. General
   (1) When this adjustment is done, the airplane must be in a position that is as level as possible.
   (2) During moderate or high wind conditions the airplane must be put in a hanger so wind gusts do not affect the adjustment.
   (3) Keep a minimum number of maintenance persons on the airplane when this adjustment is done.
   (4) The digital protractor is used as part of the G34004 adjustment equipment. If an alternate digital protractor is used, make sure the resolution, accuracy and repeatiblity is the same or better as the specifications listed below:
      (a) Resolution: 0.01 degrees (0-10 degrees)
      (b) Accuracy: ± 0.05 degrees (0-10 degrees)
      (c) Repeatability: ± 0.05 degrees
   (5) KELL STROM PRO 3600;
      Do not use the digital protractor if a LO BAT message is shown.
   (6) LUCUS ANGLE STAR DP-60;
      Do not use the digital protractor if a LO BAT message is shown.

B. Equipment
   (1) Weather Radar Antenna Mount Adjustment
      Equipment - G34004
      (a) KS6005 Digital Protractor (recommended)
         Kerr Strom Pro 3600
      (b) DP-60 Digital Protractor (alternative)
         Lucus Angle Star
   (2) Lint-free dry cloth

C. References
   (1) AMM 25-25-01/201, Passenger Seat
   (2) AMM 53-01-01/401, Floor Panels
   (3) AMM 53-12-01/201, Nose Radome

D. Access
   (1) Location Zones

111	Radome
251	Passenger Cabin

E. Procedure

S 862-014

(1) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
  (a) On the overhead circuit breaker panel P11:
    1) 11F2, WX RADAR L

S 012-015

(2) Open the nose radome (AMM 53-12-01/201) if it is necessary.

S 012-016

(3) Remove the equipment that follows to get to the reference transfer location as shown in Fig. 201.
  (a) Remove the passenger seats (AMM 25-25-01/201).
  (b) Remove the floor panel(s) (AMM 53-01-01/401).

S 482-036

(4) Install the reference plate.

<u>NOTE</u>: For the Kell Strom Pro 3600 digital protractor, use in one mode, either the normal reference or alternate reference (ALT -0-) mode, through the entire adjustment.

The procedure that follows is written in the normal reference mode of operation.

<u>NOTE</u>: For the Lucus Angle Star DP-60 digital protractor, use in one mode, either the normal or alternate reference (ALT REF) mode, through the entire adjustment.

Use the same measure scale through the full adjustment. The procedure that follows is written in the normal mode of operation.

  (a) Find the reference transfer location between STA 1055 to 1075 at LBL 30.73.
  (b) Make clean the top and bottom surfaces of the reference plate with a lint-free dry cloth.
  (c) Make clean the reference transfer points on the pressure deck stiffeners with a lint-free dry cloth.
  (d) Install the G34004 reference plate to the reference transfer points on the pressure deck stiffeners.
  (e) Attach the reference plate to the reference transfer points with three screws and nuts.
  (f) Torque the screws from 60 to 80 pound-inches.

S 482-020

(5) Install the G34004 transfer plate on the WXR antenna mount at the nose radome:

(a) Loosen the top left and right roll adjustment bolts on the WXR antenna mount.
(b) Do not loosen the top center or the two bottom roll adjustment bolts.
(c) Install the two support bolts from the G34004 transfer plate into the two top threaded holes of the WXR antenna mount.

<u>NOTE</u>: The support bolts and washers used with the WXR antenna illustration can be used in place of the G34004 bolts.

(d) Install the G34004 transfer plate on the two top support bolts.
(e) Install the two bottom support bolts through the transfer plate into the WXR antenna mount.
(f) Torque the four support bolts for the transfer plate to 160-180 pound-inches.

S 972-019

(6) Measure the airplane pitch and roll at the reference transfer location:

<u>NOTE</u>: Make sure the digital protractor on the reference plate and the transfer plate is turned in the same direction.

Look to see if the digital protractor reads a minus angle or plus angle or it reads an up or down directional arrow.

(a) LUCAS ANGLE STAR DP060;
Push the ALT REF switch on the digital protractor to operate in the normal (gravity reference) mode.

<u>NOTE</u>: Use the digital protractor in one mode, either the normal or alternate reference (ALT RDF) mode, through the entire adjustment.

Use the same measure scale through the full adjustment. The procedure that follows is written in the normal mode of operation.

(b) Set the ON/OFF switch on the digital protractor to ON.
(c) Set the digital protractor on the reference plate to read pitch (Fig. 201).

(d) KELL STROM PRO 3600;
Make sure the digital protractor has been in position for five seconds before reading the display.

(e) Push the ALT REF switch on the digital protractor to operate in the normal (gravity reference) mode.

<u>NOTE</u>: Use the digial protractor in one mode, either the normal or alternate reference (ALT REF) mode, through the entire adjustment.

Use the same measure scale through the full adjustment. The procedure that follows is written in the normal mode of operation.

(f) Read and record the plus or minus pitch value on the digital protractor.

(g) Set the digital protractor on the reference plate to read roll (Fig. 201).

(h) KELL STROM PRO 3600;
Make sure the digital protractor has been in position for five seconds before reading the display.

(i) Read and record the plus or minus roll value on the digital protractor.

(j) LUCUS ANGLE STAR DP-60;
Keep the ON/OFF switch on the digital protractor in the ON position.

S 822-021

(7) Adjust the WXR antenna mount to the airplane pitch value:

<u>NOTE</u>: Make sure the digital protractor on the transfer plate is in the same direction as on the reference plate.

(a) Loosen the six pitch bolts that hold the WXR antenna mount to the radome structure.

(b) Make clean the measure surfaces on the transfer plate with a lint-free dry cloth.

(c) Put the digital protractor on the pitch measure surface of the transfer plate.

S 822-048

(8) KELL STROM PRO 3600;
Make sure the digital protractor has been in position for five seconds before reading the display.

(a) Move the WXR antenna mount slowly in pitch until the value is within ± 0.10 degree of the reference plate pitch value.

NOTE: For the Kell Strom Pro 3600, each time the antenna is moved, do not read the protractor display until has been in position for 5 seconds.

(b) Carefully tighten the two top and two bottom pitch adjustment bolts to a value of 50 to 80 pound-inches.
(c) Do a check of the digital protractor pitch value.
  1) The pitch value must be within the reference plate pitch value ± 0.10 degree.
(d) Tighten the two pitch pivot bolts to a value of 50 to 80 pound-inches.

S 822-022
(9) Adjust the WXR antenna mount to the airplane roll value:

NOTE: Make sure the digital protractor on the transfer plate is in the same direction as on the reference plate.

(a) Loosen the two bottom and the top center roll adjustment bolts on the WXR antenna mount.
(b) Make clean the measurement surfaces on the transfer plate with a lint-free dry cloth.
(c) Put the digital protractor on the roll measure surface of the transfer plate.
(d) KELL STROM PRO 3600;
Make sure the digital protractor has been in position for five seconds before reading the display.
(e) Move the WXR antenna mount slowly in roll until the value is within ± 0.10 degree of the reference plate roll value.

NOTE: For the Kell Strom Pro 3600, each time the antenna is moved, do not read the protractor display until the protractor has been in position for 5 seconds.

(f) Carefully tighten the two bottom and top center roll adjustment bolts to a value of 50 to 80 pound-inches.
(g) Do a check of the digital roll value.
  1) The roll value must be within the reference plate roll value ± 0.10 degree.
(h) Set the ON/OFF switch on the digital protractor to OFF.
(i) Remove the digital protractor from the transfer plate.

(j) Remove the transfer plate from the WXR antenna mount.
  1) Remove the two bottom transfer plate bolts from the WXR antenna mount.
  2) Loosen the two top support bolts.
  3) Remove the transfer plate from the WXR antenna mount.

(k) Tighten the top left and top right roll adjustment bolts to a value of 50 to 80 pound-inches.

S 082-023

(10) Remove the two top support bolts and washers, which are part of the G34004 transfer plate, from the WXR antenna mount.

S 412-024

(11) Install the two top antenna support bolts into the WXR antenna mount.

S 082-025

(12) Remove test equipment from the airplane:
  (a) Put the four transfer plate bolts with washers into the holes supplied in the transfer plate.
  (b) Remove the reference plate from the reference transfer points at STA 1055 and LBL 30.73.

S 412-033

(13) Install the equipment that follows between STA 1055 and 1075 at LBL 30.73.
  (a) Install the floor panels (AMM 53-01-01/401).
  (b) Install the passenger seats (AMM 25-25-01/201).

WEATHER RADAR TRANSCEIVER MOUNT - REMOVAL/INSTALLATION

1. General
   A. This subject has two tasks. The first task is for the removal of the weather radar transceiver mount (xcvr mount). The second task is the installation of the xcvr mount. The removal has these parts:
      (1) Remove the left WXR transceiver.
      (2) Remove the xcvr mount.
   B. Installation has these parts:
      (1) Install the xcvr mount.
      (2) Install the left WXR transceiver.
      (3) Do a test of the weather radar system.

TASK 34-43-08-004-001

2. Transceiver Mount Removal (Fig. 401)
   A. General
      (1) The xcvr mount (M10783T) is attached to the xcvr mount support. The xcvr mount support is in the forward equipment center. To remove the xcvr mount, you must mechanically and electrically disconnect it from the mount support and airplane wiring.
   B. Special Tools and Equipment

      NOTE: Use the correct insertion/extraction tool found in one of the two crimp tool kits shown below. See crimp tool kit connector index

      (1) Graphic Datakits International, Burndy P/N J1276-1 Insertion/Extraction Tool
      (2) Daniels Mfg. Corporation, Astro P/N ATB3062-2 Insertion/Extraction tool.
   C. References
      (1) AMM 06-41-00/201, Fuselage Access Door and Panels
      (2) AMM 34-43-01/401, Weather Radar Transceiver
      (3) SWPM 20-20-11
   D. Access
      (1) Location Zone
          113/114 Area Forward of NLG Wheel Well

      (2) Access Panel
          113AL Forward Equipment Center

   E. Procedure

      S 864-034
      (1) Open this circuit breaker and attach a DO-NOT-CLOSE tag:
          (a) P11 Overhead Circuit Breaker Panel
              1) 11F2, RADAR L

S 014-003

(2) Open the access door to the 113AL forward equipment center to get to the xcvr mount (AMM 06-41-00/201).

S 014-031

(3) Do this task to remove the WXR transceiver from the xcvr mount: Weather Radar Transceiver Installation (AMM 34-43-01/401).

S 024-007

(4) Remove the xcvr mount:
  (a) Disconnect the air hose clamp attached to the xcvr mount.
  (b) Remove the air hose from the air inlet on the xcvr mount.
  (c) Remove the four screws and washer and a gasket from section 3 and the xcvr mount waveguide.
  (d) Put a cover over the xcvr mount waveguide and electrical connector that is lint free.
  (e) Remove the four screws that attach the xcvr mount to the mount support.
  (f) Move the xcvr mount from left to right to make the forward area more accessible for the remainder of this removal.
  (g) Remove all ground wires from ground terminal on the xcvr mount using an insertion/extraction tool (SWPM 20-20-11).

    NOTE: Use the insertion/extraction tool for a Burndy terminal block with part number YHLZG8-1.

  (h) Remove two screws that hold the Burndy block on the xcvr mount.
  (i) Slide the Burndy block up and out of the xcvr block holder.
  (j) Remove the two top and two bottom screws,nuts and washers that attach connector D159B to the xcvr mount.
  (k) Carefully remove connector D159B from the xcvr mount.

S 424-045

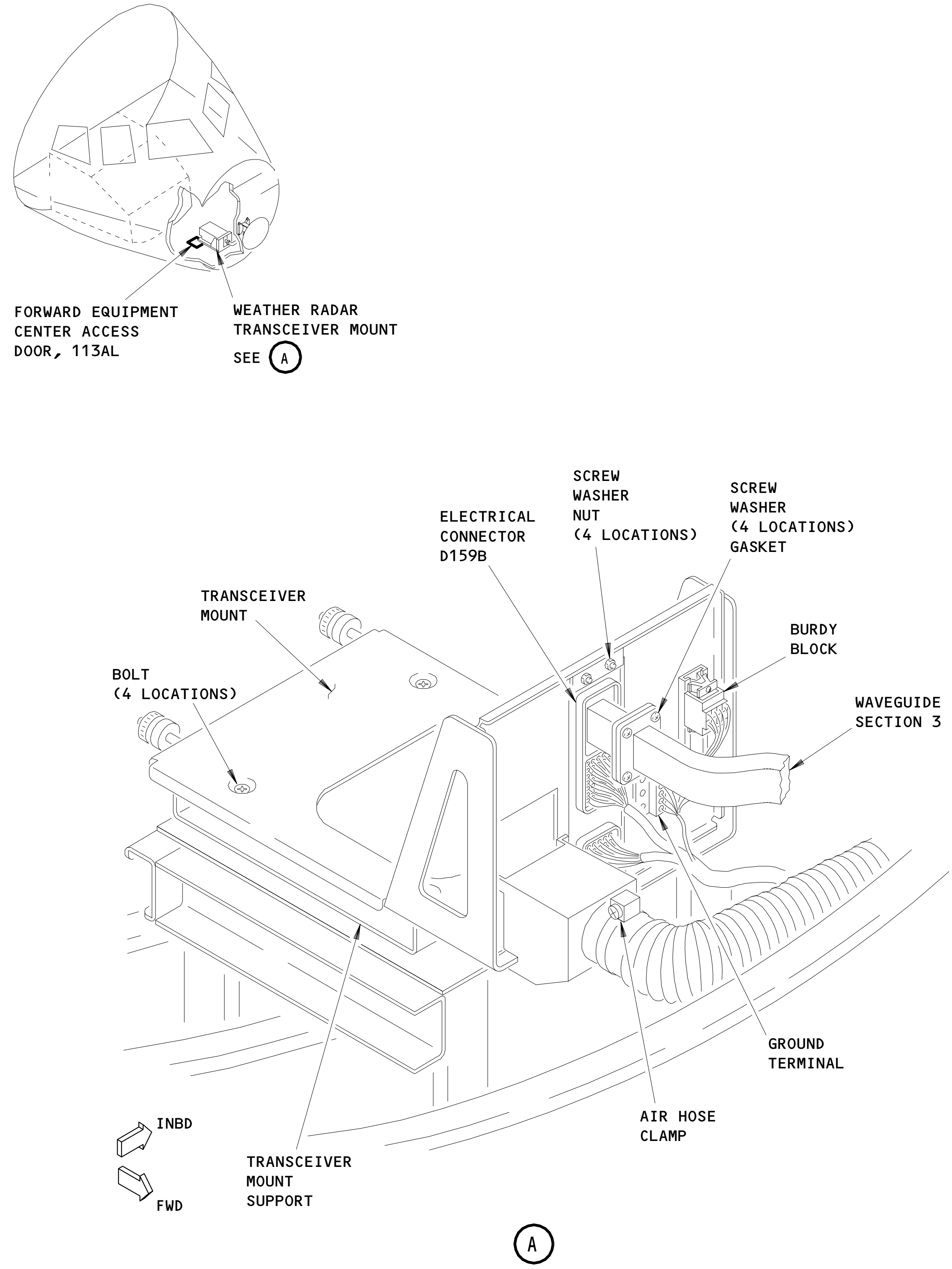
(5) Put a dust cap on waveguide section 3.

TASK 34-43-08-404-013

3. Weather Radar R/T Mount Installation (Fig. 401)

A. General

(1) The xcvr mount (M10783T) is attached to the xcvr mount support. The xcvr mount support is in the forward equipment center. To remove the xcvr mount, you must mechanically and electrically disconnect it from the mount support and airplane wiring.



Weather Radar Transciever Mount Installation
Figure 401

B. Special Tools and Equipment

<u>NOTE</u>: Use the correct insertion/extraction tool fround in one of the two crimp tool kits shown below. See crimp tool kit connector index.

(1) Graphic Datakits International, Burndy P/N J1276-1 Insertion/Extraction Tool
(2) Daniels Mfg. Corporation, Astro P/N ATB3062-2 Insertion/Extraction tool.

C. References
(1) AMM 06-41-00/201 Fuselage Access Door and Panels
(2) AMM 24-22-00/201, Manual Control
(3) AMM 34-43-01/401, Weather Radar Transceiver
(4) SWPM 20-20-11

D. Access
(1) Location Zone

113/114	Area Forward of NLG Wheel Well

(2) Access Panel

113AL	Forward Equipment Center

E. Procedure

S 864-037

(1) Make sure this circuit breaker is open with a DO-NOT-CLOSE tag attached:
  (a) P11 Overhead Circuit Breaker Panel
    1) 11F2, RADAR L

S 024-050

(2) Remove the cover from the air duct on the xcvr mount.

S 024-053

(3) Remove the cover from the electrical connector sections and waveguide section on connector DB138.

S 024-055

(4) Remove the dust cap from waveguide section 3.

S 424-021

(5) Install the xcvr mount:

<u>NOTE</u>: Replace the waveguide gasket when it is defective.

  (a) Place the xcvr mount at an angle on the mount support to the left or right to make the forward area more accessible.
  (b) Install two top and two bottom screws, nuts and washers to attach connector DB140 to the xcvr mount.
  (c) Install two top and two bottom screws, nuts and washers to attach connector DB138 to the xcvr mount.
  (d) Install all ground wires into ground terminal on the xcvr mount using an insertion/extraction tool (SWPM 20-20-11).

  <u>NOTE</u>: Use the insertion/extraction tool for a Burndy terminal block with part number YHLZG8-1.

  (e) Make sure the xcvr mount wire bundle is not damaged and is correctly attached with wire cable ties.
  (f) Carefully install the xcvr mount on the mount support and align the four mount holes.
  (g) Install the eight screws that attach the xcvr mount to the mount support.
  (h) Install the air hose onto the xcvr mount air inlet.
  (i) Tighten the air hose clamp on the xcvr mount.

S 414-056

(6) Do this task to install the WXR transceiver on the xcvr mount: Weather Radar Transceiver Installation (AMM 34-43-01/401).

F. Weather Radar System Test

S 864-032

(1) Remove the DO-NOT-CLOSE tag and close this circuit breaker:
  (a) 11F2, RADAR L

S 864-026

(2) Do this task to supply electrical power: Manual Control (AMM 24-22-00/201).

S 734-027

(3) Do this task to test the WXR xcvr mount: Weather Radar System - Adjustment/Test" (AMM 34-43-00/501).

S 414-029

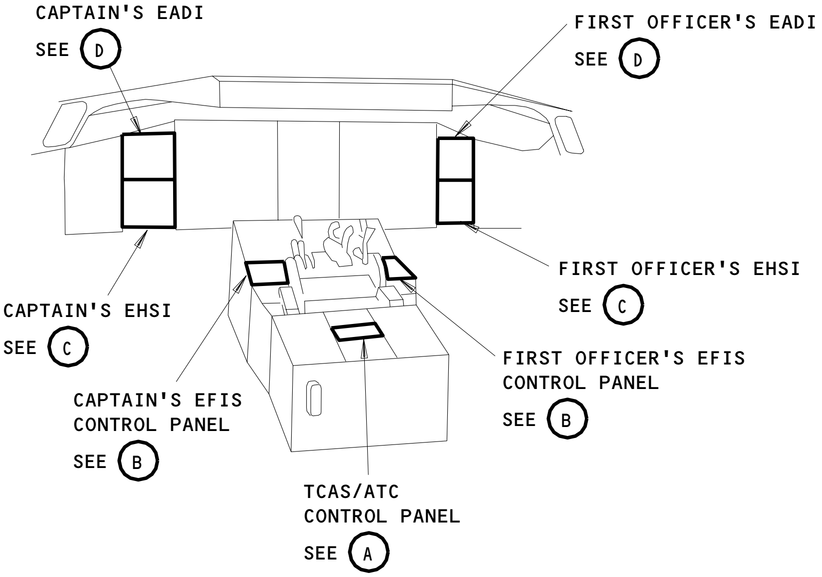
(4) Close the access door to the 113AL forward equipment center (AMM 06-41-00/201).

S 864-030

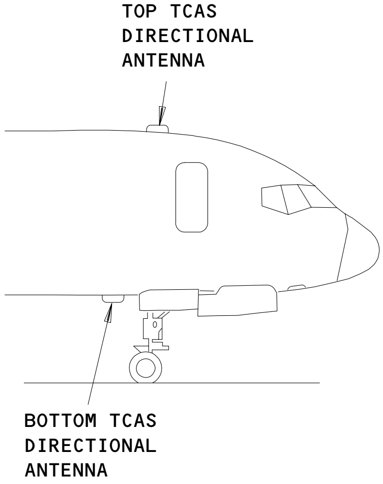
(5) If electrical power is not necessary, do this task to remove electrical power: Manual Control (AMM 24-22-00/201).

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) - DESCRIPTION & OPERATION

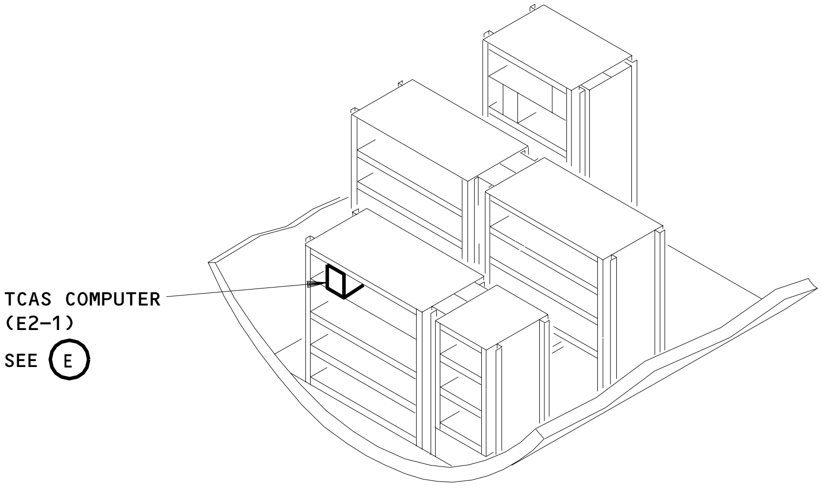
1. General
   - A. The basic Traffic Alert and Collision Avoidance System (TCAS) supplies safe separation between your airplane and other airplanes that have ATCRBS or Mode S Transponders.
   - B. One TCAS system is installed on the airplane. The TCAS system consists of one TCAS computer, two phased array directional antenna, and a control unit (ATC control panel). TCAS informations is shown on the EFIS EHSI and EADI displays.
   - C. TCAS interrogates proximate airplanes and receives the altitude, bearing and other data from the intruder airplane via Air Traffic Control (ATC) system. The TCAS computer will analyze the data and determine if the intruder airplane is a threat to your airplane. If there is a potential threat, TCAS will issue resolution advisories which will instruct the pilot to avoid the conflict. If there is no threat TCAS will track the intruder airplane's position.
   - D. TCAS operates in two modes: TA ONLY mode which only tracks the proximate airplane traffic and TA/RA mode which tracks intruder airplanes and issues resolution advisories.
   - E. The TCAS uses this equipment (Fig. 1):
     - (1) TCAS Computer
     - (2) Two Phased Array Directional Antennas
     - (3) Electronic Flight Instrument System (EFIS) Displays
       - (a) Electronic Horizontal Situation Indicator (EHSI)
       - (b) Electronic Attitude Director Indicator (EADI)
       - (c) EFIS Control Panel.
     - (4) A Mode S Transponder System that has this equipment:
       - (a) Two Mode S Transponders
       - (b) An ATC/TCAS Control Panel
       - (c) Two Omnidirectional Antennas
   - F. The TCAS computer and directional antenna are included in this section. Other TCAS equipment is included to a level necessary to understand the TCAS operation. See Chapter 34-53-00 for the mode S transponder and control panel description.
2. Component Details
   - A. TCAS Computer (see Fig. 2)
     - (1) The TCAS computer is installed in the main equipment center on shelf E2-1. The TCAS computer receives its primary power from the 115V AC Left Bus.
     - (2) The TCAS computer reads and keeps this information about your airplane:
       - (a) Heading
       - (b) Radio altimeter inputs from the left and right LRRA



FLIGHT COMPARTMENT

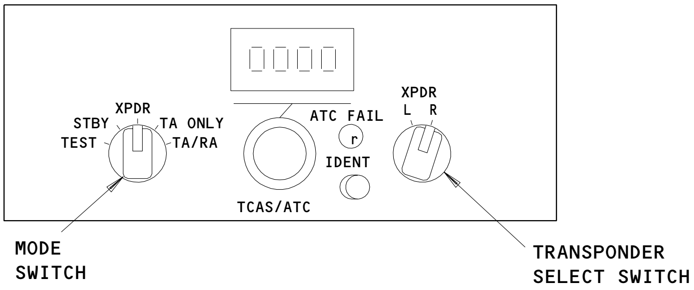


TCAS ANTENNAS



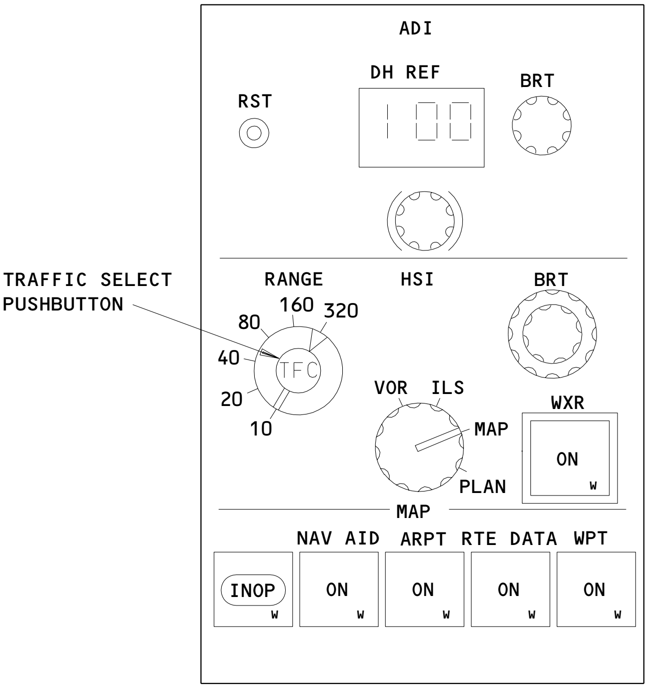
MAIN EQUIPMENT CENTER

TCAS - Component Location
Figure 1 (Sheet 1)



TCAS/ATC CONTROL PANEL

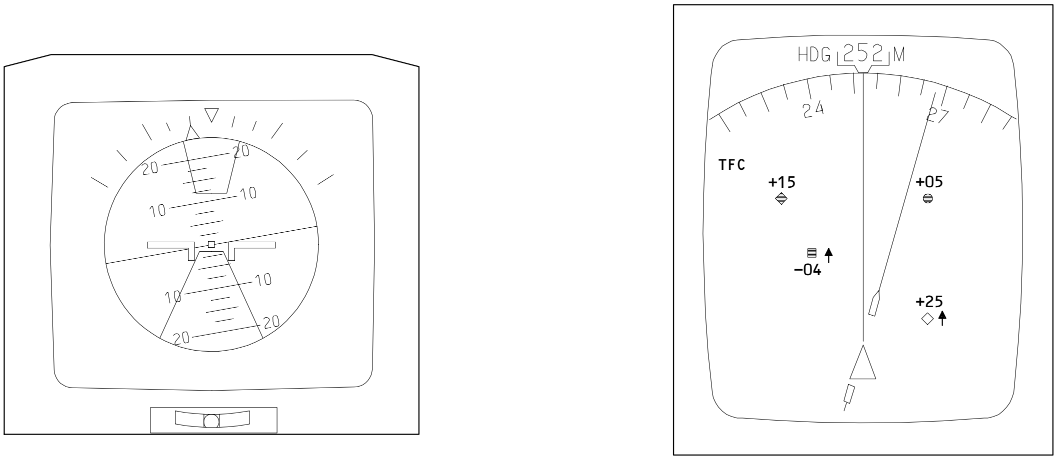
A



EFIS CONTROL PANEL

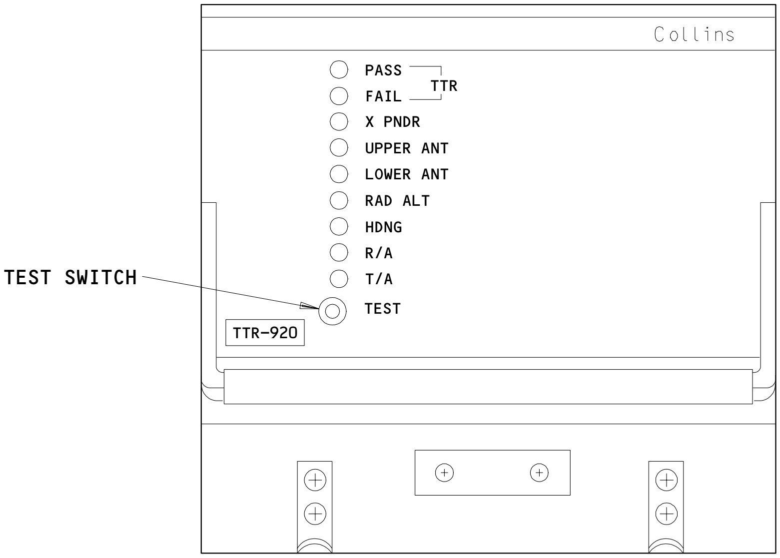
B

TCAS - Component Location
Figure 1 (Sheet 2)



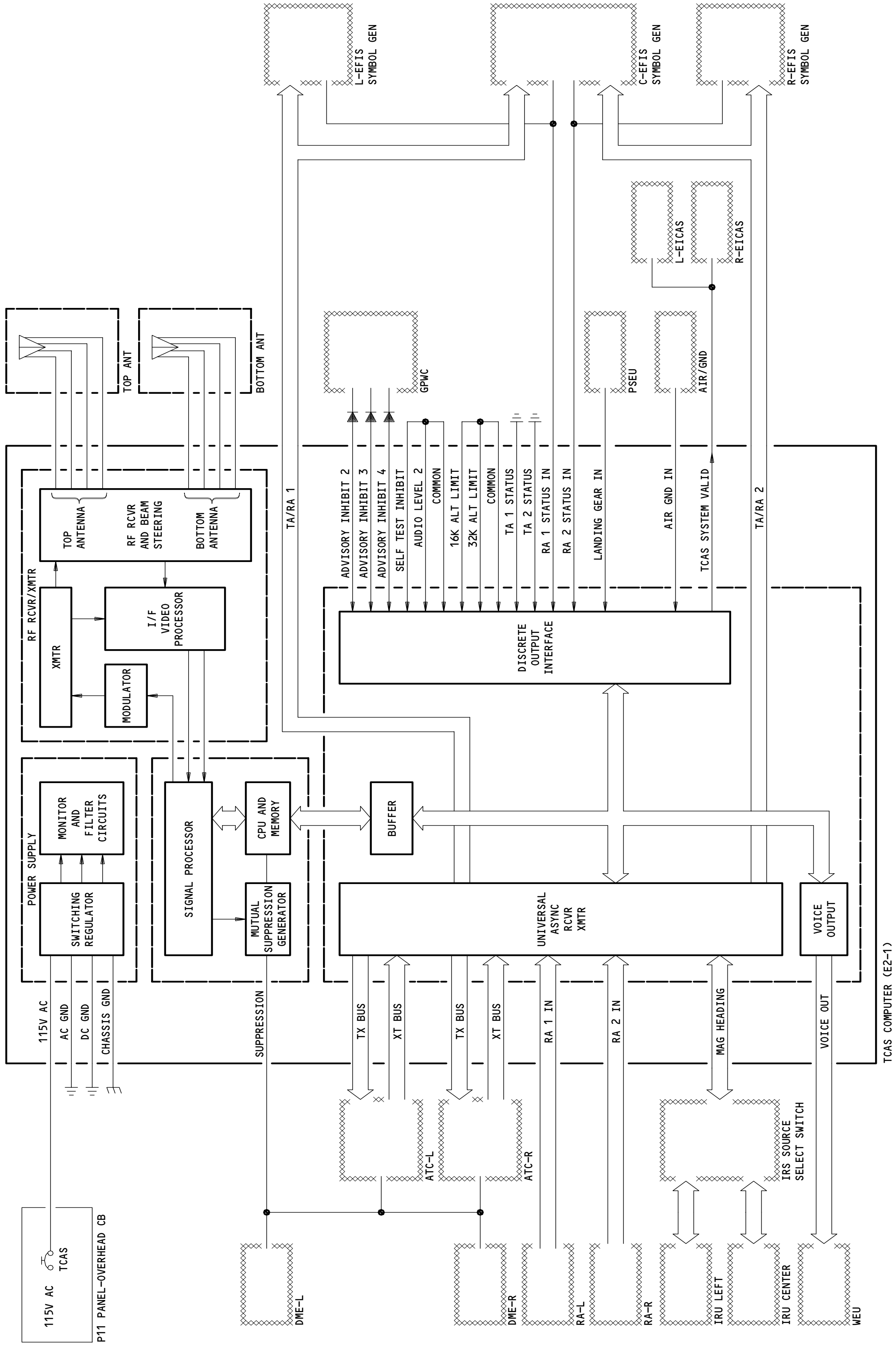
LEFT OR RIGHT EADI
(EXAMPLE)
C

LEFT OR RIGHT EHSI
(EXAMPLE)
D



TCAS COMPUTER
E

TCAS - Component Location
Figure 1 (Sheet 3)



TCAS Schematic (Example)
Figure 2

(c) Mode control requests and traffic display control inputs from the Mode S Transponder
(d) Mode S identification code
(e) Maximum airspeed data
(f) Landing gear level position
(g) Input from weight-on-gear (Air-Ground) strut switch.
(h) Advisory Delay discrete inputs from the ground prox and wind shear system.

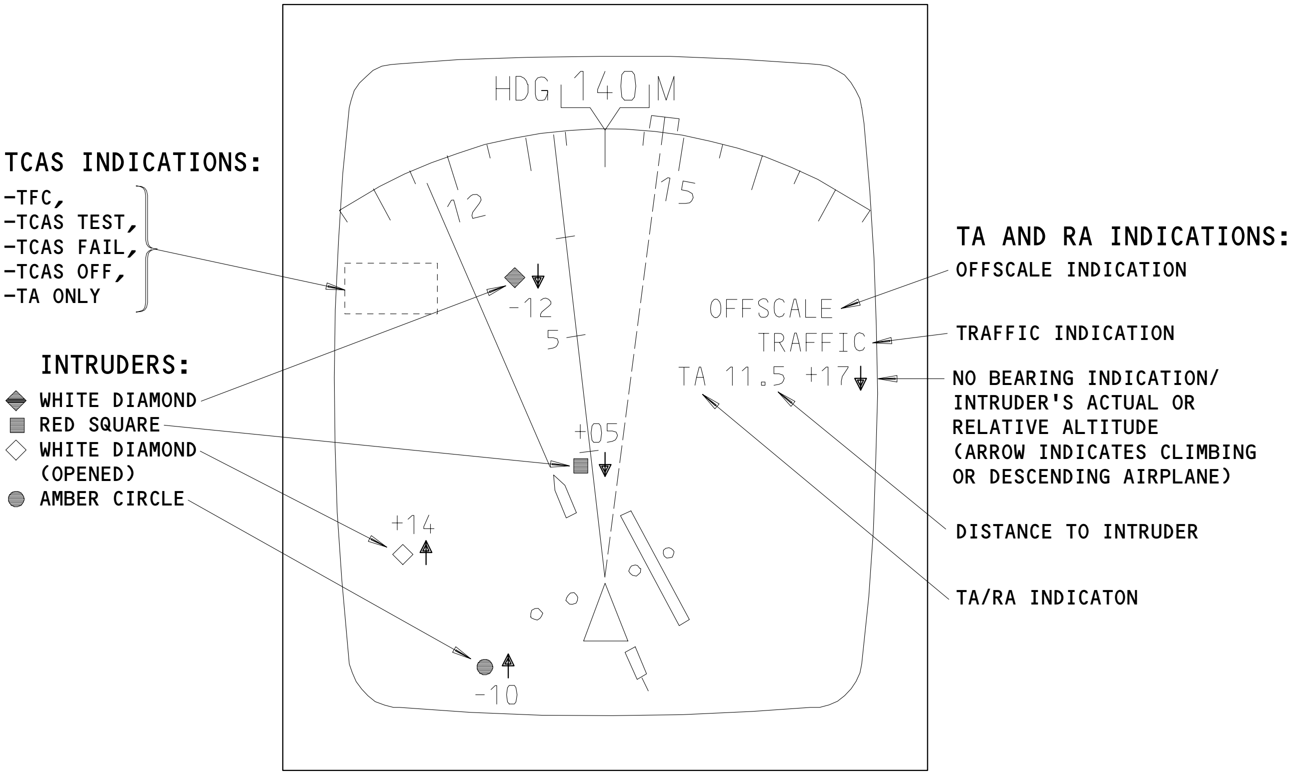
(3) The heading, input used with the pressure altitude data lets the TCAS find your airplanes position, altitude and flight path.
(4) TCAS receives radio altitude from the left or right radio altimeter. TCAS normally uses the left radio altimeter. If the left radio altimeter fails, TCAS automatically switches to the right radio altimeter. TCAS uses the radio altitude to set sensitivity levels and to calculate intruder advisories.
(5) The traffic display control inputs from the EFIS control panel controls the TCAS traffic display formats shown on the navigation displays.
(6) The mode control data from the ATC control panel sets the mode of operation for the TCAS computer.
(7) The Mode S identification code comes from the ATC transponder. The identification code is permanently connected in the airplane with wire straps in the 24 discrete bit strapped inputs to the transponder. The Mode S identification code is used by the TCAS computer during collision avoidance routines with intruders.
(8) The maximum airspeed data is used in RA calculations and to make a projection of the maximum rate that two airplanes can come together.
(9) The Air/Ground input tells the TCAS whether your airplane is in-flight or on-the-ground. TCAS self-test is inhibited in-flight.
(10) The landing gear lever in the down position causes the bottom TCAS antenna to operate in an omnidirectional mode.
(11) The Advisory Delay signals suppress RA and TA indications if windshear or ground proximity conditions occur.
(12) The TCAS program pins set the audio level of voice outputs, the climb resolution advisories inhibit at an altitude of 48,000 feet, and the self-test inhibit in air mode.
(13) If a failure is found on any of these system failure inputs, the TCAS sends failure data to the EFIS display:
(a) Failure inputs from the transponder, radio altimeters, and EFIS displays.
(b) Continuity failure in the TCAS antennas or antenna cables.
(c) Failure data or data leakage on the ARINC 429 data bus from the Mode S Transponder.
(d) Internal TCAS computer failures and failure of internal power supplies.
(e) Incorrect data from the radio altimeter.
(f) Failures that occur in the TCAS computer/transponder rf loop-around test.
(g) If a failure makes the TCAS operate unsatisfactorily, the TCAS computer stops all TCAS operations and shows the applicable indication on the display units.

(14) The TEST switch on the TCAS computer starts a self test that operates as follows:
   (a) All of the LED indicators are normally off.
   (b) Push the TEST button on the front panel of the TCAS computer.
   (c) All of the LED indicators come on.
   (d) The TTR PASS LED indicator stays on if there is no failure to the TCAS computer or other essential system that interface with TCAS.
   (e) The applicable LED failure indicator comes on if there is a failure.

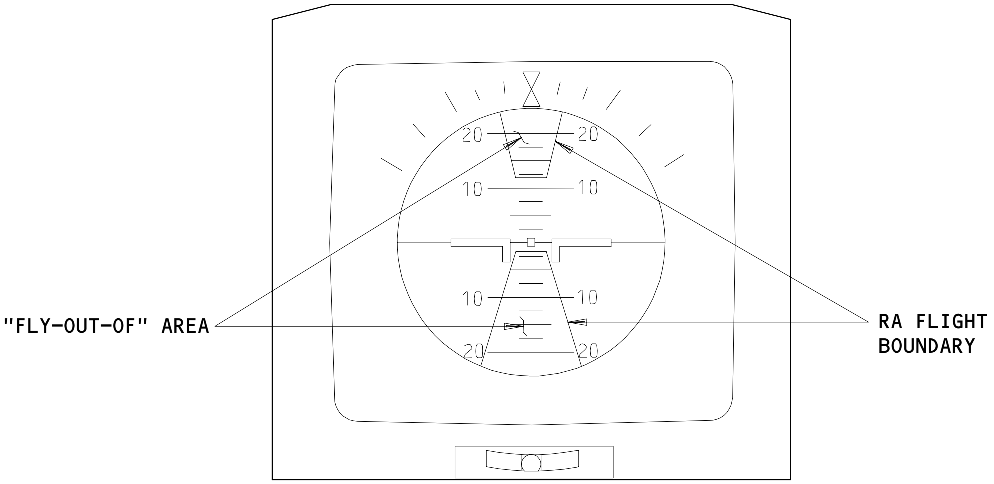
LEDs	FAILURE
TTR PASS	TCAS OK (NO FAILURE)
TTR FAIL	TCAS COMPUTER
XPNDR	ATC TRANSPONDER OR DATA LINK INTERFACE
UPPER ANT	TOP TCAS ANTENNA
LOWER ANT	BOTTOM TCAS ANTENNA
RAD ALT	NO RADIO ALTITUDE DATA
HDNG	NO HEADING DATA
R/A	RA DISPLAY
T/A	TA DISPLAY

B. Directional Antenna (Fig. 2)
   (1) The directional antenna is an electronically steerable phased array that has four top loaded monopole elements. The directional antenna is connected to the TCAS computer with four coaxial cables that have TNC plugs on the antenna end.
   (2) The TCAS uses two directional antennas. One is installed on top and the other is installed on the bottom of the airplane. These antennas transmit to and receive signals from intruder airplanes.
   (3) Each of the four elements of the directional antenna has a resistor that goes from the antenna element to ground. Each of the four resistors has a different value. The TCAS computer regularly does a continuity test on the antenna ports and will see the correct resistance value if the port is not shorted and not open.

C. EFIS Displays (Fig. 2, Fig. 3)
   (1) The EFIS displays are installed on the pilots' instrument panels.



EHSI



EADI

TCAS EFIS Displays
Figure 3

(2) The traffic display on the EHSI, enable by the TFC switch on the EFFIS control panel, helps the pilot see the intruder airplanes before RA threat conditions occur. The EHSI display supplies a display of up to 30 intruder airplanes that are equipped with Mode S or ATCRBS Transponders. The intruders must be detected on a directional antenna, and must be found within the display range.

(3) Graphics shown on the EHSI tell the pilot about TA and RA conditions and show TCAS operation modes and failure conditions.

(4) Graphics shown on the EADI tell the pilots to pull up (climb) or push down (descend). The graphics are represented as vertical pitch advisory to pilots must attain.

(5) The pilot must fly the airplane outside the RA flight boundary until the RA is resolved. Only climb and descent maneuver is required to resolve the RA.

 (a) TCAS Indications on the EHSI: (Message: Description)

  1) TFC (GREEN): Traffic display enable on the EHSI.
  2) TCAS TEST (WHITE): TCAS system on self-test mode.
  3) TCAS FAIL (YELLOW): TCAS computer fails.
  4) TCAS OFF (WHITE): TCAS system not active.
  5) TA ONLY (GREEN): Traffic Advisory ONLY mode.
  6) OFFSCALE (YELLOW/RED): When intruder airplane is out of display range or is within a display priority area. The OFFSCALE indication will be yellow if the intruder airplane is classified as a TA and red for RA.
  7) TRAFFIC (YELLOW/RED): TCAS system detects intruder airplane within the TCAS surveillance area . The TRAFFIC indication will be yellow if the intruder airplane is classified as a TA and red for RA.
  8) TA X.X ±XX (YELLOW): A no bearing intruder airplane has a TA classification. Range, relative altitude and arrow trend of the intruder airplane is also given.
  9) RA X.X ±XX (RED): A no bearing intruder airplane has a RA classification. Range, relative altitude and arrow trend of the intruder airplane is also given.
  10) OPENED WHITE DIAMOND: Non-threatening intrudder airplane with range greater than 6 nm or relative altitude greater than 1200 feet traffic.

11) FILLED WHITE DIAMOND: Non-threatening intruder airplane with range less than 6 nm and relative altitude less than 1200 feet.
12) FILLED AMBER CIRCLE: Approaching intruder airplane close enough to be of concern. Accompanied by an aural caution TRAFFIC TRAFFIC.
13) FILLED RED SQUARE: An immediate threatening traffic that requires evasive action. Accompanied by an aural command like CLIMB CLIMB or DESCEND DESCEND.
14) DOWN ARROW: Intruder airplane is decending at least 500 ft per minute.
15) UP ARROW: Intruder airplane is ascending at least 500 ft per minute.
16) RELATIVE ALTITUDE (+/- XX): Intruder airplane is XX hundred of feet above (+) / below (-) you.
17) ABSOLUTE ALTITUDE (XX.X): Intruder is at XX.X thousand of feet.

(b) TCAS Indications on the EADI:
1) Pull Up Advisory: A red vertical pitch FLY-OUT-OFF area extending from the bottom of the attitude display up to a calculated pitch angle.
2) Push Down Advisory: A red vertical pitch FLY-OUT-OFF area extending from the top of the attitude display down to a calculated pitch angle.

D. TCAS Compatible Dual ATC Control Panel

(1) The TCAS compatible dual ATC control panel is located on the P8 electronic panel. The controls operate as follows:

(a) Mode Select switch:
1) STBY: Transponder does not transmit or reply to interrogation. All TCAS broadcast, surveillance and tracking operation are disabled.
2) TA ONLY: Enable TA ONLY mode
3) RA/TA: Enable TA and RA mode

(b) TEST switch: Initiates TCAS II and Mode S transponder self-test.

3. Operation

A. Functional Description

(1) The TCAS is an airborne traffic alert and collision avoidance system that does not use ATC ground stations. The system finds intruder airplanes that have transponders that reply to ATCRBS or Mode S interrogations. TCAS monitors and makes an analysis of the possible threat of other airplanes to your airplane. The EHSI shows the intruder airplane's position. During threat situations, the system provides Traffic Advisories (TAs) and vertical movement Resolution Advisories (RAs) to help the pilot avoid mid-air collisions.

NOTE: Only intruder airplanes with altitude data (Mode C or Mode S) in their transponder replies can cause RAs to occur in the TCAS. Intruders that do not have Mode C or Mode S transponders can only cause TAs to occur in the TCAS.

(2) The EHSI shows the position of near airplanes that are, or could become, collision threats. This makes it easier for the flight crew to see intruder airplanes before they respond to an RA. RA pitch limit indications show on the EADI.

(3) The directional antenna lets the TCAS computer transmit interrogations and receive replies on one of four antenna beams. The TCAS computer electronically points the antenna beam in one of four different directions to find the bearing of intruder airplanes. The antenna does not have to move. The TCAS adjusts the drive level and phase of each of the four antenna elements in the directional antenna to point the beam.

(4) The TCAS finds airplanes that have a Mode S Transponder by listening for Mode S squitter transmissions. Mode S Transponders transmit squitter data once every second. TCAS receives the airplane's Mode S address and adds it to the interrogation list. TCAS could later interrogate those airplanes discreetly. The TCAS also finds airplanes that have transponders that do not reply to Mode S interrogations but do reply to ATCRBS interrogations. The TCAS must interrogate intruder airplanes that have Mode A and C transponders because they do not transmit squitter data. When an intruder is found, the TCAS monitors the intruder. The TCAS can monitor up to 30 intruders.

(5) The TCAS interrogates intruders continuously to monitor the intruders. When an intruder is interrogated, transponders reply after a fixed delay. The TCAS measures the time between an interrogation and a reply to find the range of the intruder. The TCAS can find the relative altitude of the intruder if the intruder has a Mode C or Mode S transponder. The TCAS uses the directional antennas to find the bearing of the intruder.

(6) The TCAS puts intruders into groups as non-threat, proximity, TA, or RA threat group airplanes. It uses the relative speed and position calculated from the reply data to put the intruder in the correct group. TCAS provides one or more of these data and instructions to the pilot:

(a) TCAS shows an intruder airplane as a symbol on the EHSI. The symbol position on the display shows the range and bearing of the intruder. The symbol's shape and color tells if the airplane has been grouped as a non-threat, proximity, TA or RA threat. The intruder's altitude is shown above the symbol if the intruder is above you, and below the symbol if the intruder is below you. A directional arrow trend next to the intruder airplane symbol shows if the intruder airplane is ascending (up arrow) or descending (down arrow) faster than 500 fpm.

NOTE: TCAS can only group and show an intruder airplane as an RA threat if the intruder is reporting altitude (Mode C or Mode S).

(b) The TCAS shows other traffic-related indications on the EHSI. When TCAS cannot determine the bearing of an intruder airplane, TCAS will display a no bearing message, red RA or yellow TA. There are a maximum of two no bearing messages. The one with the highest priority is displayed first. When a potential threat is out of the display area, the OFFSCALE indication will be displayed.

(c) The TCAS supplies a TRAFFIC alert on the cockpit audio system if an intruder airplane enters the TAU area. If the intruder airplane is grouped as a TA, the TRAFFIC indication on the EHSI is colored yellow. If the intruder airplane is grouped as a RA, the TRAFFIC indication on the EHSI is colored red.

NOTE: The TAU area represents the time to the closest point of approach by an intruder airplane. The TAU varies with the airplane altitude from 20 seconds to 45 seconds.

(d) The TCAS supplies a TA alert on the cockpit audio system if the intruder is grouped as a TA.

(e) The TCAS supplies an RA alert on the cockpit audio system and a vertical movement RA on the EADI's if the intruder is grouped as an RA.

(7) An airplane with TCAS has a Mode S Air Traffic Control (ATC) transponder and an ATC/TCAS control panel. The Mode S Transponder does the Mode S Transponder functions necessary for TCAS and the non-TCAS functions of ATCRBS (Modes A and C) Transponders.

(8) When two airplanes with TCAS are threats to each other, the TCAS in each airplane supplies data to the other and they automatically make a decision which resolution advisory occurs in each airplane. The TCAS will not allow the same vertical movement RA to occur in both airplanes.

(9) The TCAS operates at the same transmit and receive frequencies as ground stations (1030 MHz transmit and 1090 MHz receive). The TCAS and ground stations operate at transmit and receive frequencies that are opposite to the transponder transmit and receive frequencies as shown below.

SYSTEM	TRANSMIT FREQ	RECEIVE FREQ
TCAS	1030 MHz	1090 MHz
Ground Station	1030 MHz	1090 MHz
ATC transponders	1090 MHz	1030 MHz

(10) TCAS transmits 1030 MHz messages from the top and bottom TCAS antennas to interrogate ATC transponders in other airplanes. The TCAS receives 1090 MHz messages from ATC transponders through the top directional antenna and the bottom TCAS omnidirectional antenna.

B. TCAS Voice Alert

(1) The TCAS system alerts the pilot with an audible caution or command during a traffic situation.

(2) When an intruder airplanes projected path brings it close enough to be of concern (filled while diamond changing to filled yellow circle), a TRAFFIC TRAFFIC alert is sounded.

(3) When a RA is encounter, the TCAS system will voice commands for the necessary corrective maneuvers. These voice commands are as follows:
(a) Climb - climb - climb
(b) Climb, crossing climb - climb, crossing climb
(c) Descend - descend - descend
(d) Descend, crossing descend - descend, crossing descend
(e) Reduce climb - reduce climb
(f) Reduce descent - reduce descent
(g) Increase climb - increase climb
(h) Increase descent - increase descent

  - (i) Climb, climb now - climb, climb now
  - (j) Descend, descend now - descend, descend now
- (4) After a RA is resolved, intruder airplane no longer a threat, the TCAS system will announce "clear of conflict".

C. TCAS INHIBITS

- (1) When a ground proximity or windshear alert occurs, the TCAS will be set to the TA-ONLY mode and all TCAS voice alert are inhibited.
- (2) All Resolution Advisory (RAs) are inhibited when the airplane's radio altitude is less than 1100 feet during ascent and 900 feet during descent.
- (3) All TCAS audio warnings are inhibited below 600 feet radio altitude during ascent and 400 feet during descent
- (4) No TCAS "Increase descent" commands are given when the airplane's radio altitude is less than 1,450 feet.
- (5) No TCAS "Descend" commands are given when the airplane's radio altitude is less than 1,200 feet if the airplane is ascending, and 1000 feet if the airplane is descending.
- (6) TCAS CLIMB corrective actions are inhibited above barometer altitude of 48,000 feet.

D. BITE

- (1) The TCAS computer continuously runs self tests and monitors system functions when the microprocessor is not busy with system operations. The TCAS computer can detect any failure that would degrade the normal system operations. The TCAS computer also monitors the ATC system status. If a failure occurs in the ATC or TCAS systems these indications and system actions will occur in the TCAS:
  - (a) TCAS FAIL or TCAS OFF will show on the EHSI display
  - (b) Normal TCAS display indications are stopped
  - (c) Stops interrogations by your airplane TCAS
  - (d) Sends TCAS fail or TCAS off status in the Mode S transmission when interrogations are received from other airplanes.
- (2) There are two ways to start the BITE test manually:
  - (a) Push the TEST switch on the front panel of the TCAS computer
  - (b) Turn the mode select switch on the control module to TEST and hold it for at least one second.
- (3) If there is a failure during the BITE test, a failure LED indicator will come on on the front panel of the TCAS computer.
- (4) The EFIS displays show an indication of the system status.

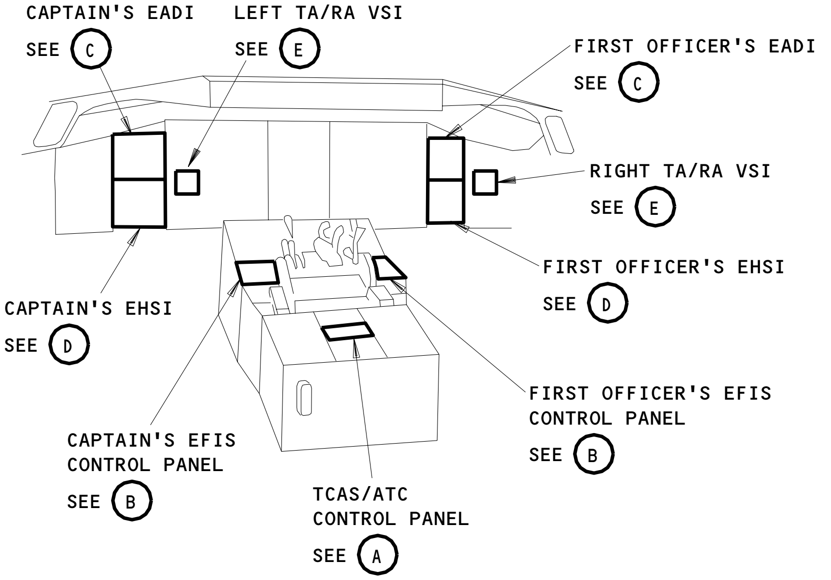
E. Control

- (1) Provide electrical power (Ref 24-22-00).
- (2) System control is provided by the mode select switch on the TCAS/ATC control panel.
  - (a) Set the mode select switch to TA/RA for normal TCAS operation.
  - (b) Set the mode select switch to TA ONLY for TA only mode. This mode keeps the TCAS from giving RAs.
  - (c) Push the TEST switch to start a self test.
  - (d) Set the mode select switch to XPDR or STBY will cause the TCAS OFF message to appear on the EHSI.
- (3) The L/R switch selects the left or right ATC transponder as the active transponder.

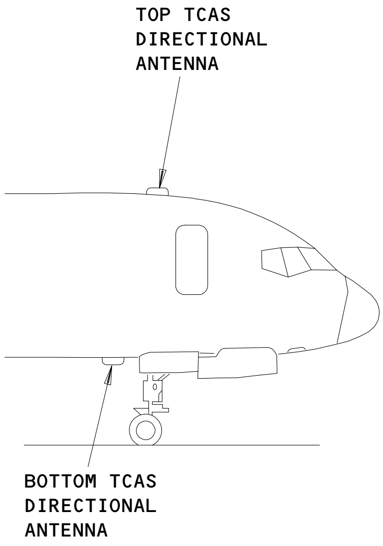
(4) The TFC switch on the EFIS control panel controls the display mode for the TCAS display on the EFIS.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) - DESCRIPTION AND OPERATION

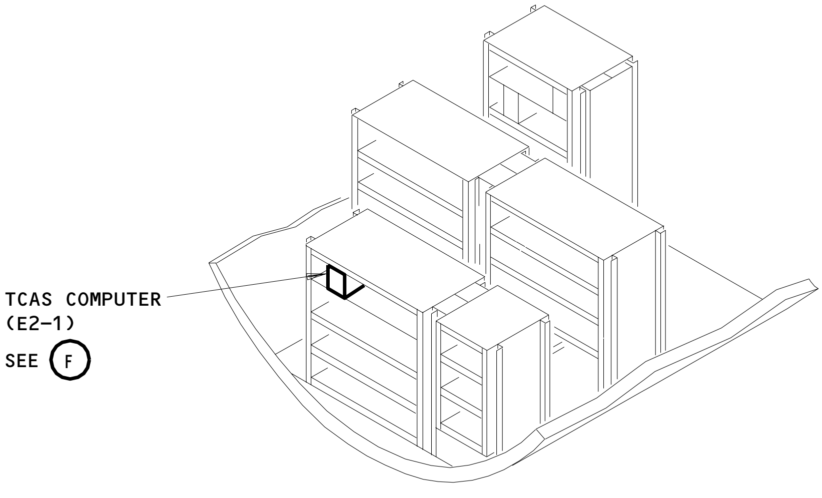
1. General
   A. The basic Traffic Alert and Collision Avoidance System (TCAS) supplies safe separation between your airplane and other airplanes that have ATCRBS or Mode S Transponders.
   B. One TCAS system is installed on the airplane. The TCAS system consists of one TCAS computer, two phased array directional antenna, and a control unit (ATC control panel). There are two possible display configurations for TCAS. One configuration TCAS is displayed on the EFIS displays (EADI and EHSI). The second configuration TCAS is displayed on the VSIs. The VSIs are called the Traffic Advisory/Resolution Advisory Vertical Speed Indicator (TA/RA VSI).
   C. TCAS interrogates proximate airplanes and receives the altitude, bearing and other data from the intruder airplane via Air Traffic Control (ATC) system. The TCAS computer will analyze the data and determine if the intruder airplane is a threat to your airplane. If there is a potential threat, TCAS will issue resolution advisories which will instruct the pilot to avoid the conflict. If there is no threat TCAS will track the intruder airplane's position.
   D. TCAS operates in two modes: TA ONLY mode which only tracks the proximate airplane traffic and TA/RA mode which tracks intruder airplanes and issues resolution advisories.
   E. The TCAS uses this equipment (Fig. 1):
      (1) TCAS Computer
      (2) Two Phased Array Directional Antennas
      (3) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY; Electronic Flight Instrument System (EFIS) Displays
         (a) Electronic Horizontal Situation Indicator (EHSI)
         (b) Electronic Attitude Director Indicator (EADI)
         (c) EFIS Control Panel.
      (4) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI; TCAS/Vertical Speed Indicator (TA/RA VSI) Displays.
      (5) A Mode S Transponder System that has this equipment:
         (a) Two Mode S Transponders
         (b) A TCAS/ATC Control Panel
         (c) Two Omnidirectional Antennas
   F. The TCAS computer control unit, and directional antenna are included in this section. Other TCAS equipment is included to a level necessary to understand the TCAS operation. Refer to Chapter 34-53-00 for the mode S transponder description.
2. Component Details
   A. TCAS Computer
      (1) The TCAS computer is installed in the main equipment center on shelf E2-1. The TCAS computer receives its primary power from the 115V AC Left Bus.
      (2) The TCAS computer reads and keeps this information about your airplane:
         (a) Radio altitude



FLIGHT COMPARTMENT



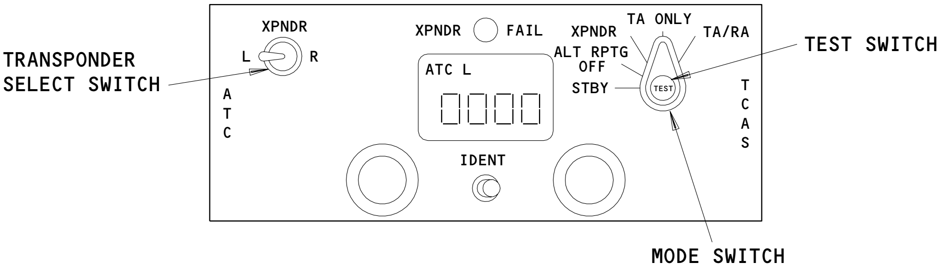
TCAS ANTENNAS



MAIN EQUIPMENT CENTER

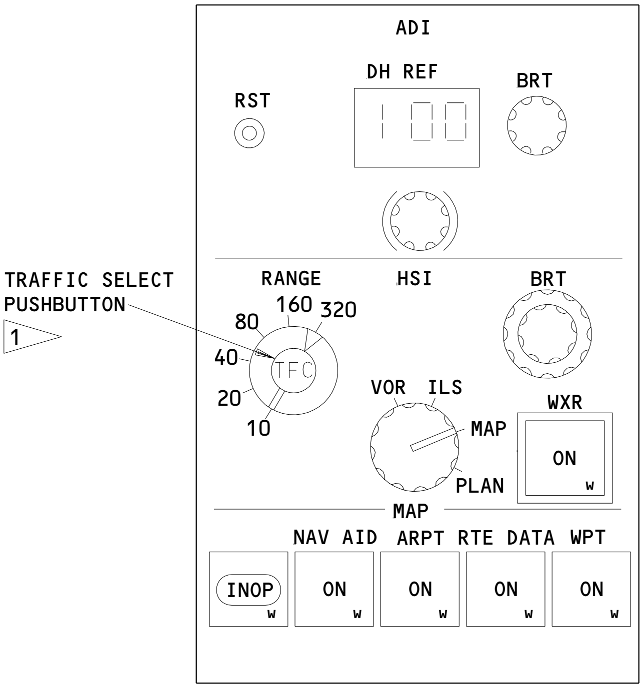
TCAS - Component Location
Figure 1 (Sheet 1)

E85976



TCAS/ATC CONTROL PANEL

A

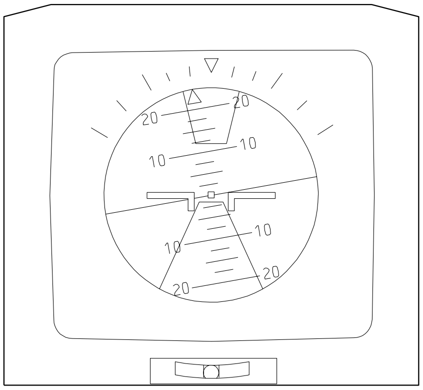


EFIS CONTROL PANEL

B

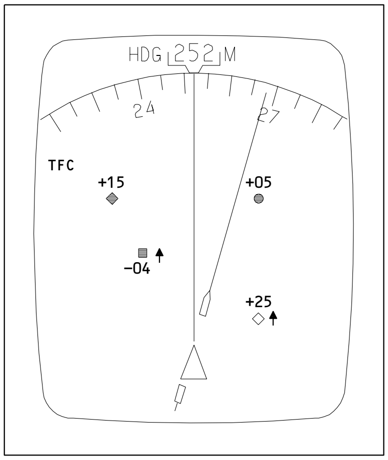
1 AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAYS

TCAS - Component Location
Figure 1 (Sheet 2)



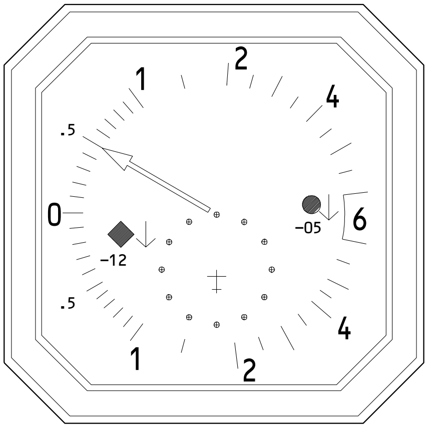
LEFT OR RIGHT EADI
(EXAMPLE)

C 1



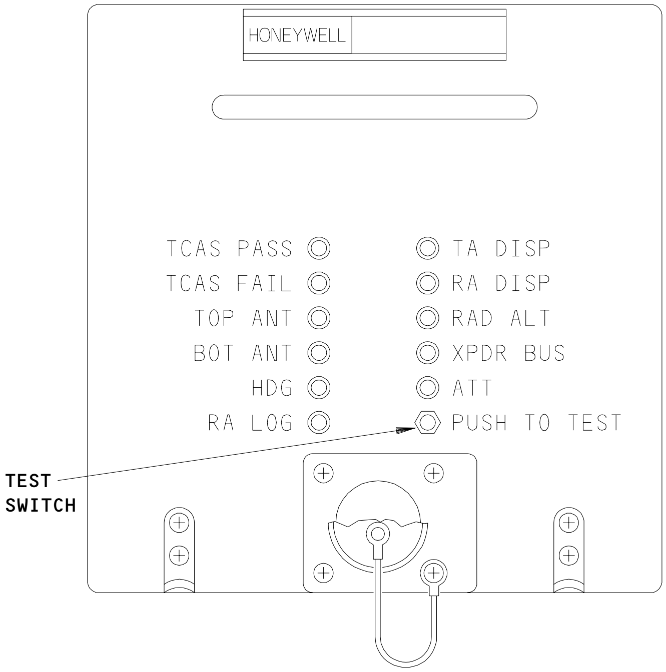
LEFT OR RIGHT EHSI
(EXAMPLE)

D 1



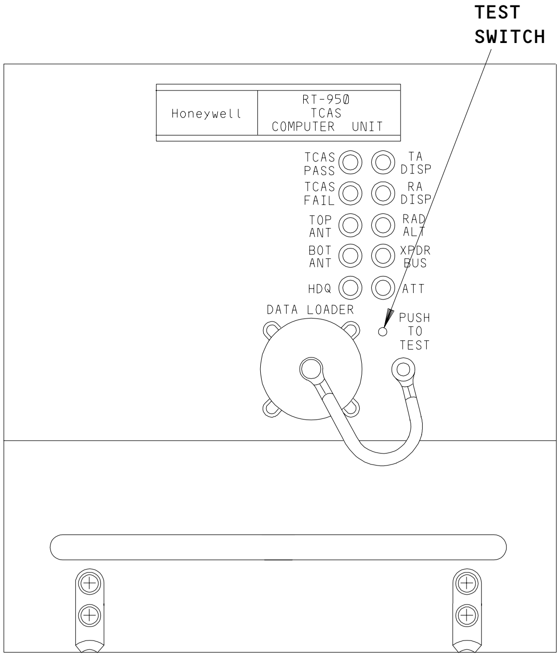
TA/RA VSI

E 2



TCAS COMPUTER

F 3



TCAS COMPUTER

F 4

1 AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAYS
2 AIRPLANES DISPLAYED ON THE TA/RA VSI
3 AIRPLANES WITH HONEYWELL TCAS SYSTEM II
4 AIRPLANES WITH HONEYWELL TCAS 2000

TCAS - Component Location
Figure 1 (Sheet 3)

(b) Mode control requests and traffic display control inputs from the Mode S Transponder
(c) Mode S identification code
(d) Maximum airspeed data
(e) Landing gear level position
(f) Input from weight-on-gear (Air-Ground) strut switch.
(g) Advisory Inhibit discrete inputs from the ground prox and wind shear system.

(3) TCAS receives radio altitude from the left or right radio altimeter. TCAS normally uses the left radio altimeter. If the left radio altimeter fails, TCAS automatically switches to the right radio altimeter. TCAS uses the radio altitude to set sensitivity levels and to calculate intruder advisories.

(4) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
The traffic display control inputs from the EFIS control panel controls the TCAS traffic display formats shown on the navigation displays.

(5) The mode control data from the ATC control panel sets the mode of operation for the TCAS computer.

(6) The Mode S identification code comes from the ATC transponder. The identification code is permanently connected in the airplane with wire straps in the 24 discrete bit strapped inputs to the transponder. The Mode S identification code is used by the TCAS computer during collision avoidance coordination with intruders.

(7) The maximum airspeed data is used in RA calculations and to make a projection of the maximum rate that two airplanes can come together.

(8) The landing gear lever in the down position causes the bottom TCAS antenna to operate in an omnidirectional mode.

(9) The Air/Ground input tells the TCAS whether your airplane is in-flight or on-the-ground. TCAS self-test will be inhibited in-flight.

(10) The Advisory Inhibit signals suppress RA and TA indications if windshear or ground proximity conditions occur.

(11) The TCAS program pins set the audio level of voice outputs, the climb resolution advisories inhibit at an altitude of 48,000 feet, and the self-test inhibit in air mode.

(12) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
If a failure is found on any of these system failure inputs, the TCAS sends failure data to the EFIS display:
(a) Failure inputs from the mode S transponder, radio altimeters, and EFIS displays.
(b) Continuity failure in the TCAS antennas or antenna cables.
(c) ARINC 429 data bus failure from the Mode S Transponder.
(d) Internal TCAS computer failures and failure of internal power supplies.
(e) Incorrect data from the radio altimeter.
(f) If a failure makes the TCAS operate unsatisfactorily, the TCAS computer stops all TCAS operations and shows the applicable indication on the display units.

(13) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
If a failure is found on any of thes system failure inputs, the TCAS sends a TCAS FAIL indication to the TA/RA VSIs:
- (a) Failure inputs form the mode S transponder, radio altimeters, and TA/RA VSI displays.
- (b) Continuity failure in the TCAS antennas or antenna cables.
- (c) Failure data or data leakage on the ARINC 429 data bus from the Mode S Transponder.
- (d) Incorrect data from the radio altimeter.

(14) The TEST switch on the TCAS computer starts a self test that operates as follows:
- (a) All of the LED indicators are normally off.
- (b) Push and hold the TEST switch on the front panel of the TCAS computer for 1.5 seconds.
- (c) All of the LED indicators come on for 3 seconds.
- (d) All of the LED indicators go off for 1 to 13 seconds.
- (e) The TCAS PASS LED indicator comes on if there is no failure to the TCAS computer or other essential system that interface with TCAS.
- (f) The applicable LED failure indicator comes on if there is a failure.

LEDs	FAILURE
TCAS PASS	TCAS OK (NO FAILURE)
TCAS FAIL	TCAS COMPUTER
TOP ANT	TOP TCAS ANTENNA OR CIRCUIT
BOT ANT	BOTTOM TCAS ANTENNA OR CIRCUIT
HDG	N/A
RA LOG	N/A
TA DISP	TA DISPLAY
RA DISP	RA DISPLAY
RAD ALT	RADIO ALTIMETER INPUT
XPDR BUS	MODE S TRANSPONDER INPUT
ATT	N/A

B. Directional Antenna

(1) The TCAS directional antenna is a four-element vertically polarized, monopole array capable of transmitting in four selectable directions. The directional antenna is connected to the TCAS computer with four coaxial cables that have TNC plugs on the antenna end.

(2) The TCAS uses two directional antennas. One is installed on top and the other is installed on the bottom of the airplane. These antennas transmit to and receive signals from intruder airplanes.

(3) Each of the four elements of the directional antenna has a resistor that goes from the antenna element to ground. Each of the four resistors has a different value. The TCAS computer regularly does a continuity test on the antenna ports and will see the correct resistance value if the port is not shorted and not open.

C. AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAYS;
EFIS Displays (Fig. 2)

(1) The EFIS displays are installed on the pilots' instrument panels. The TFC switch on the EFIS control panel enable TCAS operations to be shown on the EFIS displays.

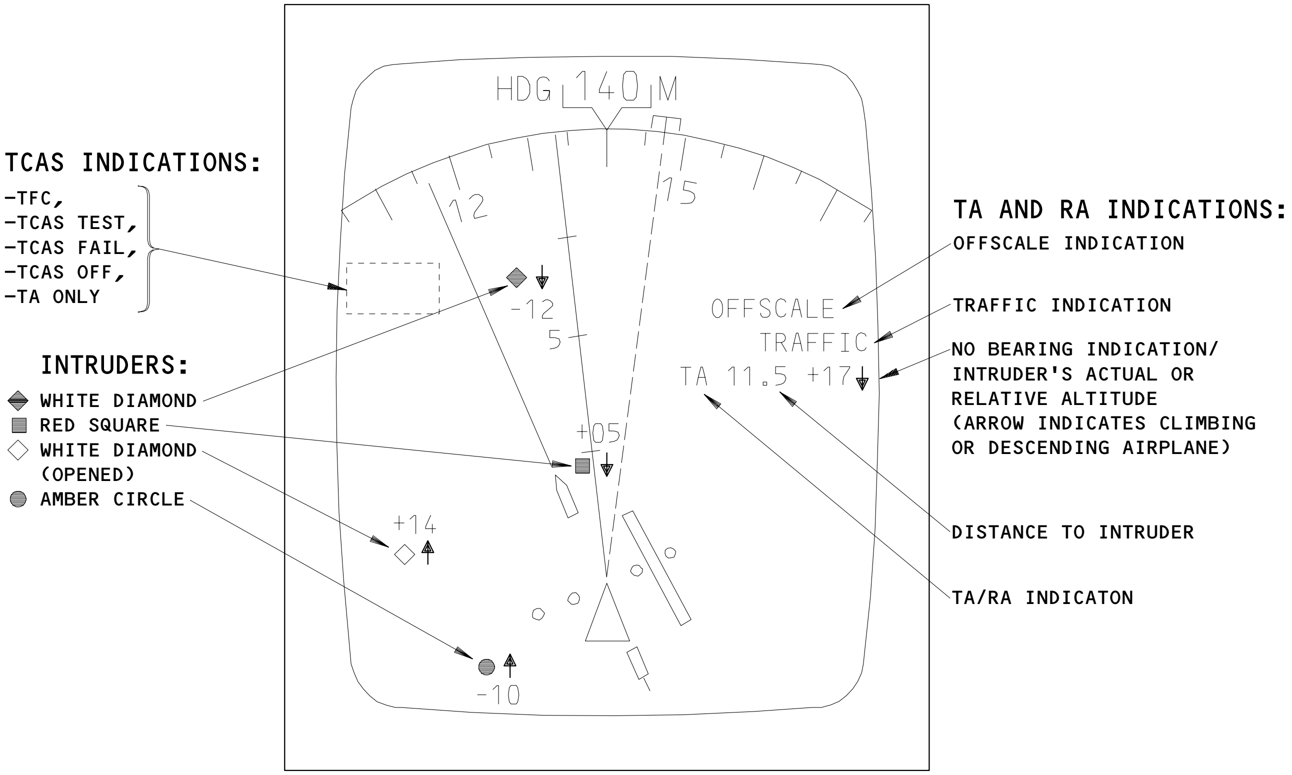
(2) The traffic display on the EHSI, enabled by the TFC switch on the EFIS control panel, helps the pilot see the intruder airplanes before RA threat conditions occur. The EHSI display supplies a display of up to 30 intruder airplanes that are equipped with Mode S or ATCRBS Transponders. The intruders must be detected on a directional antenna, and must be found within the display range.

(3) Graphics shown on the EHSI tell the pilot about TA and RA conditions and show TCAS operation modes and failure conditions.

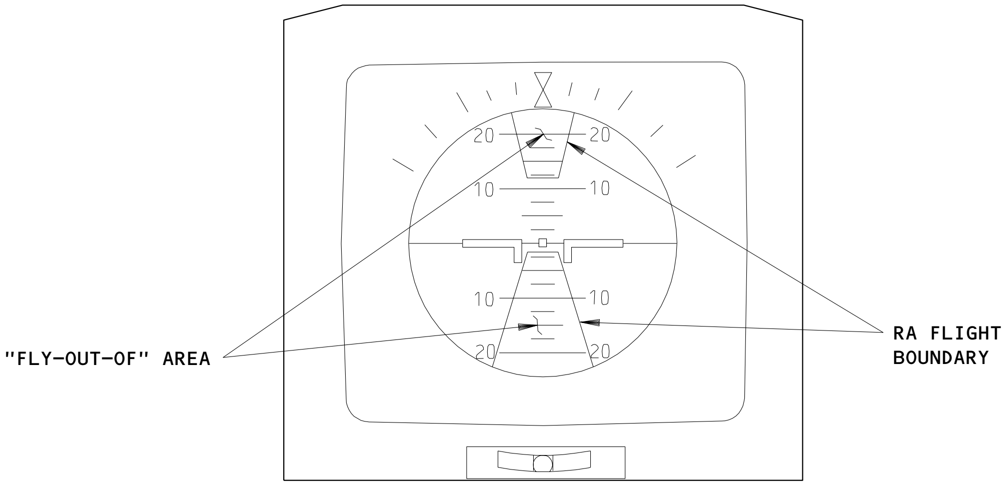
(4) Graphics shown on the EADI tell the pilots to pull up (climb) or push down (descend). The graphics are represented as vertical pitch advisory to pilots must attain.

(5) The pilot must fly the airplane outside the RA flight boundary until the RA is resolved. Only climb and descent maneuver is required to resolve the RA.

(a) TCAS Indications on the EHSI (Message-Description):
    1) TFC (GREEN) - Traffic display enable on the EHSI.
    2) TCAS TEST (WHITE) - TCAS system on self-test mode.
    3) TCAS FAIL (YELLOW) - TCAS computer fails.
    4) TCAS OFF (WHITE) - TCAS system not active.
    5) TA ONLY (GREEN) - Traffic Advisory ONLY mode.
    6) OFFSCALE (YELLOW/RED) - When intruder airplane is out of display range or is within a display priority area. The OFFSCALE indication will be yellow if the intruder airplane is classified as a TA and red for RA.



EHSI
(EXAMPLE)



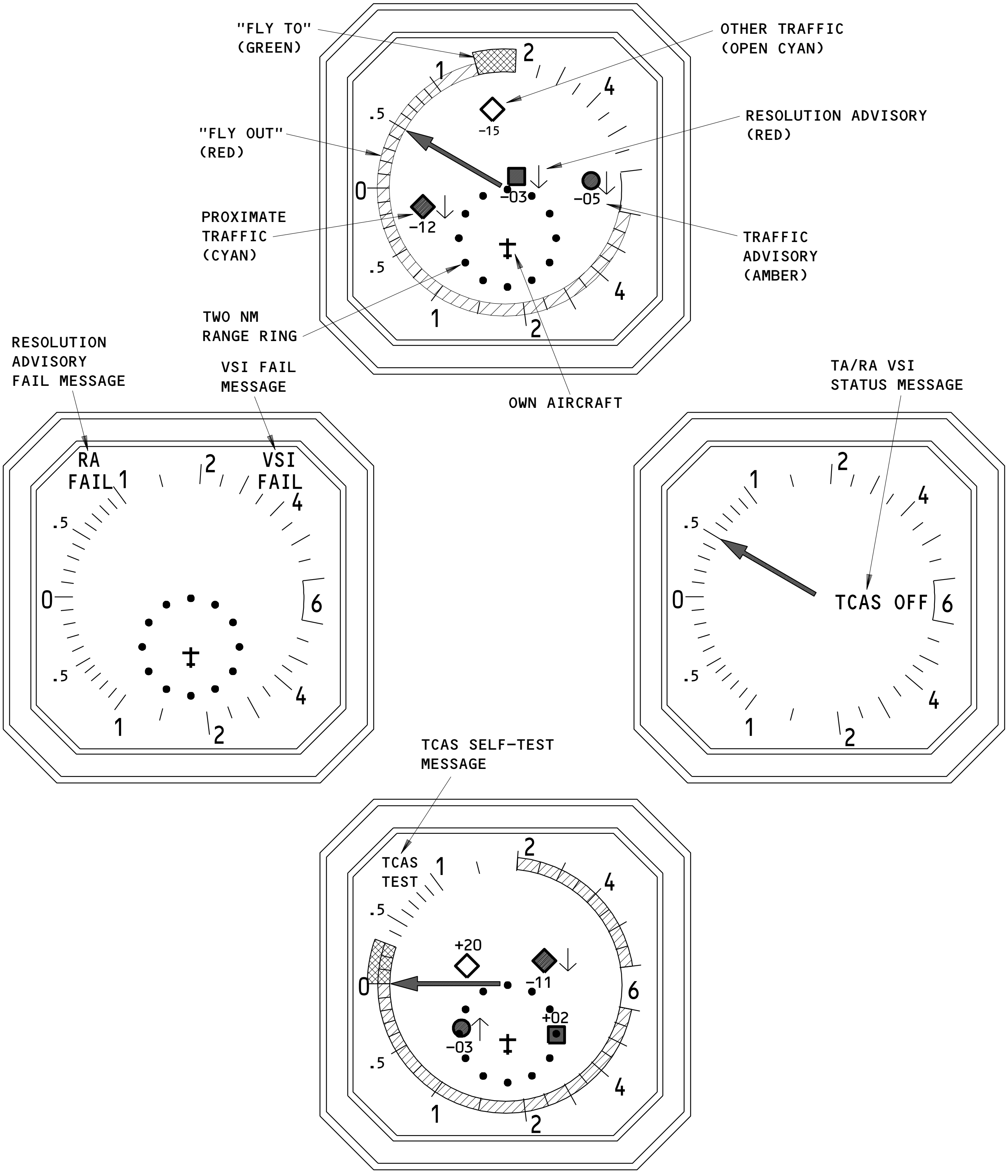
EADI
(EXAMPLE)

TCAS EFIS Displays
Figure 2 (Sheet 1)

7) TRAFFIC (YELLOW/RED) - TCAS system detects intruder airplane within the TCAS surveillance area. The TRAFFIC indication will be yellow if the intruder airplane is classified as a TA and red for RA.
8) TA X.X ±XX (YELLOW) - A no bearing intruder airplane has a TA classification. Range, relative altitude and arrow trend of the intruder airplane is also given.
9) RA X.X ±XX (RED) - A no bearing intruder airplane has a RA classification. Range, relative altitude and arrow trend of the intruder airplane is also given.
10) OPENED WHITE DIAMOND - Non-threatening intruder airplane with range greater than 6 nm or relative altitude greater than 1200 feet traffic.
11) FILLED WHITE DIAMOND - Non-threatening intruder airplane with range less than 6 nm and relative altitude less than 1200 feet.
12) FILLED AMBER CIRCLE - Approaching intruder airplane close enough to be of concern. Accompanied by an aural caution TRAFFIC.
13) FILLED RED SQUARE - An immediate threatening traffic that requires evasive action. Accompanied by an aural command like CLIMB or DESCEND.
14) DOWN ARROW - Intruder airplane is descending at least 500 ft per minute.
15) UP ARROW - Intruder airplane is ascending at least 500 ft per minute.
16) ALTITUDE RANGE (+05) - Intruder airplane is 500 feet above (+05) you.
17) ALTITUDE RANGE (-10) - Intruder airplane is 1000 feet below you.

(b) TCAS Indications on the EADI:
1) Pull Up Advisory - A red vertical pitch FLY-OUT-OFF area extending from the bottom of the attitude display up to a calculated pitch angle.
2) Push Down Advisory - A red vertical pitch FLY-OUT-OFF area extending from the top of the attitude display down to a calculated pitch angle.

D. AIRPLANES WITH THE TA/RA VSI;
TA/RA VSI Displays



TA/RA VSI DISPLAY (EXAMPLES)

TCAS EFIS Displays
Figure 2 (Sheet 2)

(1) The Vertical Speed Indicator/Traffic and Resolution Advisory Displays are on the P1 and P3 panels. The display has a full color active matrix liquid crystal display panel. It is controlled by a microprocessor that receives 429 high speed data from the IRU and TCAS computer.
(2) The TA/RA VSI can show a maximum of eight intruder airplanes within the display range.
(3) Graphics shown on the TA/RA VSI tell the pilot about the airplane's vertical speed, Proximate Traffic, Traffic Advisory and Resolution Advisory conditions and show TCAS operation modes and failure conditions.
(4) Display dimming is controlled by a combination of light sensed by an internal light sensor mounted on the bezel and the instrument panel lightning control. To dim the display, adjust the brightness of the LCD panel backlighting.

E. TCAS Compatible Dual ATC Control Panel
(1) The TCAS compatible dual ATC control panel is located on the P8 electronic panel. The controls operate as follows:
(2) TEST switch initiates TCAS and mode S transponder self-test.
  (a) Mode Select switch:
    1) TEST - Initiates TCAS II and Mode S transponder self-test
    2) STBY - Transponder does not transmit or reply to interrogation. All TCAS broadcast, surveillance and tracking operation are disabled.
    3) TA ONLY - Enable TA ONLY mode
    4) TA/RA - Enable TA and RA mode

F. For more detail on the TCAS System, refer to the wiring diagrams and functional schematics:
(1) SSM 34-45-XX: Traffic Collision Avoidance System
(2) WDM 34-45-XX: Traffic Collision Avoidance System

3. <u>Operation</u>

A. Functional Description
(1) The TCAS is an airborne traffic alert and collision avoidance system. The system finds intruder airplanes that have transponders that reply to ATCRBS or Mode S interrogations. TCAS monitors and makes an analysis of the possible threat of other airplanes to your airplane. The EHSI shows the intruder airplane's position. During threat situations, the system provides Traffic Advisories (TAs) and vertical movement Resolution Advisories (RAs) to help the pilot avoid mid-air collisions.

<u>NOTE</u>: Only intruder airplanes with altitude data (Mode C or Mode S) in their transponder replies can cause RAs to occur in the TCAS. Intruders that do not have Mode C or Mode S transponders can only cause TAs to occur in the TCAS.

(2) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
The EHSI shows the position of near airplanes that are, or could become, collision threats. This makes it easier for the flight crew to see intruder airplanes before they respond to an RA. RA pitch limit indications show on the EADI.

(3) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSIs;
The TA/RA VSIs show the position of near airplanes that are, or could become, collision threats. This makes it easier for the flight crew to see intruder airplanes before they respond to an RA. The RA vertical seperation limit also is shown on the TA/RA VSIs.

(4) The directional antenna lets the TCAS computer transmit interrogations and receive replies on one of four antenna beams. The TCAS computer electronically points the antenna beam in one of four different directions to find the bearing of intruder airplanes. The antenna does not have to move. The TCAS adjusts the level of the four antenna elements in the directional antenna to point the beam.

(5) The TCAS finds airplanes that have a Mode S Transponder by listening for Mode S squitter transmissions. Mode S Transponders transmit squitter data once every second. TCAS receives the airplane's Mode S address and adds it to the interrogation list. TCAS could later interrogate those airplanes discretely. The TCAS also finds airplanes that have transponders that do not reply to Mode S interrogations but do reply to ATCRBS interrogations. The TCAS must interrogate intruder airplanes that have Mode A and C transponders because they do not transmit squitter data. When an intruder is found, the TCAS monitors the intruder. The TCAS can monitor up to 30 intruders.

(6) The TCAS interrogates intruders continuously to monitor the intruders. When an intruder is interrogated, transponders reply after a fixed delay. The TCAS measures the time between an interrogation and a reply to find the range of the intruder. The TCAS can find the relative altitude of the intruder if the intruder has a Mode C or Mode S transponder. The TCAS uses the directional antennas to find the bearing of the intruder.

(7) The TCAS puts intruders into groups as non-threat, proximity, TA, or RA threat group airplanes. It uses the relative speed and position calculated from the reply data to put the intruder in the correct group.

(8) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
TCAS provides one or more of these data and instructions to the pilot:

(a) TCAS shows an intruder airplane as a symbol on the EHSI. The symbol position on the display shows the range and bearing of the intruder. The symbol's shape and color tells if the airplane has been grouped as a non-threat, proximity, TA or RA threat. The intruder's altitude is shown above the symbol if the intruder is above you, and below the symbol if the intruder is below you. A directional arrow trend next to the intruder airplane symbol shows if the intruder airplane is ascending (up arrow) or descending (down arrow) faster than 500 fpm.

NOTE: TCAS can only group and show an intruder airplane as an RA threat if the intruder is reporting altitude (Mode C or Mode S).

(b) The TCAS shows other traffic-related indications on the EHSI. When TCAS cannot determine the bearing of an intruder airplane, TCAS will display a no bearing message, red RA or yellow TA. There are a maximum of two no bearing messages. The one with the highest priority is displayed first. When a potential threat is out of the display area, the OFFSCALE indication will be displayed.

(c) The TCAS supplies a TRAFFIC alert on the cockpit audio system if an intruder airplane enters the TAU area. If the intruder airplane is grouped as a TA, the TRAFFIC indication on the EHSI is colored yellow. If the intruder airplane is grouped as a RA, the TRAFFIC indication on the EHSI is colored red.

<u>NOTE</u>: The TAU area represents the time to the closest point of approach by an intruder airplane. The TAU varies with the airplane altitude from 20 seconds to 45 seconds.

(d) The TCAS supplies a TA alert on the cockpit audio system if the intruder is grouped as a TA.

(e) The TCAS supplies an RA alert on the cockpit audio system and a vertical movement RA on the EADI's if the intruder is grouped as an RA.

(9) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
TCAS provides one or more of these data and instructions to the pilot:

(a) TCAS shows an intruder airplane as a symbol on the TA/RA VSI display. The symbol position on the display shows the range and bearing of the intruder. The symbol's shape and color tells if the airplane has been grouped as a nonthreat, proximity, TA or RA threat. The intruder's relative altitude is shown adjacent to the symbol if the intruder makes its reply in Mode C or Mode S.

<u>NOTE</u>: TCAS can only group and show an intruder airplane as a RA threat if the intruder is reporting altitude (Mode C or Mode S).

(b) The TCAS supplies a TA voice alert "TRAFFIC TRAFFIC" on the cockpit audio system if the intruder is grouped as a TA.

(c) The TCAS supplies an RA voice alert on the cockpit audio system and a vertical movement RA on the TA/RA VSI if the intruder is grouped as an RA.

(10) An airplane with TCAS has a Mode S Air Traffic Control (ATC) transponder and an ATC/TCAS control panel. The Mode S Transponder does the Mode S Transponder functions necessary for TCAS and the non-TCAS functions of ATCRBS (Modes A and C) Transponders.

(11) When two airplanes with TCAS are threats to each other, the TCAS in each airplane supplies data to the other and they automatically make a decision which resolution advisory occurs in each airplane. The TCAS will not allow the same vertical movement RA to occur in both airplanes.

(12) The TCAS operates at the same transmit and receive frequencies as ground stations (1030 MHz transmit and 1090 MHz receive). The TCAS and ground stations operate at transmit and receive frequencies that are opposite to the transponder transmit and receive frequencies as shown below.

SYSTEM	TRANSMIT FREQ	RECEIVE FREQ
TCAS	1030 MHz	1090 MHz
Ground Station	1030 MHz	1090 MHz
ATC transponders	1090 MHz	1030 MHz

(13) TCAS transmits 1030 MHz messages from the top and bottom TCAS antennas to interrogate ATC transponders in other airplanes. The TCAS receives 1090 MHz messages from ATC transponders through the top directional antenna and the bottom TCAS omnidirectional antenna.

B. TCAS Voice Alert

(1) The TCAS system alerts the pilot with an audible caution or command during a traffic situation.

(2) When an intruder airplanes projected path brings it close enough to be of concern (filled while diamond changing to filled yellow circle), a "Traffic Traffic" alert is sounded.

(3) When a RA is encounter, the TCAS system will voice commands for the necessary corrective maneuvers. These voice commands are as follows:

- (a) Climb - climb - climb
- (b) Climb, crossing climb - climb, crossing climb
- (c) Descend - descend - descend
- (d) Descend, crossing descend - descend, crossing decend
- (e) Reduce climb - reduce climb
- (f) Reduce descent - reduce descent
- (g) Increase climb - increase climb
- (h) Increase descent - increase descent

    (i) Climb, climb now - climb, climb now
    (j) Descend, descend now - descend, descend now
  (4) After a RA is resolved, intruder airplane no longer a threat, the TCAS system will announce "clear of conflict".

C. TCAS INHIBITS
  (1) When a ground proximity or windshear alert occurs, the TCAS will be set to the TA-ONLY mode and all TCAS voice alert are inhibited.
    (a) All Resolution Advisory (RAs) are inhibited when the airplane's radio altitude is less than 1100 feet during ascent and 900 feet during descent.
    (b) All TCAS audio warnings are inhibited below 600 feet radio altitude during ascent and 400 feet during descent.
  (2) No TCAS "Increase descent" commands are given when the airplane's radio altitude is less than 1,450 feet.
  (3) No TCAS "Descend" commands are given when the airplane's radio altitude is less than 1,200 feet if the airplane is ascending, and 1000 feet if the airplane is descending.
  (4) TCAS CLIMB corrective actions are inhibited above barometer altitude of 48,000 feet.

D. BITE
  (1) The TCAS computer continuously runs BITE tests and monitors system functions when the microprocessor is not busy with system operations. The TCAS computer can detect any failure that would degrade the normal system operations. The TCAS computer also monitors the ATC system status. If a failure occurs in the ATC or TCAS systems these indications and system actions will occur in the TCAS:
    (a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
        TCAS FAIL or TCAS OFF will show on the EHSI display
    (b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
        TCAS FAIL, RA FAIL or TCAS OFF will show on the TA/RA VSI display
    (c) Normal TCAS display indications are stopped
    (d) Stops interrogations by your airplane TCAS
    (e) Sends TCAS FAIL or TCAS OFF status in the Mode S transmission when interrogations are received from other airplanes.
  (2) There are two ways to start the BITE test manually:
    (a) Push the TEST switch on the front panel of the TCAS computer
    (b) Push the TEST switch on the control unit.
  (3) If there is a failure during the BITE test, a failure LED indicator will come on on the front panel of the TCAS computer.

E. Control
  (1) Provide electrical power (Ref 24-22-00)
  (2) System control is provided by the mode switch on the TCAS/ATC control panel.
    (a) Set the mode switch to TA/RA for normal TCAS operation.

(b) Set the mode switch to TA ONLY for TA only mode. This mode keeps the TCAS from giving RAs.

(3) The transponder select switch selects the left or right ATC transponder as the active transponder.

(4) The TFC switch on the EFIS control panel controls the display mode for the TCAS display on the EFIS.

CONDITION	AURAL	TA/RA VSI ANNUNCIATION				NOTES
		UPPER LEFT	UPPER RIGHT	CENTER	COLOR	
TRAFFIC DISPLAY CONTROL ON MODE	NORMAL					RANGE RING AND OWN AIRPLANE IN VIEW AT ALL TIMES, ALONG WITH QUALIFYING TRAFFIC.
TRAFFIC DISPLAY CONTROL AUTO MODE	NORMAL					RANGE RING AND OWN AIRCRAFT COME UP WITH TRAFFIC WHEN A TA OR RA EXISTS.
TRANSPONDER ONLY MODE	NONE			TCAS OFF	WHITE	TCAS IS NOT OPERATIONAL.
STANDBY MODE	NONE			TCAS OFF	WHITE	TCAS IS NOT OPERATIONAL, TRANSPONDER IS IN STANDBY.
VERTICAL SPEED INPUT FAILURE TO SINGLE VSI	NORMAL	RA FAIL ON FAILED SIDE	VSI FAIL ON FAILED SIDE		YELLOW	VERTICAL SPEED NEEDLE REMOVED FROM DISPLAY WITH FAILED DATA, NO RAs POSTED ON FAILED SIDE TCAS IS OPERATIONAL ON REMAINING SIDE.
VSI INPUT FAILURE TO THE TWO VSI	NONE		VSI FAIL BOTH SIDES	TCAS FAIL BOTH SIDES	YELLOW	1. VERTICAL SPEED NEEDLE REMOVED FROM THE TWO VSIs. 2. NO RA INFORMATION POSTED. TCAS IS NOT OPERATIONAL.
TA ONLY MODE	TRAFFIC-TRAFFIC ONLY	TA ONLY			WHITE (ON GRD) YELLOW (IN AIR)	TRAFFIC ALERTS ARE THE ONLY INFORMATION DISPLAYED. NO RAs.
TRANSPONDER OR ALTITUDE SOURCE FAIL	NONE			TCAS FAIL	YELLOW	TCAS IS NOT OPERATIONAL.
ALTITUDE REPORTING OFF				TCAS OFF	WHITE	TCAS IS NOT OPERATIONAL.
RA FAIL		RA FAIL	VSI FAIL		YELLOW	NO RESOLUTION ADVISORIES DISPLAYED.
TRAFFIC DISPLAY FAILURE				TD FAIL	YELLOW	NO TRAFFIC ADVISORIES DISPLAYED.
SINGLE RA/VSI FAILURE	NORMAL			X ACROSS FAILED DISPLAY	RED	1. ON FAILED SIDE - ALL SYMBOLOGY REMOVED AND REPLACED WITH A LARGE RED X, AND HEX-CODED FAILURE NUMBER. 2. TCAS OPERATIONAL ON GOOD SIDE.
DUAL RA/VSI FAILURE	NONE			X ACROSS BOTH DISPLAYS	RED	ALL SYMBOLOGY REMOVED FROM THE TWO DISPLAYS AND REPLACED WITH LARGE RED X, AND FAILURE CODE TCAS IS NOT OPERATIONAL.

TCAS Mode and Failure Annunciations
Figure 3

CONDITION	AURAL	TA/RA VSI ANNUNCIATION				NOTES
		UPPER LEFT	UPPER RIGHT	CENTER	COLOR	
TCAS SELF-TEST SELF-TEST SHOULD ONLY BE RUN IN STANDBY MODE OR ON THE GROUND.						
TCAS TEST MODE FIRST SECOND	"TCAS TEST"	TCAS TEST			WHITE	TCAS SYSTEM SELF-TEST.
TCAS TEST MODE 2 TO 8 SECONDS		TCAS TEST			WHITE	TCAS TEST PATTERN SHOWN.
TCAS TEST MODE AT 8 SECONDS	"TCAS TEST PASS/ FAIL"	TCAS TEST				TCAS TEST PATTERN REMOVED AND TCAS RETURNS TO NORMAL OPERATION UNLESS TEST SWITCH IS HELD AND AIRCRAFT IS ON THE GROUND AND TCAS IN "STBY".
TCAS EXTENDED SELF-TEST (MAINTENANCE ONLY) "EXTENDED" SELF-TEST PROVIDES MAINTENANCE INFORMATION ON SEVEN "SCREENS" SELECTED VIA 4096 CODE. THIS MODE IS AVAILABLE ONLY ON THE GROUND AND IN STANDBY. EXTENDED SELF-TEST ENDS AUTOMATICALLY WITH TCAS/TRANSPONDER MODE CHANGE OR IF THE AIRPLANE BECOMES AIRBORNE.						
TCAS EXTENDED TEST MODE (TEST SWITCH HELD AT 7 SECONDS FOR 2 SECONDS AND AIRCRAFT ON THE GROUND ONLY)				SYSTEM INFORMATION PAGES	WHITE	CURRENT STATUS OF THE TCAS SYSTEM, TRANSPONDER, ANTENNAS, RADIO ALTIMETERS, BARO ALTITUDE, ETC. IS PRESENTED IN A SERIES OF PAGES CALLED BY SELECTION OF 4096 CODE.

VSI NEEDLE	RED AREA	GREEN AREA
0 FPM	+2000 TO +6000 FPM AND 0 to -6000	0 TO +300 fpm

VERTICAL SPEED SCALE

TYPE TRAFFIC	BEARING	DISTANCE	RELATIVE ALTITUDE	ALTITUDE RATE
RA	+90 DEG	2.0 NMI	+200 FT	NO VERTICAL RATE
TA	-90 DEG	2.0 NMI	-300 FT	CLIMBING
PROX	+33.75 DEG	3.625 NMI	-1100 FT	DESCENDING
OTHER	-33.75 DEG	3.625 NMI	+2000 FT	NO VERTICAL RATE

TRAFFIC

SELF-TEST INDICATIONS DURING EIGHT-SECOND DISPLAY

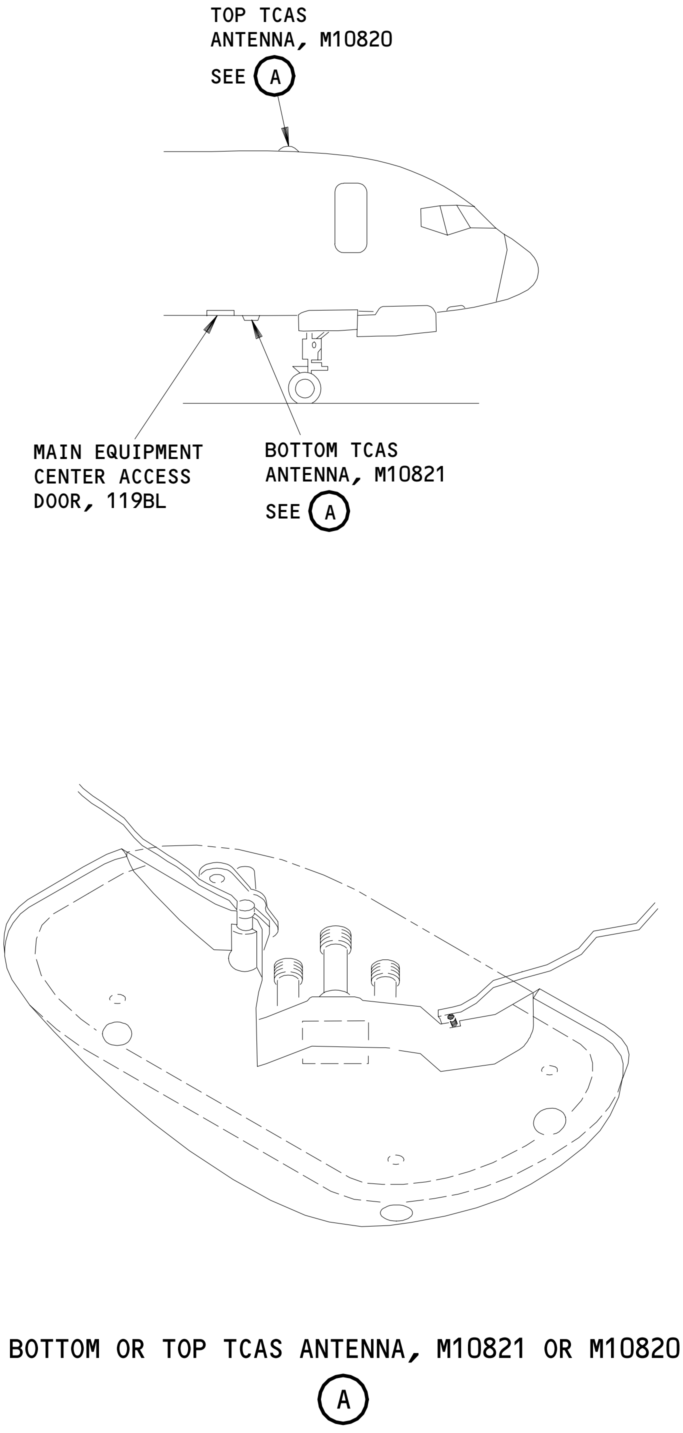
TCAS Self-Test
Figure 4

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

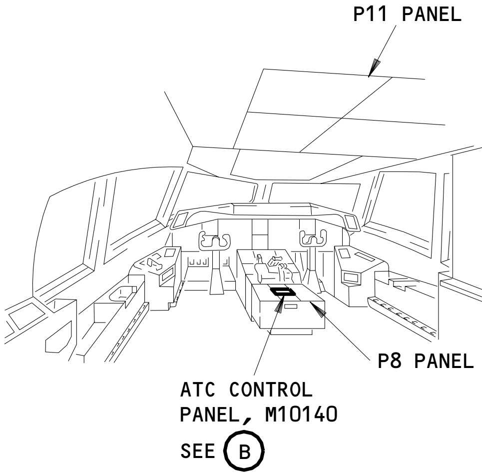
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - BOTTOM TCAS, M10821	1	1	BOTTOM OF FUSELAGE	34-45-02
ANTENNA - TOP TCAS, M10820	1	1	TOP OF FUSELAGE	34-45-02
CIRCUIT BREAKER -			FLIGHT COMPARTMENT, P11	
TCAS, C4443		1	11F3	*
COMPUTER - (FIM 31-41-00/101)				
EICAS LEFT, M10181				
EICAS RIGHT, M10182				
COMPUTER - (FIM 34-46-00/101)				
GROUND PROXIMITY, M147				
COMPUTER - TCAS, M10819	2	1	119BL, MAIN EQUIP CENTER, E2-1	34-45-01
INDICATOR - (FIM 34-22-00/101)				
LEFT ELECTRONIC HORIZONTAL SITUATION, N5				
RIGHT ELECTRONIC HORIZONTAL SITUATION, N45				
LEFT VERTICAL SPEED, N9				
RIGHT VERTICAL SPEED, N49				
INTERROGATOR - (FIM 34-55-00/101)				
LEFT DME, M123				
RIGHT DME, M124				
MODULE - (FIM 31-51-00/101)				
LEFT SIREN/OWL (AURAL WARNING), M999				
RIGHT SIREN/OWL (AURAL WARNING), M619				
MODULE - (FIM 32-30-00/101)				
LANDING GEAR LEVER, M937				
PANEL - ATC CONTROL, M10140	2	1	FLIGHT COMPARTMENT, P8	34-53-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K143				
RELAY - (FIM 31-01-37/101)				
SYS NO. 2 AIR/GND, K201				
SWITCH - (FIM 34-12-00/101)				
LEFT ADC, S482				
RIGHT ADC, S483				
SWITCH - (FIM 34-21-00/101)				
IRS SOURCE SELECT, S12				
TRANSPONDER - (FIM 34-53-00/101)				
LEFT ATC, M10141				
RIGHT ATC, M10142				

* SEE THE WDM EQUIPMENT LIST

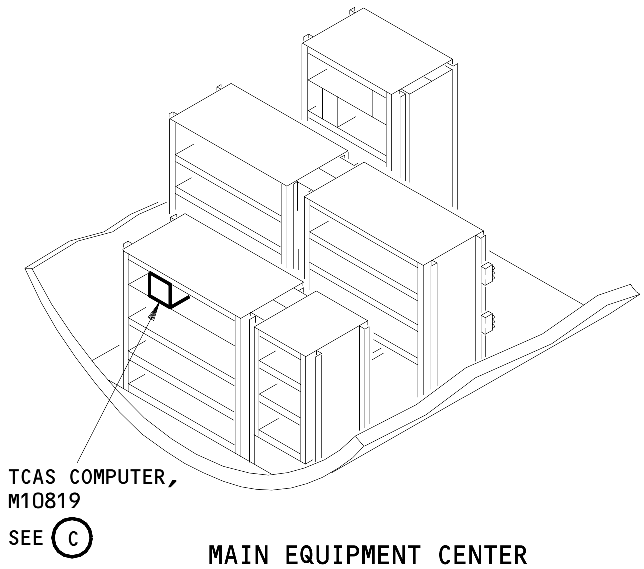
Traffic Alert and Collision Avoidance System (TCAS) - Component Index
Figure 101



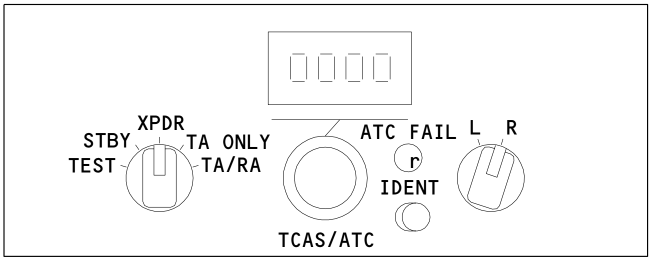
Traffic Alert and Collision Avoidance System (TCAS) - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT

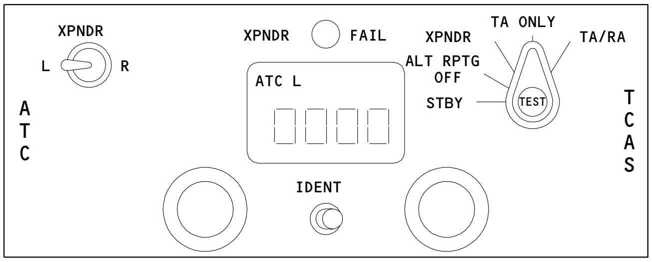


MAIN EQUIPMENT CENTER



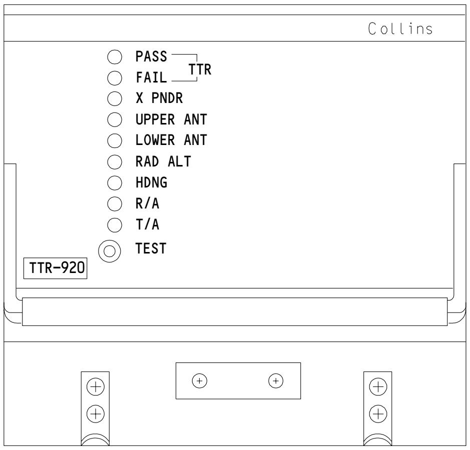
TCAS/ATC CONTROL PANEL, M10140

B 1



ATC CONTROL PANEL, M10140

B 2



TCAS COMPUTER, M10819

C

1 ILF 224,524

2 ILF 523

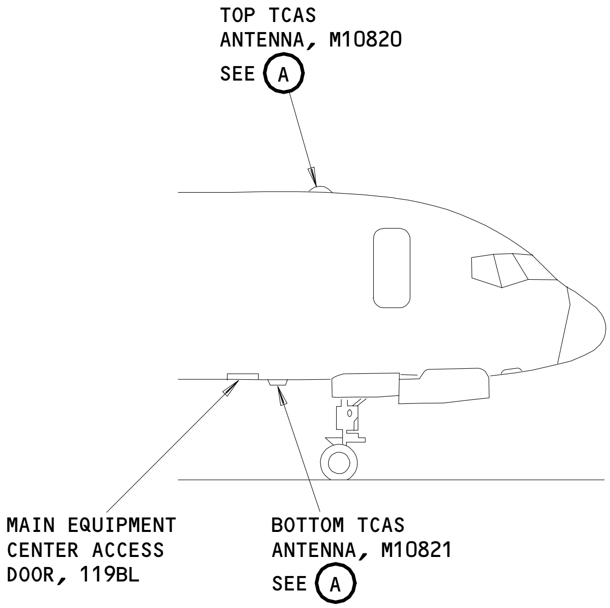
Traffic Alert and Collision Avoidance System (TCAS) - Component Location
Figure 102 (Sheet 2)

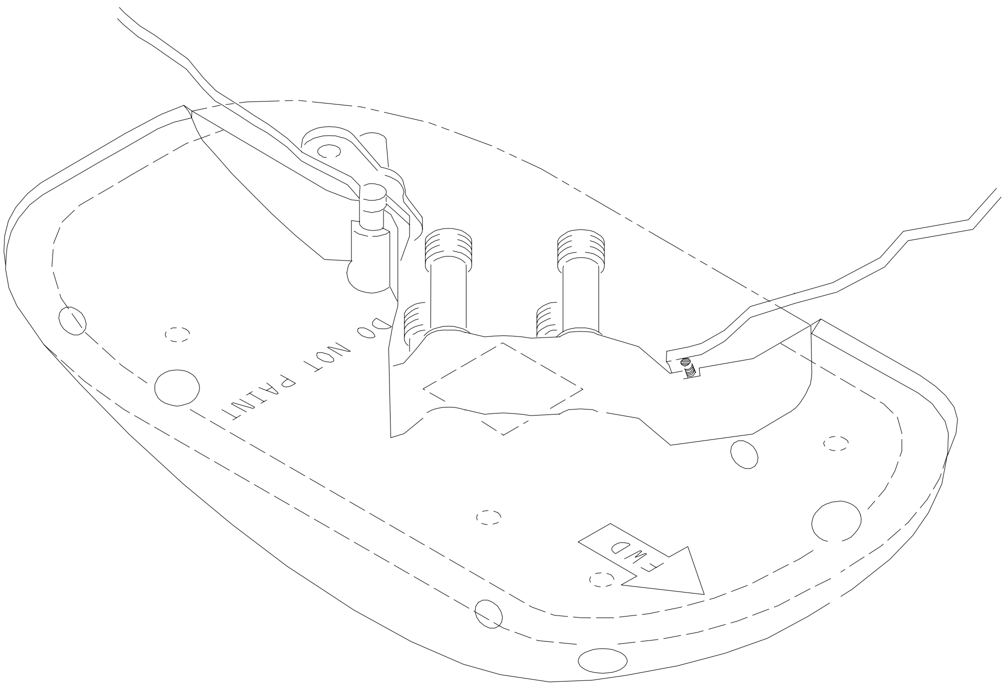
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - BOTTOM TCAS, M10821	1	1	BOTTOM OF FUSELAGE	34-45-02
ANTENNA - TOP TCAS, M10820	1	1	TOP OF FUSELAGE	34-45-02
CIRCUIT BREAKER -			FLIGHT COMPARTMENT, P11	
TCAS, C4443		1	11F3	*
COMPUTER - (FIM 31-41-00/101)				
EICAS LEFT, M10181				
EICAS RIGHT, M10182				
COMPUTER - (FIM 34-46-00/101)				
GROUND PROXIMITY, M147				
COMPUTER - TCAS, M10819	2	1	119BL, MAIN EQUIP CENTER, E2-1	34-45-01
INDICATOR - (FIM 34-22-00/101)				
LEFT ELECTRONIC HORIZONTAL SITUATION, N5				
LEFT VERTICAL SPEED, N9				
RIGHT ELECTRONIC HORIZONTAL SITUATION, N45				
RIGHT VERTICAL SPEED, N49				
INTERROGATOR - (FIM 34-55-00/101)				
LEFT DME, M123				
RIGHT DME, M124				
MODULE - (FIM 31-51-00/101)				
LEFT SIREN/OWL (AURAL WARNING), M999				
RIGHT SIREN/OWL (AURAL WARNING), M619				
MODULE - (FIM 32-30-00/101)				
LANDING GEAR LEVER, M937				
PANEL - ATC CONTROL, M10140	2	1	FLIGHT COMPARTMENT, P8	34-53-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K143				
RELAY - (FIM 31-01-37/101)				
SYS NO. 2 AIR/GND, K201				
SWITCH - (FIM 34-12-00/101)				
LEFT ADC, S482				
RIGHT ADC, S483				
SWITCH - (FIM 34-21-00/101)				
IRS SOURCE SELECT, S12				
TRANSPONDER - (FIM 34-53-00/101)				
LEFT ATC, M10141				
RIGHT ATC, M10142				

* SEE THE WDM EQUIPMENT LIST

Traffic Alert and Collision Avoidance System (TCAS) - Component Index
Figure 101

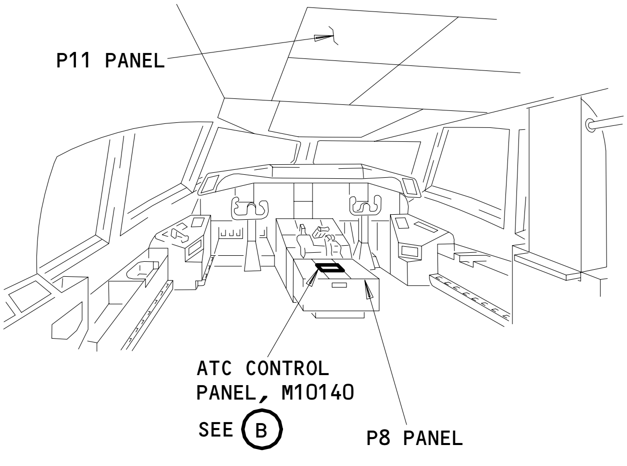




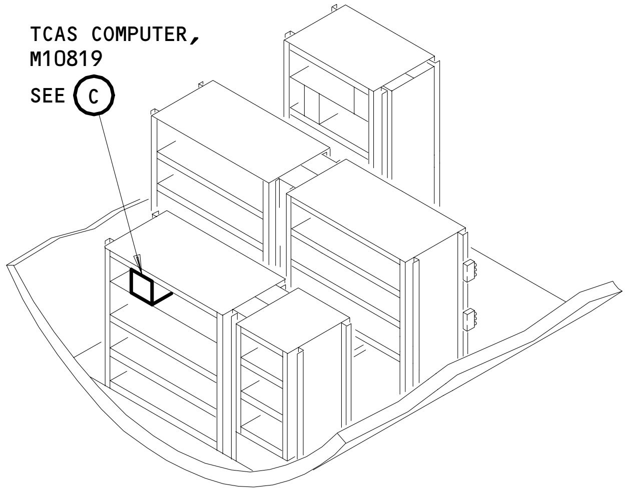
BOTTOM OR TOP TCAS ANTENNA, M10821 OR M10820

(A)

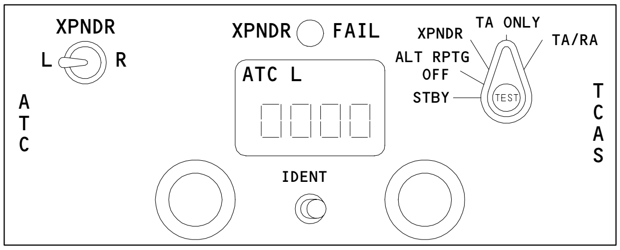
Traffic Alert and Collision Avoidance System (TCAS) - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT

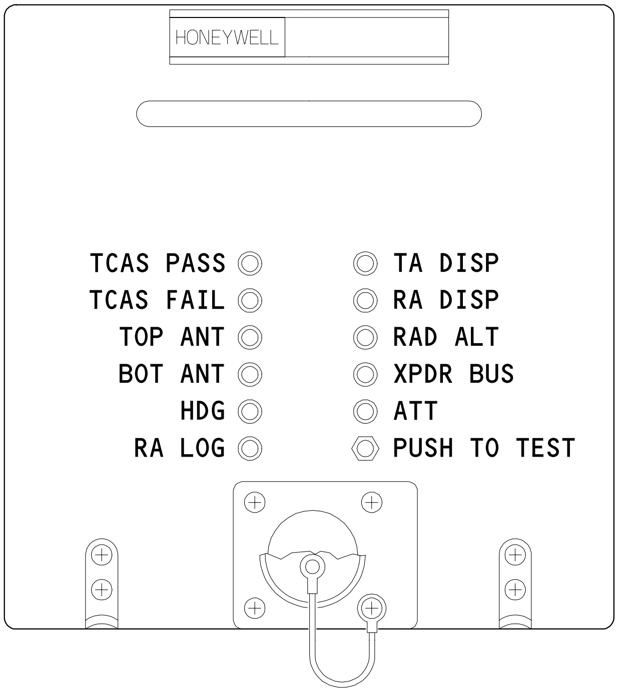


MAIN EQUIPMENT CENTER



TCAS/ATC CONTROL PANEL, M10140

B



TCAS COMPUTER, M10819

C

Traffic Alert and Collision Avoidance System (TCAS) - Component Location
Figure 102 (Sheet 2)

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) - ADJUSTMENT/TEST

1. General
   A. This procedure has two tasks. One is an operational test and the other is a system test. The operational test is a fast test of the TCAS system. The system test uses the operational test, then does a test of the system functions using additional test equipment.

TASK 34-45-00-715-158-001

2. Operational Test - TCAS
   A. General
      (1) This test is to make sure the TCAS is operating properly. It uses only the system's Built In Test Equipment (BITE) functions and special test or ground equipment is not necessary.
   B. References
      (1) 24-22-00/201, Electrical Power - control.
      (2) 31-41-00/501, Engine Indication Crew Alerting System (EICAS)
      (3) 32-09-02/201, Air/Ground Relays
      (4) 34-12-00/501, Air Data System (ADS)
      (5) 34-21-00/501, Inertial Reference System (IRS)
      (6) 34-22-00/501, Electronic Flight Instrument System (EFIS)
      (7) 34-33-00/501, Low Range Radio Altimeter (LRRA)
      (8) 34-46-00/501, Ground Proximity Warning System (GPWS)
      (9) 34-53-00/501, Air Traffic Control System (ATC)
   C. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   D. Prepare for the Operational Test

      S 865-001-001
      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-002-001
      (2) Make sure these systems are serviceable:
         (a) Air Data System (AMM 34-12-00/501)
         (b) Air Traffic Control System (AMM 34-53-00/501)
         (c) Electronic Flight Instrument System (AMM 34-22-00/501)
         (d) Engine Indication Crew Alerting System (AMM 31-41-00/501)
         (e) Ground Proximity Warning System (AMM 34-46-00/501)
         (f) Inertial Reference System (AMM 34-21-00/501)
         (g) Low Range Radio Altimeter (AMM 34-33-00/501)

S 865-004-001

(3) Turn the left, center, and right IRMP mode select switches to NAV to align all the IRUs (Ref 34-21-00/201).

<u>NOTE</u>: The IRUs change from ALIGN to NAV mode when the left, right, and center ALIGN lights on the IRMP go off.

S 865-005-001

(4) Set the EFIS mode switch on the EFIS control panel to the MAP position.

S 865-006-001

(5) Push the TFC switch on the EFIS control panel to see the TCAS indications on the EFIS displays.
  (a) Make sure the EHSI shows TFC on the display.

S 865-007-001

(6) Set the transponder select switch on the ATC control panel (referred to as the control unit for the rest of the section) to the L position.
  (a) Make sure the XPDR FAIL or XPNDR FAIL light on the control unit is off.

S 865-008-001

(7) Set the mode switch on the control unit to the STBY position.
  (a) Make sure the EHSI shows the TCAS OFF indication.
  (b) Make sure TA ONLY shows on the EHSI.

S 865-010-001

(8) Set the mode switch on the control unit to the RA/TA position.
  (a) Make sure the EHSI continues to show the TA ONLY indication.

E. Procedure

S 745-011-001

(1) Do the self test as follows:
  (a) Set and hold the mode switch on the control unit to the TEST position for one second.
  (b) Make sure these results occur:
    1) The control unit shows these indications:
      a) The IDENT CODE window shows PASS
    2) The EHSI shows the test pattern below (Fig. 501):
      a) TCAS TEST shows on the left side of the EHSI.
      b) TRAFFIC shows on the right side of the EHSI.
      c) An R/A (red square) at 3 o'clock, range of 2 miles, 200 feet above and flying level

d) A Traffic Advisory (yellow circle) at 9 o'clock, range of 2 miles, 200 feet below and climbing

e) Proximity Traffic (solid white diamond) at 1 o'clock, range 3.6 miles, 1000 feet below and descending

f) Non-Threat Traffic (open white diamond) at 11 o'clock, range of 3.6 miles, 1000 feet above and flying level.

(c) Make sure the EADI display shows the do not climb and do not descend resolution advisory.

1) A TCAS SYSTEM TEST OK synthesized voice announcement comes on at the end of the test if the test passes.

NOTE: The traffic display will show the name of the failed component and the TCAS SYSTEM TEST FAIL voice announcement comes on if a failure occurs during the self test.

S 745-012-001

(2) Do the self-test again with the transponder select switch in the R position on the control unit.

S 865-013-001

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-45-00-735-159-001

3. System Test - TCAS

A. General

(1) This test is a complete system test of the TCAS. The system test first runs the TCAS/ATC Operational Test, and then does a test of the TCAS using ground test equipment.

B. Equipment

(1) TCAS Ramp Test Set - IFR Model TCAS-201; Instruments and Flight Research, Inc, 10200 West York St, Wichita, KA 67215 or equivalent.

(2) Radio Altimeter test set

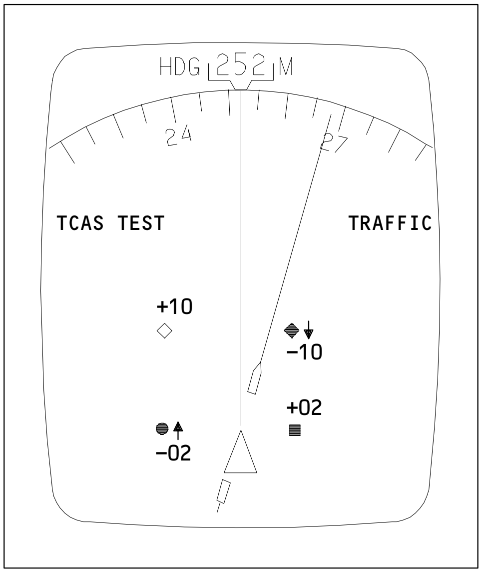
(3) Pitot/Static test set

C. References

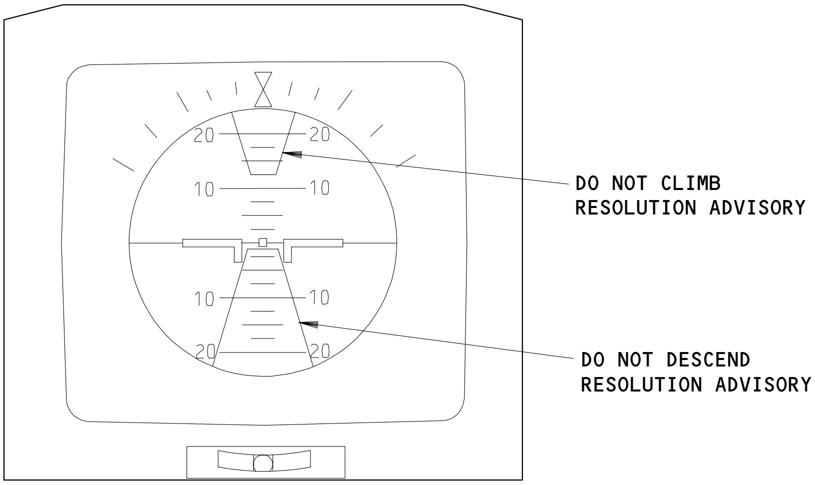
(1) AMM 24-22-00/201, Electrical Power - Control

(2) 32-09-02/201, Air/Ground Relays

D. Prepare for the System Test



EHSI
(EXAMPLE)



EADI
(EXAMPLE)

TCAS Test Pattern
Figure 501

S 865-156-001

CAUTION: DO NOT OPERATE THE TEST SET WHEN TEST SET ANTENNA IS WITHIN 15 INCHES OF AIRPLANE ANTENNA. DAMAGE TO THE TEST SET MAY OCCUR.

(1) Set up TCAS-201 tester antenna in an appropriate location (about 50 feet from the bottom TCAS antenna) forward of the airplane at 45 degrees off of the centerline to send signals to the TCAS directional antenna.

NOTE: Make sure there is no obstruction between the TCAS antenna and the test set antenna. Face the test set antenna in the direction so that the TCAS antenna under test receives the strongest signal. Use the antenna stand to prevent movements to the test set antenna which can cause TCAS to loose tracking. If ground equipment, walkways or other objects that could cause a signal obstruction or a multipath problem, choose a more suitable location for the test set and change the setup in the test set accordingly.

S 945-015-001

(2) Push the POWER switch to supply power to the TCAS-201 tester.

S 845-016-001

(3) Push the SET/CONT key on the TCAS-201 test set.

S 845-017-001

(4) Enter the distance, ± 5 feet, from the test set antenna and the bottom TCAS antenna in the HORIZ field.

S 845-018-001

(5) Enter the height difference, ± 3 feet, between the test set antenna and the bottom TCAS antenna in the VERT field.

S 845-019-001

(6) Enter the gain of the test set antenna in the GAIN field.

NOTE: The antenna gain should be listed on the test set antenna.

S 845-020-001
(7) Enter the loss of the cable in the LOSS field.

<u>NOTE</u>: The cable loss values should be listed on the cable.

E. Test the TCAS System

S 865-021-001
(1) Supply electrical power (AMM 24-22-00/201).

S 715-022-001
(2) Do the TCAS Operational Test.

S 735-023-001
(3) Do the TCAS Bearing Accuracy Test as follows:
  (a) Set the mode switch on the control unit to the TA or TA ONLY position.
  (b) Push the SCEN key on the TCAS test set to show the scenario menu.
  (c) Set up this scenario:
    1) INTRUDER TYPE: ATCRBS, ALT = OFF
    2) RANGE: 8.0 nm, RATE: 0 kt
  (d) Use the test set to interrogate the four quadrants of the TCAS antenna at bearings of 0, 90, 180, and 270 degrees.

<u>NOTE</u>: Shield the bottom TCAS antenna with an antenna shield. This is to test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

  (e) Push the RUN/STOP key to start the test.
    1) Make sure the EHSI shows the intruder's bearing ± 15 degrees.
  (f) Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna.

<u>NOTE</u>: This is to test the bottom TCAS antenna. If you moved the test set, you must change the test set setup accordingly.

  (g) Do the steps in the Bearing Accuracy Test again for the bottom antenna.

S 865-024-001

WARNING: YOU MUST CAREFULLY FOLLOW THE STEPS IN THE REFERENCED TASK TO PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE. FAILURE TO FOLLOW THE STEPS CORRECTLY CAN CAUSE THE AUTOMATIC OPERATION OF THE AIRPLANE SYSTEMS. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(4) Do the Prepare Safety-Sensitive Systems for Air Mode Simulation task (Ref 32-09-02/201).

S 865-025-001

(5) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11S15, LANDING GEAR AIR/GND SYS 1
    2) 11S19, LANDING GEAR AIR/GND SYS 2
    3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-026-001

(6) Push the TEST switch on the control unit.
  (a) Make sure a TCAS self-test does not occur.

S 865-027-001

(7) Connect the radio altimeter test set to the airplane.

S 865-028-001

(8) Set the radio altitude to 2400 feet.

NOTE: Increase the radio altitude by 600 feet per minute (fpm) or less. RAs are inhibited below 1100 feet during climb. So TA only will show below 1100 feet.

  (a) Make sure the EHSI does not show the TA ONLY indication when the radio altitude is greater than 1100 feet.

S 865-029-001

(9) Set the transponder select switch on the control unit to the L position.

S 865-030-001

(10) Set the mode switch on the control unit to the RA/TA position.

S 865-031-001

(11) Push the TFC switch on the EFIS control panel.
  (a) Make sure the EHSI shows the TFC indication.

S 865-032-001

(12) Connect a pitot/static test set to the airplane so that both air data computers can be pressurized (AMM 34-11-00/201).

S 865-033-001

(13) Use the pitot/static test set to apply an altitude of 40,000 feet.

<u>NOTE</u>: The 40,000 feet barometric altitude is chosen to minimize false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting of the ATC temporarily off or put the ATC system on standby during this procedure.

S 865-036-001

(14) Set the EFIS control unit to map mode and a range of 20 on the EHSI display.

S 865-037-001

(15) Push the SCEN key to display scenario menu.

S 865-038-001

(16) Set up this scenario:
  (a) INTRUDER TYPE: ATCRBS, ALT = ON
  (b) RANGE: 8.0 nm, RATE: +500 kt
  (c) ALTITUDE: 39,900 ft., RATE: 0 fpm

<u>NOTE</u>: Make sure the intruder's altitude is less than 100 feet below your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

S 865-039-001

(17) Push the RUN/STOP key to start the scenario.
  (a) Make sure this sequence shows on the EHSI display:
    1) The intruder moves down the 45-degree bearing mark to the airplane symbol
    2) The intruder has the correct relative altitude.

       NOTE: The relative altitude shown can be -00 or -01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.

    3) The intruder begins as Non-threat Traffic (open white diamond)
    4) The intruder changes to Proximate Traffic (solid white diamond)
    5) The intruder changes to a Traffic Advisory (solid yellow circle)
    6) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
    7) The intruder changes to a Resolution Advisory (solid red square)
    8) The TCAS gives a "climb, climb, climb" voice announcement on the flight compartment speaker.
    9) The EADI shows a vertical resolution to pull up.
    10) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "increase climb" voice announcement on the flight compartment speaker.
  (b) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker.

    NOTE: The "Clear of Conflict" announcement sometimes may not be given.

S 865-040-001

(18) Push the SCEN key to display scenario menu.

S 865-041-001

(19) Set up this scenario:
  (a) INTRUDER TYPE: Mode S
  (b) RANGE: 8.0 nm, RATE: +500 kt
  (c) ALTITUDE: 40,100 ft., RATE: 0 fpm

NOTE: Make sure the intruder's altitude is less than 100 feet above your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

S 865-042-001

(20) Push the RUN/STOP key to start the scenario.
  (a) Make sure this sequence shows on the EHSI display:
    1) The intruder moves down the 45 degree bearing mark to the airplane symbol
    2) The intruder has the correct relative altitude.

NOTE: The relative altitude shown can be +00 or +01 depending on your actual vertical separation. This is because TCAS can only display relative altitude by 100 foot increments.

    3) The intruder begins as Non-threat Traffic (open white diamond)
    4) The intruder changes to Proximate Traffic (solid white diamond)
    5) The intruder changes to a Traffic Advisory (solid yellow circle)
    6) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
    7) The intruder changes to a Resolution Advisory (solid red square) and gives a "descend, descend, descend" voice announcemewnt on the flight compartment speaker.
    8) The EADI shows a vertical resolution to push down.
    9) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "increase descent" voice announcement on the flight compartment speaker.
  (b) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker.

NOTE: The "Clear of Conflict" announcement sometimes may not be given.

S 865-043-001

(21) Set the transponder select switch on the control unit to the R position.

F. High Altitude Climb Inhibit Test

S 865-044-001

(1) Use the pitot/static test set to make a simulated altitude of 48,500 feet.

NOTE: Let the VSI return to zero after the simulated altitude is reached.

S 865-045-001

(2) Push the SCEN key on the TCAS-201 tester to show the sceneraio menu.

S 865-046-001

(3) Set up this scenerio:
   (a) RANGE 4.2 nm, RATE +500 knots
   (b) ALTITUDE 48,300 ft., RATE 0fpm

S 865-047-001

(4) Push the RUN/STOP key to start the scenario.
   (a) Make sure the relative altitude of the intruder is -02.

NOTE: If the relative altitude of the intruder is not -02, change the intruder setup altitude accordingly.

   (b) Make sure TCAS gives the "TRAFFIC, TRAFFIC" annunciation.
   (c) Make sure TCAS gives the "Monitor Vertical Speed" annunciation.

NOTE: A crossing descend resolution advisory may be given instead of the Monitor Vertical Speed resolution advisory. Decrease the intruder's altitude or increase the airplane's altitude appropriately to correct this.

S 865-048-001

(5) Return the airplane back to field level altitude.

S 865-049-001

(6) Set the radio altimeter to 0 feet.

NOTE: Decrease the radio altitude by 600 feet per minute (fpm) or less.

   (a) Make sure the EHSI shows the TA ONLY indication when the radio altitude is less than 900 feet.

G. Put the Airplane Back to Its Usual Condition

S 865-050-001

(1) Put the landing gear lever back to the down position.

S 865-051-001

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11S15, LANDING GEAR AIR/GND SYS 1
      2) 11S19, LANDING GEAR AIR/GND SYS 2
      3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
         11C19, LANDING GEAR POS SYS 2 ALTN

S 865-052-001

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-45-00-735-053-001

4. <u>System Test - TCAS</u> (with the TIC T-49 Test Set)

A. General
   (1) This test is a complete system test of the TCAS. The system test first runs the TCAS Operational Test, and then does a test of the TCAS using ground test equipment.

B. Equipment
   (1) TCAS/ATC ramp test set - TIC T-49; TEL - Instrument Electronics Corp, 728 Garden St, Carlstadt, N.J. 007072 or equivalent.
   (2) Pitot/Static test set
   (3) Radio Altimeter test set

C. Reference
   (1) AMM 24-22-00/201, Electrical Power - Control
   (2) AMM 32-09-02/201, Air/Ground Relays

D. Prepare for the System Test

S 865-054-001

(1) Put the T-49 directional antenna about 50 feet in front of the airplane on the center line.

<u>NOTE</u>: 50 feet separation between the TCAS antenna and the directional antenna is recommended. A separation between 10 to 100 feet will provide satisfactory results. Make sure there is a line of sight between the airplane's ATC, TCAS antennas and the test set directional, omnidirectional dipole antennas. Also, make sure the airplane under test is closer to the test set than other active transponders that are near.

The directional antenna will send signals to the TCAS antenna.

S 865-055-001

(2) Connect the cable of the directional antenna to the T-49 antenna connector.

S 865-056-001

(3) Supply electrical power (AMM 24-22-00/201).

S 715-057-001

(4) Do the TCAS Operational Test.

S 865-058-001

WARNING: YOU MUST CAREFULLY FOLLOW THE STEPS IN THE REFERENCED TASK TO PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE. FAILURE TO FOLLOW THE STEPS CORRECTLY CAN CAUSE THE AUTOMATIC OPERATION OF THE AIRPLANE SYSTEMS. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(5) Open these circuit breakers and attach DO-NOT-CLOSE tags:
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11S15, LANDING GEAR AIR/GND SYS 1
        2) 11S19, LANDING GEAR AIR/GND SYS 2
        3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-059-001

(6) Push the TEST switch on the control unit.
    (a) Make sure a TCAS self-test does not occur.

S 865-060-001

(7) Connect the radio altimeter test set to the airplane.

S 865-061-001

(8) Use the radio altimeter test set to make a radio altitude of 2400 feet.

NOTE: Increase the radio altitude by 600 feet per minute (fpm) or less. RAs are inhibited below 1100 feet during climb. So TA only will show below 1100 feet.

    (a) Make sure the TA ONLY indication clears from the EHSI when the radio altitude is greater than 1100 feet.

S 865-062-001

(9) Connect a pitot/static test set to the airplane so that you can pressurize the two air data computers (AMM 34-11-00/201).

S 865-063-001

(10) Use the pitot/static test to make a barometric altitude of 40,000 feet.

NOTE: The 40,000 feet barometric altitude is chosen to minimize false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting function of the ATC off or put the ATC system on standby during this procedure.

S 865-064-001

(11) Set the EFIS control unit to map mode and a range of 20 on the EHSI display.

S 865-065-001

(12) Set the mode switch on the control unit to the RA/TA position.

S 865-066-001

(13) Supply power to the TIC T-49 test set.
   (a) Make a note of the software Rev X.X of the test set.

E. TCAS Bearing Accuracy Test

S 865-067-001

(1) Set the intruder type switch on the T-49 to the ATCRBS position.

S 865-068-001

(2) Set the scenario switch on the T-49 to the fixed intruder scenario position (+1000).

NOTE: Shield the bottom TCAS antenna with an antenna shield. This is to test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

S 865-069-001

(3) Push the interrogate switch on the T-49.
   (a) Make sure the T-49 display shows the type of intruder selected.

S 865-070-001

(4) Use the test set to interrogate the four quadrants of the TCAS antenna at bearings of 0, 90, 180, and 270 degrees.
   (a) Make sure the EHSI shows the intruder's bearing 0 ±15 degrees.

S 865-071-001

(5) Set the scenario switch on the T-49 to the fixed intruder scenario position (-1000).

NOTE: Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna. This is to test the bottom TCAS antenna.

S 865-155-001

(6) Set the power setting to low (LO) on T-49 with (HI/LO) power setting switch.

NOTE: A HI power setting can increase the likelihood of multipath problem.

S 865-072-001

(7) Do the steps in the bearing accuracy test again for the bottom antenna.

F. TCAS Intruder Test

S 865-073-001

(1) Put the T-49 directional antenna 45 degrees to the right of the center line of the airplane with a 50 feet separation from the airplane.

NOTE: The directional antenna will send signals to the TCAS antenna.

S 865-074-001

(2) Set the scenario switch on the T-49 to the straight approach 14nMi position.

S 215-075-001

(3) Set the intruder type switch to the MODE S position.

S 865-076-001

(4) Push the interrogate switch.
   (a) Make sure the T-49 display shows the correct intruder type.

S 865-077-001

(5) Push the interrogate switch to start the scenario.
   (a) Make sure the T-49 display shows the airplane's altitude ±100 feet and the correct scenario (Range 14nMi, Co-Altitude, Closure rate 720 kts).

S 865-078-001

(6) Increase the airplane's altitude by 200 feet.
  (a) Make sure this sequence shows on the EHSI display.
    1) The intruder ascends to the airplane symbol from the 45 degree bearing mark.
    2) The intruder begins as Non-threat Traffic (open white diamond).
    3) The intruder changes to Proximate Traffic (solid white diamond).
    4) The intruder changes to a Traffic Advisory (solid yellow circle).
    5) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
    6) The intruder changes to a Resolution Advisory (solid red square), and gives a "climb, climb, climb" voice announcement on the flight compartment speaker.
    7) The EADI shows a vertical resolution to pull up.
    8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "increase climb" voice announcement on the flight compartment speaker.
    9) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker for T-49 with Rev 3.2 software.

S 215-079-001

(7) Set the intruder type switch on the T-49 to the TCAS position.

S 865-080-001

(8) Push the interrogate switch.
  (a) Make sure the T-49 display shows the correct intruder type.

S 865-081-001

(9) Push the interrogate switch to start the scenario.
  (a) Make sure the T-49 display shows the airplane's altitude ±100 feet and the correct scenario (Range 14nMi, Co-Altitude, Closure rate 720 kts).

S 865-082-001

(10) Decrease the airplane's altitude by 200 feet.
  (a) Make sure the T-49 display shows the correct scenario.
  (b) Make sure this sequence shows on the EHSI display.
    1) The intruder descends to the airplane symbol from the 45 degree bearing mark.

2) The intruder begins as Non-threat Traffic (open white diamond).
3) The intruder changes to Proximate Traffic (solid white diamond).
4) The intruder changes to a Traffic Advisory (solid yellow circle).
5) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
6) The intruder changes to a Resolution Advisory (solid red square), and gives a "descend, descend, descend" voice announcement on the flight compartment speaker.
7) The EADI shows a vertical resolution to push down.
8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "increase descent" voice announcement on the flight compartment speaker.
9) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker for T-49 with Rev 3.2 software.

S 865-083-001

(11) Set the transponder select switch on the control unit to the R position.

G. High Altitude Climb Inhibit Test

S 865-084-001

(1) Use the pitot/static test set to make a simulated altitude of 49,000 feet.

S 725-085-001

(2) Do the previous TCAS intruder scenario test again.
   (a) Make sure TCAS does not give a CLIMB corrective action.

S 865-086-001

(3) Return the airplane back to field level altitude.

S 865-087-001

(4) Set the radio altimeter to 0 feet.

<u>NOTE</u>: Decrease the radio altitude by 600 feet per minute (fpm) or less.

(a) Make sure the EHSI shows the TA ONLY indication when the radio altitude is less than 900 feet.

H. Put the Airplane Back to Its Usual Condition

S 865-088-001

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11S15, LANDING GEAR AIR/GND SYS 1
    2) 11S19, LANDING GEAR AIR/GND SYS 2
    3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-089-001

(2) Put the landing gear lever back to the down position.

S 865-090-001

(3) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

TASK 34-45-00-735-091-001

5. TCAS Interface Test

A. General
  (1) This Interface test is a check of the interface between TCAS and other systems that interface with TCAS. The interface check on the ATC is done in the TCAS system test.

B. References
  (1) AMM 31-41-00/501, Engine Indication Crew Altering System
  (2) AMM 34-12-00/501, Air Data System
  (3) AMM 34-21-00/501, Inertial Reference System
  (4) AMM 34-22-00/501, Electronic Flight Instrument System
  (5) AMM 34-33-00/501, Low Range Radio Altimeter
  (6) AMM 34-46-00/501, Ground Proximity Warning System
  (7) AMM 34-53-00/501, Air Traffic Control

C. Access
  (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

D. Prepare for the Test

S 715-157-001

(1) Make sure these systems are operational:
  (a) Air Data System (AMM 34-12-00/501)
  (b) Air Traffic Control System (AMM 34-53-00/501)
  (c) Electronic Flight Instrument System (AMM 34-22-00/501)
  (d) Inertial Reference System (AMM 34-21-00/501)
  (e) Low Range Radio Altimeter (AMM 34-33-00/501)
  (f) Ground Proximity Warning System (AMM 34-46-00/501)

S 215-092-001

(2) Make sure these circuit breakers are closed:
  - (a) P11 Overhead Circuit Breaker Panel:
    - 1) 11F3 or 11G2, TCAS
    - 2) 11S15, LANDING GEAR AIR/GND SYS 1
    - 3) 11S19, LANDING GEAR AIR/GND SYS 2
    - 4) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

E. GPWS Interface Test

S 865-093-001

(1) Do the GPWS self-test from the P61 miscellaneous test panel (Ref 34-46-00/501).

NOTE: The Ground Prox Test will cycle through the three aural warnings "GLIDESLOPE", "WHOOP-WHOOP PULL-UP", and "WINDSHEAR, WINDSHEAR" with a slight dleay between each warning. This is to make sure TCAS aurals are inhibited whenever these Ground Prox warnings are annunciated.

S 865-094-001

(2) During the "GLIDESLOPE" aural, set the mode switch on the control unit to the TEST position.
  - (a) Make sure the "TCAS TEST ----" aural is inhibited when the "GLIDESLOPE" aural message occurs.

S 865-095-001

(3) Do the GPWS self-test from the P61 miscellaneous test panel (AMM 34-46-00/501).

S 865-096-001

(4) During the "WHOOP-WHOOP PULL-UP" aural, set the mode switch on the control unit to the TEST position.
  - (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WHOOP-WHOOP PULL-UP" aural message occurs.

S 865-097-001

(5) Do the GPWS self-test from the P61 miscellaneous test panel (AMM 34-46-00/501).

S 865-098-001

(6) During the "WINDSHEAR, WINDSHEAR" aural, set the mode switch on the control unit to the TEST position.
  - (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WINDSHEAR, WINDSHEAR" aural message occurs.

F. AIRPLANES WITH EICAS SUPLEMENTARY PROGRAM PIN #6 SELECTED; EICAS Interface Test

S 215-101-001

(1) Make sure the upper EICAS display does not show TCAS FAIL.

S 865-102-001

(2) Open this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F3 or 11G2, TCAS

S 215-103-001

(3) Make sure the upper EICAS display shows TCAS FAIL.

<u>NOTE</u>: You possibly will have to page through messages on the upper EICAS display.

S 865-104-001

(4) Set the other EICAS computer on the EICAS display select panel.

S 865-105-001

(5) Make sure the upper EICAS display shows TCAS FAIL.

<u>NOTE</u>: You possibly will have to page through messages on the upper EICAS display.

S 865-106-001

(6) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F3 or 11G2, TCAS

S 215-107-001

(7) Make sure the upper EICAS display does not show TCAS FAIL.

G. IRS Interface Test

S 215-108-001

(1) Make sure the captain's IRS instrument source select switch is set to normal.

S 745-109-001

(2) Push the TEST switch on the front panel of the TCAS computer.
  (a) Make sure the HDNG fail light on the TCAS computer is not on.

S 865-110-001

(3) Set the left IRMP mode switch to ALIGN.

S 745-111-001

(4) Push the TEST switch on the front panel of the TCAS computer.
  (a) Make sure the HDNG fail light on the TCAS computer is on.

S 865-112-001

(5) Set the captain's IRS instruments source select switch to alternate.

S 745-113-001

(6) Push the TEST switch on the front panel of the TCAS computer.
  (a) Make sure the HDNG fail light on the TCAS computer is not on.

S 865-114-001

(7) Set the center IRMP mode switch to ALIGN.

S 745-115-001

(8) Push the TEST switch on the front panel of the TCAS computer.
  (a) Make sure the HDNG fail light on the TCAS computer is on.

S 865-116-001

(9) Set the captain's IRS instruments source select switch to normal.

S 865-117-001

(10) Set the IRMP mode switches to NAV.

H. Low Range Radio Altimeter Interface Test

S 215-118-001

(1) Make sure the two EADI's show a radio altitude between 0 and -10 feet.

S 745-119-001

(2) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" announciation.

S 865-120-001

(3) Open this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F5, LEFT RAD ALTM

S 745-121-001

(4) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

S 865-122-001

(5) Open this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F26, RIGHT RAD ALTM

S 745-123-001

(6) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure you hear the "TCAS SYSTEM TEST FAIL" annunciation.

S 865-124-001

(7) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F5, LEFT RAD ALTM

S 865-125-001

(8) Open and then close the TCAS circuit breaker to clear the latched fail state of the TCAS computer, if necessary.

S 745-126-001

(9) Push the TEST switch on the front panel of the TCAS computer.
   (a) Make sure you hear the "TCAS SYSTEM TEST OKAY" annunciation.

S 865-127-001

(10) Close this circuit breaker.
   - (a) P11 Overhead Circuit Breaker Panel:
      - 1) 11F26, RIGHT RAD ALTM

S 865-128-001

(11) Open these circuit breakers and attach DO-NOT-CLOSE tags:
   - (a) P11 Overhead Circuit Breaker Panel:
      - 1) 11S15, LANDING GEAR AIR/GND SYS 1
      - 2) 11S19, LANDING GEAR AIR/GND SYS 2
      - 3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-161-001

(12) Use the radio altimeter test set to simulate a radio altitude of 450 feet.

S 865-162-001

(13) Make sure the EADI shows the simulated radio altitude.

S 865-163-001

(14) Make sure the EHSI shows the TA ONLY indication.

S 865-164-001

(15) Use the radio altimeter test set to make a radio altitude of 1200 feet.
   - (a) Make sure the EADI shows the simulated radio altitude.
   - (b) Make sure the EHSI does not show a TA ONLY, TCAS FAIL, or TCAS OFF message.

S 865-131-001

(16) Close these circuit breakers.
   - (a) P11 Overhead Circuit Breaker Panel:
      - 1) 11S15, LANDING GEAR AIR/GND SYS 1
      - 2) 11S19, LANDING GEAR AIR/GND SYS 2

3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
11C19, LANDING GEAR POS SYS 2 ALTN

I. TCAS System EFIS Interface Test

S 865-132-001

(1) Set the radio altitude to less than 50 feet.

S 865-133-001

(2) Set the EFI switch on the left and right instrument source select panel to the NORMAL position.

S 865-134-001

(3) Push the TFC switch on the left and the right EFIS control panel.
  (a) Make sure the left and right EHSI displays show the TFC and TA ONLY indications.

S 865-135-001

(4) Open this circuit breaker:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F29 EFIS SYM GEN RIGHT

S 215-136-001

(5) Make sure only the left EHSI shows the TA ONLY and TFC indications.

S 865-137-001

(6) Close this circuit breaker:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F29 EFIS SYM GEN RIGHT

S 865-138-001

(7) Open this circuit breaker:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F8 EFIS SYM GEN LEFT

S 865-139-001

(8) Push the TFC switch on the right EFIS control panel.
  (a) Make sure the right EHSI shows the TFC indication.
  (b) Make sure only the right EHSI shows the TA ONLY indication.

S 865-140-001

(9) Set the EFI switch on the right instrument source select panel to the ALTN position.

S 865-141-001

(10) Push the TFC switch on the right EFIS control panel.
  (a) Make sure the right EHSI show the TFC and TA ONLY indications.

S 865-142-001

(11) Set the EFI switch on the right instrument source select panel to the NORMAL position.

S 865-143-001

(12) Set the EFI switch on the left instrument source select panel to the ALTN position.

S 865-144-001

(13) Push the TFC switch on the left and the right EFIS control panel.
    (a) Make sure the left and right EHSI displays show the TFC and TA ONLY indications.

S 865-145-001

(14) Open this circuit breaker:
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F29 EFIS SYM GEN RIGHT

S 215-146-001

(15) Make sure only the left EHSI shows the TA ONLY and TFC indications.

S 865-147-001

(16) Open this circuit breaker:
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F9 EFIS SYM GEN CENTER

S 865-148-001

(17) Push and release the TEST switch on the front of the TCAS computer.
    (a) Make sure the red R/A fail light comes on.

S 865-149-001

(18) Close these circuit breakers:
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11F8 EFIS SYM GEN LEFT
        2) 11F9 EFIS SYM GEN CENTER
        3) 11F29 EFIS SYM GEN RIGHT

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) - ADJUSTMENT TEST

1. General
   A. This procedure has these tasks:
      (1) An Operational Test of TCAS
         (a) The Operational Test is a fast test of TCAS.
      (2) A System Test of TCAS
         (a) The System Test uses the Operational Test then does a check of the system functions using additional test equipment.
      (3) An Interface Test of TCAS.
         (a) The Interface Test is a check of the interface between TCAS and other systems that interface with TCAS.

TASK 34-45-00-715-001-002

2. Operational Test - TCAS
   A. General
      (1) This test is to make sure the TCAS is operating correctly. It uses only the system's Built In Test Equipment (BITE) functions and special test or ground equipment is not necessary.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 31-41-00/501, Engine Indication Crew Alerting System (EICAS)

      (3) AMM 34-12-00/501, Air Data System (ADS)
      (4) AMM 34-21-00/501, Inertial Reference System (IRS)
      (5) AMM 34-22-00/501, Electronic Flight Instrument System (EFIS)
      (6) AMM 34-33-00/501, Low Range Radio Altimeter (LRRA)
      (7) AMM 34-46-00/501, Ground Proximity Warning System (GPWC)
      (8) AMM 34-53-00/501, Air Traffic Control System (ATC)
   C. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   D. Prepare for the Operational Test

      S 865-002-002
      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-003-002
      (2) Make sure these systems are serviceable:
         (a) Air Data System (AMM 34-12-00/501)
         (b) Air Traffic Control System (AMM 34-53-00/501)
         (c) Electronic Flight Instrument System (AMM 34-22-00/501)
         (d) Engine Indication Crew Alerting System (AMM 31-41-00/501)
         (e) Ground Proximity Warning System (AMM 34-46-00/501)
         (f) Inertial Reference System (AMM 34-21-00/501)
         (g) Low Range Radio Altimeter (AMM 34-33-00/501)

(h) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
11C19, LANDING GEAR POS SYS 2 ALTN

S 865-253-002

(3) Turn the left, center, and right IRMP mode select switches to NAV to align all the IRUs.

NOTE: The IRUs change from ALIGN to NAV mode when the left, right, and center ALIGN lights on the IRMP go off.

S 865-006-002

(4) Set the EFIS mode switch on the EFIS control panel to MAP.

S 865-233-002

(5) Set the range switch on the EFIS control panel to 10 miles.

S 865-235-002

(6) Set the mode switch on the control unit to the STBY position.
  (a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
      Make sure the EHSI shows TCAS OFF indication.
  (b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
      Make sure TA/RA VSI shows TCAS OFF indication.

S 865-008-002

(7) Set the transponder select switch on the ATC control panel (referred to as the control unit for the rest of this section) to the L position.
  (a) Make sure the FAIL light on the control unit is off.

S 865-009-002

(8) Set the mode switch on the control unit to the TA ONLY position.
  (a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
      Make sure the EHSI shows the TA ONLY indication.
  (b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
      Make sure the TA/RA VSI shows the TA ONLY indication.

S 865-239-002

(9) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
Push the TFC switch on the EFIS control panel.
  (a) Make sure the EHSI shows TFC on the displays.

S 865-011-002

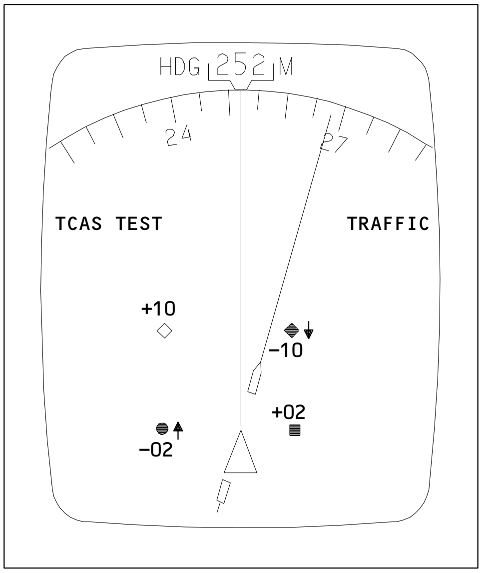
(10) Set the mode switch on the control unit to the TA/RA position.
  (a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
      Make sure the EHSI continues to show the TA ONLY indication.

(b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
Make sure the TA/RA VSI continues to show the TA ONLY indication.

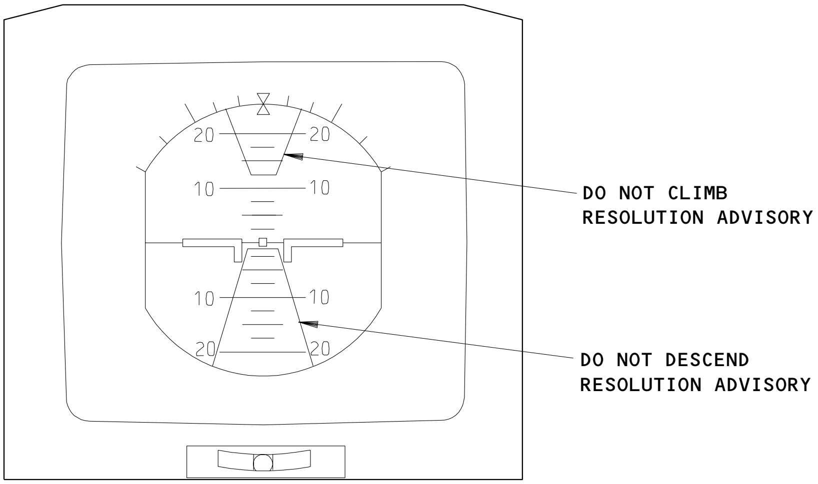
E. Procedure

S 745-012-002

(1) Do the self test as follows:
  - (a) Push the test switch on the control unit.
  - (b) Make sure these results occur:
    - 1) The control unit shows these indications:
      - a) The IDENT CODE window shows PASS
    - 2) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
      The TCAS display shows the test pattern below (Fig. 501):
      - a) TCAS TEST shows on the left side of the EHSI.
      - b) TRAFFIC (red) shows on the right side of the EHSI.
      - c) An R/A (red square) at 3 o'clock, range of 2 miles, 200 feet above and flying level.
      - d) A Traffic Advisory (yellow circle) at 9 o'clock, range of 2 miles, 200 feet below and climbing
      - e) Proximity Traffic (solid white diamond) at 1 o'clock, range 3.6 miles, 1000 feet below and descending.
      - f) Non-Threat Traffic (open white diamond) at 11 o'clock, range of 3.625 miles, 1000 feet above and flying level.
    - 3) Make sure the EADI display shows the DO NOT CLIMB and DO NOT DESCEND resolution advisory.
    - 4) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
      The TA/RA VSI shows the test pattern below (Fig. 501):
      - a) TCAS TEST shows on the left side of the TA/RA VSI.
      - b) An RA (red square) at 3 o'clock, range of 2 miles, 200 feet above and flying level
      - c) A Traffic Advisory (yellow circle) at 9 o'clock, range of 2 miles, 200 feet below and climbing
      - d) Proximity Traffic (solid white diamond) at 1 o'clock, range 3.6 miles, 1000 feet below and descending
      - e) Non-Threat Traffic (open white diamond) at 11 o'clock, range of 3.625 miles, 1000 feet above and flying level
      - f) Make sure the TA/RA VSI display shows a red band, flyout vertical scale, of 0 to 300 feet per minute and a green band fly to vertical scale, of 0 to -6000 feet per minute and 2000 to 6000 feet per minute.

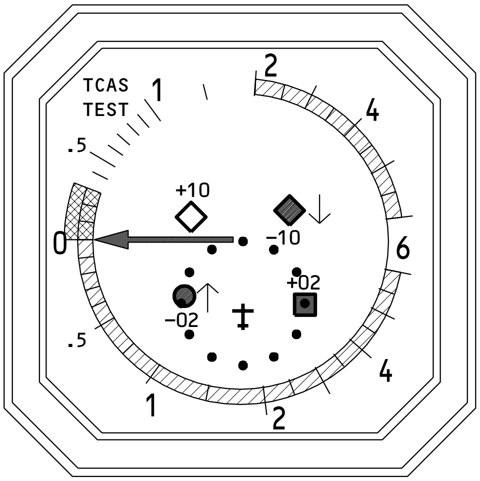


EHSI
(EXAMPLE)



EADI
(EXAMPLE)

TCAS Test Pattern
Figure 501 (Sheet 1)



TCAS - Test Pattern
Figure 501 (Sheet 2)

5) A "TCAS TEST PASS" synthesized voice announcement comes on at the end of the test if the test passes.

S 745-013-002

(2) Do the self test again with the transponder select switch in the R position on the control unit.

S 865-014-002

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-45-00-735-015-002

3. System Test - TCAS (With the IFR TCAS-201 Test Set)

A. General

(1) This test is a complete system test of the TCAS. The system test first runs the TCAS/ATC Operational Test, and then does a test of the TCAS with ground test equipment.

B. Equipment

(1) TCAS Ramp Test Set - IFR Model TCAS-201; Instruments and Flight Research, Inc, 10200 West York St, Wichita, KA 67215 or equivalent.
(2) Radio Altimeter Test Set
(3) Pitot/Static test set

C. References

(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 29-11-00/201, Main Hydraulic System
(3) AMM 32-00-20/201, Landing Gear Downlocks
(4) AMM 32-09-02/201, Air/Ground Relays
(5) AMM 34-11-00/201, Pitot-Static System (Pressurization)

D. Prepare for the System Test

S 865-016-002

CAUTION: DO NOT OPERATE THE TEST SET WHEN TEST SET ANTENNA IS WITHIN 15 INCHES OF AIRPLANE ANTENNA. DAMAGE TO THE TEST SET MAY OCCUR.

(1) Put the TCAS-201 test set antenna about 50 feet in front of the airplane at 45 degrees off the center line. The tester will send signals to the TCAS directional antenna.

NOTE: Use the manufacturers instructions to set up the TCAS-201 tester antenna. Make sure there is no obstruction between the TCAS antenna and the test set antenna. Face the test set antenna in the direction so that the TCAS antenna under test receives the strongest signal. Use the antenna stand to prevent movements to the test set antenna which can cause TCAS to loose tracking. If ground equipment, walkways or other objects that could cause a signal obstruction or a multipath problem, choose a more suitable location for the test set and change the setup in the test set accordingly.

S 945-017-002

(2) Push the POWER switch to supply power to the TCAS-201 tester.

S 845-018-002

(3) Push the SET/CONT key on the TCAS -201 test set.

S 845-019-002

(4) Enter the distance, ±5 feet, from the test set antenna and the bottom TCAS antenna in the HORIZ field.

S 845-020-002

(5) Enter the height difference, ±3 feet, between the test set antenna and the bottom TCAS antenna in the VERT field.

S 845-021-002

(6) Enter the gain of the test set antenna in the GAIN field.

NOTE: The antenna gain should be listed on the test set antenna.

S 845-022-002

(7) Enter the loss of the cable in the LOSS field.

NOTE: The cable loss values should be listed on the cable.

E. TCAS system test

S 865-023-002

(1) Supply electrical power (AMM 24-22-00/201).

S 715-024-002

(2) Do the TCAS Operational Test.

S 735-025-002

(3) Do the TCAS Bearing Accuracy Test as follows:
   (a) Set the mode switch on the control unit to the TA ONLY position.

(b) Push the SCEN key on the TCAS test set to show the scenario menu.

(c) Set up this scenario
  1) INTRUDER TYPE: ATCRBS, ALT = OFF
  2) RANGE: 8.0 nm, RATE: 0 kt

(d) Use the test set to interrogate the four quadrants of the TCAS antenna at bearing of 0, 90, 180, and 270 degrees.

NOTE: Shield the bottom TCAS antenna with an antenna shield. This is to test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

(e) Push the RUN/STOP key to start the test.
  1) Make sure the TCAS display shows the intruder's bearing ±15 degrees.

(f) Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna.

NOTE: This is to test the bottom TCAS antenna.

S 865-026-002

(4) Make sure the pressure is removed from the left hydraulic system (AMM 29-11-00/201).

S 865-027-002

WARNING: MAKE SURE THE DOWNLOCKS ARE INSTALLED ON ALL THE LANDING GEAR (BEFORE YOU MOVE THE CONTROL LEVER). WITHOUT THE DOWNLOCKS, THE LANDING GEAR COULD RETRACT AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(5) Make sure the downlocks are installed on the nose and main landing gear (AMM 32-00-20/201).

S 865-028-002

(6) Put the landing gear lever to the OFF position.
  (a) Do the steps in the Bearing Accuracy Test again for the bottom antenna.

S 865-029-002

<u>WARNING</u>: YOU MUST CAREFULLY FOLLOW THE STEPS IN THE REFERENCED TASK TO PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE. FAILURE TO FOLLOW THE STEPS CORRECTLY CAN CAUSE THE AUTOMATIC OPERATION OF THE AIRPLANE SYSTEMS. THIS CAN CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(7) Do the Prepare Safety-Sensitive System for Air Mode Simulation task (AMM 32-09-02/201).

S 865-030-002

(8) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11S15, AIR/GND SYS 1
    2) 11S19, LDG GR POS AIR/GND SYS 2
    3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
       11C19, LANDING GEAR POS SYS 2 ALTN

S 865-031-002

(9) Push the TEST switch on the control unit.
  (a) Make sure a TCAS self-test does not occur.

S 865-032-002

(10) Set the transponder select switch on the control unit to the L position.

S 865-033-002

(11) Set the mode switch on the control unit to the TA/RA position.

S 865-034-002

(12) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
     Push the TFC switch on the EFIS control panel.
  (a) Make sure the EHSI shows the TFC indication.

S 865-035-002

(13) Connect a pitot/static test set to the airplane so that both air data computers can be pressurized (AMM 34-11-00/201).

S 865-036-002

(14) Use the pitot/static test set to make an altitude of 40,000 feet.

NOTE: The 40,000 feet barometric altitude is chosen to minimize false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting of the ATC temporarily off or put the ATC system on standby during this procedure.

S 865-037-002

(15) Connect the radio altimeter test set to the airplane.

S 865-038-002

(16) Set the radio altitude to 2400 feet.

NOTE: Increase the radio altitude by 600 feet per minute (fpm) or less. RAs are inhibited below 1100 feet during climb. So TA only will show below 1100 feet.

S 865-210-002

(17) Make sure the TCAS display does not show the TA ONLY indication when the radio altitude is greater than 1100 feet.

S 865-039-002

(18) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
Set the EFIS control unit to map mode and a range of 20 on the EHSI display

S 865-040-002

(19) Push the SCEN key to display scenario menu.

S 865-041-002

(20) Set up this scenario:
(a) INTRUDER TYPE: ATCRBS, ALT = ON
(b) RANGE: 8.0 nm, RATE: +500 kt

(c) ALTITUDE: 39,900 ft., RATE: 0 fpm

NOTE: Make sure the intruder's altitude is less than 100 feet below your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

S 865-042-002

(21) Push the RUN/STOP key to start the scenario, and look for this sequence on the TCAS displays:
  - (a) The intruder moves down the 45 degree bearing mark to the airplane symbol.
  - (b) The intruder has the correct relative altitude.
  - (c) The intruder begins as Non-threat Traffic (open white diamond)
  - (d) The intruder changes to Proximate Traffic (solid white diamond)
  - (e) The intruder changes to a Traffic Advisory (solid yellow circle)
  - (f) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
  - (g) The intruder changes to a Resolution Advisory (solid red square), and gives a "climb, climb, climb" voice announcement on the flight compartment speaker.
  - (h) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
    The EADI shows a vertical resolution to pull up.
  - (i) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI DISPLAY;
    The TA/RA VSI must show a RA resolution to pull up.
  - (j) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "increase climb" voice announcement on the flight compartment speaker.
  - (k) Shortly after the intruder reaches the airplane symbol, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker.

NOTE: The "Clear of Conflict" announcement sometimes may not be given.

S 865-043-002

(22) Push the SCEN key to display scenario menu.

S 865-044-002

(23) Set up this scenario:
  (a) INTRUDER TYPE: Mode S
  (b) RANGE: 8.0 nm, RATE: +500 kt
  (c) ALTITUDE: 40,100 ft., RATE: 0 fpm

NOTE: Make sure the intruder's altitude is less than 100 feet above your airplane's barometric altitude. You can change the airplane's altitude or intruder setup on the test set to achieve this.

S 865-045-002

(24) Push the RUN/STOP key to start the scenario.
  (a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
  Make sure this sequence shows on the EHSI display:
    1) The intruder moves down the 45 degree bearing mark to the airplane symbol
    2) The intruder has the correct relative altitude.
    3) The intruder begins as Non-threat Traffic (open white diamond)
    4) The intruder changes to Proximate Traffic (solid white diamond)
    5) The intruder changes to a Traffic Advisory (solid yellow circle)
    6) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
    7) The intruder changes to a Resolution Advisory (solid red square), and gives a "descend, descend, descend" voice announcement on the flight compartment speaker and headset
    8) The EADI shows a vertical resolution to push down.
    9) Shortly before the intruder reaches the closest point of approach, the TCAS gives an "increase descent" voice announcement on the flight compartment speaker and headset

10) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker.

<u>NOTE</u>: The "Clear of Conflict" announcement sometimes may not be given.

(b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
Make sure this sequence shows on the TA/RA VSI:
1) The intruder moves down the 45 degree bearing mark to the airplane symbol
2) The intruder has the correct relative altitude.
3) The intruder begins as Non-threat Traffic (open white diamond)
4) The intruder changes to Proximate Traffic (solid white diamond)
5) The intruder changes to Traffic Advisory (solid yellow circle)
6) The TCAS gives a "TRAFFIC TRAFFIC" voice announcement on the flight compartment speaker
7) The intruder changes to a Resolution Advisory (solid red square), and gives a"CLIMB CLIMB CLIMB" voice announcement on the flight compartment speaker
8) The TA/RA VSI should show a RA resolution to pull up.
9) Shortly befor the intruder reaches the closest point of approach, the TCAS gives an "INCREASE CLIMB" voice announcement on the flight compartment speaker
10) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker.

<u>NOTE</u>: The "Clear of Conflict" announcement sometimes may not be given.

S 865-046-002
(25) Set the transponder select switch on the control unit to R.

F. High Altitude Climb Inhibit Test

S 865-047-002

(1) Use the pitot/static test set to make a simulated altitude of 48,500 feet.

<u>NOTE</u>: Let the VSI return to zero after the simulated altitude is reached.

S 865-048-002

(2) Push the SCEN key on the TCAS-201 test set to show the sceneraio menu.

S 865-049-002

(3) Set up this scenerio:
   - (a) RANGE 4.2 nm, RATE +500 knots
   - (b) ALTITUDE 48,300 ft., RATE 0fpm

S 865-050-002

(4) Push the RUN/STOP key to start the scenario.

S 945-051-002

(5) Make sure that the relative altitude of the intruder is -02.

<u>NOTE</u>: If the relative altitude of the intruder is not -02, increase or decrease your airplane's altitude accordingly.

   - (a) Make sure TCAS gives the "TRAFFIC, TRAFFIC" annunciation.
   - (b) Make sure TCAS gives the "Monitor Vertical Speed" annunciation.

<u>NOTE</u>: A crossing descend resolution advisory can be given instead of the Monitor Vertical Speed resolution advisory. Decrease the intruder's altitude or increase the airplane's altitude to correct this.

S 865-052-002

(6) Return the airplane back to field level altitude.

S 865-053-002

(7) Set the radio altimeter to 0 feet.

<u>NOTE</u>: Decrease the radio altitude by 600 feet per minute (fpm) or less.

(a) Make sure the TCAS display shows the TA ONLY indication when the radio altitude is less than 900 feet.

G. Put the Airplane Back to Its Usual Condition

S 865-054-002

(1) Put the landing gear lever back to the down position.

S 865-055-002

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
- (a) P11 Overhead Circuit Breaker Panel:
  - 1) 11S15, LANDING GEAR AIR/GND SYS 1
  - 2) 11S19, LANDING GEAR AIR/GND SYS 2
  - 3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-056-002

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-45-00-735-057-002

4. <u>System Test - TCAS</u> (With the TIC T-49 Test Set)

A. General

(1) This test is a complete system test of the TCAS. The system test first runs the TCAS Operational Test, and then does a test of the TCAS with ground test equipment.

B. Equipment

(1) TCAS/ATC ramp test set - TIC T-49; TEL - Instrument Electronics Corp, 728 Garden St, Carlstadt, N.J. 007072 or equivalent.

(2) Pitot/Static test set

(3) Radio Altimeter test set

C. Reference

(1) AMM 24-22-00/201, Electrical Power - Control

(2) AMM 29-11-00/201, Main Hydraulic System

(3) AMM 32-00-20/201, Landing Gear Downlocks

(4) AMM 32-09-02/201, Air/Ground Relays
(5) AMM 34-11-00/201 Pitot-Static System (Pressurization)

D. Prepare for the System Test

S 865-058-002

(1) Put the T-49 directional antenna about 50 feet in front of the airplane on the center line. The directional antenna will send signals to the TCAS antenna.

NOTE: A 50 foot separation between the TCAS antenna and the directional antenna is recommended. A separation between 10 to 100 feet will provide satisfactory results. Make sure there is a line of sight between the airplane's ATC, TCAS antennas and the test set directional, omnidirectional dipole antennas. Also, make sure airplane under test is closer to the test set than other active transponders that are near.

S 865-059-002

(2) Connect the cable of the directional antenna to the T-49 antenna connector.

S 865-060-002

(3) Supply electrical power (AMM 24-22-00/201).

S 715-061-002

(4) Do the TCAS Operational Test.

S 865-062-002

WARNING: PREPARE THE SAFTY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(5) Prepare the saftey-sensitive systems for air mode simulation (AMM 32-09-02/201).

S 865-063-002

(6) Open these circuit breakers and attach DO-NOT-CLOSE tags:
    (a) P11 Overhead Circuit Breaker Panel:
        1) 11S15, LANDING GEAR AIR/GND SYS 1
        2) 11S19, LANDING GEAR AIR/GND SYS 2

3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
11C19, LANDING GEAR POS SYS 2 ALTN

S 865-064-002

(7) Set the mode switch on the control unit to the TEST position.
(a) Make sure a TCAS self-test does not occur.

S 865-065-002

(8) Connect to radio altimeter test set to the airplane.

S 865-066-002

(9) Use the radio altimeter test set to make a radio altitude of 2400 feet.

NOTE: Increase the radio altitude by 600 feet per minute (fpm) or less. RAs are inhibited below 1100 feet during climb. So TA only will show below 1100 feet.

(a) Make sure the TA ONLY indication clears from the TCAS display when the radio altitude is greater than 1100 feet.

S 865-067-002

(10) Connect a pitot/static test set to the airplane so that you can pressurize the two air data computers (AMM 34-11-00/201).

S 865-068-002

(11) Use the pitot/static test to make a barometric altitude of 40,000 feet.

NOTE: The 40,000 feet barometric altitude is chosen to minimize false TCAS alert to TCAS equipped airplanes nearby. Make sure to have altitude reporting of the ATC temporarily off or put the ATC system on standby during this procedure.

S 865-069-002

(12) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
Set the EFIS control unit to map mode and a range of 20 on the EHSI display.

S 865-070-002

(13) Set the mode switch on the control unit to the TA/RA position.

S 865-071-002

(14) Supply power to the TIC T-49 test set.
(a) Make a note of the software Rev X.X of the test set.

E. TCAS Bearing Accuracy Test

S 865-072-002

(1) Set the intruder type switch on the T-49 to the ATCRBS position.

S 865-073-002

(2) Set the scenario switch on the T-49 to the fixed intruder scenario position (+1000).

<u>NOTE</u>: Shield the bottom TCAS antenna. This is to test the top TCAS antenna. You may have to get up high to be able to interrogate the top TCAS antenna from the rear of the airplane.

S 865-074-002

(3) Push the interrogate switch on the T-49.
   (a) Make sure the T-49 display shows the type of intruder set.

S 865-075-002

(4) Use the test set to interrogate the four quadrants of the TCAS antenna at bearings of 0, 90, 180, and 270 degrees.
   (a) Make sure the TCAS display shows the intruder's bearing 0 ±15 degrees.

S 865-076-002

(5) Set the scenario switch on the T-49 to the fixed intruder scenario position (-1000).

<u>NOTE</u>: Shield the top TCAS antenna or move the test set close (about 6 feet) to the bottom TCAS antenna. This is to test the bottom TCAS antenna.

S 945-077-002

(6) Set the power setting to low (LO) on T-49 with (HI/LO) power setting switch.

<u>NOTE</u>: A HI power setting can increase the likelihood of multipath problem.

S 865-078-002

(7) Make sure the pressure is removed from the left hydraulic system (AMM 29-11-00/201).

S 865-079-002

WARNING: MAKE SURE THE DOWNLOCKS ARE INSTALLED ON THE ALL LANDING GEAR (BEFORE YOU MOVE THE CONTROL LEVER). WITHOUT THE DOWNLOCKS, THE LANDING GEAR COULD RETRACT AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(8) Make sure the downlocks are installed on the nose and main landing gear (AMM 32-00-20/201).

S 865-080-002

(9) Put the landing gear lever to the OFF position.

S 865-081-002

(10) Do the steps in the bearing accuracy test again for the bottom antenna.

F. TCAS Intruder Test

S 865-082-002

(1) Put the T-49 directional antenna 45 degrees to the right of the center line of the airplane with a 50 feet separation from the airplane. The directional antenna will send signals to the TCAS antenna.

S 865-083-002

(2) Set the scenario switch on the T-49 to the straight approach 14nMi position.

S 215-084-002

(3) Set the intruder type switch is on the MODE S position.

S 865-085-002

(4) Push the interrogate switch.
   (a) Make sure the T-49 display shows the correct intruder type.

S 865-086-002

(5) Push the interrogate switch to start the scenario.
   (a) Make sure the T-49 display shows the airplane's altitude ±100 feet and the correct scenario (Range 14nMi, Co-Altitude, Closure rate 720 kts).

S 865-087-002

(6) Increase the airplane's altitude by 200 feet.

(a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
Make sure this sequence shows on the EHSI display.

1) The intruder ascends to the airplane symbol from the 45 degree bearing mark.
2) The intruder begins as Non-threat Traffic (open white diamond).
3) The intruder changes to Proximate Traffic (solid white diamond).
4) The intruder changes to a Traffic Advisory (solid yellow circle).
5) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
6) The intruder changes to a Resolution Advisory (solid red square), and gives a "climb, climb, climb" voice announcement on the flight compartment speaker.
7) The EADI shows a vertical resolution to pull up.
8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "increase climb" voice announcement on the flight compartment speaker.
9) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speaker for T-49 with Rev 3.2 software.

(b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
Make sure this sequence shows on the TA/RA VSI:

1) The intruder ascends to the airplane symbol from the 45 degree bearing mark
2) the intruder begins as a Non-threat Traffic (open white diamond)
3) The intruder changes to Proximate Traffic (solid white diamond)
4) The intruder changes to a Traffic Advisory (solid yellow circle)

5) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speakers
6) The intruder changes to a Resolution Advisory (solid red square), and gives a "CLIMB, CLIMB, CLIMB" voice announcement on the flight compartment speakers
7) The TA/RA VSI shows a vertical resolution to pull up.
8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "INCREASE CLIMB" voice announcement on the flight compartment speakers
9) Shortly after the intruder reaches the airplane symbol on the TA/RA VSI, TCAS gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speakers.

NOTE: The "CLEAR OF CONFLICT" announcement sometimes may not be given.

S 215-088-002
(7) Set the intruder type switch on the T-49 to the TCAS position.

S 865-089-002
(8) Push the interrogate switch.
(a) Make sure the T-49 display shows the correct intruder type.

S 865-090-002
(9) Push the interrogate switch to start the scenario.
(a) Make sure the T-49 display shows the airplane's altitude ±100 feet and the correct scenario (Range 14nMi, Co-Altitude, Closure rate 720 kts).

S 865-091-002
(10) Decrease the airplane's altitude by 200 feet.
(a) AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY;
Make sure this sequence shows on the EHSI display.
1) The intruder descends to the airplane symbol from the 45 degree bearing mark.

2) The intruder begins as Non-threat Traffic (open white diamond).
3) The intruder changes to Proximate Traffic (solid white diamond).
4) The intruder changes to a Traffic Advisory (solid yellow circle).
5) The TCAS gives a "TRAFFIC, TRAFFIC" voice announcement on the flight compartment speaker.
6) The intruder changes to a Resolution Advisory (solid red square), and gives a "descend, descend, descend" voice announcement on the flight compartment speaker.
7) The EADI shows a vertical resolution to push down.
8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "increase descent" voice announcement on the flight compartment speaker.
9) Shortly after the intruder reaches the airplane symbol on the EHSI, TCAS gives a "Clear of Conflict" voice announcement on the flight compartment speakers.

NOTE: The "CLEAR OF CONFLICT" announcement sometimes may not be given.

(b) AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI;
Make sure this sequence shows on the TA/RA VSI:
1) The intruder descends to the airplane symbol from the 45 degree bearing mark
2) The intruder begins as Non-threat Traffic (open white diamond)
3) The intruder changes to a Proximate Traffic (solid white diamond)
4) The intruder changes to a Traffic Advisory (solid yellow circle)
5) The TCAS gives a "TRAFFIC TRAFFIC" voice announcement on the flight deck compartment speakers
6) The intruder changes to a Resolution Advisory (solid red square), and gives a "DESCEND DESCEND DESCEND" voice announcement on the flight compartment speaker

7) The TA/RA VSI shows a vertical resolution to push down
8) Before the intruder gets to the closest point of approach, the TCAS possibly will give an "INCREASE DESCENT" voice announcement on the flight compartment speaker
9) Shortly after the intruder reaches the airplane symbol on the TA/RA VSI, TCAS gives a "CLEAR OF CONFLICT" voice announcement on the flight compartment speakers.

<u>NOTE</u>: The "CLEAR OF CONFLICT" announcement sometimes may not be given.

S 865-092-002

(11) Set the transponder select switch on the control unit to the R position.

G. High Altitude Climb Inhibit Test

S 865-093-002

(1) Use the pitot/static test set to make a simulated altitude of 49,000 feet.

S 725-094-002

(2) Do the previous TCAS intruder scenario test again.
  (a) Make sure TCAS does not give a CLIMB corrective action.

S 865-095-002

(3) Return the airplane back to field level altitude.

S 865-096-002

(4) Set the radio altimeter to 0 feet.

<u>NOTE</u>: Decrease the radio altitude by 600 feet per minute (fpm) or less.

  (a) Make sure the TCAS display shows the TA ONLY indication when the radio altitude is less than 900 feet.

H. Put the Airplane Back to Its Usual Condition

S 865-097-002

(1) Put the landing gear lever back to the down position.

S 865-098-002

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
  - (a) P11 Overhead Circuit Breaker Panel:
    - 1) 11S15, LANDING GEAR AIR/GND SYS 1
    - 2) 11S19, LANDING GEAR AIR/GND SYS 2
    - 3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-099-002

(3) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-45-00-725-100-002

5. TCAS Interface Test

A. General

(1) This Interface test is a check of the interface between TCAS and other systems that interface with TCAS. The interface checks on the ATC is done in the TCAS system test.

B. References

(1) AMM 31-41-00/501, Engine Indication Crew Alerting System
(2) AMM 34-12-00/501, Air Data System
(3) AMM 34-21-00/501, Inertial Reference System
(4) AMM 34-22-00/501, Electronic Flight Instrument System
(5) AMM 34-33-00/501, Low Range Radio Altimeter
(6) AMM 34-46-00/501, Ground Proximity Warning System
(7) AMM 34-53-00/501, Air Traffic Control

C. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

D. Prepare for the Test

S 865-101-002

(1) Make sure these systems are operational:
  - (a) Air Data System (AMM 34-12-00/501)

(b) Air Traffic Control System (AMM 34-53-00/501)
(c) Electronic Flight Instrument System (AMM 34-22-00/501)
(d) Engine Indication Crew Alerting System (AMM 31-41-00/501)
(e) Inertial Reference System (AMM 34-21-00/501)
(f) Low Range Radio Altimeter (AMM 34-33-00/501)
(g) Ground Proximity Warning System (AMM 34-46-00/501)

S 215-102-002

(2) Make sure these circuit breakers are closed:
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F3, TCAS
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LANDING GEAR AIR/GND SYS 2
    4) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
       11C19, LANDING GEAR POS SYS 2 ALTN

E. GPWS Interface Test

S 715-103-002

(1) Do the GPWS self-test from the P61 miscellaneous test panel (AMM 34-46-00/501).

<u>NOTE</u>: The Ground Prox Test will cycle through the three aural warnings "GLIDESLOPE", "WHOOP-WHOOP PULL-UP", and "WINDSHEAR, WINDSHEAR" with a slight delay between each warning. This is to make sure TCAS aurals are inhibited whenever these Ground Prox warnings are annunciated.

S 715-104-002

(2) During the "GLIDESLOPE" aural, set the mode switch on the control unit to the TEST position.
  (a) Make sure the "TCAS TEST ----" aural is inhibited when the "GLIDESLOPE" aural message occurs.

S 715-105-002

(3) Do the GPWS self-test from the P61 miscellaneous test panel (AMM 34-46-00/501).

S 715-106-002

(4) During the "WHOOP-WHOOP PULL-UP" aural, set the mode switch on the control unit to the TEST position.
  (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WHOOP-WHOOP PULL-UP" aural message occurs.

S 715-107-002

(5) Do the GPWS self-test from the P61 miscellaneous test panel (AMM 34-46-00/501).

S 715-108-002

(6) During the "WINDSHEAR, WINDSHEAR" aural, set the mode switch on the control unit to the TEST position.
  (a) Make sure the "TCAS TEST ----" aural is inhibited when the "WINDSHEAR, WINDSHEAR" aural message occurs.

F. Low Range Radio Altimeter Interface Test

S 215-111-002

(1) Make sure the two EADIs show a radio altitude between 0 and -10 feet.

S 745-112-002

(2) Push the TEST switch on the control unit.
  (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-113-002

(3) Open this circuit breaker.
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F5, LEFT RAD ALTM

S 745-114-002

(4) Push the TEST switch on the control unit.
  (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-115-002

(5) Open this circuit breaker.
  (a) P11 Overhead Circuit Breaker Panel:
    1) 11F26, RIGHT RAD ALTM

S 745-116-002

(6) Push the TEST switch on the control unit.
   (a) Make sure you hear the "TCAS TEST FAIL" annunciation.

S 865-117-002

(7) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F5, LEFT RAD ALTM

S 865-118-002

(8) Open and then close the TCAS circuit breaker to clear the latched fail state of the TCAS computer, if necessary.

S 745-119-002

(9) Push the TEST switch on the control unit.
   (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-120-002

(10) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F26, RIGHT RAD ALTM

S 865-121-002

(11) Open these circuit breakers and attach DO-NOT-CLOSE tags:
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11S15, LANDING GEAR AIR/GND SYS 1
      2) 11S19, LANDING GEAR AIR/GND SYS 2
      3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

S 865-241-002

(12) Use the radio altimeter test set to make a radio altitude of 450 feet.
   (a) Make sure the EADI shows the simulated radio altitude.

(b) Make sure the EHSI shows the TA ONLY indication.

S 865-242-002

(13) Use the radio altimeter test set to make a radio altitude of 1500 feet.
- (a) Make sure the EADI shows the simulated radio altitude.
- (b) Make sure the EHSI does not show a TA ONLY, TCAS FAIL, or TCAS OFF message.

S 865-126-002

(14) Close these circuit breakers.
- (a) P11 Overhead Circuit Breaker Panel:
  - 1) 11S15, LANDING GEAR AIR/GND SYS 1
  - 2) 11S19, LANDING GEAR AIR/GND SYS 2
  - 3) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN

G. AIRPLANES WITH TCAS DISPLAYED ON THE EFIS DISPLAY; TCAS System EFIS Interface Test

S 865-127-002

(1) Set the radio altitude to less than 50 feet.

S 865-128-002

(2) Set the left and the right EFI instrument source select switches to NORMAL.

S 865-129-002

(3) Push the TFC switch on the left and the right EFIS control panel.
- (a) Make sure the left and right EHSI displays the TFC and TA ONLY indications.

S 865-130-002

(4) Open this circuit breaker.
- (a) P11, Overhead Circuit Breaker Panel:
  - 1) 11F29, EFIS SYM GEN RIGHT

S 215-131-002
(5) Make sure only the left EHSI shows the TA ONLY and TFC indications.

S 865-132-002
(6) Close this circuit breaker.
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F29, EFIS SYS GEN RIGHT

S 865-133-002
(7) Open this circuit breaker:
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F8, EFIS SYM GEN LEFT

S 865-134-002
(8) Push the TFC switch on the right EFIS control panel.
  (a) Make sure the right EHSI shows the TFC indication.
  (b) Make sure only the right EHSI shows the TA ONLY indication.

S 865-135-002
(9) Set the right EFI instrument SOURCE select switch to ALTN.

S 865-136-002
(10) Push the TFC switch on the right EFIS control panel.
  (a) Make sure the right EHSI show the TFC and TA ONLY indications.

S 865-137-002
(11) Set the right EFI instrument source select switch to NORMAL.

S 865-138-002
(12) Set the left EFI instrument source select switch to ALTN.

S 865-139-002
(13) Push the TFC switch on the left and the right EFIS control panel.
  (a) Make sure the left and right EHSI displays the TFC and TA ONLY indications.

S 865-140-002

(14) Open this circuit breaker.
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F29, EFIS SYM GEN RIGHT

S 215-141-002

(15) Make sure only the left EHSI shows the TA ONLY and TFC indications.

S 865-142-002

(16) Open this circuit breaker.
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F9, EFIS SYM GEN CENTER

S 865-143-002

(17) Push and release the TEST switch on the front of the TCAS computer.
  (a) Make sure the red RA DISP fail light comes on.

S 865-144-002

(18) Close these circuit breakers:
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F8, EFIS SYM GEN LEFT
    2) 11F9, EFIS SYM GEN CENTER
    3) 11F29, EFIS SYM GEN RIGHT

H. AIRPLANES WITH TCAS DISPLAYED ON THE TA/RA VSI; TA/RA VSI Interface Test

S 215-211-002

(1) Make sure the left and right EHSI show a radio altitude of less than 50 feet.

S 215-212-002

(2) Make sure the left and right TA/RA VSIs show the TA ONLY indication.

S 865-213-002

(3) Open this circuit breaker.
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11E26, RIGHT VSI

S 215-214-002
(4) Make sure the left TA/RA VSI still show the TA ONLY indication.

S 865-215-002
(5) Close this circuit breaker.
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11E26, RIGHT VSI

S 215-216-002
(6) Make sure the left and right TA/RA VSIs show the TA ONLY indication.

S 865-217-002
(7) Open this circuit breaker.
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11E5, LEFT VSI

S 215-218-002
(8) Make sure the right TA/RA VSI shows the TA ONLY indication.

S 865-219-002
(9) Open this circuit breaker.
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11E26, RIGHT VSI

S 865-220-002
(10) Push and release the TEST switch on the front panel of the TCAS computer.
   (a) Make sure red RA DISP and TCAS FAIL lights on the TCAS computer come on.

S 865-221-002
(11) Close these circuit breakers.
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11E5, LEFT VSI
      2) 11E26, RIGHT VSI

S 215-222-002
(12) Make sure both EADI show a radio altitude between 0 and -10 feet.

S 865-223-002
(13) Push the TEST switch on the control panel.
   (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-224-002

(14) Open this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F5, LEFT RAD ALTM

S 865-225-002

(15) Push the TEST switch on the control panel.
   (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-226-002

(16) Open this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F26, RIGHT RAD ALTM

S 865-227-002

(17) Push the TEST switch on the control panel.
   (a) Make sure you hear the "TCAS TEST FAIL" annunciation.

S 865-228-002

(18) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F5, LEFT RAD ALTM

S 865-229-002

(19) Open and then close the TCAS circuit breaker to clear the latched fail state of the TCAS computer, if necessary.

S 865-230-002

(20) Push the TEST switch on the control panel.
   (a) Make sure you hear the "TCAS TEST PASS" annunciation.

S 865-231-002

(21) Close this circuit breaker.
   (a) P11 Overhead Circuit Breaker Panel:
      1) 11F26, RIGHT RAD ALTM

I. Put the Airplane Back to Its Usual Condition

S 865-145-002

(1) Remove the electrical power if it is not required (AMM 24-22-00/201).

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) COMPUTER REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the TCAS computer, the other is the installation of the TCAS computer.
   B. The TCAS computer, M10819, is installed on the E2 rack in the main equipment center (Fig. 401).

TASK 34-45-01-004-102

2. TCAS Computer Removal
   A. References
      (1) AMM 20-10-01/401, E/E Rack Mounted Components
      (2) AMM 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones

119/120	Main Equipment Center

      (2) Access Panels

119BL	Main Equipment Center Access Door

   C. Procedure

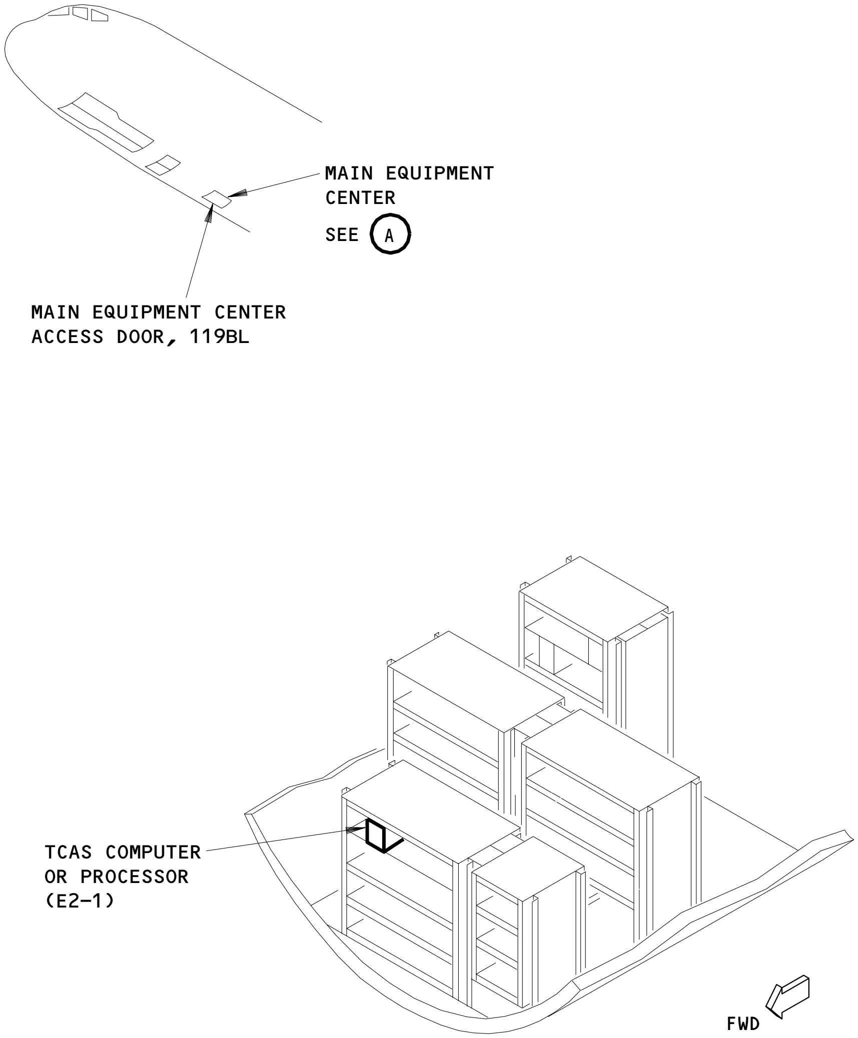
      S 864-103

      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
         (a) P11, Overhead Circuit Breaker Panel:
            1) 11F3 or 11G2, TCAS

      S 024-110

      CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

      (2) Remove the TCAS computer (AMM 20-10-01/401).



MAIN EQUIPMENT CENTER
A

TCAS - Component Location
Figure 401

S 034-111
(3) Install dust caps on the electrical connectors.

TASK 34-45-01-404-105

3. TCAS Computer Installation

A. References
   (1) AMM 20-10-01/401, E/E Rack Mounted Components
   (2) AMM 24-22-00/201, Electrical Power - Control
   (3) AMM 34-45-00/501, TCAS

B. Access
   (1) Location Zones

119/120	Main Equipment Center

   (2) Access Panels

119BL	Main Equipment Center Access Door

C. Procedure

S 864-106
(1) Make sure these circuit breakers are open:
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11F3 or 11G2, TCAS

S 434-112

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE TCAS COMPUTER. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE TCAS COMPUTER.

(2) Install the TCAS Computer (AMM 20-10-01/401).

D. TCAS Computer Test

S 864-108
(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
   (a) P11, Overhead Circuit Breaker Panel
      1) 11F3 or 11G2, TCAS

S 864-109
(2) Supply electrical power (AMM 24-22-00/201).

S 714-114
(3) Do the TCAS Operational test (AMM 34-45-00/501).

E. Put the Airplane Back to Its Usual Condition

S 864-113

(1) Remove the electrical power if it is not necessary (AMM 24-22-00/201).

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) DIRECTIONAL ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the TCAS directional antenna; the other is the installation of the TCAS directional antenna.
   B. The TCAS has two directional antennas. One is installed on the top of the airplane and the other is installed on the bottom of the airplane.

TASK 34-45-02-004-067

2. TCAS Directional Antenna Removal
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
   B. Consumable Materials
      (1) B00316 Solvent - Aliphatic Naptha, TT-N-95, Type I
   C. References
      (1) AMM 20-10-22/701, Metal Surfaces
   D. Access
      (1) Location Zones

119/120	Main Equipment Center (Exterior)
223/224	Area Above Passenger Cabin Ceiling (Exterior)

   E. Procedure

S 864-068

(1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
   (a) P11, Overhead Circuit Breaker Panel
      1) 11F3 or 11G2, TCAS

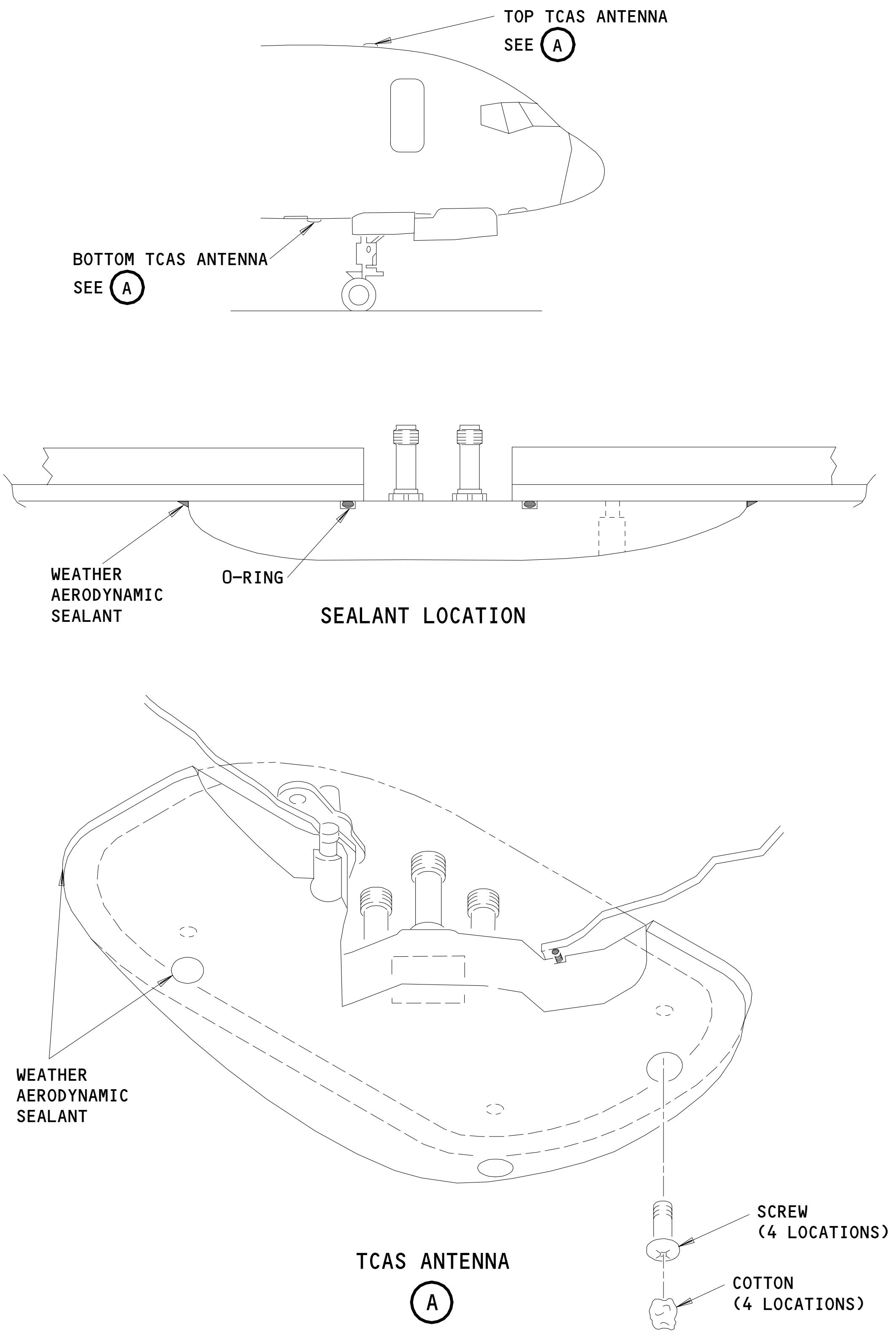
S 034-069

(2) Remove the screws the from the antenna base.

S 034-070

CAUTION: BE CAREFUL WHEN YOU USE FORCE WITH THE SEALANT REMOVAL TOOL TO BREAK THE ANTENNA SEAL. TOO MUCH FORCE CAN DAMAGE THE AIRPLANE SKIN OR THE ELECTRICAL CABLE AT THE ANTENNA BASE.

(3) Use force around the antenna with the sealant removal tool until the seal is fully broken.



TCAS Antenna Installation
Figure 401

S 014-071

CAUTION: MOVE THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLES. DAMAGE TO THE ANTENNA CABLES CAN OCCUR IF YOU PULL THE CABLES.

(4) Move the antenna until you can get access to the antenna cable connectors.

S 034-072
(5) Disconnect the antenna cables.

NOTE: Do not let the antenna cables fall into the fuselage.

S 024-073
(6) Remove the TCAS antenna.

S 144-074
(7) Remove the sealant from the airplane skin in the antenna area (Ref 20-10-22/701).

S 114-075
(8) Use a clean rag and the solvent, TT-N-95 type I, to clean the airplane surface in the antenna area (AMM 20-10-22/701).

TASK 34-45-02-404-076

3. TCAS Antenna Installation

A. Equipment
   (1) Resistance measuring bridge or ohmmeter that can measure 0.001 ohm

B. Consumable Materials
   (1) B00316 Solvent - Aliphatic Naphtha, TT-N-95, Type I
   (2) A00247 Sealant - BMS 5-95, Class B 1/2
   (3) C00064 Coating - Conversion - Alodine 1200

C. References
   - (1) AMM 20-10-22/701, Metal Surfaces
   - (2) AMM 24-22-00/201, Electrical Power - Control
   - (3) AMM 34-45-00/501, TCAS
   - (4) AMM 51-24-03/701, Corrosion Inhibiting Compound
   - (5) AMM 51-31-01/201, Seals and Sealing

D. Access
   (1) Location Zones

119/120	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling

E. Procedure

S 864-095

(1) Make sure this circuit breaker is open:
   (a) P11, Overhead Circuit Breaker Panel:
      1) 11F3 or 11G2, TCAS

S 214-078

(2) Visually examine the contact surfaces of the antenna and the airplane for corrosion and unwanted substances.

<u>NOTE</u>: If the surfaces are not clean, the ground will not be sufficient, and incorrect system operation will occur.

S 114-079

(3) Clean the contact surfaces with the solvent, aliphatic naphtha, TT-N-95, Type I (AMM 20-10-22/701).

S 624-080

(4) Apply Alodine 1200 to the contact surfaces of the antenna and the airplane (AMM 51-21-04/701).

S 434-081

(5) Make sure that an O-ring is installed on the new antenna.

S 434-082

(6) Connect the coaxial cables to the antenna as follows:

CABLE SLEEVE COLOR	TCAS ANTENNA CONNECTOR
Yellow	J1
Black	J2
Blue	J3
Red	J4

(a) Tighten the TCAS Antenna connectors 4 to 6 in-lbs (hand tight plus 1/8 turn).

S 424-083
(7) Put the antenna into position.

S 434-097
(8) Install all of the screws except one.

NOTE: Leave one screw out to do the electrical bond check.

S 434-084
(9) Tighten the screws to 20-25 pound-inches of torque.

S 764-085
(10) Make sure the resistance from the antenna base to the airplane skin is not greater than 0.001 ohms.

S 424-093
(11) Install the last screw in the antenna.

S 434-094
(12) Tighten the screw to 20-25 pound-inches of torque.

S 434-086
(13) Apply the weather aerodynamic sealant, BMS 5-95, to the outer edge of the antenna (AMM 51-31-01/201).

S 394-098
(14) Fill the screw holes with cotton and apply sealant to cover the holes (AMM 51-31-01/201).

NOTE: Do not put more than 1/8 inch of sealant into the screw-hole.

S 144-087
(15) Remove the unwanted sealant from around the antenna base (AMM 51-31-01/201).

S 864-089

(16) Remove the DO-NOT-CLOSE tags and close this circuit breaker:
  (a) P11, Overhead Circuit Breaker Panel:
    1) 11F3 or 11G2, TCAS

TASK 34-45-02-734-142

4. TCAS Antenna Test

A. Procedure

S 864-090

(1) Supply electrical power (AMM 24-22-00/201).

S 714-099

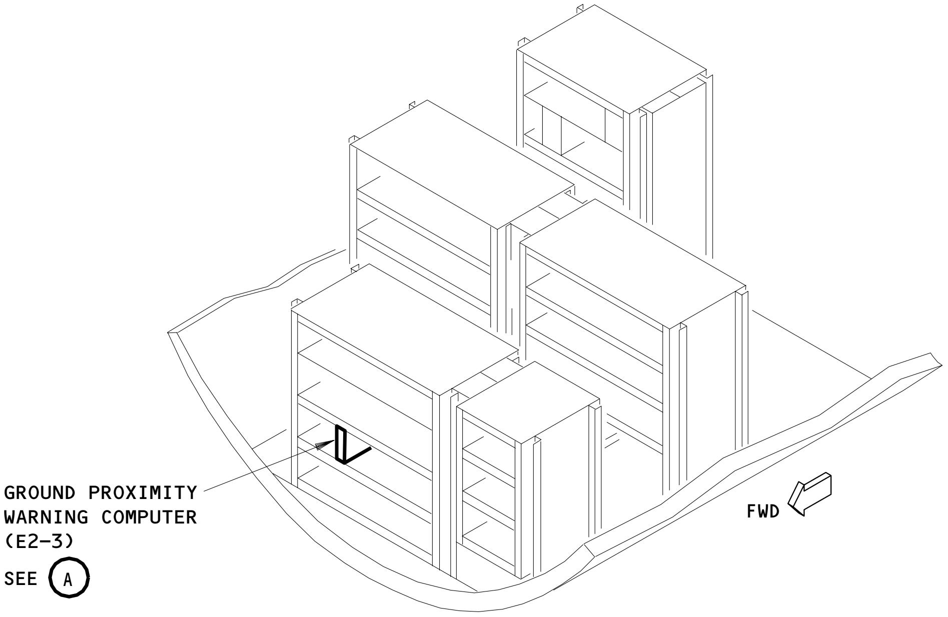
(2) Do a TCAS operational test (AMM 34-45-00/501).

S 864-091

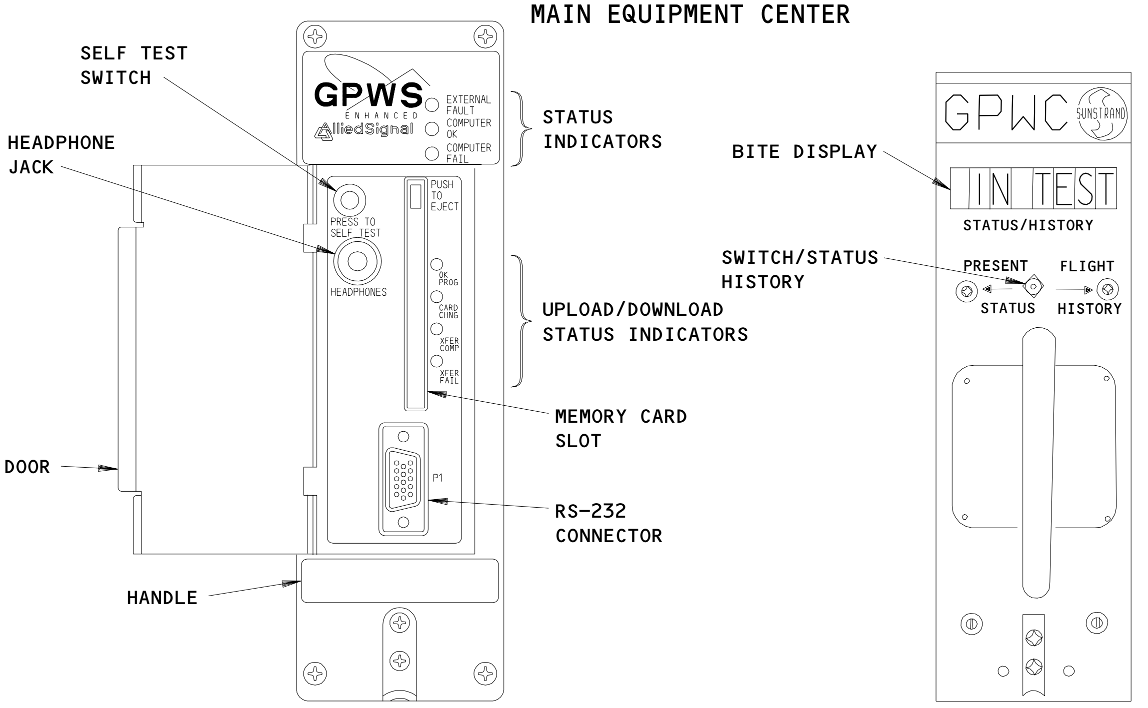
(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

GROUND PROXIMITY WARNING SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. For various flight conditions, the ground proximity warning system (GPWS) provides aural and visual warnings of airplane closeness to the terrain. The potentially dangerous flight modes are:
      (1) Mode 1 - Large Descent Rate
      (2) Mode 2 - Large Terrain Closure Rate
      (3) Mode 3 - Too Much Altitude Loss During Climbout (at Takeoff or in Go-Around) When Not In Landing Configuration
      (4) Mode 4 - Not Enough Terrain Clearance
      (5) Mode 5 - Too Much Deviation Below The Glide Slope Centerline
      (6) Mode 6 - Altitude Callouts When Descending Through Selected Radio Altitudes
      (7) Mode 7 - Windshear Detection
   B. AIRPLANES WITH ENHANCED GPWS;
      The Enhanced GPWS provides these additional modes:
      (1) Terrain Clearance Floor (TCF) - Not Enough Terrain Clearance (additional to Mode 4)
      (2) Terrain Awareness Alerting and Display (TAAD) - Aircraft Fight Path and Terrain Difference (displays terrain and provides alerts for terrain threats ahead of the aircraft).
   C. The system consists of:
      (1) 1 - Ground Proximity Warning Computer (GPWC) or Enhanced GPWC (EGPWC)
      (2) 1 - GND PROX Light-G/S INHB Switch/Light
      (3) 1 - WINDSHEAR Light
      (4) 1 - PULL UP Light
      (5) 1 - Ground Proximity Test Switch
      (6) 1 - Gear Override Switch
      (7) 1 - Flap Override Switch



MAIN EQUIPMENT CENTER



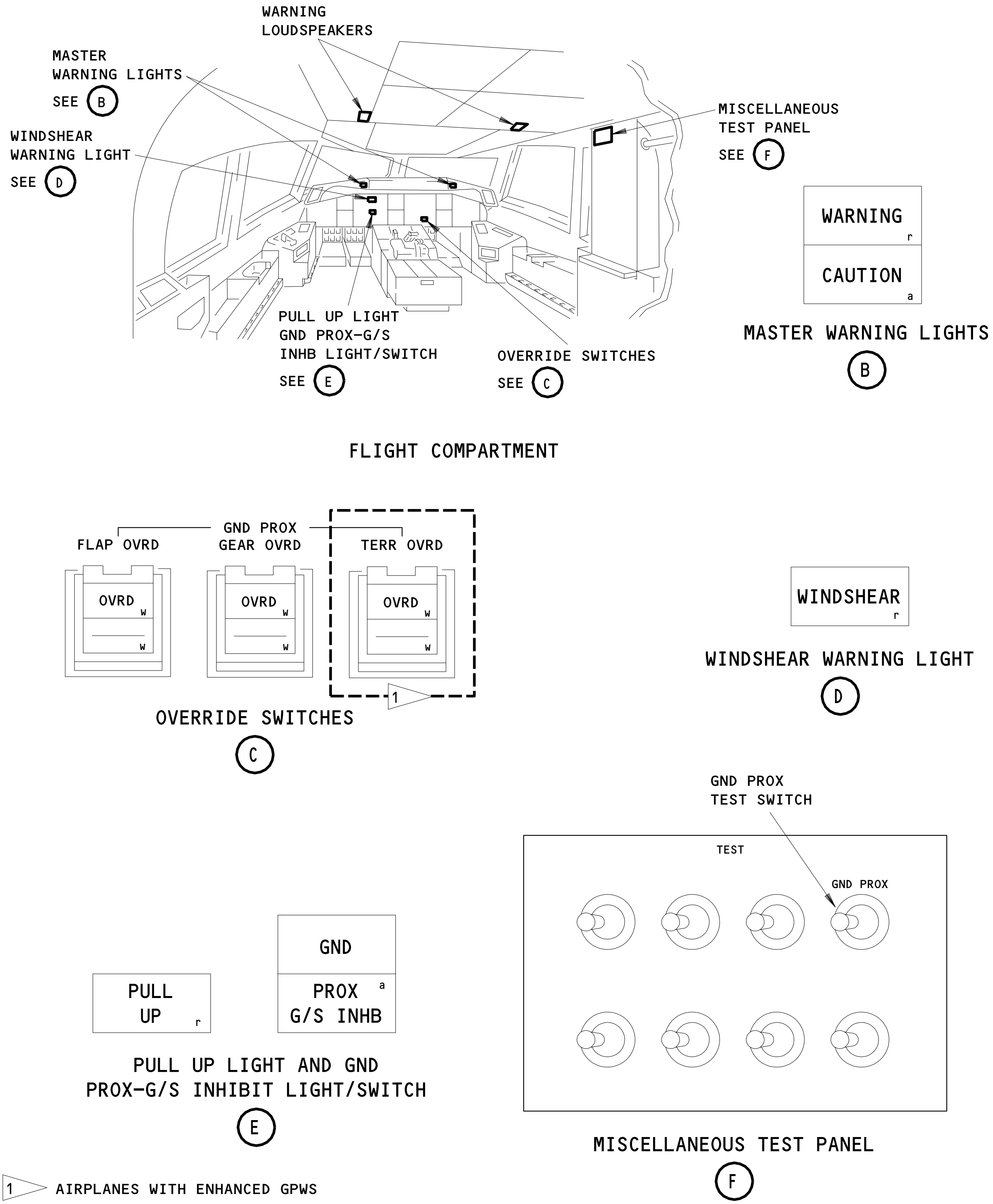
GROUND PROXIMITY WARNING COMPUTER
A 1

GROUND PROXIMITY WARNING COMPUTER
A 2

1 AIRPLANES WITH ENHANCED GPWS

2 AIRPLANES WITHOUT ENHANCED GPWS

Ground Proximity Warning System - Component Location
Figure 1 (Sheet 1)



FLIGHT COMPARTMENT

MASTER WARNING LIGHTS
B

OVERRIDE SWITCHES
C

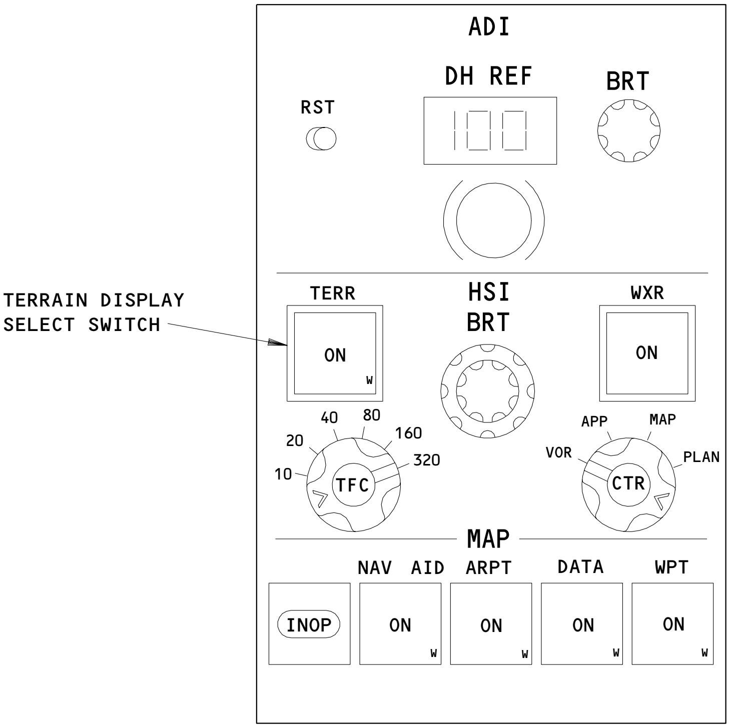
WINDSHEAR WARNING LIGHT
D

PULL UP LIGHT AND GND
PROX-G/S INHIBIT LIGHT/SWITCH
E

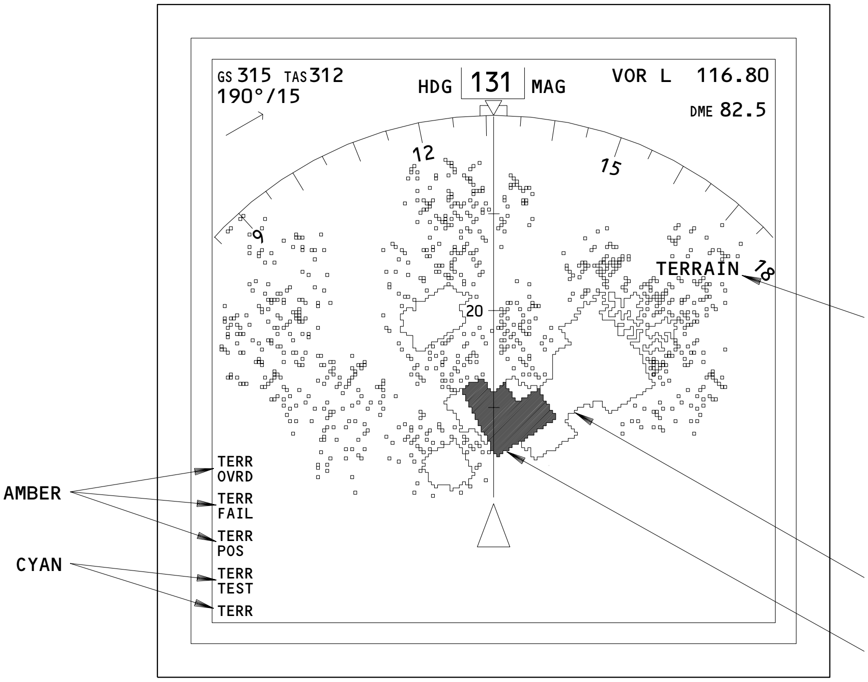
MISCELLANEOUS TEST PANEL
F

1 AIRPLANES WITH ENHANCED GPWS

Ground Proximity Warning System - Component Location
Figure 1 (Sheet 2)



EFIS CONTROL PANEL WITH A TERRAIN DISPLAY SELECT SWITCH
(EXAMPLE)



ND EGPWS TERRAIN DISPLAY
(EXAMPLE)

Ground Proximity Warning System - Component Location
Figure 1 (Sheet 3)

(8) AIRPLANES WITH ENHANCED GPWS;
- 1 - Terrain Override Switch
- 2 - Terrain Display Select Switches
- 2 - Navigation Displays and associated range, mode, and brightness controls

2. Component Details

A. Ground Proximity Warning Computer

(1) The ground proximity warning computer (GPWC), or Enhanced GPWC (EGPWC), is located on the E2-3 rack in the main equipment center. The GPWC (or EGPWC) LRU is the main element of the Ground Proximity Warning System (GPWS).

(a) AIRPLANES WITHOUT ENHANCED GPWS;
The GPWC LRU front panel contains a toggle switch and an 8-character LED BITE display. Present status or flight history data shows on the BITE display when the toggle switch is selected.

(b) AIRPLANES WITH ENHANCED GPWS;
The Enhanced GPWC LRU front panel contains three EGPWC status indicator LEDs that light to show internal or external EGPWS failures. The front panel also contains a self test switch. Pressing this switch provides access to the EGPWC self test modes, the present faults, and the fault history. The faults are annunciated through the flight deck speakers or through headphones connected to the jack located below the switch. The EGPWC front panel also has a PCMCIA interface that can be used to upload program and terrain database updates and download fault history data. There are four status LEDs to show the progress of the memory card data transfer. The EGPWC has a front panel 15-pin, D-type portable PC test connector to allow a serial data connection (RS-232) to a PC-compatible computer.

(c) AIRPLANES WITH ENHANCED GPWS;
The EGPWC operational software and terrain database may be updated using a PC card inserted into the front panel PCMCIA interface slot. Once the card is inserted, the EGPWC will automatically download data and update software without further user intervention. The data on the card is protected by checksums to ensure data integrity.

(2) The computer receives and processes input signals to determine the alert and warning mode conditions. It also generates the aural and visual alert and warning messages.

(3) The computer continuously monitors the validity of input signals and internal functions. System failures detected are stored in a non-volatile memory.

B. GND PROX TEST Switch

(1) AIRPLANES WITHOUT ENHANCED GPWS;
The TEST switch is located on the miscellaneous test panel at the right side panel P61. It provides a momentary ground discrete to the GPWC to start the self test. The self test can be performed while airborne, or on the ground, as follows:

(a) The airborne self test is enabled when the landing gear is up and the radio altitude is above 1000 feet. Setting the TEST switch for less than 5 seconds starts the test sequence.

(b) The ground self test is enabled when the radio altitude is below 30 feet. Setting the TEST switch for less than 5 seconds starts the test sequence. A total vocabulary test is started if the TEST switch is set for more than 5 seconds.

(2) AIRPLANES WITH ENHANCED GPWS;
The TEST switch provides a momentary ground discrete to the EGPWC, which is used to start or stop self test mode or to move from one self test level to another. There are six levels of self test in the EGPWC. The self test mode is only available when the airplane is on the ground.

C. Override Switches

(1) The GND PROX FLAP OVRD switch is used to inhibit the Mode 4 caution message. The switch provides an open or ground discrete to the GPWC. Open indicates normal flap operation; ground indicates a flap inhibit to the GPWC. The inhibit signal is generated by pressing the switch.

(2) The GND PROX GEAR OVRD switch is used to inhibit the Mode 4 caution message. The switch provides an open or ground discrete to the GPWC. Open indicates normal gear operation; ground indicates a gear inhibit to the GPWC. The inhibit signal is generated by pressing the switch.

(3) AIRPLANES WITH ENHANCED GPWS;
The GND PROX TERR OVRD switch is used to inhibit Terrain Clearance Floor (TCF) and Terrain Awareness Alerting and Display (TAAD) at the same time. The switch provides an open or ground discrete to the EGPWC. Open indicates normal TAAD and TCF operation; ground indicates a TAAD and TCF inhibit to the EGPWC. The inhibit signal is generated by pressing the switch. This switch does NOT inhibit Modes 1 - 7.

D. PULL UP Warning Light

(1) The red ground proximity warning PULL UP light is located on the Captain's instrument panel. The light comes on when a PULL UP warning occurs.

E. WINDSHEAR Warning Light

(1) The red ground proximity warning WINDSHEAR light is located on the Captain's instrument panel. The light comes on when a Mode 7 WINDSHEAR warning occurs. In addition, the red ground proximity warning WINDSHEAR message shows on the Captain's and First Officer's PFDs.

F. GND PROX Light-G/S INHB Switch/Light

(1) The amber GND PROX Light-G/S INHB Switch/Light provides a momentary contact to ground and an amber light. The momentary contact to ground provides the Mode 5 glideslope inhibit discrete to the GPWC. The GND PROX light illuminates when there is a GPWS alert condition. The mode 5 caution may be inhibited by pressing the switch/light provided the advisory condition has not already occurred.

G. AIRPLANES WITH ENHANCED GPWS;
Terrain Display Select Switch

(1) The TERR Terrain Display Select Switches are located on the captain's and first officer's EFIS control panels in the center aisle stand. Each switch provides a momentary ground discrete to the EGPWC. Pressing the TERR switch causes terrain data to be displayed if the navigation display (ND) is in a displayable mode such as MAP, CTR MAP, Expanded VOR, or APP. If the ND is not in a displayable mode, then pressing the switch arms the terrain display which allows terrain to be displayed immediately when a displayable ND mode is selected.

H. AIRPLANES WITH ENHANCED GPWS;
Navigation Display - Terrain Awareness Information

(1) Terrain awareness information is displayed on each navigation display (ND) when selected on the captain's or first officer's EFIS control panel. It can also be displayed automatically if a terrain caution or warning alert occurs and if it has not been selected by the pilot or first officer. The NDs are located in the main panels.

(2) The NDs can display the following Terrain Awareness Alerting and Display (TAAD) messages:
   (a) Red TERRAIN - Active TAAD warning alert
   (b) Amber TERRAIN - Active TAAD caution alert
   (c) Amber TERR FAIL - Terrain Clearance Floor (TCF), TAAD failed
   (d) Amber TERR POS - Horizontal position data is not accurate or is not available

(e) Amber TERR OVRD - Terrain override switch is in the OVRD position
(f) Cyan TERR TEST - EGPWS system is in self test mode
(g) Cyan TERR - Terrain data is being displayed
(h) Amber TERR RANGE DISAGREE - The selected EFIS control panel range and the range of the terrain do not agree
(i) Amber MAP/TERR RANGE DISAGREE - The selected EFIS control panel range and the range of the terrain and MAP display do not agree

I. AIRPLANES WITH ENHANCED GPWS;
Weather Radar/Terrain Display Select Relays

(1) The Weather Radar/Terrain Display Select Relays are driven directly by an analog ground discrete output from the EGPWC. The display system receives Weather Radar data and EGPWS terrain data on ARINC 453 type busses. The relays are used to switch the source of the ARINC 453 data between the EGPWS and the Weather Radar. The default (de-energized) position of the relays is the Weather Radar display position.

J. Warning Speakers

(1) The aural warning speakers are located on each side adjacent to the pilots' overhead panel P5. The speakers come on to annunciate the GPWS warning and advisory aural messages. The Warning Electronics Unit (WEU) controls the speakers.

K. EICAS Display Units

(1) The EICAS display units are located on the center instrument panel. They display the GPWS failure message if there is a GPWS system fault (Ref 31-41-00).

3. <u>Operation</u>

A. Functional Description

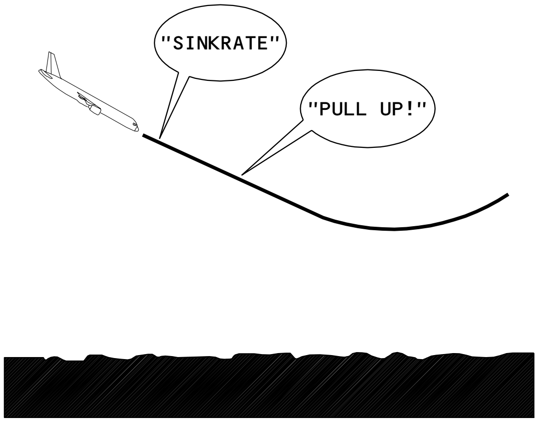
(1) Mode 1 Function (Fig. 2)

(a) Mode 1 provides warnings and advisories when the airplane has a large descent rate with respect to the altitude above ground level (AGL) during descent and approach. If the airplane barometric descent rate becomes excessive, the aural SINKRATE message is heard and the amber GND PROX light comes on. If the descent rate becomes severe, the aural changes to PULL UP, the red PULL UP indication shows, and the master warning lights come on.

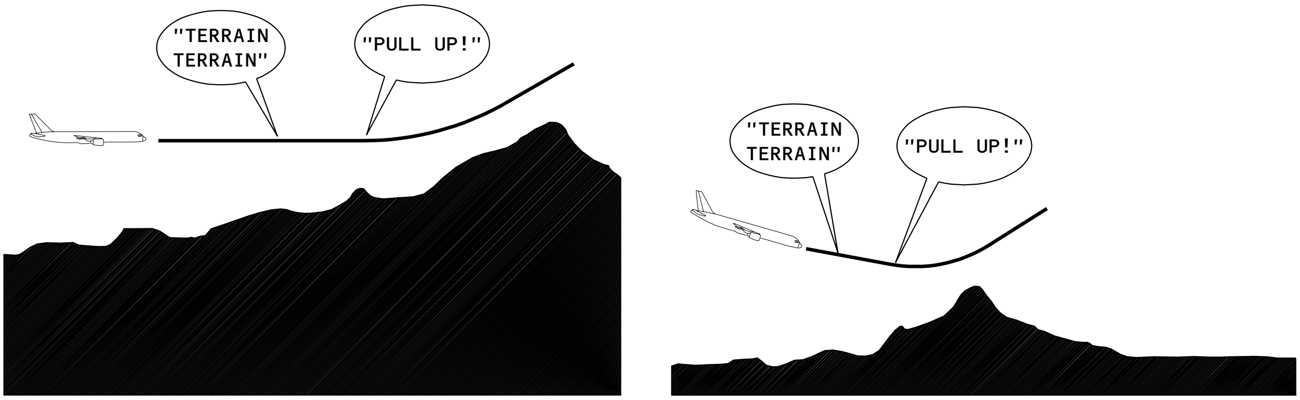
(2) Mode 2 Function (Fig. 2)

(a) Mode 2 provides warning and advisories for excessive closure rates to the terrain with respect to altitude AGL, phase of flight, and speed. Mode 2 has two sub-modes, Mode 2A and 2B.

1) Mode 2A advisories and warnings are given when the airplane is not in landing configuration. If the terrain closure rate is excessive, the aural TERRAIN TERRAIN message is heard and the amber GND PROX light comes on. If the condition is not corrected, the aural message changes to the PULL UP warning, the red PULL UP indication shows, and the master warning lights come on.

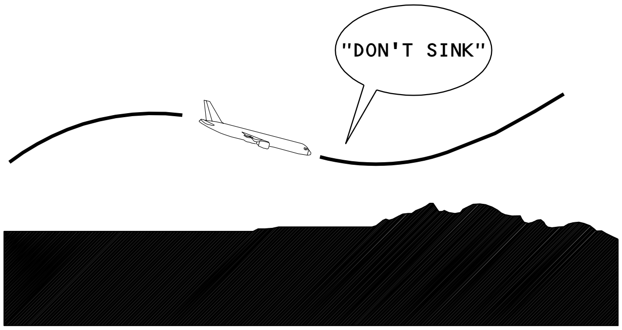


MODE 1
EXCESSIVE DESCENT RATE



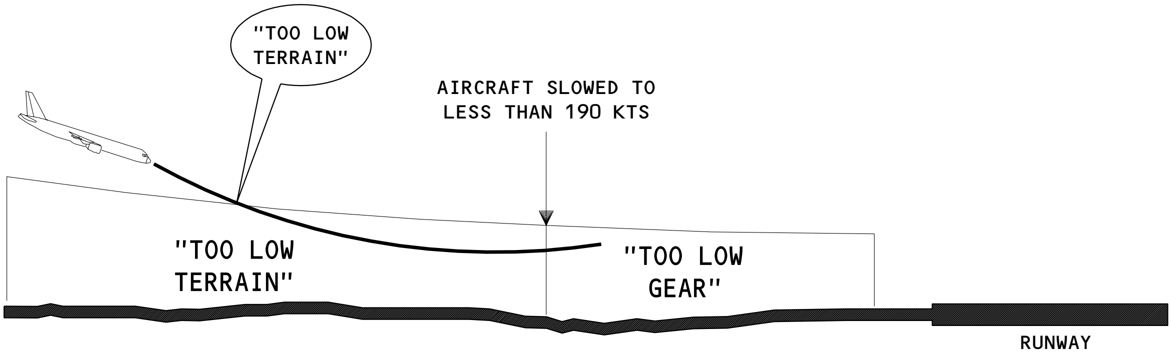
MODE 2A
EXCESSIVE TERRAIN CLOSURE RATE

MODE 2B
EXCESSIVE TERRAIN CLOSURE RATE
(FLAPS AND GEAR DOWN)

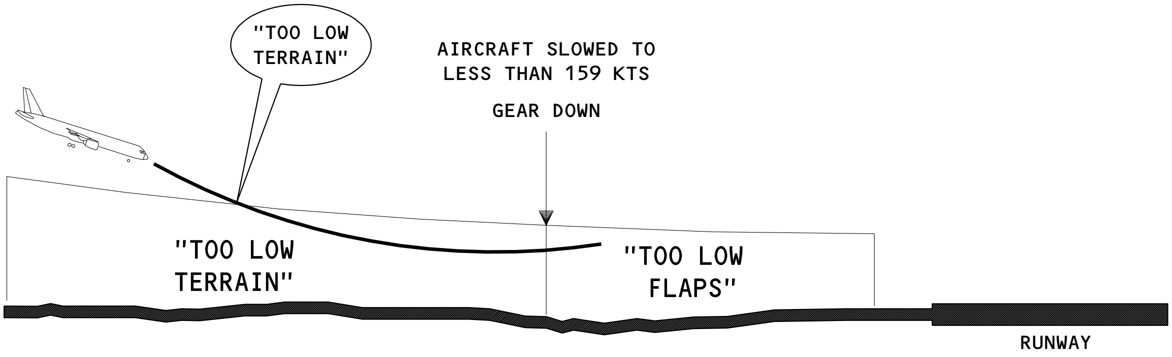


MODE 3
ALTITUDE LOSS AFTER TAKEOFF OR GO-AROUND

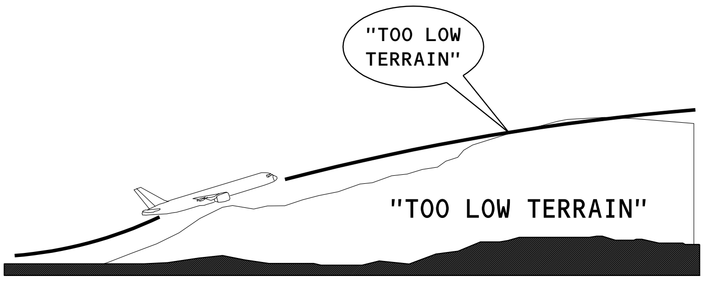
Ground Proximity Warning System Modes
Figure 2 (Sheet 1)



MODE 4A
UNSAFE TERRAIN CLEARANCE
(GEAR UP)

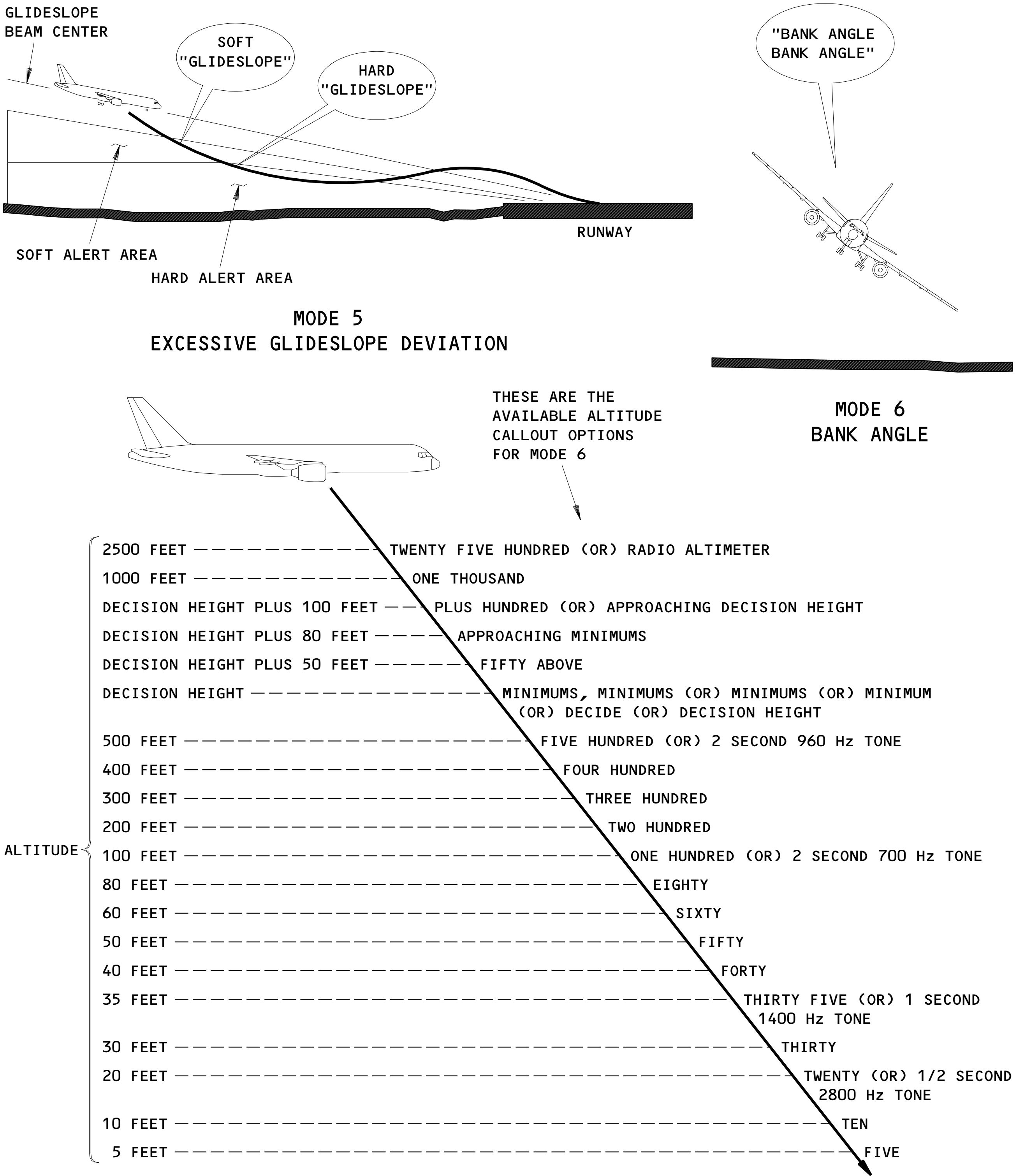


MODE 4B
UNSAFE TERRAIN CLEARANCE
(GEAR DOWN)



MODE 4C
UNSAFE TERRAIN CLEARANCE
(TAKEOFF OR GO-AROUND)

Ground Proximity Warning System Modes
Figure 2 (Sheet 2)

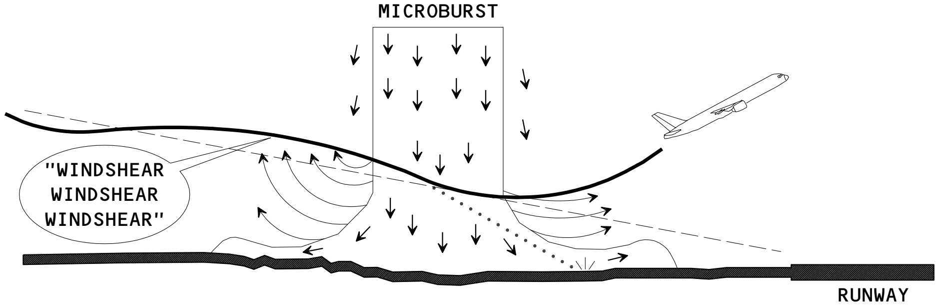


MODE 5
EXCESSIVE GLIDESLOPE DEVIATION

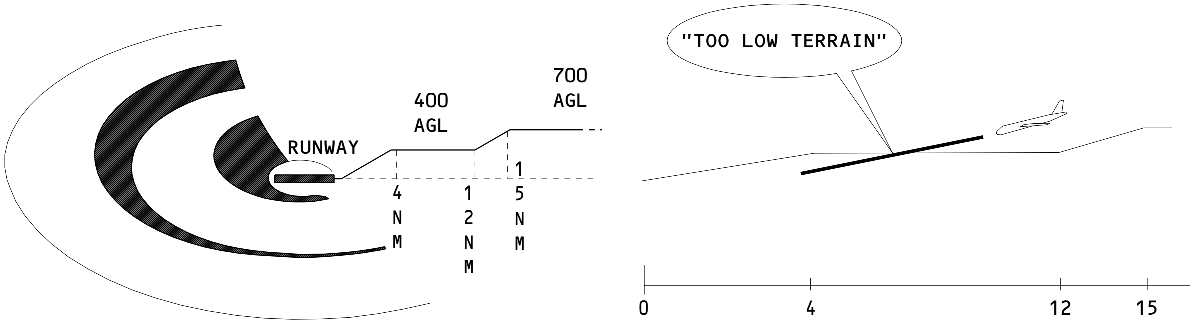
MODE 6
BANK ANGLE

MODE 6 ALTITUDE CALLOUTS

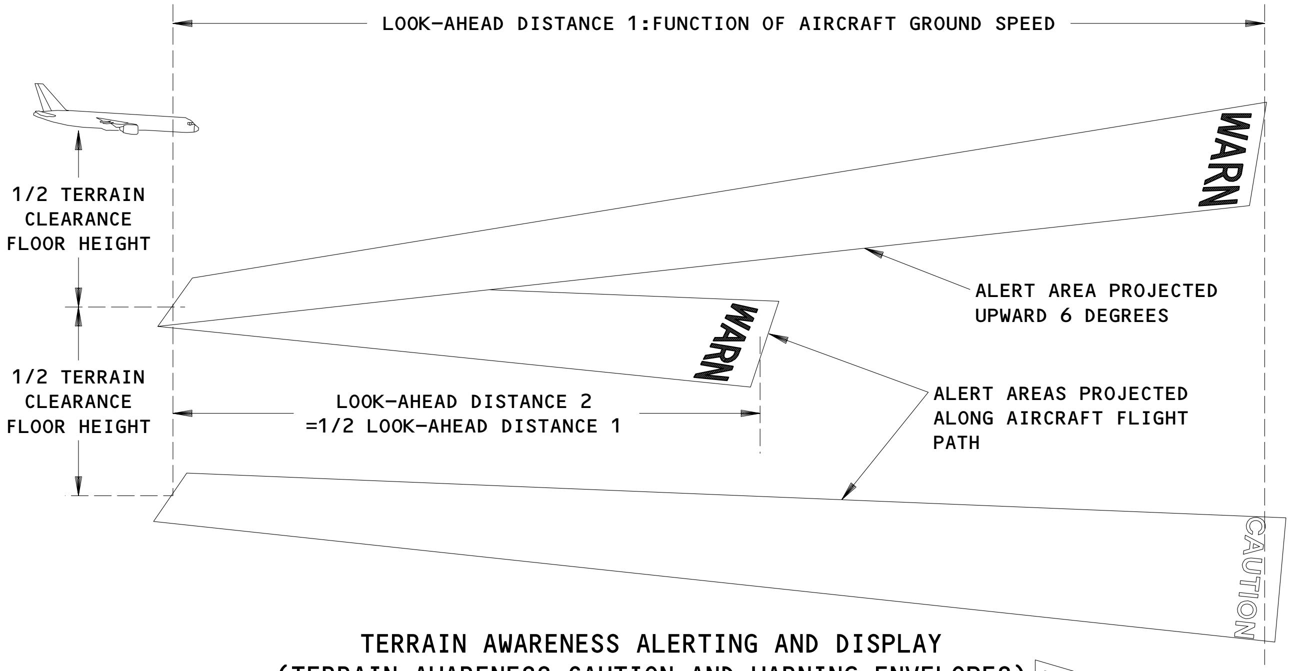
Ground Proximity Warning System Modes
Figure 2 (Sheet 3)



MODE 7
WINDSHEAR DETECTION



TERRAIN CLEARANCE FLOOR [1]



TERRAIN AWARENESS ALERTING AND DISPLAY
(TERRAIN AWARENESS CAUTION AND WARNING ENVELOPES) [1]

[1] AIRPLANES WITH ENHANCED GPWS

Ground Proximity Warning System Modes
Figure 2 (Sheet 4)

2) Mode 2B advisories and warnings are given when the flaps are in landing configuration or during an ILS approach with glideslope deviation less than plus or minus 2 dots. If the terrain closure rate is excessive, the aural TERRAIN message is heard repeatedly and the amber GND PROX light comes on. If the condition is not corrected after 1.6 seconds, the aural message changes to the PULL UP warning (repeated continuously), the red PULL UP indication shows, and the master warning lights come on. If the terrain closure rate is excessive, with the landing gear extended and the flaps in the landing configuration, the PULL UP aural warning is replaced by the TERRAIN aural caution.

(3) Mode 3 Function (Fig. 2)

(a) The mode 3 advisory signals are provided when an excessive altitude loss occurs during takeoff or missed approach. This function occurs for either the gear or flaps up. If barometric altitude decreases excessively during the initial takeoff climb or during a go-around, the DON'T SINK aural caution sounds repeatedly, and the amber GND PROX light comes on. The caution continues until a positive rate of climb is established. If the airplane descends again before climbing to the original descent altitude, another caution sounds based on the original descent altitude.

(4) Mode 4 Function (Fig. 2)

(a) Mode 4 advisory signals are provided for insufficient terrain clearances with and without the landing gear up. Mode 4 has three sub-modes: Mode 4A, 4B, and 4C.

1) Mode 4A generates advisory signals for unsafe terrain clearances with the landing gear up and flaps not in landing configuration. When the airspeed is less than 190 konts, the TOO LOW GEAR aural caution is repeated, and the amber GND PROX light comes on. If the airspeed is more than 190 knots, the TOO LOW TERRAIN aural caution is repeated, and the GND PROX light comes on.

2) Mode 4B provides a caution alert when the landing gear is down and the flaps are not in the landing position. If the airspeed is less than 159 knots, the TOO LOW FLAP aural caution is repeated and the amber GND PROX light comes on. If the airspeed is more than 159 knots, the TOO LOW TERRAIN aural caution is repeated and the amber GND PROX light comes on. If the gear is not down, the aural TOO LOW GEAR message replaces the TOO LOW FLAP caution message.

a) The TOO LOW GEAR caution is inhibited when the GND PROX GEAR OVRD switch is pressed.

b) The TOO LOW FLAP caution is inhibited when the GND PROX FLAP OVRD switch is pressed. This will simulate the flaps in a landing position if the pilot prefers to land with less than normal landing flaps.

3) Mode 4C provides alerts for insufficient terrain clearance during takeoff or go-around maneuvers. Mode 4C alerts are based on radio altitude and a minimum terrain clearance, or floor, that increases with radio altitude. Floor value can equal up to 75 percent of the maximum radio altitude achieved since takeoff or go-around. If radio altitude decreases below this floor, the aural TOO LOW TERRAIN message is heard and the amber GND PROX light comes on.

(5) Mode 5 Function (Fig. 2)

(a) Mode 5 provides caution alerts for excessive deviation from the glideslope beam during an ILS approach.

(b) If the airplane deviates excessively below an ILS glideslope, when the gear lever is down and the flaps are in landing configuration, the aural GLIDESLOPE caution message is heard and the amber GND PROX light comes on. At first the GLIDESLOPE message is heard at half the volume of the other GPWS alerts. This is called a soft alert. If the glideslope deviation increases, or if the radio altitude decreases, the GLIDESLOPE message is heard more frequently. If the glideslope deviation remains excessive, the aural GLIDESLOPE message is heard at full volume. This is called a hard alert.

(c) The GND PROX Light-G/S INHB Switch/Light can be pressed to inhibit the aural and visual mode 5 alerts.

(6) Mode 6 Function (Fig. 2)

(a) Mode 6 provides a voice at selected radio altitudes and/or barometric altitudes to advise the flight crew of the approximate radio altitude. Mode 6 can also provide a bank angle alert that gives the aural BANK ANGLE, BANK ANGLE message if the airplane's bank angle exceeds the limits defined within the GPWC.

(b) The radio altitude callout function is armed when the airplane is above 1000 feet radio altitude while in the approach mode or the airplane transitions from takeoff to approach mode. Each radio altitude aural callout is generated once while descending through the corresponding radio altitude band. Once the aural is called out, or its associated altitude band is transitioned, it will not function again until the airplane satisfies the above conditions to arm the radio altitude callout function. If two or more radio altitude callout bands are transitioned before the callouts can be issued, only the lowest altitude is called out.

(c) There are no visual alerts associated with a Mode 6 alert. Different alert callouts can be set by GPWC program pins.

(7) Mode 7 Function (Fig. 2)

(a) Mode 7 warning signals are provided when flying into an excessive windshear condition during takeoff or approach. If an excessive downdraft or tailwind condition is detected, a two tone siren followed by an aural WINDSHEAR, WINDSHEAR, WINDSHEAR warning is heard. A red WINDSHEAR message is displayed on the captain's and first officer's PFD, and the red WINDSHEAR and master warning lights come on. When the windshear warning is active, all other GPWS modes are inhibited. These modes stay inhibited as long as there is an excessive windshear condition.

(b) Aural messages are prioritized; windshear warnings take priority over all other ground proximity warning system alerts.

(8) Envelope Modulation

(a) The GPWC envelope modulation feature provides improved alert and warning protection and reduces nuisance warnings at specific locations throughout the world.

(9) AIRPLANES WITH ENHANCED GPWS;
Terrain Clearance Floor (Fig. 2)

(a) The Terrain Clearance Floor (TCF) feature creates an increasing terrain clearance envelope around the intended destination airport runway directly related to the distance from the runway. The Runway Field Clearance Floor (RFCF) similarly creates an increasing terrain clearance envelope around the intended destination runway, but specifically for those airports in which the runway elevation is higher than the adjacent terrain below the flight path. TCF alerts are based on current aircraft location, nearest runway center point position, and radio altitude. RFCF alerts are based on current aircraft location, runway center point, and height above the runway. TCF and RFCF are active during takeoff, cruise, and final approach. These alerts complement the EGPWS Mode 4 protection that provides an alert based on insufficient terrain clearance even when in landing configuration.

(b) If either the TCF or RFCF envelopes are entered, the aural message TOO LOW TERRAIN, TOO LOW TERRAIN is heard and an amber TERRAIN message is displayed on the navigation display (ND). After that, a single TOO LOW TERRAIN message is heard every time the radio altitude decreases by 20 percent. If the descent continues, the aural message PULL UP is heard, a red TERRAIN message is displayed on the ND, the red PULL UP indication shows, and master warning lights come on. The EGPWS warning messages show until the aircraft exits the alert envelope.

(10) AIRPLANES WITH ENHANCED GPWS;
Terrain Awareness Alerting and Display (Fig. 2)

(a) The Terrain Awareness Alerting and Display (TAAD) functions (terrain awareness alerting function and terrain awareness display function) predict potential conflicts between the aircraft flight path and terrain by providing a graphic display of terrain ahead. These functions use geographic position, aircraft altitude, and a terrain database to predict potential conflicts between the aircraft flight path and the terrain, and to provide graphic displays of the conflicting terrain.

1) The terrain awareness alerting algorithms continuously compute terrain clearance envelopes ahead of the aircraft. Terrain alerts are given if there is any disagreement between the boundaries of these envelopes and the terrain elevation data that is stored in the terrain database.

2) Two envelopes are computed for this function: a terrain caution alert envelope, and a terrain warning alert envelope.

3) When the aircraft enters the caution envelope, an aural CAUTION TERRAIN message is heard and an amber TERRAIN message shows on the ND. The conflicting terrain areas are also shown in solid yellow on the terrain display.

4) When the aircraft enters the warning envelope, an aural TERRAIN TERRAIN, PULL UP message is heard, a red TERRAIN message shows on the ND, the red PULL UP indication shows and the master warning lights come on. The conflicting terrain area shows in solid red on the terrain display. The PULL UP aural message is repeated until the aircraft exits the envelope.

5) EGPWS terrain display data is shown on the captain's and first officer's ND. When the terrain display is visible to the flight crew, it replaces the weather radar display. The terrain display can be selected any time by pressing the TERR switch on the EFIS control panel. If neither TERR switch is selected, the terrain data will be automatically displayed if a terrain caution or warning condition exists.

(11) Ground Proximity Warning Computer Function (Fig. 3, Fig. 3A)

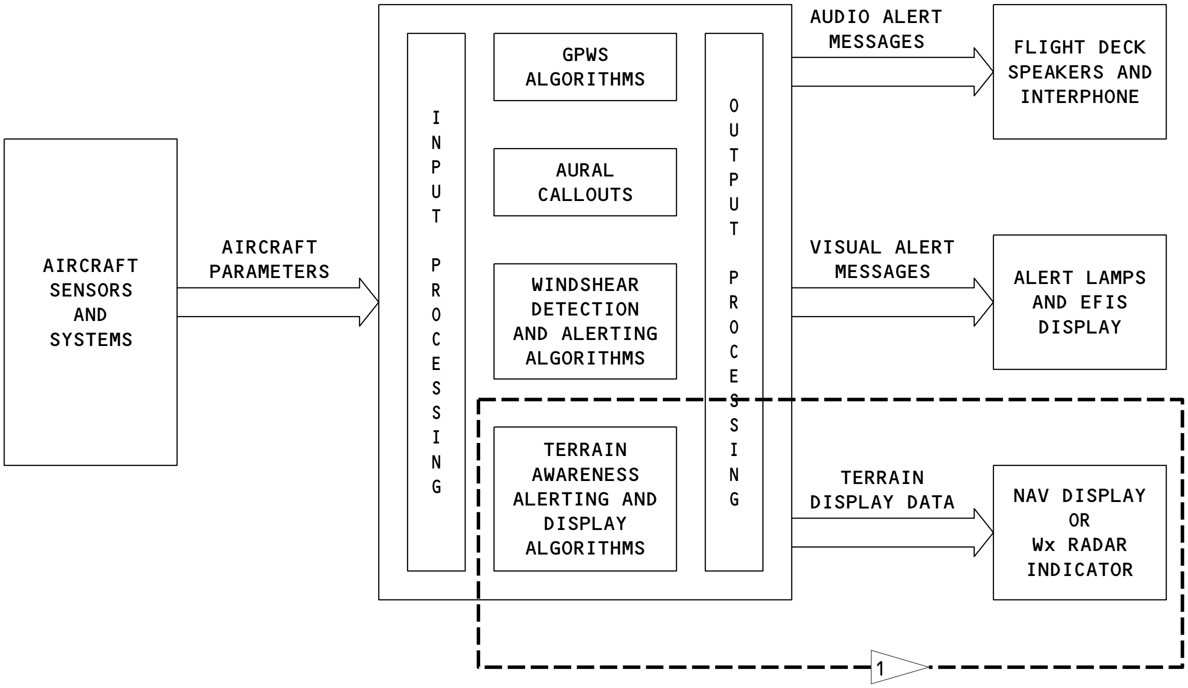
(a) The ground proximity warning computer receives input signals from several aircraft sensors and systems. These input signals are used to compute the airplane flight status. The flight status is compared with the warning and caution mode boundaries to determine if the warning and caution criteria are met. The computer generates the aural and visual messages to the warning and caution lights, displays, speakers, and the EICAS computer.

(b) The GPWS uses signals from the following systems to develop the warning and alerting modes:

1) Air Data System or combined Air Data Inertial Reference System (ADIRS)
2) EFIS System
3) Flight Management System
4) Inertial Reference System or ADIRS
5) Instrument Landing System (ILS) or ILS MMR
6) Radio Altimeter System
7) Stall Warning System

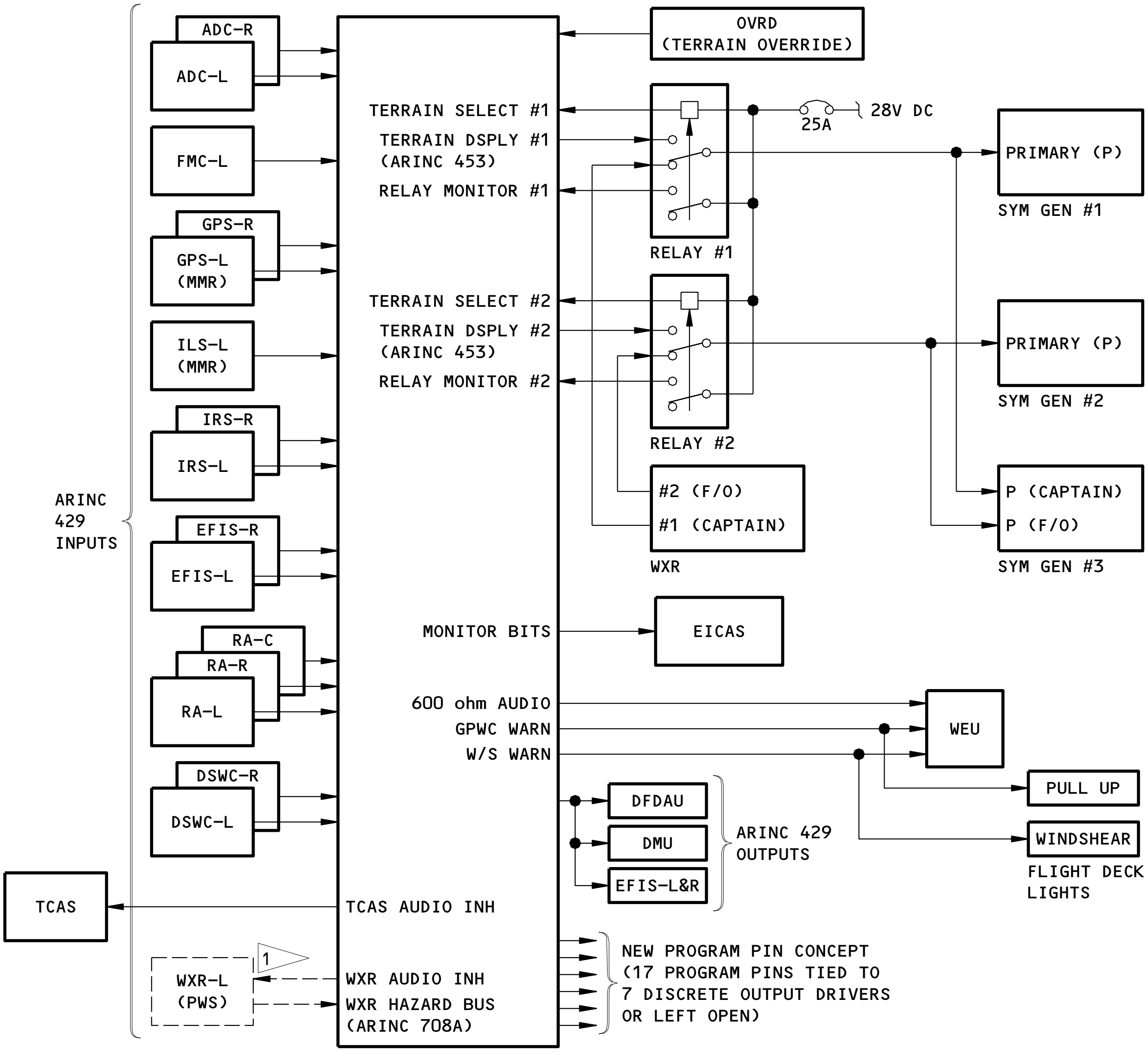
(c) AIRPLANES WITH ENHANCED GPWS;
Signals from these systems may also be used:

1) Global Positioning System Multi-Mode Receiver (MMR), if installed and connected
2) Weather Radar System, if connected
    a) Air Data System or ADIRS
    The GPWS uses true airspeed, computed airspeed, corrected barometric altitude, uncorrected barometric altitude, static air temperature, and altitude rate from the Air Data System or from the ADIRS.
    b) EFIS System
    The GPWS uses decision height and PFD discrete word data (terrain select, range) from the EFIS system.
    c) Flight Management System
    The GPWS uses latitude, longitude, and magnetic track angle data from the Flight Management System.
    d) Inertial Reference System or ADIRS
    The GPWS uses latitude, longitude, inertial altitude, inertial vertical speed, track angle magnetic, pitch attitude, roll attitude, body longitudinal acceleration, body normal acceleration, inertial vertical acceleration, pitch rate, ground speed, true track, true heading, and IRU mode data from the Inertial Reference System, or from the ADIRS.



1 AIRPLANES WITH ENHANCED GPWS

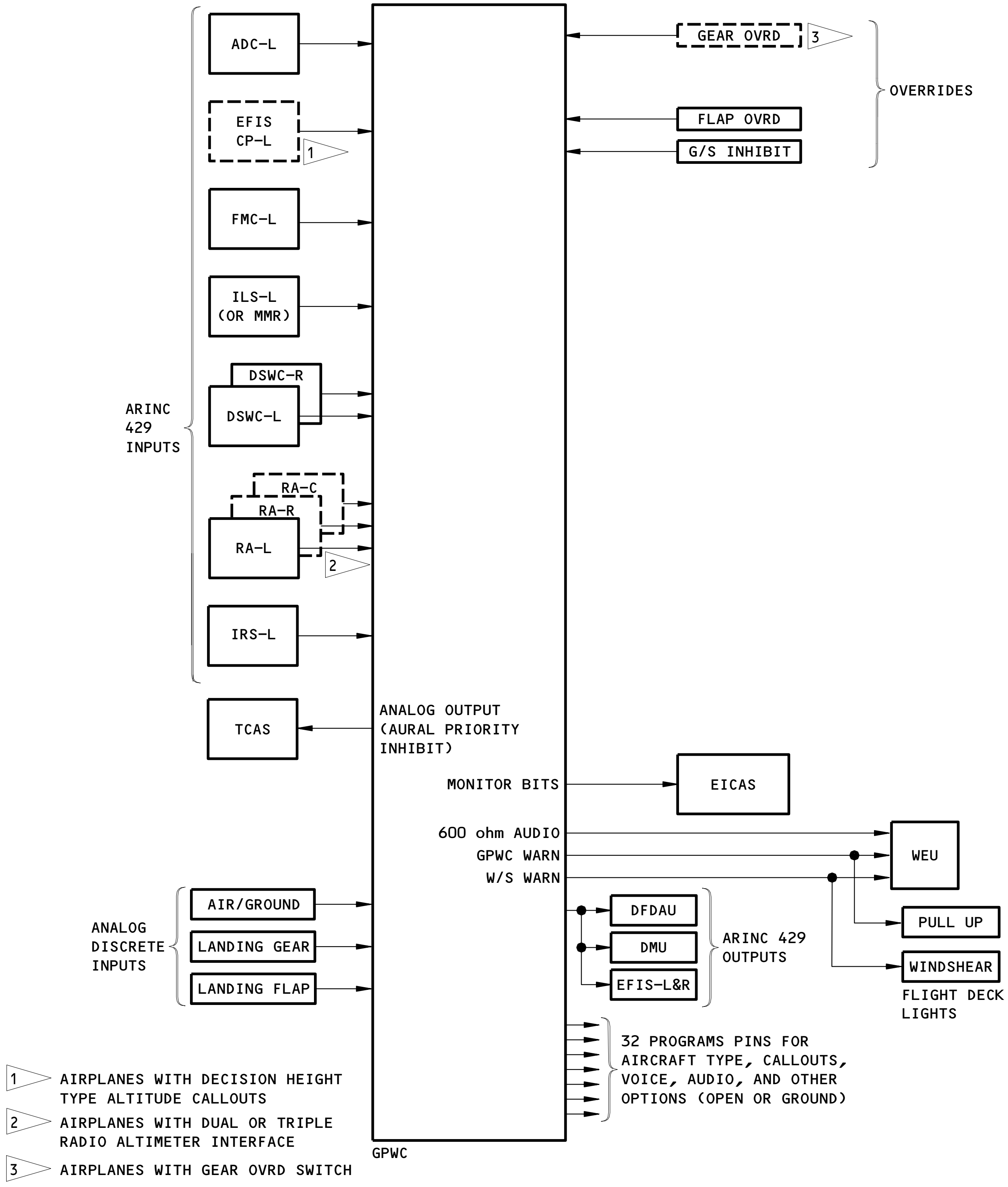
Ground Proximity Warning Computer Function
Figure 3 (Sheet 1)



1 AIRPLANES WITH PREDICTIVE WINDSHEAR (PWS)

Ground Proximity Warning Computer Function
Figure 3 (Sheet 2)

EFFECTIVITY
AIRPLANES WITH ENHANCED GPWS



Ground Proximity Warning Computer Function
Figure 3A

e) Instrument Landing System (ILS) or ILS Multi-Mode Receiver (MMR)
The GPWS uses glideslope deviation, localizer deviation, and selected runway heading data from the ILS or the MMR.

f) Radio Altimeter System
The GPWS uses radio altitude data from the Radio Altimeter System.

g) Stall Warning System
The GPWS uses indicated angle of attack, corrected angle of attack, flap position, stick shaker angle of attack, and minimum operating speed data from the Stall Warning System.

h) Global Positioning System (GPS) Multi-Mode Receiver (MMR)
The EGPWS uses latitude, longitude, latitude fine, longitude fine, altitude, vertical velocity, HDOP, VDOP, VFOM, HFOM, sensor status-NISF, date, UTC-time, ground speed, true track, and HIL data from the GPS, if GPS is installed and interfaced with the EGPWC.

i) Weather Radar System
The EGPWS uses status word data (predictive windshear alerts, onside/offside WXR data) from the Weather Radar System (WXR), if the WXR data input bus is connected.

(d) The following discrete signals are used in the computer logic for the warning and alerting modes:
1) Ground Proximity Test Switch
2) Gear Override Switch
3) Flap Override Switch
4) G/S Inhibit Switch
5) Air/Ground System

(e) AIRPLANES WITH ENHANCED GPWS;
The Enhanced GPWS also uses the following discrete signal:
1) Terrain Override Switch

(f) The Ground Proximity Test Switch is used to start the GPWC self test. The Override switches, and the G/S INHB Switch/Light are used to inhibit GPWC warnings during non-normal flight procedures. The GPWC uses the Air/Ground discrete to identify if the airplane is in the air or on the ground.

(g) AIRPLANES WITH ENHANCED GPWS;
The EGPWC also uses terrain/weather radar display bus switching relay monitor discretes to determine if the actual position of the terrain display relays differs from the commanded position.

(h) The GPWS provides ARINC 429 outputs to the following LRUs:
   1) EFIS Symbol Generators
   2) EICAS Computer
   3) Digital Flight Data Acquisition Unit (DFDAU)

(i) GPWS alerts and failures are used for alerting/advisory messages to the flight crew and are recorded by the Flight Data Recorder.

(j) AIRPLANES WITH ENHANCED GPWS;
The EGPWS provides ARINC 453 (terrain display) outputs to the EFIS Symbol Generators.
The terrain display data is first sent to the terrain switching relays. The weather radar display data is also sent to the terrain switching relays. The WXR display data or the terrain data is then switched and provided to the display system for display on the captain's and the first officer's ND's.

(k) Analog discretes are provided to the following:
   1) GND PROX Light
   2) WINDSHEAR Light
   3) PULL UP Light
   4) TCAS Computer
   5) AIRPLANES WITH ENHANCED GPWS;
      Weather Radar Transceiver(s)
   6) AIRPLANES WITH ENHANCED GPWS;
      Captain and First Officer Terrain Display Relays

(l) Lamp driver discretes are sent to dedicated flight deck lights to annunciate GPWS alerts. Dedicated discretes are sent to TCAS to inhibit lower priority TCAS alerts.

(m) AIRPLANES WITH ENHANCED GPWS;
Dedicated discretes are sent to Weather Radar to inhibit lower priority Predictive Windshear alerts.

(n) AIRPLANES WITH ENHANCED GPWS;
The captain's and first officer's terrain display discretes are used to energize the relays after manual or automatic selection of the terrain display.

(o) The GPWS provides an analog audio output to the Warning Electronic Unit (WEU). The WEU amplifies and outputs the audio signal to the flight deck warning speakers.

B. BITE and Test

(1) AIRPLANES WITH ENHANCED GPWS;
Fault Monitoring

(a) The EGPWS BITE function detects and records internal EGPWS failures. The EGPWS BITE function also detects and records failures with the systems that interface with the EGPWS.

(b) The EGPWS provides the following EICAS advisory messages:

1) GND PROX SYS
The GND PROX SYS message indicates that the EGPWS is reporting an internal or interfacing system fault that affects Modes 1-5. The GND PROX SYS message may also indicate failure of the Terrain Clearance Floor and Terrain Awareness Alerting and Display functions. GND PROX SYS will be displayed for the following reasons:
  a) There is an internal failure of the EGPWC
  b) There is a bus failure of a system that provide data to the EGPWS
  c) There is not a valid combination of EGPWC program pins
  d) There is a failure of the Terrain Clearance Floor or Terrain Awareness and Display functions.
  e) AIRPLANES WITH EICAS OPS SOFTWARE -03 THRU -99;
  The GND PROX SYS message is displayed when TERR SYS is displayed.

2) TERR POS
The TERR POS message indicates inaccurate or unavailable horizontal position input data to the EGPWC.

3) TERR OVRD
The TERR OVRD message indicates the terrain override switch is in the terrain override position.

4) WINDSHEAR SYS
The WINDSHEAR SYS message indicates that either Predictive Windshear (PWS) or the EGPWS is reporting an internal or interfacing system fault that makes part of the windshear detection and annunciation feature inoperative.
  a) AIRPLANES WITH EICAS OPS SOFTWARE -03 THRU -99;
  The WINDSHEAR SYS message will not be displayed during takeoff.

5) ALT CALLOUTS
The ALT CALLOUTS message indicates that the EGPWS is reporting a system fault that makes the Mode 6 altitude callout feature inoperative.

(c) The EGPWS provides the following EICAS status message:
  1) GND PROX SYS
     The GND PROX SYS message indicates a failure in the basic GPWS system (Modes 1-5).
  2) TERR SYS
     The TERR SYS message indicates that the EGPWS is reporting an internal or interfacing system fault that affects the TAAD and TCF modes.
  3) WINDSHEAR REAC
     The WINDSHEAR REAC message indicates that the EGPWS is reporting a system fault that makes the reactive windshear detection and annunciation feature inoperative.

(2) AIRPLANES WITH ENHANCED GPWS;
EGPWS Self Test

(a) The EGPWS self test may be initiated by setting the TEST switch to the GND PROX position. The self test can also be started by pressing the PRESS TO SELF TEST switch on the front panel of the EGPWC. Self test can only be performed when the airplane is on the ground.

(b) Self test cycles through the caution and warning modes and the altitude advisory callouts (if selected) and annunciates the flight deck messages, lights and aural warnings, and terrain display test pattern. It is also possible to hear if any EGPWS internal or external faults exist, which options are selected, and the EGPWC configuration data.

(c) The configuration data includes the following information:
  1) Part number 965-0976-0XX-YYY-ZZZ
  2) Mod Status XXXX
  3) Serial Number XXX-XXX
  4) Application Software Version XXXX
  5) Configuration Software Version XXXX
  6) Terrain Database Version XXX
  7) Envelope Mod Database Version XXX
  8) Boot Code Version XXX
  9) Aircraft Type XXX

10) Audio Menu X
11) Altitude Callout Menu XX
12) All other selected options

(d) There are 6 levels of self test. There are two types of self test cancel to help navigate through the levels of self test. When the cockpit or front panel self test button is pressed for less than 2 seconds it is called a SHORT CANCEL. When the cockpit self test button is pressed for more than 2 seconds it is called a LONG CANCEL. The 6 levels of EGPWS self test are:

1) Level 1 - Go/No Go
   This level identifies the functions that are selected and whether they are operational. There is a short level 1 self test and a long level 1 self test.
   a) Short Level 1 Self Test
      The short level 1 self test is started by pressing the self test button for less than two seconds. The short level 1 self test will indicate the EGPWC modes that are operational and it will indicate the EGPWC modes that are not operational.
   b) Long Level 1 Self Test
      The long level 1 self test is started by pressing and holding the self test button until the self test voices start. The long level 1 self test performs the short level 1 self test, then announces all of the warning, caution, and altitude callout voices that are configured.
2) Level 2 - Current Faults
   This level provides the internal and external faults that the EGPWC currently detects. The level 2 self test is started by pressing the self test button within 3 seconds of the end of the level 1 self test.
3) Level 3 - EGPWS Configuration
   This level indicates the current hardware, software, databases, and program pin inputs that the EGPWC detects. The level 3 self test is started by pressing the self test button during the level 2 self test, then pressing it again when the PRESS TO CONTINUE message is heard.
   During the level 3 self test, a SHORT CANCEL will start to announce the next level 3 configuration item. A LONG CANCEL will stop the level 3 self test and the PRESS TO CONTINUE message will be heard.

4) Level 4 - Fault History
This level provides the history of internal and external faults that the EGPWC detected over the last 10 flight legs. The level 4 self test is started by pressing the self test button after the level 3 PRESS TO CONTINUE message is heard.
During a level 4 self test, a SHORT CANCEL will start to announce the faults for the next flight leg. A LONG CANCEL will stop the level 4 self test and the PRESS TO CONTINUE message will be heard.

5) Level 5 - Warning History
This level identifies the warnings and cautions that the EGPWS has provided during the last 10 flight legs. Level 5 self test is started by pressing the self test button after the level 4 PRESS TO CONTINUE message is heard.
During a level 5 self test, a SHORT CANCEL will start to announce the warnings and cautions for the next flight leg. A LONG CANCEL will stop the level 5 self test and the PRESS TO CONTINUE message will be heard.

6) Level 6 - Discrete Test
This level announces changes in discrete inputs. The level 6 self test is started by pressing the self test button when the level 5 PRESS TO CONTINUE message is heard. A DISCRETE INPUT TEST - PRESS TO CANCEL message is heard every 60 seconds during the level 6 self test. Any discrete inputs that change state during the level 6 self test are announced. The level 6 self test is stopped by a SHORT CANCEL or a LONG CANCEL.

(3) AIRPLANES WITH ENHANCED GPWS;
EGPWC Front Panel
The EGPWC front panel has 3 EGPWS status LEDs, a PRESS TO SELF TEST switch, a PCMCIA interface, an RS-232 test plug, and a 1/4 inch audio jack.

(a) EGPWS Front Panel Status LEDs:

1) External Fault LED
The yellow External Fault LED indicates that the EGPWC has detected an external interface fault. The EGPWC should not be removed or replaced when this condition exists unless the red Computer Fail LED is also illuminated. All external faults should be fixed before removing or replacing the EGPWC.

2) Computer OK LED
The green Computer OK LED indicates that the EGPWC is operating correctly with no internal faults. The EGPWC does not need to be removed when this condition exists.

3) Computer Fail LED
The red Computer Fail LED indicates that the EGPWC has an internal fault. The EGPWC should be removed, replaced, and repaired.

(b) EGPWS Front Panel PRESS TO SELF TEST Switch
The PRESS TO SELF TEST switch is used to do the self test from the EGPWC in the electronic equipment compartment. Headphones are needed to hear the self test information.

(c) PCMCIA Interface
The PCMCIA interface is used to load the databases that the EGPWS uses. There are four LEDs next to the PCMCIA interface that show the status of the data transfer. These LEDs are only active when data is loading.

(d) RS-232 Test Plug
The RS-232 test plug can be used to download fault data from the EGPWC to a personal computer.

(e) 1/4 Inch Audio Jack
The EGPWC front panel has a headphone jack that can be used for the self test. Standard headphones with a 2-connector 1/4 inch audio plug can be used.

(4) AIRPLANES WITHOUT ENHANCED GPWS;
GPWS Front Panel Tests

(a) When the STATUS/HISTORY switch is set to the PRESENT STATUS position, the BITE display shows the system status at that time. In the FLIGHT HISTORY postion, the failure history of the system for the last ten flights is shown.

(b) AIRPLANES WITH -207 GPWC AND SUBSEQUENT;
The GPWC front panel display will show the ARINC 429 data contained on maintenance labels 351 thru 353 after the database version. These maintenance data labels show the current status of program pins, input discretes, and selected DH validity. The maintenance labels will show for 30 seconds. Select the PRESENT STATUS two times to cancel the maintenance labels. The format for these labels is as follows:

* 1*ABCDE* label 351
* 2*ABCDE* label 352
* 3*ABCDE* label 353

(c) The present status sequence is shown as follows:
  1) An all segments test of each character
  2) The airplane model
  3) A list of selected options
  4) Message IN FLIGHT FAILURE *** SEE FLIGHT HISTORY *** (only if a failure occured on the last flight)
  5) A list of current faults (if no faults occured the message SYSTEM OK or GPWS OK is shown)
  6) Current software version
  7) Current database version of the GPWC
  8) AIRPLANES WITH -207 GPWC AND SUBSEQUENT;
     GPWC eight character format displays for the maintenance data contained on labels 351, 352, and 353
  9) The message END TEST.

(d) The flight history sequence is shown as follows:
  1) A list of in-flight failures with the message shown, followed by the flights the fault occured
  2) If no faults occured during the previous ten flights the message PREVIOUS TEN FLIGHTS OK or PREVIOUS TEN FLIGHTS SYSTEM OK is shown.
  3) The message END TEST.

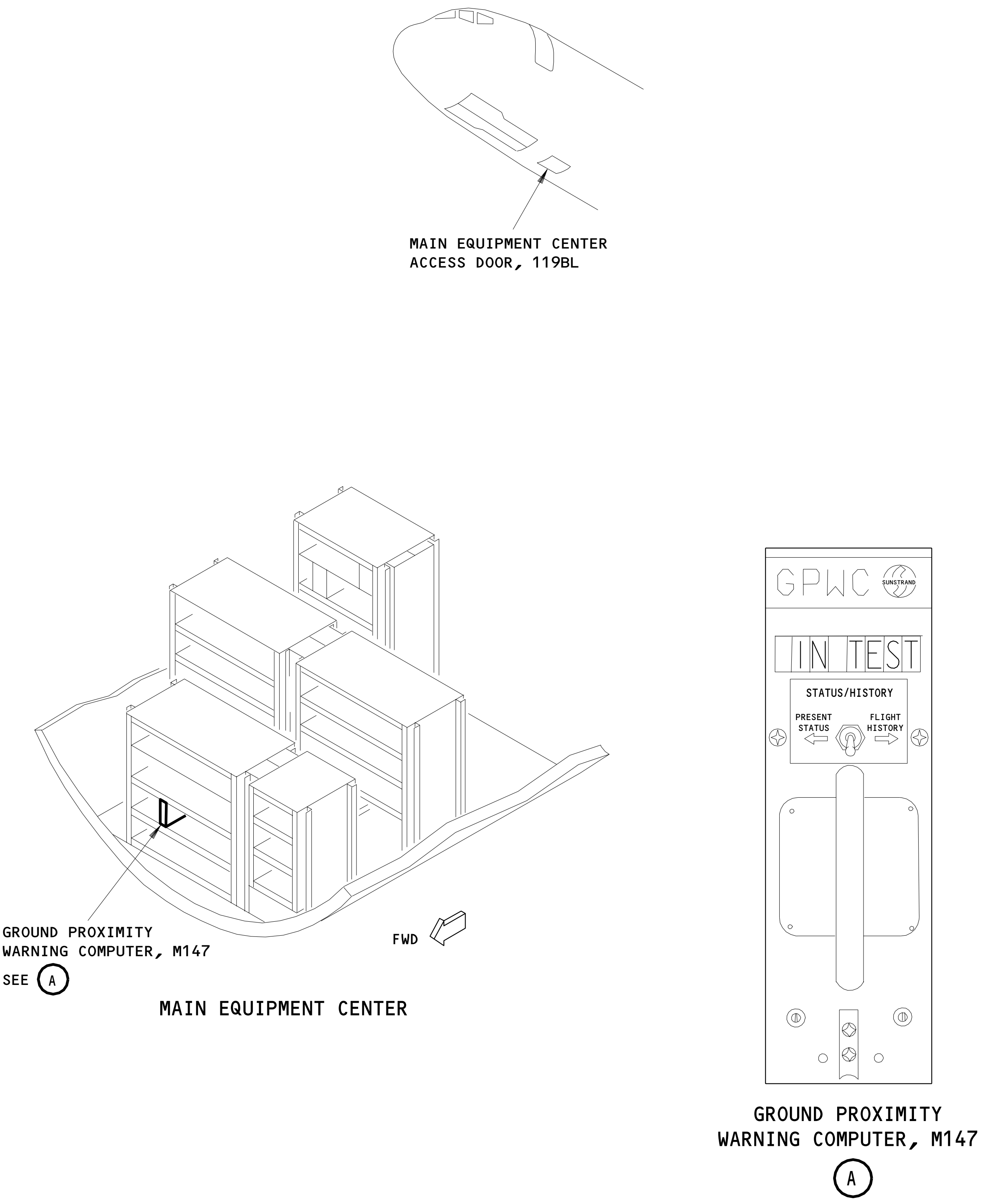
(e) The air/ground discrete input signal is used to separate each flight. The oldest data is erased from the memory so that the failures for the last ten flights are stored in memory.

GROUND PROXIMITY WARNING SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -			FLT COMPT, P11	
GND PROX, C592		1	11F4	*
COMPUTER - GROUND PROXIMITY WARNING, M147	1	1	119BL, MAIN EQUIP CTR, E2-3	34-46-01
LIGHT - GND PROX PULL UP, M779	2	1	FLT COMPT, P1	*
LIGHT - WINDSHEAR, L649	2	1	FLT COMPT, P1	*
PANEL - (FIM 30-32-00/101) MISCELLANEOUS TEST, M10398				
SWITCH - GND PROX TEST, S2	2	1	FLT COMPT, P61	*
SWITCH-LIGHT - GND PROX/CONFIG GEAR OVRD, S10231	2	1	FLT COMPT, P3	*
SWITCH-LIGHT - GND PROX FLAP OVRD, S10172	2	1	FLT COMPT, P3	*
SWITCH-LIGHT - GND PROX - G/S INHB, N10015	2	1	FLT COMPT, P1	*

* SEE THE WDM EQUIPMENT LIST

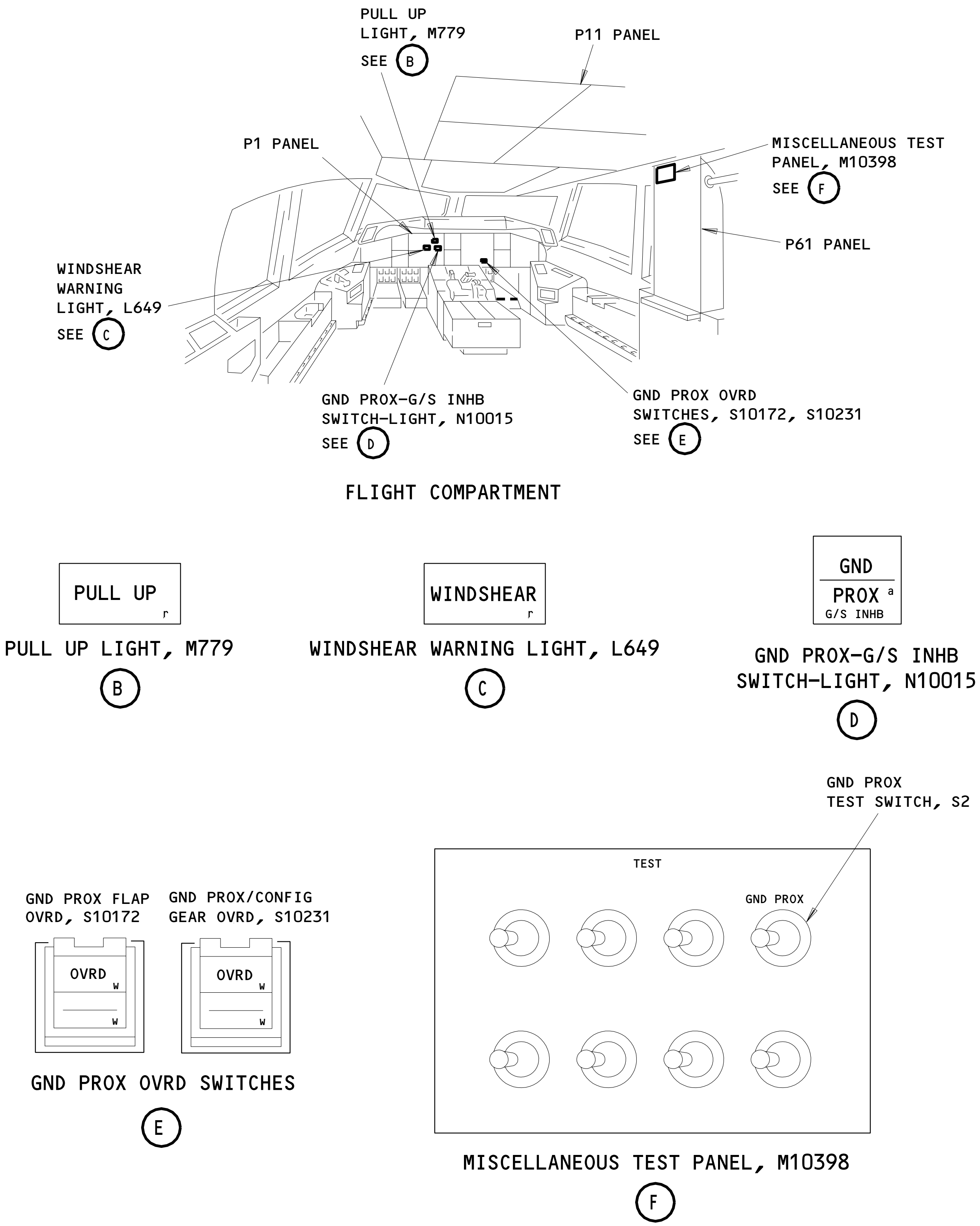
Ground Proximity Warning System - Component Index
Figure 101



Ground Proximity Warning System - Component Location
Figure 102 (Sheet 1)

EFFECTIVITY
AIRPLANES WITHOUT ENHANCED GPWC

K17452



FLIGHT COMPARTMENT

PULL UP LIGHT, M779
B

WINDSHEAR WARNING LIGHT, L649
C

GND PROX-G/S INHB
SWITCH-LIGHT, N10015
D

GND PROX OVRD SWITCHES
E

MISCELLANEOUS TEST PANEL, M10398
F

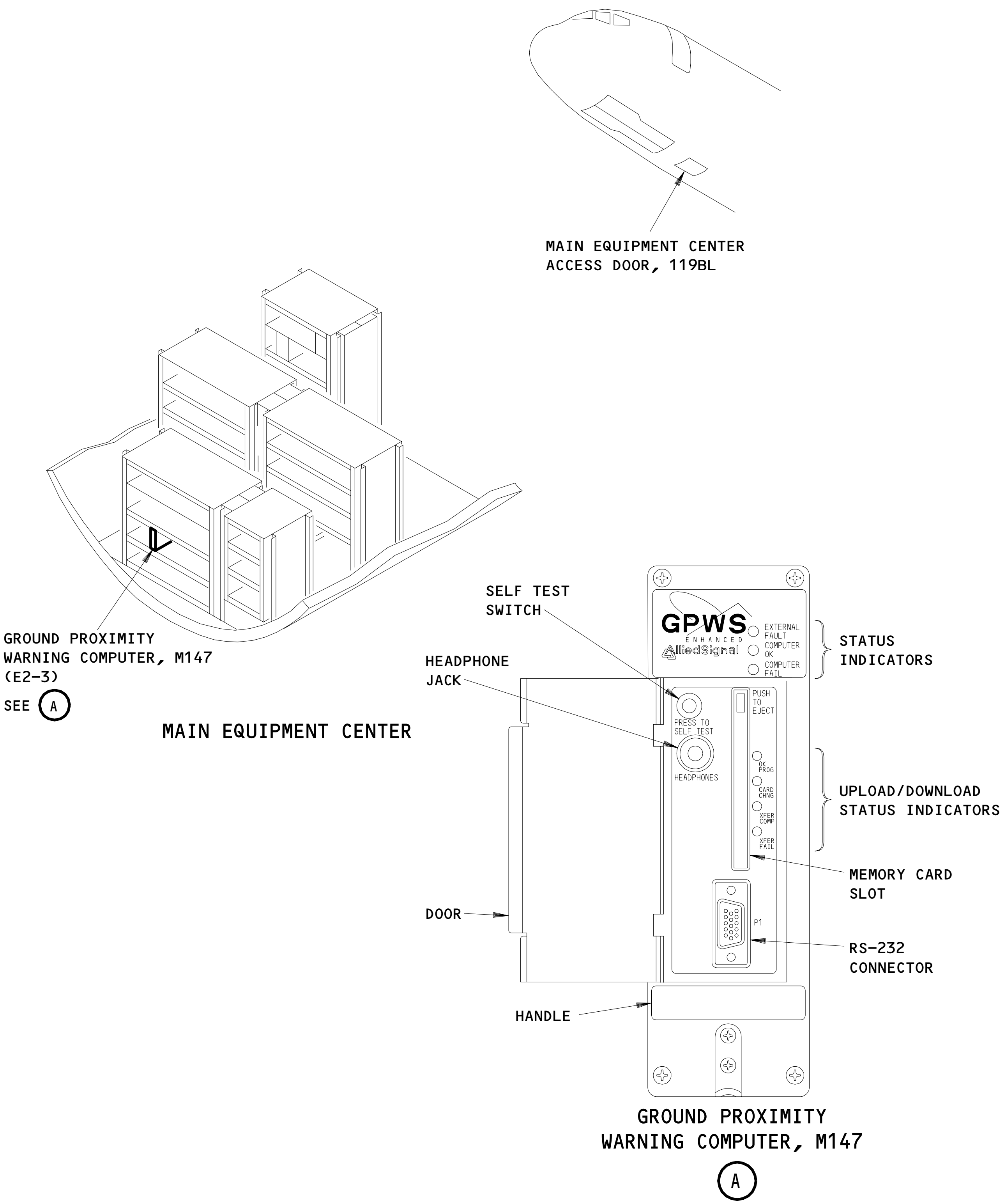
Ground Proximity Warning System - Component Location
Figure 102 (Sheet 2)

GROUND PROXIMITY WARNING SYSTEM

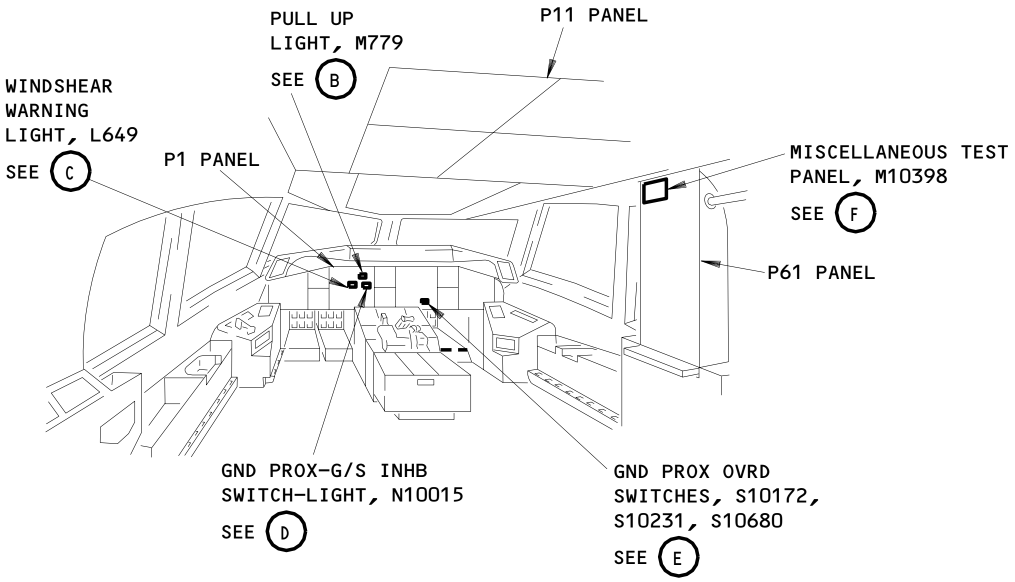
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
CIRCUIT BREAKER -			FLT COMPT, P11	
GND PROX, C592		1	11F4	*
TERRAIN DISPLAY, C4509		1	11E7	*
COMPUTER - GROUND PROXIMITY WARNING, M147	1	1	119BL, MAIN EQUIP CTR, E2-3	34-46-01
LIGHT - GND PROX PULL UP, M779	2	1	FLT COMPT, P1	*
LIGHT - WINDSHEAR, L649	2	1	FLT COMPT, P1	*
PANEL - (FIM 30-32-00/101)				
MISCELLANEOUS TEST, M10398				
SWITCH - GND PROX TEST, S2	2	1	FLT COMPT, P61	*
SWITCH-LIGHT - GND PROX GEAR OVRD, S10231	2	1	FLT COMPT, P3	*
SWITCH-LIGHT - GND PROX FLAP OVRD, S10172	2	1	FLT COMPT, P3	*
SWITCH-LIGHT - GND PROX - G/S INHB, N10015	2	1	FLT COMPT, P1	*
SWITCH-LIGHT - TERR OVRD, S10680	2	1	FLT COMPT, P3	*

* SEE THE WDM EQUIPMENT LIST

Ground Proximity Warning System - Component Index
Figure 101



Ground Proximity Warning System - Component Location
Figure 102 (Sheet 1)



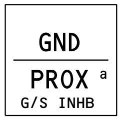
FLIGHT COMPARTMENT

PULL UP LIGHT, M779

B

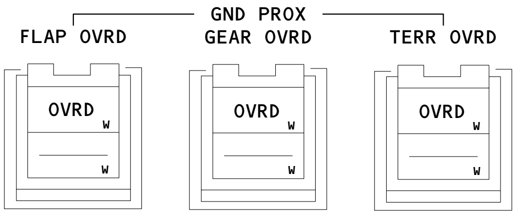
WINDSHEAR WARNING LIGHT, L649

C



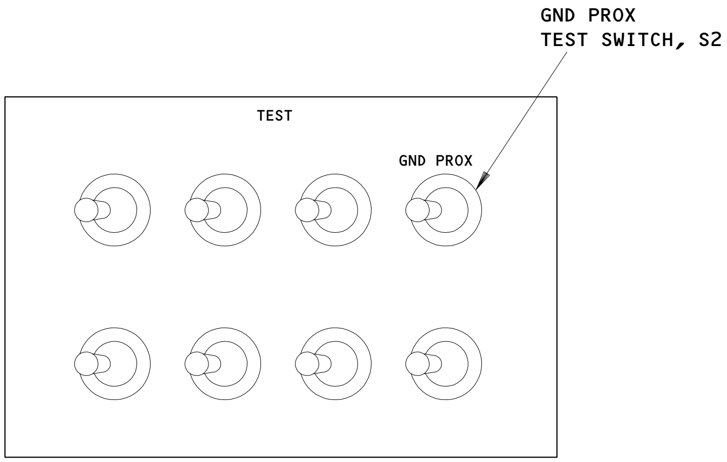
GND PROX-G/S INHB
SWITCH-LIGHT, N10015

D



GND PROX OVRD SWITCHES,
S10172, S10231, S10680

E



MISCELLANEOUS TEST PANEL, M10398

F

Ground Proximity Warning System - Component Location
Figure 102 (Sheet 2)

GROUND PROXIMITY WARNING SYSTEM - MAINTENANCE PRACTICES

1. General
   A. This procedure has these tasks:
      (1) Load the terrain database into the ground proximity warning computer (GPWC).
      (2) Verify the terrain database part number.

TASK 34-46-00-472-001

2. Load the Terrain Database (Fig. 201)
   A. General
      (1) This task provides instructions to load the terrain database into the ground proximity warning computer (GPWC).
      (2) The terrain database load is inhibited when the airplane is in the air. The database will automatically load into the GPWC after you install the database flash card into the card slot on the front panel of the GPWC.
      (3) You can ignore caution notes (shown on the PCMCIA card) about damage if you put in or remove the card when the power is on. The EGPWC automatically applies and removes PCMCIA card power.
   B. Standard Tools and Equipment
      (1) Card - Flash, PCMCIA, Loaded with the Terrain Database (commercially available)
   C. References
      (1) AMM 34-46-00/501, Ground Proximity Warning System
   D. Access
      (1) Location Zones

119/120	Main Equipment Center

   E. Procedure

S 862-002

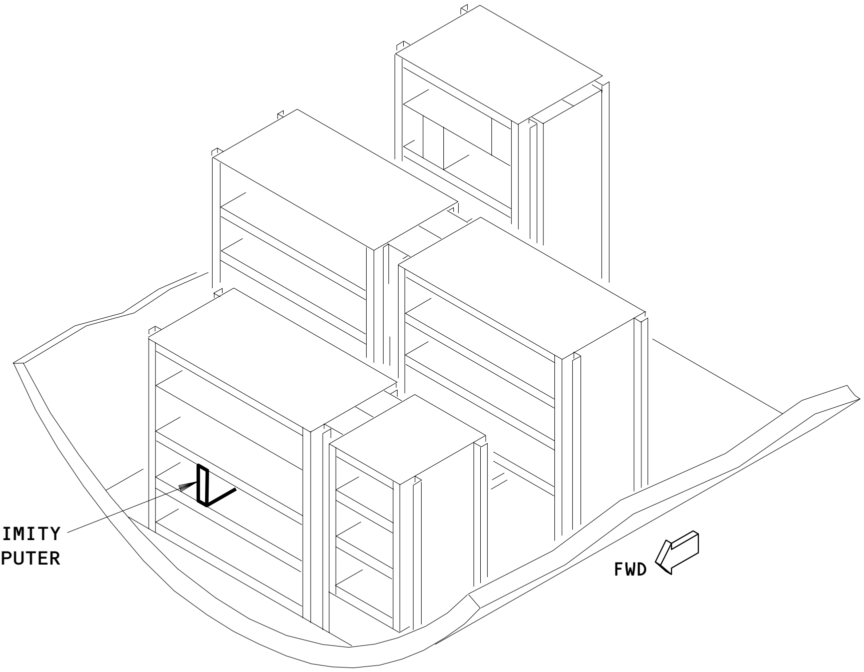
(1) Make sure the ground proximity warning system (GPWS) is operational (AMM 34-46-00/501).

S 862-003

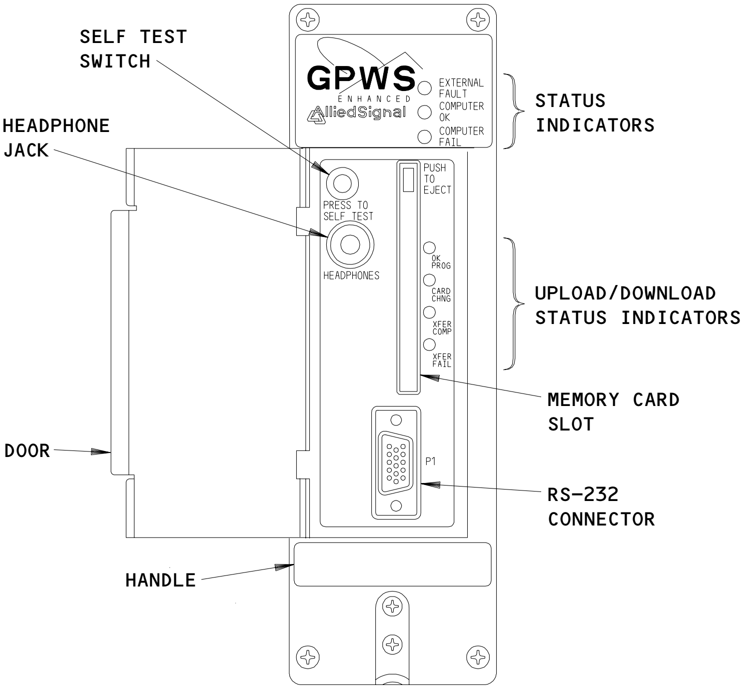
(2) Make sure the COMPUTER OK light on the front panel of the GPWC is on.

S 862-004

(3) Make sure the EXTERNAL FAULT and the COMPUTER FAIL lights on the front panel of the GPWC are off.



MAIN EQUIPMENT CENTER



GROUND PROXIMITY WARNING COMPUTER

A

Ground Proximity Warning Computer
Figure 201

S 862-005

(4) Open the door on the front panel of the GPWC.

S 862-006

(5) Make sure the IN PROG, CARD CHNG, XFER COMP, and XFER FAIL lights on the GPWC are off.

S 472-025

(6) Do these steps to load the terrain database:

<u>NOTE</u>: If you install a version of the terrain database that is not compatible with the hardware memory, then the EGPWC will not operate. Replacement of the EGPWC will be necessary. More information about version compatibility can be found in the applicable Honeywell Service Bulletin.

(a) Insert the card for the terrain database into the card slot on the GPWC.

<u>NOTE</u>: After the card is installed, the terrain database will automatically load into the GPWC. Depending on the terrain database version, it takes between 5 and 45 minutes to load the terrain database.

(b) Make sure the IN PROG light on the GPWC comes on.

(c) If the CARD CHNG light on the GPWC comes on, do these steps to change the card:

<u>NOTE</u>: When the CARD CHNG light comes on, it indicates that more than one card is necessary to load the terrain database.

1) Push the eject button on the GPWC and remove the card.
2) Insert the next card for the terrain database into the card slot on the GPWC.
3) Make sure the IN PROG light on the GPWC comes on.

(d) If the XFER FAIL light on the GPWC comes on, it indicates that the terrain database load has failed. You need to load the terrain database again.

(e) After the load of the terrain database is complete, make sure the IN PROG light on the GPWC goes off and the XFER COMP light comes on.

(f) Push the eject button on the GPWC and remove the card.

(g) Make sure the COMPUTER OK light on the GPWC is on and all the other lights are off.

S 752-020

(7) Do this task: Verify the Terrain Database Part Number (AMM 34-46-00/201).

TASK 34-46-00-702-009

3. Verify the Terrain Database Part Number (Fig. 201)

A. General

(1) This task provides instructions to verify the terrain database part number. The GPWC level 3 self-test provides aural annunciations of the current configuration that include the terrain database part number.

(2) The GPWC level 3 self-test can only be activated when the airplane is on the ground.

B. Standard Tools and Equipment

(1) Headphones - with 2 Connector 1/4 inch Audio Plug (commercially available)

C. References

(1) AMM 34-46-00/501, Ground Proximity Warning System

D. Access

(1) Location Zones

211/212	Flight Compartment
117	Electrical and Electronics Compartment, LH
118	Electrical and Electronics Compartment, RH

E. Procedure

S 862-010

(1) Make sure the ground proximity warning system (GPWS) is operational (AMM 34-46-00/501).

S 862-011

(2) Make sure the COMPUTER OK light on the front panel of the GPWC is on and the other lights are off.

S 862-013

(3) Open the door on the front panel of the GPWC.

S 862-023

(4) Plug the headphone into the headphone jack of the GPWC.

S 862-015

(5) Make sure there is no card in the card slot of the GPWC.

S 702-016

(6) Do these steps to do the level 3 self-test of the GPWC:

NOTE: The GPWC self-test has six levels that operate in sequence. The level 3 self-test will occur after the level 2 self-test.

(a) Set and release the GND PROX test switch on the miscellaneous test panel.
(b) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
(c) After the level 2 self-test starts, set and release the GND PROX switch again to go to the level 3 self-test.

NOTE: The level 3 self-test starts with the voice annunciation

"SYSTEM CONFIGURATION".

(d) You will hear a sequence of the configuration annunciations for the GPWS.
1) Make sure you hear the terrain database part number after the TERRAIN DATABASE VERSION annunciation.

NOTE: There are several configuration annunciations in the level 3 self-test. To advance to the terrain database part number annunciation, you need to push the GND PROX switch after each annunciation.

(e) Record the terrain database part number.

(f) After you hear the terrain database part number, continue to push the GND PROX switch until you hear the PRESS TO CONTINUE annunciation.

<u>NOTE</u>: After the PRESS TO CONTINUE annunciates, the level 3 self-test is complete. If you do not push the GND PROX switch again, the self-test sequence will stop.

(g) If your airline maintains a terrain database version requirement, make sure the terrain database version is correct.
  1) If the terrain database version is not correct, then do this task: Load the Terrain Database (AMM 34-46-00/201).

S 862-022

(7) Remove the headphones from the headphone jack on the GPWC.

S 862-021

(8) Close the door on the front panel of the GPWC.

GROUND PROXIMITY WARNING SYSTEM (GPWS) - ADJUSTMENT/TEST

1. General
   A. This procedures has an operational test and a system test. The operational test uses BITE to do a fast check for correct operation. The system test is a full check of the GPWS, and more test equipment is necessary.

TASK 34-46-00-715-001-001

2. GPWS - Operational Test
   A. General
      (1) The operational test uses only the BITE procedure, and test equipment or special procedures are not necessary.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 34-21-00/201, Inertial Reference System
   C. Access
      (1) Location Zones

211/212	Flight Compartment

   D. Prepare for the GPWS Test

S 865-002-001

      (1) Make sure this circuit breaker is closed:
         (a) P11 Circuit Breaker Panel
            1) 11F4, GND PROX

S 865-011-001

      (2) Supply electrical power (AMM 24-22-00/201).
   E. GPWS Operational Test

S 865-012-001

      (1) Energize and align the left IRU (AMM 34-21-00/201).

S 865-014-001

      (2) Push the STATUS switch on the EICAS display select panel to set the STATUS page.
         (a) Make sure that the EICAS message, GND PROX BITE, (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-026-001

(3) Do these steps:

- (a) Set and hold the GND PROX switch on the miscellaneous test panel for a minimum of 6 seconds.
- (b) Make sure that you see, and hear this sequence of indications:

NOTE: 12 seconds can occur before GND PROX BITE shows on the bottom display.

NOTE: SB 31-78 replaces the EICAS message GND PROX BITE with GND PROX SYS.

AURALS	WARNING LIGHTS	EADI MSG	EICAS MSG
GLIDESLOPE	GND PROX (A)		GND PROX BITE
WHOOP WHOOP PULL-UP	MASTER (R), PULL UP (R)		GND PROX BITE
SIREN	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
SINK RATE			GND PROX BITE
WHOOP WHOOP PULL-UP			GND PROX BITE
TERRAIN			GND PROX BITE
WHOOP WHOOP PULL-UP			GND PROX BITE
DON'T SINK			GND PROX BITE
TOO-LOW TERRAIN			GND PROX BITE
TOO-LOW GEAR			GND PROX BITE
TOO-LOW FLAPS			GND PROX BITE
TOO-LOW TERRAIN			GND PROX BITE
GLIDESLOPE			GND PROX BITE
SIREN			GND PROX BITE
WINDSHEAR,			GND PROX BITE
WINDSHEAR,			GND PROX BITE
WINDSHEAR			GND PROX BITE

AURALS	WARNING LIGHTS	EADI MSG	EICAS MSG

S 865-027-001

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-46-00-735-028-001

3. GPWS - System Test

A. General

(1) The system test includes the GPWS operational test and a test of the system interfaces. You must do these tests in sequence.

B. Equipment

(1) Pressure Controller, Smith Industries 3006KTQ-1
Smiths Industries Aerospace and Defense Systems
Co., Basingstoke Div.
Winchester Rd.
Basingstoke, Hants
RG22 6HP ENGLAND

(2) Adapter - Static Port, NAV-AIDS 33410LH-125-4
Nav-Aids LTD.
2955 Diab St.
Montreal, Quebec
Canada H4S 1M1

(3) Adapter - Pitot Probe, NAV-AIDS P75701-4
Nav-Aids LTD.
2955 Diab ST.
Montreal, Quebec,
Canada H4S 1M1

(4) Landing Gear Lock Pins, B32001-4
(5) MLG Lock Pin Removal/Installation Tool, A32015-1
(6) Manually operated stop watch

C. References

(1) AMM 24-22-00/201, Electrical Power Control
(2) AMM 27-51-00/201, Trailing Edge Flap System
(3) AMM 29-11-00/201, Pressurize/Depressurize Main Hydraulic System
(4) AMM 31-41-00/501, Engine Indication and Crew Alerting System
(5) AMM 32-00-20/201, Landing Gear Downlocks
(6) AMM 34-11-00/201, Pitot-Static System
(7) AMM 34-12-00/501, Air Data Computing System
(8) AMM 34-21-00/201, Inertial Reference System
(9) AMM 34-33-00/201, Radio Altimeter System

D. Access

(1) Location Zones

211/212	Flight Compartment

E. Prepare for the Test

S 865-038-001

(1) Supply electrical power (AMM 24-22-00/201).

S 865-094-001

WARNING: MAKE SURE THE FLAPS ARE CLEAR BEFORE YOU START THEM. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(2) Make sure the flaps are in the normal position (zero degrees).

S 865-095-001
(3) Install the landing gear lock pins (AMM 32-00-20/201).

S 865-096-001
(4) Remove hydraulic power from the landing gear systems.

S 435-035-001
(5) Use the pitot probe adapters to connect the pressure controller to the captain's (top left) pitot probe (AMM 34-11-00/201).

S 435-036-001
(6) Use the static port adapter to connect the pressure controller to the captain's static port (top left) (AMM 34-11-00/201).

S 865-039-001
(7) Energize and align the IRUs (AMM 34-21-00/201).

S 715-040-001
(8) Do the GPWS - Operational Test.

F. Interface Test

S 865-097-001
(1) Push the STATUS switch on the EICAS display select panel to set the STATUS page.

S 865-099-001
(2) Open the RAD ALTM LEFT (11F5) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE, shows on the bottom display.

NOTE: The EICAS message must show in less than 18 seconds.

NOTE: SB 31-78 replaces the EICAS message GND PROX BITE with GND PROX SYS.

S 865-100-001
(3) Close the RAD ALTM LEFT (11F5) circuit breaker.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

S 435-101-001
(4) Connect the Radio Altimeter Ramp Test Set to the left Radio Altimeter (RA) RT Unit (AMM 34-33-00/201).

S 865-102-001
(5) Set the radio altitude to zero plus or minus nine feet.

S 865-104-001
(6) AIRPLANES WITH ILS;
Open the ILS LEFT (11E10) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display.

S 865-105-001
(7) AIRPLANES WITH MMR;
Open the MMR LEFT (11E10) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display.

S 865-106-001
(8) AIRPLANES WITH ILS;
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

S 865-107-001
(9) AIRPLANES WITH MMR;
Close the MMR LEFT (11E10) circuit breaker.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

S 865-109-001
(10) Open the AIR DATA CMPTR LEFT (11A10) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display.

S 865-110-001
(11) Close the AIR DATA CMPTR LEFT (11A10) circuit breaker.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

S 865-111-001
(12) Open the GND PROX (11F4) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display.

S 865-112-001
(13) Close the GND PROX (11F4) circuit breaker on the P11 panel.
  (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

S 865-113-001

(14) Open the WARN ELEX A (11J33) and WARN ELEX B (11B18) circuit breakers on the P11 panel.
   - (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display.

S 865-114-001

(15) Close the WARN ELEX A (11J33) and WARN ELEX B (11B18) circuit breakers.
   - (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show.

G. Gear Input Discrete Test - Mode 4A

S 865-117-001

(1) Make sure the landing gear downlock pins are installed.

S 865-118-001

(2) Make sure the left and right hydraulic systems are released of pressure.

S 865-119-001

(3) Increase the airspeed to 150 knots.

S 865-120-001

(4) Set the radio altitude to 1500 feet.

S 865-121-001

(5) Set the landing gear lever to OFF.

S 865-122-001

(6) Decrease the radio altitude to 400 feet at a rate of less than 1800 feet per minute.
   - (a) Make sure the indications that follow occur:
      - 1) The amber GND PROX light comes on.
      - 2) You hear the aural warning, TOO LOW-GEAR, continuously.

S 865-123-001

(7) Push the GND PROX/CONFIG GEAR OVRD switch on the P3-1 panel to the OVRD position.
   - (a) Make sure the indications that follow occur:
      - 1) All the warnings stop.
      - 2) The gear OVRD indication shows.

S 865-124-001

(8) Push the GND PROX/CONFIG GEAR OVRD switch.
   - (a) Make sure the OVRD indication does not show.

S 865-125-001

(9) Increase the radio altitude to 800 feet.

S 865-126-001

(10) Slowly decrease the radio altitude to 400 feet at a rate of less than 1800 feet per minute.
  (a) Make sure the indications that follow occur:
    1) The amber GND PROX light comes on.
    2) You hear the aural warning, TOO LOW-GEAR, continuously.

S 865-127-001

(11) Move the landing gear lever to the DN position.
  (a) Make sure all the warnings stop.

H. Flap Input Discrete Test - Mode 4B

S 865-128-001

(1) Decrease the radio altitude to 150 feet at a rate of less than 1800 feet per minute.
  (a) Make sure the indications that follow occur:
    1) The amber GND PROX light comes on.
    2) You hear the aural warning, TOO LOW-FLAPS, continuously.

S 865-129-001

(2) Push the GND PROX FLAP OVRD switch on the P3-1 panel to the OVRD position.
  (a) Make sure the indications that follow occur:
    1) All the warnings stop.
    2) The flap OVRD indication shows.

S 865-130-001

(3) Increase the radio altitude to 800 feet.

S 865-131-001

(4) Push the GND PROX FLAP OVRD switch.
  (a) Make sure the OVRD indication does not show.

S 865-132-001

(5) Decrease the radio altitude to 150 feet at a rate of less than 1800 feet per minute.
  (a) Make sure the warning indications that follow occur:
    1) The amber GND PROX light comes on.
    2) You hear the aural warning, TOO LOW-FLAPS.

S 865-133-001

WARNING: KEEP ALL PERSONS, TEST FIXTURES, TOOLS, ETC., AWAY FROM THE OPERATION AREA OF THE TRAIL EDGE FLAPS AND RELATED MOVABLE PARTS. INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT PERMIT THE ALTERNATE DRIVE MOTOR TO OPERATE FOR MORE THAN FOUR MINUTES. PERMIT THE MOTOR TO COOL FOR AT LEAST 20 MINUTES AFTER USE. DAMAGE TO THE MOTOR CAN OCCUR.

(6) Use alternate electric power to set the flaps to 25 (land position) (AMM 27-51-00/201).

NOTE: It is only necessary to set the trailing edge flaps. You can ignore the stick shaker activation if it occurs during this test, or you can open the stick shaker circuit breakers (11J21 and 11C11).

(a) Make sure all warnings stop.

I. Glide Slope Inhibit Discrete Test - Mode 5

S 865-134-001

(1) Push the amber GND PROX G/S INHB switch/light on the captain's P1-3 panel and hold it for 30 seconds.
   (a) Make sure the GND PROX BITE (GND PROX SYS, POST-SB 31-78) message shows on the lower EICAS display unit.

S 865-135-001

(2) Release the amber GND PROX G/S INHB switch/light on the captain's P1-3 panel.
   (a) Make sure the GND PROX BITE (GND PROX SYS, POST-SB 31-78) message goes off.

J. Air/Ground Input Discrete Test

S 865-151-001

(1) Push the GND PROX FLAP OVRD switch.
   (a) Make sure the flap OVRD indication shows.

S 865-152-001

(2) Set the radio altitude to -10 feet.

S 865-153-001

(3) Set the airspeed to 40 knots.

S 865-154-001

(4) Increase the radio altitude to 500 feet.

S 865-155-001
(5) Set the GND PROX test switch on the miscellaneous test panel found on the right side panel.

S 865-156-001
(6) Hold the test switch for at least 6 seconds and release it.
    (a) Make sure the aural self-test sequence occurs.

S 865-157-001
(7) Open the LANDING GEAR POSITION AIR/GND SYS 2 (11C70) circuit breaker.

S 865-158-001
(8) Set the GND PROX test switch on the miscellaneous test panel found on the right side panel.

S 865-159-001
(9) Hold the test switch for at least 6 seconds and release it.
    (a) Make sure the aural self-test sequence does not occur.

S 865-160-001
(10) Close the LANDING GEAR POSITION AIR/GND SYS 2 (11C70) circuit breaker.

S 865-161-001
(11) Push the GND PROX FLAP OVRD switch.
    (a) Make sure the flap OVRD indication does not show.

K. Put the Airplane Back to Its Usual Condition

S 865-090-001
(1) Set the airspeed to zero.

S 865-089-001
(2) Set the radio altitude to zero.

S 085-060-001
(3) Remove the test equipment.

S 865-061-001
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

GROUND PROXIMITY WARNING SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure contains two tasks. The first task is the operational test of the Ground Proximity Warning System (GPWS), and the second task is the system test.
   B. The operational test uses BITE to do a fast check for correct operation. Test equipment or special procedures are not necessary.
   C. The system test uses the maintenance label (hex code) to do a complete check of the GPWS.

TASK 34-46-00-715-001-002

2. GPWS - Operational Test
   A. General
      (1) The operational test is the self-test mode of the Ground Proximity Warning Computer (GPWC). This test will make sure of the conditions that follow:
         - the GPWC modules function correctly
         - the interface and failure warning systems operate
   B. References
      (1) 24-22-00/201, Electrical Power - Control
      (2) 34-21-00/201, Inertial Reference System
   C. Access
      (1) Location Zones
         211/212 Flight Compartment

   D. Prepare for the GPWS Operational Test

      S 865-077-002
      (1) Make sure this circuit breaker is closed:
         (a) P11 Circuit Breaker Panel
            1) 11F4, GND PROX

      S 865-003-002
      (2) Supply electrical power (Ref 24-22-00/201).

E. GPWS Operational Test

S 865-086-002
(1) Energize and align the IRS (Ref 34-21-00/201).

S 865-087-002
(2) Make sure the landing gear lever is in the down position.

S 865-088-002
(3) Push the STATUS switch on the EICAS display select panel.

S 755-089-002
(4) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-090-002
(5) Make sure the EFI switches on the left and right instrument source select panels are in the NORM position.

S 865-091-002
(6) Set the COMPUTER switch on the EICAS display select panel to the L position.

S 865-092-002
(7) Set the left IRS mode switch to the NAV position.

S 745-093-002
(8) Set and hold the GND PROX test switch on the miscellaneous test panel for at least 10 seconds.
   (a) Make sure this sequence of visual and aural indications occurs:

      NOTE: The EICAS message, GND PROX BITE, may not show on the bottom display for up to 12 seconds.

      NOTE: SB 31-78 replaces the EICAS message "GND PROX BITE" with "GND PROX SYS".

AURALS	WARNING LIGHTS	EADI MSG	EICAS MESSAGE
"GLIDESLOPE"	GND PROX (A)		GND PROX BITE
"WHOOP WHOOP PULL-UP"	MASTER (R), PULL UP (R)		GND PROX BITE
SIREN	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
"WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR,	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
WINDSHEAR"	MASTER, WINDSHEAR (R)	WINDSHEAR (R)	GND PROX BITE
"SINK RATE"			GND PROX BITE
"WHOOP WHOOP PULL-UP"			GND PROX BITE
"TERRAIN"			GND PROX BITE
"WHOOP WHOOP PULL-UP"			GND PROX BITE
"DON'T SINK"			GND PROX BITE
"TOO-LOW TERRAIN"			GND PROX BITE
"TOO-LOW GEAR"			GND PROX BITE
"TOO-LOW FLAPS"			GND PROX BITE
"TOO-LOW TERRAIN"			GND PROX BITE
"GLIDESLOPE"			GND PROX BITE
GUI 010, 011			
POST SB 34-162;			
"BANK ANGLE-			GND PROX BITE
BANK ANGLE"			
SIREN			GND PROX BITE
"WINDSHEAR,			GND PROX BITE
WINDSHEAR,			GND PROX BITE
WINDSHEAR"			GND PROX BITE

F. Put the Airplane Back to Its Usual Condition

S 865-094-002

(1) Remove electrical power if it is not necessary (Ref 24-22-00/201).

TASK 34-46-00-735-095-002

3. GPWS - System Test

A. General

(1) The system test includes the GPWS operational test, does a check of the system interfaces, and makes sure of correct operation of the different GPWS modes. You must do these mode checks in sequence.

NOTE: The mode 2 test is not done because the baro rate, radio altitude, and airspeed functions are examined by other mode tests.

B. Equipment

(1) Landing Gear Lock Pin, B32001-4

(2) MLG Lock Pin Removal/Installation Tool, A32015-1
(3) Manually operated stop watch.

C. References
(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 32-00-20/201, Landing Gear Down Lock
(3) AMM 34-46-00/501, Ground Proximity Warning System

D. Access
(1) Location Zones

211/212	Flight Compartment

E. Prepare for Test

S 865-096-002
(1) Supply electrical power (Ref 24-22-00/201).

S 865-097-002

WARNING: MAKE SURE THE FLAPS ARE CLEAR BEFORE YOU START THEM. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(2) Make sure the flaps are in the normal position (zero degrees).

S 865-098-002
(3) Install the landing gear lock pins (Ref 32-00-20/201).

S 865-099-002
(4) Remove hydraulic power from the landing gear systems.

S 715-107-002
(5) Do the GPWS - Operational Test (AMM 34-46-00/501).

S 865-108-002
(6) Set the EFI switch on the left instrument source select panel to the ALTN position.

S 715-109-002

(7) Do the GPWS - Operational Test again (AMM 34-46-00/501).

S 865-110-002

(8) Set the EFI switch on the left instrument source select panel to the NORM position.

F. Interface Test

S 865-111-002

(1) Set the COMPUTER switch on the EICAS display select panel to the L position.

S 865-112-002

(2) Push the STATUS switch on the EICAS display select panel.

S 865-113-002

(3) Open the RAD ALTM LEFT (11F5) circuit breaker on the P11 panel.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display in less than 18 seconds.

S 865-114-002

(4) Close the RAD ALTM LEFT (11F5) circuit breaker.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-115-002

(5) Open the ILS LEFT (11E10) circuit breaker on the P11 panel.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display in less than 24 seconds.

S 865-116-002

(6) Close the ILS LEFT (11E10) circuit breaker.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-117-002

(7) Open the AIR DATA CMPTR LEFT (11A10) circuit breaker on the P11 panel.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display in less than 18 seconds.

S 865-118-002

(8) Close the AIR DATA CMPTR LEFT (11A10) circuit breaker.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-119-002

(9) Open the GND PROX (11F4) circuit breaker on the P11 panel.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display in less than 10 seconds.

S 865-120-002

(10) Close the GND PROX (11F4) circuit breaker.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

S 865-121-002

(11) Open the WARN ELEX A (11J33) and WARN ELEX B (11B18) circuit breakers on the P11 panel.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), shows on the bottom display in less than 12 seconds.

S 865-122-002

(12) Close the WARN ELEX A (11J33) and WARN ELEX B (11B18) circuit breakers.
   (a) Make sure the EICAS message, GND PROX BITE (GND PROX SYS, POST-SB 31-78), does not show on the bottom display.

G. Gear Discrete Test - Mode 4A

<u>NOTE</u>: Ignore the hex characters where X's show.

S 865-123-002

(1) Make sure the landing gear downlock pins are installed.

S 865-124-002

(2) Make sure the left and right hydraulic systems are released of pressure.

S 865-125-002

(3) Make sure the landing gear lever is in the DOWN position.

S 865-126-002

(4) Set the STATUS/HISTORY switch on the GPWC front panel to the PRESENT STATUS position.
   (a) Wait 25 seconds.
   (b) Make sure the GPWC display shows 1*1XXXX* after the database version

S 865-127-002

(5) Set the landing gear lever to the OFF position.
   (a) Make sure the GPWC display changes to 1*0XXXX*.

S 865-128-002

(6) Push the GND PROX/CONFIG GEAR OVRD switch on the first officer's panel, P3-1.
   (a) Make sure these indications occur:
      1) GPWC display changes to 1*1XXXX*.
      2) The GEAR OVRD indication shows.

S 865-129-002

(7) Push the GND PROX/CONFIG GEAR OVRD switch.
   (a) Make sure the GEAR OVRD indication does not show.

S 865-130-002

(8) Set the landing gear lever to the DOWN position.

H. Flap Discrete Test - Mode 4B

<u>NOTE</u>: Ignore the hex characters where X's show.

S 865-131-002

WARNING: MAKE SURE THE FLAPS ARE CLEAR BEFORE YOU START THEM. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(1) Apply hydraulic pressure to move the flaps.

NOTE: Do not pressurize the hydraulic system, if the flaps are in the landing position (25 or 30 degrees).

S 865-132-002

(2) Set the flaps to 20 degrees.

S 865-133-002

(3) Set the STATUS HISTORY switch on the GPWC front panel to the PRESENT STATUS position.
- (a) Wait 25 seconds
- (b) Make sure the GPWC display shows 1*X0XXX* after the database version.

S 865-134-002

(4) Set the flaps to 25 degrees.
- (a) Make sure the GPWC display shows 1*X1XXX*.

S 865-135-002

(5) Set the flaps to 20 degrees.
- (a) Make sure the GPWC display shows 1*X0XXX*.

S 865-136-002

(6) Push the GND PROX FLAP OVRD switch.
- (a) Make sure these indications occur:
  - 1) The GPWC display shows 1*X1XXX*.
  - 2) The FLAP OVRD indication shows.

S 865-137-002

(7) Push the GND PROX FLAP OVRD switch.
- (a) Make sure the FLAP OVRD indication does not show.

S 865-138-002

WARNING: MAKE SURE THE FLAPS ARE CLEAR BEFORE YOU START THEM. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(8) Set the flaps to 25 degrees.

I. Glideslope Inhibit Discrete Test - Mode 5

NOTE: Ignore the hex characters where X's show.

S 865-139-002

(1) Set the STATUS HISTORY switch on the GPWC front panel to the PRESENT STATUS position.
  (a) Wait 25 seconds.
  (b) Make sure the GPWC display shows 1*XX0XX* after the database version.

S 865-140-002

(2) Push and hold the yellow GND PROX G/S INHB switch/light on the captain's panel, P1-3.
  (a) Make sure the GPWC display shows 1*XX1XX*.

S 865-141-002

(3) Release the GND PROX G/S INHB switch/light.
  (a) Make sure the GPWC display shows 1*XX0XX*.

J. AIR/GND Discrete Test

NOTE: Ignore the hex characters where X's show.

S 865-142-002

(1) Set the STATUS HISTORY switch on the GPWC front panel to the PRESENT STATUS position.
  (a) Wait 25 seconds.
  (b) Make sure the GPWC display shows 1*XXX0X* after the database version.

S 865-143-002

(2) Open the LANDING GEAR POSITION AIR/GND SYS 2 (11C70) circuit breaker.
  (a) Make sure the GPWC display shows 1*XXX1X*.

S 865-144-002

(3) Close the LANDING GEAR POSITION AIR/GND SYS 2 (11C70) circuit breaker.

K. Put the Airplane Back to Its Usual Condition

S 095-165-002

(1) Remove the test equipment.

S 865-166-002

(2) Remove electrical power if it is not necessary (Ref 24-22-00/201).

GROUND PROXIMITY WARNING SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure has these tasks:
      (1) An operational test of the ground proximity warning system (GPWS)
      (2) A system test of the GPWS.
   B. The operational test uses BITE to do a fast check for correct operation. Test equipment or special procedures are not necessary.
   C. The system test uses the headphones to do a complete test of the GPWS.
      (1) The system test uses GPS data. The airplane must be moved to a position where the GPS antennas have a clear view of the GPS satellites.

TASK 34-46-00-715-001-003

2. GPWS - Operational Test
   A. General
      (1) The operational test is the self-test mode of the Ground Proximity Warning Computer (GPWC).
      (2) The operational test of the GPWS makes sure that the computer (GPWC), the module, and the interfaces to other systems operate correctly.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 31-41-00/501, Engine Indication and Crew Alerting System
      (3) AMM 34-21-00/201, Inertial Reference System
      (4) AMM 34-22-00/501, Electronic Flight Instrument System
      (5) AMM 34-31-00/501, Instrument Landing System
   C. Access
      (1) Location Zones

211/212	Flight Compartment

   D. Prepare for the Test

S 865-002-003

      (1) Supply electrical power (AMM 24-22-00/201).

S 865-003-003

      (2) Make sure the left and right IRU's are initialized and aligned (AMM 34-21-00/201).

S 865-004-003

      (3) Make sure these circuit breakers are closed:
         (a) P11 Circuit Breaker Panel
            1) 11F4, GND PROX

2) 11E7, TERR DISPLAY

S 865-005-003

(4) Make sure the landing gear lever is in the DN position.

S 865-006-003

(5) Push the STATUS switch on the EICAS display select panel (AMM 31-41-00/501).

S 755-007-003

(6) Make sure the EICAS message, GND PROX SYS, does not show on the bottom display.

S 865-008-003

(7) Make sure the EFI switches on the left and right instrument source select panels are in the NORM position.

S 865-009-003

(8) Set the COMPUTER switch on the EICAS display select panel to the L position.

S 865-010-003

(9) Make sure the left ILS is tuned to a valid frequency (AMM 34-31-00/501).

S 865-011-003

(10) Set the mode switches on the left and right EFIS control panels to the MAP position (AMM 34-22-00/501).

S 865-012-003

(11) Set the TERR switches on the left and right EFIS control panels to the on position.
  (a) Make sure the TERR message and the terrain display data show on the left and right EHSI's.

E. Procedure

S 745-013-003

(1) Set and hold the GND PROX test switch on the miscellaneous test panel for at least 10 seconds.
  (a) These messages will show at some time during the test:

NOTE: The sequence does not matter.

1) GND PROX SYS - EICAS Advisory
2) WINDSHEAR SYS - EICAS Advisory
3) ALT CALLOUTS - EICAS Advisory
4) TERR POS - EICAS Advisory
5) GND PROX SYS - EICAS Status
6) WINDSHEAR REAC - EICAS Status
7) TERR SYS - EICAS Status

8) TERR TEST - EHSI's
9) TERR FAIL - EHSI's

S 755-014-003

(2) Make sure the EICAS message, GND PROX SYS, shows on the bottom display within 30 seconds.

S 755-015-003

(3) Make sure the aural and visual indications are as follows:

AURAL	WARN LIGHTS
"GLIDESLOPE"	GND PROX G/S INHB Light (amber)
"PULL UP"	PULL UP Light (red) Master Warning Light (red)
Two Tone Siren "WINDSHEAR, WINDSHEAR, WINDSHEAR"	WINDSHEAR Light (red) WINDSHEAR message on the two EADI's (red)
"TERRAIN, TERRAIN, PULL UP"	PULL UP Light (red) Master Warning Light (red) TERRAIN message on the two EHSI's (red, then amber) GND PROX G/S INHB Light (amber)
"SINK RATE"	Off
"PULL UP"	Off
"TERRAIN"	Off
"PULL UP"	Off
"DON'T SINK, DON'T SINK"	Off Off
"TOO LOW TERRAIN"	Off
"TOO LOW GEAR"	Off
"TOO LOW FLAPS"	Off
"TOO LOW TERRAIN"	Off
"GLIDESLOPE"	Off
Two Tone Siren	Off
"WINDSHEAR, WINDSHEAR, WINDSHEAR"	Off
"TOO LOW TERRAIN"	Off
"CAUTION, TERRAIN"	Off
"CAUTION, TERRAIN"	Off
"TERRAIN, TERRAIN"	Off
"PULL UP"	Off

F. Put the Airplane Back to Its Usual Condition

S 865-016-003

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-46-00-735-017-003

3. GPWS - System Test

A. General

(1) The system test is a complete test of the GPWS. The test includes the GPWS operational test, does a check of the program pins, does a check of the system interfaces and discrete inputs, and makes sure of correct operation of the terrain display data.

(2) This test uses GPS data. The airplane must be moved to a position where the GPS antennas have a clear view of the GPS satellites.

B. Equipment

(1) Headphones

C. References

(1) AMM 24-22-00/201, Electrical Power - Control
(2) AMM 29-11-00/201, Main Hydraulic Systems
(3) AMM 32-00-20/201, Landing Gear Down Lock
(4) AMM 34-46-00/201, Maintenance Practices
(5) AMM 34-46-01/401, Removal/Installation
(6) AMM 34-46-00/501, Ground Proximity Warning System

D. Access

(1) Location Zones

211/212	Flight Compartment

E. Prepare for the Test

S 865-018-003

(1) Supply electrical power (AMM 24-22-00/201).

S 865-193-003

(2) Make sure that the airplane is in a location where it can receive GPS signals.

S 865-019-003

WARNING: MAKE SURE THE FLAPS ARE CLEAR BEFORE YOU START THEM. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

(3) Make sure the flaps are in the normal position (zero degrees).

S 865-020-003

(4) Make sure the landing gear lock pins are installed (AMM 32-00-20/201).

S 865-021-003

(5) Remove hydraulic power from the landing gear systems.

S 715-022-003

(6) Do the GPWS - Operational Test (AMM 34-46-00/501).

S 485-023-003

(7) Plug the headphones into the jack on the front panel of the GPWC.

F. Present Status Check

S 745-024-003

(1) Make sure the green COMPUTER OK light on the front panel of the GPWC is on.

G. Program Pin Test

NOTE: You can do this test in the flight compartment or in the main equipment center. If you do the test from the flight compartment, you do not need headphones and you use the GND PROX test switch on the miscellaneous switch panel. If you do the test from the electronic equipment compartment, you use the headphones and the PRESS TO SELF TEST switch on the front panel of the EGPWC.

S 745-025-003

(1) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-026-003

(2) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.

S 745-189-003

(3) After the level 2 self-test starts, set and release the GND PROX switch again to go to the level 3 self-test.

NOTE: The level 3 self-test starts with the voice annunciation "SYSTEM CONFIGURATION".

(a) Make sure you hear these aural messages in the sequence that follows:

1) PART NUMBER XXX-XXXX-XXX-XXX-XXX
2) MOD STATUS XXXX
3) SERIAL NUMBER XXX-XXX
4) APPLICATION SOFTWARE VERSION XXX
5) CONFIGURATION SOFTWARE VERSION XXXX
6) TERRAIN DATABASE VERSION XXX
7) ENVELOPE MODULATION DATABASE VERSION XXX
8) BOOT CODE VERSION XXX

9) AIRCRAFT TYPE ONE NINE NINE
10) AUDIO MENU ZERO
11) ALTITUDE CALLOUT MENU TWO
12) ALTERNATE VOLUME ONE SELECTED
13) OPTIONAL INPUTS SELECTED
14) TRIPLE RADIO ALTIMETER SELECTED
15) WINDSHEAR CAUTION DISABLED

<u>NOTE</u>: When you hear the "PRESS TO CONTINUE", wait approximately 30 seconds for the GPWC to stop the self-test mode.

H. Interface Test

S 745-183-003

(1) The Interface Test uses the Level 2 Self-Test feature of the Enhanced GPWS to test the various data bus interfaces.

<u>NOTE</u>: When you listen for specific aural messages during the test, ignore the other aural messages that can occur.

I. DSWC BUS Interface Test

S 865-028-003

(1) Open these circuit breakers:
  (a) P11 Circuit Breaker Panel
    1) 11B18, WARN ELEX B
    2) 11J33, WARN ELEX A

S 745-029-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-030-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: DSWC BUS 1 INACTIVE, DSWC BUS 2 INACTIVE

S 865-031-003
(4) Close these circuit breakers:
  (a) P11 Circuit Breaker Panel
    1) 11B18, WARN ELEX B
    2) 11J33, WARN ELEX A

J. RADIO ALTIMETER BUS Interface Test

S 865-032-003
(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F5, RADIO ALTM LEFT

S 745-033-003
(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-034-003
(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: LEFT RADIO ALTIMETER BUS INACTIVE

S 865-035-003
(4) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F5, RADIO ALTM LEFT

S 865-036-003
(5) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F26, RADIO ALTM RIGHT

S 745-037-003
(6) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-038-003
(7) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: RIGHT RADIO ALTIMETER BUS INACTIVE

S 865-039-003

(8) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F26, RADIO ALTM RIGHT

K. ILS and GPS BUS Interface Test

S 865-040-003

(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E10, MMR LEFT

S 745-041-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-042-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: ILS BUS 1 INACTIVE, GPS BUS 1 INACTIVE

S 865-043-003

(4) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E10, MMR LEFT

S 865-044-003

(5) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E31, MMR RIGHT

S 745-045-003

(6) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-046-003

(7) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: GPS BUS 2 INACTIVE

S 865-047-003

(8) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E31, MMR RIGHT

L. AIR DATA BUS Interface Test

S 865-141-003

(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11A10, AIR DATA CMPTR LEFT

S 745-049-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-050-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: AIR DATA BUS 1 INACTIVE

S 865-142-003

(4) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11A10, AIR DATA CMPTR LEFT

S 865-143-003

(5) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F30, AIR DATA CMPTR RIGHT

S 745-053-003

(6) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-054-003

(7) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: AIR DATA BUS 2 INACTIVE

S 865-144-003

(8) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F30, AIR DATA CMPTR RIGHT

M. EFIS BUS Interface Test

S 865-056-003

(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F8, EFIS SYM GEN LEFT

S 745-057-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-058-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: EFIS BUS 1 INACTIVE

S 865-059-003

(4) Set the EFI switch on the left instrument source select panel to the ALTN position.

S 745-060-003

(5) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-061-003

(6) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you do not hear the EFIS BUS 1 INACTIVE message as an EXTERNAL FAULT.

S 865-062-003

(7) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F9, EFIS SYM GEN CENTER

S 745-063-003

(8) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-064-003

(9) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: EFIS BUS 1 INACTIVE

S 865-065-003

(10) Close these circuit breakers:
  (a) P11 Circuit Breaker Panel
    1) 11F8, EFIS SYM GEN LEFT
    2) 11F9, EFIS SYM GEN CENTER

S 865-066-003

(11) Set the EFI switch on the left instrument source select panel to the NORM position.

S 865-067-003

(12) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F29, EFIS SYM GEN RIGHT

S 745-068-003

(13) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-069-003

(14) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: EFIS BUS 2 INACTIVE

S 865-070-003

(15) Set the EFI switch on the right instrument source select panel to the ALTN posiiton.

S 745-071-003

(16) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-072-003

(17) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you do not hear the EFIS BUS 2 INACTIVE message as an EXTERNAL FAULT.

S 865-073-003

(18) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11F9, EFIS SYM GEN CENTER

S 745-074-003

(19) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-075-003

(20) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: EFIS BUS 2 INACTIVE

S 865-076-003

(21) Close these circuit breakers:
  (a) P11 Circuit Breaker Panel
    1) 11F9, EFIS SYM GEN CENTER
    2) 11F29, EFIS SYM GEN RIGHT

S 865-077-003

(22) Set the EFI switch on the right instrument source select panel to the NORM position.

N. FMC BUS Interface Test

S 865-082-003

(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E9, FMCS CMPTR LEFT

S 745-083-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-084-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
  (a) Make sure you hear these aural messages:
    1) CURRENT FAULT: GPWS COMPUTER OK
       EXTERNAL FAULT: FMC BUS 1 INACTIVE

S 865-085-003

(4) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E9, FMCS CMPTR LEFT

O. AURAL WARNING BUS Interface Test

S 865-086-003

(1) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11B16, AURAL WARN SPKR LEFT

S 745-087-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel to start the level 1 self-test.
  (a) Make sure you hear the level 1 self-test start.

S 745-088-003

(3) Set and hold the GND PROX test switch on the miscellaneous test panel to stop the level 1 self-test.

S 865-089-003

(4) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11B16, AURAL WARN SPKR LEFT

S 865-090-003

(5) Open this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11H35, AURAL WARN SPKR RIGHT

S 745-091-003

(6) Set and release the GND PROX test switch on the miscellaneous test panel to start the level 1 self-test.
  (a) Make sure you hear the level 1 self-test start.

S 745-092-003

(7) Set and hold the GND PROX test switch on the miscellaneous test panel to stop the level 1 self-test.

S 865-093-003

(8) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11H35, AURAL WARN SPKR RIGHT

P. IRS BUS Interface Test

S 865-149-003

(1) Set the left IRS switch on the Inertial Reference Mode Panel (IRMP) to the OFF position.

S 745-150-003

(2) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-151-003

(3) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
    (a) Make sure you hear these aural messages:
        1) CURRENT FAULT: GPWS COMPUTER OK
           EXTERNAL FAULT: IRS BUS 1 INACTIVE

S 865-152-003

(4) Set the right IRS switch on the IRMP to the OFF position.

S 745-154-003

(5) Set and release the GND PROX test switch on the miscellaneous test panel.

S 745-153-003

(6) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
    (a) Make sure you hear these aural messages:
        1) CURRENT FAULT: GPWS COMPUTER OK
           EXTERNAL FAULT: IRS BUS 2 INACTIVE

S 865-155-003

(7) Set the left and right IRS switches on the IRMP to the NAV position.

Q. Discrete Inputs Test

S 865-094-003

(1) Make sure the TERR switches on the left and right EFIS control panels are in the on position.
    (a) Make sure the TERR message and the terrain display data show on the left and right EHSI's.

S 745-095-003

(2) Do these steps to do a level 6 self-test:
   - (a) Set and release the GND PROX test switch on the miscellaneous test panel.
   - (b) After the level 1 self-test starts, set and release the GND PROX switch again to go to the level 2 self-test.
   - (c) After the level 2 self-test starts, set and release the GND PROX switch again to go to the level 3 self-test.
   - (d) After the level 3 self-test starts, set and release the GND PROX switch again to go to the level 4 self-test.
   - (e) After the level 4 self-test starts, set and release the GND PROX switch again to go to the level 5 self-test.
   - (f) After the level 5 self-test starts, set and release the GND PROX switch again to go to the level 6 self-test.

<u>NOTE</u>: The level 6 self-test starts with the voice annunciation

"DISCRETE INPUTS TEST, PRESS TO CANCEL".

R. AIR/GROUND Discrete Test

S 865-096-003

(1) Open this circuit breaker:
   - (a) P11 Circuit Breaker Panel
      - 1) 11S19, LANDING GEAR AIR/GND SYS 2

S 755-097-003

(2) Make sure you hear this aural message:
   - (a) NOT ON GROUND

S 865-098-003

(3) Close this circuit breaker:
   - (a) P11 Circuit Breaker Panel
      - 1) 11S19, LANDING GEAR AIR/GND SYS 2

S 755-099-003

(4) Make sure you hear this aural message:
  (a) ON GROUND

S. FLAP Discrete Test

S 865-100-003

WARNING: MAKE SURE THAT THE FLAP OPERATIONS ARE CLEAR BEFORE FLAPS ARE MOVED. IF YOU DO NOT, INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

(1) Apply hydraulic pressure to move the flaps (AMM 29-11-00/201).

NOTE: If the flaps are in the landing position (25 or 30 degrees), it is not necessary to pressurize the hydraulic systems since flap movement is not required.

S 865-101-003

(2) Set the flaps to 25 degrees.

NOTE: Permit time for the flaps to move to the landing position.

S 755-102-003

(3) Make sure you hear this aural message:
  (a) LANDING FLAPS

S 865-103-003

(4) Set the flaps to 20 degrees.

S 755-104-003

(5) Make sure you hear this aural message:
  (a) NOT LANDING FLAPS

S 865-105-003

(6) Push the GND PROX FLAP OVRD switch to the OVRD position.

S 755-106-003

(7) Make sure you hear this aural message:
    (a) LANDING FLAPS

S 865-107-003

(8) Push the GND PROX FLAP OVRD switch to the off position.

S 755-108-003

(9) Make sure you hear this aural message:
    (a) NOT LANDING FLAPS

S 865-109-003

<u>WARNING</u>: MAKE SURE THAT THE FLAP OPERATIONS ARE CLEAR BEFORE FLAPS ARE MOVED. IF YOU DO NOT, INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

(10) Set the flaps to the normal position (zero degrees).

S 865-110-003

(11) Remove hydraulic pressure from the flaps.

T. GEAR Discrete Test

S 865-111-003

<u>WARNING</u>: MAKE SURE THAT ALL PERSONNEL ARE CLEAR OF THE LANDING GEAR AND THE LANDING GEAR DOORS BEFORE YOU MOVE THE LANDING GEAR CONTROL LEVER. INJURY TO PERSONNEL AND DAMAGE TO THE AIRCRAFT CAN OCCUR.

(1) Set the landing gear lever to the OFF position.

S 755-112-003

(2) Make sure you hear this aural message:
  (a) LANDING GEAR UP

S 865-113-003

(3) Push the GND PROX GEAR OVRD switch to the OVRD position.

S 755-114-003

(4) Make sure you hear this aural message:
  (a) LANDING GEAR DOWN

S 865-115-003

(5) Push the GND PROX GEAR OVRD switch to the off position.

S 755-116-003

(6) Make sure you hear this aural message:
  (a) LANDING GEAR UP

S 865-117-003

(7) Set the landing gear lever to the DN position.

S 755-118-003

(8) Make sure you hear this aural message:
  (a) LANDING GEAR DOWN

U. GLIDE SLOPE CANCEL Discrete Test

S 865-119-003

(1) Push and hold the yellow GND PROX G/S INHB switch/light.

S 755-120-003

(2) Make sure you hear this aural message:
  (a) GLIDE SLOPE CANCELLED

S 865-121-003

(3) Release the GND PROX G/S INHB switch/light.

S 755-122-003

(4) Make sure you hear this aural message:
    (a) GLIDE SLOPE ENABLED

V. TERRAIN OVERRIDE Discrete Test

S 865-123-003

(1) Push the TERR OVRD switch to the OVRD position.

S 755-124-003

(2) Make sure you hear these aural messages:
    (a) TERRAIN OFF
    (b) TERRAIN RELAY 1 OFF
    (c) TERRAIN RELAY 2 OFF

S 865-125-003

(3) Push the TERR OVRD switch to the off position.

S 755-126-003

(4) Make sure you hear these aural messages:
    (a) TERRAIN ON
    (b) TERRAIN RELAY 1 ON
    (c) TERRAIN RELAY 2 ON

S 745-127-003

(5) Set and release the GND PROX test switch on the miscellaneous test panel.

<u>NOTE</u>: This step will end the level 6 self-test.

W. Terrain Display Test

S 865-128-003

(1) Open this circuit breaker:
    (a) P11 Circuit Breaker Panel
        1) 11E7, TERR DISPLAY

S 755-129-003

(2) Make sure the terrain display data does not show on the left and right EHSI's.

S 865-130-003

(3) Close this circuit breaker:
  (a) P11 Circuit Breaker Panel
    1) 11E7, TERR DISPLAY

S 755-131-003

(4) Make sure the terrain display data shows on the left and right EHSI's.

S 755-132-003

(5) Make sure the EICAS messages, TERR SYS and GND PROX SYS, do not show on the EICAS displays.

S 865-133-003

(6) Push the TERR switch on the left EFIS control panel to the off position.

S 755-134-003

(7) Make sure the terrain display data does not show on the left EHSI.

S 865-135-003

(8) Push the TERR switch on the left EFIS control panel to the on position.

S 865-136-003

(9) Push the TERR switch on the right EFIS control panel to the off position.

S 755-137-003

(10) Make sure the terrain display data does not show on the right EHSI.

S 865-138-003

(11) Push the TERR switch on the right EFIS control panel to the on position.

X. Put the Airplane Back to Its Usual Condition

S 085-139-003

(1) Remove the test equipment.

S 865-140-003

(2) Remove electrical power if it is not necessary (AMM 24-22-00/201).

GROUND PROXIMITY WARNING COMPUTER (GPWC) - REMOVAL/INSTALLATION

1. General
   A. This procedure has these tasks:
      (1) Remove the GPWC
      (2) Install the GPWC
   B. The Ground Proximity Warning Computer (GPWC), M147, is installed on the E2-3 shelf in the main equipment center. All electrical connections are at the rear of the unit.

TASK 34-46-01-004-001

2. Remove the GPWC
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components

   B. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   C. Procedure

S 864-043

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) GUI 115;
       11F4, GND PROX CMPTR
   (b) GUI 001-114, 116-999;
       11F4, GND PROX
   (c) AIRPLANES WITH THE ENHANCED GPWC;
       11E7, TERR DISPLAY

S 024-047

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE GPWC. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE FROM YOUR BODY CAN CAUSE DAMAGE TO THE GPWC.

(2) Remove the GPWC (AMM 20-10-01/401).

TASK 34-46-01-404-005

3. Install the GPWC
   A. References
      (1) AMM 20-10-01/401, E/E Rack-Mounted Components

(2) AMM 24-22-00/201, Electrical Power - Control
(3) AMM 34-46-00/501, Ground Proximity Warning System
(4) AIRPLANES WITH THE ENHANCED GPWS;
AMM 34-46-00/201, Maintenance Practices

B. Access
(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

C. Procedure

S 754-044

(1) Make sure these circuit breakers on the P11 panel are open:
  - (a) GUI 115;
    11F4, GND PROX CMPTR
  - (b) GUI 001-114, 116-999;
    11F4, GND PROX
  - (c) AIRPLANES WITH THE ENHANCED GPWC;
    11E7, TERR DISPLAY

S 424-048

CAUTION: DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE GPWC. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE FROM YOUR BODY CAN CAUSE DAMAGE TO THE GPWC.

(2) Install the GPWC (AMM 20-10-01/401).

S 864-045

(3) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  - (a) GUI 115;
    11F4, GND PROX CMPTR
  - (b) GUI 001-114, 116-999;
    11F4, GND PROX

(c) AIRPLANES WITH THE ENHANCED GPWC;
11E7, TERR DISPLAY

D. GPWC Test

S 864-009

(1) Supply electrical power (AMM 24-22-00/201).

S 864-041

(2) AIRPLANES WITH THE ENHANCED GPWC;
Do these steps:
  (a) If it is your airline's policy to do a check of the terrain database version, then do this task: Verify the Terrain Database Part Number (AMM 34-46-00/201).
  (b) Make sure the green COMPUTER light on the front panel of the GPWC is on.

S 864-035

(3) Do this task: GPWS - Operational Test (AMM 34-46-00/501).

E. Put the Airplane Back to Its Usual Condition

S 864-027

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

VOR NAVIGATION SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)

   A. The VOR system is a navigational aid that determines relative bearing with respect to a ground station. The system receives rf signal data from the ground station and converts it into bearing and position data. This data is routed to the RDMI (AMM 34-22-00) for display of the bearing data. The data is also sent to the electronic flight instrument system (EFIS) symbol generators. Here, VOR deviation and TO/FROM data is computed for display on the EHSI (AMM 34-22-00).

   B. GUI 115;
   The rf signal data is routed to the RMI (AMM 34-22-00) instead of the RDMI for display of the bearing data.

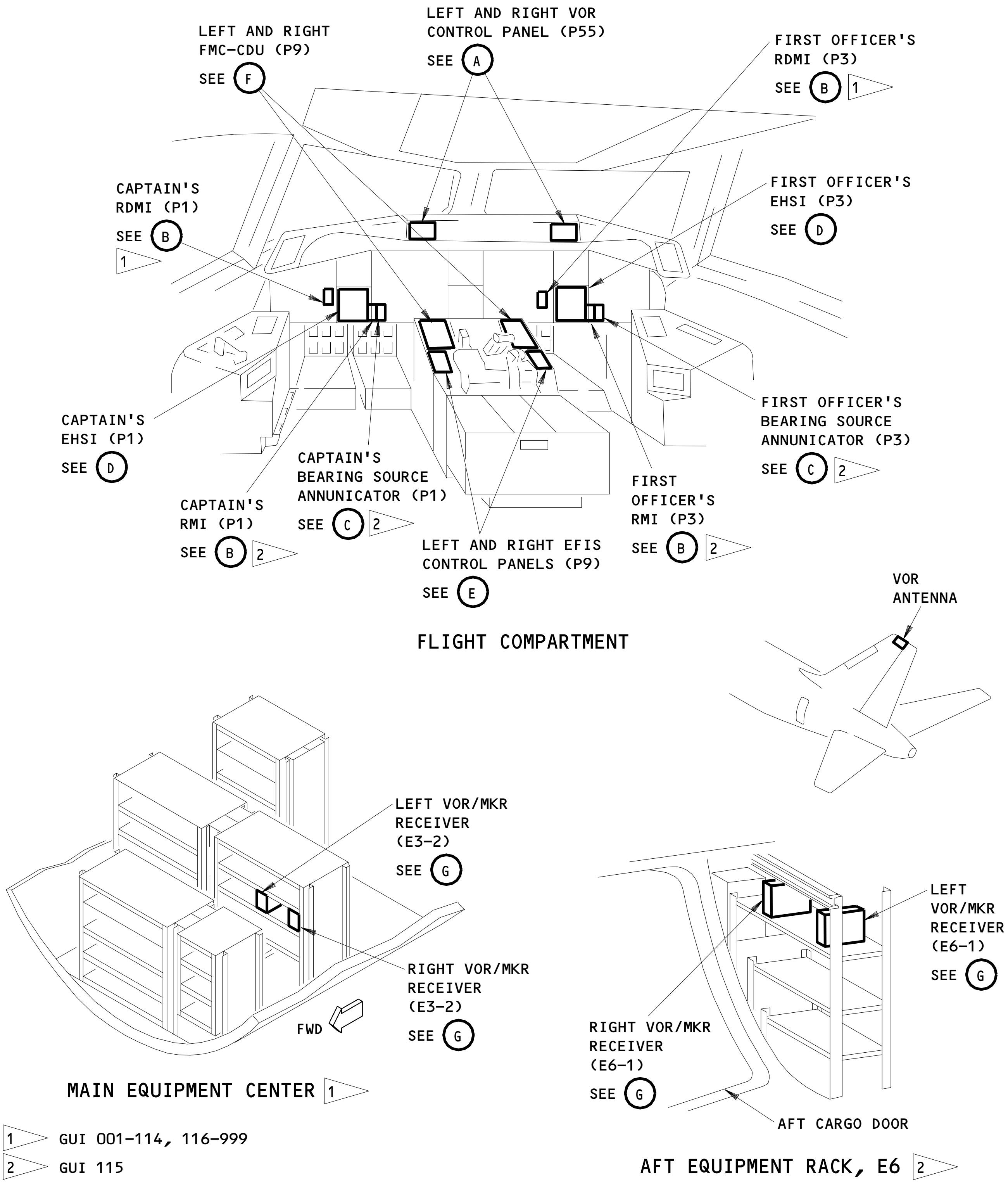
   C. The VOR ground stations broadcast direction coded rf signals within the frequency range of 108.00 MHz to 117.95 MHz. The frequency of the VOR ground station is selected on the VOR control panel. The selected ground station signals are received by the antenna and sent to the VOR receiver. The receiver processes the VOR signals to provide digital bearing output signals on an ARINC 429 digital data bus. The bearing output is a 32-bit data word that is addressed to the RDMI and to the EFIS symbol generators. It is also output to the flight management computers (FMC). The receiver also provides a VOR station audio identification signal to the interphone system.

   D. GUI 115;
   The bearing output is sent to the RMI instead of the RDMI.

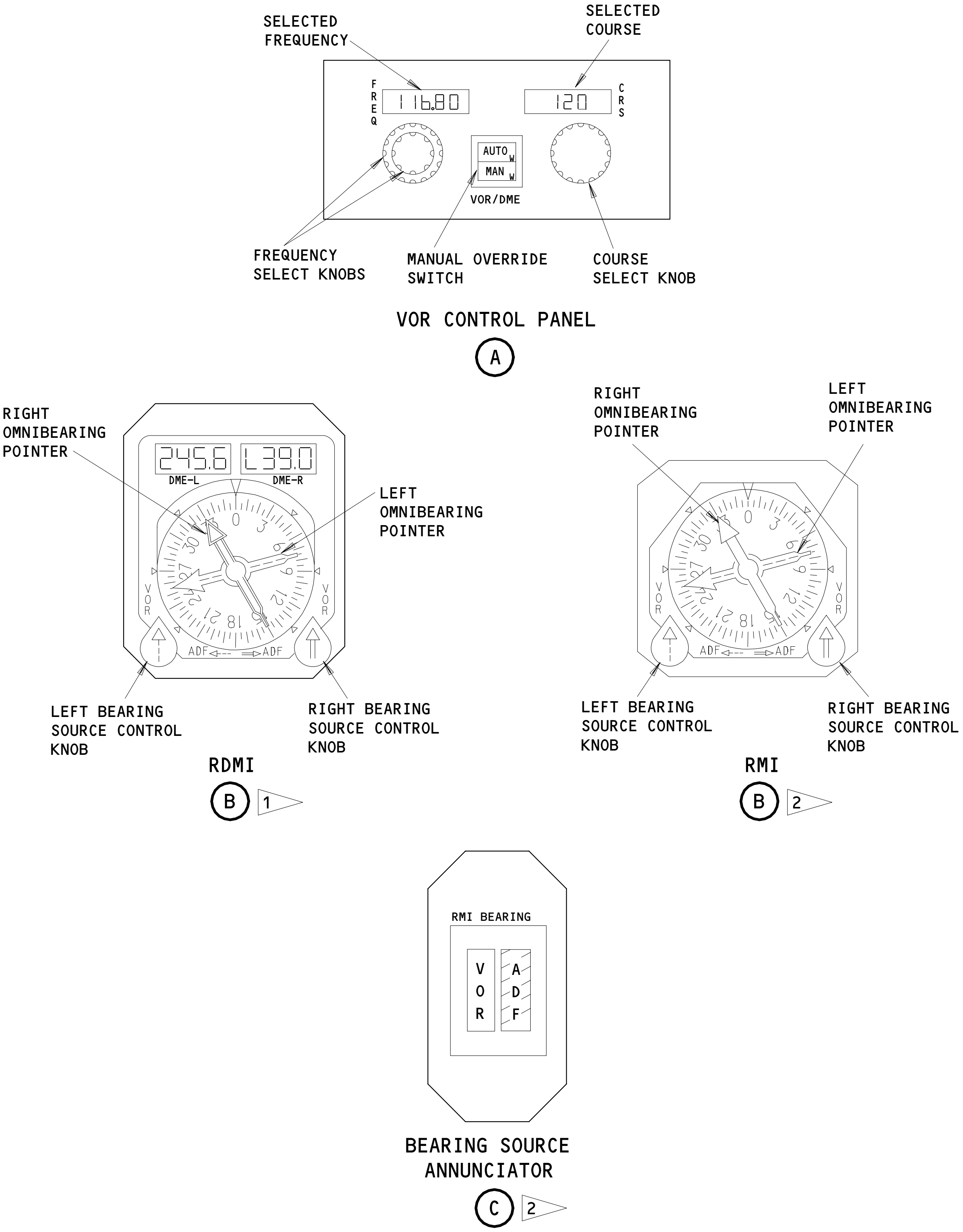
   E. A dual VOR system is installed. Each system consists of a receiver and a control panel. A single antenna is installed that has dual outputs with a separate output provided for each receiver. The left system normally provides information to the captain's (left) EFIS instruments. The right system provides input to the first officer's (right) EFIS instruments. Both receivers provide input to each RDMI where both are displayed at the same time. Both receivers also provide input to the center symbol generator in case the right or left symbol generators fail.

   F. GUI 115;
   Both receivers provide input to each RMI where both are displayed at the same time.

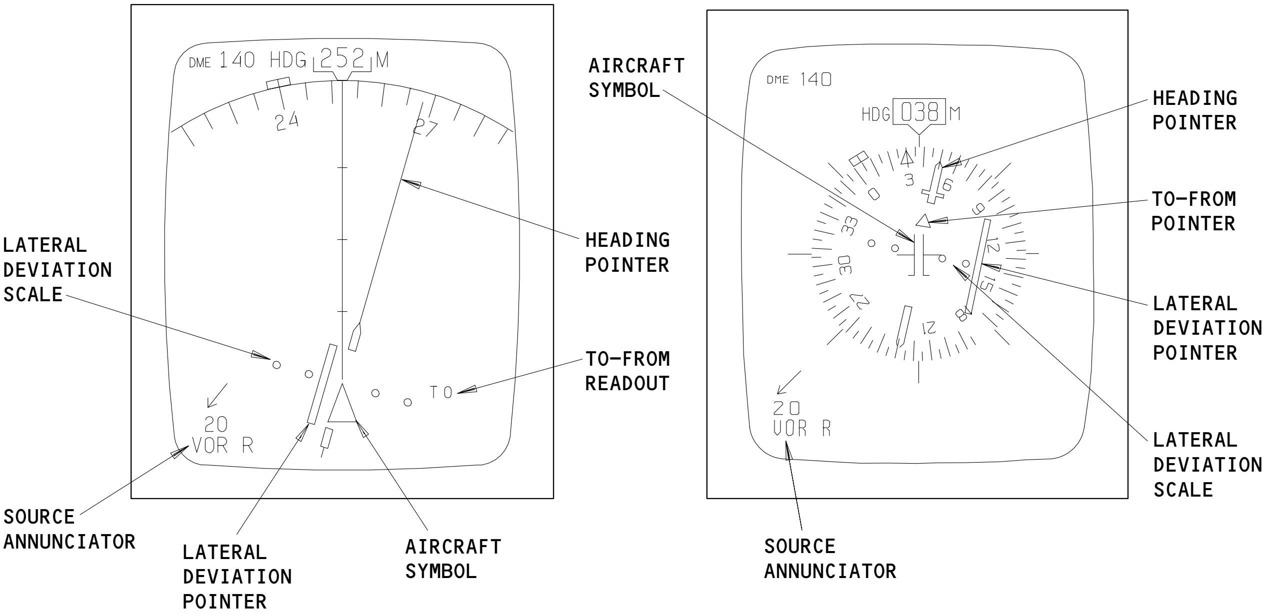
   G. GUI 001-114, 116-999;



VOR System - Component Location
Figure 1 (Sheet 1)



VOR System - Component Location
Figure 1 (Sheet 2)



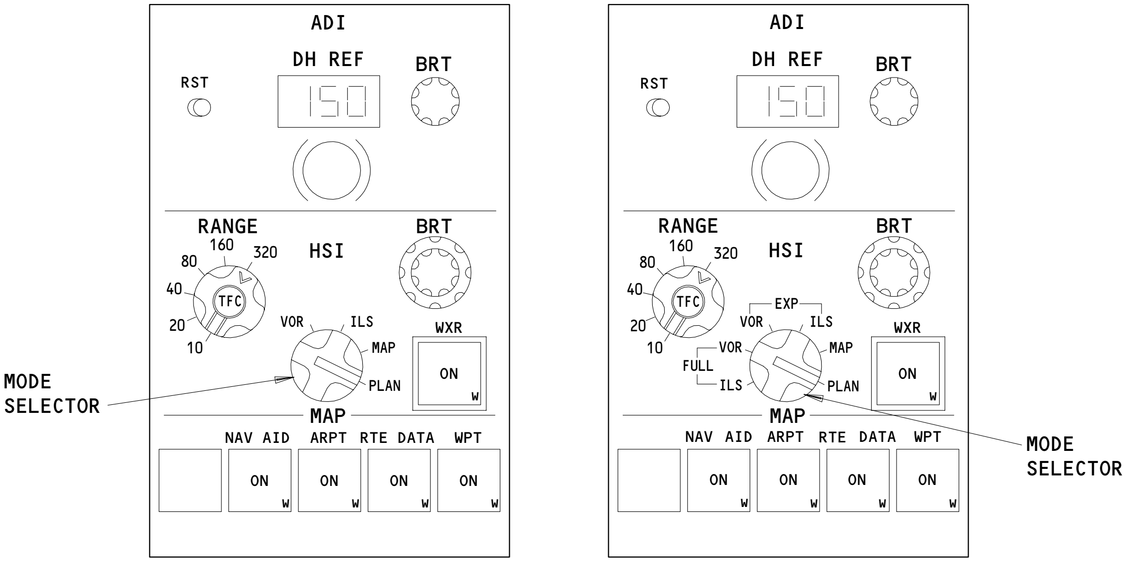
VOR - MODE 1

VOR - EXP MODE 2

VOR - FULL MODE 2

EHSI DISPLAY

D



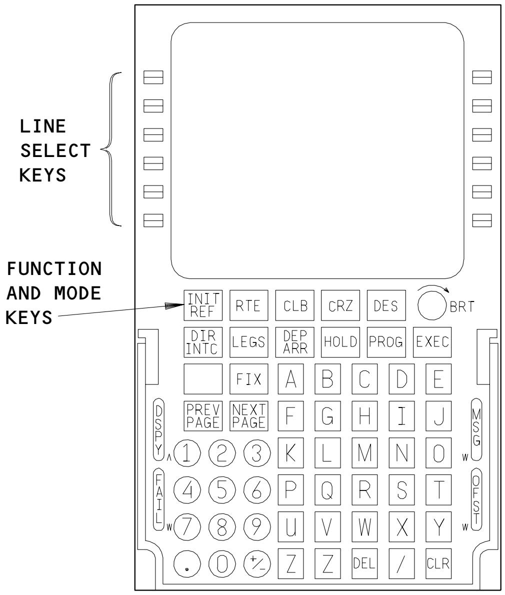
1

2

EFIS CONTROL PANEL

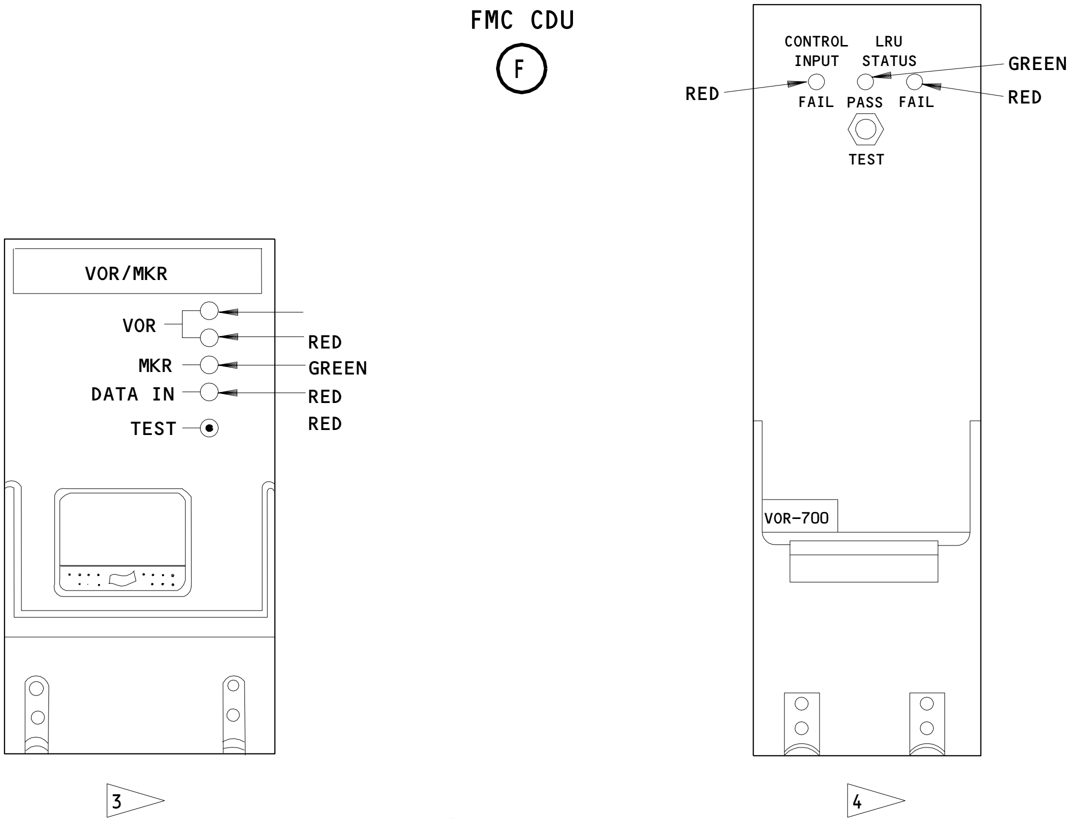
E

VOR System - Component Location
Figure 1 (Sheet 3)



FMC CDU

F



VOR/MKR RECEIVER

G

3 GUI 001, 009, 115

4 GUI 002-008, 010-114, 116-999

VOR System - Component Location
Figure 1 (Sheet 4)

The two VOR receivers also provide input to the digital flight data acquisition unit (DFDAU) for storage in the digital flight data recorder (AMM 31-31-00).

2. Component Details (Fig. 1)

A. VOR Control Panel

(1) The VOR control panel provides selection of VOR frequency and course during the VOR manual mode. The VOR frequency is selected by the two left concentric knobs for manual tuning. The outer knob selects tens and units of MHz. The inner knob selects tenths and hundredths of MHz.

(2) The VOR system is in the manual mode when the EFIS control panel is in a VOR or ILS position. When the EFIS control panel is in the MAP position, VOR is automatically tuned by the FMC. Manual tuning can be selected when EFIS is in MAP by pressing the AUTO/MAN switch/light to select MAN on the VOR control panel.

(3) VOR frequency is displayed in the window above the frequency select knob (FREQ). The 100 MHz digit is fixed at 1. The other digits display the VOR frequency as selected manually by the VOR control panel or automatically by the FMC.

(4) The VOR COURSE is selected on the ten-turn course select knob and is displayed by the three digit display above the knob.

(5) The AUTO-MAN switch is used to select the tuning mode of the VOR receiver when the EFIS mode select switch is set to MAP or PLAN. Tuning the VOR in these modes is normally controlled by the FMC (automatic) except when the AUTO-MAN switch is set to MAN. The tuning is then accomplished manually at the VOR control panel. When the EFIS switch is in the ILS or VOR position, tuning is always manually done from the VOR control panel.

(6) The captain's and first officer's VOR control panels are located on the left and right side of the glareshield (P55), respectively.

B. VOR/MKR Receiver

(1) The VOR/MKR receiver is microprocessor controlled. It provides reception of VOR signals in the frequency range of 108.00 MHz to 117.95 MHz with 50 KHz channel spacing. The receiver processes the VOR signals to provide bearing and course selection data outputs in digital data format. It also provides audio signals to the flight interphone system for station identification.

(2) The receiver has a BITE self test feature that is performed as part of the microprocessor program. BITE monitoring of the receiver occurs during normal rf signal processing. The BITE also injects signals into the receiver in the absence of input rf signals. This is done for the purpose of monitoring circuit operation. If a malfunction occurs during BITE, a fault code will be output on the ARINC 429 data bus.

(3) A test switch is also provided on the front panel for manual initiation of BITE. Results of the BITE test are shown on the front panel of the receiver.

(4) The receiver also contains the circuits for the marker beacon system (AMM 34-32-00).

(5) The left and right VOR/MKR receivers are located on shelf E6-1, in the aft equipment center, or on shelf E3-2, in the main electronic equipment center.

C. VOR Antenna

(1) The VOR antenna is a dual omnidirectional half-wave dipole. Its two outputs are isolated by a hybrid balun circuit for coax matching of the two antenna outputs.

(2) The VOR antenna is located at the top of the vertical stabilizer, under the fin cap.

D. RDMI (GUI 001-114, 116-999)

(1) The captain's and first officer's RDMI's display selected VOR or ADF bearing. The display has two rotating pointers. The two pointers display radio bearing information for two VOR stations with the compass card taken as reference. On each RDMI, the captain's selected VOR data is displayed by the left omni-bearing pointer. The first officer's selected data is displayed by the right omni-bearing pointer. Each pointer has a mode switch which is used to select VOR or ADF data for display. The RDMIs are located on the main instrument panels.

(2) The RDMI's also contain fault flags for the pointer data which come into view for invalid data or no computed data (AMM 34-22-00).

(3) The fault flags also come into view when the heading reference NORM/TRUE switch is set to TRUE (AMM 34-22-00). This feature is intended to prevent the use of misleading VOR bearing information from VOR facilities that are referenced to magnetic north.

E. RMI (GUI 115)

(1) The captain's and first officer's RMIs display selected VOR or ADF bearing. The display has two rotating pointers. The two pointers display radio bearing information for two VOR stations with the compass card taken as reference. On each RMI, the captain's selected VOR data is displayed by the left omni-bearing pointer. The first officer's selected data is displayed by the right omni-bearing pointer. Each pointer has a mode switch which is used to select VOR or ADF data for display. The RMIs are located on the main instrument panels.

(2) The RMIs also contain fault flags for the pointer data which come into view for invalid data or no computed data (AMM 34-22-00).

(3) The fault flags also come into view when the heading reference NORM/TRUE switch is set to TRUE (AMM 34-22-00). This feature is intended to prevent the use of misleading VOR bearing information from VOR facilities that are referenced to magnetic north.

(4) Bearing Source Annunciator

(a) The captain's and first officer's bearing source annunciators display which source is selected on the RMIs. When the left or right source selector on the RMI is set to VOR or ADF, the corresponding left or right annunciator displays VOR or ADF, respectively. The bearing source annunciators are located on the pilot's main panels.

F. EHSI

(1) GUI 001-114, 116-999;
The EHSI displays VOR course information when the EFIS mode select switch is in the VOR mode. They are located on the main instrument panels.

(2) GUI 115;
The EHSI displays VOR course information in either a full compass rose or an expanded scale display when the EFIS mode select switch is in the VOR-FULL or VOR-EXP mode, respectively. They are located on the main instrument panels.

(3) The system source annunciator displays the navigation system (VOR or ILS) to which the EHSI is connected.

(4) The course heading select line and pointer indicate the course selected on the control panel. The lateral deviation pointer and scale display the deviation from the selected course. When the airplane is on course, the lateral deviation pointer and heading select line will be lined up.

(5) The TO-FROM pointer indicates the direction of the tuned VOR station.

(6) The EHSI also displays VOR ground station and VOR radial positions in the MAP and PLAN modes (AMM 34-22-00).

(7) VOR failure indications are displayed on the EHSI. The resulting displays for no-computed data (NCD) and invalid data are as follows:

(a) NCD causes the deviation bar to be removed.

(b) Invalid data causes the scale and bar to be removed and a yellow VOR fault flag to appear.

(c) NCD or invalid data for the selected course causes the course pointer and line to be removed. Also, the lateral deviation bar is removed.

(8) VOR indications on the EHSI are unaffected by the position of the heading reference NORM/TRUE switch.

G. EFIS Control Panel

(1) The mode selector on the EFIS control panel selects the operating mode of the EFIS displays. It also selects the tuning mode for the VOR system. The EFIS control panel is located on the forward electronics panel P9.

(2) GUI 115;
Two different modes of VOR data can be selected. When set to VOR-FULL, the EHSI displays VOR data in a full compass rose format. When set to VOR-EXP, the EHSI displays VOR data with the heading dial scale in an expanded mode (AMM 34-22-00). Both formats display essentially the same VOR data.

(3) When the mode selector is set to a VOR or ILS or APP position, the EHSI displays VOR or ILS data respectively. The VOR/MKR receiver is manually tuned from the VOR control panel, which also displays the selected frequency. The AUTO/MAN switch is inactive in these modes. The RDMI bearing pointers display omnibearing to the VOR ground station.

(4) GUI 115;
The RMI bearing pointers display omnibearing to the VOR ground station.

(5) When the mode selector is set to the MAP or PLAN positions, the EHSI displays the MAP or PLAN data respectively. The VOR/MKR receiver is automatically tuned from the FMC or manually tuned by the VOR control panel, as selected with the AUTO/MAN switch. The VOR control panel displays the selected frequency in either case. The RDMI bearing pointers display omnibearing to the VOR ground station.

(6) GUI 115;
The RMI bearing pointers display omnibearing to the VOR ground station.

H. Flight Management Computer

(1) The left FMC automatically tunes the left and right VOR/MKR receivers when the respective left and right EFIS control panel mode selector is in the MAP or PLAN position. This tuning is done using information in the FMC flight data base. The right FMC will automatically tune the VOR/MKR receivers when the left FMC INSTR SOURCE SELECT switch is set to ALTN.

(2) The FMC control and display units (CDU) provide displays of the automatic tuning data. The CDUs display both the tuned VOR frequency and the three letter identifier of the VOR station. The CDUs are located on the forward electronics panel (P9).

3. <u>Operation</u> (Fig. 2 and 3)

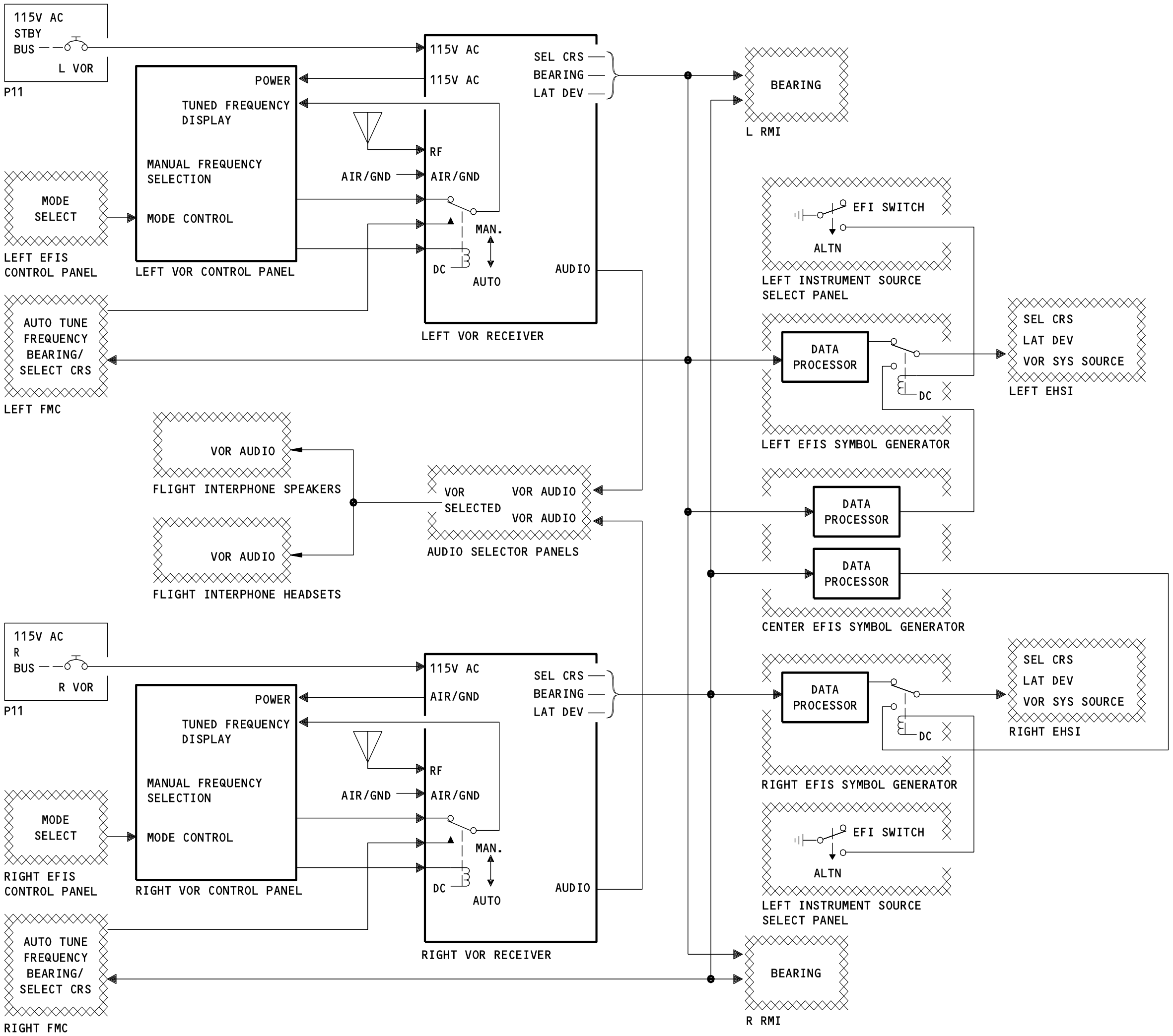
A. VOR System Block Diagram (Fig. 2)

(1) The left VOR receiver is powered by 115v ac, 400 Hz from the standby power bus. The right VOR receiver is powered by 115 v ac, 400 Hz from the right power bus. The 115v ac is routed through each receiver to supply its control panel.

(2) The manual/automatic tuning mode selection for each VOR receiver is determined by selection of display mode on the onside EFIS control panel. The onside VOR control panel also provides the pilot with manual tuning override capability.

(3) GUI 001-114, 116-999;
The VOR receiver processes rf from the VOR ground station to determine bearing, which is sent to the RDMIs, EFIS symbol generators, and FMCs.

(4) GUI 115;
The VOR receiver sends bearing to the RMIs.



VOR System Block Diagram
Figure 2 (Sheet 1)

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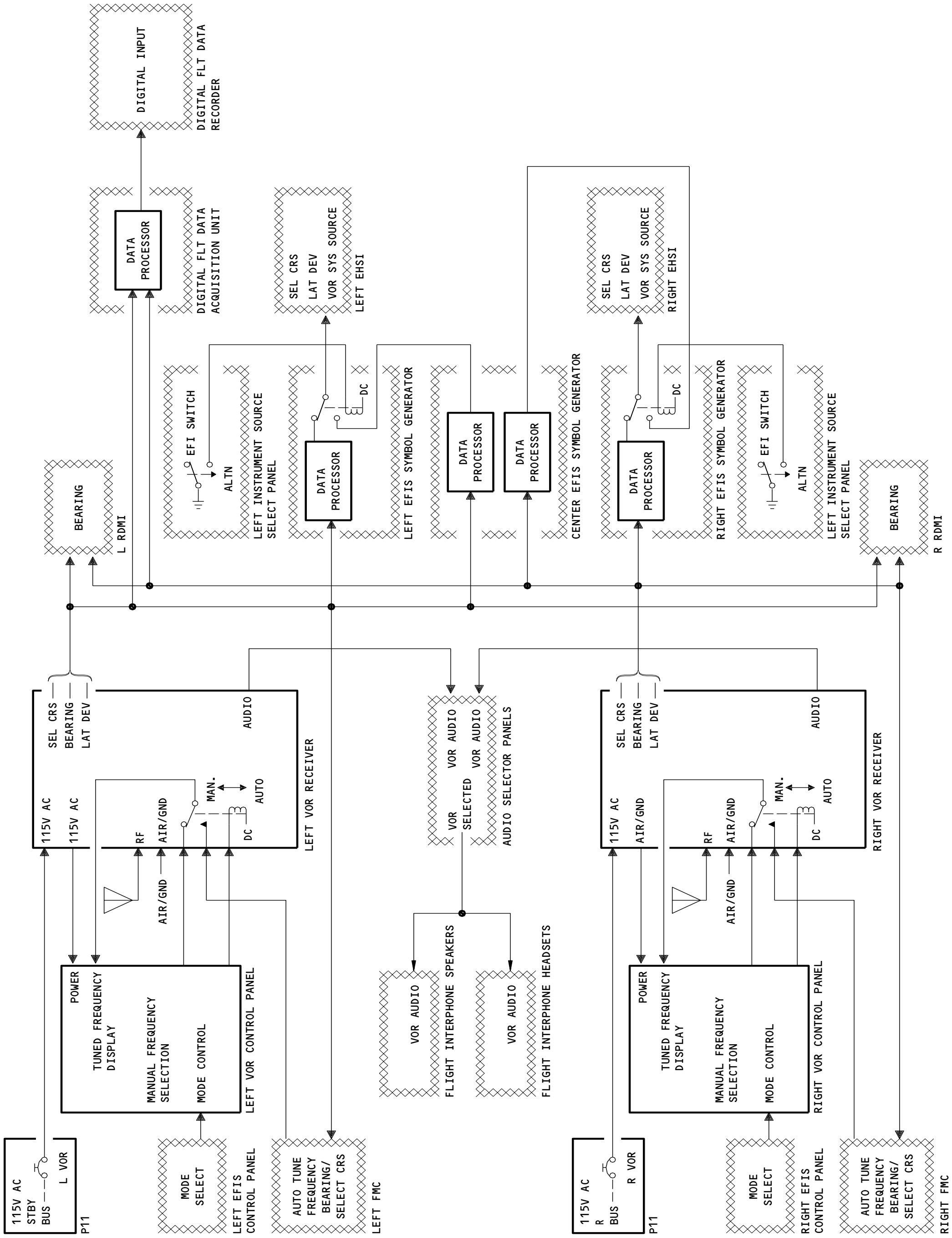


VOR System Block Diagram
Figure 2 (Sheet 2)

961824

(5) During manual or autotune modes, the VOR receiver sends the frequency actually tuned back to the VOR control panel for display, and to the FMCs for display on the control and display units (CDU).

(6) During EFIS VOR mode, the EFIS symbol generators compute VOR deviation and TO/FROM and display this data along with VOR SEL CRS and SYS SOURCE annunciator on the EHSIs. VOR audio is sent to the audio selector panels for station identification.

B. Functional Description (Fig. 3)

(1) The left VOR system is shown on the schematic and is described in the following paragraphs. Operation of the right receiver is similiar.

(2) A marker beacon receiver module is incorporated in each VOR receiver. This module is inhibited in the right VOR and active in the left VOR.

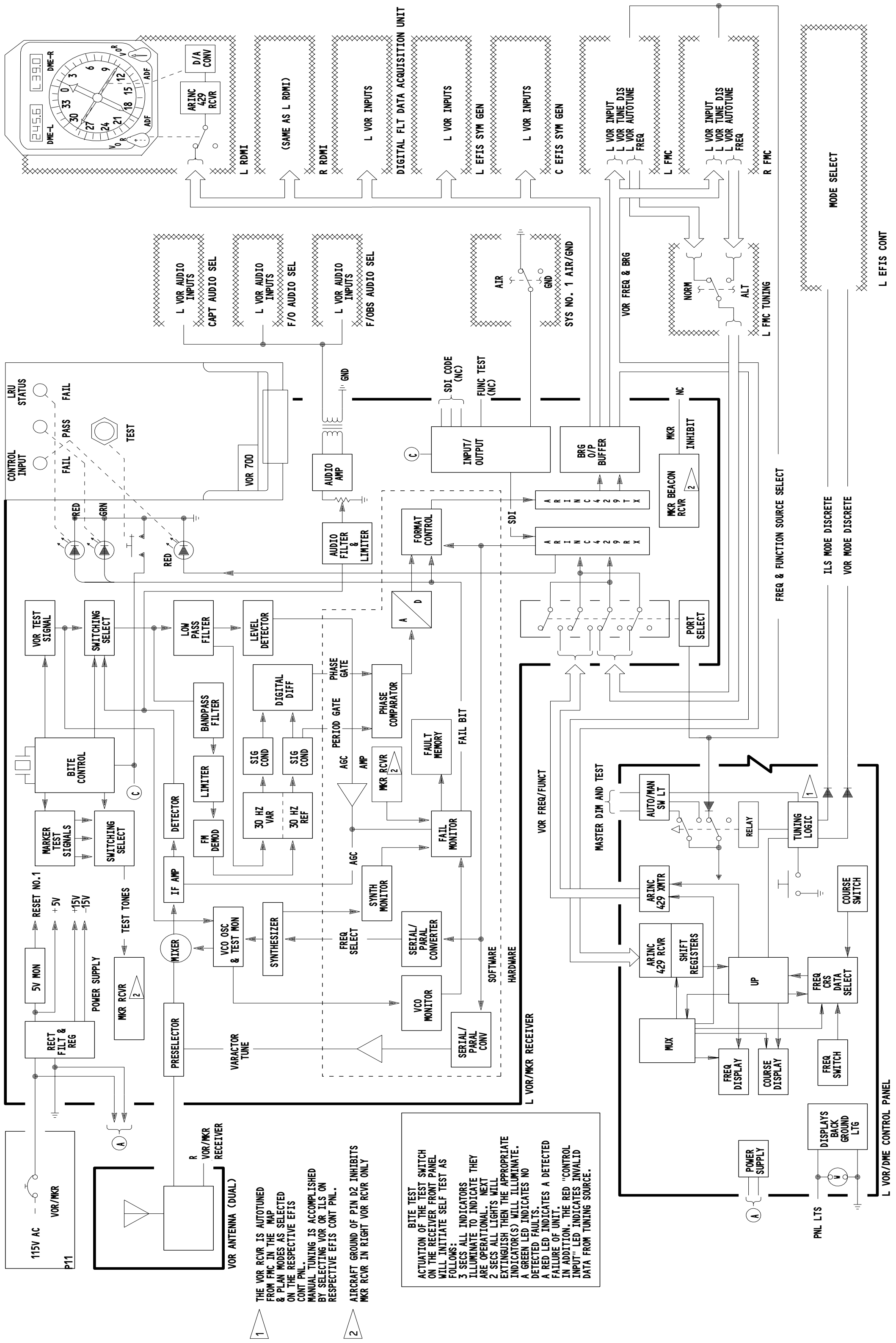
(3) The left VOR receiver and control panel are powered by 115V ac, 400 Hz from the left main bus. Power is supplied thru the left VOR/MKR circuit breaker to both the receiver and control panel.

(4) Tuning data enters the receiver at the port select circuit. Selected frequency and course are provided from the control panel when the EFIS control panel mode select switch is in the VOR or ILS mode. Manual tuning is also provided from the VOR control panel when the mode select switch is set to MAP and the manual override switch (AUTO/MAN) on the VOR control panel is set to MAN. Auto tune frequency is provided from the FMS when the mode select switch is in either the MAP or PLAN modes. The control data is received by the 429 interface module and processed by the CPU.

(5) The central processor unit (CPU) performs required control, timing, logic, and computations required for system operation. The CPU controls operations of the receiver by means of a stored program. The CPU operations are represented by the software portion on the diagrams.

(6) When power is applied to the receiver, the power supply generates the dc voltage for the internal circuits. It also provides RESET #1 voltage for initializing the CPU.

(7) Selected course and frequency tuning data are checked for validity at the input port and passed on to the CPU. The course and frequency data are processed by the CPU. However, the course data is not used by the CPU but returned to the port for output on the data bus.

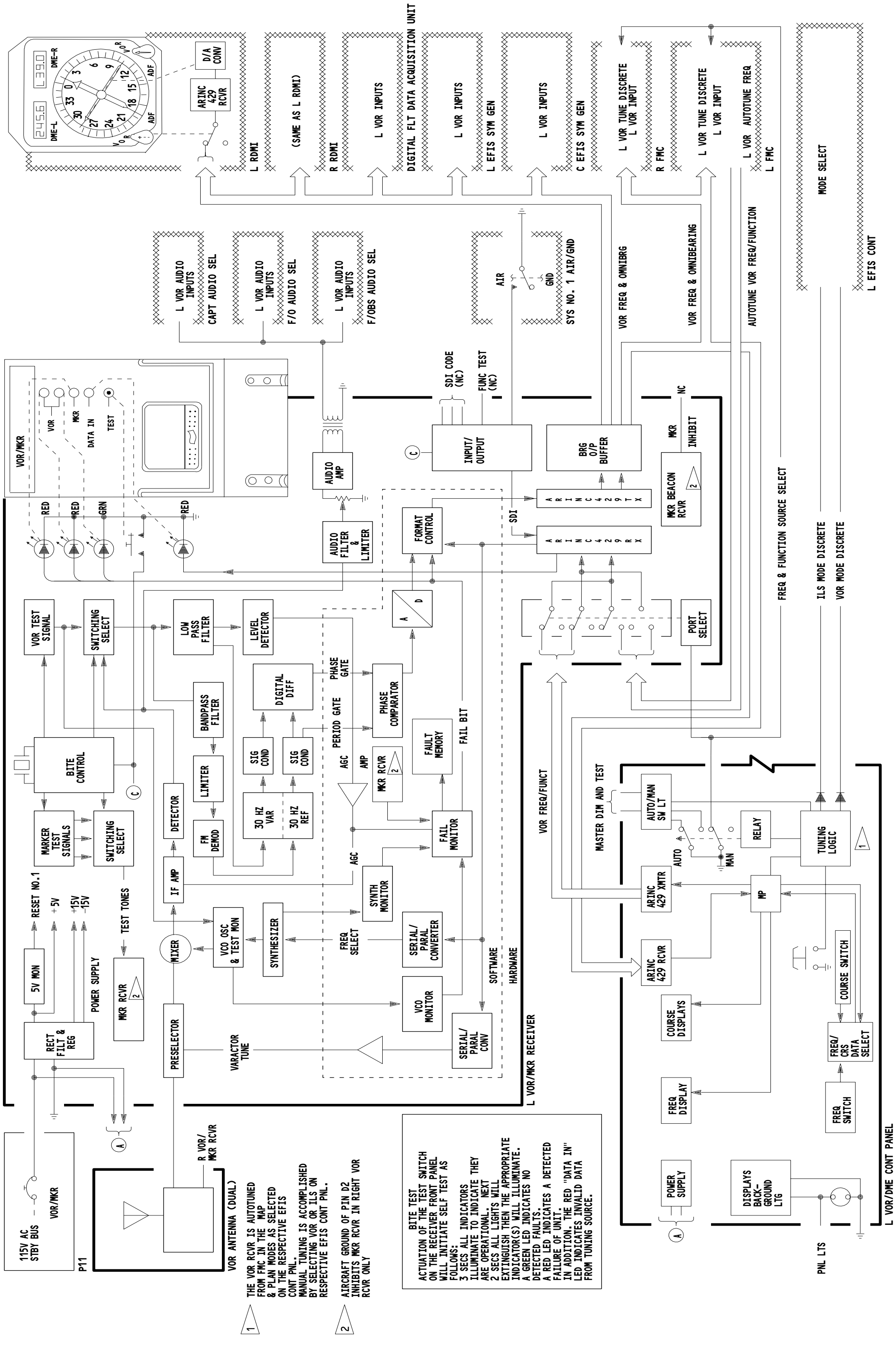


1 THE VOR RCVR IS AUTOTUNED FROM FMC IN THE MAP & PLAN MODES AS SELECTED ON THE RESPECTIVE EFIS CONT PNL. MANUAL TUNING IS ACCOMPLISHED BY SELECTING VOR OR ILS ON RESPECTIVE EFIS CONT PNL.

2 AIRCRAFT GROUND OF PIN D2 INHIBITS MKR RCVR IN RIGHT VOR RCVR ONLY

BITE TEST
ACTUATION OF THE TEST SWITCH ON THE RECEIVER FRONT PANEL WILL INITIATE SELF TEST AS FOLLOWS:
3 SECS ALL INDICATORS ILLUMINATE TO INDICATE THEY ARE OPERATIONAL. NEXT 2 SECS ALL LIGHTS WILL EXTINGUISH THEN THE APPROPRIATE INDICATOR(S) WILL ILLUMINATE.
A GREEN LED INDICATES NO DETECTED FAULTS.
A RED LED INDICATES A DETECTED FAILURE OF UNIT.
IN ADDITION, THE RED "CONTROL INPUT" LED INDICATES INVALID DATA FROM TUNING SOURCE.

VOR System Schematic (Example)
Figure 3 (Sheet 1)



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A GREEN LED INDICATES NO DETECTED FAULTS.
A RED LED INDICATES A DETECTED FAILURE OF UNIT.
IN ADDITION. THE RED "DATA IN" LED INDICATES INVALID DATA FROM TUNING SOURCE.

VOR System Schematic (Example)
Figure 3 (Sheet 2)

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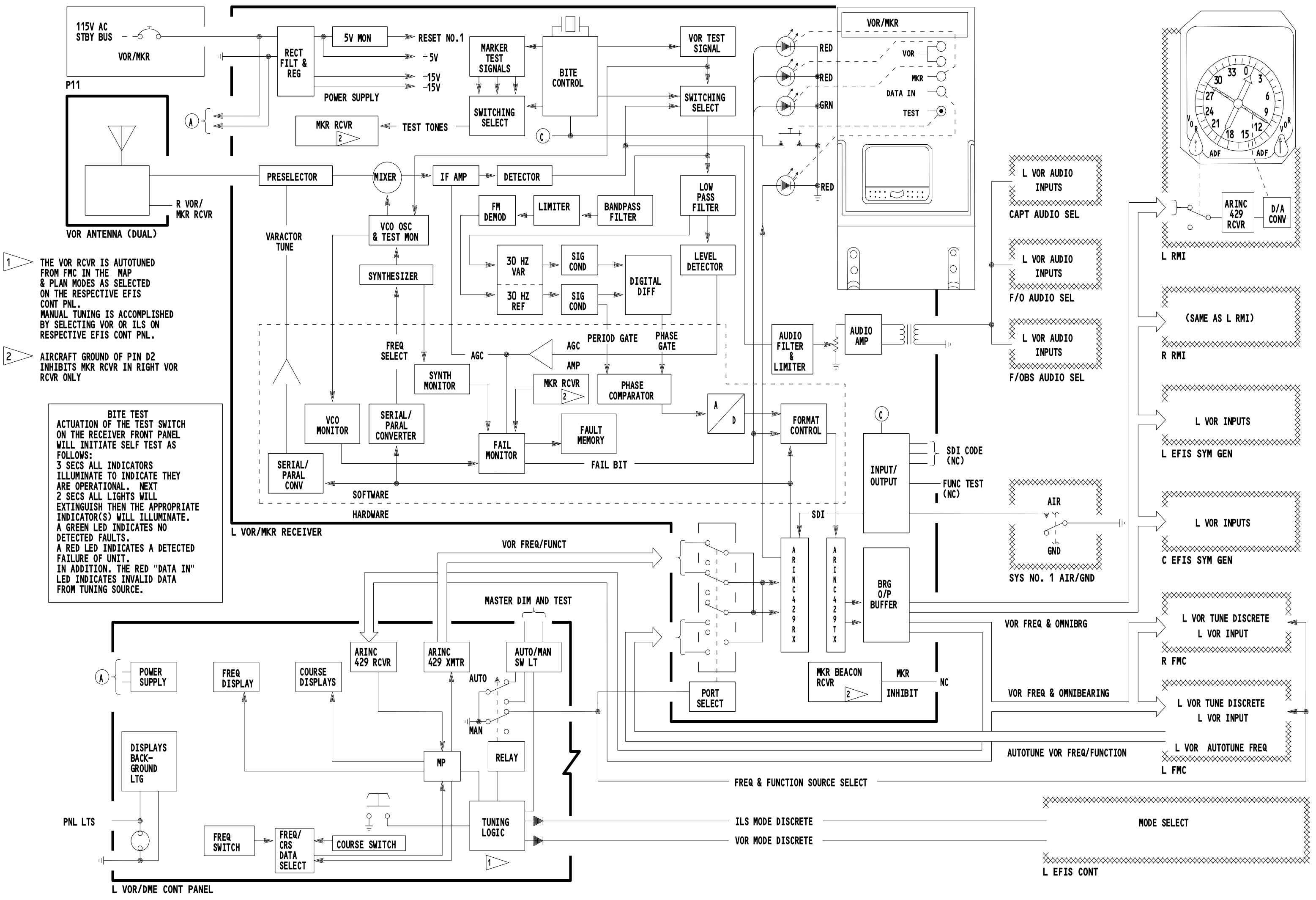


1 THE VOR RCVR IS AUTOTUNED FROM FMC IN THE MAP & PLAN MODES AS SELECTED ON THE RESPECTIVE EFIS CONT PNL. MANUAL TUNING IS ACCOMPLISHED BY SELECTING VOR OR ILS ON RESPECTIVE EFIS CONT PNL.

2 AIRCRAFT GROUND OF PIN D2 INHIBITS MKR RCVR IN RIGHT VOR RCVR ONLY

BITE TEST
ACTUATION OF THE TEST SWITCH ON THE RECEIVER FRONT PANEL WILL INITIATE SELF TEST AS FOLLOWS:
3 SECS ALL INDICATORS ILLUMINATE TO INDICATE THEY ARE OPERATIONAL. NEXT 2 SECS ALL LIGHTS WILL EXTINGUISH THEN THE APPROPRIATE INDICATOR(S) WILL ILLUMINATE.
A GREEN LED INDICATES NO DETECTED FAULTS.
A RED LED INDICATES A DETECTED FAILURE OF UNIT.
IN ADDITION, THE RED "DATA IN" LED INDICATES INVALID DATA FROM TUNING SOURCE.

VOR System Schematic (Example)
Figure 3 (Sheet 3)

(8) The CPU uses the input tuning frequency to tune the preselector in the front-end of the receiver to the selected station. The tuning voltage for the preselector is provided by a CPU controlled varactor circuit. The output frequency of the synthesizer is also controlled by outputs of the CPU module. The output signal of the synthesizer is applied to the VCO oscillator. The VCO oscillator provides a low-side injection signal that is fed to the mixer. The mixer combines the input rf signal from the antenna with the VCO injection signal to produce an 18.1 MHz IF. The IF signal is fed to the detector circuit where the VOR modulation signals are recovered from the IF signal. These modulation signals include a 9960-Hz subcarrier signal which modulates at ± 480 Hz at a 30-Hz rate. The latter signal creates a 30-Hz variable and a 30-Hz reference signal within the receivers.

(9) The output of the detector circuit is applied to the audio filter and limiter. The filter passes audio frequencies within the range of 350 Hz to 2500 Hz and rejects the other outputs of the receiver. The limiter filters out all noise spikes. The voice and keyed identity tones are fed to the audio amplifier and out to the audio select panels.

(10) The output of the detector circuit is also applied to the switching select circuit. During normal operation, this output is fed through the selector to the low pass and 9960 Hz band-pass filters. However, when the TEST switch is pressed on the front panel, the VOR test signal is substituted for the received VOR signal.

(11) The 30 Hz variable phase signal is passed through the low pass filter to a 30-Hz bandpass filter. This signal is also converted to an AGC signal to control the IF amplifier. The AGC voltage is based upon the strength of the detected audio signals.

(12) The output of switching select circuit is applied to the bandpass filter. The 9960-Hz is passed through this filter and the 30 Hz variable-phase component is rejected. This 9960 Hz signal is fed to the demodulator where the 30 Hz reference signal is recovered. The variable and reference signals are conditioned and fed to the phase comparator.

(13) The phase comparator accepts the reference period and variable-phase inputs. It compares the phase relationship between the two signals. When the two signals are in phase, the output of the phase comparator is in phase with the input variable phase signal. This corresponds to a VOR bearing of zero degrees. For any bearing other than zero degrees, the output of the comparator is proportional to the bearing.

(14) The CPU processes the bearing data to provide digital bearing output signals through the ARINC 429 transmitter and output buffer. The receiver provides VOR status and bearing data on the digital data bus to the right and left RDMIs. For the manual tuning mode, it also provides bearing and selected course to the EFIS symbol generators for display on the EHSI. For the auto tune mode, deviation data from the FMC is routed to the EFIS symbol generator. TO/FROM data is generated within the EFIS symbol generator from the bearing data and displayed along with the VOR deviation on the EHSI.

(15) GUI 115;
The receiver provides VOR status and bearing data on the digital data bus to the right and left RMIs.

(16) The selected frequency data is processed by the CPU and output on the digital data bus for display on the control panel.

C. BITE

(1) System Monitoring

(a) The VOR contains self-test and monitoring features that check for proper operation of the unit. This BITE program is activated as part of the CPU program. During normal rf signal processing, the BITE network continuously checks functions that affect the accuracy of the VOR. It checks the performance of the VCO, the synthesizer, and receiver AGC. It tests the VOR rf input data at the receiver input from the antenna. In the absence of rf input signals, it injects a modulated test frequency into the front end mixer. If the rf inputs are good, it injects a test signal at the switching circuit. In either case, the CPU monitors receiver performance. The data is compared to data stored in memory in the program to verify proper operation.

(b) The BITE program also checks the input tuning and course data from the control panel for integrity. The BITE also monitors the output data for comparison with the calculated data output from the CPU. The BITE program also monitors performance of the CPU and CPU program execution.

(c) For detected faults, the receiver will output failure warning codes on the ARINC 429 data bus. For receiver failures, an invalid data code is output. When computed data is not available for reasons other than equipment failure, a no computed data (NCD) code is output. Fault displays on the EHSIs will be as described for the EHSI in component details. The NAV flag will come into view on the RDMIs for invalid or no computed data.

(d) GUI 115;
The NAV flag will come into view on the RMIs for invalid or no computed data.

(e) All receiver faults detected during the BITE program are stored in a nonvolatile fault memory. The faults are stored by flight segments for subsequent evaluation in the shop. Each flight segment starts when the airplane takes off as detected by the air/ground relay. If a fault exists continuously, it is only stored once. If it exists intermittently, it is stored each time it occurs. The maximum number of faults that can be stored for any flight segment is 13. This test data history is available on the ATE connector for shop personnel.

1) GUI 002-008, 010-114, 116-999;
The fault memory can store faults for up to 49 flights.

2) GUI 001, 009, 115;
The fault memory can store faults for up to 63 flights. Also, in addition to the data available on the ATE connector, an internal fault display indicates a number corresponding to the failed module. This display is enabled for modules with continuous faults, but not for those with intermittent faults.

(2) Self-Test

(a) Pushing the test switch on the receiver front panel initiates a BITE test of the receiver. For the test, VOR test signals are injected into either the front end of the receiver or at the switching circuit as determined by the CPU program. These signals are processed and checked in the same manner as for normal operation.

(b) GUI 001, 009, 115;
If two or more identical faults are stored in the flight fault memory from at least two of the last four flight segments, the front panel lights will show the failed condition.

(c) The front panel test lights show status of the receiver self-test. Before performing the manual self-test, the EFIS control panel must be set to a VOR mode. When the test switch is pressed for at least 6 seconds, all the lights will come on for 3 seconds to indicate that they are operative. The lights then extinguish for 2 seconds. The lights re-light to indicate the status of the receiver and the input ARINC 429 control words as follows:

(d) GUI 002-008, 010-114, 116-999;
The green LRU STATUS PASS light will come on to show a pass condition and the red LRU STATUS FAIL light will come on for fail condition. The red CONTROL INPUT FAIL indicator will come on when data from the selected tuning source is invalid.

(e) GUI 001, 009, 115;
The green VOR light will come on to show a pass condition. The red VOR light will come on to indicate a fail condition for the VOR receiver. The red DATA IN light will come on to indicate loss of or invalid data words from the selected tuning source. The red MKR light will come on for a market beacon module failure (left VOR/MKR receiver only).

(f) During normal operation, these lights will be off. The front panel lights are operational only when the TEST button is pushed.

(g) GUI 001-114, 116-999;
The test also causes the RDMI flag to appear for 6 seconds and the RDMI pointer to drive to 180 degrees, with the RDMI set to the VOR position. The pointer will stay in this position until the test button is released.

(h) GUI 115;
The test also causes the RMI flag to appear for 6 seconds and the RMI pointer to drive to 180 degrees, with the RMI set to the VOR position. The pointer will stay in this position until the test button is released.

D. Control
- (1) To turn on the VOR system, do the following:
  - (a) Provide electrical power (AMM 24-22-00).
  - (b) Close the following overhead panel P11 circuit breakers:
    - 1) 11A2, VOR/MKR L
    - 2) 11E33, VOR R
  - (c) Tune VOR control panel to the desired frequency and course.

VOR NAVIGATION SYSTEM

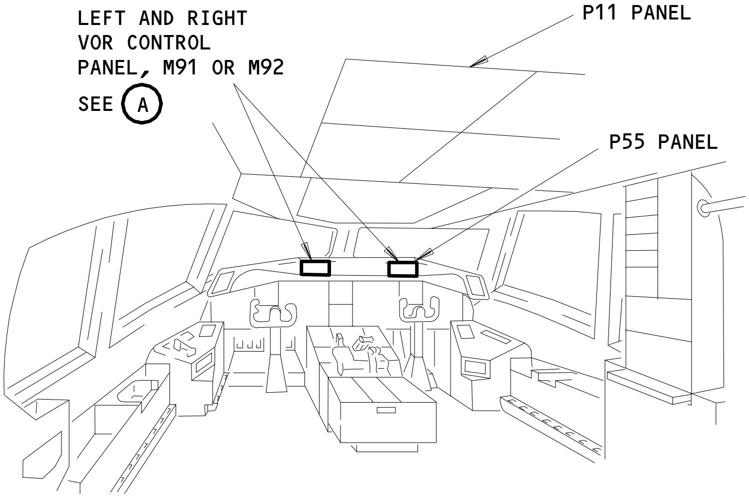
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
ANTENNA - DUAL VOR, M262	1	1	326, VERTICAL STAB.	34-51-03
CIRCUIT BREAKERS -	1		FLT COMPT, P11	
VOR MKR LEFT, C595		1	11A2	*
VOR RIGHT, C596		1	11E33	*
INDICATORS - (34-22-00/101)				
LEFT RADIO MAGNETIC, M10024 1▷				
RIGHT RADIO MAGNETIC, M10026 1▷				
LEFT RADIO DIRECTION MAGNETIC, N3 2▷				
RIGHT RADIO DIRECTION MAGNETIC, N43 2▷				
PANELS - (34-22-00/101)				
LEFT EFIS CONTROL, M94				
RIGHT EFIS CONTROL, M93				
PANEL - LEFT VOR/DME CONTROL, M91	1	1	FLT COMPT, P55	34-51-02
PANEL - RIGHT VOR/DME CONTROL, M92	1	1	FLT COMPT, P55	34-51-02
RECEIVER - LEFT VOR/MARKER, M186	2	1	822, AFT CARGO COMPT, E6-1 1▷; 119BL, MAIN EQUIP CTR, E3-2 2▷	34-51-01
RECEIVER - RIGHT VOR/MARKER, M187	2	1	822, AFT CARGO COMPT, E6-1 1▷; 119BL, MAIN EQUIP CTR, E3-2 2▷	34-51-01
RELAY - (31-01-36/101)				
SYS NO. 1 AIR/GND, K167				
RELAY - (31-01-37/101)				
SYS NO. 2 AIR/GND, K214				

* SEE THE WDM EQUIPMENT LIST

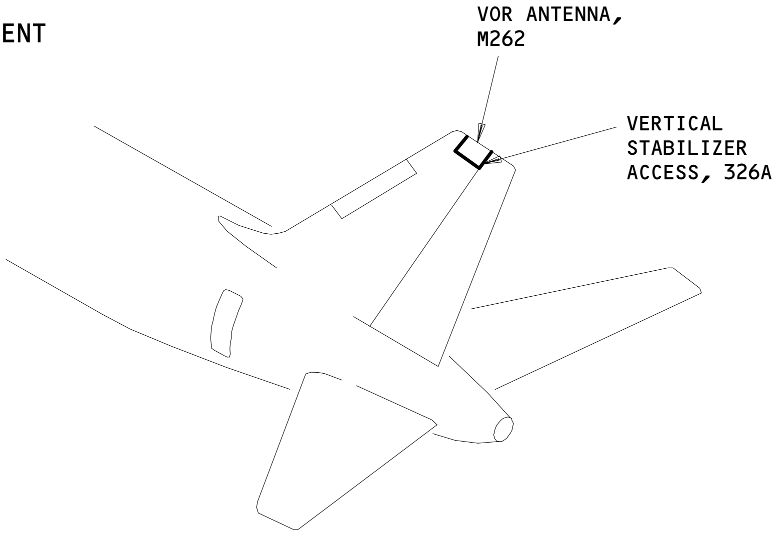
1▷ GUI 115

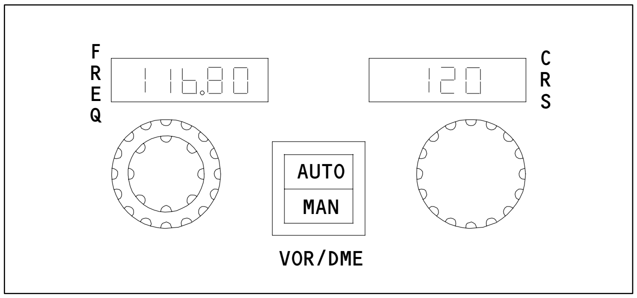
2▷ GUI 001-114,116-999

VOR Navigation System - Component Index
Figure 101



FLIGHT COMPARTMENT

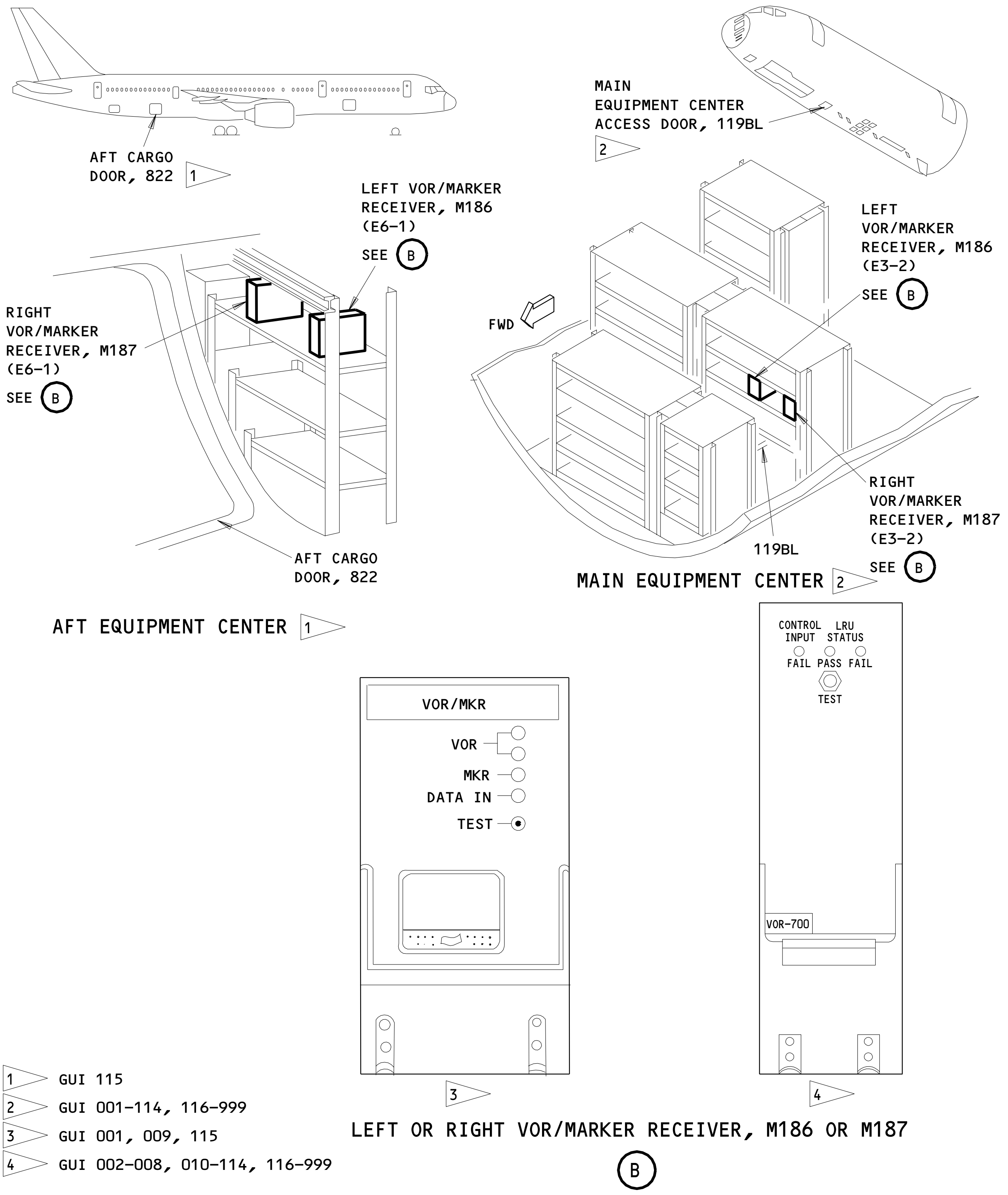




LEFT OR RIGHT VOR CONTROL PANEL, M91 OR M92

(A)

VOR Navigation System - Component Location
Figure 102 (Sheet 1)



1 GUI 115
2 GUI 001-114, 116-999
3 GUI 001, 009, 115
4 GUI 002-008, 010-114, 116-999

VOR Navigation System - Component Location
Figure 102 (Sheet 2)

VOR NAVIGATION SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure has two tasks. The Operational Test is a fast check of the system, and test equipment is not necessary. The System Test uses a ramp test set to do a full test of the system.

TASK 34-51-00-715-001

2. VOR Navigation System - Operational Test

A. General
  (1) The Operational Test uses the BITE functions of the VOR system.

B. References
  (1) 24-22-00/201, Electrical Power-Control
  (2) 34-21-00/501, Inertial Reference System (IRS)

C. Access
  (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

D. Prepare for the Operational Test

S 865-002
  (1) Supply electrical power (AMM 24-22-00/201).

S 865-100
  (2) Make sure these systems are servicable:
    (a) The inertial reference system (IRS) (Ref 34-21-00).
    (b) The electronic flight instrument system (EFIS) (Ref 34-22-00).

S 745-004
  (3) Push the indicator lights TEST switch on the overhead panel, P5.

S 755-005
  (4) Make sure the MAN and AUTO indicators on the two VOR control panels come on.

S 755-006
(5) Make sure all the display lines in the frequency and course windows come on to show -188.88.

S 865-007
(6) Push the indicator lights TEST switch on the P5 panel to release it from the test mode.

S 865-101
(7) GUI 001-114, 116-999;
Turn the bearing source switches for the left and right pointers on each RDMI to the VOR position.

S 865-103
(8) GUI 115;
Do the steps that follow:
   (a) Turn the bearing source switches for the left and right pointers on each RMI to the VOR position.
   (b) Make sure the left and right bearing source annunciators show VOR.

S 865-015
(9) Energize and align the left and right Inertial Reference Systems (Ref 34-21-00/201).

S 865-016
(10) Set the mode select switch on the EFIS control panels to the VOR, VOR-EXP, or VOR-CTR position.

S 755-022
(11) Make sure the HDG REF switch on the instrument panel, P3-1, is in the NORM position.

E. Procedure

S 745-023
(1) Push and hold the TEST switch on the left VOR receiver.

S 755-111

(2) GUI 001-114, 116-999;
Make sure this sequence occurs on the left and right RDMIs:

S 755-113

(3) GUI 115;
Make sure this sequence occurs on the left and right RMIs:
  (a) The left bearing flag comes into view for approximately 6 seconds.
  (b) The left bearing flag goes out of view, and the thin bearing pointer shows 180 ±2 degrees.

S 755-026

(4) At the same time, make sure this sequence occurs on the left VOR receiver:
  (a) All the lights come on.
  (b) All the lights go off.
  (c) The green LED comes on and stays on.

S 745-094

(5) Release the TEST switch on the left VOR receiver.

S 745-027

(6) Push and hold the TEST switch on the right VOR receiver.

S 755-114

(7) GUI 001-114, 116-999;
Make sure this sequence occurs on the left and right RDMIs:

S 755-116

(8) GUI 115;
Make sure this sequence occurs on the left and right RMIs:
  (a) The right bearing flag comes into view for approximately 6 seconds.
  (b) The right bearing flag goes out of view, and the thick bearing pointer shows 180 ±2 degrees.

(c) All the LEDs come on
(d) All the LEDs go off
(e) The green LED comes on and stays on.

S 745-095
(9) Release the TEST switch on the right VOR receiver.

S 865-031
(10) Remove electrical power if it is not necessary (AMM 24-22-00).

TASK 34-51-00-735-032

3. VOR Navigation System - System Test

A. General

(1) In the VOR navigation system test, the Operational Test is done first. A ramp test set is then used to supply VOR test frequencies to do a test of the bearing indications and the audio output function.

B. Equipment

(1) VOR/ILS Ramp Test Set, NAV402AP (preferred), NAV401L (optional)
Instrument & Flight Research Inc.
10200 West York Street
Wichita, KS, 67215

C. References

(1) AMM 23-42-00/501, Cabin Interphone System
(2) AMM 24-22-00/201, Electrical Power-Control

D. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

E. Procedure

S 715-033
(1) Do the VOR Operational Test.

S 865-117
(2) Make sure that the cabin interphone system is serviceable (AMM 23-42-00/501).

S 865-120
(3) GUI 115;
Set the mode select switch on the EFIS control panels to the VOR-FULL position.

S 865-122
(4) GUI 001-114, 116-999;
Set the mode select switch on the EFIS control panels to the VOR position.

S 755-041
(5) Make sure the MAN indicator on the VOR control panels is on.

S 865-042
(6) Turn the frequency select control on the VOR control panels to the necessary frequency.

S 865-230
(7) Set the course select control to 000.

S 755-124
(8) GUI 001-114, 116-999;
Make sure the bearing flags stay in view on each RDMI.

S 755-126
(9) GUI 115;
Make sure the bearing flags stay in view on each RMI.

S 865-045
(10) Follow the instructions to prepare the test set for the VOR system.

S 865-046
(11) Set these test set controls as follows:
  (a) The FREQUENCY to the local approved test frequency
  (b) The VOR BEARING to 000.00 degrees
  (c) The TO/FROM to the FROM position.

S 755-127
(12) GUI 001-114, 116-999;
On each RDMI, make sure the bearing flags go out of view and the thin and thick pointers show 180 ±2 degrees.

S 755-129
(13) GUI 115;
On each RMI, make sure the bearing flags go out of view and the thin and thick pointers show 180 ±2 degrees.

S 865-049
(14) Set the input bearing signal from the test set, in sequence, to the 90.0, 180.0, and 270.0 degree positions.

S 755-132
(15) GUI 001-114, 116-999;
Make sure the thin and thick pointers on the RDMIs show, in sequence, 270 ±2, 0 ±2, and 90 ±2 degrees.

S 755-134
(16) GUI 115;
Make sure the thin and thick pointers on the RMIs show, in sequence, 270 ±2, 0 ±2, and 90 ±2 degrees.

S 865-225
(17) Set the test set control to VOR BEARING 350.00 degrees.

S 755-053
(18) Make sure the TO/FROM annunciator shows TO on the EHSIs.

S 865-054
(19) Turn the course select control on the left VOR control panel until the lateral deviation pointer on the captain's EHSI moves to two dots right.

S 755-055
(20) Make sure the CRS indicator on the left VOR control panel shows 010.

S 865-056
(21) Turn the course select control on the right VOR control panel until the lateral deviation pointer on the first officer's EHSI moves to two dots right.

S 755-057
(22) Make sure the CRS indicator on the right VOR control panel shows 010.

S 865-058
(23) Set the course select control to 000.

S 865-166
(24) GUI 001-114, 116-999;
Set the mode select switch on the EFIS control panels to the ILS position.

S 865-138
(25) GUI 115;
Set the mode select switch on the EFIS control panels to the ILS-FULL position.

S 755-140
(26) GUI 001-114, 116-999;
Make sure no change occurs on the VOR control panels or on the two RDMIs.

S 755-142
(27) GUI 115;
Make sure no change occurs on the VOR control panels or on the two RMIs.

S 865-144
(28) GUI 001-114, 116-999;
Set the mode select switch on the EFIS control panels back to the VOR position.

S 865-147
(29) GUI 115;
Set the mode select switch on the EFIS control panels back to the VOR-FULL position.

S 865-074
(30) Supply a 1020 Hz audio tone in the VOR signal from the test set.

S 865-075
(31) On the captain's audio select panel, do these steps as follows:
  - (a) Set the filter switch to the RANGE position.
  - (b) Set the L VOR control to the on position.
  - (c) Adjust the volume to a minimum.
  - (d) Make sure an audio tone is heard on the flight compartment speaker. Adjust the speaker volume if it is necessary.
  - (e) Set the L VOR control to the off position.
  - (f) Set the R VOR control to the on position.
  - (g) Make sure an audio tone is heard on the flight compartment speaker. Adjust the speaker volume if it is necessary.

S 865-076
(32) Do the audio tone test for the remaining audio select panels.

S 865-078
(33) Select a frequency other than the test frequency on the two VOR control panels.

S 755-149
(34) GUI 001-114, 116-999;
Make sure the bearing flags come into view on each RDMI.

S 755-151
(35) GUI 115;
Make sure the bearing flags come into view on each RMI.

S 865-081
(36) Change the frequency on the VOR control panels back to the test frequency.

S 755-152
(37) GUI 001-114, 116-999;
On each RDMI, make sure the bearing flags go out of view and the thin and thick pointers show 0 ±2 degrees.

S 755-154
(38) GUI 115;
On each RMI, make sure the bearing flags go out of view and the thin and thick pointers show 0 ±2 degrees.

S 865-084

(39) Set the mode select switch on the EFIS control panels to the MAP position.

S 755-087

(40) Make sure the AUTO indicator on each VOR control panel comes on.

S 865-088

(41) Push the AUTO/MAN switch/light on each VOR control panel.

S 755-089

(42) Make sure these results occur:
  - (a) The MAN indicator on each VOR control panel comes on.
  - (b) The approved test frequency is shown on the FREQ display of the VOR control panels.
  - (c) GUI 001-114, 116-999;
    Do the steps that follow:
    - 1) The bearing flags go out of view on each RDMI.
    - 2) The pointers show a bearing of 0 ±2 degrees on each RDMI.
  - (d) GUI 115;
    Do the steps that follow:
    - 1) The bearing flags go out of view on each RMI.
    - 2) The pointers show a bearing of 0 ±2 degrees on each RMI.

S 865-090

(43) Remove the test equipment.

F. Put the Airplane Back to Its Usual Condition

S 865-091

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

VOR/MKR RECEIVER - REMOVAL/INSTALLATION

1. General
    A. This procedure has two tasks. One is the removal of the VOR/MKR receiver; the other is the installation of the VOR/MKR receiver.
    B. The left, M186, and right, M187, VOR/MKR receivers are installed on the E3-2 rack in the main electronic equipment center. All electrical connections are at the rear of the units.

TASK 34-51-01-004-001

2. Remove the VOR/MKR Receiver
    A. References
        (1) 20-10-01/401, E/E Rack Mounted Components
    B. Access
        (1) Location Zones
            119/120   Main Equipment Center
    C. Prepare for Removal

            S 864-002

        (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
            (a) 11A2, VOR/MKR L
            (b) 11E33, VOR R
    D. Procedure

            S 024-003

        (1) Remove the VOR/MKR receiver (AMM 20-10-01).

TASK 34-51-01-404-004

3. Install the VOR/MKR Receiver
    A. References
        (1) 20-10-01/401, E/E Rack Mounted Components
        (2) 24-22-00/201, Electrical Power - Control
    B. Access
        (1) Location Zones
            119/120   Main Equipment Center
            211/212   Flight Compartment

C. Prepare for Installation

S 754-005

(1) Make sure these circuit breakers on the P11 panel are open:
   (a) 11A2, VOR/MKR L
   (b) 11E33, VOR R

D. Procedure

S 424-006

(1) Install the VOR/MKR receiver (AMM 20-10-01).

S 864-007

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) 11A2, VOR/MKR L
   (b) 11E33, VOR R

E. VOR/MKR Receiver Test

S 864-008

(1) Supply electrical power (AMM 24-22-00).

S 864-009

(2) Make sure the mode select switches on the left and right EFIS control panels are set to the VOR position.

S 744-013

(3) Push and hold the TEST switch on the VOR/MKR receiver.

S 754-011

(4) Make sure the sequence that follows occurs:
   (a) All the LEDs come on
   (b) All the LEDs go off
   (c) The green LED comes on and stays on.

S 744-014

(5) Release the TEST switch on the VOR/MKR receiver.

S 864-022

(6) Do the Marker Beacon System Operational Test (AMM 34-32-00/501).

F. Put the Airplane Back to Its Usual Condition

S 864-012

(1) Remove electrical power if it is not necessary (AMM 24-22-00).

VOR CONTROL PANEL - MAINTENANCE PRACTICES

1. General
   A. This procedure has three tasks. The first is the replacement of the AUTO/MAN switch/light. The second is the removal of the VOR control panel. The last is the installation of the VOR control panel.
   B. The switch/light is replaced from the front of the panel. Lamps are on the back of the switch/light. The switch must be in the off position for replacement.
   C. The left, M91, and right, M92, VOR control panels are installed on the left and right side of the pilots' glareshield. Electrical connections are at the rear of the panel.

TASK 34-51-02-032-001

2. VOR Control Panel Switch/Light Replacement
   A. Access
      (1) Location Zones
         211/212 Flight Compartment

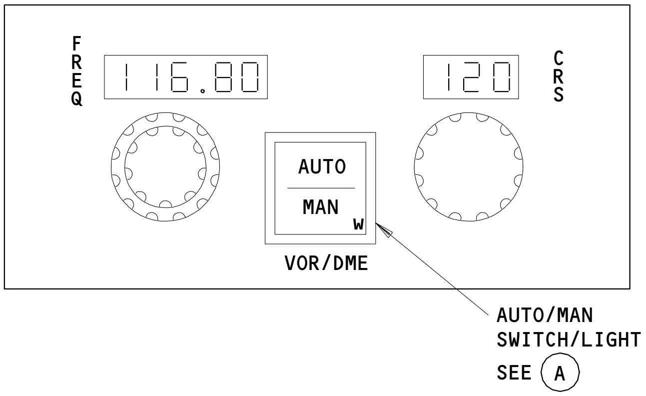
   B. Lamp Replacement

      S 862-002
      (1) Open these applicable circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) For the left VOR panel:
            1) 11A33, INDICATOR LIGHTS 2
         (b) For the right VOR panel:
            1) 11P29, R IND LTS 2

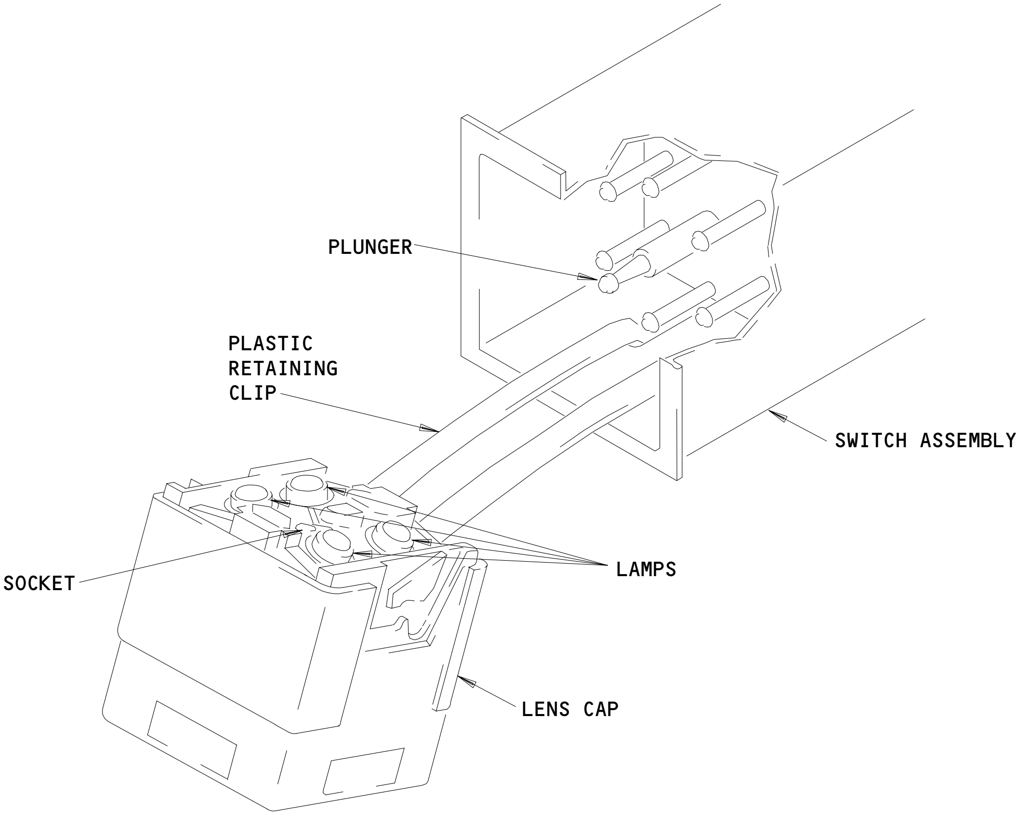
      S 012-036

      CAUTION: DO NOT REPLACE THE LAMPS WITH THE POWER ON. DAMAGE TO THE SWITCH CAN OCCUR.

      (2) Use a small screwdriver or knife to pry loose the switch/light.



VOR CONTROL PANEL



AUTO/MAN SWITCH/LIGHT ASSEMBLY

Ⓐ

VOR AUTO/MAN Lamp Installation
Figure 201

S 012-037
(3) Pull straight out on the lens cap assembly.

S 012-038
(4) The assembly will be held by a plastic retainer clip after removal from the panel.

S 862-042
(5) When fully extended, the lens can be turned down 90° to get access to the lamps.

S 032-007

<u>CAUTION</u>: MAKE SURE THE REPLACEMENT LAMPS ARE RATED FOR 28V DC AND NOT 5V DC. DAMAGE TO THE VOR/DME CONTROL PANEL CAN OCCUR.

(6) Remove and replace the necessary lamp.

C. Switch/Light Lens Assembly Installation

S 432-019

<u>CAUTION</u>: MAKE SURE THE SOCKET OF THE LENS CAP IS CORRECTLY MATED WITH THE PLUNGER OF THE SWITCH ASSEMBLY. IF IT IS NOT, THE PLUNGER CAN BE FORCED AGAINST ONE OF THE SWITCH CONTACTS AND CAUSE THE SWITCH TO SHORT OUT.

(1) Carefully put the lens cap into the switch assembly.

S 422-020
(2) Carefully push the lens cap in until the switch engages; then release the switch.

S 862-021
(3) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P11 panel:
  (a) For the left VOR panel:
    1) 11A33, INDICATOR LIGHTS 2
  (b) For the right VOR panel:
    1) 11D29, R IND LTS 2

TASK 34-51-02-002-022

3. <u>Remove the VOR Control Panel</u>

A. Access
  (1) Location Zones
    211/212 Flight Compartment

B. Prepare for Removal

S 862-023
(1) Open these applicable circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
  (a) For the left VOR panel:
    1) 11A2, VOR/MKR L
  (b) For the right VOR panel:
    1) 11E33, VOR R

C. Procedure

S 032-024
(1) Loosen the screws on the control panel.

S 012-025
(2) Pull out the VOR control panel to get to the coaxial cable.

S 032-026
(3) Disconnect the coaxial cable.

S 022-027
(4) Remove the VOR control panel.

TASK 34-51-02-422-043

4. Install the VOR Control Panel

A. References
  (1) 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones
    211/212 Flight Compartment

C. Prepare for Installation

S 752-028
(1) Make sure these applicable circuit breakers on the P11 panel are open:
  (a) For the left VOR panel:
    1) 11A2, VOR/MKR L
  (b) For the right VOR panel:
    1) 11E33, VOR R

D. Procedure

S 432-029
(1) Connect the coaxial cable to the control panel.

S 422-030
(2) Install the VOR control panel.

S 432-031
(3) Tighten the screws.

S 862-032

(4) Remove the DO-NOT-CLOSE tags and close these applicable circuit breakers on the P11 panel:
  - (a) For the left VOR panel:
    - 1) 11A2, VOR/MKR L
  - (b) For the right VOR panel:
    - 1) 11E33, VOR R

E. VOR Control Panel Test

S 862-033

(1) Supply electrical power (Ref 24-22-00).

S 752-034

(2) Make sure the VOR control panel lights come on.

F. Put the Airplane Back to Its Usual Condition

S 862-035

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

VOR ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the VOR antenna; the other is the installation of the VOR antenna.
   B. The VOR antenna, M262, is installed under the fin tip for the vertical stabilizer.

TASK 34-51-03-004-001

2. Remove the VOR Antenna
   A. References
      (1) 55-31-01/401, Vertical Stabilizer Fin Tip
   B. Access
      (1) Location Zone
         326 Vertical Stabilizer - Tip

   C. Prepare for Removal

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11A2, VOR/MKR L
         (b) 11E33, VOR R
   D. Procedure

      S 014-003
      (1) Remove the fin tip for the vertical stabilizer (Ref 55-31-01).

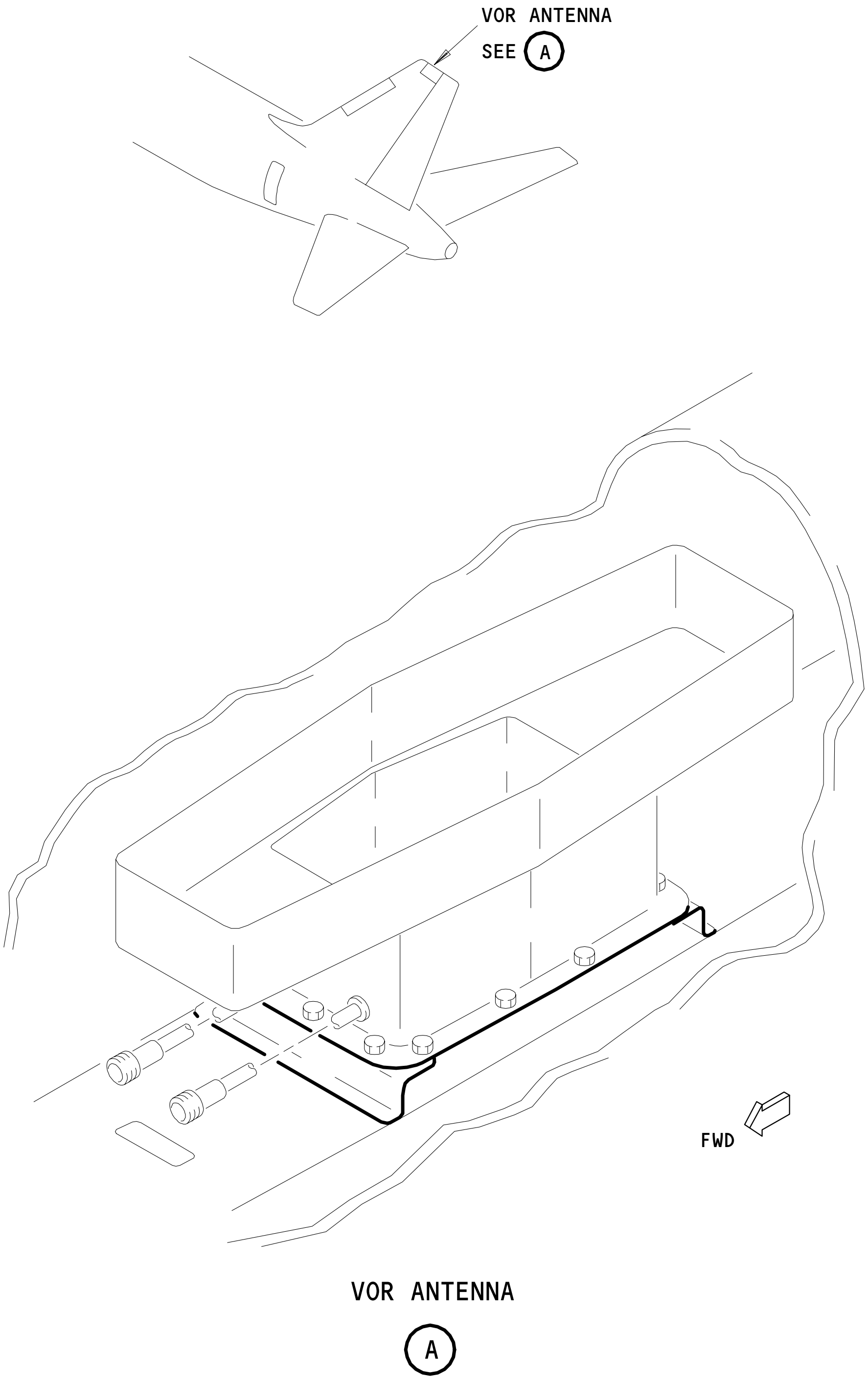
      S 034-004
      (2) Disconnect the antenna cable.

      S 034-005
      (3) Remove the antenna fasteners.

      S 024-006
      (4) Lift and remove the antenna.

TASK 34-51-03-404-007

3. Install the VOR Antenna
   A. Equipment
      (1) VOR/ILS Ramp Test Set, Instrument Flight Research NAV402AP



VOR Antenna Installation
Figure 401

B. Consumable Materials
(1) B00184 Solvent - BMS 11-7
(2) G00009 Compound - Corrosion Inhibiting - BMS 3-23

C. References
(1) AMM 20-10-22/701, Metal Surfaces
(2) AMM 24-22-00/201, Electrical Power - Control
(3) AMM 51-24-03/701, Corrosion Inhibiting Coating
(4) AMM 55-31-01/401, Vertical Stabilizer Fin Tip

D. Access
(1) Location Zone

211/212	Flight Compartment
326	Vertical Stabilizer - Tip

E. Prepare for Installation

S 754-008
(1) Make sure these circuit breakers on the P11 panel are open:
(a) 11A2, VOR/MKR L
(b) 11E33, VOR R

F. Procedure

S 214-009
(1) Make sure there is no corrosion on the electrical connectors or the coaxial cable.

S 214-010
(2) Visually examine the mating surfaces of the antenna and the airplane for corrosion.

S 144-011
(3) Clean the mating surfaces with a stainless steel brush until the surfaces have no corrosion (AMM 51-24-03/701).

NOTE: Corrosion can occur again if a material other than stainless steel is used.

S 114-012
(4) Clean the mating surfaces with the solvent, BMS 11-7 (Ref 20-10-22).

S 624-013
(5) Apply a corrosion inhibiting compound, BMS 3-23, to the mating surfaces of the antenna and the airplane (AMM 51-24-03/701).

S 424-014
(6) Put the VOR antenna into position, and install the fasteners.

S 434-015
(7) Connect the antenna cable.

S 414-016
(8) Install the fin tip for the vertical stabilizer (Ref 55-31-01).

S 864-017
(9) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
(a) 11A2, VOR/MKR L
(b) 11E33, VOR R

G. VOR Antenna Test

S 864-018
(1) Supply electrical power (Ref 24-22-00).

S 864-032
(2) GUI 115;
set the mode select switch on the two EFIS control panels to the VOR-FULL or VOR-EXP position.

S 864-036
(3) GUI 001-114, 116-999;
set the mode select switch on the two EFIS control panels to the VOR position.

S 864-037
(4) GUI 001-114, 116-999;
Set the bearing source switches on the two radio distance magnetic indicators (RDMIs) to the VOR position.

S 864-038

(5) GUI 115;
Set the bearing source switches on the two radio magnetic indicators (RMIs) to the VOR position.

S 864-023

(6) Follow the instructions to prepare the test set, and set these controls as follows:
  (a) The FREQUENCY to the approved test frequency
  (b) The VOR BEARING to 000.0 degrees
  (c) The TO/FROM to the FROM position.

S 864-024

(7) Activate the VOR signal generator.

S 864-039

(8) GUI 001-114, 116-999;
Make sure the bearing pointers on the RDMIs point to 180 ±2 degrees.

S 864-040

(9) GUI 115;
Make sure the bearing pointers on the RMIs point to 180 ±2 degrees.

S 084-027

(10) Deactivate and remove the test set.

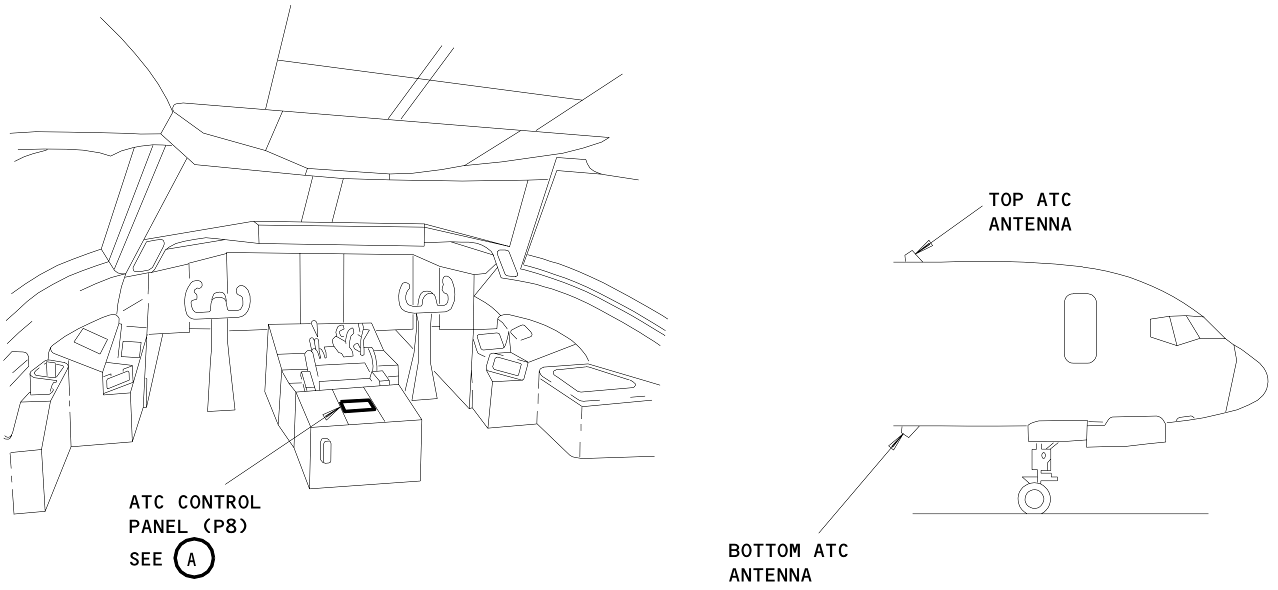
H. Put the Airplane Back to Its Usual Condition

S 864-028

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

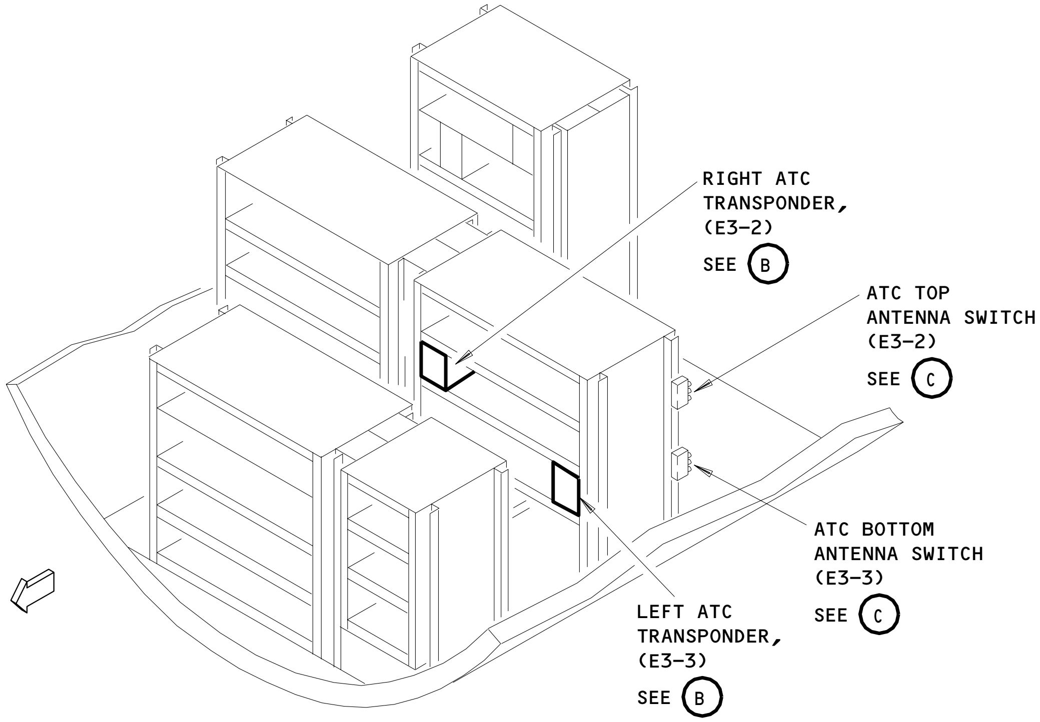
ATC SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The air traffic control mode select (ATC/MODE S) system provides altitude and identification reply signals to an interrogating ATC ground station. These reply signal are used to identify and locate an airplane as it moves through an ATC ground station sector.
   B. Two ATC systems are installed on the airplane with each system containing a transponder, antenna switching and an antenna. A mutual control panel provides control for both systems and selects the left or right transponder for system use. Only one transponder is used for operation at any one time.
   C. Both the ATC and DME systems operate in the same frequency range. A mutual suppression circuit is connected between both ATC transponders and the DME interrogaters. This is to prevent simultaneous transmission of any two systems.
2. Component Details (Fig. 1)
   A. Transponder
      (1) The two ATC transponders are located in the main equipment center. The left transponder is located on rack E3-3, the right on rack E3-2. Each transponder is microprocessor controlled and operates in the L band frequency range with a transmission frequency of 1090 MHz.
      (2) The TEST switch on the transponder front panel initiates a self-test. This self-test checks the antenna, all transponder circuits, data from the control panel, and the front panel status lights.
      (3) To facilitate bench level testing, faults for up to 15 previous flights are stored in memory. Real time faults can be displayed on a group of internal indicator lights.
      (4) System status is displayed by eight LED indicators on the transponder front panel as follows:
         (a) The TPR lights indicate operational status of the transponder.
            1) The green TPR status light, during normal operation, shows that the transponder is currently replying to a valid ATC interrogation. During self-test, it shows that the transponder passes the manual self-test.
            2) The red TPR status light indicates a BITE detected failure of the transponder.
         (b) The red DATA IN light indicates faulty data from the ATC control panel.
         (c) The red ALT light indicates faulty data from the air data system.
         (d) The red TOP or BOT antenna light comes on when an open or short circuit condition exists.



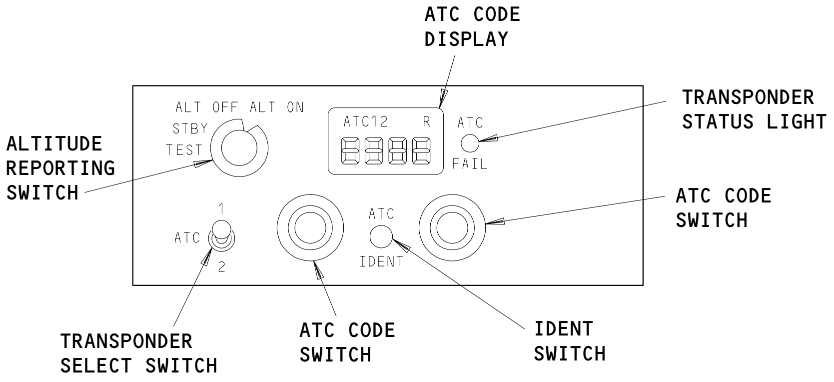
FLIGHT COMPARTMENT

ATC ANTENNAS



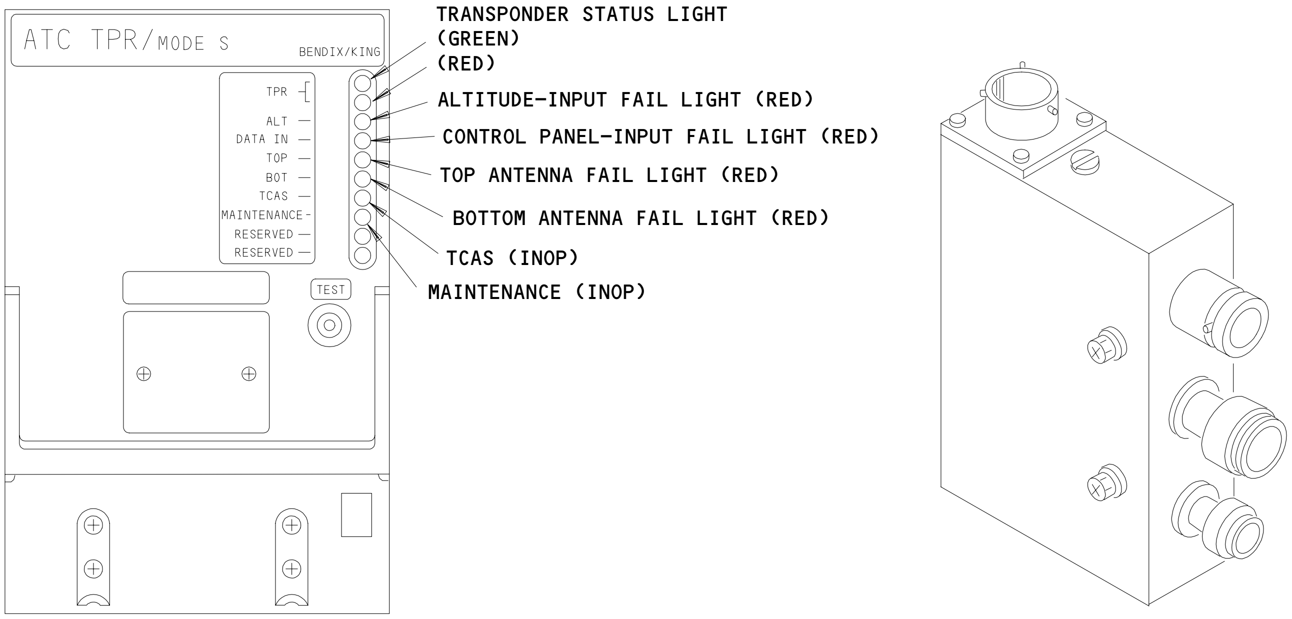
MAIN EQUIPMENT CENTER

ATC System - Component Location
Figure 1 (Sheet 1)



ATC/MODE S CONTROL PANEL

A



ATC/MODE S TRANSPONDER

B

ATC ANTENNA SWITCH

C

ATC System - Component Location
Figure 1 (Sheet 2)

(e) The red TCAS and MAINTENANCE light indicators are inoperable at this time.

(5) The system status lights (TPR, BOT, TOP, ALT, AND DATA IN) are operational only when the test button has been pushed, except the green TPR light. This light is operational whenever power is applied to the transponder. The TPR light comes on when the transponder is replying to a signal.

B. Control Panel

(1) The dual ATC control panel is located on the P8 electronics panel. The controls and indicators operate in the following manner.

(a) The ATC code switches select the 4-digit identification code which is displayed in the ATC code display window. The left hand outer knob selects the thousands and the inner knob the hundreds digits. The right hand inner knob selects the tens and the outer knob the units digits.

(b) The transponder select switch (ATC 1, 2) activates the left or right transponder, as selected. Both transponders are off with the altitude reporting switch in the STBY position.

(c) The altitude reporting switch enables the transponder to reply with coded altitude information supplied by left and right ADCs.

(d) The identification switch causes the transponder to transmit a special pulse with each ATC code reply generated. This is used to identify the airplane on the ground station scope.

(e) The yellow transponder status light (ATC FAIL) comes on when the transponder currently selected sends a discrete fault signal to the control panel. This output discrete (active low) is also connected to the EICAS computers to generate the ATC FAULT advisory message.

(f) The TEST switch makes sure the operational status of the ATC control panel is functioning properly. If a fault is detected in the control panel, the ATC FAIL light will come on.

C. Antenna and Antenna Switching

(1) The two ATC antennas are conventional L blade-type units located on the top and bottom of the fuselage.

(2) The antenna switch enables the left or right transponder to transmit and receive signals using both the top and the bottom ATC antenna.

3. Operation

A. Functional Description

(1) Each transponder is powered by the 115V AC, 400 Hz from the corresponding left or right bus. Power to the transponders is controlled by the control panel ATC 1 and 2 selector switch. Setting this switch to either 1 or 2 applies power to the control panel and to the selected transponder. Setting the switch to STBY disconnects power to both transponders.

(2) Control data for the transponders is generated in the control panel. This control data includes the ATC code select signals, the identification signal, the altitude reporting signal, and the ADC source select discrete. All are entered into the ARINC 429 transmitters and sent over digital data buses to the transponders. The encoded selection data also operates the ATC control panel display.

(3) The left and right ADCs provide altitude data to both transponders in ARINC 429 digital data format. When the altitude reporting switch is on, the selected transponder uses this data to form altitude coded replies. Under normal conditions, the left unit uses the signals from the left ADC and the right unit from the right ADC. The left transponder will switch to the right ADC if the AIR DATA switch on the captain's INSTR SOURCE SEL panel is set to ALTN. Similarly, the right transponder will switch to the left ADC if the AIR DATA switch on the first officer's INSTR SOURCE SEL panel is set to ALTN.

(4) Three different modes of interrogation, signals are alternately sent by the ATC ground radar systems. Mode A signals ask the transponder for just the assigned ATC (4096) code. Mode C signals ask for just pressure altitude data. Mode S signals ask for the airplanes mode S address and other surveillance information.

(5) Interrogation signals received at the antenna are routed to the receiver thru the rf switch. The rf switch allows one antenna to be used to both receive and transmit signals. The interrogation signals, operating at 1030 MHz, are reduced to a 60 MHz IF signal in the receiver. The IF signal is coupled to the video processor where pulse width and pulse amplitude are checked. Valid signals are converted to digital pulses and routed to the digital processor.

(6) The digital processor encodes and generates replies. Reply signals are transmitted between two framing pulses 20.3 microseconds apart. The data format between the framing pulses depends on the mode of the interrogation signals received.
   (a) If mode A signals are received, the reply signal is formatted with assigned ATC code data set on the ATC control panel.
   (b) If mode C signals are received, the reply signal is formatted with pressure altitude data if the altitude reporting switch is set to the ALT ON position. If the altitude reporting switch is set to the ALT OFF position, the transponder will reply with only the two framing pulses.

(c) If mode S signals are received, the reply signal format can include the ATC (4096) code, pressure altitude data and other surveillance information used by the TCAS system. A discrete 24-bit mode S address always accompany each reply.

(d) The mode S transponder allows bidirectional air-to-air, ground-to-air and air-to-ground data link.

(7) In addition to the information pulses, a special position identification (SPI) pulse will be included in the mode A replies when requested by the ground station. The pulse is initiated when the identification switch is pushed on the ATC control panel. The pulse is transmitted with each mode A response up to 20 seconds after the identification switch is pressed.

(8) The reply signals are fed from the digital processor to the transmitter. The transmitter generates the replies in 1090 MHz pulse format. The reply is sent to the circulator which protects against severe impedance changes at the antenna port. The replies proceed on through the switching network and out to the antenna.

(9) When the ATC is transmitting, the mutual suppression circuit generates the suppression signal. This signal inhibits the DMEs from transmitting at the same time as the ATC transponder. Only one ATC transponder is activated at any one time.

(10) The green TPR light comes on or flickers during ATC transponder transmission.

B. BITE

(1) The BITE microprocessor monitors system functions during normal system operation. All internal circuits plus the power supply are checked. The input signals from the control panel and the selected air data computer are also checked. The BITE checks receiver performance, transmitter output and interface signal data.

(2) All faults detected during flight are stored in a fault memory. Faults occurring on the ground are only stored when the TEST button is pushed. Faults on up to 15 flights can be recorded to assist bench level trouble shooting. The air/ground relay discrete enables the flight count. The signal increases the memory count by one each time the airplane lifts off the ground. The maximum number of faults that can be stored for any flight segment is 13.

(3) When the BITE monitor detects a fault, a discrete signal is sent to the ATC control panel. The transponder select switch provides switching between the discrete from the left transponder and that from the right. The discrete signal is sent from the control panel to the two EICAS computers. This causes the level C alert message ATC FAULT to be displayed on the upper EICAS display unit.

(4) If no valid interrogations are received by the transponder, the BITE initiates a self-test. During this test, the test oscillator injects a 1030 Hz signal that is directed to the receiver path. The signal includes alternate mode A and C simulated interrogations. This signal is processed in the normal manner as previously described. The processor checks the receiver output to find out if the mode A or C signals were properly decoded. It also examines the transmit section to determine whether the correct response was made.

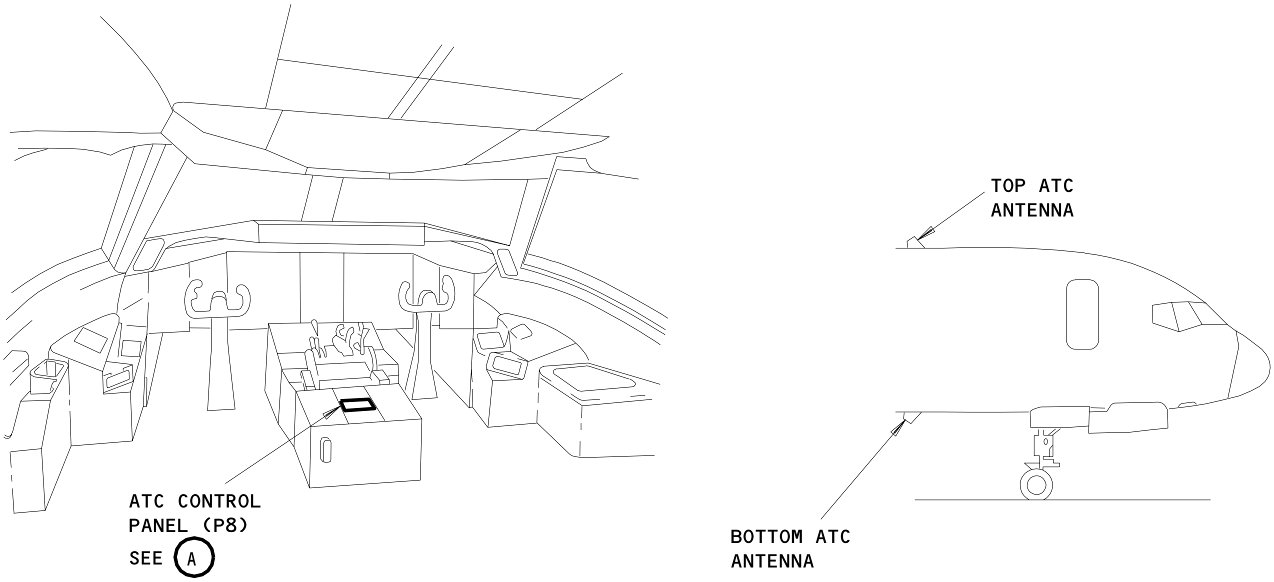
(5) Self Test
  (a) The system self-test can also be initiated manually by pressing the TEST switch on the transponder. The TEST switch needs to be held in for a minimum of 6 seconds. Sequencing of the test will automatically occur as follows:
    1) All the LEDs come on.
    2) All the LEDs go off. These tests are conducted as described in the BITE initiated self-test.
    3) The green LED comes on to indicate a successful test.

C. Control
  (1) Supply electrical power (Ref 24-22-00/201).
  (2) Close ATC L and ATC R circuit breakers on panel P11.
  (3) To use the left or right transponder, set the transponder select switch on the ATC control panel to the applicable 1 or 2 position.

D. For more detail on the ATC System, refer to these wiring diagrams and functional schematics:
  (1) WDM 34-53-XX: ATC System
  (2) SSM 34-53-XX: ATC System

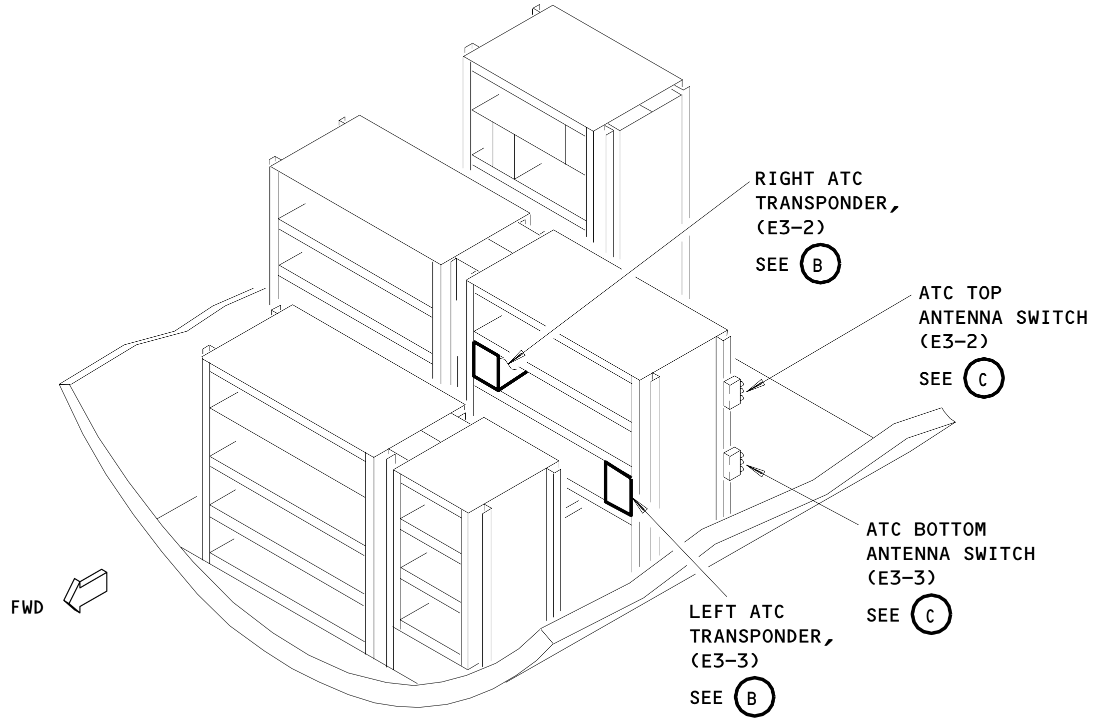
ATC SYSTEM - DESCRIPTION AND OPERATION

1. General
    A. The air traffic control mode select (ATC/MODE S) system provides altitude and identification reply signals to an interrogating ATC ground station. These reply signal are used to identify and locate an airplane as it moves through an ATC ground station sector.
    B. Two ATC systems are installed on the airplane with each system containing a transponder, antenna switching and an antenna. A mutual control panel provides control for both systems and selects the left or right transponder for system use. Only one transponder is used for operation at any one time.
    C. Both the ATC and DME systems operate in the same frequency range. A mutual suppression circuit is connected between both ATC transponders and the DME interrogaters. This is to prevent simultaneous transmission of any two systems.
2. Component Details (Fig. 1)
    A. Transponder
        (1) The two ATC transponders are located in the main equipment center. The left transponder is located on rack E3-3, the right on rack E3-2. Each transponder is microprocessor controlled and operates in the L band frequency range with a transmission frequency of 1090 MHz.
        (2) The TEST switch on the transponder front panel initiates a self-test. This self-test checks the antenna, all transponder circuits, data from the control panel, and the front panel status lights.
        (3) To facilitate bench level testing, faults for up to 49 previous flights are stored in memory. Real time faults can be displayed on a group of internal indicator lights.
        (4) System status is displayed by six LED indicators on the transponder front panel as follows:
            (a) The TPR PASS/FAIL lights indicate operational status of the transponder.
                1) The green TPR-PASS status light, during normal operation, shows that the transponder is currently replying to a valid ATC interrogation. During self-test, it shows that the transponder passes the manual self-test.
                2) The red TPR-FAIL status light indicates a BITE detected failure of the transponder.
            (b) The red CTL light indicates faulty data from the ATC control panel.
            (c) The red ALT light indicates faulty data from the air data system.



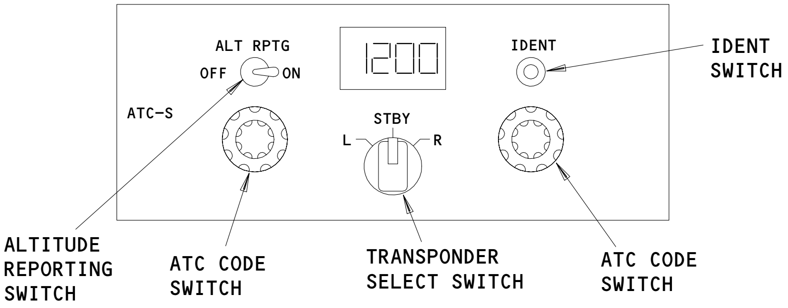
FLIGHT COMPARTMENT

ATC ANTENNAS



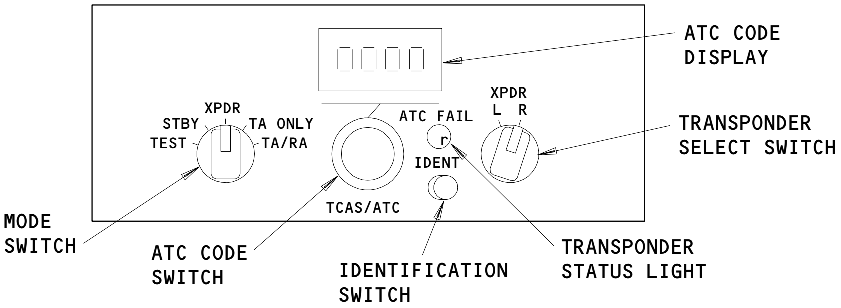
MAIN EQUIPMENT CENTER

ATC System - Component Location
Figure 1 (Sheet 1)



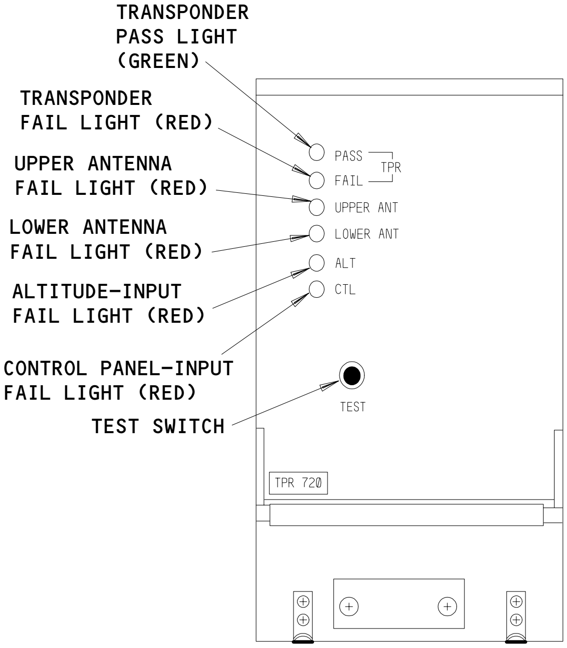
ATC/MODE S CONTROL PANEL

Ⓐ 1



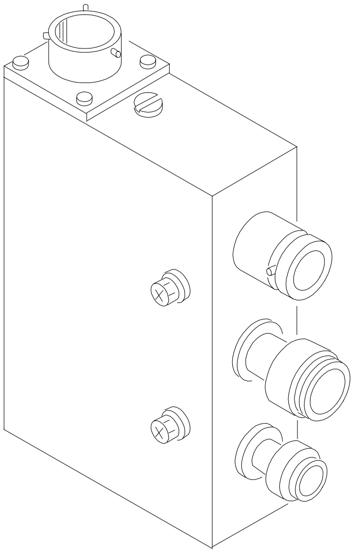
ATC/MODE S CONTROL PANEL

Ⓐ 2



ATC/MODE S TRANSPONDER

Ⓑ



ATC ANTENNA SWITCH

Ⓒ

1 GUI 001-006

2 GUI 007-114,116-999

ATC System - Component Location
Figure 1 (Sheet 2)

(d) The red LOWER ANT and UPPER ANT light indicates a detected antenna fault.

(5) The system status lights (TPR, UPPER ANT, LOWER ANT, ALT, AND CTL) are operational only when the test button has been pressed, except the green TPR - PASS light. This light is operational whenever power is applied to the transponder. The TPR - PASS light comes on when the transponder is replying to a signal, and remains on for about 15 seconds after the transmission ends.

B. Control Panel

(1) The dual ATC control panel is located on the P8 electronics panel. The controls and indicators operate in the following manner.

(a) GUI 001-006;
the ATC code switches select the 4-digit identification code which is displayed in the ATC code display window. The left hand outer knob selects the thousands and the inner knob the hundreds digits. The right hand inner knob selects the tens and the outer knob the units digits.

(b) GUI 007-114, 116-999;
the ATC code switches select the 4-digit identification code which is displayed in the ATC code display window. The outer knob selects the thousands and hundreds digits. The inner knob selects the tens and units digits.

(c) GUI 001-006;
the transponder select switch activates the left or right transponder, as selected. Both transponders are off with the switch in the STBY position.

(d) GUI 007-114, 116-999;
the transponder select switch activates the left or right transponder, as selected.

(e) GUI 001-006;
the altitude reporting switch enables the transponder to reply with coded altitude information supplied by left and right ADCs.

(f) GUI 007-114, 116-999;
the mode switch in the XPDR position activates the selected transponder unit and enables the altitude reporting function. In the STBY position, both transponders are inactive. In the TEST position, a self-test is performed.

(g) The identification switch causes the transponder to transmit a special pulse with each ATC code reply generated. This is used to identify the airplane on the ground station scope.

C. Antenna and Antenna Switching

(1) The two ATC antennas are conventional L blade-type units located on the top and bottom of the fuselage.

(2) The antenna switch enables the left or right transponder to transmit and receive signals using both the top and the bottom ATC antenna.

3. Operation

A. Functional Description

(1) GUI 001-006;
each transponder is powered by the 115V AC, 400 Hz from the corresponding left or right bus. Power to the transponders is controlled by the control panel L/STBY/R selector switch. Setting this switch to either L or R applies power to the control panel and to the selected transponder. Setting the switch to STBY disconnects power to both transponders.

(2) GUI 007-114, 116-999;
each transponder is powered by the 115V AC, 400Hz from the corresponding left or right bus.

(3) Control data for the transponders is generated in the control panel. This control data includes the ATC code select signals, the identification signal, the altitude reporting signal, and the ADC source select discrete. All are entered into the ARINC 429 transmitters and sent over digital data buses to the transponders. The encoded selection data also operates the ATC control panel display.

(4) The left and right ADCs provide altitude data to both transponders in ARINC 429 digital data format. When the ALT RPTG switch is on, the selected transponder uses this data to form altitude coded replies. Under normal conditions, the left unit uses the signals from the left ADC and the right unit from the right ADC. The left transponder will switch to the right ADC if the AIR DATA switch on the captain's INSTR SOURCE SEL panel is set to ALTN. Similarly, the right transponder will switch to the left ADC if the AIR DATA switch on the first officer's INSTR SOURCE SEL panel is set to ALTN.

(5) Three different modes of interrogation, signals are alternately sent by the ATC ground radar systems. Mode A signals ask the transponder for just the assigned ATC (4096) code. Mode C signals ask for just pressure altitude data. Mode S signals ask for the airplanes mode S address and other surveillance information.

(6) Interrogation signals received at the antenna are routed to the receiver thru the rf switch. The rf switch allows one antenna to be used to both receive and transmit signals. The interrogation signals, operating at 1030 MHz, are reduced to a 60 MHz IF signal in the receiver. The IF signal is coupled to the video processor where pulse width and pulse amplitude are checked. Valid signals are converted to digital pulses and routed to the digital processor.

(7) The digital processor encodes and generates replies. Reply signals are transmitted between two framing pulses 20.3 microseconds apart. The data format between the framing pulses depends on the mode of the interrogation signals received.

   (a) If mode A signals are received, the reply signal is formatted with assigned ATC code data set on the ATC control panel.

(b) If mode C signals are received, the reply signal is formatted with pressure altitude data if the altitude reporting switch is set to ON. If the altitude reporting switch is set to OFF, the transponder will reply with only the two framing pulses.
(c) If mode S signals are received, the reply signal format can include the ATC (4096) code, pressure altitude data and other surveillance information used by the TCAS system. A discrete 24-bit mode S address always accompany each reply.
(d) The mode S transponder allows bidirectional air-to-air, ground-to-air and air-to-ground data link.

(8) In addition to the information pulses, a special position identification (SPI) pulse will be included in the mode A replies when requested by the ground station. The pulse is initiated when the identification switch is pushed on the ATC control panel. The pulse is transmitted with each mode A response up to 20 seconds after the identification switch is pressed.

(9) The reply signals are fed from the digital processor to the transmitter. The transmitter generates the replies in 1090 MHz pulse format. The reply is sent to the circulator which protects against severe impedance changes at the antenna port. The replies proceed on through the switching network and out to the antenna.

(10) When the ATC is transmitting, the mutual suppression circuit generates the suppression signal. This signal inhibits the DMEs from transmitting at the same time as the ATC transponder. Only one ATC transponder is activated at any one time.

(11) The green TPR-PASS light comes on or flickers during ATC transponder transmission.

B. BITE

(1) The BITE microprocessor monitors system functions during normal system operation. All internal circuits plus the power supply are checked. The input signals from the control panel and the selected air data computer are also checked. The BITE checks receiver performance, transmitter output and interface signal data.

(2) The BITE microprocessor includes a flight fault memory. While this memory is installed, it is not used under the current mode of BITE programming. The air/ground relay discrete received by the BITE microprocessor is only used in conjunction with an operating flight fault memory.

(3) If no valid interrogations are received by the transponder, the BITE initiates a self-test. During this test, the test oscillator injects a 1030 Hz signal that is directed to the receiver path. The signal includes alternate mode A and C simulated interrogations. This signal is processed in the normal manner as previously described. The processor checks the receiver output to find out if the mode A or C signals were properly decoded. It also examines the transmit section to determine whether the correct response was made.

(4) Self Test
  (a) The system self-test can be initiated manually by pressing the TEST switch on the transponder. The TEST switch does not need to be held in. Sequencing of the test will automatically occur as follows:
    1) All front panel lights come on for about 1 second.
    2) All red status lights go off during the internal tests. These tests are conducted as described in the BITE initiated self-test.
    3) The green light will come on to show that the self-test operation was successful.

C. Control
  (1) Provide electrical power (Ref 24-22-00/201).
  (2) Close ATC L and ATC R circuit breakers on panel P11.
  (3) Select left or right transponder as desired by setting the transponder select switch on the ATC control to L or R.
  (4) GUI 001-006;
  to provide altitude reporting data, set the altitude reporting switch in the ON posiiton.
  (5) GUI 007-114, 116-999;
  to provide altitude reporting data, set the mode switch in the XPDR position.

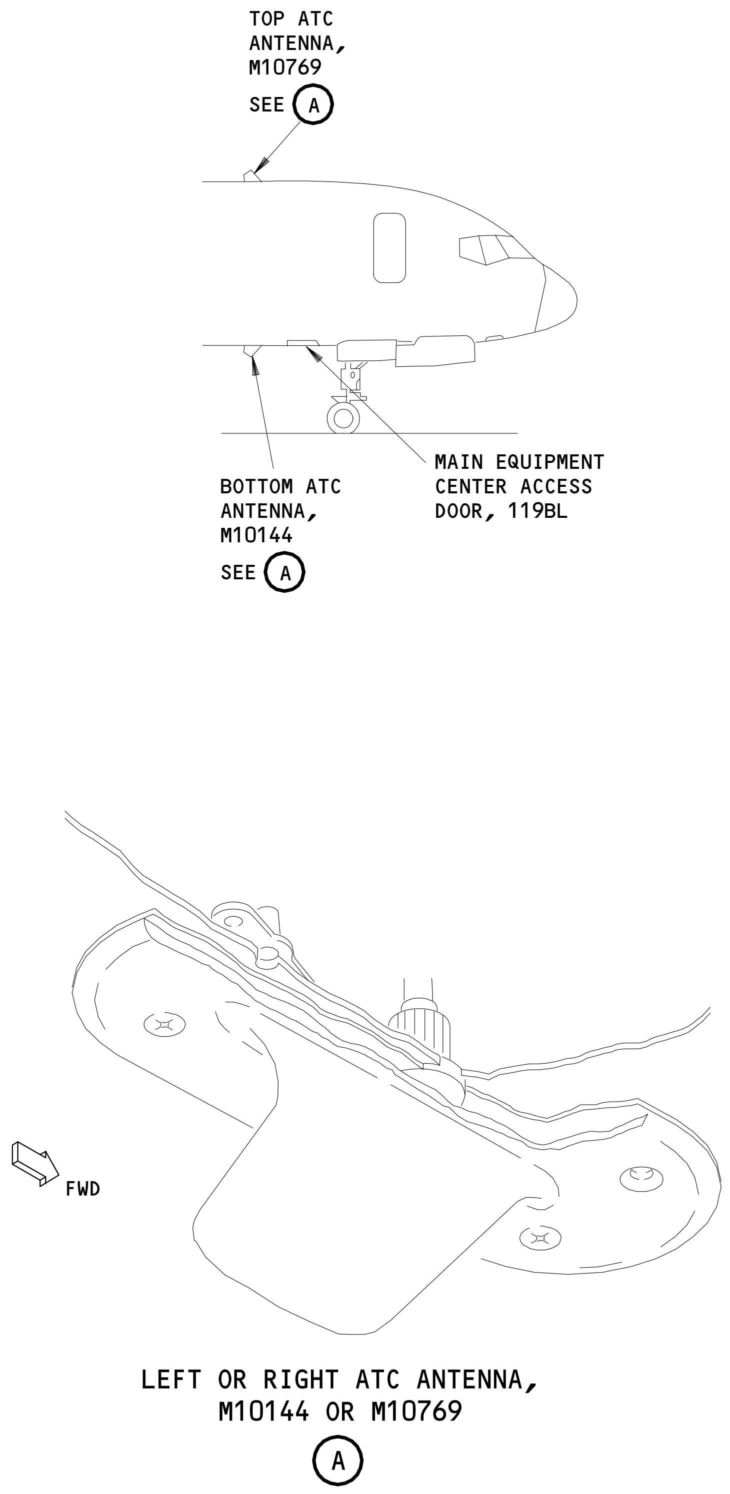
D. For more details on the ATC System, refer to these wiring diagrrams and functional schematics:
  (1) WDM 34-53-XX: ATC System
  (2) SSM 34-53-XX: ATC System

AIR TRAFFIC CONTROL (ATC) SYSTEM

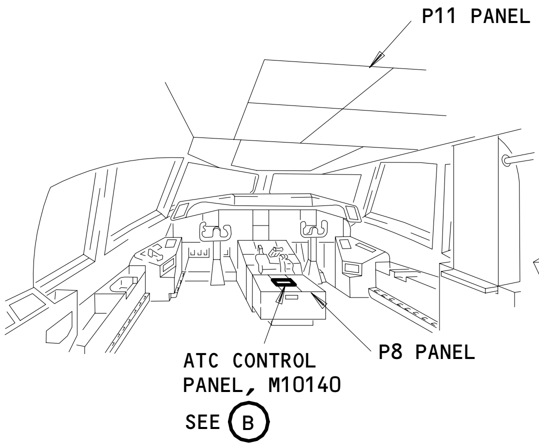
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - BOTTOM ATC, M10144	1	1	BOTTOM OF FUSELAGE	34-53-03
ANTENNA - TOP ATC, M10769	1	1	TOP OF FUSELAGE	34-53-03
CIRCUIT BREAKER -			FLIGHT COMPT, P11	
ATC ANT SWITCH, C4423		1	11C20	*
ATC LEFT, C4051		1	11F7	*
ATC RIGHT, C4052		1	11F28	*
COMPUTER - (FIM 31-41-00/101)				
EICAS LEFT, M10181				
EICAS RIGHT, M10182				
PANEL - ATC CONTROL, M10140	2	1	FLIGHT COMPT, P8	34-53-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K143				
RELAY - (FIM 31-01-37/101)				
SYS NO. 2 AIR/GND, K201				
SWITCH - (FIM 34-12-00/101)				
LEFT ADC, S482				
RIGHT ADC, S483				
SWITCH - BOTTOM ATC ANT, S10564	2	1	119BL, MAIN EQUIP CENTER, E3-3	34-53-04
SWITCH - TOP ATC ANT, S10563	2	1	119BL, MAIN EQUIP CENTER, E3-2	34-53-04
TRANSPONDER - LEFT ATC, M10141	2	1	119BL, MAIN EQUIP CENTER, E3-3	34-53-01
TRANSPONDER - RIGHT ATC, M10142	2	1	119BL, MAIN EQUIP CENTER, E3-2	34-53-01

* SEE THE WDM EQUIPMENT LIST

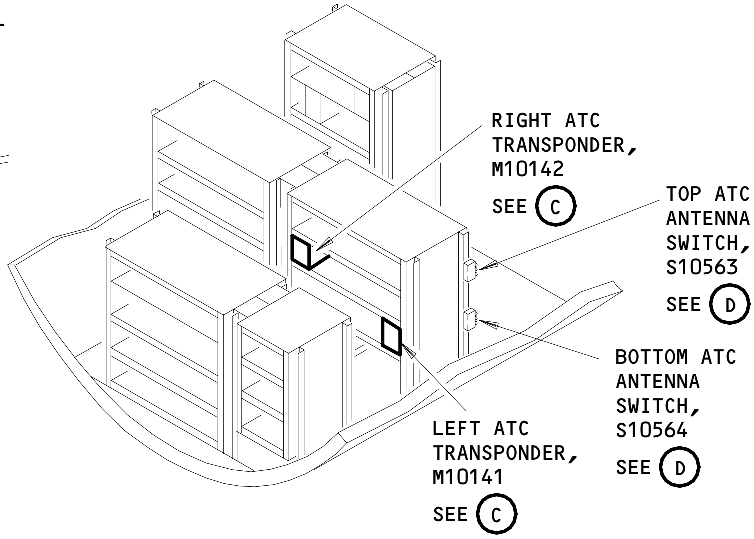
Air Traffic Control (ATC) System - Component Index
Figure 101



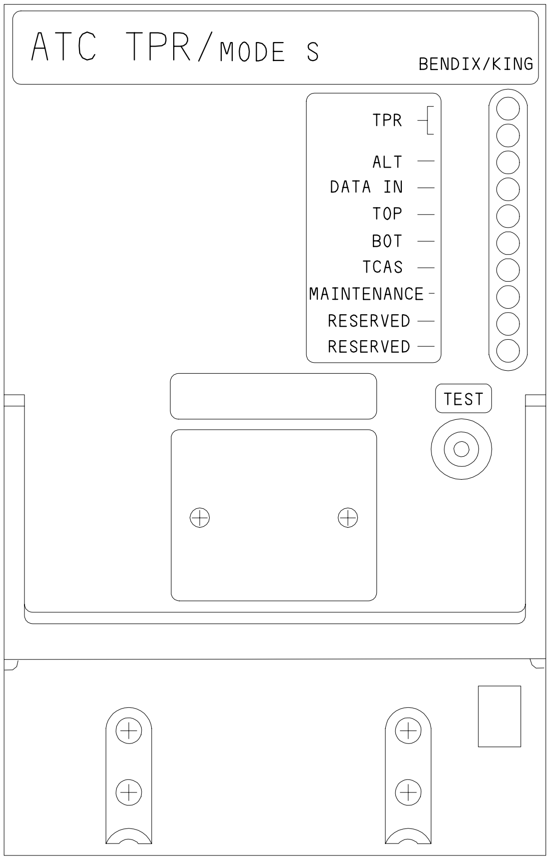
Air Traffic Control (ATC) System - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT

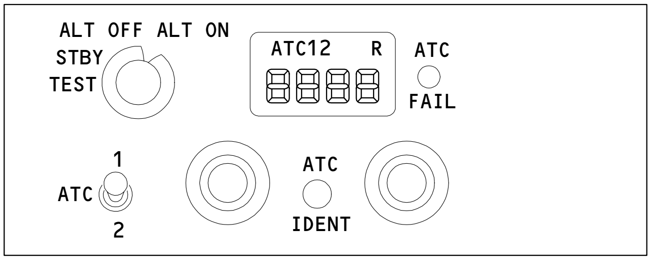


MAIN EQUIPMENT CENTER



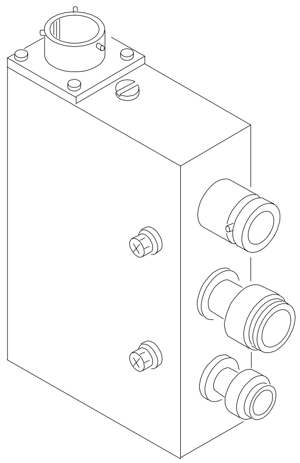
LEFT OR RIGHT ATC TRANSPONDER, M10141 OR M10142

Ⓒ



ATC CONTROL PANEL, M10140

Ⓑ



ATC ANTENNA SWITCH, S10563 OR S10564

Ⓓ

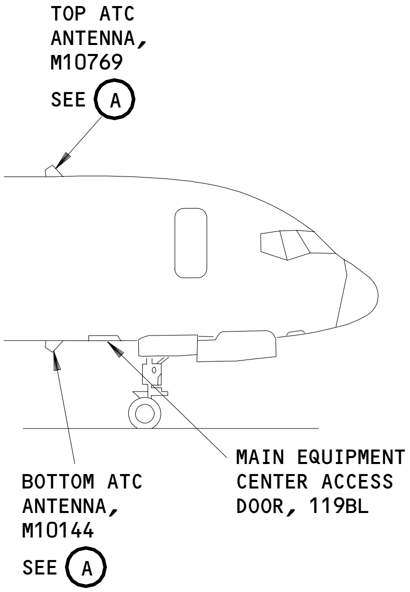
Air Traffic Control (ATC) System - Component Location
Figure 102 (Sheet 2)

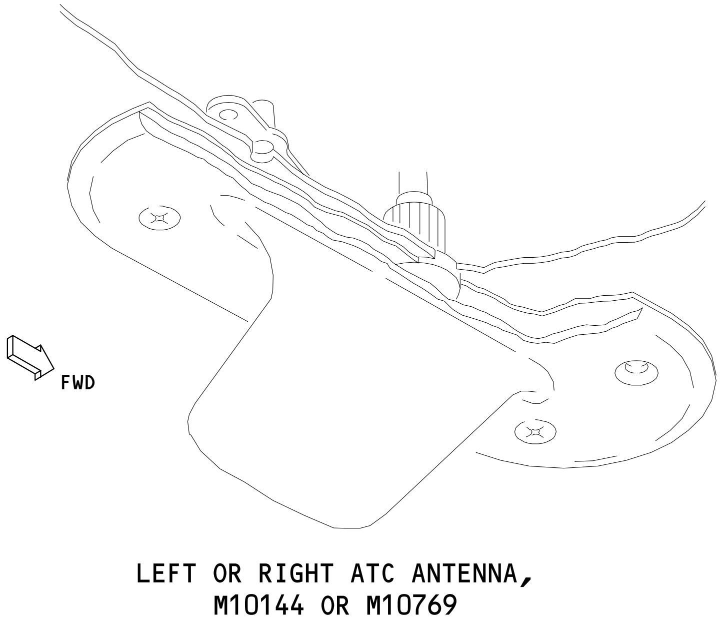
AIR TRAFFIC CONTROL (ATC) SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - BOTTOM ATC, M10144	1	1	BOTTOM OF FUSELAGE	34-53-03
ANTENNA - TOP ATC, M10769	1	1	TOP OF FUSELAGE	34-53-03
CIRCUIT BREAKER -			FLIGHT COMPT, P11	
ATC ANT SWITCH, C4423		1	11C20	*
ATC LEFT, C4051		1	11F7	*
ATC RIGHT, C4052		1	11F28	*
COMPUTER - (FIM 31-41-00/101)				
EICAS LEFT, M10181				
EICAS RIGHT, M10182				
PANEL - ATC CONTROL, M10140	2	1	FLIGHT COMPT, P8	34-53-02
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GND, K143				
RELAY - (FIM 31-01-37/101)				
SYS NO. 2 AIR/GND, K201				
SWITCH - (FIM 34-12-00/101)				
LEFT ADC, S482				
RIGHT ADC, S483				
SWITCH - BOTTOM ATC ANT, S10564	2	1	119BL, MAIN EQUIP CENTER, E3-3	34-53-04
SWITCH - TOP ATC ANT, S10563	2	1	119BL, MAIN EQUIP CENTER, E3-2	34-53-04
TRANSPONDER - LEFT ATC, M10141	2	1	119BL, MAIN EQUIP CENTER, E3-3	34-53-01
TRANSPONDER - RIGHT ATC, M10142	2	1	119BL, MAIN EQUIP CENTER, E3-2	34-53-01

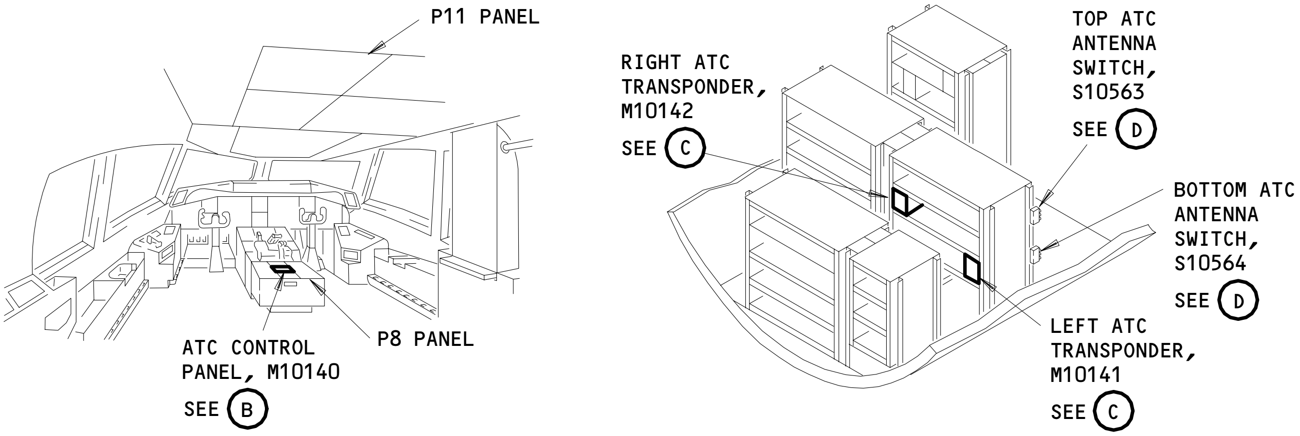
* SEE THE WDM EQUIPMENT LIST

Air Traffic Control (ATC) System - Component Index
Figure 101



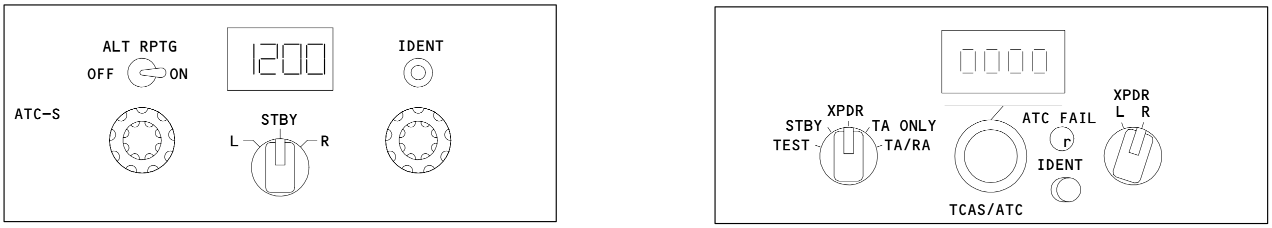


Air Traffic Control (ATC) System - Component Location
Figure 102 (Sheet 1)



FLIGHT COMPARTMENT

MAIN EQUIPMENT CENTER

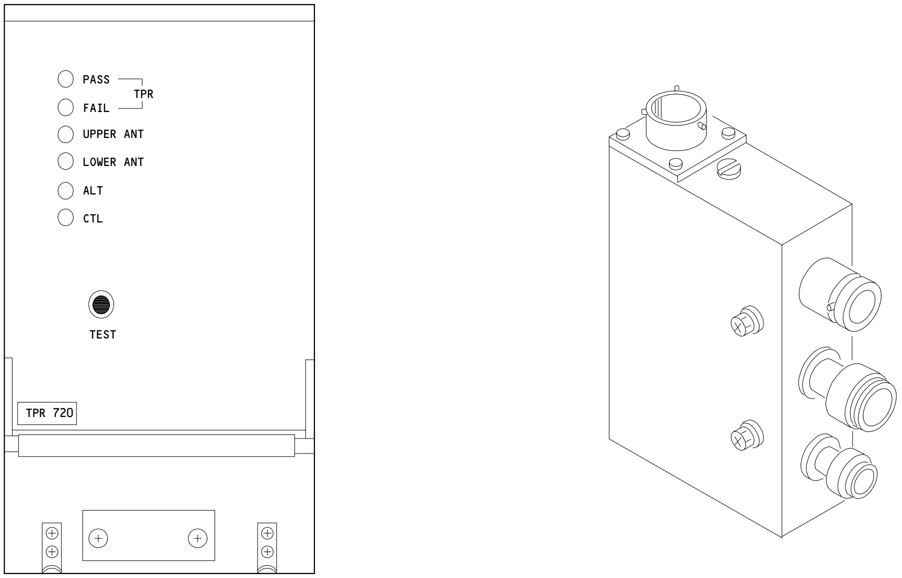


ATC CONTROL PANEL, M10140

B 1

ATC CONTROL PANEL, M10140

B 2



LEFT OR RIGHT ATC TRANSPONDER, M10141 OR M10142

C

ATC ANTENNA SWITCH, S10563 OR S10564

D

1 GUI 001-006

2 GUI 007-114,116-999

Air Traffic Control (ATC) System - Component Location
Figure 102 (Sheet 2)

AIR TRAFFIC CONTROL (ATC) SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure has two tasks. One is an operational test; the other is a system test. The operational test is a fast check of the ATC system. The system test first does the operational test. Then, it uses test equipment to examine ATC code reception and altitude reporting. This procedure also has steps to measure the transponder sensitivity, the side lobe suppression, and the transmitter frequency.

TASK 34-53-00-715-347-003

2. Operational Test - ATC System
   A. General
      (1) This test examines the ATC system for correct operation. It uses only the system's BITE function, and no special test or ground equipment is necessary.
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
   C. Access
      (1) Location Zones

119	Main Equipment Center
211/212	Flight Compartment

   D. Prepare for the Operational Test

S 865-348-003

      (1) Supply electrical power (AMM 24-22-00/201).

S 865-349-003

      (2) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:
         (a) 11A10, AIR DATA CMPTR LEFT
         (b) 11A11, AIR DATA AOA SENSOR LEFT
         (c) 11A12, AIR DATA BARO CORRECT LEFT
         (d) 11C20, ATC ANT SWITCH
         (e) 11E2, ALTM LEFT
         (f) 11E23, ALTM RIGHT
         (g) 11F7, ATC LEFT
         (h) 11F28, ATC RIGHT
         (i) 11F30, AIR DATA CMPTR RIGHT
         (j) 11F31, AIR DATA AOA SENSOR RIGHT
         (k) 11F32, AIR DATA BARO CORRECT RIGHT
         (l) EICAS (6 locations)

S 865-350-003

(3) Set the transponder select switch on the ATC control panel to the 1 position.

E. Procedure

S 755-352-003

(1) Make sure the ATC FAIL light on the ATC control panel is off.

S 755-590-003

(2) Make sure the message, ATC FAULT, does not come into view on EICAS.

<u>NOTE</u>: If necessary push the CANCEL switch on the EICAS DISPLAY select panel to see more messages.

S 745-353-003

(3) Push and hold the TEST switch on the left ATC transponder.

S 755-354-003

(4) Make sure the sequence that follows occurs:
  (a) All the LEDs come on
  (b) All the LEDs go off
  (c) The green LED comes on and stays on.

S 745-355-003

(5) Release the TEST switch on the ATC transponder.

S 865-356-003

(6) Set the transponder select switch on the ATC control panel to the 2 position.

S 715-357-003

(7) Do the self-test procedure again for the right ATC transponder.

F. Put the Airplane Back to Its Usual Condition

S 865-358-003

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-557-003

3. System Test - ATC system (With IFR 601)

A. General

(1) This system test is a more complete check of the ATC system. The system test first does the ATC - Operational Test. Then it uses ground test equipment to examine the left and right ATC systems.

NOTE: Two types of test equipment (IFR ATC 601 and TIC T-48/49) are described in two separate tests. Do only one test. Use the test set that is available.

(2) The IFR 601 test set is used to test the functionality of the mode S transponder. All twenty tests can be run automatically in the AUTO mode or individually in single test mode. Results from the last test are shown on each test page. The PASSED/FAILED indication is shown on top of the page. To do a single test, use the select keys to get to the desired test and push the RUN/STOP key.

B. Equipment
  (1) ATC Transponder Ramp Test Set IFR ATC-601

C. References
  (1) AMM 24-22-00/201, Manual Control
  (2) AMM 32-09-02/201, Flight Mode Simulation
  (3) AMM 34-12-00/501, Air Data Computing (ADC) System

D. Access
  (1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the System Test

S 845-452-003

CAUTION: DO NOT PLACE THE REMOTE TEST SET ANTENNA CLOSER THAN 15 INCHES (.40 METERS) TO THE AIRCRAFT ANTENNA WITH THE TEST SET ON. THIS WILL CAUSE DAMAGE TO THE TEST SET.

(1) Put the test antenna at a convenient bearing and distance from the ATC antennas under test.

NOTE: The test set antenna must be within the line of sight of the ATC antennas.

S 845-455-003

(2) Put the test set antenna in position towards the aircraft antenna.

S 845-456-003

(3) Connect the coaxial cable from the remote test set antenna to the test set.

S 715-558-003

(4) Do the ATC Operational Test.

S 865-458-003

(5) Set the PWR switch on the test set to the ON position.

NOTE: The test set is a source of interference for radio and L-band radar equipment operating on the airplane and located near the test set. Turn the test set off as soon as the test is completed or when you must perform other radio checks on the airplane.

S 865-459-003

(6) Push the SETUP key to enter the SETUP menu.

NOTE: For information regarding the battery test, timing and recharging refer to the operation section of the test set operators manual.

S 865-559-003

(7) Push the SELF TEST key on the test set.

S 865-574-003

(8) Push the RUN/STOP key to start the self test.
    (a) Make sure the test set display shows PASSED.

S 865-560-003

(9) Push the SETUP key to enter the SETUP menu.

S 865-460-003

(10) Enter the distance from the test set antenna to the aircraft antenna in the RANGE field for the TOP and BOTTOM antenna.

S 865-561-003

(11) Enter 21 feet in the HEIGHT field for the TOP antenna and 8 feet for the BOTTOM antenna.

S 865-562-003

(12) Choose the bottom antenna on the SELECTED field.

S 865-372-003

(13) Enter the gain listed on the test set antenna into the GAIN_1030 and GAIN_1090 field.

S 865-373-003

(14) Enter the cable loss listed on the cable in the LOSS field.
  (a) Use the SLEW keys to change the values.
  (b) Use the SELECT keys to change the items.
  (c) Use the SELECT keys to select the antenna which you must test.

S 865-563-003

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(15) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

S 865-564-003

(16) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-539-003

(17) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. ATC System Test

S 865-587-003

(1) Set the code switches on the ATC control panel to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-568-003

(2) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-566-003

(3) Set the altitude reporting switch on the ATC control panel to the ALT ON position.

S 865-461-003

(4) Push the AUTO TEST key on the test set.

S 865-569-003

(5) Use the RUN/STOP key to start or stop individual test.

S 865-570-003

(6) Use the SELECT key to select each individual test.

S 735-327-003

(7) Do a check of the REPLY DELAY TEST.
  (a) Make sure the reply delay is 128.00us (±0.25us) for Mode S.
  (b) Make sure the reply delay is 128.00us (±0.5 us) for ITM.
  (c) Make sure the reply delay is 3.00us (±0.50us) for ATC A and C.

S 735-462-003

(8) Do a check of the REPLY JITTER TEST.
  (a) Make sure the reply jitter is ≤ 0.05us for mode S.
  (b) Make sure the reply jitter is ≤ 0.06us for ITM A and C.
  (c) Make sure the reply jitter is ≤ 0.1us for ATC A and C.

S 735-463-003

(9) Do a check of the ATCRBS REPLY TEST.
  (a) Make sure the spacing of the F1 to F2 pulse is 20.3us (±0.10us)
  (b) Make sure the duration of the F1, F2 pulse is 0.45us (±0.10us).

S 735-464-003

(10) Do a check of the SLS LEVEL TEST.
  (a) Make sure the reply is received when the SLS pulse is -9dB and no reply is received when the SLS pulse is 0dB.

NOTE: Run the SLS level test in less than 95 feet (28.96 meters) of the UUT antenna.

S 735-465-003

(11) Do a check of the ATCRBS ONLY ALL-CALL TEST.
  (a) Make sure the mode S transponder did not reply to the interrogation (PASSED TEST).

S 735-466-003

(12) Do a check of the MODE S ALL CALL TEST.
- (a) Make sure the test set shows PASSED and the airplane's mode S address.

S 735-467-003

(13) Do a check of the INVALID MODE S ADDRESS TEST.
- (a) Make sure the mode S transponder did not reply (PASSED TEST).

S 735-468-003

(14) Do a check of the SPR ON/OFF TEST.
- (a) Make sure a reply is receive when SPR is ON and no reply is receive when SPR is OFF.

S 735-469-003

(15) Do a check of the MODE S UFO TEST.
- (a) Make sure (Down-link format) DF=0, AC=(airplane's altitude) and ADDRESS={airplane's mode S address (WDM 34-53-12 or WDM 34-53-22).

  NOTE: Make sure the reported altitude is within ±125 feet of the altitude shown on the captain's and first officer's altimeter (applicable for all the altitude reporting checks). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-470-003

(16) Do a check of the MODE S UF4 TEST.
- (a) Make sure DF=4, AC=(airplane's altitude) and ADDRESS=(airplane's mode address).

S 735-471-003

(17) Do a check of the MODE S UF5 TEST.
- (a) Make sure DF=5, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

S 735-472-003

(18) Do a check of the MODE S UF11 TEST.
- (a) Make sure DF=11 and AA=(airplane's address).

(b) Make sure the CA field is not void.

<u>NOTE</u>: The value of the CA field is determined by the manufacturer.

S 735-473-003

(19) Do a check of the MODE S UF16 TEST.

(a) Make sure DF=16, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF16 test is not a failure of the ATC system.

S 735-474-003

(20) Do a check of the MODE S UF20 TEST.

(a) Make sure DF=20, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF20 test is not a failure of the ATC system.

S 735-475-003

(21) Do a check of the MODE S UF21 TEST.

(a) Make sure DF=21, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF21 test is not a failure of the ATC system.

S 735-476-003

(22) Do a check of the SQUITTER TEST.

(a) Make sure the squitter's period is between 0.8 to 1.2 seconds.

<u>NOTE</u>: If the test set antenna is in line of sight with only one of the ATC antennas, the squitter period will be between 1.6 to 2.4 seconds.

S 735-477-003

(23) Do a check of the FREQUENCY TEST.

(a) Make sure the reply frequency of the transponder is 1090 MHz ±1MHz.

S 865-540-003

(24) Move the test set to less than 50 feet from the top ATC antenna.

NOTE: Make sure the top ATC antenna is not in the line of sight of the test set antenna. Follow the test set operator's quide to reduce multipath errors. Do the test several times with the test set at different locations until you get valid results.

S 865-541-003

(25) Push the SETUP key on the test set and enter the appropriate range for the top and bottom antenna.

S 735-478-003

(26) Do a check of the DIVERSITY TEST.
  (a) Make sure the power level difference is ≥ 20dB between 'on' antenna squitters and 'off' antenna squitters.

  NOTE: To make sure the dynamic range is ≥ 20dB, a diversity test must be run at a distance of less than 50 feet (15.2 meters) from the airplane antenna.

S 735-479-003

(27) Do a check of the MTL DIFFERENCE TEST.
  (a) Make sure the Minimum Threshold Level (MTL) difference between mode A and mode C is ≤ 1.0dBm.

S 865-542-003

(28) Push the PWR TEST key on the test set.

S 865-543-003

(29) Use the SELECT key on the test set and select the bottom antenna.

NOTE: Make sure the top ATC antenna is not in the line of sight of the test set antenna during the POWER TEST.

S 865-544-003

(30) Push the antenna push button switch.

S 865-545-003

(31) Slowly move the test set antenna 6 feet (1.8 meters) vertically from the ground, at less than 1 FT/SEC (30 CM/SEC).

S 865-546-003

(32) Push the antenna push button switch a second time to stop the test when the test set antenna is approximately 6 feet high.

S 735-480-003

(33) Do a check of the POWER TEST.

- (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBm) and 500W (ERP = 57.0 dBm).

  NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

- (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).
- (c) Make sure the test set shows PASSED for the BOT AVG (dBm).

S 865-547-003

(34) Insert the antenna shield over the bottom ATC antenna.

S 865-548-003

(35) Move the test set so that it is in the line of sight of the top ATC antenna.

S 865-549-003

(36) Push the SETUP key on the test set.

- (a) Enter the appropriate range for the top antenna.
- (b) Choose the top antenna on the SELECTED field.

S 865-550-003

(37) Push the PWR TEST key on the test set.

S 865-551-003

(38) Use the SELECT key on the test set and select the top antenna.

S 735-552-003

(39) Do a check of the POWER TEST.

- (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBM) and 500W (ERP = 57.0 dBm).

  NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

- (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).
- (c) Make sure the test set shows PASSED for the TOP AVG (dBm).

S 715-571-003

(40) Do the system test again for the right or No. 2 ATC system.

NOTE: On the test set, select the other ATC antenna.

G. Put the Airplane Back to Its Usual Condition

S 845-481-003

(1) Remove the ATC ramp test set.

S 865-553-003

(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-554-003

(3) Close these circuit breakers.
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
       11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-482-003

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-592-003

4. System Test - ATC system (With IFR 601-2)

A. General

(1) This system test is a more complete check of the ATC system. The system test first does the ATC - Operational Test. Then it uses ground test equipment to examine the left and right ATC systems.

(2) Requirements for Elementary Surveillance, Enhanced Surveillance and Extended Squitter require transponder testing be done with the IFR-601 (-2) with software version 3.0 or greater.

(3) For this procedure, IFR-601-2 refers to a IFR ATC-601 with software version 3.0 or greater. The only difference is the software version. The hardware is the same.

(4) The IFR-601-2 test set uses thirty-nine (39) different tests to check the functionality of the ATC transponder. All thirty-nine (39) tests can be run automatically in the AUTO mode, or individually in the single test mode.

(5) Results from the last test are shown on each test page. The PASSED/FAILED indication is shown on top of the page. To do a single test, use the select keys to get to the desired test and push the RUN/STOP key.

(6) The details of individual tests conducted during the AUTO TEST are stored in memory and may be reviewed by using the SELECT keys.

(7) When a individual test is selected, the test may be started with the RUN/STOP key, and will continue to run until the RUN/STOP key is pressed again.

B. Equipment

(1) ATC Transponder Ramp Test Set IFR ATC-601

C. References

(1) AMM 22-10-00/501, Autopilot Flight Director System (AFDS)
(2) AMM 24-22-00/201, Manual Control
(3) AMM 32-09-02/201, Flight Mode Simulation
(4) AMM 34-12-00/501, Air Data Computing (ADC) System
(5) AMM 34-21-00/501, Inertial Reference System (IRS)
(6) AMM 34/58-00/501, Global Positioning System (GPS)
(7) AMM 34-61-00/501, Flight Management Computer System (FMCS)

D. Access

(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the System Test

S 845-593-003

CAUTION: DO NOT PLACE THE REMOTE TEST SET ANTENNA CLOSER THAN 15 INCHES (.40 METERS) TO THE AIRCRAFT ANTENNA WITH THE TEST SET ON. THIS WILL CAUSE DAMAGE TO THE TEST SET.

(1) Put the test antenna at a convenient bearing and distance from the ATC antennas under test.

NOTE: The test set antenna must be within the line of sight of the ATC antennas.

S 845-594-003

(2) Put the test set antenna in position towards the aircraft antenna.

S 845-595-003

(3) Connect the coaxial cable from the remote test set antenna to the test set.

S 715-596-003

(4) Do the ATC Operational Test.

S 865-597-003

(5) Set the PWR switch on the test set to the ON position.

NOTE: The test set is a source of interference for radio and L-band radar equipment operating on the airplane and located near the test set. Turn the test set off as soon as the test is completed or when you must perform other radio checks on the airplane.

(a) The Start-Up screen will display.
    1) The software version is shown on this screen.
(b) Make sure the software version is 3.0 or greater.

S 865-599-003

(6) Push the SELF TEST key on the test set, to enter the self test menu.

S 865-600-003

(7) Push the RUN/STOP key to start the self test.
(a) Make sure the test set display shows PASSED.

S 865-601-003

(8) Push the SETUP key to enter the SETUP menu.
(a) Enter the required data into the Setup Menu.

NOTE: Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 865-602-003

(9) Enter the distance from the test set antenna to the aircraft antenna in the RANGE field for the TOP and BOTTOM antenna.

S 865-603-003

(10) Enter 21 feet in the HEIGHT field for the TOP antenna and 8 feet for the BOTTOM antenna.

S 865-604-003

(11) Choose the bottom antenna on the SELECTED field.

S 865-605-003

(12) Enter the gain listed on the test set antenna into the GAIN_1030 and GAIN_1090 field.

S 865-606-003

(13) Enter the cable loss listed on the cable in the LOSS field.
(a) Use the SLEW keys to change the values.
(b) Use the SELECT keys to change the items.
(c) Use the SELECT keys to select the antenna which you must test.

S 865-607-003

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(14) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

S 865-608-003

(15) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
       11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-609-003

(16) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. ATC System Test

S 865-610-003

(1) Set the code switches on the ATC control panel to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-611-003

(2) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-612-003

(3) Set the altitude reporting switch on the ATC control panel to the ALT ON position.

S 865-613-003

(4) Push the AUTO TEST key on the test set.

S 865-614-003

(5) Use the RUN/STOP key to start or stop testing.
  - (a) The AUTO test will run until it is finished. The results are stored in the tester memory for review.

    NOTE: Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 865-695-003

(6) To run Individual Tests, use the SELECT key to select each test.
  - (a) Use the RUN/STOP key to start or stop the individual tests.

S 865-696-003

(7) Review the test results screens.

S 735-616-003

(8) Do a check of the REPLY DELAY TEST.
  - (a) Make sure the reply delay is 128.00us (±0.25us) for Mode S.
  - (b) Make sure the reply delay is 128.00us (±0.5 us) for ITM.
  - (c) Make sure the reply delay is 3.00us (±0.50us) for ATC A and C.

S 735-617-003

(9) Do a check of the REPLY JITTER TEST.
  - (a) Make sure the reply jitter is ≤ 0.05us for mode S.
  - (b) Make sure the reply jitter is ≤ 0.06us for ITM A and C.
  - (c) Make sure the reply jitter is ≤ 0.1us for ATC A and C.

S 735-618-003

(10) Do a check of the ATCRBS REPLY TEST.
  - (a) Make sure the spacing of the F1 to F2 pulse is 20.3us (±0.10us)
  - (b) Make sure the duration of the F1, F2 pulse is 0.45us (±0.10us).

S 735-619-003

(11) Do a check of the SLS LEVEL TEST.
  - (a) Make sure the reply is received when the SLS pulse is -9dB and no reply is received when the SLS pulse is 0dB.

    NOTE: Run the SLS level test in less than 95 feet (28.96 meters) of the UUT antenna.

S 735-620-003

(12) Do a check of the ATCRBS ONLY ALL-CALL TEST.
  - (a) Make sure the mode S transponder did not reply to the interrogation (PASSED TEST).

S 735-621-003

(13) Do a check of the MODE S ALL CALL TEST.
  (a) Make sure the test set shows PASSED and the airplane's mode S address.

S 735-622-003

(14) Do a check of the INVALID MODE S ADDRESS TEST.
  (a) Make sure the mode S transponder did not reply (PASSED TEST).

S 735-623-003

(15) Do a check of the SPR ON/OFF TEST.
  (a) Make sure a reply is receive when SPR is ON and no reply is receive when SPR is OFF.

S 735-624-003

(16) Do a check of the MODE S UFO TEST.
  (a) Make sure (Down-link format) DF=0, AC=(airplane's altitude) and ADDRESS={airplane's mode S address (WDM 34-53-12 or WDM 34-53-22).

<u>NOTE</u>: Make sure the reported altitude is within ±125 feet of the altitude shown on the captain's and first officer's altimeter (applicable for all the altitude reporting checks). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-625-003

(17) Do a check of the MODE S UF4 TEST.
  (a) Make sure DF=4, AC=(airplane's altitude) and ADDRESS=(airplane's mode address).

S 735-626-003

(18) Do a check of the MODE S UF5 TEST.
  (a) Make sure DF=5, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

S 735-627-003

(19) Do a check of the MODE S UF11 TEST.
  (a) Make sure DF=11 and AA=(airplane's address).
  (b) Make sure the CA field is not void.

<u>NOTE</u>: The value of the CA field is determined by the manufacturer.

S 735-628-003

(20) Do a check of the MODE S UF16 TEST.

(a) Make sure DF=16, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF16 test is not a failure of the ATC system.

S 735-629-003

(21) Do a check of the MODE S UF20 TEST.

(a) Make sure DF=20, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF20 test is not a failure of the ATC system.

S 735-630-003

(22) Do a check of the MODE S UF21 TEST.

(a) Make sure DF=21, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF21 test is not a failure of the ATC system.

S 735-631-003

(23) Do a check of the SQUITTER TEST.

(a) Make sure the squitter's period is between 0.8 to 1.2 seconds.

<u>NOTE</u>: If the test set antenna is in line of sight with only one of the ATC antennas, the squitter period will be between 1.6 to 2.4 seconds.

S 735-632-003

(24) Do a check of the FREQUENCY TEST.

(a) Make sure the reply frequency of the transponder is 1090 MHz ±1MHz.

S 865-633-003

(25) Move the test set to less than 50 feet from the top ATC antenna.

<u>NOTE</u>: Make sure the top ATC antenna is not in the line of sight of the test set antenna. Follow the test set operator's quide to reduce multipath errors. Do the test several times with the test set at different locations until you get valid results.

S 865-634-003

(26) Push the SETUP key on the test set and enter the appropriate range for the top and bottom antenna.

S 735-635-003

(27) Do a check of the DIVERSITY TEST.

(a) Make sure the power level difference is ≥ 20dB between 'on' antenna squitters and 'off' antenna squitters.

NOTE: To make sure the dynamic range is ≥ 20dB, a diversity test must be run at a distance of less than 50 feet (15.2 meters) from the airplane antenna.

S 735-636-003

(28) Do a check of the MTL DIFFERENCE TEST.

(a) Make sure the Minimum Threshold Level (MTL) difference between mode A and mode C is ≤ 1.0dBm.

S 865-637-003

(29) Push the PWR TEST key on the test set.

S 865-638-003

(30) Use the SELECT key on the test set and select the bottom antenna.

NOTE: Make sure the top ATC antenna is not in the line of sight of the test set antenna during the POWER TEST.

S 865-639-003

(31) Push the antenna push button switch.

S 865-640-003

(32) Slowly move the test set antenna 6 feet (1.8 meters) vertically from the ground, at less than 1 FT/SEC (30 CM/SEC).

S 865-641-003

(33) Push the antenna push button switch a second time to stop the test when the test set antenna is approximately 6 feet high.

S 735-642-003

(34) Do a check of the POWER TEST.

(a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBm) and 500W (ERP = 57.0 dBm).

NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

(b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).

(c) Make sure the test set shows PASSED for the BOT AVG (dBm).

S 865-643-003

(35) Insert the antenna shield over the bottom ATC antenna.

S 865-644-003

(36) Move the test set so that it is in the line of sight of the top ATC antenna.

S 865-645-003

(37) Push the SETUP key on the test set.
- (a) Enter the appropriate range for the top antenna.
- (b) Choose the top antenna on the SELECTED field.

S 865-646-003

(38) Push the PWR TEST key on the test set.

S 865-647-003

(39) Use the SELECT key on the test set and select the top antenna.

S 735-648-003

(40) Do a check of the POWER TEST.
- (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBM) and 500W (ERP = 57.0 dBm).

  NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

- (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).
- (c) Make sure the test set shows PASSED for the TOP AVG (dBm).

S 865-697-003

(41) Do a check of the other test results for Elementary Surveillance, Enhanced Surveillance, and Extended Squitter functions.

NOTE: Refer to the IFR-601-2 Operations Manual for details of these tests.

S 865-698-003

(42) Do the identification test.

NOTE: For the IFR-601-2, use the ATCRBS individual test. Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 715-649-003
(43) Do the system test again for the right or No. 2 ATC system.

NOTE: On the test set, select the other ATC antenna.

G. Put the Airplane Back to Its Usual Condition

S 845-650-003
(1) Remove the ATC ramp test set.

S 865-651-003
(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-652-003
(3) Close these circuit breakers.
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-653-003
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-575-003

5. System Test - ATC System (With the TIC T-48(series) or T-49(series))

A. General
  (1) This system test uses the TIC T-48 or T-49 test set to completely test the functionality of the ATC transponder. The test set can do all the tests automatically or each test individually. If a test has failed, the test sequence will abort and a failed message shows. All data will show at the end of the test if the test is successful.
  (2) In the operation with the antenna coupler, TAP 125 or TAP 135 is used with the applicable test set. It is necessary when testing during a check of the output power, receiver, sensitivity and radio frequency. For mode S diversity channel isolation check, the TAP 125 or TAP 135 is necessary.

B. Equipment
  (1) ATC Transponder Ramp Test Set TIC T-48(series) or T-49(series)
  (2) RF through-line wattmeter Bird model 43 or equivalent (up to 500 watts).

C. References
  (1) AMM 24-22-00/201, Electrical Power Control
  (2) AMM 32-09-02/201, Flight Mode Simulation
  (3) AMM 34-12-00/501, Air Data Computing (ADC) System

D. Access

(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the ATC System Test

S 715-578-003

(1) Do the ATC Operational Test:

S 715-579-003

(2) Prepare to test the ATC System:
  (a) Install the Antenna Test Equipment (T49/TAP125/TAP135).
    1) Remove the TAP-125 or TAP-135 from its carrying case.
    2) Unwind the coupler cable.
    3) Pull the pull-ring to separate the spring loaded clamp.
  (b) Slide the couplers over the blade antennas (upper and lower).
  (c) Insert the TAP125-50/TAP-135 antenna coupler over the top antenna and TAP125-10/TAP-135 coupler over the bottom antenna.

NOTE: The couplers have no orientation.

    1) Center the couplers over the antennas and compress the EMI gasket.
      a) Use the coupler with the long lead to test the upper antenna.
  (d) Connect one antenna coupler connector to the test set antenna connector.

NOTE: Connect only ONE of the TAP 125/TAP 135 cables to the test set. The opposite test cable does not have to be terminated. The anti-radiation coupler associated with the unconnected cable attenuates the transponder power by 20dB (for example, 250 watts to 2.5 watts). The anti radiation coupler prevents un-solicited interrogation from surrounding aircraft equipped with Mode S transponders or TCAS. This configuration is required for Mode S diversity check.

  (e) Apply power to the test set and follow operating procedures.
  (f) Supply electrical power (AMM 24-22-00/201).

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

  (g) Prepare the safety-sensitivity systems for air mode simulation (AMM 32-09-02/201).

(h) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  1) P11 Overhead Circuit Breaker Panel:
    a) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    b) 11S15, AIR/GND SYS 1
    c) 11S19, LDG GR POS AIR/GND SYS 2

(i) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. Automatic ATC System Test

S 865-580-003

(1) On the ATC control panel, set the code switches to a desired ATC ID code.

<u>NOTE</u>: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-507-003

(2) On the ATC control panel, put the ATC system on standby.

S 865-533-003

(3) Push the INTERROGATE switch.

(a) Test set display will initially be as follows:

- TEL Instrument
- T-4X Rev.XX

<u>NOTE</u>: This is a momentary display, to read hold the switch.

(b) After the tester has determined the type of transponder under test (Mode S, Mode A, Mode C, etc.) the display will change to "no reply from xpdr".

<u>NOTE</u>: The test set will automatically turn itself off after two minutes of inactivity.

S 865-508-003

(4) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-511-003

(5) Set the mode switch on the ATC control panel to the ALT ON position.

S 865-515-003

(6) Close these circuit breakers.
   (a) P11 Overhead Circuit Breaker Panel:
      1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
         11C19, LANDING GEAR POS SYS 2 ALTN
      2) 11S15, AIR/GND SYS 1
      3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-516-003

(7) Push the INTERROGATE switch.
   (a) Make sure the test set shows "no reply from xpdr".

S 865-517-003

(8) Open these circuit breakers.
   (a) P11 Overhead Circuit Breaker Panel:
      1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
         11C19, LANDING GEAR POS SYS 2 ALTN
      2) 11S15, AIR/GND SYS 1
      3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-573-003

(9) Push the INTERROGATE switch.
   (a) Make sure the test set shows the correct transponder type.

      NOTE: If the test set shows "no reply from xpdr", do a check on the test antenna connections. Also, make sure the ATC system is operational.

S 865-581-003

(10) Push the INTERROGATE switch again and the test set will initiate and run a sequence of tests on the transponder.

   NOTE: It will stop at any failed test. To continue push the TEST button.

   (a) When the tests are completed the test display sould be as follows:

```
    CCCC XXXXXX YYYYY'
 ZZZ W mmm dbm nnn MHz
```

      1) CCCC   is code selected.

2) XXXXXX is aircraft identifier.
3) YYYYY is aircraft altitude in feet (must be + or - 125 feet of Capt's and F/O's altimeter).
4) ZZZ is the transmitter power output (must be > 125 and < 500W).
5) mmm is the receiver sensitivity (must be between -77 and -71 dbm).
6) nnn is the frequency deviation (+ or - 1 MHz max. allowed).

S 865-582-003

(11) Do the steps that follow to do the DIVERSITY CHECK:

(a) For a test set with the TAP 125/TAP 135 option, push the TEST button on the test set until you get to the DIVERSITY CHECK.
  1) Make sure to pause between each press of the test button to allow the test set to execute that step.
  2) Make sure the test set shows DIVERSITY and then either PASS or FAIL.

NOTE: The test may initially fail due to strong local## radiation. This is usually a temporary situation. Repeat the test. Any PASS indicates a good system.

(b) For a test set without the TAP 125/TAP 135 option, do the Mode S Diversity Channel Isolation Test as follows:
  1) Disconnect the antenna cable at the antenna switch connector and connect the RF through-line wattmeter in its place.
  2) Make a note of the maximum power output and the minimum power output measured by the RF through-line wattmeter during Mode S squitter transmission period.
    a) Make sure the minimum power output is 100 times or 20 db lower than the maximum power output.
  3) Disconnect the RF through-line wattmeter.
  4) Connect the antenna cable to the antenna switch connector.

S 865-583-003

(12) Do the steps that follow to do the MAX TRUE AIRSPEED TEST:

(a) Push the TEST button on the test set until you get to the MAX TRUE AIRSPEED TEST.
  1) Be sure to pause between each press of the test button to allow the tester to allow the tester to execute that test step.

(b) Make sure the test set shows the max true airspeed that is pin programmed in each transponder.
  1) The tester display must be:

- MAX TRUE AIRSPEED
- GT300 & LE 600 Kts

S 865-584-003

(13) Do the steps that follow to do the IDENT BUTTON CHECK:
  (a) On the ATC control panel:
    1) Set the Code Select switch to a desired ATC ID code.

       NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

    2) Set the transponder select switch to L or No. 1.
    3) Set the Transponder switch to XPDR.
  (b) Make sure the test set shows the desired ATC ID code.
  (c) Turn the test set off.
  (d) Wait a moment, then push INTERROGATE.
    1) Allow the tester to acquire and determine the type of transponder under test.
  (e) Simultaneously push the control panel IDENT button and the test set TEST button.
  (f) Make sure that the message "IDENT" is shown on the tester.

S 865-591-003

(14) Remove the TAP-125/TAP-135 cable from the test set and connect the other TAP-125/TAP-135 cable and repeat the automatic ATC system test.

S 865-585-003

(15) Do the test again as necessary for the right system:
  (a) To test the right system put the control panel switch to R or 2.

S 845-586-003

(16) If all the tests passed, do the "Put the Airplane Back to its Usual Condition" steps at the end of this task.

G. Manual ATC System Test

NOTE: If the automatic system test passed the manual test is not required.

S 865-519-003

(1) Change the ATC ID code on the ATC control panel to its compliment. The compliment of the code is 7777 minus the code.

EXAMPLE: If the code is 0340, its compliment is:

7777 - 0340 = 7437 compliment.

S 865-520-003

(2) Push the identification switch on the ATC control panel.

S 965-521-003

(3) Push the TEST switch on the test set to run ATCRBS/A test.
  (a) Make sure the test set shows the IDENT indication, the ATC ID code selected on th e ATC control panel, and a %REPLY greater than 90%.

S 865-536-003

(4) Set the mode switch on the ATC control panel to the ALT OFF position.

S 865-537-003

(5) Push the TEST switch on the test set to run the ATCRBS/C test.
  (a) Make sure the test set shows no altitude data and %REPLY greater 90%.

S 865-538-003

(6) Set the mode switch on the ATC control panel to the ALT ON position.

S 865-572-003

(7) Push the TEST switch on the test set to run the ATCRBS/C test.
  (a) Make sure the test set shows the airplane's altitude and %REPLY greater than 90%.

S 865-522-003

(8) Push the TEST switch on the test set to run the ATCRBS/A Mode S ALL test.
  (a) Make sure the test set shows the airplane's mode S address, and %REPLY greater than 90%.

S 865-523-003

(9) Push the TEST switch on the test set to run the ATCRBS/C Mode S ALL test.
  (a) Make sure the test set shows the airplane's mode S address, and %REPLY greater than 90%.

S 865-524-003

(10) Push the TEST switch on the test set to run the ATCRBS/A only test.
  (a) Make sure the test set shows NO Reply From XPDR.

S 865-525-003

(11) Push the TEST switch on the test set to run the ATCRBS/C only test.
  (a) Make sure the test set shows No Reply From XPDR.

S 865-526-003

(12) Push the TEST switch on the test set to run the Mode S Surv (Identity/Altitude/Short) test.
  (a) Make sure the test set shows the airplane's mode S address, the airplane's altitude, and %REPLY greater than 90%.

(b) Push the TEST switch on the test set to run the Mode S Comm (Identity/Altitude/Short) test.
  1) Make sure the test set shows the airplane's mode S address, the airplane's altitude, and %REPLY greater than 99%.

     NOTE: Failure to reply by the transponder is not a failure of the ATC system. Contact the transponder vendor about the capability of the transponder.

S 865-527-003

(13) Push the TEST switch on the test set to run the Undesired replies test.
  (a) Make sure the test set shows No Replies.

S 865-528-003

(14) Push the TEST switch on the test set to run the Squitter test.
  (a) Make sure the test set shows PASS.

S 735-576-003

(15) For test set with the TAP 125/TAP 135 option, push the test switch on the test set to run the Mode S Diversity Channel Isolation Test.

NOTE: The test set should show the Diversity test page.

  (a) Make sure the test set shows PASS.

S 735-529-003

(16) For test set without the TAP 125/TAP 135 option, do the Mode S Diversity Channel Isolation Test as follows:
  (a) Disconnect the antenna cable at the top antenna switch connector, D1431, and connect the RF through-line wattmeter in its place.
  (b) Make a note of the maximum power output and the minimum power output measured by the RF throught-line wattmeter during mode S squitter transmission period.
    1) Make sure the minumum power output is 100 times or 20 db lower than the maximum power output.
  (c) Disconnect the RF through-line wattmeter.
  (d) Connect the antenna cable at the top antenna switch connector, D1431.

S 865-530-003

(17) Remove the antenna coupler from the lower ATC antenna and insert it to the top ATC antenna.

NOTE: Make sure the orientation of the antenna coupler setup is correct.

S 735-531-003

(18) Do the system test again for the right or No. 2 ATC system.

H. Put the Airplane Back to its Usual Condition

S 845-491-003

(1) Remove the test set.

S 865-555-003

(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-556-003

(3) Close these circuit breakers.
- (a) P11 Overhead Circuit Breaker Panel:
  - 1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
  - 2) 11S15, AIR/GND SYS 1
  - 3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-492-003

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-654-003

6. <u>System Test - ATC System (With the TIC TR-220)</u>

A. General

(1) This system test is a full check of the ATC system. The system test first does the ATC operational test and then uses the TR-220 test set to examine the left and right ATC systems.

(2) The test set can perform all the tests automatically or each test individually. Each test is shown as it is being performed. If a test has failed, the test sequence will abort and a failed message is displayed. All data will be shown at the end of the test if the test is successful.

(3) When conducting tests in the MANUAL sequence, you initialize the sequence by toggling the AUTO/TEST/MANUAL switch to the MANUAL position. The Test Set then commences a series of tests and displays the individual results of each test ending in the POWER, RECEIVER EFFICIENCY and FREQUENCY page.
(4) After each test is completed, you must toggle the MANUAL switch to advance to the next test in the series.
(5) Operation with the antenna coupler TAP-135 used with the test set, reduces Radio Frequency emissions from the transponder being tested. It is not necessary to use the coupler to perform these tests.
(6) If it is necessary to simulate the aircraft being tested as being at altitude, notify the local ATC that the transponder testing is in progress.

B. Equipment
  (1) ATC Transponder Ramp Test Set TIC TR-220

C. References
  (1) AMM 22-10-00/501, Autopilot Flight Director System (AFDS)
  (2) AMM 24-22-00/201, Electrical Power Control
  (3) AMM 32-09-02/201, Flight Mode Simulation
  (4) AMM 34-12-00/501, Air Data Computing (ADC) System
  (5) AMM 34-21-00/501, Inertial Reference System (IRS)
  (6) AMM 34-61-00/501, Flight Management Computer System (FMCS)

D. Access
  (1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the ATC System Test

S 715-655-003
  (1) Do the ATC Operational Test:

S 715-656-003
  (2) Prepare to test the ATC System:
    (a) Apply power to the test set and follow operating procedures.
    (b) Supply electrical power (AMM 24-22-00/201).

<u>WARNING</u>: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

    (c) Prepare the safety-sensitivity systems for air mode simulation (AMM 32-09-02/201).

(d) Open these circuit breakers and attach DO-NOT-CLOSE tags:
    1) P11 Overhead Circuit Breaker Panel:
        a) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
        b) 11S15, AIR/GND SYS 1
        c) 11S19, LDG GR POS AIR/GND SYS 2

(e) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. Automatic ATC System Test

S 865-657-003

(1) On the ATC control panel, set the code switches to a desired ATC ID code.

<u>NOTE</u>: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-658-003

(2) On the ATC control panel, put the ATC system on standby.

S 865-659-003

(3) Put the TEST SET switch in the ON position.
    (a) The test set will display a start-up screen, then do a self test.
    (b) If the self-test passes, the display will indicate SELF TEST PASS.

S 865-660-003

(4) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-661-003

(5) Set the mode switch on the ATC control panel to the ALT ON position.

S 865-702-003

(6) Turn the UUT FUNCTION switch on the test set to the XPDR position.

S 865-699-003

(7) Press the AUTO/TEST/MANUAL switch to the AUTO position and the test set will start and run a sequence of tests on the transponder.

NOTE: It will stop at any failed test, to continue press the AUTO/TEST/MANUAL Switch to the AUTO position.

S 865-700-003

(8) To repeat a failed test, push the AUTO/TEST/MANUAL switch to the MANUAL position.
   (a) When the tests are completed, the test set display will alternate between two screens. The screens displayed depend on which type of transponder was found and tested by the test set.

   NOTE: Refer to the TR-220 Operating Manual for detailed information.

   (b) Make sure the data displayed on the test set is correct for the airplane being tested.

S 865-703-003

(9) To run manual tests, toggle the AUTO/TEST/MANUAL switch to the MANUAL position.
   (a) The tests will run in order.
   (b) To repeat a failed Manual test, toggle the AUTO/TEST/MANUAL switch to the MANUAL position.
   (c) For information about Manual Testing, refer to the TR-220 Operating Manual.

S 865-667-003

(10) Do the steps that follow to do the DIVERSITY CHECK:
   (a) Make sure to pause between each press of the test button to allow the test set to execute that step.

(b) Make sure the test set shows DIVERSITY and then either PASS or FAIL.

<u>NOTE</u>: The test may initially fail due to strong local radiation. This is usually a temporary situation. Repeat the test. Any PASS indicates a good system.

S 865-668-003

(11) Do the steps that follow to do the MAX TRUE AIRSPEED TEST:
  (a) Push the TEST button on the test set until you get to the MAX TRUE AIRSPEED TEST.
    1) Be sure to pause between each press of the test button to allow the tester to allow the tester to execute that test step.
  (b) Make sure the test set shows the max true airspeed that is pin programmed in each transponder.
    1) The tester display must be:

- MAX TRUE AIRSPEED
- GT300 & LE 600 Kts

S 865-669-003

(12) Do the steps that follow to do the IDENT BUTTON CHECK:
  (a) On the ATC control panel:
    1) Set the Code Select switch to a desired ATC ID code.

<u>NOTE</u>: Do not use codes 7500, 7600, or 7700. These are emergency codes.

    2) Set the transponder select switch to L or No. 1.
    3) Set the Transponder switch to XPDR.
  (b) The IDENT test must be run in the Manual Mode on the test set.
    1) Select either the MODE A, or the MC Test on the test set.
    2) Allow the test set to complete the test.

(c) Press the IDENT switch on the transponder control panel.
(d) Make sure that the message "IDENT" is displayed on the tester.

S 865-671-003
(13) Do the test again as necessary for the right system:
(a) To test the right system put the control panel switch to R or 2.

S 845-672-003
(14) If all the tests passed, do the "Put the Airplane Back to its Usual Condition" steps at the end of this task.

S 735-690-003
(15) Do the system test again for the right or No. 2 ATC system.

G. Put the Airplane Back to its Usual Condition

S 845-691-003
(1) Remove the test set.

S 865-692-003
(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-693-003
(3) Close these circuit breakers.
(a) P11 Overhead Circuit Breaker Panel:
1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
2) 11S15, AIR/GND SYS 1
3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-694-003
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AIR TRAFFIC CONTROL (ATC) SYSTEM - ADJUSTMENT/TEST

1. General

   A. This procedure has two tasks. One is an operational test; the other is a system test. The operational test is a fast check of the ATC system. The system test first does the operational test. Then, it uses test equipment to examine ATC code reception and altitude reporting. This procedure also has steps to measure the transponder sensitivity, the side lobe suppression, and the transmitter frequency.

TASK 34-53-00-715-213-004

2. ATC System - Operational Test

   A. General

      (1) This test examines the ATC system for correct operation. It uses only the system's BITE function, and no special test or ground equipment is necessary.

   B. References

      (1) AMM 24-22-00/201, Electrical Power - Control

   C. Access

      (1) Location Zones

119	Main Equipment Center
211/212	Flight Compartment

   D. Prepare for the Operational Test

      S 865-214-004

      (1) Supply electrical power (AMM 24-22-00/201).

      S 865-215-004

      (2) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:
         (a) 11A10, AIR DATA CMPTR LEFT
         (b) 11A11, AIR DATA AOA SENSOR LEFT
         (c) 11A12, AIR DATA BARO CORRECT LEFT
         (d) 11E28, ATC ANT SWITCH
         (e) 11E2, ALTM LEFT
         (f) 11E23, ALTM RIGHT
         (g) 11F7, ATC LEFT
         (h) 11F28, ATC RIGHT
         (i) 11F30, AIR DATA CMPTR RIGHT
         (j) 11F31, AIR DATA AOA SENSOR RIGHT
         (k) 11F32, AIR DATA BARO CORRECT RIGHT
         (l) EICAS (6 locations)

E. Procedure

S 865-484-004

(1) Set the transponder select switch on the ATC control panel to the L position.

S 865-514-004

(2) Set the ATC mode switch to XPNDR.

S 755-216-004

(3) Make sure the EICAS message, ATC FAULT, does not show on the top display.

<u>NOTE</u>: If it is necessary, push the CANCEL switch on the EICAS DISPLAY select panel to see more messages.

S 745-217-004

(4) Push and hold the TEST switch on the left ATC transponder.

S 755-218-004

(5) Make sure the sequence that follows occurs:
   (a) All the LEDs come on
   (b) All the LEDs go off
   (c) The green LED comes on and stays on.
   (d) The EICAS message, ATC FAULT, shows.

S 745-220-004

(6) Release the TEST switch on the ATC transponder.

S 865-221-004

(7) Set the transponder select switch on the ATC control panel to the R position.

S 715-222-004

(8) Do the self-test procedure again for the right ATC transponder.

F. Put the Airplane Back to Its Usual Condition

S 865-223-004

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-441-004

3. <u>ATC System - System Test (With the IFR 601)</u>

A. General

(1) This system test is a more complete check of the ATC system. The system test first does the ATC - Operational Test. Then it uses ground test equipment to examine the left and right ATC systems.

NOTE: Two types of test equipment (IFR ATC 601 and TIC T-48/49) are described in two separate tests. Do only one test. Use the test set that is available.

(2) The IFR 601 test set is used to test the functionality of the mode S transponder. All twenty tests can be run automatically in the AUTO mode or individually in single test mode. Results from the last test are shown on each test page. The PASSED/FAILED indication is shown on top of the page. To do a single test, use the select keys to get to the desired test and push the RUN/STOP key.

B. Equipment
  (1) ATC Transponder Ramp Test Set IFR ATC-601

C. References
  (1) AMM 24-22-00/201, Manual Control
  (2) AMM 32-09-02/201, Flight Mode Simulation
  (3) AMM 34-12-00/501, Air Data Computing (ADC) System

D. Access
  (1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the System Test

S 845-320-004

CAUTION: DO NOT PLACE THE REMOTE TEST SET ANTENNA CLOSER THAN 15 INCHES (.40 METERS) TO THE AIRCRAFT ANTENNA WITH THE TEST SET ON. THIS WILL CAUSE DAMAGE TO THE TEST SET.

(1) Put the test set antenna at a convenient bearing and distance from the ATC antennas under test.

NOTE: The test set antenna must be within the line of sight of the ATC antennas.

S 845-322-004

(2) Put the test set antenna in position towards the aircraft antenna.

S 845-323-004

(3) Connect the coaxial cable from the remote test set antenna to the test set.

S 715-440-004

(4) Do the ATC Operational Test.
   (a) Make sure the Operational Test passes.

S 865-325-004

(5) Set the PWR switch on the test set to the ON position.

<u>NOTE</u>: The test set is a source of interference for radio and L-band radar equipment operating on the airplane and located near the test set. Turn the test set off as soon as the test is completed or when you must perform other radio checks on the airplane.

S 865-326-004

(6) Push the SETUP key to enter the SETUP menu.

<u>NOTE</u>: For information regarding the battery test, timing and recharging refer to the operation section of the test set operators manual.

S 865-442-004

(7) Push the SELF TEST key on the test set.

S 865-443-004

(8) Push the RUN/STOP key to start the self test.
   (a) Make sure the test set display shows PASSED.

S 865-444-004

(9) Push the SETUP key to enter the SETUP menu.

S 865-327-004

(10) Enter the distance from the test set antenna to the aircraft antenna in the RANGE field for the TOP and BOTTOM antenna.

S 865-445-004

(11) Enter 21 feet in the HEIGHT field for the TOP antenna and 8 feet for the BOTTOM antenna.

S 865-446-004

(12) Choose the bottom antenna on the SELECTED field.

S 865-237-004

(13) Enter the gain listed on the test set antenna into the GAIN_1030 and GAIN_1090 field.

S 865-238-004

(14) Enter the cable loss listed on the cable in the LOSS field.
  (a) Use the SLEW keys to change the values.
  (b) Use the SELECT keys to change the items.
  (c) Use the SELECT keys to select the antenna which you must test.

S 865-447-004

<u>WARNING</u>: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(15) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

S 865-448-004

(16) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-422-004

(17) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. ATC System Test

S 865-502-004

(1) Set the code switches on the ATC control panel to a desired ATC ID code.

<u>NOTE</u>: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-450-004

(2) Set the transponder select switch on the ATC control panael to the left or No. 1 system.

S 865-452-004

(3) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the ON position.

S 865-453-004

(4) GUI 007-114, 116-999;
Set the mode switch on the ATC control panel to the XPDR position.

S 865-328-004

(5) Push the AUTO TEST key on the test set.

S 865-454-004

(6) Use the RUN/STOP key to start or stop individual test.

S 865-455-004

(7) Use the SELECT key to select each individual test.

S 735-329-004

(8) Do a check of the REPLY DELAY TEST.
   (a) Make sure the reply delay is 128.00us (±0.25us) for mode S.
   (b) Make sure the reply delay is 128.00us (±0.5 us) for ITM.
   (c) Make sure the reply delay is 3.00us (±0.50us) for ATC A and C.

S 735-330-004

(9) Do a check of the REPLY JITTER TEST.
   (a) Make sure the reply jitter is ≤ 0.05us for mode S.
   (b) Make sure the reply jitter is ≤ 0.06us for ITM A and C.
   (c) Make sure the reply jitter is ≤ 0.1us for ATC A and C.

S 735-331-004

(10) Do a check of the ATCRBS REPLY TEST.
   (a) Make sure the spacing of the F1 to F2 pulse is 20.3us (±0.10us)

(b) Make sure the duration of the F1, F2 pulse is 0.45us (±0.10us).

S 735-332-004

(11) Do a check of the SLS LEVEL TEST.

(a) Make sure the reply is received when the SLS pulse is -9dB and no reply is received when the SLS pulse is 0dB.

<u>NOTE</u>: Run the SLS level test in less than 95 feet (28.96 meters) of the UUT antenna.

S 735-333-004

(12) Do a check of the ATC ONLY ALL-CALL TEST.

(a) Make sure the mode S transponder did not reply to the interrogation (PASSED TEST).

S 735-334-004

(13) Do a check of the MODE S ALL CALL TEST.

(a) Make sure the test set shows PASSED and the airplane's mode S address.

S 735-335-004

(14) Do a check of the INVALID MODE S ADDRESS TEST.

(a) Make sure the mode S transponder did not reply (PASSED TEST).

S 735-336-004

(15) Do a check of the SPR ON/OFF TEST.

(a) Make sure a reply is received when SPR is ON and no reply is received when SPR is OFF.

S 735-337-004

(16) Do a check of the MODE S UFO TEST.

(a) Make sure (Down-link format) DF=0, AC=(airplane's altitude) and ADDRESS={airplane's mode S address (WDM 34-53-12 or WDM 34-53-22)}.

<u>NOTE</u>: Make sure the reported altitude is within ±125 feet of the altitude shown on the captain's and first officer's altimeter (applicable for all the altitude reporting checks). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-338-004

(17) Do a check of the MODE S UF4 TEST.
  (a) Make sure DF=4, AC=(airplane's altitude) and ADDRESS=(airplane's mode address).

S 735-339-004

(18) Do a check of the MODE S UF5 TEST.
  (a) Make sure DF=5, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-340-004

(19) Do a check of the MODE S UF11 TEST.
  (a) Make sure DF=11 and AA=(airplane's address).
  (b) Make sure the CA field is not void.

NOTE: The value of the CA field is determined by the manufacturer.

S 735-341-004

(20) Do a check of the MODE S UF16 TEST.
  (a) Make sure DF=16, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

NOTE: No reply to the UF16 test is not a failure of the ATC system.

S 735-342-004

(21) Do a check of the MODE S UF20 TEST.
  (a) Make sure DF=20, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

NOTE: No reply to the UF20 test is not a failure of the ATC system.

S 735-343-004

(22) Do a check of the MODE S UF21 TEST.

(a) Make sure DF=21, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF21 test is not a failure of the ATC system.

S 735-344-004

(23) Do a check of the SQUITTER TEST.

(a) Make sure the squitter's period is between 0.8 to 1.2 seconds.

<u>NOTE</u>: If the test set antenna is in line of sight with only one of the ATC antennas, the squitter period will be between 1.6 to 2.4 seconds.

S 735-345-004

(24) Do a check of the FREQUENCY TEST.

(a) Make sure the reply frequency of the transponder is 1090 MHz ±1MHz.

S 865-423-004

(25) Move the test set to less than 50 feet from the top ATC antenna.

<u>NOTE</u>: Make sure the top ATC antenna is not in the line of sight of the test set antenna. Follow the test set operator's quide to reduce multipath errors. Do the test several times with the test set at different locations until you get valid results.

S 865-424-004

(26) Push the SETUP key on the test set and enter the appropriate range for the top and bottom antenna.

S 735-346-004

(27) Do a check of the DIVERSITY TEST.

(a) Make sure the power level difference is ≥ 20dB between 'on' antenna squitters and 'off' antenna squitters.

NOTE: To make sure the dynamic range is ≥ 20dB, a diversity test must be run at a distance of less than 50 feet (15.2 meters) from the airplane antenna.

S 735-347-004

(28) Do a check of the MTL DIFFERENCE TEST.

(a) Make sure the Minimum Threshold Level (MTL) difference between mode A and mode C is ≤ 1.0dBm.

S 865-425-004

(29) Push the PWR TEST key on the test set.

S 865-426-004

(30) Use the SELECT key on the test set and select the bottom antenna.

NOTE: Make sure the top ATC antenna is not in the line of sight of the test set antenna during the POWER TEST.

S 865-427-004

(31) Push the antenna push button switch.

S 865-428-004

(32) Slowly move the test set antenna 6 feet (1.8 meters) vertically from the ground, at less than 1 FT/SEC (30 CM/SEC).

S 865-429-004

(33) Push the antenna push button switch a second time to stop the test when the test set antenna is approximately 6 feet high.

S 735-348-004

(34) Do a check of the POWER TEST.

  (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBm) and 500W (ERP = 57.0 dBm).

    NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

  (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).

  (c) Make sure the test set shows PASSED for the BOT AVG (dBm).

S 865-430-004

(35) Insert the antenna shield over the bottom ATC antenna.

S 865-431-004

(36) Move the test set so that it is in the line of sight of the top ATC antenna.

S 865-432-004

(37) Push the SETUP key on the test set.

  (a) Enter the appropriate range for the top antenna.

  (b) Choose the top antenna on the SELECTED field.

S 865-433-004

(38) Push the PWR TEST key on the test set.

S 865-434-004

(39) Use the SELECT key on the test set and select the top antenna.

S 735-435-004

(40) Do a check of the POWER TEST.

  (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBM) and 500W (ERP = 57.0 dBm).

    NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

  (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).

  (c) Make sure the test set shows PASSED for the TOP AVG (dBm).

S 715-456-004

(41) Do the system test again for the right or No. 2 ATC system.

NOTE: On the test set, select the other ATC antenna.

G. Put the Airplane Back to Its Usual Condition

S 865-349-004

(1) Remove the ATC ramp test set.

S 865-436-004

(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-437-004

(3) Close these circuit breakers.
   (a) P11 Overhead Circuit Breaker Panel:
      1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
      2) 11S15, AIR/GND SYS 1
      3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-350-004

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-515-004

4. <u>ATC System - System Test (With the IFR 601-2)</u>

A. General

(1) This system test is a more complete check of the ATC system. The system test first does the ATC - Operational Test. Then it uses ground test equipment to examine the left and right ATC systems.

(2) Requirements for Elementary Surveillance, Enhanced Surveillance and Extended Squitter require transponder testing be done with the IFR-601 (-2) with software version 3.0 or greater.

(3) For this procedure, IFR-601-2 refers to a IFR ATC-601 with software version 3.0 or greater. The only difference is the software version. The hardware is the same.

(4) The IFR-601-2 test set uses thirty-nine (39) different tests to check the functionality of the ATC transponder. All thirty-nine (39) tests can be run automatically in the AUTO mode, or individually in the single test mode.

(5) Results from the last test are shown on each test page. The PASSED/FAILED indication is shown on top of the page. To do a single test, use the select keys to get to the desired test and push the RUN/STOP key.
(6) The details of individual tests conducted during the AUTO TEST are stored in memory and may be reviewed by using the SELECT keys.
(7) When a individual test is selected, the test is started with the RUN/STOP key, and will continue to run until the RUN/STOP key is pressed again.

B. Equipment
(1) ATC Transponder Ramp Test Set IFR ATC-601

C. References
(1) AMM 22-10-00/501, Autopilot Flight Director System (AFDS)
(2) AMM 24-22-00/201, Manual Control
(3) AMM 32-09-02/201, Flight Mode Simulation
(4) AMM 34-12-00/501, Air Data Computing (ADC) System

D. Access
(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the System Test

S 845-516-004

<u>CAUTION</u>: DO NOT PLACE THE REMOTE TEST SET ANTENNA CLOSER THAN 15 INCHES (.40 METERS) TO THE AIRCRAFT ANTENNA WITH THE TEST SET ON. THIS WILL CAUSE DAMAGE TO THE TEST SET.

(1) Put the test set antenna at a convenient bearing and distance from the ATC antennas under test.

NOTE: The test set antenna must be within the line of sight of the ATC antennas.

S 845-517-004
(2) Put the test set antenna in position towards the aircraft antenna.

S 845-518-004
(3) Connect the coaxial cable from the remote test set antenna to the test set.

S 715-519-004
(4) Do the ATC Operational Test.
(a) Make sure the Operational Test passes.

S 865-520-004

(5) Set the PWR switch on the test set to the ON position.

<u>NOTE</u>: The test set is a source of interference for radio and L-band radar equipment operating on the airplane and located near the test set. Turn the test set off as soon as the test is completed or when you must perform other radio checks on the airplane.

(a) The Start-Up screen will display.
  1) The software version is shown on this screen.

(b) Make sure the software version is 3.0 or greater.

S 865-522-004

(6) Push the SELF TEST key on the test set, to enter the self test menu.
 (a) Push the RUN/STOP key to start the self test.
  1) Make sure the test set display shows PASSED.

S 865-524-004

(7) Push the SETUP key to enter the SETUP menu.
 (a) Enter the required data into the Setup Menu.

NOTE: Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 865-525-004

(8) Enter the distance from the test set antenna to the aircraft antenna in the RANGE field for the TOP and BOTTOM antenna.

S 865-526-004

(9) Enter 21 feet in the HEIGHT field for the TOP antenna and 8 feet for the BOTTOM antenna.

S 865-527-004

(10) Choose the bottom antenna on the SELECTED field.

S 865-528-004

(11) Enter the gain listed on the test set antenna into the GAIN_1030 and GAIN_1090 field.

S 865-529-004

(12) Enter the cable loss listed on the cable in the LOSS field.
 (a) Use the SLEW keys to change the values.
 (b) Use the SELECT keys to change the items.
 (c) Use the SELECT keys to select the antenna which you must test.

S 865-530-004

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(13) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

S 865-531-004

(14) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-532-004

(15) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. ATC System Test

S 865-533-004

(1) Set the code switches on the ATC control panel to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-534-004

(2) Set the transponder select switch on the ATC control panael to the left or No. 1 system.

S 865-538-004

(3) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the ON position.

S 865-541-004

(4) GUI 007-114, 116-999;
Set the mode switch on the ATC control panel to the XPDR position.

S 865-543-004

(5) Push the AUTO TEST key on the test set.

S 865-544-004

(6) Use the RUN/STOP key to start or stop testing.
 (a) The AUTO test will run until it is finished. The results are stored in the tester memory for review.

 NOTE: Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 865-649-004

(7) To run Individual Tests, use the SELECT key to select each test.
 (a) Use the RUN/STOP key to start or stop the individual tests.

S 865-650-004

(8) Review the test results screens.

S 735-546-004

(9) Do a check of the REPLY DELAY TEST.
 (a) Make sure the reply delay is 128.00us (±0.25us) for mode S.
 (b) Make sure the reply delay is 128.00us (±0.5 us) for ITM.
 (c) Make sure the reply delay is 3.00us (±0.50us) for ATC A and C.

S 735-547-004

(10) Do a check of the REPLY JITTER TEST.
 (a) Make sure the reply jitter is ≤ 0.05us for mode S.
 (b) Make sure the reply jitter is ≤ 0.06us for ITM A and C.
 (c) Make sure the reply jitter is ≤ 0.1us for ATC A and C.

S 735-548-004

(11) Do a check of the ATCRBS REPLY TEST.
 (a) Make sure the spacing of the F1 to F2 pulse is 20.3us (±0.10us)
 (b) Make sure the duration of the F1, F2 pulse is 0.45us (±0.10us).

S 735-549-004

(12) Do a check of the SLS LEVEL TEST.
 (a) Make sure the reply is received when the SLS pulse is -9dB and no reply is received when the SLS pulse is 0dB.

 NOTE: Run the SLS level test in less than 95 feet (28.96 meters) of the UUT antenna.

S 735-550-004

(13) Do a check of the ATC ONLY ALL-CALL TEST.
 (a) Make sure the mode S transponder did not reply to the interrogation (PASSED TEST).

S 735-551-004

(14) Do a check of the MODE S ALL CALL TEST.
    (a) Make sure the test set shows PASSED and the airplane's mode S address.

S 735-552-004

(15) Do a check of the INVALID MODE S ADDRESS TEST.
    (a) Make sure the mode S transponder did not reply (PASSED TEST).

S 735-553-004

(16) Do a check of the SPR ON/OFF TEST.
    (a) Make sure a reply is received when SPR is ON and no reply is received when SPR is OFF.

S 735-554-004

(17) Do a check of the MODE S UFO TEST.
    (a) Make sure (Down-link format) DF=0, AC=(airplane's altitude) and ADDRESS={airplane's mode S address (WDM 34-53-12 or WDM 34-53-22)}.

<u>NOTE</u>: Make sure the reported altitude is within ±125 feet of the altitude shown on the captain's and first officer's altimeter (applicable for all the altitude reporting checks). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-555-004

(18) Do a check of the MODE S UF4 TEST.
    (a) Make sure DF=4, AC=(airplane's altitude) and ADDRESS=(airplane's mode address).

S 735-556-004

(19) Do a check of the MODE S UF5 TEST.
    (a) Make sure DF=5, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address). Observe that the airplane's Mode-S address is displayed in hexadecimal.

S 735-557-004

(20) Do a check of the MODE S UF11 TEST.
    (a) Make sure DF=11 and AA=(airplane's address).
    (b) Make sure the CA field is not void.

<u>NOTE</u>: The value of the CA field is determined by the manufacturer.

S 735-558-004

(21) Do a check of the MODE S UF16 TEST.

(a) Make sure DF=16, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF16 test is not a failure of the ATC system.

S 735-559-004

(22) Do a check of the MODE S UF20 TEST.

(a) Make sure DF=20, AC=(airplane's altitude) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF20 test is not a failure of the ATC system.

S 735-560-004

(23) Do a check of the MODE S UF21 TEST.

(a) Make sure DF=21, ID=(selected ATC ID code on the ATC control panel) and ADDRESS=(airplane's mode S address).

<u>NOTE</u>: No reply to the UF21 test is not a failure of the ATC system.

S 735-561-004

(24) Do a check of the SQUITTER TEST.

(a) Make sure the squitter's period is between 0.8 to 1.2 seconds.

<u>NOTE</u>: If the test set antenna is in line of sight with only one of the ATC antennas, the squitter period will be between 1.6 to 2.4 seconds.

S 735-562-004

(25) Do a check of the FREQUENCY TEST.

(a) Make sure the reply frequency of the transponder is 1090 MHz ±1MHz.

S 865-563-004

(26) Move the test set to less than 50 feet from the top ATC antenna.

<u>NOTE</u>: Make sure the top ATC antenna is not in the line of sight of the test set antenna. Follow the test set operator's quide to reduce multipath errors. Do the test several times with the test set at different locations until you get valid results.

S 865-564-004

(27) Push the SETUP key on the test set and enter the appropriate range for the top and bottom antenna.

S 735-565-004

(28) Do a check of the DIVERSITY TEST.

(a) Make sure the power level difference is ≥ 20dB between 'on' antenna squitters and 'off' antenna squitters.

<u>NOTE</u>: To make sure the dynamic range is ≥ 20dB, a diversity test must be run at a distance of less than 50 feet (15.2 meters) from the airplane antenna.

S 735-566-004

(29) Do a check of the MTL DIFFERENCE TEST.

(a) Make sure the Minimum Threshold Level (MTL) difference between mode A and mode C is ≤ 1.0dBm.

S 865-567-004

(30) Push the PWR TEST key on the test set.

S 865-568-004

(31) Use the SELECT key on the test set and select the bottom antenna.

<u>NOTE</u>: Make sure the top ATC antenna is not in the line of sight of the test set antenna during the POWER TEST.

S 865-569-004

(32) Push the antenna push button switch.

S 865-570-004

(33) Slowly move the test set antenna 6 feet (1.8 meters) vertically from the ground, at less than 1 FT/SEC (30 CM/SEC).

S 865-571-004

(34) Push the antenna push button switch a second time to stop the test when the test set antenna is approximately 6 feet high.

S 735-572-004

(35) Do a check of the POWER TEST.

(a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBm) and 500W (ERP = 57.0 dBm).

<u>NOTE</u>: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

(b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).

(c) Make sure the test set shows PASSED for the BOT AVG (dBm).

S 865-573-004

(36) Insert the antenna shield over the bottom ATC antenna.

S 865-574-004

(37) Move the test set so that it is in the line of sight of the top ATC antenna.

S 865-575-004

(38) Push the SETUP key on the test set.
- (a) Enter the appropriate range for the top antenna.
- (b) Choose the top antenna on the SELECTED field.

S 865-576-004

(39) Push the PWR TEST key on the test set.

S 865-577-004

(40) Use the SELECT key on the test set and select the top antenna.

S 735-578-004

(41) Do a check of the POWER TEST.
- (a) Make sure the peak power output of the transponder is between 125W (ERP = 51.0 dBM) and 500W (ERP = 57.0 dBm).

  NOTE: Effective Radiated Power (ERP) is the product of the antenna output power and antenna gain.

- (b) Make sure the Minimum Threshold Level (MTL) sensitivity is -74dBm (±3dBm).
- (c) Make sure the test set shows PASSED for the TOP AVG (dBm).

S 865-651-004

(42) Do a check of the other test results for Elementary Surveillance, Enhanced Surveillance,and Extended Squitter functions.

NOTE: Refer to the IFR-601-2 Operations Manual for details of these tests.

S 865-654-004

(43) Do the identification test.

NOTE: For the IFR-601-2, use the ATCRBS individual test. Refer to the IFR ATC-601-2 Operation Manual for detailed information.

S 715-579-004

(44) Do the system test again for the right or No. 2 ATC system.

NOTE: On the test set, select the other ATC antenna.

G. Put the Airplane Back to Its Usual Condition

S 865-580-004

(1) Remove the ATC ramp test set.

S 865-581-004

(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-582-004

(3) Close these circuit breakers.
  (a) P11 Overhead Circuit Breaker Panel:
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
       11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-583-004

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-409-004

5. System Test - ATC System (With the TIC T-48(series) or T-49(series))

A. General

(1) This system test is a more complete check of the ATC system. The system test first does the ATC - Operational Test. Then it uses ground test equipment to examine the left and right ATC systems. The test may be run in either the automatic mode followed by some manual tests or in manual mode for all tests. At the end of this task there is a procedure to return the airplane to its usual condition.

NOTE: Two types of test equipment (IFR ATC 601 and TIC T-48/49/49C/49CA) are described in two separate tests. Do only one test. Use the test set that is available.

(2) This sytem test uses the TIC T-48 or T-49 test set to completely test the functionality of the ATC transponder. The test set can do the tests automatically or each test individually. If a test has failed, the test sequence will abort and a failed message will show. All data will show at the end of the test if the test is successful.

(3) Operation with the antenna coupler, TAP-115, TAP-118, or TAP 125 used with the applicable test set, is necessary when the test is to do a check of the output power, receiver, sensitivity and radio frequency. For mode S diversity channel isolation check, the TAP 125 is necessary.

B. Equipment

(1) ATC Transponder Ramp Test Set TIC T-48(series) or T-49(series)
Tel Instruments Electronics Corp.
728 Garden St., Carlstadt, NJ 07472

(2) RF through-line wattmeter Bird model 43 or equivalent (up to 500 watts).

C. References

(1) AMM 24-22-00/201, Electrical Power Control
(2) AMM 32-09-02/201, Flight Mode Simulation
(3) AMM 34-12-00/501, Air Data Computing (ADC) System

D. Access

(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the ATC System Test

S 865-492-004
(1) Do the ATC Operational Test.

S 865-493-004
(2) Prepare to test the ATC System:
   (a) Install the Antenna Test Equipment.
      1) Pull the pull-ring to separate the spring loaded clamp.
      2) Slide the couplers over the blade antennas (upper and lower).

      NOTE: The coupler has no orientation.

      3) Center the couplers over the antennas and compress the EMI gasket.
         a) Use the coupler with the long lead to test the upper antenna.

NOTE: Connect only ONE of the TAP 125 cables to the test set. The opposite test cable does not have to be terminated. The anti-radiation coupler associated with the unconnected cable attenuates the transponder radiated power by 20 db (for example, from 250 watts to 2.5 watts). The anti-radiation coupler prevents un-solicited interrogation from surrounding aircraft equipped with Mode S transponders or TCAS. This configuration is required for the Mode S Diversity Check.

(b) Connect one antenna coupler connector to the test set antenna connector.
(c) Apply power to the test set and follow operating procedures.
(d) Supply electrical power (AMM 24-22-00/201).

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(e) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).
(f) Open these circuit breakers and attach DO-NOT-CLOSE tags:
    1) P11 Overhead Circuit Breaker Panel:
        a) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
        b) 11S15, AIR/GND SYS 1
        c) 11S19, LDG GR POS AIR/GND SYS 2
(g) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. Automatic ATC System Test

S 865-503-004

(1) On the ATC control panel, set the code switches to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-375-004

(2) On the ATC control panel, put the ATC system on standby.

S 865-464-004

(3) Push the INTERROGATE switch.

(a) Test set display will initially be as follows:

TEL Instrument
T-4X Rev.XX

NOTE: This is a momentary display, to read hold the switch.

(b) After the tester has determined the type of transponder under test (Mode S, Mode A, Mode C, etc.) the display will change to "no reply from xpdr".

NOTE: The test set will automatically turn itself off after two minutes of inactivity.

S 865-376-004

(4) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-418-004

(5) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the ON position.

S 865-419-004

(6) GUI 007-114, 116-999;
Set the mode switch on the ATC control panel to the XPDR position.

S 865-383-004

(7) Close these circuit breakers.

(a) P11 Overhead Circuit Breaker Panel:
  1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
     11C19, LANDING GEAR POS SYS 2 ALTN
  2) 11S15, AIR/GND SYS 1
  3) 11S19, LDG GR POS AIR/GND SYS 2

S 865-384-004

(8) Push the INTERROGATE switch.

(a) Make sure the test set shows "no reply from xpdr".

S 865-385-004

(9) Open these circuit breakers.

(a) P11, Overhead Circuit Breaker Panel:
  1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19;
     11C19, LANDING GEAR POS SYS 2 ALTN
  2) 11S15, AIR/GND SYS 1

3) 11S19, LDG GR POS AIR/GND SYS 2

S 735-461-004

(10) Push the INTERROGATE switch.

(a) Make sure the test set shows the correct transponder type.

<u>NOTE</u>: If the test set shows "no reply from xpdr", do a check on the test antenna connections. Also, make sure the ATC system is operational.

S 865-494-004

(11) Push the INTERROGATE switch again and the test set will initiate and run a sequence of tests on the transponder.

<u>NOTE</u>: It will stop at any failed test. To continue push the TEST button.

(a) When the tests are completed the test display should be as follows:

```
      CCCC XXXXXX YYYYY'
   ZZZ W mmm dbm nnn MHZ
```

1)	CCCC	is code selected.
2)	XXXXXX	is aircraft identifier.
3)	YYYYY	aircraft altitude in feet (must be + or - 125 feet of Capt's and F/O's altimeter).
4)	ZZZ	is the transmitter power output (must be > 125 and < 500W).
5)	mmm	is the receiver sensitivity (must be between -77 and -71 dbm).
6)	nnn	is the frequency deviation (+ or - 1 MHz max. allowed).

S 865-495-004

(12) Do the steps that follow to do the DIVERSITY CHECK:

(a) For a test set with the TAP 125 option, push the TEST button on the test set until you get to the DIVERSITY CHECK.

1) Make sure to pause between each press of the test button to allow the test set to execute that test step.

2) Make sure the test set shows DIVERSITY and then either PASS or FAIL.

NOTE: The test may initially fail due to strong local radiation. This is usually a temporary situation, repeat the test. Any PASS indicates a good system.

(b) For a test set without the TAP 125 option, do the Mode S Diversity Channel Isolation Test as follows:
  1) Disconnect the antenna cable at the antenna switch connector and connect the RF through-line wattmeter in its place.
  2) Make a note of the maximum power output and the minimum power output measured by the through-line wattmeter during Mode S squitter transmission period.
    a) Make sure the minimum power output is 100 times or 20 db lower than the maximum power output.
  3) Disconnect the RF through-line wattmeter.
  4) Connect the antenna cable to the antenna switch connector.

S 865-496-004

(13) Do the steps that follow to do the MAX TRUE AIRSPEED TEST:
  (a) Push the TEST button on the test set until you get to the MAX TRUE AIRSPEED TEST.
    1) Be sure to pause between each press of the test button to allow the tester to execute that test step.
  (b) Make sure the Test set shows the max true airspeed that is pin programmed in each transponder.
    1) The tester display must be:

- MAX TRUE AIRSPEED
- GT300 & LE 600 Kts

S 865-497-004

(14) Do the steps that follow for the IDENT BUTTON CHECK:
  (a) On the ATC control panel:
    1) Set the Code Select switch to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

    2) Set the transponder select switch to L or No. 1.
    3) Set the Transponder switch to XPDR.
  (b) Make sure the test set shows the desired ATC ID code.
  (c) Turn test set off.
  (d) Wait a moment, then push INTERROGATE.
    1) Allow the tester to acquire and determine the type of transponder under test.
  (e) At the same time push the control panel IDENT button and the test set TEST button.

(f) Make sure that the message "IDENT" is shown on the tester.

S 865-512-004

(15) Remove the TAP-125 cable from the test set and connect the other TAP-125 cable and repeat the automatic ATC system test.

S 865-498-004

(16) Do the test again as necessary for the right system:
(a) To test the right system put the control panel switch to R or 2.

S 865-499-004

(17) If all the tests passed, do the "Put the Airplane Back to its Usual Condition" steps at the end of this task.

G. Manual ATC System Test

NOTE: If the automatic system test passed the manual test is not required.

S 865-387-004

(1) Change the ATC ID code on the ATC control panel to its compliment. The compliment of the code is 7777 minus the code.

EXAMPLE: If the code is 0340, its compliment is:

7777 - 0340 = 7437 compliment.

S 865-388-004

(2) Push the identification switch on the ATC control panel.

S 865-389-004

(3) Push the TEST switch on the test set to do the ATCRBS/A test.
(a) Make sure the test set shows the IDENT indication, the ATC ID code selected on the ATC control panel, and a %REPLY greater than 90%.

S 865-421-004

(4) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the OFF position.

S 865-475-004

(5) Push the TEST switch on the test set to do the ATCRBS/C test.
(a) GUI 001-006;
Make sure the test set shows no altitude data and %REPLY greater than 90%.

S 865-420-004
(6) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the ON position.

S 865-460-004
(7) GUI 001-006;
Push the STORE switch on the test set to do the ATCRBS/C test again.
  (a) Make sure the test set shows the airplane's altitude and %REPLY greater than 90%.

S 865-467-004
(8) Push the TEST switch on the test set to do the ATCRBS/A Mode S ALL test.
  (a) Make sure the test set shows the airplane's mode S address and %REPLY greater than 90%.

S 865-468-004
(9) Push the TEST switch on the test set to do the ATCRBS/C Mode S ALL test.
  (a) Make sure the test set shows the airplane's mode S address and %REPLY greater than 90%.

S 865-469-004
(10) Push the TEST switch on the test set to do the ATCRBS/A only test.
  (a) Make sure the test set shows NO Reply From XPDR.

S 865-470-004
(11) Push the TEST switch on the test set to do the ATCRBS/C only test.
  (a) Make sure the test set shows No Reply From XPDR.

S 865-471-004
(12) Push the TEST switch on the test set to do the Mode S Surv (Identity/Altitude/Short) test.
  (a) Make sure the test set shows the airplane's mode S address, the airplane's altitude, and %REPLY greater than 90%.

S 865-501-004

(13) Push the TEST switch on the test set to do the Mode S Comm (Identity/Altitude/Short) test.

(a) Make sure the test set shows the airplane's mode S address, the airplane's altitude, and %REPLY greater than 99%.

NOTE: Failure to reply by the transponder is not a failure of the ATC system. Contact the transponder vendor about the capability of the transponder.

S 865-472-004

(14) Push the TEST switch on the test set to do the Undesired replies test.

(a) Make sure the test set shows No Replies.

S 865-473-004

(15) Push the TEST switch on the test set to do the Squitter test.

(a) Make sure the test set shows PASS.

S 735-399-004

(16) For test set with the TAP 125 option, push the TEST switch on the test set to run the Mode S Diversity Channel Isolation Test.

NOTE: The test set should show the Diversity test page.

(a) Make sure the test set shows PASS.

S 735-397-004

(17) For test set without the TAP 125 option, do the Mode S Diversity Channel Isolation Test as follows:

(a) Disconnect the antenna cable at the top antenna switch connector, D1431, and connect the RF through-line wattmeter in its place.

(b) Make a note of the maximum power output and the minimum power output measured by the RF throught-line wattmeter during mode S squitter transmission period.

1) Make sure the minumum power output is 100 times or 20 db lower than the maximum power output.

(c) Disconnect the RF through-line wattmeter.
(d) Connect the antenna cable at the top antenna switch connector, D1431.

S 865-411-004
(18) Remove the antenna coupler from the lower ATC antenna and insert it onto the top ATC antenna.

NOTE: Make sure the orientation of the antenna coupler setup is correct.

S 735-410-004
(19) Do the system test again for the right or No. 2 ATC system.

H. Put the Airplane Back to its Usual Condition

S 845-359-004
(1) Remove the TAP-118 or TAP-125 and the TIC T-48/T-49 test set.

S 865-438-004
(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-439-004
(3) Close these circuit breakers:
(a) P11, Overhead Circuit Breaker Panel
1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
2) 11S15, AIR/GND SYS 1
3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-360-004
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-53-00-735-584-004

6. System Test - ATC System (With the TIC TR-220)

A. General
(1) This system test is a full check of the ATC system. The system test first does the ATC operational test and then uses the TR-220 test set to examine the left and right ATC systems.

(2) The test set can perform all the tests automatically, or each test individually. Each test is shown as it is being performed. If a test has failed, the test sequence will abort, and a failed message is displayed. All data will be shown at the end of the test, if the test is successful.

(3) When conducting tests in the MANUAL sequence, you initialize the sequence by toggling the AUTO/TEST/MANUAL switch to the MANUAL position. The Test Set runs a series of tests, and displays the individual results of each test ending in the POWER, RECEIVER EFFICIENCY and FREQUENCY page.

(4) After each test is completed, you must toggle the MANUAL switch to advance to the next test in the series.

(5) Operation with the antenna coupler TAP-135 used with the test set, reduces Radio Frequency emissions from the transponder being tested. It is not necessary to use the coupler to perform these tests.

(6) If it is necessary to simulate the aircraft being tested as being at altitude, notify the local ATC that the transponder testing is in progress.

B. Equipment

(1) ATC Transponder Ramp Test Set TIC TR-220
Tel Instruments Electronics Corp.
728 Garden St., Carlstadt, NJ 07472

C. References

(1) AMM 22-10-00/501, Autopilot Flight Director System (AFDS)
(2) AMM 24-22-00/201, Electrical Power Control
(3) AMM 32-09-02/201, Flight Mode Simulation
(4) AMM 34-12-00/501, Air Data Computing (ADC) System
(5) AMM 34-21-00/501, Inertial Reference System (IRS)
(6) AMM 34-61-00/501, Flight Management Computer System (FMCS)

D. Access

(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

E. Prepare for the ATC System Test

S 865-586-004

(1) Do the ATC Operational Test.

S 865-587-004

(2) Prepare to test the ATC System:
  (a) Put the TEST SET switch in the ON position.
    1) The test set will display a start-up screen, then do a self test.
    2) If the self-test passes, the display will indicate SELF TEST PASS.

(b) Supply electrical power (AMM 24-22-00/201).

WARNING: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(c) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).

(d) Open these circuit breakers and attach DO-NOT-CLOSE tags:
  1) P11 Overhead Circuit Breaker Panel:
    a) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    b) 11S15, AIR/GND SYS 1
    c) 11S19, LDG GR POS AIR/GND SYS 2

(e) Set the captain's and first officer's altimeter to 29.92 (inches of mercury).

F. Automatic ATC System Test

S 865-588-004

(1) On the ATC control panel, set the code switches to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

S 865-589-004

(2) On the ATC control panel, put the ATC system on standby.

S 865-592-004

(3) Set the transponder select switch on the ATC control panel to the left or No. 1 system.

S 865-596-004

(4) GUI 001-006;
Set the altitude reporting switch on the ATC control panel to the ON position.

S 865-599-004

(5) GUI 007-114, 116-999;
Set the mode switch on the ATC control panel to the XPDR position.

S 865-605-004

(6) Turn the UUT FUNCTION switch on the test set to the XPDR position.
    (a) The test set will determine the transponder type and display the correct Start Page.

S 865-653-004

(7) Press the AUTO/TEST/MANUAL switch to the AUTO position and the test set will start and run a sequence of tests on the transponder.

    NOTE: It will stop at any failed test, to continue press the AUTO/TEST/MANUAL Switch to the AUTO position.

    (a) To repeat a failed test, push the AUTO/TEST/MANUAL switch to the MANUAL position.
        1) When the tests are completed, the test set display will alternate between two screens. The screens displayeddepend on which type of transponder was found and tested by thetest set

        NOTE: Refer to the TR-220 Operating Manual for detailed information.

S 865-655-004

(8) Make sure the data displayed on the test set is correct for the airplane being tested.

S 865-656-004

(9) To run manual tests, toggle the AUTO/TEST/MANUAL switch to the MANUAL position.
    (a) The tests will run in order.

(b) To repeat a failed Manual test, toggle the AUTO/TEST/MANUAL switch to the MANUAL position.
(c) For information about Manual Testing, refer to the TR-220 Operating Manual.

S 865-606-004

(10) Do the steps that follow to do the DIVERSITY CHECK:
(a) Make sure to pause between each press of the test button to allow the test set to execute that test step.
(b) Make sure the test set shows DIVERSITY and then either PASS or FAIL.

NOTE: The test may initially fail due to strong local radiation. This is usually a temporary situation, repeat the test. Any PASS indicates a good system.

S 865-608-004

(11) Do the steps that follow for the IDENT BUTTON CHECK:
(a) The IDENT test must be run in the Manual Mode on the test set.
(b) Select either the MODE A, or the MC Test on the test set.
(c) On the ATC control panel:
1) Set the Code Select switch to a desired ATC ID code.

NOTE: Do not use codes 7500, 7600, or 7700. These are emergency codes.

2) Set the transponder select switch to L or No. 1.
3) Set the Transponder switch to XPDR.
(d) Allow the test set to complete the test.
(e) Make sure the test set shows the desired ATC ID code.
(f) Press the IDENT switch on the transponder control panel.

S 865-611-004

(12) Do the test again as necessary for the right system:
(a) To test the right system put the control panel switch to R or 2.

S 865-612-004

(13) If all the tests passed, do the "Put the Airplane Back to its Usual Condition" steps at the end of this task.

G. Manual ATC System Test

NOTE: If the automatic system test passed the manual test is not required.

S 865-613-004

(1) Refer to the TR-220 Operating Manual for detailed information.

H. Put the Airplane Back to its Usual Condition

S 845-644-004

(1) Remove the TIC TR-220 test set.

S 865-646-004

(2) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).

S 865-647-004

(3) Close these circuit breakers:
  (a) P11, Overhead Circuit Breaker Panel
    1) AIRPLANES WITH THE "LANDING GEAR POS SYS 2 ALTN" CIRCUIT BREAKER INSTALLED AT PANEL GRID LOCATION 11C19; 11C19, LANDING GEAR POS SYS 2 ALTN
    2) 11S15, AIR/GND SYS 1
    3) 11S19, LDG GR POS AIR/GND SYS 2

S 845-648-004

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AIR TRAFFIC CONTROL (ATC) TRANSPONDER - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ATC transponder, the other is the installation of the ATC transponder.
   B. The left, M10141, and right, M10142, ATC transponders are installed on the E3 rack in the main equipment center.

TASK 34-53-01-004-001

2. Remove the ATC Transponder
   A. References
      (1) AMM 20-10-01/401, E/E Rack Mounted Components
   B. Access
      (1) Location Zones

119	Main Equipment Center

      (2) Access Panels

119BL	Main Equipment Access Door

   C. Prepare for Removal

      S 864-002

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11F7, ATC LEFT
         (b) 11F28, ATC RIGHT
   D. Procedure

      S 024-003

      (1) Remove the ATC transponder (AMM 20-10-01/401).

TASK 34-53-01-404-004

3. Install the ATC Transponder

   A. References
      (1) AMM 20-10-01/401, E/E Rack Mounted Components

(2) AMM 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

119	Main Equipment Center
119	Main Equipment Center (Exterior)
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior)

C. Prepare for Installation

S 864-104

(1) Make sure these circuit breakers on the P11 panel are open:
   - (a) 11F7, ATC LEFT
   - (b) 11F28, ATC RIGHT

D. Procedure

S 424-006

(1) Install the ATC transponder (AMM 20-10-01/401).

E. Prepare for the ATC Transponder Test

S 864-055

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   - (a) 11F7, ATC LEFT
   - (b) 11F28, ATC RIGHT

S 864-008

(2) Supply electrical power (Ref 24-22-00).

S 754-009

(3) Make sure these circuit breakers on the P11 panel are closed:
   - (a) AIR DATA (4 locations)
   - (b) 11E2, ALTM LEFT
   - (c) 11E23, ALTM RIGHT

S 864-162

(4) Set the transponder select switch on the ATC control panel to the applicable 1 or 2 (L or R) position.

F. ATC Transponder Test

NOTE: This is not a full test of the system. If a full test is necessary, do this task: Air Traffic Control (ATC) System - Adjustment/Test (AMM 34-53-00/501).

S 744-019

(1) Push and hold the TEST switch on the applicable ATC transponder.

S 754-020

(2) Make sure the sequence that follows occurs:
  (a) All the LEDs come on during the lamp test.
  (b) All the red LEDs go off.
  (c) The green LED stays on after the self test.

S 744-021

(3) Release the TEST switch on the ATC transponder.

G. Put the Airplane Back to Its Usual Condition

S 864-047

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

DUAL AIR TRAFFIC CONTROL (ATC) CONTROL PANEL - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ATC control panel; the other is the installation of the ATC control panel.
   B. The ATC control panel, M10140, is installed on the aisle control stand, P8. Electrical connections are at the rear of the control panel.

TASK 34-53-02-004-001

2. Remove the ATC Control Panel
   A. Access
      (1) Location Zones
          211/212 Flight Compartment

   B. Prepare for Removal

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
          (a) 11F7, ATC LEFT
          (b) 11F28, ATC RIGHT
   C. Procedure

      S 034-003
      (1) Loosen and remove the screws on the control panel.

      S 014-004
      (2) Move the control panel out to get access to the electrical cable.

      S 034-005
      (3) Disconnect the two electrical connectors.

      S 024-006
      (4) Remove the ATC control panel.

TASK 34-53-02-404-007

3. Install the ATC Control Panel
   A. References
      (1) 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones
      211/212 Flight Compartment

C. Prepare for Installation

S 754-008

(1) Make sure these circuit breakers on the P11 panel are open:
  - (a) 11F7, ATC LEFT
  - (b) 11F28, ATC RIGHT

D. Procedure

S 434-009

(1) Connect the two electrical connectors to the control panel.

S 424-010

(2) Install the ATC control panel.

S 434-011

(3) Tighten the screws on the control panel.

S 864-012

(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  - (a) 11F7, ATC LEFT
  - (b) 11F28, ATC RIGHT

E. ATC Control Panel Test

S 864-013

(1) Supply electrical power (Ref 24-22-00/201).

S 754-014

(2) Make sure the control panel lights come on.

S 864-025

(3) Set the transponder select switch on the ATC control panel to the L or 1 position.

S 864-026

(4) Push and hold the TEST switch on the front panel of the left ATC transponder.

- (a) Make sure the sequence that follows occurs:
  - 1) ALL LEDS come on during the lamp test.
  - 2) All red LEDS go off.
  - 3) The green LED stays on after the self test.

S 864-027

(5) Release the TEST switch on the ATC transponder.

S 864-039

(6) Set the transponder select switch on the ATC control panel to the R or 2 position.

S 744-041

(7) Push and hold the TEST switch on the front panel of the right ATC transponder.

- (a) Make sure the sequence that follows occurs:
  - 1) ALL LEDS come on during the lamp test.
  - 2) All red LEDs go off.
  - 3) The green LED stays on after the self test.

S 744-045

(8) Release the TEST switch on the ATC transponder.

F. Put the Airplane Back to Its Usual Condition

S 864-029

(1) Set the ATC system on standby.

S 864-015

(2) Remove electrical power if it is not necessary (Ref 24-22-00/201).

AIR TRAFFIC CONTROL (ATC) ANTENNA - REMOVAL/INSTALLATION

1. General

A. This procedure has two tasks. One is the removal of the ATC antenna; the other is the installation of the ATC antenna.

TASK 34-53-03-004-001

2. Remove the ATC Antenna

A. Equipment
   (1) Sealant removal tool - hardwood or plastic

B. Consumable Materials
   (1) B00184 Solvent - BMS 11-7

C. References
   (1) AMM 20-10-22/701, Metal Surfaces

D. Access
   (1) Location Zones

119/120	Main Equipment Center (Exterior)
223/224	Area Above Passenger Cabin Ceiling (Exterior) *(Mode S airplanes only)

E. Prepare for Removal

S 864-002

(1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
   (a) 11C20, ATC ANT SWITCH
   (b) 11F7, ATC LEFT
   (c) 11F28, ATC RIGHT

F. Procedure

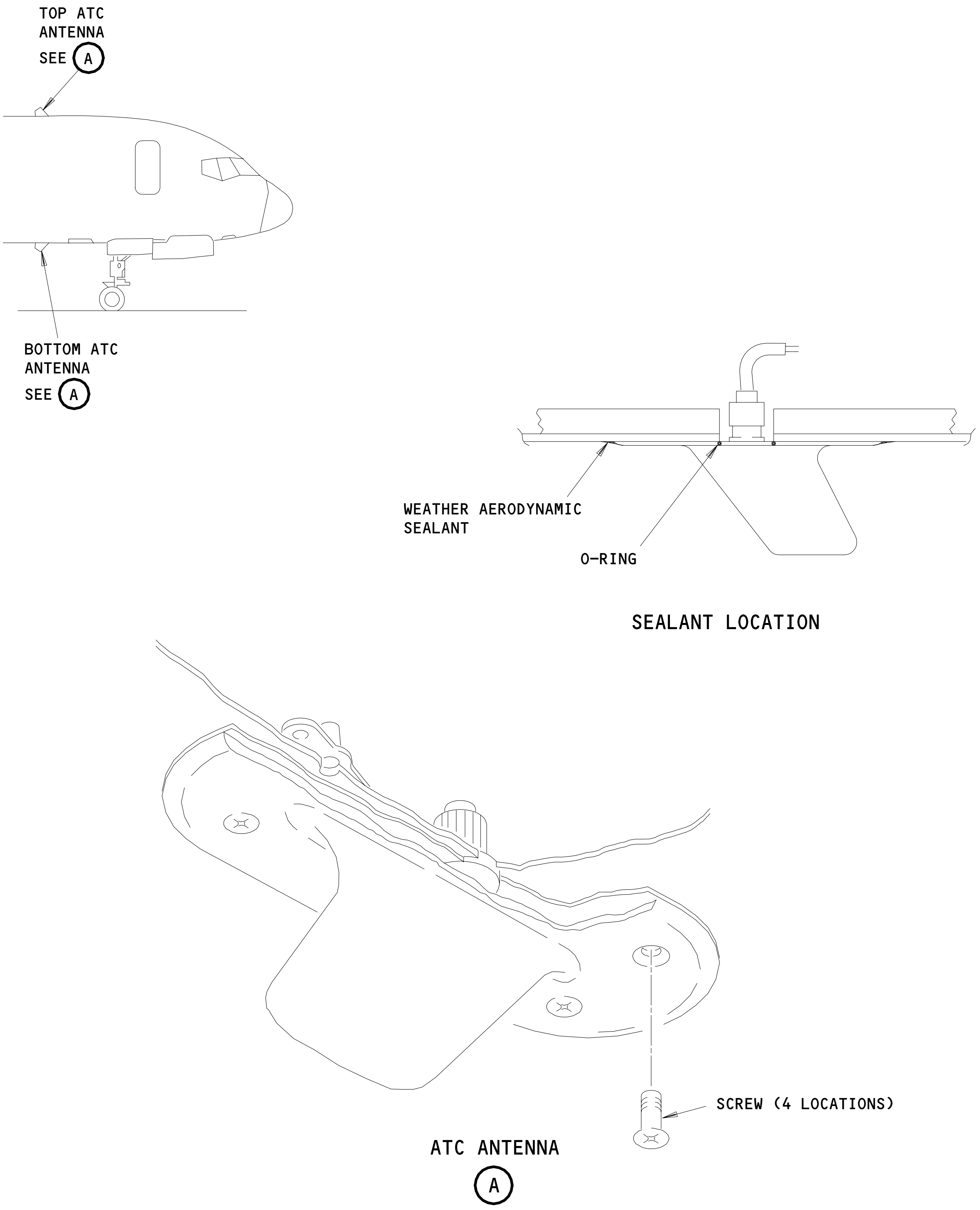
S 034-003

(1) Remove the screws from the antenna base.

S 034-004

<u>CAUTION</u>: BE CAREFUL WHEN YOU USE FORCE WITH THE SEALANT REMOVAL TOOL TO BREAK THE ANTENNA SEAL. TOO MUCH FORCE CAN DAMAGE THE AIRPLANE SKIN OR THE ELECTRICAL CABLE AT THE ANTENNA BASE.

(2) Use force around the antenna with the sealant removal tool until the seal is fully broken.



ATC Antenna Installation
Figure 401

S 014-005

CAUTION: MOVE THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLE. DAMAGE TO THE ANTENNA CABLE CAN OCCUR IF YOU PULL THE CABLE.

(3) Move the antenna until you can get access to the antenna cable connector.

S 034-006
(4) Disconnect the antenna cable.

NOTE: Do not let the antenna cable fall into the fuselage.

S 024-007
(5) Remove the ATC antenna.

S 144-008
(6) Remove the sealant from the airplane skin in the antenna area (Ref 20-10-22).

S 114-009
(7) Clean the airplane surface in the antenna area with the solvent, BMS 11-7, and a clean rag (AMM 20-10-22/701).

TASK 34-53-03-404-066

3. Install the ATC Antenna

A. Equipment
  (1) Resistance measuring bridge or ohmmeter that can measure .001 ohm

B. Consumable Materials
  (1) B00184 Solvent - BMS 3-2, Type 1
  (2) A00247 Sealant - BMS 5-95, Class B 1/2
  (3) G00009 Coating - Conversion - Alodine 1200

C. References
  (1) AMM 20-10-22/701, Metal Surfaces
  (2) AMM 24-22-00/201, Electrical Power - Control
  (3) AMM 51-21-04/701, Alodine Coating
  (4) AMM 51-31-01/201, Seals and Sealing

D. Access
  (1) Location Zones

119/120	Main Equipment Center (Exterior)
119/120	Main Equipment Center
211/212	Flight Compartment
223/224	Area Above Passenger Cabin Ceiling (Exterior) *(Mode S airplanes)

E. Prepare for Installation

S 754-010

(1) Make sure these circuit breakers on the P11 panel are open:
  (a) 11C20, ATC ANT SWITCH
  (b) 11F7, ATC LEFT
  (c) 11F28, ATC RIGHT

F. Procedure

S 214-011

(1) Visually examine the mating surfaces of the antenna and the airplane for corrosion and unwanted substances.

<u>NOTE</u>: If the surfaces are not clean, the grounding will not be sufficient, and incorrect system operation will occur.

S 114-012

(2) Clean the mating surfaces with the solvent, BMS 3-2 (AMM 20-10-22/701)

S 624-013

(3) Apply Alodine 1200 to the mating surfaces of the antenna and the airplane (AMM 51-21-04/701).

S 434-014

(4) Make sure that an O-ring is installed on the new antenna.

S 434-015

(5) Connect the coaxial cable to the antenna.

S 424-016

(6) Put the antenna into position and install the screws.

S 434-017

(7) Tighten the screws to 20-25 pound-inches of torque.

S 764-018

(8) Make sure the resistance from the antenna base to the airplane skin is not greater than .001 ohms.

S 434-019

(9) Apply the weather aerodynamic sealant, BMS 5-95, to the outer edge of the antenna (AMM 51-31-01/201).

S 144-020

(10) Remove the unwanted sealant from around the antenna base (AMM 51-31-01/201).

S 864-021

(11) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11C20, ATC ANT SWITCH
  (b) 11F7, ATC LEFT
  (c) 11F28, ATC RIGHT

TASK 34-53-03-714-145

4. ATC Antenna Test

A. Procedure

S 864-022

(1) Supply electrical power (AMM 24-22-00/201).

S 864-069

(2) GUI 001-114, 116-999;
set the transponder select switch on the ATC control panel to the applicable L or R position.

S 864-071

(3) GUI 115;
set the transponder select switch on the ATC control panel to the applicable 1 or 2 position.

S 744-031

(4) Push and hold the TEST switch on the applicable ATC transponder.

S 754-032

(5) Make sure the sequence that follows occurs:
  (a) All the LEDs come on during the lamp test.
  (b) All the red LEDs go off.
  (c) The green LED stays on after the self test.

S 744-033

(6) Release the TEST switch on the ATC transponder.

B. Put the Airplane Back to Its Usual Condition

S 864-081

(1) GUI 007-114, 116-999;
Set the mode switch on the ATC control panel to the STBY position.

S 864-075

(2) GUI 115;
set the altitude reporting select switch on the ATC control panel to the STBY position.

S 864-076

(3) GUI 001-006;
set the transponder select switch on the ATC control panel to the STBY position.

S 864-054

(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AIR TRAFFIC CONTROL (ATC) ANTENNA SWITCH - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the ATC antenna switch and the other is the installation of the ATC antenna switch.
   B. The top and bottom ATC antenna switch, S10563 and S10564, installations are the same. The ATC antenna switches are installed on the E3 rack.

TASK 34-53-04-004-001

2. Remove the ATC Antenna Switch
   A. Access
      (1) Location Zones

119/120	Main Equipment Center
121/122	Forward Cargo Compartment

      (2) Access Panels

821	No. 1 Cargo Door
822	No. 2 Cargo Door.

   B. Prepare for Removal

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11C20, ATC ANT SWITCH
         (b) 11F7, ATC LEFT
         (c) 11F28, ATC RIGHT
   C. Procedure

      S 014-030
      (1) Get access to the ATC antenna switch on the E3 rack in the main equipment center.

      NOTE: You can also get access to the ATC antenna switch from the forward cargo area. Remove the bulkhead lining (AMM 25-50-03/401) to get access to the ATC antenna switch.

      S 034-003
      (2) Remove the electrical connector from the ATC antenna switch.

      S 034-004
      (3) Remove the nuts and screws from the ATC antenna switch.

      S 024-005
      (4) Remove the ATC antenna switch.

TASK 34-53-04-404-006

3. Install the ATC Antenna Switch

A. Equipment

- (1) Resistance measuring bridge or ohmmeter which can measure 0.001 ohm

B. References

- (1) AMM 20-10-21/401, Electrical Bonding
- (2) AMM 20-10-22/701, Metal Surfaces
- (3) AMM 24-22-00/201, Electrical Power - Control

C. Access

(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

D. Prepare for Installation

S 754-007

(1) Make sure these circuit breakers on the P11 panel are open:
- (a) 11C20, ATC ANT SWITCH
- (b) 11F7, ATC LEFT
- (c) 11F28, ATC RIGHT

E. Procedure

S 214-008

(1) Make sure the ATC antenna switch bracket has no corrosion. If not, clean the mating surfaces (AMM 20-10-22/701).

S 424-009

(2) Install the ATC antenna switch on the bracket with the electrical bond fastener (AMM 20-10-21/401).

NOTE: Make sure the two ATC antenna switches have the same mod level of the same part number.

S 434-010

(3) Tighten the screws on the ATC antenna switch.

S 764-011

(4) Make sure the resistance from the ATC antenna switch to the E3 rack is less than 0.001 ohm.

S 864-012

(5) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
- (a) 11C20, ATC ANT SWITCH

(b) 11F7, ATC LEFT
(c) 11F28, ATC RIGHT

F. ATC Antenna Switch Test

S 864-013
(1) Supply electrical power (AMM 24-22-00/201).

S 864-079
(2) Set the transponder select switch on the ATC control panel to the L or 1 position.

S 864-019
(3) Push and hold the TEST switch on the left ATC transponder.
   (a) Make sure all the LEDs come on during the lamp test.
   (b) Make sure the red LEDs go off.
   (c) Make sure the green LED stays on after the self test.

S 864-059
(4) Release the TEST switch.

S 864-078
(5) Set the transponder select switch on the ATC control panel to the 2 or R position.

S 864-037
(6) Push and hold the TEST switch on the right ATC transponder.
   (a) Make sure all the LEDs come on during the lamp test.
   (b) Make sure the red LEDs go off.
   (c) Make sure the green LED stays on after the self test.

S 864-060
(7) Release the TEST switch.

G. Put the Airplane Back to Its Usual Condition

S 864-063
(1) GUI 001-006;
set the transponder select switch on the ATC control panel to the STBY position.

S 864-064
(2) GUI 001-006;
set the altitude reporting select switch on the ATC control panel to the STBY position.

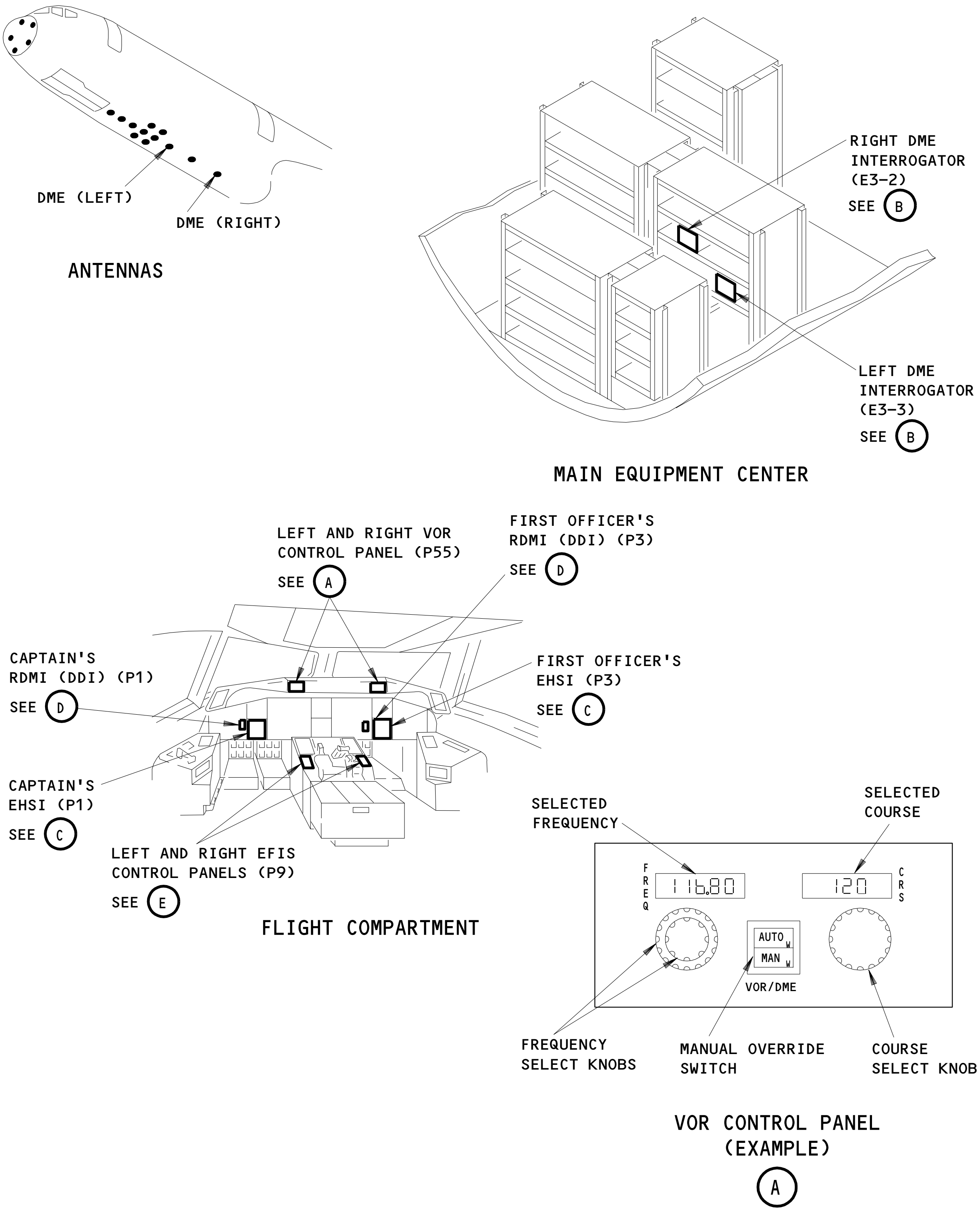
S 864-040
(3) GUI 007-999;
Set the mode switch on the ATC control panel to the STBY position.

S 864-055
(4) Remove electrical power if it is not necessary (AMM 24-22-00/201).

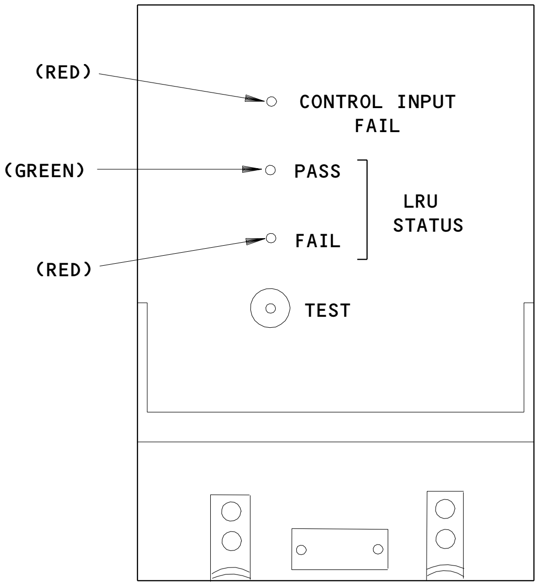
DME SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   - A. The distance measuring equipment (DME) system measures the airplane-to-station slant-range (line-of-sight) distance. This distance is displayed as nautical miles to go on flight deck instruments.
   - B. TWO DME systems are installed. Each system has an interrogator (receiver/transmitter), an antenna, and two distance indicators on the RDMIs (or DDIs).
   - C. The DME transmits pulsed rf signals to a ground station and receives replies from that station. It determines distance by measuring the time it takes to receive a reply from the station. The signals travel at a constant rate (light speed) and thus distance is proportional to travel time.
   - D. The DME system operates in the L-band frequency range. It has a transmit frequency of 1025 to 1150 MHz and a receive frequency of 962 to 1213 MHz.
   - E. The DME and ATC systems operate in the same L-band frequency range. The TCAS system (if installed) operates in the same L-band frequency range. To prevent intersystem interference only one system is allowed to transmit at any one time. A mutual transmission suppression signal is provided from the on-line system to prevent the others from transmitting.
   - F. Distance to the DME station is displayed on both RDMIs (or DDIs) and the selected EHSIs. Distance is also transmitted to the FMCs on ARINC 429 serial digital data buses. Audio from the ground station is fed to the audio selector panels.

2. Component Details
   - A. DME Antenna
     - (1) The DME antennas are L-band blades which are the same as the ATC antennas. Each antenna has a 52 ohm coax output with a VSWR of 5:1 or less over the DME frequency band. The two DME antennas are located on the bottom of the fuselage.
   - B. DME Interrogator
     - (1) The DME interrogators transmit and receive rf signals to compute distance to a station. The transmitter section operates between 1025 and 1150 MHz at 316 watts (min) power. The receiver section operates between 962 and 1213 MHz. The interrogation range is 320 nautical miles with a dynamic range capability of 0 to greater than 1000 knots of airspeed.
     - (2) AIRPLANES WITH DME-700 SERIES INTERROGATORS;
       The front panel lights operate only in conjunction with the test button. Pushing the test switch initiates a BITE test of the interrogator. The lights indicate status of the system after test. At the end of the test, a good LRU is indicated by the green LRU STATUS-PASS light on and the red light off. A bad LRU is indicated by the red LRU STATUS-FAIL light on. The CONTROL INPUT FAIL light comes on when data from the VOR or ILS control panel is invalid.

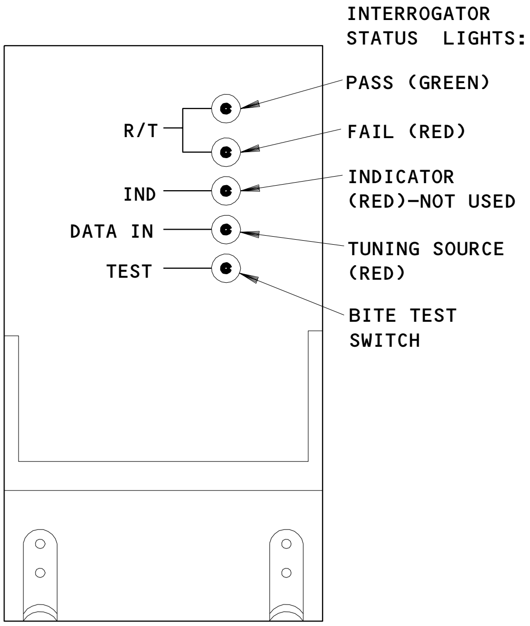


DME System - Component Location
Figure 1 (Sheet 1)



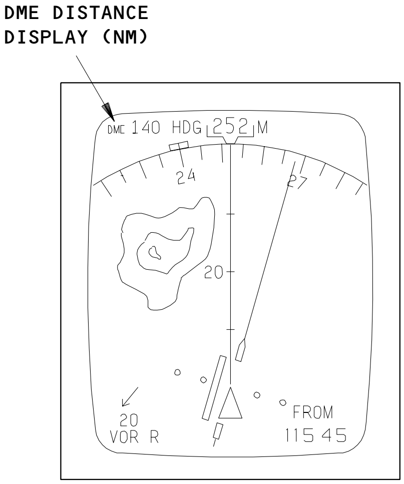
DME INTERROGATOR

B 1



DME INTERROGATOR

B 2



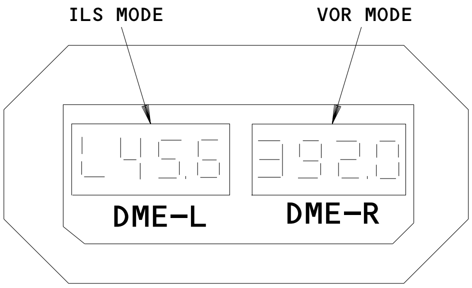
EHSI DISPLAY
(EXAMPLE)

C

1 AIRPLANES WITH COLLINS DME-700 SERIES INTERROGATORS

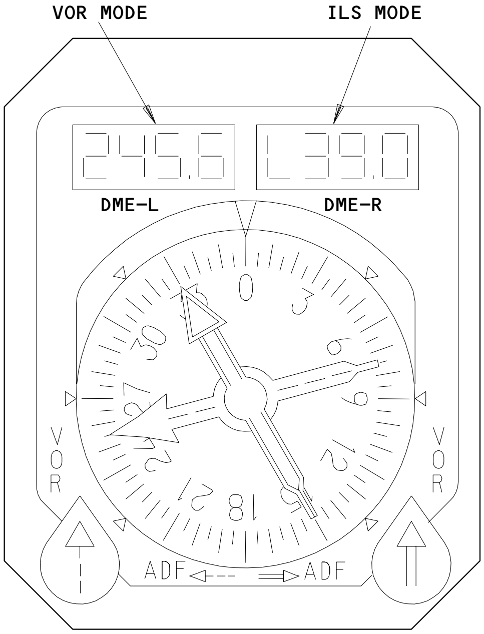
2 AIRPLANES WITH ALLIEDSIGNAL DMA-37A SERIES INTERROGATORS

DME System - Component Location
Figure 1 (Sheet 2)



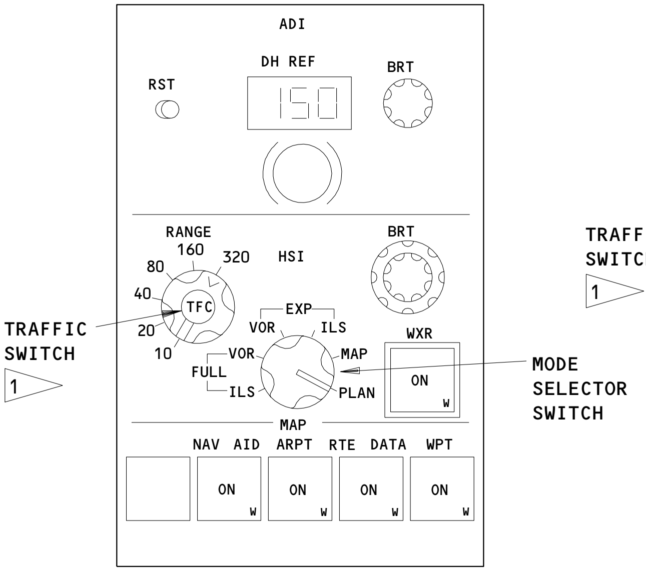
DUAL DISTANCE INDICATOR
(P1,P3)

D 2



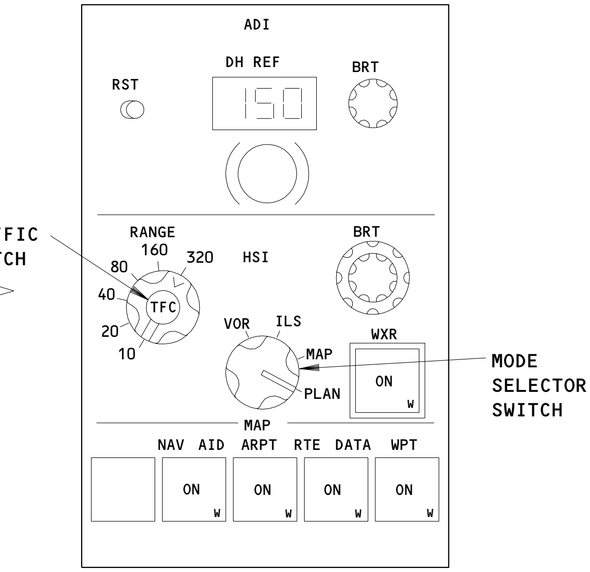
RDMI (P1,P3)

D 3



EFIS CONTROL PANEL (P9)

E 2



EFIS CONTROL PANEL (P9)

E 3

1 IF TCAS INSTALLED
2 GUI 115
3 GUI 001-114,116-999

DME System - Component Location
Figure 1 (Sheet 3)

(3) AIRPLANES WITH DMA-37A SERIES INTERROGATORS;
The front panel lights operate only in conjunction with the test button. Pushing the test switch initiates a BITE test of the interrogator. The lights indicate status of the system after test. The green R/T light on indicates a good LRU. The red R/T light on indicates a bad LRU or one with two or more faults stored from the last four flight segments in flight fault memory. The red DATA IN light indicates invalid data from the VOR or ILS control panel. The red IND light is not used.

(4) The interrogators are located in the main equipment center, the left on rack E3-3, the right on rack E3-2.

C. EFIS Control Panel

(1) DME mode control is accomplished from the EFIS control panel. When the EFIS control panel mode select switch is set to VOR, the DME frequency is paired with the VOR frequency. The VOR frequency is manually tuned at the VOR control panel (Ref 34-51-00). In the ILS (APP) mode, the DME frequency is paired with the ILS frequency and tuning is done at the ILS control panel (Ref 34-31-00). The DME is automatically tuned by the flight management computer (FMC) when the EFIS control panel is set to MAP or PLAN. Appropriate DME station tuning is fed to the DME from the FMC database as the flight progresses (Ref 34-61-00).

D. RDMI OR DDI

(1) The RDMI or DDI provides a digital display of computed slant range distance for both DME systems.

(2) DME no computed data is indicated by the readout showing all dashes. All digits in the display go blank if there is a malfunction in the DME system (Ref 34-22-00). For EFIS ILS (APP) mode, the readout also shows dashes when the distance is ≥ 100 nmi.

(3) The DME display will also go blank if the tuned DME frequency does not correspond with the ILS or VOR station selected.

E. EHSI

(1) DME range is displayed on the upper left corner of the EHSIs. The DME display is blanked for invalid data. A no computed data condition is annunciated by dashes.

(2) The EHSI DME display will also go blank if the tuned DME frequency does not correspond with the ILS or VOR station selected.

3. Operation

A. DME System Block Diagram (Fig. 2)

(1) The DME interrogator power supply receives 115 volt ac, 400 Hz through the overhead circuit breaker panel P11.

(2) The EFIS control panel selects DME modes of operation by sending open/ground logic discretes to the VOR control panel. The tuning logic circuit trips the ILS and manual relays to the appropriate tuning mode.

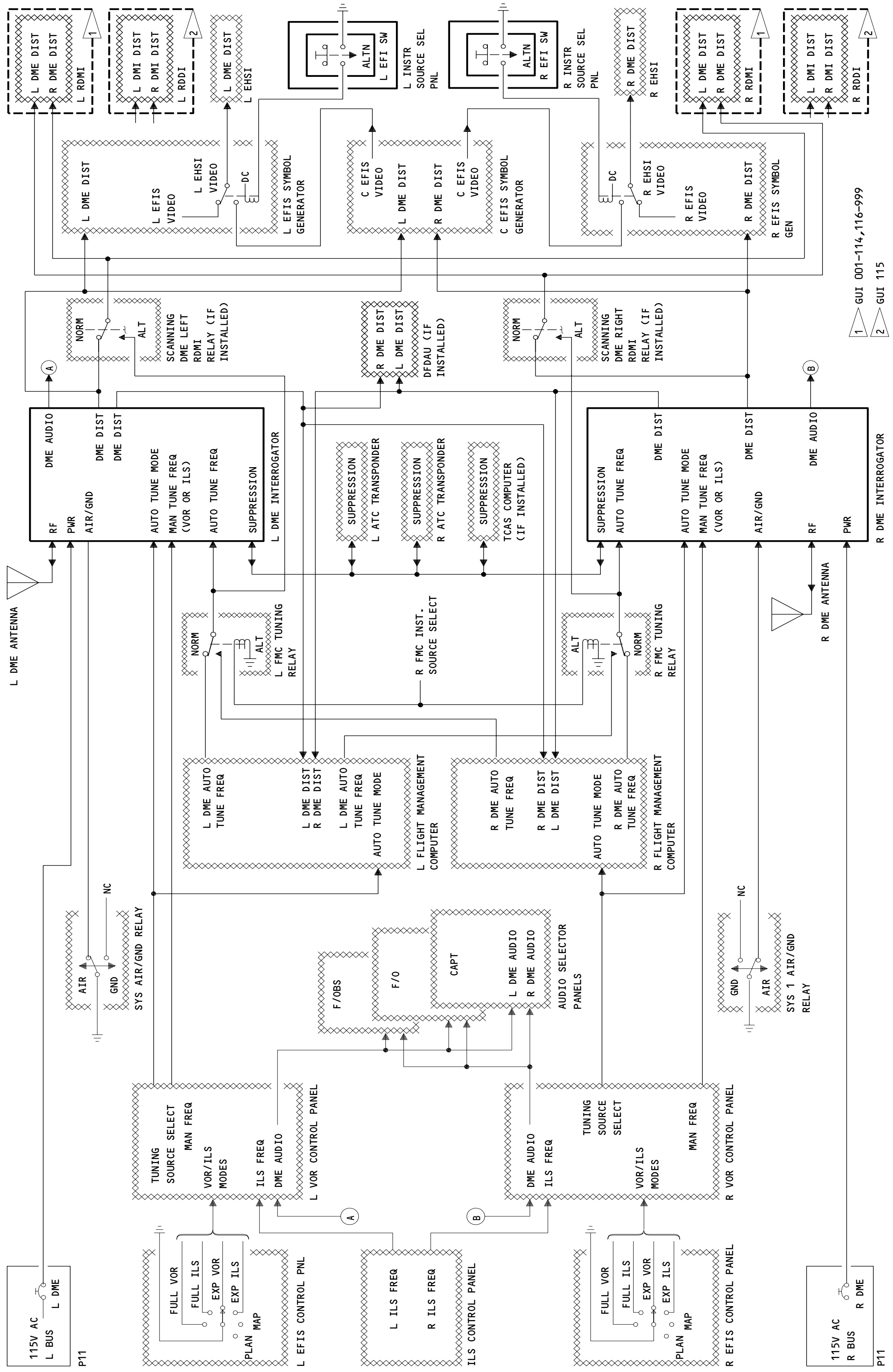
(3) Each DME interrogator generates a suppression pulse for use internally and for suppressing the receivers of the opposite DME and ATC transponders and TCAS computer (if installed) when interrogation pulses are being transmitted. In addition, the DME interrogator accepts suppression pulses to protect its receiver when the other L-band equipment is transmitting.

(4) Each DME ground station periodically transmits an identification signal along with distance data. This identification signal is decoded in the DME interrogator and routed back through the onside VOR control panel to the audio selector panels.

(5) The DME interrogator determines the slant range distance to the tuned ground station. DME distance data is sent from each interrogator to both FMCs for navigation position fixing, and is sent for display to both RDMIs (DDIs) and to the left, right and center EFIS symbol generators for display on EHSIs.

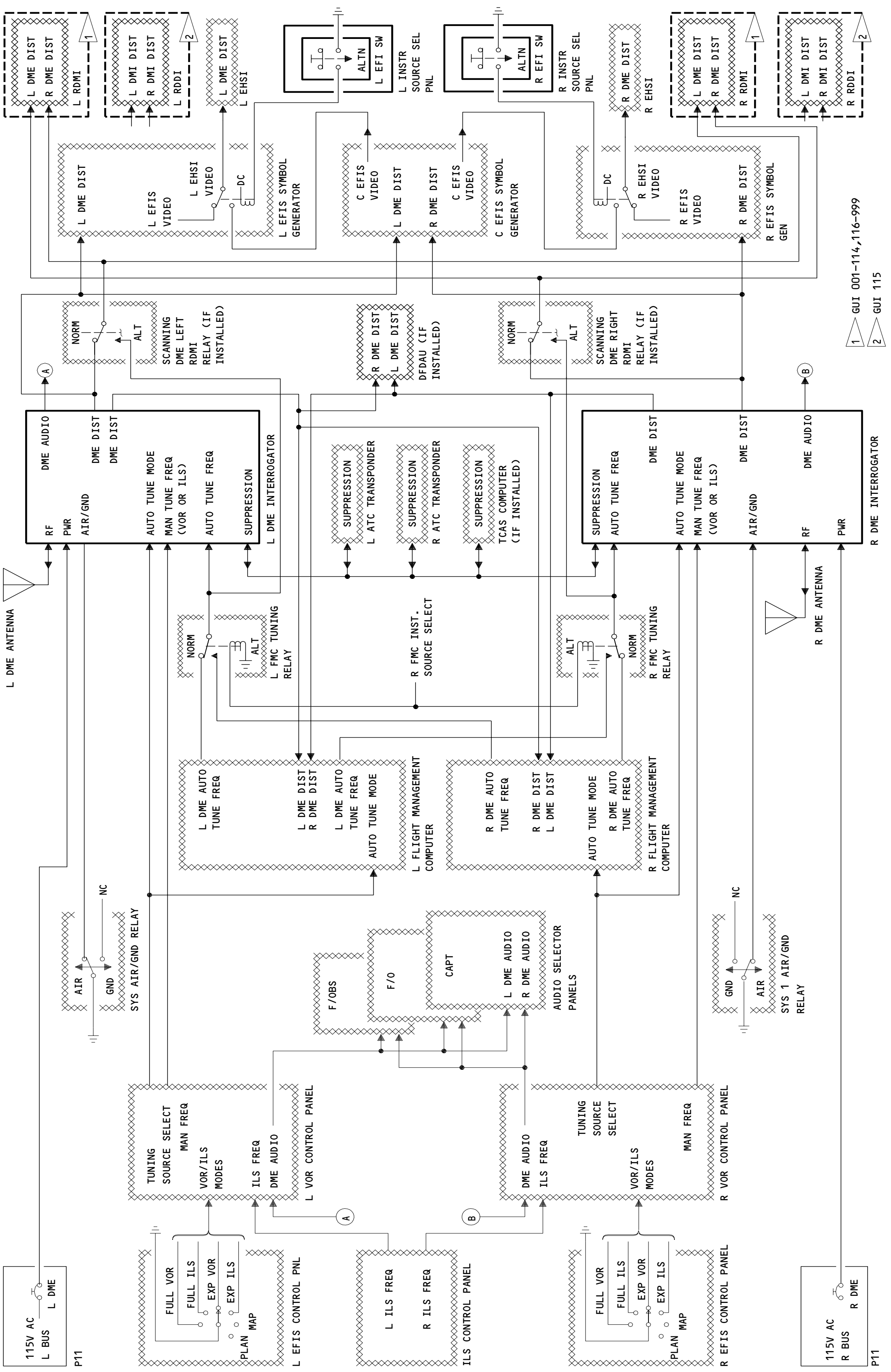
(6) The FMC tuning relays located between the L and R FMCs send bus outputs to the DME tuning input port. In the normal position the relay connects the L FMC bus output to the DME input port. When the instrument source select switches the relay to the alternate position, the R FMC is connected to the DME input port.

(7) The scanning DME L and R RDMI (DDIs) relays are located between the FMC distance outputs from the FMC tuning relays and the distance output from DME interrogator. The output of the scanning DME relay is sent to the L and R RDMIs (DDIs). In the normal position the scanning DME relays send DME distance from the L DME or R DME to the RDMIs (DDIs). In the alternate position the FMC sends distance data to the RDMIs (DDIs). The relay is set to the alternate position by a discrete signal from the L or R FMC.



DME System Block Diagram
Figure 2 (Sheet 1)

H73160



DME System Block Diagram
Figure 2 (Sheet 2)

(8) DME slant range distance is sent from each interrogator to the digital flight data acquisition unit (DFDAU) (if interfaced).

(9) The EHSIs display DME distance in EFIS VOR and ILS modes, but display FMC generated distance-to-go to the next waypoint in EFIS MAP and PLAN modes.

(10) The air/ground relays identify flight legs for the nonvolatile fault memory.

B. Functional Description

(1) DME Modes of Operation (Fig. 3)

(a) DME modes of operation are shown on the graphic. A description of the operation of each mode is given along with the DME display for that mode. The conditions for each mode are as follows:

1) The STANDBY mode occurs at initial turn-on and is the fall-back mode when ground station pulses are absent. In this mode, the transmitter is off but the receiver counts the number of pulse pairs received from the ground station. When the DME is within range of the ground station, sufficient pulse pairs will be counted by the receiver. This causes the DME to operate in the search mode.

2) In the SEARCH mode, the interrogator transmits pulse pairs and looks for ground station replies. Reply pulses are stored in memory for later analysis. Upon reception of synchronous reply pulses, the DME converts the time to distance and switches to the track mode.

3) The TRACK mode occurs after lock-on in the previous search mode. Slant range distance is displayed on the indicator and updated as the airplane moves closer to or farther from the station.

4) In the DIRECTED SCAN mode, the DME has the capability of interrogating and providing distance information for one to five frequencies. However, by system design, the DME only has to provide distance information for one frequency. The bit logic of the input digital frequency tuning word is always set to command the DME to perform in the one frequency DIRECTED SCAN mode.

5) Three abnormal conditions exist that will cause the DME not to operate in the one frequency DIRECTED SCAN mode. Under these conditions, the DME will automatically revert to FREE SCAN operation. The abnormal conditions are:

a) if the digital tuning signal falls below 5 words per second,

MODE	DESCRIPTION OF OPERATION	RDMI DISPLAY	DDI DISPLAY
STANDBY	TRANSMISSION INHIBITED; RECEIVER (AND AUDIO) OPERATIVE.	4 DASHES (NO COMPUTED DATA)	4 DASHES (NO COMPUTED DATA)
SEARCH	>650 PULSE PAIRS PER SECOND RECEIVED TRANSMITTER ON AND OPERATING WITH HIGH PRF.	4 DASHES	4 DASHES
TRACK	THREE-OR-MORE (OUT OF 5) CORRECT PULSE PAIRS RECEIVED IN SEARCH MODE.	SLANT RANGE	SLANT RANGE
SCAN	MULTIPLE STATION TUNING FIVE STATIONS OR LESS SPECIFIED IN FOREGRUND LOOP UP TO 15 MAY BE SCANNED IN BACKGROUND LOOP.	SELECTED STATION SLANT RANGE	SELECTED STATION SLANT RANGE
MEMORY	LOSS OF RETURN PULSES FOR 2 SECONDS COMPUTES RANGE (EXTRAPOLATED FROM PREVIOUS DISTANCE)	SLANT RANGE	SLANT RANGE
FAULT	INTERROGATOR MALFUNCTION (DURING CONTINOUS MONITORING OPERATION)	BLANK DISPLAY	BLANK DISPLAY
SELF-TEST [1] [2]	PUSH AND HOLD THE TEST SWITCH, WAIT FOR THE INTERROGATOR TO CYCLE THROUGH THE SELF-TEST. INTERROGATOR FRONT PANEL LIGHTS WILL COME ON.	SEQUENCES THRU: 1. BLANK DISPLAY 2. DASHES 3. 0.0 NM	SEQUENCES THRU: 1. BLANK DISPLAY 2. DASHES 3. 0.0 NM

[1] AIRPLANES WITH COLLINS DME-700 SERIES INTERROGATORS

[2] AIRPLANES WITH ALLIEDSIGNAL DMA-37A SERIES INTERROGATORS

DME Modes of Operation
Figure 3

b) the tuning word sign/status matrix indicates an invalid condition, or

c) the word parity is incorrect.

6) In FREE SCAN mode, the DME provides distance information for all stations that are in the DME range. The DME can independently scan all available channels and form a foreground and a background loop. The foreground loop is defined as a set of up to five of the closest stations. If the FMC selects fewer than five, the DME will fill in the remainder if told to do so. Foreground stations are given priority service at frequent intervals. The background loop consists of all of the remaining available stations. The DME delivers an output from up to fifteen of these background stations in addition to the five stations in the foreground loop. The background stations are scanned as time permits between foreground station outputs. One of the foreground stations is selected through the FMCs for flight deck display. The identification of the selected station is available on the PROGRESS page of the FMC control display unit (CDU).

7) The system operates in the MEMORY mode when station reply pulses are lost. The airplane range is then extrapolated from the most recent range data stored in memory. This occurs for approximately 10 seconds or until sufficient signal strength is regained.

8) The DME enters the FAULT mode whenever it detects a fault. DME monitoring circuits continuously check the system and alert the flight crew if a fault has been detected.

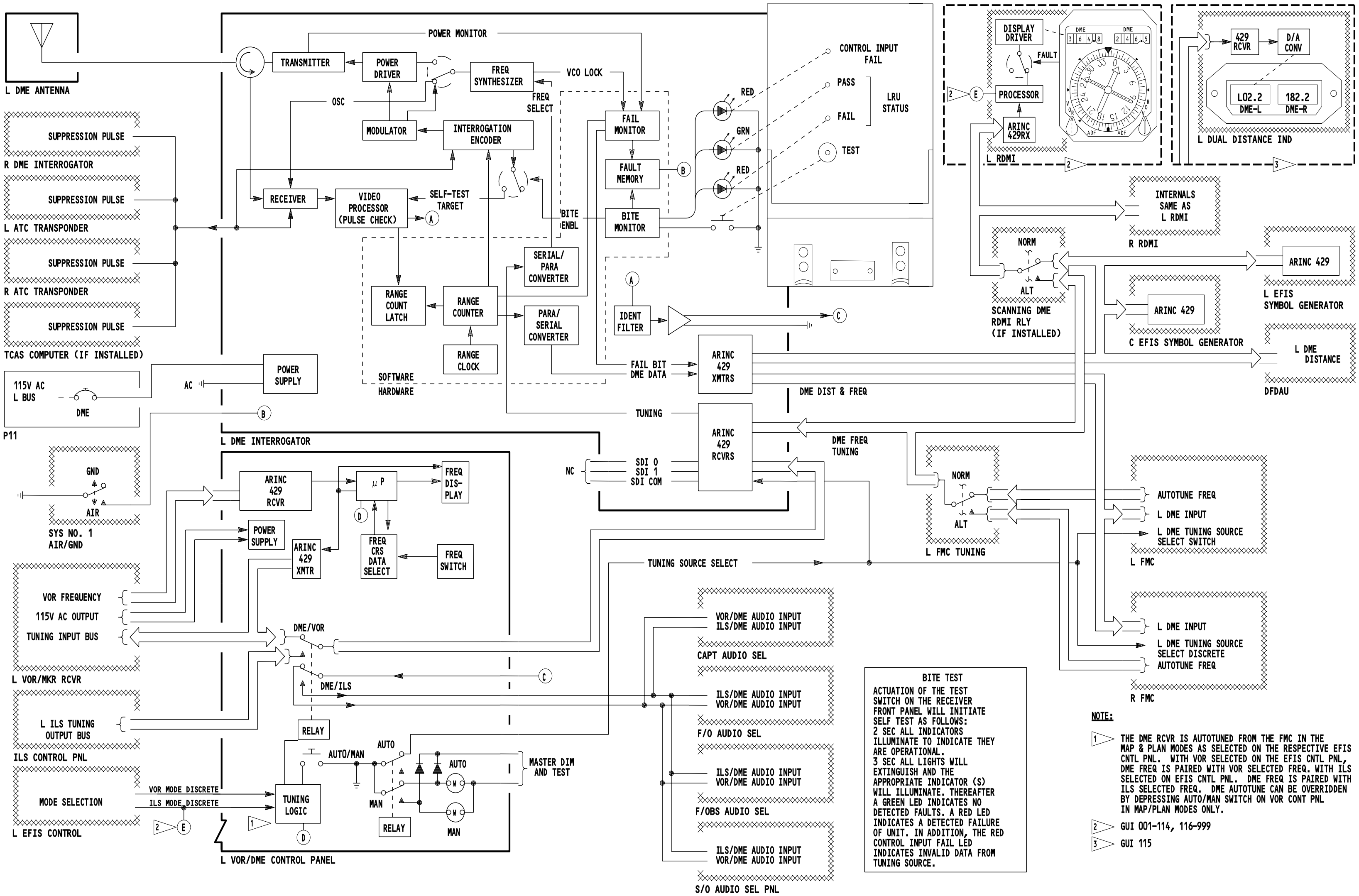
9) The SELF-TEST mode is initiated by pressing the test switch on the interrogator front panel. Indicators on the interrogator front panel show pass/fail and input status of the LRU.

(2) System Operation (Fig. 4)

(a) The left DME system is shown on the schematic. The right DME system is similar. The DME system receives 115 vac, 400 Hz power through the overhead circuit breaker panel, P11. A power supply circuit in the interrogator develops regulated DC voltages. Power for the VOR control panel comes from the VOR receiver.

(b) The EFIS control panel selects DME modes of operation by sending open/ground logic discretes to the VOR control panel. The tuning logic circuit trips the ILS and manual relays to the appropriate tuning mode.

(c) In the VOR mode, the ILS relay and the manual relay are in the VOR and MAN positions, respectively. DME channels are automatically paired with the selected VOR frequency. The VOR frequency is encoded and sent to the DME interrogator on an ARINC 429 data bus. VOR/DME audio is routed from the interrogator to the audio select panels by the ILS relay.



BITE TEST
ACTUATION OF THE TEST SWITCH ON THE RECEIVER FRONT PANEL WILL INITIATE SELF TEST AS FOLLOWS:
2 SEC ALL INDICATORS ILLUMINATE TO INDICATE THEY ARE OPERATIONAL.
3 SEC ALL LIGHTS WILL EXTINGUISH AND THE APPROPRIATE INDICATOR (S) WILL ILLUMINATE. THEREAFTER A GREEN LED INDICATES NO DETECTED FAULTS. A RED LED INDICATES A DETECTED FAILURE OF UNIT. IN ADDITION, THE RED CONTROL INPUT FAIL LED INDICATES INVALID DATA FROM TUNING SOURCE.

NOTE:

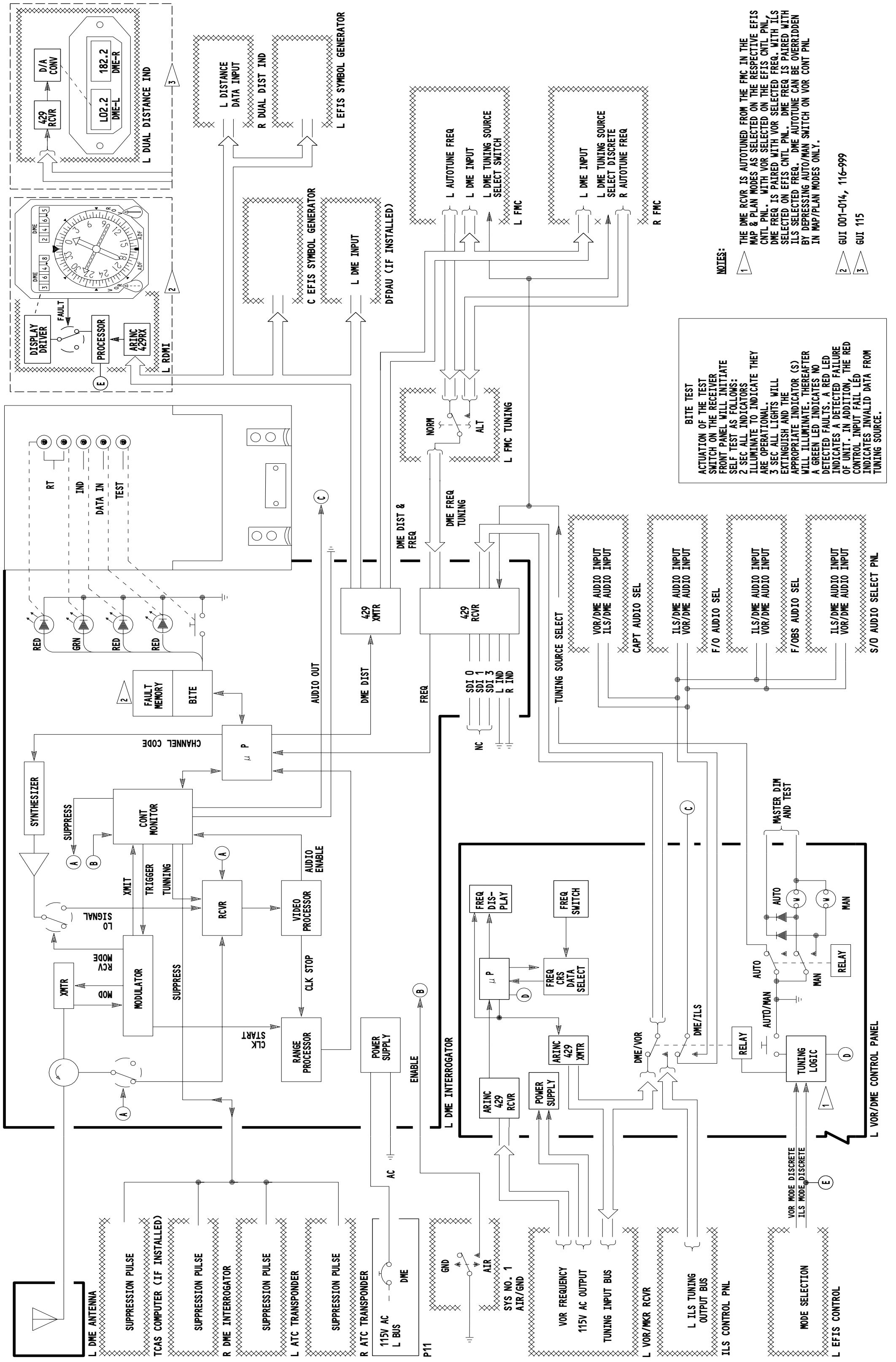
1 THE DME RCVR IS AUTOTUNED FROM THE FMC IN THE MAP & PLAN MODES AS SELECTED ON THE RESPECTIVE EFIS CNTL PNL. WITH VOR SELECTED ON THE EFIS CNTL PNL, DME FREQ IS PAIRED WITH VOR SELECTED FREQ. WITH ILS SELECTED ON EFIS CNTL PNL. DME FREQ IS PAIRED WITH ILS SELECTED FREQ. DME AUTOTUNE CAN BE OVERRIDDEN BY DEPRESSING AUTO/MAN SWITCH ON VOR CONT PNL IN MAP/PLAN MODES ONLY.

2 GUI 001-114, 116-999

3 GUI 115

DME System Schematic (Example)
Figure 4 (Sheet 1)

H73185



NOTES:

1. THE DME RCVR IS AUTOTUNED FROM THE FMC IN THE MAP & PLAN MODES AS SELECTED ON THE RESPECTIVE EFIS CNTL PNL. WITH VOR SELECTED ON THE EFIS CNTL PNL, DME FREQ IS PAIRED WITH VOR SELECTED FREQ. WITH ILS SELECTED ON EFIS CNTL PNL. DME FREQ IS PAIRED WITH ILS SELECTED FREQ. DME AUTOTUNE CAN BE OVERRIDDEN BY DEPRESSING AUTO/MAN SWITCH ON VOR CONT PNL IN MAP/PLAN MODES ONLY.
2. GUI 001-014, 116-999
3. GUI 115

BITE TEST

ACTUATION OF THE TEST SWITCH ON THE RECEIVER FRONT PANEL WILL INITIATE SELF TEST AS FOLLOWS:
2 SEC ALL INDICATORS ILLUMINATE TO INDICATE THEY ARE OPERATIONAL.
3 SEC ALL LIGHTS WILL EXTINGUISH AND THE APPROPRIATE INDICATOR (S) WILL ILLUMINATE. THEREAFTER A GREEN LED INDICATES NO DETECTED FAULTS. A RED LED INDICATES A DETECTED FAILURE OF UNIT. IN ADDITION, THE RED CONTROL INPUT FAIL LED INDICATES INVALID DATA FROM TUNING SOURCE.

DME System Schematic (Example)
Figure 4 (Sheet 2)

(d) In the ILS (APP) mode, the ILS relay and the manual relay are in the ILS and MAN positions, respectively. The ILS control panel selects the DME frequency in the same manner as the VOR control panel. ILS/DME audio is fed to the audio select panels.

(e) AIRPLANES WITH ILS-700 OR ILS-900 SERIES RECEIVERS;
When the ILS receiver is on the parked position, there will be no Morse code station ident output is fed to the audio select panels.

(f) AIRPLANES WITH RIA-35A OR RIA-35B SERIES RECEIVERS;
When the Bendix receiver P/N 2041230-3514 thru -3517 is tuned to 108.XX (odd tenths) or 111.XX (odd tenths) and the park position is selected on the ILS control panel, the receiver will continue to monitor the previously tuned frequency. Therefore, the audio ident for that frequency may be heard.

<u>NOTE</u>: The control panel park selection is positioned below 108.XX and above 111.XX (one detent from 108.XX ccww, and one detent from 111.XX cw). If the receiver was previously tuned to 108.xx or 111.xx and then park is selected, te receiver will remain tuned to that frequency and the audio may be heared on the audio control panel. However, if the receiver was previously tuned to 109.XX or 110.XX and then park is selected, the audio may not be hearf on the audio control panel.

(g) The EFIS symbol generator monitors the DME to verify that the tuned DME frequency corresponds with the ILS or VOR station selected. If the tuned DME frequency does not correspond with the selected ILS (APP) or VOR station, the DME display will blank on both the RDMI (or DDIs) and EHSI.

(h) In the EFIS MAP or PLAN mode, the manual relay switches to AUTO, sending a discrete to the DME. This activates the DME autotune frequency input port, allowing automatic selection of DME stations. If the AUTO/MAN manual override switch has been pressed on the VOR control panel, the DME frequency will be paired with the VOR frequency from the VOR control panel. If power to the VOR control panel is lost, the DME switches to FMC autotuning.

(i) Coaxial suppression lines interconnect the ATC TCAS (if installed) and DME L-band systems on the airplane. A suppression pulse is transmitted by a system whenever it is transmitting. The pulse goes to the other three systems, keeping then from transmitting. This prevents interference between L-band systems. When the DME receives a suppression pulse, it detunes its front end. This is done to protect the receiver section from close range, high power transient signals from the other L-band systems.

(j) The ARINC 429 bus interface contains two ports for frequency and mode control. A source select discrete from the VOR control panel determines which input port is to be used. Frequency tuning commands are received over the ARINC 429 data bus and stored in the range processor. The range, BITE, and counter processor blocks, hereafter called the CPU, is the central processing unit of the DME interrogator. It controls DME operations by means of a stored program.

(k) The CPU initiates ground station interrogations. It also computes range from the ground station reply pulse pairs after they are received and decoded by the video processor. The CPU also controls the pulse pair decoding, IF AGC, and ARINC 429 interface functions of the video processor. It also provides the monitor and self-test functions.

(l) The CPU sends tuning commands to the receiver and to the frequency synthesizer. The synthesizer generates an IF signal at the desired transmit frequency in the 1025-1150 MHz band. The synthesizer uses a crystal oscillator as a frequency source. It uses a phase locked loop to select frequency. The L-band output of the synthesizer is sent to both the receiver and to the power driver as a local oscillator signal.

(m) The power driver amplifies and modulates the L-band signal to generate a square waveform output signal. The waveform of the output signal is controlled by the modulator. Modulation is controlled by a square trigger pulse applied to the modulator from the range count network in the CPU. This produces an RF pulse pair output from the power driver with a 316-watt (min) level.

(n) The rf pulse pair output is connected to the antenna through a circulator. It is then transmitted as an interrogation to the ground station. The multiport circulator provides VSWR protection for the transmitter.

(o) The circulator directs received rf signals from the antenna to the input of the receiver. The receiver is tunable over the frequency range of 962 to 1213 MHz. Tuning is controlled by the VCO signal from the synthesizer. The receiver uses the local oscillator signal from the synthesizer to produce video pulse IF output signals. The IF output signals are routed to the video processor.

(p) The video processor decodes the IF video pulses and sends the data to the CPU when a valid pulse pair is received. It also sends the IF video signals to the IDENT filter. The filter detects the 1350 Hz tone and sends it to the audio select panels by way of the VOR control panel.

(q) The received video data pulse pairs are applied to the range counter network in the CPU. This network latches and deposits the range count of the first pulse into the CPU memory. The range count of each additional received pulse pair is sequentially deposited into the memory until the end of the interrogation cycle. The memory now contains the distance (or time) of all random (squitter) and reply pulse pairs received during the interrogation cycle.

(r) The CPU then initiates a second interrogation, and the range counts of all decoded receiver pulse are again entered into memory. This process continues for as many interrogations as required. The CPU compares the range count of successive interrogations to locate the reply pulses that occur at the same distance. It then computes range from the selected reply and formats the distance for output over the ARINC 429 data bus. Separate outputs are used for the FMCs and the flight instruments.

(s) Suppression pulses are sent to the DME by other onboard L-band systems which are about to transmit a high energy signal. The interrogator protects the front end of the receiver by switching in an attenuator when this signal is received. The interrogator also sends out a suppression pulse.

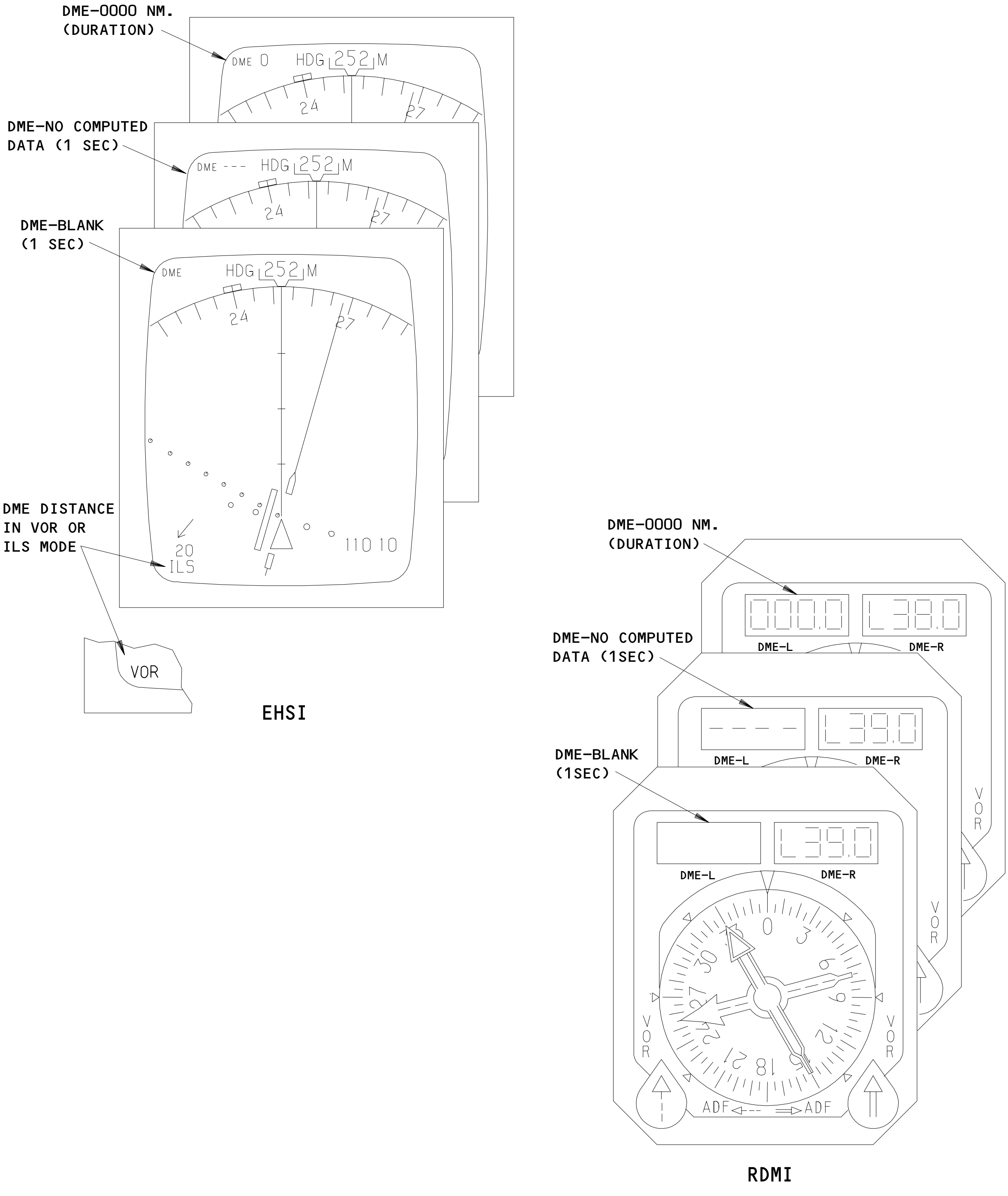
C. BITE (Fig. 5)

(1) The DME contains self-test and monitoring features that check for proper operation of the unit. During in-flight modes, the BITE network continuously checks functions that affect the accuracy of the DME. It checks synthesizer lock, range clock accuracy, CPU program execution, and ARINC 429 tuning data. Also, during each interrogation cycle, a test target signal is injected into the receive circuits. The self-test distance computation is then checked for accuracy.

(2) Detected faults are output to the FMCs and flight instruments on the ARINC 429 data bus. On the EHSIs and RDMIs (or DDIs) for a DME invalid data fault, the distance numerics are removed, and for a no computed data fault, the numerics are replaced with dashes.

(3) The DME display will also go blank if the tuned DME frequency does not correspond with the ILS or VOR station selected.

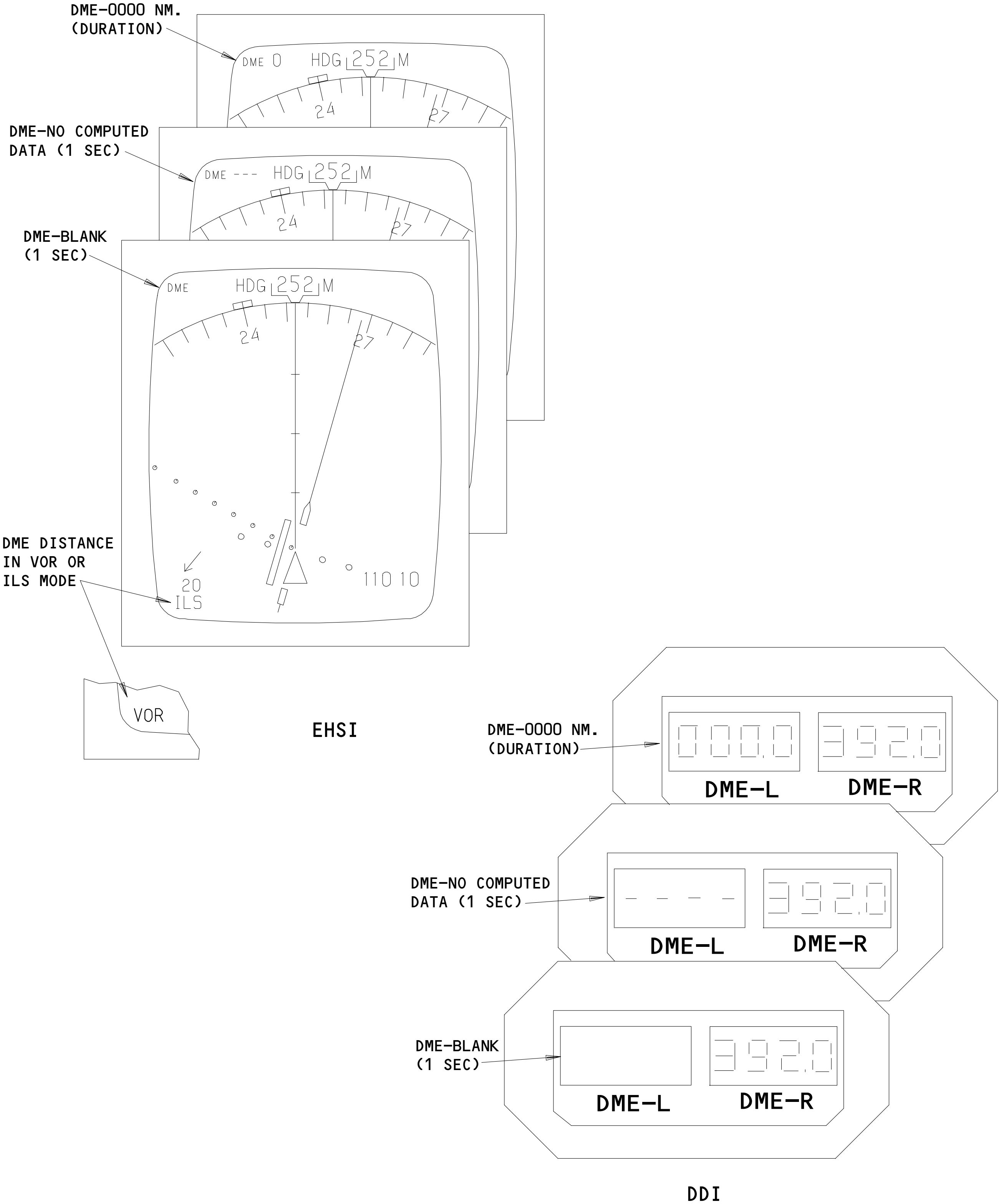
(4) Other functions are checked at intermittent times. These include receiver sensitivity, transmitter power level, data bus operation, AGC tracking and lock on and track of the self- test distance signal. Checks are run on these functions at power turn-on and when a mode change command is made from the data bus. They are also run when the DME fails to lock on a signal and when the manual self-test button is pressed.



EHSI

RDMI

DME Displays - Test Sequence
Figure 5 (Sheet 1)



DME Displays - Test Sequence
Figure 5 (Sheet 2)

(5) AIRPLANES WITH DME-700 SERIES INTERROGATORS;
All faults detected during the intermittent and continous monitoring self-tests are stored in a nonvolatile fault memory. The faults are stored by flight segments for subsequent evaluation in the shop. Each flight segment starts when the airplane takes off as detected by the air to ground relay. The BITE memory can store 10 failures per each flight segment and can store failures for 50 flight segments. The test data history is available on the ATE connector for shop personnel.

(6) AIRPLANES WITH DME-700 SERIES INTERROGATORS;
The interrogator front panel LEDs work only in conjunction with the manual self-test switch. Pushing the test switch initiates a BITE test of the interrogator. When the test switch is pressed and held the following sequence takes place:
- (a) All three LEDs come on for one to three seconds to indicate they are operational.
- (b) All three LEDs go off for one to three seconds and then come on to indicate system status as follows:
  - 1) Green LRU STATUS-PASS light on indicates a good LRU.
  - 2) Red LRU STATUS-FAIL light on indicates a bad LRU.
  - 3) Red CONTROL INPUT FAIL light comes on to indicate invalid or missing ARINC 429 data from the VOR or ILS control panel.

(7) AIRPLANES WITH DMA-37A SERIES INTERROGATORS;
All faults detected during the intermittent and continuous monitoring self-tests are stored in a non-volatile fault memory. The faults are stored by flight segments for subsequent evaluation in the shop. Each flight segment starts when the airplanes takes off as detected by the air to ground relay. The fault memory can store faults for up to 63 flights. The maximum number of faults that can be stored for any flight segment is 13. If a fault exists continuously it is stored only once. If it exists intermittently and remains for one second or more, it is stored each time it occurs. The test data history is available on the ATE connector for shop personnel.

(8) AIRPLANES WITH DMA-37A SERIES INTERROGATORS;
The interrogator front panel LEDs work only in conjunction with the manual self-test switch. Pushing the test switch initiates a BITE test of the interrogator. When the test switch is pressed for at least 6 seconds, the lights come on to indicate that they are operative. The lights then go off for 2 seconds. The lights then stay off or come on to indicate status as follows:
- (a) The green R/T light on indicates a good LRU
- (b) The red R/T light on indicates a failed LRU caused by either a present fault or if two or more identical faults from at least two of the last four flight segments are stored in the flight fault memory.
- (c) The red DATA IN light on indicates invalid or loss of data from the selected tuning source.

(d) The red IND light is not used and should not come on at the end of the test. A pin is grounded in the rear of the unit to prevent this light from displaying invalid faults.

(e) The red IND light on indicates the DDI has a self-detected fault and has sent a fault discrete to the interrogator.

D. Control

(1) Provide electrical power (24-22-00).

(2) Close DME and EFIS circuit breakers on the P11 panel.

(3) DME frequency control is determined by the position of the EFIS control panel mode switch.

(4) The following provides description of DME frequency control for EFIS control panel mode switch positions:

(a) VOR position - Tune DME with the VOR control panel.

(b) ILS (APP) position - Tune DME with ILS control panel.

(c) MAP or Plan position - DME is tuned automatically by the FMC.

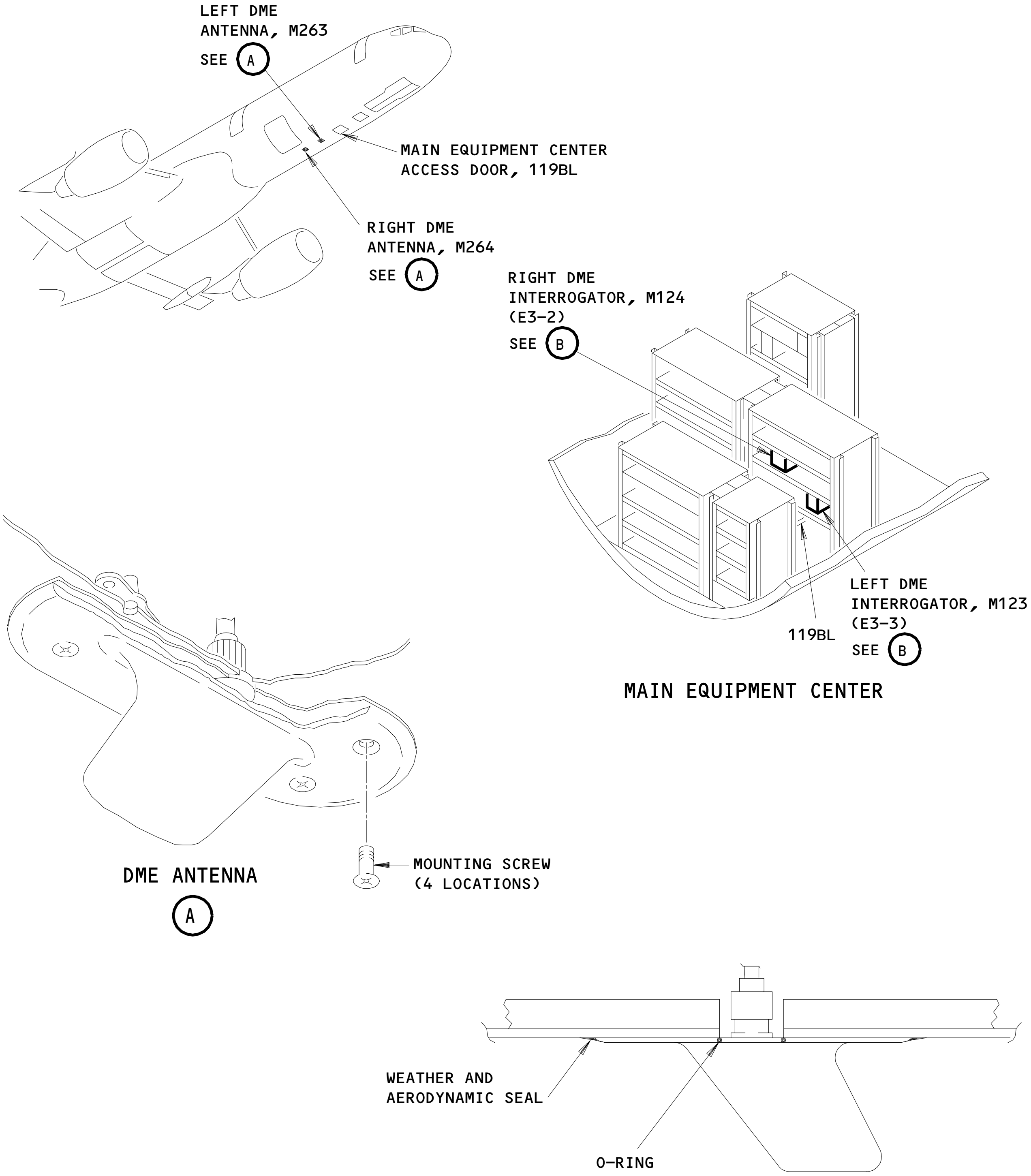
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA				
LEFT DME, M263	--	1	BOTTOM FUSELAGE	34-55-02
RIGHT DME, M264	--	1	BOTTOM FUSELAGE	34-55-02
CIRCUIT BREAKERS - NAVIGATION			FLT COMPT, P11	
LEFT DME, C582		1	11E11	*
RIGHT DME, C583		1	11E32	*
INDICATORS - (FIM 34-22-00/101) [1]				
LEFT RADIO DISTANCE MAGNETIC, N3	--	1		
RIGHT RADIO DISTANCE MAGNETIC, N43	--	1		
INDICATOR				
LEFT DUAL DISTANCE, N10030 [2]	--	1	FLT COMPT, P1-1	34-55-03
RIGHT DUAL DISTANCE, N10031 [2]	--	1	FLT COMPT, P3-1	34-55-03
INTERROGATOR				
LEFT DME, M123	--	1	119BL, MAIN EQUIP CTR, E3-3	34-55-01
RIGHT DME, M124	--	1	119BL, MAIN EQUIP CTR, E3-2	34-55-01
PANELS - (FIM 34-22-00/101)				
LEFT EFIS CONTROL, M94				
RIGHT EFIS CONTROL, M93				
PANELS - (FIM 34-51-00/101)				
LEFT VOR CONTROL, M91				
RIGHT VOR CONTROL, M92				
RELAY - (FIM 31-01-36/101)				
SYSTEM NO. 1 AIR/GROUND, K167				
RELAY - (FIM 31-01-37/101)				
SYSTEM NO. 2 AIR/GROUND, K214				

* SEE THE WDM EQUIPMENT LIST

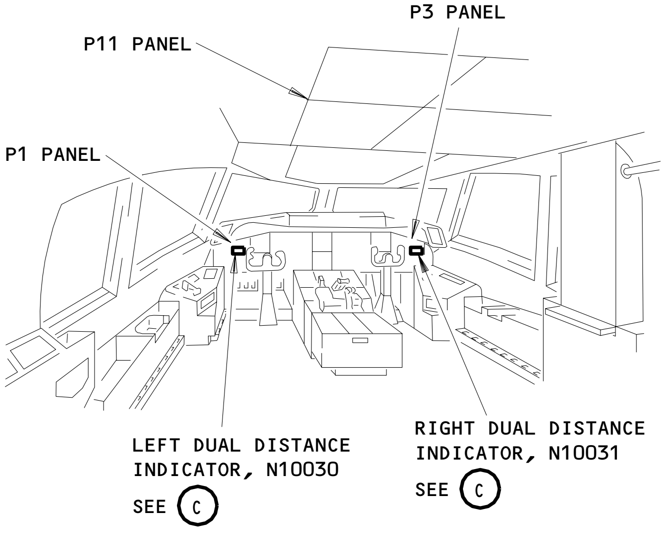
[1] GUI 001-114,116-999

[2] GUI 115

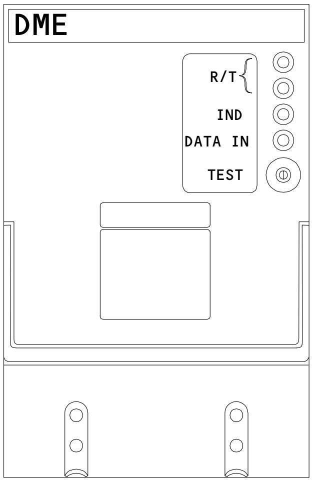
DME System - Component Index
Figure 101



DME System - Component Location
Figure 102 (Sheet 1)

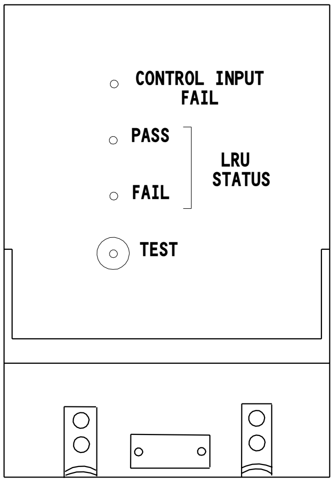


FLIGHT COMPARTMENT



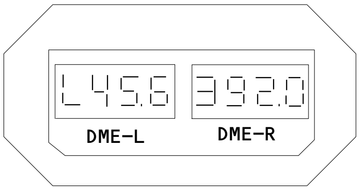
LEFT OR RIGHT DME
INTERROGATOR, M123 OR M124

B 2



LEFT OR RIGHT DME
INTERROGATOR, M123 OR M124

B 1



LEFT OR RIGHT DUAL DISTANCE
INDICATOR, N10030 OR N10031

C

1 AIRPLANES WITH COLLINS DME-700 SERIES INTERROGATORS

2 AIRPLANES WITH ALLIED SIGNAL DMA-37A SERIES INTERROGATORS

DME System - Component Location
Figure 102 (Sheet 2)

DME SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure has two tasks for the Distance Measuring Equipment (DME) system:
      (1) An operational test
      (2) A system test.
   B. The operational test is a fast check of the DME system by the system BITE. The system test makes sure all functions of the DME operate correctly. The system test also does a test of the DME identification reception. An external DME test set is used in the system test.

TASK 34-55-00-715-110

2. DME System - Operational Test
   A. General
      (1) The operational test has these tasks:
         (a) The prepare for a DME operational test
         (b) The test of the VOR control panel indicator
         (c) The DME system self test.
   B. References
      (1) AMM 21-58-00/501, Equipment Cooling System
      (2) AMM 23-41-00/501, Service Interphone System
      (3) AMM 23-51-00/501, Flight Interphone System
      (4) AMM 24-22-00/201, Electrical Power Control
      (5) AMM 34-21-00/501, Inertial Reference System
      (6) AMM 34-31-00/501, Instrument Landing System
      (7) AMM 34-51-00/501, VHF Omnidirection Range (VOR) System
   C. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   D. Procedure

S 865-111

      (1) Prepare for the DME operational test:
         (a) Supply electrical power (AMM 24-22-00/201).

CAUTION: MAKE SURE THE EQUIPMENT COOLING SYSTEM OPERATES BEFORE THE ELECTRONIC SYSTEMS ARE OPERATED. THE EQUIPMENT COOLING SYSTEM MUST BE SET FOR CORRECT COOLING. IF THESE CAUTIONS ARE NOT OBEYED, DAMAGE TO THE ELETRONIC SYSTEMS CAN OCCUR.

(b) Supply equipment cooling (AMM 21-58-00/501).
(c) Make sure that the Service Interphone System is serviceable (AMM 23-41-00/501).
(d) Make sure the Flight Interphone System is serviceable (AMM 23-51-00/501).
(e) Align the Inertial Reference System in the nav mode (AMM 34-21-00/501).
(f) Make sure the Instrument Landing System is serviceable (AMM 34-31-00/501).
(g) Make sure the VOR System is serviceable (AMM 34-51-00/501).
(h) Make sure these circuit breakers on the overhead circuit breaker panel P11 are closed:
    1) 11E11, DME LEFT
    2) 11E32, DME RIGHT
(i) Set the mode select switch on the left (right) EFIS control panel to the VOR or VOR FULL, or VOR CTR position.

S 715-112
(2) Do a test of the VOR control panel indicators:
(a) Push the TEST switch on the overhead lights control panel, P5.
    1) Make sure the AUTO and MAN indicators on the L and R VOR controls panel come on.
(b) Push the TEST switch again on the overhead lights panel to remove electrical power from the test circuits.
    1) Make sure the AUTO indicator on the L and R VOR control panels go off.

S 715-113
(3) Do the left (right) DME system self test:

NOTE: During the DME left self-test the DME-L indicator on the left and right RDMI's show the test results. During the DME right self-test the DME-R indicator on the left and right RDMI's show the test results.

<u>NOTE</u>: During the DME left self-test the DME-L indicator on the left and right RDMI or DDI's show the test results. During the DME right self-test the DME-R indicator on the left and right RDMI or DDI's show the test results.

(a) AIRPLANES WITH DME-700 SEREIS INTERROGATORS;
Push and hold the TEST switch on the left (right) interrogator and Make sure this sequence occurs:
1) All three LEDs come on for one to four seconds to indicate they are serviceable.
2) All three LEDs go off for one to four seconds, and then come on to indicate system status as follows:
    a) Green LRU STATUS-PASS LED shows interrogator passed the BITE self-test.
    b) Red LRU STATUS-FAIL LED shows interrogator failed the BITE self-test.
    c) Red CONTROL INPUT FAIL LED shows invalid or no ARINC 429 data to the interrogator.
3) Release the TEST switch on the left (right) interrogator.

(b) AIRPLANES WITH DMA-37A SERIES INTERROGATORS;
Push and hold the TEST switch on the left (right) interrogator and Make sure this sequence occurs:
1) All four LEDs come on for one to three second to indicate they are serviceable.
2) All four LEDs go off for one to three second, and then come on to shows the system status as follows:
    a) Green R/T LED shows that the interrogator has passed the BITE self-test.
    b) Red R/T LED shows that the interrogator has failed the BITE self-test.
    c) Red DATA IN LED shows that there is invalid or no ARINC 429 data to the interrogator.
    d) Red IND indicator is not used.
3) Release the TEST switch on the left (right) interrogator.
4) Make sure all LEDs go off.

(c) AIRPLANES WITH DME-700 OR DMA-37A SERIES INTERROGATORS; Push and hold the TEST switch on the left interrogator and Make sure this sequence occurs:

(d) Make sure the DME-L indicator on the left and right RDMI or DDIs show this sequence:
  1) No data for the first second.
  2) All dashes for two seconds.
  3) 000.0 ±0.5 NM for the remaining time of the test.

NOTE: In the test, the DME may momentarily show the distance to the tuned station and not the displayed sequence which is the usual condition.

(e) Release the TEST switch on the left interrogator.

(f) AIRPLANES WITH DME-700 AND DMA-37A SERIES INTERROGATORS; Push and hold the TEST switch on the right interrogator and make sure this sequence occurs:

(g) Make sure the DME-R indicator on the left and right RDMI or DDIs show this sequence:
  1) No data for the first second.
  2) All dashes for two seconds.
  3) 000.0 ±0.5 NM for the remaining time of the test.

NOTE: In the test, the DME may momentarily show the distance to the tuned station and not the displayed sequence which is the usual condition.

(h) Release the TEST switch on the right interrogator.

(i) If no more tests of the DME system are necessary, do the DME System Shutdown (AMM 34-55-00/501).

TASK 34-55-00-735-024

3. System Test - DME System

A. General

(1) The system test does a full test of the DME system which includes range calculations in the interrogator and distance displayed on the DME distance indicators. In addition, the system test includes a DME audio tone and an auto-tune mode test.

(2) The DME system test has these tasks:
  (a) The Prepare for the System Test
  (b) The VOR/DME Mode and Audio Test
  (c) The ILS/DME Mode and Audio Test
  (d) The Auto-Tune Mode Test

B. Equipment

(1) Use one of the two ramp test sets listed below.
  (a) Transponder/DME Ramp Test Set - Tel Instrument Electronics Corp. (TIC) Model T24B

(b) Transponder/DME Ramp Test Set - Tel Instrument Electronics Corp.(TIC) Model T48D

(c) Transponder/DME Ramp Test Set - IFR Systems, Inc.(IF) Model ATC-600A . Test Set Commercially available (Alternative)

(d) Transponder/DME Ramp Test Set - IFR Systems, Inc. Model ATC-600A-1 Test Set Commercially available. (Alternative)

(e) Transponder/DME Ramp Test Set - IFR Systems, Inc. Model ATC-600A-2 (Recommended)

C. References
(1) AMM 23-41-00/501, Service Interphone System
(2) AMM 23-51-00/501, Flight Interphone System
(3) 24-22-00/201, Electrical Power - Control
(4) AMM 24-22-00/201, Electrical Power Control
(5) AMM 34-21-00/501, Inertial Reference System
(6) AMM 34-31-00/501, Instrument Landing System
(7) AMM 34-51-00/501, VHF Omnidirection Range (VOR) System
(8) AMM 34-61-00/501, Flight Management Computer System

D. Access
(1) Location Zones

119/120	Main Equipment Center (Exterior)
211/212	Flight Compartment

E. Prepare for the Test

S 865-129
(1) Supply electrical power (AMM 24-22-00/201).

S 865-122
(2) Make sure that the Service Interphone System is serviceable (AMM 23-41-00/501).

S 865-123
(3) Make sure the Flight Instrument System is serviceable (AMM 23-51-00/501).

S 865-124
(4) Make sure the Inertial Reference System is aligned in the nav mode (AMM 34-21-00/501).

S 865-125
(5) Make sure the Instrument Landing System is serviceable (AMM 34-31-00/501).

S 865-126
(6) Make sure the VOR System is serviceable (AMM 34-51-00/501).

S 865-127

(7) Make sure the Flight Management Computer System is serviceable (AMM 34-61-00/501).

S 865-128

(8) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:
   - (a) 11E11, DME LEFT
   - (b) 11E32, DME RIGHT

S 715-133

(9) Do the DME operational test (AMM 34-55-00/501).

S 865-134

(10) Connect the test set antenna to the antenna (ANTENNA) connector on the test set.

S 865-135

CAUTION: NEVER PLACE REMOTE TEST SET ANTENNA CLOSER THAN 15 INCHES TO AIRPLANE ANTENNA WITH TEST SET ON. DAMAGE TO TEST SET WILL RESULT.

(11) Put the test set antenna between and at the same level of the airplane left and right DME antennas.

S 865-138

(12) Set the bearing source select switches on the RDMIs (if installed) to the VOR position.

S 865-140

(13) Set the mode select switch on the left (right) EFIS control panel to the VOR, VOR FULL, or VOR-CTR position.

S 865-141

(14) Set the other VOR control (unit not under test) to a frequency different than the test frequency.

S 865-142

(15) Set these controls and switches on the TIC Model T24B test set:
   - (a) Frequency channel - approved VOR or ILS-paired test frequency
   - (b) Squitter - ON (NOTE: average of 2700 PPS)
   - (c) IDENT switch - OFF
   - (d) DIST/VEL- DIST
   - (e) DISTANCE N.M. - 150.0 nautical miles (NM)
   - (f) EFF - 70 percent.

S 865-143

(16) Set these controls and switches on the TIC Model T48D test set:
   - (a) DME MODE - 108.00 (978)

(b) IDENT switch - off
(c) RANGE/VELOCITY - 130.

S 865-144

(17) Set these controls and switches on the IFR Model ATC 600A Test Set:
(a) PWR switch - AC or BAT
(b) Mode switch - DME
(c) VELOCITY Select switch - RANGE
(d) Velocity HI/LO switch - HI
(e) Squitter SQTR/OFF switch OFF
(f) X/Y switch - Y
(g) SLEW switches - 150 NM range

F. VOR/DME Mode and Audio Test

S 735-145

(1) Do the left (right) VOR/DME mode test:
(a) Set an approved test frequency on the left (right) VOR control panel.
1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show all dashes.
(b) TIC MODEL T24B DME TEST SET;
Set the POWER switch to the ON position.
1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show 150.0 ±1.0 NM.
(c) TIC MODEL T48D DME TEST SET;
Set the DC power switch to the ON position.
1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show 130.0 ±1.0 NM.
(d) IFR MODEL ATC-600A DME TEST SET;
Do these steps:
1) Set the X/Y switch to the 17X (108.00 MHz) position.
2) Set the SQTR/OFF switch to SQTR.
3) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show 150.0 ±1.0 NM.
(e) Change the range to 90.0 NM on the DME test set.
1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show 90.0 ±0.5 NM.

S 735-146

(2) Do the left (right) VOR/DME audio test at each of the audio select panels:
(a) Make sure the mode select switch on the left (right) EFIS control panel is set to the VOR, VOR FULL OR VOR-CTR position.
(b) Set the controls on the left, right or first observers audio select panel as follows:
1) Set the VOR switch to the on position.
2) Adjust the VOR volume if it is necessary.
(c) TIC MODEL T24B DME TEST SET;
Set the IDENT switch on the DME test set to the ON position.
(d) TIC MODEL T48D DME TEST SET;
Hold the IDENT switch on the DME test set to the on position.

(e) IFR MODEL ATC 600A DME TEST SET;
Hold the IDENT/50% RPLY switch to the IDENT position.

1) Make sure an audio tone is heard.

(f) Set the VOR switch on the audio select panel to the off position.
1) Make sure there is no audio tone.

(g) TIC MODEL T24B DME TEST SET;
Set the IDENT switch to the OFF position.

(h) TIC MODEL T48D DME TEST SET;
Release the IDENT switch to the off position.

(i) IFR MODEL ATC-600A DME TEST SET;
Release the IDENT/50% RPLY switch.

(j) If no more tests of the DME system are necessary, do the DME System Shutdown.

G. ILS (APP)/DME Mode and Audio Test

S 735-147

(1) Do the left (right) ILS (APP)/DME mode test:

(a) TIC MODEL T24B DME TEST SET;
Do these steps:
1) Set the POWER switch to the ON position.
2) Set the 108.10 MHz FREQ switch to the on position.

(b) TIC MODEL T48D DME TEST SET;
Set the DC power switch to the ON position.

(c) IFR MODEL ATC-600A DME TEST SET;
Do these steps:
1) Set the X/Y switch to the 17Y (108.05 MHz) position.
2) Set the SQTR/OFF switch to SQTR.

(d) Make sure the RANGE OR DISTANCE switch on the DME test set is set to the 90 mile position.

(e) Set the mode select switch on the left (right) EFIS control panel to the ILS (APP) or ILS FULL, or ILS-CTR position.
1) Make sure the MAN indicator on the VOR control panel stays on.

(f) TIC MODEL T24B DME TEST SET;
Set the 108.10 MHz FREQ switch to the on position.

(g) TIC MODEL T48D DME TEST SET;
Set the DME MODE switch to the 108.10 position.

(h) IFR MODEL ATC-600A DME TEST SET;
Set the X/Y switch to the 18X (108.10 MHz) position.

(i) Set the same frequency on the ILS control panel as shown on the DME test set.
1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show L 90 ±0.5 NM.

(j) Set the frequency on the ILS control panel to a frequency other than the test frequency.
  1) Make sure the left (right) distance indicators change to all dashes.

(k) Set the frequency on the ILS control panel back to the test frequency.
  1) Make sure the left (right) distance indicators again show L 90 ±0.5 NM.

S 735-148

(2) Do the left (right) ILS audio test:

(a) Set the mode select switch on the EFIS control panel to the ILS (APP) position.

(b) Set the controls on the left, rights or first observers audio select panel as follows:
  1) Set the ILS switch to the on position.
  2) Adjust the ILS volume as necessary.

(c) TIC MODEL T24B DME TEST SET;
Set the IDENT switch on the DME test set to the ON position.

(d) TIC MODEL T48D DME TEST SET;
Hold the IDENT switch on the DME test set to the on position.

(e) IFR Model ATC 600A DME TEST SET:
Hold the IDENT/50% RPLY switch to the IDENT position.

  1) Make sure an audio tone is heard.

(f) Set the ILS switch to the off position.
  1) Make sure there is no audio tone.

(g) Set the IDENT switch on the DME test set to the off position.

(h) If no more tests of the DME system are necessary, do the DME System Shutdown.

H. Auto-Tune Mode Test

S 735-149

(1) Do the left (right) auto tune mode test:

(a) Set the mode select switch on the left (right) EFIS control panel to the VOR or VOR FULL, or VOR-CTR position.

(b) Make sure the L(R) VOR control panel frequency is set to 108.00 MHz.

(c) TIC MODEL T24B DME TEST SET;
Set the POWER switch to the ON position.

(d) TIC MODEL T48D DME TEST SET;
Set the DC power switch to the ON position.

(e) IFR MODEL ATC-600A DME TEST SET;
Do these steps:

1) Set the X/Y switch to the 17X (108.00) position.
2) Set the SQTR/OFF switch to SQTR.

(f) Make sure the RANGE OR DISTANCE switch on the DME test set is set to the 90 mile position.

(g) Set the mode select switch on the left (right) EFIS control panel to the MAP position.

1) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show all dashes.

<u>NOTE</u>: Step shows the DME system is tuned by the Flight Management Computer System.

2) Make sure the AUTO indicator on the left (right) VOR control panel comes on.

(h) Push the AUTO/MAN switch/light on the left (right) VOR control panel.

1) Make sure the MAN indicator on the left (right) VOR control panel comes on.
2) Make sure the DME-L (DME-R) indicator on the RDMIs or DDIs show 90.0 ±0.5 NM.

(i) If no more tests of the DME system are necessary, do the DME System Shutdown.

TASK 34-55-00-845-130

4. <u>DME System Shutdown</u>

A. General

(1) Do the DME system shutdown when the DME operational tests or system tests are done. Remove the DME test set, set the circuit breakers to the shutdown configuration and shutdown the interface systems.

B. References

(1) AMM 23-41-00/501, Service Interphone System
(2) AMM 23-51-00/501, Flight Interphone System
(3) AMM 24-22-00/201, Electrical Power Control
(4) AMM 34-21-00/501, Inertial Reference System

(5) AMM 34-31-00/501, Instrument Landing System
(6) AMM 34-51-00/501, VHF Omnidirection Range (VOR) System
(7) AMM 34-61-00/501, Flight Management Computer System

C. Access

(1) Location Zones

119/120	Main Equipment Center (Exterior)
211/212	Flight Compartment

D. Procedure

S 845-117

(1) Shut down the DME system as follows:
   (a) Remove power from the test set.
   (b) Disconnect the test set antenna from the test set connector.
   (c) Put the test set antenna into the test set case.
   (d) Make sure these circuit breakers are closed.
      1) P11 Overhead Circuit Breaker Panel
         a) 11E11, DME LEFT
         b) 11E32, DME RIGHT

S 865-118

(2) Shutdown these interface systems if they are no longer necessary:
   (a) Service Interphone System (AMM 23-41-00/501).
   (b) Flight Interphone System (AMM 23-51-00/501).
   (c) Inertial Reference System (AMM 34-21-00/501).
   (d) Instrument Landing System (AMM 34-31-00/501).
   (e) VHF Omnidirection Range (VOR) System (AMM 34-51-00/501).
   (f) Flight Management Computer System (AMM 34-61-00/501)

S 865-119

(3) Remove electrical power if it is not necessary (AMM 24-22-00/201).

DISTANCE MEASURING EQUIPMENT (DME) INTERROGATOR - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the DME interrogator; the other is the installation of the DME interrogator.
   B. The left, M123, and right, M124, DME interrogators are installed in the main equipment center on the E3-3 and E3-2 racks. Electrical connections are made at the rear of the DME interrogators.

TASK 34-55-01-024-001

2. Remove the DME Interrogator
   A. References
      (1) 20-10-01/401, E/E Rack Mounted Components
   B. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   C. Prepare for Removal

      S 864-002

      (1) Open this circuit breaker on the overhead panel P11, as applicable, and attach a DO-NOT-CLOSE tag:
         (a) 11E11, DME LEFT
         (b) 11E32, DME RIGHT
   D. Procedure

      S 024-003

      (1) Remove the DME interrogator (Ref 20-10-01).

TASK 34-55-01-424-004

3. Install the DME Interrogator
   A. References
      (1) 24-22-00/201, Electrical Power - Control
   B. Access
      (1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

   C. Prepare for the Installation

      S 864-005

      (1) Make sure this circuit breaker on the P11 panel, if it is applicable, is open:
         (a) 11E11, DME LEFT

(b) 11E32, DME RIGHT

D. Procedure

S 424-006

(1) Install the DME interrogator.

S 864-007

(2) Remove the DO-NOT-CLOSE tag and close this circuit breaker on the P11 panel, as applicable:
   (a) 11E11, DME LEFT
   (b) 11E32, DME RIGHT

E. DME Interrogator Test

S 864-008

(1) Supply electrical power (Ref 24-22-00).

S 714-015

(2) Do the Operational Test of the DME System (AMM 34-55-00/501).

F. Put the Airplane Back to Its Usual Condition

S 094-012

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

DISTANCE MEASURING EQUIPMENT (DME) ANTENNA - REMOVAL/INSTALLATION

1. General
   A. The left, M263, and right, M264, DME antenna installations are the same.
   B. This procedure has two tasks. One is the removal of the DME antenna; the other is the installation of the DME antenna.

TASK 34-55-02-024-001

2. Remove the DME Antenna (Fig. 401)
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
   B. Consumable Materials
      (1) B00184 Solvent - BMS 11-7
   C. References
      (1) AMM 20-10-22/701, Metal Surfaces
   D. Access
      (1) Location Zones
         119/120 Main Equipment Center (Exterior)

   E. Prepare for the Removal

      S 864-002

      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11E11, DME LEFT
         (b) 11E32, DME RIGHT
   F. Procedure

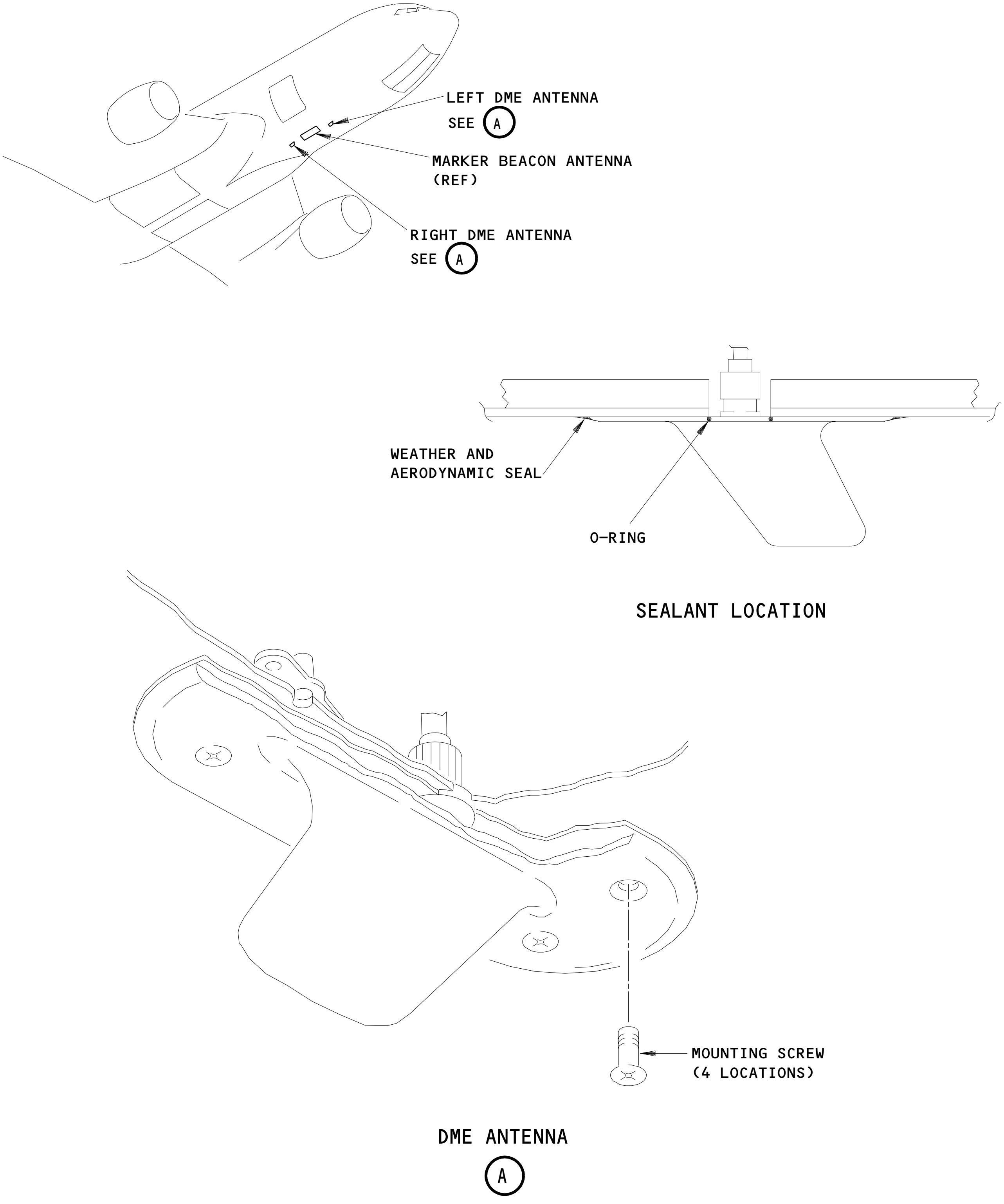
      S 034-003

      (1) Remove the screws from the antenna base.

      S 034-004

CAUTION: BE CAREFUL WHEN YOU USE FORCE WITH THE SEALANT REMOVAL TOOL TO BREAK THE ANTENNA SEAL. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE AIRPLANE SKIN OR THE ELECTRICAL CABLE AT THE ANTENNA BASE.

      (2) Use force around the antenna with the sealant removal tool until the seal is fully broken.



DME Antenna Installation
Figure 401

S 144-005

CAUTION: LOWER THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLE. DAMAGE TO THE ANTENNA CABLE CAN OCCUR IF YOU PULL THE CABLE.

(3) Lower the antenna until you can get access to the antenna cable connector.

S 034-006
(4) Disconnect the antenna cable.

S 024-008
(5) Remove the DME antenna.

S 144-007
(6) Remove the sealant from the airplane skin in the antenna area (AMM 20-10-22/701).

S 114-009
(7) Clean the airplane surface in the antenna area with the solvent, BMS 11-7, and a clean rag (AMM 20-10-22/701).

TASK 34-55-02-424-010
3. Install the DME Antenna (Fig. 401)
   A. Equipment
      (1) Resistance measuring bridge or ohmmeter that can measure .001 ohm
      (2) Transponder/DME-Ramp Test Set, IFR ATC600A
      (3) Torque wrench - commercially available (For torque ranges, Ref Fig. 401)
   B. Consumable Materials
      (1) A00144 Compound - Sealing - BMS 5-95, Class B 1/2
      (2) G00009 Coating - Conversion - Alodine 1200
      (3) B00184 Solvent - BMS 3-2, Type 1
   C. References
      (1) AMM 20-10-22/701, Metal Surfaces

(2) AMM 20-30-88/201, Airplane Structure Cleaning Solvents (Series 88)
(3) AMM 24-22-00/201, Electrical Power - Control
(4) AMM 51-21-04/701, Alodine Coating
(5) AMM 51-31-01/201, Seals and Sealing
(6) AMM 20-30-88, Solvents for Final Cleaning of Metal Before Non-Structural Bonding (Series 88)

D. Access

(1) Location Zones

119/120	Main Equipment Center
119/120	Main Equipment Center (Exterior)
211/212	Flight Compartment

E. Prepare for the Installation

S 864-011

(1) Make sure these circuit breakers on the P11 panel are open:
(a) 11E11, DME LEFT
(b) 11E32, DME RIGHT

F. Procedure

S 214-012

(1) Visually examine the mating surfaces of the antenna and the airplane for corrosion and unwanted material.

<u>NOTE</u>: If the surfaces are not clean, the grounding will not be sufficient, and incorrect system operation will occur.

S 114-013

(2) Clean the mating surface with the solvent, Series 88 (AMM 20-30-88/201, AMM 20-30-88).

S 624-014

(3) Apply Alodine 1200 to the mating surfaces of the antenna and the airplane (AMM 51-21-04/701).

S 434-015

(4) Make sure you install an O-ring on the new antenna.

S 434-016

(5) Connect the coaxial cable to the antenna.

S 424-017

(6) Put the antenna into position and wet install the mounting screws with BMS 5-95 (AMM 51-31-01/201).

S 434-018

(7) Tighten the screws to 20-25 pound-inches of torque.

S 764-019

(8) Make sure the resistance from the antenna base to the airplane skin is not more than .001 ohm.

S 434-020

(9) Apply the sealant to the outer edge of the antenna to make a weather and aerodynamic seal (AMM 51-31-01/201).

S 144-021

(10) Remove the unwanted sealant from the area around the antenna base (AMM 51-31-01/201).

S 864-022

(11) Remove the DO-NOT-CLOSE tag and close these circuit breakers on the P11 panel:
   (a) 11E11, DME LEFT
   (b) 11E32, DME RIGHT

G. DME Antenna Test

S 864-031

(1) Supply electrical power (AMM 24-22-00/201).

S 864-026

CAUTION: DO NOT OPERATE THE TEST SET WHEN ITS ANTENNA IS LESS THAN 15 INCHES FROM THE AIRPLANE ANTENNA. DAMAGE TO THE TEST SET CAN OCCUR.

(2) Adjust the remote test antenna to the same height as the applicable (left or right) DME antenna.

S 864-023

(3) Put the test antenna to a specified horizontal distance from the applicable (left or right) DME antenna. The test antenna coaxial cable shows the necessary distance (approximately 21 inches).

S 864-032

(4) Put the loose end of the coaxial cable into the flight compartment and connect it to the test set.

S 864-024

(5) Set the mode select switch on the applicable EFIS control panel to the VOR position.

S 864-025

(6) Set an approved test frequency on the applicable VOR control panel.

S 864-027

(7) Energize the DME signal generator and set the controls to these positions:
  - (a) Frequency channel - approved test frequency (VOR channel)
  - (b) Squitter - ON
  - (c) IDENT switch - ON
  - (d) Range/Velocity - Range
  - (e) Distance - 150.0 nautical miles (NM)
  - (f) Reply rate - 70 percent

S 754-028

(8) Make sure the DME distance display for the applicable DME system shows 150.00 ±1.0 NM.

S 864-029

(9) Remove the test set.

H. Put the Airplane Back to Its Usual Condition

S 864-030

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

DUAL DISTANCE INDICATOR (DDI) - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. One is the removal of the DDI; the other is the installation of the DDI.

TASK 34-55-03-024-001

2. Remove the DDI
   A. References
      (1) 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones

211/212	Control Cabin

   C. Prepare for the Removal

S 864-002

      (1) Open these circuit breakers on the overhead panel P11 and attach DO-NOT-CLOSE tags:
         (a) 11E11, DME LEFT
         (b) 11E32, DME RIGHT
   D. Procedure

S 914-014

CAUTION: DO NOT TOUCH THE DDI BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE DDI.

      (1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-01).

S 034-003

      (2) Loosen the instrument clamp screws on the front panel adjacent to the DDI.

S 024-004

(3) Move the DDI out of the instrument panel to get access to the electrical connection.

S 034-005

(4) Disconnect the electrical cables at the rear of the DDI.

S 024-015

(5) Remove the DDI.

TASK 34-55-03-424-006

3. Install the DDI

A. References
   - (1) 20-41-01/201, Electrostatic Sensitive Devices
   - (2) 24-22-00/201, Electrical Power - Control

B. Access
   - (1) Location Zones

211/212	Flight Compartment

C. Prepare for the Installation

S 864-007

(1) Make sure these circuit breakers on the P11 panel are open:
   - (a) 11E11, DME LEFT
   - (b) 11E32, DME RIGHT

D. Procedure

S 914-017

CAUTION: DO NOT TOUCH THE DDI BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE DDI.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-01).

S 434-008

(2) Connect the electrical cables to the connectors at the rear of the DDI.

S 424-016

(3) Install the DDI.

S 434-009

(4) Tighten the instrument clamp screws.

E. DDI Test

S 864-010

(1) Supply electrical power (Ref 24-22-00).

S 864-011

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) 11E11, DME LEFT
   (b) 11E32, DME RIGHT

S 214-012

(3) Make sure the DDI panel lights come on.

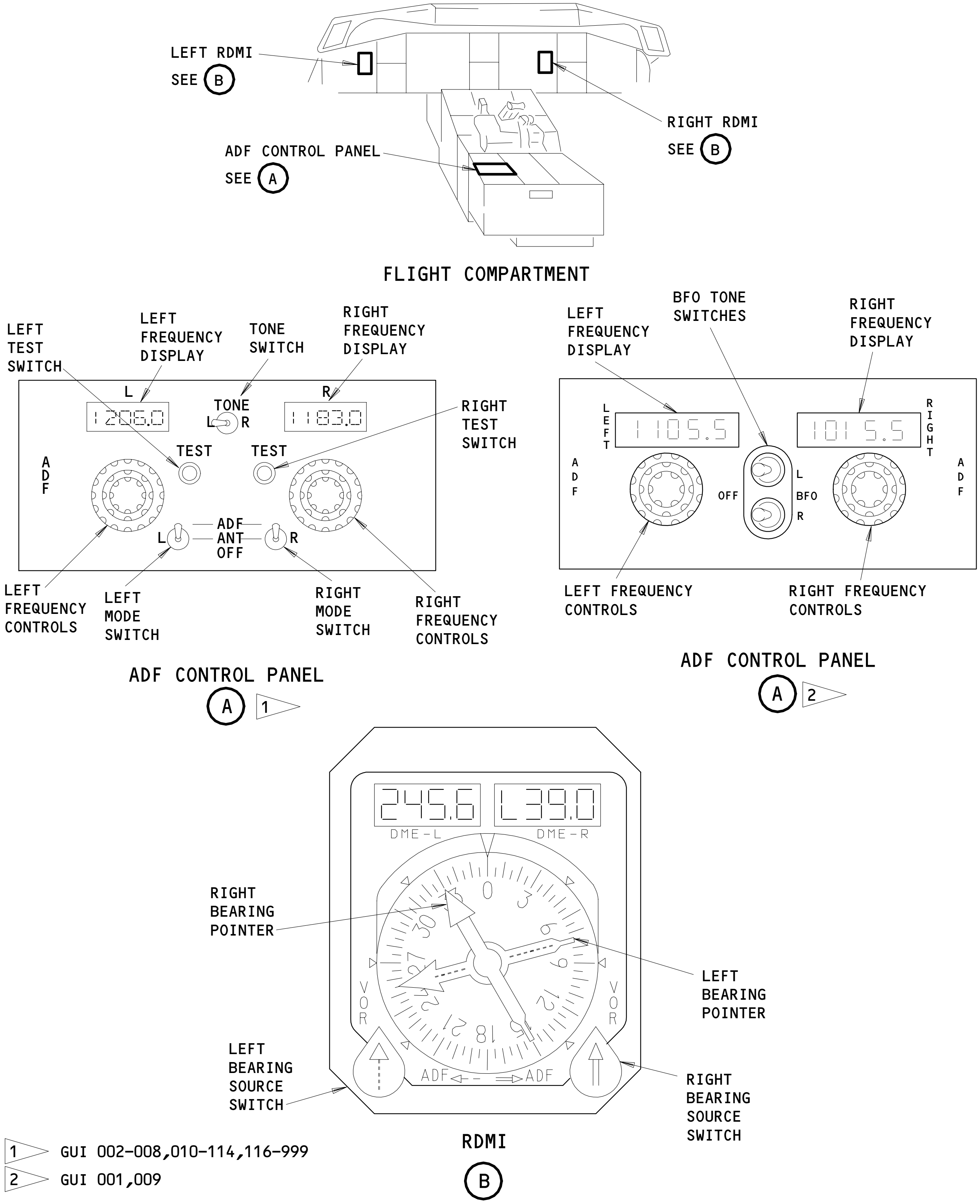
F. Put the Airplane Back to Its Usual Condition

S 864-013

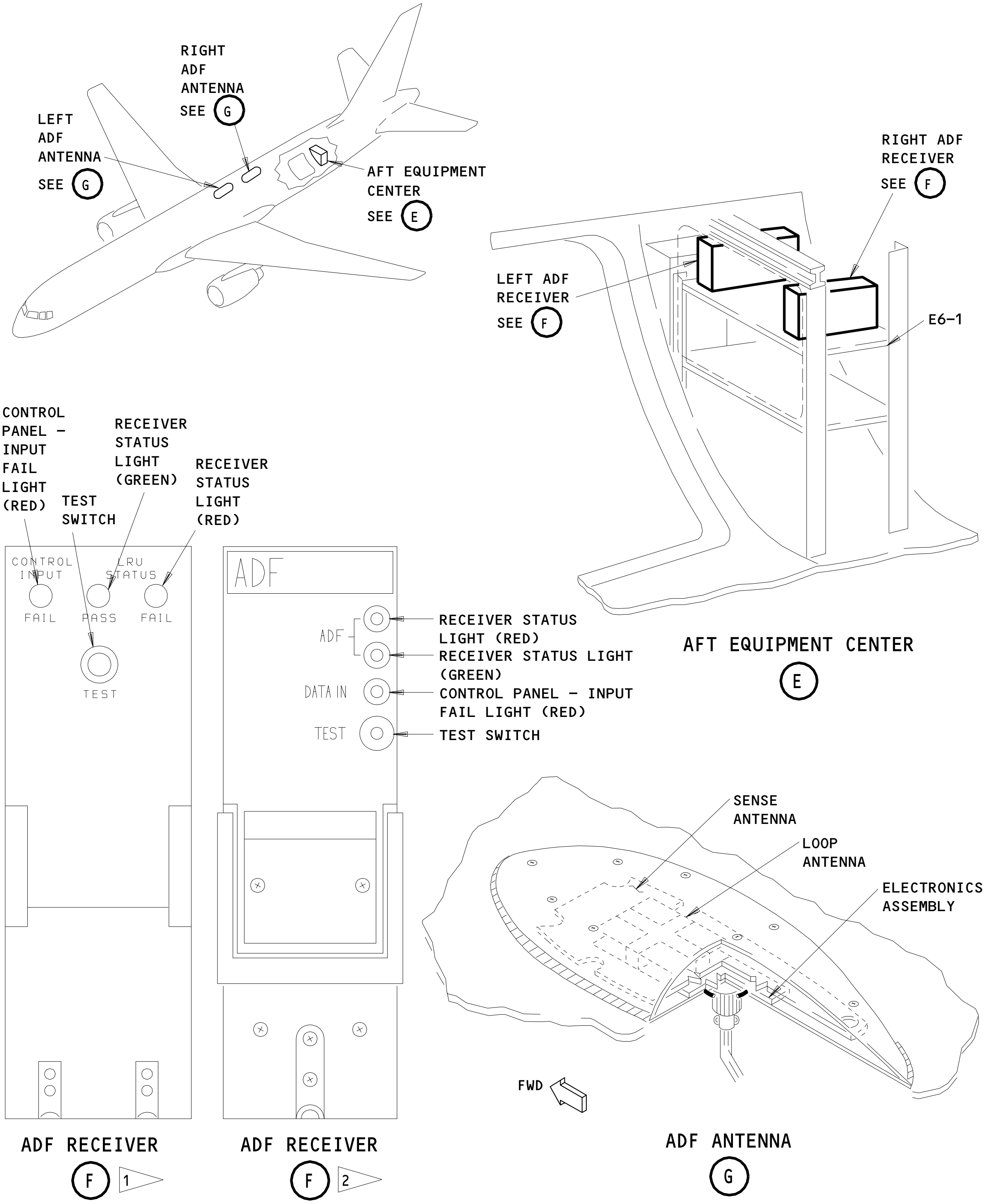
(1) Remove electrical power if it is not necessary (Ref 24-22-00).

AUTOMATIC DIRECTION FINDER SYSTEM - DESCRIPTION AND OPERATION

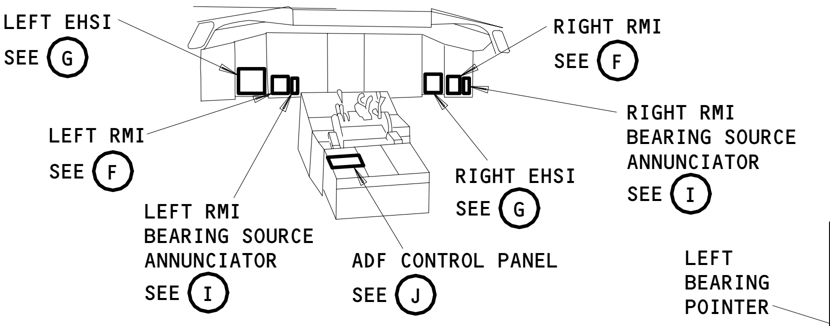
1. General (Fig. 1)
   - A. The automatic direction finder (ADF) system provides bearing to and/or audio reception from selected ground stations. The system is capable of receiving and processing signals on the frequency range from 190KHz to 1750KHz. These frequencies include standard AM broadcast stations and nondirectional beacons.
   - B. Two ADF systems are installed. Each system includes a fixed sense/loop antenna and a receiver. A common dual control panel provides control of both systems.
   - C. GUI 001-114, 116-999;
     The system sends data to the radio distance magnetic indicators (RDMIs) and the flight interphone system.
   - D. GUI 115;
     the system sends data to the radio magnetic indicators (RMIs) the RMI bearing source indicators, and the flight interphone system.
2. Component Detail (Fig. 1)
   - A. Antenna
     - (1) The ADF antenna is comprised of one omnidirectional sense and two bidirectional loop antennas. They are enclosed in a tear-drop shaped synthetic shell. The sense antenna is used for audio reception. It also provides a reference phase signal. This signal is used to resolve the 180° phase ambiguity of the loop antennas. The loop antennas provide bearing signals to the ADF receiver. They are mounted at 90° to each other. One winding is mounted parallel to the airplane centerline.
     - (2) The antennas are located on the top centerline of the fuselage. The left system antenna is forward of the right antenna.
   - B. Control Panel
     - (1) GUI 002-008, 010-114, 116-999;
       The ADF control panel is used to select the frequency and mode of operation for the ADF system. It is located on the aft electronics panel (P8).
     - (2) GUI 001, 009, 115;
       The ADF control panel is used to select the frequency for the ADF system. It is located on the aft electronics panel (P8).



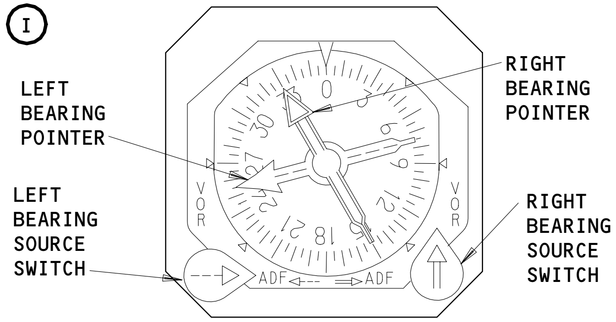
Automatic Direction Finder System - Component Detail
Figure 1 (Sheet 1)



Automatic Direction Finder System - Component Location
Figure 1 (Sheet 2)

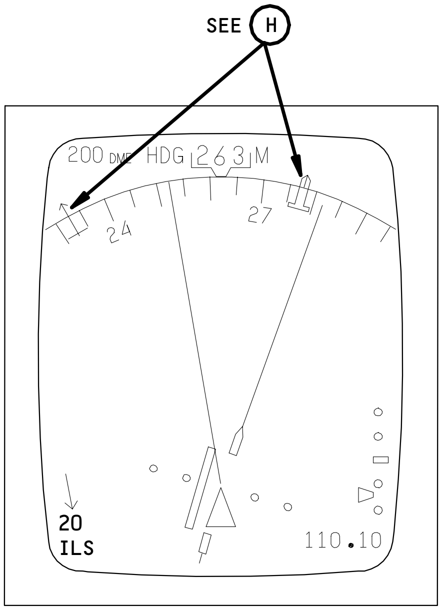


FLIGHT COMPARTMENT



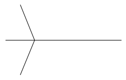
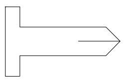
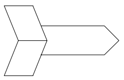
RMI

F



EHSI (INTERFACE)

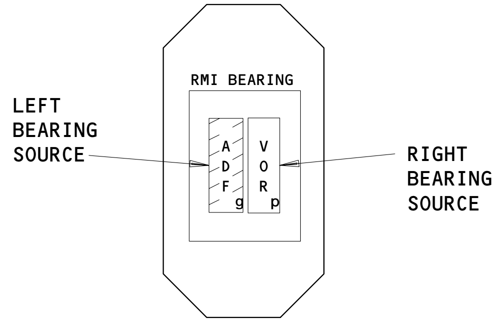
G

SYMBOL	NAME	CONDITION
	ADF-L	WHEN ADF-L SYS ON, ONE SYMBOL DISPLAYED (WHEN IN VIEW) ON HDG TAPE FOR EFIS MAP, EXP-ILS, AND EXP-VOR MODES. BOTH SYMBOLS DISPLAYED ON HDG TAPE FOR EFIS FULL-ILS AND FULL-VOR MODES.
	ADF-L RECIPROCAL	
	ADF-R	WHEN ADF-R SYS ON, SAME CONDITIONS AS ABOVE.
	ADF-R RECIPROCAL	

EFIS EHSI-ADF SYMBOLOGY

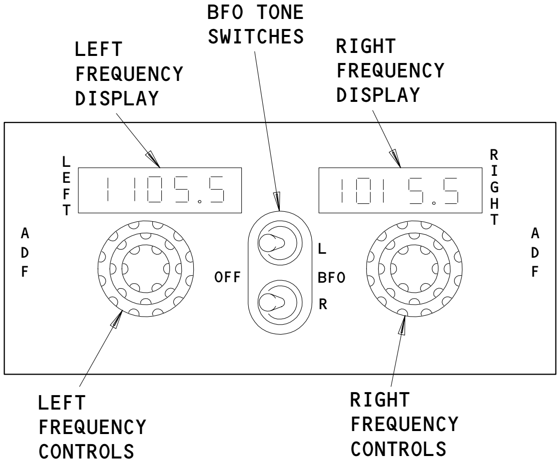
H

Automatic Direction Finder System - Component Detail
Figure 1 (Sheet 3)



RMI BEARING SOURCE ANNUNCIATOR

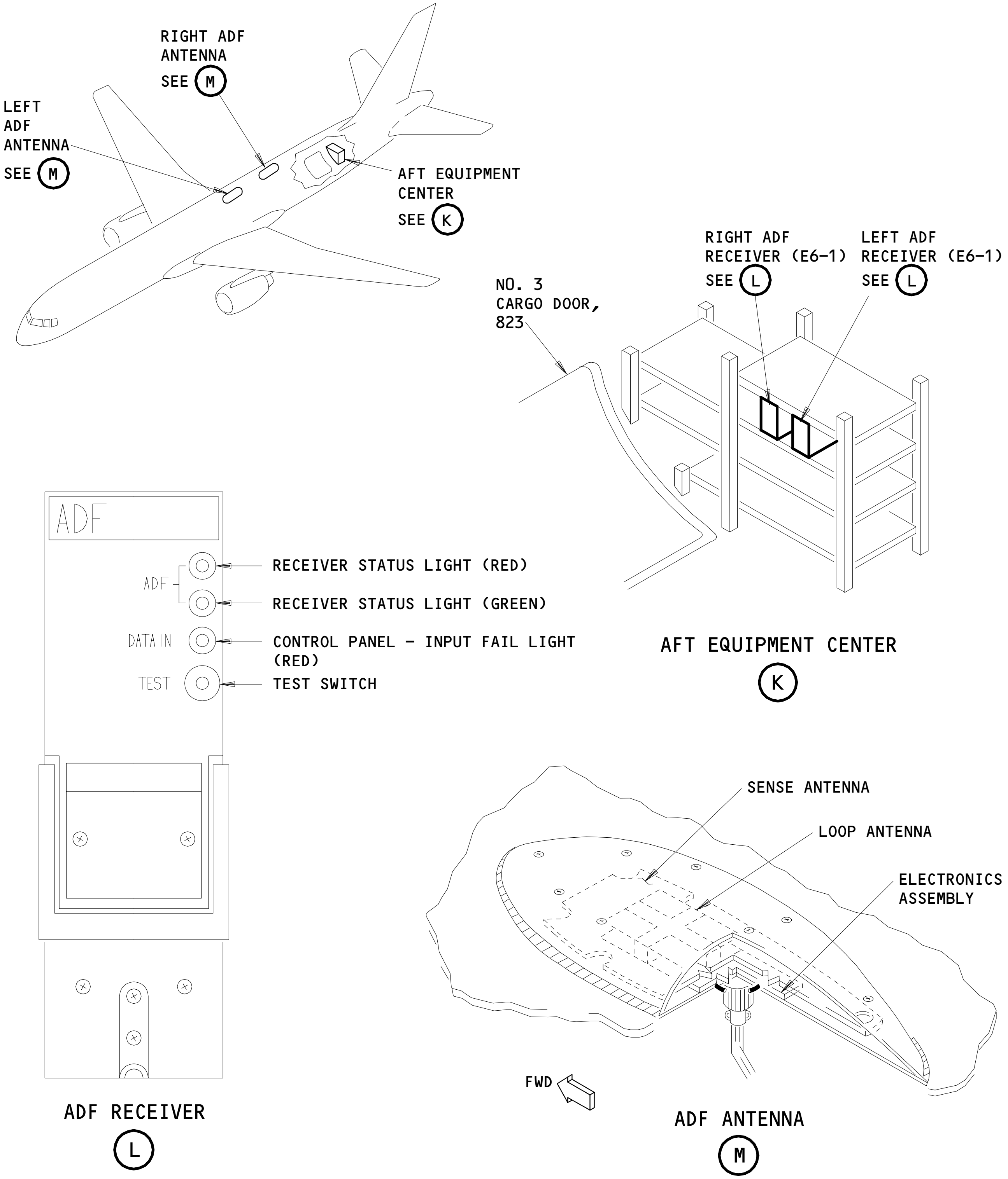
I



ADF CONTROL PANEL

J

Automatic Direction Finder System - Component Detail
Figure 1 (Sheet 4)



Automatic Direction Finder System - Component Detail
Figure 1 (Sheet 5)

(3) GUI 002-008, 010-114, 116-999;
The two modes of operation are selected on the mode selector switch. The antenna (ANT) mode is used to receive AM radio broadcasts. No bearing information is displayed. In the ANT mode, only the sense antenna circuits are used. In the ADF mode all ANT mode functions are performed. Also, bearing to the selected station is determined and displayed on the RDMIs. This mode requires both sense and loop antenna inputs.

(4) The left and right ADF receiver operating frequencies are selected on the left and right sets of three concentric knobs, respectively. The outer knobs select kHz in thousands and hundreds. The middle knob selects the 10 kHz range and the inner knob selects units in 0.5 kHz increments. The selected frequency is displayed in the window above each set of knobs.

(5) GUI 002-008, 010-114, 116-999;
the TEST buttons initiate a system self test for the corresponding left or right unit.

(6) GUI 001, 009, 115;
the left and right BFO switches, when ON, enable a 1020 Hz tone to be injected into the respective receiver's audio output. This is used to verify station reception.

(7) GUI 002-008, 010-114, 116-999;
the TONE switch is used during ANT mode to inject a 1020 Hz tone into the left or right receiver's audio output. This is used to verify station reception.

C. Receiver

(1) The ADF receivers are located on rack E6 in the aft equipment center.

(2) GUI 002-008, 010-114, 116-999;
The ADF receiver processes the rf signals from the antenna. It operates in the mode and frequency selected on the control panel. The receiver provides bearing and/or audio output signals accordingly. The front panel of the receiver contains a self test switch and three pass/fail status lights.

(3) GUI 001, 009, 115;
The ADF receiver processes the rf signals from the antenna. It operates at the frequency selected on the control panel. The receiver provides bearing and/or audio output signals accordingly. The front panel of the receiver contains a self test switch and three pass/fail status lights.

D. GUI 001-114, 116-999;
RDMI (Interface)

E. GUI 115;
RMI and RMI Bearing Source Annunciator (Interface)

(1) GUI 115;
the RMIs display ADF bearing when either VOR/ADF switch is in the ADF position. The left switch and narrow pointer, control and display left ADF system bearing, respectively. The right switch and wide pointer, control and display right ADF system bearing, respectively. For an ADF system malfunction, the respective bearing flag will come into view.

(2) GUI 001-114, 116-999;
the RDMIs display ADF bearing when either VOR/ADF switch is in the ADF position. The left switch and narrow pointer, control and display left ADF system bearing, respectively. The right switch and wide pointer, control and display right ADF system bearing, respectively. For an ADF system malfunction, the respective bearing flag will come into view.

(3) GUI 115;
the RMI bearing source annunciators display the selected bearing modes (ADF or VOR) for their respective RMI. (Captain,s displays left RMI left and right modes. F/O's displays right RMI left and right modes.)

(4) GUI 001-114, 116-999;
the two RDMIs are located on the captain's and first officer's instrument panels (P1 and P3) respectively.

(5) GUI 115;
the two RMIs and RMI bearing source annunciators are located on the captain's and first officer's instrument panels (P1 and P3), respectively.

F. GUI 115;
Electronic Horizontal Situation Indicator (EHSI) (Interface)

(1) The two EHSIs are located on the captain's and first officer's instrument panels (P1 and P3) respectively.

G. Flight Interphone System (Interface)

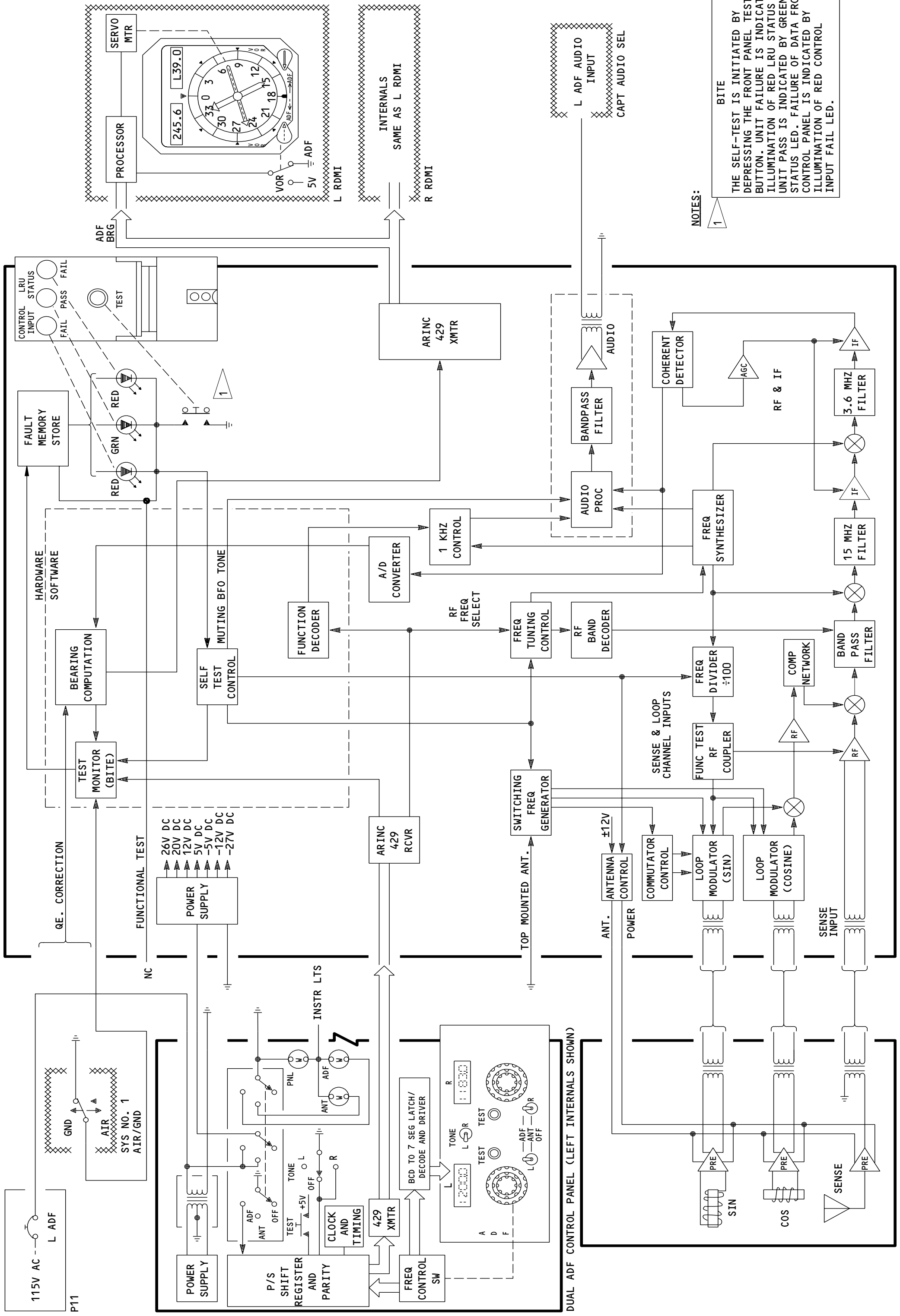
(1) The flight interphone system provides audio output as received from the ADF receiver. This can be standard AM radio, weather, or identification tone audio output. The output depends upon the frequency (ground station) selected on the ADF control panel.

3. Operation (Fig. 2)

A. Functional Description

(1) Power

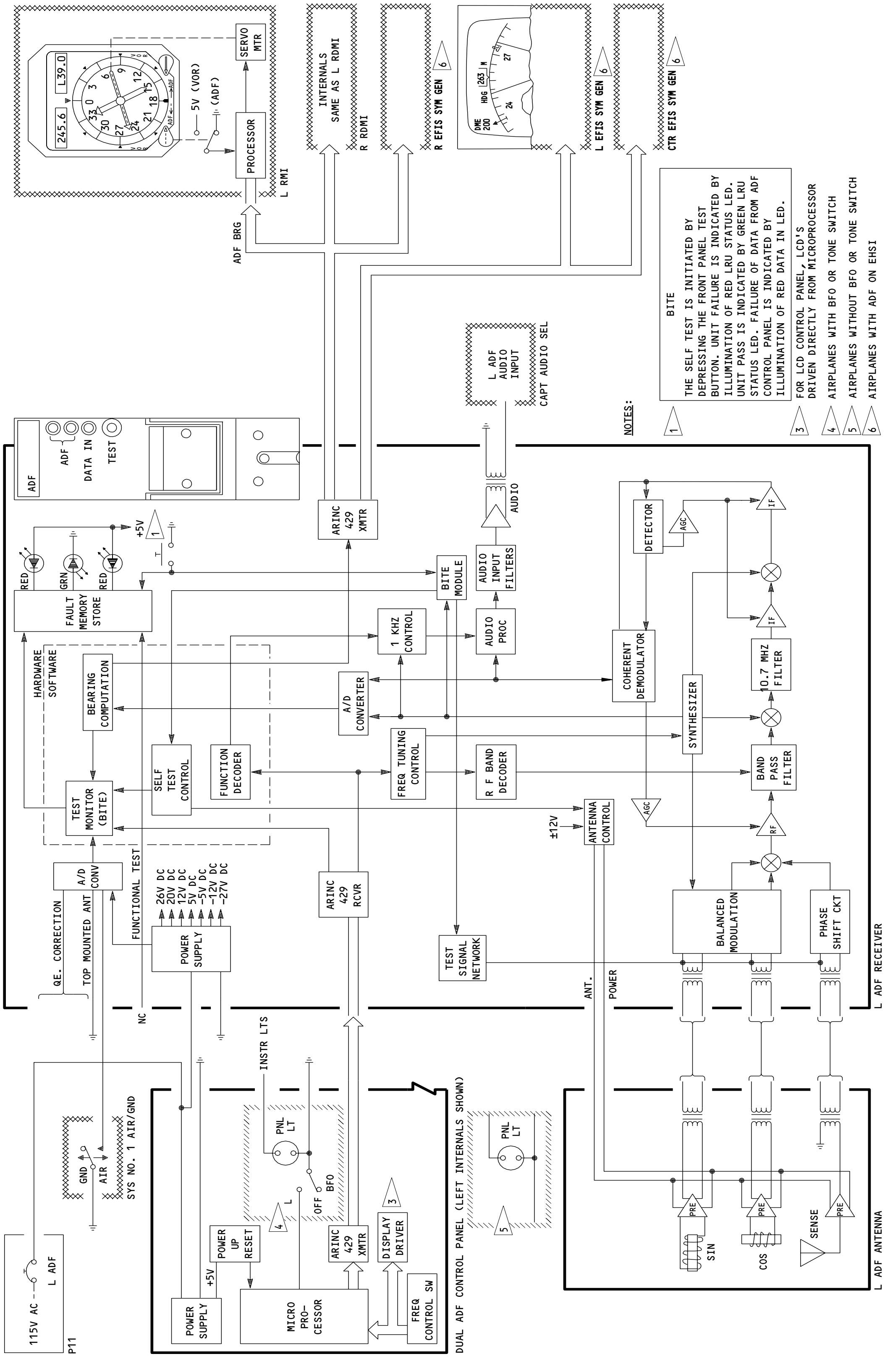
(a) The ADF control panel receives a dual power input of 115v ac.



NOTES:

1 BITE
THE SELF-TEST IS INITIATED BY DEPRESSING THE FRONT PANEL TEST BUTTON. UNIT FAILURE IS INDICATED BY ILLUMINATION OF RED LRU STATUS LED. UNIT PASS IS INDICATED BY GREEN LRU STATUS LED. FAILURE OF DATA FROM ADF CONTROL PANEL IS INDICATED BY ILLUMINATION OF RED CONTROL INPUT FAIL LED.

ADF System Schematic (Example)
Figure 2 (Sheet 1)



NOTES:

1 BITE
THE SELF TEST IS INITIATED BY DEPRESSING THE FRONT PANEL TEST BUTTON. UNIT FAILURE IS INDICATED BY ILLUMINATION OF RED LRU STATUS LED. UNIT PASS IS INDICATED BY GREEN LRU STATUS LED. FAILURE OF DATA FROM ADF CONTROL PANEL IS INDICATED BY ILLUMINATION OF RED DATA IN LED.

3 FOR LCD CONTROL PANEL, LCD'S DRIVEN DIRECTLY FROM MICROPROCESSOR

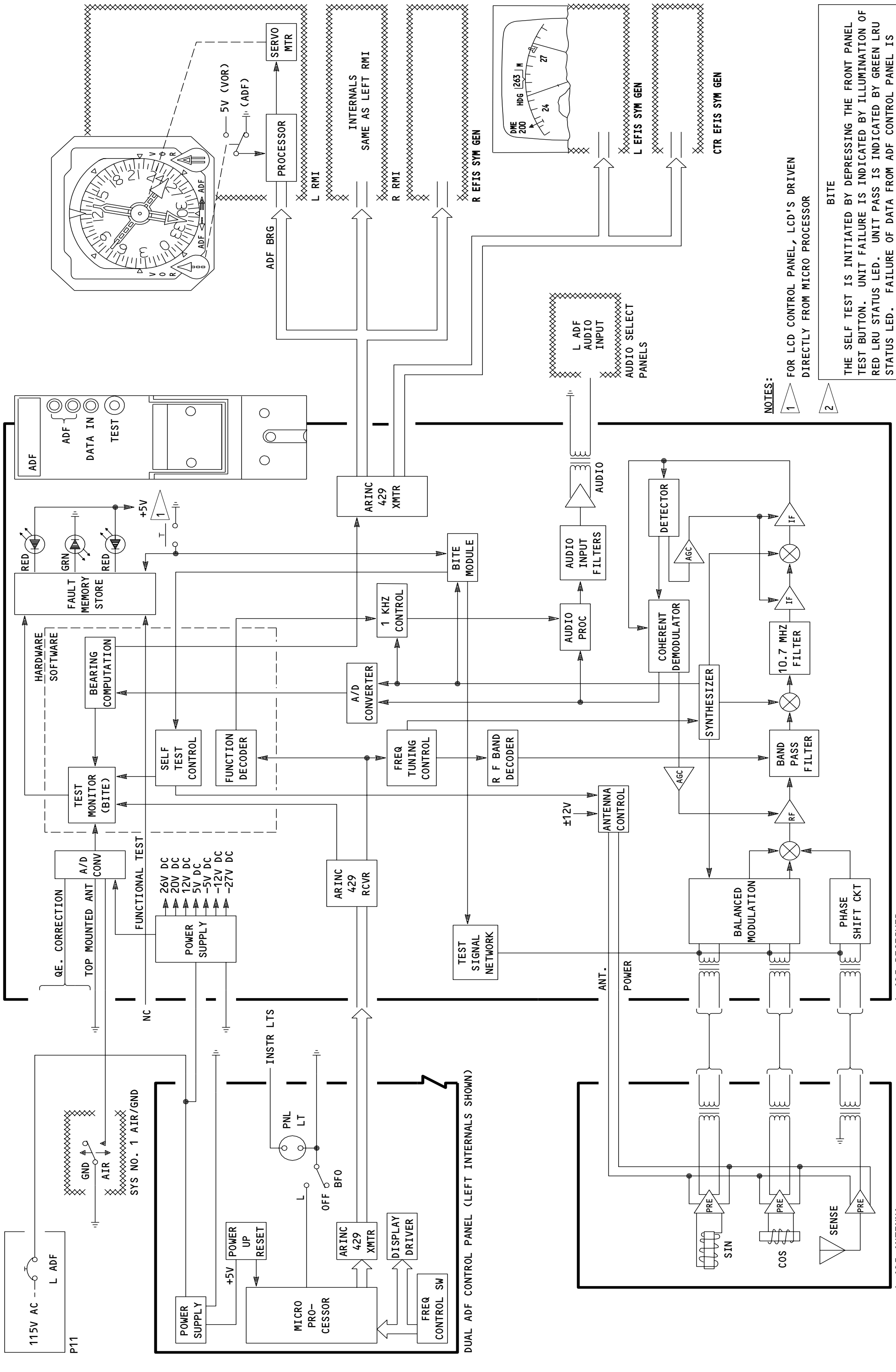
4 AIRPLANES WITH BFO OR TONE SWITCH

5 AIRPLANES WITHOUT BFO OR TONE SWITCH

6 AIRPLANES WITH ADF ON EHSI

ADF System Schematic (Example)
Figure 2 (Sheet 2)

E70807



NOTES:

1 FOR LCD CONTROL PANEL, LCD'S DRIVEN DIRECTLY FROM MICRO PROCESSOR

2 BITE
THE SELF TEST IS INITIATED BY DEPRESSING THE FRONT PANEL TEST BUTTON. UNIT FAILURE IS INDICATED BY ILLUMINATION OF RED LRU STATUS LED. UNIT PASS IS INDICATED BY GREEN LRU STATUS LED. FAILURE OF DATA FROM ADF CONTROL PANEL IS INDICATED BY ILLUMINATION OF RED DATA IN LED.

ADF System Schematic (Example)
Figure 2 (Sheet 3)

A72110

(b) GUI 001, 003-999;
the left system receives power from the left main power bus. The right system receives power from the standby power bus.

(c) GUI 002;
The left system receives power from the standby power bus. The right system receives power from the standby power bus.

(d) The power is routed from the control panel to the respective receiver which provides power for receiver circuit operation and ±12v dc to its corresponding antenna.

(2) Signal Processing.

(a) GUI 002-008, 010-114, 116-999;
the ADF control panel begins operation by coupling frequency data (channel select) and mode data to the signal processor, in the ADF receiver. The data is examined and if it is valid, a serial data word is coupled to the synthesizer module. (The ARINC 429 LSI is time shared between the control input data and the bearing data output). The serial data word contains the selected channel frequency data for VCO control as well as ADF/ANT mode select data. The synthesizer module contains an ADF LSI that provides mode control and modulation control signals (31 Hz four phases). The modulation control signals are provided to convert the antenna sense and loop signals to a composite phase modulated signal.

(b) GUI 001, 009, 115;
the ADF control panel begins operation by coupling frequency data (channel select) to the signal processor in the ADF receiver. The data is examined and if it is valid, a serial data word is coupled to the synthesizer module. (The ARINC 429 LSI is time shared between the control input data and the bearing data output). The serial data word contains the selected channel frequency data for VCO control. The synthesizer module contains an ADF LSI that provides modulation control signals (31 Hz four phases). The modulation control signals are provided to convert the antenna sense and loop signals to a composite phase modulated signal.

(c) The incoming radio beacon signal is received by the ADF antenna. Three separate signals are coupled to the receiver module. These are:

1) A sense signal
2) A loop signal proportional in amplitude to the cosine of the angle (ϕ) through the centerline of the aircraft to the radio beacon.
3) A loop signal proportional to sine (ϕ).

(d) GUI 002-008, 010-114, 116-999;
When the ADF system is in the ANT mode, the sense signal is processed through the receiver in conventional superheterodyne fashion. The audio output signal is then coupled to the aircraft audio system.

(e) GUI 002-008, 010-114, 116-999;
when the ADF system is in ADF mode, the loop signals are balance modulated by reference 31 Hz modulation control signals. The 31 Hz control signal is composed of four selected phases in quadrature. The balance modulated loop signals are summed together with the sense signal. This is done in a controlled phase relationship to form a composite phase modulated carrier signal. The signal is then coupled through the receiver to the IF circuits and then to the coherent demodulator module.

(f) GUI 001, 009, 115;
The sense signals are processed through the receiver in conventional superheterodyne fashion. The audio output signal is then coupled to the aircraft audio system. The loop signals are balance modulated by reference 31 Hz modulation control signals. The 31 Hz control signal is composed of four selected phases in quadrature. The balance modulated loop signals are summed together with the sense signal. This is done in a controlled phase relationship to form a composite phase modulated carrier signal. The signal is then coupled through the receiver to the IF circuits and then to the coherent demodulator module.

(g) The coherent demodulator senses the presence of a signal from the IF circuit. It then phase locks a tracking VCO to the signal. The phase modulation component of the signal is recovered from the VCO phase lock circuit. The recovered signal contains the original bearing information received by the ADF antenna. This signal is filtered and then coupled to the processor module. The recovered bearing data signal is compared to the reference modulation control signal in the signal processor. It is converted to a 12-bit bearing data field. The signal processor contains a microprocessor circuit which filters the incoming signal to reduce the effect of noise components.

(h) A correction is made for quadrantal error (QE) due to signal distortion by the aircraft structure. Connections are made at the rear connector of the ADF receiver to provide for the desired QE correction.

(i) GUI 001-114, 116-999;
a data word containing bearing, parity, system configuration, and status data is assembled in the signal processor module. This data is output to the RDMIs via an ARINC 429 digital data bus (Ref 34-22-00).

(j) GUI 115;
a data word containing bearing, parity, system configuration, and status data is assembled in the signal processor module. This data is output to the RMIs via an ARINC 429 digital data bus (Ref 34-22-00).

B. BITE and SELF TEST

(1) The BITE module contains a circuit which when enabled, injects an on-channel test signal into the input circuits of the receiver. The receiver response is compared to the expected response to determine if the unit is operational.

(2) GUI 002-008, 010-114, 116-999;
the ADF receiver continuously monitors system operation. All detected faults are stored in the fault memory. The system stores fault conditions for the past 15 flights. Each flight segment is marked by operation of the air/ground relay. Fault memory may be accessed on the ground by an ATE connector on the rear of the unit. Also, a seven segment LED readout inside the receiver shows detected faults. It is used for shop maintenance.

(3) GUI 001, 009;
The ADF receiver continuously monitors system operation. All detected faults are stored in a nonvolatile fault memory. Any active faults will be annunciated on the RDMI's or on the RCVR front panel during a self-test. The fault memory can store faults for up to 63 flights. The maximum number of faults that can be stored for any flight segment is 13. If a fault exists continuously, it is stored only once. If it exists intermittently and remains for 1 second or more, it is stored each time it occurs. Fault memory may be accessed on the ground by an ATE connector on the rear of the unit. Also, a seven segment LED readout inside the RCVR shows detected faults. It is used for shop maintenance.

(4) GUI 115;
the ADF receiver continuously monitors system operation. All detected faults are stored in a nonvolatile fault memory. Any active faults will be annunciated on the RMI's or on the RCVR front panel during a self-test. The fault memory can store faults for up to 63 flights. The maximum number of faults that can be stored for any flight segment is 13. If a fault exists continuously, it is stored only once. If it exists intermittently and remains for 1 second or more, it is stored each time it occurs. Fault memory may be accessed on the ground by an ATE connector on the rear of the unit. Also, a seven segment LED readout inside the RCVR shows detected faults. It is used for shop maintenance.

(5) GUI 001, 009;
System self-test is always initiated at power turn on. It also can be initiated at any other time by pressing the TEST button on the ADF receiver front panel. At the start of the test, the lights on the receiver front panel illuminate for three seconds and then turn off. The RDMI bearing flag appears for six seconds and for the duration of the test, the bearing pointer is driven to 135°.

(6) GUI 002-008, 010-114, 116-999;
system self-test is always initiated at power turn on. It also can be initiated at any other time by pressing the TEST button on the ADF control panel or the ADF receiver front panel. At the start of the test, the lights on the receiver front panel illuminate for three seconds and then turn off. The RDMI bearing flag appears for six seconds and for the duration of the test, the bearing pointer is driven to 135°.

(7) GUI 115;
system self-test is always initiated at power turn on. It also can be initiated at any other time by pressing the TEST button on the ADF receiver front panel. At the start of the test, the lights on the receiver front panel illuminate for three seconds and then turn off. The RMI bearing flag appears for six seconds and for the duration of the test, the bearing pointer is driven to 135°.

(8) GUI 002-008, 010-114, 116-999;
if the test passes, the green PASS light will illuminate at the end of the test. If the test fails, the red LRU STATUS FAIL light will illuminate at the end of the test. In addition, the red CONTROL INPUT FAIL light will illuminate in the event of a control panel fault.

(9) GUI 001, 009, 115;
if the test passes, the green ADF light will illuminate at the end of the test. If the test fails, the red ADF light will illuminate at the end of the test. In addition, the red DATA IN light will illuminate in the event of a control panel fault.

(10) GUI 001, 009, 115;
The red ADF light will come on when either a present ADF receiver fault or if two or more identical faults from at least two of the last four flight segments are stored in the flight fault memory.

(11) GUI 002-008, 010-114, 116-999;
an rf and audio circuit test is accomplished by setting the control panel mode selector to ANT. A local radio station is tuned and the audio output is monitored on the flight interphone system. (Ref 23-51-00)

(12) GUI 001, 009, 115;
an rf and audio circuit test is accomplished by setting the control panel frequency to a local radio station and the audio output is monitored on the flight interphone system (Ref 23-51-00).

C. Control

(1) To place the ADF system in operation, the following steps are required:
    (a) Provide electrical power (Ref 24-22-00)

(b) Close the following overhead panel P11 circuit breakers:
  1) GUI 001-114, 116-999;
     11A4, ADF RIGHT
  2) GUI 115;
     11A6, RBA L
  3) GUI 001-114, 116-999;
     11A6, RDMI LEFT
  4) GUI 115;
     11A7, RMI L
  5) 11F6, ADF LEFT
  6) GUI 115;
     11F23, RMI R
  7) GUI 115;
     11F25, RBA R
  8) GUI 001-114, 116-999;
     11F25, RDMI RIGHT
  9) GUI 115;
     11F27, ADF RIGHT

(c) GUI 002-008, 010-114, 116-999;
on the ADF control panel, set both frequency select knobs to select a known broadcast frequency and place mode switch to ADF.

(d) GUI 001, 009, 115;
On the ADF control panel, set both frequency select knobs to a known broadcast frequency.

(e) GUI 115;
on left and right RMIs, place the mode switches in ADF.

(f) GUI 001-114, 116-999;
on left and right RDMIs, set the mode switches in ADF.

(g) On all audio select panels, place ADF volume controls to desired level.

(2) GUI 115;
On both RMIs, make sure that both BRG flags are out of view. Also, make sure that both bearing needles are pointing to the selected station(s).

(3) GUI 001-114, 116-999;
on both RDMIs, check that both BRG flags are out of view. Also, check that both bearing needles are pointing to the selected station(s).

(4) On each audio select panel, check that selected station is being received clearly.

AUTOMATIC DIRECTION FINDER (ADF) SYSTEM

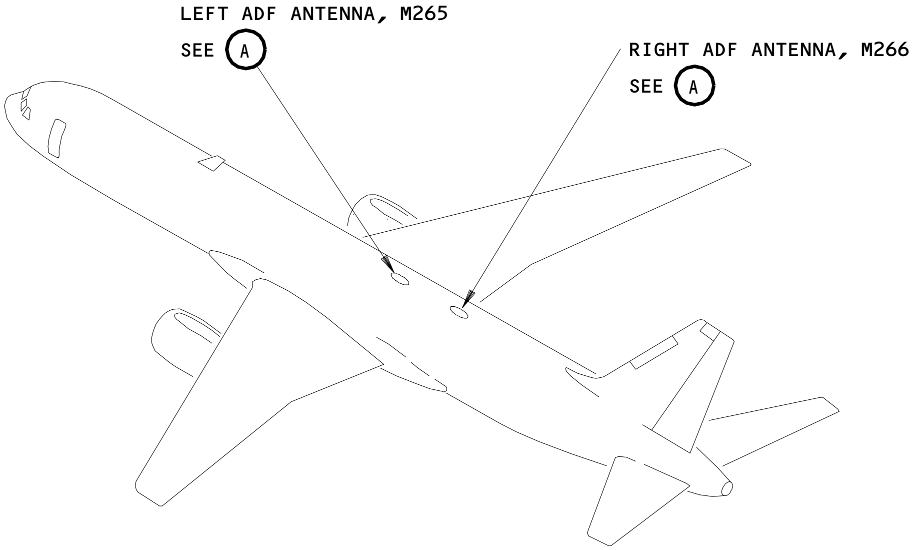
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - LEFT ADF, M265	1	1	TOP OF FUSELAGE	34-57-03
ANTENNA - RIGHT ADF, M266	1	1	TOP OF FUSELAGE	34-57-03
CIRCUIT BREAKER -	2		FLIGHT COMPARTMENT, P11	
ADF LEFT, C607		1	11F6	*
ADF RIGHT, C4118		1	[1] 11A4; [2] 11F27	*
INDICATOR - (FIM 34-22-00/101)				
LEFT RDMI, N3 [1]				
RIGHT RDMI, N43 [1]				
LEFT RMI, N10026 [2]				
RIGHT RMI, N10024 [2]				
PANEL - ADF CONTROL, M1046	2	1	FLIGHT COMPARTMENT, P8	34-57-02
RECEIVER - LEFT ADF, M215	2	1	822, AFT EQUIPMENT CENTER, E6-1	34-57-01
RECEIVER - RIGHT ADF, M216	2	1	822, AFT EQUIPMENT CENTER, E6-1	34-57-01
RELAY - (FIM 31-01-36/101)				
SYS NO. 1 AIR/GROUND, K167				

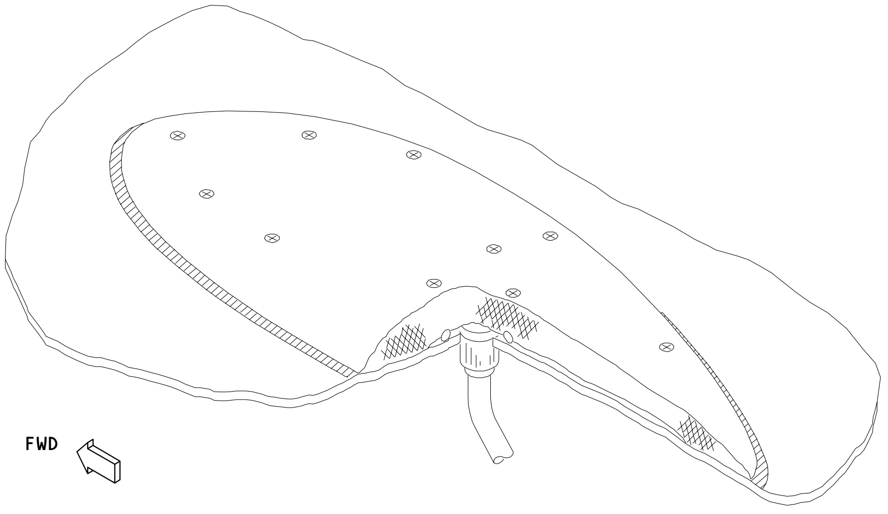
* SEE THE WDM EQUIPMENT LIST

[1] GUI 001-114,116-999

[2] GUI 115

Automatic Direction Finder (ADF) System - Component Index
Figure 101

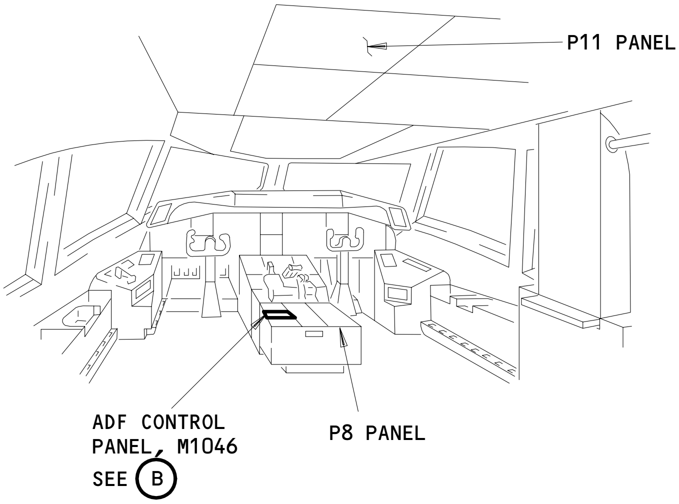




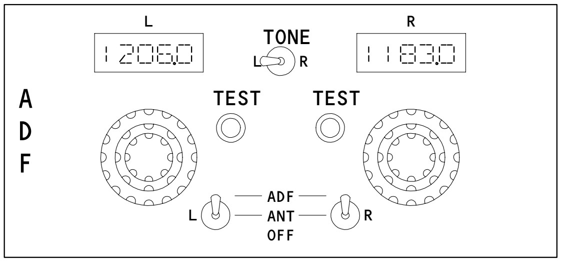
LEFT OR RIGHT ADF ANTENNA, M265 OR M266

A

Automatic Direction Finder (ADF) System - Component Location
Figure 102 (Sheet 1)

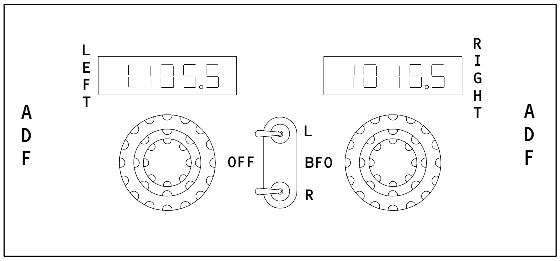


FLIGHT COMPARTMENT



ADF CONTROL PANEL, M1046

B 3



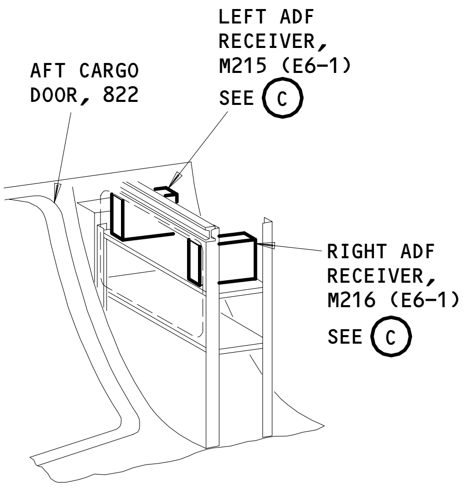
ADF CONTROL PANEL, M1046

B 4

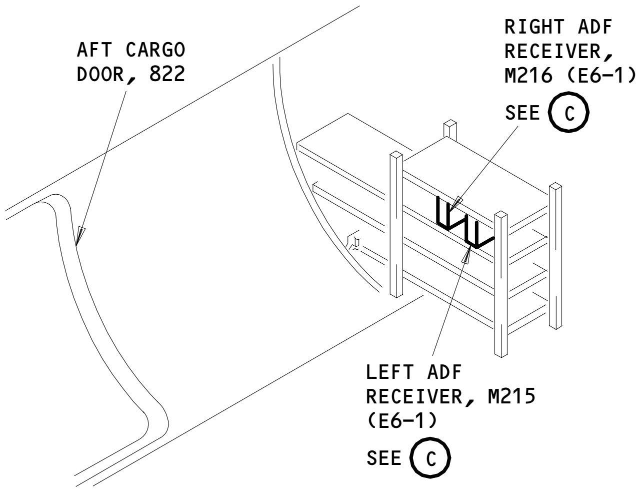
3 GUI 002-008,010-114

4 GUI 001,009,115

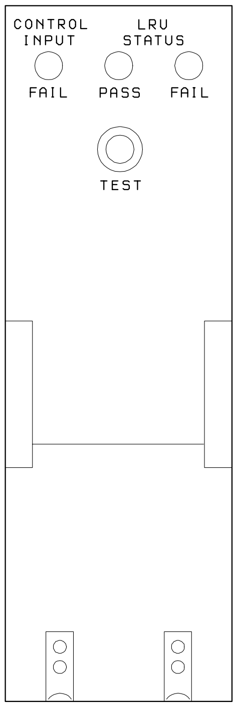
Automatic Direction Finder (ADF) System - Component Location
Figure 102 (Sheet 2)



AFT EQUIPMENT CENTER 5

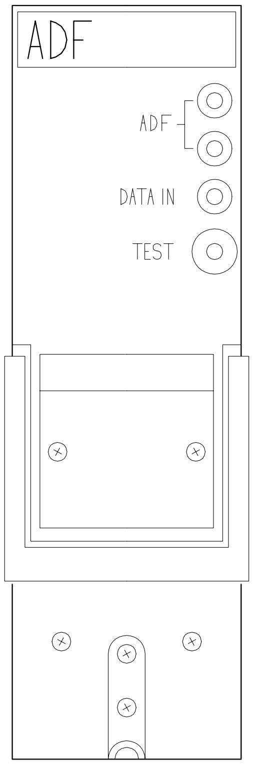


AFT EQUIPMENT CENTER 6



LEFT OR RIGHT ADF RECEIVER,
M215 OR M216

C 3



LEFT OR RIGHT ADF RECEIVER,
M215 OR M216

C 4

5 GUI 001-114,116-999
6 GUI 115

Automatic Direction Finder (ADF) System - Component Location
Figure 102 (Sheet 3)

AUTOMATIC DIRECTION FINDER SYSTEM - ADJUSTMENT/TEST

1. General
   A. This procedure is an operational test of all the units in the automatic direction finder (ADF) system. It is necessary to have operational approved broadcast and low frequency transmitting stations in the area.

      NOTE: Bearing checks made in an airplane hangar are not satisfactory.

TASK 34-57-00-715-001

2. ADF System - Operational Test
   A. Equipment
      (1) Headphone
   B. References
      (1) AMM 24-22-00/201, Electrical Power - Control
      (2) AMM 23-51-00/501, Flight Interphone System
   C. Access
      (1) Location Zones

153/154	Aft Cargo Compartment
211/212	Flight Compartment

   D. Prepare for the Operational Test

      S 865-002
      (1) Supply electrical power (Ref 24-22-00).

      S 865-125
      (2) Make sure the Flight Interphone System is on (AMM 23-51-00/501).

      S 865-003
      (3) Make sure these circuit breakers on the overhead circuit breaker panel, P11, are closed:
         (a) GUI 001-114, 116-999;
             11A4, ADF RIGHT
         (b) GUI 001-114, 116-999;
             11A6, RDMI LEFT
         (c) GUI 115;
             11A6, RBA L

(d) GUI 115;
    11A7, RMI L
(e) 11F6, ADF LEFT
(f) GUI 115;
    11F23, RMI R
(g) GUI 001-114, 116-999;
    11F25, RDMI R
(h) GUI 115;
    11F25, RBA R
(i) GUI 115;
    11F27, ADF RIGHT

E. Left ADF Test

S 865-070

(1) GUI 001-114, 116-999;
on the RDMIs, set the left and right bearing source switches to the ADF position.

S 865-071

(2) GUI 115;
on the RMIs, set the left and right bearing source switches to the ADF position.

S 755-072

(3) GUI 115;
make sure the RMI bearing source annunciators show ADF for the two systems.

S 865-073

(4) GUI 115;
set the mode switch on the EFIS control panels to the MAP position.

S 745-012

(5) Push and hold the TEST switch on the left ADF receiver.
    (a) Make sure this sequence occurs as follows on the left ADF receiver:
        1) All the LEDs come on

2) All the LEDs go off
3) The green LED comes on and stays on.

S 755-013

(6) Make sure this sequence of indications occurs as follows:
  - (a) GUI 001-114, 116-999;
    the left ADF/VOR warning flags on the RDMIs show.
  - (b) GUI 115;
    the ADF L fail flag comes into view on the EHSIs at the same time as the RMI warning flags come into view.
  - (c) GUI 001-114, 116-999;
    on the RDMIs, the flags do not show and the thin bearing pointers go to 135° (±5) relative to the top of the display.
  - (d) GUI 115;
    on the RMIs, the flags go out of view and the thin bearing pointers go to 135° (±5) relative to the top of the display.
  - (e) GUI 115;
    on the EHSIs, the flags go out of view and the ADF pointer goes to 135° (±5°).

S 745-014

(7) Release the TEST switch on the left ADF receiver.

F. Right ADF Test

S 715-074

(1) GUI 001-114, 116-999;
do the right ADF test the same as the left ADF test. Use the right ADF receiver, the right bearing source switches and right ADF/VOR warning flags on the RDMIs.

S 715-075

(2) GUI 115;
do the right ADF test the same as the left ADF test. Use the right ADF receiver, and the right bearing source switches and right ADF warning flags on the RMIs.

G. Prepare for the Left ADF Audio Test

S 865-017

(1) On the ADF control panel, set the controls as follows:
  (a) GUI 001, 009, 115;
  the BFO switch to the L position.
  (b) GUI 002-008, 010-114, 116-999;
  the left mode switch to the ANT position
  (c) GUI 002-008, 010-114, 116-999;
  the TONE switch to the L position.

S 755-076

(2) GUI 001-114, 116-999;
make sure the left ADF/VOR warning flags on the RDMIs come into view.

S 755-077

(3) GUI 115;
make sure the left ADF/VOR warning flags on the RMIs come into view.

H. The Left ADF Audio Test

S 865-022

(1) On the captain's audio selector panel, set the controls as follows:
  (a) The L ADF audio switch to the ON position
  (b) All other audio switches to the off position
  (c) GUI 001-114, 116-999;
  the filter switch to the BOTH position.
  (d) GUI 115;
  the filter switch to the ON position.

S 865-023

(2) Connect the headphones.

S 865-024

(3) On the ADF control panel, turn the left frequency controls to a CW broadcast frequency.

S 755-026

(4) Make sure a 1020 CW identification tone is heard on the headphones.

S 865-027

(5) On the captain's audio selector panel, adjust the L ADF volume if necessary.

S 715-028

(6) Do the Audio Test for the remaining audio selector panels.

I. Prepare for the Right ADF Audio Test

S 865-029

(1) On the ADF control panel, set the controls as follows:
   (a) GUI 001, 009, 115;
       the BFO switch to the R position.
   (b) GUI 002-008, 010-114, 116-999;
       the right mode switch to the ANT position
   (c) GUI 002-008, 010-114, 116-999;
       the TONE switch to the R position.

J. The Right ADF Audio Test

S 715-031

(1) Do the right ADF audio test the same as the left ADF audio test. Use the right system ADF controls, and the R ADF interphone controls (Turn off the L ADF interphone controls).

K. Prepare for the ADF Bearing Test

S 865-032

(1) On the ADF control panel, set the controls as follows:
   (a) GUI 001, 009, 115;
       the BFO switches to the OFF position.
   (b) GUI 002-008, 010-114, 116-999;
       the mode switches to the ADF position
   (c) GUI 002-008, 010-114, 116-999;
       the TONE switch to the off position.

L. The Right ADF Bearing Test

S 865-047
(1) On the ADF control panel, turn the right frequency controls to an approved broadcast frequency between 190 and 1750 kHz.

S 755-078
(2) GUI 001-114, 116-999;
make sure the thick bearing pointer on the RDMIs points to the correct bearing.

S 755-079
(3) GUI 115;
make sure the thick bearing pointer on the RMIs points to the correct bearing.

S 755-050
(4) On the captain's audio selector panel, make sure a clear signal is heard on the headphones.

S 715-051
(5) Do the Right ADF Bearing Test again for each audio selector panel.

M. The Left ADF Bearing Test

S 865-052
(1) On the captain's audio selector panel, turn off the R ADF volume and adjust the L ADF volume as necessary.

S 865-054
(2) On the ADF control panel, turn the left frequency controls to an approved broadcast frequency between 190 and 1750 kHz.

S 755-080
(3) GUI 001-114, 116-999;
make sure the thin bearing pointer on the RDMIs points to the correct bearing.

S 755-081
(4) GUI 115;
make sure the thin bearing pointer on the RMIs points to the correct bearing.

S 755-058

(5) On the captain's audio selector panel, make sure a clear signal is heard on the headphones.

S 865-059

(6) On the ADF control panel, turn the left and right frequency controls to the same broadcast frequency.

S 755-082

(7) GUI 001-114, 116-999;
make sure the thin and thick bearing pointers on the RDMIs point to the correct bearing.

S 755-083

(8) GUI 115;
make sure the thin and thick bearing pointers on the RMIs point to the correct bearing.

N. Put the Airplane Back to Its Usual Condition

S 865-063

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

AUTOMATIC DIRECTION FINDER (ADF) RECEIVER - REMOVAL/INSTALLATION

1. General
    A. This procedure has two tasks. One is the removal of the ADF receiver. The other is the installation of the ADF receiver.
    B. The left, M215, and right, M216, ADF receivers are installed on the E6 rack in the aft equipment center.
    C. All electrical connections are at the rear of the unit.

TASK 34-57-01-004-001

2. Remove the ADF Receiver
    A. References
        (1) AMM 20-10-01/401, E/E Rack-Mounted Components
    B. Access
        (1) Location Zones
            153/154 Aft Cargo Compartment
    C. Prepare for the Removal

        S 864-002

        (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
            (a) GUI 001-114, 116-999;
                11A4, ADF RIGHT
            (b) 11F6, ADF LEFT
            (c) GUI 115;
                11F27, ADF RIGHT
    D. Procedure

        S 014-003

        (1) Loosen the rack door fasteners, and open the door.

        S 024-004

        (2) Remove the ADF receiver (AMM 20-10-01/401).

TASK 34-57-01-404-006

3. Install the ADF Receiver
    A. References
        (1) AMM 20-10-01/401, E/E Rack-Mounted Components

(2) AMM 24-22-00/201, Electrical Power - Control

B. Access

(1) Location Zones

153/154	Aft Cargo Compartment
211/212	Flight Compartment

C. Prepare for the Installation

S 864-007

(1) Make sure these circuit breakers on the P11 panel are open:

(a) GUI 001-114, 116-999;
11A4, ADF RIGHT

(b) 11F6, ADF LEFT

(c) GUI 115;
11F27, ADF RIGHT

S 214-008

(2) Make sure the receiver and rack connectors do not have loose, dirty, or broken pins.

S 424-009

(3) Install the ADF receiver (AMM 20-10-01/401).

S 864-011

(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:

(a) GUI 001-114, 116-999;
11A4, ADF RIGHT

(b) 11F6, ADF LEFT

(c) GUI 115;
11F27, ADF RIGHT

D. ADF Receiver Test

S 864-012

(1) Make sure this circuit breaker on the P11 panel is closed:

(a) GUI 001-114, 116-999;
11A6, RDMI LEFT

(b) GUI 115;
11A7, RMI L

S 864-013
(2) Supply electrical power (AMM 24-22-00/201).

S 864-029
(3) GUI 115;
set the two bearing source switches on the left RMI to the ADF position.

S 864-030
(4) GUI 001-114, 116-999;
set the two bearing source switches on the left RDMI to the ADF position.

S 864-041
(5) Make sure the ADF receiver is not tuned to a valid AM broadcast station in the area.

S 744-019
(6) Push and hold the TEST switch on the applicable ADF receiver.
   (a) Make sure this sequence occurs on the ADF receiver:
      1) All the LEDs come on
      2) All the LEDs go off
      3) The green LED comes on and stays on.

S 754-031
(7) GUI 001-114, 116-999;
make sure these indications occur on the RDMI:

S 754-032
(8) GUI 115;
make sure these indications occur on the RMI:
   (a) The applicable ADF/VOR flag comes into view.
   (b) Next, the applicable bearing pointer goes to 135°.

S 414-023
(9) Close the rack door, and tighten the fasteners.

E. Put the Airplane Back to Its Usual Condition

S 864-024
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AUTOMATIC DIRECTION FINDER (ADF) CONTROL PANEL - REMOVAL/INSTALLATION

1. General
    A. This procedure has two tasks. One is the removal of the ADF control panel and the other is the installation of the ADF control panel.
    B. The ADF control panel is installed on the aisle control stand, P8.

TASK 34-57-02-004-001

2. Remove the ADF Control Panel
    A. Access
        (1) Location Zones
            211/212 Flight Compartment

    B. Prepare for the Removal

        S 864-002
        (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
            (a) GUI 001-114, 116-999;
                11A4, ADF RIGHT
            (b) 11F6, ADF LEFT
            (c) GUI 115;
                11F27, ADF RIGHT
    C. Procedure

        S 034-003
        (1) Loosen the screws on the control panel.

        S 014-004
        (2) Move the control panel out to get access to the electrical cable.

        S 034-005
        (3) Disconnect the electrical cable.

        S 024-006
        (4) Remove the ADF control panel.

TASK 34-57-02-404-007

3. Install the ADF Control Panel
    A. References
        (1) AMM 24-22-00/201, Electrical Power - Control

B. Access
   (1) Location Zones
       211/212 Flight Compartment

C. Prepare for the Installation

S 864-008

(1) Make sure these circuit breakers on the P11 panel are open:
   (a) GUI 001-114, 116-999;
       11A4, ADF RIGHT
   (b) 11F6, ADF LEFT
   (c) GUI 115;
       11F27, ADF RIGHT

D. Procedure

S 434-009

(1) Connect the electrical cable to the control panel.

S 424-010

(2) Install the ADF control panel.

S 434-011

(3) Tighten the screws.

S 864-012

(4) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   (a) GUI 001-114, 116-999;
       11A4, ADF RIGHT
   (b) 11F6, ADF LEFT
   (c) GUI 115;
       11F27, ADF RIGHT

S 864-013

(5) Supply electrical power (AMM 24-22-00/201).

S 754-016

(6) Make sure the control panel lights come on.

E. Put the Airplane Back to Its Usual Condition

S 864-015

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

AUTOMATIC DIRECTION FINDER (ADF) ANTENNA - REMOVAL/INSTALLATION

1. General
   A. Two ADF antennas are installed on the top of the fuselage. The left system antenna is installed in the forward position.

TASK 34-57-03-004-001

2. Remove the ADF Antenna
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
   B. Consumable Materials
      (1) B00184 Solvent - BMS 11-7
   C. References
      (1) AMM 20-10-22/701, Metal Surfaces
   D. Access
      (1) Location Zones
          243/244   Area Above Passenger Cabin Ceiling (Exterior)

   E. Prepare for the Removal

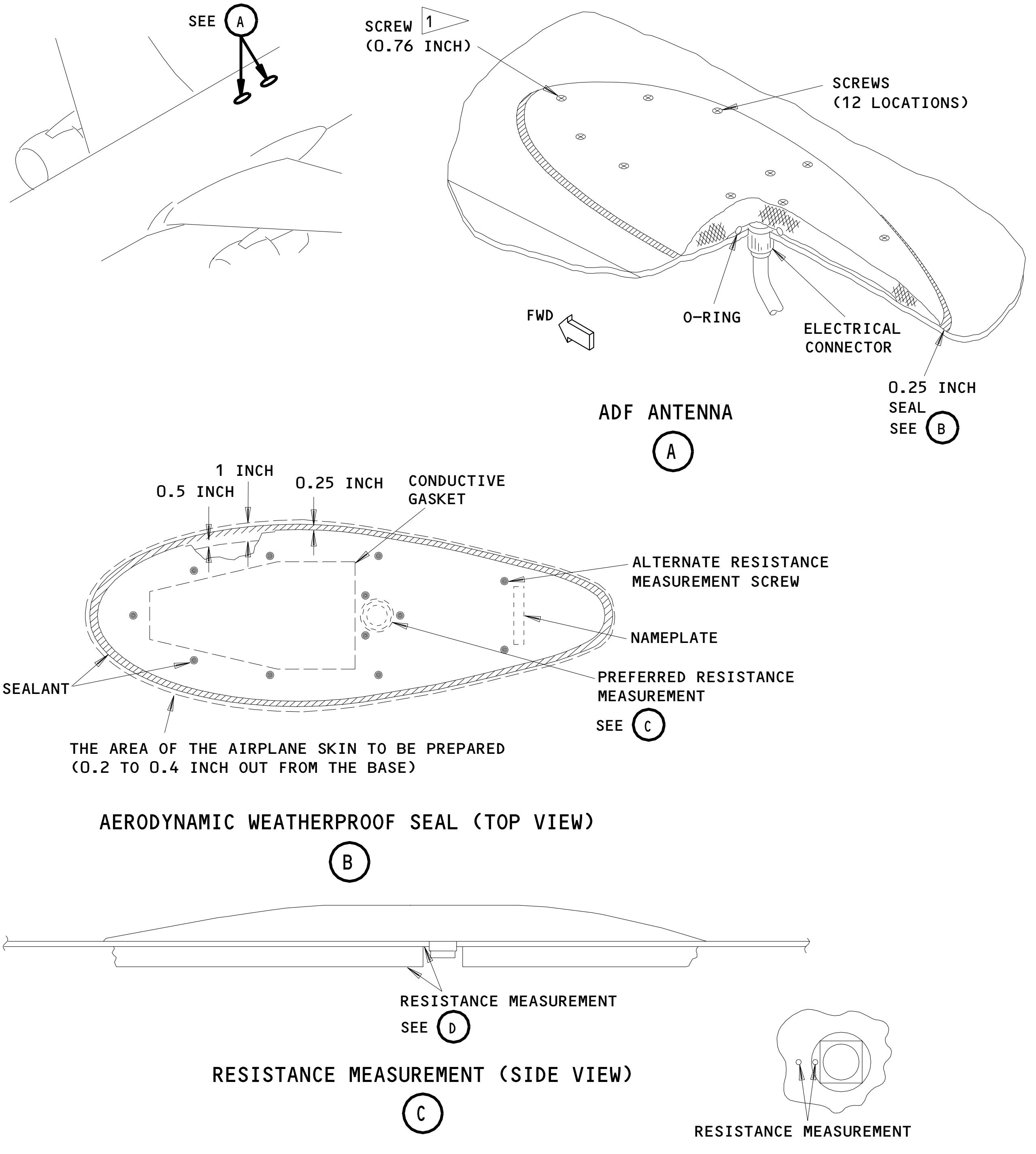
      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
          (a) GUI 001-114, 116-999;
              11A4, ADF RIGHT
          (b) 11F6, ADF LEFT
          (c) GUI 115;
              11F27, ADF RIGHT
   F. Procedure

      S 034-003
      (1) Remove the screws from the antenna.

      S 034-004

CAUTION: BE CAREFUL WHEN YOU USE FORCE WITH THE SEALANT REMOVAL TOOL TO BREAK THE ANTENNA SEAL. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE AIRPLANE SKIN OR THE ELECTRICAL CABLE AT THE ANTENNA BOTTOM.

      (2) Use force around the antenna with the sealant removal tool until the seal is fully broken.



NOTE: ALL THE SCREWS ARE NO. 10 5/32 HEX ALLEN TYPE. ALL THE SCREWS EXCEPT 1 ARE 1.55 INCHES LONG.

ADF Antenna Installation
Figure 401

S 014-005

CAUTION: MOVE THE ANTENNA ONLY AS FAR AS NECESSARY TO DISCONNECT THE CABLE. DAMAGE TO THE ANTENNA CABLE CAN OCCUR IF YOU PULL THE CABLE.

(3) Move the antenna until you can get access to the antenna cable connector.

S 034-006

(4) Disconnect the antenna cable.

NOTE: Do not let the antenna cable fall into the fuselage.

S 434-007

(5) Put a cover on the cable connector.

S 024-008

(6) Remove the ADF antenna.

S 144-009

(7) Remove the sealant from the airplane skin in the antenna area (Ref 20-10-22).

S 114-010

(8) Clean the airplane surface in the antenna area with the solvent, BMS 11-7, and a clean rag (AMM 20-10-22).

TASK 34-57-03-404-070

3. Install the ADF Antenna

A. Equipment
  (1) Resistance measuring bridge or ohmmeter which can measure 0.001 ohm
B. Consumable Materials
  (1) A00230 Sealant - BMS 5-37

(2) A00247 Sealant - BMS 5-95 Chromate type Class B-2
(3) C00175 Alodine 1000, MIL-C-5541
(4) G00286 Parting Agent - 4A 183

C. References
(1) AMM 20-10-22/701, Metal Surfaces
(2) AMM 24-22-00/201, Electrical Power - Control
(3) AMM 25-22-00/001, Passenger Compartment Ceiling Lining
(4) AMM 25-22-01/401, Sculptured Ceiling Panels
(5) AMM 25-22-02/401, Lowered Ceiling Panels
(6) AMM 25-28-02/401, Center Overhead Stowage Bins
(7) AMM 51-21-04/701, Alodine Coating
(8) AMM 51-31-01/201, Seals and Sealing
(9) SWPM 20-20-00, Electrical Bonding

D. Access
(1) Location Zones

211/212	Flight Compartment
243/244	Area Above Passenger Cabin Ceiling
243/244	Area Above Passenger Cabin Ceiling (Exterior)

E. Procedure

S 214-038
(1) Make sure the antenna bottom is clean (AMM 20-10-22).

S 624-039
(2) On the airplane skin, 0.2 to 0.4 inch out from the edge of the antenna bottom, prepare the surface, apply alodine 1000, and permit it to dry (AMM 51-21-04).

S 434-040
(3) On the antenna bottom, apply a parting agent and then a removable mating surface seal, BMS 5-37 (AMM 51-31-01).

S 434-041
(4) Do not let them touch the nameplate, decal, or the conductive gasket.

S 434-043
(5) Make sure a new O-ring is installed on the new antenna.

S 034-044
(6) Remove the cover from the cable connector.

S 434-045
(7) Connect the electrical cable to the antenna.

S 424-114
(8) Put the antenna into position and install the screws. Start with the three screws around the connector, then the most forward screw, and last, the opposite screws around the antenna.

S 424-115
(9) Tighten the screws to 20-25 pound-inches of torque in the same sequence as they were installed.

S 144-116
(10) Remove the unwanted sealant from the area around the antenna bottom (AMM 51-31-01).

S 764-046
(11) Do the resistance measurement as follows:
  (a) Remove the items that follow as applicable to get access to the antenna from inside the airplane:
    1) Sculptured Ceiling Panels (AMM 25-22-01/401)
    2) Lowered Ceiling Panels (AMM 25-22-02/401)
    3) Overhead Stowage Bins (AMM 25-28-02/401)
    4) Ceiling Insulation (AMM 25-22-00/001).
  (b) Preferred Procedure
    1) Use an ohmmeter to make sure the resistance is less than 0.001 ohm between the antenna connector and the airplane structure (SWPM 20-20-00).
  (c) Alternate Procedure
    1) Use an ohmmeter to make sure the resistance is less than 0.001 ohm between the tab/washer on the right rear screw and the airplane skin (SWPM 20-20-00).

S 434-047
(12) Apply a weatherproof sealant, BMS 5-95, in a 1/4 inch seal, at 45 degrees, around the outer edge of the antenna bottom (AMM 51-31-01).

S 434-048

(13) Apply the sealant, BMS 5-95, on all the screw hole, counter-bored areas to make a smooth antenna surface (AMM 51-31-01). Do not fill the allen head screw holes.

S 144-049

(14) Remove the unwanted sealant from around the antenna bottom (AMM 51-31-01).

S 864-050

(15) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  - (a) GUI 001-114, 116-999;
    11A4, ADF RIGHT
  - (b) 11F6, ADF LEFT
  - (c) GUI 115;
    11F27, ADF RIGHT

F. ADF Antenna Test

S 864-051

(1) Supply electrical power (AMM 24-22-00/201).

S 864-052

(2) Make sure these circuit breakers on the P11 panel are closed:
  - (a) GUI 001-114, 116-999;
    11A6, RDMI LEFT
  - (b) GUI 115;
    11A6, RBA L
  - (c) GUI 115;
    11A7, RMI L
  - (d) GUI 115;
    11F23, RMI R
  - (e) GUI 001-114, 116-999;
    11F25, RDMI RIGHT

S 864-053
(3) On the ADF control panel, set the controls as follows:
  (a) GUI 001, 009, 115;
  The BFO switches to the OFF position.
  (b) GUI 002-008, 010-114, 116-999;
  The mode switches to the ADF position.
  (c) GUI 002-008, 010-114, 116-999;
  The TONE switch to the off position.
  (d) Set the applicable frequency control to a broadcast station from 550 to 830 kHz.

S 864-079
(4) GUI 001-114, 116-999;
Set the bearing source switches on the RDMIs to the ADF position.

S 864-080
(5) GUI 115;
Set the bearing source switches on the RMIs to the ADF position.

S 754-081
(6) GUI 001-114, 116-999;
Make sure the RDMIs show the correct bearing.

S 754-082
(7) GUI 115;
Make sure the RMIs show the correct bearing.

G. Put the Airplane Back to Its Usual Condition

S 864-059
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

GLOBAL POSITIONING SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The global positioning system (GPS) is a satellite-based radio navigation system that calculates airplane position and instantaneous time with a high degree of accuracy. The GPS carrier frequencies are 1575.42 megahertz and 1227.6 megahertz. Commercial receivers use the 1575.42 megahertz frequency only.
   B. The GPS consists of two multi-mode receivers (MMR) and two active antennas. Power is applied to the system through the MMR-L and MMR-R circuit breakers on the P11 overhead circuit breaker panel.
   C. The GPS uses position and velocity data from the Inertial Reference System (IRS) to assist with initialization of the MMR and as input to MMR degraded modes of operation. The GPS supplies information to the flight management computer system (FMCS) CDUs, the EFIS, and EICAS. MMR warnings are displayed on EICAS and the CDU scratchpad.
   D. The GPS antennas receive position and time data from several satellites. The MMRs calculate the airplane position by determining the distance from the known location of the satellites in view. The GPS and other navigation systems send data to the FMCS for use in the FMCS calculation of airplane position.
2. Component Detail
   A. Global Positioning System (GPS) Receiver Module
      (1) The GPS receiver modules is located in the left and right MMR (AMM 34-31-00). The left MMR is located in the main electronic equipment center E2-3 and the right MMR is on the E2-2.
      (2) The GPS receiver module is an L-band receiver which receives the satellite RF inputs from the antenna and then filters, amplifies and processes these inputs to determine the airplanes three dimensional position, velocity and time.
      (3) The GPS receiver module measures the transit time of each signal to determine the airplanes relative distance to each satellite. At least four satellites are tracked in the navigation mode. As the number of satellites in view increases, the GPS module's ability to detect satellite failures improves.
      (4) Measurements obtained from the satellite signals are compared with estimates computed in a previous filter update. The resulting differences are used for subsequent updates.
      (5) An internal clock is used as a time reference to measure the distance to each satellite being tracked. The clock is assumed to be wrong by an amount called the clock bias. This parameter is calculated at the same time the satellite distances are calculated.
      (6) ARINC 429 transmitters send satellite measurements and navigation data to the flight management computer system (FMCS). If a failure is detected, a failure discrete is sent to the master caution unit.

B. GPS Antenna

(1) The GPS antenna receives L-band radio frequency signals from the navigation satellites. The antenna is small and flat (approximately 0.75 inch thick, 3 inches wide, and 5 inches long). There is a single coaxial connector at the bottom of the antenna.

(2) The GPS antenna impedance is 50 ohms. A masking angle of 5 degrees is used to reject the signals from satellites less than 5 degrees above the horizon.

(3) Satellite signals reflected from the surface of the ocean can change the polarization of the signals. The antenna is designed to receive signals with the correct polarization and to reject the reflected signals.

C. GPS Position Determination

(1) Each Multi-Mode receiver (MMR) uses the principle of ranging to measure the distance between the MMR and the satellites. The MMR memory has an almanac of the location of the satellites in their orbits at any time.

(2) The MMR measures the time it takes for a radio signal to go from a satellite to the airplane. Since the MMR knows the location of the satellite, and that the radio signal travels at the speed of light, it can calculate the distance to the satellite.

(3) However, since this is one-way ranging, the MMR must know precisely at what time the satellite sent the radio signal. The MMR compares the satellite signal to a signal the MMR generates at the same time as the satellite. The difference between the two signals is the time the signal took to get to the MMR.

(4) Each satellite has atomic clocks to keep accurate time. All the satellites have precisely the same time. The MMR in the airplane has an internal clock but it is not atomic, so it is not as accurate. Thus, it is not possible for the MMR to have precisely the same time as the satellite.

(5) The MMR assumes that its internal clock is off by some clock bias. This is an unknown that the MMR must calculate. This clock bias represents the difference between the MMR time and the GPS satellite time.

(6) To calculate the airplane position (latitude, longitude, and altitude) and the clock bias, the MMR must use data from at least four satellites. The MMR measures the distances to all the satellites at the same time. It then solves for the four unknowns, latitude, longitude, altitude, and clock bias by the use of four equations.

D. GPS Displays

(1) The latitude longitude as computed by the GPS-L and GPS-R can be viewed by pressing the RTE key on the FMCS CDU and then selecting the POS REF page (AMM 34-61-00/001).

(2) The EICAS evaluates failure and activity indication from left and right FMC before it set the status messages. If one (left or right) GPS receiver module indicates a fault, then EICAS displays GPS L or GPS R advisory message. If both module indicate a fault, then EICAS displays GPS advisory message instead of GPS l and GPS R advisory message.

E. GPS Signals

(1) All GPS satellites simultaneously transmit at the same frequency. A spread-spectrum modulation technique enables pseudo random codes and navigation data to be transmitted simultaneously at the same frequency without interference. Each satellite has a unique pseudo random code.

NOTE: A pseudo random code is a signal with a distinct pattern which is used to identify a particular satellite.

(2) GPS signals are transmitted at very low power, often below that of thermal noise. Spread-spectrum modulation is used to transform the signal from high power to a large band width. This technique spreads the carrier power over a wide frequency sprectrum.

(3) The MMR knows the transmitted carrier frequency, the type of modulation, the pseudo random code, and the code bit rate. The receiver generates a copy of the signal expected from each satellite. The respective codes from each satellite are aligned, synchronized and then tracked.

(4) The receiver decodes the spread spectrum signal by knowing what to look for and where to look, below the noise level for repeating patterns. The signal is multiplied by the selected code and is converted to a high-power, narrow-band signal. The signal is demodulated to obtain the navigation data.

F. GPS Modes of Operation

(1) The MMR operates in the following modes:
   (a) Self-test
   (b) Initialization
   (c) Acquisition
   (d) Altitude aiding
   (e) Aided
   (f) Fault

(2) During the self-test mode, the MMR tests its internal circuits to verify proper operation. The test occurs automatically on power-up. If the self-test fails, the MMR enters the fault mode.

(3) The MMR enters the initialization mode if the self-test passes. This mode lasts about 30 seconds while the signal processing sections are initialized with values of latitude, longitude, and altitude. During this mode there are no navigation outputs.

(4) In the acquisition mode, the MMR searches for and locks onto the satellite signals. The MMR must find at least four satellites before it starts to calculate GPS data. The MMR uses position data from the IRS that was obtained in the initialization mode in order to calculate which satellites are in view. If the IRS position data is not available, the MMR can still acquire satellite signals. In this case, the MMR must look for all the satellites. This requires approximately 10 minutes.

(5) The MMR enters the navigation mode after it acquires and locks onto at least four satellites. While in the navigation mode, the MMR updates and outputs positions, velocities, accelerations, and time.

(6) If the MMR is unable to track at least four or more satellites, it enters the altitude-aided mode. With only three satellites in view, the MMR uses IRS inertial altitude plus the length of the earth's radius as the fourth range. The MMR re-enters the navigation mode when four satellites are acquired.

(7) The MMR enters the aided mode during short periods (less than 30 seconds) of bad satellite coverage. In the aided mode, the MMR receives altitude, track, and ground speed from the IRS. The MMR uses these inputs to continue the calculation of navigation data. If the MMR cannot track a sufficient number of satellites for 30 seconds, it reverts to the acquisition mode.

(8) The MMR enters the fault mode if a critical fault is detected. In this mode the navigation data is invalid, and the MMR is no longer useful for navigation on that flight. The other MMR continues to supply navigation data to the FMCS.

3. Operation

A. Functional Description

(1) The satellite segment is a group of satellites that orbit approximately 10,900 nautical miles above the earth. Each satellite completes an orbit once every 12 hours. The full group of operational satellites consists of 21 primaries and 3 spares.

(2) The user segment includes all GPS users. Each user receives the signals from four or more satellites and calculates the recevier's position. Based on information from the internal almanac, the MMR selects the satellite constellation which provides the highest accuracy for position determination. The MMR automatically switches to new constallations as the satellites progress in their orbits and the airplane proceeds on its flight path.

(3) The purpose of the control segment is to monitor and correct satellite orbits and clocks, to calculate and format the satellite navigation message, and to periodically update the message via the upload stations. The message consists of data concerning the future positions of the satellites, as well as corrections for satellite time.

(4) The control segment consists of one master control station, five monitor stations, and three upload stations. The stations are located in a world-wide arrangement to optimize satellite control. All monitor stations are equipped with atomic clocks and multi-channel receivers that receive signals from the satellites in view. By receiving the same signals and navigation messages as the users, the monitor stations can determine whether the satellites are providing optimal performance data.

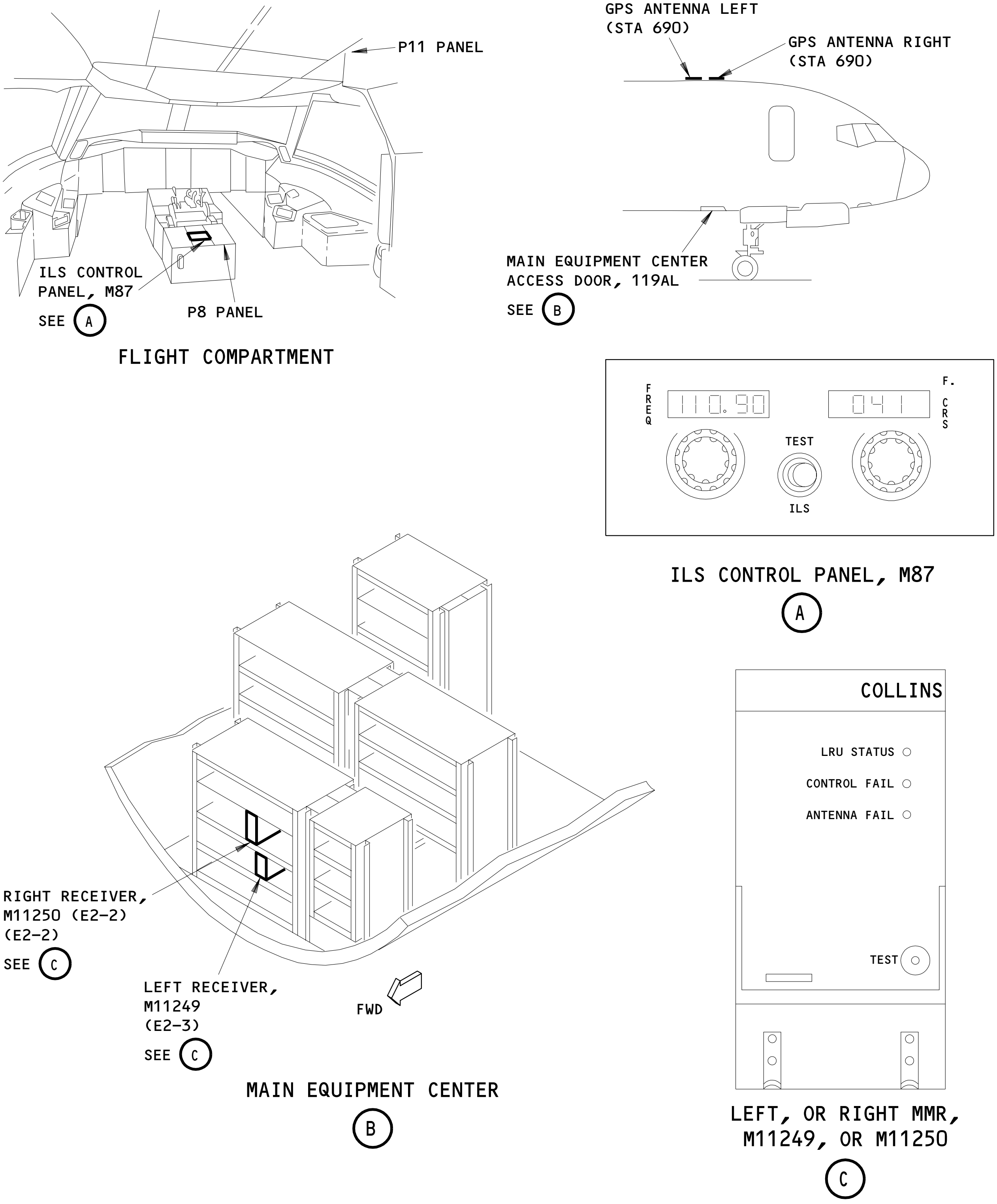
(5) The master control station directs all operations in the control segment. It continuously receives the data collected by the monitor stations. This data is used to formulate the navigation message which contains individual orbital parameters and clock corrections for all satellites. The navigation message is relayed to the satellites three times a day by the upload stations.

GLOBAL POSITIONING SYSTEM (GPS)

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	AMM REFERENCE
ANTENNA - L GPS, M11247		1		
ANTENNA - R GPS, M11248		1		
CIRCUIT BREAKER -			FLT COMPT, P11	
MMR LEFT, C4600		1	11E10	*
MMR RIGHT, C4601		1	11E31	*
RECEIVER - LEFT MULTI-MODE, M11249	1	1	119AL, MAIN EQUIP CTR, E2-3	34-31-01
RECEIVER - RIGHT MULTI-MODE, M11250	1	1	119AL, MAIN EQUIP CTR, E2-2	34-31-01

* SEE THE WDM EQUIPMENT LIST

Global Positioning System (GPS) - Component Index
Figure 101



FLIGHT COMPARTMENT

ILS CONTROL PANEL, M87
A

MAIN EQUIPMENT CENTER
B

LEFT, OR RIGHT MMR,
M11249, OR M11250
C

GPS - Component Location
Figure 102

GLOBAL POSITIONING SYSTEM - ADJUSTMENT/TEST

1. General

A. This procedure has two tasks.

(1) This first task is an operational test of the Global Positioning System (GPS). The second task is a system test of the GPS.

NOTE: The airplane must be moved to a position where the GPS antennas have a clear view of the GPS satellites.

TASK 34-58-00-715-001

2. Operational Test - Global Positioning System

A. General

(1) This task does a GPS position check.

B. Reference

(1) AMM 24-22-00/201, Manual Control

C. Access

(1) Location Zones

211/212 Flight Compartment

D. Prepare for the Test

S 865-002

(1) Supply electrical power (AMM 24-22-00/201).

S 865-003

(2) Make sure these circuit breakers on the P11 panel are closed:
  - (a) 11E10, MMR-L
  - (b) 11E31, MMR-R
  - (c) 11A3, MMR-C

E. Procedure

S 585-004

(1) Move the airplane to a position where the GPS antennas have a clear view of the GPS satellites.

S 865-015

(2) Set the FMC source select switch to the NORMAL position.

S 715-005

(3) Do these steps to see the GPS position on an MCDU:
  - (a) Push the INIT/REF key on one of the MCDU.
  - (b) Push the line select key (LSK) that is adjacent to <INDEX on both MCDUs.

(c) Push the LSK that is adjacent to <POS on both MCDUs.
  1) Make sure the POS INIT Page 1/4 is shown on both MCDUs.
  2) Make sure GPS position is shown on both MCDUs.
  3) Make sure GPS header is shown next to UTC.
(d) Push the LSK that is adjacent to <INDEX on both MCDUs.
(e) Push the LSK that is adjacent to <MAINT on both MCDUs.
(f) Push the LSK that is adjacent to <SENSORS on both MCDUs.
(g) Push the NEXT PAGE key on the MCDU.
  1) Make sure the Left and Right Status of the GPS sensors on the SENSOR STATUS page 2/2 on both MCDUs shows OK.
(h) Open this circuit breaker on the P11-1 panel:
  1) 11E10, MMR-L
  2) Make sure the Left GPS status on the MCDU is FAIL.
(i) Close this circuit breaker on the P11-1 panel:
  1) 11E10, MMR-L
  2) Make sure the left GPS status on the MCDU returns to OK.
(j) Open this circuit breaker on the P11-2 panel:
  1) 11E31, MMR-R
  2) Make sure the Right GPS status on the MCDU is FAIL.
(k) Close this circuit breaker on the P11-2 panel:
  1) 11E31, MMR-R
  2) Make sure the right GPS status on the MCDU returns to OK.

F. Put the Airplane Back to Its Usual Condition

S 865-016

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-58-00-735-006

3. System Test - Global Positioning System

A. General
(1) This task does a GPS interface check.

B. Reference
(1) AMM 24-22-00/201, Manual Control

C. Access
(1) Location Zones

211/212	Flight Compartment

D. Prepare for the Test

S 865-007

(1) Supply electrical power (AMM 24-22-00/201).

S 865-008

(2) Make sure these circuit breakers on the P11 panel are closed:
   - (a) 11E10, MMR-L
   - (b) 11E31, MMR-R
   - (c) 11A3, MMR-C

E. Procedure

S 585-009

(1) Move the airplane to a position where the GPS antennas have a clear view of the GPS satellites.

S 865-010

(2) Set the FMC source select switch to the NORMAL position.

S 715-011

(3) Do these steps to see the GPS position output:
   - (a) Push the INIT/REF key on one of the MCDU.
   - (b) Push the line select key (LSK) that is adjacent to <INDEX.
   - (c) Push the LSK that is adjacent to <POS.
   - (d) Push the NEXT PAGE key on the MCDU two (2) times.
     - 1) Make sure the GPS R position is shown on line 5 of the MCDU displays.
     - 2) Make sure the GPS L position is shown on the line above the GPS R position.

NOTE: As much as 10 minutes of time can be necessary for the positions to show on the CDU.

S 715-012

(4) Do these steps to do a check of the GPS/FMC and GPS/MCU (master caution unit) data busses.
   - (a) Open this circuit breaker on the P11-2 panel:
     - 1) 11E31, MMR-R
     - 2) Make sure the GPS R position on line 5 is blank on the MCDU.
     - 3) Make sure the GPS L position stays in view on the MCDU.
     - 4) Make sure the R GPS fault message appears on the left side of the EICAS.
   - (b) Open this circuit breaker on the P11-1 panel:
     - 1) 11E10, MMR-L
     - 2) Make sure the GPS L position goes out of view on the MCDU.
     - 3) Make sure the GPS R position stays out of view on the MCDU.
     - 4) Make sure the GPS fault message appears on the left side of the EICAS.

(c) Close these circuit breakers on the P11 panel:
   1) 11E10, MMR-L
   2) 11E31, MMR-R

(d) Make sure the GPS fault message has cleared from the EICAS display.

F. Put the Airplane Back to Its Usual Condition

S 865-014

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

GPS ANTENNA - REMOVAL/INSTALLATION

1. General
   A. This procedure has two tasks. The first task is the removal of a GPS antenna. The second task is the installation of a GPS antenna.
   B. There are two GPS antennas on the airplane. The left antenna is installed at station 300A. The right antenna is installed at station 300B.

TASK 34-58-01-024-001

2. GPS Antenna Removal (Fig. 401)
   A. Equipment
      (1) Sealant removal tool - hardwood or plastic
   B. Access
      (1) Location Zones
         107 Forward Half of Cabin, Right

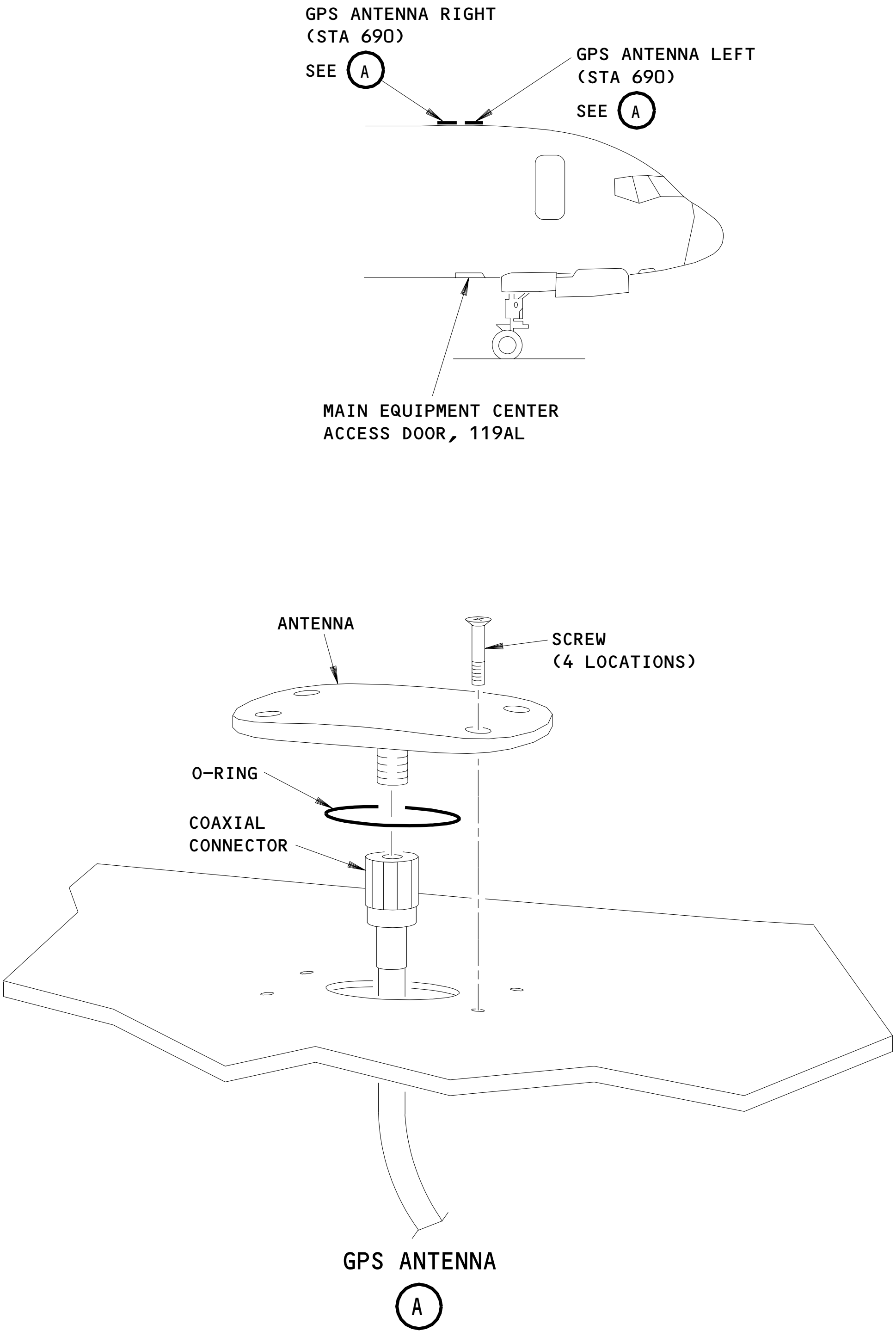
   C. Removal Procedure

      S 864-002
      (1) Open these circuit breakers on the overhead circuit breaker panel and attach DO-NOT-CLOSE tags:
         (a) 11E10, MMR L
         (b) 11E31, MMR R

      S 024-003
      (2) Remove the GPS antenna:

      CAUTION: BE CAREFUL WHEN YOU USE THE SEALANT REMOVAL TOOL TO BREAK THE SEAL. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE AIRPLANE SKIN, THE COAXIAL CABLE, OR THE ANTENNA.

         (a) Use the sealant removal tool to break the seal all around the antenna.
         (b) Remove the sealant that covers the antenna screws.
         (c) Remove the antenna screws.



Global Positioning System Antenna Installation
Figure 401

CAUTION: MOVE THE ANTENNA THE LEAST DISTANCE NECESSARY TO DISCONNECT THE CONNECTOR. DAMAGE TO THE CABLE CAN OCCUR IF YOU PULL THE CABLE WITH TOO MUCH FORCE.

(d) Carefully pull the antenna until you can get access to the connector.
(e) Disconnect the connector.

NOTE: Make sure the cable and connector do not fall into the airplane fuselage.

(f) Remove the GPS antenna.

TASK 34-58-01-424-004

3. GPS Antenna Installation (Fig. 401).
   A. Equipment
      (1) Resistance measuring bridge or ohmmeter
      (2) Spatula - fillet smoothing tool, hardwood or plastic
   B. Consumable Materials
      (1) A00145 Sealant - BMS 5-95, Class B-2
      (2) B00184 Solvent - BMS 11-7
      (3) C00175 Primer - BMS 10-79, Type III
      (4) C00855 Alodine
      (5) D00254 Grease - Sillicone - Dow Corning 4 - SAE AS8660
      (6) G00033 Woven Cheesecloth - BMS 15-5
      (7) G00009 Corrosion Inhibiting Compound - BMS 3-27 (Preferred)
      (8) C50056 Compound - Non-drying Corrosion Inhibiting Resin Mix, BMS 3-38 (Alternate)
      (9) G50136 Paste - Corrosion Inhibiting Non-drying, BMS 3-38 (Alternate)
      (10) G50237 Compound - Corrosion Inhibiting Non-drying Cor-Ban 27L, BMS 3-38 (Alternate)
   C. References
      (1) AMM 20-10-22/701, Metal Surfaces
      (2) AMM 24-22-00/201, Manual Control
      (3) AMM 51-21-04/701, Alodine Coating
      (4) AMM 51-31-01/201, Seals and Sealing
   D. Access
      (1) Location Zones

107	Forward Half of Cabin, Right

E. Installation Procedure

S 864-005

(1) Open these circuit breakers on the overhead circuit breaker panel and attach DO-NOT-CLOSE tags:
  (a) 11E10, MMR L
  (b) 11E31, MMR R

S 114-006

(2) Clean the airplane skin and the inner antenna surface with the solvent, BMS 11-7 (AMM 20-10-22/701).

S 144-007

(3) If there is corrosion on the airplane skin below the antenna, prepare the airplane skin as follows:
  (a) Remove the corrosion (AMM 20-10-22/701).
  (b) Clean the airplane skin in the area of the corrosion with the solvent, BMS 11-7 (AMM 20-10-22/701).
  (c) Apply a layer of alodine on the airplane skin in the area where the antenna touches the skin (AMM 51-21-04/701).
  (d) On top of the alodine, apply two layers of the BMS 10-79 Type III primer.

  NOTE: Let each layer dry for the correct cure time.

S 624-008

(4) Apply a layer of the BMS 3-27 (preferred) or BMS 3-38 (alternate) corrosion inhibiting compound in the screw holes and in the coaxial cable hole.

S 624-009

(5) Apply a very thin layer of the BMS 3-27 (preferred) or BMS 3-38 (alternate) on the base of the antenna.

NOTE: Do not get the BMS 3-27 or BMS 3-38 on the O-ring or the O-ring groove.

S 214-010
(6) Examine the O-ring and replace it if it is damaged.

S 624-011
(7) Apply a layer of the BMS 3-24 grease on the O-ring and O-ring groove.

S 434-012
(8) Install the O-ring on the antenna.

S 624-013
(9) Apply a layer of the BMS 3-27 (preferred) or BMS 3-38 (alternate) corrosion inhibiting compound on the threads and shank of the antenna screws.

S 424-014
(10) Install the GPS antenna.
  (a) Connect the electrical connector to the antenna.
  (b) Apply a large quantity of Dow Corning 4 grease, D00254, to the outside coaxial connector, and at the exterior connector/antenna interface.
  (c) Put the antenna into its position on the airplane.
  (d) Install three of the botls that hold the antenna.

    <u>NOTE</u>: For GPS antenna connectors with hex nuts, make sure the bolts are tightened to 8 to 12 in-lbs. For the coaxial connector that does not have hex nuts, these botls are installed manually. Do not use power or pneumatic tools to install these bolts.
  (e) Remove the unwanted BMS 3-27 or BMS 3-38 corrosion inhibiting compound from the around the antenna with the BMS 11-7 solvent (AMM 20-10-22/701).

S 764-015
(11) Do a check of the resistance between the antenna and the airplane skin as follows:
  (a) Connect the ohmmeter between the base of the antenna and the airplane skin.

    <u>NOTE</u>: Get access to the base of the antenna through the hole for the last screw.

    1) Make sure the measured resistance is 0.025 ohms or less.

S 434-016
(12) Install the last screw that holds the antenna.

S 114-017

(13) Remove the unwanted BMS 3-27 corrosion inhibiting compound from around the head of each screw with the BMS 11-7 solvent (AMM 20-10-22/701).

S 394-018

(14) Apply the aerodynamic seal as follows (AMM 51-31-01/201):
   (a) Apply the BMS 5-95 sealant around the antenna where it touches the airplane skin.

   NOTE: Make sure no air bubbles are in the sealant. Use a sufficient quantity of the sealant to make the surface smooth.

   (b) Make an aerodynamic fillet seal with the fillet smoothing spatula.
   (c) Remove all the unwanted BMS 5-95 sealant from the area around the antenna.
   (d) Fill the screw holes with the BMS 5-95 sealant.

   NOTE: Make the sealant smooth in relation to the antenna surface.

F. GPS Antenna Installation Test

S 864-019

(1) Supply electrical power (AMM 24-22-00/201).

S 864-020

(2) Remove the DO-NOT-CLOSE tags on the overhead circuit breaker panel and close these circuit breakers:
   (a) 11E10, MMR L
   (b) 11E31, MMR R

S 584-021

(3) Move the airplane to a position where the GPS antennas have a clear view of the GPS satellites.

S 864-024

(4) Set the FMC source select switch to the NORMAL position.

S 714-022

(5) Do these steps to see the GPS position output:
  (a) Push the INIT REF key on one of the MCDU.
  (b) Push the line select key (LSK) that is adjacent to <INDEX.
  (c) Push the LSK that is adjacent to <POS.
  (d) Push the NEXT PAGE key on the MCDU two (2) times.
    1) Make sure the GPS R position is shown on line 5 of the MCDU displays.
    2) Make sure the GPS L position is shown on line 3 of the MCDU displays.

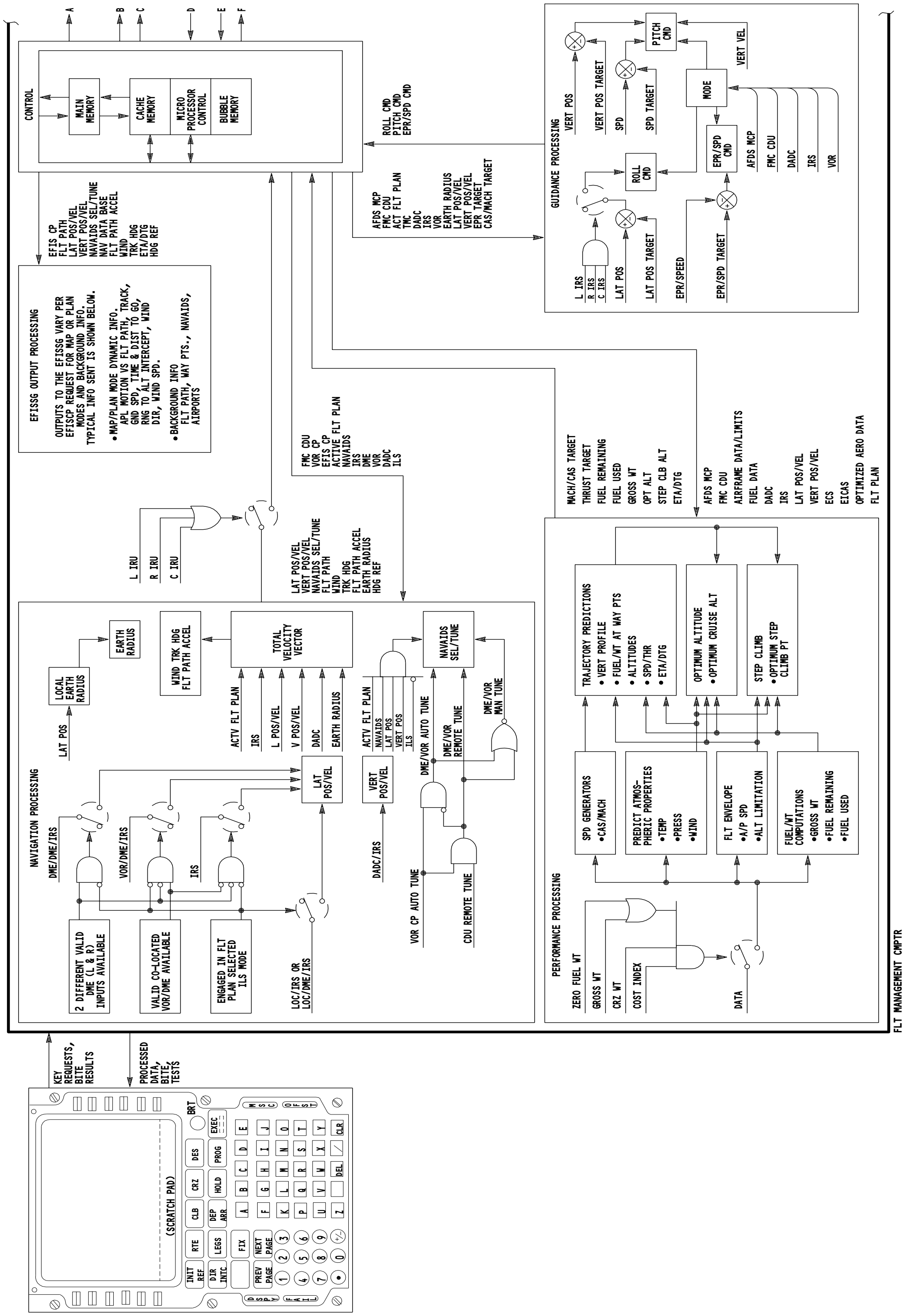
G. Put The Airplane Back to Its Usual Condition

S 864-023

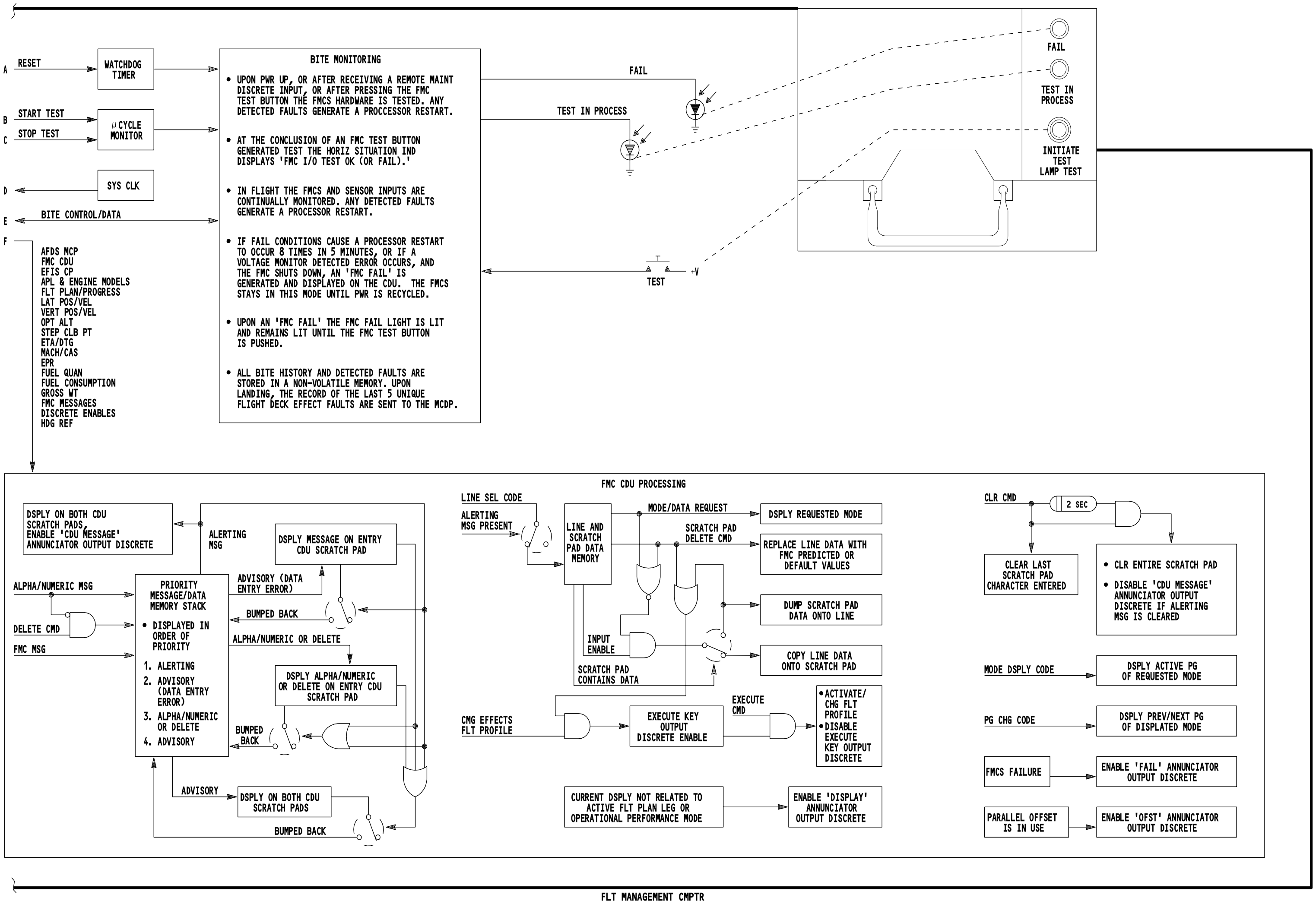
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

FLIGHT MANAGEMENT COMPUTER SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The Flight Management Computer System (FMCS) provides flight information to the pilots in the form of navigation, performance management, guidance, and integrated displays. It provides lateral and vertical steering signals for the roll and pitch channels of the autopilot/flight director system (Ref 22-10-00, Autopilot [Flight Control]). It also provides commands to the thrust management system for vertical path guidance (Ref 22-32-00, Thrust Management System). Flight plan mapping and path data are displayed on flight instrument system horizontal situation indicators (Ref 34-22-00, Flight Instrument System). Recorded in-flight faults are sent to a maintenance control display panel (Ref 22-41-00, Maintenance Monitor).
   B. The FMCS hardware consists of two Flight Management Computers (FMC) and two Control/Display Units (CDU). The FMCs, located in the main electrical/electronic compartment, are the central signal processors for the flight management functions. The CDUs, located on aisle stand forward electronic panel P-9, provide the interfaces between the pilot and FMC.
   C. The pilots can manually input data to the FMCS through four units: Control Display Unit, AFCS Mode Control Panel, EFIS Control Panel, and Thrust Mode Select Panel.
   D. FMC Interface - Inputs (Fig. 2)
      (1) General
         (a) Each FMC receives sensor information on ARINC 429 digital input buses. The IRS and offside FMC (Intersystem) buses are high speed. None of the input buses are switched.
         (b) Each FMC can operate independent of the other. Each receives identical information from the interfacing sensors and controls. The multiple input of identical information allows source selection and averaging of data within the FMC. The FMC continuously receives input data from all inputs except the Data Loader.
      (2) The FMCS receives digital input data from the following systems:
         (a) Air Data Computing System (ADCS)
            1) The ADCS (Ref 34-12-00) provides an ARINC 429 bus from each of the computers. Bus data consists of altitude, Mach, computed airspeed (CAS), true airspeed (TAS), true air temperature (TAT), static air temperature (SAT), maximum operating schedule, and an ADC discrete word. Air data inputs are primarily used for performance computations. Both FMCs normally use the left ADC. If the left ADC is not valid, the right ADC is selected.



Flight Management Computer Schematic
Figure 1 (Sheet 1)



Flight Management Computer Schematic
Figure 1 (Sheet 2)

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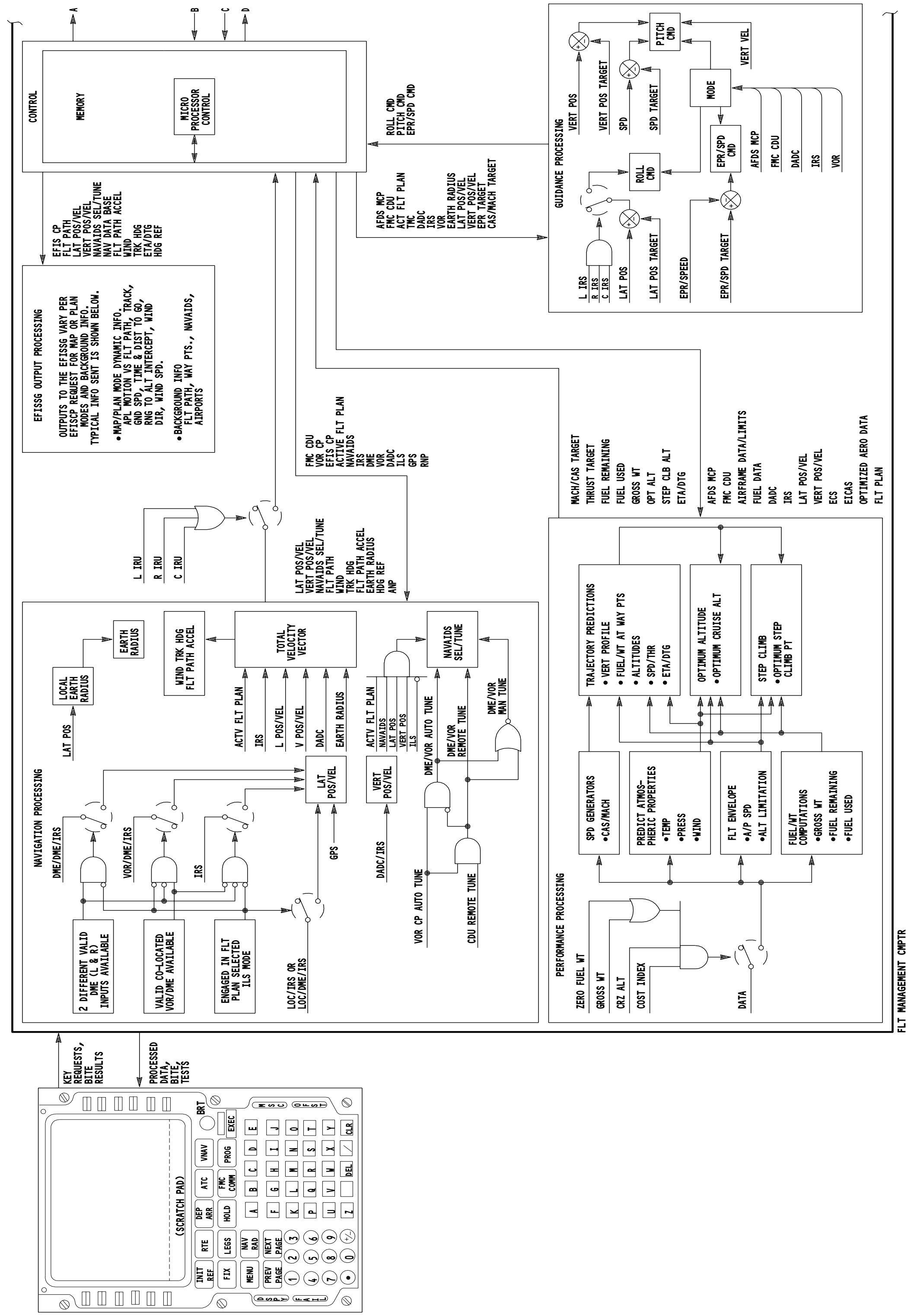
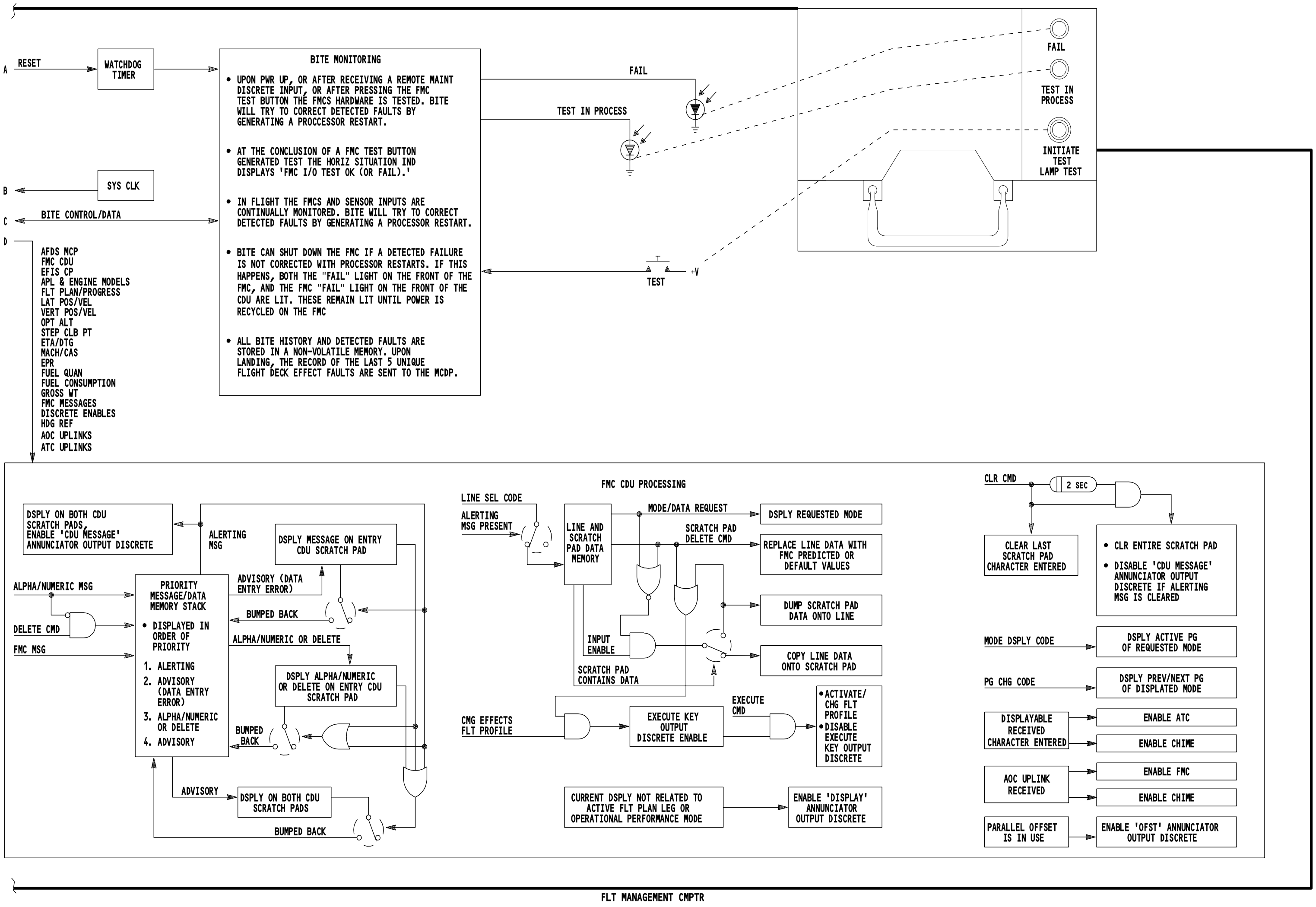


Flight Management Computer Schematic
Figure 1 (Sheet 3)

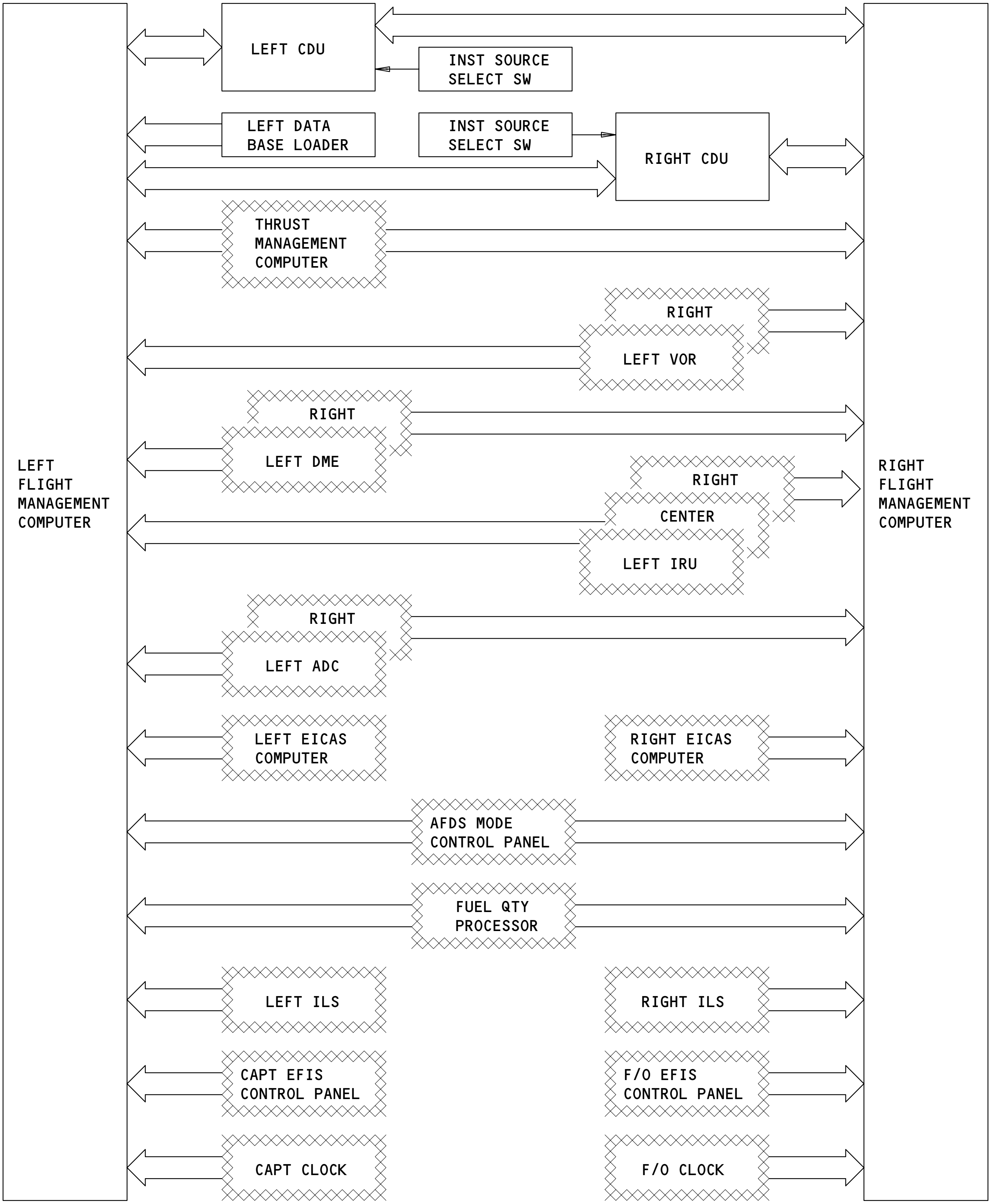


BITE MONITORING

- UPON PWR UP, OR AFTER RECEIVING A REMOTE MAINT DISCRETE INPUT, OR AFTER PRESSING THE FMC TEST BUTTON THE FMCS HARDWARE IS TESTED. BITE WILL TRY TO CORRECT DETECTED FAULTS BY GENERATING A PROCCESSOR RESTART.
- AT THE CONCLUSION OF A FMC TEST BUTTON GENERATED TEST THE HORIZ SITUATION IND DISPLAYS 'FMC I/O TEST OK (OR FAIL).'
- IN FLIGHT THE FMCS AND SENSOR INPUTS ARE CONTINUALLY MONITORED. BITE WILL TRY TO CORRECT DETECTED FAULTS BY GENERATING A PROCESSOR RESTART.
- BITE CAN SHUT DOWN THE FMC IF A DETECTED FAILURE IS NOT CORRECTED WITH PROCESSOR RESTARTS. IF THIS HAPPENS, BOTH THE "FAIL" LIGHT ON THE FRONT OF THE FMC, AND THE FMC "FAIL" LIGHT ON THE FRONT OF THE CDU ARE LIT. THESE REMAIN LIT UNTIL POWER IS RECYCLED ON THE FMC
- ALL BITE HISTORY AND DETECTED FAULTS ARE STORED IN A NON-VOLATILE MEMORY. UPON LANDING, THE RECORD OF THE LAST 5 UNIQUE FLIGHT DECK EFFECT FAULTS ARE SENT TO THE MCDP.

Flight Management Computer Schematic
Figure 1 (Sheet 4)

K22467



FMC Digital Inputs
Figure 2

(b) Inertial Reference System (IRS)
  1) The IRS (Ref 34-21-00) provides an ARINC 429 bus from each of three IRUs. The bus data consists of present position, heading, attitude, inertial altitude, speed (three axes), velocity (three axes), and acceleration (three axes). The bus also contains a discrete word identifying IRS status.
  2) If the IRS does not have its own keyboard, the IRS requires initialization from the FMCS before it is able to operate in the NAV mode. Each of the IRUs receive initial present position and initial heading on an ARINC 429 output bus from the FMC.
  3) The FMC uses the weighted average from the three IRUs for position data. It uses the arithemic average from the three IRUs for velocity data.

(c) Clock
  1) Each of the two clocks is connected to its own FMC. However, both FMCs use the left clock if it is valid. The right clock is used only if the left clock is invalid. The FMC uses the minutes and seconds inputs from the clocks and maintains the hours internally.

(d) DME/VOR
  1) The DME and VOR position data is received independently from the NAV sensors. The DME system (Ref 34-55-00) provides ARINC 429 bus data which contains DME distance and DME frequency. The DME system also provides an auto/manual tuning discrete to the FMCS.
  2) The VOR system (Ref 34-51-00) provides an ARINC 429 bus that contains VOR bearing and VOR frequency. The VOR system also provides an auto/manual tuning discrete to the FMCS.
  3) The FMCS provides for automatic tuning of the DME/VOR receivers on an ARINC 429 BUS.

(e) ILS
  1) The Instrument Landing System (ILS) (AMM 34-31-00/001) provides ARINC 429 bus data that contains the ILS frequency, localizer deviation, and glide slope deviation. The localizer deviation and ILS frequency are used for navigation computations. Glideslope deviation is not presently used by the FMCS. The FMCS does not provide outputs to the ILS.

2) The left ILS receiver is connected to the left FMC. The right ILS receiver is connected to the right FMC. Both FMCs use the left ILS data, if valid. The right ILS data is used if the left ILS data is invalid. The ILS data is transmitted between FMCs over the intersystem bus.

(f) Fuel

1) The FMCs uses fuel flow, provided by EICAS, and fuel quantity, provided by the Fuel Quantity Indicating System, for calculating the fuel status. If the fuel quantity data from the fuel quantity indicating processor unit totalizer is invalid, the FMC uses only the fuel flow data. If one or both of the fuel flow inputs are invalid, the FMC uses the totalizer data only.

(g) TMS

1) The Thrust Management System (TMS) (AMM 22-32-00/001) provides ARINC 429 bus data containing flap position, assumed outside air temperature, TMS mode status, actual EPR, reference EPR, and EPR derating. The TMS data is used in performance and guidance calculations.

2) If the TMC data is invalid, the FMC uses the flap position data from the AFCS MCP. The bleed air analog discrete inputs are provided by the ECS bleed configuration cards.

(3) Analog Discretes (Fig. 3)

(a) The FMC interface analog discretes consist of two types - condition dependent and hardwired discretes.

(b) The condition dependent discretes are:

1) The VOR/DME automatic or manual tune selection for left and right receivers.

2) The bleed air conditions for each engine that sense the status of the cowl anti-ice valve, isolation valve, wing anti-ice valve, and ECS Packs. The bleed air data is also connected to the EECs.

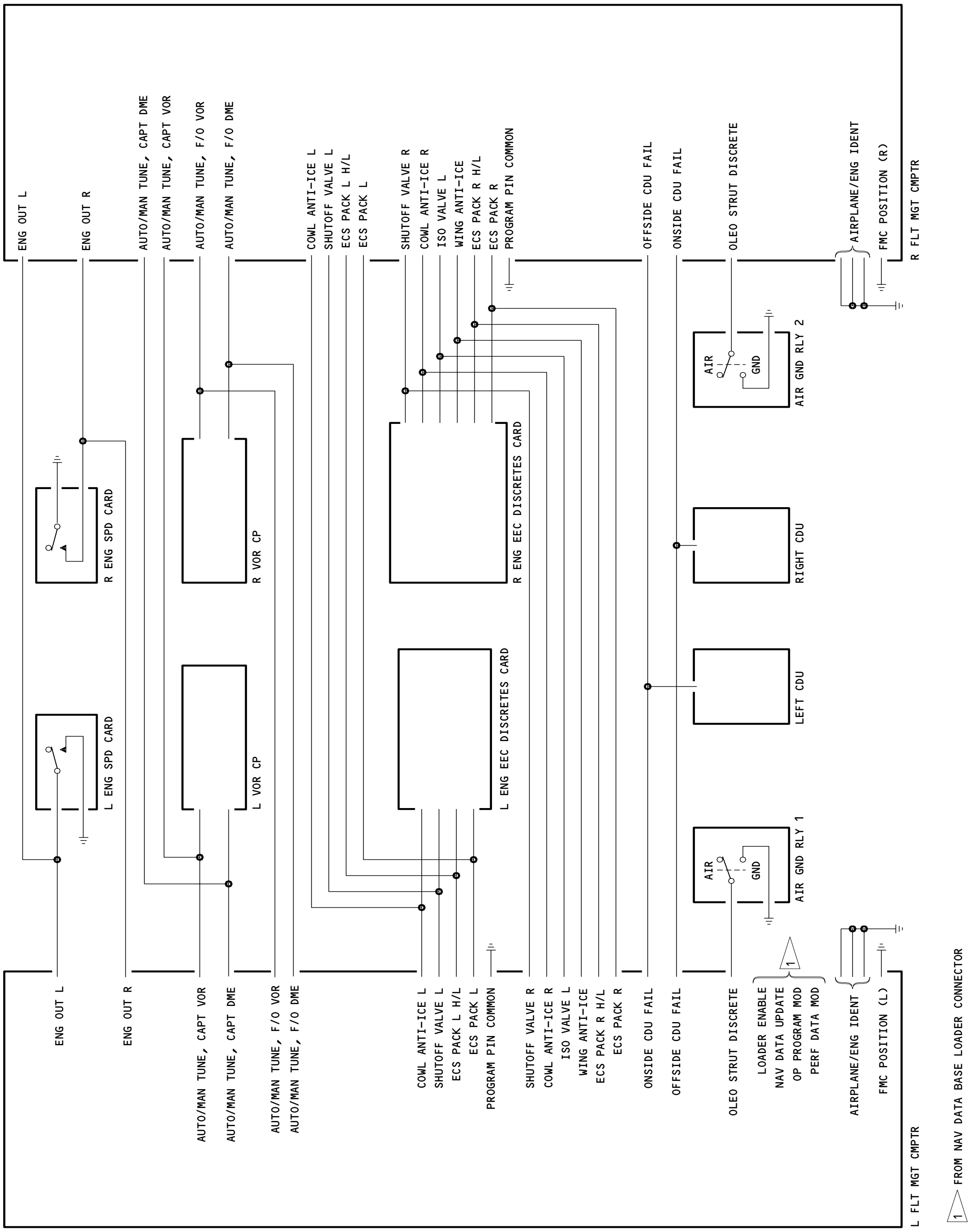
3) The AIR/GND relay, which sets the oleo strut discrete and enables the data base update.

4) The ENG OUT discrete from the engine speed card indicates N3 <45%.

(c) The hard-wired discretes select the airplane and engine identification codes and determine FMC position (left or right).

(4) FMC Interface Program Pins (Fig. 4)

(a) The program pins are used to identify the configuration and location of the FMCs and enable certain FMC options. The pins may be connected to ground, left open, or connected to a dc voltage through airplane wiring. For the function of each pin refer to Fig. 4.



FMC Interface - Analog Discretes
Figure 3

PROGRAM PINS	CONNECTOR LEFT D173 RIGHT D177	PINS	CONDITION LEFT FMC			CONDITION RIGHT FMC			CONFIGURATION
			OPEN	GND	+28VDC	OPEN	GND	+28VDC	
AIRFRAME/ENGINE IDENT	B	C11 D11 E11 F11 G11 H11 J11 C15 H15	X X X X X X	 X X X 		X X X X X X	 X X X 		757-200 RB211-535E4
AUTOTUNE MASTER/SLAVE	A	K07	X				X		OPEN=MASTER,GND=SLAVE
CAA RULES OPTION [1]	B	C13		X			X		GND=OPTION USED
CAA RULES OPTION [2]	B	C13	X			X			GND=OPTION USED
METRIC OPTION (KILOGRAMS) [5] [7]	B	B13		X			X		GND=METRIC OPTION USED
METRIC OPTION (KILOGRAMS) [6] [8]	B	B13	X			X			GND=METRIC OPTION USED
MAGNETIC/TRUE	A	K04	X			X			GND=TRUE HDG/TRK USED
MAINTENANCE TEST ENABLE	A	K03	X			X			GND=TEST,OPEN=IN SERVICE
OFFSIDE CDU ENABLE	A	K05	X			X			GND=INHIBIT,OPEN=ENABLE
PERFORMANCE OPTION CODE	B	D15 E15 F15 K15	X X X X			X X X X			GROWTH CAPABILITY
REMOTE TUNE ENABLE	B	D13	X			X			GND=ENABLE
SOURCE DESTINATION IDENT 1	B	K01		X		X			GND=L FMC (MASTER)
SOURCE DESTINATION IDENT 2	B	K03	X				X		GND=R FMC (SLAVE)
ASSUMED TEMP DERATE OPTION	B	B15	X			X			GND=FMC DERATE ENABLE
SPEEDTAPE [3]	B	J15		X			X		GND=SPEEDTAPE ENABLE
SPEEDTAPE [4]	B	J15	X			X			GND=SPEEDTAPE ENABLE
MCDU [9]	B	K14		X		X			GND=MCDU INSTALLED

[1] GUI 001, 009

[2] GUI 002-008, 010-999

[3] GUI 001, 008, 010-114, 116-999

[4] GUI 009, 115

[5] GUI 001-003, 005, 009-999

[6] GUI 004, 006-008

[7] GUI 115 PRE-SB 31-173

[8] GUI 115 POST-SB 31-173

[9] GUI 115 POST-SB 34-414

FMC Interface - Program Pins
Figure 4

(b) Pins C11, D11, E11, F11, G11, and H11 select the airplane type, engine model, and FMC configuration. Pin K07 selects which FMC is the master for autotune frequency selections. While each FMC tunes its corresponding VOR/DME, the master FMC normally selects the frequency. Pins K01 and K03 (connector B) identify the left and right FMCs respectively. This determines the master/slave protocol. With pin K05 grounded, the FMC does not respond to the off-side CDU.

(c) Metric units and CAA (British Civil Aviation Authority) rules are enabled by grounding pins B13 and C13. Leaving pin K04 open allows the FMCs controlled displays to use magnetic heading and track between latitudes of 70 degrees North and 60 degrees South. If pin K04 is grounded, true heading and track is used. Pin K03 (connector A) controls the maintenance test enable function.

(d) The REMOTE TUNE ENABLE discrete is enabled by grounding pin D13. If this discrete is enabled, then only the VOR receivers can be remote tuned. When the discrete is not enabled both the VORs and the DMEs can be remote tuned. The VORs and DMEs can be autotuned in either configuration.

E. FMC Interface - Outputs (Fig. 5)

(1) Each FMC has two general digital output buses, and one dedicated output bus to the electronic flight instrument system (EFIS) symbol generators. Two output discretes are also available from each FMC. The Data Base Loader has its own dedicated bus.

(2) In-Flight Faults recorded by the FMCS are transmitted continuously to the MCDP over a general output bus.

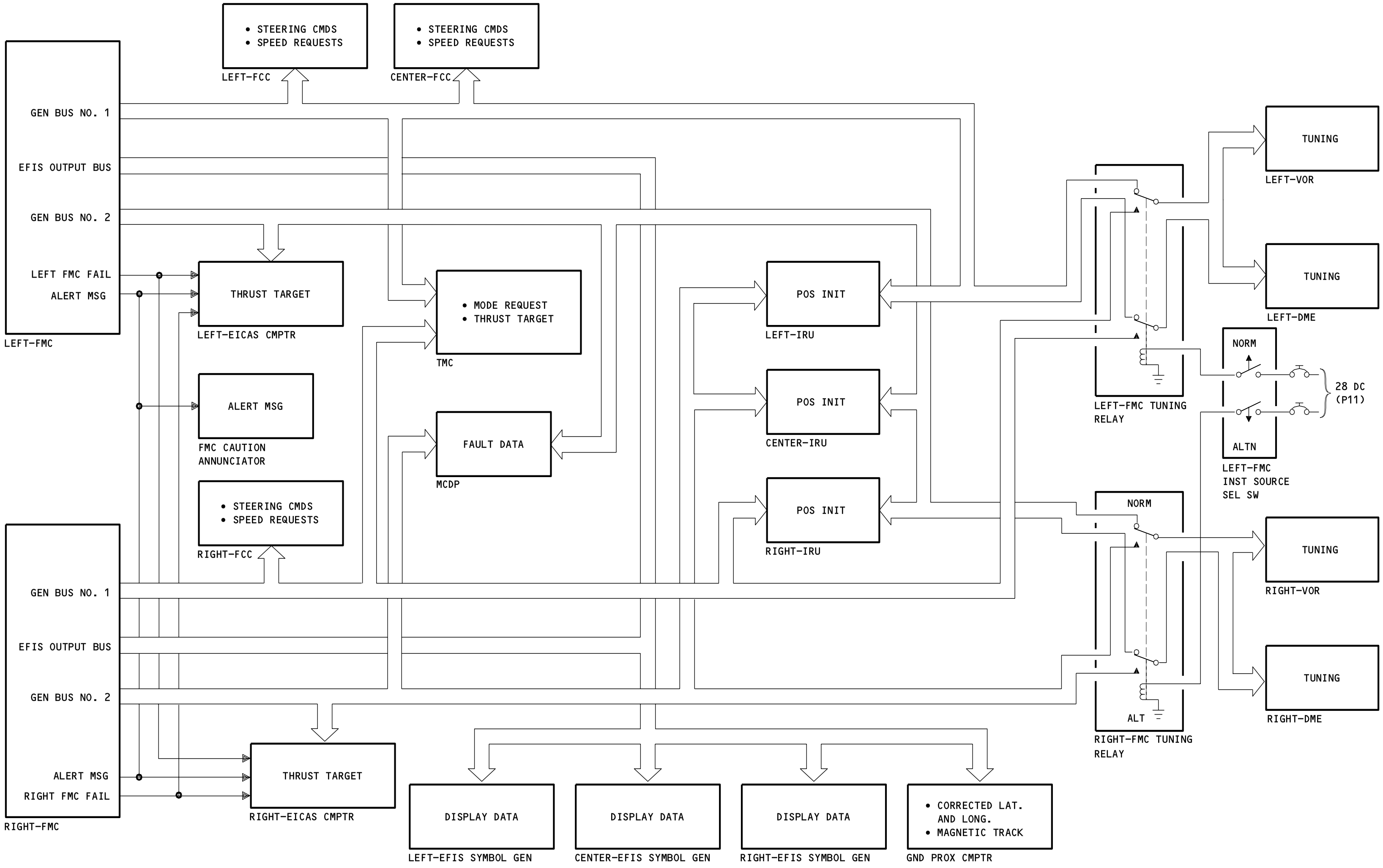
(3) All user systems except FCC, VOR and DME receive inputs from both FMCs. The VOR and DME receive data only from their corresponding FMC.

(4) The FMC source for the left and center FCC is the left FMC. The FMC source for the right FCC is the right FMC.

2. <u>Component Details</u> (Fig. 6)

A. Flight Management Computer

(1) The Flight Management Computers (FMC) are on the E2 rack in the main Electrical/Electronics compartment.



FMCS Outputs Schematic
Figure 5 (Sheet 1)

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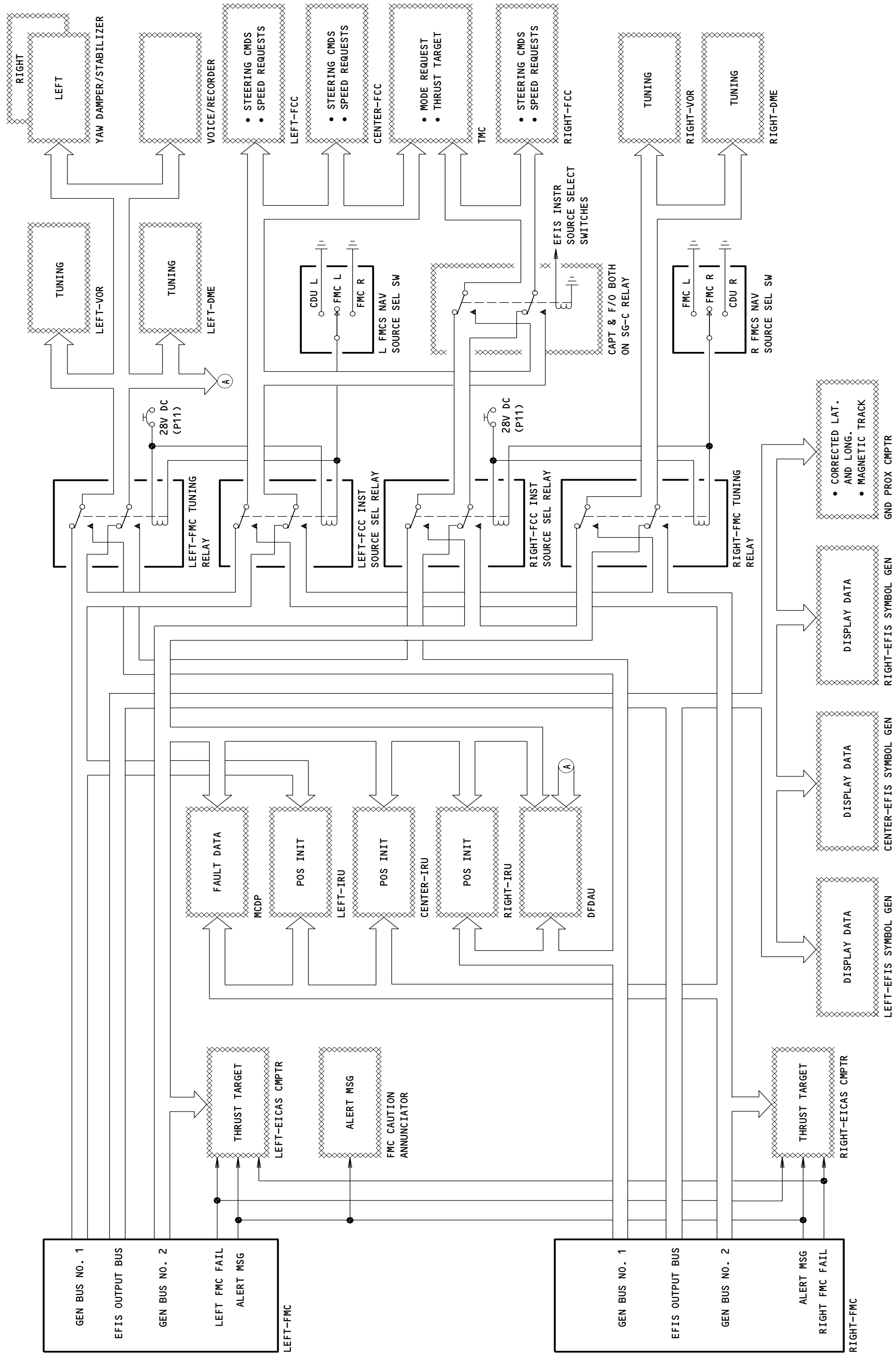
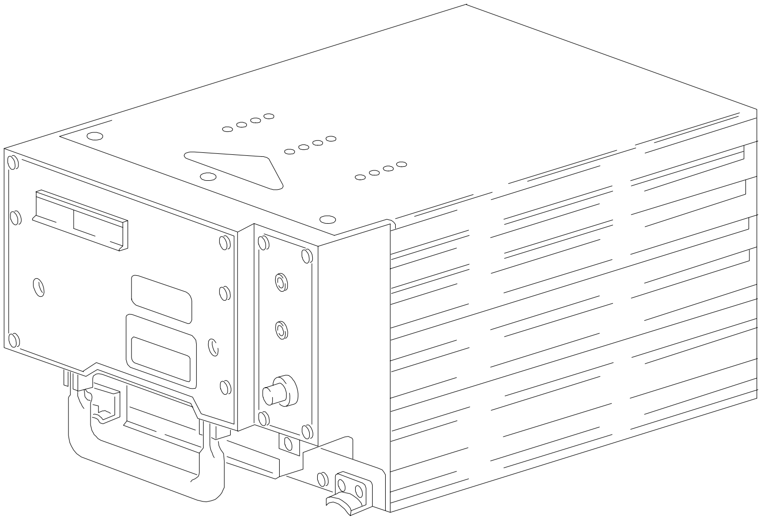
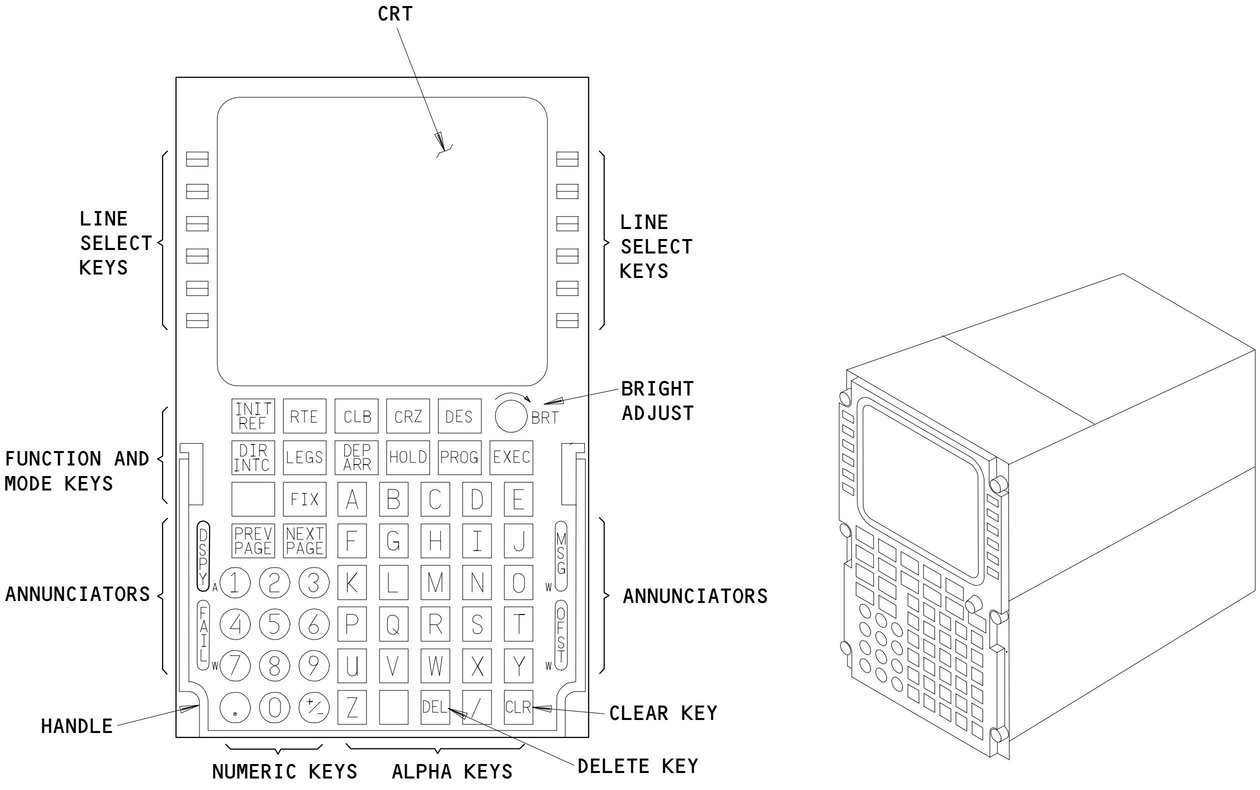


FMCS Outputs Switching Schematic
Figure 5 (Sheet 2)

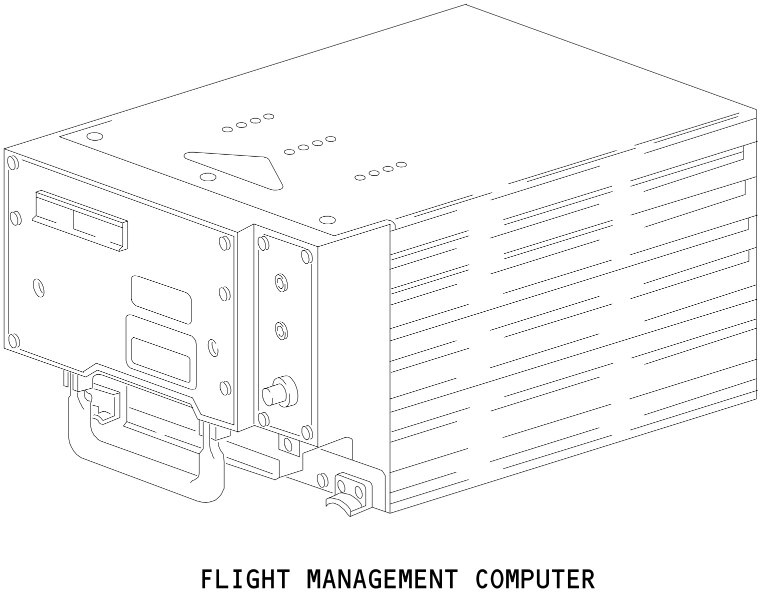


FLIGHT MANAGEMENT COMPUTER

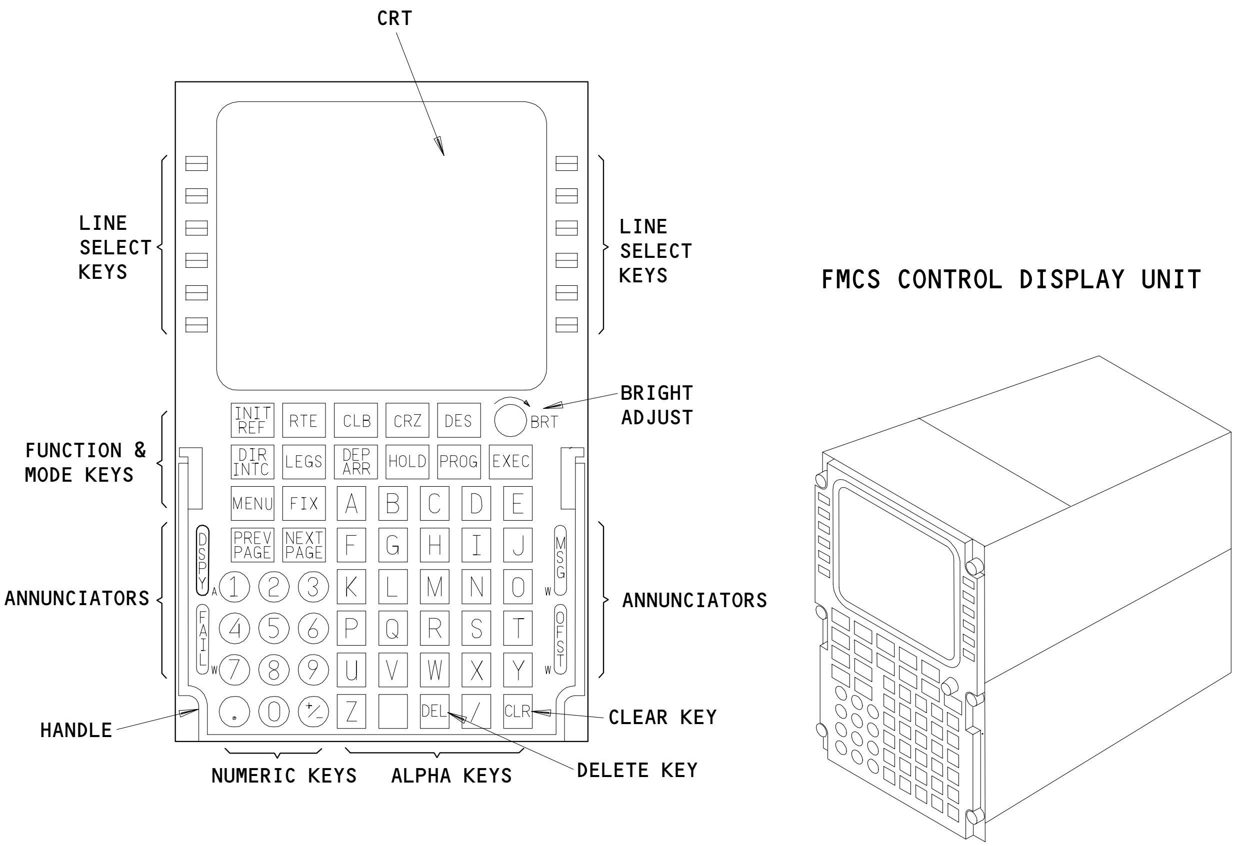


FMCS CONTROL DISPLAY UNIT

FMCS Components
Figure 6 (Sheet 1)



FLIGHT MANAGEMENT COMPUTER



FMCS CONTROL DISPLAY UNIT

FMCS Components
Figure 6 (Sheet 2)

(2) The FMC front panel has one handle for removing and installing the unit. The front panel has an FMC fail annunciator that illuminates when the FMC BITE failure bit is set. A yellow "TEST IN PROGRESS" light illuminates while the FMC BITE test is being conducted and goes out when the test is complete. The TEST switch on the FMC starts the self-test and resets the FMC FAIL annunciator when set.
   (a) The FMC is a 16-bit digital computer with ARINC 429 inputs and outputs, a power supply and three basic functional subsystems.

(3) Power Supply
   (a) The FMC power supply consists of 400 Hz, 115 vac that is rectified and filtered. The power supply provides an unregulated dc voltage to the switch regulator stage, which provides the following dc voltages: +5v, -5v, +12v, -12v, +15v, -15v, and +5v dc with four second holdup for RAM use. The positive and negative 15v dc outputs are regulated to within ten percent, and all other voltages are regulated to within five percent. The switching regulator provides the following functions:
      1) Reference voltage generation
      2) Oscillator
      3) Regulation
      4) DC to pulse-width conversion
      5) Overcurrent shutdown
      6) Soft start

(4) Basic Subsystems
   (a) The master processor subsystem accomplishes principle decision making and complex arithmetic tasks such as performance and navigation.
      1) The SDP 175-3 processor provides 16-bit fixed point arithmetic and 32-bit floating point arithmetic. The 175-3 processor has 16k words of private fast access memory, thirteen general purpose registers, and a comprehensive instruction set.
      2) The DRAM/CMOS memory consists of the following elements:
         a) The DRAM provides 256k words of working memory to the SDP 175-3 organized as 256k by 17 bits, with a 16-bit data field and the seventeenth bit reserved for parity detection.

b) The CMOS static RAM (SRAM) provides 16k words of memory protection from short term power transients. Integrity of data in SRAM is quaranteed for at least four seconds.

c) The electrically erasable PROM array (EEPROM) provides 2k words of memory to store the SDP 175-3 boot program.

(b) The mass memory subsystem controls bubble memory operation, checkpoints valuable data, and responds to memory requests from other subsystems.

1) The mass storage memory unit consists of 8 one-million bit bubble memory devices operating in parallel. A Bubble Processor/Sequencer element contains an eight-bit microprocessor based processing subsystem and a CMOS sequenced gate array. This element controls the bubble memory and is the interface between the bubble memory and bus masters.

(c) The input/output subsystem formats and filters data used externally, and by subsystems.

1) The Discrete I/O circuit is capable of outputting 8 ground-open discrete signals and inputting 56 discrete signals.

2) Two identical ARINC 429 transmitter/receiver cards: function to convert two TTL signal, 16-bit data words to and from a single 32-bit ARINC 429-5 return to zero formatted bit stream.

3) The I/O Processor Controller Arbitration Monitor reduces the burden of real-time input/output data processing on the Master Processor Subsystem. The unit combines a 16-bit microprocessor and supporting circuitry to form the Direct Memory Access (DMA) system. The DMA system maintains block pointers, screens input data validity, enables ARINC 429 receivers, and provides interrupt and status for data in order to handle the large volume of FMC I/O data.

(d) FMC BITE (Built in Test Equipment) combines both hardware monitors and software check programs. BITE detected failures are reported on the CDU and are recorded in nonvolatile (bubble) memory for future maintenance use.

B. FMCS Control Display Unit (Fig. 6)

(1) The CDUs are on the left and right sides of the forward electronic control stand in the flight compartment. They are forced-air cooled. Each unit requires 400 Hz, 115 vac and dissipates 65 watts. A handle on the CDU assists in removal and installation of the unit. One multi-pin connector is at the rear of the unit.

(a) The FMCS control display unit allows data entry, selection, and display for the flight crew. The CDU consists of a keyboard, a CRT display, line select keys and annunciators.

- (b) The CRT is about 4.5 inches wide and 3.5 inches high. Twenty four characters can be displayed on each line. The fourteen display lines are used for page title, data titles, data display and scratch pad. Data entries appear in the scratch pad (bottom line) and are moved to the proper line by line select keys.
- (c) The keyboard has 54 keys including the complete alphabet, all decimal numbers, eleven mode keys, three function keys, delete key, clear key, slash (/), plus/minus, and a decimal point.
- (d) Keyboard switches are back lighted. They do not light when pressed.

(2) Line select keys provide three functions:
- (a) Move data from the scratch pad to the selected line.
- (b) Move data from the selected line to the scratch pad.
- (c) Access data that is identified by the selected line.

(3) Pressing an alpha key enters the selected alphabet character into the scratch pad. Pressing a numeric key enters the selected number into the scratch pad.

(4) The eleven mode keys are used to control the type of data currently accessible on the CDU. Data is associated with data page type and page number. Insertion, modification, or display of data is only accomplished when the proper page is active.
- (a) The INIT/REF (initialization/reference) key provides access to data needed to initialize the FMC and IRS for flight. It also provides access to reference data.
- (b) The RTE (route) key provides access to routes entered in FMCS. If the key is pressed with no active flight plan designated, RTE 1 is displayed. Otherwise, the current leg of the route and continuation of the active route is displayed.
- (c) The LEGS key allows entry and display of detailed data for each leg of a flight plan.
- (d) AIRPLANES WITH -103, -104, -130 OR -131 CDU;
  The DIR/INTC (direct/intercept) key allows development of a guidance path to fly the airplane from the present position to any waypoint, or to intercept a course to a specified waypoint. This function is performed on the RTE LEGS page.
- (e) The DEP/ARR (departure/arrival) key is used to display departure or arrival data for designated airports. If the DEP/ARR key is pressed and no active route has been designated, an index is displayed. Otherwise the display is determined by airplane location. Departure/arrival data can be line selected into the active route.
- (f) The FIX key allows creation of waypoint fixes used with the EFIS map display. The waypoint fix is the intersection point of the present route and a selected radial from a known waypoint.
- (g) The HOLD key allows entry of a holding pattern at any waypoint.
- (h) The PROG (progress) key displays current dynamic flight and navigation information. The PROG key also allows comparison of current data with distance to go, ETA, and fuel remaining for manually entered alternate destinations.

(i) AIRPLANES WITH -103, -104, -130, OR -131 CDU;
The CLB (climb) key provides display of the current or planned climb mode. It also allows evaluation and selection of other climb modes.

(j) AIRPLANES WITH -103, -104, -130 OR -131 CDU;
The CRZ (cruise) key provides display of the current or planned cruise mode. It also allows evaluation and selection of other cruise modes.

(k) AIRPLANES WITH -103, -104, -130 OR -131 CDU;
The DES (descent) key provides display of the current or planned descent mode. It also allows evaluation and selection of other descent modes.

(l) AIRPLANES WITH -161 OR LATER CDU;
The MENU key provides access to subsystems for CDU control as well as alternate EICAS/EFIS control functions.

(m) AIRPLANES WITH -161 OR LATER CDU;
The ATC key provides access to the ATC LOGON/STATUS page and other ATC data link pages.

(n) AIRPLANES WITH -161 OR LATER CDU;
The VNAV key provides access to the climb (CLB), cruise (CRZ), and descent (DES) pages for current or planned modes.

(5) The CDU keyboard has three function keys that control data displayed on the CDU.
  (a) The EXEC (execute) key is used to activate the flight plan, change the flight plan, or change the active guidance mode. The EXEC key is the FMCS command key.
  (b) The NEXT PAGE key causes the CDU to display the next higher page number of multiple page displays.
  (c) The PREV PAGE (previous page) key causes the CDU to display the next lower page number of multiple page displays.

(6) The CLR (clear) key erases data from the scratch pad. A single brief press of the key erases either the last character of a data entry or a complete message. A longer press of the key erases the entire data entry.

(7) The DEL (delete) key removes data entered in a data line. Pressing the DEL key inserts DELETE into the scratch pad. Pressing a line select key then replaces data entered on that line with computer predicted values or with default values.

(8) The CDU has four annunciators that light to alert the flight crew to some condition.
  (a) The MSG (message) annunciator lights when a FMC message is in the scratch pad.
  (b) The DSPY (display) annunciator lights when the current display is not related to the active flight plan leg or to the current performance mode.
  (c) The FAIL annunciator lights when selected FMCS failures occur.
  (d) The OFST (offset) annunciator lights when a parallel offset is in use.

(9) The control display unit receives data to be displayed from the FMC. It also decodes and transmits CDU key closures to the FMC.

(10) The CDU receives 115 vac input for its power supply and 5 vac input for panel lighting.

(11) The CDU receives digital data from both flight management computers. Each FMC has a dedicated ARINC 429 data bus to each CDU.

(12) The CDU receives analog discretes from the master dim and test system (for lamp test and bright/dim control) and the FMC.

(13) Data into the CDU is received by the ARINC 429 data bus receiver or the A/D circuits.

(14) Data for CRT display is stored in the display buffer/memory and stroke written on the CRT. The CRT brightness is controlled by the BRT control and by the ambient light sensors.

(15) The keyboard/annunciator control decodes data and drives annunciators. It also decodes key closures and transfers the data to the CDU processor.

(16) The processor formats data for output to the FMC and displays key closures on the CRT.

(17) CDU failures are transmitted to both FMCS as analog discretes.

3. Operation (Fig. 7)

A. Functional Description

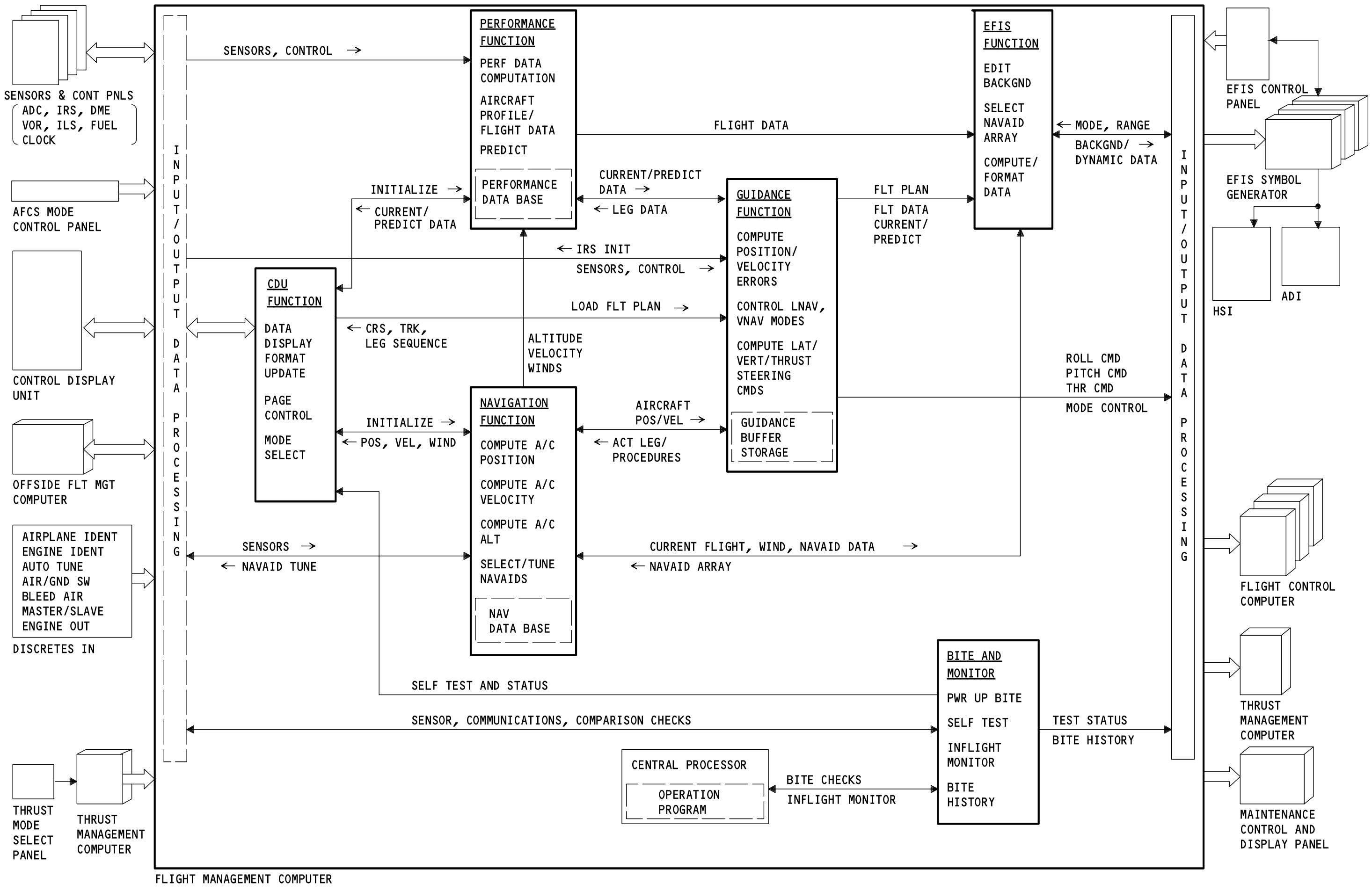
(1) General

(a) The FMC functions receive control and sensor inputs, and then perform the necessary calculations to provide display and steering outputs. The FMC functions are divided into seven major areas: input/output, navigation, performance, EFIS, CDU, Guidance, BITE and Monitor.

(b) The FMC Input/Output (I/O) uses 23 ARINC 429 digital receivers and nine (9) transmitters to communicate with the system components.

(c) Analog discretes identify switching and process the enabling functions.

(d) The received digital data is identified, reformated (Binary Coded Decimal-BCD to Binary Numerical Representation-BNR), scaled, and stored for routing to the using functions. Validation checks are performed on the input data. The checks consist of Sign Status Matrix (SSM) checks, parity checks, and activity monitoring (check for proper updating of data).



FMC Functional Block
Figure 7

(e) The output data is formated and scaled before being transmitted to the other systems.

(f) The FMC navigation function determines the airplane position in terms of latitude and longitude by using radio and IRS data. The navigation function computes horizontal and vertical velocity vectors of the airplane. It computes winds and airplane altitude, and performs automatic tuning of the VOR and DME receivers.

(g) The FMC performance function computes the airplane performance factors, flight profile, and associated data. It predicts airplanes vertical position and velocities for each segment of the entire route.

(h) The FMC EFIS function uses the data from the other functions that are stored in the guidance buffer or NAV Data base. It provides data to the EFIS symbol generators for display on the EADI and EHSI.

(i) The FMC CDU function provides for the formatting and updating of the displayed pages on the CDU. It provides page control from leg sequencing and mode control based on CDU selections. It also provides advisory and alert messages based on conditions.

(j) The FMC guidance function stores the active route for lateral and vertical navigation. It determines the airplanes position and the sequencing points. The guidance function provides HDG, PATH, CLB, and CRZ mode control for LNAV and VNAV. It provides SPD, THR, PATH, and VSPD mode requests for VNAV and HDG HLD, HDG SEL, CRS CAPT (course capture), and PATH mode requests for LNAV. It provides roll and pitch commands to the FCCs, and thrust commands to the TMC.

(k) The FMC BITE and monitoring function:

1) provide diagnostic and fault consolidation functions.
2) performs a comprehensive self test on power up and when the self-test button is pushed.
3) monitors FMC interfaces and communications.
4) records failures in non-volatile memory.

(2) Control and Display (Fig. 8)

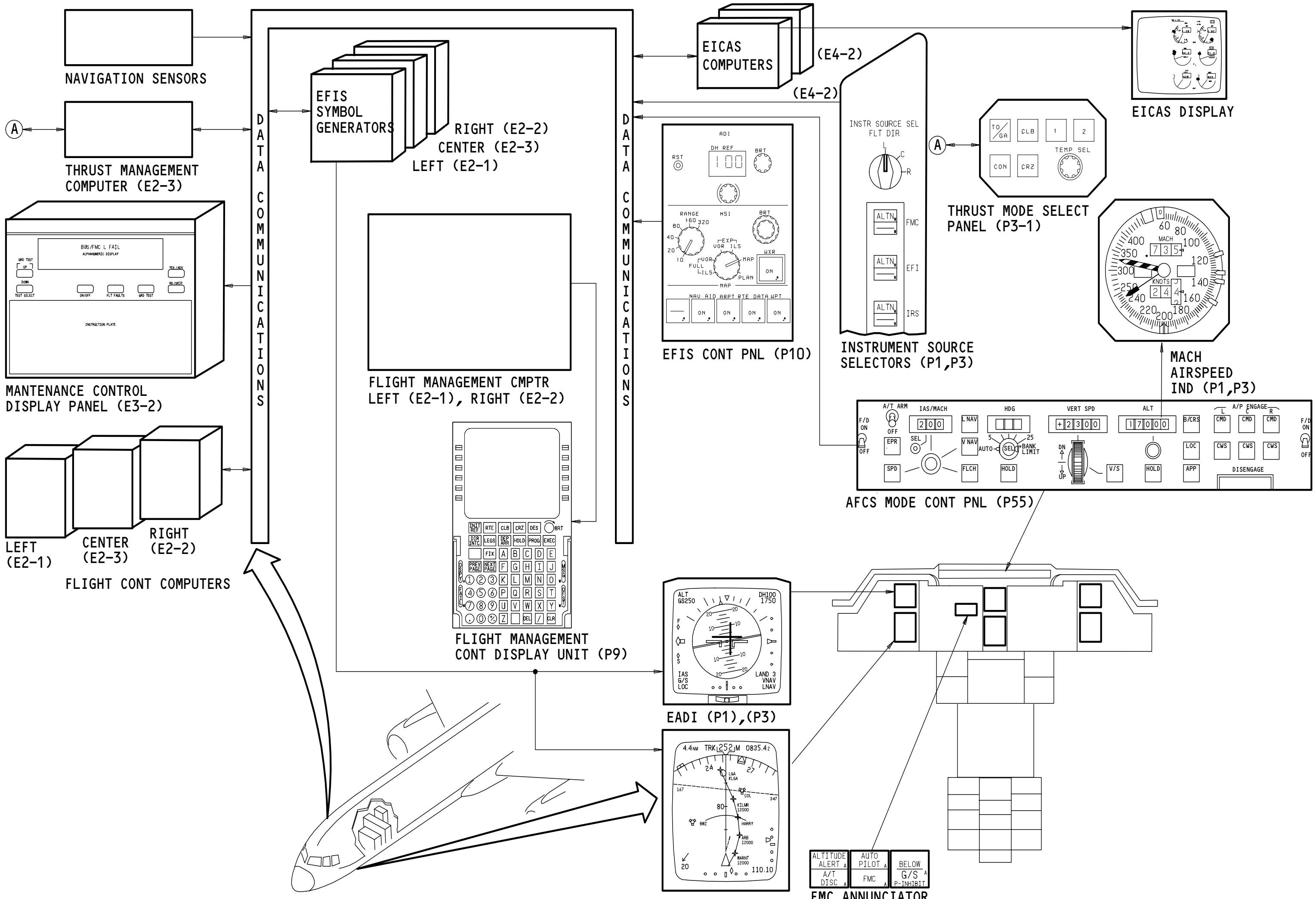
(a) In addition to the FMC and the CDU, four other components control FMC operation. These are the EFIS control panel, the AFCS mode control panel, the FMC instrument source select switches, and the Thrust Mode Select Panel (TMSP).

1) The EFIS control panel controls the EHSI display of FMC data with range, mode, and background display selectors. The range selector controls the range display in all modes and selects the FMC map edit area in map and plan modes. The mode selector allows the pilot to view raw VOR or ILS data; or view a track orientated map, or north oriented plan display of his selected route (Ref 34-22-00).

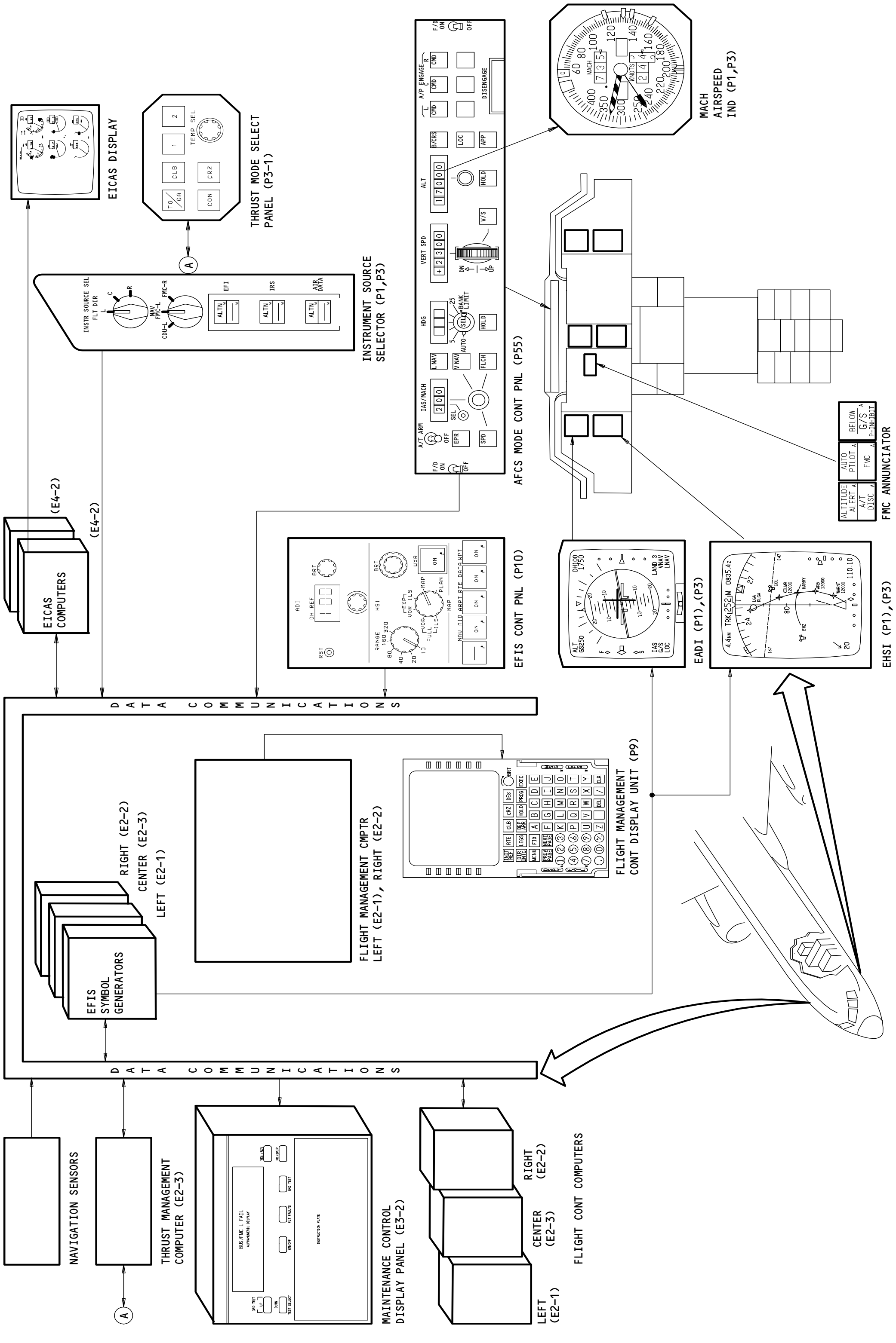
2) The AFCS mode control panel provides a LNAV and VNAV selection and annunciation for FMC lateral (roll channel) and vertical (pitch channel) steering. It also provides and displays the selected IAS/MACH and altitude for use in the VNAV mode. The IAS/MACH display is used by the pilots to indicate the target airspeed selected for VNAV mode. The altitude displayed must be selected higher or lower than the current altitude. This allows a climb or descent in the VNAV mode. The autopilot does not fly the airplane away from the MCP selected altitude except under manual or glideslope control (Ref 22-10-00).

3) GUI 115 PRE-SB 34-414;
GUI 001-114, 116-999;
The FMC instrument source select switches allow the captain and first officer (F/O) to select which FMC is used with his CDU. With both source select switches in the normal position, each CDU communicates with its onside FMC. If an alternate source is selected for a FMC, that CDU communicates with its offside FMC. The left source select switch controls which FMC is tuning the navaids (Ref 34-22-00).

4) GUI 115 POST-SB 34-414;
The NAV instrument source select switches let the captain and first officer (F/O) set which FMC is used with his CDU. With the captain's NAV switch in the FMC-L position and the F/O's NAV switch in the FMC-R position, each CDU interfaces with its onside FMC. The L or R position of the NAV switch also shows which FMC is tuning the navaids. When a NAV switch is set to the CDU position, the EFIS symbol generator uses EFIS data from the CDU as alternate navigation.



Flight Management System - Control and Display
Figure 8 (Sheet 1)



Flight Management System - Control and Display
Figure 8 (Sheet 2)

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5) The Thrust Mode Select Panel (TMSP) provides for manual selection of an assumed temperature for derating the FMC calculated thrust setting (Ref 22-31-00).

(b) The annunciators in the lower left corner of the Electronic Attitude Director Indicator (EADI) are for TMC autothrottle and AFDS pitch modes. The lower right annunciators are for the AFDS roll modes.

1) The bottom line of the pitch mode annunciator shows which pitch or thrust mode is engaged. The engaged pitch or thrust mode annunciator is green. The AFDS pitch mode displays VNAV when the FCC is using vertical steering commands from the FMC. The VNAV mode does have an armed pitch mode on the ground.

2) The second line of the roll mode annunciator shows which roll mode is armed. The armed mode is displayed in white. When ADI displays LNAV white, it indicates that the AFDS is ready to use LNAV data. The roll engaged mode displays LNAV green when the FCC is using lateral steering commands from the FMC.

(c) When the Electronic Horizontal Situation Indicator (EHSI) is in MAP or PLAN modes, the selected route and background data from the FMC are displayed. The FMC provides dynamic data to the EFIS in all modes (VOR, ILS, MAP, PLAN). The dynamic data includes position, drift angle, track, vertical and lateral errors, speed, winds, and radio frequencies (Ref 34-22-00).

(d) The Mach/Airspeed Indicators (MASI) are on the pilots P1 and P3 instrument panels. Each MASI has an airspeed bug that is driven by the AFCS Mode Control Panel (MCP). When VNAV is engaged, the FMC computed airspeed value is used by the MCP. The MCP then drives the MASI airspeed bug to the FMC computed value. If the FMC computed value is a Mach number, the Mach number is converted to an airspeed to drive the bug.

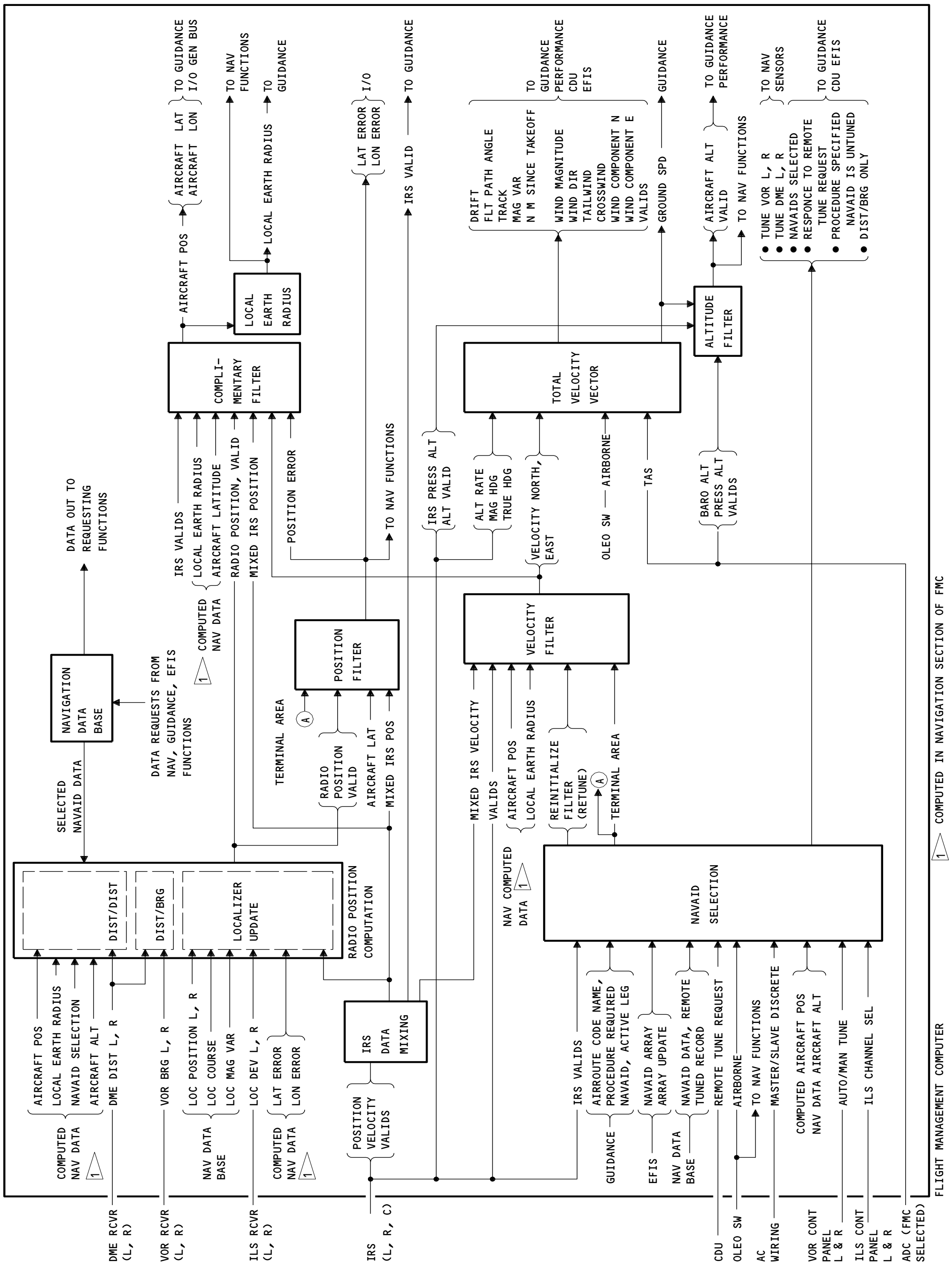
(e) There is an EPR (Engine Pressure Ratio) indicator on the Engine Indicator and Crew Alerting System display for each engine. The reference bug is automatically set to the FMC EPR computed value when VNAV is engaged (Ref 31-41-00).

(f) The Flight Management Computer (FMC) annunciator light is on the P2 instrument panel. The FMC annunciator is an amber caution light that indicates a FMC BITE or Monitor failure has occurred.

(3) FMC Functional Block - Navigation (Fig. 9)

(a) FMC Navigation Requirements

1) The FMC navigation function generates data representing airplane location and motion for use by other FMC functions. Data includes:
   a) Airplane present position above the surface of the earth.
   b) Airplane attitude above the surface of the earth.
   c) Airplane velocity relative to present position.
2) The FMC navigation function uses data from the navigation data base, internal computations, and sensor systems. The FMC selects and autotunes navaids and manages the data base.
3) The airplane position is determined from the three IRU positions and radio determined position.
   a) First priority radio position is from two DME systems.
   b) Second priority radio position is from one DME and one VOR system.
   c) IRS data is used alone if radio data is not valid to solve radio position.
   d) Localizer data is used for position update during an ILS approach.
4) At least one co-located VOR/DME is required to determine radio position. Radio position is not used when the airplane is on the ground.
5) Data from all sources is combined to compute airplane position in latitude and longitude. Position computations are filtered to provide smoothing.
6) Computed LAT/LON error is used for IRS correction.
7) Local earth radius is computed based on airplane present position.



FMC Functional Block - Navigation
Figure 9

8) The airplane altitude is determined from a combination of ADC barometric altitude and IRS inertial altitude. Altitude computations are filtered to prevent transients due to source switching or barometric adjustment.
9) The FMC computes altitude so that total system error does not exceed 130 feet under any condition from takeoff through landing.
10) Airplane velocity is determined from IRS velocity and navigation computed parameters.
11) Computed velocity is combined with other navigation data to compute airplane dynamic conditions.
    a) Drift angle is the difference between true heading and track.
    b) Track is the path of the airplane on the earth's surface.
    c) Ground speed is the speed of the airplane along the track.
    d) Distance since takeoff is airplane distance along track.
    e) Magnetic variation is difference between true heading and magnetic heading.
    f) Wind data consists of wind magnitude and direction relative to true north and wind magnitude along the desired course.
    g) Flight path angle is the vertical angle between the flight path and the horizontal.
12) The EFIS function provides an edited list of 20 navaids closest to the airplane. Navaids are selected as required by the guidance buffer and as specified by the pilot on the navaid control panel.
13) The FMC monitors the navaids near the airplane and selects two to provide needed position information. The best navaids are chosen within the constraints of any remote tune requests. The FMC then determines procedures, distance to navaid, type of navaid, and airplane altitude.
14) The FMC transmits navaid channel numbers via the I/O function for tuning.

15) Data needed for radio navigation, route selection, and guidance is stored in non-volatile memory in the navigation data base. User functions access the data base for data needed for computations.
16) The navigation data base is updated periodically using a data base loader.
17) The FMC's navigation function provides airplane present postion and velocity data. This data is used by the guidance function for airplane control and the IDS for display on the ND.
    a) The basic navigational output data is computed using optimally mixed inputs of:
    b) IRS's position, velocity, heading and altitude data
    c) Data from the FMCS Navigational Data Base (NDB)
    d) Distance information from the two DMEs
    e) Bearing information from the two VORs
    f) Altitude and true airspeed data from the Air Data Computer (ADC)
    g) ILS localizer and glideslope deviation data when the airplane is in the approach mode.
18) This information is combined and filtered by the FMC to produce the following navigation outputs:
    a) Airplane position (latitude and longitude)
    b) Track angle
    c) Wind vectors (north and east wind components, wind magnitude, wind bearing, tail wind and crosswind)
    d) Baro-corrected altitude
    e) Airplane velocity (ground speed)
    f) Local earth radius
19) The FMC controls the tuning of navaids and directing navaid data into channels while in autotune. The FMC uses the NDB to select the navaids to be tuned. The FMC directs the navaid information into DME channels to obtain the best VHF NAV radio positioning mode. These VHF NAV radio positions are combined with the inertial position from the IRSs to obtain the best positioning mode. These nav modes are listed in order of preference:
    a) IRS/ILS (approach only)

        b) IRS/DME/DME (distance and distance)
        c) IRS/DME/VOR (distance and bearing)
        d) IRS only

20) The FMC also uses information from the IRSs and the ADC to calculate inertial and wind vectors.

21) The FMC's position and velocity filters are automatically initialized when the following occurs:
    a) An IRU or ADIRU becomes valid after power up.
    b) At takeoff
        1. The FMCs position is initialized to the runway's threshold latitude and longitude. If a displacement has been entered, it is used to correct the IRS errors at takeoff.
    c) Recovery from an FMC power interrupt.
        1. For short term power interrupts, the filters are initalized to the last position. There is no observable position change.
        2. If both FMCs are powered up simultaneously, the master FMC will be selected by the FMC master logic. If the FMCs are powered up separately, the FMC that is powered up first will be the master FMC.

22) Initialization of radio corrections IRS validation
    a) The FMC's I/O process performs a validity check of the IRS activity and SSM status. If they are valid and the airplane is on the ground, the radio corrections are set to zero and there is no softfault status.
    b) After a short-term power interrupt, the radio corrections (velocity and position) sent to the IRS, will retain their values, previous to the power interrupt.
    c) After a long term power interrupt the radio corrections to the IRS velocity are set to zero. The position radio corrections will be set to zero if the offside FMC position is invalid. If not, the position radio correction to the IRS will be an adjusted position in which the onside FMC position equals the offside FMC position. The softfault will be reset.

23) IRS position and velocity processing
    a) The IRS provides the basic position and velocity which the FMC uses for navigation. These IRS outputs are used with radio positioning but will be used alone if radio updating is not possible.
    b) Each individual IRU will go through a signal validation process. This process will validate both the position and velocity signals. If either of these signals are not valid the corresponding IRU will not be used.
    c) If a softfault failure exists for an IRU, that IRU will not be used by the FMC. All or none of the IRUs may be used. The IRU's data will be routed as follows:

- 1. IRS (3): All three IRUs are valid and each FMC will use the mixed IRS position and the averaged velocity. Both FMCs will contain the same data.
- 2. IRS (2): Two IRUs are valid. The FMCs will use the closest IRU. The FMCs will contain different data and the master FMCs data will be used for navigation.
- 3. IRS (1): ONE IRU IS valid. The valid IRU's data will be used by both FMCs for navigation.
- 4. IRS (0): No IRUs are valid and the FMCs use the VHF NAV radio updating for navigation.

24) Radio position processing
  - a) The FMC selects the best VHF NAV radio positioning NAVMODE to be used. These NAVMODES, listed in order of priority, are ILS/DME, DME/DME and VOR/DME. The FMC bases its selection of these NAVMODES on the type of navaids available and the geometry of the navaids with respect to the airplane. The ILS/DME NAVMODE will only be used during airplane approach.
  - b) ILS/DME positioning is determined from the airplane deviation from the ILS center beam and the IRS estimated position. Both FMCs will use data from a selected ILS sensor to prevent divergence of the two navigation solutions. If one of the FMCs fail, the operating FMC will use the onside ILS for positioning.
  - c) The DME/DME NAVMODE calculates airplane position from the slant range distance from two DME stations. There are five priority channels used by the FMC. The FMC controls the allocation of DME data into these channels.
  - d) VOR/DME NAVMODE uses the DME slant range distance data and the collocated VOR bearing data to compute airplane position. The bearing of the airplane with respect to the VOR navaids north reference must be corrected to true north by adding the magnetic variance to the VORs north bearing.

25) FMCS Optimal Position and Velocity Processing
  - a) The FMC uses the VHF NAV radio position and IRS inertial data to produce accurate airplane position and velocity.
  - b) IRS velocity and radio position are combined to derive the IRS velocity error. Velocity error components are added to the IRS velocity components to produce north and east velocity components.

26) Inertial vectors are the airplanes north and east velocity components. They consist of:
  - a) The track angle filter combines track angle and track to obtain the degree/frame track angle rate. The track angle is the true heading when the airplane is on the ground.

        - b) Ground speed magnitude is calculated by using the filtered velocity components.
        - c) Vertical flight path is calculated from the ground velocity magnitude and the airplane velocity.
        - d) Drift angle is calculated from computed track angle and true heading.
        - e) Magnetic variation is computed from true heading and magnetic heading from the IRS.
    - 27) North and east wind velocity components are only valid when:
        - a) Vertical flight path angle is valid
        - b) Airplane velocity is valid
        - c) True heading is valid
        - d) Airplane ground speed is greater than 80 knots
        - e) True air speed (TAS) is valid
    - 28) Thw wind vector components are computed from the difference between TAS for the true heading and ground speed for the track. This will produce raw north and east components. These components are filtered to produce filtered north and east wind velocity components.
    - 29) Wind magnitude, bearing, tailwind and crosswind are computed by combining the filtered north and east wind components.
- (b) Altitude Computation
    - 1) The FMC airplane altitude is computed from the ADC barometric pressure and altitude and the IRS pressure altitude. If both ADC altitude inputs are valid, the baro correction is the difference between the two. The baro correction is filtered and added to the IRS's pressure altitude (or to the ADC pressure altitude if the IRS pressure altitude is invalid). The altitude valid flag is then set to true.
- (c) Local Earth Radius Computation
    - 1) Calculations of the earths radius will be done at a rate of 0.1 Hz when the IRS position has been entered. The initialization radius or base radius will be 3437.74677 nm. The computed earth radius will be used in the complementary position filter.
- (d) Tuning management
    - 1) To improve airplane position, the FMC's navigation function combines VHF NAV radio data and the IRS position.
        - a) ILS receivers provide angular deviation measurements from a fixed bearing. This data has the highest accuracy but is only used on airplane approach due to its short range.
        - b) DME interrogators provide distance information from the airplane to ground facilities. These VHF NAV radios provide the second highest accuracy and are usable at distances from 9 to over 200 nm.

c) VOR receivers provide bearing measurements between the airplane and the ground facilities north reference. There VHF NAV radios provide the poorest accuracy with a 130 nm range. These receivers will operate in conjunction with the DME interrogators.

2) DME tuning

a) AIRPLANES WITH NON-SCANNING DME;
Scanning DME option is disabled, in this mode of operartion, each DME can tune only one station at a time. When the DMEs are in a single channel operation and there is no manual, procedure or remote tuning, the FMC chooses the best available navaids for DME/DME updating. If one DME is in manual, procedure or remote tuned, then the FMC will autotune the remaining DME to a station which provides the best DME/DME updating from the tuned station. If that is not posible, then the FMC will attempt VOR/DME updating using first the closer, then the farther of the two stations.

b) AIRPLANES WITH SCANNING DME;
Scanning DME option is enabled, in this mode of operation the DME interrogator has the capability of free scanning 252 separate frequencies. Five of these frequencies will be used by the FMC for VHF NAV radio updating. The frequency command for these five frequencies originates in the FMC. The FMC automatically generates tunning commands, as a function of the available navigation aid ground stations relative to the navigation position estimate and the airplane altitude, by the station selection process in the FMC NDB.

c) The DME will tune the FMC's selected stations. These stations will be stored in memory slots in the DME.

d) There are two station types required by the FMC to be tuned and placed into one of the five memory slots.

1. Manually tuned stations: These stations are used for displaying distance data on the IDS displays and have top tuning priority.

2. Procedure tuned stations are associated with a particular flight plan procedure. The tuning frequency will be supplied by the FMC navigational data base.

e) The DME will tune and store station data in accordance with the FMC. The memory slot preference where the station data is stored is controlled by the FMC. The memory slot allocation is as follows:

1. Memory slots 1 and 2 contain distance data from autotuned stations making the best DME/DME pairing. This data is used for VHF NAV radio position updating.

2. If there is a DME/DME pair in memory slots 1 and 2 and there is no manual, procedure or route tuned stations required, then the FMC will direct the second best DME/DME pair into memory slots 3 and 4. This second best DME/DME pair will be directed into memory slots 1 and 2 for VHF NAV radio position updating if the primary DME/DME pair previously in memory slots 1 and 2 become invalid.
3. If there is a manual, procedure or route tuned station required, this station will be put in memory slot 3. The FMC will attempt to find a station which will create a DME/DME pair with this station. If found, the FMC will put this stations distance data into memory slot 4.
4. If there is a manual, procedure or route tuned station in which the FMC can create its only DME/DME pairing, then memory slots 3 and 4 will be used for VHF NAV radio position updating with memory slot 3 containing the manual, procedure or route tuned station.

3) DME/VOR tuning
   a) The VOR receivers will only be able to tune in one frequency corresponding to a station selected by the FMC. This VOR station, which is colocated with the DME station, will provide bearing information.
   b) These DME/VOR colocated stations can be tuned by the FMC for VHF NAV radio position updating. The FMC will use this mode of radio position updating if no DME/DME pair is available and the airplane is not in the approach mode thereby using the ILS station for VHF NAV radio position updating.
   c) The FMC will automatically down mode to DME/VOR VHF NAV radio positioning when the following occurs:
      1. If no DME/DME pairing can be created and there is no manual, procedure or route tuned stations.
      2. If there can be no DME/DME pair created and there is a manual, procedure or route tuned station.

(e) VHF NAV Radio Validation

1) The initial radio validation occurs in the I/O processor of the FMC. The activity of the bus is checked. This determines if the data received has changed between two consecutive inputs. If the data has not changed it is invalid. If the data is valid, the I/O processor determines the state of the sign signal matrix (SSM). If the SSM is not normal, the data is invalid. If the SSM is normal then the data goes through further validation.
2) The ILS is considered valid by the FMC if:
   a) Raw data passes the input processing validation.
   b) The localizer deviation is less than 1.25 degrees.
   c) Received frequency matches the frequency stored in the NDB for the selected runway.

3) The VOR and DME go through two validation processes. These are short-term and long-term validation. The long term validation will be dependent upon the short-term validation. These processes are described as follows:

4) Short-term validation
   a) The DME is short term valid if:
      1. Raw data passes the I/O process validation.
      2. The frequency is between 108.00 and 117.95 mega Hertz.
      3. The DME ground distance does not exceed a rate of change of 1nm per second with respect to the FMCs calculated ground distance.
      4. The tuned frequency is the same as the received frequency.
      5. The airplane is not within the zone of confusion (inverted cone with an apex of 60 degrees).
      6. The actual DME ground distance does not differ from the FMC's estimated distance by a predetermined tolerance.
      7. The ground range is less than 300 nm.
      8. There are two DME/DME pairs considered for updating and the position of the airplane given by these pairs does not differ by 0.8 or 0.5 nm where one is a procedure tuned navaid.
      9. The DME/DME pair is geometrically valid, the crossing angle between the two DMEs must not exceed more than 150 degrees or be less than 30 degrees. The optimal crossing angle is 90 degrees.
   b) The VOR is considered short-term valid if:
      1. Raw data passes the I/O process validation.
      2. The tuned frequency is equal to the received frequency.
      3. The airplane is not within the zone of confusion (an inverted cone with an apex of 60 degrees, or ground range is less than 1.5 nm) for the respective ground station.
      4. The airplane is flying away from the VOR station at a range no greater than 25 nm, or flying towards the station at a range no greater than 40 nm.
      5. The noise amplitude on the VOR signal does not exceed 2.5 degrees.

5) Long-term validation of DMEs and VORs is the basis for autoselection and NAV MODE selection. If either become long-term invalid, it will not be used for navigation. If either become long-term valid, it will be used for navigation.
    a) DMEs and VORs will become long-term invalid if 50 percent or less of the last 20 data samples were short-term valid. If 70 percent or more of the last 20 data samples were short-term valid, then the DMEs and VORS are valid. Both DMEs and VORs are initially long-term valid except when specified as long-term invalid.

(f) Polar Navigation
    1) When the airplane is greater than 85 degrees north or south latitude, it is in the polar region. In the polar region, each FMC will use only one IRU position instead of the mixed position of all IRUs for airplane positioning.
    2) After reaching the polar region, each FMC's mixed IRU position will gradually change to equal the selected single IRU position. This gradual change will minimize airplane maneuvering and prevent any sudden movement of the ND's display.
    3) If the FMCs were using single IRU postions prior to entering the polar region, they will continue to use the same IRU for position data. However, the FMC function which gradually makes equal the IRS position and the FMC position will automatically become active.
    4) When leaving the polar region (less than 83.5 degrees north or south) the FMCs will resume using mixed IRS position, if the mixed IRS position is valid. There will be no instantaneous change in either FMC position when returnig to the mixed IRS position.

(g) Navaid Blackballing and Inhibiting
    1) Blackballing or inhibiting of navaids can be accomplished in several ways.
        a) Automatically
        b) Pilot entry
        c) Through the navigational data base.
        d) When a navaid is inhibited automatically through long-term validation criteria, this navaid cannot be used for radio updating in the autoselection mode. However, they can be tuned through manual, procedure or route tuning and can be used for radio updating when in one of these modes.
    2) Several options are available to the pilot through entries in the REF NAV DATA page.
        a) Entries in the NAV INHIBIT field inhibit both DME/DME and DME/VOR VHF NAV radio updating through autoselection. It will not inhibit the navaid to be used in manual, procedure or route tuned modes.

b) Entries in the VOR INHIBIT field will inhibit VOR/DME VHF NAV radio updating in autoselection. It will not inhibit DME/DME VHF NAV radio updating in either autoselection or manual, procedure or route tuned modes.

c) Entries in the VOR/DME INHIBIT field result in all VOR/DME VHF NAV radio updating modes being inhibited.

3) Navaids blackballed through the navigation data base are inhibited for use in VHF NAV radio updating. If the VOR only portion is specified as blackballed in the data base, only the VOR is inhibited for use. If the DME portion is specified as blackballed in the data base, the DME is inhibited for use and the VOR will not be used. If both the VOR and DME portions of the navaid facilities are specified as blackballed, the whole navaid is inhibited. Whenever the DME portion of a navaid is inhibited for use through the navigation data base, the navaid will not be used, regardless of the tuning mode inluding manual, procedure or route tuned stations.

(h) Alternate Navigation

1) When the two FMCs have failed, the CDU provides alternate navigation functions through the LEGS and PROGRESS pages. The ACT IRS LEGS page will be shown when the LEGS mode key is selected and the onside FMC has failed. This page provides the means of data input and display details of each leg of the route.

2) The IRS PROGRESS page will be shown when the PROG mode key is pushed and the two FMCs have a failure. This page will show data in relation to the progress of the flight.

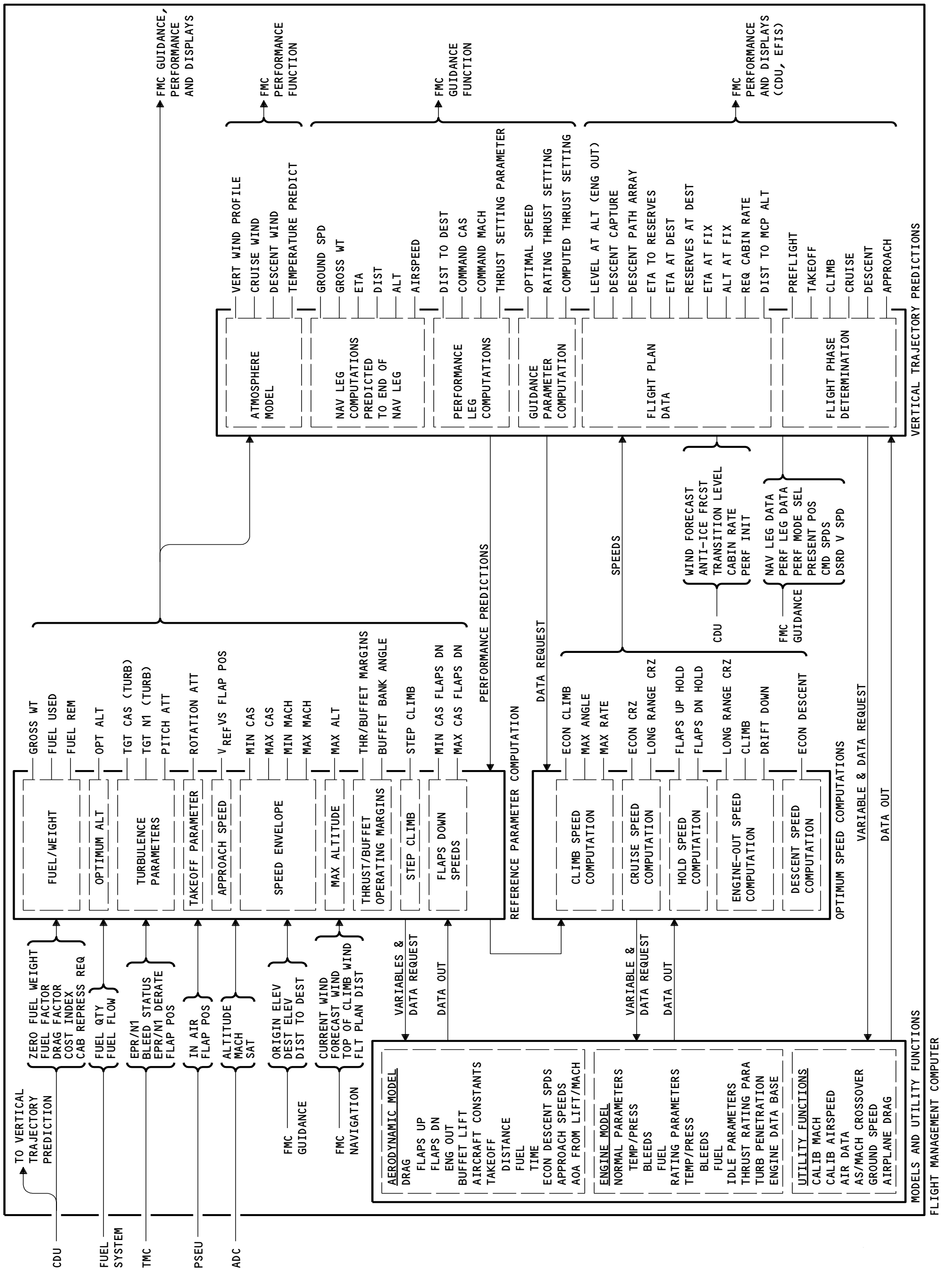
(i) FMC Nav Data Base

1) The navigation data base contains data needed to support airline route structures. The data base is customized according to individual airline requirements, providing data for the geographic areas of navigation.

2) Data stored in the data base is displayed on the CDU IDENT page but is not accessable for update. The navigation data base can be cross-loaded between FMCs through CDU action.

3) The data base contains identifier, location, frequency, elevation, and type for the following navaids:
   a) VOR
   b) VORTAC
   c) VOR/DME
   d) DME
   e) TACAN
4) Airport data includes reference point, threshold location, runway length and heading, elevation, and ILS facilities.
5) Supporting data such as waypoints, intersections, and turnpoints is provided for high level enroute airways and for low level terminal area airways.
6) The data base contains terminal area procedures for departures, arrivals, transitions, and approach. Supporting data includes navaids, waypoints, intersections, and details such as course, heading, distance, and crossing altitude.
7) Supporting data such as frequency, identifier, course, crossing altitude, distance, and missed approach procedures is provided for ILS approach.
8) The navigation data base also includes data for company routes as required by individual airlines.
9) Any data in the navigation data base is available for display on the CDU or EFIS.
10) The data base is loaded into the FMC through plugs located on the first observers panel P17. A portable data base loader is required.
11) Data must be loaded onto the left FMC then cross loaded onto the right FMC.
12) The FMC hardware manufacturer makes available an updated data base every 28 days.

(4) FMC Functional Block - Performance (Fig. 10)
   (a) General
      1) The FMC makes calculations for guidance input limit, optimum speed and altitude, and vertical trajectory predictions.



FMC Functional Block - Performance
Figure 10

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2) Data stored in the performance data base is used to model the atmosphere, airplane aerodynamics, and type of engine installed. Inputs from external sources and other FMC functions provide data needed to complete FMC calculations.
3) The performance data base, which is protected from CDU manipulation, can be changed in the airplane with the use of a portable Data Loader.
4) Data entered through the CDU includes cost index, gross weight, cruise altitude, fuel reserves, winds and temperature, drag factor, and fuel flow factor.
    a) Cost index, used for ECONOMY calculations, is the ratio of time-costs to fuel-costs.
    b) Cost index, fuel reserves, winds and temperature are entered through the CDU PERF INIT page.
    c) Drag factor and fuel flow factor are entered through the CDU PERF FACTORS page.
5) Individual functions of the performance calculations compute reference parameters, models and utilities, optimum speeds, and vertical trajectory predictions.
6) The reference parameter computations provide data for other FMC computations and for display. Data is generated in ten categories.
7) Fuel/weight continuously computes airplane gross weight, fuel used, and fuel remaining.
    a) Gross weight or zero fuel weight (ZFW) must be entered on the CDU.
    b) Fuel used is computed from fuel flow and subtracted from initial fuel to compute fuel remaining.
    c) If the FMC computed fuel differs from the totalizer fuel value by more then 3000 pounds, the totalizer fuel value is used.
    d) Fuel/weight data is displayed on the CDU PERF INIT page.
8) Optimum altitude computes minimum cruise cost based on altitude.
    a) Data includes distance, weight, temperature, climb profile, descent profile, and winds.
9) Turbulence parameters computes target CAS, target N1, and pitch attitude for turbulence penetration.
10) Takeoff parameter computes rotation attitude based on in-air flap position.
11) Approach speed computes speed based on weight and flap position. It is displayed on the CDU APPROACH REF page.
12) Speed envelope computes min/max Mach and airspeeds for normal and engine out operation.
    a) Minimum and maximum speeds are calculated based on altitude, available thrust, weight, and airplane operating limits.
    b) Speed envelope outputs establish limits for command speeds to guidance and limits to CDU entries.

13) Maximum altitude continuously computes airplane altitude limits for normal conditions and for one engine-out conditions.
    a) Maximum altitude is calculated based on airplane weight, thrust, air temperature, wind velocity, and mode of operation. Altitude is limited by airplane certified altitude, airplane maneuvering and climb capabilities.
    b) Maximum altitude outputs are used to limit other FMC computations and to limit CDU entries.
14) Thrust/buffet operating margins computes margin values and checks airplane operation to determine if margins are satisfied.
    a) Thrust/buffet margins are computed based on airplane weight, altitude, Mach, air temperature, and available thrust.
    b) Margins are computed for low speed buffet and for high speed buffet. Climb thrust and cruise thrust are computed for normal conditions and for one engine-out conditions.
15) Step climb computes the best position along the flight plan to climb to a higher cruise altitude.
    a) The step point is displayed on CDU CRZ pages.
16) Flaps down speed computes minimum airspeed and maximum airspeed for flight with flaps down.
17) Models and utilities includes aerodynamic model data, engine model data, and utilities.
18) Aerodynamic model provides airplane dependant data to other FMC functions.
    a) Variable data stored in the data base includes drag, lift, distance, speed, and angle of attack.
    b) Constant data stored in the data base includes flap airspeeds, turbulence penetration, target rotation angle and input limits.
19) Engine model computes normal parameters, rating parameters, idle parameters, thrust rating EPR, and fuel flow. Engine data is provided to other FMC functions on request.
    a) Data stored in the engine model data base includes bleed flows, thrust setting adjustments and conversions, and fuel flow adjustments for bleeds and altitude. Also stored are thrust ratings with adjustments for bleeds and altitude for cruise thrust, climb thrust, and one engine-out thrust.
20) Utilities perform conversions and computations and provide data to other FMC functions.
    a) Utilities converts Mach to airspeed and airspeed to Mach.
    b) Utilities computes Mach, Static Air Temperature (SAT), speed of sound, Mach/airspeed crossover, drag, and ground speed.

21) Optimal speeds are computed as requested by other FMC functions for climb, cruise, hold, one engine-out, and descent.
    a) Speed computations are based on airplane weight, altitude, airplane speed and thrust limits, air temperature, and, for ECON only, cost index and winds.
    b) Speeds are used for performance predictions and as target speeds for guidance.

22) The vertical trajectory predictions computes data relative to performance legs, vertical profile, and mode control panel altitude setting.

23) Frequency of computation varies with the type of data.
    a) Data for active nav leg, next nav leg, climb to mode control panel altitude, descent to mode control panel altitude, and active performance leg (except cruise) is computed every five seconds.
    b) Data for the remainder of the flight is computed every five minutes.

24) Predictions are made for:
    a) Fixed points include waypoints, fix, and destination.
    b) Computed points include target altitude, top-of-climb, step climb, and top-of-descent.

(b) Speed Envelope Characteristics

1) The FMC computes speed limits for internal use from:
    a) Maximum operating airspeed/maximum operating Mach limit (Vmo/Mmo)
    b) Low speed (stall) buffet margin.
    c) High speed (Mach) buffet margin.
    d) Maximum cruise thrust for low and high speed operation.

2) The airplane cannot maneuver outside the speed envelope at 1.3 g without encountering stall or Mach buffet. The speed envelope is defined by the buffet boundary computed internally by the FMC.

3) The FMC computes Vmo/Mmo limits from structural and aerodynamic limitations of the airplane.

4) Sustained speeds at a given altitude are limited by maximum cruise thrust. The FMC normally does not command speeds outside this limit.

(c) Optimum Step Climb Calculations

1) The FMC investigates many points along the cruise segment of flight for cost savings at a higher altitude. It then selects the optimum point for a step-climb.

2) Cost index is considered for all computations involving speed/fuel trades for best economy.

(d) Economy Climb Profile

1) Economy climb is a two-part climb that approximates the optimum climb speed.
    a) The initial climb airspeed is an average of the economy speed at 9000 feet and at the crossover altitude.

      - b) The final climb airspeed is at cruise Mach for the next leg.
      - c) The crossover altitude is the altitude at which the economy climb speed at 9000 feet is the same as the cruise Mach for the next leg.
    - 2) Cost index is used to determine the best economy speed for all segments.
  - (e) Long Range Cruise Speed Calculation
    - 1) The long range cruise speed is slightly higher than maximum range cruise speed and provides 99 percent of the maximum range for given fuel and weight.
    - 2) Long range cruise is used at pilot option.
  - (f) Vertical Trajectory Predictions
    - 1) Vertical trajectory predictions are performed at different times and updated at different rates depending on flight conditions. Predictions are used for the following purposes:
      - a) Provide information for EFIS and CDU display.
      - b) Enable the pilot to determine the best course of action based on current conditions.
      - c) Provide projected guidance conditions at the end of the current leg and during following legs.
      - d) Provide data for performance legs calculations.
      - e) Define navigate and performance legs.
      - f) Compute flight phase and active guidance parameters.
    - 2) The vertical profile is made up of performance legs defined by flight plan entered points, performance computed points, and manually controlled points. Points defining the vertical profile may or may not coincide with points defining the lateral profile.
    - 3) Flight plan entered points include:
      - a) Origin elevation.
      - b) Destination elevation.
      - c) Waypoint constraints.
      - d) Cruise altitude.
      - e) Climb and descent target altitudes.
    - 4) Performance computed points include:
      - a) Top-of-climb
      - b) Step climb
      - c) Top-of-descent
    - 5) Manually controlled points are mode control panel selected altitudes.
    - 6) Legs can also be defined for drift down on a single engine or a step climb.
    - 7) Combinations of altitude, airspeed, ground speed, flight path, distance to destination, estimated time of arrival, and gross weight are computed for points along the profile. The FMC also computes speeds, Mach, thrust, distances, gross weight, and winds along each performance leg of the vertical profile.

8) Termination positions are predicted for navigation legs that terminate at an altitude. A great circle path is assumed between waypoints where a flight plan discontinuity exists.

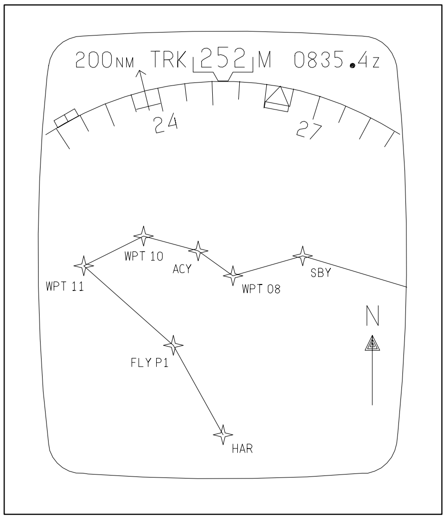
(g) Descent Path Calculations

1) The FMC produces a descent path array containing all data necessary to provide guidance along the path. Data consists of constraining factors and computed factors.
2) Constraining factors include:
    a) Mach/speed restrictions.
    b) Altitude constraints.
    c) Standard procedures.
    d) Repressurization constraints.
3) Computed factors include:
    a) Speed for descent legs.
    b) Path for descent legs.
    c) Thrust for descent legs.
    d) Top-of-descent.
    e) Repressurization segment.
    f) Acceleration/deceleration path.
    g) Required cabin rate of repressurization.
4) The FMC computes the descent path beginning with the last altitude restriction before airplane destination. Descent path segments of constant speed or economy descent are computed in reverse order and include segments necessary for acceleration or deceleration.
5) The repressurization segment is defined so that cabin altitude and airplane altitude are equal at the airplane destination without exceeding the maximum allowable cabin repressurization rate.
6) The top of descent point is determined from the intersection of the descent path with the cruise altitude.
7) Path changes may be made at set altitudes, calculated altitudes, or geographical locations.

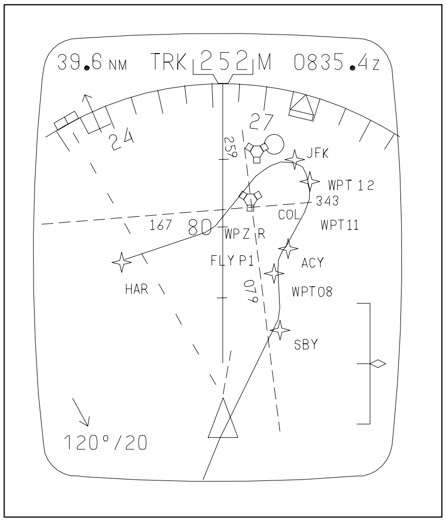
(5) EFIS - EHSI (Map and Plan Modes) (Fig. 11)

(a) General

1) For a description of the EHSI symbols, refer to AMM 34-22-00/001.
2) The FMC provides data to the EFIS symbol generators over a dedicated ARINC 429 bus. The bus carries:
    a) Dynamic data, which is transmitted for all EFIS modes, is updated every 50 milleseconds.
    b) Background data, which is transmitted for EFIS map and plan modes, is updated every five seconds.
3) The display reference position for the map mode is the airplane position. The map mode is oriented with the airplane track at the top of the display. The reference position is dynamic, moving as the airplane moves.
4) The map displays selected routes. Desired background data may be selected at the EFIS control panel for display.



EHSI DISPLAY (PLAN MODE)



EHSI DISPLAY (MAP MODE)

EFIS-EHSI (Map and Plan Modes)
Figure 11

5) Data provided by the FMC includes:
   a) Wind speed
   b) Wind angle
   c) Track angle
   d) Time to go/distance to go
   e) Range to altitude
   f) Curved trend vector
   g) Compass scale
   h) Vertical deviation
   i) Lateral deviation

6) The display reference position for the plan mode is a waypoint selected on the CDU RTE LEGS page or the current active waypoint. If no waypoints are entered, the display is referenced to the airplane origin. The plan mode is oriented with north at the top of the display. The reference position does not move.

7) Data provided by the FMC includes:
   a) Track angle
   b) Time to go/distance to go
   c) Compass scale

8) Desired background data may be selected at the EFIS control panel for display.

9) Dynamic data is displayed for the VOR/ILS mode.

10) Data provided by the FMC includes:
   a) Wind speed
   b) Wind angle
   c) Track angle

11) Data provided to EFIS by the FMC includes both FMC generated data and data received by the FMC from external sources.

12) Data generated within the FMC comes from four FMC functions.
   a) The FMC guidance function provides flight plan definition, leg data, leg transition data, vertical and lateral errors, and drift.

  - b) The FMC performance function provides distance to destination.
  - c) The FMC navigation function provides airplane position, track, speed, altitude, wind data, and nav aid frequencies.
  - d) The FMC CDU function provides map reference position, offset path, page identity, selected reference points and reference point radials.

13) Data generated outside the FMC comes from three external sources.
  - a) The inertial reference system provides acceleration and heading.
  - b) The VOR provides selected course.
  - c) The EFIS control panel provides data, range selection, and EFIS mode.

14) Data from all sources is transmitted by the FMC directly to the EFIS symbol generator over the EFIS data bus.

15) The FMC computes a map edit area for the EFIS. The edit area includes all map points currently displayed and all map points that could appear in the next 10 seconds. Background data is provided only for the edit area.

16) The FMC selects an array of navaids from the navigation data base. Selection is made beginning with the navaid nearest the airplane and working out to the maximum range. The array is limited to the 20 nearest navaids. Autotune navaids are selected from the array by the navigation function.

17) Flight plan data required for display is computed by the EFIS function and stored in the guidance buffers. Time to waypoint and range to altitude are computed by the EFIS function and are transmitted to the EFIS symbol generator as dynamic data.

18) The FMC transmits 64-word blocks of background data to the EFIS symbol generator once every five seconds. The block contains only data that has been updated since the previous block was transmitted. A maximum of eight blocks, or 512 words, are used for background data.

19) Complete background data is transmitted within one second of a mode change, scale change, EFIS map data selection, or a CDU action. The EFIS control inputs respond to CDU actions within 100 msec.

20) The FMC establishes the priority for data sent to the EFIS symbol generator. If background data exceeds 512 words, the most important data is displayed.

(6) FMC Functional Block - Guidance (Fig. 12)

(a) General

1) The guidance function of the FMC performs flight plan storage of navigation and performance legs and guidance initialization for both lateral and vertical profiles. The guidance initialization process includes flight plan activation, leg sequencing, leg updating, and path definition.

2) With each leg of the lateral path defined, three modules are used to determine roll steering commands along each leg or transition between legs.

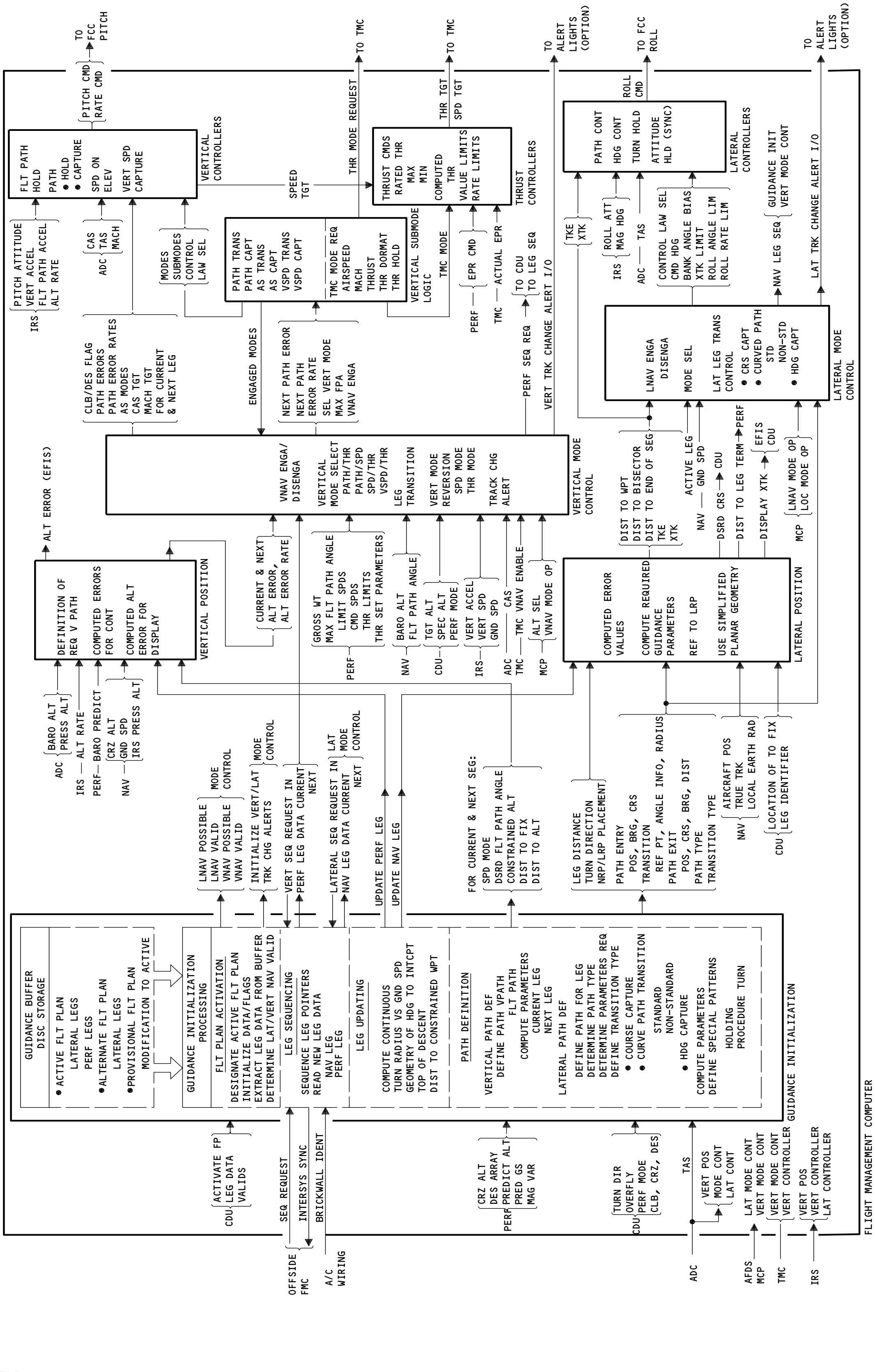
3) The lateral position module compares current airplane position to the desired position (defined track) and generates errors. Error calculation uses planar approximations about computed lateral reference points.

4) The lateral mode control module controls the engagement and disengagement of the LNAV mode, selects the proper mode control to steer and performs leg sequencing.

5) Using path and/or heading errors and mode control inputs, the lateral controllers compute roll attitude commands that cause the FCCs to steer the airplane along the intended route.

6) Each leg of the vertical profile is defined and in some cases broken into smaller segments by the performance function of the FMC. Five modules are used to determine pitch and thrust steering commands for each segment of each vertical leg.

7) The vertical position module compares current airplane altitude and altitude rate with the desired flight path and generates errors for this path and the next.



FMC Functional Block Guidance
Figure 12

8) The vertical mode control module controls the engagement and disengagement of the VNAV mode. It also selects the proper mode for control of the pitch axis and the throttles and sends appropriate requests to the submode logic. At the proper time, the vertical mode control module performs leg and segment sequencing.

9) The vertical submode logic module flies the plane to defined legs and transitions as requested by vertical mode control. It also performs all switching required during transitions and capture maneuvers, and sends mode request logic to the TMC.

10) Vertical controllers use errors, ratio, targets, mode and submode selections to compute pitch displacement and pitch rate commands. They return the necessary quantities back to submode logic to enable switching submodes at appropriate times and supply airspeed targets to the thrust controllers. The thrust controllers provide thrust and airspeed targets to the TMC.

(b) Flight Plan Records

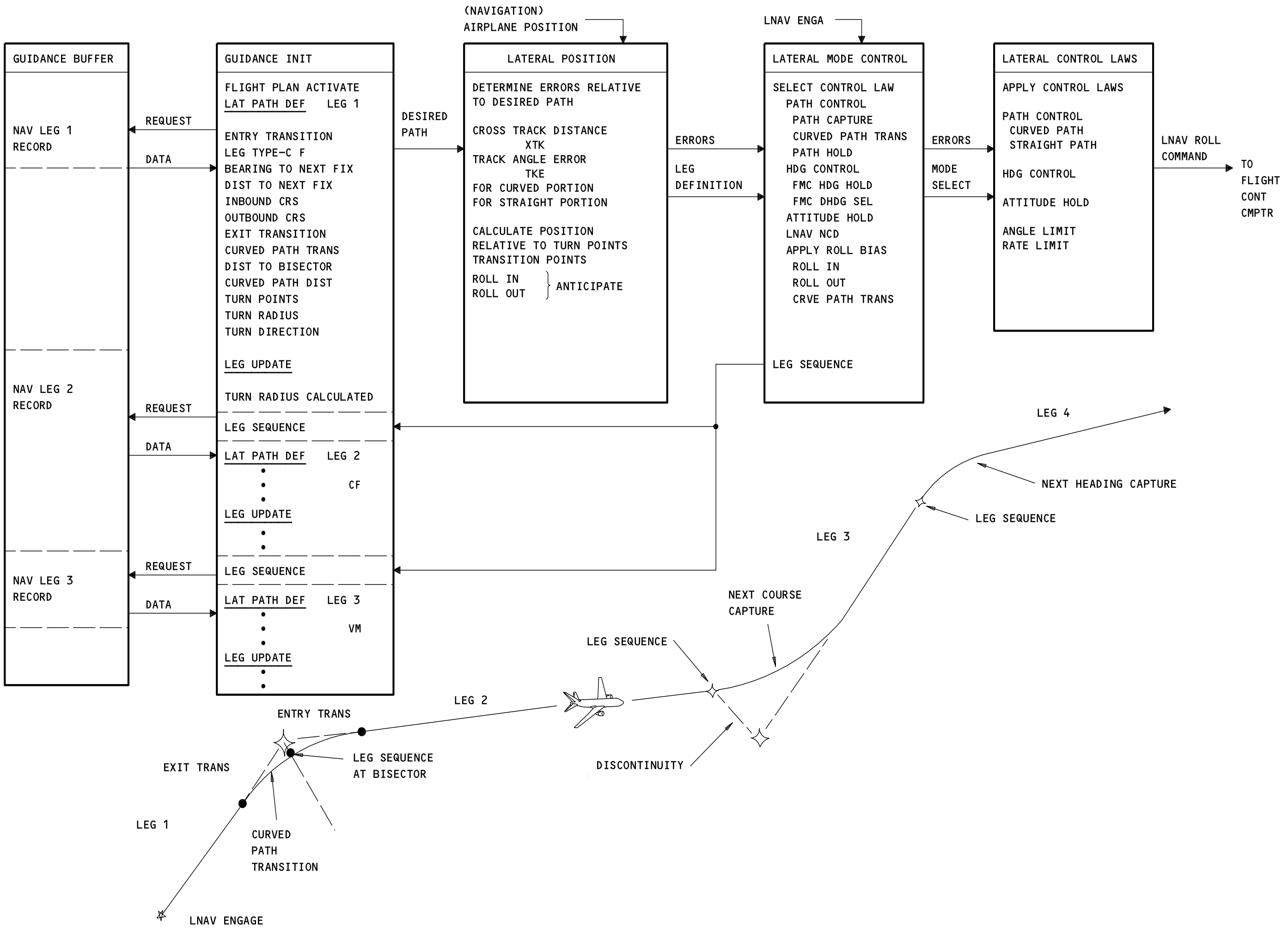
1) Three flight plans are stored in the guidance buffer:

a) The active flight plan: This plan is selected by executing a route through the CDU. Performance legs define the vertical profile. Navigation legs define the lateral profile. Some NAV waypoints may place altitude constraints on the vertical path, but generally the two records are independent. Only the active flight plan is used for VNAV and LNAV guidance computations.

b) The inactive flight plan: This plan contains only the navigation legs. This may be a company route or a pilot-selected string of waypoints and procedures. To be used for guidance, the inactive flight plan must be activated and executed. The vertical profile is defined only after activation.

c) The provisional flight plan: This plan is temporary and, modifies the NAV or performance legs. These modifications must be executed before they affect the active flight plan. The provisional flight plan is eliminated if the modifications are executed.

(c) LNAV Guidance - General (Fig. 13)



LNAV Guidance General
Figure 13

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1) The LNAV Route consists of lateral legs connected by transitions. These transitions are automatically initiated to allow smooth control between legs. Heading control is used for straight paths and path control for curved paths. Normal guidance is provided across discontinuities if certain criteria are met (close proximity or intercept heading).
2) If LNAV is still engaged at the end of the defined route, or at a discontinuity where capture of the next leg is impossible, control reverts to HDG HOLD.
3) The guidance buffer stores records of each defined LNAV leg. Guidance initialization activates the flight plan, selects data from correct NAV leg record, and assembles data to define a lateral path in a manner usable to the guidance function. Guidance initialization also updates dynamic leg parameters and responds to leg sequence requests with next leg data.
4) Lateral position determines airplane position errors relative to the path; calculates airplane position relative to transition points, turn points, etc.; and provides leg sequence requests at the proper time.
5) Lateral mode control properly routes the signals for processing. It enables transition (path, course, or heading capture), and leg guidance (path control, heading select, or heading hold). Lateral mode control also enables synchronization during LNAV disengaged.
6) Lateral control laws use mode control and signal inputs to perform steering computations, filtering, and limiting. Lateral control laws provide roll attitude commands to the FCC.

(d) NAV Leg Transition Descriptions

1) The LNAV guidance is capable of steering the airplane through all normal transitions between the 15 possible navigation legs. Transitions are divided into three categories: curved path transition, course capture transition, and heading capture transition.
2) Curved path transition is the normal transition for an automatic course change at a waypoint. A circular path tangent to the active course and the next course is calculated. Errors are measured from the arc during the transition. When the errors are zero, a bank angle bias maintains the proper bank for the turn. Roll-in and roll-out anticipation are computed for accurate tracking of the path. Leg sequencing takes place at the bisector.

3) Non-standard curved path transition is the same as the standard curved path transition except that no bisector is calculated. Leg sequencing occurs at the beginning of transition. This method is used for course intercept (VI) or direct-to-fix (DF) legs.

4) Whenever off-path conditions occur, the course capture transition is used. The turn direction may be specified but no circular path is computed. Path errors, cross track distance (XTK) and track angle error (TKE), steer the airplane back to the path.

5) Heading capture transition is used whenever the next leg requires guidance to a specified heading. The transition begins at the termination of the active leg. Heading error provides the only guidance.

(e) LNAV Engage

1) The LNAV mode is initiated by pressing the LNAV switch/light on the MCP which generates an LNAV mode request to the FCC. The FCC determines if the A/P is currently capable of engaging in LNAV. If this validity check is passed, the FCC sends an LNAV arm signal to the MCP, which then sends an LNAV mode operate signal to the FMC.

2) Two conditions will prevent LNAV ENGAGE. One occurs when the airplane is flown beyond the defined route. The other occurs when the airplane is not in position to capture the route (proximity test failed). The proximity test requires that the transmitter is within 2.5 nautical miles; or that the airplane is on an intercept heading and satisfies the capture criteria based on speed and intercept angle. Once LNAV is engaged, neither of these conditions causes disengagement.

3) For continued LNAV engagement, the following conditions must exist:
   a) LNAV is possible - navigational data and critical sensors are valid.
   b) LNAV is valid - route and additional data and sensor inputs are valid.
   c) Lateral leg defined - path, HDG, or HDG HOLD.
   d) No FMC failure.

4) Anytime LNAV ENGAGE goes low for any reason, the LNAV mode operate must be cycled low to high before LNAV ENGAGE can occur.

5) Data management provides true airspeed and magnetic heading to the heading control logic and roll angle to the horizontal steering circuits. Path control provides a roll signal based on track errors (TKE and XTK).

6) When LNAV is disengaged, steering signals are transmitted with a Sign Status Matrix (SSM) indicating No Computed Data (NCD) (Fig. 19). The steering signals are generated by using actual airplane roll angle as a roll command. Path control (B from Fig. 19) and heading control outputs are isolated from the summing point at the input to the roll command limiter. The steering signal is therefore synchronized to airplane bank angle so that no transients occur at LNAV engage. The steering signal is not used by the FCC until the SSM goes from NCD to a valid condition.

(f) LNAV Heading Control

1) There are two methods of heading control from the FMC:
    a) Heading select (HDG SEL) control begins at the termination of the active leg when the next leg is a heading leg. The difference between current airplane heading and selected heading generates a heading error and consequently a roll steering command.
    b) Heading hold (HDG HOLD) is used whenever a path mode is called for but capture criteria are not satisfied (proximity test). It is also used when the airplane reaches the terminating waypoint of the last defined route leg. Heading hold causes the airplane to maintain the current heading. Current heading is sampled and held at the time of HDG HOLD engage. Any deviation from this heading causes roll commands to be generated to return the airplane to that heading.

(g) LNAV Course Capture

1) Course capture is used to capture a navigational leg whenever an off-path condition exists. The following reasons can cause an off-path condition:
    a) Pilot using the F/D and not following the commands.
    b) The terminal fix of this leg does not overlie the next leg.
    c) The offset path is cancelled automatically or manually.
    d) Procedures require the airplane to overfly a waypoint.

2) A required turn direction may be specified to capture a course.

3) If a course change of less than 3 degrees or greater than 135 degrees is required and the airplane is on-path, the airplane will overfly the terminal fix and a course capture can be used to acquire the next course.

4) Course capture uses path errors, cross-track distance, and track angle error to fly the airplane to the desired path. During a capture, the airplane will turn through the smallest angle to the new course unless a turn direction is specified. The course capture point is calculated so that by using the maximum bank angle (17 deg) and bank rate (2 deg/sec) the airplane will fly to the desired course with no overshoot.
5) In the off-path condition the airplane turns through the smallest angle and makes a normal capture at the proper capture point. There is no overshoot.
6) In overfly, the airplane crosses over the desired course and turns through the smallest angle to the new course. Capture is latched at the capture point. If the overshoot is large, normal capture is accomplished by approaching the new course from the far side at an angle of 45 degrees.
7) Maximum bank in a specified turn direction is commanded by bank angle bias. This bias is removed if the specified turn direction is the smallest angle. In this type of capture the airplane crosses the desired course and intercepts it at a 45 degree angle (for large overshoot). Normal capture takes place as the airplane returns to the desired course.
8) Capture distance is computed based on TKE and ground speed. If the capture detector output is high, lateral path capture logic is maintained through leg sequencing. If no turn direction is specified, path errors (XKT and TKE) are used to steer the airplane toward the desired course. Undesirable transients during course capture or leg sequencing are eliminated through the roll command limiter and the roll command rate limiter.
9) After LATL PATH CAPTURE logic goes high, the airplane may turn the opposite of normal course capture turn direction, in which case a 25 degree bank angle bias is inserted.
10) The airplane maintains this 25 degree bank in the correct direction until a normal course capture takes over.
11) The LATL PATH CAPTURE logic closes the switch allowing the output of path control to be applied to the roll command limiter.
12) Path errors continue to control the airplane when it is established on the path. Since leg sequencing normally occurs at the capture point, the pilot's only indication that he is on the path is when the airplane rolls to wings level and the correct map is displayed on the EHSI.

(h) LNAV Path Control

1) Most legs of a navigational route consist of defined paths between pairs of waypoints. Each such leg is divided into three segments: a curved entry path, a straight path, and a curved exit path. Leg sequencing takes place at the bisector of the course change angle.

2) The LNAV guidance uses path errors to steer the airplane to the defined path segment whether it is a curved or straight segment.

3) During a curved path transition, the airplane is constantly under path control. A turn radius is computed by the FMC based on ground speed and course change angle. This curved path is tangent to both the active leg and the next leg.

4) A nominal bank angle, based on ground speed and less than applicable limits, is computed and used as a bias to fly the curved path. When the path errors (TKE and XTK) are zero, the airplane maintains the nominal bank angle. A roll-in anticipation and a roll-out anticipation distance is computed for each transition. The bank angle bias is applied only after roll-in logic and after roll-out logic and is not used for straight path segments.

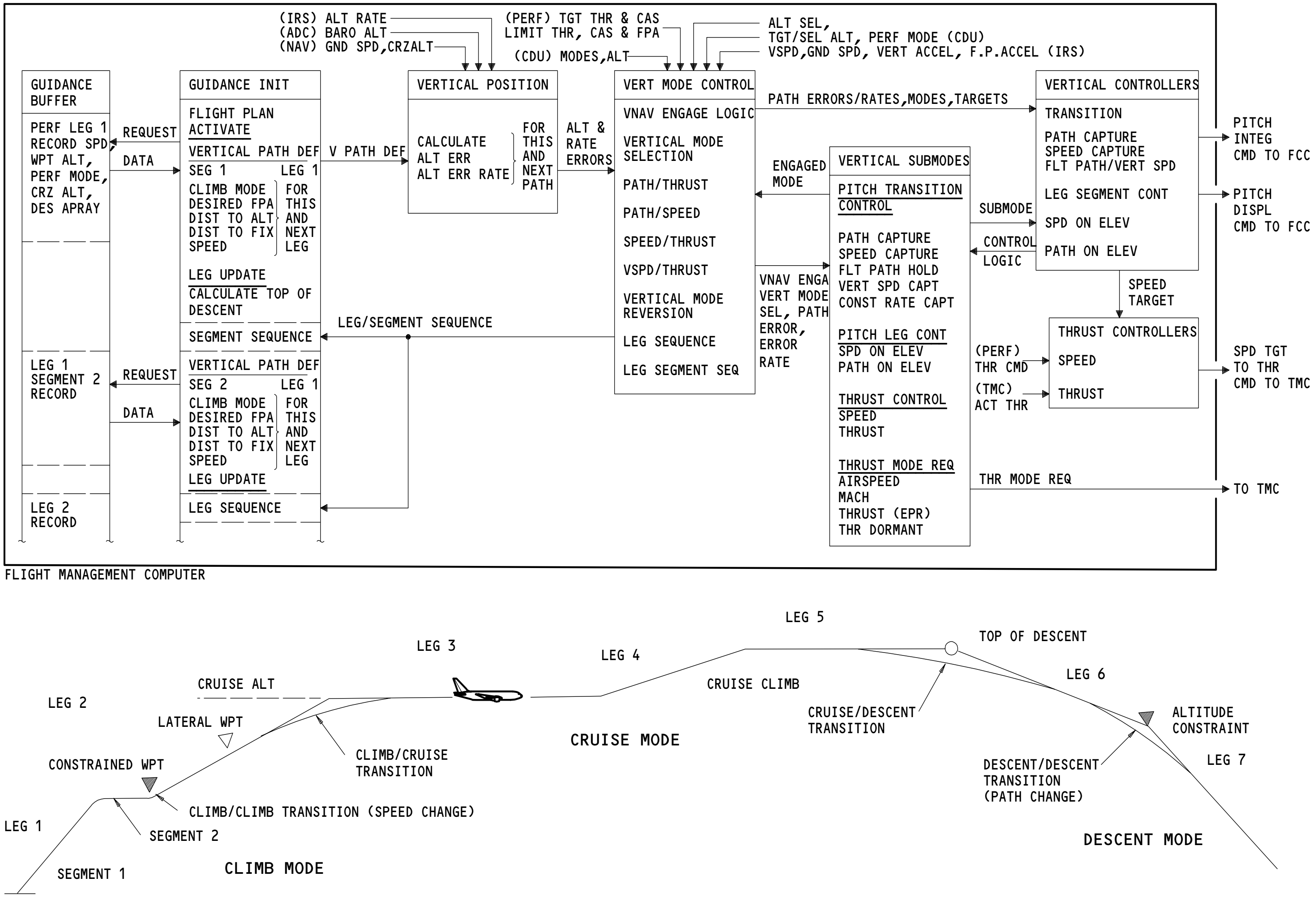
5) No attitude change should occur at leg sequencing since the curved path radius and nominal bank angle for the exit segment of the active leg and for the entry segment of the next leg are identical.

6) The nominal bank angle bias is removed during straight path segments. Path errors alone steer the airplane to maintain the desired path. If path errors are zero, the commanded bank angle returns to zero.

(i) VNAV Guidance General (Fig. 14)

1) The vertical flight profile is comprised of climb, cruise, and descent performance legs.

2) The performance legs are further separated into smaller segments. Each segment is individually controlled in VNAV by use of the proper pitch and thrust controllers. The controllers provide smooth, transient free transitions between segments. The FMC accommodates VNAV mode transitions between the following vertical leg segments:
   a) Speed Climb to Speed Climb (speed or thrust change)
   b) Speed Climb to Cruise
   c) Cruise to Speed Climb
   d) Cruise to Cruise (speed change)
   e) Cruise to Speed Descent
   f) Cruise to Path Descent
   g) Speed Descent to Speed Climb (go around)
   h) Speed Descent to Cruise



VNAV Guidance General
Figure 14

      i) Speed Descent to Speed Descent (speed change)
      j) Speed Descent to Path Descent
      k) Path Descent to Speed Climb (go around)
      l) Path Descent to Cruise
      m) Path Descent to Speed Descent
      n) Path Descent to Path Descent (path change)
    3) The VNAV guidance function of the FMC is divided into seven sections as shown in Fig. 14.

(j) VNAV Performance Leg Definition - Climb
    1) Each leg begins or ends at a transition altitude or an altitude constraint. The climb mode ends upon reaching the selected cruise altitude. One of five performance modes may be selected for each climb.
      a) Economy
      b) Manual
      c) Maximum rate
      d) Maximum angle
      e) Engine out
    2) Each climb leg may be divided into segments. A segment change allows level flight when reaching a constraining altitude while remaining in the climb mode.
    3) The FMC mode and submode logic determine which vertical controllers (pitch or thrust) are used to control each segment of each leg. When at a climb leg or segment transition, new vertical controllers or new altitude and speed targets cause guidance to the new segment. The following transitions occur with controller changes:
      a) Speed on elevator to path on elevator
      b) Thrust on throttles to speed on throttles
    4) New altitude and speed targets provide transitions without controller changes.

(k) VNAV Performance Leg Definition - Cruise
    1) The cruise mode of a flight plan begins when the cruise altitude is reached. One of four performance modes may be selected for cruise legs.
      a) Economy
      b) Long range cruise
      c) Manual cruise
      d) Engine out
    2) Only one cruise performance mode is used at any time. The cruise mode ends at the calculated top-of-descent point if VNAV is allowed to transition to a descent mode (lower MCP altitude selected).

3) The only automatic transitions involving cruise legs are transitions into cruise at the top-of-climb, and out of cruise at the top-of-descent. Cruise climb and cruise descent are initiated through CDU action. Mode and submode logic determines which vertical controllers are used during cruise legs. The normal control is path-on-elevators and speed-on-throttle.

(l) VNAV Performance Leg Definition - Descent

1) Each descent leg begins or ends at a transition point or altitude constraint. One of the following two performance modes may be selected:
   a) Economy descent
   b) Manual descent

2) The descent profile contains lateral overlaps or discontinuities between legs. The airplane maneuvers either vertically or horizontally to capture the next leg. The descent mode begins at the top of descent and ends at a defined or default end of descent.

3) The performance function of the FMC provides a descent path array that divides each descent leg into small segments. Segment transitions normally require a change in flight path angle. This occurs at approximately 3000 ft. intervals. Acceleration, deceleration, descents across discontinuities, anti-ice, and repressurization segments use non-standard control.

4) Mode and submode logic determine which vertical controllers are used to control each segment. Normal descents require path on elevator and thrust (idle) on throttles for most segments (speed is not directly controlled). Speed reversion is used if the airplane approaches maximum or minimum speed limits.

(m) VNAV Engage

1) The VNAV mode is initiated by pressing the VNAV switch on the Mode Control Panel (MCP). This generates a VNAV mode request to the Flight Control Computer (FCC). The FCC determines if the autopilot is currently capable of engaging in VNAV (validity check). If the validity check is passed, the FCC sends a VNAV ARM signal back to the MCP. This illuminates the VNAV switch/light and allows a VNAV MODE OPERATE signal to be sent to the FMC and TMC.

2) The VNAV mode cannot be engaged if the airplane has flown beyond the defined navigation route. If the airplane flies beyond the route with VNAV engaged, no disengagement takes place. Instead, the FMC automatically defines altitude hold as the active leg (vertical path/speed).

3) VNAV engagement requires the following:
   - a) VNAV POSSIBLE - the critical IRS and ADC sensor inputs must be valid.
   - b) VNAV VALID - the vertical leg must be defined, the FMC navigation data must be valid, and the performance function must be initialized. (An ORIGIN must be entered on the Active Route Page of the CDU before the FMC can calculate performance predictions).
   - c) No FMC Failure - When an FMC FAIL occurs, the VNAV MODE OPERATE signal must be cycled to high to re-engage VNAV.
   - d) FMC Target Altitude/MCP Clearance Altitude - If the FMC climbs through, descends through, or flies away from the MCP clearance altitude VNAV disengagement occurs.

4) Engaging VNAV with the airplane between the FMC target altitude and the MCP clearance altitude results in a command to level the airplane and maintain speed if the airplane is more than 150 ft. from the FMC target altitude. If VNAV is engaged within 150 ft. of the FMC target altitude, the FMC smoothly maneuvers to capture the target regardless of the MCP setting. A CDU alerting message is generated when the FMC cannot fly the airplane to its target altitude.

5) Thrust targets for the speed/Mach modes and the thrust mode are continuously generated with VNAV engaged. The TMS receives either a speed target or a thrust target, depending on the performance mode selected. Speed targets are used for cruise and VFR approach modes and are in terms of CAS or Mach. Thrust targets are used for climb and descent modes. An idle thrust target is used for most descents. Thrust mode requests to the TMC enabling the use of these targets require a TMC VNAV ENABLE signal from the TMC. This signal assumes that A/T ARM is selected on the MCP and the TMC is ready to accept FMC commands.

(n) VNAV Climb

1) Primary control during VNAV climbs is speed on elevators and thrust on throttles.

2) The GAMMA HOLD function prevents the airplane from going to descent to attain an increased commanded speed during climb. It also prevents a descent-to-climb transition to capture a lower speed.

3) The FLIGHT PATH HOLD function maintains a zero flight path during a speed transition or GAMMA HOLD.
   - a) The current value of inertial speed is held and compared to the dynamic value of vertical speed from the IRS. Any difference causes a vertical speed error.

b) The steering and steering rate paths, which use the vertical speed error, are sent to the pitch channel of the FCC. Here they cause proper elevator command.

4) The THRUST HOLD function is generated when speed and EPR errors require one target to increase and the other to decrease. It is used only during speed transition to prevent change to the thrust target in the TMC.

a) The maximum value of current EPR from either engine is sampled and held to be used as an EPR target value for the TMC.

b) Since the THRUST HOLD logic also generates a THRUST MODE REQUEST, the TMC controls the throttles to maintain the actual (current) EPR.

5) The Mach or Computed Airspeed (CAS) target for the active performance leg is converted to true airspeed (TAS). If the MCP SPEED SEL knob is pressed with VNAV engaged, the MCP displayed speed becomes the current target for speed mode operation. The TAS from external sources is compared to the target to generate a SPD ON ELEV STRG RATE CMD. The differentiated TAS target is combined with filtered TAS and flight path acceleration to generate the SPD ON ELEV STRG CMD. The two commands are used whenever the SPD ON ELEVATOR logic is high (from the submode logic).

6) The STRG and STRG RATE commands are smoothed in mode transition smoothing. They are limited to a vertical acceleration of 0.1g and a total pitch altitude command of +15° or -10°. The vertical steering signal causes immediate elevator deflection. The vertical steering rate signal causes the FCC pitch command integrator to ramp to establish a new reference pitch attitude. Gain adjustments in the steering rate command determine how quickly a new reference should be established.

(o) VNAV Cruise-Path/Speed Control

1) Primary control during cruise is path on elevators and speed on throttles. The path control uses path error and path error rate to control the airplane. Path errors and error rates are measured from the next path during capture, and from the active path once established on the path (path hold) .

2) When the next performance leg is a path leg, the guidance function computes a path capture point. The capture point allows the airplane to maneuver to the next path in a smooth manner with no overshoot. The transition is achieved without exceeding the pitch attitude limits or vertical acceleration limits.

3) A detector determines when the airplane reaches the capture point and starts the normal capture. The path error signal causes the airplane to continue flying toward the next path. The path error rate is a damping signal. Once the airplane has flown to the new path and the path error and error rate have reduced below certain thresholds, the transition is complete. The path capture control then ends and path hold begins.

4) The DEVIATION SIGN (from signal flow) determines which side (above or below) of the capture point the airplane is on. When the DEVIATION SIGN changes state (0 to 1 or 1 to 0), the airplane has passed through the capture point. Also, PATH CAPTURE goes high and is latched. The PATH CAPTURE causes the speed mode request (TAS or Mach), defined for the next path, to be sent to the TMC.

5) The path capture control law provides steering and steering rate signals. These signals cause the airplane to fly a 0.05 g circular arc to the new path. A positive or negative g bias (gain programmed by TAS) is summed with the steering rate command during the initial part of the capture maneuver. This aids in flying the airplane to the new path and to more quickly establish a new reference pitch attitude. Steering and steering rate commands are smoothed and limited and sent to the FCC.

6) During PATH/SPEED capture and hold maneuvers the throttles are controlled to maintain the speed commanded by the active performance mode. The SPEED and MACH targets from the performance function are used. The next leg values are used during capture. The established leg values are used after capture. Target values are sent as CAS and Mach to the TMC along with the proper speed mode request (AIRSPEED REQUEST or MACH REQUEST).

(p) VNAV Descent

1) Primary control during most descents is path-on-elevator and thrust-on-throttles. Speed is not directly controlled during this type of descent. If the speed comes close to Vmax or Vmin during a VPATH/Thrust descent, the FMC reverts to speed/thrust control.

2) For a normal capture, vertical speed error is used, with a gain difference, in both the steering and steering rate path to the pitch channel. The STRG and STRG RATE commands are smoothed in mode transition smoothing. They are limited to a vertical acceleration of 0.1 g and limited to a total pitch attitude command of +15 degrees and -10 degrees. The signals are then sent to the pitch channel of the FCC where they cause the proper elevator command.

3) The cruise descent mode may be used to accomplish the following:
   a) A pilot initiated cruise descent
   b) An early descent (before reaching top of descent)
   c) A fly across to a lateral discontinuity in the descent path.

4) A cruise descent is accomplished in two parts. A vertical speed of 1000 ft/min is captured while the throttles maintain airspeed. Then, the elevators hold airspeed while the throttles go dormant. With the throttles dormant, the pilot can adjust throttle position to adjust descent rate without the TMC returning the throttles to their original position.

5) Constant rate capture is utilized under the following conditions:
   a) Late capture before crossing the next path
   b) Late capture after crossing the next path with the path errors still within limits.
   c) Capture change - capture request during a path capture.

6) A constant rate capture may occur with either a VPATH/SPD or VPATH/Thrust request.

7) For a capture requiring pitch up, the constant rate capture control commands pitch up to the maximum flight path angle as computed by the performance function. The airplane overshoots the desired path and performs a normal capture from the far side.

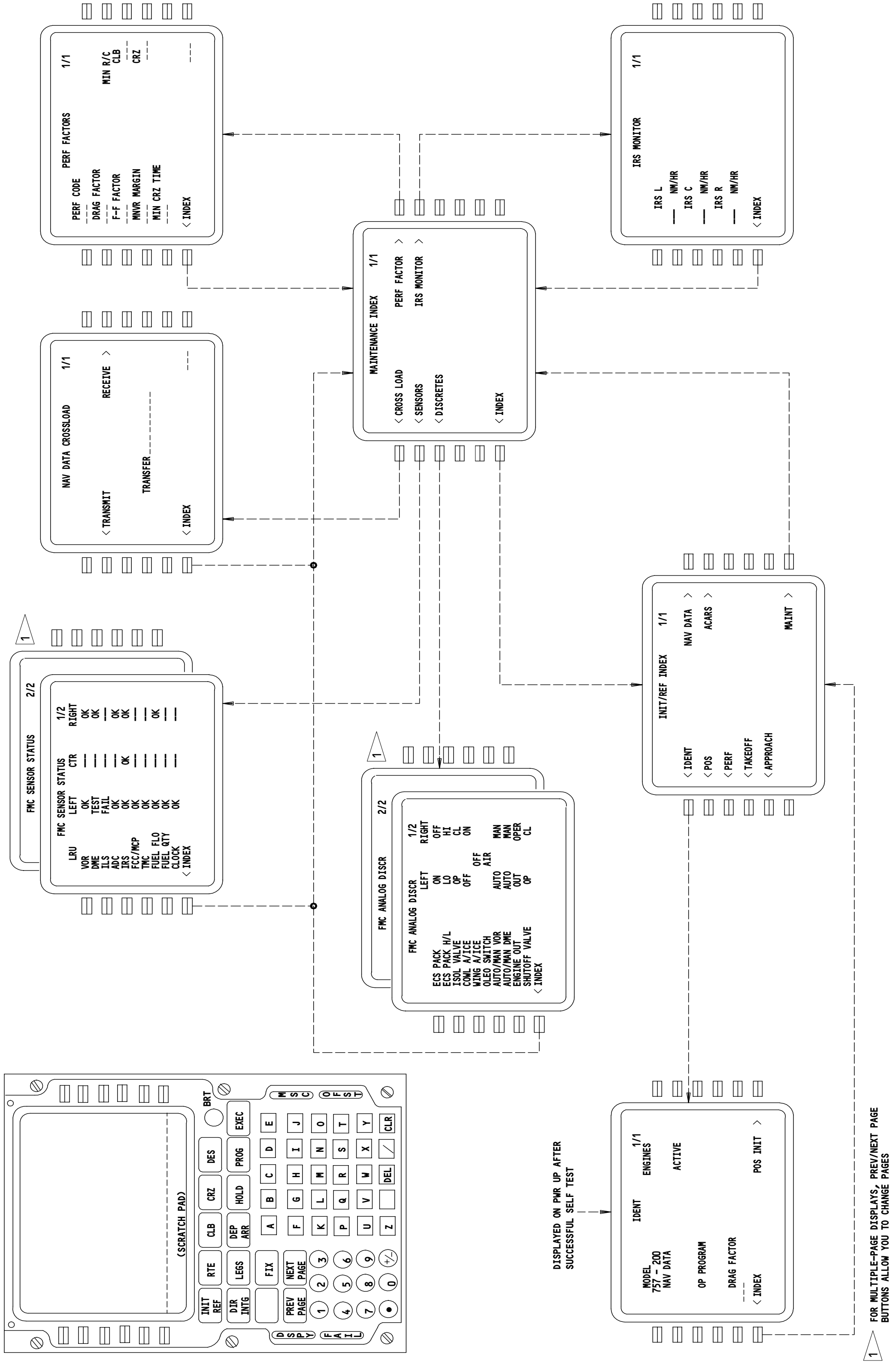
8) For a capture requiring pitch down, the constant rate capture control commands pitch down to achieve a 75 ft/sec descent rate. The airplane flies through the desired path and performs a normal capture from the far side. Normal path capture is inhibited during a constant rate capture request.

(7) FMC Functional Block - Maintenance Index (Fig. 15)

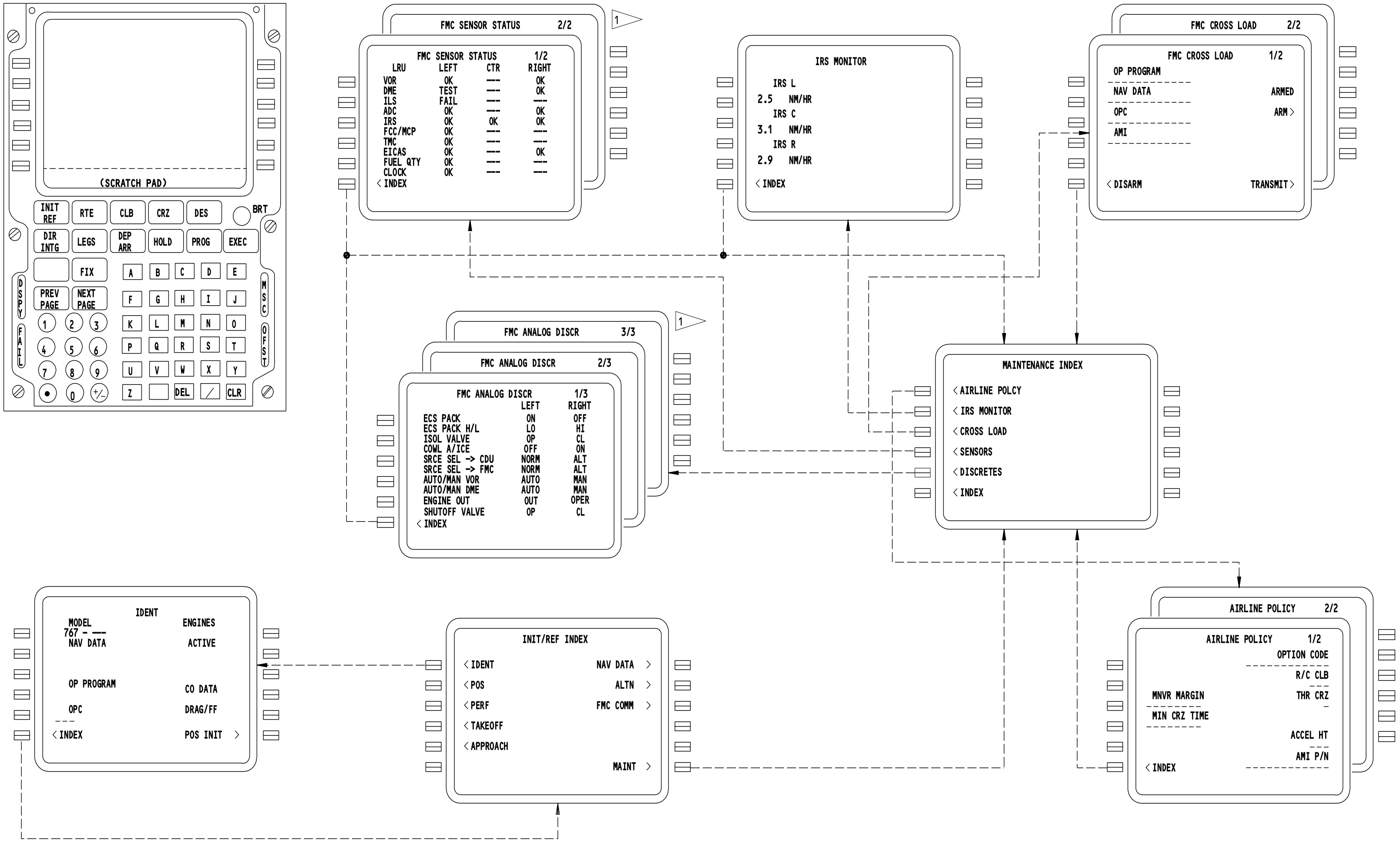
(a) General

1) The CDU allows control of the FMC and is the primary display for the pilot.

2) Four flight management functions are performed through the CDU.
   a) Flight planning includes establishing navigation parameters, route selection, route leg definition, and departure/arrival data. Flight planning also includes monitoring flight progress and selection of waypoint fixes.



FMCS Maintenance Index
Figure 15 (Sheet 1)



1 FOR MULTIPLE-PAGE DISPLAYS, PREV/NEXT PAGE BUTTONS ALLOW YOU TO CHANGE PAGES

FMCS Maintenance Index
Figure 15 (Sheet 2)

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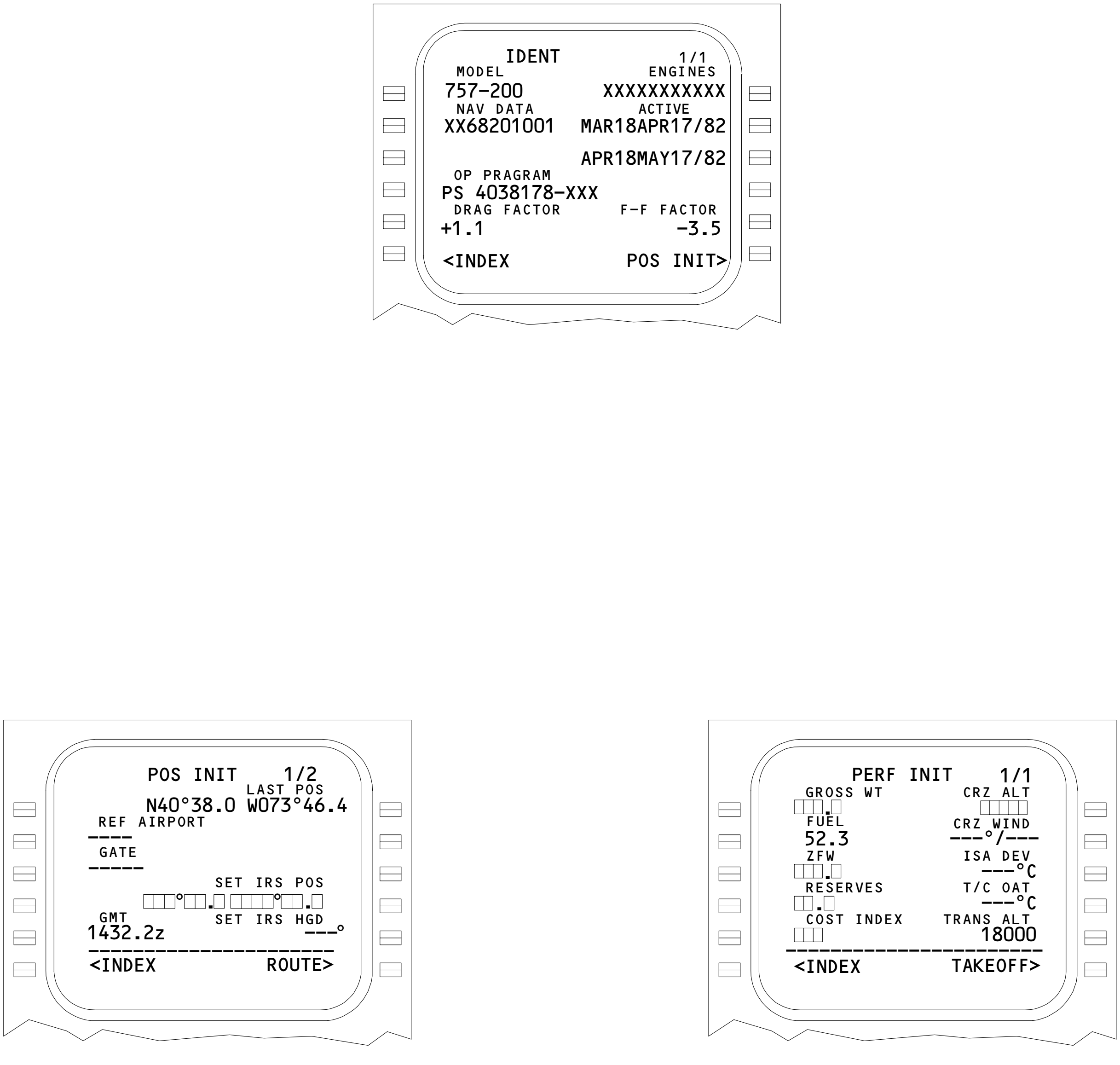
        b) Navigation function selection includes defining direct-to flight paths, intercept flight paths, and holding patterns.
        c) Performance function selection includes selecting climb modes, cruise modes, and descent modes for the flight path.
        d) Flight data inputs include altitudes, winds, temperatures, and cabin repressurization rate.
    3) Data from the CDUs is received on dedicated ARINC 429 data buses. The FMC checks data for validity and rejects invalid data. If the onside CDU fails, data from the offside CDU is available.
    4) The FMCS CDU display is controlled by the FMC. Each FMC contains two independent display buffers, one for each CDU.
    5) The FMC formats all data for display on the CDU. The data is updated when dynamic conditions change, when there is a CDU request for data, or when there is a change in the active leg.
    6) The identity and format of information displayed on the CDU is determined by the FMC processing.
    7) The FMC alert conditions are displayed on the CDU scratch pad and by CDU annunciators.
    8) The FMC Maintenance Index page permits selection of these other pages which may be used for maintenance activities.
        a) Nav Data Crossload - provides for initiation and status of a transfer of the navigation data base from one FMC to the other.
        b) Sensor Status - lists all sensors providing data to the FMC and their valid or invalid status.
        c) Analog Discretes - provides display of status of input analog discretes
    9) Perf Factors - provides for display and entry of performance factors.
        a) IRS Monitor - displays position error rate for each IRS.

(b) FMCS CDU Displays - IDENT (Fig. 16)
    1) The IDENT page is automatically displayed when power is applied to the FMCS or when the self-test has been successfully completed.
    2) The IDENT page can be line-selected from the INDEX page line select key 1L.
    3) The IDENT page displays information about the airplane, FMC software program, and the navigation data base. Information includes:
        a) Airplane Type.



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□□.□                  ---°C
 COST INDEX       TRANS ALT
□□□                   18000
--------------------------
<INDEX             TAKEOFF>
```

FMCS CDU Displays - Ident and Initialization
Figure 16

    - b) Engine Type.
    - c) Current and new navigation data base.
    - d) Operational program identity.
    - e) Drag adjustment factor.
    - f) Fuel flow adjustment factor.
  - 4) A new data base can be activated when the airplane is on the ground.
    - a) Press line select key 3R to write the new data base identity in the scratch pad.
    - b) Press line select key 2R to transfer the data base identity to line 2. The previous data base is then cleared and the new data is active.
  - 5) Adjustment factors can only be changed on the MAINTENANCE page.
- (c) FMCS CDU Displays - Initialization (Fig. 16)
  - 1) POS INIT and PERF INIT pages are line-selected from the INIT/REF INDEX page (press INIT REF key).
  - 2) The POS INIT and PERF INIT pages are line-selected from the IDENT page.
  - 3) Initialization pages can be selected only when the airplane is on the ground. The POS INIT page should be selected if the IRS has not been initialized. The PERF INIT page should be selected if the IRS has been initialized.
  - 4) The initialization pages provide a means to initialize the IRS and the FMC performance calculations.
  - 5) The POS INIT page provides three options for selecting IRS present position:
    - a) Select the last position of the IRS - Press line select key next to LAST POS, then line select key next to SET IRS POS.
    - b) Select the current position from the data base - Enter the airport identifier in line 2 to request LAT/LON from the data base. Press line select key 2R, then line select key 4R. If necessary, enter gate identifier in line 3 to request LAT/LON from the data base. Press line select key 3R, then line select key 4R.
    - c) Manually set the IRS position - Enter LAT/LON into the scratch pad and then press line select key next to SET IRS POS.
  - 6) The GMT must be entered whenever the airplane clocks are set to local time. Enter GMT in the scratch pad and press line select key next to GMT.
  - 7) IRS heading must be entered when the IRS is operated in the altitude mode. Enter heading in the scratch pad and press line select key next to SET IRS HDG.
  - 8) POS INIT page 2 displays LAT/LON and ground speed from the FMC and each IRS.
  - 9) Performance initialization data is entered on the PERF INIT page. The page displays boxes for data that must be entered and dashes for data that is optional to enter.

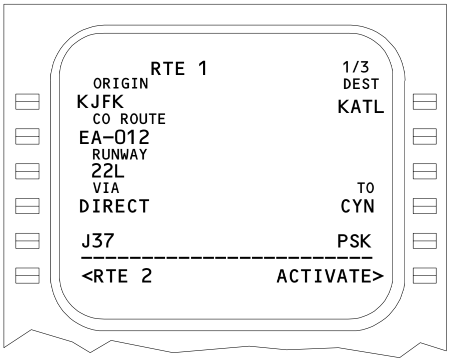
10) Either gross weight or zero fuel weight must be entered in the CDU through the scratch pad. When either value has been entered, the FMC computes and displays the other value.
11) The FMC provides fuel quantity from the fuel totalizer for display. The fuel totalizer value for fuel can be manually overwritten. If no data is available from the totalizer, boxes are displayed indicating a value must be manually entered. If fuel is manually entered, the word MANUAL is displayed following the value, and the FMC ignores fuel totalizer inputs for the rest of the flight.
12) The COST INDEX is initialized to the default value in the company route. The default value can be manually overwritten. If the data base does not contain a default value, boxes are displayed. This indicates a manual entry is needed. Acceptable values are 000 through 999.
13) The CRZ ALT (cruise altitude) must be entered. Any altitude value exceeding the maximum for the airplane configuration is rejected by the FMC.
14) The CRZ WIND may be entered but is not required.
15) The ISA DEV (International Standard Atmosphere) and estimated T/C OAT (Top of Climb Outside Air Temperature) may be entered but are not required. If either value is entered, the FMC computes and displays the other value. Format for both must be ±NN (i.e. a two digit number).
16) The transition altitude is initialized to a default value of 18000 ft. The value is automatically changed when entering a departure procedure with a stored transition altitude. The transition altitude can be manually overwritten.
17) Fuel reserves must be manually entered thru the CDU.

(d) FMCS CDU Displays - ROUTE (Fig. 17)

1) Route pages are accessed by pressing the RTE key on the CDU, line select key next to ROUTE on the POS INIT page, POS REF page or TAKEOFF REF page.
2) The route pages let you enter a desired route into the FMC. The complete route is displayed in clearance language. It includes origin, destination and waypoints.
3) The company route is a stored standard route. It can be requested from the FMC data by entering the company route identifier in the scratch pad. Now press line select key next to CO ROUTE.
4) Route data other than stored company routes must be manually entered. All waypoints and route legs must be individually entered. Three route pages are available.

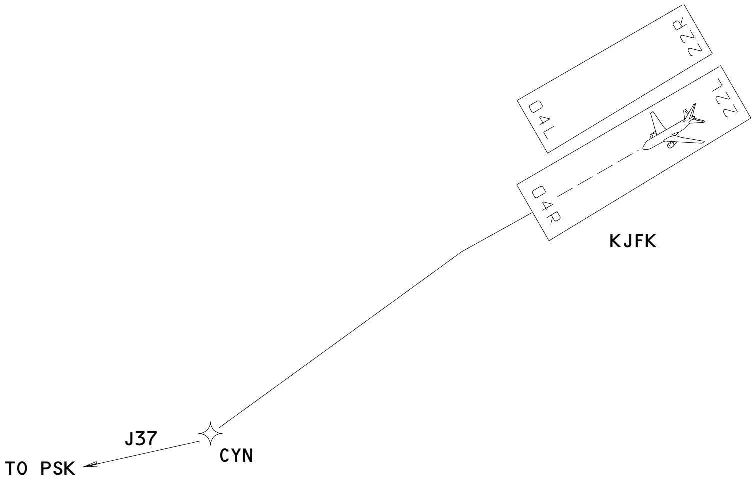
(e) FMCS CDU Displays - Route Legs (Fig. 17)

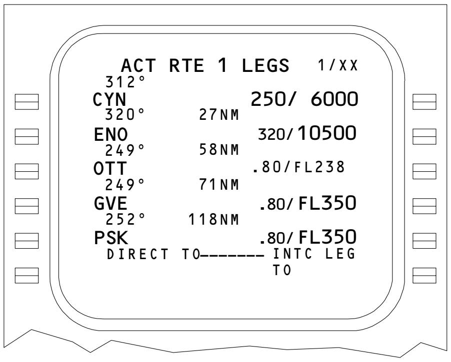
1) Route legs pages are accessed by pressing the LEGS or DIR INTC key on the CDU, or line select LEGS key 6R on the ACT RTE data pages.
2) The route legs pages lets you enter vertical and lateral leg data in the FMC.



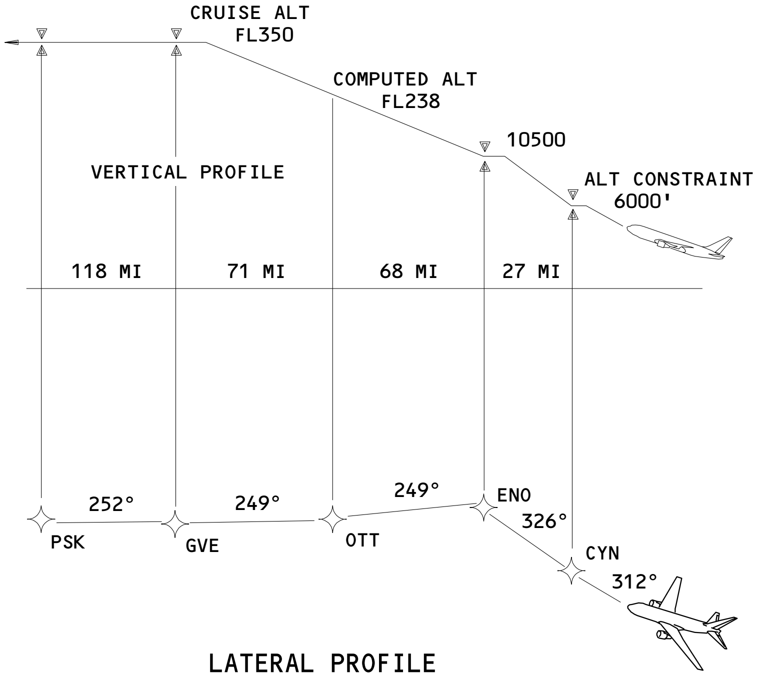
```
        RTE 1              1/3
  ORIGIN                  DEST
 KJFK                     KATL
  CO ROUTE
 EA-012
  RUNWAY
  22L
  VIA                       TO
 DIRECT                    CYN

 J37                       PSK
 -------------------------
 <RTE 2           ACTIVATE>
```





```
   ACT RTE 1 LEGS    1/XX
  312°
 CYN              250/ 6000
  320°      27NM
 ENO              320/10500
  249°      58NM
 OTT              .80/FL238
  249°      71NM
 GVE              .80/ FL350
  252°     118NM
 PSK              .80/ FL350
  DIRECT TO-------  INTC LEG
                    TO
```



FMCS CDU Displays - Route and Route Legs
Figure 17

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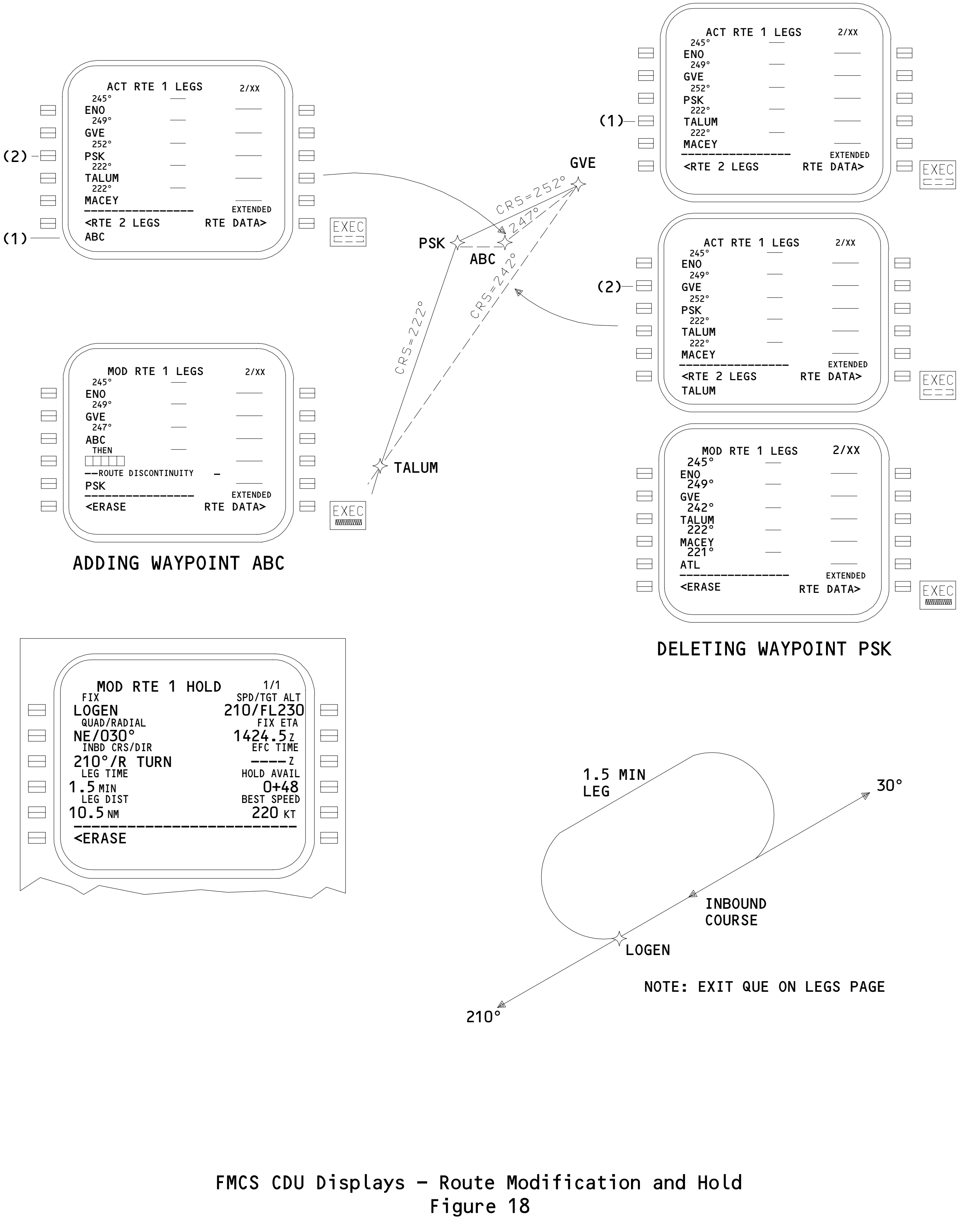
3) The route legs pages display leg heading, leg speed and altitude profile, and leg length for each leg. The route legs pages also display waypoint identities for each leg.
   a) Predicted data values computed by the FMC are displayed in small sized numerals.
4) Extended data is displayed on ACT RTE DATA page when the EHSI is not in the plan mode.
5) Data is automatically retrieved from the data base by selection of a company route. Data can also be manually entered on the route pages of the CDU.
6) If the EHSI is in the PLAN mode the prompt MAP CTR STEP on the CDU RTE LEGS page is used to change the center of the EHSI display.
   a) The center symbol (CTR) appears next to the waypoint that is centered on the EHSI display.
   b) Each time the key is pressed the center symbol will step down the page to the next waypoint. The EHSI display is then centered on that waypoint.
7) Direct/Intercept is performed on a RTE LEGS page after pressing the DIR INTC key on the CDU. Line 6L will display DIRECT TO and line 6R will display INTC LEG.
8) Any valid waypoint being displayed can be selected for direct to flight, or a valid waypoint can be manually entered. The EXEC key must be pressed to initiate the direct to flight.
9) Any valid waypoint being displayed can be selected for intercept leg. When the desired waypoint is line selected into the scratch pad and line select key 6R pressed, MOD RTE LEGS is displayed, allowing insertion of an intercept course.

(f) Route Modification (Fig. 18)
1) A new waypoint can be inserted into a route on the RTE LEGS pages.
   a) Insert the waypoint identifier in the scratch pad.
   b) Line select the existing waypoint that the new waypoint is to precede.

   NOTE: Any route discontinuity is displayed on a MOD RTE LEGS page and must be resolved.

   c) Line select the waypoint intended to follow the new waypoint into the scratch pad and then into line 4L.
2) A waypoint can be removed from a leg by overwriting it with the next waypoint in the leg.
   a) Line select the waypoint following the one to be deleted. The selected waypoint will appear in the scratch pad.
   b) Line select the waypoint to be deleted. It will be removed from the route leg without a discontinuity existing.



```
ACT RTE 1 LEGS          2/XX
 245°
ENO
 249°
GVE
 252°
PSK
 222°
TALUM
 222°
MACEY
----------------     EXTENDED
<RTE 2 LEGS         RTE DATA>
ABC
```

```
MOD RTE 1 LEGS          2/XX
 245°
ENO
 249°
GVE
 247°
ABC
 THEN
□□□□□
--ROUTE DISCONTINUITY  -
PSK
----------------     EXTENDED
<ERASE              RTE DATA>
```

```
ACT RTE 1 LEGS          2/XX
 245°
ENO
 249°
GVE
 252°
PSK
 222°
TALUM
 222°
MACEY
----------------     EXTENDED
<RTE 2 LEGS         RTE DATA>
```

```
ACT RTE 1 LEGS          2/XX
 245°
ENO
 249°
GVE
 252°
PSK
 222°
TALUM
 222°
MACEY
----------------     EXTENDED
<RTE 2 LEGS         RTE DATA>
TALUM
```

```
MOD RTE 1 LEGS          2/XX
 245°
ENO
 249°
GVE
 242°
TALUM
 222°
MACEY
 221°
ATL
----------------     EXTENDED
<ERASE              RTE DATA>
```

```
MOD RTE 1 HOLD              1/1
 FIX                SPD/TGT ALT
LOGEN                210/FL230
 QUAD/RADIAL            FIX ETA
NE/030°                1424.5Z
 INBD CRS/DIR          EFC TIME
210°/R TURN              ----Z
 LEG TIME            HOLD AVAIL
1.5 MIN                   0+48
 LEG DIST            BEST SPEED
10.5 NM                 220 KT
---------------------------
<ERASE
```

FMCS CDU Displays - Route Modification and Hold
Figure 18

3) A route offset can be inserted into a route by the pilot when airborne and an active or modified route exists.
   a) Valid entries are right or left lateral offsets of from 1 to 20 NM in alphanumeric format (i.e., L10).
   b) The effect propogates along the route until one of the points listed below is reached:
      1. An end-of-route waypoint
      2. The beginning of an approach procedure
      3. The beginning of an approach transition
      4. A route discontinuity.
   c) When an offset is active, the CDU OFST annunciator is lit. The offset can be cancelled by pushing the CDU DIR/INTC key or by the entry of 0 NM offset.

(g) FMCS CDU Displays - Hold (Fig. 18)

1) Hold is displayed by:
   a) Pressing HOLD key on CDU after a holding fix has been entered into the route.
   b) Automatically after a holding fix has been entered in the RTE LEGS page.
2) Hold provides a means of entering and displaying holding pattern details in the FMC. Display details are:
   a) FIX identifies location of the hold.
   b) QUAD/RADIAL identifies the holding quadrant (NE, NW, SE, or SW) and valid radial.
   c) INBD CRS/DIR identifies course to enter the holding pattern and direction of turns in the holding pattern.
   d) LEG TIME displays time to fly the holding pattern.
   e) LEG DIST displays length of the holding pattern flight path, and is normally computed.
   f) SPD/TGT ALT displays assigned holding speed and altitude.
   g) FIX ETA displays computed time to next pass of the FIX location.
   h) EFC TIME displays time to expected further clearance, or expected time to exit the holding pattern.
   i) HOLD AVAIL displays time remaining before exit is required to reach destination with required reserves.
   j) BEST SPEED displays the best speed for the current altitude.
3) Some items have default values if data is not manually entered.
   a) Inbound course defaults to a course-to-fix from the preceding leg, and turn direction defaults to a right turn.
   b) Leg time defaults to 1.5 minutes for altitudes above 14,000 feet and 1.0 minute for altitudes under 14,000 feet.

c) Speed defaults to the best speed for the assigned altitude.

4) ERASE deletes a holding fix and returns the display to RTE LEGS pages.

(h) FMCS CDU Displays - PROGRESS (Fig. 19)

1) The progress page is displayed by pressing the PROG key on the CDU. It provides a display of data relative to the progress of the flight.

2) Current dynamic flight data is displayed on two pages. Page 1 of 2 data includes:

a) Identity, actual time of arrival, and altitude of the last waypoint crossed.

b) Distance to go (DTG), ETA and FUEL remaining for TO waypoint, NEXT waypoint and destination.

c) TO data can be top of climb (T/C), step climb, top of descent (T/D), advisory top of descent (T/D Advisory), and end of descent (E/D).

d) Navaid tuning and navigation mode. Navigation mode includes the number of valid IRSs and the nav mode currently in use.

3) Page 2 of 2 data includes:

a) Head wind and cross wind speed.

b) Cross track (XTK) and vertical track (VTK) error.

c) Current command speed (CMD SPD), wind direction and speed (WIND), and true airspeed (TAS).

d) Static air temperature, fuel used and fuel quantity.

4) Both computed fuel quantity and totalizer fuel quantity are displayed. If there is a discrepency of 3000 pounds or more the source of data (computed or totalizer) can be line-selected using keys next to FUEL QTY labeled USE.

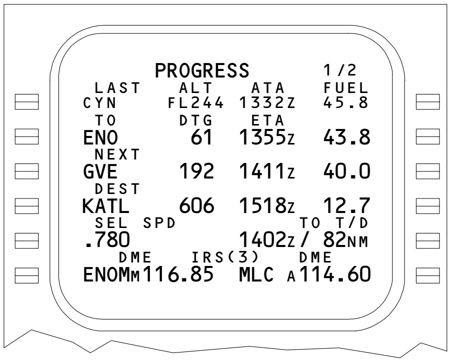
5) If the destination has been overwritten with an alternate destination, leaving the page and then returning deletes the alternate.

6) Nav aid tuning is indicated by the small letter following the station identifier.

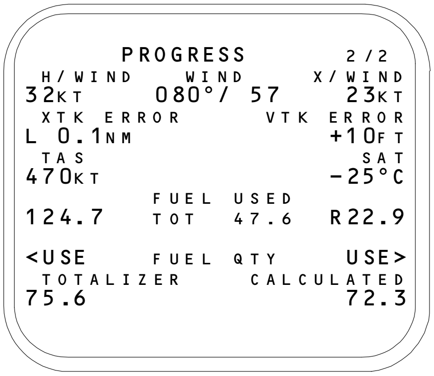
a) M - manually tuned via control panel.

b) A - Auto tuned via FMC search algorithm.

c) P - auto tuned via FMC data base procedure.



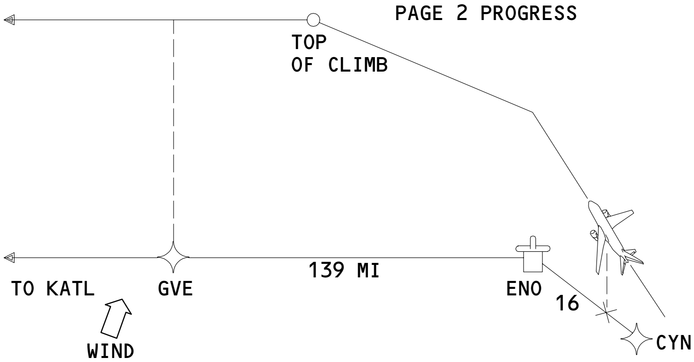
```
      PROGRESS          1/2
 LAST     ALT     ATA    FUEL
CYN      FL244   1332Z   45.8
 TO       DTG     ETA
ENO        61    1355Z   43.8
 NEXT
GVE       192    1411Z   40.0
 DEST
KATL      606    1518Z   12.7
 SEL SPD               TO T/D
.780             1402Z/ 82NM
    DME    IRS(3)    DME
ENOMM116.85   MLC A114.60
```

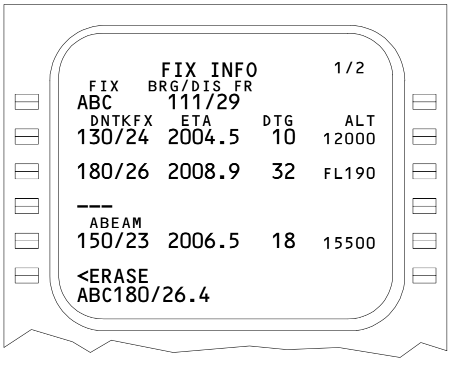


```
         PROGRESS          2/2
 H/WIND     WIND      X/WIND
32KT      080°/ 57       23KT
 XTK ERROR           VTK ERROR
L 0.1NM                 +10FT
 TAS                      SAT
470KT                    -25°C
            FUEL  USED
124.7       TOT   47.6   R22.9

<USE        FUEL  QTY     USE>
 TOTALIZER          CALCULATED
75.6                      72.3
```

PAGE 2 PROGRESS



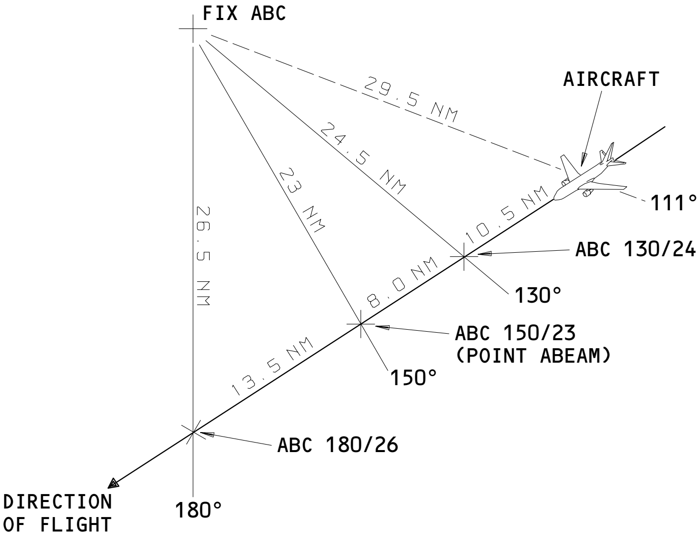


```
        FIX INFO          1/2
 FIX   BRG/DIS FR
ABC     111/29
 DNTKFX   ETA      DTG      ALT
130/24  2004.5     10     12000

180/26  2008.9     32     FL190

---
 ABEAM
150/23  2006.5     18     15500

<ERASE
ABC180/26.4
```



FMCS CDU Displays - Progress and Fix
Figure 19

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d) R - Remotely tuned via manual input to FMC CDU (CDU keyboard entry).

7) Remote tuning is accomplished by entering either the station identifier or frequency. Entering an "A" returns system to auto tuning.

(i) FMCS CDU Displays - FIX (Fig. 19)

1) The FIX page is displayed by pressing the FIX key on the CDU.

2) The FIX page provides a means of creating waypoint fixes and waypoints from the intersection points between the preset flight plan and selected radials from known waypoints. Waypoint fixes and waypoints are used with the HSI map display.

3) Two FIX pages are available allowing creation of two fixes.

4) Initially only a prompt (ABEAM) is displayed for CDU line 5L. All other data results from CDU entries or computations for CDU entered data.

5) A waypoint fix for airplane present position can be created for valid navaids and waypoints held in the data base.

a) Key the waypoint identifier into the scratch pad and press line selected key next to FIX. The waypoint identifier, bearing and distance will appear in line 1 of the DCU.

b) The waypoint fix is also displayed on the HSI map display.

6) Down Track fixes are created on CDU lines 2 through 4.

a) Key the desired bearing from the waypoint into the scratch pad and press line select key 2L, 3L, or 4L.

b) The assigned bearing is displayed on the selected line. The FMC computes and displays distance from the waypoint to the flight path, ETA at the point of intersection, distance-to-go to the point of intersection, and predicted altitude at the point of intersection. The radial from the waypoint to the intersection with the flight path is also displayed on the EHSI map.

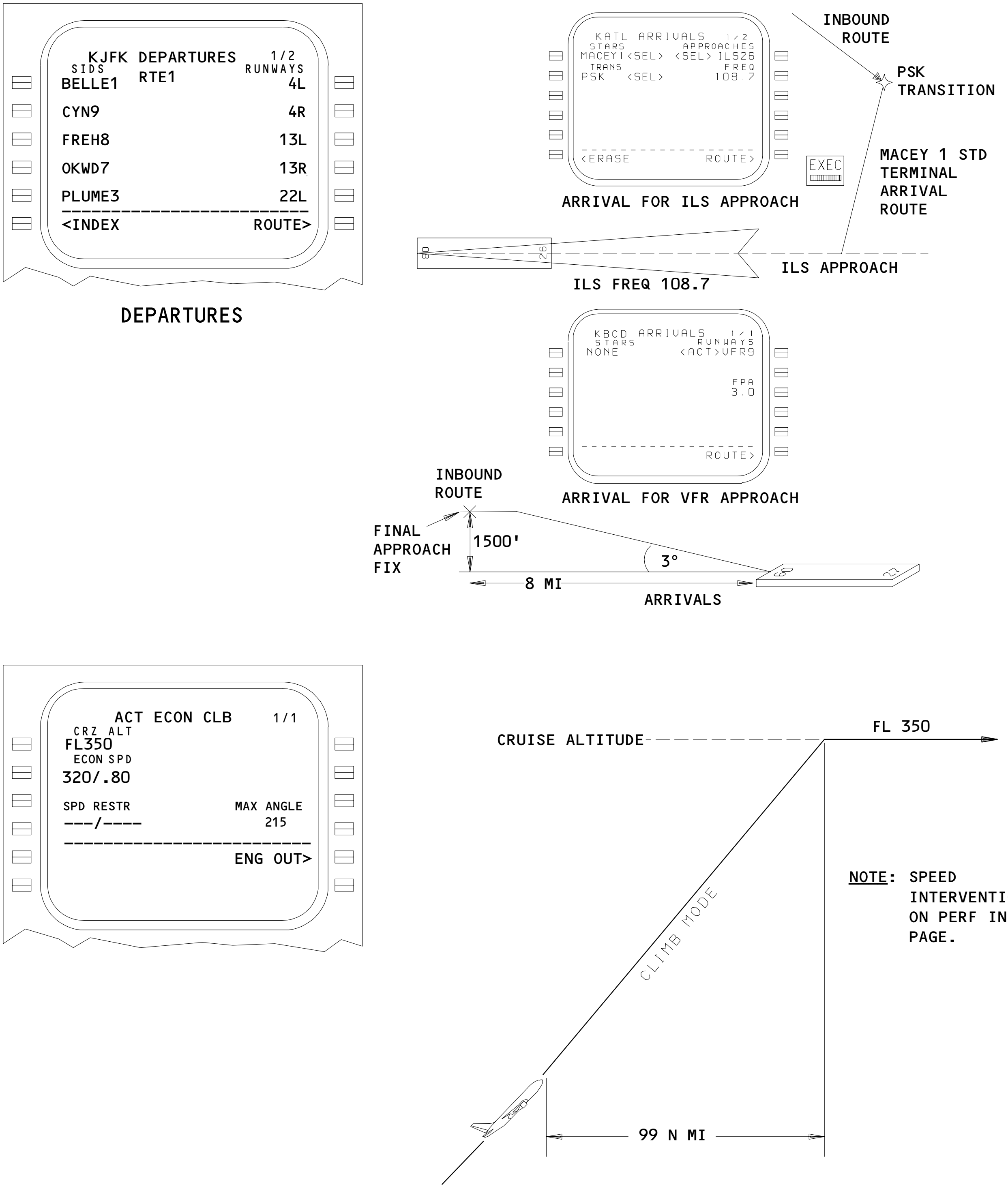
7) A down track fix for the shortest distance between the waypoint and the flight path can be line selected.

a) Press line select key 5L. The prompt ABM will be replaced by ABEAM and the FMC will compute and display all down-track-fix data.

8) A waypoint can be created at any down-track-fix location by line selecting the desired fix into the scratch pad. Now display the desired route page and line select the fix into the route.

9) Pressing line select key 6L (ERASE) deletes all fix data from the CDU and from the EHSI.

(j) FMCS CDU Displays - DEPARTURES/ARRIVALS (Fig. 20)



```
KJFK DEPARTURES      1/2
 SIDS    RTE1     RUNWAYS
BELLE1                 4L
CYN9                   4R
FREH8                 13L
OKWD7                 13R
PLUME3                22L
-------------------------
<INDEX             ROUTE>
```

```
 KATL ARRIVALS      1/2
  STARS        APPROACHES
MACEY1<SEL>  <SEL> ILS26
  TRANS              FREQ
PSK   <SEL>          108.7

-------------------------
<ERASE             ROUTE>
```

```
 KBCD ARRIVALS      1/1
  STARS           RUNWAYS
 NONE          <ACT>VFR9
                      FPA
                      3.0

-------------------------
                   ROUTE>
```

```
ACT ECON CLB          1/1
 CRZ ALT
FL350
 ECON SPD
320/.80
SPD RESTR       MAX ANGLE
---/----              215
-------------------------
                ENG OUT>
```

NOTE: SPEED INTERVENTION ON PERF INIT PAGE.

FMCS CDU Displays - Departures/Arrivals and Climb
Figure 20

1) Departure and arrival pages are displayed by pressing the DEP ARR key on the CDU. The departure page can be line selected from the TAKEOFF REF page.
   a) If the airplane is on the ground and an active route exists, a departure page for the origin airport is displayed.
   b) The arrival page for the origin airport is displayed if the airplane is less than 50 miles from origin or less than half way to destination. Otherwise, the arrival page for the destination airport is displayed.
   c) If an active route does not exist, the DEP/ARR INDEX page is displayed. Left line select keys display departure pages and right line select keys display arrival pages.
2) The departure and arrival pages provide lists of procedures related to selected airports. The pilot can select procedures and insert them into the active flight plan.
3) The departure page displays SIDs and runways for the selected airport. Departure selections are displayed on the EHSI.
4) Line selection of an SID displays that SID on line one, limits runways to those associated with that SID, and displays applicable transitions.
5) SIDs, runways, and transitions are inserted into the route when line selected.
   a) Press ERASE to delete departure selections from the route.
   b) Press EXEC key on the CDU to activate departure selections inserted in the route.
6) The arrival page displays STARs and approaches for the selected airport. Arrival selections are also displayed on the EHSI.
7) Line selection of a STAR displays that STAR on line one, limits approaches to those associated with that STAR, and displays applicable transitions.
8) STARs, approaches, and transitions are inserted into the route when line selected.
   a) Press ERASE to delete arrival selections from the route.
   b) Press EXEC key on the CDU to activate arrival selecitons inserted in the route.

9) If a non-ILS runway is selected, the FMC computes and enters a VFR approach.
   a) Flight path angle is 3 degrees. A default flight path angle can be manually overwritten. Limits are 2.4 through 3.7 degrees.
   b) Final approach is created along the extended runway centerline, from 2000 feet to 50 feet above runway elevation.

(k) FMCS CDU Displays - CLIMB (Fig. 20)

1) These are climb mode pages available for display.
   a) Selectable speed mode is displayed by pressing the CLB key on the CDU when MAX RATE, MAX ANGLE, and ENG OUT are not active. The selectable speed page is automatically displayed anytime a new speed is entered on any other climb page.
   b) Economy mode (ECON) is displayed by pressing the line select key next to ECON SPD on any other climb page.
   c) Maximum rate mode (MAX RATE) is displayed by pressing the CLB key on the CDU when maximum rate is the active climb mode. Maximum rate is also displayed by pressing line select key 5L on any other climb page.
   d) Engine out mode (ENG OUT) is displayed by pressing the CLB key on the CDU when engine out is the active climb mode. Engine out is also displayed by pressing the line select key next to ENG OUT on any other climb page. This mode is only available on airplanes with a full-up FMCS.

2) Any climb page except CRZ CLB can be displayed by pressing the PREV PAGE/NEXT PAGE keys when any climb page is displayed.

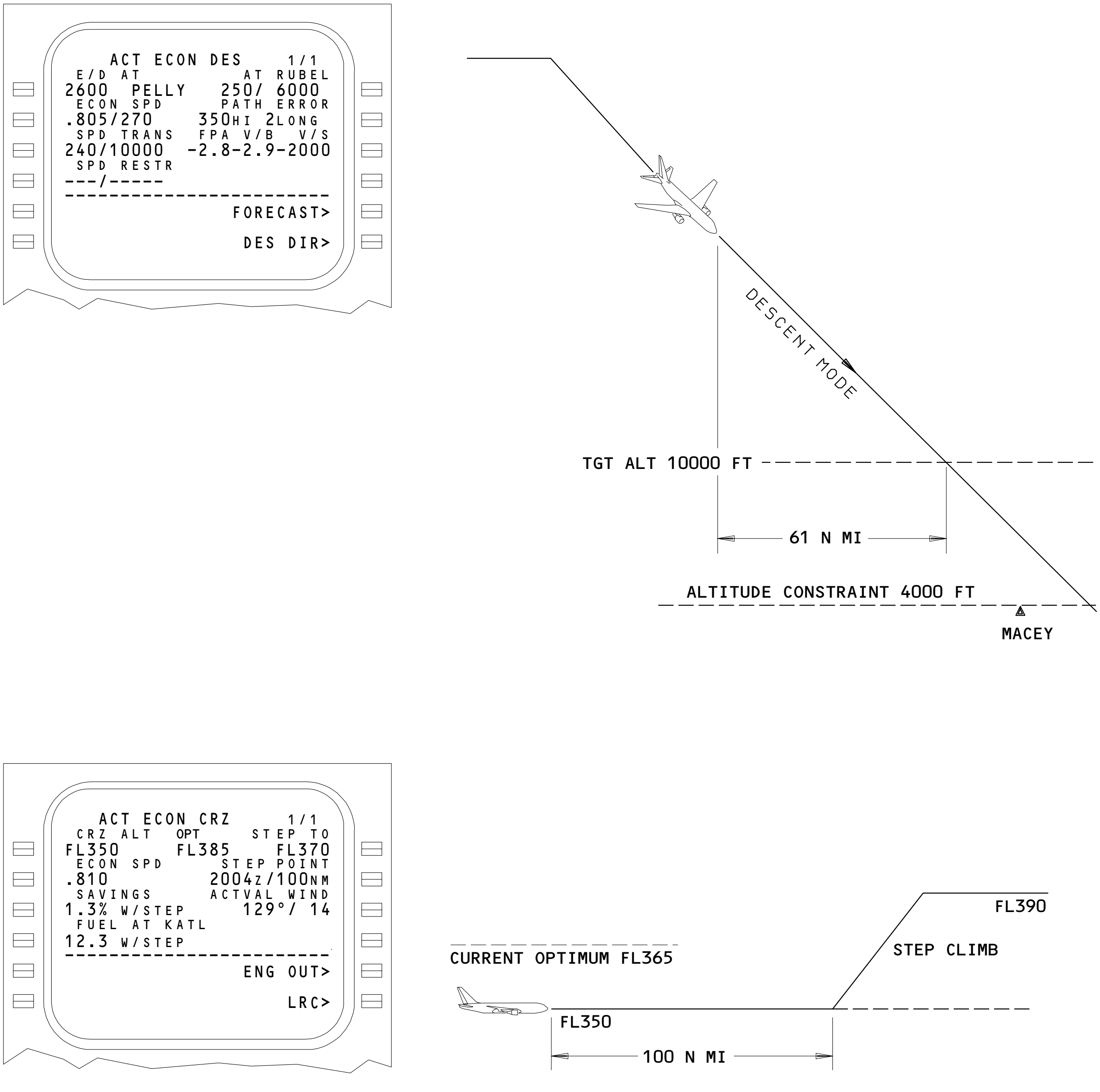
3) Multiple climb segments can be defined. Climb pages provide a means of evaluating and selecting current or planned climb segments.

4) CRZ CLB provides a means of initiating a cruise climb to a selected altitude.

5) Data displayed on climb mode pages is similar regardless of mode:
    a) Cruise altitude (CRZ ALT) is displayed for all modes.
    b) Command speed (CMD SPD) is a computed value on all CLB pages except selectable speed.
    c) Waypoint identifier (if applicable)
    d) Predicted altitude undershoot at a waypoint (if applicable).
    e) The Max Angle speed for the current conditions.
6) Command speed can be overwritten at the CDU, resulting in display of selectable speed climb pages.
7) Manual intervention is possible using speed select on the AFCS MCP. Manual intervention does not change page format.
8) Line select keys next to ECON, MAX ANGLE, ENG OUT and CLB DIR display alternate climb pages.
    a) Capture lights the EXEC key on the CDU and delete all CLB pages previous to the displayed page.
9) Line 6R displays CLB DIR when climb is active and an altitude constraint exists in the flight plan between current altitude and the cruise altitude.

(l) FMCS CDU Displays - CRUISE (Fig. 21)

1) Pressing the CRZ key on the CDU displays the active cruise mode page. If an active mode has not been selected the ECON CRZ page is displayed.
2) Transition from climb to cruise automatically displays the active cruise mode page.
3) Line select keys are used to display ECON CRZ, LCR CRZ and ENG OUT CRZ when a cruise page is being displayed.
4) Selectable speed cruise is displayed when a speed is entered on any other CRZ pages.
5) Cruise pages provide a means of evaluating and selecting current or planned cruise mode. Cruise modes can be modified. However, only one cruise segment can exist at a time. Any change to cruise mode will propagate to Top of Descent (T/D) in the flight plan.
6) Data is displayed for economy (ECON), selectable speed, long range cruise (LRC), engine out (ENG OUT), cruise climb (CRZ CLB) and cruise desent (CRZ DES).
    a) Cruise altitude (CRZ ALT)



```
   ACT ECON DES     1/1
 E/D AT           AT RUBEL
2600  PELLY    250/ 6000
 ECON SPD        PATH ERROR
.805/270     350HI 2LONG
 SPD TRANS   FPA V/B   V/S
240/10000  -2.8-2.9-2000
 SPD RESTR
---/-----
------------------------
               FORECAST>
                DES DIR>
```

```
  ACT ECON CRZ       1/1
 CRZ ALT   OPT     STEP TO
FL350     FL385     FL370
 ECON SPD         STEP POINT
.810          2004z/100NM
 SAVINGS        ACTVAL WIND
1.3% W/STEP      129°/ 14
 FUEL AT KATL
12.3 W/STEP
------------------------
                ENG OUT>
                    LRC>
```

FMCS CDU Displays - Cruise and Descent
Figure 21

    b) Computed command speed (CMD SPD)
    c) Any savings or penalty.
    d) Predicted fuel weight at destination.
    e) Next higher altitude in the flight plan. Altitude can be overwritten.
    f) ETA and DTG
    g) Wind direction and magnitude

(m) FMCS CDU Displays - DESCENT (Fig. 21)

- 1) Pressing the DES key on the CDU displays the active descent page.
  - a) If the selectable speed mode is active or if the airplane has passed the top of descent, selectable speed descent is displayed.
  - b) If selectable speed is not active or the airplane is below the top of descent, economy descent is displayed.
  - c) If no other mode is active or the airplane has not reached top of descent, cruise descent is displayed.
- 2) Line select keys are used to display ECON DES and CRZ DES pages when a descent page is being displayed.
- 3) If any descent page is being displayed, any other descent page can be displayed by pressing the NEXT PAGE/PREV PAGE keys on the CDU.
- 4) If the speed on the ECON DES page is overwritten, the selectable speed descent page is displayed.
- 5) If an altitude less than cruise altitude is entered on a cruise page, CRZ DES is displayed.
- 6) Economy descent and selectable speed descent provide a means of evaluating, selecting, and revising current or planned segments of descent modes.
- 7) CRZ DES provides a means to initiate an early descent and a step descent.
- 8) The descent mode pages provide a means of creating multiple segments for the descent phase of flight.
- 9) Descent pages display data on airplane altitude and rate of descent.
  - a) Lowest altitude constraint and cruise altitude (CRZ ALT).
  - b) Computed command speed (CMD SPD) (Command speed can be overwritten. If speed is manually entered the selectable speed page is automatically displayed).
  - c) Speed Transition Altitude
  - d) Target error (This identifies the first downtrack waypoint with an altitude constraint, and computed error caused by deviations from normal descent path. A scratch pad message to add a drag factor may also be displayed).

- e) The waypoint at which the displayed altitude constraint occurs.
- f) Computed speed desired at target altitude.

10) DESCENT FORECASTS page provides a means of entering forecasted values for transition level, cabin rate, wind and altitude at which anti-ice is expected to start.

(n) FMCS CDU Displays - Messages

1) Advisory or alerting messages are generated by FMC software when a condition exists which degrades the operational viability of the system.
2) Alerting messages appear in the scratch pad regardless of the prior contents of the line.
3) Messages are cleared from the scratch pad line by the reset logic defined below.
4) Any uncleared messages or alpha-numeric data are stored in a message stack. An alerting message that has been pushed out of the scratch pad by another alerting message, is put in the top of the stack. Alpha-numeric data is stored below alerting messages. Uncleared advisory messages are stored below both data and alerting messages.
5) As the CLR key is pressed, the stack is displayed sequentially from top to bottom.
6) Advisory and alerting messages illuminate the message (MSG) annunciator light.
7) Only the alerting message sets the CDU MESSAGE output discrete. An EICAS message is also displayed to indicate a message is in the CDU scratchpad.
8) Clearing the message and/or reset of the message logic cancels the message unless the logic causing the message is reset.
9) Alerting Messages
   - a) END OF ROUTE - passing last route leg termination.
   - b) END OF OFFSET - Five NM, until end of last offset leg termination.
   - c) Limit ALT FLXXX - FMC attempts to attain or VNAV is selected at an altitude greater than the VNAV limit altitude.
   - d) RESYNCING OTHER FMC - Offside FMC has just powered up or failed comparison data check and is being resynchronized to onside FMC.
   - e) RESYNC FAIL - SINGLE FMC - FMCS resynchronization attempts are unsuccessful.
   - f) SINGLE FMC OPERATION - Onside FMC has determined that offside FMC is not available.
   - g) DISCONTINUITY - passing last waypoint prior to a discontinuity.

h) NO ACTIVE ROUTE - no active lateral route and LNAV selected on MCP.
i) PERF/VNAV UNAVAILABLE - insufficient data in FMC.
j) FUEL DISAGREE - PROG PG 2 - fuel quantity totalizer and computed fuel quantity disagree by 3000 lb.
k) IRS NAV ONLY - dual radio navigation inputs lost and FMC in IRS mode only for navigation.
l) VERIFY POSITION - The difference between computed radio position and FMC position using IRUs or between left and right FMC positions exceeds comparison threshold.
m) NAV INVALID - TUNE XXXX - When an RNAV, or VOR approach procedure requires a specific navaid be tuned and it is not tuned.
n) DRAG REQUIRED - airplane unable to maintain tracking of descent path due to unforecast tailwind.
o) THRUST REQUIRED - The aircraft is unable to maintain precomputed nominal descent path without increasing thrust and autothrottle is not engaged.
p) UNABLE NEXT ALT - next climb restriction cannot be met due to undershoot.
q) RESET MCP ALT - passing top of descent point without lowering MCP selected altitude.
r) INSUFFICIENT FUEL - change in flight conditions or route causes computed fuel burn to exceed total fuel.
s) CHK ALT TGT - VNAV is engaged when the airplane is between MCP selected altitude or FMC target altitude (VNAV holds level flight).
t) DESCENT PATH DELETED - The last remaining altitude constraint required to define the descent profile is deleted.
u) NAV DATA OUT OF DATE - Clock calendar data exceeds the NAV database valid calendar cycle.
v) IRS MOTION - The inertial reference system (IRS) has detected aircraft motion during the alignment process.
w) CYCLES IRS OFF-NAV - Alignment conditions in the IRS require cycling the IRS mode select switch.
x) ENTER IRS POSITION - A condition exists that requires re-entering of the latitude/longitude for present position initialization.

y) VIA OFFSET INVALID - Flight condition in-validate diversion via OFFSET while OFFSET is selected VIA option and the ALTN or XXXX ALTN page is displayed.
z) RW/ILS FREQ ERROR - When an ILS is selected for autotuning and it is not tuned.
aa) RW/ILS CRS ERROR - When ILS is selected for autotuning and the course of the localizer center beam bearing is not tuned.
ab) CHECK AIRLINE POLICY - When one or more AMI parameters which are displayed on the AIRLINE POLICY page are invalid forcing the FMC to use the default values.
ac) FMC X OUTPUT LOSS - Single FMC transmitter and/or FMC output discrete failure.
ad) TAKEOFF SPEEDS DELETED - A change is detected in the parameters required for QRH speeds computation.
ae) UNABLE TO SEND MSG - Message cannot be delivered due to protocol breakdown between the FMC and the ACARS MU or due to the FMC data link queue being full.
af) IRS POS/ORIGIN DISAGREE - Valid inertial position differs from active origin airport position by more than 6NM.
ag) UNABLE RTA - The RTA is not achievable within the applicable arrival time tolerance.
ah) UNABLE FLXXX AT RTA FIX - The predicted crossing altitude at the RTA fix is less than the FLXXX, but the predicted ETA is still within tolerance.
ai) RTA FIX DELETED - The RTA fix has been deleted from the MOD flight plan.
aj) VERIFY RNP-POS REF 2 - Manually entered RNP exceeds the default RNP value for the current flight phase.
ak) ATC REPORT LIST FULL - When 10 reports have been generated in response to ATC REPORT or CONFIRM requests.
al) INVALID ATC UPLINK - When ant ATC uplink message received by the FMC contains format or other errors.

am) PARTIAL CLEARANCE LOADED - FMC was able to load only a portion of the data contained in the uplink message.
an) RE-LOGON TO ATC COMM - No ATC data link connections exist.
ao) UNABLE TO LOAD CLEARANCE - FMC was unable to load any of the data contained in the uplink message.
ap) ATC COMM ESTABLISHED - ATC data link is successfully established.
aq) MESSAGE LIMIT EXCEEDED - Crew attempts to select more than 5 message elements to include in the downlink message.
ar) RESPONSE TO ATC UPLINK - An ATC uplink is received while the pending uplink storage is full.
as) SET CLOCK TO UTC TIME - The GPS UTC time on the POS INIT page disagrees with the flight deck clock by more than 12 seconds.
at) SET THRUST MODE TO X - Accepted thrust mode is not the same as the thrust mode being received from the TMC.
au) SPLIT IRS OPERATION - An inertial unit is failed resulting in change to number of inertial units used for navigation.
av) ATC COMM TERMINATED - ATC COMM terminated without transfer.
aw) ROUTE X UPLINK READY - Receipt of a flight plan uplink message that contains the route data that ready to be loaded into RTE1 or RTE2.
ax) PARTIAL ROUTE X UPLINK - Receipt of an uplink message that contains route data and part of the route data can be loaded into RTE1 or RTE2.
ay) PERF INIT UPLINK - Receipt of a performance initialization uplink message.
az) TAKEOFF DATA UPLINK - Receipt of a take off data uplink message.
ba) TAKEOFF DATA LOADED - Execution of a new departure runway or entry of a new runway on the TAKEOFF REF page.
bb) WIND DATA UPLINK READY - Receipt of an uplink message that contains en route wind data.
bc) DES FORECST UPLINK READY - Receipt of a wind uplink data message that contains descent forecast data.
bd) ALTN UPLINK - Receipt of an alternate uplink message that contains the Company Preferred Alternates data.
be) ALTN LIST UPLINK - Receipt of an alternate uplink message that contains alternate flight list data.
bf) ALTN INHIBIT UPLINK - Receipt of an alternate unlink message that contains only alternate inhibit data.
bg) FLT NUMBER UPLINK - Receipt of a flight uplink message that contains only flight number data.
bh) INVALID TAKEOFF XXX/YYY - The loaded runway/intersection takeoff data record has invalid data.

10) Advisory Messages
    a) NOT IN DATA BASE - required data not found in NAV data base or in route.
    b) RE-ENTER IRS POSITION - five seconds after entering present position, different position data was received back from any IRS.
    c) MAX ALT FLXXX - maximum attainable altitude is displayed for reference on the performance initialization page, or an altitude greater than maximum altitude has been entered on any other page.
    d) MAX ALT XXXXX MSL - Maximum single engine altitude (displayed when engine out climb or descent page is displayed).
    e) RUNWAY N/A FOR SID - runway not compatible with selected departure.
    f) XXXX (origin airport) - origin airport on page 1 of RTE page contains no data. Origin airport from POS INIT page displayed for reference.
    g) ARR N/A FOR RUNWAY - selected approach is not compatible with the selected arrival.
    h) STANDBY ONE - the FMC requires more than one half second to display data.
    i) VOR AAA INVALID - VOR input signal lost when remotely tuned through the CDU.
    j) NOT ON INTERCEPT HEADING - LNAV selected on MCP but airplane cannot make capture on the present heading.
    k) INVALID ENTRY - entry has an incorrect format or range or both.
    l) INVALID DELETE - delete key has no application for the selected data.
    m) XXXXX (MCP altitude) - MCP altitude is displayed when the target altitude does not equal MCP selected altitude.
    n) NO ACTIVE ROUTE - DIR/INTC key pressed when no active route exists.
    o) XXXKT (MCP selected airspeed) or .XXM (MCP selected Mach) - manual speed control is activated via MCP while VNAV is engaged.
    p) USE PREVIOUS PAGE - target altitude entry attempted which is incompatible with the target waypoint/altitude restriction on the previous page.
    q) RW/ILS FREQ DISCR - at localizer capture the tuned ILS frequency does not match the frequency for the runway displayed on the active RTE LEGS page.
    r) SELECT RUNWAY - selected procedure is runway dependent and no compatible runway has been selected.
    s) END OF ROUTE - passing last route leg termination.
    t) DISCONTINUITY - passing last waypoint prior to a discontinuity.
    u) NO ACTIVE ROUTE - no active lateral route and LNAV selected on MCP.

v) PERF/VNAV UNAVAILABLE - insufficient data in FMC.
w) FUEL QTY ERROR - PROG 2/2 - fuel quantity totalizer and computed fuel quantity disagree by 3000 lb.
x) IRS NAV ONLY - dual radio navigation inputs lost and FMC in IRS mode only for navigation.
y) NAV INVALID - TUNE XXXX - terminal area procedure requires a specific navaid be tuned and it is not tuned.
z) DRAG REQUIRED - airplane unable to maintain tracking of descent path due to unforecast tailwind.
aa) THRUST REQUIRED - airplane unable to maintain precomputed nominal descent path without increasing thrust and autothrottle is not engaged.
ab) UNABLE NEXT ALT - next climb restriction cannot be met due to undershoot.
ac) RESET MCP ALT - passing top of descent point without lowering MCP selected altitude.
ad) INSUFFICIENT FUEL - change in flight conditions or route causes computed fuel burn to exceed total fuel, less reserves.
ae) CHK ALT TGT - VNAV is engaged when the airplane is between MCP selected altitude or FMC target altitude (VNAV holds level flight).
af) DESCENT PATH DELETED - The last remaining altitude constraint required to define the descent profile is deleted.
ag) LIMIT ALT FLXXX - FMC attempts to attain, or VNAV is selected at an altitude greater than the VNAV limit altitude.
ah) RESYNCING OTHER FMC - Offside FMC has just powered up or failed comparison data check and is being resychronized to onside FMC.
ai) RESYNCH FAIL - SINGLE FMC - FMCS resynchronization attempts are unsuccessful.
aj) SINGLE FMC OPERATION - Onside FMC has determined that offside FMC is not available.
ak) NO ACTIVE ROUTE - DIR/INTC key pressed when no active route exists.
al) INVALID TUNE REQUEST - Attempt to remotely tune unfeasible NAVAID on radio that is not manually tuned.
am) MANUALLY TUNED - Attempt to remotely tune NAVAID that is manually tuned.
an) UNABLE CRZ ALT - Performance predicts a zero cruise time at the entered cruise altitude.
ao) ROUTE FULL - Route/s filled to allowable capacity.
ap) CRS REVERSAL AT FA FIX - A conflict exists between default FA waypoint (strung as a result of a runway or VFR approach selection) and the preceding flight plan waypoint such that a course reversal occurs.

aq) RW/ILS FREQ DISCR - at localizer capture the tuned ILS frequency does not match the frequency for the runway displayed on the active RTE LEGS page.

B. FMC BITE and Monitoring (Fig. 22)

(1) General

(a) The FMC BITE/Monitoring functions consist of:

1) Power-Up BITE
2) BITE Monitoring function
3) FMCS System Test

(b) These functions are a combination of internal software and hardware monitors, with the majority of the capability provided by BITE software in the FMC and CDU.

(c) The BITE function has Maintenance Control and Display Panel (MCDP) software. This sends FMC faults to the MCDP for recording.

(2) Power Up BITE

(a) Power-Up BITE performs the internal FMC hardware and software checks below:

1) RAM, PROM, and mass storage memory devices
2) ARINC 429 transmitters
3) Program pin configuration
4) Onside and offside data base comparison
5) Power supply voltage
6) I/O controller operation
7) Software configuration
8) Microprocessor operation

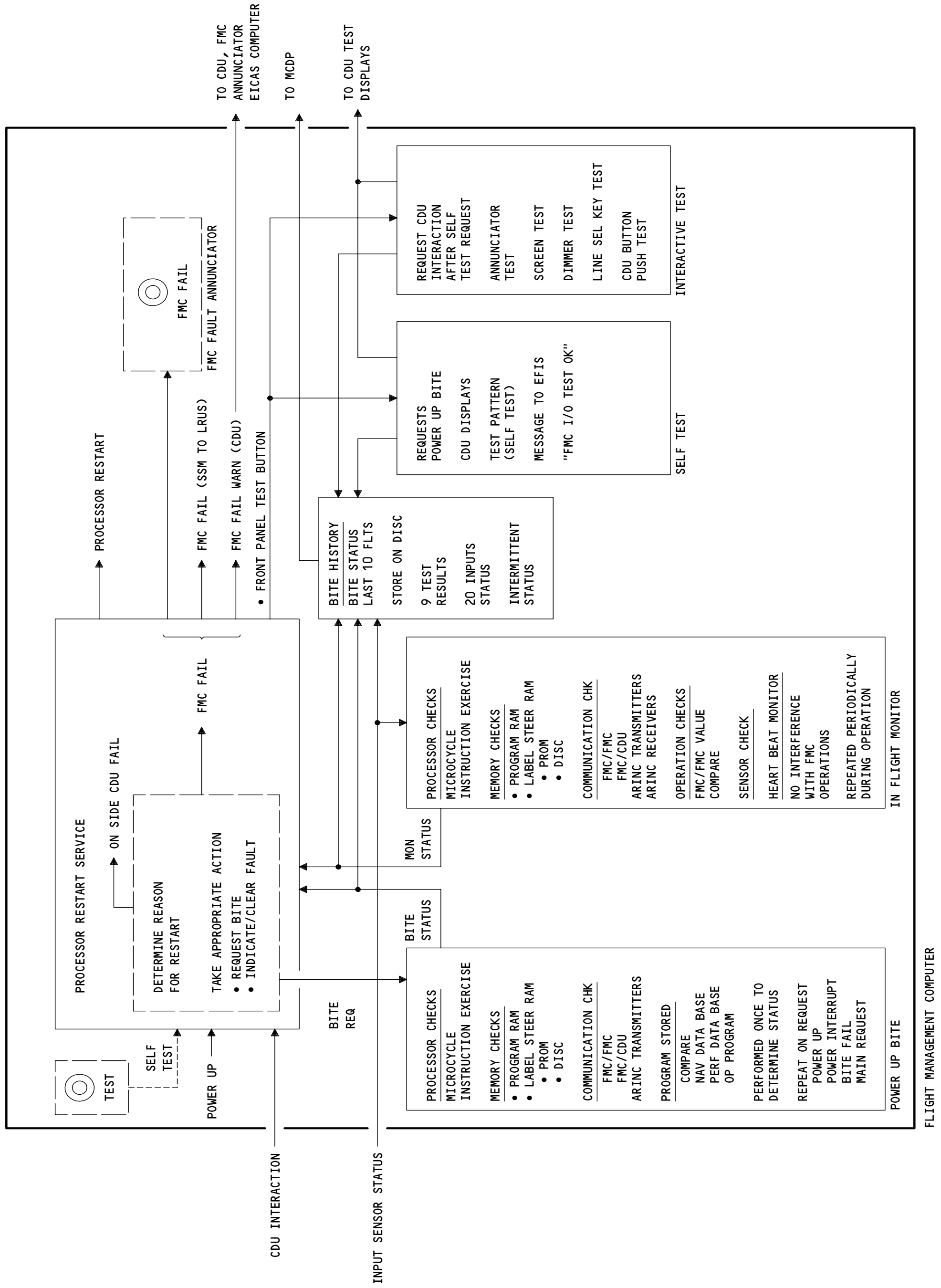
(b) CDU BITE is also performed during Power Up BITE which performs internal CDU checks similar to those performed by FMC BITE.

(3) Monitoring Function

(a) The monitoring function provides a continuous check of FMCS components. Monitoring includes power up checks, which do not affect normal system operation, heartbeat monitor, exception checks, and interface monitors.

(b) Interface Monitoring: CDUs

1) The FMC checks the onside CDU during normal operation, if no response is detected, the test receiver is aligned with the CDU receiver in the FMC. If no activity is detected by the test receiver, the CDU transmitter is assumed to be failed. If the test receiver detects activity, then the FMC CDU receiver is assumed failed and the FMC is failed. Either onside or offside CDUs are checked in this test depending upon position of FMC source select switch.



FMC Functional Block - Bite and Monitoring
Figure 22

- (c) Resynch Activity/Indications
  - 1) Occurs when one FMC passes data via the FMC intersystem bus to the other FMC to keep both FMCs in an identical operating state. In dual FMC mode, both FMCs operate independently but must maintain data synchronization. If one FMC detects a problem, an extensive set of self-tests are run, and a resynch will occur to restore data synchronization.
  - 2) The time required for a single resynch is approximately 15 seconds. During the resynch process, the FMC cannot continue to output data. All output buses on the receiving FMC, except for intersystem bus to the other FMC are deactivated during the resynch process.
  - 3) In case of a normal single event resynch, RESYNCHING OTHER FMC will appear on CDU and MSG annunciator illuminates on face control panel of CDU.
  - 4) L or R FMC FAIL message may also occur temporarily during a resynch.

    NOTE: CDU keys should not be pressed and power should not be turned off while a resynch is in progress.

- (d) Interface Monitoring: Intersystem Bus
  - 1) If no activity is detected on the Intersystem Bus (ISB) receiver, the FMC test receiver is aligned to the ISB receiver. If the test receiver detects no activity, the transmitter is assumed failed, and that FMC is failed.

(4) FMCS System Test
- (a) The FMCS System Test is initiated by pressing the "TEST" button on the FMC front panel.
- (b) For the first 15 seconds of the FMCS system test, the FMC outputs test data onto both general busses. The FMC then performs a restart, which causes all power-up/BITE tests to be run.

(5) Failure Indications
- (a) An FMC failure produces these indications:
  - 1) Blank onside CDU screen with the message "FMC FAIL" displayed.

2) Fail light illuminated on the corresponding CDU panel.
3) FAIL light illuminated on FMC front panel.

(b) A CDU failure produces the following indications:
1) Blank CDU screen
2) CDU fail indication on offside CDU sensor status page.

(6) BITE History

(a) BITE history is a permanent record of the BITE status of the system covering the last 10 flights of the aircraft. BITE history contains information on most recent test failure reasons for FMC latch as well as additional failure isolation data.

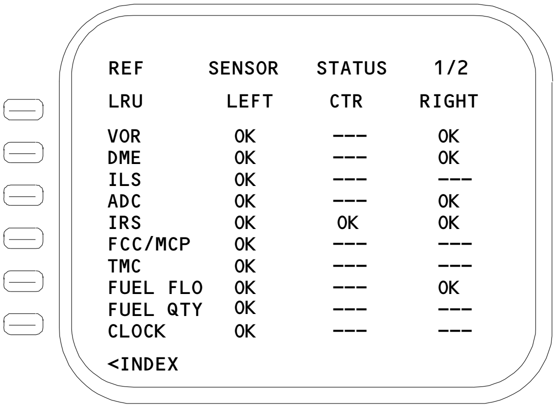
(b) BITE history records intermittent sensor failures when airborne, but does not record intermittent failures for test failures or for CDU BITE.

(c) The FMC stores fault conditions in BITE history and transmits fault data to the MCDP (AMM 22-00-02/201). Inflight fault information is limited to those detected faults which produce FMC failures or an LNAV/VNAV mode failure. Fault data is transmitted to the MCDP at airplane touchdown.

(7) Reference Sensor Status Pages (Fig. 23)

(a) Line selection of SENSORS on the INIT/REF displays the REF SENSOR STATUS page. This verifies proper operation of all input sensors. The unit status has one of the following labels:
1) OK - the unit is connected and operating properly.
2) TEST - The unit is connected but is in the SELF-TEST mode.
3) FAIL - The unit is either not connected, not powered, or not operating properly.
4) (- - -) - The unit is not required for the airplane configuration or is not required for this FMC.

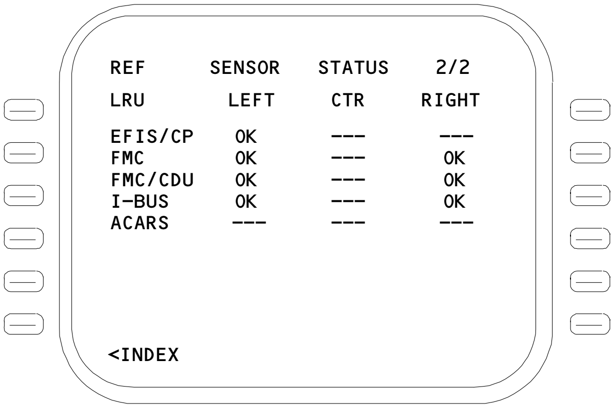
(b) Other indications used for troubleshooting, functional test, and fault isolation are the following:
1) CDU annunciations - FAIL, DSPY, MSG, and OFST
2) FMC caution light
3) CDU messages



```
REF      SENSOR   STATUS    1/2
LRU        LEFT     CTR     RIGHT

VOR         OK      ---      OK
DME         OK      ---      OK
ILS         OK      ---      ---
ADC         OK      ---      OK
IRS         OK      OK       OK
FCC/MCP     OK      ---      ---
TMC         OK      ---      ---
FUEL FLO    OK      ---      OK
FUEL QTY    OK      ---      ---
CLOCK       OK      ---      ---
<INDEX
```

LCDU PAGE 1



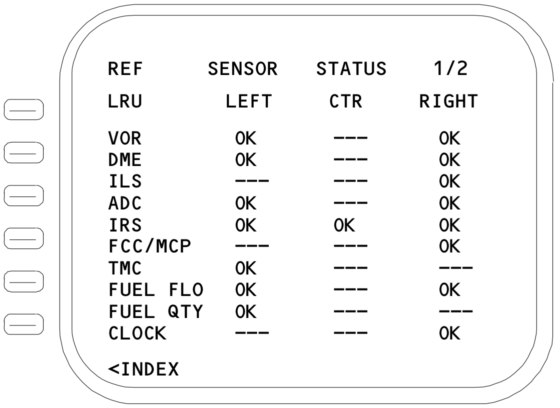
```
REF      SENSOR   STATUS    2/2
LRU        LEFT     CTR     RIGHT

EFIS/CP     OK      ---      ---
FMC         OK      ---      OK
FMC/CDU     OK      ---      OK
I-BUS       OK      ---      OK
ACARS      ---      ---      ---




<INDEX
```

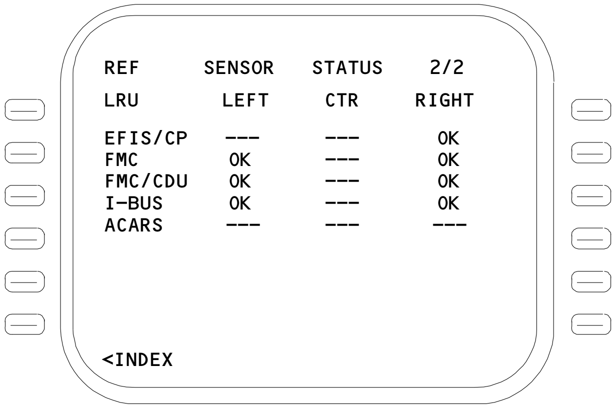
LCDU PAGE 2



```
REF      SENSOR   STATUS    1/2
LRU        LEFT     CTR     RIGHT

VOR         OK      ---      OK
DME         OK      ---      OK
ILS        ---      ---      OK
ADC         OK      ---      OK
IRS         OK      OK       OK
FCC/MCP    ---      ---      OK
TMC         OK      ---      ---
FUEL FLO    OK      ---      OK
FUEL QTY    OK      ---      ---
CLOCK      ---      ---      OK
<INDEX
```

RCDU PAGE 1



```
REF      SENSOR   STATUS    2/2
LRU        LEFT     CTR     RIGHT

EFIS/CP    ---      ---      OK
FMC         OK      ---      OK
FMC/CDU     OK      ---      OK
I-BUS       OK      ---      OK
ACARS      ---      ---      ---

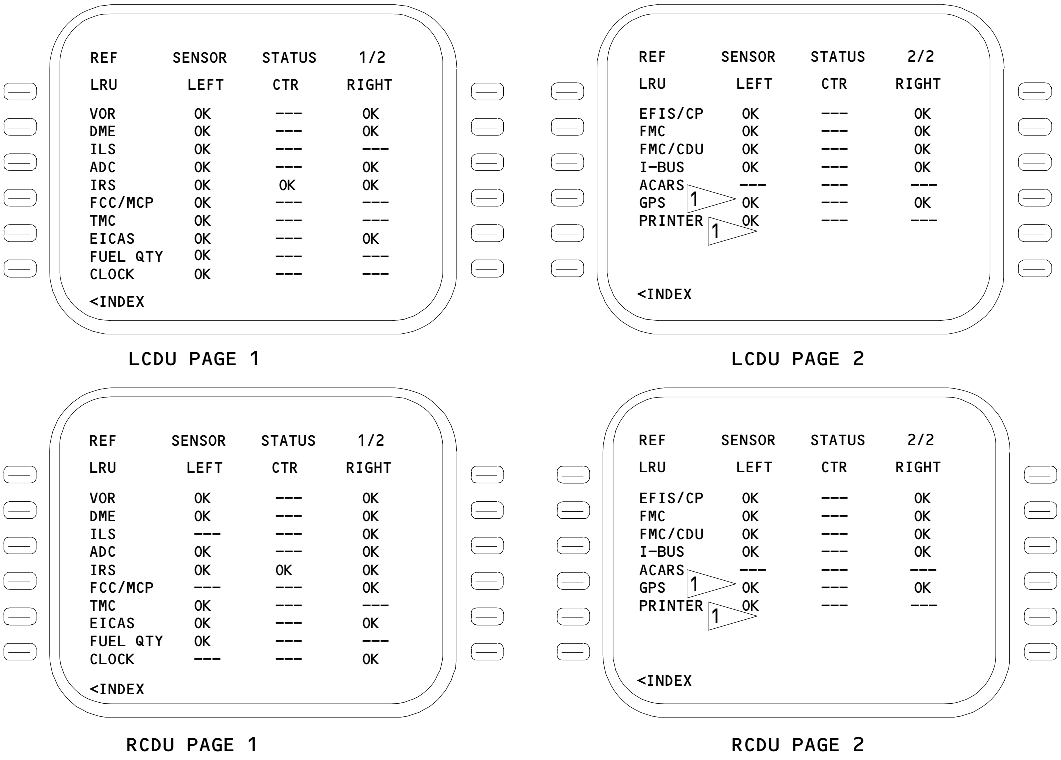



<INDEX
```

RCDU PAGE 2

FMC Reference Sensor Status Pages
Figure 23 (Sheet 1)

K24256



```
REF      SENSOR    STATUS     1/2
LRU        LEFT     CTR     RIGHT

VOR        OK       ---      OK
DME        OK       ---      OK
ILS        OK       ---      ---
ADC        OK       ---      OK
IRS        OK       OK       OK
FCC/MCP    OK       ---      ---
TMC        OK       ---      ---
EICAS      OK       ---      OK
FUEL QTY   OK       ---      ---
CLOCK      OK       ---      ---

<INDEX
```

LCDU PAGE 1

```
REF      SENSOR    STATUS     2/2
LRU        LEFT     CTR     RIGHT

EFIS/CP    OK       ---      OK
FMC        OK       ---      OK
FMC/CDU    OK       ---      OK
I-BUS      OK       ---      OK
ACARS      ---      ---      ---
GPS   1    OK       ---      OK
PRINTER    OK       ---      ---
        1

<INDEX
```

LCDU PAGE 2

```
REF      SENSOR    STATUS     1/2
LRU        LEFT     CTR     RIGHT

VOR        OK       ---      OK
DME        OK       ---      OK
ILS        ---      ---      OK
ADC        OK       ---      OK
IRS        OK       OK       OK
FCC/MCP    ---      ---      OK
TMC        OK       ---      ---
EICAS      OK       ---      OK
FUEL QTY   OK       ---      ---
CLOCK      ---      ---      OK

<INDEX
```

RCDU PAGE 1

```
REF      SENSOR    STATUS     2/2
LRU        LEFT     CTR     RIGHT

EFIS/CP    OK       ---      OK
FMC        OK       ---      OK
FMC/CDU    OK       ---      OK
I-BUS      OK       ---      OK
ACARS      ---      ---      ---
GPS   1    OK       ---      OK
PRINTER    OK       ---      ---
        1

<INDEX
```

RCDU PAGE 2

1 IF ENABLED

FMC Reference Sensor Status Pages
Figure 23 (Sheet 2)

4) Normal CDU operation

C. Control

(1) The flight management computer system operates whenever power is applied. Proper operation requires that interfacing systems are operational. An IDENT page is then displayed on each CDU.

(2) Ensure circuit breakers are closed for the following systems:
  (a) Air/Ground Relays (32-09-02)
  (b) Clocks (31-25-00)
  (c) Engine Indicating and Crew Alerting System (31-41-00)
  (d) Air Data Computing System (34-12-00)
  (e) Flight Instrument System (34-22-00)
  (f) ILS Navigation System (34-31-00)
  (g) VOR System (34-51-00)
  (h) DME System (34-55-00)
  (i) Autopilot (Flight Control) (22-10-00)
  (j) Thrust Management System (22-32-00)
  (k) Fuel Flow Indicating System (73-31-00)
  (l) Integral Panel Lighting (33-13-00)

(3) Ensure FMC source select switches on panels P1 and P3 are in the normal position (alternate not selected).

(4) Ensure FMCS circuit breakers on panel P11 are closed.
  (a) L FMCS CMPTR
  (b) R FMCS CMPTR
  (c) L FMCS CDU
  (d) R FMCS CDU

(5) The flight management computer system is turned off by removing power.

FLIGHT MANAGEMENT COMPUTER SYSTEM

COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
CARD - (77-35-00/101)				
ENG ECS DISCRETES LEFT, M10313				
ENG ECS DISCRETES RIGHT, M10312				
CLOCK - (31-25-00/101)				
CAPT, N2				
F/O, N42				
CIRCUIT BREAKER -	1		FLT COMPT, P11	
DBLDR, C630 [2]		1	11F27	*
FMCS CDU LEFT, C597		1	11E8	*
FMCS CDU RIGHT, C598		1	11E29	*
FMCS CMPTR LEFT, C609		1	11E9	*
FMCS CMPTR RIGHT, C610		1	11E30	*
FMC TUNING LEFT, C641		1	11F13	*
CIRCUIT BREAKER -	2		119BL, MAIN EQUIP CTR, P37	
FMCS DATA BASE LOAD, C630 [1]		1	37E8	*
COMPUTER - (34-12-00/101)				
AIR DATA LEFT, M100				
AIR DATA RIGHT, M101				
COMPUTER - (31-41-00/101)				
EICAS L, M10181				
EICAS R, M10182				
COMPUTER - FLIGHT MANAGEMENT L, M134	2	1	119BL, MAIN EQUIP CTR, E2-1	34-61-01
COMPUTER - FLIGHT MANAGEMENT R, M135	2	1	119BL, MAIN EQUIP CTR, E2-2	34-61-01
COMPUTER - (22-32-00/101)				
THRUST MANAGEMENT, M183				
CONNECTOR - DATA BASE LOADER L, D917	1	1	FLT COMPT	*
INDICATOR - (34-13-00/101)				
CAPT MACH/AIRSPEED, N1				
F/O'S MACH/AIRSPEED, N41				
INDICATOR - (34-22-00/101)				
CAPT ELECTRONIC ATTITUDE DIRECTOR, N4				
CAPT ELECTRONIC HORIZONTAL SITUATION, N5				
CAPT RADIO DISTANCE MAGNETIC, N3				
F/O'S ELECTRONIC ATTITUDE DIRECTOR, N44				
F/O'S ELECTRONIC HORIZONTAL SITUATION, N45				
F/O'S RADIO DISTANCE MAGNETIC, N43				
INTERROGATOR - (34-55-00/101)				
DME L, M123				
DME R, M124				
LIGHT - FMC ANNUNCIATOR, L471	1	1	FLT COMPT, P1-3	*
PANEL - (22-11-00/101)				
AFCS MODE CONTROL, M90				
PANEL - (34-22-00/101)				
EFIS CONTROL L, M94				
EFIS CONTROL R, M93				
PANEL - (34-51-00/101)				
VOR CONTROL L, M91				
VOR CONTROL R, M92				
RECEIVER - (34-51-00/101)				
VOR L, M186				
VOR R, M187				

* SEE THE WDM EQUIPMENT LIST

[1] GUI 001-009,115

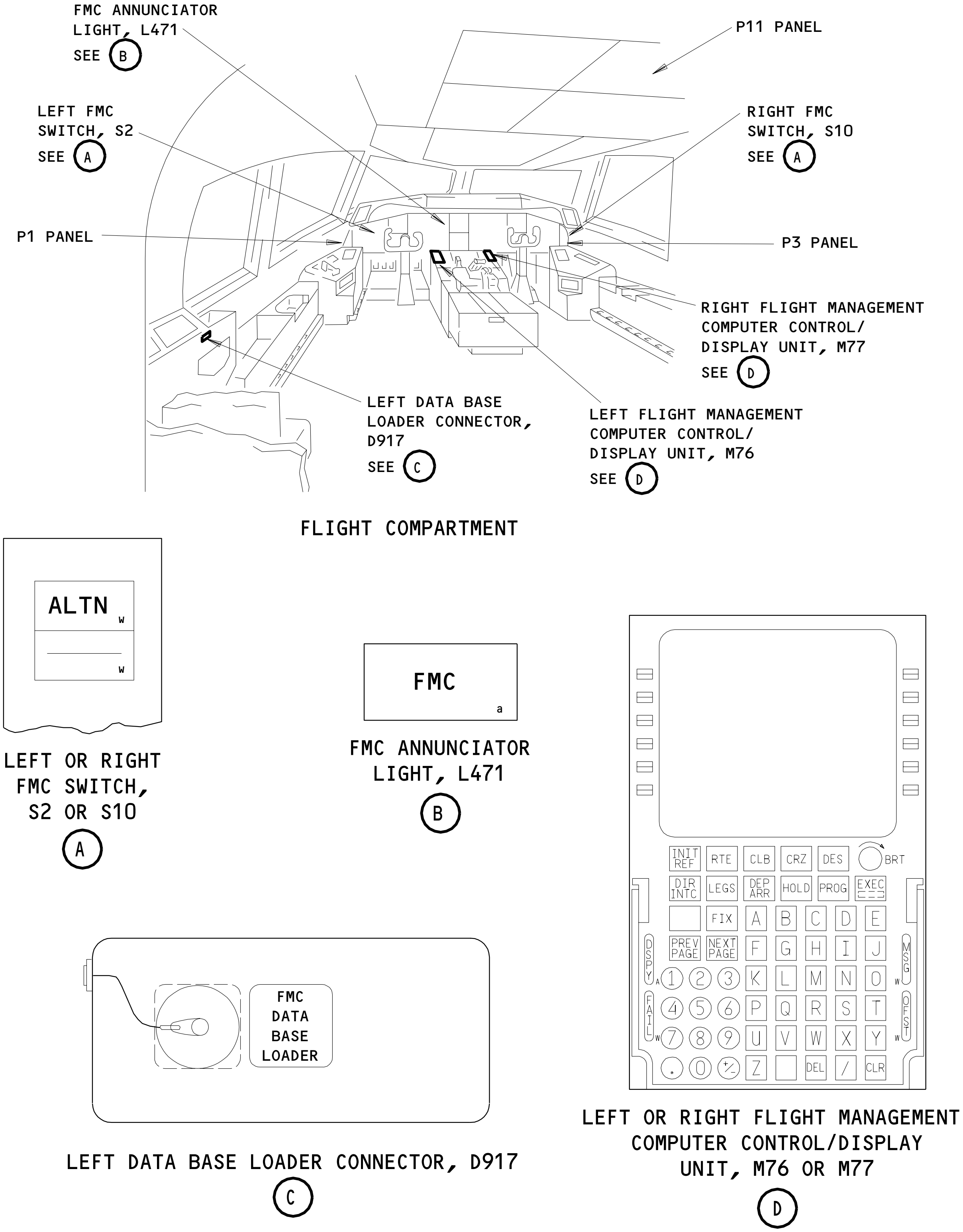
[2] GUI 010-114,116-999

Flight Management Computer System - Component Index
Figure 101 (Sheet 1)

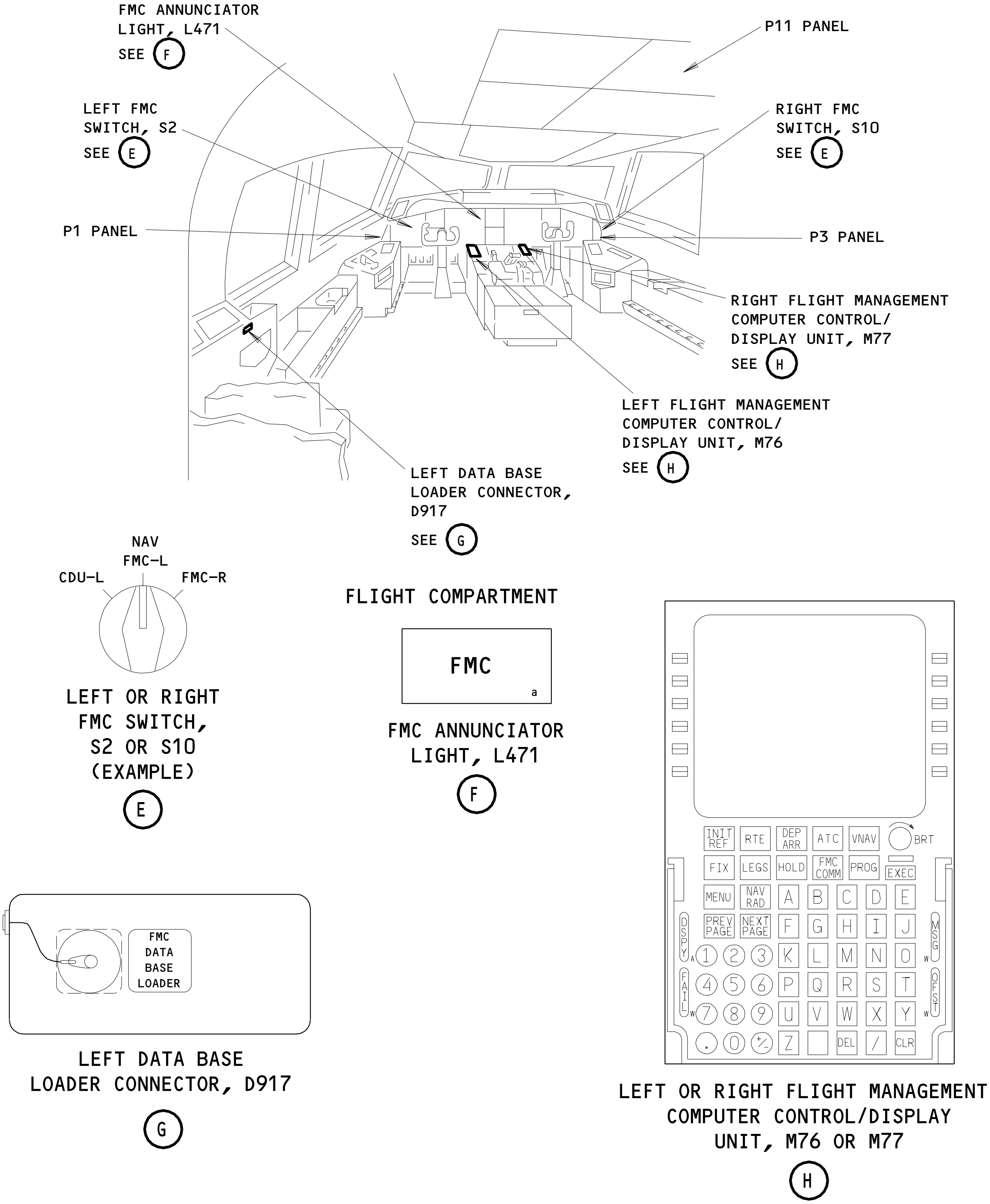
COMPONENT	FIG. 102 SHT	QTY	ACCESS/AREA	REFERENCE
RELAY - (REF 31-01-36, FIG. 101) FMC TUNING L, K757 SYS 1 AIR/GND, K124				
RELAY - (REF 31-01-37, FIG. 101) FMC TUNING R, K758 SYS 2 AIR/GND, K10203				
SWITCH - CAPT FMC SOURCE SELECT, S2	1	1	FLT COMPT, P1	*
SWITCH - F/O'S FMC SOURCE SELECT, S10	1	1	FLT COMPT, P3	*
SYMBOL GENERATOR - (REF 34-22-00, FIG. 101) EFIS C, M149 EFIS L, M148 EFIS R, M150				
UNIT - (REF 31-31-00, FIG. 101) DIGITAL FLIGHT DATA ACQUISITION, M138				
UNIT - L FLIGHT MANAGEMENT COMPUTER CONTROL/ DISPLAY, M76	1	1	FLT COMPT, P9	34-61-02
UNIT - R FLIGHT MANAGEMENT COMPUTER CONTROL/ DISPLAY, M77	1	1	FLT COMPT, P9	34-61-02
UNIT - (REF 28-41-00, FIG. 101) FUEL QUANTITY PROCESSOR, M121				
UNIT - (REF 34-21-00, FIG. 101) INERTIAL REFERENCE CTR, M160 INERTIAL REFERENCE L, M159 INERTIAL REFERENCE R, M161				

* SEE THE WDM EQUIPMENT LIST

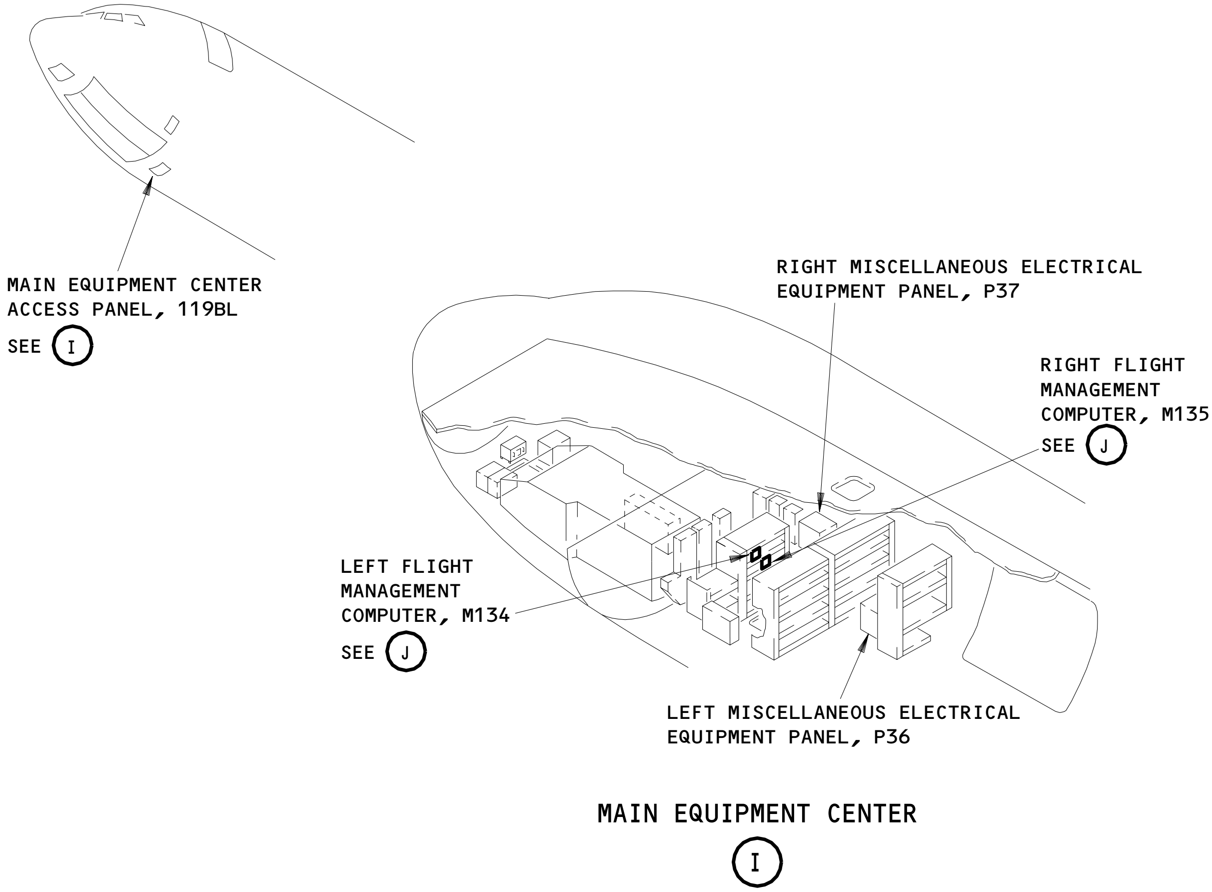
Flight Management Computer System - Component Index
Figure 101 (Sheet 2)

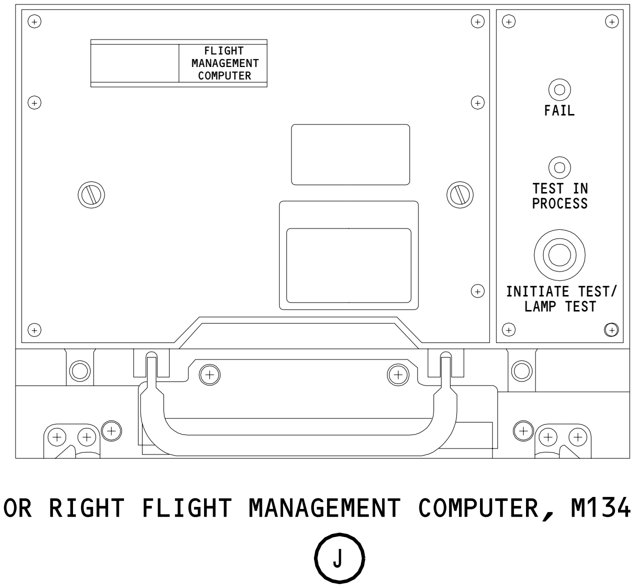


Flight Management Computer System - Component Location
Figure 102 (Sheet 1)



Flight Management Computer System - Component Location
Figure 102 (Sheet 2)





Flight Management Computer System - Component Location
Figure 102 (Sheet 3)

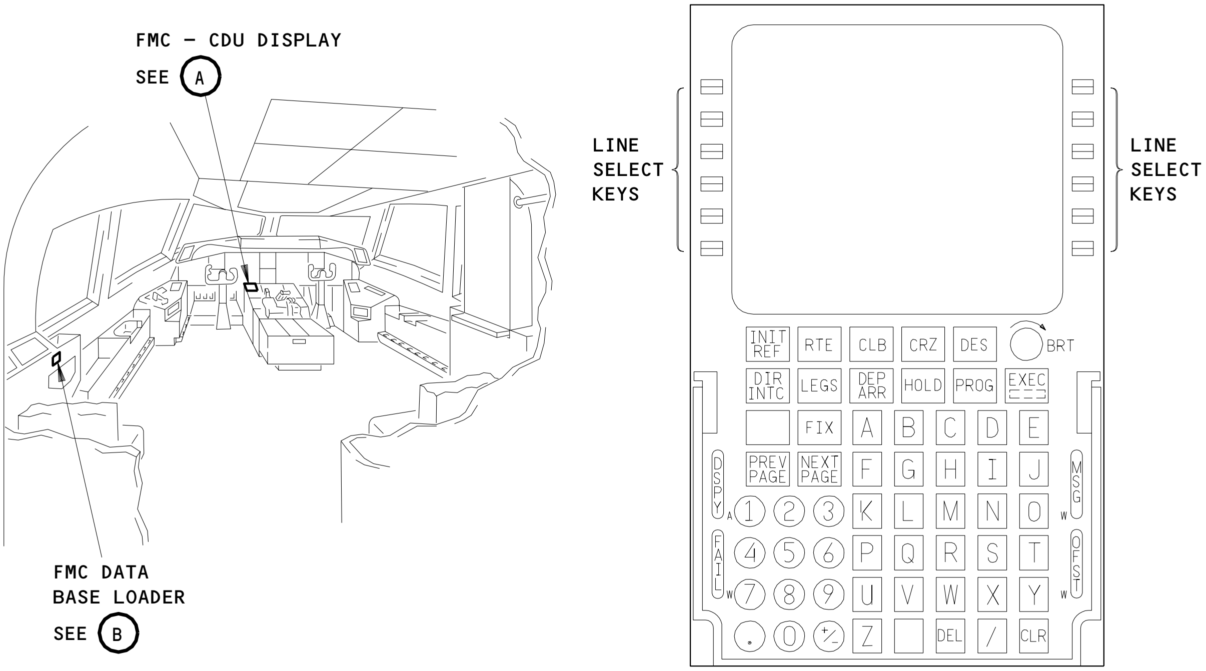
FLIGHT MANAGEMENT COMPUTER SYSTEM - MAINTENANCE PRACTICES

1. General
   A. The flight management computer system is made up of two complete systems. Each has a flight management computer (FMC) and a control display unit (CDU). Each FMC contains a bubble memory for the operational program, performance data base, and navigation data base.
   B. The navigation data base has nav aid data and geographic data and also two different company route data sets. The company route data sets give arrival, departure, and route data valid for a specificed four week time period. One data set becomes out of date as the other data set starts to be used.
   C. Three procedures to handle the FMC data are included for the flight management computer system. These are:
      (1) Navigational Database input with the Portable Data Loader (PDL).
      (2) Cross Load the navigation data base from one FMC to the other.
      (3) Change the Performance Factors.

TASK 34-61-00-422-001-001

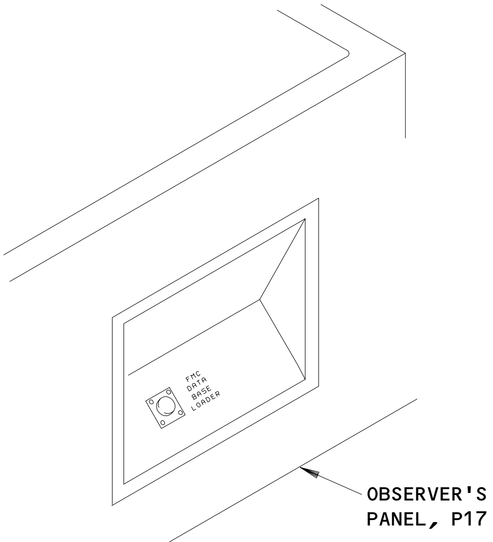
2. Navigational Database Input with the Portable Data Loader
   A. General
      (1) The PDL is a unit that can be moved on the airplane by hand. The PDL is used to input data into the FMC. In one kind of PDL, Data is moved from a tape in the PDL to the bubble memory in the FMC. In the other kind of PDL, data is moved from a disk in the PDL to the bubble memory in the FMC.
      (2) The PDL connects with the FMCs through input data connector found on the P17 panel. Connector D917 connects with the left FMC through an interface lead.
      (3) The PDL receives power through the connector. All control of data movement is automatically done by the loader.

         NOTE: The data load of a new navigation data base causes the FMC performance factors to go to the default values. The performance factors must be put in by hand after the new data base has been put in. Put in new factors if other than the default values are wanted.



FLIGHT COMPARTMENT

FMC - CDU DISPLAY
(EXAMPLE)
A



FMC DATA BASE LOADER
B

FMC Data Loading
Figure 201

(4) A PDL is not a Boeing supplied part. Refer to the PDL supplier for instructions for operation. PDLs have a disk drive for software installation from disks. Some PDLs have an internal mass storage device. If the software is stored in the PDL, then disks are not necessary.

(5) The airplane must be on the ground with the engines shutdown before you can install software.

(6) To read about software installation times and data loaders, do this task: On-Airplane Software Installation (AMM 20-15-11/201).

B. Equipment

(1) Data Loader (or alternative tool)

(a) 11615-02 Loader - Data, Portable, ARINC 615-3 (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(b) 11615-20 Loader - Data, Portable, ARINC 615-3, Includes Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(c) 18000-02 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(d) 2231560-1-B Loader - Data, Portable, ARINC 615, with Two 3.5 Inch Disk Drives (alternative)
Teledyne Controls (Vendor Code 98571)
12333 W. Olympic Blvd., Los Angeles, CA 90064-1021

(e) 30100 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(f) 465130-01-01 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Litton Systems, Inc. (Vendor Code 30782)
6101 Condor Drive, Moorpark, CA 93021-2602

(g) 80000-03-01010203 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(h) 964-0400-024 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(i) 964-0400-025 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(j) YV68A110 Loader - Data, Portable, ARINC 615 (alternative)
SFIM (Vendor Code F6158)
SA 13 AV Marcel Ramofo Garmier, Massy, 91301 France

(2) Most up to date version of the navigation data base disk.

C. References
(1) AMM 20-15-11/201, On-Airplane Software Installation
(2) AMM 24-22-00/201, Electrical Power-Control
(3) FIM 34-61-00/101, Flight Management Computer System

D. Access
(1) Location Zones

119/120	Main Equipment Center
211/212	Flight Compartment

(2) Access Panels

119BL	Main Equipment Center

E. Prepare to input data.

NOTE: The procedure that follows is used to put data into the left FMC and That data must then be given to the right FMC by the Nav Data Cross Load procedure.

S 862-002-001
(1) Supply electrical power (Ref 24-22-00).

S 862-003-001
(2) Make sure that the FMC Source Select switches on panels P1 and P3 are in the normal position.

S 862-004-001

(3) Close these circuit breakers on the overhead panel P11:
  (a) 11E8, FMCS CDU LEFT
  (b) 11E9, FMCS CMPTR LEFT
  (c) 11E29, FMCS CDU RIGHT
  (d) 11E30, FMCS CMPTR RIGHT

S 862-005-001

(4) Make sure the two CDU displays are the same.

S 862-058-001

(5) Push this sequence of line select keys (LSK) to get to the PERF FACTORS page.
  (a) From the IDENT page, push the <INDEX prompt LSK.
  (b) Push the PERF FACTR> prompt LSK.
  (c) Record the PERF FACTORS values shown on the CDU.

NOTE: You will need these performance factor values to put in the FMC after you load the navigation database.

F. FMC Navigational Database Input

S 862-006-001

(1) Open these circuit breakers on the overhead panel P11:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E30, FMCS CMPTR RIGHT

S 862-062-001

(2) Open this circuit breaker on the Miscellaneous Equipment Panel, P37:
  (a) 37E8, FMCS DATA BASE LOADER

S 492-063-001

CAUTION: MAKE SURE THE ON/OFF SWITCH ON THE PDL IS IN THE OFF POSITION, THEN CONNECT THE INTERFACE LEAD FROM FMC DATA BASE LOADER CONNECTOR TO PREVENT DAMAGE TO THE EQUIPMENT .

(3) Connect the PDL interface lead to left FMC data base loader connector, D917.

S 862-066-001

(4) Close this circuit breaker on the overhead panel P11:
   (a) 11E9, FMCS CMPTR LEFT

S 862-008-001

(5) Close this circuit breaker on the Miscellaneous Equipment Panel, P37:
   (a) 37E8, FMCS DATA BASE LOADER

S 472-111-001

(6) SOFTWARE INSTALLATION WITH A PDL DISK DRIVE;
Do these steps to install the software:

<u>NOTE</u>: For more information on how to use the PDL, refer to the supplier's instructions for the PDL.

(a) Set the power switch on the PDL to the on position.

<u>CAUTION</u>: BEFORE YOU INSTALL THE DISK INTO THE PDL, MAKE SURE THE NAVIGATION DATABASE PART NUMBER IS CORRECT.

(b) Put the navigation database disk into the disk drive of the PDL.

(c) Follow the prompts on the data loader to complete the installation.
   1) If there is more than one disk to install, wait 10 seconds after each disk is completed before you remove it and install the subsequent disk.

   <u>NOTE</u>: CHNG, CHANGE DISK, DISK CHANGE and INSERT DISK are examples of data loader prompts for a subsequent disk. If the loader indicates the load is complete after only one disk, this indicates the software is already installed and no further disks need to be loaded.

(d) Remove the disk from the disk drive when the software installation is completed.

<u>NOTE</u>: COMP, LOAD COMPLETE and TRANSF COMPLETE are examples of data loader prompts for a completed installation.

S 472-112-001

(7) SOFTWARE INSTALLATION WITH A PDL MASS STORAGE DEVICE;
Follow the PDL supplier instructions to install the software.

CAUTION: BEFORE YOU INSTALL THE DISK INTO THE PDL, MAKE SURE THE NAVIGATION DATABASE PART NUMBER IS CORRECT.

(a) Make sure you have the correct navigation database software.

S 862-113-001

(8) Set the power switch on the PDL to the off position.

S 862-114-001

(9) Do these steps:
   (a) Open this circuit breaker on the P37 panel:
      1) 37E8, FMCS DATA BASE LOADER

CAUTION: MAKE SURE THE ON/OFF SWITCH ON THE PDL IS IN THE OFF POSITION, THEN DISCONNECT THE INTERFACE LEAD FROM FMC DATA BASE LOADER CONNECTOR TO THE PDL TO PREVENT DAMAGE TO THE EQUIPMENT.

   (b) Make sure the power switch on the PDL is in the off position.
   (c) Remove the interface cable from the left FMC database loader connector, D917, on the P17 panel.
   (d) Push the eject button and remove the diskette.

S 862-123-001

(10) Do the Crossload the Navigation Database from one FMC to the other FMC procedure.

G. Approval of Data Input.

S 862-014-001

(1) Make sure the two CDU IDENT pages are the same and the data is as follows:

NOTE: If the NAV DATA CROSSLOAD page shows on one of the CDUs then do the Crossload the Navigation Database from one FMC to the other FMC procedure.

   (a) MODEL and ENGINES show the correct airplane configuration.
   (b) Look at and note the OP PROGRAM part number that shows directly below the OP PROGRAM title on the L and R CDUs.

(c) Make sure the part numbers are correct and the same.

NOTE: Get the correct OP PROGRAM part number from the approved airline department.

(d) Make sure the NAV DATA part number that shows directly below the NAV DATA title is the last applicable data base that has been released.
  1) If NAV DATA date needs to be changed with the other date shown, do the Company Data Set Interchange as follows:
    a) Push the third LSK on the right side of CDU.
    b) Make sure the data on third line of CDU shows on the bottom of the CDU.
    c) Push the second LSK on the right side of CDU.
    d) Make sure dates on the two lines have changed with each other.

(e) The DRAG FACTOR and F-F FACTOR values are correct.

NOTE: If you need to change the drag factor and fuel flow factor, do the Change the Performance Factors procedure (AMM 34-61-00/201).

H. Put the Airplane Back to Its Usual Condition.

S 862-015-001

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

TASK 34-61-00-422-053-001

3. Nav Data Cross Load

A. General

(1) The flight management computer (FMC) system can of transfer the complete navigation data base from one FMC to the other FMC . A Nav Data Cross load can be done only when the airplane is on the ground and when the navigation data bases are different.

(2) The performance factors, such as the DRAG FACTOR and FUEL FLOW FACTOR are reset to the default values when you crossload the navigation database from one FMC to the other FMC. You should record these values for later use.

B. References

(1) 24-22-00/201, Electrical Power-Control

C. Access

(1) Location Zones

211/212	Flight Compartment

D. Prepare to cross load data.

S 862-016-001

(1) Supply electrical power (Ref 24-22-00).

S 862-017-001
(2) Follow airline procedures and identify FMC with correct nav data base.

NOTE: Throughout this procedure, the FMC with the correct nav data base is referred to as the FMC that transmits . The FMC with the nav data base that is to be changed is referred to as the FMC that receives.

S 862-018-001
(3) Set the FMC Source Select switches on the P1 and the P3 panels to the normal position.

S 862-019-001
(4) Close these P11 panel circuit breakers:
(a) 11E8, FMCS CDU LEFT
(b) 11E29, FMCS CDU RIGHT

S 862-020-001
(5) Open these P11 panel circuit breakers:
(a) 11E9, FMCS CMPTR LEFT
(b) 11E30, FMCS CMPTR RIGHT

S 862-021-001
(6) Close FMCS CMPTR circuit breaker for the FMC that transmits.

S 862-022-001
(7) Let that FMC start to work and then close the FMCS CMPTR circuit breaker for the FMC that receives.

S 862-023-001
(8) Make sure the CDU for the FMC that transmits shows IDENT page.

S 862-124-001
(9) Make sure the CDU for the FMC that receives shows the NAV DATA CROSSLOAD page.

NOTE: IF the navigation database part numbers of the two FMCs do not match, the FMC CROSSLOAD page will show on the CDU. If the FMC CROSSLOAD page does not show on the CDU, you do not need to do the navigation database crossload.

E. Do a Cross Load of the Navigation Data Base.

S 862-025-001

(1) Do these actions on CDU for the FMC that transmits:
   - (a) Push the LSK adjacent to the <INDEX prompt on the lower left side of the CDU display.
   - (b) Make sure the CDU page title is INIT/REF INDEX.
   - (c) Push the LSK adjacent to the MAINT> prompt on the lower right side of the CDU display.
   - (d) Make sure the CDU page title is MAINTENANCE INDEX.
   - (e) Push the LSK adjacent to the <CROSS LOAD prompt on top left side of CDU display.
   - (f) Make sure the display is as shown below.

```
 NAV DATA CROSSLOAD 1/1


<TRANSMIT       RECEIVE>








<INDEX              ---
 SINGLE FMC OPERATION
```

S 862-026-001

(2) Push the CLR key on the two CDUs (removes the message).

S 862-027-001

(3) Use the CDU keyboard to put in the word ARM on the two CDUs.

S 862-028-001

(4) Make sure the word ARM shows on the bottom line of the two CDUs.

S 862-029-001

(5) Push the bottom LSK on the right side of the two CDUs.

S 862-064-001

(6) Make sure the word ARM shows up on the bottom line of the two CDUs adjacent to the LSKs that were pushed.

S 862-030-001

<u>CAUTION</u>: THE TRANSMIT AND RECEIVE LINE SELECT KEYS MUST BE USED CAREFULLY TO MAKE SURE NAVIGATION DATA BASE MOVEMENT GOES INTO THE APPLICABLE FMC . THE TWO FMCS WILL NEED THE INITIAL DATA BASE LOADED INTO THEM IF THE INCORRECT DIRECTION IS USED.

(7) Push the line select key adjacent to the <TRANSMIT prompt on left side of FMC CDU display that is to transmit.

S 862-032-001

(8) Push the line select key adjacent to the RECEIVE> prompt on right side of FMC CDU display that is to receive.

S 862-033-001

(9) Make sure TRANSFER IN PROGRESS shows on the FMC CDU that transmits

NOTE: It takes approximately 15 minutes to crossload a navigational data base. If the crossload is interrupted, the FMC can get into a mode where it will no longer accept a crossload or even a direct load using the data loader. You should power off both FMCs for approximately 10 seconds and power them up again. Leave the FMCs powered without interruption for approximately 30 minutes and then do the data load again, either crossload or direct load.

S 862-034-001

(10) Make sure TRANSFER IN PROGRESS shows on the FMC CDU that transmits.
    (a) When the data movement is done the line on the CDU that shows TRANSFER IN PROGRESS will be replaced by TRANSFER COMPLETE.

(b) Failure to complete data transfer causes the display TRANSFER IN PROGRESS to be replaced by TRANSFER ABORTED.

F. Data crossload check.

S 862-035-001

(1) If the message RESYNCING FMC shows then it is necessary to stop until it goes out.

S 862-036-001

(2) Push the LSK adjacent to the <Index prompt on the CDU display.

S 862-037-001

(3) Make sure the MAINTENANCE INDEX page is shown.

S 862-038-001

(4) Push the LSK adjacent to the <Index prompt on the CDU display.

S 862-039-001

(5) Make sure the INIT REF INDEX page is shown.

S 862-040-001

(6) Push the LSK adjacent to the <IDENT prompt on the CDU display.

S 862-041-001

(7) Make sure the IDENT page is shown.

S 862-043-001

(8) On the two CDUs, compare the data that follows:
  (a) MODEL and ENGINES show the correct airplane configuration.
  (b) NAV DATA part number that shows directly below the NAV DATA title is the same for the two CDUs.
  (c) That today's date is in the range between the two dates that are directly under ACTIVE.
  (d) If today's date is in between the two dates on the third line. Do a Company Data Set Interchange as follows:
    1) Push the third LSK on the right side of CDU.

2) Make sure the data on third line of CDU shows on the bottom of the CDU.
3) Push the second LSK on the right side of CDU.

(e) Make sure dates on the two lines have changed with each other.
(f) Make sure the NAV data base is the last applicable data base released .
(g) Make sure the values for the performance factors are correct. If not, do the Drag Factor/Fuel Flow Factor Modification procedure.

G. Put the Airplane Back to Its Usual Condition.

S 862-044-001

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

TASK 34-61-00-422-122-001

4. Change the Performance Factors

A. General

(1) Performance factors go to the default values when a data base is put in. If other than the standard values are used then they must be put in again. When the two FMCs are on, the factors are changed in the two FMCs at the same time. The new values are kept in the FMC when power is removed.

B. References

(1) 24-22-00/201, Electrical Power-Control

C. Access

(1) Location Zones

211/212	Flight Compartment

D. Procdeure

S 862-065-001

(1) Close these circuit breakers on the P11 panel:

(a) 11E8, FMCS CDU LEFT
(b) 11E9, FMCS CMPTR LEFT
(c) 11E29, FMCS CDU RIGHT
(d) 11E30, FMCS CMPTR RIGHT

S 862-108-001

(2) Push this sequence of Line Select Keys (LSK) on the left CDU:
  - (a) Push the MODE key, INIT REF.
    - 1) Make sure the CDU display shows the POS INIT or the PERF INIT page.
  - (b) Push LSK 6L that is adjacent to the INDEX prompt on the CDU.
    - 1) Make sure the CDU display shows the INIT REF INDEX page.
  - (c) Push LSK 6R that is adjacent to the MAINT prompt on the CDU.
    - 1) Make sure the CDU display shows the MAINTENANCE INDEX page.
  - (d) Push LSK 1R that is adjacent to the PERF FACTOR prompt on the CDU.
    - 1) Make sure the CDU display shows the PERF FACTORS page.
  - (e) Push the "A""R""M" sequence of keys on the CDU.
  - (f) Push LSK 6R on the CDU.
  - (g) Make sure the CDU display shows "ARM" adjacent to the 6R LSK

S 862-047-001

(3) If it is necessary to enter new numbers, do the following:
  - (a) Drag Factor: 0.0
    - 1) Push LSK 2L.
  - (b) Fuel Flow: 0.0
    - 1) Push LSK 3L.
  - (c) Mnvr Margin: 1.3 [1]
    - [1] AWW 701-704 with SB 57A45 is 1.4.
    - 1) Push LSK 4L.
  - (d) Min Crz Time: 1
    - 1) Push LSK 5L.
  - (e) Min R/C Clb: 100
    - 1) Push LSK 3R.
  - (f) Min R/C Crz: 0
    - 1) Push LSK 4R.

S 862-049-001

(4) Open these circuit breakers on the P11 panel for 15 seconds and then close them:
  - (a) 11E9, FMCS CMPTR LEFT

(b) 11E30, FMCS CMPTR RIGHT

S 862-050-001

(5) Make sure on the CDU IDENT page that the value put in is correctly shown.

E. Put the Airplane Back to Its Usual Condition.

S 862-051-001

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

FLIGHT MANAGEMENT COMPUTER SYSTEM - MAINTENANCE PRACTICES

1. General

A. The flight management computer system is made up of two complete systems. Each has a flight management computer (FMC) and a control display unit (CDU). Each FMC contains the memory for the operational program software, the navigation database, the operational program configuration, the airline modification information, and the flight information and data output files.

(1) The operational program software (OPS) is the application software resident in the FMC. This software is required for normal operation and to implement the features in the FMC.

(2) The navigation database has nav aid data, geographic data, and two different company route data-sets. The company route data sets give arrival, departure, and route data for a specific 28-day period. When the current data set is out of date, the other data set becomes active for the FMC to use.

(3) The operational program configuration (OPC) is used to enable the features in the FMC. The OPC contains the FMC features that is one to one correlated to the feature in the OPS.

(4) The airline modification information (AMI) software contains the airplane parameters and datalink tables according to the airline policies and airplane characteristics.

(5) The flight information and data output (FIDO) file defines the specific FMC data that outputs on the dedicated ARINC 429 data bus for recording and analysis purposes.

B. There are two procedures to load the software into the FMC.

(1) Load the FMC software with the Portable Data Loader (PDL)

(2) Crossload the software from one FMC to the other FMC.

C. The Drag Factor and Fuel Flow Factor Modification procedure provides instruction to change the drag factor and the fuel flow factor. These values are usually set to zero as default.

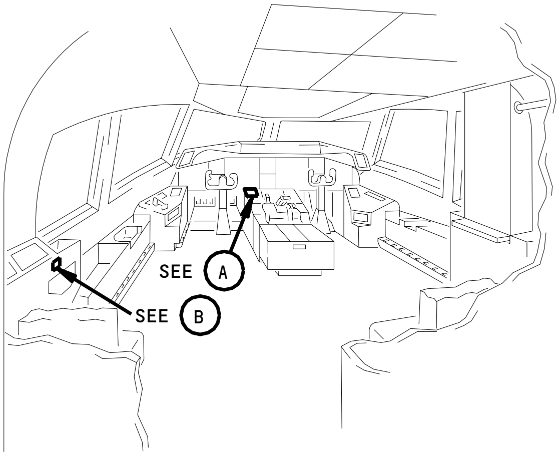
TASK 34-61-00-342-001-004

2. Load the FMC Software with the Portable Data Loader

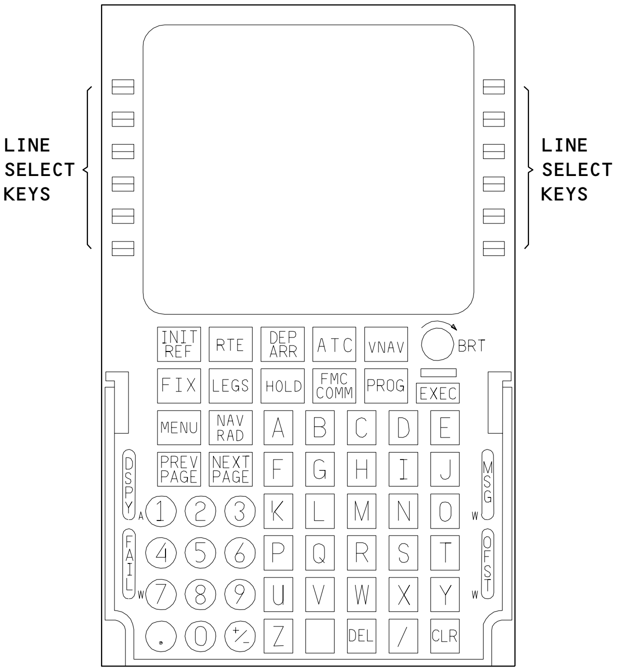
A. General

(1) The FMC software consists of the operational program software (OPS), the navigational database, the operational program configuration (OPC), the airline modification information (AMI), and the flight information and data output (FIDO). You can load each of the file separately as necessary. The FMC requires all five files to operate correctly.

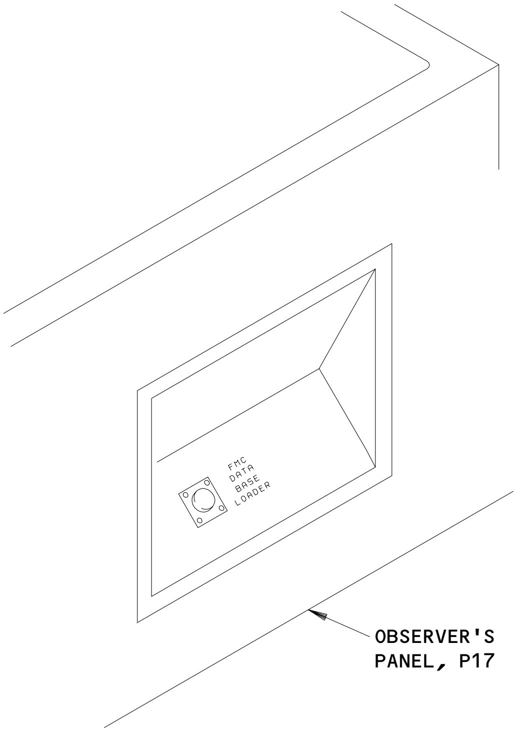
(2) You can use the PDL to load the software from the diskette into the FMC memory.



FLIGHT COMPARTMENT



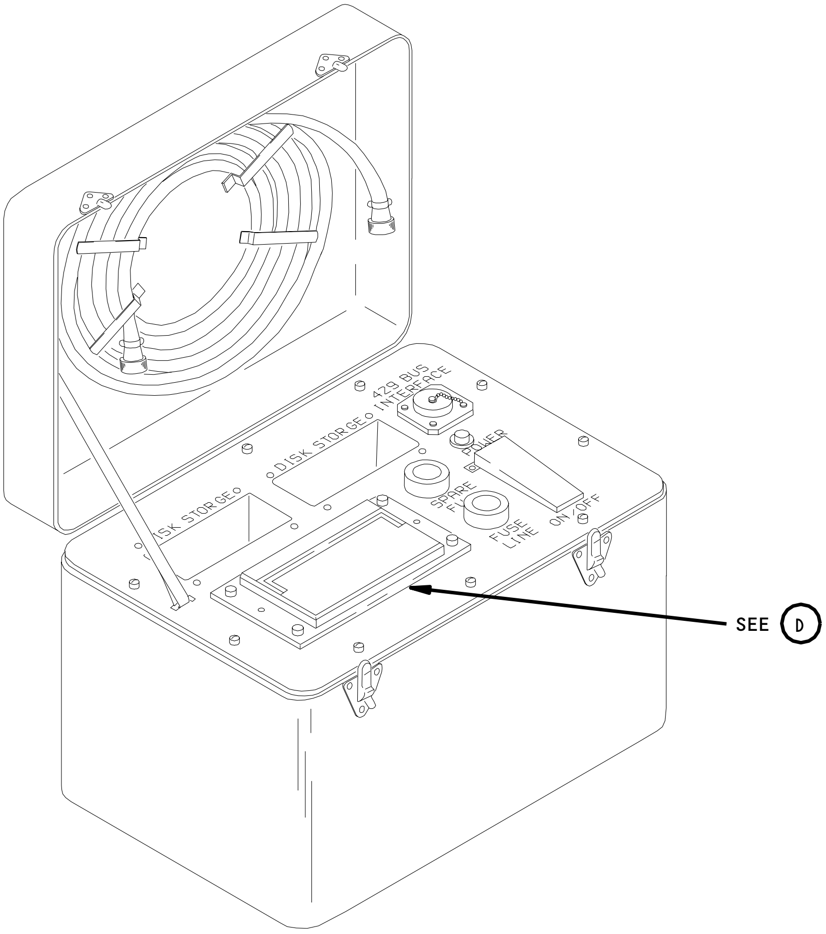
A



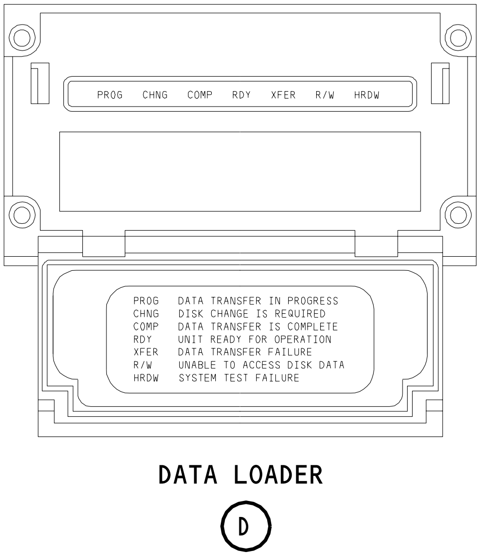
FMC DATA BASE LOADER CONNECTOR

B

FMC Data Loading
Figure 201 (Sheet 1)



PORTABLE DATA LOADER



DATA LOADER

D

FMC Data Loading
Figure 201 (Sheet 2)

(3) The PDL interfaces with the left FMC through a cable that connects between the PDL and the left FMC Database Loader connector, D917, on the P17 panel.

(4) The PDL receives power from the the airplane thru the FMC Database Loader connector or the Data Transfer Unit Receptacle.

(5) A PDL is not a Boeing supplied part. Refer to the PDL supplier for instructions for operation. PDLs have a disk drive for software installation from disks. Some PDLs have an internal mass storage device. If the software is stored in the PDL, then disks are not necessary.

(6) The airplane must be on the ground with the engines shutdown before you can install software.

(7) To read about software installation times and data loaders, do this task: On-Airplane Software Installation (AMM 20-15-11/201).

B. Equipment

(1) Data Loader (or alternative tool)

(a) 11615-02 Loader - Data, Portable, ARINC 615-3 (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(b) 11615-20 Loader - Data, Portable, ARINC 615-3, Includes Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(c) 18000-02 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Qualtair Equipment and Engineering (Vendor Code 1HEC2)
15720 Mill Creek Boulevard, Suite 200, Mill Creek, WA 98012

(d) 2231560-1-B Loader - Data, Portable, ARINC 615, with Two 3.5 Inch Disk Drives (alternative)
Teledyne Controls (Vendor Code 98571)
12333 W. Olympic Blvd., Los Angeles, CA 90064-1021

(e) 30100 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(f) 465130-01-01 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Litton Systems, Inc. (Vendor Code 30782)
6101 Condor Drive, Moorpark, CA 93021-2602

(g) 80000-03-01010203 Loader - Data, Portable, ARINC 615/A with Mass Storage Device (alternative)
Demo Systems, Inc. (Vendor Code 0BAW0)
379 Science Dr., MoorPark, CA 93021

(h) 964-0400-024 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(i) 964-0400-025 Loader - Data, Portable, ARINC 615, 3.5 Inch Diskette (alternative)
Honeywell, Inc. (Vendor Code 97896)
15001 N.E. 36th St., P.O. Box 97001, Redmond WA 98073-9701

(j) YV68A110 Loader - Data, Portable, ARINC 615 (alternative)
SFIM (Vendor Code F6158)
SA 13 AV Marcel Ramofo Garmier, Massy, 91301 France

(2) Database Loader, Sundstrand 964-0400-006
Sundstrand Aviation Division
P.O. Box 7002
4747 Harrison Ave
Rockford, IL 61101

C. References
- (1) AMM 20-15-11/201, On-Airplane Software Installation
- (2) AMM 24-22-00/201, Electrical Power - Control

D. Access
(1) Location Zones
211/211 Flight Compartment

E. Prepare to Load the Software

S 862-002-004
(1) Supply electrical power (AMM 24-22-00/201).

S 862-032-004
(2) Make sure that the FMC Source Select switches on the P1-1 and P3-3 panels are in the NORMAL onside FMC position.

S 862-004-004
(3) Close these circuit breakers on the overhead panel P11:
- (a) 11E8, FMCS CDU LEFT
- (b) 11E29, FMCS CDU RIGHT

S 862-005-004
(4) Open these circuit breakers on the overhead panel, P11:
- (a) 11E9, FMCS CMPTR LEFT
- (b) 11E30, FMCS CMPTR RIGHT

S 862-033-004

(5) Open this circuit breaker on the Miscellaneous Equipment Panel, P37:
   (a) 37E8, FMCS DATA BASE LOADER

F. Load the Software

S 862-006-004

(1) Do these steps to load the software into the left FMC:

<u>CAUTION</u>: MAKE SURE THE POWER ON/OFF SWITCH ON THE PDL IS IN THE OFF POSITION BEFORE YOU CONNECT THE INTERFACE CABLE. THIS WILL PROVENT DAMAGE TO THE FMC AND THE PDL.

   (a) Make sure the power ON/OFF switch on the PDL is in the OFF position.
   (b) Connect the interface cable from the PDL to the FMC Database Loader connector, D917, on the P17 panel.
   (c) Close this circuit breaker on the overhead panel P11:
      1) 11E9, FMCS CMPTR LEFT
   (d) Make sure this circuit breaker on the overhead panel, P11, is open:
      1) 11E30, FMCS CMPTR RIGHT
   (e) Close this circuit breaker on the Miscellaneous Equipment Panel, P37:
      1) 37E8, FMCS DATA BASE LOADER

S 472-026-004

(2) SOFTWARE INSTALLATION WITH A PDL DISK DRIVE;
Do these steps to install the software:

<u>NOTE</u>: For more information on how to use the PDL, refer to the supplier's instructions for the PDL.

   (a) Set the power switch on the PDL to the on position.

<u>CAUTION</u>: BEFORE YOU INSTALL THE DISK INTO THE PDL, MAKE SURE THE NAVIGATION DATABASE PART NUMBER IS CORRECT.

   (b) Put the navigation database disk into the disk drive of the PDL.

(c) Follow the prompts on the data loader to complete the installation.
   1) If there is more than one disk to install, wait 10 seconds after each disk is completed before you remove it and install the subsequent disk.

      NOTE: CHNG, CHANGE DISK, DISK CHANGE and INSERT DISK are examples of data loader prompts for a subsequent disk. If the loader indicates the load is complete after only one disk, this indicates the software is already installed and no further disks need to be loaded.

(d) Remove the disk from the disk drive when the software installation is completed.

   NOTE: COMP, LOAD COMPLETE and TRANSF COMPLETE are examples of data loader prompts for a completed installation.

S 472-027-004

(3) SOFTWARE INSTALLATION WITH A PDL MASS STORAGE DEVICE; Follow the PDL supplier instructions to install the software.

CAUTION: BEFORE YOU INSTALL THE DISK INTO THE PDL, MAKE SURE THE NAVIGATION DATABASE PART NUMBER IS CORRECT.

(a) Make sure you have the correct navigation database software.

S 862-028-004

(4) Set the power switch on the PDL to the off position.

S 862-029-004

(5) Do these steps:
(a) Open this circuit breaker on the Miscellaneous Equipment Panel, P37:
   1) 37E8, FMCS DATA BASE LOADER

CAUTION: MAKE SURE THE POWER ON/OFF SWITCH ON THE PDL IS IN THE OFF POSITION BEFORE YOU DISCONNECT THE INTERFACE CABLE. THIS WILL PREVENT DAMAGE TO THE FMC AND THE PDL.

(b) Remove the interface cable from the FMC Database Loader connector, D917, on the P17 panel.

S 862-031-004

(6) Approve the data input as follows:
(a) Make sure the MENU page shows on the left CDU.
(b) Make sure the <FMC prompt shows on the MENU page of the left CDU.

(c) Push the line select key (LSK) adjacent to the <FMC prompt on the left CDU.
(d) Make sure the IDENT page shows on the left CDU.
(e) Make sure the OP PROGRAM, the OPC, and the NAV DATA part numbers that show on the left CDU are correct.
(f) Close this circuit breaker on the overhead panel, P11:
 1) 11F30, FMCS CMPTR RIGHT
(g) When the two FMCs have different software, the FMC CROSSLOAD page will show on the CDU. Do the data crossload procedure (AMM 34-61-00/201) to load the data into the FMC that has the incorrect software.
(h) Make sure the NAV DATA, the OP PROGRAM, and the OPC part numbers that show on the left and right CDUs are correct.

G. Put the Airplane Back to Its Usual Condition

S 862-008-004

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-61-00-342-009-004

3. FMC Software Crossload

A. General
(1) The flight management computer (FMC) software can be crossloaded from one FMC to the other FMC. A FMC Data Crossload can be done only when the airplane is on the ground and when there are differences between the two FMC software.
(2) During the FMC self-test, if the FMC detects a condition that the software part numbers of the two FMCs are different, the FMC CROSSLOAD pages will show and lock on the CDUs. You must do the software crossload procedure or do the software load procedure to correct this condition.

B. References
(1) AMM 24-22-00/201, Electrical Power - Control

C. Access
(1) Loacation Zones
 211/211 Flight Compartment

D. Data Crossload Procedure

S 862-010-004

(1) Supply electrical power (AMM 24-22-00/201).

S 862-034-004

(2) Make sure that the FMC Source Select switches on the P1-1 and P3-3 panels are in the NORMAL onside FMC position.

S 862-012-004

(3) Close these circuit breakers on the overhead panel P11:
 (a) 11E8, FMCS CDU LEFT
 (b) 11E9, FMCS CMPTR LEFT
 (c) 11E29, FMCS CDU RIGHT
 (d) 11E30, FMCS CMPTR RIGHT

S 862-013-004

(4) After the FMC self-test is complete, if the FMC detects a condition where the software part numbers do not match, the FMC CROSSLOAD pages will show on the two CDUs.

<u>NOTE</u>: If the FMC CROSSLOAD page does not show on the CDU, you do not need to do the data crossload.

S 862-014-004

(5) Make sure the FMC CROSSLOAD page shows on the CDU.

S 862-015-004

(6) Make sure the ARM> prompt shows adjacent to the software part numbers.

<u>NOTE</u>: The ARM> prompt only shows adjacent to the software part number that does not match between the two CDUs. You must do the data crossload to correct this condition.

S 862-016-004

(7) Identify the FMC that has the correct software. This FMC will be the transmit FMC and will be referred to as the FMC/CDU that transmits.

S 862-017-004

(8) Do these steps to transmit the data from one FMC to another FMC.
   (a) Push the LSK adjacent to the ARM> prompt on the FMC/CDU that transmits.

   <u>NOTE</u>: You can arm more than one software that you want to crossload at the same time.

   (b) Make sure the ARM> prompt changes to ARMED on the FMC/CDU that transmits.
   (c) Make sure the TRANSMIT> prompt shows adjacent to the LSK 6R on the FMC/CDU that transmits.
   (d) Push the LSK adjacent to the TRANSMIT> prompt on the FMC/CDU that transmits.

(e) Make sure the TRANSFER IN PROGRESS shows on the FMC/CDU that transmits.

<u>NOTE</u>: It takes approximately 15 minutes to crossload a navigational data base. If the cross load is interrupted, the FMC can get into a mode where it will no longer accept a crossload or even a direct load using the data loader. You should power off both FMCs for approximately 10 seconds and power them up again. Leave the FMCs powered without interruption for approximately 30 minutes and then do the data load again, either crossload or direct load.

(f) Make sure the MENU page shows on the FMC/CDU that receives.
(g) Make sure the FMC> prompt does not show on the FMC/CDU that receives.
(h) After the data transfer is complete, the TRANSFER COMPLETE will replace the TRANSFER IN PROGRESS on the FMC/CDU that transmits.
(i) If the data crossload fails to complete transfer the data, the TRANSFER ABORTED will replace the TRANSFER IN PROGRESS on the FMC/CDU that transmits.

S 862-018-004
(9) Do these steps to do the data crossload check:
(a) After the data transfer is complete, make sure the IDENT page shows on the FMC/CDU that receives.
(b) Push the INIT REF function key on the FMC/CDU that transmits.
(c) Push the LSK adjacent to the <INDEX prompt on the FMC/CDU that transmits.
(d) Make sure the INIT/REF INDEX page shows on the FMC/CDU that transmits.
(e) Push the LSK adjacent to the <IDENT prompt on the FMC/CDU that transmits.
(f) Make sure the IDENT page shows on the FMC/CDU that transmits.
(g) Make sure the NAV DATA, the OP PROGRAM, and the OPC part numbers are the same on the two CDUs.
(h) Make sure the drag factor and the fuel flow factor values are correct. If they are not, do the Drag Factor/Fuel Flow Factor Modification procedure to correct it.

E. Put the Airplane Back to Its Usual Condition

S 862-019-004
(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-61-00-342-020-004

4. Drag Factor/Fuel Flow Factor Modification Procedure

A. General

(1) This procedure provides instructions to change the drag factor and the fuel flow factor. If other than the standard values are used, you need to change the values. When the two FMCs are on, the factors are changed in the two FMCs at the same time. The new values are kept in the FMC when power is removed.

B. References

(1) AMM 24-22-00/201, Electrical Power - Control

C. Access

(1) Loacation Zones

211/211 Flight Compartment

D. Procedure

S 862-021-004

(1) Close these circuit breakers on the P11 panel:
- (a) 11E8, FMCS CDU LEFT
- (b) 11E9, FMCS CMPTR LEFT
- (c) 11E29, FMCS CDU RIGHT
- (d) 11E30, FMCS CMPTR RIGHT

S 862-022-004

(2) Do these steps to change the drag factor and the fuel flow factor:
- (a) Make sure the IDENT page shows on the CDU.
- (b) Push the alphanumeric keys A, R, M, to make ARM show in the scratchpad area.
- (c) Push the LSK for the DRAG and FUEL FLOW FACTORS line.
- (d) Make sure ARM shows to the left of the DRAG/FF line on the CDU.
- (e) If necessary, get the new number from below (or other values if necessary) and put it in with the CDU numeric keys. Include the negative sign (-) if necessary, and decimal sign if a decimal number is put in. If no value is entered, the defaults are as the following table.

AIRPLANE CONFIGURATION	DRAG FACTOR	FUEL FLOW	MNVR MARGIN	MIN CRZ TIME	MIN R/C CLB	MIN R/C CRZ
All	0	0	1.3	1	100	0

- (f) After you put in the number, push the applicable LSK on the CDU to move the number into the FMC.

S 862-023-004

(3) Open these circuit breakers on the P11 panel for 15 seconds and then close them:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E30, FMCS CMPTR RIGHT

S 862-024-004

(4) Make sure the CDU IDENT page shows the value that you put in.

E. Put the Airplane Back to Its Usual Condition

S 862-025-004

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

FLIGHT MANAGEMENT COMPUTER SYSTEM - ADJUSTMENT/TEST

1. General
   A. There are two Flight Management Computers (FMC) and two Control Display Units (CDU) in the Flight Management Computer System (FMCS).
   B. This procedure has these tasks:
      (1) The Flight Management Computer System Operational Test.
      (2) The Flight Management Computer System (FMCS) System Test.

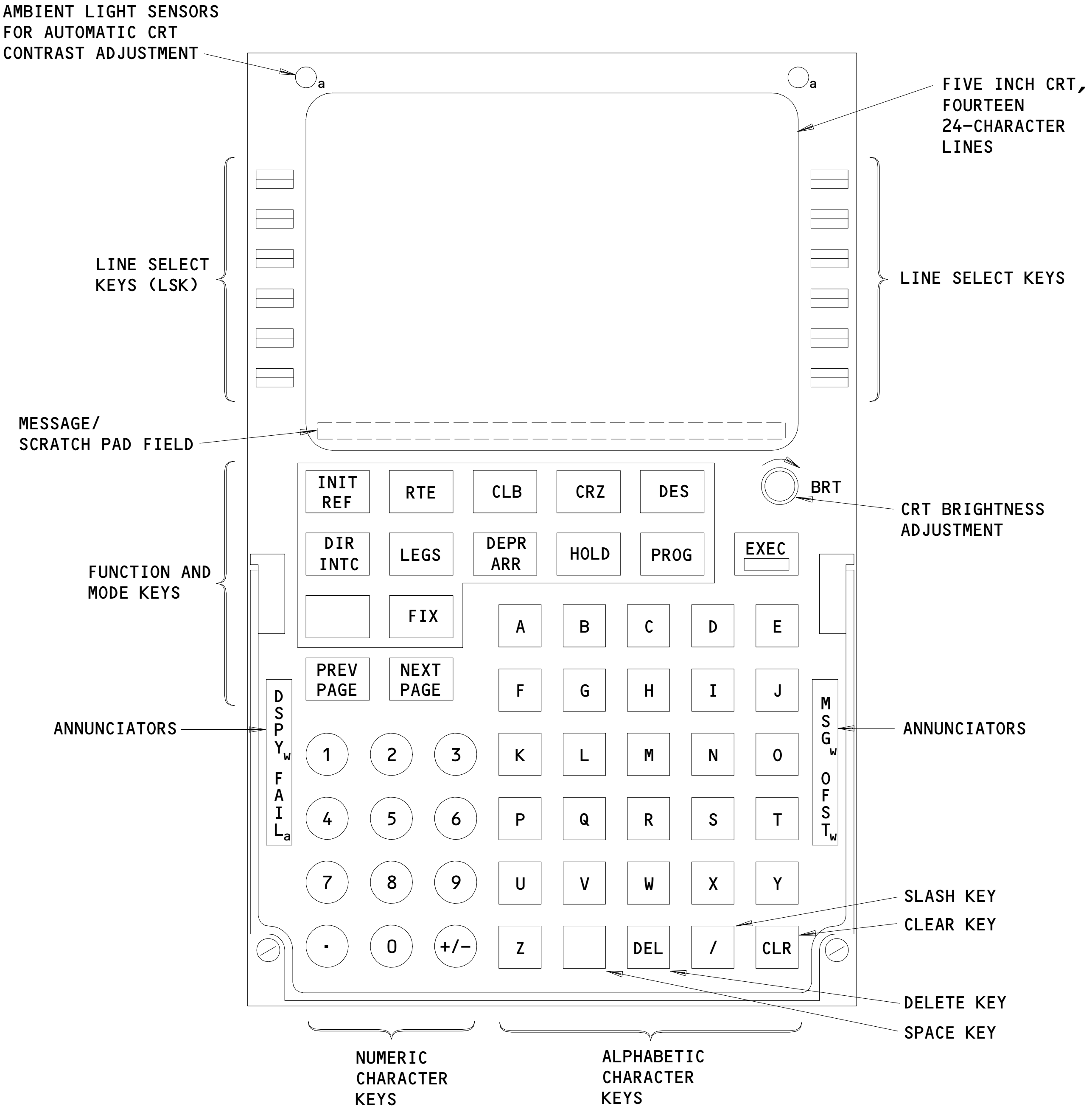
TASK 34-61-00-715-001

2. Flight Management Computer System - Operational Test
   A. References
      (1) AMM 22-10-00/501, Autopilot (Flight Control)
      (2) AMM 22-32-00/501, Thrust Management System
      (3) AMM 24-22-00/201, Electrical Power - Control
      (4) AMM 27-61-00/201, Spoiler/Speed Control System
      (5) AMM 28-41-00/501, Fuel Quantity Indicating System
      (6) AMM 31-25-00/501, Clocks
      (7) AMM 31-41-00/201, Engine Indication and Crew Alerting System
      (8) AMM 31-51-00/501, Warning System
      (9) AMM 32-09-02/201, Air/Ground Relays
      (10) AMM 33-16-00/501, Master Dim and Test
      (11) AMM 34-12-00/501, Air Data Computing System
      (12) AMM 34-21-00/501, Inertial Reference System
      (13) AMM 34-22-00/501, Flight Instrument System
      (14) AMM 34-31-00/501, ILS Navigation System
      (15) AMM 34-51-00/501, VOR System
      (16) AMM 34-55-00/501, DME System
      (17) AMM 73-31-00/501, Fuel Flow Indicating System
   B. Access
      (1) Location Zones

119/120	Main Equipment Center

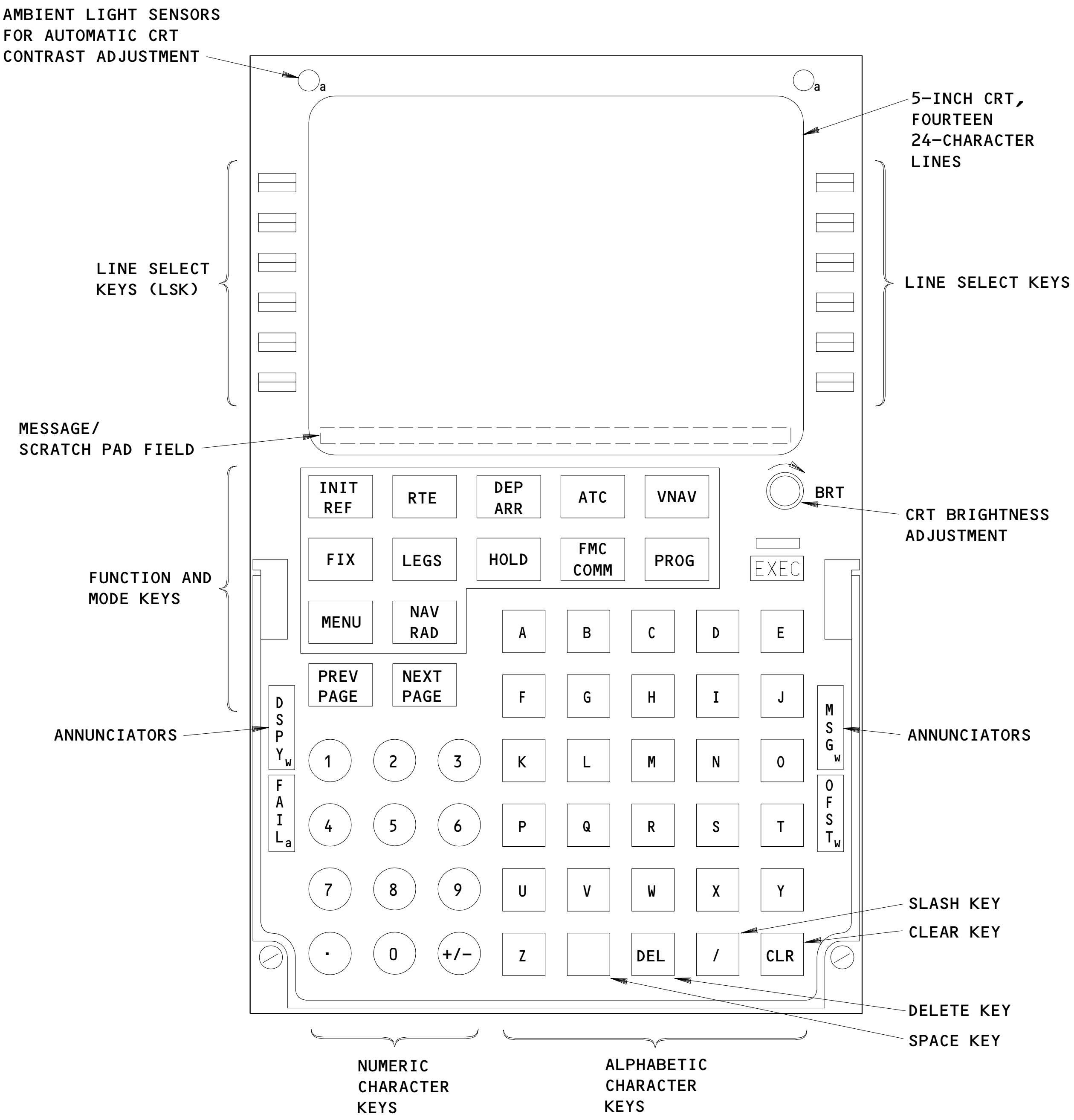
      (2) Access Panels

119AL	Main Equipment Center



FMCS Control Display Unit
Figure 501 (Sheet 1)

EFFECTIVITY
GUI 115 PRE-SB 34-414;
GUI 001-114, 116-999



FMCS Control Display Unit
Figure 501 (Sheet 2)

C. Prepare For Test

S 865-002

(1) Supply electrical power (AMM 24-22-00/201).

S 865-003

(2) Close these circuit breakers on the overhead circuit breaker panel, P11:
  (a) 11E8, FMCS CDU LEFT
  (b) 11E9, FMCS CMPTR LEFT
  (c) 11E29, FMCS CDU RIGHT
  (d) 11E30, FMCS CMPTR RIGHT
  (e) 11F13, FMC TUNING LEFT or 11C18, FMC SW LEFT
  (f) 11F33, FMC TUNING RIGHT or 11F13, FMC SW RIGHT

S 865-004

(3) Make sure these systems are operational:
  (a) Air/Ground Systems (AMM 32-09-02/501)
  (b) Air Data System (AMM 34-12-00/501)
  (c) Autopilot/Flight Director System (AMM 22-10-00/501)
  (d) Clock System (AMM 31-25-00/501)
  (e) DME (AMM 34-55-00/501)
  (f) Electronic Flight Instrument System (AMM 34-22-00/501)
  (g) Engine Indication and Crew Alerting System (AMM 31-41-00/501)
  (h) Fuel Quantity Indicating System (AMM 28-41-00/501)
  (i) Inertial Reference System (AMM 34-21-00/501)
  (j) ILS (AMM 34-31-00/501)
  (k) Thrust Management System (AMM 22-32-00/501)
  (l) VOR (AMM 34-51-00/501)
  (m) Warning Electronic System (AMM 31-51-00/501)

D. Procedure

S 865-036

(1) Set the FMC switches on the instrument source select panels, P1 and P3, to the normal position.

S 865-052

(2) Momentarily push the TEST switch on the front of the FMC to initiate the FMC self-test.

NOTE: During the self-test, FMC does not output the data for display on the CDU.

S 865-053

(3) After the FMC self-test is complete, make sure the following occur:
  (a) Make sure the FAIL indicator on the front of the FMC is off after the TEST IN PROGRESS indicator goes off.

(b) Make sure the following data shows on the IDENT page of the two CDUs.
  1) The MODEL and ENGINES on the two CDUs are the same and correct.
  2) The NAV DATA and OP PROGRAM part numbers on the two CDUs are the same and correct.

     NOTE: If the Nav Data Crossload page shows on one of the two CDUs, there is a difference in navigation databases between the FMCs. Do the Navigation Database Crossload (AMM 34-61-00/201).

  3) Make sure the ACTIVE dates for the navigation database on the two CDUs are the same and correct. The second set of dates should be for the time immediately before or after the ACTIVE dates.
  4) GUI 003 POST-SB 34-301;
     GUI 115 POST-SB 34-379;
     Make sure that the drag factor and the fuel flow (FF) factor are correct.

(c) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 002, 004-114, 116-999;
Do these steps to verify the performance factor data on the PERF FACTORS page of the two CDUs.
  1) Push the INIT REF mode select key on the two CDUs.
  2) Make sure the POS INIT or PERF INIT page shows on the two CDUs.
  3) Push the LSK adjacent to the INDEX prompt on the two CDUs.
  4) Make sure the INIT REF INDEX page shows on the two CDUs.
  5) Push the LSK adjacent to the MAINT prompt on the two CDUs.
  6) Make sure the MAINTENANCE INDEX page shows on the two CDUs.
  7) Push the LSK adjacent to the PERF FACTOR prompt on the two CDUs.
  8) Make sure the PERF FACTORS page shows on the two CDUs.
  9) Make sure the performance factors on the PERF FACTORS page are correct (AMM 34-61-00/201).

E. Put the Airplane Back to Its Usual Condition

S 865-006

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

TASK 34-61-00-735-007

3. Flight Management Computer System - System Test

A. General

(1) The FMCS system test consists of these tests:
  (a) FMCS - CDU interface test
  (b) FMC source select switch test
  (c) FMC discretes input test

ATC/TCAS status test
- (d) FMC - EICAS message test
- (e) FMC - IRS initialization interface test
- (f) FMC input sensor status test
- (g) FMC - VOR/DME interface test
- (h) FMC - EICAS interface test.

(2) The Autopilot/Flight Director System Adjustment Test (AMM 22-10-00/501) is used to test these Flight Management Computer System Interfaces:
- (a) Thrust Management Computer
- (b) Flight Control Computers
- (c) AFCS Mode Control Panel
- (d) Maintenance Control Display Panel

B. Test Flight Management Computer System

S 735-009

(1) Do a test of the FMC - CDU Interface
- (a) AIRPLANES WITH FMC-CDU NORMAL/ALT SWITCH;
  Set the left and right FMC source select switches on the P1 and the P3 panels to the normal position.
- (b) AIRPLANES WITH FMC-CDU NAV SOURCE SELECT SWITCH;
  Set the left FMC NAV Source Select switch on the P1 panel to the FMC-L position and the right FMC NAV Source Select switch on the P3 panel to the FMC-R position.
- (c) Open these circuit breakers on the P11 panel:
  - 1) 11E9, FMCS CMPTR LEFT
  - 2) 11E30, FMCS CMPTR RIGHT
- (d) Make sure the EFI switches on the P1 and P3 panels are in the normal position.
- (e) Close these circuits breakers on the P11 panel:
  - 1) 11E8, FMCS CDU LEFT
  - 2) 11E29, FMCS CDU RIGHT
- (f) GUI 115 POST-SB 34-414;
  Make sure the two CDUs show the MENU page.
- (g) Make sure the FAIL annunciator is on for the two CDUs.
- (h) Turn the IND LIGHTS switch between DIM and BRT on the overhead panel, P5.

  NOTE: Make sure the LT OVRD switch on the forward overhead panel, P5, is in the off position.

- (i) Make sure the FAIL annunciator on the two CDUs change the brightness levels.
- (j) Close these circuit breakers on the P11 panel:
  - 1) 11E9, FMCS CMPTR LEFT
  - 2) 11E30, FMCS CMPTR RIGHT
- (k) Make sure the FAIL annunciator on the two CDUs is off.
- (l) Make sure the two CDU displays are the same and show the correct IDENT page data.

S 735-011

(2) Do a test of the FMC-CDU NORMAL/ALT Switch
- (a) Make sure the left and right source select switches on P1 and P3 panels are in the normal position.
- (b) Open this circuit breaker on the P11 panel:
  - 1) 11E9, FMCS CMPTR LEFT
- (c) Make sure the message FMC is shown on the left CDU in less than 40 seconds.
- (d) Push the left FMC source select switch on the P1 panel.
- (e) Make sure the left FMC source select switch is in the ALTN position.
- (f) Make sure the left CDU shows the IDENT page.
- (g) Make sure the EICAS message L-FMC FAIL is shown.
- (h) Push the left FMC source select switch on the P1 panel
- (i) Close this circuit breaker on the P11 panel.
  - 1) 11E9, FMCS CMPTR LEFT
- (j) Open this circuit breaker on the P11 panel:
  - 1) 11E30, FMCS CMPTR RIGHT
- (k) Make sure the message FMC is shown on the right CDU in less than 40 seconds.
- (l) Push the right FMC source select switch on the P3 panel.
- (m) Make sure the right FMC Source Select FMC switch is in the ALTN position.
- (n) Make sure the right CDU shows the IDENT page.
- (o) Make sure the EICAS message R-FMC FAIL is shown.
- (p) Push the right FMC source select switch on the P3 panel.
- (q) Close this circuit breaker on the P11 panel.
  - 1) 11E30, FMCS CMPTR RIGHT
- (r) Push the CLEAR button on the two CDUs until there are no longer messages on the bottom line of the CDUs.

S 865-089

(3) AIRPLANES WITH FMC-CDU NAV SOURCE SELECT SWITCH;
Do a test of the FMC - CDU NAV Source Select Switch
- (a) Set the left FMC NAV Source Select switch on the P1 panel to the FMC-L position and the right FMC NAV Source Select switch on the P3 panel to the FMC-R position.

(b) Open this circuit breaker on the P11 panel:
  1) 11E9, FMCS CMPTR LEFT
(c) Make sure the left CDU display is off momentarily and then comes back on.
(d) Make sure the FAIL light on the left CDU is on.
(e) Make sure the MAP flag shows on the captain's EHSI.
(f) Turn the left FMC NAV source select switch to the FMC-R position.
(g) Make sure the FAIL light on the left CDU is off.
(h) Make sure the MAP flag does not show on the captain's EHSI.
(i) Push the LSK adjacent to the "<FMC" prompt on the left CDU display.
(j) Make sure the left CDU display goes back to the display that was shown before the circuit breaker was opened.
(k) Make sure the top EICAS display shows the message L-FMC FAIL.
(l) Push the INT REF key on the left CDU.
(m) Make sure the POS INIT or the PERF INIT page shows on the left CDU.
(n) Turn the left FMC NAV source select switch to the FMC-L position.
(o) Close this circuit breaker on the P11 panel:
  1) 11E9, FMCS CMPTR LEFT
(p) Open this circuit breaker on the P11 panel:
  1) 11E30, FMCS CMPTR RIGHT
(q) Make sure the right CDU display is off momentarily and then comes back on.
(r) Make sure the FAIL light on the right CDU is on.
(s) Make sure the MAP flag shows on the F/O's EHSI.
(t) Turn the right FMC NAV source select switch to the FMC-L position.
(u) Make sure the FAIL light on the right CDU is off.
(v) Make sure the MAP flag does not show on the F/O's EHSI.
(w) Push the LSK adjacent to the "<FMC" prompt on the right CDU display.
(x) Make sure the right CDU display goes back to the display that was shown before the circuit breaker was opened.
(y) Push the INT REF key on the right CDU.
(z) Make sure the POS INIT or the PERF INIT page shows on the right CDU.
(aa) Make sure the top EICAS display shows the message R-FMC FAIL.
(ab) Turn the right FMC NAV source select switch to the FMC-R position.
(ac) Open these circuit breakers on the P11 panel.
  1) 11E9, FMCS CMPTR L
  2) 11E30, FMCS CMPTR R
(ad) Make sure the FAIL Lights on the two CDUs are on.
(ae) Make sure the MAP flags show on the captain's and F/O's EHSIs.
(af) Set the left FMC NAV source select switch to the CDU-L position.
(ag) Make sure the MAP flag does not show on the captain's EHSI.

(ah) Set the right FMC NAV source select switch to the CDU-R position.
(ai) Make sure the MAP flag does not show on the F/O's EHSI.
(aj) Set the left FMC NAV source select switch to the FMC-L position.
(ak) Close this circuit breaker on the P11 panel:
(al) 11E9, FMCS CMPTR L
(am) Make sure the MENU page shows on the left CDU.
(an) Make sure the FAIL light on the left CDU is off.
(ao) Set the right FMC NAV source select switch to the FMC-R position.
(ap) Close this circuit breaker on the P11 panel.
    1) 11E30, FMCS CMPTR R
(aq) Make sure the MENU page shows on the right CDU.
(ar) Make sure the FAIL light on the right CDU is off.
(as) Open this circuit breaker on the P11 panel.
    1) 11E30, FMCS CMPTR R
    2) 11F33, FMS SW R
(at) Push the left and right EFI source select switches on the P1-1 and P3-3 panels to the ALTN position.
(au) Make sure the INSTR SWITCH message shows on the EICAS display.
(av) Push the left and right EFI souce select switches on the P1-1 and P3-3 panels to the normal position.
(aw) Set the left FMC NAV source select switch to the CDU-L position.
(ax) Make sure the INSTR SWITCH message does not show on the EICAS display.
(ay) Set the right FMC NAV source select switch to the FMC-L position.
(az) Make sure the INSTR SWITCH does not show on the EICAS display.
(ba) Set the left FMC NAV source select switch to the FMC-L position.
(bb) Set the right FMC NAV source select switch to the FMC-R position.
(bc) Close these circuit breakers on the P11 panel.
    1) 11F30, FMCS CMPTR R
    2) 11F33, FMS SW R
(bd) Push the CLEAR key on the two CDUs until there are no longer messages on the bottom line of the CDUs.

S 735-033

(4) Do a test of the FMC discretes input

<u>NOTE</u>: This test uses two people, one in the flight compartment and one in the main equipment center.

(a) Energize and align the Inertial Reference Units in the NAV mode (AMM 34-21-00/501).

(b) Close these circuit breakers on the P11 panel:
  1) 11A14, AIR COND PACK LEFT FLOW CONT
  2) 11A29, AIR COND PACK RIGHT FLOW CONT
  3) 11B2, ISOL VALVE CONT
  4) 11C16, FLAP/SLAT ELEC UNIT 2 SENSOR
  5) 11G14, FLAP/SLAT ELEC UNIT 1 SENSOR
  6) 11G23, FLAP/SLAT ELEC UNIT 3 SENSOR
  7) 11L5, LEFT ENGINE ELECTRONIC ENGINE CONTROL SUPV
  8) 11L32, RIGHT ENGINE ELECTRONIC ENGINE CONTROL SUPV
  9) 11M13, LEFT PACK FLOW CONT
  10) 11M22, RIGHT PACK FLOW CONT
  11) 11Q10, L ENG BLEED

(c) Make sure the switches below are in the positions shown:

SWITCH NAME	POSITION	LOCATION
PACK L, R	OFF	Overhead Panel P5
ANTI ICE ENGINE/WING	OFF	Overhead Panel P5
ISOL VLV	OPEN	Overhead Panel P5
REV THRUST LEVERS	NOT ACTIVATED	Quadrant Stand P10

(d) Do these steps to get to the FMC ANALOG DISCR page on the two CDUs.
  1) Push the mode key, INIT REF.
    a) Make sure the CDU display shows the POS INIT or the PERF INIT page.
  2) Push LSK adjacent to the INDEX prompt on the CDU.
    a) Make sure the CDU display shows the INIT REF INDEX page.

    - 3) Push LSK adjacent to the MAINT prompt on the CDU.
        - a) Make sure the CDU display shows the MAINTENANCE INDEX page.
    - 4) Push LSK adjacent to the DISC (discretes) prompt on the CDU.
        - a) Make sure the CDU display shows the FMC ANALOG DISCR page.
- (e) Open the P50 panel door located in the E/E bay.
    - 1) Push and hold the L and R ECS BLEED CARDS switches to the HI position.
    - 2) Make sure the CDU display shows the following:
        - a) Make sure the ECS PACK shows ON.
        - b) Make sure the ECS PACK H/L shows HI.
        - c) Make sure the COWL A/I discrete shows ON.
        - d) Make sure the ISOLATION VALVE LEFT discrete shows OP.
        - e) Make sure the SHUTOFF VALVE discrete shows OP.
        - f) Make sure the WING A/ICE discrete shows ON.
        - g) GUI 001-002, 004-115 PRE-SB 34-301;
- (f) Push the switch on the L and R ECS BLEED cards to the LO position.
    - 1) Make sure the CDU display shows the following:
        - a) Make sure the ECS PACK discrete shows OFF.
        - b) Make sure the ECS PACK H/L discrete shows LO.
        - c) GUI 001-002, 004-115 PRE-SB 34-301;
          Make sure the WING A/ICE discrete shows OFF.
        - d) Make sure the COWL A/I discrete shows OFF.
        - e) Make sure the ISOLATION VALVE LEFT discrete shows CL.
        - f) Make sure the SHUTOFF VALVE discrete shows CL.
- (g) Turn the L EFIS mode select switch to the MAP position.
    - 1) Make sure the AUTO/MAN VOR (LEFT) discrete shows AUTO.
    - 2) Make sure the AUTO/MAN DME (LEFT) discrete shows AUTO.
- (h) Turn the L EFIS mode select switch to the ILS position.
    - 1) Make sure the AUTO/MAN VOR (LEFT) shows MAN.
    - 2) Make sure the AUTO/MAN DME (LEFT) discrete shows MAN.
- (i) Turn the L EFIS mode select switch to the VOR position.
    - 1) Make sure the AUTO/MAN VOR (LEFT) discrete shows MAN.
    - 2) Make sure the AUTO/MAN DME (LEFT) discrete shows MAN.
- (j) Turn the R EFIS mode select switch to the MAP position.
    - 1) Make sure the AUTO/MAN VOR discrete shows AUTO.
    - 2) Make sure the AUTO/MAN DME discrete shows AUTO.
- (k) Turn the R EFIS mode select switch to the ILS position.
    - 1) Make sure the AUTO/MAN VOR discrete shows MAN.
    - 2) Make sure the AUTO/MAN DME discrete shows MAN.

(l) Turn the R EFIS mode select switch to the VOR position.
  1) Make sure the AUTO/MAN VOR discrete shows MAN.
  2) Make sure the AUTO/MAN DME discrete shows MAN.
(m) GUI 003 POST-SB 34-301;
  Do these steps to do a check of the WING A/ICE discrete on the FMC ANALOG DICS 2/3 page.
  1) Push the NEXT PAGE key on the CDU to get to the FMC ANALOG DISCR 2/3 page.
  2) Push and hold the L and R ECS BLEED switch to the HI position.
    a) Make sure the WING A/ICE discrete shows ON.
  3) Push the L and R ECS BLEED switch to the LO position.
    a) Make sure the WING A/ICE discrete shows OFF.
(n) Make sure the OLEO SWITCH shows GND on the L and R CDU.

<u>WARNING</u>: PREPARE THE SAFETY-SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

(o) Prepare the safety-sensitive systems for air mode simulation (AMM 32-09-02/201).
(p) Open this circuit breaker on the P11 panel.
  1) 11S15, AIR/GND SYS 1
(q) Make sure the OLEO SWITCH shows AIR on the L CDU.
(r) Open this circuit breaker on the P11 panel:
  1) 11S19, AIR/GND SYS 2
(s) Make sure the OLEO SWITCH shows AIR on the R CDU.

<u>WARNING</u>: DO THE DEACTIVATION PROCEDURE FOR THE SPOILERS OR MOVE ALL PERSONS AND EQUIPMENT AWAY FROM THE SPOILERS. THE SPOILERS CAN RETRACT QUICKLY AND CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

(t) Do the deactivation procedure for the spoilers (AMM 27-61-00/201) or move all persons and equipment away from the spoilers.
(u) Close this circuit breaker on the P11 panel:
  1) 11S15, AIR/GND SYS 1
(v) Make sure OLEO SWITCH shows GND on the L CDU.
(w) Close this circuit breaker on the P11 panel:
  1) 11S19, AIR/GND SYS 2
(x) Make sure the OLEO SWITCH shows GND on the R CDU.
(y) Put the safety-sensitive systems back to their initial conditions (AMM 32-09-02/201).
(z) Set the HDG REF switch on P3-1 panel to NORM.
(aa) Make sure that MAG/TRUE is set to MAG.
(ab) Set the HDG REF switch to TRUE.
(ac) Make sure that MAG/TRUE is now set to TRUE.
(ad) Set the HDG REF switch to NORM.

Do these steps to do a check of the ATC/TCAS status.

1) Make sure the ATC/TCAS mode select switch on the ATC/TCAS control panel does not set to the TA or TA/RA position.
2) Make sure the TCAS STATUS shows NORM on the CDUs.
3) Make sure the TCAS MODE shows STNDBY on the CDUs.
4) Open this circuit breaker on the P11 panel:
    a) 11F3, TCAS
5) Make sure the TCAS STATUS shows FAIL on the CDUs.
6) Make sure the TCAS MODE shows STNDBY on the CDUs.
7) Close this circuit breaker on the P11 panel:
    a) 11F3, TCAS
8) Set the ATC/TCAS mode select switch on the ATC/TCAS control panel to the TA or TA/RA position.
9) Make sure the TCAS STATUS shows NORM on the CDUs.
10) Make sure the TCAS MODE shows ENABLE on the CDUs.

(ae) Make sure the MCDU/CDU shows MCDU on the CDUs.
(af) Make sure the PERF CODE shows 1111 on the CDUs.
(ag) Push the NEXT PAGE key on the CDU to get the FMC ANALOG DISC 3/3 page.
(ah) Make sure the AIRCRAFT/SIMULATOR shows AIR on the CDUs.
(ai) Make sure the LOADER ENABLE shows DISABLE on the CDUs.
(aj) Make sure the NAV DATA UPDATE shows ENABLE on the CDUs.

S 735-015

(5) Do a test of the FMC - EICAS message Test.

<u>NOTE</u>: This test uses two people, one in the flight compartment and one in the main equipment center. For non-PIP and non-GPS airplanes, in a normal operation, "L GPS" Advisory Message is momentarily displayed when the self-test is initiated from the front panel of the Left (or Right) FMC, you should ignore the "L GPS" Advisory Message.

(a) Open this circuit breaker on the P11 panel:
    1) 11E30, FMCS CMPTR RIGHT
(b) Push the CLR key on the left CDU to clear all the messages on the left CDU.
(c) Push the TEST button on the front of the left FMC.
(d) Make sure the EICAS message FMC MESSAGE is shown and the yellow FMC warning light on the P1-3 panel is on.
(e) Close this circuit breaker on the P11 panel:
    1) 11E30, FMCS CMPTR RIGHT
(f) Open this circuit breaker on the P11 panel:
    1) 11E9, FMCS CMPTR LEFT
(g) Push the CLR key on the right CDU to clear all the messages on the right CDU.
(h) Push the TEST button on the front of the right FMC.
(i) Make sure the EICAS message FMC MESSAGE is shown and the yellow FMC warning light on the P1-3 panel is on.
(j) Close this circuit breaker on the P11 panel:
    1) 11E9, FMCS CMPTR LEFT

S 735-118

(6) GUI 115 POST-SB 34-414;
Do a test of the FMC - IRS Initialization Interface.
- (a) Open these circuit breakers on the P11 panel:
  - 1) 11E9, FMCS CMPTR L
  - 2) 11E30, FMCS CMPTR R
- (b) Make sure the MENU page shows on the two CDUs.
- (c) Make sure the FAIL light on the two CDUs is on.
- (d) Push the PROG key on the two CDUs.
- (e) Make sure the IRS PROGRESS page shows on the two CDUs.
- (f) Make sure the IRS position data shows below the IRS L heading on the left CDU.
- (g) Make sure the IRS position data shows below the IRS R heading on the right CDU.
- (h) Close these circuit breakers on the P11 panel:
  - 1) 11E9, FMCS CMPTR L
  - 2) 11E30, FMCS CMPTR R

S 735-078

(7) Do a test of the FMC - IRS Initialization Interface.
- (a) Make sure the two CDUs show the POS INIT page.
- (b) Use the left CDU keyboard to put in the geographic position of the airplane in the form NXXXX.XWXXXXX.X. Data that was put in will appear on the scratchpad of the CDU.

  NOTE: The geographic position that was put in must include the zeros in the front and decimal point between minutes and tenths of minutes.

- (c) Push the LSK adjacent to the SET IRS POS on the CDU.
- (d) If the message ENTER IRS POSITION shows on the bottom line of the CDU, the IRS position must be put in again.
- (e) If the message ENTER IRS POSITION does not show on the scratch pad of the CDU, do these steps:
  - 1) Push the NEXT PAGE key on the CDU.

Make sure the CDU shows as follows:

```
     POS REF        2/2
 FMC POS             GS
NXX°XX.X WXXX°XX.X   XKT
 IRS L
NXX°XX.X WXXX°XX.X   XKT
 IRS C
NXX°XX.X WXXX°XX.X   XKT
 IRS R
NXX°XX.X WXXX°XX.X   XKT


------------------------
<INDEX            ROUTE>
```

2) Make sure the positions for IRS L, IRS C, and IRS R are the same on the CDU.

S 735-017

(8) Do a test of the Input Sensor Status

(a) Make sure the IRUs are aligned and in the NAV mode (AMM 34-21-00/201).

(b) Push this sequence of Line Select Keys (LSK) on the CDUs to get to the FMC SENSOR STATUS page.

1) Push the mode key, INIT REF.

a) Make sure the CDU displays show the POS INIT or the PERF INIT page.

2) Push the LSK adjacent to the INDEX prompt on the CDUs.

a) Make sure the CDU displays show the INIT REF INDEX page.

3) Push the LSK adjacent to the MAINT prompt on the CDUs.

a) Make sure the CDU displays show the MAINTENANCE INDEX page.

4) Push the LSK adjacent to the SENSORS prompt on the CDU.
   - a) Make sure the left CDU displays show the L FMC SENSOR STATUS page.
   - b) Make sure the right CDU display shows the R FMC SENSOR STATUS page.

(c) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 002, 004-114, 115-999;
Make sure the left CDU display shows the sensor status as follows:

NOTE: Unit status will be shown in one of these conditions:

OK = connected and correctly operates.

TEST = connected but in self test mode.

FAIL = not connected, or not powered, or will not operate.

--- = interface is not in the airplane.

```
REF  SENSOR  STATUS 1/2
 LRU    LEFT  CTR  RIGHT
VOR       OK   ---     OK
DME       OK   ---     OK
ILS       OK   ---     ---
ADC       OK   ---     OK
IRS       OK    OK     OK
FCC/MCP   OK   ---     ---
TMC       OK   ---     ---
FUEL FLO  OK   ---     OK
FUEL QTY  OK   ---     ---
CLOCK     OK   ---     ---
<INDEX
```

(d) GUI 003 POST-SB 34-301;
Make sure the left CDU display shows the sensor status as follows:

NOTE: Unit status will be shown in one of these conditions:

OK = connected and correctly operates.

TEST = connected but in self test mode.

FAIL = not connected, or not powered, or will not operate.

--- = interface is not in the airplane.

```
L FMC  SENSOR  STATUS 1/2
 LRU    LEFT  CTR  RIGHT
VOR      OK   ---     OK
DME      OK   ---     OK
ILS      OK   ---    ---
ADC      OK   ---     OK
IRS      OK    OK     OK
FCC/MCP  OK   ---    ---
TMC      OK   ---    ---
EICAS    OK   ---     OK
FUEL QTY OK   ---    ---
CLOCK    OK   ---    ---
<INDEX
```

(e) GUI 001, 115 POST-SB 34-379;
Make sure the left CDU display shows the sensor status as follows:

NOTE: Unit status will be shown in one of these conditions:

OK = connected and correctly operates.

TEST = connected but in self test mode.

```
L FMC  SENSOR  STATUS 1/2
 LRU    LEFT  CTR  RIGHT
VOR      OK   ---     OK
DME      OK   ---     OK
ILS      OK   ---     ---
ADC      OK   ---     OK
IRS      OK    OK     OK
FCC/MCP  OK   ---     ---
TMC      OK   ---     ---
EICAS    OK   ---     ---
FUEL QTY OK   ---     ---
CLOCK    OK   ---     ---
<INDEX
```

(f) Push the NEXT PAGE key on the left CDU.

(g) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 001, 002, 004-114, 116-999;
Make sure the left CDU shows the sensor status as follows:

```
REF  SENSOR  STATUS 2/2
 LRU    LEFT  CTR  RIGHT
EFIS/CP  OK   ---    ---
FMC      OK   ---     OK
FMC/CDU  OK   ---     OK
I-BUS    OK   ---     OK


<INDEX
```

(h) GUI 003 POST-SB 34-301;
GUI 001, 115 POST-SB 34-379;
Make sure the left CDU shows the sensor status as follows:

```
L FMC  SENSOR  STATUS 2/2
 LRU    LEFT  CTR  RIGHT
EFIS/CP  OK   ---     OK
FMC      OK   ---     OK
FMC/CDU  OK   ---     OK
I-BUS    OK   ---     OK
ACARS    OK   ---    ---
GPS      OK   ---     OK
PRINTER  OK   ---    ---


<INDEX
```

(i) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 002, 004-114, 116-999;

Make sure the right CDU shows the sensor status as follows:

```
REF  SENSOR  STATUS 1/2
 LRU    LEFT  CTR  RIGHT
VOR      OK   ---     OK
DME      OK   ---     OK
ILS     ---   ---     OK
ADC      OK   ---     OK
IRS      OK    OK     OK
FCC/MCP ---   ---     OK
TMC      OK   ---    ---
FUEL FLO OK   ---     OK
FUEL QTY OK   ---    ---
CLOCK   ---   ---     OK
<INDEX
```

(j) GUI 003 POST-SB 34-301;
GUI 001, 115 POST-SB 34-379;
Make sure the right CDU shows the sensor status as follows:

```
R FMC  SENSOR  STATUS 1/2
 LRU    LEFT  CTR  RIGHT
VOR      OK   ---     OK
DME      OK   ---     OK
ILS     ---   ---     OK
ADC      OK   ---     OK
IRS      OK    OK     OK
FCC/MCP ---   ---     OK
TMC      OK   ---    ---
EICAS    OK   ---     OK
FUEL QTY OK   ---    ---
CLOCK   ---   ---     OK
<INDEX
```

(k) Push the NEXT PAGE key on the right CDU.

(l) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 002, 004-114, 116-999;
Make sure the right CDU shows the sensor status as follows:

```
REF  SENSOR  STATUS 2/2
 LRU    LEFT  CTR  RIGHT
EFIS/CP ---   ---     OK
FMC      OK   ---     OK
FMC/CDU  OK   ---     OK
I-BUS    OK   ---     OK


<INDEX
```

(m) Open this circuit breaker on the P11 panel.
  1) 11E9, FMCS CMPTR LEFT

(n) GUI 003 POST-SB 34-301;
GUI 001, 115 POST-SB 34-379;
Make sure the right CDU shows the sensor status as follows:

```
R FMC  SENSOR  STATUS 2/2
 LRU    LEFT  CTR  RIGHT
EFIS/CP  OK   ---     OK
FMC      FAIL ---     OK
FMC/CDU  OK   ---     OK
I-BUS    FAIL ---     OK
ACARS    ---  ---     OK
GPS      OK   ---     OK
PRINTER  OK  ---


<INDEX
```

<u>NOTE</u>: Displays for right and left CDUs are different since some sensors are connected to only one FMC.

S 735-018

(9) Do a test of the FMC - VOR/DME Interface
  (a) Set the left and right EFIS control panels to MAP.

(b) Set the left and right VOR control panels to AUTO.
(c) Set the left and right FMC source select switches on the P1 and the P3 panels to the normal position.
(d) Select the R FMC SENSOR STATUS page on the right CDU.
(e) Push the test button on the front of the left FMC and make sure the SENSOR STATUS page on the right CDU shows the left and right DME status as "FAIL", then "TEST", then "OK".

<u>NOTE</u>: Depending on the type of radio receiver used, the display "FAIL" may not appear.

(f) Set the FMC source select switches on panels P1 and P3 to the ALTN position.
(g) Push the test button on the front of the right FMC and make sure the SENSOR STATUS page on the right CDU shows the left and right DME status as "FAIL", then "TEST", then "OK".

<u>NOTE</u>: Depending on the type of radio receiver used, the display "FAIL" may not appear.

(h) Set the left and right FMC source select switches on the P1 and on the P3 panels to the normal position.
(i) Open this circuit breaker on the P11 panel:
 1) 11E30, FMCS CMPTR RIGHT
(j) Set the right FMC source select switch on the P3 panel to the ALTN position.
(k) Push the PROG or NAV RAD mode key on the left CDU.
(l) Push and hold the CLR key on left CDU for 5 seconds.
(m) Use left CDU keyboard to put in the three letter code of a local VOR station.
(n) Push the LSK adjacent to the data line below the VOR/DME heading.
(o) Make sure the VOR station code and frequency are shown below the VOR/DME heading.
(p) Make sure the left VOR control panel shows the same frequency shown on the left CDU.
(q) Use left CDU keyboard to put in a different three letter code of a local VOR station.

(r) Push the LSK adjacent to the data line below the VOR/DME heading.
(s) Make sure the VOR station code and frequency are shown below the VOR/DME heading.
(t) Make sure the right VOR control panel shows the same frequency shown on the left CDU.
(u) Open this circuit breaker on the P11 panel:
  1) 11E9, FMCS CMPTR LEFT
(v) Close this circuit breaker on the P11 panel:
  1) 11E30, FMCS CMPTR RIGHT
(w) Set the right FMC source select switch to the NORM position.
(x) Set the left FMC source select switch to the ALTN position.
(y) Push the PROG or NAV RAD mode key on the right CDU.
(z) Push and hold the CLR key on right CDU for 5 seconds.
(aa) Use the right CDU keyboard to put in the three letter code of a local VOR station.
(ab) Push the LSK adjacent to the data line below the VOR/DME heading.
(ac) Make sure the VOR station code and frequency are shown below the VOR/DME heading.
(ad) Make sure the left VOR control panel shows the same frequency shown on the right CDU.
(ae) Use the right CDU keyboard to put in a different letter code of a local VOR station.
(af) Push the LSK adjacent to the data line below the VOR/DME heading.
(ag) Make sure the VOR station code and frequency are shown below the VOR/DME heading.
(ah) Make sure the right VOR control panel shows the same frequency shown on the right CDU.
(ai) Set the left FMC Source Select switch to the normal position.
(aj) Open this circuit breaker on the P11 panel for 15 seconds and then close it:
  1) 11E30, FMCS CMPTR RIGHT
(ak) Close this circuit breaker on the P11 panel:
  1) 11E9, FMCS CMPTR LEFT

S 735-019

(10) Do a test of the FMC - EICAS Interface

(a) Push this sequence of keys on the two CDUs:

KEY	NAME	PAGE DISPLAY
INIT REF Mode Key	INIT REF	POS INIT
6L	INDEX	INIT/REF INDEX
3L	PERF	PERF INIT

(b) GUI 001, 115 POST-SB 31-173;
GUI 004, 006-008;
use left CDU keyboard to enter 120.

(c) GUI 001, 115 PRE-SB 31-173;
GUI 002, 003, 005, 007-114, 116-999;
use left CDU keyboard to enter 60.

(d) Push the third LSK from the top on the left side adjacent to ZFW.

(e) On the P61 panel, push the PERF/APU switch on EICAS MAINT panel.

(f) Turn the COMPUTER switch on the EICAS DISPLAY select panel to the L position.

(g) Compare the GROSS WT value at the top right corner of the lower EICAS display and the GROSS WT value on the left CDU. Make sure the values are less than ±0.1 of each other.

(h) GUI 115 POST-SB 31-173;
GUI 004, 006-008;
use right CDU keyboard to enter 130.

(i) GUI 001, 115 PRE-SB 31-173;
GUI 001-003, 005, 007;
GUI 008-114, 116-999;
use right CDU keyboard to enter 55.

(j) Push the third LSK from the top on the left side adjacent to ZFW.

(k) Turn the COMPUTER switch on the EICAS DISPLAY select panel to the R position.

(l) Compare the GROSS WT value at the top right corner on the lower EICAS display and the GROSS WT value on the right CDU. Make sure the values are less than ±0.1 of each other.

C. Put the Airplane Back to Its Usual Condition.

S 865-020

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

FLIGHT MANAGEMENT COMPUTER - MAINTENANCE PRACTICES

1. General
   A. This procedure has one task and is applicable to only pegasus FMC. This task is to do the download of the BITE history data from the Flight Management Computer (FMC) to a Data Loader. The BITE history data is a record of recent FMC fault that gives sufficient data to find the cause of the fault. To support such an investigation, it is necessary to get the BITE data from the left and right FMC.
   B. The newer versions of the software have the capability to dump BITE history from the L FMC and R FMC at the same time to a single diskette, by connecting to only one of the FMC (either one). You should make sure both FMC's are powered on. You should make sure that the correct dumping BITE software for pegasus 2000 and on is used. The dumping BITE software for pegasus 97 or pegasus 98 will not work for pegasus 2000 and on.
   C. After the download is complete the diskette(s) contain(s) "lbitehist.dmp" and "rbitehist.dmp" files.
   D. After you get the BITE data, send the diskette(s) to Honeywell for Boeing/Honeywell investigation:

      Honeywell Inc.
      Air Transport Systems
      P. O. Box 21111
      Phoenix, AZ 85036-1111

      ATTENTION:
      Customer Support Engineering
      B757/767 FMC BITE Information
      M/S: K25C5

TASK 34-61-01-972-001

2. FMC BITE History Data Download
   A. Equipment
      (1) A formatted 3-1/2 inch high density floppy diskette which contains the applicable BITE dump software.

          NOTE: You can get a copy of this diskette from your local Honeywell Customer Support Representative or Customer Engineering at Honeywell Commercial Flight Systems Group in Phoenix, AZ.

      (2) Database Loader, Sundstrand 964-0400-010 or equivalent
          Sundstrand Aviation Division
          PO Box 7002
          4747 Harrison Ave.
          Rockford, IL 61101

B. References
  (1) 24-22-00/201, Electrical Power - Control

C. Access
  (1) Location Zones
    211/212 Flight Compartment

D. Procedure

S 862-002
(1) Supply electrical power (AMM 24-22-00/201).

S 862-003
(2) Make sure these circuit breakers on the overhead panel, P11, are closed:
  (a) 11E8, FMCS CDU LEFT
  (b) 11E9, FMCS CMPTR LEFT
  (c) 11E29, FMCS CDU RIGHT
  (d) 11E30, FMCS CMPTR RIGHT

S 862-028
(3) Make sure that the FMC SOURCE SELECT switch on the P1-1 and the P3-3 panels are in the NORMAL onside FMC condition.

S 862-006
(4) Do these steps to connect the interface cable from the Portable Data Loader (PDL) to the airplane.
  (a) Open this circuit breaker on the P37 panel:
    1) 37E8, FMC DATABASE LOADER

<u>CAUTION</u>: MAKE SURE THE POWER ON/OFF SWITCH ON THE PDL IS IN THE OFF POSITION BEFORE YOU CONNECT THE INTERFACE CABLE. THIS WILL PREVENT DAMAGE TO THE FMC AND THE PDL.

  (b) Make sure the power ON/OFF switch on the PDL is in the OFF position.
  (c) Connect the interface cable from the PDL to the FMC Database Loader connector D917 on the P17 panel.
  (d) Close this circuit breaker on the P37 panel:
    1) 37E8, FMC DATABASE LOADER
  (e) Set the power ON/OFF switch on the PDL to the ON position.

S 972-011
(5) Put the diskette into the data loader to download the data from the FMC.

NOTE: If there is a diskette in the data loader, push the eject key and then put the diskette back into the data loader.

S 862-012

(6) Make sure the RDY light on the data loader comes on.

S 972-013

(7) After approximately 15 seconds, make sure the PROG and RDY lights on the data loader come on.

S 972-014

(8) Do these steps if the PROG light does not come on:
  (a) Make sure the data loader selector switch is set to the correct FMC position.
  (b) Make sure you use a 3-1/2 inch high density diskette and it is formatted with the correct configuration file.
  (c) Make sure the diskette is not write protected.
  (d) Make sure the diskette is not full.

  NOTE: The blank MENU page will show on the CDU during the data download. You can not get access to other pages when a download is in progress.

S 972-015

(9) After approximately 4 minutes , the COMP light on the data loader comes on indicates that the download is complete.

S 862-016

(10) Remove the diskette from the data loader.

NOTE: For the airplanes with a single FMC Database Loader connector on the P17 panel, you need to move the right FMC to the left FMC location before you can download the BITE data (AMM 34-61-01/401).

S 862-021

(11) Do these steps to remove the PDL interface cable from the airplane.
  (a) Open this circuit breaker on the P37 panel:
    1) 37E8, FMC DATABASE LOADER
  (b) Set the power ON/OFF switch on the PDL to the OFF position.
  (c) Remove the interface cable from the FMC Database Loader connector D917 on the P17 panel.

E. Put the Airplane Back to Its Usual Condition

S 862-022

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

FLIGHT MANAGEMENT COMPUTER - REMOVAL/INSTALLATION

1. General
   - A. This procedure has these tasks:
     - (1) A removal of the Flight Management Computer (FMC)
     - (2) An installation of the FMC.
   - B. Two flight management computers (FMC) are installed in the main equipment center. They are on the second and third shelves of the E-2 rack. The Removal/Installation steps are the same for each FMC.

TASK 34-61-01-024-001

2. Remove the Flight Management Computer
   - A. References
     - (1) AMM 20-10-01/401, E/E Rack Mounted Components
     - (2) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
     - (3) AMM 24-22-00/201, Electrical Power - Control
   - B. Access
     - (1) Location Zones

119	Main Equipment Center
211/212	Flight Compartment

     - (2) Access Panels

119AL	Main Equipment Center

   - C. Prepare To Remove Flight Management Computer

S 864-002

(1) Open these circuit breakers on the overhead panel P11 and attach DO-NOT-CLOSE tags:
   - (a) 11E8, FMCS CDU LEFT
   - (b) 11E9, FMCS CMPTR LEFT
   - (c) 11E29, FMCS CDU RIGHT
   - (d) 11E30, FMCS CMPTR RIGHT

S 864-011

CAUTION: DO NOT TOUCH THE FMC BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE FMC.

(2) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 024-004

(3) Remove the FMC (AMM 20-10-01/401).

TASK 34-61-01-424-005

3. Install the Flight Management Computer

A. General

(1) The ground state is normally registered in the FMC when it removed from the airplane. The FMC will not operate if energized when the Air/Ground relays are set in the air mode position.

(2) If this type of failure occurs, put the Air/Ground relays in the ground position. Remove electrical power from the FMCs for a minimum of 10 seconds and then supply the electrical power to the FMCs.

B. References

(1) AMM 20-10-01/401, E/E Rack Mounted Components
(2) AMM 20-41-01/201, Electrostatic Discharge Sensitive Devices
(3) AMM 24-22-00/201, Electrical Power - Control
(4) AMM 32-09-02/201, Air/Ground Relays
(5) AMM 34-61-00/201, Flight Management Computer System

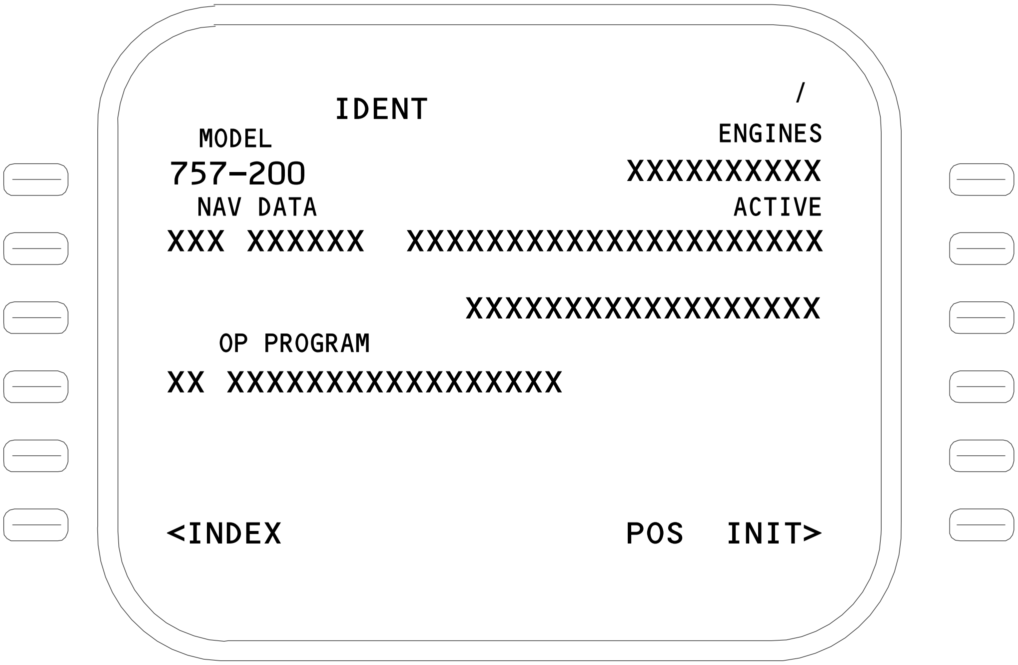
C. Access

(1) Location Zones

119	Main Equipment Center
211/212	Flight Compartment

(2) Access Panels

119AL	Main Equipment Center



FMCS CDU Ident Display
Figure 401

D. Procedure

S 864-012

CAUTION: DO NOT TOUCH THE FMC BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE FMC.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (AMM 20-41-01/201).

S 864-007

(2) Set the Air/Ground relays to the ground position (AMM 32-09-02/201).

S 424-008

(3) Install the Flight Management Computer (AMM 20-10-01/401).

S 714-010

(4) Test Flight Management Computer
  (a) Supply electrical power (AMM 24-22-00/201).
  (b) AIRPLANES WITH FMC-CDU NORMAL/ALT SWITCH;
      Set the FMC Source Select switches on P1 and P3 panels to the normal position.
  (c) AIRPLANES WITH FMC-CDU NAV SOURCE SELECT SWITCH;
      Set the L FMC NAV Source Select switch on the P1 panel to the FMC-L position and the R FMC NAV Source Select switch on the P3 panel to the FMC-R position .
  (d) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
      1) 11E8, FMCS CDU LEFT
      2) 11E29, FMCS CDU RIGHT
  (e) Make sure the FAIL annunciators on the two CDUs are on.
  (f) GUI 003 POST-SB 34-301;
      GUI 001, 115 POST-SB 34-379;
      Do these steps:
      1) Make sure the FMCS CMPTR circuit breaker for the FMC that was not replaced is open.
      2) Close the FMCS CMPTR circuit breaker for the FMC that was replaced.
      3) Make sure the MENU page is shown on the CDU that is on the same side as the FMC that was replaced.

NOTE: If the <FMC prompt does not show on the MENU page, install the operational program (OP PROGRAM) (AMM 34-61-00/201). Make sure the <FMC prompt is shown after you install the OP PROGRAM.

4) Make sure the OP PROGRAM part number on the CDU IDENT page for the FMC that was replaced is correct.
5) If operational program (OP PROGRAM) part number is incorrect, install the operational program (AMM 34-61-00/201).
6) Open the FMCS CMPTR circuit breaker for the FMC that was replaced.
7) Close the FMCS CMPTR circuit breaker for the FMC that was not replaced.
8) Make sure the MENU page is shown on the CDU that is on the same side as the FMC that was not replaced.

NOTE: If the <FMC prompt does not show on the MENU page, install the operational program (OP PROGRAM) (AMM 34-61-00/201). Make sure the <FMC prompt is shown after you install the OP PROGRAM.

9) Make sure the OP PROGRAM part number on the CDU IDENT page for the FMC that was not replaced is correct.
10) If operational program (OP PROGRAM) part number is incorrect, install the operational program (AMM 34-61-00/201).
11) After the FMC that was not replaced is powered up, close the FMCS CMPTR circuit breaker for the FMC that was replaced.
12) Make sure the FAIL annunciators are off.
13) Make sure the NAV database is correct.

NOTE: If the NAV DATA CROSSLOAD page shows on one of the two the CDUs, do the Navigation Database Crossload procedure (AMM 34-61-00/201).

14) Make sure the values for DRAG FACTOR and F-F FACTOR are correct (AMM 34-61-00/201).

(g) GUI 003 PRE-SB 34-301;
GUI 001, 115 PRE-SB 34-379;
GUI 001, 002, 004-114, 116-999;
do these steps:

1) Close the FMCS CMPTR circuit breaker for the FMC that was not replaced.
2) After the FMC that was not replaced is powered up, close the FMCS CMPTR circuit breaker for the FMC that was replaced.

<u>NOTE</u>: If the CDU for the FMC that was replaced shows the NAV DATA CROSSLOAD page, do the Nav Data Crossload procedure (AMM 34-61-00/201).

3) Make sure the FAIL annunciators on the two CDUs are off.
4) Make sure the IDENT page shows on the two CDUs.

<u>NOTE</u>: If the IDENT page does not show, install the operational program (OP PROGRAM) (AMM 34-61-00/201). Make sure the IDENT page is shown after the OP PROGRAM is installed.

5) Make sure the OP PROGRAM part number on the IDENT page of the two CDUs is correct.
6) Make sure the NAV database is correct.
7) Make sure the values for DRAG FACTOR and F-F FACTOR are correct (AMM 34-61-00/201).

E. Put the Airplane Back to Its Usual Condition.

S 864-009

(1) Remove electrical power if it is not necessary (AMM 24-22-00/201).

FLIGHT MANAGEMENT COMPUTER CONTROL DISPLAY UNIT - MAINTENANCE PRACTICES

1. General
   A. Two flight management computer system (FMCS) control display units (CDU) are installed in the forward electronic control panel, P9, on the forward electronics control stand. Each CDU is held in place by six quick release fasteners. Removal/Installation steps are identical for each CDU.
   B. This procedure has these tasks:
      (1) Remove the FMCS Control Display Unit.
      (2) Install the FMCS Control Display Unit.
      (3) Test the FMCS Control Display Unit.
      (4) Clean the CRT of the Control Display Unit.
      (5) Replace the CDU Annunciator Lamp.
      (6) Replace the CDU EXEC Key/Lamp.

TASK 34-61-02-022-001

2. Remove the FMCS Control Display Unit
   A. References
      (1) 20-41-01/201, Electrostatic Sensitive Devices
   B. Access
      (1) Location Zones
         211/212 Flight Compartment

   C. Prepare for Removal

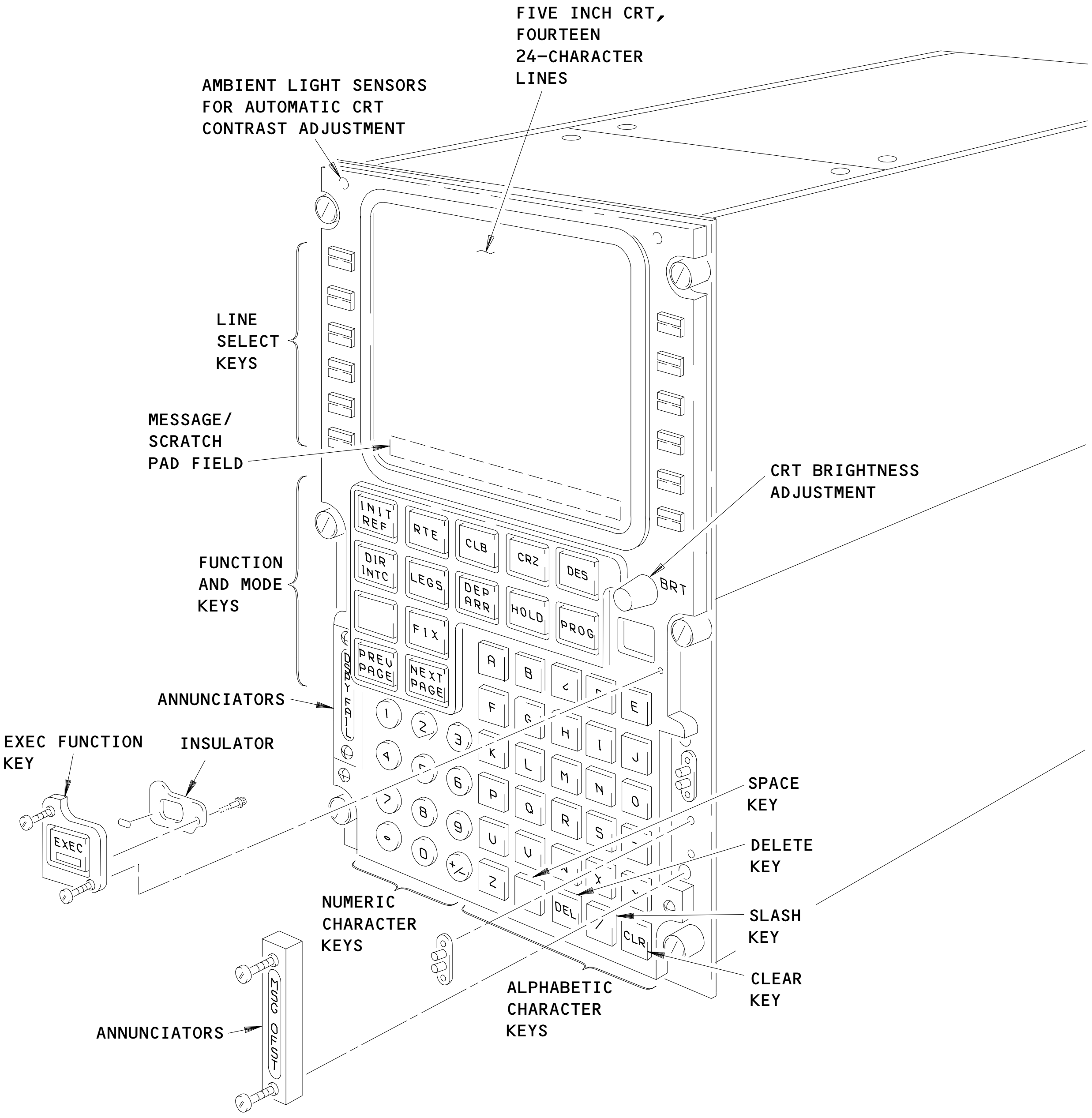
      S 862-051
      (1) Open these circuit breakers on the overhead circuit breaker panel, P11, and attach DO-NOT-CLOSE tags:
         (a) 11E9, FMCS CMPTR LEFT
         (b) 11E8, FMCS CDU LEFT
         (c) 11E30, FMCS CMPTR RIGHT
         (d) 11E29, FMCS CDU RIGHT
         (e) 11N1, INSTRUMENT & PANEL AISLE STAND
   D. CDU Removal

      S 912-003

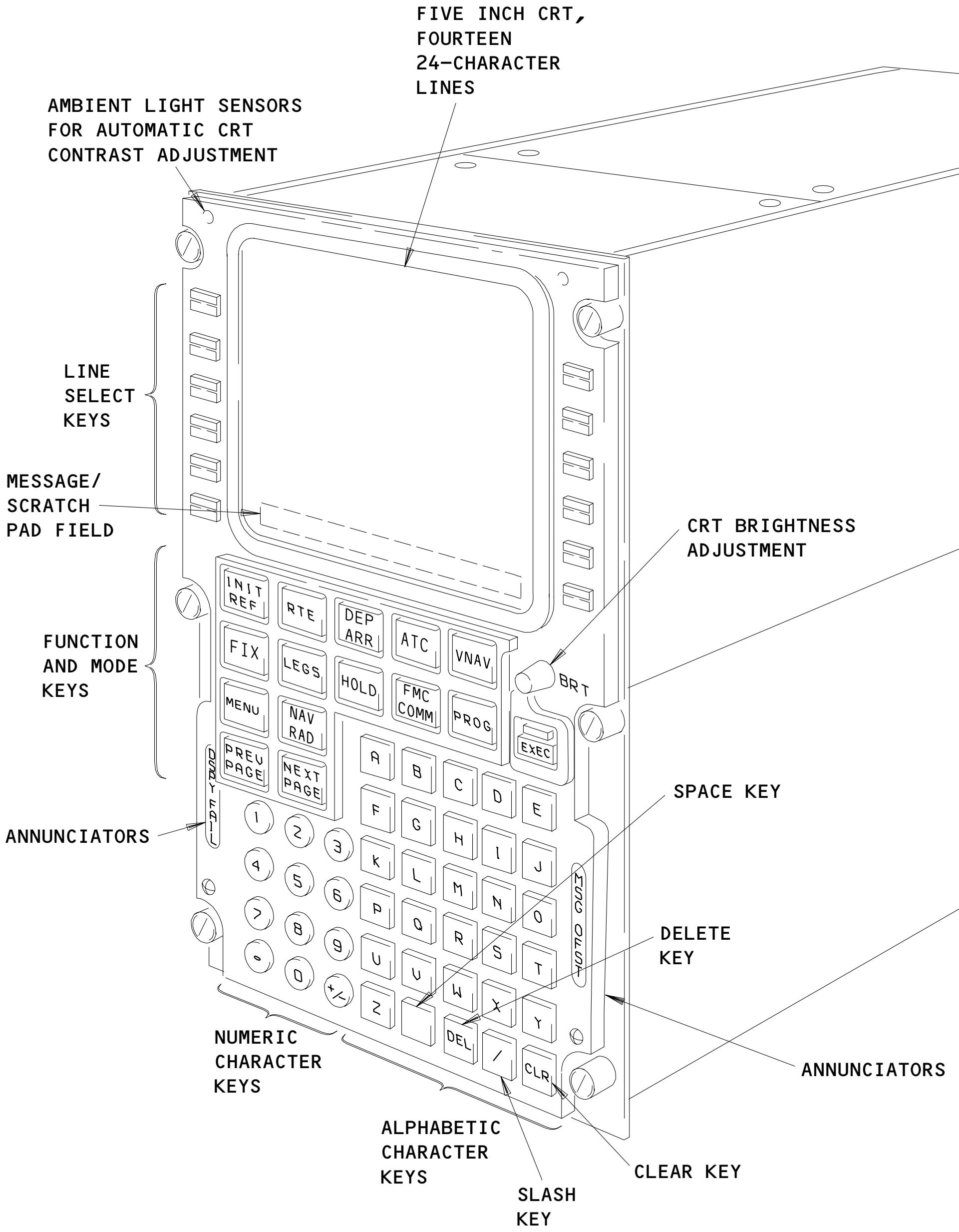
      CAUTION: DO NOT TOUCH THE FMC CDU BEFORE YOU DO THE PROCEDURE FOR ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE FMC CDU.

      (1) Do the procedure for electrostatic discharge sensitive devices (Ref 20-41-01).

      S 032-004
      (2) Loosen the six quick-release fasteners on the front panel of the CDU.



FMCS Control Display Unit
Figure 201 (Sheet 1)



FMCS Control Display Unit
Figure 201 (Sheet 2)

S 032-005
(3) Lift the handle and pull the CDU out of the P9 panel until you can disconnect the cable attached to the rear of the CDU.

S 032-006
(4) Disconnect the cable from the CDU.

S 432-007
(5) Install the dust covers.

S 022-008
(6) Remove the unit from the control stand.

S 162-095
(7) Make sure the inlet screen at the rear of the FMC CDU is clean.

TASK 34-61-02-422-035

3. Install the FMCS Control Display Unit

A. References
  (1) 20-41-01/201, Electrostatic Sensitive Devices

B. Access
  (1) Location Zones
    211/212 Flight Compartment

C. Procedure

S 862-009
(1) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E8, FMCS CDU LEFT
  (c) 11E30, FMCS CMPTR RIGHT
  (d) 11E29, FMCS CDU RIGHT
  (e) 11N1, INSTRUMENT & PANEL AISLE STAND

S 912-010

CAUTION: DO NOT TOUCH THE FMC CDU BEFORE YOU DO THE PROCEDURE FOR ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (AMM 20-41-01/201). ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE FMC CDU.

(2) Do the procedure for electrostatic discharge sensitive devices (Ref 20-41-01).

S 862-011
(3) Make sure the air inlet screen for the CDU is clean. Clean inlet screen if necessary.

S 032-012
(4) Remove dust covers on the rear of the CDU.

S 432-013
(5) Connect cable to rear of CDU.

S 412-014
(6) Carefully lower CDU into the P9 panel.

S 862-052
(7) Push down the CDU handle.

S 432-016
(8) Tighten the six quick-release fasteners.

TASK 34-61-02-712-036

4. Test the FMCS Control Display Unit

A. References
  (1) 24-22-00/201, Electrical Power - Control

B. Access
  (1) Location Zones

211/212	Flight Compartment

C. Prepare for Test

S 862-017
(1) Supply electrical power (Ref 24-22-00).

S 862-018
(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel.
  (a) 11N1, AISLE STAND INSTRUMENT & PANEL

S 862-100
(3) AIRPLANES WITH THE FMC-CDU NORMAL/ALT SWITCH;
Set the FMC Source Select switches on the P1 and P3 panels to the normal position.

S 862-101

(4) AIRPLANES WITH THE FMC-CDU NAV SOURCE SELECT SWITCH;
Set both the FMC NAV Source Select switches on the P1 (P3) panels to the FMC-L (FMC-R) positions.

D. Test the CDU

S 862-025

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   - (a) 11E8, FMCS CDU LEFT
   - (b) 11E29, FMCS CDU RIGHT

S 862-026

(2) Make sure the FAIL indicator shows on the two CDUs.

S 862-027

(3) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
   - (a) 11E9, FMCS CMPTR LEFT
   - (b) 11E30, FMCS CMPTR RIGHT

S 862-028

(4) Make sure the FAIL indicators are not on and the IDENT page shows on the CDU displays.

S 862-029

(5) Push the line select key adjacent to the POS INIT prompt on the replaced CDU.

S 862-030

(6) Make sure the POS INIT page shows on the CDU display.

E. Put the Airplane Back to Its Usual Condition.

S 862-031

(1) Remove electrical power if it is not necessary (Ref 24-22-00).

TASK 34-61-02-162-032

5. Clean the CRT of the Control Display Unit

A. Equipment
  (1) Brush - Soft bristle (commercially available)

B. Consumable Materials
  (1) B50012 Cleaner, Optical Cleaning, Calotherm Solution - Supaspray (use with Supacloth)
  (2) B50013 Cloth, Calocoat Hi-Tech Lenscloth - Supacloth (use with Supaspray)
  (3) G02457 Cleaner, Wet/Dry Anti-static Sachet - ALGLAS Visial ALG/CR 215

C. Access
  (1) Location Zones
    211/212 Flight Compartment

D. Procedure

S 102-103

CAUTION: DO NOT USE ABRASIVE MATERIALS OR SOLVENTS WHEN YOU CLEAN THE DISPLAY SURFACE. ABRASIVE MATERIALS AND SOLVENTS WILL CAUSE DAMAGE TO THE DISPLAY SURFACE.

(1) Remove all particles from the display surface with a clean, soft, natural-bristle brush.

S 102-104

(2) Carefully clean the display surface with the Supaspray and Supacloth or the wet/dry sachets:
  (a) Apply 2 or 3 sprays of the Supaspray to the Supacloth, or open the wet sachet.
  (b) Use the moist cloth or wet sachet to carefully clean the display surface in a straight line from top to bottom.

(c) Gradually move from one side of the display surface to the other side while you clean from top to bottom.
(d) When the display surface is clean, use a clean, dry area of the cloth or the dry sachet in a straight line from top to bottom to carefully dry the display surface.

TASK 34-61-02-902-004

6. <u>Replace the CDU Annunciator Lamp</u> (Fig. 201)

A. General
   (1) The front panel of the CDU contains four annunciators. The DSPY and FAIL annunciators are on the left side of the CDU. The MSG and OFST annunciators are on the right side of the CDU. Each annunciator has two lamps. The lamps are installed on the circuit board assembly.

B. Reference
   (1) 24-22-00/201, Manual Control

C. Access
   (1) Location Zones
      211/212 Flight Compartment

D. Procedure

S 862-005
   (1) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
      (a) 11E9, FMCS CMPTR LEFT
      (b) 11E8, FMCS CDU LEFT
      (c) 11E30, FMCS CMPTR RIGHT
      (d) 11E29, FMCS CDU RIGHT
      (e) 11N1, INSTRUMENT & PANEL AISLE STAND

S 022-011
   (2) Remove the annunciator lamp as follows:
      (a) Loosen the two captive screws that connect the left or right annunciator assembly.
      (b) Remove the annunciator assembly to get to the two annunciator lamps.
      (c) Remove the defective lamp from the terminals on the circuit board.

S 422-006
(3) Install the annunciator lamp as follows:
  (a) Install the annunciator lamp on the terminals on the circuit board.
  (b) Install the annunciator assembly on the keyboard assembly .
  (c) Tighten the two captive screws.

E. CDU Annunciator Lamp Test

S 862-007
(1) Apply electrical power (Ref 24-22-00/201).

S 862-008
(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E8, FMCS CDU LEFT
  (c) 11E30, FMCS CMPTR RIGHT
  (d) 11E29, FMCS CDU RIGHT
  (e) 11N1, INSTRUMENT & PANEL AISLE STAND

S 712-009
(3) Do a test of the CDU annunciator lamps as follows:
  (a) Push and hold the IND LTS switch, on the P5 pilots overhead panel, in the TEST position.
  (b) Make sure the lamps for the CDU annunciators (DSPL, FAIL, MSG and OFST) come on.
  (c) Release the IND LTS switch.
  (d) Make sure that the lamps for the CDU annunciators go off.

S 862-010
(4) Remove the electrical power if it is not necessary (Ref 24-22-00/201).

TASK 34-61-02-342-068

7. <u>Replace the CDU EXEC Key/Lamp</u> (Fig. 201)

A. General
(1) The front panel of the CDU contains an EXEC key. The EXEC key is on the right side of the CDU below the BRT knob.

B. Reference
(1) 24-22-00/201, Manual Control

C. Access
(1) Location Zones
  211/212 Flight Compartment

D. Procedure

S 862-037
(1) Open these circuit breakers on the P11 panel and attach DO-NOT-CLOSE tags:
  (a) 11E9, FMCS CMPTR LEFT
  (b) 11E8, FMCS CDU LEFT

  - (c) 11E30, FMCS CMPTR RIGHT
  - (d) 11E29, FMCS CDU RIGHT
  - (e) 11N1, INSTRUMENT & PANEL AISLE STAND

S 022-038

(2) Remove the EXEC key assembly as follows:
  - (a) Loosen the two captive screws in the EXEC key assembly.
  - (b) Remove the EXEC key assembly from the keyboard assembly.
  - (c) Remove the two screws from the EXEC key assembly.
  - (d) Remove the lamp circuit board from the EXEC key assembly.

S 422-039

(3) Install the EXEC key assembly as follows:
  - (a) Install the lamp circuit board in the EXEC key assembly.
  - (b) Tighten the two screws on the EXEC key assembly.
  - (c) Install the EXEC key assembly on the keyboard assembly .
  - (d) Tighten the two captive screws.

E. EXEC key Lamp Test

S 862-040

(1) Apply electrical power (AMM 24-22-00/201).

S 862-041

(2) Remove the DO-NOT-CLOSE tags and close these circuit breakers on the P11 panel:
  - (a) 11E9, FMCS CMPTR LEFT
  - (b) 11E8, FMCS CDU LEFT
  - (c) 11E30, FMCS CMPTR RIGHT
  - (d) 11E29, FMCS CDU RIGHT
  - (e) 11N1, INSTRUMENT & PANEL AISLE STAND

S 712-042

(3) Do a test of the EXEC key assembly as follows:
  - (a) Press the RTE key on the CDU that has the replaced EXEC key assembly.
  - (b) If the RTE 1 or RTE 2 page is displayed, do these steps:
    - 1) Push the LSK adjacent to the ACTIVATE> prompt.
    - 2) Make sure the EXEC lamp is on.
  - (c) Push the LSK adjacent to the ERASE> prompt.
  - (d) Make sure the EXEC key lamp is off.
  - (e) If the ACT RTE 1 or ACT RTE 2 page is displayed, do these steps:
    - 1) Push the first LSK on the left side of the CDU display to erase the current flight plan.
    - 2) Make sure the EXEC lamp is on.
  - (f) Push the LSK adjacent to the ERASE> prompt.
  - (g) Make sure the EXEC key lamp is off.

S 862-043

(4) Remove the electrical power if it is not necessary (AMM 24-22-00/201).