SECTION 2-18

NAVIGATION AND COMMUNICATION

TABLE OF CONTENTS

NOTE: Optional equipment are marked with an asterisk (*) and its description may not be present in this manual.

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GENERAL

The standard EMB-145 navigation and communication resources are provided by the Radio Management System (RMS). The RMS is controlled through two Radio Management Units (RMU 1 and 2), an auxiliary control unit, the Tuning Backup Control Head (TBCH), and three individual Digital Audio Panels (DAP).

The two RMUs provide radio frequency and mode control. Alternatively, the RMU 2 frequencies may be selected through the TBCH.

The Audio System is controlled via three individual Digital Audio Panels, available for the captain, copilot and observer.

The Radio Management System also provides interface with the Passenger Address System, Aural Warning Unit and Cockpit Voice Recorder.

Optional communication equipment includes an HF transceiver, Third VHF NAV/COM, SELCAL and Aircraft Communication Addressing and Reporting System (ACARS).

The navigation may be performed using only the standard navigation radio sensors, or using the Flight Management System (FMS) resources. The FMS is an optional equipment that uses the standard navigation radio sensors, GPS (Global Positioning System) sensors, and, also optionally, the IRS (Inertial Reference System) for positioning and navigation.

Heading inputs to the Integrated Navigation Unit are provided by the AHRS (Attitude and Heading Reference System) or by the IRS. These equipment also provide roll and pitch attitudes for the Electronic Attitude Director Indicator (EADI).

The navigation information is normally presented on the PFD and MFD and may also be available on the RMU, through its navigation backup page.

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RADIO MANAGEMENT SYSTEM (RMS)

The EMB-145 models are equipped with a Radio Management System (RMS) that provides management of the following equipment and associated functions:

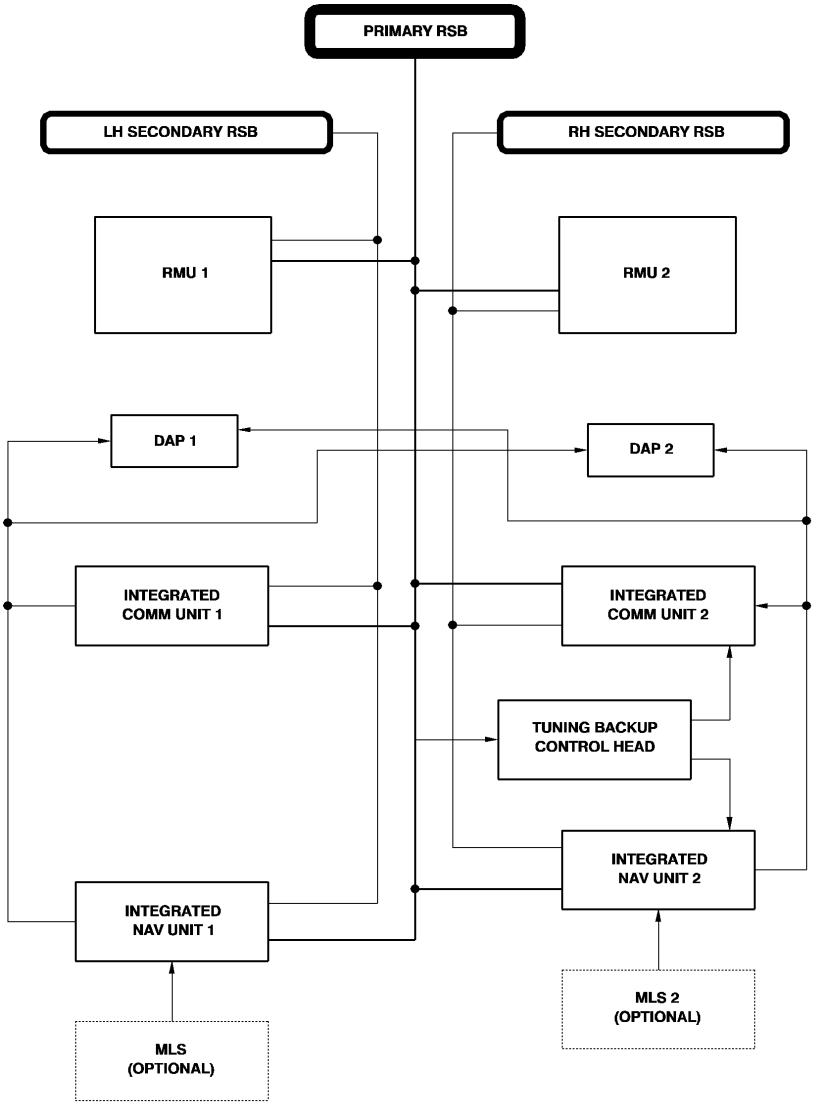
– Dual VHF COM
– Dual VHF NAV (VOR, LOC, GS and Marker Beacon)
– Single or dual (optional) ADF
– Single or dual (optional) Transponder (ATC and Mode S)
– TCAS
– MLS (optional)
– Single or dual (optional) DME (including DME Hold)
– Digital Audio Panel

The RMS consists basically of the following major components:

– Remote mounted:
  – Integrated Navigation Unit (INU)
  – Integrated Communication Unit (ICU)
– Cockpit Mounted:
  – 2 Radio Management Unit (RMU)
  – 1 Tuning Backup Control Head (TBCH)
  – 3 Digital Audio Panel (DAP)

With the exception of the Digital Audio Panel, all components of the RMS are connected through the digital Radio System Buses (RSB) that allows complete control and information exchange between the units of the entire RMS. Audio switching control is provided by means of the controls on the Digital Audio Panel itself. The audio signals are transmitted from the remote units to the Digital Audio Panel through dedicated digital audio buses.

The navigation and communication data are displayed on the RMU, PFD and MFD displays.



RMS SCHEMATIC

AOM-145/1114

INTEGRATED COMMUNICATION UNIT (RCZ-851E)

The Integrated Communication Unit incorporates an internal VHF communication transceiver module and the ATC transponder module which interfaces through a cluster module to the Radio System Bus for operation.

This unit provides digitized audio signals to the Digital Audio Panel and conventional analog audio interfaces to other systems. The following modules may be provided in this unit:

– VHF Communication Transceiver Module (TR-850) - This module is a conventional VHF COM transceiver that operates in the frequency range of 118 to 136.975 MHz.

– Mode S Diversity Transponder Module (XS-852) - This transponder module provides full ATCRBS, Mode S and TCAS data communications capability. The Mode S Transponder module has the encoding and decoding capability required for Mode S operation in addition to the capability to operate as a conventional Air Traffic Control Radio Beacon Service (ATCRBS) transponder. The Mode S operation allows digital addressing of an individual airplane and the transmission of messages back and forth between the air and the ground.

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INTEGRATED NAVIGATION UNIT (RNZ-851)

The Integrated Navigation Unit is a complete self-contained navigation system. The system consists of the VOR, localizer, glide slope and marker beacon receiver modules, the ADF module, a six-channel scanning DME module, and audio digitizers. The system also incorporates two L-Band antenna (optional), two ADF antenna (optional), two MB antenna, two VOR/ILS antenna and one GS dual antenna.

The following modules are provided in this unit:

– VHF NAV Receiver Module (NV-850) - The VHF NAV receiver is a module of the Integrated Navigation Unit and houses the major navigation functions of the VOR/LOC receiver, glide slope receiver and marker beacon receiver.
The ILS meets Category II instrument landing requirements.
Housed within the NAV receiver is a glideslope receiver which provides 40 channels of glideslope information for the conventional ILS. Also includes a 75 MHz marker beacon receiver which detects and transmits the tones of the marker beacons to the Audio System.

– DME Transceiver Module (DM-850) - The DME module is a six-channel DME that simultaneously tracks four selected channels for distance, groundspeed and time to station as well as monitoring two additional channels for the ident functions. This feature gives the system the capability of tracking four channels and having the decoded identifier readily available from two additional channels. The unit dedicates two of the four selected channels to the FMS (if installed). Thus, with the FMS installed, there are two remaining channels to control and display ident, distance, time to station and ground speed. Even with the FMS installed, the preset or standby VOR channel, when selected, provides instant station identification since it was one of the two additional channel being monitored.

– ADF Receiver Module - The ADF System comprises the ADF receiver (DF-850) and the companion ADF antenna (AT-860). The ADF receiver operates in the frequency ranges of 100 to 1799.5 kHz and 2181 to 2183 kHz (marine emergency frequency range).

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RADIO MANAGEMENT UNIT (RMU)

The Radio Management Unit consists of a display and a bezel panel that provide control of the communications and radio navigation equipment. Additional airplane systems information is also available on specific RMU selectable pages.

The EMB-145 is equipped with two RMUs, each one responsible for controlling the on-side radio equipment (e.g., RMU 1 controls the NAV/COM 1). However, through the cross-side operating mode it is possible to select the opposite side radio frequencies.

There is no master switch for the RMUs: when the airplane is energized, both RMUs (and the EICAS) are automatically turned ON. However, only the COM 1 radio is available (dashes on the remaining RMUs fields) until the AVIONICS MASTER is switched ON.

Additionally, in the event of an electrical emergency the RMU is a backup display for the main panel (PFDs and MFDs). In this condition the main panel is turned off and the NAVIGATION Backup Page, that presents basic navigation information, may be accessed through RMU page.

RMU PAGES

Available RMU pages are as follows: RADIO Page, NAV and COM MEMORY Pages, ATC/TCAS Control Page, NAVIGATION Backup Page, ENGINE Backup Pages 1 and 2, SYS SELECT Page (COM band options) and MAINTENANCE Page.

Pressing the Page Control Button (PGE) selects the Page Menu. Pressing the Line Select Button associated with the desired page will cause the respective page to be displayed. The RADIO Page will be displayed again when the Line Select Button associated with the RETURN TO RADIOS label is pressed.

RADIO PAGE

Normally presented after power up, the Radio Page is divided into five dedicated windows. Each window groups the data associated with a particular function: COM, NAV, ATC/TCAS, ADF and MLS (optional). In addition the windows provide complete control of the frequency and operating modes of the associated function.

NAVIGATION/COMMUNICATION MEMORY PAGES

The Memory Page presents two similar displays called First Memory Page and Second Memory Page. The First Memory Page shows memory locations 1 through 6 and the Second Memory Page shows memory location 7 through 12. Both the COM and NAV Memory Pages are functionally identical.

ATC/TCAS CONTROL PAGE

The ATC/TCAS Control Page allows the pilot to select various TCAS operational features:

- Intruder Altitude
  - REL: Target's altitude displayed relative to one's own airplane (default).
  - FL: Target's altitude displayed as flight level (reverts to REL after 20 sec).
- TA Display
  - AUTO: Traffic targets displayed only when TA or RA target conditions exist.
  - MANUAL: All traffic targets displayed within the viewing airspace.
- Flight ID
  Allows Mode S coding to reflect the current flight's call sign.
- Flight Level 1/2
  Display of the transponder's encoded altitude and the air data source for that altitude.

NAVIGATION BACKUP PAGE

The NAVIGATION Backup Page consists of a backup navigation display that presents HSI, MB, DME, NAV (VOR) and ADF information.

ENGINE BACKUP PAGE

The ENGINE Backup Page displays information normally presented on the EICAS, as engine and systems indications, as well as EICAS messages. The ENGINE Backup Page is divided into two pages. The first presents only engine indications, while the second presents systems indications and EICAS messages. For further information on Engine Backup Page refer to Section 2-10 - Powerplant and 2-4 - Crew Awareness.

SYSTEM SELECT PAGE

The SYS SELECT Page allows the selection of COM 1 and COM 2 between Narrow and Wide bands.

MAINTENANCE PAGE

This page displays test results information depending upon the type of test that is being carried out (power on self-test or pilot activated self-test). Two pages may be presented if a failure is detected, depending if the failure is in the RMS or in one of the radios. This page is not available in flight.

RMU NORMAL OPERATION

RMU SELF-TEST

On the ground, the RMS performs a self-test each time power is applied after power off periods greater than 10 seconds. This test monitors the primary and secondary radio system buses as well as the individual Radio Systems for proper operation. Each function test status is displayed in its respective window.

Under normal conditions, the COM will be operational within 7 seconds after power on and the remaining radio equipment units within 50 seconds. The test can be terminated by pressing the Test Button in the RMU Bezel Panel.

If any bus or radio test parameter failure occurs, an associated error message will be displayed on the test failure window, below the COM and NAV windows. Radio System failures are displayed in the first failure window and function failures in a second failure window. The failure windows may be removed by pressing and holding the Test Button. If the test is successfully completed the RMU will display the Radio Page with the same radio configuration prior to the last power down.

NOTE: Any radio equipment that is not powered up when the test is initiated by the RMU will generate an error message.

Additionally the pilot may perform a test by pressing the Test Button on the RMU Bezel Panel which causes the activation of the self-test of the component associated with the window in which the yellow cursor is located. Upon successful completion of this test, a PASS message will be displayed for a short time in the window, indicating the successful completion of the test. If this test is not successful completed, an error message (ERR) will be displayed in the window.

NOTE: Errors detected by the self-test indicate one or more parameter outside their self-test limit but may not necessarily indicate non-operation of the function. The pilot should verify the operation of the function.

CROSS-SIDE OPERATION

The RMU is provided with a feature called cross-side operating mode. This feature allows the RMU to be changed from its normal operating mode of tuning the on-side radio equipment to the mode of tuning the opposite side radio equipment.

The cross-side operation is selected by pressing the cross-side Transfer Button, labeled 1/2, on the RMU Bezel Panel, with the yellow cursor box in any window, except the ATC/TCAS window. The entire RMU display and operation is transferred from the opposite side to the side that has commanded the Cross-side Operating Mode. If the yellow cursor box is in the ATC/TCAS window, pressing the cross-side Transfer Button selects which transponder (1 or 2) will be in operation.

In the cross-side operation, the RMU Window/Control Side Ident will be displayed in magenta on the side that has selected the operation and any change made will be displayed in yellow on the opposite side RMU to indicate that the change was carried out remotely.

COM OPERATION

The normal COM operation is enabled with the RMU Radio Page displayed. The COM window has two frequency lines. The upper line displays the active COM frequency while the lower line displays the preset frequency. Pressing the Line Select Button associated with the preset frequency will cause the yellow cursor box to move to enclose that frequency. In this condition the enclosed preset frequency may be changed through the Frequency Tuning Knobs. When the Frequency Tuning Knobs are actuated the label MEMORY and the associated memory location number, both below the lower frequency line, will change to a TEMP label indicating that the new preset frequency is not yet stored in the memory of the RMU. Frequency storage may be accomplished by pressing the Memory Storage Button, labeled STO, on the RMU Bezel Panel. This action will also provide the previous MEMORY label and the associated memory location number to replace the TEMP label, indicating that the new preset frequency has been stored in the indicated memory location.

Placing the yellow cursor box to enclose the MEMORY label, by pressing a second time the Line Select Button beside the COM window, will allow scrolling through the entire RMU stored memory. This may be performed by rotating the Frequency Tuning Knob either clockwise to memory location increment or counterclockwise to decrement.

The exchange between the active frequency displayed in the upper line of the window and the preset frequency displayed in the lower line may be accomplished by pressing the Frequency Transfer Button on the upper left corner of the RMU Bezel Panel. This effectively causes the COM to change to the new active frequency that previously was the preset frequency. In this condition, the previous active frequency drops down to the second line of the COM window and becomes a temporary preset frequency. This is indicated by the TEMP label displayed under that frequency. The TEMP label also indicates, in this case, that the frequency displayed in the second line has not been stored in a memory location.

NOTE: The RMU controls the third VHF for airplanes equipped with Honeywell Third VHF System RCZ-833/853 models.

- Direct COM Tuning

Direct COM tuning is accomplished by pressing and holding for approximately 3 seconds the Line Select Button beside the COM preset frequency line. The yellow cursor box will enclose the active frequency allowing direct COM tuning to that frequency, and the preset frequency line will be blank.

To exit from direct COM tuning, press and hold the Line Select Button beside the preset frequency line, until the preset frequency appears on the COM window.

- Squelch Function

The COM squelch function is controlled through the Squelch Control Button, labeled SQ, on the RMU control bezel. Pressing this button will cause the COM radio to open its squelch and allow any noise or signal present in the receiver to be heard in the Audio System. The squelch open condition is indicated by the SQ label displayed on the top of the COM window. Pressing the Squelch Control Button again will close the radio squelch immediately.

- Automatic Time-Out

After approximately two minutes of continuous transmission, the transceiver turns its transmitter off and a beep sound in the audio system alerts the pilot to the fact. The transceiver then reverts to receiver mode in order to prevent a stuck microphone button from blocking the communications channel. Should the time-out occur, the pilot can reset it by simply releasing the push to talk button and pressing it again.

NAV OPERATION

The NAV operation is identical to the COM operation. However, NAV controls are accomplished by actuation of the Frequency Transfer Button and the Line Select Button located on the upper RH of the RMU Bezel Panel. Furthermore, the NAV window has an additional function called DME Split Tuning Mode. The operation in the DME Split Tuning Mode is similar to the operation in the DME Hold Mode.

The NAV system also incorporates FMS autotuning capability. Through the NAV Memory Page it is possible for the FMS to perform automatic tuning of the navigation radios (raw data) along the route by pressing the upper RH Frequency Transfer Button, which enables or disables the FMS autotuning capability. When the VOR or the ILS frequency is autotuned by the FMS, a magenta VOR or ILS frequency and a magenta AUTO label will be displayed on the top border of the RADIO Page NAV window.

DME OPERATION

In the normal DME operations only one of the six DME channels is paired with the VOR active frequency and one other with the preset VOR frequency. However, pressing the DME Select Button, labeled DME, on the RMU Bezel Panel, will enable the DME to be tuned independently of the VOR active frequency.

Pressing the DME Select Button once will cause the NAV window to split into two windows. The top window will display the active VOR frequency and the lower window, with the DME label, will display the active DME frequency in VHF format. When the NAV window is split, an H (DME Hold) label is displayed in the DME window to indicate that the DME is not paired with the active VOR/ILS frequency. In this case the DME hold condition will also be announced on the PFD. In this condition, the DME may be tuned directly by simply pressing the associated Line Select Button beside the DME window and tuning the new DME channel through the Frequency Tuning Knobs.

Pressing the DME Select Button again will cause the frequency to be displayed in the channel format (TACAN).

Pressing the DME Select Button for the third time will cause the NAV window to resume its normal mode with the active and preset frequencies being displayed while returning the DME to the condition of channeling with the active VOR frequency.

ADF OPERATION

The tuning of ADF frequencies is similar to that performed on the airplane's other radios equipment. Pressing the Line Select Button beside the ADF frequency display will move the yellow cursor box to surround the ADF frequency in the RMU display. Then, slowly turning the Frequency Tuning Inner Knob clockwise causes the ADF frequencies to advance in 0.5 kHz increments while slowly turning the outer knob clockwise will cause the frequencies to advance in 10 kHz increments. ADF tuning through the Frequency Tuning Knobs is accomplished using proportional rate. If the knobs are turned in slow deliberate steps the frequency will follow likewise. However, if the knob is turned rapidly, the frequency will skip several steps, depending upon the speed at which the knob is turned. This allows accomplishing large frequency changes with a very slight rotation of the knob.

The RMU also has the capability of storing an ADF frequency. This is accomplished by selecting the desired ADF frequency and then pressing the Memory Storage Button on the RMU Bezel Panel. To retrieve the stored frequency from memory, the ADF frequency Line Select Button must be pressed for 2 seconds.

The ADF is provided with a mode control capability. ADF operational modes can be selected by moving the yellow cursor box to the ADF modes field in the ADF window and then pressing the Line Select Button beside the ADF modes field or rotating the Frequency Tuning Knobs. Repeatedly pressing the Line Select Button will cause the modes to step in one direction while rotating the Frequency Tuning Knobs will select the modes either up or down the current location.

The ADF operational modes are the following:

- ANT - The ADF receives signal only.
- ADF - The ADF receives signal and calculates relative bearings to station.
- BFO - The ADF adds a beat frequency oscillator for reception of CW signals.
- VOICE - The ADF opens width of IF bandwidth for better aural reception.

NOTE: Bearing information is available in the ADF and BFO modes only.

TRANSPONDER AND TCAS OPERATION

Transponder operation is similar to other radio equipment since it requires moving the yellow cursor box to a desired function. In order to tune a desired ATC code, press the Line Select beside the ATC code display. This action will enable the Frequency Tuning Knobs to change the ATC codes. The outer knob sets the thousands and hundreds digits and the inner knob sets the tens and ones digits.

Pressing and holding the code Line Select Button will recall the stored preset code (typically used for VFR). A new code may be stored by setting the code and then pressing the Memory Storage Button on the RMU Bezel Panel.

Pressing the Line Select Button associated with the transponder operating mode display will move the yellow cursor box to surround the mode annunciation in the ATC/TCAS window allowing to set a new transponder mode if a non-standby mode is selected. Once the mode annunciation is surrounded, pressing the Transfer Button 1/2 will select which transponder will be in operation (e.g., 1 ATC ON to 2 ATC ON).

The transponder operational modes are the following:

– ATC ON - Replies on Modes S and A, no altitude reporting.
– ATC ALT - Replies on Modes A, C and S, with altitude reporting.
– TA ONLY - TCAS Advisory Mode is selected.
– TA/RA - TCAS Traffic Advisory/Resolution Advisory Mode is selected.

ABNORMAL RMU OPERATION

Loss of the Primary Radio System Bus will disable the cross-side control capability and also the TBCH. However, no radio functions will be lost. The radios on both sides will still be functional through the Secondary Radio System Buses.

Loss of the left and/or right Secondary Radio System Bus will not disable the radio functions. The radios may be tuned, in this condition, through the Primary Radio System Bus or through the cross-side control feature.

As a safety feature of the RMU, if any component of the Radio System fails to respond to the commands from the RMU, the frequencies or the operating commands associated with that particular function will be removed from the RMU display and replaced with dashes.

RMU CONTROLS AND INDICATORS

RMU BEZEL PANEL

1 - FREQUENCY TRANSFER BUTTON

- When pressed, the active frequency (upper line) and the preset frequency (lower line) in the COM or NAV windows exchange location and function.

2 - LINE SELECT BUTTONS

- The first press of the button moves a yellow cursor box to surround the data field associated with that particular Line Select Button. This enables the Frequency Tuning Knobs to change the data or the mode marked by the cursor. For some functions, additional pressing of the Line Select Button will toggle modes or recall stored frequencies. The Line Select Buttons, if kept pressed, allows ADF and ATC memories to be recalled, and to enter or exit Direct Tune Mode for COM and NAV.

3 - FREQUENCY TUNING OUTER KNOB

- Allows the data field enclosed by the cursor to be modified. The data may be frequency setting, stored frequencies or mode, depending upon the data field. When setting a frequency, this knob controls the digits to the left of the decimal point. Furthermore, this knob also controls the RMU brightness, which is enabled by pressing the Dimming Button.

4 - FREQUENCY TUNING INNER KNOB

- Is functionally similar to the Frequency Tuning Outer Knob except that when setting the frequency, this knob controls the digits to the right of the decimal point.

5 - MEMORY STORAGE BUTTON

- Pressing this button will cause a temporary (TEMP) COM or NAV pre-select frequency to be stored in the memory and assigned numbered location, provided the cursor has first been placed around that frequency.

  NOTE: ADF and ATC have only one memory location.

6 - DME SELECT BUTTON

- Allows selection of the DME Hold Mode, tuning a different DME channel, not paired with the VOR/ILS frequency, without changing the active VOR frequency. Repeated pressing of this button enables display and selection of the DME channels in VHF and TACAN formats, and then back to the paired VOR/DME mode.

7 - CROSS-SIDE TRANSFER BUTTON

- With the cursor in any window, except the ATC or TCAS display, pressing this button will transfer the entire RMU operation and display from the cross-side system.
- With the cursor in the ATC or TCAS window, pressing this button selects which transponder will be in operation.
- With enhanced TCAS, the button allows control of TCAS data in the cross-side display.

8 - TEST BUTTON

- When pressed, causes the component associated with the present position of the yellow cursor box to activate its internal self-test circuits for a complete end-to-end test of the function. To properly accomplish the equipment self-test, the Test Button must be pressed and held down as follows:
  - About 2 seconds for COM transceiver self-test.
  - From 5 to 7 seconds for DME, ATC and ADF self-test.
  - About 20 seconds for NAV (VOR/ILS) self-test.
- Releasing the Test Button at any time immediately returns the equipment to its normal operation in the actual function.
- If the Test Button is held pressed for 30 seconds or more, the radios are automatically commanded back into normal operation.

9 - PAGE CONTROL BUTTON

- Provides access to the page menu.

10 - DIMMING BUTTON

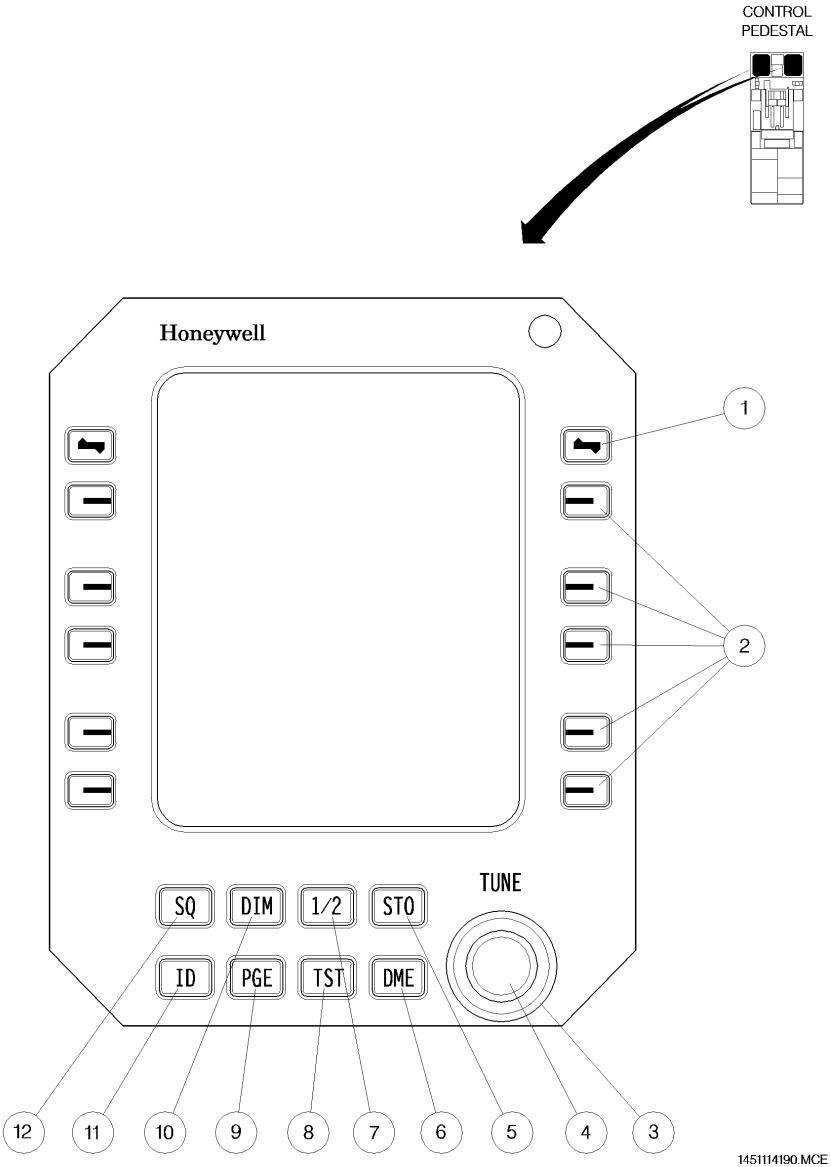
- The RMU features an automatic screen brightness adjustment, within a limited range, to keep the display visibility optimized. The Dimming Button enables RMU brightness to be controlled manually through the Frequency Tuning Outer Knob. The manual dimming control can be disabled by pressing the Dimming Button again or any Line Select Button.

11 - TRANSPONDER IDENTIFICATION MODE BUTTON

- Selects the Transponder Identification Response Mode. The ident squawk will stop after 18 seconds.

12 - SQUELCH CONTROL BUTTON

- Causes the COM radio to open its squelch allowing any noise or signal present in the radio to be heard in the Audio System. The label SQ is displayed on the top line of the COM window when the squelch is open. When pressed a second time the Squelch Control Button closes the squelch.



RMU BEZEL PANEL

RMU DISPLAY

PAGE MENU

1 - PAGE MENU IDENTIFICATION

- Indicates that Page MENU is selected.
- Color: White.

2 - COM AND NAV MEMORY PAGE LABEL

- To access the COM or NAV MEMORY Pages press the Line Select Button adjacent to the desired page.
- Color: Green.

3 - ATC/TCAS PAGE LABEL

- To access the ATC/TCAS Page press the Line Select Button adjacent to this label.
- Color: Green.

4 - NAVIGATION PAGE LABEL

- To access the NAVIGATION Page press the Line Select Button adjacent to this label.
- Color: Green.

5 - ENGINE PAGE LABEL

- To access the ENGINE Page press the Line Select Button adjacent to this label.
- Color: Green.

6 - SYS SELECT PAGE LABEL

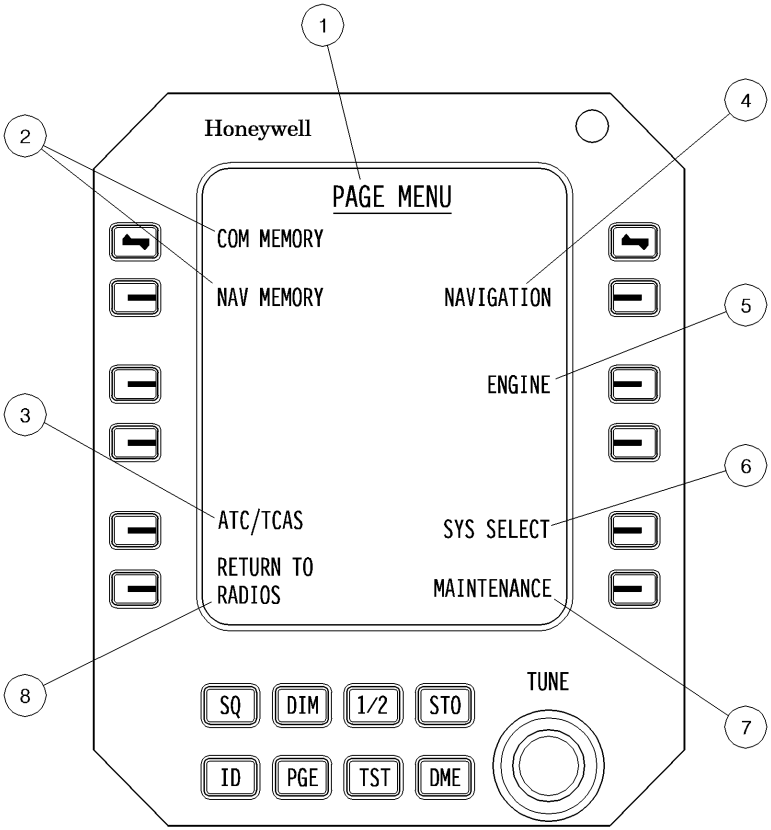
- To access the SYS SELECT Page press the Line Select Button adjacent to this label.
- Color: Green.

7 - MAINTENANCE PAGE LABEL

- To access the MAINTENANCE Page press the Line Select Button adjacent to this label.
- Color: Green.

8 - RETURN TO RADIOS PAGE LABEL

- To return to the RADIOS Page press the Line Select Button adjacent to this label.
- Color: Green.



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PAGE MENU

RADIO PAGE

1 - PRESET FREQUENCY MEMORY LOCATION (ONLY FOR NAV AND COM WINDOWS)

- Identifies the preset frequency as temporary (TEMP label) or retrieved from the memory (MEMORY label followed by its memory location).
- Colors:
  - Cyan for on-side operation.
  - Yellow for cross-side operation.
- When marked by the yellow cursor box, the memory location labels and their associated stored frequencies can be scrolled by using the Frequency Tuning Knobs.

2 - COM WINDOW/CONTROL SIDE IDENTIFICATION

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

3 - VHF COM ACTIVE FREQUENCY

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

4 - VHF COM PRESET FREQUENCY

- Indicates the preset frequency.
- Colors:
  - Cyan for on-side operation.
  - Yellow for cross-side operation.

NOTE: When DME Hold is not selected, the NAV Window also presents a similar preset frequency field.

5 - NAV WINDOW/CONTROL SIDE IDENTIFICATION

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

6 - VHF NAV ACTIVE FREQUENCY

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

7 - DME HOLD MODE ANNUNCIATION

- Indicates that the DME is in Hold Mode and the active DME channel is selected separately from the active VOR/ILS frequency.
- Color: Yellow.

8 - DME STATION IDENTIFICATION CODE

- Displays the digital identification code of the ground station to which the DME is tuned with.
- Color: White.

9 - DME HOLD MODE FREQUENCY

- Indicates the active frequency in DME Hold Mode operation, in VHF (represented) or TACAN formats.
- Color: White.

10 - ADF WINDOW/CONTROL SIDE IDENTIFICATION

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

11 - ADF ACTIVE FREQUENCY

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

12 - ADF MODES FIELD

- Displays the ADF modes as selected either through the second ADF Line Select Button (achieved by repeated pressing) or through the Frequency Tuning Knobs when the yellow cursor box is located in this field.
- Color: Green.

13 - TRANSPONDER OPERATING MODE ANNUNCIATION

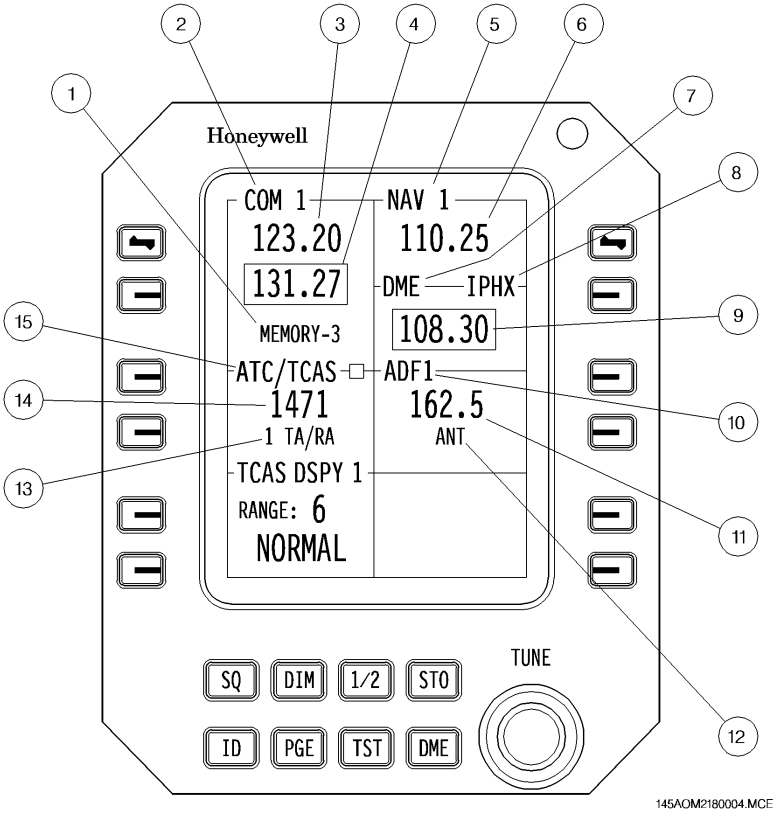
- Displays the active transponder operating mode as selected through the Frequency Tuning Knobs when the yellow cursor box is located in this field. Pressing the Line Select Button beside this field will alternate between the pre-selected transponder mode and the standby mode.
- Color: Green.

14 - ATC CODE

- Displays the active ATC code number.
- Color: White.

15 - ATC/TCAS WINDOW

- Identifies the window as the ATC/TCAS window.
- Colors: White.



RMU RADIO PAGE

COM MEMORY PAGE

1 - MEMORY PAGE IDENTIFICATION

- Identifies the page as a COM Memory Page.
- Color: White.

2 - ACTIVE COM FREQUENCY

- Identifies the COM frequency that is currently active.
- Color: White.

3 - SQUELCH MODE INDICATION

- Indicates if squelch is open.
- Color: Yellow

4 - MEMORY PAGE SELECTED ANNUNCIATION

- Indicates that the Memory Page is selected.
- Color: Green.

5 - MEMORIES DISPLAY

- Displays the preset frequencies and their associated locations.
- When there is no frequency stored in a memory location only the location number will be displayed in the associated memory display line.
- Colors:
  - Memory identifications are green.
  - Frequency is cyan.

6 - MEMORY INSERT PROMPT

- If it is desirable to insert a new frequency in a particular memory location, simply press the Line Select Button beside the location line, moving the yellow cursor box to that line. Then press the Line Select Button beside the Insert prompt label. This will cause all the data in memory from the insert location downward to shift one position down. The cursor will remain in the insertion selected location allowing the new frequency to be tuned and stored in that memory location. A MEM FULL (Memory Full) annunciation will be displayed in the RMU display if the 12 memory locations are filled and the Line Select Button associated with the Insert prompt is pressed.
- Color: Green.

7 - MEMORY DELETE PROMPT

- To delete a frequency from the memory, press the Line Select Button adjacent to the line associated with the frequency to be deleted. Then press the Line Select Button adjacent to the Delete prompt. The frequency enclosed by the cursor will be deleted from the memory. Higher numbered memory locations will then move upward to fill the empty memory location.
- Color: Green.

8 - RADIO PAGE RETURN PROMPT

- Pressing the associated Line Select Button will return the RMU display to the Radio Page.
- Color: Green.

9 - MEMORY MORE PROMPT

- The More prompt allows to display memory locations 7 through 12, by pressing the associated Line Select Button. All actions described for memory locations 1 through 6 are also applicable to memory locations 7 through 12. If locations 1 through 6 are not filled, the Second Memory Page will not be accessible.
- Color: Green.

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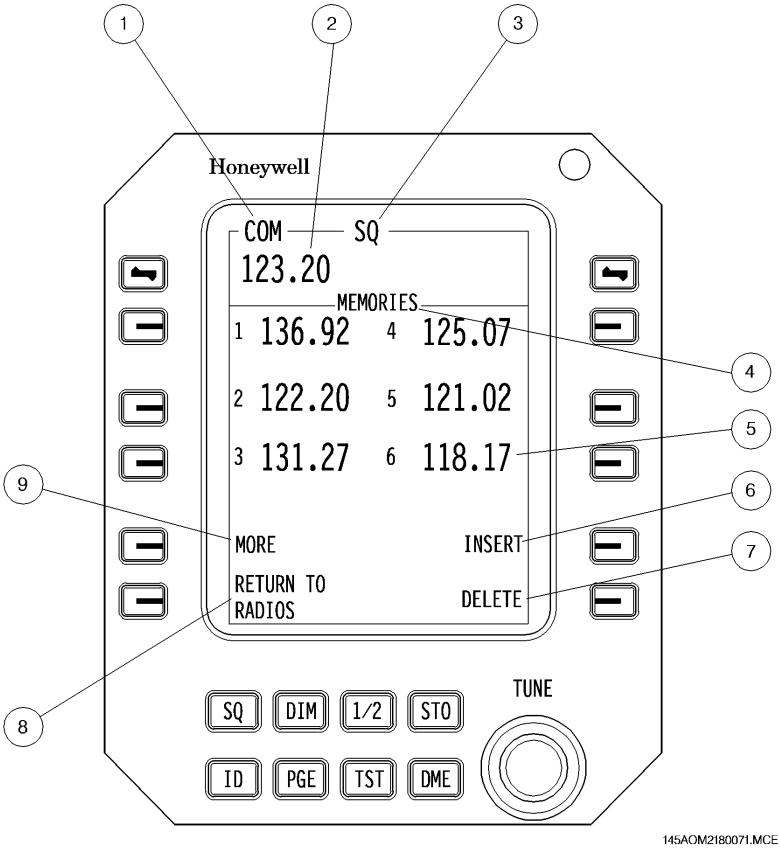

RMU COM MEMORY PAGE

NAV MEMORY PAGE

1 - MEMORY PAGE IDENTIFICATION

- Identifies the page as a NAV Memory Page.
- Color: White.

2 - ACTIVE NAV FREQUENCY

- Identifies the NAV frequency that is currently active.
- Color: White.

3 - NAV FMS STATUS ANNUNCIATION

- In the NAV Memory Page, this field displays the FMS ENABLED or DISABLED annunciation. This will be present whether or not the Radio System interfaces with the FMS. To tune the radios via FMS, the FMS ENABLED annunciation shall be set.
- Color: Yellow

NOTE: When the VOR or the ILS frequency is autotuned by the FMS, a magenta VOR or ILS frequency and a magenta AUTO label will be displayed on the top border of the RADIO Page NAV window.

4 - MEMORY PAGE SELECTED ANNUNCIATION

- Indicates that the Memory Page is selected.
- Color: Green.

5 - MEMORIES DISPLAY

- Displays the preset frequencies and their associated locations.
- When there is no frequency stored in a memory location only the location number will be displayed in the associated memory display line.
- Colors:
  - Memory identifications is green.
  - Frequency is cyan.

6 - MEMORY INSERT PROMPT

- If it is desirable to insert a new frequency in a particular memory location, simply press the Line Select Button beside the location line, moving the yellow cursor box to that line. Then press the Line Select Button beside the Insert prompt label. This will cause all the data in memory from the insert location downward to shift one position down. The cursor will remain in the insertion selected location allowing the new frequency to be tuned and stored in that memory location. A MEM FULL (Memory Full) annunciation will be displayed in the RMU display if the 12 memory locations are filled and the Line Select Button associated with the Insert prompt is pressed.
- Color: Green.

7 - MEMORY DELETE PROMPT

- To delete a frequency from the memory, press the Line Select Button adjacent to the line associated with the frequency to be deleted. Then press the Line Select Button adjacent to the Delete prompt. The frequency enclosed by the cursor will be deleted from the memory. Higher numbered memory locations will then move upward to fill the empty memory location.
- Color: Green.

8 - RADIO PAGE RETURN PROMPT

- Pressing the associated Line Select Button will return the RMU display to the Radio Page.
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- The More prompt allows to display memory locations 7 through 12, by pressing the associated Line Select Button. All actions described for memory locations 1 through 6 are also applicable to memory locations 7 through 12. If locations 1 through 6 are not filled, the Second Memory Page will not be accessible.
- Color: Green.

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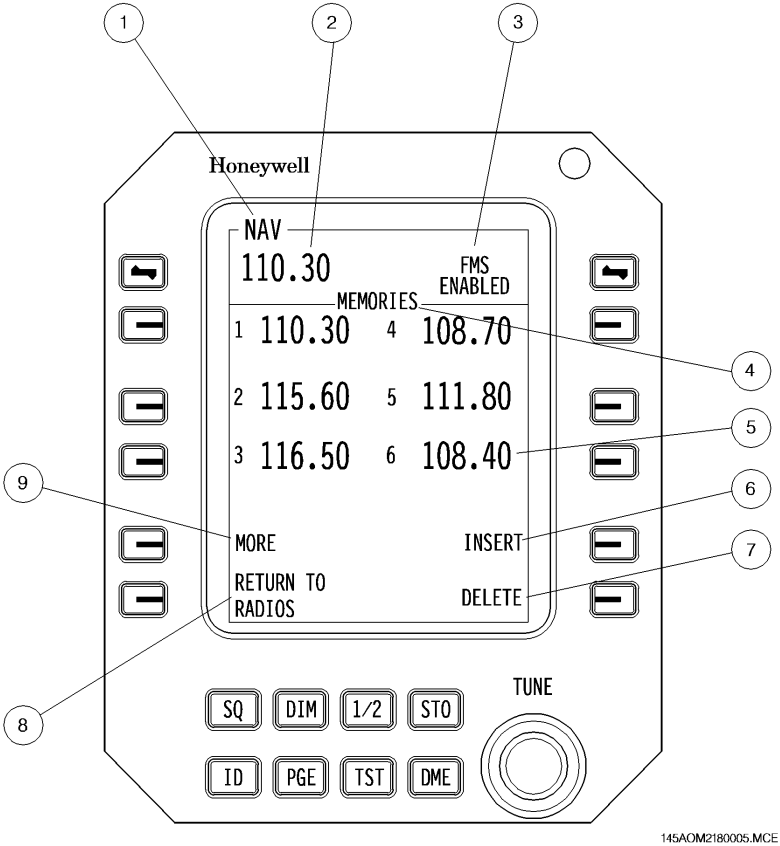


RMU NAV MEMORY PAGE

ATC/TCAS CONTROL PAGE

1 - INTRUDER ALTITUDE DISPLAY

- REL (green): Target's altitude displayed relative to one's own airplane (default).
- FL (cyan): Target's altitude displayed as flight level (reverts to REL after 20 sec).

2 - TA DISPLAY

- AUTO (green): Traffic targets displayed only when TA or RA target condition exists.
- MANUAL (cyan): All traffic targets displayed within the viewing airspace.

3 - FLIGHT ID

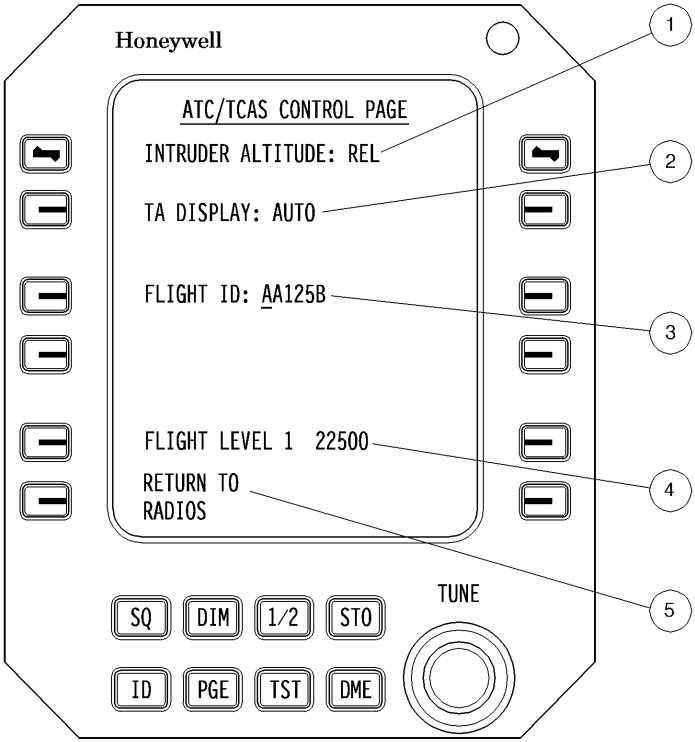
- Allows Mode S coding to reflect the current flight's call sign. The outer tuning knob moves the character position designator and the inner tuning knob selects the desired alphanumeric character.
- Color: White

4 - FLIGHT LEVEL 1/2

- Display of the transponder's encoded altitude and the air data source for that altitude.
- Color: Green.

5 - RADIO PAGE RETURN PROMPT

- Pressing the associated Line Select Button will return the RMU display to the Radio Page.
- Color: Green.



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RMU ATC/TCAS CONTROL PAGE

NAVIGATION BACKUP PAGE

NOTE: - The navigation information presented on the Navigation Backup Page are operationally identical to that normally presented on the PFD.

- The compass card is presented only in arc partial format.
- The selected course and the DME distance to station are boxed.
- NAV and ADF active frequencies are also presented.

1 - ACTIVE NAV FREQUENCY

2 - BEARING 1 POINTER

3 - BEARING 2 POINTER

4 - ACTIVE ADF FREQUENCY

5 - COURSE DEVIATION BAR

6 - COURSE DEVIATION SCALE

7 - DME DISTANCE TO STATION

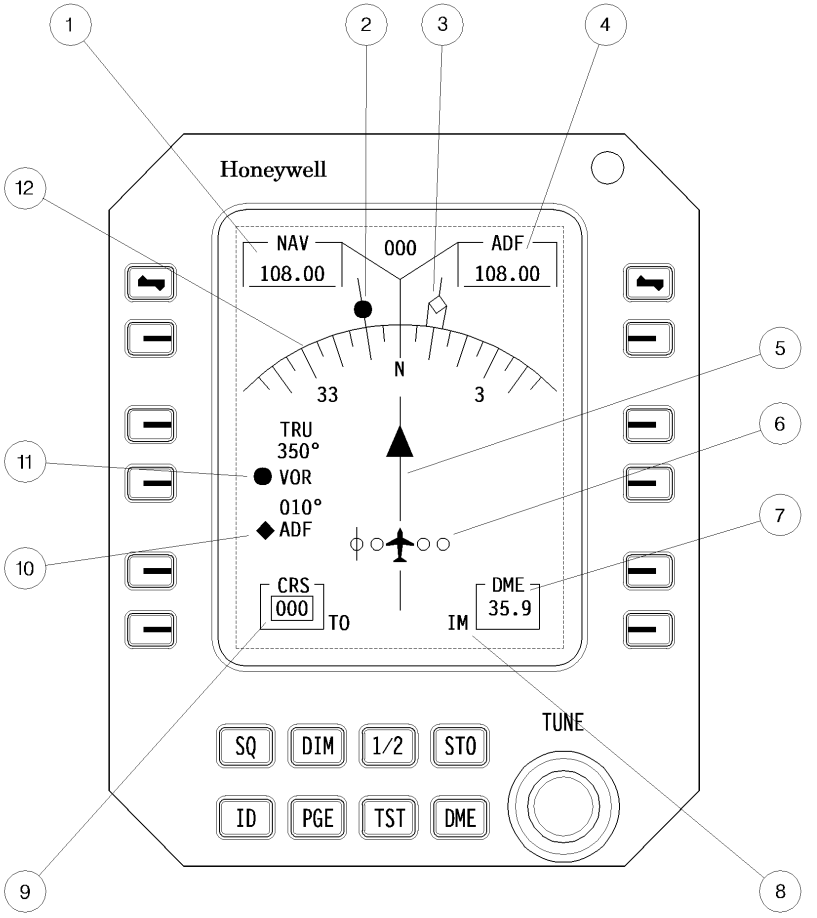
8 - MARKER BEACON DISPLAY

9 - SELECTED COURSE

10 - BEARING 2 SOURCE ANNUNCIATION

11 - BEARING 1 SOURCE ANNUNCIATION

12 - COMPASS CARD DISPLAY



RMU NAV BACKUP PAGE

RMU ENGINE BACKUP PAGES

1 - THRUST MODES

- This is the thrust mode when both engines are operating in the same mode. If the engines are operating in different modes, it is displayed above each N1 indication its respective thrust mode.
- Labels: T/O-1 or ALT T/O-1 (A, A1, A1/1, A3 engines);
  T/O or ALT T/O-1 (A1P or A1/3 engines);
  E T/O, T/O or ALT T/O-1 (A1E engine);
  CON, CLB or CRZ.

2 - N1 INDICATION (FAN SPEED)

- Displays N1 speed in RPM percentage both digitally and on an analog scale.

3 - INTERSTAGE TURBINE TEMPERATURE (ITT)

- Indicates the temperature in degrees Celsius.

4 - N2 INDICATION (CORE SPEED)

- Displays N2 speed in RPM percentage.

5 - FUEL FLOW INDICATION (FF)

- Indicates fuel flow in PPH or KPH.

6 - OIL PRESSURE

- Indicates engine oil pressure in psi. Refer to section 2-10 Powerplant for further information.

7 - OIL TEMPERATURE

- Oil temperature indication ranges from 0° to 180°C.

8 - FUEL QUANTITY (FQ)

- Indicates the fuel quantity for each tank in lb or kg.

9 - FLAPS

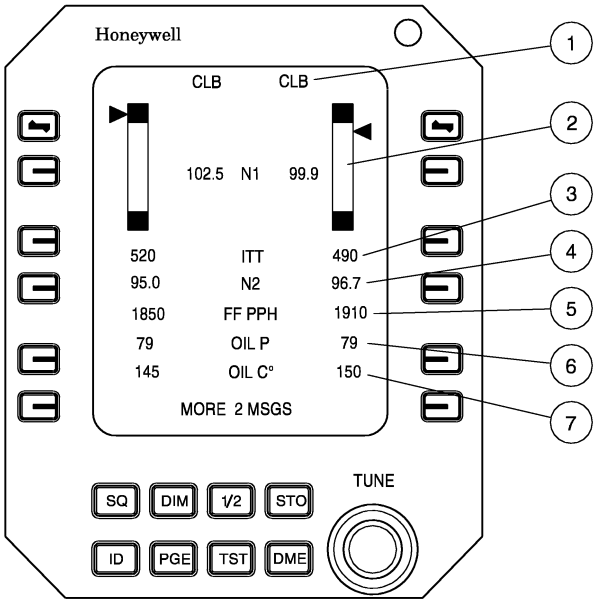
- Flaps indication ranges from 0° to 45°, with discrete indications on 0°, 9°, 18°, 22°, 45°.
- In-transit, flap position is replaced by the actual flap position.

10 - LANDING GEAR DOWN LOCKED

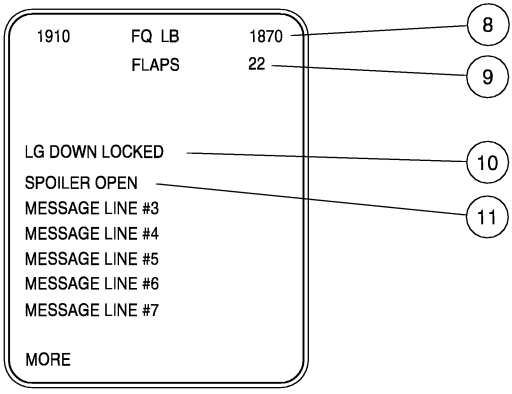
- Landing gear down locked is presented on the RMU through the green indication LG DOWN LOCKED.

11 - SPOILER OPEN

- Displays SPOILER OPEN when any of the surfaces are open.



BACK-UP PAGE 1



BACK-UP PAGE 2

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RMU ENGINE BACKUP PAGES

SYSTEM SELECT PAGE

1 - SYSTEM SELECT PAGE IDENTIFICATION

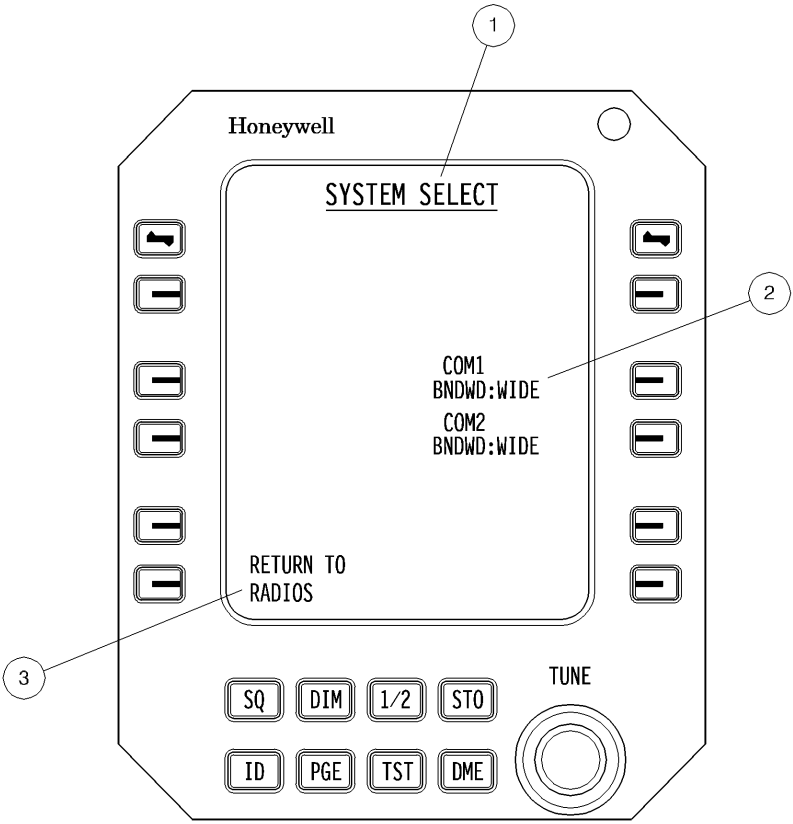
- Identifies the SYS SELECT Page.
- Color: White.

2 - COM 1 AND COM 2 BANDWIDTH SELECTION FIELD

- Indicates the current COM 1 and COM 2 status regarding bandwidth selection. Pressing the Line Select Button beside the COM 1/COM 2 line field will toggle the receiver bandwidth from WIDE (2 digits at the right of the decimal point) to NARROW (3 digits at the right of the decimal point) or vice-versa.
- Color:
  - Cyan for COM 1 (2) BNDWD label.
  - Green for WIDE/NARROW indication.

3 - RADIO PAGE RETURN PROMPT

- Pressing the associated Line Select Button will return the RMU display to the Radio Page.
- Color: Green.



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RMU SYSTEM SELECT PAGE

MAINTENANCE PAGE (POWER ON SELF-TEST)

1 - TEST PAGE IDENTIFICATION

- Indicates where a failure has been detected.
- Color: White.

2 - FAILURE SIDE IDENTIFICATION

- Indicates the side of the detected failure.
- Color: Green.

3 - FAILURE IDENTIFICATION

- Identifies the detected failure according to the table below.
- Color: Red.

ERROR MESSAGE	MEANING	ACTION	DECISION
RMU ERR	One or more internal parameters were measured and found to be outside their self-test limit	1. Check that CDH is not in EMERG Mode. 2. On main tuning page, perform tuning test on all radios by setting frequency and determining that radio is operating.	If tuning test fails, the RMU is not fully operable.
PRI BUS	Full RMU communications with all COMs, NAVs, and cross-side RMU cannot be established on the primary bus.	1. Check that all radio circuit breakers are on. 2. Check RMU ON/OFF Page for all functions ON. 3. Check that CDH is not in EMERG Mode. 4. If 1 or 2 (or 3 if installed) are sources, correct and turn RMU power off for 10 seconds. Reapply power to start new POST. 5. If error persists, perform on-side and cross-side tuning off all radios and activate auxiliary tuning sources to determine which functions are still available.	Any of these messages indicate that system redundancy has been reduced.
SEC BUS	Full RMU communications with the on-side COM and NAV cannot be established using the secondary bus		
NAV UNIT/ COM UNIT	The NAV units and/or COM units cannot fully communicate with both RMUs over primary bus and/or the on-side RMU over secondary bus.		

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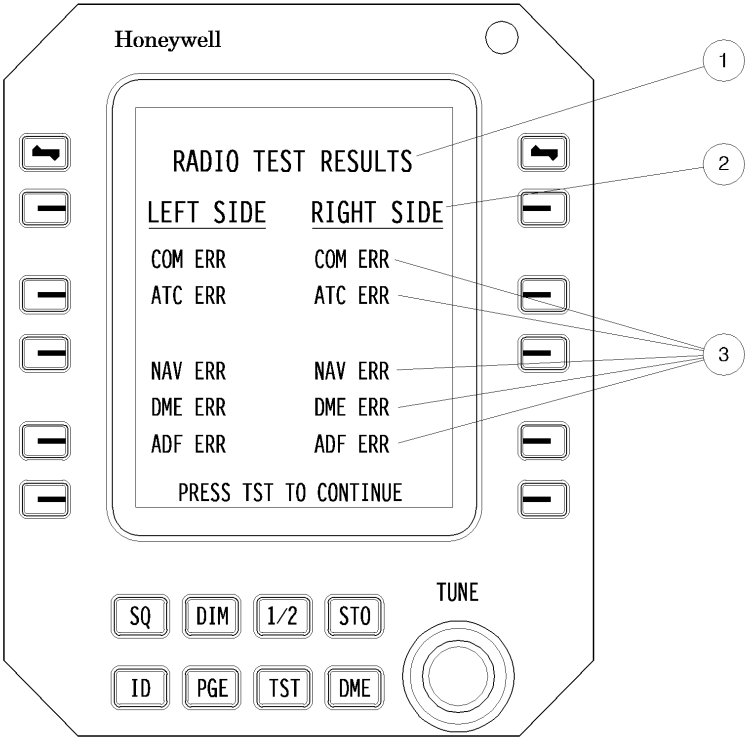

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RMU MAINTENANCE PAGE (POWER ON SELF TEST)

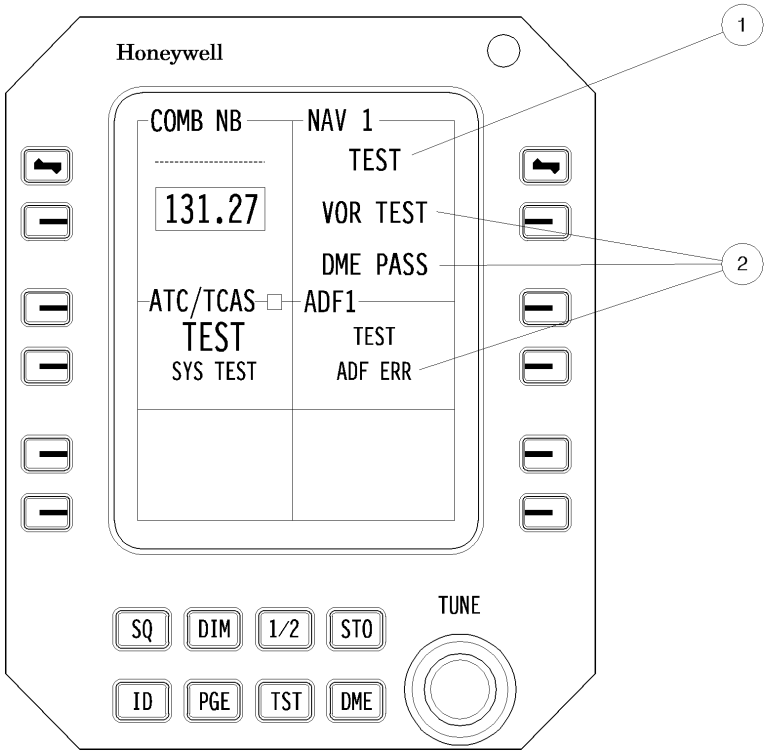
MAINTENANCE PAGE (PILOT ACTIVATED SELF TEST)

1 - SYSTEM TEST IDENTIFICATION

- Indicates which unit is being tested.
- Color: Amber.

2 - TEST RESULT INDICATION

- Indicates whether the tested system is operating normally or not.
- Color:
  - Green for successful tests.
  - Red for unsuccessful tests.



RMU MAINTENANCE PAGE (PILOT ACTIVATED SELF TEST)

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TUNING BACKUP CONTROL HEAD

The Tuning Backup Control Head is a unit that provides an alternative means of tuning the NAV 2 and COM 2.

The TBCH is energized only when the AVIONICS MASTER is switched ON, and in normal operation it displays the RMU 2 NAV and COM active frequencies (NAV 2 and COM 2).

NORMAL MODE

In the Normal Mode, the TBCH displays the RMU 2 NAV and COM active frequencies. Each time these frequencies are tuned via RMU, the TBCH display is updated automatically. The same occurs when these frequencies are tuned via TBCH, the RMU 2 NAV and COM active frequencies being also updated automatically.

It is also possible to tune the RMU 1 NAV and COM active frequencies using the RMU cross-side operational mode (see 2-18-11, page 4).

EMERGENCY MODE

When the TBCH is set to the Emergency Mode, the Radio Management System will accept only the NAV and COM tuning via TBCH, ignoring the RMUs control.

The RMUs will recover their capability of tuning the radio frequencies only when the TBCH is set to the Normal Mode again.

SELF TEST

After power up, the Tuning Backup Control Head performs a self-test. This test consists of saving the frequencies that the COM and NAV units are tuned to as indicated by the Radio System Bus (RSB), and then changing the frequency outputs to the COM and NAV and verifying that they have changed on the RSB. Failures are announced in the display line associated with the function as an error message followed by an error code “ERXX”, with the “XX” showing a two-digit error code.
This test is performed only on the ground, when the unit is turned on.

TBCH CONTROLS AND INDICATORS

1 - SYSTEM INSTALLATION ANNUNCIATION

- Indicates to which Radio System the Tuning Backup Control Head is connected.

2 - REMOTE TUNE ANNUNCIATION

- Indicates that radio is tuned from a source other than the Tuning Backup Control Head.
- Presented only when the unit is strapped for NAV only or COM only tuning.

3 - TUNING CURSOR

- Indicates which frequency may be changed by the Tuning Knobs.

4 - NAV AUDIO ON ANNUNCIATION

- Indicates that the NAV audio is selected on.

5 - EMERGENCY MODE ANNUNCIATION

- Indicates when the unit has been selected to the Emergency Mode, which inhibits RMU tuning capability.

NOTE: - This annunciation is not related to the emergency COM frequency of 121.5 MHz.

6 - SQUELCH ANNUNCIATION

- Indicates that the squelch is opened by the SQ Switch.

7 - TRANSMIT ANNUNCIATION

- Indicates that the COM transmitter is ON.

8 - NAV AUDIO BUTTON

- Toggles NAV audio on and off.

9 - SQUELCH BUTTON

- Toggles the COM squelch on and off.

10 - TUNING KNOBS

- Change the frequency indicated by the tuning cursor.
- Inner knob changes the frequency decimal digits in steps of 0.025 MHz for VHF and 0.050 MHz for VOR/LOC.

On airplanes Post-Mod. SB 145-23-0003 or with an equivalent modification factory incorporated, it also changes the frequencies in the VHF sub-band that contains the 8.33 kHz spaced channels according to appropriate selection on the RMU. These frequencies are identified in voice communications by the channel names as exemplified below:

Frequency (MHz)	Spacing	Channel Name
132,0000	**25**	**132,000**
132,0000	8.33	132,005
132,0083	8.33	132,010
132,0166	8.33	132,015
132,0250	**25**	**132,025**
132,0250	8.33	132,030
132,0333	8.33	132,035
132,0416	8.33	132,040
132,0500	**25**	**132,050**
132,0...	8....	132,...

- Outer knob changes the frequency non-decimal digits in steps of 1 MHz for both VHF and VOR/LOC.

11 - NORMAL/EMERGENCY MODE SELECTOR KNOB/BUTTON

- When knob rotated clockwise selects normal Mode.
- When knob rotated counterclockwise selects Emergency Mode.
- On airplanes Post-Mod. SB 145-23-0003 or with an equivalent modification factory incorporated, the EMRG button toggles the Emergency mode on and off.

12 - TRANSFER BUTTON

- Alternately selects between the COM frequency (top) or the NAV frequency (bottom) to be connected to the Tuning Knobs.
- In the NAV only or COM only configurations, toggles the active (top) frequency with the preset (bottom) frequency. In addition, holding the button down for two seconds will remove the preset frequency and place the unit in the Direct Tuning Mode. To return to the Active/Preset Tuning Mode, hold down the transfer key for two seconds.

13 - RADIO TUNING ANNUNCIATION

- Identifies the frequency at the top and bottom lines.

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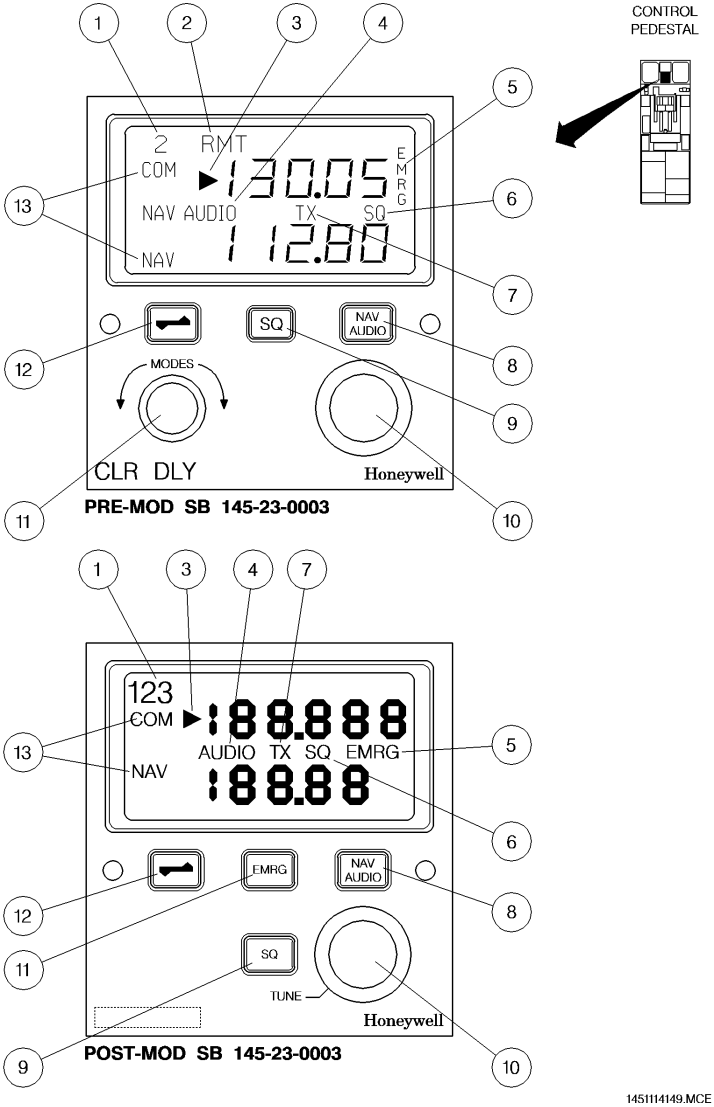

TUNING BACKUP CONTROL HEAD

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DIGITAL AUDIO PANEL

The EMB-145 is equipped with three individual Digital Audio Panels (DAP), one each for the captain, copilot and observer.

This unit allows each flight crew member to select an individual transceiver, the intercommunication function further permitting individual selection and audio level adjustment of the following communications equipment:

- VHF communication
- Crew/ramp station intercommunication
- Passenger address
- Reception and amplification of the NAV/COM audio signals

NORMAL MODE

In the normal mode, each flight crew member may select one COM transceiver (VHF COM 1, VHF COM 2, VHF COM 3 or HF), the interphone function and, simultaneously, several audio receivers (COM 1, 2 and 3, HF, NAV 1 and 2, ADF 1 and 2, and DME 1 and 2).

Also, the unit may provide volume control for each radio equipment, microphone selection between Boom and Mask (Oxygen Masks), and audio output selection between Speakers and Headphones.

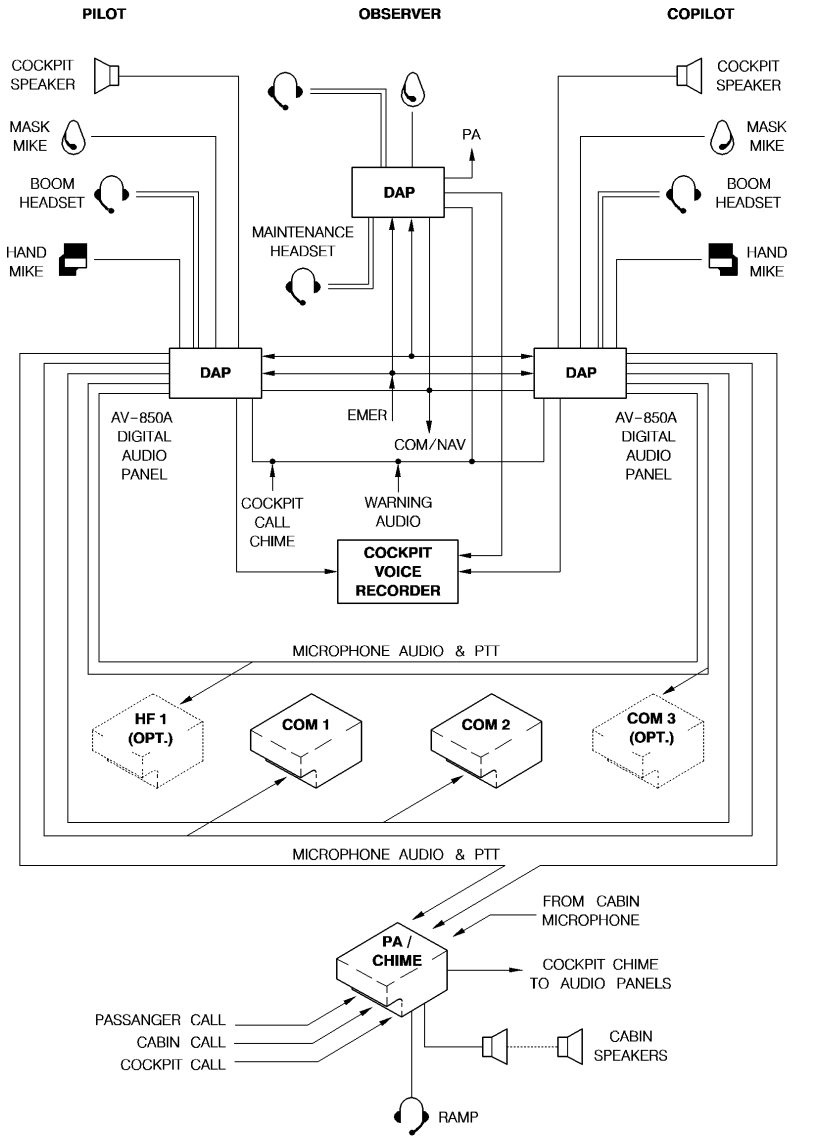
Other features are the capability to filter the NDB/VOR audio signals, attenuating morse code or voice signals. Finally, Normal Mode allows marker beacon audio sensitivity control, which also may silence temporarily that type of signal.

EMERGENCY MODE

The emergency mode must be selected in case of Digital Audio Panel power loss. In this case the captain will be directly connected to the COM 1 and NAV 1 and the copilot to the COM 2 and NAV 2.

The interphone function will also be lost.

If power is recovered the Digital Audio Panel may be returned to the normal mode of operation by selecting another MICROPHONE button (COM 1, 2, 3 or HF).



COMMUNICATION SYSTEM SCHEMATIC

DIGITAL AUDIO PANEL CONTROLS AND INDICATORS

1 - MICROPHONE SELECTOR BUTTONS

- When pressed enables transmission and reception of radio signals through the respective COM unit (COM 1, COM 2, COM 3, HF).
- Simultaneous selection of more than one microphone selector button is not possible. Pressing a different microphone selector button will cause the previously selected button to be deselected.
- A bar illuminates inside the button to indicate that it is pressed.

2 - AUDIO CONTROL KNOBS

- When depressed, turns on the associated COM/NAV audio.
- When rotated, provides volume control for the associated COM/NAV audio.

3 - PASSENGER BUTTON

- When pressed enables the crew to make the speech to the passenger cabin while simultaneously deselecting the previously selected COM transmitter.

4 - EMERGENCY BUTTON

- In case of power loss to the Digital Audio Panel, connects microphone directly to the emergency COM mic outputs and headphone unit to COM and NAV audio.
- The captain is connected to COM 1 and NAV 1 and the copilot to COM 2 and NAV 2. Observer radio communications capability is lost.

5 - BOOM/MASK BUTTON

- Alternates selection between the boom (pressed) and the mask (released) microphones.

6 - ID/VOICE BUTTON

- When pressed (ID position), NDB and VOR audio signals are filtered in order to enhance morse code identification.
- When depressed (VOICE position), VOR/ILS audio signals are filtered in order to reduce morse code signal, enhancing the VOR/ILS voice associated messages (e.g., ATIS messages).

7 - HEADPHONE MASTER VOLUME CONTROL KNOB

- Allows adjustment of headphone amplifier volume.

8 - INTERPHONE SELECTOR KNOB

- When depressed, enables communications between captain, copilot, observer, and ramp station via airplane interphone.
- When rotated, provides interphone volume control.

NOTE: To enable the interphone function the respective control wheel and observer communications switch must also be set at the HOT position.

9 - MARKER BEACON SENSITIVITY/MUTE KNOB

- The mute function is enabled by pressing the marker beacon sensitivity/mute knob and it is used to temporarily silence the marker beacon audio signal. The audio signal will be automatically re-enabled according the following schedule:
  - If the mute function was selected when the marker beacon audio level was above a certain threshold setting, the audio will be re-enabled 5 seconds after the audio level descends below that threshold setting.
  - If the mute function was selected when the marker beacon audio level was below that threshold setting, the audio signal will be mute during 20 seconds, and then it will be re-enabled.
- The marker beacon sensitivity/mute knob, when rotated, also controls the sensitivity of the Marker Beacon receiver.

10 - MARKER BEACON VOLUME KNOB

- When rotated, allows to control the marker beacon audio volume.

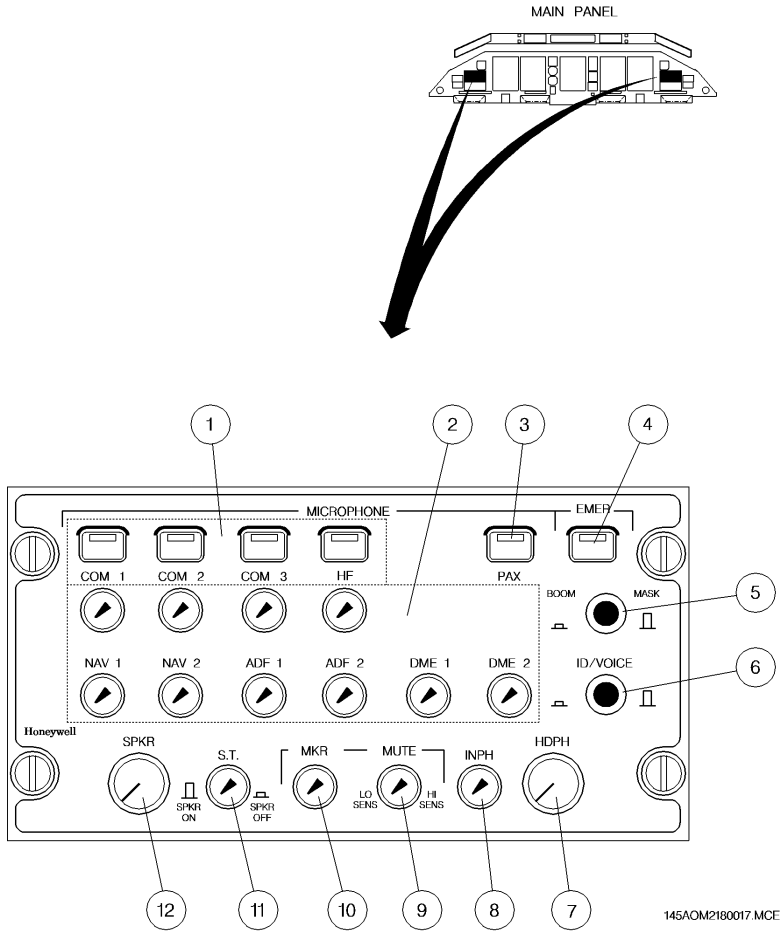
NOTE: Does not allow volume settings below a certain level in order to prevent the marker beacon audio from being adjusted too low to be heard, that the marker signal could be missed.

11 - SIDETONE KNOB

- This knob selects the speaker ON (depressed) or OFF (pressed). It must be pressed when the headphones are used.
- The sidetone control is made by rotating the sidetone knob, which prevents undesirable feedback of speaker sidetone audio into the transmitting microphone.

12 - SPEAKER MASTER VOLUME CONTROL KNOB

- When rotated, allows adjustment of speaker volume.



DIGITAL AUDIO PANEL

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COMMUNICATION CONTROLS AND INDICATORS

COCKPIT

CONTROL WHEEL COMMUNICATIONS SWITCH (PTT)

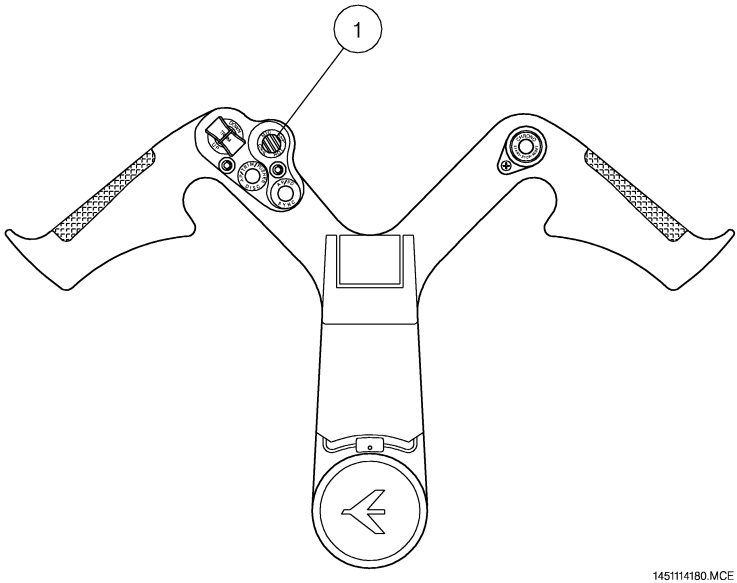
1 - CONTROL WHEEL COMMUNICATIONS SWITCH

PTT POSITION - Momentary position. When pressed allows VHF and HF transmissions and speech to the passengers through Passenger Address System. Releasing this button, it returns to the HOT position and VHF, HF or passenger cabin transmissions will be interrupted.

NOTE: For VHF transmissions, a continuous command of PTT switch is limited to 2 minutes. If the PTT switch is pressed longer than 2 minutes, the message MIC STK will be displayed on RMU, and the microphone will be disabled.

HOT POSITION - Allows communication between crew members and between crew members and ramp station.

OFF POSITION - Allows only audio reception.



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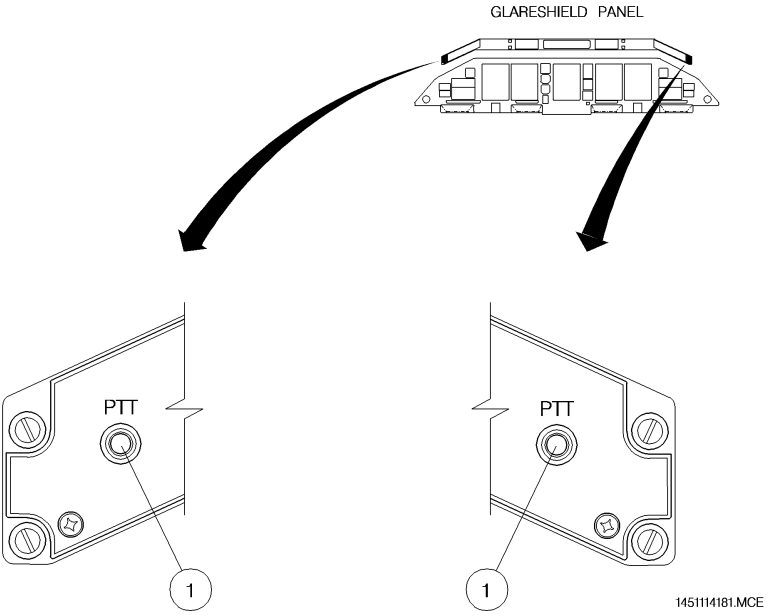
CONTROL WHEEL

GLARESHIELD COMMUNICATION SWITCH (PTT)

1 - GLARESHIELD MIC PTT BUTTON

- When pressed allows VHF and HF transmission and speech to passengers through the Passenger Address System. Releasing this button will interrupt transmission.



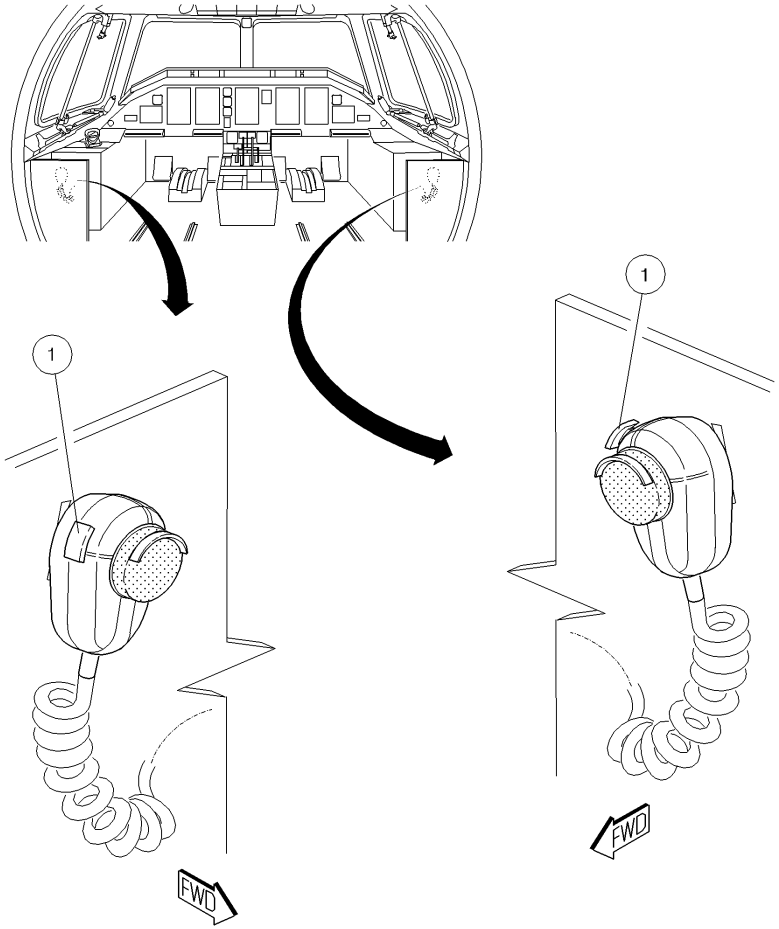
GLARESHIELD PANEL

CAPTAIN AND COPILOT HAND MICROPHONE

1 - HAND MIC PTT BUTTON

- When pressed allows VHF and HF transmission and speech to passengers through the Passenger Address System. Releasing this button will interrupt transmission.

PILOT AND COPILOT CONSOLES



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PILOT AND COPILOT CONSOLE

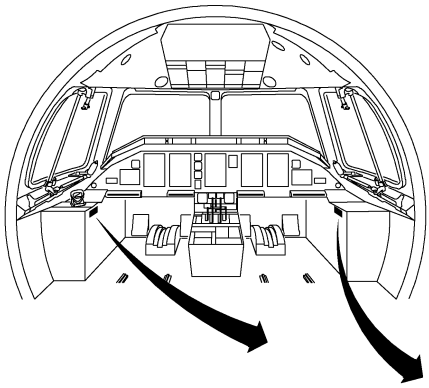
CAPTAIN AND COPILOT JACK PANELS

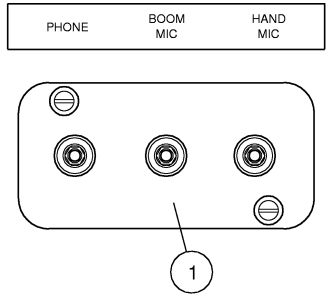
1 - CAPTAIN AND COPILOT JACKS

– Allows plugging-in the headphone, the boom microphone, and the hand microphone.

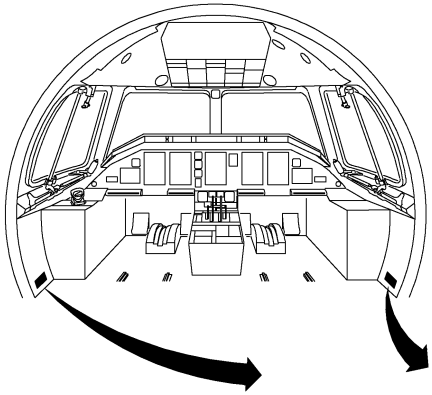
2 - HEADSET ANR

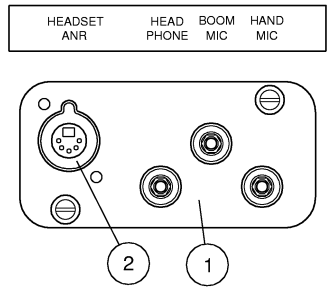
– Allows plugging-in the headphone with the Active Noise Reduction feature.





OR





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CAPTAIN AND COPILOT JACK PANELS

OBSERVER JACK PANEL AND COMMUNICATION SWITCH (PTT)

1 - BOOM JACK

– Allows plugging-in the boom microphone.

2 - HEADPHONE JACK

– Allows plugging-in in the headphone.

3 - OBSERVER MICROPHONE SWITCH

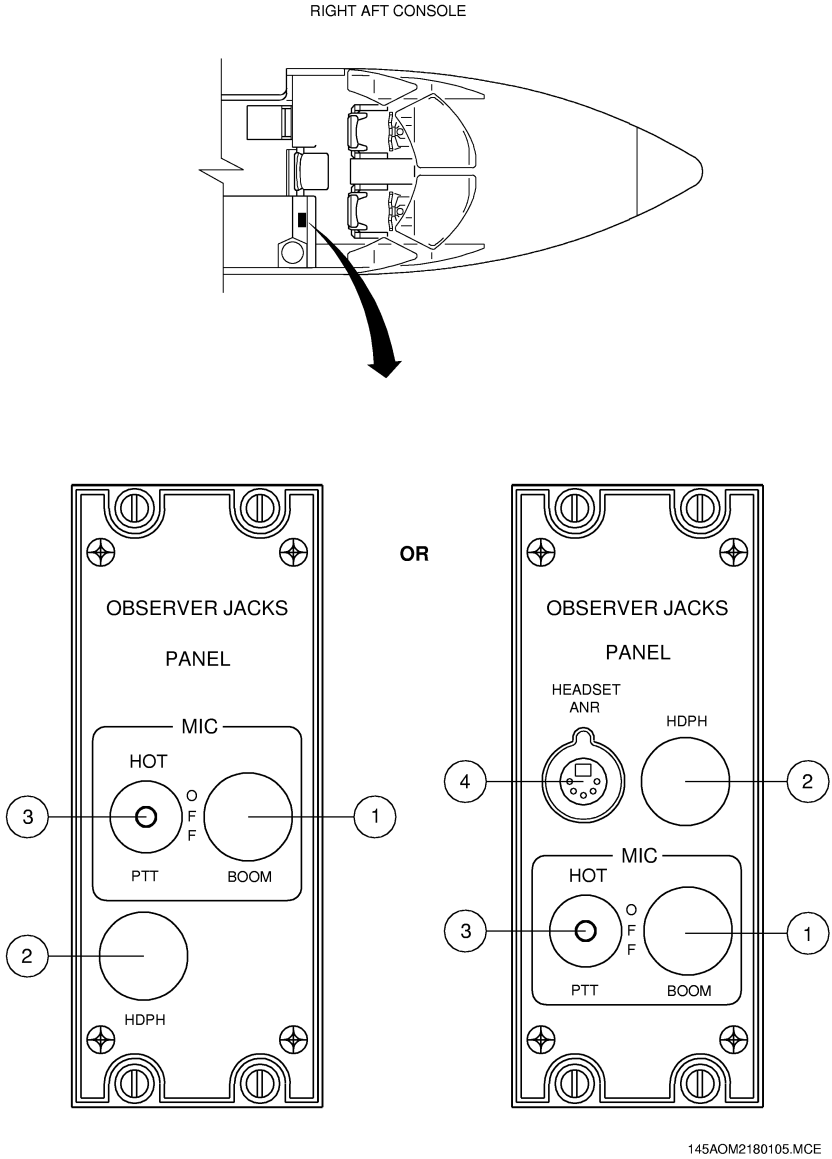
HOT POSITION - Allows communication with crew members and ramp station.

OFF POSITION - Allows only audio reception.

PTT POSITION - Momentary position. When pressed allows VHF and HF transmissions and speech to passengers through the passenger address system. Releasing this button, it returns to the OFF position and transmissions will be interrupted, remaining only in audio reception.

4 - HEADSET ANR

– Allows plugging-in in the headphone with the Active Noise Reduction (ANR) feature. The Sennheiser headset model HMEC25-CAP is certified for ANR function. A switch in the headset cord activates or deactivates the active noise reduction feature. If the noise reduction feature malfunctions the headset must be used with this feature disabled.



OBSERVER JACK PANEL

RAMP STATION

FRONT AND REAR RAMP PANELS

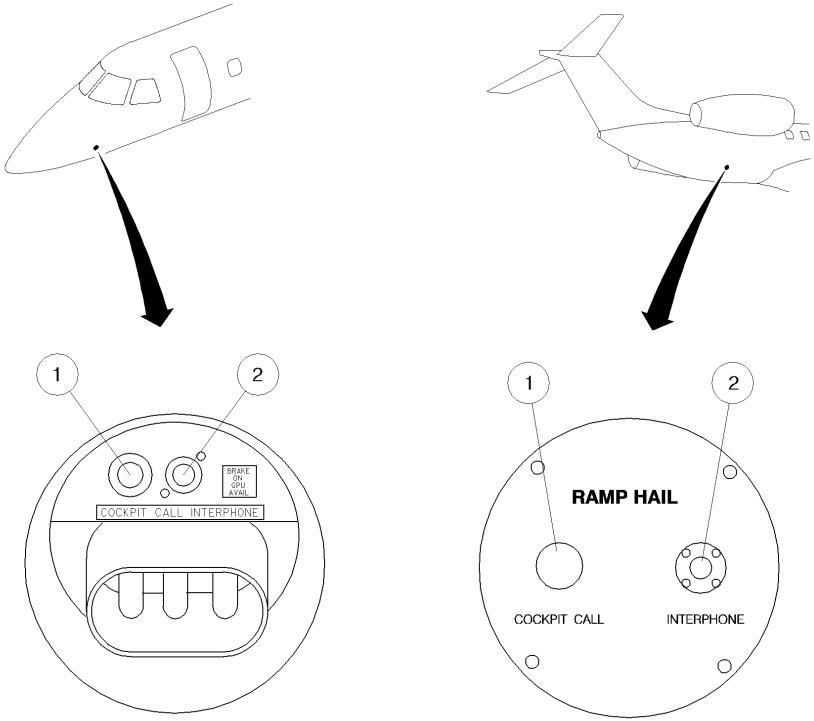
1 - COCKPIT CALL BUTTON (momentary action)

- When pressed, generates a tone in the headphones and cockpit speakers.

2 - MICROPHONE/HEADPHONE JACK

- Allows ramp crew to plug in a headphone and a microphone equipped with a PTT Button.

NOTE: Ground crew panel is linked to the Hot Mic.



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FRONT AND REAR RAMP PANELS

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HF COMMUNICATION SYSTEM - HF-230

The airplane may be equipped with a HF-230 High-Frequency Communication System. All functions of the HF-230 System are controlled by the CTL-230 Control Panel located at the control pedestal.

HF OPERATING MODES

The HF-230 High-Frequency Communications System provides the following operating modes:

AMPLITUDE MODULATION

Amplitude modulation (AM) is a transmission process in which a selected frequency (called carrier frequency) and two sidebands (frequencies above and below the carrier) are generated and transmitted. The upper sideband (USB) is the sum of the carrier frequency and the voice, while the lower sideband (LSB) is the difference between the two. The disadvantages of AM are that it occupies a wide spectrum and is inefficient in the sense that a great deal of unneeded carrier is generated, as well as redundant information in the unused sideband.

SINGLE SIDEBAND

Single sideband operation achieves the same function as AM with considerably greater efficiency. The SSB transmitter electronically eliminates most or all of the carrier wave and one of the sidebands. The major advantages of SSB (either USB or LSB) as opposed to AM are greater talking power (about eight times that of AM for a given power input), reduced power drain, longer range and conservation of the spectrum (since only one sideband is required to transmit the message).

SUPPRESSED CARRIER AND REDUCED CARRIER

The SSB operation with the carrier frequency eliminated is referred to as single sideband suppressed carrier and is designated as the TEL SUP CAR mode in the HF-230.
If a small portion of the carrier frequency is transmitted along with the sideband, then the operation is referred to as single sideband reduced carrier. and is designated as the TEL PLT CAR mode in the HF-230.

SIMPLEX AND HALF-DUPLEX OPERATION

Simplex operation means that the transmission and reception frequencies are the same. An example of simplex operation would be communications with a control tower using a VHF COMM transceiver. Half-duplex means transmit on one frequency and reception on another frequency. All 176 of the ITU channels provided the HF-230 are permanently programmed for half-duplex operation and will normally be worked in the TEL SUP CAR mode. The 40 user programmed channels can be programmed for either simplex or half-duplex operation, and can operate in any of the available modes (AM, USB, LSB, TEL SUP CAR, or TEL PLT CAR).

NOTE: The use of LSB is legal for some international and off-shore communications, but is not authorized for use in the United States and most European countries.

HF NORMAL OPERATION

There are two types of operation:

- Discrete frequency tuning.

- Programmable channel.

DISCRETE FREQUENCY TUNING OPERATION

In the discrete frequency mode of operation, the user may directly tune any one of 280,000 frequencies over the range of 2.0 to 29.9999 MHz.

1 - Access discrete frequency operation.

Apply power to the system by rotating the volume (V) knob clockwise from the OFF position.
With power applied to the system, ensure that the CHAN/FREQ switch is in the FREQ position.
This can be confirmed by noting that four dashes appear in the CHAN display.

2 - Enter the frequency.

Use the four frequency select knobs to enter the desired frequency in the FREQ kHz display.

3 - Select the transmission mode.

Pull out and rotate the left inner (PULL MODE) knob in either direction, to assign one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR).

4 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. A steady 1000-Hz tone will be heard in the headset or speaker while the antenna coupler is been tuned. Approximately 1 second after antenna coupler tuning cycle is completed (tuning cycle may require from 5 to 30 seconds), the 1000-Hz tone will cease, indicating that the system is ready for use on the selected frequency. Adjust volume (V) and squelch (S) controls as desired.

NOTE: - The discrete frequency mode always provides simplex operation (transmit and receive frequencies are the same).

- Always key the PTT after selecting a new frequency to initiate the antenna coupler tuning cycle. If this is not done, you may experience poor reception or miss important calls.
- During operation, if the receive (R) or transmit (T) annunciators on the CTL-230 flash, this indicates that the receive or transmit (as applicable) frequency data does not match that being sent by the CTL-230. An equipment malfunction is probable and the system should be checked by maintenance personnel.

PROGRAMMABLE CHANNEL OPERATION

In the channel mode operation, the user may select ITU and user programmed channels by their channel numbers. For user programmed channels:

1 - Access channelized operation.
Apply power to system (rotate the V knob from the OFF position), and position the CHAN/FREQ switch to the CHAN position.

2 - Rotate the left outer channel select knob until user channel 1 or 40 appears on the right side of the CHAN display. Use the right outer channel select knob to select the desired channel number within the user programmed channels.

3 - Tune the antenna.
Momentarily key the PTT to initiate antenna coupler tuning cycle. Adjust volume and squelch controls, as desired.

THE 40 USER CHANNELS PROGRAMMING PROCEDURE

The 40 user programmable channels available in the HF-230 system can be programmed on the ground or in flight. All programmed information is stored in a nonvolatile memory and can be recalled by selecting the desired user channel number.

There are three types of channels that can be programmed:

1 - Half-duplex
The user programs two different frequencies, one for receive and one for transmit. The user also assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) to the selected channel. Half-duplex operation is available only when the HF-230 is being operated in the CHAN mode.

2 - Simplex

The user programs the same frequency for receive and for transmit. The user also assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) to the selected channel. Simplex operation is used by ARINC, ATC (Air Traffic Control), and others.

3 - Receive-only

The user programs a frequency for reception and assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR), but does not program a transmit frequency.
The transmitter and power amplifier are locked out and cannot be used when a channel has been programmed for receive-only operation.

Receive-only channels are used to listen to frequency standards (WWV) for example, time, weather, Omega status, and geophysical alert broadcasts

HALF-DUPLEX CHANNEL PROGRAMMING PROCEDURE

1 - Access channelized operation.
Apply power to the system by rotating the volume (V) knob clockwise from the OFF position. With power applied to the system, ensure that the CHAN/FREQ switch is in the CHAN position.

2 - Select the desired user channel.

Rotate the left outer channel select knob in either direction until user channel 1 or 40 appears at the right side of the CHAN display. Then use the right outer channel select knob to select the desired channel number (from 1 to 40) that you wish to program.

3 - Initiate program mode.

Press the program (PGM) button once to initiate the programming sequence. At this point, the entire display on the CTL-230 will slowly begin to blink.

4 - Enter the receive frequency and mode of operation.

Set the desired receive frequency using the four frequency select knobs. This procedure is identical to tuning a discrete frequency which has been previously described. The receive frequency will appear in the FREQ kHz display. Next, select the desired operating mode (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) by pulling out on the PULL MODE knob and rotating it until the appropriate mode appears in the MODE display.

5 - Store the receive frequency and mode of operation.

With the desired receive frequency and mode being displayed, press the PGM button once again to store the data. The CTL-230 display will blank for a short period of time to confirm storage.

6 - Enter and store the transmit frequency.

When the display returns, it will be blinking faster with the transmit frequency displayed (initially this is the same as the already programmed receive frequency). At this point, you have approximately 20 seconds to begin entering the desired transmit frequency. If no changes are made during the next 20 seconds, the currently displayed transmit frequency will become invalid and you will have created a receive-only channel. Set the desired transmit frequency using the four frequency select knobs. This procedure is identical to entering the receive described above. With the desired transmit frequency shown in the FREQ kHz display, press the PGM button once again to store the data.

As before, the CTL-230 display will blank for a short period of time to confirm storage. The display will then return to normal with the new channel data (channel number, mode, and receive frequency) showing.

7 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. Adjust the volume (V) and squelch (S) controls, as desired.

NOTE: If additional user channels are to be programmed, repeat steps 2 through 6 at this time. Ensure that you make and keep for reference a list of channel numbers, and the receive and transmit frequencies, as well as the mode of operation that are programmed on the individual channels.

SIMPLEX CHANNEL PROGRAMMING PROCEDURE

When you program a channel for simplex operation, both the receive and the transmit frequencies will be the same. Programming a simplex channel is similar to programming a half-duplex channel, except the PGM button is pressed twice after the receive frequency and mode of operation are entered to store the frequency in both the receive and the transmit positions.

RECEIVE-ONLY CHANNEL PROGRAMMING PROCEDURE

When you program a channel for receive-only operation, only a receive frequency is entered and stored. Programming a receive-only channel is similar to programming a simplex channel except the PGM button is pressed only once after the receive frequency and mode of operation are entered. The programming sequence is then terminated without entering a transmit frequency.

Program sequence can be terminated in any one of the three ways:
- By momentarily keying the PTT.
- By positioning the CHAN/FREQ switch to FREQ and then back to CHAN.
- By waiting for the 20-second timer to run out (this is the preferred method).

THE 176 ITU CORRESPONDENCE CHANNELS OPERATION

The 176 ITU (International Telecommunication Union) public correspondence channels (and their receive and transmit frequencies) in the maritime radiotelephone network are permanently programmed in the nonvolatile memory of the CTL-230 Control. The 176 ITU channels all operate half-duplex in TEL SUP CAR (preferred) or TEL PLT CAR modes only.

Perform the following steps to operate on the ITU channels:

1 - Access channelized operation.

Apply power to the system by rotating the volume (V) knob clockwise from the OFF position.
With power applied to the system, ensure that the CHAN/FREQ switch is in the CHAN position.

2 - Select the desired ITU channel.

Rotate the left outer channel select knob in either direction until the desired ITU band appears in the one or two left-hand digits in the CHAN display. Next use the right outer channel select knob to select the individual channel number within the ITU band (the two right-hand digits in the CHAN display.
When the ITU channel numbers have been entered, the airplane receive frequency will appear in the FREQ kHz display and the R annunciator will be illuminated.

NOTE: Refer to a list of the ITU maritime radiotelephone channels to see that the above incrementing and decrementing changes are consistent with the actual ITU channel numbers.

3 - Select the operating mode.

Pull out and rotate the left inner (PULL MODE) knob in either direction to select between TEL SUP CAR or TEL PLT CAR mode.
When the mode has been selected, push the knob back in.

4 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. A steady 1000-Hz tone will be heard in the headset or speaker while the antenna coupler is tuning. Approximately 1-second after completion of the antenna coupler tuning cycle (tuning cycle may require from 5 to 30 seconds), the 1000-Hz tone will cease, indicating that the system is ready for use on the selected ITU channel. Adjust volume (V) and squelch (S) controls as desired.
When transmitting, the receive frequency and R annunciator in the FREQ kHz display are replaced with the aircraft transmit frequency and a T annunciator.

FAULT INDICATION

If the antenna coupler does not tune after approximately 35 to 40 seconds, the steady 1000-Hz tone will begin to beep, indicating a fault has occurred. To clear the fault, simply rotate one of the Frequency/Channel Select Knobs away from and then back to the desired frequency or channel and initiate another tuning cycle by momentarily pressing the PTT button. The 1000-Hz tone should again be heard and then disappear at the end of the tuning cycle. If the beeping recurs, try the clearing procedure a second time. If a fault is still indicated, there is probably an equipment malfunction.

HF CONTROLS AND INDICATORS

CTL-230 CONTROL PANEL

1 - GAS DISCHARGE DISPLAY

- Shows channel number (CHAN), mode of operation (MODE), transmit and receive frequency in kilohertz, and separate R (receive) and T (transmit) annunciators.

2 - CHANNEL FREQUENCY SELECT KNOBS

- Knob functions when selecting a discrete frequency

FREQUENCY SELECT KNOB	KNOB FUNCTION
Left outer	Selects the MHz digits (2 through 29) in the FREQ kHz display.
Left inner (pushed in)	Selects the 100-kHz digit (0 through 9) in the FREQ kHz display.
Left inner (pulled out)	Rotate to select USB, AM, LSB modes.
Right outer	Selects the 10-kHz digit (0 through 9) in the FREQ kHz display.
Right inner (pushed in)	Selects the 1-kHz digit (0 through 9) in the FREQ kHz display.
Right inner (pulled out)	Selects the 100-Hz digit (0 through 9) in the FREQ kHz display.

– Knob functions when selecting a user programmed channel.

CHANNEL SELECT KNOB	KNOB FUNCTION
Left outer	Rotate until brings up user channel number 1 or 40. If user channel 1 is being displayed, the next clockwise increment of the knob will cause ITU channel 401 to be displayed, then 601, 801, and on. User channels are designated by 1-or 2-digit channel numbers appearing at the right side of the CHAN display (the left two or three digits are blanked).
Left inner (pushed in or pulled out)	No effect on user channels.
Right outer	With user channel 1 displayed, clockwise rotation of this knob will increment through the 40 user channels one channel at a time. The next increment past user channel 40 will cause the lowest ITU channel number (401) to be called up. With user channel 40 displayed, counterclockwise rotation of the right outer knob will decrement through the user channels, 1 channel at a time. The next decrement past user channel 1 will cause the highest ITU channel number (2510) to be called up.
Right inner (pushed in or pulled out)	No effect on user channels.

– Knob functions when selecting an ITU telephone channel

CHANNEL SELECT KNOB	KNOB FUNCTION
Left outer	This knob is used to select the ITU band (the one or two left-hand digits in the CHAN display). Clockwise rotation of the knob increments the CHAN display to the next higher ITU band and counterclockwise rotation decrements to the next lower ITU band. If ITU channel 401 is being displayed, the next clockwise increment of the knob will cause ITU channel 601 to be displayed, then 801, 1201, 1601, and 2201. Rollover occurs between the top ITU band (22 MHz) and user programmed channel number 1, and between the lowest ITU band (4 MHz) and user programmed channel number 40.
Left inner (pushed in)	No effect on ITU channels.
Left inner (pulled out)	Rotate to select between TEL SUP CAR and TEL PLT CAR models.
Right outer	This knob selects the individual channel number within the ITU band (the two right-hand digits in the CHAN display). If the channel number is incremented beyond the highest channel for that band, the lowest channel for the next higher band will appear. For example, if ITU channel 427 is being displayed, the next clockwise increment of the knob will cause ITU channel 601 to be displayed. Likewise, decrementing below the lowest channel in a band will select the highest channel in the next lower band.
Right inner (pushed in or pulled out)	No effect on ITU channels

3 - PROGRAM BUTTON

- Allows the user to store frequencies in the 40 user programmed channels (refer to Programmable Channel Operation section for proper operation).

4 - CHANNEL/FREQUENCY SWITCH

- The channel/frequency select knobs are used to select the desired user channel or ITU telephone channel number (CHAN/FREQ switch positioned to CHAN) or the proper transmit and receive frequencies when operating in the discrete frequency mode number (CHAN/FREQ switch positioned to FREQ). The knobs are also used to enter frequencies when programming the user channels number (CHAN/FREQ switch positioned to CHAN).

5 - SQUELCH/TEST CONTROL

- This knob is adjusted to mute undesired background noise. The noise proper setting is made by rotating the S (squelch) knob clockwise from TST (test) position until background noise can be heard and by turning it counterclockwise until the background noise disappears or is just barely audible.
- When the S knob is in the TST position, the squelch circuit is, in effect, removed from the receiver audio circuit in the TST, maximum background noise (depending on the volume control setting) will be heard.
- Setting the squelch control too far clockwise can result in blocking out weak signals. There are times when it will be necessary to leave the squelch control in the TST position to maintain satisfactory reception. This is because of conditions relating to propagation and the ionosphere that causes the HF receiver to operate with a signal that is subject to considerable fading and which is marginally strong.

6 - OFF/ CLARIFIER CONTROL

- Concentric with the volume knob, and sharing the same OFF position, the CLAR knob is used when receiving SSB signals that may be slightly off frequency.
- The CLAR knob can help eliminate unnatural sounds when receiving USB, LSB, or either of the telephone modes.
- The clarifier function does not affect AM reception, and is disabled during transmit or when the CLAR knob is set to OFF position.
- To operate the clarifier, rotate the CLAR knob clockwise from off until the centering dot is visible on the knob skirt at the mid rotation point. This is the neutral or zero shift position. From this position, the CLAR knob is adjusted clockwise or counterclockwise for the best clarity or the most natural sound of the signal being received.

NOTE: When the audio quality of the received SSB signal is good and natural sounding, the CLAR knob should remain in the OFF position.

7. OFF/VOLUME CONTROL

- Turns system off and on and controls volume. Rotating the V knob clockwise from the OFF position turns the system on. Continued clockwise rotation increases audio level. When the system is turned OFF, the discrete frequency or channel, and mode of operation displayed on the CTL-230 will be stored in nonvolatile memory and will be restored to the display the next time the system is turned on.

  NOTE: It is recommended that the HF-230 system be turned on at least 15 minutes before use, to ensure frequency stability under varying environmental conditions.

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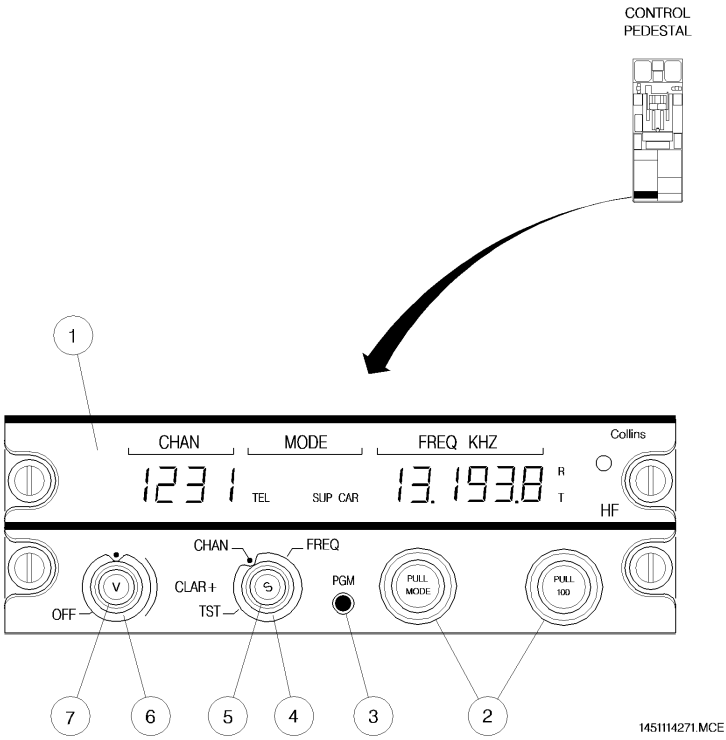

CTL-230 HF CONTROL PANEL

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THIRD VHF COMMUNICATIONS SYSTEM

The airplane may be equipped with a third VHF Communications System. All functions of the Collins VHF-22A System are controlled by the CTL-22 VHF Control Panel located at the main panel.

The Avionics Master DC Bus 1 supplies the third VHF Communications System with a protective 5A circuit breaker.

THIRD VHF COM CONTROLS AND INDICATORS

1 - ACTIVE FREQUENCY DISPLAY

- Displays the active frequency (frequency to which the equipment is tuned) and diagnostics messages.

2 - XFR/MEM SWITCH

- This is a 3-position, spring-loaded toggle switch.
- When held to the XFR position, the preset frequency is transferred up to the active display and the equipment retunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window.
- When held to the MEM position, one of the six stacked memory frequencies is loaded into the preset display.
- Successive pushes cycle the six memory frequencies through the display.

3 - FREQUENCY SELECT KNOBS

- Two concentric knobs control the preset or active frequency displays.
- The large knob changes the digits to the left of the decimal point in 1 MHz steps.
- The smaller knob changes the digits to the right of the decimal point in 0.005 MHz steps.
- Numbers roll over at the upper and lower frequency limits.

4 - ACTIVE BUTTON

- Push the ACT button for about 2 seconds to enable the frequency select knobs to directly retune the VHF-22A (active frequency).
- The bottom window will display dashes and the upper window will continue to display the active frequency.
- Push the ACT button a second time to return the control to the normal 2-display mode.

5 - TEST BUTTON

- The self-test diagnostic routine is initiated in the transceiver by pushing the TEST button.
- The active and preset display intensity will flash, modulating its brightness from minimum to maximum indicating self-test in progress.
- The active frequency display will show four dashes and the preset frequency display will show “00”.
- An audio tone will be heard from the audio system.
- At the completion of the self-test program, the display will return to its normal operation if no problem occurs.
- In case of a detected failure, “diAG” (diagnostic) letters will be displayed in the active and a 2-digit diagnostic code will be displayed in the preset display.
- Record any diagnostic codes displayed to help maintenance personnel in locating the problem.

6 - STORE BUTTON

- The STO button allows up to six preset frequencies to be selected and entered into the controls non-volatile memory.
- After presetting the frequency to be stored, push the STO button. The upper window displays the channel number of available memory (CH1 through CH6); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the MEM switch may be used to advance through channel numbers without changing the preset display. Push the STO button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

7 - POWER AND MODE KNOB

OFF - Turns off the system.
ON - Turns on the system.
SQ OFF - Disables the receiver squelch circuits. Use this position to set volume control or, if necessary, to try to receive a very weak signal that cannot operate the squelch circuits.

8 - ANNUNCIATORS

- The COM control contains MEM (memory) and TX (transmit) annunciators.
- The MEM annunciator illuminates whenever a preset frequency is being displayed in the lower window.
- The TX annunciator illuminates whenever the VHF-22A is transmitting.

9 - PRESET FREQUENCY DISPLAY

- Displays the preset (inactive) frequency and diagnostics messages.
- The frequencies displayed on the COM control show only five of the six digits.

10 - COMPARE ANNUNCIATOR

- ACT momentarily illuminates when active and preset frequencies are being switched.
- ACT flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

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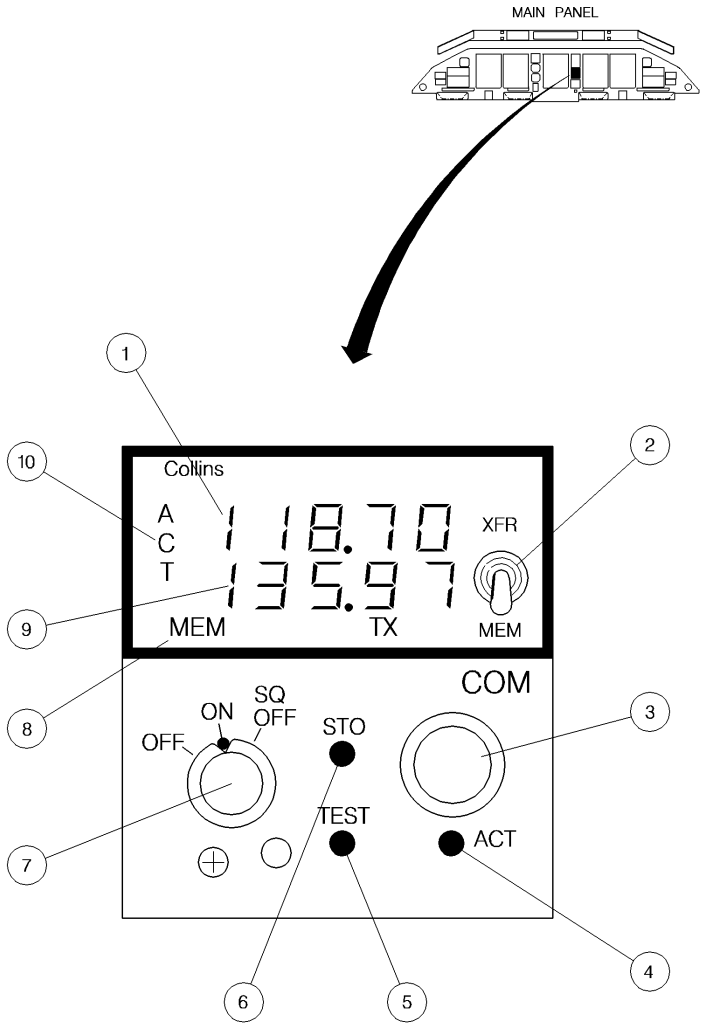

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CTL-22 VHF CONTROL PANEL

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SELCAL SYSTEM

The Ground-to-Air Selective Calling (SELCAL) System operates in conjunction with the communication radios. The SELCAL provides continuous monitoring of a pre-set frequency, eliminating the need to continuously monitor the communication frequencies by the flight crew.

The SELCAL permits ground stations, equipped with encoding equipment, to call individual airplane by transmitting a coded signal. This coded signal will activate only one SELCAL unit to respond to that particular coded signal. In this case, a SELCAL voice message is activated through the Aural Warning Unit. Once activated, the system is reset for further monitoring by pressing the SELCAL Button, located on the Main Panel, or actuating the PTT function (on Control Wheel or glareshield panel).

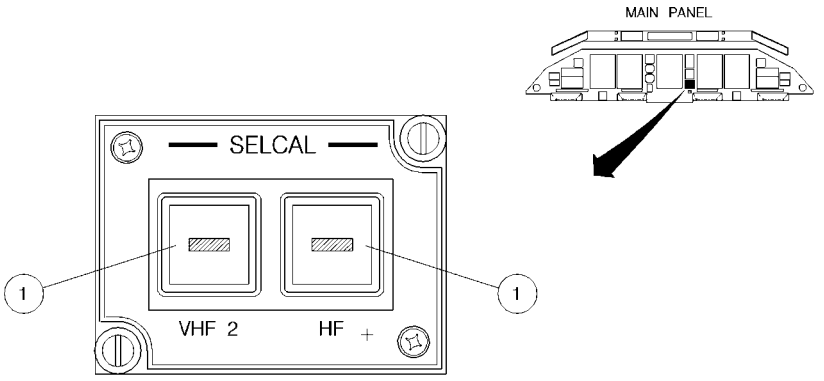
NOTE: - For some airplanes the SELCAL enables only the VHF 2 operation or only the HF operation.

- SELCAL will recognize the coded signal from ground stations only if the associated system (HF or VHF2) is powered on and its frequency is adjusted to the ground station frequency.

SELCAL CONTROLS AND INDICATORS

1 - SELCAL BUTTON

- A striped bar illuminates inside the associated button to alert the crew that communication is desired on VHF 2 or HF. A SELCAL voice message sounds simultaneously.
- When pressed, after a system activation, the striped bar extinguishes and the system is reset.



NOTE: FOR SOME AIRPLANES THE SELCAL PANEL IS PROVIDED WITH ONLY ONE BUTTON (EITHER VHF2 OR HF).

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SELCAL PANEL

COCKPIT VOICE RECORDER

The Solid State Cockpit Voice Recorder System records all audio signals transmitted and received by the crew members via the Digital Audio Panels, and any audible noise in the cockpit, through an area microphone installed below the standby compass.

The CVR is in operation whenever the essential DC Bus 2 is energized, storing the last 2 hours of recorded information in a solid state crash survivable memory unit. Any data older than 2 hours is automatically overwritten by the most recent audio inputs.

A crash impact switch cuts off power to the CVR immediately after experiencing a 5 G impact in order to preserve the recorded data.

The CVR also incorporates an Underwater Locator Beacon (ULB). Powered by a dedicated battery, the ULB starts transmitting an acoustic signal in the 37.5 kHz frequency once it senses contact with water, thus easing wreckage site location of a submerged airplane. The signal is transmitted during approximately 30 days.

A signal from the captain's clock allows timing correlation between CVR and FDRS.

SELF TEST

When the TEST button is pressed the unit performs a functional self-test to verify the integrity of the system. A successful self-test results in a one-second activation of the status LED on the control panel and a two-second tone (800 Hz for Honeywell equipment and 620 to 660 Hz for L3 equipment) that may be heard from a headphone plugged to the CVR control panel jack. If a failure is detected during the test, the status LED will not be activated and the aural tone will not be heard.

ERASE FUNCTION

Previously recorded CVR data may be made unavailable if the ERASE button on the CVR control panel is pressed, provided the airplane is on the ground and with the parking brake applied. In this case, only the CVR manufacturer (for Honeywell equipment) will be able to recover the “erased” data.

When the ERASE button is pressed (for 2 seconds for L3 equipment), a two-second 400 Hz tone may be heard from a headphone plugged to the CVR control panel jack, confirming that the erase command was successful.

COCKPIT VOICE RECORDER CONTROLS AND INDICATORS

1 - ERASE BUTTON

- Erases previously recorded data from the crash survivable memory.
- Function is available only on the ground, with the parking brake applied.

2 - TEST BUTTON

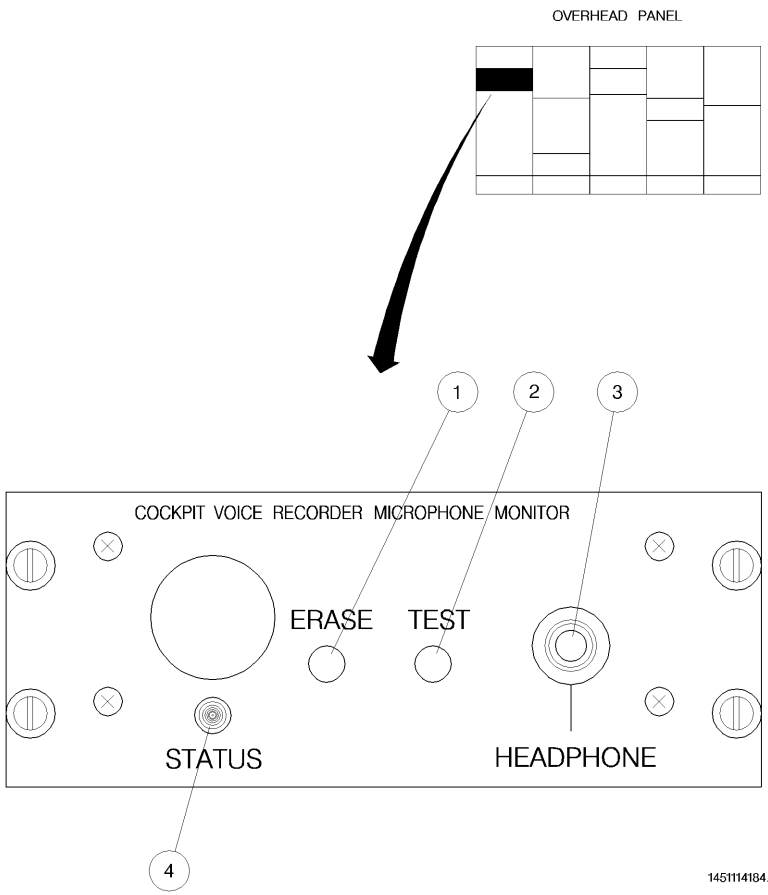
- Tests system integrity.
- A successful self-test results in a one second activation of the status LED.
- In case of failure, the status LED on the control panel is not activated.

3 - HEADPHONE JACK

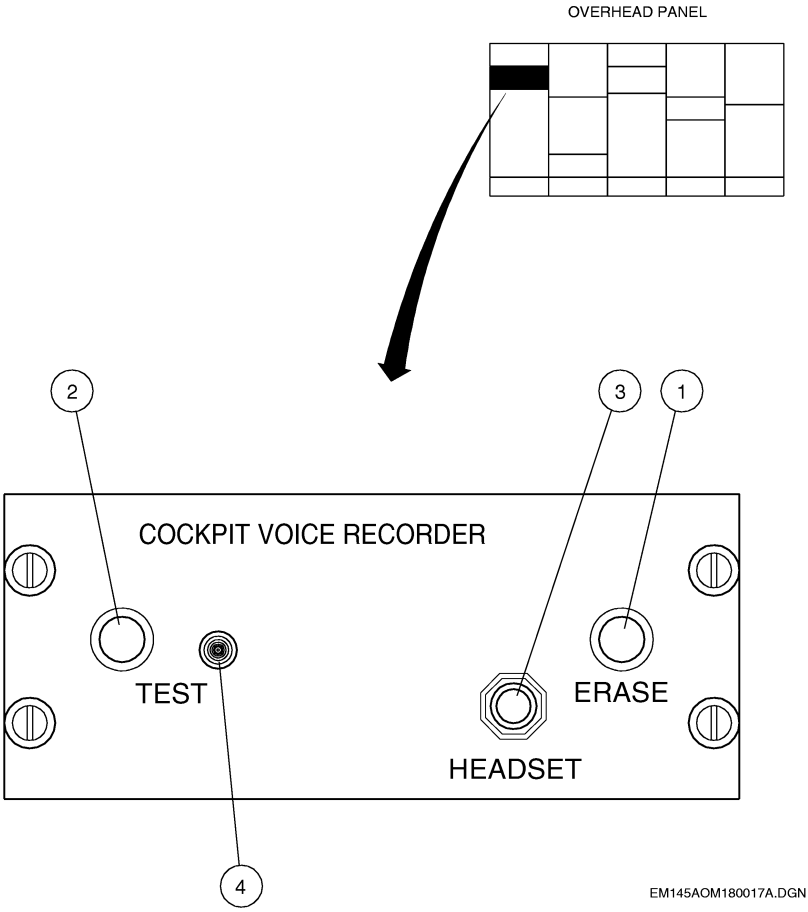
- Allows plugging a headphone to monitor the test tone, the erase tone and recorded audio signals.

4 - STATUS LED

- Illuminates during one second to indicate a successful test.



HONEYWELL COCKPIT VOICE RECORDER PANEL



L3 COCKPIT VOICE RECORDER PANEL

PASSENGER ADDRESS SYSTEM

The Passenger Address System (PAS) provides communication between cockpit and flight attendants, and announcements from cockpit or flight attendants to the passenger cabin.

The PAS also interfaces with the audio entertainment and prerecorded announcement systems to provide music and safety briefing/flight information through the passenger loudspeakers.

The following functions are available through the PAS:

– Voice announcement transmission (speech) to the PAX cabin.
– Call function from captain, copilot and observer to flight attendant and vice-versa through chime tone.
– Call function from passenger to attendant, through chime tone.
– Chime tone for NO SMOKING and FASTEN SEAT BELTS signals.
– Interface to boarding music and passenger briefing.

The PAS component responsible for sending/receiving signals to/from cockpit, attendant handsets, and for passenger entertainment and prerecorded announcement systems is the Passenger Address Amplifier (PAA), located in the airplane electronic compartment.

The PAA establishes the priority among the input signals from the several sources and then drives these signals to the proper cabin loudspeakers. The PAA also provides the logic for generation of the aural and visual annunciators, chimes for attendant, passenger and cockpit calls, and for NO SMOKING and FASTEN SEAT BELTS signals.

PASSENGER ADDRESS OPERATING MODES

MUTED MODE

The Muted Mode is automatically selected during power up and when no other mode is selected. In this mode there will be no chimes, no lights and no microphones enabled during power up or power supply transients.

PILOT-TO-PASSENGER MODE

The Pilot-to-Passenger Mode is enabled by pressing the Passenger Button, labeled PAX, on the Digital Audio Panel. When this mode is enabled the captain, copilot or observer may transmit announcements to the passengers, by pressing the respective PTT. The priority of the transmission through the system is the following: captain, copilot, observer. There are no chimes in this mode.

ATTENDANT-TO-PASSENGER MODE

The Attendant-to-Passenger Mode is enabled by pressing the PA Button in the Attendant Handset. When this mode is enabled the flight attendant may transmit announcements to the passengers, by pressing the Attendant Handset PTT. If the PAX Button is selected on the Digital Audio Panel in the cockpit, besides listening the attendant announcements in the cockpit speaker or headphones, the pilots and observer take priority over the attendant announcements.

Some airplanes have a knob installed in the main panel or in the control pedestal which allows to adjust the volume of the PA announcements in the flight deck.

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PASSENGER ADDRESS CONTROLS AND INDICATORS

INTERPHONE CONTROL UNIT

1 - CABIN BUTTON

- Allows interphone communication between pilots and flight attendant.
- Generates a “ding-dong” chime through the Passenger Address Amplifier and illuminates the PILOT light on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that it is pressed.

2 - CABIN EMERGENCY BUTTON

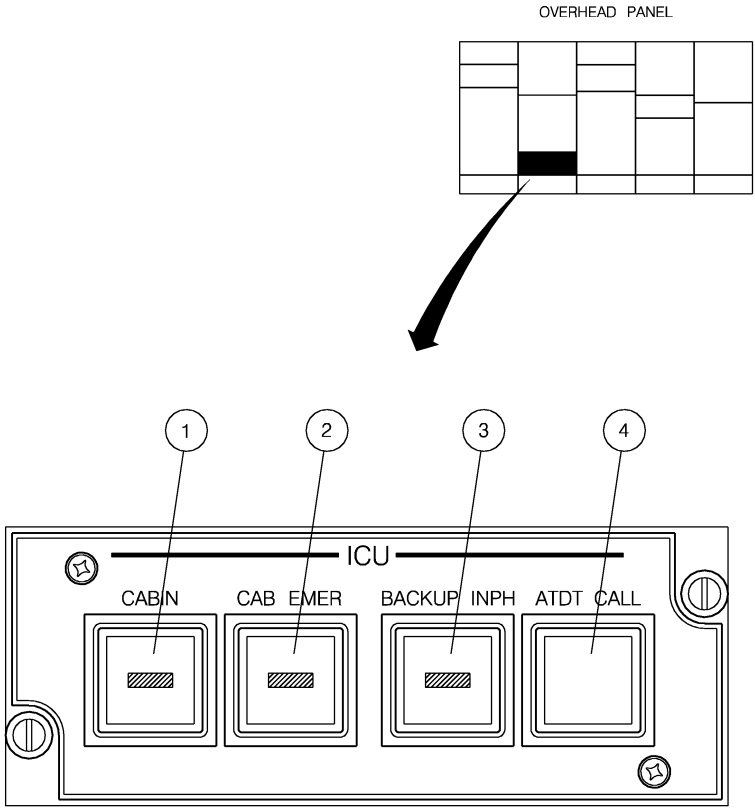
- Provides the same functions as the Cabin Button, except that it illuminates the Pilot Emergency Light, labeled EMER PILOT, on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that it is pressed.

3 - BACKUP INTERPHONE BUTTON

- Allows interphone communication between pilots and attendant, in case of normal mode failure.
- Illuminates CABIN and CAB EMERG buttons on the ICU, and PILOT and EMERG PILOT annunciators on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that is pressed.

4 - FLIGHT ATTENDANT CALL BUTTON

- Generates a chime in the passenger address, to call a flight attendant.
- During backup operation generates a tone in the chime located in the passenger cabin ceiling, near the emergency exits.



INTERPHONE CONTROL UNIT

ATTENDANT HANDSET

1 - PRESS TO TALK BUTTON

- When pressed allows flight attendant to address the passengers, or communicate with the other flight attendant station or pilots, depending on the channel selected.

2 - BUTTONS AND ANNUNCIATORS

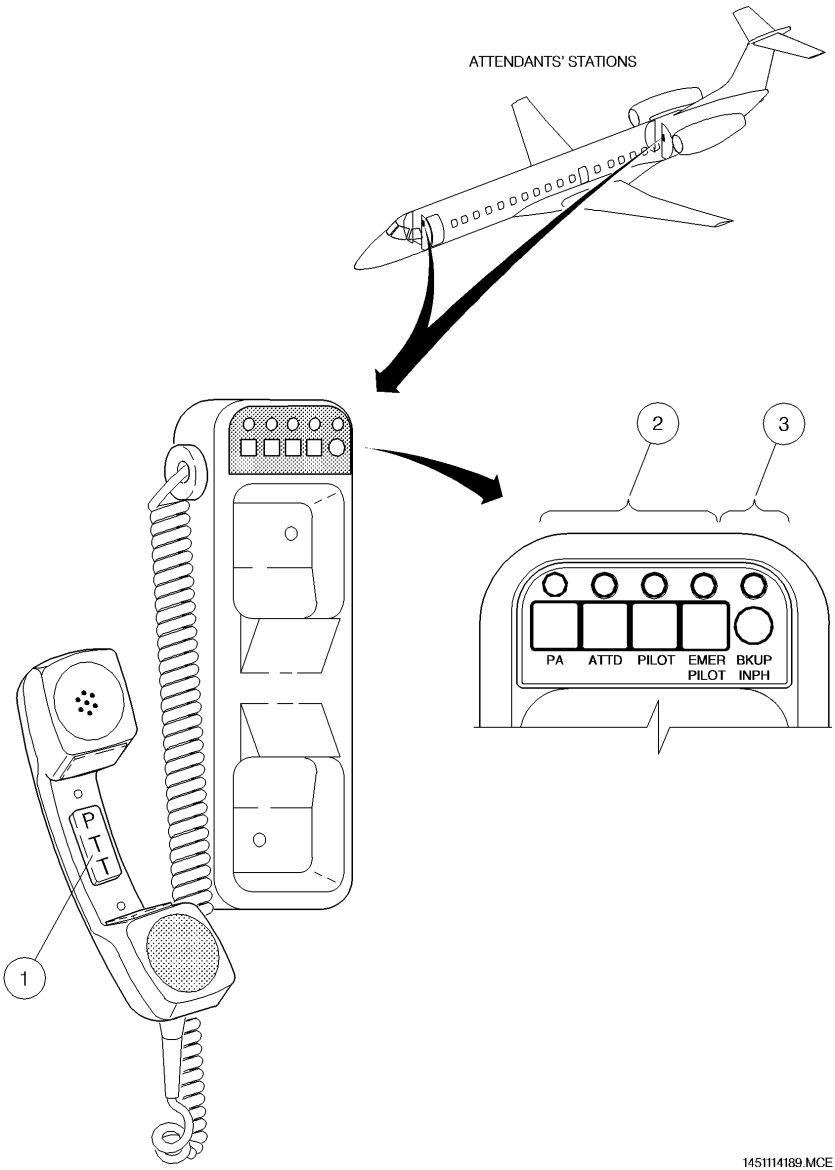
- When pressed and according to the selected channel it allows the flight attendant to address the passengers (PA), or to communicate with the other attendant station (ATTD) or pilots (PILOT and EMER PILOT). The associated annunciator illuminates to indicate which button is pressed.
- Annunciator colors:
  - ATTD, PILOT and PA: green.
  - EMER PILOT: red.

3 - BACKUP INTERPHONE BUTTON

- When pressed, establishes a permanent communication between pilots and flight attendant, in case of normal mode failure.
- When pressed, BKUP INPH, EMER PILOT, and PILOT annunciators of the station which commanded the backup mode remains illuminated.
- BKUP INPH annunciator is amber.

ATTENDANT'S CALL PANEL

Refer to Section 2-2 – Equipment and Furnishings.



ATTENDANT HANDSET

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ATTITUDE AND HEADING REFERENCE SYSTEM (AHRS)

On EMB-145/135 airplanes, the equipment responsible for generating attitude and heading data is the Attitude and Heading Reference System (AHRS). Optionally the AHRS may be replaced by the Inertial Reference System (IRS) that, aside generating attitude and heading data, may still provide position information to the Flight Management System (FMS).

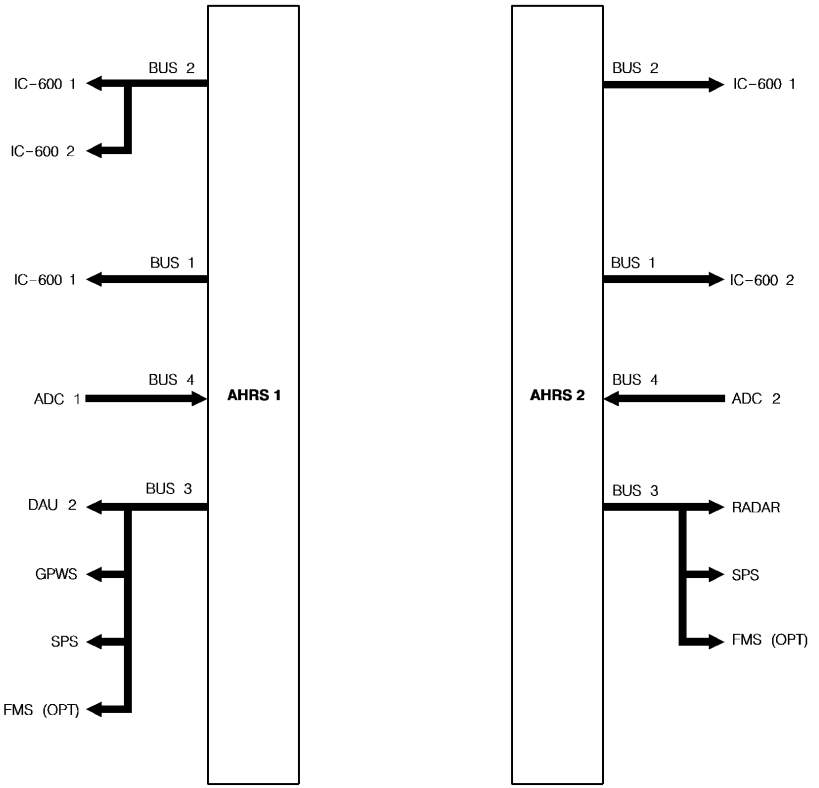
There are two types of AHRS installed on EMB-145/135 airplanes: the AH-800 and the AH-900.

Regardless of version, the airplane is equipped with two identical and independent units, identified as AHRS 1 and AHRS 2.

The interface of the AHRS with other systems and equipment of the airplane is the following:

- Air Data Computers (ADC 1 and ADC 2): The AHRS 1 and AHRS 2 receive true airspeed information from the ADC 1 and ADC 2 respectively, to improve the precision of the computed navigation data.
- Integrated Computers (IC1 and IC2): The AHRS 1 and AHRS 2 provide pitch, roll and heading information to the respective PFD, and heading information to the respective MFD, through the IC-600s. Data is transmitted separately to both sides, to ensure that single IC failure does not compromise the data path.
- Radio Management Units (RMU 1 and RMU 2): The AHRS 1 provides heading information to both RMUs via DAU 2.
- Autopilot System: The AHRS 1 provides pitch, roll and acceleration information to the Autopilot System via IC-600-1.
- Weather Radar: The AHRS 2 provides attitude information to the Weather Radar for antenna stabilization.
- Flight Management System (FMS): The AHRS provides attitude and heading information to the FMS.
- EGPWS/GPWS: The AHRS 1 provides attitude and heading information to the EGPWS/GPWS.

– Stall Protection System (SPS): The AHRS provides attitude rate variation and vertical acceleration information to the SPS.
– Integrated Standby Instrument System (ISIS): the AHRS 1 provides heading information to the ISIS.
– Windshear Detection And Escape Guidance System: The AHRS 1 provides attitude rate variation and vertical acceleration information to the windshear computer.
– Flight Data Recorder (FDR): The AHRS 1 provides attitude and heading information to the FDR via DAU 2 and IC-600.



AHRS SCHEMATIC

AH-800 AHRS VERSION

Each AH-800 AHRS consists of an Attitude and Heading Computer (AHC), a Magnetic Flux Detector Unit (MFDU), a Memory Module and an AHRS Control Panel.

Each AHC uses two 28 VDC power inputs, one for normal power (primary source) and other for backup power (airplane batteries). The AHC 1 primary power source is the Essential DC Bus 1 and its backup power source is the Backup Essential Bus. The AHC 2 primary power source is the DC Bus 2 and its backup power source is the Backup Bus 2. If the AHC loses the primary power, it automatically transfers to backup power.

When the AHC operates solely on backup power, it will operate for 40 minutes.

ATTITUDE AND HEADING COMPUTER (AHC)

The major component of the AHRS is the AHC. The AHC contains three single axis interferometer fiber optic gyros (IFOG) mounted along the principal axis of the unit to measure the airplane angular motion. The signals processed and generated by the IFOGs as well as the information of attitude, heading and airplane axis accelerations are transmitted by the AHC in digital format to the airplane systems and equipment interfaced with the AHRS. In addition, the AHC provides excitation, current feedback control and signal demodulation interfaces to the flux detector.

MAGNETIC FLUX DETECTOR UNIT (MFDU)

The AHRS uses the wing tip mounted MFDU as long term magnetic reference. The flux detector senses the horizontal component of the earth magnetic field and provides continuous magnetic heading reference to the AHC. The heading reference is processed by the AHC to compute an inertial stabilized magnetic heading output.

MEMORY MODULE

The memory module is used to store the AHC mounting tray alignment coefficients, flux valve compensation coefficients and discrete data (orientation, source/destination identifier and interface digital buses).

AHRS CONTROL PANEL

The AHRS control panel allows canceling the magnetic field distortion as well as selecting the Directional Gyro (DG) or Slaved (SLVD) Modes.

AH-800 OPERATING MODES

The AHRS has six fundamental operating modes, which are described below.

– **Initialization mode:** The Initialization Mode is entered upon power up of the system. During the operation in this mode the AHRS performs self-tests to determine the condition of its components (sensors, AHC, power supply, etc). Furthermore the AHRS performs a first order leveling process to determine pitch and roll, and further slaves the magnetic heading to the flux valve. At the end of the Initialization Mode the system enters the Full Performance Mode, unless the crew selects the DG Mode or the system detects a lack of input, in this case reverting automatically to the Basic Mode.

– **Full Performance Mode:** The Full Performance Mode (slaved) is the standard system operating configuration. When operating in this mode, the TAS input from the ADC is used in the vertical channel (pitch and roll) to produce a Schuler tuned erection loop for pitch and roll attitude, and the flux valve is used as a continuous heading reference.

NOTE: When switched from DG to SLVD (Full Performance Mode) the system performs automatic synchronization to the flux valve.

– **DG Mode:** The DG Mode, which causes the heading channel to operate as a free non-slaved gyro, is selected by the flight crew and is used when operating in charted areas of unreliable magnetic heading or in case of a failure in the flux valve.

– **Basic Mode:** The Basic Mode is entered automatically by the system if the TAS becomes invalid. AHRS attitude output in this mode is corrected by a simple first-order erection loop similar to that of a conventional vertical gyro.

– **Test Mode:** The Test Mode is to be operated mainly by the ground personnel during maintenance procedures. This mode is activated through a switch located in the maintenance panel behind the pilot seat when the airplane is on the ground. During the test, the system verifies the outputs for proper operation of the data channels, interconnections and indications.

– **Maintenance Mode:** The Maintenance Mode is used for maintenance purposes only.

AH-800 EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	AHRS 1 (2) OVERHEAT	The associated AHRS computer is overheated.
ADVISORY	AHRS 1 (2) BASIC MODE	The TAS input signal from the ADC has been lost in the associated AHRS.

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AH-800 CONTROLS AND INDICATORS

AHRS CONTROL PANEL

1 - AHRS MODE SELECTOR SWITCH

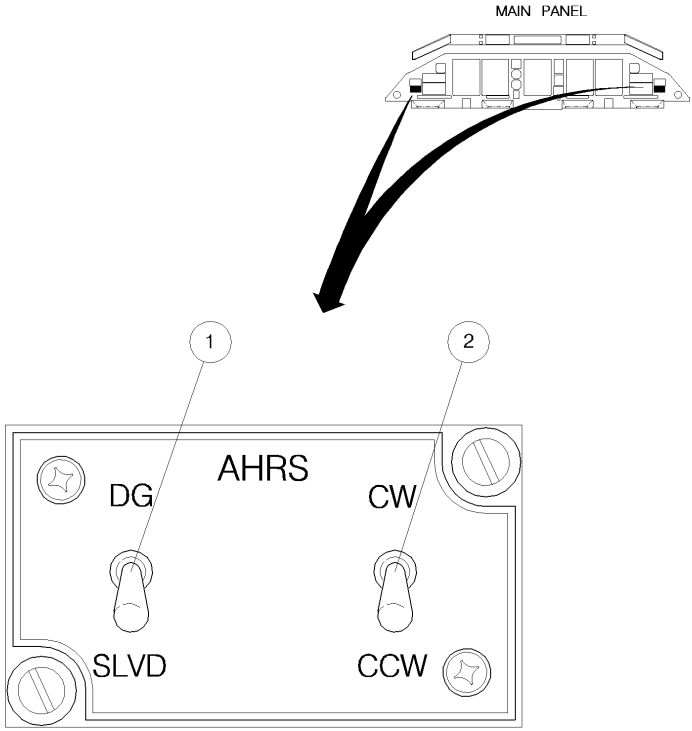
DG - Selects the Directional Gyro Mode. In this condition the AHRS heading channel operates as a free non-slaved gyro.

SLVD - The AHRS operates slaved to the flux valve, which will provide a continuous heading reference.

2 - SLEWING SWITCH

CW - Allows selection, in the clockwise direction, of the desired heading to which the gyro will be slaved when the AHRS is not slaved to the magnetic heading of the flux valve (DG Mode selected).

CCW - Allows selection, in the counter-clockwise direction, of the desired heading to which the gyro will be slaved when the AHRS is not slaved to the magnetic heading of the flux valve (DG Mode selected).



AHRS CONTROL PANEL (AH-800 VERSION ONLY)

AH-900 AHRS VERSION

The AH-900 AHRS version is basically an attitude and heading reference system that senses linear motion and angular rates through inertial sensors. Heading orientation is also obtained through the inertial sensors, dispensing the magnetic flux detectors.

Each AHRS consists of one Attitude and Heading Reference Unit, the AHRU 1 and AHRU 2, located in the forward electronics compartment.

There are no cockpit control panels.

ATTITUDE AND HEADING REFERENCE UNIT (AHRU)

The Attitude and Heading Reference Unit contains three laser gyros and three accelerometers that are mounted on each of the three axis inside of the AHRU, which it uses to measure inertial motion.

The AHRU requires initialization data from the Flight Management System (FMS) and Air Data Computer (ADC). From inertial measurements, initialization data, and air data inputs, the AHRU performs the calculations necessary to provide heading and attitude data to the airplane.

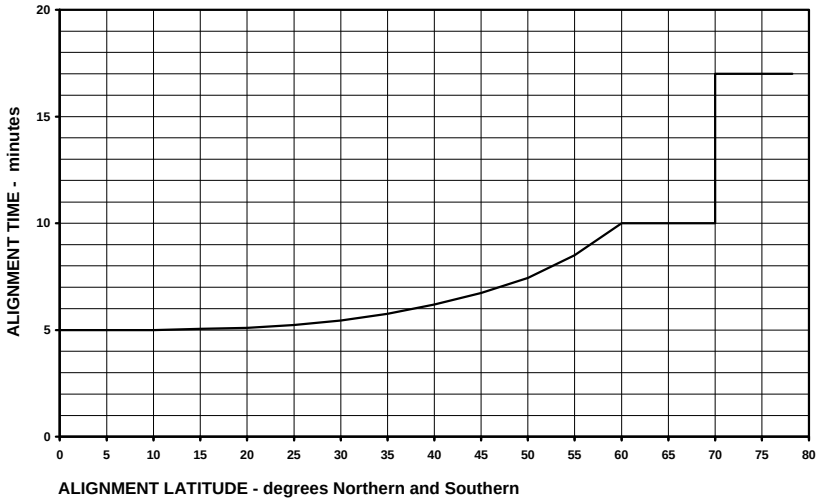
Each AHRU uses two 28 VDC power inputs, one for normal power (primary source) and the other for backup power (airplane batteries). The AHRU 1 primary power source is the Essential DC Bus 1 and its backup power source is the Backup Essential Bus. The AHRU 2 primary power source is the DC Bus 2 and its backup power source is the Backup Bus 2. If the AHRU loses primary power, it automatically transfers to backup power.

When the AHRU operates solely on backup power, it will operate for 40 minutes and the AHRS 1 (2) ON BATT advisory message will be presented on the EICAS.

AH-900 OPERATING MODES

ALIGNMENT MODE

The alignment mode initiates when the airplane is energized. The AHRU aligns its reference axis to the local vertical and true north, and estimates the horizontal earth rate components to compute latitude. The latitude at which the AHRU is aligned affects the alignment time. The relationship between alignment time and latitude is shown in the chart below.



The airplane must remain stationary during alignment (AHRS 1 (2) ALN advisory message presented on the EICAS). If the AHRU detects excessive airplane motion (AHRS 1 (2) EXC MOTION advisory message is presented on the EICAS), it starts an automatic full realignment 30±1 seconds after the motion stops. Normal passenger-loading or cargo-loading activities should not cause excessive airplane motion condition.

NOTE: To complete the alignment, the AHRU requires a valid input of the airplane's present position (latitude and longitude) from the FMS or optionally through the MFD 1. The present position input through MFD 1 bezel is possible only in airplanes equipped with EICAS 18.5 and on.

If the present position is not entered during the normal alignment time, the AHRS 1 (2) ALN FAULT caution message will be displayed on the EICAS. For airplanes equipped with EICAS 18.5 and on, the AHRS 1 (2) NO PPOS or ARHS 1-2 NO PPOS advisory messages will be displayed on it. The AHRU will not enter the NAV mode until it receives a valid position input.

The AHRU accepts multiple entries of latitude and longitude, which means that various positions may be stored. This feature allows the pilot to select the current position previously stored, instead of enter it again.

A new position entry writes over the previous entry. More than one entry may be necessary to confirm, update or correct the position. This occurs because the AHRU does not accept new position inputs until 2 seconds after the previous input or new position input that has more than 1 degree of disagreement from the stored latitude/longitude from the last power down from the NAV mode.

The AHRU conducts a position-compare test on latitude and longitude immediately after each data has been entered. The AHRU uses only the latest entry for its test calculations. To pass the test, the entered data must compare within 1 degree of the stored latitude/longitude from the last power down from the NAV mode. If the test fails, the AHRS 1 (2) ALN FAULT caution message is presented on the EICAS.

For airplanes equipped with EICAS 18.5 and on, whenever the airplane is on the ground and the AH-900 is in align mode, the MAP/PLAN label on MFD 1 main menu changes to PPOS INIT. By selecting PPOS INIT, the operator will access the Present Position Initialization menu, and will be able to set the present- position coordinates with the data set knob or confirm the stored one. The coordinates are sent to the AH-900 computer when the ENT bezel button is pressed.

No attitude and heading data is displayed during align mode.

NAVIGATION MODE

The AHRU enters the NAV mode from the align mode. In the NAV mode, the AHRU uses the last valid position data entered during the align mode as its initial present position, and updates the present position based only on inertial data while it remains in the NAV mode. The AHRU algebraically adds computed magnetic variation from a magnetic variation topographical map (MAGVAR) to true heading and true track to produce magnetic heading and track magnetic angle. The magnetic heading and magnetic tracking angle outputs are set to no computed data (NCD) inside a northern and southern latitude cutout area.

ATTITUDE MODE

The attitude mode is the AHRU's reversionary mode. It is automatically entered by the AHRU if power is lost in flight, and it provides a quick attitude restart: during the first 20 seconds in the attitude transitional mode, the AHRU enters the erect attitude transitional mode. In this transitional mode the AHRS 1 (2) ALN advisory message is displayed on the EICAS and the AHRU computes a new level axis set. The aircraft must be held steady, straight and level until the AHRS 1 (2) ALN message extinguishes.

When operating in the attitude mode the AHRS 1 (2) ATT MODE advisory message is presented on the EICAS. In this mode, attitude outputs are not as accurate as when operating in the NAV mode, and magnetic heading is not available.

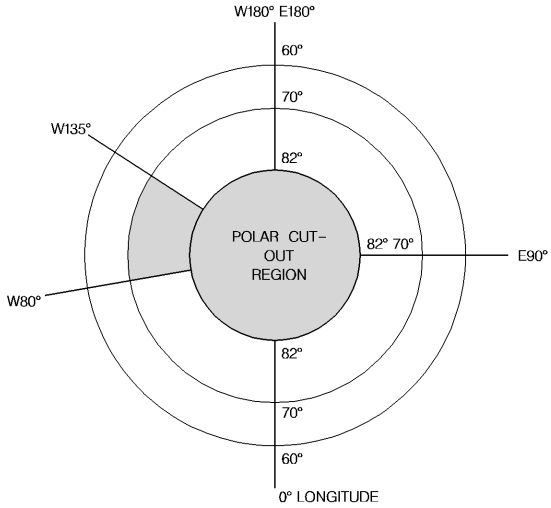
For airplanes equipped with EICAS 18 and on, the AH-900 must be initialized with magnetic heading. In this case the operator needs to know the airplane's magnetic heading. Whenever the airplane is in the air and the AH-900 is in attitude mode, a menu bezel button annunciates MHDG INIT on the pilot's MFD. The AHRS 1 (2) NO MAG HDG or AHRS 1-2 NO MAG HDG advisory messages will be displayed on the EICAS. By selecting MHDG INIT, the operator will access the Magnetic Heading Initialization menu, and will be able to set the magnetic heading with the data set knob. The magnetic heading data is sent to the AH-900 computer when the ENT bezel button is pressed. The associated EICAS messages are cleared.

POWER-DOWN MODE

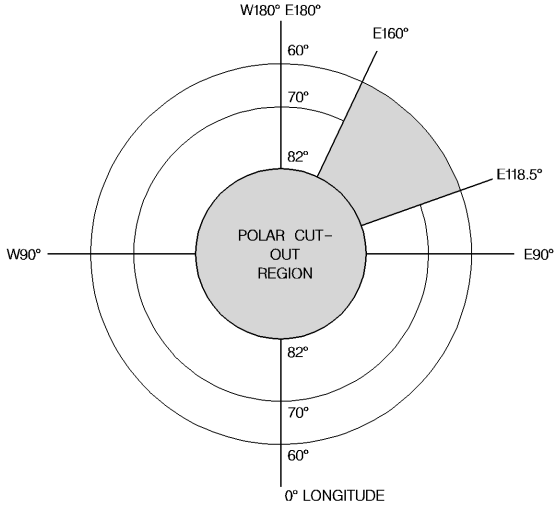
The AHRU enters the power-down mode automatically when the system detects an "end-of-flight" event. In this mode, the AHRU will transfer the last calculated position and other AHRS parameters to its non-volatile memory.

AH-900 EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	AHRS 1 (2) OVERHEAT	The associated AHRS is overheated.
	AHRS 1 (2) ALN FAULT	The associated AHRS did not complete the alignment phase successfully.
	AHRS 1 (2) FAIL	The associated AHRS has failed.
ADVISORY	AHRS 1 (2) ATT MODE	The associated AHRS is in the attitude mode.
	AHRS 1 (2) ALN	The associated AHRS is in the alignment phase.
	AHRS 1 (2) ON BATT	The associated AHRS is being powered by the airplane batteries.
	AHRS 1 (2) EXC MOTION	The associated AHRS detected excessive motion during the alignment phase.
	AHRS 1 (2) NO PPOS	The present position has not been set.
	AHRS 1-2 NO PPOS	The present position has not been set.
	AHRS 1 (2) NO MAG HDG	Magnetic heading has not been set.
	AHRS 1-2 NO MAG HDG	Magnetic heading has not been set.



NORTHERN LATITUDE CUTOUT



SOUTHERN LATITUDE CUTOUT

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MAGNETIC VARIATION LATITUDE CUTOUTS (AH-900 ONLY)

AHRS INDICATIONS ON THE PFD

ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

1 - ATTITUDE SPHERE

- Color:
  - Sky: blue.
  - Ground: brown.

2 - ROLL SCALE

- Color: White
- Range: 360 degrees.
- Resolution: 10, 20, 30 and 60 degrees for left and right roll attitudes.
- Fixed pointers (unfilled triangles) are located at zero degrees and 45 degrees (LH and RH).

3 - ROLL POINTER

- Color: White.
- Provides the roll angular indication against the roll scale.

4 - EXCESSIVE PITCH CHEVRONS

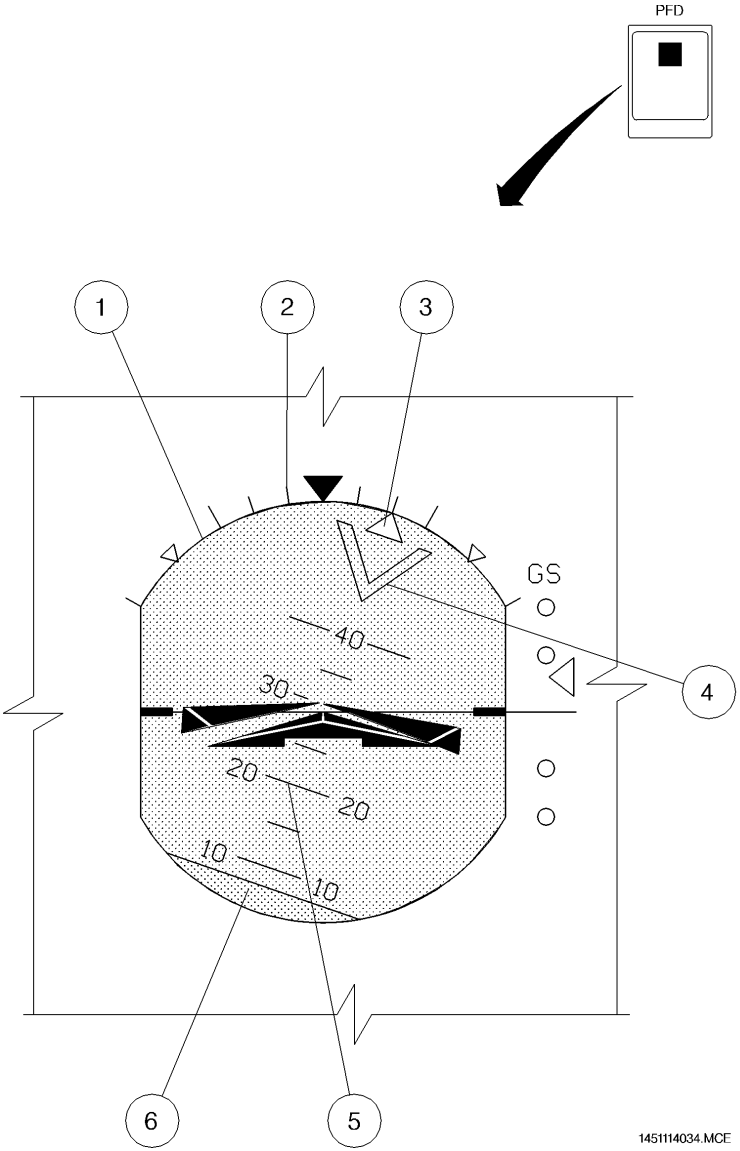
- Color: Red
- Marks –45 and 65 degrees pitch up, and 35, 50 and 65 degrees pitch down.

5 - PITCH SCALE

- Color: White.
- Range: 0 to 90 degrees (pitch up and pitch down).
- Marks:
  - Pitch up: 0, 5, 10, 15, 20, 25, 30, 40, 60 and 90 degrees.
  - Pitch down: 5, 10, 15, 20, 25, 30, 45, 60 and 90 degrees.

6 - GROUND/SKY REFERENCE EYEBROW

- Color: Blue or brown.
- The eyebrow provides a quick ground/sky reference for attitudes where the horizon line is out of the display.



ELECTRONIC ATTITUDE DIRECTOR INDICATOR

ATTITUDE DECLUTTER

When there is an excessive attitude situation, certain indicators are removed in order to declutter the PFD.

Excessive attitude situation occurs when roll attitude is greater than 65 degrees, or pitch attitude greater than 30 degrees nose up or 20 degrees nose down.

In this case, the following symbology shall be removed from the display:

– Flight Director couple arrow,
– Low Bank limit arc,
– Flight Director command bars,
– Vertical Deviation scale, pointer and label,
– Radio Altitude digits, label and box,
– Marker beacons indicators,
– Decision Height digits and labels,
– Selected Airspeed bug and indicators,
– Vertical Speed bug and indicators,
– Selected Altitude bug, indicators and box,
– All failure flags associated with the items listed above,
– The Heading, Radio Altitude, LOC, GS, and ILS comparison monitor displays

The PFD indicators will be restored when both conditions below are met:

– Roll attitude less than 63 degrees left and right.
– Pitch less than 28 degrees nose up and greater than 18 degrees nose down.

ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

1 - COMPASS CARD DISPLAY

May be displayed in the Full Compass or Arc formats, selected via the Display Control Panel (see section 2-18-40).

- Color: white.
- Range: 360 degrees.
- Resolution: 5 degrees.

2 - HEADING LUBBER LINE (FULL COMPASS FORMAT)

- Color: White.
- Provides the current heading reading against the heading scale.

3 - CURRENT HEADING DIGITAL DISPLAY (ARC FORMAT)

- Color:
  - Open box: white
  - Digits: white
- Range: 0 to 360 degrees.
- Resolution: 1 degree.

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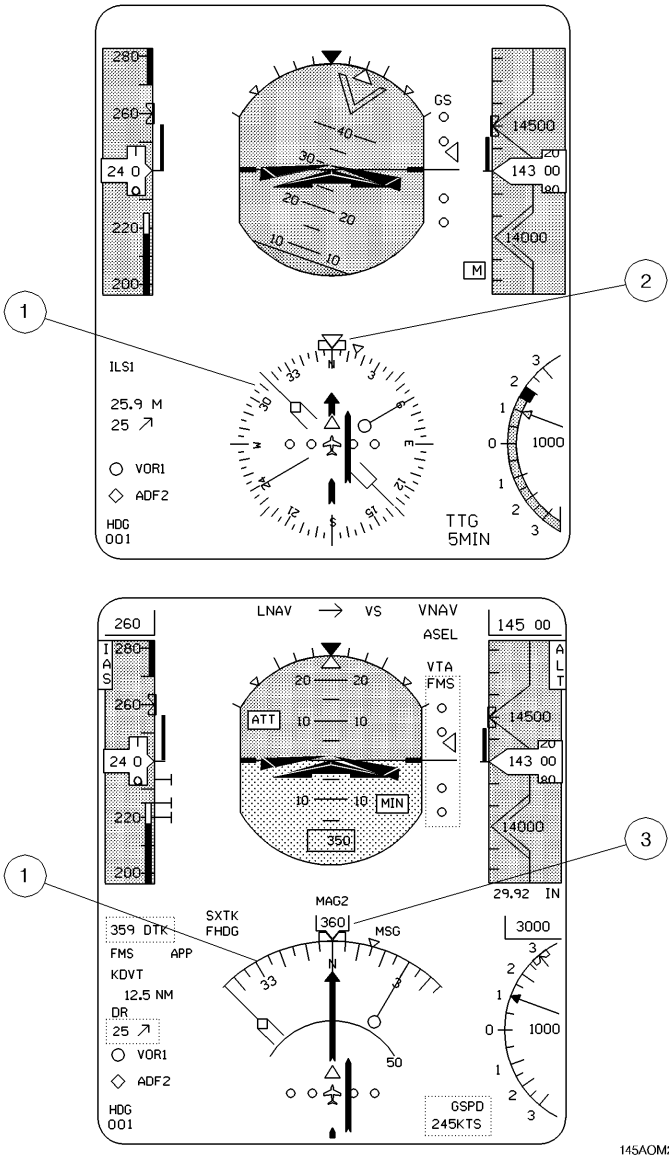

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EHSI - FULL COMPASS AND ARC FORMATS

COMPARISON MONITORS

1 - ATTITUDE COMPARISON MONITOR DISPLAY

- Label: ROL, PIT or ATT.
- Color: Amber.
- If roll information deviates by more than 6 degrees between PFD 1 and PFD 2, a ROL comparison monitor will be displayed inside the attitude sphere.
- If pitch information deviates by more than 5 degrees between PFD 1 and PFD 2, a PIT comparison monitor will be displayed in the upper-left portion of the attitude sphere.
  Simultaneous activation of the both pitch and roll comparison monitors will be announced by an ATT label displayed in the upper-left portion of the attitude sphere, in the same field of the ROL and PIT comparison monitors.

2 - ATTITUDE FAILURE DISPLAY

- Removal of the pitch scale and roll pointer.
- Coloring the attitude sphere all blue.
- A red ATT FAIL label is displayed on the top center of the attitude sphere.

3 - ATTITUDE SOURCE ANNUNCIATION

- Label: ATT1 for AHRS 1 and ATT2 for AHRS 2.
- Color: Amber when one AHRS supplies both sides or both AHRS are supplying cross-side.
- Annunciations are removed when both AHRS are supplying on-side PFDs.

4 - HEADING SOURCE ANNUNCIATION

- Label:
  - MAG1 or MAG2 when AHRS heading source is magnetic.
  - DG1 or DG2 when AHRS heading source is the directional gyro.
- Color:
  - For MAG: amber when the same AHRS is supplying both sides or both AHRS are supplying cross-side.

  - For DG: - amber when the same AHRS is supplying both sides.
    - white when both AHRS are supplying on-side.
- When both AHRS are supplying on-side, annunciation is removed.
- If a heading source becomes invalid the heading source annunciation will refer to the invalid heading source, HDG1 or HDG2, as applicable.

5 - HEADING COMPARISON MONITOR DISPLAY

- Color: Amber.
- Label: HDG
- Activated when a difference of 6 degrees between both PFDs is detected and airplane roll is less than 6 degrees.
- For airplane rolls greater than 6 degrees, annunciation will be displayed if the difference between both PFDs is greater than 12 degrees.
- The HDG threshold will be restored to 6 degrees if airplane roll is less than 5 degrees for 90 seconds. Otherwise, a 12 degrees HDG threshold will be maintained.

6 - HEADING FAILURE DISPLAY

- Digital heading bug symbol is removed and a red HDG FAIL annunciation is displayed on the PFD and MFD compass cards.
- The bearing pointers, map display, To/From, selected heading bug, drift angle, selected course/track and course deviation displays will be removed.
- Heading source annunciation will be HDG 1 or HDG 2.
- Heading select and course select/desired track digital display will be replaced by amber dashes.

NOTE: In case of heading splits, check if there sources for magnetic interference near the airplane. If this is cause for the problem, the heading split should disappear during the taxi.

7 - COURSE DEVIATION FAILURE

- Pointer is removed.
- Red X displayed over the scale.

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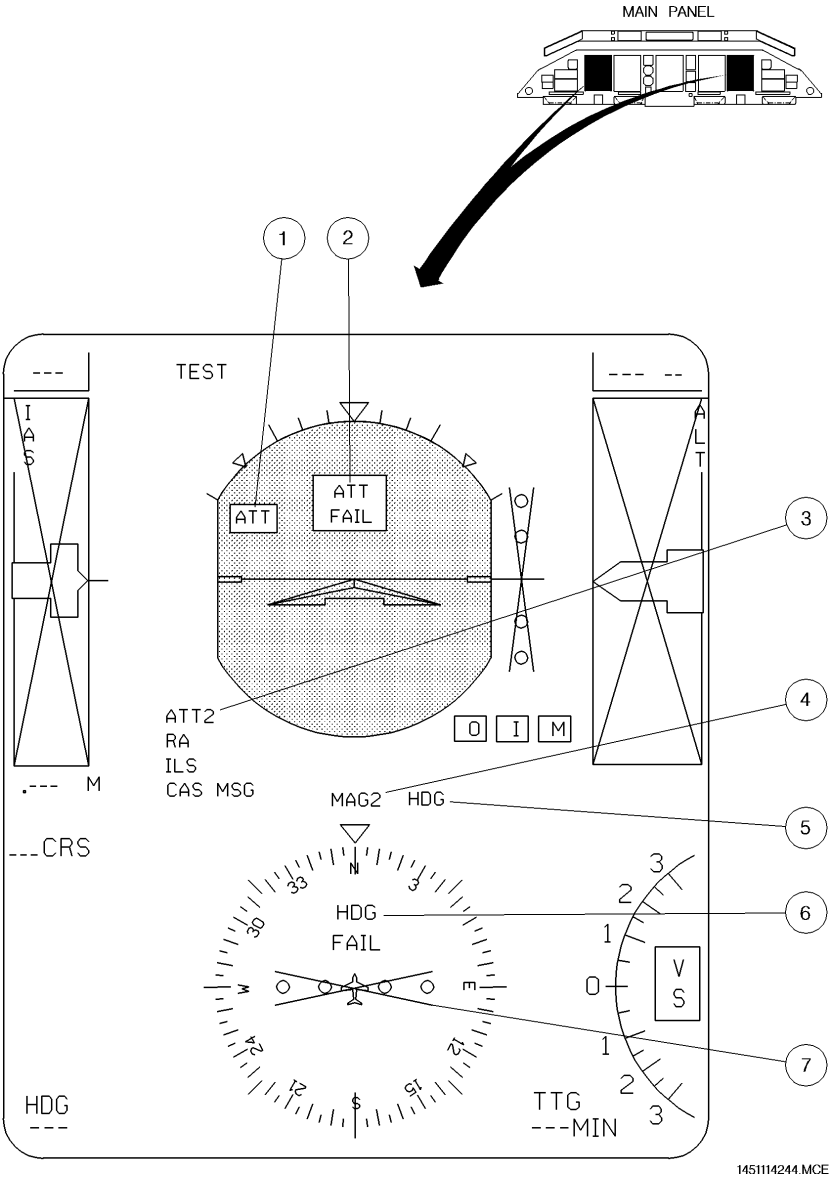

AHRS FAIL INDICATION ON THE PFD (BOTH AH-800 AND AH-900)

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FLIGHT MANAGEMENT SYSTEM

The FMZ 2000 Flight Management System (FMS) controls a complete range of navigation functions. Its primary purpose is to provide high accuracy in long range lateral and vertical navigation. The system may be installed with a single or dual configuration. Should the airplane have a dual configuration, each unit can provide navigation data to the other unit. For additional information on functions and operation, refer to the manufacturer's manual.

The FMS is mainly composed of the following components:

– Control Display Unit (CDU).
– Navigation Computer (NZ).
– Data Loader (DL) or Portable Data Transfer Unit (PDTU).

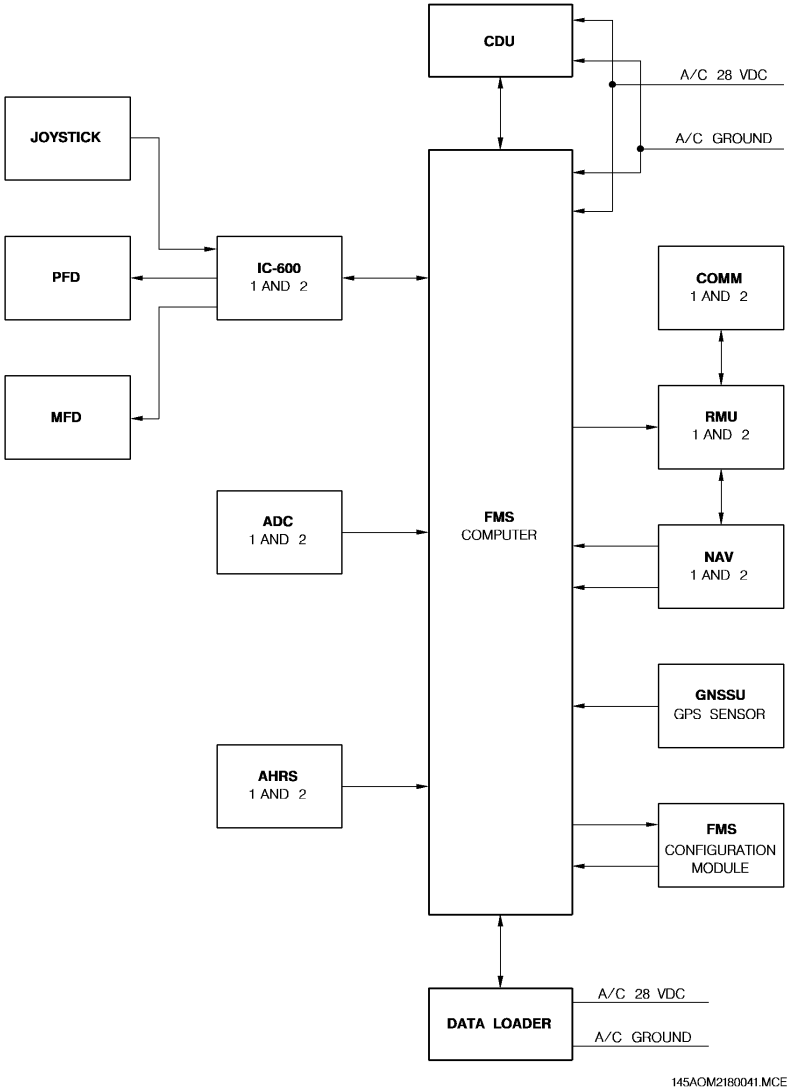
The FMS operates in the following situations: Oceanic, Remote, North Atlantic Minimum Navigation Performance Specification Airspace, Enroute, Terminal, Non-Precision Approach and Required Navigation Performance 10.

The FMS interfaces with the followings systems and equipment:

– GPS sensor(s), ADC 1 and 2 - The GPS receives satellite data through the passive GPS antenna, processing and blending collected data with ADC data and sends the resulting information to the FMS computer.
– AHRS/IRS 1 and 2 - Provides the necessary data to compute wind and for Dead Reckoning Mode, when the subsystem is not capable of navigating by itself.
– MFD and PFD - The FMS provides data for display navigation guidance on the PFD and navigation map data on the MFD.
– RMU 1 and 2 - The RMU interfaces with the FMS computer to control the operating frequencies, modes and channels of the various radios. For the dual configuration, each RMU supplies each respective on-side NZ.
– COM 1 and 2, NAV 1 and 2 - The FMS includes a radio-tuning page on which the pilot can manually select the VHF NAV and COM frequencies. Only the NAV frequency is fed back to the FMS computer for verification of the tuning action. COM 1 and 2 interface with FMS through the RMUs. The FMS can also automatically select the NAV radio frequencies. The FMS tune function for tuning communication frequencies with 8.33 kHz frequency spacing is available only for the Honeywell NZ5.2 FMS software version.
– The FMS also provides latitude and longitude to TCAS.

The Control Display Unit (CDU), located on the control pedestal, provides control functions management and operating modes for proper FMS operation. The EMB-145 should have two types of FMZ 2000 CDU installed, CD-810 or CD-820. In dual FMS configuration, the intermix operation is not recommended.

The CD-810 CDU is equipped with a Cathodic Ray Tube (CRT). The CD-820 CDU is equipped with a full-color Liquid Crystal Display (LCD) and contains nine lines, being the first a title line and the ninth the scratchpad.



FMS SCHEMATIC

FMS OPERATING MODES

FMS FUNCTIONS

NAVIGATION

The navigation function computes the airplane position and velocity for all phases of flight. The navigation priority modes, based on sensor accuracy, are as follows:

– GPS
– DME/DME
– VOR/DME
– IRS (if installed)

The GPS is the most accurate sensor. When the GPS is in use, the other sensors are still monitored for position differences, but they do not contribute to FMS position, unless the GPS becomes inaccurate, unavailable or is manually deselected. In this case, the FMS automatically tunes the DME/DME in order to provide position. When DME/DME is not accurate, the VOR/DME is selected.

On airplanes equipped with dual Inertial Reference System (IRS), replacing the AHRS, the IRS is used as a primary navigation sensor when other navaid are not available.

If all position sensors and radios are lost, the FMS shifts to Degrade Mode (DGRAD) and in approximately 2 minutes it enters the Dead Reckoning Mode (DR). In this mode, the position is calculated using the last known airplane position. The ground speed and track are estimated with AHRS/IRS heading, ADC TAS and the last known wind data.

The dual FMS configuration (NZ5.2 software version and on) may operate with dual IRS and dual GPS providing four long-range navigation sensors. The sensors status may be accessed in the NAV INDEX 1/2 page.

In this configuration, on-side FMS outputs and flight plan information are available to the opposite-side FMS through an interconnecting bus.

The automatic tuning is made through the RMU for computing an optimum position. The FMS also includes a radio-tuning page on which the pilot can manually select VHF NAV, COM, ADF and transponder frequencies. The NZ5.2 software version and on has the capability of tuning communication frequencies in the 8.33 kHz channel spacing.

FLIGHT PLANNING

The flight planning function computes the active flight plan with both lateral and vertical definition.

When the FMS long-range navigation is selected, the flight director command bars will provide the visual command to bank the airplane to the desired track.

The VNAV is applicable only for the descent path and it is not coupled to the flight director, being only a reference information displayed on the PFD glide slope scale.

Additionally the navigation computer can be programmed by the operator to automatically fly different types of holding patterns.

DATA BASE

The database contains worldwide coverage of navaids, airways, departure procedures, approach procedures, Standard Terminal Arrival Routes (STARs), airports and runways. This information is updated every 28 days. The database can also store up to 200 pilot-defined flight plans and waypoints, which are only updated when changed by the pilot.

In single configuration, the Data Loader (DL) is used to update the Database, transferring data to and from the Navigation Computer. In this configuration, this unit can be installed on the left lateral console, close to the pilot's mask stowage box.

In dual configuration, the Portable Data Transfer Unit (PDTU) is used to reload entire information package at each update by using a 3 $^{1}/_{2}$" floppy disk.

NAVIGATION DISPLAY

A multiple waypoints map, based on the airplane's present position, can be displayed on the MFD. It comprises the Waypoints connected by white lines defining a pre-planned route, and also navaids and airports.

FMS MODES

The dual FMS configuration provides four operating modes that may be accessed through the FMS MAINTENANCE 1/3 page:

DUAL MODE

In this mode, the following information is automatically transferred to the cross-side FMS: flight plan, performance data, waypoints defined by the pilot, flight plans created in one system and radio tuning.

NOTE: For the proper operation in DUAL mode it is necessary to use the same software version, same NAV and CUSTOM data bases and same settings for both systems in the Configuration Modules. The initial position difference between both systems shall not be more than 10 NM.

INITIATED TRANSFER MODE

In this mode the flight plan and performance data entry will only be transferred to the cross-side FMS through the prompt command available in the last page of the ACTIVE FLT PLAN pages. Waypoints defined by the pilot, created flight plans and radio tuning are automatically transferred to the cross-side FMS.

NOTE: For the proper operation in INITIATED TRANSFER mode it is necessary to use the same software version, same NAV and CUSTOM data bases and same settings for both systems in the Configuration Modules. The initial position difference between both systems shall not be more than 10 NM.

INDEPENDENT MODE

In this mode, only the radio tuning is automatically transferred to the cross-side FMS.

NOTE: To operate in the INDEPENDENT mode, it is necessary to use the same software version and same settings in the Configuration Modules. If any of these requirements is not accomplished, the system automatically passes for the possible operating mode. For instance, if only the CUSTOM database differs in both systems, the operating mode automatically switches from DUAL to INDEPENDENT.

SINGLE MODE

No information is exchanged between both systems.

FMS CONTROLS AND INDICATORS

CONTROL DISPLAY UNIT (CDU)

1 - ANNUNCIATORS

The CD-810 CDU has the annunciator lights directly above the display and the CD-820 CDU has the annunciators on the top of LCD display.

- Colors:
  - White: indicating advisory annunciation.
  - Amber: indicating alerting annunciation.

DSPLY (White)	Illuminates when the CDU displays a page that is not relative to the current airplane lateral or vertical flight path. This annunciator is not shown on the PFD.
DR (Amber)	Illuminates when a radio updating loss occurs, as well as all other position sensors, for a period longer than 2 minutes.
DGRAD (Amber)	Illuminates when the FMS cannot guarantee the position accuracy for the present phase of the flight.
MSG (White)	Illuminates when there is a message (advisory or alert) on the scratchpad. The annunciator turns off when the message is cleared from the scratchpad.
OFFSET (White)	Illuminates when a lateral offset path has been entered in the FMS. The annunciator turns off when the offset is removed.
APRCH (White)	Illuminates when the FMS is selected as navigation source and the following conditions are valid: a non-precision instrument approach has been activated from the navigation database, the airplane position is between 2 NM outside the final approach fix and the missed approach point, the DGRAD must be off and FMS using approved sensors for non-precision approach.

NOTE: The FMS transmits all the annunciators to the PFD, except the DSPLY annunciator, so the pilot must not trust only on the FMS CDU for checking the FMS system status.

2 - LINE SELECT BUTTONS

- There are four line select buttons on each side of the CDU that provide the following functions:
  - Select submodes within major modes when in an indexed display.
  - Used as direct access to the other FMS modes when in a non-indexed display.
  - Enter data to the scratchpad.

3 - BRIGHTNESS CONTROL KNOB/BUTTON

- Used to manually control the brightness of the display.
- After using this knob, the photo sensors are activated and maintain the brightness level through a wide range of lighting conditions. In CD-820 CDU the brightness is adjusted pressing up or down the Bright/Dim button, so a control bar will be displayed in the scratchpad.
- The brightness can be adjusted so that, during daylight conditions, the display cannot be seen.

4 - MODE BUTTONS

PERF Displays the performance pages.

NAV Displays the NAV index pages.

FPL It may be used to display the first page of the active flight plan, if the flight plan was previously entered, to manually create a flight plan, to select a stored flight plan and to create a flight plan for storage.

PROG Displays the first progress page, the current status of the flight.

DIR Displays the active flight plan with the DIRECT and INTERCEPT prompts.

5 - ALPHANUMERIC BUTTONS

- Consist of alphabet letters, the numbers 0 through 9, a decimal, a dash and a slash. It is used to enter inputs to the FMS. In the CD-820 a SP (Space) key is used to insert a space following a character in the scratchpad, and a +/- (Plus/Minus) key will result in a - being entered, changing to + in a subsequent press.
- The alphanumeric keys make entries only on the scratchpad.

6 - FUNCTIONS BUTTONS

PREV Changes the current page to the previous page.

NEXT Changes the current page to the next page.

CLR Clears alphanumeric entries in the scratchpad or a scratchpad message.

DEL Works together with line select buttons in order to delete waypoints and other items displayed on the CDU. This button is inhibited when a message is displayed.

The CD-820 has five function buttons directly above the LCD display that will not work if pressed. The following messages will be displayed in the scratchpad:

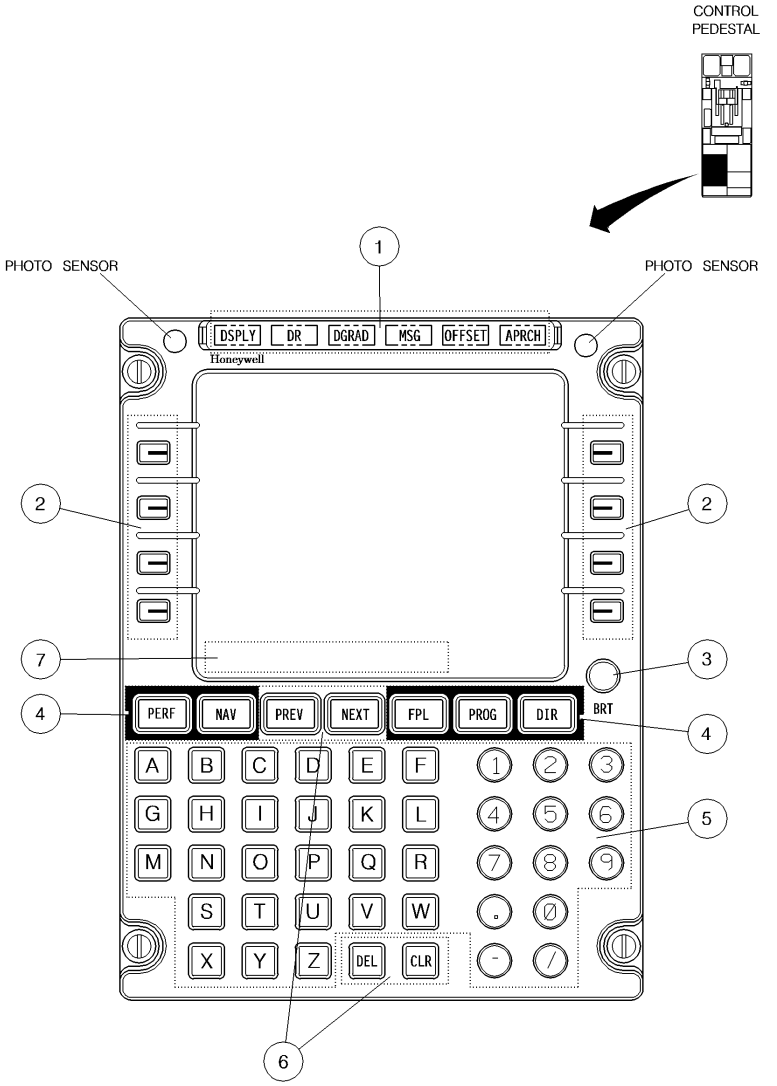
VIDEO	VIDEO NOT AVAILABLE.
GRAPHIC	GRAPHIC NOT AVAILABLE.
ATC	ATC NOT AVAILABLE.
BACK	BACK COMPLETE.
FN	FN NOT AVAILABLE.

7 - SCRATCHPAD

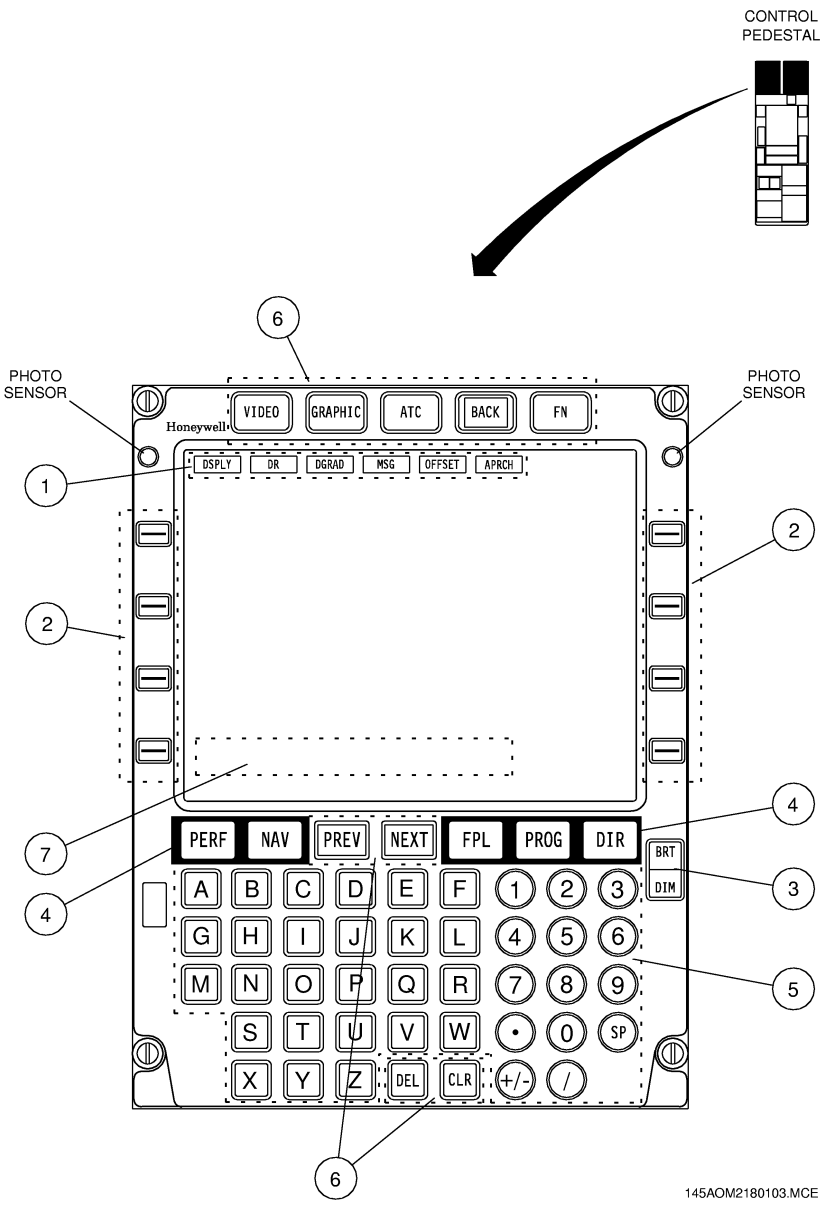
- It is the working area, located on the bottom line of the display, where the pilot can enter data and/or verify data before line selecting the data into its proper position.
- Data is retained on the scratchpad throughout all mode and page changes.
- The scratchpad also provides advisory and alerting messages to be displayed.

The colors on the CD-820 are designed to highlight important information. Color assignments are coordinated as much as possible with other displays. See below the parameters associated to each color:

Vertical	Cyan (Blue)
Atmospheric Data	Cyan (Blue)
Lateral	Green
FROM Waypoint	Yellow
TO Waypoint	Magenta
Prompts and Titles	White
Flight Plan Names	Orange
Index Selections	Green



FMZ 2000 FMS CD-810 CONTROL PANEL



FMZ 2000 FMS CD-820 CONTROL PANEL

JOYSTICK (OPTIONAL)

The joystick functions are available through the joystick controller that is located on the control pedestal and through the selection of the MFD JSTK menu.

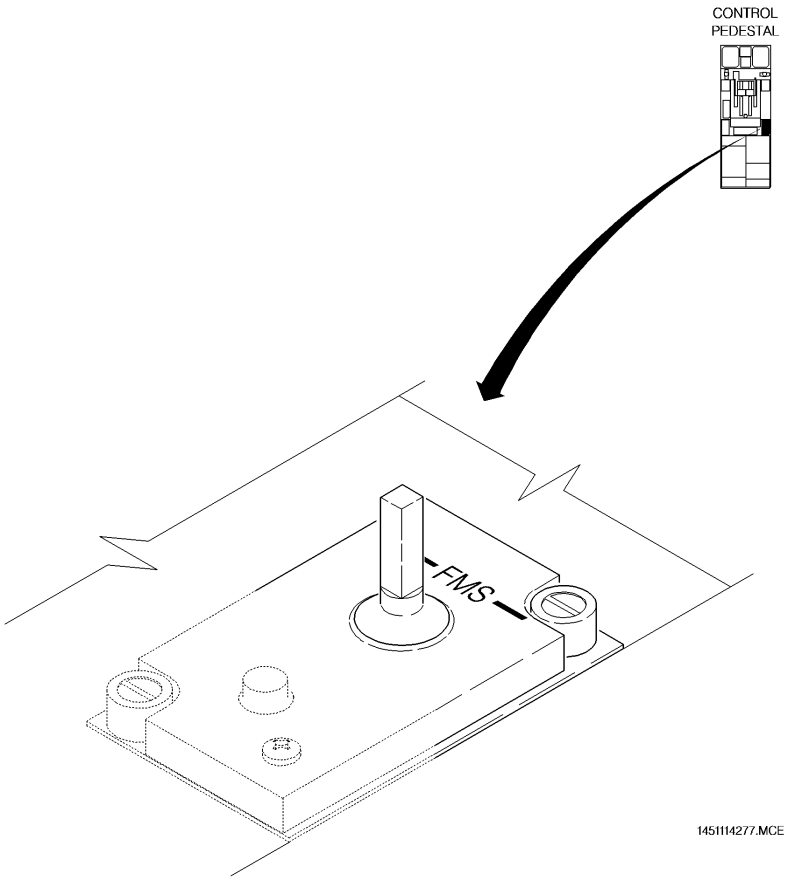
When the MFD joystick menu is selected, the joystick controller is available to control the Designator Symbol movement on the MFD FMS flight plan.

JOYSTICK OPERATION

On power-up, the designator is co-located with the present flight plan waypoint position.

If MAP mode is selected, moving the joystick controller, will cause the Designator Symbol to be displayed in blue color with a broken line which moves in the same direction from its last waypoint position.

If PLAN mode is selected, moving the joystick controller, the flight plan moves to the opposite direction from its last position, while the Designator Symbol remains fixed at the center of the plan format.



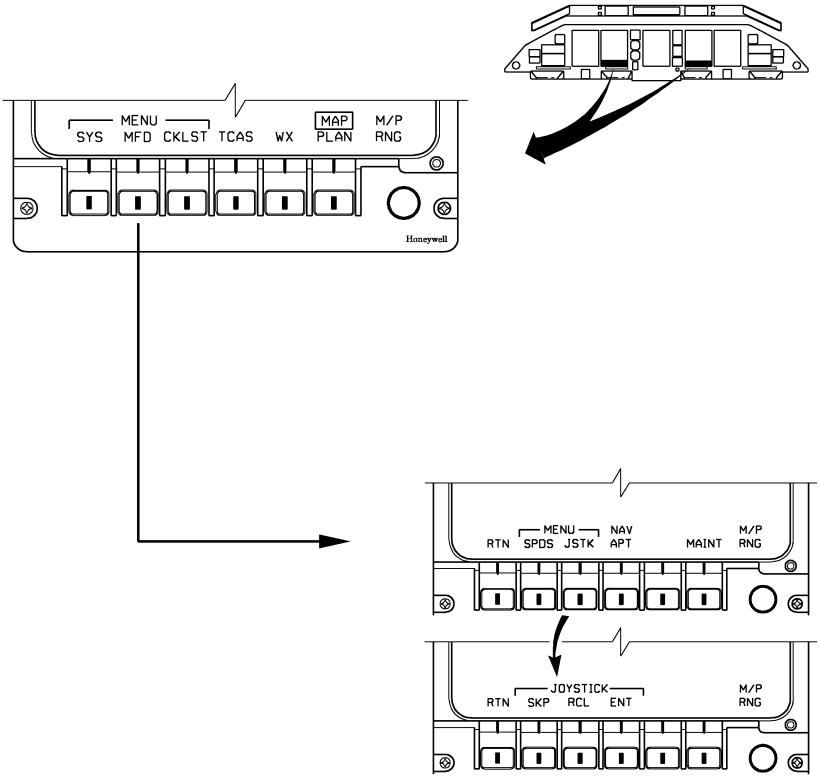
JOYSTICK CONTROLLER

JOYSTICK MENU BUTTONS FUNCTION AT MAP MODE

- SKIP ("SKP") button: Skips the designator to the position of the next waypoint in the flight plan in case of the designator is co-located with a plan waypoint. Otherwise, the designator broken line tail skips to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with the flight plan waypoint. Otherwise, the designator is positioned over the waypoint from which the designator line is extended and the designator line is removed from the display.
- ENTER ("ENT") button: The latitude and longitude coordinates of the designator are transmitted to the selected FMS scratchpad as a requested waypoint.

JOYSTICK MENU BUTTONS FUNCTION AT PLAN MODE

- SKIP ("SKP") button: Positions the flight plan so the next waypoint is displayed over the designator in case of the designator is co-located with a flight plan waypoint. Otherwise, skips the tail of the designator line to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with a flight plan waypoint. Otherwise, it positions the designator over the waypoint from which the designator line is extended and removes the designator line from the display.
- ENTER ("ENT") button: The latitude and longitude coordinates of the designator are transmitted to the selected FMS scratchpad as a requested waypoint.



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MFD JOYSTICK MENU

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NAVIGATION DISPLAYS

The navigation data provided by the Radio Management System and Flight Management System are displayed to the crew through the PFDs, MFDs and RMUs.

ADF and/or VHF NAV bearings and VHF NAV or FMS CDI (Course Deviation Indicator) are displayed on the PFD in an Electronic Horizontal Situation Indicator (EHSI). The EHSI navigation sources as well as the display format (Full Compass or Arc) may be selected by the crew via the Display Control Panel (DCP).

Several other navigation data are also presented on the PFDs: GS (Glide Slope) pointer, DME distance, Ground Speed/Time-to-go, marker beacon indicators, wind intensity and direction vector, etc.

The MFDs present Weather Radar, TCAS and the route selected on the FMS. Additional information is also presented on the MFD: wind intensity and direction vector, TAS, Time-to-go, etc.

The RMUs NAV Backup Page also present the EHSI, in the Arc format only (see section 2-18-11).

DISPLAYS CONTROLS AND INDICATORS

DISPLAY CONTROL PANEL (DCP)

1 - DISPLAY FORMATS SELECTOR BUTTON

- Pressing the FULL/WX Button alternates the EHSI presentation on the PFD between Full Compass format and Arc format.
- In Arc format the Weather Radar Display is also presented whenever the Weather Radar is operating.

2 - GROUND SPEED AND TIME-TO-GO SELECTOR BUTTON

- Pressing the GSPD/TTG Button alternates the respective information on the PFD between ground speed and time-to-go.

3 - ELAPSED TIME SELECTOR BUTTON

- The first actuation enters the Elapsed Time Mode on the PFD respective field. The subsequent actuation provides the following sequence of control: RESET - ELAPSED TIME - STOP - REPEAT.

4 - NAVIGATION SOURCES SELECTOR BUTTON

- Provides the selection of the VHF NAV (VOR, ILS and MLS) as navigation source for the EHSI. If the VHF NAV is already selected, pressing the NAV Button selects the opposite VHF NAV as navigation source for the on-side EHSI. Pressing the NAV Button once again will restore the normal operation: VHF NAV 1 information presented on the PFD 1 and VHF NAV 2 information presented on the PFD 2.

5 - FMS SOURCE SELECTOR BUTTON (OPTIONAL)

- Provides the selection of the FMS as navigation source for the EHSI.
- On airplanes equipped with dual FMS, pressing the FMS Button for the second time selects the opposite FMS as navigation source for the on-side EHSI (and for the on-side MFD MAP). Pressing the FMS Button once again will restore the normal operation: FMS 1 information presented on the PFD 1 (and MFD 1) and FMS 2 information presented on the PFD 2 (and MFD 2).

6 - BEARING SELECTOR KNOB

OFF: The associated PFD bearing pointers are disabled.

NAV 1 (2): Selects the respective VHF NAV as source for the associated bearing pointer.

ADF: Selects the respective ADF as source for the associated bearing pointer.

FMS: Selects the FMS as source for the associated bearing pointer.

7- DECISION HEIGHT SETTING AND IC-600 TEST KNOB

- Provides the Radio Altimeter (RA) decision height setting.
- When pressed on ground provides the IC-600 and RA test activation. Refer to Section 2-4 – Crew Awareness for further information on test function and Section 2-17 – Flight Instruments for further information on decision height setting and RA test in flight.

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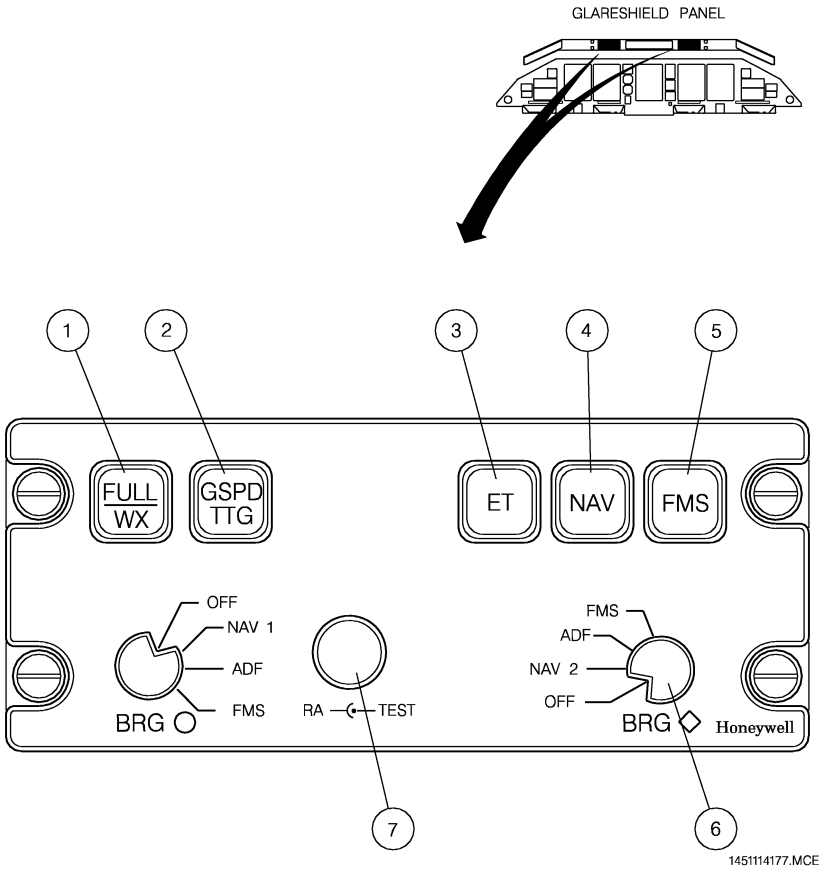


DISPLAYS CONTROL PANEL

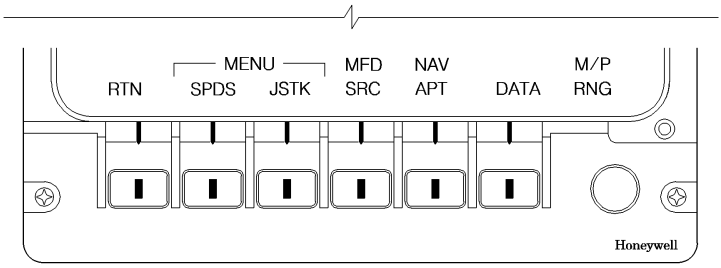
FMS SOURCE SELECTION ON THE MFD

As explained on the Display Control Panel (DCP) description (see section 2-18-40), pressing the FMS Button on that panel selects the FMS as navigation source for the PFD and MFD.

On airplanes equipped with dual FMS, pressing the FMS Button (on the Display Control Panel) for the second time selects the opposite side FMS as navigation source for the on-side EHSI (and for the on-side MFD MAP). Pressing the FMS Button once again will restore the normal operation: FMS 1 information presented on the PFD 1 (and MFD 1) and FMS 2 information presented on the PFD 2 (and MFD 2).

However, on airplanes equipped with dual FMS it is possible to select the opposite side FMS as MFD navigation source even if the FMS is not selected as navigation source for the PFD.

In this case, pressing the MFD Bezel Button adjacent to the MFD SRC label (presented on the MFD submenu), the on-side MFD will display the opposite side FMS data. This label is not presented if the FMS is already selected as navigation source for the PFD.



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CROSS-SIDE FMS SOURCE SELECTION ON THE MFD

ADF, VHF NAV AND DME INDICATIONS ON THE PFD

1 - VERTICAL DEVIATION DISPLAY

- Color:
  - Scale: white
  - GS Pointer: - green
    - yellow if the same source is supplying both sides.
  - GS label: green.
- For glide slope presentation the pointer will be parked up or down of the deviation display when the deviation exceeds the external dots.
- Glide slope information will be displayed when SRN NAV is selected for display and tuned to LOC is active.

2 - MARKER BEACON DISPLAY

- Color:
  - O label: cyan.
  - M label: amber.
  - I label: white.
  - Box: white.
- An O, an M or an I flashing annunciation is displayed when the outer marker, the middle marker or the inner marker is detected, respectively.
- A beacon box surrounding the MB flashing annunciations will be shown when a SRN is displayed, tuned-to-localizer is active and a marker is also active.

3 - BEARING POINTER

- Color:
  - Cyan for Bearing 1
  - White for Bearing 2
- Circle coded for #1 source {VOR 1, ADF (for single installation) or ADF 1 (for dual installation)}.
- Diamond coded for #2 source {VOR 2, ADF (for single installation) or ADF 2 (for dual installation)}.
- Pointer is removed if the selected source signal is invalid.

4 - TO/FROM POINTER

- Color: White.
- Displayed towards the nose or the tail of the airplane to indicate, respectively, "TO" or "FROM" the navigation aid.

5 - DME FIELD

- Displays Ground Speed, Time-to-go, and Elapsed Time.
- GROUND SPEED DISPLAY
  - Color: Digits: green.
    GSPD label: white.
  - Range: 0 to 550 KIAS.
  - Resolution: 1 KIAS.
- TIME TO GO DISPLAY
  - Color: Digits: the same of the NAV source color.
    TTG label: white.
  - Range: 0 to 399 min.
  - Resolution: 1 minute.
- ELAPSED TIME
  - Color:
  - Digits: green.
    ET label: green.
  - Range: 00:00 to 09:59 h.
  - Resolution: Displayed in the format minutes: seconds (for less than one hour), and hours (minutes for more than one hour).

6 - COURSE DEVIATION SCALE

- Color: White.

7 - COURSE DEVIATION BAR

- Color:
  - Green: when the source is the on-side VOR.
  - Yellow: when the source is the cross-side VOR.
- Indicates against the course deviation scale, the difference between the selected course and the VOR bearing.

8 - BEARING SOURCE ANNUNCIATIONS

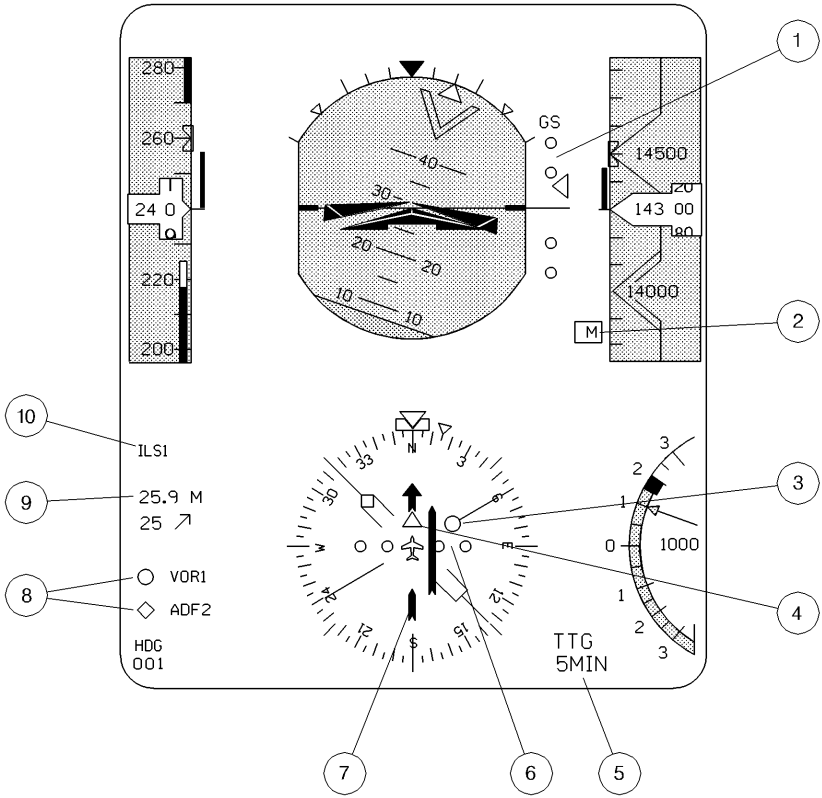
- Label: VOR1, VOR2, ADF1 or ADF2.
- Color:
  - Cyan for Bearing 1
  - White for Bearing 2
- Circle coded for #1 source {VOR 1, ADF (for single installation) or ADF 1 (for dual installation)}.
- Diamond coded for #2 source {VOR 2, ADF (for single installation) or ADF 2 (for dual installation)}.
- Indicates the current source of input to the bearing pointers.
- Source annunciation will be retained on the PFD, even in case of an invalid bearing signal.

9 - DME HOLDING AND DISTANCE ANNUNCIATION

- Color:
  - Digits: green.
  - NM label: white.
  - H label: amber.
- Range:
  - Short Range NAV: 0 to 300 NM.
- Resolution: 0.1 NM.
- When the DME hold is active an H label is displayed on the RH of the DME distance digital readout. In this condition the H label replaces the distance NM label.

10 - COURSE DEVIATION NAV SOURCE ANNUNCIATION

- Label: VOR1, VOR2, ILS1, ILS2 or FMS (optional)
- Color:
  - Yellow: when the same source is selected for both sides or is supplying cross-side.
  - Green: when both sides present on-side sources, even if they are different.



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ADF, VHF NAV AND DME INDICATIONS ON THE PFD (EHSI IN FULL COMPASS FORMAT)

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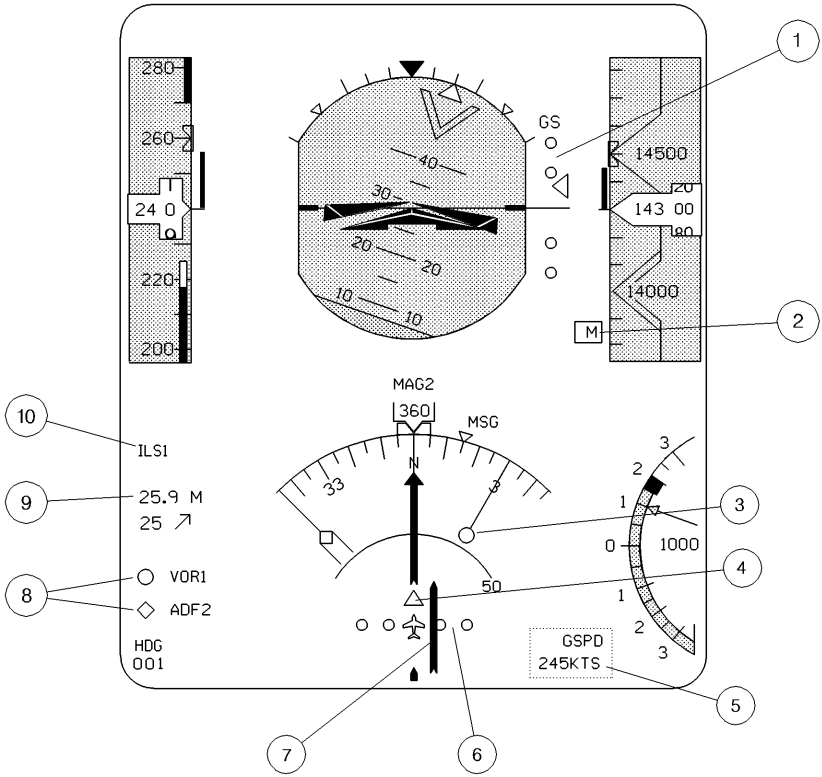

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ADF, VHF NAV AND DME INDICATIONS ON THE PFD (EHSI IN ARC FORMAT)

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FMS INDICATION ON THE PFD

1 - VERTICAL ALERT ANNUNCIATION

- Label: VTA
- Color: Amber
- The VTA is displayed when the vertical alert bit is received from the FMS.

2 - VERTICAL DEVIATION DISPLAY

- When the FMS VNAV is selected the Vertical Deviation is activated.
- The Vertical Deviation Display indicates the vertical deviation between the airplane and the selected vertical path.
- Label: FMS
- Color: Amber
  - The FMS label and the scale are white.
  - If the FMS is the navigation source for only one side, the pointer will be magenta, otherwise it will be amber.

3 - MESSAGE ANNUNCIATION

- Label: MSG
- Color: Amber
- The MSG is displayed when a message is available on the FMS Panel.

4 - GROUND SPEED/TIME TO GO DATA

- Label: GSPD for Ground Speed.
  TTG for Time To Go.
- Color: Labels and units are white.
  - For single configuration, if the FMS is the navigation source for only one side, the GSPD and TTG readouts will be magenta, otherwise, they will be amber.
  - For dual configuration, if each FMS is the navigation source of the respective side, the GSPD and TTG readouts will be magenta. Otherwise, they will be amber.
- The Ground Speed unit is knots (KTS) and the Time To Go unit is minutes (MIN).
- The resolution of the digital values is 1 unit.
- For invalid values, the digits will be replaced with three amber dashes.

5 - DRIFT ANGLE BUG

- Color: Magenta.
- The Drift Angle Bug rotates around the compass card, providing the reading of the airplane tracking.

6 - COURSE DEVIATION BAR

- Color: If the FMS is the navigation source for only one side, the Course Deviation Bar will be magenta, otherwise, it will be amber.

7 - TO/FROM POINTER

- Color: White.

8 - BEARING POINTER

- Color: Cyan for Bearing 1 (circle shaped).
  White for Bearing 2 (diamond shaped).

9 - BEARING SOURCE ANNUNCIATIONS

- Color: Cyan for Bearing 1 (circle shaped).
  White for Bearing 2 (diamond shaped) in single FMS configuration.
  In dual configuration there will be an indication if FMS 1 or 2 is being used.

10 - WIND VECTOR DISPLAY

- Color: Magenta.
- A single vector shows the direction of the wind relative to the airplane symbol. The digits indicate the wind intensity in knots.

11 - DEGRADE MODE/DEAD RECKONING MODE/WAYPOINT ANNUNCIATIONS

- Label: DGRAD for Degrade Mode (single FMS configuration only)
  DR for Dead Reckoning mode.
  WPT for waypoint.
- Color: Amber
- WPT is lit when the airplane is approaching the next waypoint.

12 - DISTANCE DISPLAY

- Color:
  - In single configuration, if the FMS is the navigation source for only one side, the distance readout will be magenta. Otherwise, it will be amber.
  - In dual configuration, if each FMS is the navigation source of the respective side, the distance readout will be magenta, otherwise it will be amber.
  - The unit is white.
  - The distance unit is nautical miles (NM).

13 - TO WAYPOINT SYMBOL

- Label: Waypoint identifier name (Ex: KDVT).
- Color: Magenta. For dual configuration, when using cross-side information, the color is amber.
- In the sequence established, the TO waypoint is the next one from the current airplane position.

14 - APPROACH/TERMINAL AREA ANNUNCIATIONS

- Label: APP for Approach.
  TERM for Terminal Area.
- Color: Cyan.
- When APP is displayed it indicates that the FMS is in the flight approach phase and also can indicate that the lateral deviation scaling has been set to approach scale factor.
- In the APP mode the deviation indicator sensitivity and FMS tracking gains are increased.
- The TERM annunciator is displayed when the airplane enters in the terminal area or when the lateral deviation scaling has been set to the enroute scale factor.
- Priority is given to the APP message.

15 - FMS SOURCE ANNUNCIATION

- Label: FMS.
- Color:
  - For single configuration, if the FMS is the navigation source for only one side, the FMS label will be magenta. Otherwise, it will be amber.
  - For dual configuration, if each FMS is the navigation source for the respective side, the FMS label will be magenta, otherwise it will be amber.
- FMS is displayed only when a single source is installed.

16 - HEADING ANNUNCIATION

- Label: HDG SEL (For dual FMS configuration).
- Color: White. For dual configuration, if each FMS is the navigation source for the respective side the color will be white, otherwise it will be amber.

17 - SELECTED COURSE/DESIRED TRACK ANNUNCIATIONS AND READOUTS

- Label: DTK for Desired Track.
  CRS for Selected Course.
- Color:
  - For single configuration, if the FMS is the navigation source for only one side, the CRS label will be green and DTK will be magenta. Otherwise, both labels will be amber.
  - For dual configuration, if each FMS is the navigation source for the respective side, the CRS and DTK labels will be magenta. Otherwise they will be amber.
  - The readouts will have the same color as the CRS and DTK annunciations.
- DTK is displayed when the FMS is the selected navigation source.

18 - CROSSTRACK ANNUNCIATION

- Label: SXTK
- Color:
  - For single configuration, if the FMS is the navigation source for only one side the label will be magenta, otherwise it will be amber.
  - For dual configuration: The color will be ever amber.
- SXTK is displayed to indicate that the airplane is off track.

19 - CAPTURED LATERAL MODE

- Refer to Section 2-19 - Autopilot.

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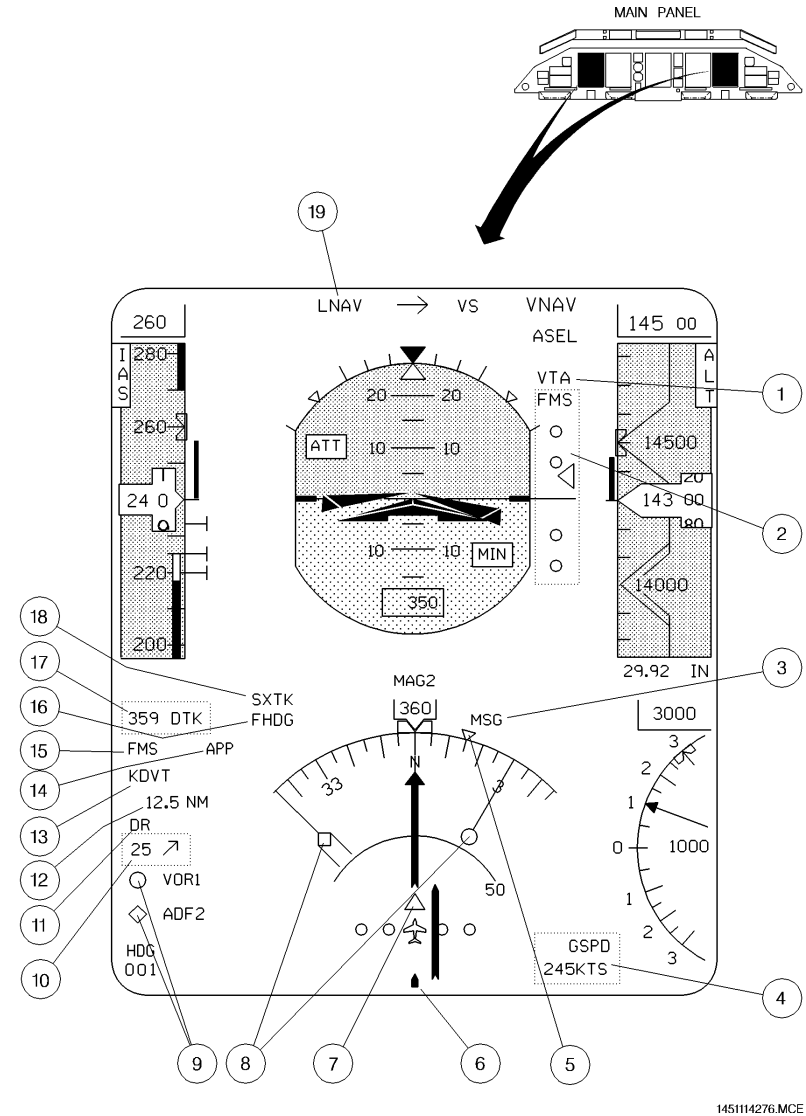

FMS INDICATION ON THE PFD

FMS INDICATION ON THE MFD

1 - FMS SOURCE ANNUNCIATION

- Label: FMS for single configuration.
  FMS1 or FMS2 for dual configuration.
- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.

2 - DRIFT ANGLE BUG

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- The Drift Angle Bug rotates around the compass card, providing the reading of the airplane tracking.

3 - WAYPOINT SYMBOL

- Label: Waypoint identifier name (Ex: KDVT).
- Color: All Waypoints are white except the TO waypoint.
- Waypoint is displayed as a four pointed star at the geographical locations, referenced to the current present position, where the selected transitions of the flight plan occur.
- A maximum of 10 Waypoints can be displayed, including the FROM waypoint.
- A navigation aid or airport can also be located on the flight plan at a transition point and is accounted in the maximum allowable number of Waypoints.

4 - AIRPORT ANNUNCIATION

- Label: APT.
- Color: Cyan.
- Appears when an airport symbol is shown along the route.

5 - NAVAID ANNUNCIATION

- Label: NAV.
- Color: Cyan for single or green for dual configuration.
- Appears when a navaid symbol is shown along the route.

6 - DESIGNATOR RANGE AND BEARING READOUT

- Color: Cyan.
- The range readout indicates the distance between the airplane and the Designator Symbol.
- The bearing readout bearing location of the Designator Symbol related to the airplane position.

7 - TO WAYPOINT SYMBOL

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- In the sequence established, the TO Waypoint is the next one from the current airplane position.

8 - LATERAL DEVIATION DISPLAY

- Color: White.
- Right after the values there is a letter which may be L or R standing for Left and Right respectively.

9 - WIND VECTOR DISPLAY

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- A single vector shows the direction of the wind relative to the airplane symbol. The digits indicate the wind intensity in knots.

10 - DESIGNATOR SYMBOL

- Color:
  - Same color of the Waypoint: If the Designator is co-located with a connected Waypoint.
  - Cyan: If it is not connected.
- The Designator symbol is displayed as an unfilled rectangle applied in two distinct methods: co-located with a Waypoint or positioned with the joystick.
- Designator will not be displayed if it represents the current position.

11 - TO WAYPOINT DATA ANNUNCIATIONS

- It is composed of the annunciators and presented as follows:
  - Identification.
  - Distance in nautical miles (NM).
  - Time to the TO Waypoint in minutes (MIN).voyeur
- Color:
  - For single FMS configuration the identification is magenta. The distance and the time are white.
  - For dual FMS configuration the identification, distance and time are magenta, when the source is the on-side FMS, or yellow, when the source is the cross-side FMS

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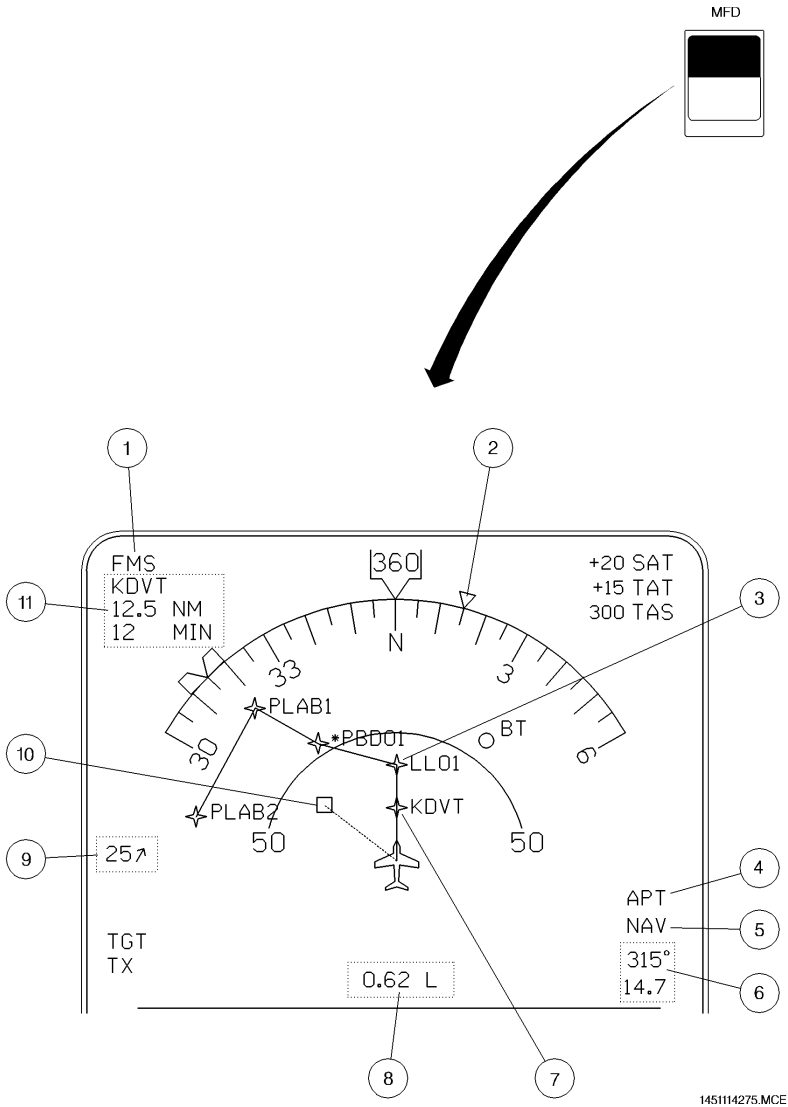

FMS INDICATION ON THE MFD

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WEATHER RADAR SYSTEM

The airplane can be equipped with P-660 or P-880 weather radar models and 12 inch antenna. For additional information on functions and operations, refer to the manufacturer's manual.

The weather radar system is designed for detection and analysis of precipitation in storms along the flight path of the airplane. The system provides the flight crew with visual indications regarding rainfall intensity and turbulence content.

Precipitation intensity level is displayed in four bright colors (magenta, red, yellow and green) contrasted against a deep black background on the PFDs' and MFDs' radar mode field. Magenta represents the heaviest rainfall intensity while green indicates the lightest.

The radar may also be used for ground mapping. When operating in ground mapping mode, prominent landmarks are displayed, which allows identification of coastlines, mountainous regions, cities or even large structures.

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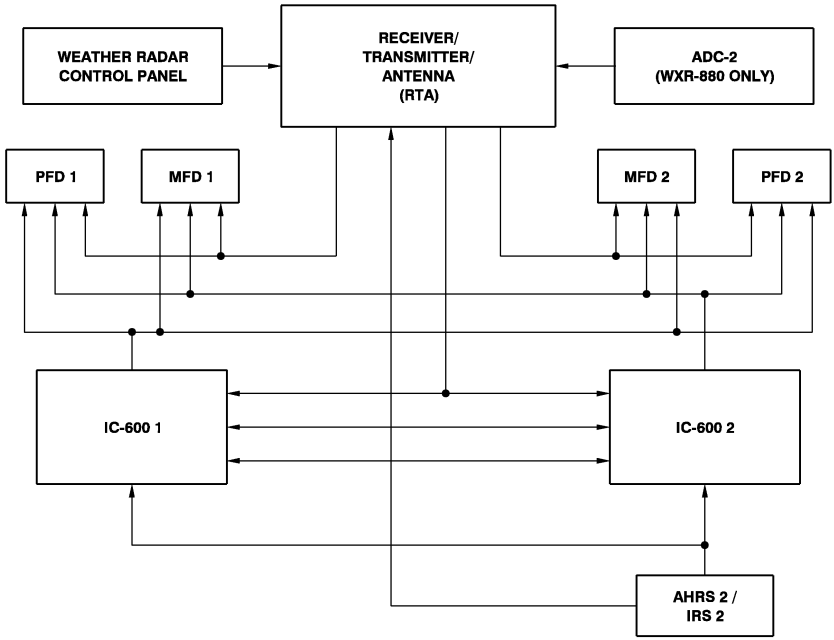
GENERAL

The weather radar system consists of an integrated Receiver/Transmitter/Antenna unit (RTA) and a dedicated control panel. The RTA transmits and receives on the X-band radio frequency. The RTA processes radar echoes received by the antenna. The scan-converted data are displayed on PFDs' and MFDs' radar mode field.

The weather radar system run on 28 V DC powered by one of the Avionics Switched DC Buses. Should a power supply failure occur, the weather radar system will become inoperative, as there is no backup power source for this system.

The weather radar interfaces with other airplane systems and equipment as presented in the schematic diagram below.



WEATHER RADAR SCHEMATIC

WEATHER RADAR NORMAL OPERATION

The weather radar is controlled through the weather radar control panel and via the MFD Bezel Buttons. The weather radar control panel provides control functions and operating modes management for proper weather radar operation. The weather radar control panel may be located on the control pedestal forward panel or on the glareshield panel. Some airplanes may optionally be equipped with two weather radar control panels.

INTERPRETING WEATHER RADAR IMAGES

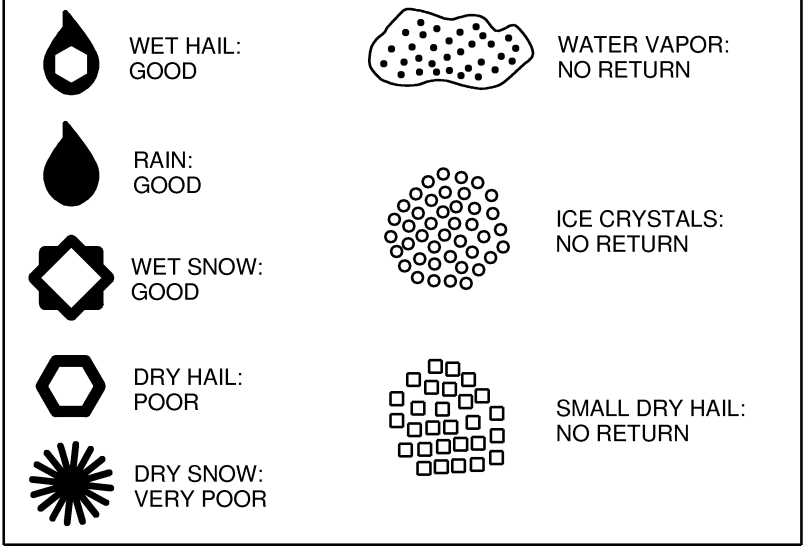
The weather radar is a water detector. It is calibrated to best see water in its liquid form and with an ideal raindrop diameter. The weather radar can see rain, wet snow, wet hail and dry hail (depending on its diameter). The radar can not see water vapor, ice crystals and small dry hail.

At higher altitudes, there is less humidity in the air and consequently there is less water condensation. It means that heavy precipitation and dense cells are less likely to occur. As a result, flight level 200 (FL200) is defined as "FREEZING LEVEL", i.e., presence of water in its liquid form is not forecast above this level. However, CBs and other phenomena may push humidity and water, sometimes supercooled water, to higher altitudes due to convective activity.

WARNING: DRY HAIL CAN BE PREVALENT AT HIGHER ALTITUDES. SINCE ITS RADAR REFLECTIVE RETURN IS POOR, IT MAY NOT BE DETECTED.

Use increased gain when flying near storm tops in order to display the normally weaker returns that could be associated with hail.

**WHAT THE WEATHER RADAR SEES
(REFLECTIVE LEVEL)**



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RADAR WARM UP PERIOD

When power is first applied to the radar, a period of 40 to 100 seconds is required to allow its magnetron to warm up. The radar displays the WAIT message on the PFDs' and MFDs' radar mode field and does not transmit or perform an antenna scan. After the completion of warm-up period, the radar automatically become operational in the selected mode or goes to forced standby (FSBY) if the airplane is on the ground.

GROUND OPERATION PRECAUTIONS

If the radar system is to be operated in any mode other than standby or forced standby while the airplane is on the ground, the following precautions should be taken:

- Direct nose of airplane so that antenna scan sector is free of large metallic objects such as hangars or other airplanes for a distance of 30 meters (100 feet).The antenna must be tilted fully upwards.
- Avoid using the weather radar during airplane refueling or within 30 meters (100 feet) of any other airplane undergoing refueling operations.
- Avoid using the weather radar if personnel are standing too close to the 270° forward sector of airplane.

WEATHER RADAR OPERATING MODES AND FUNCTIONS

TEST MODE (TST)

After the radar warm-up period is over, the TEST mode may be selected. A special test pattern made up of color bands is displayed. A series of green/yellow/red/magenta/white bands indicate that the signal to color conversion circuits are operating normally. A 100-mile range is automatically selected. A green TEST label will be displayed on the PFDs' and MFDs' radar mode field.

When the airplane is on the ground and the TEST mode is entered, the first page always includes RADAR OK or RADAR FAIL to indicate the current state of the radar, as follows:
RADAR OK: indicates that no faults were found and the radar is ready for service. It is combined with the END OF LIST page.
RADAR FAIL: indicates a radar fault.

During the weather radar test, several fault messages may be presented to the crew. The POC (Power On Counter), aside recording an existing fault, also stores fault information from previous power-on cycles. However, if the first page announces "RADAR OK", the radar is ready for service.

STANDBY MODE (SBY)

The standby mode should be selected any time it is desired to keep the system powered without transmitting. When SBY mode is selected the WX radar remains in a ready state, with the antenna scan motionless and stowed in a tilt-up position. In addition, the transmitter is inhibited and the display memory is erased.

For airplanes equipped with dual control panel, placing only one controller in SBY does not shut the transmitter OFF. Instead, the no-SBY controller governs radar operation. If both controllers are placed in SBY, the transmitter is shut OFF.

In standby mode a STBY label is displayed on the PFDs' and MFDs' radar mode field.

FORCED STANDBY MODE (FSBY)

The FSBY is an automatic, non-selectable radar mode, that forces the radar into standby when the airplane is on the ground (weight-on-wheels logic) regardless of the selected active radar mode. This is a safety feature that inhibits the transmitter on the ground to eliminate X-band microwave radiation hazards. In FSBY mode, the transmitter and the antenna scan are both inhibited, memory is erased and a FSBY label is displayed on the PFDs' and MFDs' radar mode field.

The forced standby mode may be overridden on the ground by pushing the STAB button 4 times in 3 seconds.

CAUTION: IF FSBY MODE IS OVERRIDEN ON THE GROUND AND ANY RADAR ACTIVE MODE IS SELECTED, THE TRANSMITTER IS TURNED ON. THE RADAR MUST NOT BE OPERATED UNDER THIS CONDITION WHILE REFUELING, NEAR FUEL SPILLS OR PEOPLE.

WEATHER DETECTION MODE (WX)

The WX mode is used to detect areas of severe weather. This will allow the pilots to avoid dangerous weather conditions and possible turbulence areas. WX may be used on the ground, often prior to takeoff, in order to monitor the weather in the immediate vicinity. In this case, the forced standby mode may be overridden.

In WX Mode, the weather radar system is fully operational and all internal parameters are set for enroute weather detection. A WX label is displayed on the PFDs' and MFDs' radar mode field.

The levels and colors associated with the storm category are as follows:

LEVEL	COLOR	RAINFALL CATEGORY
4	Magenta	Extreme/Intense
3	Red	Very Strong/Strong
2	Amber	Moderate
1	Green	Moderate/Weak
0	Black	Weak

RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE FUNCTION (REACT or RCT)

The REACT is a sub mode of the weather detection mode and when selected activates three separate but related functions:

- **Attenuation Compensation** - Storms with high rainfall rates can attenuate the radar energy making it impossible to see a second cell hidden behind the first cell.
  In the REACT mode, the radar incorporates a function that automatically adjusts receiver gain by an amount equal to the amount of attenuation, i.e., the greater the amount of attenuation, the higher the receiver gain and thus, the more sensitive the receiver.

- **Cyan REACT Field** - Since there is a maximum limit to receiver gain, strong targets (high attenuation levels) cause the receiver to reach its maximum gain value and weather targets can no longer be calibrated. The point where red level weather target calibration is no longer possible is highlighted by changing the background field from black to cyan.
  Cyan areas should be avoided. Any target detected inside a cyan area should be considered very dangerous. All targets in the cyan field are displayed as a magenta-colored 4^{th} level precipitation.

- **Shadowing** - This is an operating technique similar to the Cyan REACT Field. To use the shadowing technique, tilt the antenna down until the ground is being painted just in front of the storm cell(s). An area characterized by no ground returns behind the storm cell has the appearance of a shadow. The cell that produces radar shadowing is a very strong and dangerous cell and should be avoided by 20 NM.

FLIGHT PLAN MODE (FP)

When the Flight Plan Mode is selected a singular display of navigation data and a FLTPLAN label are presented on the PFDs' and MFDs' radar mode field. The radar is put in standby and there is no radar data displayed in this mode.

GROUND MAPPING MODE (GMAP)

This mode is used to alert the flight crew regarding hazards caused by ground targets. This is especially useful in areas of rapidly changing terrain, such as mountainous regions. In this mode the system is fully operational and all internal parameters are set to enhance returns from ground targets.

The TILT control should be turned down until the desired amount of terrain is displayed. The degree of down-tilt depends upon airplane altitude and the selected range. Receiver characteristics are altered to provide equalization of ground-target reflection versus range. The selection of calibrated GAIN will generally provide the desired mapping display. If required, variable gain may be used to reduce the level of strong returns.

In the ground mapping mode a GMAP label is displayed on the PFDs' and MFDs' radar mode field, and the color scheme is changed to cyan, yellow and magenta. Cyan represents the least reflective return, yellow is a moderate return and magenta represents the most highly reflective target return.

For airplanes equipped with dual control panels, it is possible to have one pilot working the GMAP while the other one is using the regular WX mode.

CAUTION: WEATHER TYPE TARGETS ARE NOT CALIBRATED WHEN THE RADAR IS IN THE GMAP MODE. THEREFORE, THE PILOT SHOULD NOT USE THE GMAP MODE FOR WEATHER DETECTION.

TURBULENCE DETECTION FUNCTION (TRB) (P-880 MODEL ONLY)

When this mode is selected, the radar processes return signals in order to determine if a turbulence condition is present. Areas of potentially hazardous turbulence are displayed as white. Any areas shown as turbulence should be avoided.

Turbulence detection function may only be engaged in the WX mode and at selected ranges of 50 NM or less. When the TRB function is active, a T letter will be displayed on the PFDs' and MFDs' radar mode field.

CAUTION: ALTHOUGH TURBULENCE MAY EXIST WITHIN ANY STORM CELL, WEATHER RADAR CAN ONLY DETECT TURBULENCE IN AREAS OF RAINFALL.

TARGET ALERT (TGT)

Target alert is selectable in all but the 300-mile range. When selected, target alert monitors for red or magenta weather beyond the selected range and 7.5° on either side of the airplane's heading. If such weather is detected within the monitored area and outside the selected range, the target alert annunciation TGT label changes from a green armed condition to an yellow TGT alert condition on the PFDs' and MFDs' radar mode field. This annunciation advises the flight crew that potentially hazardous targets lie directly in front and outside of the selected range. When this warning is received, the flight crew should select longer ranges to view the questionable target.

The target alert is inactive within the selected range. Selecting target alert forces the system to calibrate gain, and turns off the variable gain mode. Target alert can only be selected in WX and FP modes.

NOTE: Keep TGT alert enabled when using short ranges. This allows the issuing of an alert if a new storm cell develops ahead of the airplane's flightpath.

ANTENNA STABILIZATION (STAB or STB)

The antenna is normally pitch and roll-stabilized by using attitude information from the AHRS or IRS. Momentarily pushing the STAB (or STB) button disables antenna stabilization and an amber “STAB” annunciation label is presented on the PFDs’ and MFDs’ radar mode field.

RECEIVER GAIN (GAIN)

The GAIN knob is a rotary control and push/pull switch that controls radar receiver gain. Two gain modes are available: calibrated or variable.

Calibrated: When the GAIN knob is pushed in, receiver gain is preset and calibrated, which is the normal mode of operation. In calibrated gain, the rotary function of the GAIN knob is disabled.

Variable (VAR): When the GAIN knob is pulled out, the system enters the variable gain mode. Variable gain is used for additional weather analysis and for ground mapping. In the WX mode, variable gain can increase receiver sensitivity over the calibrated level to show very weak targets or can be reduced below the calibrated level to eliminate weak returns. In the GMAP mode, variable gain is used to reduce the level of strong returns from ground targets.

Rotation of the knob counter-clockwise reduces receiver sensitivity. Rotating clockwise increases receiver sensitivity until its maximum. A digital readout and gain setting label are displayed on the PFDs’ and MFDs’ radar mode field.

NOTE: When REACT or TGT modes are selected, the system will be forced into calibrated gain.

CAUTION: VARIABLE GAIN MAY BE USED ONLY FOR SHORT PERIODS OF TIME. DO NOT LEAVE THE RADAR IN VARIABLE GAIN SINCE SIGNIFICANT WEATHER TARGETS MAY NOT BE DISPLAYED.

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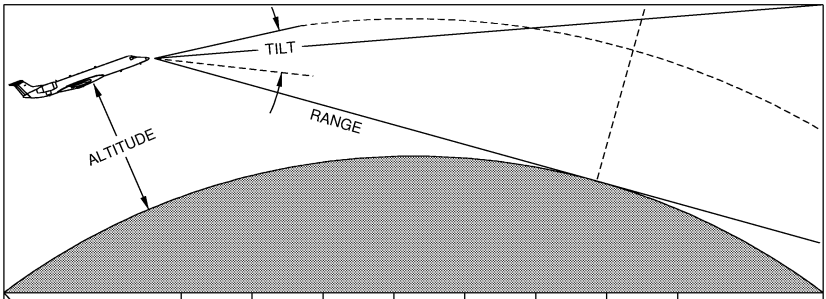
TILT

Tilt management is crucial to the safe operation of weather radar. If improperly managed, weather targets can be missed or underestimated. Proper tilt management demands that tilt be changed continuously.

To find the best tilt angle after the airplane is airborne, adjust the TILT antenna downward until a few ground targets are visible at the edge of the display. The table below gives the approximate tilt settings for minimal ground target display for different altitudes and ranges. If the altitude changes or a different range is selected, adjust the tilt control as required to minimize ground returns.

When flying at high altitudes, tilt downward frequently to avoid flying above storm tops. When in low altitude or approaching for landing, tilt management must be performed manually, with the radar beam vertically sweeping from up to down to avoid flying above or below a storm line.

During takeoff, the radar must be adjusted to a minimum range scale, with a horizontal RH and LH scan and with the antenna positioned upwards (climbing angle).



RANGE SCALE - nm / ALTITUDE - ft	5	10	25	50	100	200	300	LINE OF SIGHT - nm
40000	(TILT LIMITED REGION)		-12	-4	-1	+1	(LINE OF SIGHT LIMITED REGION)	246
35000			-10	-3	0	+1		230
30000			-8	-2	0	+1		213
25000			-6	-1	+1			195
20000			-4	0	+1			174
15000		-11	-2	+1	+2			151
10000		-6	0	+2	+2			123
5000	-5	-1	+2	+2				87
4000	-4	0	+2	+3				78
3000	-2	+1	+3	+3				67
2000	0	+2	+3	+3				55
1000	+2	+3	+3					39

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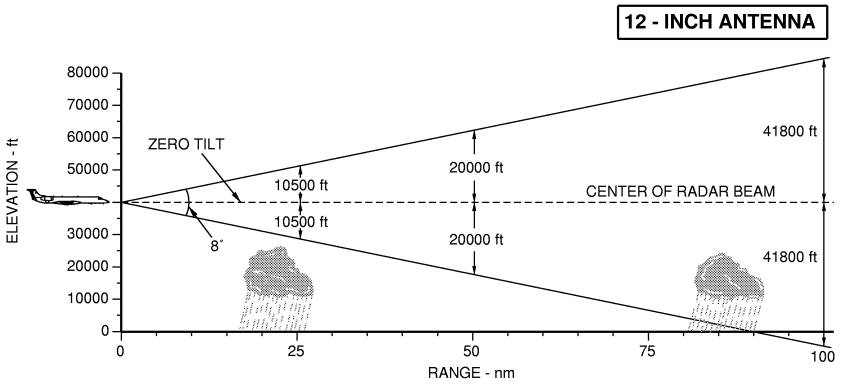
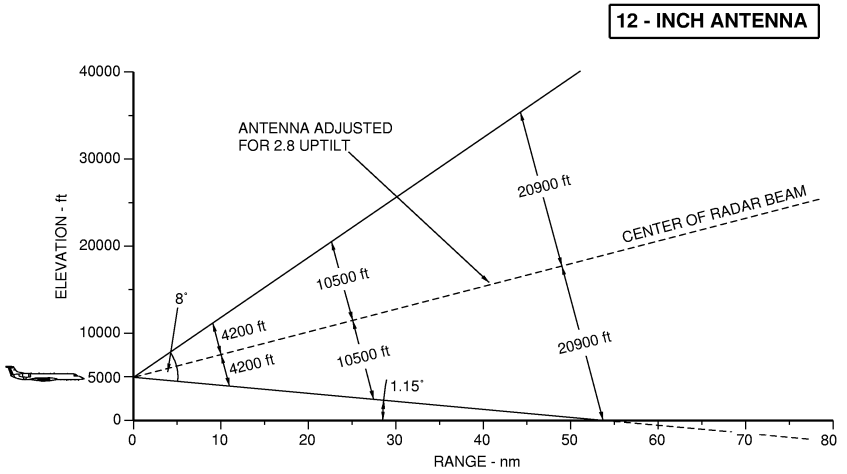
TILT SETTINGS FOR MINIMAL GROUND TARGET DISPLAY (12 inch antenna)

The figure below helps to visualize the relationship between tilt angle, flight altitude and selected range. It shows the distance above and below airplane altitude that is illuminated by the radar during level flight with 0° tilt (high altitude) and a low altitude situation, with antenna adjusted for 2.8° up-tilt.



RADAR BEAM ILLUMINATION HIGH ALTITUDE



RADAR BEAM ILLUMINATION LOW ALTITUDE

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ALTITUDE COMPENSATED TILT (ACT) (P-880 MODEL ONLY)

In ACT, the antenna tilt is automatically adjusted with regard to the selected range and airplane altitude. ACT adjusts the tilt to show a few ground targets at the edge of the display. The TILT knob can be used for fixed offset corrections of up to 2°.

NOTE: Proper tilt management demands that tilt be changed continuously, even in airplanes equipped with ACT.

SLAVE (SLV) (DUAL CONTROL PANEL ONLY)

For airplanes equipped with dual weather radar control panels, one controller can be slaved to the other by selecting OFF on that controller only. This condition is annunciated by the illumination of SLV on the control panel. The slave mode allows one controller to set the radar modes for both sides. In the slave mode, the PFDs and MFDs radar information are identical and simultaneously updated.

NOTE: In the slaved condition, both control panels must be set to off before the radar system turns off.

RADOME

The radome is the primary factor behind degraded weather radar performance. The problems affecting the radome are as follows:

- A water film over the radome's surface when flying in rain.
- Greased radome.
- Cracked radome.
- Holes caused by lightning strike/electrostatic discharges.
- Excessive application of antistatic paint.

Water Film Over The Radome's Surface: When flying in rain, there is indication that at some specific altitudes and speeds a water film is formed on the radome, altering the weather radar indications. The radar display may disappear or turn red. To avoid this problem, there is a hydrophobic coating product named Cytonix® that can be applied to the radome surface.

Greased Radome: The presence of grease or dirt over the radome's surface also impairs radar transmission. These should be reported immediately to maintenance personnel for cleaning or corrective action.

Electrostatic Discharges: Static electricity influences radar performance. The right bonding is necessary. Bonding is accomplished through two metallic meshes that link the radome's metallic bulkhead (diverters) to the airplane's airframe. It is important to make sure that they are in good condition and not painted. If both the metallic meshes and screws are painted, this will isolate the static power generated in the radome, resulting in electrical discharges that will follow towards the radar antenna and/or generate noise in the audio system.

Cracked Radome: Small holes caused by electrostatic discharges, minor damage to structure or paint can cause water infiltration in the radome's honeycomb composite structure. It can result in significant radar signal attenuation, distortion and in some cases, can cause dark spots on the radar screen.

WEATHER RADAR CONTROLS AND INDICATORS

WEATHER RADAR CONTROL PANEL

1 - RANGE SELECT BUTTONS

- Allow selection of the radar's operating range, from 5 to 300 NM full scale in WX, REACT, or GMAP mode. In FP mode, additional ranges of 500 and 1000 NM are available. In test mode the range is automatically set to 100 NM.
- The up-arrow button selects increasing ranges, while the down-arrow button selects decreasing ranges. Upon reaching maximum or minimum range, further pushing of the button causes the range to rollover to minimum or maximum range, respectively.

2 - TURBULENCE DETECTION FUNCTION BUTTON (P-880 Model Only)

- Alternate pressings turns on or off the radar's turbulence detection function.
- Function can be used only in WX or RCT mode, with selected range of 50 NM or less.

3 - STABILIZATION FUNCTION BUTTON

- When momentarily pressed, disables antenna stabilization function. The STAB OFF annunciator will illuminate on the control panel.
- On the ground, after warm-up period, pressing the STB button four times within 3 seconds will inhibit the forced standby (FSBY) function.

4 - SLAVE ANNUNCIATOR (Dual Control Panels Only)

- Illuminates to indicate that one controller is slaved to the other.

5 - TARGET ALERT CONTROL BUTTON

- Alternate pressing selects or cancels the target alert feature.
- Selectable only in the WX and FP Modes.

6 - SECTOR SCAN BUTTON (SECT)

- When momentarily pressed, selects either the radar's normal 12 sweeps per minute for a 120° full scan or the faster update 24 sweeps per minute for a 60° sector scan.

7 - ANTENNA TILT CONTROL KNOB

- The TILT knob is a rotary control that allows manual control of the antenna's tilt angle. Clockwise rotation tilts the beam upward 0° to +15°. Counter-clockwise rotation tilts beam downward 0° to –15°. A digital readout of the antenna tilt angle is displayed on the MFD.
- The range between +5° and -5° is expanded for setting ease.

ALTITUDE COMPENSATED TILT (PULL ACT) (P-880 Model Only)

- Pulling out the TILT knob activates the auto tilt control, which automatically readjusts tilt between ± 2° based on changes in barometric altitude and/or selected range.

8 - RADAR MODES CONTROL KNOB

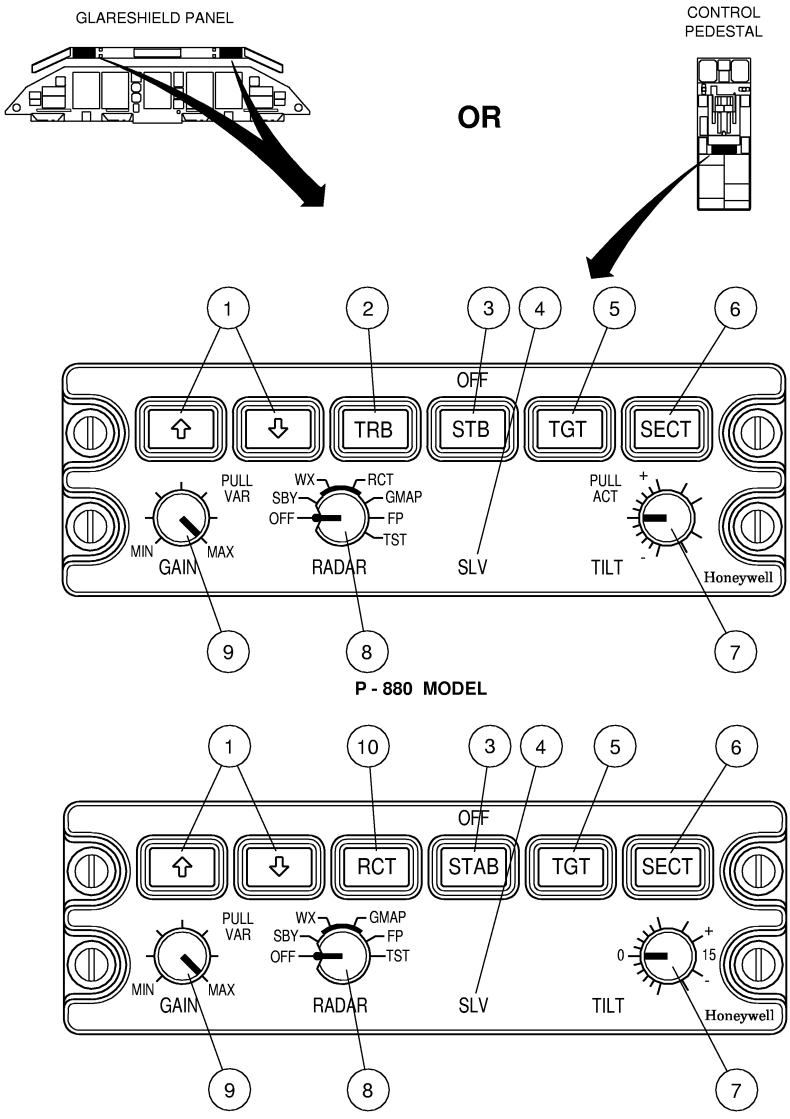
OFF - Turns off the weather radar.
SBY - Selects the weather radar standby operating mode.
WX - Selects the weather radar detection operating mode.
RCT - Selects the REACT function (P-880 Model only).
GMAP - Selects the weather radar ground mapping operating mode.
FP - Selects the weather radar flight plan operating mode.
TST - Selects the weather radar test mode.

9 - GAIN CONTROL KNOB

- Allows receiver gain control.
- When pushed in, receiver gain is preset and calibrated. Rotary function of the GAIN knob is disabled
- When pulled out, sets receiver gain to variable (VAR) mode.

10 - RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE FUNCTION BUTTON (P-660 Model Only)

- When pressed (momentarily), enables the REACT.
- REACT is always selected in test mode.
- REACT is available in all modes except MAP.



NOTE: THE AIRPLANE MAY BE OPTIONALLY EQUIPPED WITH TWO WEATHER RADAR CONTROL PANELS LOCATED ON THE GLARESHIELD PANEL.

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WEATHER RADAR CONTROL PANEL

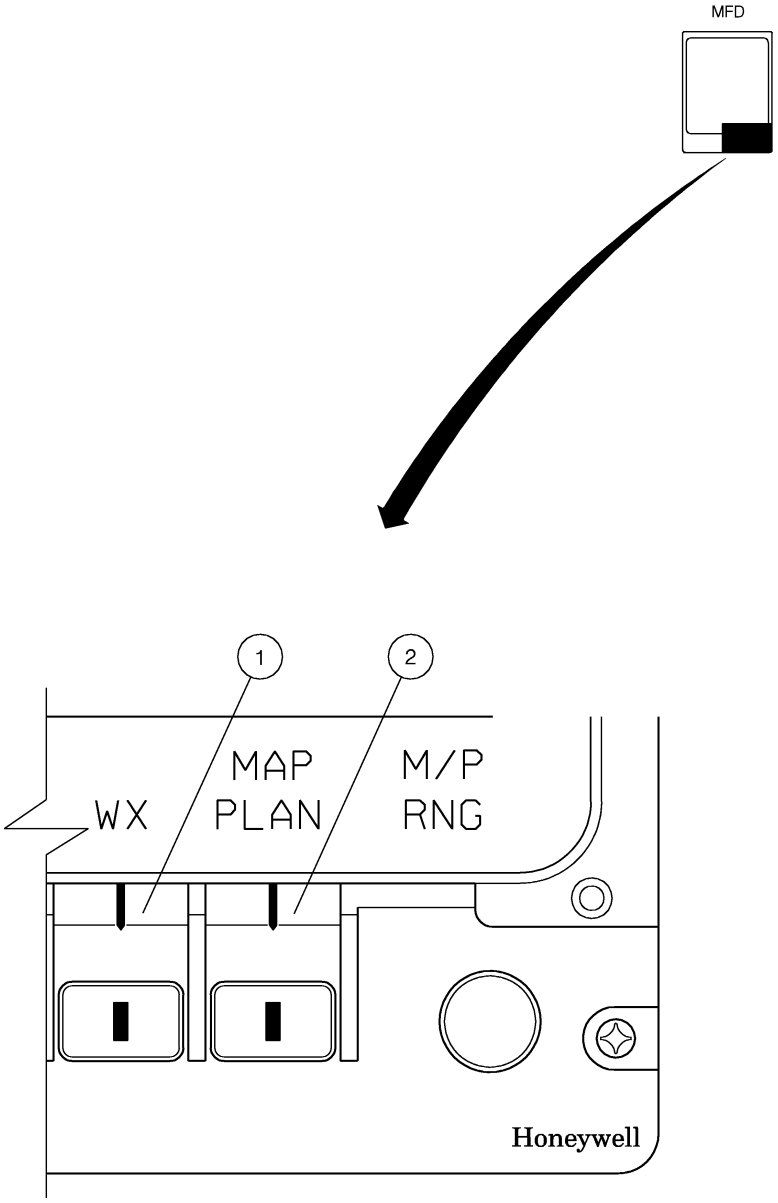
MFD BEZEL PANEL

1 - WEATHER RADAR DISPLAY SELECTOR BUTTON

- Alternate pressing of the weather radar display selector button allows the weather radar to be displayed or removed from the MFD. Control of all other weather radar functions is accomplished by the radar control panel. When the weather radar is selected, the WX label on the MFD menu, above this button, will be highlighted by a white box.
- The weather radar can only be selected for display in map format. If the weather radar is selected with plan format already selected on the MFD, it will force the display to revert to map format.

2 - MAP/PLAN FORMATS CONTROL BUTTON

– Alternate pressing of the map/plan formats control button will cause the MFD to toggle between map and plan formats. A white box around will highlight the selected MFD format.
– If the weather radar is displayed on the MFD and the plan format is selected, the weather radar will be removed from the display. However, if the MFD map format is selected again, the weather radar display will be restored on the MFD.



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MFD BEZEL PANEL

WEATHER RADAR DISPLAY ON THE PFD AND MFD

1 - ANTENNA POSITION INDICATOR (API)

- Color: Amber.
- The API is displayed as an arc at the current range outer limit.
- Indicates the radar antenna alternate sweep position and provides a picture bus activity indication.

2 - WEATHER RADAR PATCH

- Indicates an area of radar reflection.
- Color:
  - Magenta: high intensity reflection.
  - Red: medium-high intensity reflection.
  - Yellow: medium intensity reflection.
  - Green: low intensity reflection.

3 - WEATHER RADAR TURBULENCE INDICATION

- Indicates an area of detected turbulence.
- Color: white.

4 - WEATHER RADAR REACT INDICATION

- Indicates an area where radar receiver gain compensation has reached its maximum value.
- Color: cyan.

5 - WEATHER RADAR RANGE ARC VALUE

- Color: white.
- Indicates the radar range selected in the weather radar control panel.

6 - WEATHER RADAR ANTENNA TILT ANGLE DISPLAY

- Color: green.
- Range: –15 to +15°.
- Resolution: 1°.

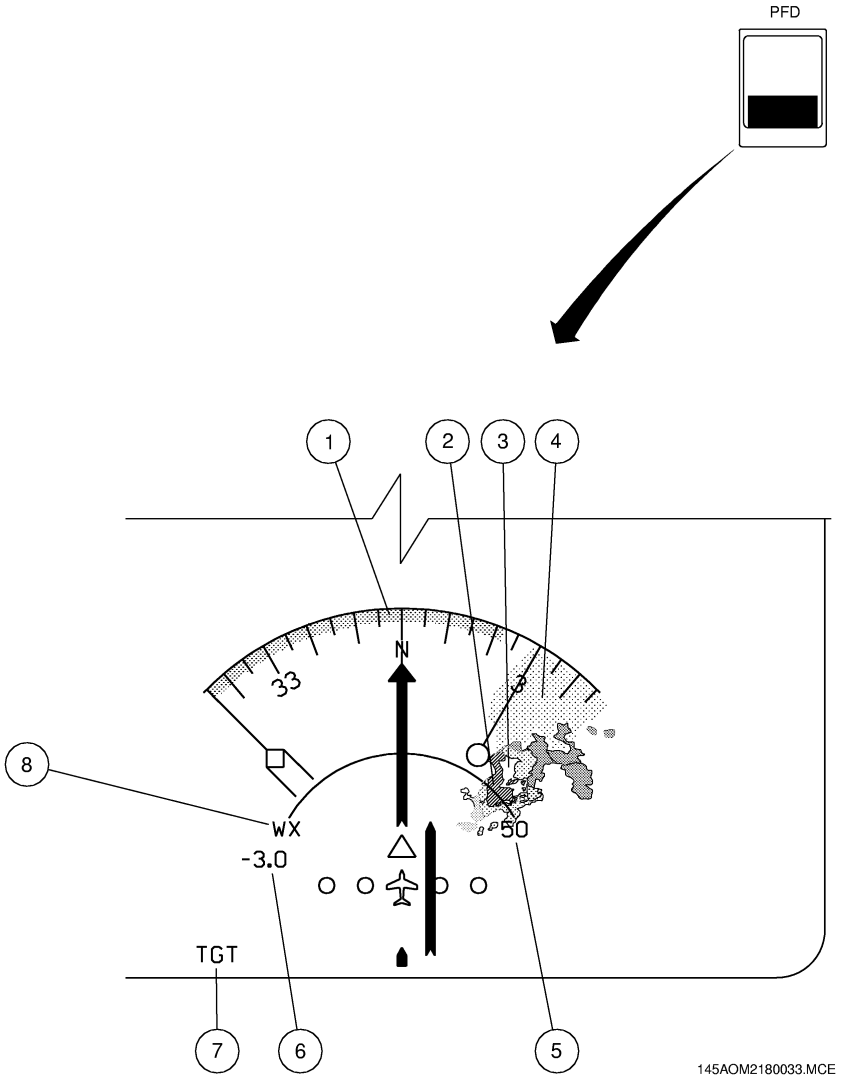
7 - WEATHER RADAR TARGET MODE AND ALERT ANNUNCIATION

- Color:
  - TGT label: green or amber.
  - VAR label: amber.
- The VAR label will be displayed in the same field as that used for TGT annunciation to indicate a variable gain indication. Priority is given to TGT annunciation.

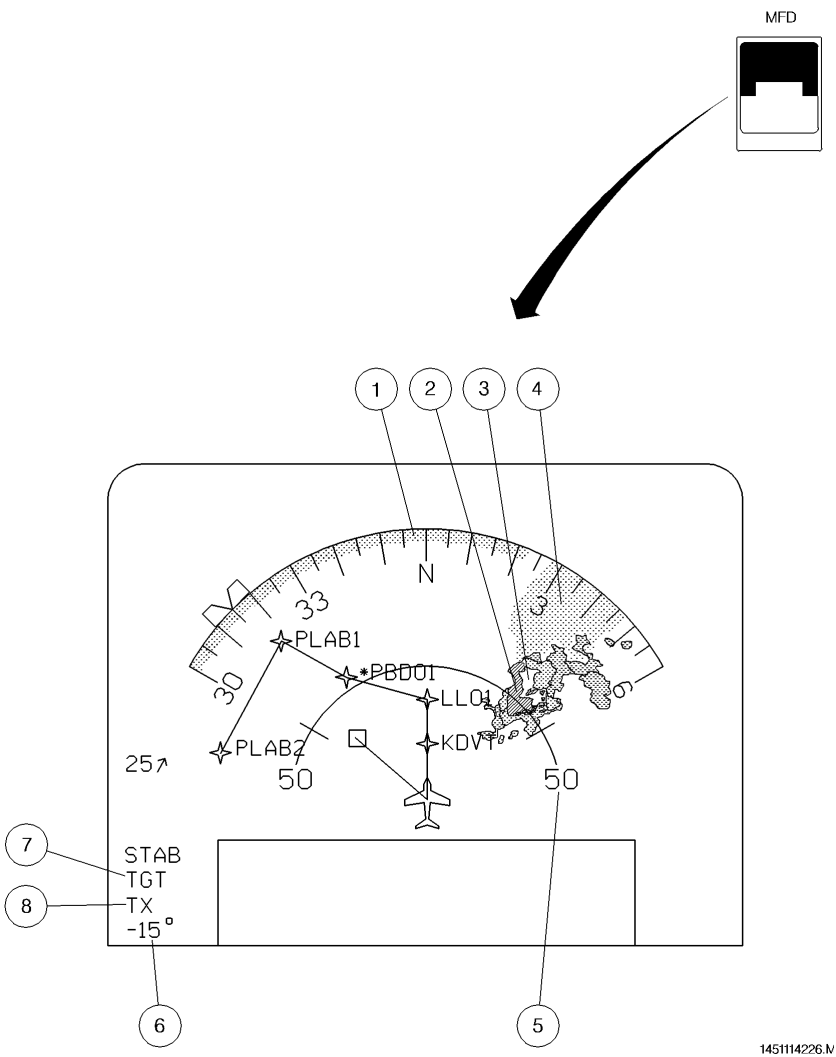
8 - WEATHER RADAR MODES ANNUNCIATION DISPLAY

– Indicates the selected mode in the weather radar control panel.

DISPLAY		MODE DESCRIPTION
ANNUNCIATION	COLOR	
STAB	AMBER	Stabilization off.
TGT	GREEN	Target alert enable.
TGT	AMBER	Target alert enable and level 3 WX return detected in the forward 15° of antenna scan.
VAR	AMBER	Variable gain.
WX	GREEN	Normal WX ON and selected for display.
WX	AMBER	Invalid WX control bus.
TX	GREEN	WX is transmitting but not selected for display, or in STBY or FSTBY.
TX	AMBER	WX is transmitting and weight on wheels indicates on ground, but not selected for display, or in STBY and FSTBY.
WAIT	GREEN	Warm up period of approximately 40 to 100 seconds.
STBY	GREEN	Normal standby.
FSBY	GREEN	Forced standby.
TEST	GREEN	Test mode and no faults.
FAIL	AMBER	Test mode and faults.
RCT	GREEN	Normal WX with REACT.
FPLN	GREEN	Flight plan mode.
GMAP	GREEN	Ground map mode.
GCR	AMBER	Normal WX with ground clutter reduction.
R/T	GREEN	WX with REACT and turbulence.
WX/T	GREEN	Normal WX with turbulence.



WEATHER RADAR DISPLAY ON PFD



WEATHER RADAR DISPLAY ON MFD

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PRECISION AREA NAVIGATION (P-RNAV)

P-RNAV defines European RNAV operations, which satisfy a required track-keeping accuracy of ±1 NM for at least 95% of the flight time, path coding in accordance with ARINC 424 (or an equivalent standard), and the automatic selection, verification and, where appropriate, de-selection of navigation aids.
P-RNAV operations determines aircraft position in the horizontal plane using inputs from the following types of positioning sensors (in no specific order of priority):

– Distance Measurement Equipment (DME) giving measurements from two or more ground station (DME/DME);
– VHF Omni-directional Range (VOR) with a co-located DME (VOR/DME), where it is identified as meeting the requirements of the procedures;
– Global Navigation Satellite System (GNSS);
– Inertial Navigation System (INS) or Inertial Reference System (IRS), with automatic updating from suitable radio based navigation equipment.

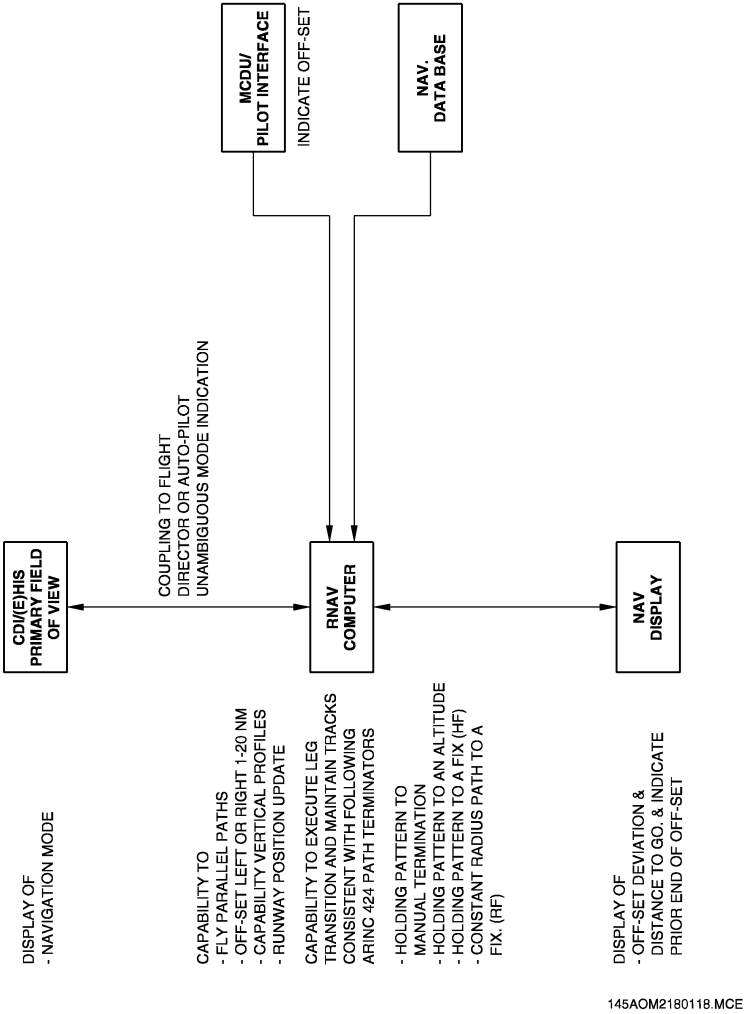
P-RNAV is used for departures, arrivals and approach (FAWP - Final Approach Waypoint), and not used on final approach, i.e. from FAWP to RWY and missed approach.

LIMITATIONS

– For P-RNAV operations in terminal airspace, obstacle clearance protection, up to the FAWP, will assume that aircraft comply with the P-RNAV accuracy requirements;
– Obstacle clearance altitude has been based upon the infrastructure giving the poorest precision;
– The minimum flight crew are 2 Pilots;
– It is not permissible to use, for any period of time, data from an inertial system as the only means of positioning;
– The system must display essential information in the Pilot's primary field of view such as:
  – Lateral Deviation;
  – TO/FROM waypoints;
  – Failure flag (failure of P-RNAV system);

- Unless automatic updating of the actual departure point is provided, the flight crew must ensure initialization on the runway either means of a manual runway threshold or intersection update, as applicable. This is to preclude any inappropriate or inadvertent position shift after take-off;
- Where reliance is placed on the use of radar to assist contingency procedures, its performance has been shown to be adequate for that purpose, and the requirement for a radar service is identified in the AIP
- P-RNAV operations must use FMS to control all lateral navigation functions. For FMS limitations, refer to Section 1-01-60 (Limitations, System: FMS) of AOM.
- The system must have means to display to the flight crew the following items:
  - The active (TO) waypoint and distance/bearing to this point;
  - Ground speed or time to the active (TO) waypoint;
  - Automatic tuning of VOR and DME navigation aids used for position updating together with the capability to inhibit individual navigation aids;
  - RNAV system failure;
  - Alternate means of displaying navigation information, sufficient to perform cross-checks procedures.

P-RNAV SYSTEM



NORMAL PROCEDURES

- Verify NOTAM (Notice to Airman) for non-available P-RNAV procedure, if navigational aids, identified in the AIP as critical for a specific P-RNAV procedure, are not available;
- Use phraseology appropriate to P-RNAV operations;
- When the VOR or DME is not available or shutdown, the flight crew have to inhibit the navigation aid from the automatic selection process;
- The flight crew must notify ATC of any problem with the RNAV system that results in loss of the required navigation capability, together with the proposed course of action;
- Discrepancies that invalidate a procedure must be reported to the navigation database supplier and affected procedures must be prohibited by an operators notice to its flight crew.

PRE-FLIGHT PLANNING

- Verify the required navigation aids critical to the operation of specific procedure, and if they are identified in the AIP (Aeronautical Information Publication) and on the relevant charts;
- Check availability of the navigation infrastructure and onboard equipment for the period of intended operation;
- The navigation database must be appropriate for the region of the intended operation and must include the navigation aids, waypoints, and coded terminal airspace procedures for the departure, arrival and alternate airfields;
- When specified in the AIP that dual P-RNAV procedure are required for specific terminal P-RNAV procedure, the availability of dual P-RNAV system must be confirmed;
- If a stand-alone GPS is to be used for P-RNAV, the availability of RAIM must be confirmed;

DEPARTURE

- Both Pilots must verify if the navigation database is current and if aircraft position has been entered correctly;
- The PNF (Pilot Not Flying) must verify the desired path and the aircraft position relative to the path;
- The active flight plan should be checked by comparing the charts with the MAP display and the MCDU;

- A procedure shall not be used if doubt exists as to the validity of the procedure in the navigation database;
- The creation of new waypoints by manual entry into the RNAV system by the flight crew is not permitted;
- Route modifications in the terminal area may take form of radar headings or direct to clearances;
- Prior to take off, the flight crew must verify that the R-NAV system is available and operating correctly and, where applicable, the correct airport and runway data have been loaded;
- Unless automatic updating of the actual departure point is provided, the flight crew must ensure initialization on the runway either by means of a manual runway threshold or intersection update, as applicable. This is to preclude any inappropriate or inadvertent position shift after take-off. Where GNSS is used, the signal must be acquired before the take-off roll commences and GNSS position may be used in place of the runway update;
- During the procedure and where feasible, flight progress should be monitored for navigational reasonableness, by cross-checks, with conventional aids using the primary displays in conjunction with the MCDU.
- When automatic update for departure is not available, the procedure should be flown by conventional navigation means. A transition to the P-RNAV structure should be made at the point where the aircraft has entered DME/DME coverage and has had sufficient time to achieve an adequate input. If a procedure is designed to be started conventionally, then the latest point of transition to the P-RNAV structure will be marked on the charts. If a Pilot elects to start a P-RNAV procedure using conventional methods, there will not be any indication on the charts of the transition point to the P-RNAV structure.

ARRIVAL

Prior to the arrival phase, the flight crew should verify that the correct terminal procedure has been loaded. The active flight plan should be checked by comparing the charts with the MAP display and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over.

- If required by procedure, a check will need to be made to confirm that updating will exclude a particular navigation aid. A procedure shall not be used if doubt exists as to the procedure in the navigation database;
- Where the contingency to revert to a conventional arrival procedure the flight crew must make the necessary preparation;
- During the procedure and where feasible, flight progress should be monitored for navigational reasonableness by cross-checks with conventional navigation aids using the primary displays in conjunction with the MCDU. In particular, for a VOR/DME RNAV procedure, the reference VOR/DME used for the construction of the procedure must be displayed and checked by the flight crew. For RNAV systems without GNSS updating, a navigation reasonableness check is required during the descent phase before reaching the Initial Approach Waypoint (IAWP). For GNSS based systems, absence of an integrity alarm is considered sufficient. If the check fails, a conventional procedure must then be flown;
- Route modifications in the terminal area may take the form of radar headings or direct to clearances and the flight crew must be capable of reacting in a timely fashion. This may include the insertion of tactical waypoints loaded from the database. Manual entry or modification by the flight crew of a loaded procedure, using temporary waypoints or fixes not provided in the data base, is not permitted;
- Although a particular method is not mandated, any published altitude or speed constraints must be observed.

CONTINGENCY PROCEDURES

- The flight crew must notify ATC of any problem with the RNAV system that results in the loss of required navigation capability, together with the proposed course of action;
- In the event of communication failure, the crew should continue with the RNAV procedure in accordance with the published lost communication procedure;
- In case of loss of P-RNAV capability, the flight crew should navigate using an alternative means of navigation. The alternate means need not be an RNAV system;
- Cautions and warnings for the following conditions:
  - Failure of the RNAV system components including those affecting flight technical error;

  - Flight director – discontinue the P-RNAV procedure following the approved missed approach procedure or if feasible revert to a conventional or IRS procedure and inform ATC;
  - Automatic Flight – continue the approach using manual flight, and if the flight path cannot be followed perform a approved missed approach procedure and inform ATC;
- Multiple system failures – If a multiple system failures occurs such as affecting GNSS, Flight Director, and any other used for P-RNAV procedure, a missed approach procedure must be performed and inform ATC;
- Failure of navigation sensors - discontinue the P-RNAV procedure following the approved missed approach procedure or if feasible revert to a conventional or IRS procedure and inform ATC.

INCIDENT REPORTING

Significant incidents associated with the operation of the aircraft which affect or could affect the safety of RNAV operations, need to be reported on the appropriate report manifest.
Specific examples may include:

- Aircraft system malfunctions during P-RNAV operations which lead to:
  - Navigations errors not associated with transitions between different navigation modes;
  - Significant navigation errors attributed to incorrect data or a navigation database coding error;
  - Unexpected deviations in lateral or vertical flight path not cause by Pilot input;
  - Significant misleading information without a failure warning;
  - Total loss or multiple navigation equipment failure;
- Problems with ground navigational facilities leading to significant navigational errors not associated with transitions between different navigation modes.

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