1. GENERAL.

The Electronic Flight Instrument System (EFIS) receives data from various aircraft systems and converts the data to appropriate symbols and texts for presentation on the flight and navigation displays.

EFIS receives sensor data from both sides of the avionics systems and provides comparison monitoring capability. Parameters monitored, as appropriate, are roll, pitch, heading, altitude, airspeed, radio altitude, localizer and glideslope. Comparator warnings are displayed on the PFD.

EFIS consists of the following units:

- L and R Primary Flight Display, PFD
- L and R Navigation Display, ND
- L and R Display Control Panel, DCP
- L and R Reversionary switches
- L and R Brightness control
- EFIS Source switches
- Metric Altitude readout switch
- EFIS maintenance switches.

The PFD and ND CRTs are physically and software-wise identical units. The CRTs can therefore function as PFD, ND or backup for EICAS. Manipulation of the CRT (in case of CRT failure) functions are by the EFIS SOURCE and the reversionary switches.

1.1. Primary Flight Display (PFD).

The PFD provides an enhanced forward view presentation:

- Pitch and roll attitude
- Steering commands
- Lateral deviation
- Vertical deviation
- Radio height
- Decision Height set and annunciation
- Marker Beacon annunciation
- Flight guidance mode annunciation
- Autopilot annunciation
- Comparator functions
- Slip/Skid indicator.

In addition, air data information is integrated into the display:

- MACH readout
- Airspeed
- Speed bugs
- Airspeed trend vector
- Barometric altitude
- Barometric correction readout
- Altitude alert set
- MDA readout
- Vertical speed scale.

The lower portion of the display presents horizontal situation information:

- 190 degrees HSI arc
- Selected heading bug
- ADF or VOR bearing pointer
- Course pointer and selected course digital read-out
- Lateral deviation bar and scale with TO/FROM indication.

1.2. Navigation Display (ND).

The baseline system contains the basic modes of ROSE, ARC, MAP, and Maintenance Diagnostics. If all options are installed, the MFD can operate in additional modes which are selected by the DCP:

Options	Modes added
FMS	- Present Position (PPSN)MAP (replaces VOR MAP Mode) - Plan Map.
TCAS	TCAS.

The ROSE mode is a full compass rose mode with VOR/ILS information displayed using course pointer and lateral deviation bar.

The ARC mode is a partial compass rose mode with VOR/ILS information displayed using course pointer and lateral deviation bar. Weather data can be superimposed on the ARC display.

The MAP mode is a partial compass rose with the position of the two currently tuned navaids placed by the display using raw VOR/DME data. Weather data can be superimposed on the MAP display.

The Present Position MAP mode displays geographically positioned FMS symbols representing airports, waypoints, VOR/DMEs, etc. The Present Position MAP mode is a present position navigational map with a heading-up display. It is also possible to display FMS remote page performance data in this mode. Weather data can be superimposed on the MAP display.

The Plan MAP mode displays geographically positioned FMS symbols representing airports, waypoints, VOR/DMEs etc. The Plan MAP mode is a True North map representation for entering of a flight plan.

The TCAS mode displays TCAS traffic and resolution advisories (TA/RA) in a 360-degree coverage area around the own aircraft. Weather data can be superimposed on the TCAS display.

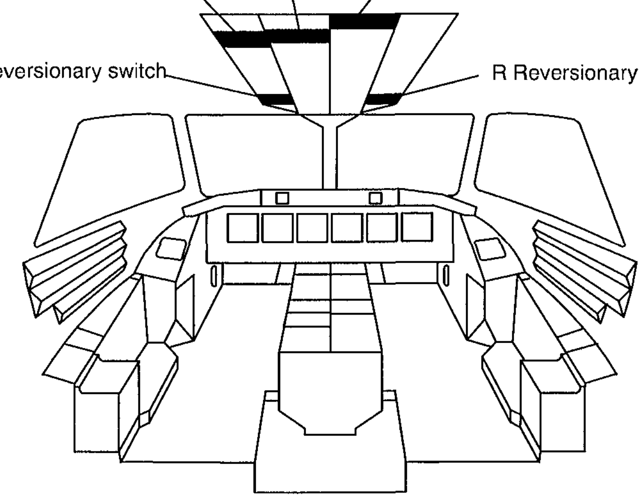
1.3. Display Control Panel (DCP).

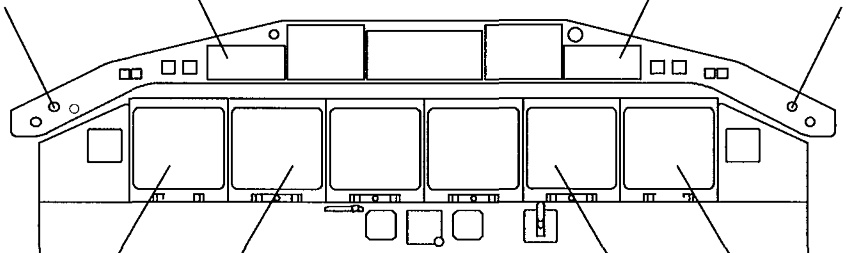
The DCP controls the display of information on the PFD and MFD independently. The panel contains two rotary knobs and nine pushbuttons.

1.4. EFIS Displays.

Both the PFDs and NDs are identical 7,25 by 7.25 inch color cathode ray tubes, CRTs.

Each CRT is provided with a BRT knob for individual display lighting. Two main display brightness controls for L and R side are also provided on the glareshield panel. The displays are supplied with cool air from a brushless DC fan under each display. The fan function is not monitored but the display temperature is, and if the temperature exceeds 110°C a "DISPLAY TEMP" message is displayed. If the temperature continues to increase the display automatically shuts down at 115°C.





B4846

FIG.1. EFIS component location.

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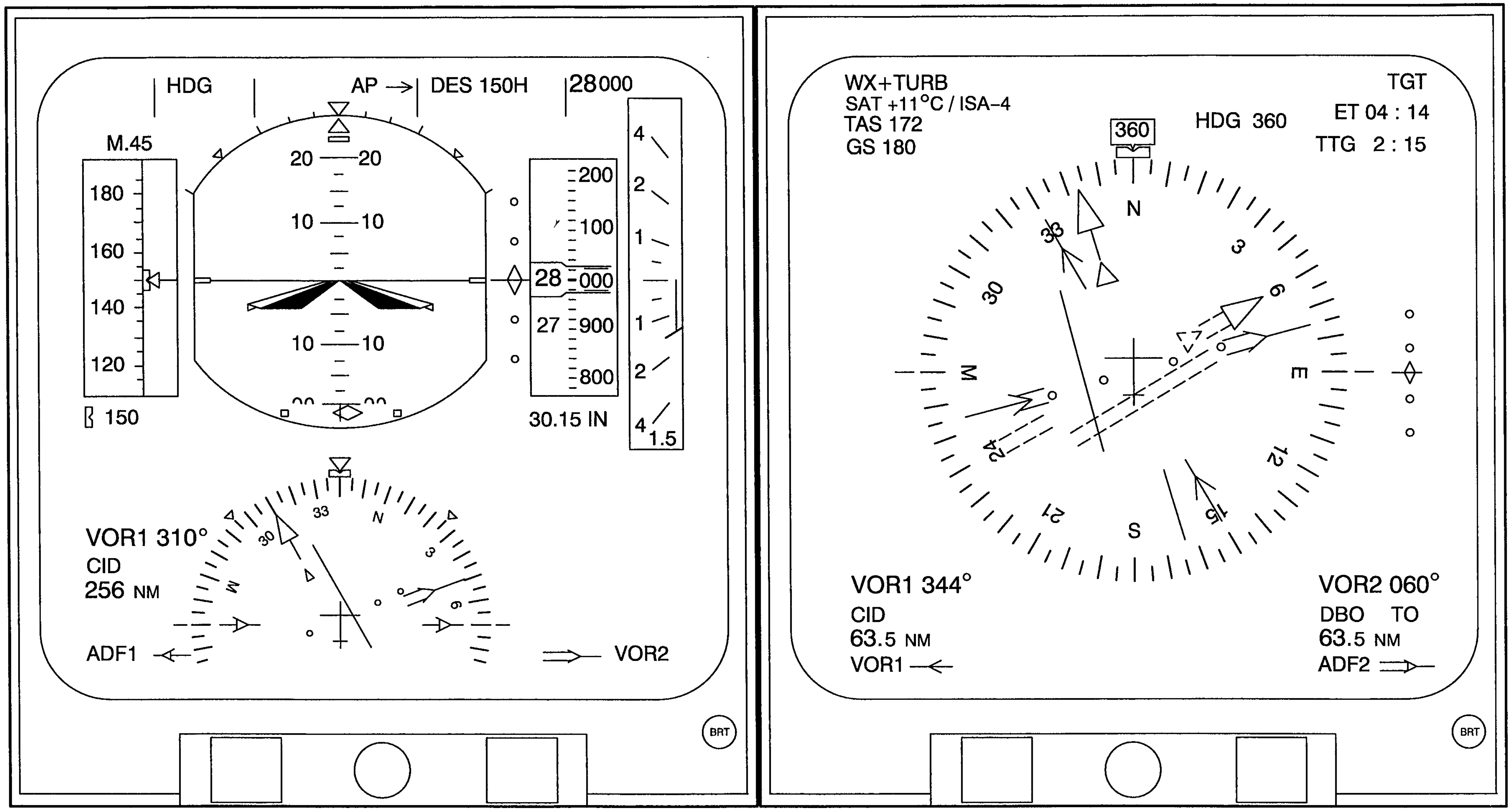
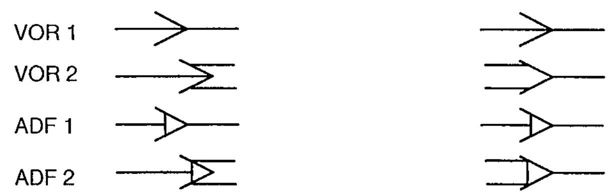
FIG.2.

2. CONTROLS AND INDICATORS.



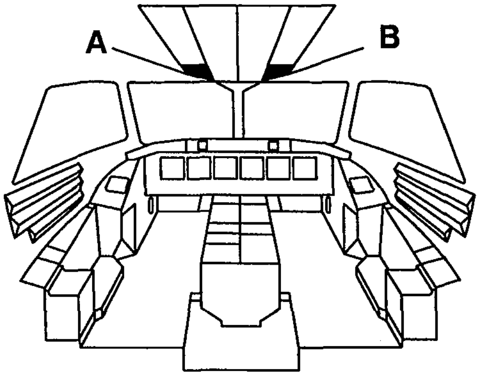
Two bearing pointers can be displayed in all combinations.



NOTE
All the following illustrations of EFIS in section 4 are intended to show the symbology and does not show real flight situations.

B1730

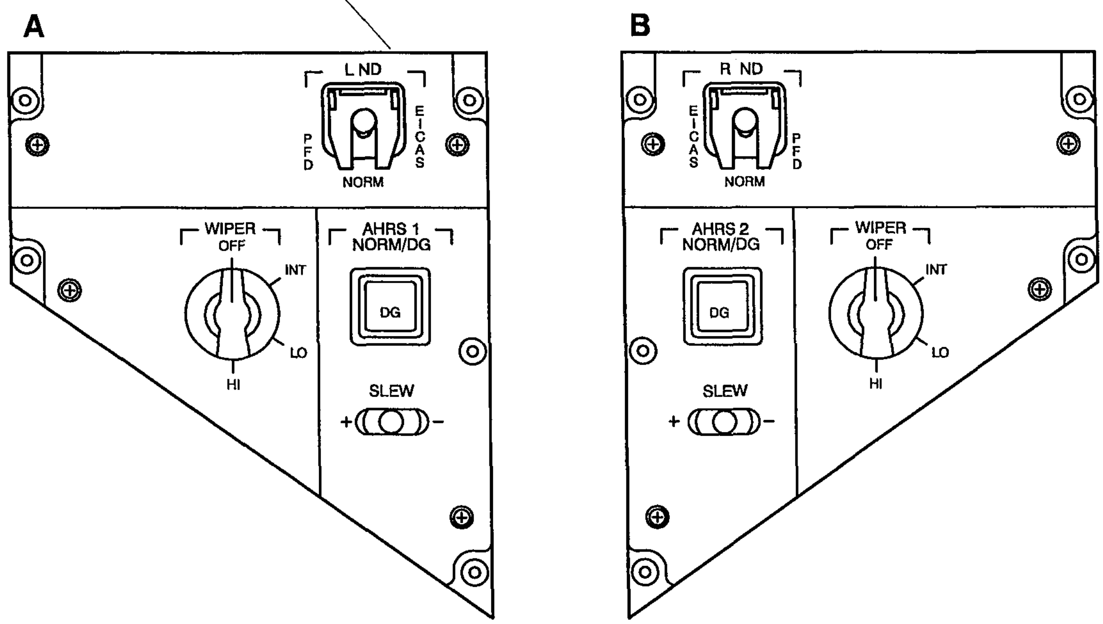
FIG. 3. LH flight instruments – PFD and ND.



L ND switch

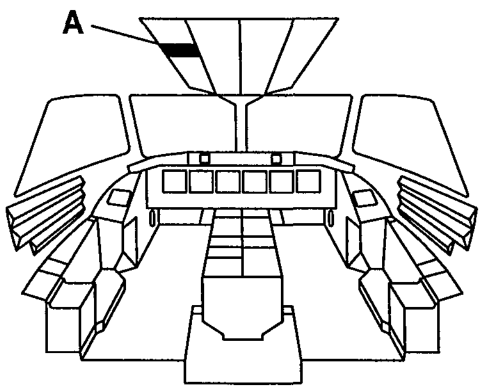
If the L PFD fails, L PFD can be displayed on L ND by setting the L ND switch to PFD.

Equal function on the right panel for R ND.

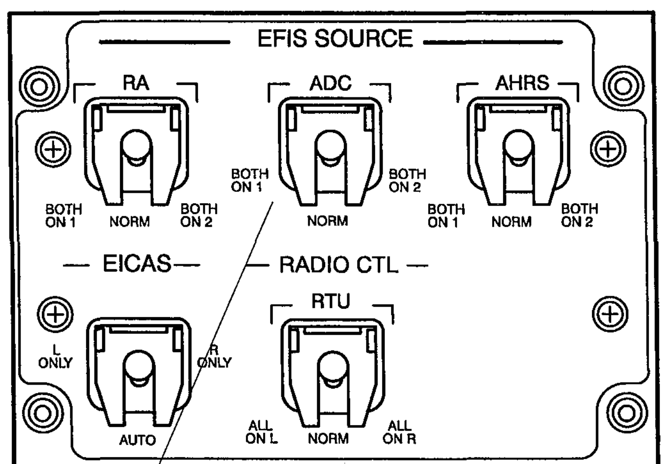


B4773

FIG. 4. – Reversionary switches.



A EFIS SOURCE PANEL



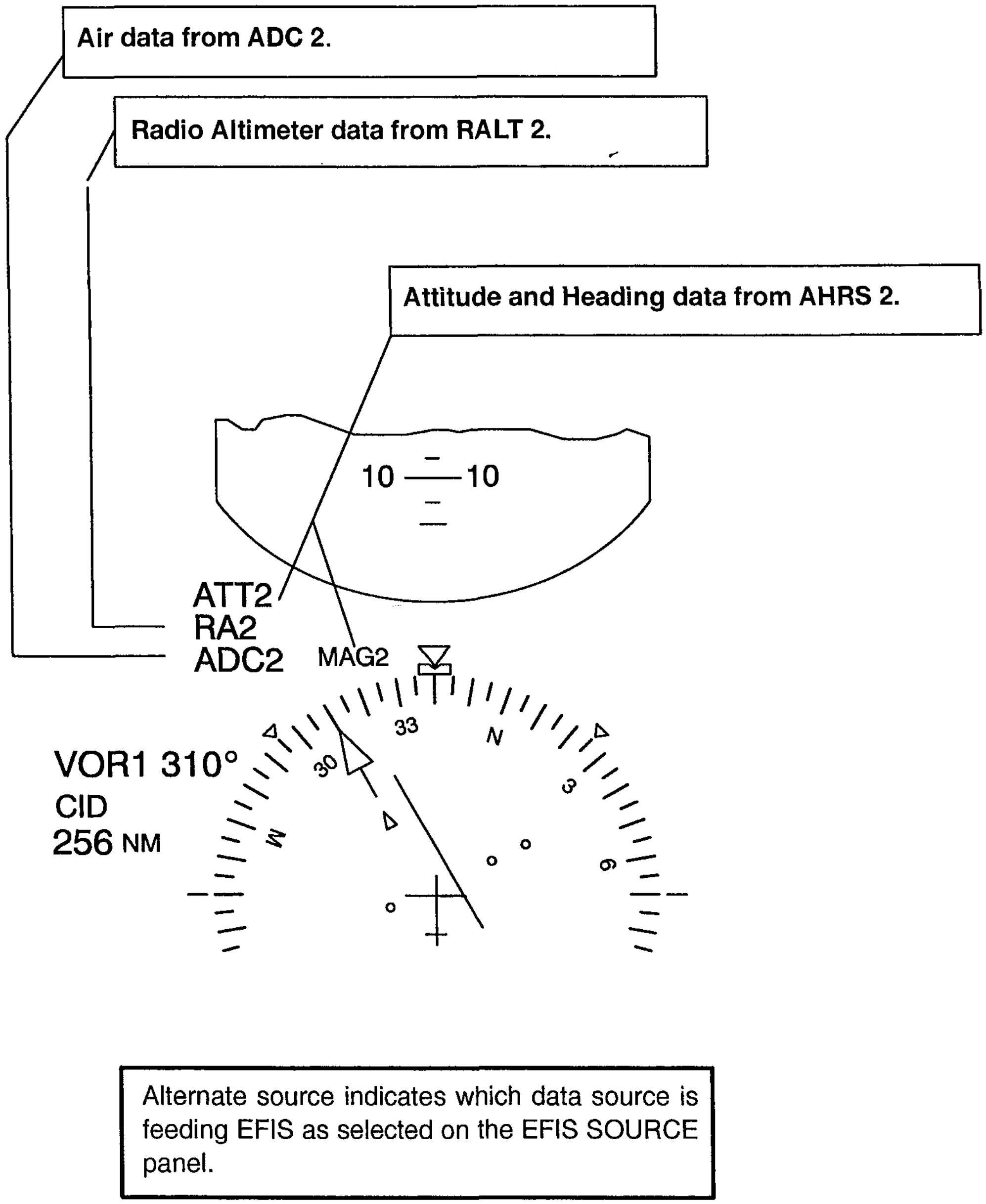
EFIS SOURCE switches

See respective system description for switch functions

RA	–	Chapter 4/5
ADC	–	Chapter 4/3
AHRS	–	Chapter 4/4

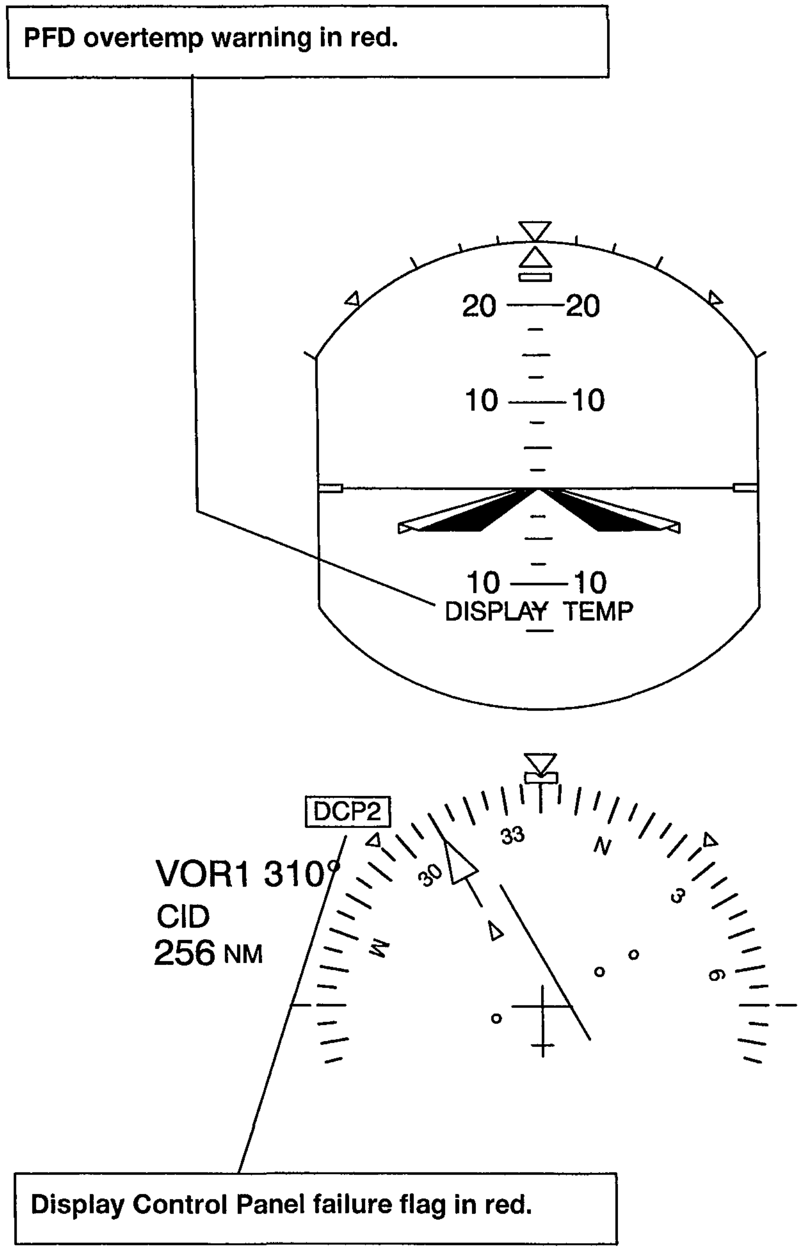
B4732

FIG. 5. EFIS SOURCE switches.



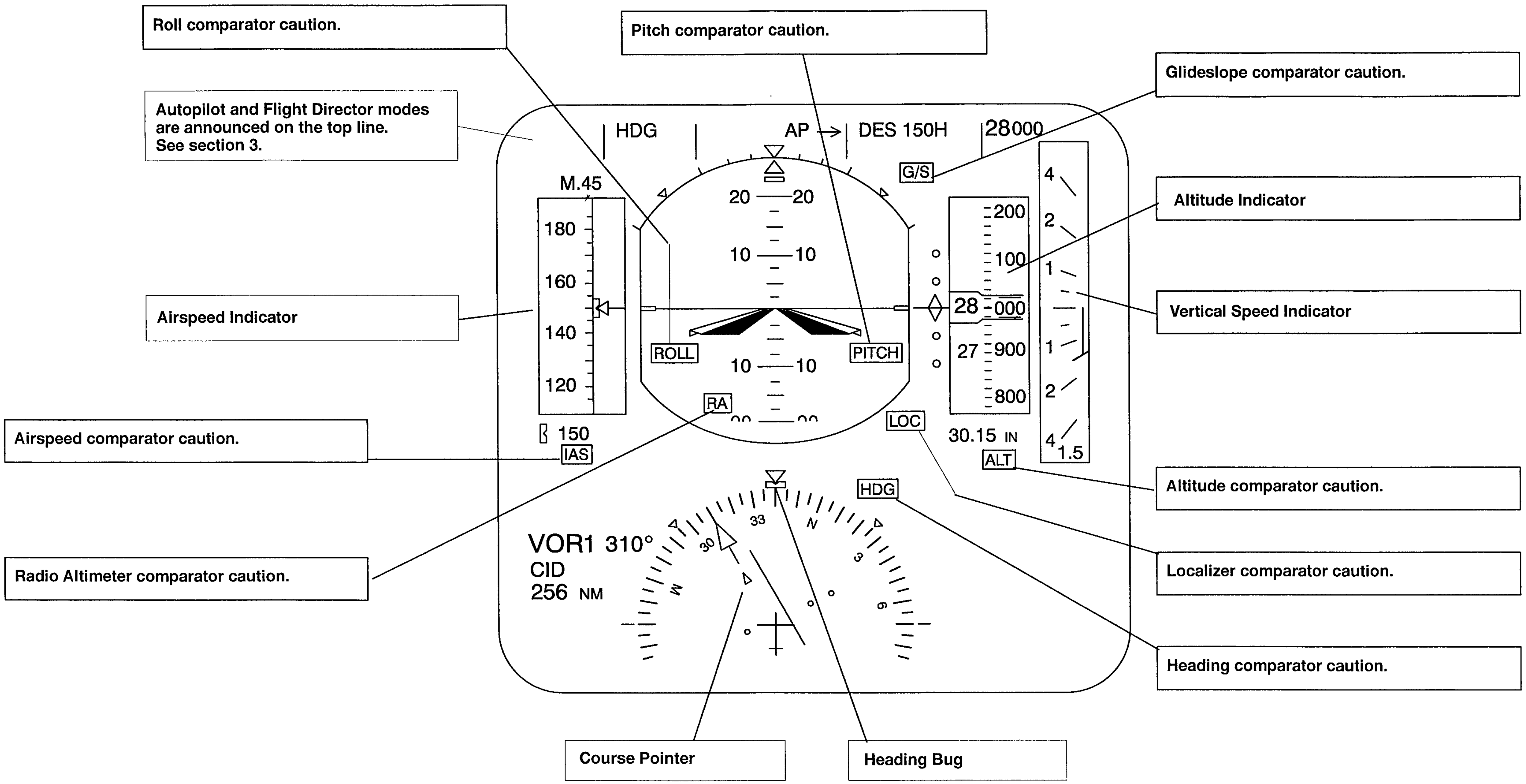
B2797

FIG. 6. Alternate sources selected on the EFIS SOURCE panel.



B2798

FIG. 7. Flags and Warnings.



B2800

FIG. 8. Comparator cautions.

NAV SOURCE selector

Selects the navigation source to be displayed on PFD and flown by the auto flight system. The VOR/LOC position selects the on–side navigation receiver. The SEL position provides selection of optional navigation sources.

Elapsed Time on ND

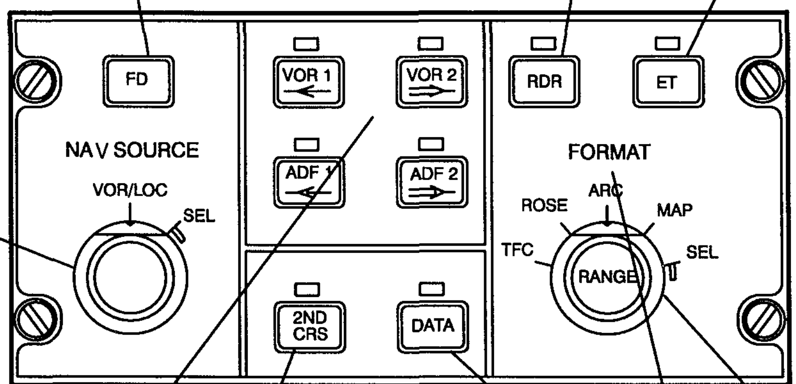
Start/stop/reset function

Flight Director button

See section 3

Weather radar on ND

See chapter 4.6



B1810

ND FORMAT selector

2ND CRS button

Select other side's course pointer and NAV data on ND.

DATA button

Removes non–essential data from ND for declutter.

VOR/ADF buttons

- Push to select/deselect
- All combinations can be selected except ADF 1 and VOR 1 together or ADF 2 and VOR 2 together.

RANGE selector for MAP and RDR mode

Full	Half (ARC)
5	2.5
10	5
20	10
40	20
80	40
160	80
320	160
640	320 (only in MAP mode)

FIG. 9. Display Control Panel, DCP.

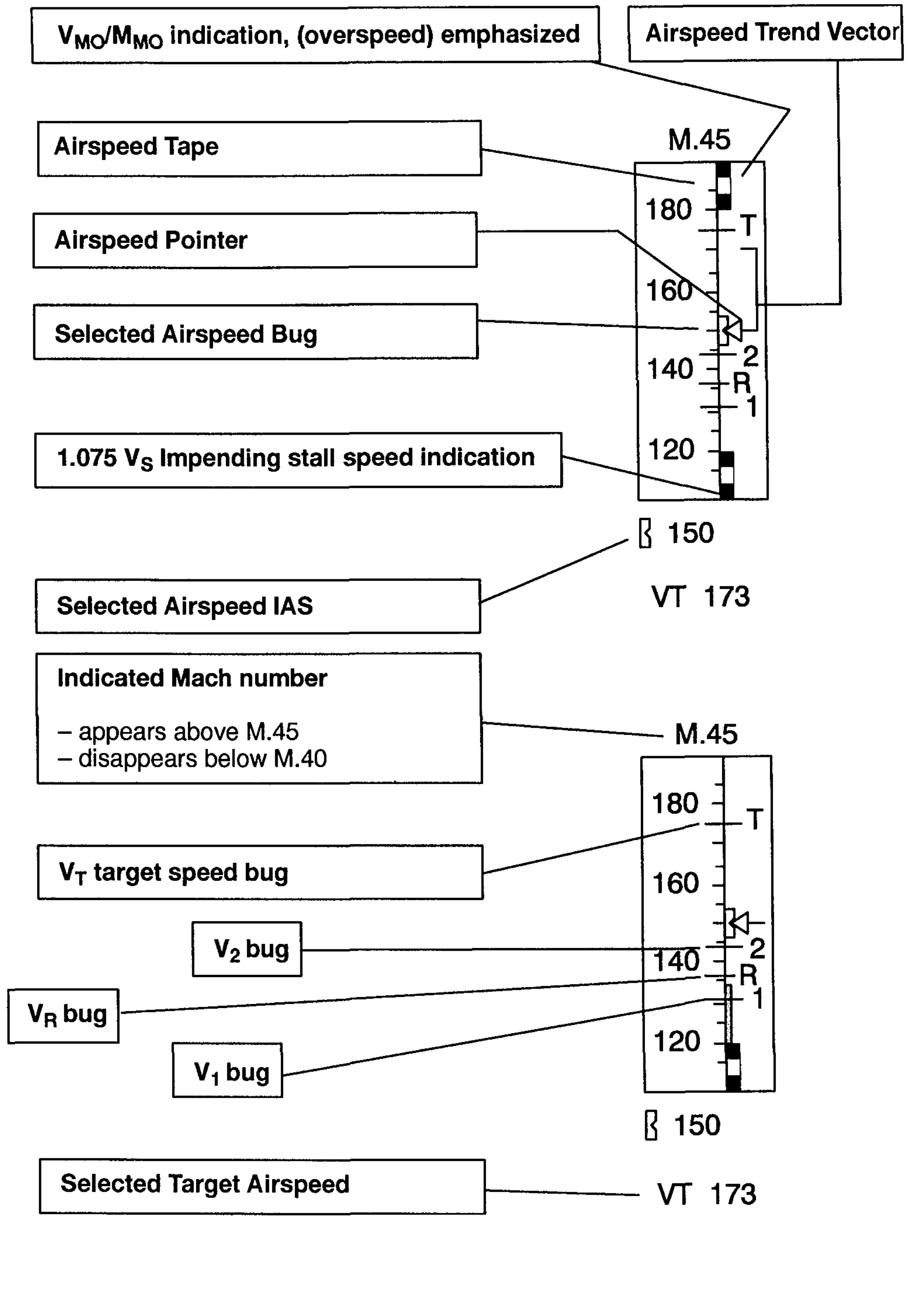
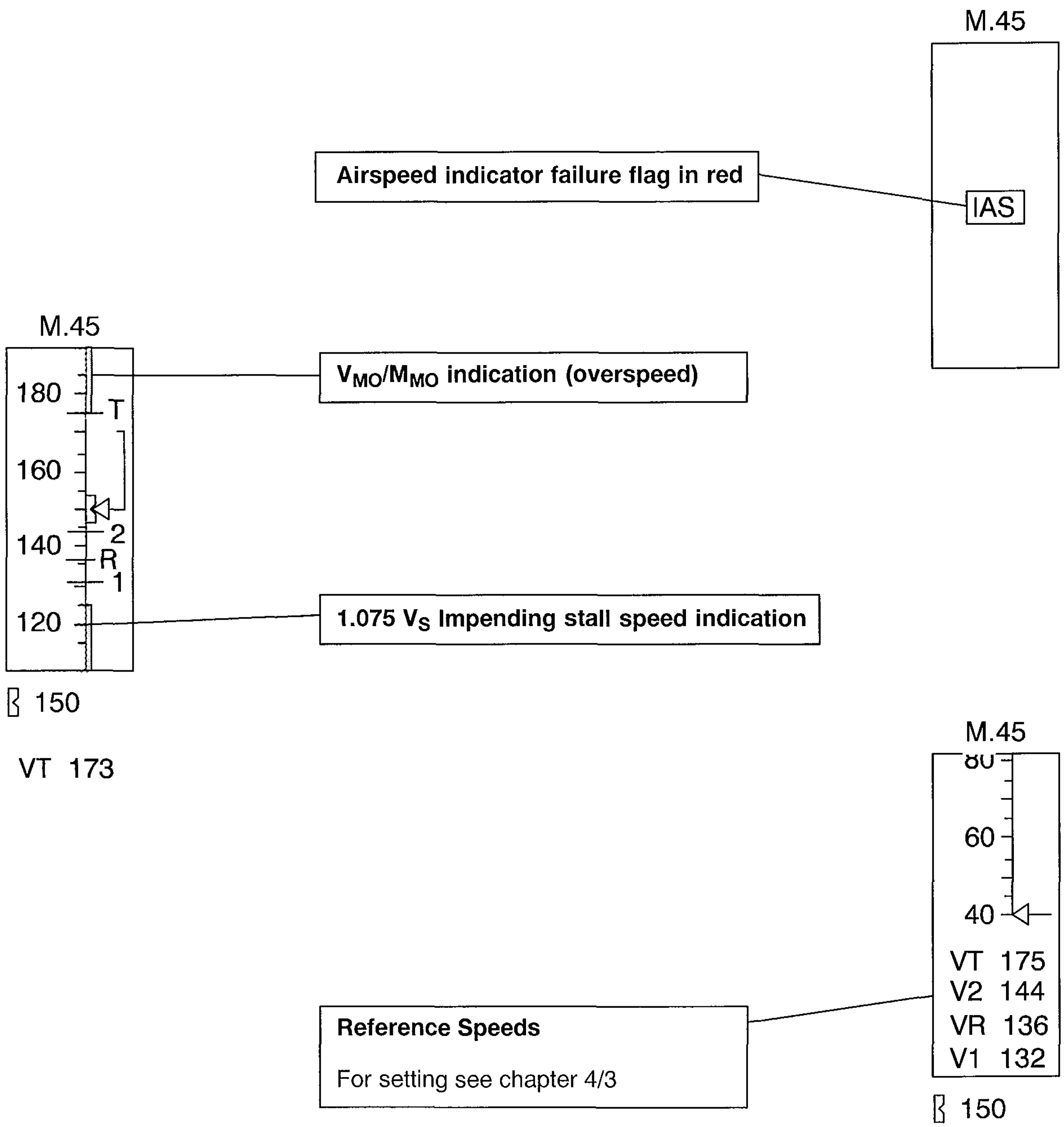


FIG. 10. Airspeed Indicator on PFD.



B2807

FIG. 11. Airspeed Indicator on PFD.

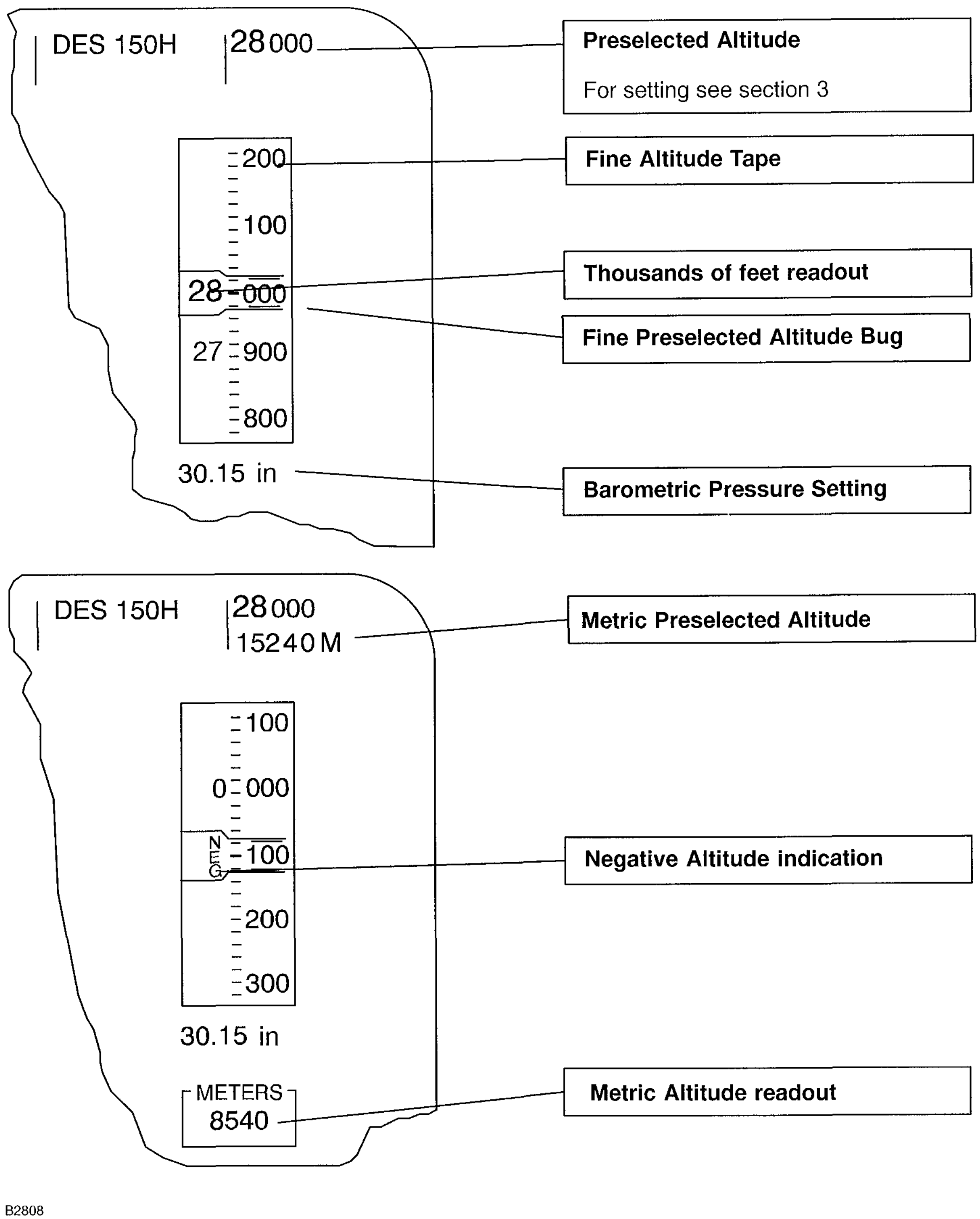
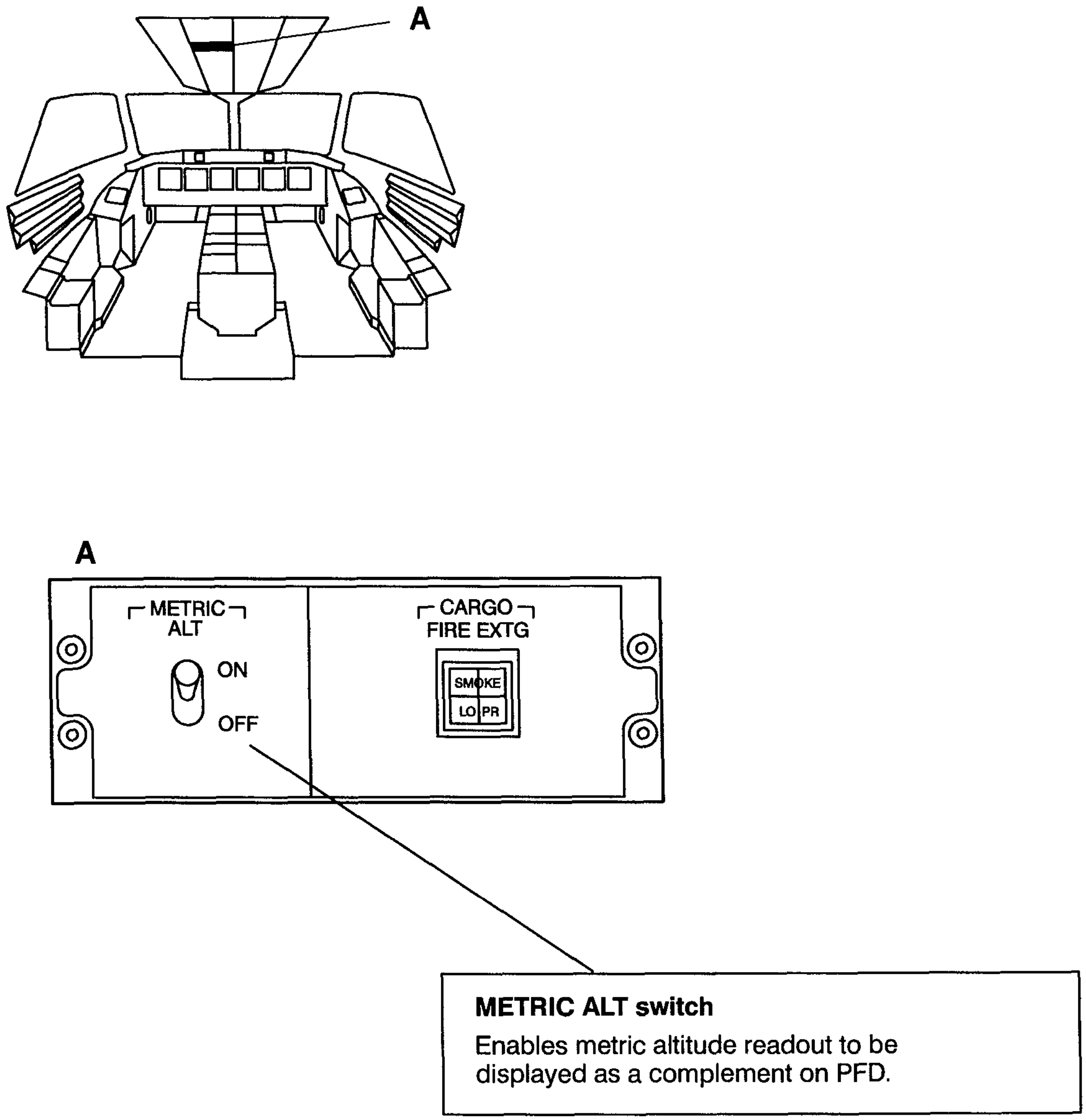
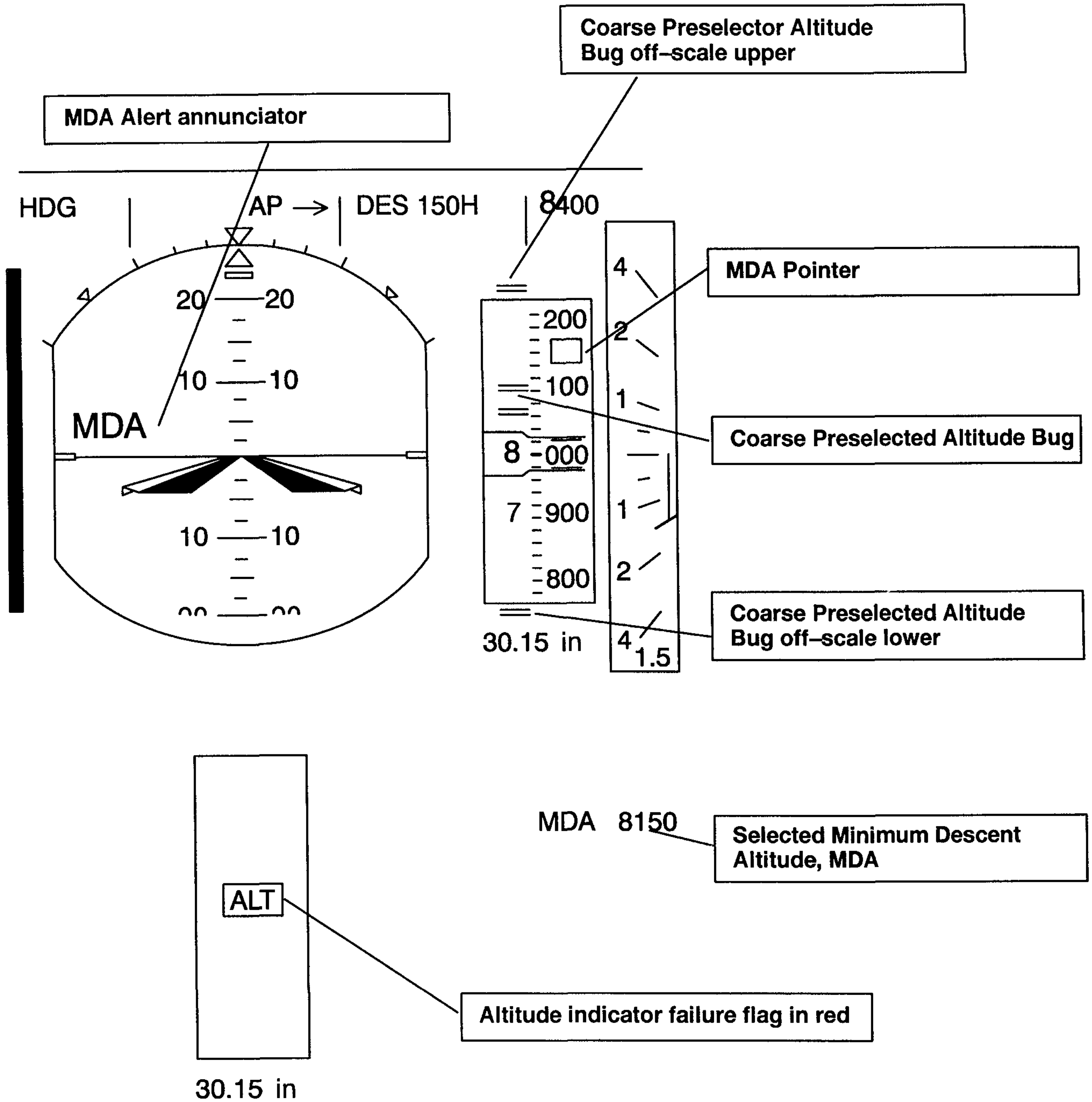


FIG. 12. Barometric Altitude indicator on PFD.



B4910

FIG. 13. Metric Altitude readout switch.



B2809

FIG. 14. Barometric Altitude indicator on PFD.

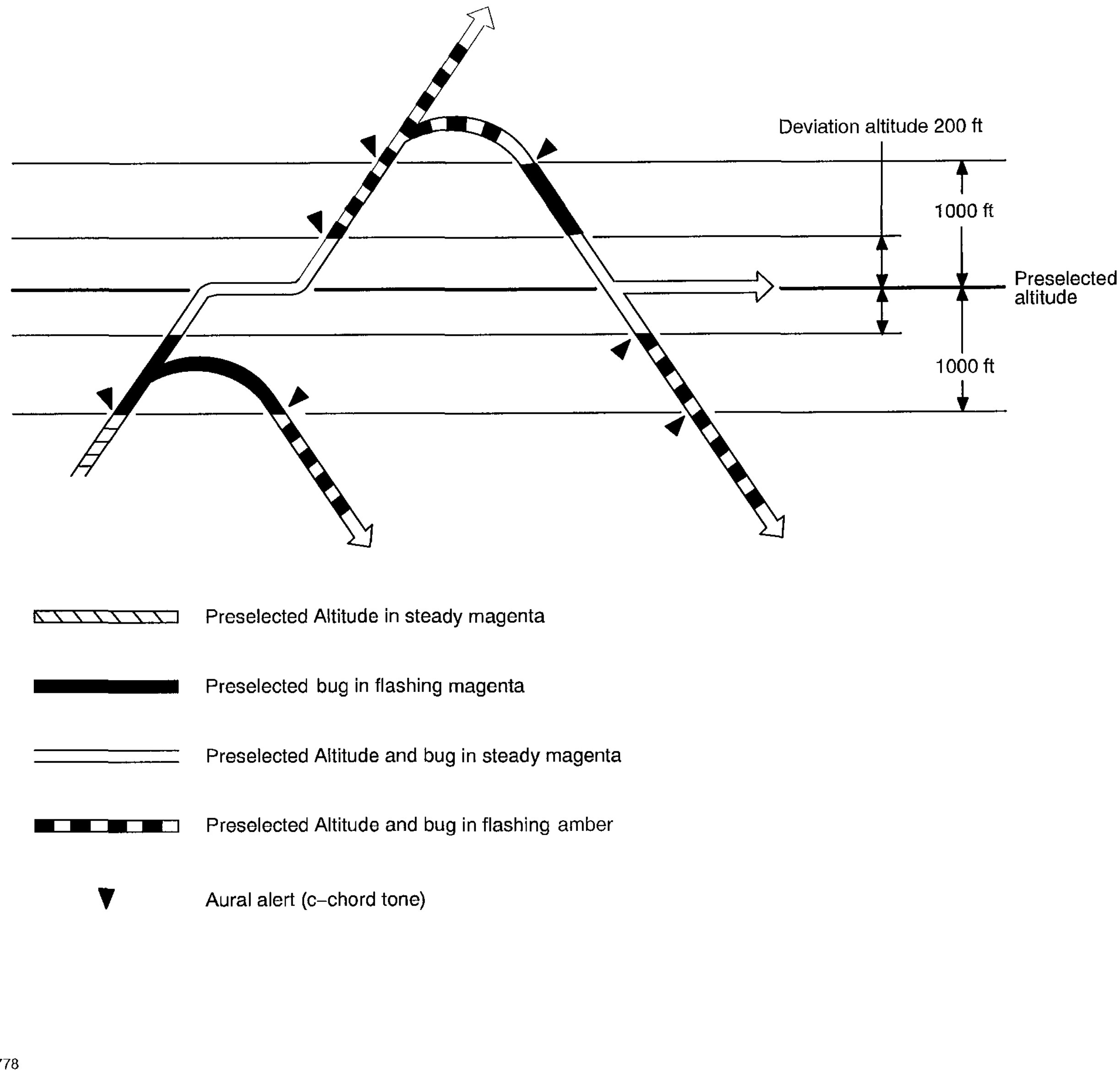
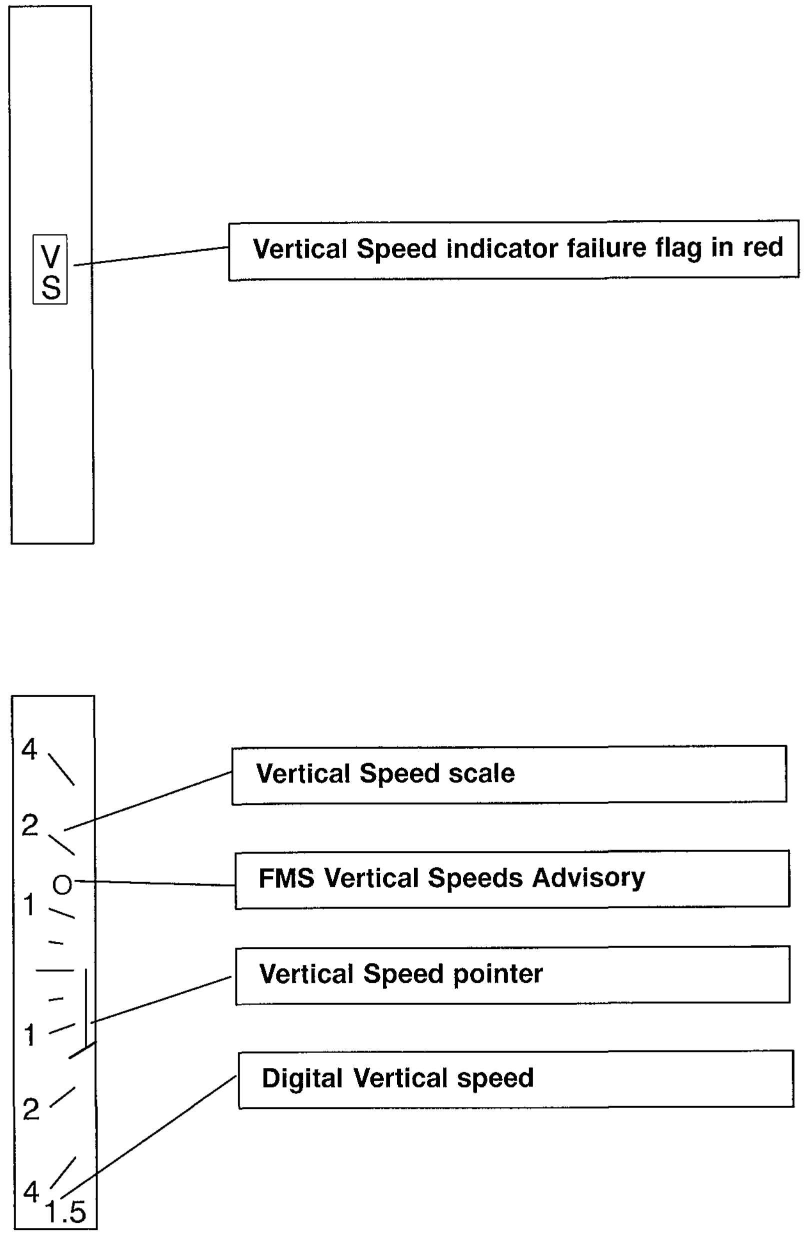


FIG. 15. Altitude preselect alert envelope.



B2810

FIG. 16. Vertical speed indicator on PFD.

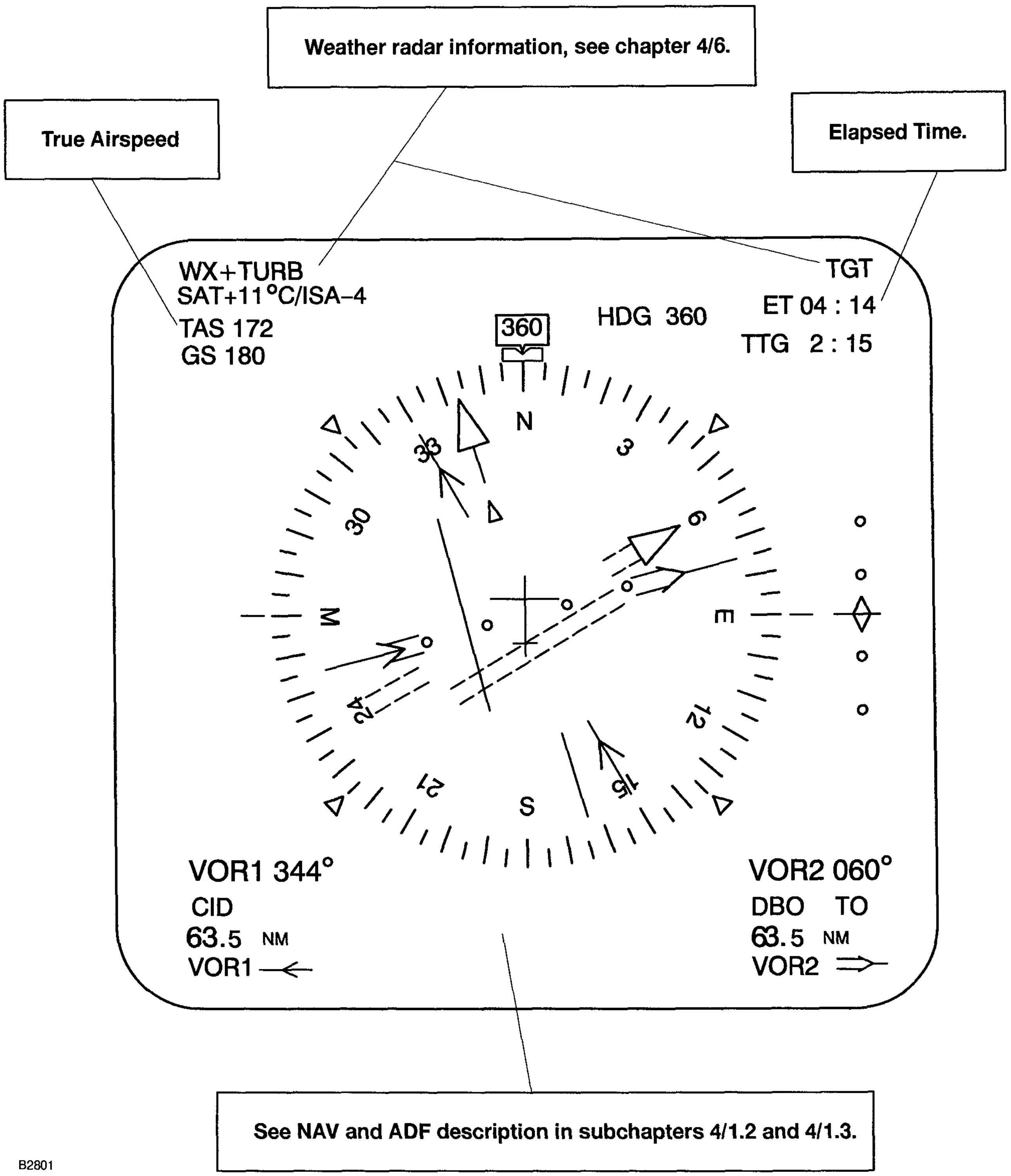
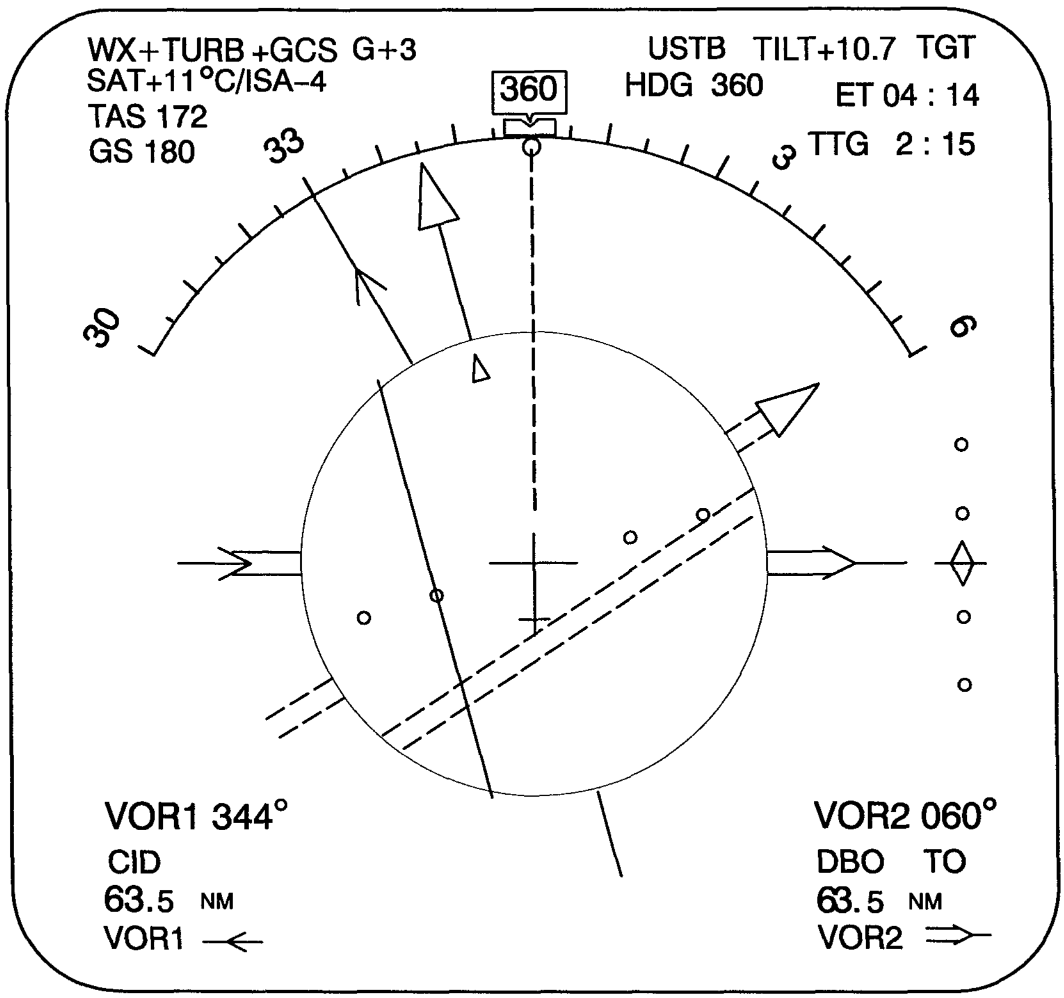


FIG. 17. ROSE MODE.



B2802

FIG. 18. ARC Mode.

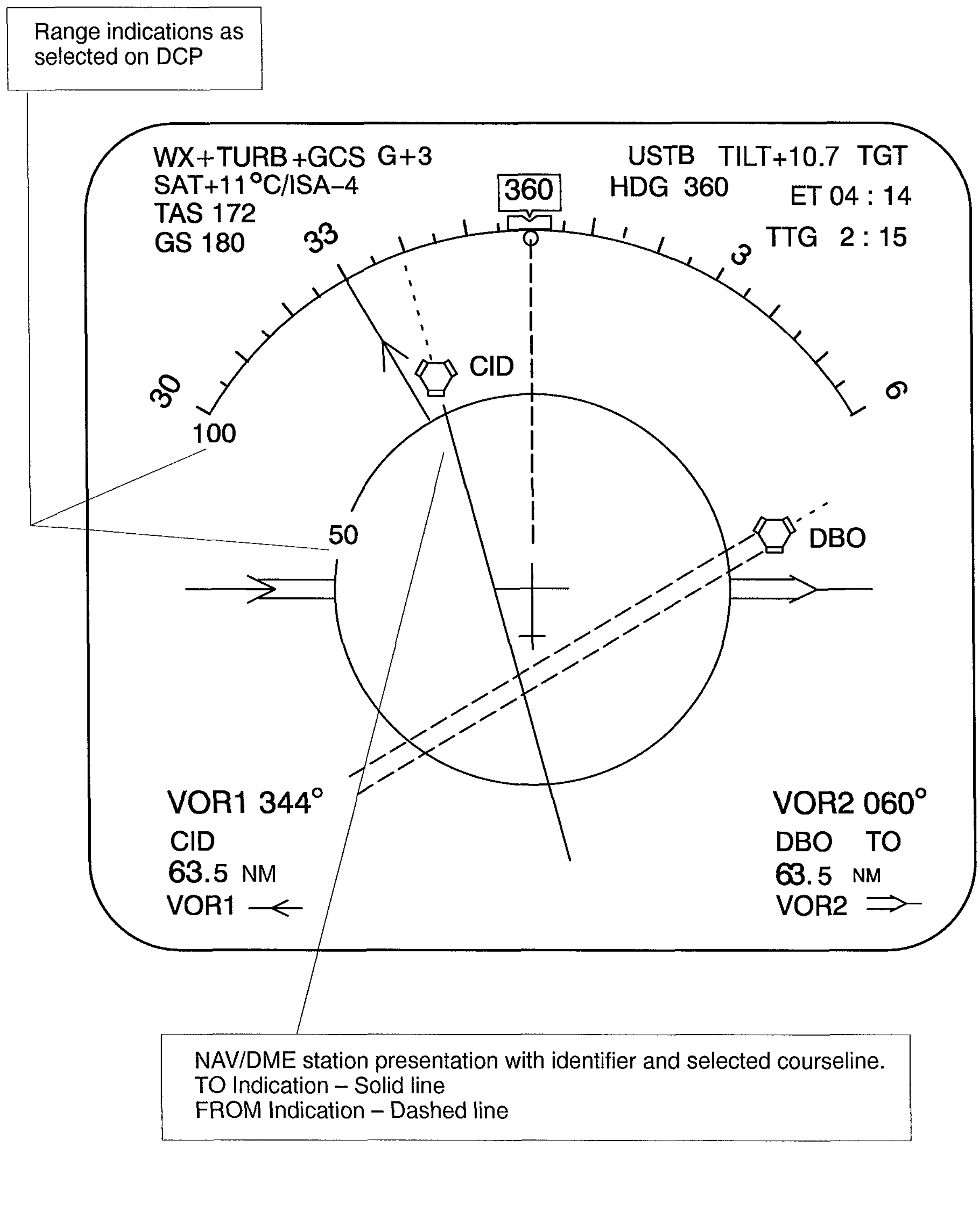
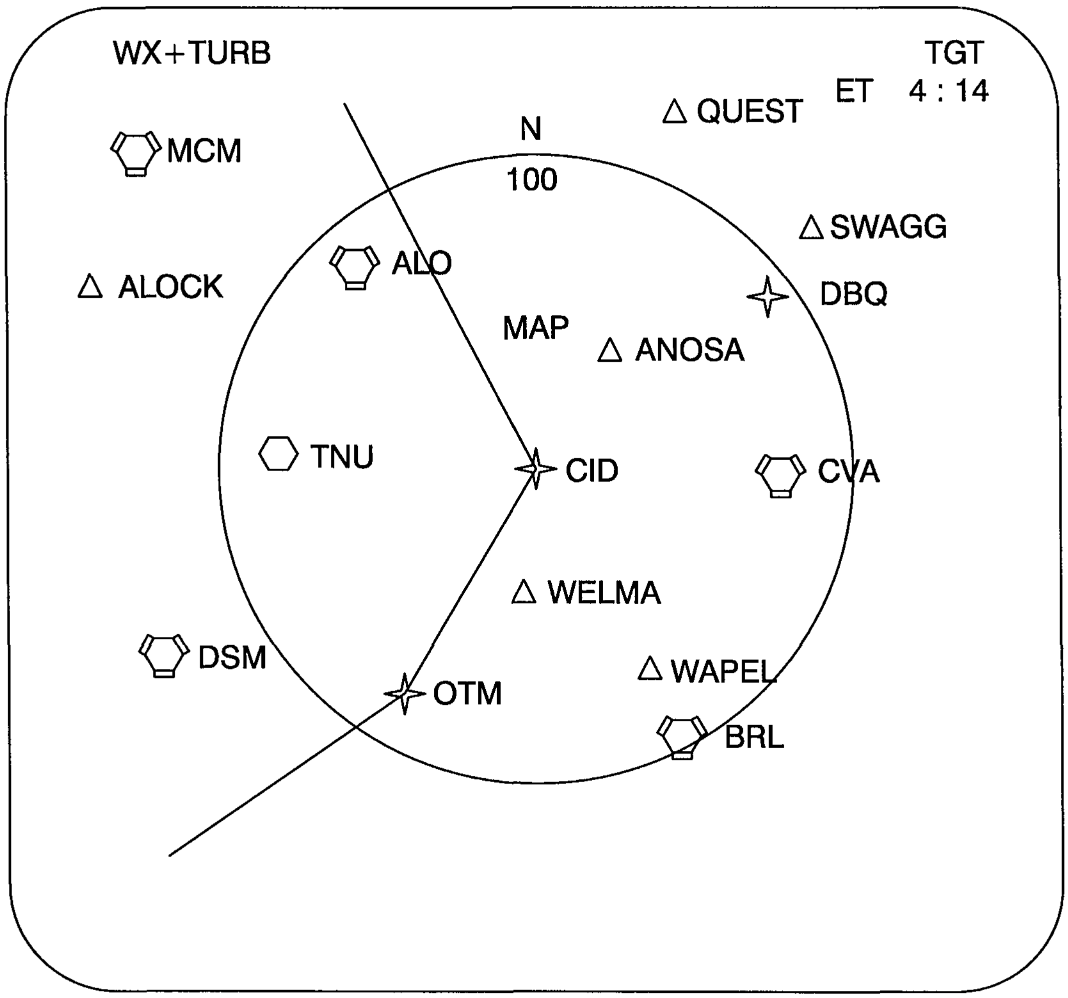


FIG. 19. MAP Mode.



See description in chapter 4/11

B2804

FIG. 20. Plan Mode (SEL on DCP and only if FMS installed).

3. ELECTRICAL POWER SUPPLY.

EFIS

Left EFIS.

PFD and cooling fan	L BAT AVIONICS BUS	G – 20	EFIS L PFD
ND and cooling fan	L AVIONICS BUS	G – 19	EFIS L ND
DCP	L AVIONICS BUS	G – 18	EFIS L DCP

Right EFIS.

PFD and cooling fan	R BAT AVIONICS BUS	N – 20	EFIS R PFD
ND and cooling fan	R AVIONICS BUS	N – 19	EFIS R ND
DCP	R AVIONICS BUS	N – 18	EFIS R DCP

IAPS

Left IAPS.

Power and Flight Director	L AVIONICS BUS	G – 15	L IAPS PWR/FD
Power	L AVIONICS BUS	G – 16	L IAPS PWR
Cooling fan	L AVIONICS BUS	G – 17	L IAPS FAN

Right IAPS.

Power and Flight Director	R AVIONICS BUS	N – 15	R IAPS PWR/FD
Power	R AVIONICS BUS	N – 16	R IAPS PWR
Cooling fan	R AVIONICS BUS	N – 17	R IAPS FAN

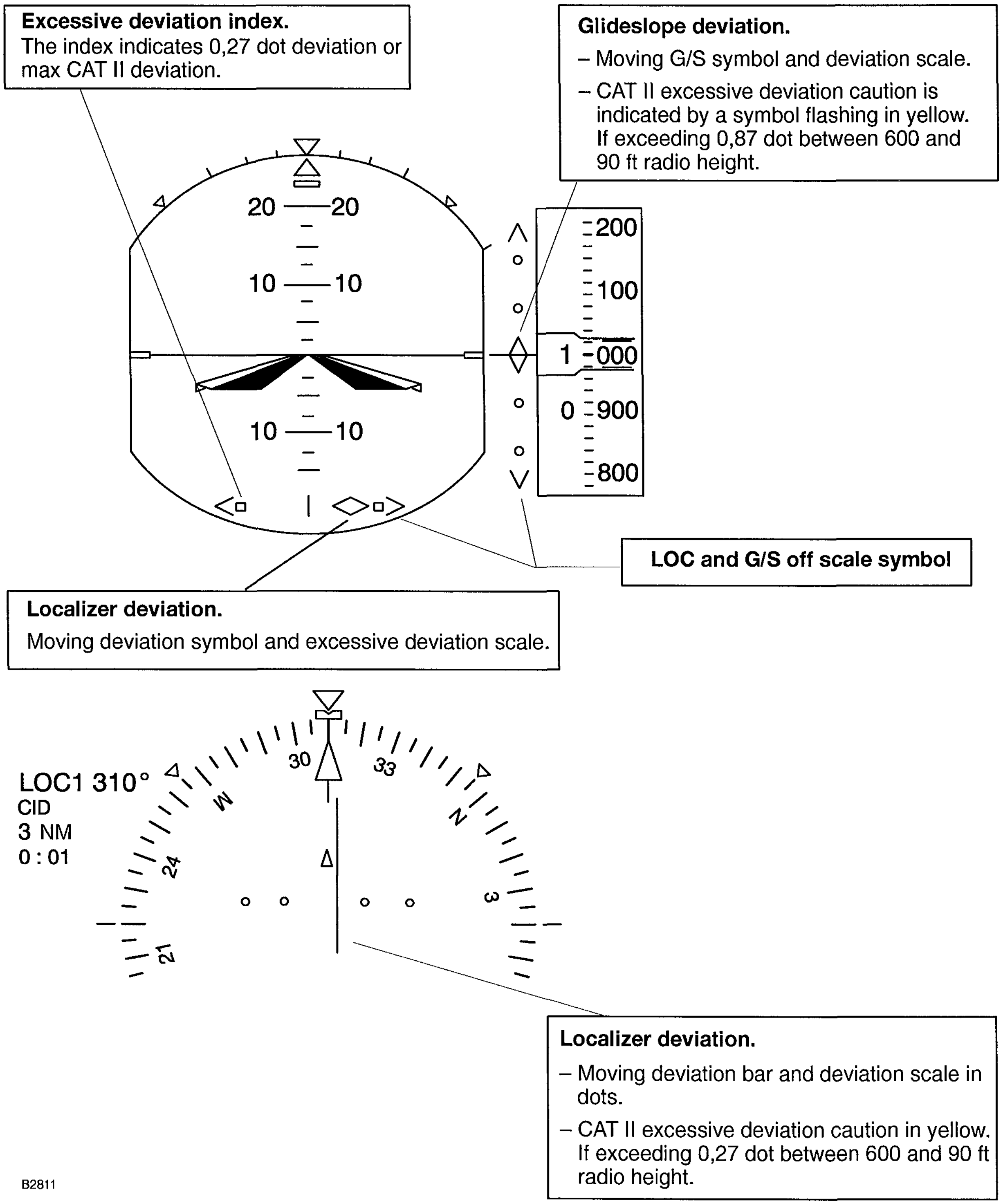
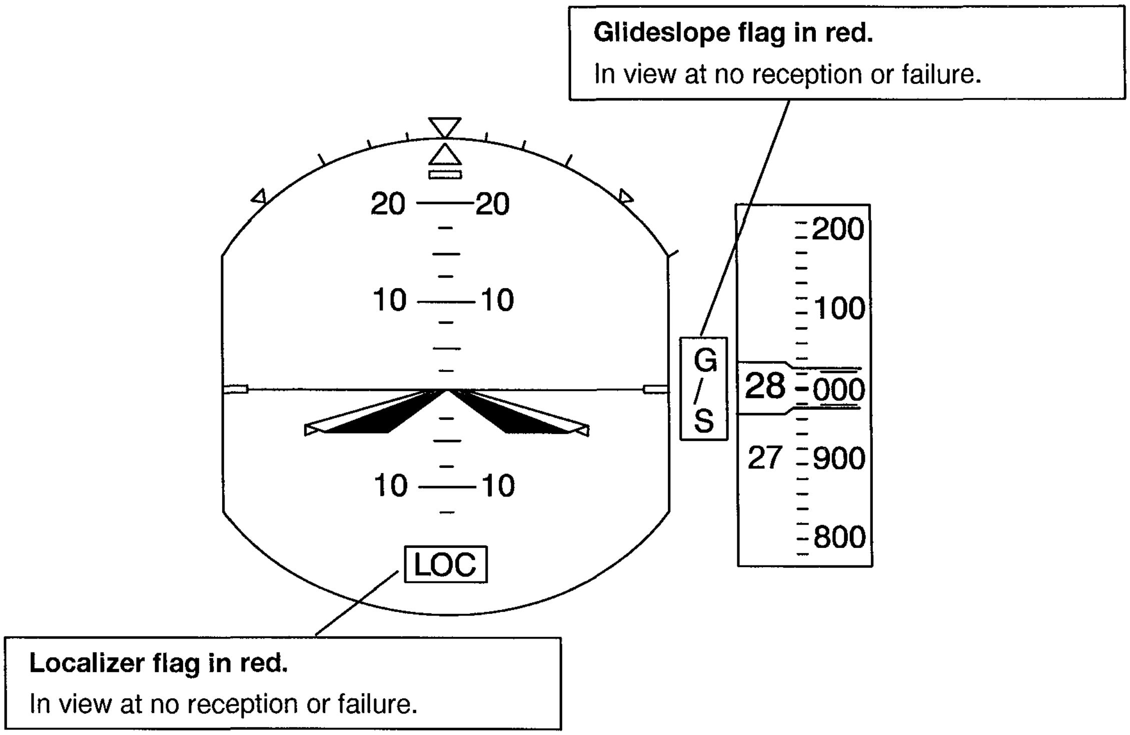
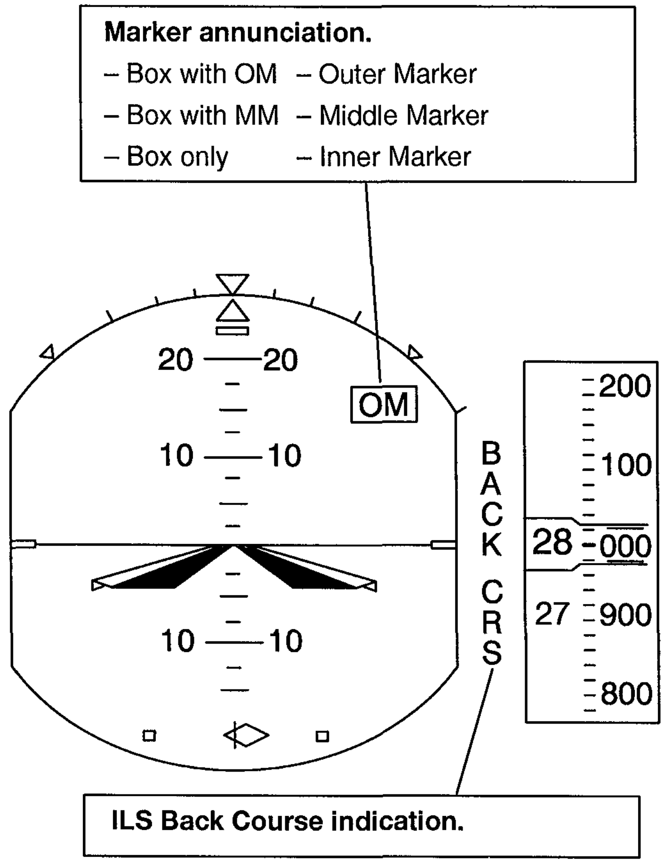


FIG. 1. LOC and GS indications.



B5524

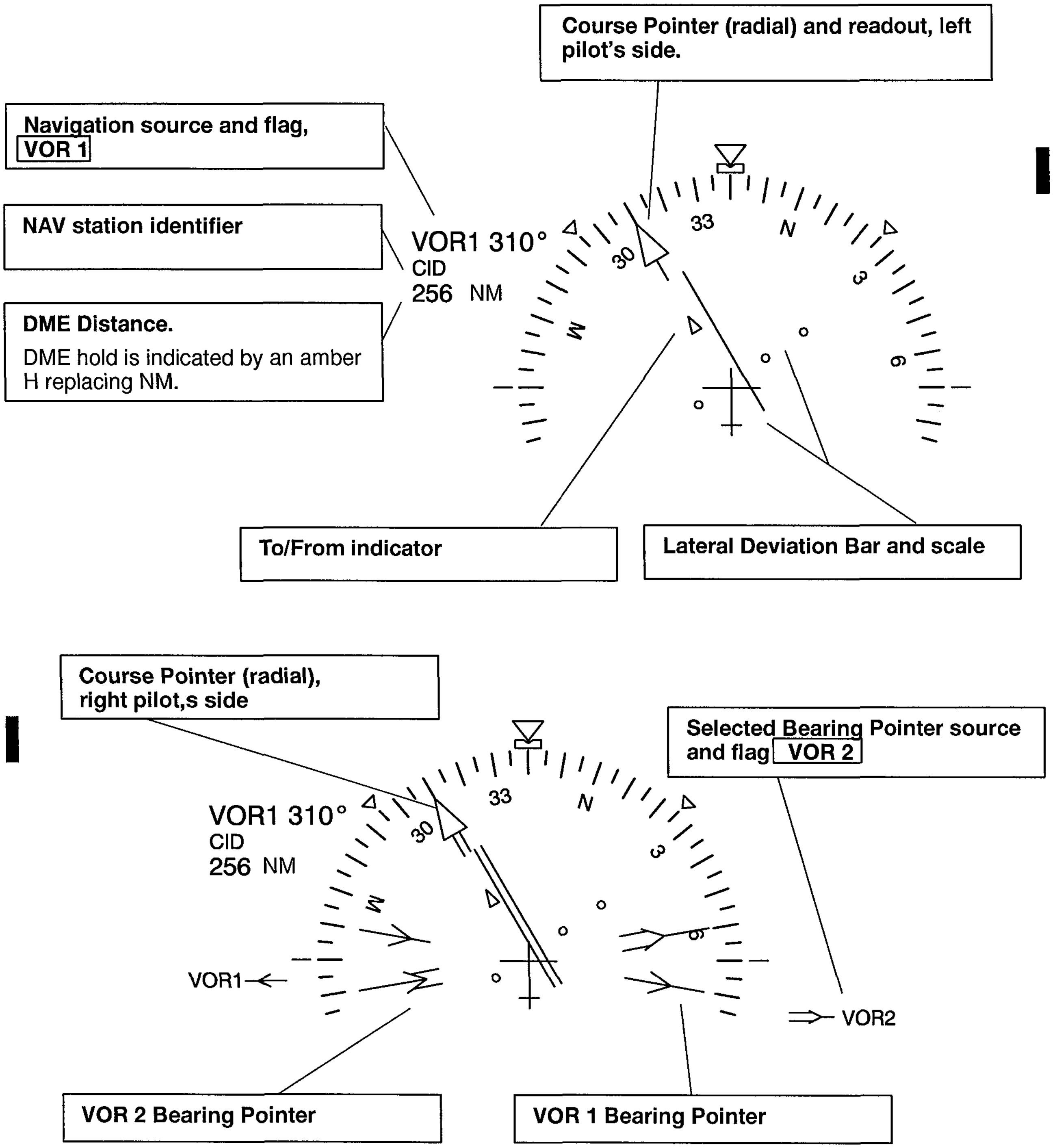
FIG. 2. LOC and GS flags.



> NOTE
> The Back Course is automatically corrected for by EFIS. With the CRS selector set for normal localizer inbound course, the LOC indication is not reversed when flying:
>
> – Inbound on the Back course
>
> – Outbound on the Localizer inbound course

B2812

FIG. 3. Back Course and Marker indication.



B2813

FIG. 4. NAV presentation on PFD.

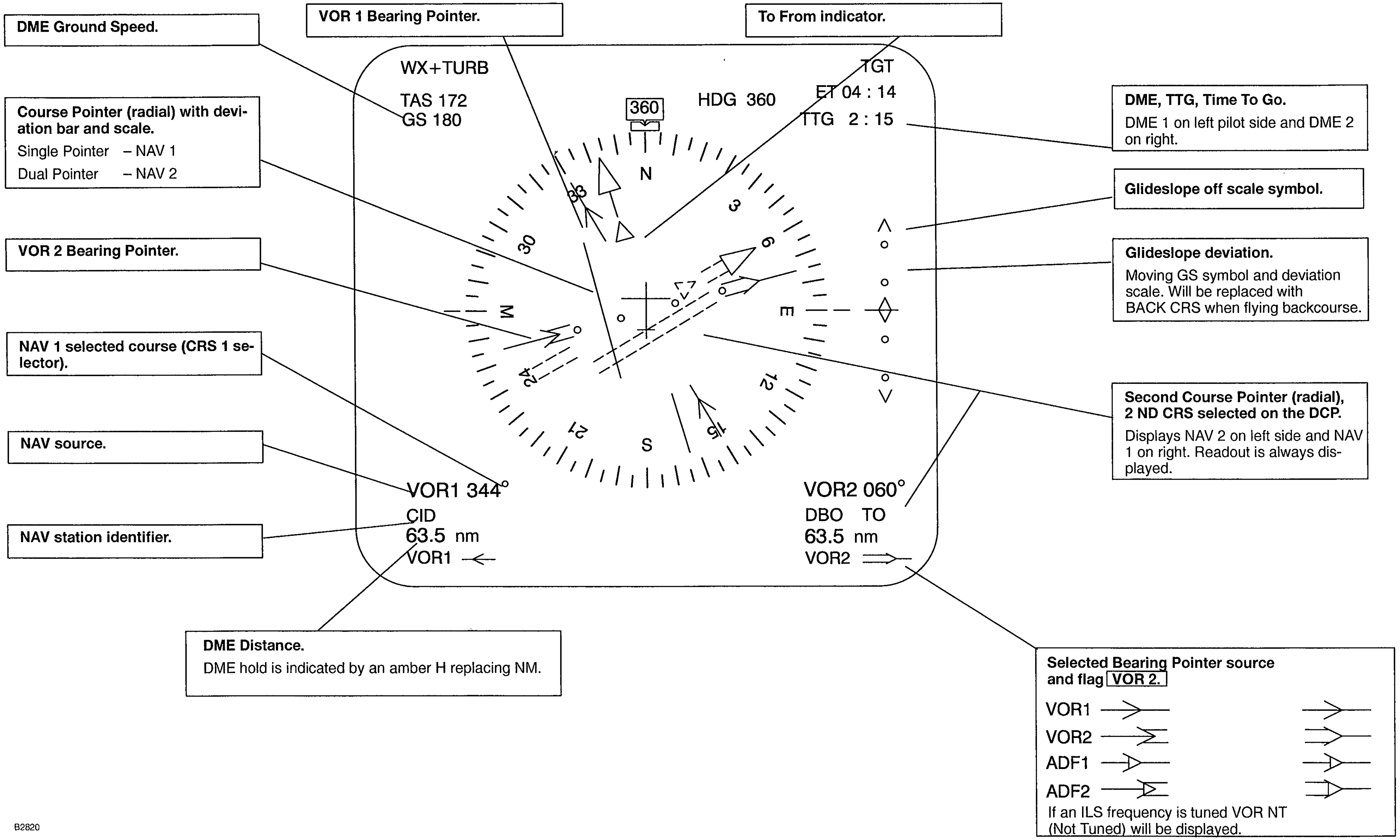
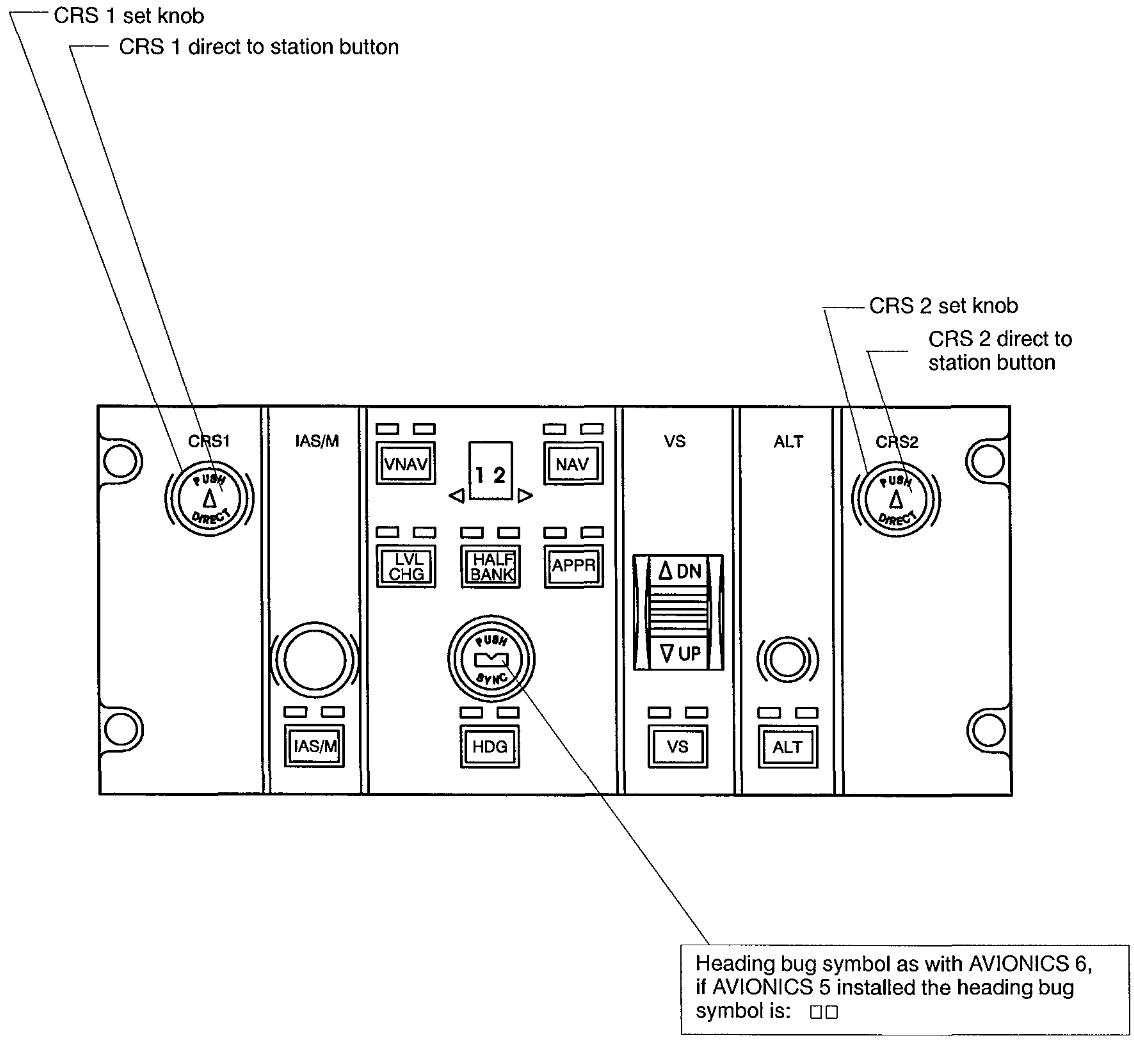
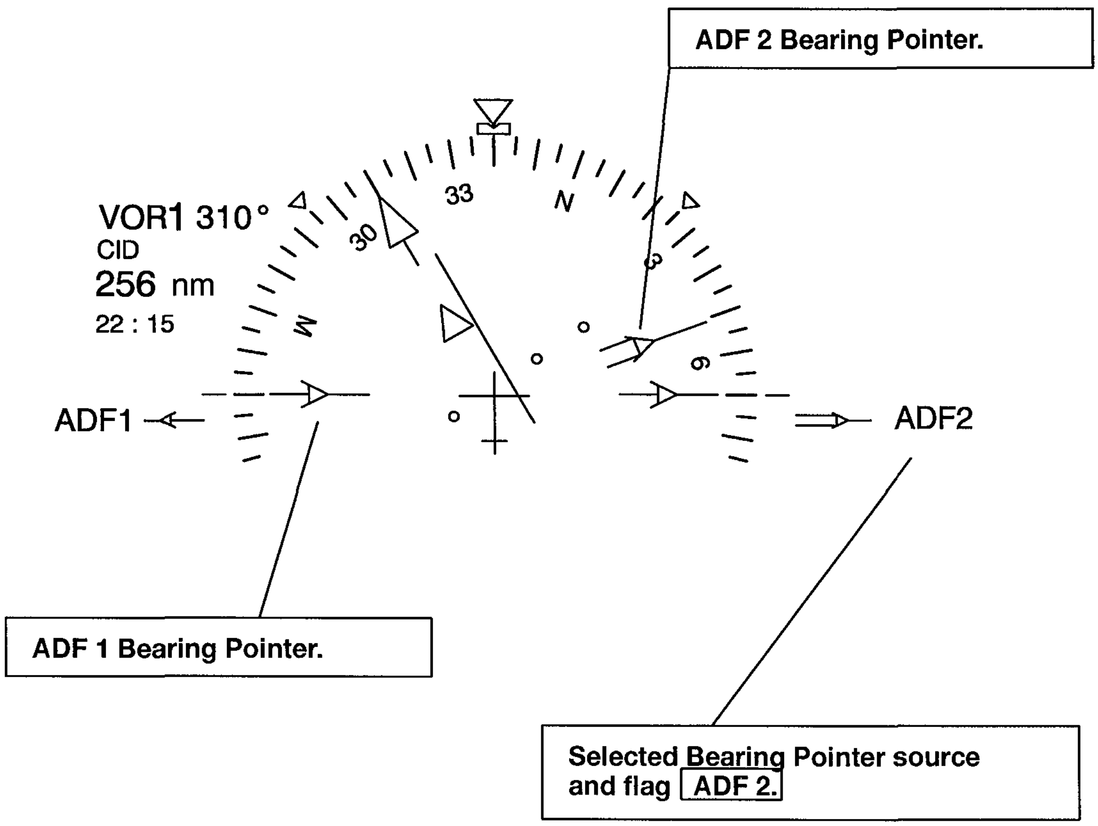


FIG. 5. NAV presentation on ND, left pilot side.



B4395

FIG. 6. Course knobs on the Flight Control Panel (FCP).



B2830

FIG. 1. ADF presentation on PFD.

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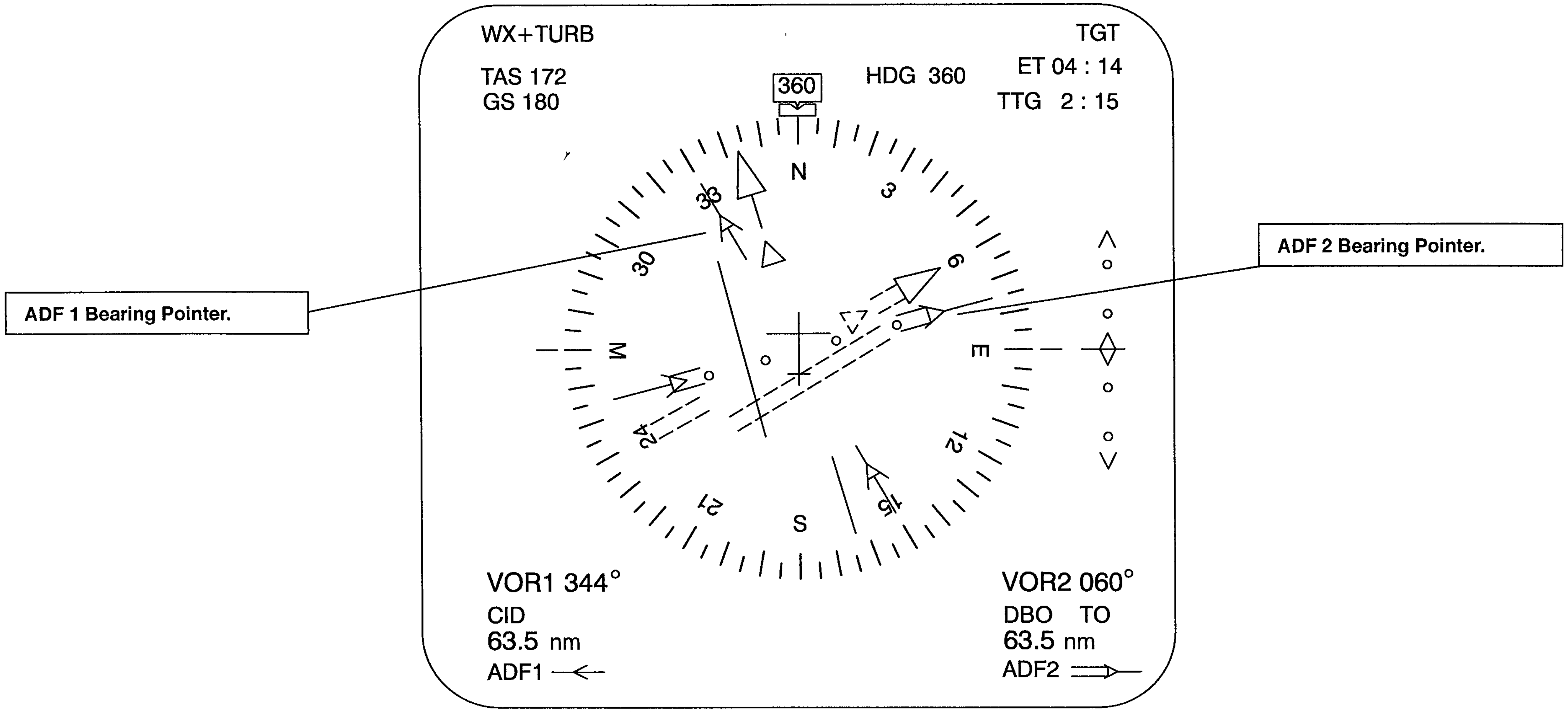
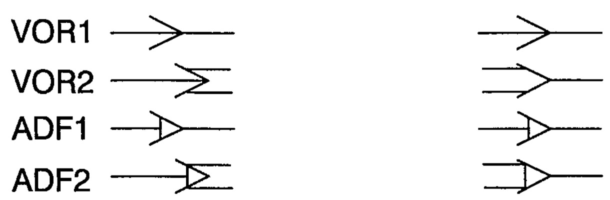




B2829

FIG. 2. ADF presentation on ND, left side.

1. GENERAL.

The Radio Tune Units (RTU), provide integrated control of several combinations of aircraft communication and navigation radio systems. The RTUs also provide single point control of both on–side and cross–side radios (1/2 button).

There are two separate RTU's for control of L and R radio systems respectively.

Typically each RTU controls:

– 1 VHF COM

– 1 VHF NAV

– 1 DME

– 1 ADF

– 1 Transponder.

The RTU can also provide the following options:

– HF COM

– ACAS/TCAS (see chapter 17/6)

– IRS initialization.

Each RTU can display a Course Deviation Indicator (CDI) page with COM, NAV/DME and Transponder controls. Description of the NAV, DME, ADF navigation data presentation on EFIS is provided in the EFIS chapter.

External FMS keyboard tuning commands may tune the VHF COM, NAV, DME, ADF and Transponder radios on both the onside and cross–side through the RTU. Additionally, an external FMS may tune the NAV and paired DME radios automatically (AUTOTUNE) through the RTU (if optional FMS installed).

The RTU display utilizes a stroke written color cathode ray tube. The minimum display brightness will insure adequate sunlight readability. The RTU displays are generated in color.

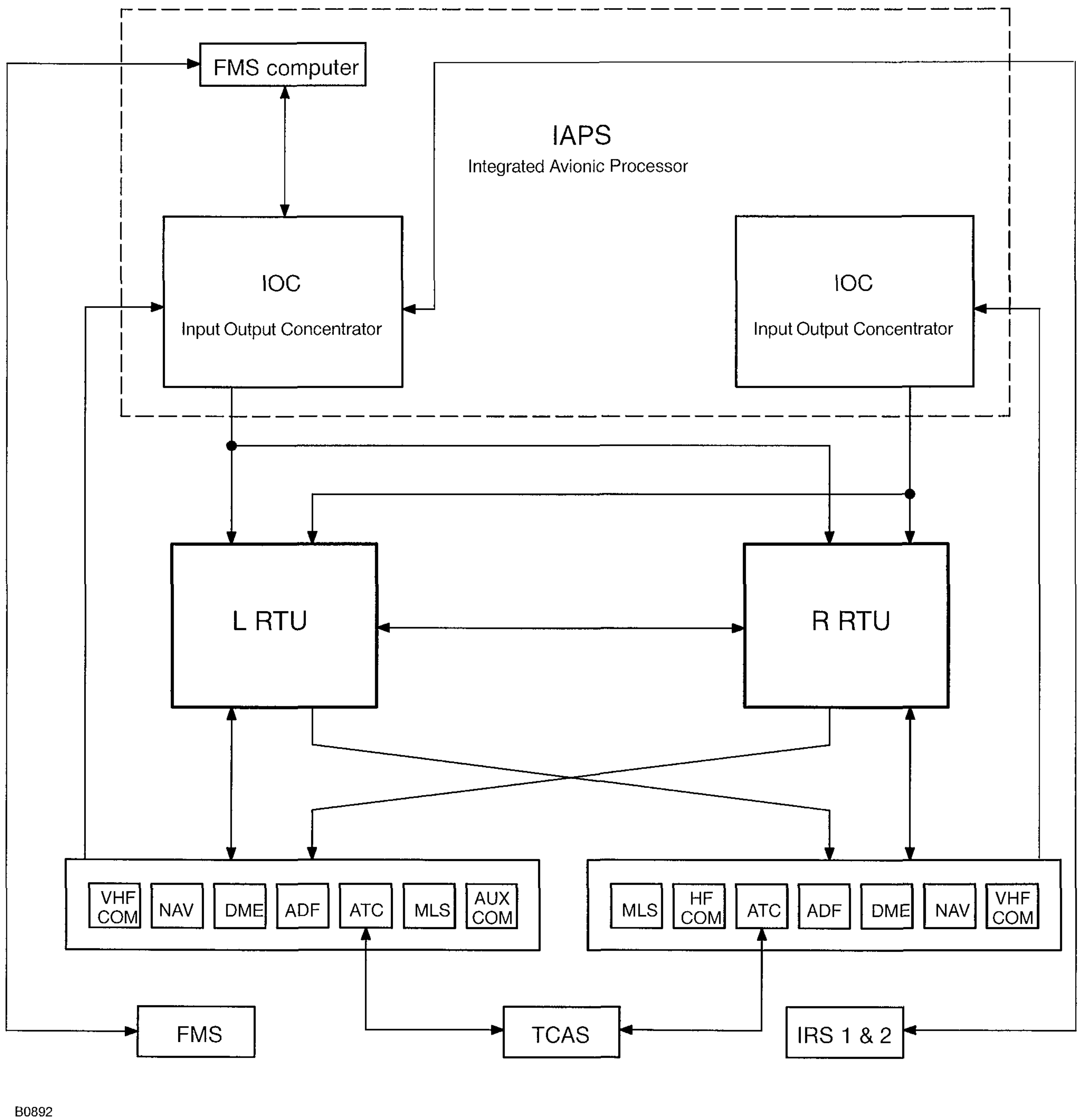
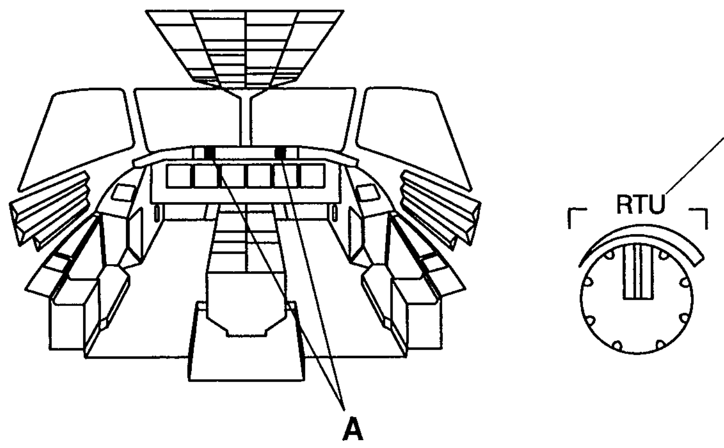


FIG. 1. Dual Radio Tune Unit, RTU System Diagram

2. CONTROLS AND INDICATORS.

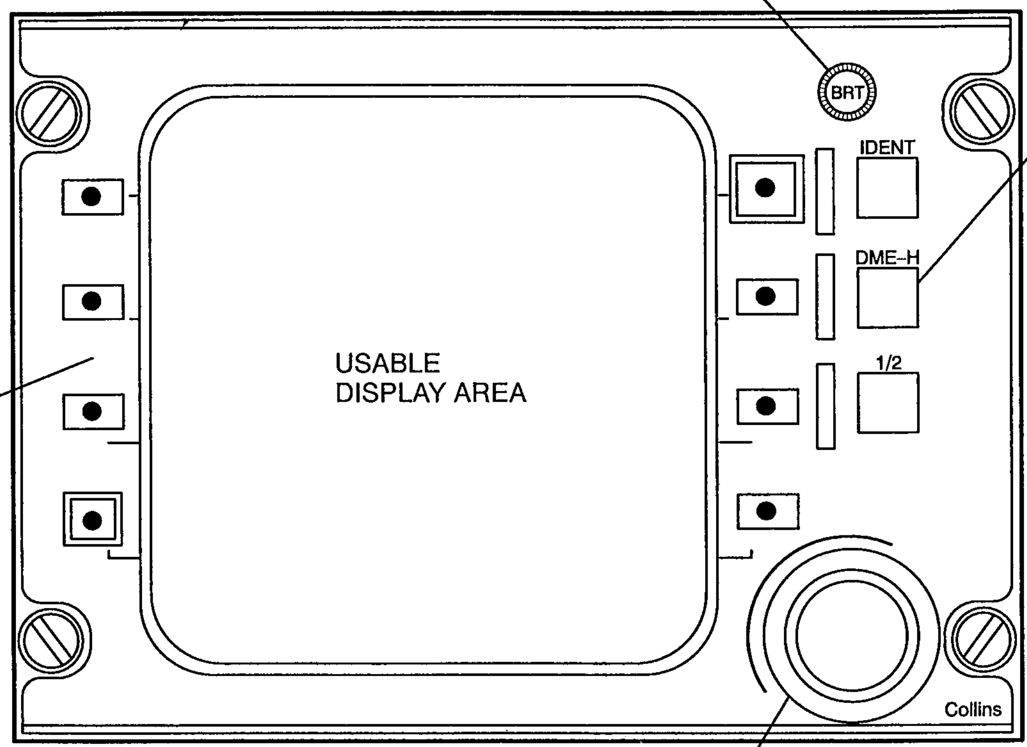


A RADIO TUNE UNIT, RTU

BRT and RTU dim control.

The RTU CRT dimming may be controlled from the external RTU dimming control (located to the left of the LH RTU) and trimmed with the BRT control on the front panel.

The RTU panel lighting is controlled from Panel and instrument Lighting System.



Line Select pushbuttons.

The RTU has eight (8) panel mounted line select pushbuttons adjacent to the display, four to the left of the display and four to the right. The functions performed by each of these pushbuttons differ depending on which display is present.

The operation of these pushbuttons is disabled when the tune knob clusters are being rotated. All of the line select pushbuttons will be debounced.

Dedicated pushbuttons.

The operation of each of these pushbuttons is disabled when the tune knob clusters are being rotated.

IDENT.

Pressing the IDENT switch initiates transmission of the aircraft identifier by the active ATC transponder. This is a momentary action switch function.

An IDENT annunciator will be displayed on the MAIN PAGE and ATC PAGE.

DME HOLD.

Pressing the DME HOLD pushbutton toggles the DME Hold function of the controlled DME receiver. When the DME Hold function is enabled, it will be annunciated on the MAIN PAGE and the NAV PAGE.

While the DME hold function is active, the DME radio frequency may be tuned directly from the NAV PAGE.

1/2 button.

The1/2 button allows the display of the cross–side RTU data. When the 1/2 pushbutton is first pressed, the cross–side radio configuration is displayed. In this way each RTU may tune both onside and cross–side radios without affecting the cross–side RTU operation.

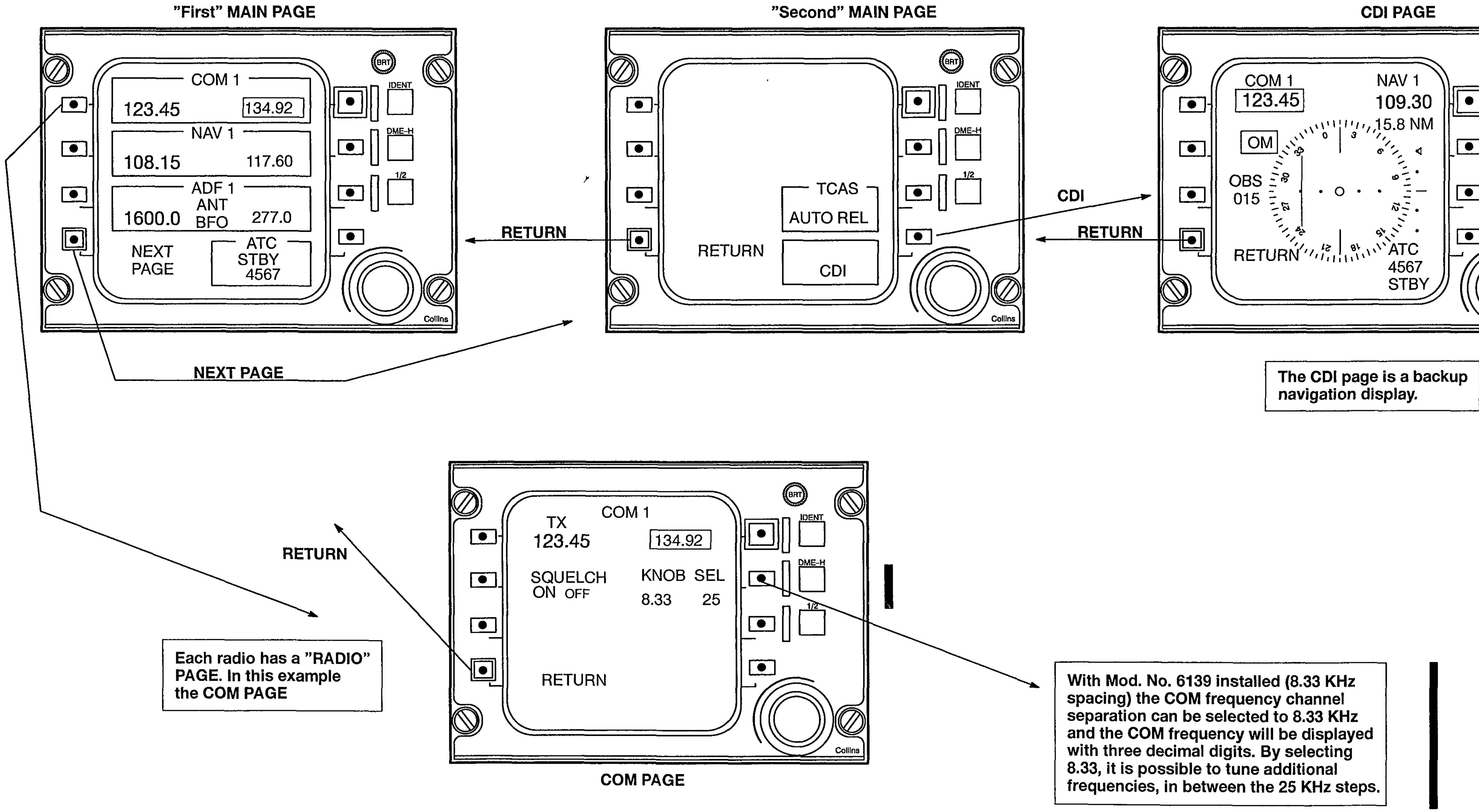
When the 1/2 button has been selected only the Active frequencies displayed are equal with the other sides Active frequencies. A Standby frequency on one side can not be set from the other side.

Tune knob.

A two (2) concentric knob cluster is used to tune the radios interfaced to the RTU. The radio to be tuned is selected using the line select pushbuttons adjacent to the RTU display. In most cases, the tune window around the value to be tuned confirms the selection. The larger diameter knob of the tune knob cluster tunes the most significant digits of the selected value and the smaller diameter knob tunes the least significant digits. With Mod. No. 6139 installed (8.33 KHz spacing) the COM frequency will be displayed with three decimal digits. Both knobs in the tune knob cluster are rate aided.

B3381

FIG. 2. Radio Tune Unit, RTU – Usable Display Area.



B1729

FIG. 3. RTU display hierarchy.

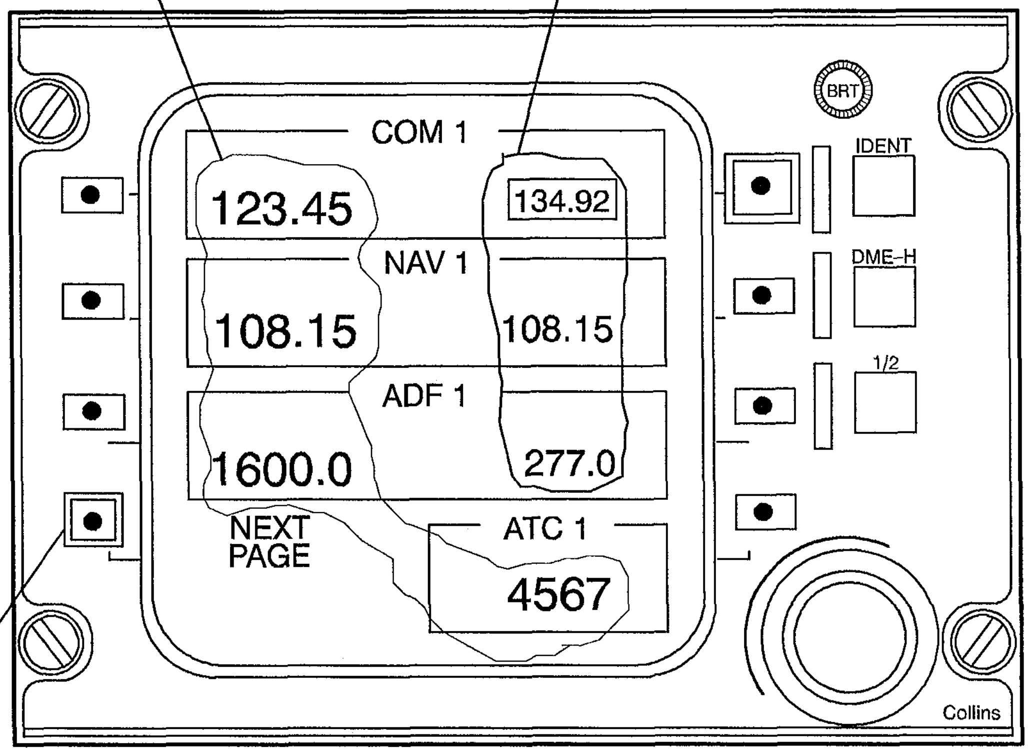
Display Hierarchy.

The RTU display has three (3) levels of pages. The first level is the MAIN PAGE, the second level is the "RADIO" PAGE, and the third level is the PRESET PAGE.

ACTIVE display in green color.

Fault is indicated by amber dashes.

PRESET display in white.



Access to the "Second" MAIN PAGE from the "First" MAIN PAGE is accomplished by pressing the bottom line select pushbutton on the left adjacent to the "NEXT PAGE" annunciator.

"First" MAIN PAGE.

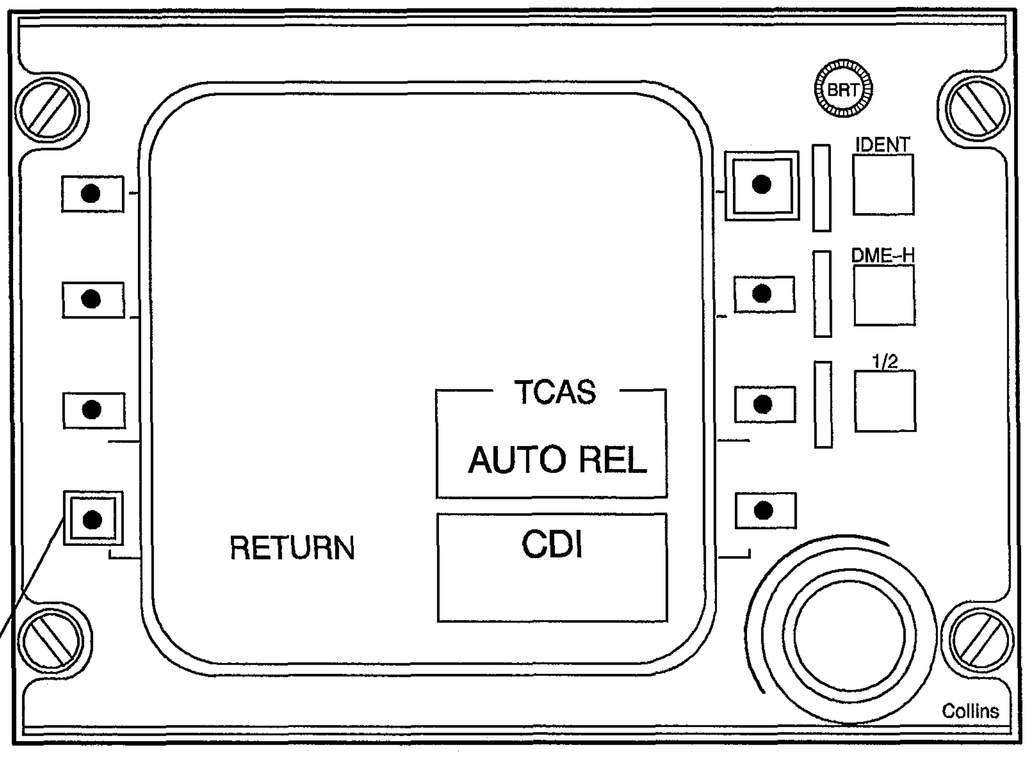
The MAIN PAGE provide an operational summary of all of the radios controlled by the RTU. The MAIN PAGE is the power-up default display for the RTU. The "First" MAIN PAGE provides operational summaries for each of the four (4) basic radios (VHF COM, VHF NAV, ADF, and ATC transponder). Additional radios and options are displayed on the "Second" MAIN PAGE.

B0893

FIG. 4. "First" MAIN PAGE.

"Second" MAIN PAGE.

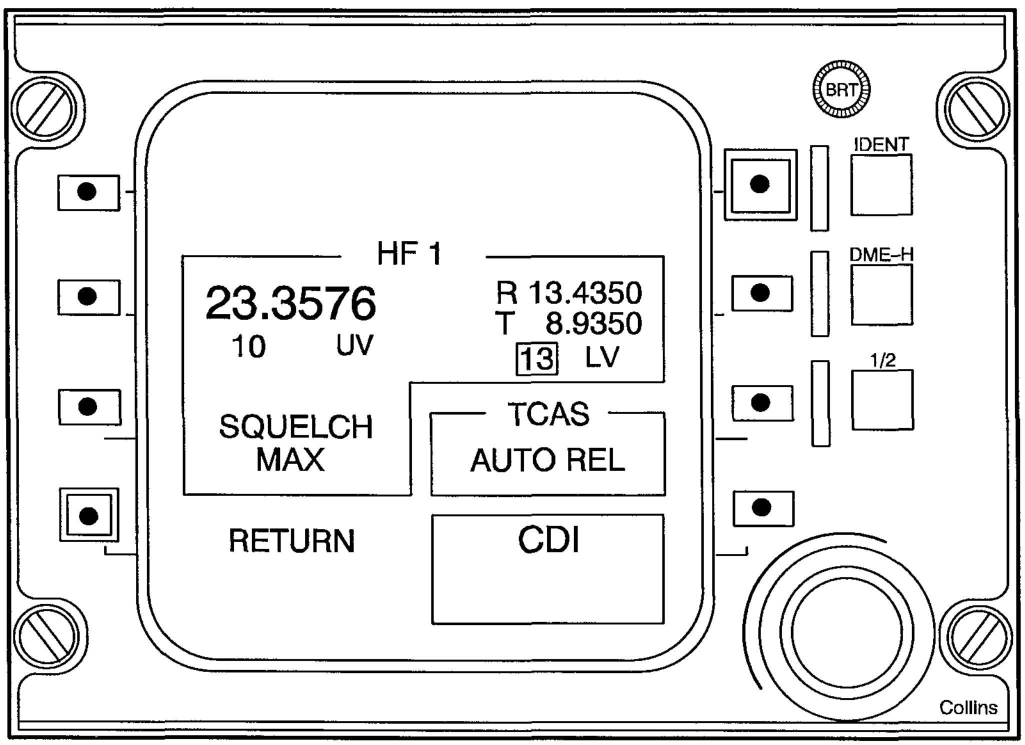
The "Second" MAIN PAGE provides operational summaries for other, optional radios controlled by the RTU which would include optional COM, HF COM, and TCAS. An optional COM and an HF COM can not be accommodated on the same page. If an optional radio is not present in the configuration, the subdisplay for that radio, including the box outline, is left blank.



Return to the "First" MAIN PAGE is from the "Second" MAIN PAGE and is accomplished by pressing the bottom line select pushbutton on the left adjacent to the "RETURN" annunciator.

B0896

FIG. 5. "Second" MAIN PAGE with optional TCAS.



B0897

FIG. 6. "Second" MAIN PAGE with optional HF COM.

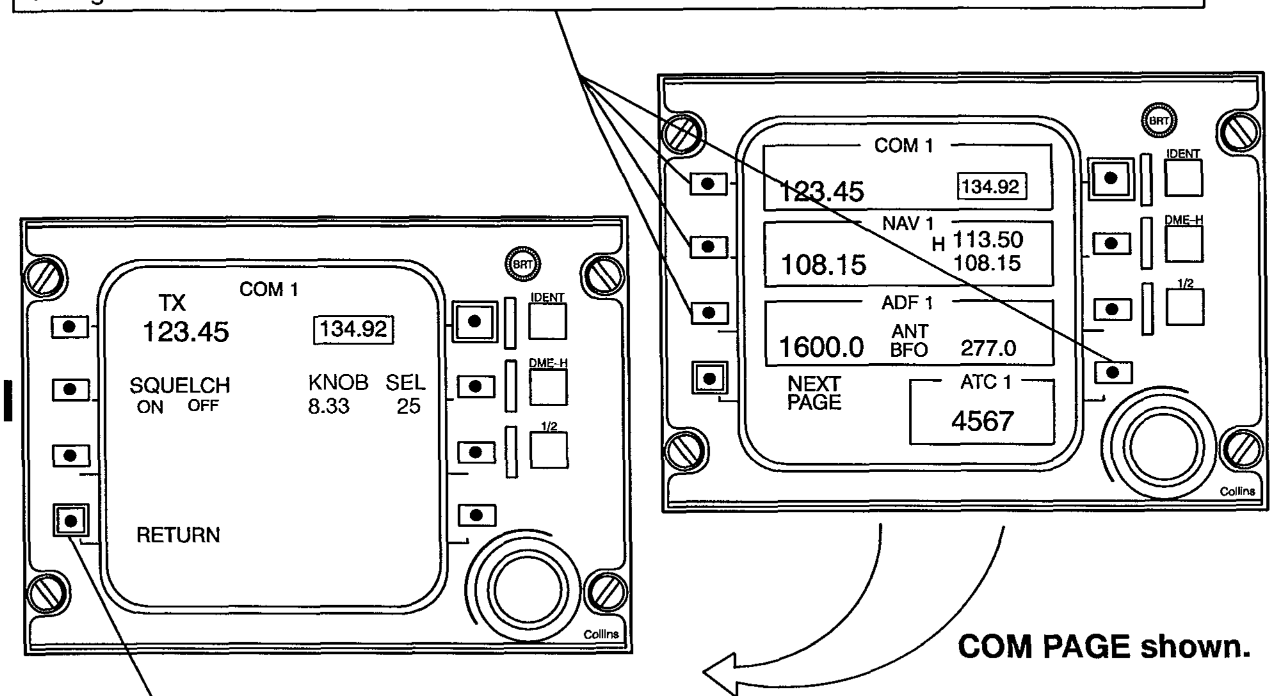
"RADIO" PAGE.

Each radio has a dedicated page for controls not shown on the MAIN PAGE. The page is called COM PAGE, NAV PAGE etc.

The "RADIO" PAGE is the second level of the RTU display hierarchy.

For radios which have both Active and Preset values displayed on the MAIN PAGE, the "RADIO" PAGE is accessed by the line select pushbutton adjacent to the Active value for that radio.

For radios which have only an Active value displayed on the MAIN PAGE, The "RADIO" PAGE is accessed by, first, pressing the line select pushbutton adjacent to the Active value for that radio which causes the tune window to surround that Active value and, second, pressing that line select pushbutton again.



COM PAGE shown.

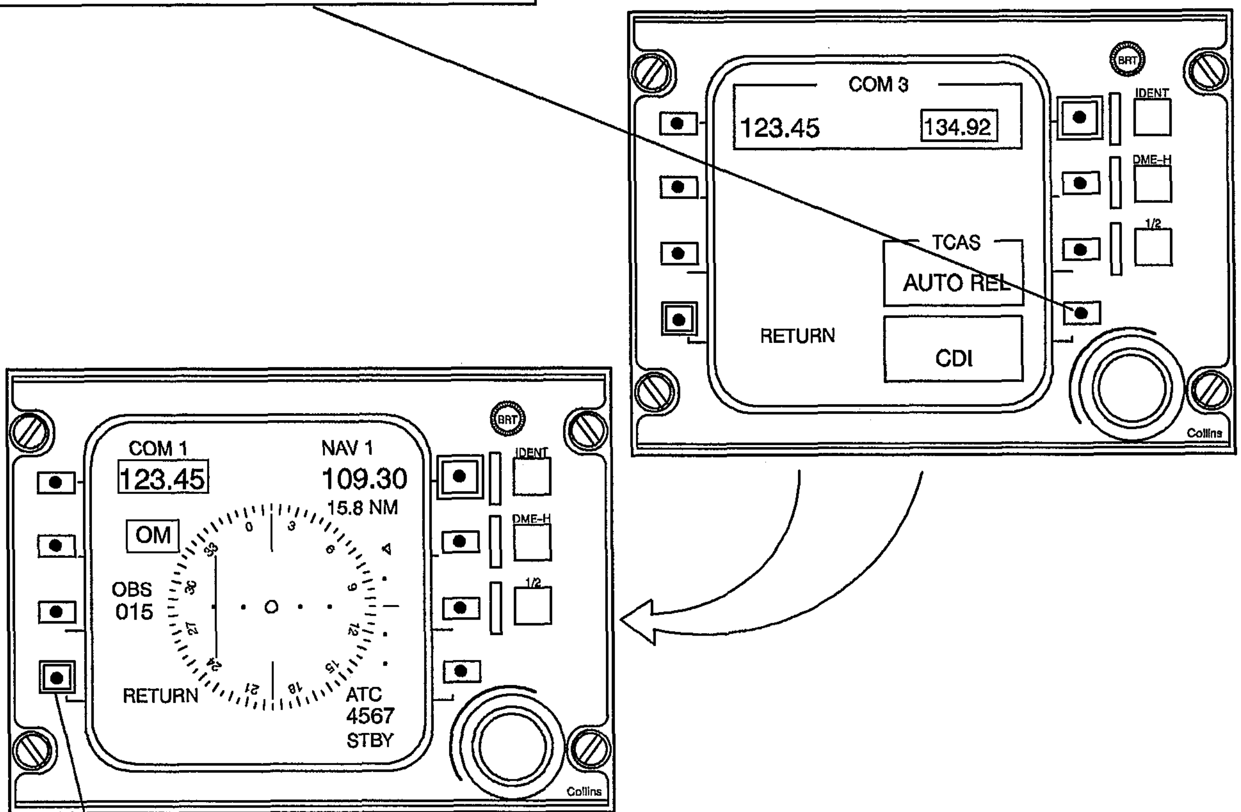
Return to the MAIN PAGE is accomplished by pressing the line select pushbutton left adjacent to the "RETURN" annunciator.

The "RADIO" PAGE for each radio displays the same information as shown on the MAIN PAGE for that radio plus more detailed control functions as may be applicable. Similar functions for each "RADIO" PAGE are located in the same relative positions on the display. An example of the COM "RADIO" PAGE is shown above. The annunciator at the top center of the "RADIO" PAGE indicates the radio that is controlled from that particular "RADIO" PAGE.

B1992

FIG. 7. "Radio" Page.

Access to the CDI PAGE is accomplished by pressing the line select pushbutton on the right adjacent to the "CDI" annunciator.



Return to the MAIN PAGE is accomplished by pressing the line select pushbutton left adjacent to the "RETURN" annunciator.

Course Deviation Indicator, CDI PAGE.

The CDI Page is a backup navigation display and can be displayed on either RTU. The CDI page provides rough course data and allows controls of the onside COM, NAV, DME and ATC radios.

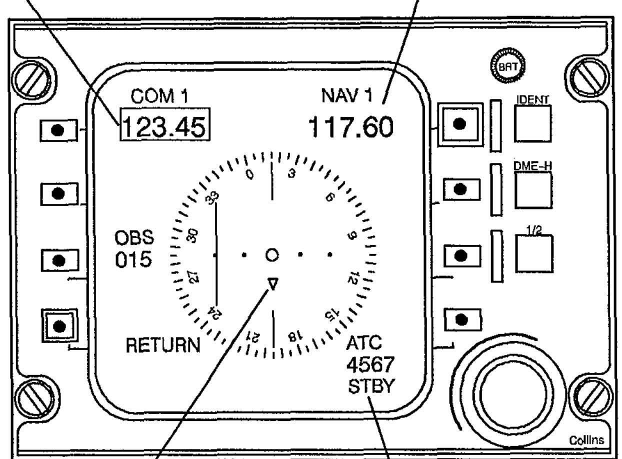
The prominent feature of the CDI page is the omnibearing selector (OBS) ring. The OBS ring is rotated around its center by selecting OBS; pressing the third line select pushbutton on the left selects the omnibearing selector ring for bearing selection. When the line select pushbutton has been pressed, the tune window surrounds the bearing value which may be tuned using either knob of the tune knob cluster. The bearing value is displayed directly underneath the "OBS" label. The value pointed to on the OBS ring by the top of the track pointer is also the selected bearing.

B1995

FIG. 8. CDI Display Page.

The COM Active frequency is tuned directly from the CDI page by pressing the top line select pushbutton on the left. The tune window will surround the Active COM frequency which will allow it to be tuned with the tune knob. The default tune window position is around the COM Active frequency.

The NAV Active frequency is tuned directly from the CDI page by pressing the top line select pushbutton on the right. The tune window will surround the Active NAV frequency which will allow it to be tuned with the tune knob.

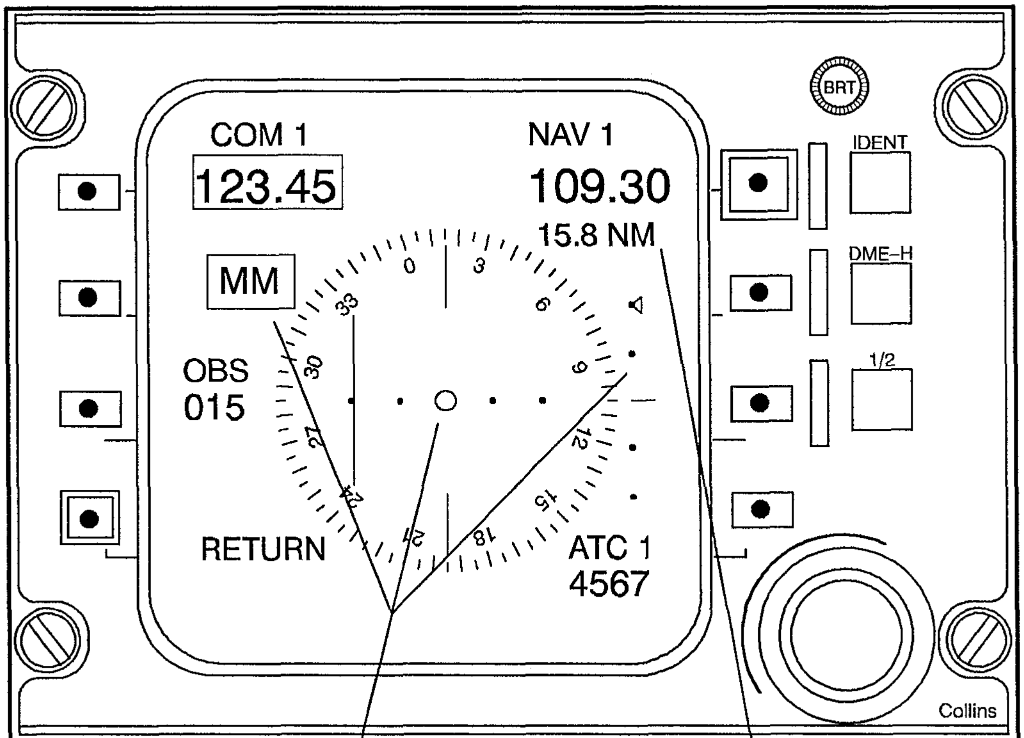


When a VOR NAV frequency has been selected, a "TO/FROM" arrow is displayed off the inner end of the top or bottom of the track pointer segments.

The ATC transponder code is selected directly from the CDI page by pressing the bottom line select pushbutton on the right. The tune window will surround the ATC transponder code which will allow it to be selected with the tune knob. When the ATC transponder is in the standby mode, a "STBY" annunciator is displayed directly below the ATC transponder code.

B1996

FIG. 9. CDI Page with VOR.



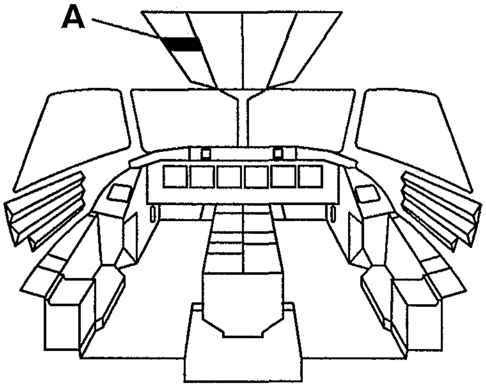
A lateral deviation scale is positioned horizontally in the center of the OBS ring. If an ILS related NAV frequency has been selected, a glideslope scale is displayed immediately to the right of the OBS ring. The Marker annunciator is displayed below the COM frequency.

If the DME is enabled, the DME distance is displayed below the NAV frequency.

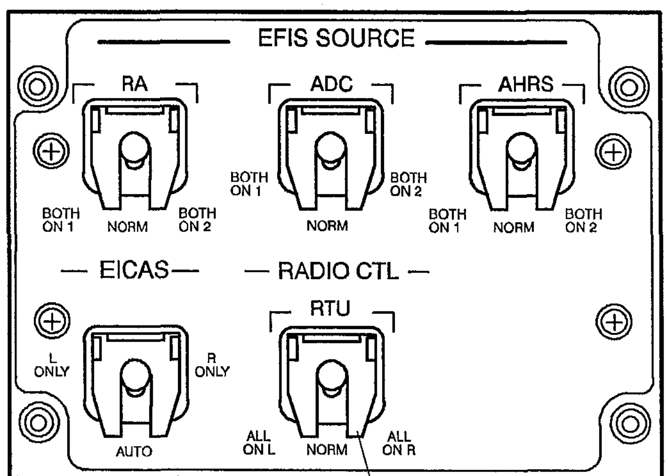
If the DME Hold function has been activated, the "NM" annunciator is replaced by an "H" annunciator. The DME Hold frequency is not tuned separately from the CDI page as it is on the NAV PAGE.

B0910

FIG. 10. CDI Page with ILS.



A EFIS SOURCE PANEL



RTU / ALL ON L / NORM / ALL ON R switch

If one RTU fails all radios can be controlled from the remaining RTU by selecting ALL ON L or R.

B4732

FIG. 11. Radio control switch.

3. ELECTRICAL POWER SUPPLY.

L RTU	EMER AVIONIC BUS	F–18	L RTU
R RTU	R AVIONIC BUS	M–18	R RTU without mod No 5735
R RTU	R BAT AVIONIC BUS	M–18	R RTU with mod No 5735

1. GENERAL.

There are two identical and independent VHF communication systems. The frequency range is 118.000 to 136.975 MHz, selectable in 25 kHz steps or 8.33 kHz steps with Mod. No. 6139 installed.

With Mod. No. 6139 installed the 25 kHz space has been modified with three frequencies, each with 8.33 kHz spacing. These frequencies are referred to as "channels", since the displayed frequency is not the actual frequency tuned. For example, a frequency with 25 kHz spacing, as 118.000 MHz, can now be selected with 8.33 kHz spacing by, in this case, selecting 118.005 on the control unit. If 118.010 is selected the actual frequency tuned is 118.008 MHz. 118.017 MHz is tuned by selecting 118.015 etc. This method ensures that the equipment will always operate in the proper spacing mode. In practice this will not cause any confusion, since the pilot will be asked to tune a channel as if it was a frequency. The control unit is also modified with three decimal places to ensure proper frequency/channel selection.

The controls are on RTU, MAIN PAGE and COM PAGE. The COM 1 antenna is mounted on the bottom and the COM 2 antenna on the top of the fuselage.

The transmission (PTT button keying) is recorded on the Digital Flight Data Recorder (DFDR) via the Flight Data Acquisition Unit (FDAU). The communication will also be recorded by the Cockpit Voice Recorder via the Audio Integrating System.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

COM controls are provided by the RTU. Two frequencies are displayed, one active that tunes the transceiver and one preset which easily can be made active.

A TX annunciator (on the COM PAGE only) will come on when the transceiver transmits.

The RTU also has a squelch function which is active as long as the SQUELCH/ON/OFF is set in the ON position.

2. 2. Transceiver.

The transceiver produces an amplitude modulated signal of the selected frequency and this signal is directly fed to the antenna. In reception mode, the selected frequency is demodulated and the generated audio signal is transferred to the Audio Integrating System for distribution.

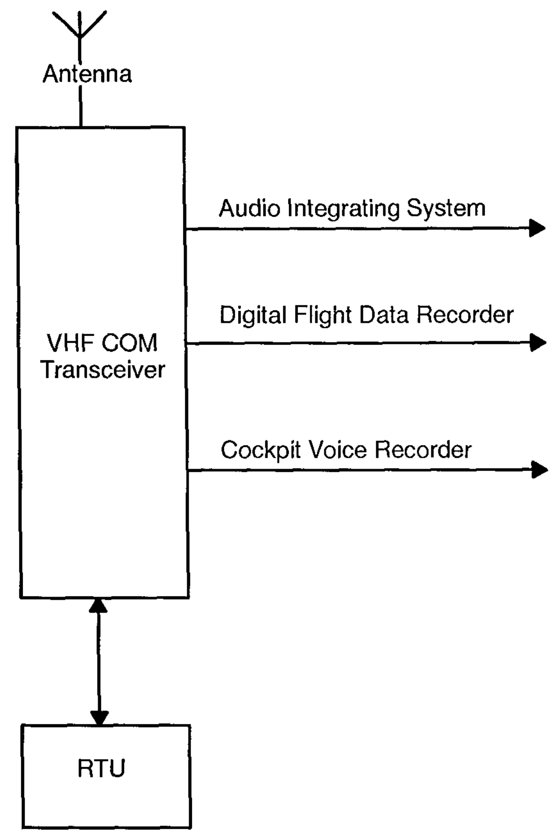


FIG. 1. VHF COM – schematic (COM 1 shown).

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3. CONTROLS AND INDICATORS.

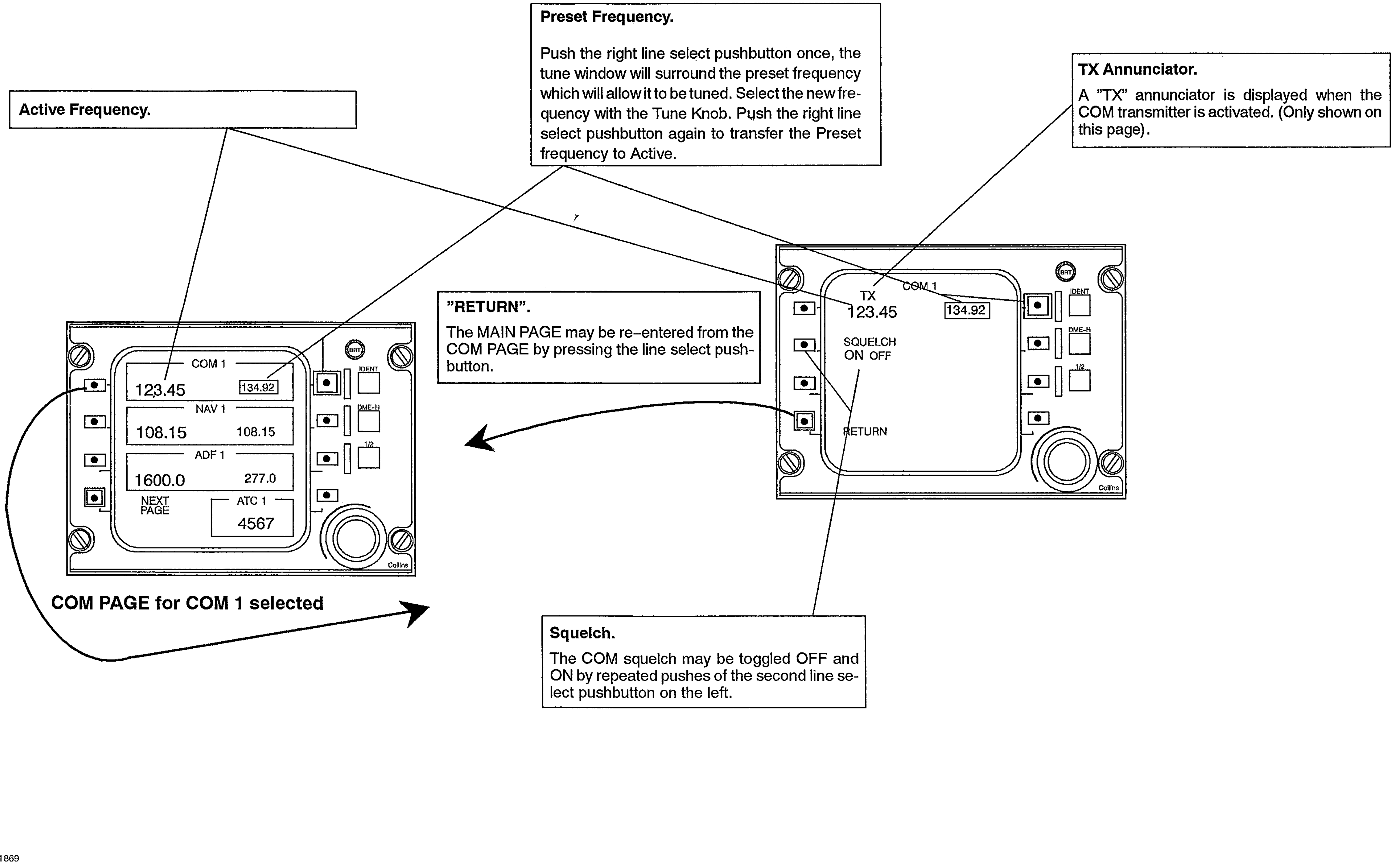


FIG. 2. COM on MAIN and COM PAGES.

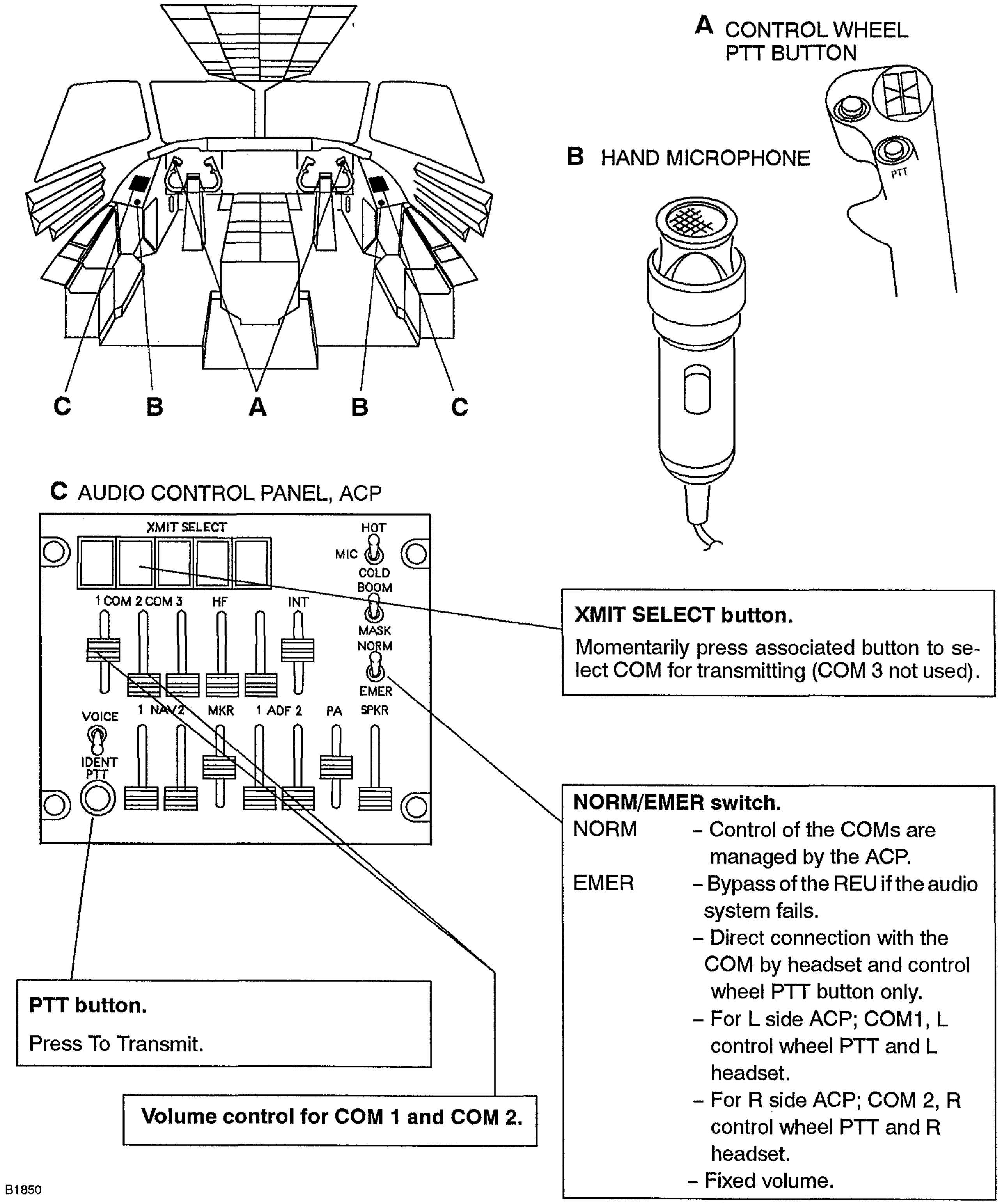
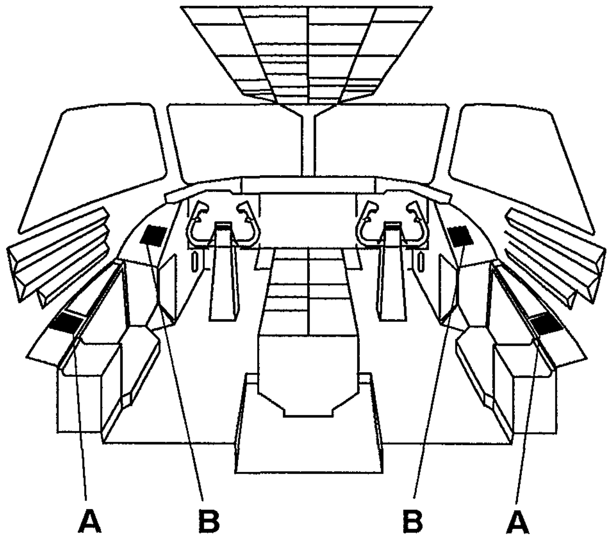
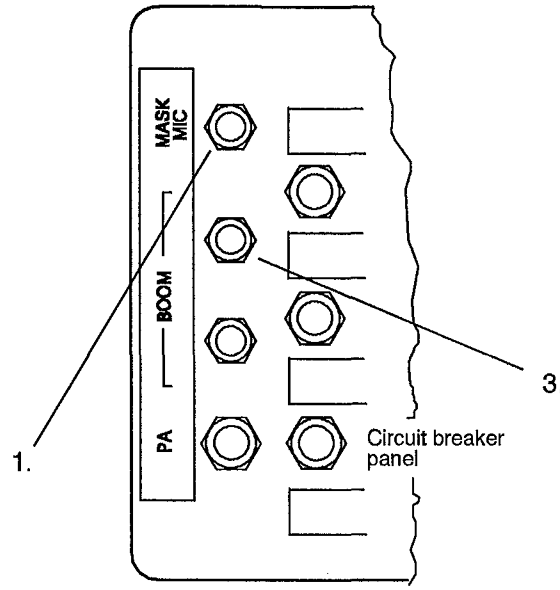


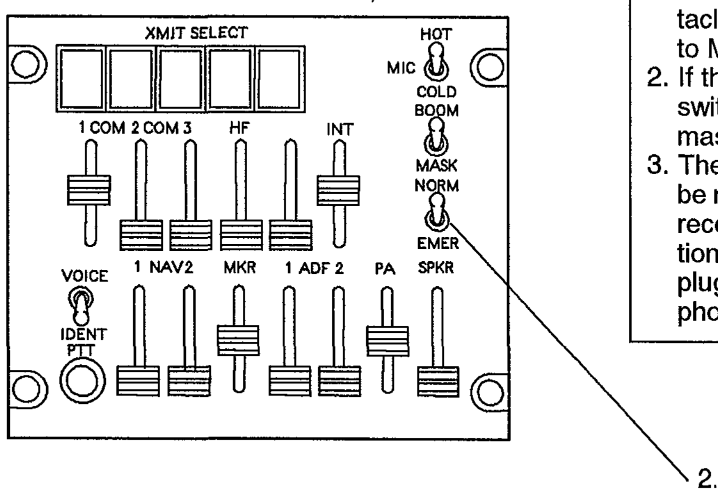
FIG. 3. VHF COM – controls.



A PILOTS JACK PANEL



B AUDIO CONTROL PANEL, ACP



Oxygen mask use.

1. The oxygen mask microphone plug is normally connected to the OXY MASK receptacle and with the BOOM MASK switch set to MASK when oxygen mask in use.
2. If the ACP fails and/or the NORM EMER switch is set to EMERG when oxygen mask in use.
3. The oxygen mask microphone plug must be reconnected to the BOOM microphone receptacle to provide microphone function. Disconnect the headset microphone plug and connect the oxygen mask microphone plug.

B1851

Fig. 4. ACP failure and NORM EMERG switch – oxygen mask use.

4. ELECTRICAL POWER SUPPLY.

VHF 1	EMER AVIONIC BUS	E–17	VHF COM 1
VHF 2	R AVIONIC BUS	L–16	VHF COM 2 without mod No 5735
VHF 2	R BAT AVIONIC BUS	L–16	VHF COM 2 with mod No 5735

1. GENERAL.

The VOR/ILS/Marker system receives signals from the selected station (VOR or ILS) and presents them as navigation information on the PFD and ND. This information is also sent to the FD/AP as guidance for navigation and approach. The station identification signal as well as the Marker signals can be heard over the audio integrating system. This function, reception and generation of indicator and guidance data, is performed by the navigation receiver. There are two such systems installed. The distribution of data is shown in which are located on the glareshield panel. Figure 1.

The VOR or ILS frequencies are selected on the RTUs. When a VOR or ILS frequency is selected, the DME frequency, if paired to that station, is also automatically selected.

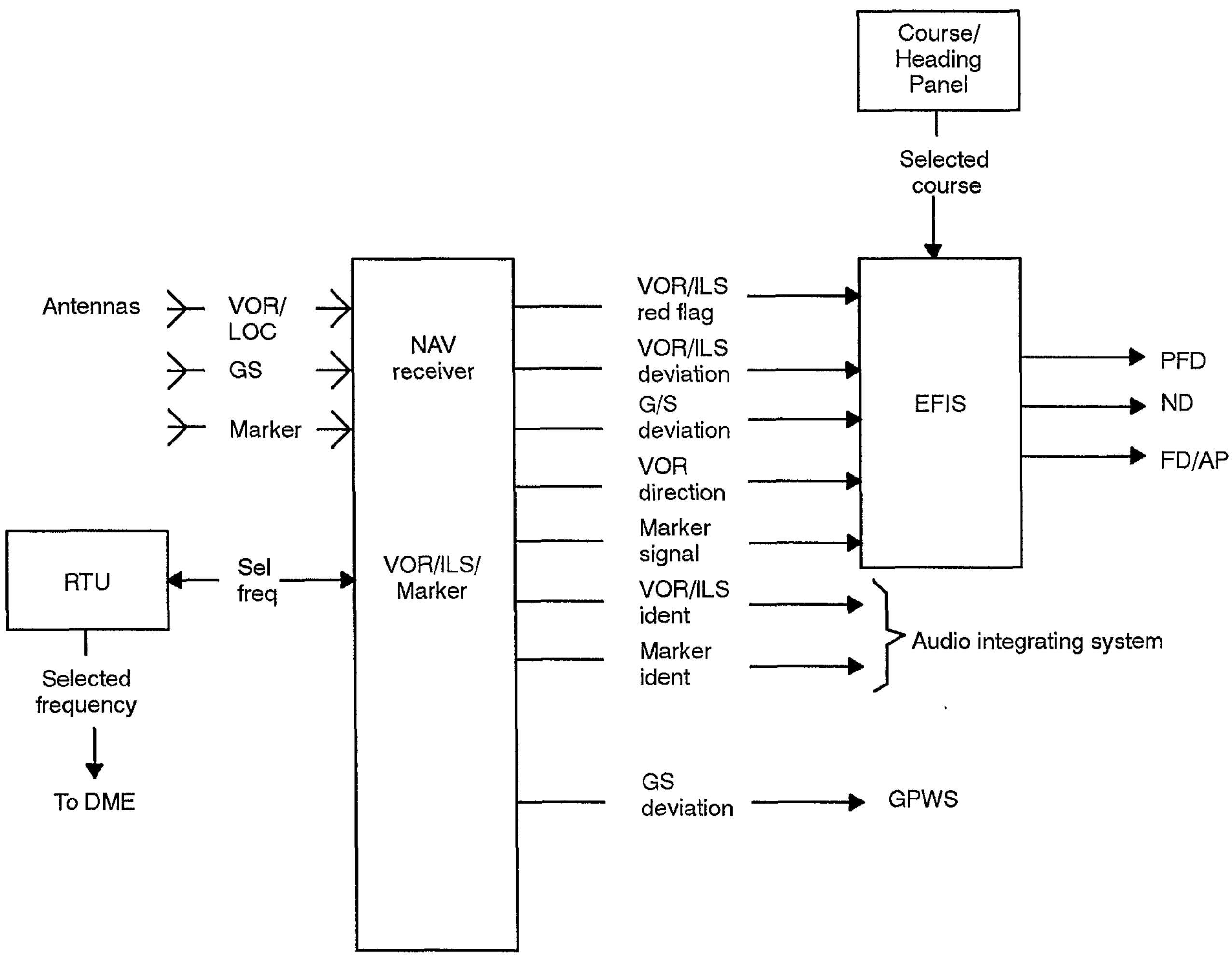


FIG. 1. VOR/ILS/Marker system – schematic.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

NAV controls are provided by the RTU. Two frequencies are displayed: the active that tunes the receiver and the preset which easily can be made active. A selected DME station can be retained by a HOLD mode and a new VOR/ILS frequency can be tuned without affecting the DME.

2. 2. Navigation receiver.

The navigation receiver contains circuitry for the VOR, ILS (Localizer and glideslope) and Marker functions.

VOR.

Both a frequency and the course (CRS) to a station have to be selected. The receiver then compares the received radial with the selected course and calculates the deviation. The selected course and deviation is displayed by the course pointer on the PFD and on the ND. The deviation is angular* presented. The VOR pointer will display magnetic bearing to the received VOR system.

* Angular means that the displayed deviation represents the angle between aircraft and selected radial and is thus unaffected by distance.

TO and FROM indication is determined by the system from the selected course with respect to the received radial.

The magnetic information for the presentation of the course is received from the Attitude/Heading Reference System (AHRS). The VOR receiver also generates a flag signal which, in case of failure or no reception of selected station, is displayed on the PFD and ND.

ILS.

When an ILS frequency is selected, both the localizer and the glideslope receivers are tuned. The receivers determine aircraft movements with respect to received localizer and glideslope signals and with selected localizer inbound course (CRS 1/CRS 2 knobs). The aircraft movements are then converted into direct proportional localizer and glideslope deviations. The localizer and glideslope deviations are displayed on the PFD and ND by LOC and GS symbols.

Marker.

The marker system receives the signals from the marker beacons and determines type of marker. The station signals are then modulated and presented on the PFD as follows:

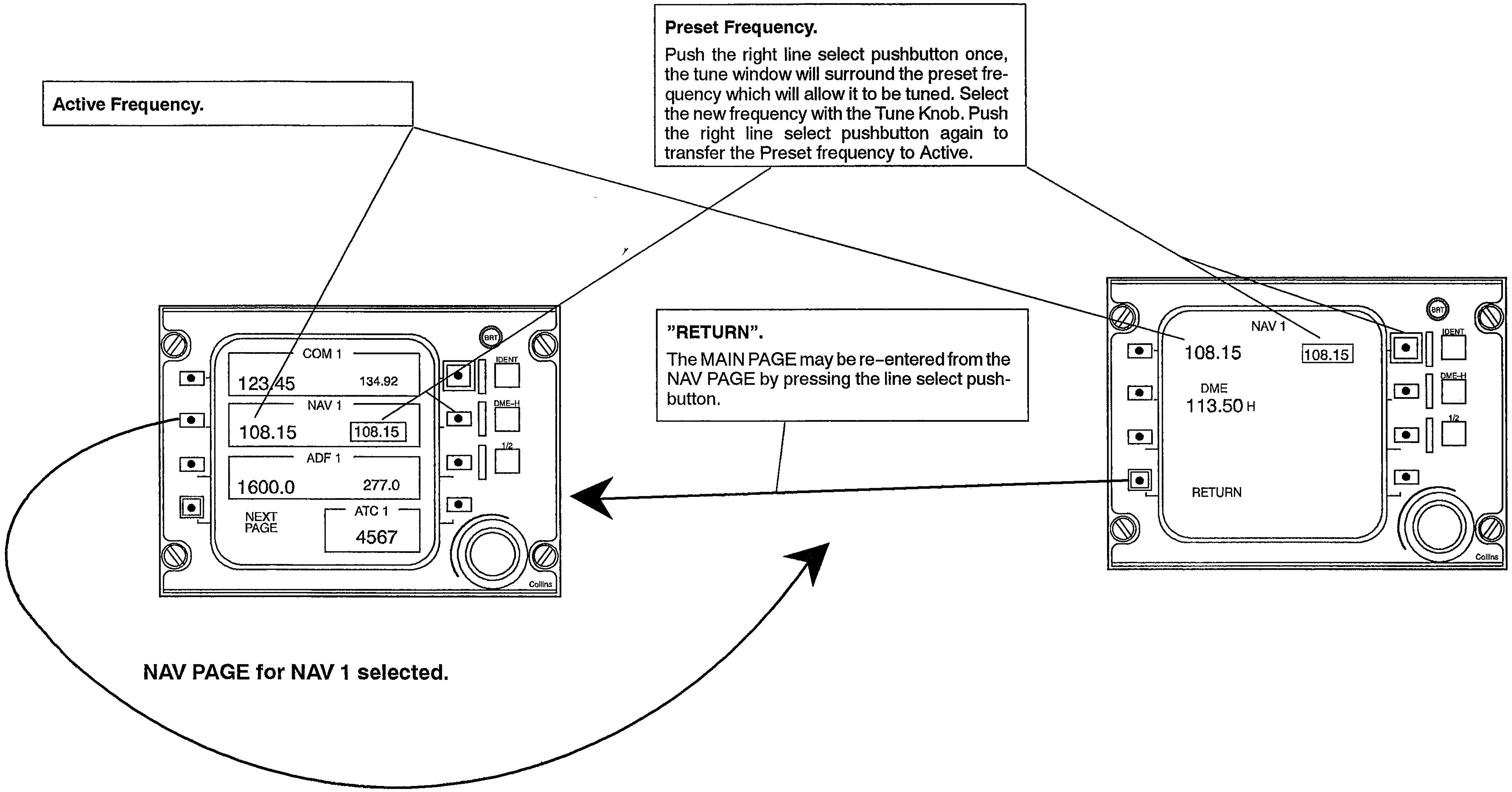
- 400 Hz tone and [OM] symbol in cyan;
- 1300 Hz tone and [MM] symbol in amber;
- 3000 Hz tone and [ ] symbol in white

The marker audio signals are filtered out and made audible via the audio integrating system.

2. 3. Antennas.

- A dual antenna is used for the VOR/LOC signals. It is located on the upper part of the fin.
- A dual antenna is also used for the glideslope signals. This antenna is installed inside the nose radome.
- The marker signals are received by an antenna (common for both marker receivers) mounted on the bottom of the fuselage forward of the wing.

3. CONTROLS AND INDICATORS.



B1997

FIG. 2. NAV on MAIN and NAV PAGE.

4. ELECTRICAL POWER SUPPLY.

VOR/ILS/Marker 1	EMER AVIONIC BUS	E–20	NAV 1
VOR/ILS/Marker 2	R AVIONIC BUS	L–19	NAV 2

1. GENERAL.

The Distance Measuring Equipment (DME) provides slant distance to a ground station. The DME station does not have to be specially selected if it is paired with a selected ILS or VOR station. DME distance, GS and Time To Go are displayed on the ND. DME distance is also displayed on the PFD.

> NOTE
> See chapter EFIS regarding description of DME presentation on EFIS.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Transceiver.

The frequency information is received from the RTU as a data stream which is transferred into a frequency control circuitry that tunes both the transmitter and the receiver.

The airborne system interrogates a ground station by transmitting squitter pulses which are returned as reply pulse pairs by the ground station after a fixed delay time, equal for all stations. The airborne system can distinguish the reply as its own signals from other aircraft replies and measure the time difference between transmitted and received signal and thus determine the distance. This distance, the straight line between the aircraft and the ground station, is the slant range. Time To Go and Groundspeed are both calculated and based upon the rate of change of DME distance.

The DME ground station also sends an identification signal which can be heard over the audio integrating system.

The inhibit circuits of the ATC transponder and DME systems are interconnected in order to avoid interference between the DME and the transponder. The DME is inhibited when the transponder transmits and vice versa.

2. 2. RTU.

DME controls are provided by the RTU. When a VOR/ILS frequency is selected, the DME frequency, if paired to that station, is also selected. The DME frequency can also be held in order to select a new VOR/ILS or DME frequency without affecting the previously selected DME station. By entering the NAV PAGE, the DME frequency can also be tuned directly when in HOLD mode.

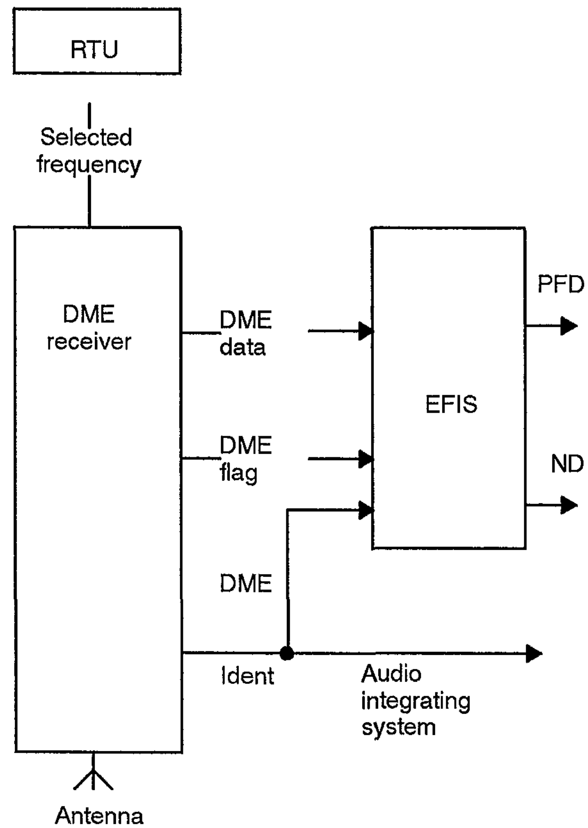


FIG. 1. DME system – schematic.

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3. CONTROLS AND INDICATORS.

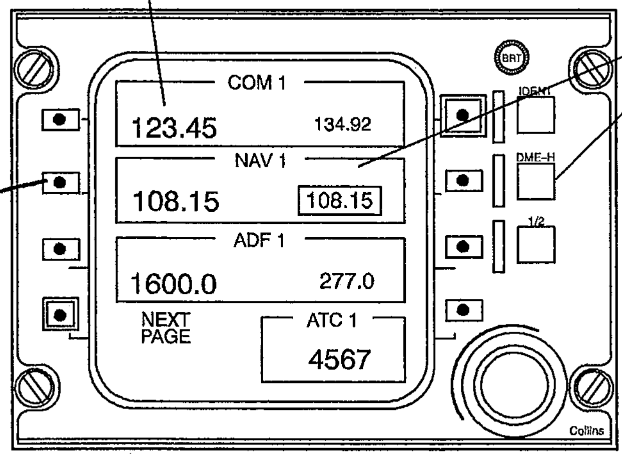
Active Frequency.

The DME will be paired to be active NAV frequency. If DME is set to HOLD the DME frequency may be tuned directly from the NAV PAGE.

DME HOLD.

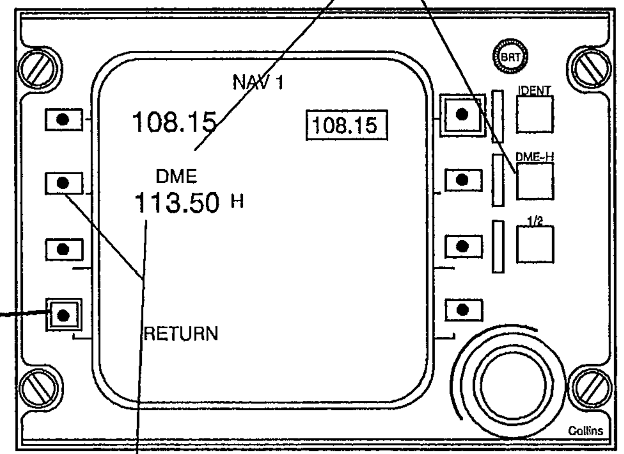
Pressing the DME HOLD pushbutton toggles the DME Hold function of the controlled DME receiver. When the DME hold function is enabled, it will be annunciated on the MAIN PAGE and on the NAV PAGE.

While the DME hold function is active, the DME radio frequency may be tuned directly from the NAV PAGE.



"RETURN".

The MAIN PAGE may be re-entered from the NAV PAGE by pressing the line select pushbutton to the "RETURN" annunciator.



NAV PAGE for NAV 1 selected.

DME frequency change in HOLD mode only.

The DME frequency appears only when DME is set to hold.

Push the left line select pushbutton once, the tune window will surround the DME hold frequency which will allow it to be tuned. Select the new frequency with the Tune Knob.

Also see NAV description for the other controls.

B1998

FIG. 2. DME on MAIN and NAV PAGE.

4. ELECTRICAL POWER SUPPLY.

DME 1	L AVIONIC BUS	E–21	DME 1
DME 2	R AVIONIC BUS	L–20	DME 2

1. GENERAL.

The Automatic Direction Finder (ADF) detects the relative bearing to a selected radio station (NDB) in the frequency range 190 - 1799 kHz.

The radio bearing is combined with the magnetic compass indication which thus indicates the magnetic bearing to the selected ADF station. The ADF bearing is displayed on the PFD and the ND.

If two systems are installed they are completely separated. The bearing indication is displayed by pointers. If selected on the DCP the single pointer indicates ADF 1 and the double pointer indicates ADF 2.

> NOTE
> See chapter EFIS regarding descriptions of ADF presentation on EFIS.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Antenna.

There is a dual antenna installed on the top of the fuselage. The antenna is of the integrated type i.e. it contains a loop and a sense antenna. A dual amplifier provides two independent outputs to the ADF receivers.

2. 2. RTU.

ADF controls are provided by the RTU. Two frequencies are displayed, one active that tunes the receiver and one preset which easily can be made active. ADF, ANT and BFO settings are also displayed.

2. 3. Receiver.

The receiver consists principally of two parts, the normal radio and audio amplifiers for the station signals and a circuitry to determine the direction to the station.

2. 4. System function.

When in the normal mode (ADF), the signals from the selected station are routed to the audio integrating system and can be heard as an identification signal. The signals are also routed to a circuit that determinates the bearing to the station. In ANT mode the loop antenna output is disabled and the result is only audio without bearing indication. In BFO mode unmodulated signals (Continuous Wave, CW) are received and identified.

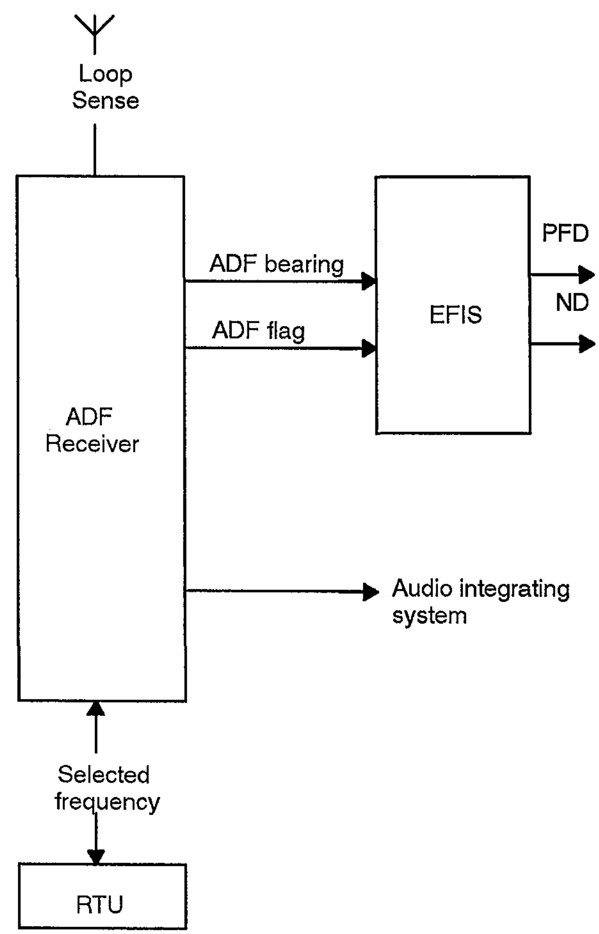


FIG. 1. ADF - schematic.

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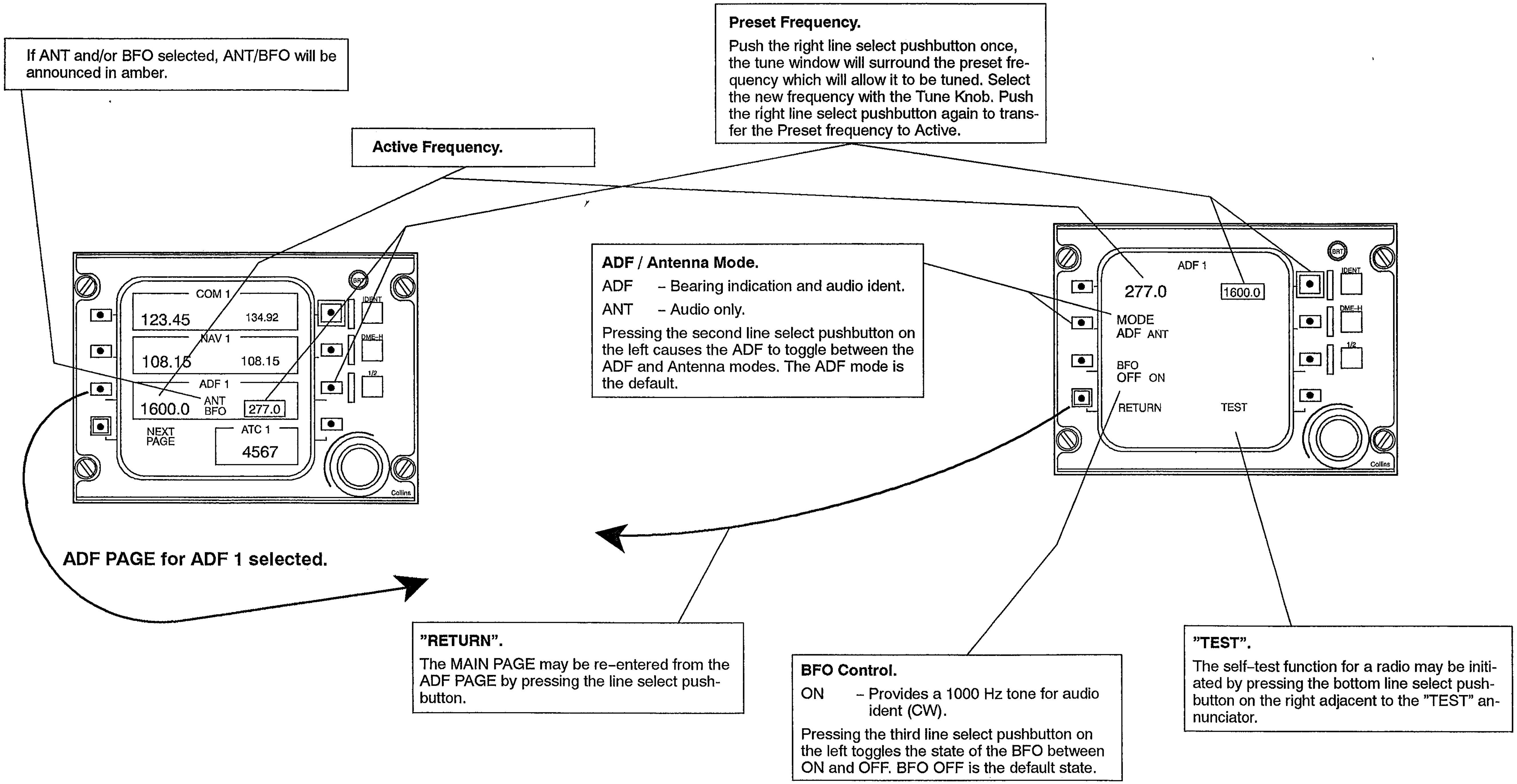
3. CONTROLS AND INDICATORS.



B1999

FIG. 2. ADF on MAIN and ADF PAGE.

4. ELECTRICAL POWER SUPPLY.

ADF 1	L AVIONIC BUS	E–22	ADF1
ADF 2	R AVIONIC BUS	L–21	ADF2

1. GENERAL.

The Air Traffic Control (ATC) Transponder receives and replies to interrogations from ATC ground stations by transmitting information consisting of aircraft identifier (code number) and, if selected, the altitude of the aircraft.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

Transponder controls are provided by the RTU. The Transponder window displays selected transponder (ATC 1 or ATC 2), transponder code and selected transponder mode.

A selector is also provided on the glareshield panel for selection of ATC 1 – STBY – ATC 2.

2. 2. Transmitter.

The interrogation and reply modes:

- Mode A and S selected:
  Transponder replies to Mode A interrogations with ident code.
- Mode C and S selected:
  Transponder replies to Mode A and Mode C interrogations with ident code and flight altitude.

As for Mode C, Mode S is also capable of discrete addressing and sending/receiving data link messages. In Mode S each transponder acquires a unique identity and responds when interrogated according to that identity.

Mode S Transponder is used in combination with TCAS.

The identification code is set by the pilot and stored in the transponder. The altitude information is received as a code from the Air Data Computer. A reply is recognized by the REPLY annunciator on the TRANSPONDER PAGE. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk IDENT"). The pulse which is repeated during approx 20 seconds is triggered by the IDENT button on the RTU.

The inhibit circuits of the Transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The Transponder is inhibited when the DME transmits and vice versa.

The transponder transmission is inhibited on ground (even with ATC 1 or ATC 2 selected), unless Mod. No. 6243 (transponder active on ground) is installed. With Mod. 6243 installed the transponder will transmit Mode S information on ground (with ATC 1 or ATC 2 selected).

2. 3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

Two antennas per Transponder are installed, one on the top and the other on the bottom of the fuselage. This provides for more reliable air–to–air surveillance and communications.

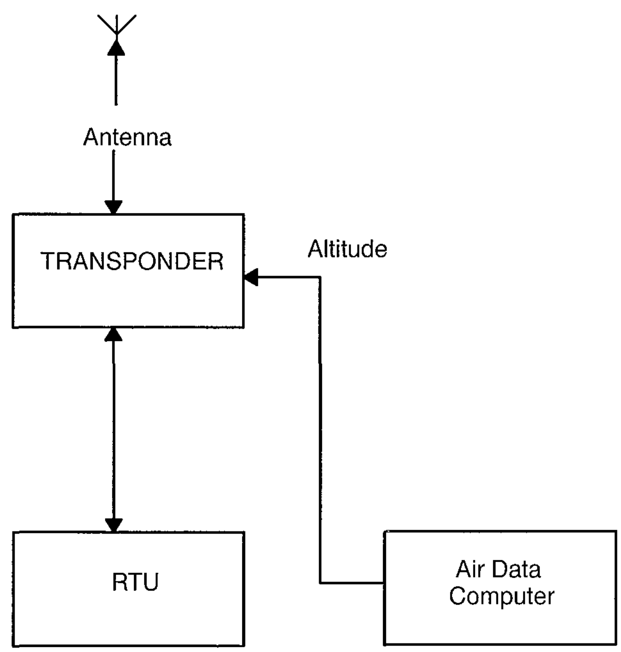


FIG. 1. ATC Transponder – schematic.

Applicable to aircraft with basic ATC

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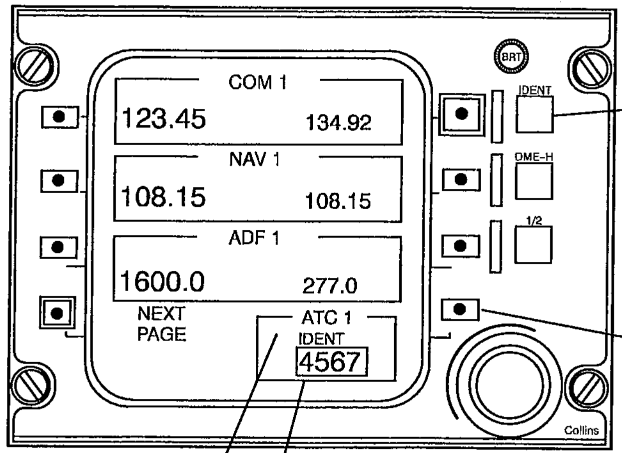
3. CONTROLS AND INDICATORS.



IDENT.

Pressing the IDENT button initiates transmission of the aircraft identifier by the selected Transponder. Ident transmission is indicated by the IDENT annunciator.

Transponder code.

Push the right line select pushbutton once, the tune window will surround the present code which will allow it to be tuned. Select the new code with the Tune Knob.

Transponder PAGE.

Push the button twice to enter the Transponder PAGE.

Altitude Reporting.

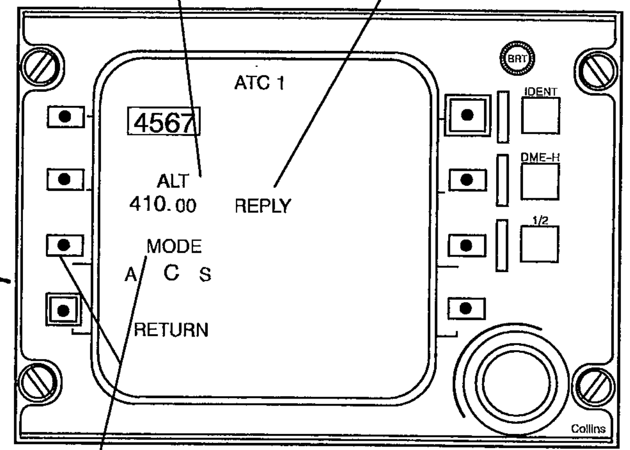
When the Transponder is in mode C and mode S, an "ALT" annunciator together with the reported altitude is displayed. The lack of valid ADC altitude data while the Transponder is in mode C is indicated by three (3) amber dashes in place of the altitude data.

Status annunciator.

REPLY – The ATC interrogation is announced for 0.5 seconds by a "REPLY".

IDENT – When ident is transmitted.

STBY – Transponder in standby,



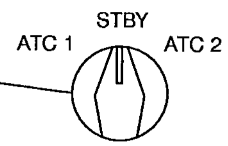
Transponder Mode and Status annunciator.

"RETURN".

The MAIN PAGE may be re–entered from the Transponder PAGE by pressing the line select pushbutton.

Transponder.

Even though there are two Transponders installed, only one can be selected and displayed at each time but that transponder is controlled by either RTU. The Transponders are indicated as ATC 1 or ATC 2. The active Transponder is selected by the external ATC selector on the glareshield panel (beside the right RTU).



Transponder MODE.

The modes are sequentially selected by repeatedly pressing the left line select pushbutton Selected mode is announced with the largest letter.

B2000

FIG. 2. Transponder on MAIN and TRANSPONDER PAGE.

Applicable to aircraft with basic ATC

1. GENERAL.

The Air Traffic Control (ATC) Transponder receives and replies to interrogations from ATC ground stations by transmitting information consisting of aircraft identifier (code number) and, if selected, the altitude of the aircraft. With Mod. no. 6231 installed (Elementary Surveillance), the transponder also transmitts a flight ID code.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

Transponder controls are provided by the RTU. The Transponder window displays selected transponder (ATC 1 or ATC 2), transponder code, Flight ID and selected transponder mode.

NOTE
Unlike the ATC code, Flight ID can not be entered via the FMS.

A selector is also provided on the glareshield panel for selection of ATC 1 – STBY – ATC 2.

2. 2. Transmitter.

The interrogation and reply modes:

- Mode A and S selected:
  Transponder replies to Mode A interrogations with ident code and flight ID.
- Mode C and S selected:
  Transponder replies to Mode A and Mode C interrogations with ident code, flight ID and flight altitude.

As for Mode C, Mode S is also capable of discrete addressing and sending/receiving data link messages. In Mode S each transponder acquires a unique identity and responds when interrogated according to that identity.

Mode S Transponder is used in combination with TCAS.

The identification code and flight ID is set by the pilot and stored in the transponder. The altitude information is received as a code from the Air Data Computer. A reply is recognized by the REPLY annunciator on the TRANSPONDER PAGE. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk or flight ID IDENT").

The pulse which is repeated during approx 20 seconds is triggered by the IDENT button on the RTU.

The inhibit circuits of the Transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The Transponder is inhibited when the DME transmits and vice versa.

The transponder transmission is inhibited on ground (even with ATC 1 or ATC 2 selected), unless Mod. No. 6243 (transponder active on ground) is installed. With Mod. 6243 installed the transponder will transmit Mode S information on ground (with ATC 1 or ATC 2 selected).

2. 3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

Two antennas per Transponder are installed, one on the top and the other on the bottom of the fuselage. This provides for more reliable air–to–air surveillance and communications.

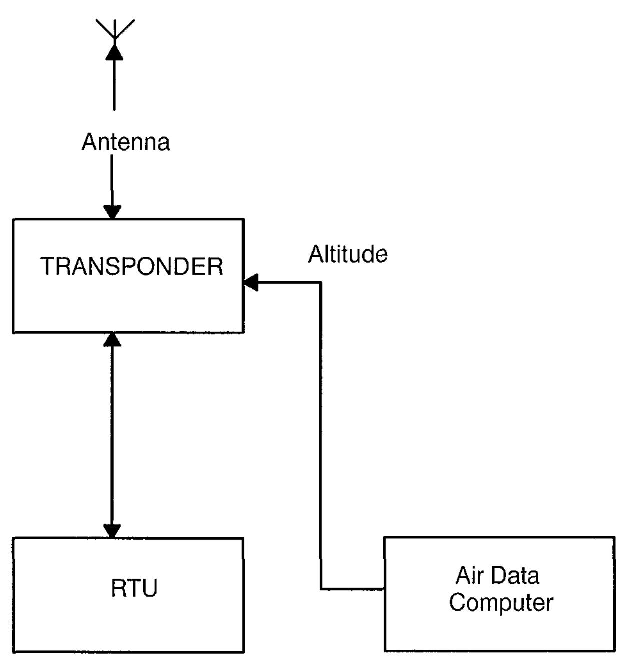


FIG. 1. ATC Transponder – schematic.

Applicable to a/c with Elementary Surveillance ATC (Flight ID)

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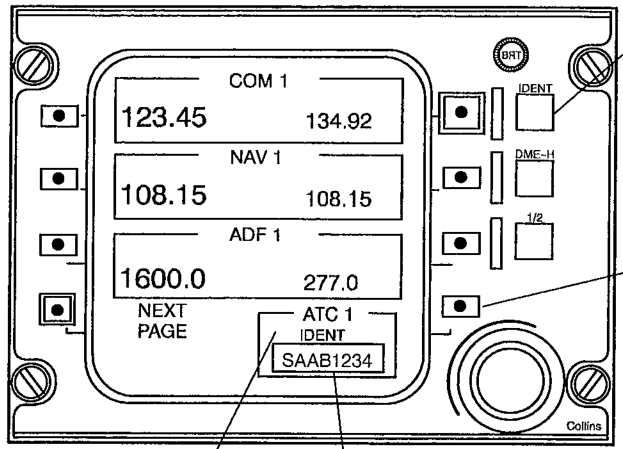
3. CONTROLS AND INDICATORS.

IDENT.
Pressing the IDENT button initiates transmission of the aircraft identifier by the selected Transponder. Ident transmission is indicated by the IDENT annunciator.

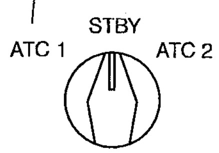
Transponder code / flight ID.
Push the right line select pushbutton once, the tune window will surround the present code/ flight ID which will allow it to be tuned. Select the new code with the Tune Knob.

Transponder PAGE.
Push the button twice to enter the Transponder PAGE.



Transponder Mode and Status annunciator.

Transponder.
Even though there are two Transponders installed, only one can be selected and displayed at each time but that transponder is controlled by either RTU. The Transponders are indicated as ATC 1 or ATC 2. The active Transponder is selected by the external ATC selector on the glareshield panel (beside the right RTU).



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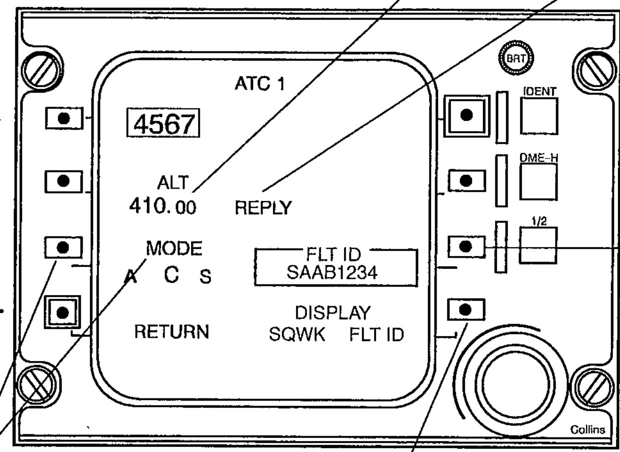
"RETURN".
The MAIN PAGE may be re–entered from the Transponder PAGE by pressing the line select pushbutton.

Transponder MODE.
The modes are sequentially selected by repeatedly pressing the left line select pushbutton Selected mode is announced with the largest letter.

"RETURN".
The Transponder PAGE may be re–entered from the Flight ID PAGE by pressing the line select pushbutton.

Altitude Reporting.
When the Transponder is in mode C and mode S, an "ALT" annunciator together with the reported altitude is displayed. The lack of valid ADC altitude data while the Transponder is in mode C is indicated by three (3) amber dashes in place of the altitude data.

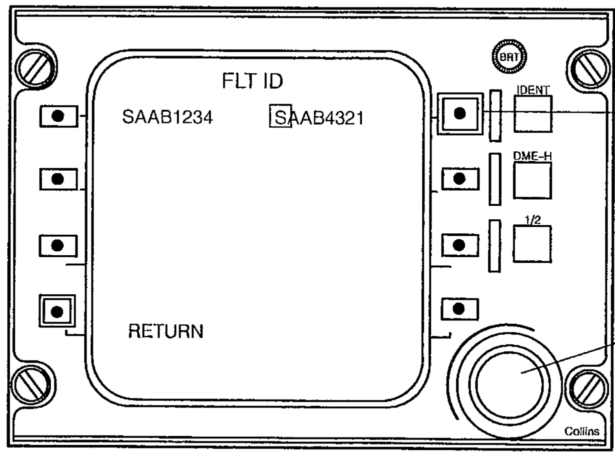
Status annunciator.
REPLY – The ATC interrogation is announced for 0.5 seconds by a "REPLY".
IDENT – When ident is transmitted.
STBY – Transponder in standby,



Flight ID.
Push the right line select pushbutton once, the tune window will surround the present flight ID which will allow it to be tuned. Select the new flight ID code with the Tune Knob.

Flight ID PAGE.
Push the button twice to enter the Flight ID PAGE.

Display select.
Push the right line select pushbutton to select SQWK or FLT ID presentation on the MAIN PAGE.



Active and preset Flight ID.
Push the right line select pushbutton to toggle between preset and active Flight ID. Active Flight ID is displayed to the left and preset ID to the right.

Preset Flight ID.
Change the preset flight ID code with the Tune Knob.

FIG. 2. Transponder on MAIN and TRANSPONDER PAGE.

1. GENERAL.

The Air Traffic Control (ATC) Transponder receives and replies to interrogations from ATC ground stations by transmitting information consisting of aircraft identifier (code number) and, if selected, the altitude of the aircraft.

With Mod. no. 6249 installed (Enhanced Surveillance), the transponder also transmitts a flight ID code and via ARINC 429 buses various aircraft parameters such as manetic heading, air and ground speed, selected altitude, roll angle, vertical rate and true track angle (see also limitations, section 22.4.2.6 for available aircraft parameters and statement of compliance).

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

Transponder controls are provided by the RTU. The Transponder window displays selected transponder (ATC 1 or ATC 2), transponder code, Flight ID and selected transponder mode.

NOTE
Unlike the ATC code, Flight ID can not be entered via the FMS.

A selector is also provided on the glareshield panel for selection of ATC 1 – STBY – ATC 2.

2. 2. Transmitter.

The interrogation and reply modes:

- Mode A and S selected:
  Transponder replies to Mode A interrogations with ident code and flight ID.
- Mode C and S selected:
  Transponder replies to Mode A and Mode C interrogations with ident code, flight ID and flight altitude.

As for Mode C, Mode S is also capable of discrete addressing and sending/receiving data link messages. In Mode S each transponder acquires a unique identity and responds when interrogated according to that identity.

Mode S Transponder is used in combination with TCAS.

The identification code and flight ID is set by the pilot and stored in the transponder. The altitude information is received as a code from the Air Data Computer. A reply is recognized by the REPLY annunciator on the TRANSPONDER PAGE. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk or flight ID IDENT").

The pulse which is repeated during approx 20 seconds is triggered by the IDENT button on the RTU.

The inhibit circuits of the Transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The Transponder is inhibited when the DME transmits and vice versa.

The transponder transmission is inhibited on ground (even with ATC 1 or ATC 2 selected), unless Mod. No. 6243 (transponder active on ground) is installed. With Mod. 6243 installed the transponder will transmit Mode S information on ground (with ATC 1 or ATC 2 selected).

2. 3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

Two antennas per Transponder are installed, one on the top and the other on the bottom of the fuselage. This provides for more reliable air–to–air surveillance and communications.

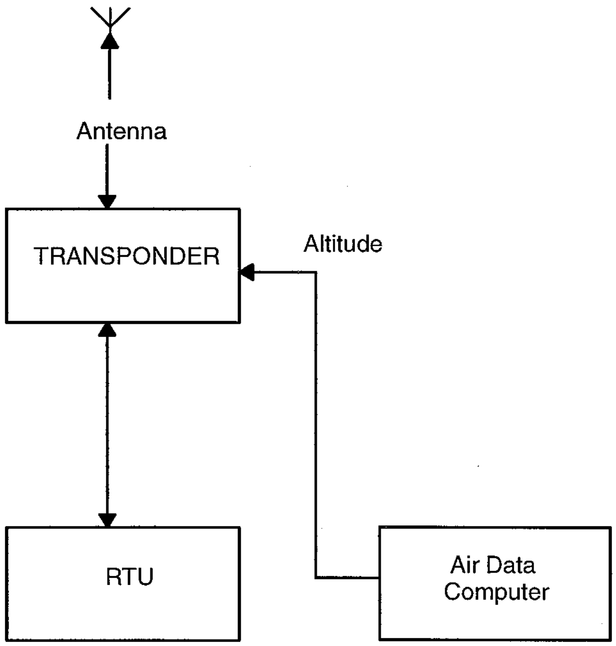


FIG. 1. ATC Transponder – schematic.

Applicable to a/c with Enhanced Surveillance ATC

3. CONTROLS AND INDICATORS.

IDENT.

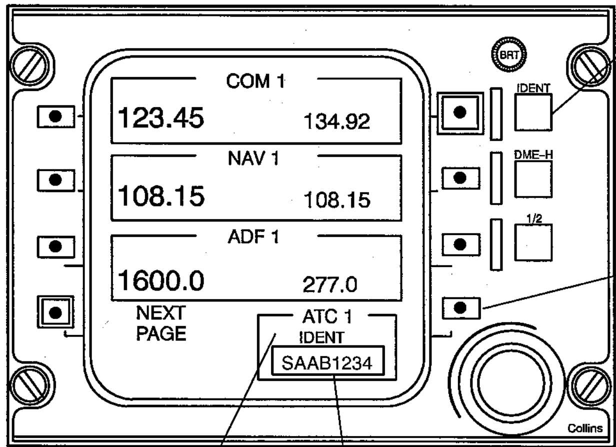
Pressing the IDENT button initiates transmission of the aircraft identifier by the selected Transponder. Ident transmission is indicated by the IDENT annunciator.

Transponder code / flight ID.

Push the right line select pushbutton once, the tune window will surround the present code/ flight ID which will allow it to be tuned. Select the new code with the Tune Knob.

Transponder PAGE.

Push the button twice to enter the Transponder PAGE.



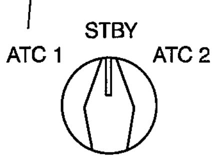
"RETURN".

The MAIN PAGE may be re–entered from the Transponder PAGE by pressing the line select pushbutton.

Transponder Mode and Status annunciator.

Transponder.

Even though there are two Transponders installed, only one can be selected and displayed at each time but that transponder is controlled by either RTU. The Transponders are indicated as ATC 1 or ATC 2. The active Transponder is selected by the external ATC selector on the glareshield panel (beside the right RTU).



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Transponder MODE.

The modes are sequentially selected by repeatedly pressing the left line select pushbutton Selected mode is announced with the largest letter.

"RETURN".

The Transponder PAGE may be re–entered from the Flight ID PAGE by pressing the line select pushbutton.

Altitude Reporting.

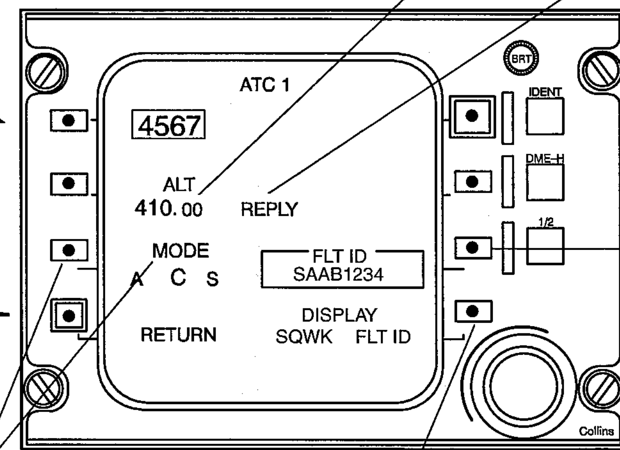
When the Transponder is in mode C and mode S, an "ALT" annunciator together with the reported altitude is displayed. The lack of valid ADC altitude data while the Transponder is in mode C is indicated by three (3) amber dashes in place of the altitude data.

Status annunciator.

REPLY – The ATC interrogation is announced for 0.5 seconds by a "REPLY".

IDENT – When ident is transmitted.

STBY – Transponder in standby,



Flight ID.

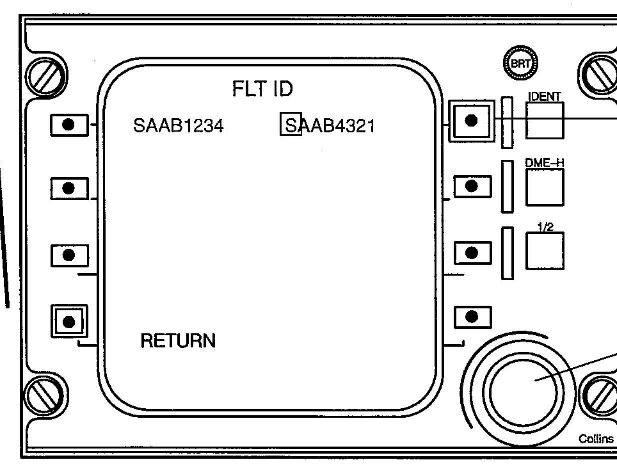
Push the right line select pushbutton once, the tune window will surround the present flight ID which will allow it to be tuned. Select the new flight ID code with the Tune Knob.

Flight ID PAGE.

Push the button twice to enter the Flight ID PAGE.

Display select.

Push the right line select pushbutton to select SQWK or FLT ID presentation on the MAIN PAGE.



Active and preset Flight ID.

Push the right line select pushbutton to toggle between preset and active Flight ID. Active Flight ID is displayed to the left and preset ID to the right.

Preset Flight ID.

Change the preset flight ID code with the Tune Knob.

FIG. 2. Transponder on MAIN and TRANSPONDER PAGE.

Applicable to a/c with Enhanced Surveillance ATC

4. ELECTRICAL POWER SUPPLY.

ATC Transponder 1	EMERGENCY AVIONIC BUS	E–23	XPDR1
ATC Transponder 2	R AVIONIC BUS	L–22	XPDR2

1. GENERAL.

The HF 9000 communication system provides a two–way voice link in the high frequency range 2.0 – 29.9999 MHz. A 100–Hz frequency spacing allows selection of a large number of distinct frequencies. The following communication modes can be selected:

- USB = Upper side band (single side band transmission).
- LSB = Lower side band.
- AM = Amplitude modulated.

The one HF system consists of controls by the RTU, a transceiver and an antenna with antenna coupler in the dorsal fin section.

Audio control and PTT are managed through the Audio Integrating system, all communication is recorded by the CVR (Cockpit Voice Recorder) and PTT by the (FDR) Flight Data Recorder via the FDAU (Flight Data Acquisition Unit).

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. RTU.

HF controls are provided by the RTU. Two frequencies are displayed, one active that tunes the transceiver and one as preset which easily can be made active.

A TX annunciator on the HF PAGE will come on when the transceiver transmits.

A programmable memory facility is also contained in the RTU. The frequencies can be preset on the PRESET PAGE. The RTU also provides controls for HF modes, Tune mode, Squelch and Power Level selection.

2. 2. Transceiver.

The transceiver contains the frequency synthesizer and the channel program memory which will automatically be tuned to the selected frequency/channel. The transceiver also contains the receiver/exciter.

2. 3. Antenna coupler and Antenna.

Because the HF system operates over such a wide frequency range, it is not possible to match the actual length of the aircraft HF antenna to each of the HF.

The antenna coupler function is to change its electrical impedance, thereby tuning the antenna to each frequency and making the antenna appear to the transmitted signal as if it were the ideal physical length.

During the tuning cycle, which is started by a momentary PTT operation, the antenna coupler requires from 5 to 15 seconds, during which a steady 1000 Hz tone will be heard. Within 1 second after completion of the tuning cycle, the tone will cease, indicating that the HF is ready for transmitting.

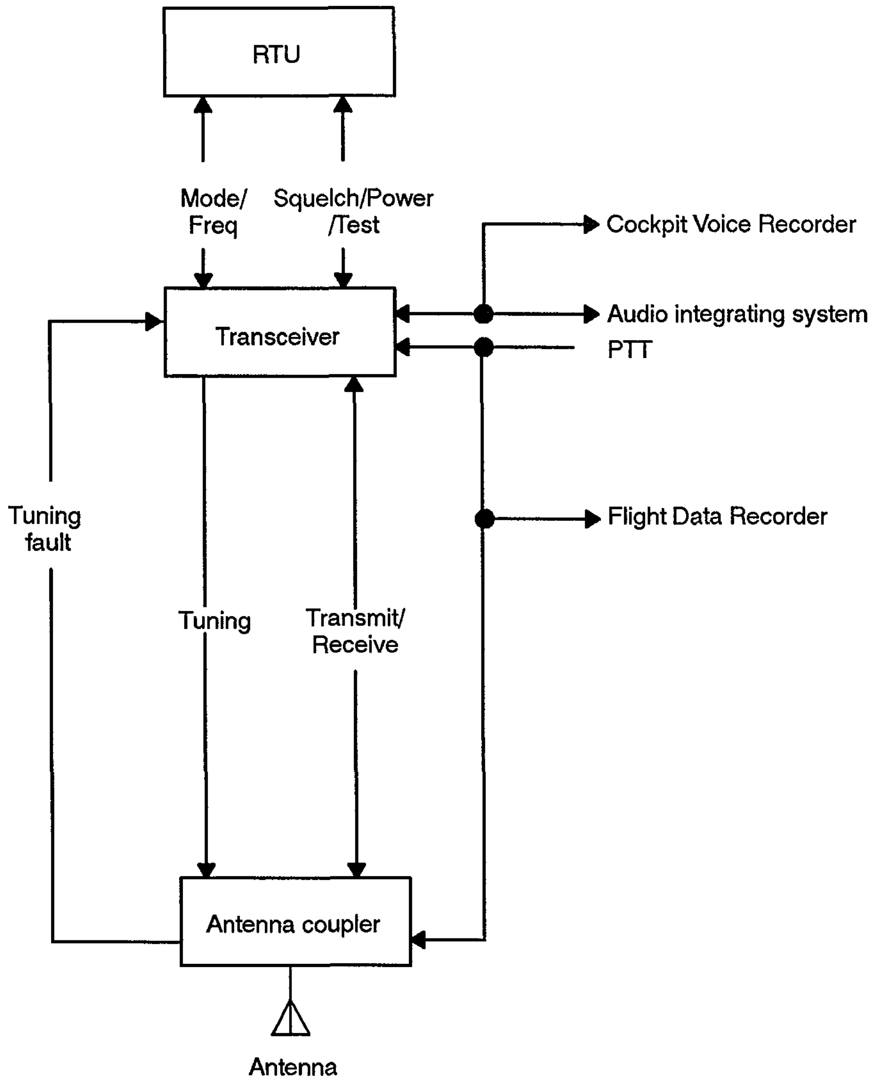


FIG. 1. HF COM– schematic.

3. **CONTROLS AND INDICATORS.**

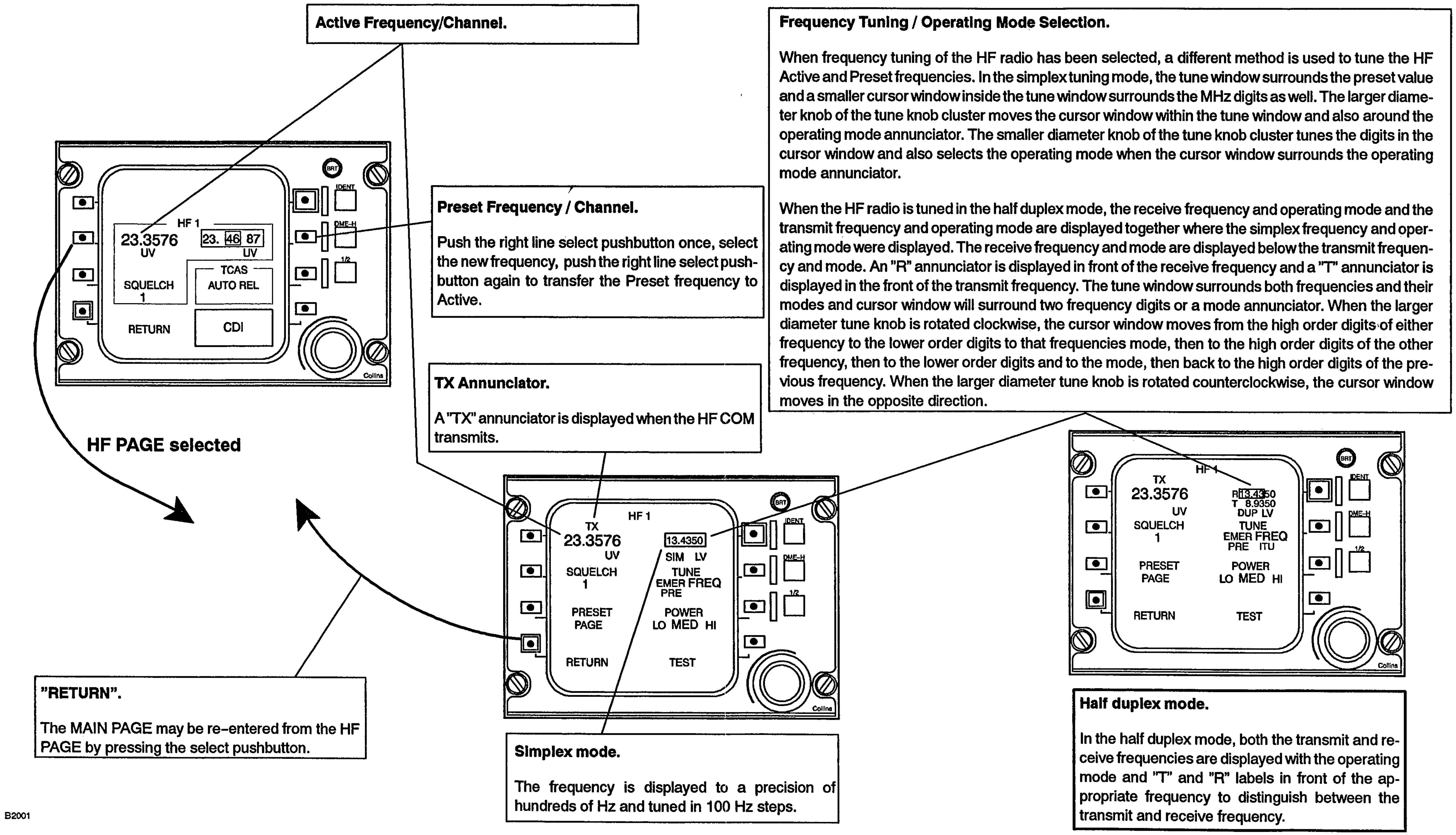
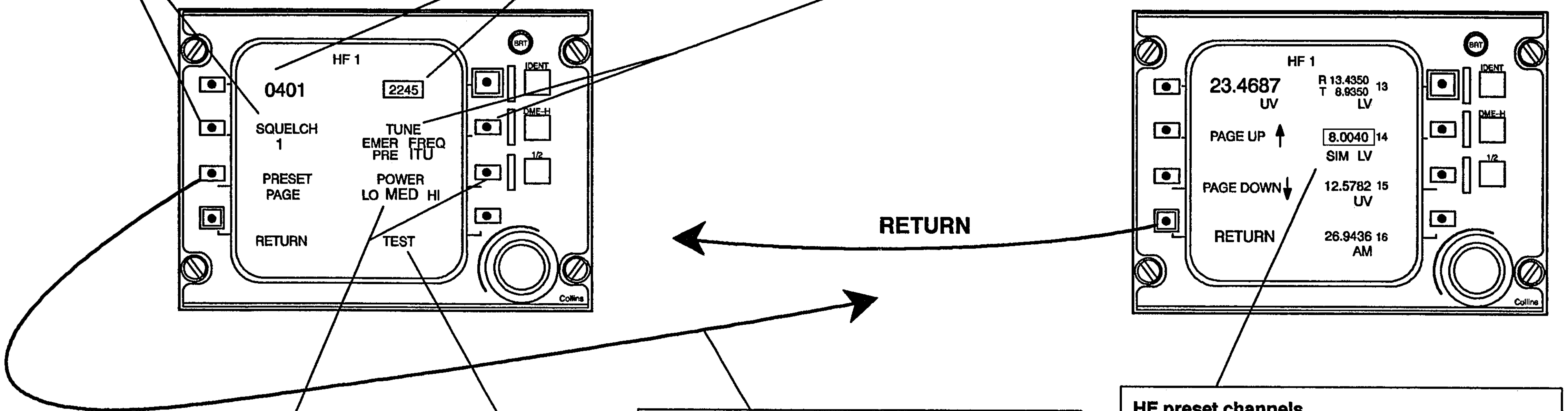


FIG. 2. HF on MAIN and HF PAGE with Simplex and half duplex mode.

Squelch.
Pressing the second line select pushbutton on the left causes the HF receiver squelch level to be set. The four available squelch levels are maximum (MAX), intermediate 2 (2), intermediate 1 (1), and off (OFF). Repeated pressing of this line select pushbutton cycles through the available squelch levels.

Channel Tuning.
When channel tuning of the HF radio has been selected, the active channel number is displayed adjacent to the top line select pushbutton on the left. The preset channel number is displayed adjacent to the top line select pushbutton on the right. Either knob of the tune knob cluster may be used to select the desired preset channel.

Tune Mode Selector.
Pressing the second line select pushbutton on the right selects between frequency (FR) tuning, numbered preset channel (CH), maritime channel (ITU), and emergency channel (EM) selection modes of the HF COM.



Power Level Selection.
Pressing the third line select pushbutton on the left causes the HF transmit power level to be set. The three available power levels are high (HI), medium (MED), and low (LO). Repeated pressing of this line select pushbutton cycles through the available power levels.

HF Preset Page Selection.
The HF PRESET PAGE may be entered by pressing the third line select pushbutton adjacent to the "PRESET PAGE" annunciator.

"TEST".
The self-test function for a radio may be initiated by pressing the bottom line select pushbutton on the right adjacent to the "TEST" annunciator.

HF preset channels.
The memory contains sixteen (16) channels, four channels may be shown at one time. The remaining channels may be viewed by pressing the line select pushbuttons adjacent to the "PAGE UP" and "PAGE DOWN" annunciators. Press associated line select pushbutton and use the tune knob to preset a channel. A second push on the line select pushbutton makes the channel Active. The previous Active frequency will disappear and can not be recovered.

B2002

FIG. 3. HF PAGE with ITU channel mode and HF PRESET PAGE.

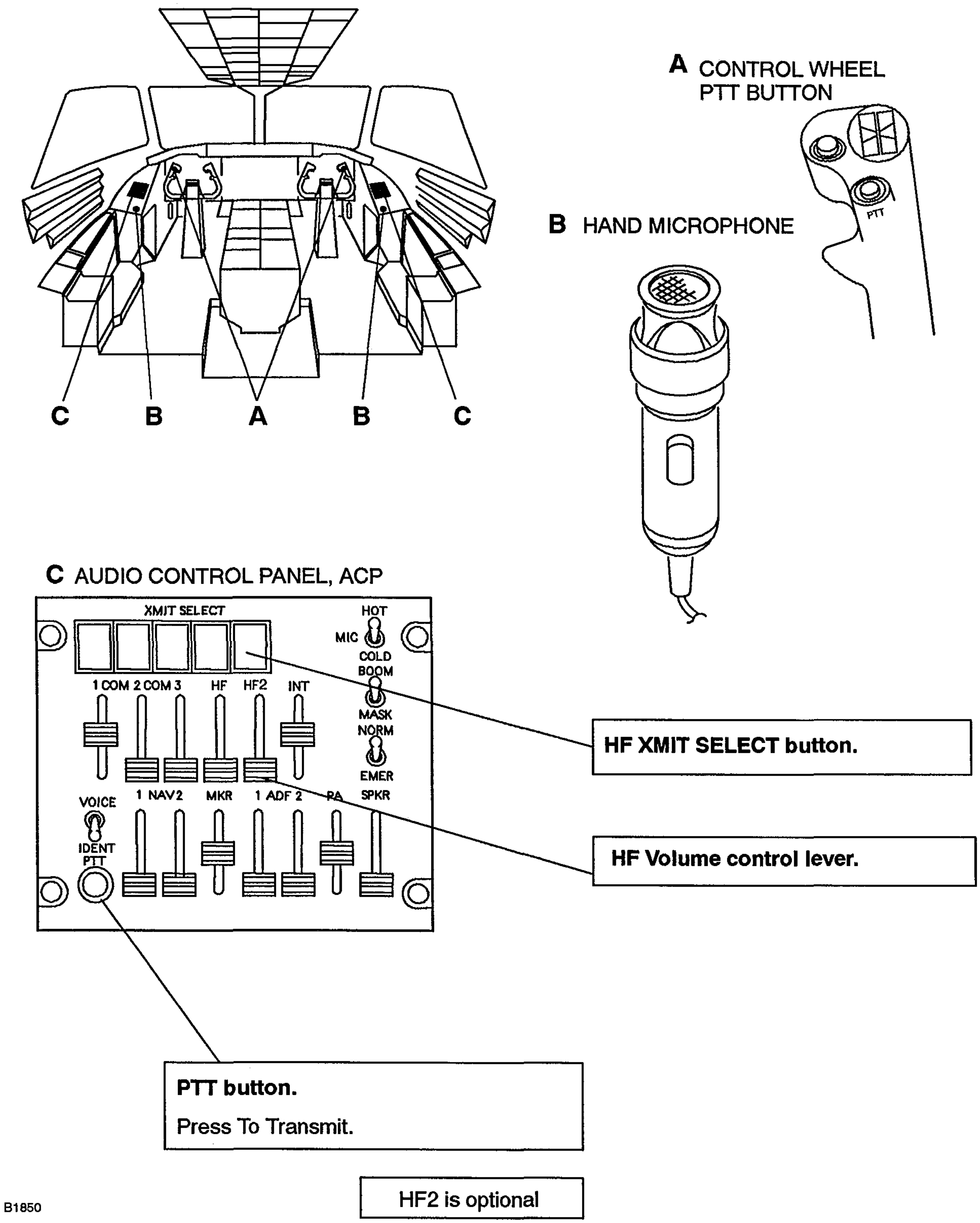


FIG. 3. HF COM - controls.

4. ELECTRICAL POWER SUPPLY.

HF1	L AVIONIC BUS	E–18	COM HF
HF2	R AVIONIC BUS	M–19	COM HF2

1. GENERAL.

As an option, the left RTU can provide backup for IRS Initialization. The RTU will provide two possible inputs when the IRS is in ATT Mode, the RTU will provide Heading input.

2. OPERATION.

2. 1. Entering the IRS CONTROL page.

Entry the IRS CONTROL page will occur through the NAV page using the bottom right line select. "IRS CTL" will be displayed at this line select position.

Present Position Entry for IRS NAV mode.

Present position will be accomplished from the IRS Control page. Present position latitude and longitude will be entered into the data entry field with the front panel rotary knobs. **The latitude and longitude data entry fields can be selected using the larger tune knob.** Tuning input will occur by tuning the direction, degrees, minutes, seconds and tenths of seconds individually using the small tune knob.

At power up, the RTU will set longitude and latitude to zero. The latitude direction will be set to N and the longitude direction to W. Heading data will be set to 360.

The RTU will monitor the status of each IRS individually and then determines which IRS CONTROL page can be selected. NAV will have priority over ATT. As long as one IRS has NAV mode selected and initialization is needed, the page for Present position entry will be displayed. Once initialization is complete, the RTU will automatically revert to the page for Heading entry if the other IRS has ATT mode selected.

The RTU will not transmit present position until the ENTER line select key is pressed signifying that data entry has been completed and the coordinates verified.

Present Position Re–entry.

If the IRS indicates that present position must be re–entered, the RTU will display "REENTER POSITION" in the appropriate field. The RTU latitude and longitude data fields will contain the previous data was transmitted since the RTU was last powered up. If the coordinates are still correct, the data can be verified again by pressing the ENTER button. Otherwise, the latitude and longitude data fields can be modified.

Heading Entry for IRS ATT mode.

If the IRS indicates that the IRS requires heading input, the RTU will enable heading entry from the IRS Control page and display SET HEADING in as shown. Heading data will be entered into the data entry field using the rotary knobs.

At power up, the RTU will set heading to 360.

The RTU will not transmit heading data until the ENTER line select key is pressed signifying that data entry has been completed and verified.

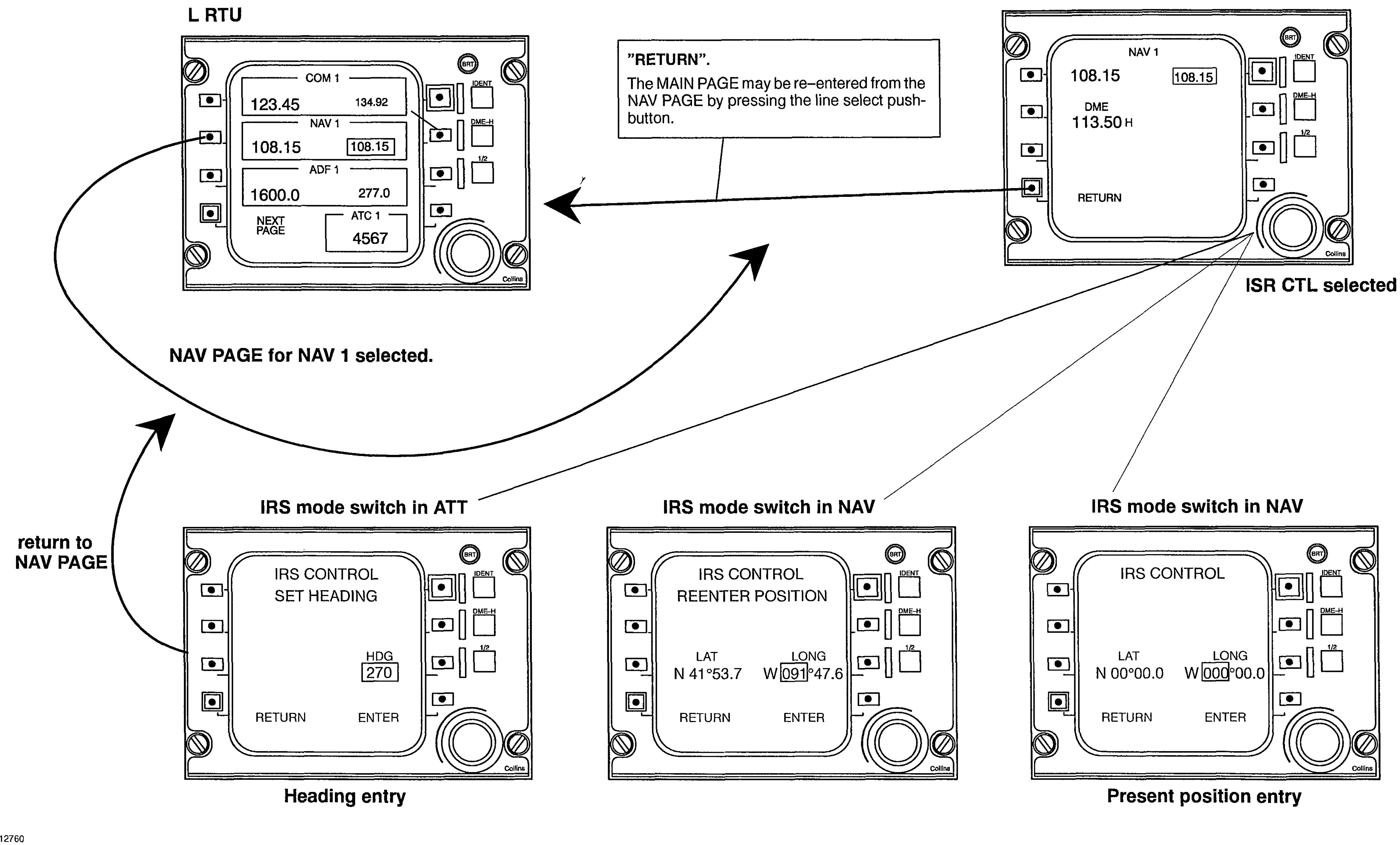


FIG. 1. IRS CONTROL PAGE (only left RTU).

1. GENERAL.

The air data system uses three pitot/static tubes which sense the pitot and the static pressures and feeds that information to the Air Data Computers (ADC) and to the pneumatic instruments. The ADC calculates the various data to be displayed on the electronic instruments, EFIS, or to be supplied to other systems as shown in Fig. 1.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Pitot/static systems.

The aircraft is equipped with two main and one standby pitot/static systems. The two main pitot/static tubes have two separate static chambers. Each static chamber is interconnected with the corresponding chamber in the other tube. The purpose is to eliminate pressure differences between the two systems. The interconnections are provided with shutoff valves to isolate the systems for example should a static leak occur. The left main tube supplies the left ADC and the right main tube supplies the right ADC.

The standby pitot/static tube has only one static chamber and supplies the standby instruments.

All three pitot/static tubes are electrically heated to prevent icing. A heating failure will trigger a caution. See also ICE AND RAIN PROTECTION. The tubes are located as follows:

- Left main tube and standby (upper tube) on the left side of the a/c fwd fuselage.
- Right main tube on the right side of the a/c fwd fuselage.

2. 2. Temperature probe.

The Total Air Temperature probe (TAT), senses total air temperature for the ADC. The probe is electrically heated to prevent icing. See also ICE AND RAIN PROTECTION. Should the heater fail, the OAT caution will come on. The TAT probe is located on the upper part of the fwd fuselage.

2. 3. Air Data Computer (ADC).

The ADC senses the air temperature, it also converts the pitot and static pressures into electrical signals. Barosetting is received from the Air Data Panel. From all inputs the ADC calculates the following parameters:

- Altitude (ALT).
- Vertical speed (VS).
- Indicated airspeed (IAS).
- Indicated airspeed Trend vector.
- True airspeed (TAS).
- Mach (M).
- Low speed cue.
- Maximum operating air speed (V_{MO} / M_{MO}).
- Total air temperature (TAT).
- Static air temperature (SAT).

These parameters are available as digital signals and are supplied to many systems as shown in the schematic.

2. 4. Air data presentation.

For air data presentation on PFD and ND see the EFIS description.

The standby Altimeter and Airspeed Indicator are pneumatic instruments directly supplied by the standby pitot tube.

The standby altimeter is provided with a vibrator to eliminate errors due to mechanical friction. The standby instrument lighting is controlled from the PANEL lighting knob (overhead). At power loss, lighting power is supplied from the EMERGENCY BUS.

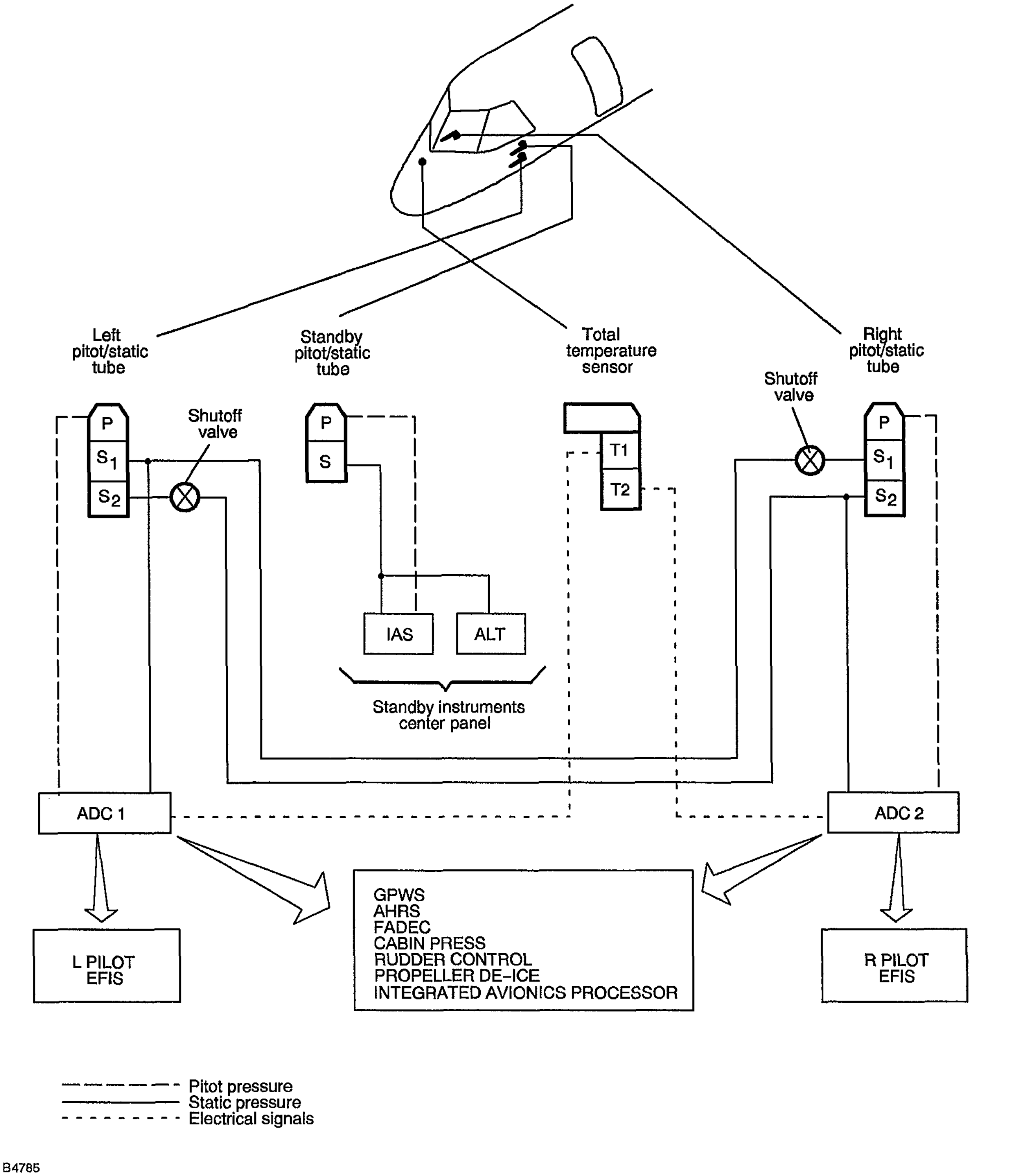


FIG. 1. Pitot Static system.

3. CONTROLS AND INDICATORS.

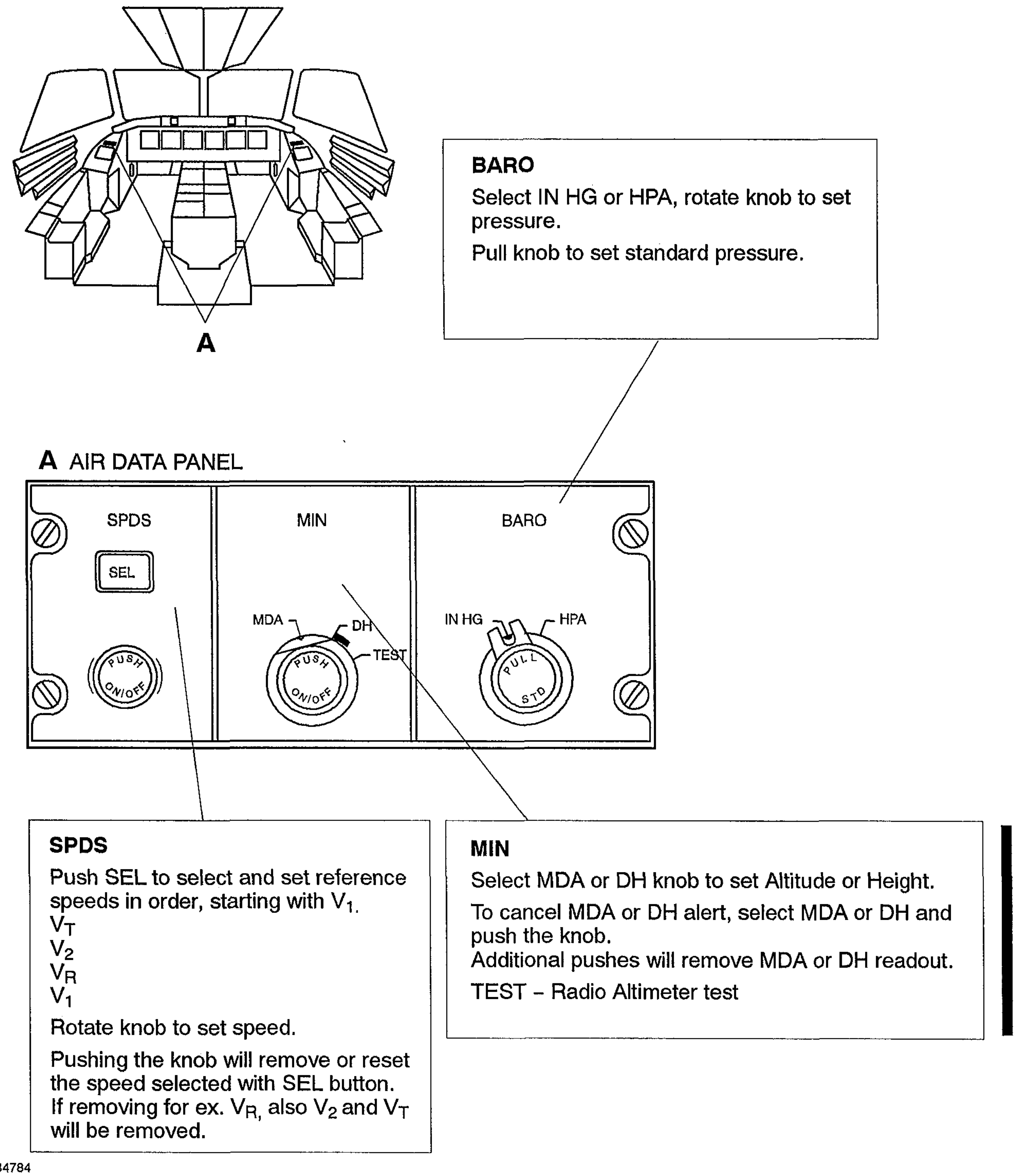
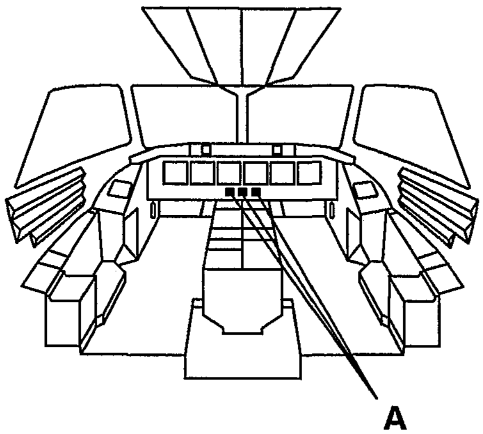
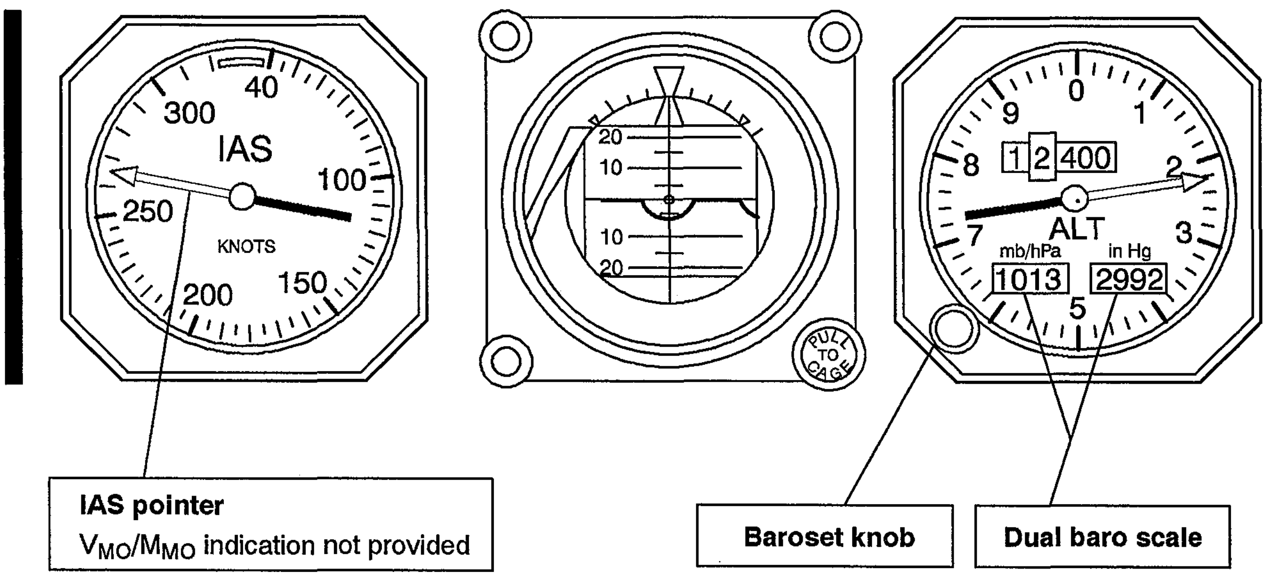


FIG. 2. Air Data Panel.

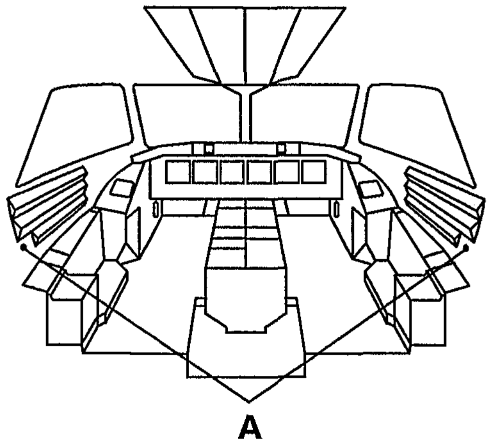


A STANDBY INSTRUMENTS

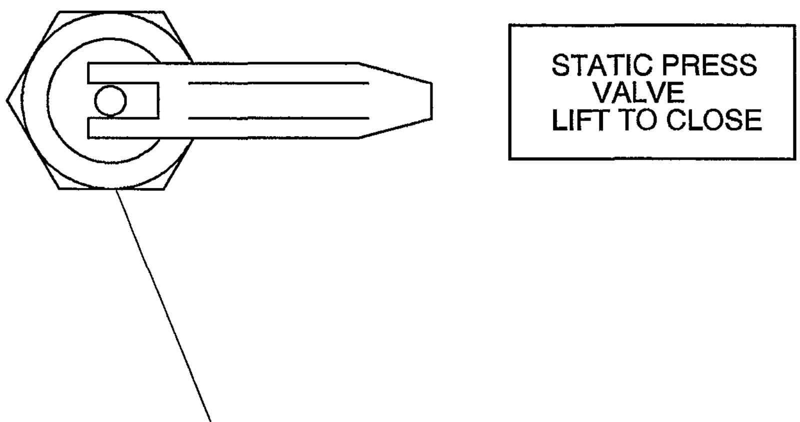


B4764

FIG. 3. Standby instruments.



A STATIC PRESSURE SHUTOFF VALVE



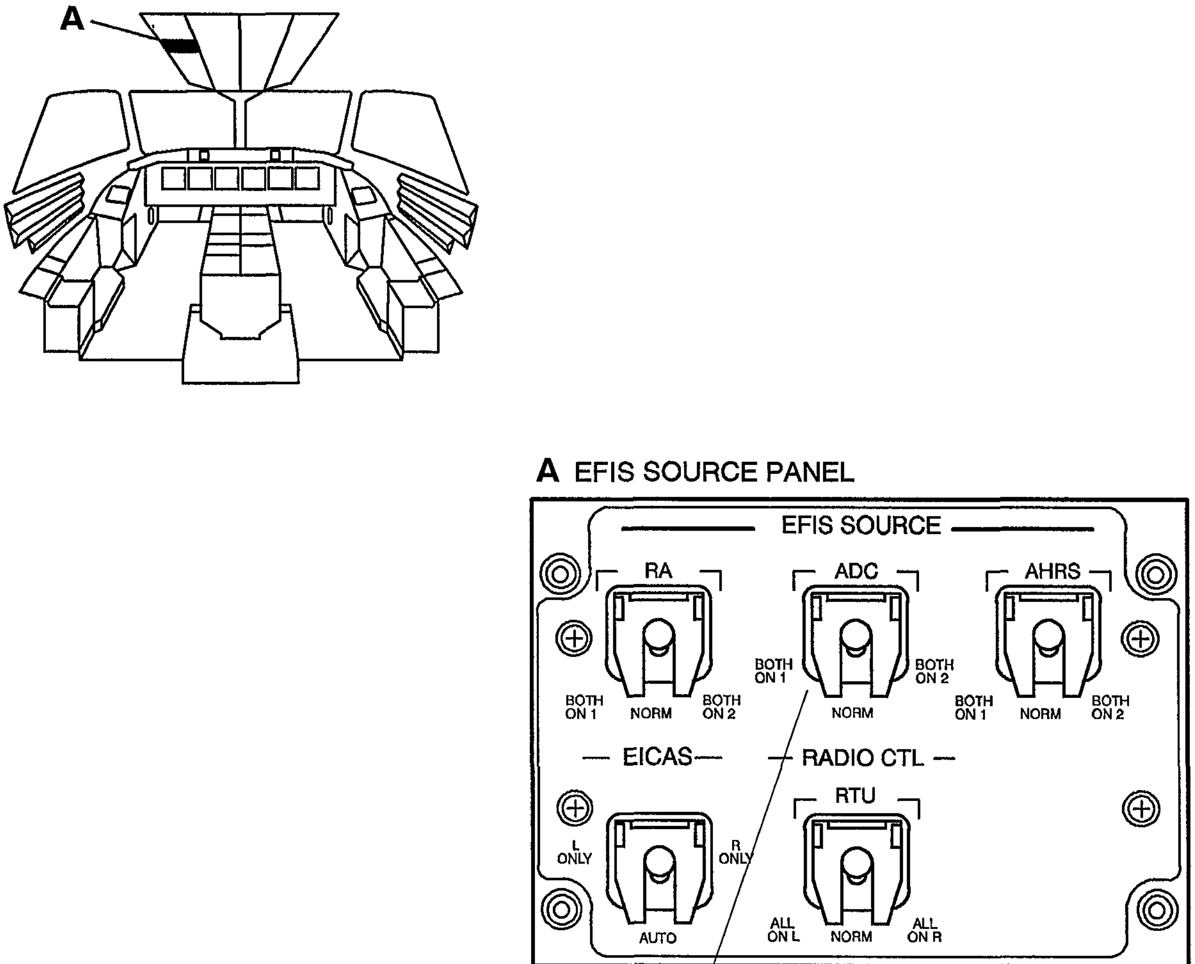
Lift the valve arm to close the static pressure interconnection.

If for ex. left pitot is damaged by birdstrike or leaking, close the left side valve to eliminate the effect on the right side air data presentation. The left side air data will remain erroneous.

The effect of a static leak is only possible to reduce if the leak is located between the static port and the onside valve.

B4783

FIG. 4. Static pressure shut off valves.



ADC switch
Should one ADC fail select other ADC to supply both L and R EFIS.
- ADC 1 failure select BOTH ON 2
- ADC 2 failure select BOTH ON 1

B4732

FIG. 5. ADC switch.

4. ELECTRICAL POWER SUPPLY.

L ADC and L Air Data Panel	L BAT AVIONICS BUS	F –17	ADC 1
R ADC and R Air Data Panel	R BAT AVIONICS BUS	M –17	ADC 2
Standby Altimeter vibrator	EMERGENCY AVIONICS BUS	G – 11	STBY ALT VIB

1. GENERAL.

The attitude and heading information comes from the two Attitude/Heading Computers (AHC) and their subsystems which together are called Attitude/Heading Reference System (AHRS).

The AHRS replaces vertical and directional gyros with sensors that give angular rates and accelerations which, after processing in a microcomputer, result in the normal attitude and heading outputs to the FD/AP and EFIS.

An important difference from a normal gyro is that the unit is not space oriented but oriented to the aircraft axes. This is called a "strap down" system. The AHRS is also provided with an internal fault monitoring circuit.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Attitude/Heading computer.

The sensing elements in this system are piezoelectric crystals. These crystals have a sensitive axis which will generate a voltage when exposed to stresses.

The elements are combined into sensor units which measure the angular rate and the acceleration in two axes. By combining two such units the necessary three axes (pitch, roll and yaw) can be covered. The fourth channel is redundant and used for monitoring purposes.

The strap-down principle means that the sensor can not be levelled and aligned as a normal gyro or platform. The space orientation is determined by the computer which calculates corrections based upon the measured accelerations. In order to remove vehicle acceleration errors in the gravity measurements used for levelling, TAS and vertical speed from the ADC's are also entered into the computer.

2.2. Flux Detector.

Each system has one flux detector located in the wing to avoid magnetic disturbances. The detector unit consists of two coils oriented 90° apart which sense the horizontal components of the magnetic field. The coil system is kept horizontal by a fluid damped pendulum.

The output representing the direction of the magnetic field is transferred to the computer where it is compensated for magnetic errors of the detector. The compensated signal slaves the heading information and the result is thus magnetic heading. Each computer has a compensator card for adjustment of the magnetic error, which is set at the aircraft compass swing (maintenance).

The system also provides manual slew control (DG mode) of the magnetic heading if the heading is disturbed by ferrous material in the aircraft surroundings.

3. CONTROLS AND INDICATORS.

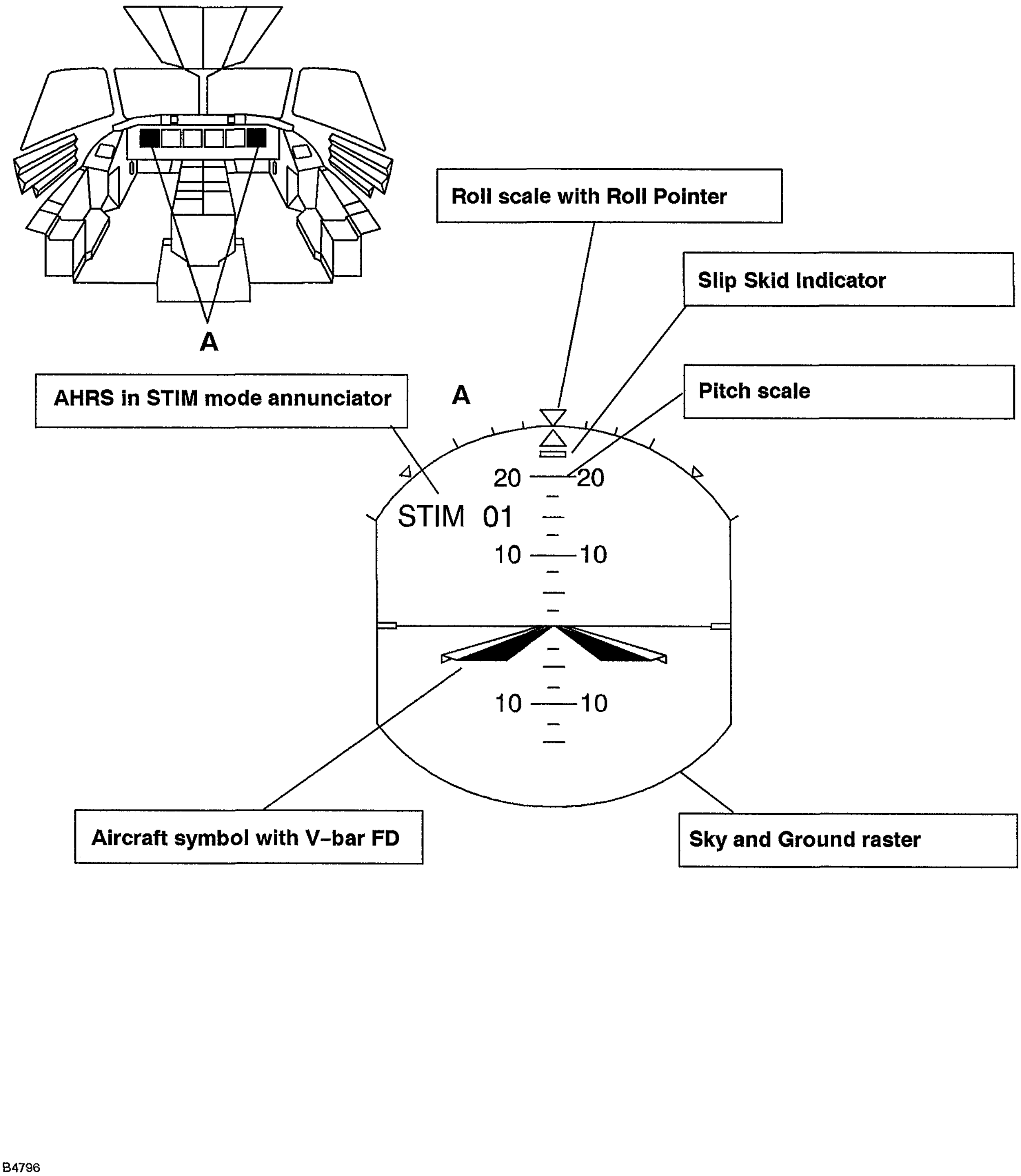
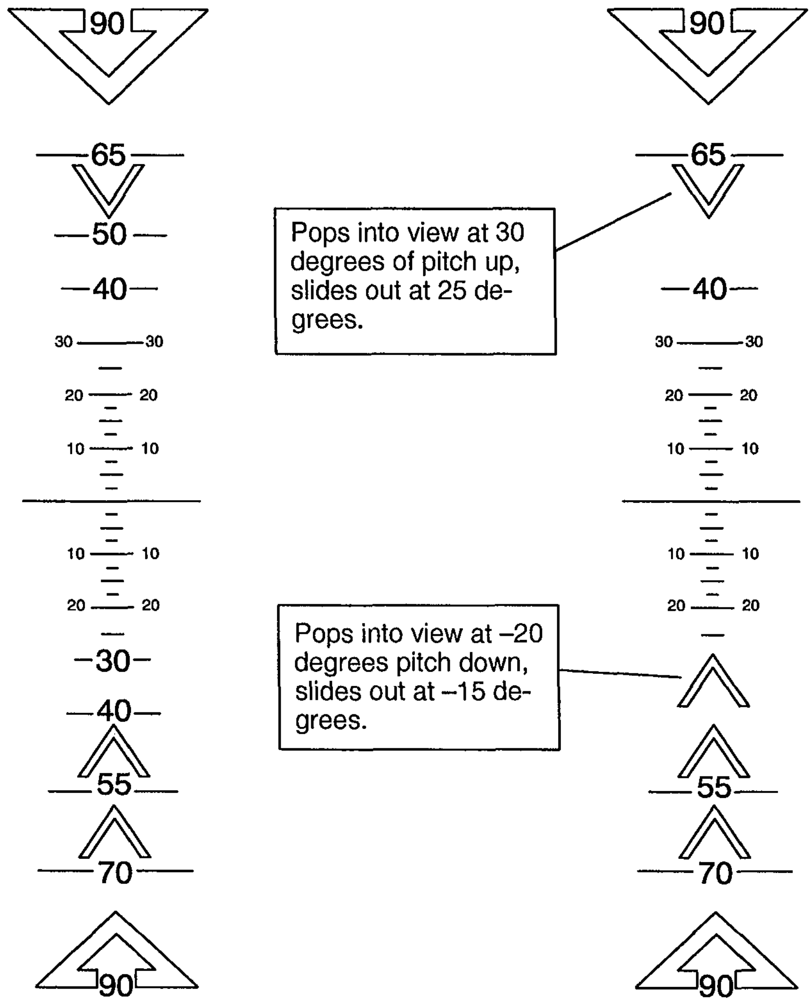


FIG. 1. Attitude indications.



B2832

FIG. 2. Pitch scale detail.

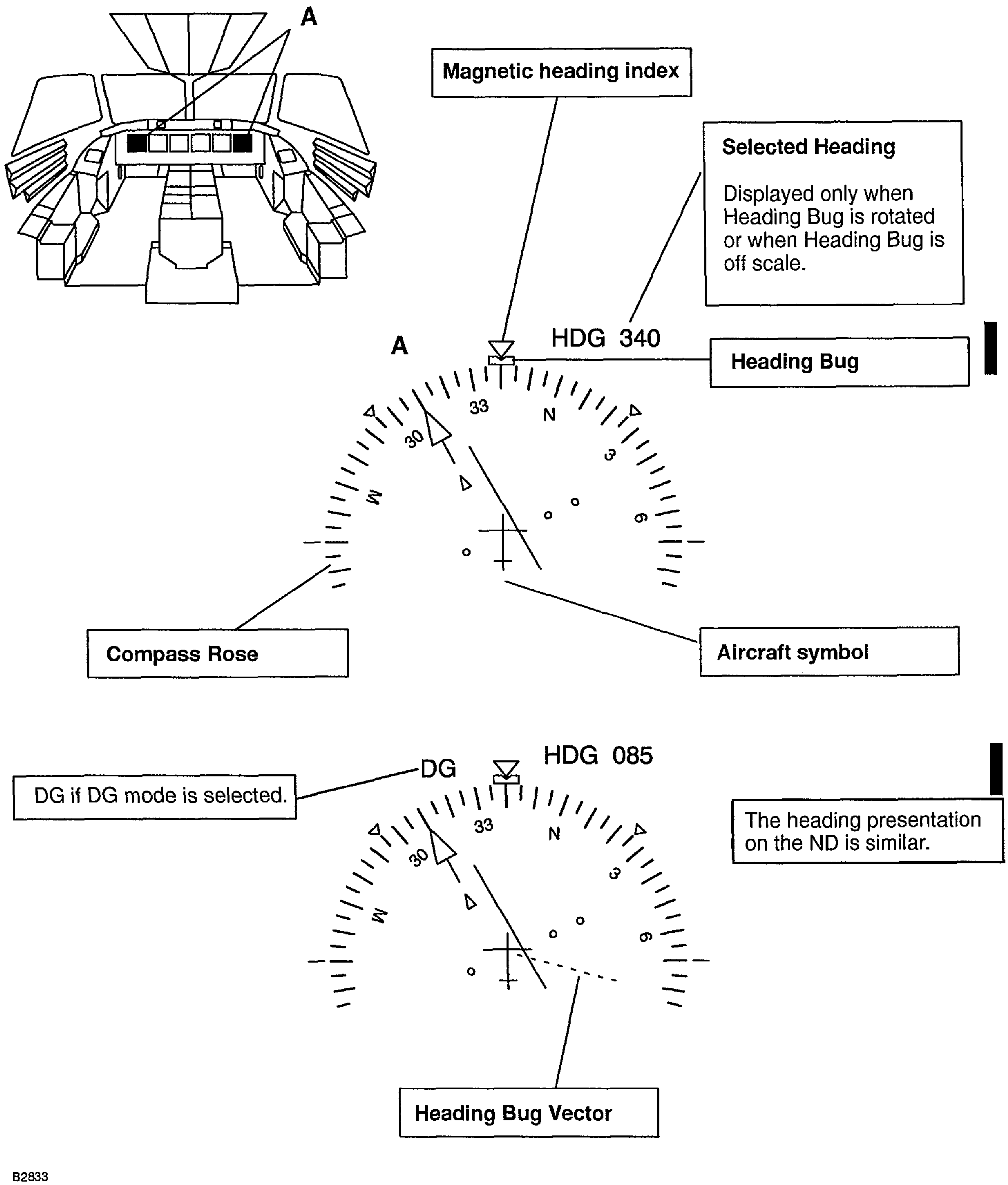


FIG. 3. Heading indications (PFD shown).

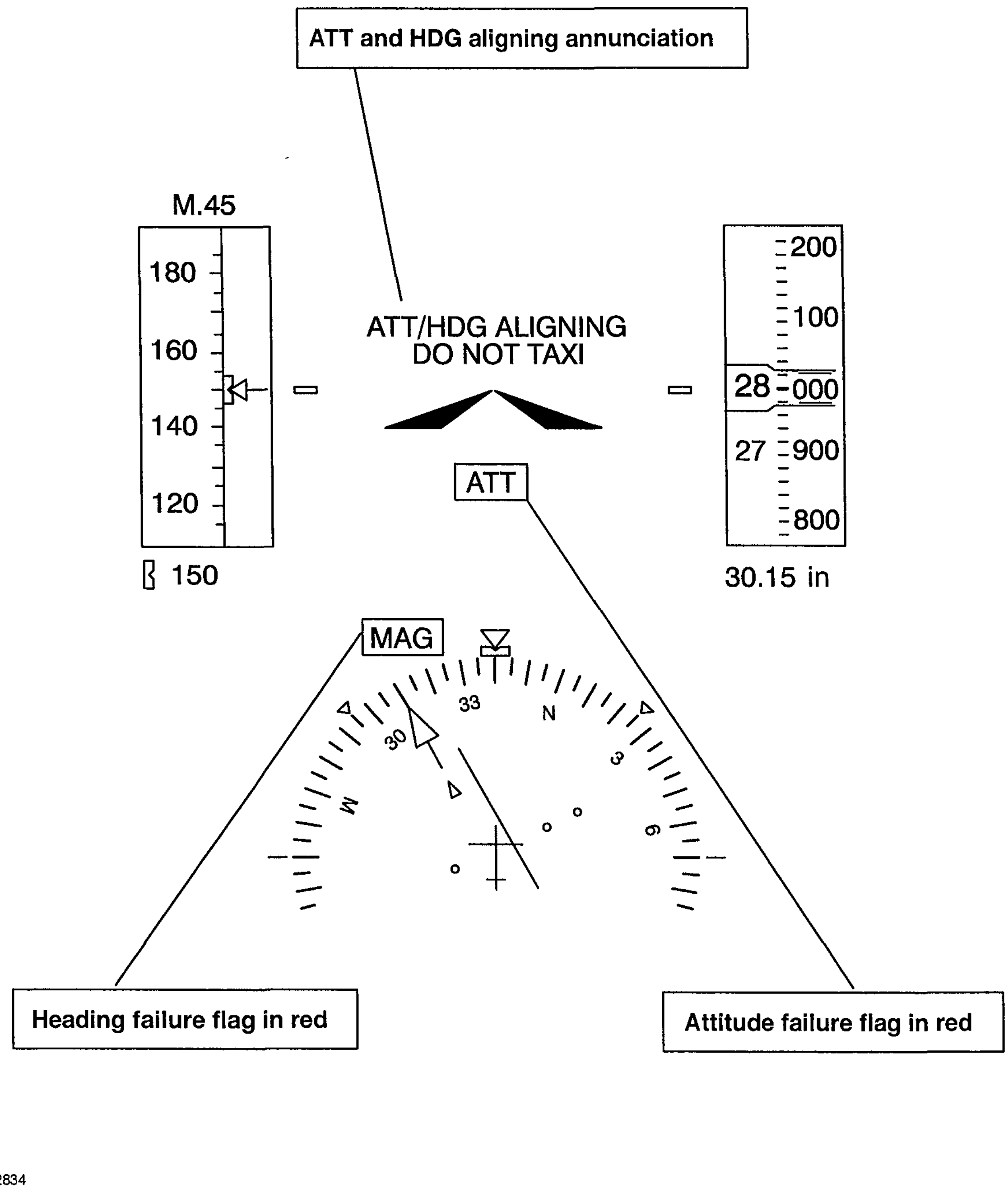
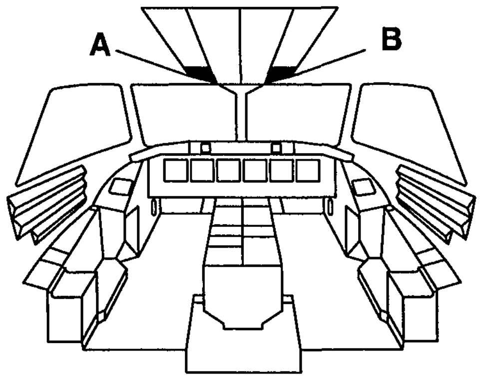


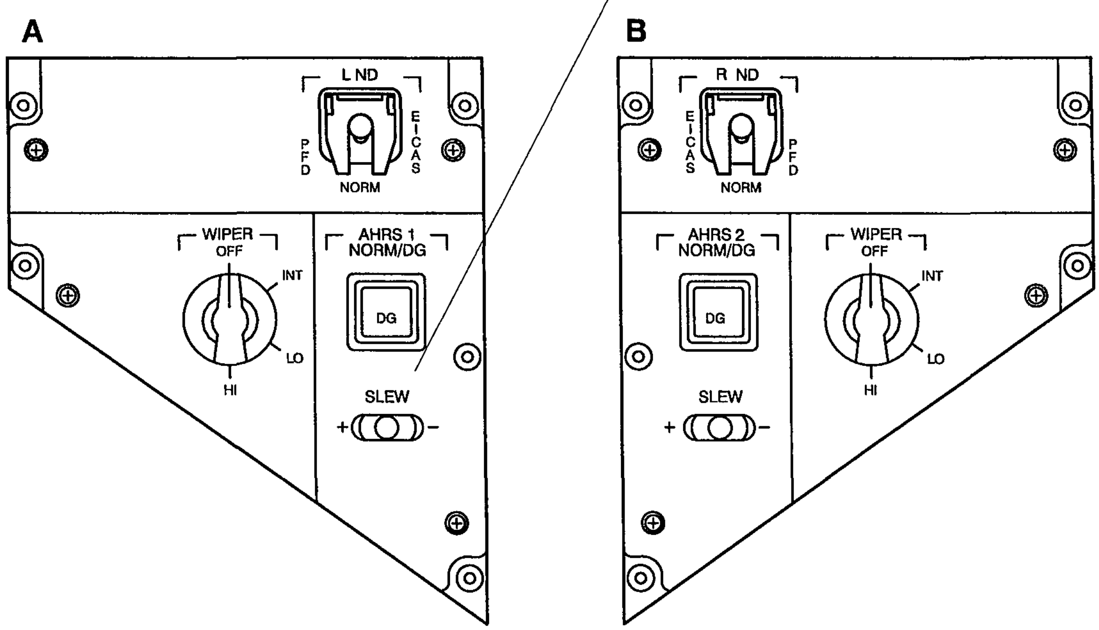
FIG. 4. Flags and annunciators.



AHRS 1 NORM/DG button

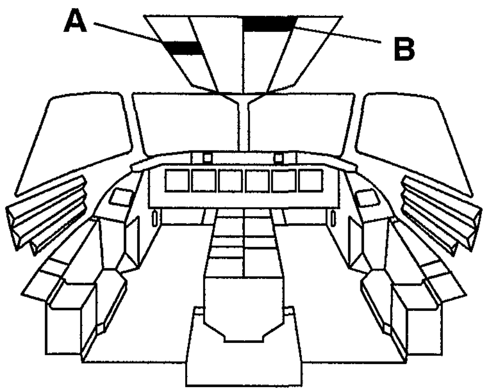
- If ground material causes heading readout difference, AHRS can be disconnected from the flux detector and set to Direct Gyro, DG. In DG the SLEW switch allows manual setting of the magnetic heading. Momentary SLEW operation gives 1 deg/sec, and if held 15 deg/sec.
- Momentarily, selecting/releasing AHRS 1 NORM/DG will quick slave the magnetic heading to the flux detector.
- If AHRS 1 NORM/DG used during takeoff, reset to NORM must be performed when stable flight conditions are reached.

  NOTE: DG can not be used if the autopilot is engaged.

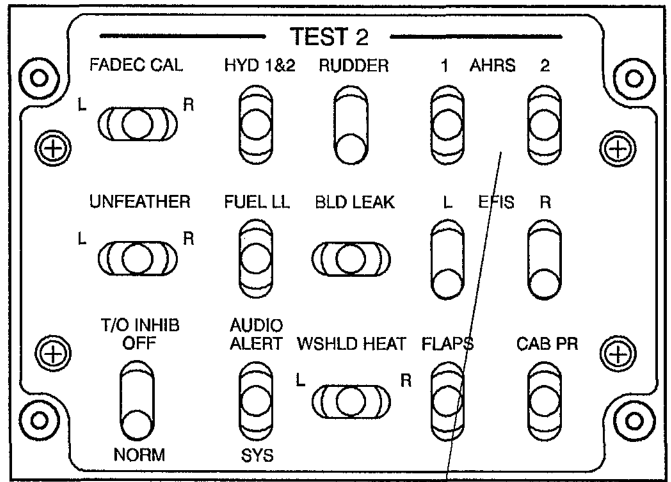


B4773

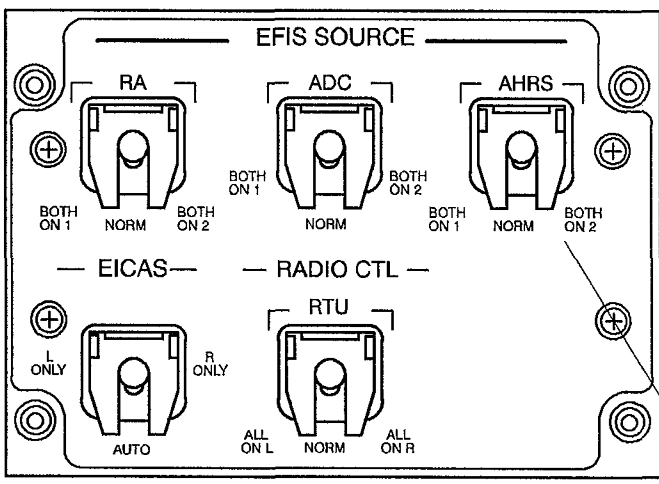
FIG. 5. AHRS NORM/DG buttons.



B TEST 2 PANEL



A EFIS SOURCE PANEL



1 AHRS 2 switches

AHRS test switches, maintenance only

AHRS switch

Should one AHRS fail, select other AHRS to supply both L and R EFIS

- AHRS 1 failure select BOTH ON 2
- AHRS 2 failure select BOTH ON 1

B4804

FIG. 6. AHRS switch.

4. ELECTRICAL POWER SUPPLY.

AHRS 1 main power	L BAT AVIONICS BUS	F – 16	AHC 1 AVION
AHRS 1 ground backup	L MAIN/BAT BUS	F – 15	AHC 1 GND BACK UP
AHRS 2 main power	R BAT AVIONICS BUS	M – 15	AHC 2 AVION
AHRS 2 ground backup	R MAIN/BAT BUS	M – 16	AHC 2 GND BACK UP

1. GENERAL.

The attitude and heading information comes from the two Inertial Reference Units (IRU) and their subsystems which together are called Inertial Reference System (IRS).

The IRS replaces vertical and directional gyros with sensors that give angular rates and accelerations which, after processing in a microcomputer, result in the normal attitude and heading outputs to the FD/AP and EFIS. The IRS also computes present position.

The system sensors consist of laser gyros and accelerometers. The IRS is also provided with an internal fault monitoring circuit.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Inertial Reference Unit.

The Inertial Reference Unit (IRU) consists of the inertial instruments (laser gyros and accelerometers), microprocessors, memory, power supply and the major system electronics required to interface the unit with other aircraft avionics. The IRU measures inertial motion and computes the appropriate outputs, i.e. accelerations, angular rates, angular accelerations, attitudes, attitude rates, drift angle, flight path data, ground speed, heading (true and magnetic), inertial position, inertial velocity vectors and wind data.

The laser gyro is an undithered instrument with a 184 mm path length, operating in four modes to avoid lock–in. Two two–mode gyros are located in the same cavity; one of the pair of gyros is right circularly polarized and the other left. A fixed frequency bias is imparted to each beam. The sign of this frequency bias is dependent upon polarization and direction of rotation. Coupling of similarly polarized beams is prevented by the opposing sign of the bias and coupling of similarly biased beams is prevented by dissimilar polarization. The four beams are then combined and processed such that the output of the gyros is due to inertial motion only.

The FMS is used for manually entering data to the IRS. As an option, the left RTU can be used as backup for data entry. At system start up, present position data is entered to enable IRS initialization and in attitude mode heading is input to the IRS. Selection between true and magnetic heading mode is also made via the FMS. Both IRS 1 and 2 are simultaneously receiving the FMS data.

2.2. IRS Mode switch.

The two IRS mode select switches are located on the overhead panel, the switch for system 1 on left wiper/ avionic panel and the switch for system 2 on right wiper/avionic panel.

The mode select switch is used to select operating mode, OFF, NAV or ATT, for the respective system.

OFF turns off the IRS power, if the aircraft is on ground. In the air, the system stays in navigation mode although the switch is set to OFF. This is done in order to prevent accidental shut–downs since the system cannot by reinitialized when the aircraft is in motion. When the aircraft is parked for a longer stop the switch should be set to OFF.

NAV is the normal operating mode. NAV turns system power on and selects initialization mode. The initialization sequence is automatic but the aircraft must remain stationary. During the initialization period the pilot must enter present position via the FMS. The initialization process takes approximately 7 minutes to complete during which various initialization tasks and instrument tests are made followed by accelerometer levelling and gyro compassing. Once the process is finished, the system automatically sequences into navigation mode. The system must have entered navigation mode before the aircraft is moved.

ATT is attitude mode in which the system only provides pitch, roll and platform heading. Selecting ATT disables navigation for the rest of the flight. To prevent accidental selection of attitude reference mode the switch is guarded. The primary objective of the attitude mode is to maintain pitch and roll output signals when the system cannot operate in navigation mode. This condition can occur after an inflight complete power interrupt, IRU detected internal failure or detected inaccuracies due to high sensor drift rates. Attitude mode is indicated by the annunciation "DG" on EFIS. Upon entering attitude mode, heading must be manually entered into the system. This heading must then periodically be manually updated to compensate for drift.

2.3. Initialization.

When the mode select switch is moved out of the OFF position a turn–on test sequence is initiated. If the system temperature is below –40°C the system computers will be held in reset mode until the system temperature reaches –40°C (also see section 37 Winter Operations). Next the system enters the alignment mode, consisting of coarse levelling and gyro compassing. During this mode present position must be entered as described in section 25 NORMAL PROCEDURES. Present position is entered through the FMS or the left RTU for backup. Also see FMS Initialization, 4/11.1 and RTU and IRS Initialization 4/2.8. The test compares the entered position to the position from last flight. The two positions must not differ more than 3nm + 3nm/hour x T, where T is the time in navigation mode during last flight. If the test fails, the system requests a new position to be entered. If the same position is received the test is ignored and the data accepted. A latitude test compares the entered latitude with the estimated latitude and expects them to be within 30 arc minutes. The system will not cycle to navigation mode until this test is passed. An excessive motion test that ensures that the aircraft is not moving is run during the gyro compassing period. If this test fails alignment is restarted.

The alignment mode is normally completed 7 minutes after system turn–on and the system then automatically sequences into navigation mode. At temperatures below ±0°C the initialization time will increase with temperature drop from 7 minutes to maximum 16 minutes for temperatures below –12°C. Initialization is indicated by turning compass cards and red ATT and MAG/TRU (TRUE for Avionics 6) flags on EFIS. The messages ATT/HDG ALIGNING DO NOT TAXI will also flash on the PFD.

2.4. Power Supply.

Primary power to IRS 1 and 2 is supplied by the L/R Bat Avionics Busses. These busses are normally energized from the generators, but automatically switches over to battery back–up at failures when airborne.

To maintain operation of IRS on the ground, the IRS has back–up power from the L/R Main/Bat Bus. The IRS drops off the Main/Bat Bus 12 minutes after loss of primary power.

2.5. Operation at High Latitudes.

For a normal 7 minute initialization, accurate data is obtained up to ± 73° latitude. Almost the same accuracies are achieved up to ± 82° if the system is held in alignment mode for 15 minutes. This is accomplished by not entering present position until 15 minutes after system turn–on.

When operating at high latitudes a possibility to select true heading for display is available. The selection is made on the FMS, page FMS CONTROL. When true heading mode is selected a "T" shows up on the PFD/ ND after all data referenced to true north. This indicates that the bearing pointer position is not geometrically correct on the display.

3. CONTROLS AND INDICATORS.

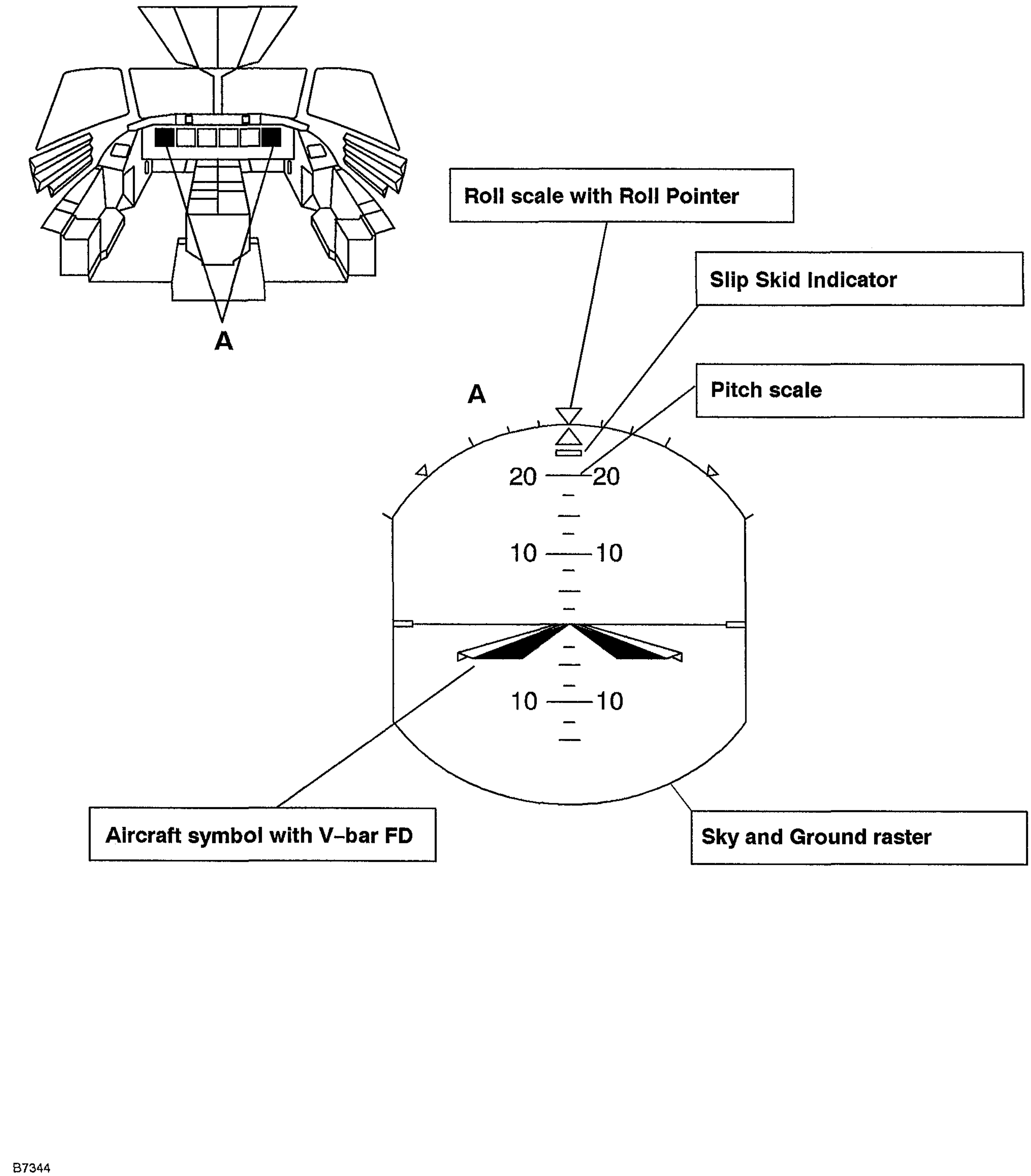


FIG. 1. Attitude indications.

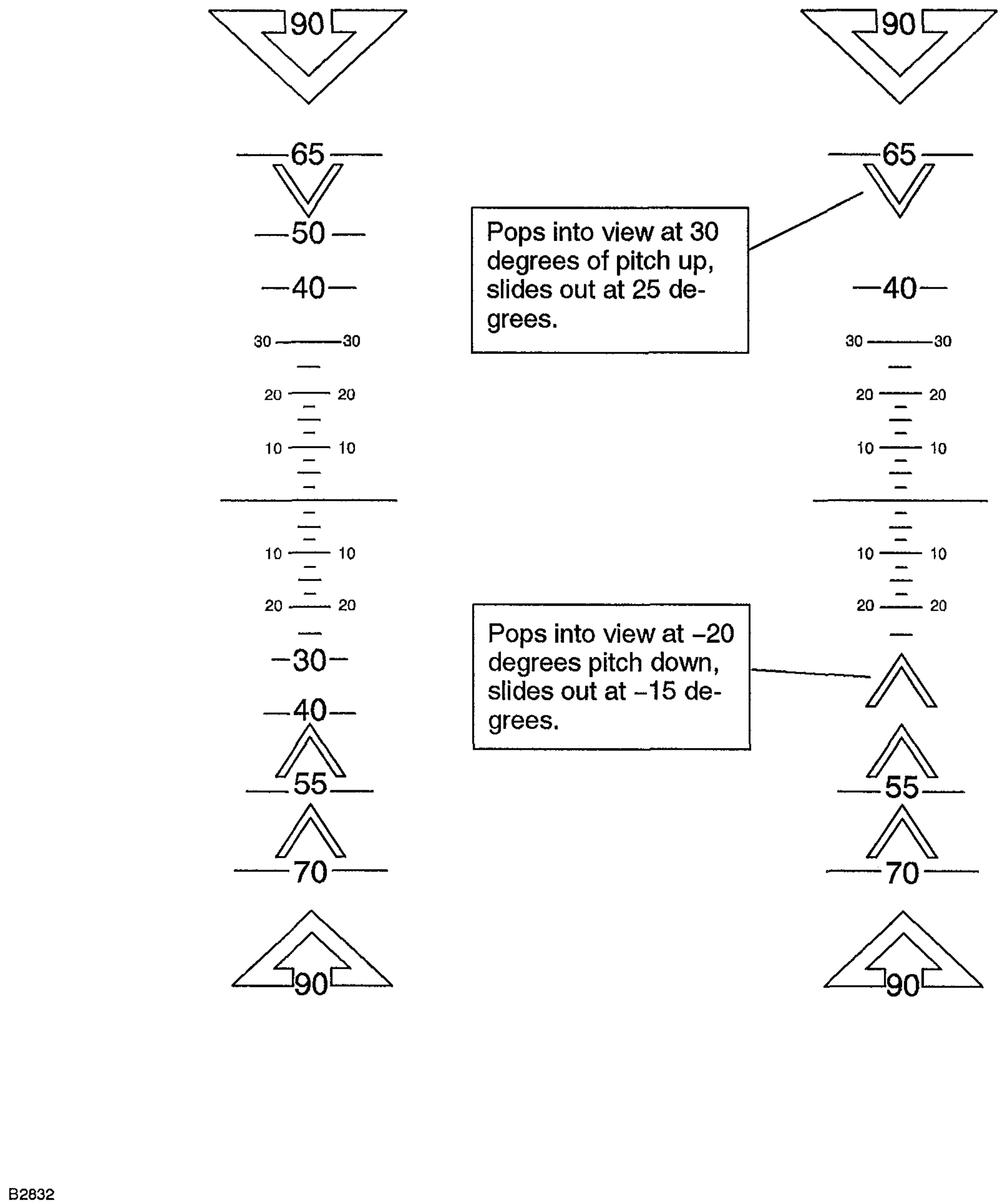


FIG. 2. Pitch scale detail.

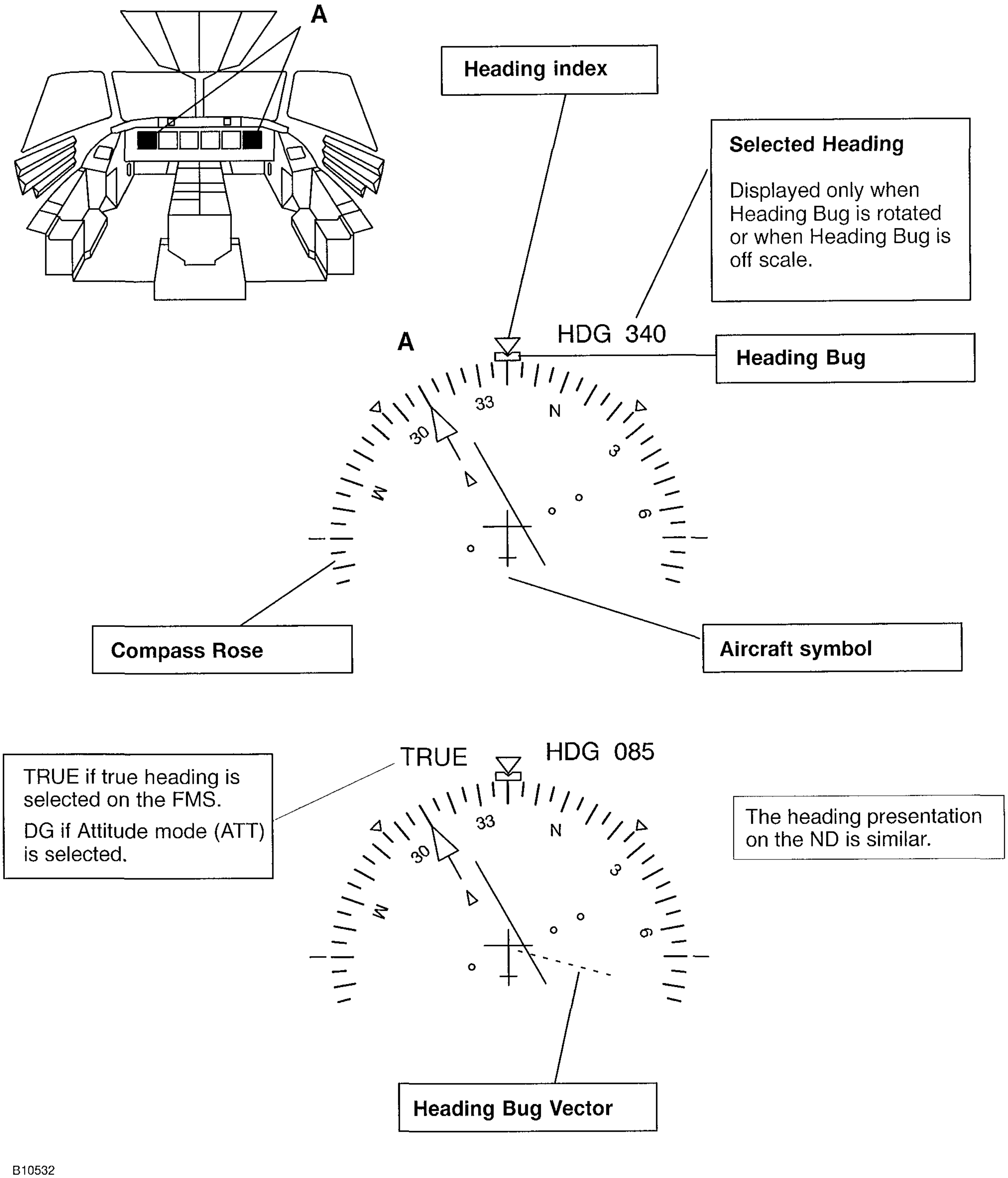
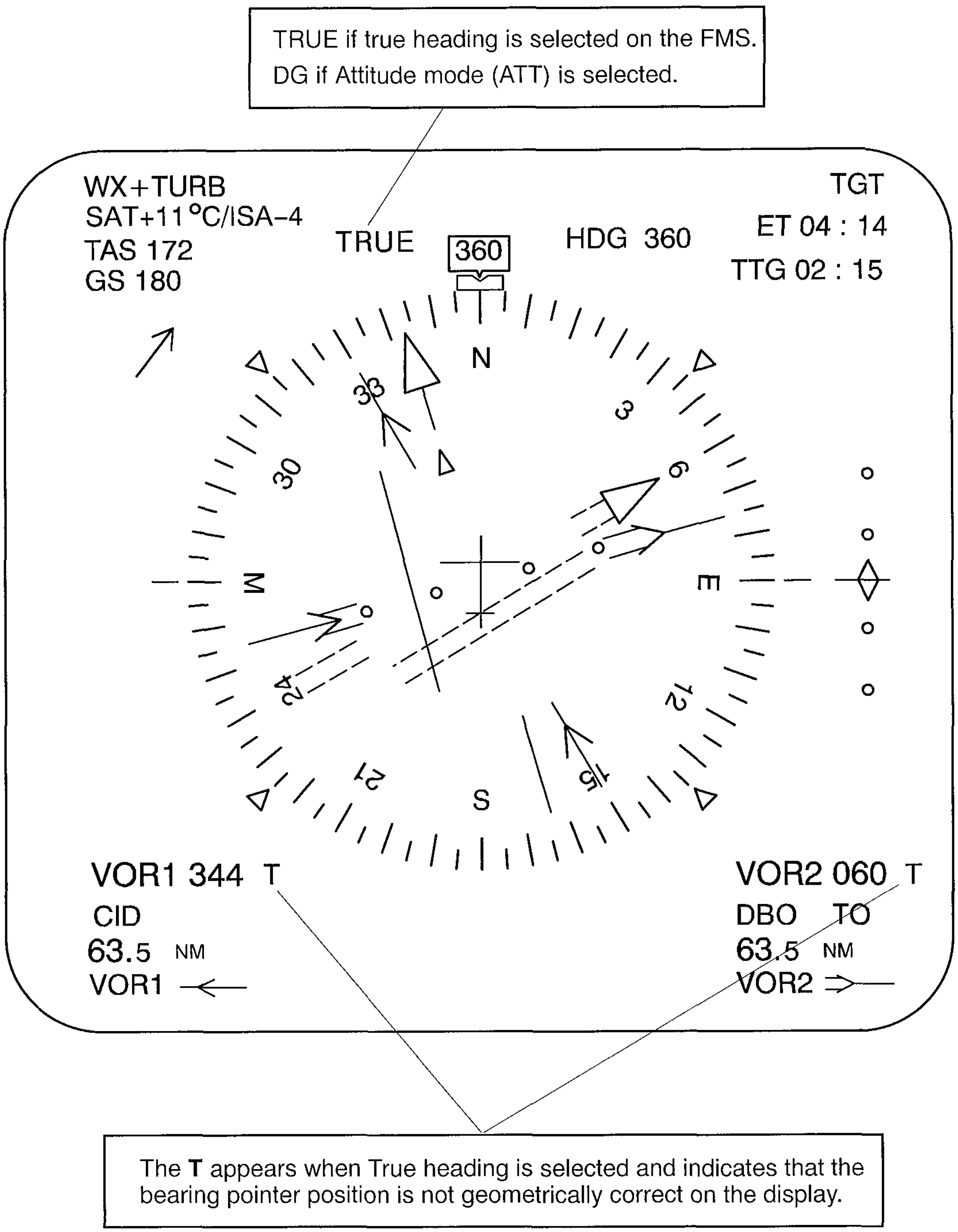


FIG. 3. Heading indications (PFD shown).



B10533

FIG. 4. True heading indications on ND.

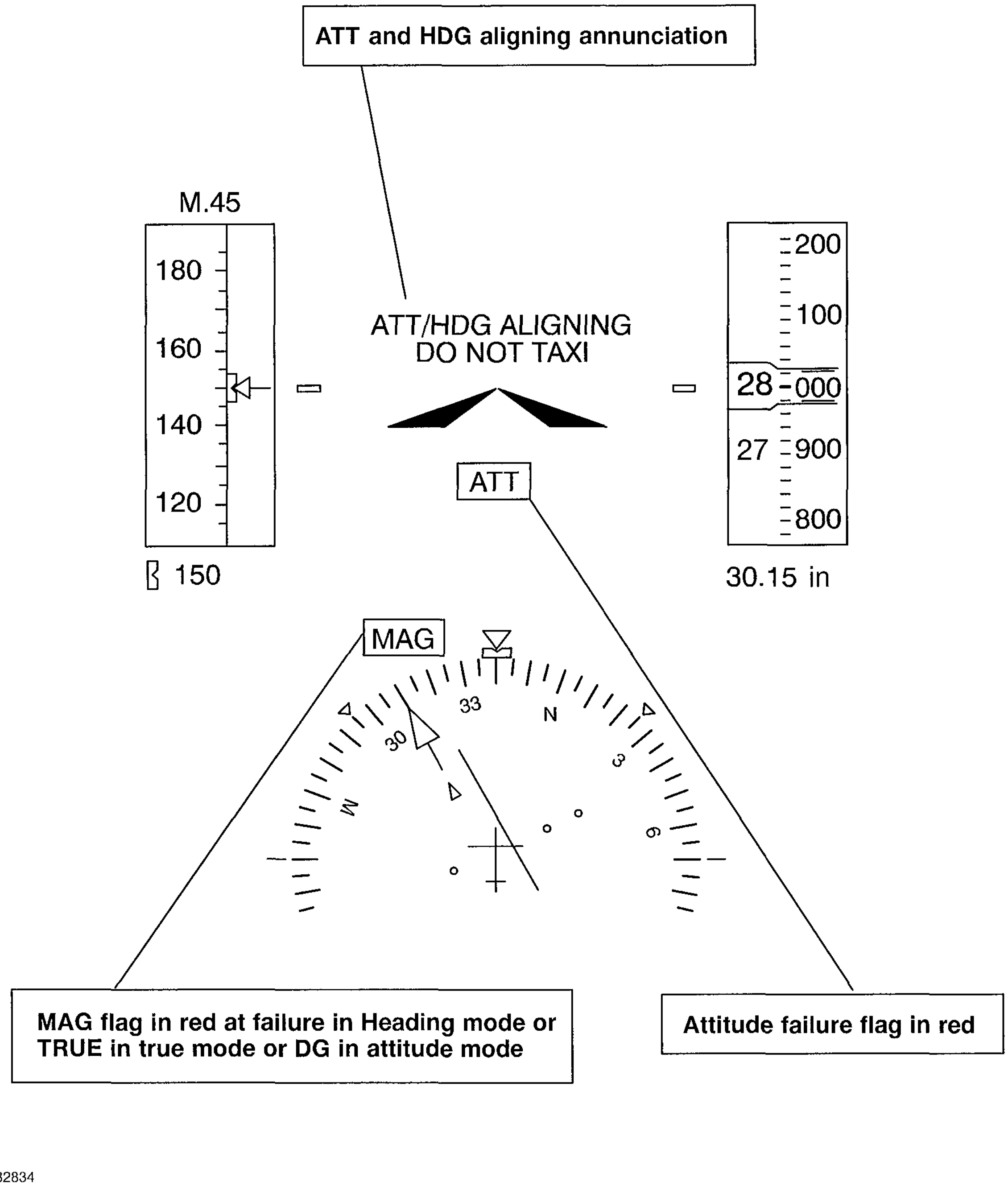
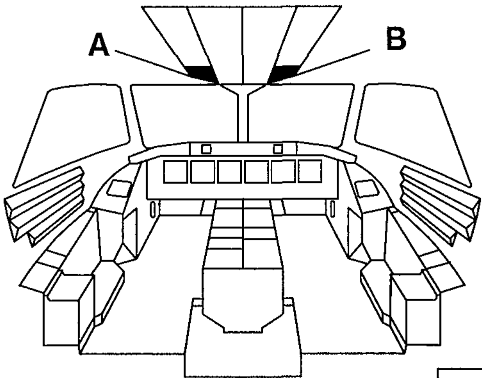


FIG. 5. Flags and annunciators.



IRS MODE SWITCHES

ATT – Attitude mode in which the IRS only provides pitch, roll and heading.

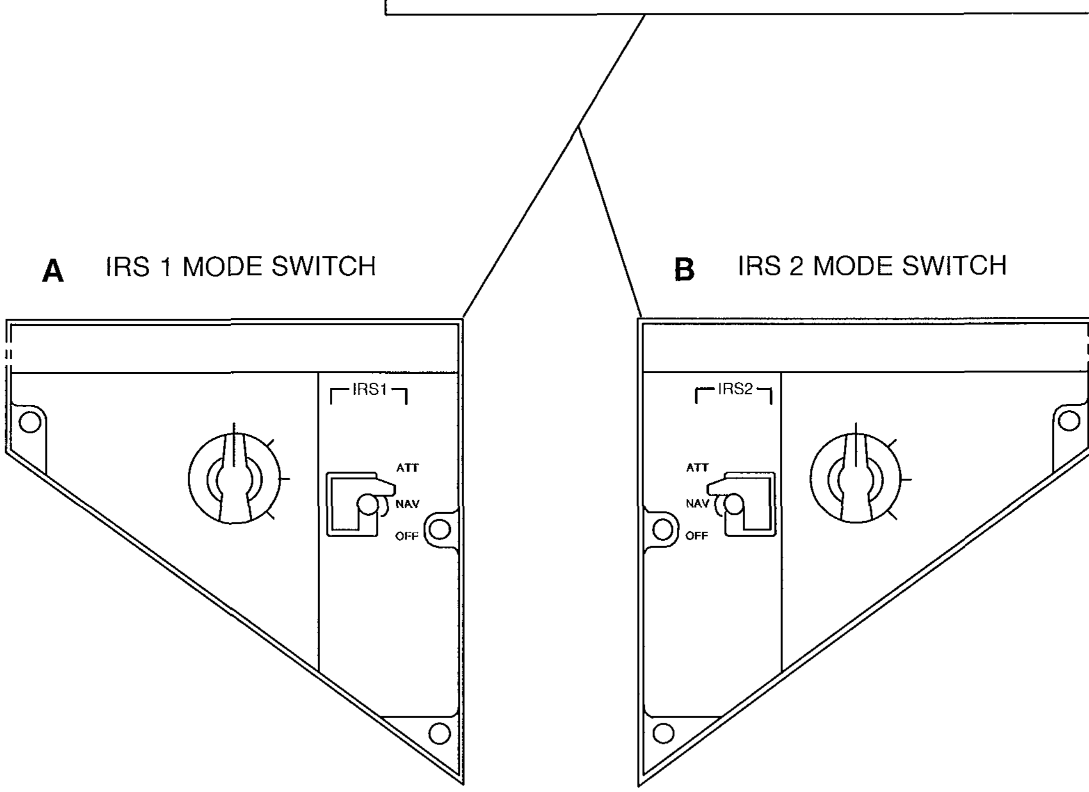
NAV – Normal operating mode.

OFF – On ground, IRS power supply is switched OFF.

– Airborne, IRS cannot be shut OFF, remains in NAV mode.

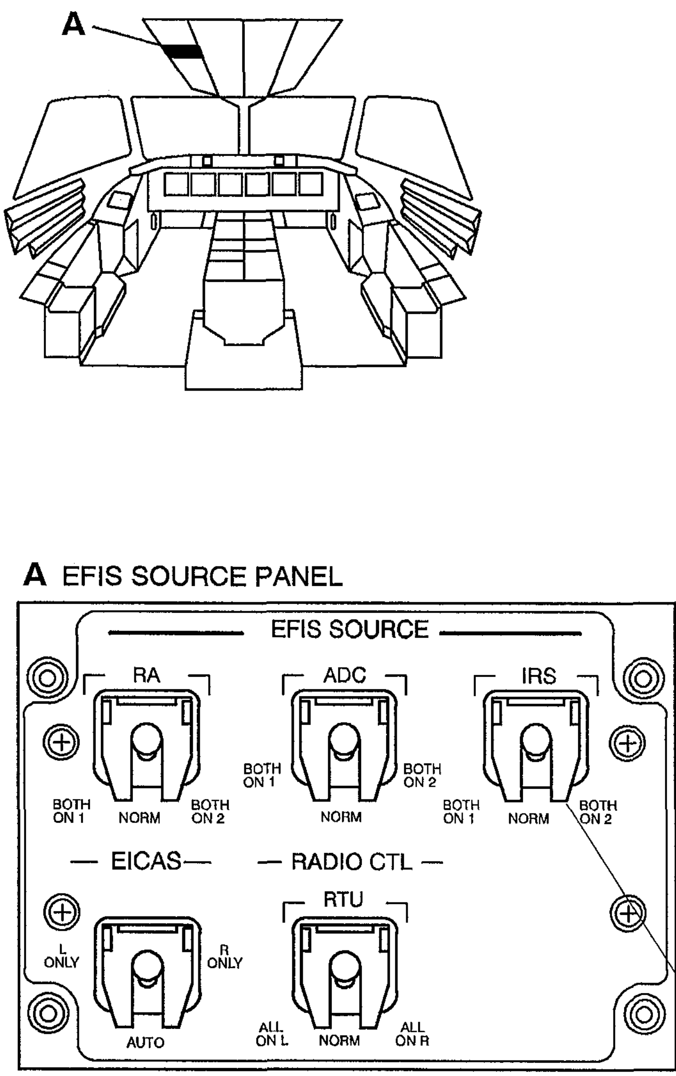
A IRS 1 MODE SWITCH

B IRS 2 MODE SWITCH



B7345

FIG. 6. IRS Mode select switches.



IRS switch

Should one IRS fail, select other IRS to supply both L and R EFIS

- IRS 1 failure select BOTH ON 2
- IRS 2 failure select BOTH ON 1

B7346

FIG. 7. IRS switch.

4. ELECTRICAL POWER SUPPLY.

IRS 1 main power	L BAT AVIONICS BUS	F – 16	IRS 1 AVION
IRS 1 ground backup	L MAIN/BAT BUS	F – 15	IRS 1 GND BACK UP
IRS 2 main power	R BAT AVIONICS BUS	M – 15	IRS 2 AVION
IRS 2 ground backup	R MAIN/BAT BUS	M – 16	IRS 2 GND BACK UP

1. GENERAL.

As a back-up to the normal Attiude/Heading presentation, there is a standby horizon and a standby compass.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Standby horizon.

The aircraft is provided with a standby horizon which is a self-contained instrument with an internal vertical gyro. The gyro is erected manually by a caging knob on the instrument.

2.2. Standby compass.

The standby compass is a self-contained magnetic compass which is compensated for magnetic disturbance including the influence from the aircraft electrical system during normal operation.

2.3. Deviation card.

A deviation card for the standby compass is located underneath the forward part of the overhead panel.

3. CONTROLS AND INDICATORS.

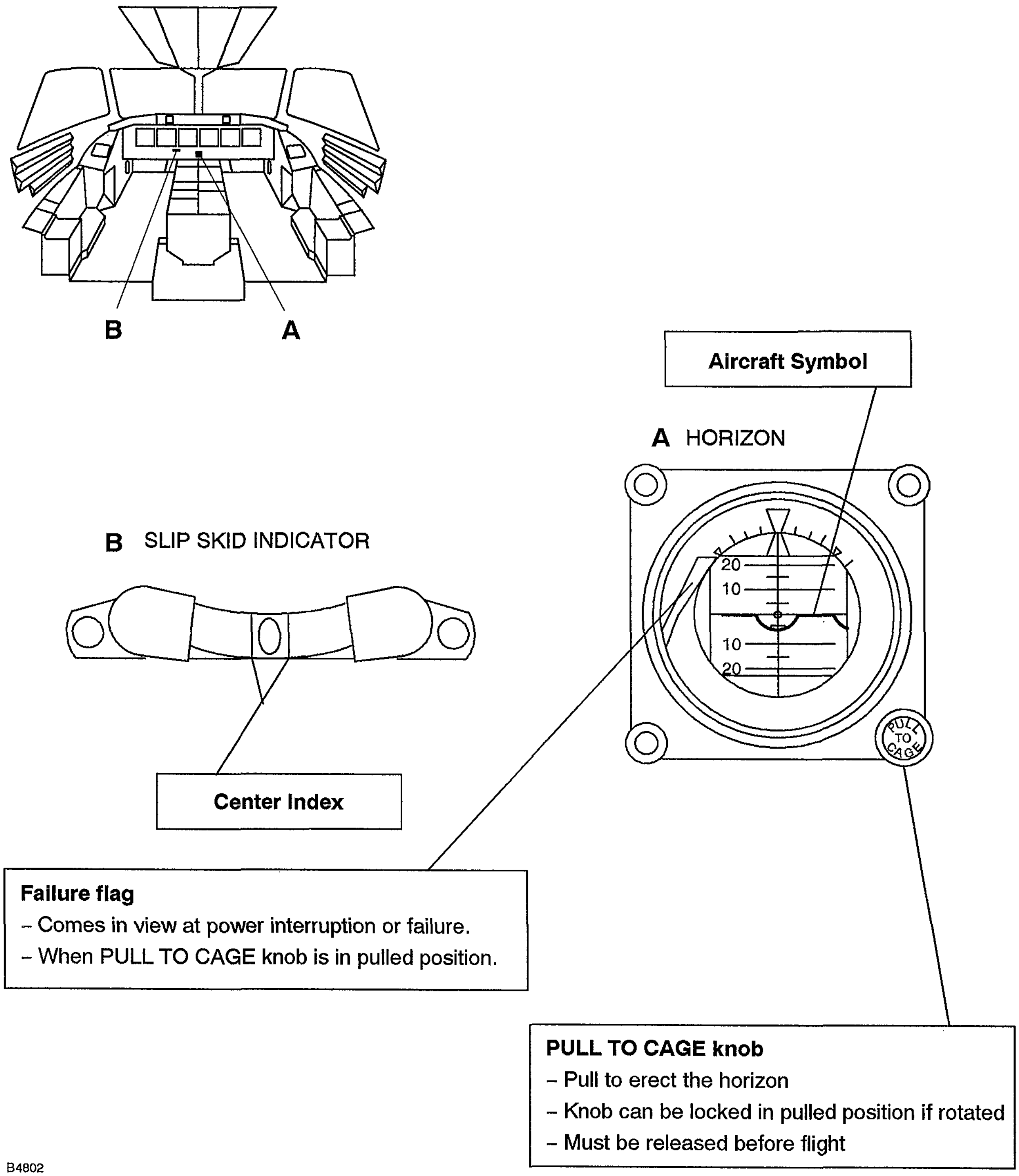
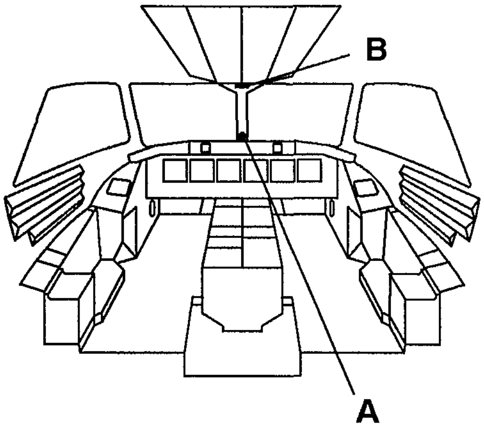
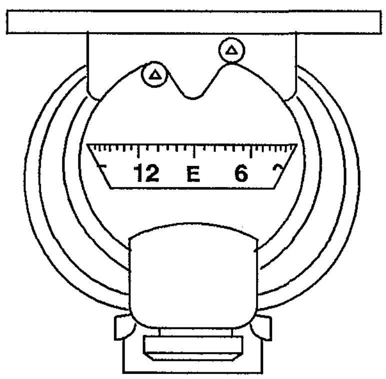


FIG. 1. Standby Horizon and standby Slip Skid Indicator.



A STANDBY COMPASS



B COMPASS DEVIATION CARD

FOR	STEER NORM	STEER EMER	FOR	STEER NORM	STEER EMER
N			S		
30			210		
60			240		
E			W		
120			300		
150			330		

EMER: BAT PWR
L&R AVION OFF

CORR VALID FOR:
WIPERS OFF

DATE	SIGN

B4803

FIG. 2. Standby Compass and Deviation card.

4. ELECTRICAL POWER SUPPLY.

Standby horizon	EMER AVIONICS BUS	G – 10	STBY HORIZON
Standby compass electromagnet	R AVION BUS	N – 21	STBY COMP CORR

1. GENERAL.

Basic aircraft is configured with one radio altimeter installed but a dual system is available as an option. One radio altimeter provides radio height to both PFDs.

The radio altimeter system provides a readout corresponding to the height above ground. This information is displayed on the PFD and used for GPWS (Closure rate), ACAS/TCAS, EICAS and the AP/FD.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Transceiver.

The transceiver measures the time between generated and reflected signal and transforms this time into an analog signal representing the height. The range is 0 – 2500 feet. The height is displayed in10 feet increments below 1000 and in 50 feet increments between 1000 and 2500 feet. The radio altimeter is also provided with a self–test function.

2.2. Antenna.

The antennas are located on the forward part of the bottom fuselage.

2.3. Indication.

The radio height is displayed on the PFD together with the DH, Decision Height annunciator. The DH comes on and alerts the pilot when aircraft radio height is less than or equal to the selected Decision Height. The DH annunciation is inhibited on ground and becomes enabled after takeoff when aircraft reaches selected DH plus 100 ft.

3. CONTROLS AND INDICATORS.

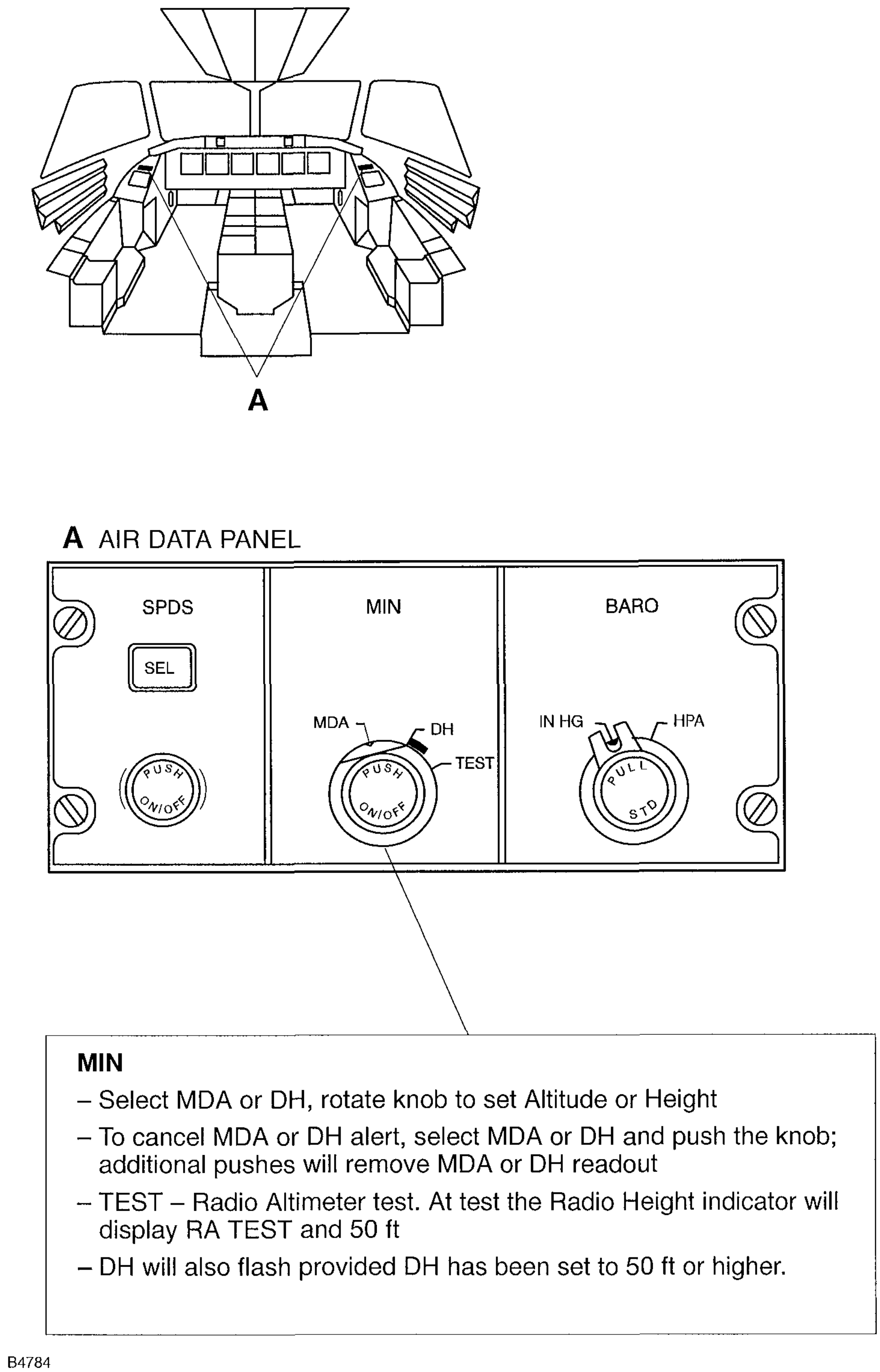


FIG. 1. Air Data panel – DH selection and test.

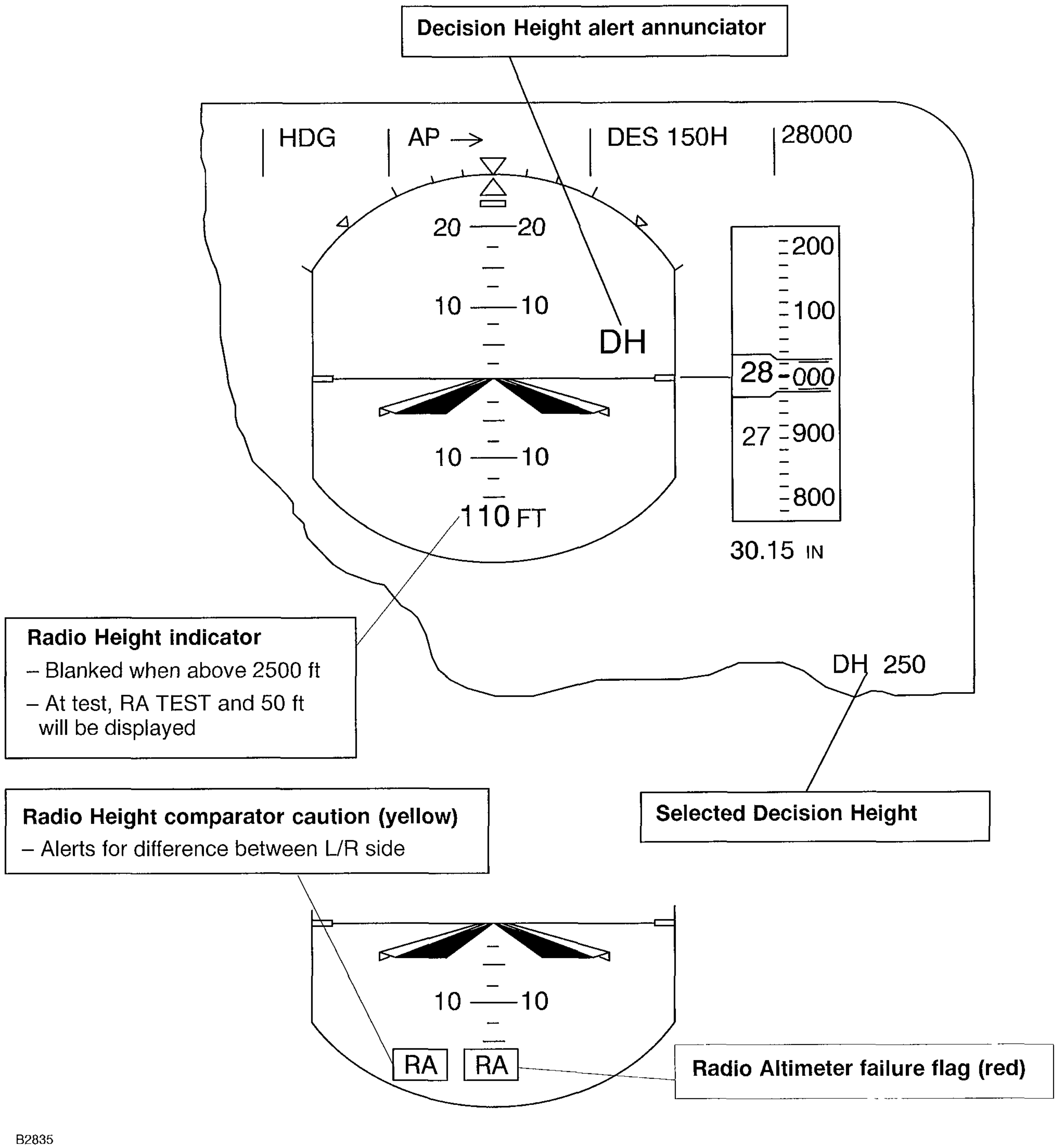
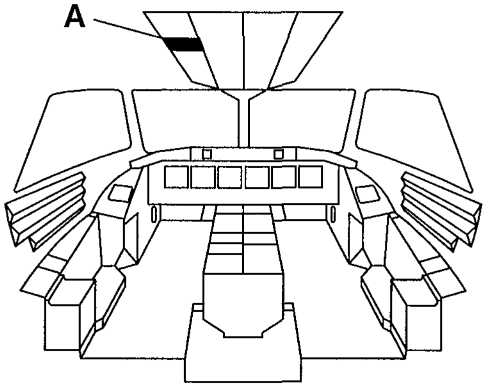
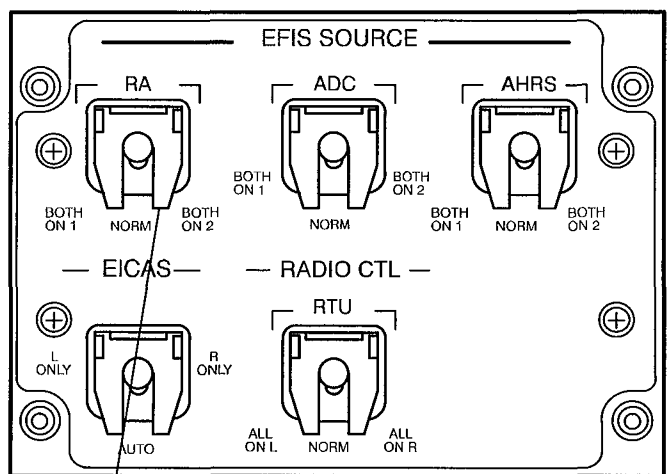


FIG. 2. Radio Altimeter indications.



A EFIS SOURCE PANEL



RA switch

Should one Radio Altimeter fail, select other Radio Altimeter to supply both L and R EFIS

– Radio Altimeter 1 failure: select BOTH ON 2

– Radio Altimeter 2 failure: select BOTH ON 1.

B4732

FIG. 3. RA switch (if optional second radio altimeter installed).

4. ELECTRICAL POWER SUPPLY.

Radio altimeter 1	L AVIONICS BUS	F – 14	RADIO ALT 1
Radio altimeter 2	R AVIONICS BUS	M – 14	RADIO ALT 2 (optional)

1. GENERAL.

The aircraft is provided with an airborne radar system which is used mainly for avoidance of severe weather but can also be used for ground mapping. The system will detect and present weather conditions in an angle of 120 degrees and to the range of 320 NM in front of the aircraft. Flight hazards due to weather conditions are primarily the result of turbulence and hail. Wet hail can be detected by radar, but turbulent air by itself will not provide a radar echo. (Examples are clear–air turbulence and aircraft vortices.) Areas having high rainfall rates are normally associated with turbulence, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with the rainfall is implied. Small areas with extremely heavy rainfall rate or large areas of moderate rainfall rate can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This may mask or cause strong targets at a farther range to appear much less intense than they actually are. Always assume that all weather behind another is at least one level higher than what's being presented on the radar picture. Proper use of the RANGE, GAIN and TILT controls will aid the user in interpreting the displayed targets.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like the beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the moisture (rain drops and ice) present in clouds in front of the aircraft, reflects some of this energy back to the antenna. The reflected energy provides a measure of moisture intensity which is converted into a color code. The radar color picture will therefore represent a cross section of the cloud situation in front of the aircraft.

Even though the color code corresponds to a certain amount of moisture, rain and ice, bear in mind that the radar beam will also be reflected by the ground surface, mountains etc. Therefore the pilot must know his position before relying on the radar picture being just weather.

The Weather Radar is a four–color display system and the picture can be presented on both ND's.

The weather radar is not a go/no go signal, it is a weather analysis instrument and must be used in conjunction with a knowledge of the atmospheric conditions. It should not be used to make a decision to fly through a convective weather system, but as a guide of how far to circumnavigate it.

1. 1. Operational Modes.

Weather detection (WX position).

The signals representing echoes from targets at different ranges are treated with a Sensitivity Time Control (STC) which means that the target intensity remains relatively constant for close–in ranges. The radar beam power is higher but with lower resolution than for ground mapping.

Detectable weather is color coded with the black screen representing no detectable moisture, while detectable weather appears as one of four colors: green, yellow, red or magenta (least reflective to most reflective).

In some weather conditions, echoes at a certain distance and density could absorb enough beam energy to cause a very low level, if any, return signal to the radar (leaving a shadow area beyond the echo). This will cause the PAC alert (Path Attenuation Correction) bar to appear on the radar picture extending beyond the absorbing echo which alerts the pilot to possible hidden severe weather beyond the displayed echo. However, the pilot is still the master and should be monitoring the radar picture as the PAC alert has levels which have to be exceeded before the PAC alert bar comes on.

Please note that the PAC function is intended for weather detection modes only. Using a weather detection more and downward tilt to produce a ground map will probably produce a display which makes correct interpretation more difficult. The PAC circuits interpret the return signals from ground targets as intense storm targets and tries to compensate for attenuated signal, resulting in the PAC alert bar to appear. In MAP mode, the PAC alert is disabled.

The color code for the weather picture is:

WXR 840 COLOR	dbz	VIP-LEVEL	RAINFALL RATES in/hr	RAINFALL RATES mm/hr	VIP-DEFINITIONS
BLACK	< 20	--	<0,03	<1	--
GREEN	> 20	1	0,03 – 0,15	1 – 4	Minimum detectable moisture level (weak): – Weak rainfall rate. – Light to moderate turbulence is possible with lightning.
YELLOW	> 30	2	0,15 – 0,5	4 – 13	Moderate moisture level. – Moderate rainfall rate. – Light to moderate turbulence is possible with lightning.
RED	> 40	3	0,5 – 1,0	13 – 25	Strong moisture level. – Strong rainfall rate. – Severe turbulence is possible with lightning.
		4	1,0 – 2,0	25 – 50	Very high moisture level. – Very high rainfall rate. – Severe turbulence is likely with lightning.
MAGENTA	> 50	5	2,0 – 5,0	50 – 125	Intense moisture level. – Intensive rainfall rate. –Severe turbulence is very likely with lightning, organized wind gusts and hail.
	> 60	6	>5,0	>125	Extreme moisture level. – Extreme rainfall rate. – Severe turbulence is certain with large hail, lightning and extensive wind gusts.

VIP = Video Integrated Processor (U.S National Weather Service).

Ground mapping (MAP position).

The signals representing ground echoes are treated with the Sensitivity Time Controller (STC) in order to keep constant echo intensity for close–in ranges. The shape of the radar beam is more narrow and with lower beam power than for weather detection in order to provide better resolution of the ground echo returns.

CAUTION

Do not rely on MAP mode only for navigation.

The colors for the ground picture are somewhat changed:

WXR 840 COLOR	DEFINITIONS
CYAN	Ground targets with low reflectivity.
GREEN	Ground targets with moderate reflectivity.
YELLOW	Ground targets with strong reflectivity.
MAGENTA	Ground targets with most reflectivity.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Antenna.

The antenna is installed in the nose of the aircraft and covered with a kevlar radome. It has a scan sector of 120°. The antenna is also stabilized up to 30° in roll and pitch to compensate for aircraft movement in order to have a stable scanning. The antenna can be manually titled between ±15° from the aircraft's x–axis or from horizontal with stabilization selected.

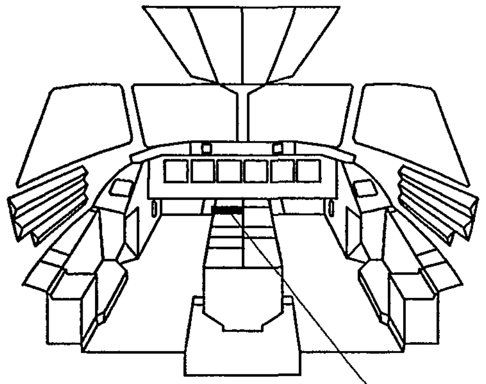
2. 2. Transceiver.

The transceiver works in the X–band at a frequency of 9,345 GHz. It transmits and receives the radar beam and transforms the result into digital information fed to the radar control panel.

2. 3. Weather radar control panel – WXP.

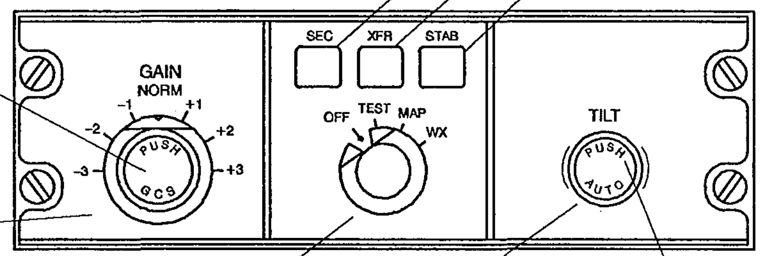
The control panel is provided with the necessary controls to select the various modes and functions. The control panel also contains the microprocessor that creates and controls the radar picture presented on the ND's from the digital information sent by the transceiver.

3. CONTROLS AND INDICATORS.



A

A WEATHER RADAR CONTROL PANEL



GCS, Ground Clutter Suppression button

Only for WX mode.
Push and release the GCS button to reduce the intensity of ground returns.

This makes the precipitation return easier to see. Note that the GCS feature may also reduce the intensity of, or completely eliminate weaker precipitation returns. For this reason, the GCS feature times out after approximately 12 seconds. When selected, GCS is annunciated on the ND.

SEC, Sector Scan button

Push the SEC button to reduce the normal 120 degree scan (60 degrees either side of center) to a 60–degree scan.

Reducing the sector scan effectively increases the radar update rate. Push the SEC button again to return to the full 120-degree scan. Annunciation is via the reduced size of the range arcs.

XFR, Transfer button

Press the button to transfer the radar range control to the other pilot's DCP (RANGE knob). Indicated by XRING on the ND top line.

The range indication on ND is in amber on the side that does not have control of radar range.

STB, Stabilization button

Press the STB button to enable the radar antenna stabilization.

The STB button is latching and is normally left in the on (pushed in) position.
Off is indicated by USTAB on the ND. Antenna stabilization is turned off in the event of an attitude signal failure and indicated by a flashing USTAB on the ND.

GAIN control

Rotate this knob to change the gain of the radar receiver above or below the NORM setting.

Normal system operation is with the knob in the NORM position. Settings other than NORM are annunciated on the ND (e.g. G+2, G–3).

Each step reduces or increases the receiver sensitivity by 6 dbz for a total of 18 dbz. By reducing the gain, it is possible to evaluate the relative severity of the weather system because the weather echoes will gradually disappear from the radar picture leaving only the stronger echoes. Do not leave the GAIN control reduced or increased after use, always return to NORM position.

MODE selector

Rotate this knob to select system operating modes.
- OFF – RDR OFF will be displayed in upper left corner of the ND.
- MAP – Use this mode for ground mapping.
- WX – Weather detection mode. Targets appears in green, amber, red or magenta.

TILT Control

Rotate this knob to change the tilt angle of the stabilized radar antenna.

The tilt setting in tenths of a degree (eg, T + 10.7, T–5.3, etc) is displayed on the ND.

AUTO, Autotilt button

Push the button to select the autotilt feature.

Autotilt is designed to reduce pilot workload. First use the TILT control to adjust the antenna to the optimum tilt angle for the present range and flight altitude. After this is done, select autotilt by pushing the button. With autotilt selected, changing ranges or altitudes causes the antenna to automatically tilt up or down to maintain the same ratio of tilt angle to range that were present prior to selecting autotilt. Annunciation is on the ND with an "A" placed before the tilt angle (e.g. A + 5,6, etc. in tenths of a degree).

B3275

FIG. 1. Weather Radar – controlpanel

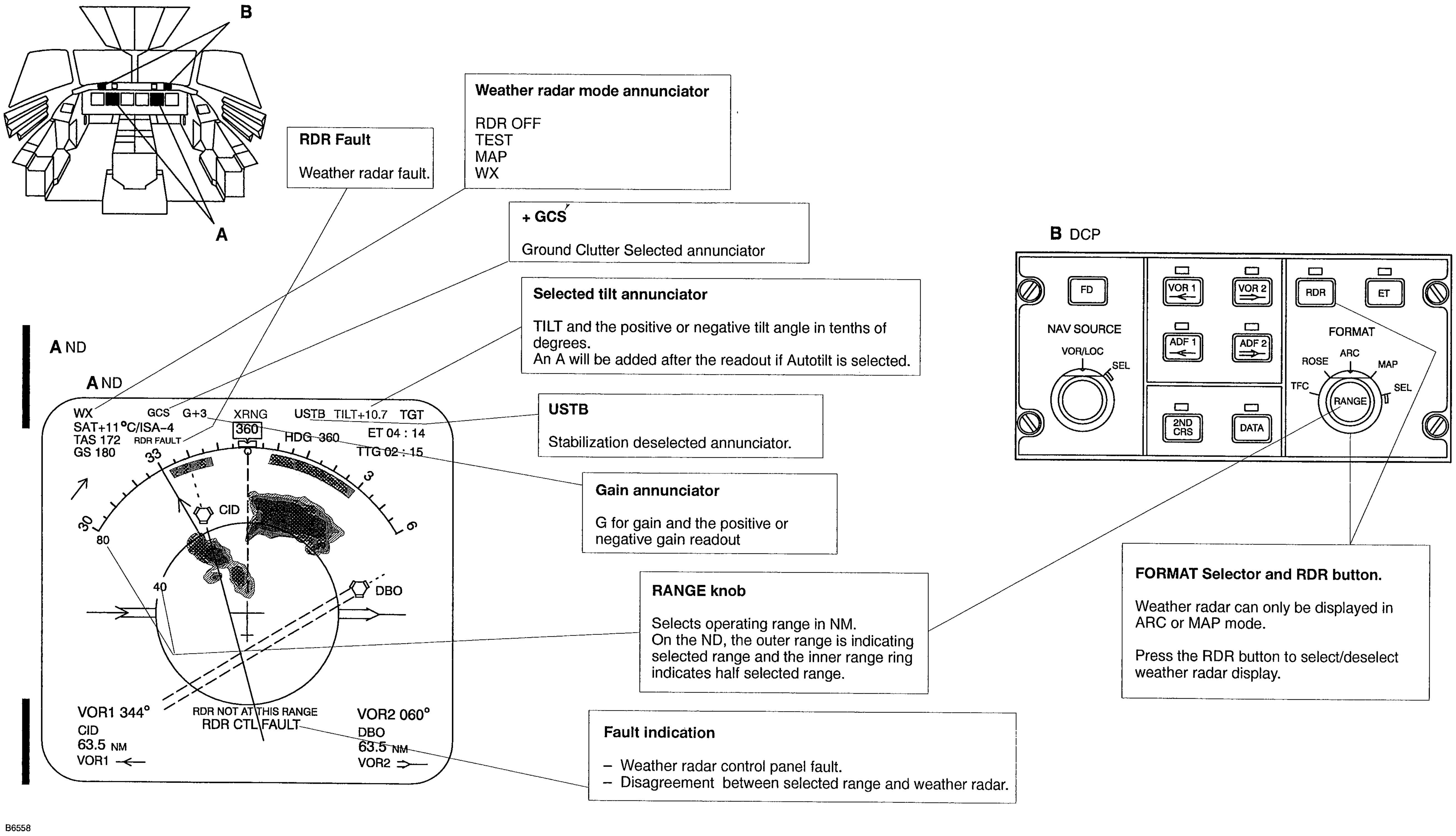
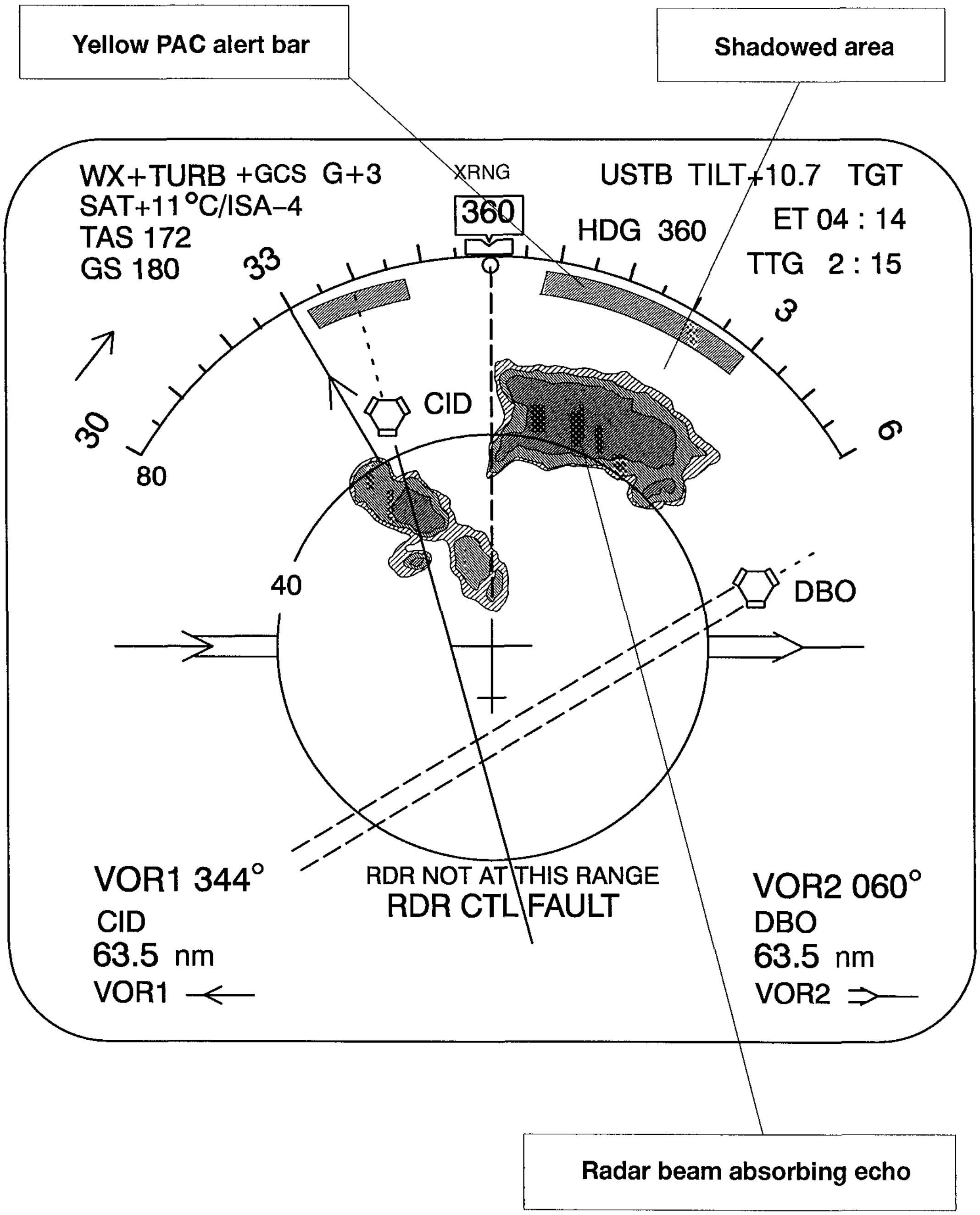


FIG. 2. Weather Radar presentation and controls.



B3403

FIG.3. Radar picture with PAC alert.

4. ELECTRICAL POWER SUPPLY.

Weather Radar power	L AVIONICS BUS	E–19	WX RADAR PWR

1. GENERAL.

The aircraft is provided with an airborne radar system which is used mainly for avoidance of severe weather but can also be used for ground mapping. The system will detect and present weather conditions in an angle of 120 degrees and to the range of 320 NM in front of the aircraft. Flight hazards due to weather conditions are primarily the result of turbulence and hail. Wet hail can be detected by radar, but turbulent air by itself will not provide a radar echo. (Examples are clear–air turbulence and aircraft vortices.) Areas having high rainfall rates are normally associated with turbulence, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with the rainfall is implied. Small areas with extremely heavy rainfall rate or large areas of moderate rainfall rate can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This may mask or cause strong targets at a farther range to appear much less intense than they actually are. Always assume that all weather behind another is at least one level higher than what's being presented on the radar picture. Proper use of the RANGE, GAIN and TILT controls will aid the user in interpreting the displayed targets.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like the beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the moisture (rain drops and ice) present in clouds in front of the aircraft, reflects some of this energy back to the antenna. The reflected energy provides a measure of moisture intensity which is converted into a color code. The radar color picture will therefore represent a cross section of the cloud situation in front of the aircraft.

Even though the color code corresponds to a certain amount of moisture, rain and ice, bear in mind that the radar beam will also be reflected by the ground surface, mountains etc. Therefore the pilot must know his position before relying on the radar picture being just weather.

The Weather Radar is a four–color display system and the picture can be presented on both ND's.

The weather radar is not a go/no go signal, it is a weather analysis instrument and must be used in conjunction with a knowledge of the atmospheric conditions. It should not be used to make a decision to fly through a convective weather system, but as a guide of how far to circumnavigate it.

1. 1. Operational Modes.

Weather detection (WX position).

The signals representing echoes from targets at different ranges are treated with a Sensitivity Time Control (STC) which means that the target intensity remains relatively constant for close–in ranges. The radar beam power is higher but with lower resolution than for ground mapping.

Detectable weather is color coded with the black screen representing no detectable moisture, while detectable weather appears as one of four colors: green, yellow, red or magenta (least reflective to most reflective).

In some weather conditions, echoes at a certain distance and density could absorb enough beam energy to cause a very low level, if any, return signal to the radar (leaving a shadow area beyond the echo). This will cause the PAC alert (Path Attenuation Correction) bar to appear on the radar picture extending beyond the absorbing echo which alerts the pilot to possible hidden severe weather beyond the displayed echo. However, the pilot is still the master and should be monitoring the radar picture as the PAC alert has levels which have to be exceeded before the PAC alert bar comes on.

Please note that the PAC function is intended for weather detection modes only. Using a weather detection mode and downward tilt to produce a ground map will probably produce a display which makes correct interpretation more difficult. The PAC circuits interpret the return signals from ground targets as intense storm targets and tries to compensate for attenuated signal, resulting in the PAC alert bar to appear. In MAP mode, the PAC alert is disabled.

Weather with turbulence (WX+T-position).

Same weather detection as for WX mode but also allows precipitation related turbulence to be detected on the 5, 10, 20 and 40 NM ranges. (Turbulence cannot be detected at ranges greater then 40 NM). Same color code as for normal weather detection except that magenta indicates both most reflective precipitation and precipitation related turbulence where the wind velocity exceeds 16.4 ft/s (5 m/s). A flashing TRB on the ND indicates an area of turbulence within 5 to 40 nm ± 15° of dead ahead. TURB mode instantly removes all green, yellow, red and magenta precipitation echoes from the display except for areas of detectable precipitation related turbulence, which appears in magenta and can be observed alone. The TURB position of the MODE selector is spring loaded, meaning the selector must be held in the TURB position. Releasing the selector returns it to the WX+T position and restores the full weather radar display. As in the WX+T mode, the turbulence can only be detected in the 5, 10, 20 and 40 NM ranges.

The color code for the weather picture is:

WXR 850 COLOR	dbz	VIP–LEVEL	RAINFALL RATES in/hr	RAINFALL RATE mm/hr	VIP–DEFINITIONS
BLACK	< 20	--	<0,03	<1	--
GREEN	> 20	1	0,03 – 0,15	1 – 4	Minimum detectable moisture level (weak): – Weak rainfall rate. – Light to moderate turbulence is possible with lightning.
YELLOW	> 30	2	0,15 – 0,5	4 – 13	Moderate moisture level. – Moderate rainfall rate. – Light to moderate turbulence is possible with lightning.
RED	> 40	3	0,5 – 1,0	13 – 25	Strong moisture level. – Strong rainfall rate. – Severe turbulence is possible with lightning.
		4	1,0 – 2,0	25 – 50	Very high moisture level. – Very high rainfall rate. – Severe turbulence is likely with lightning.
MAGENTA	> 50	5	2,0 – 5,0	50 – 125	Intense moisture level. – Intensive rainfall rate. – Severe turbulence is very likely with lightning, organized wind gusts and hail.
	> 60	6	>5,0	>125	Extreme moisture level. – Extreme rainfall rate. – Severe turbulence is certain with large hail, lightning and extensive wind gusts.
MAGENTA	--	--	>0,03	>1	Turbulence related to precipitation. – In WX+T or TURB mode only and for turbulence greater than 16.4 ft/s (5m/s) (moderate turbulence).

VIP = Video Integrated Processor (U.S National Weather Service).

For reference, the U.S National Weather Service defines light turbulence as 0 to 19 ft/sec (0 to 5,8 m/sec) and moderate turbulence as 19 to 35 ft/s (5,8 to 10,7 m/s).

Ground mapping (MAP-position).

The signals representing ground echoes are treated with the Sensitivity Time Controller, STC, in order to keep constant echo intensity for close-in ranges, the shape of the radar beam is more narrow and with lower beam power than for weather detection in order to provide better resolution of the ground echo returns. The PAC alert and ground clutter suppression (GCS) functions are disabled in MAP mode.

CAUTION

Do not rely on MAP mode only for navigation.

The colors for the ground picture are somewhat changed:

WXR 850 COLOR	DEFINITIONS
CYAN	Ground targets with low reflectivity.
GREEN	Ground targets with moderate reflectivity.
YELLOW	Ground targets with strong reflectivity.
MAGENTA	Ground targets with most reflectivity.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Physical description.

The system consists of two separate units, the Receiver-Transmitter-Antenna and the weather radar panel. The mechanical feature of the TWR 850 radar is its compact construction, combining the receiver, transmitter and antenna into a single unit. The forward part of this unit is the flat-plate antenna. Directly behind the antenna is the RF assembly, consisting of the transmitter and receiver. Mating the antenna and receiver-transmitter eliminates the need for a waveguide.

2. 2. Antenna.

The RTA-858 antenna plate is installed in the nose of the aircraft and covered with a kevlar radome. It has a scan sector of 120°. The antenna is also stabilized up to 30° in roll and pitch to compensate for aircraft movement in order to have a stable scanning. The antenna can be manually titled between ±15° from the aircraft's x-axis or from horizontal with stabilization selected.

2. 3. Transceiver.

The transceiver works in the X-band at a frequency of 9,345 GHz. It transmits and receives the radar beam and transforms the result into digital information fed to the radar control panel.

2. 4. Weather radar control panel - WXP.

The control panel is provided with the necessary controls to select the various modes and functions. The control panel also contains a microprocessor that creates and controls the radar picture presented on the ND's from the digital information sent by the transceiver.

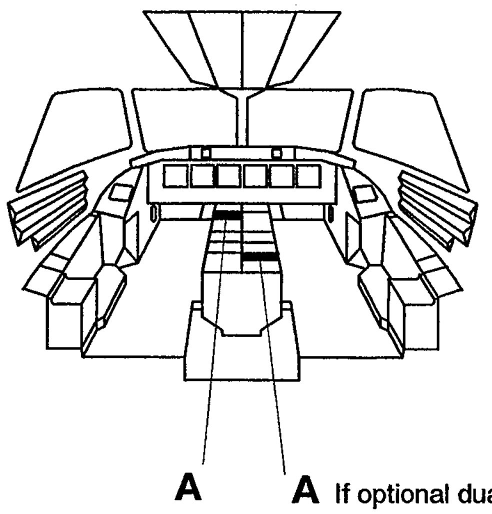
2. 5. Optional dual Weather radar control panels.

Dual weather radar control panels provides individual settings for presentation of the weather radar on respective sides ND. One antenna sweep provides data to one side and the next sweep to the other side. The radar picture update rate is half compared with a single control panel system.

2. 6. Optional automatic Weather radar switch-off and override function.

The automatic radar switch-off function is provided by the weight on wheels switches when the aircraft is on ground. For radar operation on ground the automatic radar switch-off function can be overridden by a switch.

3. CONTROLS AND INDICATORS.



A **A** If optional dual control panels installed.

GAIN control

Rotate this knob to change the gain of the radar receiver above or below the NORM setting.

Normal system operation is with the knob in the NORM position. Setting other than NORM are annunciated on the ND (e.g. G+2, G–3).

Each stop reduces or increases the receiver sensitivity by 6 dbz for a total of 18 dbz. By reducing the gain, it is possible to evaluate the relative severity of the weather system because the weather echoes will gradually disappear from the radar picture leaving only the stronger echoes. Do not leave the GAIN control reduced or increased after use, always return to NORM position.

GCS, Ground Clutter Suppression button

Only for WX mode and WX + T modes.
Push and release the GCS button to reduce the intensity of ground returns.

This makes the precipitation returns easier to see. Note that the GCS feature may also reduce the intensity of, or completely eliminate weaker precipitation returns. For this reason, the GCS feature times out after approximately 12 seconds. When selected, GCS is annunciated on the ND.

SEC, Sector Scan button

Push the SEC button to reduce the normal 120 degree scan (60 degrees either side of center) to a 60–degree scan.

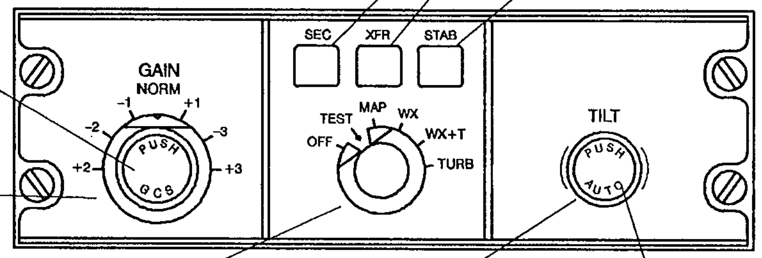
Reducing the sector scan effectively increases the radar update rate. Push the SEC button again to return to the full 120–degree scan. Annunciation is via the reduced size of the range arcs.

XFR, Transfer button

Press the button to transfer the radar range control to the other pilot's DCP (RANGE knob). Indicated by XRING on the ND top line.

The range indication on ND is in amber on the side that does not have control of radar range.

A WEATHER RADAR CONTROL PANEL



STB, Stabilization button

Press the STB button to enable the radar antenna stabilization.

The STB button is latching and is normally left in the on (pushed in) position.
Off is indicated by USTAB on the ND. Antenna stabilization is turned off in the event of an attitude signal failure and indicated by a flashing USTAB on the ND.

MODE selector

Rotate this knob to select system operating modes.

- OFF – RDR OFF will be displayed in upper left corner of the ND.
- TEST– Test picture will be displayed on ND.
- MAP – Use this mode for ground mapping.
- WX – Weather detection mode. Targets appears in green, amber, red or magenta.
- WX+T Same as WX but also allows precipitation related turbulence to be detected on the 5,10, 20 and 40 mile ranges.
- TURB– Spring loaded, when held removes all targets except detected areas of precipitation related turbulence which appear in magenta.

TILT Control

Rotate this knob to change the tilt angle of the stabilized radar antenna.

The tilt setting in tenths of a degree (eg, T + 10.7, T–5.3, etc) is displayed on the ND.

AUTO, Autotilt button

Push the button to select the autotilt feature.

Autopilot is designed to reduce pilot workload. First use the TILT control to adjust the antenna to the optimum tilt angle for the present range and flight altitude. After this is done, select autotilt by pushing the button. With autotilt selected, changing ranges or altitudes causes the antenna to automatically tilt up or down to maintain the same ratio of tilt angle to range that were present prior to selecting autotilt. Annunciation is on the ND with an "A" placed before the tilt angle (e.g. A + 5,6, etc.in tenths of a degree).

B3276

FiG. 1. Weather Radar – control panel

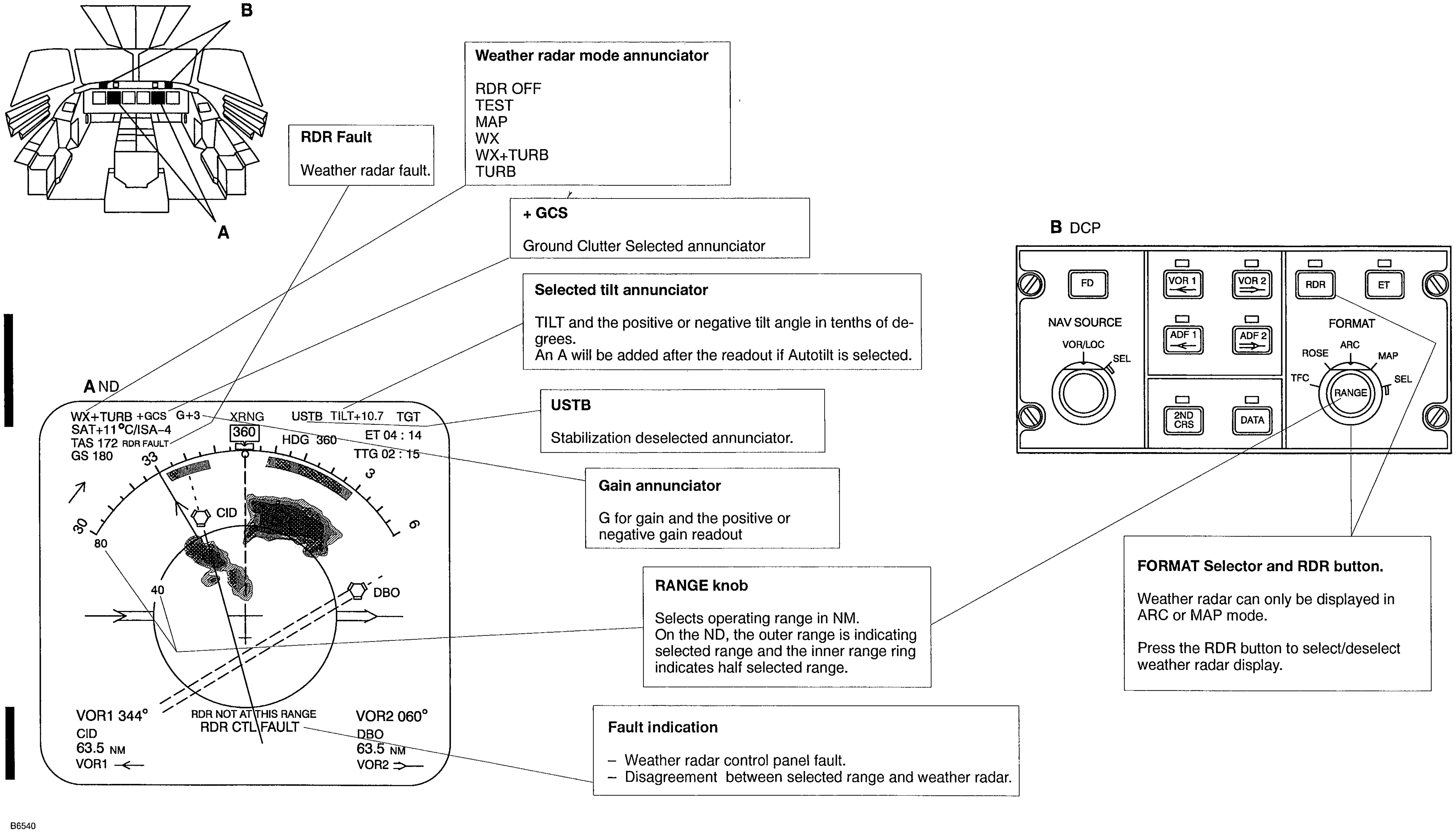
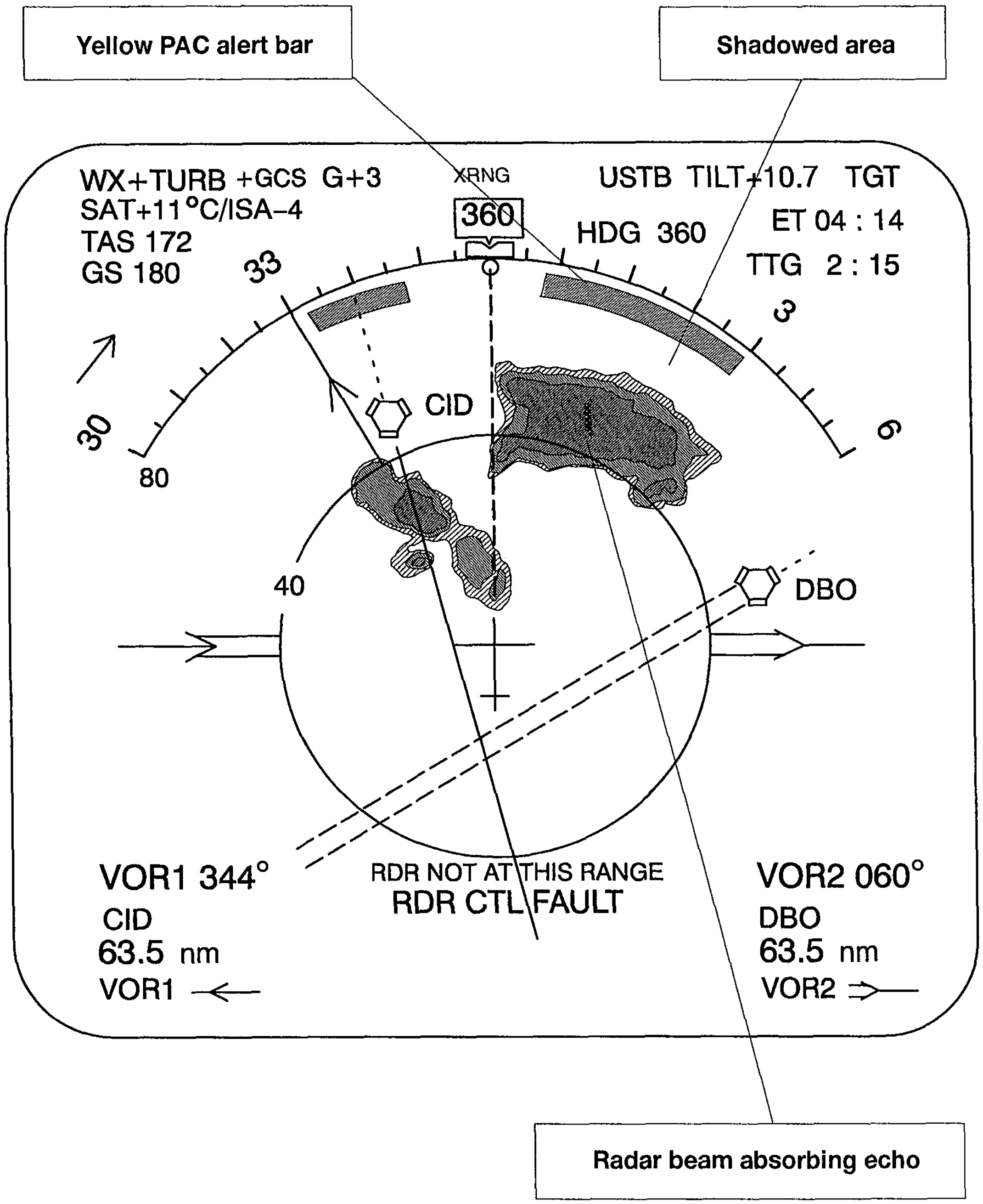
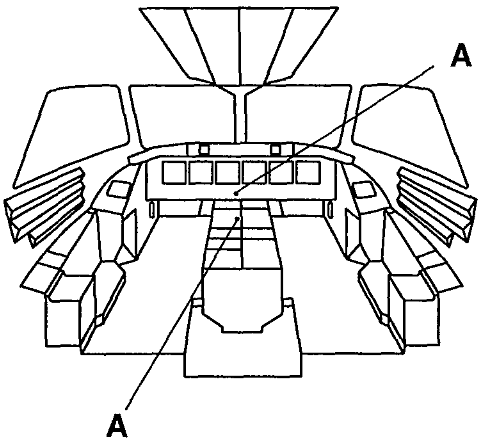


FIG. 2. Weather Radar presentation and controls.

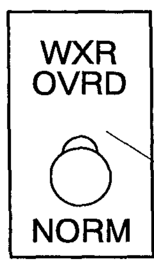


B3403

FIG.3. Radar picture with PAC alert.



A AUTOMATIC RADAR SWITCH–OFF OVERRIDE



WXR OVRD NORM switch

WXR OVRD
– Overrides the automatic weather radar switch–off function.

NORM
– Normal automatic weather radar switch–off function is provided by weight on wheels.

B8153

FIG.4. Optional automatic weather radar switch–off override.

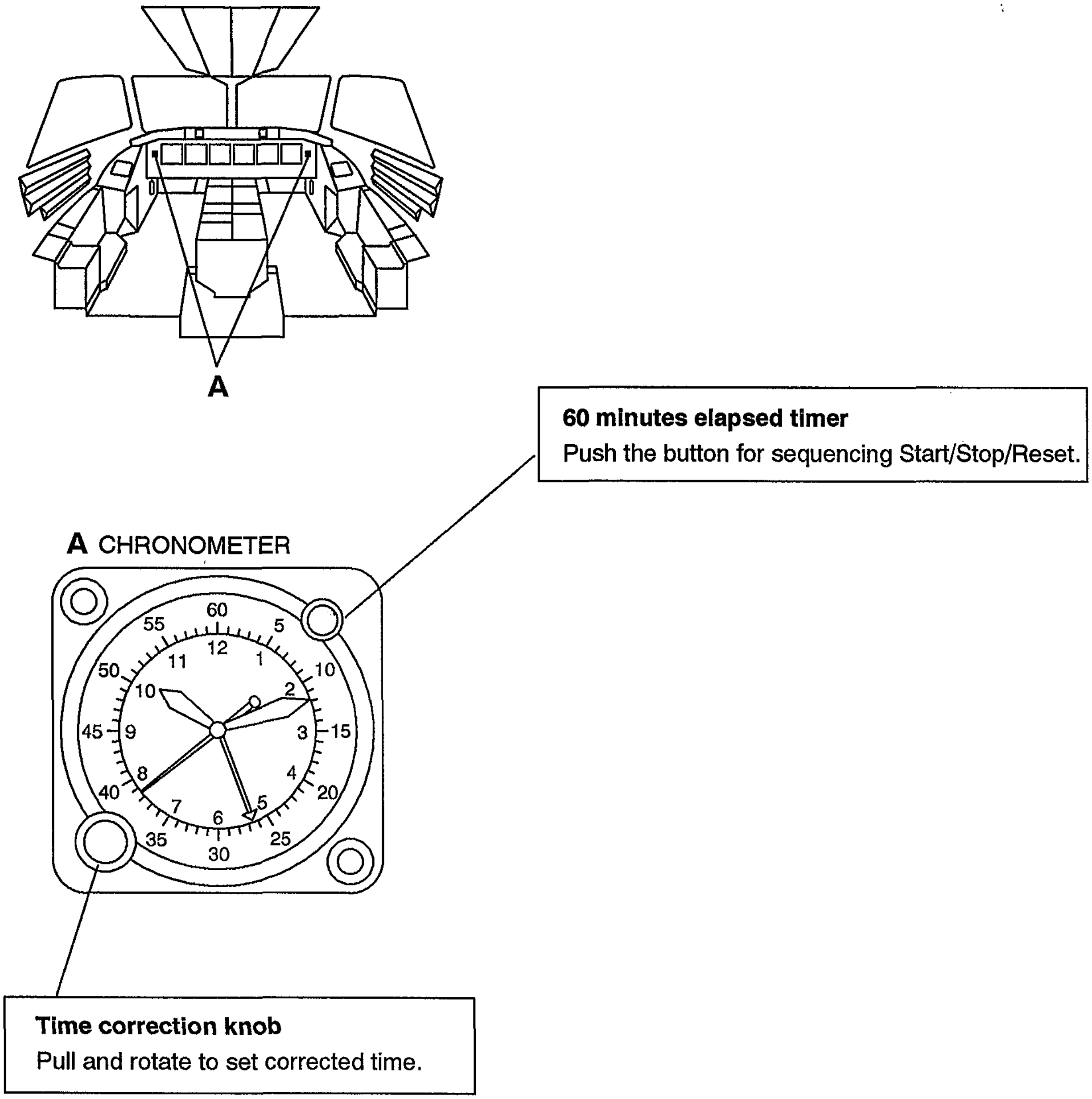
4. ELECTRICAL POWER SUPPLY.

Weather Radar power	L AVIONICS BUS	E–19	WX RADAR PWR

1. GENERAL.

The chronometer is the primary timepiece on the flightdeck. A 60 minutes elapsed timer is also provided in the chronometer.

2. CONTROLS AND INDICATORS.



B4786

FIG.1. Aircraft chronometer.

3. ELECTRICAL POWER SUPPLY.

L Chronometer	G–12	L HOT BAT BUS	L CLOCK
R Chronometer	N–11	R HOT BAT BUS	R CLOCK

1. GENERAL.

The audio integrating system provides the pilots with intercom and audio control.

The VHF COM and HF COM (if installed) systems, as well as audio signals from the radio navigation systems are, together with the cockpit and ground crew interconnected with the audio integrating system. The audio integrating system will then provide the pilot with a corresponding number of audio channels, which can be selected and controlled by any of the two Audio Control Panels. The communication and the audio signals are listened to and spoken with by either headsets or cockpit loudspeakers and hand microphones.

All communication is recorded by the CVR (Cockpit Voice Recorder). The Press To Transmit signals for the COMs are recorded by the Flight Data Recorder.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Digital Remote Electronic Unit (DREU).

The DREU, which forms the central part of the audio integrating system, serves as a distribution and switching center for the systems that are interconnected with it.

For communication, two pilot jack panels provide connection of the headsets to the DREU. There are also two loudspeakers and hand microphones connected to the DREU for backup.

The DREU contains two identical audio channels, each controlled by respective side's Audio Control Panel (ACP). A third audio channel is provided if the optional Observer's ACP is installed.

Aural warning, GPWS and PA chime signals have fixed audio levels and can be heard regardless of volume setting.

If one or both audio channels fail, the VHF COM and the NAV ident can be bypassed the DREU and switched directly to the headsets by the NORM/ EMER switch on associated ACP.

2.2. Audio Control Panel (ACP).

Two ACPs are installed in the cockpit, one for each pilot. The ACPs are furnished with slide levers for volume control and a number of pushbuttons and switches that allow various controls of the audio system. The selected volume levels and switch settings are converted into digital data and sent to the DREU for control of the systems interconnected with the DREU.

2.3. Loudspeakers.

Two loudspeakers are installed in the cockpit, one above each pilot. Aural warnings, GPWS, and PA chime signals have fixed audio levels and can be heard regardless of volume setting.

2.4. Pilot jack panel.

Two pilot jack panels provide connections of the headsets to the DREU, standard headset connectors are accepted; PJ–055B earphone and PJ–068B microphone. For oxygen mask use, a separate jack connects the mask microphone to the DREU. PA calls with the mask microphone can be made by pushing the PA button on the jack panel, see also chapter 4/9.

2.5. Observer's jack panel.

The observers jack panel provides connection of the observers headset to the DREU. The same type of connectors are accepted as for pilot jack panel. A MIC switch provides on/off function of the observers microphone. There is also a PHONE switch which allows the observer to listen to either the left or the right pilot's communication.

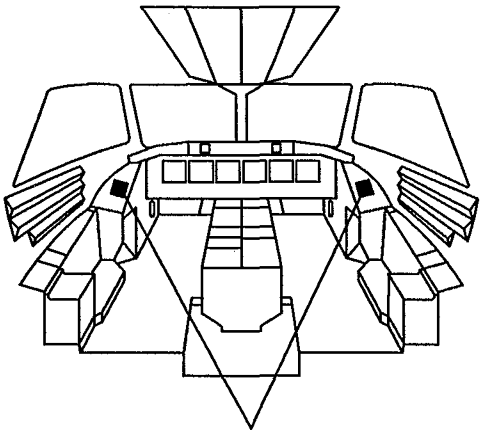
2.6. Observers Audio Control Panel (OACP).

An optional observers audio control panel can be provided instead of the observers jack panel. The OACP has slide levers for volume control. A MIC switch provides on/off function of the observer's microphone. There is also a PHONE switch which allows the observer to listen to either the left or the right pilot's communication. The same type of connectors are accepted as for pilot jack panel.

2.7. Ground crew jack panel.

The a/c is provided with three ground crew jack panels. One in the nose wheel well, one in the cargo doorway, and one on the wing fuel panel. The headset jacks and call buttons allow intercom between ground crew and flight deck. Ground crew call is announced on flight deck by a bell sound. Whenever a ground crew is connected, EICAS will display the message GND CREW.

3. CONTROLS AND INDICATORS.



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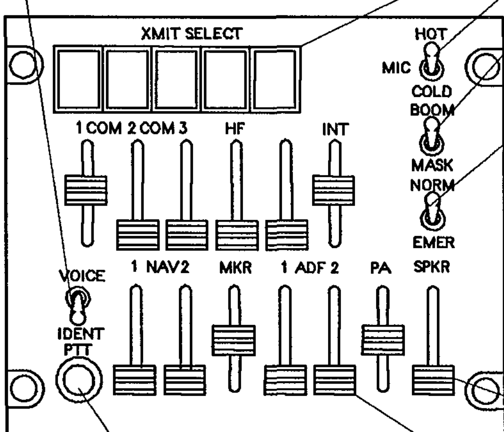


A

XMIT SELECT pushbuttons
- Momentarily push associated button to select COM/HF for transmitting (HF if installed, COM 3 not used).
- Selected button illuminates.

MIC switch
HOT – Headset or mask microphone is continuously on in the intercom.
COLD – The microphone is only on in the intercom when the PTT is depressed for transmission.

BOOM/MASK switch
BOOM – Headset microphone selected.
MASK – Oxygen mask microphone selected.

NORM/EMER switch
NORM – Control of the COMs via ACP.
EMER – Bypass of the DREU if the audio system fails.
- Direct connection with the COM by headset and control wheel PTT button only.
- For L side ACP, COM 1, L control wheel PTT and L headset.
- For R side ACP, COM 2, R control wheel PTT and R headset.
- Direct connection with the NAV ident. For L ACP, NAV 1. For R ACP, NAV 2.
- Fixed volume.

VOICE/IDENT selector
VOICE – Voice signals only.
IDENT – Both audio code and voice signals.

Loudspeaker volume
Even if the volume is turned down, warning signals and PA chime signals can still be heard over the loudspeaker.

PTT button
Press to transmit.

Volume controls
Slide levers for volume control of associated system, for example:
INT – intercom
MKR – marker
PA – cabin PA
(COM 3 not used).

B4627

FIG.1. Audio Control Panel, ACP - controls.

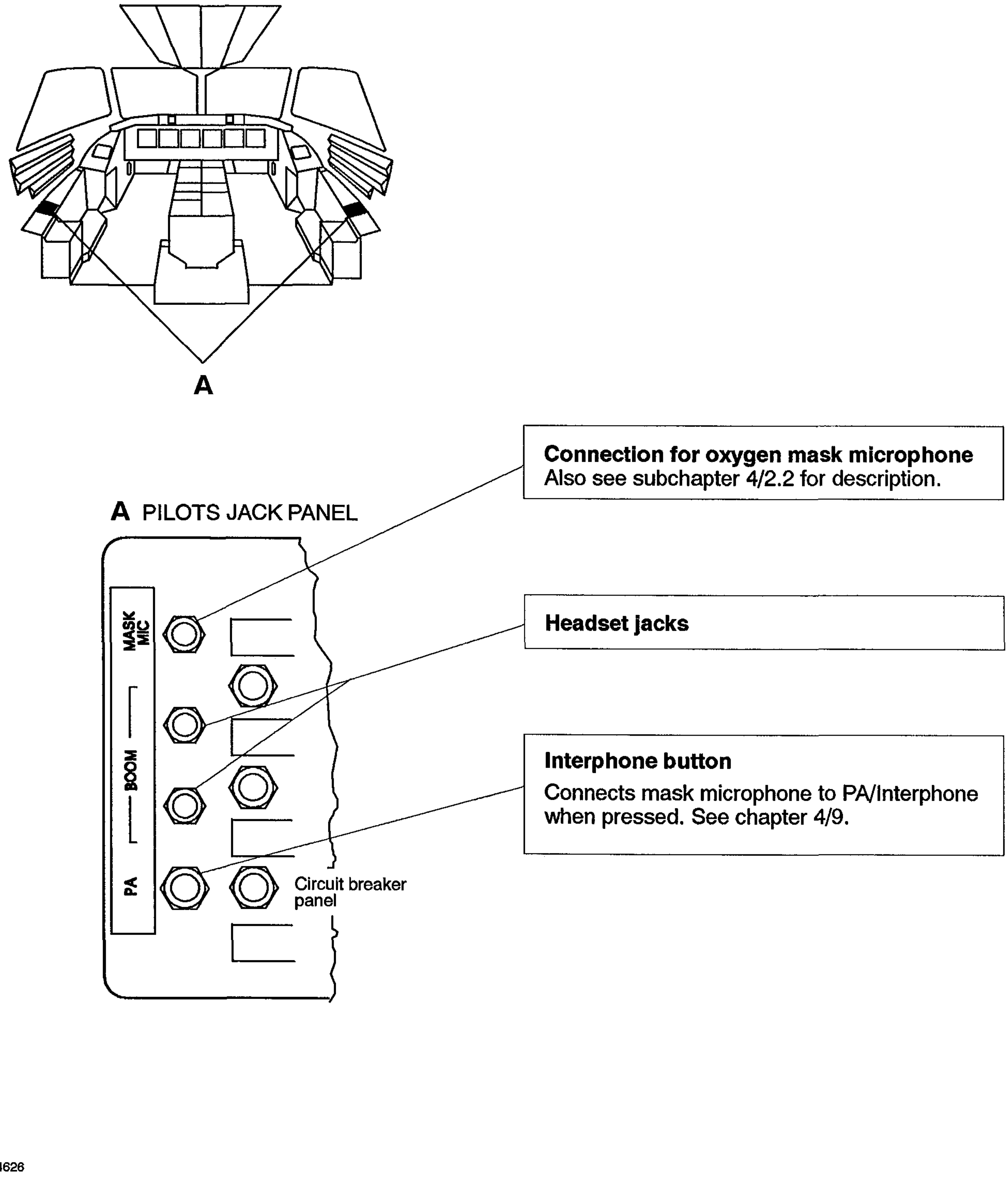
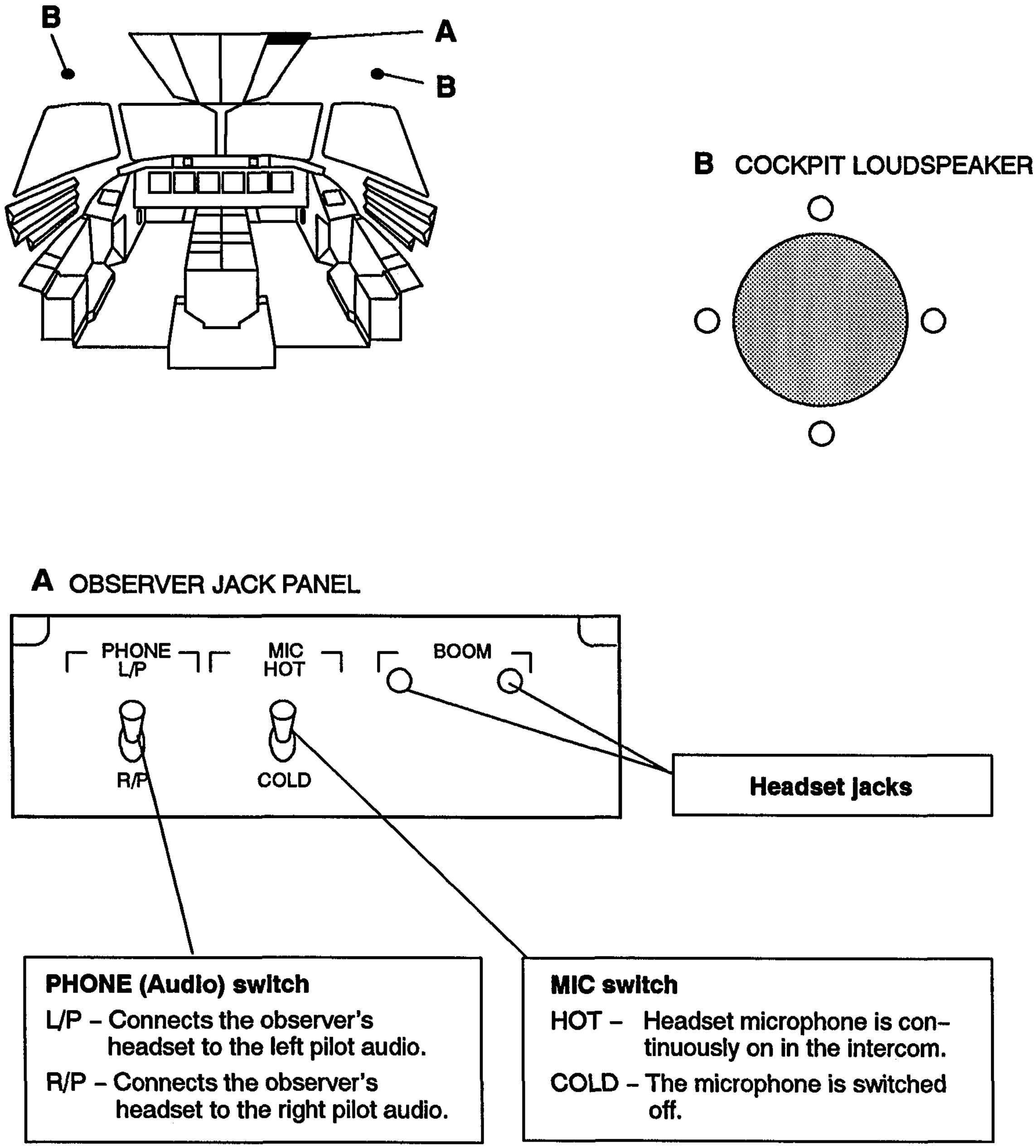
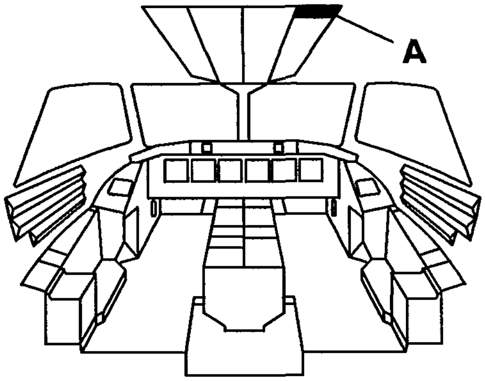


FIG.2. Pilots jack panel (left side shown).



B4625

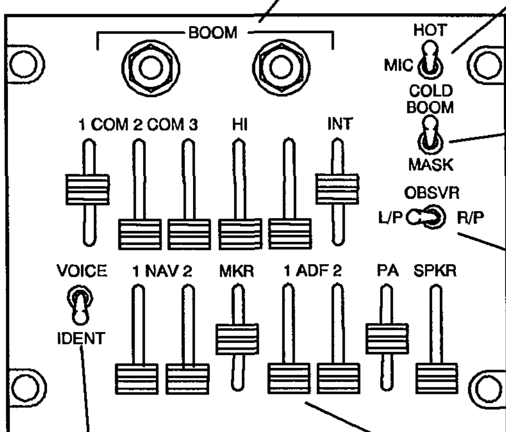
FIG.3. Loudspeaker and standard observer jack panel – controls and jacks.



Headset jacks

MIC switch
HOT – Headset microphone is continuously on in the intercom.
COLD – The microphone is switched off.

A OBSERVER AUDIO CONTROL PANEL



BOOM/MASK switch
BOOM – Headset microphone selected.
MASK – Oxygen mask microphone selected.

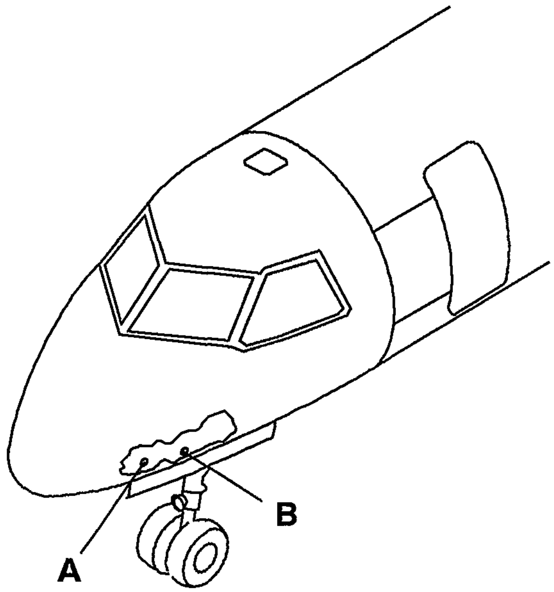
OBSVR switch
L/P – Connects the observer's headset to the left pilot audio.
R/P – Connects the observer's headset to the right pilot audio.

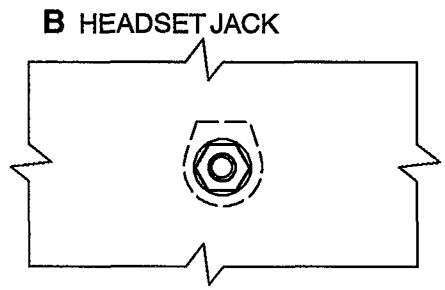
VOICE/IDENT selector
VOICE – Voice signals only.
IDENT – Both audio code and voice signals.

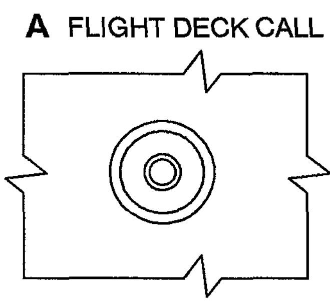
Volume controls
Slide levers for volume control of associated system, for example:
INT – intercom
MKR – marker
PA – cabin PA
(COM 3 not used).

B5074

FIG.4. Observer audio control panel (optional).







The other two ground crew stations are found in the left cargo door–way and on the wing refueling panel.

B4624

FIG.5. Ground Crew stations.

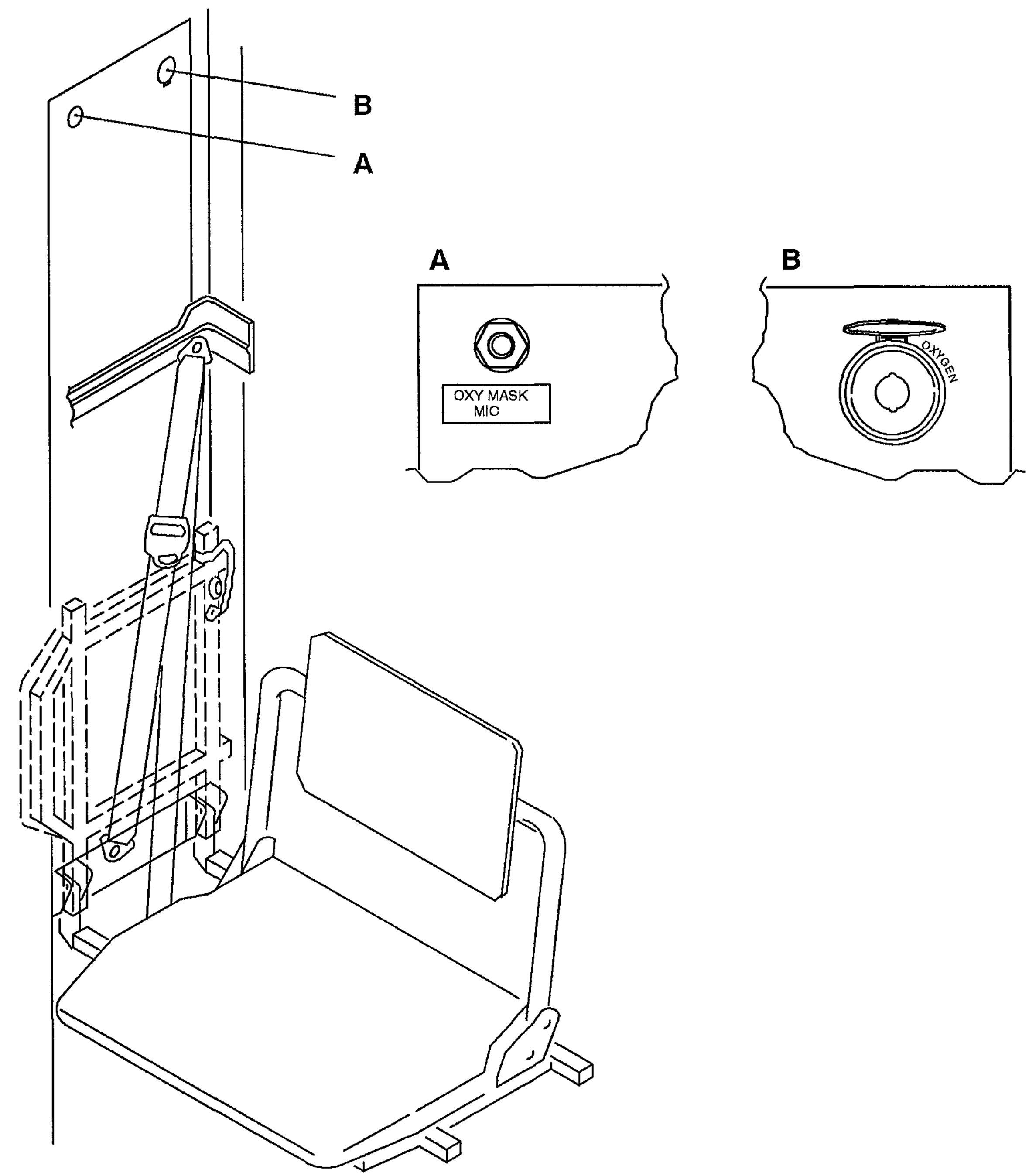


FIG.6. Observer oxygen mask microphone jack.

4. ELECTRICAL POWER SUPPLY.

Left pilot audio	L BAT BUS	E–15	L AUDIO	
Right pilot audio	R BAT BUS	L–14	R AUDIO	
Observer audio	R AVIONICS BUS	L–15	OBSVR AUDIO	(optional)

1. GENERAL.

The Passenger Address (PA) and Interphone are two combined systems, utilizing the same amplifier unit (PA amplifier) located in the avionics rack.

The PA system provides the passengers with flight attendant call buttons which gives a chime in the cabin loudspeaker system for attention.

The chime will also be heard as soon as "NO SMOKING" or "SEAT BELT" signs are operated on/off.

Optional boarding music/entertainment systems can be connected to the PA system.

The PA system has the following functions:

- Flight attendant call buttons.
- NO SMOKING/ SEAT BELT signs.
- Loudspeakers for distribution of messages.
- Boarding music/entertainment systems.

The Interphone system provides communication via the interphones between flight deck and cabin crew. Passenger messages can also be given over the cabin loudspeakers from any crew station. PA, CALL, EMER and ATT lights are used together with HI–LOW chime tones to alert the flight deck/cabin crews about any calls.

The Interphone gives the following communications:

- Flight deck to passenger.
- Flight deck to cabin crew station.
- Cabin crew station to flight deck.
- Cabin crew station to passenger.
- Between forward/aft cabin crew stations (optional).

The optional cabin interphone, if provided, is located at the rear cabin crew station. An ATT button is provided for communication between the two cabin crew stations.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. PA Amplifier.

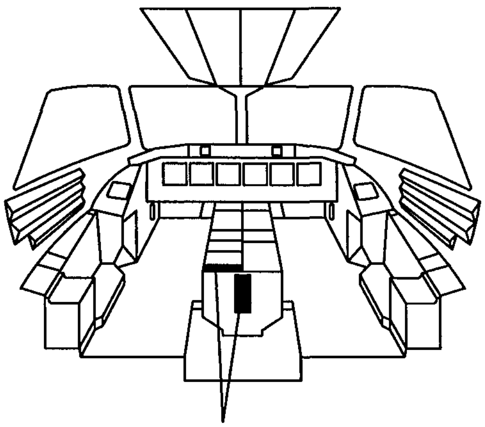
The amplifier has three fixed audio levels. The low level is used on ground, before engine start. After engine start, the audio level is increased by 6 dB, controlled by condition lever position. At take–off controlled by WOW, the audio level increases by another 6 dB.

2.2. Flight deck/cabin interphone.

Similar types of interphone are used on the flight deck and in the cabin. The interphones are provided with noise cancelling microphones. The pushbuttons for mode of communication are located on the upper part of the cradle. The controls of the flight deck interphone are by lighted pushbuttons on the center pedestal. The handset contained PTT button is only required to be used for PA calls. The cabin interphones are also protected against inadvertent use, therefore the handset must be released before selecting a button.

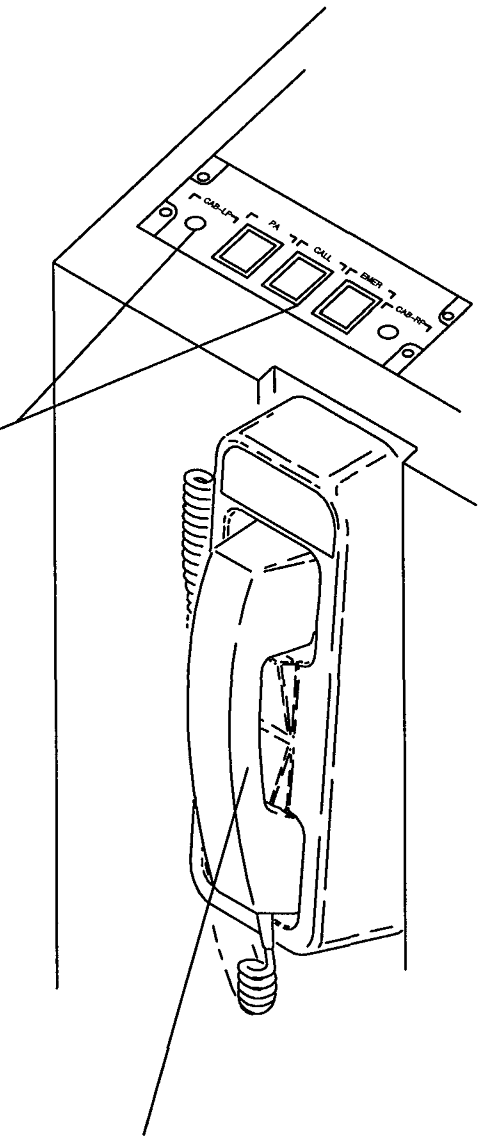
2.3. Loudspeakers.

The loudspeakers in the cabin are evenly distributed above the passenger seats including one in the lavatory area.



A

A FLIGHT DECK INTERPHONE



Interphone calls with headset (with or without oxygen mask) in use.

Calls to cabin:

- Select a function button (PA, CALL, or EMER).
- Press the CAB interphone button and give message in headset/mask micro phone.
- After message, release CAB inter– phone button which also resets the selected function button.

Calls from cabin:

- Press the cabin interphone button to answer message.
- After message release cabin interphone button.

NOTE
If oxygen mask is used together with headset, the BOOM MASK switch on the ACP must be in MASK position.

Interphone calls.

Calls to cabin:

- Lift the handset and select (PA,CALL, or EMER).

Calls from cabin:

- Lift the handset and answer message.

Emergency calls are identified by triple HI–LOW chimes and a red message EMER CALL on PED.

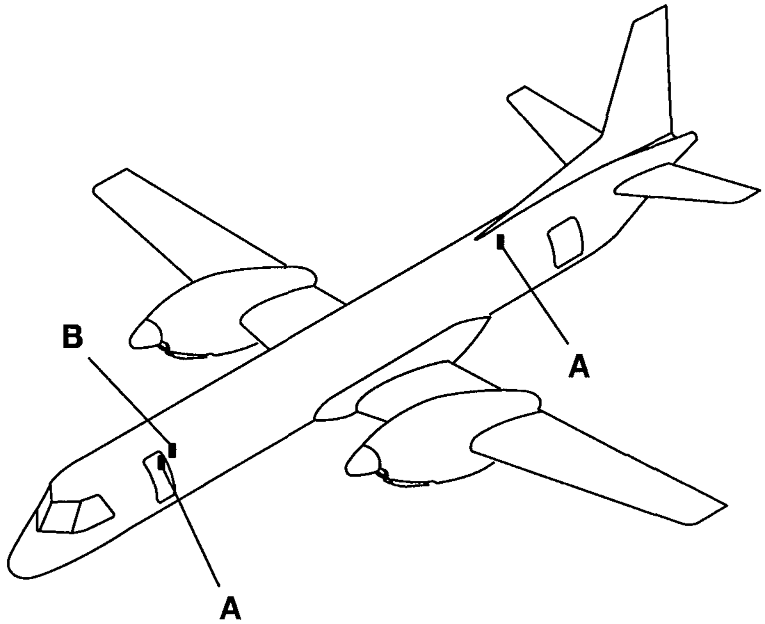
Flight deck calls are identified by single HI–LOW chime and a green CALL message on SED.

Push To Talk button

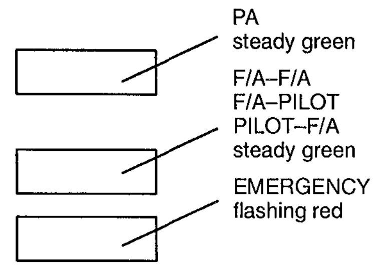
Only needed for PA calls.

B4621

FIG. 1. Flight deck interphone.



B CALL INDICATOR LIGHTS



A CABIN INTERPHONE

Call buttons

EMG – Emergency call to flight deck
PA – Passenger calls
FLT – Flight deck call
ATT – Call between fwd and aft interphones (F/A to F/A) (optional).

The phone is protected against inadvertent use, the handset must be released before use.

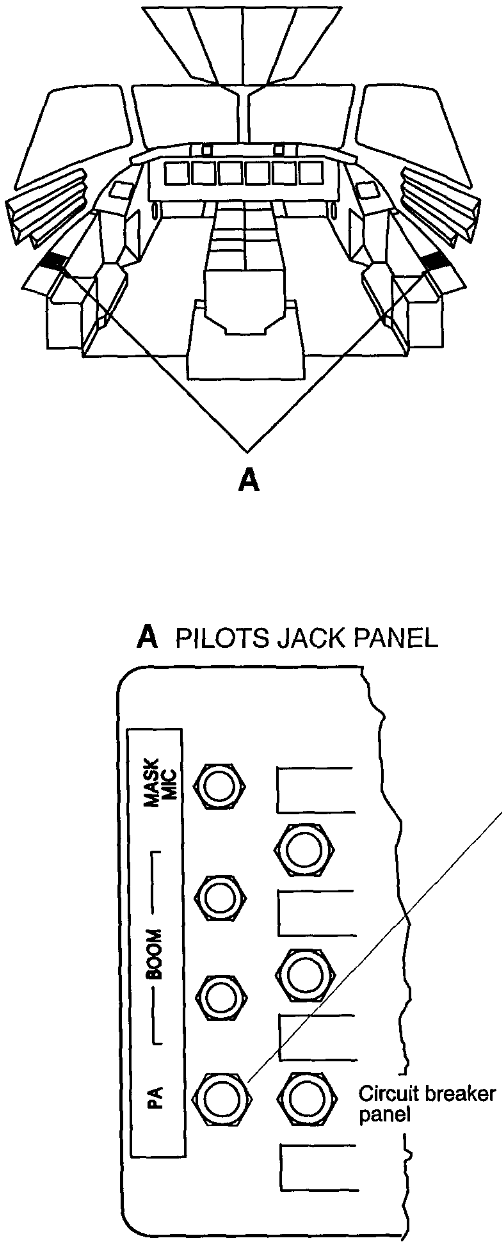
EMG calls are identified by triple HI–LOW chimes.

FLT calls are identified by single HI–LOW chime.

Push To Talk button
Only needed for PA calls.

B4668

FIG. 2. Cabin interphone and indicator lights.



PA calls with oxygen mask and using the PA button.

Calls to cabin:

- When oxygen mask PA button is pressed, the mask microphone will automatically be switched to PA for passenger messages.

No other function can be selected.

- After message, release oxygen mask PA button.

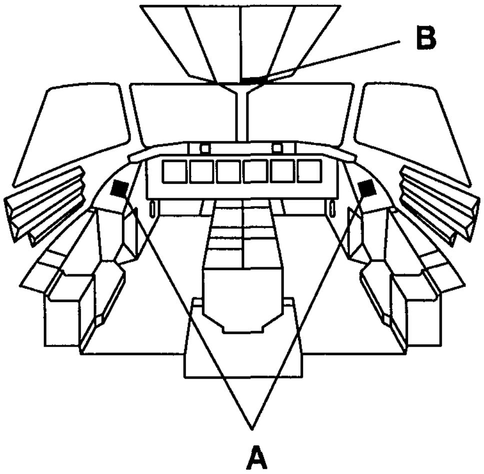
Calls from cabin:

- Press oxygen mask PA button to answer message. The answer will be heard over the cabin loud–speakers.
- After message, release oxygen mask PA button.

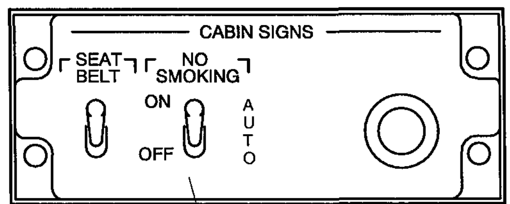
NOTE
When oxygen mask in use the PA button and oxygen mask is the only way to give PA calls if the NORM EMER switch on one ACP is in EMER position. The other pilot is not affected.

B4626

FIG. 3. PA calls with oxygen mask in use.



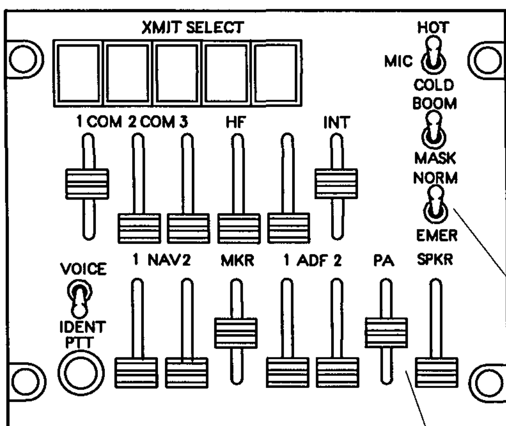
B CABIN SIGN PANEL



SEAT BELT and NO SMOKING gives LO chime in cabin whenever operated.

NO SMOKING, AUTO position automatically illuminates the NO SMOKING sign as long as the landing gear is extended.

A AUDIO CONTROL PANEL



NORM EMER switch (EMER selected).

If oxygen mask in use:

Only PA messages can be given on that side and from the oxygen mask using the PA button on the pilots jack panel:

All other PA/Interphone functions are inoperative. The other pilot side is not affected.

If oxygen mask not in use:

Use Flight Deck handset for PA and cabin calls.

Cabin PA volume.

Messages given to the passengers from flight crew or flight attendant can be listened to by increasing the PA volume lever.

B4622

FIG. 4. PA lever and Cabin signs.

3. ELECTRICAL POWER SUPPLY.

PA	L BAT BUS	E – 16	PA

1. GENERAL.

The Digital Passenger Briefing System (PBS) provides an easy way for the crew to inform their passenger of important messages, i.a. in connection with;

- Takeoff
- Landing
- Overwater
- Turbulence
- Fasten seatbelt / No smoking
- Cabin conveniences

The system can provide messages in up to four languages.

2. FUNCTIONAL DESCRIPTION.

2.1. Individual Units and Interfaces.

The PBS consists of following units:

- Remote Computer (fwd galley) which receives control signals and provides Passenger Briefing and Boarding Music signals to the PA–system for cabin distribution
- Control Head

The system interfaces with the following equipment:

- The Passenger Address Amplifier (PAA)

2.2. Power Supply.

The 28 VDC RH ESSENTIAL BUS energizes the Remote Computer by means of circuit breaker "BOARD MUSIC".

The Control Head is powered from the Remote Computer.

2.3. Component Description.

Remote Computer
The PBS has no moving parts at all. The passenger briefing message is produced in a recording studio using digital techniques. The PBS computer is programmed to store digital information. To play a message, the PBS computer recalls the message from memory, translates the digital information into "recorder–type" electrical signals, and sends these signals to the PA–system. In principle, it works like the compact disc player, except that the information is stored in memory, rather than on a spinning disc. It is installed in fwd LH galley.

Control Head
The Control Head is the human interface with the system.

The front face of the compact case features:

- ON/OFF switchbutton
- LED display
- Message Selection and volume UP/DOWN arrow buttons
- START/PAUSE button
- Four Language Selection Buttons

The Control Head gives control and indication of the mode of operation.

The letters on the buttons are backlighted for night viewing and intensity is controlled externally by a photosensor.

ON/OFF pushbutton
The button labelled "ON" is a momentary action on/off switch.

LED (Light Edmitted Diode) display
The 10 character LED display is used to present information to the user. This information includes the titles of the available messages, active languages and whether or not the unit is currently speaking. Other diagnostic messages are also presented using the LED. The intensity of the LED display is automatically controlled by the photosensor on the control face.

UP/DOWN arrows
The UP/DOWN arrows, located just to the right of the LED display are used to scroll through the list of available messages. The message titles are displayed on the LED.

PLAY/PAUSE button
Pressing the PLAY button causes the PBS to begin reading the message to the passengers. Pressing the PLAY button while a message is in progress pauses the message.

Four Language Selection buttons
The Language buttons 1 trough 4 are used to select or deselect language for subsequent play. Pressing a button selects the associated language; pressing it again deselects the language. A "T/O EF" symbol in the LED display indicates that Takeoff briefing will be played first in English then in French.

2.4. Operation.

Power Up
The system is activated by depressing and releasing the "ON" button. The LED momentarily displays the message "TESTING" to indicate that the self test has been initiated.

Self Test
During the power up process, the computer performs a self test. It also flashes several messages in succession at approximately two second intervals:

- Filename (a unique name determined by Heads Up)
- Revision Date
- Version Number
- Aircraft Type
- DATA TEST (to indicate that the integrity of the message is being verified by the computer)

A successful self test is indicated by a message title appearing on the LED.

NOTE
The self test performs a "checksum" calculation on the memory of the computer. This calculation can be time consuming. Should it be necessary to initiate a briefing before the self test has been completed, press any key on the control head once and release immediately to cancel the self test.

2.5. Manual Briefings.

Selecting Languages
The Language keys, labelled 1, 2, 3 and 4, are used to select and deselect the required languages. While the PBS can hold up to four languages, it is designed so that once the required languages of a given passenger load are determined, the computer can play only those languages.

Active Languages
Languages that are played are called "active" languages. Pressing a language key causes that language to be active or inactive. Active languages are indicated by a character appearing in the right side of the LED display. For example, pressing "1" button once causes the "E" (for English) symbol to appear, then pressing it again causes the "E" to disappear.

Language Order
It is polite to speak the native language first, then any other languages. The left–most active language symbol always indicates the language that will be spoken first. The right–most symbol is the language that will be spoken last. Language are spoken in the order that they are entered, with the most recently activated language (last to be spoken) on the right.

The PBS allows for the language order to be changed in a simple fashion. To exchange the order of the languages, press "1" to deselect English, then press "1" again to reselect English. The active languages will now be displayed as "FE".

Selecting a Briefing
Use the UP/DOWN arrow to scroll through the list of available message titles. Note that since the LED display is only 10 characters wide, abbreviation of the message titles may be required. For example Takeoff is abbreviated as T/O.

Starting a Briefing
Press PLAY button to start a briefing. The active language indications will be replaced by the message "PLAY". The voiced messages should be heard at this time. The system will play the message in the first active language, then automatically start the next language.

Stopping a Briefing
If you desire to interrupt a message in progress, press the PLAY button. The PLAY indication will extinguish. The system will return to the beginning of the sentence it was speaking when interrupted, and wait. Pressing the PLAY button again will restart the message from the beginning of that sentence.

To restart the briefing from the beginning, use the UP/DOWN arrow to select a different message, then reselect the desired message. This process "re–initialize" that message. Press the PLAY button to start the message.

Replaying a Message
Once a manual message has been completed, the computer will not allow the message to be given again simply by pressing the PLAY button. This feature prevents accidental sending of a message once it has been given.

To repeat a message, select a different message using the UP/DOWN keys, then select the desired message. This process initializes the message. Press PLAY button to start the briefing.

2.6. Music Function.

The system has up to 180 minutes of pre–recorded music. This music can be played in the cabin by selecting the MUSIC message title and pressing PLAY.

2.7. Changing Briefings, Boarding Music or adding Languages.

The system is designed so that the message can be changed without removing the unit from the aircraft. This is accomplished by using a PCMCIA memory card to store new data file in the PBS computer.

If you desire to change the message in your PBS perform the following steps:

- Contact the company Heads Up Technologies to describe the changes
- "Heads Up" will produce the script and mail the new message to you on PCMCIA card
- It is also possible to produce an own message or music on a DAT tape and mail it to Heads Up
- Refer to the Message Update manual that accompanies further instructions

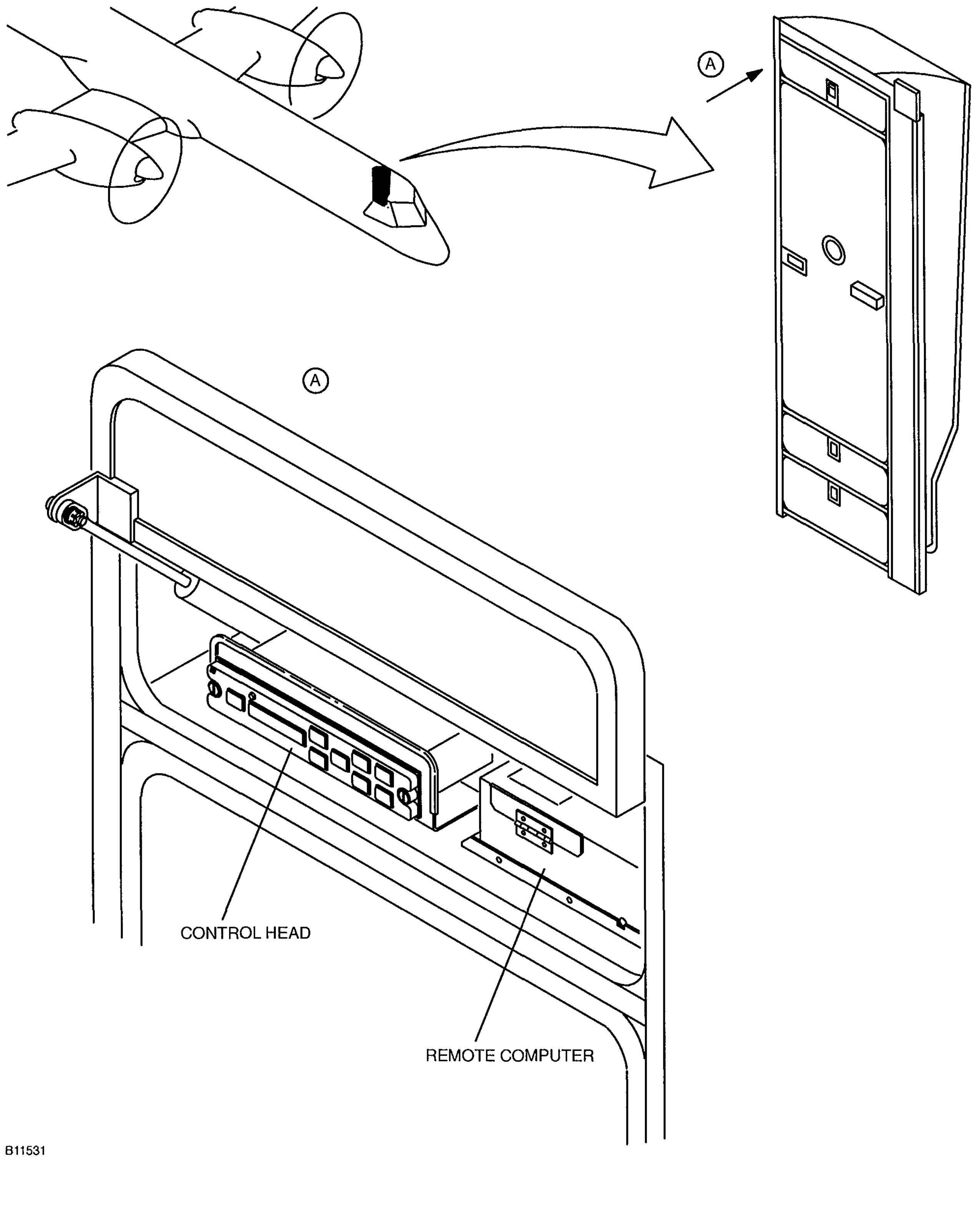


FIG. 1. Location of the Passenger Briefing and Boarding Music system (RYB)

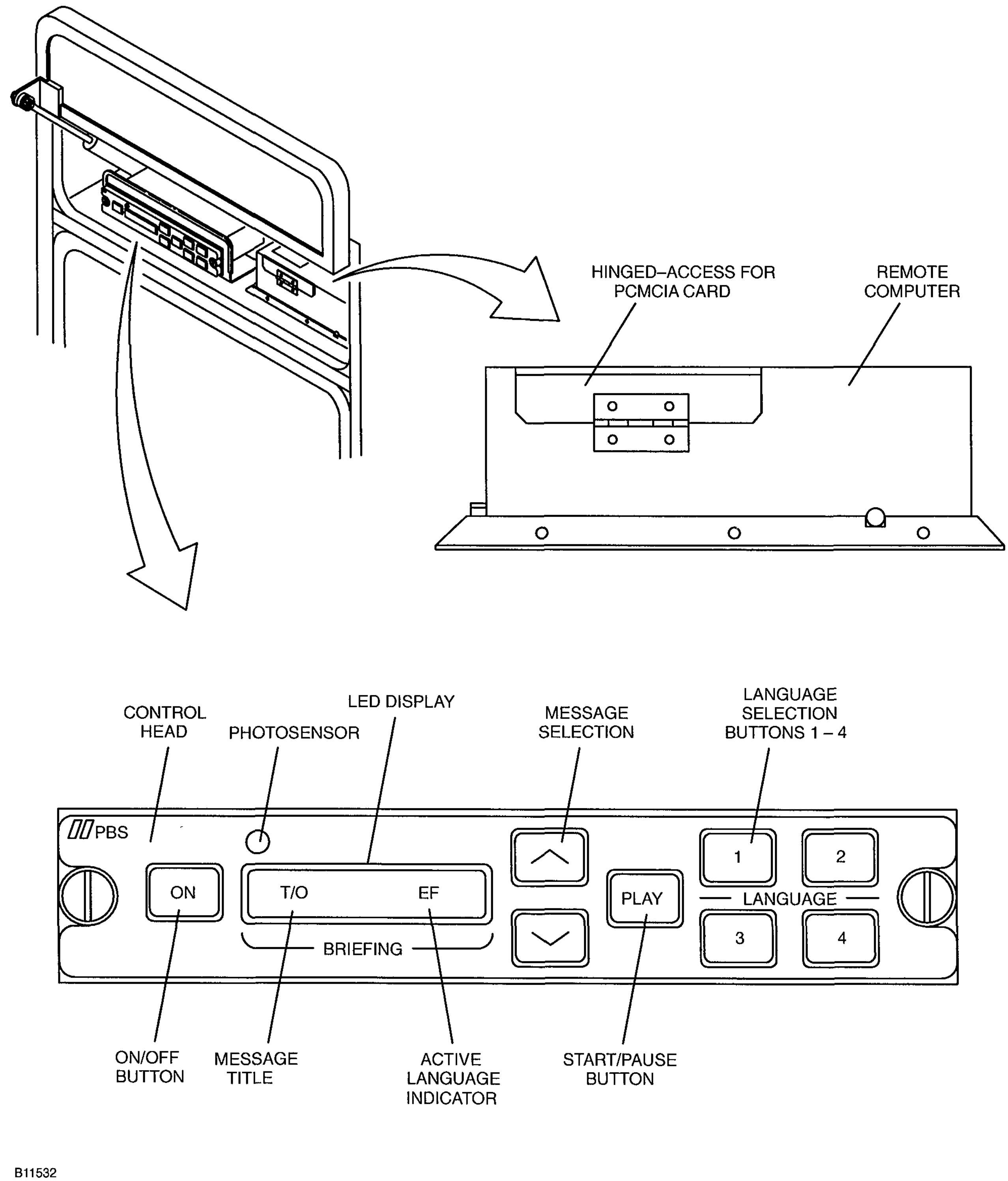


FIG. 2. Control Head – Controls

3. ELECTRICAL POWER SUPPLY.

Passenger Briefing and Boarding Music	R ESS BUS	M – 21	BOARD MUSIC

TO BE ISSUED LATER

1. GENERAL.

The Flight Management System, FMS, is a worldwide navigation system that statistically combines raw data inputs from several navigation sensors using Kalman filtering to arrive at an optimum computation for aircraft position. The system gives extended capability for flight planning and navigation. Steering commands can be generated to provide basic horizontal area navigation functions and provisions are also included for advisory vertical navigation. Since the FMS contains provisions for tuning the left side radios, and therefore can serve as a back up for the left side Radio Tuning Unit, it gives improved dispatch reliability.

FMS–4200 is an optional system in Saab 2000 and is available as a single or dual installation. In addition, the FMS is available with single or dual GPS. The FMS 4200 contains the 8.33 kHz separation and has the capability to store pilot defined routes.

2. FUNCTIONAL DESCRIPTION.

2.1. Flight Management System. Individual Units.

The Flight Management System, FMS, consists of the following units:

– 1 Flight Management Computer, FMC.

– 1 Control Display Unit, CDU.

– 1 FMS Radio Control Switch.

– 1 Data Base Unit.

If a second FMS is installed, the following units are added:

– 1 Flight Management Computer 2, FMS 2.

– 1 Control Display Unit 2, CDU 2.

The following units are added if the FMS has GPS installed:

– 1 or 2 Global Positioning Sensors.

– 1 or 2 GPS Antenna Units.

2.2. Flight Management Computer, FMC.

The FMC is a plug–in module located in the IAPS Card Cage cabinet in the avionics rack. The FMC is the computational center of the FMS and includes a 2 Megabyte navigation data base.

2.3. Navigation Data Base.

The navigation data base contains waypoint information on VORs, DMEs, enroute intersections, non–directional beacons, and airports (including airport reference points, airport runway thresholds and airport terminal waypoints). In addition to waypoint data, the FMS–4200 data base includes airways, SIDs and STARs. The region of data base coverage is tailored to meet the needs of the user. The FMS stores the data base for two consecutive 28–day periods of effectivity.

The data base is loaded from a 3.5 inch floppy disk via the data base unit.

With a dual FMS installation, the data base must be loaded separately in each FMS.

2.4. Company Routes / Flight Number.

The FMS allows up to 1000 company routes to be stored in the data base. The routes are loaded from disk along with the navigation data base. The company routes are deleted whenever a new navigation data base is loaded.

Each company route may specify origin and destination airports, runways, departure and arrival procedures, and the route path. The enroute path may be specified in terms of airways and waypoints. A specific company route may be retrieved from the data base and loaded into a flight plan.

A company route may include the flight number. If not, the flight number may be manually entered on the first FPLN page. In both cases the flight number is automatically transferred to the EICAS system.

2.5. Control Display Unit, CDU.

The Control Display Unit, located on the center pedestal, is the interface between the flight management system and the pilots. Data and commands are entered to the FMS via the keyboard and information is displayed to the pilots through a multicolor cathode ray tube.

2.6. Keyboard.

The CDU keyboard has four different types of keys.

Data Entry Keys: The data entry keys are the 0–9 number keys, the A–Z letter keys, the DEL key, the CLR key, the period (.) , slash (/), plus/minus (+/–), and the space key.

Function Keys: The following keys are used to directly access certain functions of the FMS: INDEX, FPLN, LEGS, DEP–ARR, HOLD, DIR/INTC, FIX, SEC FPLN, RADIO, MFD–DATA, MFD–MENU, MFD–ADV, MSG, PROG, PERF, VNAV (inactive, part of a growth function), MCDU–MENU.

Line Select Keys: The CDU has six pairs of line select keys bordering the display. A line select key selects the function or data shown on the adjacent data line (if the function/data is active/selectable).

Miscellaneous Keys: NEXT PAGE, PREV PAGE, EXEC, arrow up, arrow down (arrow keys are inactive, part of a growth function).

2.7. Display.

The CDU display format consists of pages with 15 lines of 24 characters. There are two character sizes, large and small, available. The displayed data may be shown in six different colors. The display is arranged into a title line, six label/data line pairs, a scratchpad line, and an annunciator line.

Title Line: The title line contains a page title and an indication of page number when multiple pages are accessible.

Label/Data Line Pairs: There are six data lines arranged adjacent to the six line select keys. Above each of the six data lines is a label line commonly used to label data.

Scratchpad Line: A single scratchpad line is reserved on every page for data entry and for displaying messages to the crew. The scratchpad line is common to all pages and is not altered when a new page is displayed. Pressing any data entry key causes the appropriate character to be appended to the current scratchpad entry. Data from certain data lines may be entered into an empty scratchpad line by pressing the line select key adjacent to the data line. Data in the scratchpad may be entered into a data line by pressing the line select key adjacent to the data line. If the scratchpad data is accepted, the scratchpad is cleared. Attempts to enter invalid scratchpad data into a data line will result in an error message on the scratchpad line.

Annunciator Line: A single annunciator line is reserved on every page for annunciation of conditions requiring pilot attention or knowledge. The annunciations that may appear are:

OFFSET	A parallel offset track has been entered into the flight plan.
EXEC	The active flight plan has been modified and needs to be confirmed by pressing the EXEC key.
MSG	The message page holds messages. Press MSG key to display the message.

EXEC FPLN MOD Indicates that the modified flight plan has not been approved with the EXEC key.

2.8. FMS Radio Control Selector.

The FMS Radio Control Selector is a 3–way rotary selector situated on the OH. When the selector is in the middle position, NORM, the RTU:s and the FMS (via the RTU:s) have full access to the radios. If a failure to the FMS is blocking the normal RTU tuning of the radios, the FMS will be bypassed by setting the FMS Radio Control Selector to position OFF. This prevents the FMS from tuning any of the the radios.

The normal way for the FMS to tune the radios is via the RTU. If, for any reason, both RTU:s are unserviceable there is still a possibility to tune the left side radios from the FMS. By setting the FMS Radio Control Selector in position L RADIOS the FMS can tune the left side radios bypassing the RTU:s. This position overrides the setting of the RTU Radio Control Switch and both RTU:s will be blanked.

2.9. Dimming and Panel Lighting.

CRT dimming for the CDU is provided by the EICAS INT CTRL knob on the GLARESHIELD panel. CDU panel lighting is controlled by the PANELS knob on OH panel INT LIGHTS

2.10. Initialization.

The first page presented after power up is the STATUS page. This page displays the name of the navigation data base, the period of effectivity of the data base, time (UTC), date, and the FMS software configuration number. The UTC and DATE lines may be used to enter time and date if valid clock data is not being received.

The POS INIT pages allow initialization of the position of the FMS and IRS (if installed). On the POS INIT page the current FMS position is displayed. An entry line for airport is available. When on the ground the airport entry line is prefilled with the destination airport from last flight, if one has been defined. In any case, the pilot may enter the identifier of any airport in the data base. Following the airport entry, the location of the airport reference point is displayed to the right. This location may be copied into the scratchpad and entered into the SET POS line for position initialization. A line is also presented for a gate identifier. The entry of a valid gate identifier is allowed only after an airport has been entered. Such an entry will cause the location of the gate to be displayed. This location may also be used for position initialization.

Any time a sensor or the FMS requires initialization, the SET POS display line will indicate that an entry is required. Any entry into the SET POS line will cause the position of the FMS and IRS (if installed) to be initialized to the entry value. A value entered in the SET POS line will be dashed two minutes after the entry if the aircraft is airborne (or two minutes after take off if aircraft is on ground).

The second POS INIT page displays the current position and ground speeds of the FMS and the IRS/GPS. Any of the displayed positions may be copied into the SET POS line of the first POS INIT page. A line select option to update position from the received signals of a collocated VOR/DME is presented on the page. A line for entry of a navaid identifier is prefilled with the identifier of the closest collocated VOR/DME. Pressing the UPDATE FROM NAVAID line select key will place the position determined from the navaid in the scratchpad. This position is updated regularly from the received signals. A CONFIRM POS line select option is presented which when pressed will cause the FMS and the LRN:s to be updated to the displayed position.

Before takeoff the position of the FMS may be updated to the position of the runway threshold. On the LEGS page an option is presented for this function.

2.11. Flight Plans.

Flight plans and are defined as direct legs between waypoints may include airways, SIDs, STARs and parallel offsets. The flight plan waypoints are deleted from the flight plan as they are passed. The flight plan is presented on the CDU using the pages FPLN and LEGS. The FPLN pages present the flight plan in terms of airways, SIDs and STARs. The LEGS pages provide the detail of each leg of the flight plan. The system allows two flight plans to be available for viewing and editing. Each flight plan is independent of the other and none of them is active until the pilot specifically selects it for activation.

2.12. Flight Plan Entry.

Origin and Destination Airports

The first FPLN page allows the pilot to enter the origin and destination airports. These permit the FMS to present the proper SIDs, STARs and runways during entry of these items. Entering an origin airport will clear the flight plan if it exists.

Company Route

The first FPLN page does also allow the pilot to enter a company route. The company route may specify origin airport, destination airport, runways, SIDs, STARs, and other routing information.

Airway

Airways are edited into the flight plan from the FPLN pages. The entry process requires the pilot to specify the airway identifier, and in most cases the desired entry and/or exit waypoints on the airway.

Departure/Runway

SIDs may be edited into the flight plan from a DEPART page. Also the departure runway may be specified on this page. The origin airport entry is required to select a SID related to the departure airport.

Arrival/Runway

STARs may be edited into the flight plan from an ARRIVAL page. The destination airport entry is required to select a STAR or a runway threshold at the destination airport.

Direct Leg

Paths which are flown from one waypoint to another waypoint may be entered on the FPLN page. In this case the pilot does not enter data in the VIA field. Direct legs can be appended to the flight plan also on the LEGS page.

2.13. Flight Plan Editing.

Edits on FPLN Page
To change airways, SIDs or STARs the crew must edit the flight plan from the FPLN page.

Edits on LEGS Page
Waypoints defining individual legs in the flight plan may be edited on the LEGS page. Valid waypoint identifiers are those corresponding to navaids, NDB:s, airway intersections, airport reference points, and terminal waypoints associated with either origin or destination airports. In addition, the pilot may define waypoints by a place/bearing/distance specification, by an intersection of place/bearing with place/bearing, or by latitude/longitude. In these cases the FMC creates an identifier for the waypoint. On the LEGS page waypoints may be inserted, deleted and bypassed.

Holding Patterns
Holding patterns may be defined for each flight plan on the HOLD page. The pilot may select a flight plan waypoint, enter a non–flight plan waypoint, or select present position as the holding fix. After selecting a holding fix the HOLD page is prefilled with holding pattern parameters. Other holding pattern parameters can be specified by the pilot. The holding patterns depicted give an "idealized" representation.

To exit a holding press the EXIT HOLD line select key on the HOLD page. Conforming the flight plan change will cause the FMS to exit the holding pattern. After passing the fix the FMS will steer to the flight plan leg following the holding fix.

- Do not execute a modified flight plan before leaving the hold at holding fix.
- If leaving the hold at other points, use HDG mode until on approximate heading towards next waypoint and then select "direct to" and execute.

Parallel Offset
A parallel offset of up to 99 nm left or right of the entered flight plan may be established whenever an offset is allowed. Offsets are terminated at flight plan discontinuities, holding patterns, heading legs, and in certain other situations. A parallel offset is announced with OFFSET on the annunciator line of the CDU and on the PFD.

Direct To/Course Edit
A direct–to edit to the flight plan creates an active leg which is a great circle path from the aircraft position to the desired waypoint. The computed great circle path allows for the space required to turn the aircraft from the current heading to the required heading. In this way the aircraft will not perform an "S" turn to acquire the new course. A course edit is similar to direct–to except that the pilot specifies the great circle path into the desired waypoint by means of a course angle.

Heading Legs
Heading legs that are part of data base stored procedures are entered into the flight plan when the procedure is selected.

2.14. Inspection of Waypoints.

Waypoints stored in the data base may be inspected on the DATA BASE page. After entry of an ident the latitude, longitude and other relevant data is presented. Airport related data (runways and terminal waypoints) must be accessed by entering the airport identifier.

2.15. Fix Waypoints.

Pilot defined waypoints that are defined by the intersection of the active flight plan and selected radials or distances from a reference waypoint may be created on the FIX INFO page. The fixes defined can be displayed on the Multifunction Display.

2.16. Navigation.

The FMS accepts data from multiple navigation sensors and, using a Kalman filter, computes a position estimate. The primary mode of navigation uses all selected sensors. The FMS smooths the transients caused by changes in the available sensor data.

The data from each sensor is weighted according to its error characteristics so that the FMS position estimate is the best possible. The following table shows the priority of the different sensors in the FMS position solution:

1) GPS (if installed)
2) DME/DME
3) VOR/DME (range less than 40 nm)
4) IRS (if installed)
5) VOR/DME (range greater than 40 nm)
6) Dead reckoning

Rho/rho (distance/distance) navigation is performed for VOR/DME stations if it is valid, otherwise rho/theta (distance/radial) navigation is performed. The FMS navaid selection algorithm selects the best navaids in the area and automatically tunes the VOR and DME receivers to them. The algorithm accounts for station geometry, station class, altitude of aircraft, distance to station and other factors when selecting the proper navaids.

2.17. Steering.

From the Display Control Panel it is possible to select FMS as the navigation source to be displayed on the PFD and flown by the Flight Control System. The FMS provides smooth steering for all legs of the flight plan including holding patterns. The active leg is displayed as the first leg on the LEGS page of the active flight plan. The path of the active leg may be any of the following kinds:

Great Circle Track
The direct flight path between two fixed waypoints is computed as a great circle track. The FMS continually computes a roll steering command so that the ground track of the aircraft is on the computed great circle path.

Heading Leg
Certain departure and arrival procedures include heading legs. On these legs, the FMS steers to a constant heading. Within specified heading error limits, the FMS computes a roll command which is proportional to the heading error.

Holding Pattern
The FMS has the provisions for entry of holding patterns in the flight plan. The FMS will steer the appropriate entry procedure and the racetrack path of the holding pattern.

SID/STAR Legs
The FMS will steer all the common legs used by ARINC 424 data base suppliers to define SID:s and STAR:s.

Parallel Offset
The FMS will steer the pilot–entered parallel offset from the active flight plan. The parallel offset is canceled when any of the following conditions is encountered:

– Direct–To flight plan edit.

– Course Edit.

– Flight Plan Discontinuity.

– Flight Plan Course change of greater than 100 degrees.

– Sequence to a leg type that does not support offset path.

Turns
Turns are achieved by a nearly constant bank angle command computed by the FMS. The roll command provided by the FMS to effect a turn is calculated to be appropriate for the amount of heading change desired. For small heading changes a small maximum roll command is produced. During the turn, the FMS continuously recomputes the required bank angle using the current winds, airspeed and aircraft heading.

Roll Command Limits
The FMS receives and accounts for roll angle limits imposed by the autopilot.

Turn Anticipation
Turn anticipation is provided at all non–overfly waypoints. The turn anticipation accounts for the course change, current winds, the speed of the aircraft, and corner cut limitations.

Overfly Waypoint
Overfly waypoints are commonly used in departure and arrival procedures before heading legs. For such waypoints, the FMS steering algorithm sequences to the next flight plan leg at the time the waypoint is passed.

Off–Course
If the aircraft is significantly off the active flight plan path, the FMS steers toward the active flight plan leg with a course cut angle of up to 90 degrees.

Engaging FMS Lateral Steering
FMS lateral steering is engaged by selecting FMS as the active nav source on the Display Control Panel. At the time that the FMS determines that it is proper to begin lateral steering, it will issue a command to the Flight Control System which will cause the FMS generated steering commands to become active. FMS will begin lateral steering only if near the active flight plan leg.

Disengaging/Terminating FMS Lateral Steering
The FMS lateral steering may be manually disengaged. In addition to manually disengaging FMS steering, the steering provided by the FMS will terminate automatically at flight plan discontinuities, and at certain other conditions.

2.18. Radio Tuning.

The RADIO key on the CDU provides access to a CDU page which permits the tuning of COM, NAV, ADF radios and selection of the transponder code. The page also allows the pilot to select manual or automatic tuning of the NAV radios. The NAV radios may be tuned by frequency or station identifier. The FMS contains the 8.33 kHz frequency separation.

The radio tuning function depends on the setting of the FMS Radio Control Selector , see paragraph 2.8.

2.19. MFD Control.

The output to the MFDs enables two different types of map to be displayed. From the Display Control Panel the pilot can select either the Present Position Map or the Plan Map. The contents of the maps presented on the MFDs are controlled from the MFD MENU on the CDU. The MFD MENU allows the crew to select independently high level VORs, low level VORs, airway intersections, airports, terminal waypoints related to the origin or destination airports, NDBs, ALT, ETA and LRN position.

By pressing the MFD DATA key there is also a possibility to display FMS text data on the MFD. The actual data to be shown is selected from the MFD MENU on the CDU. FMS must be selected as the source for the MFD to show FMS text data. Selectable pages are progress page, nav status, position summary, LRN status and VOR/DME status.

Present Position Map
The Present Position Map displays geographically positioned FMS symbols representing airports, waypoints, holding patterns, procedure turns etc. The Present Position Map is a navigational map with the top of the map oriented to aircraft heading. Weather data can be superimposed on the map display.

Plan Map
The Plan Map displays geographically positioned FMS symbols representing airports, waypoints, holding patterns, procedure turns etc. The Plan Map is a True North–up map representation used for display of FMS flight plans. Any waypoint in the displayed flight plan can be selected as center of the map.

2.20. Progress Page.

The PROGRESS page is presented on the CDU when the PROG function key is pressed. The PROGRESS page shows distances and ATD/ATA/ETA for the departure, last passed waypoint, the TO waypoint, the waypoint after the TO waypoint and the destination. A second PROGRESS page shows wind, temperature, true airspeed and crosstrack distance.

2.21. Performance Calculation.

The following functionality is provided for system configurations supporting performance mode.

Predicted time, fuel remaining and altitude at each waypoint in the flight plan, destination and alternate destination are estimated on the basis of stored airplane climb, cruise and descent performance database and a fuel flow correction factor adjusted for each airplane. Top of climb and top of descent locations are calculated and descent path smoothing computations are performed.

The performance data base stored in the FMS consists of the following data tables:

Takeoff – distance travelled, time and fuel used vs airport elevation, gross weight and initial climb speed.

Climb – air distance travelled, time and fuel used vs altitude, gross weight and initial climb speed.

Cruise – fuel flow vs altitude, gross weight, IAS/Mach and ISA.

Descent – fuel used vs altitude, gross weight, IAS/Mach, ISA and VPA.

Approach – distance travelled, time and fuel consumed vs airport elevation, gross weight and final descent speed.

The performance calculations use the following data:

- flight plan route (origin, destination, waypoints, SID, STAR, approach, airway)
- speed/altitude restrictions at waypoints
- altitude dependent speed limit
- cruise altitude
- average wind in climb, cruise and descent
- wind on individual cruise legs
- climb, cruise and descent IAS/Mach speeds
- descent flight path angle
- gross weight
- initial fuel
- taxi fuel allocation
- reserve fuel allocation.

Speed altitude restrictions at waypoints are automatically initialized from the SID, STAR and approach specifications. Maximum climb power is assumed during climb.

Top of climb location is computed for each climb segment that terminates at a climb altitude constraint followed by an altitude hold segment or at planned cruise altitude.

Top of descent location is computed for each descent segment that terminates in a descent altitude constraint preceded by an altitude hold segment.

2.22. VNAV setup page.

Advisory Vertical Navigation, VNAV

The VNAV is a vigilance function to ensure that altitude constraints at waypoints are honored, that speed constraints at waypoints and speed limits at altitudes are honored, and that the vertical flight profile as specified by the pilot is followed.

FMS provides multiple waypoint Advisory VNAV for each phase of flight. Advisory VNAV can not be coupled to the flight control system. It can only provide visual information which you may use to fly the aiplane along a vertical path.

In a flight plan, each waypoint can show, as appropriate:

- an altitude constraint
- a vertical speed and direction
- a vertical path angle
- a speed constraint.

2.23. MCDU Menu.

The MCDU MENU key on the CDU gives access to a CDU page where the CDU may be selected as control head for ACARS, if ACARS is installed.

2.24. FMS System Monitoring.

The FMS continually performs sensor monitoring to assure a valid position estimate. A sensor with an unreasonable signal will not be used in the position estimate.

Data from the VOR and DME navaids will not be used if the FMS is within the cone of confusion of the navaid of if the FMS position is outside the service volume of the navaid. DME data is not used if the received identifier differs from the expected identifier or if a geometry constraint is not met. If poor rho/rho geometry is detected the FMS will revert to rho/theta navigation.

Position data from a sensor which is significantly different from the computed FMS position will cause an annunciation of CHK POS on the PFD together with an indication of the errant sensor on the CDU. Possible CDU messages are VOR–FMS DISAGREE, DME–FMS DISAGREE, IRS–FMS DISAGREE, GPS–FMS DISAGREE and FMS–FMS DISAGREE.

If GPS is the only sensor used for FMS position determining a message GPS ONLY is presented on the PFD/CDU. If an IRS is the sole sensor providing position information and the error model of the IRS indicates that the IRS may not meet the required accuracy an annunciation IRS ONLY is shown on the PFD/CDU.

The FMS will normally use the on–side heading source. When this source indicates invalid data the FMS will automatically begin using the cross–side heading source data. In the same manner the FMS will normally use the on–side air data source. When his source indicates invalid data the FMS will automatically begin using the cross–side air data.

The crew can manually monitor the FMS navigation. This is accomplished by selecting independent VOR and ADF bearings on the PFD and by checking that the tuned navaid arrows are well centered to the navaid symbols on MFD Present Position Map.

2.25. Dual FMS Installation.

With a dual FMS installation the two FMS operates in a synchronized mode. After approval of a flight plan the activated flight plan is transferred to the crosside FMS. Initialization of FMS position, selection of active data base and deselection of sensors are also communicated to the other FMS.

If both FMSs are selected as navigation sources,, the FMS which is the active nav source will control the flight plan leg sequencing. Each FMS will autotune only onside VOR/DME.

2.26. Global Positioning Sensor.

The Global Positioning Sensor processes the GPS signals received from the antenna, together with position and velocity aiding information from other aircraft systems, and outputs raw satellite measurement data and an autonomous position, velocity and time solution.

The Global Positioning Sensor is a 12 channel continuous tracking receiver using the L1 C/A code Standard Positioning Service. The system is automatic in operation and has no associated switches or other controls. The computed data is output to the FMS.

At power–on the Global Positioning Sensor initializes itself, carries out self tests and then acquires initialization data from the aircraft systems prior to selecting, acquiring and then tracking the GPS satellite signals. If there is no valid initialization data available, it enters a search mode where the Global Positioning Sensor tries to locate any satellites visible.

The GPS Antenna Unit receives signals from the GPS satellites and boosts them with an integrated preamplifier to compensate for transmission losses in the antenna cable. A filter blocks spurious signals.

2.27. GPS Operating Modes.

The GPS has the following operating modes:

– Initialization

– Acquisition

– Navigation

– Altitude Aided

– Aided.

Initialization Mode
The GPS enters initialization mode at power–up. The GPS hardware is initialized and internal tests are carried out. External strapping is read and the system configured for the required interface operation. If a short time power interrupt occurs, a warm start initialization will be performed if valid navigation parameters are stored in the memory. The warm start enables rapid return to normal operation.

Acquisition Mode
The acquisition mode is the period during which the system acquires, locks on to and begins tracking the satellite signals. When the conditions are met, the system will transition to either navigation mode or altitude aided mode.

If no valid initialization data is received, no stored warm start data is available; or, if no usable satellites are visible, the GPS enters a search mode. In this mode the system will search for any satellite it can find.

When a satellite is found its signal will be tracked and once four satellites are tracked a rough estimate of the position will be calculated. An iterative procedure is used to improve the initial estimate.

Navigation Mode
Navigation mode is the normal operating mode of the system. In addition to tracking the satellites the system is now required to generate measurements and estimate its position and velocity. In navigation mode the system tracks up to 12 satellites.

With initialization data available from the FMS, the time to first fix is approximately 75 seconds. Without this data the time extends to 10 minutes.

Altitude Aided Mode
This mode is entered when the GPS encounters adverse satellite coverage. A navigation solution is output, calculated by using pressure altitude. The system will continuously attempt to reacquire satellites to reenter navigation mode.

Aided Mode
When insufficient satellites are tracked to allow the GPS to stay in navigation or altitude aided mode, such as during aircraft maneuvering, GPS enters the aided mode. While in this mode, the GPS uses direction and speed to dead reckon the navigation solution. If direction and speed are not available, GPS reverts to acquisition mode.

The system will continuously attempt to re–acquire satellites to reenter either altitude aided mode or navigation mode.

2.28. GPS System Monitoring.

The system performs satellite integrity monitoring using internal hardware monitoring, satellite health monitoring (almanac and ephemeris data) and Receiver Autonomous Integrity Monitoring (RAIM) and produces a satellite integrity status. The satellite integrity status is output to the FMS which uses it to determine if the navigation solution meets the performance requirements for the current phase of flight. The satellite integrity monitoring isolates unhealthy satellites from the navigation solution.

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3. CONTROLS AND INDICATORS.

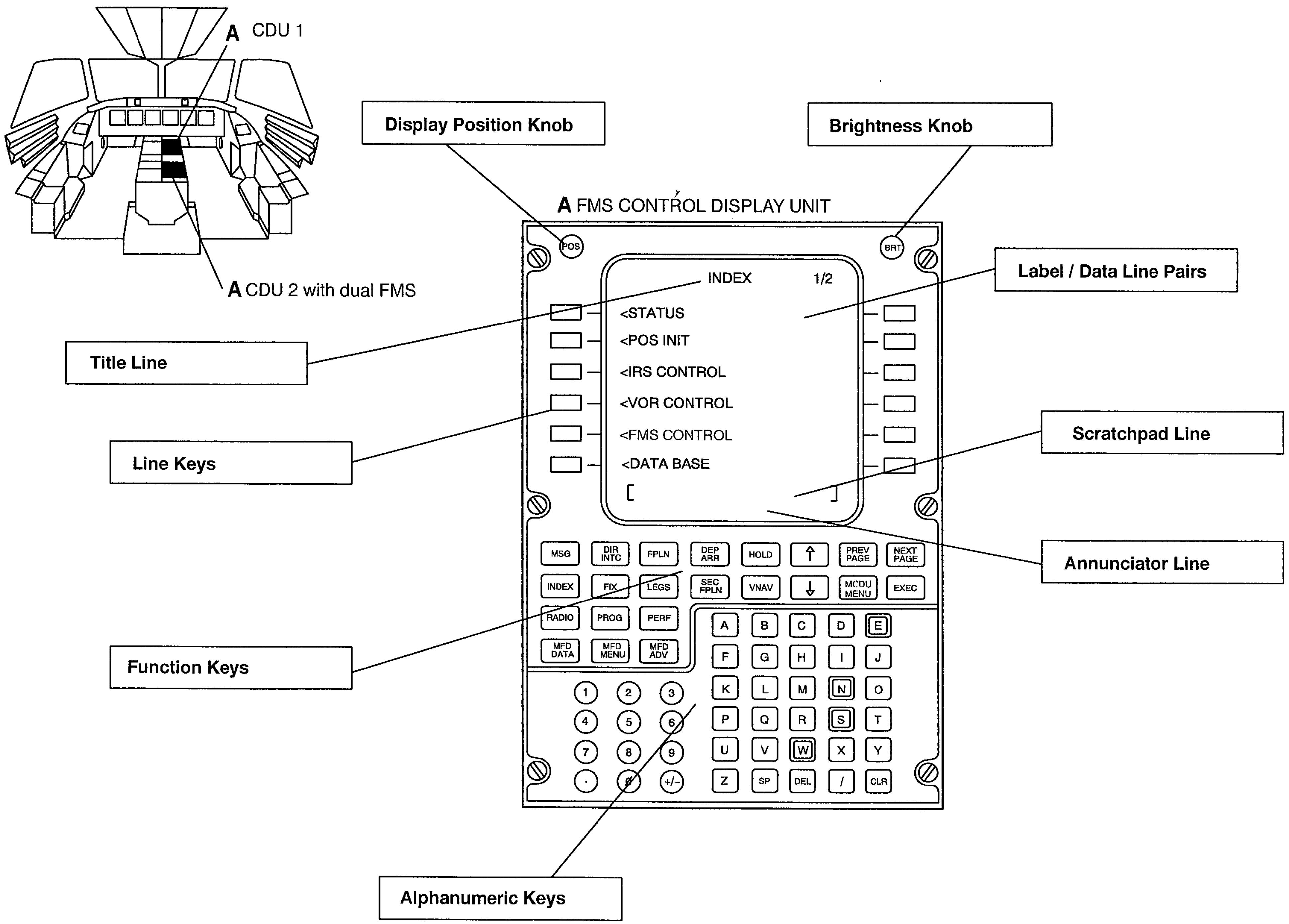


FIG. 1. FMS Control Display Unit, CDU.

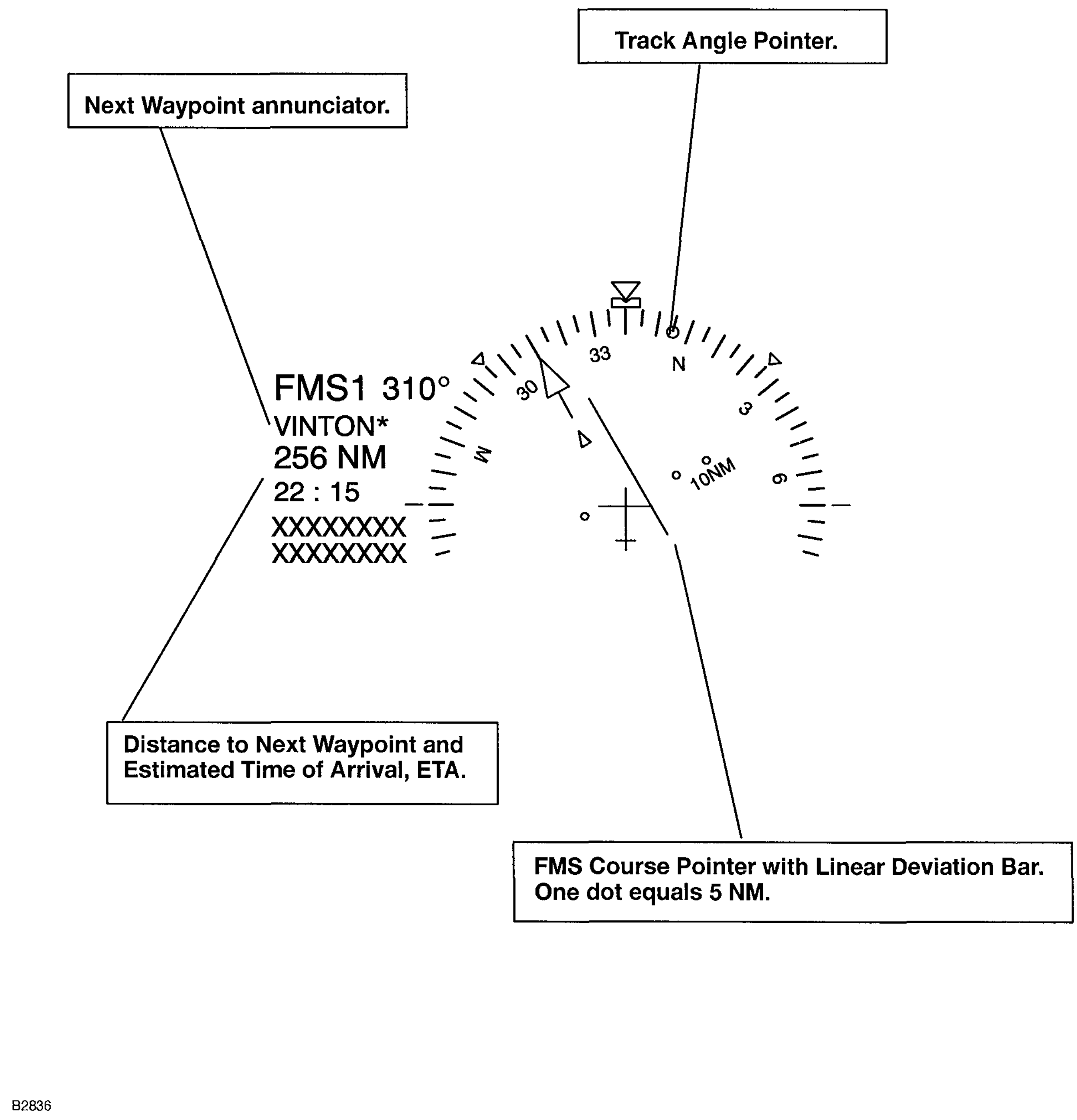
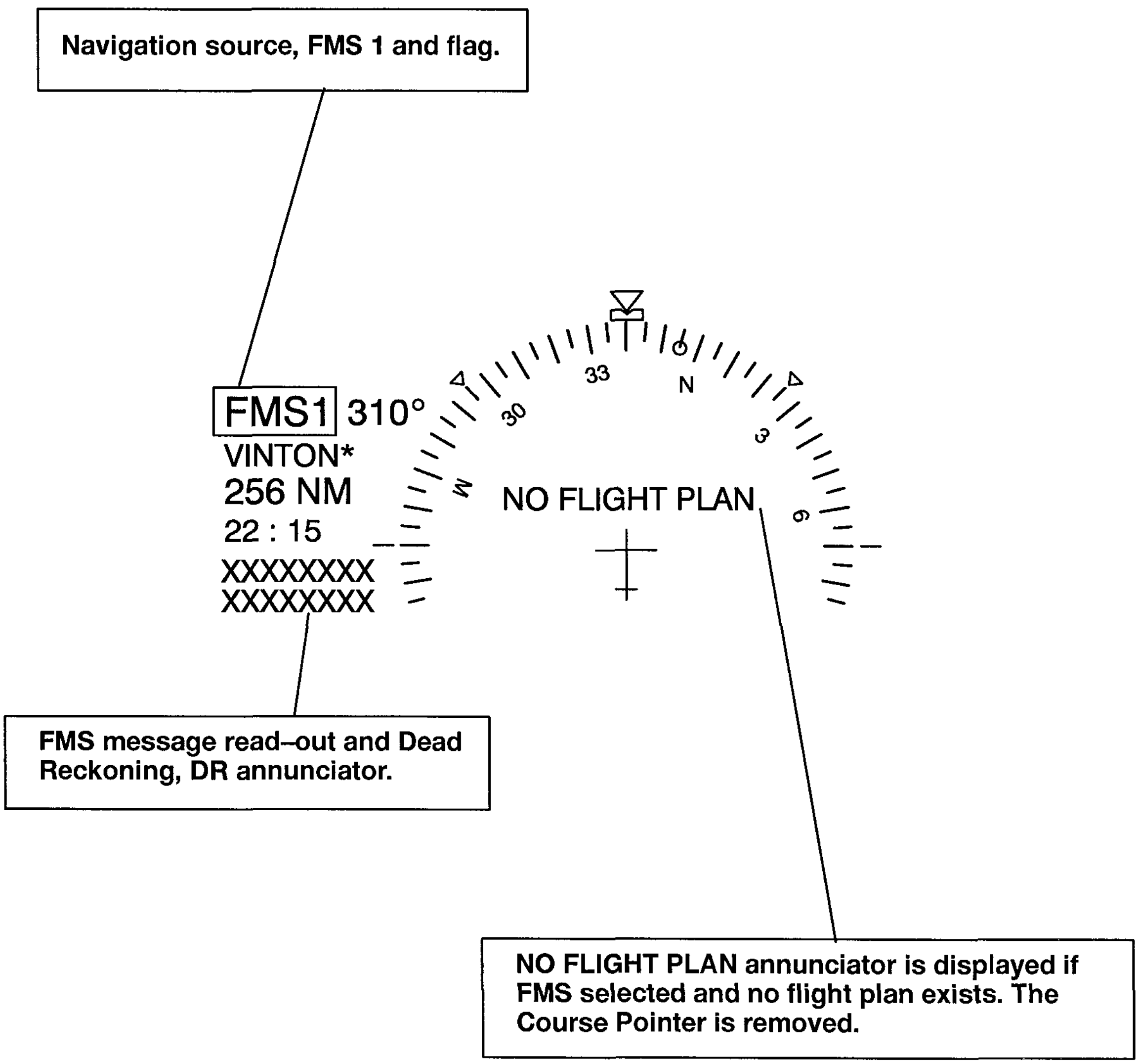
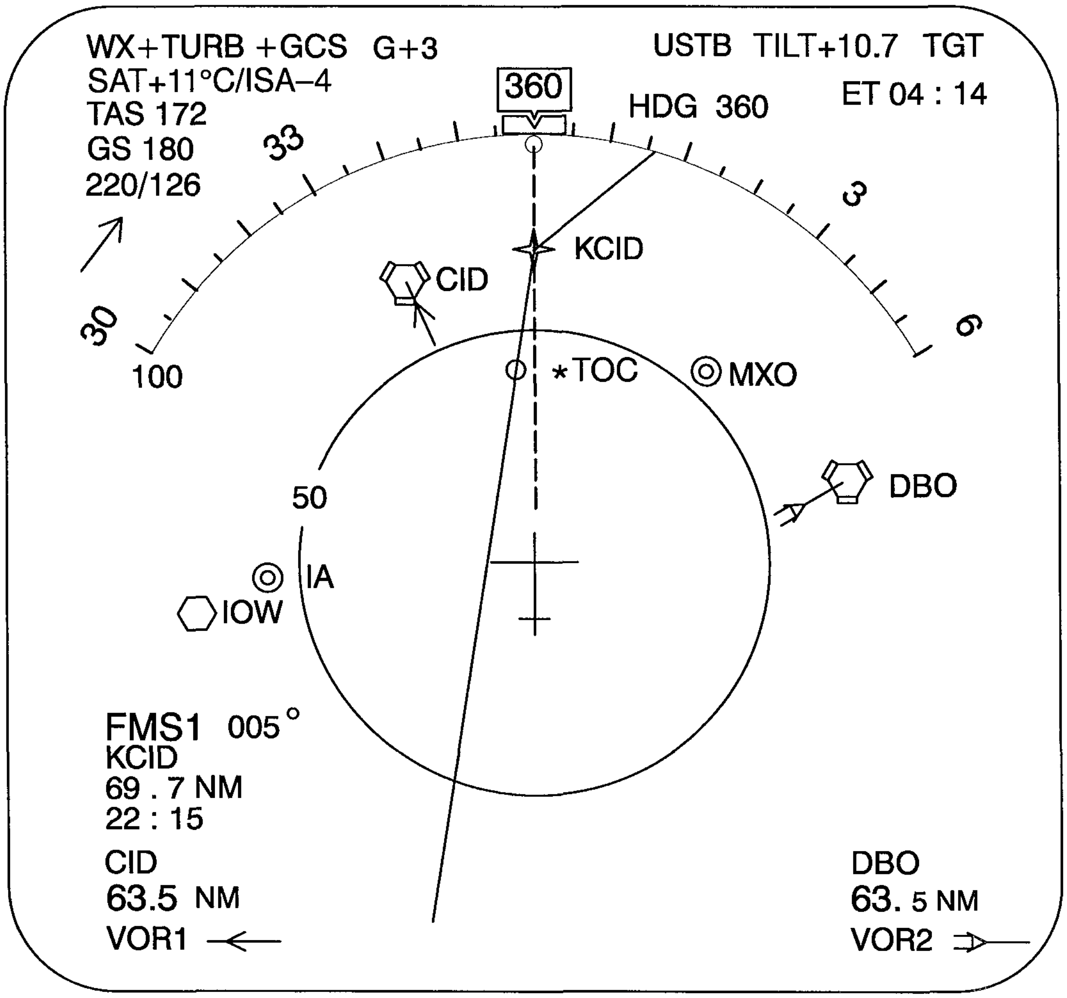


FIG. 2. FMS presentation on PFD.



B2837

FIG. 3. FMS flag and annunciators on PFD.



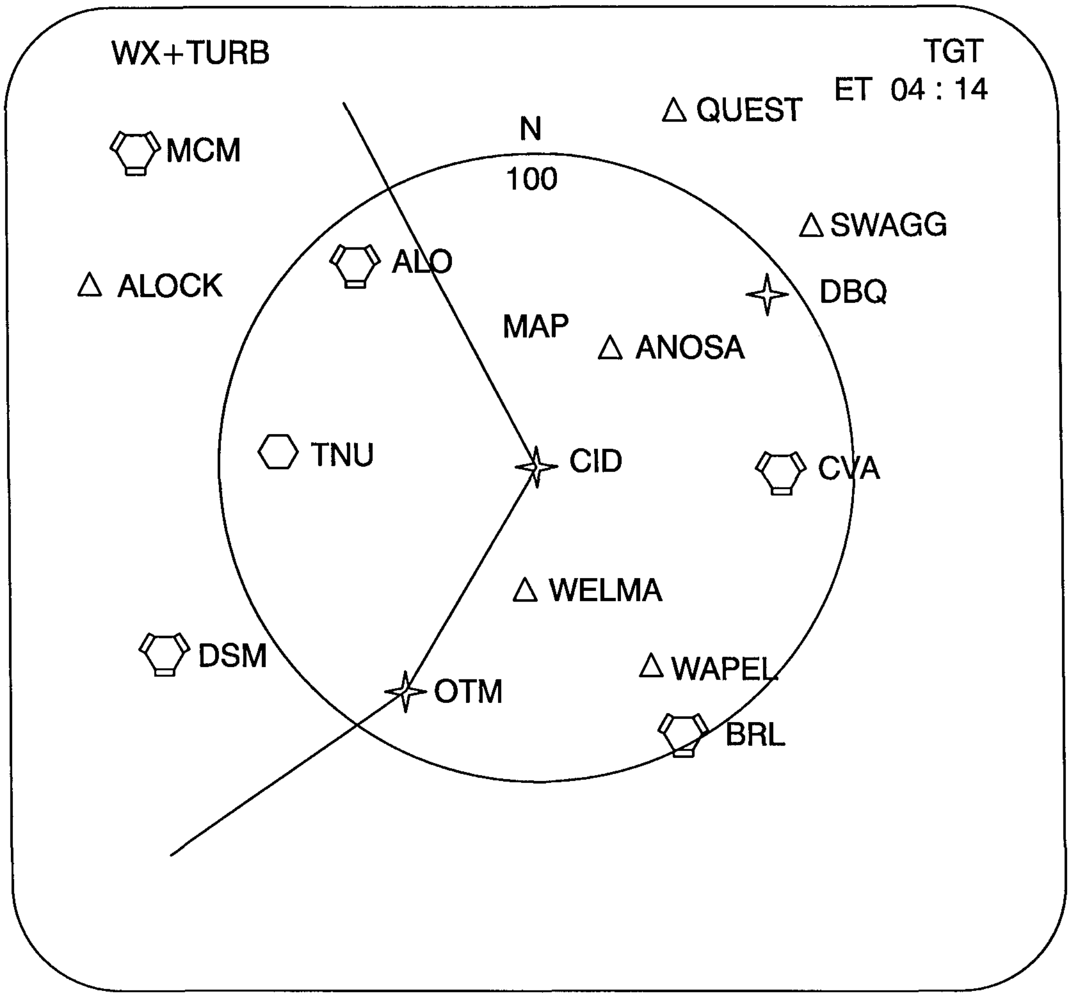
FMS Present Position Map mode shows a pictorial view of the relationship between the aircraft's present position and selected navaids and waypoints from the FMS navigation data base. The top of the map is oriented to aircraft heading.

FMS Present Position Map mode displays geographically positioned FMS symbols representing waypoints, airports, intersections, NDBs, VORs, VORTACs, TACANs, holding patterns, active flight plans and procedure turns. Weather radar can be superimposed on the MAP display.

B13761

FIG. 4. FMS Present Position Map mode on ND.

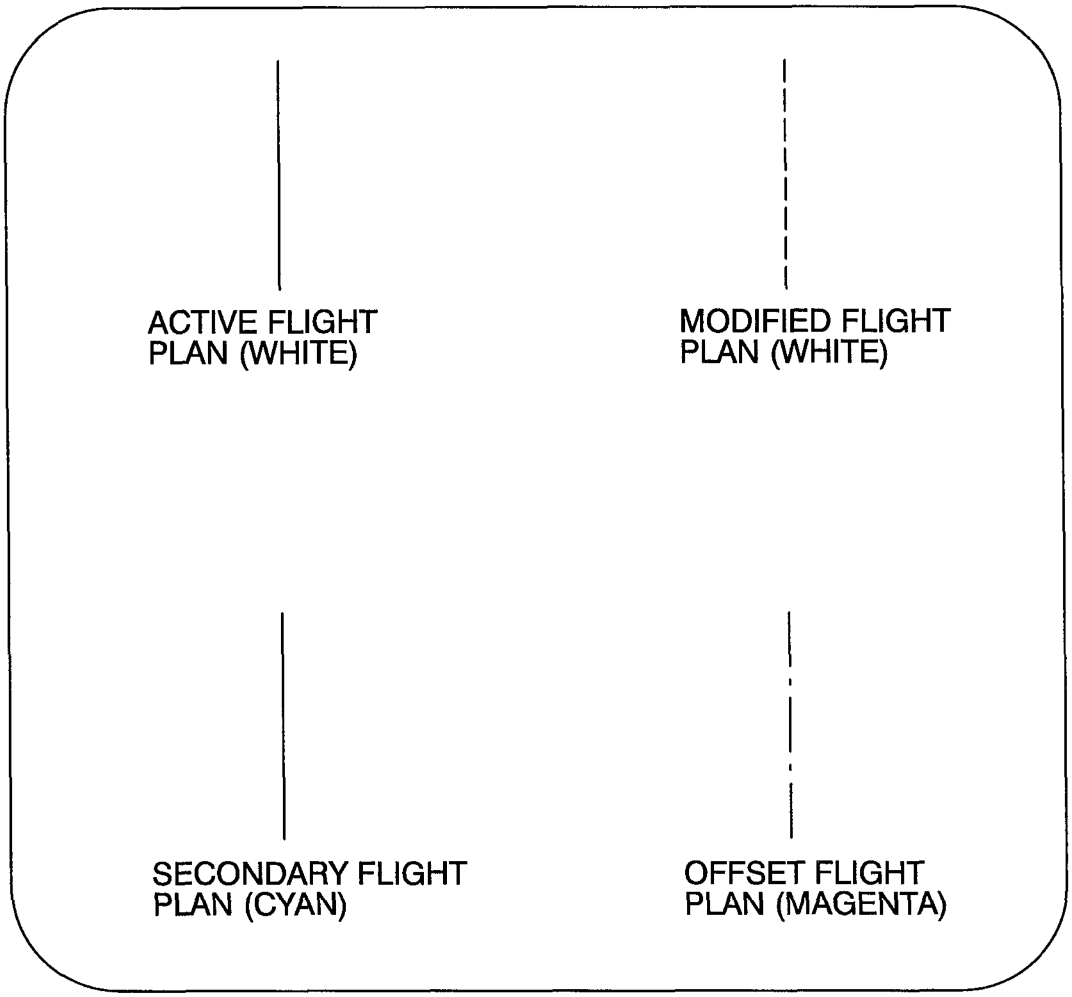
All symbology that is part of a flight plan is displayed in white, except for the next waypoint of the flight plan which is displayed in magenta. Map background symbology is displayed in cyan. All of the navaids can be identified with a string of up to seven characters. The identifier color matches that of the navaid it is associated with.



FMS Plan Map mode displays geographically positioned FMS symbols representing waypoints, airports, intersections, NDBs, VORs, VORTACs, TACANs, holding patterns, active flight plans and procedure turns. The top of the map is True North oriented.

B2839

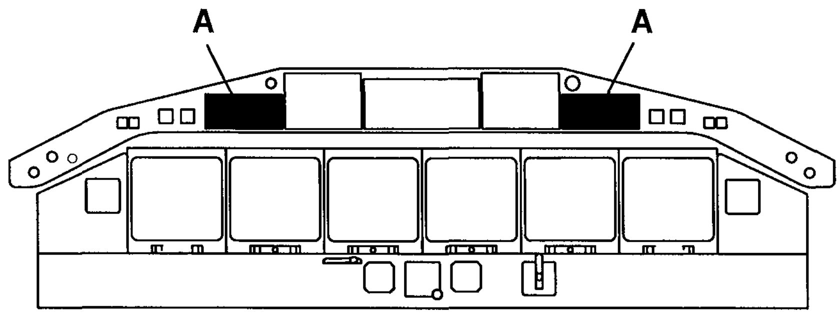
FIG. 5. FMS Plan Map mode on ND.



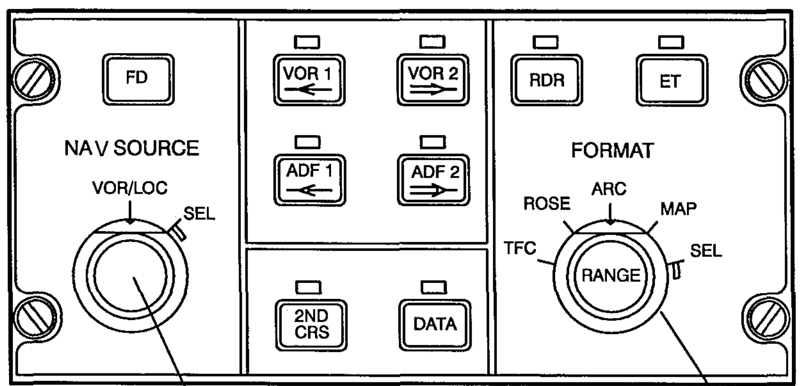
The flight plan path is indicated by a white line connecting the waypoint symbols which are part of the current flight plan. Alternate flight plans and offset flight plans are indicated by dashed vectors.

B2840

FIG. 6. FMS flight plan path and vector lines.



A DCP



NAV SOURCE selector

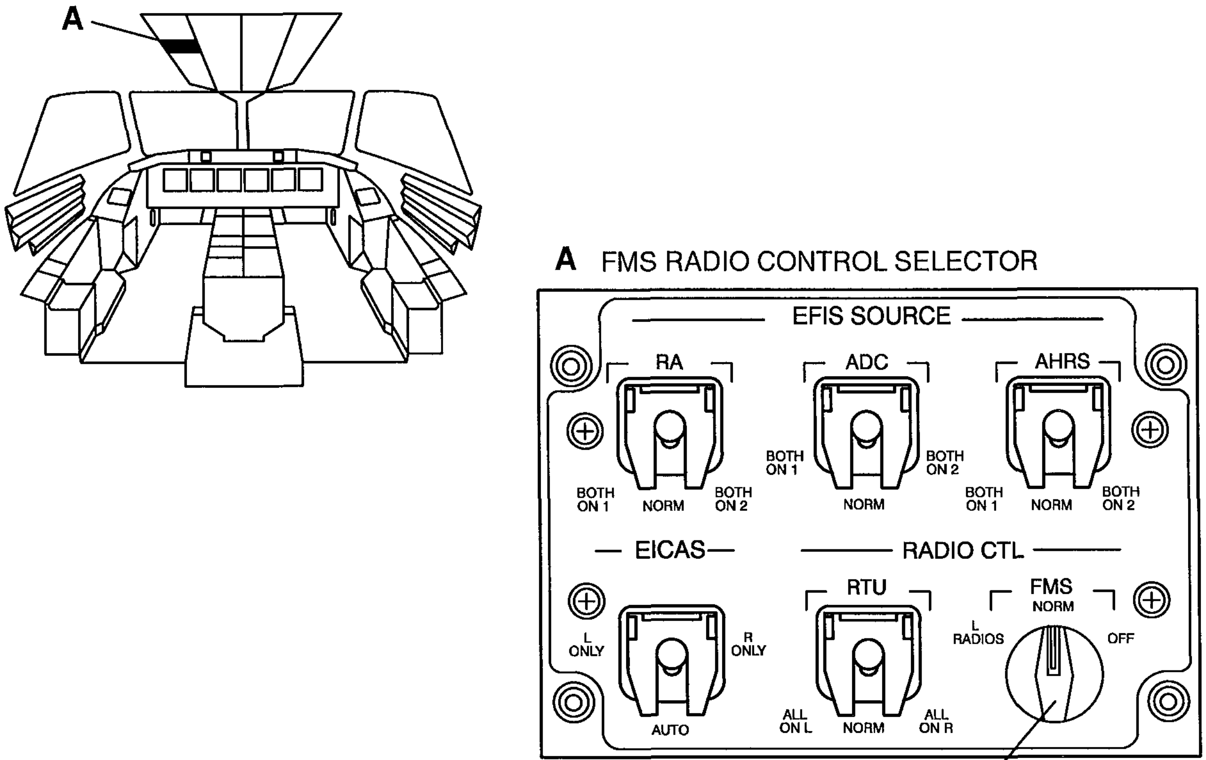
Selects the navigation source to be displayed on PFD and flown by the auto flight system. The VOR/LOC position selects the on–side navigation receiver. The SEL position provides selection of FMS.

ND FORMAT selector

MAP selects the FMS Present Position Map. The SEL position selects the FMS Plan Map.

B7471

FIG. 7. NAV SOURCE selector on the DCP.



FMS RADIO CONTROL SELECTOR

NORM
The RTUs and the FMS (via the RTUs) have full access to the radios.

OFF
If an FMS failure is blocking the normal RTU tuning of the radios, the FMS will be by-passed by setting the FMS Radio Control Selector to position OFF. This prevents the FMS from tuning any of the the radios.

L RADIOS
The normal way for the FMS to tune the radios is via the RTU. If, for any reason, both RTUs are unserviceable there is still a possibility to tune the left side radios from the FMS 1. By setting the FMS Radio Control Selector in position L RADIOS the FMS 1 can tune the left side radios bypassing the RTUs. This position overrides the setting of the RTU Radio Control Switch and both RTUs will be blanked.

B1825

FIG. 8. FMS Radio Control Selector.

4. ELECTRICAL POWER SUPPLY.

FMS 1 power supply	L AVIONICS BUS	G–16	L IAPS PWR
FMS 2 power supply	R AVIONICS BUS	N–16	R IAPS PWR
CDU 1	L AVIONICS BUS	G–21	FMS CDU 1
CDU 2	R AVIONICS BUS	N–22	FMS CDU 2
GPS 1 power supply	L AVIONICS BUS	E–14	GPS 1
GPS 2 power supply	R AVIONICS BUS	N–23	GPS 2

1. GENERAL.

The Selective Calling (SELCAL) System permits selective calling of individual aircraft over normal radio communications circuits linking a groundstation with the aircraft. The Selective Calling is accomplished by sending coded tone pulses from the ground transmitter to one of the aircraft transceivers and the Selcal decoder. SELCAL eliminates the need to monitor HF frequencies for incoming calls.

2. MAIN COMPONENTS AND SUBSYSTEM.

2.1. SELCAL.

The SELCAL system consists of a 5-channel, 16–tone call decoder and an aircraft code plug. One selective transceiver can be connected per channel. SELCAL interface with the following transceivers:

- VHF 1
- VHF 2
- HF 1 (if installed)
- HF 2 (if installed)

2.2. Code Selection.

Codes are assigned to each SELCAL equipped aircraft individually. Code selection in the aircraft is accomplished by programing of the code plug.

2.3. Call Annunciation.

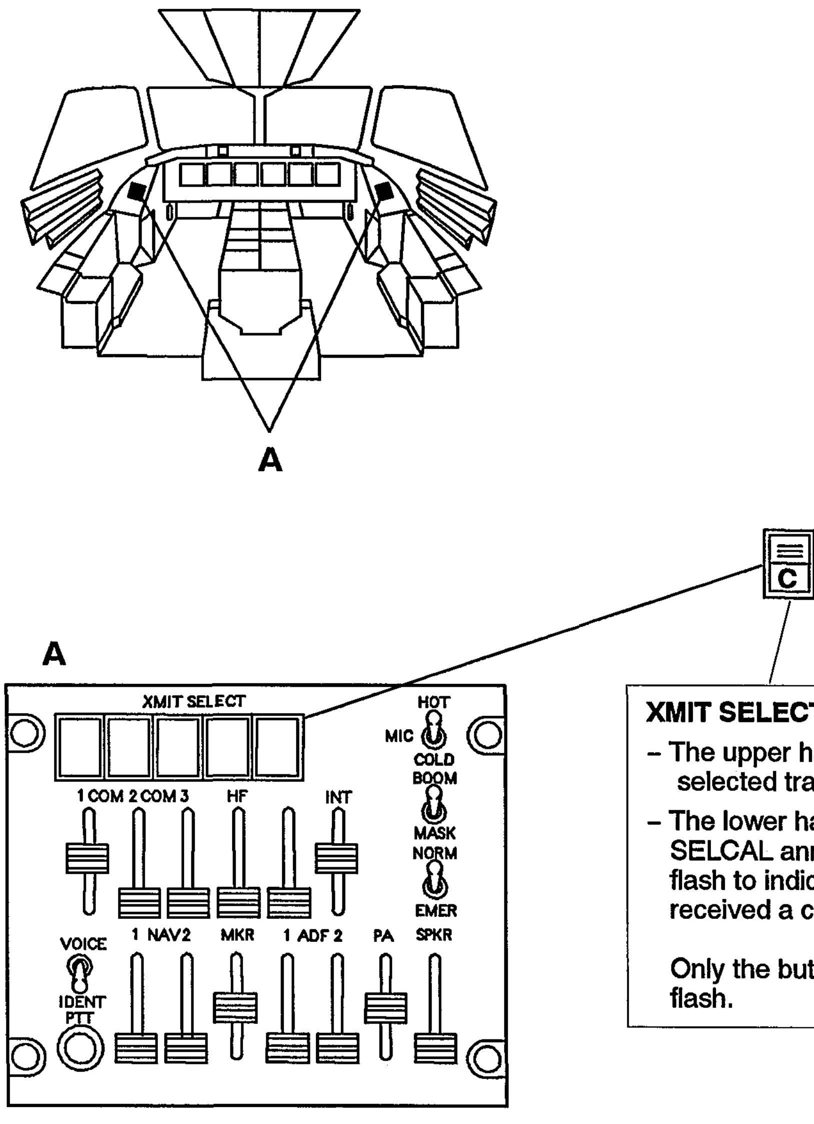
Visual annunciation of a call is accomplished by utilizing both the left and right audio control panels. The XMIT select buttons on the ACP have split legends. The upper half of the legend is used to indicate selected transmitter and the lower half of the legend is used by the SELCAL system to annunciate a received call. Aural annunciation is provided by double chime from the EICAS system. The chime will be repeated until the call is answered.

2.4. Operation.

The SELCAL Decoder is connected to both VHF– and both HF–transceivers. It monitors their audio outputs for the SELCAL tone codes. Upon receiving the code for which it is programmed SELCAL will alert the crew that a call has been received. The flashing button on the ACP indicates for which radio the call has been received. The SELCAL is automatically reset upon transmission when the call is answered.

2.5. SELCAL test.

A SELCAL test switch is provided for maintenance only.



XMIT SELECT pushbuttons

- The upper half of the button indicates selected transmitter.
- The lower half of the button is the SELCAL annunciator. The button will flash to indicate that the SELCAL has received a call.

  Only the button of the "called" radio will flash.

B8003

FIG.1. SELCAL annunciators on the ACP.

4. ELECTRICAL POWER SUPPLY.

SELCAL power supply .... R AVIONICS BUS L – 17 SELCAL

1. GENERAL.

The optional Head–Up Display System (HUD) is an electronic and optical system which generates and displays information in the left pilot forward field of view. The display is focused at optical infinity with flight and navigational data presented conformal to the real world. The displayed information is derived using existing aircraft instrument and sensor data.

The HUD System provides information for use during all phases of flight, including takeoff, visual approach. In addition to situational information, the system also calculates and displays guidance for CAT I (AI), CAT II (AII) or CAT IIIa (AIII) precision approach and landing operations.

The basic flight information like the attitude, speed, altitude, flight path, guidance and other parameters displayed in symbolic format on the HUD is similar to the information displayed on the Primary Flight Display (PFD). HUD information for monitoring, is provided on the right PFD. Voice annunciation is provided by the Ground Proximity Warning System (GPWS), when the aircraft is approaching Decision Height and when it reaches Decision Height".

HUD operation is described in chapter 24/10 and 24/14.

For detailed description and operation, see FLIGHT DYNAMICS HGS Pilot Guide for the Saab 2000.

2. FUNCTIONAL DESCRIPTION.

2.1. Main components and subsystems.

The Head–Up Display System (HUD) consists of the following units:

- Head–Up Guidance Computer (HGC), located in the avionics rack.
- HUD Control Panel (HCP), located on the center pedestal.
- Overhead Unit (OHU), located in the cockpit left side ceiling.
- Combiner, located above the windshield in the cockpit left side ceiling.

The HGC derives the display information from the aircraft sensor and instrument inputs. The HGC provides the X and Y deflection signals and brightness signal to the OHU. These signals are derived from internal calculations which determine the position and form of the flight symbology to be presented, dependent on the aircraft equipment and sensor data received by the HGC.

The HCP is used for mode selection, entering aircraft approach parameters (Runway Elevation and Reference Glideslope), HCP display brightness levels, and the HUD system test.

The OHU contains a CRT on which flight symbology is generated and a relay lens assembly for projecting the symbology on to the Combiner.

The Combiner is a Holographic Optical Element (HOE) which optically combines displayed flight symbology with the pilot view through the aircraft windshield. This optical design permits various symbols, like the artificial horizon, to overlay corresponding features of the outside world. The Combiner also displays the flight symbology at optical infinity, allowing the pilot to see the information without eye movement or a shift in eye focus. Two modes of brightness control can be selected, automatic or manual. For manual control the control knob is pushed in and for automatic control it is pulled out. Automatic brightness control uses an Ambient Light Sensor mounted on the combiner. The automatic brightness control adjusts the brightness level so that a constant contrast ratio is maintained. The value of the constant display contrast ratio can be adjusted by turning the control knob. The position of the Combiner is continuously monitored by the Combiner Alignment Detector (CAD). The Combiner has three possible positions: the operating position, a stowed position and a break away position should the Combiner be inadvertently pushed towards the windshield.

The HUD System uses information from the following systems:

Inertial Reference Systems 1 and 2

Air Data Systems 1 and 2

VOR/ILS systems 1 and 2

Radio Altimeter Systems 1 and 2

Flight Control System (FCS)

Integrated Avionics Processing System (IAPS)

HUD System outputs HUD–data to the Electronic Flight Instrument System (EFIS) and EICAS System via IAPS.

2.2. GPWS callouts.

Although the HUD System has no physical connection to the Ground Proximity Warning System (GPWS), the GPWS for the HUD option is strapped to provide the following call outs during approach:

"1000, 500, 400, 300, 200, 100, 50, 40, 30, 20, 10". "MINIMUMS" replaces the callout at the Decision Height (DH).

With the HUD System installed, these callouts will always be provided during approach, regardless of whether the HUD is used or not.

In addition a Bank angle warning has been included. The roll angle limit for this warning varies linearly from 6 degrees at 0 feet Radio Altitude to 40 degrees at and above 150 feet Radio Altitude. When the roll angle exceeds this limit for 0.2 seconds or more, two "BANK ANGLE" voice messages are given with the standard 0.75 second delay between messages.

3. OPERATION.

The HUD System provides basic flight information like attitude, speed, altitude, flight path and others to the pilot in symbolic format. The basic flight information displayed on the combiner is similar to the information displayed on the Primary Flight Display (PFD).
However, some additional information is only displayed on the PFD (e.g. analog vertical speed and with FMS 4200 installed, vertical speed advisory).
Basic flight information is available during all phases of flight. The system calculates and displays guidance for CAT I (AI), CAT II (AII) and CAT IIIa (AIII) precision approaches and landings or shows equal information of the FCS guidance presented on the pilot's PFD, depending on the selected mode. Pilot selectable parameters required for HUD operation are entered on various cockpit control panels. The parameters entered are displayed on the combiner during the appropriate phase of flight. The parameter value displayed is the value used by the HUD.

The HUD Control Panel is used to select Operating mode and to enter Runway Elevation (ELEV) and Reference Glide Slope angle (G/S). Two different Glide Slope angles can be entered, one to be used in Primary and Approach Modes, indicated by an I on the G/S line of the HCP, and one to be used in VMC Mode, indicated by a V on the G/S line of the HCP.

3. 1. Display Symbology.

Each of the modes has a separate set of symbology. The symbology of the primary mode is similar to the symbology on the PFDs and contains the same information.

The VMC mode symbology is similar to the approach modes symbology, but guidance, glideslope deviation and localizer deviation is not displayed.

The approach modes uses a very limited set of symbology, i.e. the display is de–cluttered and only the most needed information is displayed.

3.2. Modes.

The HUD System can operate in the following modes:

PRI	Primary Mode (startup mode)
AI	CAT I Approach Mode
AII	CAT II Approach Mode
AIII	CAT IIIa Approach Mode
VMC	Visual Meteorological Conditions Mode

It can also be used to monitor an FCS guided CAT I or CAT II approach, where the HUD presents FCS computed guidance on the combiner. In this case the Primary Mode is used.

3.3. Mode Selection and Annunciation.

The Primary Mode is the basic mode, automatically achieved at Power–up and when the go–around palm switches are pressed. The VMC mode is selected manually on the HCP.

Approach mode is achieved when the following conditions are fulfilled:

- FCS Approach (APPR) mode selected.
- LOC and G/S capture.
- Approach mode capability criteria fulfilled.
- DH set within the interval corresponding to the approach category below:
  - ° for AIII approach set DH within 50 – 89 ft.
  - ° for AII approach set DH within 90 – 149 ft.
  - ° for AI approach set DH 150 ft and above or DH inoperative on both sides.
- A/P disconnected.

Applicable Approach mode will be selected automatically if it was pre–selected to the standby line (STBY) on the HCP and all approach criteria are met. When approach criteria are met and the autopilot is still engaged, AIII, AII or AI (in small size letters) will be displayed on the combiner below PRI (Primary mode). After disengaging the autopilot, the Combiner display changes to approach mode, announced by AIII, AII or AI. In addition and for monitoring, both PFDs will show a green AIII, AII or AI. If the autopilot is not disconnected before descending below 1000ft AIII will flash on the combiner and a white AIII will flash on the PFDs. The autopilot must be disconnected before descending below 500ft AGL, otherwise NO AIII, NO AII or NO AI will be displayed on the combiner and latched; also an amber AIII, AII or AI will be shown on both PFDs. Recovery can only be achieved by go–around and a new approach. In AI and AII a white AI or AII will be displayed on the PFDs as soon as the capability criteria are fulfilled.

After touchdown the system will remain in approach mode but the combiner display will change to "ground roll mode", decluttered to show only necessary information for the roll out phase.

3. 4. HUD Control Panel (HCP).

The following is a simple description of HCP indications and HUD/PFD annunciations in the different modes.

Primary and VMC mode:

MODE	PRI			After power up
STBY	VMC			Guidance from FCS
ELEV	167	FT		
G/S	3.00°		I	

MODE	VMC			VMC mode selected
STBY	PRI			No guidance
ELEV	167	FT		
G/S	4.50°		V	

Category III approach mode (AIII):

MODE	PRI			DH set to 50
STBY	VMC			AIII capability criteria not met
ELEV	167	FT		HUD/PFD FMA: HDG <AP VS
G/S	3.00°		I	Guidance from FCS

MODE	PRI			AIII capability criteria met
STBY	AIII			Autopilot engaged
ELEV	167	FT		HUD/PFD FMA: LOC1 <AP G/S
G/S	3.00°		I	Guidance from FCS

MODE	AIII			Autopilot disengaged
STBY				HUD/PFD FMA: YD HUD
ELEV	167	FT		Guidance from HUD
G/S	3.00°		I	AIII on combiner, green AIII on PFDs

MODE	AIII			After Touch down
STBY	PRI			HUD/PFD FMA: YD HUD
ELEV	167	FT		Guidance cue removed
G/S	3.00°		I	AIII on combiner, green AIII on PFDs

Category II approach mode (AII):

MODE	**PRI**		
STBY	**VMC**		
ELEV	**167**	**FT**	
G/S	**3.00°**		**I**

DH set to 100
AII capability criteria not met
HUD/PFD FMA: HDG <AP VS
Guidance from FCS

MODE	**PRI**		
STBY	**VMC**	**AII**	
ELEV	**167**	**FT**	
G/S	**3.00 °**		**I**

AII capability criteria met
HUD/PFD FMA: LOC1 <AP G/S
Guidance from FCS

MODE	**PRI**		
STBY	**AII**		
ELEV	**167**	**FT**	
G/S	**3.00°**		**I**

AII selected to STBY
Autopilot engaged
HUD/PFD FMA: LOC1 <AP G/S
Guidance from FCS

MODE	**AII**		
STBY			
ELEV	**167**	**FT**	
G/S	**3.00°**		**I**

Autopilot disengaged
HUD/PFD FMA: YD HUD
Guidance from HUD
AII on combiner, green AII on PFD's

MODE	**AII**		
STBY	**PRI**		
ELEV	**167**	**FT**	
G/S	**3.00°**		**I**

After Touch down
HUD/PFD FMA: YD HUD
Guidance cue removed
AII on combiner, green AII on PFD's

Category I approach mode (AI):

MODE	**PRI**		
STBY	**VMC**		
ELEV	**167**	**FT**	
G/S	**3.00°**		**I**

DH set to 200
AI capability criteria not met
HUD/PFD FMA: HDG <AP VS
Guidance from FCS

MODE	**PRI**			AI capability criteria met
STBY	**VMC**	**AI**		HUD/PFD FMA: LOC1 <AP G/S
ELEV	**167**	**FT**		Guidance from FCS
G/S	**3.00°**		I	

MODE	**PRI**			AI selected to STBY
STBY	**AI**			Autopilot engaged
ELEV	**167**	**FT**		HUD/PFD FMA: LOC1 <AP G/S
G/S	**3.00°**		I	Guidance from FCS

MODE	**AI**			Autopilot disengaged
STBY	**VMC**	**PRI**		HUD/PFD FMA: YD HUD
ELEV	**167**	**FT**		Guidance from HUD
G/S	**3.00°**		I	AI on combiner, green AI on PFD's
				VMC selectable for circling or visual approach

MODE	**AI**			After Touch down
STBY	**PRI**			HUD/PFD FMA: YD HUD
ELEV	**167**	**FT**		Guidance cue removed
G/S	**3.00 °**		I	AI on combiner, green AI on PFD's

3.5. System Monitoring.

The System Monitor monitors sensor data validity, critical symbols and performs sensor data comparisons.

3.6. Performance Monitoring.

During an approach the pilot must follow the HUD guidance displayed on the combiner accurately, i.e. he must control speed and flightpath within specified limits. If the aircraft is flown outside these monitor limits an "APPR WARN " message is displayed on the combiner and both PFDs and a go–around must be initiated.

3.7. EFIS/EICAS Indications.

The following HUD related annunciations can be shown on the PFDs. All annunciations will be displayed on both sides, but used by the monitoring pilot:

- HUD in green replaces the AP/FD status annunciation (AP) when the flight director source is HUD (approach).
- AI / AII / AIII in green for HUD Approach Mode annunciation. White between 1000 and 500 ft AGL when mode available and AP engaged.
- AI / AII / AIII in amber indicating that HUD approach conditions are not fulfilled or AP still engaged below 500 ft AGL.
- APPR WARN, boxed, in red for approach warning and annunciation for loss of approach capability (AI / AII / AIII)below 500 ft AGL.
- FLARE in green.
- IDLE in green.
- HUD, boxed, in red for failed HUD System.

Two white status messages can be displayed on the Secondary EICAS Display (SED):

- CAT III INOP indicating that AIII mode will not be available.
- HUDS INOP indicating that the Head–Up Display System is inoperative.

3.8. Built–In Test (BIT).

The HUD contains a self test function which continuously determines the operational status of the HUD subsystems. The BIT covers power supplies, CRT deflection circuitry, input converters, processors, processor memory, program execution, shared RAM and combiner alignment. An OHU fault or a BIT detected fault in the main processing path of the HUD computer blanks the display so that no misleading information can be displayed.

A self test can also be performed via the TEST button on the HCP, on ground only.

The type of detected fault is displayed by a Fault Code on HCP display. The Fault Codes indicate faults and errors as follows:

FF	Program Flow Monitor Fault
01	HUD Computer Fan Failure
10 – 27	HUD Computer IOS Faults
31 – 39	HUD Computer CLP Faults
40 – 49	HUD Computer SM Faults
50 – 57	HUD Computer VG Faults
60	OHU Inactive
61 – 75	OHU Faults
76	OHU/Combiner Ambient Light Circuit Error
77	OHU Fan Failure
78	OHU CAD (Combiner Alignment Detector) circuit alignment failure
88	Test Mode (Operator Initiated BIT in progress)
90	HCP Inactive
91 – 97	HCP Faults
B1	Combiner Alignment Fault
B2	Combiner Stow sensing failure or Combiner Alignment sensing failure

An additional indication that a BIT detected failure has occurred is displayed by the fault message sent to the EICAS. The message displayed on Secondary EICAS Display (SED) is HUDS INOP or CAT III INOP.

Should any Fault Codes be presented on the HCP display after power up, contact maintenance.

5. CONTROLS AND INDICATORS.

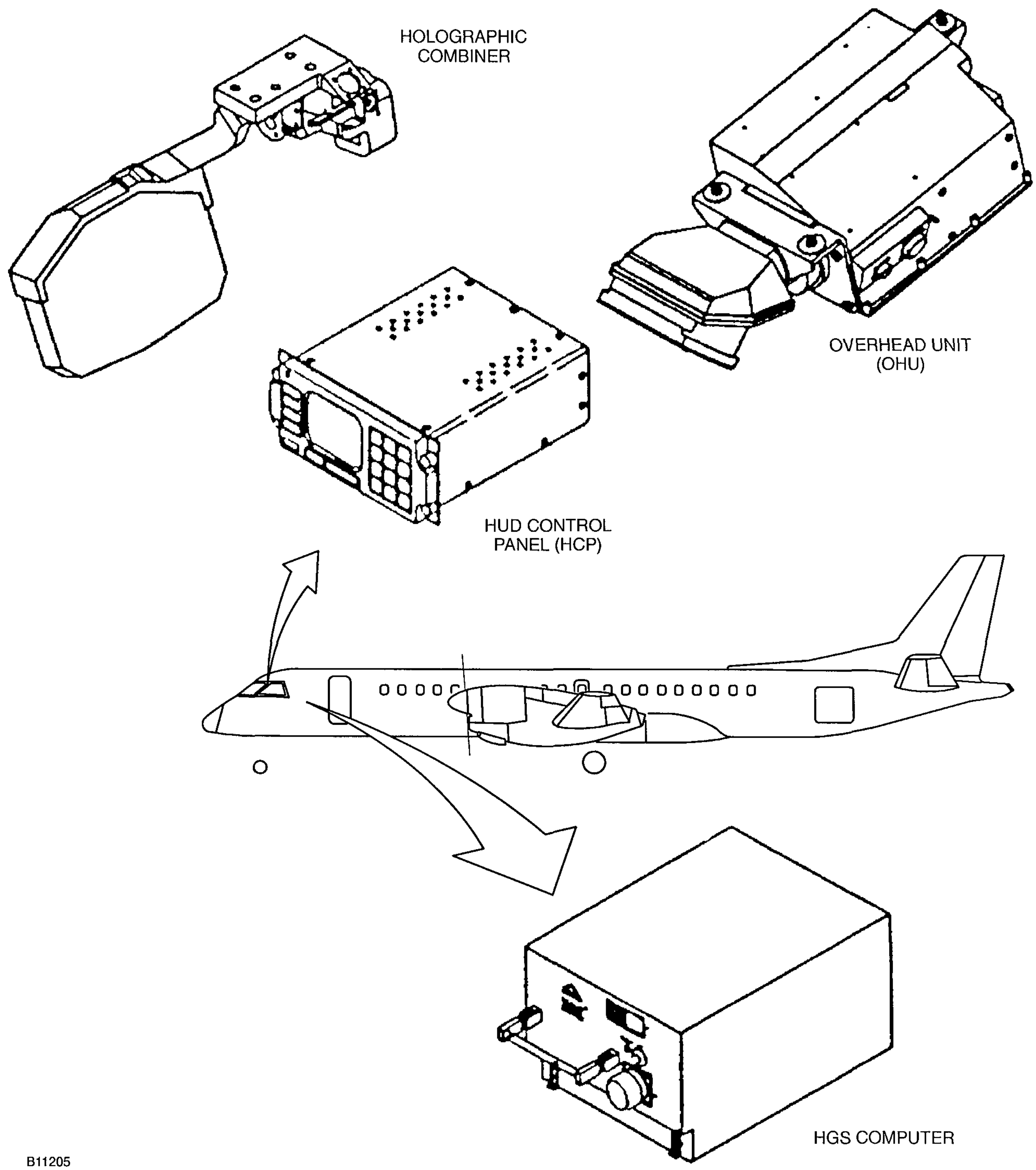
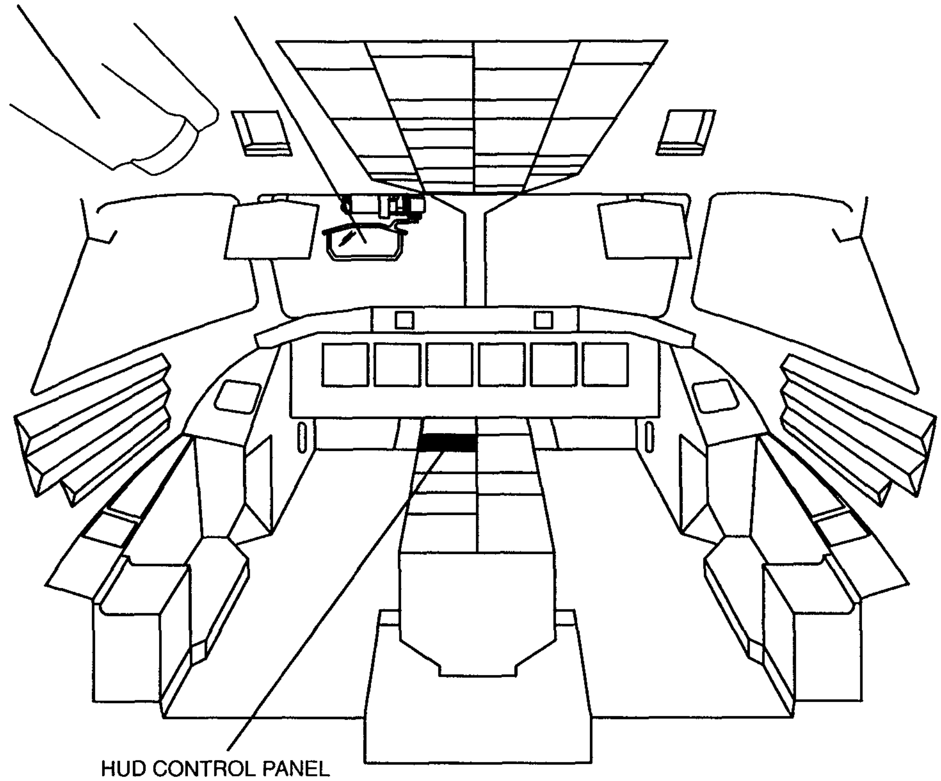


FIG.1. HUD–component location.



B9281

FIG.2. HUD–cockpit location.

The combiner has a breakaway feature that allows it to be moved forward from its normal operating position during a high G decleration. As the combiner rotates forward it engages a latch mechanism to keep it in the breakaway position. The breakaway latch is located on the front surface, opposite the stow release lever. The latch must be manually released to return the combiner to the normal operating position.

The combiner contains an infra–red optical sensing system to precisely monitor the operating position of the combiner. An out–of–tolerance condition results in a boxed "ALIGN HUD" message being displayed on the combiner, gently push the HOE frame forward and allow it to spring back to the detent position to eliminate the message.

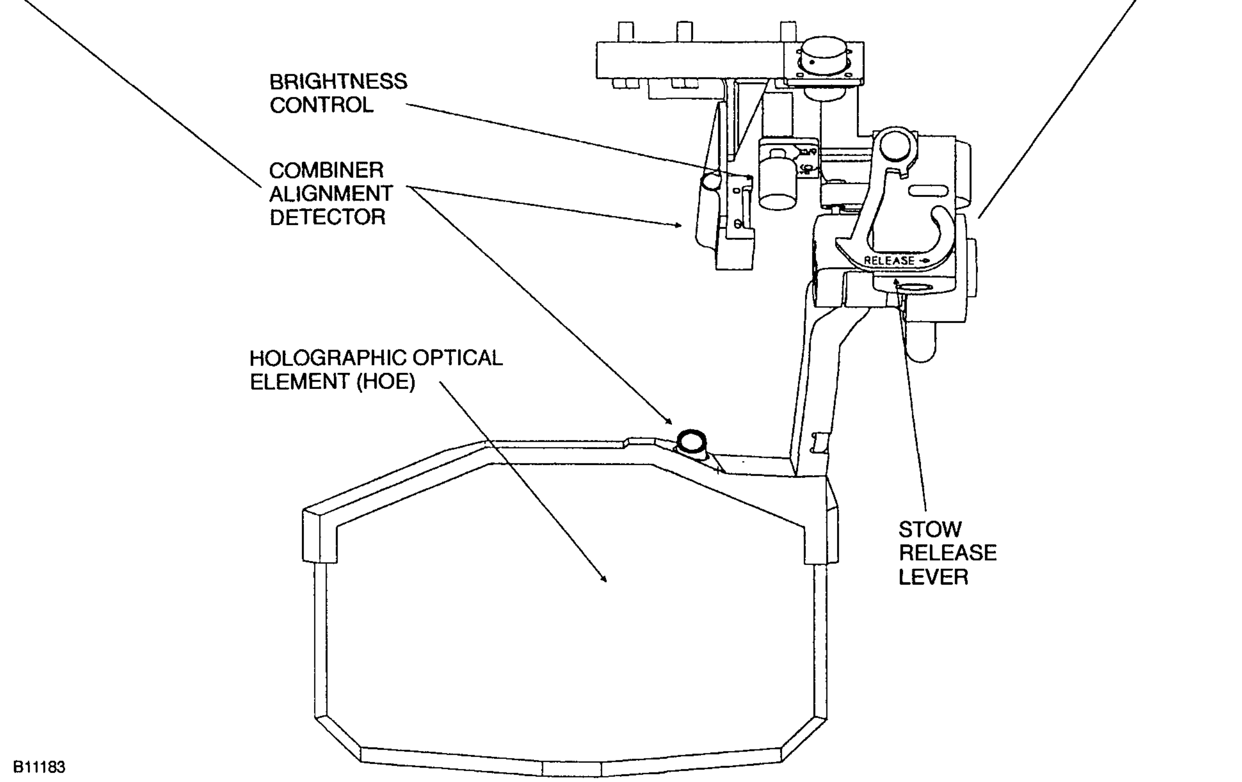
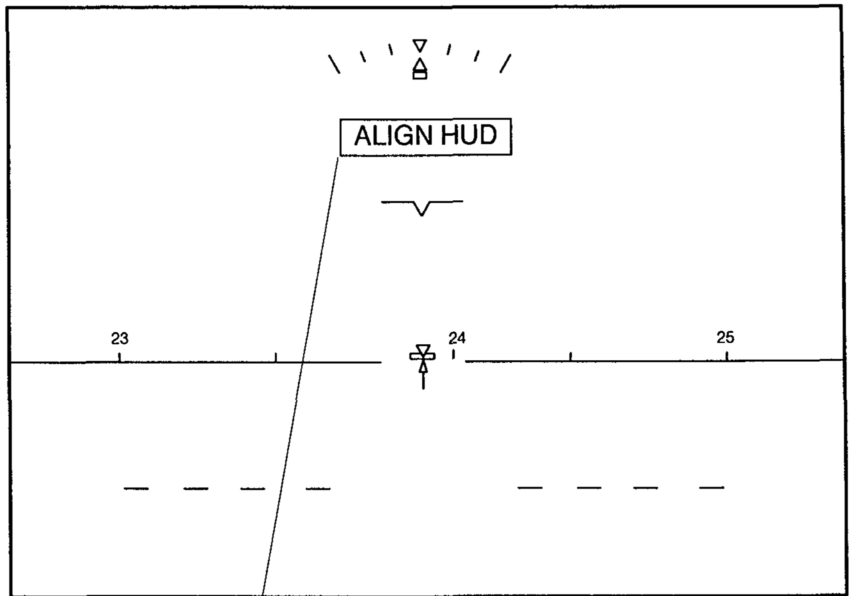


FIG.3. Combiner controls.



B11191

ALIGN HUD

Gently push the HOE frame forward and allow it to spring back to the detent position to eliminate the message.

CAUTION

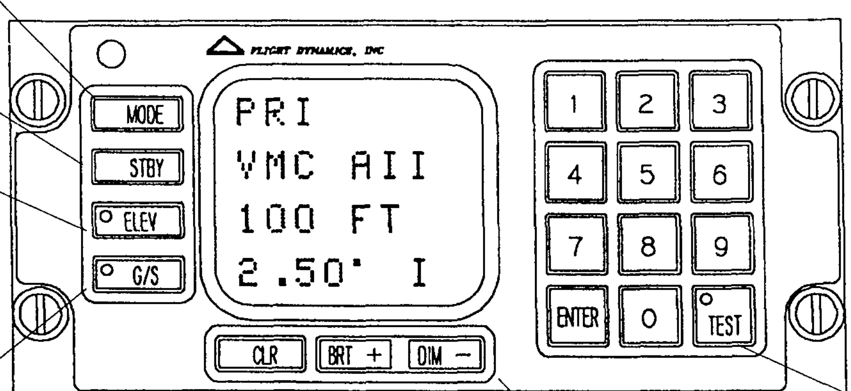
If the ALIGN HUD message cannot be eliminated, do not use the HUD system.

FIG.4. Align HUD message.

ELEV The ELEV (Elevation) pushbutton is used to enter the runway touchdown zone elevation (TDZE) for the landing runway. The ELEV pushbutton light comes on when this function is selected. The adjacent display line indicates the value entered. Elevation must be reset if the active mode has been manually changed.

STBY The STBY pushbutton is used to select the next selectable mode for use. The next selectable mode shown on the left side of this display line. The HGS approach available capability (after their respective approach capability has been met) shows on the right side of this display line.

MODE Displays the current mode in use. When the MODE pushbutton is pushed the mode shown on the left side of the STBY line moves to the MODE line and becomes the mode in use.



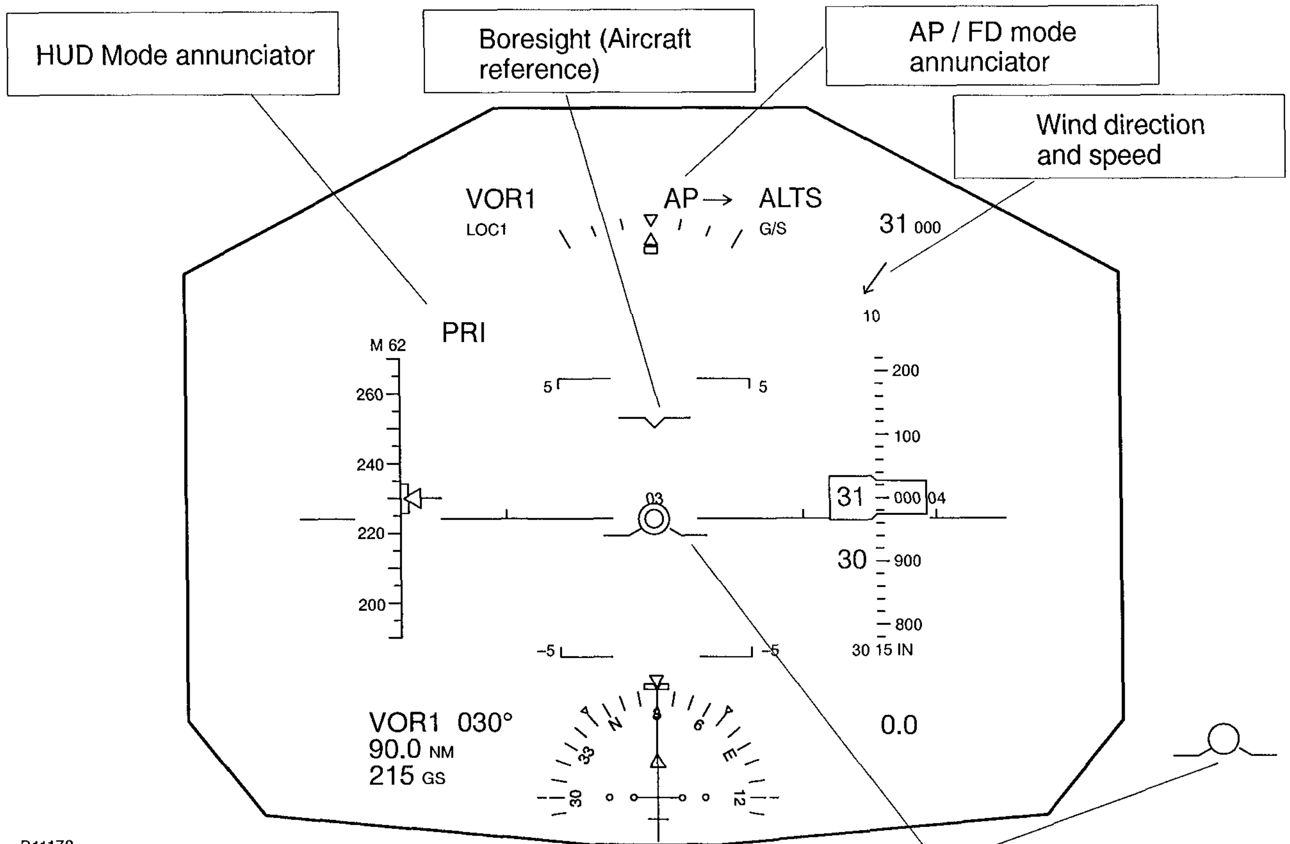
B11182

Three of the pushbuttons contains LED lights to show when they are active. There are four display lines capable of forming alphanumeric or symbolic characters. The CLR, BRT+, DIM– pushbuttons and keypad are used during data entry functions.

TEST The TEST pushbutton is used to select the HUD ground maintenance test functions. The TEST pushbutton light comes on when this function is selected.

G/S The G/S (Glideslope) pushbutton is used to enter the reference glideslope angle for an ILS (I) or visual (V) approach. Two individual glideslope angles can be set with this pushbutton. The I is used in the AIII, AII and AI modes, and the V is used in the VMC mode. The PRI mode does not have a reference glideslope line. The reference glideslope angle can be changed while in the PRI, VMC or AI (above 500 RALT) modes. It cannot be changed while in the AIII, AII or AI (below 500 RALT) modes. The G/S pushbutton light comes on when this function is selected. The adjacent display line indicates the value entered. G/S must be reset if the active mode has been manually changed.

FIG.5. HUD control panel–HCP.



B11178

FLIGHT PATH

The Flight Path Symbol shows the aircraft flight path relative to the centerline. The Flight Path symbol is displayed only while airborne and has priority over all other symbols except the Guidance Cue and the Flare command. The circular portion of the Flight Path symbol will blank any symbology that is displayed in the same location. The Flight Path is inertially–derived and provides an instantaneous indication of where the aircraft is going. The Flight Path symbol displays the actual flight path vector of the aircraft in space (center of the circle) where the lateral position represents the azimuth of the ground track reference to magnetic or true north (depending of the heading source selected) and the vertical position represents the climb or descent angle relative to the horizon. The Flight Path symbol is roll–compensated so when the aircraft is in a bank, the symbol appears relative to the horizon. The wings of the Flight Path symbol are angled downward 30° so that in a level 30° turn, the appropriate wing will overlay the Horizon Line.

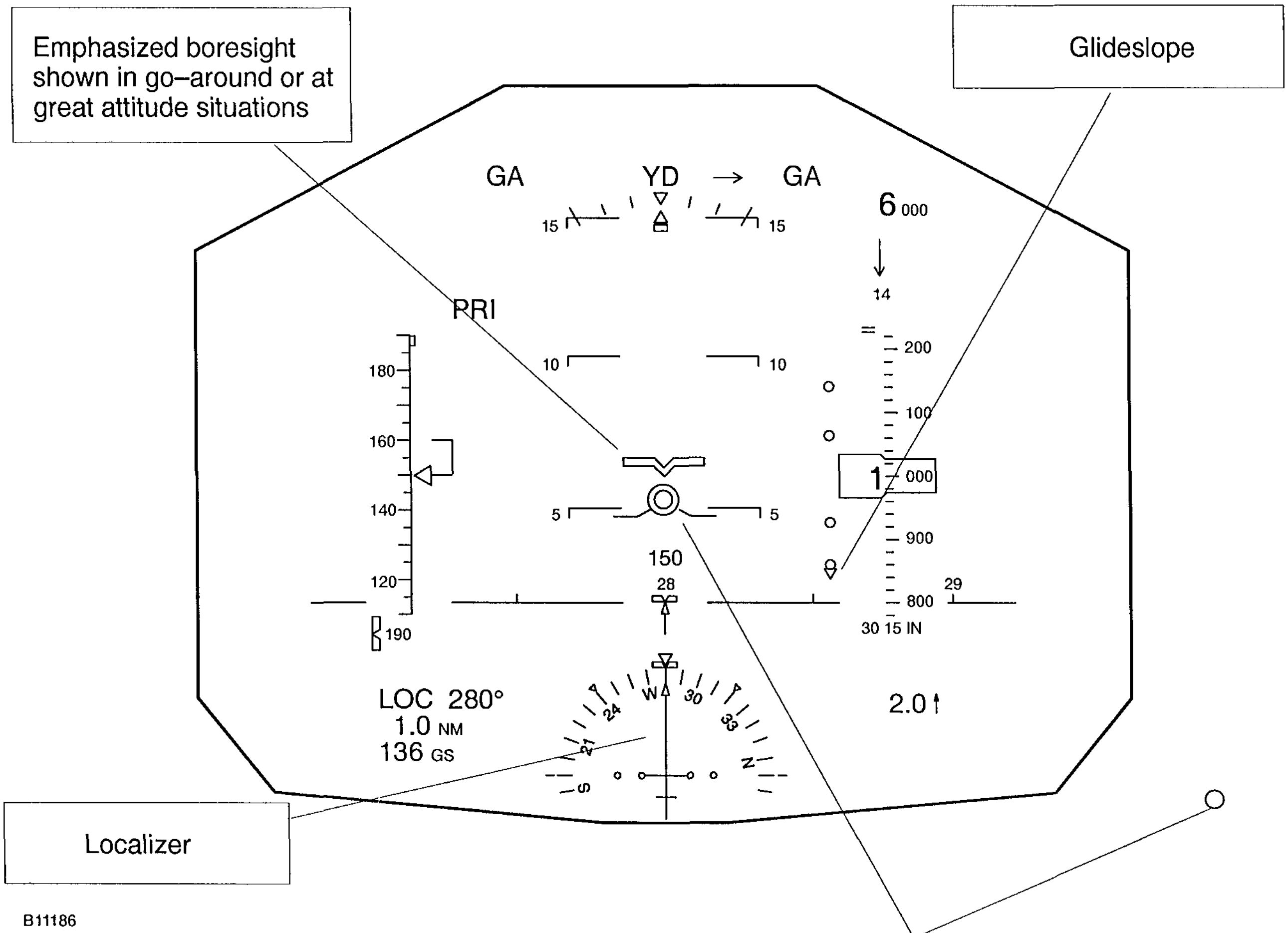
The Flight Path symbol is limited laterally or vertically to remain displayed during all phases of flight. When the Flight Path symbol is no longer conformal with the real world, it is "ghosted" (displayed as dashed lines rather then solid lines). If the Flight Path should move close to the altitude or airspeed scales, the scale is dynamically pushed to the outer edge of the display to make more room for the Flight Path.

The Flight Path symbol is "flown" using standard control inputs to maneuver the aircraft as desired. For example, it the pilot positions Flight Path above the Horizon Line, the aircraft is climbing. If it is positioned below the Horizon Line, the aircraft is descending. If the pilot positions Flight Path to overlay the runway touchdown point and the Flight Path angle is –3° (3° below the horizon), then the aircraft is tracking a –3° approach angle to the runway touchdown point.

Flight Path symbology is dependent on valid inertial data thus if IRU data is not valid, the Flight Path symbol is removed.

The Flight Path and related symbology is removed when the aircraft pitch attitude is more than +30° or more than –20° or the roll attitude is more than 65°.

FIG.6. Primary mode – in flight.



GUIDANCE CUE

The Guidance Cue represents the pitch and roll commands computed by the HUD (AIII, AII or AI modes) or the Flight Control System FCS (for PRI mode)). The Guidance Cue is a small circle.

The Guidance Cue symbol functions similarly to a conventional single cue Flight Director, but is designed for control of flight path. To satisfy the guidance command, the Flight Path symbol is "flown" to keep the Guidance Cue inside the Flight Path circle.

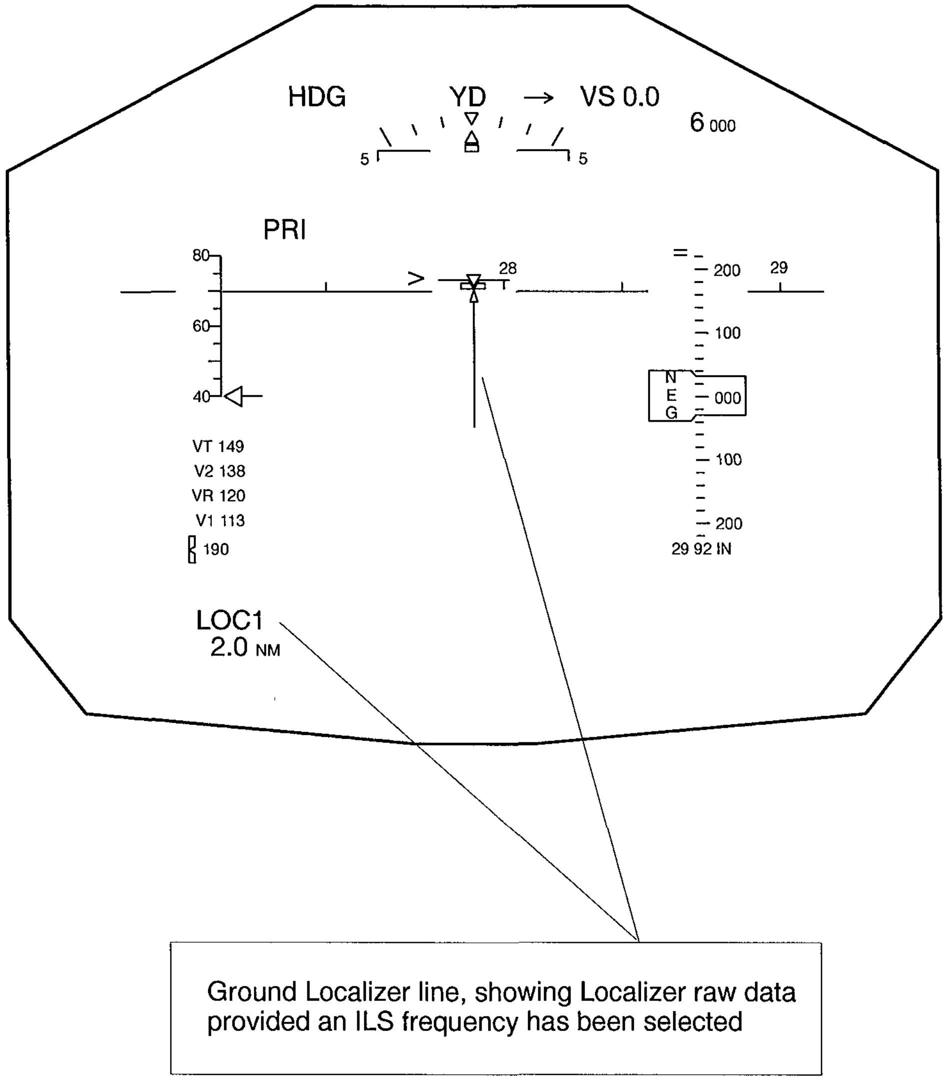
In the AIII mode, the Guidance Cue position is controlled by the HUD. The cue is displayed until touchdown. The HUD also controls the head down PFD command bars in this mode.

In the AII mode, the Guidance Cue position is controlled by the HUD. The cue is displayed until 50 ft AGL. The HUD also controls the head down PFD command bars in this mode.

In the AI mode, the Guidance Cue position is controlled by the HUD. The cue is displayed until 100 ft AGL. The HUD also controls the head down PFD command bars in this mode.

In PRI mode, the Guidance Cue position is controlled by the FCS,, but its position on the HUD display is scaled so the angular movement matches the head down PFD. The cue is displayed until 50 ft AGL if the DH is set for CAT II and 100 ft AGL if DH is set for CAT I.

FIG.7. Primary mode – go around.



B11179

FIG.8. Primary mode – on ground.

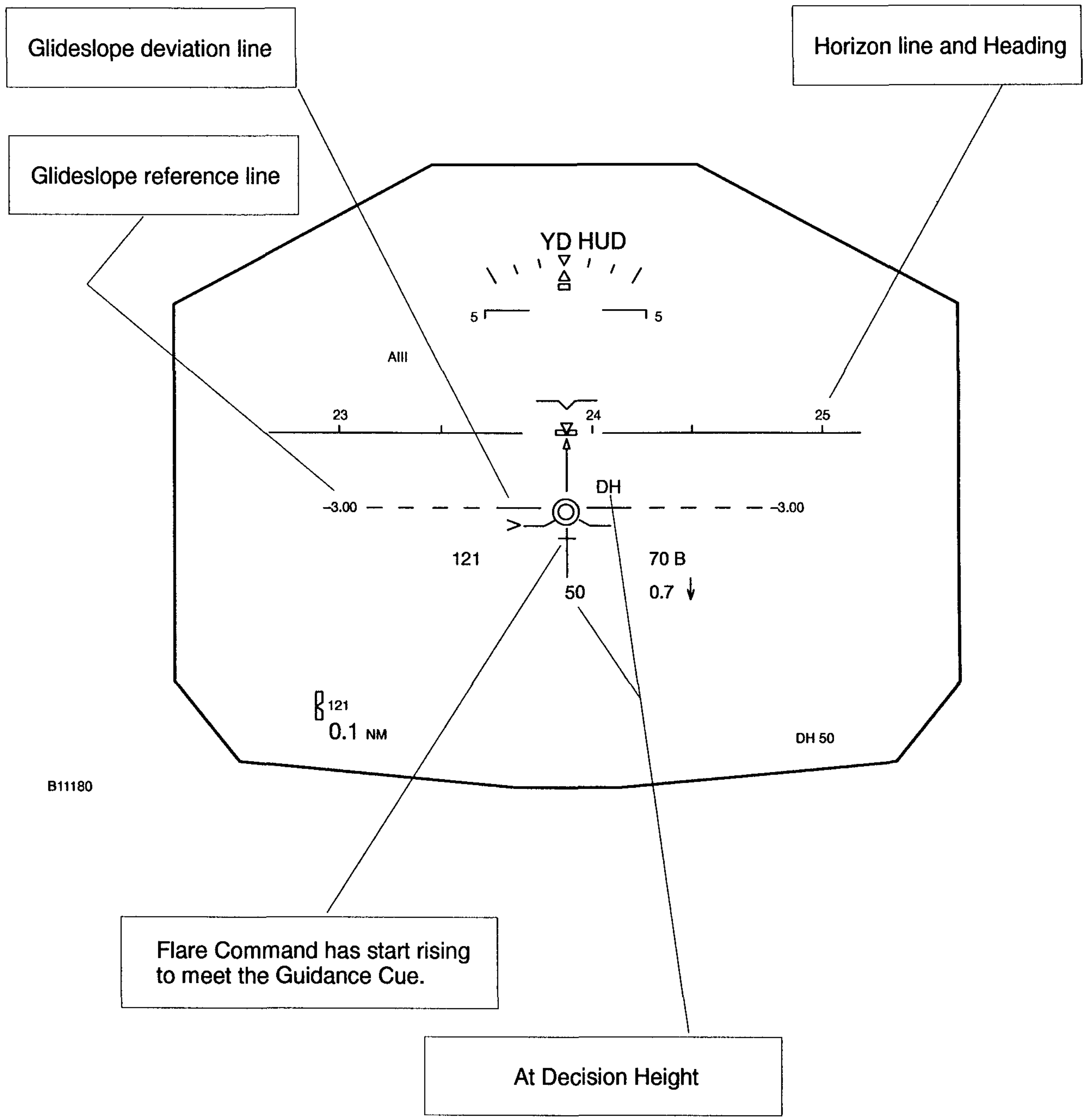
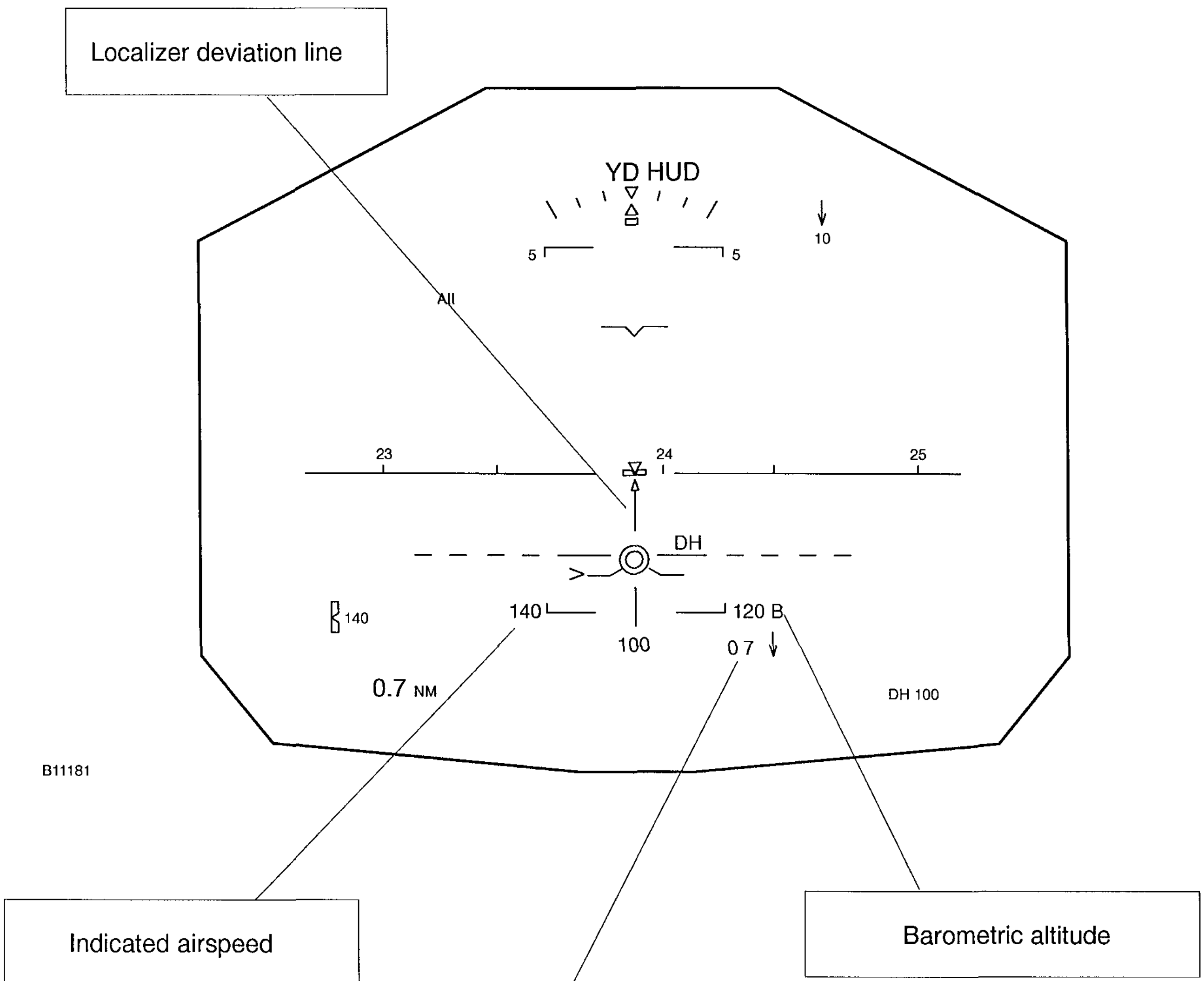


FIG.9. AIII mode – at decision height.



NOTE: Analog vertical speed and vertical speed advisory (FMS 4200) is only displayed on the PFD.

FIG.10. AII mode – at decision height.

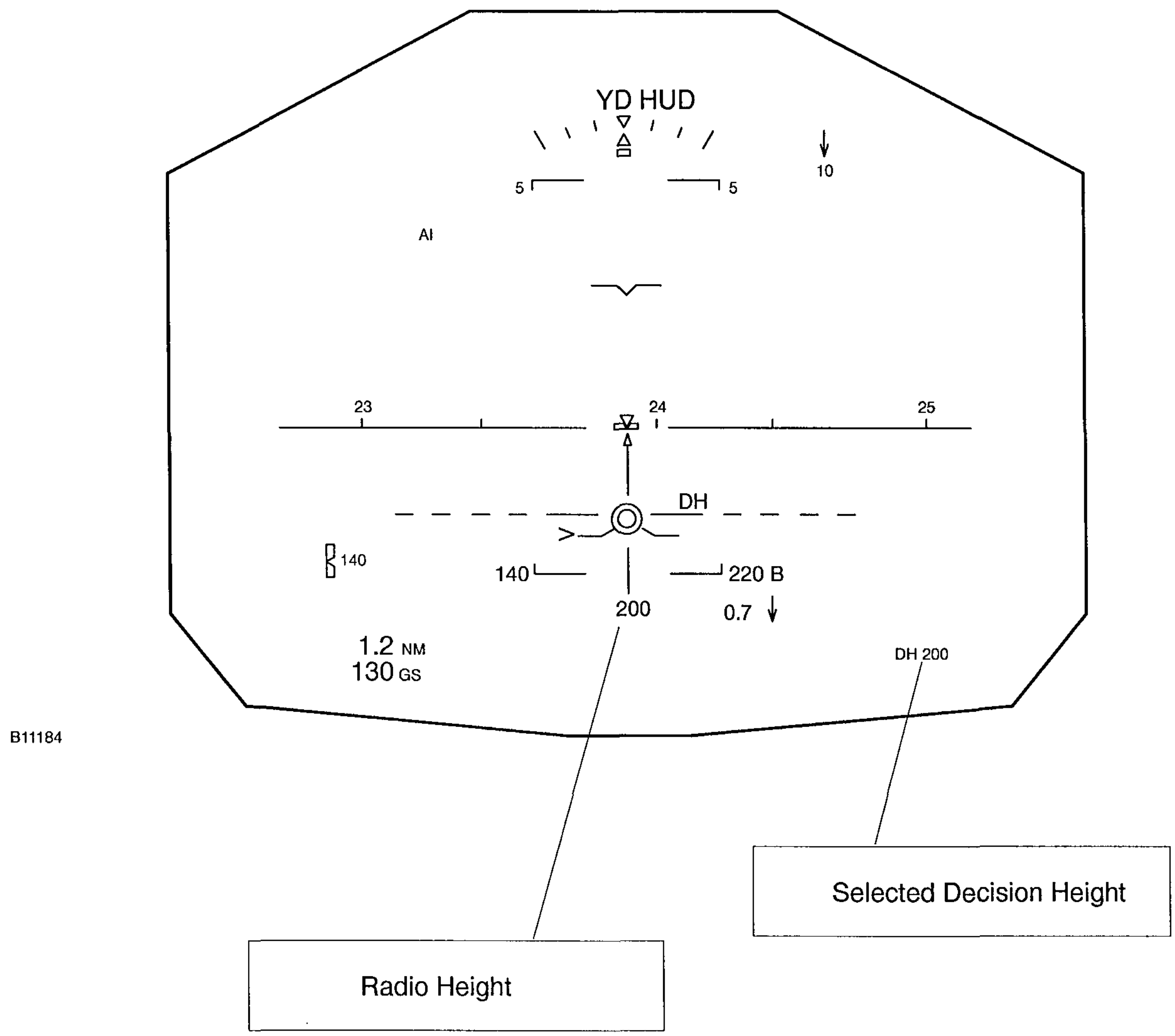
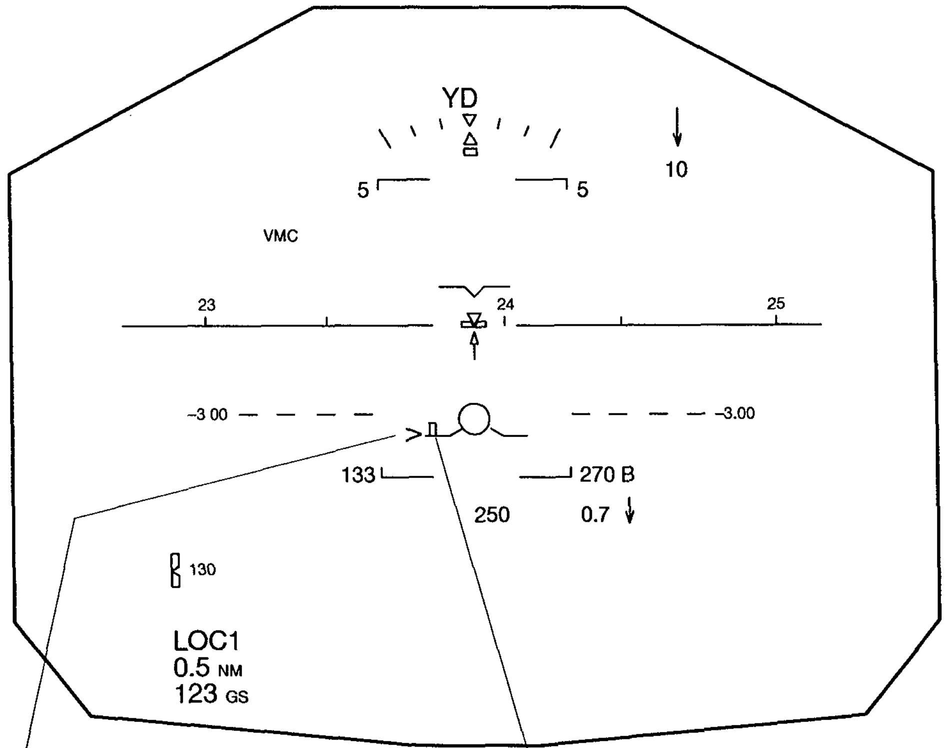


FIG.11. AI mode – at decision height.



B11185

SPEED ERROR TAPE

The speed error tape is an adjustable height rectangle that displays the difference between indicated airspeed and the selected airspeed above or below the left wing of the flight path symbol.

When airspeed is greater than reference speed, the Speed Error Tape extends above the wing and is proportional to the speed error. When airspeed is less than reference speed, the Speed Error Tape extends below the wing. Each degree of Speed Error Tape length (about the diameter of the Flight Path circle) represents approximately five knots of airspeed error. The tape length is limited to 15 knots of error and is filtered to remove any effects caused by turbulence.

FLIGHT PATH ACCELERATION

The Flight Path Acceleration symbol shows the inertial acceleration (or deceleration) of the aircraft. The display is an indication of the sum of all forces affecting the aircraft such as thrust, drag, lift and gravity.

When the aircraft is accelerating, the symbol is above the wing. When the aircraft is decelerating, it is below the wing. To maintain a steady state, the Flight Path Acceleration symbol should be positioned adjacent to the Flight Path wing.

NOTE

The Flight Path Acceleration is affected by all forces on the aircraft and the symbol actually shows the total forces at work. It is used to very effectively control speed or flight path angle. Since the symbol shows all forces on the aircraft, is should not be thought of as a throttle indicator. To avoid confusion in controlling thrust, the Flight Path Acceleration symbol is removed when a low level decreasing performance windshear condition exists below 400 RALT.

FIG.12. VMC mode.

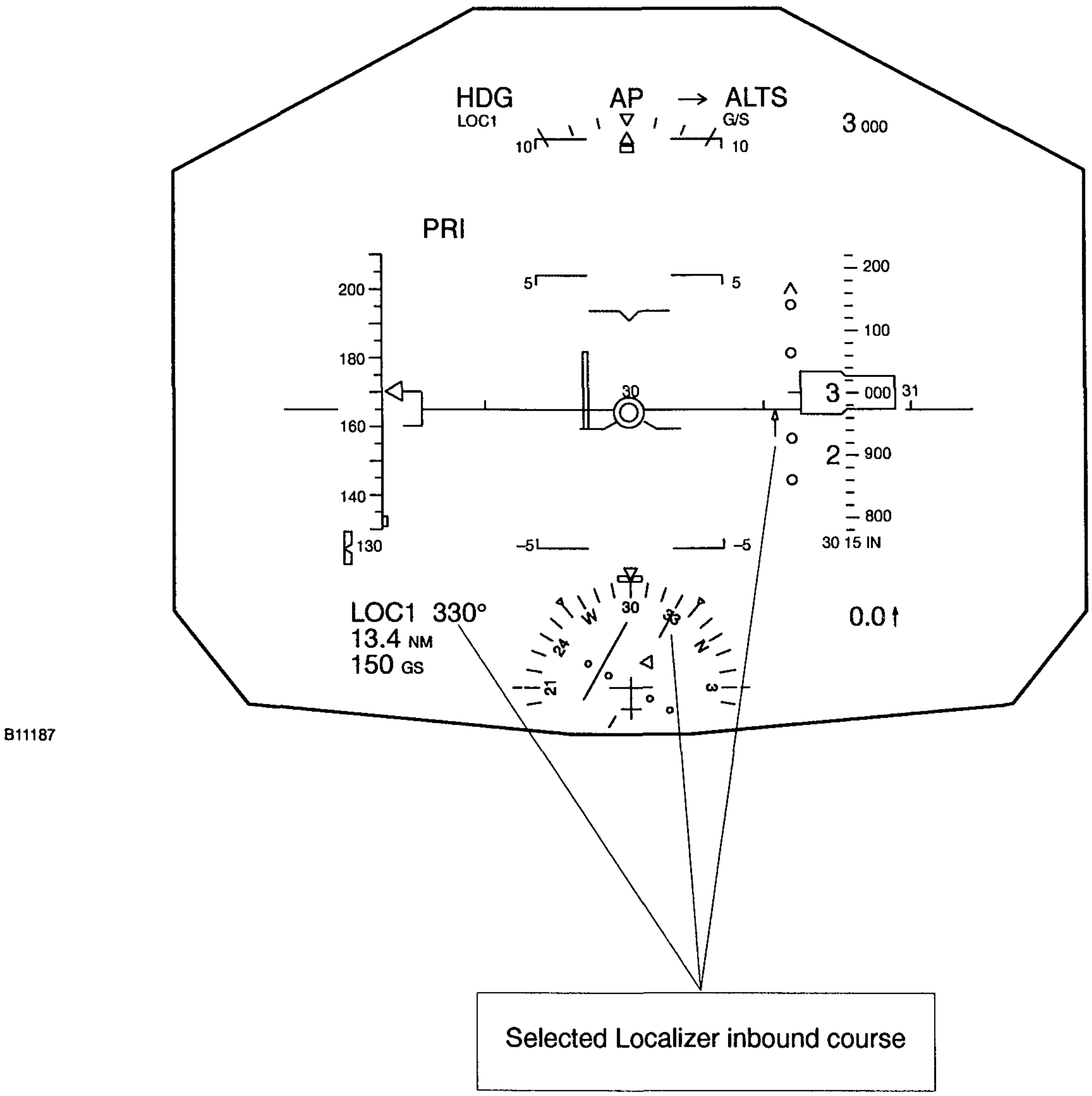


FIG.13. ILS selected course.

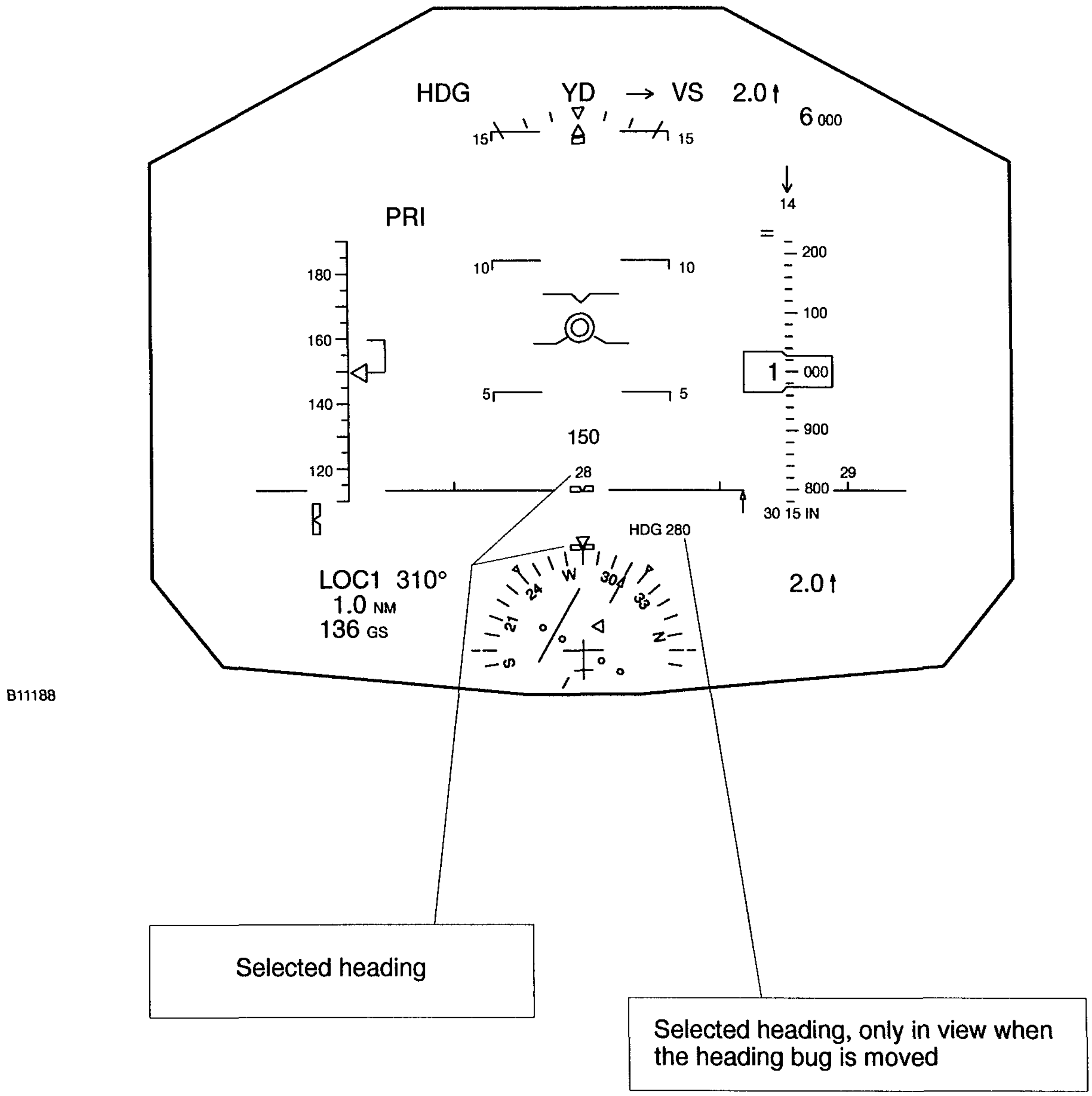
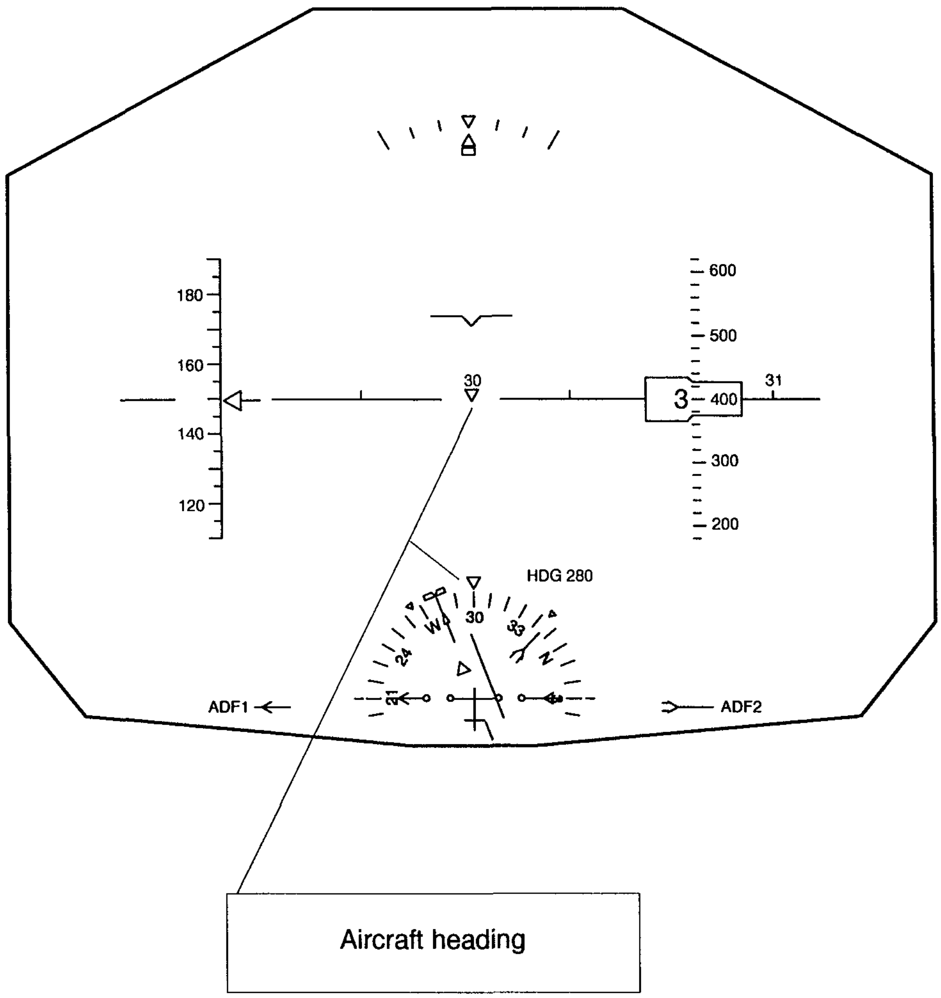
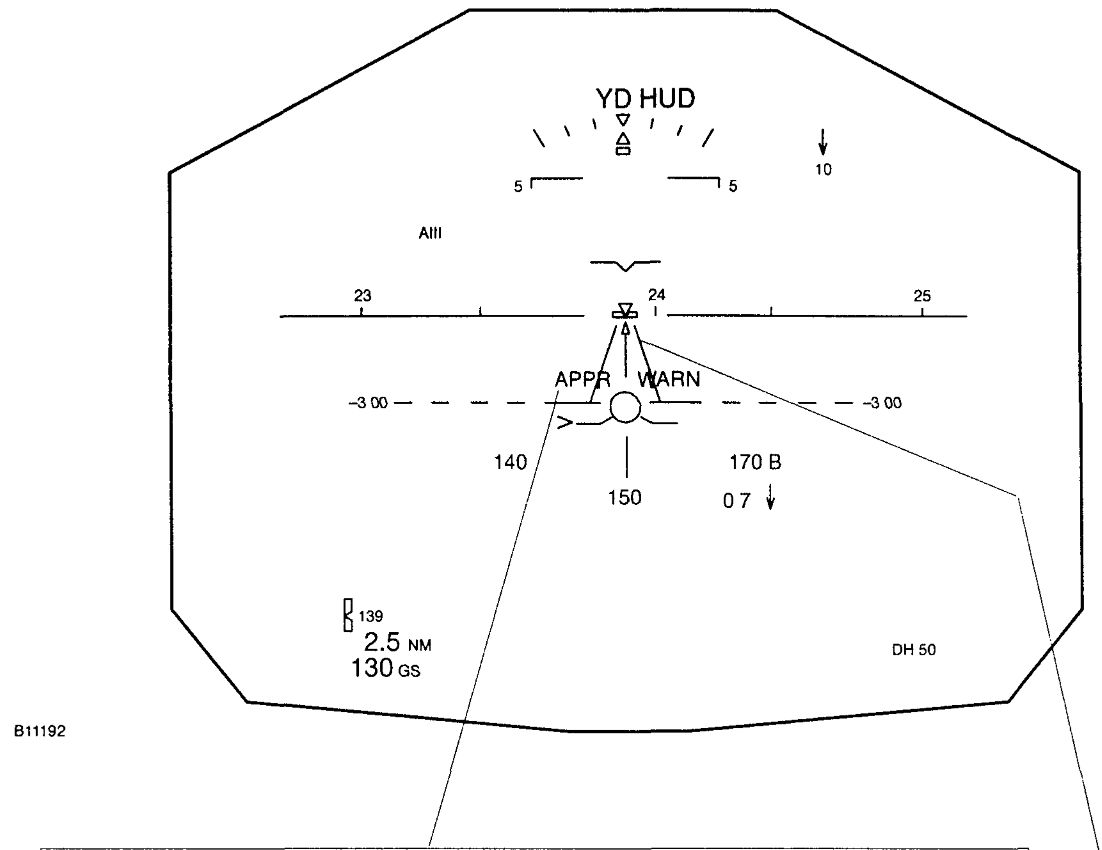


FIG.14. Selected heading.



B11190

FIG.15. Aircraft heading.



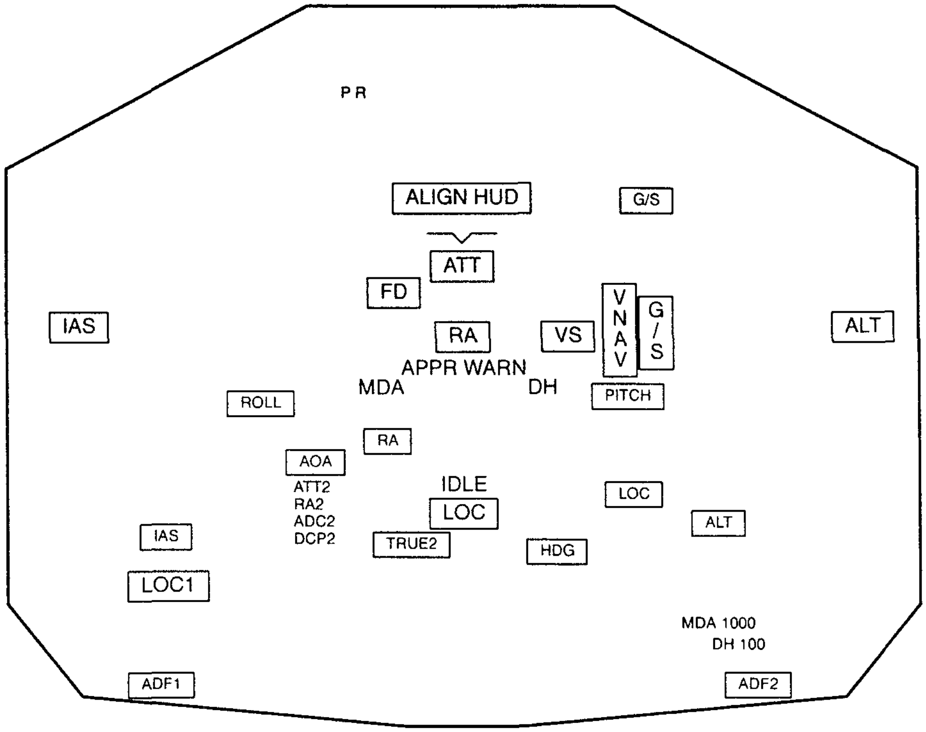
APPROACH WARNING

The APPR WARN is flashing above the Flight Path symbol if the approach conditions exceed AIII or AII approach tolerances or if any faults are detected. The Guidance Cue is also subsequently removed.

SYNTHETIC RUNWAY

The aircraft's orientation to the runway is indicated by the synthetic runway symbol, an approximate outline of the two sides of the actual runway. During an approach, the perspective of the Synthetic Runway symbol changes in the same way as does the real runway. The Synthetic Runway appears at DH +200 RALT and is removed at DH +10 RALT. It is only shown in the AIII and AII modes.

FIG.16. Approach warning and Runway symbol.



B11201

FIG.17. HUD flags and data source messages.

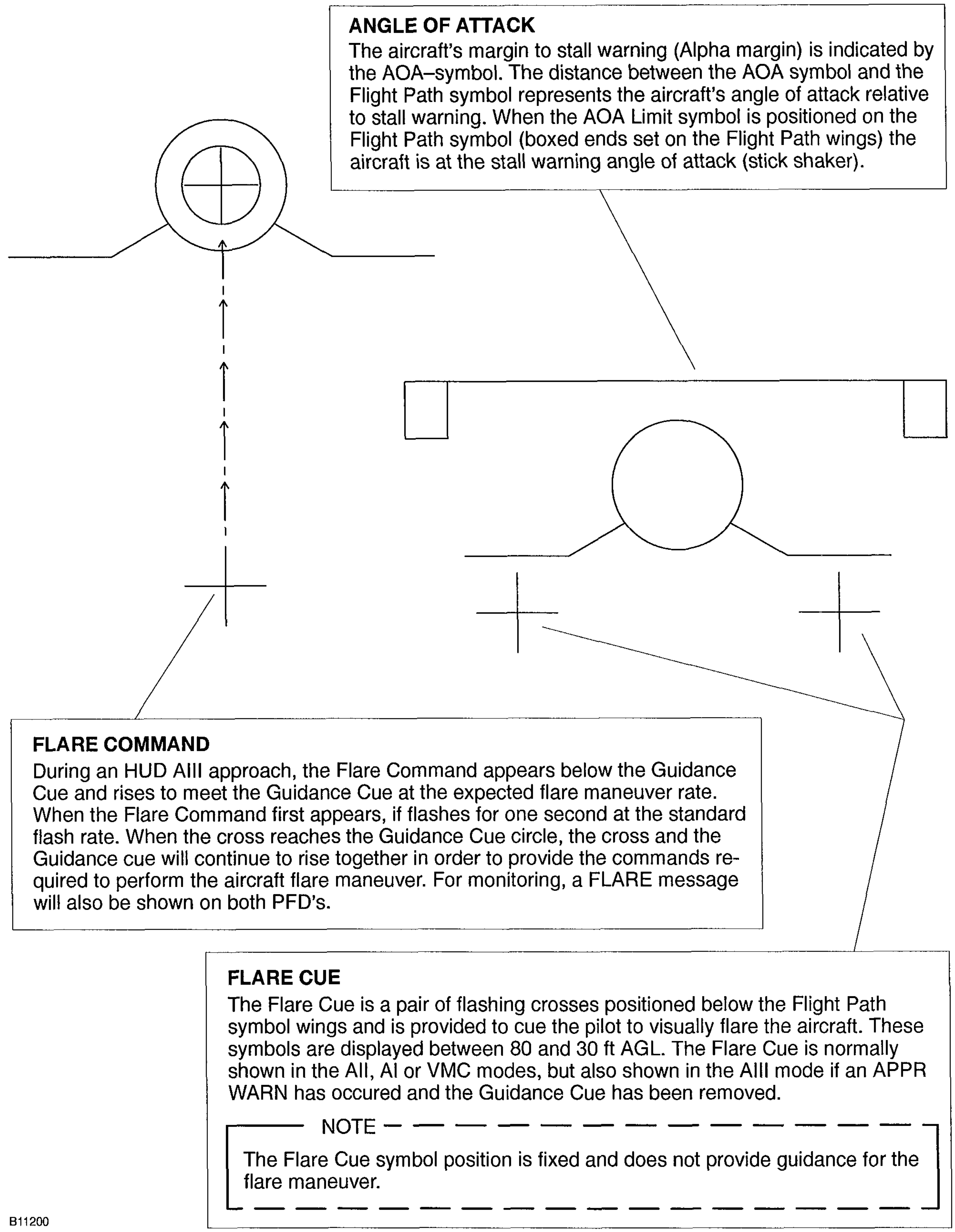
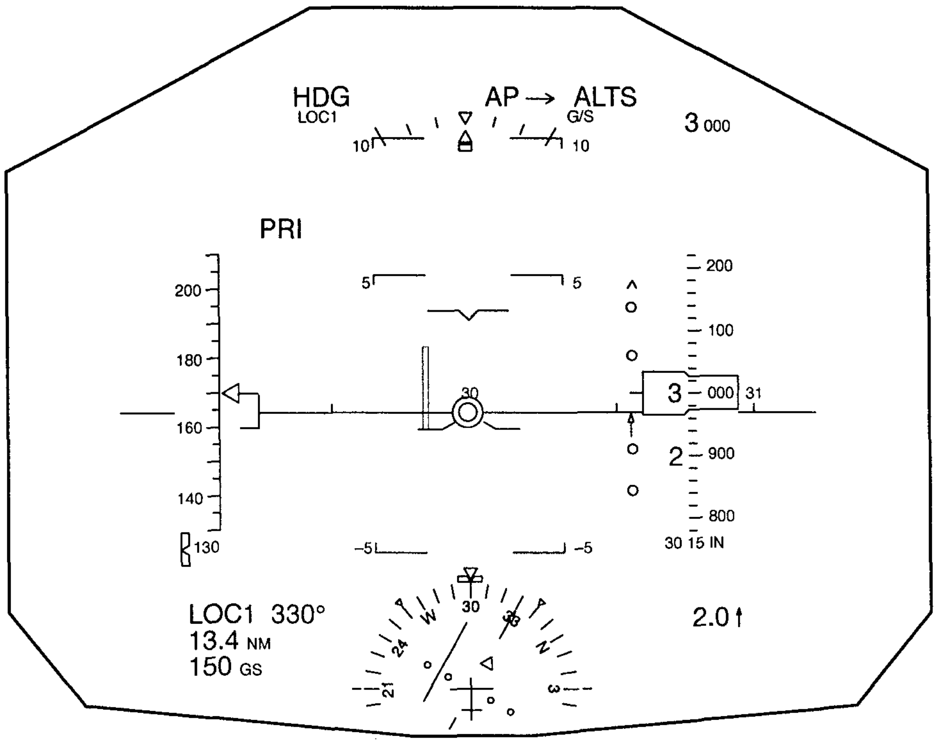


FIG.18. Flare Command and Flare Cue.

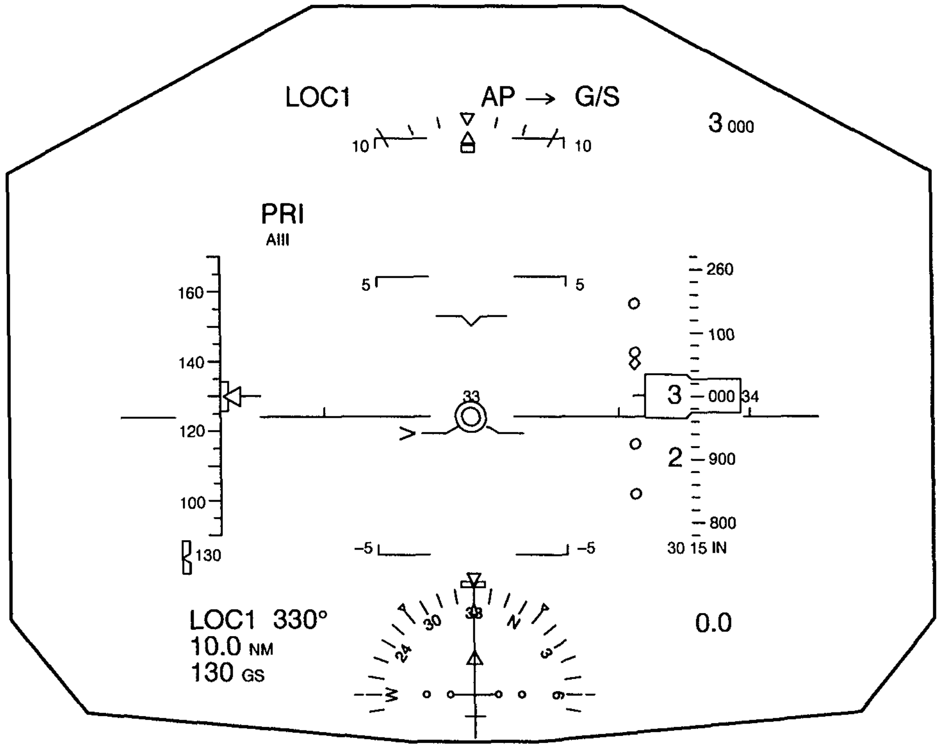


B11197

In the illustration above, the autopilot is flying a 30° intercept heading (300°) to the selected Localizer inbound course of 330°. The aircraft is level at 3000 feet intercepting from below the glideslope. The aircraft is 13.4 DME miles from the station and the airspeed is decelerating through 170 to a target of 130 knots.

The following Figures 19 to 24 shows an example of a CAT IIIa approach and landing.

FIG.19. ILS intercept.

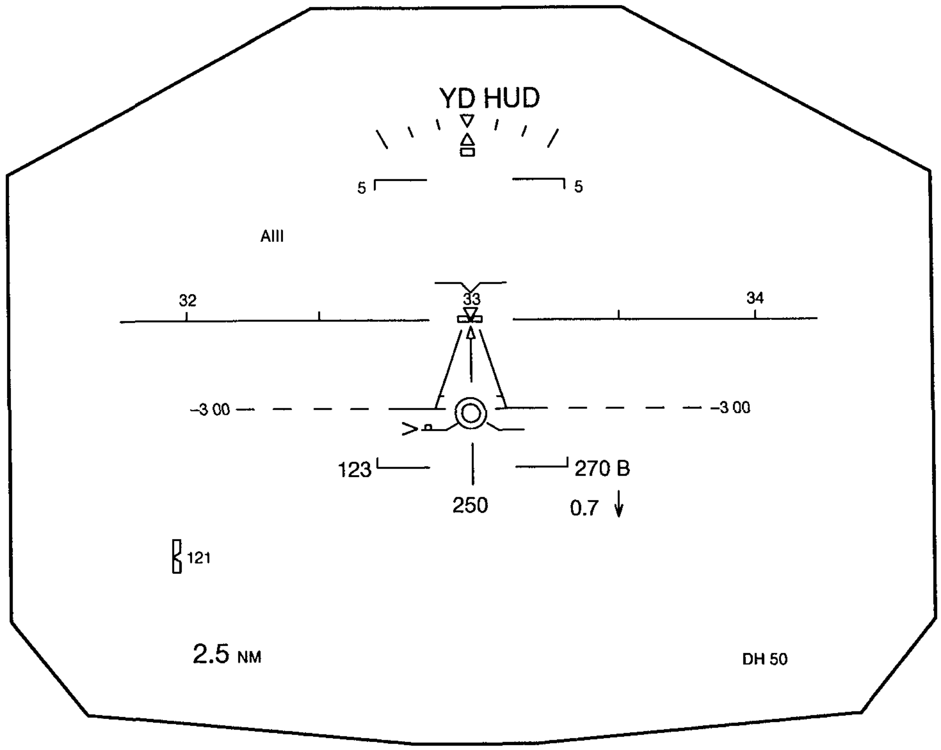


B11198

The aircraft is just completing a turn to the final approach course and has captured the localizer and glideslope.

If the pilot does not disengage the autopilot above 1000 ft AGL the small AIII message will flash until the aircraft altitude is 500 ft AGL. If the AIII mode is not selected above 500 ft AGL the AIII message will be replaced with a flashing NO AIII message and the HUD AIII mode is inhibited.

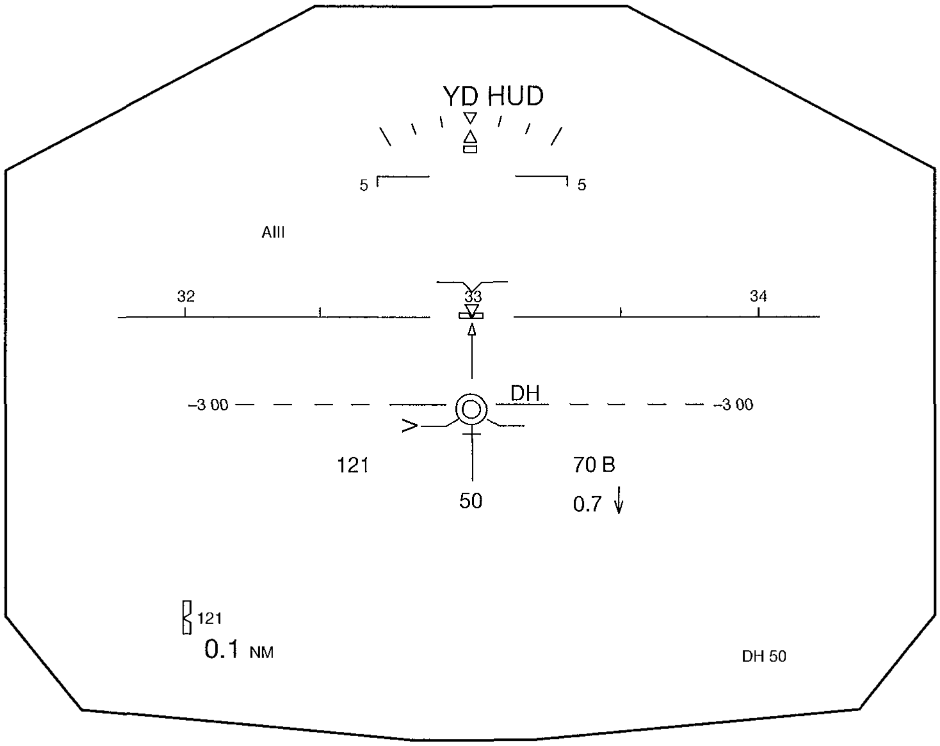
FIG.20. ILS capture.



B11194

The aircraft is on the ILS approach and the AIII mode is in use. The Guidance Cue is now independent of the FCS Flight Director and will provide guidance to touchdown. The aircraft is descending at 700 FPM through 250 RALT at 2.5 miles DME. The barometric altitude is 270 feet. The airspeed is 123 knots or 2 knots above the selected airspeed as shown by the speed error tape above the Flight Path left wing.

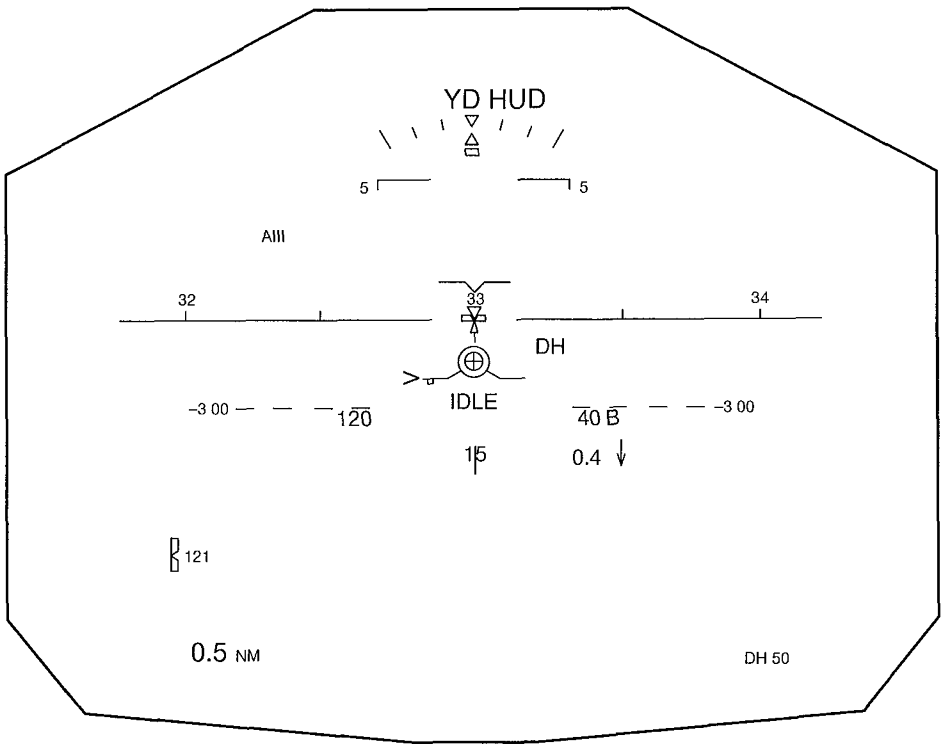
FIG.21. AIII mode – 250 RALT.



B11193

The aircraft is descending through 50 RALT and the decision height message is in view. The flare maneuver is initiated when the AIII mode Flare Command symbol (+ below the Flight Path symbol) meets the center of the Guidance Cue. When the flare maneuver begins, a FLARE message will also be shown on both PFD's. The Flare Command and Guidance cue (now tied together) should be followed up through the flare maneuver until touchdown.

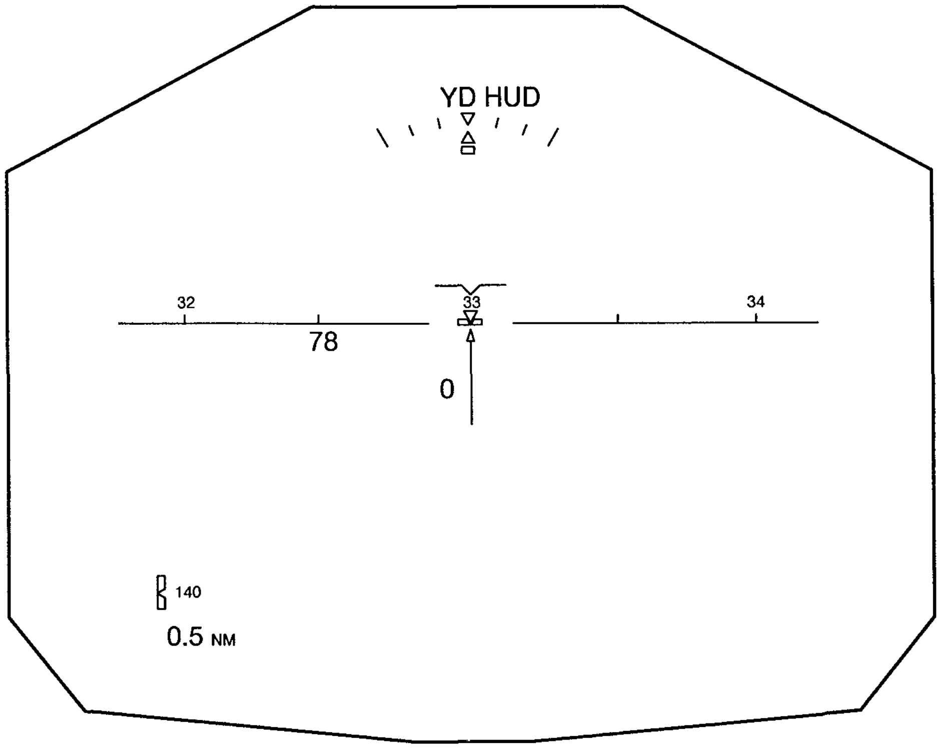
FIG.22. AIII mode – 50 RALT.



The aircraft has begun the flare maneuver to transition to the landing attitude. Radio Altimeter shows 15 feet and the HUD derived "IDLE" message is in view. An IDLE message will also be shown on both PFD's. The airspeed is 120 knots. The aircraft is positioned on the Localizer centerline. The vertical speed is 400 feet.

B16668

FIG.23. AIII mode – Flare and Touchdown.



B11199

Following the touchdown, the combiner display changes to remove unnecessary symbology. The Reference Glideslope Line, Flight Path Symbol, Guidance Cue, Radio Altimeter and Digital Vertical Speed are removed as they are not used on the ground. The Localizer Line remains displayed and provides aircraft lateral deviation indication from the runway center line.

FIG.24. AIII mode – Rollout.

5. ELECTRICAL POWER SUPPLY.

Overhead unit	L AVIONICS BUS	F – 13	OHU
HUD computer and Control panel ...	L AVIONICS BUS	G – 13	HUD HGC & HCP