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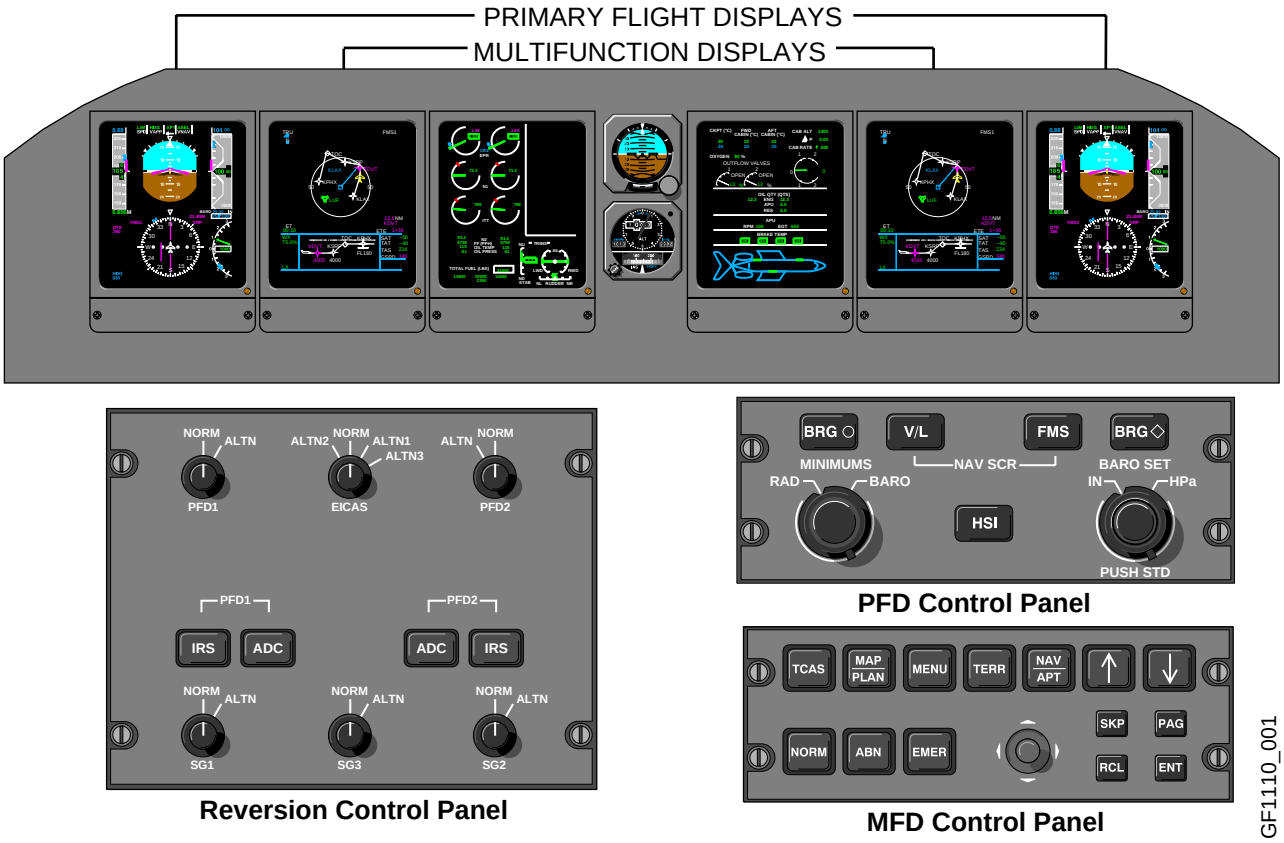
GENERAL

The flight instruments chapter includes pitot-static data, air data, attitude and heading data and electronic flight instruments system information and covers the basic flight instruments (digital/analog) and related components which provide the following information to the flight crew:

- Altitude (barometric/radio)
- Ground Speed
- Airspeed (MACH/KIAS)
- Vertical Speed
- Airspeed and Vertical Speed Trend
- True Airspeed
- Temperature Data
- Airplane Attitude
- Navigation Information
- Heading Information

Each primary flight display (PFD) and multifunction display (MFD) receives altitude, heading, airspeed and attitude data from the on-side sensors. Flight crew access to display format and display controls is provided at PFD control panel, (located on the glareshield), the reversion control panel and MFD control panel, (located on the pedestal).



Reversion Control Panel

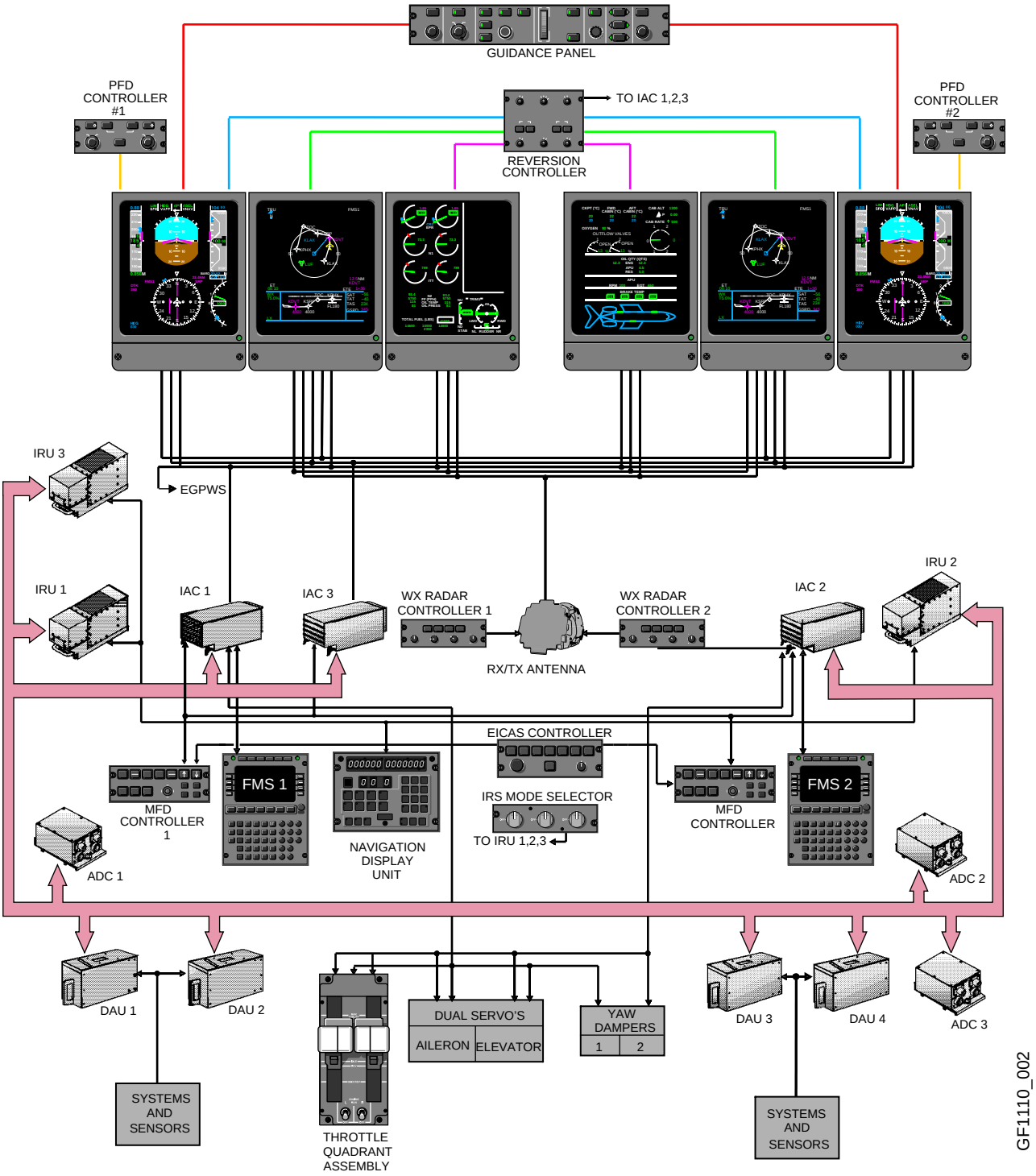
PFD Control Panel

MFD Control Panel

In the event of a PFD failure, the PFD format may be displayed on the adjacent MFD by actuation of the reversionary mode switch (PFD1 or PFD2) on the reversion control panel. MFD format can also be replaced by EICAS page and/or SYSTEMS page. For more information, see Chapter 3.

PFD format can be changed by actuation of HSI button on the PFD control panel. MFD format can be changed by actuation of the MAP/PLAN button, MENU button and/or checklist buttons (NORM, ABN and EMER) on the MFD control panel.

EFIS NETWORK



PITOT-STATIC SYSTEM

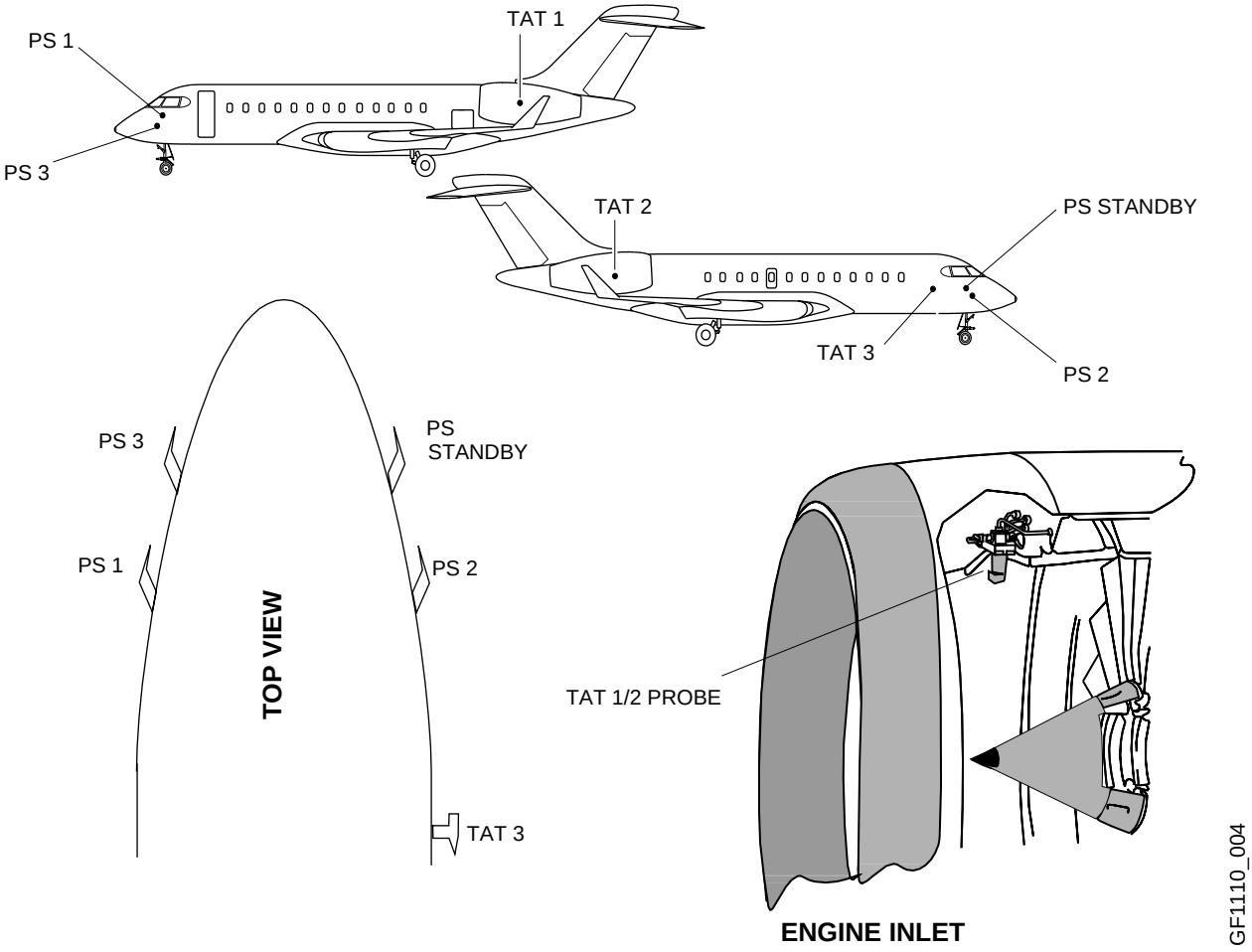
Three pitot-static (PS) systems designated PS 1, PS 2 and PS 3 are provided to supply variable pressure inputs to the 3 Air Data Computers (ADC) and to the Mach transducer. A standby PS source is also provided to supply inputs to the standby instruments.

Use and distribution of these pitot-static probes are as follows:

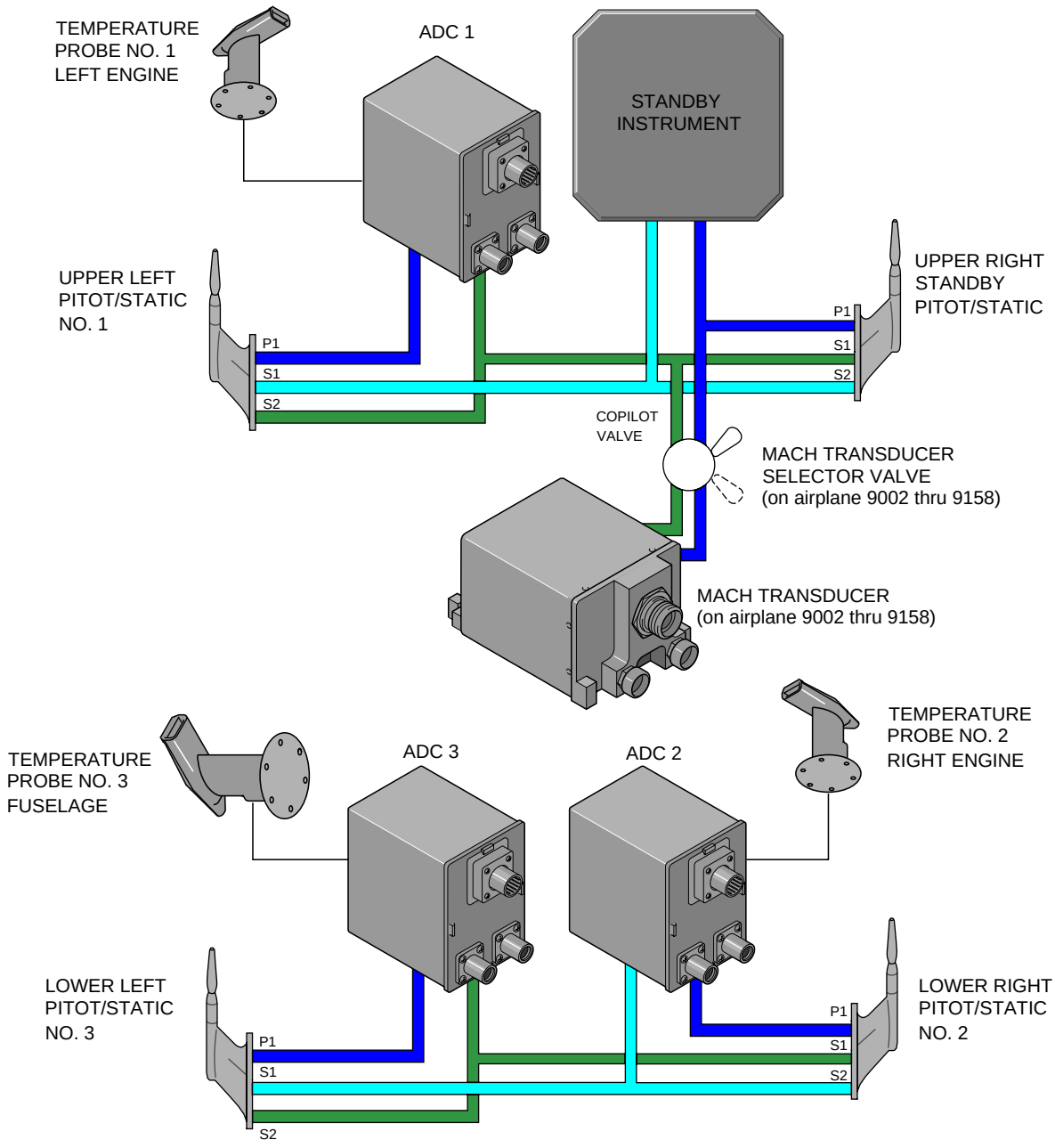
PRESSURE SOURCE	FROM	TO
P1	Pilot/Static Probe No. 1	MADC No. 1
P2	Pilot/Static Probe No. 2	MADC No. 2
P3	Pilot/Static Probe No. 3	MADC No. 3
Ps	Standby Pilot/Static Probe	Standby Instruments / Mach Transducer
S1/S2	Pilot/Static Probe No. 1 and Standby	MADC No. 1
S1/S2	Pilot/Static Probe No. 2 and No. 3	MADC No. 2
S1/S2	Pilot/Static Probe No.3 and No. 2	MADC No. 3
S1/S2	Standby Pilot/Static Probe and No. 1	Standby Instruments / Mach Transducer

PITOT-STATIC SYSTEM (CONT'D)

Three Total Air Temperature (TAT) probes are provided to supply temperature input to the ADCs. Ice protection is provided by electric heating elements for the PS probes and TAT probes (refer to Chapter 14, Ice and Rain Protection).



PITOT-STATIC SCHEMATIC

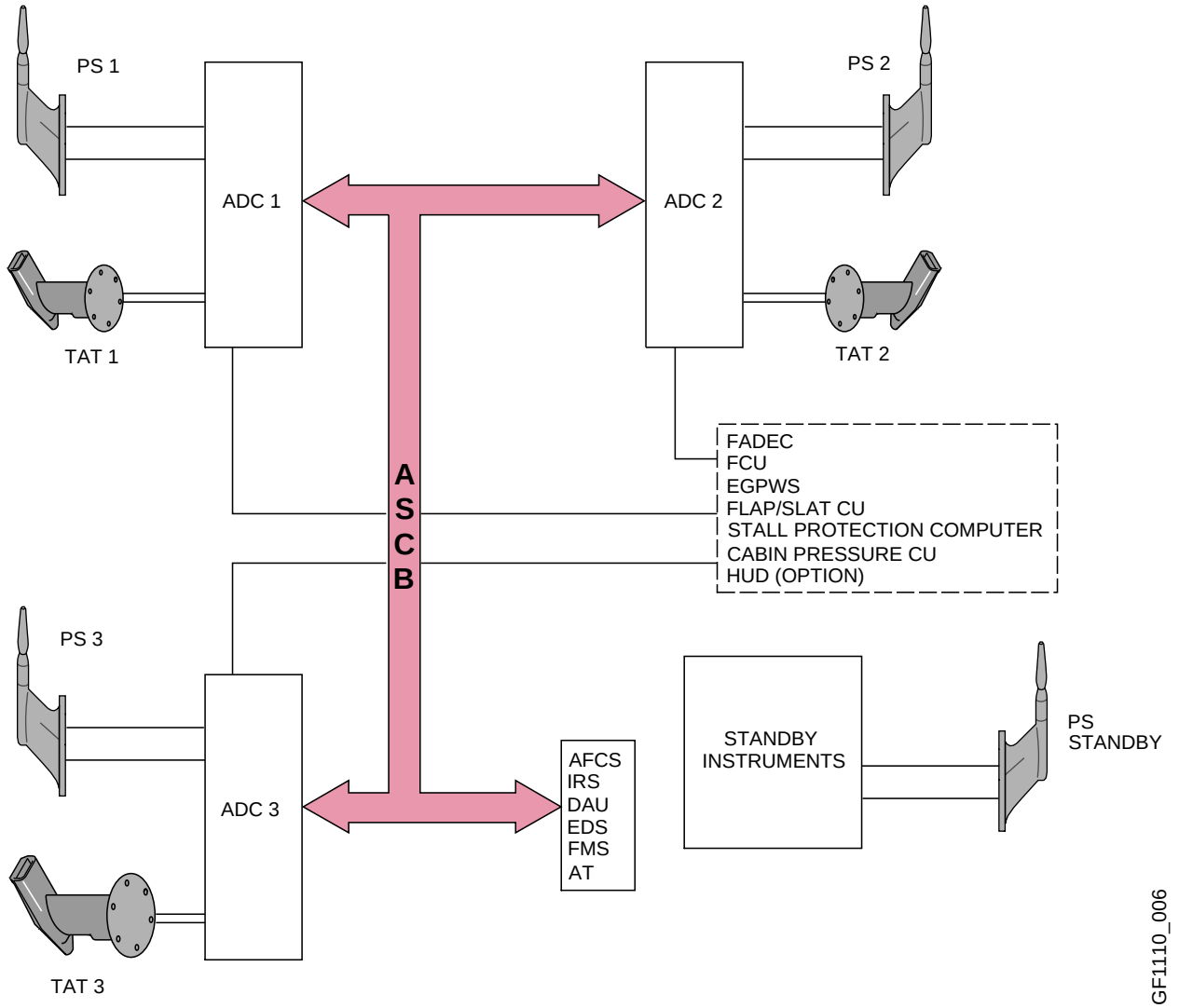


AIR DATA SYSTEM

The air data system provides computed air data (speed, altitude and temperature data) to various systems:

- Integrated Avionics Computers (IAC).
- Data Acquisition Units (DAU).
- Inertial Reference System (IRS).
- Stall Protection Computer (SPC).
- Electronic Display System (EDS) − EFIS and EICAS.
- Automatic Flight Control System (AFCS).

Pitot and static pneumatic inputs and total air temperature provide raw air data information to the ADCs. Static input to each ADC absolute sensors produces the altitude sensor data. Static and pitot inputs to each ADC differential sensor produces the airspeed sensor data.



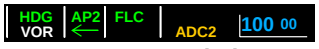
AIR DATA SYSTEM (CONT'D)

Each ADC computes the following:

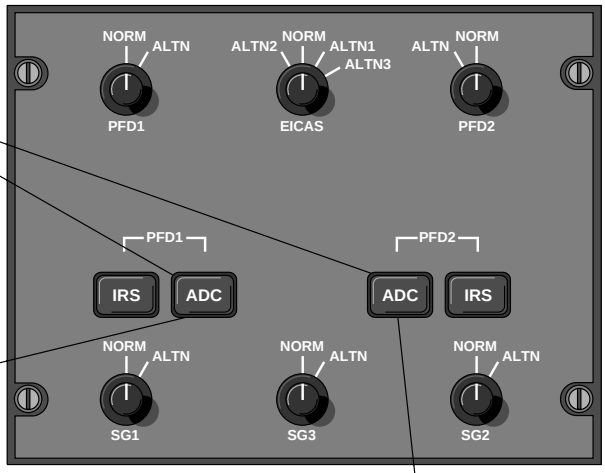
- Pressure altitude and barometric-corrected altitude.
- Vertical speed, indicated airspeed, Mach number and true airspeed (TAS).
- Static air temperature (SAT), TAT and temperature variations from ISA.
- IAS reference (using AFCS or manually using SPD switch on guidance panel).
- Vertical speed reference (VS switch on guidance panel).
- Attitude reference.
- Air speed and altitude trend vector (on PFDs).
- Alerts (preselected on flight level 180).
- Static source error correction.
- Maximum speed values (Vmo at all altitudes and Mmo at a constant).
- Overspeed warning (present airspeed and Vmo).

The reversion control panel, located on the pedestal, is used for pilot input to the air data system.

ADC Switches
Used to select reversion on appropriate ADC.



PFD Annunciation



Pilot's Side
Normally fed as follows:
- ADC 1 − if reverted then,
- ADC 3 − if reverted then,
- ADC 2.

Copilot's Side
Normally fed as follows:
- ADC 2 − if reverted then,
- ADC 3 − if reverted then,
- ADC 1.

ADC Source Annunciation

Pilots Selected ADC	Copilots Selected ADC	PFD1 Source Annunciation	PFD2 Source Annunciation
ADC1	ADC1	ADC1	ADC1
ADC1	ADC2		
ADC2	ADC1	ADC2	ADC1
ADC2	ADC2	ADC2	ADC2
ADC1	ADC3		ADC3
ADC2	ADC3	ADC2	ADC3
ADC3	ADC3	ADC3	ADC3
ADC3	ADC1	ADC3	ADC1
ADC3	ADC2	ADC3	

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INERTIAL REFERENCE SYSTEM

The Inertial Reference System (IRS) provides attitude, directional, position and 3-axis rate/accelerometer data to the following airplane systems:

- PFDs and MFDs
- Weather radar system
- AFCS
- EGPWS
- TCAS
- Stall protection system
- Fuel system
- Flight data recorder
- Air data computer
- FMS

Each IRS computer (IRS 1, IRS 2, IRS 3) receives true airspeed and altitude from the applicable (on-side, either left or right side) air data system. In the event of a failure of the on-side air data input, the off-side input is automatically selected.

The IRS mode select panel, located on the pedestal, is used to initialize the IRS and to select NAV or ATT modes.

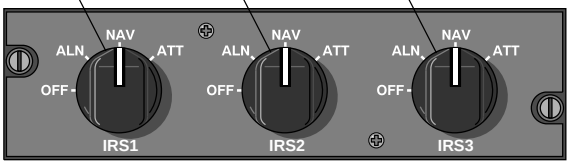
IRS Mode Switches

OFF − Removes power from IRS.

ALN − Aligns IRS in approximately 7 minutes (time to align will differ with temperature and latitude).

NAV − Normal operating mode, selected after ALN completed.

ATT − Reversionary mode, used to provide attitude information, in the event of NAV mode failure.



IRS Mode selector Panel

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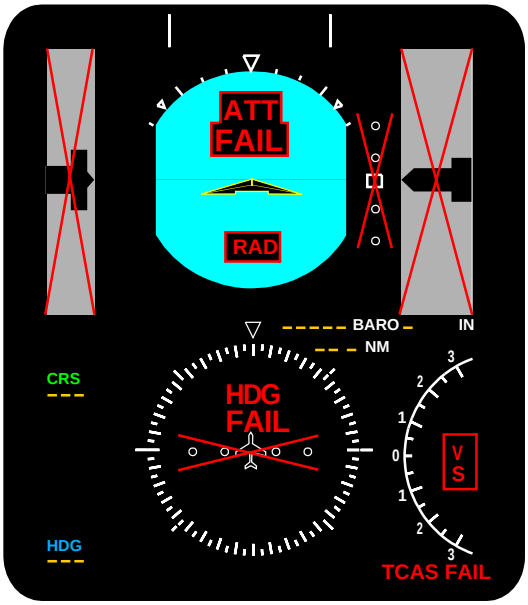
NOTE

During IRS initialization the PFD is in a failure mode.



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INERTIAL REFERENCE SYSTEM (CONT'D)

At an IRS internal temperature between −54°C and −40°C, the power supply will turn on, but normal alignment will not start until IRS temperature is >−40°C. The IRS will not go to NAV mode until the internal temperature of IRS reaches −15°C

LOW TEMPERATURE ALIGNMENT	
IRS Internal Temperature (° C)	**Time to Complete Alignment (min.)**
<−12.5	16
−12.5 to −10.0	15
−10.0 to −7.5	14
−7.5 to −5.0	13
−5.0 to −2.5	12
−2.5 to 0	11
> 0	7

Inertial reference accuracies are achieved for alignments between ± 78° of latitude. The IRS requires that the initial position be entered from either flight management system (FMS) control display unit (CDU) via the POS INIT page.

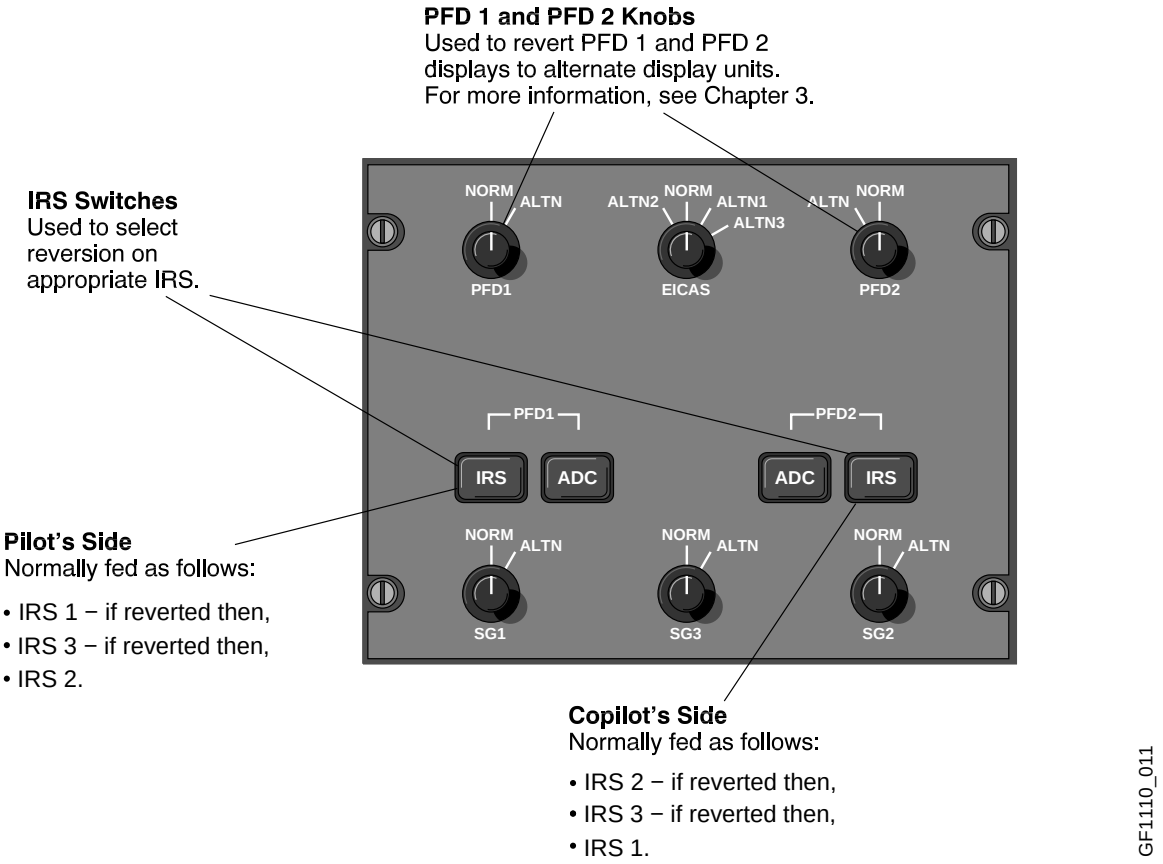
NOTE

Aircraft must be stationary during the alignment. If the aircraft is moved, the mode select switch must be set to OFF for a minimum of three seconds before the align mode can be re-established.

Align downmode is possible, once the IRS is in navigation mode, by selecting the NAV/ATT switch from NAV to ALN for a minimum of three seconds until ATT FAIL appears and back to NAV. Velocity errors are corrected and tilt errors are removed to correct the pitch and roll angles. The total rapid re-alignment time is 30 seconds. Present position may be re-entered.

INERTIAL REFERENCE SYSTEM (CONT'D)

The reversion control panel, located on the pedestal, is used for pilot reversion of the IRS and PFD.



The reversionary attitude mode, which provides attitude, heading, rate and acceleration data, but not position data, may be selected when navigation mode is not available. This condition may occur in the air, following a power interrupt or transient system fault. Attitude alignment takes 1 minute from power off to ATT mode or 34 seconds from NAV to ATT mode, provided the airplane is stationary on the ground or in straight and level flight. If excessive motion is detected, the attitude alignment is run for an additional 20 seconds. Once attitude alignment is complete, heading is entered from the FMS. Heading entries may be made, while the IRS is in the attitude mode, to correct for heading drift.

Rapid re-alignment is possible, once the IRS is in navigation mode, by selecting the NAV/ATT switch from NAV to OFF and back to NAV within 0.2 to 5 seconds. Velocity errors are corrected and tilt errors are removed to correct the pitch and roll angles. The total rapid re-alignment time is 32 seconds. Present position is required to be re-entered.

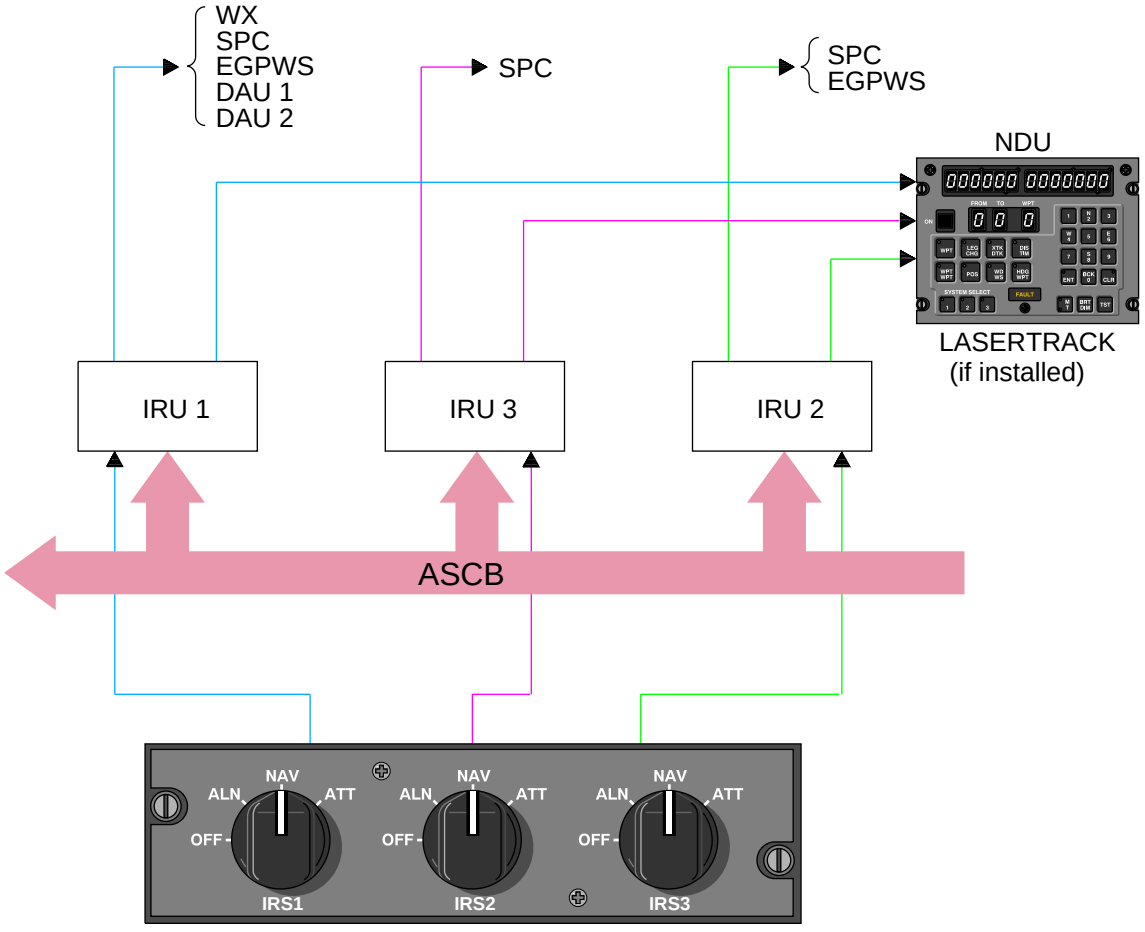
INERTIAL REFERENCE SYSTEM (CONT'D)

CAUTION

During flight, navigation reference is lost if the MSU mode select switch is set away from NAV.

NOTE

IRS will not restart or re-align on airplane battery bus power. If airplane primary power is lost, IRS can continue to operate on airplane battery bus power.



IRS Mode Selector Panel

LASERREF IV

The Global Express is equipped with the LASERREF IV. It is a combines navigation and display unit which interfaces with all 3 IRUs. It provides back-up navigation, alternate means of initializing the 3 IRUs, and a digital display of navigation data from any one of the IRUs.

It also provides navigation capability with up to 9 waypoints, an auto NAV realign function anytime the aircraft is not moving. Zeroes out velocity errors, an updated MAG MAPS.

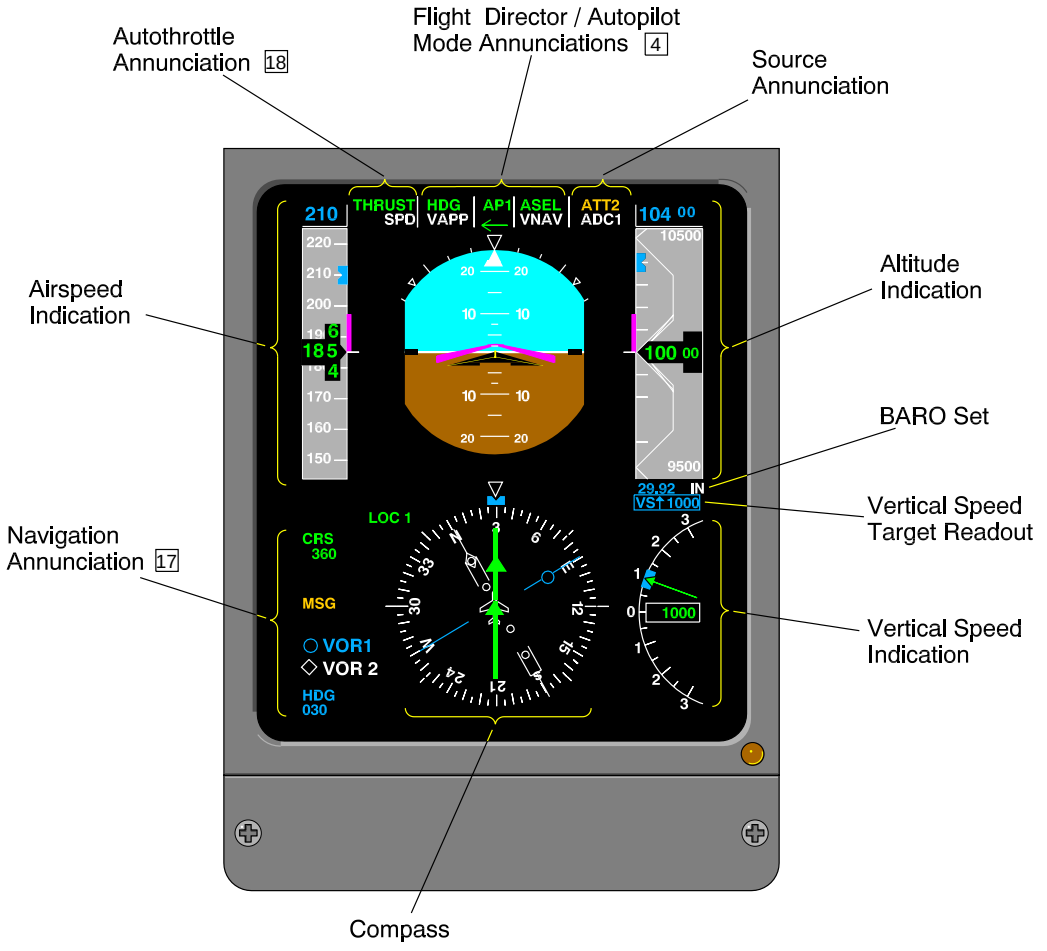
PRIMARY FLIGHT INSTRUMENTS

PFD 1 and PFD 2 are digital CRT-based versions of the traditional (analog/mechanical) flight instruments. Input to the PFDs is derived from the ADCs and IRS units selected, and commands set on flight control panel, air data reference panel and the DCPs. The PFDs function as the following flight instruments:

- Attitude Director Indicator (ADI)
- Horizontal Situation Indicator (HSI)
- Radio Magnetic Indicator (RMI)
- Altitude Indication
- Radio altimeter indicator
- Airspeed indicator (Mach and IAS)
- Vertical Speed Indicator (VSI)

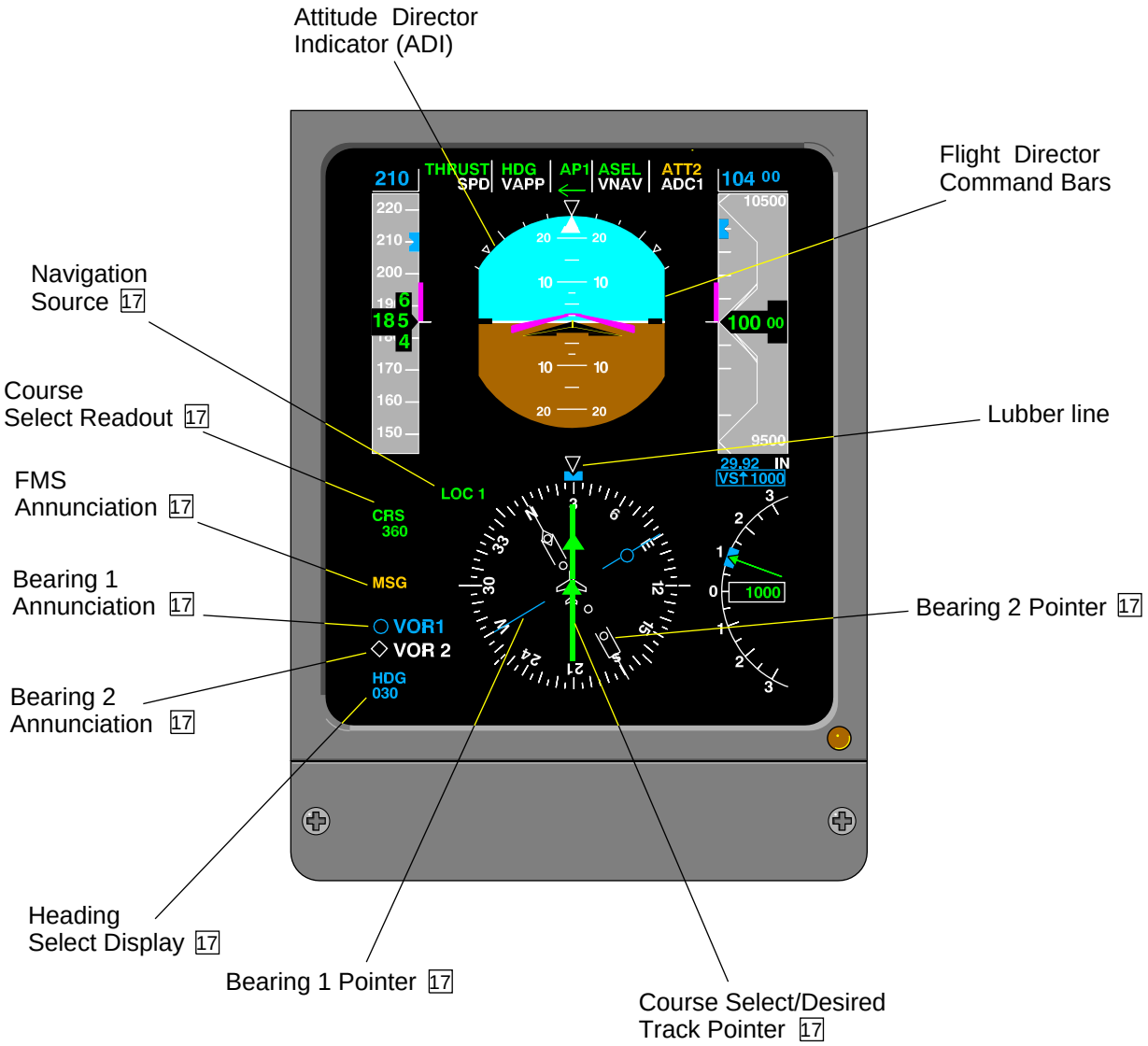
The PFDs are the mode annunciator panel for flight director and autopilot (above the ADI display). They also provide messages and cues for windshear alerts (on the ADI) and TCAS traffic alerts and commands (on the VSI).

PRIMARY FLIGHT DISPLAY



☐ Indicates Chapter in which information on item may be found.

PRIMARY FLIGHT DISPLAY (CONT'D)



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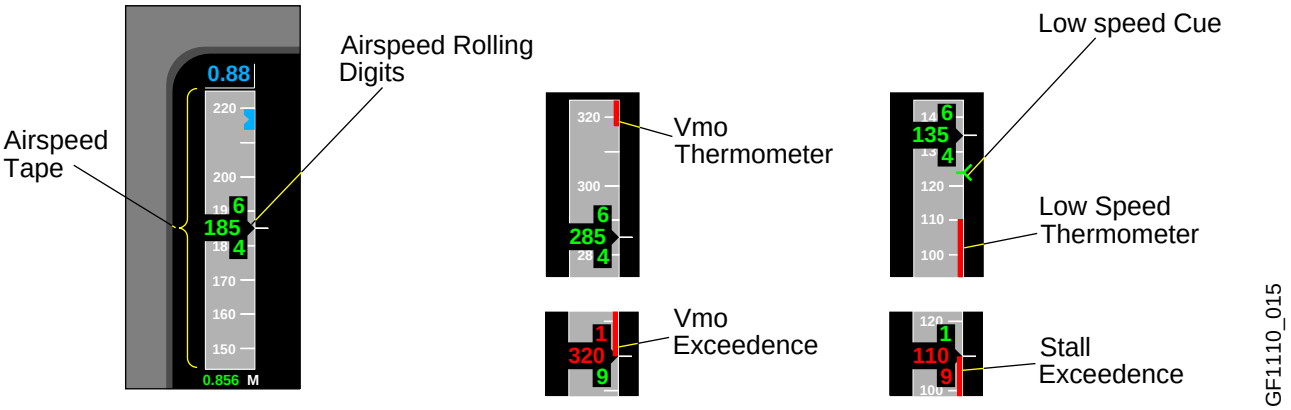
☐ Indicates Chapter in which information on item may be found.

AIRSPEED TAPE

Indicated airspeed is derived from the selected ADC. An airspeed tape capable of displaying from 30 to 900 knots (inclusive) and an airspeed trend vector are displayed on both PFDs.

The airspeed tape will display a range of ± 40 knots from current airspeed. The tape is labeled every 10 knots below 200 knots and every 20 knots above 200 knots. A V_{MO} thermometer will appear for an overspeed condition and a low speed thermometer will appear for a low speed condition. When IAS equals or exceeds V_{MO} or less than calculated stall warning speed, the digits turn red.



Airspeed Trend Vector

Airspeed trend vector represents the airspeed the airplane will attain in 10 seconds, if current acceleration is maintained. Maximum movement of the vector is 30 knots from current airspeed.

When the vector exceeds V_{MO} or less than calculated stall speed, by 1 knot, the digits turn amber.

Selected Airspeed Reference Display

Selected airspeed is always displayed. The readout can be displayed in knots (1 knot increments) or Mach (0.01 Mach increments). Pushing the SPD PUSH CHG button inner knob will toggle the speed reference from IAS to MACH or vice versa.

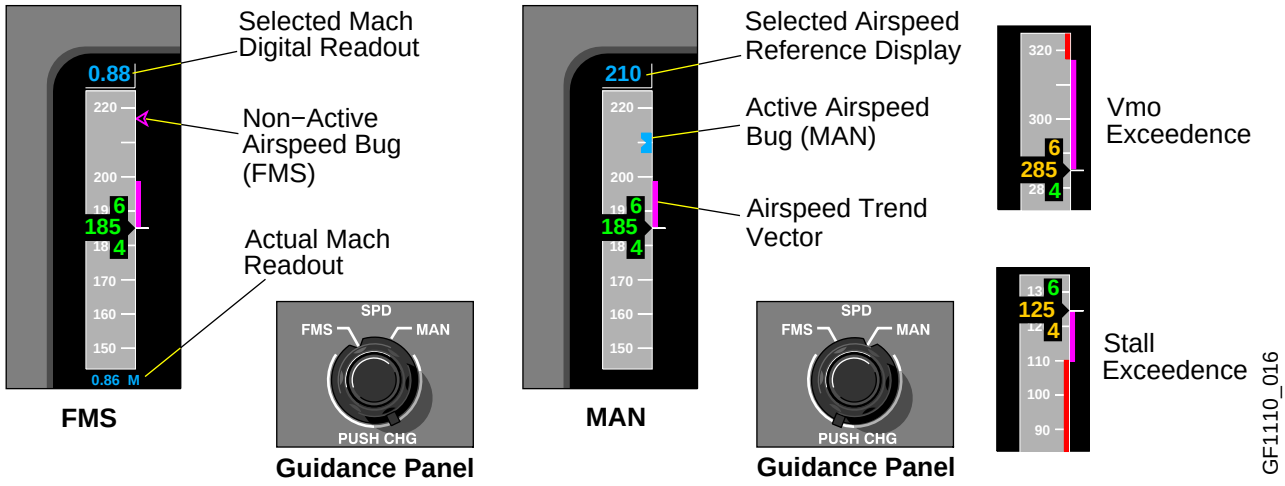
The Electronic Display System (EDS) automatically switch the speed reference from IAS to MACH at the altitude of 32,600 ft. when climbing. If MACH is switched back to IAS after climbing above 32,600 ft., the manual speed will remain the last selected. The EDS will also switch the speed reference from MACH to IAS at the altitude of less than 32,400 ft. when descending. If IAS is switched back to MACH after descending below 32,400 ft., the manual speed will remain the last selected.

Rotating the SPD PUSH CHG button outer knob sets IAS. The readout reflects the position of the IAS/MACH target bug on both PFDs. MACH is displayed at ≥ .450 M and is removed when ≤ .400 M.

AIRSPEED TAPE (CONT'D)

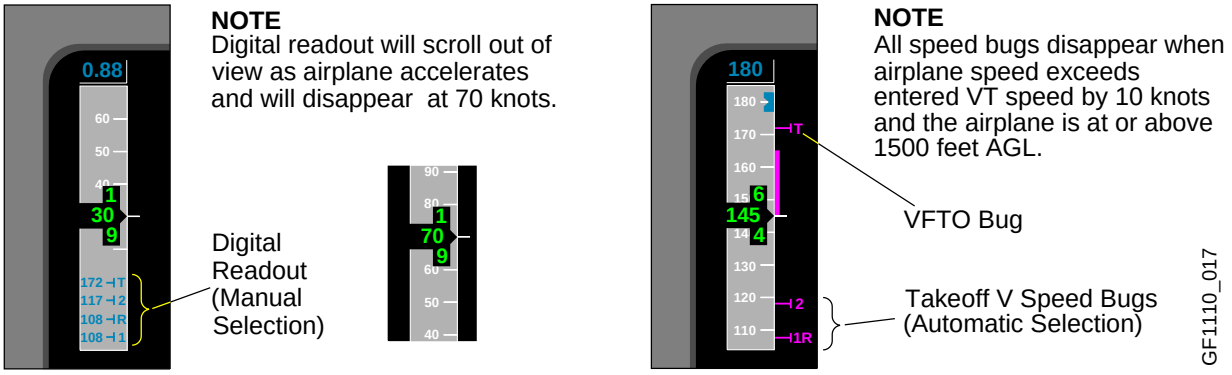
Airspeed Reference Bug

The active speed bug is always the bucket shaped bug on the inside of the airspeed tape. The standby speed bug (i.e. FMS if the active mode is MAN or MAN if the active mode is FMS) is always the triangle shaped bug on the outside of the speed bug. An airspeed reference bug is cyan when the source of that bug's speed is the MAN speed knob and magenta when the source if the bug's speed is the FMS. The value of the non-active speed bug can be changed by normal operation of the source of the speed command (SPD knob in MAN or FMS programming in FMS).



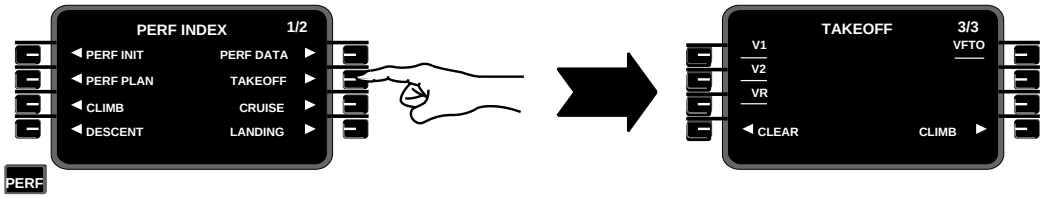
TAKEOFF V SPEED

Takeoff V speeds V1, VR, V2 are displayed on the speed tape. Digital V speeds are displayed on the bottom of the speed tape and V speed bugs are displayed on the outside of the speed tape. A final take off speed (VFTO) bug (T) is also displayed on the outside of the speed tape. V Speeds and VFTO speed are selected through the FMS, automatically (magenta) or manually (cyan).

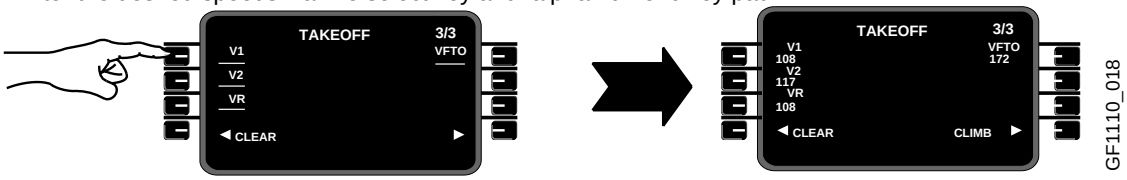


The SPEED SET page is used to configure the take-off speed page and provides TAKEOFF prompts on the ACTIVE FLT PLAN page. All speed bugs disappears when airplane speed exceeds entered VT speed by 10 knots and the airplane is at or above 1500 feet AGL. VR is positioned out further on the outside of the speed tape, to allow V1 and VR to be displayed side by side should V1 be equal to VR.

① Press PERF button and select TAKEOFF from PERF INDEX 1/2 .



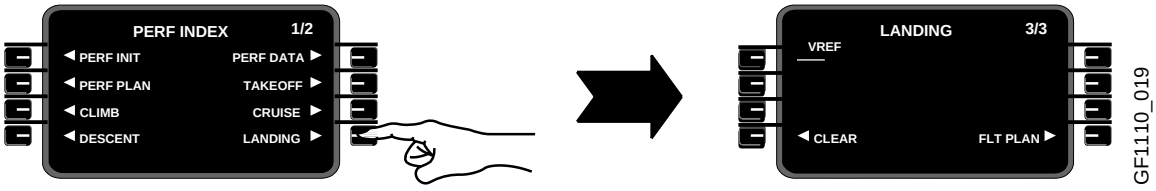
② Enter the desired speeds via line select key and alpha numeric key pad.



LANDING V SPEED

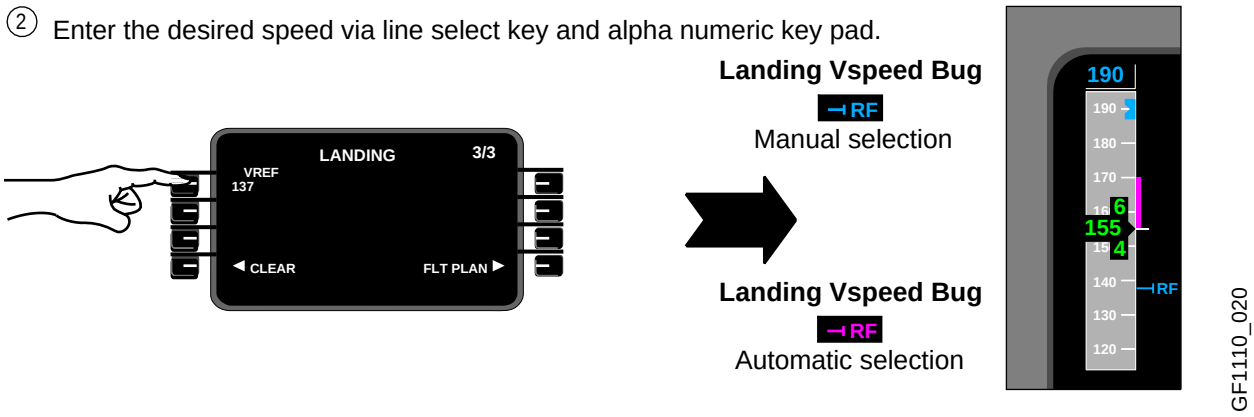
Landing V speed is selected through the FMS, automatically (magenta) or manually (cyan). The SPEED SET page is used to configure the landing speed page and provides LANDING prompts on the ACTIVE FLT PLAN page. Landing speeds can be entered at any time and are cancelled upon landing.

① Press PERF button and select LANDING from PERF INDEX 1/2.



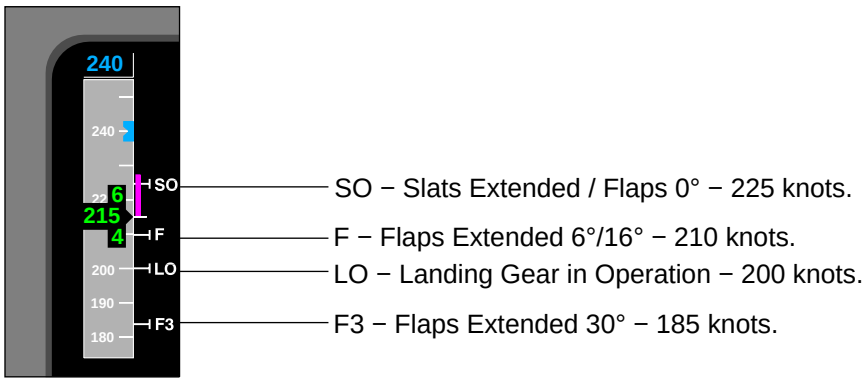
LANDING V SPEED (CONT'D)

② Enter the desired speed via line select key and alpha numeric key pad.



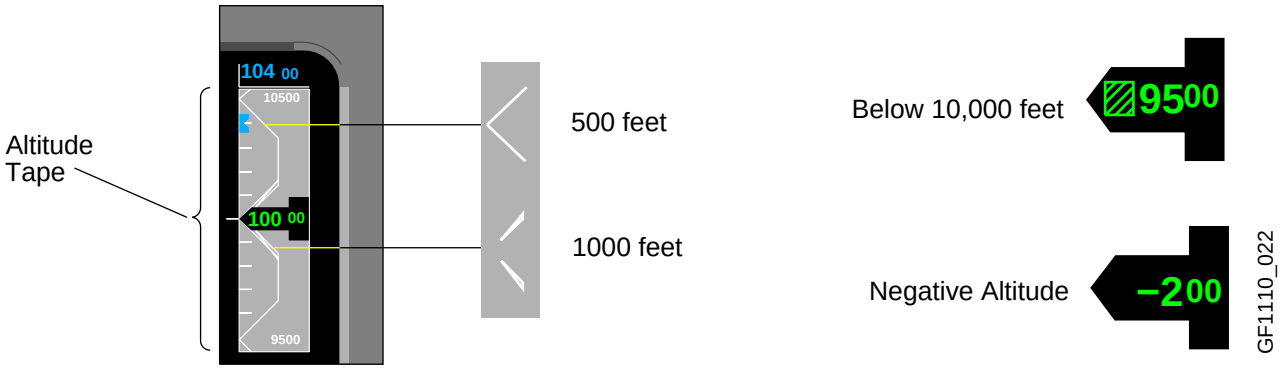
FLAP/SLAT/GEAR EXTENSION SPEED BUGS

The flap/slat/gear extension speed bugs will appear anytime the airplane is 18,000 feet and below or anytime that the landing gear is in operation, the flaps are selected out of 0 degrees and/or slats are out.



ALTITUDE TAPE

The altitude tape is capable of displaying altitudes between −980 and 65,000 feet (inclusive) and the current barometric altitude ± 550 feet. The altitude tape is labeled at every 500 feet and has a double-lined chevron at each 1000 foot altitude and a single-lined chevron at each 500 feet. A boxed barberpole symbol will appear if the digital readout is < 10,000 feet. A minus sign will appear when a negative altitude is displayed.



ALTITUDE TREND VECTOR

Altitude trend vector information is derived from the selected ADC. It will indicate what the altitude of the airplane will be in 6 consecutive seconds, based on current vertical speed.

SELECTED ALTITUDE READOUT

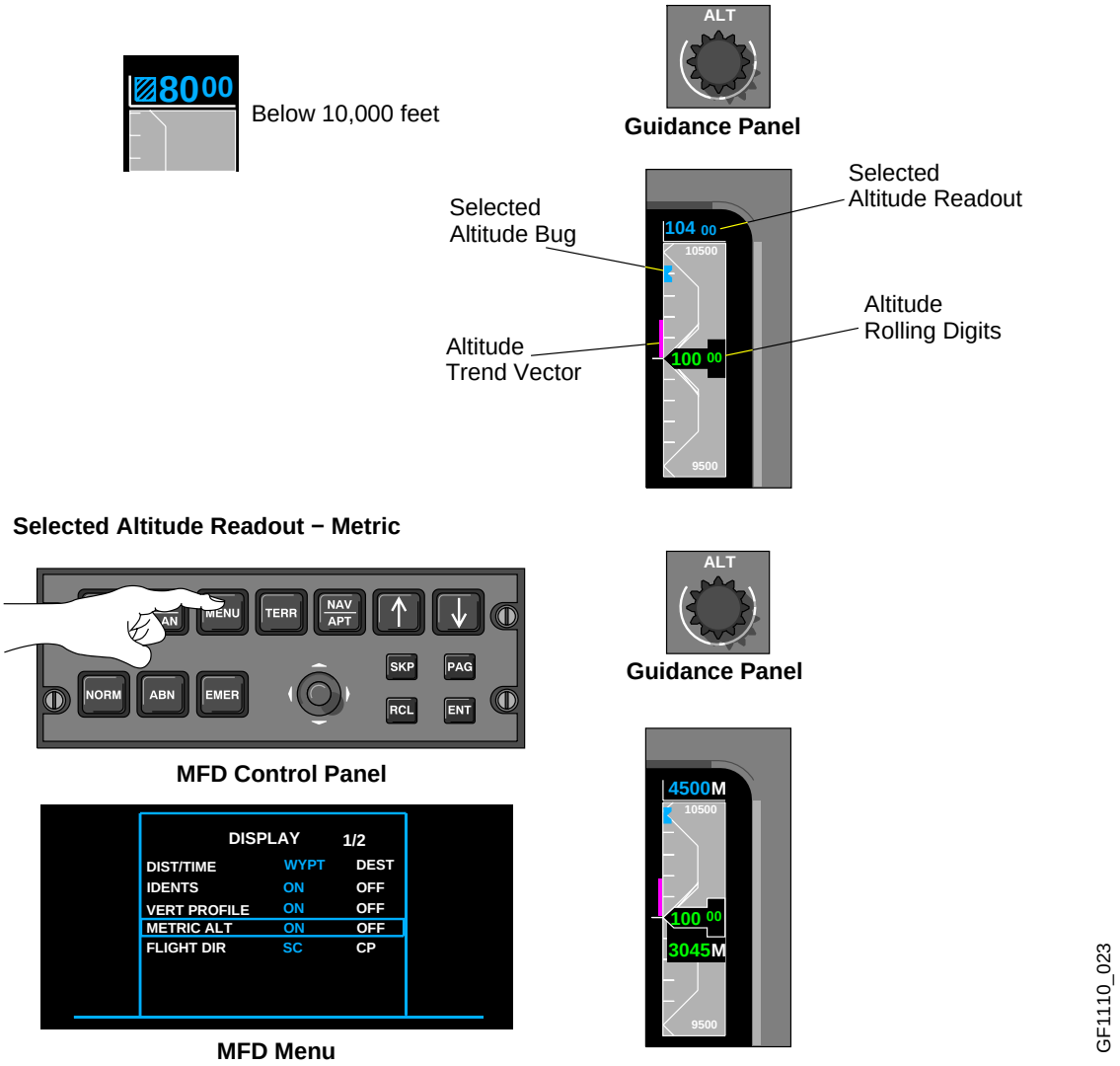
The readout reflects the position of the altitude reference bug on both PFDs, with a range of 0 to 51,000 feet.

A boxed barberpole symbol will appear if the digital readout is < 10,000 feet.

The readout can be displayed in metric, with a range of 0 to 15,500 meters, using the MENU display selection on the MFD control panel, located on the pedestal.

SELECTED ALTITUDE BUG

The altitude bug is set using the ALT knob on the guidance panel. The bug will park at the appropriate end of the altitude tape when off scale. At this position, one half of the bug will be in view.



RADIO ALTITUDE

Radio altitude is displayed on the bottom of the attitude indicator.

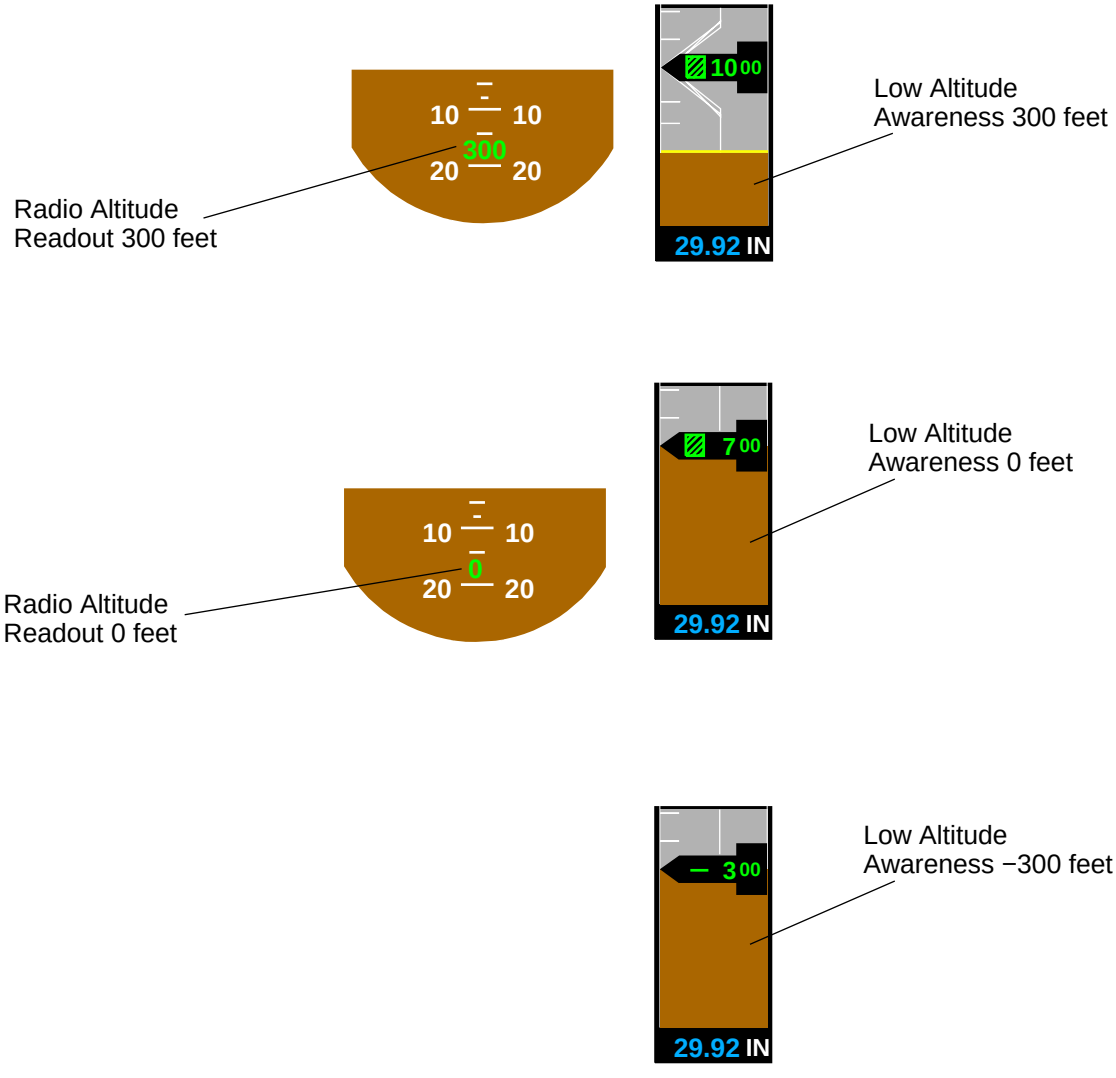
The radio altitude readout range is from 0 feet to 2550 feet and is displayed as follows:

- 5 foot increments − Altitude less than 200 feet
- 10 foot increments − Altitude ≥ 200 feet but < 1500 feet
- 50 foot increments − Altitude ≥ 1500 feet

RADIO ALTITUDE LOW ALTITUDE AWARENESS

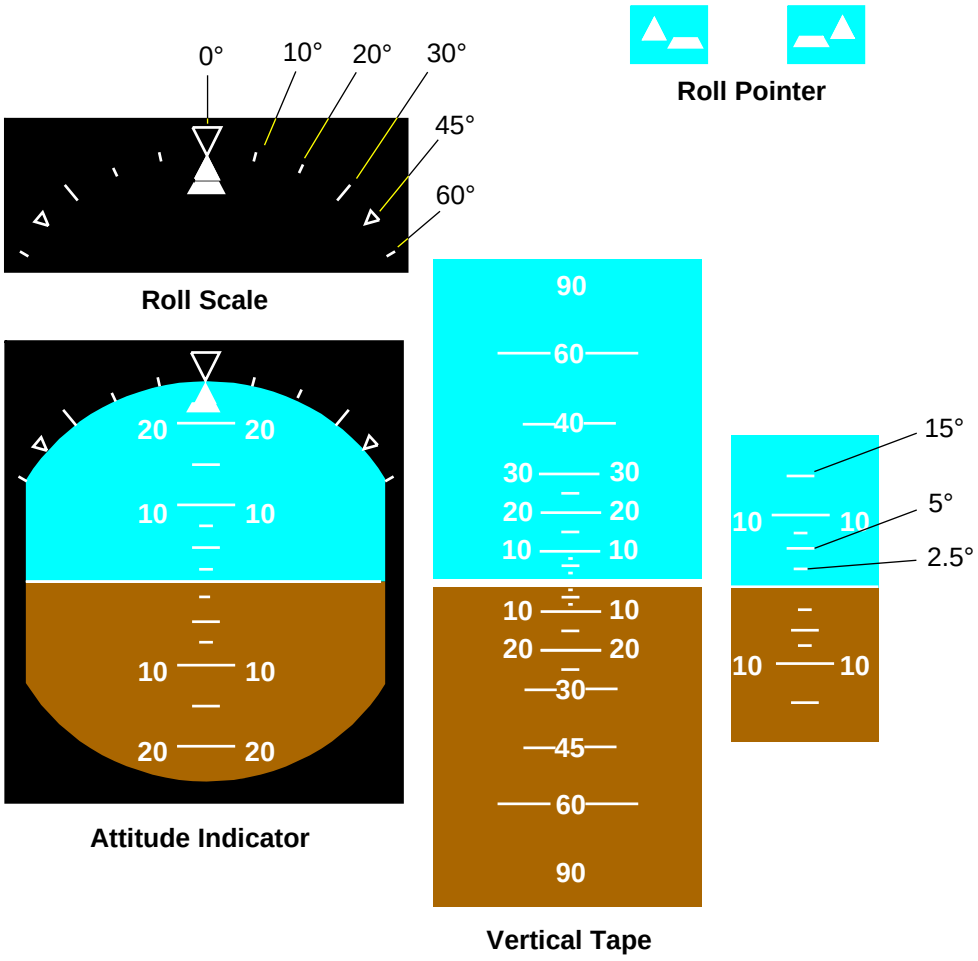
Low altitude awareness is displayed as an indication of the ground with respect to current barometric altitude.

Low altitude awareness is displayed when radio altitude is between 0 and 550 feet.



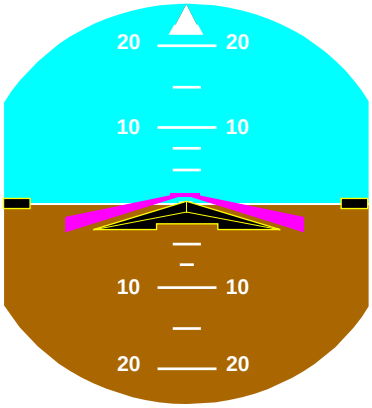
ATTITUDE DIRECTOR INDICATOR (ADI)

The ADI provides pitch, roll and roll pointer (slip/skid) information.

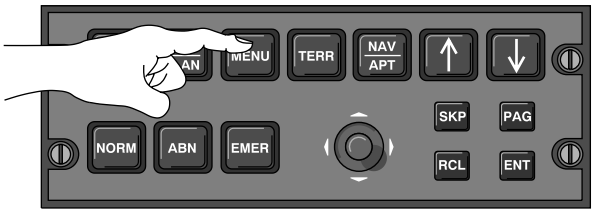


FLIGHT DIRECTOR COMMAND BARS

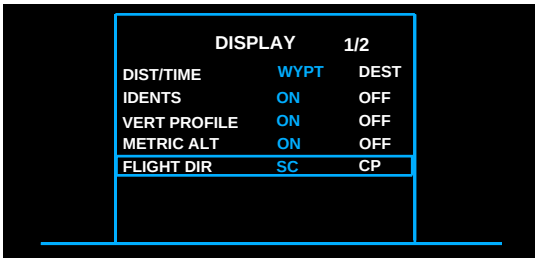
The Flight director command bars can be displayed in Single Cue (SC) airplane symbol or Cross Pointer (CP) airplane symbol. Selections are made on the MFD control panel, located on the pedestal, using the MENU button. If pitch or roll command is invalid, the flight director command bars are removed.

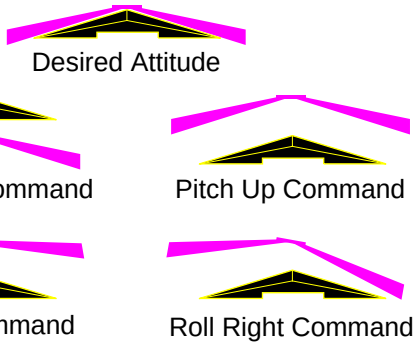


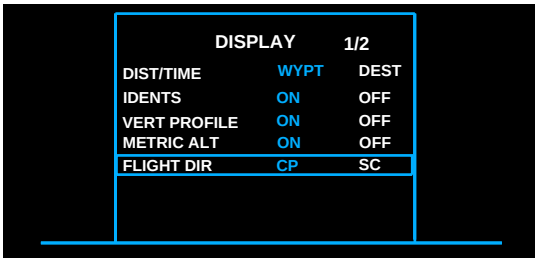
Single Cue



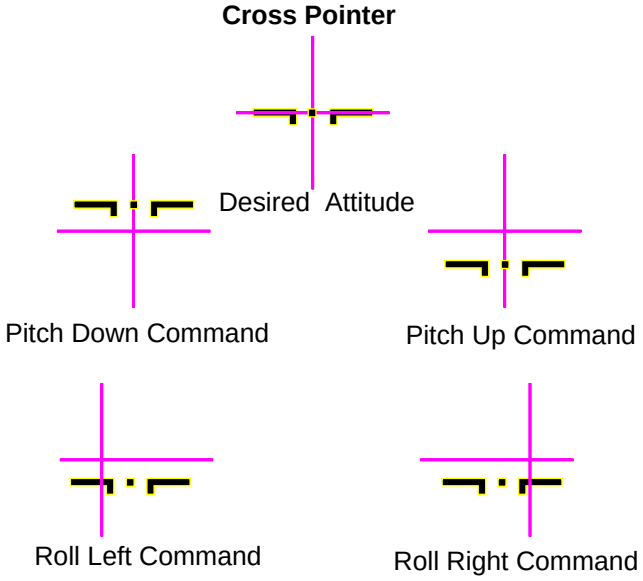
MFD Control Panel

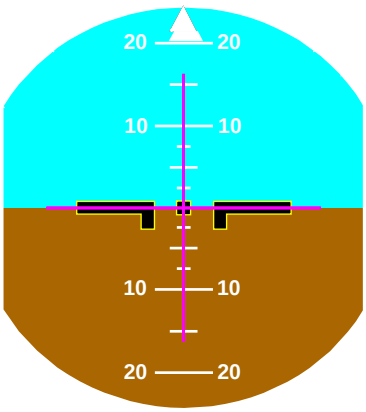






Cross Pointer

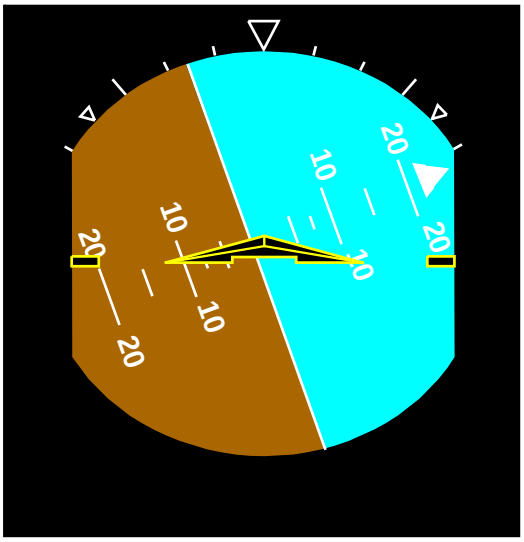




GF1110_026

ATTITUDE DECLUTTER (ROLL)

An excessive attitude occurs when roll is greater than 65 degrees. When there is an excessive attitude the following symbology will be removed:



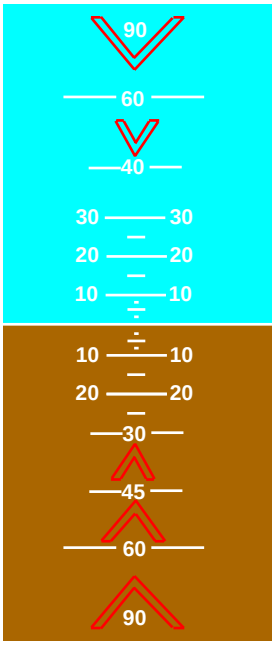
- Autopilot Flight Director Mode Annunciations Autopilot.
- HSI Select Arrow.
- Low Bank Limit Arc.
- Autopilot Flight Director Command Bars.
- Vertical deviation Scale/Pointer Annunciator (VTA).
- Marker Beacons.
- Airspeed Reference Bug/Readout.
- Airspeed VNAV Speed Bug.
- Airspeed VSpeed Bugs/Readout.
- Radio Altitude Readout.
- Decision Height Readout.
- Minimum descent Altitude Readout/Bug.
- Selected Altitude Readout/Bug.
- Altitude VNAV Target Readout/Bug.
- All failure flags for the items listed above.
- The following comparators: HDG, RAD, LOC, AZ, GS, GP, EICAS

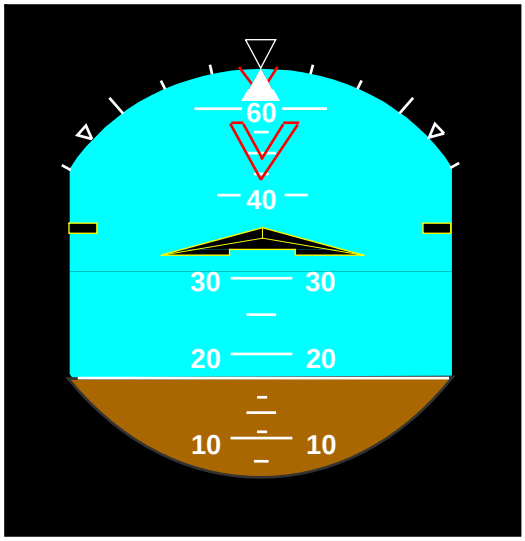
NOTE
The symbology will be restored when roll is 63 degrees or less.

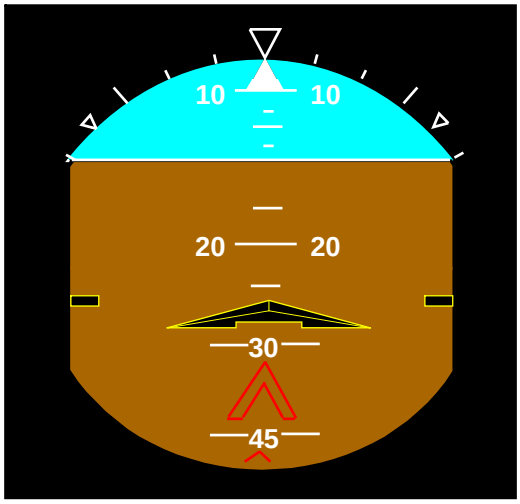
GF1110_027

ATTITUDE DECLUTTER (PITCH)

An excessive pitch occurs when pitch is greater than 30 degrees or less than −20 degrees. When there is excessive pitch, red chevrons will appear, directing the pilot to follow the direction of the chevron. When there is an excessive pitch the following symbology will be removed:







- Autopilot Flight Director Mode Annunciations.
- Autopilot HSI Select Arrow.
- Low Bank Limit Arc.
- Autopilot Flight Director Command Bar.
- Vertical Deviation Scale/Pointer Annunciator (VTA).
- Marker Beacons.
- Airspeed Reference Bug/Readout.
- Airspeed VNAV Speed Bug.
- Airspeed VSpeed Bugs/Readout.
- Radio Altitude Readout.
- Decision Height Readout.
- Minimum Descent Altitude Readout/Bug.
- Selected Altitude Readout/Bug.
- Altitude VNAV Target Readout/Bug.
- All failure flags for the items listed above.
- The following comparators: HDG, RAD, LOC, AZ, GS, GP, EICAS.

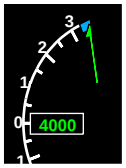
NOTE
The symbology will be restored when pitch is between 28 and −18 degrees (inclusive).

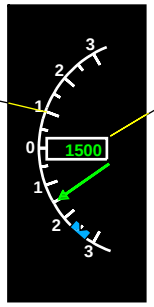
GF1110_028

VERTICAL SPEED INDICATOR (VSI)

Vertical Speed Scale
Tick marks are placed at the following: 0, ± 1000, ± 2000 and ± 3000 FPM.

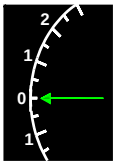
- At vertical speeds in excess of ± 3600 FPM, the pointer will park at ± 3600 FPM.
- Only one half of the arrowhead and one half of the target bug will be in view.





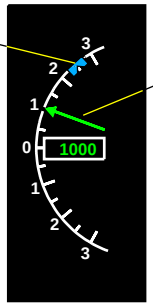
Vertical Speed Readout
The vertical speed readout has a range of ± 9999 FPM.

- For vertical speeds less than ± 1000 FPM information is rounded to the nearest 100 FPM.
- For vertical speeds more than ± 1000 FPM information is rounded to the nearest 100 FPM.
- The digital readout and box is removed for vertical speeds less than or equal to ± 500 FPM, and enabled for vertical speeds greater than or equal to ± 600 FPM .



Vertical Speed Target Bug
Displayed when flight director VS mode (cyan) or FMS VPTH mode (magenta) is active.

- When vertical speed target is within range of ± 1000 FPM it is rounded to the nearest 100 FPM.
- When vertical speed target is greater than or equal to ± 1000 FPM, information is rounded to the nearest 100 FPM.

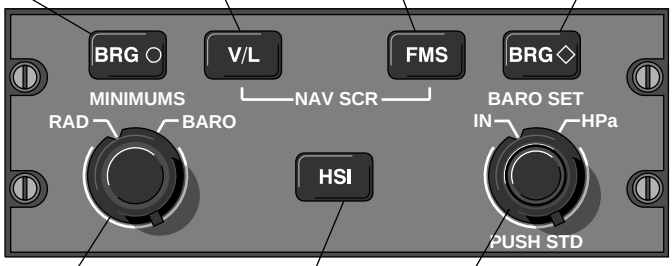


Vertical Speed Pointer

GF1110_029

PFD CONTROL PANEL

The PFD control panels (2) are located on the glareshield. Both the pilot's and co-pilot's control panels have identical but separate on-side functions. The PFD control panel is used for selection of bearing pointers, VOR/LOC source, FMS source, setting of minimums and barometric settings and compass display format.



V/L Button 17
Used to select VOR or LOC as a primary NAV source.

BRG Button 17
Used to select bearing sources, VOR 2, ADF 2, FMS 2.

FMS Button 17
Used to select FMS1, FMS 2 or FMS 3, (If installed) source or, FMS1, FMS 2 or LTRK (if installed).

BRG Button 17
Used to select bearing sources, VOR 1, ADF 1, FMS 1 (FMS 3 if installed).

MINIMUMS Knob
RAD − Sets the Decision Height (DH) value on PFD.
BARO − Sets the Minimum Descent Altitude (MDA) value on PFD.

BARO SET Knob
PUSH STD − When pushed, it will either display 29.92 (in)/hg or 1013 HPa.
IN − Sets the altimeter for inches of mercury.
HPa − Sets the altimeter for hectopascals.

HSI Button
Used to select full or partial compass display.

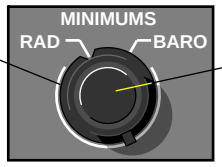
GF1110_030

☐ Indicates Chapter in which information on item may be found.

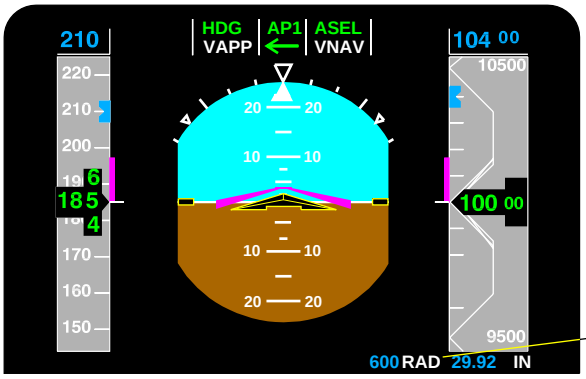
PFD CONTROL PANEL (CONT'D)

MINIMUMS Knob

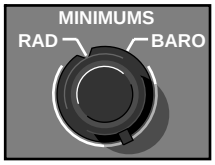
MINIMUMS Outer Knob
RAD − Sets the Decision Height (DH) value on PFD.
BARO − Sets the Minimum Descent Altitude (MDA) value on PFD.

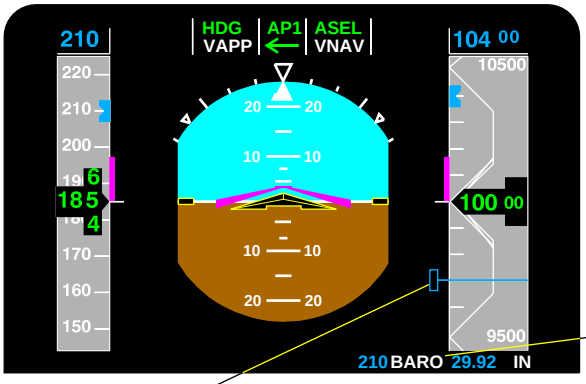


MINIMUMS Inner Knob
Slow rotation of inner knob allows for precise setting of data (1 "click" of knob = 10 feet). Rapid rotation of inner knob will change the data at a faster rate (1 "click" of knob = 100 feet).

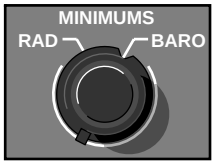


RAD
DH set from 10 to 2500 feet.





BARO
MDA set from 10 to 16000 feet.

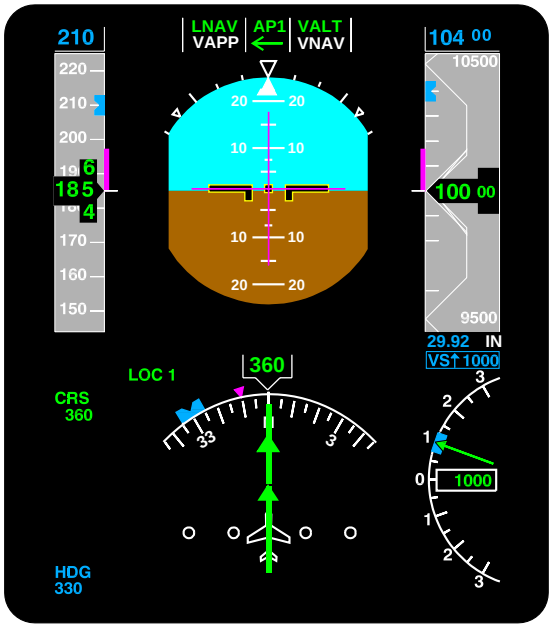


MDA Bug
Only in view when within the ends of the altitude tape.

GF1110_031

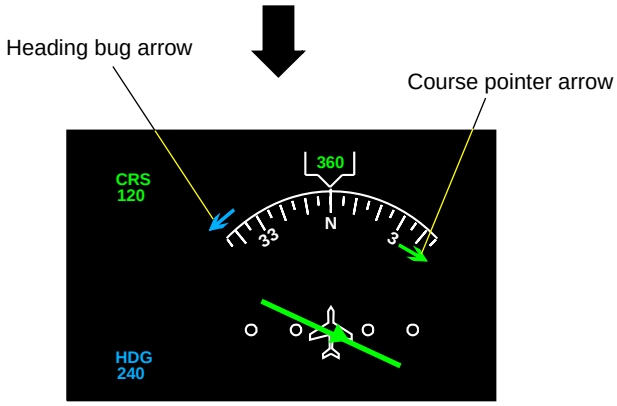
PFD CONTROL PANEL (CONT'D)

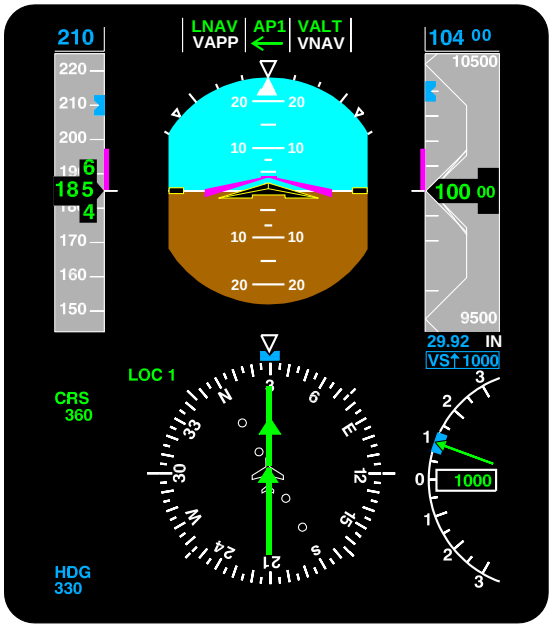
PFD (HSI)



HSI Button
Used to select full or arc (partial compass) display. Selecting HSI button will display arc (partial compass). Selecting HSI button again, will display full compass.

NOTE
If heading bug or course select pointer are out of view, an arrow will be displayed, indicating the shortest direction to the bug or pointer. When the bug or pointer comes back into view, the applicable arrow will disappear.

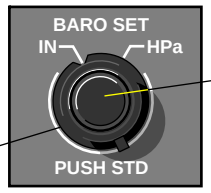




GF1110_032

PFD CONTROL PANEL (CONT'D)

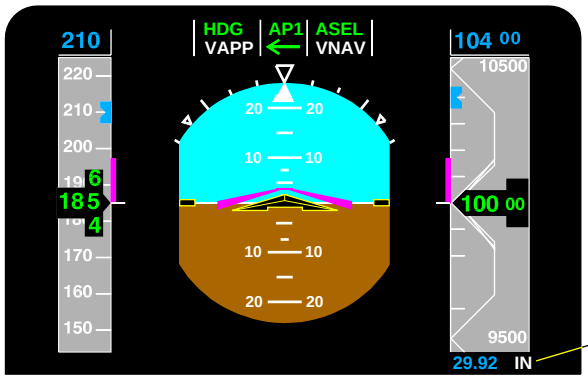
BARO SET Knob



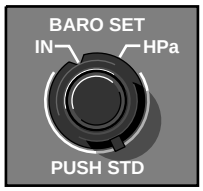
PUSH STD − When pushed, it will either display 29.92 (in)/hg or 1013 HPa.

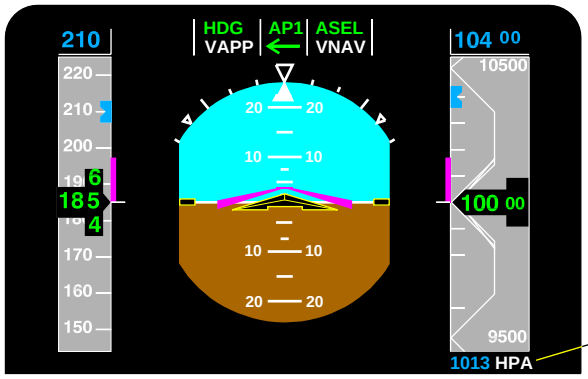
BARO SET Knob

- **IN** − Sets the altimeter for inches of mercury.
- **HPa** − Sets the altimeter for hectopascals.

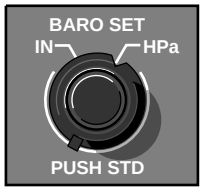


IN
Inches of mercury display range from 15.00 to 32.77 IN inclusive.





HPA
Millibar display range from 500 to 2047 HPA inclusive.

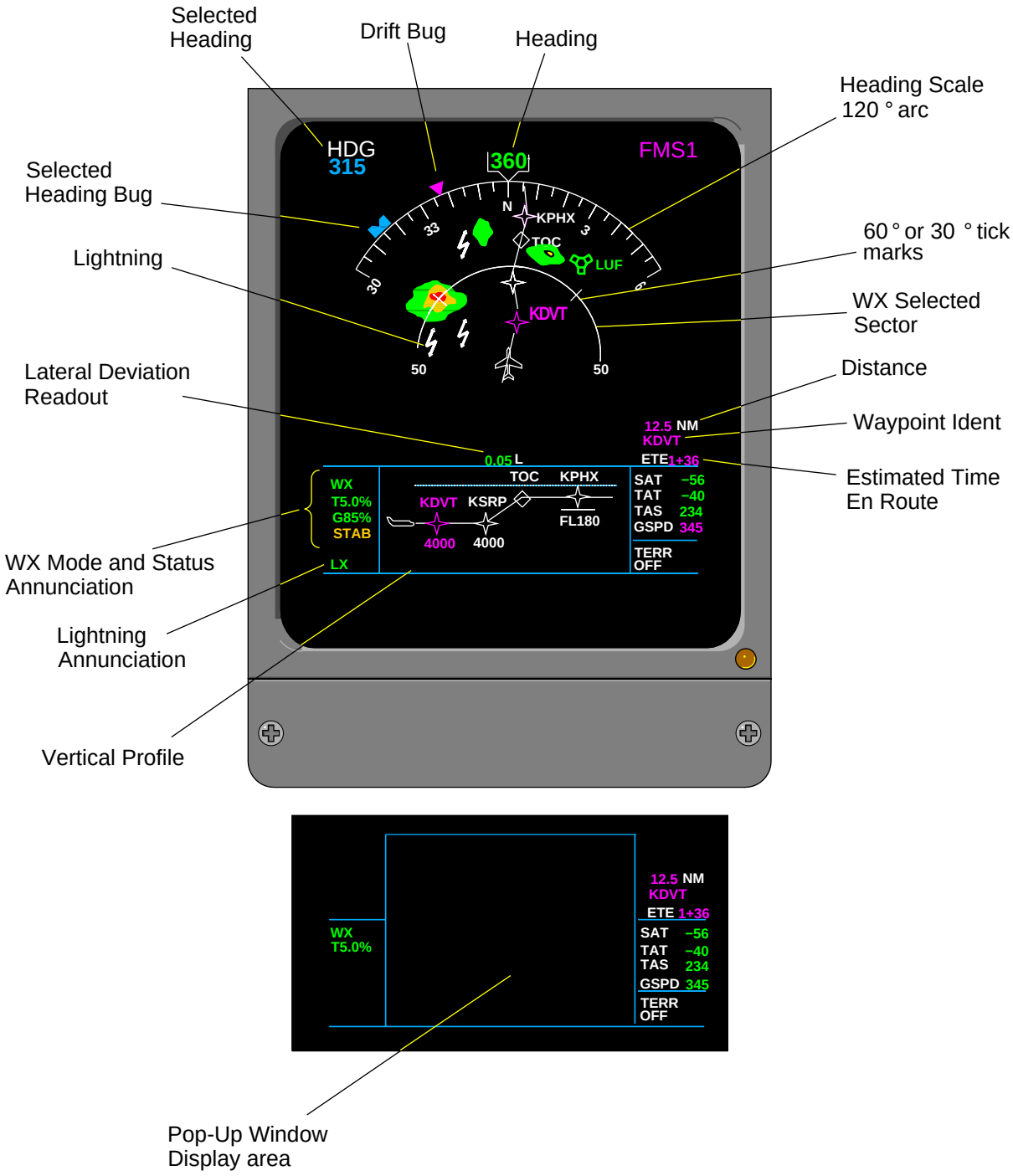


GF1110_033

MULTI-FUNCTION DISPLAY (MFD)

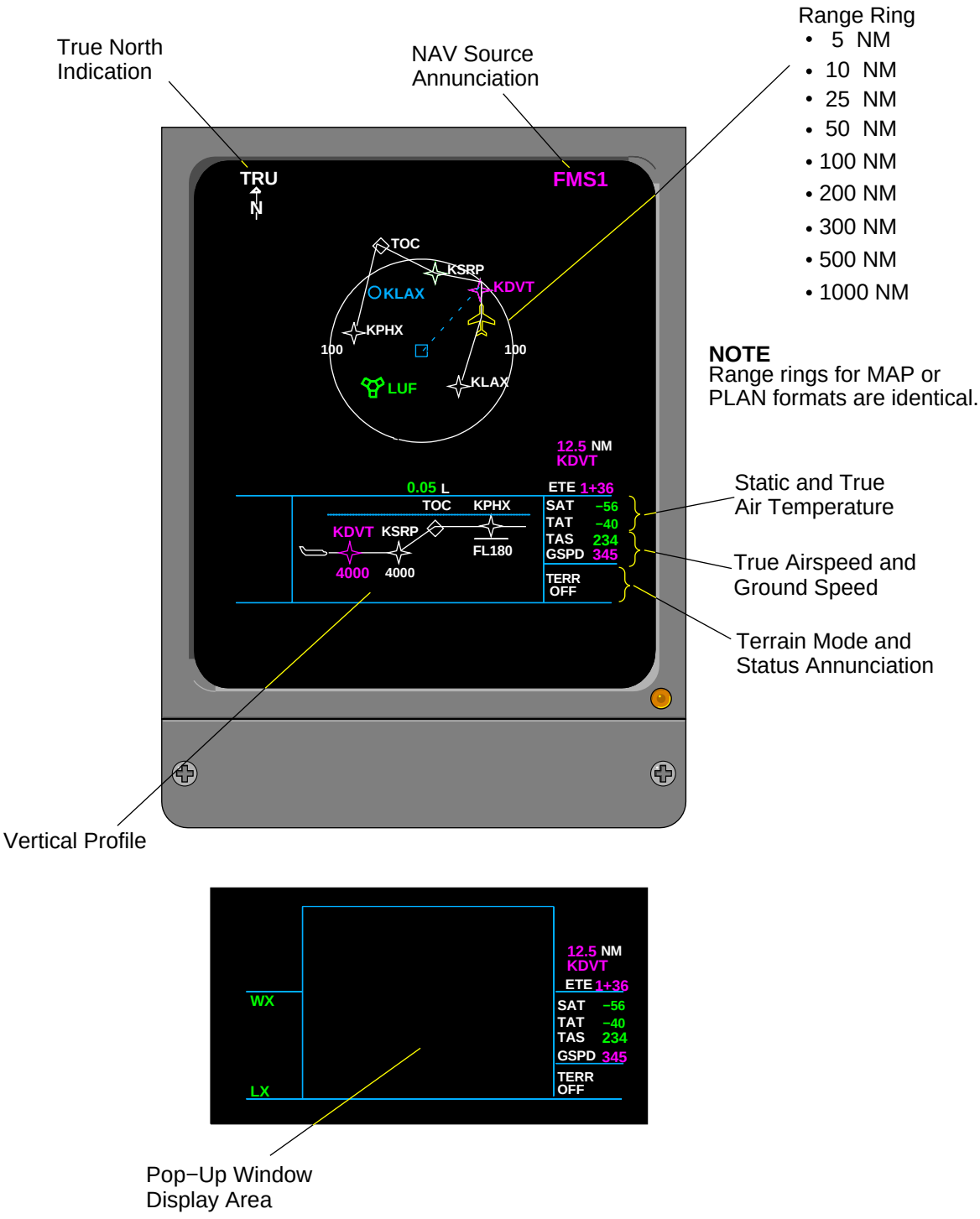
MFD 1 and MFD 2 function as an electronic version of an HSI/RMI and display weather radar information and TCAS traffic resolution advisories. The MFD can either be displayed in MAP format or PLAN format, using the MFD control panel.

MAP Format



MULTI-FUNCTION DISPLAY (MFD) (CONT'D)

PLAN Format

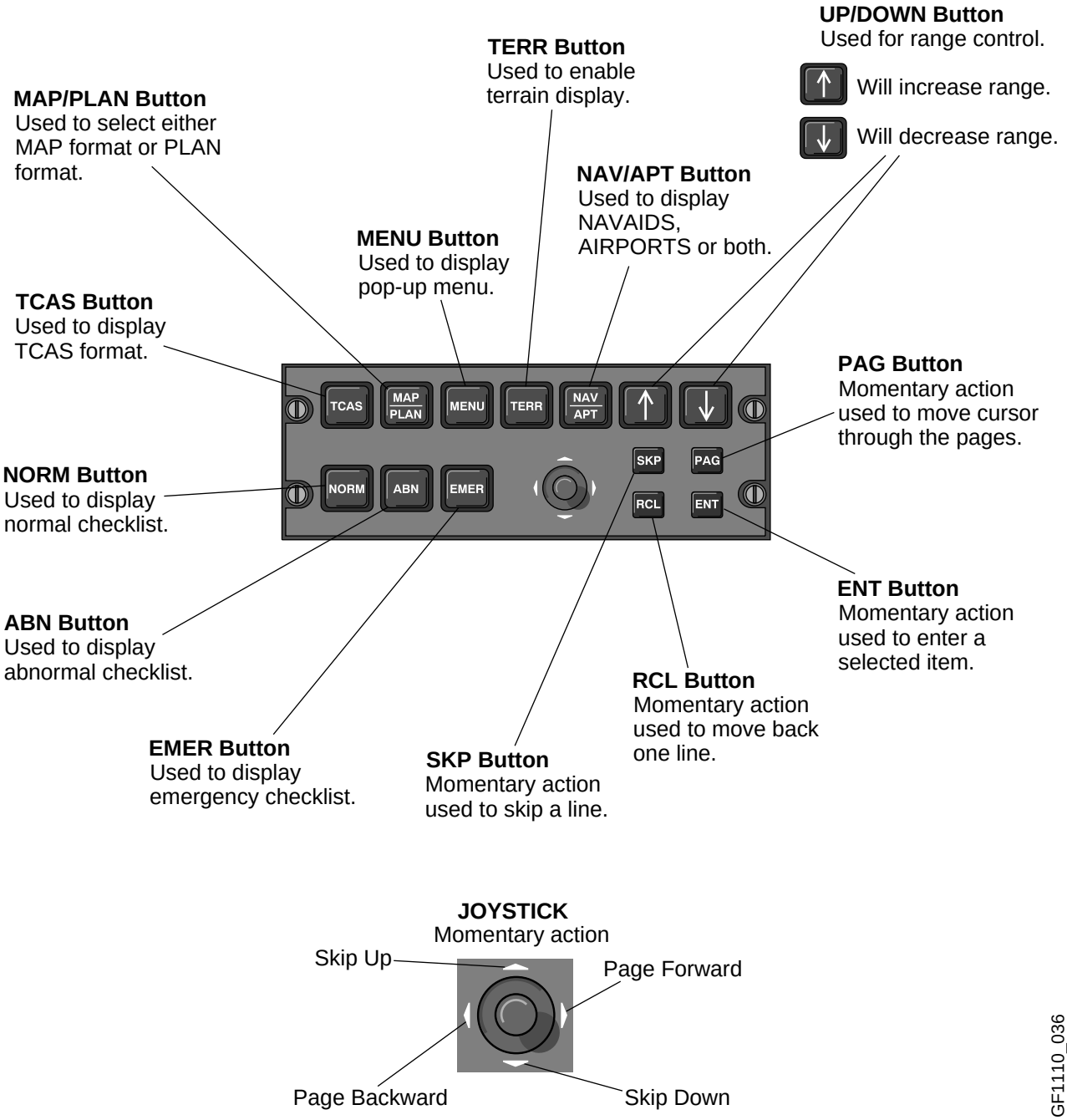


NOTE
Range rings for MAP or PLAN formats are identical.

GF1110_035

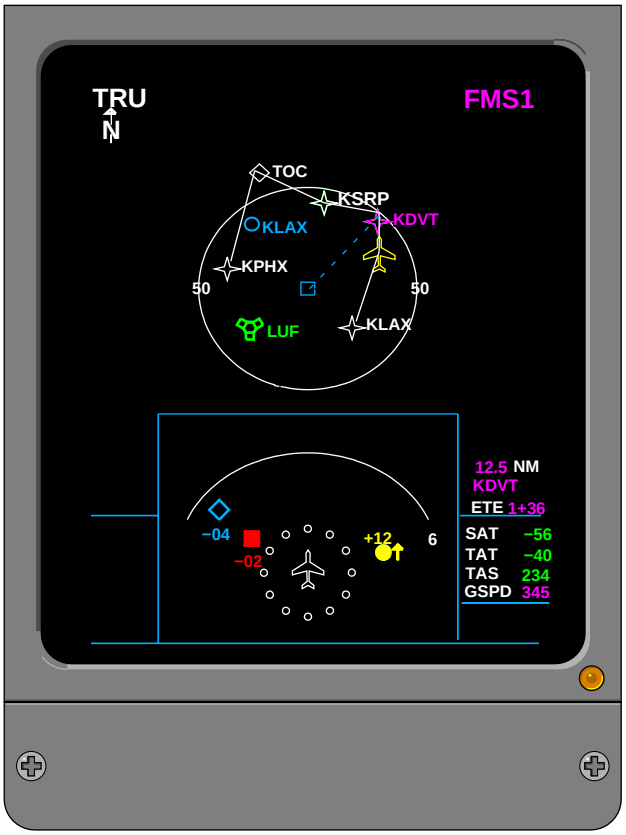
MFD CONTROL PANEL

The MFD control panels (2) are located on the pedestal. Both the pilot's and co-pilot's control panels have identical but separate on-side functions. The MFD control panel is used to display TCAS, display a multifunction pop-up menu, display terrain awareness and checklist control/display functions.

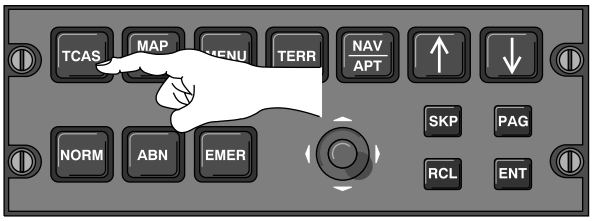


MFD CONTROL PANEL (CONT'D)

Traffic Collision Avoidance System (TCAS) Button

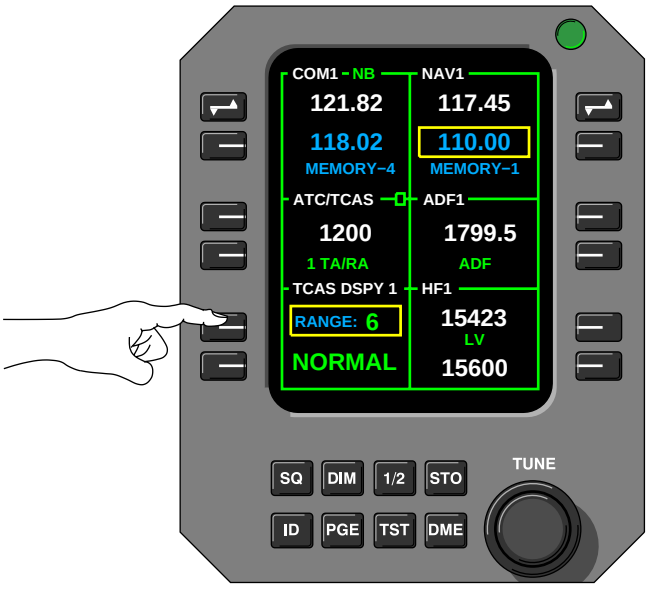


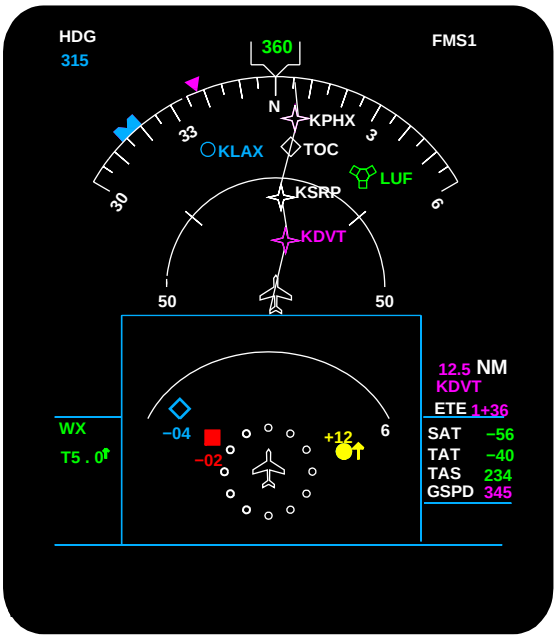
① Selecting TCAS button, will display TCAS Zoom Window at the last selected range.



The button sequence is as follows:
OFF − TCAS − TCAS MAP − TCAS OFF.

② To increase or decrease TCAS range use the line select key and tuning knob on the RMU.





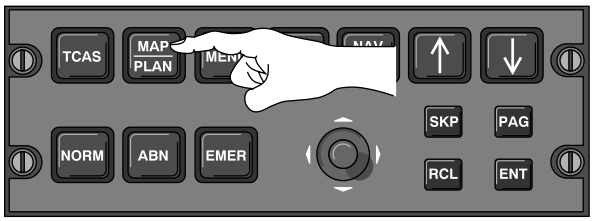
GF1110_037

MFD CONTROL PANEL (CONT'D)

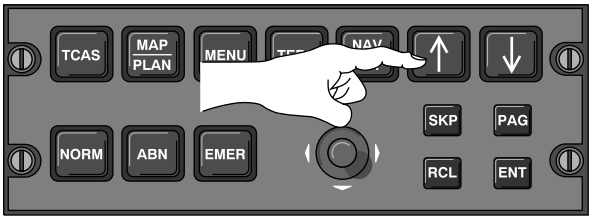
MAP/PLAN Button

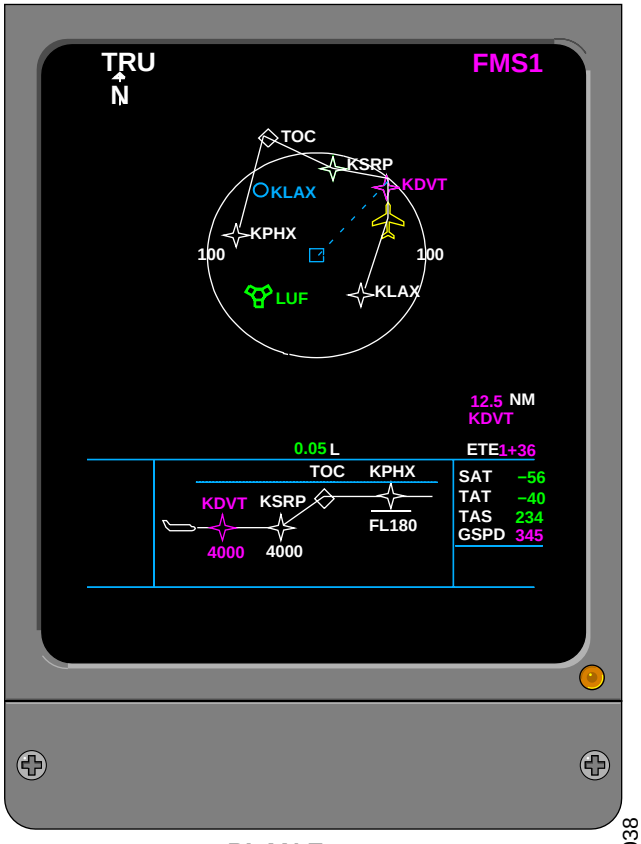
MAP Format

① Selecting MAP/PLAN button, will display MAP or PLAN format in sequence.



② To increase or decrease MAP format or Plan format range use up or down button.





PLAN Format

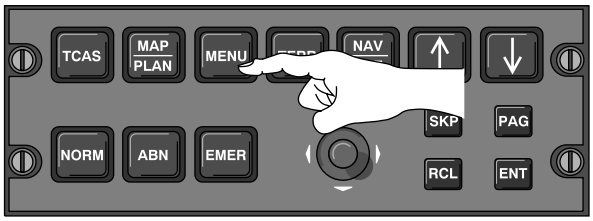
GF1110_038

NOTE
For more information, refer to Chapter 17, NAVIGATION.

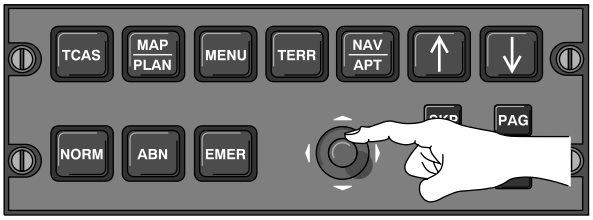
MFD CONTROL PANEL (CONT'D)

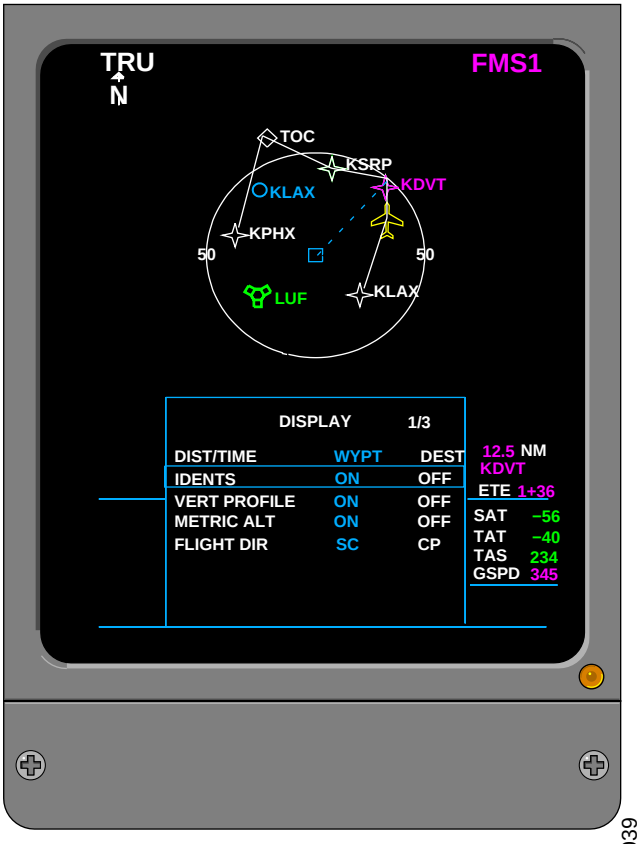
Menu Button

① Selecting MENU will display pop-up menu DISPLAY 1/3.
First line of text will be inside of box (default).



② Pull down on joystick to select next line.
Line that is selected is inside of box.



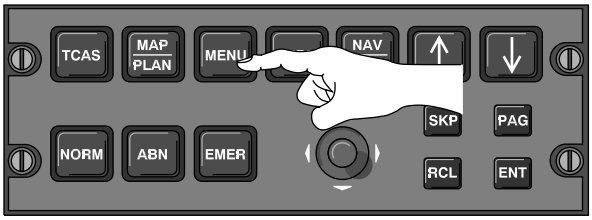


GF1110_039

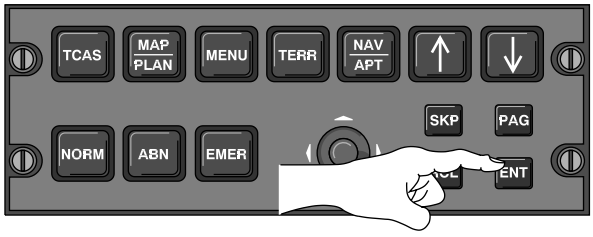
MFD CONTROL PANEL (CONT'D)

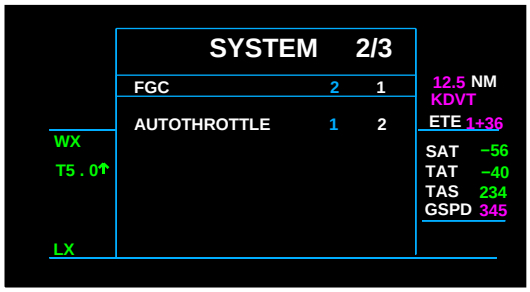
Menu Button (Cont'd)

① Selecting MENU a second time will display SYSTEM 2/3. First line of text will be inside of box (default).



② Select ENT to change mode or source. Mode or source will be cyan when active.



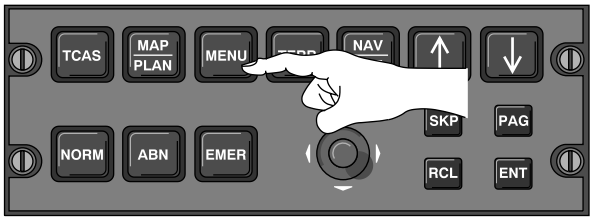


GF1110_040a

MFD CONTROL PANEL (CONT'D)

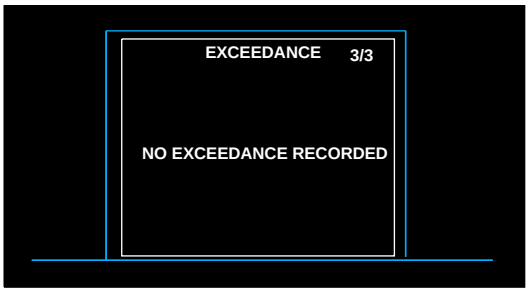
Menu Button (Cont'd)

① Selecting MENU a third time will display SYSTEM 3/3, engine EXCEEDANCE display.

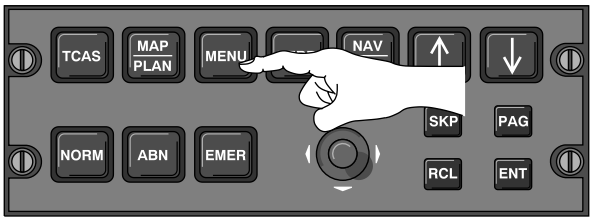


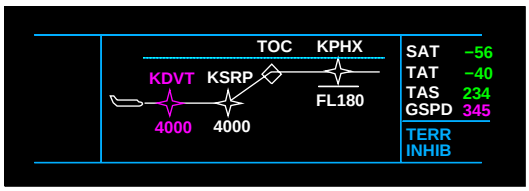
NOTE

If no engine exceedance has occured:



② Select MENU a fourth time will display the vertical profile (if previously selected).

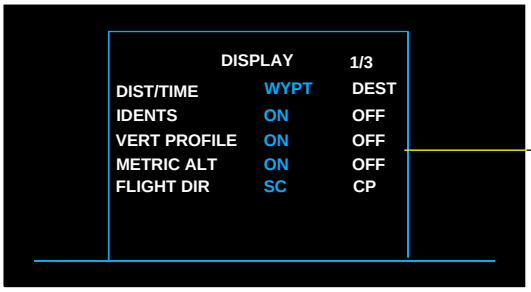




GF1110_041

MFD CONTROL PANEL (CONT'D)

Menu Pages



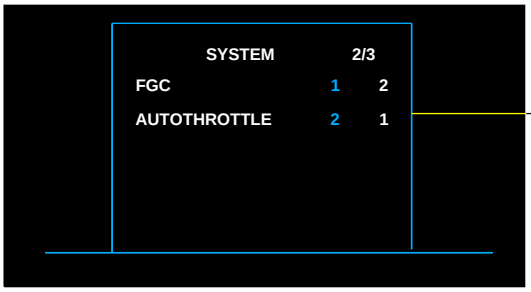
DIST/TIME
Used to indicate display of distance and time information to either the go-to waypoint or destination waypoint.

IDENTS
Used to indicate display of distance and time information.

VERT PROFILE
Used to enable/disable display of the vertical profile data.

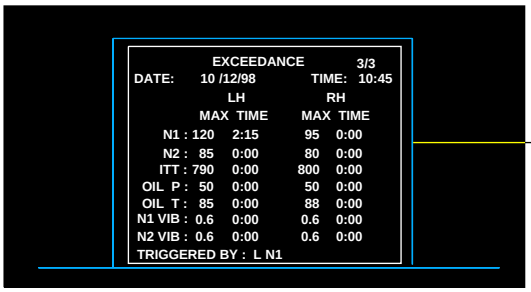
METRIC ALT
Used to enable/disable display of the metric altitude data.

FLIGHT DIR
Used to select between Single Cue (SC) or Cross Pointers (CP) flight director.



FGC
Used to select/change Flight Guidance Computer (FGC) priority.

AUTOTHROTTLE
Used to select between the two autothrottle computers.

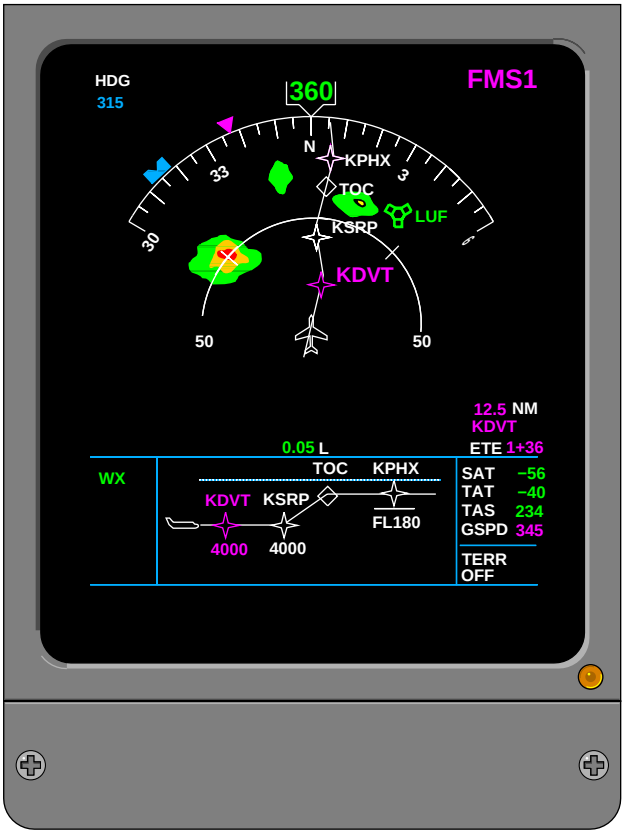


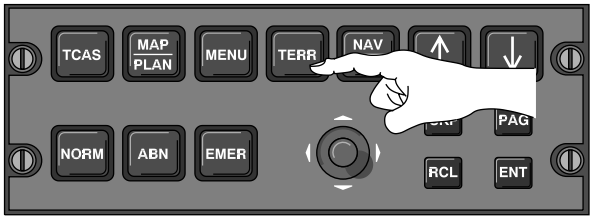
EXCEEDANCE
Displays any engine exceedance transmitted by the Engine Electronic Control (EEC). Only displayed when the airplane is on the ground. For more information, see Chapter 18 POWER PLANT.

GF1110_042

MFD CONTROL PANEL (CONT'D)

Terrain (TERR) Button



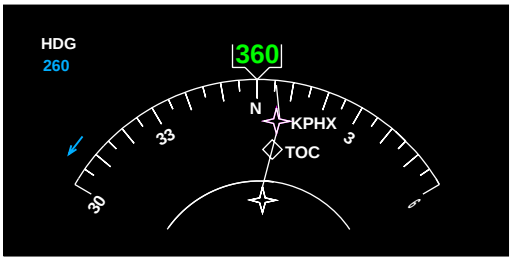


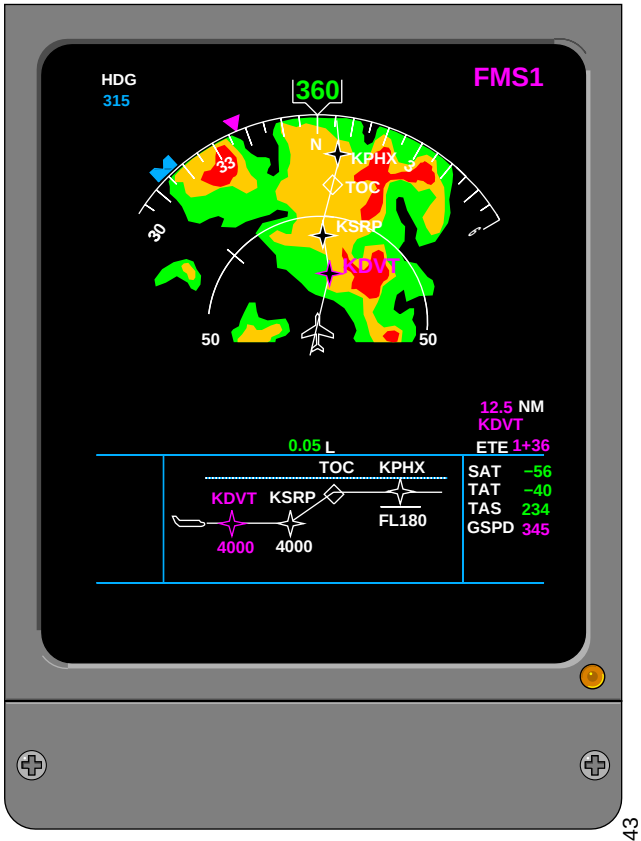
TERR Button

Selecting TERR button enables terrain displays and automatically deselects WX radar (if WX radar selected on). If selected again TERR disabled and WX RADAR enabled (if selected on).

NOTE

If heading bug is out of view, an arrow will be displayed, indicating the shortest direction to the heading bug.





GF1110_043

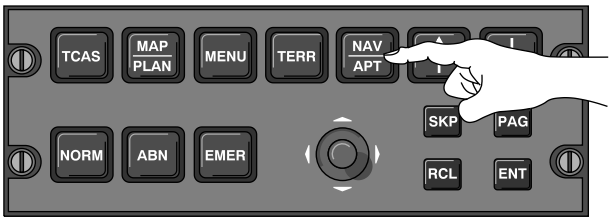
NOTE

For more information, refer to Chapter 17, NAVIGATION.

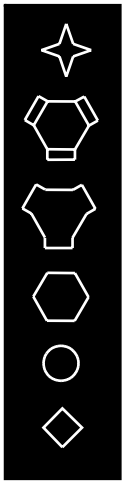
MFD CONTROL PANEL (CONT'D)

Navaids/ Airport (NAV/APT) Button

NAV/APT Button
Used to display NAVAIDS, AIRPORTS or both.



The button sequence is as follows:
NAVAIDS − AIRPORTS − BOTH − OFF.



Waypoint

Navaid: VOR/DME

Navaid: DME only

Navaid: VOR only

Airport

TOC/TOD/BOSC

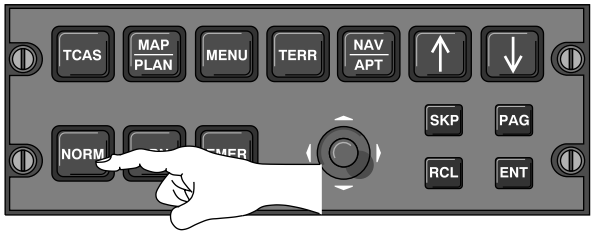
GF1110_044

NOTE
For more information, refer to Chapter 17, NAVIGATION.

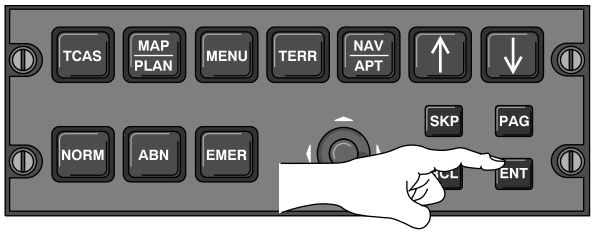
MFD CONTROL PANEL (CONT'D)

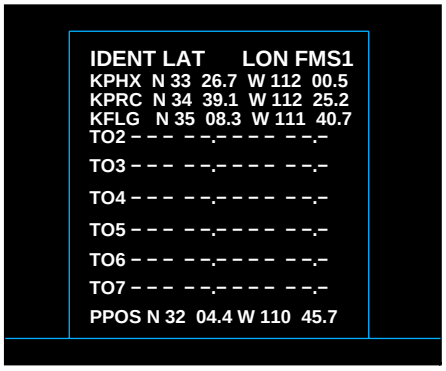
Normal Procedures (NORM) − Waypoint Listing

① Selecting NORM will display Normal Procedures index. First line is inside of box (default).



② Select ENT to view boxed information.



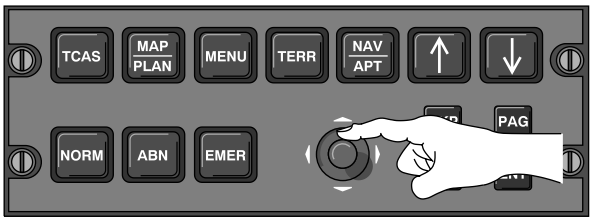


GF1110_045

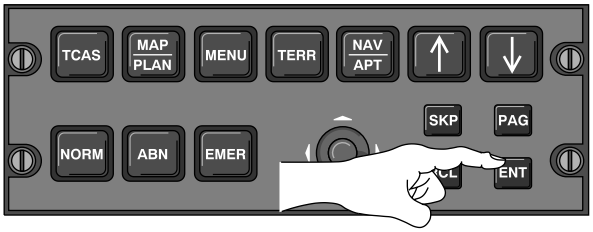
MFD CONTROL PANEL (CONT'D)

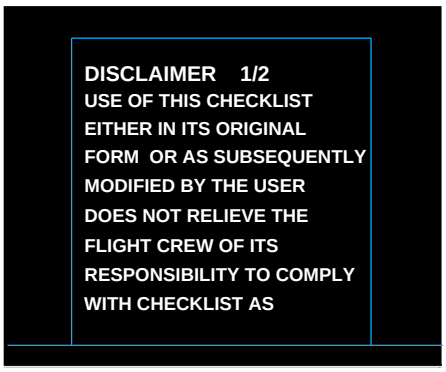
NORM − Disclaimer

① Pull down on joystick to select next line.
Line that is selected is inside of box.



② Select ENT to view boxed information.



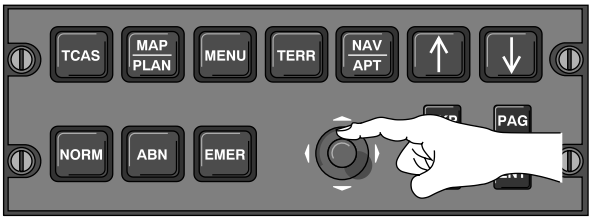


GF1110_046

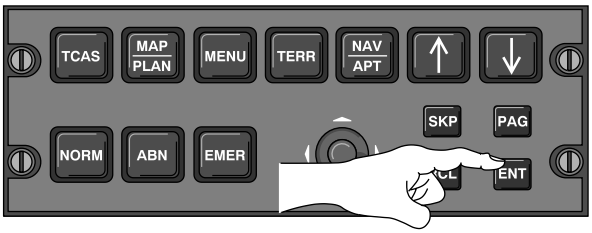
MFD CONTROL PANEL (CONT'D)

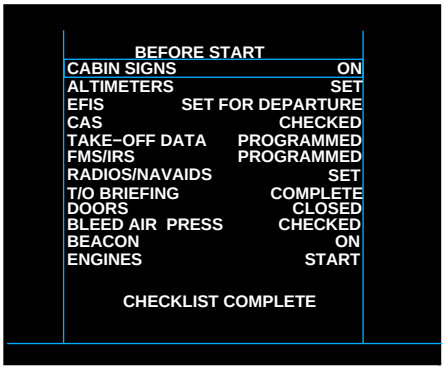
NORM − Before Start

① Pull down on joystick to select next line. Line that is selected is inside of box.

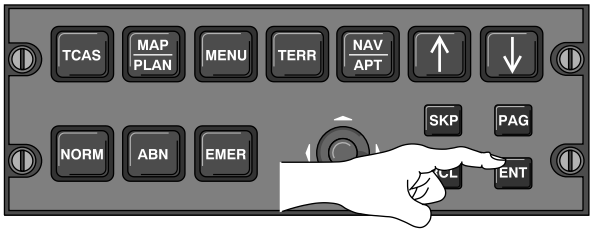


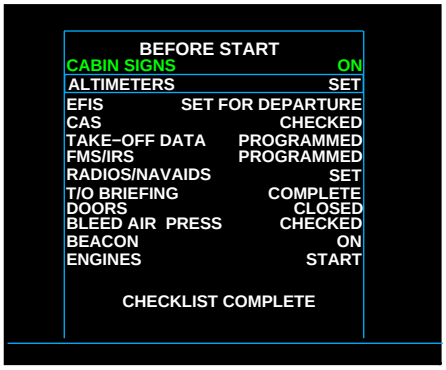
② Select ENT to view selected checklist.





③ To acknowledge checklist item, select ENT button. Once item is acknowledged, it will annunciate green and the box automatically scrolls to the next line.





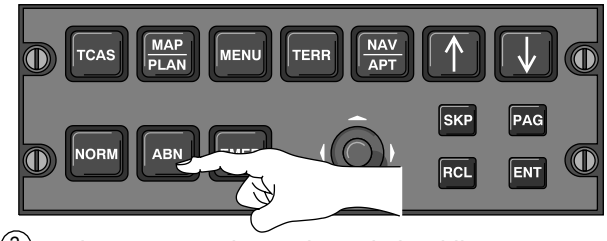
NOTE
The remainder of the normal procedures are accessed and acknowledged in the same manner.

GF1110_047

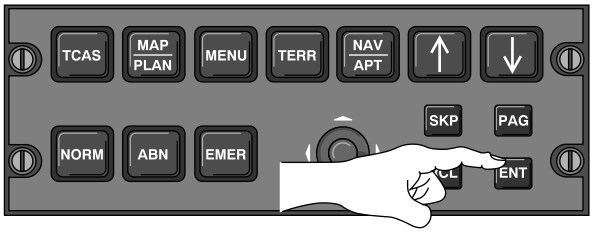
MFD CONTROL PANEL (CONT'D)

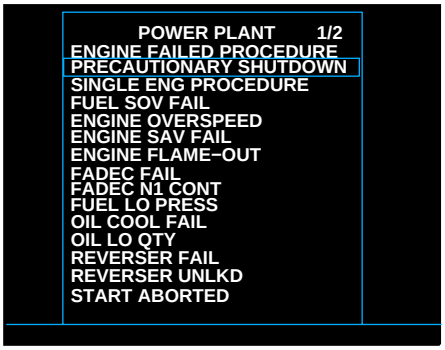
Abnormal Procedures (ABN) Button

① Selecting ABN will display Abnormal Procedures index.

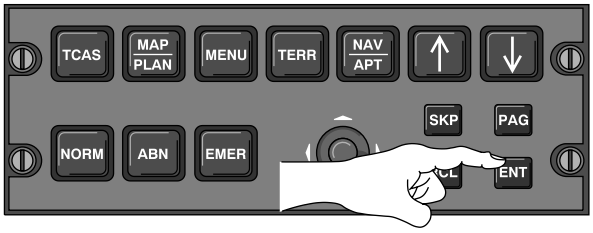


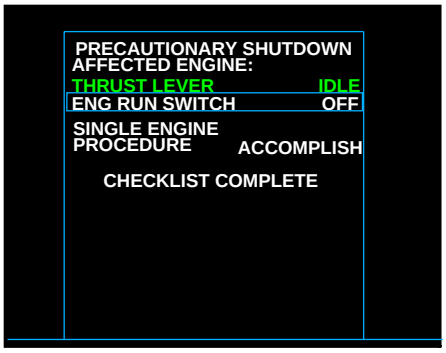
② Select ENT to view selected checklist.





③ To acknowledge checklist item, select ENT button. Once item is acknowledged, it will annunciate green and the box automatically scrolls to the next line.





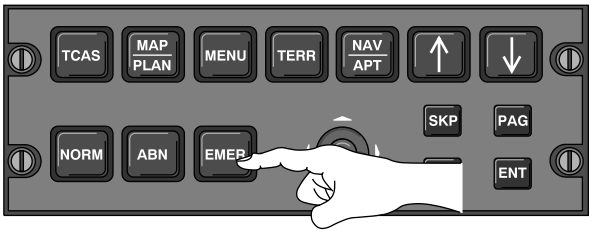
NOTE
The remainder of the abnormal procedures are accessed and acknowledged in the same manner.

GF1110_048

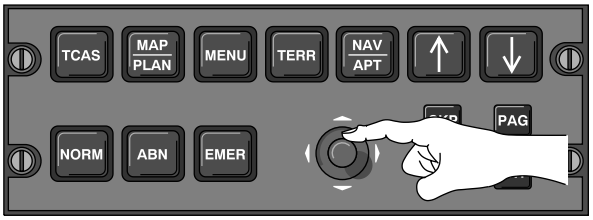
MFD CONTROL PANEL (CONT'D)

Emergency Procedures

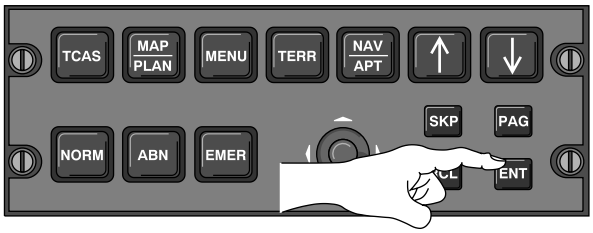
(1) Selecting EMER will display Emergency Procedures index.



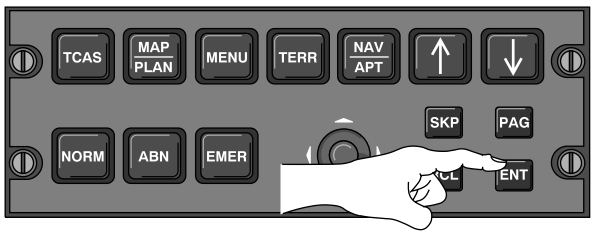
(2) Pull down on joystick to select next line. Line that is selected is inside of box.

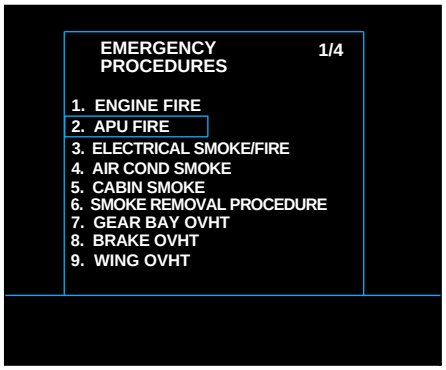


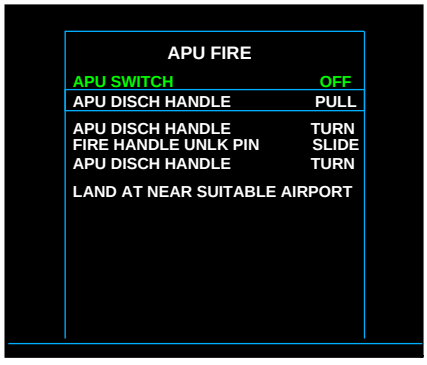
(3) Select ENT to view selected checklist.



(4) To acknowledge checklist item, select ENT button. Once item is acknowledged, it will annunciate green and the box automatically scrolls to the next line.







NOTE
The remainder of the emergency procedures are accessed and acknowledged in the same manner.

GF1110_049

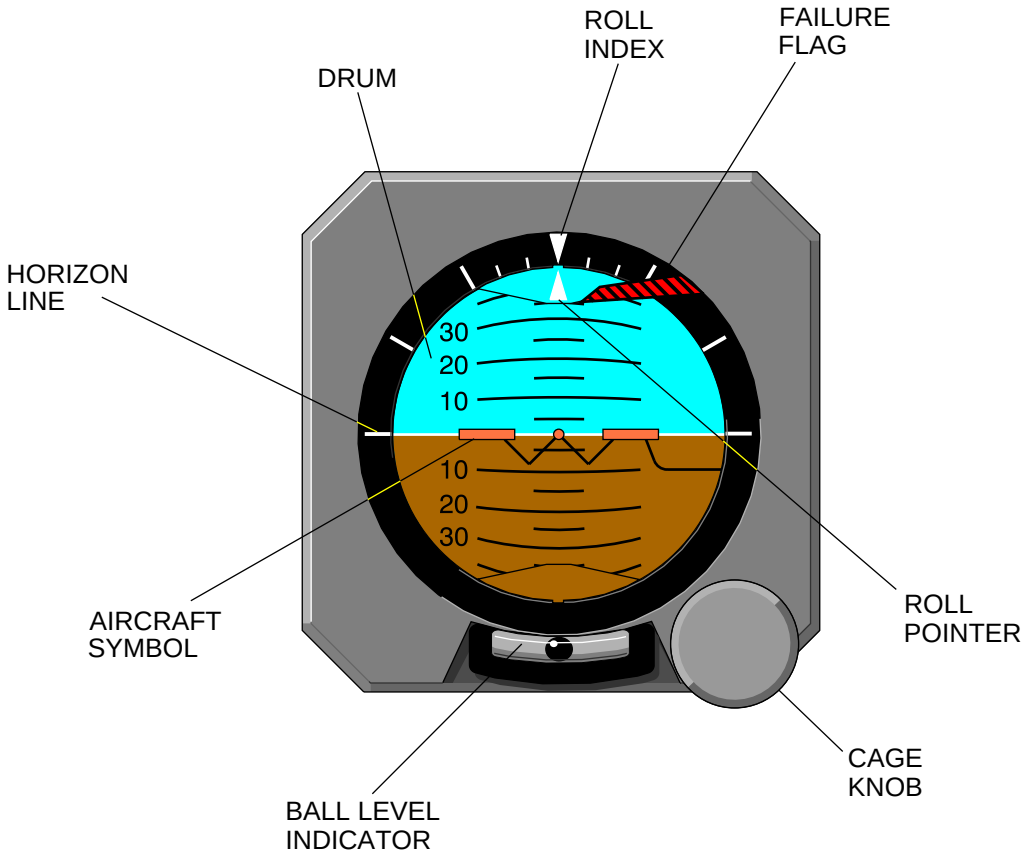
STANDBY ATTITUDE INDICATOR

The standby attitude indicator displays airplane pitch and bank angle. It is a 28 volt DC−driven gyro that provides pitch and roll information independently from the aircraft generated electrical power. The standby attitude indicator is powered from the Avionic Battery bus via the Cockpit Circuit Breaker Panel.

Effectivity:

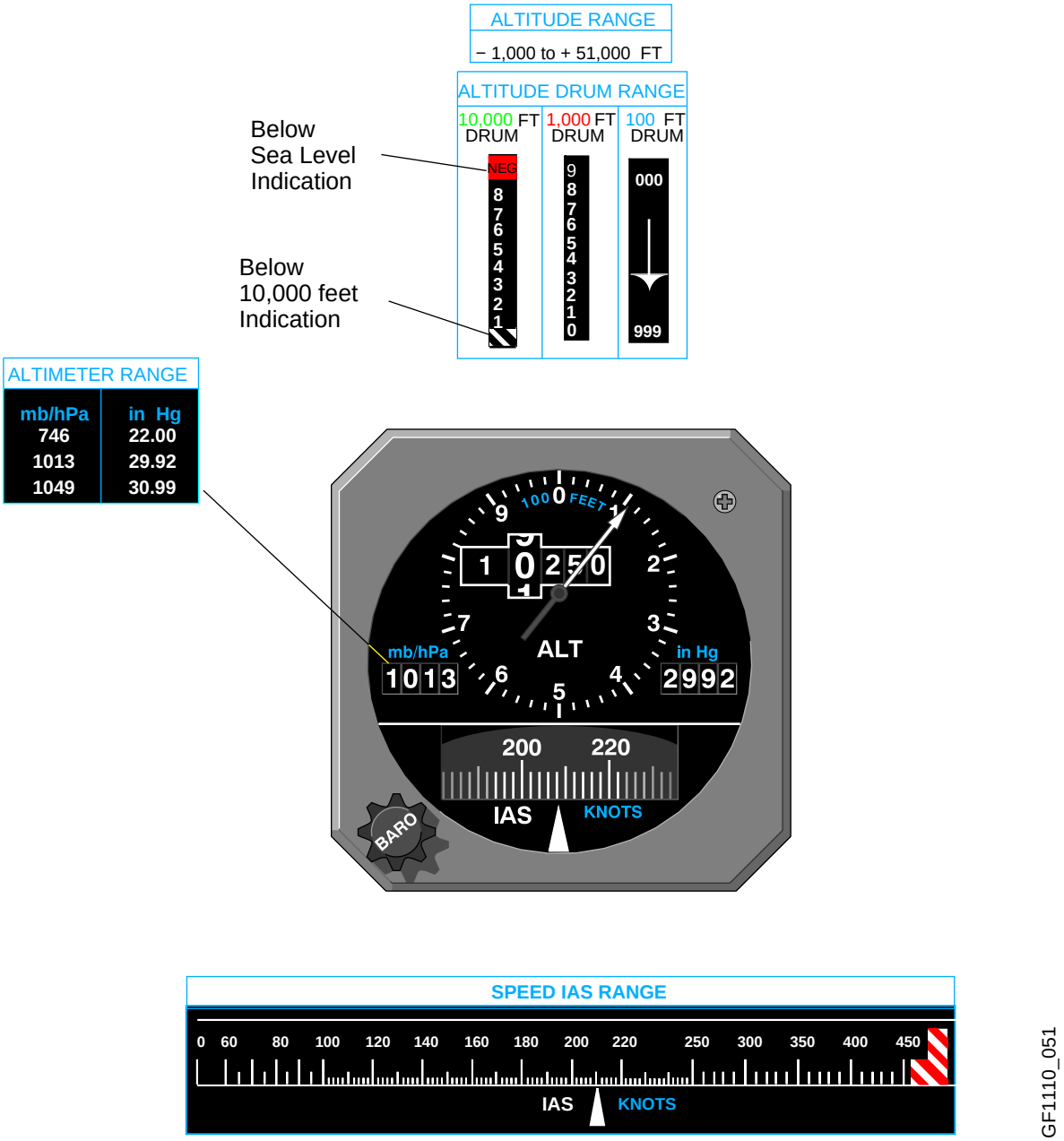
- *Airplanes 9002 thru 9104* ***not incorporating*** *Service Bulletin:*
  - *SB 700−34−022, Standby Artificial-Horizon System − Change Power Source to 28 V dc Direct From Avionics Battery Bus.*

The standby attitude indicator is powered from the battery bus via the SPDA No.1.



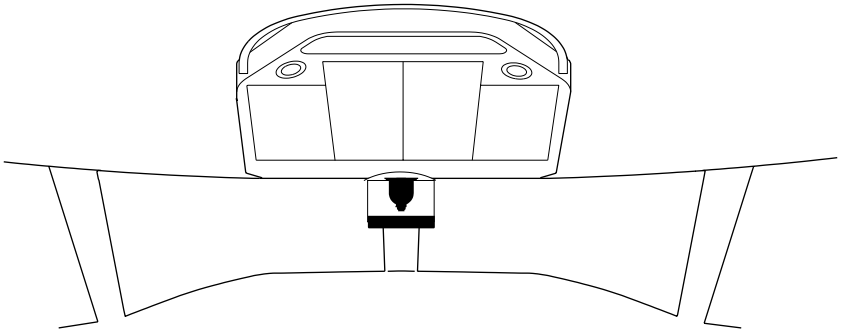
STANDBY ALTIMETER/AIRSPEED INDICATOR

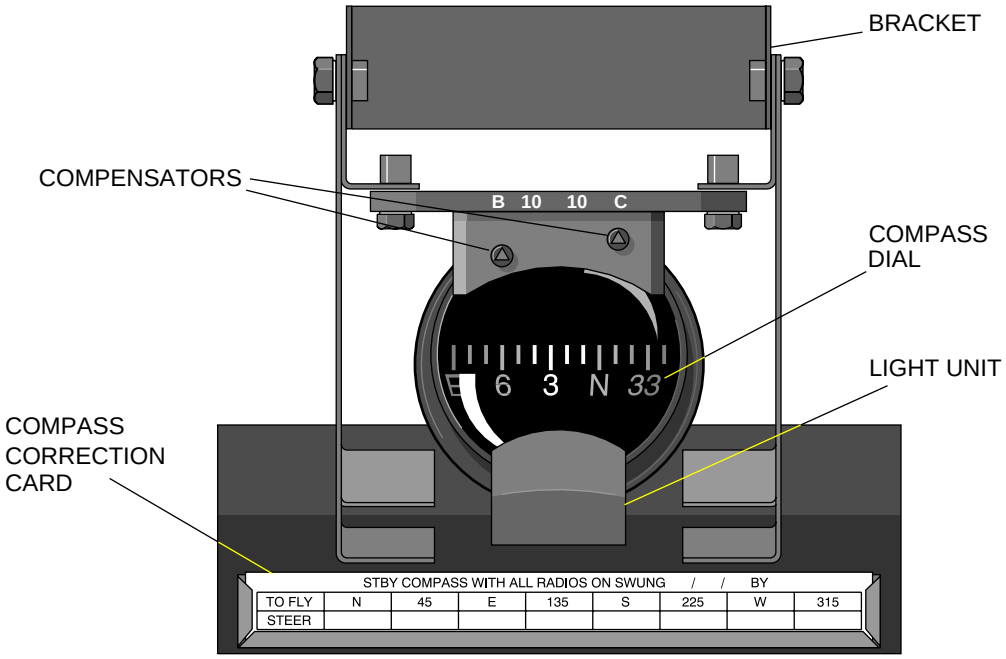
The standby Altimeter/Airspeed indicator uses the standby pitot-static source. The standby indicated airspeed readout displays non-corrected indicated airspeed.



STANDBY MAGNETIC COMPASS

A standby magnetic compass is located below the overhead panel, at the centre of the windscreen. The standby magnetic compass retracts into a compartment in the overhead panel. The compass lighting is controlled by the Cockpit Lights Integral panel, located on the pedestal.



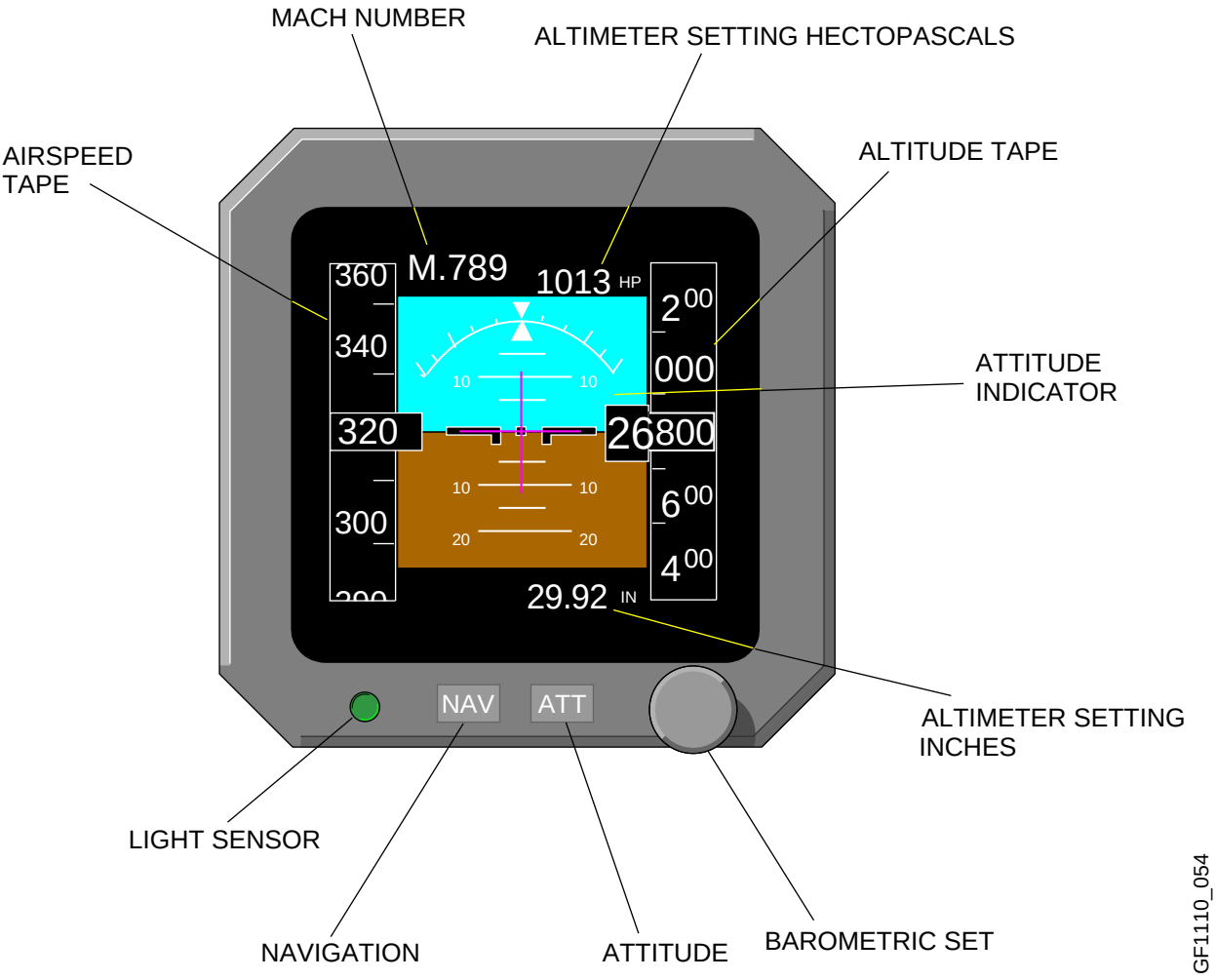


GF1110_052

STANDBY AIRSPEED/ATTITUDE/ALTIMETER (IF INSTALLED)

Incorporated in the indicator is a light sensor that provides ambient light level data to the automatic lighting system.

- A navigation (NAV) button is selected to display ILS (localizer and glideslope) deviation information.
- The ATT button is used to erect the display.



CLOCK

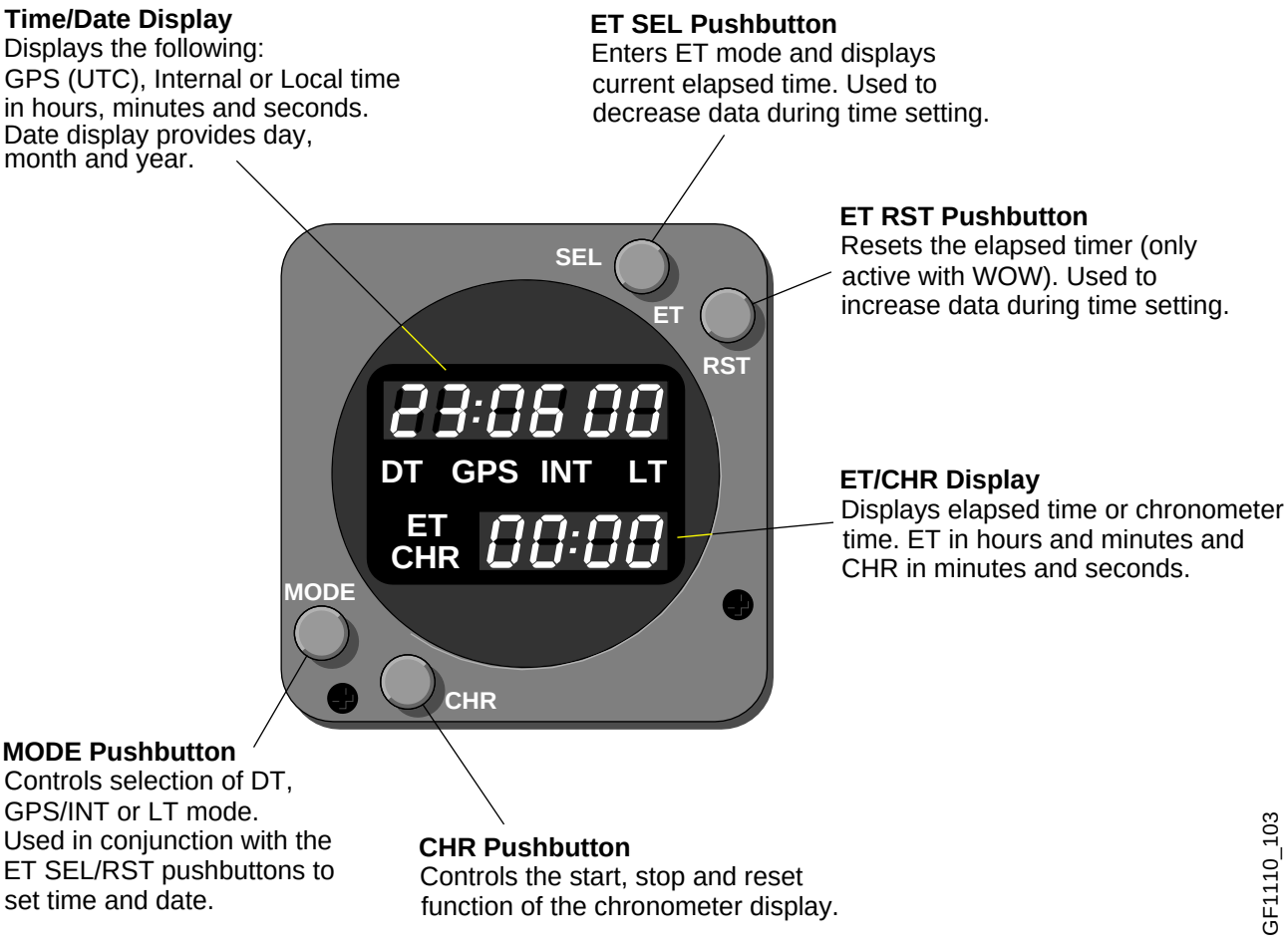
Two digital clocks synchronized to GPS time and date from GNSSU No. 1 are installed in the cockpit. The clocks provide time and date information for the avionics equipment. Each clock provides GPS or internal time and date, local time, chronometer and elapsed time functions. The clock automatically enters GPS mode when the clock receives a valid GPS signal and automatically enters internal mode if the GPS signal becomes invalid

When power is initially applied to the clock and GPS is invalid, the clock enters SET mode and all functions can be set in sequence. The clock will enter normal operation by pressing the MODE button for 2 seconds.

After the clock has been set via GPS or manually, changing the time and date is accomplished by entering each mode individually and pressing the MODE button for 2 seconds. When setting is finished, press the MODE button for 2 seconds to enter normal operation.

NOTE

If GPS is valid, only local time can be changed.



CLOCK (CONT'D)

Effectivity:

- *Airplanes 9002 thru 9122* ***not incorporating*** *Service Bulletin:*
  - *SB 700−31−012, Clock System − Introduction of two Digital Clocks Using GPS Input for Time Setting..*

Two digital electronic clocks are installed on the side panels and are the time base source for the avionics equipment.

Each clock contains its own time base with GMT, CHR, local and ET functions.

Time/Date Display
Indicates the following:
GMT, Local time, Date and year.

Chronograph Pushbutton
Controls start, stop and reset functions of chronograph display and second hand with successive push operations.

ET/CHR Display
Displays elapsed time or chronometer time. ET in hours and minutes and CHR in minutes.

Second Hand

Time Setting/Display Selector
Used in conjunction with ET/CHR push-buttons to set applicable readouts.

- **SET** − Cycles through GMT minutes/hours
  − Cycles through LOC minutes/hours
  − Cycles through day/month/year
- **GMT/LOC/DATE** − Displays time/date at upper readout.

ET Pushbutton
Controls elapsed time readout and during time setting, acts as a cursor control.

GF1110_053

CLOCK (CONT'D)

Time Setting

Set at Power−up

At the first application of power, the clock will be in GMT minutes adjustment if GPS is invalid and the clock is not transmitting on the ARINC bus. If the GPS data is valid, the clock is automatically updated and switched in GPS mode.

In the SET function, the GPS minute's digits are flashing. The flashing rate is 1 flash per second. The setting is obtained by pressing the ET RST button to increase the data. The counter increments, 1 digit for each push of the button. The INT flag is lit.

- By depressing the MODE button, the GMT hour digit is flashing, and you can adjust the display in the same way. The INT flag is lit.
- By depressing the MODE button once more, the year digits are flashing and you can adjust the display in the same way. The DT flag is it.
- By depressing the MODE button once, the month digits are flashing and you can adjust the display in the same way. The DT flag is lit.
- By depressing the MODE button once, the day digits are flashing and you can adjust the display in the same way. The DT flag is lit.
- By depressing the MODE button once, the LT minutes digits are flashing and you can adjust the display in the same way. The LT flag is lit.
- One more press on MODE button will lead to GMT minutes adjustment.
- Press the MODE button for more than 2 seconds to start the clock operation.

The default time and date for the SET mode at initialization of the clock will be: The 1st of January 2002 at 00 hr and 00 min.

Set after Syncronization by GPS or Manual Starting

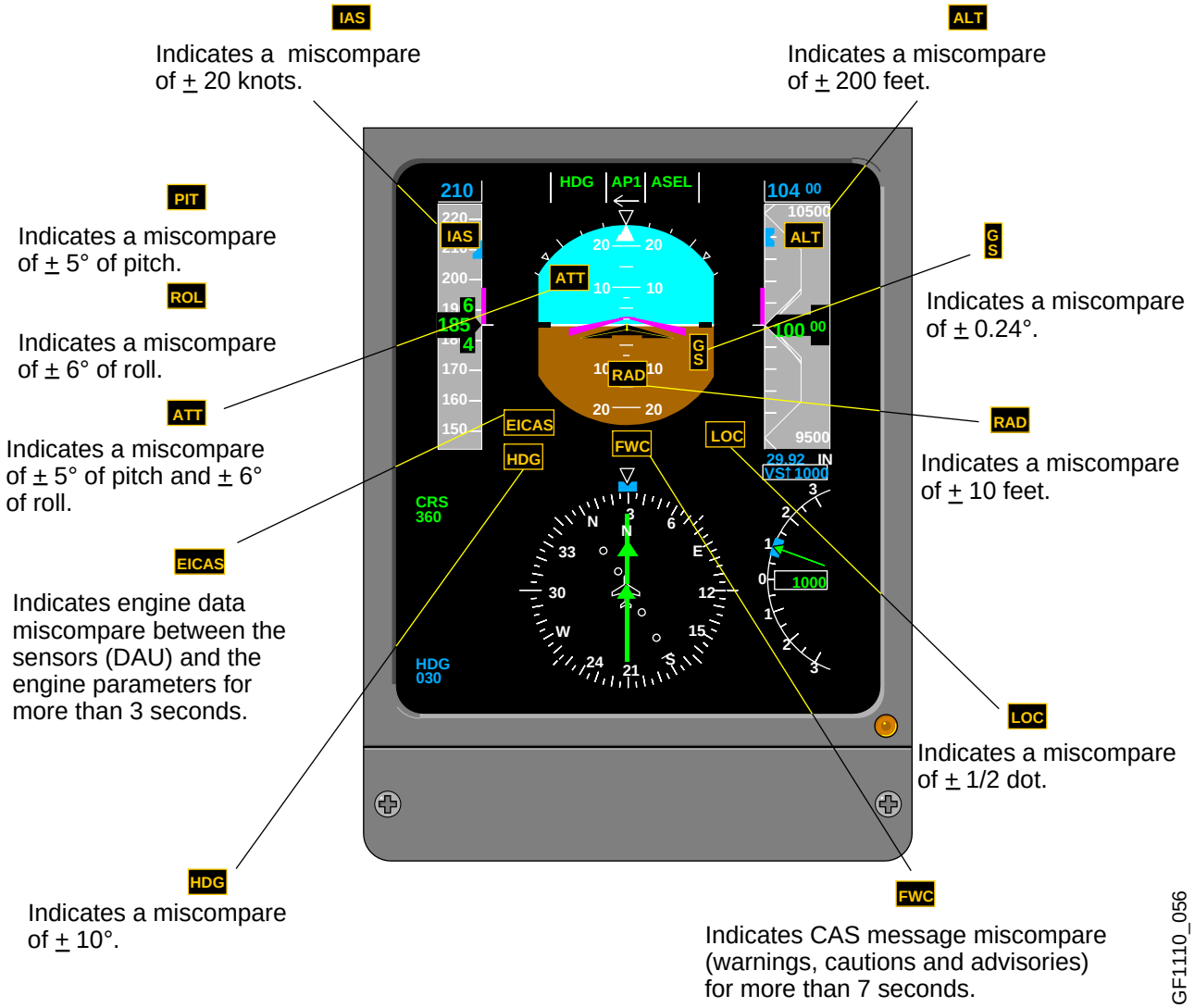
If the GPS data is valid, only the LT mode can be set.

The setting is obtained by means of the SET function which is available by pressing the MODE pushbutton for a minimum of two seconds.

- By depressing the MODE button, the setting roll in LT time if the LT setting is chosen.
- By depressing the MODE button, the setting roll in DATE if the DT setting is chosen.
- By depressing the MODE button, the setting roll in INT time if the INT setting is chosen.

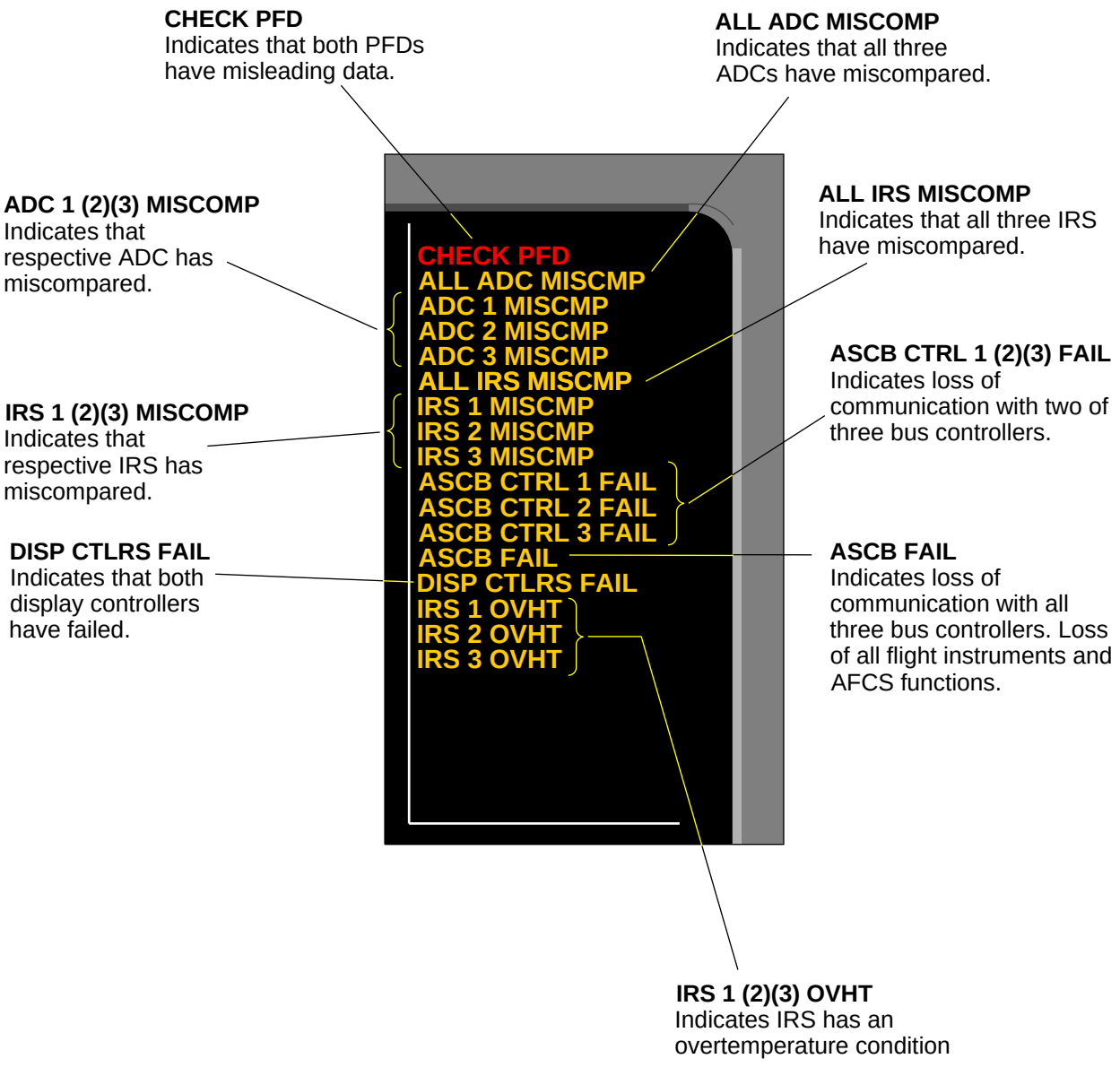
PFD COMPARISON MONITOR ANNUNCIATIONS

Comparison monitor annunciations are displayed when the difference between the data received by the pilot's and copilot's PFD, exceeds the predetermined trip thresholds.



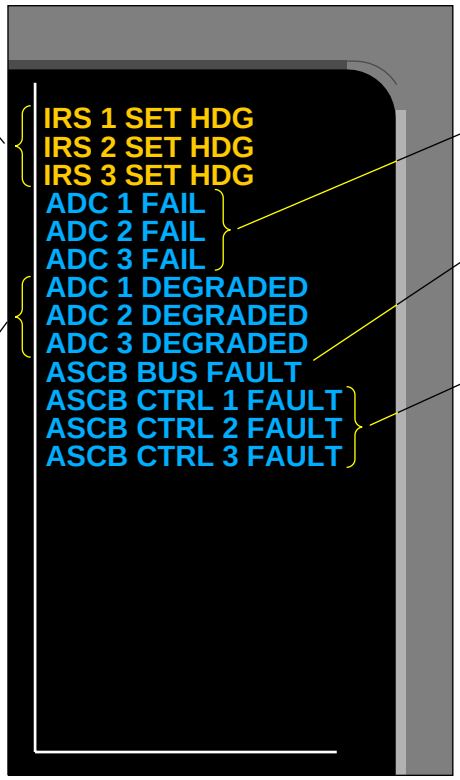
The **CHECK PFD** warning message will be displayed on the EICAS display if both PFDs have misleading data in flight or when the DC ESS and DC BUS 2 busses are powered on the ground.

FLIGHT INSTRUMENTS EICAS MESSAGES



FLIGHT INSTRUMENTS EICAS MESSAGES (CONT'D)

IRS 1−2−3 SET HDG
Indicates IRS has defaulted to a heading of 360 degrees upon entering attitude mode.



ADC 1−2−3 FAIL
Indicates that ADC has failed.

ASCB BUS FAULT
Indicates ASCB single bus failure (on ground only).

ASCB CTRL 1−2−3 FAULT
Indicates loss of communication with one bus controller.

ADC 1−2−3 DEGRADED
Indicates that ADC is unreliable. Degraded static error correction.

GF1110_101a

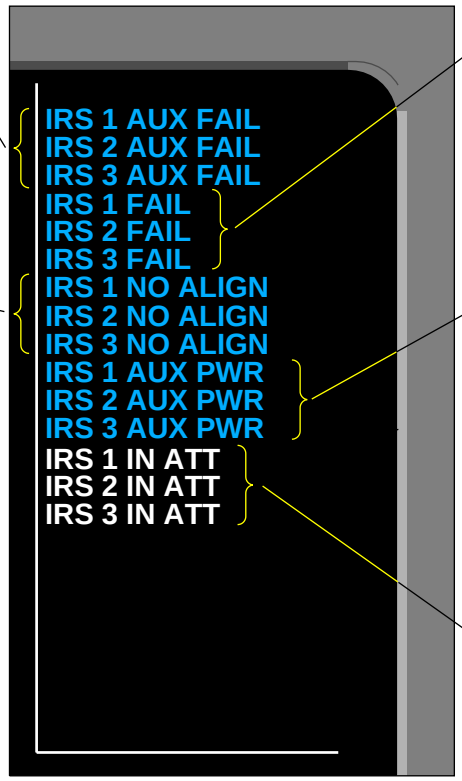
FLIGHT INSTRUMENTS EICAS MESSAGES (CONT'D)

IRS 1 (2)(3) AUX FAIL
Indicates IRS back-up power source has failed.

IRS 1 (2)(3) FAIL
Indicates IRS has failed. (IRU has detected an internal failure).

IRS 1 (2)(3) NO ALIGN
Indicates IRS fails to properly align due to improper position entry or excessive airplane motion, while in align mode.

IRS 1 (2)(3) AUX PWR
Indicates that IRS has lost its normal power source and has reverted to auxiliary DC power.



IRS 1 (2)(3) IN ATT
Indicates that IRS mode selector has been selected to ATT.

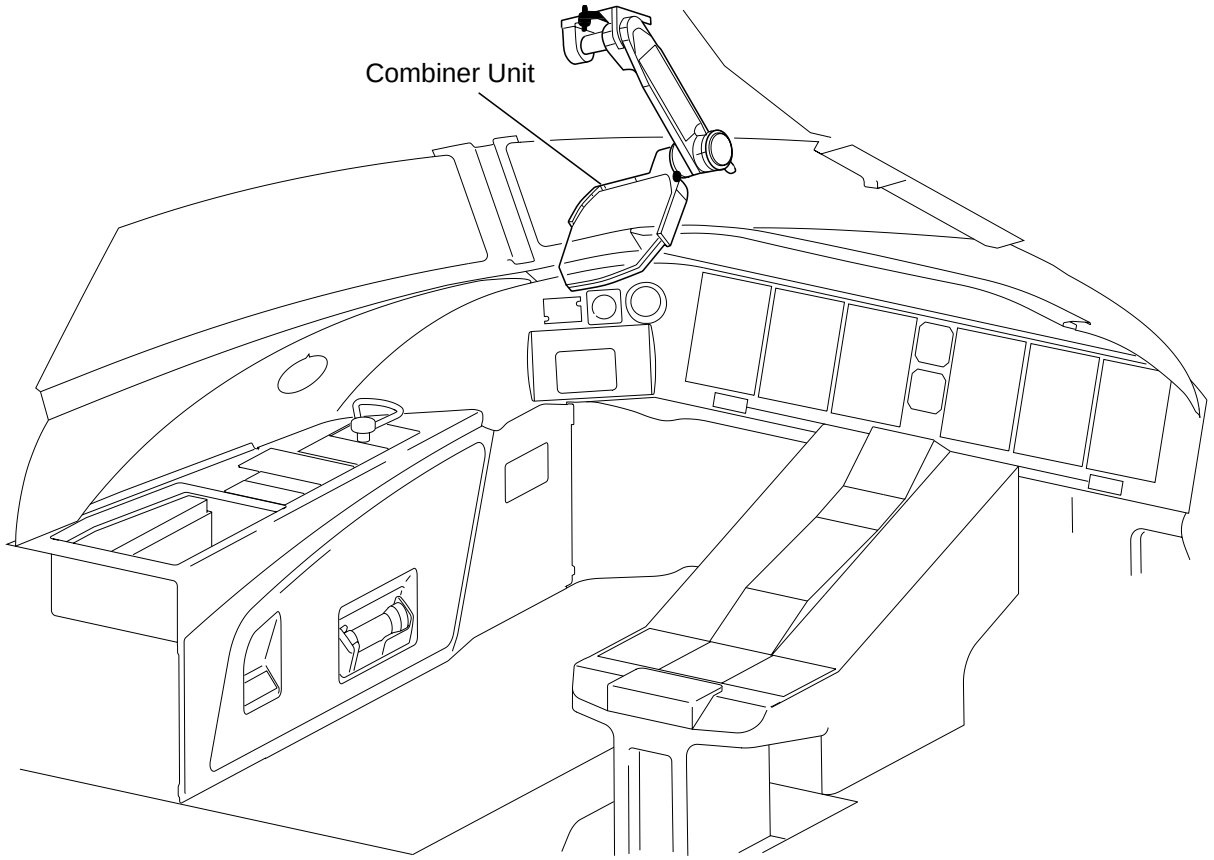
GF1110_102c

HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED)

The HUD is an electronic and optical system which is used to generate and display situational awareness and guidance to the pilot. The combiner presentation is a repeat of the pilot's PFD information (airspeed, altitude, attitude, vertical speed, autothrottle, BARO set, compass, AP/FD modes, sensor and navigation source annunciation, navigation information and flight guidance). The combiner will also display specific symbology pertaining to HUD only.

The HUD is composed of:

- Heads-Up Display Computer (HUD Computer)
- Optical Projector Unit
- Combiner Unit

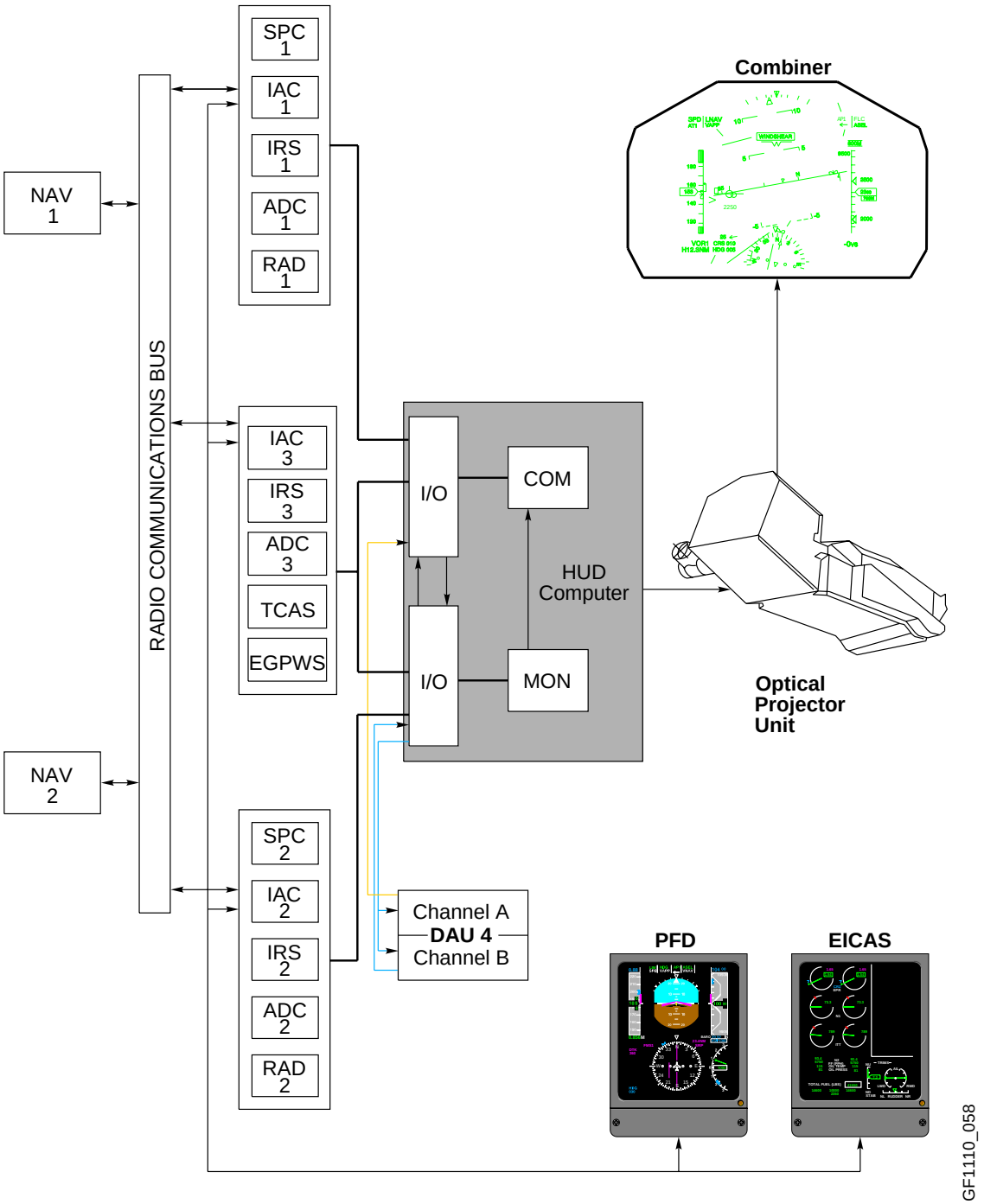


The HUD can be used for full flight operation including:

- Take-off and Go Around with pitch reference,
- Climb, Cruise and Descent with FD guidance,
- Precision (down to CAT 2) and Non-Precision Approach with FD guidance and Visual Approaches.

HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED) (CONT'D)

HUD Schematic



HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED) (CONT'D)

Head-Up Display Computer

The HUD Computer is mounted in the avionics bay and interfaces with the airplanes avionic and electrical systems. 28 VDC is supplied to the HUD Computer from the DC BUS 2 via the EMS CDU and is controlled by the HUD BRT/DIM knob located on the glareshield. The HUD Computer computes the position, value and brightness of symbols.

The computer is composed of two independent computation channels (COMmand) and (MONitor)

The COM channel performs the following:

- Input/Output (I/O) Processing − performs acquisition and validation of avionics data and sensor selection consistent with PFD and data comparison.
- Symbology Computation − performs automatic Mode management (based on airplane flight configuration), confirms the presence or absence of each symbol and position of the displayed symbols.
- Display Generation − generates deflection and blanking signals.

The MON channel performs the following:

- Input/Output (I/O) Processing − performs acquisition and validation of avionics data and sensor selection consistent with PFD and data comparison.
- Display Monitoring − monitors symbols position, numerical readout value and presence, verification of deflection signals of 3 referenced points and compares the current value with a theoretical value.
- COU Monitoring − monitors the operational position based on infra-red emission by the OPU and the reflection on a mirror located on the combiner.
- Built in Test − verifies the functionality and integrity of the system.

The acquisition module monitors the following data:

- Attitude (Pitch and Roll angle)
- Magnetic heading
- Computed airspeed
- Baro altitude
- Radio Altitude
- Localizer deviation (via IAC)
- Gideslope deviation (via IAC)

The COM and MON channels use the following sensors:

Channel	Sensors							
COM	IRS 1	ADC 1	IAC 1	RAD 1	DAU 4A	SPC 1		
MON	IRS 2	ADC 2	IAC 2	RAD 2	DAU 4B	SPC 2		
BOTH		ADC 3	IAC 3				EGPWS	TCAS

The IAC busses provide the following:

- General airplane configuration − Pilot and Copilot sensor selection, navigation/FMS data and airplane parameters (speed, system status, AP/FD/AT modes).
- Radio information and data integrity, such as VOR/ILS, DME and ADF.

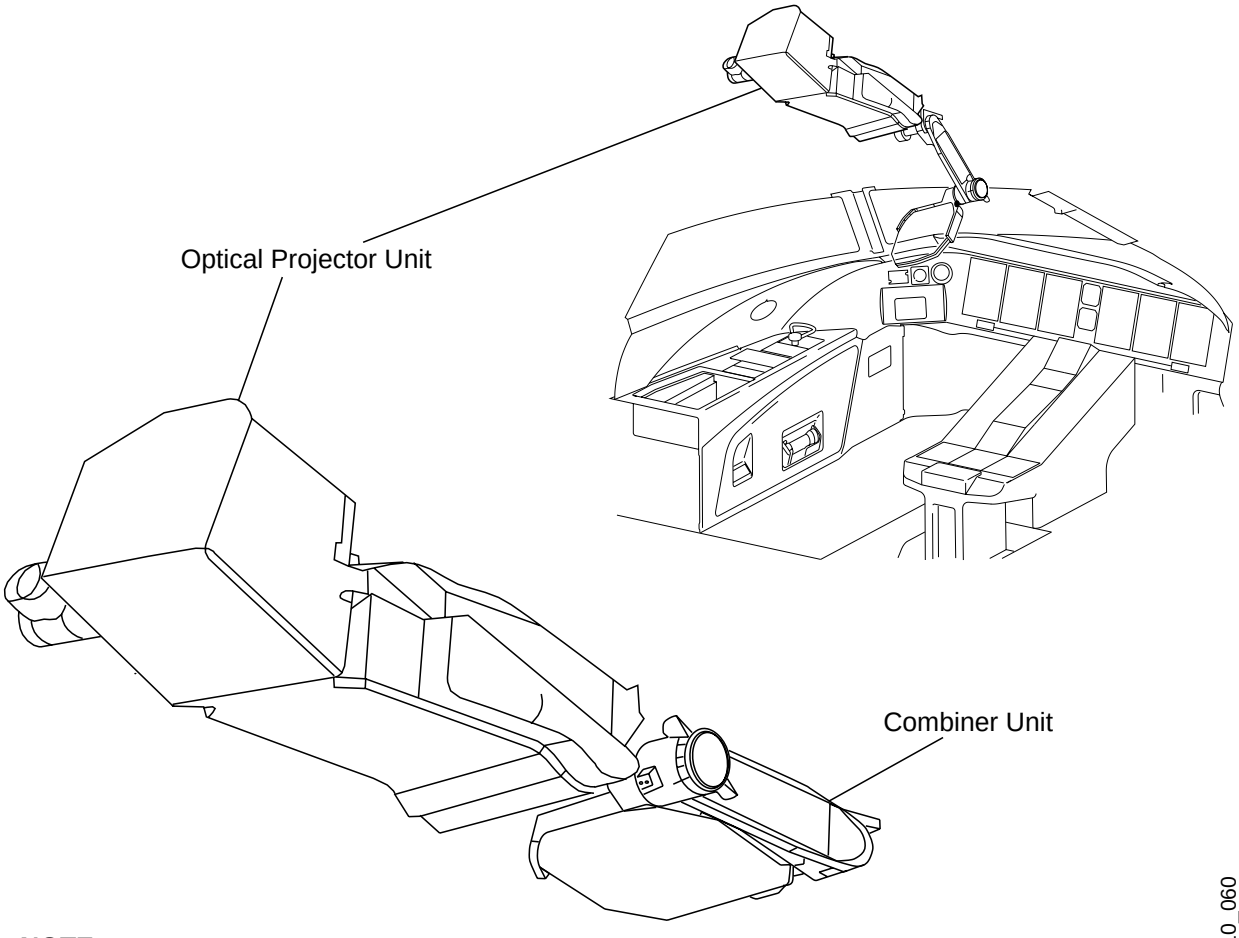
HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED) (CONT'D)

Optical Projector Unit

The Optical Projector Unit draws an image on the screen of a cathode ray tube (CRT) and this image is projected through a relay lens to the separate Combiner Unit.

The Optical Projector Unit is fitted with:

- Optical lens assembly
- Display circuits
- Internal monitoring devices
- Failure detection devices
- Combiner Unit position sensor.



NOTE
The Optical Projector Unit is hidden behind the headliner.

HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED) (CONT'D)

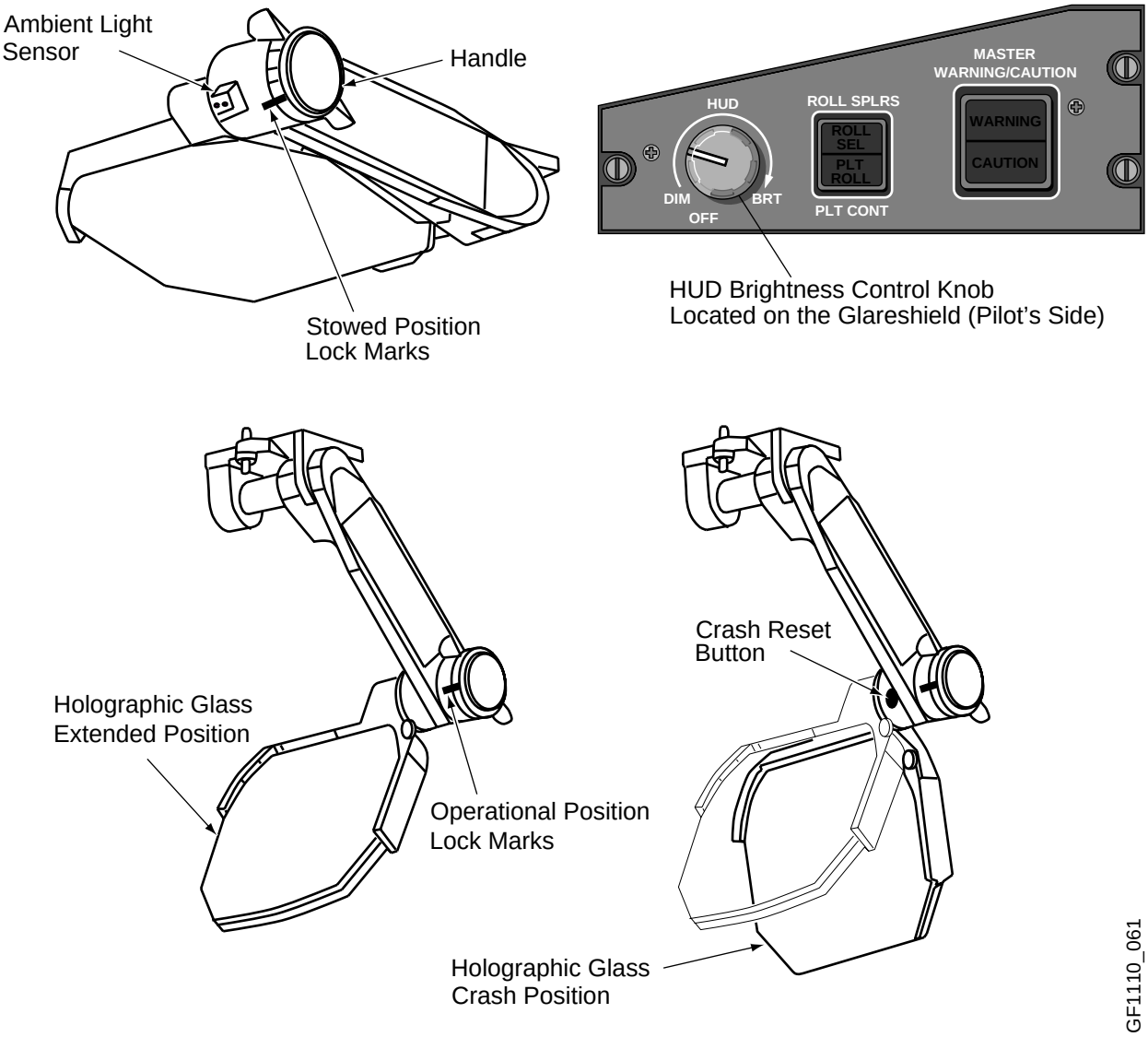
Combiner Unit

The Combiner Unit superimposes the image drawn by the Optical Projector Unit and is fitted with:

- An ambient light detector (photovoltaic cell).
- A mirror for position monitoring (enables the position detecting device to verify if the Combiner Unit is in the correct position).
- A stowage and breakaway system.

The Combiner can be selected in three different positions:

- Stowed position, when the HUD is not being used.
- Operational position, to allow symbology display.
- A crash position, in the event of an emergency.



HEAD-UP DISPLAY SYSTEM (HUD) (IF INSTALLED) (CONT'D)

Combiner Unit Folding/Unfolding

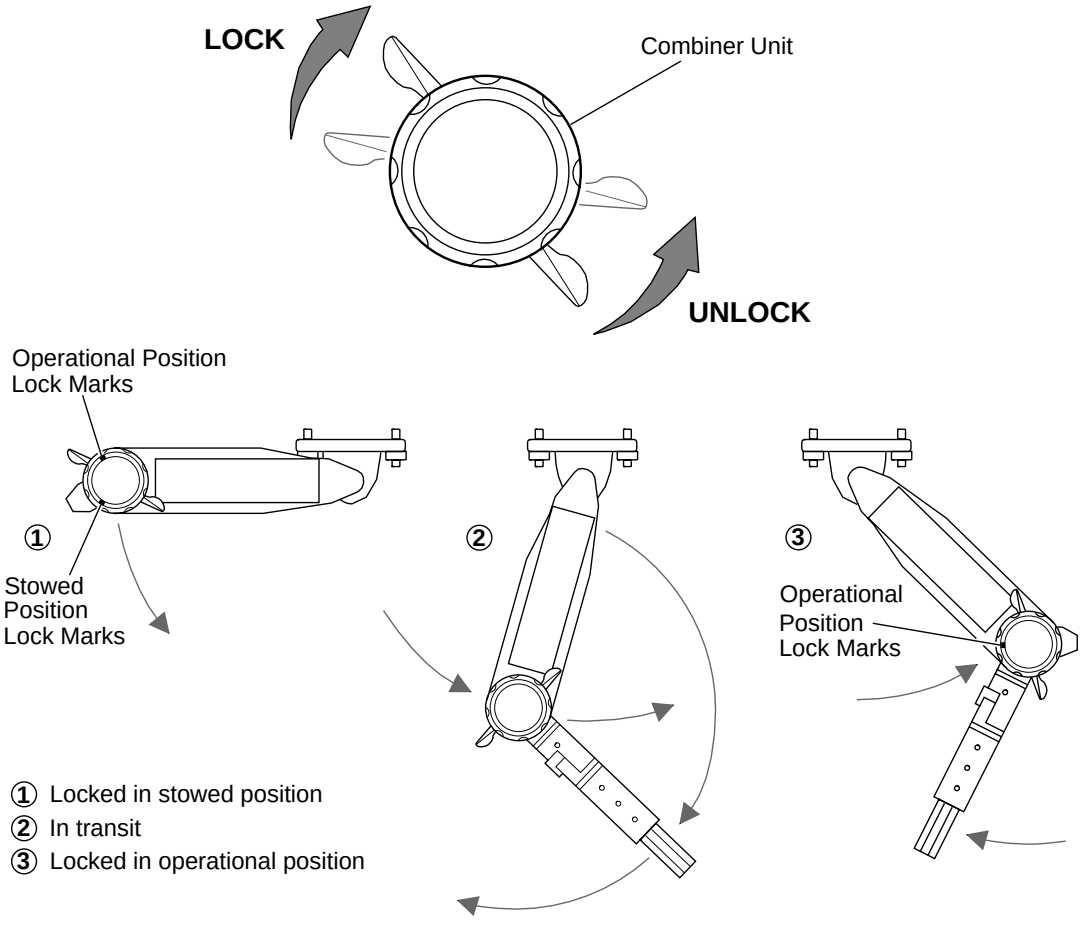
The Combiner Unit folding/unfolding operation shall extend the combiner to operate and stow after use. The image should be available within two seconds of deployement if the system is powered-up (the power-up sequence is approximately one minute).

A handle, on the right side of the arm, folds or unfolds the Combiner Unit and locks it mechanically when in the operational or stowed position.

To lock, turn the handle clockwise. To unlock, turn the handle counterclockwise.

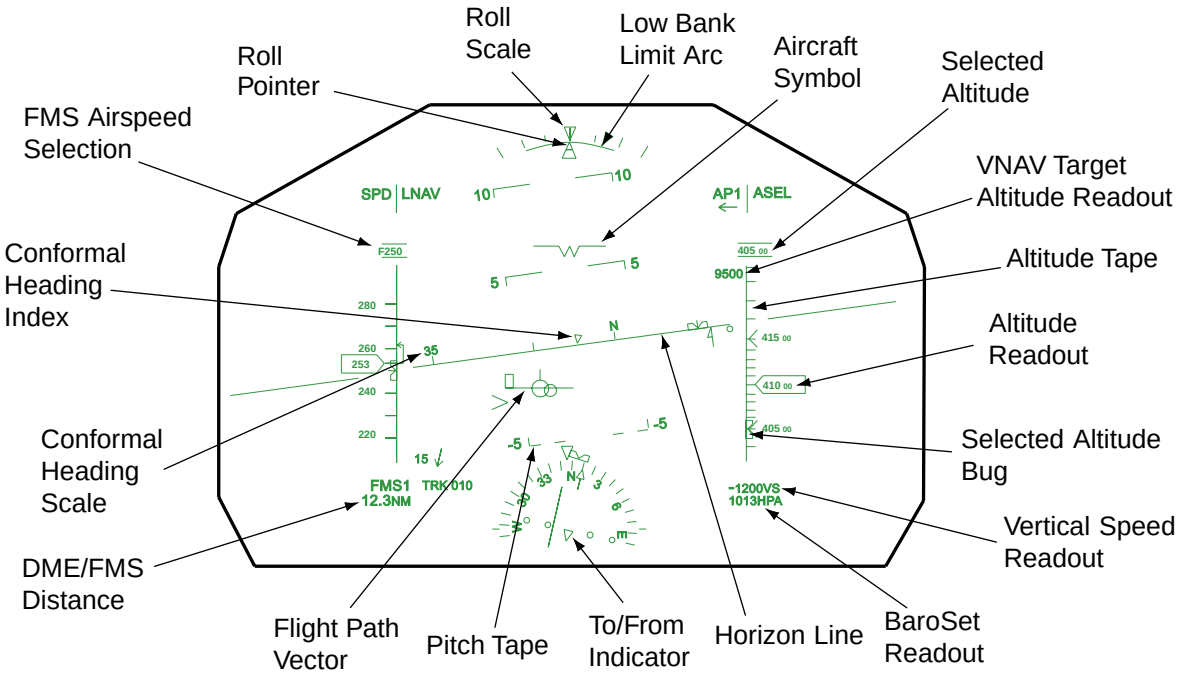
NOTE

If the Combiner Unit is accidentally moved into the crash position, the unit is locked in place. A reset button located to the left of the Combiner Unit must be pushed in to allow the return to the operational position.



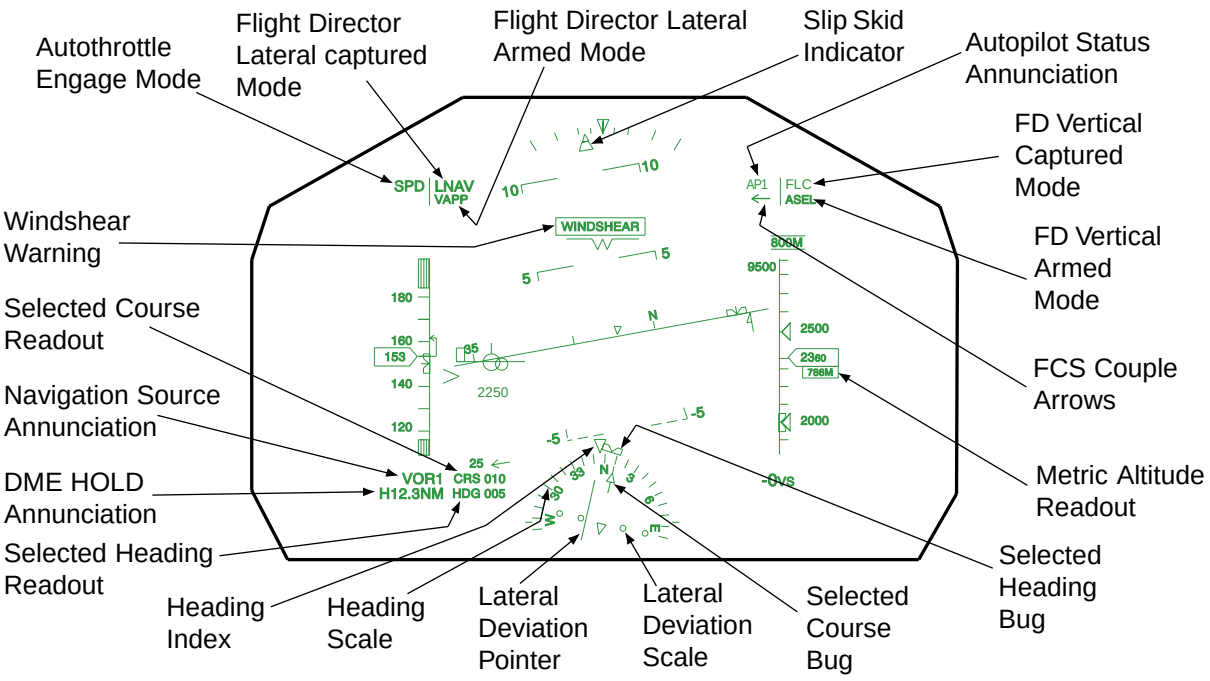
CAUTION
A "click" must be heard at locking, otherwise, the Combiner Unit is not locked.

HUD ANNUNCIATIONS



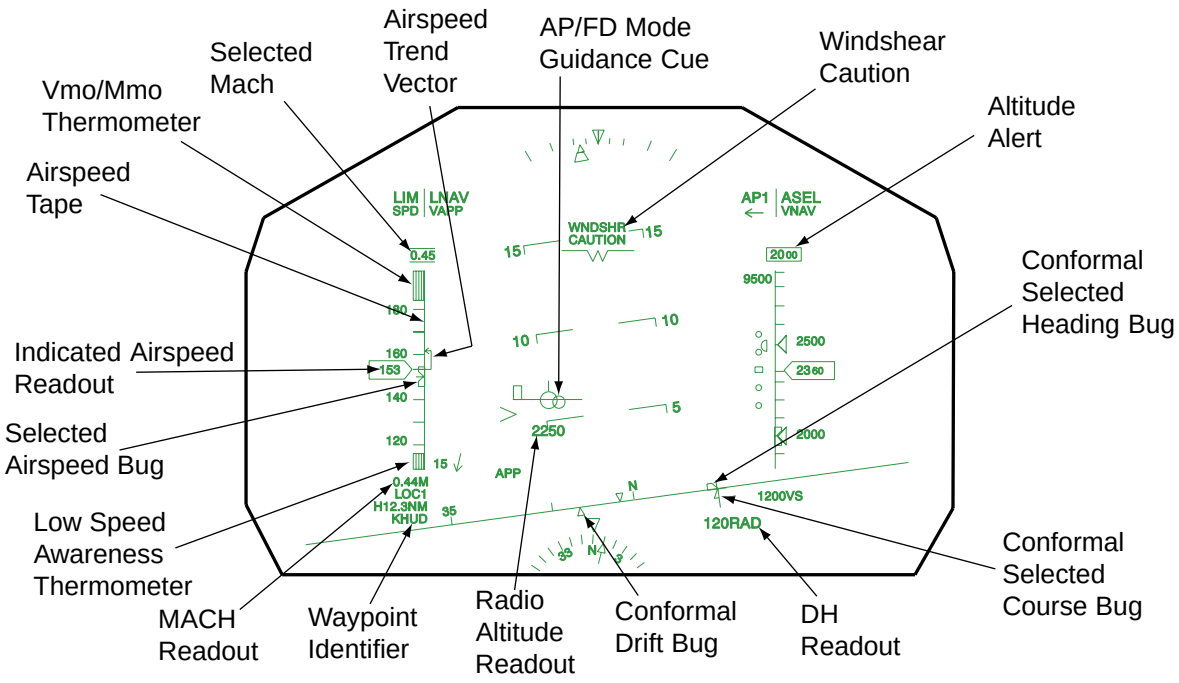
GF1110_063a

HUD ANNUNCIATIONS (CONT'D)



GF1110_064a

HUD ANNUNCIATIONS (CONT'D)



GF1110_065

HUD SYMBOLOGY

Aircraft Symbol

The aircraft symbol represents the direction in which the the airplane longitudinal axis is pointing. The symbol is similar to the aircraft symbol on the conventionnal ADI and has a fixed position on the display.

Flight Path Vector

The Flight Path Vector (FPV) indicates the airplane track and path angle. The FPV is displayed when the airspeed is greater than 80 KIAS or the nose wheel is off the ground.

The FPV symbol has priority over all other symbols except the guidance cue and the warning indications. Other symbols in the immediate vicinity of the FPV will therefore be masked.

When the aircraft path is such that the FPV should be displayed in extreme positions or outside the display limits, the FPV position will not be fully representative of the aircraft path. The FPV will therefore be “non-conformal and displayed in dotted shape. However, in all conditions, the relative position between FPV and horizon line will indicate correctly a level flight (FPV on horizon line), a climb (FPV above) or descent (FPV below).

NOTE

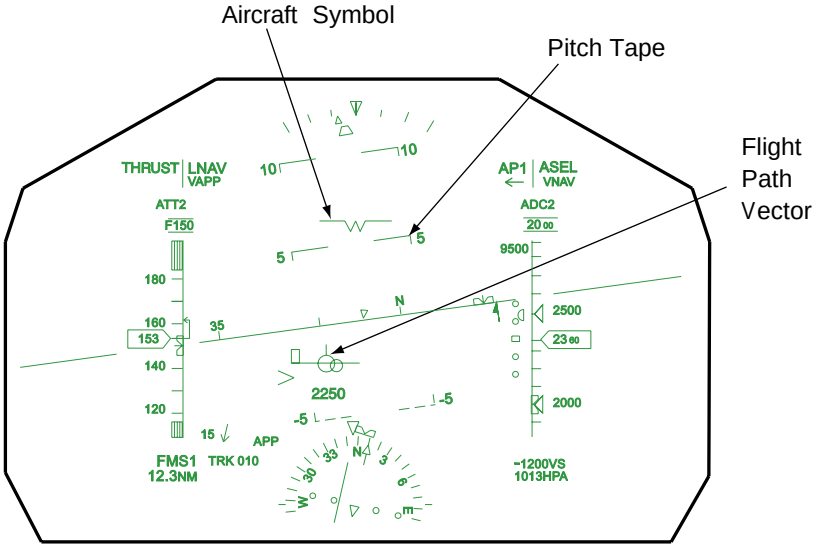
In a Slat out/Flap 0 landing configuration, the high pitch attitude during the flare may lead to a non-conformal FPV. The actual path angle may be higher than depicted by the combination of FPV and Horizon.

HUD SYMBOLOGY (CONT'D)

Pitch Tape

The pitch tape consists of a horizon line and a pitch scale which is centered on the aircraft symbol. When read in conjunction with the aircraft symbol, it indicates pitch attitude. The pitch scale is displayed in accordance with the selected IRS and is removed when the source is invalid.

The pitch scale consists of a tick mark every 5 degrees and is limited to +/− 90 degrees. The negative pitch mark are displayed as dashed lines. The 0 degree pitch mark is replaced with the horizon line. The small vertical lines at either side of the pitch line always points towards the horizon. The pitch scale is removed when the airplane is on the ground and appears when the nose wheel is off the ground.



Airspeed VSPEED Bugs

The VSpeed (V1, VR, V2, VFTO, VREF) bugs and labels are displayed in relation to the airspeed tape.

Horizon Line

The horizon line is conformal to the external scene; however, it will appear above the natural horizon at high altitude due to the curvature of the earth.

During very high or low pitch attitude, a non-conformal horizon line is displayed as a dashed line. The horizon line is displayed as wide as the combiner to reinforce attitude awareness during low visibility approaches or when the airplane is in excessive pitch attitude.

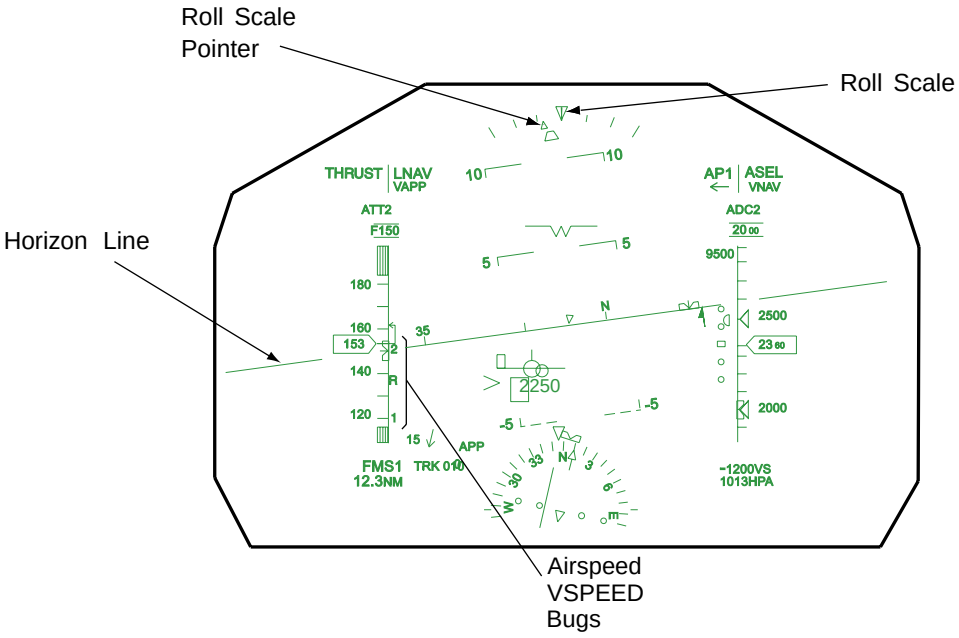
Roll Scale and Pointer

The HUD roll scale consists of tick marks at 0, +5, +10, +20, and +30 degrees displayed above and centered to the airplane reference symbol.

Additional marks are displayed for 45 degrees and 60 degrees position when the roll angle exceeds 32 degrees. The roll scale return to the normal format when the bank angle decreases below 28 degrees.

HUD SYMBOLOGY (CONT'D)

Roll Scale and Pointer (Cont'd)



GF1110_067a

HUD SYMBOLOGY (CONT'D)

Slip-Skid Indicator

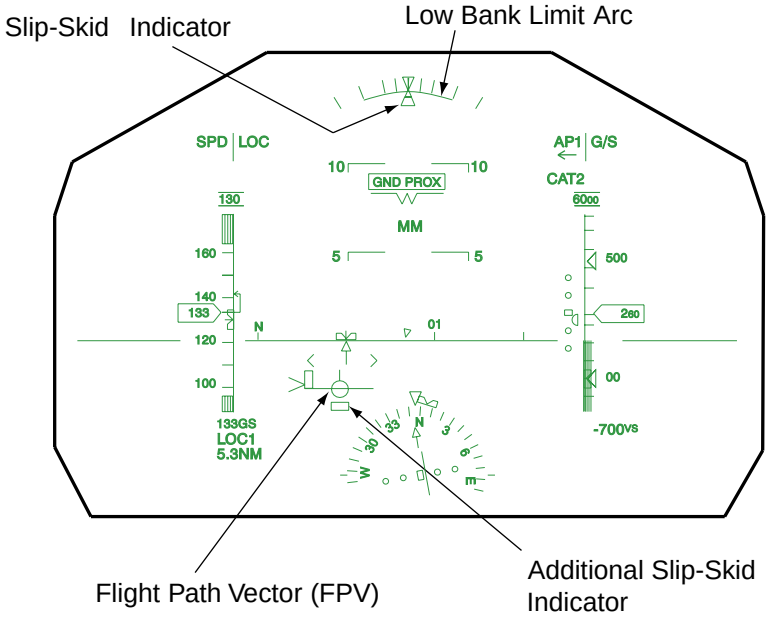
The slip-skid indicator is displayed in conjunction with the roll pointer. The top of the pyramid represents the roll pointer while the base of the pyramid is the slip-skid indicator. The slip-skid indicator moves laterally in relation to the roll pointer to indicate lateral acceleration.

When an engine failure is detected, an additional slip-skid indicator is displayed below the Flight Path Vector (FPV). It also appears when simulating an engine failure by seperating the thrust levers at or below altitudes of 20,000 feet; simultaneously, one throttle has to be below 3 degrees and the other above 8 degrees.

The slip-skid indicator can only be displayed when the airspeed is greater than 80 KIAS, and in weight off nose wheel condition.

Low Bank Limit Arc

This symbol is displayed on the roll scale to indicate that low bank Flight Director mode is active and is limiting the airplane to a bank angle of 17 degrees.



GF1110_068a

HUD SYMBOLOGY (CONT'D)

Speed Error Tape

The speed error tape is displayed above or below the left wing of the FPV. It represents the difference between the selected/targeted airspeed and the indicated airspeed. It is displayed when the Radio Altitude is greater than 50 feet.

The speed tape error is limited to 15 knots and a tick mark is displayed at every 5 knots. The speed error tape is removed during excessive airplane attitude to prevent display clutter.

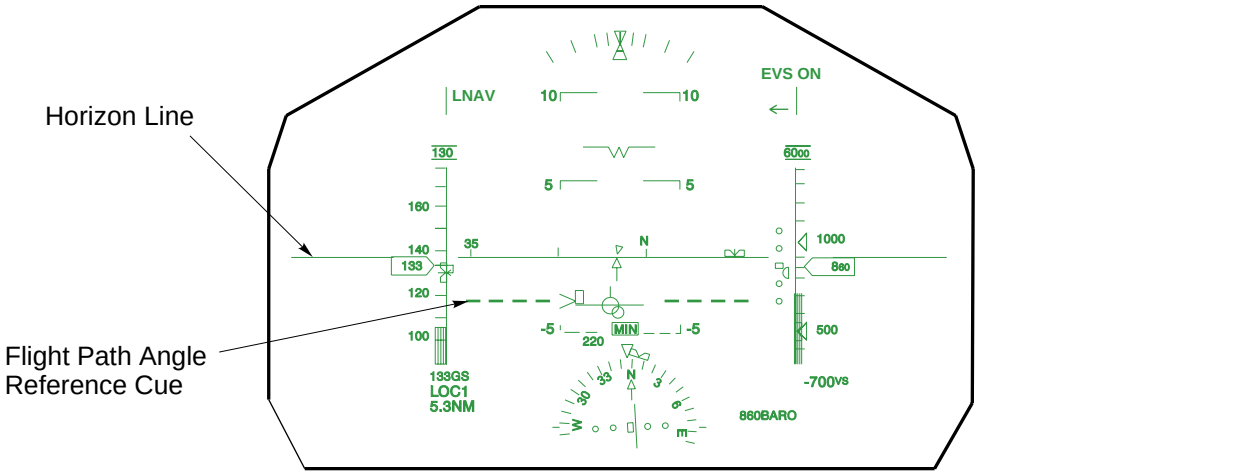
If the system is unable to compute a speed error, the speed error tape is replaced by 2 parallel lines indicating a speed error invalid.

Flight Path Angle Reference Cue

The Flight Path Angle Reference Cue consists of 2 dashed lines corresponding to the selected Approach Flight Path Angle displayed. This symbol is conformal, is referenced to the flight path vector and is derived from the FMS database.

The Flight Path Angle Reference Cue is displayed when the following conditions are met:

- A FMS approach or an ILS approach has been selected from the FMS and the aircraft is less than 7 NM from the runway threshold.
- The Horizon Line is displayed,
- Selected Flight Path Angle is valid and
- The FMS is providing a vertical Flight Path Angle.



GF1110_110a

HUD SYMBOLOGY (CONT'D)

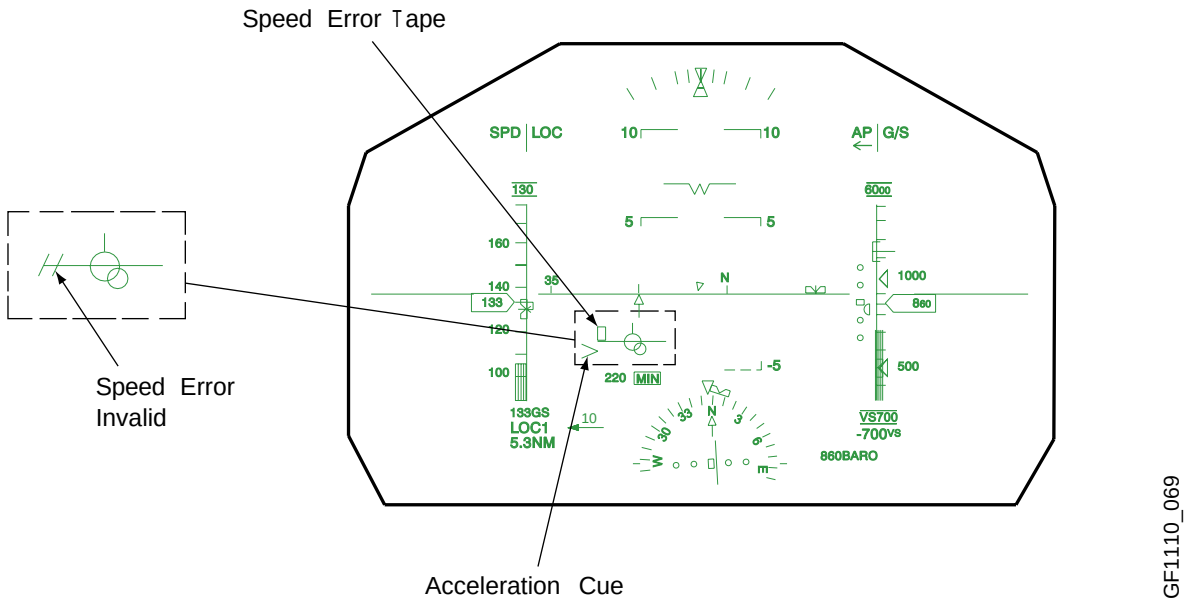
Acceleration Cue

The acceleration cue is located to the left of the FPV and represents the longitudinal acceleration/deceleration of the airplane. If the FPV is not displayed, the acceleration cue is displayed in relation to the airplane reference symbol, for example during take-off roll. The acceleration cue is displayed when the airspeed is greater than 60 knots.

The acceleration cue indicates inertial acceleration independent of airspeed trend. When climbing into an increasing headwind for example, at constant airspeed, the inertial acceleration cue will indicate a deceleration because the airplane groundspeed is decreasing. Also, during turns at constant airspeed, the acceleration cue will indicate an acceleration or deceleration as the headwind/tailwind component changes. The inertial acceleration cue can be used effectively for precise airspeed control when the airplane is straight and level under constant wind conditions.

NOTE

The basic flight instruments remains the primary reference and the acceleration cue must be interpreted with caution especially when the airplane is under dynamic wind conditions.



Flare Cue

The Flare Cue indicates a flight path to touch down at approximately minus one degree. The Flare Cue is displayed vertically in relation to the horizon line at a fixed pitch attitude and laterally in relation to the flight path vector.

The flare cue is displayed when the FD is in Approach mode, the radio altitude is lower than 50 feet, and the main wheels are weight-off-wheel.

Decision Height (DH) Readout

The Decision Height (DH) indication is located at the left of the BARO set readout. The DH readout is displayed in 10 foot increments and labeled RAD when the selected DH is valid and greater than 20 feet.

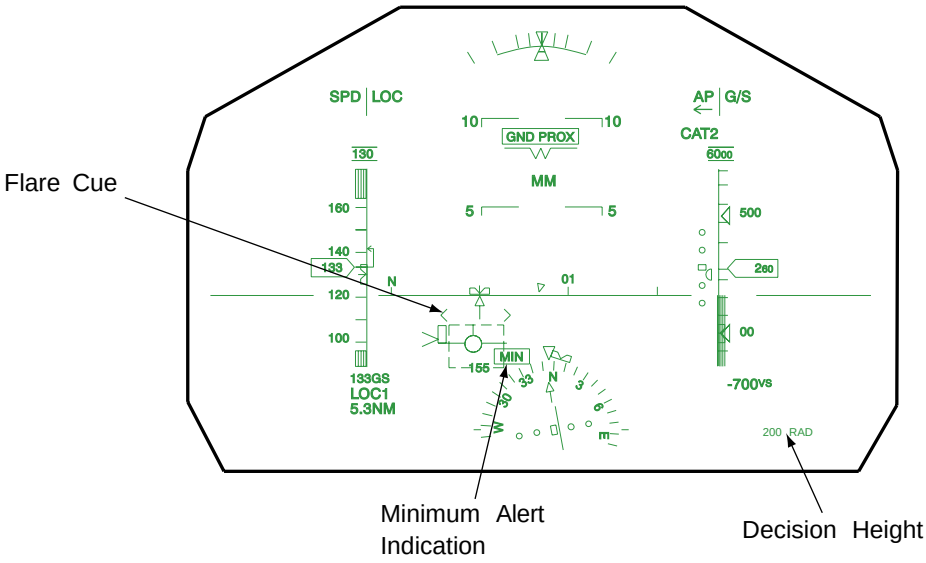
HUD SYMBOLOGY (CONT'D)

Minimum Alert Indication

When the minimum alert indication is armed, a window is displayed to the right of the radio altitude readout. When the DH or the MDA is reached, a MIN annunciation appears inside the window. The MIN annunciation is removed when the Radio Altitude readout is removed as the airplane transition to weight on wheel condition.

The minimum alert indication cannot be displayed when:

- The minimum alert is not set ON, or
- The selected DH/MDA is invalid, or
- A BARO altitude miscompare exists for DH/MDA annunciation.



GF1110_070

AP Status Annunciation

The status of the Autopilot is displayed above the altimeter tape. When the autopilot is engaged, AP1 or AP2 annunciation is displayed.

This annunciation blinks for a 10−second time period when the AP source is changed.

In the case of an autopilot abnormality, the annunciation blinks until the fault is rectified, the pilot manually disengages the autopilot or the other autopilot is selected.

In case of an uncommanded autopilot disengagement, the annunciation is boxed and blinks until the pilot acknowledges the fault by pressing the Autopilot Disengage switch.

FCS Couple Arrow

The Fligth Control System (FCS) Couple Arrow is displayed below the Autopilot Status Annunciation to indicate which FCS is active. Only 3 possibility exists:

→ FCS coupled to the right side

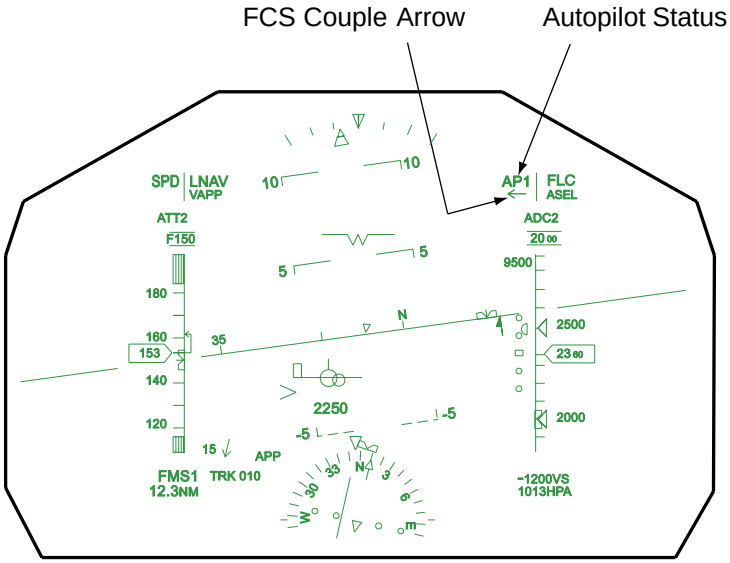
← FCS coupled to the left side

↔ Both FCS are active.

HUD SYMBOLOGY (CONT'D)

FCS Couple Arrow (Cont'd)

The double arrow is only displayed during ILS approaches. The FCS Couple Arrow blinks for 5 seconds after the Couple Arrow has been altered in direction. This can be selected from the flight guidance panel. A ghosted arrow indicates a failed FCS condition or an AFCS fail condition.



GF1110_071a

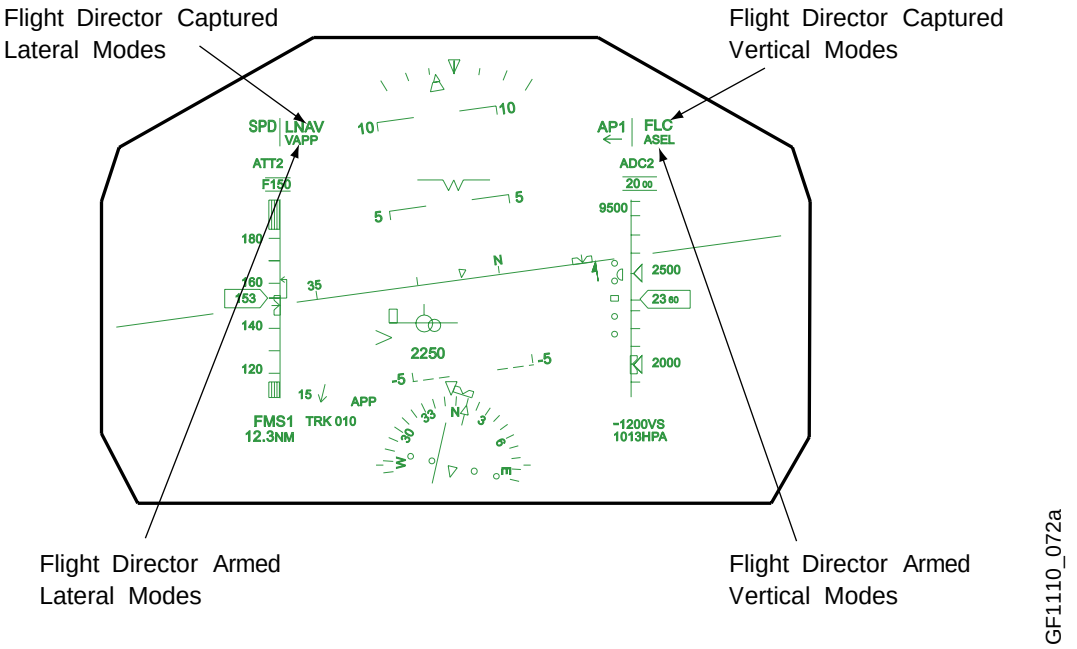
FD Mode Annunciation

The FD Modes are displayed at the top of the altitude and airspeed tapes. Here is a layout of the possible selections:

FD Lateral Modes		FD Vertical Modes	
Armed	**Captured**	**Armed**	**Captured**
LNAV	LNAV	ASEL	ASEL
LOC	LOC	–	ALT
BC	BC	–	FLC
VOR	VOR	–	VS
VAPP	VAPP	–	TO
–	HDG	–	GA
–	ROLL	–	PIT
–	*VOR	GS	GS
–	*VAPP	–	GS
–	–	–	VLC
–	–	VASEL	VASEL
–	–	–	VALT
–	–	VPTH	VPTH

HUD SYMBOLOGY (CONT'D)

FD Mode Annunciation (Cont'd)



GF1110_072a

AP/FD Mode Guidance Cue

The guidance cue is a circle that is displayed in reference to the FPV. Tracking of the FD results in a concentric display of the guidance cue and the FPV.

The guidance cue is displayed in the T/O mode one second after nose wheel lift off. The guidance cue is removed during excessive airplane attitude, TCAS resolution advisories, loss of FD modes, manual disengagement of the FD and at an approach height of 50 feet.

In the above example, the pilot or the autopilot has to roll the airplane to the right and pitch it down in order to track the guidance cue.

Autothrottle Annunciation

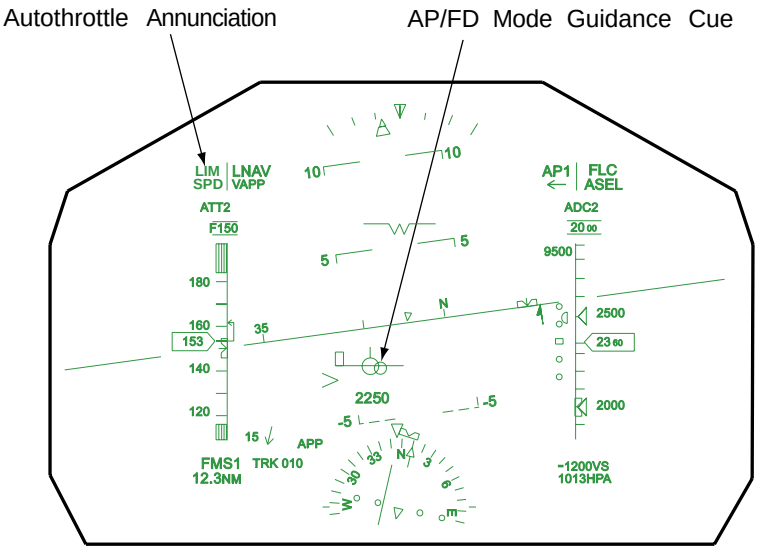
The autothrottle mode is shown above the airspeed tape. The following modes can be displayed:

LIM	for limiting speed condition
SPD	for control of airspeed
GA	for go-around mode
RETARD	for landing retard mode
THRUST	for control mode at FLC
TO	for take-off mode

During mode transition, the annunciation blinks for 5 seconds. When the autothrottle is disengaged, the last active mode flashes for 5 seconds and is then timed out.

HUD SYMBOLOGY (CONT'D)

Autothrottle Annunciation (Cont'd)



Altitude Tape

The altitude tape displays the current barometric altitude. The altitude tape consists of a vertical line with marks indicating every 100 ft increment and chevrons at every 500 ft increment.

The altitude tape can move outboard to the edge of the display in order to enable greater lateral movement of the FPV in a conformal view.

Altitude Readout

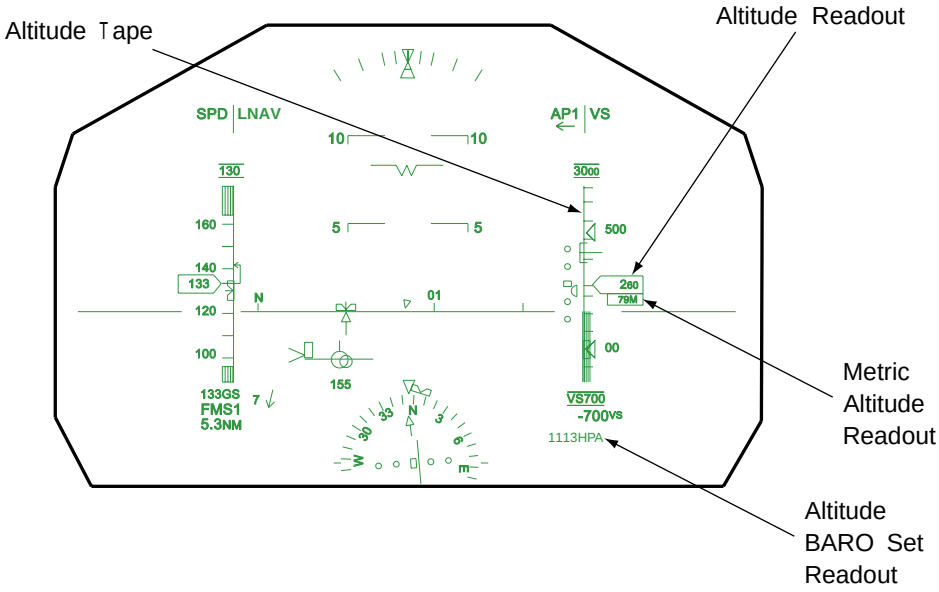
The digital readout can display altitudes between −980 feet and 65,000 feet at 20 foot increments. A minimum of 3 digits is always displayed. For negative altitude, the minus sign is displayed in place of the one thousand digit.

A metric altitude readout is available and displayed below the altitude readout. It is derived from the barometric altitude, and converted in meters. It is graduated into 5 meters increments.

HUD SYMBOLOGY (CONT'D)

Altitude BARO Set Readout

The BARO set readout is located below the altitude tape, in hectopascal (542 to 1084) or in inches of mercury (16.00 to 32.00) as indicated by the barometric set format. The BARO set readout is displayed when the selected BARO set value is adjusted by the pilot and for a 10 second period there after.



GF1110_074a

Selected Altitude Readout

The selected altitude readout is always located above the altitude tape between two horizontal lines. Negative altitudes are displayed with a minus sign in place of the one thousand digit.

The selected barometric altitude is always displayed with a minimum of 3 digits. The selected metric altitude is displayed with a minimum of one digit and the indication is rounded to the nearest 50 meters.

The selected metric altitude readout on the HUD may disagree with the PFD selected metric altitude readout upon initial selection. On intial selection the HUD displays the metric altitude rounded to the nearest 50 meters, while the PFD displays the actual metric altitude. The HUD and PFD will synchronize to the nearest 50 meters when the altitude selector is moved.

Selected Altitude Bug

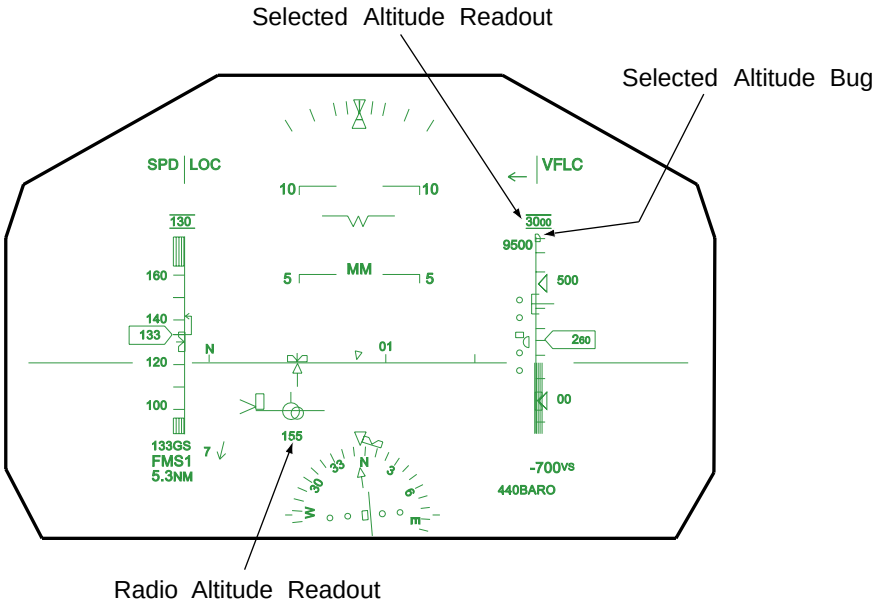
The selected altitude bug is displayed on the altitude tape in the appropriate position when within the range of the altitude displayed. When the selected altitude is off range, the altitude bug is located at the appropriate end of the altitude tape and half of the symbol is masked.

HUD SYMBOLOGY (CONT'D)

Radio Altitude Readout

The Radio Altitude readout is located below the FPV and is not displayed with the airplane weight on wheels. The range is between 0 and 2550 feet and is displayed as follows:

- 2 feet increments − Altitude less than 10 feet
- 5 feet increment − Altitude between 10 feet and 200 feet
- 10 feet increment − Altitude between 200 feet and 1500 feet
- 50 feet increment − Altitude greater than 1500 feet



GF1110_075

VNAV Target Altitude Readout

The VNAV target altitude readout is displayed at the left of the altitude tape when one of the following FD submodes is active:

VALT

VASEL

VFLC

VPTH

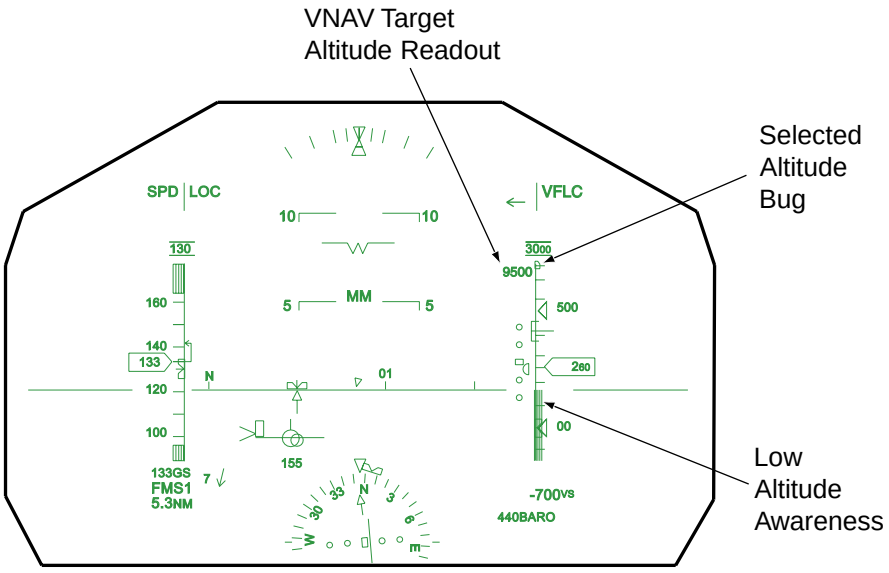
Low Altitude Awareness

The low altitude awareness indication is displayed as an indication to alert the crew of the proximity of the airplane to the ground.

The low altitude awareness indication is displayed as a bold tape that extends from the bottom of the altitude tape to a position that corresponds to the terrain altitude, based on radio altitude.

HUD SYMBOLOGY (CONT'D)

Low Altitude Awareness (Cont'd)



HUD SYMBOLOGY (CONT'D)

Airspeed Tape

The airspeed tape displays the current indicated airspeed derived from the pilot selected MADC with a range of ±40 kt from current airspeed. The airspeed indication has a total range of 30 to 900 kt.

To enable greater lateral movement of the FPV under strong crosswind condition, the airspeed tape moves outboard to the edge of the display thus maintaining the FPV in conformal view.

Airspeed Readout

The airspeed readout is located in the value window in the center of the airspeed tape. The airspeed readout is displayed in 1 kt increments and has priority over the airspeed tape and all symbology.

Airspeed Trend Vector

The airspeed trend vector indicates the airspeed the airplane will attain in 6 seconds assuming the current acceleration is maintained.

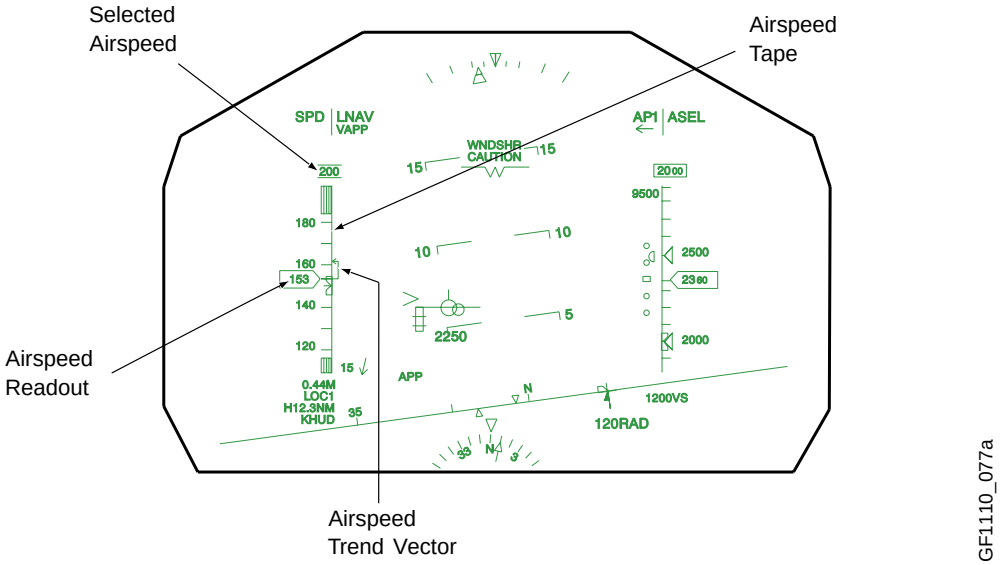
Selected Airspeed Readout

The selected airspeed readout is located above the airspeed tape between two horizontal lines. It has a resolution of 1 kt and has a range of 0 kt through 900 kt inclusively. The Selected Airspeed is displayed when:

- Indicated Airspeed is valid, and
- Selected Airspeed is valid, and
- IAS FMS/Man indicates Manual, and
- Selected Airspeed Type is IAS and less than V_{MO}.

NOTE

VMO is displayed when the selected airspeed is at V_{MO}.



HUD SYMBOLOGY (CONT'D)

Selected Airspeed Bug

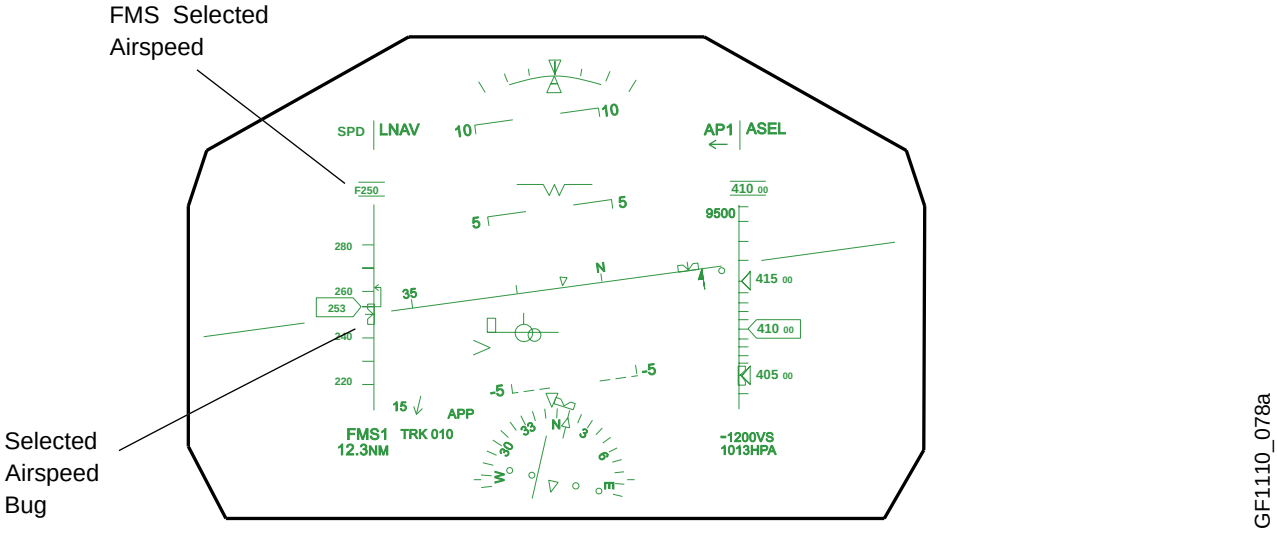
The selected airspeed bug is displayed to the left of the airspeed tape. The airspeed bug will display either Manual airspeed bug selection or FMS speed depending on the selection of IAS FMS/Man in either MAN or FMS.

When the selected airspeed is off-scale, the airspeed bug is located at the appropriate end of the airspeed tape and one half of the symbol is masked.

FMS Selected Airspeed

The FMS selected airspeed is displayed in place of the selected airspeed readout with an “F” label in large font, with a resolution of 1 kt and has a range of 0 kt through 900 kt inclusively. The FMS speed is displayed when:

- IAS is valid, and
- FMS speed is valid, and
- IAS FMS/Man indicates FMS, and
- FMS speed reference is speed.



HUD SYMBOLOGY (CONT'D)

Mach Readout

The Mach readout is located below the airspeed tape when the Mach exceeds 0.450 M and remains greater than 0.400 M. The Mach readout has a resolution of 0.001 M.

Selected Mach Readout

The selected Mach readout is displayed in large font in place of the selected airspeed readout and has a resolution of 0.01 M. The selected Mach is displayed when:

- Airspeed tape is displayed, and
- IAS FMS/Man indicates MAN, and
- Selected airspeed type is Mach and less than M_{MO}.

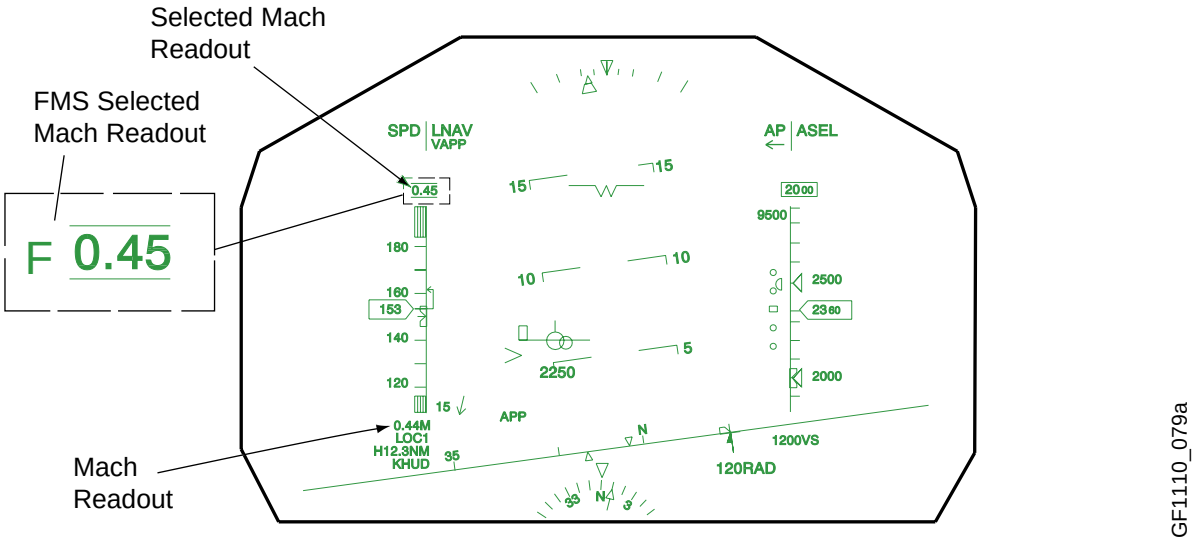
NOTE

MMO is displayed when the selected airspeed is at M_{MO}.

FMS Selected Mach Readout

The FMS selected mach readout is displayed above the airspeed tape with a letter “F”. It is displayed in large font in place of the selected airspeed readout, and has a resolution of 0.01 M. The FMS readout is displayed when:

- Airspeed tape is displayed, and
- IAS FMS/Man Indicates FMS, and
- Selected airspeed type is Mach.



HUD SYMBOLOGY (CONT'D)

V_{MO}/M_{MO} Annunciation

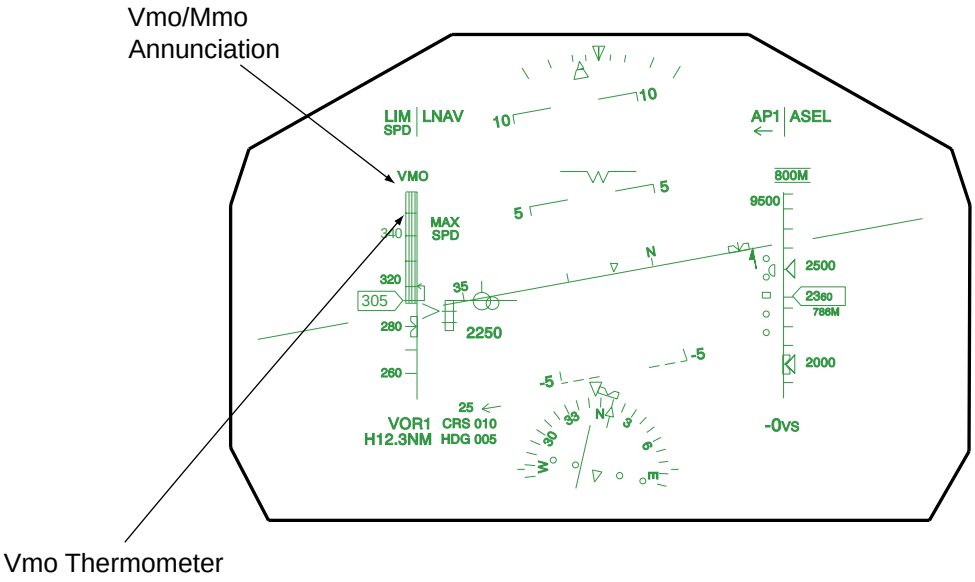
The V_{MO} indication is displayed in large font, instead of the selected airspeed when the IAS FMS/Man indicates MAN and the selected airspeed type is IAS.

The M_{MO} indication is displayed in large font, instead of the selected Mach when the airplane exceeds V_{MO}/M_{MO} and the IAS FMS/Man indicates MAN and the selected airspeed type is Mach.

V_{MO} Thermometer

The V_{MO} thermometer extends from the Vmo to the top of the airspeed tape. The following airspeeds are used instead of the V_{MO} in specific cases:

- VF3 (185 knots) when the flap angle is greater than 17°.
- VF2 (210 knots) when the flap angle is between 7° and 17°.
- VF1 (210 knots) when the flap angle is between 1° and 7°.
- VSO (225 knots) when the slat angle is greater than 1° and the flap angle is lower than 1°.
- VLE (250 knots) when the slat angle is lower than 1°, the flap angle is lower than 1° and at least one of the landing gear is down and locked.



GF1110_080

AOA Margin Indication (AMI)

The AMI displays the margin available between the current AOA and the stall AOA as defined by the Stick Shaker.

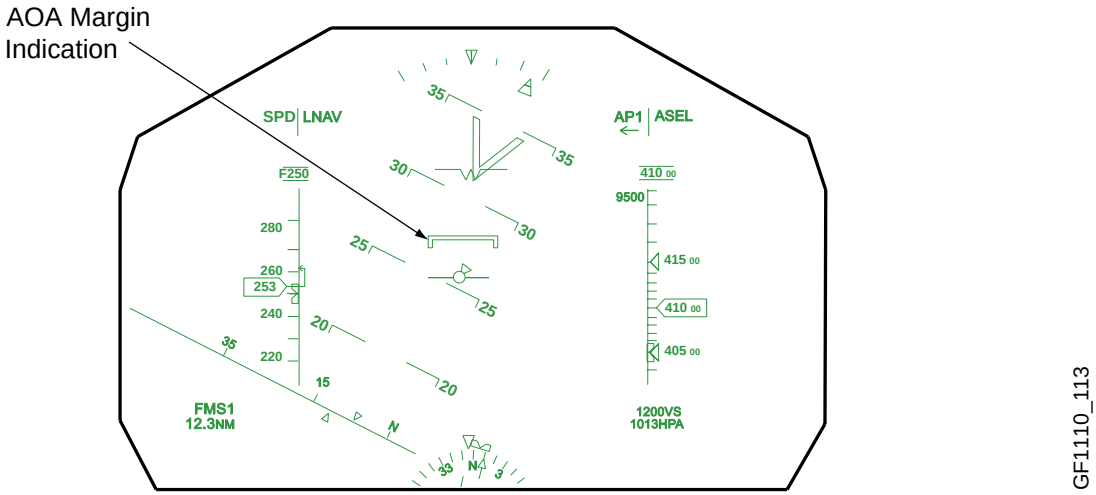
The AMI is displayed in relation to the position of the FPV; below 0.70 Mach it is displayed when the aircraft AOA vane is within 5 degrees of Stick Shaker activation and it is removed when a margin of more than 6 degrees is reached. At 0.84 Mach and above the AMI is displayed when the aircraft AOA vane is 2.5 degrees from Stick Shaker activation and it is removed when a margin of more than 3 degrees is reached. Between 0.70 and 0.84 Mach a linear range is used to display the AMI between 5 degrees and 2.5 degrees respectively.

The AMI is displayed above the FPV at half distance equal to the margin. If the symbol is superimposed to the FPV the aircraft shaker is activated.

HUD SYMBOLOGY (CONT'D)

AOA Margin Indication (AMI) (Cont'd)

During a Windshear Warning at Radio altitude of 1,500 feet or lower the AMI is displayed at all times.



Low Speed Awareness (LSA) Thermometer

The LSA thermometer extends from the bottom of the airspeed tape to the calculated stall warning speed (stick shacker initialization). The LSA thermometer is displayed when the airspeed tape is displayed and the main gear is in weight off wheels condition.

Stall Annunciation

The stall annunciation is displayed below the airplane reference symbol when the stick pusher is activated or a pusher command is provided by the stall protection system.

Ground Speed Readout

The ground speed readout is based on the FMS ground speed. It has a range of 30 kt thorough 900 kt inclusively at 1 knot increment.

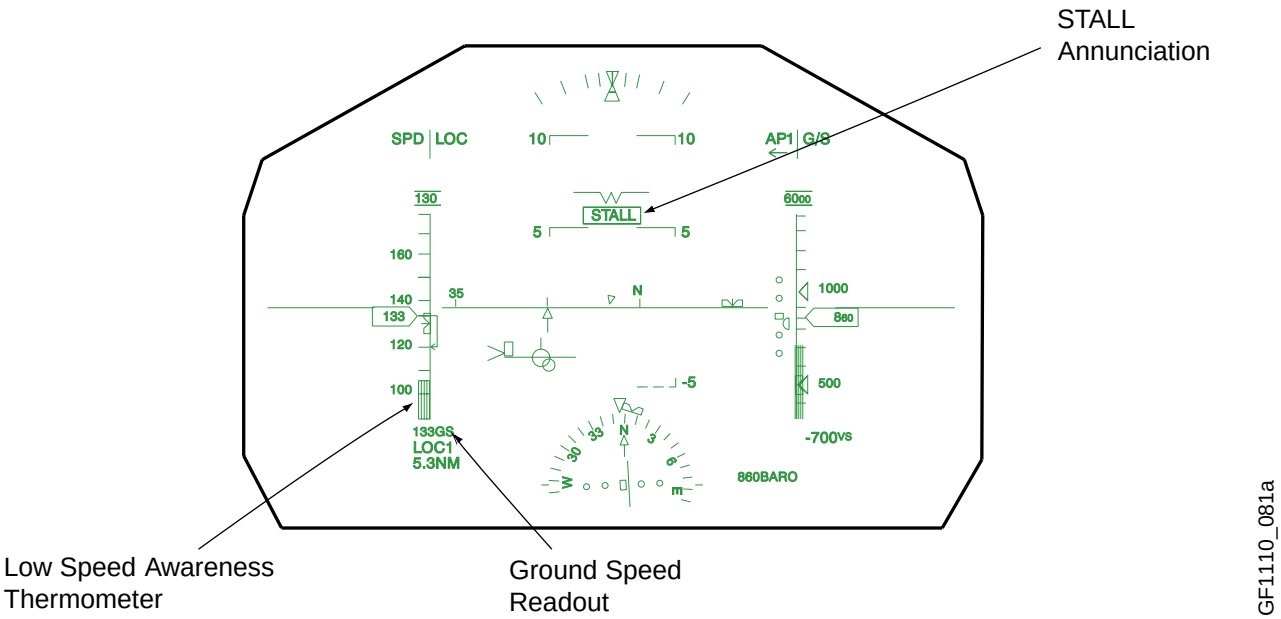
The ground speed readout is displayed in place of the Mach readout below the airspeed tape.

Ground speed is displayed when:

- Weight off wheel condition, and
- Flight Director approach mode is set.

HUD SYMBOLOGY (CONT'D)

Ground Speed Readout (Cont'd)



Vertical Speed Readout

The vertical speed readout is located below the altitude tape. The digital readout is displayed when the main landing gear is weight-off-wheel.

The range of the displayed value is ±9900 fpm. For vertical speed between ±1000 fpm the information is rounded to the nearest 50 fpm. For vertical speed greater than ±1000 fpm, the information is rounded to the nearest 100 fpm.

Vertical Speed Target

The vertical speed target is located above the vertical speed readout when the FD vertical captured submode is VS or VPTH. The vertical speed target readout is labeled VS or VN, according to the FD vertical captured mode.

The vertical speed target readout is limited to the range of −8000 fpm through 6000 fpm. The sign is replaced by an arrow pointing up (↑) for a positive value and down (↓) for a negative value. When the vertical speed target is within ±1000 fpm, the indication is rounded to the nearest 50 fpm. When the vertical speed target is exceeding ±1000 fpm, the indication is rounded to the nearest 100 fpm.

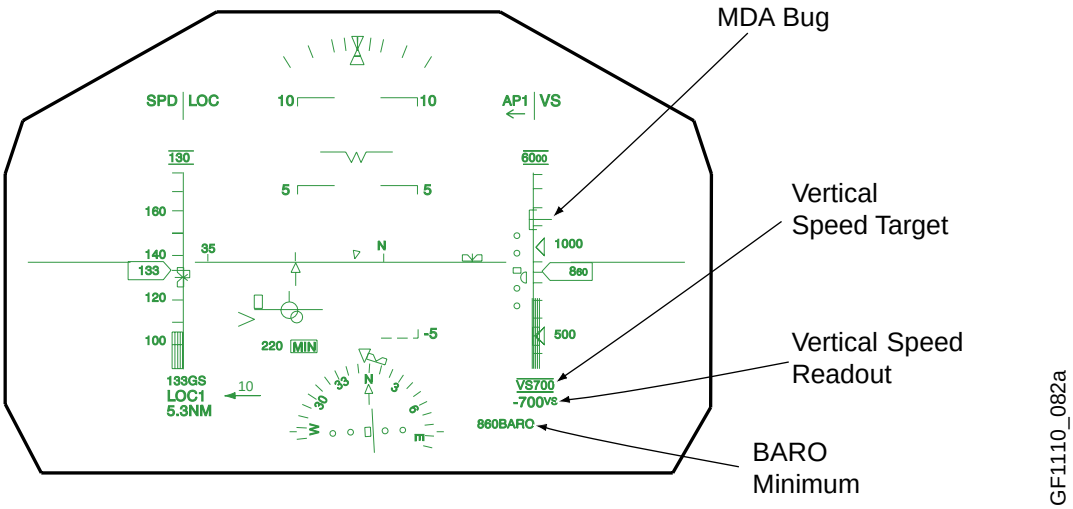
BARO Minimum Readout

The BARO minimum indication is displayed in 10 foot increments at the left of the BARO set readout and labeled BARO. It is displayed when the selected MDA is valid and greater than 20 feet.

HUD SYMBOLOGY (CONT'D)

MDA Bug

An MDA bug is displayed next to the altitude tape according to the MDA information. It is displayed when the selected MDA is valid and greater than 20 feet.



Conformal Heading Scale

The scale is marked above the horizon line in 5 degree increments and can display a range of approximately 25 degrees. The heading mode is either Magnetic or True as selected via the FMS and indicated on the HUD.

Conformal Heading Index

The conformal heading index is located above the horizon line to indicate the airplane heading in reference to the external scene.

To avoid clutter with the airplane reference symbol, it is only displayed when the pitch angle exceeds ±2 degrees and remains greater than ±1.5 degrees.

Conformal Selected Heading Bug

A selected heading bug is displayed on the horizon line and, when read in conjunction with the conformal heading scale, corresponds to selected heading.

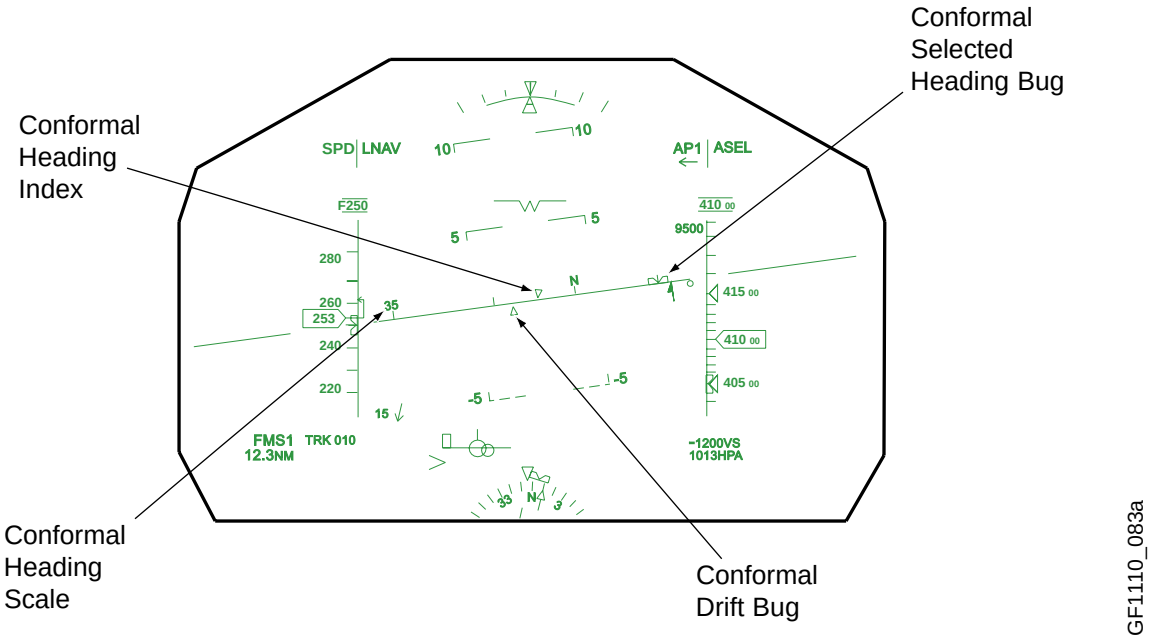
Conformal Drift Bug

The drift bug is displayed below the conformal horizon line when the FPV is more than 5 degrees away from the horizon line and remains in view until the FPV returns within 4.5 degree of the conformal heading line.

If the FPV is near the horizon line, drift can be easily discerned by the FPV lateral displacement from the center of the conformal heading index.

HUD SYMBOLOGY (CONT'D)

Conformal Drift Bug (Cont'd)



Heading Scale and Index

The partial HSI compass has a range of 200 degrees and is displayed at the bottom center of the combiner. The heading index in the shape of an inverted triangle is located at the top of the scale.

The HSI moves gradually out of view of the combiner when the horizon line lowers with high pitch attitudes. The HSI Compass is not displayed when T/O mode is selected to allow the horizon line to remain conformal as much as possible.

The HSI compass heading information is consistent with the Magnetic/True heading selected on the PFD.

Selected Heading Bug

A selected heading bug is located on the edge of the HSI compass. It is not displayed when located outside of the range of the HSI compass.

Selected Heading Readout

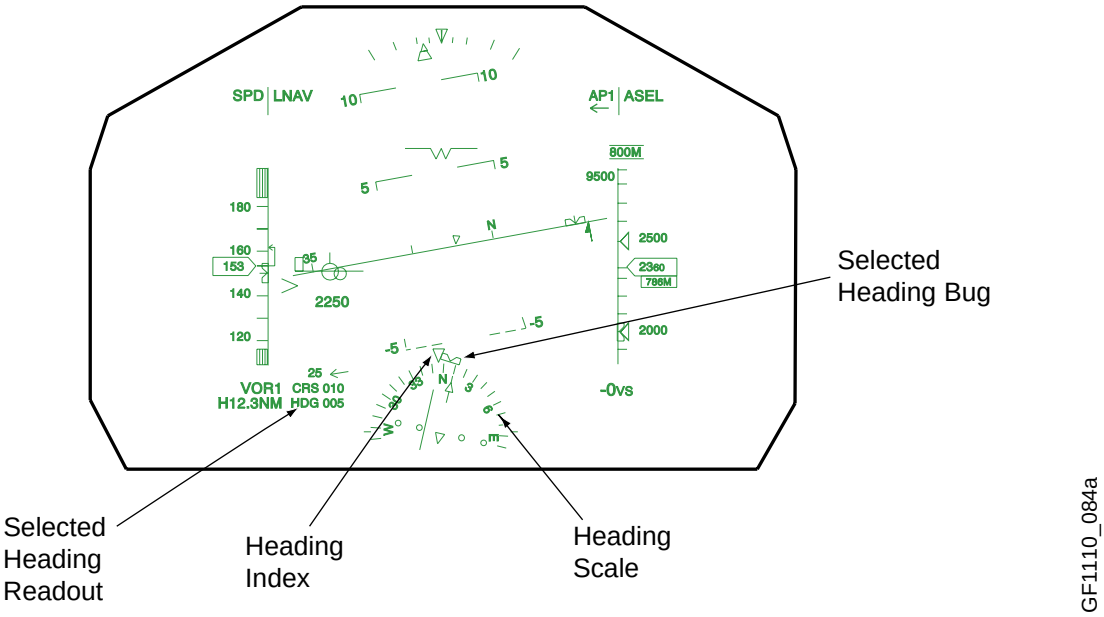
The selected heading readout is located to the left of the HSI compass. The selected heading readout is displayed when:

- The heading bug is outside the displayed conformal heading scale on the horizon line,

  or
- The selected heading value is adjusted by the pilot and for a 10 second time period thereafter.

HUD SYMBOLOGY (CONT'D)

Selected Heading Readout (Cont'd)



Conformal Course Selected Bug

The conformal selected course bug (or desired track when in FMS navigation mode) consists of an arrow pointing up below the conformal heading scale.

When the selected course value exceeds the displayed heading scale, the arrow is at the end of the conformal horizon line in between the airspeed and altitude tapes with half of the symbol displayed.

Course Selected Readout

The selected course readout is located at the left of the heading scale. It is displayed when the selected course pointer is out of view on the HSI and during course selection. The selected course readout is not displayed when the primary navigation source is the FMS.

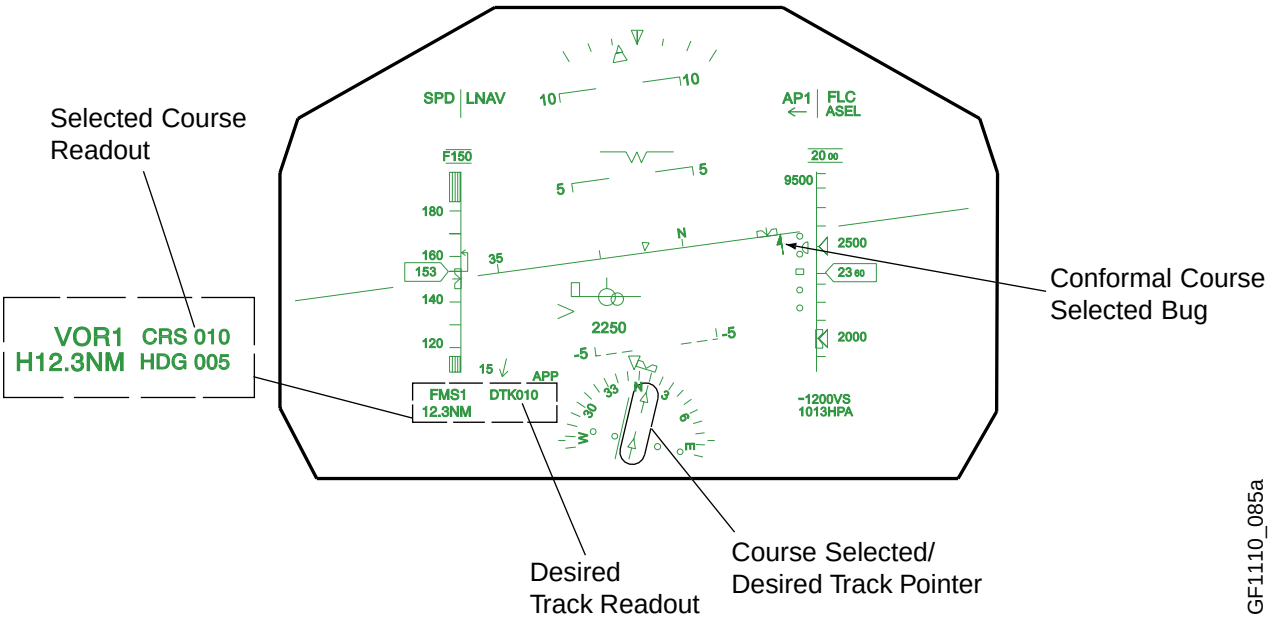
Desired Track Readout

The desired track readout is displayed in place of the selected course readout, and is labeled DTK. It is displayed when the FMS is the primary navigation source.

HUD SYMBOLOGY (CONT'D)

Course Selected/Desired Track Pointer

The selected course/desired track pointer is displayed in the HSI compass. Due to the limited display of the HSI compass, it is possible that only half the pointer is visible.



TO/FROM Indicator

The conventionnal TO/FROM Indication is displayed when VOR/LOC is selected as the primary navigation source.

When the course deviation indicator (CDI) is between ±88° in reference to the VOR course, the TO/FROM symbol indicates TO. When the CDI exceeds ±92° from the VOR course, the TO/FROM symbol indicates FROM. The indicator is removed when the course deviation is between 89° and 91°.

A square replaces the conventional TO/FROM indicator when the FMS or the LOC is selected as the navigation source.

Navigation Source Indication

The navigation source indication is displayed at the lower left of the display. The primary navigation source information and the pilot sensor selection must be present in order to display the navigation source.

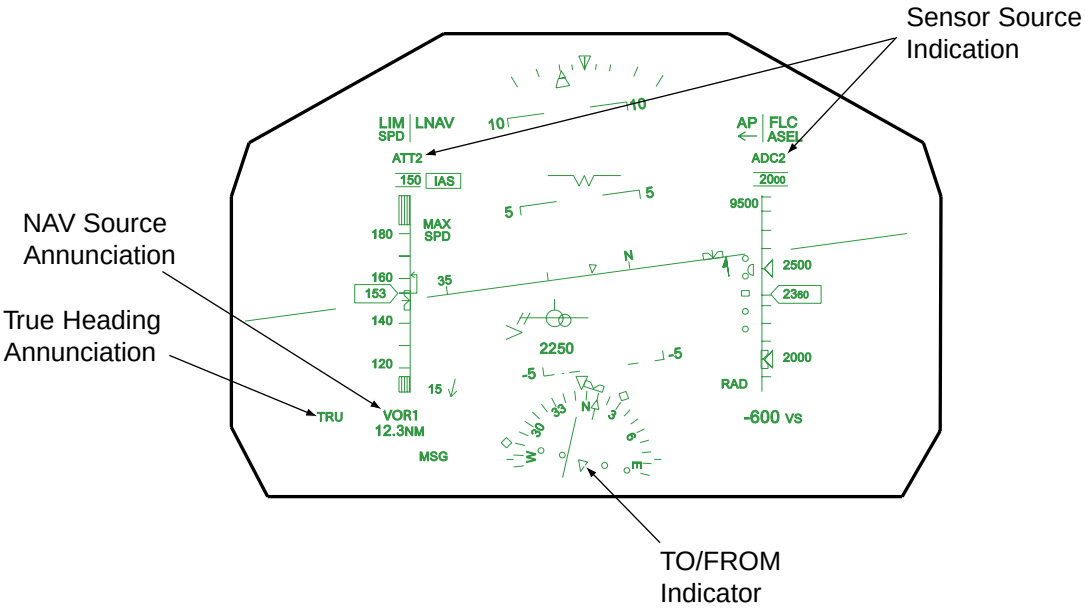
Sensor Source Indication

When an alternate data source is selected, an annunciation is displayed to indicate the source selected. The indication is displayed continuously when the pilot and the copilot use the same source.

HUD SYMBOLOGY (CONT'D)

True Heading Annunciation

The True heading annunciation is located at the left of the navigation source indication, when the FMS True heading as been selected.



Bearing Pointer

Two bearing pointers can be displayed on the HSI compass. Due to the limited visual range of the HSI compass, at least one part of the pointer will remain in view.

The bearing pointers displayed on the HUD are consistent with the selection on the pilot's PFD.

Two of the following bearings can be displayed simultaneously:

- VOR 1 or, ADF 1, or Pilot FMS and
- VOR 2 or, ADF 2, or co-pilot FMS.

Bearings are referenced to magnetic north unless true north is selected and indicated on the HUD.

Vertical deviation Scale

The vertical deviation scale is located to the left of the altitude tape. The vertical deviation scale and the altitude tape move together to the right edge of the display to accommodate the FPV when necessary.

Glideslope Deviation

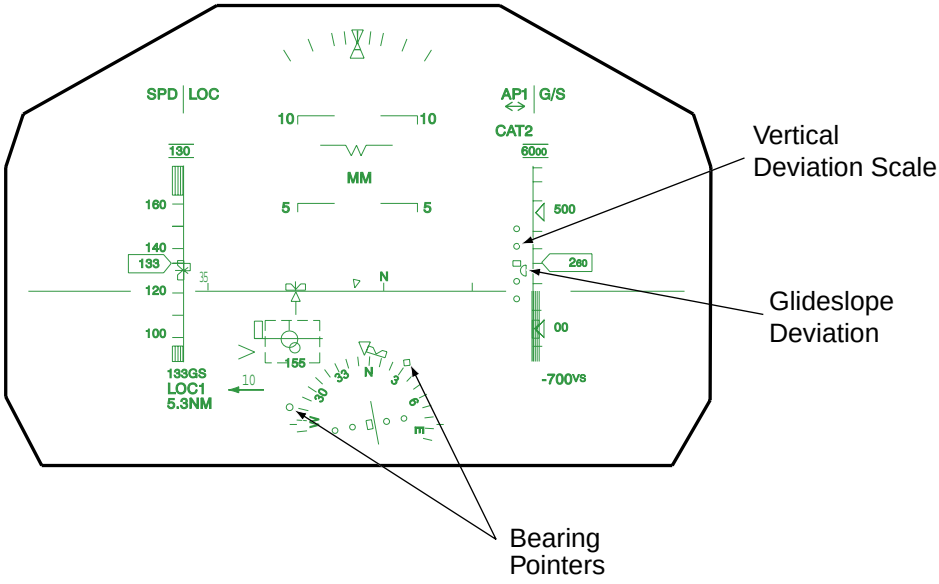
The pointer is displayed to the right of the vertical deviation scale. A limited pointer deviation is shown with half the pointer in view at the appropriate position corresponding to ±2.5 dots.

The glideslope deviation is displayed when the primary navigation source is LOC, the glideslope deviation is valid, and the airplane is not in Back Course.

The glideslope Deviation scale is not displayed in TO or GA mode or when the Radio Altitude is less than 50 ft.

HUD SYMBOLOGY (CONT'D)

Glideslope Deviation (Cont'd)



VNAV Vertical Deviation

The VNAV vertical deviation is displayed to the left of the vertical scale when the vertical captured mode is VPTH. A limited pointer deviation is shown as a half pointer in view at a position corresponding to ±2.5 dots. Also the VNAV vertical deviation is shown when a Vertical Track Alert (VTA) is annunciated on the PFD's with the associated double C-chord.

When the FMS approach sensitivity is set to normal, the ±2 dots scale corresponds to the vertical scale factor provided in feet. When the vertical scale factor is not provided, the ±2 dots scale corresponds to ±500 ft. When the FMS approach sensitivity is not set, the normal sensitivity is used.

Lateral Deviation Excessive Indication

The lateral deviation excessive annunciation is indicated by the lateral deviation scale flashing.

CAT 2 ILS Deviation Margin

The CAT 2 ILS deviation margin consists of 2 vertical dashed lines (lateral deviation limits of approximately 1/3 of a dot) and 2 horizontal dashed lines (vertical deviation limits of approximately one dot). When both limits are displayed, the shape of the CAT 2 ILS margin is a square. It is displayed in relation to the FPV. The CAT 2 ILS deviation is displayed when:

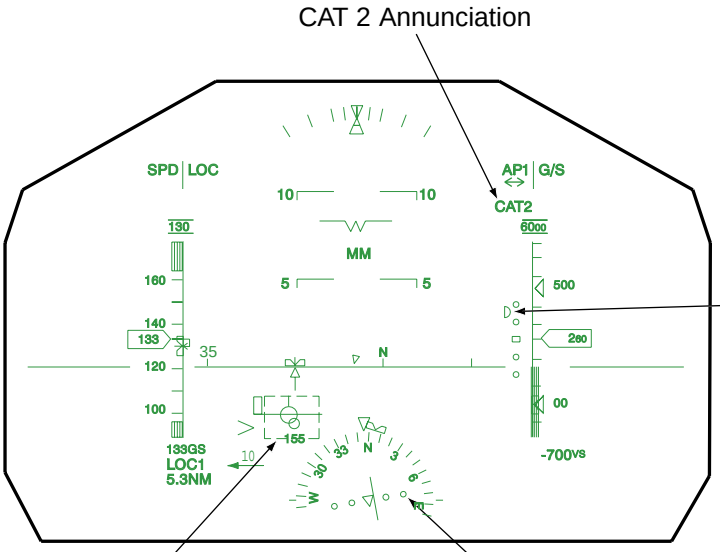
- CAT 2 mode is indicated, and
- The DH is set to a value lower than 200 ft, and
- The Radio Altitude is less than 300 ft but greater than DH.

When the LOC lateral deviation is not valid, the lateral deviation limits are removed and the vertical deviation limits are laterally centered on the FPV.

When the glideslope deviation is not valid, the vertical deviation limits are removed and the lateral deviation limits are vertically centered on the FPV.

HUD SYMBOLOGY (CONT'D)

CAT 2 ILS Deviation Margin (Cont'd)



Lateral Deviation Scale

The lateral deviation scale is a conventional CDI scale that rotates with the course pointer according to the course selected/desired track.

LOC Lateral Deviation

The LOC lateral deviation scale is a conventional CDI scale. The LOC lateral deviation is displayed when the primary navigation source is LOC and a valid LOC frequency is tuned. The LOC CDI is not displayed in TO or GA modes.

FMS Lateral Deviation

The FMS lateral deviation is a conventional CDI scale. The lateral deviation scale varies with the FMS approach sensitivity as follows:

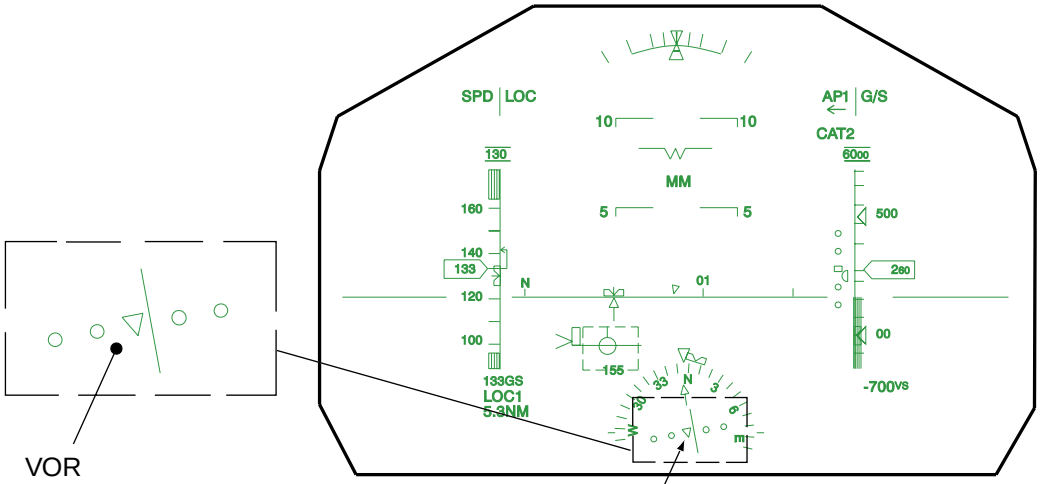
- ±5 NM when the lateral scale factor is not valid
- ±2 NM when the FMS approach sensitivity is set.

The FMS lateral deviation is displayed when the primary navigation source is FMS. The FMS lateral deviation is not displayed in TO or GA modes.

HUD SYMBOLOGY (CONT'D)

VOR Lateral Deviation

The VOR lateral deviation scale is a conventional CDI scale. The VOR CDI is displayed when the primary navigation source is VOR. The VOR CDI is not displayed in TO or GA mode.



Marker Beacon

The marker beacon annunciation is displayed below the airplane reference and blinks when passing the outer, middle and inner marker beacons.

DME/FMS Distance Readout

The DME/FMS distance is located below the navigation source indication. The range is limited from 0 through 4096 NM with a resolution of 1 NM above 100 NM and of 0.1 NM below 100 NM.

The distance information is associated with the primary navigation source indication as follows:

- VOR 1 or LOC 1 = DME 1 readout
- FMS 1 = FMS readout
- VOR 2 or LOC 2 = DME 2
- FMS 2 = FMS readout

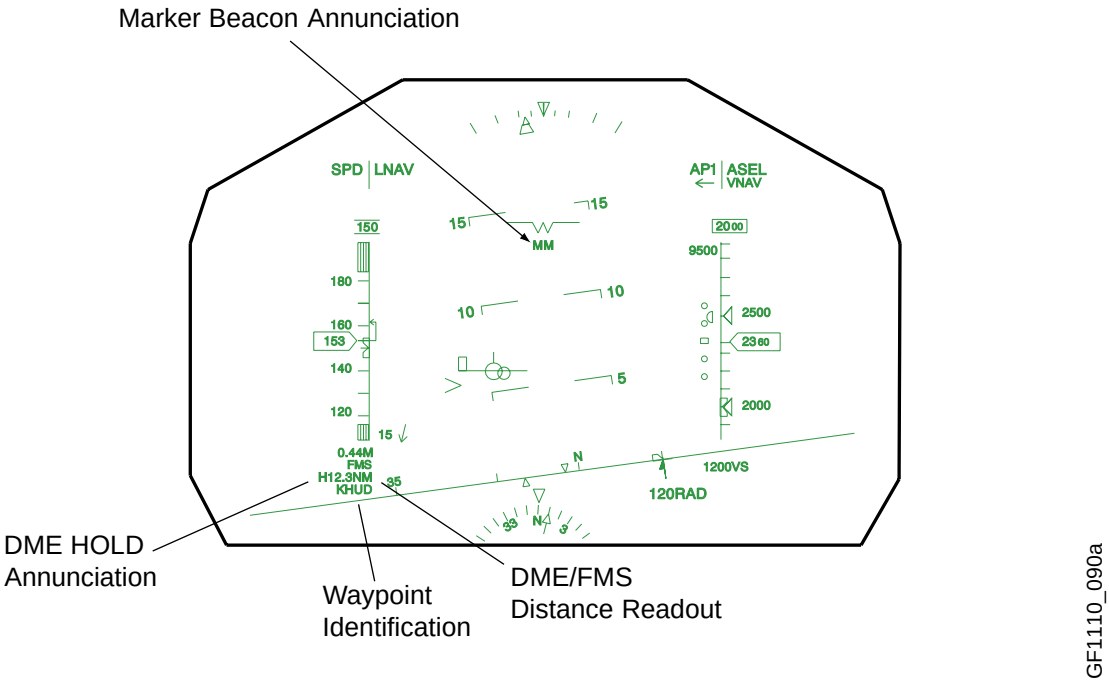
DME HOLD Annunciation

The DME HOLD annunciation is indicated by an "**H**" displayed at the left of the DME/FMS distance readout. It is displayed when the navigation source is VOR/LOC and DME HOLD has been selected

HUD SYMBOLOGY (CONT'D)

Waypoint ID

The waypoint identification consists of a maximum of 6 letters located below the DME/FMS distance readout. Depending on the navigation source selection, it displays the identifier of the DME radio frequency selected by the pilot or the next FMS waypoint. The waypoint identification is flashing when the it is overflown.



Wind Data

The wind direction is displayed in vector format using a rotary arrow at the lower right side of the airspeed tape.

The wind speed is displayed as a digital readout. The wind speed readout is enabled with wind greater than 6 kt and is disabled when below 4 kt or when weight-on-wheels is applied.

GPWS Annunciations

The GPWS warning annunciations are located above the airplane reference. The windshear caution annunciation **WNDSHR CAUTION** is annunciated without a box below the airplane reference symbol.

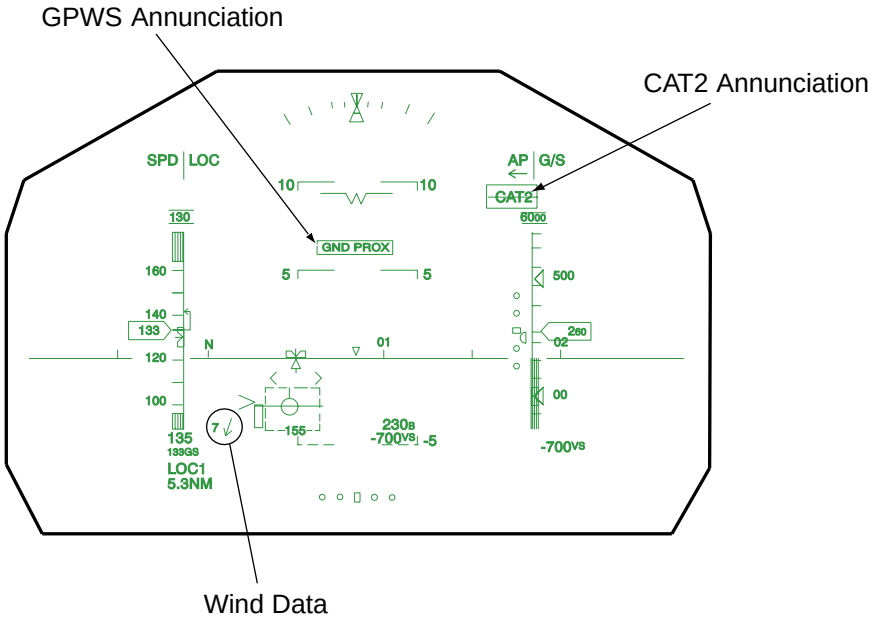
The annunciations are displayed in the following priority:

Windshear Warning	– **WINDSHEAR**
Command	– **PULL UP**
Ground Proximity	– **GND PROX**
Windshear Caution	– **WNDSHR CAUTION**

HUD SYMBOLOGY (CONT'D)

CAT 2

The CAT 2 status is located below the AP annunciation. It flashes for 5 seconds, then remains steady during the approach as long as conditions remain. In the case of the loss of CAT 2 capability, the CAT 2 annunciation is boxed and striked through.



Overspeed Protection Annunciation

The overspeed protect annunciation is displayed when the Flight Director has entered the maximum airspeed mode.

FMS Message Annunciation

This annunciation is displayed when there is a message on the FMS CDU.

TCAS Annunciation

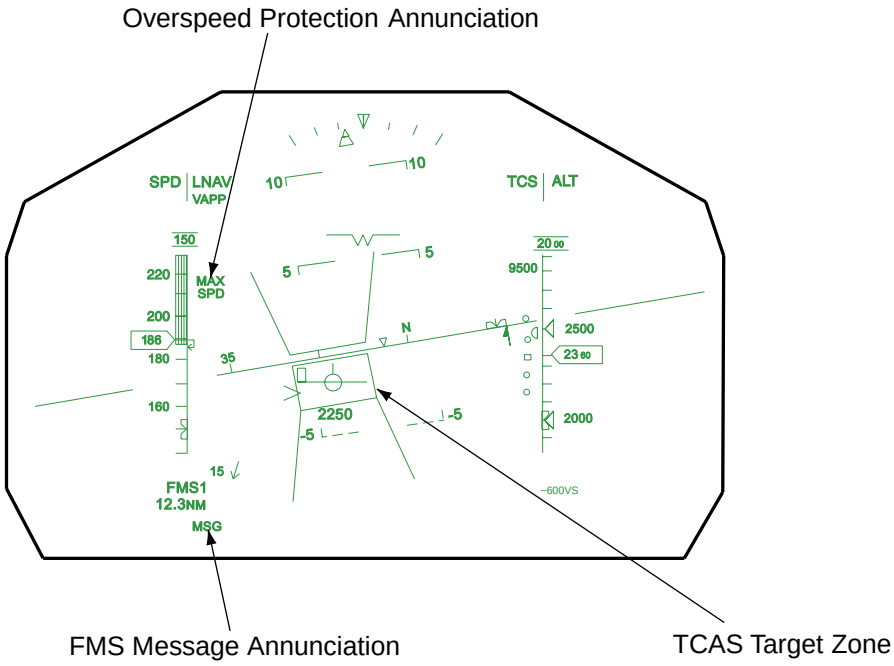
A TCAS target zone is displayed on the HUD in relation to the FPV. When the airplane is below 1100 ft radio altitude or when the TCAS is manually selected to TA, a TA ONLY annunciation is posted on the HUD.

During Resolution Advisories (RA), the TCAS avoidance zone is displayed. A flight path correction is needed when the avoidance zone is flashing. The TCAS Resolution Advisory is not displayed in case of excessive airplane attitude. The HSI is removed to avoid clutter in TCAS RA scenarios. The FD cue is removed to avoid misleading or incoherent guidance.

A boxed TCAS RA annunciation is posted above the airplane reference when the TCAS test is activated.

HUD SYMBOLOGY (CONT'D)

TCAS Annunciation (Cont'd)



HUD SYMBOLOGY (CONT'D)

Miscompare/Failure Annunciation

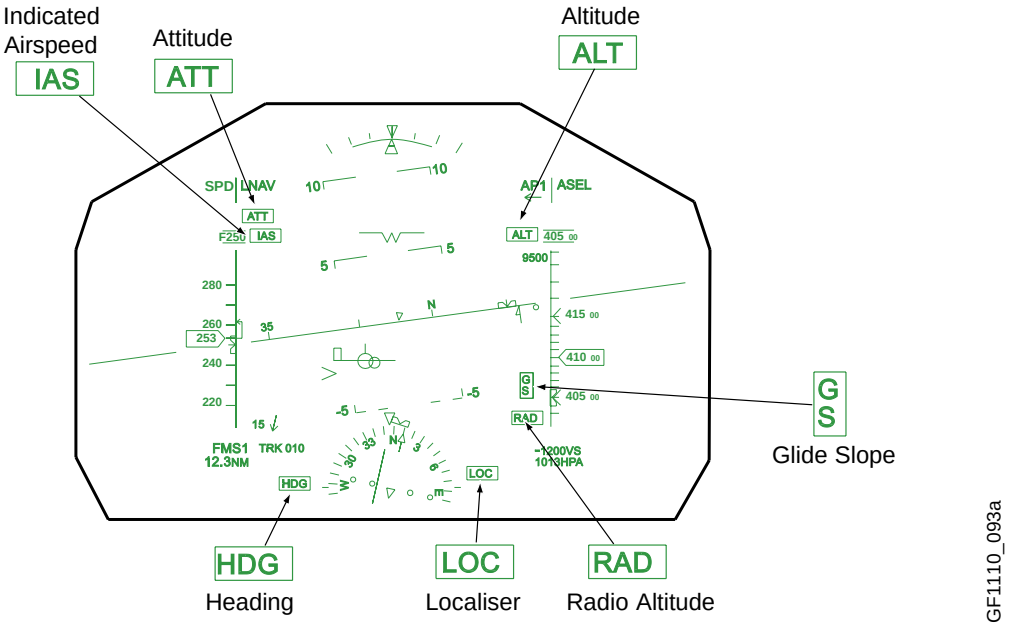
The miscompare/failure annunciations are boxed and remains steady as long as the miscompare condition exists or the applicable data is invalid.

A miscompare annunciation is indicated by a sensor flag and the corresponding parameter remains displayed (e.g. IAS boxed: speed readout and tape in view).

A failure annunciation is indicated by a flag and the removal of the associated data (e.g. ADC boxed: speed readout and tapes removed).

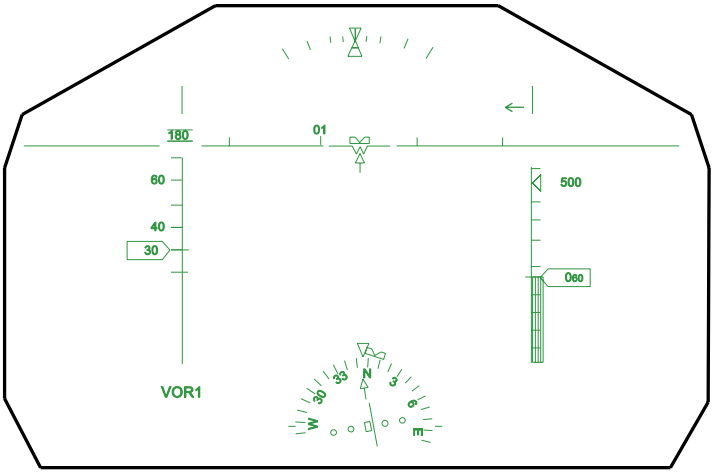
The following annunciations can be displayed:

- **ATT** for discrepancy in pitch > 5 degrees or in roll > 6 degrees
- **IAS** for discrepancy of more than 20 knots (for IAS > 60 knots)
- **ALT** for discrepancy of more than 200 feet
- **HDG** for discrepancy of more than 10 degrees
- **GS** or **LOC** for excessive deviation
- **RAD** for radio altitude miscompare.



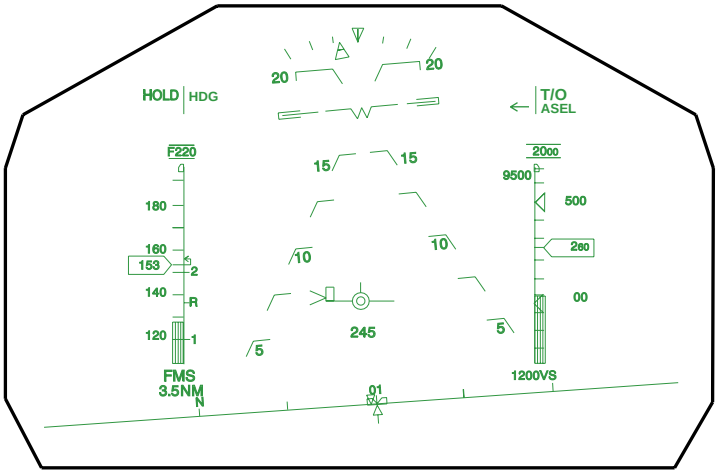
FLIGHT PROFILE

Power-up



GF1110_094

Take-off



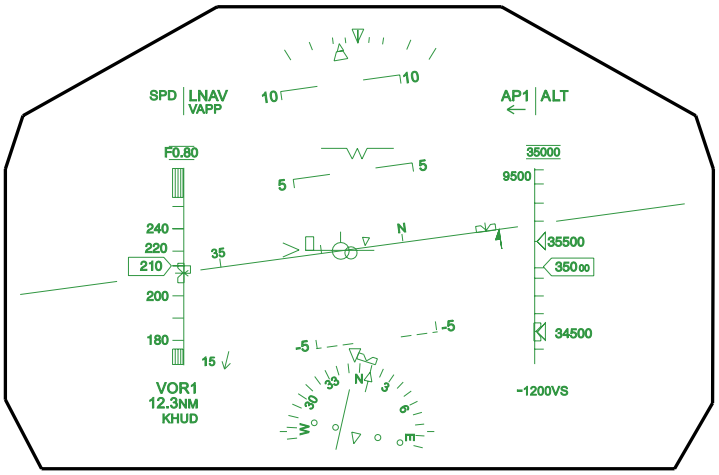
GF1110_095

When the Flight Director is in the take-off mode and the nose wheel is off the ground, the pitch scale changes to a pitch target. The take-off mode pitch target is normally set at 17.5 degrees; however, if an engine failure is detected, it is reset automatically to 13 degrees.

The aircraft symbol is superimposed on the roll and pitch scale to provide airplane attitude reference.

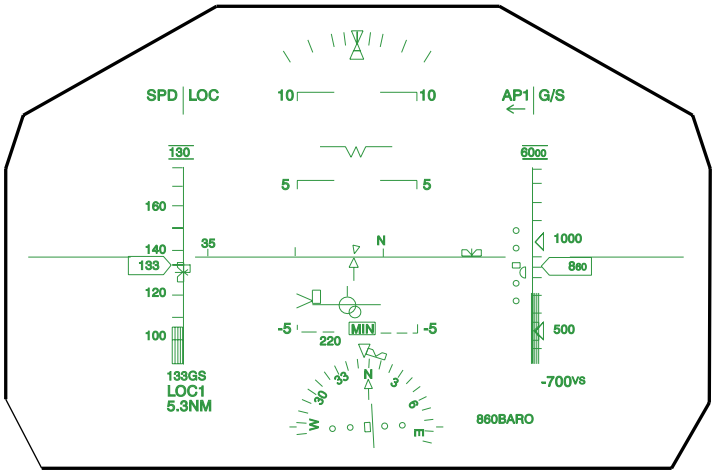
FLIGHT PROFILE (CONT'D)

Cruise



GF1110_096a

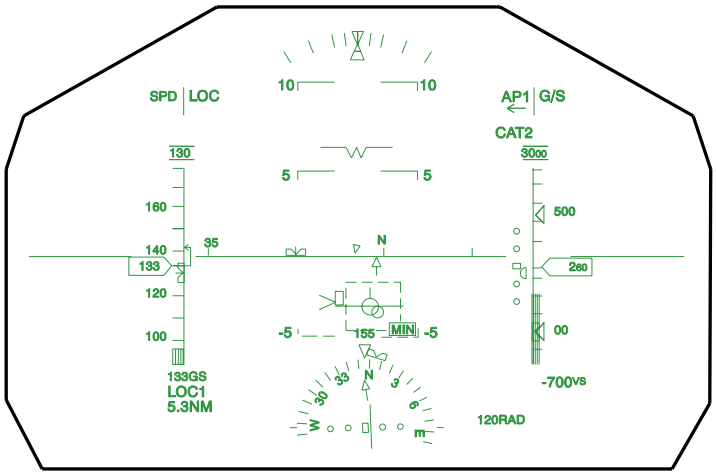
Approach CAT I



GF1110_097a

FLIGHT PROFILE (CONT'D)

Approach CAT II



GF1110_098a

FLIGHT PROFILE (CONT'D)

Excessive Attitude

The excessive attitude format is used in the following conditions:

- Roll is greater than 65° or less than −65°
- Pitch is greater than 29° or less than −20°

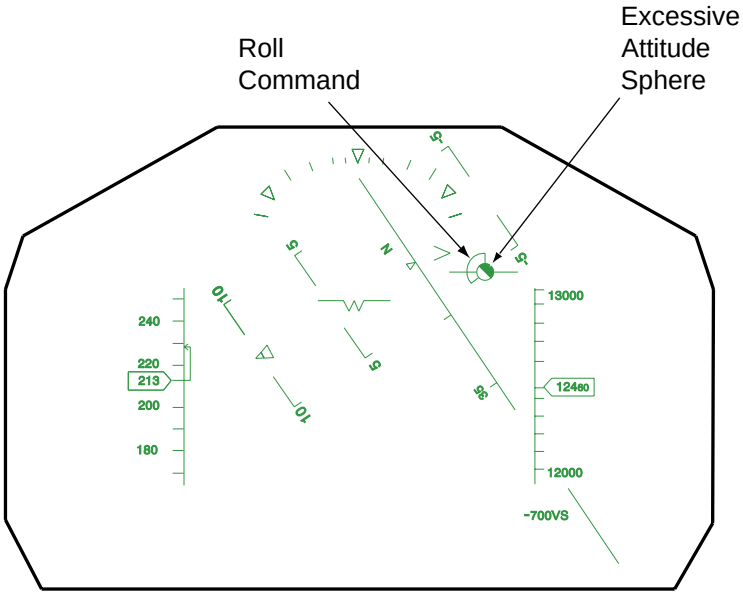
The excessive attitude format is kept until the Roll is between ±63° and the Pitch is between 28° and −18°.

To enable the pilot to focus on the essential parameters for the excessive attitude recovery, some parameters (for example, navigation information) are removed to provide a decluttered display.

When an excessive attitude occurs, a sphere is included in the center of the FPV. The sphere has 3 positions according to Pitch angle:

- One third illuminated when Pitch is greater than 5°
- One half illuminated when Pitch is between ±5°
- Two thirds illuminated when Pitch is lower than −5°.

When excessive attitude occurs, chevrons are displayed each 10° from 30° to 80° and from −20° to −80° on the pitch tape, and a roll command is displayed around the FPV. The roll command indicates the direction to roll the aircraft to return to wings level.



GF1110_099

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED)

General

The EVS consists of cockpit controls, a Head−Up Display (HUD) System, an Infrared Sensor System (ISS) and FMS CDU. The ISS consists of an Infrared Sensor Unit (ISU) and an Infrared Window (IRW).

The EVS imagery can significantly improve the pilot's capability to detect approach lights and visual references of the runway environment that may not otherwise be visible under poor visibility conditions. The EVS also provides enhanced situational awareness during night operations.

The EVS enable descent and operation below decision altitude (DA) based on the pilot's observation of the EVS image.

EVS Overview

The EVS is composed of two sub systems,

1. The Head−Up Display (HUD) System, which is comprised of the following units:
   - Head−Up Display Computer (HUD Computer)
   - Computer Mounting Tray
   - Optical Projector Unit (OPU)
   - Combiner Optical Unit (COU)
   - Mounting Tray (MTR)
   - Sun Visor
   - Cockpit Controls
2. The Infrared Sensor System (ISS), which is comprised of the following units:
   - Infrared Sensor Unit (ISU)
   - Infrared Window (IRW)

The Infrared Sensor Unit (ISU) is mounted inside the aircraft TRU bay, aft of the radome. The ISU provides a monochrome video image in RS170 standard to the HUD Computer and FMS CDU.

The Infrared Window (IRW) consists of sapphire glass mounted in an EVS heated fairing. The IRW has a heating element to protect against ice build up from the outside environment, and to prevent condensation from the inside of the TRU bay. The EVS Heater Controller (EVSHC) controls the IRW and fairing heating.

The IRW allows the ISU to see the forward scene of the aircraft, while protecting the ISU from the outside environment.

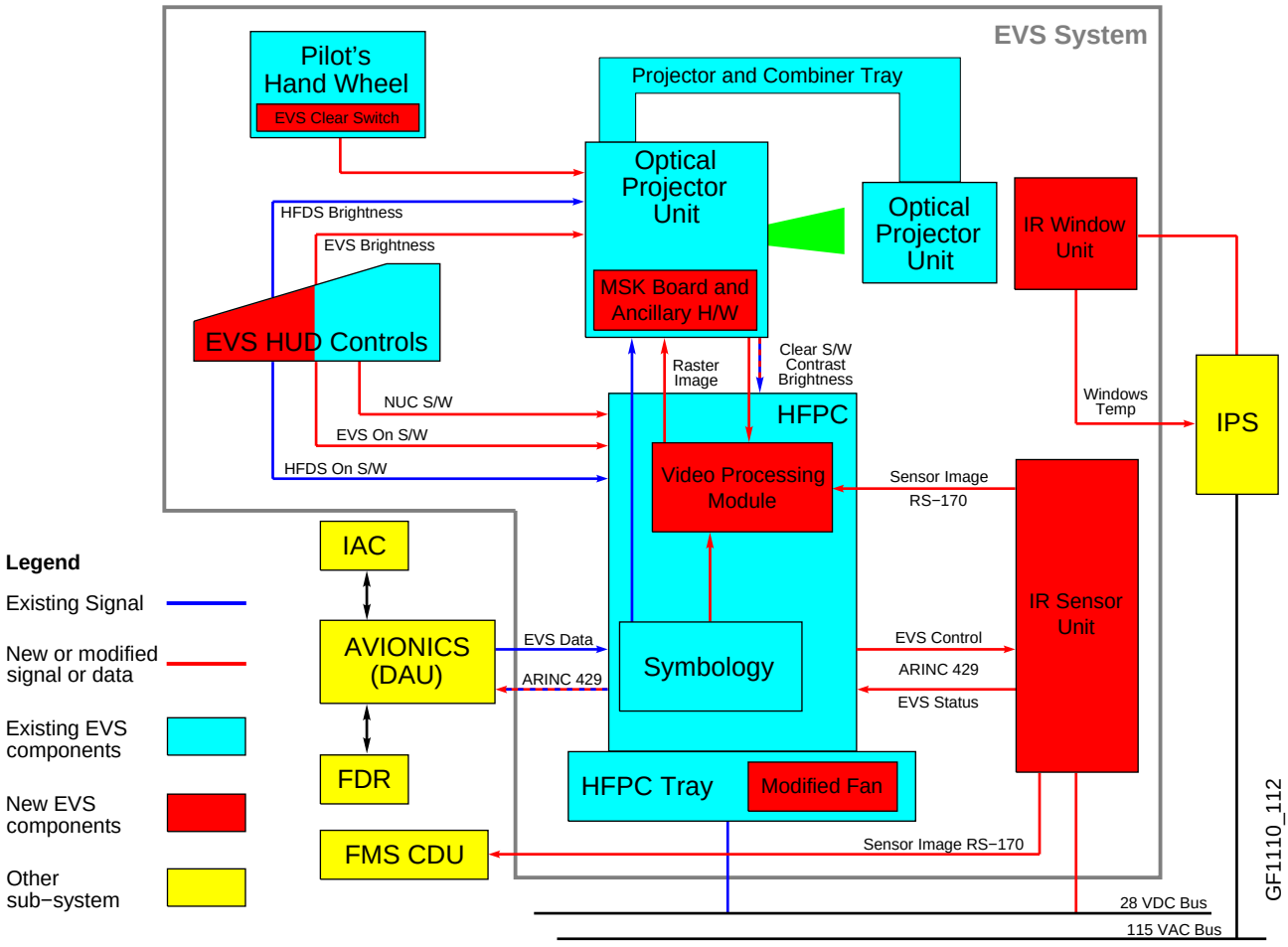
The HUD displays the IR image via the projector onto the combiner and generates the raster symbology that overlays the IR image. When the EVS image clear switch is selected to CLR or EVS is turned off, the HUD operates in the basic HUD mode.

The HUD interfaces with the ISU and the aircraft systems through ARINC 429 buses and discrete signals. All communication between the EVS and the aircraft systems are conducted via the HUD computer.

The EVS controls are located with those for the HUD on the aircraft glare shield panel.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EVS Architecture



EVS Ice Protection System Overview

The EVS Ice Protection System (EVS IPS) is comprised of the following units:

- EVS Heater Controller (EVSHC)
- EVS Heated Fairing (EVSHF)
- Infrared Window (IRW)

The EVSHC is located in the nose TRU bay and provides regulation and control of AC current to the EVS Heated Fairing and Infrared Window.

The power distribution of the EVSHC is controlled using zero-crossed Heater Power Switches (HPS) and redundant Fail Safe Relays. To ensure adequate power is distributed to the heater mats, the controller performs current monitoring and is able to detect both over and undercurrent faults.

Temperature sensors for control and monitoring are kept in separate channels for redundancy and the controller can utilize a single sensor to perform both functions in case of failure. This degraded mode is not annunciated to the pilots, but is logged as a maintenance item in CAIMS.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EVS Ice Protection System Overview (Cont'd)

The EVS Heated Fairing is a cast body of aluminium with a heater mat bonded to the inner surface. The heater mat has 3 zones of differing watt densities to account for the variation of accretion and heat transfer rates along the body of the fairing.

The EVS Ice Protection System is automatically activated upon selection of either the Left or Right Cowl Anti−Ice (CAI) switch. No additional pilot action is required to activate the EVSIPS, thus, when either CAI switch is selected "ON", a ground discrete from the switch is detected and the EVSHC enters ice protection mode (IN FLIGHT ONLY). This action activates embedded heaters within the EVS heated fairing and IRW. The heater controller then monitors the cycle with the use of embedded RTD temperature sensors. The IRW heater operates in "running wet anti−ice" configuration, providing sufficient heat only to prevent impinging water from freezing on contact. This water is free to run back and freeze on the fairing. The fairing, on the other hand is cyclically de−iced. The period of the de−icing cycle is 180 seconds. However, the duty time the heaters are actually active within this time frame is varible, depending on the Total Air Temperature.

The heated surfaces are each monitored by two RTDs. The fairing, being cyclically heated and not controlled to a given temperature, has two overheat detection RTDs. The IRW is controlled to a specific temperature set point, has one control and one overheat RTD. In the case of a single sensor failure, the remaining sensor will assume both functions.

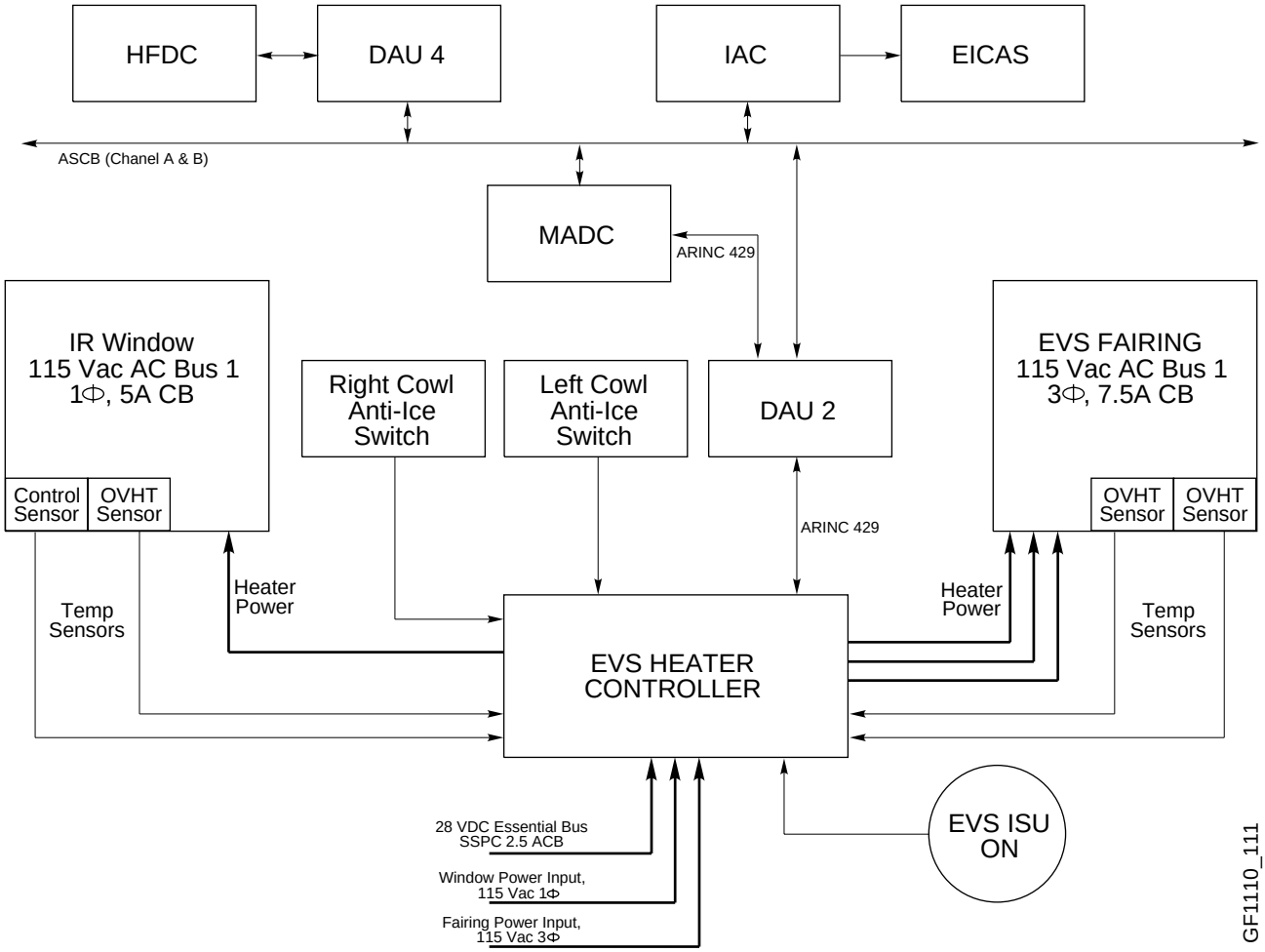
Status information is displayed to the pilot by means of the EICAS. The EVSHC communicates with the CAIMS, IAC and the DAU to provide failure indication and maintenance information.

IRW Demisting Control

The IRW is controlled by the EVSHC to a temperature sufficient to prevent condensation. The EVSHC controls the activation of the demisting based on a demist set point as calculated by the HUD based on SAT and is only active while the ISU is ON. This set point is transmitted from the HUD to the EVSHC via the DAU on the ARINC bus. When both deice and demist conditions are required, the higher window temperature is utilized to ensure both clear view and ice protection are maintained.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EVS Ice Protection System Architecture

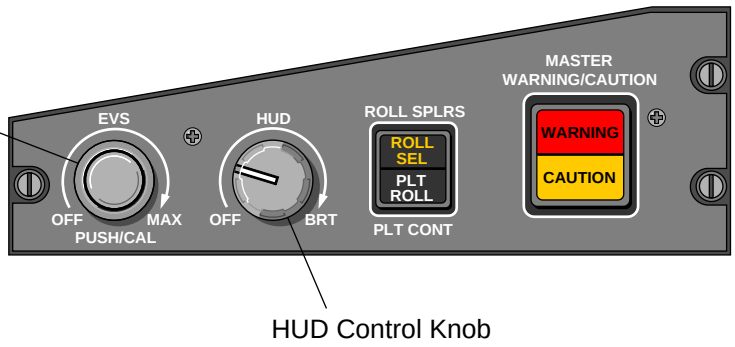


EVS Control Panel

The EVS control panel is located on the left pilot's glareshield. The EVS control panel includes the following functions:

- HUD OFF/BRT control
- EVS OFF/MAX control
- EVS Calibration (CAL) push button

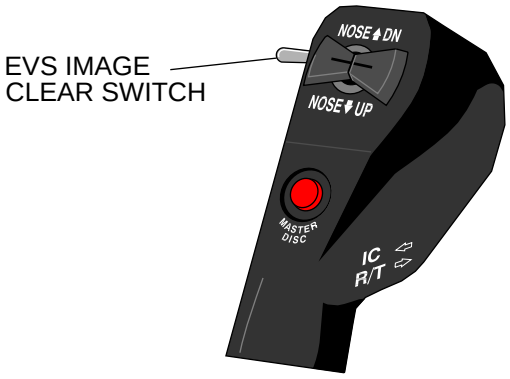
EVS Control Knob
Push button (short press)
− 6 sec CAL
Push button (long press)
− 22 sec CAL



ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EVS Clear Switch

An EVS image clear switch is incorporated into the left pilot handwheel outboard of the horizontal stabilizer trim switches. The EVS Clear Switch can be activated at any time to remove the EVS IR image and the raster symbology from the combiner while maintaining the aircraft flight symbology by reverting to the stroke mode. The function of removing the IR image is an aide in obtaining or verifying the normal vision without IR enhancement or to deal with any malfunction of the EVS that could impair the pilot's normal view through the combiner and windshield.



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Brightness Control

The HUD OFF/BRT control is used to control the overall projector brightness affecting symbology and image brightness, but not image contrast. The HUD OFF/BRT control and EVS OFF/MAX control interact in order to make it impossible to provide an EVS image that is brighter than the symbology brightness. This ensures that symbology is always available in various lighting conditions.

The EVS image brightness and contrast are controlled by a single contol knob (EVS OFF/MAX). The 12 O'clock position is the recommended EVS control seting for IMC operations. The EVS control position may be adjusted to obtain the optimum image in VMC conditions. Turning the EVS OFF/MAX control knob clockwise increases the IR image illumination. Turning the EVS OFF/MAX control knob counterclockwise decreases the IR image illumination.

Both EVS brightness and contrast affect only the video signal transmitted by the HUD computer to the HUD projector.

The EVS OFF/MAX control uses two independent brightness/contrast tables, one for night and one for day conditions. The HUD ambient light detector provides a voltage, based on sensor illumination, to the HUD computer to determine which table will be used. This operation is transparent to the pilot.

Symbology

When the EVS is in normal mode the flight symbology overlays the video image. Except for the consolidation symbols which are displayed in raster and stroke all other symbology is displayed in raster format only.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

Consolidation Symbol

Raster and stroke symbology are aligned to provide conformal flight essential symbols.

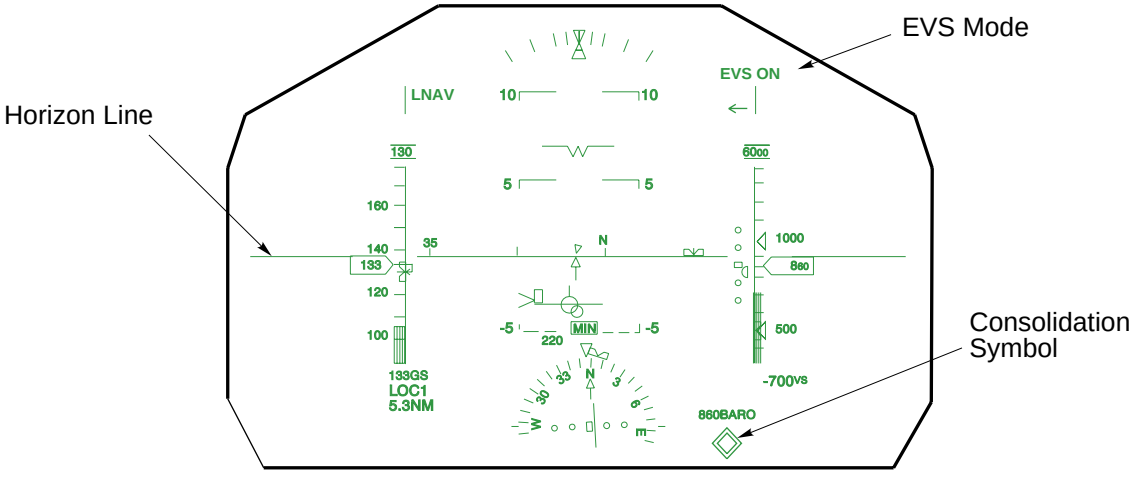
In order to ensure correct positioning of the raster symbology, two concentric diamond shaped symbols will appear after toggling the clear switch (NORM to CLR to NORM within 0.5 second). These consolidation symbols automatically clear after 5 seconds.

Alignment for conformal raster symbology is assured if the smaller stroke symbol is within the larger raster symbol, both being diamond shaped. If the stroke symbol is outside the raster symbol a positioning error of 0.5 degrees has been exceeded and EVS may not be used for approach and landing.

Prior to final approach a raster symbology alignment consolidation check is required.

NOTE

Since the consolidation symbol is only used to provide a correlation between conformal stroke and raster symbology it cannot be used to validate the acuracy of the image alignment.



Sensor Calibration

Over time the individual IR detectors of the focal plane array require recalibration to each other. If the pilot determines that the image is being degraded this function is selected by pressing the CAL button on the EVS control panel for less than 10 seconds. This activates a short calibration which removes the IR image for approximately 6 seconds and recalibrates the ISU. This function is normally used to correct a “burn in” image.

A long calibration (approximately 22 seconds) can also be selected by holding the CAL button down for more than 10 seconds. The long calibration is intended mainly for maintenance.

A long calibration is performed automatically during system power up.

NOTE

During calibration the IR image is removed from the HUD and FMS CDU. The symbology is maintained on the HUD display.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EVS Status Annunciation

The following EVS status messages can appear on the HUD above the FD Vertical Capture Mode:

- EVS: Indicates that the sensor is commanded on but has not yet reached its operating temperature.
- EVS CAL: Indicates that the sensor is in the calibration phase following a pilot request.
- EVS CLR: Indicates that the system is capable of displaying an image but the clear switch is in the CLEAR position.
- EVS ON: Indicates that the sensor image is displayed.

Upon EVS failure, the ~~EVS~~ strike through and boxed annunciation will be displayed.

The strike through and boxed ~~EVS~~ failure annunciation may be displayed even when the EVS has not been switched on. If the HUD detects a failure of its own video processing capability, the annunciation will be displayed.

When the EVS failure annunciation is displayed while the EVS is commanded off, the pilot can remove the annunciation on the HUD by toggling the EVS clear switch (NORM to CLR to NORM). This procedure will not remove the associated EICAS message.

ENHANCED VISION SYSTEM (EVS) (IF INSTALLED) (CONT'D)

EICAS Messages

EVS FAIL
Indicates an EVS failure. Either a loss of ISS or a bad status bits. The HUD will revert to stroke mode.

EVS HEAT FAIL
Indicates the IRW and/or fairing not heated. Loss of heater control. EVS image may become degraded.

HUD FAIL
Indicates an internal failure. Either a loss of HUD or bad status bit. (no image displayed)

EVS HEAT OVHT
Indicates an IRW or fairing overheat. Loss of IPS due to relay being switched off. EVS image may become degraded.

EVS DEFOG FAULT
Indicates that the IRW is not defogged. EVS image may become degraded.

HUD MISCOMPARE
Indicates sensor mispcompare not detected by IAC.

HUD MISALIGN
Indicates that the combiner unit does not detect alignment beam.

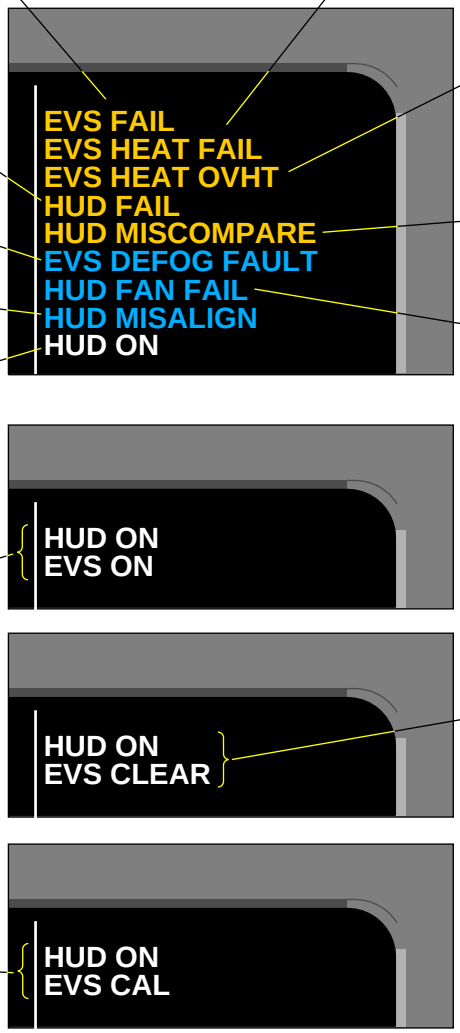
HUD FAN FAIL
Indicates a loss of fan cooling in HUD computer tray. When in approach, HUD reverts after 2 min to stroke mode.

HUD ON
Indicates that the HUD has been selected ON.

HUD ON
EVS ON
Indicates that the HUD is ON and that the EVS image is displayed.

HUD ON
EVS CLEAR
Indicates that the EVS is available but the display has been cleared using the CLEAR switch.

HUD ON
EVS CAL
Indicates EVS IR sensor calibration in progress.



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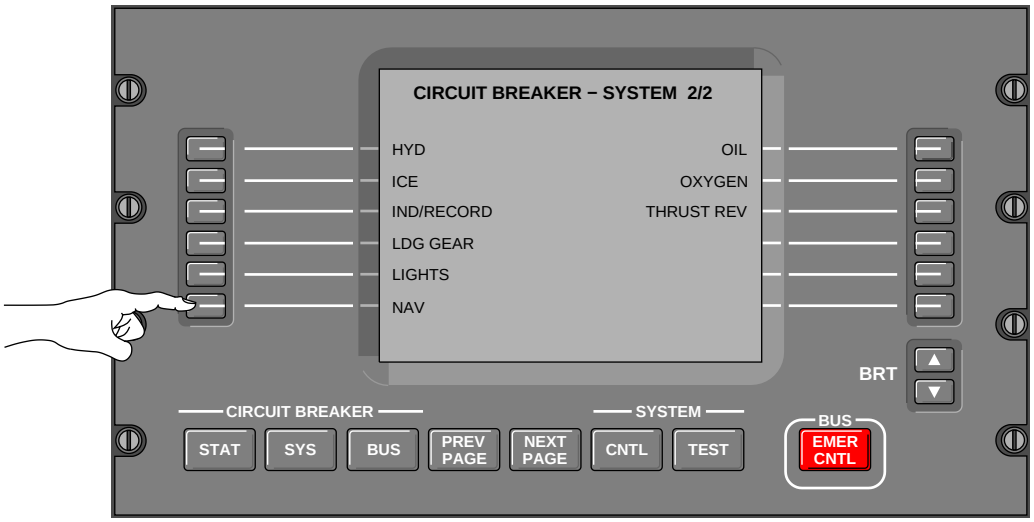
CB - NAV SYSTEM



CB – NAV SYSTEM 1/6		
ADF 1	DC 1	IN
ADF 2	DC ESS	IN
DME 1	DC 2	IN
DME 2	DC ESS	IN
FMS 1 CDU	BATT	IN
FMS 2 CDU	DC 2	IN

CB – NAV SYSTEM 2/6		
FMS 3 CDU	DC 1	IN
GPS 1	DC 1	IN
GPS 2	DC 2	IN
GPWS	DC 1	IN
HUD	DC 2	IN
IRS 1 FAN	DC ESS	IN

CB – NAV SYSTEM 3/6		
IRS 1 PWR A	DC ESS	IN
IRS 1 PWR B	BATT	IN
IRS 2 FAN	DC 2	IN
IRS 2 PWR A	DC 2	IN
IRS 2 PWR B	DC ESS	IN
IRS 3 FAN	DC 1	IN

CB – NAV SYSTEM 4/6		
IRS 3 PWR A	DC 1	IN
IRS 3 PWR B	DC ESS	IN
LIGHTNING SENSOR	DC 1	IN
MFD 1 CTLR	BATT	IN
MFD 2 CTLR	DC 2	IN
RAD ALT 1	DC 1	IN

CB – NAV SYSTEM 5/6			
RAD ALT 2	DC 2		IN
STBY ADI	AV BATT	CCBP	IN
STBY ALT/ASI	DC ESS		IN
TCAS	DC ESS		IN
VOR/ILS 1	DC 2		IN
VOR/ILS 2	DC ESS		IN

CB – NAV SYSTEM 6/6		
VOR/ILS 3 (OPT)	DC 1	IN
WX RADAR	DC 1	IN
WX RADAR CTLR 1	DC 1	IN
WX RADAR CTLR 2	DC 1	IN

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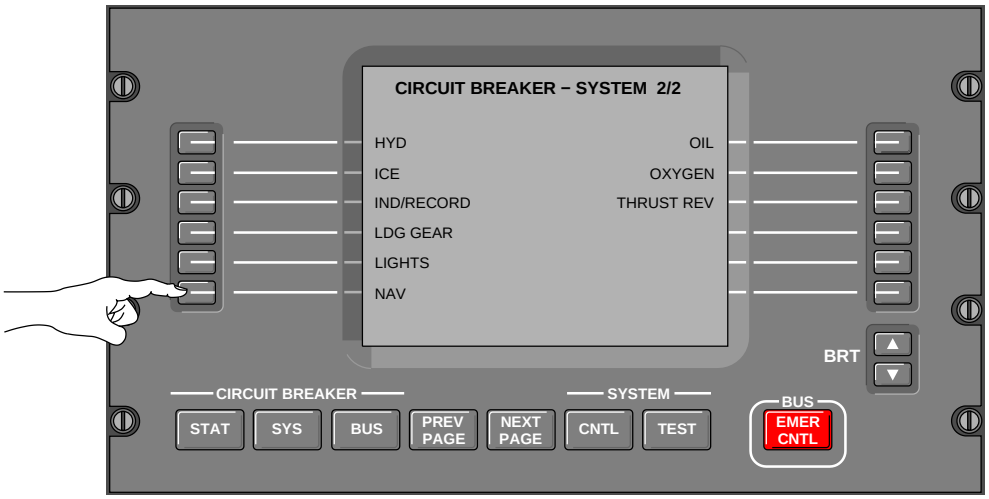
CB - NAV SYSTEM (CONT'D)

Effectivity:

- *Airplanes 9002 thru 9122* ***not incorporating*** *Service Bulletin:*
  - *SB 700−24−045, AC and DC Power Distribution − Unit Change and Activation of Build 4 Electrical System.*



CB − NAV SYSTEM		1/6
ADF 1	DC 1	IN
ADF 2	DC ESS	IN
DME 1	DC 2	IN
DME 2	DC ESS	IN
FMS 1 CDU	BATT	IN
FMS 2 CDU	DC 2	IN

CB − NAV SYSTEM		2/6
FMS 3 CDU	DC 1	IN
GPS 1	DC 1	IN
GPS 2	DC 2	IN
GPWS	DC 1	IN
HUD	DC 2	IN
HUD CTL PANEL	DC 2	IN

CB − NAV SYSTEM		3/6
IRS 1 FAN	DC ESS	IN
IRS 1 PWR A	DC ESS	IN
IRS 1 PWR B	BATT	IN
IRS 2 FAN	DC 2	IN
IRS 2 PWR A	DC 2	IN
IRS 2 PWR B	DC ESS	IN

CB − NAV SYSTEM		4/6
IRS 3 FAN	DC 1	IN
IRS 3 PWR A	DC 1	IN
IRS 3 PWR B	DC ESS	IN
LIGHTNING SENSOR	DC 1	IN
MFD 1 CTLR	BATT	IN
MFD 2 CTLR	DC 2	IN

CB − NAV SYSTEM		5/6
RAD ALT 1	DC 1	IN
RAD ALT 2	DC 2	IN
STBY ADI	BATT	IN
STBY ALT/ASI	DC ESS	IN
TCAS	DC ESS	IN
VOR/ILS 1	DC 2	IN

CB − NAV SYSTEM		6/6
VOR/ILS 2	DC ESS	IN
VOR/ILS 3 (OPT)	DC 1	IN
WX RADAR	DC 1	IN
WX RADAR CTLR 1	DC 1	IN
WX RADAR CTLR 2	DC 1	IN

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