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ACRONYMS

AAL	Above Airport Level
A/B	Above Below
ABV	ABoVe
AC	Acceleration Chevron
ADC	Air Data Computer
ADI	Attitude Director Indicator
ADF	Automtic Direction Finder
ADS	Air data System
AFCS	Automatic Flight Control System
AFM	Airplane Flight Manual
AGL	Above Ground Level
AGM	Advance Graphic Module
AHRS	Attitude and Heading Reference System
AHRU	Attitude Heading Reference Unit
ALOF	ALtitude Off
ALON	ALtitude ON
ALT	ALTitude
AMLCD	Active Matrix Liquid Crystal Display
ANT	ANTenna
AOA	Angle Of Attack
AOS	Angle Of Sideslip
APM	Aircraft Personality Module
APP	APProach
ASCB	Avionics Standard Communication
ASEL	Altitude preSElect
A/T	Auto-Throttle
ATA	Air Transport Association
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATIS	Airport Traffic Information System
ATT	ATTitude
B-RNAV	Basic aRea NAVigation
BFO	Beat Frequency Oscillator
BOW	Bassic Operating Weight
BW	BeloW
CAS	Crew Alerting System
CB	Circuit Breaker

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CCD	Cursor Control Device
CDB	Custom Data Base
CDI	Course Deviation Indicator
CFIT	Controlled Flight Into Terrain
CLC	Check-List Controller
CMC	Centralized Maintenance Computer
CMCRT	Centralized Maintenance Computer Remote Terminal
COMM	COMMunication
CPU	Central Processing Unit
CRS	CouRSe
CU	Computer Unit
DB	Directional Beacon
DCT	DireCT
DDM	Difference Depth Modulation
DGR	DeGRaded
DIRTO	DIRect TO
DME	Distance Measuring Equipment
DR	Dead Reckoning
DTG	Distance To Go
DTK	Desired Track
DU	Display Unit
EASy	Enhanced Avionics System
ECL	Electronic CheckList
EGPWM	Enhanced Ground Proximity Warning Module
EGPWS	Enhanced Ground Proximity Warning System
EFVS	Enhanced Flight Vision System
EPU	Estimated Position Uncertainly
ETA	Estimated Time to Arrival
ETE	Estimated Time Enroute
ETP	Equal Time Point
EVS	Enhance Vision System
FAF	Final Approach Fix
FCS	Flight Control System
FD	Flight Director
FMA	Flight Management Annunciator
FMS	Flight Management System
FMW	Flight Management Window
FOR	Flight Data Recorder

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FPA	Flight Path Angle
FPLN	Flight PLaN
FPS	Flight Path Symbol
FPV	Flight Path Vector
GA	Go Around
GFP	Graphical Flight Planning
GMAP	Ground MAPping
GND	GrouND
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glide Slope
HDG	HeaDinG
HSI	Horizontal Situation Indicator
HGS	Head up Guidance System
HUD	Head Up Display
IAF	Initial Approach Fix
IAS	Indicated Air Speed
ILS	Instrument Landing System
IM	Inner Marker
INAV	Interactive NAVigation window
INDS	Integrated Navigation Data Service
I/O	Input / Output
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
LAN	Local Area Network
LCD	Liquid Crystal Display
LDG	LanDinG
LED	Luminescent Electronic Diode
LSS	Lightning Sensor System
LH	Left Hand
LNAV	Lateral NAVigation
LOC	LOCalizer
LRU	Line Replaceable Unit
LSC	Low Speed Cues
MAG	MAGnetic
MAU	Modular Avionics Unit
MDU	Multifunction Display Unit
MEMS	Micro Electro-Mechanical System

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MFP	Multi-Function Probe
MGMT	ManaGeMenT
MKB	Multifunction Key Boards
MKR	MarKeR
MM	Middle Marker
MMO	Maximum Operating Mach
MRC	Modular Radio Cabinet
MSG	MeSsaGe
MSA	Minimum Safe Altitude
MSL	Mean Sea Level
NAV	NAVigation
NAVAIDS	NAVigation AIDS
NIC	Network Interface Controller
NIM	Network Interface Module
NOTAM	Notice To Air Man
OHU	OverHeat Unit
OM	Outer Marker
PDU	Primary Display Unit
PFCS	Primary Flight Control System
PMA	Permanent Magnet Alternator
PNR	Point of No Return
POF	Phase Of Flight
PPOS	Present POSition
PRB	Permanent Radio Bar
PROC	PROCeSSor
Ps	Static Pressure
Pt	Total Pressure
PWR	PoWeR
RA	Radar Altimeter
RA	Resolution Advisory
RAD	RADar
RA DH	Radar Altimeter Decision Height
RAIM	Receiver Autonomous Integrity Monitoring
RAT	Ram Air Turbine
REACT	Rain Echo Attenuation Compensation
RFCF	Runway Field Clearance Floor
RH	Right Hand
RNAV	aRea NAVigation system

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RNP	Required Navigation Performance
RP	Reversion Panel
RTA	Receiver Transmitter Antenna
SAT	Static Air Temperature
SATCOM	SATellite COMmunication
SFD	Secondary Flight Display
SID	Standard Instrument Departure
SSEC	Static Source Error Correction
SSPC	Solid State Power Controllers
STAR	Standard Terminal Arrival Route
STBY	STandBY
STD	STandarD
TA / RA	Traffic Advisory / Resolution Advisory
TACAN	TACTical Air Navigation
TAD	Terrain Awareness Display
TAT	Total Air Temperature
TAWS	Terrain Awareness & Warning System
TCAS	Traffic Collision Avoidance System
TCF	Terrain Clearance Floor
TD	Thrust Director
TERR	TERRain
TERM	TERMinal
TO	Take –Off
TOC	Top Of Climb
TOD	Top Of Descent
TOGA	Take-Off Go Around
TOLD	Take-Off Landing Data
TOSA	Take-Off Safety Altitude
TRB	TuRBulence
TRFC	TRaFfiC
TRK	Track
TRU	Transformer Rectifier Unit
TSB	Terrain Server Bus
UTC	Universal Coordinated Time
VAP	Approach speed (Velocity)
VCE	VoiCE
VDR	Vhf Digital Radio
VFR	Flaps-slats Retraction speed (Velocity)
VFT	Final Take-off speed

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VGP	Vnav Glide Path
VIDL	Vor/Ils/vhf Data Link
VIDL-G	Vor/Ils Data Link/Gps
VMCA	Minimum Control speed (Velocity) in the Air
VMCG	Minimum Control speed (Velocity) on the Ground
VMCL	Minimum Control speed (Velocity) during Landing and approach
VOR	Very high frequency Omni Range
VNAV	Vertical NAVigation
VPTH	Vertical PaTH
VRF	Reference Speed (Velocity)
VMO	Maximum Operating Speed
WPT	WayPoinT
WX	Weather radar
WX/R/T	Weather radar/React/Turbulence
XPDR	ATC Transponder

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INTRODUCTION

The Navigation chapter is split in following sub-chapters:

- 34_1: FMS, GPS (including JEPPESEN charts): Flight Management System, Global Positioning System
- 34_2: HGS: Head up Guidance System,
- 34_3: SFD: Secondary Flight Display,
- 34_4: WX - LSS: Weather Radar – Lightning Sensor System,
- 34_5: EGPWS: Enhanced Ground Proximity Warning System,
- 34_6: ATC / TCAS: Air Traffic Control / Traffic Crew Alerting System,
- 34_7: ADS: Air Data System,
- 34_8: IRS, AHRS: Inertial Reference System and Attitude and Heading Reference System,
- 34_9: RA: Radar Altimeter,
- 34_10: NAVAIDS including VOR/DME, ADF, ILS.

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INTRODUCTION

The navigation function is provided by the Flight Management System (FMS) which is a multi-sensor area navigation (RNAV) system.

The Flight Management System (FMS) provides the following functions:

- Flight preparation,
- Flight navigation,
- Performance management functions.

The FMS does not include any optional equipment.

FMS and GPS system description follows the standard ATA chapter structure, except for the controls and indications part, split as:

- 34_1-20: Controls and Indications very general description,
- 34_1-21: An overview of the different interfaces used during FMS initialization and flight planning, through an example of flight plan,
- Detailed description of each window and tab used for FMS initialization and flight planning:
 - o 34_1-23: Avionics window,
 - o 34_1-24: Sensors window,
 - o 34_1-25: Flight Management Window,
 - o 34_1-27: I NAV (Interactive Navigation),
 - o 34_1-28: I NAV - Vertical Situation Display,
 - o 34_1-29: Graphical Planning.

The description of the Flight Director modes related to the FMS is included in ATA 22_1.

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FLIGHT DECK OVERVIEW

CONTROLS

Controls of the FMS and GPS include:

- The MKB (Multifunction Key Boards),
- The CCD (Cursor Control Devices),
- Pilot Side, VNAV and LNAV pushbuttons of the Guidance Panel,
- Soft keys through the different avionics and Flight Management windows and tabs,
- Two FMS pushbuttons on the Reversion Panel (RP).

➤ *Refer to ATA 22 for a description of the VNAV and LNAV pushbuttons.*

A data-loader is available for loading FMS databases.

INDICATIONS

Cockpit indications related to FMS and GPS are displayed:

- On the PDU: Flight Management Annunciation, ADI and HSI,
- On the different avionics and Flight Management windows and tabs,
- On the INAV, for navigation data display and for FMS messages,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

➤ *Refer to CODDE 2 for the list of FMS messages.*



FIGURE 02-34_1-05-00 - FLIGHT DECK OVERVIEW

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GENERAL

The FMS functions include:

- Position computation,
- Lateral navigation (LNAV),
- Vertical navigation (VNAV),
- Speed management,
- Performances prediction and computation,
- Flight plan management / edition.

There are three FMS systems that all use the following devices to compute position and performance data:

- Two GPS modules,
- Two VOR receivers,
- Two DME,
- Three IRS.

➤ Refer to ATA 34_8 for IRS description and 34_10 for VOR/DME description.

During normal operation:

- FMS1 is used for the LH PDU,
- FMS2 is used for the RH PDU.

FMS3 will be used after manual reversion.

One of the FMS is used as the reference for:

- The flight plan synchronization,
- The MDU displays,
- The data entries (either through a keyboard or graphically),
- The custom database modifications synchronisation (waypoints, flight plans, NOTAMs)

This FMS is referred to as the "Master FMS" and is selected by the PILOT SIDE pushbutton of the Guidance Panel.

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GLOBAL POSITIONING SYSTEM (GPS)

2 GPS modules are installed, one per Modular Radio Cabinet (MRC).

GPS information is provided to the crew through the SENSORS window.

GPS operation is fully automatic.

The FMS use valid GPS data to compute the FMS position.

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FLIGHT MANAGEMENT SYSTEM (FMS)

ARCHITECTURE

Each FMS contains three types of database:

- Navigation database (NAV DATABASE),
- Performance database (AIRCRAFT DATABASE),
- User database (CUSTOM DATABASE).

Each FMS uses the following hardware resources:

- Processor card for FMS functions,
- Advanced Graphics Modules (AGM) for interface to cockpit displays for the display and functional control,
- Input/Output module to interface with external systems,
- Network Interface Controller (NIC) to interface with the Avionics Standard Communications Bus (ASCB-D), which is a high integrity airplane wide bus network,
- Databases,
- Display units (PDU / MDU).

The FMS system architecture can be understood as a single integrated navigational system supported by three FMS functions operating in a synchronized or single manner.

The EASy system provides a single output to the crew for navigation and Automatic Flight Control System (AFCS) operation. FMS functions can be considered as input systems supporting a single flight plan on the flight deck. Due to removal of dedicated FMS Control Display Units, the master FMS receives pilot input through the graphical interface or a keyboard. The master FMS (FMS selected on the PF) feeds the other FMS.

Although the system is capable of operating in single mode, it operates most efficiently in synchronized mode as continual system crosschecks provide increased system accuracy.

Each pilot can directly view guidance information provided by the selected FMS.

The master FMS for entry of all data is the PF FMS (as determined by the PILOT SIDE pushbutton on the guidance panel). When operating in synchronized mode, data entered either through a keyboard or graphically is distributed to other FMS functions.

While the active flight plan operates on the EASy flight deck, either crewmember can plan a secondary flight plan. Activation of a secondary flight plan is made graphically.

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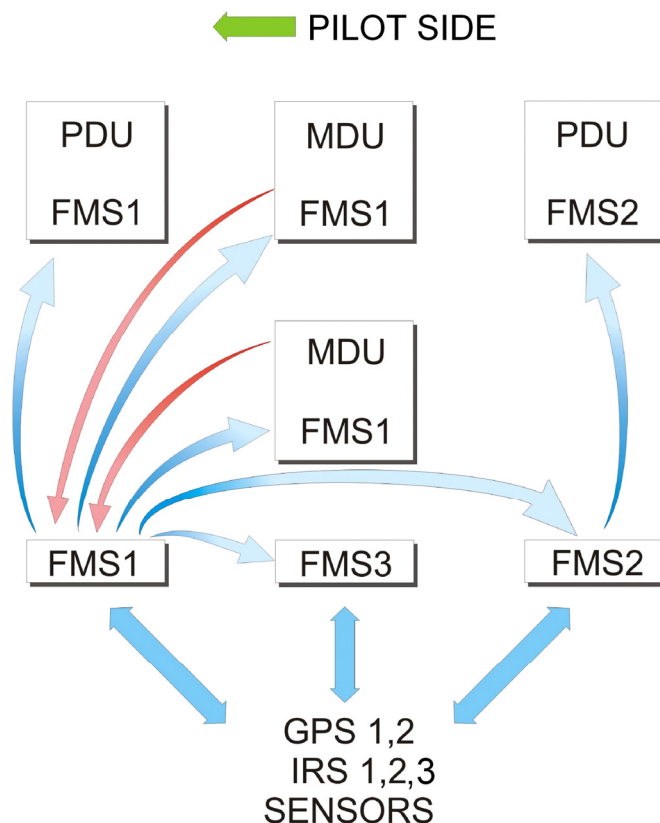


FIGURE 02-34_1-10-00 - FMS SYSTEM ARCHITECTURE

In this example, the PILOT SIDE pushbutton is on the left side which implies that FMS 1 is the master FMS.

As FMS 1 is the master FMS:

- The pilots entries from the upper and lower MDU (red arrows) are directed to FMS 1
- FMS 1 feeds FMS 2, FMS 3, left PDU and both MDU (blue arrows)
- FMS 2 feeds right PDU (blue arrow)

The 3 FMS interact with GPS, IRS and the sensors (blue double-arrows) no matter which FMS is the master FMS.

Reversions to other FMS are possible via the FMS reversion pushbuttons on the Reversion Panel (RP).

Integrated Navigation Map (I-NAV) information presented on the MDU is from the PF FMS.

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POSITION COMPUTATION

The FMS determines the best reference position update source (e.g. blended GPS position, DME-DME radio position, VOR-DME radio position or blended IRS position) to use for computing the airplane position. The current FMS mode is displayed in the SENSORS window.

The FMS uses a position and velocity filter. If no reference position source is available, the FMS uses a Dead Reckoning (DR) mode of navigation. In DR mode, a "NO POSITION SENSOR" FMS message is triggered and display in the FMS message box on the MDU (I-NAV window). A "MSG" label is also displayed in each HSI indicating a new FMS message.

HIGH LATITUDE NAVIGATION

The "high latitude area" is defined as being north of 72° 30' N or south of 59° 30' S when entering and below 72° N or above 59° S when leaving the area.

The FMS automatically switches from m to true heading when entering one of the high latitude areas. HSI heading is switched to true and an FMS message "ACTIVE MODE IS TRUE HDG" is displayed. This switch is necessary because the FMS calculates magnetic heading by using true heading and adding or subtracting the magnetic variation. Magnetic variation up to 73° N or 60° S is stored in the FMS. Above 73° N latitude and below 60° S latitude, magnetic heading cannot be calculated by the FMS.

Upon leaving a high latitude area provided MAG remains the selected mode, the FMS and HSI automatically switch back to magnetic heading. The FMS message "ACTIVE MODE IS MAG HDG" is displayed when the switch occurs.

POLAR NAVIGATION

CAUTION

This function is not certified on the basic airplane.

The "polar area" is defined as being above 85° N or below 85° S when entering the area, and below 84° N or above 84° S when leaving.

ANNUNCIATIONS

FMS annunciations will appear on the PDU and MDU when certain conditions exist.

PDU annunciations appear as 2 – 4 letters. Examples include:

- Approach mode (APP),
- Terminal mode (TERM),
- Degraded mode (DGR),
- Dead reckoning mode (DR).

MDU annunciations appear in an FMS message field that pops up in the upper portion of the I-NAV map (if selected).

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MDU message reports include:

- Unable Required Navigation Performance (RNP) condition,
- Position input differs from the FMS position by a pre-determined distance,
- FMS operational messages.

The FMS supports RNP operations down to RNP 0.3. It provides:

- Current default RNP with a manual override capability,
- Estimated Position Uncertainty (EPU) values,
- RNP capability in terms of navigation accuracy and integrity.

NOTE

Refer to CODDE 2 for the list of FMS messages.

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DESIGN PRINCIPLE

The FMS and GPS system was designed considering the following design principles:

- The FMS system is an integrated multi sensor navigation system designed to provide a world wide premium precision navigation capabilities in all phases of flight, thanks to an optimum position computation using all available sensors (GPS, IRS, Radio), and taking advantage of GPS precision positioning.
- Available feature include:
 - o Vertical and lateral precision navigation, with RNP capability down to 0.3 NM,
 - o Departure and approach procedures (extracted from a database),
 - o Non-precision and precision approaches (HUD optional),
 - o Flight planning: primary, alternate and pending flight plan for an active and a secondary flight plan,
 - o Speed management,
 - o Advisory performance predictions,
 - o Advisory Take-Off and landing data computations (not yet available at present time).
- Provisions exist to gain access to future air traffic management requirements.

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LOCATION OF EQUIPMENT

FMS modules are located in MAU channels:

- FMS1: within MAU 1A in PROC 5,
- FMS2: within MAU 2A in PROC 6,
- FMS3: within MAU 1B in NIC / PROC 2.

Data bases modules are located:

- Database 1: within MAU 1B,
- Database 2: within MAU 2B.

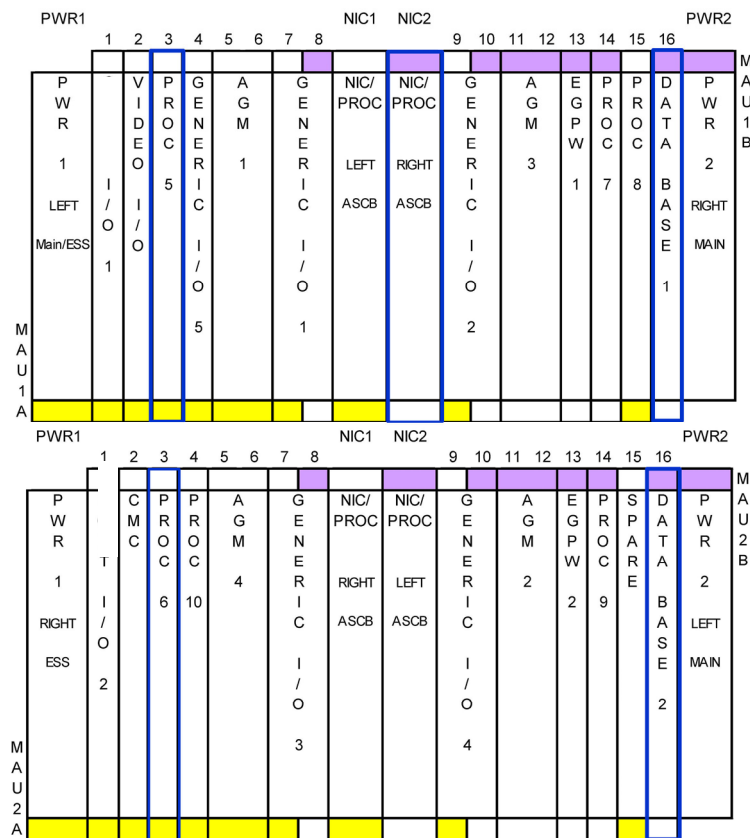


FIGURE 02-34_1-15-00 – LOCATION OF FMS PICTURE

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GPS modules are located in Modular Radio Cabinet (MRC):

- GPS 1: within MRC 1,
- GPS 2: within MRC 2.

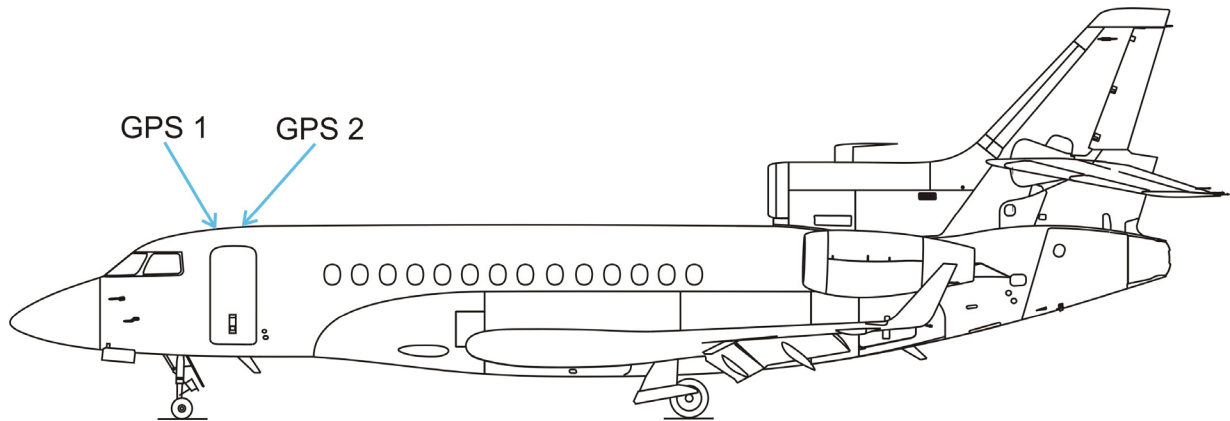


FIGURE 02-34_1-15-01 – GPS ANTENNA LOCATION

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ELECTRICAL POWER SOURCE

Following paragraph describes the power supply of the different equipment of the FMS and GPS systems.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC) ,
- Circuit Breakers (CB).

➤ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
MAU 1A	LH Essential (and LH Main when LH Essential is lost)	LH INIT	CB
MAU 1B	RH Main	RH MASTER	CB
MAU 2A	RH Essential	RH INIT	CB
MAU 2B	LH MAIN	LH MASTER	CB
GPS 1	LH Essential	LH MASTER	CB
GPS 2	RH Main	RH MASTER	CB

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CONTROLS

Controls of the FMS and GPS include:

- The MKB (Multifunction Key Boards),
- The CCD (Cursor Control Devices),
- Pilot Side, VNAV and LNAV pushbuttons of the Guidance Panel,
- Soft keys through the different avionics and Flight Management Windows and tabs,
- Two "FMS" pushbuttons on the Reversion Panel (RP).

➤ Refer to ATA 31_2 for MKB description and CCD description and, ATA22_2 for guidance panel description.

FMS REVERSION PANEL

The Reversion Panel Control allows to revert FMS 1, 2 and 3 (in case of abnormal FMS X behavior for example)

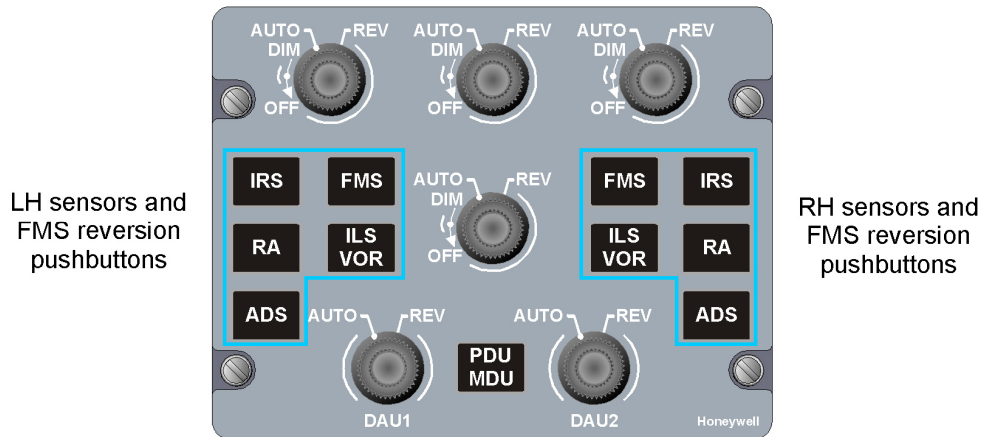


FIGURE 02-34_1-20-00 - REVERSION PANEL

The sequencing when using the FMS reversion button:

- At first push on the FMS reversion pushbutton, the FMS 3 indication only appears on the concerned pilot side, colored according to the status of the target,

NOTE

If the reversion is made on the PILOT SIDE station, the FMS source displayed in the I-NAV is also FMS3 (as the I-NAV uses the same sources than the PF).

- After the second push, all FMS navigation sources indications (in both HSI and in I-NAV) are boxed in amber,
- After the third push, the system recovers a normal configuration.

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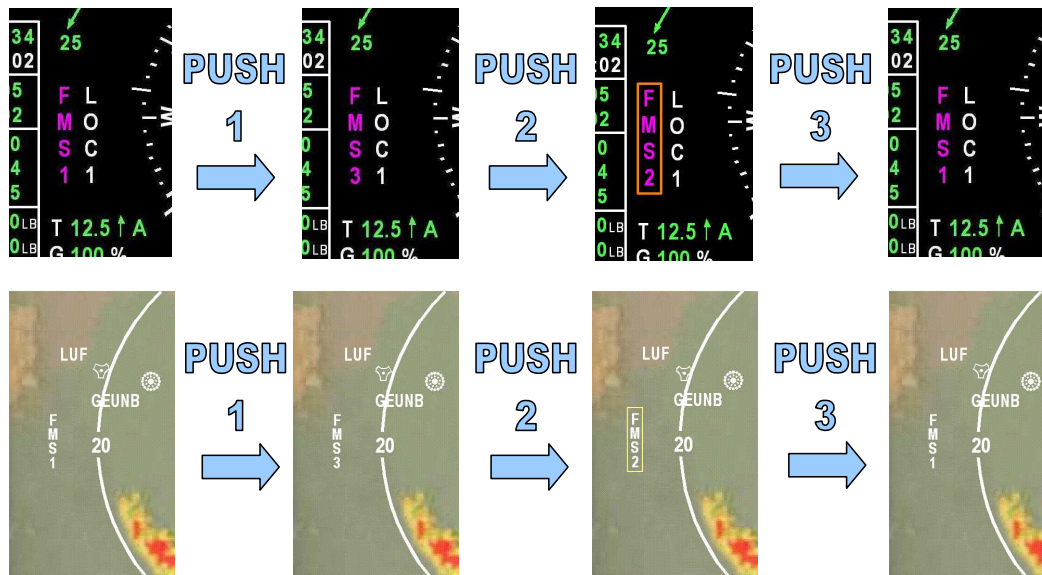


FIGURE 02-34_1-20-01 - FMS REVERSION FROM THE LEFT SIDE (PILOT FLYING SIDE)

NOTE

As the I-NAV uses the sensor of the PILOT SIDE station, a reversion on the same sensor for each pilot station implies all systems in the airplane use the same sensor.

SOFT KEYS

Most soft keys available in avionics and Flight Management Windows are briefly described in the following chapter.

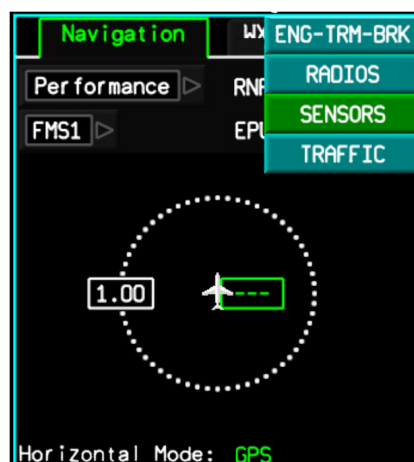


FIGURE 02-34_1-20-02 - SENSORS WINDOW SELECTION

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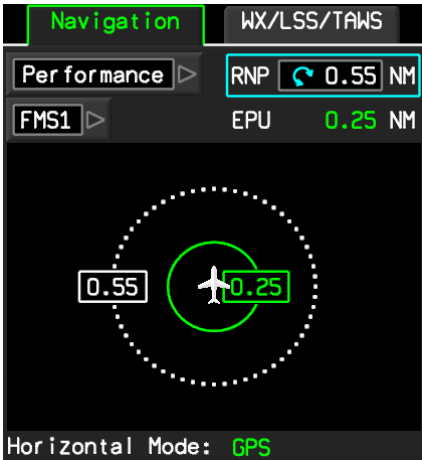


FIGURE 02-34_1-20-03 - PERFORMANCE SELECTION

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INDICATIONS

Cockpit indications related to FMS and GPS are displayed:

- On the PDU FMA, ADI and HSI,
- On the different avionics and Flight Management windows and tabs,
- On the INAV, for navigation data display and for FMS messages,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

➤ Refer to CODDE 2 for the FMS messages list

PDU



FIGURE 02-34_1-20-04 - PRIMARY DISPLAY UNIT

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INAV

INAV window is presented in:

- 34_1-27: I NAV (Interactive Navigation),
- 34_1-28: I NAV - Vertical Situation Display.

AVIONICS AND FLIGHT MANAGEMENT WINDOWS AND TABS

Most windows and tabs are presented in next chapter.

SENSORS

SENSORS window provides access to FMS navigation function:

It can be displayed (using MENU on CCD) in the lower 1/6 of both PDU.

➤ Refer to 02-34-24 for detailed description of the sensors page.



FIGURE 02-34_1-20-05 - SENSORS WINDOW SELECTION

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INTRODUCTION

The purpose of this section is to describe:

- The FMS initialization,
- The steps of flight plan insertion from airplane power up through engine start, in chronological order,
- Other FMS controls and indications, not used directly during flight plan initialization or insertion.

In this chapter, the windows and tabs are described from a general point of view. Refer to following sections 02-34_1-22 to 02-34_1-29 for detailed descriptions.

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TYPICAL PDU / MDU CONFIGURATION

AT AIRCRAFT POWER UP

With the batteries and LH INIT and RH INIT pushbuttons on, the typical PDU / MDU configuration is:



FIGURE 02-34_1-21-00 - TYPICAL TWO DISPLAYS CONFIGURATION

From this point, the description in this chapter is based on these given conditions:

- APU is running and APU air and generator are being utilized,
- A new FPLN (KTEB-KCMH) is being created (this FPLN has not been stored previously),
- IRU alignment is being performed using GPS position,
- ATIS is known,
- Enroute winds are known,
- The new FPLN will be saved.

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APU RUNNING

Isolation bus ties are closed.

Select LH MASTER and RH MASTER pushbuttons on the Guidance Panel.

PDU / MDU configuration switches to four displays. Recommended windows organization is as follows:



FIGURE 02-34_1-21-01 - TYPICAL FOUR DISPLAY CONFIGURATION

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FMS INITIALIZATION DESCRIPTION

Only one of the FMS needs to be initialized. All three FMS will be automatically synchronized

In order to initialize the FMS:

- In the lower MDU, press MENU on CCD and select **AVIONICS**,
- Select **Init** tab.

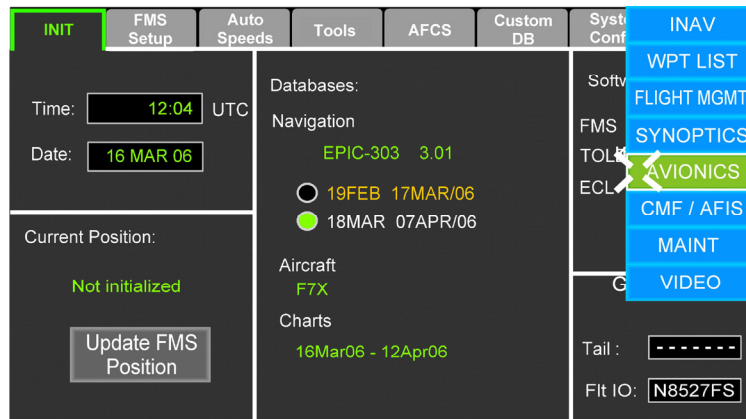


FIGURE 02-34_1-21-02 - AVIONICS PAGE

The **Init** tab provides data relevant to the airplane, FMS software, and database configuration and validity.

Verify the validity of these data.

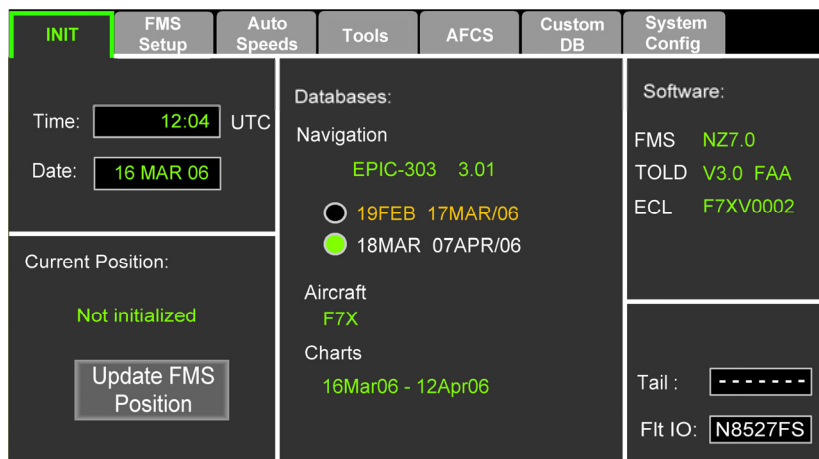


FIGURE 02-34_1-21-03 - AVIONICS WINDOW INIT TAB

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The **Init** tab also provides the "Current Position" of the master FMS. This position needs to be initialized.

In order to initialize the FMS "Current Position", click on the **Update FMS Position** soft key. A dialog box appears:

FIGURE 02-34_1-21-04 - UPDATE FMS POSITION DIALOG BOX

The dialog box displays a column of radio buttons with a corresponding available geographic position, for:

- The different GPS and IRS sensors,
- Manually entered point, and closest airport from that point.

The sensors and/or positions selected in the column of radio buttons prior to selecting "Apply" will be used for updating the FMS position.

IRS and FMS alignment is normally performed on a GPS position.

Select the radio button of choice, click on the **Apply** soft key. This initializes the FMS "Current Position" to the position selected.

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Now select **FMS Setup** tab:

INIT	FMS Setup	Auto Speeds	Tools	AFCS	Custom DB	System Config
SmartPerf Learning: <input checked="" type="radio"/> Off <input type="radio"/> On SmartPerf Mod: <input checked="" type="radio"/> Full Perf <input type="radio"/> Pilot Spd/FF <input type="radio"/> Current GS/FF		Flight Summary Output: <input type="checkbox"/> Disk <input type="checkbox"/> Printer		RNP Settings: Departure <input type="text" value="1.00"/> NM Enroute <input type="text" value="2.00"/> NM Remote <input type="text" value="10.0"/> NM Arrival <input type="text" value="1.00"/> NM Approach <input type="text" value="0.30"/> NM Missed-App <input type="text" value="1.00"/> NM		
		To Fuel: <input type="text" value="300"/> Lb LDG Fuel: <input type="text" value="200"/> Lb				

FIGURE 02-34_1-21-05 - FMS SETUP TAB

The **FMS Setup** tab allows the selection of:

- The type of data and algorithm that will be used by the FMS for performance calculation,
- The type of media used for flight summary data output,
- The estimated Fuel quantities allowances on ground, and to be used by the FMS,
- The RNP Settings.

SmartPerf Learning is selected Off for this example. **SmartPerf Mode** is defaulted to Full Perf. These are normal flight selections.

Let **Flight Summary Output** unchecked (default).

For **T/O Fuel** and **LDG Fuel**, fill in an estimated take-off fuel and landing fuel quantity allowance (for performance computation). Estimates can be found in CODDE 3, QRH 1. For this example, input “300” and “200”.

RNP Settings are already filled in based on certification values. Usually there is nothing to change here. Leave the default settings for this example. (To obtain database defaults, highlight the box, press CLR DEL on the MKB. The database default will appear in the box)

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Select the Auto Speeds tab.

FIGURE 02-34_1-21-06 - AUTO SET UP TAB

The Auto Speeds:

- Depicts the indicated speed schedule used by the FMS for each Phase Of Flight (POF: departure, climb, descent, approach and go-around). In cruise the FMS uses the speed inserted in Flight Management Window (FMW), Preflight POF, Alt/Spd tab.
- Allows to define the envelope of departure and approach POF where speeds are applied.

Climb and Descent (default values) are selected for this example,


Select a Dist to Dest (15 Nm for example)

Enter Clean, SF1 and SF2 speeds (respectively 190, 173 and 163 Kt for this example).

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TYPICAL FLIGHT PLAN INSERTION

The purpose of this section is to focus on a typical flight plan insertion and to chronologically describe the steps of a flight plan insertion via an example.

With the cursor in the AVIONICS window, Press  on the CCD and click on **FLIGHT MGMT**:

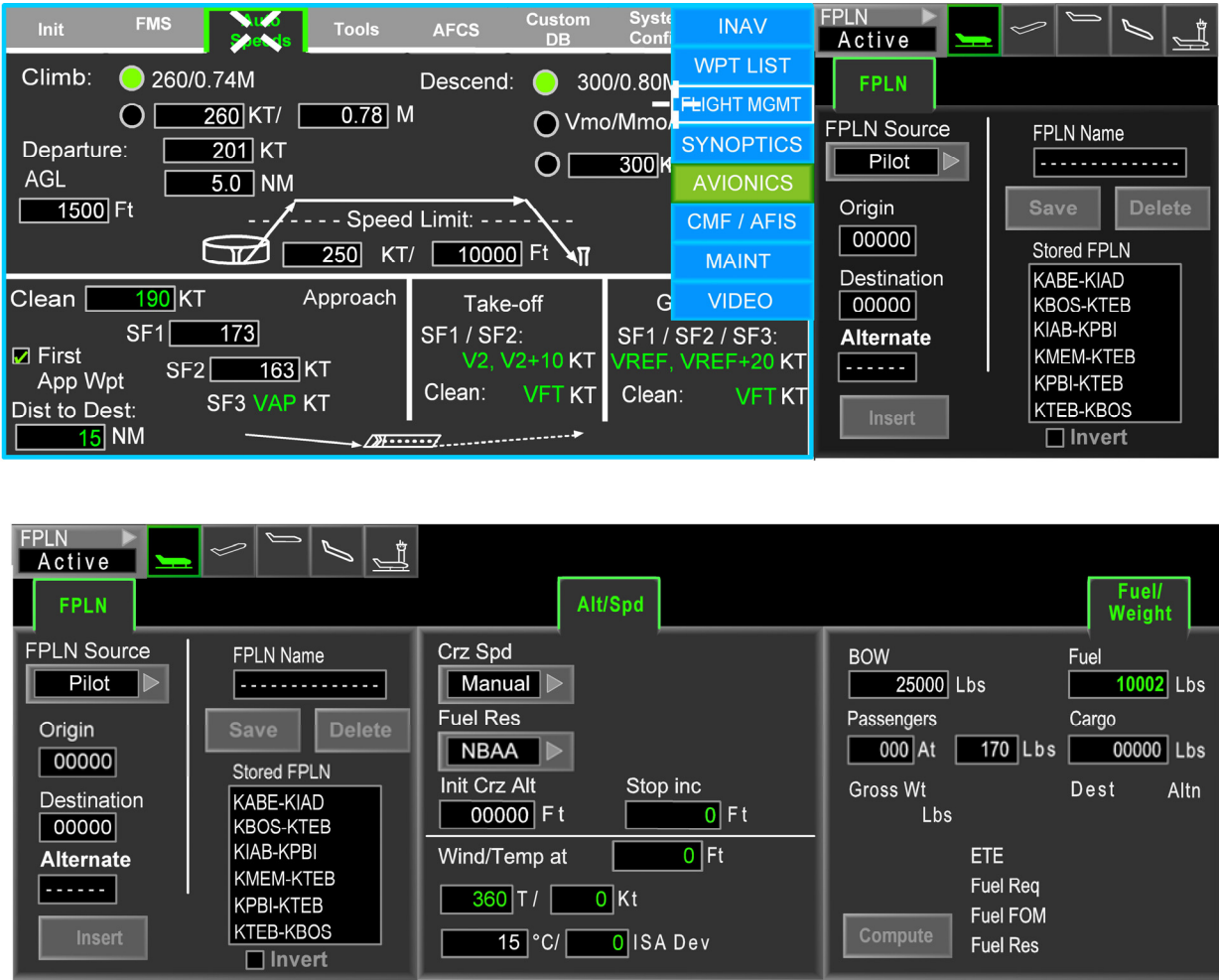


FIGURE 02-34_1-21-07 - FMS SPEEDS TAB CHANGE TO FMW

This extends the 1/6 Flight Management Window to a 1/2 window while replacing the Avionics window. The Pre-flight Phase Of Flight tab is the default display.

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NOTE

As an aid for data insertion, the cursor normally moves to the next entry box whenever data is “clicked” into place. Therefore, automatic cursor movements are assumed (and not mentioned) unless additional clarity is required.

For this example, a flight plan from Teterboro, NJ (KTEB) to Columbus, OH (KCMH) is being entered. The alternate is Cincinnati, OH (KCVG). Route details are supplied as needed.

The Pre-flight POF allows to:

Initialize the system

Activate the flight plan

Initialize performance data

Enter data in the **FPLN** tab as follows:

The screenshot shows the 'FPLN' tab selected. The interface includes several sections:

- FPLN Source:** A dropdown menu set to 'Pilot'.
- Origin:** A text box containing 'KTEB'.
- Destination:** A text box containing 'KCMH'.
- Alternate:** A text box containing 'KCVG'.
- Insert:** A blue button with a white plus sign.
- FPLN Name:** A text box containing 'KTEB-KCMH'.
- Save/Delete:** Two buttons.
- Stored FPLN:** A list of stored flight plans: KABE-KIAD, KBOS-KTEB, KIAB-KPBI, KMEM-KTEB, KPBI-KTEB, KTEB-KBOS.
- Invert:** A checkbox.
- Crz Spd:** A dropdown menu set to 'Manual'.
- Fuel Res:** A dropdown menu set to 'NBAA'.
- Init Crz Alt:** A text box containing '00000'.
- Stop inc:** A text box containing '0'.
- Wind/Temp at:** A text box containing '0'.
- ETE:** A text box containing '360'.
- Fuel Req:** A text box containing '0'.
- Fuel FOM:** A text box containing '15'.
- Fuel Res:** A text box containing '0'.
- BOW:** A text box containing '25000'.
- Fuel:** A text box containing '10002'.
- Passengers:** A text box containing '000'.
- Cargo:** A text box containing '170'.
- Gross Wt:** A text box containing '00000'.
- Dest:** A text box containing 'KCMH'.
- Altn:** A text box containing 'KCVG'.
- Compute:** A button.

FIGURE 02-34_1-21-08 - FLIGHT MGMT WINDOW

Pilot is the default FPLN Source and use it for this example.

To create a new flight plan, move the cursor to FPLN Name and enter origin and destination (separated by “-“ as shown) using the MKB. A stored FPLN could be selected, but for training purposes we are creating a new one. Press <ENTER> and the cursor moves to **Origin**. Notice that both **Origin** and **Destination** were filled in and **Insert** was illuminated by the system. From here, the cursor steps through each next step when the CCD is clicked (or <ENTER> pressed).

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NOTE

During this process, if the I-NAV map is displayed with a sufficiently large scale, the origin, destination and alternate appear in cyan as waypoints (stars). Each successive waypoint appears as they are clicked, with a cyan line from the previous waypoint.



FIGURE 02-34_1-21-10 - FPLN ENTRY IN WPT LISTUPDATE WITH FJC SELECTION

For this example, type in “FJC” on the MKB, then <ENTER>. After entering “FJC”, a secondary **Select Object** page appears with a choice of FJC in either “USA” or “CHINA”. The cursor is located in the top box (USA). Click (using the CCD) on the 1st choice (USA). That waypoint’s information is moved to the selection box with white letters and a white border. The cursor moves to the **Insert** softkey (in the lower right corner). Click **Insert** to enter the waypoint and return to the WPT LIST.

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FIGURE 02-34_1-21-11 - FPLN ENTRY SELECT OBJECT

NOTE

When entering waypoints in the WPT LIST, and multiple choices of any waypoint are available, a cyan box appears around the closest choice in the **Select Object** page.

All waypoints with the same ID are listed in order of distance from the previous waypoint (closest at the top), with a country indication next to the waypoint name.

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Type in and insert the next f legs in a similar manner (FJC, ETX, J60, DRAPE)

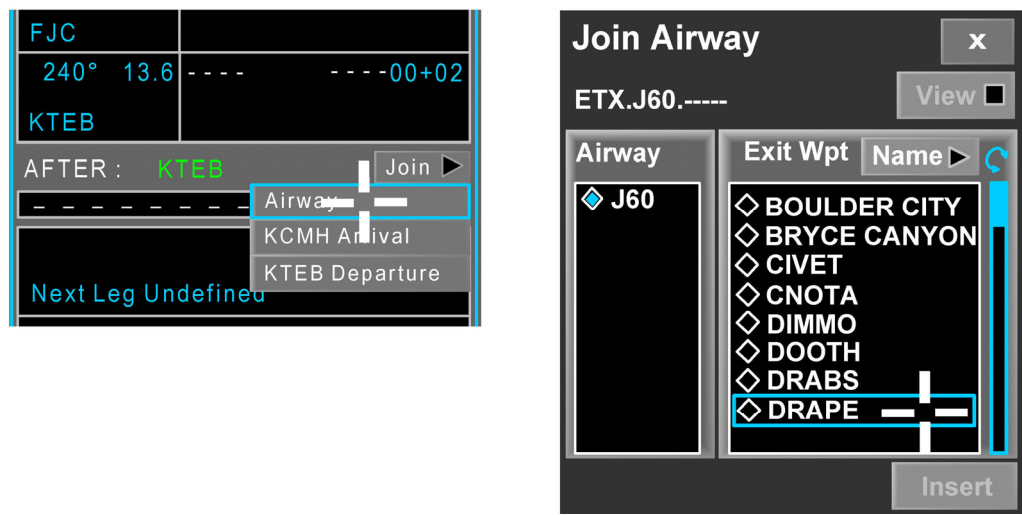


FIGURE 02-34_1-21-12 - FPLN ENTRY JOIN

When a waypoint defines the entry point onto an airway, select the **Join** menu. This opens a **Join Airway** page for airway (J60) and exit waypoint (DRAPE) selection.

NOTE

Scrolling (using the CCD Data Set Knob) is required to view portions of the **Exit Wpt** list when it exceeds the window size).

After inserting DRAPE, complete FPLN with VINSE J80 AIR KCMH). “AIR” shows as “BELLAIRE” in the **Join Airway** list. Select BELLAIRE, then click **Insert**.

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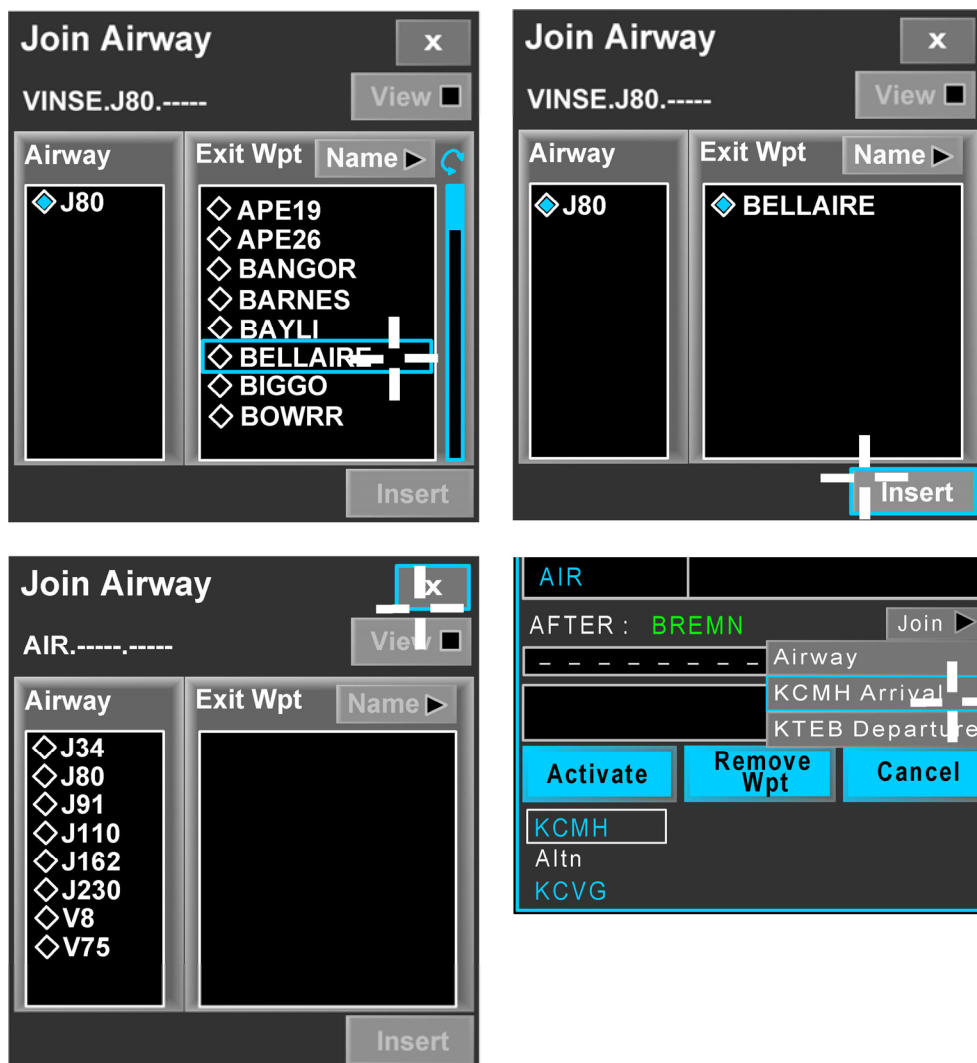


FIGURE 02-34_1-21-13 - FPLN ENTRY JOIN AIRWAY

After inserting BELLAIRE, FPLN entry is complete except for the SID, STAR and Approach. The STAR will be entered next, the SID and Approach will be entered later.

To enter the STAR, first click on the "X" in the upper right of the **Join Airway** page that appeared when BELLAIRE was inserted. An underlying **After** page appears. Click on **Join** for drop down choices.

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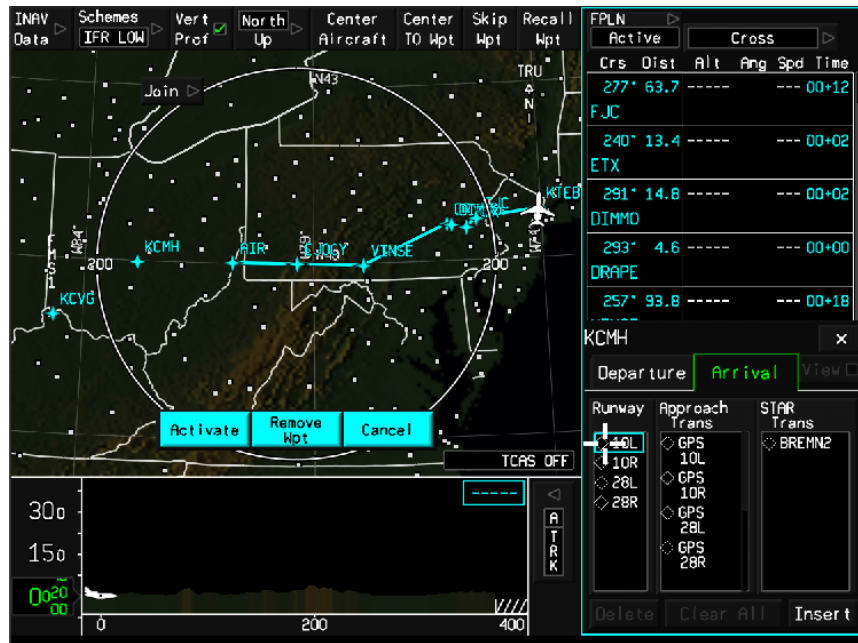


FIGURE 02-34_1-21-14 - FPLN ENTRY ARRIVAL

Select **KCMH Arrival**. Skip boxes for runway and approach choices and select “BREMN2” with the “ATR” transition, then **Insert**.

Scroll the WPT List down to view BREMN. Move the cursor to BREMN and click which brings a drop down menu.

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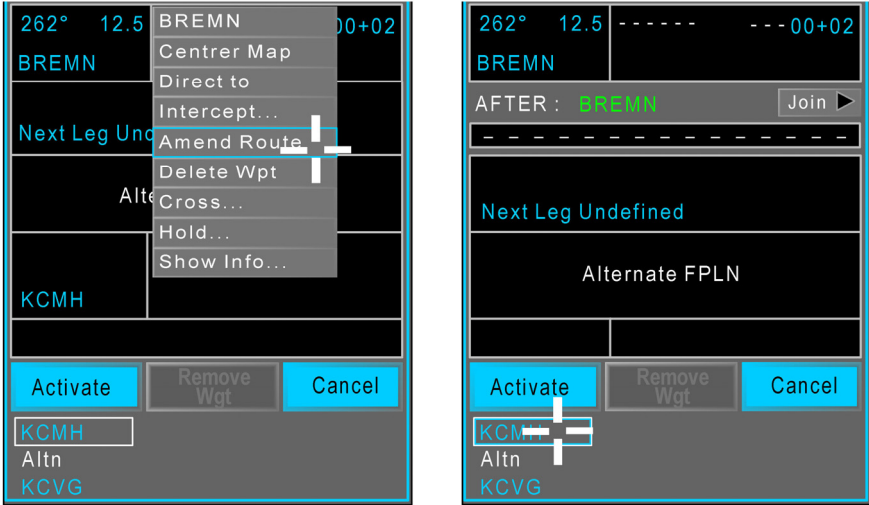


FIGURE 02-34_1-21-15 - FPLN ENTRY DESTINATION

Select **Amend Route**, which brings in the **Join** page again. Move cursor to highlight the **Dest** box (lower left of WPT LIST) and click. Destination (KCMH) is added to the list and the cursor moves to the **Activate** softkey.

Before activating, double-check for accuracy of all FPLN entries.

NOTE

Once the FPLN is activated, cyan waypoints and routes turn white.

Clarity and detail decrease as the I-NAV map scale increases.



FIGURE 02-34_1-21-16 - COMPLETE FPLN IN WPT LIST

Check the FPLN route for accuracy, discontinuities and that Destination is the last waypoint. This example requires the scroll feature to view the entire WPT LIST. Check the WPT LIST and I-NAV map to insure all legs are correct. Use a combination of scale adjustment and **Skip Wpt** / **Recall Wpt** to view the FPLN on the I-NAV map. If correct, then click **Activate** to confirm.

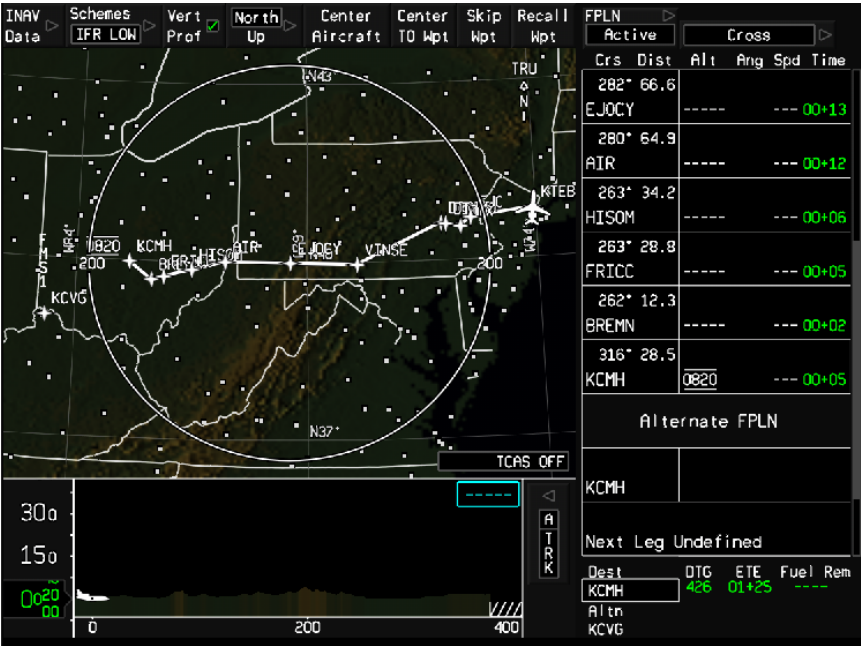


FIGURE 02-34_1-21-17 - COMPLETE FPLN IN I-NAV

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NOTE

If an incorrect waypoint has been found in the FPLN, click on the waypoint in question in either the I-NAV map or the WPT LIST. A dropdown menu appears. Select **Delete Wpt** and click.

The cursor moves to the **Activate** softkey. A cyan line is drawn on the I-NAV map to display the pending change. If correct, click **Activate** to complete the delete process.

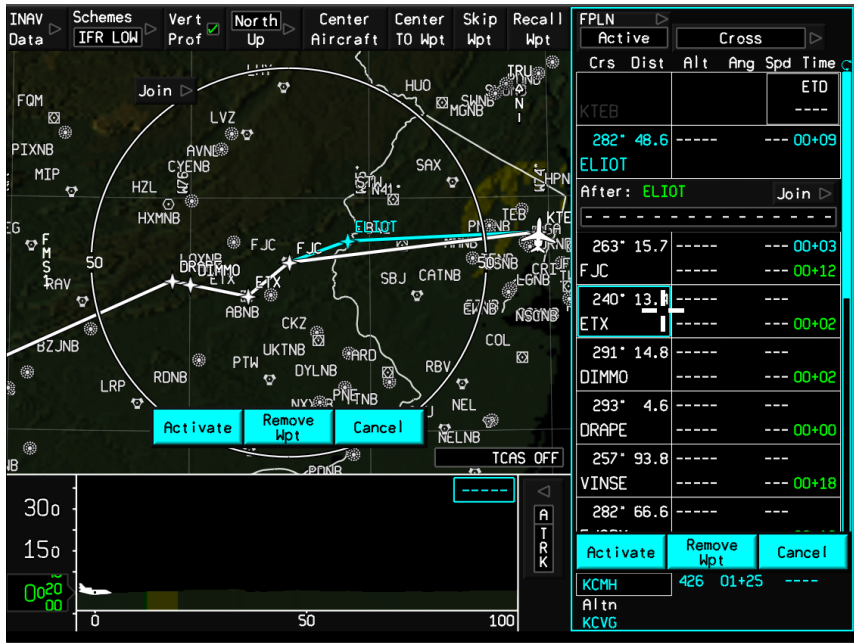


FIGURE 02-34_1-21-18 - I-NAV AND WPT LIST WINDOW CHANGE SEQUENCE

A change in FPLN was just received and must be inserted. The FPLN now reads ELIOT J60 DRAPE VINSE J80 AIR. A leg from ELIOT to ETX must be added and one from FJC to ETX must be deleted. To accomplish this, click on KTEB and place ELIOT in the **After** page. After entering, click **Join** in the ensuing page. Select J80 and DRAPE as appropriate. Once **Insert** is clicked, the new route is inserted and FJC is deleted. If everything is correct, click **Activate** to confirm.

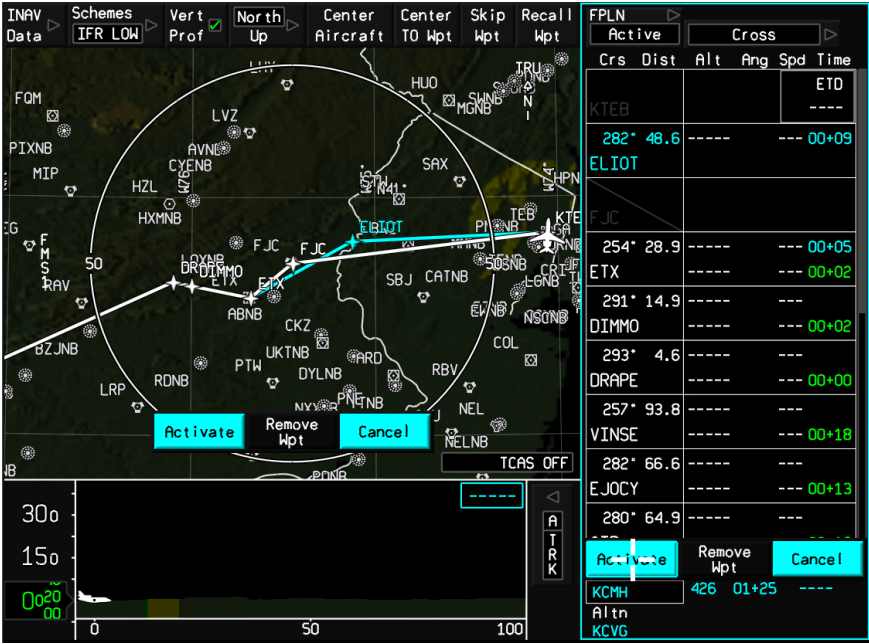


FIGURE 02-34_1-21-19 - SEQUENCE TO CHANGE LEGS IN FPLN

NOTE

Additional methods of changing flight plans and removing waypoints are discussed in other chapters.

Clicking **Activate** accepts the flight plan into memory and moves the cursor to the lower MDU, into the Flight Management Window (**Alt/Spd** tab, "Crz Spd" pull down menu):

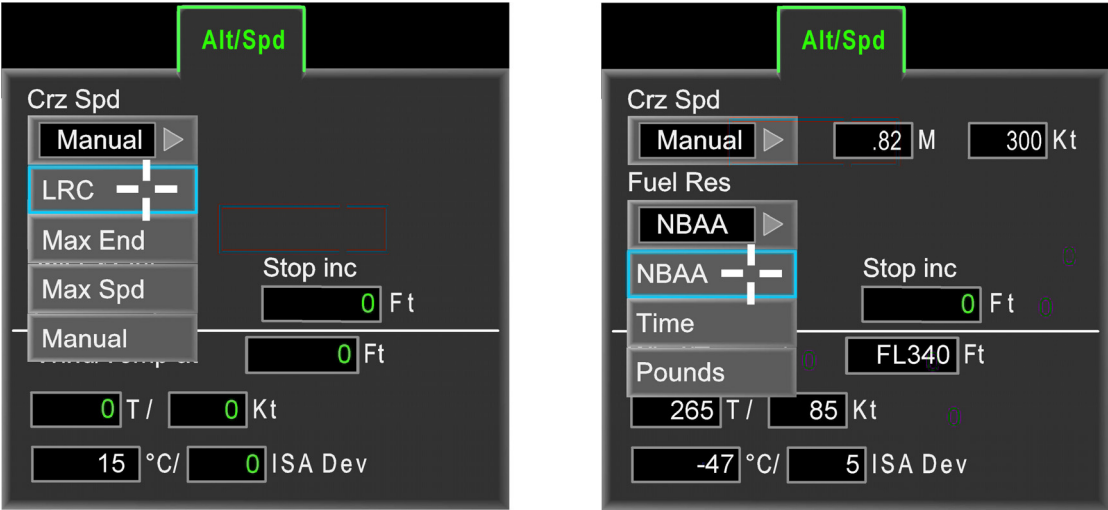


FIGURE 02-34_1-15-20 - ALT / SPD TAB

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Navigating through the **Alt/Spd** tab is aided by an automatic cursor movement to the next box as it did in the **FPLN** tab.

For this example, click “Manual” and insert “.82” and “300” in the M and Kt boxes.

Click **Fuel Res** to drop down another menu:

Click “NBAA” for this example.

Continue inserting data on this tab with the following given conditions:

- Initial cruise altitude: FL340
- Step increase: 0 feet
- Wind/Temperature at:
 - o FL340
 - o 265 T / 85 Kt
 - o -47°C / + 5 ISA Deviation (input either temperature or ISA Deviation and the other will be calculated)

The cursor moves to the **FUEL / Weight** tab when this data input is complete.

The screenshot displays the 'FUEL / WEIGHT' tab of the FMS interface. The top navigation bar shows 'FPLN' as the active tab, with 'FUEL / Weight' highlighted in green. The interface is divided into several sections:

- FPLN Source:** Includes fields for 'Pilot' (set to Pilot), 'Origin' (00000), 'Destination' (00000), and 'Alternate' (-----). An 'Insert' button is at the bottom.
- FPLN Name:** Shows 'KTEB-KCMH' with 'Save' and 'Delete' buttons. Below is a list of 'Stored FPLN' options: KABE-KIAD, KBOS-KTEB, KIAB-KPBI, KMEM-KTEB, KPBI-KTEB, and KTEB-KBOS. An 'Invert' checkbox is at the bottom.
- Crz Spd:** Features a 'Manual' dropdown, input fields for '.82' M and '300' Kt, and a 'Fuel Res' dropdown set to 'NBAA'.
- Init Crz Alt:** Input field set to 'FL340' Ft, with a 'Stop inc' field set to '0' Ft.
- Wind/Temp at:** Input fields for 'FL340' Ft, '265' T, '85' Kt, '-47' °C, and '5' ISA Dev.
- BOW:** Input field set to '25000' Lbs.
- Fuel:** Input field set to '10002' Lbs.
- Passengers:** Input fields for '1' At and '190' Lbs.
- Cargo:** Input field set to '50' Lbs.
- Gross Wt:** Calculated value of '35242' Lbs.
- Dest:** 'KCMH'.
- Altn:** 'KCVG'.
- ETE:** '01+25'.
- Fuel Req:** '00+00'.
- Fuel FOM:** (blank).
- Fuel Res:** (blank).

A blue 'Compute' button is located at the bottom center of the interface.

FIGURE 02-34_1-21-21 - FUEL / WEIGHT TAB

In the **Fuel/Weight** tab, complete all boxes (BOW, Fuel, etc.) with the following data:

- BOW – 25000 Lbs
- Fuel – 10002 Lbs (Use CLR DEL key on MKB to set box to actual fuel quantity)
- Passengers – 1 At 190 Lbs
- Cargo – 50 Lbs

When all required inputs are satisfied, the **Compute** button illuminates. Click **Compute**. The system re-computes **ETE** and computes **Fuel Req**, **Fuel FOM** and **Fuel Res**. The computed results are displayed both here and on the WPT LIST:

Fuel/
Weight

BOW	Fuel
<input type="text" value="25000"/> Lbs	<input style="color: green;" type="text" value="10002"/> Lbs
Passengers	Cargo
<input type="text" value="1"/> At <input type="text" value="190"/> Lbs	<input type="text" value="50"/> Lbs
Gross Wt	Dest Altn
35242 Lbs	KCMH KCVG
	ETE 01+25 00+00
	Fuel Req 5.2
	Fuel FOM .1
	Fuel Res 1.8
<input type="button" value="Compute"/>	

262° 12.3	
BREMN	----- --- 00+02
316° 28.5	
KCMH	<u>0820</u> --- 00+05
Alternate FPLN	
KCMH	
Dest	DTG ETE Fuel Rem
<input type="text" value="KCMH"/>	462 01+25 4.8
Altn	
KCVG	

FIGURE 02-34_1-21-22 - FUEL / WEIGHT TAB AND WPT LIST ESTIMATION DATA

NOTE

At power up, the green value in the **Fuel** box is the total fuel quantity as indicated by the fuel gauges. It must be updated for correct computations during pre-flight if refuelling is done after power up.

Fuel quantity (indicated in the **Fuel** box) is automatically synchronized with the fuel gauges during the first engine start (initial fuel flow detection) and during the last engine shut-down (cessation of fuel flow).

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Flight setting is organized into five Phases Of Flight (POF) displayed in the Flight Management Window (FMW):

- Pre-flight
- Departure
- Cruise
- Arrival
- Post-flight.

Now select the departure POF on the FMW.

Departure POF provides:

- SID data in order to retrieve and activate the departure procedure,
- Take-off Configuration data in order to initialize the Take-Off and Landing Data (TOLD),
- Display of advisory TOLD (if installed).

The screenshot displays the Departure POF FMW interface with three main tabs: **SID**, **Takeoff Config**, and **Takeoff Data**.

SID Tab: Shows fields for Orig (Runway / SID), Rwy (000), Hdg (000°), Elev (16 Ft), Loc (00000 Ft), Trk (00000 Ft), Disp Thr (100 Ft), Slope (0.0%), TOSA (420 Ft), and Trans Alt (18000 Ft).

Takeoff Config Tab: Shows Surface Wind (000° / 000 Kt), Baro Set (29.92), Press Alt (16 Ft), OAT (+15 °C / +59 °F), and Manual Vspeed Active.

Takeoff Data Tab: Shows T/O Wt (Lbs), Vspd (Kt), and Wind (Pitch Att 10.1°). The Vspd table lists: V1 (114), VR (126), V2 (126), VFR (158), VFT (171), and VREF (130).

FIGURE 02-34_1-21-23 - DEPARTURE POF FMW

In the **SID** tab, click on **Runway/SID** to drop down the procedure dialog box. Select Departure Runway (01), then SID Transition (TETRO5):

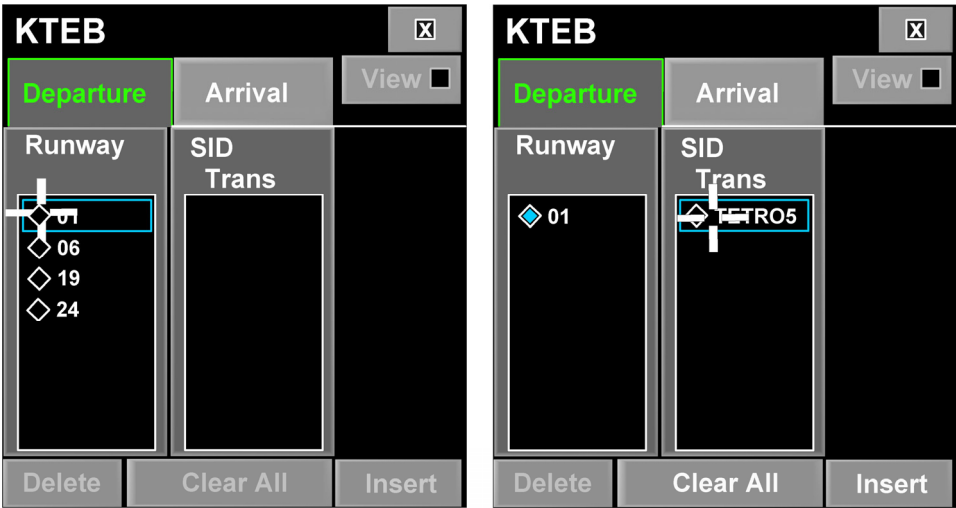


FIGURE 02-34_1-21-24 - SID TAB PROCEDURE DIALOG BOX

NOTE

Select the **View** check box to check departure route before insertion.

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Click **Insert**:

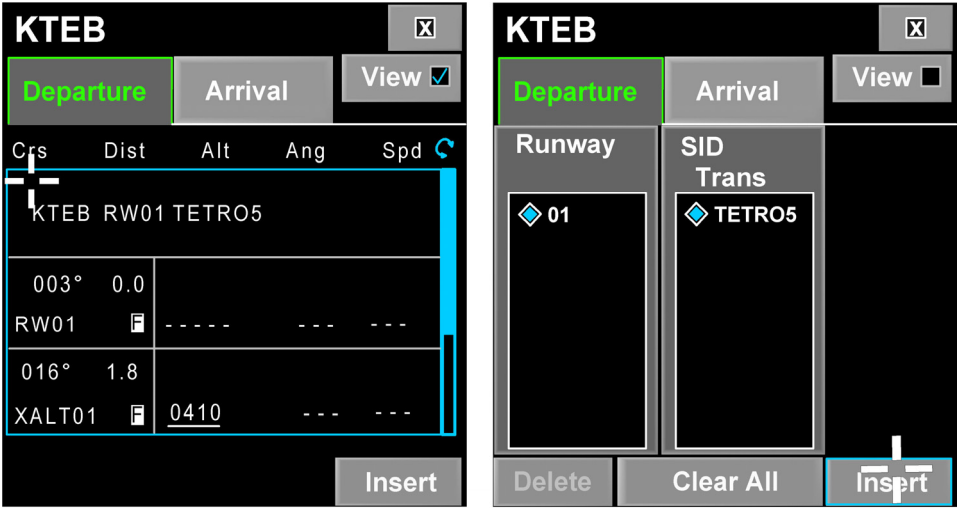


FIGURE 02-34_1-21-25 - SID TAB PROCEDURE DIALOG BOX INSERT

The cursor moves to the WPT LIST on the **Activate** softkey.

In this example, cancel the discontinuity, if one exists, by clicking on the **Discontinuity** box. A dropdown menu appears. Click “Delete Wpt” which removes the discontinuity, then confirm by clicking **Activate** :



FIGURE 02-34_1-21-26 - I-NAV AND WAYPOINT LIST WINDOW WITH DISCONTINUITY

NOTE

It is not always acceptable to delete a discontinuity. A discontinuity is frequently used to serve as a “break” in the flight plan to allow for ATC instructions to the next fix (i.e. radar vectors, etc.). It is up to the crew to determine when it is appropriate to delete any discontinuity.

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With the flight plan now complete, move the cursor to FMW / pre-flight POF, FPLN tab, into **FPLN Name** box. Using the MKB, enter FPLN name (e.g. KTEB-KCMH) and **SAVE**. This saves the FPLN for future use.

FIGURE 02-34_1-21-28 - FPLN TAB (SAVE FPLN)

NOTE

It is not necessary to click **Insert** to store a FPLN as all data is already entered.


SID, STAR and Alternate portions are not saved in a stored FPLN.

Crews need to add them to a retrieved FPLN.

The flight plan insertion and FMS flight preparation is now complete.

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Prior to the departure briefing, configure PDU (VOR Course Deviation Indicator and ADF needle in the HSI and corresponding frequencies) as appropriate.

Place cursor on ENG-TRM window (PDU) and press  pushbutton. Click **RADIOS** tab and select **NAV / ADF**. Set frequencies as required.

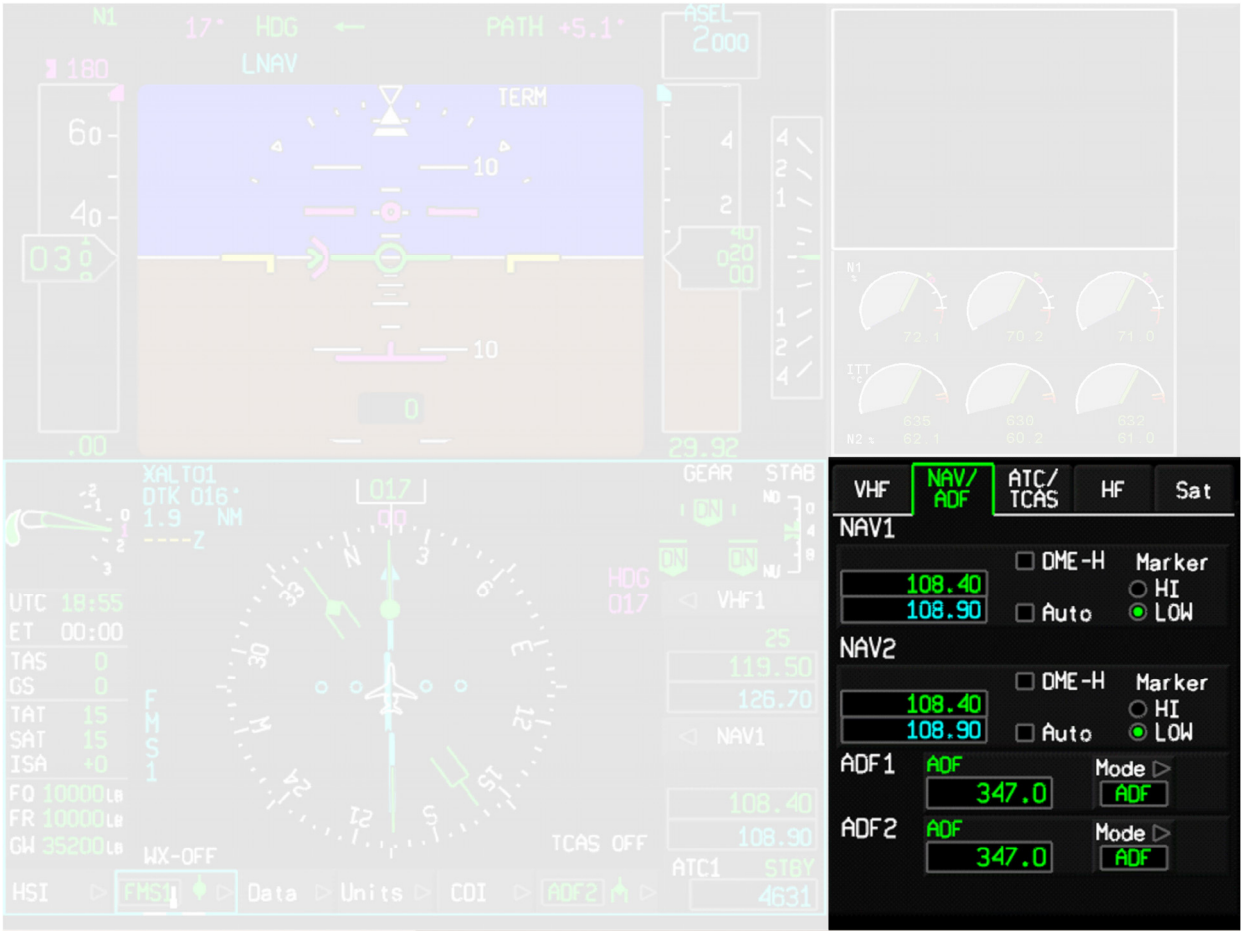


FIGURE 02-34_1-21-29 - RADIOS MENU NAV / ADF TAB

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GENERAL

The AVIONICS window is accessed through the MDU MENU.

INIT	FMS Setup	Auto Speeds	Tools	AFCS	Custom DB	System Config
Time: 12:04 UTC Date: 16 MAR 06		Databases: Navigation EPIC-303 3.01 ○ 19FEB 17MAR/06 ● 18MAR 07APR/06			Software: FMS NZ7.0 TOLD V3.0 FAA ECL F7XV0002	
Current Position: Not initialized Update FMS Position		Aircraft F7X Charts 16Mar06 - 12Apr06			Tail : ----- Flt IO: N8527FS	

FIGURE 02-34_1-23-00 - AVIONICS WINDOW INIT TAB

The Avionics window provides system initialization, setup, database management, and tool functions through seven main tabs:

- **Init**
- **FMS Setup**
- **FMS Speeds**
- **Tools**
- **AFCS**
- **Custom DB**
- **System Config**

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TABS DESCRIPTION

INIT TAB

Init tab is the default tab at power up. **Init** provides:

- Initialization of system internal time and date. Values are synchronized to internal system clock, then to GPS when it becomes available. Manually setting time and date is allowed only when GPS time is not available. To enter time and date manually, move cursor to time box and enter information using keyboard. Pressing <ENTER> will enter data and move cursor to the next box.
- Current Position. The Current Position field contains the master FMS position readout. Selecting the **Update FMS Position** soft key, pops up the Update FMS Position dialog box that provides multiple sensor position choices. Radio buttons choice include:
 - o Lat/Lon. Allows manual entry of latitude and longitude.
 - o Ref Wpt. Default is nearest airport. Allows manual entry of an airport ICAO code or any other waypoint. Its coordinates are automatically displayed.
 - o Available GPS and/or IRS. Choose between available sensors (their individual current position references are already displayed).

Selecting any radio button activates the **Apply** soft key. Select **Apply** to complete the update process.

FIGURE 02-34_1-23-01 - UPDATE FMS POSITION DIALOG BOX

- **Databases** Displays Navigation database cycle (with a choice between two for currency), Airplane database (appropriate to this airplane), and Charts database currency (if Charts function is installed). It is the crew's responsibility to ensure databases are appropriate and current.
- **Software** versions. Displays loaded versions of FMS, TOLD and ECL databases. It is the crew's responsibility to ensure databases are appropriate and current.
- **Tail #** and **Flt ID** Displays airplane tail number and Flt ID information. They are modifiable and saved by the system. Flt ID is used by the transponder for ATC purposes. If deleted, both display white dashes.

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FMS SETUP TAB

FIGURE 02-34_1-23-02 - FMS SETUP TAB OF AVIONICS WINDOW

FMS Setup tab contains all setup functions of the FMS:

- **SmartPerf Learning** field allows “learning” to be enabled (default - On) or disabled. This function should normally be disabled. When used, it should be enabled only for longer-range flights (greater than 600 NM).

NOTE

SmartPerf Learning should be set to Off as the airplane performance database supplied with the airplane is the result of extensive flight test and operations data.

Enabling **SmartPerf Learning** will not enhance this database and may result in degraded calculations of performance planning for some flights.

- **SmartPerf Mode** selection (default Full Perf). The crew may decide to deselect Full Perf when the flight is not representative of a normal flight or when the “normal profile” as depicted in the performance data will not be flown (i.e. short, low altitude legs, training flights, etc.). When Full Perf is not available, system default is Current GS/FF. Selection of Pilot Spd/FF or Current GS/FF is recommended only when Full Perf data is determined to be inaccurate.

NOTE

SmartPerf provides a complete mission prediction function. It is a fully integrated, lateral and vertical flight plan program that calculates optimum speeds and altitudes while predicting ETA's and fuel requirements. It can be used anytime prior to and during the flight to assist the crew in planning the requirements of the mission.

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- **Flight Summary Output** fields allows for the selection of the desired output medium for the Post Flight data. The Post Flight data can be output directly to a printer, if installed, or saved to a disk. The Post Flight data will send to the printer or the DMU via the CMC after the airplane has landed and park brake is on.
- **TO Fuel** sets fuel quantity allowance for take-off performance calculations. It provides allowance for fuel burned from engine start to the beginning of take-off roll. Once airborne, actual data supersedes this data.
- **LDG Fuel** sets fuel quantity allowance for after landing performance calculations. It provides allowance for fuel burned from weight-on-wheels to de-powering the airplane.

NOTE

TO Fuel and **LDG Fuel** values are estimated by the crew for the taxi, before take-off and after landing. Defaults come from the last entered value or if blank, the airplane database. Manually entered values are retained between power cycles.

RNP Settings provides RNP selection for a particular phase of flight. Default values are:

- Departure: 1.0
- Enroute: 2.0
- Remote / Oceanic: 10.0
- Arrival: 1.0
- Approach: 0.3
- Missed approach: 1.0 or the last entered value

The order of priority for the active RNP limit is:

- Airplane database values (on initial power-up),
- Manual entries override airplane database values during a power cycle. Manual entries are made from either:
 - o SENSORS window (Performance Menu in the Navigation Tab), or
 - o Values entered in the **RNP Settings** window

All selections are synchronized for all FMS, except for the Flight Summary Output selection which applies to the master FMS (only one FMS prints or save the data).

NOTE

Approach is defined as 2 NM before FAF. If a RNP level lower than 1.0 is required before this point, the setting must be modified accordingly.

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AUTO SPEEDS TAB

FIGURE 02-34_1-23-03 - FMS SPEEDS TAB OF AVIONICS WINDOW

Auto Speeds tab provides entry windows for speeds used by the FMS. All data within this tab is synchronized between all FMS when in synchronous mode.

Climb provides:

- A default value from the airplane data base (if data base is not available, this selection is grayed and not available).
- A manual selection. The manual field default values are the last entered values.

Departure provides entry of a target airspeed and the altitude and range from origin airport (effective area) for its use. For instance, it can be used to set restrictions for departure airport airspace. Defaults are 2,500' AGL and 4 NM. Speed defaults to the last entered value, the airplane database value, or 200 kts (if no value is provided by airplane database). If below 1500 ft above airfield and the airplane descent more than 200 ft (or if gear or slats/flaps are extended), the FMS speed revert automatically to Approach speed. The FMS understand that it is a quick return to base.

Speed Limit entry of an airspeed target that is used as the maximum speed below the entered altitude. It can be used to set general speed restrictions for airspace, such as 250 knots below 10,000 ft in the US. Default values are 250 kts / 10,000 ft. It is possible to delete Speed/Altitude limit (it becomes dashed). On power-up, the field retains last entered value unless previously deleted. In that case it will use the default value.

Descent provides three selections:

- The airplane data base default
- A Vmo/Mmo and manually entered angle
- A manual combination of airspeed / mach / angle

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Approach speeds provides for specification of different speeds for all Slats/Flaps (SF) configurations. They are used for performance planning purposes automatic power control and crew reference. Default values come from the airplane database or last entered value and are modifiable by the crew unless otherwise stated below. Entry of speeds higher than placard speed limits for a given configuration results in an invalid entry and will not be accepted. Entries smaller than a minimum IAS indicates a delta from Vref and are displayed as “VRF+” plus the entry.

Each field is as follows:

- **Clean** provides entry for Clean configuration (range = [150 kts; 200kts]),
- **SF1** provides entry for SF1 configuration (range = [140 kts; 190kts] or in Vref mode: range = [VRF+15; VRF+50]),
- **SF2** field is similar in operation to the SF1 (range = [130 kts; 180kts] or in Vref mode: range = [VRF+5; VRF+40]),
- **SF3** displays VAP. VAP is not modifiable.

NOTE

During an ILS approach, if LOC and GS are dropped for any reason, the FD will revert to ROLL/PATH. The FMS concurrently switches to the climb POF mode if ASEL is set to at least 150 feet above current airplane altitude. In the event the AP is engaged in this situation, the FMS engages the climb schedule set in the FMS Speeds tab (of the AVIONICS window).

FMS instructions for transition to approach speeds are provided in this window. Radius of approach area is defined by either **First App Wpt** or **Dist To Dest**:

- **First App Wpt** check box indicates that approach speed is to be activated at the first waypoint of the approach. Default is last selection or checked (from airplane database).
- **Dist To Dest** provides a radius from destination at which approach speeds become active. Default is last entered value or 15 nm (from airplane database).

NOTE 1

If checkbox is not checked at least 5 nm prior to first approach waypoint, FMS speed transitions to approach speed schedule at next approach waypoint or at selected Dist To Dest (whichever is further from destination airport).

NOTE 2

If a waypoint is inserted in Flight Plan between first approach waypoint and IAF and a direct to (DIRTO) this waypoint is activated, it becomes the first approach waypoint.

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NOTE 3

When flight plan waypoints require an oblique turn at the IAF, the airplane may not enter a 5 nm radius around the IAF. In this situation, the next approach waypoint will be used as the first approach waypoint and transition to approach speed schedule will occur at this next waypoint.

NOTE 4

If an approach transition is not selected (i.e. Vectors selected instead) for approaches with multiple IAF's, the IAF may not be the first approach waypoint.
The first approach waypoint may be the next waypoint in the approach procedure.
As a result, approach speed schedule will transition at this next waypoint.

Take-off displays the AFCS speed target limits during Take-Off mode (TO in FMA) and are not modifiable:

- **SF1** **SF2** = V2, V2+10 kts,
- **Clean** = VFT.

Go Around displays the AFCS speed target limits during Go-Around mode (GA in FMA) and are not modifiable:

- **SF1** **SF2** **SF3** = VREF, VREF+20 kts,
- **Clean** = VFT.

If FMS speed is selected on the Guidance Panel during Go-Around, FMS speed target bug is set at 190 kts and this speed target will become active when exiting GA mode (as indicated in FMA) if no flight plan change has been made.

NOTE

Use manual speed when SID (Take-Off) or missed approach (Go Around) standard procedures contain speed constraint.

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TOOLS TAB

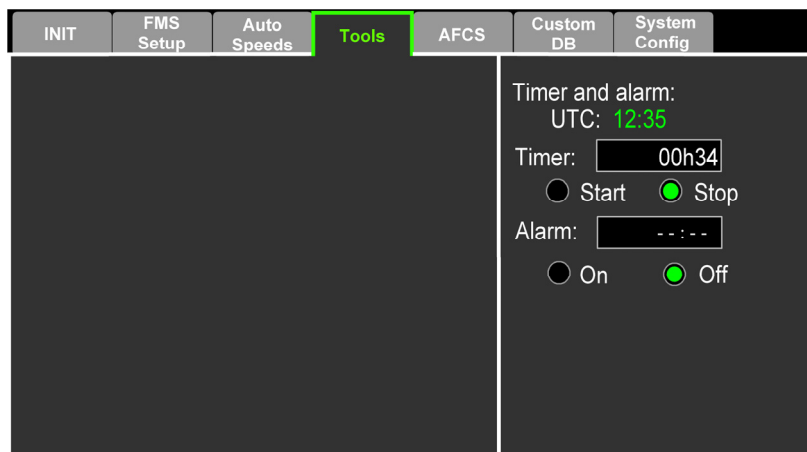


FIGURE 02-34_1-23-04 - TOOLS TAB OF AVIONICS WINDOW

Tools tab provides three time functions:

- **Timer and Alarm** displays current UTC in green (non-modifiable). Time is derived from airplane time.
- **Timer** provides for setting a time duration which counts down to zero. Format is XXhYYmZZs. Default state is inactive with white dashes displayed. When timer reaches zero, an aural tone sounds and a **UTC** label flashes in the HSI until the timer is stopped. Selecting the Start radio button starts the timer. Stop suspends it.
- **Alarm** provides for setting a reminder alarm to sound at an upcoming UTC. Format of this field is XX:YY. Default state is inactive with white dashes displayed. When current UTC time equals entered alarm time, an aural tone sounds and a **UTC** label flashes in the HSI until the alarm is turned off. Selecting the On radio button turns the alarm on. Selecting Off deactivates it.

Aural timer and alarm tones may be silenced by pressing the SIL pushbutton.

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AFCS TAB

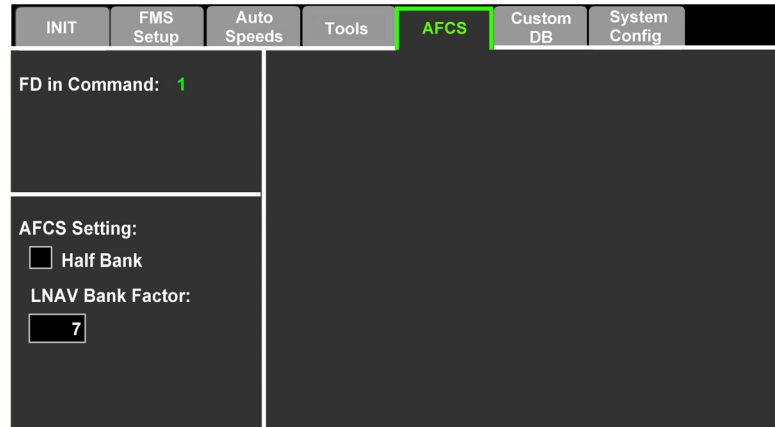


FIGURE 02-34_1-23-05 - AFCS TAB OF AVIONICS WINDOW

AFCS tab contains AFCS selections and settings which include:

- **FD in command** selection is FD1 at each power-up. It cannot be directly selected by the crew. In case of a FD failure, FD in Command is automatically changed. If no FD is in command (i.e. both flight directors are invalid), the FD in command field displays an amber dash.
- **AFCS Setting**: has the following selections:
 - o **Half Bank** limits bank to ½ of normal value (available only in HDG mode),
 - o **LNAV Bank Factor** is a crew input value limited between 0 and 15. The default value is 7. LNAV bank factor is used in computation of turn radii for nominal turns (fly-by transitions) in LNAV mode. Low LNAV bank factors require greater turn radii and high LNAV bank factors require smaller turn radii. While turn radius computations by the FMS always comply with airway lateral deviation limits, if airway limits are not the limiting item determining turn radius, LNAV bank factor allows the crew to increase or decrease nominal bank angle during fly-by transitions.

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CUSTOM DB TAB



FIGURE 02-34_1-23-06 - CUSTOM DB TAB OF AVIONICS WINDOW

Custom DB manages the custom databases of the airplane which include:

- Pilot Waypoints
- Flight Plan
- NOTAM

The FMS pulldown menu provides source selection of displayed custom database (CDB) information. It is available (and displayed) only when there is a detected difference between any of the FMS custom databases.

Pilots waypoints: The list contains all currently defined pilot waypoints in the custom data base. A scroll bar is displayed when the list exceeds window area.

Delete Pilot Wpt soft key removes selected waypoint from custom data base.

Delete All Pilot Wpts soft key is always selectable. It removes all pilot defined waypoints from custom data base.

Delete All FPLNs soft key is always selectable. It removes all pilot defined flight plans from custom data base.

NOTE

The ability to delete a single flight plan is managed through the Preflight Phase on the Flight Management Window.

Delete All NOTAMs is always selectable. It removes all NOTAM from custom data base.

NOTE

The ability to delete a single NOTAM navaide is managed through the SENSORS Window.

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Delete All Custom DBs is always selectable. It deletes the entire custom data base (waypoints, flight plans and NOTAM).

The cross-load area is for cross-loading custom databases between FMS:

- “From” selects a single FMS as the source
- “To” selects destination of the cross-load. A one-to-one or a one-to-many transfer can be selected.

Once “From” and “To” selections have been made, the **Xload** soft key becomes active. Selecting **Xload** initiates the load and causes the soft key to change to **Abort** soft key. Selecting **Abort** cancels the cross-load. (The abort causes the receiving FMS to have an empty custom database and forces it into the “Single” mode).

During cross-load, the current DB section being transferred and its percent (complete) are displayed in green. When transfer complete, the FMS are automatically placed in synchronous mode.

SYSTEM CONFIG TAB

INIT	FMS Setup	Auto Speeds	Tools	AFCS	Custom DB	System Config
System Config ID		Aircraft Type				
Page 001 of 014		Aircraft Serial Number				
Next		Aircraft Transponder Code				
		Aircraft Registration Number				
		Top Level System Part Number				
		Top Level System Mod Status				
		Configuration Part Number				

FIGURE 02-34_1-23-07 AVIONICS WINDOW SYSTEM CONFIG TAB

System Config tab is only available on the ground. It displays configuration information for all installed software/data base and is used for return to service type operations.

Prev and **Next** soft keys are used to cycle through the pages. It does not present the SELCAL code.

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GENERAL

SENSORS window can be displayed (using MENU on CCD) in the lower 1/6 of both PDU. It provides access to:

- Airplane position sensors management (IRS, VOR / DME, GPS)
- Navigation function (FMS)
- Environment sensors (WX, LSS and TAWS)



FIGURE 02-34_1-24-00 - SENSORS WINDOW SELECTION

There are two main tabs:

- **Navigation** provides access to multiple levels of navigation information
- **WX/LSS/TAWS** provides primary menu operation/display for Lightning Sensor System (LSS), and secondary menu for operation/display of Weather Radar (WX) and Terrain Awareness and Warning System (TAWS).

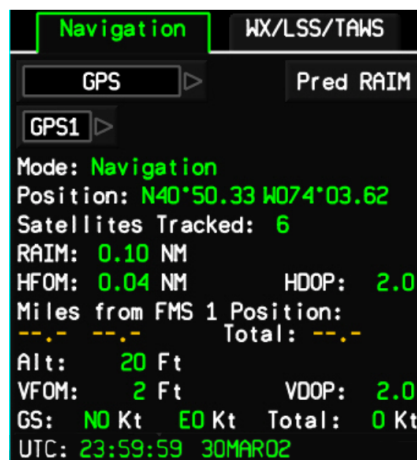


FIGURE 02-34_1-24-01 - SENSORS WINDOW NAVIGATION TAB

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NAVIGATION TAB

In the **Navigation** tab, a drop down menu in the top left corner allows selection of different levels of navigation information. These selections provide hierarchical navigation status.

The highest levels contain summary information and provide graphics for quick understanding. Lower levels contain specific sensor information and detail. They are used to resolve higher selection navigation issues.

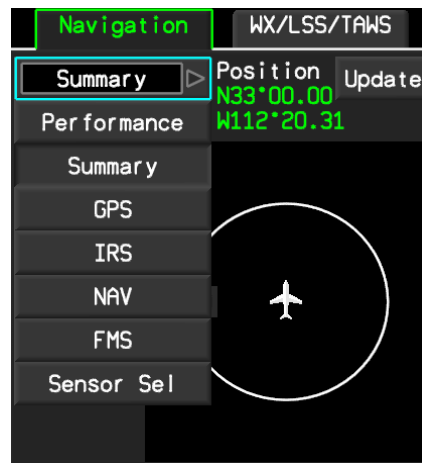


FIGURE 02-34_1-24-02 - NAVIGATION TAB DROP DOWN MENU

PERFORMANCE SELECTION

The highest level page (default), called Performance, provides a summary of navigation status:

- Estimated Position Uncertainty (EPU)
- Required Navigation Performance (RNP) for the current POF
- FMS Horizontal Navigation Mode

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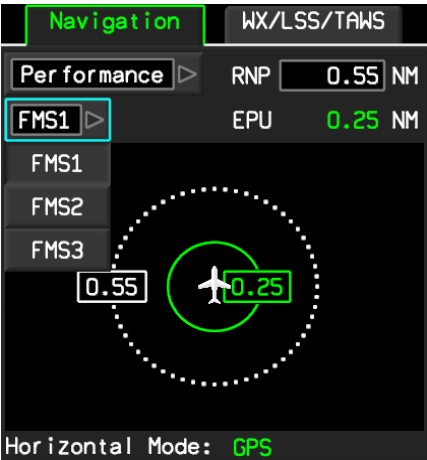


FIGURE 02-34_1-24-03 - PERFORMANCE DROP DOWN MENU

The choice of any FMS is available in Performance. The selected FMS is the data source for the page and provides EPU, RNP, and Horizontal Mode. In fully synchronous mode, RNP should always be identical for all FMS.

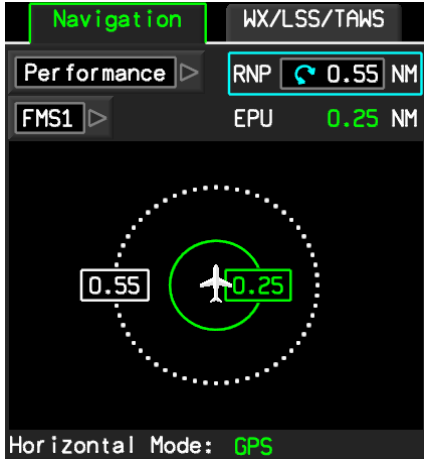


FIGURE 02-34_1-24-04 - PERFORMANCE SELECTION

The graphical presentation provides a synthesis of airplane navigation performance using limit circles: EPU is green, RNP is white dots.

RNP values vary according to each POF.

RNP is settable in the upper right corner. Default values come from the RNP setup (if adjusted in **Avionics** tab) or the database. The value is displayed in green (default) or white (pilot entry). If a pilot entry is greater than the default value, a dialog box “ Confirm Entry” pops up with “Yes” or “No” selections.

The EPU value is computed by the indicated FMS. It is green (normal) or amber (when exceeding RNP value). It’s value corresponds to ring radius in NM. If EPU is greater than RNP, the EPU circle fills in and turns amber to alert the pilot.

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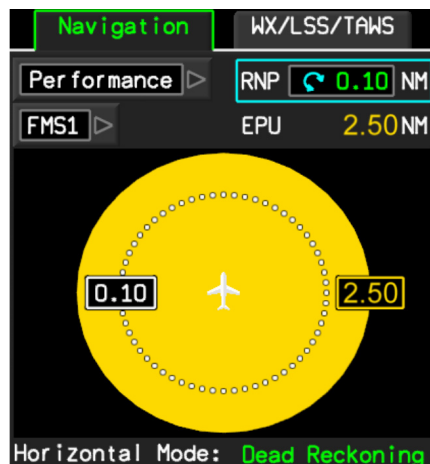


FIGURE 02-34_1-24-05 - RNP LOWER THAN EPU

Horizontal Mode readout at the bottom of the window displays current FMS navigation mode in green. Possible modes are:

- GPS
- DME/DME
- VOR/DME
- IRS
- Dead Reckoning

For example, during a FMS approach, RNP is automatically selected at 0.3 NM. If EPU becomes higher than RNP, the **APP** annunciation at the Top of the ADI becomes amber (**APP**) and the **DGR** indication is displayed at the bottom of the HSI. The FMS message "UNABLE RNP" would be displayed in the INAV window. In this example, once the RAIM equals value exceeds 0.3 NM, a CAS message **NAV: FMS / GPS .. MONITOR** will appear. In this example, if in IMC conditions, the crew is required to perform a go around.

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SUMMARY SELECTION

This page provides a graphical presentation of the relative position of all position sources including the currently calculated airplane position.



FIGURE 02-34_1-24-06 - NAVIGATION TAB SUMMARY SELECTION

Current airplane coordinates are displayed in the top right corner. The **Update** soft key updates current position of the indicated FMS.

NOTE

The Navigation tab **Update** soft key only affects the selected FMS when in Single mode.

The check boxes on the left hand side enables or disables indicated position source display on the graphic.

The graphic depicts current airplane position in the center (as computed by the selected FMS). The white range ring is set to current RNP value. A digital readout displays range. The display is always depicted North Up.

Position sources are displayed relative to the airplane. If a source is beyond the page limit, it is indicated with an arrow at the correct bearing.

Labels for the sensor positions are:

- F = FMS
- G = GPS
- I = IRS
- N = Nav Radio

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Update FMS Position Menu

When the **Update** soft key is clicked, the **Update FMS Position** Menu drops down:

FIGURE 02-34_1-24-07 - UPDATE FMS POSITION SELECTED

The drop down menu provides selection choices to update FMS current position:

- **Lat/Lon** provides for a manual latitude and longitude
- **Ref Wpt** provides for a waypoint identifier. The lat/lon of that point is then determined and displayed adjacent to that radio button in green.
- All other configured source radio buttons and their respective positions.

Clicking **Apply** updates indicated FMS position with selected position.

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GPS SELECTION

The GPS selection page provides for selection of installed GPS and displays key information about them. All data comes from the selected GPS. It is not modifiable.

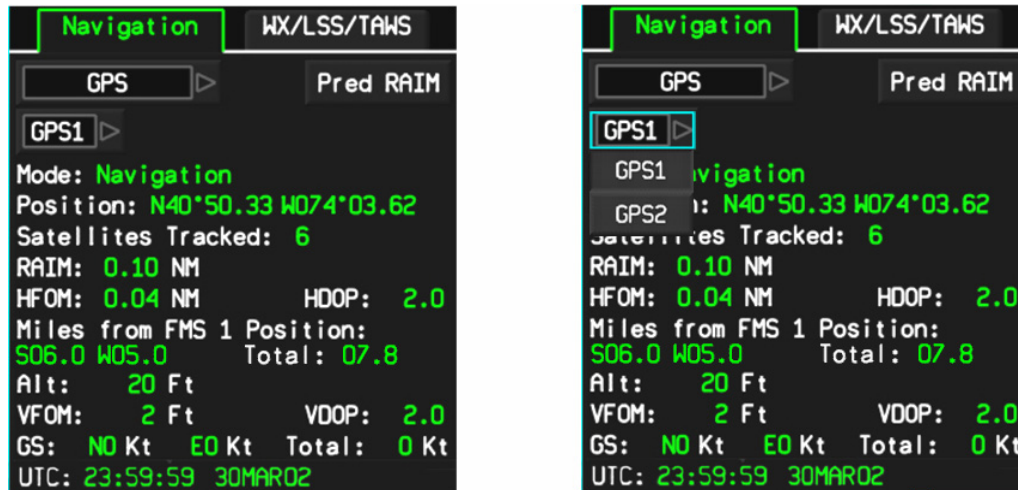


FIGURE 02-34_1-24-08 - NAVIGATION TAB GPS SELECTION

RAIM (Receiver Autonomous Integrity Monitoring) is the horizontal integrity limit of RAIM

HFOM (Horizontal Figure Of Merit) is the horizontal accuracy (in NM) of the calculated GPS position. It is equivalent to EPU.

HDOP (Horizontal Dilution Of Precision) corresponds to horizontal quality from a geometry standpoint. It represents a summation of all errors relating to the ability of the system to calculate an accurate position. HFOM is a function of HDOP.

Miles from FMS 1 Position is the distance between current GPS position and current FMS position (in this case, FMS 1 is the FMS in control). The displays provide Lat/Lon and NM differences.

Alt is the geometric altitude (in FT) of the airplane above the WGS-84 model of the Earth surface. It is used by the EGPWS to validate RA data and for CFIT protection.

VFOM (Vertical Figure Of Merit) is vertical accuracy (in ft) of the calculated GPS altitude.

VDOP (Vertical Dilution Of Precision) corresponds to vertical quality from a geometry standpoint. It represents a summation of all errors relating to the ability of the system to calculate an accurate altitude. VFOM is a function of VDOP.

HDOP and **VDOP** values are based on a scale from 1 to an unlimited value. A low number equates to better accuracy. A "3" is considered high.

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Clicking the **Pred RAIM** soft key (Predictive Receiver Autonomous Integrity Monitoring) provides a drop down page containing:

- **Dest** (Destination) and **Time** (ETA)
- **RAIM** indicates availability (“yes or “no”) for indicated UTC times. Additional availability is given for 5 minute intervals before and after ETA.
- **Wpt** and **Time** provides input of any waypoint and ETA (within 24 hours of current time) to compute a predictive RAIM availability. Additional availability is given for 5 minute intervals before and after ETA.
- **Sat Desel** provides ability to deselect satellites (by satellite number) for either Destination or Pilot Waypoint Predictive RAIM calculation. Deleting a pilot entry returns the boxes to dashes. **Sat Desel** boxes are automatically cleared upon landing.

If the result of predictive RAIM computation is that RAIM conditions will not be available, **UNAVAIL** is displayed next to RAIM.

Navigation WX/LSS/TAWS

GPS **Pred RAIM**

GPS1

Mode: **Navigation**

Position: **N40°50.33 W074°03.62**

Satellites Tracked: **6**

RAIM: **0.10 NM**

HFOM: **0.04 NM** HDOP: **2.0**

Miles from FMS 1 Position:

506.0 W05.0 Total: **07.8**

Alt: **20 Ft**

VFOM: **2 Ft** VDOP: **2.0**

GS: **NO Kt** EO Kt Total: **0 Kt**

UTC: **23:59:59 30MAR02**

GPS1 Pred RAIM X

Dest: **KGJT** Wpt: **KGJT**

Time: **1015 z** Time: **1820 z**

RAIM: YES	RAIM: NO
1000 YES	1805 NO
1005 YES	1810 NO
1010 YES	1815 NO
1020 NO	1825 YES
1025 NO	1830 YES
1030 NO	1835 YES

Sat Desel: Sat Desel:

12 13	1 2
-- --	-- --

FIGURE 02-34_1-24-09 - PREDICTED RAIM PAGE

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IRS SELECTION

The IRS selection page provides for selection of installed IRS and displays key information about them. All data on this page comes from the selected IRS except for **Miles from FMS 1 Position** (corresponding to master FMS) and **Drift Rate**, which are computed by the FMS.

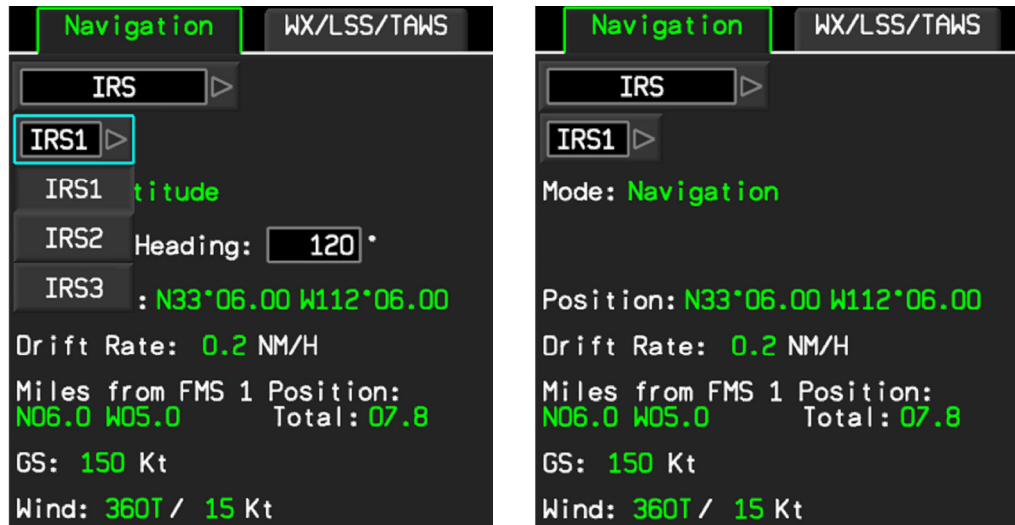


FIGURE 02-34_1-24-10 - IRS SELECTED

Mode indications include:

- **Align** – automatic mode at power up. Time to Nav parameter is displayed below the parameter.
- **Navigation** – automatically displayed when IRS alignment completed (“Time to Nav” disappears).
- **Attitude** – displayed when position computation is lost while attitude remains available. A manual heading input is now required, and a **Set Mag Heading** input line is displayed to provide for its input into the IRS.

During initial alignment, IRS alignment position is automatically set to FMS position. Alignment duration depends on the latitude (approximately 7 min at 45° N or S).

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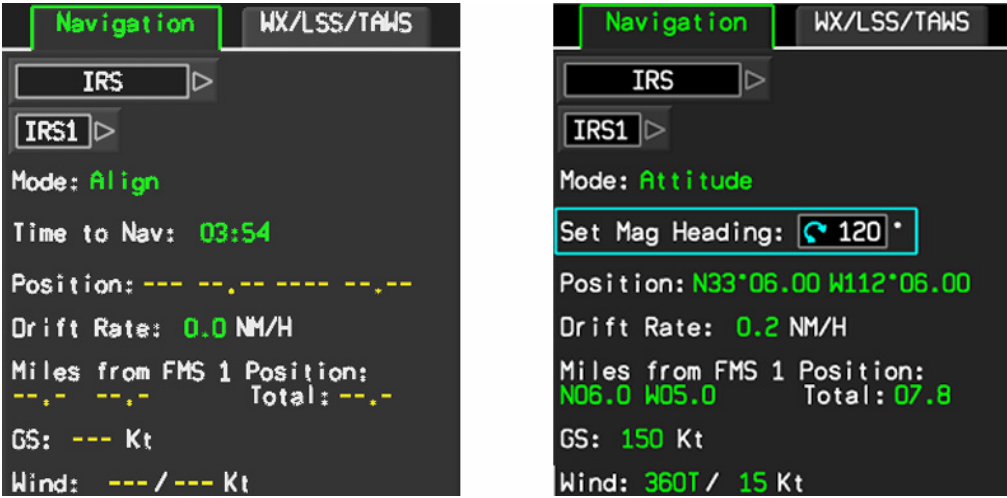


FIGURE 02-34_1-24-11 - IRS SELECTION MODE ALIGN AND ATTITUDE

IRS data displayed on the page is self-explanatory. Time to Nav is not presented during in flight alignment.

This page is the only place in the EASy system that Wind information is available.

NAV SELECTION

The NAV selection page provides for selection of installed VOR radio's and displays key information about them. All data on this page comes from the selected VOR except for **Miles from FMS 1 Position** (corresponding to the master FMS), **Position**, and position sources, which are computed by the FMS. Frequency IDENTs are displayed based on existing FMS database information. If a data parameter is not available, it is displayed with amber dashes.

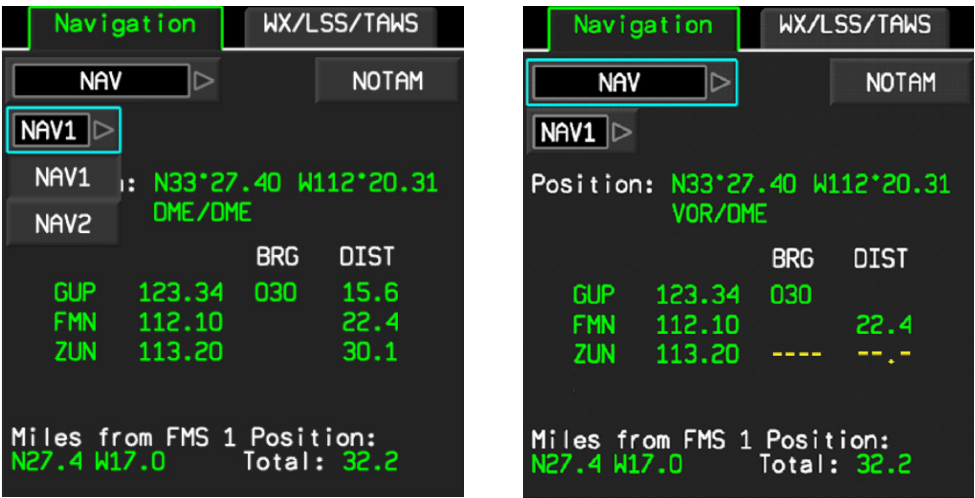


FIGURE 02-34_1-24-12 - NAV SELECTED

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The pilot can prevent the FMS from using a particular VOR and/or DME station for position computation by using the **NOTAM** soft key. The **NOTAM** soft key displays a NOTAM List page that contains up to six NOTAM (three permanent, and three temporary). Temporary NOTAM are cleared at power off and “permanent” NOTAM are stored in FMS memory until removed by pilot. The default is white dashes. To use it the pilot has to enter the NAVAID identifier in the NOTAM list. If the custom DB is not available due to a crossloading or uploading function, **Updating DB** is displayed below the NOTAM list and entry boxes are grayed.



FIGURE 02-34_1-24-13 - NOTAM LIST PAGE

FMS SELECTION

This window provides selection between **Synchronous** or **Single** mode for each FMS. **Synchronous** is the default selection.

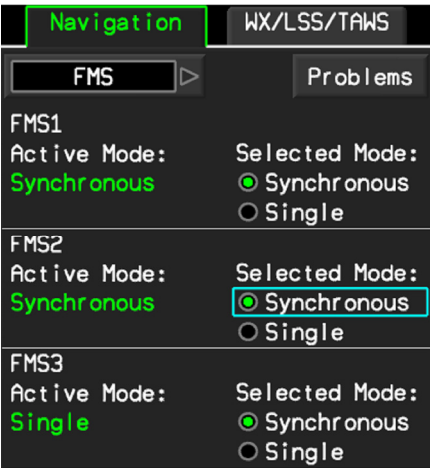


FIGURE 02-34_1-24-14 - FMS SELECTED

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If active mode does not match selected mode for any FMS, the **Problems** soft key becomes selectable. Clicking **Problems** displays the problems page.

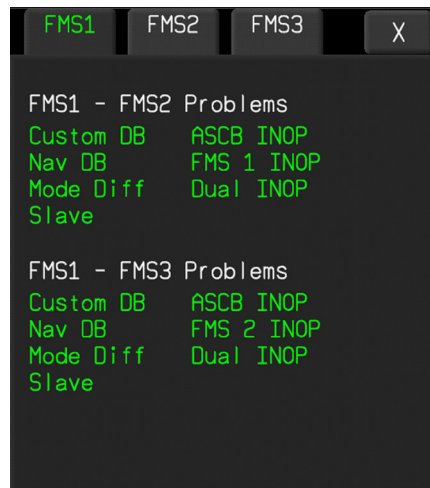


FIGURE 02-34_1-24-15 - PROBLEMS PAGE

Problems that prevent the active mode from transitioning to selected mode are listed for each FMS.

Problem messages include:

- **Custom DB** – Both FMS (or three if available) do not have the same Custom DB loaded and can not synchronize. The pilot must transfer Custom DB from one FMS to the other(s) (requires approximately 1 min).
- **Nav DB** – Both FMS (or three if available) do not have the same Navigation DB loaded and can not synchronize. The pilot must transfer Navigation DB from one FMS to the other(s) (requires approximately 45 min).
- **Mode Diff** – Active mode does not match selected mode of any FMS
- **Slave** – FMS disagree as to which is the master
- **Single** – FMS are unable to synchronize or pilot selected single.
- **ASCB INOP** – Avionics Standard Communications Bus (ASCB) is inoperative, and information can not be transmitted between FMS. System automatically drops into **Single** mode. Will be accompanied by **Single** message and may be accompanied by **FMS X INOP** or other FMS problem messages.
- **FMS X INOP** – indicated FMS is inoperative
- **Dual INOP** – indicates that the FMS are not able to operate in synchronous mode due to excessive automatic transitions to single mode. Usually accompanied by another message such as **Single**, **Custom DB** and /or **Nav DB**. System latches in **Single** mode until power down.

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SENSOR SEL SELECTION

This window provides selection or de-selection of sensors for use by the FMS in their position calculation.

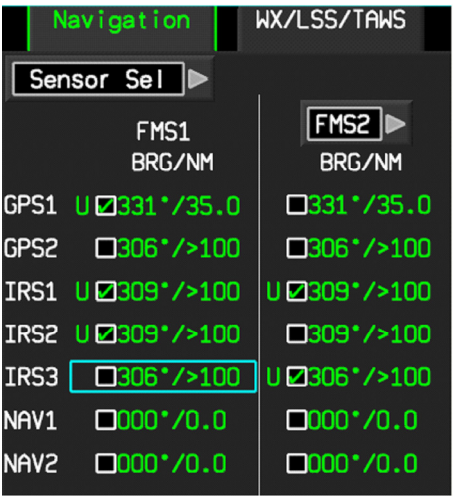


FIGURE 02-34_1-24-16 SENSOR SELECTION

The default is the on-side FMS. The right column defaults to the cross-side selected FMS. The third (non displayed) FMS is available through a drop down menu. To select a sensor, click the corresponding check box. When the sensor is correctly being used, a **U** is displayed. Distance and bearing from the indicated FMS for the sensor are displayed in green.

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WX / LSS / TAWS TAB

The **WX/LSS/TAWS** tab provides menu-controlled secondary modes / functions of the Weather Radar, LSS, and TAWS.

Primary controls of these functions are provided by selection and/or soft key in the Sensors page or through the MKB.

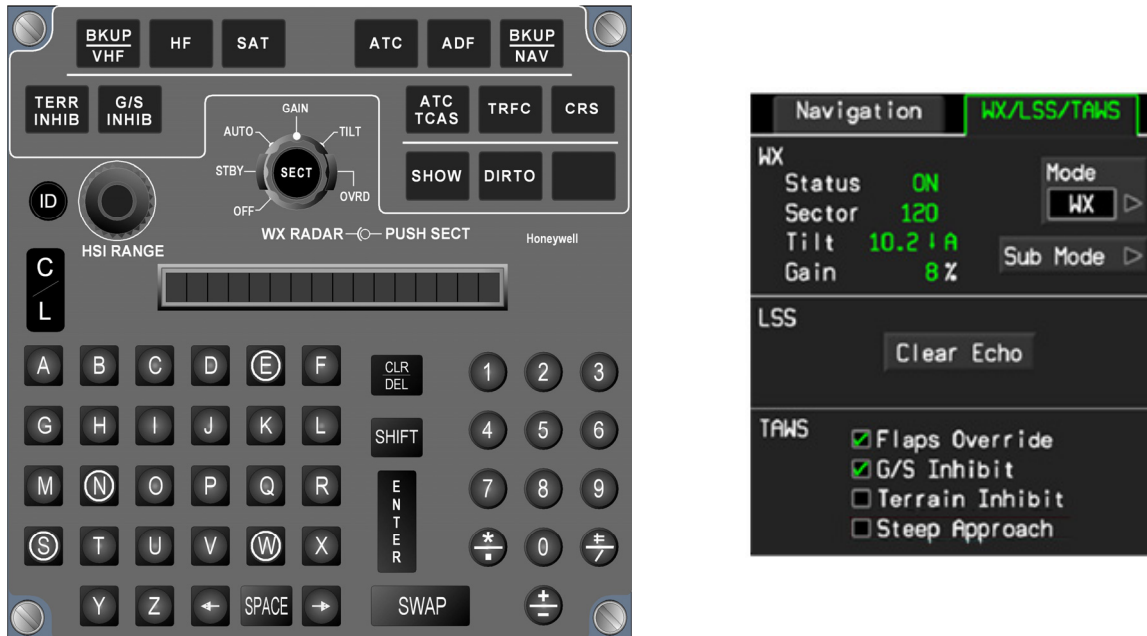


FIGURE 02-34_1-24-17 - WX / LSS / TAWS PAGE

WX controls include:

- **Status**, **Sector**, **Tilt** and **Gain**
- **Mode** selection:
 - o **WX** – normal weather mode (default)
 - o **GMAP** – ground mapping mode
- **Sub Mode** selection enables:
 - **REACT** (Rain Echo Attenuation Compensation Technique) – attenuation compensation of radar signal for rainfall
 - **TURB** (Turbulence) – turbulence detection mode
 - **TGT** (Target) – radar target feature
 - **STAB** (Stabilization) – in-flight attitude stabilization

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GENERAL

The Flight Management Window **FLIGHT MGMT** is accessible from the main menu on the CCD. It provides pilot interface for:

- FMS performance initialization,
- Performance prediction and computation,
- SID, STAR and approach retrieval and review,
- Advisory take-off and landing data computation when installed.

The screenshot displays the Flight Management Window in a 1/2 format. It features several sections:

- FPLN Source:** Pilot, Origin (00000), Destination (00000), Alternate (-----), and an Insert button.
- FPLN Name:** A text field with a Save button and a Delete button.
- Stored FPLN:** A list of flight paths including KABE-KIAD, KBOS-KTEB, KIAB-KPBI, KMEM-KTEB, KPBI-KTEB, and KTEB-KBOS, with an Invert checkbox.
- Crz Spd:** LCR, Fuel Res (NBAA), Init Crz Alt (00000 Ft), Stop inc (0 Ft), Wind/Temp at (0 Ft), 360 T / 0 Kt, 15 °C / 0 ISA Dev.
- BOW:** 25000 Lbs, Passengers (000 At 170 Lbs), Gross Wt (Lbs), ETE, Fuel Req, Fuel FOM, Fuel Res.
- Fuel/Weight:** Fuel (10002 Lbs), Cargo (00000 Lbs), Dest, Altn.

 A Compute button is located at the bottom right.

FIGURE 02-34_1-25-00 - FLIGHT MGMT WINDOW (1/2 FORMAT)

The Flight Management Window (FMW) can be displayed on either MDU in the 1/6, 1/3 horizontal, or 1/2 format. 1/6 and 1/2 are the most commonly used.

The screenshot displays the Flight Management Window in a 1/3 horizontal format. It shows a condensed version of the 1/2 format, with fields for FPLN Source, FPLN Name, Stored FPLN, Crz Spd, Fuel Res, Init Crz Alt, Stop inc, Wind/Temp at, BOW, and Fuel/Weight. The layout is more compact, with some fields truncated or shown in a smaller font.

1/3 HORIZONTAL WINDOW

The screenshot displays the Flight Management Window in a 1/6 window format. This is the most compact view, showing only the essential fields: FPLN Source, FPLN Name, Stored FPLN, Crz Spd, Fuel Res, Init Crz Alt, Stop inc, Wind/Temp at, BOW, and Fuel/Weight. The layout is highly condensed, with many fields truncated.

1/6 WINDOW

FIGURE 02-34-20-01 - FLIGHT MGMT WINDOW FORMATS

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The FMW provides access to Flight Management System (FMS) performance using:

- Route Type Controller (RTC)
- Phase Of Flight selection (POF)

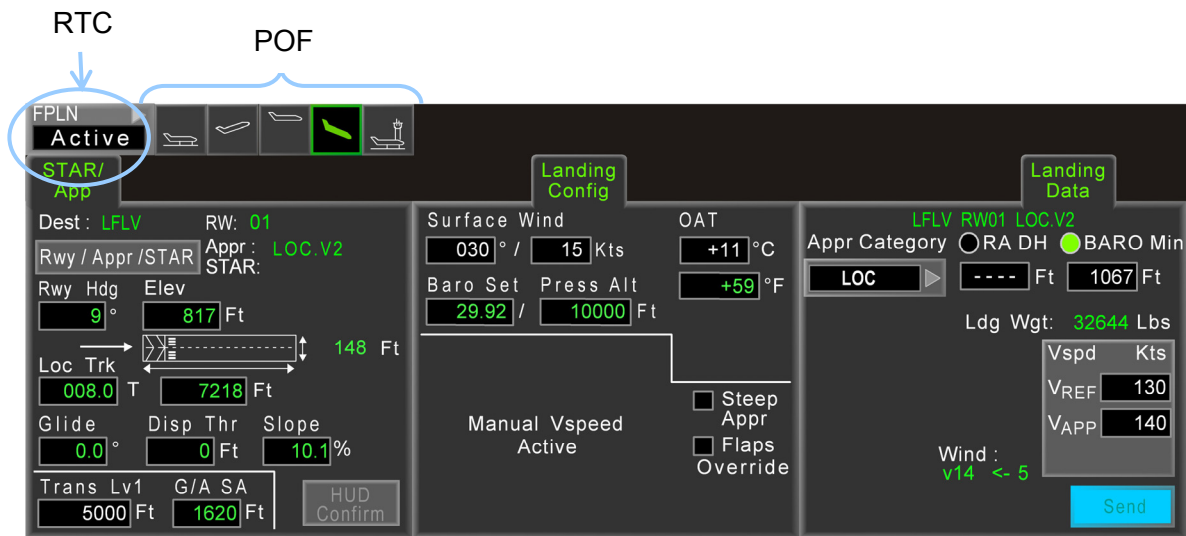


FIGURE 02-34_1-25-02 - FMW RTC AND POF SELECTOR (1/2 WINDOW)

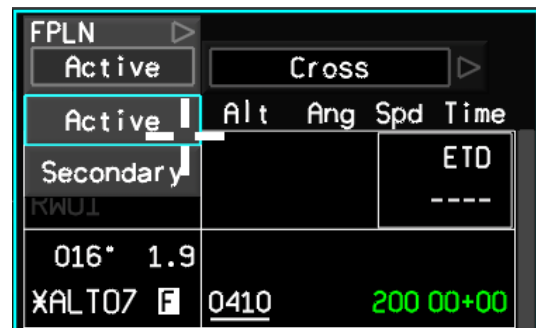
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ROUTE TYPE CONTROLLER (RTC)

In the FMW and WPT LIST windows, a Route Type Controller (RTC), located in the top left corner, toggles between active and secondary flight plans. These controllers are identical in function.



RTC IN FMW



RTC IN WPT LIST

FIGURE 02-34_1-25-03 - RTC DROP DOWN MENU

The active flight plan is the flight plan currently in use by the FMS. The active flight plan is the primary flight plan and contains:

- FROM waypoint
- TO waypoint (may also be the destination)
- Destination
- Missed approach procedure
- Alternate flight plan (if desired and inserted)

While one FPLN is active, the FMS provides capability to build and review a completely independent flight plan. It is designated the secondary flight plan.

A secondary flight plan contains (as a minimum):

- FROM waypoint
- TO waypoint (may also be the destination)
- Destination

A secondary FPLN display in the I-Nav map can be distinguished by:

- "Secondary" embedded in the border
- No airplane symbol
- FLPN route lines are dashed instead of solid

When a secondary FPLN is saved, performance information is stored, but departure (runway and SID) and arrival (STAR, approach, and runway) information is not.

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PHASE OF FLIGHT SELECTION

The FMW contains Phases Of Flight (POF) information pages sequenced and organized to crew tasks during flight.

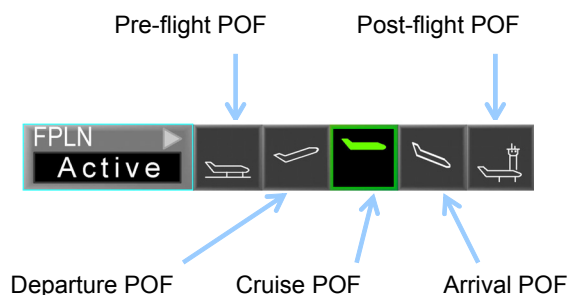


FIGURE 02-34_1-25-04 - PHASE OF FLIGHT SELECTION

Manual selection tabs, indicating each phase, are located at the top of the window. Each tab, with its corresponding POF pictogram, displays in green when selected. Selection of a tab brings the appropriate POF page into view. Each window displays multiple fields relative to selected POF for selected Route Type.

The five POF pages contain:

- Preflight – flight plan creation/selection, including altitude, speed and fuel requirements
- Departure – runway and SID selection including weather data initialization and advisory take-off (TOLD) performance computations when installed
- Cruise – performance summary data including what-if computations and One Engine Out conditions
- Approach – terminal procedures (runway, approach and STAR), including weather data initialization and advisory landing (TOLD) performance computations when installed
- Post-flight – summary data

After entering parameters, the cursor automatically moves to the next field or tab to ease insertion of data and provide sequential prompts.

The screenshot shows the 'SID' tab selected in the 'FPLN Active' row. The 'Runway / SID' section displays: Rwy: 000, Hdg: 000°, Elev: 16 Ft, Loc: 000000 Ft, Trk: 000000 Ft, Disp Thr: 100 Ft, Slope: 0.0%, TOSA: 420 Ft, Trans Alt: 18000 Ft. The 'Takeoff Config' section displays: Surface Wind: 000° / 000 Kt, Baro Set: 29.92, Press Alt: 16 Ft, OAT: +15°C, +59°F. The 'Takeoff Data' section displays: T/O Wt: Lbs, Vspd: Kt, V1: 114, VR: 126, V2: 126, VFR: 158, VFT: 171, VREF: 130, Pitch Att: 10.1°.

FIGURE 02-34_1-25-05 - 1/2 WINDOW LAYOUT

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PRE-FLIGHT PHASE OF FLIGHT (POF)

The pre-flight POF provides for system initialization, active flight plan selection, performance initialization, and performance data. The figure below illustrates pre-flight POF displayed using 1/2 window.

The screenshot displays the PRE-FLIGHT POF TAB (1/2 WINDOW) interface. At the top, there are three tabs: 'FPLN' (selected), 'Alt/Spd', and 'Fuel/Weight'. The 'FPLN' tab is active, showing the following fields and controls:

- FPLN Source:** A dropdown menu set to 'Pilot'.
- Origin:** A text field containing '00000'.
- Destination:** A text field containing '00000'.
- Alternate:** A text field containing '-----'.
- Insert:** A button.
- FPLN Name:** A text field containing '-----'.
- Save:** A button.
- Delete:** A button.
- Stored FPLN:** A list of stored flight plans: KABE-KIAD, KBOS-KTEB, KIAB-KPBI, KMEM-KTEB, KPBI-KTEB, and KTEB-KBOS. There is an 'Invert' checkbox below the list.
- Crz Spd:** A dropdown menu set to 'LCR'.
- Fuel Res:** A dropdown menu set to 'NBAA'.
- Init Crz Alt:** A text field containing '00000' Ft.
- Stop inc:** A text field containing '0' Ft.
- Wind/Temp at:** A text field containing '360' T / '0' Kt.
- 15 °C / '0' ISA Dev:** A text field.
- BOW:** A text field containing '25000' Lbs.
- Fuel:** A text field containing '10002' Lbs.
- Passengers:** A text field containing '000' At.
- Cargo:** A text field containing '170' Lbs.
- Gross Wt:** A text field containing '00000' Lbs.
- Dest:** A text field.
- Altn:** A text field.
- ETE:** A text field.
- Fuel Req:** A text field.
- Fuel FOM:** A text field.
- Fuel Res:** A text field.
- Compute:** A button.

FIGURE 02-34_1-25-06 - PRE-FLIGHT POF TAB (1/2 WINDOW)

FPLN PAGE

The Flight Plan (FPLN) tab provides the ability to create, retrieve, save and delete a FPLN. A FPLN can be created entirely by the crew or modified from a stored FPLN.

The screenshot displays the FPLN TAB (1/6 WINDOW) interface. At the top, there are three tabs: 'FPLN' (selected), 'Alt/Spd', and 'Fuel/Weight'. The 'FPLN' tab is active, showing the following fields and controls:

- FPLN Source:** A dropdown menu set to 'Pilot'.
- Origin:** A text field containing '00000'.
- Destination:** A text field containing '00000'.
- Alternate:** A text field containing '-----'.
- Insert:** A button.
- FPLN Name:** A text field containing '-----'.
- Save:** A button.
- Delete:** A button.
- Stored FPLN:** A list of stored flight plans: KABE-KIAD, KBOS-KTEB, KIAB-KPBI, KMEM-KTEB, KPBI-KTEB, and KTEB-KBOS. There is an 'Invert' checkbox below the list.

FIGURE 02-34_1-25-07 - FPLN TAB (1/6 WINDOW)

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There are three ways to enter FPLN airport origin and destination:

- Key in airport ICAO identifiers for Origin and Destination fields using MKB
- Key in a FPLN name in **FPLN Name** field (ICAO identifier dash separated; e.g. KTEB-KCMH). Origin and Destination are automatically updated after <ENTER> activation on CCD or MKB
- Select a flight plan from the **Stored FPLN**.
- **Insert** soft key inserts selected flight plan into the pending flight plan

Delete and **Save** soft keys respectively deletes the selected flight plan from the stored list or saves the active (or secondary) flight plan to the stored list.

Pilot Selection

This selection allows the pilot to create a flight plan by directly inserting Origin and Destination or by selecting a flight plan from the **Stored FPLN** list. Pilot is the default selection.



FIGURE 02-34_1-25-08 - AVAILABLE SELECTIONS FOR THE ACTIVE FPLN

The **Invert** check box is used to reverse **Origin** and **Destination** (and an entire FPLN).

AFIS Selection (optional)

The Airborne Flight Information System (AFIS) is used to download a flight plan and weather information from a flight planning provider.

➤ *Refer to CODDE 1 / Chapter 02 / ATA 23 for AFIS description*

Upon initial entry to this page, all soft keys are unselectable (greyed out) and all boxes default to white dashes.

AFIS data is requested by either **Number** (default) or **FPLN Data**.

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When the **Number** radio button is selected, the **Transmit Request** soft key remains greyed out until a number has been entered. Once entered, **Transmit Request** soft key becomes available (cyan). Selecting **Transmit Request** initiates transmission of a flight plan request to the AFIS provider.

When the **FPLN Data** radio button is selected, the **Transmit Request** soft key is greyed out until **Orig**, **Dest**, **ETD** and **Date** have been entered. Once this data has been properly entered, the **Transmit Request** soft key becomes available. Selecting **Transmit Request** initiates transmission of a flight plan request to the AFIS provider.

If there is a Communication Management Function (CMF) failure, the **Transmit Request** soft key remains unselectable.

Once the requested flight plan is received, the FMS message (on the I-NAV map) FLT PLN RECEIVED is displayed and the **Insert** soft key becomes selectable to download flight plan data.

Insert downloads the flight plan directly to the active or secondary flight plan (as determined by RTC selection).

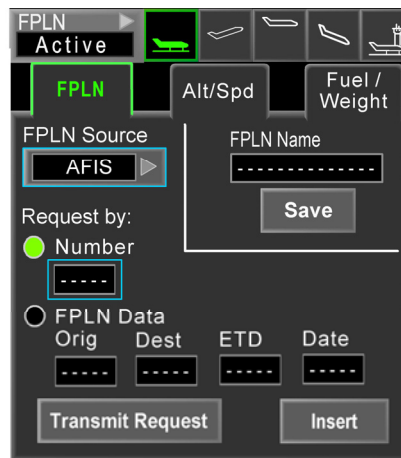


FIGURE 02-34_1-25-09 - FPLN TAB AFIS SELECTION

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DMU Selection

DMU provides selection of a flight plan from one of the physical media (CD/DVD, PCMCIA 1 or PCMCIA 2) that can be inserted into the data loader if the DMU is available (connected, and operating).

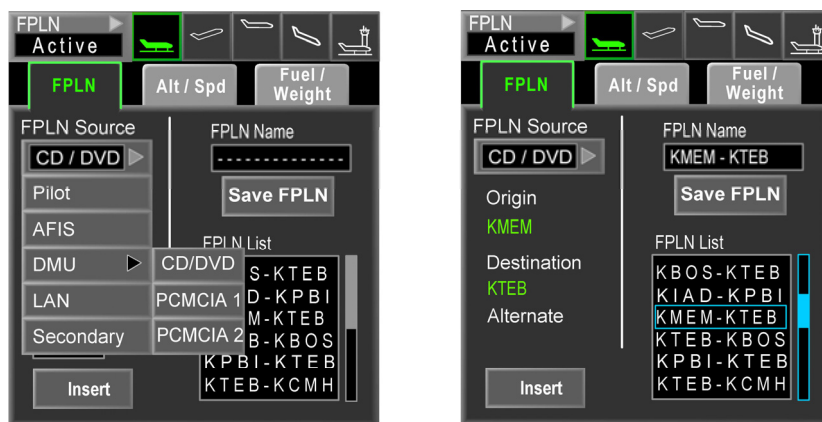


FIGURE 02-34_1-25-10 - FPLN TAB DMU SELECTION (CD/DVD)

NOTE

The data loader must be closed and locked to authorize the reading of PCMCIA card.

LAN Selection

LAN provides selection of a flight plan from a PC connected to the airplane LAN, if available (properly configured, connected and operating).

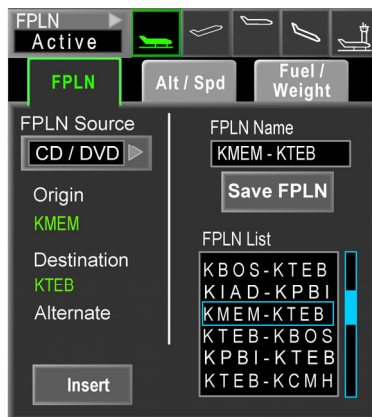


FIGURE 02-34_1-25-11 - FPLN TAB LAN SELECTION

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Secondary Selection

Secondary provides for the secondary flight plan to be moved into the Active Flight Plan, with or without performance computation (Perf Init check box).

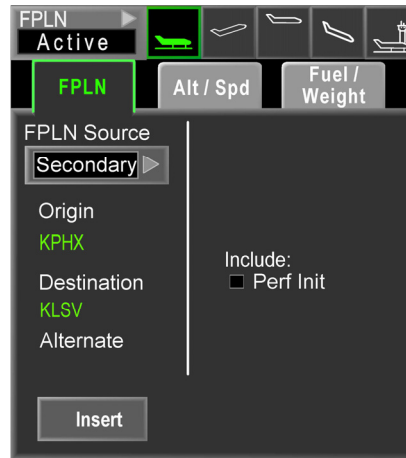


FIGURE 02-34_1-25-12 - FPLN TAB SECONDARY SELECTION

NOTE

Insert key remains blue lighted even if the flight plan is correctly send in active flight plan.

ALT / SPD TAB

The Altitude Speed tab provides input for mission parameters and forecasted weather data.

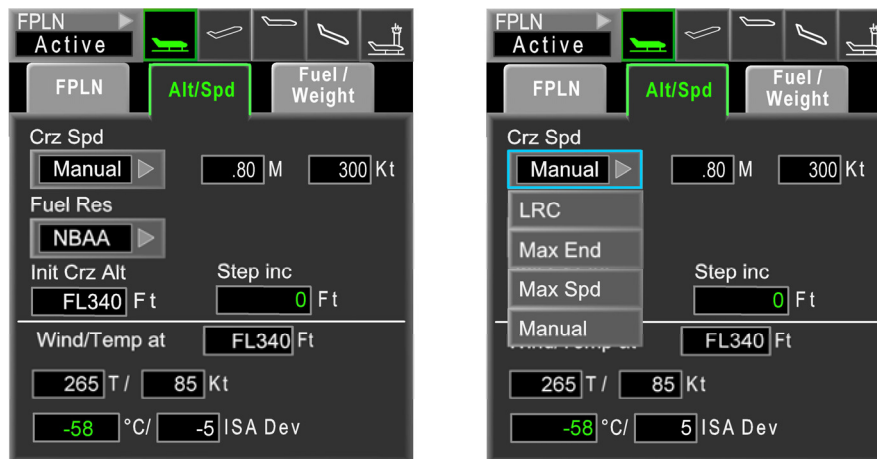


FIGURE 02-34_1-25-13 - ALT / SPD TAB

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The upper part of the tab gathers mission parameters:

Cruise speed **Crz Spd**: Long Range Cruise **LRC**, Maximum Endurance **Max End**, Maximum Speed **Max Spd**, or **Manual**

- Fuel reserves **Fuel Res**: NBAA standard, Time, or Pounds
- Initial cruise altitude **Init Crz Alt**
- Step increment **Step Inc**

Crz Spd Selections

The Cruise Speed drop down menu contains:

- **LRC** – Long Range Cruise is defined as a cruise mach providing maximum distance at a given altitude. This speed is faster than maximum specific range speed and considered worthwhile due to reduced flight time and overall flight hour costs.
- **Max End** – Maximum endurance speed is defined as the speed where fuel flow is minimized.
- **Max Spd** – Maximum speed is defined as the maximum speed the airplane can fly
- **Manual** – requires a specific cruise speed entry of both Mach number and knots (entry boxes appear when Manual selected).

NOTE

The first three options are available only when Full Perf is the active Performance mode. In Pilot Spd / FF or Current GS / FF, only Manual is available.



FIGURE 02-34_1-25-14 - ALT / SPEED TAB - FUEL RESERVE

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Fuel Res

The Fuel Reserve drop down menu contains:

- **NBAA** – a minimum reserve based on a 200 NM alternate under no-wind conditions. If an alternate is provided that is greater than 200 NM from destination, then fuel required for this alternate is computed instead. Required reserve also includes 30 min. of holding at the end of the mission.
- **Time** – a reserve with reference to a designated length of time (hours and minutes).
- **Pounds** – a reserve with reference to a fuel quantity in pounds.

Once entered, this information is transferred to the Cruise POF page. An FMS message is displayed when remaining fuel reaches computed value (NBAA, Time or Pounds).

Init Crz Alt

Initial Cruise Altitude is initially displayed with white boxes as it is a mandatory entry. It should be set to a flight level compatible with FPLN length for operational efficiency.

NOTE

Inappropriate selection of Crz Alt may result in a prediction of Top Of Descent (TOD) being prior to Top Of Climb (TOC), which will cause inaccurate performance computations.

During climb, if ASEL is set above FMW cruise altitude, FMW cruise altitude is reset to the ASEL without indication to the crew. If ASEL is then reset to a lower altitude and the airplane levels at that lower altitude (having never reached the higher altitude), the FMS will remain in the climb mode with no obvious indication to the crew. In this case, FMW cruise altitude must be reset back to current altitude in order for the FMS to transition from climb to cruise mode.

For example: FMW and ASEL are set for FL340. A climb is initiated to FL370. ASEL is inadvertently set to FL380 and immediately returned to FL370. Automatically, the FMS internally resets its cruise altitude to FL380. The crew should reset the FMW Cruise Alt to FL370, or when the airplane levels at FL370, the FMS will remain in the “climb” mode.

If the FMS remains in climb mode during cruise, fuel usage and flight time computations will be overstated until TOD calculations override expected climb considerations.

If cruise altitude is properly reset in the FMW (Cruise POF, What-If Tab), a change in estimated fuel and time will occur which more accurately reflects true predicted data.

Step Inc

Step Increment is anticipated incremental step climb interval for performance calculations. Initially it is displayed with white dashes as it is an optional entry. It is displayed only in the Full Perf mode.

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Wind/Temp

The lower part of the page provides for input of expected enroute atmospheric conditions: wind and temperature (either temperature or ISA deviation) for the entered altitude. It is best to provide this input for the closest to actual altitude as possible.

If left blank, the FMS will use zero wind and ISA conditions (tempered by actual onboard sensors while in flight) for all cruise predictions.

FUEL / WEIGHT TAB

The **Fuel/Weight** tab is used to enter fuel and weight information for the active flight plan.

FIGURE 02-34_1-25-15 - FUEL / WEIGHT TAB

Basic Operating Weight (**BOW**) is initially filled with either the last pilot entered value or the default value from the airplane database.

Fuel is displayed green when Fuel Quantity is received from the FQMC on power-up. It becomes white if the crew manually changes this value. It reverts back to green once Fuel Flow is detected (e.g. engine start) since FQMC input is updated to the FMS during engine start.

Passengers indicate total number and average weight (in pounds) of each. The first box is number of passengers and is initially displayed with white boxes. The second is weight per passenger and is initially displayed in white with the last manually entered value during a continuous power cycle. If power was interrupted, the default comes from the aircraft database.

Cargo indicates in pounds and is initially displayed with white boxes.

Gross Wt is automatically displayed in green once all weight data is entered regardless of the **Compute** soft key state.

ETE is automatically calculated once origin and destination have been inserted and actuated. It is updated with **Compute** activated calculations.

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Fuel Req, Fuel FOM, Fuel Res for destination are computed by the system on command (**Compute** soft key) and displayed once calculation is complete. Fuel Req and Fuel Res are in thousands of pounds. Fuel FOM (Figure Of Merit) provides calculation tolerance in lbs. down to 100 lbs. accuracy.

Upon completion of pre-flight POF data entry, the **Compute** soft key is highlighted. Clicking **Compute** starts performance computations. Once calculation is complete, ETE (hours + minutes) and fuel values (thousands of pounds) are displayed in green.

This information is available only in Full Perf mode.

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DEPARTURE POF

The Departure POF contains three tabs:

- **SID** – retrieves and activates departure procedures
- **Takeoff Config** – initializes TOLD computations when installed
- **Takeoff Data** – displays advisory take-off data computed by the Take-Off and Landing Data (TOLD) function when installed and send pitch attitude / take off speeds to ADI.

The screenshot displays the Departure POF (1/2 WINDOW) interface. It features three main tabs: **SID**, **Takeoff Config**, and **Takeoff Data**. The **SID** tab is active, showing fields for Origin (KTEB), Runway (01), and SID (TETRO5). It includes a Runway / SID selection button, a diagram of the runway with a 150 Ft width, and various parameters like Rwy Hdg (16°), Elev (9 Ft), Loc Trk, Disp Thr (100 Ft), Slope (0.0%), TOSA (410 Ft), and Trans Alt (18000 Ft). The **Takeoff Config** tab shows Surface Wind (340° / 10 Kt), OAT (+15°C / +59°F), Baro Set (29.92), and Press Alt (9 Ft). The **Takeoff Data** tab displays T/O Wt (35242 Lbs), Wind (18 Kt), Pitch Att (14.0°), and a table of speeds: V₁ (114 Kt), V_R (126 Kt), V₂ (126 Kt), V_{FR} (158 Kt), V_{FT} (171 Kt), and V_{REF} (130 Kt). A **Send** button is located at the bottom right of the **Takeoff Data** tab.

FIGURE 02-34_1-25-16 - DEPARTURE POF (1/2 WINDOW)

CAUTION

Complete SID tab data prior to Take-off Config tab to avoid resetting parameters.

SID TAB

The **SID** tab provides retrieval of runway and departure route information from the navigation database and places it into the pending FPLN. It automatically displays parameters for the departure runway. Click **Runway/SID** soft key to open a Procedure dialog box that displays available Runways, SID and transitions for origin airport. Once Runway and/or SID have been selected, they are displayed at the top of the SID tab.

➤ Refer to I-NAV Graphical Flight Planning section for Procedure Dialog Box description.

Runway parameters, retrieved from the navigation database, are automatically displayed. They are modifiable by the crew.

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FIGURE 02-34_1-25-17 - SID TAB IN DEPARTURE POF WITHOUT TOLD

TOSA corresponds to Take Off Safety Altitude. Default is 400 ft above runway elevation. Entering a value resets the altitude tape bugs on both ADI.

When a Secondary flight plan is utilized as the active flight plan while in flight, **TOSA** is unavailable.

Trans Alt corresponds to transition altitude and defaults to the last pilot entry or the airplane database. Pilot entries are maintained through power off cycles. The crew is responsible for confirming its accuracy and changing when necessary.

Trans Alt in the **SID** tab is synchronized with **Trans Lvl** in the **STAR/App** tab in the Arrival Phase Of Flight.

Trans Alt / **Trans Lvl** is used for both the Active and Secondary FPLN. These parameters can be modified only on the active flight plan using either the **SID** or **STAR/App** tabs.

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TAKEOFF TABS (CONFIG AND DATA)

Takeoff tabs provide a method for crew members to input airport and airplane data, calculate TOLD performance when installed, and display critical parameters. **Takeoff Config** provides the input format and **Takeoff Data** provides computed results.

Takeoff Config Tab

Takeoff Config tab provides for input of critical airport and airplane data required for TOLD computations when installed.

FIGURE 02-34_1-25-18 - TAKEOFF CONFIG TAB WITHOUT TOLD

The upper part of the tab window provides for entry of runway conditions (wind, pressure, temperature). Default entries are provided for all fields except surface winds. Surface winds are required entries.

OAT – enter either a Celsius or Fahrenheit value. System automatically computes and displays other parameter.

Baro Set – Altimeter setting default is 1013 hPa or 29.92 in. (The last value used determines scale).

Press Alt – Pressure altitude is computed from runway altitude and **Baro Set** value.

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Takeoff Data Tab

Takeoff Data tab provides a synthesis of take-off data. It can be considered to be an electronic TOLD card.

FPLN Active		
SID	Takeoff Config	Takeoff Data
KPHX RW08R EAGUL3 ZUN		
T/O Wt: 24000 Lbs	Vspd	Kt
Wind: v10 -> 10	V1	114
	VR	126
	V2	126
	VFR	158
	VFT	171
	VREF	130
Pitch Att: 14.0 °		
Send		

FIGURE 02-34_1-25-19 - TAKE-OFF DATA TAB

Origin airport, selected runway, and SID are displayed at the top of the tab once activated within the flight plan.

Take-off weight and wind component are displayed.

Takeoff weight, takeoff distance and runway available are self-explanatory.

Wind is given as head-wind or tail-wind, and cross-wind component.

Wind data display as:

- ↓ = headwind
- ↑ = tailwind
- ← = right crosswind
- → = left crosswind

The crew must manually insert T/O **Pitch Att** field. This value corresponds to the AFM value for initial rotation at VR.

The crew must manually insert each Vspeed value. Take-off weight and wind components remain displayed.

Clicking **Send** soft key sends Vspsds to speed tapes and ADI box windows on both PDU.

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CRUISE POF

Cruise POF provides four tabs of information:

- What-If Init
- What-If Data
- E.O. Range

They provide a summary of current cruise conditions and various range calculations based on both current conditions and projected scenarios.



FIGURE 02-34_1-25-20 - CRUISE POF (1/2 WINDOW)

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CRUISE SUMMARY TAB

Spd (airspeed), **Crz** (cruise altitude), and **Step** (step climb) are based on inputs from preflight unless updated by the crew. Updates are input using the **What-If Init** tab.

Ceil (Ceiling) and **Opt** (Optimum altitude) are based on a blend of available information. The FMS uses manual input predictions, current condition measurements, and Smart Perf (or other selected choice on **FMS Setup** tab) to obtain these figures.

Ceil is the maximum altitude for any given CAS / Mach mode, based on current FMS weight and computed wind/temperature conditions.

Opt is the altitude between max certified ceiling (47,000 ft) and sea level at which the greatest specific range can be achieved for any given CAS / Mach mode, based on current FMS weight and computed wind/temperature conditions

Both of these altitudes will vary depending on selected speed (Manual, Max speed, or Max Endurance Speed).

In Figure 02-34-20-23, **Ceil 42.3** and **Opt 42.3** would mean maximum altitude is 42,800 ft and optimum altitude is 42,600 ft for the current speed mode (**Spd**).

Specific range is calculated using current FMS weight and current wind / temperature from aircraft database performance data (Smart Perf) once sufficient learning has been performed.

NOTE

Since ceiling, optimum altitude and specific range are calculated from the airplane database, they are based on information that is not certified. It is subject to potential errors contained in the database.

Fuel summary information is displayed digitally and with synthetic bar-graphics to display projected fuel remaining at destination and alternate based on a blend of current mission parameters (speed, cruise altitude, step climbs, atmospheric conditions), current airplane weight and predicted mission conditions (for remainder of flight).

There are two pairs of fuel bar-graphics: the left pair represents destination fuel, the right pair represents alternate fuel.

The white bars in both pairs represent pre-planned fuel prior to take-off (labeled "Preflt"). The green bars represent current fuel estimates during flight (labeled "Actual").

A white line represents fuel reserves as defined before take-off.

In the event of an engine out condition, tab title becomes **Cruise Sum E.O** (Cruise summary engine out) to inform crew that predictions are based on engine-out data.

NOTE

For NBAA computed fuel reserves, white bars do not extend to the alternate, since alternate fuel is included in NBAA computations.

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To Reserves represents **Range** and **Endurance** available excluding reserve requirements (white line).

Destination and alternate identifiers are displayed beneath the bars along with ETE.



FIGURE 02-34_1-25-21 - CRUISE SUMMARY TAB NORMAL AND ENGINE OUT

WHAT-IF TABS

What-if tabs provide a method for crews to input a scenario, calculate effect on fuel, range, and time, and display results for active FPLN. It is not available for a secondary FPLN.

What-If Init provides the input format and **What-If Data** provides computed results.

What-If Init Tab

What-If Init provides for modifications of critical parameters to calculate effects of potential changes to the overall flight plan. These modifications can be made either inflight or during preflight.

For more details on boxes in this tab refer to the **Alt/Spd** tab of the Preflight phase of flight. Defaults are the current (active) settings.

Compute soft key is greyed-out until a change is made on this page.

Clicking **Compute** initiates performance computations, and greys-out the soft key.

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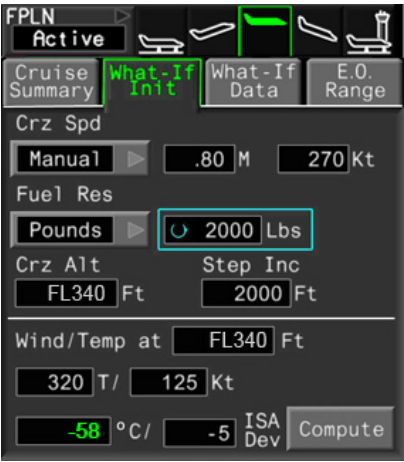


FIGURE 02-34_1-25-22 - WHAT-IF INIT TAB NORMAL

What-If Data Tab

What-If Data displays results from What-If computations.

New data conditions are displayed in green at the top of the page for each of the categories.

New fuel prediction (cyan) is displayed next to the current estimate (green).

Reserves are indicated by a white line and accompanying digital data.

Destination, to where predicted data applies, is displayed in the lower left corner.

Selecting **Active** moves changes into the active flight plan and clears this window.

Selecting **Cancel** clears the window without changing active flight plan data.

Active and **Cancel** soft keys are not available when greyed-out.

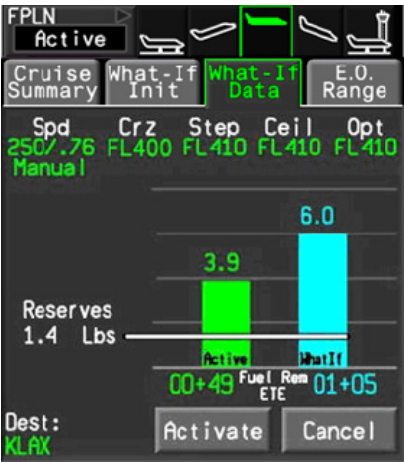


FIGURE 02-34_1-25-23 - WHAT-IF DATA TAB NORMAL

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E.O. RANGE TAB

E.O. Range displays critical information to the crew regarding a potential engine out situation. No crew input is available. E.O. computations are continually updated during flight.

This tab is not available for the Secondary flight plan.

The FMS computes optimum range, speed, and altitude for engine out conditions using current airplane weight and OAT. **Crz Alt** and **Crz Spd** are determined by the FMS during these computations.

To Reserve Fuel is the **ETE** and **Range** excluding reserve requirements.

To Zero Fuel and **ISA Dev** are self-explanatory.

When an Engine Out condition is detected, this tab is removed and the titles of the other tabs are renamed as indicated below:



FIGURE 02-34_1-25-24 - E.O. RANGE TAB NORMAL

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ARRIVAL POF

Arrival POF provides interface for selection of arrival and approach, landing configuration, and Landing Data. The figure below illustrates arrival POF displayed in a 1/2 window.

FIGURE 02-34_1-25-25 - ARRIVAL POF (1/2 WINDOW)

STAR/APP TAB

STAR/App provides selection and display of arrival procedures (STAR and Approach) and landing runway parameters. Clicking **Rwy/App/STAR** soft key drops down the **Arrival** menu to displays available Runways, Approaches and STAR for destination. Select appropriate radio buttons to load data into temporary storage.

Insert soft key becomes active when any data is selected in the **Arrival** menu. Clicking **Insert** places temporary arrival and approach data into the I-NAV window and WPT LIST. After confirming accuracy of data, click **Activate** (available in I-NAV window or WPT list) which inserts the temporary data into flight plan and causes the **Arrival** menu to disappear (display returns to **STAR/App** page). On the **STAR/App** page, confirm **Dest**, **RW**, **Appr**, and **STAR** contain accurate data. If incorrect, repeat selection process (click **Rwy/App/STAR**).

Upon selection of a runway, all runway information is retrieved from navigation database and displayed in green. All boxes contain information except **Lock Trk** (refer to HGS). The runway picture itself is static and does not change based on runway length or width.

The runway diagram displays all runway data base parameters (heading, elevation, width, length, ILS glide slope, displaced threshold and runway slope). This information must be verified by the crew. These parameters can be overridden if necessary, and will be displayed in white when changed.

For circle to land approaches, complete page with direct approach data (e.g. ILS 35L) but insert **Rwy Hdg** for runway in use (e.g. 304° for Rwy 30). (Other information such as Elev, Rwy Length, Disp Thr, Slope and Baro Min may also need to be manually entered for the runway in use.) Once compute is calculated, wind computations are related to runway in use (Rwy 30).

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FIGURE 02-34_1-25-26 - ARRIVAL POF FOR CIRCLE APPROACH

When **Disp Thr** (displaced threshold) is entered, available runway length is recalculated.

Slope (runway slope) is indicated in tenths of a percent with an up (positive) or down (negative) arrow.

Trans Lvl (transition level) defaults to the last entered value. When a new software load occurs, the default is 18,000 feet.

G/A SA (Go Around Safety Altitude) defaults to 800 ft above runway elevation as indicated in **Elev**. If runway elevation is not available, it defaults to white dashes. Setting a value resets bugs on the altitude tapes on both ADI.

HUD Confirm soft key sends loc true track, glide slope reference, landing elevation and runway length to the HUD for synthetic runway display. It is linked to the **Lock Trk**, **Glide**, **Elev**, and length boxes.

NOTE

The correct setting of localizer true track is a key element for proper HGS operation during approach. It is automatically inserted for CAT III approaches.
It must be verified for accuracy by the crew.

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FIGURE 02-34_1-25-27 - STAR / APP TAB

NOTE 1

All data input is white when modified by the crew.

NOTE 2

Use **CLR DEL** push button on MKB to clear manual entries and reset database parameters.

Once reset, the color of each parameter changes from white to green.

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LANDING TABS (CONFIG AND DATA)

Landing tabs provide a method for crews to input airport and airplane data, calculate landing performance, and display critical parameters. **Landing Config** provides the input format and **Landing Data** provides computed results.

Landing Config Tab

Landing Config tab provides for input of critical airport and airplane data required for TOLD computations when installed.

FIGURE 02-34_1-25-28 - LANDING CONFIG TAB

The upper part of the tab window provides for entry of runway conditions (wind, pressure, temperature). Default entries are provided for all fields except surface winds.

OAT – enter either a Celsius or Fahrenheit value. System automatically computes and displays other parameter.

Baro Set – altimeter setting default is 1013 hPa or 29.92 in. (The last value used determines scale).

Press Alt – pressure altitude is computed from runway altitude and **Baro Set** value.

The lower part of the tab window provides for entry of airplane data.

When **Steep Appr** check box is checked, the system automatically sets EGPWS mode 1 to steep approach envelope. The steep approach selection automatically set also the default value for the flight director and Autopilot ILS steep approach. No performance calculations are affected. It can also be set using **SENSORS** window. Crew is alerted by “STEEP” annunciation on PDU (ADI window). **Steep Appr** is automatically de-selected at Go-Around selection.

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Flaps Override inhibits "TOO LOW FLAPS" aural warning at 250 ft RA when not in SF3 configuration during final approach. Crew is alerted by "FLAPS OVRD" annunciation on PDU HSI window). It can also be set using SENSORS window.

Landing Data Tab

Landing Data tab provides a synthesis of landing data. It can be considered to be an electronic TOLD card.

FIGURE 02-34_1-25-29 - LANDING DATA TAB

The upper part of the page provides a summary of selected procedures and gathers approach category and minimums information. The lower part is used to input landing speeds for display on the PDU.

New terminology used for minimums (**RA DH** and **Baro Min**) allows compliance with new regulations and terminology, especially concerning FMS VNAV approaches, and **CAT2** / **CAT3** approaches:

RA DH – approach minima based on radio altimeter (RA) (normally **CAT2 / HUD2** and **HUD3** precision approaches).

Baro Min – approach based on barometric altitude / height (**CAT1** ILS, **FMS / VGP**, **LOC**, **B/C** and all non-precision approaches).

App Category (Approach Category) is related to all other information in top half of this tab. Selection of a particular approach type simultaneously selects a “minimums restriction” radio button (**RA DH** or **Baro Min**) and inserts a minimum altitude into its corresponding “minimums” box. The “minimums” box value may be modified to a higher value, but not to a lower one. The default is **FMS / VGP** approach with corresponding minimums set to runway elevation (as displayed on the **STAR/App** tab) + 250 ft.

When an ILS approach is selected (in the **STAR/App** tab), **CAT1** becomes the default in the **App Category** box.

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If an approach other than **ILS** is selected (in the **STAR/App** tab), **FMS / VGP** becomes the default in the **App Category** box.

The figure below depicts the drop down menu display for **App Category**:

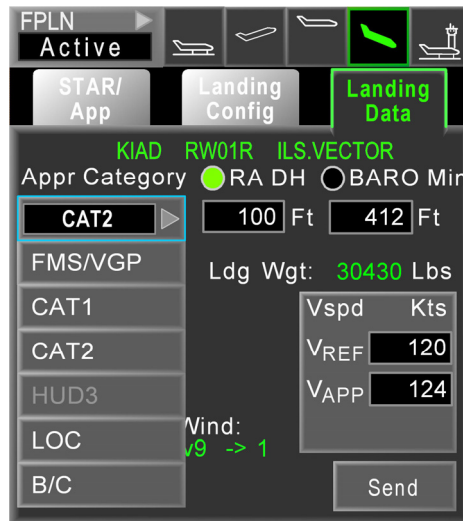


FIGURE 02-34_1-25-30 - LANDING DATA TAB APP CATEGORY DROP DOWN MENU

When **FMS / VGP** approach is selected:

- **Baro Min** radio button is selected
- Corresponding minimums set to runway elevation (as displayed on the **STAR/App** tab) + 250 ft. The crew can modify to a higher value when appropriate. If no runway elevation is available, the field defaults to 250 ft, and can be modified higher.
- At APP mode selection on the GP, **VGP** appears in the FMA
- causes **VGP** to appear in the FMA at the appropriate time during the approach

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When **CAT1** appears (or is selected):

- **Baro Min** radio button is selected
- Corresponding minimums set to runway elevation (as displayed on the **STAR/App** tab) + 200 ft. The crew can modify to a higher value when appropriate. If no runway elevation is available, the field defaults to 200 ft, and can be modified higher.
- Auto-tunes ILS Frequency
- Sets front course in HSI CDI
- At APP mode selection on the GP, **G/S** appears in the FMA
- Causes **G/S** to appear in the FMA at the appropriate time during the approach

NOTE

If a pilot selected a CAT1 approach and he changed from BARO-Min to RA DH, the approach type will be automatically select as CAT2 approach. In that case, the approach menu will stay as CAT1. Nevertheless, when the LOC will be capture, an amber CAT2 will be displayed in ADI. This should warn the pilot.

When **CAT2 / HUD2** is selected:

- **RA DH** radio button is selected
- 100 (ft) is defaulted into the minimums box. Can be modified to between 100 ft and 199 ft. This selection also impacts TOLD computations (if installed) by limiting Maximum Landing Weight.
- Auto-tunes ILS Frequency
- Sets front course in HSI CDI
- At APP mode selection, **G/S** appears in the FMA
- Causes **G/S** to appear in the FMA at the appropriate time during the approach
- Causes "CAT2 / HUD2" to appear in the ADI at the appropriate time during the approach

When **HUD3** is selected:

- **RA DH** radio button is selected
- 50 (ft) is defaulted into the minimums box. Can be modified to between 50 ft and 99 ft.
- Auto-tunes ILS Frequency
- Sets front course in HSI CDI
- At APP mode selection on the GP, **G/S** appears in the FMA
- Causes **G/S** to appear in the FMA at the appropriate time during the approach
- Causes "HUD3" to appear in the ADI at the appropriate time during the approach

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When **LOC** is selected:

- **Baro Min** radio button is selected
- Corresponding minimums set to runway elevation (as displayed on the **STAR/App** tab) + 250 ft. The crew can modify to a higher value when appropriate. If no runway elevation is available, the field defaults to 250 ft, and can be modified higher
- Auto-tunes ILS Frequency
- Sets front course in HSI CDI
- At APP mode selection on the GP, **LOC** appears in the FMA
- **LOC** mode will appear in the FMA at the appropriate time during the approach
- No vertical guidance is provided

When **B/C** is selected:

- **Baro Min** radio button is selected
- Corresponding minimums set to runway elevation (as displayed on the **STAR/App** tab) + 250 ft. The crew can modify to a higher value when appropriate. If no runway elevation is available, the field defaults to 250 ft, and can be modified higher
- Auto-tunes ILS Frequency
- Sets front course in HSI CDI
- At APP mode selection on the GP, **B/C** appears in the FMA
- Causes **B/C** mode to appear in the FMA at the appropriate time during the approach
- No vertical guidance is provided

In the lower section of the page, the crew members have to enter each landing speed value for display on the PDU

Wind components are displayed as in the **Takeoff Data** tab (arrows for wind direction and digital values for wind velocities).

Landing Weight is also displayed in the lower section of the page.

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POST-FLIGHT POF

The Post-flight POF provides a flight summary. Figure 02-34-20-35 illustrates Post-flight POF displayed in a 1/2 window.

Flight Sum 1	Flight Sum 2	Flight Sum 3
Date: 05 JUN 06 Tail : FWNCO Crew: JOHN SMITH JANE DOE Passengers: 1	Avg TAS: 307 Kt Air Dist: 256 NM Avg GS: 235 Kt Gnd Dist: 235 NM KTEB Taxi Time: 1145z T/O Time: 1154z KIAD Ldg Time: 1244z Apron Time: 1255z Flight Time: 00+50 Block Time: 01+00	FU1: 1600 Lbs FU2: 1600 Lbs IRS1 Drift: 1.1 NM/H IRS2 Drift: 1.2 NM/H IRS3 Drift: 1.2 NM/H

FIGURE 02-34_1-25-31 - FLIGHT SUM TABS (1/2 WINDOW)

(Post-flight POF supports three tabs labeled Flight Sum 1, Flight Sum 2, and Flight Sum 3 for the active flight plan. Post-flight pages are unavailable for the Secondary flight plan.

When the **Printer** checkbox for the **Flight Summary Output** is checked on the Avionics window **FMS Setup** tab, information displayed on the three Flight Sum tabs is sent to the printer in text format upon landing. This information is saved to a file upon landing if the **Disk** checkbox for **Flight Summary Output** selection is checked.

FLIGHT SUM 1

Tail # on this tab is synchronized with **Tail #** on the Avionics window **Init** tab (i.e. entry on **Flight Sum 1** tab will be reflected on the Avionics window **Init** tab, and vice-versa). If there is no value available from the Avionics window, this box displays white dashes.

Crew boxes default to dashes and are used for entry of the pilots' names.

Passengers displays the number of passengers from the **FUEL / Weight** tab from the Preflight POF. If not defined, the area is blank.

FLIGHT SUM 2

All associated data for display is provided by the FMS and is based on the values recorded and computed for the Active flight plan. If a particular data item is not available for display, then its associated display field is blank.

Avg TAS displays average airspeed based on **Flight Time** and air distance. If **Air Dist** is displayed in amber, **Avg TAS** is also displayed in amber.

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Air Dist displays total air distance for the flight. During flight, if TAS becomes invalid, **Air Dist** displays in amber at the last valid value. When TAS becomes valid again, distance computation resumes with the assumption that TAS since the last valid value was constant and equal to current value. With TAS valid again, **Air Dist** will be displayed in green as computed by the FMS.

Avg GS displays average ground speed based on **Block Time** and ground distance. If **Gnd Dist** is displayed in amber, **Avg GS** is also displayed amber.

Gnd Dist displays total ground distance for the flight. During flight, if ground speed becomes invalid, **Gnd Dist** displays in amber at the last valid value. When ground speed becomes valid again, distance computation resumes with the assumption that ground speed since the last valid value was constant and equal to current value. With ground speed valid again, **Gnd Dist** will be displayed in green as computed by the FMS.

ICAO identifiers for the active flight plan's origin and destination is displayed in green beneath their respective takeoff and landing icon.

Taxi Time displays time recorded from original parking brake release after system power-up. Any subsequent setting and/or releasing of the parking brake does not cause **Taxi Time** to change. If the system is powered up while the parking brake is already released, power up time is captured for **Taxi Time**.

T/O Time displays takeoff time (Zulu) in green.

Ldg Time displays landing time (Zulu) in green.

Apron Time displays time recorded when the parking brake was set after flight. If the parking brake is set, and then released and later reset, the latest time is captured.

Flight Time is elapsed time in flight measured once **T/O Time** is displayed.

Block Time is overall duration between **Taxi Time** and **Apron Time**. If in flight or after landing prior to setting parking brake, it is duration between **Taxi Time** and current time.

Block Time is displayed as soon as **Taxi Time** is available.

For quick turn operations (power is not shut down), **Apron Time** continues to be displayed until the airplane goes airborne again. Once airborne for the next leg, the last release of the parking brake prior to takeoff is used as the new **Taxi Time**.

FLIGHT SUM 3

All associated data for display is provided by the FMS and is based on the values recorded and computed for the Active flight plan. If a particular data item is not available for display, then its associated display field is blank.

Fuel Used values (**FU1**, **FU2**) are the same as those displayed on the Fuel Synoptic.

Drift Rates values (**IRS1 Drift**, **IRS2 Drift**, etc...) for all installed IRS are the same as those displayed on the Sensors window.

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FMS APPROACHES

There are 4 different ways to conduct FMS based approaches:

- LNAV only with non FMS vertical mode :
 - o LNAV + PATH
 - o LNAV + VS
- Full FMS approaches
 - o Standard VNAV operation (LNAV + VPATH) :
 - o VGP approaches (LNAV + VGP)

Below is described the full FMS approaches (LNAV+VPATH and LNAV+VGP).

APPROACH TYPE SELECTION

The approach procedure is selected in the FMW / Arrival POF / STAR/App tab. This procedure is activated in the waypoint list or in the I-NAV.

All the waypoint associated constraints are coming from the database. They allow the system to build the lateral and vertical trajectory.

These constraints are displayed in white at approach selection. Three type of constraint exists: AT, AT or ABOVE, AT or below. These constraints can be modified by the pilot.

Three waypoints are important for the final approach for vertical guidance computation:

- RWY (runway)

This waypoint is located at the runway threshold and always has an AT altitude constraint of runway threshold + 50ft.

- FAF (Final Approach Fix)

Between the FAF and the MAPT, the final approach path and the final approach course are defined. The final approach course may be different from the runway course. Both courses can not be modified by the pilot.

- MAPT (Missed Approach Point)

This waypoint is the first waypoint of the missed approach. At its location, if pilots have not the runway in sight, they have to perform a Go-Around.

The altitude constraint at the MAPT is the bottom of the defined approach procedure. This waypoint is not necessarily at the place where the MDA is reached. It is not possible to change, delete or insert a waypoint between the FAF and the MAPT.

If the MAPT is well before the runway threshold or after the runway threshold, the final approach path ends at the MAPT.

If the MAPT is just before the runway threshold (approximately 0.2NM), the final approach path ends at the runway threshold + 50ft.

In this last case, the approach is coded as a VGP approach.

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APPROACH TYPE ACTIVATION

FMS approaches are all the selection available in the FMW / Arrival tab except the ILS approaches (i.e. RNAV, GPS, NDB, NDB-DME, VOR, VOR-DME, VORTAC).

The pilot has to enter the baro-minimum selection for the corresponding approach. Baro Min is selected by default at runway elevation + 250 ft. The crew can only select a value above runway elevation plus 250 ft.

NOTE

The FMS based approaches are only QNH operation.
The system is not design for QFE operation.

VNAV

The vertical trajectory is managed by the pilot through the ASEL.

No pilot specific action for VNAV approaches in addition to the ASEL management.

VGP

VGP is published when the slope between the FAF and the MAPT is published as well as the Threshold Crossing Height (TCH). If the slope and the TCH are not published but MAPT is located ahead of the runway threshold, VGP approach should be available.

There is no VGP approach capability for approaches featuring a MAPT located beyond the runway threshold.

The vertical profile proposed by the system should be checked by the crew. It is the crew responsibility to check the system proposed VGP angle against the chart-published descent angle.

NOTE

It is recommended to not use VGP mode when the published path is below 3° PATH (example -2.7°). In such case, the VGP mode will force the reference path to -3° and the capture will occur after the FAF.

When the system is capable to perform a VGP approach, a “VGP RW..X” excitement field will be displayed in FMA to indicate to the pilot that the mode can be armed. Once the pilot will press APP button, the VGP mode will be armed.

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“VGP RW..X” excitement can occur if one of the following conditions is met:

- The FAF is the "To" WPT,
- A "Vertical Direct To" the FAF has been selected. In that case the excitement will occur at the FAF,
- Inbound the FAF in an holding pattern (FAF is the Holding Fix),
- When LNAV mode is captured after a "Vectors to final",
- When intercepting a course to the FAF.

As soon as the VGP is armed, the vertical deviation scale displays the vertical deviation from the reference path for VGP (Reference slope between the FAF and the MAP).

When a Vertical Direct To is performed on the FAF, the vertical deviation scale is used for the Vertical Direct To function. As the VGP requires also the vertical deviation scale, the VGP mode can not be armed as long as the Vertical Direct To is not sequenced. The early sequence occurs 50ft above the FAF.

This is the reason why, in such case, if a Vertical Direct To the FAF is performed, the VGP excitement will appear at the FAF and the VGP will be captured after the FAF which may generate a steep slope in order to recover quickly the reference path between the FAF and the MAPT.

APPROACH TYPE GUIDANCE

Vertical guidance control laws are completely identical between VNAV and VGP.

The VTA (Vertical Track Alert) indication will flash on ADI 10s prior to TOD activation.

VNAV

A vertical deviation scale is generally displayed except for default VPATH mode activation. The default path is -3°.

This mode is activated in holding pattern when ASEL is selected below the aircraft when the current mode is VALT.

VGP

The VGP mode is similar to VPTH mode but the altitude pre-selector (ASEL) is ignored. When VGP is active, the ASEL can be selected to the missed approach altitude. In this case, there is no "RESET ASEL" FMS message.

VGP selection will allow the engagement of the VGP flight director mode through the APP button provided the following conditions are fulfilled:

- FMS is displayed on the PF (couple side) HSI,
- A non-localizer based approach has been selected,
- FMS not in DEGRADE or DR mode,
- The FAF, then the MAPT must be the active (To) waypoint,
- “VGP RW..X” excitement in FMA.

If the engagement of the VGP occurred after the FAF, the descent angle can be up to twice the referenced path. This design allows minimizing the time needed to recover the reference path.

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If the mode is not able to reach the referenced path, a FMS message “UNABLE NEXT ALT” will be displayed on I-NAV, and the MAPT altitude constraint will become amber in ADI window, Waypoint List window and Vertical Situation Display (I-NAV window).

VERTICAL NAVIGATION MODE EXIT

The main different way to exit vertical navigation mode are:

- Go-Around (modes becomes ROL / GA)
- Change in lateral mode and/or vertical mode (CLB, VS)

VNAV

Use of path wheel reverts VPATH to PATH.

VGP

Use of path wheel does not allow exiting VGP (same behaviour compared to a GS mode for ILS).

When crossing the missed approach point the vertical guidance (VGP) is lost. The vertical mode reverts to PATH at the current path.

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GENERAL

I-NAV is the Interactive Navigation map of the EASy flight deck. I-NAV map:

- Displays various layers of data base information (terrain, airways, nav aids, airports, geopolitical, airspace ...)
- Merges information from on-board sensors (FMS flight plan, aircraft position, weather, TCAS plots)
- Provides intuitive, synthetic horizontal plane view of aircraft situational environment

Using the CCD, direct modification of flight plans can be completed on the I-NAV map.

All graphical flight plan modifications are performed using the intuitive object-task method:

- Click on map object to be modified (with the CCD)
- Task menu appears containing all valid tasks that can be performed
- Click on desired choice
- Activate choice

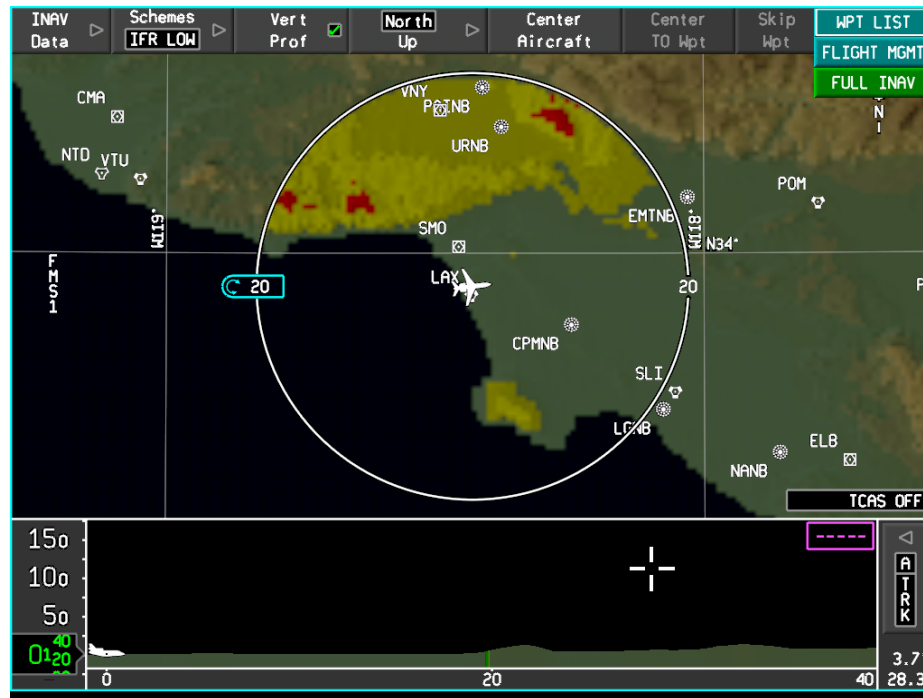


FIGURE 02-34_1-27-00 - FULL WINDOW I-NAV

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I-NAV WINDOW LAYOUT

I-NAV can be displayed in a 1/3, 2/3 or full window format in each MDU. Information capacity remains the same in all formats.

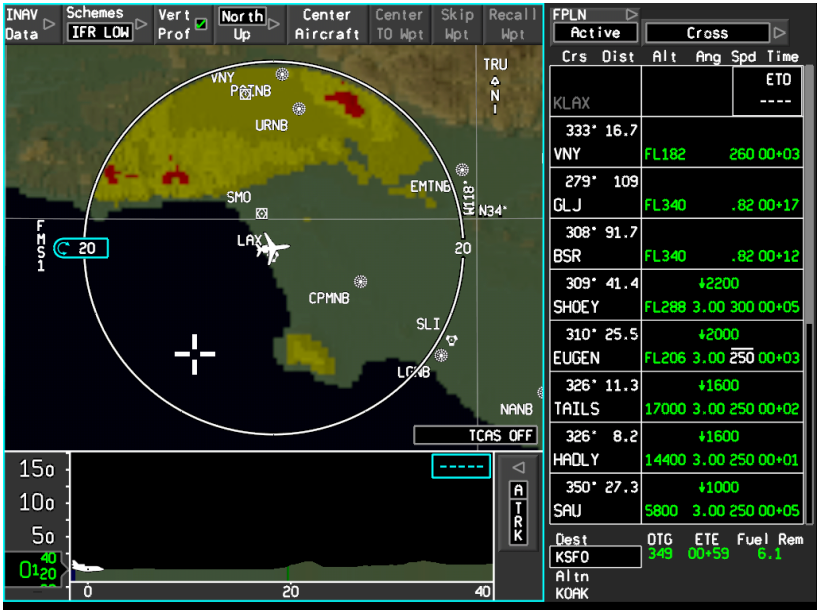


FIGURE 02-34_1-27-01 - 2/3 I-NAV WINDOW IN UPPER MDU



FIGURE 02-34_1-27-02 - 1/3 I-NAV WINDOW IN LOWER MDU

Two I-NAV maps can be displayed simultaneously and independently, one on each MDU, each with a different set of data.

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I-NAV MAP

I-NAV map increases situational awareness and eases some aspects of flight planning. It uses a map projection that displays great circle legs as straight lines. I-Nav uses topographical color-coding to provide a 3-dimensional display of terrain.

MANAGING THE MAP

A Tool Bar is located at the top of the I-NAV Map for various control functions:

- **I-NAV Data** – a drop down menu that provides selection for various symbols, display functions (WX, terrain, TCAS) and other flight related data (airways, Airspace boundaries, fixes, etc.).
- **Schemes** – recovers one of two default layers of I-NAV Data for display (**IFR HI** or **IFR LOW**). Both default choices display Boundaries, Terrain, and Traffic.
- **IFR HI** – adds Airports and Alternate FPLN.
- **IFR LOW** – adds NDB, VOR, Constraints, and Missed Approach.
- Whenever a choice is made using **I-NAV Data** Menu, **Schemes** box changes to **PILOT** which indicates map display data is manually set by the crew.
- **Vert Prof** checkbox – displays a vertical profile which appears at the bottom of Full and 2/3 I-Nav windows.
- Map Center and Orientation – provides multiple ways to re-center or orientate map.

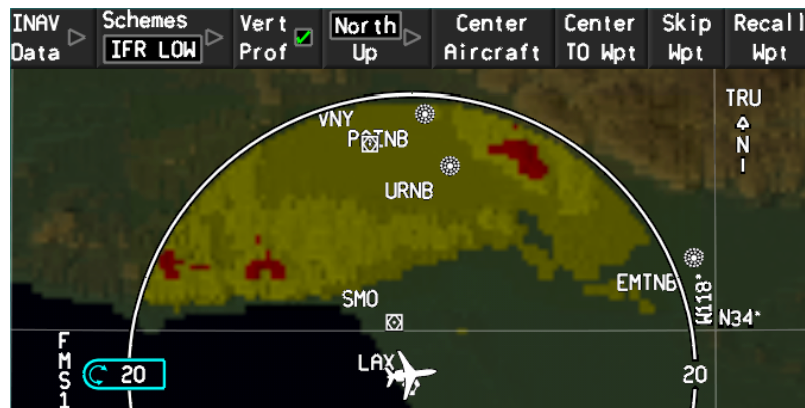


FIGURE 02-34_1-27-03 - I-NAV TOOL BAR

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I-NAV with vertical profile



I-NAV without vertical profile

FIGURE 02-34_1-27-04 - 2/3 I-NAV WINDOW VERTICAL PROFILE

MAP RANGE ADJUSTMENT

Symbols and text on the map are range dependent. More detail is visible on smaller scales due to an automatic de-clutter feature. It is a crew responsibility to select appropriate layers of information (through I-NAV scale and layer selection) depending on flight phase.

Map range can be adjusted by using CCD data set knob whenever the cursor is in the lateral map (including scroll frame). The inner knob provides small range adjustment while the outer knob provides higher range adjustment. Maximum half range is 750 NM; minimum is 0.5 NM.

MAP CENTER AND ORIENTATION

The map may be oriented Heading Up (mag or true) or North Up (only true):

- Heading Up – aircraft positioned at 1/3 of the I-NAV height and map displayed along aircraft heading. A 180° compass arc is provided. When using the 1/3 display window, the aircraft is at the bottom of the window. This function is not available with any “centering” function.
- North Up – map displayed with True North pointing up. Map may be centered on the aircraft or any waypoint or fix. It is possible to scroll the map in every geographical direction by using “scroll frame”.

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FIGURE 02-34_1-27-05 - I-NAV IN HEADING UP

The scroll frame is the area just inside the edges of the map in North Up format. It is highlighted when the cursor is within the frame area. To scroll the map, the cursor must be within the frame area on the desired directional edge (top, either side, or bottom) and the <ENTER> pushbutton of the CCD the crew must be held depressed. The map continuously moves until the button is released. When the scrolling action is stopped, the aircraft moves again on the I-NAV map. Using scroll frame when in Heading Up automatically reverts the map to North Up.

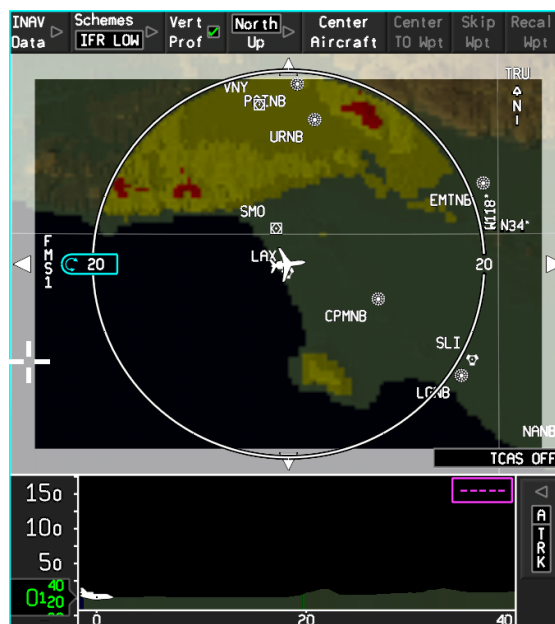


FIGURE 02-34_1-27-06 - I-NAV SCROLL FRAME

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I-NAV DATA MENU

The I-NAV Data Menu provides all controls to manage the layers of the I-NAV map. To open, click the I-NAV Data menu key in the I-NAV Tool bar. Each item corresponds to a layer of data (same capacity in North-up or Heading-up).

Display priority (during auto de-clutter) is from top to bottom:

- WX – weather radar image from pilot side PDU WX image (default), and adjustment of brightness (using CCD knob)
- LSS (optional) – lighting symbols
- Traffic – TCAS traffic plots
- FPLN sub-menu – active flight plan, alternate flight plan and missed approach
- Fixes sub-menu – airports, VOR, ADF, Intersections
- Airways sub-menu – high altitude, low altitude airways
- Airspaces sub-menu – special use, terminal airspaces
- Boundaries – international boundaries, rivers
- Terrain – absolute terrain information and situational awareness terrain (e.g. relative terrain) and adjustment of its brightness (using CCD data set knob).



FIGURE 02-34_1-27-07 - I-NAV DATA MENU

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FMS MESSAGE FIELD

Messages generated by FMS system are displayed in a dedicated box located in the middle top part of the I-NAV. A white “MSG” annunciation is displayed in the HSI when an FMS message is displayed in I-NAV.

The dialog box displays the last messages (if many messages are triggered).




FIGURE 02-34_1-27-08 - FMS MESSAGES IN I-NAV

The last messages can be acknowledged (simultaneously for all FMS) by pressing the  white pushbutton located on the eyebrow.

NOTE

This pushbutton does not illuminate when an FMS message is triggered.

When I-NAV is not displayed, only the MSG annunciation in the HSI is displayed and the  white pushbutton on the eyebrow has no action (no blind acknowledgement).

GENERAL

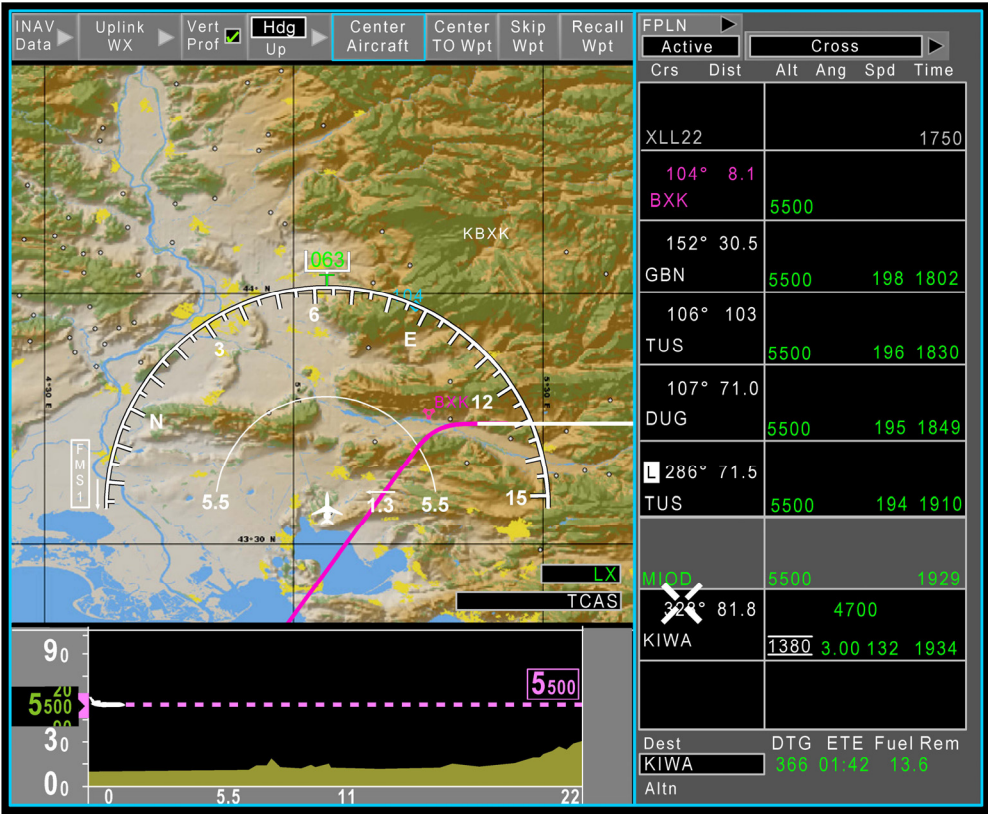


FIGURE 02-34_1-28-00 - INAV TOOL BAR

The Vert Prof selection (VSD) is available and visible only when the INAV window size is greater than 1/3rd, but for both Secondary and Active Flight Plans.

The Vert Prof is defaulted to Selected upon power up. When selected, VSD is always displayed at the bottom of INAV window.

The reference setting for all VSD barometric altitudes is the Pilot Flying barometric setting.

NOTE

Below transition altitude or level, altimeter setting must be set to QNH for the use of VNAV and VSD.

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VERTICAL SITUATION DISPLAY

VSD SELECTION



FIGURE 02-34_1-28-01 - INAV TOOL BAR

The selection/deselection of the VSD is done by the pilot through the INAV tool bar using the Vert Prof button.

LIST OF OBJECTS DISPLAYED

Airplane

The airplane symbol is allowed to move its position vertically and horizontally on the VSD.

The airplane symbol vertical position in VSD window is computed according to the airplane barometric altitude. A framed label with green text on a black background showing the A/C barometric altitude in feet is displayed at A/C symbol height on the Y-axis scale.

The airplane symbol horizontal position in VSD window is computed according to INAV modes. The airplane symbol is horizontal, constant in size and always oriented to the right. The default color of the airplane symbol is white. The zero position of the airplane is at the center of the symbol represented by a black dot, consistent with INAV.

Cursor Angle and Distance

The angle and horizontal distance values from the airplane symbol zero position to the cursor position in VSD are displayed at the bottom right corner of VSD.

The cursor is free-flowing within VSD. In case where the two cursors are simultaneously present in VSD, priority rules are that of MDU cursor conflict. In this case, flight path angle and horizontal distance are computed with the active cursor position.

Flight Plan

Flight plan items (Waypoints, Legs, TOC, TOD and BOSC, Missed Approach, Intermediate Leveloffs) are displayed in VSD if FPL is displayed.

Default symbol for flight plan waypoints is the upright four-branch star.

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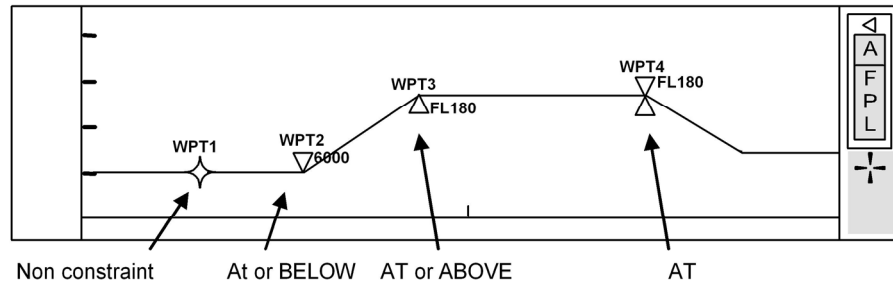


FIGURE 02-34_1-28-02 VSD - FLIGHT PLAN

Waypoints are positioned in VSD according to their predicted barometric altitude. Waypoints defined by Flight Level are positioned using the VSD barometric reference setting. The waypoint name are displayed above waypoint symbol.

Default FPL waypoint color is white.

Waypoints with crossing constraints are depicted as follows (constraint symbols replace default waypoint symbol):

- upward pointing triangle for "AT or ABOVE" constraints
- downward pointing triangle for "AT or BELOW" constraint
- upward and downward pointing triangles for "AT" constraint
- If the constraints layer is selected (via the INAV Data Menu) the numeric value of the constraint is also displayed to the right of the constraint symbol

The color of the constraints (symbol and text) follows the color shown on the waypoint list.

If VNAV is engaged then the active leg is displayed in Magenta as follows:

- If VALT or VASEL is active the TO leg is displayed Magenta up to the TOD or BOSC
- If VPTH is active the TO leg is displayed Magenta

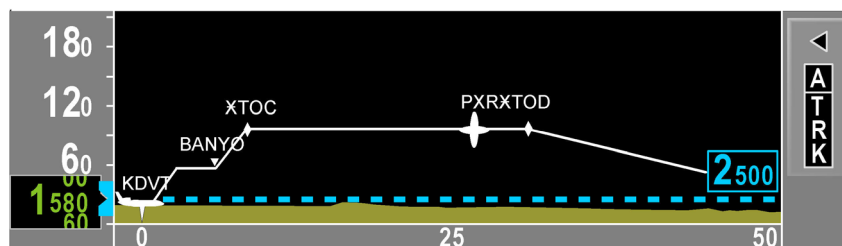


FIGURE 02-34_1-28-03 VSD - TOP OF CLIMB, TOP OF DESCENT

The symbol for top of climb (TOC), Bottom of Step Climb (BOSC) and top of descent (TOD) is the diamond. Downpath TOC points associated with a BOSC are labeled Top of Step Climb (TOSC).

The TOD, TOC and BOSC points remain displayed after they are sequenced, until the FROM waypoint changes. This is in order to maintain the correct path visualization.

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Flight Path

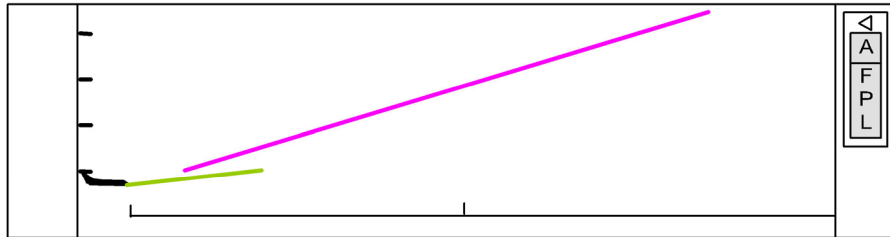


FIGURE 02-34_1-28-04 VSD - ACTUAL AND COMMANDED FLIGHT PATH

Actual flight path is depicted as a solid green line extending from the airplane nose to 2 cm ahead of the airplane.

Actual flight path is displayed if the following conditions are all met :

- Airplane symbol is displayed
- Xrange is less than or equal to 150 NM
- Climb/Descent rate exceeds ± 300 feet per minute

Commanded flight path is depicted as a solid magenta line extending from the airplane nose to the limit of VSD window boundary.

Commanded flight path is displayed if the following conditions are all met :

- Airplane symbol is displayed
- Xrange is less than or equal to 150 NM
- path mode is active

ILS Beam Symbol

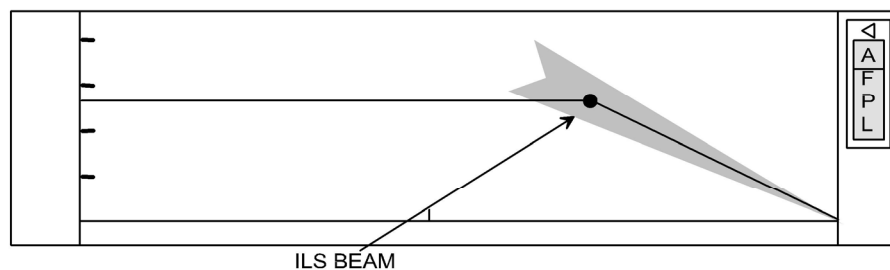


FIGURE 02-34_1-28-05 VSD - ILS BEAM

ILS beam is positioned appropriately with respect to the glideslope from the Navigation Database.

Glideslope feather top angle is sharp and ILS beam length in VSD is consistent with that of INAV lateral map.

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Scales

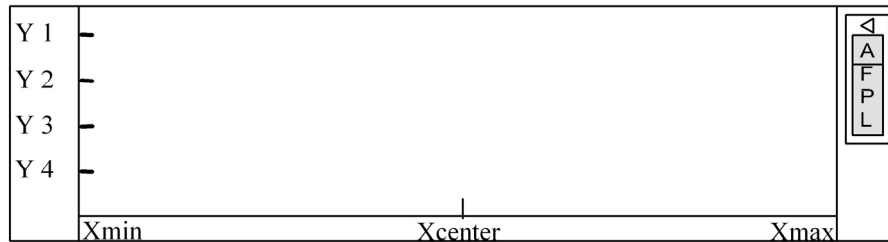


FIGURE 02-34_1-28-06 VSD - SCALES

The X-axis displays three ticks at the bottom of VSD window: from left to right, Xmin, Xcenter and Xmax. In Heading Up, a fourth tick, Xquarter, is displayed at the half INAV range ($X_{center}/2$).

The Y-axis displays three to five ticks at the left of VSD window. The Y-ticks labels are in feet and indicate a rounded-off barometric altitude.

The ticks scroll up and down the vertical scale to reflect the airplane motion in the vertical plan.

Selected Altitude

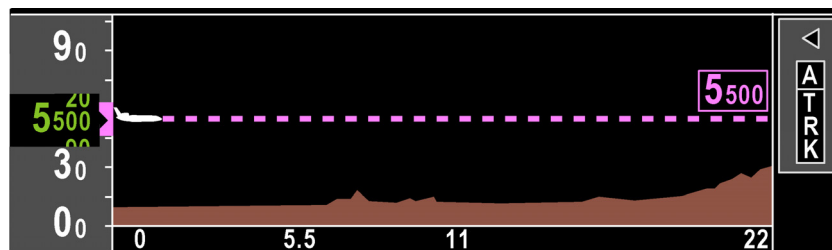


FIGURE 02-34_1-28-07 VSD - SELECTED ALTITUDE

The altitude bug and the dashed line are positioned in VSD according to their barometric altitude.

The altitude label is displayed in a frame, near dashed line to the right in the VSD window. The altitude label displays selected altitude in feet as set on the ADI.

The Selected Altitude Bug and readout park at the limit of the display when beyond the displayable range.

Color for altitude bug, dashed line and altitude label complies with the color displayed on the ADI.

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Terrain

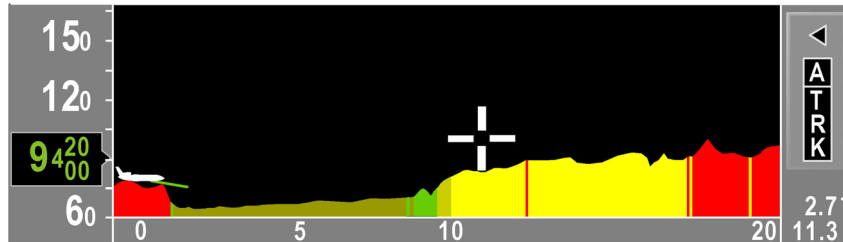


FIGURE 02-34_1-28-08 VSD - TERRAIN

Terrain is displayed on the full length of VSD if available, according to its barometric altitude. Terrain is extracted from current track or flight plan according to VSD modes.

When terrain or part of the terrain is not available, a crosshatch line is represented at the bottom of the display. When terrain is available but located below the lower limit of the vertical scale, only the black background is visible.

MODE DISPLAY

SELECTED MODE

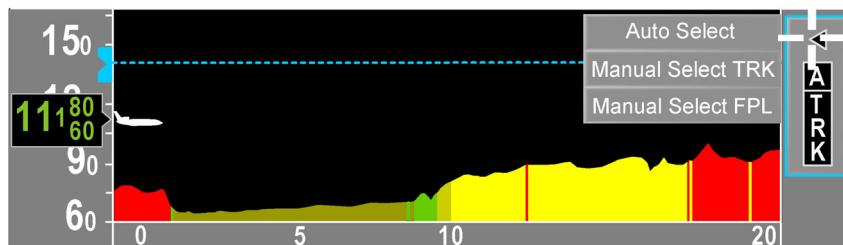


FIGURE 02-34_1-28-09 VSD - MODE DISPLAY

The mode menu is located at the top right corner of VSD.

The manually selected modes are:

- AutoSelect
- Manual TRK
- Manual FPL

The pending and secondary modes are selected automatically by the system (due to crew member selections elsewhere). They are mutually exclusive and have priority over manually selected modes.

At initialization, the VSD default mode is the AutoSelect mode.

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- **Manual TRK mode**

The purpose of this mode is to see the terrain straight ahead of the airplane current track. Therefore, in this mode the airplane is always displayed in VSD.

The terrain displayed in VSD is extracted along the airplane current track.

- **Manual FPL mode**

The purpose of this mode is to see the terrain along the active FPL. Therefore, in this mode the active FPL is always displayed in VSD. If no active FPL exists then VSD is blank.

The terrain displayed in VSD is extracted along the active FPL displayed in VSD.

In Manual FPL mode, the airplane symbol is removed from the VSD.

- **AutoSelect mode**

In this mode, the system selects automatically the Track or FPL mode.

The system selects the FPL mode if E-GPWS Warning/Alert is not active and If the airplane is on the ground, or if LNAV is active.

The system selects Track mode as soon as FPL mode is not selected.

- **Pending mode**

The purpose of this mode is to see the terrain along the pending FPL. Therefore, in this mode the pending FPL (only) is always displayed in VSD.

The terrain displayed in VSD is always extracted along the pending FPL.

If I-NAV is in pending configuration (active or secondary), pending mode is automatically selected.

When I-NAV exits from pending configuration, the VSD mode returns to the previous pilot selected mode.

- **Secondary mode**

The purpose of this mode is to see the terrain along secondary FPL. Therefore, in this mode the secondary FPL is always displayed in VSD whereas the A/C is never displayed.

The terrain displayed in VSD is always extracted along the secondary FPL (Current or Pending) displayed in VSD.

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I-NAV MODE

As the I-NAV lateral map and the VSD are two different displays of the same situation, VSD configuration inherits from INAV modes.

■ Point Centering

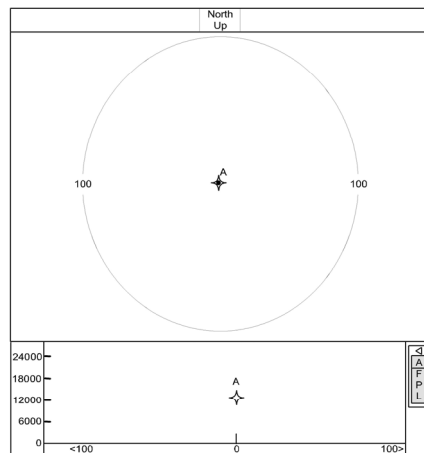


FIGURE 02-34_1-28-10 VSD - I-NAV CENTERED ABOUT A FIXED POINT

When I-NAV lateral map is centered about a waypoint, VSD displays situation near the waypoint according to I-NAV lateral map range.

When I-NAV lateral map is centered about a remote location, VSD is blank.

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■ Airplane Centering

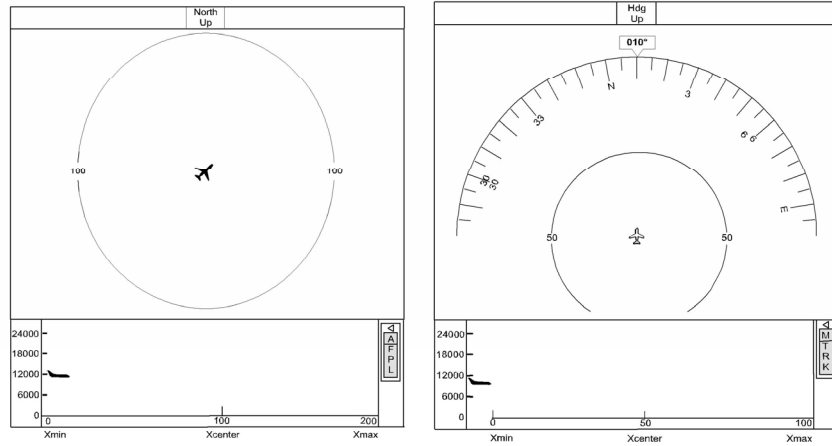


FIGURE 02-34_1-28-11 VSD - I-NAV CENTERED ABOUT THE AIRPLANE

When I-NAV lateral map is centered about the airplane, VSD displays situation near airplane position according to INAV lateral map range.

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GENERAL

Basic as well as complex flight plan modifications can be performed graphically directly on I-NAV using the intuitive object-task method. Crew click on an object on the map with the CCD, a task menu is presented which contains all the valid tasks which can be performed on the selected object.

Note that all graphical flight plan modifications can also be performed on the WPT LIST window using the same object-task methods or combined between I-NAV and WPT LIST.

LATERAL MAP DISPLAY

The lateral map primary function is to display lateral-positioning information. It is capable, but not limited to displaying the following information:

- Magnetic or True Heading,
- Graphical representation of the flight plan,
- Navigation data base,
- Weather (radar and lighting),
- Traffic,
- Wind direction and speed,
- Miscellaneous annunciators.

The lateral map has two user selectable display modes:

- North-Up,
- Heading-Up.

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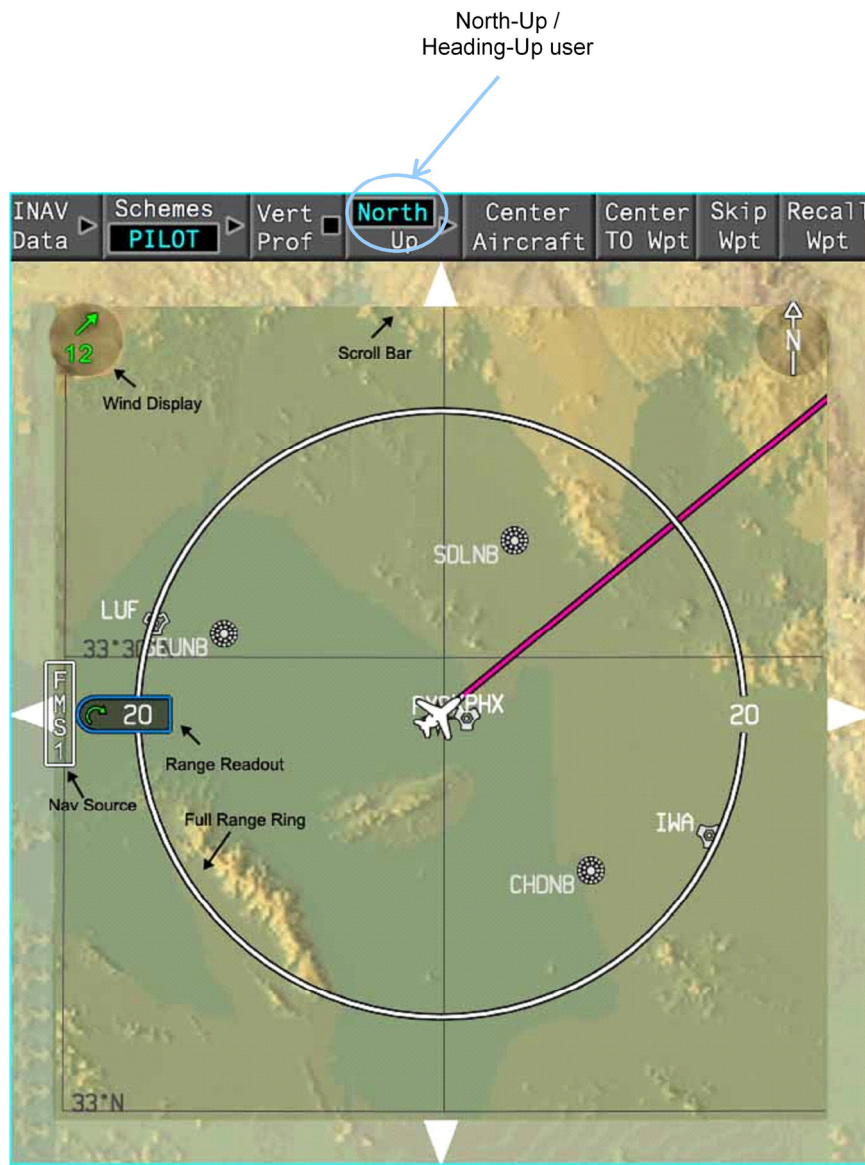


FIGURE 02-34_1-29-00 - NORTH-UP MODE LATERAL MAP

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FIGURE 02-34_1-29-01 - HEADING-UP LATERAL MAP

LATERAL MAP MANAGEMENT

The I-NAV is capable of being displayed in:

- 2/3 window (default selection),
- full window,
- 1/3 window format.

The lateral map functionality do not change upon window format.

The power-up default selections are:

- North-Up,
- Lateral map half range set to 10 NM,
- **Center Aircraft** selected,
- FMS selected position, if no position is available the map centers on the lat/lon coordinates: N45° 46.579' E000° 36.758' without the airplane symbol displayed,
- IFR Low scheme.

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I-NAV TOOL BAR



FIGURE 02-34_1-29-02 - I-NAV TOOL BAR

I-NAV tool bar provides controls of the main features of the I-NAV map and access to sub-menus to customize I-NAV contents. I-NAV tool bar is permanently displayed at the top of the I-NAV window.

If Uplink Weather is installed in the airplane then the Uplink WX menu is displayed instead of Schemes menu.

I-NAV Data pull down menu

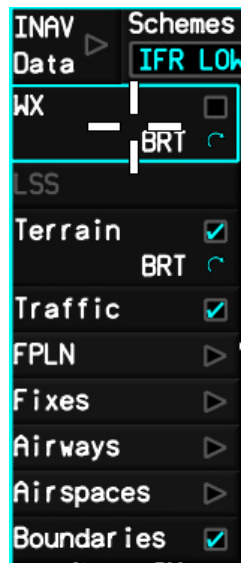


FIGURE 02-34_1-29-03 - I-NAV PULL DOWN MENU

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I-NAV Data pull-down menu provides all the controls to manage data layers that can be displayed on I-NAV:

- WX selection enables display of the weather radar image. This selection is available in both North-Up or Heading-Up modes. While the cursor remains positioned on the WX check box, the transparency **BRT** of the WX layer is capable of being increased or decreased with the CCD data set knob,
- LSS selection enables lightning sensors system display (optional),
- Terrain selection enables the terrain layer. While the cursor remains positioned on the terrain check box, the terrain layer brightness **BRT** is capable of being increased (full brightness) or decreased (10% brightness) by turning the data set knob,
- Traffic selection enables the Traffic Alert (TA) and Collision Avoidance System display layer. This selection is available in North-Up or Heading-Up modes,
- FPLN menu allows to select the following flight plan options:
 - o missed Approach,
 - o alternate,
 - o constraints.

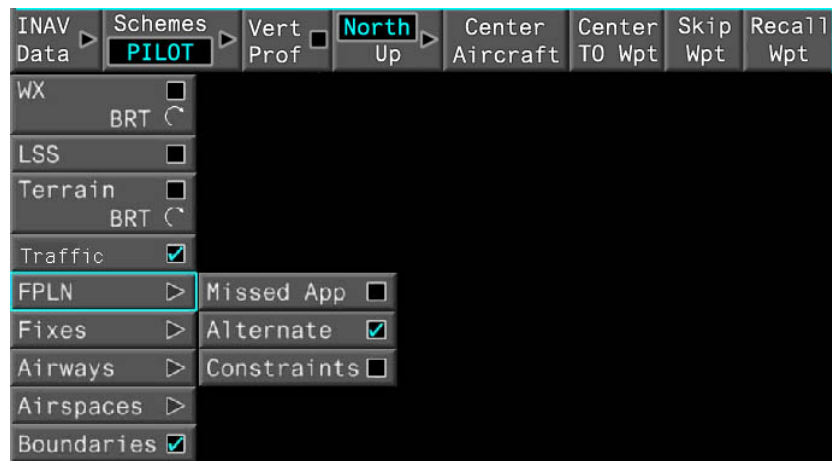


FIGURE 02-34_1-29-04 - I-NAV FPLN SELECTIONS

Fixes menu allows the following selections to be displayed on I-NAV:

- Airports,
- VOR,
- NDB,
- Intersection,
- VOR course.

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FIGURE 02-34_1-29-05 - I-NAV FIXES SELECTIONS

Airways menu allows the selection of different airways to be displayed on I-NAV:

- HI ALT,
- LOW ALT.

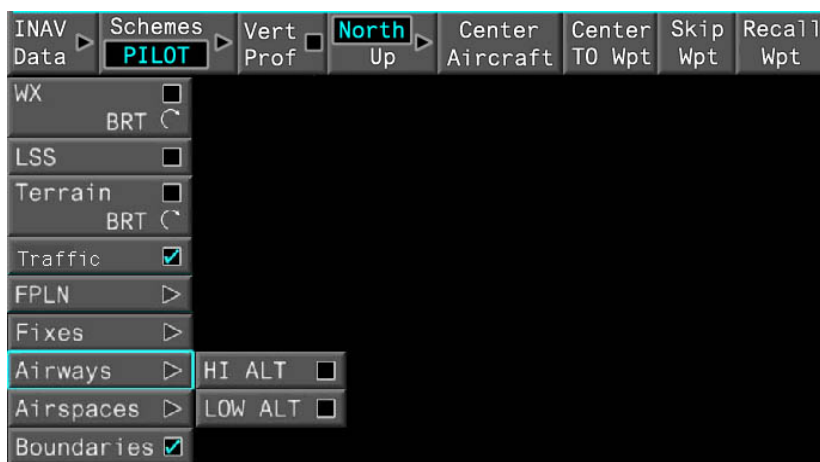


FIGURE 02-34_1-29-06 - I-NAV AIRWAYS SELECTIONS

Airspaces menu allows the following selections to be displayed on I-NAV:

- Terminal,
- Special Use Airspace (SUA).

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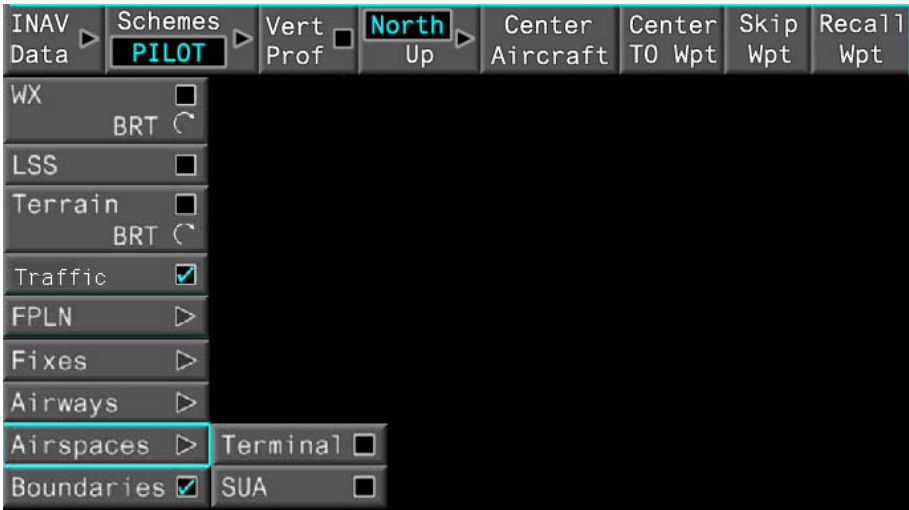


FIGURE 02-34_1-29-07 - I-NAV AIRSPACES SELECTIONS

Boundaries selection turns on/off the geopolitical and Latitude/Longitude gridlines layer.

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Schemes pull down menu

Schemes pull-down menu gives access to 3 map schemes offering a pre-defined set of data layers: IFR High Alt scheme, IFR Low Alt scheme. Any change to these standards scheme reverts the I-NAV in **PILOT** Defined Scheme where pilot has all the authority to select data to be displayed,

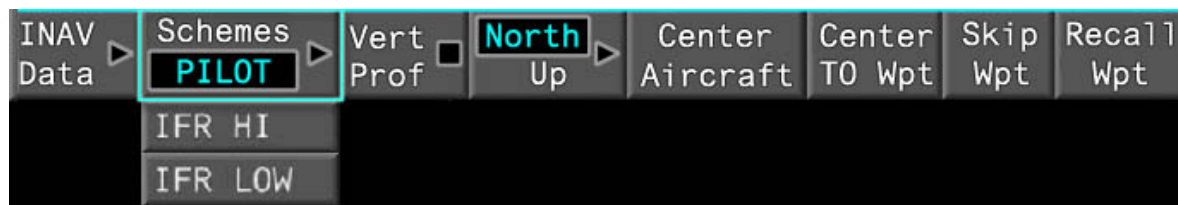


FIGURE 02-34_1-29-08 - SCHEMES PULL DOWN MENU

Scheme configuration:

IFR HI SCHEME	IFR LOW SCHEME
Airports = Selected	Airports = Not Selected
Alternate FPLN = Selected	Alternate FPLN = Not Selected
Boundaries = Selected	Boundaries = Selected
Constraints = Not Selected	Constraints = Selected
High Altitude Airway = Not Selected	High Altitude Airway = Not Selected
Intersections = Not Selected	Intersections = Not Selected
Low Altitude Airway = Not Selected	Low Altitude Airway = Not Selected
Lss = Not Selected	Lss = Not Selected
Missed Approach = Not Selected	Missed Approach = Selected
NDBs = Not Selected	NDBs = Selected
SUA = Not Selected	SUA = Not Selected
Terminal Airspace = Not Selected	Terminal Airspace = Not Selected
Terrain = Selected	Terrain = Selected
Traffic = Selected	Traffic = Selected
VOR Course = Not Selected	VOR Course = Not Selected
VORs = Not Selected	VORs = Selected
WX = Not Selected	WX = Not Selected

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Uplink WX pull down menu (optional)

The Uplink Wx menu is only displayed if airplane is equipped with Uplink Weather option.

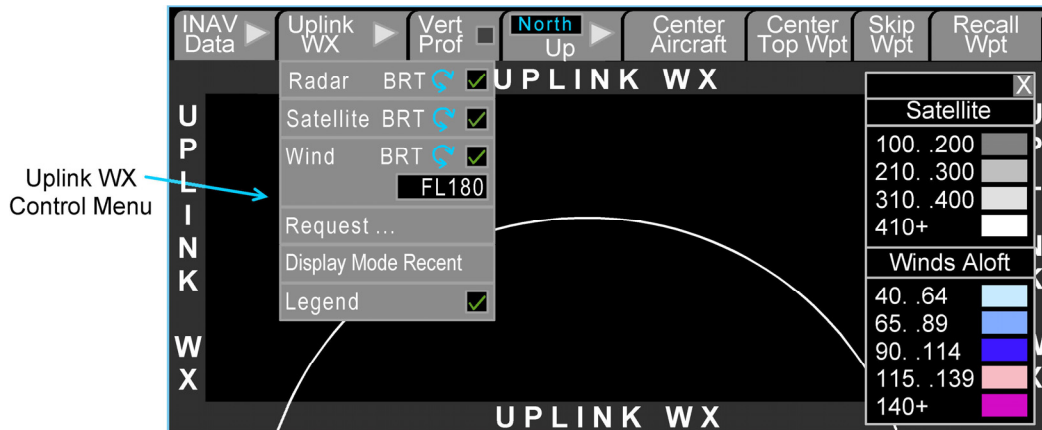


FIGURE 02-34_1-29-09 - MAP MODE PULL DOWN MENU

- **Satellite** selection enables to turn on/off the Satellite layer.
- **Radar** selection enables to turn on/off the Radar layer.
- **Wind** selection enables to turn on/off the Winds Aloft layer. Winds Aloft data reports direction and velocity of winds at different altitude ranges within which winds are considered the same. The Winds altitude range shall be set using the Data Set knob. The Winds altitude range field shall be followed by the label "Ft".
- **Request ...** selection enables to open the "Request Data" tab of the Uplink WX dialog box.
- **Display Most Recent** selection enables to update the INAV with the most recent uplinked WX products.
- **Legend** selection enables to open/close the Uplink WX data legend.

Vert Prof check box

Vertical Profile selection turns on / off the vertical profile display.

Map mode menu

Map mode selection allows to select between North-Up or Heading-Up graphical representation mode.



FIGURE 02-34_1-29-10 - MAP MODE PULL DOWN MENU

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Center Airplane

The **Center Aircraft** soft key allows center the I-NAV on airplane.

Center TO Wpt

This selection is used to center the TO waypoint on the lateral map in North-Up mode.

If the I-NAV reference is Heading-Up, selecting **Center To Wpt** automatically changes to North-Up selection.

If there is a pending flight plan, the **Center To Wpt** selection follows the pending flight plan instead of the active flight plan.

Skip Wpt

Skip Wpt selection allows to center the next waypoint in the flight plan on the lateral map display in North-Up. If a waypoint is not currently centered, Skip defaults to the TO waypoint.

If the I-NAV reference is Heading-Up, selecting **Skip Wpt** automatically changes to North-Up.

When the destination waypoint has been centered on the lateral map, selecting **Skip Wpt** displays FROM waypoint centered on the lateral map.

If there is a pending flight plan, the Skip Wpt selection follows the pending flight plan instead of the active flight plan.

Recall wpt

Selecting **Recall Wpt** centers the previous waypoint in the flight plan on the lateral map display in North-Up. If a waypoint is not currently centered, Recall defaults to the TO waypoint.

If the I-NAV reference is Heading-Up, selecting **Recall Wpt** automatically changes to North-Up.

When the FROM waypoint has been centered on the lateral map, selection of the **Recall Wpt** displays the destination waypoint centered on the lateral map.

If there is a pending flight plan, the **Recall Wpt** selection follows the pending flight plan instead of the active flight plan.

NOTE

When I-NAV displays Secondary Flight Plan, the following options are not available (corresponding soft keys are grayed): Center Airplane, Center TO, WX layer, Traffic layer, LSS layer.

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FMS LATERAL DEVIATION

The FMS lateral deviation annunciation is displayed on the right side of the airplane symbol when in Heading-Up.

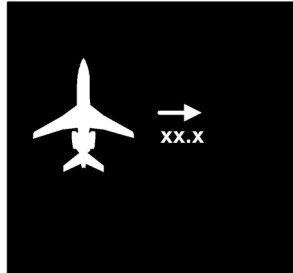


FIGURE 02-34_1-29-11 - CROSS TRACK ERROR ANNUNCIATION

DESIRED TRACK

The desired track line originates at the center of the airplane symbol, passes through the track bug and continues on the until the edge of the lateral map.

When in North-Up mode, the desired track line is displayed only when the airplane symbol is visible on the Lateral Map Display.

When in Heading-Up mode, the desired track line is drawn regardless of the heading / track bug location (e.g if the bug is behind the airplane, the line is drawn from the airplane nose to the bottom of the display).

When TRK mode is engaged, the desired track line is magenta, white otherwise.

ANNUNCIATIONS

Wind direction and velocity

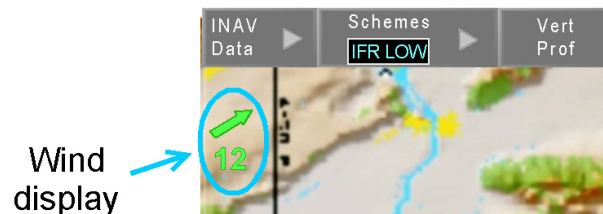


FIGURE 02-34_1-29-12 - WIND DISPLAY

The wind direction and velocity is in vector format and is displayed in Heading-Up or North-Up modes. It is only displayed when the airplane is centered.

The display consists of a digital wind velocity readout and a wind direction arrow indicating the direction the wind is blowing towards.

The IRS selected on coupled side is the wind data source.

The FMS selected on coupled side is the wind data source.

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Navigation source annunciation

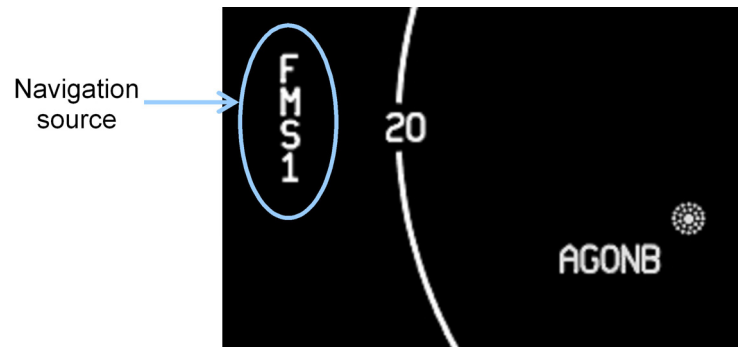


FIGURE 02-34_1-29-13 - NAVIGATION SOURCE ANNUNCIATION

The annunciation color matches the HSI.

The PF selected FMS (master FMS) is the data source.

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FMS FLIGHT PLAN MAP DATA

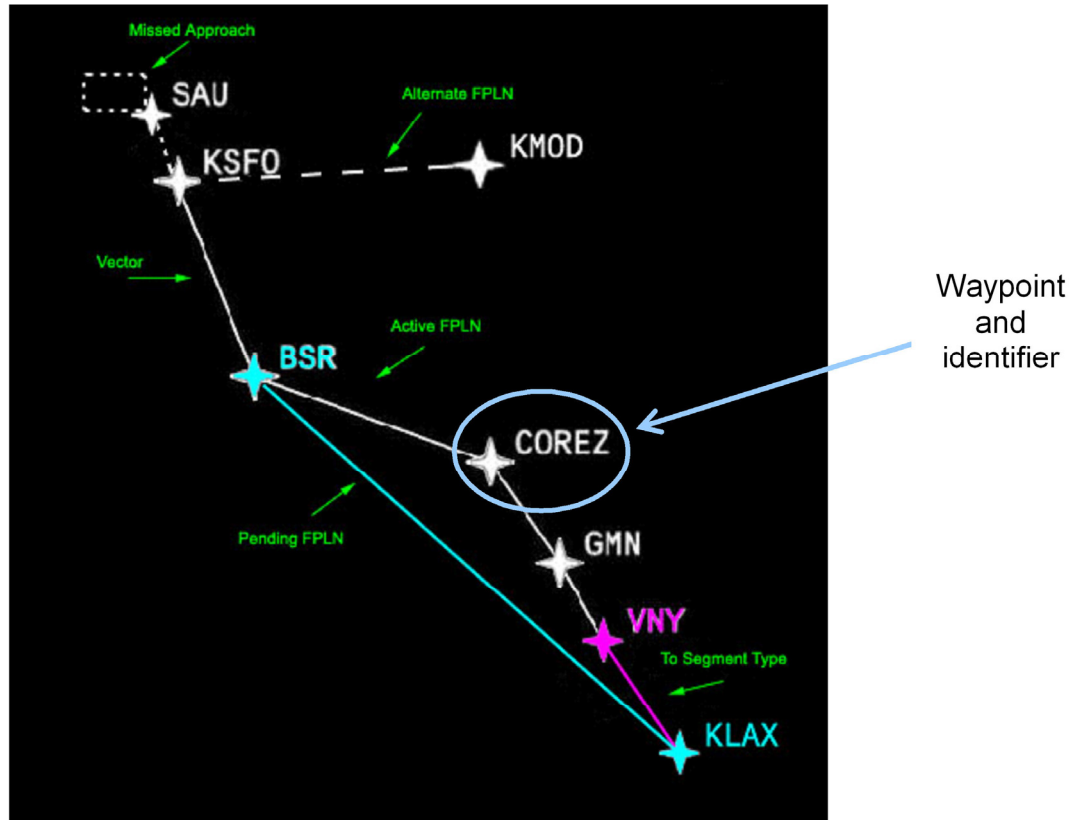


FIGURE 02-34_1-29-14 - FMS FLIGHT PLAN EXAMPLE

Flyover symbol



FIGURE 02-34_1-29-15 - FLYOVER SYMBOL

Altitude profile point



FIGURE 02-34_1-29-16 - ALTITUDE PROFILE POINT AND IDENTIFIER

Altitude profile points consist in TOC (Top Of Climb), TOD (Top Of Descent) and BOSC (Bottom Of Step Climb).

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Arrow icon

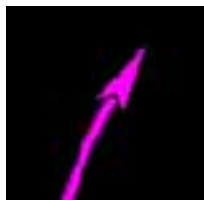


FIGURE 02-34_1-29-17 - TURN ARROW ICON

The arrow icon indicates a turn direction in the flight plan.

Constraints

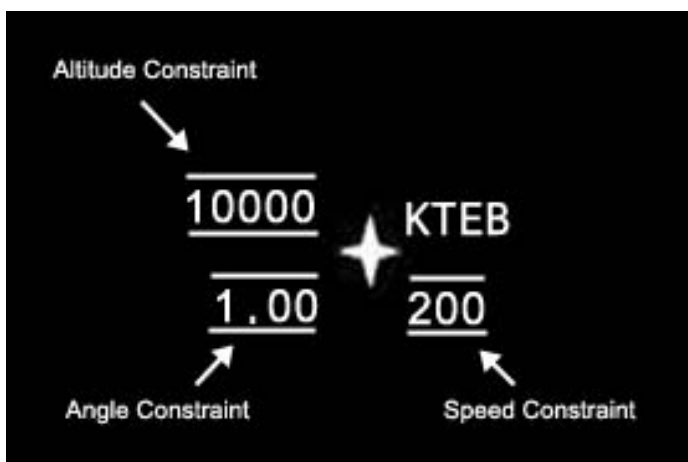


FIGURE 02-34_1-29-18 - CONSTRAINTS EXAMPLE

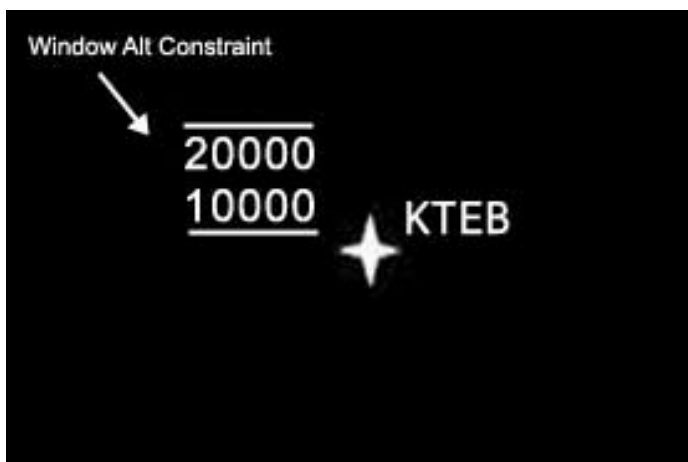


FIGURE 02-34_1-29-19 - ALTITUDE BLOCK CONSTRAINT EXAMPLE

The format matches the representation on the waypoint list.

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MAP SCROLLING



FIGURE 02-34_1-29-20 - SCROLL BAR

The scroll bar is displayed when the cursor is placed at the edge of the map, and disappears when the cursor is moved away from the scroll bar.

While scrolling is active the following layers are removed:

- Traffic,
- Desired track line,
- VOR course line,
- Constraints,
- Lateral deviation,
- LSS,
- WX,
- VOR,
- NDB,
- Intersections,
- Airports,
- Obstacles,
- Lat/Lon lines,
- Terrain.

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RANGE AND FMS MESSAGE DEDICATED BOX

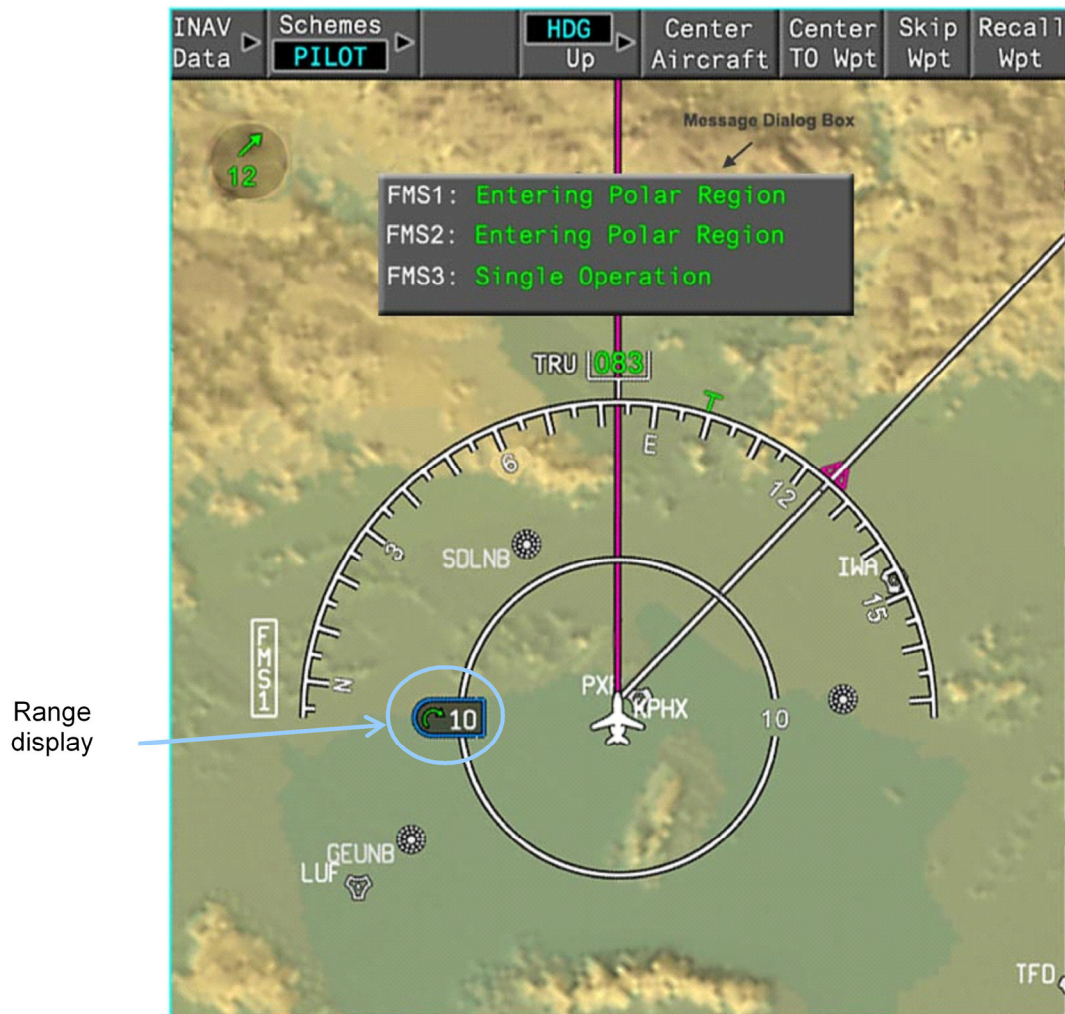


FIGURE 02-34_1-29-21 - FMS MESSAGE DEDICATED BOX AND RANGE EXAMPLE

In Heading-Up mode, the range values vary between 0.5 and 375 NM.

In North-Up mode, the range values vary between 1 and 750 NM.

Message system is independent from the I-NAV control interface and is issued to alert the pilot of a situation detected by the FMS / TOLD.

The FMS MSG pushbutton, located on eyebrow, only clears one message at a time.

AIRPORT LAYER

Airports are selectable for display from the I-NAV tool bar menu.

The airports symbols are displayed per the following tables:










NAME	SYMBOL	DISPLAYED RANGE
Airport		$0.5 \leq \text{Half range} \leq 5$
		$0.5 \leq \text{Half range} \leq 5$
		$0.5 \leq \text{Half range} \leq 5$
		$5.5 \leq \text{Half range} \leq 150$
	None	$175 \leq \text{Half range} \leq 375$



FIGURE 02-34_1-29-22 - AIRPORT SYMBOLS

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VOR LAYER

CATEGORY	NAME	SYMBOL	DISPLAYED RANGE
VOR	VOR		$0.5 \leq \text{Half range} \leq 100$
		●	$125 \leq \text{Half range} \leq 200$
		none	$225 \leq \text{Half range} \leq 375$
	DME only		$0.5 \leq \text{Half range} \leq 100$
		●	$125 \leq \text{Half range} \leq 200$
		none	$225 \leq \text{Half range} \leq 375$
	VOR/DME		$0.5 \leq \text{Half range} \leq 100$
		●	$125 \leq \text{Half range} \leq 200$
		none	$225 \leq \text{Half range} \leq 375$
	TACAN		$0.5 \leq \text{Half range} \leq 100$
		●	$125 \leq \text{Half range} \leq 200$
		none	$225 \leq \text{Half range} \leq 375$
	VORTAC		$0.5 \leq \text{Half range} \leq 100$
		●	$125 \leq \text{Half range} \leq 200$
		none	$225 \leq \text{Half range} \leq 375$

VOR are selectable for display from the I-NAV tool bar menu.

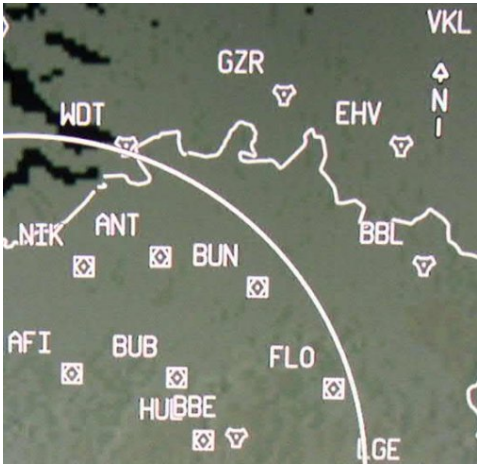



FIGURE 02-34_1-29-23 - VOR SYMBOLS

NDB LAYER

CATEGORY	SYMBOL	DISPLAYED RANGE
NDB		0.5 ≤ Half range ≤ 50
	none	52.5 ≤ Half range ≤ 375

NDB are selectable for display from the I-NAV tool bar menu.



FIGURE 02-34_1-29-24 - NDB SYMBOL

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OBSTACLES

Obstacles are always displayed on the lateral map when the lateral half range is less than or equal to 10 NM.

Obstacles (defined as obstacles from 200 ft to 1,000 ft AGL), are displayed on the lateral map as follow:



FIGURE 02-34_1-29-27 - OBSTACLE SYMBOL

LARGE OBSTACLES

Large obstacles (defined as obstacles above 1,000 ft AGL), are displayed on the lateral map as follow:



FIGURE 02-34_1-29-28 - LARGE OBSTACLE

OBSTACLE INFORMATION

When the cursor is moved over an obstacle currently displayed in the field of view of the I-NAV lateral map display, the obstacle under the cursor is displayed as follow:

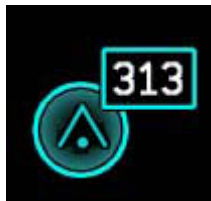


FIGURE 02-34_1-29-29 - CURSOR OVER OBSTACLE

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OBJECT TASK MENU

Displaying the Task Menu associated with a graphical object is accomplished by clicking on the desired object symbol on the map. The task menu displays all the valid tasks associated with that object.

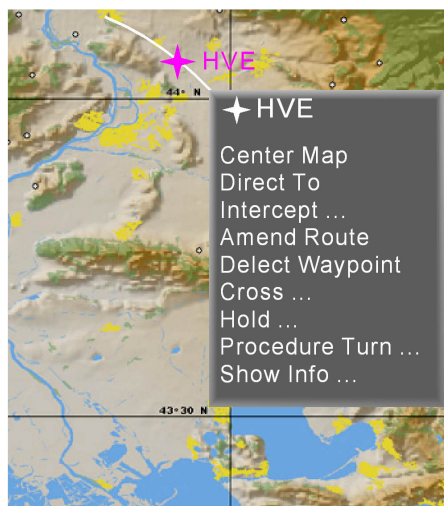


FIGURE 02-34_1-29-32 - TASK MENU ON HVE VOR

A click within a task menu item selects the associated function. To exit the menu, move the cursor outside the menu.

GRAPHICAL FLIGHT PLANNING TASKS

The following tables defines for all the interactive objects categories of the I-NAV the associated tasks (and its corresponding dialog box). Note that some objects can combine task of two of these categories: for instance, a navaid in the flight plan combines tasks from the active flight plan waypoint category and navaid category.

Airplane symbol object



ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map and lock it on airplane symbol
Lateral Offset ...	LAT OFFSET	Defining a lateral flight plan offset when in LNAV (It is necessary to click the airplane symbol first in the I-NAV)

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Active flight plan waypoint category



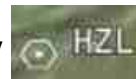
ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR?
Center Map		Center Map on this waypoint
Direct To		Perform a direct to on this waypoint from present position
Intercept ...	INTERCEPT	Intercept wpt by radial / CRS + distance or heading select
Amend Route		Amend flight plan route downstream this waypoint
Delete Waypoint		Delete this waypoint from flight plan
Cross ...	CROSS	Define a crossing constraint on this waypoint: altitude (A/B), Speed (IAS, Mach), Time (at), Angle
Hold ...	HOLD	Define a holding pattern on this waypoint
Procedure Turn ...	P. TURN	Modify Procedure Turn of this waypoint IF EXISTING (this waypoint is part of a data base retrieved APPR)
Show Info ...	SHOW INFO	Show any data base and FMS progress information on this waypoint

NOTE

Tasks from airport or navaid categories can be added if waypoint is an airport or a navaid.

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VOR, VOR DME, TACAN, VORTAC category and ADF category



ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map on this object
Direct To		Perform a direct to on this object from present position
Show Info ...	SHOW INFO	Show any data base and FMS progress information on this object
Tune NAV1 (*)		Tune navaid active frequency on NAV1 (*)
Tune NAV2 (*)		Tune navaid active frequency on NAV2 (*)

(*) For ADF, NAVx is replaced by ADF.

AIRWAY category

ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map on this airway at the row position
Intercept		Intercept a named fix this airway by heading select leg
Show Info ...	SHOW INFO	Show any data base and FMS progress information on this object

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AIRPORT category



ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map on this airport
Direct To		Perform a direct to on this airport from present position
Departure / arrival ...	PROCEDURE	Select a RWY, SID, STAR or APPR for this airport
Change Dest		Change destination to this airport (pending mode is entered to allow modification of new route between old destination and this new destination)
Show Info ...	SHOW INFO	Show any data base and FMS progress information on this airport

Lat / Lon object category

ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map on this object
Direct To		Perform a direct to on this object from present position

DIRECT WPT object category

ASSOCIATED TASKS	DIALOG BOX ASSOCIATED WITH TASK	WHAT FOR ?
Center Map		Center Map on this waypoint
Amend Route		Amend flight plan route downstream this waypoint

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INSERTING WAYPOINTS

When a pending flight plan modification is open, it is possible to insert multiple waypoints, airways or terminal procedures during the same operation (using **Amend Route** and **Delete** if necessary,...).

Multiple waypoints can be inserted in the pending FPLN using I-NAV, during the same operation. This is indicated by a cyan “rubber band” line that tracks the cursor after selecting Direct To or Amend Route tasks. Each time the CCD is clicked, a new waypoint is added to the flight plan and the cyan rubber banding continues from the new waypoint. A line is also drawn between the last stringed waypoint and the flight plan waypoint on which the FMS wants to close the modification.

If a mistake is made while stringing waypoints, the crew can delete the waypoint just entered, change the airway, exit a dialog box then continue the flight plan modifications.



FIGURE 02-34_1-29-33 - FLIGHT PLAN ACTIVATION IN WPT LIST

Activate and **Cancel** soft keys are automatically displayed in the I-NAV and at the bottom of the WPT LIST. A click on the **Activate** soft key activates the FPLN. The pending FPLN becomes the active FPLN in the WPT LIST and in the I-NAV.

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Inserting WayPoint (WPT)

In the active FPLN, it is possible to insert waypoints, airways or terminal procedures by using Amend Route on the WPT LIST.

WPT can be inserted in sequence during a single flight plan modification by entering the WPT names through the MKB. If there is only one WPT corresponding to the identifier, it is automatically inserted in the pending FPLN. If there are multiple WPT corresponding to the identifier, a list of all corresponding WPT are displayed and the crew has to choose the right one.

An airway can be inserted by using **Join** soft key displayed in the WPT List during Amend route procedure. All available airways are displayed. After selection of one airway, the crew has to choose the exit WPT of the airway.

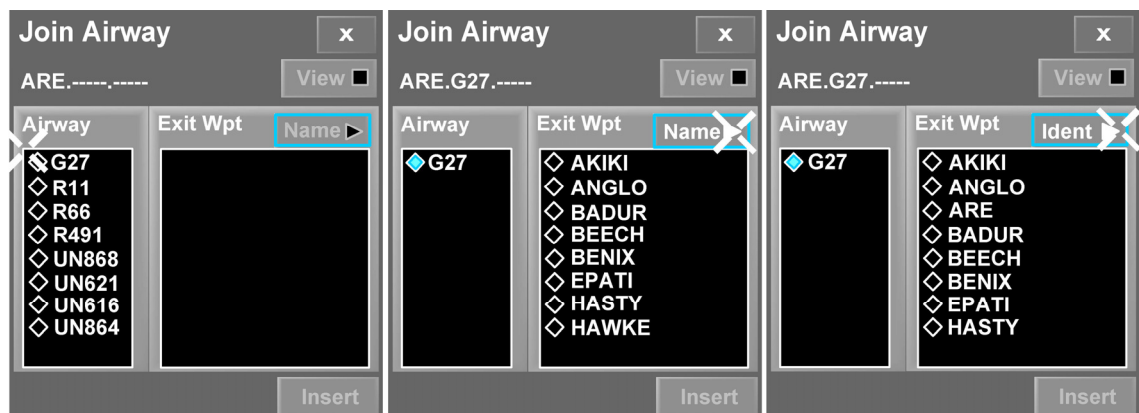


FIGURE 02-34_1-29-34 - JOIN AIRWAY DIALOG BOX

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DIALOG BOXES

The dialog boxes are selected through the Task Menu. The Task Menu is displayed by clicking on the desired object symbol on the map.

The dialog box selected is displayed on the upper left part of the I-NAV.



FIGURE 02-34_1-29-35 - DIALOG BOX

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CROSS dialog box

FIGURE 02-34_1-29-36 - CROSS DIALOG BOX

Cross dialog box can be opened for any WPT. Constraints on the WPT can be inserted:

- Past / Prior To distance crossing,
- Flyover the waypoint,
- ALT crossing (AT, At or above, At or Below),
- Speed constraint CAS/Mach (at and past waypoint),
- Time At Constraint,
- Angle Constraint,
- Climb / Descent override (used for example when the TOD is not computed if the cruise altitude inserted in the FMW FPLN page was not reached during the flight),
- vertical Direct To activation (Cleared to alt),
- **Apply** applies constraint in the pending flight plan,
- **Delete** deletes all the constraints on the WPT,
- **Default** reverts to default constraint from data base (ALT, SPEED, and ANGLE).

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HOLD dialog box

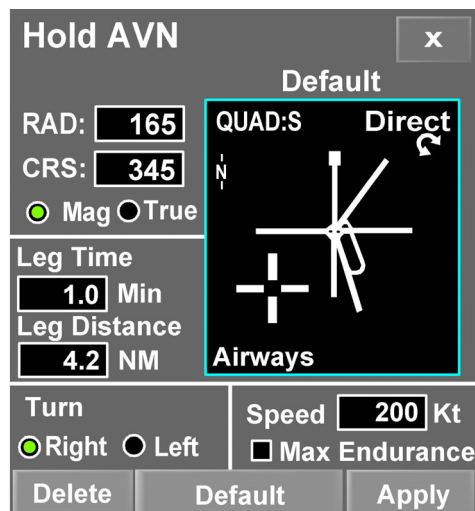


FIGURE 02-34_1-29-37 - HOLD DIALOG BOX

Hold dialog box can be opened for any WPT (except destination and specific WPT) A holding pattern can be inserted with the following parameters:

- RAD or CRS (in TRU and MAG ref),
- Leg Time (MIN) or Leg Distance (NM),
- Right or Left Turn,
- Speed (190 kt by default), Max Endurance option.

Real Time picture of the holding pattern (displayed using same I-NAV orientation: North Up or Heading Up) is drawn and indicates the QUAD and the type of entry (DIRECT, PARALLEL, TEAR DROP).

Apply soft keys applies constraint in the pending flight plan.

Delete soft keys deletes all the constraints on the WPT.

Default soft key.

As Published reverts to default data base parameters.

NOTE

The turns of the holding pattern are not displayed with the speed defined in the dialog box but with the speed (TAS) of the airplane when the holding pattern is activated.

It is recommended not to modify the holding speed when FMS speed command is reducing the speed before entering in holding pattern.

When crossing the fix the airplane speed determines the holding pattern.

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PROC TURN dialog box

FIGURE 02-34_1-29-38 - PROC TURN DIALOG BOX

PROC TURN dialog box can be opened on a WPT supporting an existing data base procedure turn. **PROC TURN** box allows modifying the following procedure turn parameters:

- Outbound time (MIN) or distance (NM),
- Angle (between outbound leg and outbound course).

Real time picture of the procedure turn (displayed using same I-NAV orientation: North Up or Heading Up) is drawn and indicates the direction of turn, boundary distance and inbound course. **DELETE**, **AS PUBLISHED** and **APPLY** soft keys have the same functions as in **Hold** dialog box.

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PROCEDURE dialog box



FIGURE 02-34_1-29-39 - PROCEDURE DIALOG BOX (DEPARTURE TAB)



FIGURE 02-34_1-29-40 - PROCEDURE DIALOG BOX (ARRIVAL TAB)

PROCEDURE dialog box can be open for any airport object or when using **Insert** PROCEDURE menu in pending mode. It allows selecting and/or reviewing a complete terminal procedure. PROCEDURE dialog box contains two tabs: **Departure** and **Arrival**.

In **Departure** tab, one scrolling list is dedicated to Runway selection, one other to SID and Transition selection (transition are displayed only when a SID is selected).

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In **Arrival** tab, scrolling lists allow respectively to select Runway, Approach, Approach Trans, STAR and STAR Trans. It is possible to directly select an approach with the corresponding runway automatically selected.

Each time a selection is made in one of the scrolling list, the other lists collapses to display only the items that connect to the selection: for instance, selecting an approach automatically selects the corresponding runway and STAR / Trans list collapses to display only the STAR matching the selected approach.

In both **Departure** and **Arrival** tabs:

- **Insert** soft key is used to insert the selected / Runway and/or procedure in the pending flight plan,
- **Clear All** soft key is used to clear all pilot selection.
- **View** check box is used to review the procedure. The **View** dialog box displays, in a WPT LIST type format, the log of the selected procedure. I-NAV and dialog box reverts to their previous format when exiting view mode.

In a waypoint list format before activating it. Transitions I-NAV and the dialog box in VIEW mode:

- In I-NAV, range and center is adapted in North Up mode to display the full selected procedure. No flight plan modification is authorized in **View** mode.

LATERAL OFFSET dialog box

LATERAL **Offset** dialog box is opened by clicking airplane symbol on the map when in LNAV mode. It allows defining a lateral offset (0.1 to 30 NM) on authorized legs (not on procedure, pattern, terminal area and polar region). When offset is applied, it is not possible to use PPOS Hold task.

Delete cancels the offset. An FMS message warns the crew when offset ends.

To cancel or modify an active offset, the dialog box has to be re-open by first clicking airplane symbol in I-NAV and then selecting **Offset** dialog box.

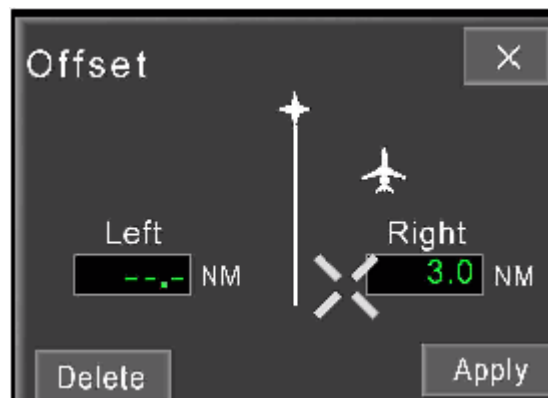


FIGURE 02-34_1-29-41 - LATERAL OFFSET DIALOG BOX

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INSERT AIRWAY dialog box

Insert airway dialog box is opened using the **Join** soft key while in pending mode. It displays all the available airways crossing the last stringed WPT.

Airway scrolling list allows selecting the airway. Exit WPT scrolling list allows selecting the exit WPT for the selected airway. These WPT can be displayed by their full name (NAME) or by their identifier (IDENT). NAME / IDENT selection is made through the pull-down menu above the Exit WPT scrolling list.

Insert soft key inserts the selected airway segment in the pending flight plan. **View** check box activates I-NAV view mode: north up orientation, range and center adapted to display the selected airway segment.

INTERCEPT dialog box

INTERCEPT dialog box is open using the **Intercept** task on any WPT of the active FPLN. The figure illustrates an intercept task on AVN VOR.

Intercept dialog box allows defining how to intercept the selected WPT. When the cursor is inside the dialog box, the CCD knob allows modifying the intercept course indicated by the cyan arrow. The course and the corresponding radial are displayed on the top of the dialog box.

Airways that intercept the designated object are also displayed. The format of the intercepted dialog box is always North Up.

Apply soft key inserts the intercept leg in the pending flight plan.

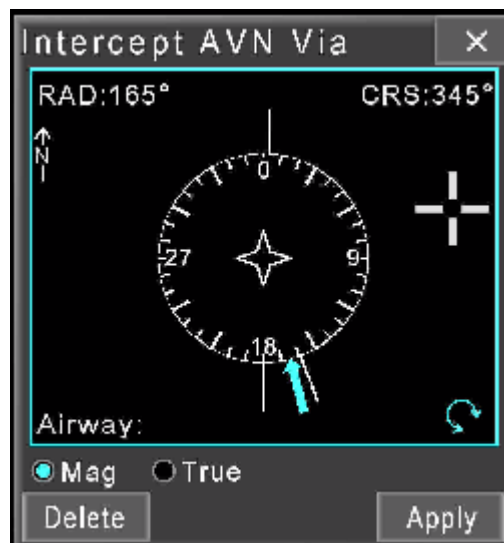


FIGURE 02-34_1-29-42 - INTERCEPT DIALOG BOX

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SHOW INFO dialog box

The Show Info dialog box allows pilots to access information from the navigation database for a selected object. SHOW INFO dialog box can be opened for any WPT or NAVAID.

The Show provides information about the active flight plan waypoints.

This information consists of three parts:

- navigation data base information,
- flight plan log information
- crossing point information.

Flight plan log information is the default displayed data.

■ Data Base

The Data Base page is displayed by selecting Data Base tab.

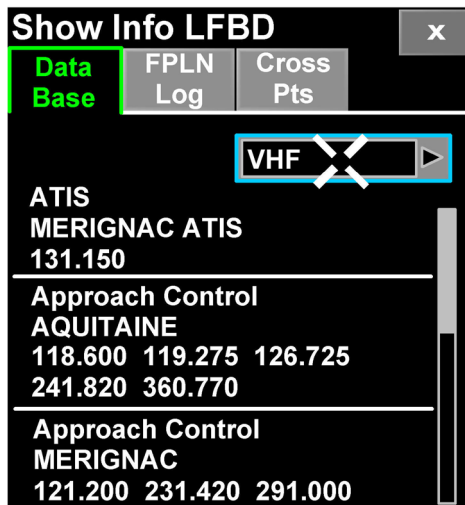


FIGURE 02-34_1-29-43 - DATA BASE TAB OF SHOW DIALOG BOX

Within Data Base page the following informations are accessible:

- VHF Nav aids
- NBD
- Airport data
- Runway at the selected airport
- COMM tuning airport
- Airport services
- ILS
- Named waypoint
- Tempory waypoints
- Pilot defined waypoints

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The data comes from Jeppesen data base which is loaded with the blue disk that contains chart.

■ FPLN Log

The Flight Plan Log page is the default page or is displayed by selecting **FPLN Log** tab.

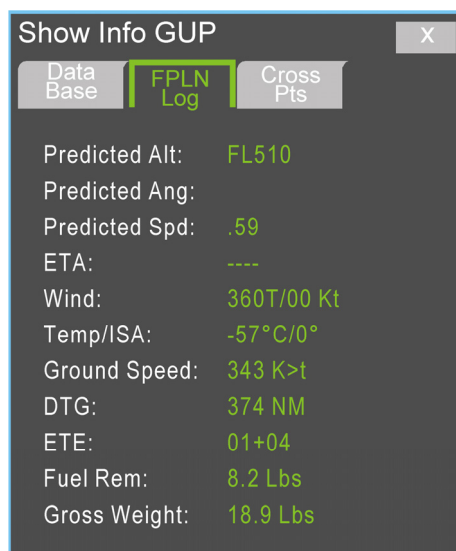


FIGURE 02-34_1-29-44 - FPLN LOG TAB OF SHOW DIALOG BOX

Flight Plan Log tab displays the predicted values for the waypoint selected.

While the flight Plan log tab is open, any operation which results in new predicted values will be reflected dynamically on the flight plan log tab.

Flight Plan log tab for a waypoint is a snapshot of the predicted data displayed in the waypoint list window, for the waypoint selected by the crew member.

■ Cross Pts

The Crossing Points page is displayed by selecting **Cross Pts** tab.

The Cross Pts tab uses the data available from the active FPLN and the navigation database to display the desired crossing point data. Within the Cross Points category, PPOS Direct, and CROSS Radial computations are be provided.

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- PPOS Direct

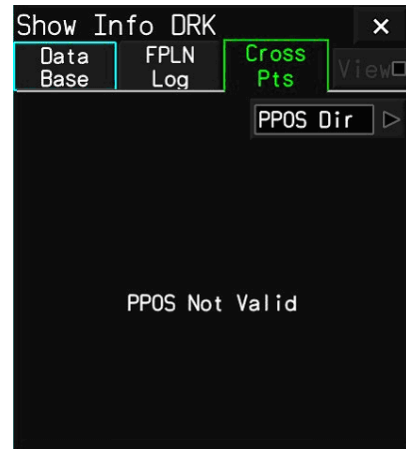
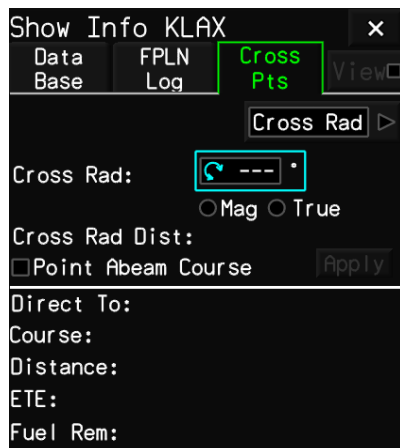


FIGURE 02-34_1-29-45 - CROSS PTS TAB - PPOS DIR PAGE

The PPOS Direct page displays the direct-to information from the airplane present position (PPOS) to the waypoint selected by the crew member. FMS computes the radial from waypoint to PPOS as well as the course, distance, ETE, and fuel remaining if the airplane were to fly direct from PPOS to waypoint. Fuel remaining is displayed in thousands of pound. If the airplane position is not valid, "PPOS Not Valid" is displayed on a black background.

- Cross Rad



Before computation



After computation

FIGURE 02-34_1-29-46 - CROSS PTS TAB - CROSS RAD PAGE

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The Crossing Radial page displays information on the point which results when the flight plan path crosses a specified radial.

FMS computes the distance from radial to waypoint as well as the course, distance, ETE and Fuel remaining if the airplane were to fly from PPOs to waypoint.

The results of the calculations are displayed in green.

Show Info KLAX
 Data Base | FPLN Log | **Cross Pts** | View ☐
 Cross Rad: °
 O Mag ☐ True ☐
 Cross Rad Dist:
☒ Point Abeam Course | Apply
 Direct To: **KLAX/076/0.0**
 Course: **049°**
 Distance: **6747 NM**
 ETE: **19+16**
 Fuel Rem: **---**

FIGURE 02-34_1-29-47 - CROSS PTS TAB - POINT ABEAM COURSE

The point abeam is the lat/lon location in the flight plan where the Show Info designated object is 90 degrees to the flight plan

When the Point Abeam Course checkbox is checked, the FMS computes the distance and radial from the crew member waypoint selection (e.g. KLAX) to point, which results when the airplane passes abeam a crew member waypoint selection, as well as the course, distance, ETE, and fuel remaining if the airplane were to fly direct from PPOS to the point intersection.

The results of the calculations are displayed in green.

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DEFINE WPT dialog box

The define waypoint dialog box can be invoked by one of the following scenarios:

- Unknown or custom waypoint entry in the “Enter Identifier” text field in the “Show Wpt” tab of the show dialog box
- Unknown entry in the “Wpt 1” or “Wpt 2” of the “ETP” tab in the show dialog box
- Unknown entry in the Wpt field of the “PNR” tab in the show dialog box
- Unknown entry in the Waypoint list Text Entry field of Amend route and Direct To
- Unknown entry in the FMW window
- Unknown Entry in the Avionics window
- Selecting the Define Wpt Task Menu on the Map

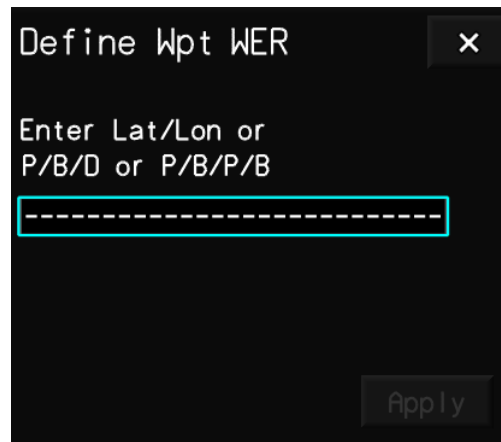


FIGURE 02-34_1-29-48 - DEFINE WPT DIALOG BOX

Crew member has the possibility to define waypoints either by:

- latitude/longitude
- place/bearing/distance
- place/bearing/place/bearing

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■ latitude/longitude

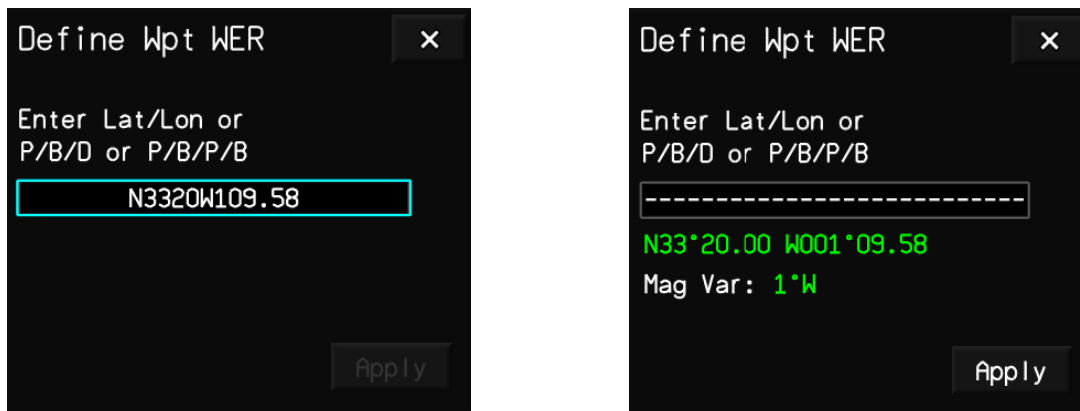


FIGURE 02-34_1-29-49 - DEFINE WPT DIALOG BOX - LAT/LON FORMAT

The crew member inserts data in latitude and longitude and presses <ENTER> on the MNKB or CCD. The waypoint position is displayed in green.

By clicking on **Apply** the waypoint is defined, inserted into the database and the dialog box is closed.

■ place/bearing/distance



FIGURE 02-34_1-29-50 - DEFINE WPT DIALOG BOX - PLACE/BEARING/DISTANCE FORMAT

The crew member inserts data place/bearing/distance and presses <ENTER> on the MKB or CCD. The waypoint position is displayed in green.

By clicking on **Apply** the waypoint is defined, inserted into the database and the dialog box is closed.

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- place/bearing/distance

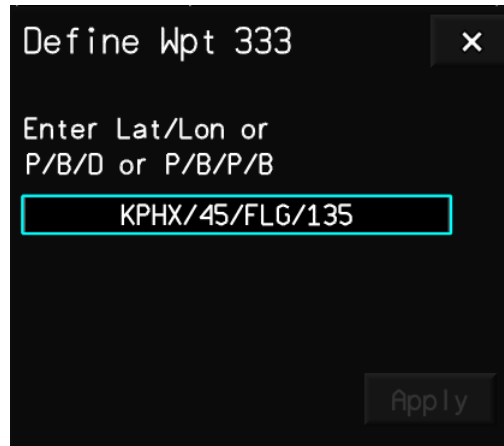


FIGURE 02-34_1-29-51 - DEFINE WPT DIALOG BOX - PLACE/BEARING/ PLACE/BEARING

The crew member inserts data place/bearing/ place/bearing and presses <ENTER> on the MKB or CCD. The waypoint position is displayed in green.

By clicking on **Apply** the waypoint is defined, inserted into the database and the dialog box is closed.

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SHOW FUNCTION

The Show function provides the crew member the capability to display an object on INAV relative to the current airplane position.

It also allows for the creation of Custom Waypoints and access to the Equal Time Point (ETP), Point of No Return (PNR), and Lat/Lon Crossing functionality.



FIGURE 02-34_1-29-52 - SHOW DIALOG BOX

When using the SHOW Short cut on MKB, the Show Dialog box pops-up in the I-NAV with Object tab selected and cursor automatically jumps on the Enter Identifier field.

Object tab

The default Show dialog box display Object tab with "Ident" radio button selected and all the check boxes checked. The crew member fills it and presses <ENTER> on the CCD or the MKB. Then the lateral map shall re-scale to display the entered object.

The crew member can manually move the cursor to the "Name" radio button and clicks on it. The cursor automatically jumps to the "Enter Identifier" field and the crew member enters the text string and presses <ENTER> on the MKB or CCD. The Select Object dialog box opens showing all objects whose name starting text matches the text string. The crew member designates the desired object. Then SHOW dialog boxes close and the lateral map shall re-scale to display the entered object.

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ETP EO tab

ETP (Equal Time Point) is the physical point along the flight plan where the time to go back to the origin is the same as the time to continue to the destination.

The figure shows three sequential screenshots of the ETP computation interface. Each screenshot has a 'Show' tab with sub-tabs: Object, ETP (selected), PNR, and L/L Cross. The interface includes input fields for Wpt1, Crz Alt, and Wind, and a 'Compute' button. Below the inputs is a table with columns: Origin To, Dist, ETE, and Fuel Rem. The 'ETP Along FPLN' result is shown at the bottom.

Wpt1	Crz Alt	Wind	Origin To	Dist	ETE	Fuel Rem	ETP Along FPLN
KPHX	000	100 Kts	KPHX	5 NM	00+02	9.6 Lbs	5 NM 00+02 9.6 Lbs
KINW	000	7 Kts	KDEN	525 NM	01+15	7.0 Lbs	5 NM 00+02 9.6 Lbs
KPHX	005	105 Kts	KPHX	5 NM	00+02	9.6 Lbs	5 NM 00+02 9.6 Lbs
KDEN	015	200 Kts	KDEN	525 NM	01+15	7.0 Lbs	5 NM 00+02 9.6 Lbs
KPHX	040	060 Kts	KPHX	5 NM	00+02	9.6 Lbs	BEYOND DESTINATION
KDEN	070	020 Kts	KDEN	525 NM	01+15	7.0 Lbs	BEYOND DESTINATION

FIGURE 02-34_1-29-53 - EXAMPLE OF AN ETP COMPUTATION

To get the ETP calculations, the crew member must fill the readouts related to both waypoints: name (identifier), and wind at the cruise altitude. Then a compute key is available to start the computation.

In case the computed ETP is either behind the A/C or beyond the destination it will be indicated at the bottom of the box.

PNR tab

PNR (Point of Non Return) is a point along the flight plan where the fuel to reach the destination is less than the fuel to return to the waypoint.

The figure shows two sequential screenshots of the PNR computation interface. Each screenshot has a 'Show' tab with sub-tabs: Object, ETP, PNR (selected), and L/L Cross. The interface includes input fields for Wpt, Crz Alt, and Wind, and a 'Compute' button. Below the inputs is a table with columns: Origin To, Dist, ETE, and Fuel Rem. The 'PNR' result is shown at the bottom.

Wpt	Crz Alt	Wind	Origin To	Dist	ETE	Fuel Rem	PNR
KPHX	010	007 Kts	KPHX	5 NM	00+02	9.6 Lbs	BEYOND DESTINATION
KPHX	060	010 Kts	KPHX	5 NM	00+02	9.6 Lbs	5 NM 00+02 9.6 Lbs

FIGURE 02-34_1-29-54 - EXAMPLE OF AN PNR COMPUTATION

The principle to operate this function is similar to ETP. The crew member must insert the waypoint from which the PNR calculation will be performed (it is automatically assumed that the current flight plan dest is the destination) with the wind at a specified altitude.

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L/L Cross tab

This tab enables the crew member to be provided with course/distance and time fuel data about crossing a waypoint defined with latitude and longitude. This point must be located along the flight plan.

The figure shows two states of the 'Show' window. In the first state, the 'L/L Cross' tab is active, and the 'Enter Lat or Lon:' field is empty, indicated by a dashed line. In the second state, the same field contains the coordinates 'N33°42.00 W111°37.04000'. Below this, the 'Direct to:' label is followed by the same coordinates. At the bottom, a table displays flight data: Crs (039°), Dist (25.3 NM), ETE (00+05), and Fuel Rem (50.0 Lbs).

FIGURE 02-34_1-29-55 - EXAMPLE OF LAT/LON COMPUTATION

Once the data is entered the result will be displayed at the bottom of the tab.

If the crew member enters a latitude/longitude which does not cross the flight plan then “No Crossing Point Found” message is displayed.

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SYSTEM MONITORING

FMS and GPS are monitored with regard to following parameters:

- Validity of FMS modules,
- Validity of GPS modules,
- Difference of position between FMS and GPS,
- Horizontal integrity limit of GPS.

➤ *Refer to 02-34_1-10, for the annunciations provided by the FMS.*

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ACTIVE PROTECTIONS

The FMS and GPS systems do not feature any automatic protections.

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No supplementary information to be provided at present time on System Protections.

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FMS DATABASE LOADING

Upload of files and databases are requested to:

- Periodically update navigation and terrain databases requested for the INAV and FMS EASy functions, and Jeppesen electronic charts (if the option was selected by the operator),
- Load a flight plan prepared on an external computer and stored on a CD-ROM or on a PCMCIA memory PC-CARD.

The navigation and terrain databases and the Jeppesen electronic charts are distributed to the operator by the Integrated Navigation Data Service (INDS) which was developed through an alliance of Honeywell and Jeppesen, to provide state-of-the-art data service for the EASy cockpit.

These data are provided under the format of CD-ROM:

- INDS CD-ROM #1 (Blue), updated every 14 days, containing Jeppesen e-Charts (if the option was selected by the operator), obstacles, geopolitical information, airport information,
- INDS CD-ROM #2 (Red), updated every 28 days, containing navigation data and airspace and communications data,
- INDS CD-ROM #3 (Green), updated every 6 to 12 months, containing terrain data.

The upload of navigation files and databases can be performed:

- Either from the cockpit by inserting the INDS CD-ROM or the PCMCIA memory PC-CARD containing the flight plan to be uploaded in the Data Management Unit (DMU) drive, and controlling the loading process with the Centralized Maintenance Computer (CMC),
- Or from a laptop connected to the Local Area Network (LAN) as a CMC Remote Terminal (CMCRT), by inserting the INDS CD-ROM or the PCMCIA memory PC-CARD containing the flight plan to be uploaded in the corresponding laptop drive.

➤ *Refer to ATA 45 for additional information about the Centralized Maintenance Computer.*

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INTRODUCTION

The optional Head up Guidance System (HGS) is an electronic and optical system that generates and displays information in the pilot's forward field of view.

The HGS provides information during all phases of flight. The displayed information is derived from aircraft instruments and sensor data.

At the present time, the HGS is approved for CAT 1 approaches and AutoPilot coupled approaches using Flight Director computed by Modular Avionics Unit (MAU). The HGS is non capable of Enhanced Flight Vision System (EFVS).

The HGS is composed of three components:

- HGS computer,
- Overhead Unit (OHU),
- Head Up Display (HUD) Combiner.

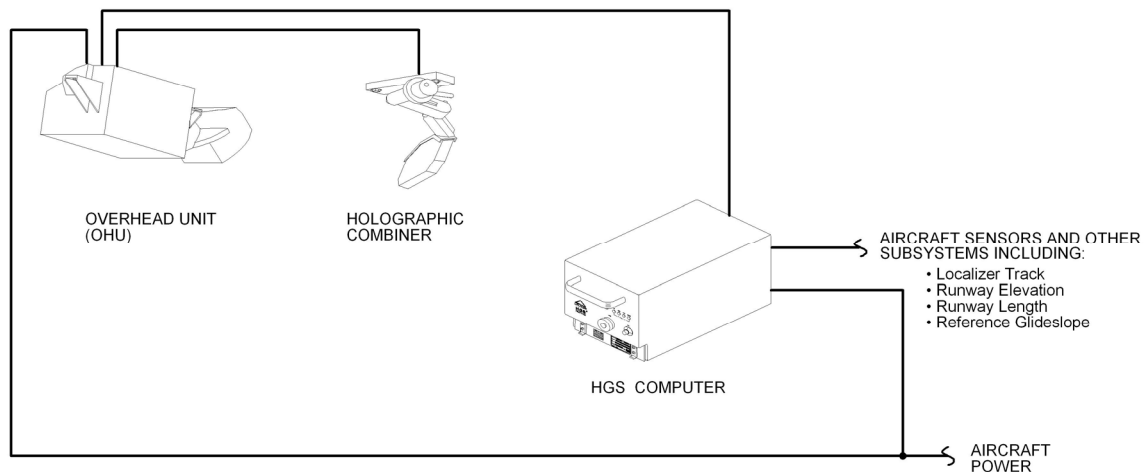


FIGURE 02-34_2-05-00 - HGS COMPONENTS

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FLIGHT DECK OVERVIEW

CONTROLS

Controls of the Head up Guidance System include:

- Head Up Display Combiner,
- Flight Management Window,
- Left sidestick (HUD DCT pushbutton),
- Servicing page accessible through TEST synoptic.

INDICATIONS

Cockpit indications are displayed:

- On the Head Up Display (HUD) combiner,
- On the ADI for flags,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

NOTE

HUD DCT pushbutton is a provision for Enhanced Flight Vision System.

At the present time, the HGS is approved for HUD CAT 1 also no flags are displayed in ADI.

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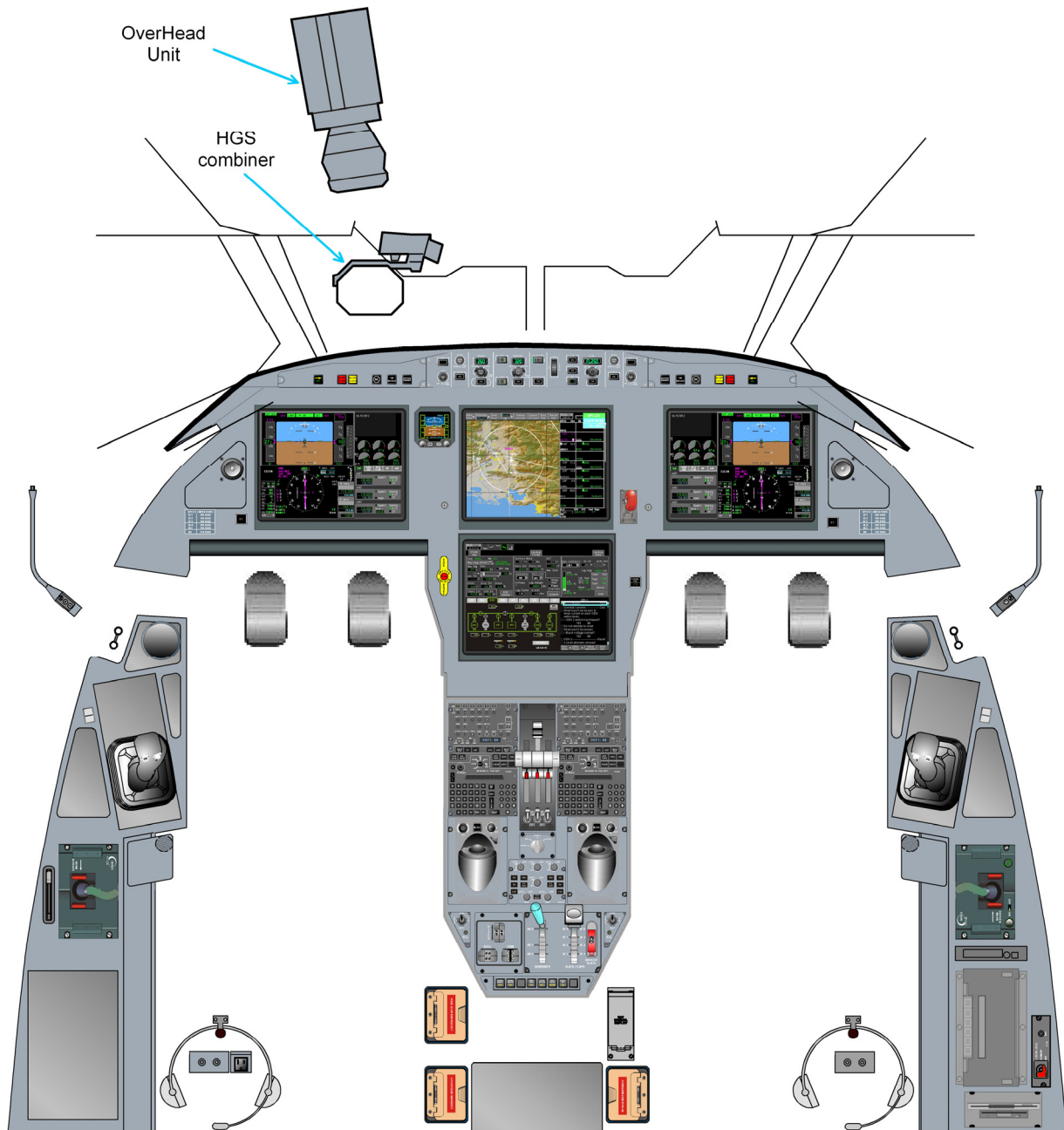


FIGURE 02-34_2-05-01 - FLIGHT DECK OVERVIEW

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GENERAL

The HGS is composed of the three components:

- HGS computer,
- Overhead Unit (OHU),
- Head Up Display (HUD) Combiner.

The Optical effects of the curved windshield are compensated for in the optics and pre-distortion map.

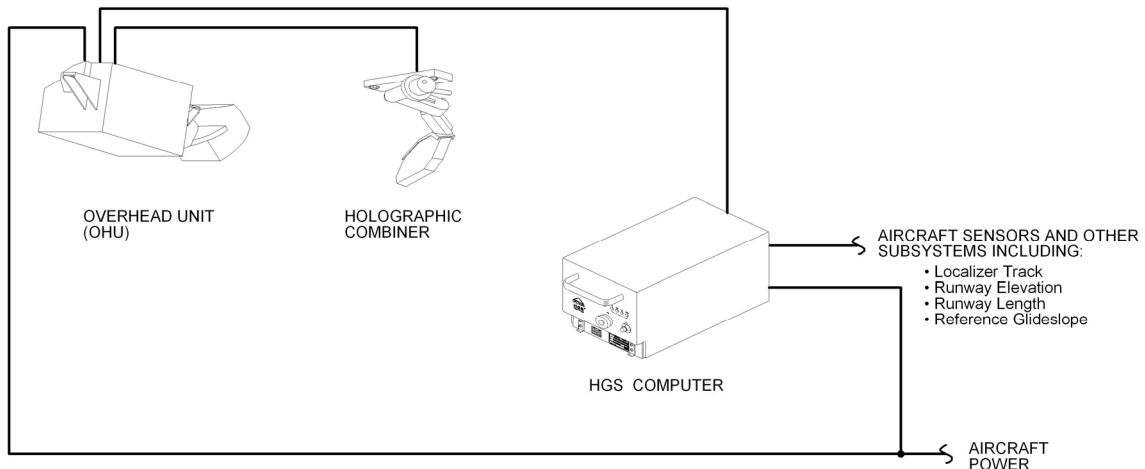


FIGURE 02-34_2-10-00 - HGS COMPONENTS

HUD COMBINER

The Combiner is an optical element, which optically combines displayed flight symbology with the pilot's view through the aircraft windscreen.

This optical design permits various symbols, like the artificial horizon, to overlay corresponding features of the outside world.

The Combiner also displays the flight symbology at optical infinity, allowing the pilot to see the information without a shift in eye focus.

The combiner also includes symbology controls.

To move the Combiner glass from the stow to the operating position, push the stow lever and rotate the Combiner glass down and forward until the Combiner glass moves into the operating position. When the Combiner glass moves into the operating position, the stow switch automatically turns on the high-voltage power supply in the OHU. After a brief warm-up period, the OHU projects symbology onto the Combiner glass.

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The HGS Combiner is removed from the pilot's forward field-of view by moving it to the stowed position:

- Combiner may be manually stowed by simply rotating the bottom of the Combiner aft and upward.
- The Combiner locks into the stowed position and must be manually released prior to deployment.

The HGS display brightness can be adjusted, from zero to full intensity through the brightness control located on the Combiner:

- A manual adjustment mode is available that allows a constant luminance to be set by the pilot.
- An automatic adjustment mode is also available that allows a constant contrast ratio to be set by the pilot (the actual luminance of the Combiner display varies with the sensed luminance of the ambient light).

OVERHEAD UNIT

The Overhead Unit (OHU) projects the flight symbology, generated by the HGS Computer, onto the Combiner.

Within the OHU is an LCD, a relay lens assembly, power supply and supporting electronics.

HGS COMPUTER

The HGS Computer provides the symbology drive signals to the OHU.

These signals are derived from internal calculations, which determine the position and form of the flight symbology to be presented, dependent on the aircraft equipment and sensor data received by the HGS Computer.

The HGS Computer provides display functions for Flight Director (FD) guidance, HGS guided approach, visual approach and unusual altitude.

The HGS Computer receives the approach, like the localizer track, the runway length, the runway elevation, and the reference glideslope from the Flight Management Window.

At present time, the guidance is providing by AFCS and the FD displayed in the HUD is computed by AFCS hosted in the MAU.

HGS monitor data fed back from OHU to verify the conformal symbols are properly resolved. HGS blanks the display if a failure is detected or removes the symbol detected failed.

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PRINCIPAL DIAGRAM

The HGS interconnect includes:

- Video and control from HGS Computer to the OHU,
- Video feed back, serial data and combiner settings from OHU to the HGS Computer,
- Power from OHU to the Combiner,
- Settings and position from the Combiner to the OHU.

The HGS Computer requires inputs from other systems in the airplane. The HGS receives these inputs through dual independent input/output subsystems contained within the HGS Computer. These inputs consist of digital and analog data from these sensors and equipment:

- Inertial Reference Unit (IRU),
- Radio Altimeter (RA),
- Modular Avionics Units (MAU),
- Pilot sidestick (provision for EFVS).

The HGS Computer provides outputs to MAU2 consisting of:

- Flight data recorder information (FDR),
- Annunciations for displayed in PDU,
- Auto-Throttle data (A/T),
- Maintenance data (CMC).

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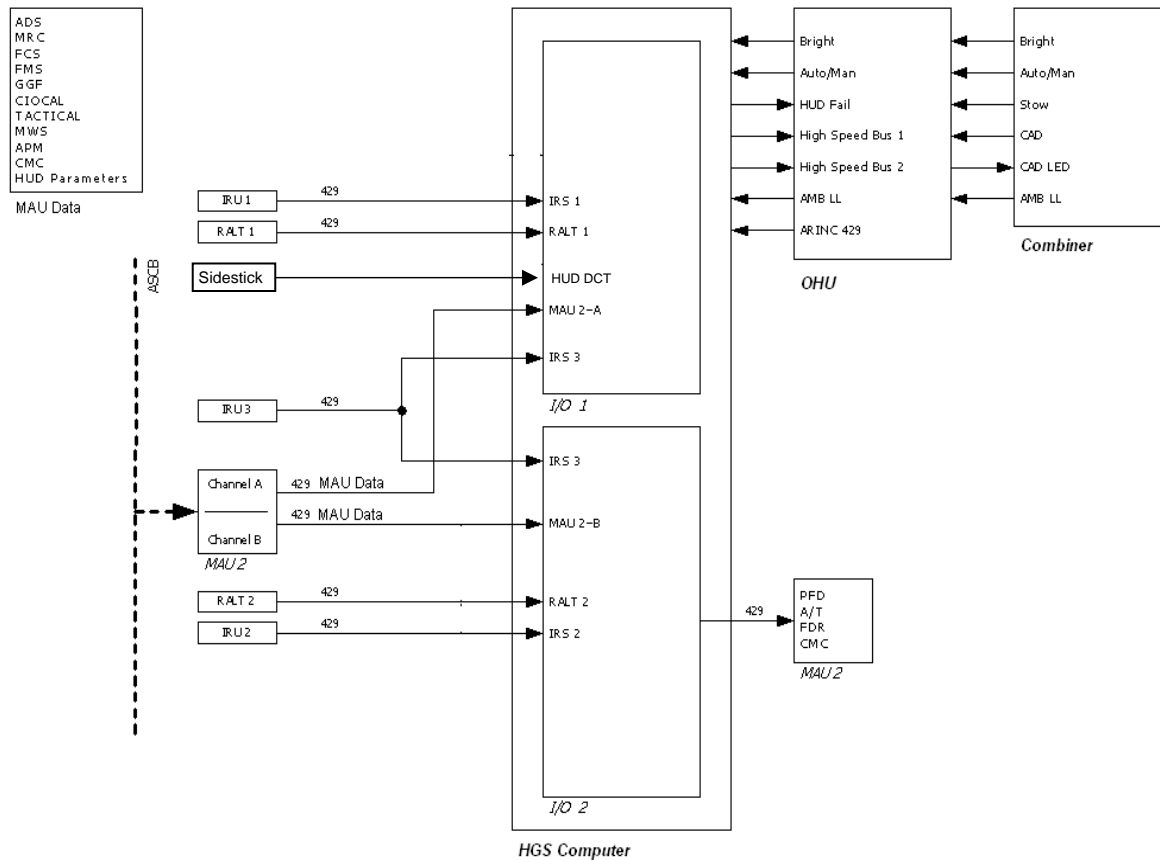


FIGURE 02-34_2-10-01 HGS INTERFACES

The HGS Computer provides source selection among redundant HGS inputs. This allows the HGS to revert to a valid source when a failure has occurred to the currently selected source. The source selection in the HGS is the same as the one used in the corresponding ADI.

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HEAD UP GUIDANCE SYSTEM MODES

The HGS has two display formats: primary and approach.

The primary display format is available for

- Take-off,
- Climb,
- Enroute,
- Descent and non ILS approach and landing.

The approach display format is available for:

- CAT1 approach mode: available for manual or AutoPilot engaged CAT I ILS approach with minimum decision altitude or RA DH of 200 feet above runway elevation or higher.
- CAT2 approach mode: available for AutoPilot engaged CAT II ILS approach with minimum decision heights from 199 to 100 feet.
- HUD2 approach mode: available for manual CAT II ILS approach and landing with minimum decision heights from 199 to 100 feet.
- HUD3 approach mode: available for manual CAT III ILS approach and landing with minimum decision heights from 99 to 50 feet.

Only CAT 1 and CAT 2 approaches mode are available at present time.

At present, HUD is used to perform a CATI and CATII approaches. HUD2 and HUD3 will be available later.

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DESIGN PRINCIPLES

The Combiner support mechanism is robust and has been designed and manufactured to minimize the positioning errors of the combiner glass.

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EQUIPMENT LOCATION

The HGS computer is installed in the nose cone.

The OHU and Combiner are located on the left side of the cockpit, above and forward of the left pilot.

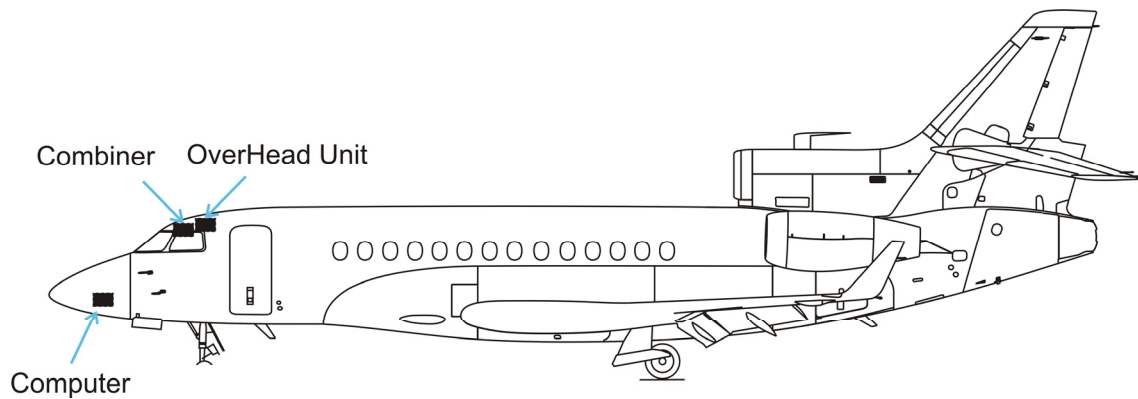


FIGURE 02-34_2-15-00 HGS EQUIPMENT LOCATION

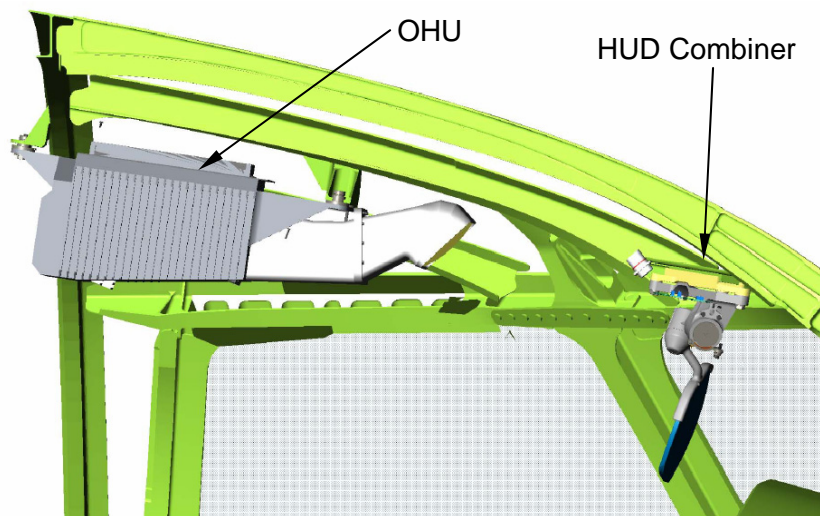


FIGURE 02-34_2-15-01 OHU AND COMBINER LOCATION

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the Head up Guidance System.

Electrical protection is provided:

- Either by Solid State Power Controllers (SSPC),
- Or by Circuit Breakers (CB).

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
OHU	LH Main	LH MASTER	CB
HGS Computer	LH Main	LH MASTER	CB

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HGS COMPUTER INTERFACES

The HGS Computer requires inputs from other systems in the airplane. These inputs consist of digital and analog data from these equipments:

- Three Inertial Reference Unit for:
 - o Altitudes,
 - o Headings,
 - o Track,
 - o Hybrid track,
 - o Body acceleration,
 - o Inertial vertical speed,
 - o Ground speed.
- Dual Radio Altimeter for:
 - o Altitude above ground data.
- Modular Avionics Units 2 for:
 - o Air Data System data (Altimeter settings and airspeed),
 - o Radio-navigation data,
 - o FMS for navigation data,
 - o AFCS commands and modes,
 - o FMW data (runway elevation, runway length, localizer track and reference glideslope),
 - o Airplane systems data (slats /flaps control lever positions, landing gear positions)
 - o PDU data,
 - o Miscompare annunciation,
 - o EGPWS data,
 - o TCAS data,
 - o Clock data (time and date).

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The HGS Computer receives data throughout the 3B and 4B Generic I/O housed in the MAU2.

In case of a MAU 2 channel B failure, the HUD Combiner is not operable.

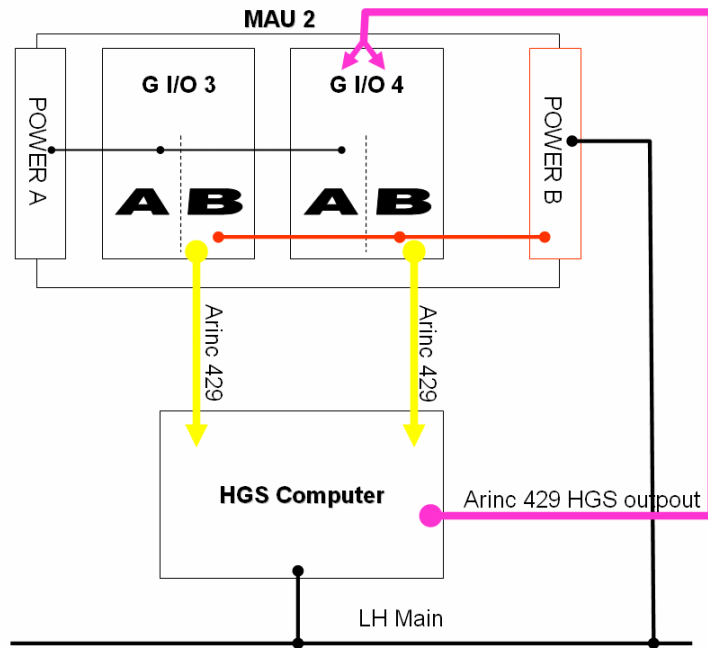


FIGURE 02-34_2-15-02 INTERFACE BETWEEN HGS AND MAU

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CONTROLS

Crew has control on the Head up Guidance System through:

- Controls on Head Up Display Combiner,
- Softkeys in the Flight Management Window,
- HUD DCT pushbutton or EVS pushbutton if M618 is installed on the airplane, available on sidestick (provision).

HUD COMBINER CONTROLS

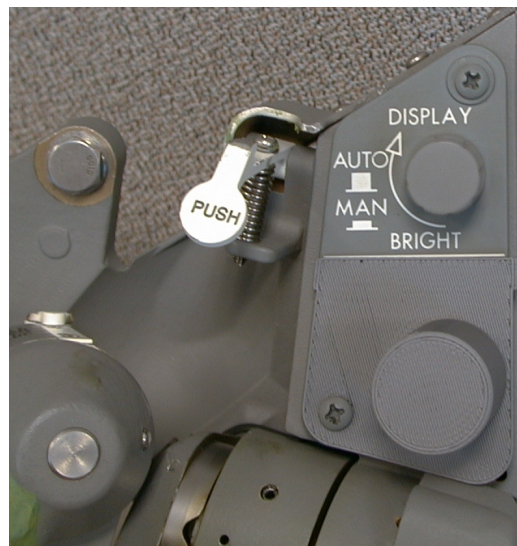


FIGURE 02-34_2-20-00 HUD COMBINER CONTROLS

The Combiner contains an integrated display brightness control knob with an Automatic/Manual selector switch:

- Pull the BRIGHT knob to select automatic (AUTO) brightness mode,
- Push the BRIGHT knob to select manual (MAN) brightness mode,
- Turn the BRIGHT knob to adjust the brightness:
 - o Rotate the knob clockwise to increase the display intensity,
 - o Rotate the knob counter-clockwise to decrease the display intensity.

In AUTO mode the brightness automatically changes to maintain the level set by the pilot. This gives a constant contrast ratio to the detected light conditions and allows the display to remain visible without manual adjustment as the airplane travels through a variety of light conditions.

In MAN mode the brightness level does not change once it is set by the pilot. Thus, when the airplane travels through a variety of light conditions, it is possible for the display to not be visible.

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FLIGHT MANAGEMENT WINDOW

The HGS computer receives the approach and take-off parameters from the MAU via the Flight Management Window.

Departure Phase Of Flight

At present time, the HUD CONFIRM pushbutton available in SID tab has no effect on the HUD.



FIGURE 02-34_2-20-01 - DEPARTURE POOF OF THE FMW

If the HGS is not installed, the HUD CONFIRM sofkey is removed.

Once there is data in both fields, HUD CONFIRM softkey become selectable.

Selecting the softkey has no effect and the softkey becomes non-selectable again until a change is made to any one of the parameters.

This pushbutton is a provision for the HGS guided takeoff.

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Arrival Phase Of Flight

The localizer track, runway elevation, glideslope and runway length parameters are required:

- To display the glideslope reference, the swinging loc and the synthetic runway,
- To perform an HUD2/3 approach (not available at present time).

The runway length, runway elevation, localizer track and glideslope parameters displayed in the STAR / App tab of the Arrival POF are sent to the HGS Computer after the crewmembers have confirmed them via the HUD CONFIRM softkey.



FIGURE 02-34_2-20-02 - ARRIVAL POF, STAR/APP TAB OF THE FMW

If the HGS is not installed, the HUD CONFIRM softkey is removed.

Once there is data in all of the four fields, HUD CONFIRM softkey become selectable.

Selecting the softkey confirms data for the HGS and the softkey becomes non-selectable again until a change is made to any one of the parameters.

Upon selection of the runway, all the runway information is retrieved from the database and displayed automatically.

If the parameters are not confirmed:

- The synthetic runway, the swinging localizer and the glideslope reference are not displayed,
- The HUD 2/3 approach capability is lost and NO HUD 2/3 annunciation is displayed in the HUD (HUD 2/3 approach capability not available at present time).

Approach category and minimums information are selected through the Landing Data tab.

At present time; HUD2 and HUD3 section are not possible.

➤ Refer to sub section 02-34_1-25 for more information about approach category selection.

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SIDESTICK

At present time, the pushbutton HUD DCT or EVS pushbutton if M618 is installed on the airplane is not operative.

This pushbutton is a provision for EFVS option.

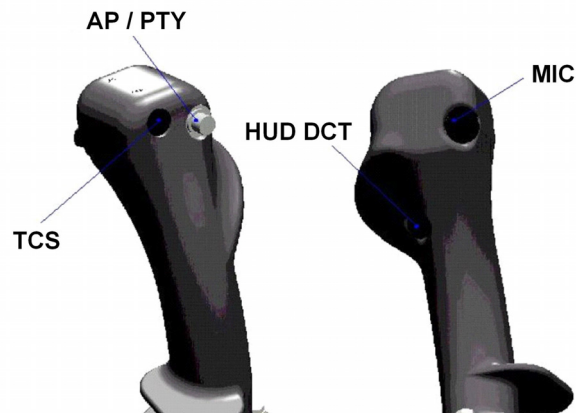


FIGURE 02-34_2-20-03 - HUD DCT OR EVS PUSHBUTTON

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INDICATIONS

Cockpit indications are displayed:

- On the Head Up Display (HUD) combiner,
- On the ADI for flags,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

NOTE

At the present time the HUD 2 and HUD 3 approaches are not available but the corresponding indication are described.

HUD SYMBOLOGY

The HUD Symbology is designed to enable the pilot to control and monitor the airplane during all flight phases, whether being manually flown or when using the autopilot.

It is designed to be consistent with the ADI display formats to prevent any ambiguity between the head-up and the head-down displays.

The following symbologies are provided by the HGS:

- Attitude information
- Airspeed information
- Altitude information
- Conformal symbology (Flight path, Heading Scale, Conformal Selected Course, Conformal Selected Heading, Synthetic Runway)
- Energy and speed management (Flight Path acceleration, Speed Error Tape, Vertical Speed, Thrust Director)
- Source annunciations
- Miscompares and Failure annunciations
- Flight Management System information
- Navigation information
- TCAS advisory with corrective action
- Flight Control Mode / HGS Mode annunciations
- Flight Director Guidance and Mode annunciations
- Autothrottle annunciations
- EGPWS windshear annunciations
- Remaining runway distance during rollout at landing
- Unusual Attitude Recovery

Basic flight information is available during all phases of flight.

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The main symbology differences between ADI and HUD are limited to the airplane reference symbol, the flight director symbol and the path symbol.

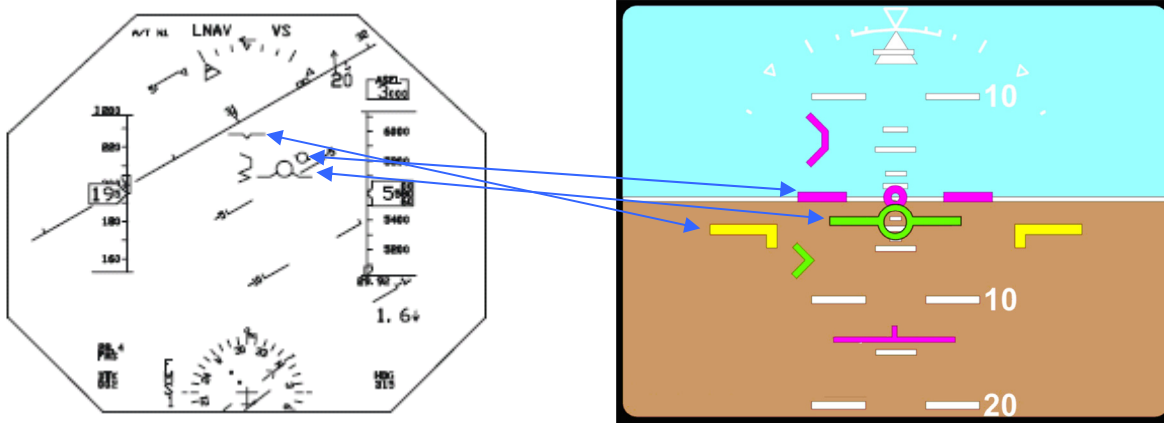


FIGURE 02-34_2-20-04 HUD AND ADI SYMBOLOGY DIFFERENCES

Three symbols displayed in the ADI are not duplicated in the HUD:

- PFCS speed protection bugs,
- The progressive indication of the position of the airbrakes when the lever is less than AB1 position. AB1 annunciation is displayed as soon as the AB1 is greater than 0,
- The ICE annunciation.

The symbology shown later in this sub-section are for identification purposes only, they are not intend to match the exact display format.

The following HUD symbology descriptions and illustrations are presented in six parts:

- Visual take-off symbology: describes symbol used during take-off,
- Enroute symbology: describes symbol used anytime,
- Approach symbology: describes symbols used during an ILS approach,
- Unusual attitude display,
- Flags and reversion annunciations display,
- Advisories and annunciations display.

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Visual take-off symbology

The Visual Takeoff display provides situational awareness to the pilot during the takeoff roll without active guidance.

This display is invoked when the aircraft is not configured for guided takeoff. A typical representation of the symbology for the Visual Takeoff display is shown in the following figure:

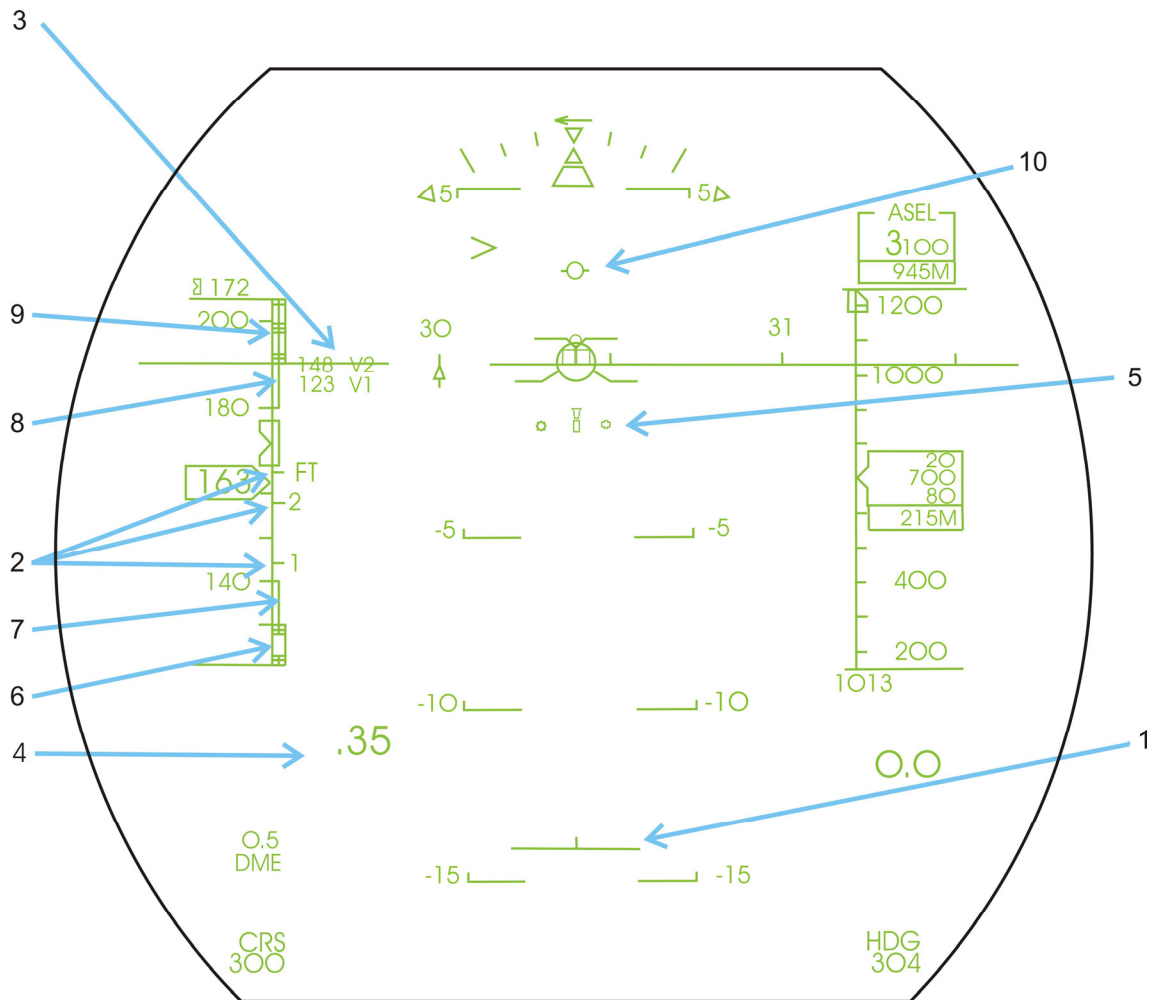


FIGURE 02-34_2-20-05 VISUAL TAKE-OFF SYMBOLOGY

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SYMBOL	ID#
Rotation Symbol	1
Airspeed Reference Bugs	2
Speed Reference Table	3
Longitudinal Acceleration	4
Ground Lateral Deviation Scale / Pointer	5
AOA max cue	6
Low speed cue	7
Airspeed limitation	8
Maximum operating speed tape	9
Flight Director Guidance cue	10

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Enroute symbology

The Enroute display provides situational awareness and/or flight director information to the pilot during enroute operations. VOR and FMS information is also available. This is the default display when the airplane is in air.

Navigation source displaying is different between the ADI and the HUD.

A typical representation of the symbology for the Enroute display is shown in the figure:

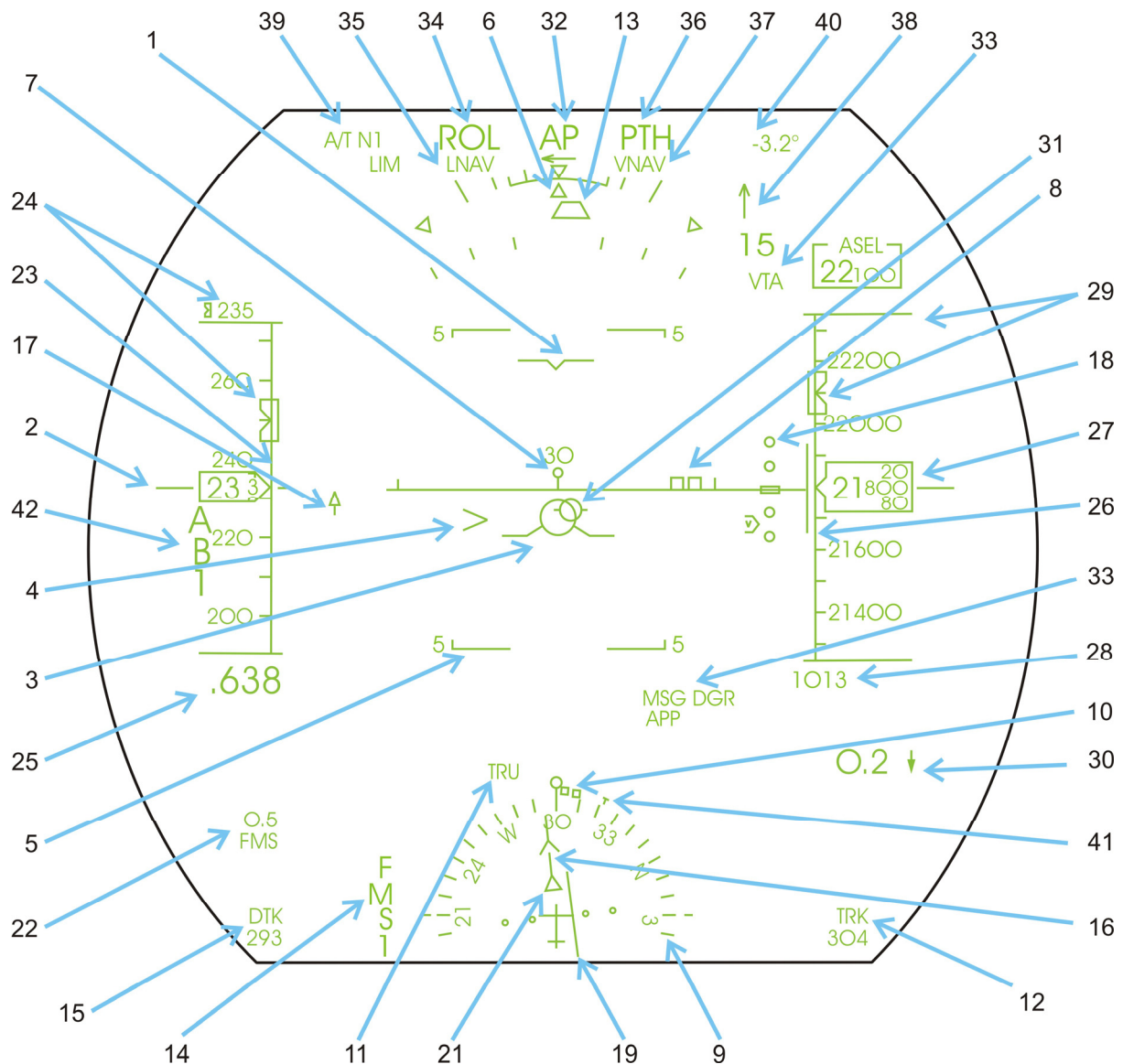


FIGURE 02-34_2-20-06 - ENROUTE SYMBOLOGY

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SYMBOL	ID#
Aircraft Reference	1
Horizon Line	2
Flight Path	3
Flight Path Acceleration	4
Pitch Scale	5
Roll Scale and Pointer	6
Conformal Heading Scale and Index	7
Conformal Selected Heading Bug	8
Partial Compass Rose	9
Selected Heading Bug	10
Heading Source	11
Digital Selected Heading / Track	12
Slip / Skid Indicator	13
Navigation Source	14
Digital Selected Course / Desired Track	15
Selected Course Arrow	16
Conformal Selected Course Bug	17
VNAV Scale / VNAV Pointer	18
Lateral Deviation Indicator	19
To / From Indicator	21

SYMBOL	ID#
Digital Distance Data	22
Airspeed Scale	23
Selected Airspeed Bugs	24
Indicated Mach Digital Readout	25
Altitude Scale	26
Odometer / Altitude Drum	27
Baro Pressure Setting	28
Selected Altitude	29
Digital Vertical Speed	30
Flight Director Guidance Cue	31
Autopilot Status	32
FMS Annunciations	33
FD Lateral Capture Mode	34
FD Lateral Arm Mode	35
FD Vertical Capture Mode	36
FD Vertical Arm Mode	37
Wind Speed and Direction	38
Autothrottle Annunciations	39
Flight Path Command	40
Track Angle Pointer	41
Air Brake Annunciations	42

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Approach symbology

This display is invoked when guided approach mode is active.

A typical representation of the symbology for the HGS Approach display is shown in the figure:

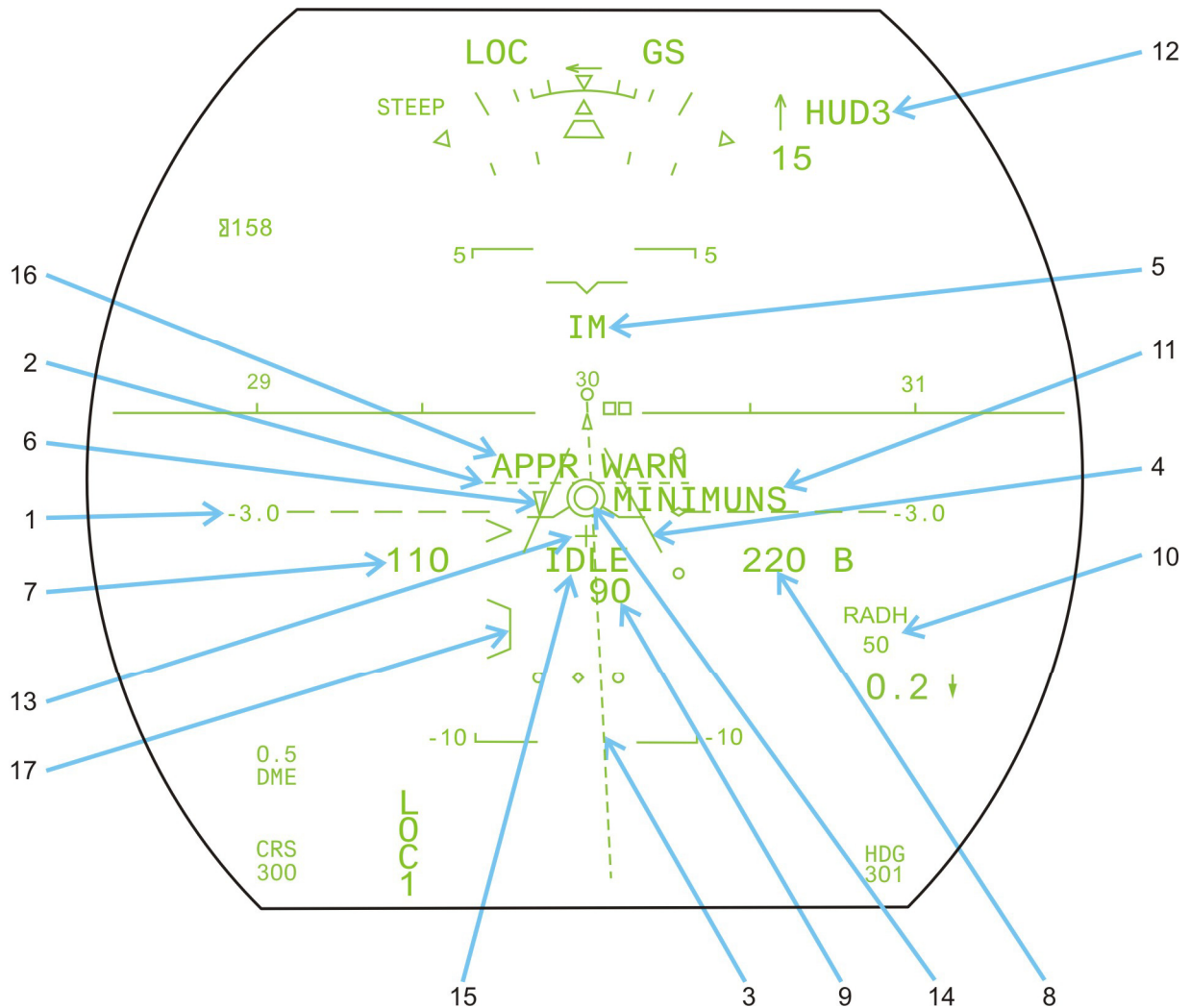


FIGURE 02-34_2-20-07 - APPROACH SYMBOLOGY

When the ILS is captured the speed tape symbol, altitude tape symbol and partial compass rose symbol are removed from the display.

At present time, symbols 12, 13, 15 and 16 are not available.

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SYMBOL	ID#
Glideslope Reference Line	1
Glideslope Deviation Line	2
Swinging Localizer	3
Synthetic Runway	4
Marker Beacons	5
Speed Error Tape	6
Digital Airspeed	7
Digital Barometric Altitude	8
Digital Radio Altitude	9
Digital Decision Height	10
Minimum Height Alert	11
HGS Mode Annunciations (not available at present time)	12
Flare Command (not available at present time)	13
HGS Approach Guidance Cue	14
Idle Message (not available at present time)	15
HGS Warning Annunciations (not available at present time)	16
Thrust director cue	17

NOTE

If an ILS frequency is selected, the HUD displays LOC and G/S deviation even in FMS/VGP approach.

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Unusual attitude display

During unusual attitudes (same triggering logics as the head down ADI), the HGS display will automatically switch to a format designed for recognition and recovery assistance. When the airplane attitude is restored to a stable condition, the display format is returned to the operating display format.

A typical representation of the symbology for the Unusual Attitude display is shown in the figure:

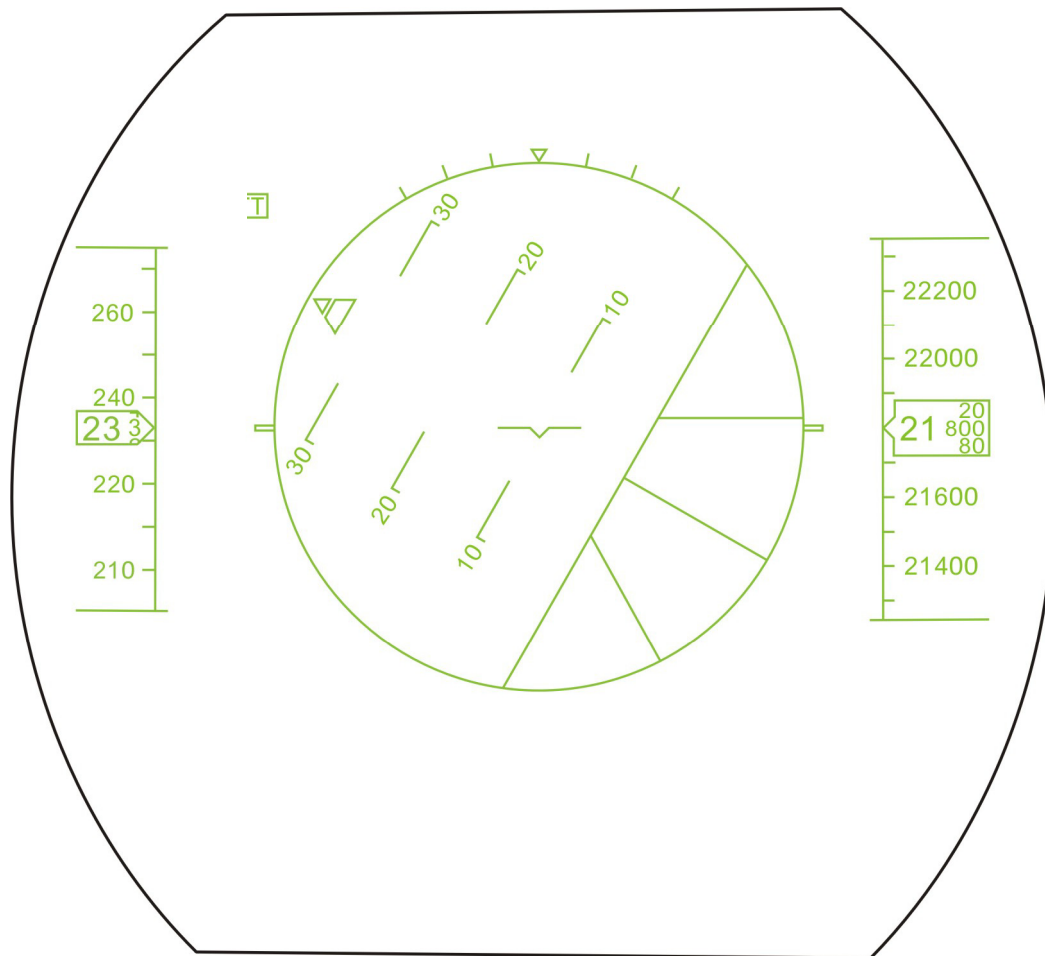


FIGURE 02-34_2-20-08 - UNUSUAL ATTITUDE DSIPLAY

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Flags and reversion annunciations display

A typical presentation of the Failure Flags / Comparator Flags / Reversion Annunciations is shown in the figure.

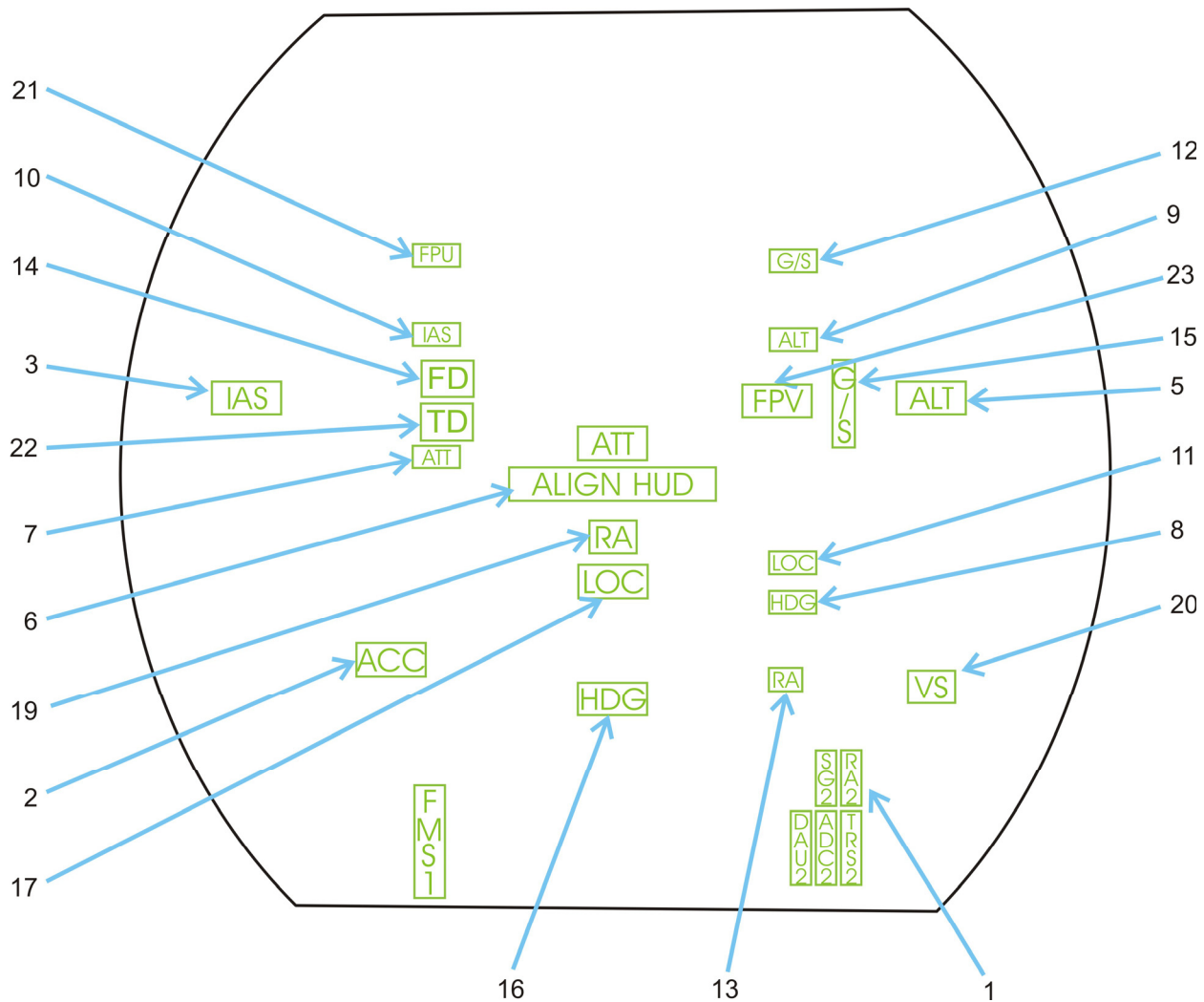


FIGURE 02-34_2-20-09 - FLAGS AND REVERSION ANNUNCIATION

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SYMBOL	ID#
Alternate Source Selection	1
Longitudinal Acceleration Fault	2
Airspeed Fault	3
Attitude Fault	4
Barometric Altitude Fault	5
Combiner Alignment Message	6
Attitude Comparator	7
Heading Comparator	8
Altitude Comparator	9
Airspeed Comparator	10
Localizer Comparator	11
Glideslope Comparator	12
Radio Altitude Comparator	13
Flight Director Fault	14
Glideslope Fault	15
Heading Fault	16
Localizer Fault	17
Navigation Source Fault	18
Radio Altitude Fault	19
Vertical Speed Fault	20
Flight Path Comparator	21
Thrust director fault	22
Flight Path Fault	23

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Advisories and annunciations display

Typical presentations of advisories and annunciations are shown in the figure.

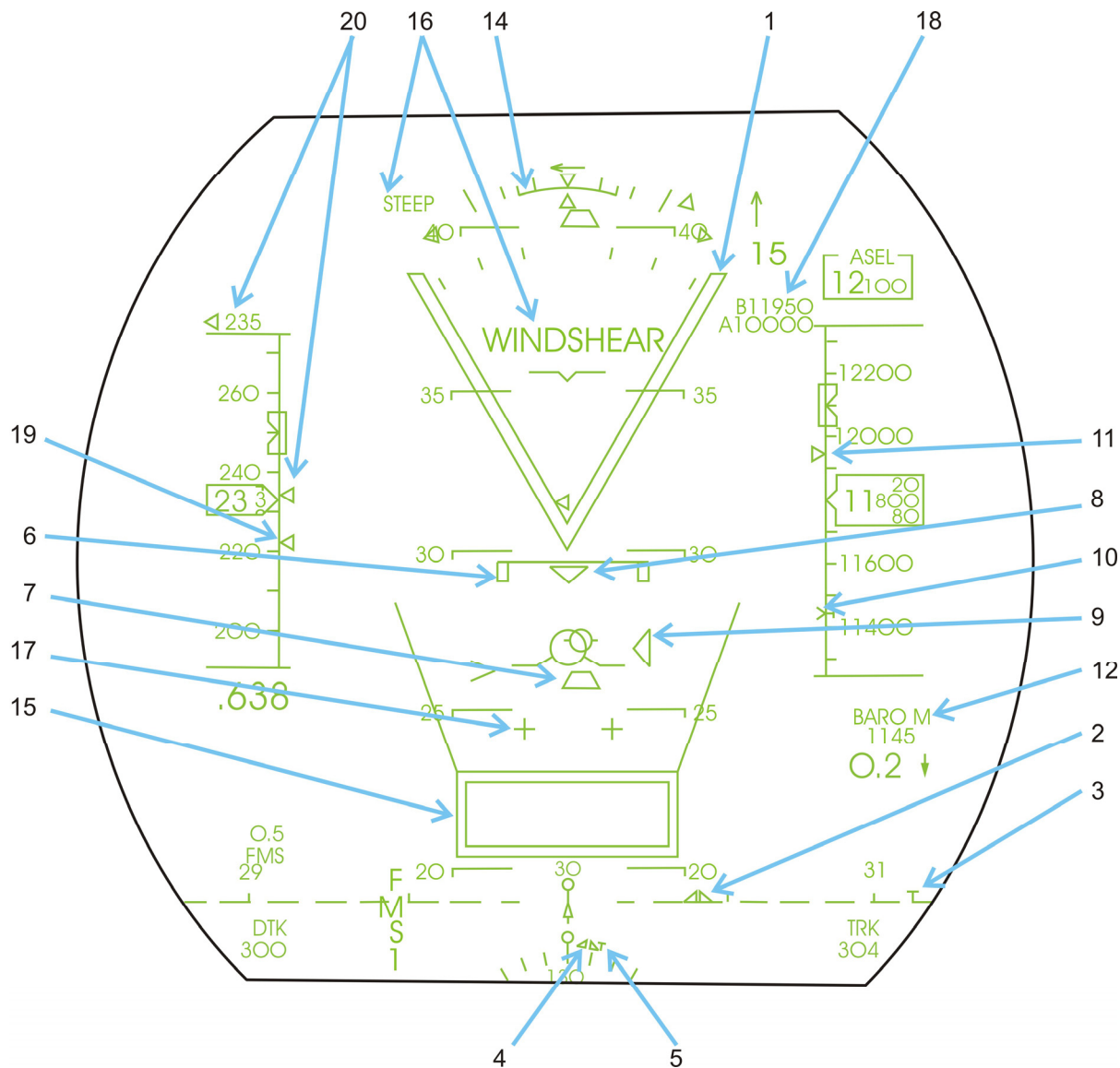


FIGURE 02-34_2-20-10 - ADVISORIES AND ANNUNCIATION

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SYMBOL	ID#
Pitch Chevron	1
Conformal Selected Track Bug	2
Conformal Track Angle Pointer	3
Selected Track Bug	4
Track Pointer	5
Angle of Attack Limit	6
Slip/Skid Indicator	7
Excessive Glideslope Deviation	8
Excessive Localizer Deviation	9
Minimum Descent Altitude Pointer	10
FMS VNAV Target Altitude Readout / Pointer	11
Digital Minimum Descent Altitude	12
Minimum Descent Altitude Alert	13
Low Bank Limit Arc	14
TCAS Resolution Advisory Box	15
Windshear / Ground Proximity Annunciations	16
Flare Cue	17
FMS Constraint Altitude	18
FMS Selected Airspeed	19
Speed Protection Bug / Readout	20

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ADI WINDOW

The following HUD annunciations are displayed in ADI:

- **IDLE** is displayed in HUD2 or HUD3 mode approach as a reminder for the pilot to reduce the airplane thrust levers to idle for touchdown. If active, the Auto-Throttle reduces the thrust levers to idle.
- **FLARE** is displayed in HUD2 or HUD3 mode approach as a reminder for the pilot to initiate flare.
- **APPR WARN** is displayed in HUD2 or HUD3 mode approach when HUD2 or HUD3 capability is lost, or if approach and landing tolerance is out of tolerance below 500 feet AGL.

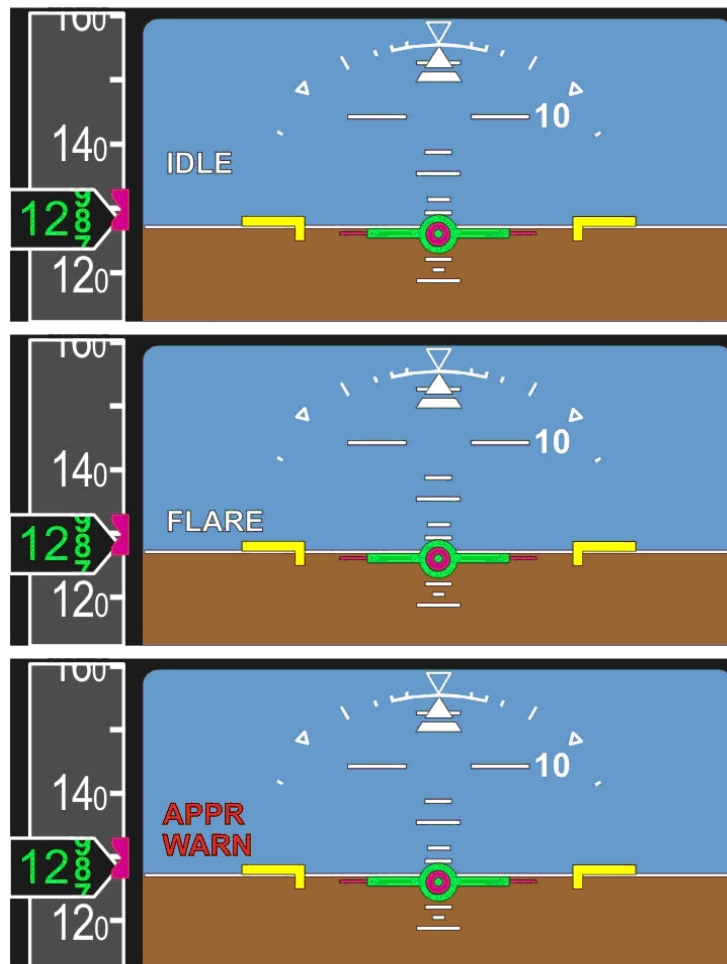


FIGURE 02-34_2-20-11 IDLE, FLARE, APPR WARN ANNUNCIATIONS

IDLE, **FLARE** and **APPR WARN** are displayed flashing for 10 sec then they are steady.

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**APPR
WARN** have priority over **IDLE** and **FLARE**.

When HUD2/3 mode approach is active the following approach mode annunciation is displayed in ADI:

- HUD2/3 is displayed in green if the HUD CAT2/3 conditiond are valid,
- HUD2/3 is displayed in amber if the conditions are not valid and radio altitude is above 200 ft,
- HUD2/3 is displayed in red if the conditions are not valid and the radio altitude is below 200 ft.

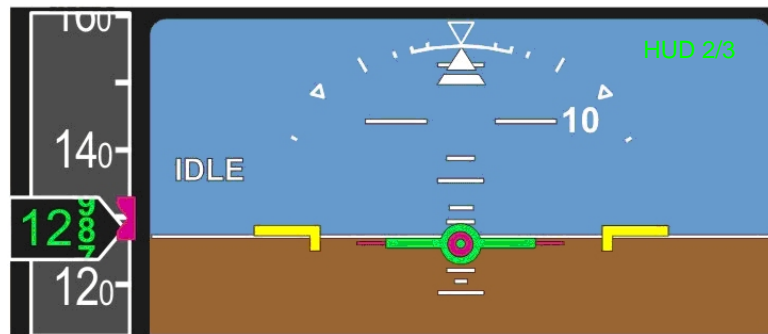


FIGURE 02-34_2-20-12 HUD2/3 APPROACH MODE ANNUNCIATION

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INDICATIONS

Symbols description and illustrations are grouped under each chapter according to:

- Mode annunciations and roll scale,
- Attitude Direction Indicator,
- Airspeed,
- Altitude,
- Horizontal Situation Indicator and navigation data.

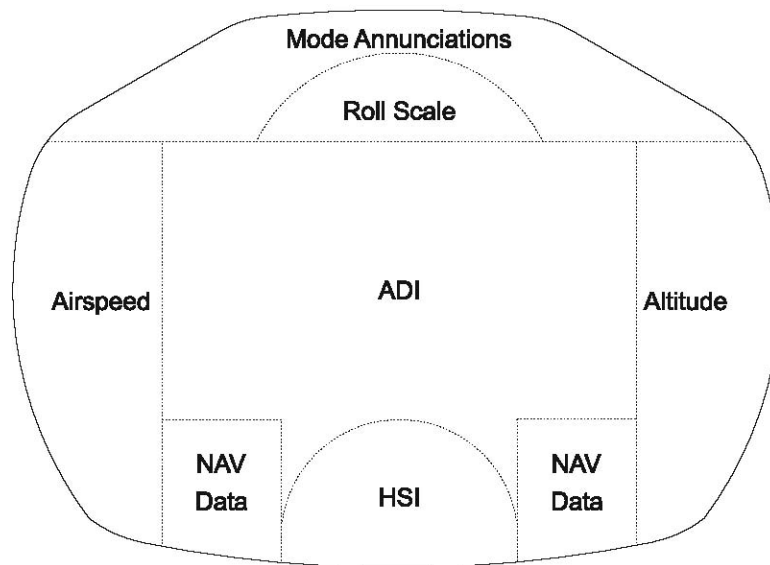


FIGURE 02-34_2-25-00 - HUD SYMBOLOGY

MODE ANNUNCIATIONS AND ROLL SCALE

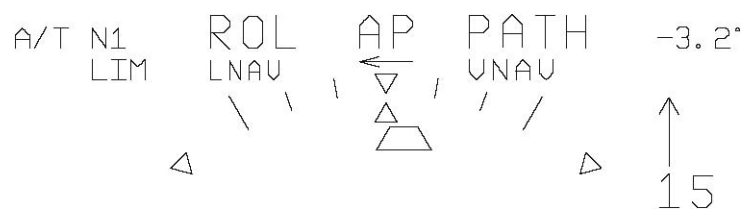


FIGURE 02-34_2-25-01 - ANNUNCIATIONS AND ROLL SCALE

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ADI SYMBOLS GROUP

Navigation mode

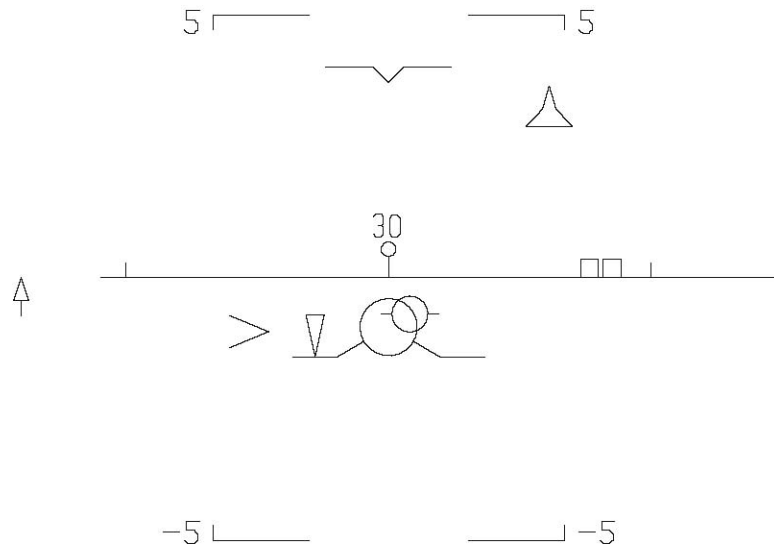


FIGURE 02-34_2-25-02 - ADI IN NAVIGATION MODE

Take-off mode

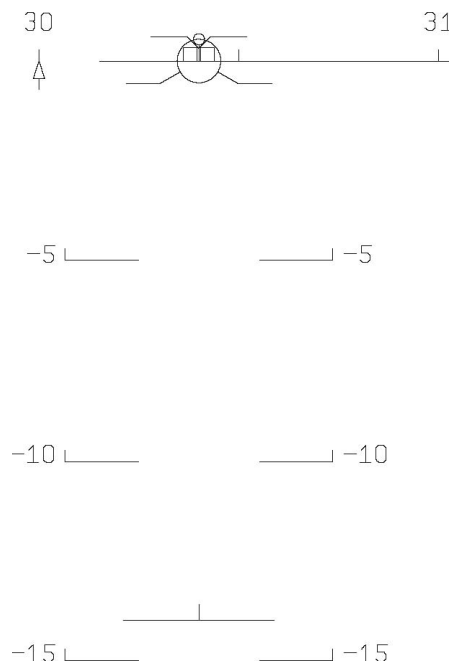


FIGURE 02-34_2-25-03 - ADI IN TAKE-OFF MODE

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Approach mode

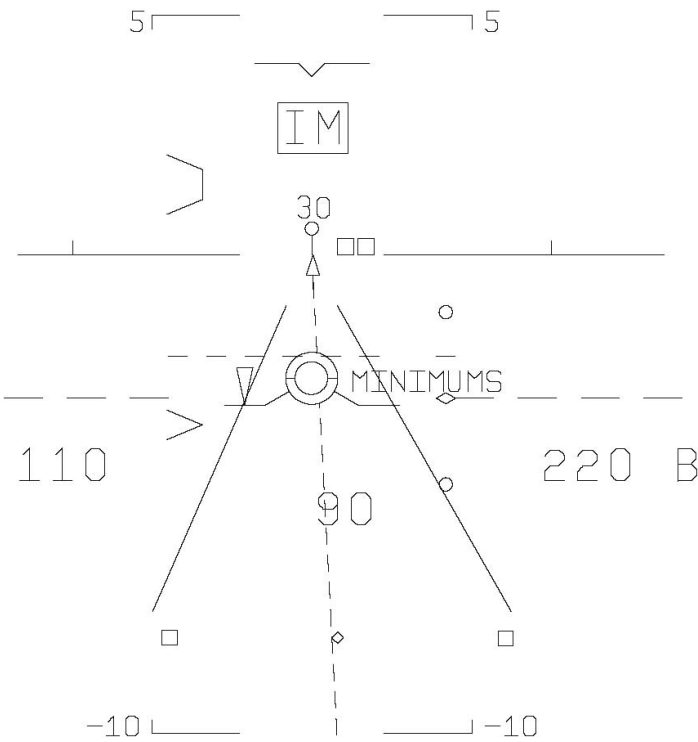


FIGURE 02-34_2-25-04 - ADI IN APPROACH MODE

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AIRSPEED SYMBOLS GROUP

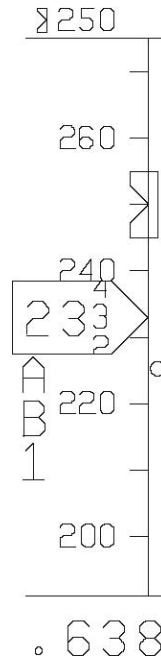


FIGURE 02-34_2-25-05 - AIRSPEED SYMBOLS GROUP

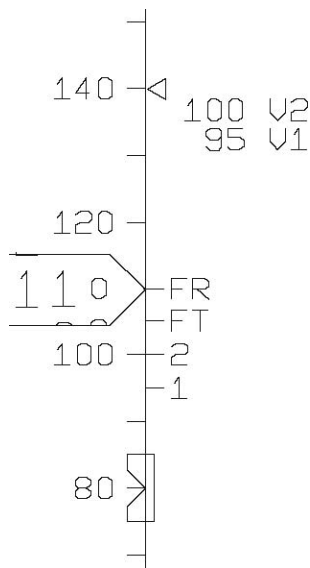


FIGURE 02-34_2-25-06 - AIRSPEED SYMBOLS GROUP IN TAKE-OFF MODE

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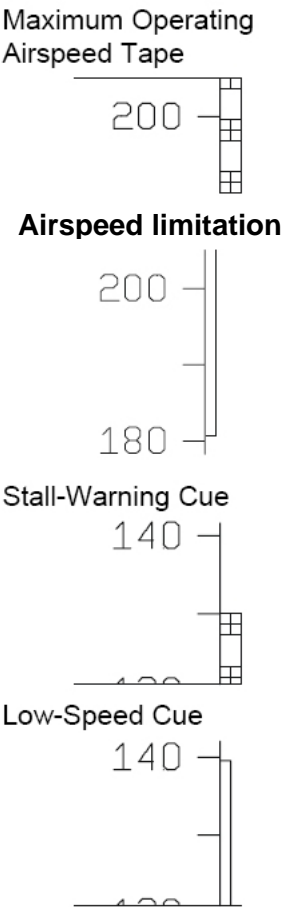


FIGURE 02-34_2-25-07 - SPECIFIC AIRSPEED SYMBOLS

02-34_2-25	ATA 34_2 – HEAD UP GUIDANCE SYSTEM CONTROLS AND INDICATIONS - SUPPLEMENTARY INFORMATION	FALCON 7X
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ALTITUDE SYMBOLS GROUP

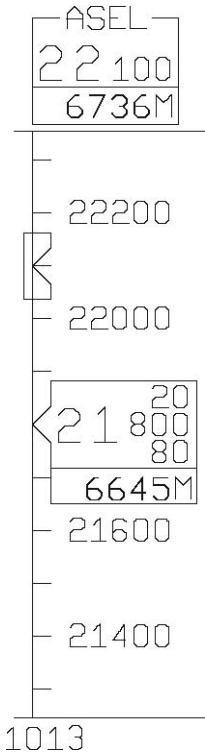


FIGURE 02-34_2-25-08 - ALTITUDES SYMBOLS GROUP

FALCON 7X	ATA 34_2 – HEAD UP GUIDANCE SYSTEM CONTROLS AND INDICATIONS - SUPPLEMENTARY INFORMATION	02-34_2-25
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NAVIGATION AND HSI YMBOLS GROUP

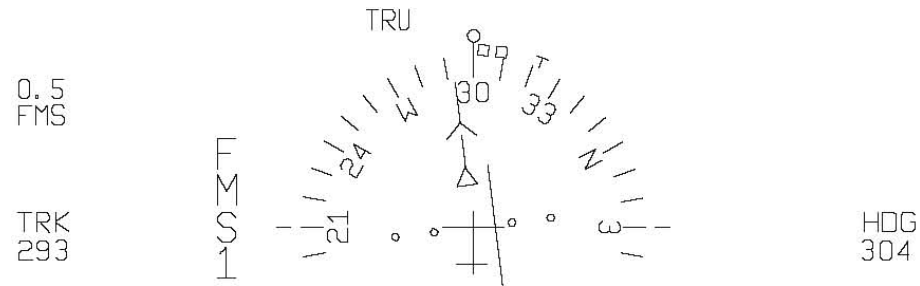


FIGURE 02-34_2-25-09 - NAVIGATION AND HSI SYMBOLS GROUP



FIGURE 02-34_2-25-10 - SYMBOLS DISPLAYED IN APPROACH MODE

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SYSTEM MONITORING

The Head up Guidance System monitors:

- The proper operation of the HGS Computer and OHU hardware and software,
- The critical symbol monitor,
- The Combiner glass alignment.

The critical symbol monitor tests the integrity of the HGS display path by monitoring the displayed position of 10 selected critical symbols:

- Aircraft reference,
- Horizon line,
- Flight path,
- Ground roll reference,
- HGS ground roll guidance cue,
- HGS approach guidance cue,
- Unusual attitude aircraft reference,
- Unusual reference horizon line,
- Test symbol,
- Speed error tape.

The critical symbol monitor indicates a failure if a symbol's measured deviation from the expected position or the deviation between the calculated sensor value and the actual sensor input value exceeds a specified tolerance.

The system response to this fault detection is either the blanking of the entire display, or the removal of the individual critical symbol from the display.

An optically combiner alignment detector using an LED and two detectors continuously measures the angle of the combiner glass. An advisory CAS message and HUD annunciation are displayed if the combiner misalignment error gets outside the acceptable range.

➤ *Refer to CODDE 2 for a complete list of CAS messages.*

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ACTIVE PROTECTIONS

A series of tests performed automatically each time the system is powered up.

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No supplementary information to be provided on System Protections at present time.

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At present time, the Head Up Guidance System does not require any Ground Operation action.

➤ *Refer to Ground Servicing manual.*

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INTRODUCTION

The Secondary Flight Display (SFD) is a standby instrument, displaying airplane attitude data from a backup source Attitude and Heading Reference System (AHRS) and Air Data System (ADS).

The secondary Flight Display (SFD) system allows the full time elaboration and display of:

- Attitude,
- Airspeed / Mach number,
- Altitude,
- Magnetic heading,
- ILS deviation data,
- Flight Path Vector (FPV),
- VMO / MMO,
- Slip / skid data.

The SFD is located on the cockpit panel between LH DU and UP DU.

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FLIGHT DECK OVERVIEW

CONTROLS

SFD controls include:

- BRT brightness control knob,
- MENU pushbutton,
- STD standard altimeter setting pushbutton,
- SET data setting knob.

INDICATIONS

The SFD stands for both pilots in normal / abnormal / emergency operations and is dedicated to the display of:

- Attitude data: airplane attitude, magnetic heading, flight path symbol, slip / skid,
- Air data: airspeed, Mach, VMO / MMO, altitude,
- ILS data: localizer deviation, glideslope deviation, MKR beacons (IM / MM / OM),
- ILS frequency.

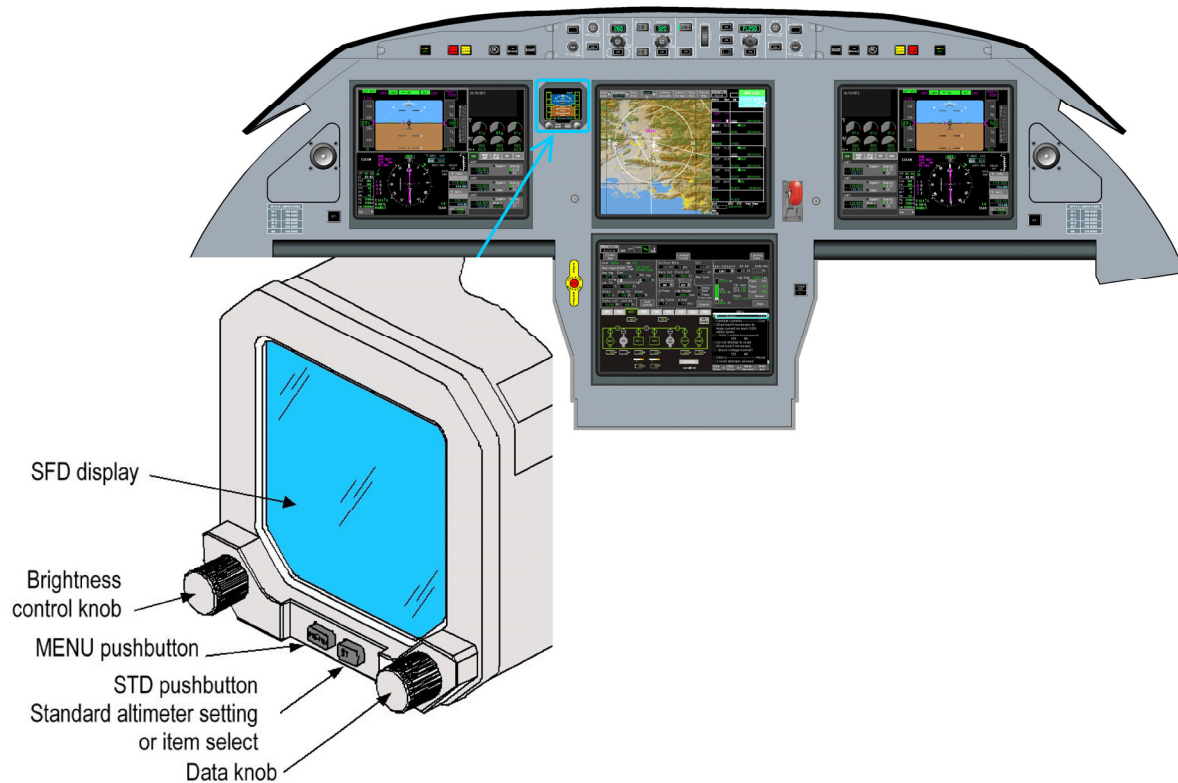


FIGURE 02-34_3-05-00 - SFD LOCATION

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GENERAL

The Secondary Flight Display provides mainly the following functions:

- Display of Air Data,
- Display of attitude
- Display of magnetic heading,
- Display of localizer and glide slope deviations.

The Secondary Flight Displays is composed of:

- A LCD display unit,
- A CPU card,
- A bezel cController.

The SFD receives data from:

- A dual channel AHRS,
 - The ADS 3 and ADS 4,
 - The VIDL-G 1.
- AHRS and magnetometer are described in sub-sections 02-34_8
- ADS are described in sub-section 02-34_7
- VIDL-G are described in sub-section 02-34_10

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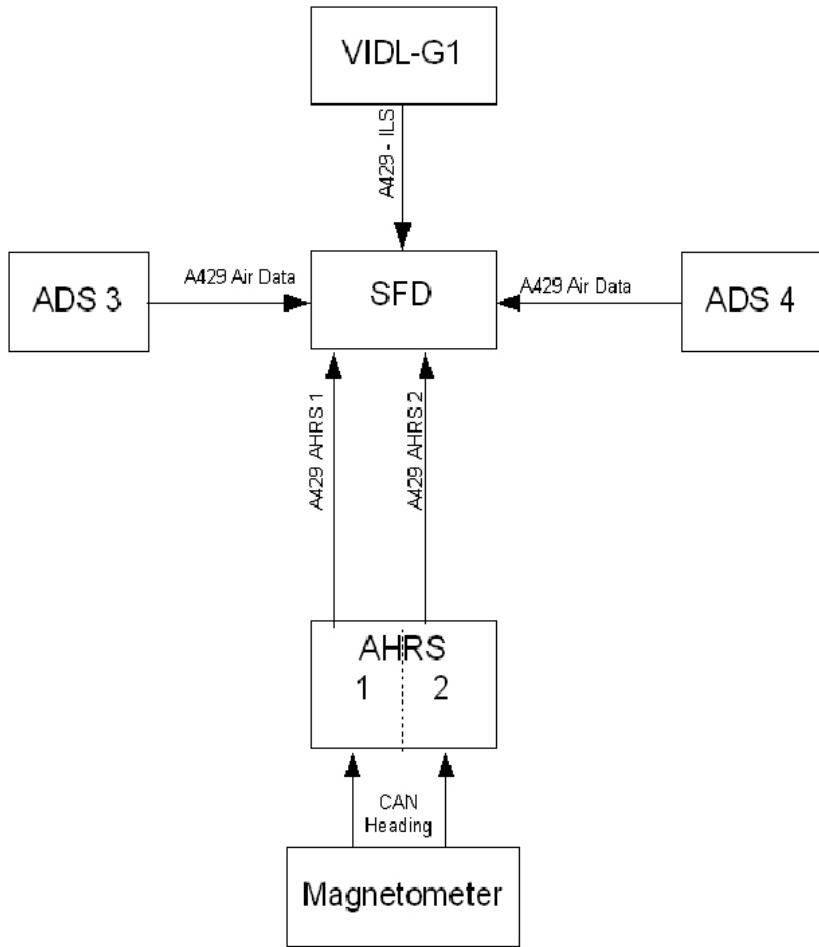


FIGURE 02-34_3-10-00 - PRINCIPLE DIAGRAM

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DESIGN PRINCIPLES

The SFD is designed to provide the crew with backup means in order to:

- 1 - Fly the airplane,
- 2 - Perform an ILS approach.

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MATERIAL DESCRIPTION

The Secondary Flight Displays composed of:

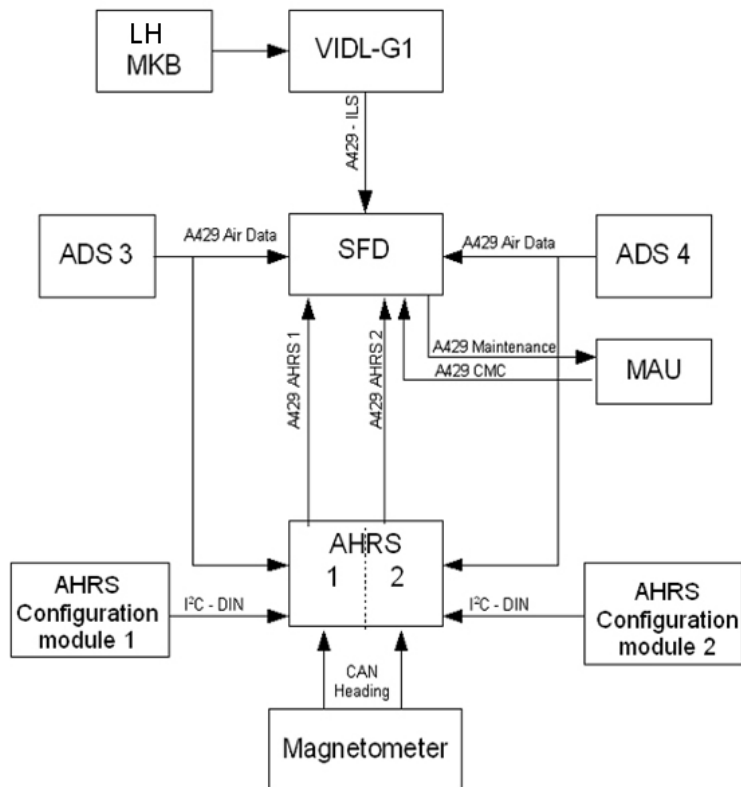
- A LCD display unit,
- A CPU card,
- A bezel controller,
- A power supply.

The SFD received data from

- A dual channel AHRS,
- The ADS 3 and ADS 4,
- The VIDL-G 1.

Each AHRS module receives data from:

- Its configuration module,
- A magnetometer



MAU connection is only used for maintenance purpose

FIGURE 02-34_3-15-00 - PRINCIPLE DIAGRAM

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The SFD is composed of:

- A LCD display unit:

Contains the Active Matrix Liquid Crystal Display (AMLCD), has an active viewing area of 2.27" by 2.27" (57.66mm x 57.66mm). This AMLCD has a Quad pixel arrangement (R,G,B,W), with a resolution of 240 x 240 (color groups).

- A CPU card:

Contains the microprocessor and it's support circuits; RAM memory; Non-volatile memory for the microprocessor code; AMLCD Graphics engine; ARINC 429 I/O; RS-232 I/O; Discrete inputs and outputs; Harmonization Bus interface; PWM outputs for the AMLCD Backlight and nomenclature backlights; front bezel control interfaces; and the 3.3 volt and 1.8 volt dc-dc converters to power the microprocessor.

- A bezel controller:

Contains the front bezel brightness control ("BRT" knob); "MENU" pushbutton switch; "STD" pushbutton switch; Baro-settings front panel control ("SET" knob), and the nomenclature backlight LED's.

- A power supply:

Converts the airplane power into various power sources needed by the components of the SFD. In addition it contains the control circuitry for operation of the AMLCD Display

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EQUIPMENT LOCATION

The SFD is located in the front panel between the LH DU and the UP DU.

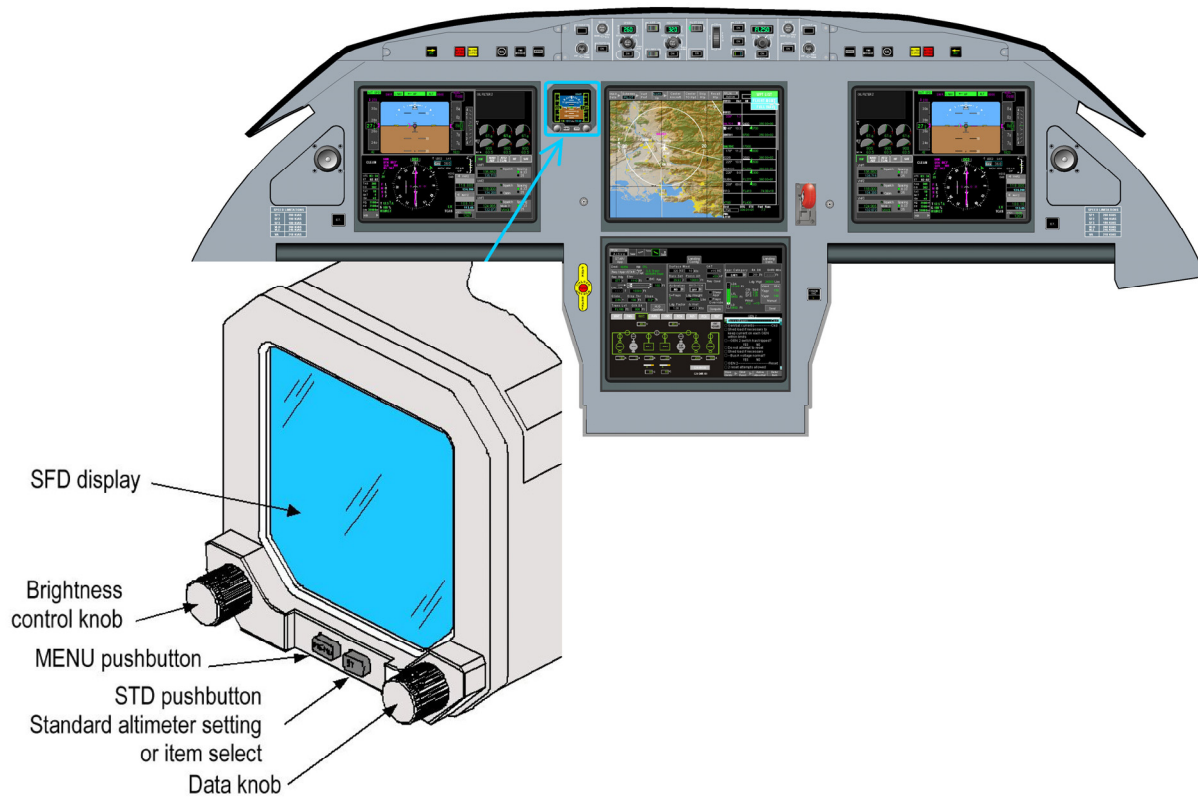


FIGURE 02-34_3-15-01 - SFD LOCATION

- Location of ADS 3 and ADS 4 are described in subsection 02-34_7-15.
- Location of AHRS and magnetometer are described in subsection 02-34_8-15.

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the SFD and the different equipment which transmit data to the SFD.

Electrical protection is provided:

- Either by Solid State Power Controllers (SSPC),
- Or by Circuit Breakers (CB).

➤ Refer to ATA 24 – ELECTRICAL POWER for additional information.

EQUIPMENT	POWER SUPPLY	TYPE OF PROTECTION
SFD	RH Essential	CB
Magnetometer	RH Essential	CB
AHRS channel 1	PMA1	Fuse inside PMA Converter
AHRS channel 2	RH Essential	CB
VIDL-G 1	LH Essential	CB
ADS 3	LH Essential	CB
ADS 4	RH Essentiel	CB

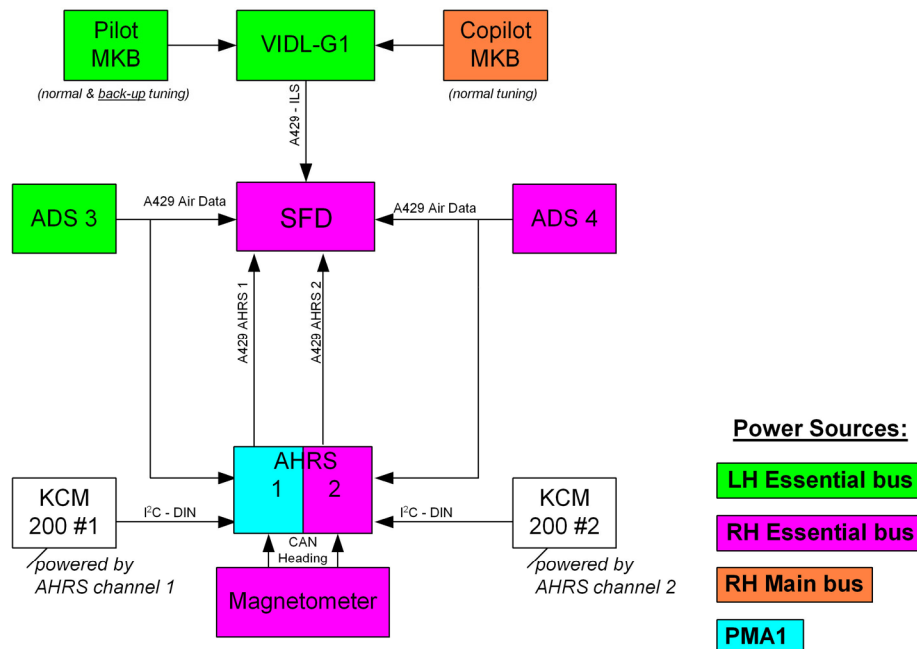


FIGURE 02-34_3-15-02 - ELECTRICAL POWER SOURCE

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DATA ELABORATION DETAILED DESCRIPTION

SOURCE SELECTION

The two sources are:

- Primary sources = AHRS 2 with ADS 4 (selected by default)
- Secondary sources = AHRS 1 with ADS 3.

The use of the secondary sources is automatically selected when the primary sources fail using an automatic reversion logic based on AHRS and ADS data validity.

If at least one of the following data is invalid SFD reverts to the other sources:

- AHRS A429 labels validity:
 - o Magnetic Heading Angle,
 - o Pitch Angle,
 - o Roll Angle,
 - o Body Lateral Acceleration,
 - o Flight Path Angle.
- ADS A429 labels validity:
 - o Pressure Altitude,
 - o Mach,
 - o VMO / MMO,
 - o Calibrated Airspeed.

In addition, if the ADS is not heating the SFD reverts to the other sources ("ADS Heater On" data).

The SFD does not combine primary and secondary data sources as a result of its selection logic.

In the event of a reversion due to a primary source failure, the SFD will not revert back to the primary source unless the primary source has been operating correctly for at least 10 seconds, in order to avoid nuisance switching as a result of an intermittent failure.

HEADING INFORMATION

The AHRS determines its heading to be degraded as soon as the magnetometer measures an horizontal magnetic field below 80 milli-Gauss.

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ATTITUDE INFORMATION:

The AHRS system provides SFD with the following information, for display purpose:

- Magnetic Heading Angle,
- Pitch Angle,
- Roll Angle,
- Body Lateral Acceleration (to display in SFD the Slip/Skid indication),
- Flight Path Angle.

Each AHRS receives following air data information, to compute the air FPA:

- True Airspeed,
- Altitude rate,
- Pressure Altitude.

The True Airspeed is also used to compensate AHRS sensors' acceleration during aircraft acceleration and turns.

AIR DATA INFORMATION

Each ADS provides SFD with the following information, for display purpose:

- Pressure Altitude,
- Mach,
- VMO / MMO,
- Calibrated Airspeed.

In addition, "ADS Heater On" data is sent.

LOCALIZER & GLIDESLOPE INFORMATION

The VIDL-G 1 provides SFD with the following information, for display purpose:

- Localizer Deviation,
- Glideslope Deviation,
- ILS frequency,
- Marker Beacons data.

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CONTROLS

Crew controls concerning the SFD consist of:

- BRT brightness control knob,
- MENU pushbutton,
- STD pushbutton,
- SET data setting knob.

These controls are available on the front panel of the SFD.

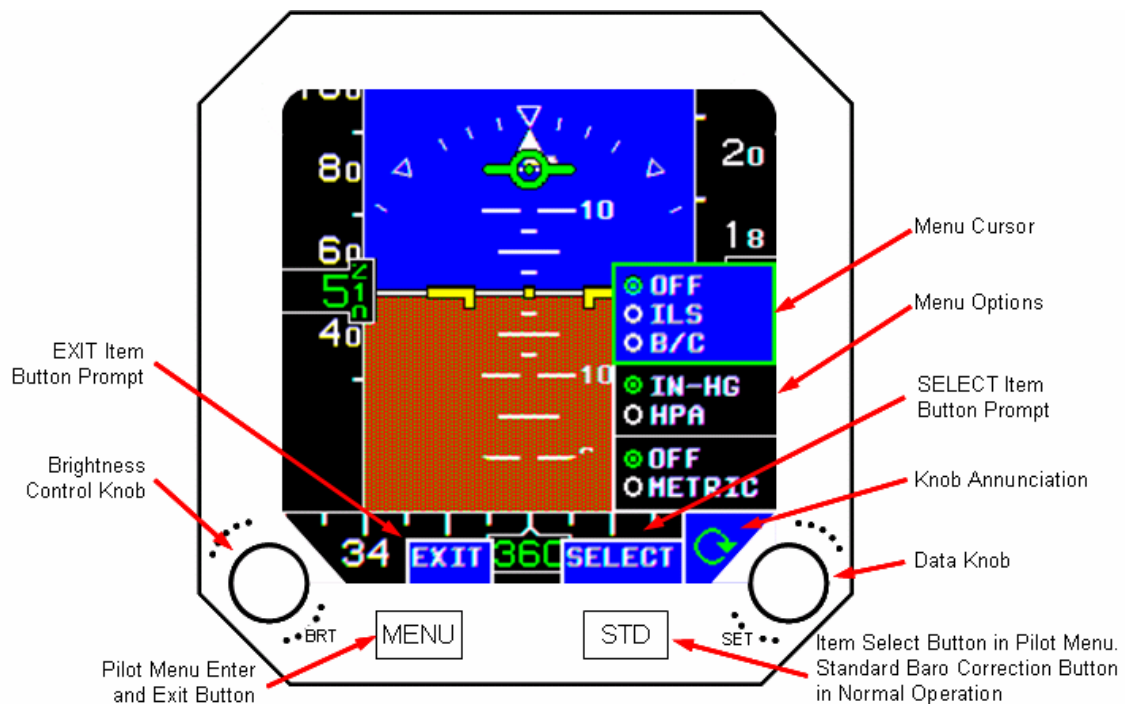






FIGURE 02-34_3-20-00 - SECONDARY FLIGHT DISPLAY


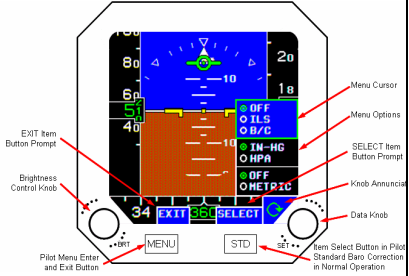

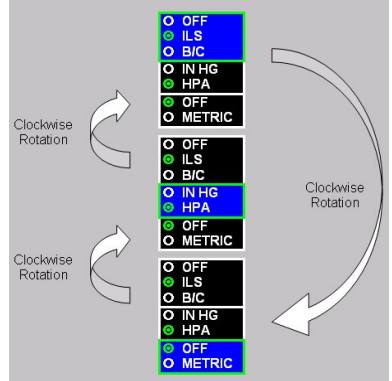
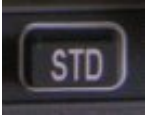
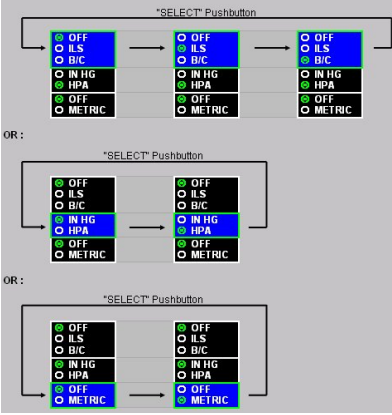
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MENU pushbutton allows selecting or de-selecting the display of Menu Options.


STD pushbutton and SET knob have various functionalities following the display or not of the Menu Options.

CONTROL / MENU	FUNCTION	LOCAL INDICATION
	- Adjusts the brightness of the display backlight.	
 / without Menu Options	- Allows setting the Barometric Correction value when Menu Options is not displayed.	
 / without menu Options	- Displays STD in place of the digital readout of the Barometric Correction value when Menu Options is not displayed.	 STD display

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CONTROL / MENU	FUNCTION	LOCAL INDICATION
 / without Menu Options	<ul style="list-style-type: none"> - Allows selecting Menu option. - Once MENU pushbutton has been depressed the following items are displayed: <ul style="list-style-type: none"> o “EXIT” prompt, o “SELECT” prompts, o the “Menu Options” and the knob annunciation. <div style="border: 1px solid black; padding: 10px; margin-top: 10px; text-align: center;"> NOTE Menu and prompts automatically disappear 10 seconds after the last pilot action. </div>	
 / with Menu Options	<ul style="list-style-type: none"> - Allows moving the Menu Option Select Box in the Menu Option. - A clockwise rotation of the knob moves the Menu Option Select Box up and a counter clockwise rotation moves the Menu Option Select Box down. 	
 / with Menu Options	<ul style="list-style-type: none"> - Allows changing the mode selection within the selected group 	

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CONTROL / MENU	FUNCTION	LOCAL INDICATION
 / with Menu Options	<ul style="list-style-type: none"> - Allows exiting Menu Options - Once MENU pushbutton has been depressed the following items are removed: <ul style="list-style-type: none"> o “EXIT” prompt, o “SELECT” prompts, o the “Menu Options” and the knob annunciation. 	

NOTE

Upon start, the SFD will retain the previous mode selection except for ILS mode which will be initialized to OFF.

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INDICATIONS

All indications concerning the SFD functionality are displayed in the SFD.

AIRSPEED DISPLAY

The airspeed is displayed using the following symbology:

- Airspeed tape,
- Airspeed readout,
- Mach Readout,
- VMO / MMO barber pole,
- Altitude tape,
- Altitude readout,
- Barometric set readout.,

The airspeed related symbology is based on data from the automatically selected Air Data system (ADS 4 or ADS 3). Baro correction is directly performed in the SFD.

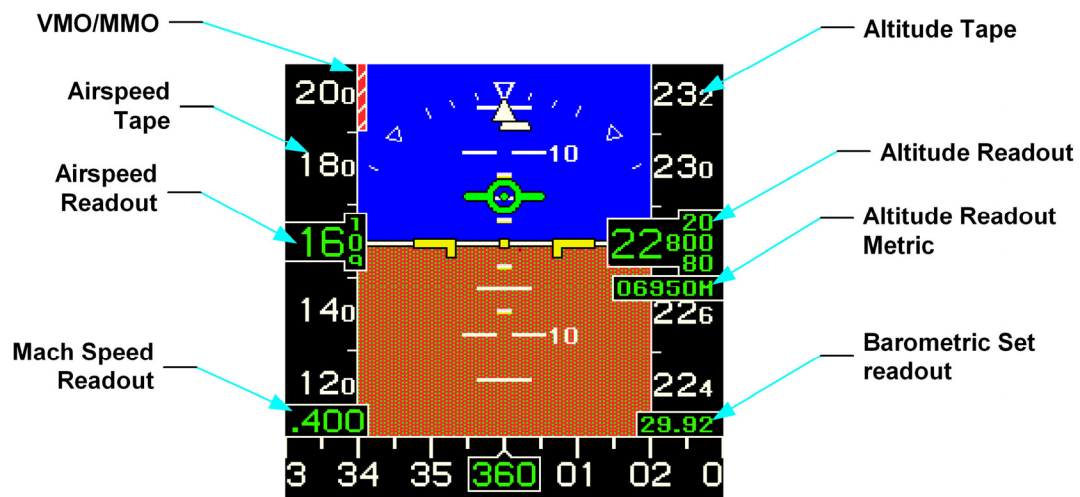


FIGURE 02-34_3-20-01 – AIRSPEED DISPLAY

ATTITUDE DISPLAY

The aircraft pitch and roll attitudes are displayed using the following symbology:

- Horizon Line,
- Sky,
- Ground,
- Pitch Tape,
- Roll Scale and Pointer,
- Slip/Skid Indicator,
- Flight Path Vector,
- Aircraft symbol.

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The attitude related symbology is based on data from the automatically selected AHRS channel.

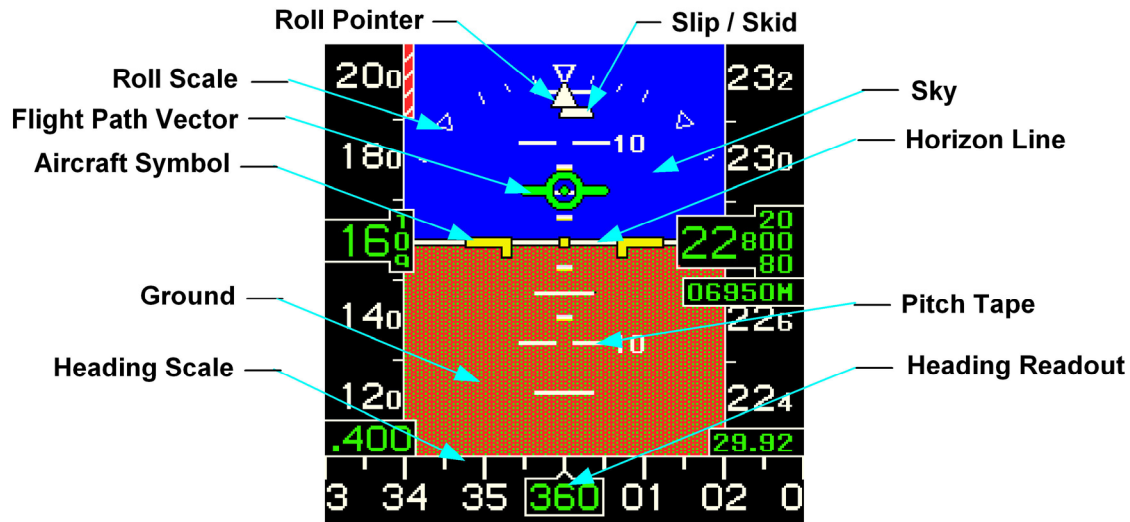


FIGURE 02-34_3-20-02 – ATTITUDE DISPLAY

HEADING DISPLAY

Heading is displayed using the following symbology:

- Heading tape,
- Heading readout,
- "HDG" yellow flag.

The heading related symbology is based on data from the automatically selected AHRS channel.

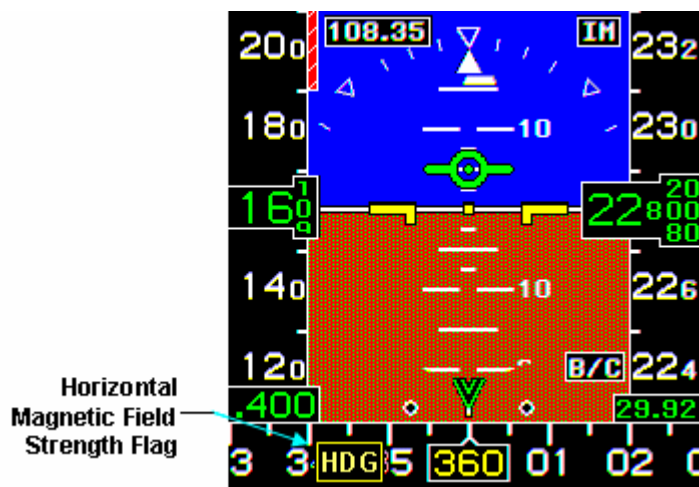


FIGURE 02-34_3-20-03 - HEADING DISPLAY IN CASE OF LOW HORIZONTAL MAGNETIC FIELD

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ILS SYMBOLOGY DISPLAY

ILS is displayed using the following symbology:

- Localizer deviation scale,
- Localizer deviation pointer,
- Glideslope deviation scale,
- Glideslope deviation pointer.

The ILS symbology is only displayed when an ILS frequency has been tuned on the NAV radio and valid ILS data is received.

The ILS symbology is based on data from the VIDL-G 1.

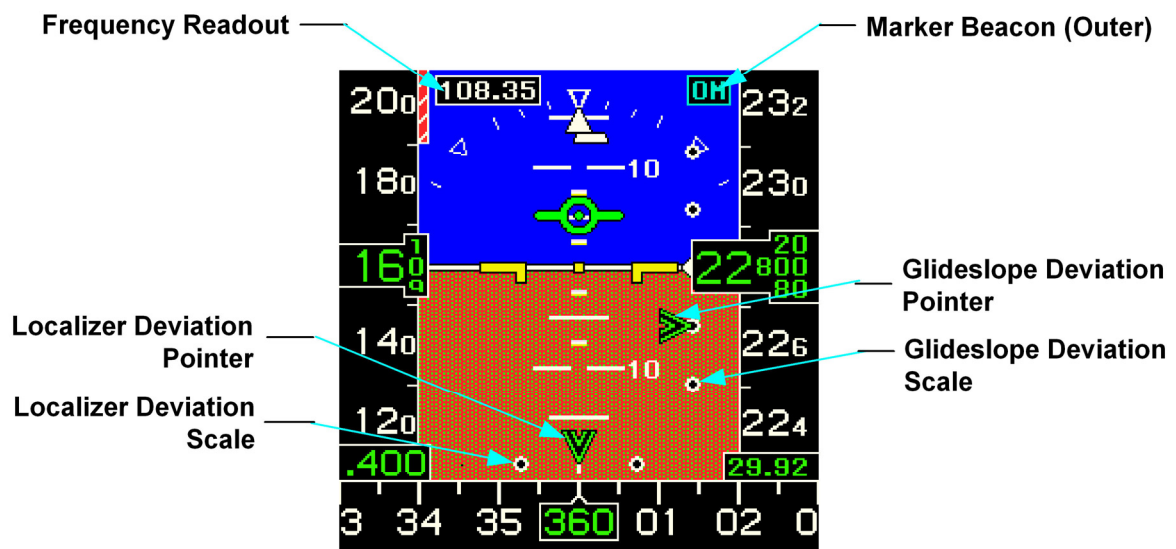


FIGURE 02-34_3-20-04 – HEADING DISPLAY

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FAILURE FLAGS DISPLAY AND REVERSION ANNUNCIATION

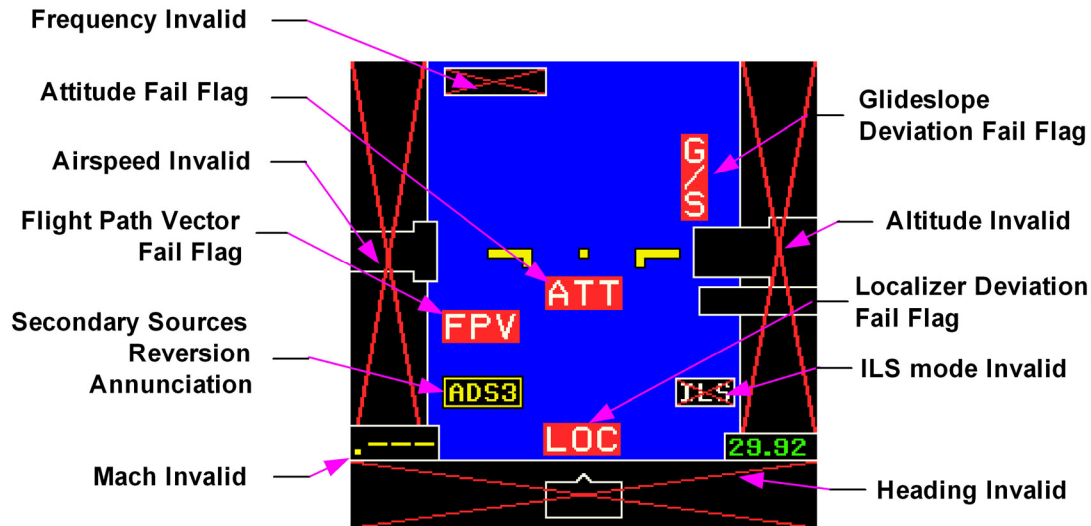


FIGURE 02-34_3-20-05 – SFD FLAGS DISPLAY AND REVERSION ANNUNCIATION

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CONTROLS

The MENU pushbutton allows selecting or de-selecting the display of Menu Options.

The STD pushbutton and the SET knob have various functionalities following the display or not of the Menu Options.

When the Menu Options is displayed the SFD enters in the Menu Pilot Mode.

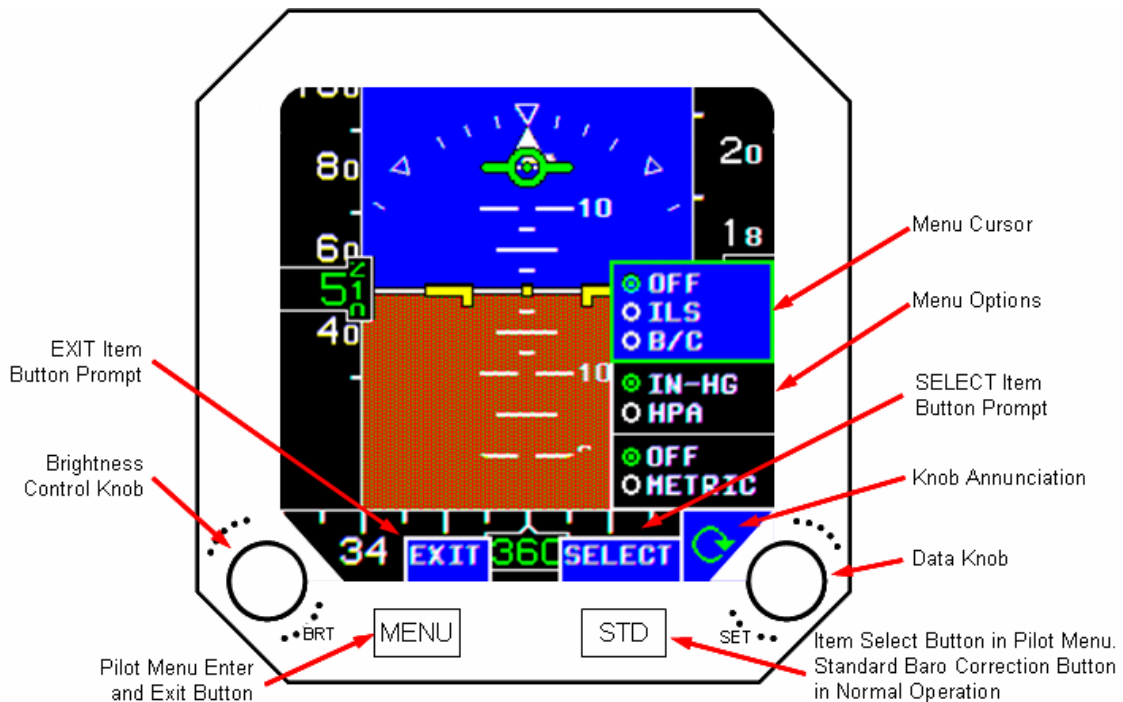


FIGURE 02-34_3-25-00 – SFD CONTROLS

MENU PILOT MODE OPERATION

Menu Pilot Mode is entered by pressing the “MENU” button while Menu Options is not displayed.

Once Pilot Menu Mode has been entered the following items are displayed: the “EXIT” and “SELECT” prompts, the Menu Options and the knob annunciation. The prompts and menu may obscure some symbology.

The Pilot Menu Mode will automatically exit 10 seconds after the last pilot action and the unit will resume normal SFD operation.

The Menu Options is displayed along the right hand side of the display on a blue background with a green outline for the selected Menu Options Group (Menu Cursor). When Pilot Menu Mode is entered, the Menu Cursor is initially placed at the ILS Mode Group (this is to minimize knob usage for common actions).

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The non-selected menu groups have white text on a black background. The menu selection options are radio button type. Each menu group is segregated into mutually exclusive selections by white lines. The currently selected menu is displayed in white characters with a green dot inside a green circle. The non-selected menu is displayed in white characters with a white circle without dot. Selecting a new item within a radio button group deactivates the previously active item of the group and activates the selected item.

The rotary knob controls a Menu Cursor to permit selection of the Menu Options Group. The Menu Cursor is colored green. A Knob Annunciation, green circular arrow, to indicate rotation is displayed adjacent to the Menu Select rotary knob. A clockwise rotation of the knob moves the Menu Cursor up and a counter clockwise rotation moves the Menu Cursor down. When the Menu Cursor has the top group selected and the knob is rotated clockwise, then the Menu Cursor will be swapped to the bottom group. When the Menu Cursor has the bottom group selected and the knob is rotated counter clockwise, then the Menu Cursor be swapped to the top group.

The “SELECT” prompt is displayed in white characters with a white outline on a blue background immediately above the “STD” pushbutton. Pressing the “STD” pushbutton changes the mode selection within the selected group.

The ILS Mode group will power-up with "OFF" selected after a cold start, otherwise this group retains the previous selection after a warm start. Both the Barometric and Altitude groups' menu selections are retained during removal of power.

The “EXIT” prompt is displayed in white characters with a white outline on a blue background immediately above the “MENU” button. Pressing the “MENU” pushbutton exits the Pilot Menu Mode and SFD leaves the Menu Pilot Mode operation.

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INDICATIONS

AIRSPEED DISPLAY

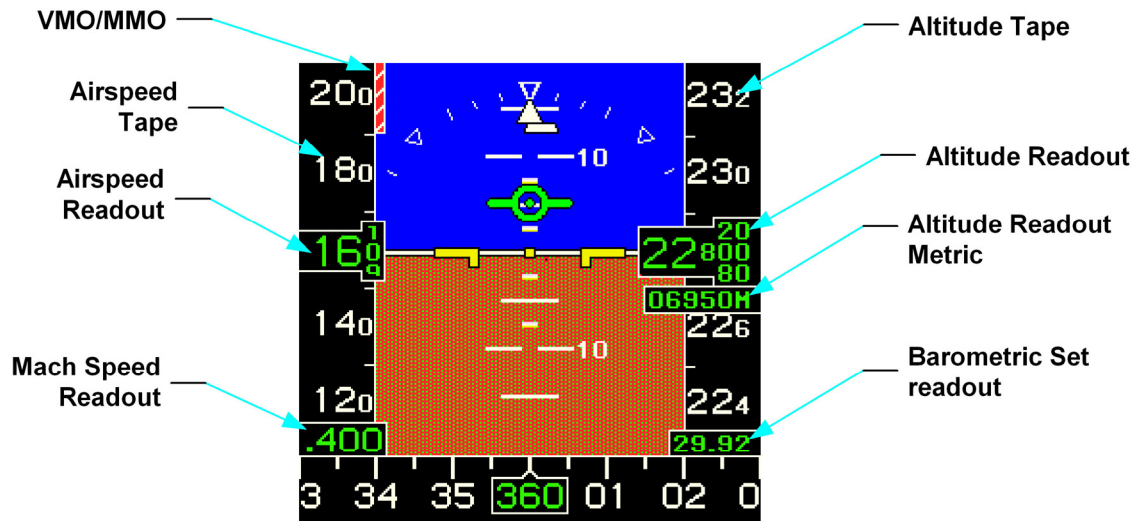


FIGURE 02-34_3-25-01 – SFD AIRSPEED DISPLAY

Airspeed Tape

The airspeed tape scale is limited from 30 to 900 knots, with no leading zeros.

The airspeed tape has white tick marks every 20 knots beginning at 30 knots and continuing to the upper limit of the scale. White airspeed labels in 20 knot increments are displayed beginning at 40 knots and continuing to the upper limit of the scale. The right digit is always a zero.

The viewable range of the airspeed tape is approximately 80 knots. The scale moves down for increasing speed values and up for decreasing speed values.

When data is deemed invalid, a X is displayed on the tape and all information is removed.

Airspeed Readout

The data is limited from 30 to 900 knots with a resolution of 1 knot. Leading zeros will be suppressed. The right digit will show part of the next higher and lower values.

The digits will roll down for increasing values and up for decreasing values.

The airspeed readout and background will change to white digits on a red background when the airspeed is equal to or greater than VMO / MMO.

When data is deemed invalid, the readout is removed.

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Mach Number Readout

The data is limited from .400 to .998 Mach three digit display with the leading zero suppressed. The resolution is 0.001.

The Mach number is present any time Mach is greater than 0.450 (when mach increasing) and is removed below 0.400 (when mach decreasing).

The Mach number (readout and background) is displayed in the same colors as the airspeed digits.

When Mach is deemed invalid, amber dashes are displayed.

VMO / MMO thermometer

The VMO / MMO thermometer is displayed as a red and white “barber pole” extending from the VMO / MMO (maximum airspeed indicator / maximum mach operation) value to the top of the Airspeed Tape.

The displayed value corresponds to the airspeed and Mach equivalent in excess of the airplane's VMO / MMO curve received from the Smartprobe.

Altitude Tape

The altitude tape scale is limited from –2000 to 65000 feet, with no leading zeros. It has tick marks represented for every odd 100 feet increment.


The labels are represented in 200 foot increments for even numbered hundreds displaying only the hundreds, thousands and ten-thousand digits.

The scale moves down for increasing values and up for decreasing values

When data is deemed invalid, a  is displayed on the tape and all information is removed.



Altitude Readout

The English altitude readout is limited from –2000 to 65000 feet, with no leading zeros and a resolution of 20 feet.

The Metric altitude readout is selectable by the pilot menu. The Metric altitude readout is limited from –610 to +19810 meters, with no leading zeros and a resolution of 5 meters. The label  is displayed following the digital readout to indicate metric units.

The altitude digits will roll down for increasing values and up for decreasing values.

If the value becomes negative:

- For English altitude, a  appears vertically in the ten-thousands place.
- For metric altitude a  minus sign is displayed before the readout digits

When data is deemed invalid, the readout is removed.

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Barometric Readout

The barometric readout is displayed in either hectoPascals (hPa) or Inches of mercury (In-Hg) format depending on the pilot menu selection.

The power up default will be 29.92 In-Hg.

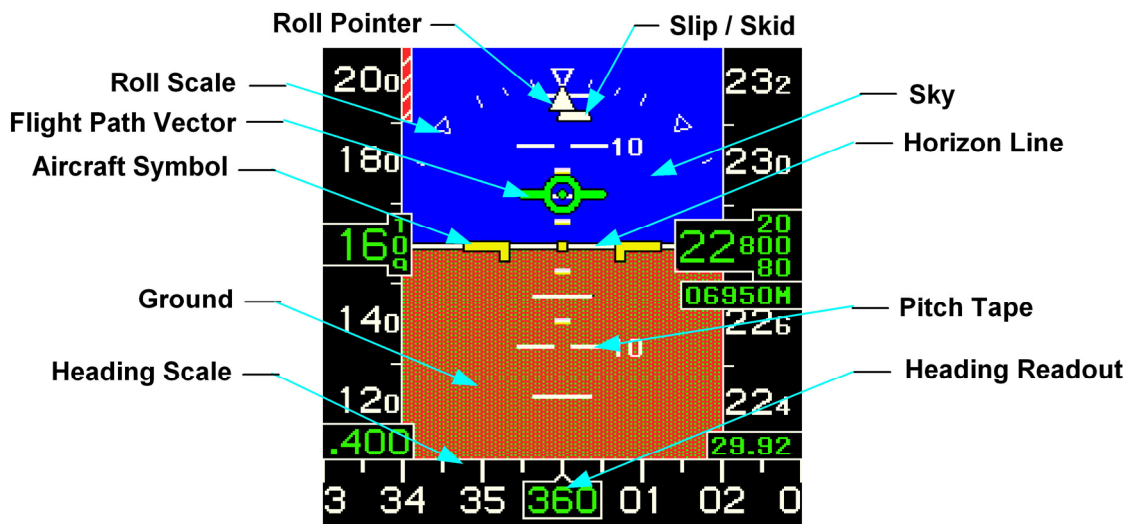
The Metric value will be limited from 542 to 1,084 hPa; no leading zeros, and will be rounded to a resolution of 1 hPa. The English value will be limited from 16.00 to 32.00 In-Hg and be rounded to a resolution of 0.01 In-Hg.

The adjustment of the value is possible through the SET data knob that selects the value step by step (1 hPa or 0.01 in-Hg). A direct STD selection is possible (press the STD pushbutton) in that case **STD** is displayed instead of the digital value.

ADS source reversion annunciation

A yellow **ADS3** flag is displayed when the secondary source is automatically selected (refer to sub-section 02-34_2-10-05 for source selection description).

ATTITUDE DISPLAY



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Sky / Ground Symbol

The sky is displayed in dark blue and is located above the horizon line.

The ground is displayed in brown and is located below the horizon line.

Whatever the pitch value is, a minimum sky or ground representation remains in view in order to indicate the closest path to normal attitude.

When the data is deemed invalid, the shading becomes completely cyan and attitude fail indication **ATT** is displayed,

Pitch Tape Symbol

The attitude pitch tape is capable of displaying 30 degrees of amplitude. It displays values between ± 90 degrees.

The pitch tape moves down for positive inputs and up for negative inputs. The pitch tape also moves along with the roll scale which has the horizon line as the rotating point.

The labels on the tape will be ± 10 ; ± 20 ; ± 30 ; $+40$, -45 ; ± 60 and ± 90 . The pitch tape has small 2-1/2 degree tick marks for ± 2.5 , ± 7.5 degrees; medium tick marks at the 5 degree positions from -25 to $+35$ degrees; and longer split marks at 10 degree positions for ± 10 , ± 20 , ± 30 , $+40$, -45 , ± 60 , and ± 90 .

Red chevrons will point to the horizon to alert the pilot of extreme pitch conditions. Downward pointing chevrons will be located on the pitch tape between $+90$ and $+75$ and also between $+60$ and $+45$ degrees. Upward pointing chevrons will be located on the pitch tape between -90 and -75 , -60 and -50 and also -45 and -35 degrees.

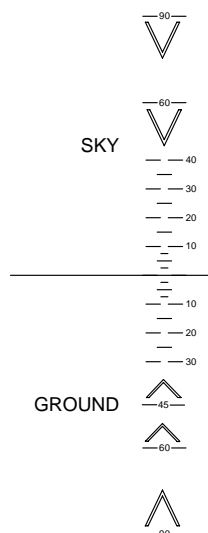


FIGURE 02-34_3-25-03 – SFD PITCH TAPE

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The attitude pitch tape may be compressed by a pitch compression factor. The pitch compression factor is calculated using the flight path angle. For flight path angles greater than +15.0 the pitch compression factor is defined to be the flight path angle divided by 15.0. For flight path angles less than -15.5 the pitch compression factor is defined to be the flight path angle divided by -15.5. The pitch compression factor will be limited between 1.0 and 3.0. No pitch compression will be applied for flight path angles between -15.5 and 15.0. When the pitch compression factor is greater than 1.0, the 2-1/2 degree tick marks will be removed. When the pitch compression factor is greater than 2.0, the 5 degree tick marks are also removed.

Roll Scale and Pointer

The roll scale and pointer are displayed in white. The roll scale has tick marks representing ± 10 , ± 20 , ± 30 and ± 60 degrees. The roll scale has inverted triangles that represent 0 and ± 45 degrees. The roll pointer is displayed as a filled triangle. The roll pointer is capable of displaying ± 180 degrees of roll. It moves counterclockwise for the positive inputs and clockwise for negative inputs.

Slip/Skid Indicator Symbol

The bottom half of the roll pointer is used to indicate slip / skid information. The slip/skid indicator moves to the left for positive inputs and to the right for negative inputs. It is limited to $\pm 0.11g$. The indicator rotates with the attitude roll. It is displayed normally in white but will turn yellow when the limit of $\pm 0.11g$ is exceeded.

Aircraft symbol

The aircraft symbol is displayed in yellow and is used in conjunction with the attitude pitch tape to reflect the aircraft pitch. The aircraft symbol is a fixed object displayed in the center of the attitude display. The aircraft symbol center dot is always displayed, except when it is behind the Flight Path Vector symbol.

Flight Path Vector Symbol

Flight Path Vector (FPV) symbol is based on the air data parameters.

The symbol moves only in the vertical axis centered on the SFD screen, the wings are always parallel to the lower edge of display. The symbol is displayed in foreground (on and not behind the attitude scale).

This symbol is removed when the data is deemed invalid or if going out of range. When the data is deemed invalid, a **FPV** red flag is displayed.

For FPV display, the normal range is:

- roll attitude $\pm 70^\circ$,
- pitch attitude $+ 40^\circ / - 20^\circ$.

Out of these ranges the FPS is removed.

This symbol is comparable to the PDU one when in zero wind condition. In windy conditions, the FPS takes into account the wind gradient.

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When the Attitude Pitch Tape is compressed, the Flight Path Vector symbol is highlighted in yellow. When the maximum compression factor of 3 is reached, the Flight Path Vector symbol is removed.



FIGURE 02-34_2-25-04 - SFD FLIGHT PATH SYMBOL

HEADING DISPLAY

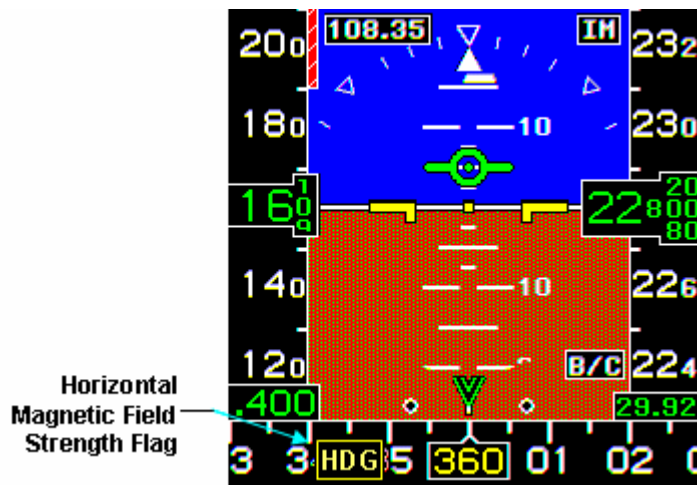


FIGURE 02-34_3-25-05 – SFD HEADING DISPLAY

Heading Tape

The heading tape represents approximately ± 30 degrees each side of the aircraft heading. Tick marks are located every 5 degrees.

Every 10 degrees, a numerical value is displayed. This numeric value will be the two most significant digits of the compass angle. For example "01" represents 10 degrees from Magnetic North and "34" represents 340 degrees from North.

The cardinal points, North, East, South, and West are represented by "N", "E", "S" and "W". The scale moves as the aircraft changes direction with respect to Magnetic North.

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Heading Readout

The heading readout consists of 3 green digits. The data will be limited from 1 to 360 degrees with a resolution of 1 degree. The upper center portion of the outline will come to a point and will be a reference for the Heading Tape symbol.

Heading flag

A yellow **HDG** flag is displayed in the heading tape when the Magnetometer measures a low horizontal magnetic field strength (below 80 milli-Gauss). When this is the case, the heading readout is also displayed in yellow instead of green.

ILS SYMBOLOGY DISPLAY

The ILS symbology is only displayed when an ILS frequency has been tuned on the VILD-G 1 and valid ILS data is received.

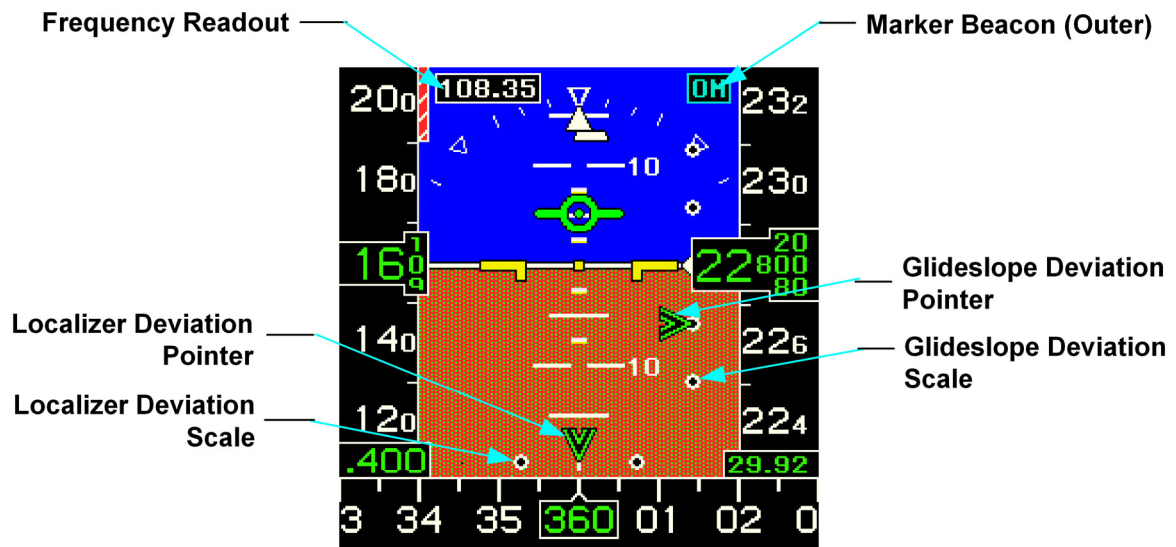


FIGURE 02-34_3-25-06 – HEADING DISPLAY

ILS Operating Mode

The ILS symbology operates in either a standard front course ILS configuration or a back course configuration, depending on the pilot menu selection.

The ILS operating mode is displayed in the lower right hand corner of the attitude display area:

- When the ILS is operating in back course mode **B/C** is displayed in white on a black background with a white outline.
- When the ILS is operating in front course mode, no ILS mode indication is displayed.

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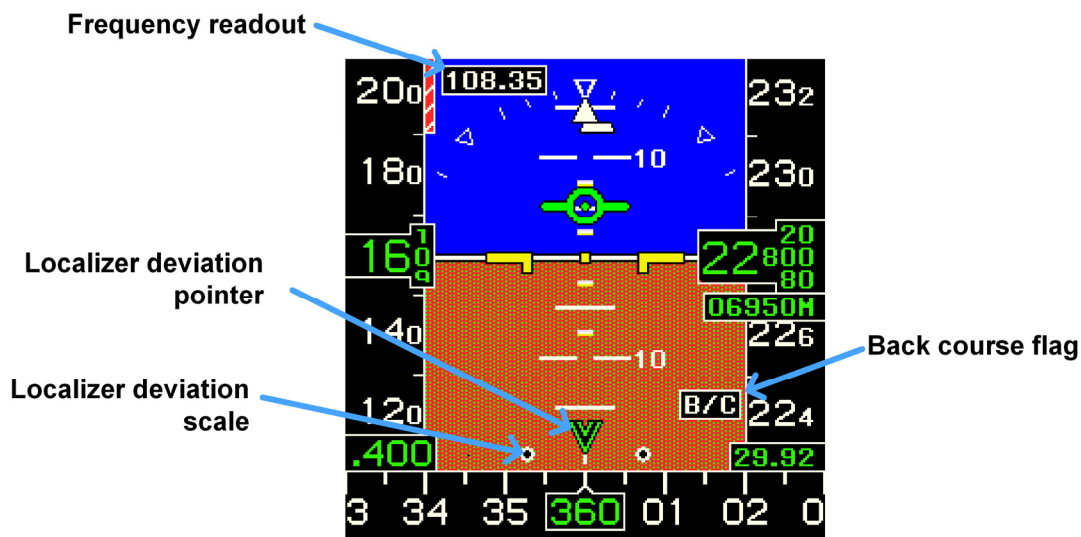


FIGURE 02-34_3-25-07 - SFD IN B/C MODE

LOC is displayed when LOC data is deemed invalid.

G/S is displayed when GS data is deemed invalid.

ILS Frequency Readout

The ILS frequency is displayed in the upper left hand corner of the attitude display area.

The displayed ILS frequency range is limited from 108.10 MHz to 111.95 MHz, including only odd tenth of Mhz (as 108.10, 108.15, 108.30, 108.35, 108.50, etc...). Any frequency that is not of this subset of frequencies is defined as invalid frequency. The unit MHz is not displayed.

Localizer Deviation Scale and Pointer

The localizer deviation scale is located at the bottom center of the attitude display area.

The localizer deviation pointer consists of a green arrow that point down to the localizer deviation scale symbol.

When in forward course operation, a positive deviation moves the pointer to the right and a negative deviation moves the pointer to the left.

When in back course operation, a positive deviation moves the pointer to the left and a negative deviation moves the pointer to the right.

A deviation of one dot is 0.0775 Difference Depth Modulation (DDM). The total deviation is limited to 0.1550 DDM, where ½ of the pointer is displayed when the limit is reached.

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TABLE LOCALIZER DEVIATION SCALE	
POINTER DEFLECTION	'LOC' LATERAL DEVIATION
One Dot Right	+ 0.0775 DDM
Zero Index	+ 0.0000 DDM
One Dot Left	- 0.0775 DDM

Glideslope Deviation Scale and Pointer

The glideslope deviation scale is located to the right of the attitude display area and aligned with the center of the aircraft symbol.

The glideslope deviation pointer consists of a green arrow that points right to the glideslope deviation scale symbol.

A positive deviation moves the pointer down and a negative deviation moves the pointer up. A deviation of one dot is 0.0875 DDM.

The total deviation is limited to ± 0.3500 DDM, where $\frac{1}{2}$ of the pointer is displayed when the limit is reached.

TABLE VERTICAL DEVIATION SCALE LIMITS	
POINTER DEFLECTION	'GS' VERTICAL DEVIATION
125% Up	- 0.3500 DDM
100% Up	- 0.1750 DDM
50% Up	- 0.0875 DDM
0%	+ 0.0000 DDM
50% Down	+ 0.0875 DDM
100% Down	+ 0.1750 DDM
125% Down	+ 0.3500 DDM

Marker Beacons

Each marker beacon is displayed in the same location in the upper right corner of the attitude display area above the roll scale.

The marker beacons have the following priority: inner, middle, and outer. With a transition to a new marker beacon with the appropriate priority the marker beacon symbol flashes for 15 seconds at an approximate rate of 2Hz. After 15 seconds the marker beacon is displayed steady.

For the inner marker beacon,  annunciation is displayed.

For the middle marker beacon,  annunciation is displayed.

For the outer marker beacon,  annunciation is displayed.

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SYSTEM MONITORING

There is no specific monitoring inside the SFD.

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ACTIVE PROTECTIONS

The SFD automatically selects a valid set of sources [AHRS + ADS] :

- Primary sources = AHRS 2 with ADS 4 (selected by default) or,
- Secondary sources = AHRS 1 with ADS 3.

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No supplementary information to be provided on the SFD protections at present time.

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The SFD does not require any Ground Operation action.

➤ *Refer to Ground Servicing Manual.*

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INTRODUCTION

WEATHER RADAR

The weather radar is designed for weather detection and ground mapping.

The primary purpose of the airborne weather radar is to detect storms along the flight path and give the crew a visual color indication of rainfall intensity and turbulence content. After proper evaluation, the crew can chart a course to avoid storm areas.

The radar can be operated in any of the following modes:

- Standby (STBY),
- On:
 - o Weather (WX),
 - o Ground mapping (GMAP),
- Test.

LIGHTNING SENSOR SYSTEM

The Lightning Sensor System (LSS) is an option, control and displays are available only if the LSS is installed on the airplane.

LSS is a system to aid the crew in finding areas of storm activity and operates in junction with the weather radar. LSS information can also be displayed when weather radar is off or failed.

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FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the weather radar and the LSS is performed

- Via the weather radar control on the Multifunction Keyboard (MKB),
- Via a soft key in the SENSORS window,
- Via a soft key in the TEST synoptic.

INDICATIONS

Crew indications with regard to weather radar and LSS are located in:

- The lower PDU on the Horizontal Situation Indicator (HSI),
- The MDU on the I-NAV,
- The ENG-CAS window for CAS messages,
- The STATus synoptic / FAULT tab for fault messages.

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FIGURE 02-34_4-05-00 - FLIGHT DECK OVERVIEW

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GENERAL

This radar uses a magnetron with a 10 kW nominal power output. The system consists of a WU-880 integrated RTA unit using an 18 inch antenna.

The weather radar range can be adjusted. The system can detect storms up to 300 NM from the airplane. A target alert option can be activated to alert the crew when severe weather outside of the selected range is detected.

The antenna sweep is selectable for either 120° (14 scans per minute) or 60° (20 scans per minute). A weather radar controller is available on each pilot side. When the radar is simultaneously operated by both pilots, the sweep from left to right is controlled by the left controller. The right controller controls the right to left sweep.

When one controller is set OFF and the other controller is in an operating mode (mode other than OFF), the side from where the radar is operating controls both radar sweeps.

The antenna tilt is manually adjustable between -15° down and +15° up with respect to the horizon. When the stabilization feature is active, the antenna tilts to maintain the line-of-sight with respect to the horizon within 30° pitch attitude limit, regardless of the airplane attitude. The antenna can be stabilized in the pitch and roll axis through attitude information from the IRS.

The gain can be manually adjustable to set the sensitivity of the receiver. The optimum gain setting is obtained in automatic gain.

Transmission of video data from the weather radar and the Advance Graphic Module (AGM) in the MAU is accomplished by use of the weather radar picture bus.

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PRINCIPAL DIAGRAM

The weather radar uses the following data:

- IRS data: airplane attitudes
- Controls data: controls performed by crew members via MKB and SENSORS window

The weather radar provides the following data:

- Video data to display weather layer in the HSI window and/or the I-NAV window,
- The weather radar status.

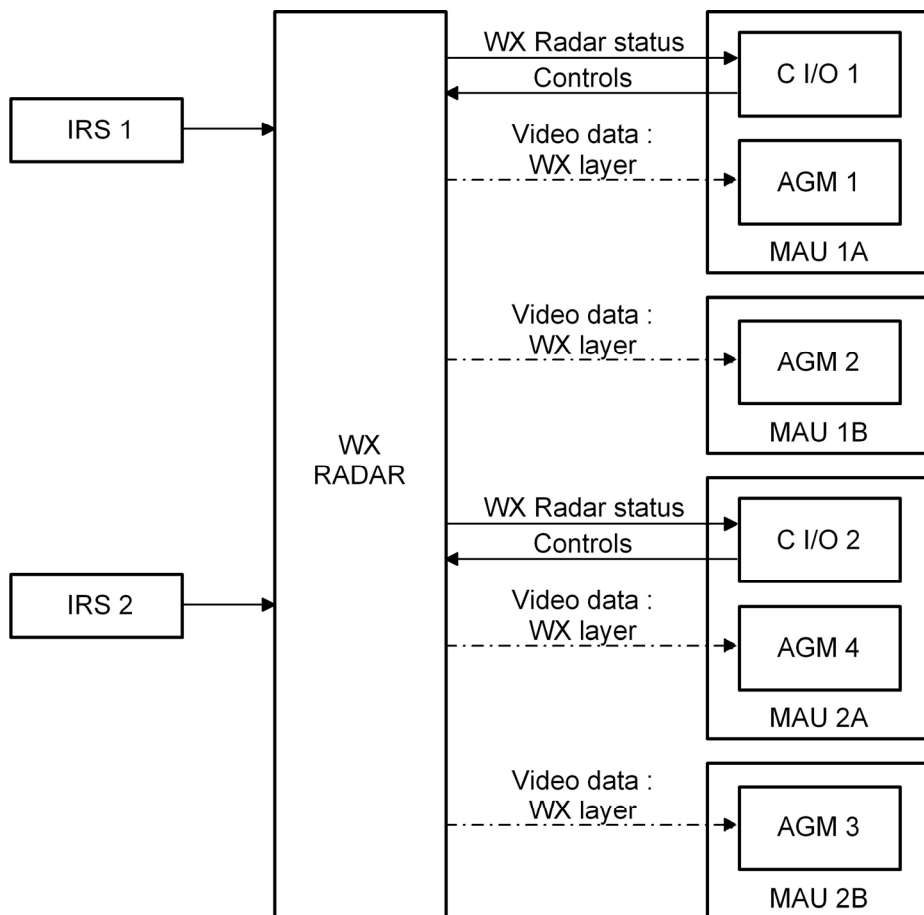


FIGURE 02-34_4-10-00 - WEATHER RADAR PRINCIPAL DIAGRAM

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RADAR MODES

Radar can be operated in any of the four modes:

- Standby (STBY),
- Weather (WX),
- Ground mapping (GMAP),
- Test.

These modes control the basic operation of the radar.

The radar can be operated in the following sub-modes:

- Rain Echo Attenuation Compensation (REACT),
- Turbulence,
- Target,
- Stabilization.

STANDBY MODE

In STBY mode, the antenna is stowed in tilt up position and the transmitter is disabled. Both weather radar MKB controllers must be selected to STBY to be in standby.

STBY should be selected any time it is desired to keep power on the system without transmitting.

On ground the radar is forced in standby mode. Pilot can override this protection using a dedicated control on the MKB.

WEATHER MODE

In WX mode, the transmitter is transmitting and the antenna is scanning. The storm intensity levels are displayed in four bright colors. Each color represents a specific level of precipitation.

GROUND MAPPING

The GMAP mode enables to produce more returns from less reflective targets on the ground. The TILT control is turned down until the desired amount of terrain is displayed. The degree of down-tilt depends upon airplane altitude and selected range.

TEST MODE

In test mode, the weather radar operates in self-test mode. The test mode is triggered through the TEST synoptic.

The test mode is a passive test without radar emission.

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CAUTION

When the airplane is on the ground and forced standby is overridden, the radar transmitter is on and emitting X-band microwave energy in the test mode.

RAIN ECHO ATTENUATION COMPENSATION SUB-MODE

This sub-mode allows, when passing through rainfall, to detect further potential weather by compensating for attenuation of the radar signal. This sub-mode is always selected in TEST mode.

This sub-mode is available in all modes except GMAP mode.

TURBULENCE SUB-MODE

This sub-mode is used to identify possible airmass turbulence with the associated rainfall intensity at range of 50 NM and less.

TARGET SUB-MODE

When this sub-mode is selected, the system monitors for severe weather targets beyond the selected range and within $\pm 7.5^\circ$ of dead ahead.

The target sub-mode is available in any weather radar range other than 300 NM range.

STABILIZATION SUB-MODE

When this sub-mode is selected, the radar sweep is stabilized in reference to the horizon.

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LIGHTNING SENSOR SYSTEM

The optional LSS is used to detect electromagnetic activities of the lightning strikes and to locate areas of activity in a 200 NM radius around the airplane and to give the crew a visual display of lightning rate of occurrence and position relative to the airplane.

LSS consists of the following components:

- A lightning sensor processor,
- A lightning sensor antenna.

The LSS is always powered on and the visual display is selected by crew members. The system can be safely operated on the ground because it is passive (it does not transmit).

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EQUIPMENT LOCATION

Weather radar and LSS computer are installed in the nose cone.

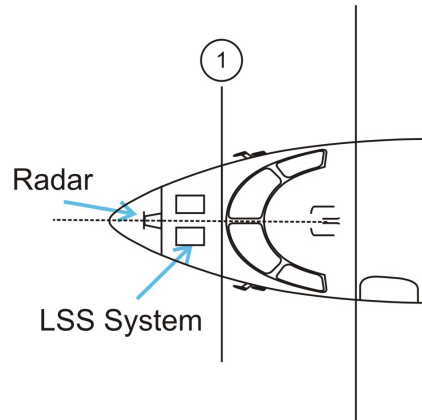


FIGURE 02-34_4-15-00 - EQUIPMENT LOCATION

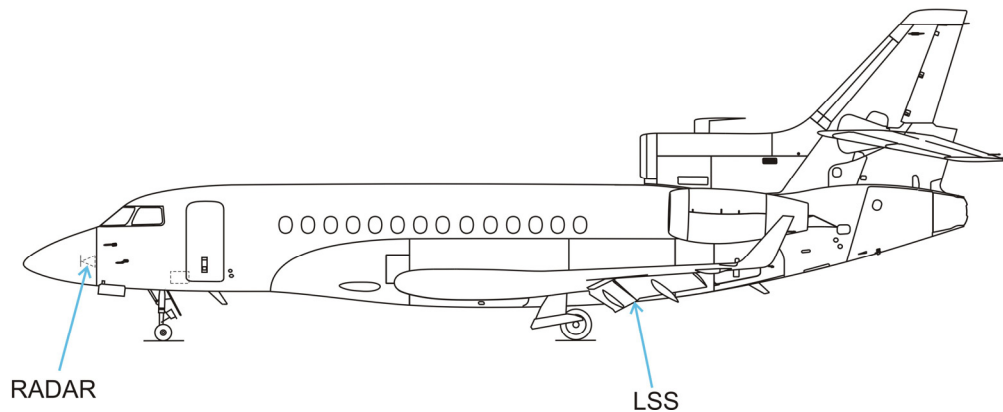
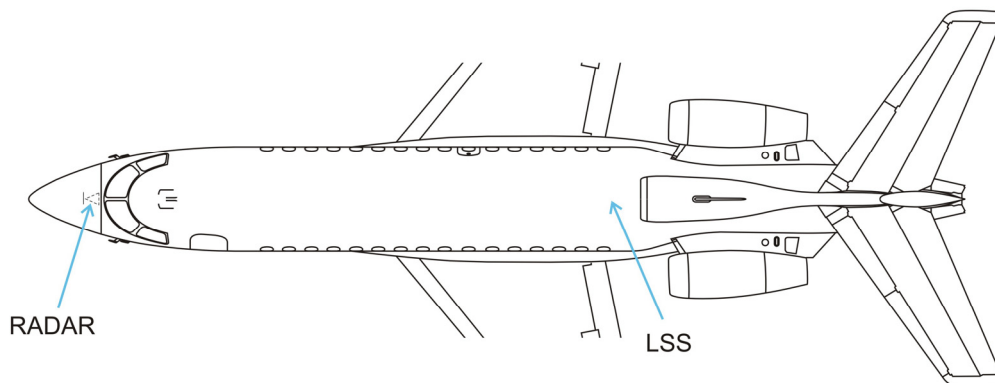


FIGURE 02-34_4-15-01 - RADAR AND LSS ANTENNA LOCATION

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the weather radar and the LSS.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC),
- Circuit Breakers (CB).

➤ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
Weather radar	LH MAIN	Not relevant	CB
LSS	RH MAIN	RH MASTER	CB

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CONTROL

Crew has control on the weather radar through:

- MKB,
- SENSORS window,
- TEST synoptic page.

MULTIFUNCTION KEYBOARD (MKB)

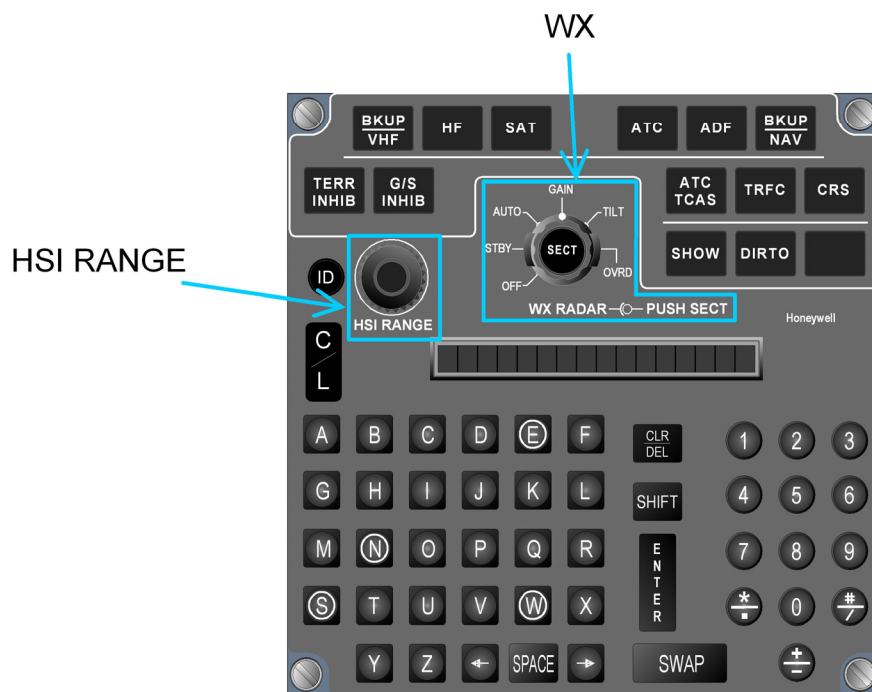


FIGURE 02-34_4-20-00 - WEATHER RADAR CONTROL

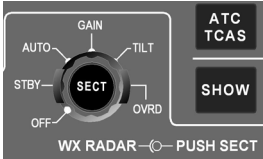
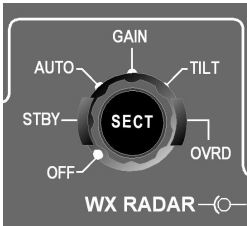
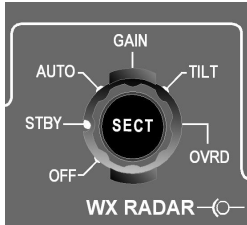
The primary control for the weather radar is the WX RADAR controller of the MKB. The crew can directly access functions using the weather management knob, the inner knob allowing to set a value.

WX RADAR control is composed of:





- A outer rotary switch to select:
 - o OFF,
 - o STBY,
 - o AUTO,
 - o GAIN,
 - o TILT,
 - o OVRD.
- A inner rotary knob to modify gain and tilt values when selected,
- A center pushbutton to select SECT.

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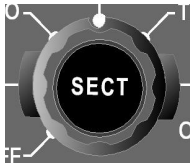
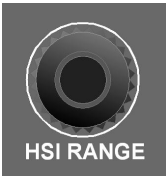
Synthetic table

CONTROL	FUNCTION	TO ACTIVATE	DISPLAY
		TO DEACTIVATE	
	OFF is used to set the radar off		<p>WX status is displayed in HSI window, I-NAV window :</p> <p>WX OFF</p> <p>WX status is displayed in Sensors window:</p> <p>OFF green on black background</p>
	STBY position is used to power the radar (but the radar is not transmitting). It takes two minutes to warm the radar.		<p>WX status is displayed in HSI window, I-NAV window :</p> <p>When the rotary switch is moved to STBY, WAIT flashing is displayed for two minutes at the bottom of the HSI, then steady STBY is displayed</p> <p>WX status is displayed in Sensors window:</p> <p>ON green on black background</p>

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CONTROL	FUNCTION	TO ACTIVATE	DISPLAY
		TO DEACTIVATE	
	In AUTO position the tilt and the gain of the radar are automatically set by the system depending on the range of the HSI. (The inner rotary knob has no effect on the tilt and on the gain). The mode of operation is either Ground Map (GMAP) or Weather (WX) as defined in Sensors window. Weather is the power-up default		Tilt and gain values are displayed in HSI window, I-NAV window and Sensors window
	GAIN allows to modify manually the gain by using the inner rotary Knob (the tilt does not change)		Gain value is displayed in HSI window, I-NAV window and Sensors window
	TILT allows to modify manually the tilt using the WX radar rotary knob (the GAIN is fixed)		Tilt value is displayed in HSI window, I-NAV window and Sensors window
	OVRD allows transmitting when the airplane is on the ground. This position is spring loaded and has to be maintained for 5 seconds to activate the radar		Radar status is displayed in HSI window, I-NAV window and Sensors window

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CONTROL	FUNCTION	TO ACTIVATE	DISPLAY
		TO DEACTIVATE	
	SECT pushbutton allows to change the sweep between 120° (14 scans per minute) and 60° (20 scans per minute). At power up the default is 120°		Sector value is displayed in Sensors window
	When in HSI arc format the HSI range knob changes the weather radar range	HSI RANGE	HSI range value is displayed in HSI window

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SENSORS PAGE CONTROLS (WX/LSS/TAWS)

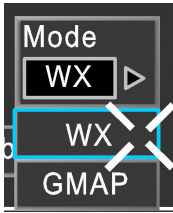
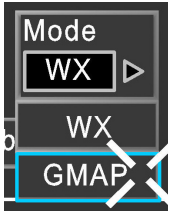
The radar information displays the status of the onside controller/sweep.

The Mode and Sub Mode selections are only applicable for the onside sweep.



FIGURE 02-34_4-20-01 - RADAR FUNCTION

Mode

CONTROL	FUNCTION	DISPLAY
WX mode 	This position allows the radar to work or to transmit and receive in WX mode.	Radar mode is displayed in HSI window and I-NAV window: WX
GMAP 	This position allows the radar to work or to transmit and receive in ground mapping mode	Radar mode is displayed in HSI window and I-NAV window: GMAP

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Sub Mode

Sub modes allows to access specific functions of the radar.

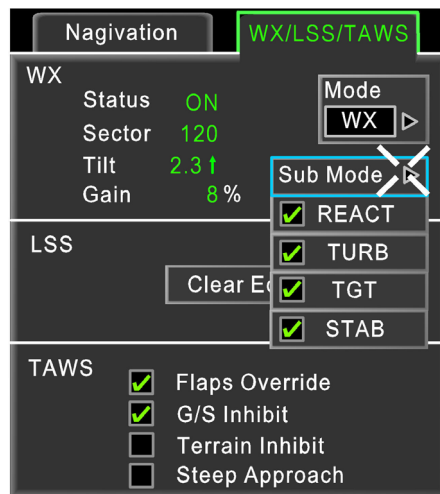


FIGURE 02-34_4-20-02 - RADAR SUB MODE FUNCTION

CONTROL	FUNCTION	LOCATION INDICATION
REACT <input checked="" type="checkbox"/> REACT	Rain Echo Attenuation Compensation Technique. This function allows, when passing through rainfall, to detect further potential weather (by compensating for attenuation of the radar signal)	WX sub mode is displayed in HSI window and I-NAV window: WX/R/T
TURB (TURBulence) <input checked="" type="checkbox"/> TURB	This function is used to identify possible airmass turbulence with the associated rainfall intensity. Areas of potentially hazardous turbulence are displayed as white	WX sub mode is displayed in HSI window, I-NAV window: WX/T
TGT (TarGeT) <input checked="" type="checkbox"/> TGT	When selected, the system monitors for severe weather targets beyond the selected range and within 7.5° range.	Target annunciation is displayed in HSI window and I-NAV window TGT green or TGT amber flashes
STAB (STABILization) <input checked="" type="checkbox"/> STAB	When this function is selected, the radar sweep is stabilized in reference to the horizon.	WX sub mode is displayed in HSI window and I-NAV window: STAB

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TEST SYNOPTIC PAGE

The weather radar has a self-test mode that is engaged through the test synoptic page on the MDU.

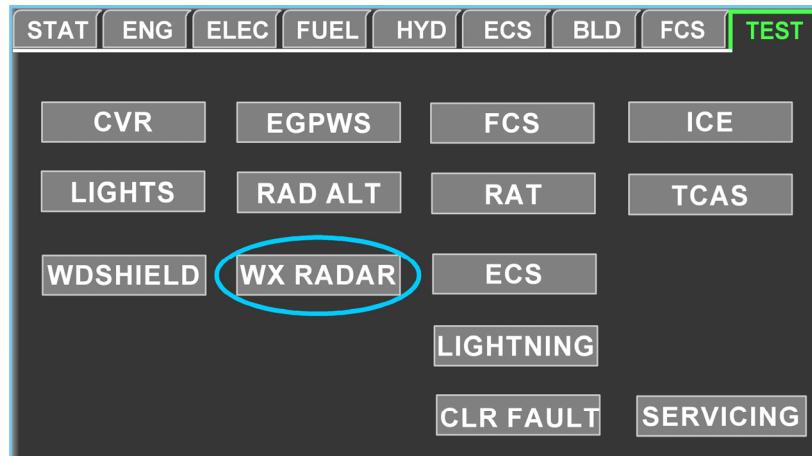


FIGURE 02-34_4-20-03 - TEST SYNOPTIC

In the self-test mode, a special test pattern (1) shows on the HSI and the INAV window. The test pattern supplies a series of green/yellow/red/cyan/magenta/white bands to show that the signal-to-color conversion circuits in the weather radar operate satisfactorily.

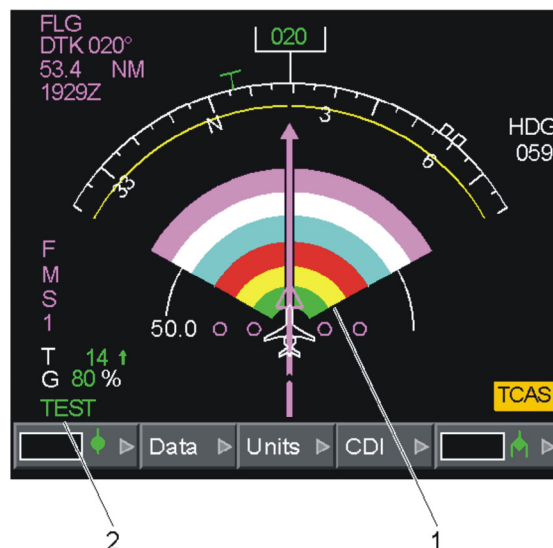


FIGURE 02-34_4-20-04 - TEST PATTERN

During the test mode, the **TEST** annunciation shows on the HSI and the INAV window.

If the test fails, the **WX** annunciation shows on the HSI and the INAV window.

If the airplane is on ground and the standby mode is not overridden, the transmitter and antenna do not operate: amber FSTBY annunciation flashes shows on the HSI and the I-NAV window.

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INDICATION

The weather layer can be displayed:

- On the HSI window,
- On the I-NAV window.

The radar status and operating modes are displayed:

- On the SENSORS window,
- On the HSI window,
- On the I-NAV window.

WEATHER LAYER

WX mode

The storm intensity levels are displayed in four bright colors. Each color represents a specific level of precipitation.

The following color code is applicable in:

- AUTO mode,
- Rain Eco Attenuation Compensation Technique sub-mode,
- Target sub-mode.

The system is calibrated as described below:

RAINFALL RATE	COLOR
Less than moderate rainfall 1 to 4 mm/h 0.04 to 0.16 in/h	Green
Moderate rainfall 4 to 12 mm/h 0.16 to 0.47 in/h	Yellow
Heavy rainfall 12 to 50 mm/h 0.47 to 2 in/h	Red
Very heavy rainfall > 50 mm/h > 2 in/h	Magenta

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Ground mapping mode

The reflected signals from various ground surfaces are displayed in three colors:

GROUND SURFACE	COLOR
Least reflective returns for standing water	Cyan
Moderate returns for the ground	Yellow
Strong returns for cities and mountains	Magenta

WX layer in the HSI

To obtain the WX layer in the HSI, the crew has to select the WX function in the Data menu of the HSI. The layer is only displayed when in ARC format.

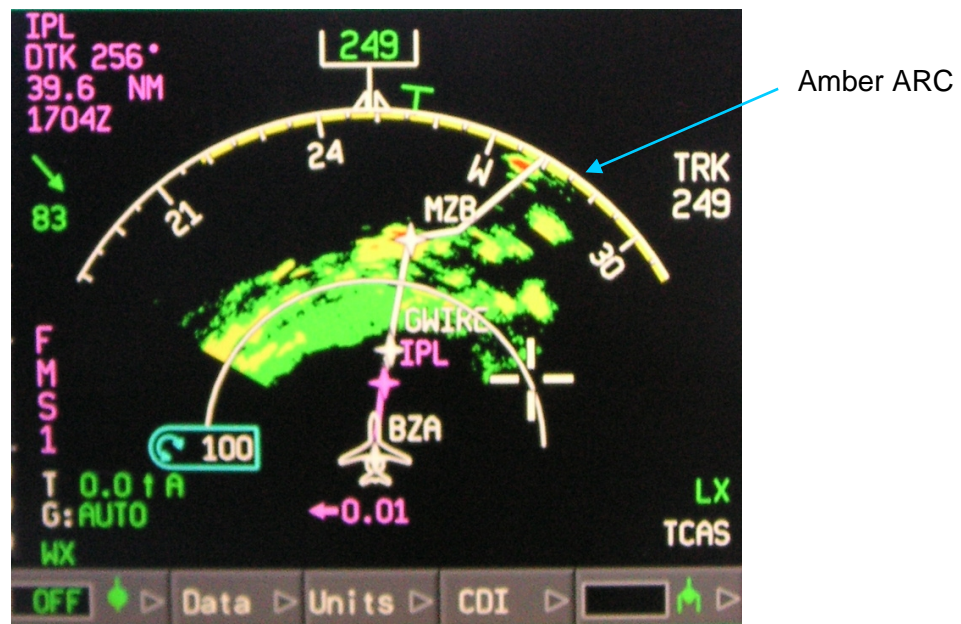


FIGURE 02-34_4-20-05 - WX DISPLAY ON HSI

The radar sweep is displayed with an amber arc as the antenna makes the sweep.

WX layer in the I-NAV

In the I-NAV window, the WX layer is selected through the I-NAV Data menu of the I-NAV toolbar. The brightness of the layer can be adjusted using the CCD rotary knob when the cursor is on the WX position of the menu as shown below.

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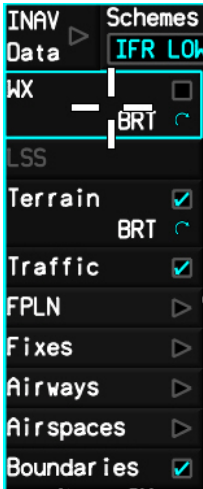


FIGURE 02-34_4-20-06 - WX DISPLAY SELECTION THROUGH I-NAV DATA MENU

The WX layer can be displayed in either HDG or North Up configuration.
The WX layer is displayed within 60° or 120° to the airplane axes, as follows:

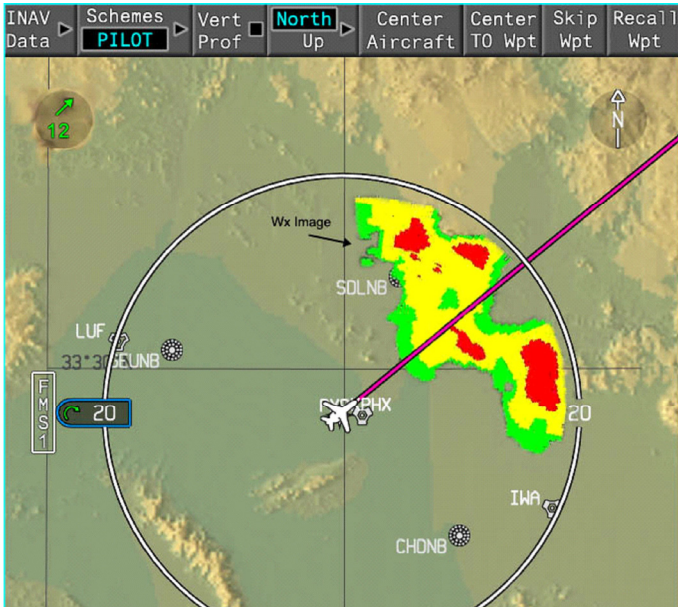


FIGURE 02-34_4-20-07 - WX LAYER ON I-NAV

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WEATHER RADAR STATUS

The weather radar annunciations are displayed on the lower left portion of the HSI.



FIGURE 02-34_4-20-08 - WX LAYER ON HSI

When the WX layer is selected in the I-NAV, the WX annunciations appear in the lower left-corner of I-NAV window.

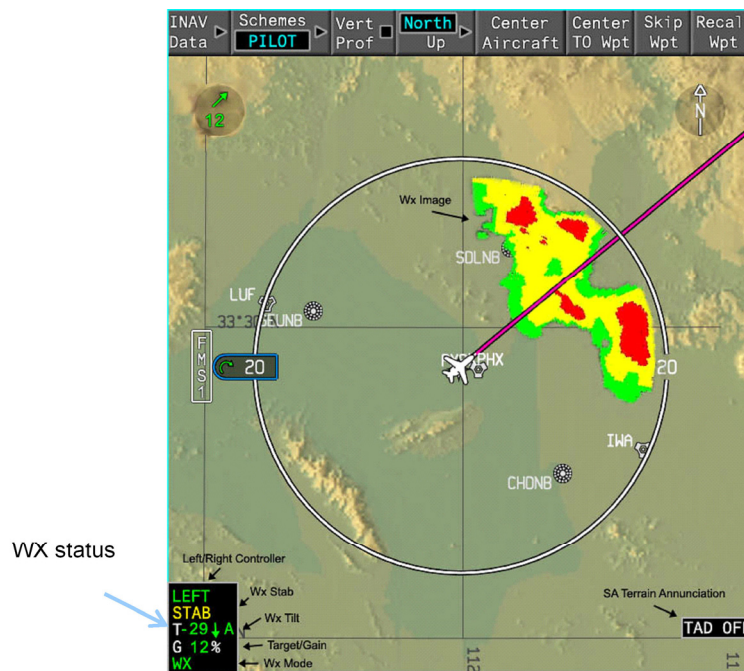
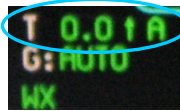

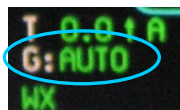

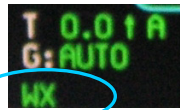






FIGURE 02-34_4-20-09 - WX DISPLAY IN I-NAV

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FUNCTION	INDICATION IN HSI	INDICATION IN I-NAV
Tilt information: Tilt angle value (T), direction (↑ or ↓), tilt mode (A in automatic mode, none in manual mode).		
Gain value (G): The gain value is displayed if TGT mode and REACT are not selected. In automatic gain, the green AUTO is displayed instead of the gain value.		
Target annunciation is displayed instead of gain: - Selected mode without alert: green TGT - Selected mode with alert: the TGT label turn to amber and flash for as long as the alert condition exists.	- Without alert: TGT - Alert mode: TGT and flashes	- Without alert: TGT - Alert mode: TGT and flashes
WX mode is either: - WX OFF , - WX STBY , - WAIT , - FSBY (force standby when on ground), - WX , - GMAP , - TEST (test in progress), - WX/R/T (REACT+TURB), - WX/T (TURB), - OVRD (override force standby mode), - WX (failed).		
STAB annunciation: Amber STAB annunciation is displayed when the WX antenna stabilization is off.		

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FUNCTION	INDICATION IN HSI	INDICATION IN I-NAV
Which controller is active: green LEFT or RIGHT annunciation as selected by the PILOT SIDE selector on the Guidance Panel. The pilot side WX controller controls the layer on the lateral map.	Not displayed	

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CONTROL

The LSS controls are available:

- Via a soft key in the SENSORS window, WX / LSS / TAWS tab,
- Via a soft key in the TEST synoptic.

SENSORS WINDOW (WX / LSS / TAWS TAB)

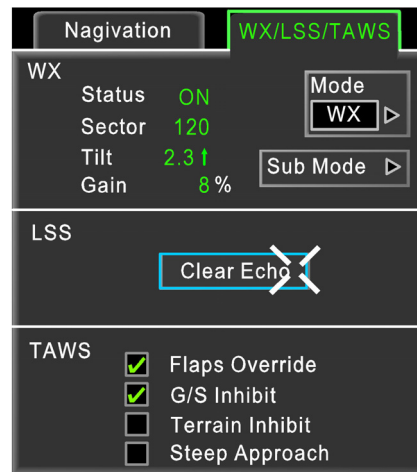


FIGURE 02-34_4-25-00 - WX FUNCTION

The **Clear Echo** soft key removes all the lightning symbols from the display. This soft key is available in the Sensors window.

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TEST



FIGURE 02-34_4-25-01 - TEST SYNOPTIC

The crew can verify the operation of the LSS by triggering LSS test through the TEST window. The test sends simulated lightning activity to the antenna for a complete test of the system. This results in a lightning symbol display at a bearing of 45° right at 25 NM. The simulation advances the severity to a lightning level 3 within 15 seconds after entry in the test mode. A lightning alert is generated along the outermost range at a bearing of 45° right and remains for 3 to 7 seconds. The level 3 symbol degrades and fades out within 2 minutes.

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INDICATION

The LSS information is displayed:

- In the HSI and,
- In the I-NAV.

LSS DISPLAY

The LSS indicates cells of lightning activity using white rate symbols that show three levels of lightning activity in a circular cell around symbol. The white rate symbol upgrades in level as more lighting strokes are detected in the cell and downgrades in level as two minutes pass with no new lightning strokes being detected.

An alert symbol is displayed at the outermost range arc of the display and is shown for five seconds to indicate a lightning stroke on that bearing. This symbol is displayed in magenta.

LSS symbols are the following:





LEVEL	SYNOPTIC
Level 1 Light	
Level 2 Medium	
Level 3 Heavy	
Alert	

FIGURE 02-34_4-25-02 - LIGHTNING INTENSITY

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When the first lightning stroke occurs, the alert symbol is displayed for five seconds on the bearing of the stroke, and a level 1 white symbol is displayed at the strongest part of the stroke. If, 30 seconds later, another stroke is detected in the cell, an alert symbol is displayed for five seconds. The level 1 symbol location is moved to the average position of the two strokes. If another stroke is detected within 30 seconds, an alert symbol is displayed for five seconds, the white symbol is upgraded to level 2 and the location is changed to the average of the three strokes. After one more minute and no lightning stroke is detected (two minutes after the first stroke), the rate symbol is downgraded to level 1 but the position is not moved. If no more strokes are detected in the cell one more minute later (two minutes after the last stroke), the rate symbol is removed from the display.

If additional strokes are detected, the level symbol is upgraded and its position is updated.

Any strokes detected outside existing cells, a level symbol is displayed at the new locations.

LSS symbols and LSS modes are displayed in the HSI if the LSS is selected through the control bar and if the HSI format is ARC. The LSS modes are displayed in the lower right corner of the HSI.



FIGURE 02-34_4-25-03 - LIGHTNING DISPLAY

LSS symbols and LSS modes are displayed in the I-NAV if the LSS is selected through the I-NAV Data pull-down menu.

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FIGURE 02-34_4-25-04 - I-NAV DATA PULL DOWN MENU

NOTE

On the I-NAV window the LSS layer is displayed in 360° circle around the airplane.

The LSS mode is displayed in left lower side of the HSI window.

The LSS modes displayed in HSI and I-NAV are the following:

FUNCTION	INDICATION
Normal mode	LX
Self calibration mode	LX/C
Clear mode	LX/CL
Test mode	LX/T
LSS failure	LX

When the LSS is failed the FAULT message "AVC: LSS FAIL" is displayed on FAULT tab of the STATUS synoptic page.

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SYSTEM MONITORING

The weather radar and LSS systems are monitored for equipments integrity.

➤ *Refer to CODDE 2 for an exhaustive description of CAS and FAULT messages.*

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ACTIVE PROTECTION

On ground the radar emission is inhibited except in override mode.

The LSS does not provide any active protection.

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No supplementary information to be provided on System Protections at present time.

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PRECAUTION

When the airplane is on the ground and forced standby is overridden, the following precaution must be performed:

- Direct nose of airplane so that antenna sector is free of large metallic objects such as hangars or other airplane for a distance of 100 feet (30 meters) and tilt antenna fully upwards,
- Avoid operation during refueling of airplane or during refueling operations within 100 feet,
- Avoid operation if personnel are standing too close to the 270° forward sector of airplane.

➤ *Refer to Ground Servicing Manual.*

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INTRODUCTION

The Enhanced Ground Proximity Warning System (EGPWS) helps to prevent accidents mainly caused by Controlled Flight Into Terrain (CFIT) or severe windshear, by providing the flight crew with aural alert messages, visual annunciations and displays in the event that the boundaries of any alerting envelope are exceeded.

The functions integrated in the EGPWS are:

- Basic Ground Proximity Warning,
- Enhanced Ground Proximity Warning.

A second EGPWS module is optional.

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FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the EGPWS is performed

- Via GLIDE SLOPE INHIBIT and TERRAIN INHIBIT pushbuttons on the Multifunction Keyboard (MKB),
- Via GLIDE SLOPE INHIBIT, TERRAIN INHIBIT, FLAPS OVERRIDE and STEEP APPROACH soft key in the SENSORS window,
- via FLAPS OVERRIDE and STEEP APPROACH soft key in the Flight Management Window (FMW),
- Via an EGPWS soft key in the TEST synoptic to trigger pre-flight test of the EGPWS,
- Via SIL pushbutton on the Guidance Panel (GP) to inhibit EGPWS aural alerts.

A data-loader is available for loading of Terrain databases.

INDICATIONS

Crew indications with regard to the EGPWS are located in:

- The upper PDU on the Attitude Direction Indicator (ADI) for visual alerts,
- The lower PDU on the Horizontal Situation Indicator (HSI) for annunciation modes,
- The MDU on the I-NAV window for terrain display,
- The PDU on the TRAFFIC window for terrain display;
- The ENG-CAS window for CAS messages,
- The STATUS synoptic / FAULT tab for fault messages,
- The aural alerts.

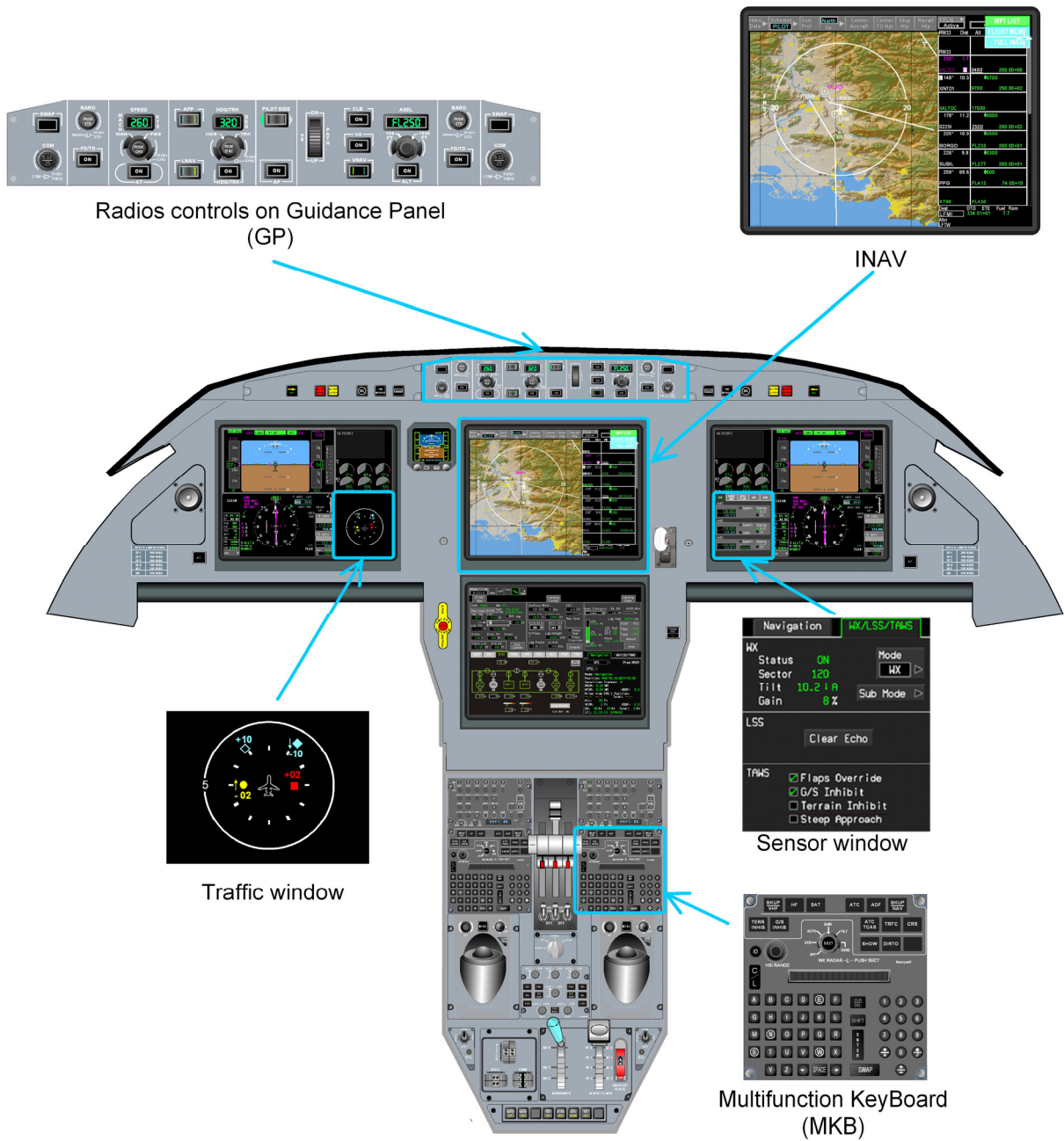


FIGURE 02-34_5-05-00 - FLIGHT DECK OVERVIEW

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GENERAL

The EGPWS system is part of the EASy system. The EGPWM, housed in MAU 1B, contains the system threat database and processes the E-GPWS functions

The EGPWS functions integrated in the EGPWM are:

- Basic Ground Proximity Warning,
- Enhanced Ground Proximity Warning.

The basic Ground Proximity Warning System (GPWS) consists of 6 modes.

- Mode 1 – Excessive Descent Rate,
- Mode 2 – Excessive Terrain Closure Rate,
- Mode 3 – Altitude Loss After Takeoff,
- Mode 4 – Unsafe Terrain Clearance,
- Mode 5 – Excessive Glideslope Deviation,
- Mode 6 – Altitude Awareness Callouts.

The functions here above are part of the basic GPWS integrated in the EGPWS. When the EGPWS enhanced modes are lost in case of failure or if the terrain function has been de-selected by the crew, these modes are always active.

Enhanced Ground Proximity Warning consists of 4 modes:

- Mode 7 – Windshear Detection,
- Excessive Bank Angle Alert,
- Terrain Clearance Floor,
- Terrain and Obstacles Alerts.

The EGPW Module (EGPWM) contains the system terrain database. Using this database, it performs processing related to conventional EGPWS functionality.

In addition, the EGPWM provides requested terrain data to the Advance Graphic Module (AGM) via a high speed Terrain Server Bus (TSB).

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PRINCIPAL DIAGRAM

Each EGPWM contains two data bases:

- Terrain data base,
- Envelop EGPWS data base.

Each EGPWM uses the following hardware resources:

- Processor card for EGPWS functions,
- Terrain server function;
- Advanced Graphics Modules (AGM) for interface to cockpit displays for the display and functional control,
- Input/Output module to interface with external systems,
- Network interface card to interface with the Avionics Standard Communications Bus (ASCB-D), which is a high integrity airplane wide bus network,
- Databases,
- Control Input Output module for Aural Warning Function.

Following diagram shows a representation of communication between EGPWM and other avionics systems.

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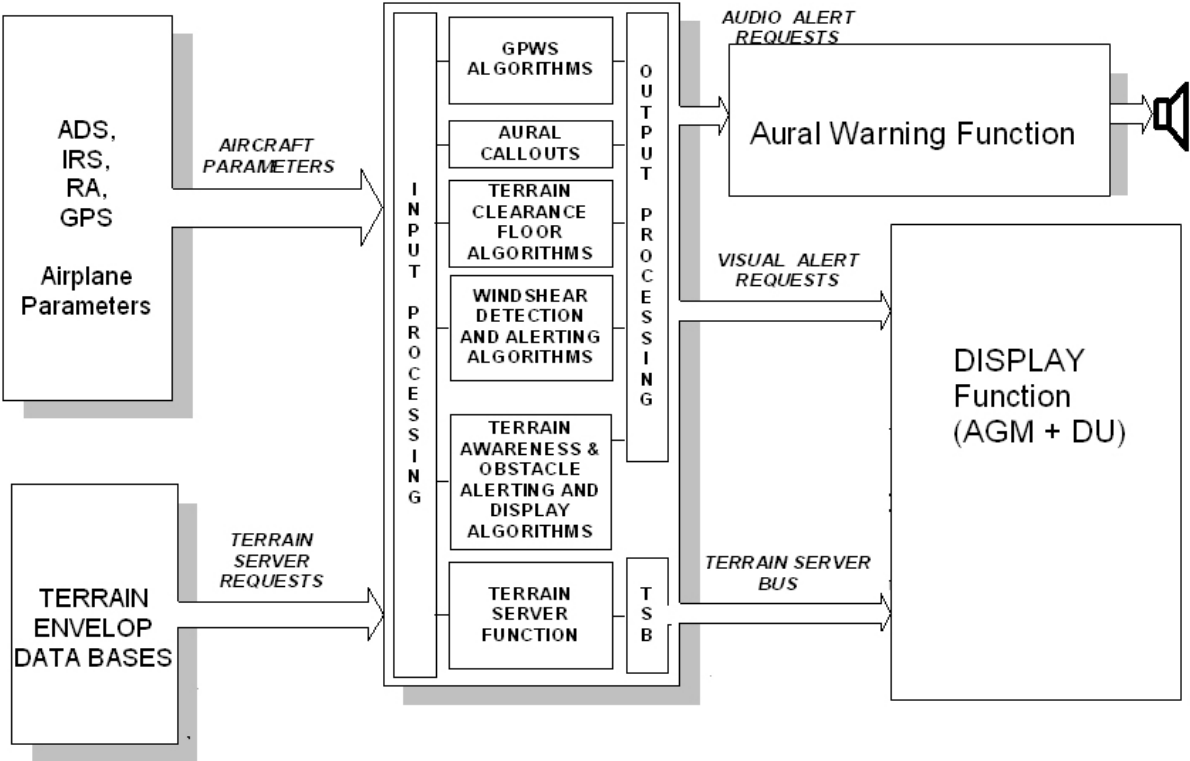


FIGURE 02-34_5-10-00 - EGPWM INTERFACES

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EGPWS FUNCTIONS

MODE 1 – EXCESSIVE DESCENT RATE

Mode 1 provides alerts when the airplane has excessive descent rate close to the terrain.

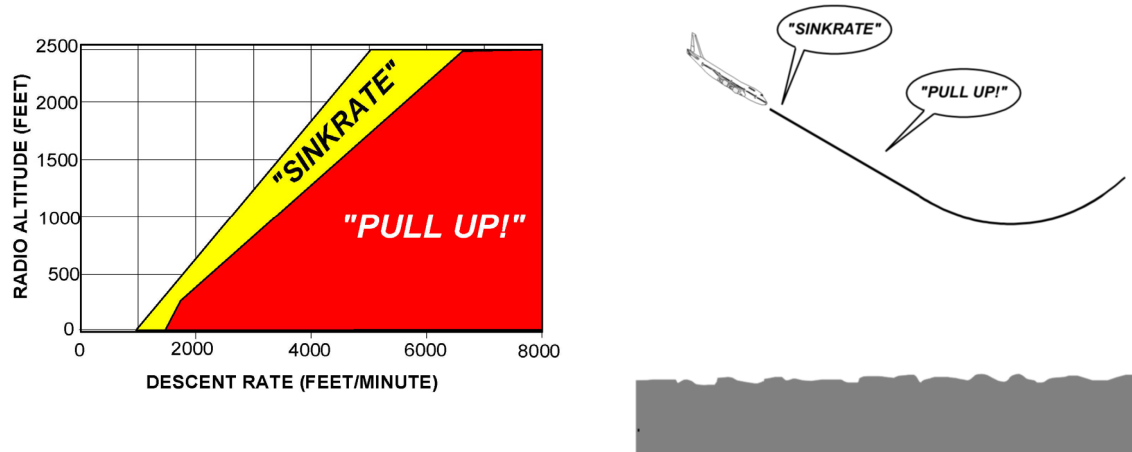


FIGURE 02-34_5-10-01 - EXCESSIVE RATE OF DESCENT

MODE 2 – EXCESSIVE TERRAIN CLOSURE RATE

Mode 2 provides alerts when the airplane is closing with the terrain at an excessive rate.

It is not necessary for the airplane to be descending in order to produce a mode 2 alert; level flight (or even a climb) towards obstructing terrain can result in hazardous terrain closure rate.

Mode 2 has two sub-modes, referred to as mode 2A and mode 2B, the active sub-mode being determined by the airplane configuration.

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Mode 2A

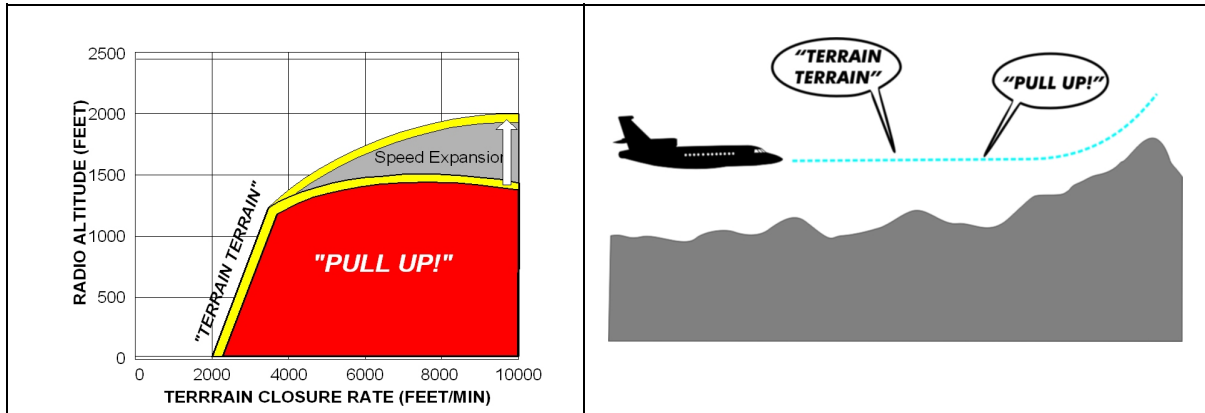


FIGURE 02-34_5-10-02 - MODE 2A - EXCESSIVE TERRAIN CLOSURE RATE

Mode 2A is enabled when the conditions for enabling mode 2B are not satisfied (see subsection 02-34_5-15).

Mode 2B

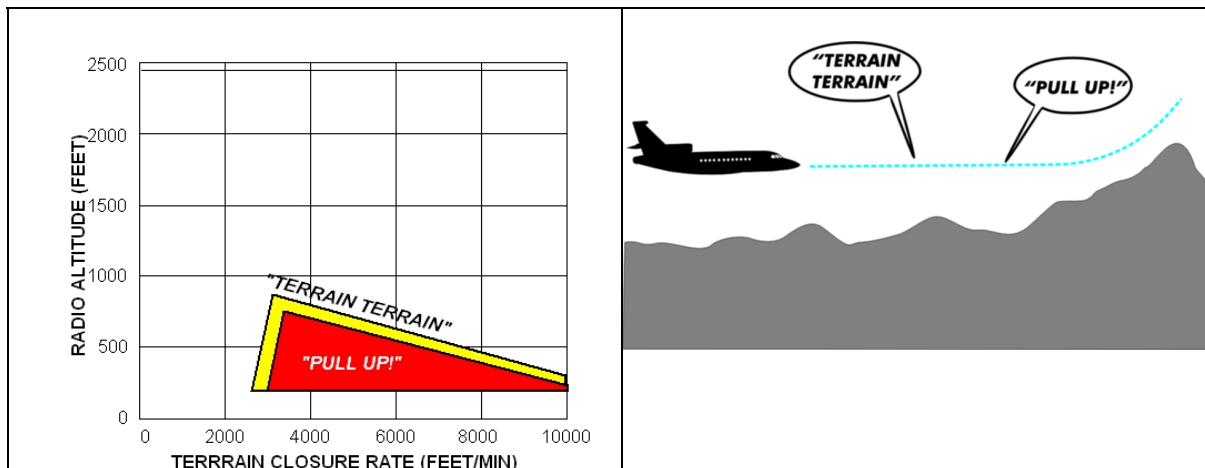


FIGURE 02-34_5-10-03 - MODE 2B - EXCESSIVE TERRAIN CLOSURE RATE

Mode 2B provides a desensitized alert envelope, permitting normal landing approach maneuvering close to the terrain without producing unwanted alerts.

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MODE 3 – ALTITUDE LOSS AFTER TAKEOFF

Mode 3 provides alerts when the airplane loses a significant amount of altitude immediately after takeoff or during a missed approach.

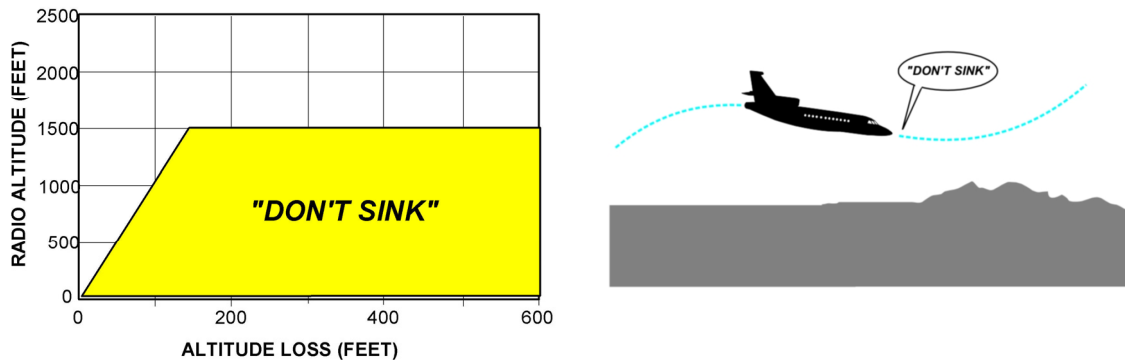


FIGURE 02-34_5-10-04 - ALTITUDE LOSS AFTER TAKE-OFF

MODE 4 – UNSAFE TERRAIN CLEARANCE

Mode 4 provides alerts for insufficient terrain clearance with respect to phase of flight and speed.

Mode 4 exists in three sub-modes:

- Mode 4A is active during cruise and approach with gear not in landing configuration.
- Mode 4B is active in cruise and approach, but with gear in landing configuration.
- Mode 4C is active during the takeoff phase of flight with either the gear or flaps not in landing configuration.

Mode 4A

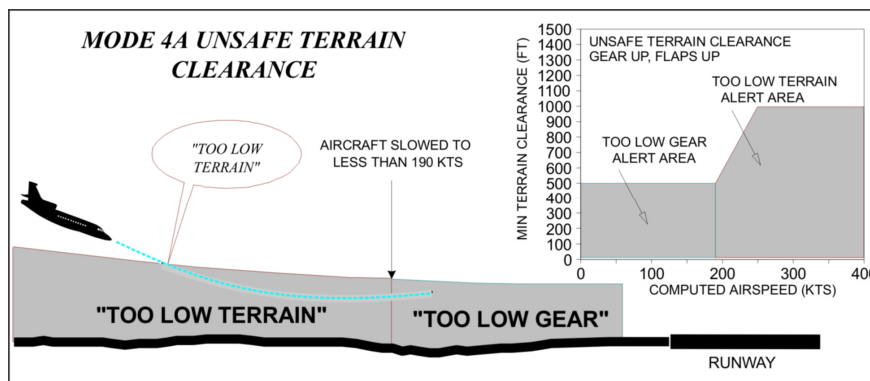


FIGURE 02-34_5-10-05 - UNSAFE TERRAIN CLEARANCE - MODE 4A

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Mode 4B

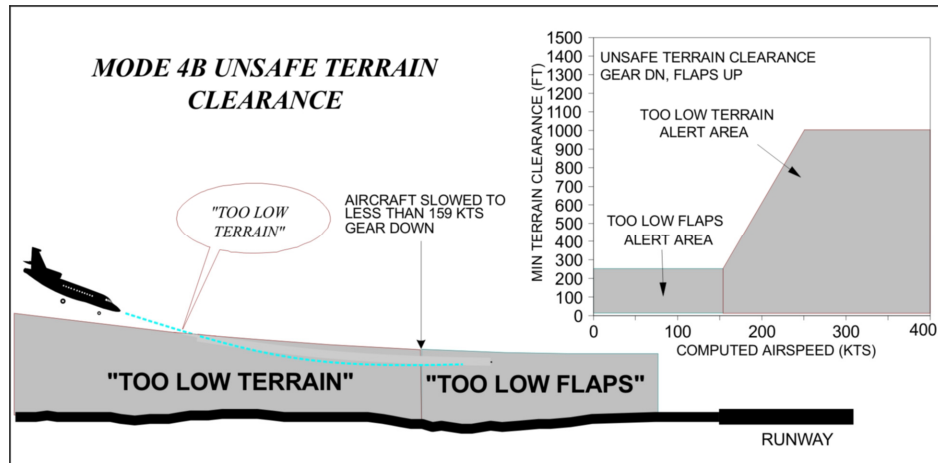


FIGURE 02-34_5-10-06 - UNSAFE TERRAIN CLEARANCE - MODE 4B

Mode 4C

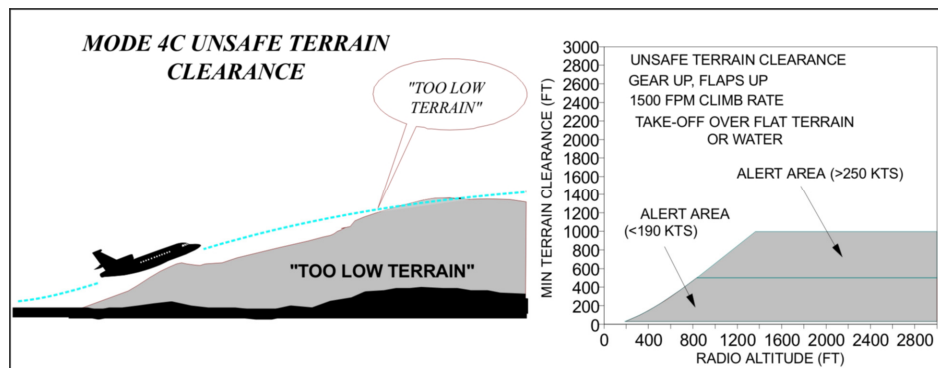


FIGURE 02-34_5-10-07 - UNSAFE TERRAIN CLEARANCE - MODE 4C

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MODE 5 – EXCESSIVE GLIDESLOPE DEVIATION

Mode 5 provides alerting when the airplane flight path descends below the glideslope beam on front course ILS approaches.

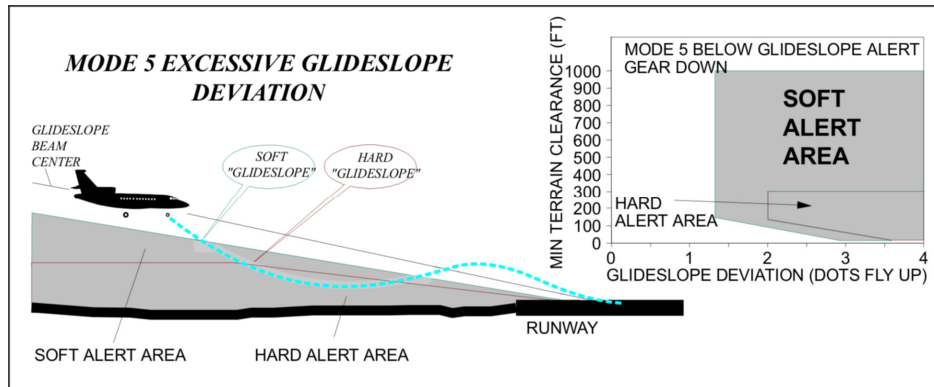


FIGURE 02-34_5-10-08 - EXCESSIVE GLIDESLOPE DEVIATION

MODE 6 – ALTITUDE AWARENESS CALLOUTS

Mode 6 provides voice alerts and callouts for descent below predefined altitudes

MODE 7 – WINDSHEAR DETECTION

Mode 7 produces alerts for flight into an excessive windshear condition during takeoff or final approach.

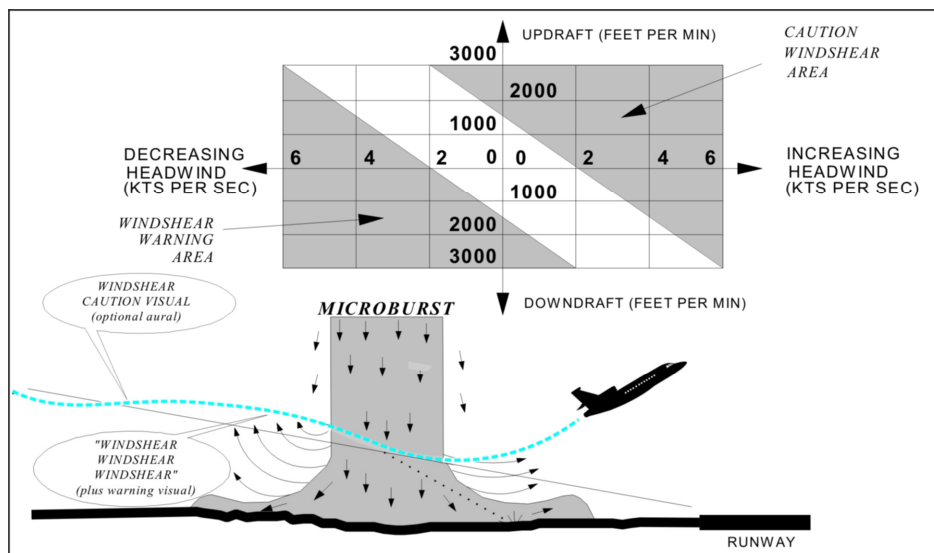


FIGURE 02-34_5-10-09 - WINSHEAR DETECTION

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EXCESSIVE BANK ANGLE CALLOUT

The bank angle feature provides protection for over-banking during maneuvering on approach or climbout and while at altitude. In addition, it protects against wing or engine strikes close to the runway.

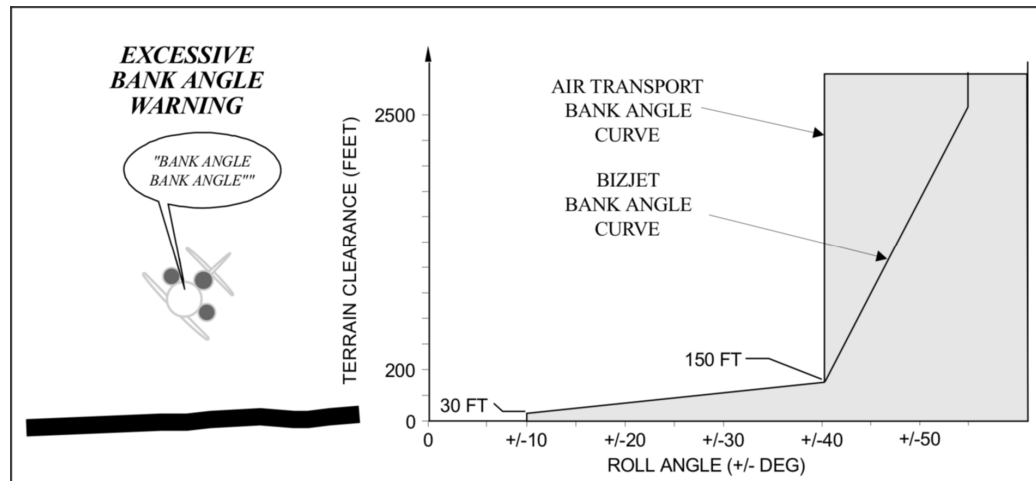


FIGURE 02-34_5-10-10 - EXCESSIVE BANK ANGLE CALL-OUT

A Bank Angle curve violation produces the aural "Bank Angle Bank Angle".

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TERRAIN CLEARANCE FLOOR

The Terrain Clearance Floor function includes two features,

- Basic Terrain Clearance Floor (TCF): creates an increasing terrain clearance envelope around the intended airport runway directly related to the distance from the runway,
- Runway Field Clearance Floor (RFCF): provides alerts based on height above the destination runway also directly related from the distance from the runway.

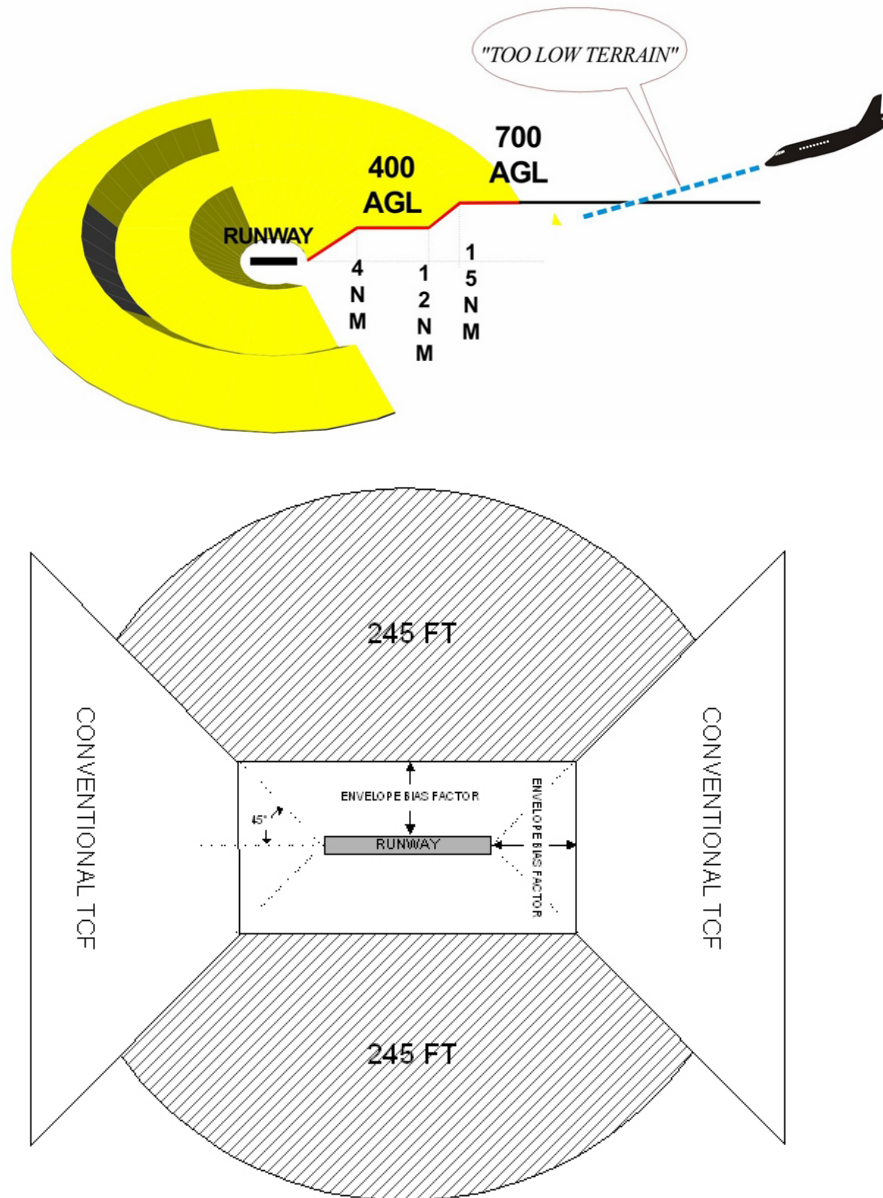


FIGURE 02-34_5-10-11 - TERRAIN CLEARANCE FLOOR

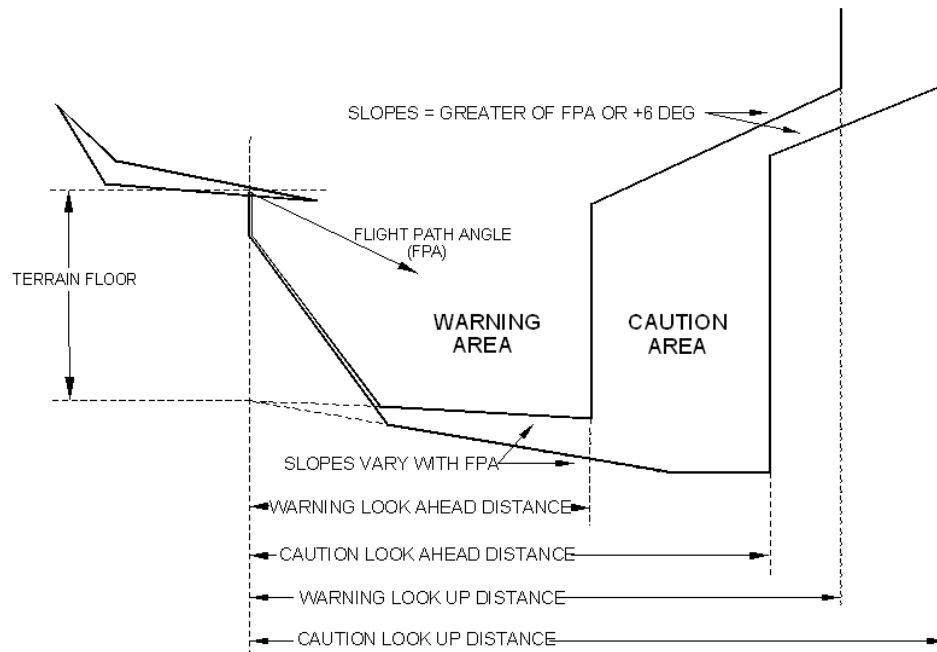
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TERRAIN AND OBSTACLE ALERTS

The Terrain and Obstacle Alerts function continuously computes terrain clearance envelopes ahead of the airplane.

If the boundaries of these computed envelopes conflict with terrain elevation data in the threat database, then alerts are issued.

Two envelopes are computed, one corresponding to a terrain caution alert level and the other to a terrain warning alert level.



LOOK AHEAD DISTANCES VARY WITH GROUND SPEED AND DISTANCE TO RUNWAY
TERRAIN FLOOR VARIES WITH DISTANCE TO RUNWAY

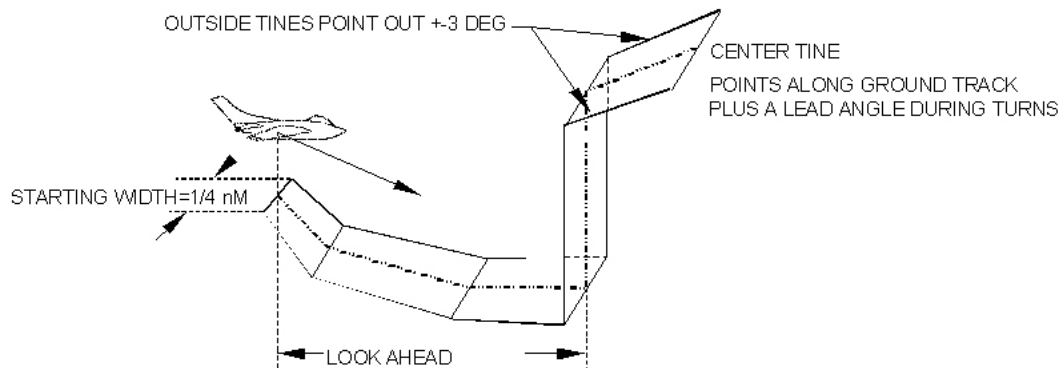


FIGURE 02-34_5-10-12 - TERRAIN DETECTION ENVELOPE – PERSPECTIVE VIEW

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DESIGN PRINCIPLES

The system is designed to be fully compatible with normal operations of commercial airplane: unwanted alerts will be very rare if the flight crew maintains situational awareness with respect to the terrain and if the crew follows correct avoidance procedures for any significant windshear activity.

The EGPWS architecture permits to interface with the Advance Graphic Modules (AGM).

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EQUIPMENT LOCATION

The EGPWS function is implemented:

- Within MAU 1B: in EGPW 1,
- Within MAU 2B: in optional EGPW 2.

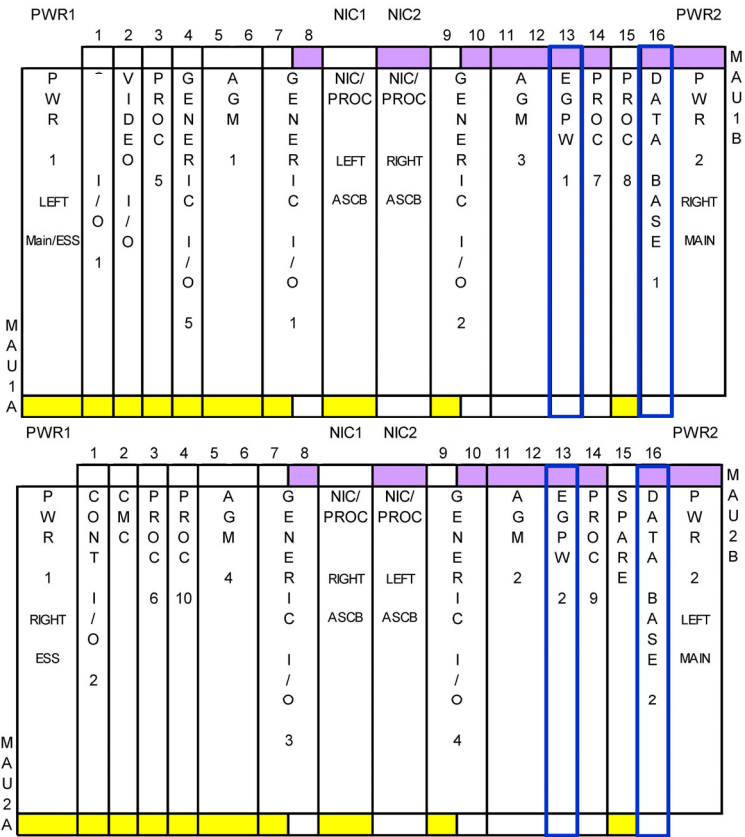


FIGURE 02-34_5-15-00 - IMPLEMENTATION OF EGPWS FUNCTION IN THE MAU

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the EGPWS.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC),
- Circuit Breakers (CB).

➤ Refer to ATA 24 – ELECTRICAL POWER for additional information.

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
MAU 1B	RH Main	RH MASTER	CB
MAU 2B	LH Main	LH MASTER	CB

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FUNCTIONS

MODE 1 – EXCESSIVE DESCENT RATE

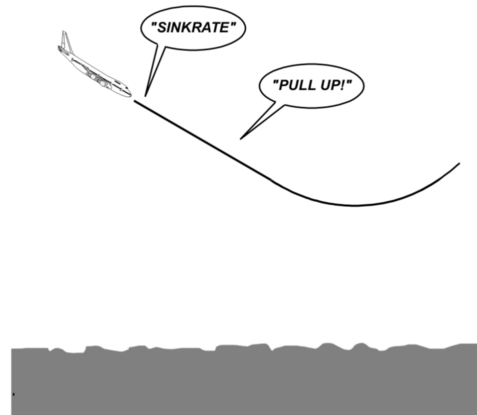
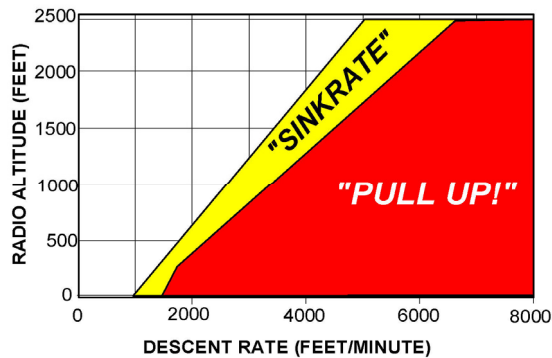


FIGURE 02-34_5-15-01 - EXCESSIVE RATE OF DESCENT

If the airplane penetrates the outer (yellow) alert boundary:

- The voice aural "SINKRATE" is generated,
- **GND PROX** annunciation is displayed in the ADI.

If the airplane penetrates the inner (red) alert boundary:

- The voice aural "PULL UP" is generated,
- **PULL UP** annunciation is displayed in the ADI.

The alert boundaries are defined in terms of airplane vertical speed and radio altitude.

Mode 1 is active regardless of the flight phase whenever Radio Altitude is valid and tracking less than 2,450 ft AGL. Lower level cutoff when using Inertial Vertical Speed (IVS) occurs at 10 feet radio altitude during landing. With IVS the mode is re-enabled at 30 feet radio altitude during takeoff.

MODE 2 – EXCESSIVE TERRAIN CLOSURE RATE

Mode 2 has two sub-modes, referred to as mode 2A and mode 2B, the active sub-mode being determined by the airplane configuration.

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Mode 2A

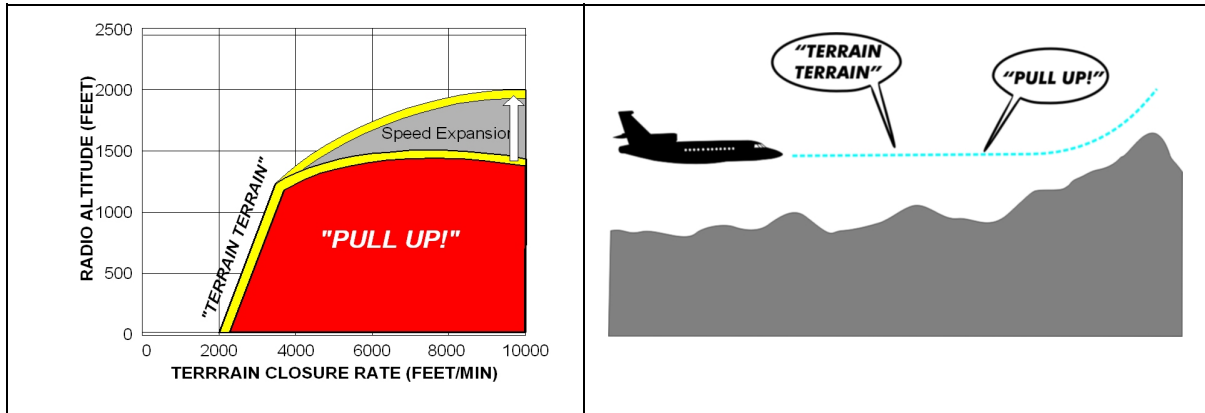


FIGURE 02-34_5-15-02 – MODE 2A - EXCESSIVE TERRAIN CLOSURE RATE

Mode 2A is enabled when the conditions for enabling mode 2B are not satisfied (see below). The mode 2A maximum upper boundary is reduced to 950 ft for all airspeeds when Terrain Awareness functions are available and of high integrity.

If the airplane penetrates the mode 2A alerting envelope (yellow):

- The voice aural “TERRAIN TERRAIN” is generated initially,
- **GND PROX** annunciation is displayed in the ADI.

If the airplane continues to penetrate the envelope (red):

- The voice aural “PULL UP” is repeated continuously generated,
- **PULL UP** annunciation is displayed in the ADI until the warning envelope is exited.

Mode 2B

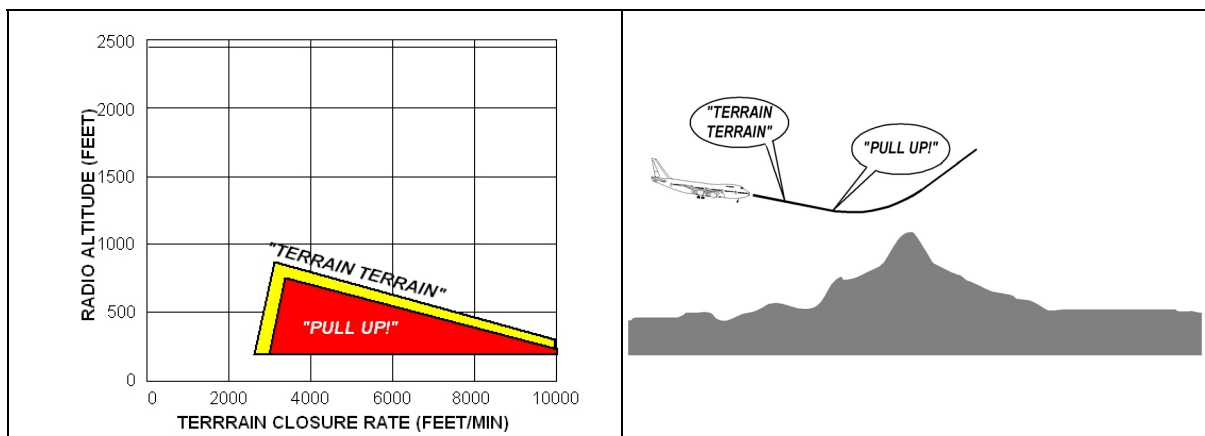


FIGURE 02-34_5-15-03 – MODE 2B - EXCESSIVE TERRAIN CLOSURE RATE

Mode 2B provides a desensitized alert envelope, permitting normal landing approach maneuvering close to the terrain without producing unwanted alerts.

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Mode 2B is active regardless of the flight phase whenever the radio altitude is valid and tracking less than 2,450 ft AGL.

Mode 2B is enabled for four conditions:

- Whenever flaps are selected to the landing position,
- If the airplane is performing an ILS approach and is within ± 2 dots of both localizer and glideslope centerlines,
- If the airplane is within 10 miles and 3500 ft of the destination runway and the Terrain Awareness function is of high integrity,
- During the first 60 seconds after take off.

If the airplane penetrates the mode 2B envelope with either gear or flaps not in landing configuration:

- The voice aural “TERRAIN TERRAIN” is generated initially,
- **GND PROX** annunciation is displayed in the ADI.

If the airplane continues to penetrate the envelope, then:

- The voice aural “PULL UP” is repeated continuously
- **PULL UP** annunciation is displayed in the ADI until the warning envelope is exited.

If the airplane penetrates the mode 2B envelope with both gear and flaps in landing configuration:

- The voice aural “TERRAIN” is repeated until the envelope is exited.

MODE 3 – ALTITUDE LOSS AFTER TAKE OFF

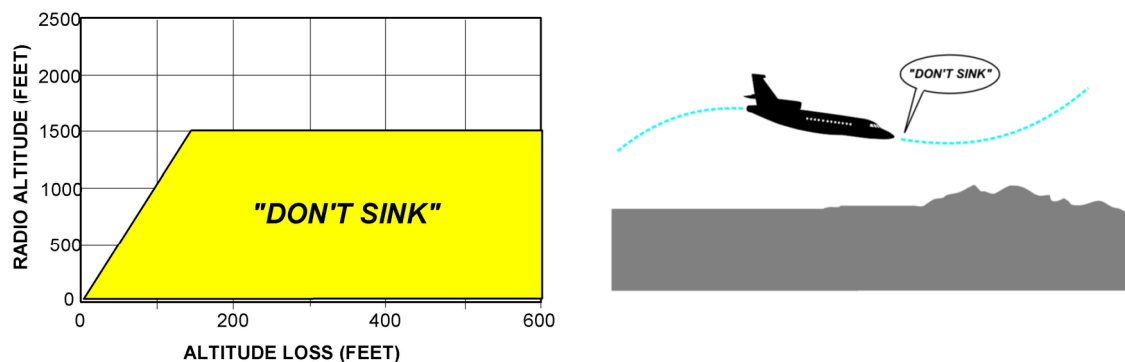


FIGURE 02-34_5-15-04 ALTITUDE LOSS AFTER TAKE-OFF

Mode 3 is enabled after Take Off or Go Around when landing gear or flaps are not in the landing configuration, and stays enabled until the EGPW detects that the airplane has gained sufficient altitude that it is no longer in the Take Off phase of flight.

If the airplane penetrates the mode 3 envelope:

- The voice aural “DON'T SINK DON'T SINK” is generated,
- **GND PROX** annunciation is displayed in the ADI.

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MODE 4 – UNSAFE TERRAIN CLEARANCE

Mode 4A

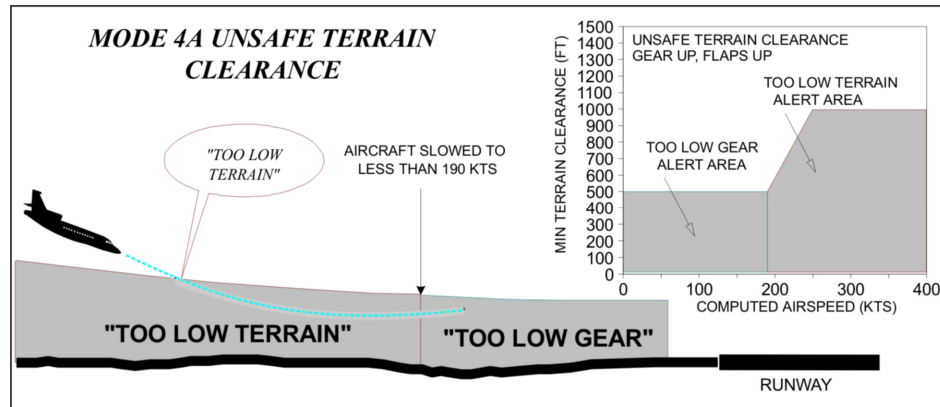


FIGURE 02-34_5-15-05 - UNSAFE TERRAIN CLEARANCE - MODE 4A

With gear still up:

- If the airplane penetrates the boundary at 500 feet radio altitude, the voice aural will be "TOO LOW GEAR",
- Above 190 knots the upper boundary increases linearly with airspeed to a maximum of 1000 feet radio altitude at 250 knots or more. Penetrating this boundary produces the voice aural "TOO LOW TERRAIN" and **GND PROX** annunciation is displayed in the ADI.

The Mode 4A maximum is reduced to 500 ft when Terrain Inhibit is not selected, and Terrain Clearance Floor function is enabled or Terrain Awareness function is available and operating in a state of high integrity.

Mode 4B

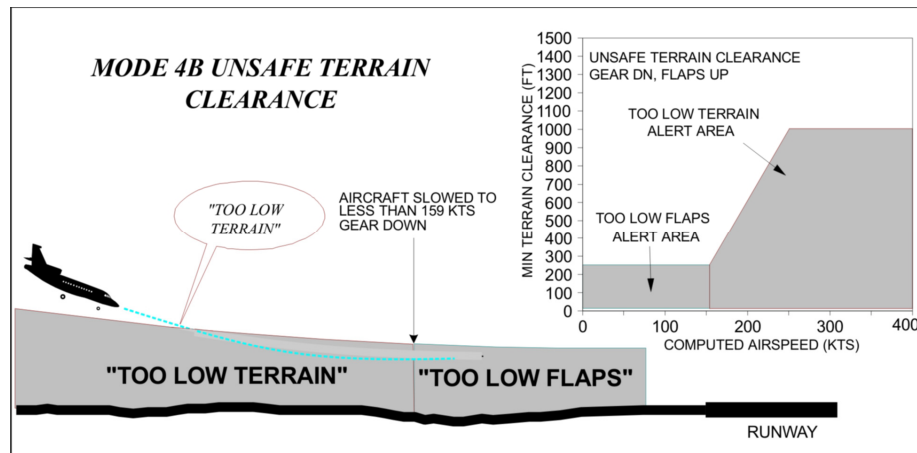


FIGURE 02-34_5-15-06 - UNSAFE TERRAIN CLEARANCE - MODE 4B

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With gear down and flaps not in landing configuration:

- Penetration below 159 knots results in the voice aural "TOO LOW FLAPS",
- Above 159 knots the voice aural is "TOO LOW TERRAIN" and **GND PROX** annunciation is displayed in the ADI.

The Mode 4B maximum is reduced to 245 ft when Terrain Inhibit is not selected, and Terrain Clearance Floor function is enable or Terrain Awareness function is available and operating in a state of high integrity.

Mode 4C

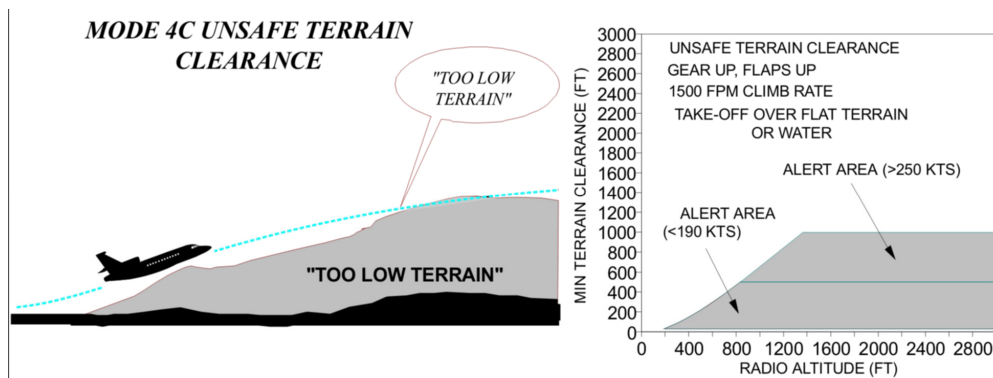


FIGURE 02-34_5-15-07 UNSAFE TERRAIN CLEARANCE - MODE 4C

The sloped portion of the envelope boundary is described by the equation:

$$\text{Minimum terrain clearance} = 0.75 * \text{Radio altitude}$$

Mode 4C is based on a minimum terrain clearance, or floor, that increases with radio altitude during takeoff. A value equal to 75% of the current radio altitude is accumulated in a long term filter. Any decrease of radio altitude below the filter value with gear or flaps up will result in the voice aural.

If the airplane penetrates the mode 4C envelope:

- The voice aural is "TOO LOW TERRAIN",
- **GND PROX** annunciation in the ADI.

NOTE

Mode 3 versus Mode 4C: to keep these two different takeoff mode protections clear it can simply be remembered that Mode 3 protects against the aircraft gradually sinking down to terrain and Mode 4C protects against terrain that is gradually rising.

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MODE 5 – EXCESSIVE GLIDESLOPE DEVIATION

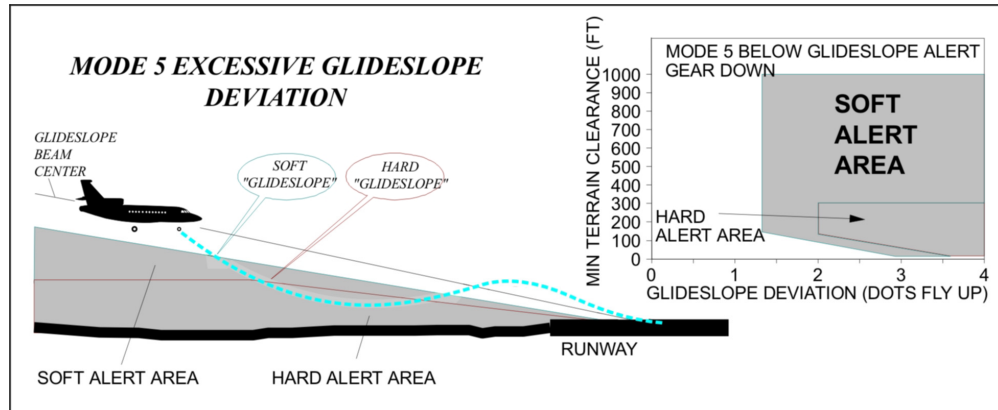


FIGURE 02-34_5-15-08 - EXCESSIVE GLIDESLOPE DEVIATION

The first alert activation occurs whenever the airplane is more than 1.3 dots below the beam and is called a “soft” glideslope alert because the volume level of the “Glideslope” alert is approximately one half (-6 dB) that of the other alerts.

A second alert boundary occurs below 300 feet radio altitude with greater than 2 dots deviation and is called “loud” or “hard” glideslope alert because the volume level is increased to that of the other alerts.

Mode 5 alerts activate amber **GND PROX** annunciation in ADI.

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MODE 6 – ALTITUDE AWARENESS CALL OUTS

ALTITUDE TYPE CALL OUTS	
MINIMUMS	Provides Minimums call out for descent below minimums setting
APPROACHING MINIMUMS	Provides Approaching Minimums call out for descent below minimums setting plus 80 feet
1,000	Provides One Thousand call out for descent below 1,000 feet
500	Provides Five Hundred call out for descent below 500 feet

LOW ALTITUDE CALL-OUTS	
300	Provides Three Hundred call out for descent below 300 feet
200	Provides Two Hundred call out for descent below 200 feet
50*	Provides Fifty call out for descent below 50 feet
40*	Provides Forty call out for descent below 40 feet
30*	Provides Thirty call out for descent below 30 feet
20*	Provides Twenty call out for descent below 20 feet
10*	Provides Ten call out for descent below 10 feet
5	Provides Five call out for descent below 5 feet

NOTE

*: means that annunciations are mandatory for HUD CAT III approaches

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MODE 7 – WINDSHEAR DETECTION

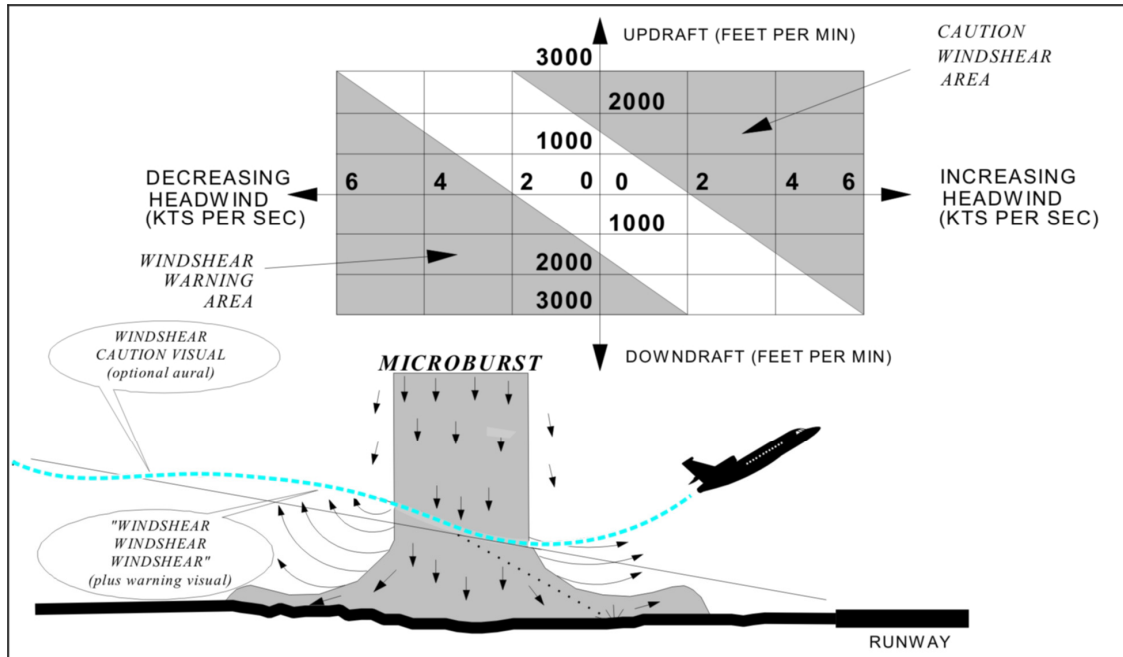


FIGURE 02-34_5-10-09 - WINSHEAR DETECTION

Windshear detection is active between 10 and 1,500 ft AGL during the initial Take Off and final approach phases of flight.

Windshear warning alerts are given for decreasing head wind (or increasing tail wind) and severe vertical down drafts. The windshear warning activates:

- The voice aural "WINDSHEAR WINDSHEAR WINDSHEAR"
- **WINDSHEAR** annunciation in the ADI.

Windshear caution alerts are given for increasing head wind (or decreasing tail wind) and severe up drafts. The windshear caution activates:

- **WINDSHEAR** annunciation is displayed in the ADI.

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EXCESSIVE BANK ANGLE CALLOUT

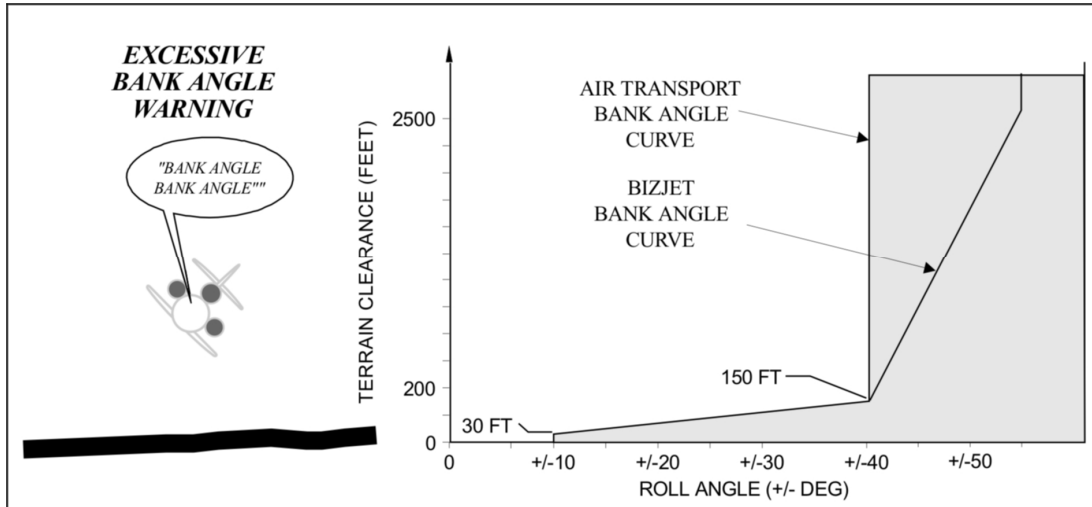


FIGURE 02-34_5-15-10 - EXCESSIVE BANK ANGLE CALL-OUT

A Bank Angle curve violation produces the aural “BANK ANGLE BANK ANGLE”.

TERRAIN CLEARANCE FLOOR

Basic TCF creates an increasing terrain clearance envelope (using Radio Altitude AGL) around the intended airport runway directly related to the distance from the runway.

The RFCF function provides alerts based on height (MSL, not AGL) above the destination runway also directly related to the distance from the runway.

TCF is active whenever valid radion altitude is present. RFCF is active whenever the airplane is within 5 Nm of the runway.

When the airplane penetrates the TCF (or RFCF) alert envelope:

- The voice aural “TOO LOW TERRAIN” is generated
- **GND PROX** annunciation is displayed in the ADI.

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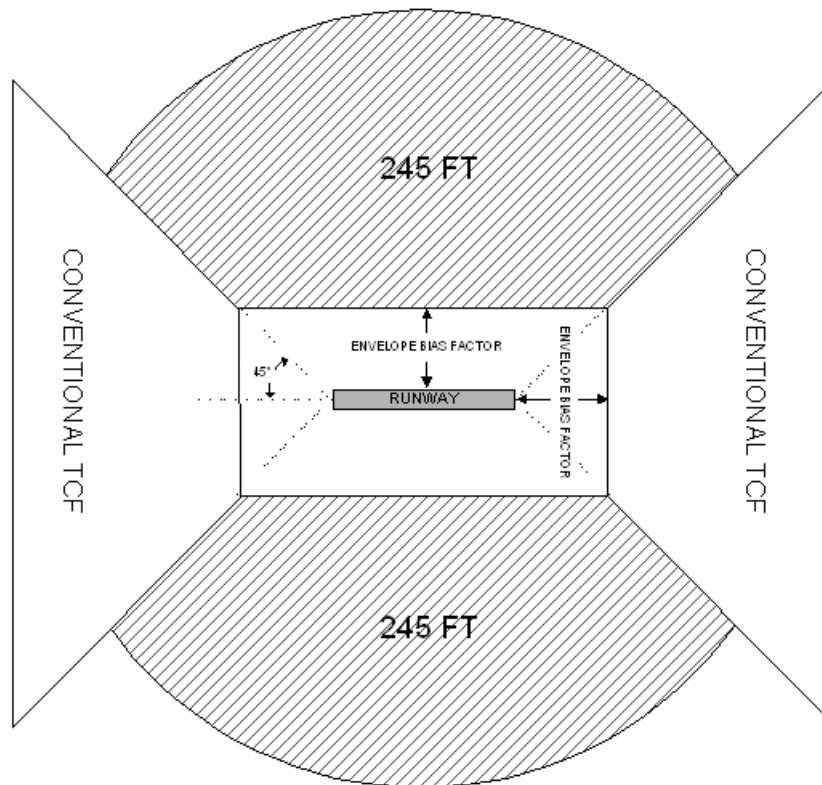
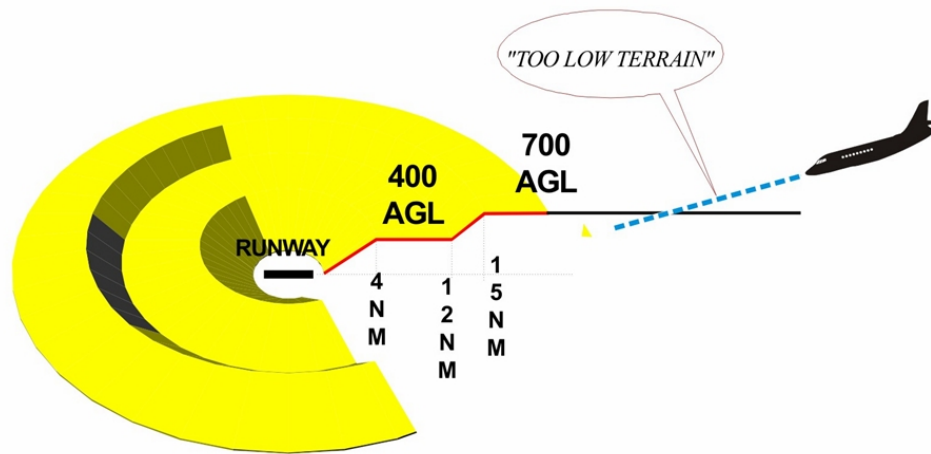
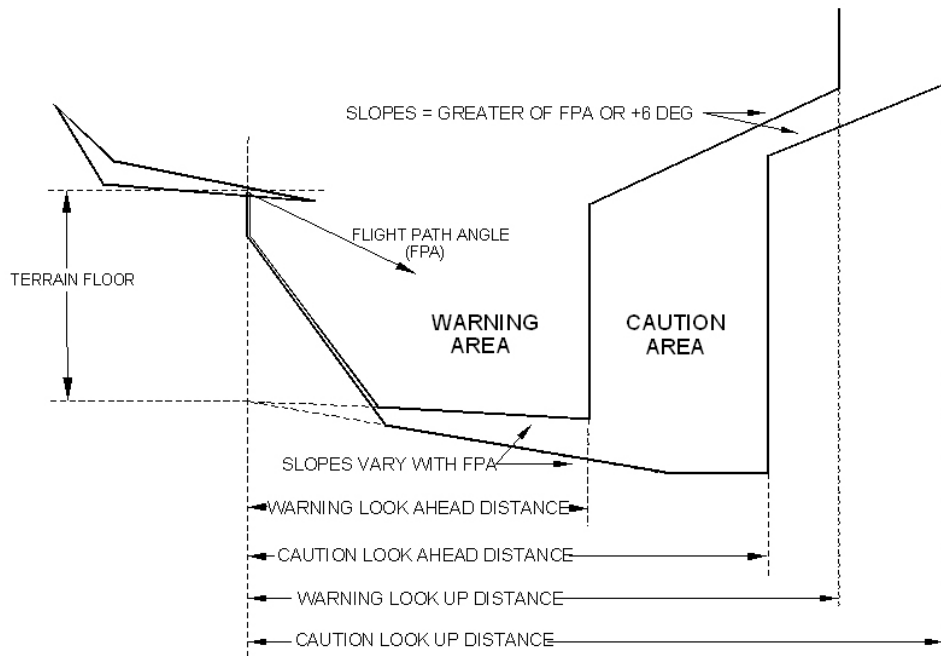


FIGURE 02-34_5-15-11 - TERRAIN CLEARANCE FLOOR

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TERRAIN AND OBSTACLE ALERTS

Two envelopes are computed, one corresponding to a terrain caution alert level and the other to a terrain warning alert level.



LOOK AHEAD DISTANCES VARY WITH GROUND SPEED AND DISTANCE TO RUNWAY
TERRAIN FLOOR VARIES WITH DISTANCE TO RUNWAY

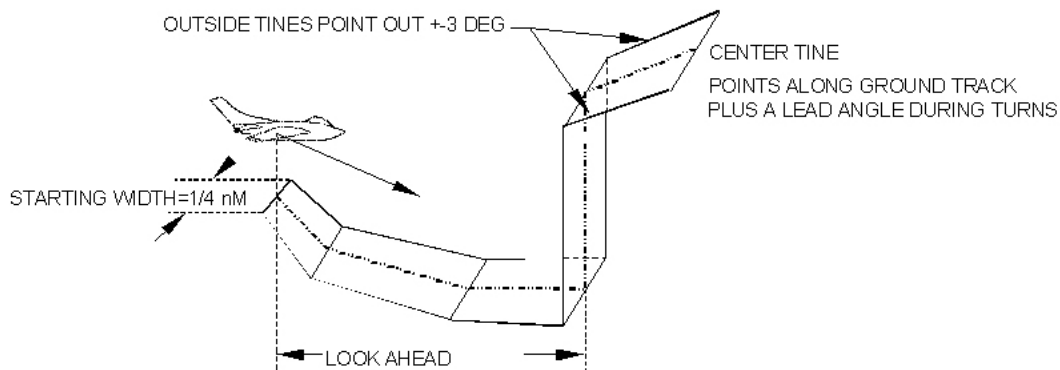


FIGURE 02-34_5-15-12 - TERRAIN DETECTION ENVELOPE – PERSPECTIVE VIEW

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During a terrain caution alert:

- A specific audio alert is generated:
 - o If terrain caution alert : voice aural “CAUTION TERRAIN, CAUTION TERRAIN,”,
 - o If obstacle caution alert : voice aural “CAUTION OBSTACLE, CAUTION OBSTACLE”.
- **GND PROX** annunciation is displayed in the ADI,
- TRAFFIC window is popped-up in the COUPLE SIDE station with terrain layer flashing yellow.

The aural warning is repeated every 10 seconds if still within the terrain caution envelope.

During a terrain warning alert:

- A specific audio alert is generated:
 - o If terrain alert : voice aural “TERRAIN TERRAIN, PULL UP”,
 - o If obstacle alert : voice aural “OBSTACLE OBSTACLE, PULL UP”.
- **PULL UP** annunciation is displayed in the ADI,
- TRAFFIC window is pop-up in the COUPLE SIDE station with terrain layer flashing red.

The phrase “PULL UP” is then repeated continuously while within the warning envelope.

SYSTEM LIMITATION

The performance of the EGPWS terrain protection is linked with the performance of navigation. RNP must be maintained at the good level.

In case of message "UNABLE RNP", the terrain function is not available and an amber **TERR** indication is provided in the lower part of the HSI.

If the terrain function is not available, the basic GPWS function remains active (if all sensors required by this function are available).

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DUAL EGPWM INSTALLATION (OPTION)

The F7X installation will use dual EGPWM as an option for redundancy. In the event that the primary module fails then the secondary module will be available to perform all system functions.

In a dual installation both EGPWM continuously process data but only one of the two modules will become the priority source and used for display and aural alerts.

Under normal power conditions, EGPWM 1 will be in priority since it will have power applied before EGPWM 2.

There is no indication in the display to indicate which one is used.

In case of failure of one EGPWM or one EGPWS functionality the crew is alerted by a corresponding fault message in the STATus synoptic / FAULT tab.

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CONTROLS

Crew has control on the Enhanced Ground Proximity Warning System through:



- The Multifunction Key Board (MKB);
- The SENSORS window,
- The Flight Management Window,
- The TEST synoptic.

MULTIFUNCTION KEY BOARD



FIGURE 02-34_5-20-00 - MULTIFUNCTION KEY BOARD

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CONTROL	FUNCTION	DISPLAY
	Allows to inhibit "GLIDE SLOPE" aural warning (EGPWS Mode 5).	G/S INHIB white text is displayed in the right lower part of the HSI window
		TAWS: G/S CANCEL Advisory CAS message
	Allows to deactivate the enhanced modes Terrain Clearance Floor and Terrain and Obstacles Alerts to avoid unwanted alerts. Conditions to use this function are described in the AFM, Limitations section	TERR INHIB white text is displayed in the right lower part of the HSI window
		TAWS: TERR INHIBIT Advisory CAS message

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FLAPS OVERRIDE

Flaps override soft key is available:

- In the SENSORS window,
- In the Flight Management Window (Arrival Phase Of Flight / Landing Config tab).

When flaps override is selected:

- **FLAPS OVRD** text is displayed in the right lower part of the HSI window,
- **TAWS: FLAP OVRD** is displayed in the ENG-CAS window.

This soft key allows the crew to simulate flaps in landing configuration (no alert) whatever the flaps configuration. This allows flying without "TOO LOW FLAPS" aural alert which appears at 250 ft RA during approach if SF3 configuration is not set.

STEEP APPROACH

Steep approach soft key is available:

- In the SENSORS window
- In the Flight Management Window (Arrival Phase Of Flight / Landing Config tab)

When steep approach is selected:

- **STEEP** white text is displayed, on the left of the roll pointer, on the ADI window.

This soft key allows steep landing without GPWS mode 1 nuisance alert ("SINK RATE").



FIGURE 02-34_5-20-01 - SENSORS WINDOW

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EGPWS TEST

The EGPWS test soft key available through the TEST synoptic, allows testing the EGPWS system.

The test soft key is selectable only on ground. The test sequence is activated by selecting the TEST soft key.

When the EGPWS test is activated, the cockpit visuals are activated and voices are issued to indicate what functions are correctly operating.

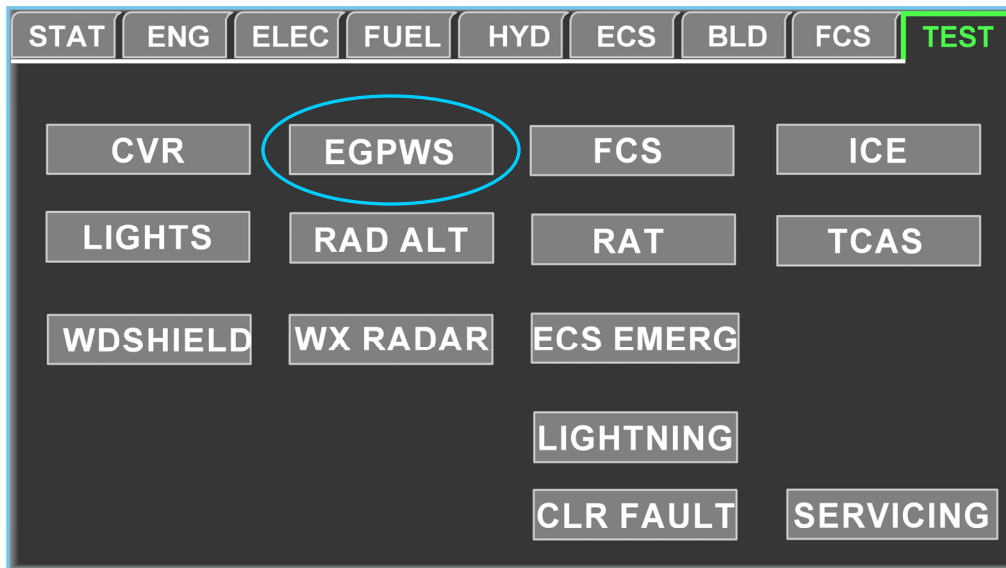


FIGURE 02-34_5-20-02 - EGPWS TEST

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DISPLAYS

TERRAIN DISPLAY

I-NAV

The terrain layer is selectable on the I-NAV through the I-NAV Data menu.



FIGURE 02-34_5-20-03 - I-NAV DATA MENU

I-NAV can display all three types of terrain display:

- Absolute Terrain,
- Terrain Awareness Display (TAD),
- Alerting terrain.

All I-NAV information is displayed based on the same airplane FMS position.

Absolute Terrain and TAD terrain are available on NORTH UP format. Alerting Terrain is not available in this format to avoid confusion about the terrain threat direction.

■ Absolute terrain

Only displayed on I-NAV via the Terrain layer selection. This terrain can be dimmed. Terrain color code is based on Absolute Height above sea level (blue, green, brown).

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■ Terrain Awareness Display (TAD)

Only displayed on I-NAV when Absolute Terrain is displayed. If Wx layer is also selected TAD is inhibited (annunciated by TAD OFF on the I-NAV bottom right). TAD can be dimmed in conjunction with the Absolute Terrain. The color code is based on relative height between the airplane compared to the terrain (High intensity for red, High and Low intensity for yellow, Low and very Low intensity for green). EGPWS geometric Altitude is used to determine the color of terrain (5 levels). The TAD is displayed 20 NM around the airplane FMS (Pilot Flying Side) position.

■ EGPWS Alerting Terrain Display

If there is a terrain alert, the I-NAV is automatically forced in HDG UP format with a 5 NM range. There is no pop-up if the terrain is not displayed. The flashing red or yellow terrain cannot be dimmed.

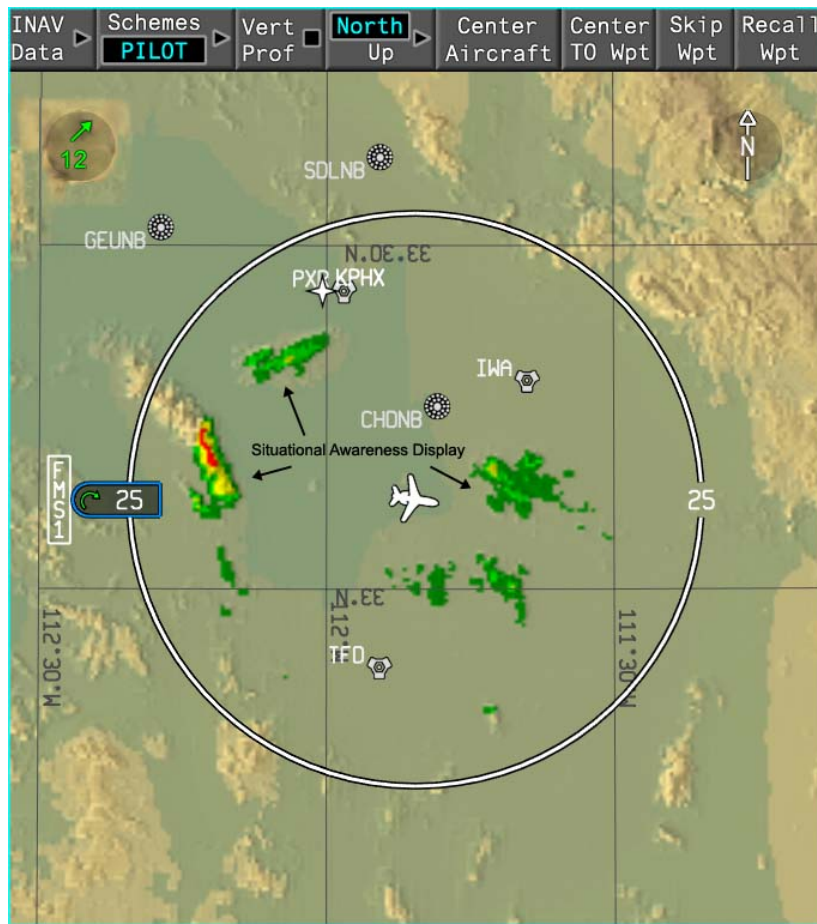


FIGURE 02-34_5-20-04 - TERRAIN AWARENESS DISPLAY

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TRAFFIC window

In case of caution or warning terrain alert, there is a TRAFFIC window pop-up on the PILOT SIDE station. This window only displays EGPWS alerting terrain, flashing red or yellow. The display is HDG UP oriented with a full 5 NM range (not modifiable).

NOTE

In case of EGPWS alert, the TCAS mode is automatically selected in TA only.
After a 1/6 window pop-up on the pilot flying side, there is no automatic return to the previous selection at the end of the alert.

➤ Refer to sub section 02-34_6 for TCAS description.



FIGURE 02-34_5-20-05 - TRAFFIC WINDOW

STATUS DISPLAY

The above selections statuses are displayed in the lower part of the PDU (HSI window):

- **TERR TEST** : test in progress,
- **TERR** : Terrain failure,
- **FLAPS OVRD** : Flaps override is selected,
- **G/S INHIB** : G/S inhibit is selected,
- **TERR INHIB** : Terrain inhibit is selected.

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FIGURE 02-34_5-20-06 - SENSORS STATUS AREA

White CAS message status annunciation allows the crew to have a permanent status information of the associated EGPWS selected mode:

TAWS: FLAP OVRD

TAWS: G/S CANCEL

TAWS: TERR INHIBIT

On the upper part of the PDU (ADI window), **STEEP** is displayed when the steep approach mode is selected.



FIGURE 02-34_5-20-07 - STEEP ANNUNCIATION

VISUAL ALERTING

An EGPWS alerts is displayed in the ADI window:

- Flashing **PULL UP** in case of EGPWS warning,
- Flashing **GND PROX** in case of other EGPWS caution alerts,
- Flashing **WINDSHEAR** in case of windshear warning,
- Flashing **WINDSHEAR** in case of windshear warning.

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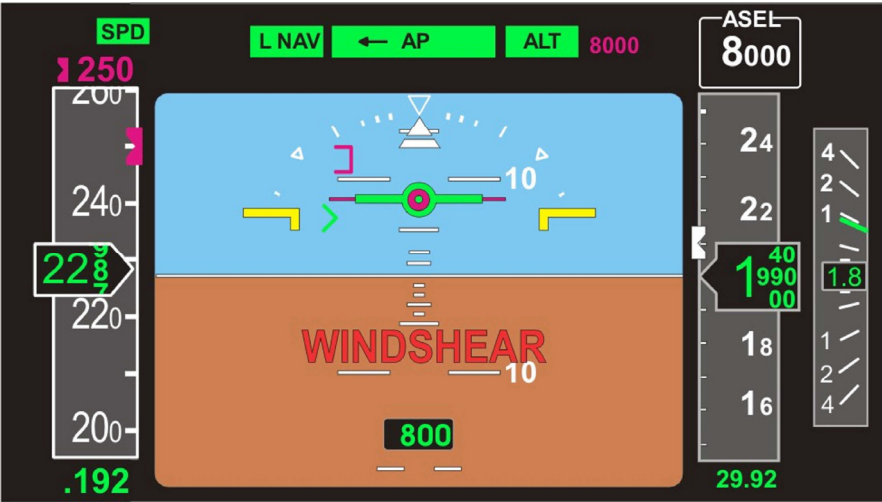


FIGURE 02-34_5-20-08 - WINDSHEAR INDICATION

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AURAL MESSAGES

ALERT / WARNING CONDITION	BASIC AUDIO MENU
MODE 7 WINDSHEAR WARNING	WINDSHEAR WINDSHEAR WINDSHEAR
MODE 1 PULL UP	PULL UP
MODE 2 PULL UP PREFACE	TERRAIN TERRAIN
MODE 2 PULL UP	PULL UP
TERRAIN AWARENESS PREFACE	TERRAIN TERRAIN (FAA) TERRAIN AHEAD (EASA)
TERRAIN AWARENESS WARNING	PULL UP
OBSTACLE AWARENESS PREFACE	OBSTACLE OBSTACLE (FAA) OBSTACLE AHEAD (EASA)
OBSTACLE AWARENESS WARNING	PULL UP
MODE 2 TERRAIN	TERRAIN TERRAIN
MODE 6 MINIMUMS	Selected call out
TERRAIN AWARENESS CAUTION	CAUTION TERRAIN (PAUSE) CAUTION TERRAIN (7 sec pause)
OBSTACLE AWARENESS CAUTION	CAUTION OBSTACLE (PAUSE) CAUTION OBSTACLE (7 sec pause)
MODE 4 TOO LOW TERRAIN	TOO LOW TERRAIN
TCF TOO LOW TERRAIN	TOO LOW TERRAIN
MODE 6 ALTITUDE CALL OUTS	Selected call out
MODE 4 TOO LOW GEAR	TOO LOW GEAR
MODE 4 TOO LOW FLAPS	TOO LOW FLAPS
MODE 1 SINKRATE	SINKRATE (PAUSE) SINKRATE
MODE 3 DON'T SINK	DON'T SINK (PAUSE) DON'T SINK
MODE 5 GLIDE SLOPE	GLIDE SLOPE
MODE 6 APPROACHING DH	Selected call out
MODE 6 BANK ANGLE	BANK ANGLE (PAUSE) BANK ANGLE

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ALERT / WARNING CONDITION	BASIC AUDIO MENU
MODE 7 WINDSHEAR ALERT	(quiet)

MODE 6 CALL OUTS

MODE 6 MINIMUMS	
MINIMUMS	Provides Minimums call out for descent below minimums setting
APPROACHING MINIMUMS	Provides Approaching Minimums call out for descent below minimums setting plus 80 feet

MODE 6 ALTITUDE CALL OUTS	
1,000	Provides One Thousand call out for descent below 1,000 feet
500	Provides Five Hundred call out for descent below 500 feet

MODE 6 APPROACHING DH	
300	Provides Three Hundred call out for descent below 300 feet
200	Provides Two Hundred call out for descent below 200 feet
50*	Provides Fifty call out for descent below 50 feet
40*	Provides Forty call out for descent below 40 feet
30*	Provides Thirty call out for descent below 30 feet
20*	Provides Twenty call out for descent below 20 feet
10*	Provides Ten call out for descent below 10 feet
5	Provides Five call out for descent below 5 feet

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CONTROLS

EGPWS TEST

When the EGPWS test is activated, the cockpit visuals are activated and voices are issued to indicate what functions are correctly operating.

If no faults exist and flaps override, G/S inhibit, Terrain inhibit and Steep approach are not selected the voice result of the test would typically be:

- "GLIDE SLOPE ----PULL UP----WINDSHEAR WINDSHEAR WINDSHEAR----TERRAIN TERRAIN, PULL UP"
- However, if no valid glide slope input was present then the sequence would be : "GLIDE SLOPE INOP----PULL UP----WINDSHEAR WINDSHEAR WINDSHEAR----TERRAIN TERRAIN, PULL UP"

The TRAFFIC window is popped-up with Terrain display.

The normal test sequence will be altered to reflect switch input settings as follows:

- It will say "TERRAIN INHIBITED" instead of "TERRAIN TERRAIN, Pull Up" if the Terrain Inhibit is selected.
- It will say "GPWS INHIBITED" instead of "GLIDE SLOPE----PULL UP" if the G/S Inhibit is selected.
- It will say "GPWS INHIBITED" and "TERRAIN TERRAIN" instead of "GLIDE SLOPE----PULL UP" and "TERRAIN TERRAIN, PULL UP" if the Terrain Inhibit is selected.
- It will only say "SELF TEST INHIBITED, STEEP APPROACH ACTIVATED" if the Steep Approach is selected.

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DISPLAYS

TERRAIN DISPLAY

Situation awareness altitude levels:

LEVEL	COLOR	ALTITUDE RANGE
Level 1	Solid High Unit Intensity Red	Terrain more than 2,000 ft above aircraft altitude
Level 2	High Intensity Yellow	Terrain between 1,000 and 2,000 ft above aircraft altitude
Level 3	Low Intensity Yellow	Terrain that is 500 feet (250 feet with gear down) below to 1,000 ft above aircraft altitude
Level 4	Low Intensity Green	Terrain that is 500 feet (250 feet with gear down) below to 1,000 ft below aircraft altitude
Level 5	Very Low Intensity Green	Terrain that is 1,000 feet below to 2,000 ft below aircraft altitude

STATUS DISPLAY

Status indications have the following priority display order (from higher to lower):

- **TERR TEST**
- **TERR**
- **FLAPS OVRD**
- **G/S INHIB**
- **TERR INHIB**

VISUAL ALERTING

All these annunciations flash at a rate of 1 second on / 0.5 second off.

Annunciations have the following priority display order (from higher to lower):

- **WINDSHEAR**
- **PULL UP**
- **GND PROX**
- **WINDSHEAR**

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SYSTEM MONITORING

EGPWS is monitored with regard to following parameters:

- Integrity of EGPW Module,
- Validity of the terrain data base.
- *Refer to CODDE 2 for a complete list of CAS messages.*

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ACTIVE PROTECTION

The basic system does not provide any automatic protection.

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In a dual installation, if the active module fails the other module is automatically set in the control.

The crew is alerted by a fault message.

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DATABASE LOADING

Upload of terrain database is requested to periodically update: every 6 to 12 months.

The terrain database is provided under the format of green CD-ROM.

The upload of terrain database can be performed:

- Either from the cockpit by inserting the CD-ROM in the Data Management Unit (DMU) drive, and controlling the loading process with the Centralized Maintenance Computer (CMC),
- Or from a laptop connected to the Local Area Network (LAN) as a CMC Remote Terminal (CMCRT), by inserting the CD-ROM.

➤ *Refer to ATA 45 for additional information about the Centralized Maintenance Computer.*

The EGPWS do not require any Ground Operation action.

➤ *Refer to Ground Servicing Manual*

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INTRODUCTION

In the EASy system, Air Traffic Control transponder (ATC) and Traffic and Collision Avoidance System (TCAS) are integrated.

The ATC installed in the F7X is a transponder mode S.

The TCAS system is an onboard advisory system designed to be the last safety net in order to avoid collisions.

The TCAS detects unsafe traffic conflicts with other airplanes and assists the crew member in avoiding intruders inside a protected airspace. This is done by interrogating the surrounding airplane transponders.

If the intruding airplane is also equipped with a TCAS II compatible system, the two systems can communicate their mutual intentions through the Mode S transponders. The coordinated advisories that result allow the two airplanes to execute complementary avoidance maneuvers.

An intruder not equipped with a transponder is invisible to TCAS.

The Traffic alert and Collision Avoidance System does not include any optional equipment.

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FLIGHT DECK OVERVIEW

CONTROLS

Controls of the TCAS and ATC include:

- The MKB (Multifunction Key Boards),
- Soft keys and selections through the RADIOS window, ATC/TCAS tab,
- Soft key in the TEST synoptic to trigger the test of the TCAS,
- The transponder code setting in Permanent Radio Bar of the HSI window and in the RADIOS window.

INDICATIONS

Cockpit indications related to TCAS and ATC are available:

- In the ADI for TCAS guidance in case of Resolution Advisory (RA) and alert messages,
- In the and HSI for ATC/TCAS status,
- In the I-NAV window for TCAS status and layers,
- In the TRAFFIC window,
- In the ENG-CAS window for CAS messages,
- In the STATus synoptic / FAULT tab for fault messages,
- Through aural warning.

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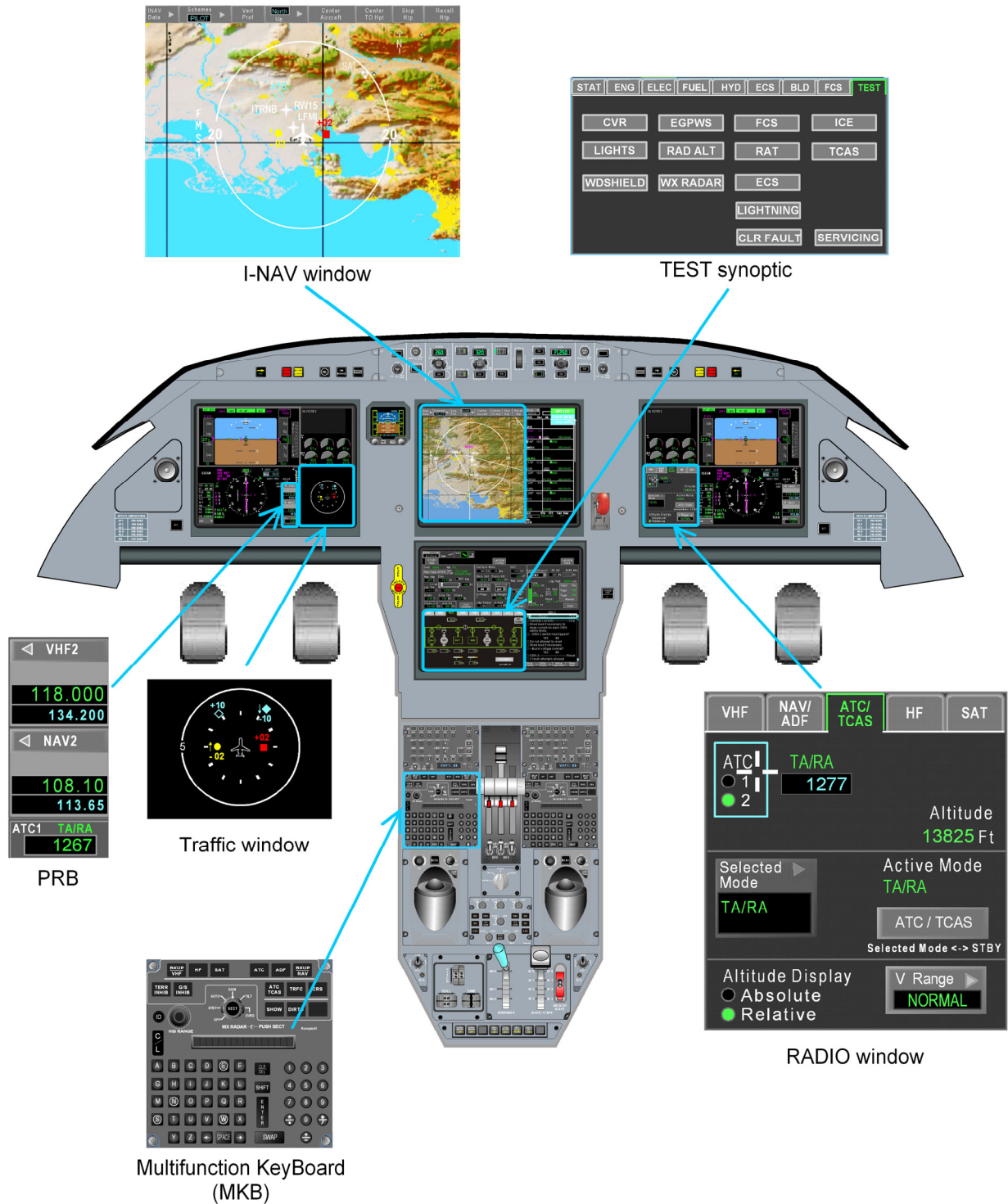


FIGURE 02-34_6-05-00 - FLIGHT DECK OVERVIEW

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GENERAL

The Traffic Collision Avoidance System (TCAS) is composed of:

- A TCAS Computer Unit (CU),
- A top directional TCAS antenna,
- A bottom directional TCAS antenna,
- The Air Traffic Control (ATC) module 1 and 2: transponder Mode S,
- A top ATC antenna,
- A bottom ATC antenna.

The TCAS operates with either of the two onboard Mode S transponders (ATC 1 or ATC 2), one of which operates as a spare. The default selection is ATC 1.

Transponders are housed in a dedicated module located in the two Modular Radio Cabinets.

TCAS provides two types of advisories, corresponding to time based protection zones around the airplane:

- Resolution Advisory (RA): warning area,
- Traffic Advisory (TA): caution area.

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PRINCIPAL DIAGRAM

The TCAS is interfaced with the following equipment:

- Radar Altimeter (RA) 1 and 2,
- Air Data System (ADS): TCAS CU is interfaced via each transponder module to obtain the airplane altitude information,
- Modular Avionics Unit (MAU):
 - o MAU sends data :
 - To indicate the airplane cannot climb at the rate of 1,500 ft/min ("Climb inhibit" discrete input),
 - To indicate airplane cannot climb at the rate of 2,500 ft/min ("Increased climb inhibit" discrete input) ,
 - To indicate landing gear is extended ("Landing gear" discrete input),
 - To force the TCAS to enter in Traffic Advisory only mode.
 - o MAU receives from the TCAS data to:
 - To be record in the DFDR any Resolution Advisory,
 - To displayed ATC/TCAS status and traffic and resolution advisories,
 - To inhibit all the TCAS aural alerts.
- Audio Panel: to generate TCAS aural alerts.

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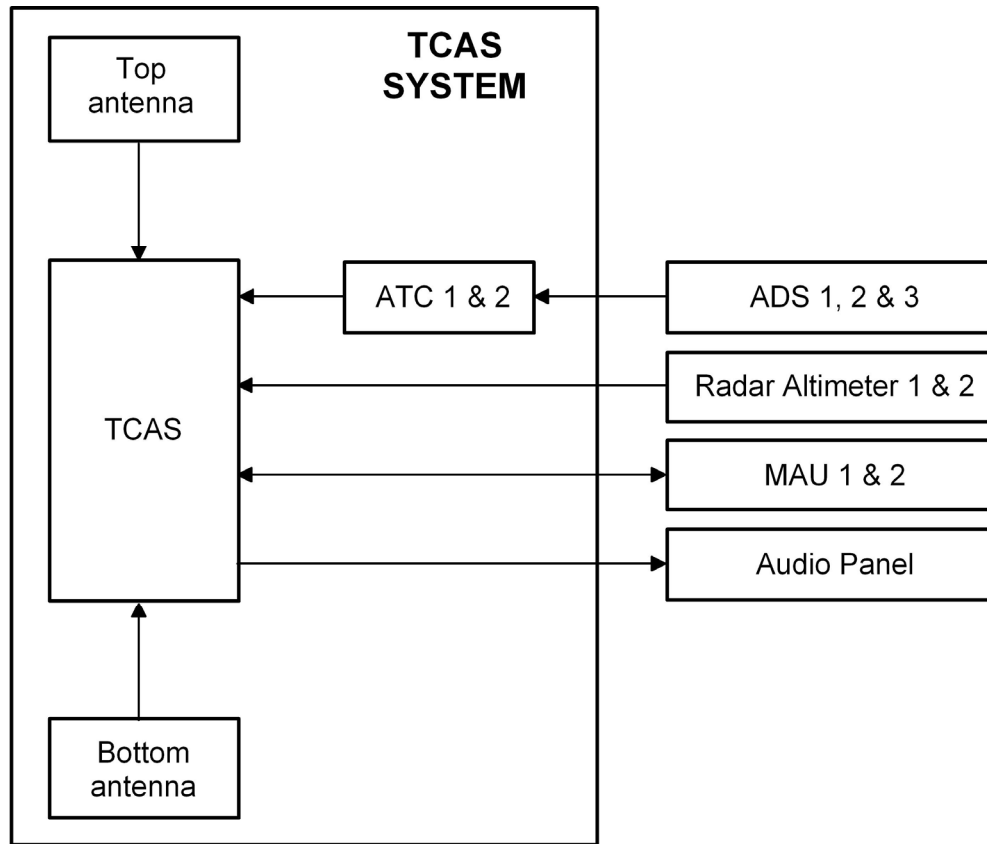


FIGURE 02-34_6-10-00 - PRINCIPAL DIAGRAM

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EQUIPMENT LOCATION

The TCAS is installed under the floor, close to the passenger door between frames 11 and 12.

The Air Traffic Control 1 (ATC 1) module is located in the Modular Radio Cabinet 1.

The Air Traffic Control 2 (ATC 2) module is located in the Modular Radio Cabinet 2.

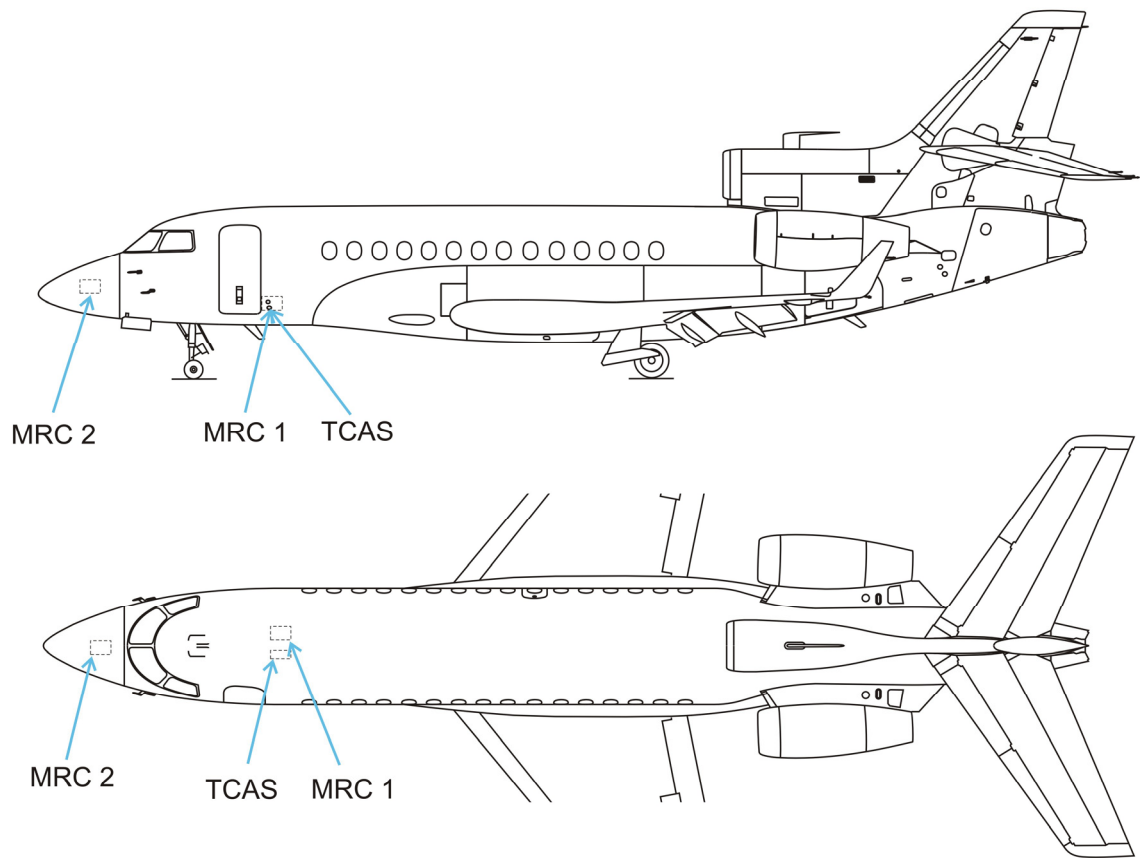


FIGURE 02-34_6-15-00 - LOCATION EQUIPMENT

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ANTENNAS

Two TCAS directional antennas are located:

- One at the top of the fuselage,
- One at the bottom of the fuselage.

Two ATC 1&2 antennas are located:

- One at the top of the fuselage,
- One at the bottom of the fuselage.

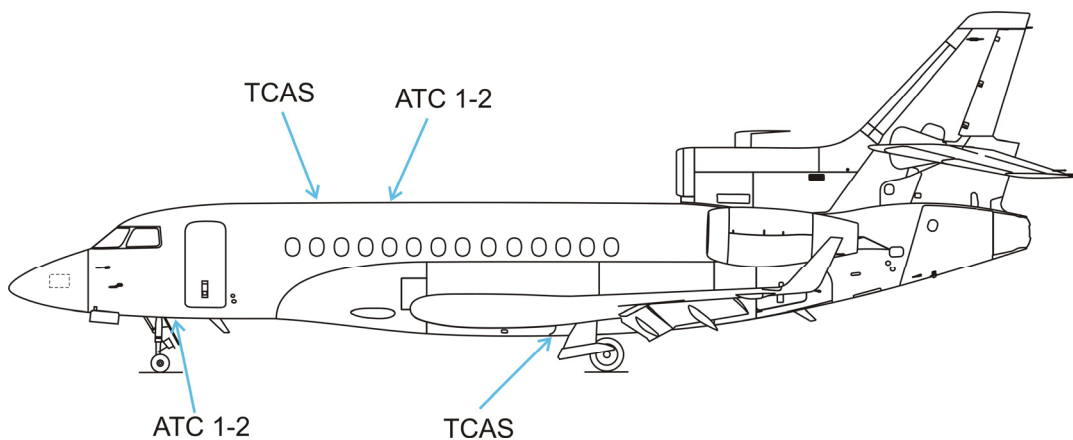


FIGURE 02-34_6-15-01 - TCAS AND ATC ANTENNAS

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the TCAS.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC),
- Circuit Breakers (CB).

➤ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
TCAS CU	LH Main	LH MASTER	CB
ATC module 1	LH Essential	LH INIT	CB
ATC module 2	RH Main	RH MASTER	CB

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ATC / TCAS MODES

ATC

Four different modes are available for ATC:

- Standby mode: ATC is off,
- Mode A: ATC is on and not transmits the altitude airplane. This mode is activated when ALT OFF is selected by the crew members,
- Mode C: ATC is on and transmits the airplane altitude (standard pressure altitude from ADS selected on COUPLE SIDE station). This mode is activated when ALT ON is selected by the crew members,
- Mode S: default mode when ATC is not in standby or ALT OFF or ALT ON mode.

When ALT OFF mode or ALT ON mode is activated the TCAS is in standby mode.

TCAS

When on the TCAS continually plots local air traffic on the display and, in the event of a conflicting flight path, guides the pilot towards the correct avoidance maneuver.

If the intruding airplane is also equipped with a TCAS II compatible system, the two systems can communicate their mutual intentions through the Mode S transponders. The coordinated advisories that result allow the two airplanes to execute complementary avoidance maneuvers.

Vertical guidance to avoid midair collisions is accomplished by interrogating the Air Traffic Control Radar Beacon System (ATCRBS) and Mode S transponders of potential threat aircraft, tracking their responses and providing advisories to the flight crew to assure vertical separation.

Two levels of advisories correspond to time-based protection zones around the airplane are provided:

- Resolution Advisories (RA), warning area:
 - o Indicate what vertical maneuver to be performed or avoided in order to assure safe separation.
- Traffic Advisories (TA), caution area:
 - o Indicate the range, bearing and relative altitude of the intruder to aid in visual acquisition of the intruder aircraft.

Four different modes are available for the ATC / TCAS:

- Standby mode: TCAS are off,
- TA / RA mode: TCAS generates both RA and TA,
- TA Only mode: TCAS generates only TA, RA is inhibited (display and aural alerts):
 - o Manually when TA only mode is selected,
 - o Automatically:
 - below 900 ft during approach
 - below 1,100 ft during take off
- Test mode: TCAS test is in progress.

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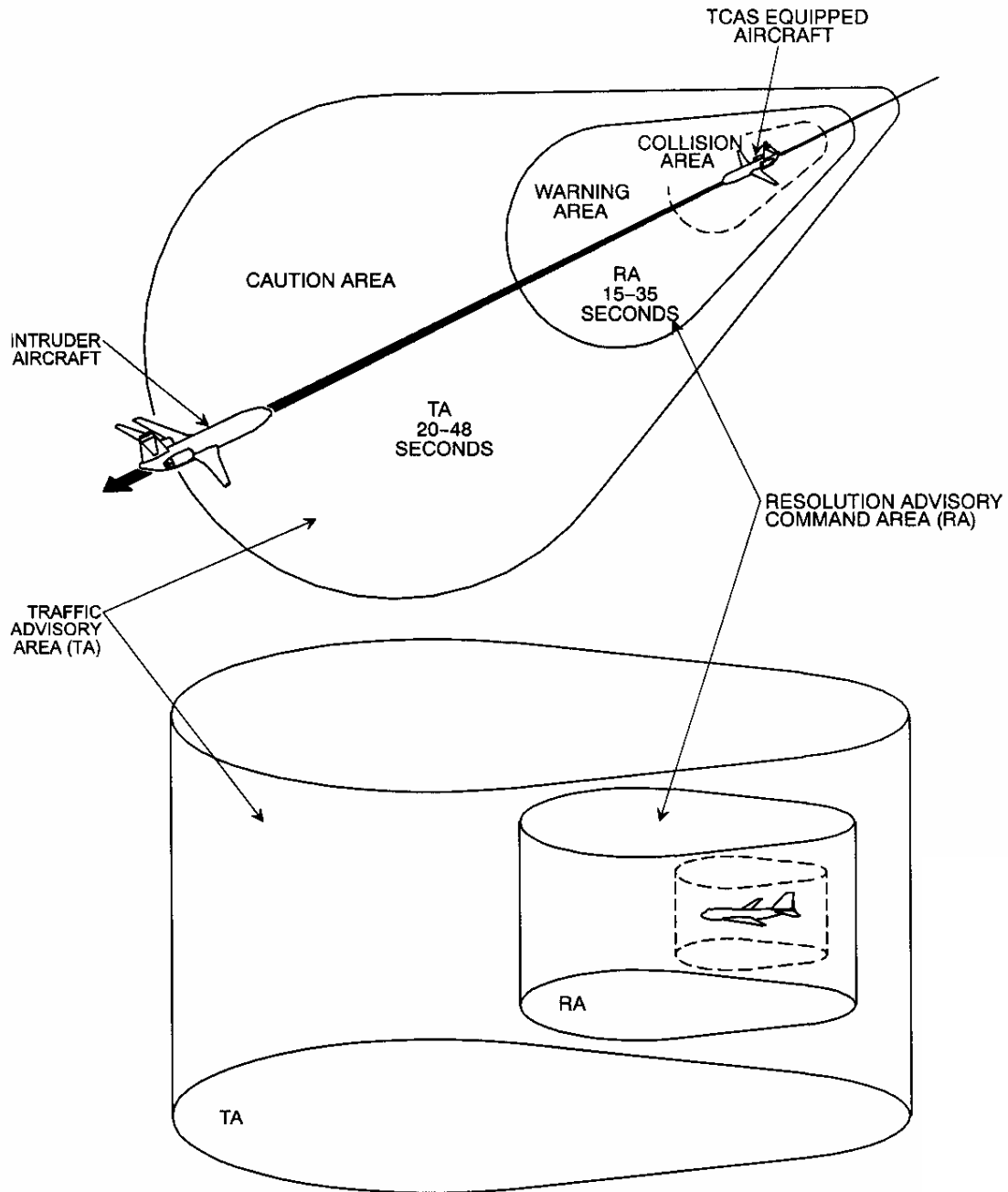


FIGURE 02-34_6-15-02 - TA/RA AIRSPACE COVERAGE

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CONTROLS

Crew has control on the Traffic Collision Avoidance System through:

- The Multifunction Key Board (MKB),
- The RADIOS window, ATC/TCAS tab,
- The HSI window for ATC code setting,
- The TEST synoptic.

MULTIFUNCTION KEY BOARD

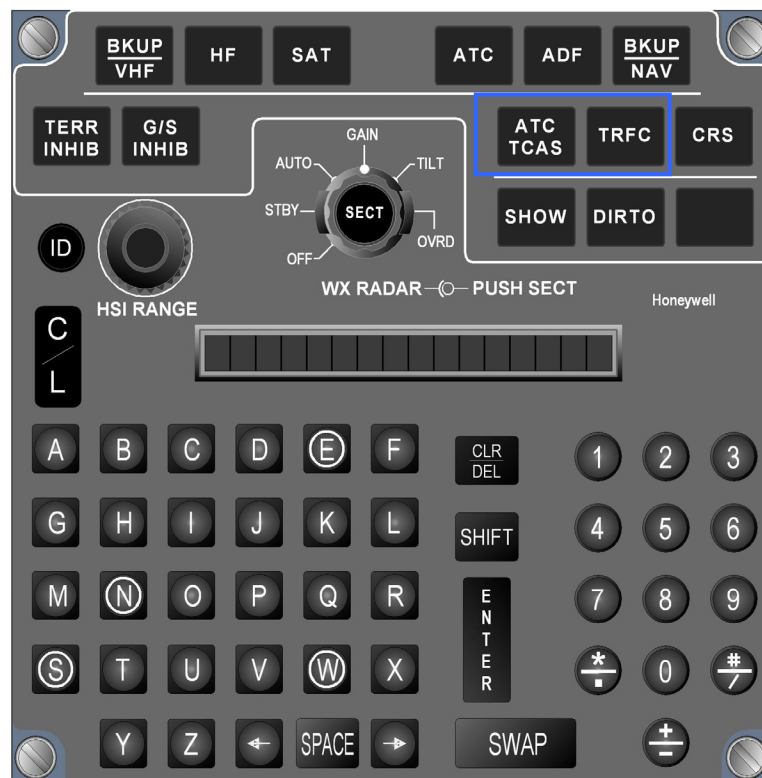

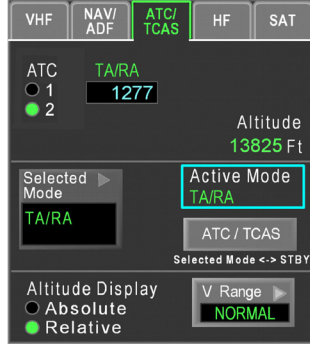

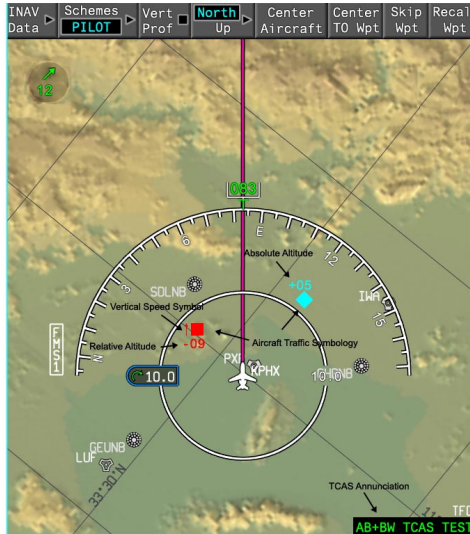

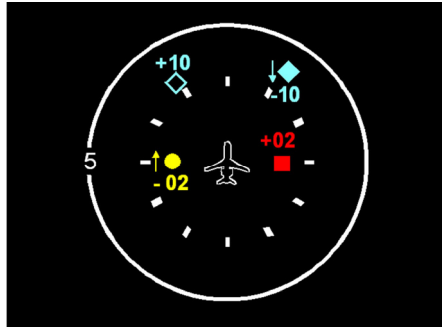


FIGURE 02-34_6-20-00 - MULTIFUNCTION KEYBOARD

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CONTROL	FUNCTION	DISPLAY
	Allows to switch between the selected mode and the stand-by mode	 <p>Active mode is displayed in the RADIOS window, ATC/TCAS tab</p>
		 <p>TCAS active mode is displayed in the lower right corner of the HSI</p>
		 <p>TCAS active mode is displayed in lower right corner of the I-NAV window</p>

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CONTROL	FUNCTION	DISPLAY
	Allows to display the TRAFFIC window in the 1/6 lower of the PDU	

RADIOS WINDOW

The following controls are available through the RADIOS Window, ATC/TCAS tab:

- ATC module selection and code setting,
- ATC/TCAS mode selection,
- Activation / deactivation of the selected mode,
- Altitude display,
- Vertical range selection.

ATC module selection and code setting

The default ATC selection is 1. The crew member can select ATC 1 or ATC 2.

The code setting of the ATC is done through the ATC field in the RADIOS window.

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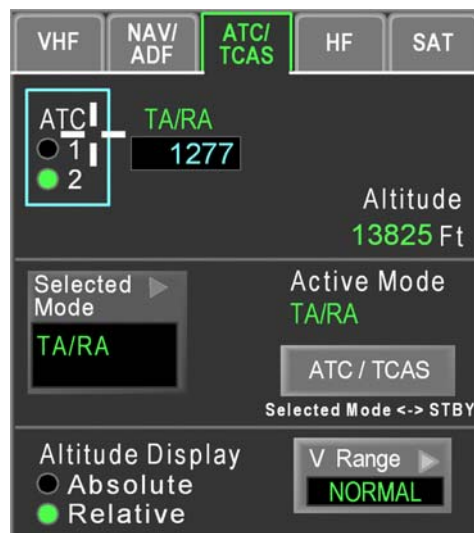


FIGURE 02-34_6-20-01 – ATC MODULE SELECTION ON RADIOS WINDOW

NOTE

The code setting of the ATC is also possible through the ATC field in the Permanent Radio Bar (PRB) of the HSI window

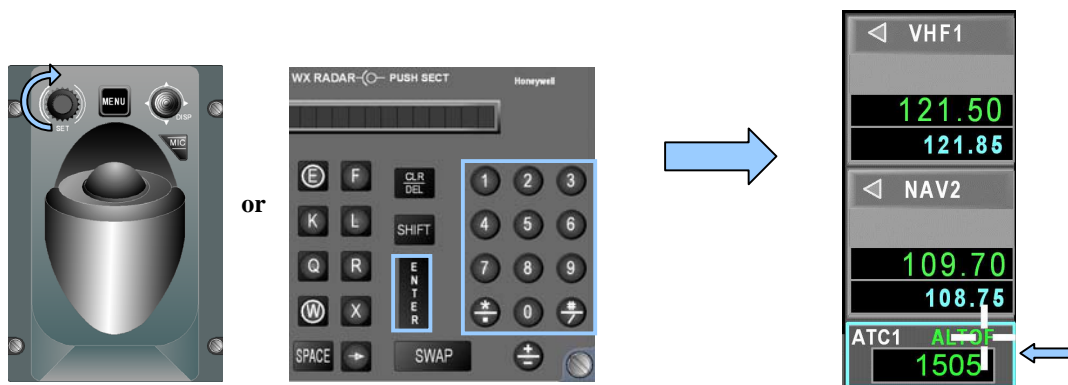


FIGURE 02-34_6-20-02 - SETTING THE ATC CODE ON THE PRB

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ATC / TCAS mode selection

Four different modes selection are available:

- TA/RA: TCAS generates both TA and RA,
- TA Only: only TA are generated, RA are inhibited (display and aural alerts),
- Alt Off: allows the ATC to switch off the altitude transmission (mode A), the TCAS is in standby mode (TCAS OFF is displayed in the HSI),
- Alt On: allows the ATC to transmit the airplane altitude (mode C), the TCAS is in standby mode (TCAS OFF is displayed in the HSI).

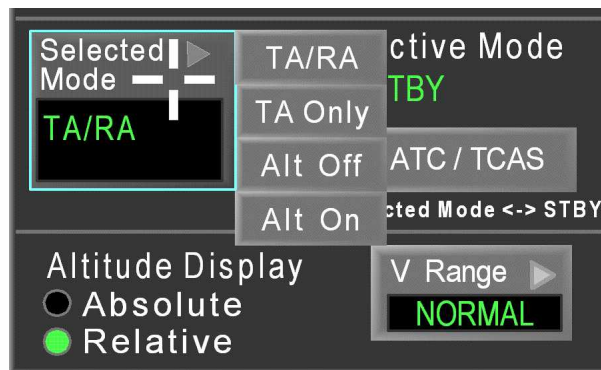


FIGURE 02-34_6-20-03 - SELECTED MODE PULL DOWN MENU

Activation / deactivation selected mode

The "ATC / TCAS" soft key allows to switch between the selected mode and the stand-by mode.

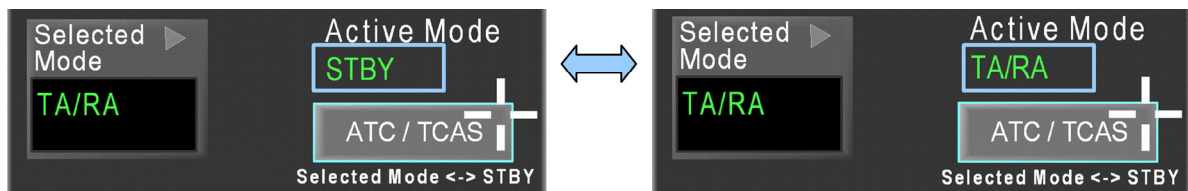


FIGURE 02-34_6-20-04 - ACTIVATING / DEACTIVATING SELECTED MODE

TCAS active mode is displayed in the lower right corner of the HSI and in the lower right corner of the I-NAV window.

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Altitude display

The crew can select how the TCAS plots are displayed in the TRAFFIC window and in I-NAV window:

- Absolute altitude:
 - o Corresponds to the airplane altitude (The absolute altitude depends of the baro setting selected by the pilot),
 - o The Absolute mode is temporary and reverts to Relative mode after 10 seconds.
- Relative altitude:
 - o Indicates vertical separation between airplane and intruders:
 - o For example: + 10 means the intruder is 1,000 ft above, - 05 means the intruder is 500 ft below.

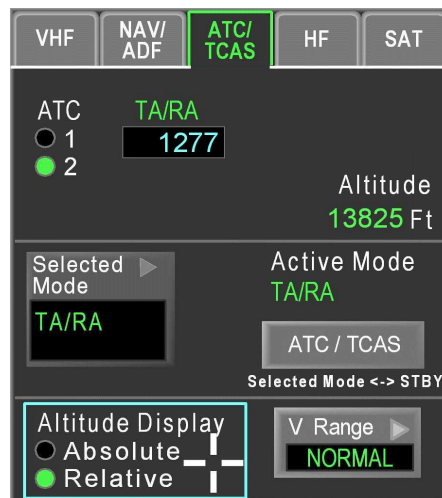


FIGURE 02-34_6-20-05 - RELATIVE ALTITUDE SELECTION

Vertical range selection

The pilot can choose the vertical range of the TCAS through four ranges:

- The **Normal** range shows the intruders that are flying within 2,700 ft above and below the airplane (default selection),
- The Above / Below (**A/B**) range shows all the traffic in a unrestricted vertical range (7000 ft above and below the airplane),
- The **Below** range gives a higher display range below the airplane of 7,000 ft and 2,700 ft above,
- The **Above** range gives a higher display range above the airplane of 7,000 ft and 2,700 ft below.

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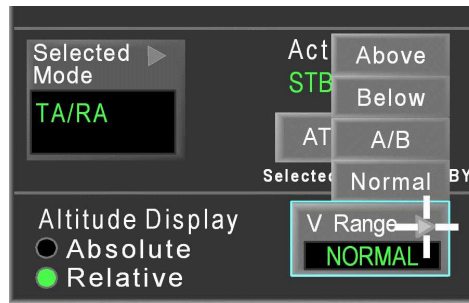


FIGURE 02-34_6-20-06 - VERTICAL RANGE SETTING

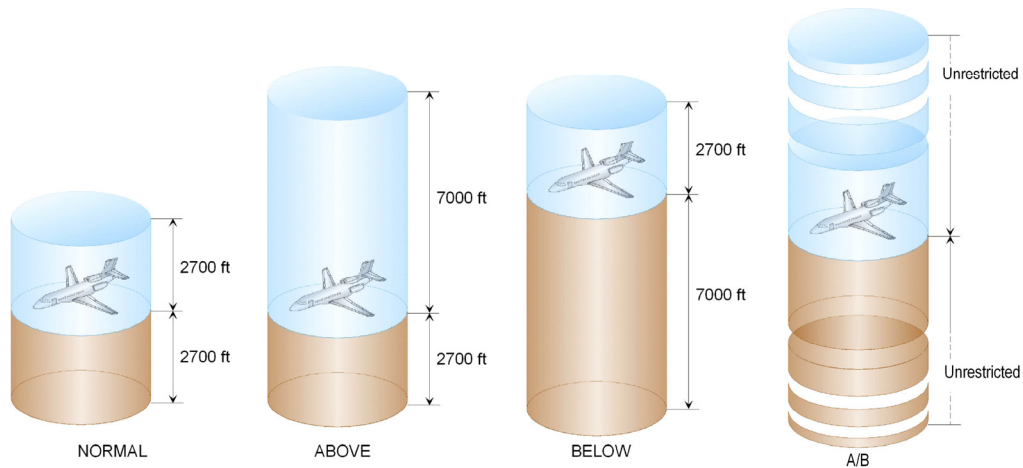


FIGURE 02-34_6-20-07 - TCAS VERTICAL RANGE DISPLAY

TCAS TEST

The test mode is available in all TCAS modes and can be initiated at any time, on the ground or in flight.

Test is launched by depressing the TCAS soft key on the TEST window. During test:

- Aural voice "TCAS TEST" is heard,
- TRAFFIC window is automatically popped up on the COUPLE SIDE PDU,
- Four TCAS plots are displayed on TRAFFIC window and in the I-NAV window:
 - o RA symbol: at 3 o'clock, 2 NM, relative altitude + 200 ft above,
 - o TA symbol : at 9 o'clock, 2 NM, relative altitude - 200 ft below, climbing,
 - o Proximate traffic symbol: at 3.6 NM, altitude relative +1,000 ft above,
 - o Other traffic symbol : at 3.6 NM, altitude relative +1,000 ft above.
- RA guidance is displayed in the ADI (Attitude display and Vertical Speed), (1)
- **TCAS TEST** is displayed in the bottom of the HSI window.

NOTA:

When the test is launched in flight, the RA guidance of test is not displayed in the ADI.

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After eight seconds and if test is successful, an aural voice “TCAS TEST PASS” is announced.

If the test fails, an aural voice “TCAS TEST FAIL” is announced, and **AVC: TCAS FAIL** message is displayed.



FIGURE 02-34_6-20-08 - TCAS SUCCESSFUL TEST

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INDICATIONS

ATC / TCAS indications have specific symbology and are displayed as follow:

- TCAS layer symbology:
 - o In the TRAFFIC window,
 - o In the I-NAV window.
- ATC / TCAS status:
 - o In the HSI window,
 - o In the I-NAV window,
 - o In PRB of the HSI window,
- Resolution Advisory guidance on ADI (Attitude display and Vertical Speed),
- TCAS aural alerts.

TCAS LAYER SYMBOLOGY

The TCAS plots symbology consists of 4 different shapes, which indicate the threat level of each intruder.

INTRUDER TYPE	SYMBOL
Other Traffic	
Proximate Traffic	
Traffic Advisory	
Resolution Advisory	

Each TCAS plot has an associated altitude display which can be either absolute or relative following the selection performed through the RADIOS window and a vertical speed symbol:

- Altitude is displayed on a 3-character field representing hundred of feet (i.e. +20, -20) and in the same color as the plot symbol:
 - o Above the plot symbol for relative altitudes greater than or equal to zero,
 - o Below the plot symbol for relative altitudes less than zero.
- The vertical speed symbol consists in an arrow pointing in the direction of the intruder vertical speed.

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TCAS layer in the TRAFFIC window

The TRAFFIC window is accessed through:

- 1/6 lower window menu of each PDU,
- The TRFC pushbutton of each MKB.

This window is automatically popped up on the COUPLE SIDE station if a TCAS RA or TA becomes active.

NOTE

After a 1/6 window pop-up on the COUPLE SIDE station, there is no automatic return to the previous selection at the end of the alert.

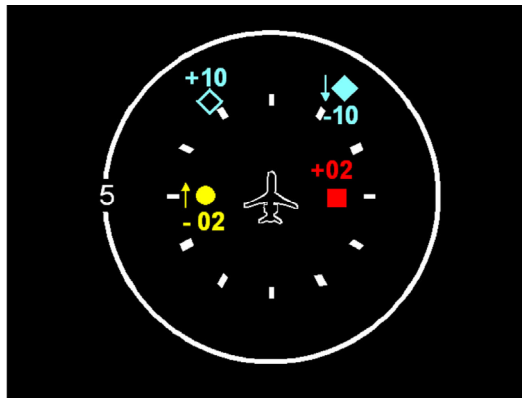


FIGURE 02-34_6-20-09 - TRAFFIC WINDOW

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TCAS layer in the I-NAV window

The TCAS layer is selectable on the I-NAV through the I-NAV Data menu.



FIGURE 02-34_6-20-10 - I-NAV DATA MENU

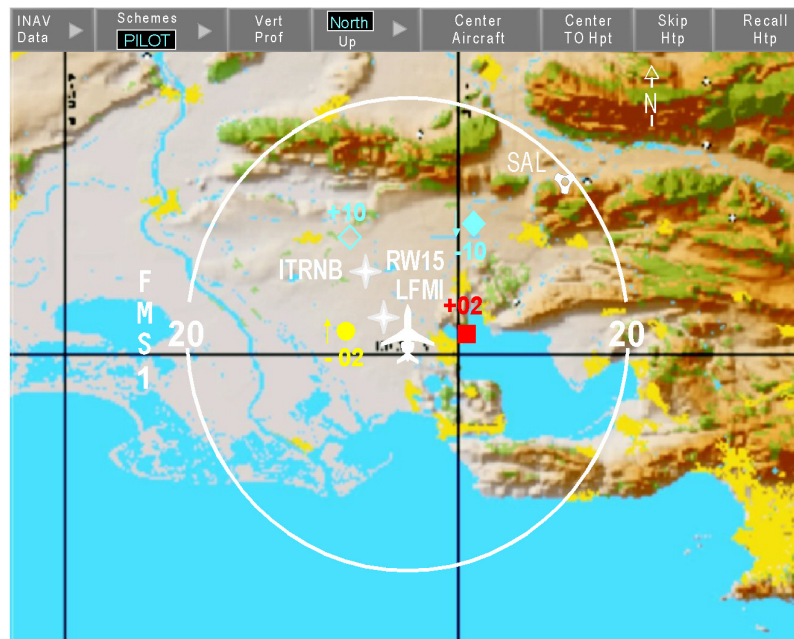


FIGURE 02-34_6-20-11 - TCAS LAYER IN THE I-NAV WINDOW

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ATC / TCAS STATUS DISPLAY

TCAS

The TCAS mode status is displayed in the lower right corner of the HSI window and in the lower right corner of the I-NAV window.

TCAS mode status:

- **TCAS OFF** : TCAS is in standby mode,
- **TCAS** : TCAS is in TA/RA mode ,
- **TA ONLY** : TCAS is in TA Only mode without any intruder,
- **TA ONLY** : TCAS is in TA Only mode with an intruder,
- **RA FAIL** : Resolution Advisory failure in TA/RA mode,
- **TCAS TEST** : TCAS is in test mode,
- **TCAS** : TCAS is failed.

NOTE

RA FAIL is related to TCAS Resolution Advisory. It does not mean Radio Altimeter failure.

The TCAS vertical range status is displayed in the lower part of the HSI window and in the lower right corner of the I-NAV window.

- **AB+BW** : unrestricted area,
- **ABV** : above area ,
- **BW** : below area.



FIGURE 02-34_6-20-12 – TCAS STATUS DISPLAY IN THE HSI WINDOW

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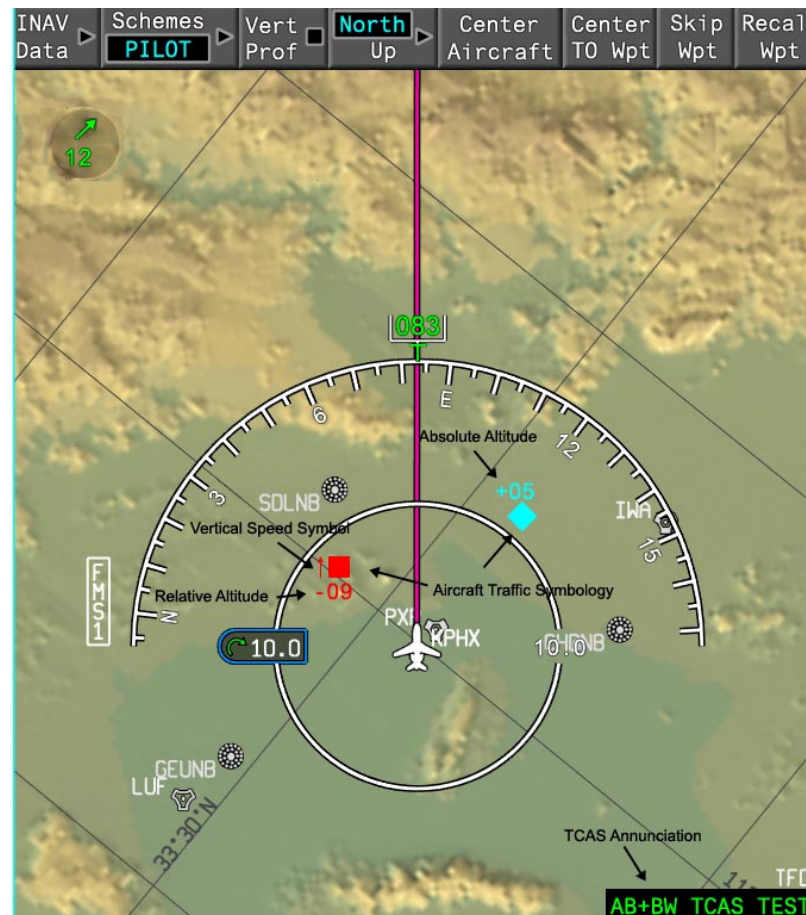


FIGURE 02-34_6-20-13 – TCAS STATUS DISPLAY IN THE I-NAV WINDOW

ATC

The selected transponder module number, code and mode are displayed in Permanent Radio Bar (PRB):

- STBY: ATC is in standby mode,
- ALOF: ATC is in mode A (ALT OFF selected in the SENSORS window), airplane altitude is not transmitted,
- ALON: ATC is in mode C (ALT ON selected in the SENSORS window), airplane altitude is transmitted.

In addition, the following TCAS modes are also displayed in the PRB:

- TA/RA: TCAS in TA/RA mode,
- TA: TCAS in TA Only mode.

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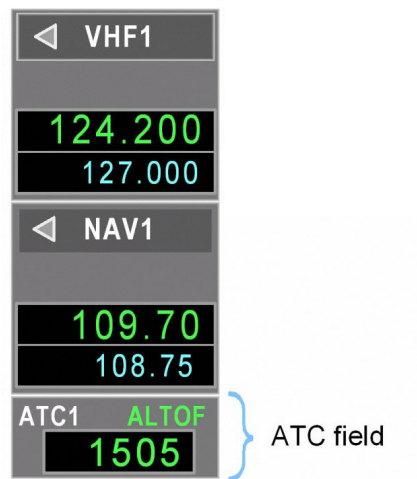


FIGURE 02-34_6-20-14 – PERMANENT RADIO BAR IN THE HSI WINDOW

RESOLUTION ADVISORY GUIDANCE

When a Resolution Advisory is detected:

- The TRAFFIC window is automatically displayed on COUPLE SIDE station,
- Guidance is displayed on both ADI (Attitude display and Vertical Speed tape).

The Resolution Advisory (RA) symbol is separate in two parts:

- A preventive area, the Flight Path Vector symbol must be maintained out of this area:
 - o One or two red fixed size trapezoidal shaped in the ADI sphere,
 - o A red bar on the vertical speed tape.
- A corrective area to avoid the collision. The he Flight Path Vector symbol must be in this area until end of the RA:
- A dynamic green “fly to” zone located in the ADI sphere,
- Green red bar on the vertical speed tape.

The avoidance zones indicates path targets that be avoided if the advisory is a preventive RA or a corrective RA.

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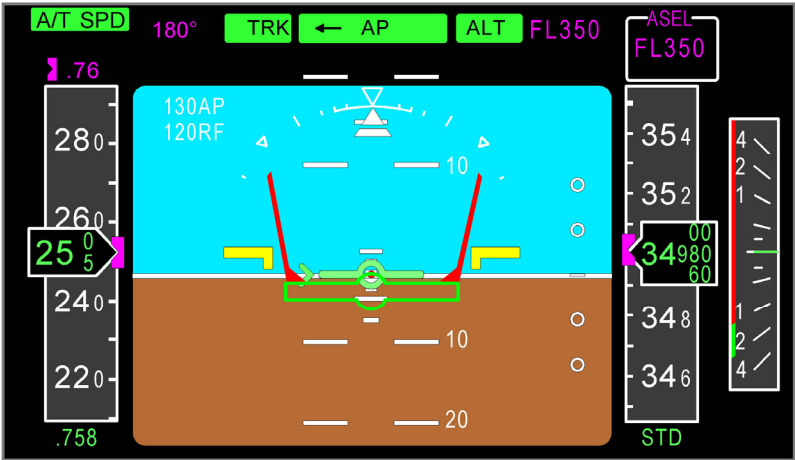


FIGURE 02-34_6-20-15 - RA DESCENT

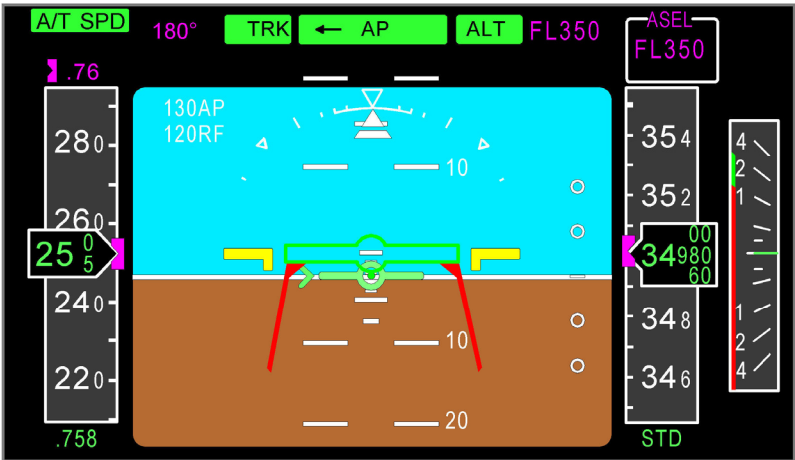


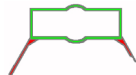

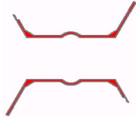
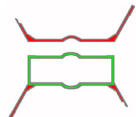
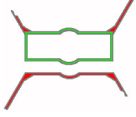
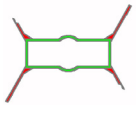


FIGURE 02-34_6-20-16 - RA CLIMB

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The following table provides the various combinations of the up and down sense resolution advisories.

RA DISPLAY	DESCRIPTION
	Up- Sense Preventive
	Down- Sense Preventive
	Up- Sense Corrective
	Down- Sense Corrective
	Dual-Negative, Preventive
	Dual-Negative, Preventive Climb-Corrective, Descend-
	Dual-Negative, Preventive Descend-Corrective, Climb-
	Special Condition Advisory

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TCAS AURAL ALERTS

The following is list of aural alerts generated from the TCAS system:

DESCRIPTION	LEVEL	VOICE MESSAGE
Follows a climb advisory when TCAS has determined that a reversal of vertical speed is necessary to provide adequate separation.	TCAS RA Warning	DESCEND, DESCEND, NOW, DESCEND, DESCEND NOW
Follows a descend advisory when TCAS has determined that a reversal of vertical speed is necessary to provide adequate separation.	TCAS RA Warning	CLIMB, CLIMB, NOW, CLIMB, CLIMB, NOW
Indicates that the pilot must immediately increase the descent rate to that shown by the green zone on the vertical speed tape.	TCAS RA Warning	INCREASE DESCENT, INCREASE DESCENT
Indicates that the pilot must immediately increase the climb rate to that shown by the green zone on the vertical speed tape.	TCAS RA Warning	INCREASE CLIMB, INCREASE CLIMB
Indicates that the pilot must immediately begin to descend at the rate indicated in the ADI window.	TCAS RA Warning	DESCEND, DESCEND
Indicates that the pilot must start a descent at the rate shown in the AD window.	TCAS RA Warning	DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND
Indicates that the pilot must start a climb at the rate shown in the ADI window.	TCAS RA Warning	CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB
Indicates that the pilot must immediately begin to climb at the rate indicated in the ADI window.	TCAS RA Warning	CLIMB, CLIMB, CLIMB
The target vertical speed for this green zone is a reduction of climb or descent.	TCAS RA Warning	ADJUST VERTICAL SPEED, ADJUST
Safe separation is based upon maintaining the current vertical speed which is depicted by the green zone on the vertical speed tape.	TCAS RA Warning	MAINTAIN VERTICAL SPEED, MAINTAIN

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DESCRIPTION	LEVEL	VOICE MESSAGE
Maintain vertical speed while crossing the intruder's flight path.	TCAS RA Warning	MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN
Indicates that certain changes in vertical speed may not be safe. The pilot is to monitor the vertical speed of the aircraft, keeping the vertical speed pointer out of the red area on the vertical speed tape.	TCAS RA Warning	MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED
Confirms the encounter has ended and separation is increasing. A return to the original ATC clearance profile is expected.	TCAS RA Warning	CLEAR OF CONFLICT
TCAS predicts an intruder will enter the collision area within 20 to 48 seconds	TCAS TA Caution	TRAFFIC, TRAFFIC

The TCAS audio level is preset and is not adjustable by the crew.

➤ Refer to section 31_3 for more information on the aural warning function.

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No supplementary information to be provided on Controls and Indications at present time.

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MONITORING OF THE SYSTEM

The TCAS fail annunciation (status in HSI window, I-NAV windows and amber CAS message) is displayed when the following equipment fails:

- TCAS component unit,
- Transponder in use,
- Top TCAS antenna,
- Bottom TCAS antenna.
- ATC 1 and ATC 2 transponder.*

If only the transponder selected fails:

- When the transponder ATC 1 in use fails, the CAS message "COM: XPDR 1 FAIL" is displayed. The TCAS switches to standby, TCAS OFF is displayed (status in HSI, I-NAV window).
- When the transponder ATC 2 in use fails, the CAS message "COM: XPDR 2 FAIL" is displayed. The TCAS switches to standby, TCAS OFF is displayed (status in HSI, I-NAV window).

If no altitude information is provided, for example due to ADS failure, the TCAS switches to standby, TCAS OFF is displayed.

➤ *Refer to CODDE 2 for an exhaustive description of CAS messages.*

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ACTIVE PROTECTIONS

The ATC / TCAS system does not provide any automatic protection.

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No supplementary information to be provided on System Protections at present time.

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The ATC / TCAS system does not require any Ground Operation action.

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INTRODUCTION

The Air Data information is displayed on the LH and RH Primary Display Unit (PDU), the Secondary Flight Display (SFD) and Head Up Display (HUD) if installed:

- Altitudes,
- Airspeeds,
- Mach number,
- Airspeed limits (VMO/MMO and Low Speed Cues),
- Temperatures,
- Angle Of Attack (AOA) path limit.

Air Data information are also provided to the Primary Flight Control System (PFCS) and other airplane systems (Engines, Pressurization, Fuel, AFCS....).

The Air Data information is provided by:

- Four "SmartProbes", so called because they incorporate not only the sensors but also the Air Data Computer,
- Two Total Air Temperature (TAT) probes mounted on the forward fuselage,
- The three IRS for the Vertical Speed (VS).

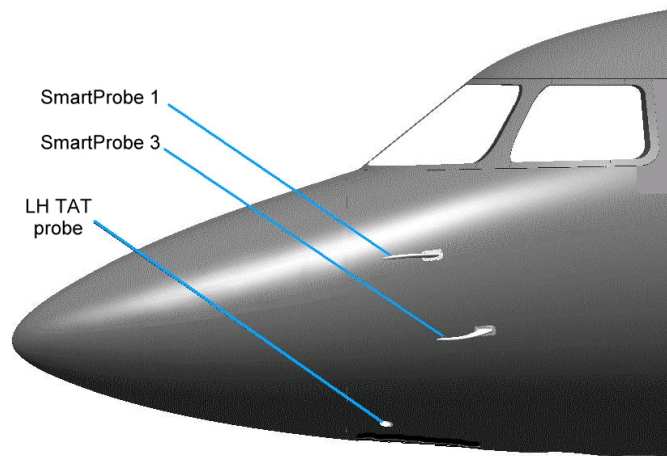


FIGURE 02-34_7-05-00 - LH PROBES

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FLIGHT DECK OVERVIEW

CONTROLS

Controls of the Air Data System include:

- Probe Heat control on the Overhead Panel (refer to ATA 30),
- Two barometric correction setting knobs (one for each pilot) located on the Guidance Panel,
- One barometric correction setting knob on the SFD,
- An "ADS" pushbutton on the Reversion Panel (RP),
- The "IRS" pushbutton on the Reversion Panel for reversion of Vertical Speed data source.

INDICATIONS

Cockpit indications are displayed:

- On the HSI and ADI of the PDU and HUD and Secondary Flight Display for speed and altitude data,
- On the ADI for flags,
- On the CAS window and sub-page "FAULT" of the "STATus" synoptic for failure messages.

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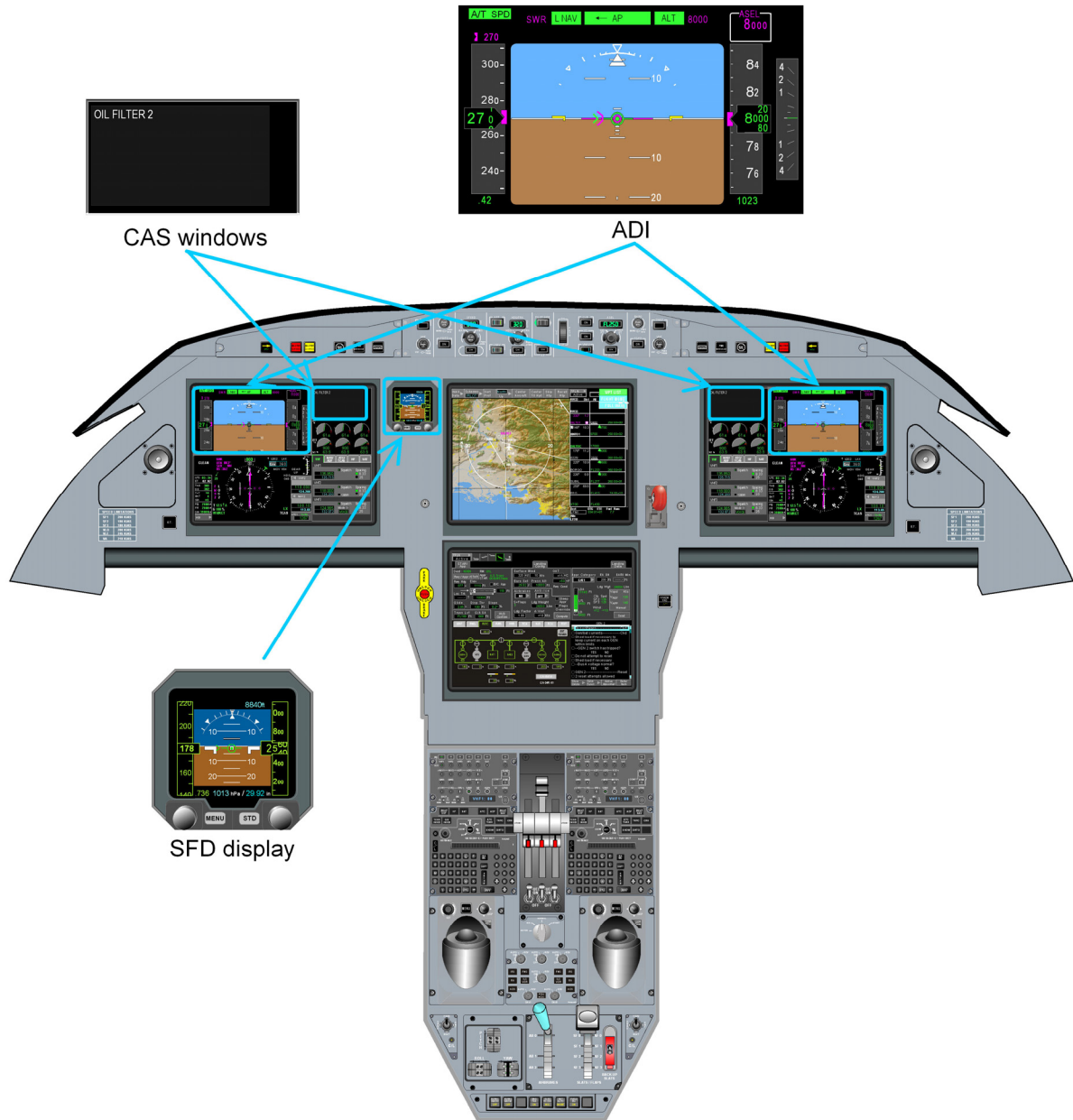


FIGURE 02-34_7-05-01 - FLIGHT DECK OVERVIEW

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GENERAL

DISPLAYED AIR DATA INFORMATION

The Air Data information is displayed on the LH and RH PDU, and on the Secondary Flight Display.

On the LH and RH PDU, the following data is available:

- Baro corrected altitude (pilot and copilot) and baro correction,
- Indicated and True Airspeeds (IAS and TAS),
- True Mach,
- VMO / MMO indication and Low Speed Cues,
- Vertical Speed information (baro inertial),
- Total and Static Air Temperature (TAT and SAT),

On the Secondary Flight Display (SFD), the following data is available:

- Baro corrected altitude,
- Indicated airspeed,
- Mach number,
- VMO / MMO.

AIR DATA INFORMATION PROVIDED TO OTHER SYSTEMS

➤ *Refer to the Description - Supplementary Information section*

SMART PROBES

Each of the four SmartProbes includes, in the same equipment:

- A Multi Function Probe, (which replaces the usual Pitot probe, Static probe, and AOA probe),
- A dual-channel Air Data Computer.

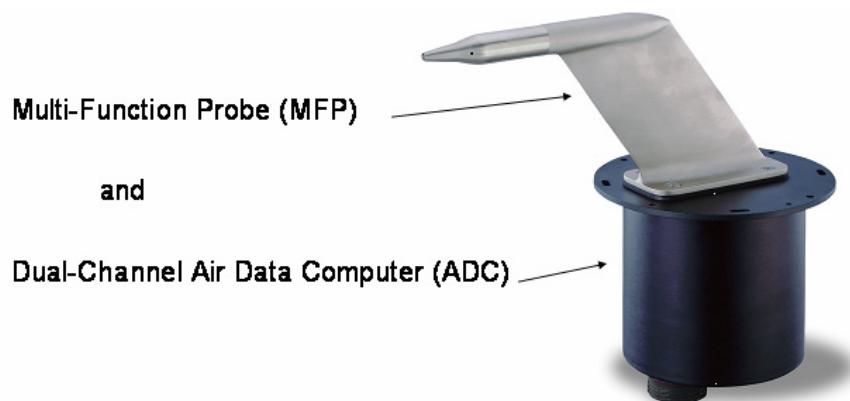


FIGURE 02-34_7-10-00 - SMART PROBE

The ADC of each Smart Probe has two independent and dissimilar channels, A and B.

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AIR DATA SYSTEM

GENERAL

Most of the Air Data information is elaborated by the four Air Data System (ADS1 to ADS4). The TAT, TAS and SAT are provided by the ADS using data from the two TAT sensors. The Vertical Speed is provided by the IRS, using data received from the ADS (baro inertial Vertical Speed).

DISPLAYS CONFIGURATION

In standard conditions, display sources are the following:

- ADS1 is used by the LH pilot,
- ADS2 is used by the RH pilot,
- ADS4 is used by the Secondary Flight Display,

In non standard conditions, ADS3 is used for:

- LH or RH display after manual reversion,
- Secondary Flight Display after automatic reversion in case of failure of ADS4.

SMART PROBES USED BY EACH AIR DATA SYSTEM

Each of the four Air Data System is using data from two Smart Probes located on opposite sides of the fuselage,

- One of the two Smart Probes performs all calculations,
- Part of the opposite Smart Probe provides data to the first Smart Probe for sideslip compensation.

The following figure associates one color to each Air Data System, with the following code:

- Full color is used for the calculation part of the Smart Probe,
- Stripes of the same color are used for the Sideslip compensation part performed by the opposite Smart Probe.

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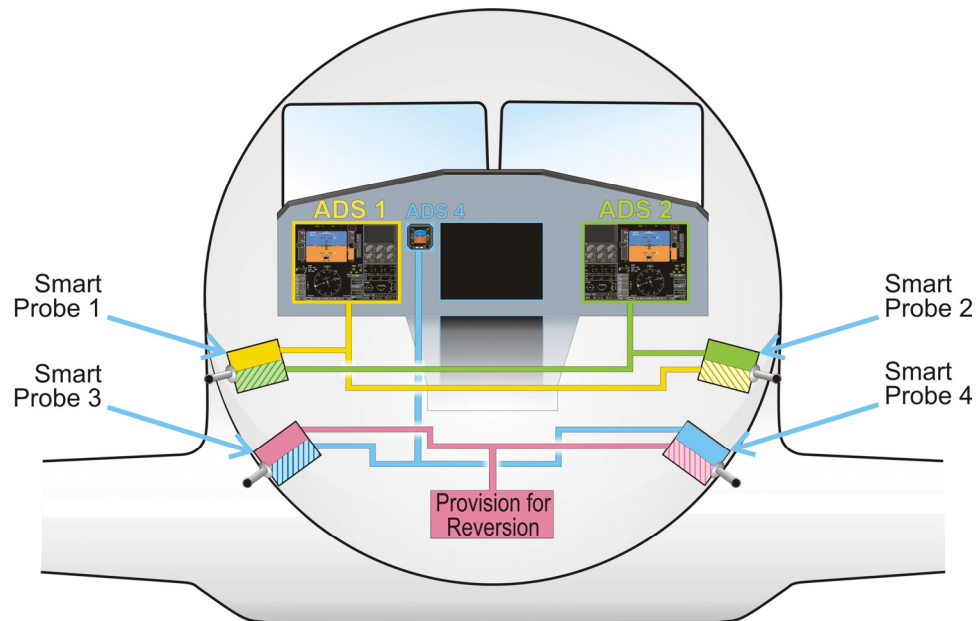


FIGURE 02-34_7-10-01 - DISPLAYS CONFIGURATION AND ADS COMPOSITION

For example, ADS1 (yellow) uses Smart Probe 1 for calculations and Smart Probe 2 for Sideslip compensation.

ADS3 (blue), which uses Smart Probe 3 for calculation and Smart Probe 4 for Sideslip compensation, is used for display only in case of reversion.

LOSS OF SIDESLIP COMPENSATION

Because the sideslip compensation is performed by the opposite Smart Probe, the complete loss of one Smart Probe (affecting both channels, for example total loss of heading, mechanical damage, etc.) will induce the loss of sideslip compensation for the opposite ADS.

For example, if the probe heating of Smart Probe 2 fails:

- The sideslip compensation of the opposite ADS (ADS1) is lost,
- In icing condition, the ADS2 corresponding to Smart Probe 2 may be misleading.

A message is provided to alert the crew members when a system is not compensated for side-slip induced error on static pressure. The crew members should then take precautions when using the implicated system when in slip conditions.

AIRPLANE CONFIGURATION ADAPTATION

The airplane configuration (landing gear, or RAT position) is taken into account by the system to adapt the corrections performed on the data due to the position of the probes:

- For static pressure data (altitude, speed, mach) only RAT position is taken into account,
- For angle of attack and angle of sideslip, both landing gear and RAT position are taken into account.

If an ADS does not receive the airplane configuration information, the configuration is considered, by default, as "Clean configuration" (i.e landing gear retracted and RAT not deployed). This will be indicated by **SSEC** flag in the PDU which use this ADS.

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TEMPERATURE DATA ELABORATION

The LH and RH TAT Probes are two identical probes mounted on the forward fuselage.

Each ADS receives temperature data from one of the two TAT sensors:

- ADS 1 and 3 use TAT 1,
- ADS 2 and 4 use TAT 2.

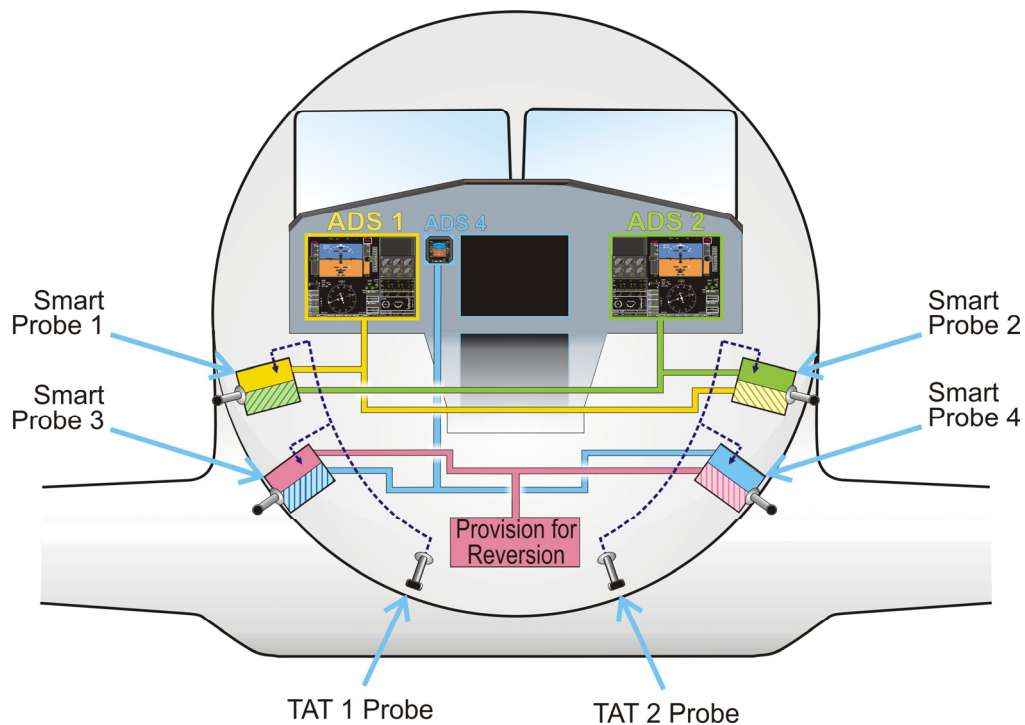


FIGURE 02-34_7-10-02 - TRANSMISSION OF TAT TO ADS

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PROBE HEATING

Smart Probes and TAT sensors are protected against icing conditions by heating elements.

➤ *For information about heating elements in the probes refer to section ATA 30*

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DESIGN PRINCIPLES

The Air Data System was designed taking into account the following design principles:

- With regard to the selected technology:
 - o The Smart Probe technology was selected as it was proven to be efficient on military aircraft,
 - o It allows reducing the number of probes and increasing the number of available Air Data sources,
 - o Opposite Smart Probes use different types of electronic components to allow dissimilarity in case of problem on one type of component.
- With regard to the architecture:
 - o In normal conditions, the three displays (LH and RH PDU, Secondary Flight Display) use different data sources. It is also the case if only one reversion is performed.
 - o For data calculation, the LH and RH displays use probes of different types of electronic components to ensure detection of a problem in case of degradation of a given type of component.

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EQUIPMENT LOCATION

➤ *Refer to General section.*

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ELECTRICAL POWER SUPPLY

The following paragraph describes the power supply of the different equipment of the air data system.

Electrical protection is provided either by:

- Solid State Power Controllers (SSPC) ,
- Circuit Breakers (CB).

➤ Refer to ATA 24 – ELECTRICAL POWER for additional information.

EQUIPMENT	POWER SUPPLY	TYPE OF PROTECTION
ADS 1 channel A	LH Main	CB
ADS 1 channel B	RH Main	CB
ADS 2 channel A	LH Main	CB
ADS 2 channel B	RH Main	CB
ADS 3 channel A	LH Essential	CB
ADS 3 channel B	RH Essential	CB
ADS 4 channel A	LH Essential	CB
ADS 4 channel B	RH Essential	CB
TAT 1	LH Main	CB
TAT 2	RH Main	CB

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SMARTPROBES

Each Smart Probe is made up of:

- A Multi-Function Probe(MFP)
- A dual-channel Air Data Computer (ADC).

The ADC of each Smart Probe has two independent and dissimilar channels, A and B.

Each channel has dissimilar complex hardware and dissimilar software and conducts local air data calculations independently from the other channel.

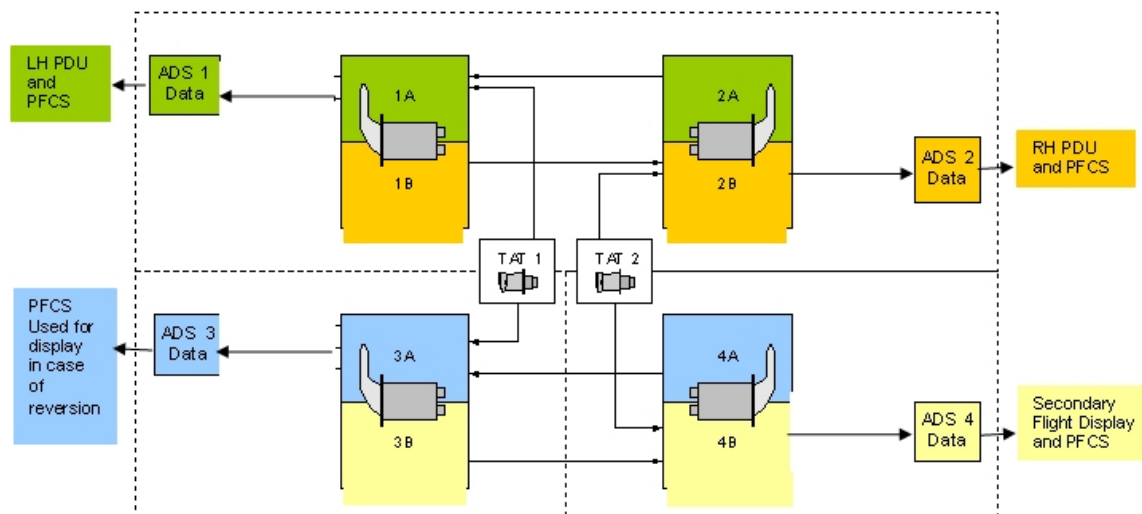


FIGURE 02-34_7-15-00- RELATION BETWEEN ADS, SMART PROBES, DISPLAYS AND PFCS

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AIR DATA INFORMATION PROVIDED TO OTHER SYSTEMS

The following Air Data information is provided to the Primary Flight Control System (PFCS):

- Angle Of Attack (AOA),
- Angle Of Sideslip (AOS),
- Mach,
- Altitude,
- True Static and Total Pressures (Ps and Pt),
- VMO / MMO.

The following Air Data information is provided to the avionics for use by other systems:

SYSTEM USING AIR DATA	DATA USED	FUNCTION
Pressurization	True Static Pressure	Cabin Delta P control
Engines	Pt, Ps, TAT	N1/N2 governing, thrust settings
Steering system	True Airspeed	Monitoring of BCU speed. Data used to limit steering authority
AHRS	Altitude, True Airspeed	Baro inertial filter
EGPWS	Altitude, SAT	Terrain awareness
AFCS	Ps, Pt, Altitude, Airspeed	Flight Director
Anti-Icing	Altitude/Ps, TAT, SAT	Pressure limitation downstream A/I + bleed valves
Fuel	Airspeed	Improve fuel quantity measurement accuracy

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BAROMETRIC CORRECTION INPUT

Each pilot has a barometric correction setting knob available on the Guidance Panel.

When a pilot turns its BARO knob, the MAU will convert the individual knob clicks into a barometric setting value in units of inch Hg. This barometric setting input in inch Hg is then sent to the ADS by the MAU and used by the ADS to compute a barometric setting value in units of mb and barometric corrected altitude.

The barometric setting values (inch Hg and mb) are transmitted back to the MAU where this returned barometric setting value will be displayed for the LH PDU and RH PDU in the units (mb or Inch Hg) selected.

Each Smart Probe receives both the LH pilot and RH pilot barometric knob settings.

In case of ADS reversion on a PDU by a pilot, the avionics will ensure that the displayed barometric corrected altitude reflects the barometric setting selected by this pilot.

The barometric correction for the SFD is not performed by the Smart Probes but within the SFD, based on the crew members input performed directly on the SFD front panel.

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CONTROLS

Controls of the Air Data System consist in:

- Two barometric setting knobs (one for each pilot) located on the Guidance Panel (GP),
- One barometric setting knob on the Secondary Flight Display (SFD),
- A menu available in HSI window to select the units of pressure and altitude,
- Two ADS pushbutton on the Reversion Panel (RP),
- Two IRS pushbutton on the Reversion Panel would be used for reversion of Vertical speed data source (refer to ATA 34_8),
- Probe Heat control on the Overhead Panel (refer to ATA 30).

BAROMETRIC SETTINGS

The barometric setting knobs are located:

- On the Guidance Panel for the PDU,
- On the Secondary Flight Display for its own display.

Guidance Panel



FIGURE 02-34_7-20-00 - BARO SETTING KNOBS ON GUIDANCE PANEL

On the Guidance Panel:

- The LH barometric setting knob is dedicated to the LH PDU,
- The RH barometric setting knob is dedicated to the RH PDU.
- Pushing on the barometric setting knob will automatically set the barometric setting correction to “standard” setting.

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A menu located in the HSI window (sub-menu of the HSI tool bar) is available for the crew to select either Hpa or Inch-Hg as the units of pressure.

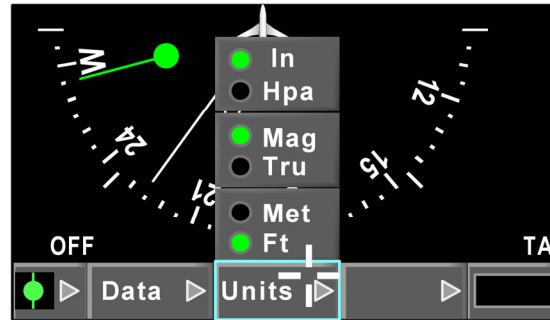


FIGURE 02-34_7-20-01 - UNITS MENU

Secondary Flight Display (SFD)

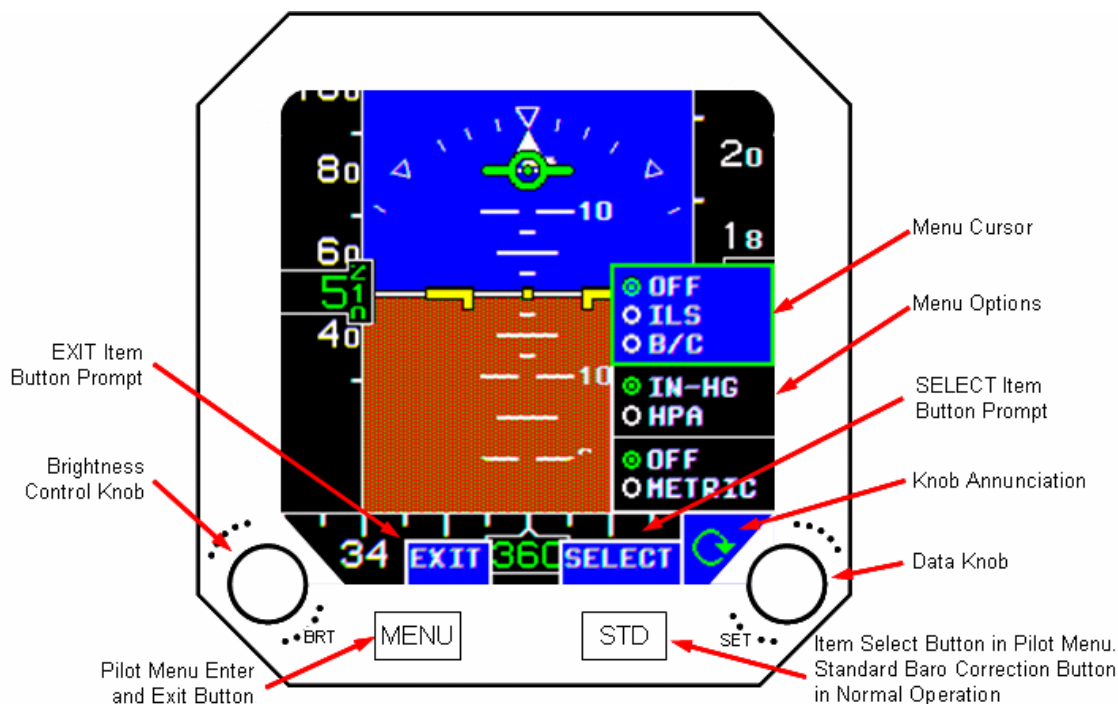




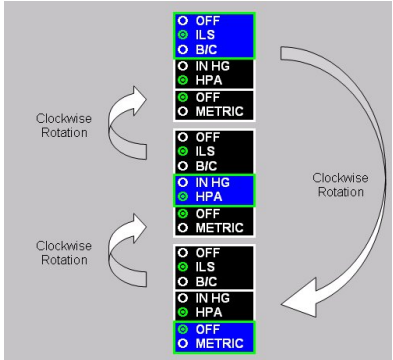

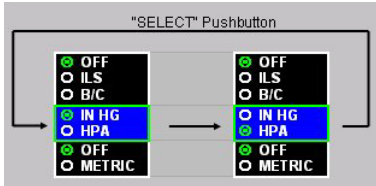


FIGURE 02-34_7-20-02 - SECONDARY FLIGHT DISPLAY

On the Secondary Flight Display:

- A barometric setting knob allows adjusting the barometric altitude on the SFD only.
- A selection of either Inch-Hg or Hpa is also available on the SFD through Menu Options.

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CONTROL / MENU	FUNCTION	LOCAL INDICATION
 / without Menu selected	<ul style="list-style-type: none"> - Allows setting the Barometric Correction value when Menu Options is not displayed. 	
 / without menu selected	<ul style="list-style-type: none"> - Displays STD in place of the digital readout of the Barometric Correction value when Menu Options is not displayed. 	
 with Menu Selected	<ul style="list-style-type: none"> - Allows moving the Menu Option Select Box in the Menu Option. - A clockwise rotation of the knob moves the Menu Option Select Box up and a counter clockwise rotation moves the Menu Option Select Box down. 	
 / with Menu Options	<ul style="list-style-type: none"> - Allows changing the mode selection within the selected group, and therefore to select "IN Hg" or "HPA" 	

REVERSIONS

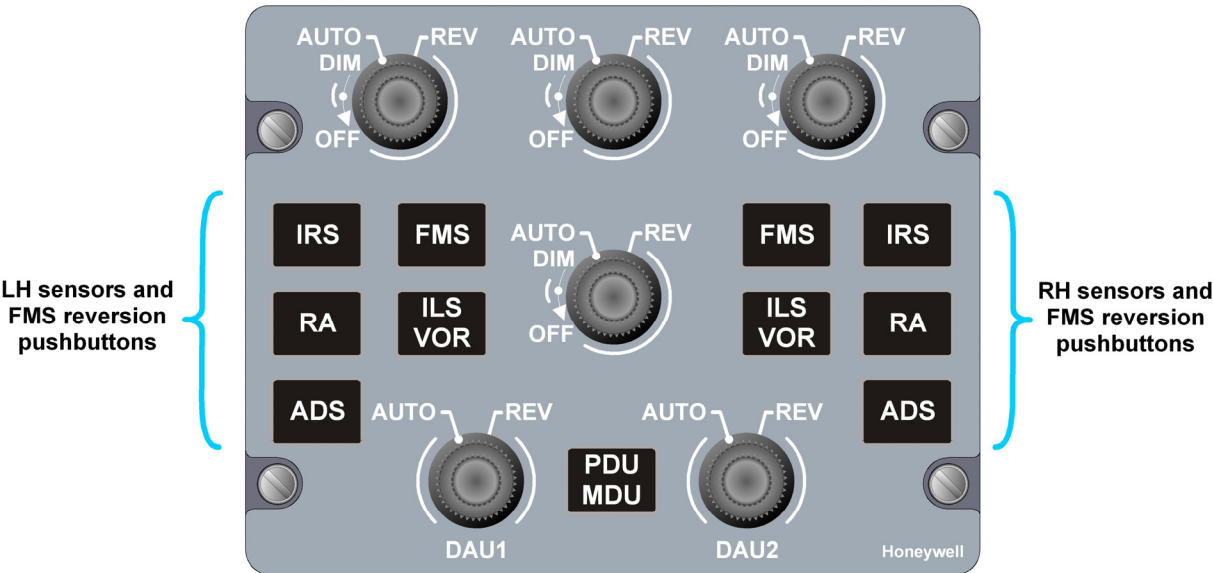


FIGURE 02-34_7-20-03 - REVERSION PANEL

CONTROL / MENU	FUNCTION	LOCAL INDICATION
<div>ADS</div>	<p>Allows using the other ADS source for display of air data on PDU, with the following cycle when pushing on the reversion switch:</p> <ul style="list-style-type: none"> - On the LH side: ADS 1 initially, ADS3, ADS2 - On the RH side: ADS2 initially, ADS3, ADS1. 	<p>The screenshot shows the PDU display with the following data: ALT 8000, ASEL 8000, 84, 82, 20, 8000, 80, 78, 76, 1023. The display is divided into a blue upper section and a brown lower section.</p>

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INDICATIONS

Indications are provided

- On the Attitude Director Indicator (ADI) and Horizontal Situation Indicator (HSI) of the PDU and the HUD and the Secondary Flight Display for speed and altitude data,
- On the ADI for flags,
- On the ENG-CAS window and sub-page FAULT of the STATus synoptic for failure messages.

Additionally, aural alerts ("INCREASE SPEED", "STALL", continuous VMO/MMO) are provided in case of low or excessive speed or Mach.

ATTITUDE DIRECTOR INDICATOR

The following air data information is provided on the ADI window of the PDU and on the HUD:

- On the airspeed tape: Indicated Airspeed, Low Speed Cues, VMO/MMO Cues,
- On the altitude tape: barometric corrected altitude, barometric setting, vertical speed indicator and value,
- Reversion and miscompare flags.

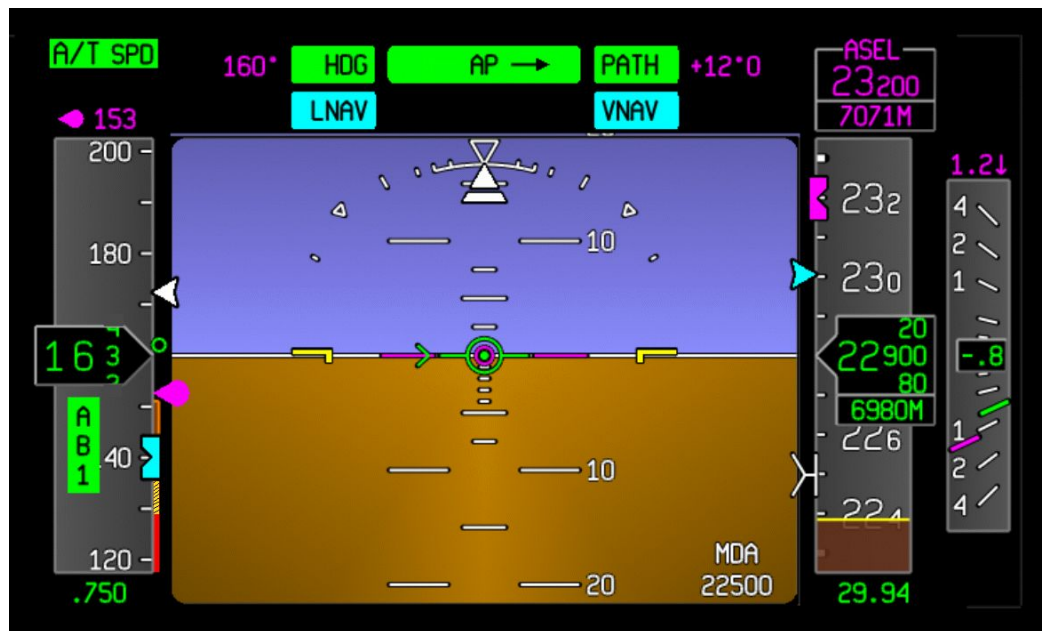


FIGURE 02-34_7-20-04 - ATTITUDE DIRECTOR INDICATOR WINDOW

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Airspeed tape

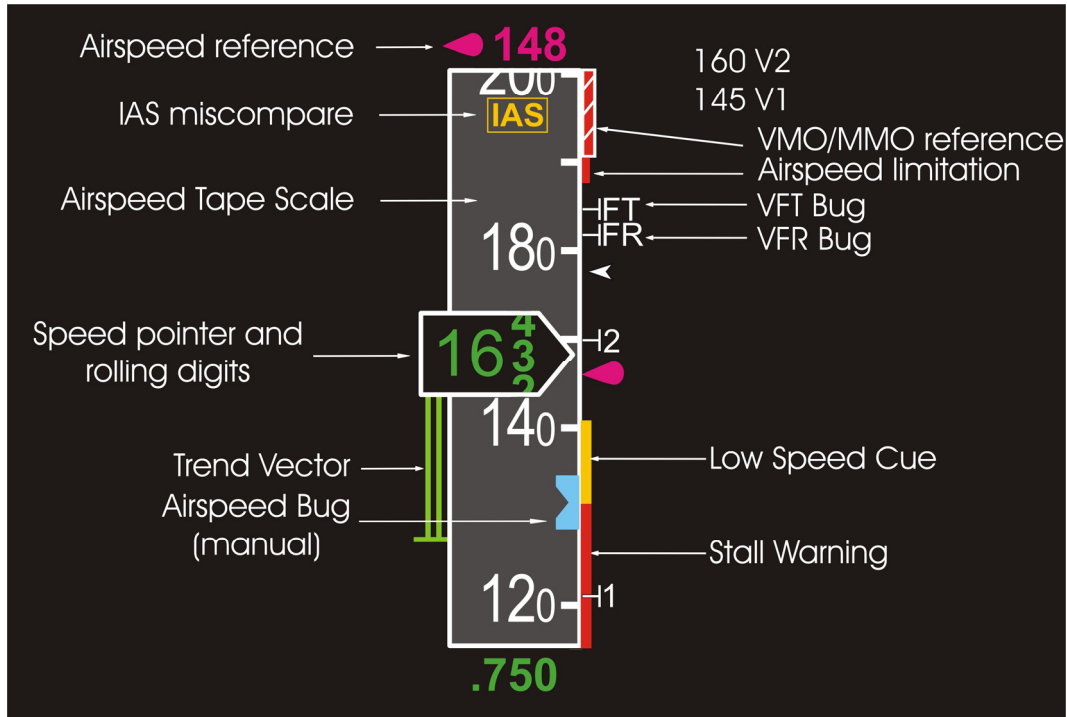


FIGURE 02-34_7-20-05 - AIRSPEED TAPE SYMBOLS

Speed tape and mach number are displayed on the left side of Attitude Direction Indicator (ADI).

MMO/VMO indication is displayed on the upper part of the speed tape.

Airspeed limitation (V constraint) is displayed only when the current airplane configuration (gear / flap position) and certain failures require speed limitations that are on or less than the airspeed tape scale. This limitation may therefore correspond to speed lower than VMO/MMO.

The Low Speed Cues (LSC) is elaborated by the MAU based on the Aircraft Angle-of-Attack transmitted by the Primary Flight Control System (PFCS) and displayed on the lower part of the speed tape.

- Refer to ATA 22_3 "Speed and stall protections" for a description of Low Speed Cues, VMO/MMO and associated aural warning.

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Altitude Tape area

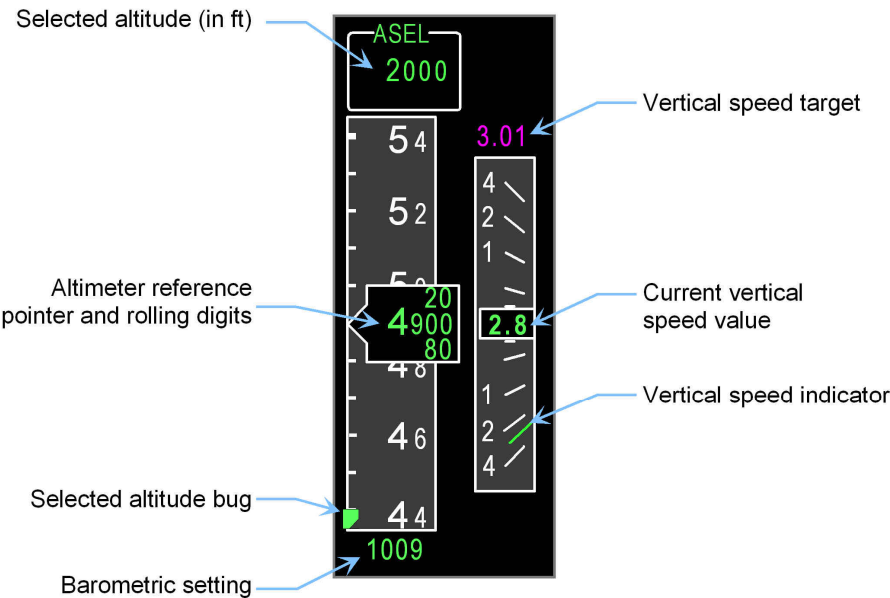


FIGURE 02-34_7-20-06 - ALTITUDE TAPE SYMBOLS

A menu located in the HSI window (sub-menu of the HSI tool bar) is available for the crew to select either meter or feet as the units of altitude.

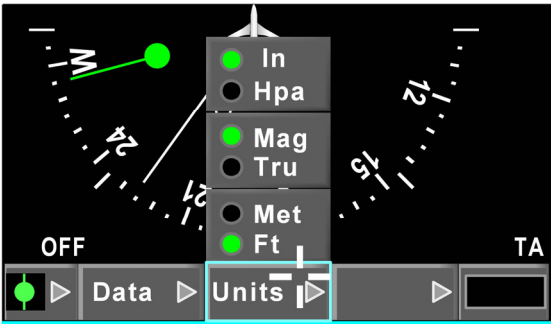


FIGURE 02-34_7-20-07 - UNITS MENU AND

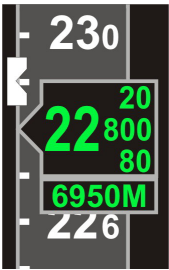


FIGURE 02-34_7-20-08 - ALTIMETER READOUT IN METER

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Reversion and miscompare flags

In case of reversion of one of the ADS, a flag will be displayed in the ADI to warn the crew that several displays possibly receive data from the same source.

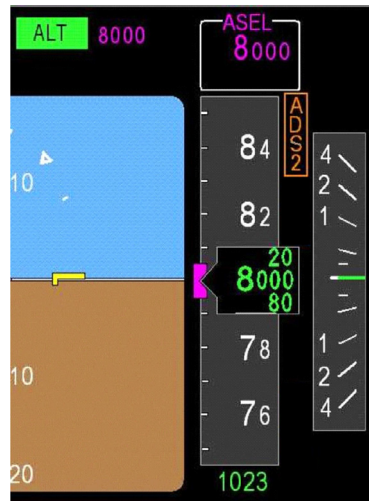


FIGURE 02-34_7-20-09 - ADS 2 REVERSION

Flag reversion is displayed in amber when the both PDU are using the same ADS.

Flag reversion is displayed in white when the both PDU are using different ADS.

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A miscompare indication is triggered when a difference between left and right ADI exists on certain ADS parameters:

- **ATT** - Attitude difference of 6° of roll or 5° of pitch,
- **FPV** - Flight Path Vector difference of 1° or 10% (whichever is greater),
- **IAS** - Airspeed difference of 10 knots,
- **ALT** - Altitude difference of 200 feet.

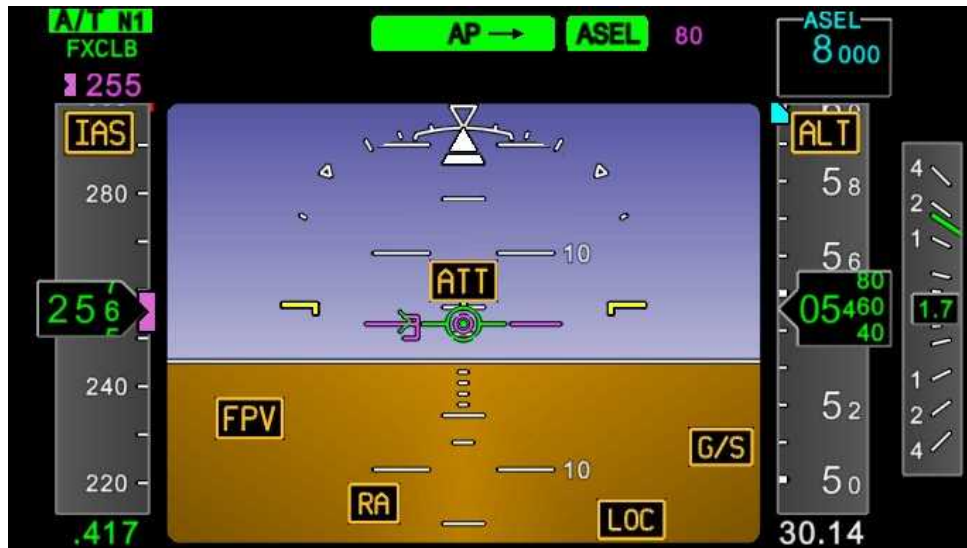


FIGURE 02-34_7-20-10 - LOCATION OF MISCOMPARE FLAGS ON ADI

SSEC flag is displayed on the altitude tape when Static Source Error Correction from the on-side ADS is lost.

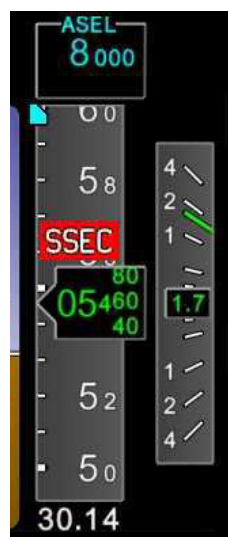


FIGURE 02-34_7-20-11 - SSEC INDICATIONS ON ADI WINDOW

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HSI WINDOW

The following air data information is provided on the HSI of the PDU:

- True Air Speed (TAS),
- Total and Static Air Temperature (TAT, SAT),
- Deviation from ISA standard atmosphere temperature.

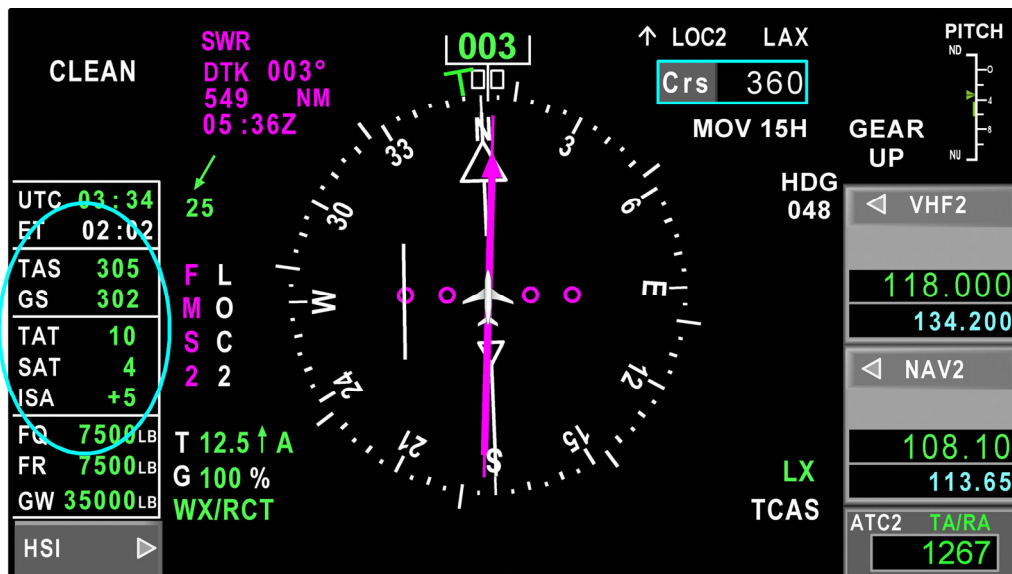


FIGURE 02-34_7-20-12 - HSI WINDOW ROSE FORMAT

HEAD UP DISPLAY

The following air data information is provided on the HUD:

- On the airspeed tape: Indicated Airspeed, Low Speed Cues, VMO/MMO Cues
- On the altitude tape: barometric corrected altitude, barometric setting, vertical speed indicator and value,
- Reversion flags,
- Miscompare flags.

➤ Refer to ATA 34_2 "Controls and Indications" sub-section for more information.

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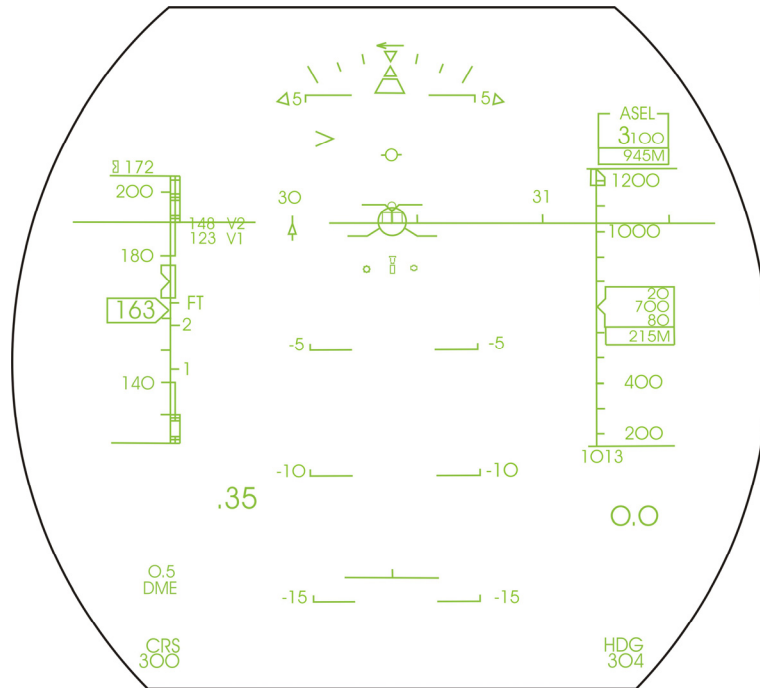


FIGURE 02-34_7-20-13 - HUD WITH SPEED AND ALTITUDE TAPE

SECONDARY FLIGHT DISPLAY

The airspeed is displayed using the following symbology:

- Airspeed tape,
- Airspeed readout,
- Mach Readout,
- Altitude tape,
- Altitude readout,
- Barometric set readout.

➤ Refer to ATA 34_3 "Controls and Indications - Supplementary information" sub-section for more information.

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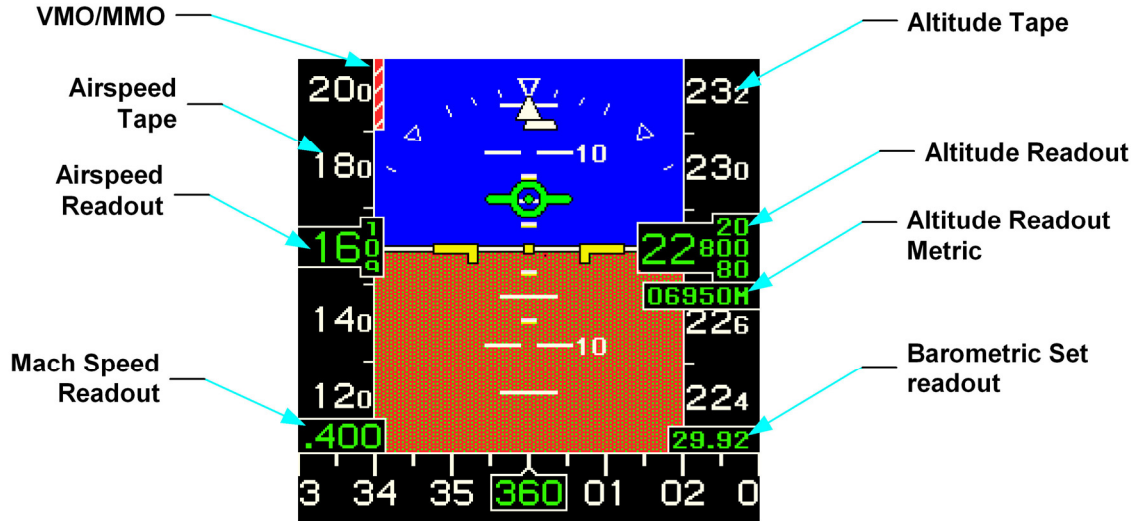


FIGURE 02-34_7-20-14 – AIRSPEED DISPLAY

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No supplementary information to be provided on controls and indications at present time.

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MONITORING OF THE SYSTEM

The Air Data System is continuously monitored with regard to the following parameters:

- Integrity of each Smart Probe and probe heating,
- Integrity of the opposite Smart Probe for sideslip compensation,
- Availability of the probe heating of the opposite Smart Probe for sideslip compensation,
- Availability of airplane configuration information (Landing Gear, RAT, Slats/Flaps position) for data correction,
- Difference of value between the altitude and airspeed information displayed on the LH and RH PDU.

In addition, ADS miscompare is monitoring by the AFCS system.

➤ *Refer to CODDE 2 for an exhaustive description of CAS messages and Flags.*

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ACTIVE PROTECTIONS

In case of failure of ADS4, the Secondary Flight Display will automatically revert to ADS3, and the crew members will be alerted by a flag displayed on the SFD.

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No supplementary information to be provided on System Protections at present time.

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GENERAL

Covers must be placed on the probes when the airplane is on ground to avoid any contamination, and removed during the pre-flight.

The condition of Smart Probes and TAT sensors should be checked thoroughly during the pre-flight, as well as condition of the fuselage in this area.

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SMART PROBES

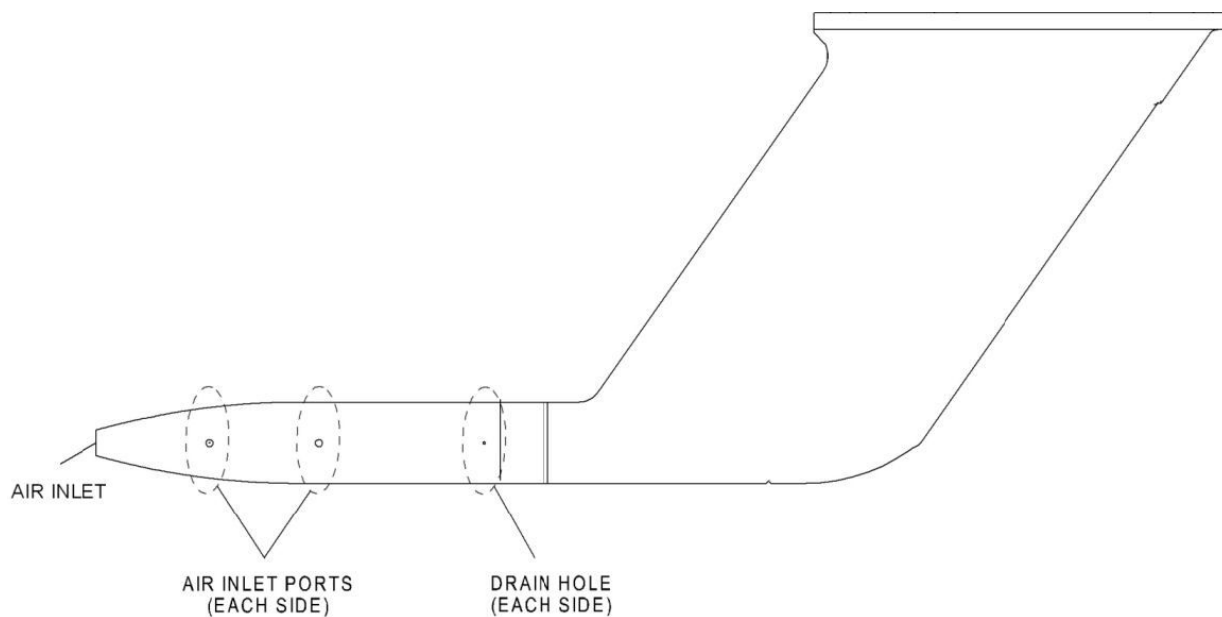


FIGURE 02-34_7-40-00 - SMART PROBE

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TAT PROBES

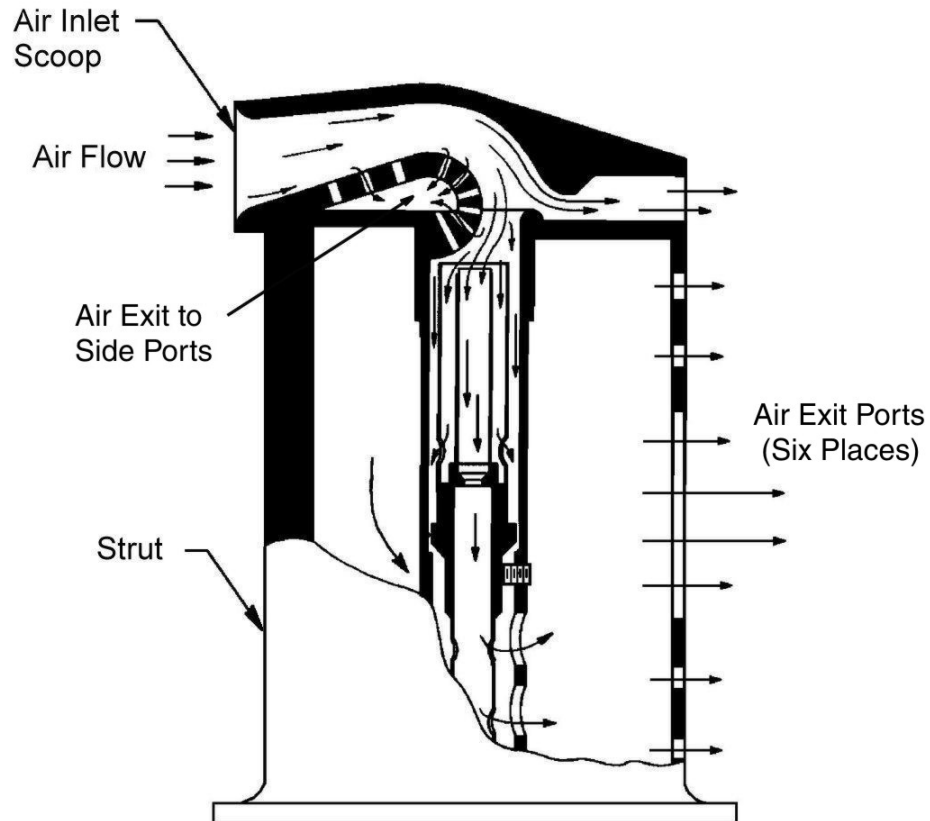


FIGURE 02-34_7-40-01 - TAT PROBE

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INTRODUCTION

INERTIAL REFERENCE SYSTEM

Three Inertial Reference Systems (IRS) are installed in the aircraft.

Each IRS is a three-axis inertial sensor system.

The purpose of the Inertial Reference System is to process and to output inertial reference and GPS hybrid information to provide attitude, motion and position information for display and for other systems.

ATTITUDE HEADING REFERENCE SYSTEM

The Attitude Heading Reference System (AHRS) supplies attitude, heading, air, and acceleration data through the ARINC 429 data bus to the Secondary Flight Display (SFD).

The AHRS is also used by the Primary Flight Control System in case of miscompare or loss of the IRS.

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FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the IRS is performed

- Via two IRS pushbutton located on the Reversion Panel (RP).

INDICATIONS

Crew indications with regard to IRS are located in:

- The upper PDU on the Attitude Director Indicator (ADI),
- The NAVIGATION tab of the SENSORS window,
- The ENG-CAS window for CAS messages,
- The STATUS synoptic / FAULT tab for fault messages.

There is no dedicated control for the AHRS.

Information elaborated by the AHRS is displayed in the Secondary Flight Display (SFD).

➤ *Refer to 02-34_3 sub-sections for Secondary Flight Display description.*

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INERTIAL REFERENCE SYSTEM

GENERAL

The Inertial Reference System is composed of:

- An Aircraft Personality Module (APM),
- An Inertial Reference Unit (IRU).

The Airplane Personality Module (APM) is a self-contained memory device external to the IRU. Airplane registration, aircraft type, and equipment configuration information (the position of the IRS and the alignment error between the IRU mounting tray and the airplane reference axes) is held in the APM.

IRU has two functions:

- The inertial reference function,
- The global positioning function.

Inertial reference function:

The inertial reference function contains three force-rebalance accelerometers and three laser gyros which the IRU uses to measure inertial motion.

The inertial reference function receives system initialization, air data, and GPS inputs on its ARINC 429 high-speed input buses:

- Latitude and longitude data for system initialization from Modular Avionics Unit (MAU),
- Air Data System (ADS) altitude, altitude rate, and true airspeed inputs from MAU.

From these measurements and inputs, the inertial reference function continuously calculates and outputs:

- Body frame:
 - o Longitudinal, lateral, and normal Accelerations,
 - o Pitch, roll, and yaw rates.
- Local level frame;
 - o Pitch and roll angles,
 - o Pitch and roll attitude rates,
 - o Turn rate,
 - o Flight path angle and flight path acceleration,
 - o Inertial vertical speed and inertial vertical acceleration,
 - o Platform heading.
- Earth frame parameters:
 - o Latitude and longitude,
 - o N-S velocity, E-W velocity, and ground speed,
 - o Inertial altitude,
 - o True and magnetic heading,
 - o Track angle true and track angle magnetic,
 - o Track angle rate,

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- o Wind speed and wind direction true,
- o Drift angle,
- o Along track and cross track accelerations,
- o Along heading and cross heading accelerations.

Global positioning function:

The global positioning function uses existing inertial reference hardware components to receive GPS data from the GPS function in VIDL-G module.

The global positioning function receives one time mark signal unique for each GPS receiver and GPS satellite and measurement data.

The IRU makes sure that the two GPS input channels are satisfactory and uses one of the channels as the primary source.

The global positioning function blends the receiver GPS autonomous pseudo range with inertial and air data altitude to achieve optimal position, velocity, and attitude performance.

The global positioning function provides the following output parameters:

- Hybrid latitude and longitude,
- Hybrid N-S velocity, E-W velocity, and ground Speed,
- Hybrid altitude and vertical velocity,
- Hybrid true heading, track angle, and flight path angle,
- Hybrid horizontal and vertical figure of merit.

The IRU uses kalman filter to supply corrected hybrid navigation outputs.

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IRS MODES OF OPERATION

The IRU manages automatically the following modes:

- Power up,
- Stationary alignment,
- Alignment in motion,
- Navigation,
- Auto re-alignment,
- Attitude,
- End of flight.

The IRS changes its mode according to its internal state, detection of motion, without any action of the crew.

Stationary alignment

The stationary alignment mode is the primary method of alignment. The IRU performs a stationary alignment when the airplane is on the ground with no motion, otherwise the IRU enters in align in motion mode.

The stationary alignment requires an initial latitude and longitude. If not received from GPS input, initial position shall be entered by the crew members. A CAS message is displayed if this data is not received or if IRU senses too much airplane motion during the stationary alignment.

The time necessary to complete a stationary alignment varies with latitude, and can take from 5 minutes to 17 minutes:

- 5 minutes at 0° latitude
- 10 minutes at $\pm 60^\circ$ latitude
- 10 minutes at $\pm 60^\circ < \text{latitude} \leq \pm 70.24^\circ$
- 17 minutes at $\pm 70.24^\circ < \text{latitude} \leq \pm 78.25^\circ$

Alignment in motion

Alignment in motion mode is a background function primarily used for recovery of full inertial navigation function after a temporary loss of power while in air. Alignment in motion mode is concurrent with attitude mode. Alignment in motion mode does not directly affect primary attitude / heading or rate output data.

Latitude and aircraft motion have an effect on the time necessary to complete the alignment in motion mode. Typically, the time period to complete align in motion is between 15 minutes and 30 minutes. The flight conditions that follow have an effect on the time that is necessary for the alignment to complete:

- A change in heading does not occur during alignment,
- There are no changes in acceleration during alignment,
- An east to west flight trajectory such that the IRU rotational rates in inertial space is nearly equal to zero.

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During alignment:

- Crew members can manually enter a heading on the SENSORS window,
- The Flight Path Symbol (FPS) and Acceleration Chevron (AC) are not available until re-alignment is complete.

Valid data from the GPS is necessary for the alignment in motion mode. If this mode does not complete satisfactorily, the micro IRU stays in the attitude mode (attitude data is available, positional data is not available).

Navigation

The IRU enters in navigation mode after alignment mode.

During the navigation mode, the IRU algebraically adds the calculated magnetic variation from a magnetic variation topographical map to true heading and true track to supply the magnetic heading and track angle magnetic.

When flying above latitude 82° North or below 82° South, or within the north and south magnetic polar cut-out regions, the magnetic heading and magnetic track angle are not available for the crew. The south magnetic polar cut-out is south of 60 South between 120 East longitude and 160 East longitude. The north magnetic polar cut-out is north of 73.125 North between 80 West longitudes and 130 West longitudes.

If the pitch angle is more than 85 degrees nose up or 85 degrees nose down, the IRU keeps the roll and heading outputs at the value calculated last and sets the roll attitude rate to zero.

Auto re-alignment

The auto re-alignment mode is done with the navigation mode when the airplane is not in motion to keep optimal performance.

The IRU enters again in alignment mode under one of these three conditions:

- Following a stationary alignment to navigation mode transition and no motion is detected,
- Following both a stationary alignment to navigation mode transition and the presence of previous motion and the aircraft is still prior to first flight,
- The airplane becomes stationary for a period of time following a flight. The IRU continues to provide valid navigation mode outputs during and after auto re-alignment estimates are applied.

The GPS position is used to automatically reinitialize the micro IRU position if the GPS position is available and valid.

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Attitude

The attitude mode is used to get pitch and roll attitudes quickly after the power-up mode completes. The attitude mode operates at the same time as the alignment modes (either stationary alignment or alignment in motion).

The Attitude mode has the two sub-modes that follow:

- Reversionary attitude mode:

This mode operates with the stationary alignment mode. This mode uses an initial set heading entry for valid output of magnetic heading to supply the platform heading (in addition to the other parameters). The reversionary mode operates independently of GPS measurements. This mode completes in 4 minutes to 10 minutes.

- Align In Motion attitude mode:

This mode operates with the alignment in motion mode. This mode supplies much better attitude and heading performance. The GPS-based Align In Motion attitudes are continuously compared with the reversionary mode attitudes to make sure of the integrity of the IRU attitudes. If the IRU senses a miscompare, the IRU automatically goes back to the reversionary attitude.

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ATTITUDE HEADING REFERENCE SYSTEM

The Attitude Heading Reference System (AHRS) is a dual-channel. The AHRS contains:

- One Attitude Heading Reference Unit (AHRU),
- One magnetometer,
- Two configuration modules.

The AHRU is a two-channel unit with separate boards for each channel. The two channels are the same and operate independently of each other. The AHRU has two independent power supplies, one for each channel.

Each AHRU channel calculates and transmits the following data:

- Roll attitude,
- Pitch attitude,
- Heading,
- Flight path angle,
- Roll attitude rate,
- Pitch attitude rate,
- Roll body rate,
- Pitch body rate,
- Yaw body rate,
- Longitudinal acceleration,
- Lateral acceleration,
- Normal acceleration,
- Vertical acceleration.

Micro Electro-Mechanical System (MEMS) technology replaces conventional gyro technology and supplies attitude and heading reference data for the pilot, navigation, and control use.

The magnetometer supplies a single source of magnetic heading for both channels of the AHRU.

Each channel of the AHRU is connected to a configuration module (one per channel). The configuration module stores specific parameters, installation options and calibration data that are necessary for the AHRU to operate.

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DESIGN PRINCIPLES

The following design principles were applied in the design:

- Magnetometer is located in vertical fin, just below Horizontal Stabilizer. It is mounted away from ferrous materials such as nickel, iron, steel, and cobalt. In fact, ferrous material may disturb the earth's magnetic field and distort the magnetometer readings. Although these hard-iron effects can be calibrated out, it is best to minimize their effect in order to prevent the sensor outputs from saturating,
- AHRS and magnetometer are not placed in area of excessive vibration,
- The two channels of AHRU are designed as identical and independent to achieve a higher level of availability,
- In the AHRS the Micro Electro-Mechanical System (MEMS) technology replaces conventional gyro technology
- The AHRS configuration module allows for quick replacement of the LRU eliminating the need for extensive measurement for level and shimming.

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MATERIAL DESCRIPTION

INERTIAL REFERENCE SYSTEM

The IRU receives on its ARINC 429 high-speed input buses:

- Latitude and longitude data for system initialization from Modular Avionics Unit (MAU),
- Air Data System (ADS) altitude, altitude rate, and true airspeed inputs from MAU,
- GPS inputs from VIDL-G module via NIM module.

The IRU sends computed data to:

- Modular Avionics Unit (MAU),
- Weather radar,
- SATCOM,
- Primary Flight Control System.

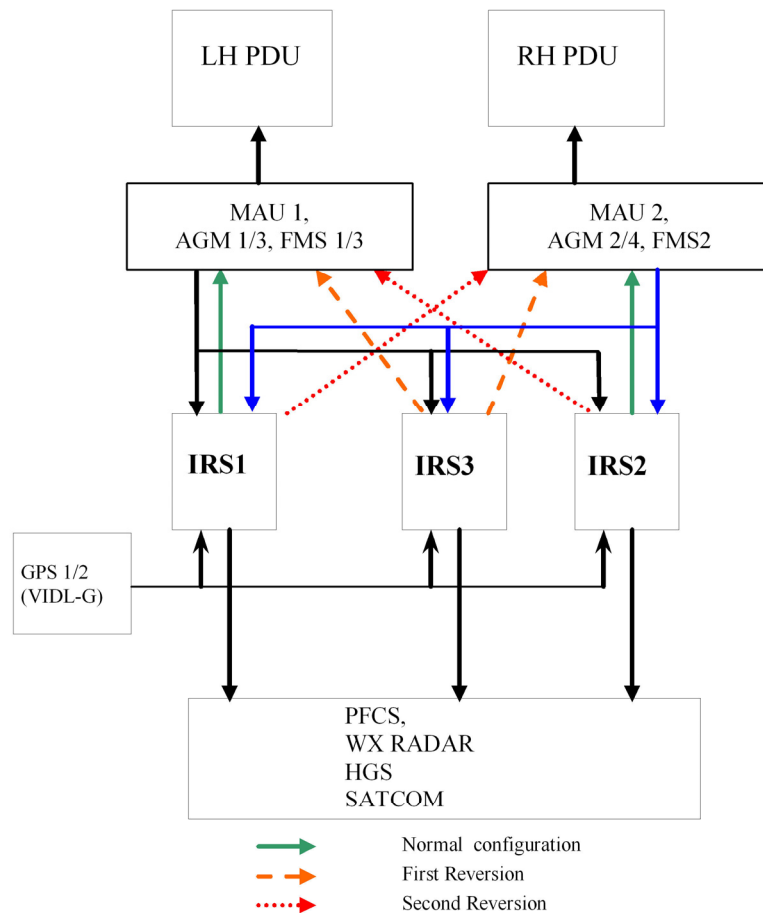


FIGURE 02-34_8-15-00 - PRINCIPAL DIAGRAM

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EQUIPMENT LOCATION

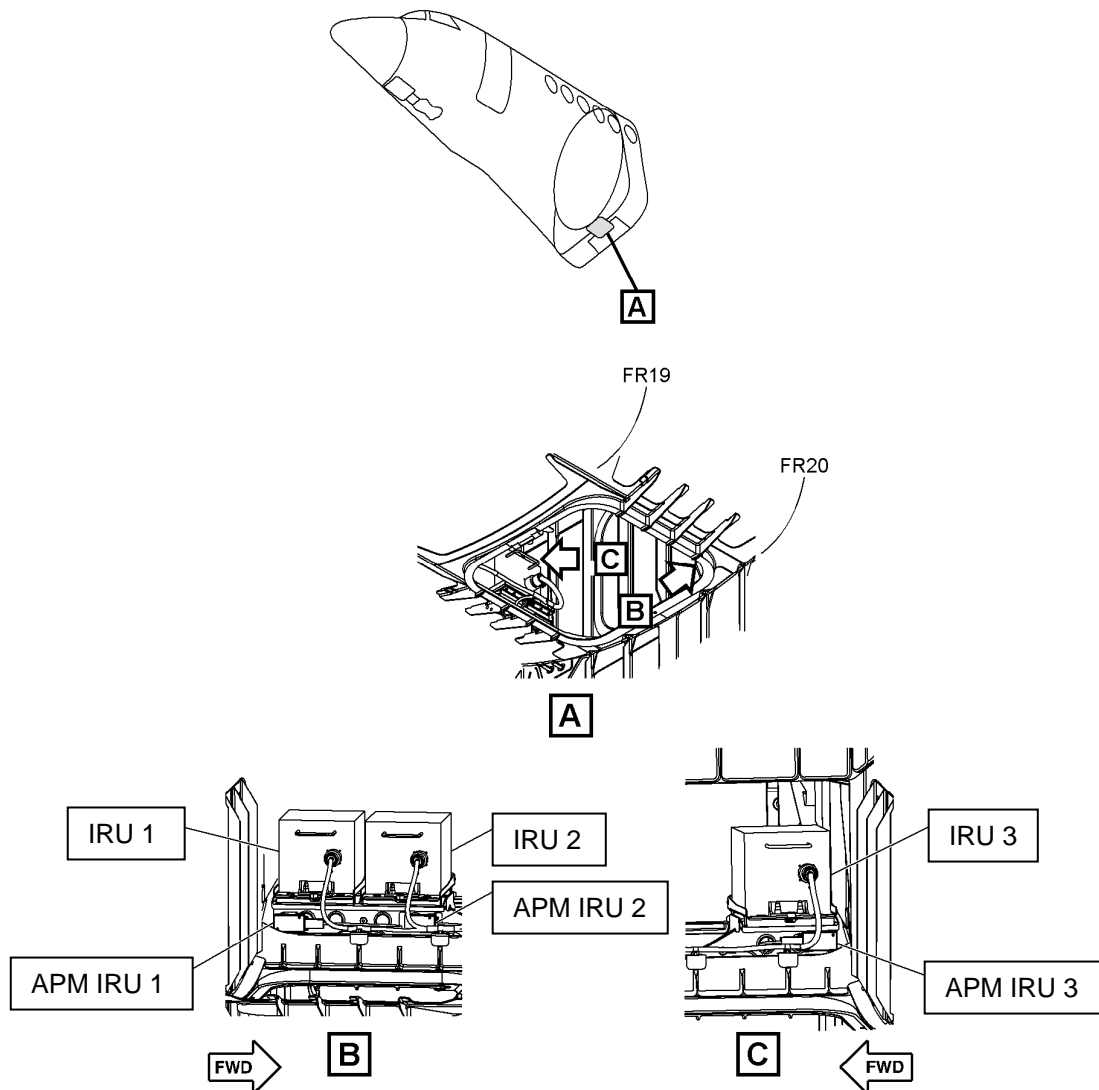


FIGURE 02-34_8-15-02 – IRS EQUIPMENT LOCATION

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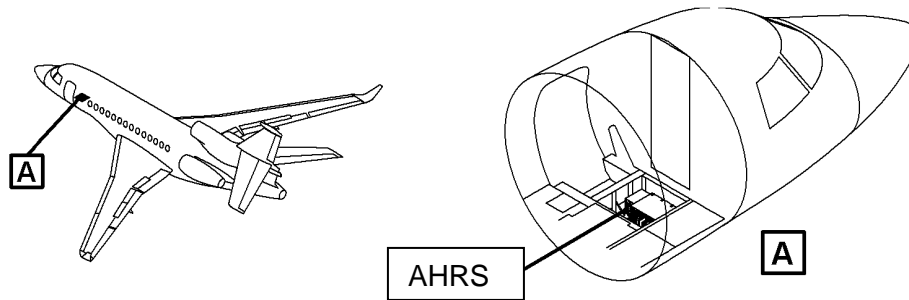


FIGURE 02-34_8-15-03 - AHRS LOCATION

Magnetometer is located in vertical fin, just below Horizontal Stabilizer.

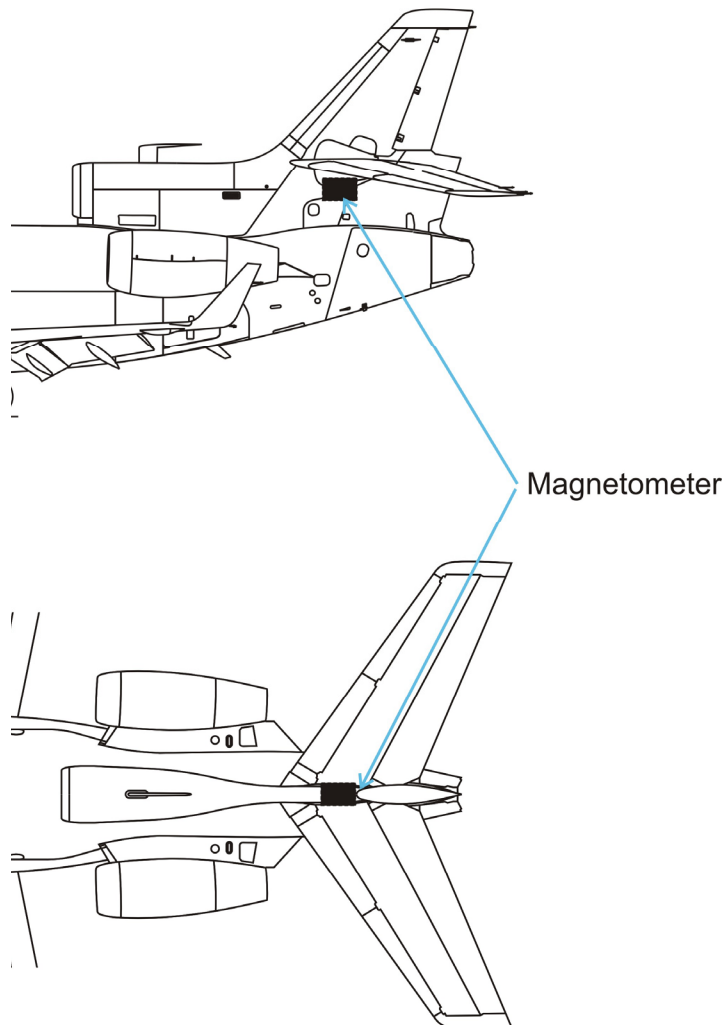


FIGURE 02-34_8-15-04 - MAGNETOMETER LOCATION

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the IRS and AHRS.

Electrical protection is provided:

- Either by Solid State Power Controllers (SSPC),
- Or by Circuit Breakers (CB).

➤ *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	TYPE OF PROTECTION
IRS 1	LH Essential	CB
IRS 2	RH Essential	CB
IRS 3	On ground: RH Essential	CB
	In flight: PMA 2	Fuse inside PMA converter
Magnetometer	RH Essential	CB
AHRS channel 1	PMA 1	Fuse inside PMA converter
AHRS channel 2	RH Essential	CB

IRS3 is powered through PMA2 converter as primary source. In addition to the primary source, and only when the park brake is parked and airplane is grounded, the IRS3 is powered also by the RH Essential bus bar, as a secondary source. In that way, IRS3 is powered and can start alignment before engine run-up.

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CONTROL

Crew has control on the IRS system through the Reversion Panel.

REVERSION PANEL

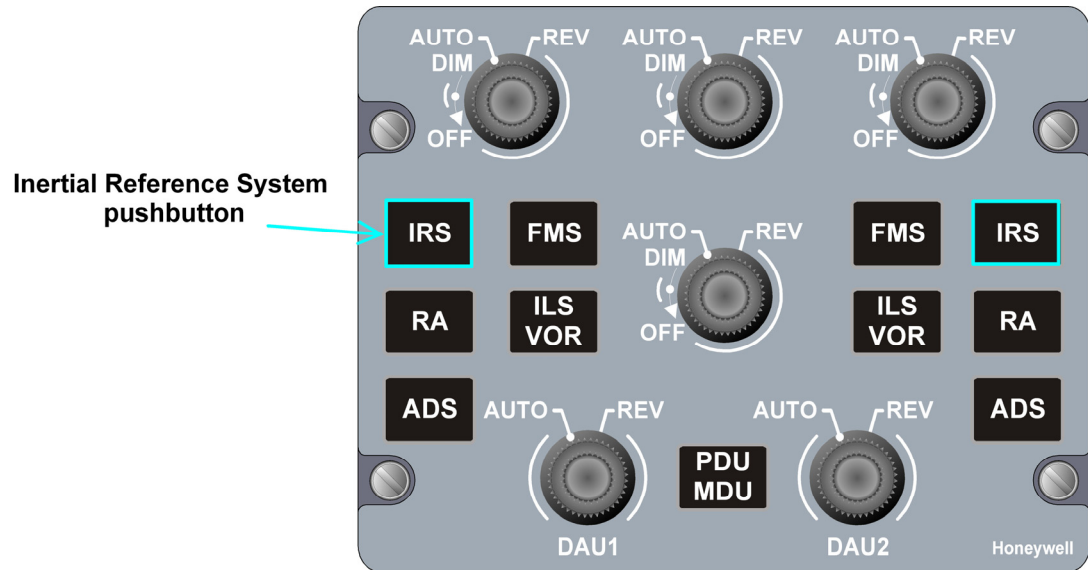


FIGURE 02-34_8-20-00 - REVERSION PANEL

CONTROL	FUNCTION	LOCAL INDICATION
<div>IRS</div>	<p>Allows using the other IRS source for display on PDU, with the following cycle when pushing on the reversion switch:</p> <ul style="list-style-type: none"> - On the LH side: IRS 1 initially, IRS 3, IRS 2. - On the RH side: IRS 2 initially, IRS 3, IRS 1. 	<p>The screenshot shows a PDU display with a green 'ALT 8000' at the top left, a pink 'ASEL 8000' at the top right, and a central vertical scale with numbers 84, 82, 20, 78, 76, and 1023. There are also smaller numbers 4, 2, 1, 1, 2, 4 on the right side of the scale.</p>

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INDICATION

Crew has indication on the Inertial Reference System through:

- The upper PDU on the Attitude Director Indicator (ADI),
- The NAVIGATION tab of the SENSORS window,
- The ENG-CAS window for CAS messages,
- The STATus synoptic / FAULT tab for fault messages.

ADI WINDOW

Reversion flag

IRS reversion caption is located in the ADI. When a reversion is done, the name of the reverted sensor appears in white if the sensors using in the both side is different, in amber if the same sensor is used.

For example:

- The first reversion (from a nominal situation) on one side, only displays a white reversion symbol on the corresponding ADI,
- The second push reverts to the next sensor (the one used by the other crew member). In that case the reversion symbol is displayed in amber in both ADI,
- A third push brings the on-side sensor back and lights off the reversion symbols (original situation).

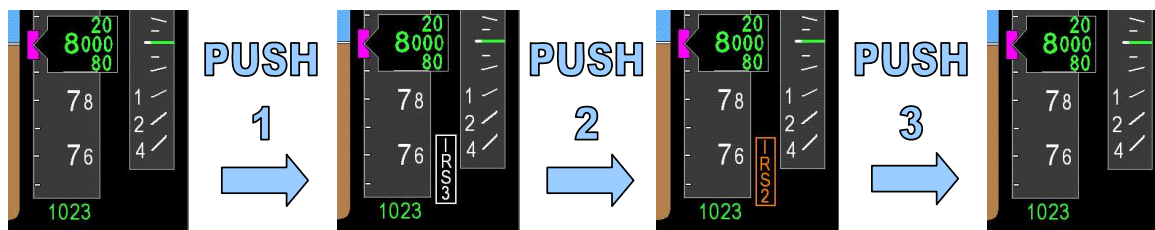


FIGURE 02-34_8-20-01 - IRS REVERSION FROM LH STATION

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ATTitude display

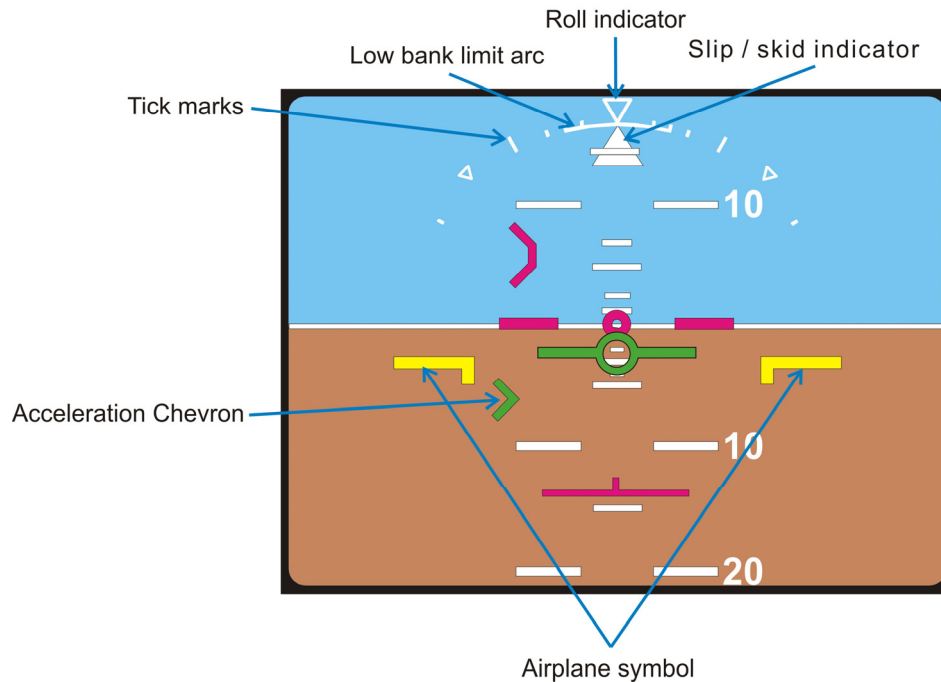


FIGURE 02-34_8-20-02 - ADI

■ Airplane symbol

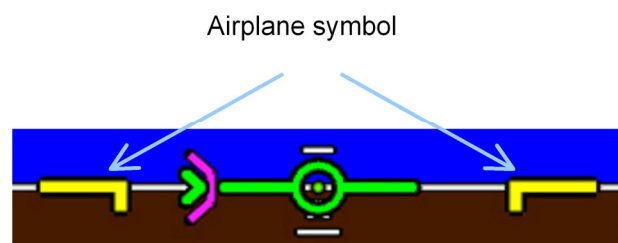


FIGURE 02-34_8-20-03 - AIRPLANE SYMBOL

The attitude reference airplane symbol is a fixed object displayed in the center of the ADI sphere. The symbol is displayed in yellow and is used in conjunction with the attitude pitch tape to reflect airplane pitch.

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■ Acceleration Chevron (AC)

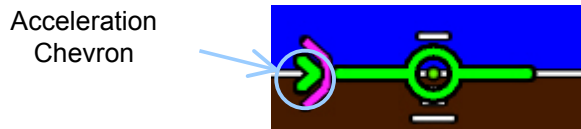


FIGURE 02-34_8-20-04 - ACCELERATION CHEVRON

The flight path Acceleration Chevron (AC) is displayed green and referenced to the Flight Path Symbol (FPS). When alongside the FPS, the acceleration chevron represents a zero acceleration along flight path. When the AC is above the FPS, the airplane is accelerating. When the AC is below the FPS, the airplane is decelerating.

■ Attitude pitch tape

The attitude pitch tape can display 35 degrees of field of view, and values between 0 and ± 90 degrees.

■ Pitch compression

When the FPS is outside of the pitch tape field of view (e.g high AOA or windshear condition) a pitch compression is applied to the pitch scale to position the FPS at the correct value on the pitch scale while maintaining the horizon inside the field of view.

When the compression is greater than a factor of 1, the 1 degree tick marks are removed. When the compression has reached a factor of 2, the 5 degree tick marks are removed.

The maximum compression factor is 3 (field of view at 105°). Beyond this value the FPA is ghosted (dashed lines) to indicate that the FPA value is no longer on the pitch tape. When the FPA is ghosted, the compression rate is frozen at 3, the tape remains compressed. Once the FPA is no longer ghosted, the tape begins to expand back to normal. Once the FPA is ghosted it no longer indicates the correct position, however, it continues to correctly show a climbing or descending state.

The following symbols are not affected by compression:

- Flight Director (FD),
- Thrust Director (TD),
- AOA path limit symbol.

The following symbols are affected by the compression factor:

- TCAS path targets,
- Flight Path Symbol (FPS).

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■ Roll scale and pointer

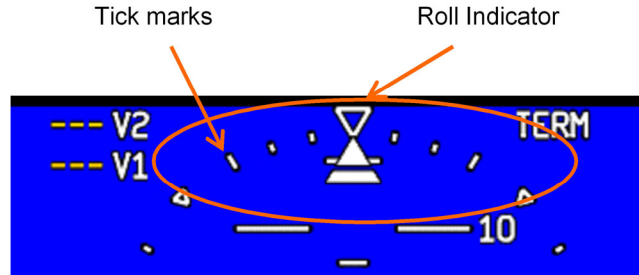


FIGURE 02-34_8-20-05 - ROLL SCALE AND POINTER

The roll scale displays the roll angle of the airplane. The tick marks on the scale represent respectively ± 10 , ± 20 , ± 30 and ± 60 degrees; three inverted triangles represent 0 and ± 45 degrees.

■ Slip / skid indicator

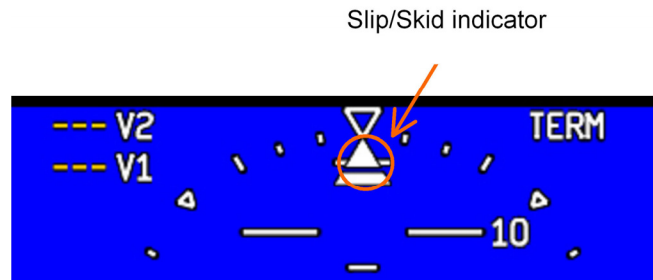


FIGURE 02-34_8-20-06 - SLIP / SKID INDICATOR

The bottom half of the roll pointer indicates the slip-skid, relatively to lateral acceleration. Normally displayed in white, it turns amber when the lateral acceleration is too high.

■ Low bank limit arc



FIGURE 02-34_8-20-07 - LOW BANK LIMIT ARC

The low bank limit arc ($\pm 15^\circ$) indication is displayed:

- Automatically when in HDG/Track and crossing 32600 ft in climb,
- When low bank is selected in **AFCS** tab of avionics window.

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■ Heading scale

The heading scale appears in the ADI only in a two DU configuration and when the PNF has removed the HSI. The scale appears on the horizon line.

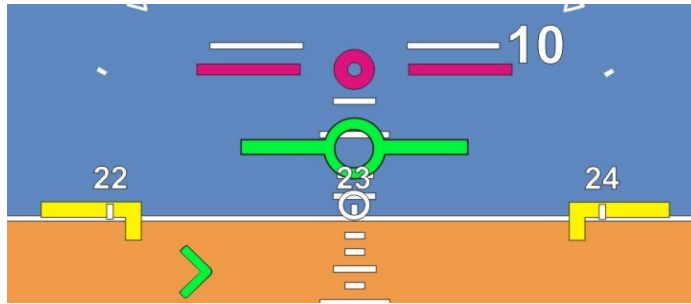


FIGURE 02-34_8-20-08 - TWO DU ADI CONFIGURATION

■ Mismatch indications

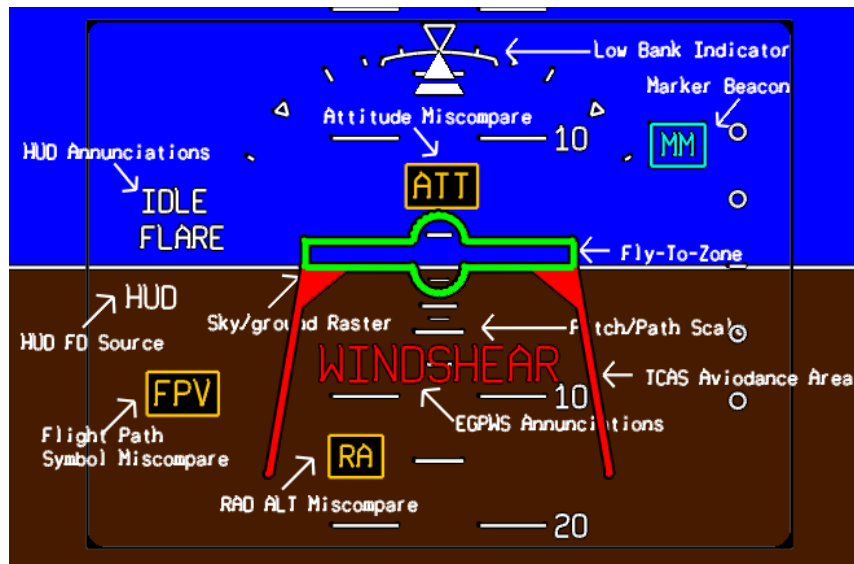


FIGURE 02-34_8-20-09 – ADI WITH ATTITUDE AND FLIGHT PATH SYMBOL MISMATCH DISPLAY

Mismatch flags alert the following:

- **ATT** - Attitude difference of 6° of roll or 5° of pitch,
- **FPV** - Flight Path Vector difference of 1° or 10% (whichever is greater).

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■ Failure indications

In most cases, if data are invalid the corresponding indication(s) are removed. In some other cases when it is necessary for the crew to be aware of a failure, the failure indication is displayed on the ADI in white text with a red background.

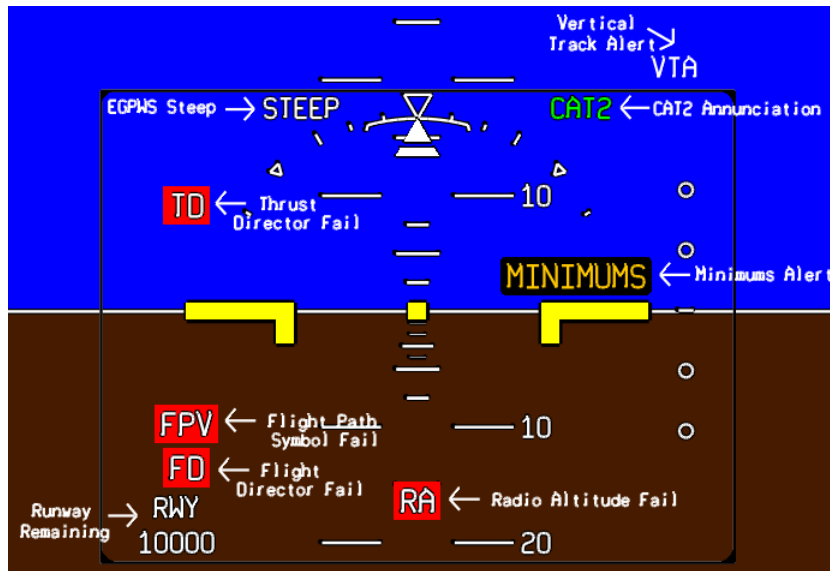


FIGURE 02-34_8-20-10 - FAILURE INDICATIONS ON ADI

FPV

FPV flag is triggered when the FPV computations are not available for the corresponding IRS. (e.g during in flight alignment phase).

ATT

ATT flag is triggered when attitude from the on-side IRS is lost.

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Airspeed tape

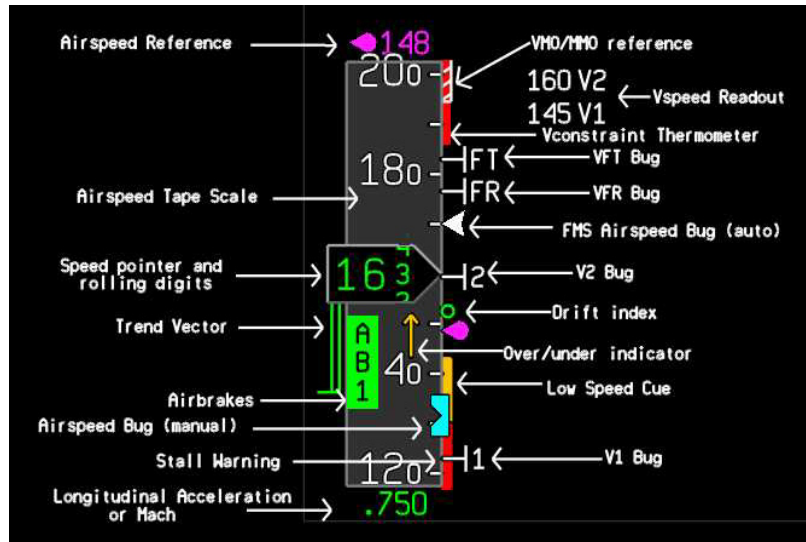


FIGURE 02-34_8-20-11 - AIRSPEED TAPE

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■ Longitudinal acceleration and Mach readout

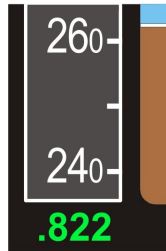


FIGURE 02-34_8-20-12 - LONGITUDINAL ACCELERATION AND MACH READOUT

The longitudinal acceleration is located at the bottom of the airspeed tape when on ground. It is displayed in green and has a range of $\pm .99$. On ground, when the data is invalid, the readout is replaced by an **ACC**. The **ACC** is removed when in flight if the data is still invalid.

The Mach readout is displayed at the bottom of the airspeed tape when in flight. It is displayed in the same colors as the airspeed digits and has a range of .400 to .998 Mach. It is displayed when MACH is greater than .450 Mach and is removed below .400 Mach.

When Mach is invalid, the readout is amber dashed (---).

NOTE

The displayed Mach is an indicated Mach.
The true Mach shall be calculated with the correction table provided by the AFM.

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Vertical speed tape

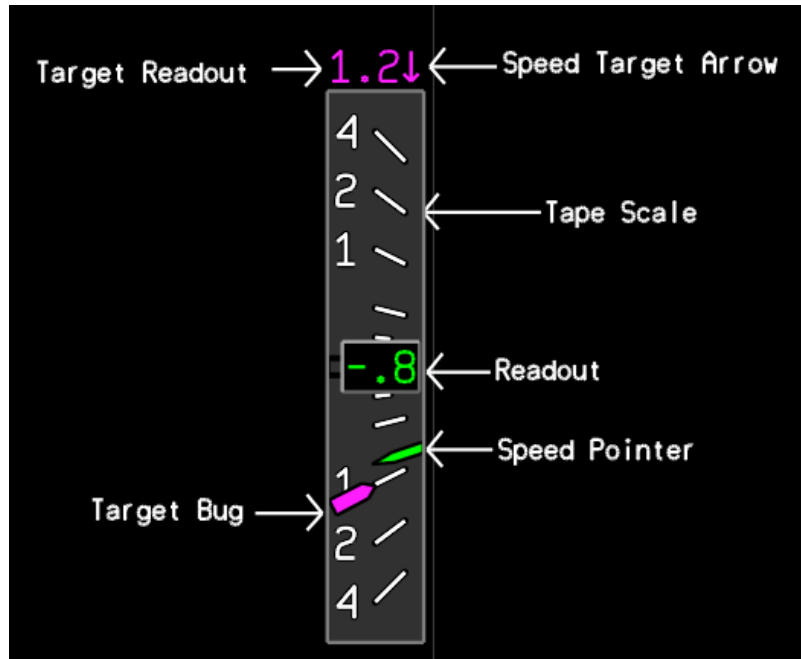


FIGURE 02-34_8-20-13 - VERTICAL SPEED TAPE

■ Vertical speed tape

The vertical speed is a fixed scale with a moving speed pointer. Each tick mark on the scale represents respectively 0, ± 250 ft/min, ± 500 ft/min, $\pm 1,000$ ft/min, $\pm 2,000$ ft/min, and $\pm 4,000$ ft/min.

When the VS is invalid, all the symbols are removed from the tape and a red VS flag is displayed at the top of the scale.

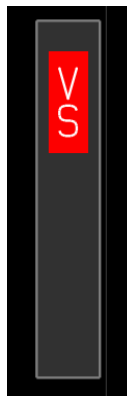


FIGURE 02-34_8-20-14 - VERTICAL SPEED TAPE INVALID

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- **Vertical speed readout**

The vertical speed readout is displayed in green in the middle of the vertical speed scale. It indicates vertical speed in feet per minute (100 ft/min increments).

Negative values for the vertical speed are displayed with minus sign at the beginning of the readout.



FIGURE 02-34_8-20-15 - VERTICAL SPEED AT ZERO

- **Vertical speed pointer**

The vertical speed pointer is displayed in green. It gives an analog display of the VS.

- **Vertical speed target readout and arrow**



FIGURE 02-34_8-20-16 - VERTICAL SPEED TARGET

The vertical speed target is displayed above the tape in magenta when in vertical VS captured mode (100 ft/min increments). It is set using the VS / PATH wheel on the GP when in VS.

The vertical speed target bug is displayed on the tape in magenta when in VS.

The arrow displayed close to the target indicates if a positive or negative VS is set.

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SENSORS WINDOW

IRS selection

The selection of IRS available is displayed in the navigation tab (IRS 1, IRS 2 or IRS 3).

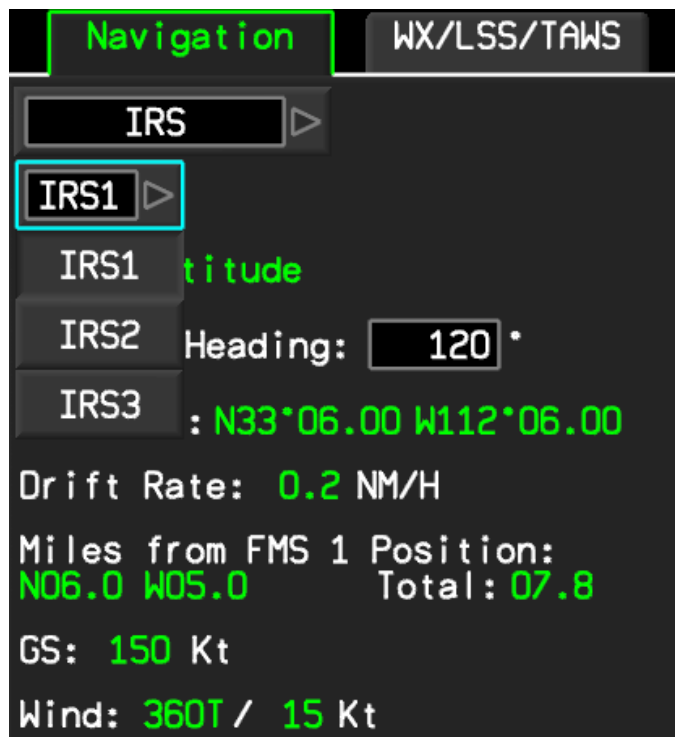


FIGURE 02-34_8-20-17 – IRS SELECTION

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Navigation mode

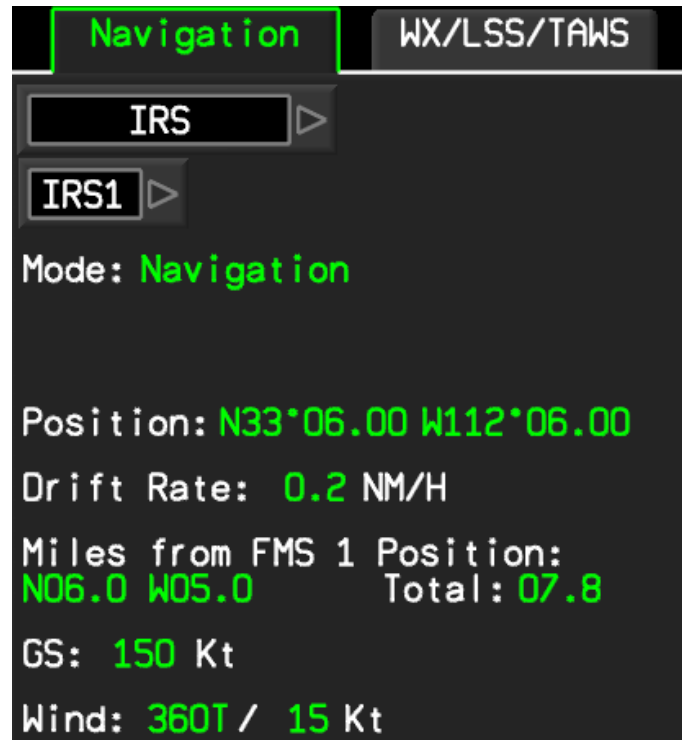


FIGURE 02-34_8-20-18 – NAVIGATION MODE

All data on the page in this configuration is non-modifiable.

All data comes from the selected IRS except for the "Miles from FMS x Position" and the "Drift Rate" which are computed by the FMS.

The FMS x corresponds to the FMS driving the Display Unit in which this window is displayed.

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Align mode

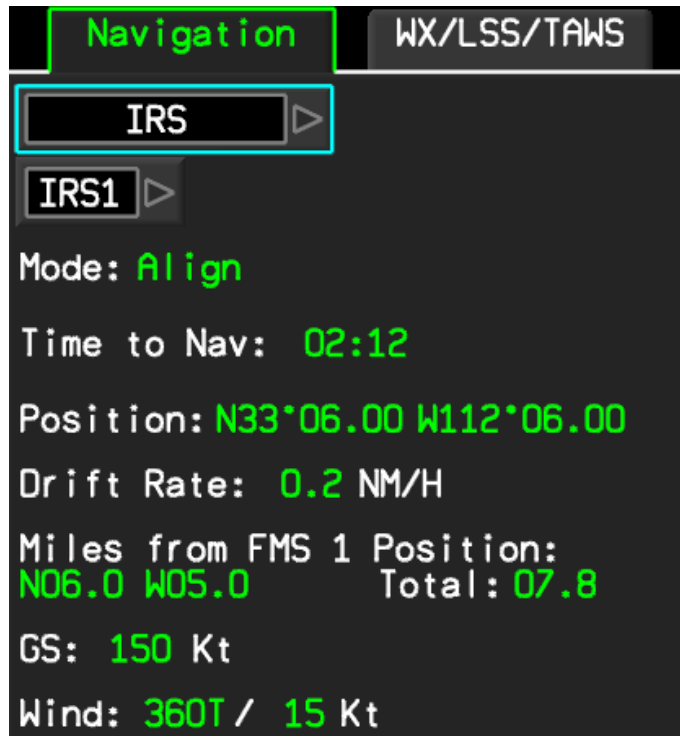


FIGURE 02-34_8-20-19 – ALIGN MODE

Any available data is displayed, and what is not available is shown with amber dashes.

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Attitude mode

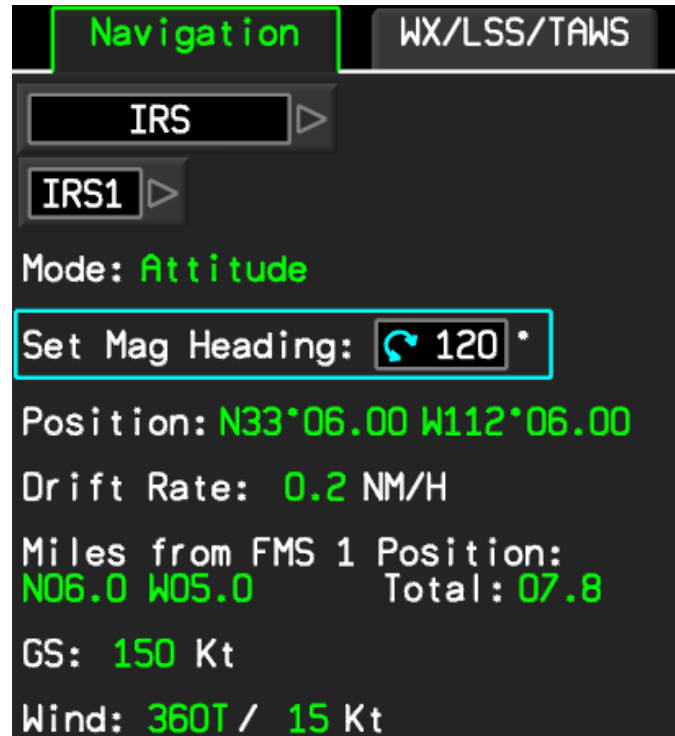


FIGURE 02-34_8-20-20 – ATTITUDE MODE

If the mode of the IRS becomes “Attitude” and a heading input is required, the **Set Mag Heading:** entry field is displayed in the Navigation tab.

This entry field allows for a manual input of a magnetic heading into the IRS. Entry into this field will result in the FMS providing an output of the entered heading to the IRS.

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MONITORING OF THE SYSTEM

IRS is monitored with regard to following parameters:

- Availability of an initial latitude and longitude,
 - Validity of GPS data,
 - Availability of ADS data.
- *Refer to CODDE 2 for a complete list of CAS messages.*

Many monitoring functions are performed within the AHRS channels and across channels to ensure system integrity:

- The angular rate and acceleration sensors in each channel are skewed with respect to each other to facilitate an integrity monitor. Sensor data is exchanged between the channels and compared using a parity matrix. This method can identify an out of tolerance sensor and therefore, determine proper channel to use in the event of a sensor failure.
- *Refer to 02-34_3, for the annunciations provided by the AHRS and displayed on the SFD.*

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ACTIVE PROTECTIONS

The IRS and AHRS systems do not feature any automatic protections.

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No supplementary information to be provided on System Protections at present time.

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The IRS and AHRS do not require any Ground Operation action.

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INTRODUCTION

The Radar Altimeter system operates over large differences in terrain, weather conditions, and airplane attitude to calculate the airplane altitude during approach and landing.

Two Radar Altimeter are installed on the FALCON 7X.

The two Radar Altimeters provide the crew with exact distance to ground information when the airplane is within 2500 ft or less of the ground.

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FLIGHT DECK OVERVIEW

CONTROLS

Controls of the RA include:

- The Reversion Panel,
- The TEST synoptic page.

INDICATIONS

Cockpit indications related to RA are available:

- In the ADI window,
- The ENG-CAS window to display CAS messages,
- The STATUS synoptic page / FAULT tab for fault messages.

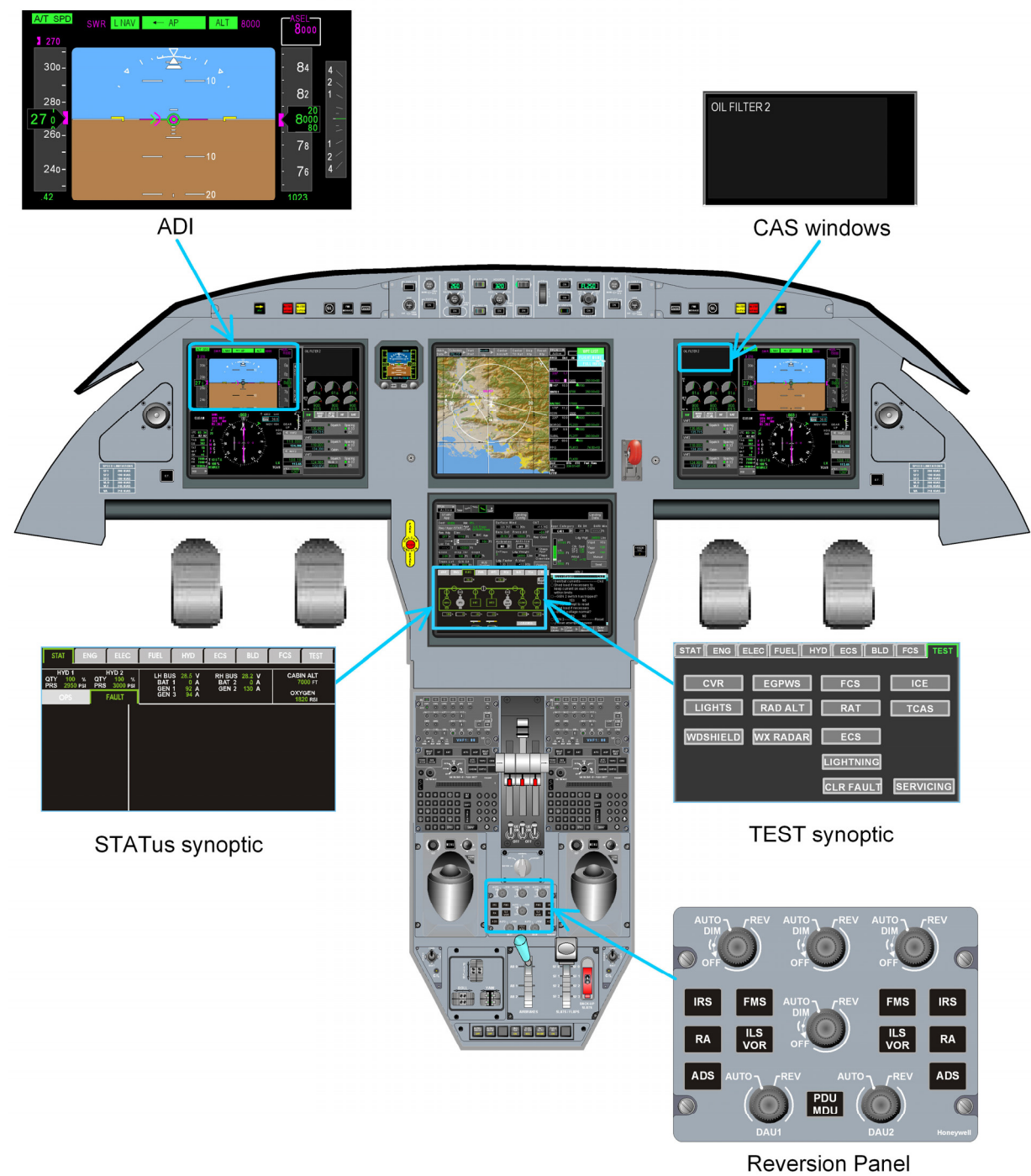


FIGURE 02-34_9-05-00 - FLIGHT DECK OVERVIEW

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GENERAL

Each Radar Altimeter (RA) system includes the following components:

- A RA receiver/transmitter,
- A RA transmitter antenna,
- A RA receiver antennas,
- A RA system configuration module.

The RA system is energized before takeoff.

During the flight, it monitors the airplane altitude up to the maximum range of the system.

The RA system indicates when the airplane reaches altitude. The Radar Altimeter system also shows the ground separation and climb conditions during night or instrument takeoffs, and the ground clearance during approaches.

Each PDU shows the radar altitude data as a digital display in the Attitude Director Indicator (ADI) window.

By default, the RA 1 is displayed in LH ADI and the RA 2 in RH ADI. Pushbuttons on Reversion Panel allow changing this configuration.

RADAR ALTIMETER RECEIVER / TRANSMITTER

The RA receiver/transmitter transmits and receives frequency-modulated continuous wave signals through the radar altimeter Antennas.

The RA receiver/transmitter measures the time interval between the transmitted and received signals to calculate the airplane altitude.

RADAR ALTIMETER ANTENNAS

The receive antenna receives the frequency-modulated continuous wave signal reflection from the ground and supplies it to the receiver part of the radar altimeter receiver/transmitter.

The transmitter part of the RA receiver/transmitter supplies the frequency-modulated continuous wave signals to the transmit antenna, which transmits the signal to the ground.

RADAR ALTIMETER SYSTEM CONFIGURATION MODULE

The radar altimeter system configuration module stores the zero offset altitude settings. The zero offset altitude settings is a radar altitude of 0 ft when the main wheels first touch down and have a negative offset value when taxiing or stationary on the ground.

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PRINCIPLE DIAGRAM

Each RA receiver/transmitters send digital radar altitude data to the Modular Avionics Unit (MAU) and Traffic Control Avoidance System (TCAS) through ARINC 429 data bus.

The MAU changes the digital radar altitude data to a format that shows on the LH pilot and RH pilot PDU.

The MAU transmits the digital radar altitude data to the combines recorder, EGPWS module and PFCS.

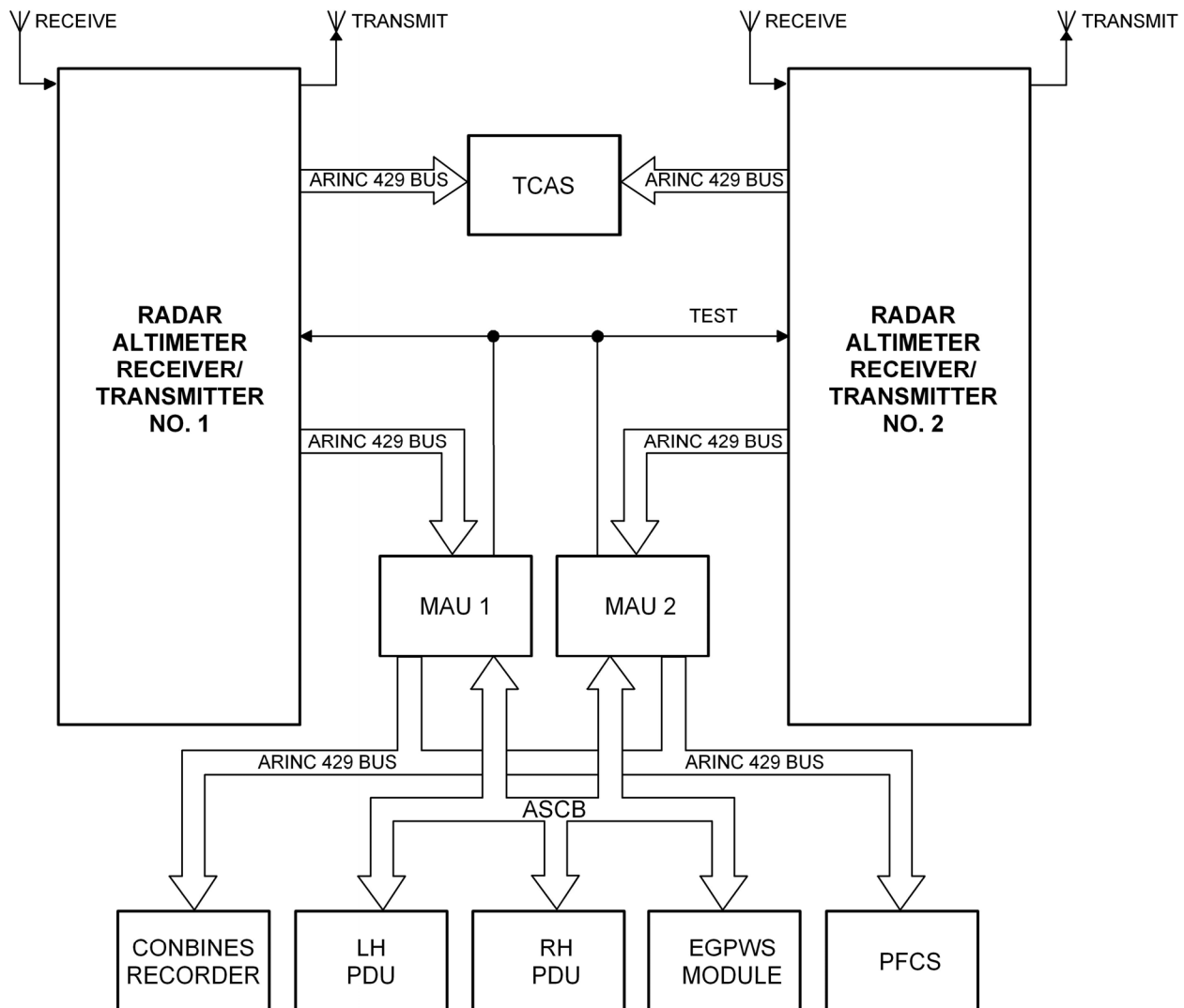


FIGURE 02-34_9-10-00 - PRINCIPAL DIAGRAM

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RA system provides data to:

- The Enhanced Ground Proximity Warning System,
- The Flight Director (FD) for approach mode (glideslope),
- The Traffic Crew Alerting System (TCAS) to inhibit the descent Resolution Advisory (RA), the TCAS is put in TA only mode when below 1,000 ft,
- The combines recorder,
- The Primary Flight Control System (PFCS).

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DESIGN PRINCIPLES

The RA system was designed taking into account the following design principles:

- The location of antennas lets each antenna operate at the usual limits of pitch and roll.

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EQUIPMENT LOCATION

RADIO ALTIMETERS TRANSMITTER / RECEIVER 1 AND 2 LOCATION

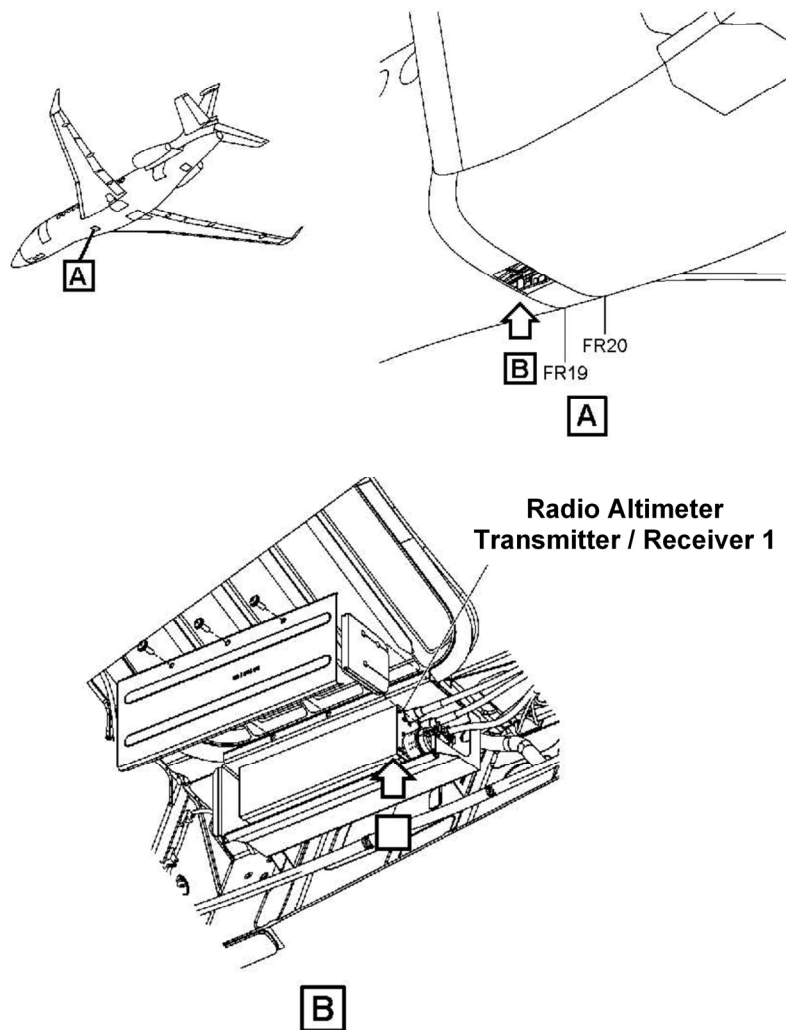


FIGURE 02-34_9-15-00 - RADIO ALTIMETERS LOCATION

The RA transmitter / receiver 2 is beside the RA transmitter / receiver 1.

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ANTENNAS LOCATION

The Radio Altimeter antennas are located on the bottom on the airplane fuselage.

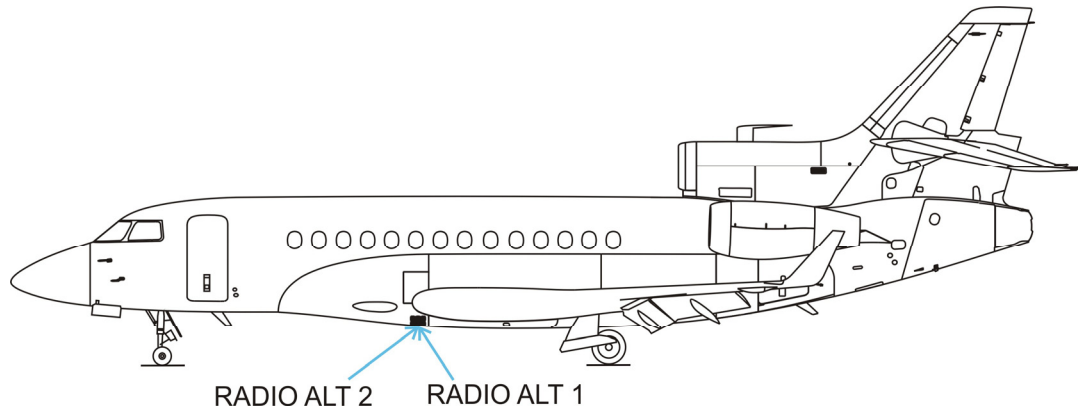


FIGURE 02-34_9-15-01 - RADIO ALTIMETERS ANTENNA

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ELECTRICAL POWER SOURCE

The following paragraph describes the power supply of the different equipment of the Radio Altimeter system.

Electrical protection is provided:

- Either by Solid State Power Controllers (SSPC),
 - Or by Circuit Breakers (CB).
- *Refer to ATA 24 – ELECTRICAL POWER for additional information.*

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
RA 1	LH Main	LH MASTER	SSPC
RA 2	RH Main	RH MASTER	CB

CONTROLS

Crew has control on the Radio Altimeter system through:

- The Reversion Panel,
- The TEST synoptic page.

REVERSION PANEL

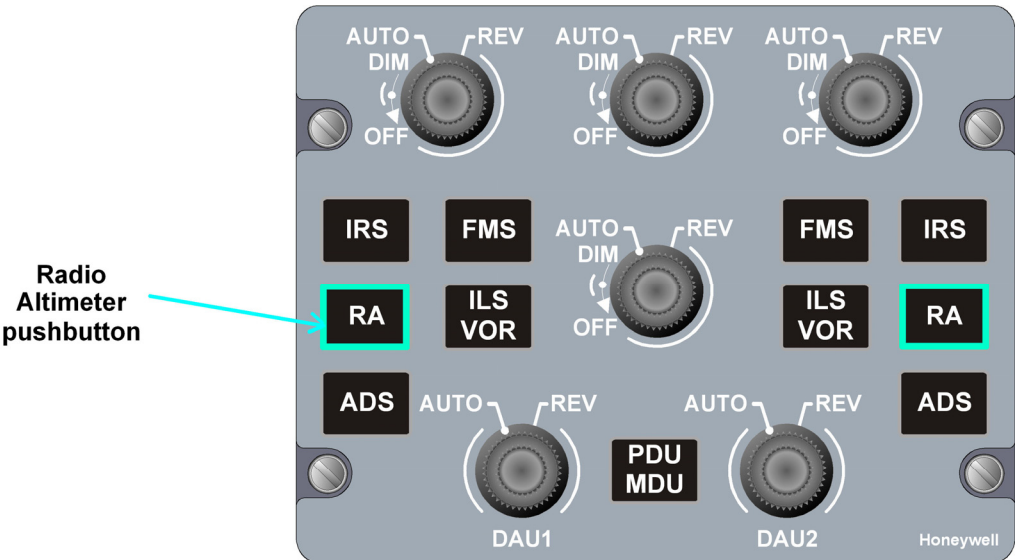


FIGURE 02-34_9-20-00 - REVERSION PANEL

CONTROL	FUNCTION	LOCAL INDICATION
<div>RA</div>	<p>Allows using the other RA source for display on PDU, with the following cycle when pushing on the reversion switch:</p> <ul style="list-style-type: none"> - On the LH side: RA 1 initially, RA 2. - On the RH side: RA 2 initially, RA1. 	

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TEST SYNOPTIC

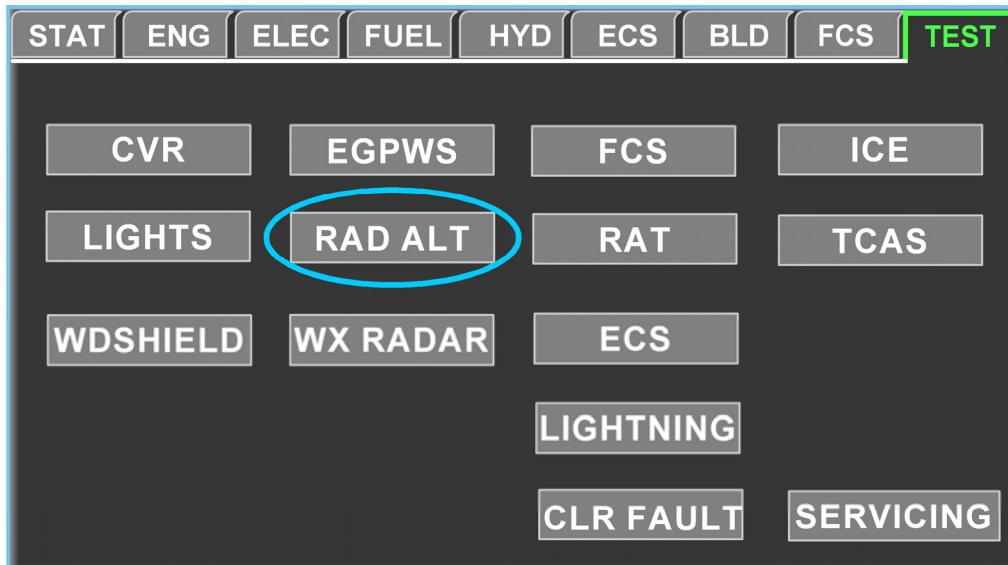


FIGURE 02-34_9-20-01 – TEST SYNOPTIC

To operate the RA self-test the crew members click on the TEST soft key.

The test is successful if during the test:

- The same RA value is displayed in the ADI window,
- The white RA text on red background is displayed in the ADI window,
- There is no RA CAS message or RA FAULT message.

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INDICATIONS

Crew has indication on the Radio Altimeter system through:

- The ADI window,
- The ENG-CAS window to display CAS messages,
- The STATUS synoptic page / FAULT tab for fault messages.

ADI WINDOW

Radio altitude value

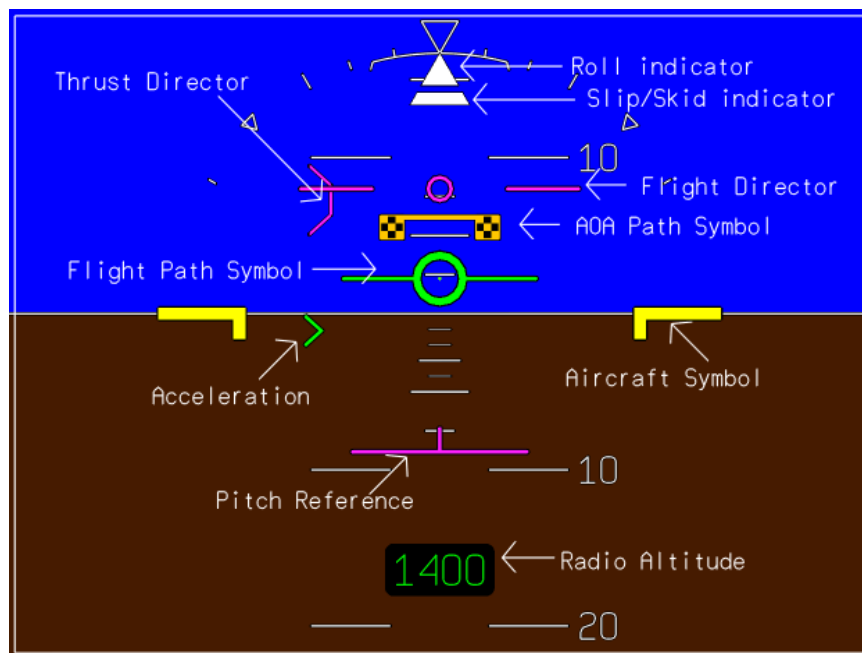


FIGURE 02-34_9-20-02 – ADI WITH RADIO ALTITUDE DISPLAY

The radio altitude digits will be displayed in green text with black background with the range of -20 to +2,500 feet on the ADI. The resolution is 5 feet.

For radio altitude less than -20 feet, the display remains at -20 feet.

For radio altitude greater than +2,500 feet, the display is removed.

Radio altimeter decision height

The Radio Altimeter Decision Height (RA DH) is displayed in white and is located on the lower right corner of the ADI window.

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Radio altitude in failure mode

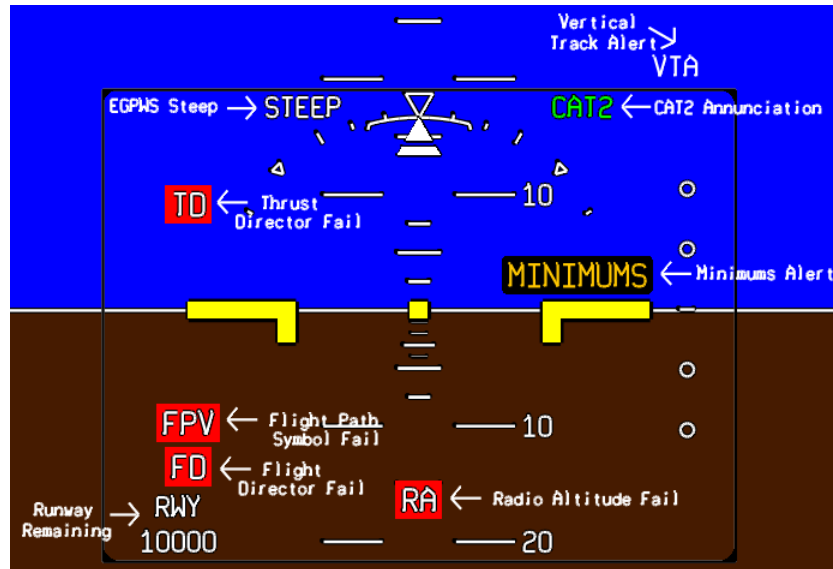


FIGURE 02-34_9-20-03 – ADI WITH RADIO ALTITUDE FAIL DISPLAY

RA flag is displayed when corresponding Radar Altimeter is failed.

Radio altitude in miscompare mode

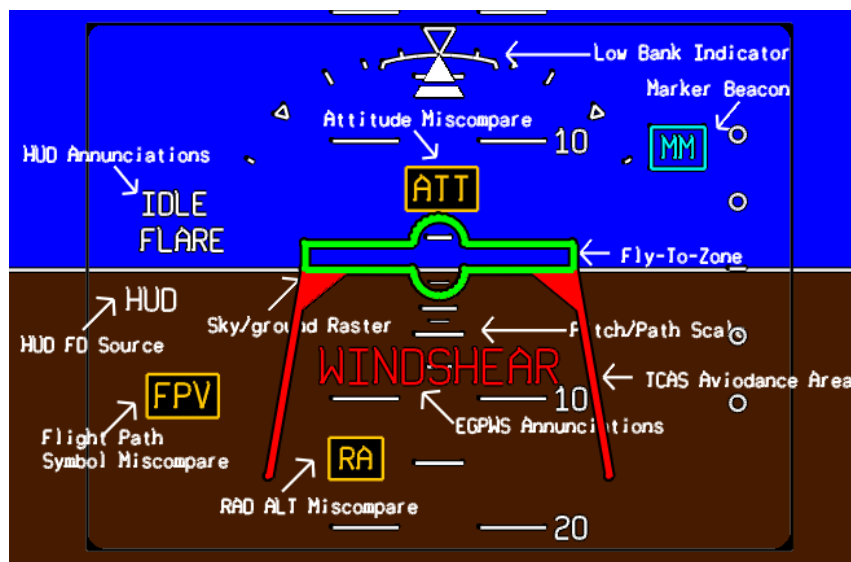


FIGURE 02-34_9-20-04 – ADI WITH RADIO ALTITUDE MISCOMPARE DISPLAY

Miscompare **RA** flags alert the following:

- Non-linear altitude difference of 10 feet (at zero) to 333 feet (at 2,500),

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Reversion flag

In case of reversion of one of the RA, a flag will be displayed in the ADI to warn the crew that displays receive RA data from the same source.

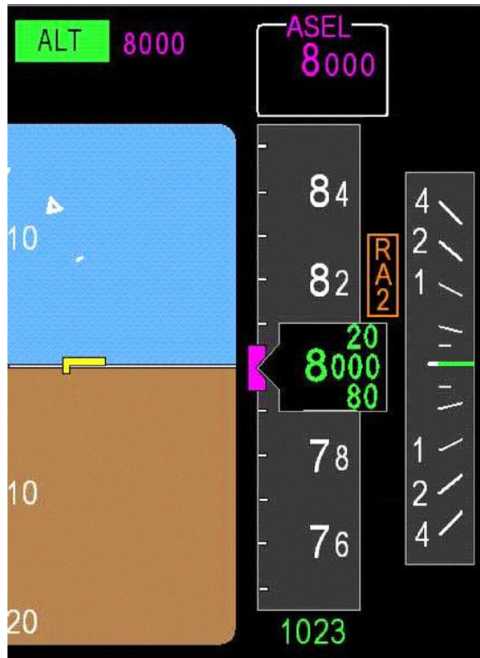


FIGURE 02-34_9-20-05 - RA 2 REVERSION

ATTitude display: low altitude awareness

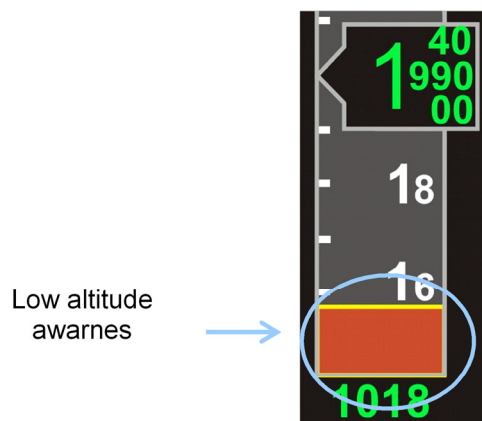


FIGURE 02-34_9-20-06 - LOW ALTITUDE AWARENESS

The low altitude awareness symbol is displayed when approaching the ground. The ground is displayed brown with a yellow line at the top. The ground is displayed when the RA is lower than 550 ft.

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MONITORING OF THE SYSTEM

A power-on built in test starts when the radar altimeter system has been energized.

➤ *Refer to CODDE 2 for a complete list of CAS messages and FAULT messages.*

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ACTIVE PROTECTIONS

The RA system does not provide any automatic protection.

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No supplementary information to be provided on System Protections at present time.

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The RA system does not require any Ground Operation action.

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INTRODUCTION

The radio navigation system provides VOR, LOC, GS, MB, DME and ADF information for navigation purpose:

- VOR: for radio direction information,
- ILS: for approach and landing navigation guidance information that includes the Localizer, Glideslope and Marker Beacon,
- DME: for slant range, ground speed and time to station,
- ADF: for determining relative bearing compared to a selected station.

This information is used directly by the pilots and / or by the Flight Management System (FMS) and /or by the Flight Director (FD).

The Secondary Flight Display (SFD) uses the VOR / LOC1 information.

There is no optional equipment associated with the NAVAIDS systems.

- *Refer to section 34_9 for Radio Altimeter description and section 34_1 for Global Position System description.*

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FLIGHT DECK OVERVIEW

CONTROLS

The management of NAVAIDS is done through controls located:

- On the Audio Panel,
- On the CCD (Cursor Control Device),
- On the MKB (Multifunction Keyboard),
- On the RADIOS window,
- On the SENSORS window,
- On the I-NAV window,
- On Waypoint list window.

INDICATIONS

NAVAIDS indications are displayed:

- On the Horizontal Situation Indicator (HSI) window,
- On the RADIOS window,
- On the SENSORS window,
- On the ADI window,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

Audio tone is generated for Marker Beacon.

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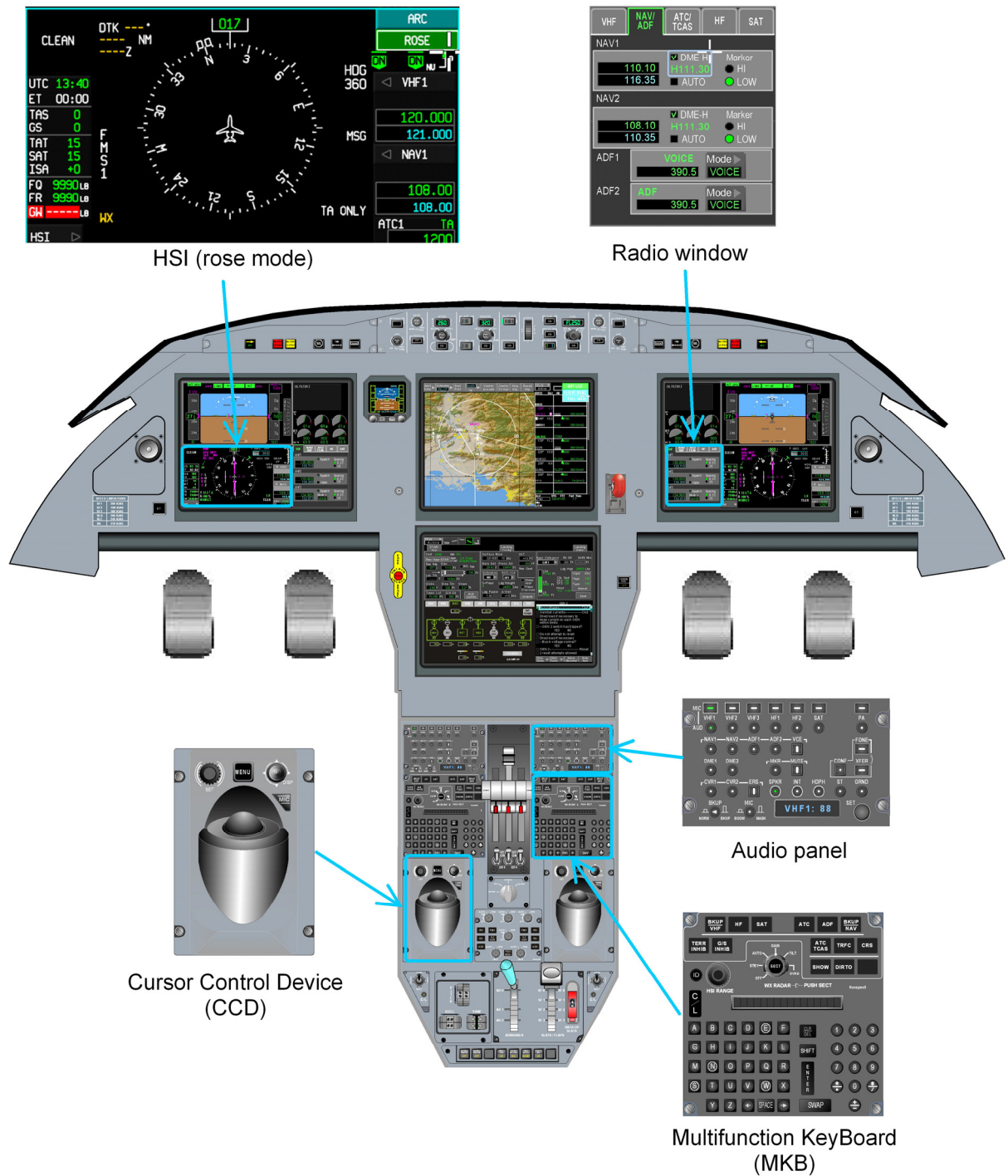


FIGURE 02-34_10-05-00 - FLIGHT DECK OVERVIEW

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VOR SYSTEM

VOR function is performed by:

- VIDL-G 1 (VOR/ILS Data Link/GPS 1) module located in MRC1,
- VIDL-G 2 (VOR/ILS Data Link/GPS 2) module located in MRC2,
- Antennas associated to VOR1 and VOR2.

In emergency mode VOR tuning is always possible directly through the MKB.

The VOR/LOC receiver operates over the frequency range 108.0 MHz to 117.95 MHz in 50 kHz increments.

The VOR information can be displayed to the pilots via the HSI window in the form of arc or rose.

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ILS SYSTEM

The ILS system is comprised of the localizer, glide slope and marker beacon receivers. The ILS system receivers are housed in the VIDL-G module.

ILS function is performed by:

- VIDL-G 1 (VOR/ILS Data Link/GPS 1) module located in MRC1,
- VIDL-G 2 (VOR/ILS Data Link/GPS 2) module located in MRC2,
- Antennas associated to VOR1 and VOR2;
- Antennas associated to GS 1 and GS2.

The ILS receiver information is displayed on the PDU:

- A small course deviation indicator on the lower portion of the ADI and
- A glide slope indicator present on the right hand side of the ADI.

The ILS information can also be displayed in the Secondary Flight Display.

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DME SYSTEM

The Distance Measuring Equipment allows to transmit an UHF signal to the selected station. The ground station receives this signal and transmits a reply back to the airplane. The DME module records the round trip time of this signal exchange and computes slant range, ground speed and time to station.

DME function is performed by:

- DME1 module located in MRC1,
- DME2 module located in MRC2,
- Antennas associated to DME1 and DME2.

The DME contains a transmitter and receiver module, along with all the processing circuitry.

The DME operates over the frequency band 960.0 to 1215.0 MHz in 1 MHz increments and has six channels.

The DME has a selectable hold mode allowing the pilot to hold the current DME station data on the display and tune the VOR or ILS to a different frequency.

If hold is selected, the DME will continue to display information of the station that was the primary radio-navigation frequency when the hold mode was checked, even if the pilot changes radio-navigation frequencies.

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ADF SYSTEM

The ADF is a radio receiver used for determining relative bearing compared to a selected station.

The ADF is capable of receiving signals from station which transmit in the low or medium frequency band. This means that it receives regular commercial broadcasting stations or special Non Directional radio Beacons (NDB). It will not receive signal from VOR stations.

ADF function is performed by:

- ADF1 module located in MRC1,
- ADF2 module located in MRC2,
- Antennas associated to ADF1 and ADF2.

The ADF operates:

- In normal operation, over the frequency band of 190.0 to 1799.5 kHz in 500 Hz increments,
- In maritime emergency listening, the ADF can receive the frequency band of 2181 to 2183 kHz,
- Can tune frequencies in the range from 100 kHz to 190 kHz.

The ADF has four selectable modes:

- ADF mode receives the ADF station's signal and displays the relative bearing to station: the bearing pointer appears on the compass rose (when selected) on the pilot or copilot PDU.
- Antenna (ANT) mode receives the ADF station's signal only and does not compute bearing: it is used for identifying the station.
- Beat Frequency Oscillator (BFO) mode adds a tone that can be heard in the ADF receiver when the carrier is on. BFO are used for receiving transmitters that do not have the tone put in such as coastal or maritime stations.
- Voice mode opens the IF bandwidth for improved audio fidelity. It serves no navigation purpose.

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PRINCIPLE DIAGRAM

VOR data are sent from VIDL-G module to the MAU (for FMS and display) through the NIM module and ASCB bus. Data travels the same path in reverse to go back to the VIDL-G in the event of a VOR frequency tune or course change.

ILS data are sent from VIDL-G module to the MAU (for a FMS and displays) through the NIM module and ASCB bus. Data travels the same path in reverse to go back to the VIDL-G in the event of an ILS frequency tune change.

A backup tuning mode allows tuning ILS frequencies via a dedicated bus (ARINC-429) between MKB and VIDL-G module through NIM module.

Localizer (LOC) and Glide Slope (GS) are sending to the SFD via ARINC 429 bus.

DME data are sent from DME module to the MAU (for FMS and display) through the NIM module and ASCB bus. Data travels the same path in reverse to go back to the DME in the event of a VOR frequency tune or course change.

A backup tuning mode allows tuning DME frequencies via a dedicated bus (ARINC-429) between MKB and VIDL-G module through NIM module.

ADF data are sent from ADF module to the MAU (for displays) through the NIM module and ASCB bus. Data travels the same path in reverse to go back to the ADF module in the event of an ADF frequency tune change.

ADF audio signal are sent from ADF module to the Audio Panel through NIM module and digital audio buses.

This diagram shows as an example:

- MRC1 modules, including the NIM, VIDL-G, DME and ADF,
- VOR, LOC, GS, ADF and DME antennas,
- Links between the MAU and MRC,
- The Audio Panels,
- Digital audio bus controlled by the NIM (blue on the diagram) ,
- The A429 connection between NIM and the MKB (red on the diagram).

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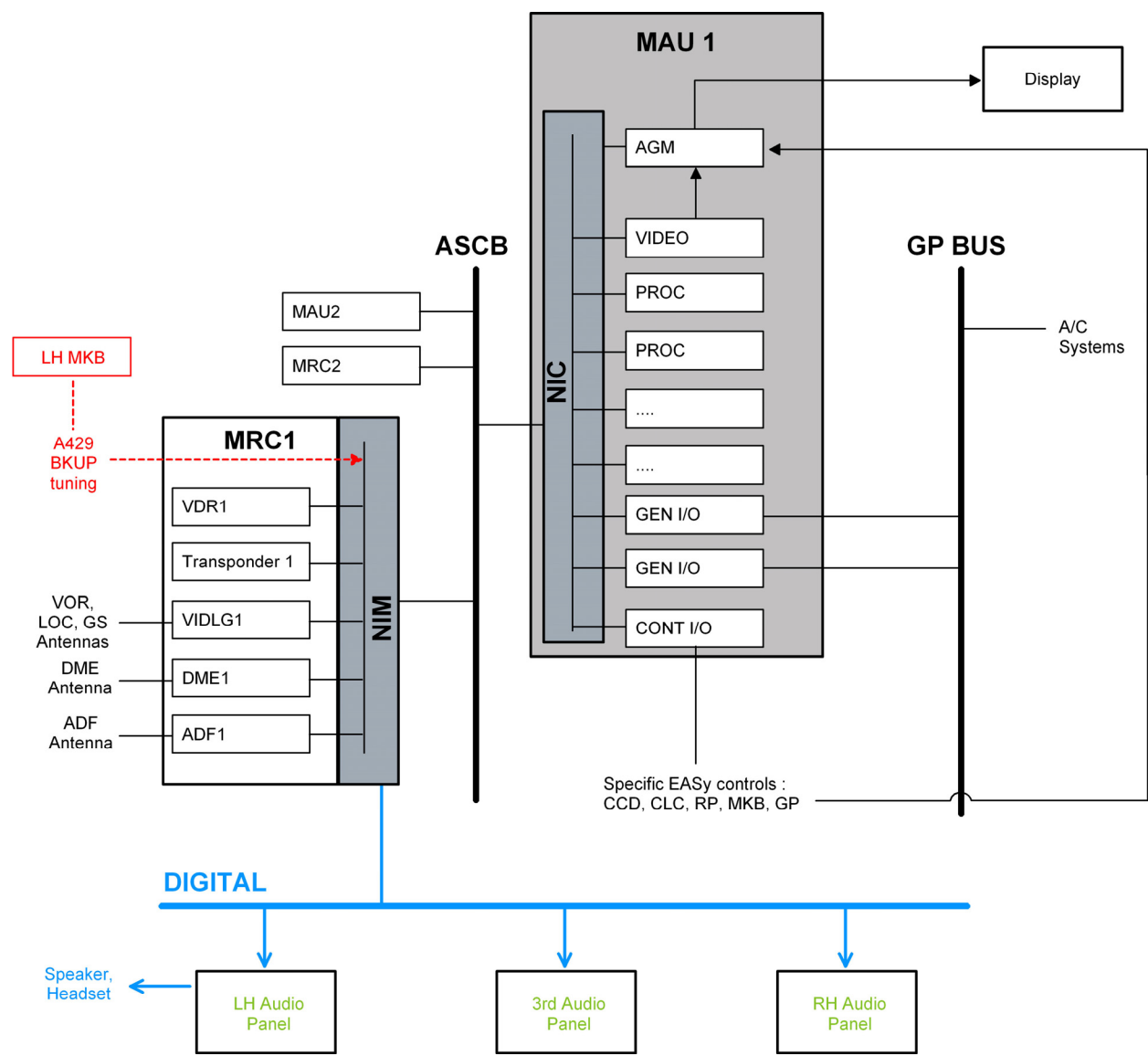


FIGURE 02-34_10-10-00 - NAVAIDS SYSTEM PRINCIPLE DIAGRAM

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DESIGN PRINCIPLES

The NAVAIDS system was designed considering the following design drivers:

- With regard to electrical power supply:
 - o One NIM module (MRC 1) is powered by Essential bus and the other (MRC 2) is powered by Main bus,
 - o Each module of the MRC has a separate power supply.
- With regard to architecture:
 - o A backup tuning of the VOR is available using the MKB, via a dedicated bus (ARINC-429) between MKB and VIDL-G module in case of failure of ASCB bus or NIM.

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EQUIPMENT LOCATION

MRC 1 is installed in the fuselage under the floor near frame 12.

MRC 2 is installed in the cone right side on the upper shelf.

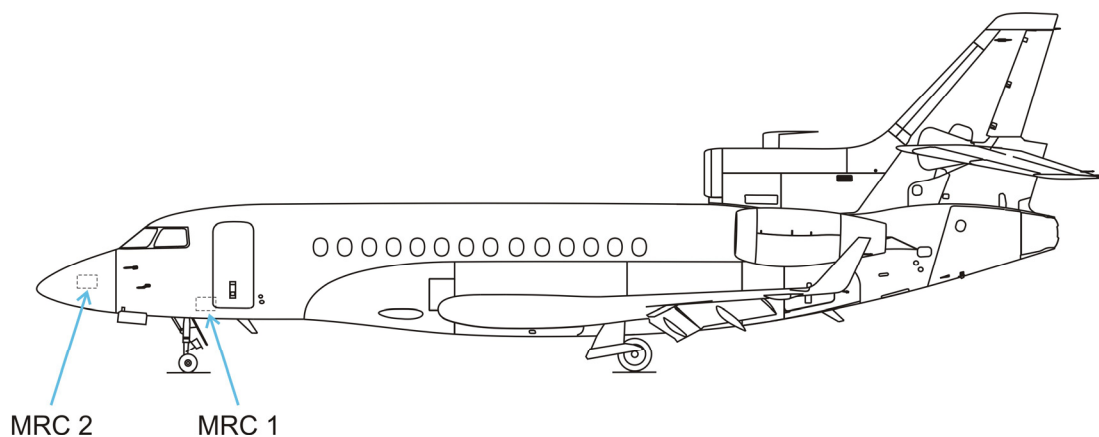


FIGURE 02-34_10-15-00 - LOCATION EQUIPMENT

ANTENNAS

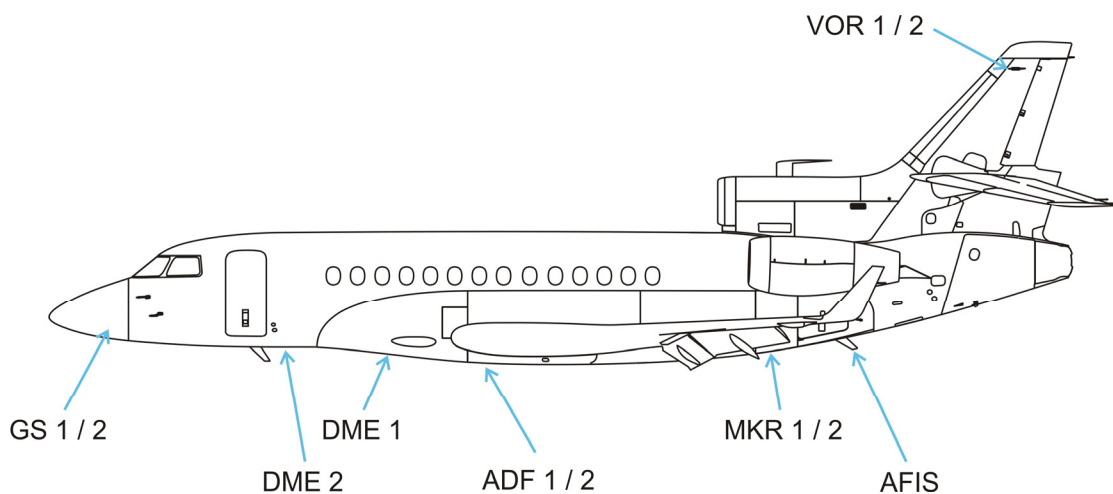


FIGURE 02-34_10-15-01 - NAVAIDS ANTENNAS

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ELECTRICAL POWER SOURCE

Following paragraph describes the power supply of the different equipment of the NAVAIDS.

Electrical protection is provided either by:


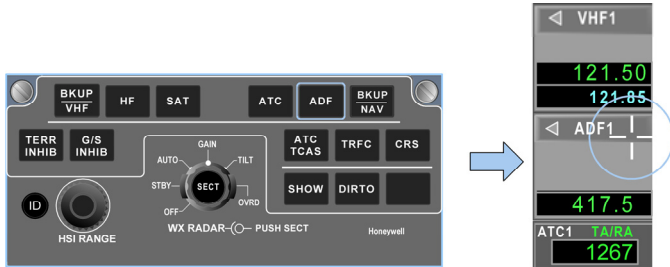




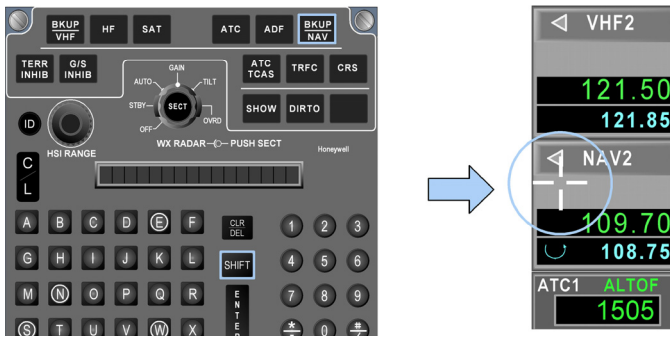

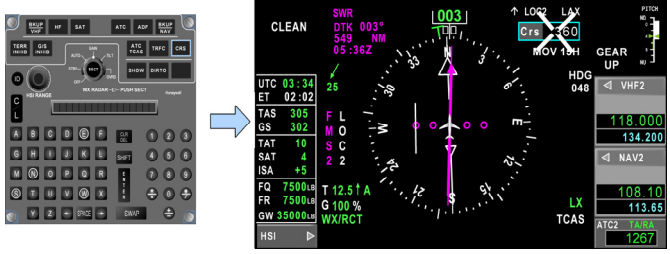
- Solid State Power Controllers (SSPC) ,
- Circuit Breakers (CB).

➤ Refer to ATA 24 – ELECTRICAL POWER for additional information.

EQUIPMENT	POWER SUPPLY	MASTER SWITCH	TYPE OF PROTECTION
MRC 1 NIM	LH Essential	Not relevant	CB
MRC 2 NIM	RH Main	RH MASTER	CB
VIDL-G 1	LH Essential	LH INIT	CB
VIDL-G2	RH Main	RH MASTER	CB
ADF 1	LH Essential	LH INIT	CB
ADF 2	RH MAIN	RH MASTER	CB
DME 1	LH Main	LH MASTER	CB
DME 2	RH Main	RH MASTER	CB

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Buttons description:

CONTROL	FUNCTION	LOCALISATION
	At anytime, pressing the ADF shortcut on the MKB positions the cursor on the on-side Permanent Radio Bar (on ADF1 on the LHDU or ADF2 on the RHDU).	
	At any time, pressing the BKUP / NAV shortcut on the MKB positions the CCD cursor on the on-side Permanent Radio Bar (on NAV1 on the LHDU and on NAV2 on the RHDU).	
 + 	Enable tuning the on-side NAV frequency in case of loss of normal tuning.	
	Allows to display the VOR / LOC CDI on the on-side PDU	

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AUDIO PANEL

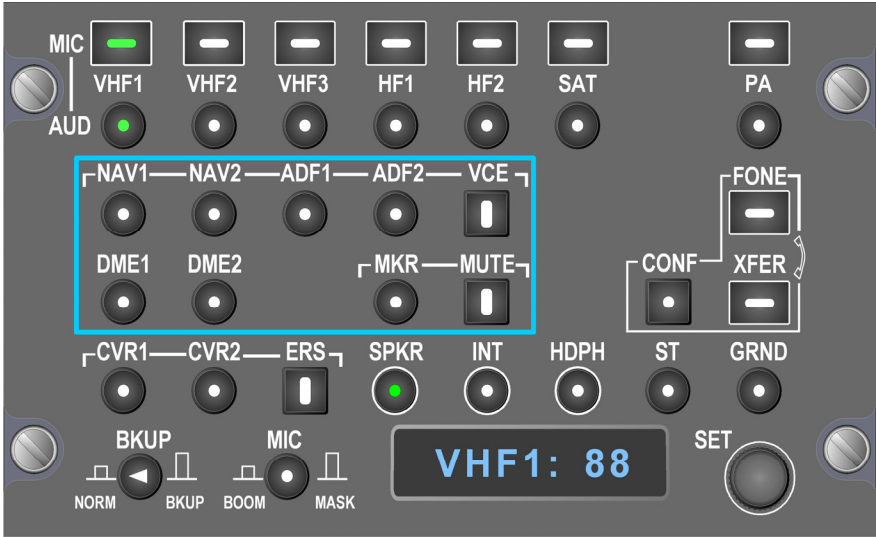

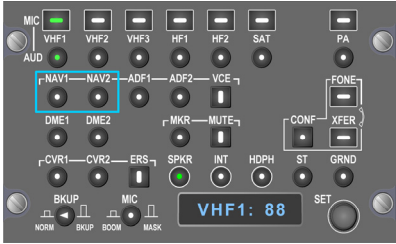

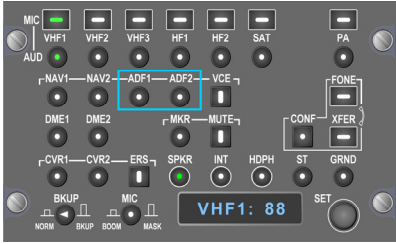

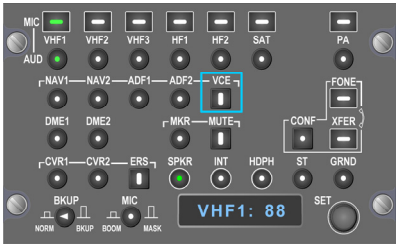

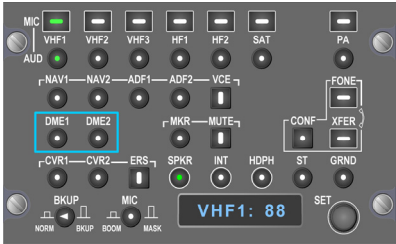

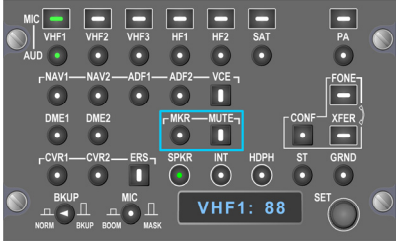


FIGURE 02-34_10-20-01 – AUDIO PANEL

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Buttons description:

CONTROL	RADIO DEVICE OR FUNCTION	CHARACTERISTICS	LOCALISATION
	NAV 1 and 2	Selects reception of NAV1 and NAV2.	
	ADF 1 and 2	Selects reception of ADF1 and ADF2.	
	VOICE for VOR and ADF	VCE is a filter for VOR and ADF, which lowers the Morse code audio level transmitted by the ground station. Only voice is audible (ATIS for example) when VCE is selected.	
	DME 1 and 2	Selects reception of DME1 and DME2.	
	MARKER	Selects MKR listening (MKR). Marker sound can be muted (MUTE) for a few seconds, after which it will automatically revert to the normal sound level.	

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PERMANENT RADIO BAR

On the Permanent Radio Bar of the HSI, each crew member can see the NAV or ADF frequency through the pull down menu of the customized field.

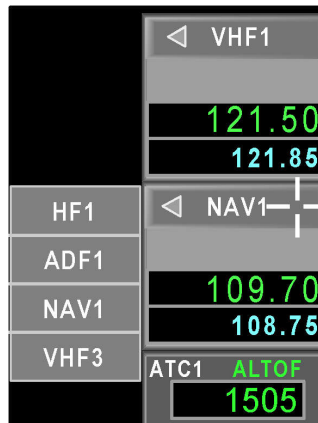



FIGURE 02-34_10-20-02 - PULL DOWN MENU FOR NAV SELECTION (LH PRB)

Once the cursor is on the NAV or AF frequency field, tune the preset frequency:

- By rotating the knob on the CCD base (outer ring for units, inner for decimals),
- Or by dialing the frequency on the MKB and pressing  to validate

Swap on request between active and preset frequencies, by clicking <ENTER> on the CCD or pressing the **SWAP** pushbutton on the MKB, as for the VHF and HF frequency swapping.

RADIO WINDOW

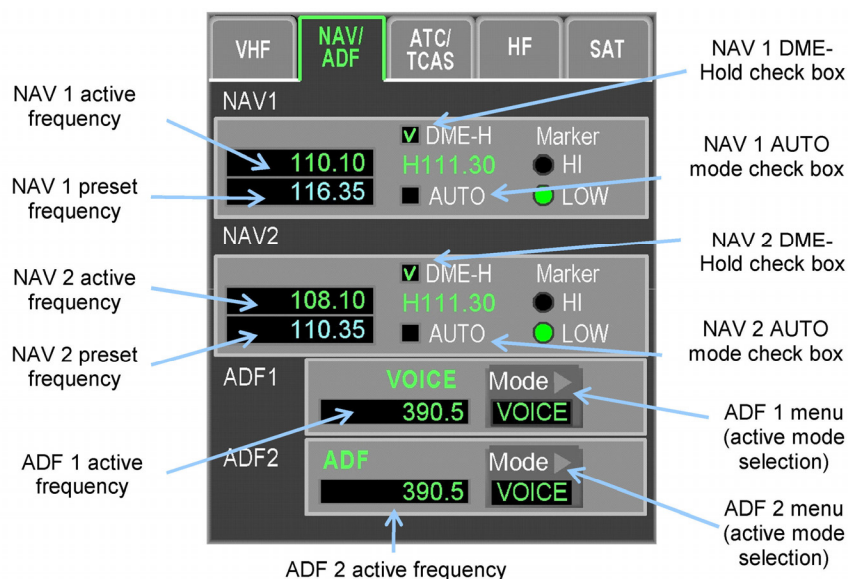


FIGURE 02-34_10-20-03 - NAV / ADF TAB ON THE RADIOS WINDOW

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Tuning

When on the NAV / ADF page, position the cursor on the desired NAV field, and do as on the Permanent Radio Bar (PRB) through the CCD or the MKB.

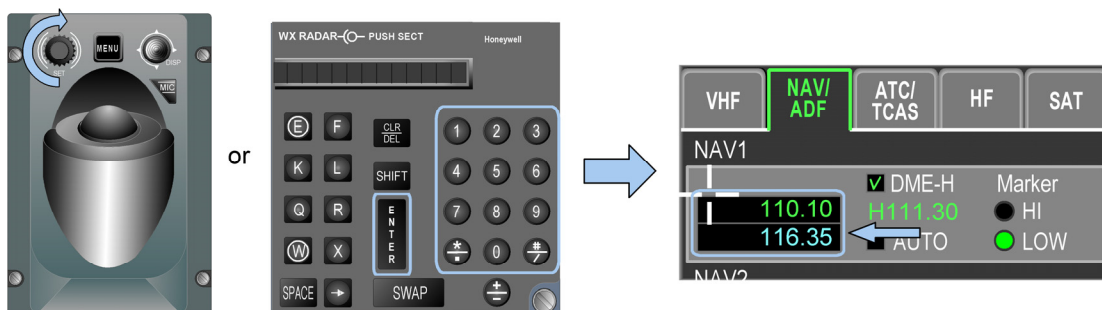


FIGURE 02-34_10-20-04 – NAV FREQUENCY CHANGE ON THE NAV / ADF TAB

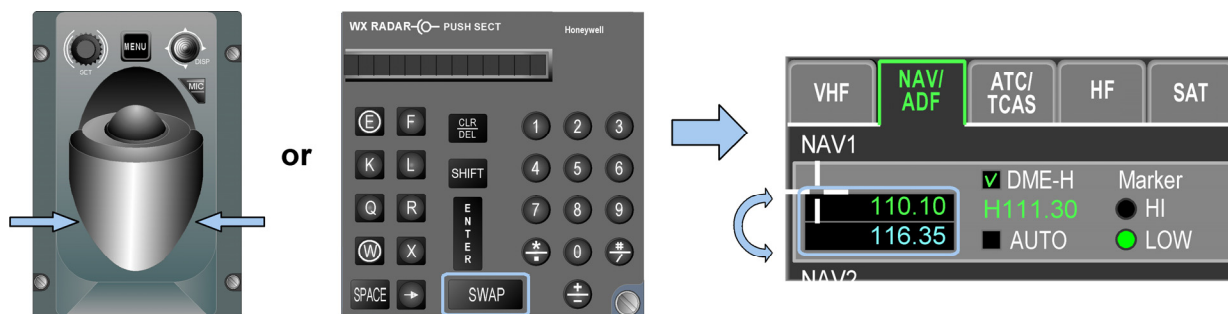


FIGURE 02-34_10-20-05 – NAV FREQUENCY SWAPPING ON THE NAV / ADF PAGE

NOTE

Only preset frequency can be tuned.
To become active, it has to be swapped with the active frequency.

NAV modes

Several modes are available for the NAV setting: DME-H, AUTO and Marker.

■ DME-H mode

This function holds a DME station frequency in memory and makes selection of another NAV frequency possible. When selected, a green **H** and the frequency of the held station appears below the DME-H field.

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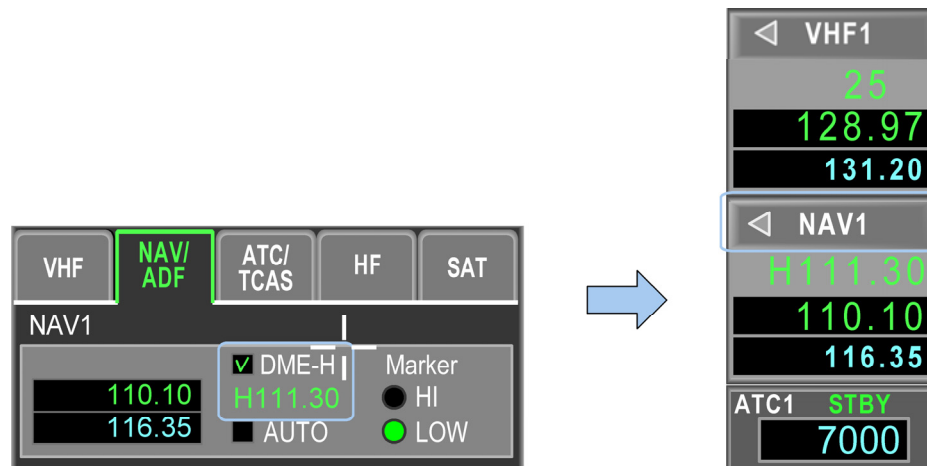


FIGURE 02-34_10-20-06 - DME FREQUENCY HOLD

■ AUTO mode

The AUTO mode enables the FMS to auto-tune the NAV frequency. Manually tuning the frequency deselects the AUTO mode if engaged. The default state is not selected. When Autotune is activated, "AUTO" indication is displayed in the permanent radio bar.

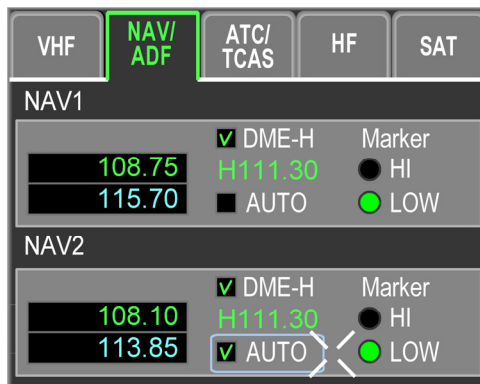


FIGURE 02-34_10-20-07 - SELECTING THE AUTO MODE ON NAV 2

During auto tuning, the FMS tunes both VOR on the next WAYPOINT TO of the Waypoint List (if one existing).

During auto tuning, the FMS tunes both ILS, only when a procedure associated to an ILS is selected. The auto tuning selects automatically (bellow 20 Nm) the VOR CDI with the CRS associated with the published approach.

NOTE

The AUTO mode is disconnected when a VOR frequency is manually selected on the Horizontal Situation Indicator (HSI).

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■ MARKER

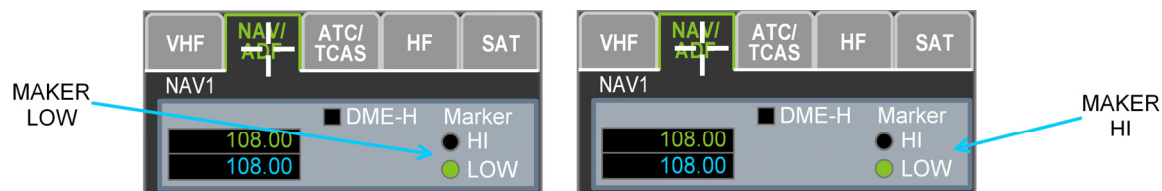


FIGURE02-34_10-20-08 – HI AND LOW MARKER

HI or LOW marker selection sets marker sensitivity. Listening to the audio marker can be done by pressing the MKR pushbutton on the Audio Panel.

ADF modes

The ADF can be operated through four modes, which can be selected in the pop-up menu in RADIOS window:

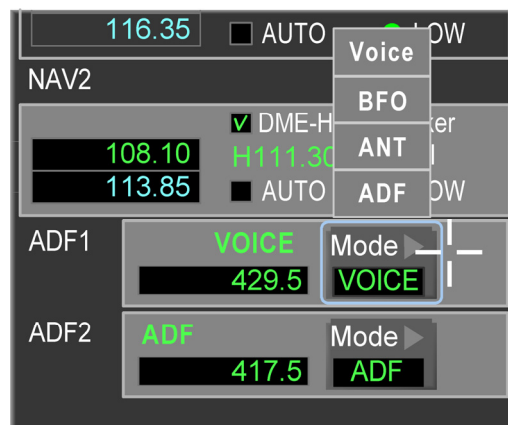


FIGURE 02-34_10-20-09 - ADF MODES SELECTION

When on the NAV / ADF page, position the cursor on the desired ADF field, and do as on the Permanent Radio Bar (PRB) through the CCD or the MKB.

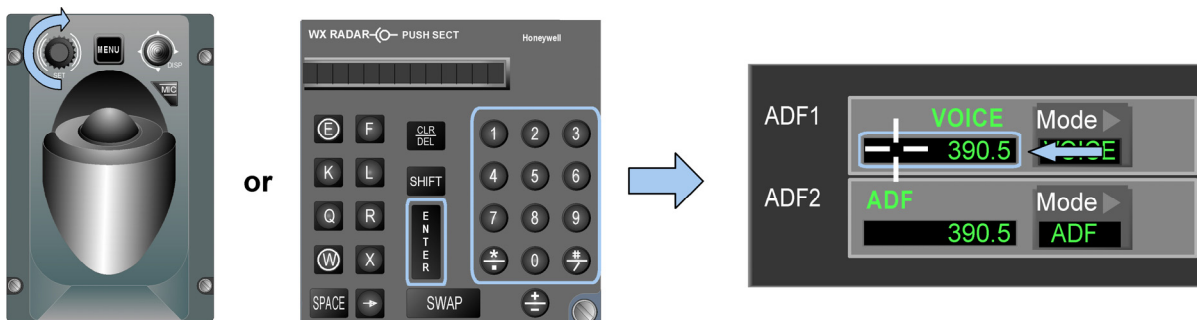


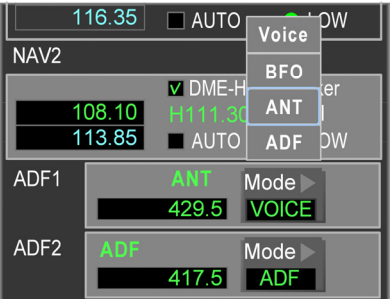
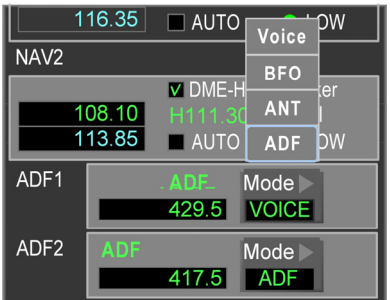


FIGURE 02-34_10-20-10 - TUNING THE ADF 1

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CONTROLS	FUNCTION	LOCAL INDICATION
<p>VOICE</p> 	<p>Mode opens the IF bandwidth for improved audio fidelity. It serves no navigation purpose.</p>	
<p>BFO (Beat Frequency Oscillator)</p> 	<p>Mode adds a tone that can be heard in the ADF receiver when the carrier is on. BFO are used for receiving transmitters that do not have the tone such as coastal or maritime stations.</p>	
<p>ANT</p> 	<p>Mode receives the ADF station signal only and does not compute bearing: it is used for identifying the station.</p>	
<p>ADF</p> 	<p>Mode receives the ADF station signal and displays the relative bearing to station: the bearing pointer appears on the compass rose on LF or RH PDU (normal operation).</p>	

Voice, BFO, ANT and ADF will appear at the top of the ADF box when selected.

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I-NAV WINDOW

Tuning can be done in the I-NAV window, by clicking on the lateral map and selecting the Tune NAV1 / Tune NAV2 option on the task menu

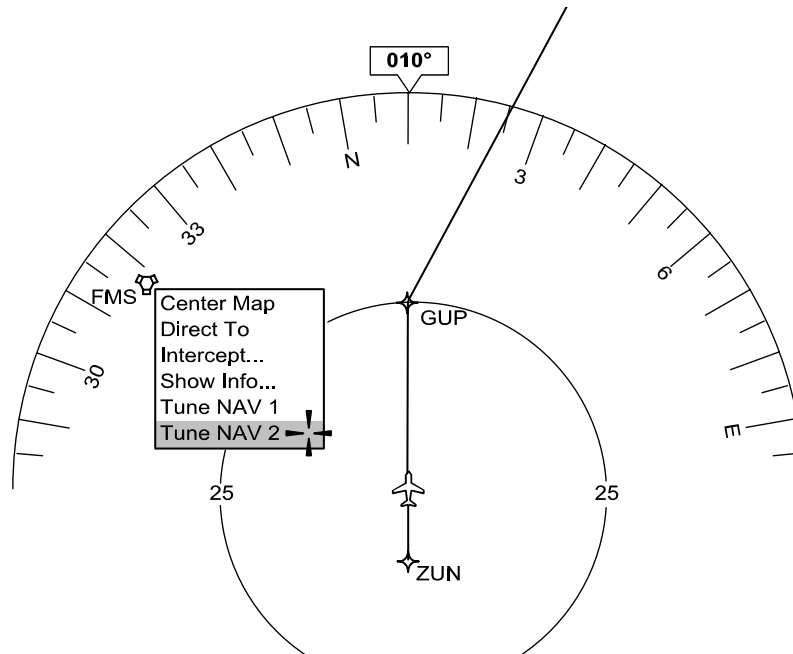


FIGURE 02-34_10-20-11 - NAV GRAPHICAL TUNING

WAYPOINT LIST WINDOW

Tuning an ADF can be done in the waypoint list window, but the selected NAVAID should be a part of a flight plan.

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INDICATIONS

Crew indications with regard to NAVAIDS are located in:

- The Permanent Radio Bar (PRB) for status modes,
- The HSI window for Course Deviation Indicator (CDI) and bearings,
- The ADI for ILS information (vertical and lateral deviation, excessive deviation and marker beacon).

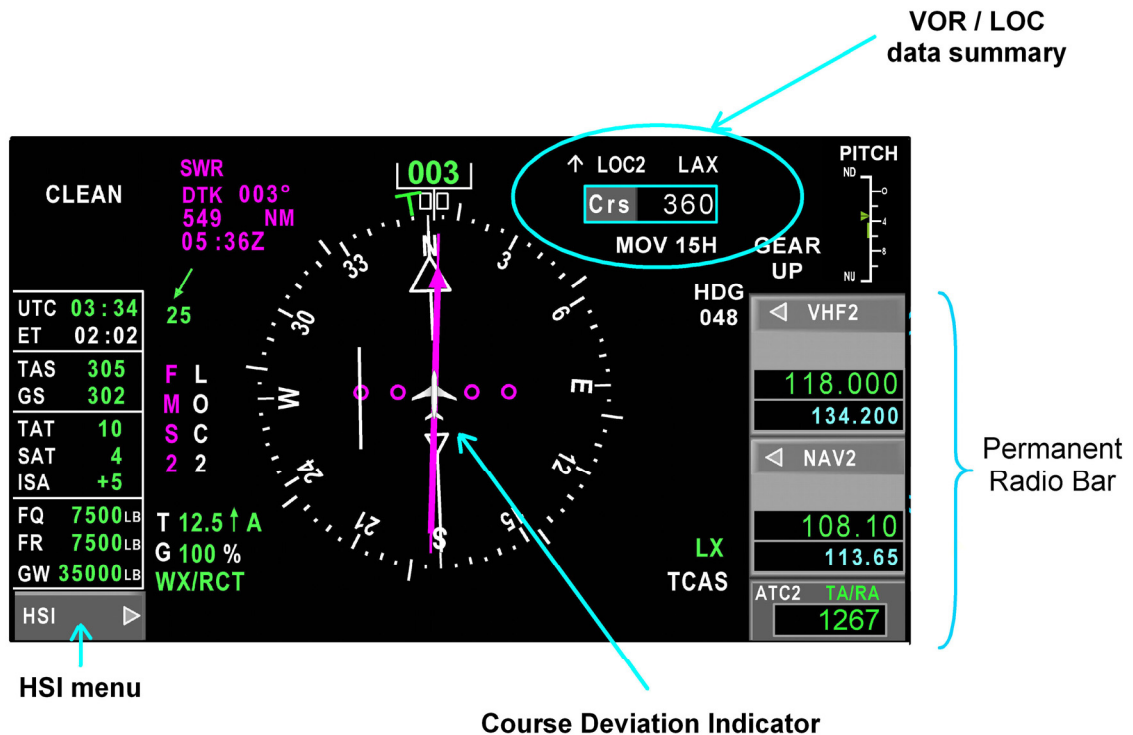


FIGURE 02-34_10-20-12 - HSI WINDOW

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PERMANENT RADIO BAR

On the Permanent Radio Bar of the HSI, each crew member can visualize his NAV frequencies through the pull down menu of the customized field:

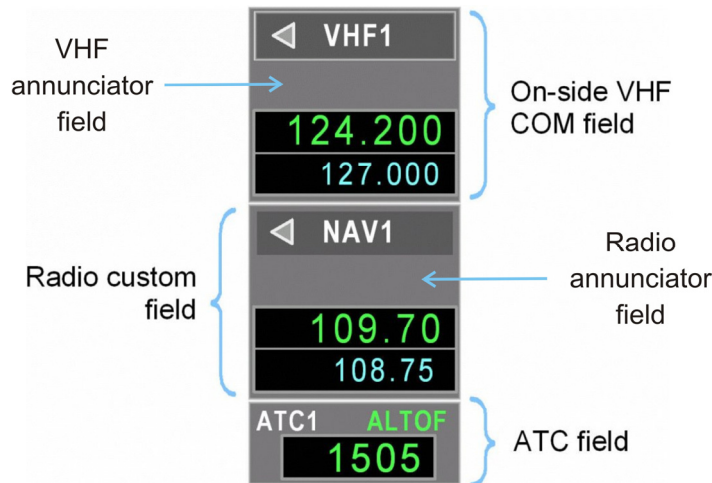


FIGURE 02-34_10-20-13 – LH PERMANENT RADIO BAR

The PRB is graphically divided into three fields:

- The top field permanently displays on-side VHF,
- The middle field provides a space to display a pilot selected radio among all the installed radios (NAV, ADF, HF, except VHF):
 - o Pull down menu allows to select radio among NAV, ADF and HF.
 - o Active frequency is displayed in green with station ident while preset frequency is displayed cyan, except for ADF where only active frequency is displayed,
 - o When NAV is selected, annunciator field displays either AUTO when FMS auto-tuning is active or "H" with held frequency,
 - o When ADF, annunciator field displays either ADF, ANT, BFO or VOICE.
- The bottom field of the permanent bar permanently displays ATC and TCAS information.

BEARINGS

HSI menu can be displayed or removed from display by clicking on the HSI tool bar located on the HSI bottom left corner.



FIGURE 02-34_10-20-14 HSI TOOL BAR

HSI features menu gathers all controls to customize the HSI content. All these controls are arranged in sub-menu:

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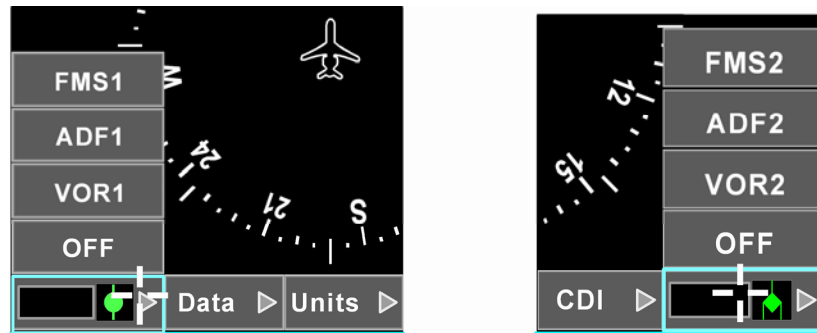


FIGURE 02-34_10-20-15 - BEARING MENU

In the left bearing menu, each crew member can choose to display in his HSI, either the FMS1, FMS3, ADF1 or VOR1 bearing (primary bearing with circle shape), or to remove the bearing (OFF).

They are displayed in white in the menu, and once selected, they are displayed in green inside the pushbutton.

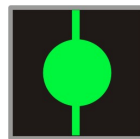


FIGURE 02-34_10-20-16 - PRIMARY BEARING

In the right bearing menu, each crew member can choose to display in his HSI, either the FMS2, FMS3, ADF2 or VOR2 bearing (secondary bearing with diamond shape), or to remove the bearing (OFF).



FIGURE 02-34_10-20-17 - SECONDARY BEARING

A VOR bearing is based on the selection in the tool bar and not Tuned-to-LOC, if the data is invalid or Tuned-to-LOC the VOR bearing pointer is removed.

The other bearing pointer, ADF and FMS, are based on the data being valid and the selection in the tool bar, if the data is invalid or selection is OFF the bearing pointer is removed.

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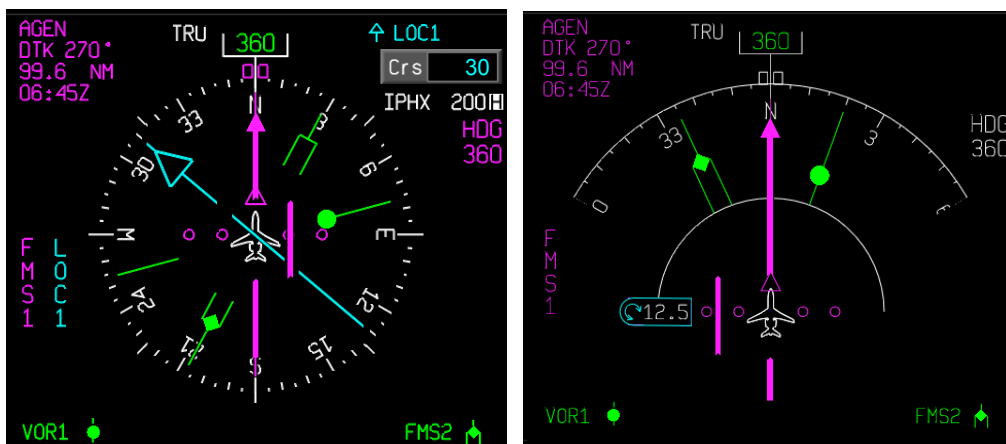


FIGURE 02-34_10-20-18 - BEARINGS IN HSI ROSE AND ARC FORMAT

COURSE DEVIATION INDICATOR

The CDI comes from FMS or the navigation radios based on the primary NAV source:

- If the NAV source is FMS, the CDI is positioned corresponding to the desired track digital readout. The FMS CDI is visually represented with a thick line.
- If the NAV source is VOR or LOC, the CDI is positioned corresponding to the course select digital readout. The VOR or LOC CDI is represented with a thin line.

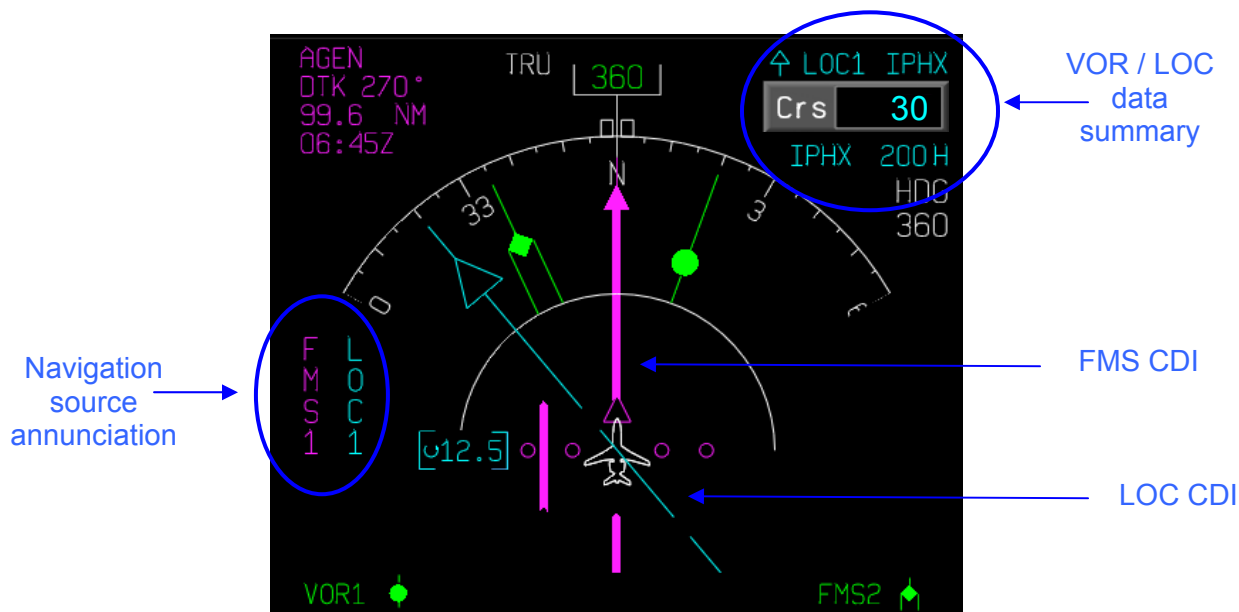


FIGURE 02-34_10-20-19 - FMS LOC CDI IN ARC MODE

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The two CDI can be displayed at the same time.

The VOR / LOC CDI can be selected through:

- The CDI menu on HSI tool bar,
- The **CRS** pushbutton on the MKB,
- Section of corresponding AP mode (LOC or B/C).

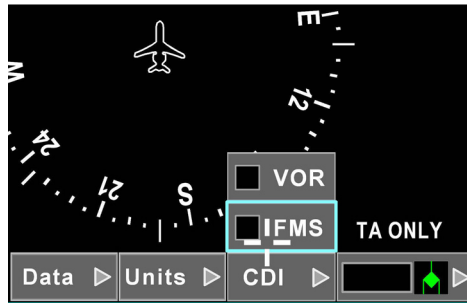


FIGURE 02-34_10-20-20 - CDI MENU

When a VOR CDI is displayed a VOR / LOC data summary is displayed at the top right corner of the ROSE or ARC:

- VOR or LOC pointer icon,
- Tuned station identification,
- Selected course field,
- DME information if available.

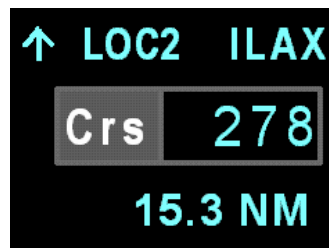


FIGURE 02-34_10-20-21 - VOR/LOC DATA SUMMARY

When VOR CDI is selected with an ILS frequency, LOC is displayed and the Loc / Glide deviations are displayed on the ADI. Once the approach is armed and LOC captured, the FMS CDI is automatically removed from both sides.

CDI cannot be removed when displayed in magenta since it is the active source.

If the flight plan is selected for display through the HSI tool bar, the CDI is removed and the flight plan is displayed with a digital cross track error. When deselecting the flight plan, the CDI is displayed if selected.

According to the lateral active or armed mode, the color of the VOR or LOC data, navigation source annunciation and CDI can be:

- Magenta if LOC mode is active,
- Cyan if LOC mode is armed,
- White if a VOR station is tuned or ILS station tuned without LOC active or armed.

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ILS INFORMATION

Vertical and lateral deviations scale

Vertical deviation scale is displayed in ADI if a G/S is detected by ILS receiver or VNAV is computed by Flight Management System, depending on the navigation source. When in radio navigation source, the G/S pointer is displayed if a glide slope is detected.

Lateral deviation scale and lateral pointer are displayed if a LOC is detected by ILS receiver.

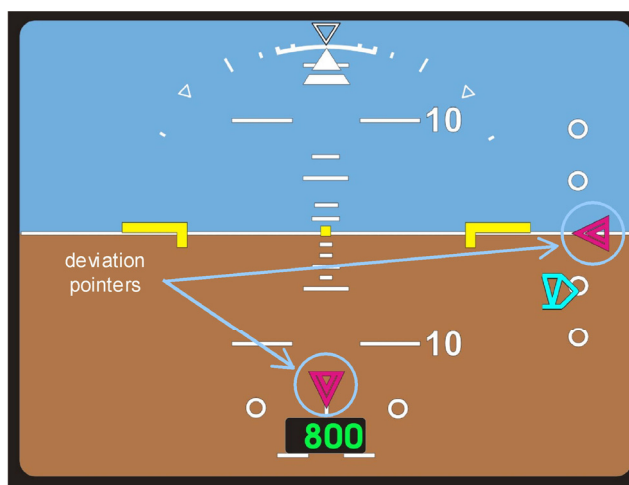


FIGURE 02-34_10-20-22 - LOC / GLIDE DEVIATION POINTERS

According to the vertical active or armed mode, the color of vertical deviation pointer is:

- Cyan if G/S is armed,
- Magenta if G/S is active,
- White if LOC is tuned and G/S is not armed or active.

According to the lateral active or armed mode, the color of lateral deviation pointer is:

- Magenta if LOC or B/C mode is active,
- Cyan if LOC or B/C mode is armed,
- White if LOC is tuned, LOC and B/C are not armed or active.

G/S flag is displayed in place of vertical deviation scale, If G/S mode is active or armed and the glide slope receiver is failed.

LOC flag is displayed in place of lateral vertical scale, If LOC or B/C mode is active or armed and the localizer receiver is failed.

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Excessive deviations indicator

Vertical excessive deviation indication is displayed as left and right triangles when the proper condition exists.

Lateral excessive deviation indication is displayed as up and down triangles when the proper condition exists.

Color of triangles:

- Amber if the radio altitude is above of 200 ft,
- Red if the radio altitude is equal or below of 200 ft.

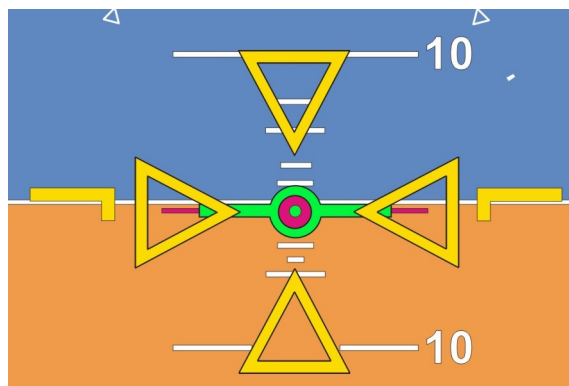


FIGURE - 02-34_10-20-23 EXCESSIVE DEVIATION TRIANGLES

Marker beacon

If the airplane passes over any marker beacons, the appropriate annunciation is displayed on the ADI and the audio tone is sounded if MKR is selected on the Audio Panel.

The inner, middle and outer marker beacons are displayed at the same location.

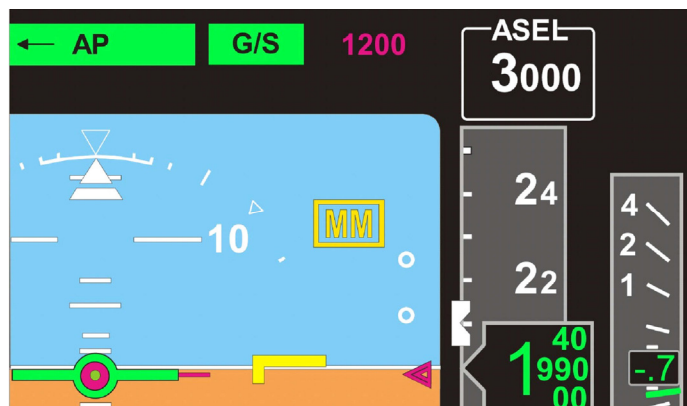





FIGURE 02-34_10-20-24 - MARKER BEACON INDICATION LOCATION

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Inner Marker annunciation is represented by: 

Middle Marker annunciation is represented by: 

Outer Marker annunciation is represented by: 

When a low to high transition is seen from the appropriate marker beacon, the marker beacon flashes normal video to blank for 15 seconds then steady.

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INDICATION

VERTICAL DEVIATIONS SCALE

In radio navigation source, the vertical deviation scale is defined in angular deviation.

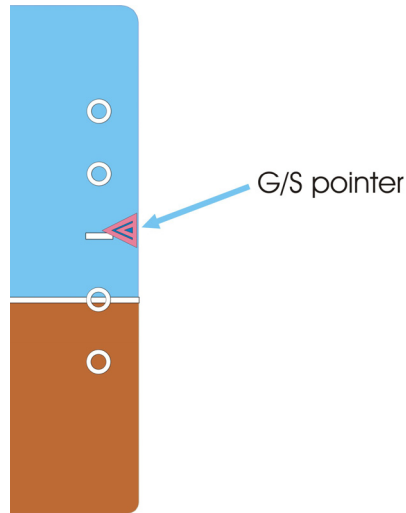


FIGURE 02-34_10-25-00 - VERTICAL DEVIATION SCALE VALUES

Each dot on the scale represents respectively:

SCALE	VALUES
second dot up	$+ 0.24 \times \text{Glide path angle}$
first dot up	$+ 0.12 \times \text{Glide path angle}$
zero	Glide path angle
first dot down	$- 0.12 \times \text{Glide path angle}$
second dot down	$- 0.24 \times \text{Glide path angle}$

EXCESSIVE DEVIATIONS

If CAT 2 is active and the lateral deviation exceeds $+0.0259$ DDM (1 dot) the left triangle is displayed.

If CAT 2 is active and the lateral deviation exceeds -0.0259 DDM (1 dot) the right triangle is displayed.

If a CAT 2 is active and the vertical deviation exceeds $+0.0875$ DDM (1 dot) (LOC) the up triangle is displayed.

If a CAT 2 is active and the vertical deviation exceeds -0.0875 DDM (1 dot) (LOC) the down triangle is displayed.

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MONITORING OF THE SYSTEM

➤ Refer to CODDE2 for an exhaustive description of CAS messages and FAULT messages.

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ACTIVE PROTECTIONS

The NAVAIDS system does not provide any automatic protection.

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No supplementary information to be provided on System Protections at present time.

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The NAVAIDS do not require any Ground Operation action.

➤ *Refer to Ground Servicing Manual.*