

NAVIGATION
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GENERAL

The navigation system includes those units and components which provide the following data to the flight crew:

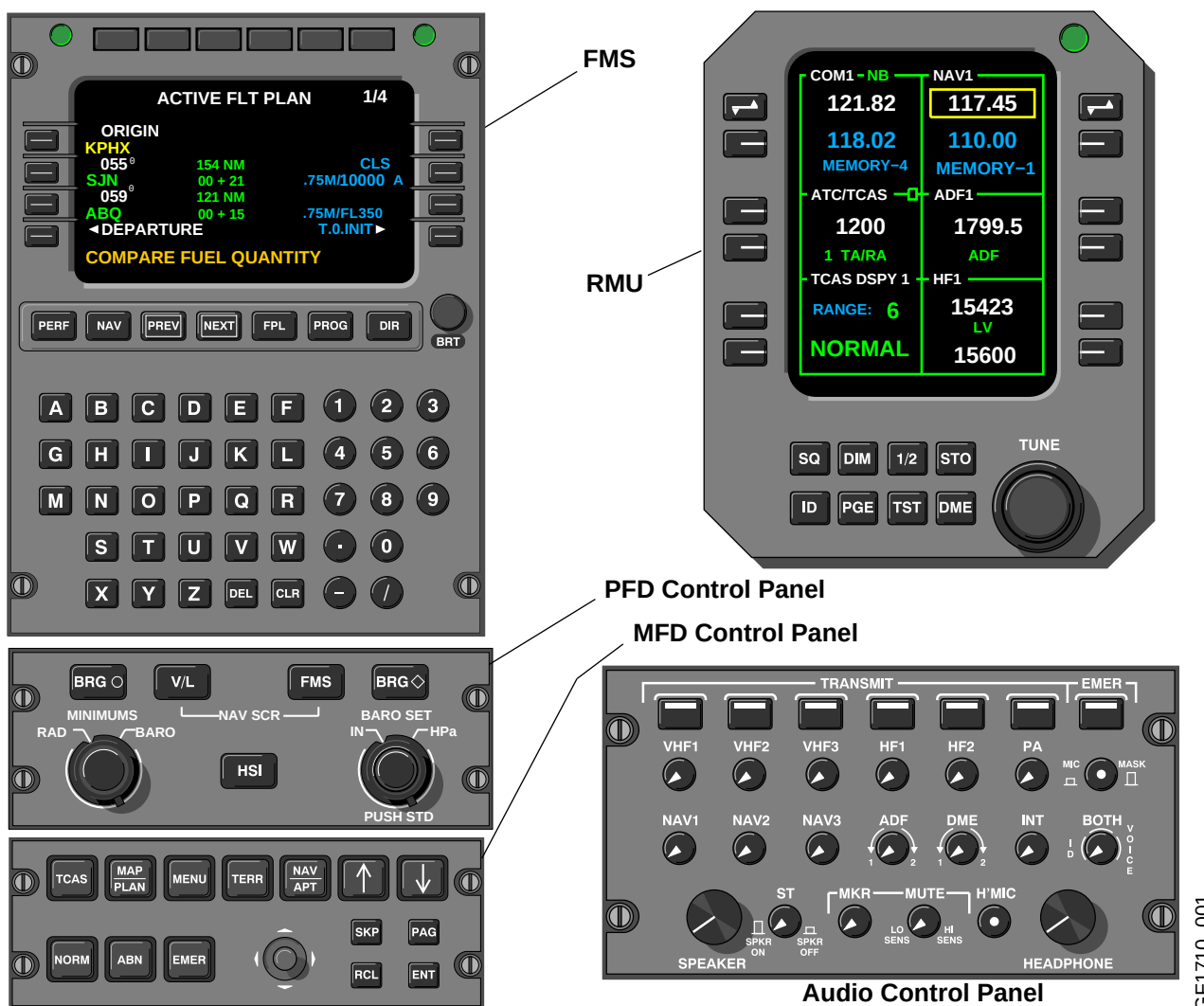
- Position Systems – Dual VHF navigation systems (providing VOR, LOC, GS and MB signals), FMS, ADF, DME and ATC transponder systems.
- Independent Position Systems – Weather radar, TCAS.

The navigation receivers are tuned by the Radio Management Units (RMU) and navigation data is displayed on the PFDs and MFDs.

MFD control panels (located on the pedestal) permit control over MFD format. PFD control panel (located on the glareshield) permits control over navigation source and bearing source display.

The partial compass rose on the PFDs echos the MFD bearing information for the navigation aid selected on the PFD control panel and tuned by the RMUs.

VOR, DME, ADF and MB audio selection and monitoring is provided at the audio control panels (located on the pedestal).



AUDIO CONTROL PANEL

The audio control panels, located on the pedestal, are used to select radios or PA for transmission and/or receive communication/information from NAV, ADF, DME and MB. For more information, see Chapter 6 COMMUNICATIONS.

Receive Buttons

- NAV1, NAV2, NAV3 (if installed)
- ADF1, ADF2
- DME1, DME2

**MKR Button**

Controls on-side marker beacon receiver sensitivity.

MUTE Button

Used to temporarily silence the marker beacon audio (non-latching).

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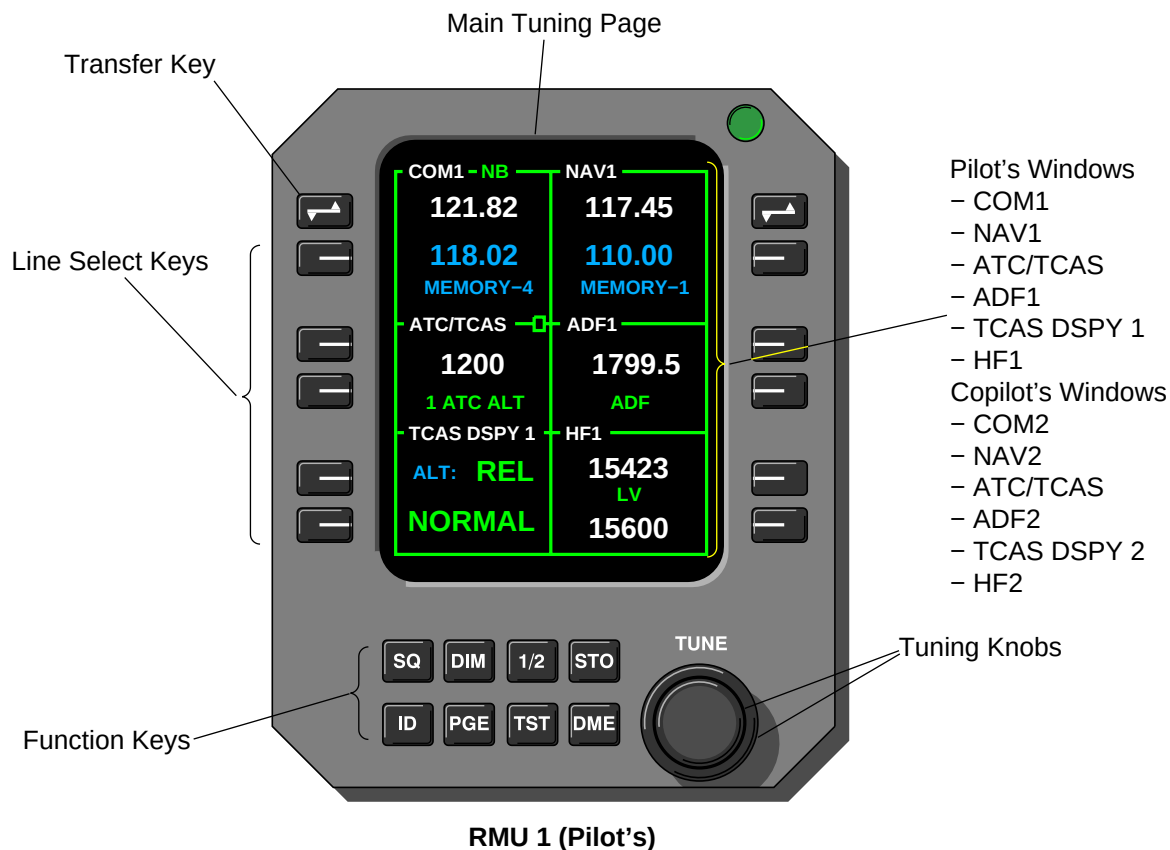
RADIO MANAGEMENT UNIT (RMU)

The RMUs, located on the pedestal are used for frequency and mode control. With the exception of a DME indicator, all navigation data is displayed on EFIS.

Each RMU controls the following functional modules:

- An Integrated Navigation Unit, incorporating a VHF NAV Transceiver Module, a DME Transceiver Module and an ADF Receiver Module.
- An Integrated Communication Unit, incorporating a VHF COM Transceiver Module, a Mode S Transponder Module and a TCAS Interface Module.

Any selectable parameter, such as VOR or ADF frequency, may be changed by pressing the corresponding line select key, then by rotating the tuning knobs to set a desired value. For more information, see Chapter 6 COMMUNICATIONS.



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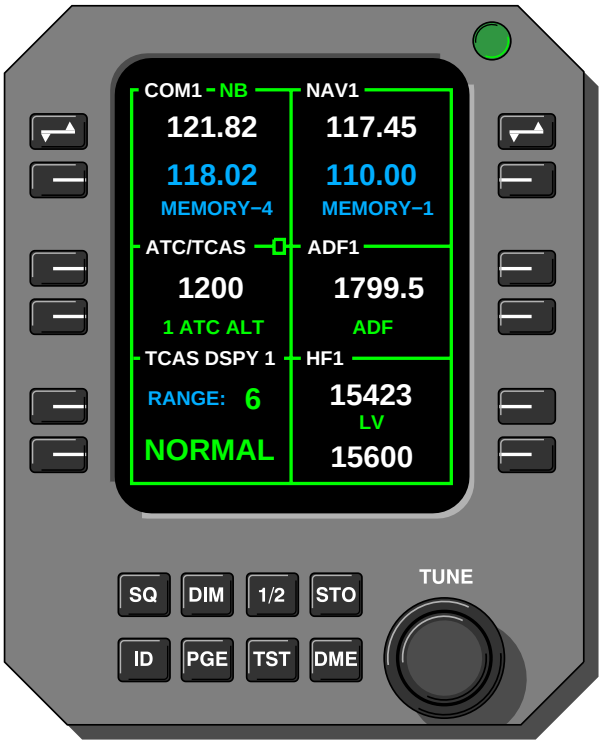
VHF NAVIGATION RECEIVERS

The two VHF Navigation receivers (NAV 1 and NAV 2) provide VHF omnirange (VOR), Localizer (LOC), Glideslope (GS) and Marker Beacon (MB) signals to the navigation systems and flight crew.

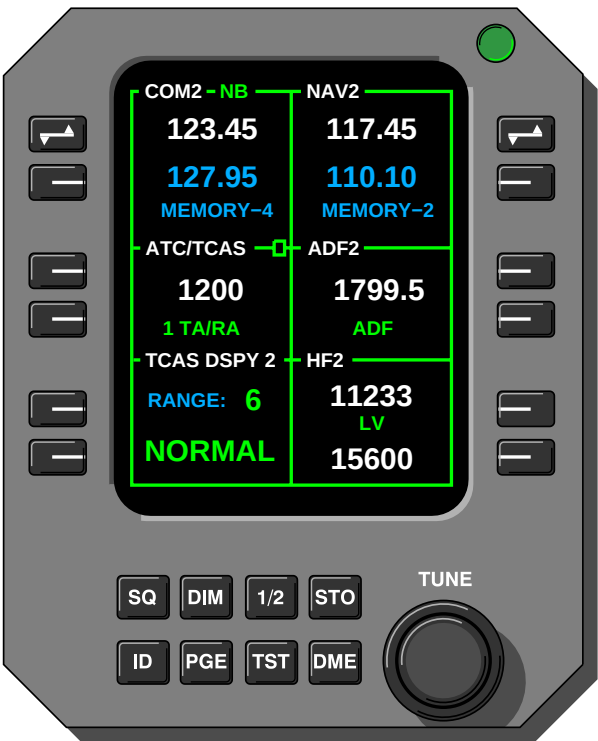
The navigation receivers operate in the following ranges:

System	Frequency Range	Channel Spacing
VOR	108.00 to 117.9 MHz	50 kHz (160 chan)
LOC	108.10 to 111.95 MHz	50 kHz (40 chan)
GS	329.15 to 335.00 MHz	150 kHz (40 chan)
MB	75.00 MHz	Preset

Frequency selection is through radio tuning units located on the pedestal.



RMU 1 (Pilot's)



RMU 2 (Copilot's)

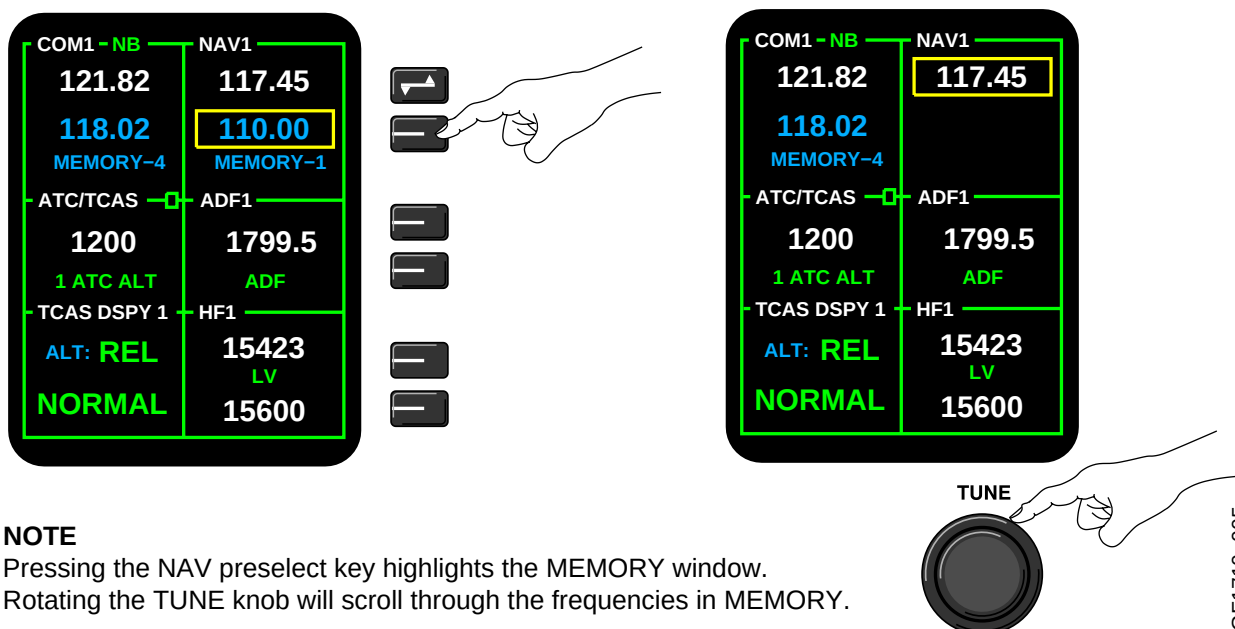
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NAV 1 (2)

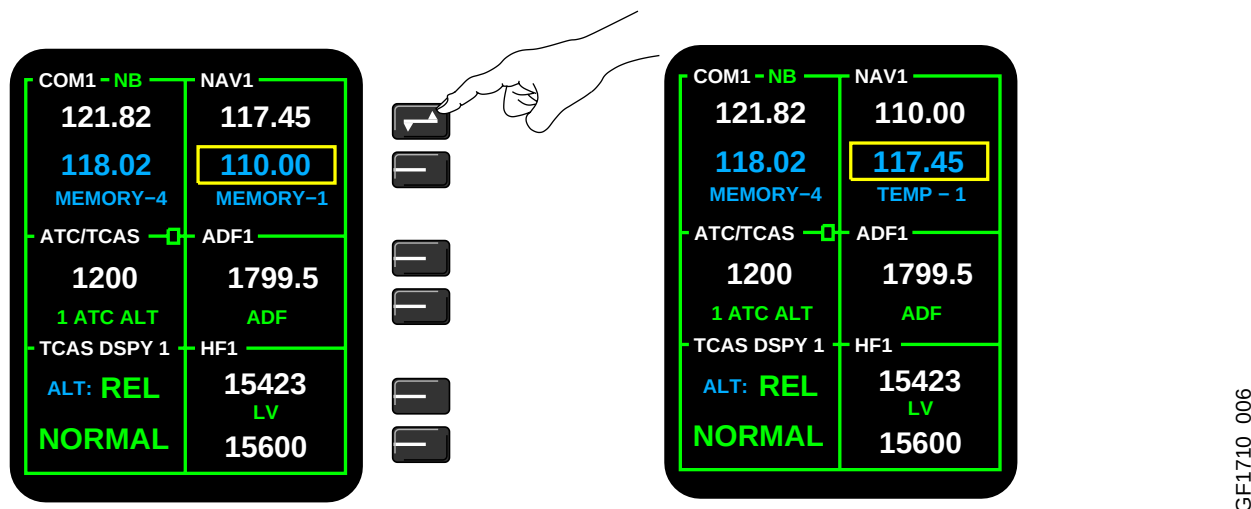
The VHF NAV receiver houses the major navigation functions of the VOR/LOC receiver, glideslope receiver and marker beacon receiver.

The NAV line select key is used to select navigation frequencies (VOR, LOC, GS and DME). The cursor will automatically reposition to the NAV receiver active frequency after 17 seconds.

Pressing and holding NAV preselect key for more than 3 seconds moves cursor to the top and blanks the preselect window and allows direct tuning of NAV receiver active frequency.

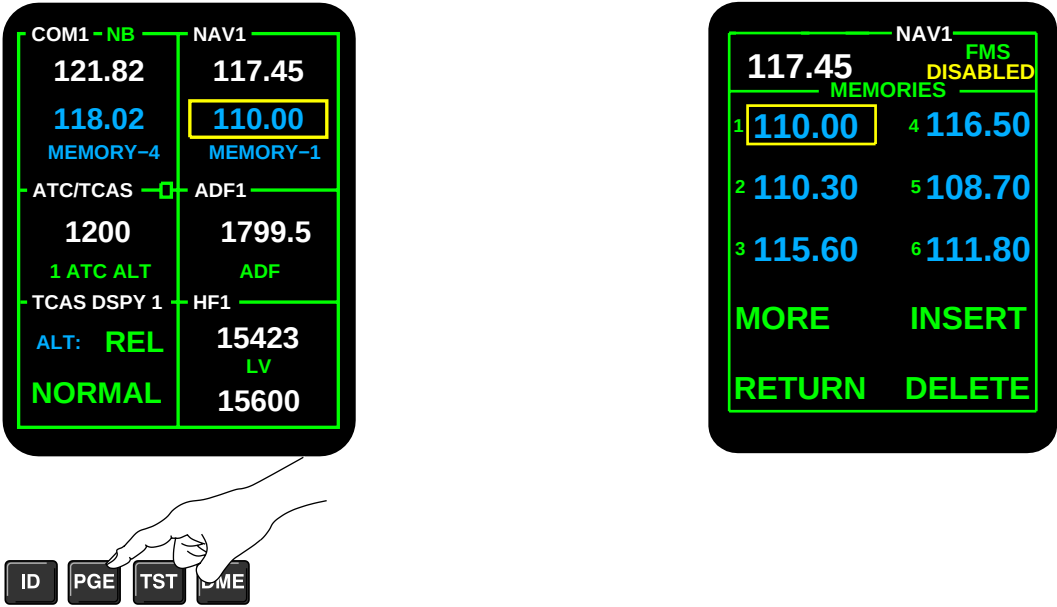


Pressing the transfer key will toggle the Active and Preset frequencies, channeling the NAV receiver to what had been the Preset.



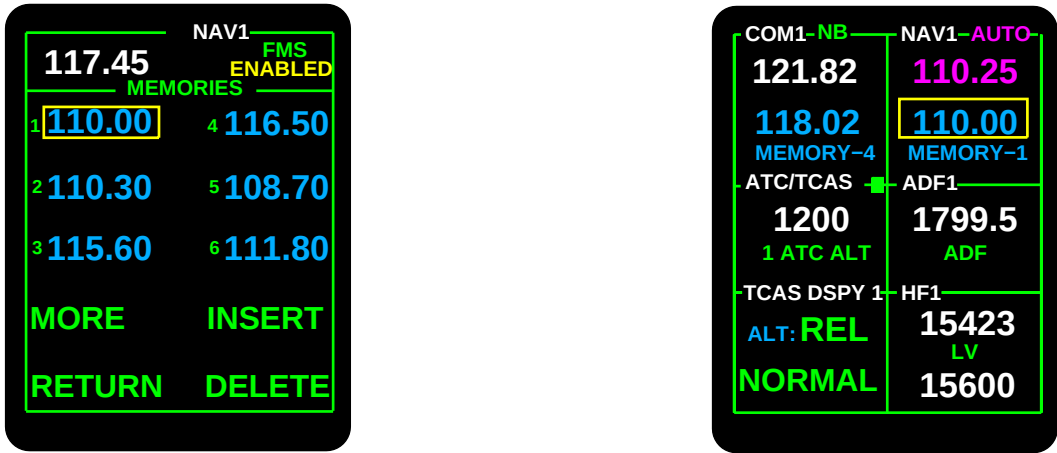
NAV 1 (2) (CONT'D)

While on the main tuning page, press the PGE button once to bring the NAV memory page into view.



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An FMS autotuned VOR or ILS frequency is displayed on the main tuning page. To override an FMS autotuned VOR or ILS frequency, toggle the transfer key, or enter a new active frequency.



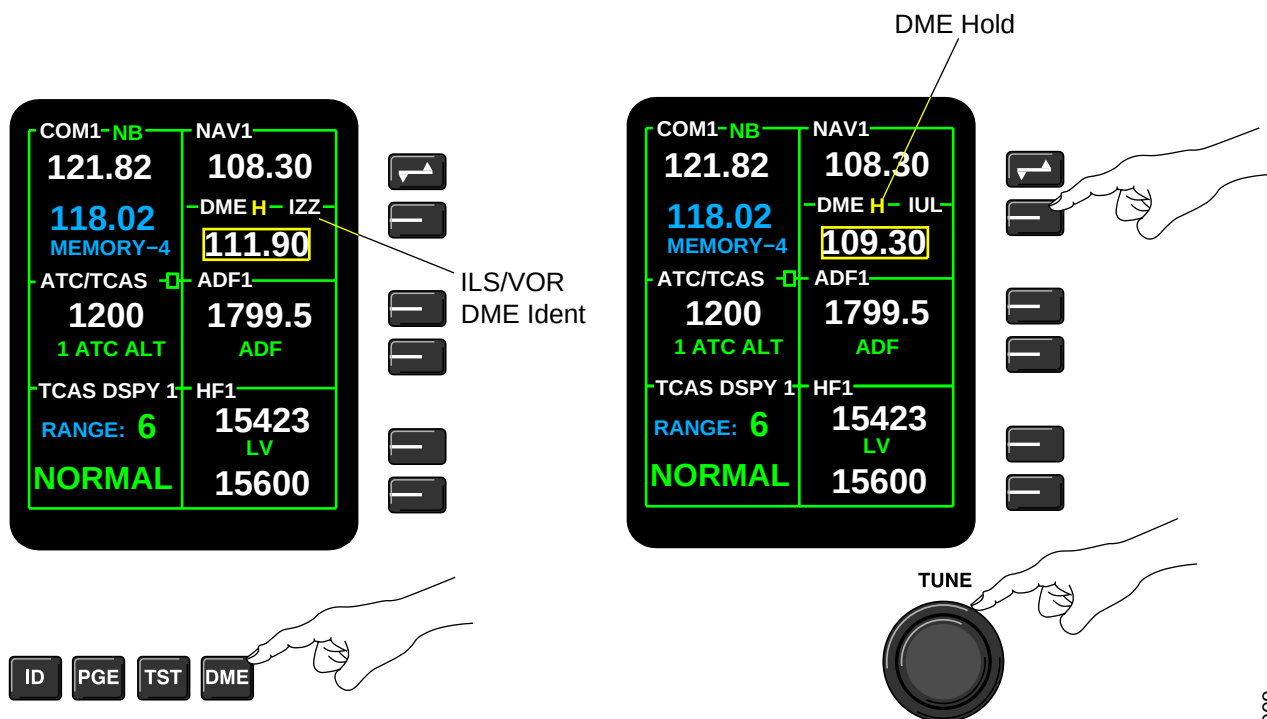
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DISTANCE MEASURING EQUIPMENT (DME)

The DME simultaneously tracks four selected DME channels for distance, groundspeed and time to station, as well as monitoring two additional channels for ident functions. DME dedicates two of the four channels to the FMS.

In normal VOR/ILS/DME operations, one of the six DME channels is paired with the active frequency and another with a preset frequency. Pushing the DME function key will split the NAV window on the main tuning page, allowing the active DME channel to be selected separate from the active VOR/ILS frequency.

An **H** (hold) will be displayed to indicate that the distance display is not paired with the VOR/ILS navigation data. When DME hold is no longer required, cycle the DME function button until the split is removed from the NAV window.

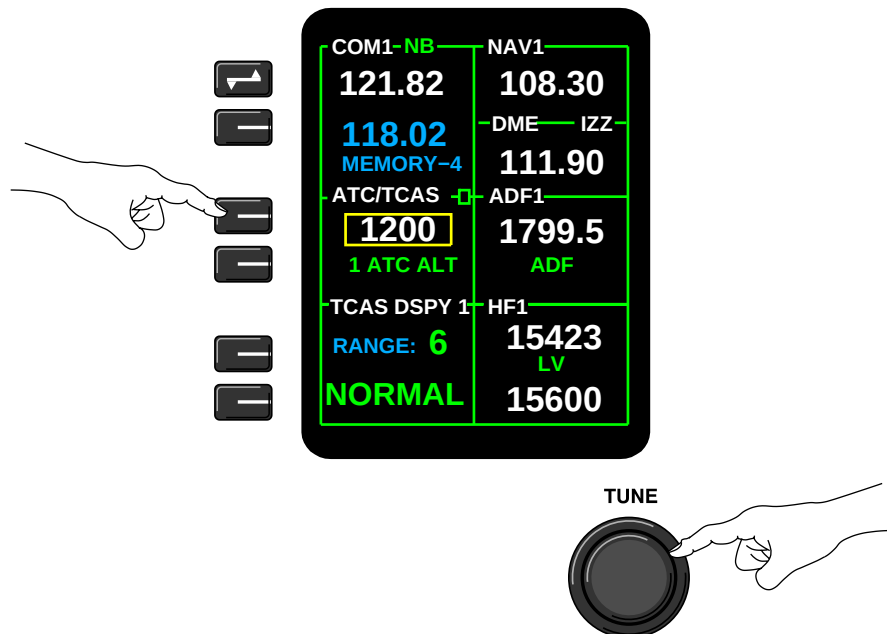
**NOTE**

Cycling the DME function button will display the following in sequence:
VOR/ILS – VOR/ILS and DME – VOR/ILS and TACAN – VOR/ILS.

AIR TRAFFIC CONTROL (ATC) TRANSPONDER

ATC Transponder operations are controlled by the adjacent line select keys and the tuning knobs.

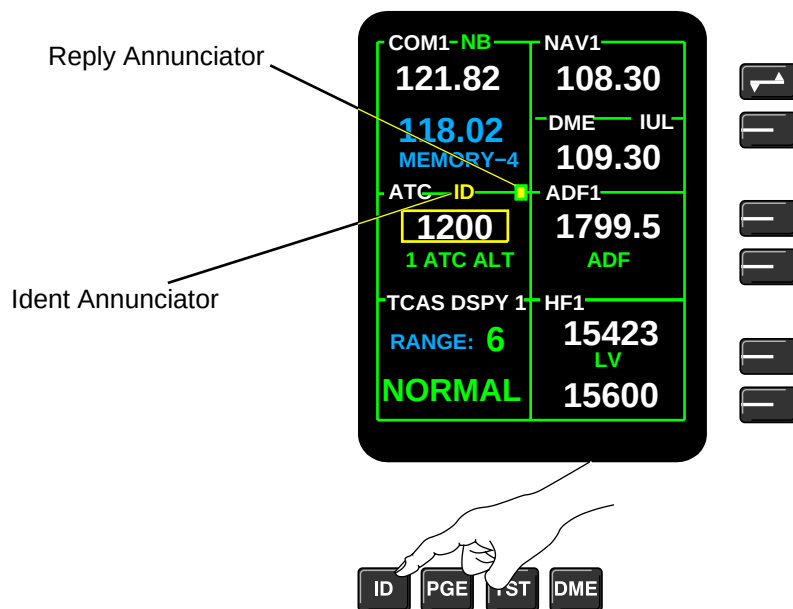
Both RMUs will display the same transponder information. If a code or mode is changed on one RMU, the other RMU will track it.



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The transponder will go into ident mode for approximately 18 seconds when the ID function key is pushed and an **ID** annunciator will appear.

A reply annunciator (rectangular box), located in the upper right corner of the ATC window, will turn yellow, whenever the transponder is replying to an interrogation from a ground station or TCAS. When ID button is pressed, the reply annunciator will come on steady for approximately 20 seconds.



GF1710_011

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

The TCAS is an airborne system that interrogates ATC transponders in nearby airplanes to identify and display potential and predicted collision threats, within 700 feet of closest point of approach. TCAS monitors a radius of up to 40 nautical miles about the airplane, computes range, bearing and closure rate of up to 12 other transponder equipped airplanes relative to the “own” airplane. TCAS and ATC transponder modes are set on the RMUs.

Active (interrogated) range is possible up to 70 to 100 NM depending on atmospheric conditions. Passive range to a distance of 120 NM is possible if intruder aircraft has a TCAS change 7 and a GPS installed.

The system provides appropriate aural and visual cues to the flight crew when TCAS computer analysis of an airplane signal predicts a penetration of TCAS protected airspace.

Target/Threat Advisories

The system provides four types of advisories:

- Traffic Advisory  – Traffic advisories (TA) symbols appear on the MFD, when target(s) is projected to converge with the TCAS equipped airplane in less than 45 seconds, with the closest point of approach being inside a minimum vertical separation envelope. Traffic advisories are generated for aircraft with operative mode S, mode C, or mode A transponders. The relative bearing and range of the intruder are displayed.
- Resolution Advisory  – Resolution advisories (RA) intruder symbols appear on the MFD, when target (s) is predicted to penetrate the protected vertical envelope in less than 30 seconds. A green fly-to Pitch Target Zone rectangle is also displayed on the PFD ADI which indicates the rate that must be achieved to maintain safe separation. Similarly, red Pitch Avoidance Zones appear which indicate pitch rates that should be avoided. RA display can only be issued if intruder airplane is equipped with mode S transponder.
- Proximity Traffic  – Proximity Traffic (PT) symbols appear on the MFD when non-threat airplane(s), which have a flight path that approaches the collision area. The PT symbol is displayed if the target does not qualify for a TA but is currently within 6.5 NM and 1200 feet of the TCAS airplane.
- Other Traffic  – Other Traffic (OT) symbols appear on the MFD to indicate targets outside of the 1200 foot relative altitude region of PT, up to the TCAS range set by the pilot and at a relative altitude difference of 2700 feet.

The TCAS system provides no indication of traffic conflicts if the intruder airplane is without an operative transponder.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

TCAS Symbology

DATA TAGS	DEFINITION
Up Arrow ↑	Indicates climbing traffic.
Down Arrow ↓	Indicates descending traffic.
Plus Sign (+)	Relative altitude threat, airplane is above own airplane.
Minus Sign (-)	Relative altitude threat, airplane is below own airplane.

THREAT LEVEL	CAUSE	SYMBOL
Resolution Advisory (RA)	Intruding aircraft is 100 feet above and descending at least 500 feet per minute.	+01 
Traffic Advisory (TA)	Intruding aircraft level with and not climbing or descending.	
Proximate Traffic (PT)	Traffic is 1,200 feet below and climbing at least 500 feet per minute.	-12 
Other Traffic (OT)	Traffic is 2,700 feet above and descending at least 500 feet per minute.	+27 

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TCAS Modes

The following TCAS modes are selectable on the RMU:

- TA/RA Mode – Normal operation mode providing full TCAS coverage. TCAS tracks up to 12 airplanes in the surrounding airspace and generates TAs and RAs as required.
- TA ONLY Mode – TCAS tracks all PT airplanes and generates TAs, no RAs. Automatically selected when airplane is flying lower than 1100 feet AGL (while climbing) or 900 feet AGL (while descending).
- TEST Mode – Pressing the TST button on the RMU, will start a self-test program that will verify proper operation of the TA and RA displays and of the aural advisories. The TEST mode does not affect normal TCAS operation. Should an actual TA or RA occur during TEST sequence, the test is automatically terminated and the advisory is announced and displayed.

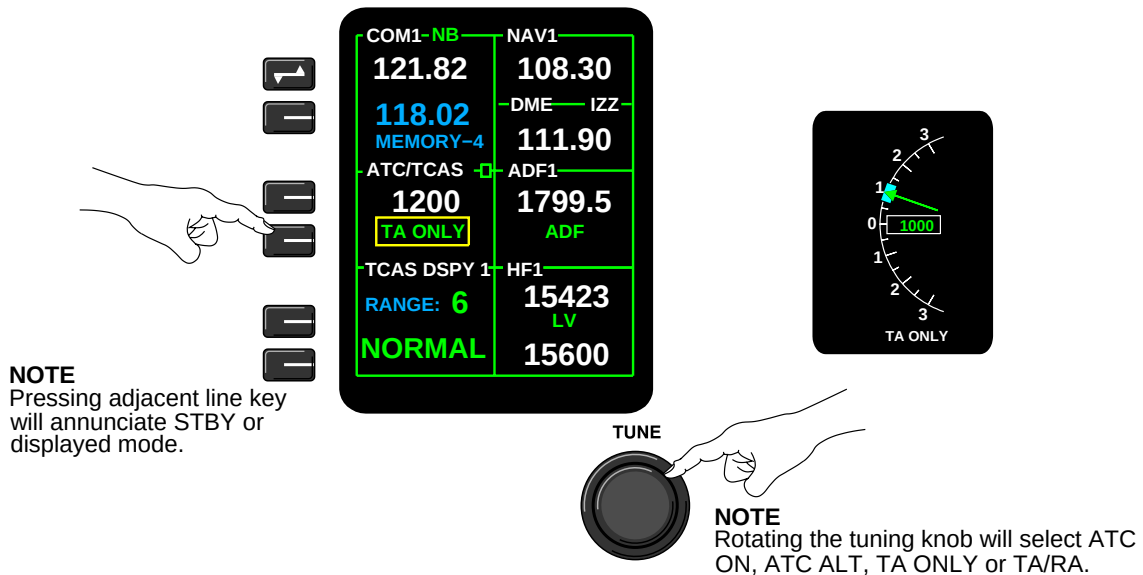
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

ATC/TCAS Mode Select

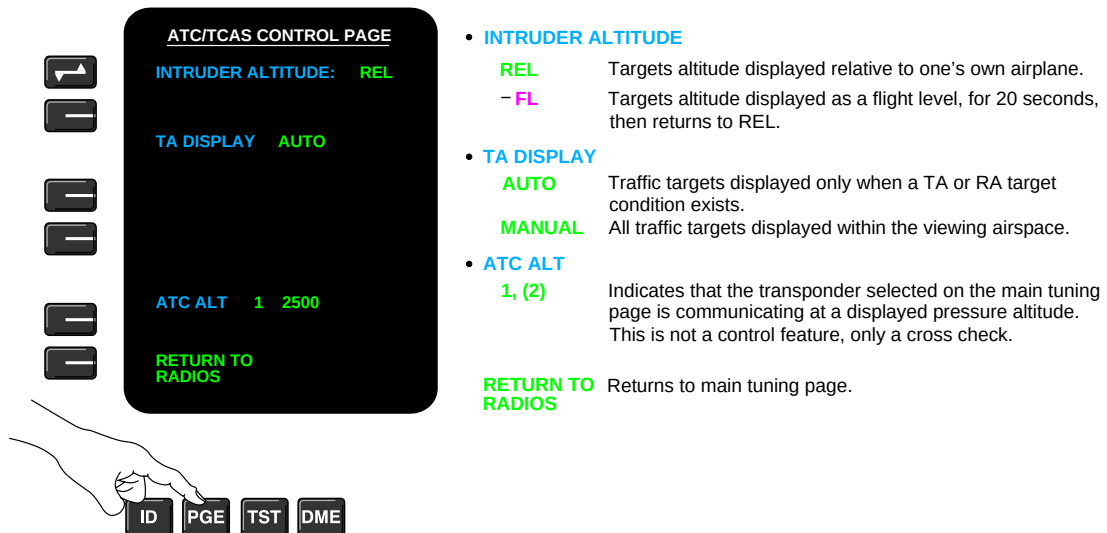
ATC/TCAS operations are controlled by the adjacent line select keys and the tuning knobs.

The modes are:

- ATC ON – Replies on Modes S and A, no altitude reporting.
- ATC ALT – Replies on Modes A, C and S, with altitude reporting.
- STANDBY – Transponder in standby mode.
- TA ONLY – TCAS traffic advisory mode selected.
- TA/RA – TCAS traffic advisory/resolution advisory mode selected.



The PGE function key provides access to a menu page. The menu allows access to the TCAS operational selections.



TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

TCAS DSPY 1 (2) Select

The primary TCAS selection is selected via the adjacent line select keys. The TCAS selections are as follows:

- Range – Selectable at **6**, **12**, **20**, **40**, **80**, and **120** NM.
- Altitude Band Select –

NORMAL:

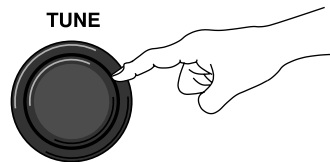
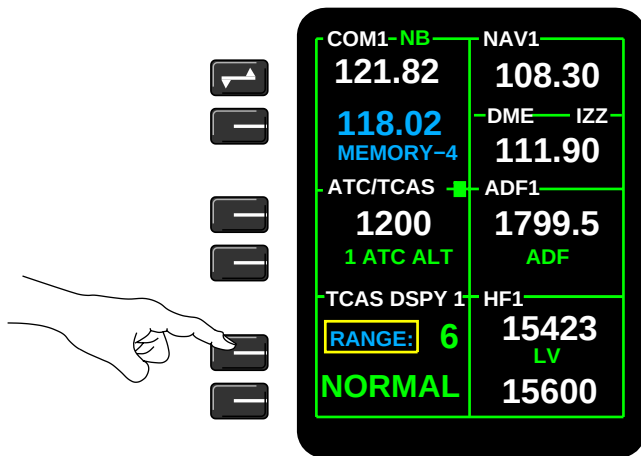
With TA display set to AUTO, ± 1200 feet TCAS display altitude.
With TA display set to MANUAL, ± 2700 feet TCAS display altitude.

ABOVE:

+7000 feet, -2700 feet TCAS display altitude.

BELOW:

-7000 feet, +2700 feet TCAS display altitude.

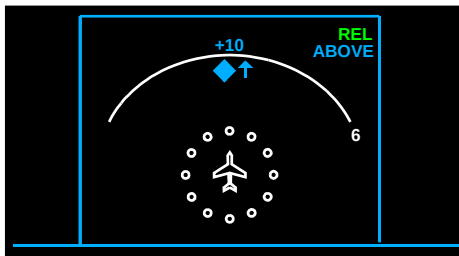
**NOTE**

Rotate the tuning knob to change the range when adjacent line select key is selected.
Rotate the tuning knob to change the altitude band select when adjacent line select key is selected.

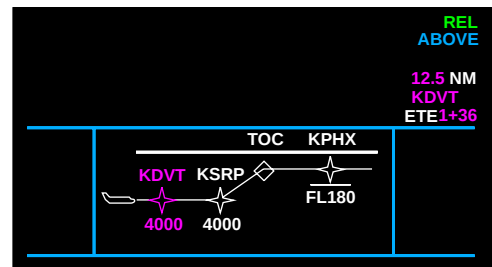
GF1710_019

TCAS Mode Select Annunciation

The indications for intruder alert and altitude band selections are as follows:



TCAS Zoom Window



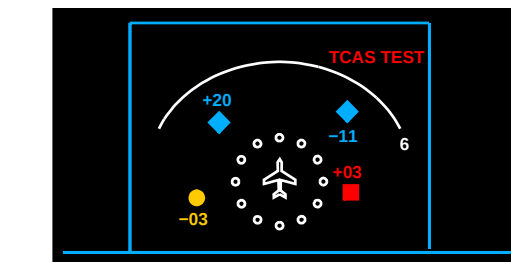
MFD (MAP format)

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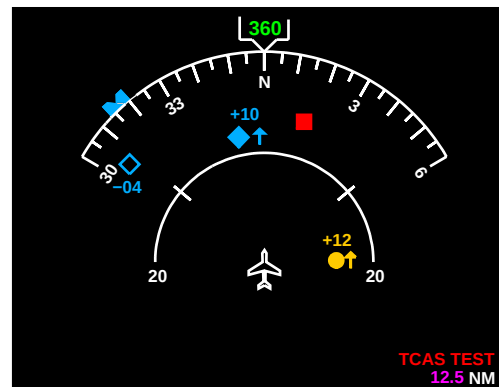
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

TCAS Mode Select Annunciation (Cont'd)

The indications for TCAS TEST are as follows:

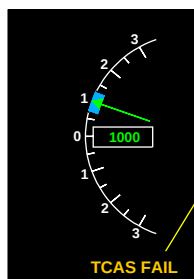


TCAS TEST (when test initiated), then
TCAS TEST PASS
or
TCAS TEST FAIL



TCAS Status Messages

TCAS status messages are annunciated as follows:



TCAS Status Message Area

- **TCAS FAIL** –Indicates TCAS failure.
- **TCAS TEST** –Indicates a functional test is in progress.
- **TCAS STBY** –Indicates TCAS is selected and transponder is in STBY.
- **TA ONLY** –Indicates that TCAS has been selected to traffic advisories only
- **RA FAIL** –Indicates resolution advisory failure.

Digitized Voice

TCAS will provide voice warnings. The voice warnings cannot be cancelled or reduced in volume. TA voice warning is "TRAFFIC, TRAFFIC"

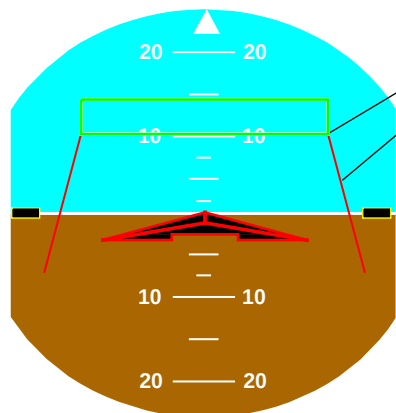
RA voice warnings are:

- ADJUST VERTICAL SPEED, ADJUST.
- CLEAR OF CONFLICT
- CLIMB, CLIMB NOW! – CLIMB, CLIMB NOW!
- CLIMB, CROSSING CLIMB – CLIMB, CROSSING CLIMB.
- CLIMB – CLIMB.
- DESCEND, CROSSING DESCEND – DESCEND, CROSSING DESCEND.
- DESCEND, DESCEND NOW! – DESCEND, DESCEND NOW!
- DESCEND – DESCEND.
- INCREASE CLIMB – INCREASE CLIMB.
- INCREASE DESCENT – INCREASE DESCENT.
- MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN.
- MAINTAIN VERTICAL SPEED, MAINTAIN.
- MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

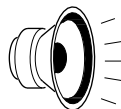
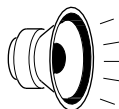
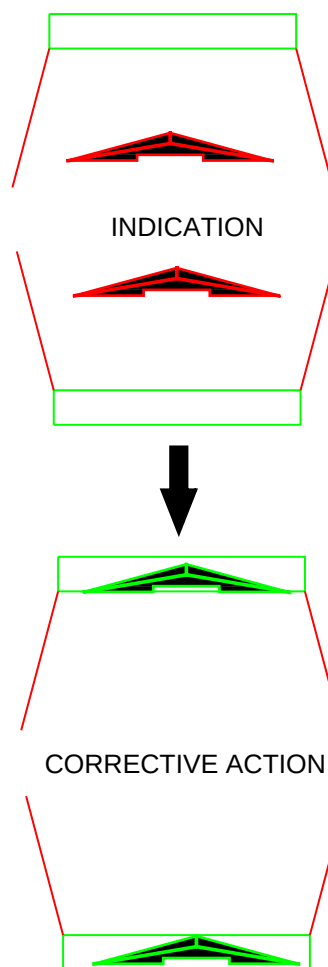
Resolution Advisories

TCAS resolution advisories and status messages are displayed on the PFDs. The vertical maneuver is also accompanied by TCAS voice warnings.



Resolution Advisory Indication

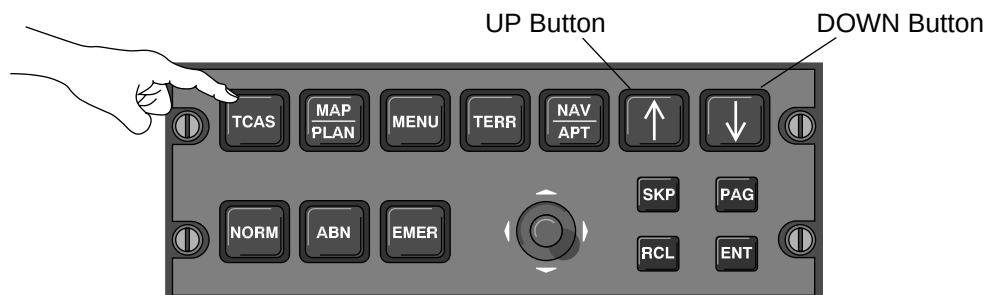
- Green rectangle advises pilot of fly-to-zone.
- Red avoidance zone advises pilot to fly out of, or do not enter indicated area.

CLIMB
CLIMBDESCEND
DESCENDCLEAR
OF
CONFLICT

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

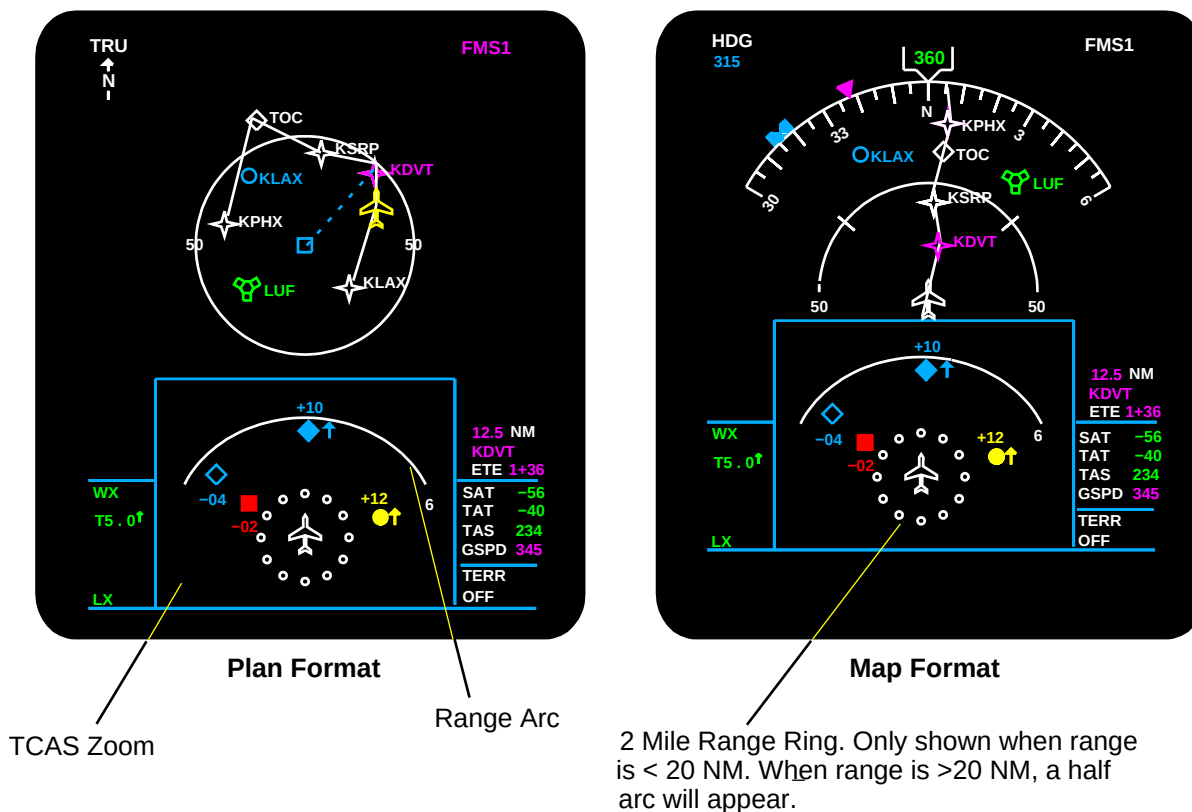
TCAS Zoom Window

TCAS zoom window is displayed on either or both MFDs and is selected on the MFD control panel, located on the pedestal. Ranges of 6, 12, 20, 40 and 120 NM can be selected by using the up or down buttons on the MFD control panel or on the RMU.



NOTE

The TCAS zoom window shall be restored after menu usage, if the TCAS zoom window was previously in use.

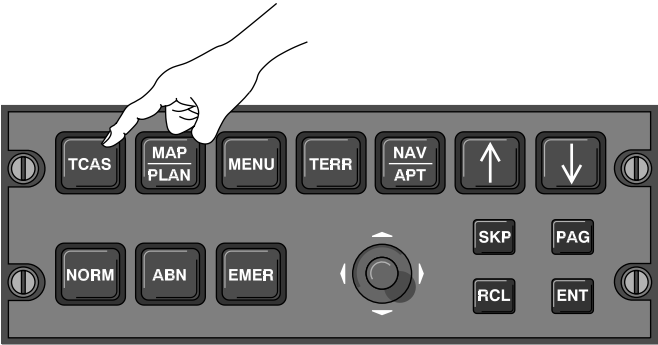


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TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) (CONT'D)

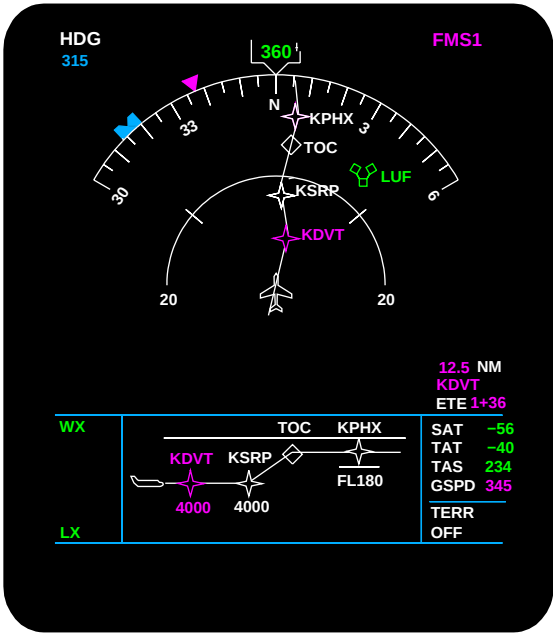
TCAS Traffic Display (MAP Format)

- The TCAS overlay is the default condition on the MFD during power-up. TCAS display can also be enabled on MAP format and is selected through the TCAS button on the MFD control panel. TCAS cannot be displayed on PLAN format.

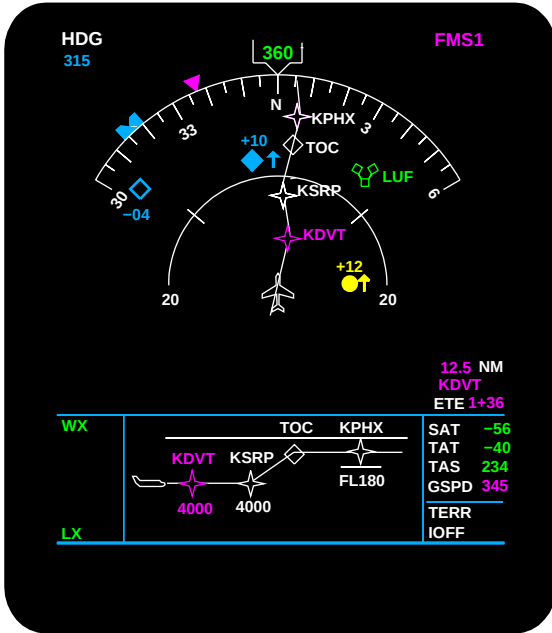


The button sequence is as follows:
not shown – TCAS zoom window – TCAS overlay – TCAS zoom window – not shown

NOTE
TCAS STBY, TA ONLY, TCAS, TCAS FAIL (amber), TCAS TEST (red) are available annunciations.



TCAS not shown



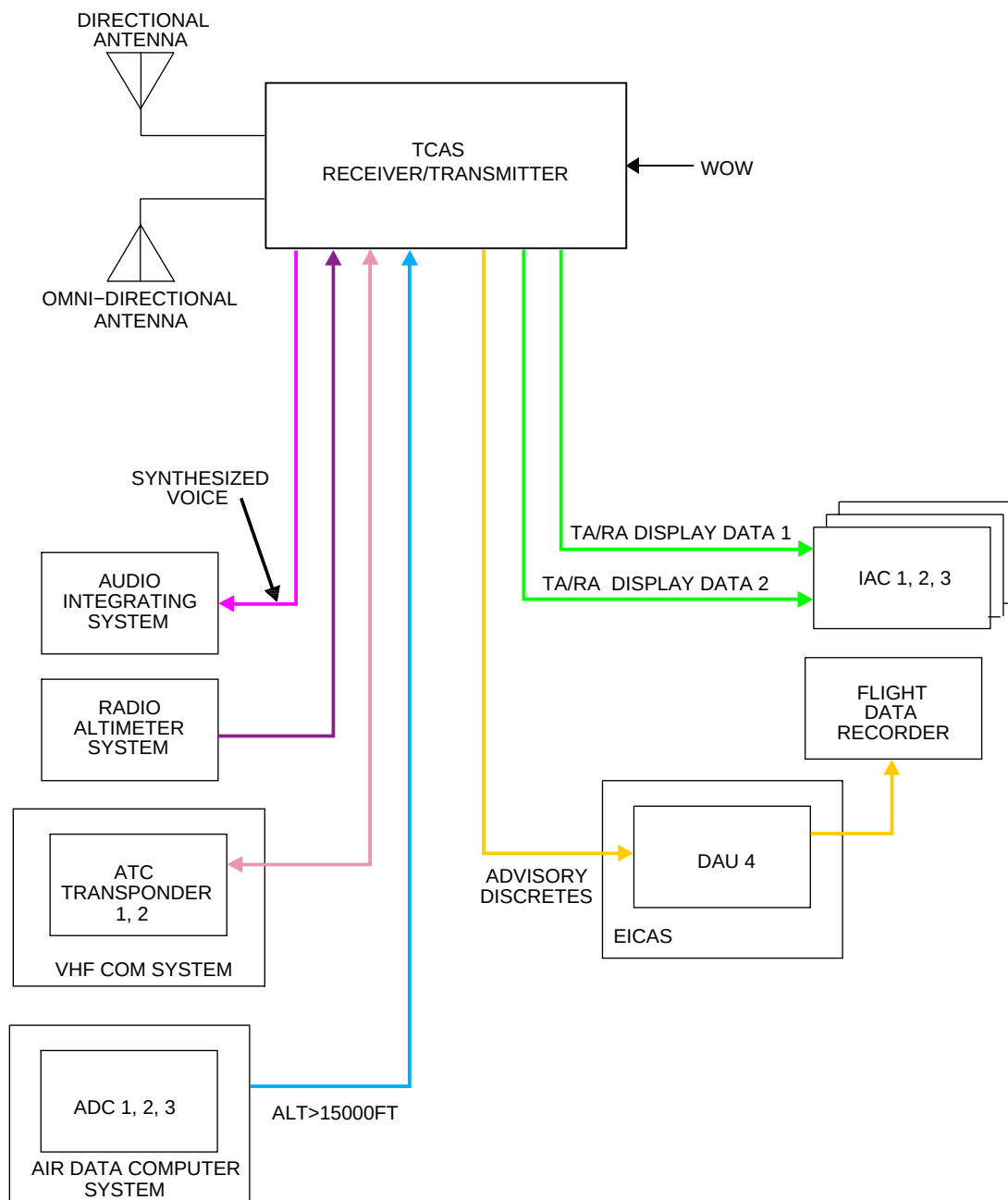
TCAS overlay

NOTE

- TCAS STBY msg displayed on MFD and PFD when TCAS is selected with transponder in STBY.

GF1710_025a

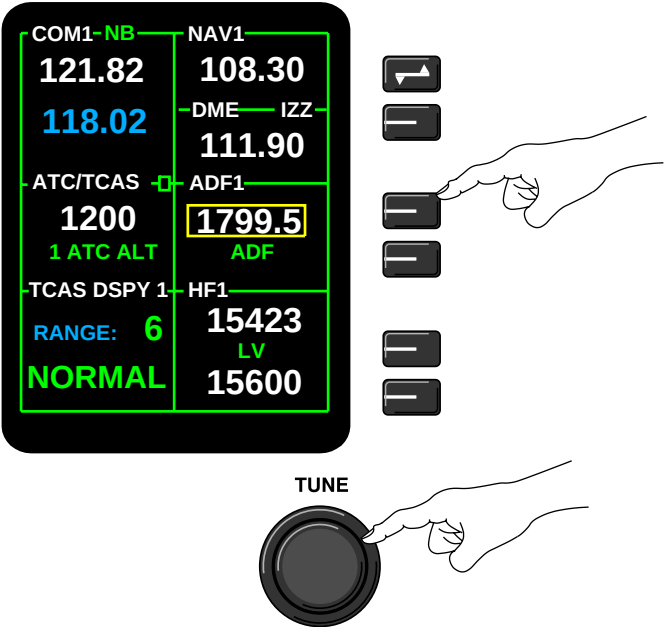
TCAS SCHEMATIC



GF1710_026

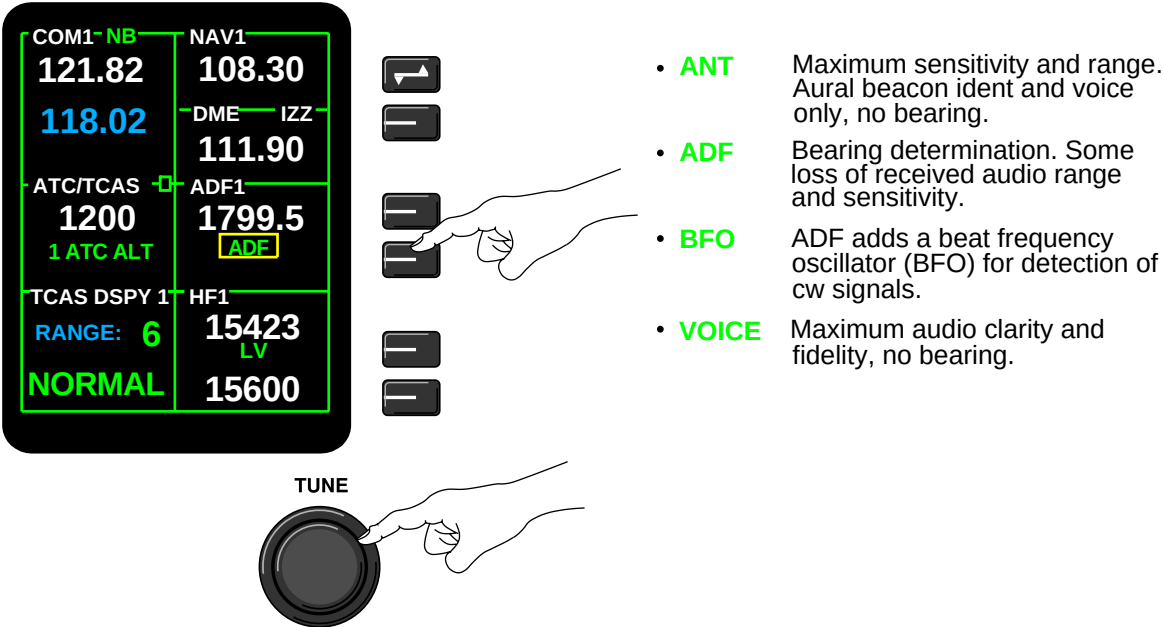
AUTOMATIC DIRECTION FINDER (ADF)

The two ADF receivers (ADF1 and ADF2) provide relative bearing between the airplane and a selected ground station for display on the PFDs. ADF operations are controlled by the adjacent line select keys and the tuning knobs. For more information, see Chapter 6 COMMUNICATIONS.



GF1710_027

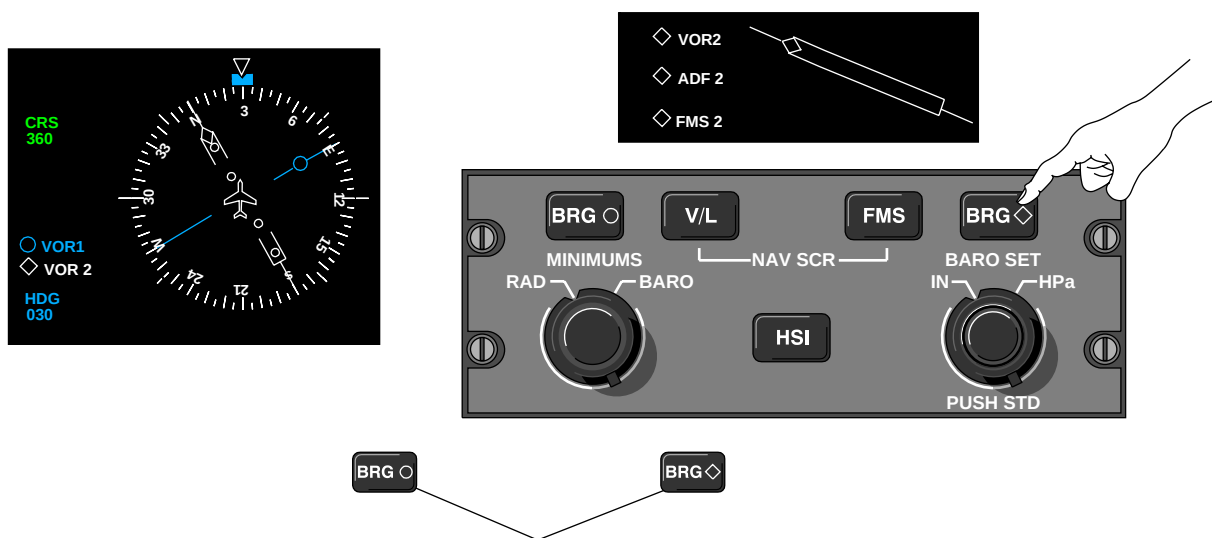
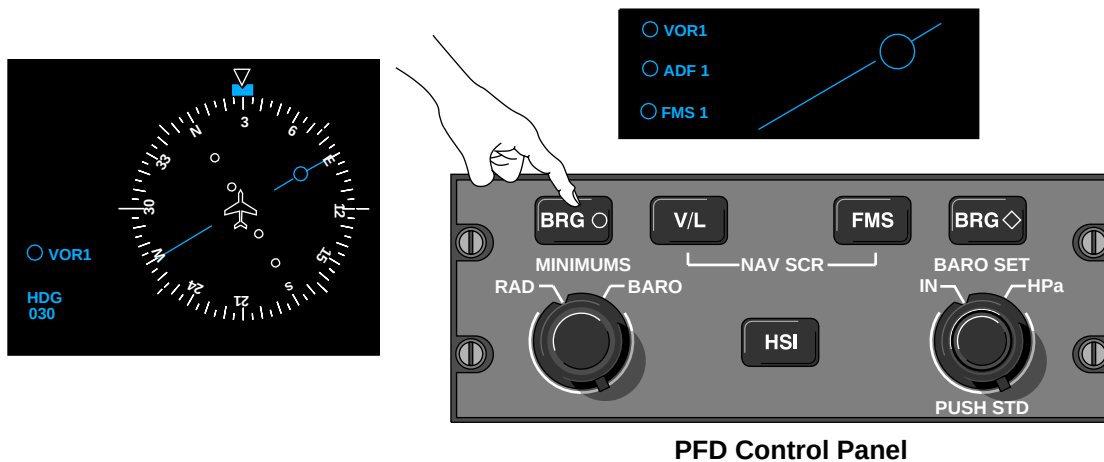
The receivers operate in the following modes and are controlled by the adjacent line select keys or the tuning knobs.



GF1710_028

BEARING (BRG) SOURCE

Bearing information, VOR1, ADF1 or FMS1 and bearing information VOR2, ADF2 or FMS2, is selected on either the pilot's and/or the copilot's PFD control panel, located on the glareshield.



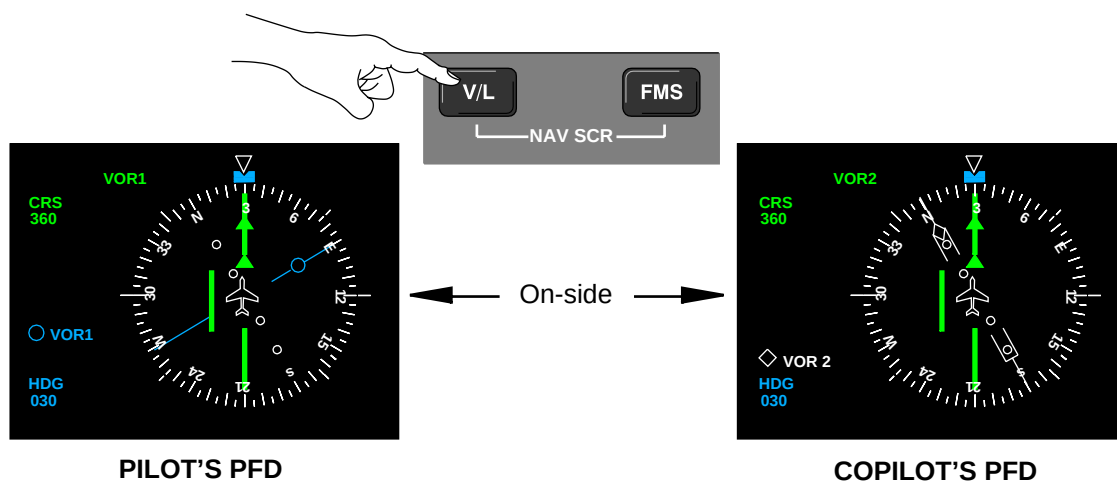
Pushing BRG button (s) will toggle the following in sequence:

- VOR
- ADF
- FMS
- Blank

GF1710_029

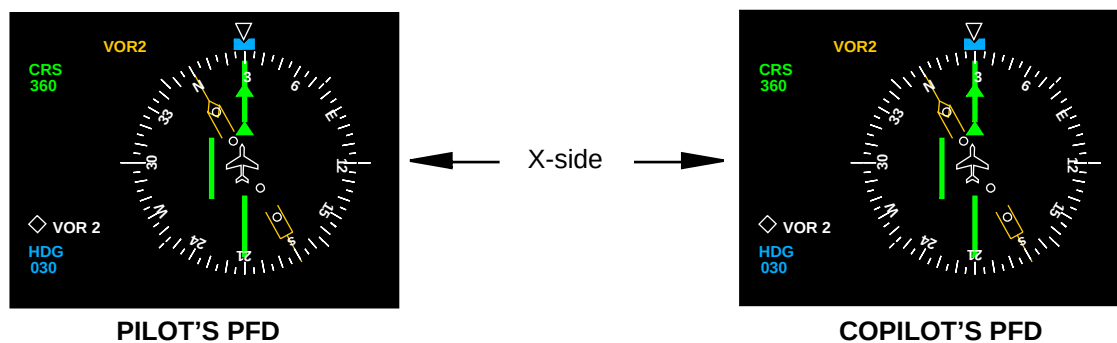
VOR/LOC NAV SOURCE

NAV source, VOR/LOC, is selectable on the pilot's and/or the copilot's PFD control panel.



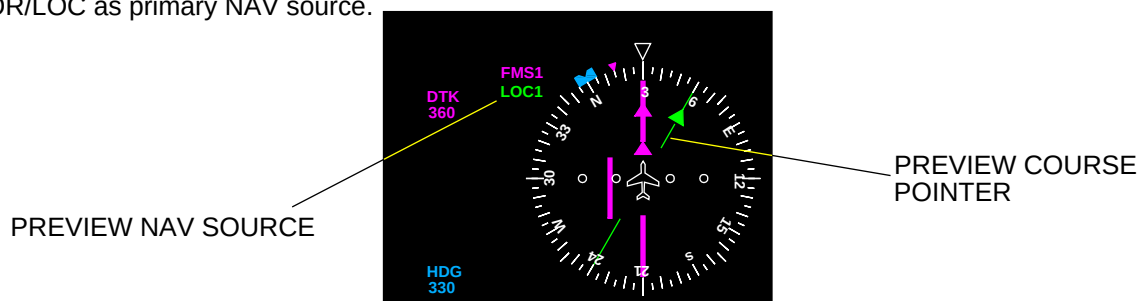
NOTE

Pushing V/L button will toggle the NAV source in the following sequence:
on-side **VOR/LOC** – X-side **VOR/LOC** – on-side **VOR/LOC**



NOTE

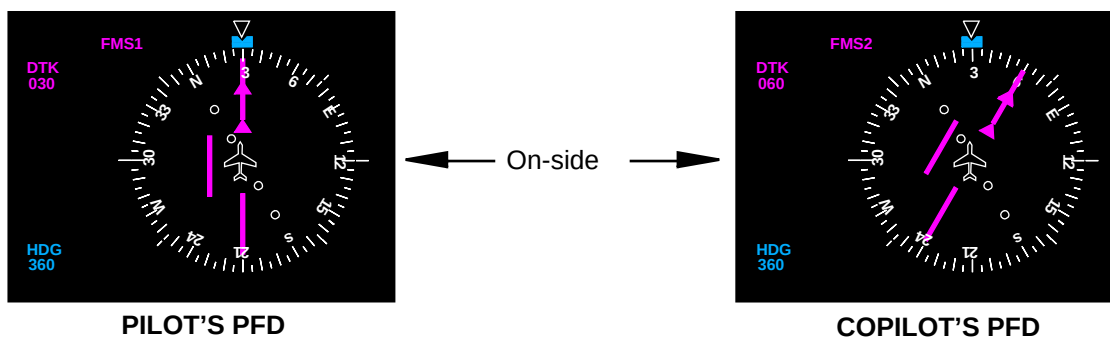
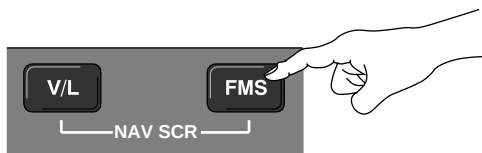
If FMS is the primary NAV source, the first push of the V/L button will set preview NAV source. The second push of V/L button will cancel FMS as primary NAV source and set VOR/LOC as primary NAV source.



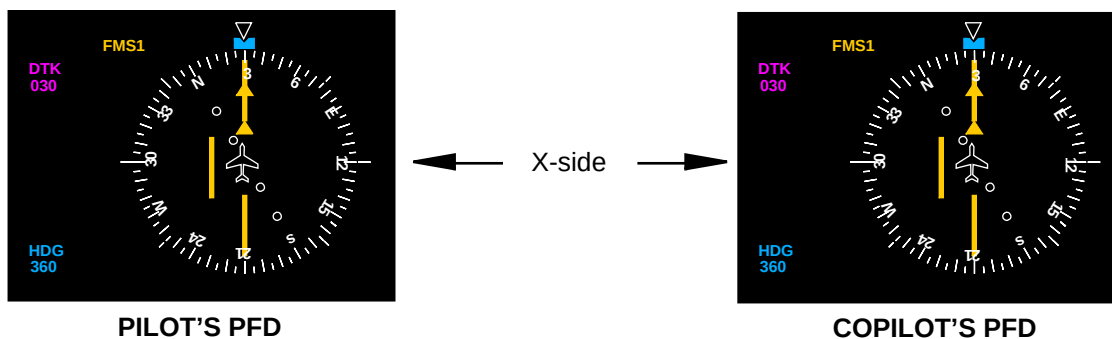
GF1710_030

FMS NAV SOURCE

FMS source, FMS1, FMS2, FMS3 (if installed) or Navigation Display Unit (NDU), also referred to as Lasertrack (LTRK) (if installed) is selectable on the pilot's and/or the copilot's PFD control panel.

**NOTE**

Pushing FMS button will toggle the NAV source in the following sequence:
 on-side **FMS** – X-side **FMS** – **LTRK** (if installed) – on-side **FMS** or,
 on-side **FMS** – **FMS3** (if installed) – X-side **FMS** – on-side **FMS**.

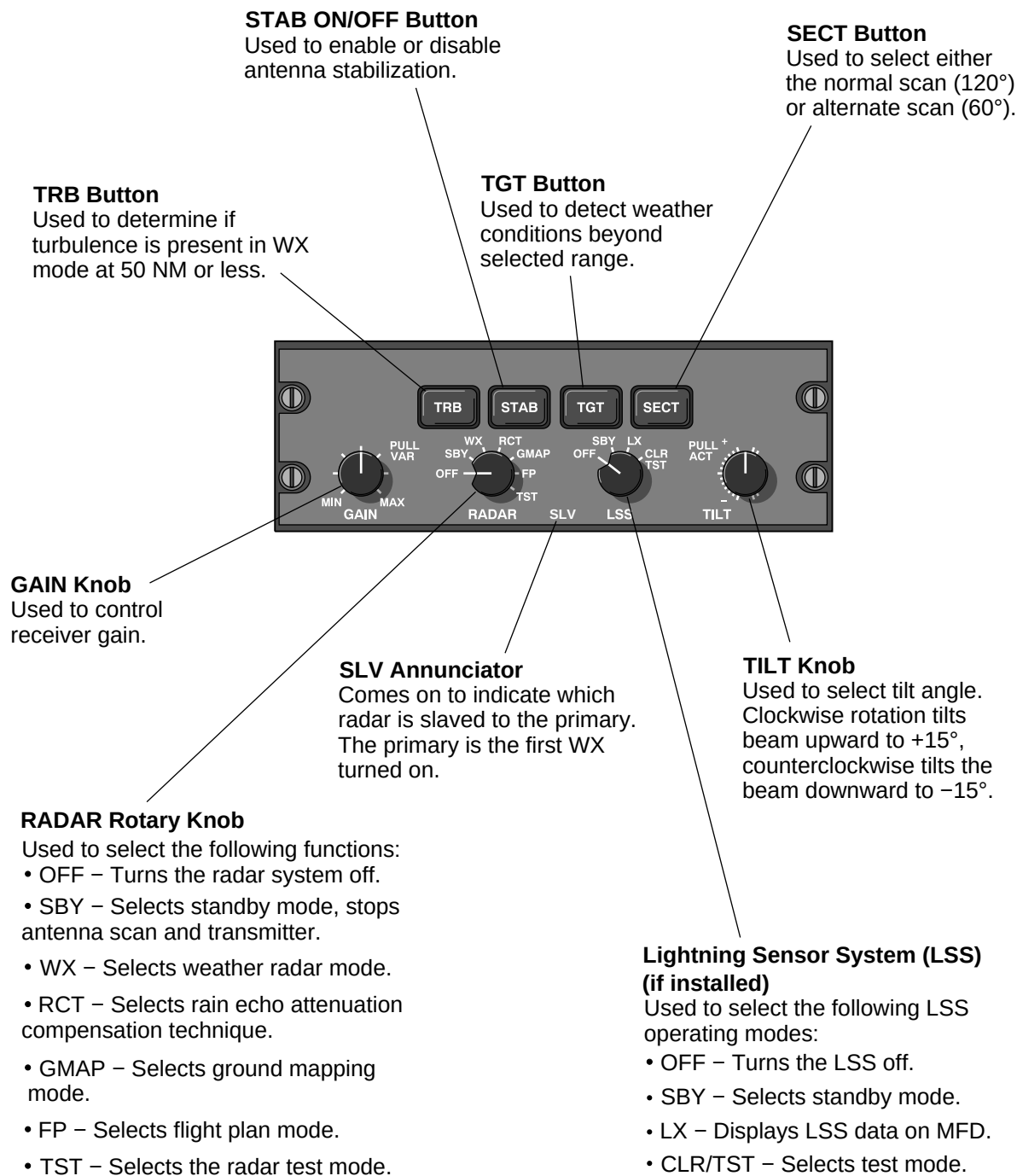
**NOTE**

If V/L is the primary NAV source, pushing the FMS button will cancel V/L as primary NAV source and will set on-side FMS as primary NAV source. Pushing FMS button while V/L preview NAV source is displayed, will cancel preview NAV source.

GF1710_031

WEATHER RADAR (WX)

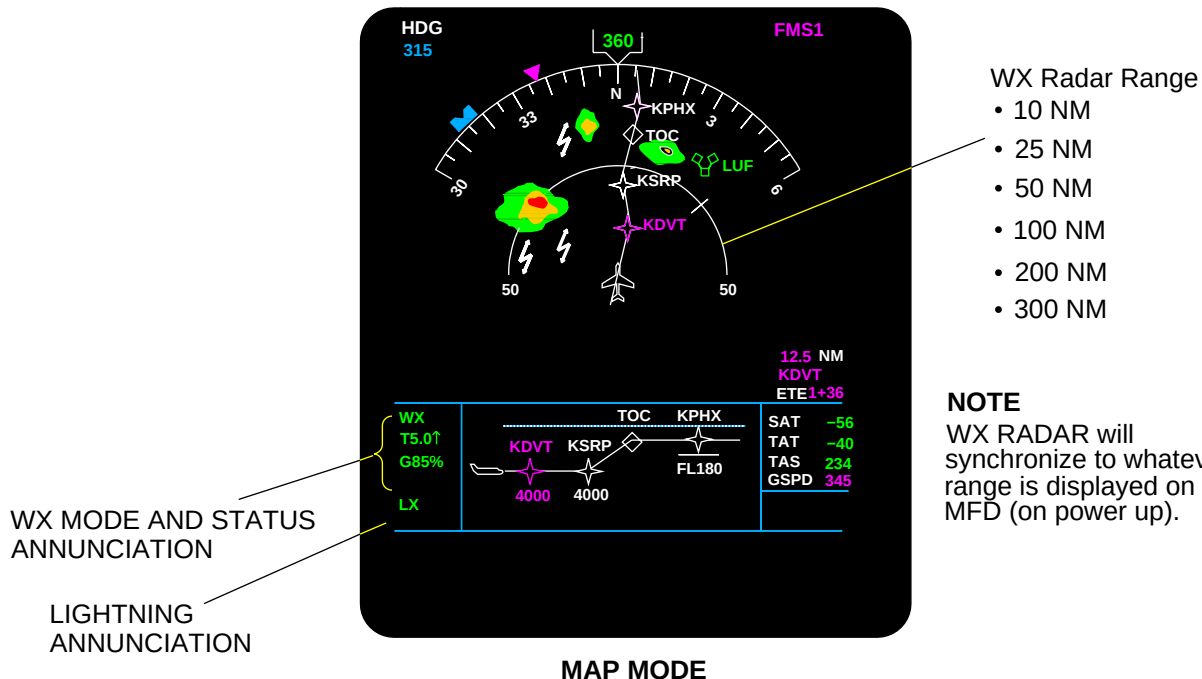
The weather radar control panel, located on the pedestal, controls GAIN, RADAR modes, TILT and Lightning Sensor System (LSS) (if installed). It also enables turbulence (TRB) mode, antenna stabilization (STAB), target alert (TGT) and sector scan (SECT).



GF1710_032

WEATHER RADAR (WX) (CONT'D)

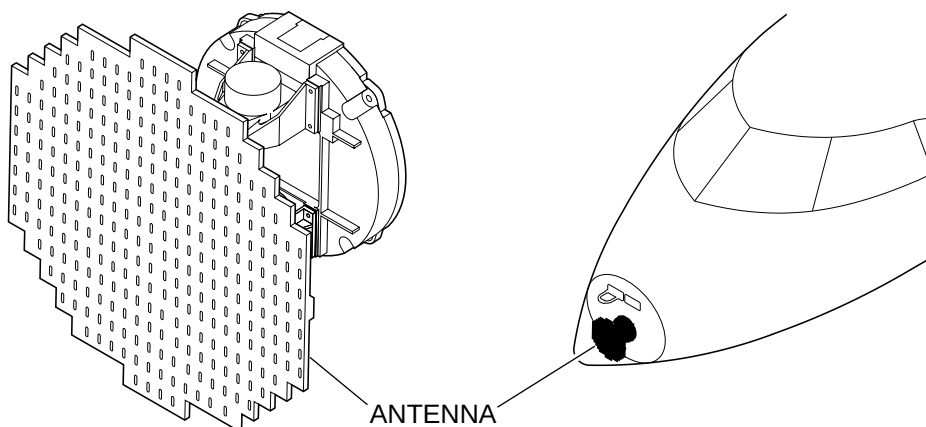
- The weather radar system provides a display of X-band radar detectable areas of precipitation along and within 60° on either side of the airplane's flight path. Weather radar returns, turbulence and lightning (if LSS installed) are displayed on the MFDs (MAP mode only). A range of up to 300 NM from the airplane is selectable using the up or down buttons on the MFD control panel.



GF1710_033

RADAR ANTENNA

- The antenna sweep is selectable for either 120° (60° each side of the airplane) or 60° (30° each side). The antenna tilt is adjustable between -15° (down) and +15° (up). The antenna maintains its stabilization with respect to the horizon regardless of the airplane attitude (within -15° to +15°).



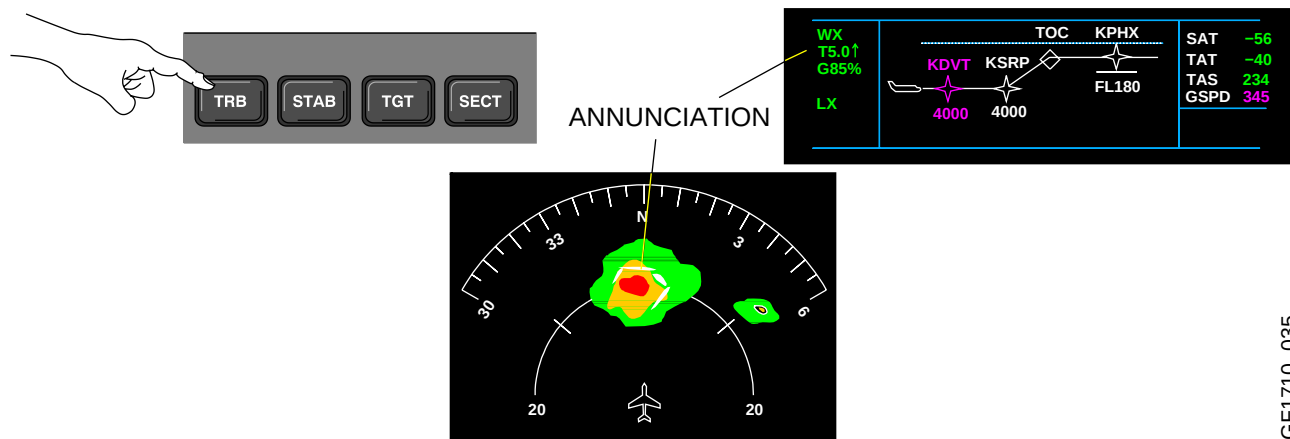
GF1710_034

MODE SELECTION

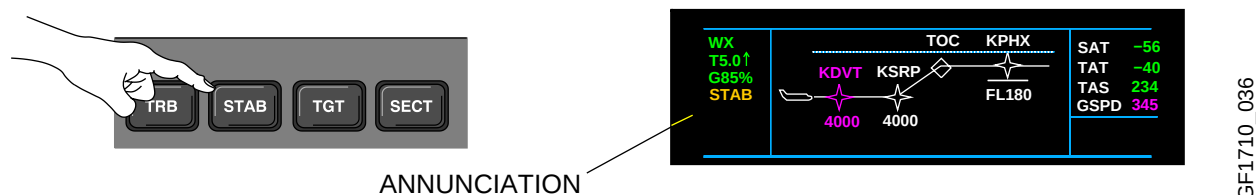
The weather radar operating modes, gain and antenna tilt functions are all controlled by the two radar control panels. Both the pilot and copilot can look at different ranges and tilt settings at the same time on their respective MFDs.

The weather radar modes and features are as follows:

TRB – Momentarily pressing the TRB button enables the turbulence mode. When this mode is selected, the radar determines if turbulence is present. TRB can only be engaged in the WX mode and in selected ranges of 50 NM or less. The weather/turbulence **WX/T** mode is annunciated in the status display. Areas of at least moderate turbulence are shown in white.



STAB – Momentarily pressing the STAB button, holds the elevation of the antenna beam constant at all azimuths, regardless of airplane bank or pitch maneuvers and relative to the earth's surface. The stabilization system uses IRS as a reference. Momentarily pressing the STAB button disables antenna stabilization and **STAB** is annunciated in the status display.



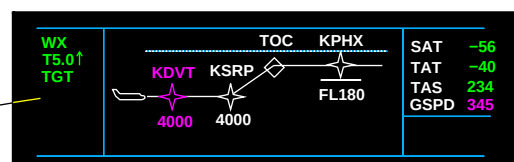
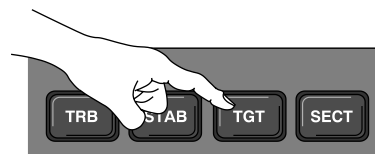
MODE SELECTION (CONT'D)

TGT – Target alert monitors for red or magenta weather conditions (rainfall rate) beyond the selected range and 7.5° on each side of the airplane heading and is selectable in all but the 300 NM range. If such weather is detected, outside the selected range the TGT alert annunciation changes from green armed to an amber alert condition on the MFD WX Status display. When this warning is received, the pilot should select longer ranges to view target alert. When TGT button is selected, TGT annunciation will replace the GAIN annunciation in the status display.

Rainfall Rate		Colour
in/hr	mm/hr	
.04 to .16	1 to 4	Green
.16 to .47	4 to 12	Yellow
.47 to 2.0	12 to 50	Red
>2	>50	Magenta

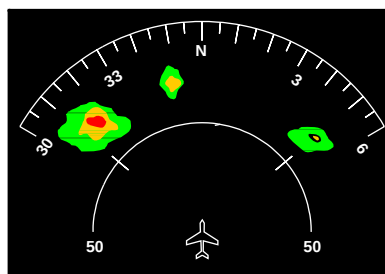
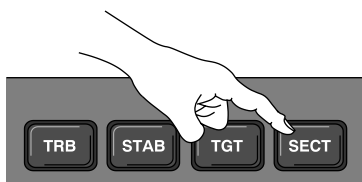
RAINFALL COLOUR CODING

TGT will be displayed as **TGT** (flashing), if red or magenta is detected outside selected range.

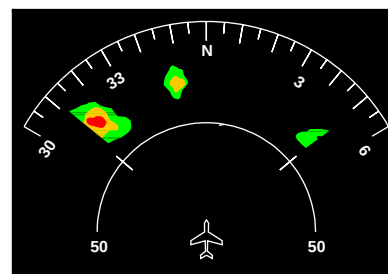


GF1710_037

SECT – The normal radar sweep is $\pm 60^\circ$ from the airplane nose at a rate of 14 sweeps/min. Pressing SECT button reduces the angle of sweep to $\pm 30^\circ$ at a rate of 28 sweeps/min. Pressing the SECT button again, returns to normal sweep. Both the pilot's and copilot's displays will show the same sweep angle.



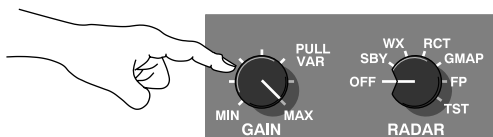
120° arc



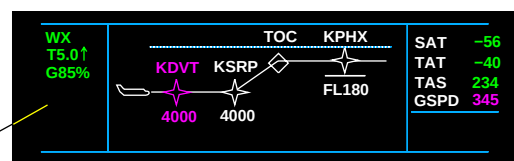
60° arc

GF1710_038

GAIN – The GAIN knob is a rotary control and push/pull switch that is used to control the receiver gain. Push on the GAIN switch to enable the preset calibrated gain mode. Calibrated gain is the normal mode and is used for weather avoidance. Pull out on the GAIN switch to enable the variable gain mode. Variable gain is used to provide additional weather analysis and for ground mapping. In WX mode, variable gain receiver sensitivity can be increased to show weak targets or can be reduced to eliminate weak returns.



ANNUNCIATION

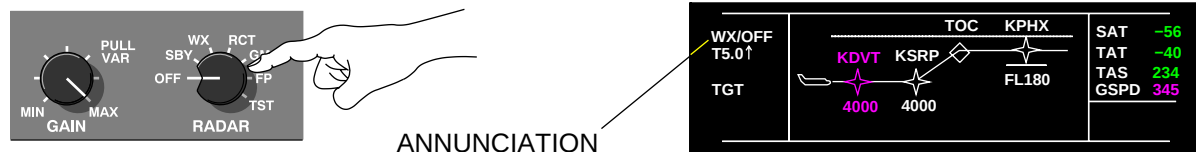


GF1710_039

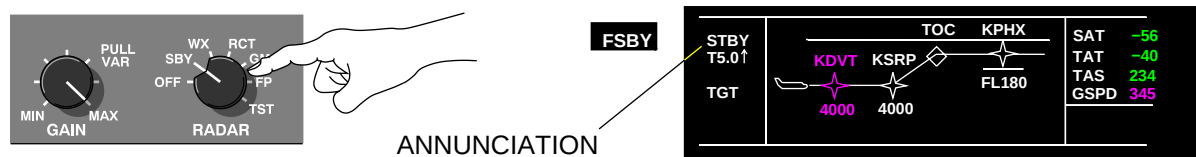
WX SYSTEM OPERATION

The RADAR rotary knob is used to select the following functions:

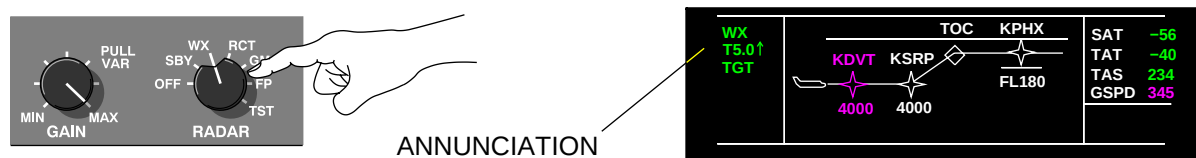
OFF – Turns the radar off. The system is no longer radiating and the antenna is stowed.



SBY – Selects the WX system in standby mode. It takes approximately 45 seconds for the system to warm up after being switched out of OFF. There is also a hidden mode, Forced Standby (FSBY). This mode is enabled automatically on the ground, if the airplane is powered up, with the radar powered. To exit FSBY, push STAB button 4 times within 3 seconds. This mode prevents the radar from radiating, thereby protecting the ground personnel from radiation exposure.

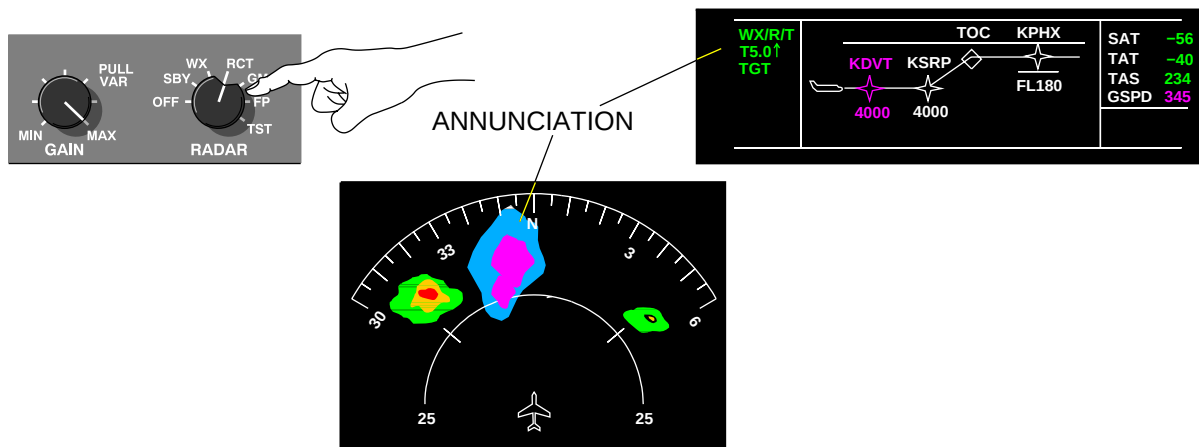


WX – Selects the WX mode of operation. When WX is selected, airplane inflight, the system is fully operational and all parameters are set for enroute weather detection. If the rotary knob is moved directly from OFF to WX, the system will first go into SBY for approximately 45 seconds, then become active.



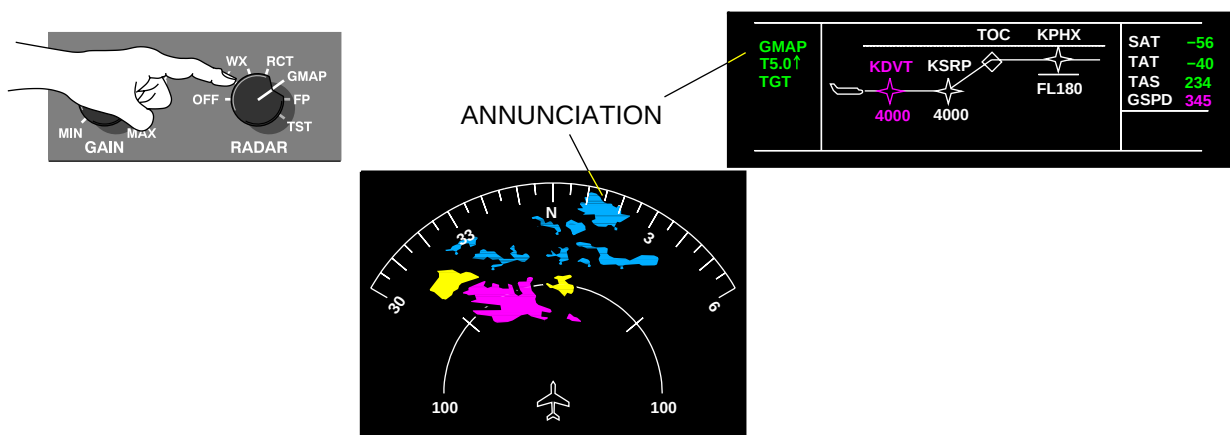
WX SYSTEM OPERATION (CONT'D)

RCT – Enables the Rain Attenuation Compensation Technique (REACT). The REACT compensates for attenuation of the radar signal as it passes through rainfall. Strong targets (high attenuation levels) cause the receiver to reach its maximum gain value in a short time/short range. Weak targets (low attenuation levels) cause the receiver to reach its maximum gain in a longer time/longer range. When this maximum gain value is reached, a cyan background field will appear. Any target inside of the cyan area will appear in magenta colour, indicating maximum field severity.



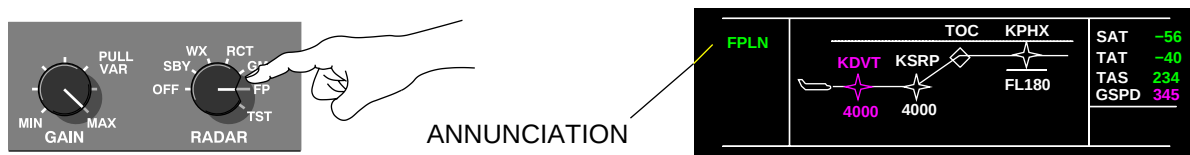
GF1710_043

GMAP – Selects the ground mapping mode. The auto TILT control is turned down until the desired amount of terrain is displayed. The colour scheme is changed to cyan (least reflective return), yellow (moderate return) and magenta (strong return).



GF1710_044

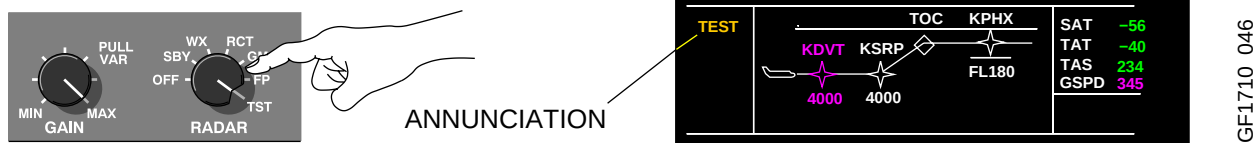
FP – Selects the flight plan mode. This clears the screen of radar data so ancillary data can be displayed, such as navigation displays and lightning data. In the FP mode the radar RTA is put to standby and the FPLN legend is displayed in the mode field.



GF1710_045

WX SYSTEM OPERATION (CONT'D)

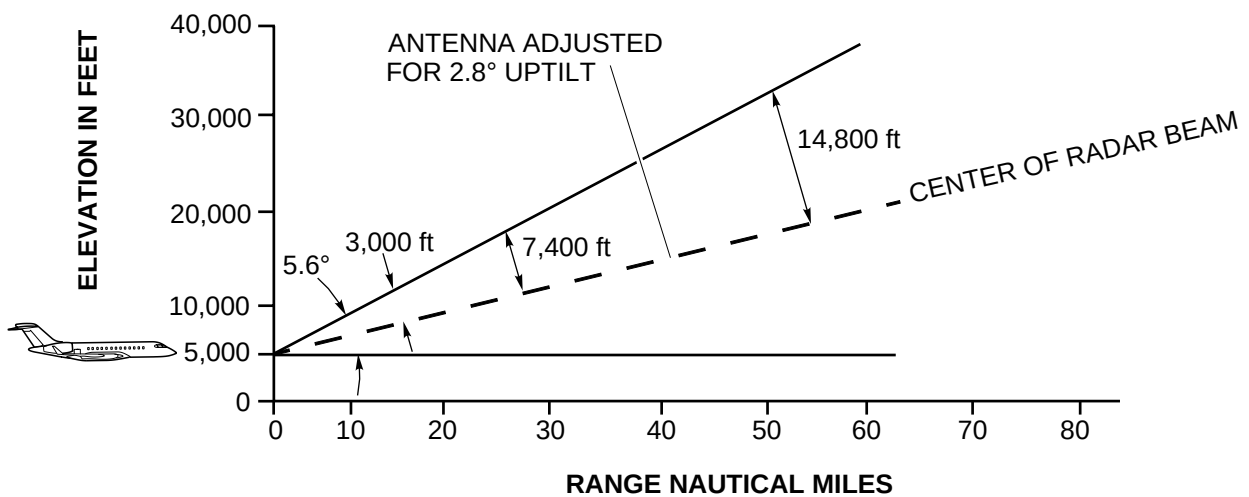
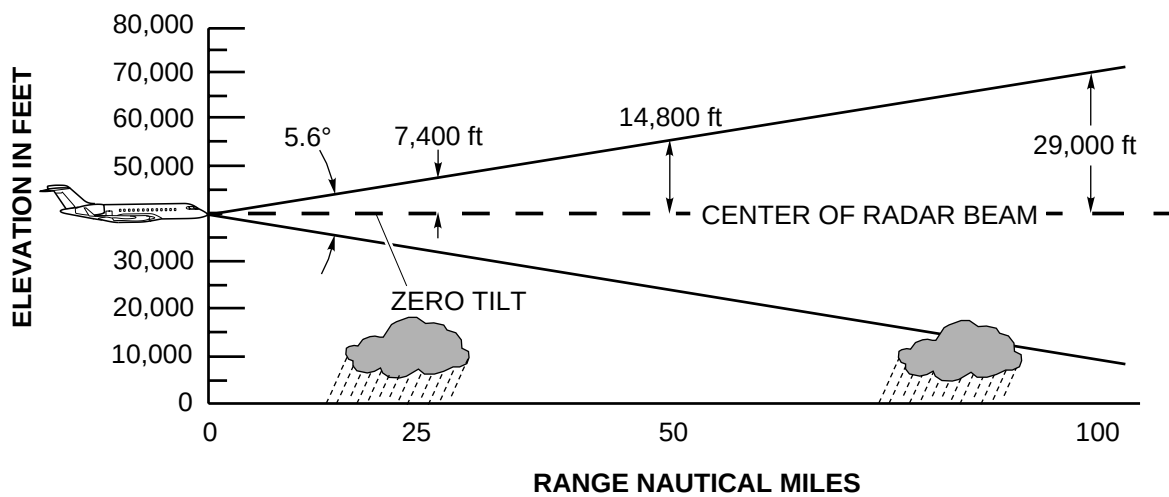
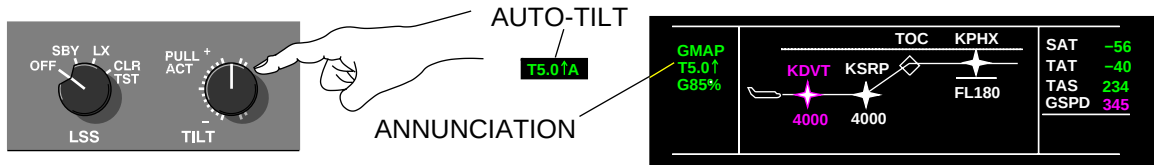
TST – Selects the test mode. The test position selects a special test pattern, to verify system operation. When the TEST is complete, the radar enters the FSBY mode.



WX SYSTEM OPERATION (CONT'D)

TILT

The TILT rotary knob is used to manually select the tilt angle of the antenna. Clockwise rotation of the knob tilts the antenna upward to $+15^\circ$ and counter-clockwise rotation of knob tilts antenna downward to -15° . When the TILT knob is pulled out (auto-tilt), the antenna tilt is automatically adjusted with regard to selected range and barometric altitude. The tilt control can fine tune the tilt setting by $\pm 2^\circ$. When in auto-tilt, an A symbol will appear following the digital tilt readout.



GF1710_048a

WX SYSTEM OPERATION (CONT'D)

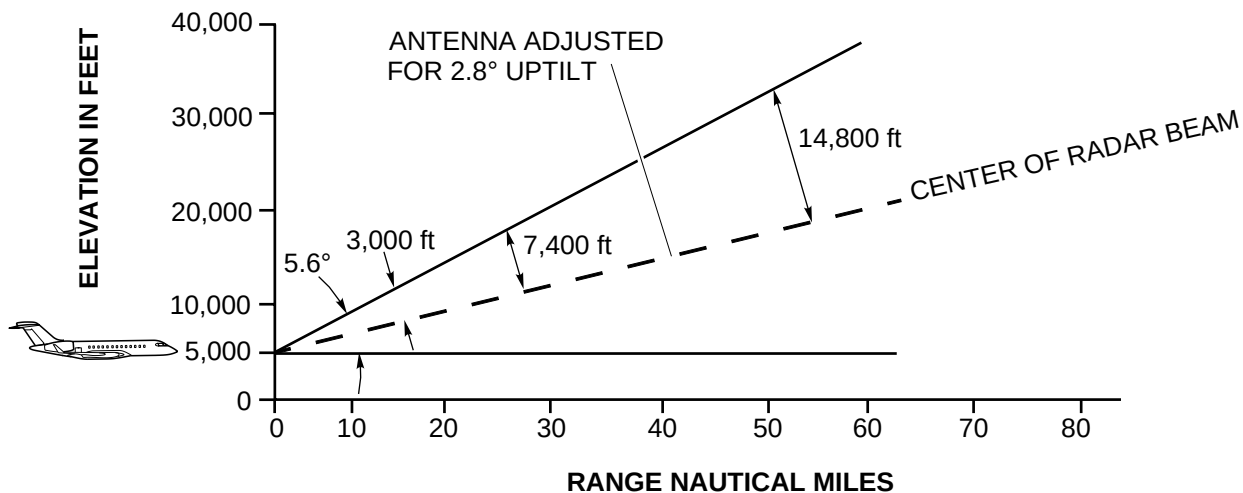
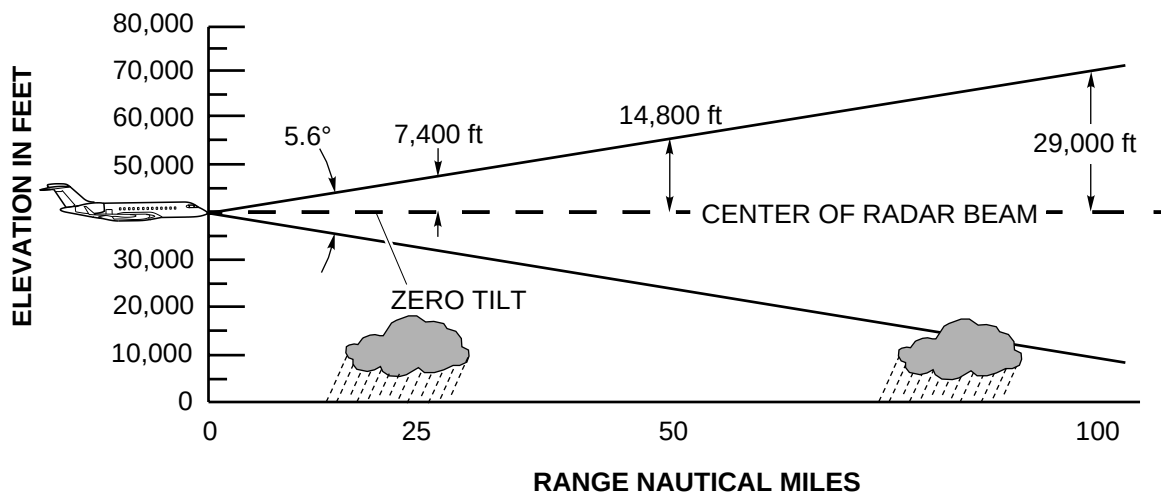
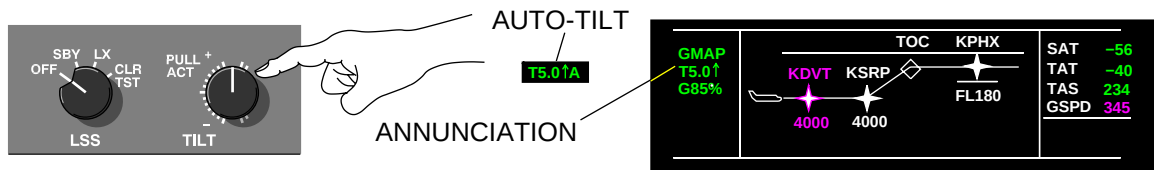
TILT MANAGEMENT

The pilot can use tilt management techniques to minimize ground clutter when viewing weather targets.

Assume the aircraft is flying over relatively smooth terrain that is equivalent to sea level in altitude. The pilot must make adjustments for the effects of mountainous terrain.

The following figure helps to visualize the relationship between tilt angle, flight altitude, and selected range. It shows:

- Distance above and below aircraft altitude that is illuminated by the flat-plate radiator during level flight with 0° tilt.
- Respective low altitude situation, with the antenna adjusted for 2.8° up-tilt.



GF1710_048a

WX SYSTEM OPERATION (CONT'D)

TILT MANAGEMENT (Cont'd)

The following figure gives the approximate tilt settings at which ground targets begin to be displayed on the image periphery for an 18-inch radiator. The range at which ground targets can be observed is affected by the curvature of the earth, the distance from the aircraft to the horizon, and altitude above the ground. As the tilt control is rotated downward, ground targets first appear on the display at less than maximum range.

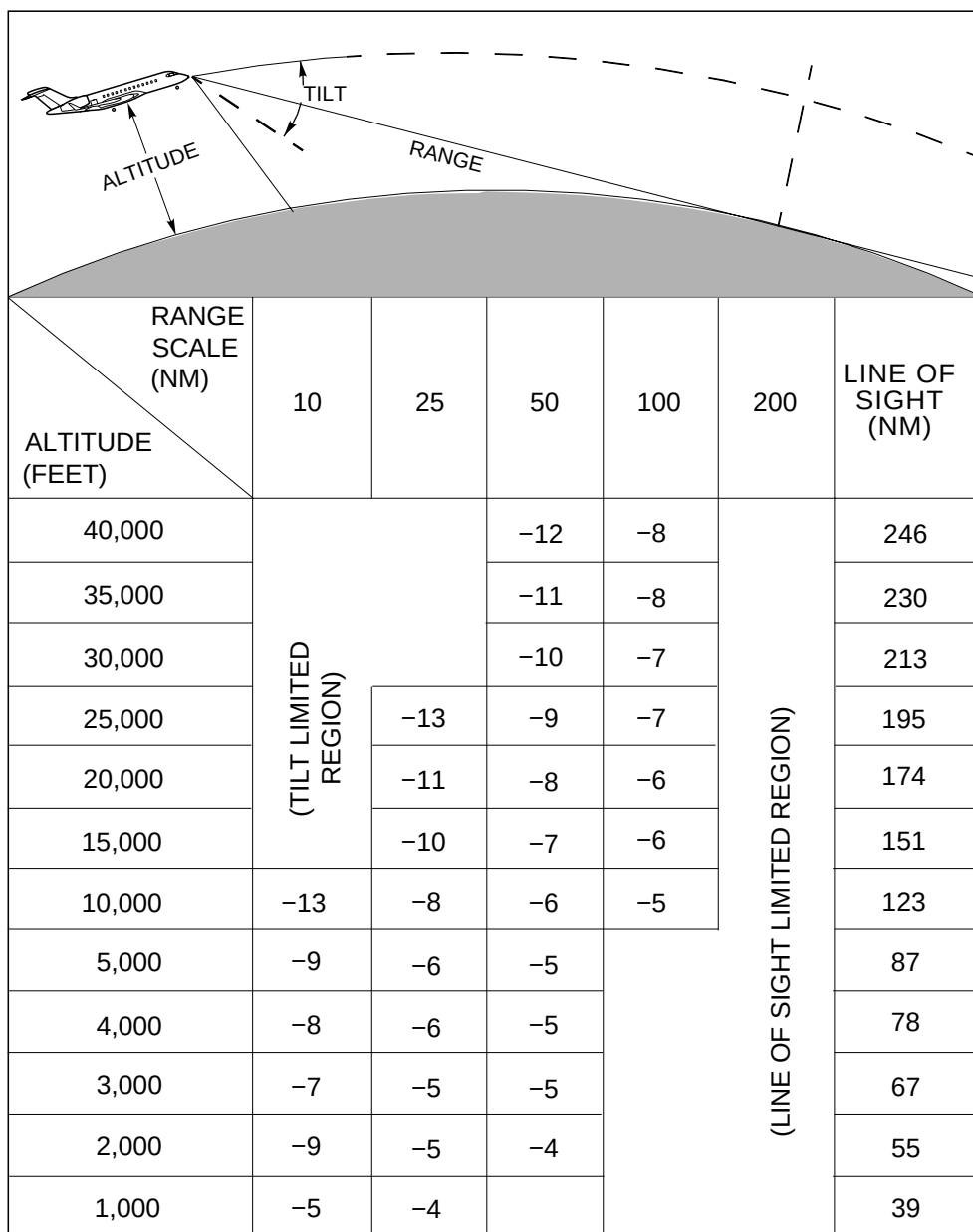
To find the ideal tilt angle after the aircraft is airborne, adjust the TILT control so that ground clutter does not interfere with viewing of weather targets. Usually, this can be done by tilting the antenna downward in 1° increments until ground targets begin to appear at the display periphery. Ground returns can be distinguished from strong storm cells by watching for closer ground targets that are displayed.

When ground targets are displayed, move the tilt angle upward in 1° increments until the ground targets begin to disappear. Proper tilt adjustment is a pilot judgment, but typically the best tilt angle lies where ground targets are barely visible or just off the radar image.

WX SYSTEM OPERATION (CONT'D)

TILT MANAGEMENT (Cont'd)

The figure gives the approximate tilt settings required for different altitudes and ranges. If the altitude changes or a different range is selected, adjust the tilt control as required to minimize ground returns.



GF1710_182

Tilt angles shown are approximate. Where the tilt angle is not listed, the operator must exercise good judgment.

NOTE

The line of sight distance is nominal. Atmospheric conditions and terrain affect this value.

WX SYSTEM OPERATION (CONT'D)

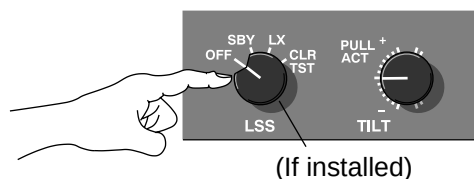
TILT MANAGEMENT (Cont'd)

For more information on WX Radar, see manufacturer's Manual A28-146-102-00.

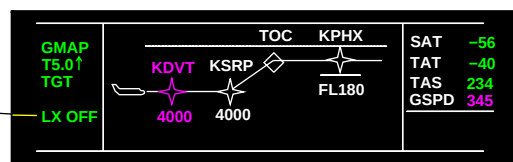
LIGHTNING SENSOR SYSTEM (LSS) (IF INSTALLED)

The lightning sensor system is used to detect lightning. The LSS rotary knob is used to select the following functions:

OFF – Turns off the LSS.

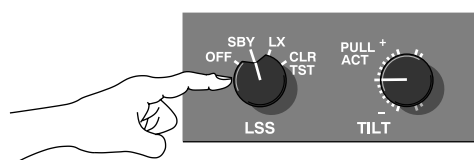


ANNUNCIATION

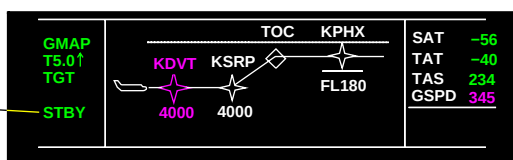


GF1710_049

SBY – Selects the LSS in standby mode. The data is inhibited, but LSS accumulates data.

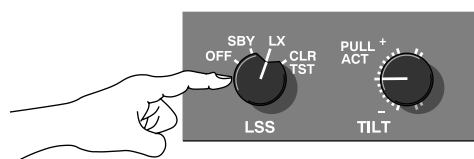


ANNUNCIATION

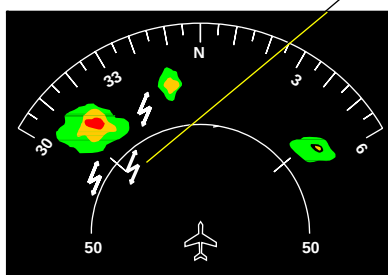
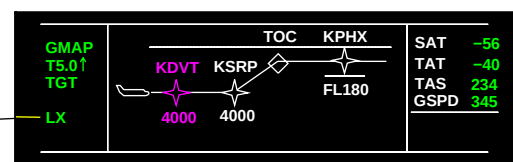


GF1710_050

LX – LSS is fully operational and displays data on the MFD.



ANNUNCIATION



Rate 1: Lightning rate of 2–15 strokes in the last 2 minutes.

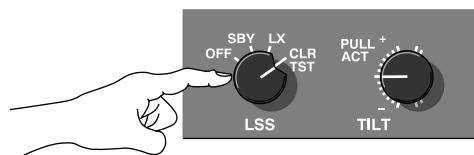
Rate 2: Lightning rate of 16–31 strokes in the last 2 minutes.

Rate 3: Lightning rate of >32 strokes in the last 2 minutes.

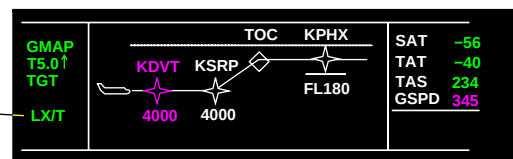
ALERT: Range is indeterminate but bearing accurately determined. Azimuth should be closely monitored.

GF1710_051

CLR/TST – LSS accumulated data is cleared from memory. After 3 seconds the test mode is initiated.



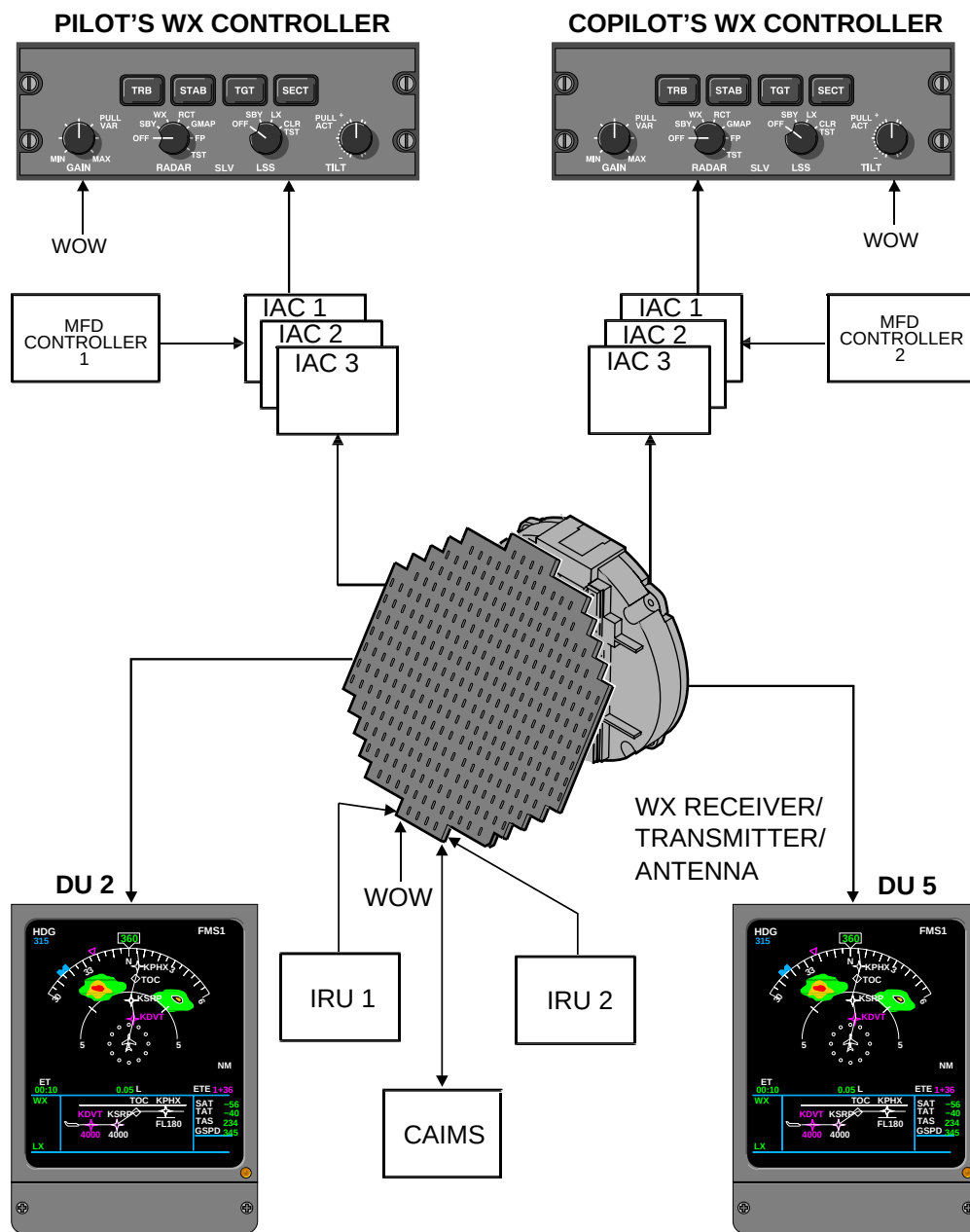
ANNUNCIATION



GF1710_052

For more information on Lightning Sensor System, see manufacturer's manual.

WEATHER RADAR SCHEMATIC



ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

The primary purpose of the EGPWS is to provide alerts and warnings to avoid controlled flight into terrain and to provide detected windshear warning.

The EGPWS is categorized into 7 modes. The basic GPWS function is comprised of modes 1 through 6. The windshear function and the enhanced feature, terrain awareness alerting and display function, are mode 7.

The Enhanced Ground Proximity Warning Computer (EGPWC) processes all inputs and provides all aural and visual alerts and warnings. The following priority, from highest to lowest, is used to determine which annunciation is displayed if more than one is active :

- **WIND SHEAR**
- **PULL UP**
- **GND PROX**
- **WIND SHEAR**

An alert annunciation indicates potential for impact with terrain. A warning annunciation indicates a prediction for impact with terrain. All annunciations are displayed on pilot's and copilot's PFDs.

The MFD control panel provides for the selection of the Terrain display on the respective MFD.



For more information on the MFD Control Panel, see Chapters 3 and 11.

GF1710_058

The EGPWS control panel, located on the pedestal, provides for the selection of GS WARN (MUTED), FLAP OVRD (OVRD) and TERRAIN (MUTED).

GS WARN Switch

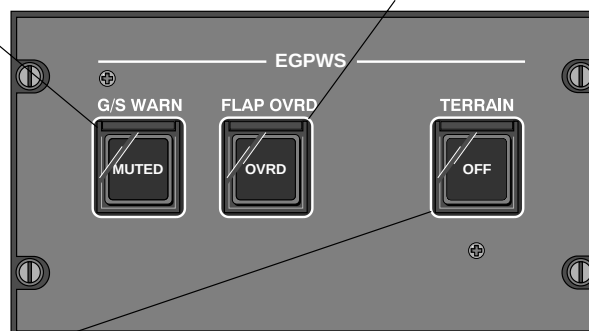
Used to mute glideslope warning.

FLAP OVRD Switch

Used to mute flap aural warning when flaps are not properly configured for landing.

TERRAIN Switch

Used to inhibit terrain clearance floor, terrain awareness alerting and display functions (in a case where landing at an airport, that is not in the database).



GF1710_059

EGPWS MODES

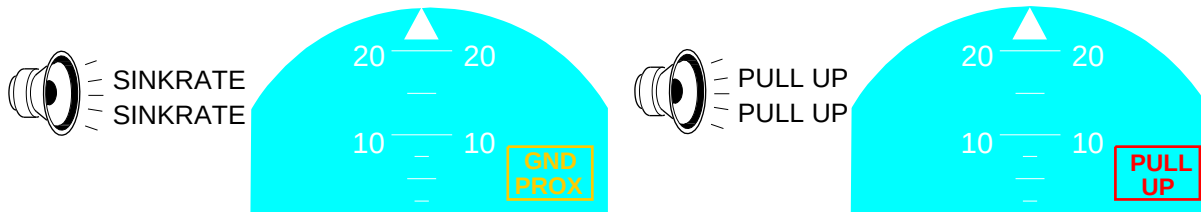
EGPWS modes are as follows:

Mode 1 – Excessive Descent rate

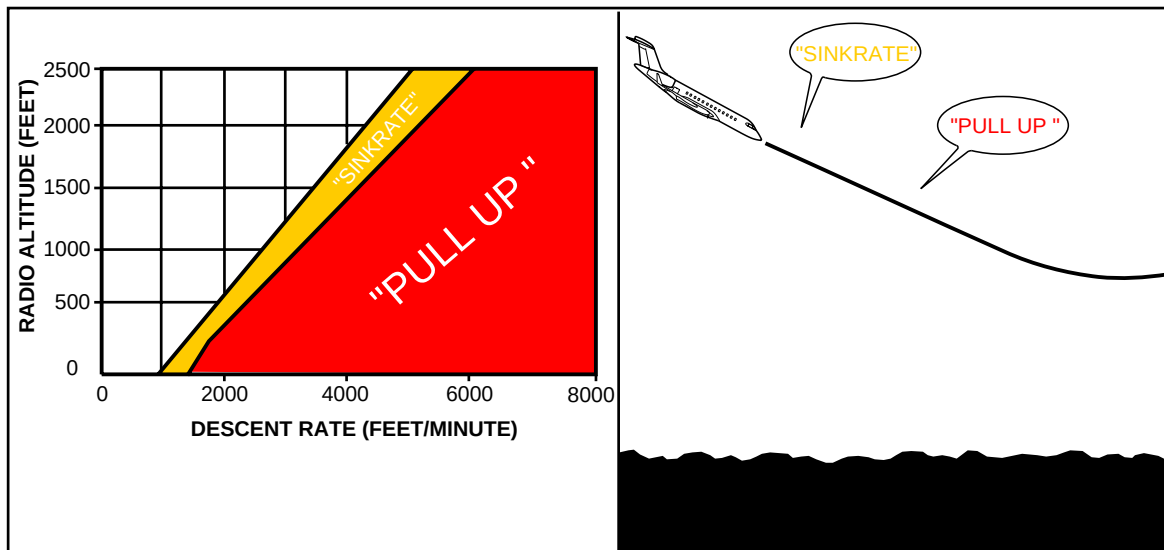
Mode 1 provides aural and visual alerts and warnings in the event that the EGPWC determines that the rate of descent is excessive with respect to airplane altitude. The mode is active when the airplane is less than 2500 ft AGL. Mode 1 requires radio altitude and rate of descent data.

The annunciation envelope consists of two areas: alert and warning.

- Penetration of the alert area will annunciate a **GND PROX** alert on the PFD and generate an aural “SINKRATE, SINKRATE”. The aural alert will be annunciated once and will be repeated only if condition degrades by more than 20% based on computed time to impact. The visual alert will remain until the condition is rectified.
- Penetration of the warning area will annunciate a **PULL UP** alert on the PFD and generate an aural “PULL UP” warning. The aural warning is annunciated continuously until the condition is rectified.



GF1710_060

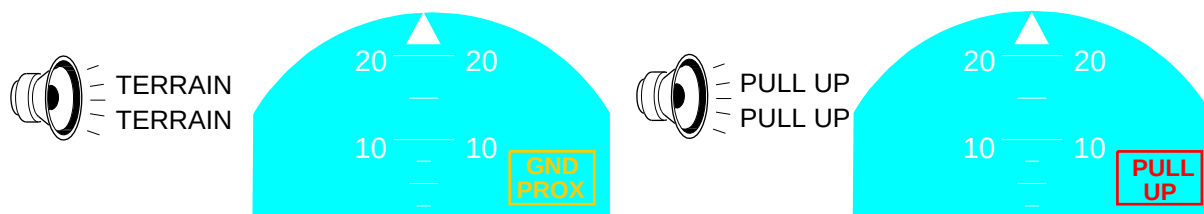


GF1710_061

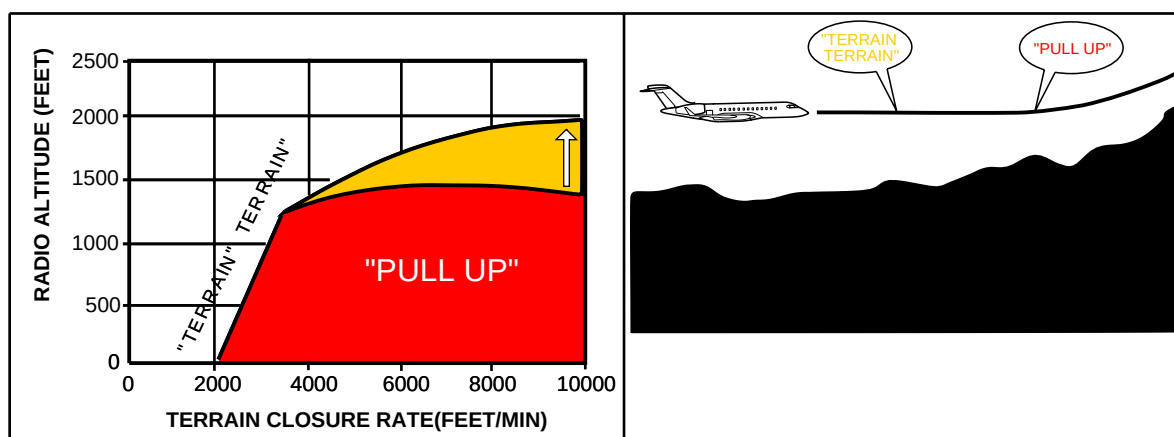
EGPWS MODES (CONT'D)

Mode 2 – Excessive Terrain Closure Rate

Mode 2 provides alerts and warnings when the EGPWC detects that the closure rate between the airplane and terrain is excessive. The airplane need not be in descent, rising terrain may be encountered in level flight, or the terrain may be rising at a rate greater than the airplane rate of climb. Mode 2 uses radio altitude and vertical speed inputs.



GF1710_062



GF1710_063

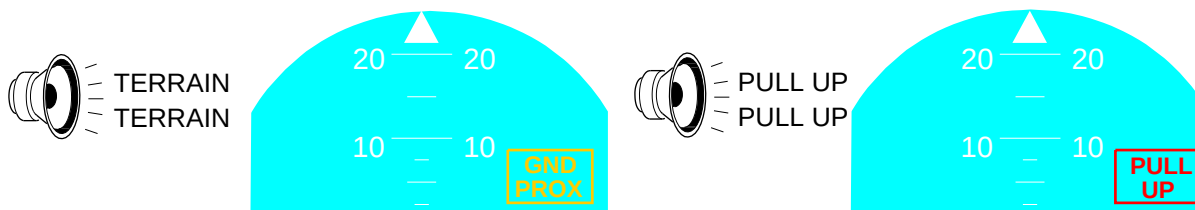
Mode 2 has two sub-modes: Mode 2A and Mode 2B.

- Mode 2A – Activated when flaps are not in the landing position. Penetration of the alert area will annunciate a **GND PROX** on the PFD and generate an aural "TERRAIN, TERRAIN". The aural is annunciated once and the visual alert will remain until the condition is rectified. Penetration of the warning area will annunciate a **PULL UP** alert on the PFD and generate an aural "PULL UP" warning. The aural and visual warning are annunciated continuously until the condition is rectified.

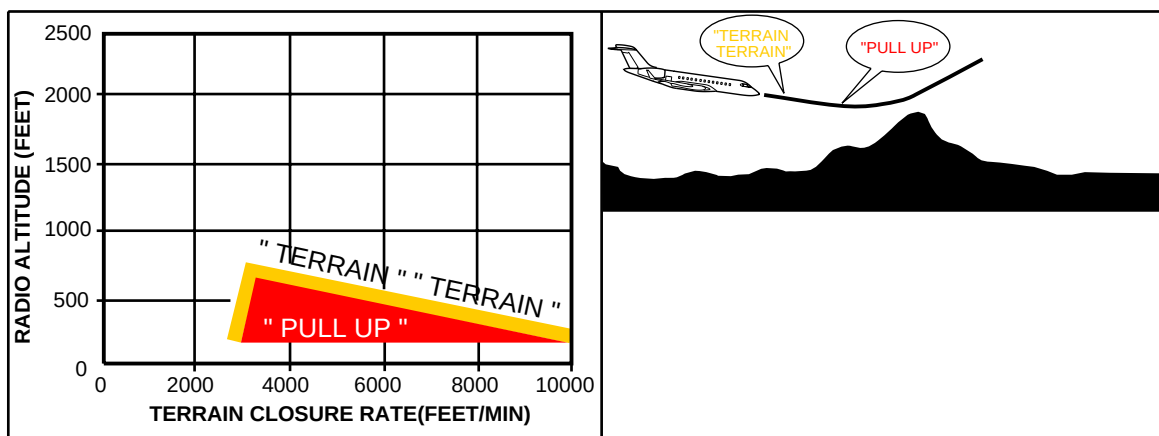
EGPWS MODES (CONT'D)

Mode 2 – Excessive Terrain Closure Rate (Cont'd)

- Mode 2B – Activated when flaps are in the landing configuration, or in the event the flaps are up and the airplane is on an ILS approach and the glideslope and localizer deviations are less than ± 2 dots and for 60 seconds after take-off. Penetration of the alert area will annunciate a **GND PROX** on the PFD and enable an aural “TERRAIN,TERRAIN”. The aural and the visual alerts are annunciated continuously and will remain until the condition is rectified. Penetration of the warning area will annunciate a **PULL UP** alert on the PFD and generate an aural “PULL UP” warning. The aural and visual warning are annunciated continuously until the condition is rectified. The Mode 2B warning envelope is inhibited at an altitude below 30 feet AGL.



GF1710_064



GF1710_065

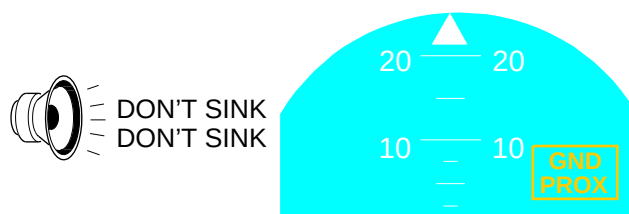
EGPWS MODES (CONT'D)

Mode 3 – Altitude Loss After Take-off

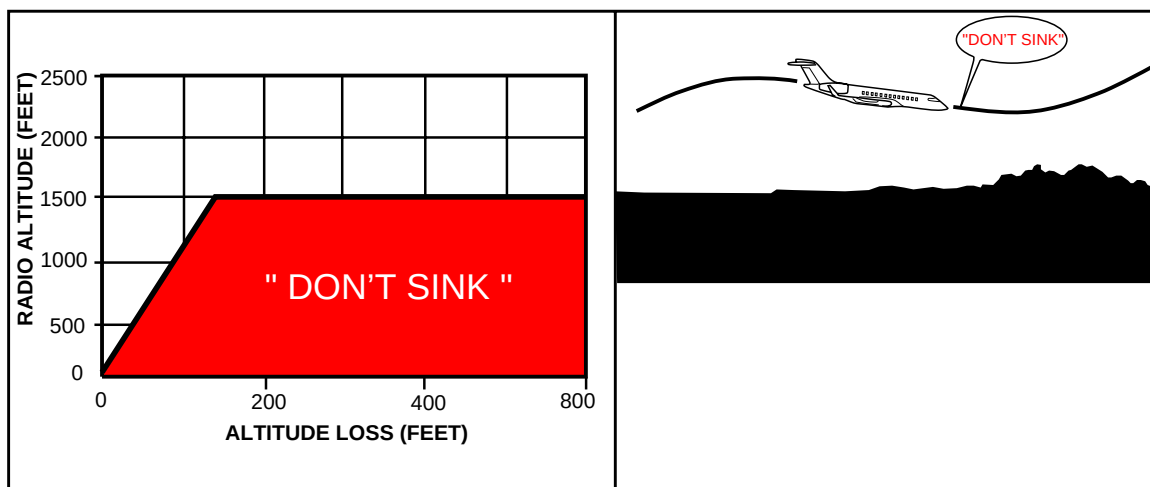
Mode 3 provides warnings when the EGPWC detects that a significant amount of altitude is lost immediately after take-off or during a go-around. Mode 3 uses radio altitude, barometric altitude and altitude rate.

If a descent is initiated following take-off or go-around, the EGPWC stores the altitude value at which the descent began and compares successive altitude data to the stored value. Activation of the warning is induced when the minimum terrain clearance, as a function of altitude lost, is exceeded.

Penetration of the alert area will annunciate a **GND PROX** alert on the PFD and generate an aural "DONT SINK, DONT SINK" warning. The aural warning is annunciated only once, unless the altitude value degrades by more than 20% from the initially stored value and again at each additional 20% degradation from the initially stored value. This condition will remain until the airplane regains the initial altitude value. Mode 3 is inhibited for radio altitude values in excess of 1500 feet.



GF1710_066



GF1710_067

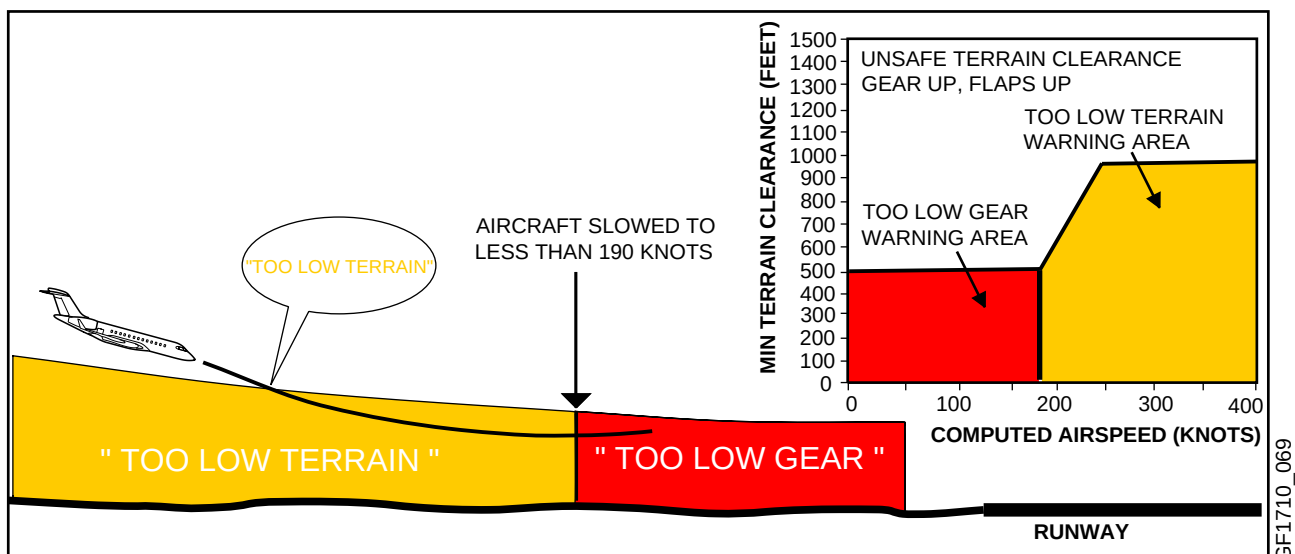
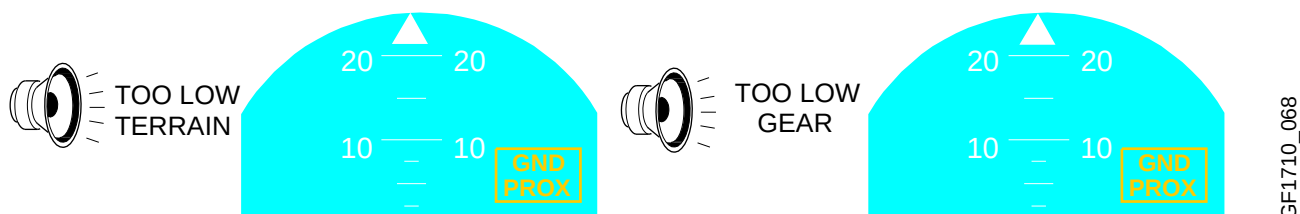
EGPWS MODES (CONT'D)

Mode 4 – Unsafe Terrain Clearance

Mode 4 provides alerts and warnings for insufficient terrain clearance based on airplane phase of flight and airspeed. Mode 4 requires radio altitude, computed airspeed, gear position and flap position inputs. The alert and warning envelopes are based on minimum allowable terrain clearance as a function of computed airspeed.

Mode 4 is divided into 3 sub-modes: Mode 4A, Mode 4B and Mode 4C.

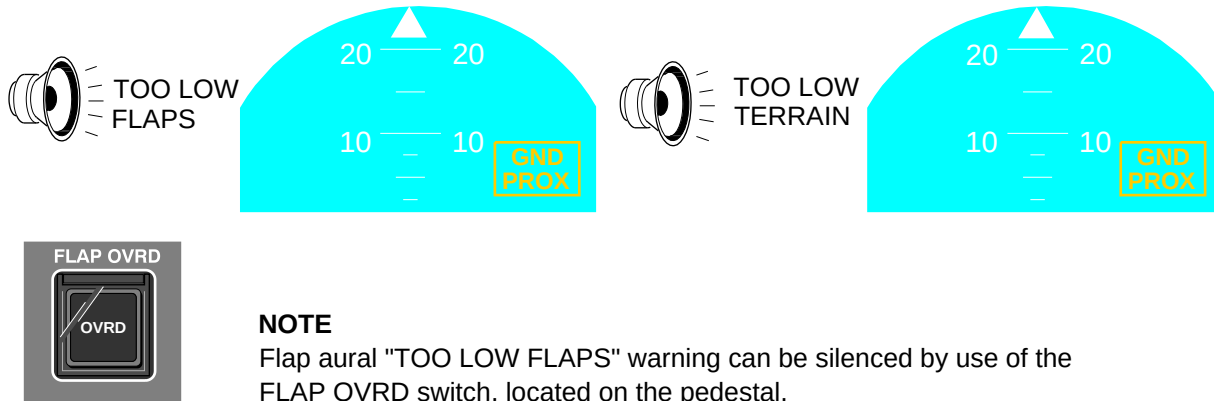
- Mode 4A – Active when the airplane is in cruise or approach phase of flight and the landing gear is not in the landing position. The alert envelope for Mode 4A begins at 30 feet AGL and extends vertically to an altitude of 500 feet AGL. Penetration of the alert area, above 190 knots, the upper boundary increases with airspeed to a maximum of 1000 feet radio altitude at 250 knots or more and will annunciate a **GND PROX** message and generate a continuous aural "TOO LOW TERRAIN" warning. Penetration of the alert area, below 190 knots, will annunciate a **GND PROX** alert on the PFD and generate an aural "TOO LOW GEAR" warning. The aural and visual remain until the airplane exits the envelope.



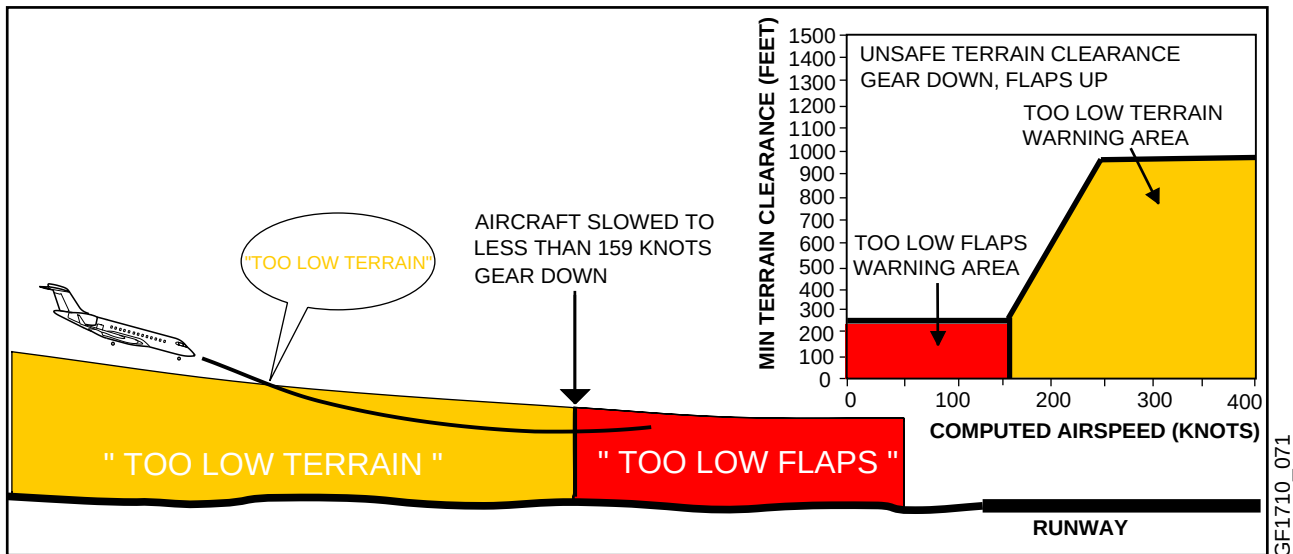
EGPWS MODES (CONT'D)

Mode 4 – Unsafe Terrain Clearance (Cont'd)

- Mode 4B – Active when the airplane is in cruise or approach phase of flight and the landing gear is in the landing position. The alert envelope for Mode 4B begins at 30 feet AGL and extends vertically to an altitude of 245 feet AGL. Penetration of the alert area, above 159 knots, will annunciate a **GND PROX** message and generate a continuous aural "TOO LOW TERRAIN" warning. The aural and visual remain until the airplane exits the envelope. Penetration of the alert area, below 159 knots, will annunciate a **GND PROX** message on the PFD and generate an aural "TOO LOW FLAPS" warning.



GF1710_070

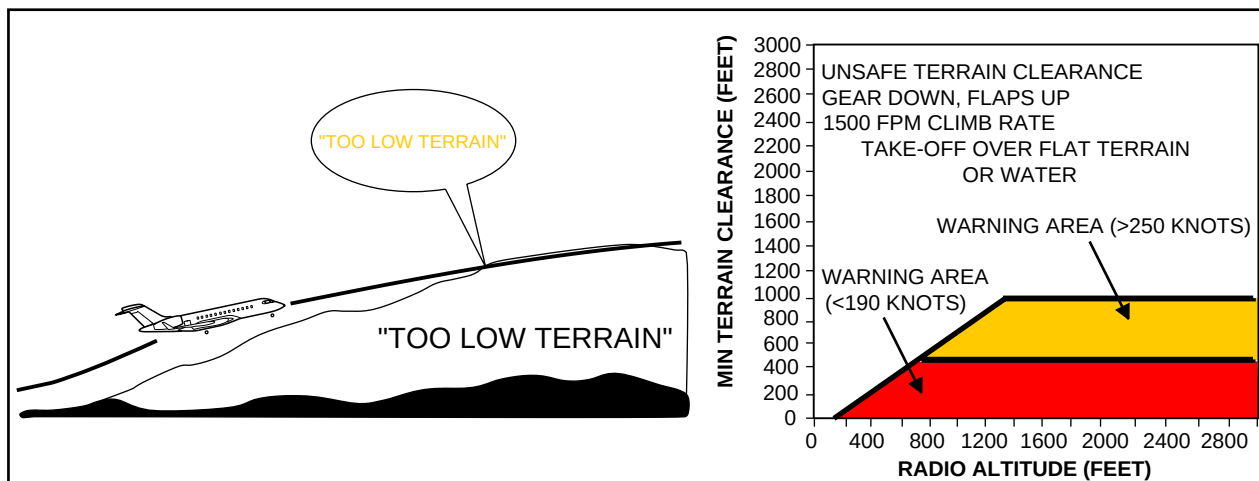
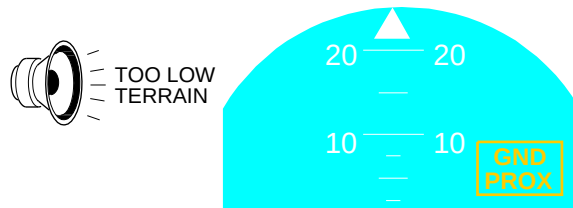


GF1710_071

EGPWS MODES (CONT'D)

Mode 4 – Unsafe Terrain Clearance (Cont'd)

- Mode 4C is based on a minimum terrain clearance, or floor, that increases with radio altitude during take-off. Any decrease in altitude below minimum terrain clearance will annunciate a **GND PROX** message and generate an aural "TOO LOW TERRAIN" warning.



GF1710_072

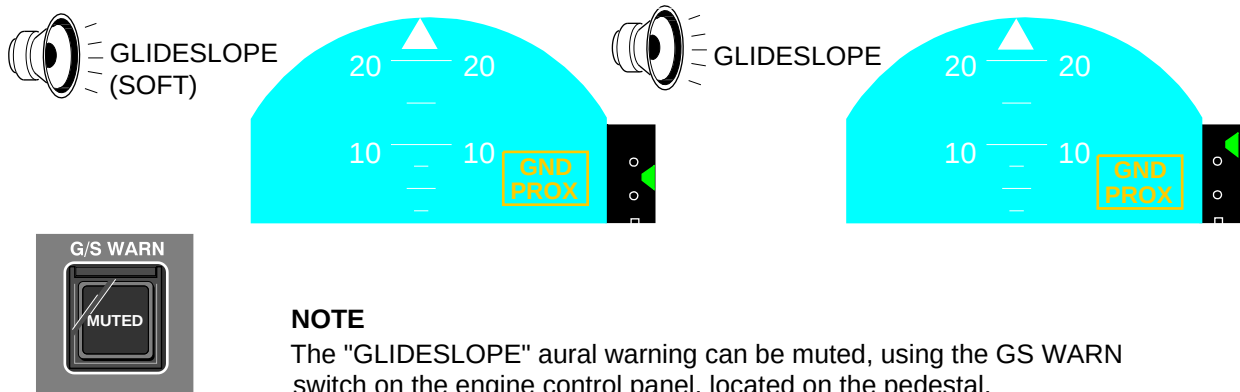
GF1710_073

EGPWS MODES (CONT'D)

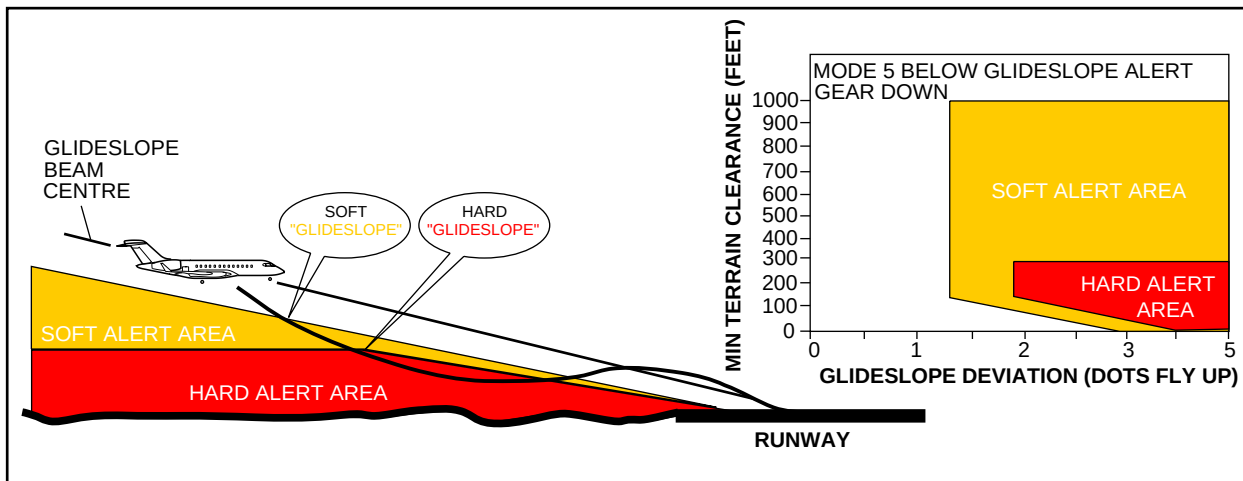
Mode 5 – Descent Below Glideslope

Mode 5 provides alerts and warnings when the airplane descends below the glideslope on an ILS approach. The alerts and warnings are annunciated in two distinct tones, depending on the position of the airplane on the glideslope.

When the airplane descends more than 1.3 dots (but not more than 2 dots) below the glideslope, a soft (6dB) aural “GLIDESLOPE” is generated. If the airplane continues to descend and deviates more than 2 dots below the glideslope, an aural “GLIDESLOPE” warning is generated at the same volume level as all other warnings. A **GND PROX** message is annunciated on the PFD. The aural and visual alerts and warnings are continuously annunciated until the airplane exits the alert envelope.



GF1710_074



GF1710_075

Mode 6 – Callouts

Mode 6 provides the following advisory alerts: transition through approach minimums, altitude callouts on approach and excessive bank angles.

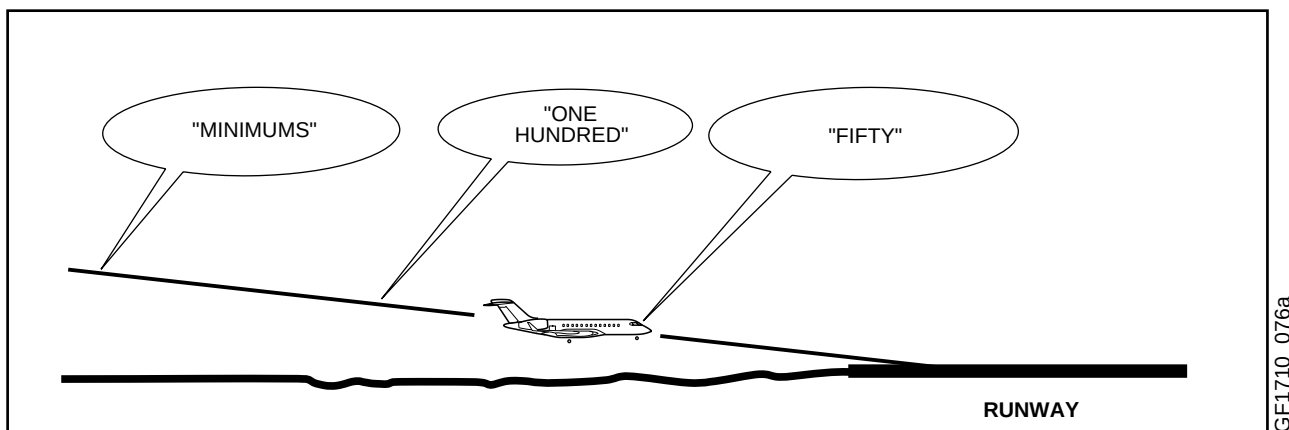
- Transition through the preset approach minimums, (APPROACHING DECISION HEIGHT or APPROACHING MINIMUMS), generates an aural “MINIMUMS, MINIMUMS” warning. The warning function is enabled between 1000 feet and 10 feet radio altitude for DH minimums and when the corrected altitude exceeds the MDA value by 200 feet. The landing gear must be down for activation of the warning.

EGPWS MODES (CONT'D)

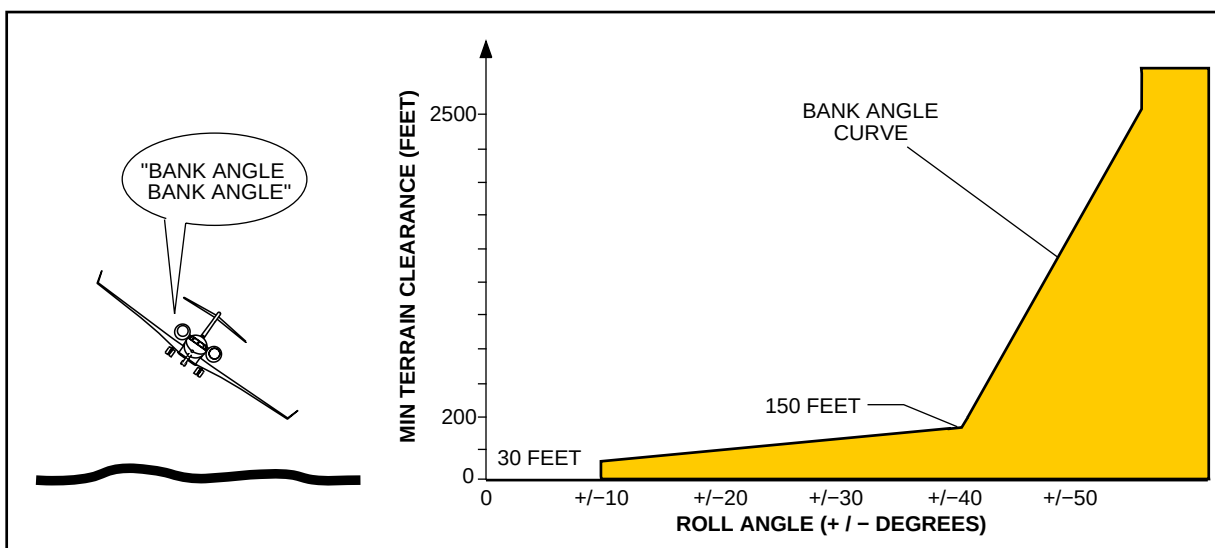
Mode 6 – Callouts (Cont'd)

- An altitude callout function generates annunciation for descent below predetermined altitudes. The aural “ONE HUNDRED”, “FIFTY” and “THIRTY” indicates the transition through 100, 50 and 30 feet AGL. The last annunciated or transition altitude is memorized. This will prevent the repeat annunciation of a callout, should the airplane transition through said altitudes again. The memory is cleared and reset, once the airplane climbs to an altitude greater than 1000 feet, or in the event a transition occurs from approach mode to take-off mode.

A “smart altitude callout” provides an aural “FIVE HUNDRED” at 500 feet radio altitude during a non-precision approach. The callout is generated during a precision approach if the airplane flight path deviates greater than ± 2 dots of either the glideslope or localizer. The callout is also generated during a backcourse approach.



- The excessive bank angle alert is a function of the roll angle with respect to altitude above ground level. The alert envelope varies linearly from a 10° bank at 30 feet AGL and to 40° of bank at 150 feet AGL, to 55° of bank at 2450 feet AGL. This will generate an aural “BANK ANGLE, BANK ANGLE”. The alert is annunciated once and will repeat if the bank angle increases by 20%. The alert will be annunciated continuously if the bank angle is increased to 55°. The alert will be annunciated until the bank angle is decreased below said value.

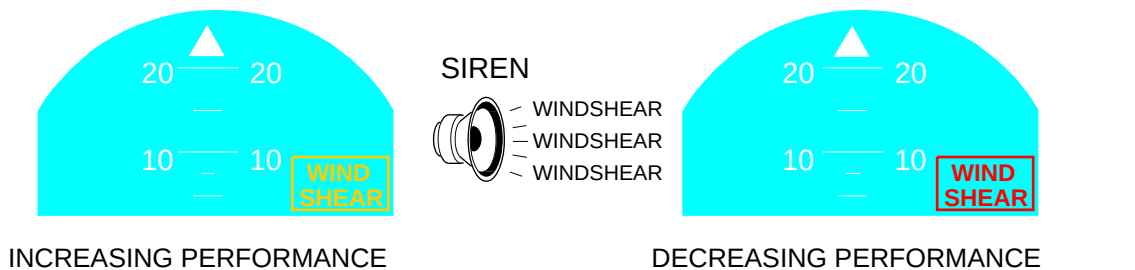


EGPWS MODES (CONT'D)

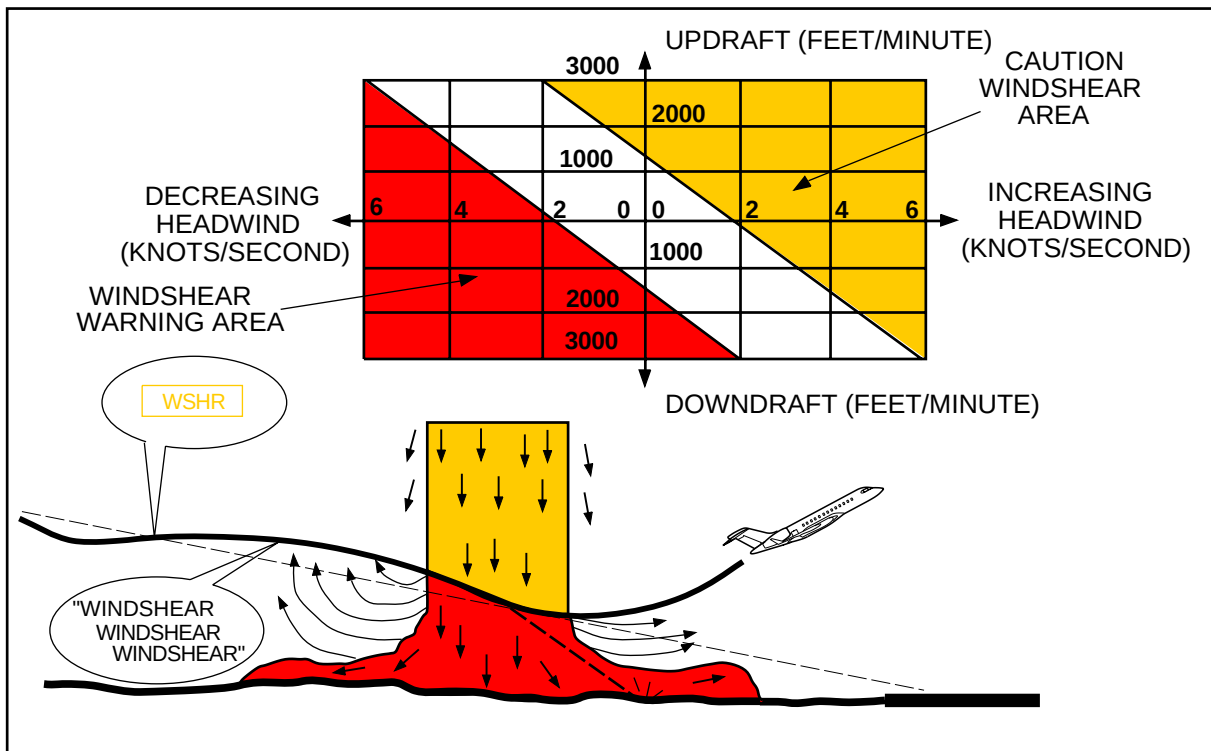
Mode 7 – Windshear Warning

Mode 7 provides alerts and warnings in the event that significant windshear is detected by the EGPWC. Mode 7 is active during take-off and landing phase of flight only, between 10 and 1500 feet AGL. There are two types of windshear warnings: increasing performance (updraft/headwind) and decreasing performance (downdraft/tailwind).

- When the EGPWC senses an increasing headwind (or decreasing tailwind) and/or a severe updraft, an increasing performance annunciation **WINDSHEAR** will be posted on the PFD. It will flash for 5 seconds then remain steady.
- When the EGPWC senses an increasing tailwind (or decreasing headwind) and/or a severe downdraft a decreasing performance annunciation **WINDSHEAR** will be posted on the PFD. It will flash for 5 seconds, then remains steady and an aural siren and “WINDSHEAR, WINDSHEAR, WINDSHEAR” warning are activated.



GF1710_078



GF1710_079

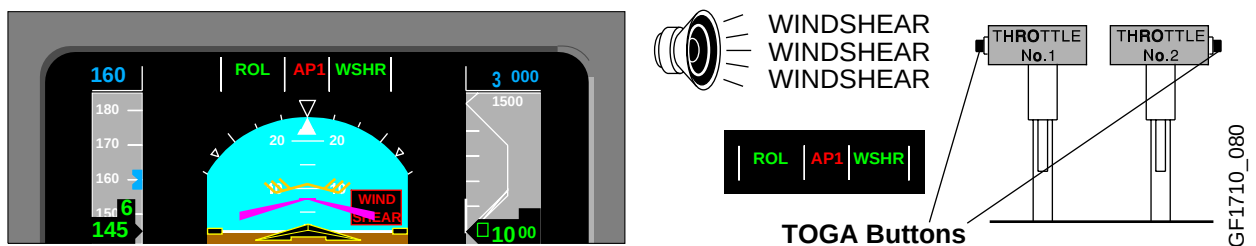
EGPWS MODES (CONT'D)

Windshear Flight Director Mode Annunciations

The **WSHR** mode can only be activated when a windshear warning is present. The mode can be activated by depressing either TOGA button on the thrust levers or by pushing either thrust lever beyond 37 degrees. If however the airplane is already in TOGA mode, or has either thrust lever beyond 37 degrees at the point at which the windshear warning is posted, the mode sets automatically.

The **WSHR** mode cannot be cancelled when a windshear warning persists. Any selection of the FD or AP engage buttons are ignored but yaw damper function is unaffected. Once the windshear warning has cleared, WSHR mode can be cancelled by any selection of FD or engagement of AP.

A **WSHR** mode annunciation is displayed on the vertical mode and a **ROL** mode annunciation is displayed on the lateral mode.

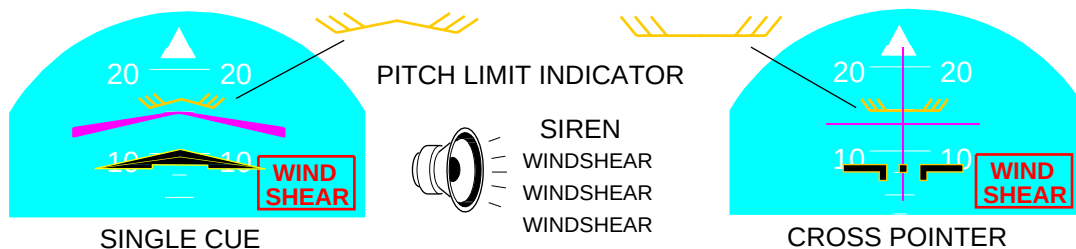


Windshear Escape Guidance

The windshear mode will provide windshear escape guidance consisting of lateral and vertical modes as follows:

- Vertical guidance will provide optimal escape guidance.
- Lateral guidance will be provided to maintain wings level.

A pitch limit indicator and windshear annunciation are displayed on both PFDs, during an increasing or decreasing performance windshear. The pitch limit indicator will differ depending on selection of Single Cue or Cross Pointer.



Windshear escape guidance is designed to allow the airplane to accelerate through the windshear where airplane performance permits. Where airplane performance does not permit, the **WSHR** mode will prevent the airplane from descending. The **WSHR** mode will command a descent if the airplane approaches the stall warning point, to prevent the airplane from stalling.

For an increasing performance windshear, guidance will be given to maintain a slightly positive flight path angle (1.5 degrees) until airspeed (CAS) reaches 20 knots above the CAS recorded when the windshear mode was set. Guidance is then provided to climb the airplane at that speed.

EGPWS MODES (CONT'D)**Windshear Escape Guidance (Cont'd)**

For a decreasing performance windshear, guidance will be provided to maintain a slightly positive flight path angle (1.5 degrees) until the AOA increases to within 2 degrees of stick shaker firing angle. The airplane will then be allowed to descend maintaining this margin to shaker. Between 400 and 10 feet (RAD ALT) margin to stick shaker will be reduced linearly to provide guidance at stick shaker AOA.

Terrain Awareness Alerting

The terrain alerting function computes minimum terrain clearance envelopes for areas along the flightpath of the airplane. The function uses airspeed and flightpath angle data in conjunction with a database containing worldwide topographical relief information in grid format. The database does not account for man-made obstructions except for all known man-made obstacles in Canada and the United States.

The terrain display is available by pressing "TERR" button on the MFD control panel. Terrain within 2000 feet of the airplane altitude is displayed. Terrain will automatically pop up, in MAP mode, on the MFD at a 10NM range, if there is a terrain threat caution at 60 seconds from impact.

TERR Button

Selecting TERR button enables terrain displays, (MAP mode only). Automatically deselects WX radar (if selected). Selecting TERR button again will re-enable WX radar (if previously selected).

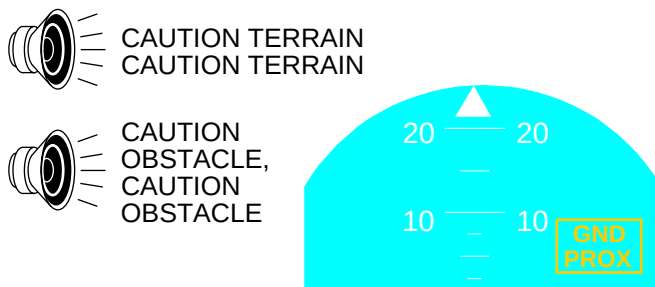


GF1710_082

EGPWS MODES (CONT'D)

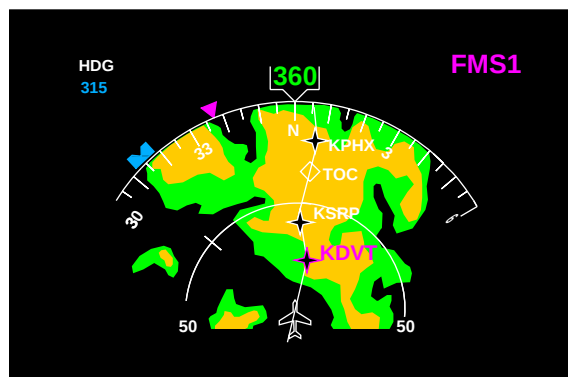
Terrain Awareness Alerting (Cont'd)

When a terrain threat is detected, a "CAUTION TERRAIN, CAUTION TERRAIN" aural is generated and **GND PROX** is annunciated on the PFD. When an obstacle threat is detected, a "CAUTION OBSTACLE, CAUTION OBSTACLE" aural is generated and **GND PROX** is annunciated on the PFD. When alerts are activated, areas which meet the terrain threat alert criteria are depicted yellow.

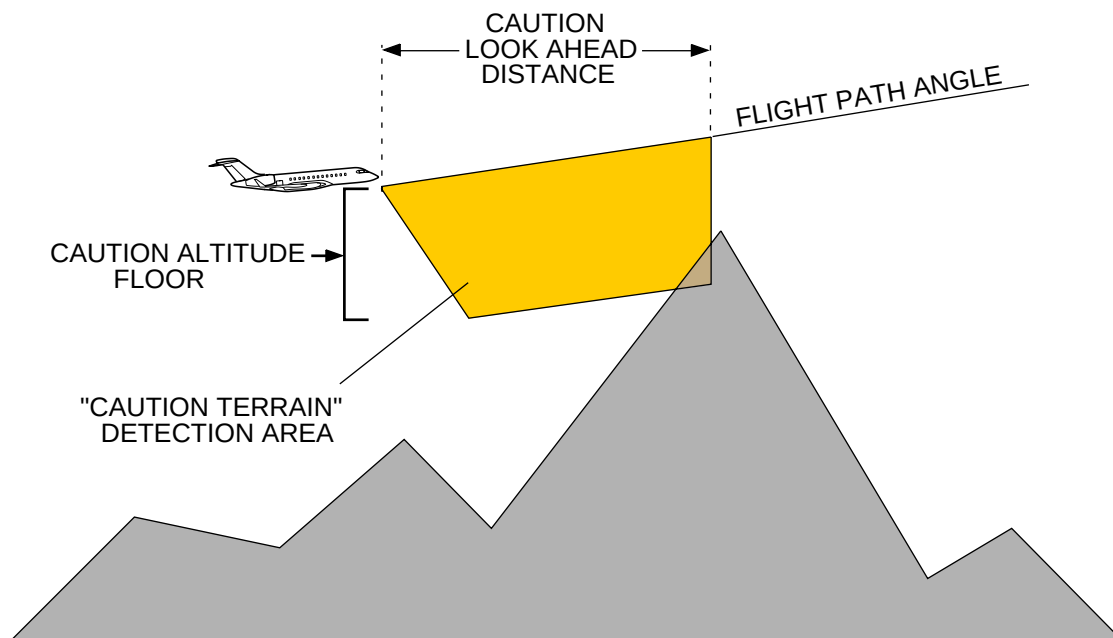


NOTE

If in PLAN mode and auto pop-up occurs, MFD format will automatically change to MAP mode, with the terrain map displayed.



GF1710_083

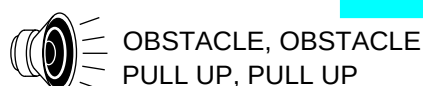
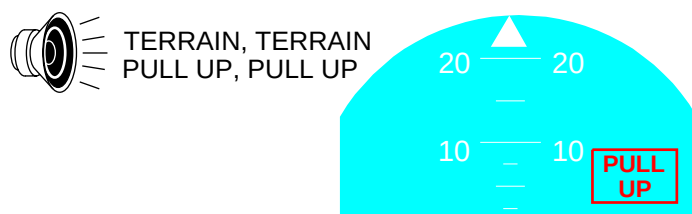


GF1710_084

EGPWS MODES (CONT'D)

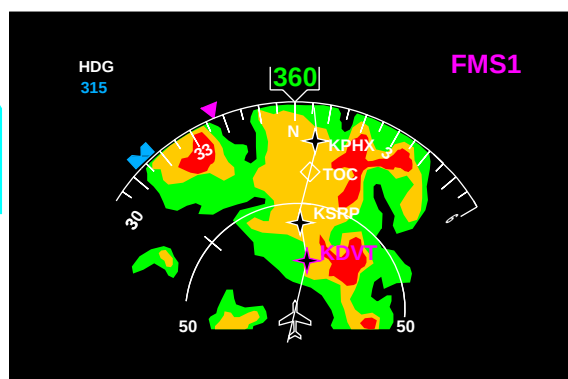
Terrain Awareness Alerting (Cont'd)

When a collision with terrain is predicted, an aural “TERRAIN, TERRAIN, PULL UP, PULL UP” warning is generated and **PULL UP** is annunciated on the PFD. When a collision with an obstacle is predicted, an aural “OBSTACLE, OBSTACLE, PULL UP, PULL UP” warning is generated and **PULL UP** is annunciated on the PFD. When warnings are activated, areas which meet the terrain collision alert criteria are depicted red. Terrain will automatically pop up, in MAP mode, on MFD at a 10NM range, if there is a terrain warning at 30 seconds from impact.

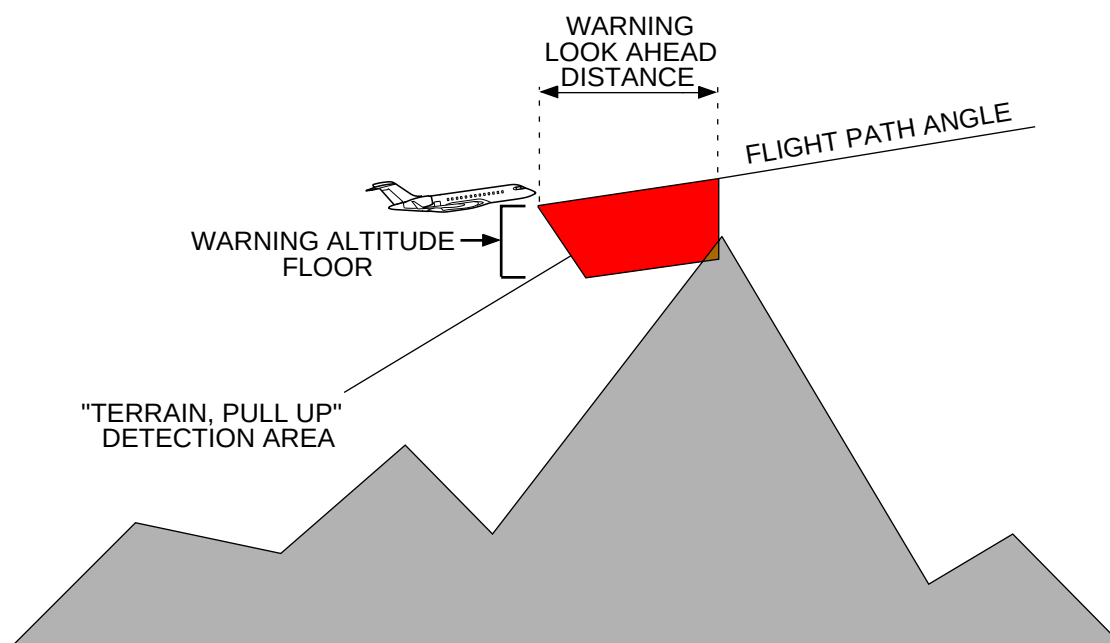


NOTE

If in PLAN mode and auto pop-up occurs, MFD format will automatically change to MAP mode, with the terrain map displayed.



GF1710_085

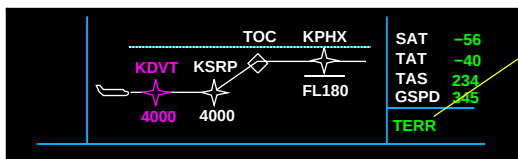


GF1710_086

EGPWS MODES (CONT'D)

Annunciations

All terrain annunciations are displayed on the MFD. The annunciations are as follows:



BLANK:	TERR not selected.
TERR:	TERR has been selected.
TERR TEST:	Indicates a self-test.
TERR FAIL:	Indicates internal failure, or loss of communication with EFIS.
CNTRL FAIL:	Indicates loss of range control for terrain map.
TERR N/A:	Position Uncertain.
TERR OFF:	Terrain system selected OFF, using the switch selection on the overhead panel.



NOTE

In a case where landing at an airport that is not in the database, all TERRAIN functions can be inhibited, by selecting the TERRAIN switch, located on the overhead panel.

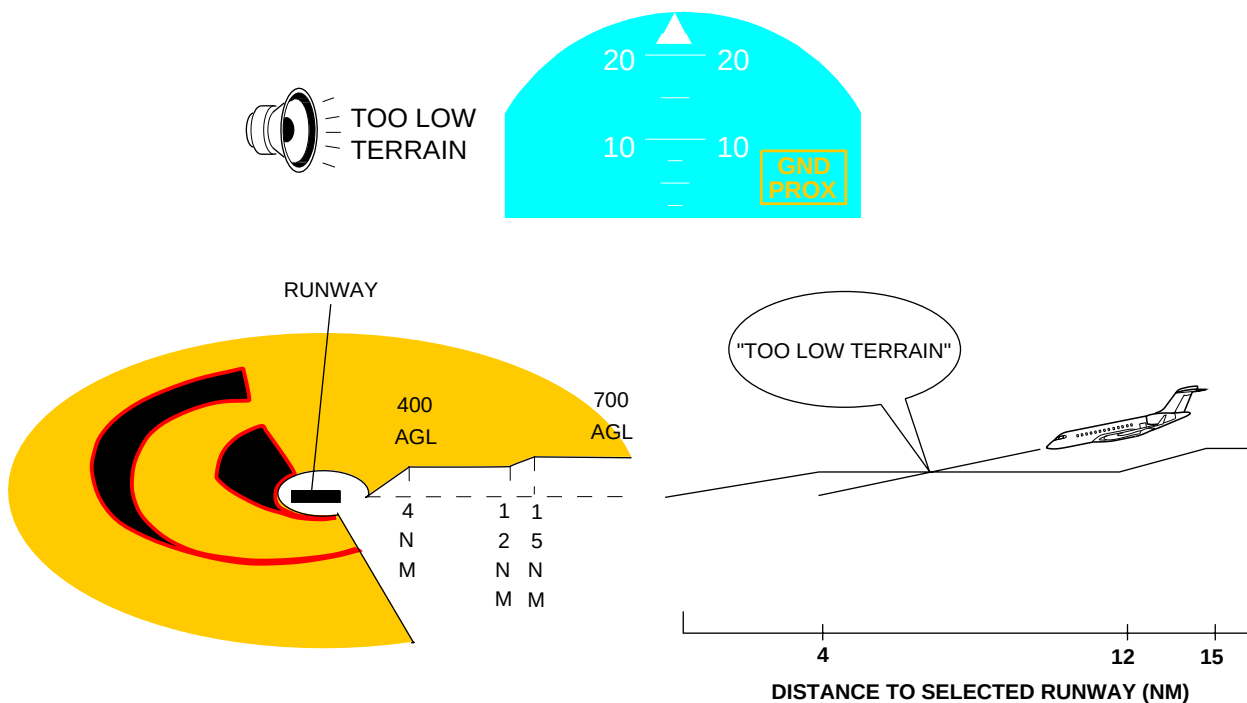
GF1710_087

Terrain Clearance Floor (TCF)

The TCF function supplements the GPWS function by providing an additional terrain clearance alert envelope around airports. The TCF criteria is used to determine alert and warning envelopes.

TCF creates an increasing terrain clearance envelope around the intended airport runway directly related to the distance from the runway. TCF alerts are based on current airplane location, nearest runway center point position and radio altitude, along with an internal database that includes all worldwide, hard-surfaced runways greater than 3500 feet in length.

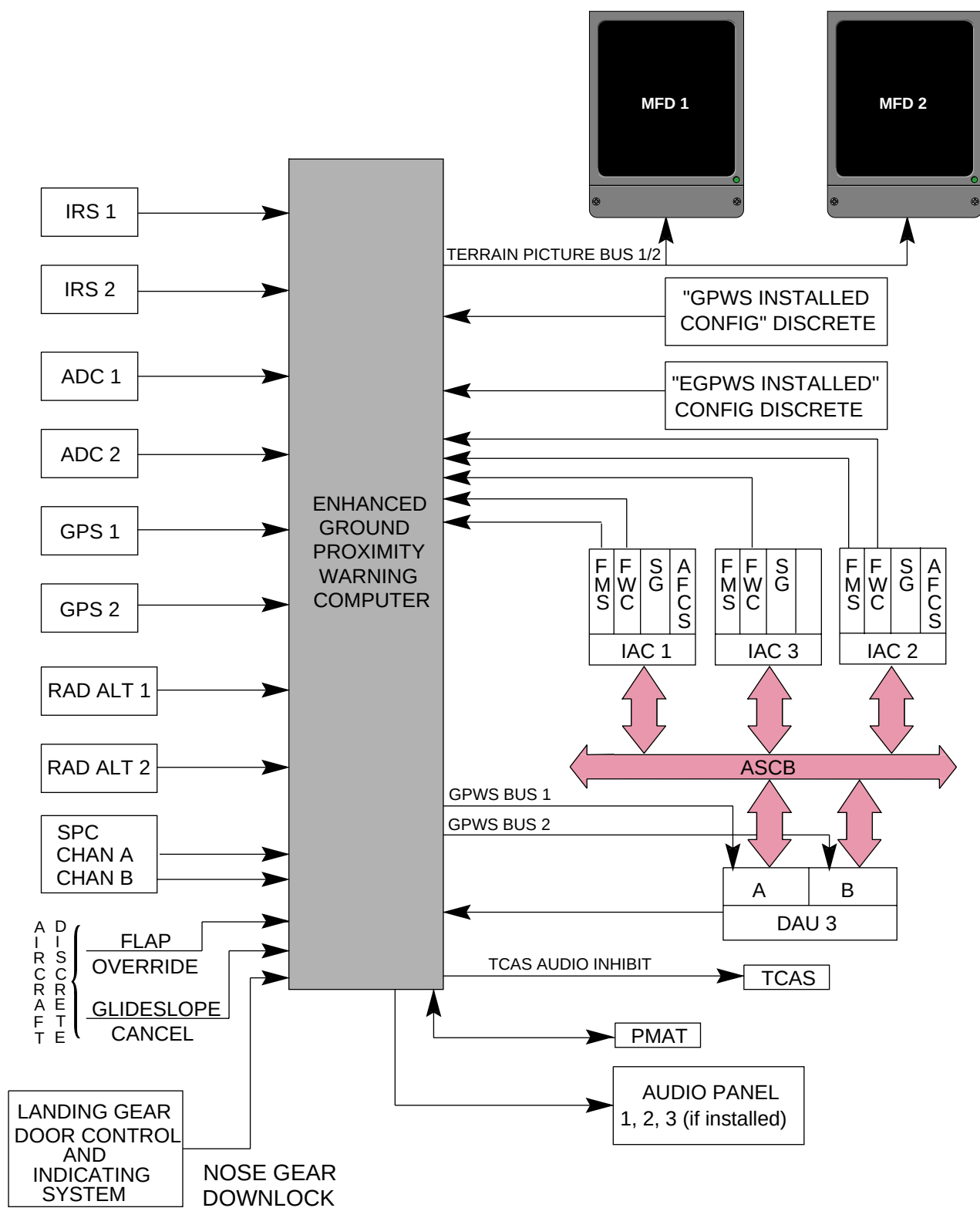
Penetration of the alert envelope will generate an aural "TOO LOW TERRAIN" and a **GND PROX** message is displayed on the PFD. The aural alert is repeated twice and again thereafter if the radio altitude value decreases by more than 20% from the altitude at which the initial warning was issued. The **GND PROX** message remains displayed until the airplane exits the alert envelope.



GF1710_088

GF1710_089

EGPWS SCHEMATIC



GF1710_090

FLIGHT MANAGEMENT SYSTEM (FMS)

The FMS performs the functions of navigation, flight planning and guidance of the airplane. The FMS is a full flight regime in both Lateral Navigation (LNAV) and Vertical Navigation (VNAV).

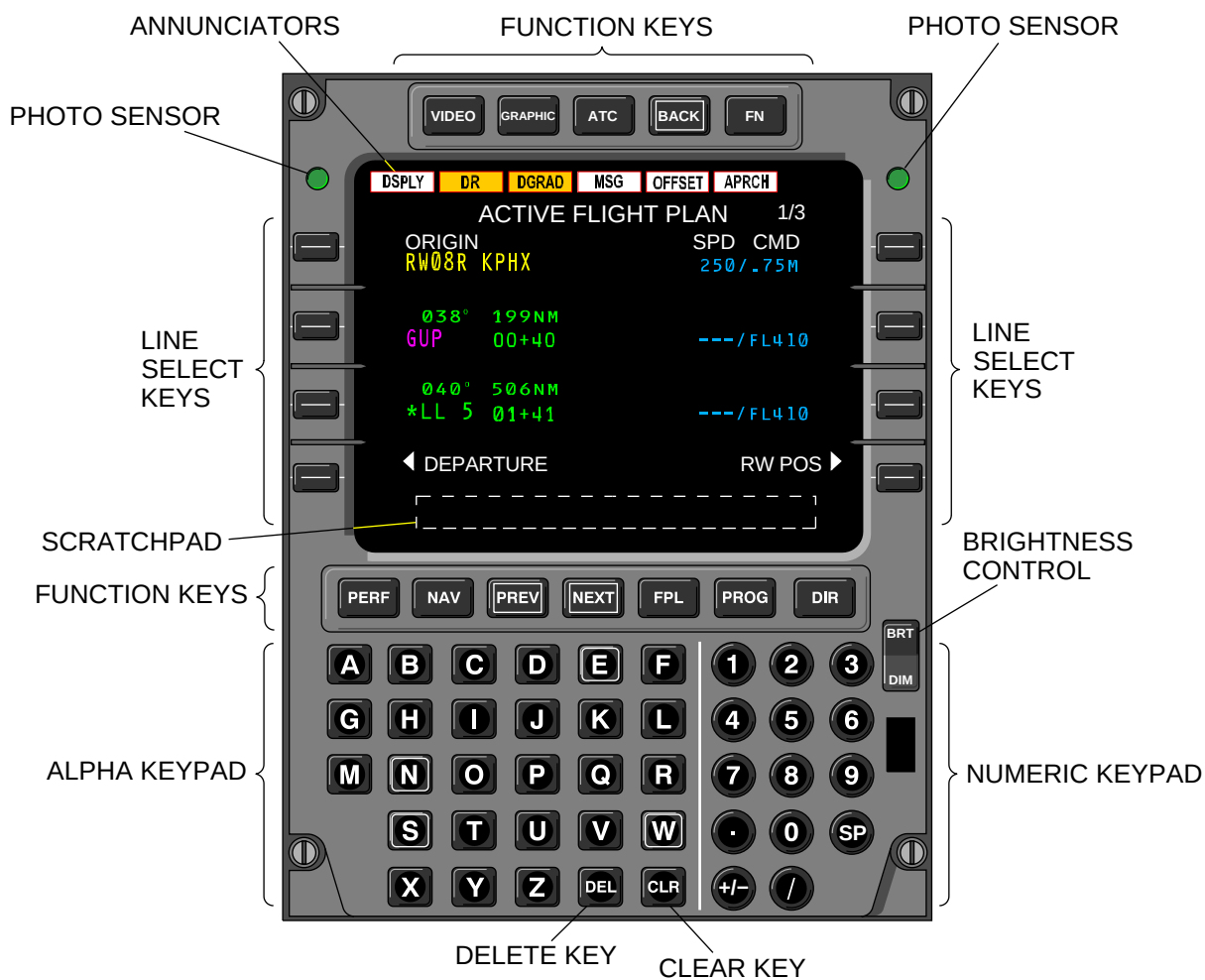
There are two Control Display Units (CDU), located on the pedestal. A third FMS (optional) can also be installed on the pedestal. The displayed data is shown in the following colours:

- **CYAN** (Vertical & Atmospheric Data).
- **GREEN** (Lateral and Index Sections).
- **YELLOW** (FROM Waypoint).
- **MAGENTA** (TO Waypoint).
- **ORANGE** (Flight Plan Names).
- **WHITE** (Prompts and Titles).

GF1710_091

FMS Display Unit

The CDU is a full color Liquid Crystal Display (LCD) capable of displaying video from various external sources and can offer other graphical capabilities.

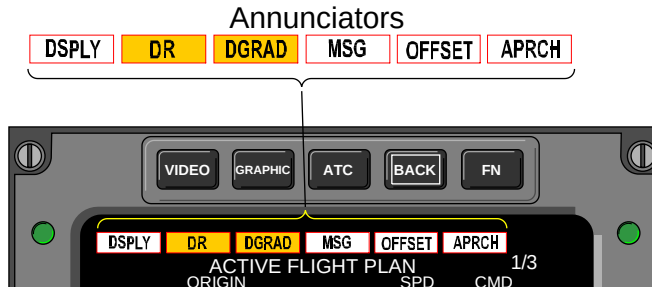


GF1710_092

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Annunciators

There are six annunciators located at the top of the Control Display Unit (CDU) LCD panel. The annunciators are left justified. White annunciators indicate an advisory annunciation, amber annunciators indicate an alerting annunciation.



GF1710_094

The annunciators are:

DSPLY (Display) – is lit when the CDU displays:

- A flight plan page other than the first page of the active flight plan.
- A stored flight plan page.
- Any of the review pages for SIDs and STARs/approaches.
- A CHANGE ACTIVE LEG message.
- Defining an INTERCEPT waypoint on the active leg.

DR (Dead Reckoning) – is lit when operating in the DR mode for longer than 2 minutes. The DR mode is defined as the loss of radio updating and all other position sensors.

DGRAD (Degraded) – is lit when the FMS cannot guarantee the position accuracy for the present phase of flight due to sensor availability. If the DR annunciator is lit when DGRAD is lit, DGRAD annunciator goes out. The annunciator is lit if both of the following conditions are valid:

- The sensors being used to navigate are not approved for the current phase of flight.
- A non-precision instrument approach (NDB, NDB/DME, VOR, VOR/DME, GPS, RNAV, or DME/DME) is selected. If no approach, or an ILS, LOC, LOC-BC, LDA, SDF, or MLS approach is selected, the APRCH annunciator does not light.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Annunciators (Cont'd)

Flight Phase	Approved sensors (Navigation Mode)			
	GPS	DME/DME	VOR/DME	IRS
Departure or Terminal	X	X	X	(see note)
Enroute	X	X	X	X
Oceanic	X	X	X	X
VOR/DME or VOR Approach	X	X	X	–
GPS Approach	X	–	–	–
NBD Approach	X	X	–	–

NOTE: The FMS uses IRS as the navigation mode for a limited time in these phases of flight. The time is determined in the FMS by estimating when the drift rate error of the IRS exceeds 1.7 NM for departure and terminal operations.

MSG (Message) – is lit when a message is displayed in the scratchpad. Messages are displayed in the CDU scratchpad to inform or alert the pilot as to the system status. The annunciator goes out after the message(s) has been cleared from the scratchpad. For a list of FMS messages, refer to the Flight Management System Pilot's Guide. Messages are divided into two groups:

- Advisory messages – Contains information that is useful to the pilot. Are usually the result of a pilot action on the CDU.

INVALID ENTRY

- Alerting messages – Alert the pilot to FMS status.

COMPARE FMS POSITIONS

If a graphic or video is currently displayed on the CDU-820 and a message appears, the CDU display will immediately return to the FMS page and a message will be shown in the scratchpad.

OFFSET (Offset) – is lit when a lateral offset has been entered on PROGRESS page. The annunciator goes out when the offset is removed.

APRCH (Approach) – indicates that FMS is in approach mode of operation. In this mode, the EFIS deviation sensitivity and FMS tracking gains are increased. APRCH is lit when the following conditions are valid:

- FMS is selected navigation source on EFIS.
- A non-precision instrument approach is selected
- The airplane position is between 2 NM outside the Final Approach Fix (FAF) and the Missed Approach Point (MAP).
- The DGRAD annunciator must not be displayed.
- The FMS must be using approved sensors for the selected approach procedure (VOR, VOR DME, NDB, GPS).

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Brightness Control

Both the manual and automatic (photo sensor) brightness controls are used to increase or decrease the display brightness. When selected manually, a bright/dim bar is displayed in the scratchpad. The bright/dim bar level is controlled by pressing BRT or DIM. After the adjustment is made, the photo sensors monitor the ambient light and maintain the brightness level over various lighting conditions.



GF1710_099

Line Select Keys

Data is selected to a line from the scratchpad or vice-versa using the line select keys. These keys are identified from top to bottom as 1L through 4L on the left side and 1R through 4R on the right side.



GF1710_101

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Line Select Keys (Cont'd)

The line select keys are used for:

- Direct Access Prompts/Function selects – In the case of a NAV or PERF index display (see function keys), the line select keys are used to select functions from the index. In displays other than index, keys 4L and 4R are primarily used for direct access to other functions in the FMS. The functions that are most likely to be accessed from the present page and phase of flight are displayed as prompts.
- Transfer Line Data to Scratchpad – If the scratchpad is empty, pushing a line select key transfers the respective line data to the scratchpad.
- Transfer of Scratchpad Data to Line Fields – Once data has been entered into the scratchpad, either through line selection or manual keyboard entry, it can be selected to any of the allowable line select fields on a page.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Legend

The following conventions are used in this section to indicate actions, results and sequences:

**PUSH A FUNCTION KEY OR LINE KEY**

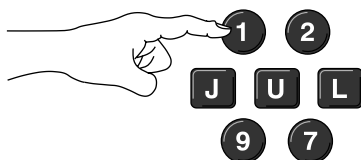
The finger indicates to push a function or line key. Keys shown under finger, are keys to push.

**SEQUENCE OF ACTIONS**

Circled numbers show sequences for graphic images and their relationship to written steps of text. Must be followed in sequence to achieve desired results.

**RESULT OF ACTION**

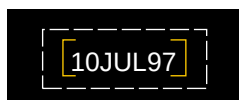
Points to expected result of an action. Unexpected results may indicate incorrect key inputs.

**SEQUENCE OF KEYS TO PUSH**

Indicates that a series of key inputs are required. Push data keys from left to right, top to bottom.

**SPECIFIC DISPLAY RESULT (BOXED AREA)**

Indicates where to look for expected result.

**SPECIFIC DISPLAY RESULT-SCRATCHPAD ENTRY (BRACKETS)**

Locates the scratchpad display line on a figure.

**CLEAR KEY**

Used to clear data from scratchpad.

NOTE

For more information, refer to the Flight Management System Pilot's Guide.

Function Keys

The seven function keys access primary functions, menus and paging.



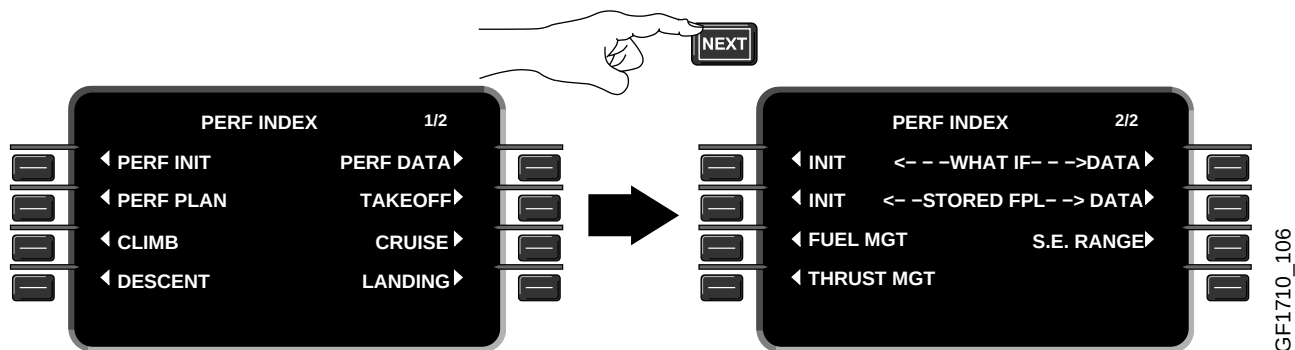
GF1710_103

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

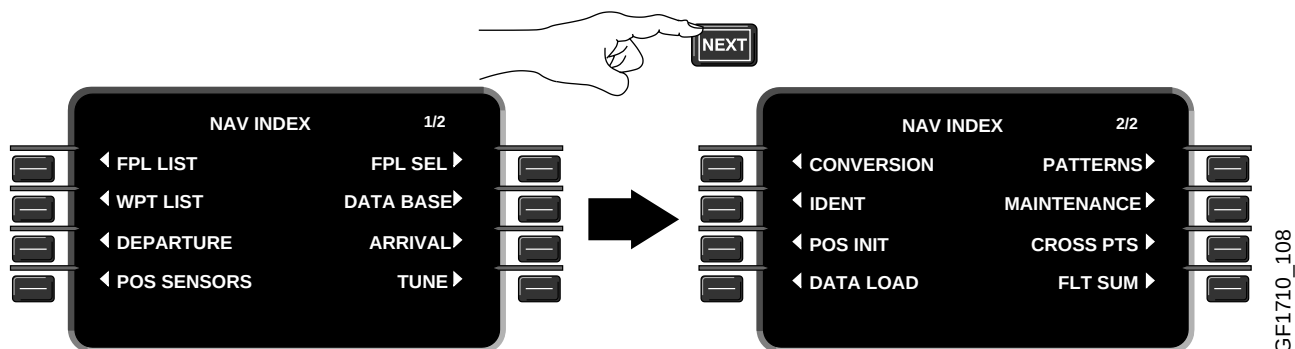
Function Keys (Cont'd)

The function keys are as follows:

- **PERF** (Performance) Key – Pushing the PERF function key displays page 1 of the performance index. Any functions can be selected by pushing the respective line select key. To view the next page of PERF INDEX push NEXT function key.



- **NAV** (Navigation) Key – Pushing the NAV function key displays page 1 of the navigation index. Any functions can be selected by pushing the respective line select key. To view the next page of NAV INDEX push NEXT function key.

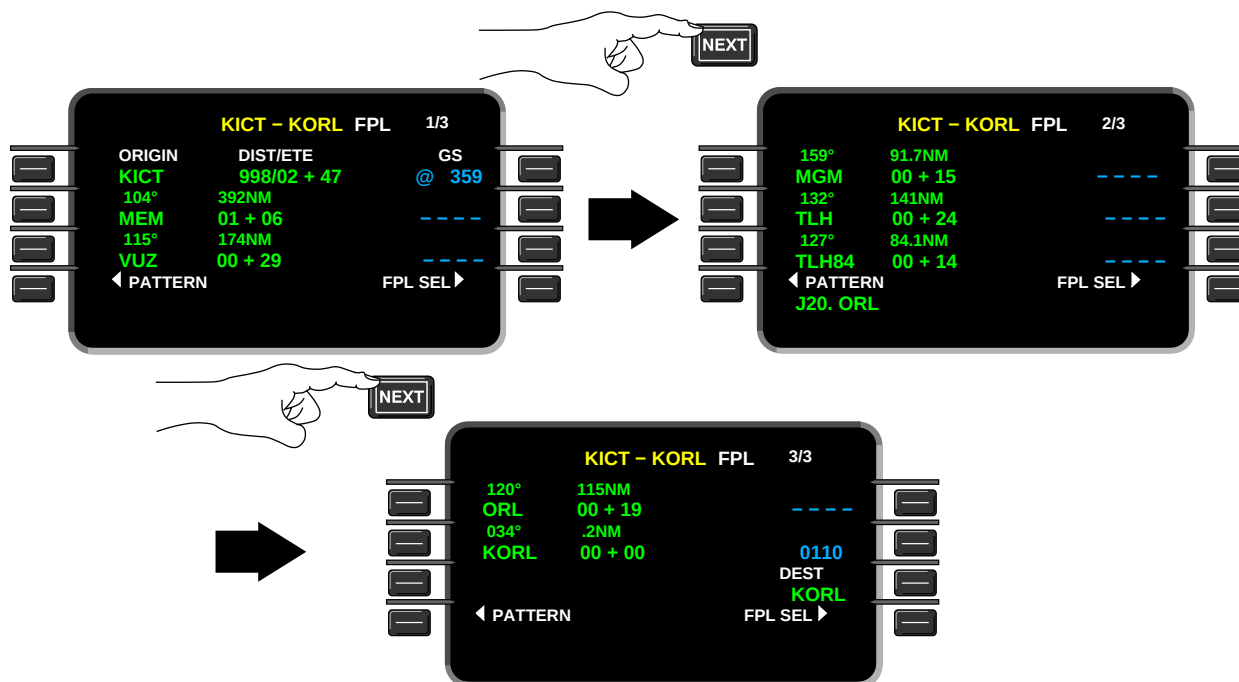


- **PREV** **NEXT** (Previous and Next) Paging Keys – The specific page and number of pages **2/2** in a particular function or menu display are shown in the upper right hand corner of the display. Page changes are made by pushing the PREV (previous) and NEXT keys. The keys can be held down for repeated page changing.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

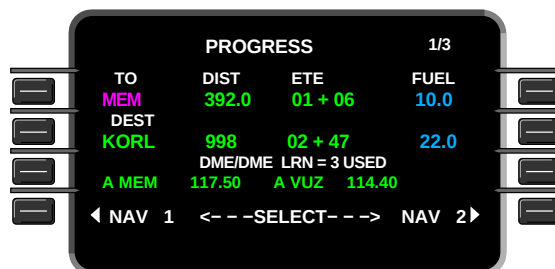
Function Keys (Cont'd)

- FPL** (Flight Plan) Key – Pushing the FPL key displays the first page of the active flight plan, even if another page of the active flight plan is being displayed. If there is no flight plan entered, the pilot can manually create a flight plan, select a stored flight plan, load a flight plan from a disk and/or create a stored flight plan.



GF1710_111

- PROG** (Progress) Key– Pushing the PROG key displays the current status of the flight. There are three progress pages that report progress along the flight plan. These pages summarize important flight parameters and the airplane's relationship to the flight plan. The first progress page displays estimated time enroute (ETE), distance to and fuel projection for the TO waypoint and destination. It also displays the current NAV mode, the number of long range NAVs used and the nav aids that are presently tuned for radio updating.

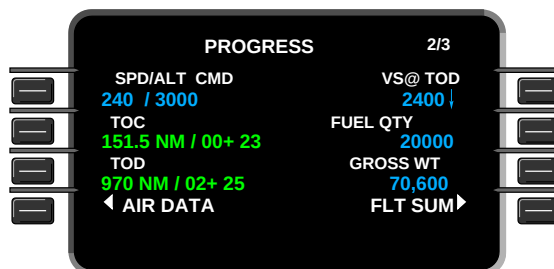


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FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

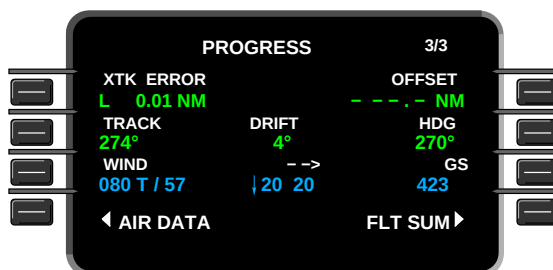
Function Keys (Cont'd)

- The second progress page reflects changes based on inputs to the VNAV FMS function. The speed/altitude command (SPD/ALT CMD) reflects the current command of speed/altitude that the FMS is sending to the flight guidance computer. If there is no command, the line is titled but blank. The 1R line select displays the expected vertical speed when a path has been defined in VNAV.



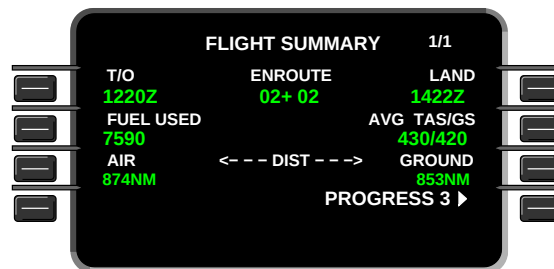
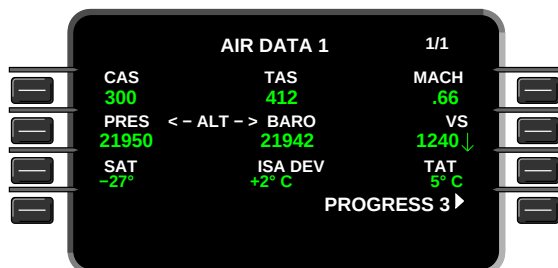
GF1710_114

- The third progress page displays cross track error (XTK ERROR), lateral offset, current track and heading in magnetic or true, current wind in vector form and component form, drift angle and ground speed.



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- The AIR DATA page displays the values for the on-side ADC. If the on-side ADC fails, the information comes from the off-side ADC. The ADC source is displayed on the title.
- The Flight Summary FLT SUM displays flight information, fuel used, average TAS/GS and total distance both air and ground.

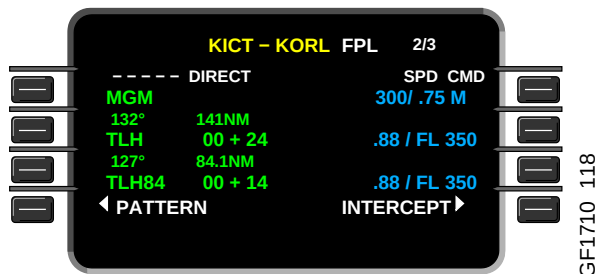


GF1710_116

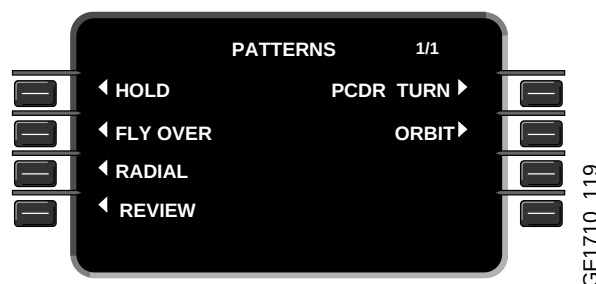
FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Function Keys (Cont'd)

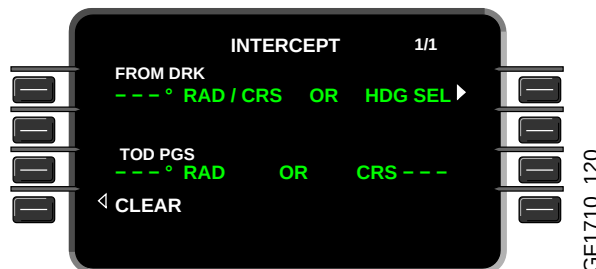
- **DIR** (Direct-to/pattern/intercept) Key – Pushing the DIR function key inserts DIRECT, PATTERN and INTERCEPT prompts on the ACTIVE FLT PLAN pages. If other than an active flight plan page is displayed when pushing the button, the first page of the flight plan is displayed. If the active flight plan is already displayed, it will remain on the current page of the flight plan.
 - **DIRECT** – The FMS DIRECT-TO function can either be lateral or vertical. The left line select keys are used for lateral and the right line select keys are used for vertical direct-to. Lateral DIRECT-TO computes the turn and the course from the end of the turn. If the direct-to waypoint is in the flight plan, pushing the line select key next to the direct-to waypoint engages the direct-to. A direct-to course is calculated and the airplane begins turning for the waypoint. Vertical DIRECT-TO is connected to an altitude constraint at a waypoint in the flight plan. The altitude constraint must be in the flight plan before the vertical direct-to is done. Vertical DIRECT-TO can be used for climbs and descents. The airplane does not respond to the vertical DIRECT-TO unless the altitude selector is properly set above for climbs and below for descents.



- **PATTERNS** – The PATTERNS prompt is used to start the pattern definition or review procedures. PATTERNS can also be selected from the NAV INDEX. The following patterns are available: HOLD, PROCEDURE TURN, FLYOVER, ORBIT and RADIAL.



- **INTERCEPT** – INTERCEPT is used to define an intercept waypoint inserted in the flight plan between two other waypoints. The crossing of these two courses is the intercept waypoint.



FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Function Keys (Cont'd)

- **VIDEO** Key (CDU-820 only) – Depending on installation, pressing the VIDEO function key results in the following:
 - The scratchpad message VIDEO NOT AVAILABLE will be displayed if there is no external video input to the or if access is externally selectable.
 - The LCD will display a video signal if one video input is available. If multiple video inputs are available but selectable externally to the CDU, the LCD will display the externally selected video input.
 - If more than one video input is available and video selection is internal to the CDU, the VIDEO INDEX page will be displayed.

If a video input is being displayed, selection of other function keys (PERF, NAV, FPL, PROG, DIR) will return the display to normal FMS operation.

NOTE

If an annunciator and/or scratchpad message is displayed while viewing a video input, the display will return to the page shown before the VIDEO key was pressed.

- **GRAPHIC** Key (CDU-820 only) – Depending on installation, pressing the GRAPHIC function key results in the following:
 - The scratchpad message GRAPHIC NOT AVAILABLE will be displayed if there is no external video input to the or if access is externally selectable.
 - If a graphic input is available and access is internal to the CDU, the GRAPHIC INDEX page will be displayed.

If a graphic input is being displayed, selection of other function keys (PERF, NAV, FPL, PROG, DIR) will return the display to normal FMS operation.

NOTE

If an annunciator and/or scratchpad message is displayed while viewing a video input, the display will return to the page shown before the GRAPHIC key was pressed.

- **ATC** (Air Traffic Control) Key (CDU-820 only) – Pressing the ATC function key will display the scratchpad message ATC NOT AVAILABLE.
- **BACK** Key (CDU-820 only) – Pressing the BACK function key will display the scratchpad message BACK COMPLETE unless video or graphic input is available. If a video or graphic input is accessed through the VIDEO INDEX or GRAPHIC INDEX page, pressing the BACK function key will return the display to the VIDEO INDEX or GRAPHIC INDEX page. Pressing the BACK function key again will return the display to the page shown before the VIDEO or GRAPHIC key was pressed. Pressing the BACK function key a third time will display BACK COMPLETE in the scratchpad.
- **FN** (Function) Key (CDU-820 only) – Pressing the FN function key will display the scratchpad message FN NOT AVAILABLE.

Pressing and holding the FN function key for 5 seconds will display the SYSTEM SETUP page.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)**Scratchpad**

The scratchpad is a working area where the pilot can enter data and/or verify data before line selecting the data into its proper position. Alphanumeric entries are made into the scratchpad using the keyboard. As each key is pushed, the character is displayed in the scratchpad. Information in the scratchpad does not affect FMS until it is moved to another line on the display. Data is retained in the scratchpad throughout all mode and page changes.



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Alphanumeric Keys

The alphanumeric keys are used to make entries into the scratchpad. The letters of the alphabet, the numbers 0 to 9, a decimal, a dash and a slash are each represented with a CDU key.

Clear (CLR) Key

The CLR key has the following functions:

- When a message is displayed in the scratchpad, pushing the CLR key deletes the message.
- Temporary waypoints are identified with an asterisk (*) or pound sign (#) as the first character. When any entry beginning an * or a # is in the scratchpad, pushing the CLR key deletes the entire entry.
- When an alphanumeric entry is made in the scratchpad, one character is cleared from the scratchpad (from right to left) each time the CLR key is pushed. If the CLR key is held down after the first character is cleared, other characters are cleared, one at a time, until the key is released.

Delete (DEL) Key

The DEL key is used to delete items from the FMS. When the DEL key is pushed, "DELETE" is displayed in the scratchpad. The DEL key can be line selected to delete waypoints or other items displayed in the CDU data fields. When there is a message displayed, the delete function is inhibited. DEL is also used to return default values after entries have been made.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

FMS Update

To update an FMS (pre-flight), proceed as follows:

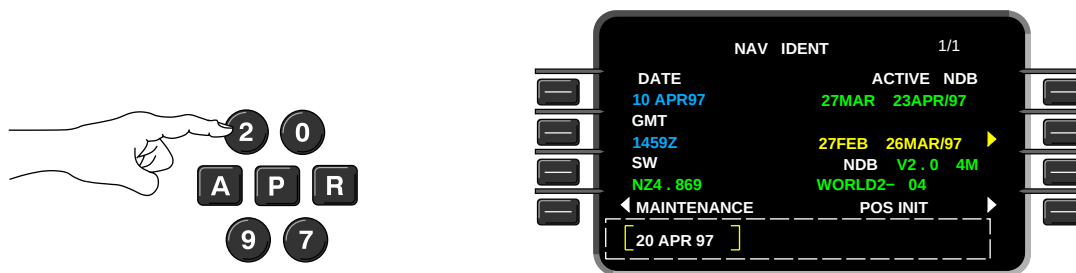
The NAV IDENT page is displayed when power is first applied. All parameters should be checked and/or set.

NOTE

The date and time displayed on this page is synchronized with GPS date and time. The date and time can be changed only if the GPS is failed or does not have a valid date/time.

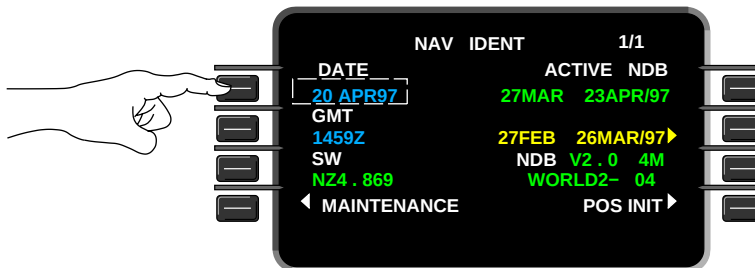
DATE

1. To set the date, enter information in scratchpad using the alphanumerical keys.



GF1710_122

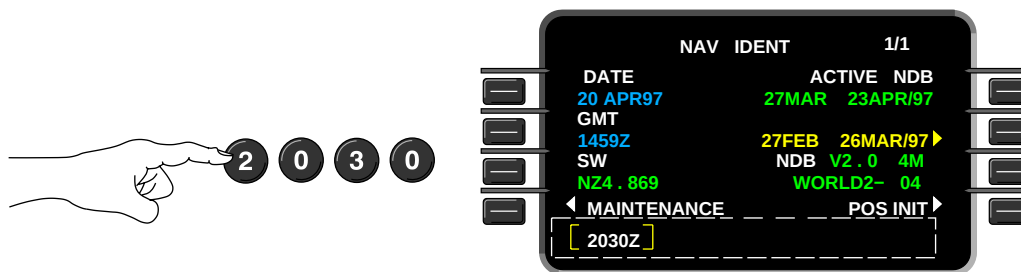
2. To enter the new date press 1L.



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TIME

1. To set the time, enter information in scratchpad using the alphanumerical keys.



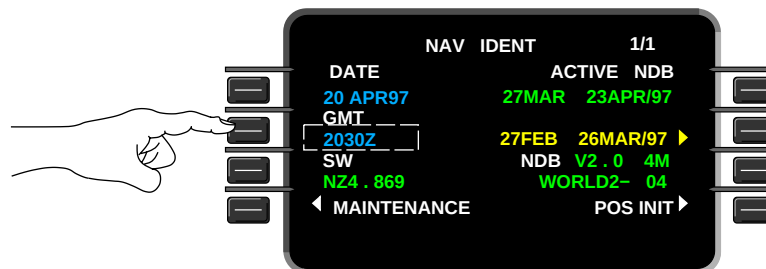
GF1710_124

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

FMS Update (Cont'd)

TIME (Cont'd)

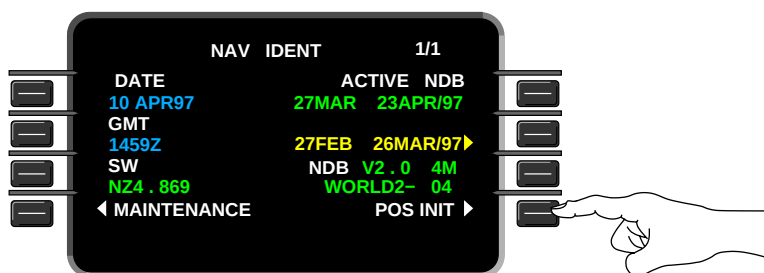
- To enter the new time press 2L.



GF1710_125

Position Initialization (POS INIT)

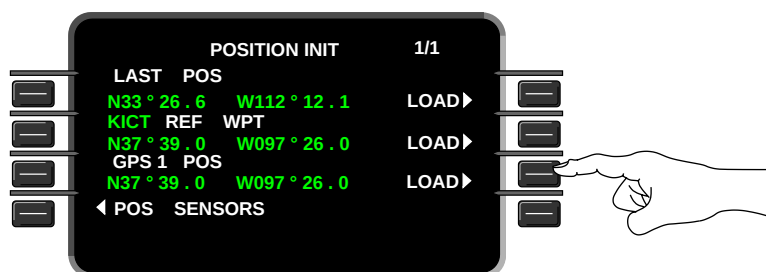
- To select POS INIT press 4R.



GF1710_126

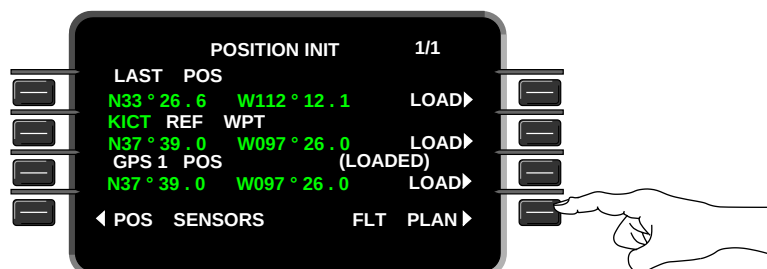
The POSITION INIT page displays the LAST POS coordinates and the closest ramp within 3 NM or closest airport reference point (KCIT) within 3 NM of the last position.

- To initialize position, select appropriate LOAD prompt.



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- After initialization, the FLT PLN prompt is displayed. Select 4R to continue pre-flight.

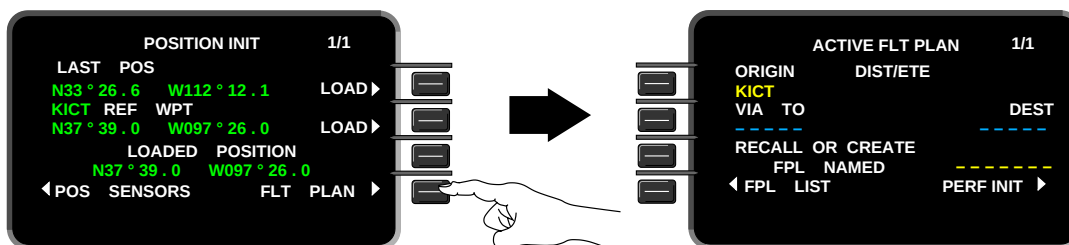


GF1710_128

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

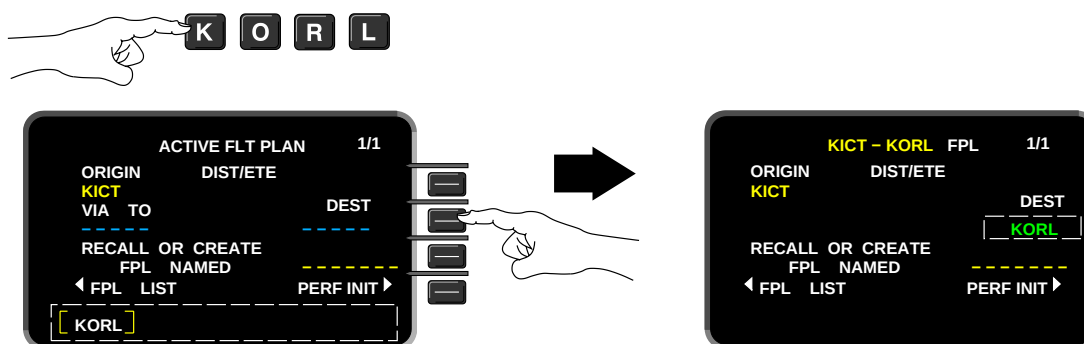
Flight Plan

1. To select FLT PLN press 4R.



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2. Enter destination (KORL) in the scratchpad and press 2R.

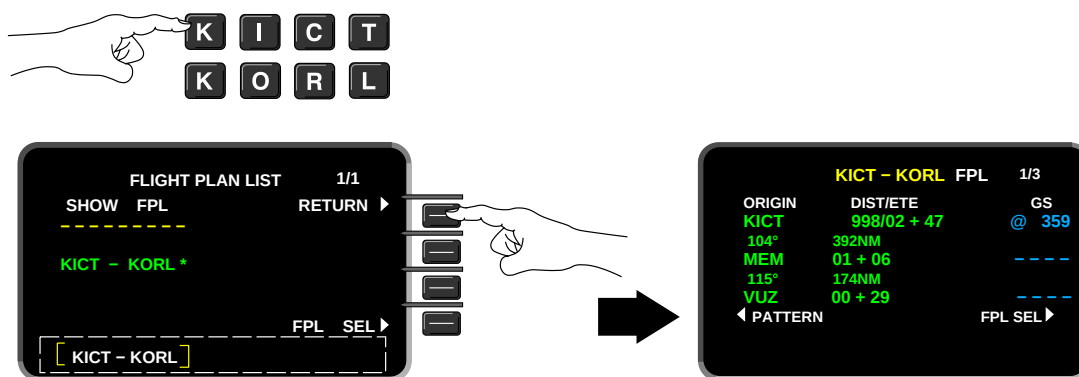


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When a destination is entered, the FMS searches for stored flight plans with the same origin and destination. If any flight plans are found, the FLIGHT PLAN LIST page is displayed.

Flight Plan (stored)

1. Enter flight plan name in the scratchpad and press 1R.



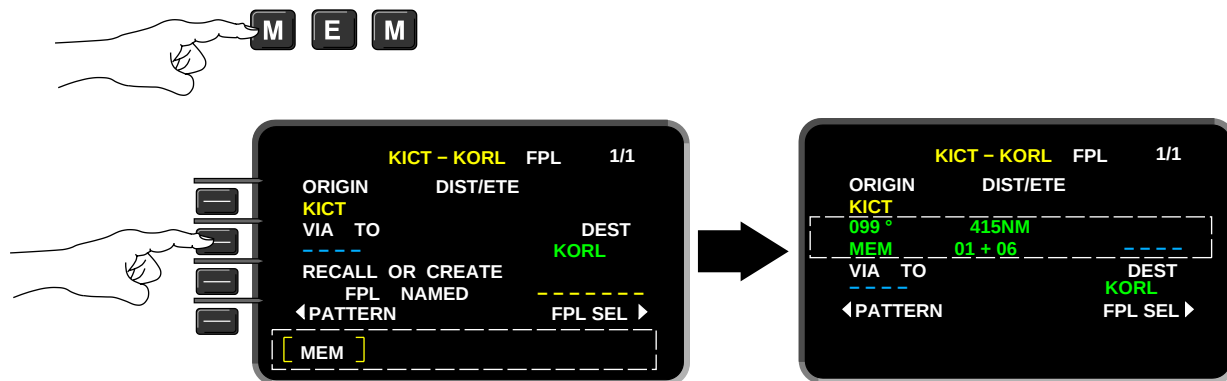
GF1710_132

If a flight plan name is entered that has not been previously defined, the FMS displays pages that are used to enter an undefined flight plan. The flight plan can also be selected through the FPL LIST from the NAV INDEX page.

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

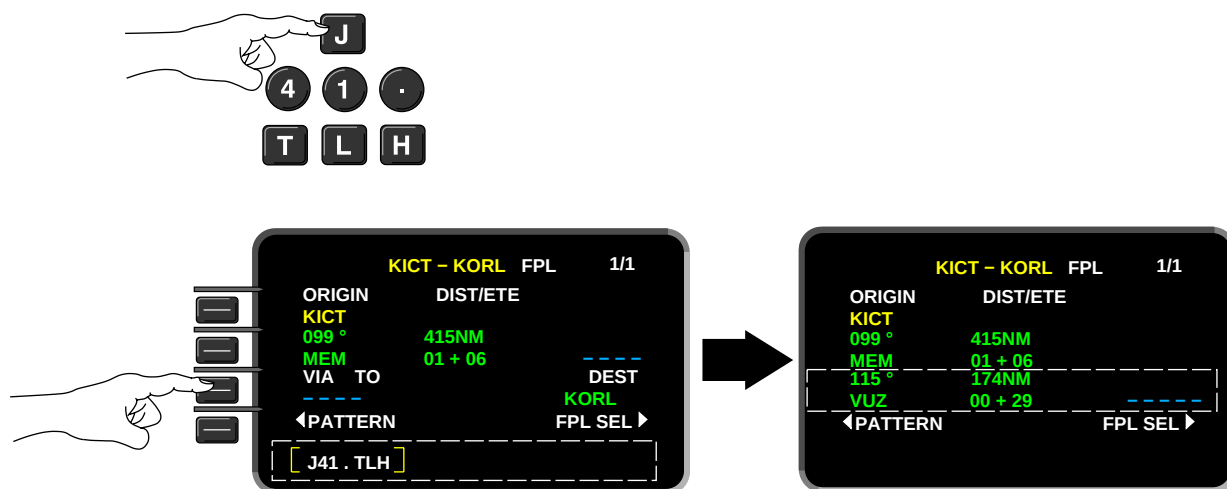
Flight Plan (Manual)

1. Enter the waypoints and/or airways in the scratchpad and press 2L.



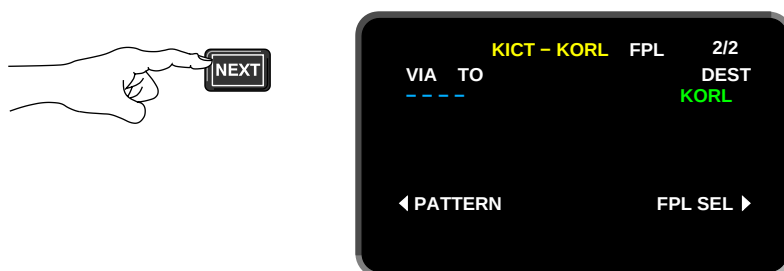
GF1710_133

2. Enter the waypoints and/or airways in the scratchpad and press 3L.



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3. Press NEXT to view next page and enter the remaining waypoints and/or airways.



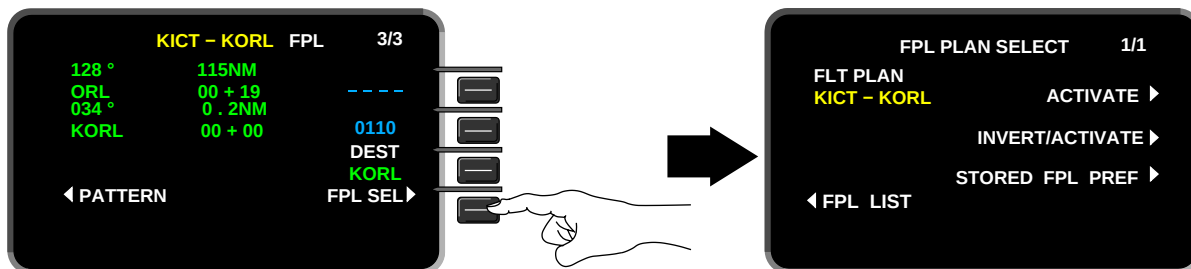
GF1710_135

FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Flight Plan (Manual) (Cont'd)

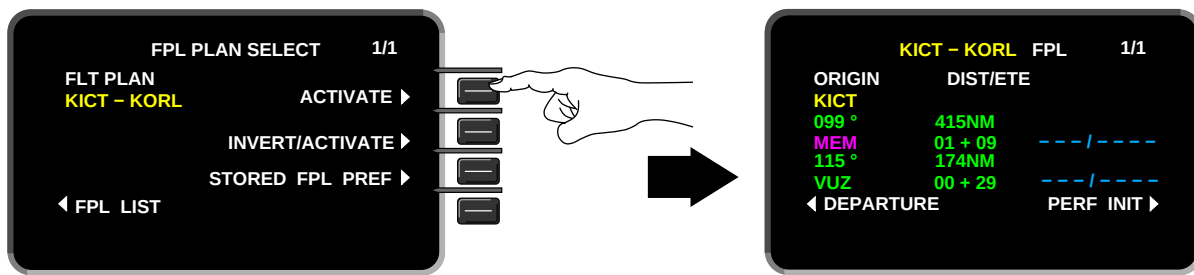
Once all the flight plan waypoints and/or airways have been entered and the destination is inserted, select FPL SEL.

1. Press 4R to display FLIGHT PLAN SELECT page.



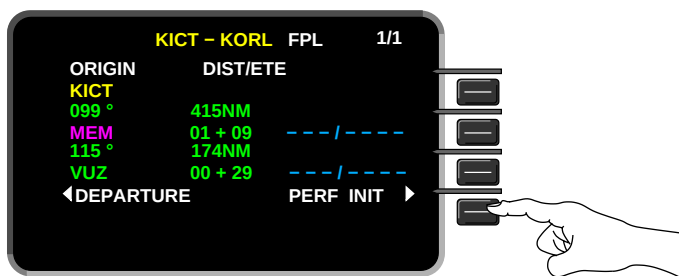
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2. Press 1R to activate flight plan.



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3. Press 4R to display PERF INIT page.

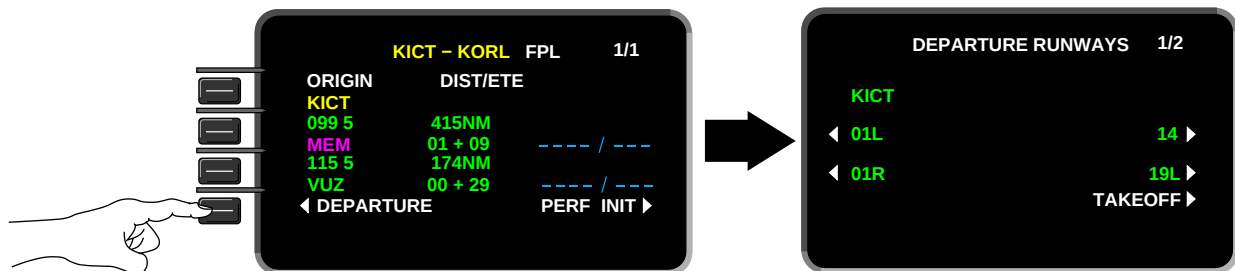


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Departures

To select departure runway and take-off information:

1. Press 4L to display DEPARTURE RUNWAYS page.



GF1710_139

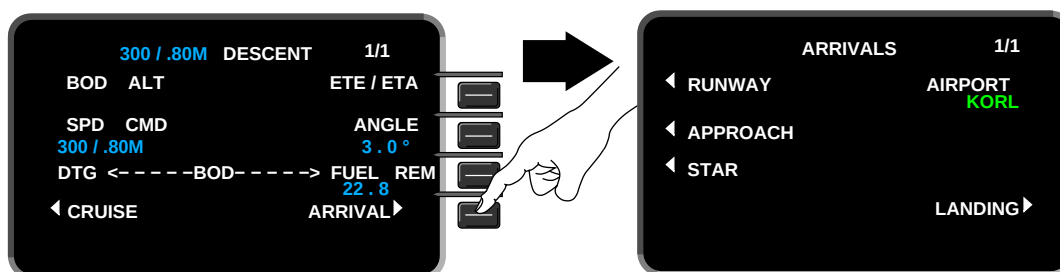
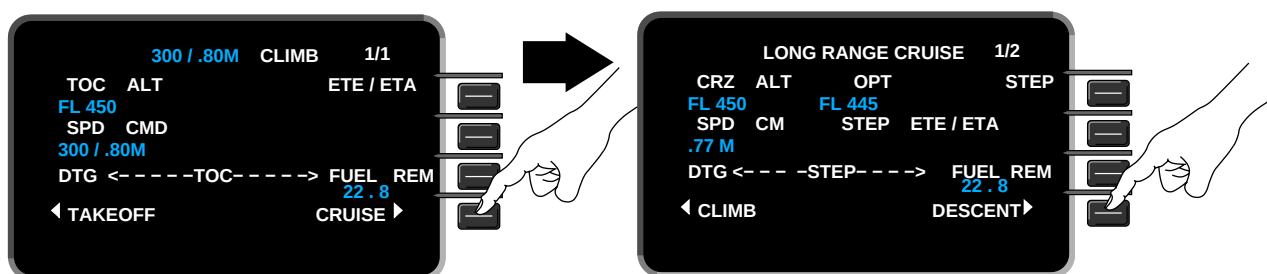
FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Departures (Cont'd)

2. Select appropriate runway and press 4R to display TAKE-OFF page.



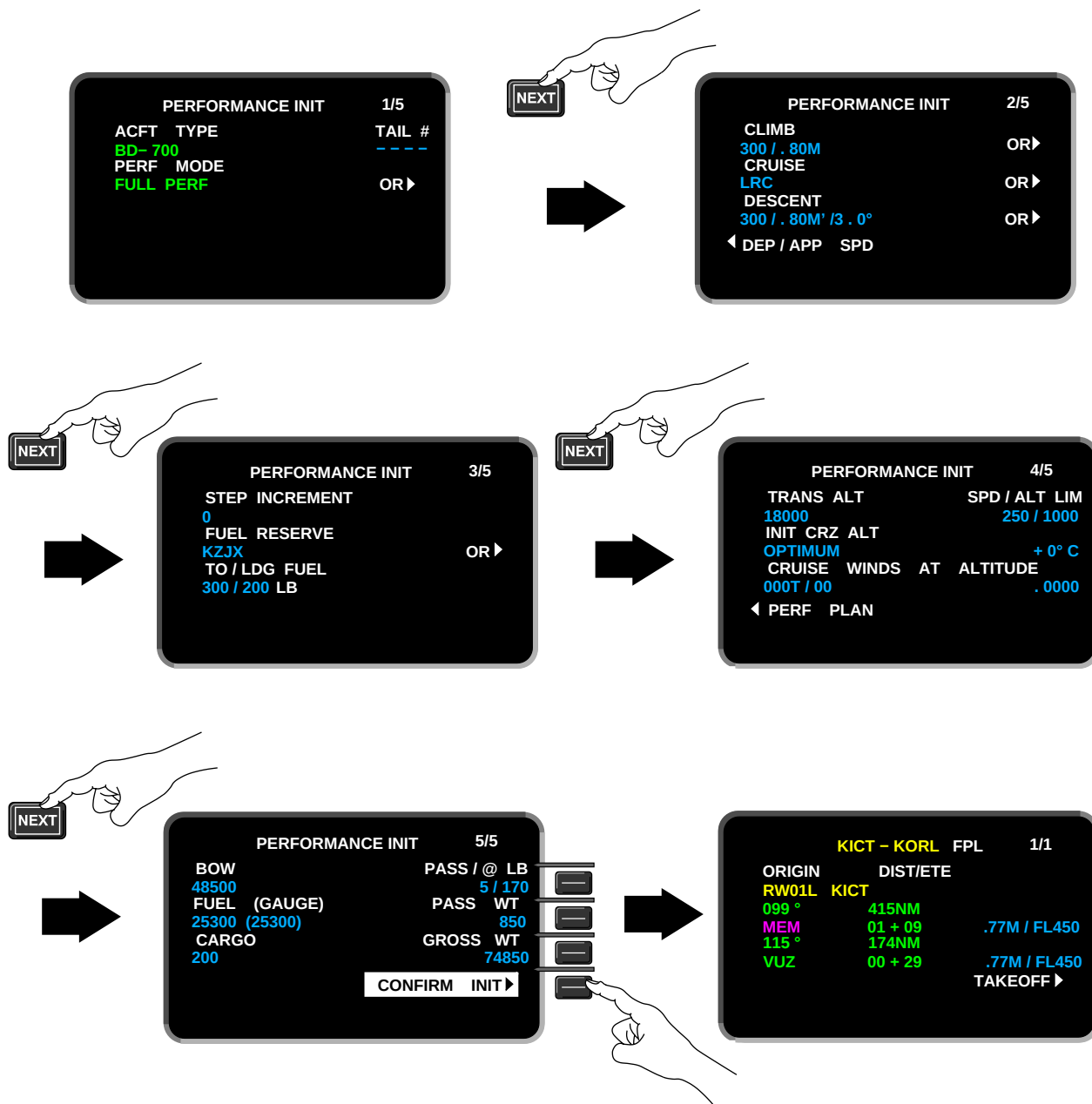
To enter climb, cruise, descent and arrival information select line 4R on each subsequent page.



FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

Performance Initialization

The following are examples of the information that can be found on the PERFORMANCE INIT pages. All pilot entries will appear in cyan. When all performance information has been entered, press 4R on page 5/5 of PERFORMANCE INIT.



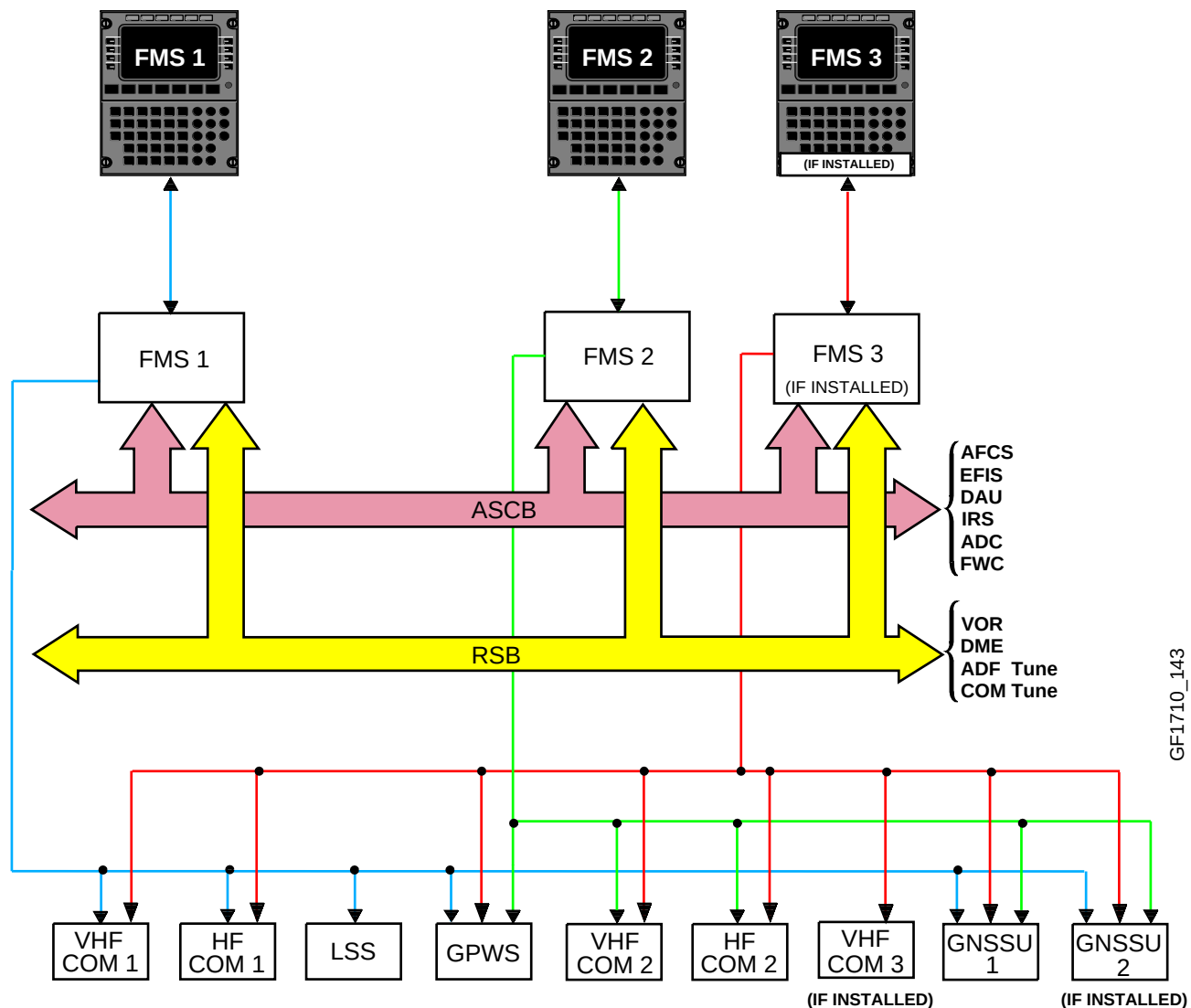
NOTE

For more information, refer to the Flight Management System Pilot's Guide.

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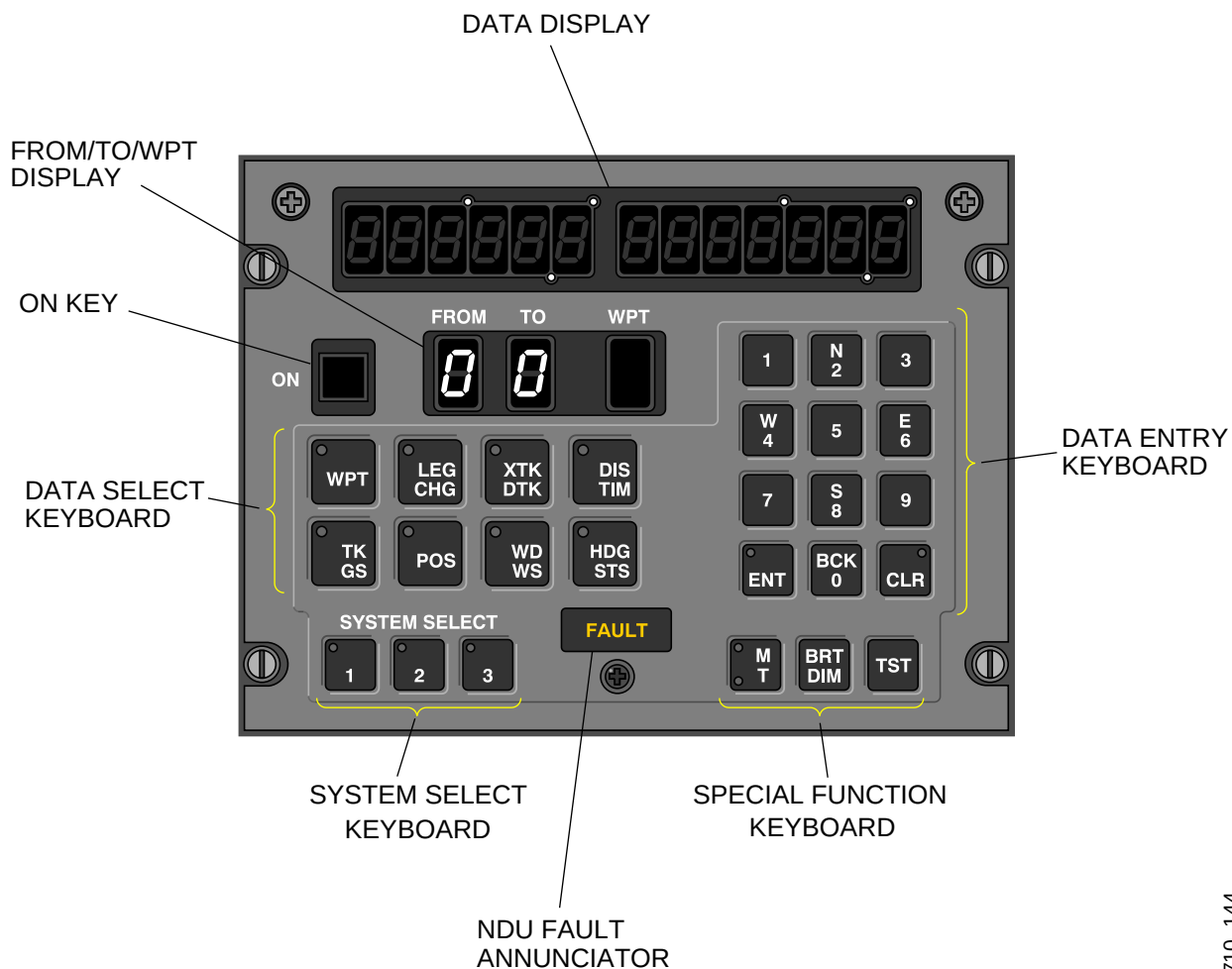
FLIGHT MANAGEMENT SYSTEM (FMS) (CONT'D)

FMS Schematic



NAVIGATION DISPLAY UNIT (IF INSTALLED)

The Navigation Display Unit (NDU), also referred to as Lasertrack IV (LTRK), located on the pilot's side panel, is a combined navigation computer and display unit, that is used to initialize up to three inertial reference units (IRU) and to display navigation data based on a nine-waypoint flight plan and IRS inputs.



The following describes the controls of the NDU:

ON Key

The ON Key  is used to power on and power off the NDU.

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NAVIGATION DISPLAY UNIT (IF INSTALLED) (CONT'D)

Data Entry Keyboard

The data entry keyboard is used to enter, display, modify, or transmit initialization, leg change and flight plan data. The data entry keyboard consists of the following:



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The enter  key is used to accept entered data that is being displayed on the data display. A cue light illuminates to indicate that operator action is required.

The clear  key is used to remove entered data and clear the display. A cue light illuminates to indicate that operator action is required.

The back  key is used to select the number and position of the previous waypoint for display when the WPT cue light is illuminated.

Special Function Keyboard

The special function keyboard consists of the following:



The magnetic/true north  key is used to indicate north reference. When the M cue light is illuminated, the NDU displays data referenced to magnetic north.



When the T cue light is illuminated, the NDU displays data referenced to true north.

The bright/dim  key is used to control the lighting of the NDU display. When first pressed and held, the display intensity increases until the brightest level is reached. When pressed and held a second time, the display intensity decreases until the dimmest level is reached.

The test  key is used to start a test of all NDU annunciators, cue lights and display.

System Select Keys



The system select keys are used to select data for display from IRU1, IRU2, or IRU3. The NDU displays data from one IRU at a time. The selected IRUs cue light is illuminated.

NAVIGATION DISPLAY UNIT (IF INSTALLED) (CONT'D)

Data Select Keyboard

The data select keyboard is used to select data for display. Each key contains a cue light that indicates what type of data has been selected. When the WPT, LEG CHG, POS, or HDG STS key is pressed, the operator can enter new data or modify the data that the NDU is displaying. The data select keyboard consists of the following:



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The waypoint key is used to build and display a flight plan consisting of one to nine waypoints. When this key is repeatedly pressed, the NDU displays the successive flight plan waypoints by number and position.



The leg change key is used to define or modify the current flight plan leg by displaying the FROM and TO waypoint numbers. The current leg must be defined before navigation data can be defined and displayed.



The crosstrack/desired track key is used to select and display the crosstrack error in nautical miles from the current leg and the desired track of that leg.



The distance/time key is used to select and display the distance and time to the TO waypoint based upon present position and current ground speed.



The track/ground speed key is used to select and display the current track and ground speed.



The position key is used to initialize and display the present position of the airplane.



The wind direction/wind speed key is used to select and display the current wind direction and wind speed.

NAVIGATION DISPLAY UNIT (IF INSTALLED) (CONT'D)

Data Select Keyboard (Cont'd)



The heading/status key is used to display the current airplane heading. When the IRU is in align mode, the NDU displays alignment status (time remaining until NAV mode entry). When the IRU is in NAV mode, the NDU displays heading in the left display. When the IRU is in attitude mode, the NDU displays magnetic heading in the left display and "ATT" in the right.



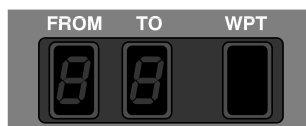
Displays

The NDU contains a data display and a FROM TO WPT display.

The NDU data display consists of two displays, a six position and a seven position display, each having degree, decimal and minute indicators.



The FROM TO WPT display has three elements that display the FROM and TO waypoint numbers of the current leg and the number of the waypoint defined by the position being displayed.



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Fault Annunciator

The NDU FAULT annunciator is illuminated when the NDU BITE detects internal failures.



NDU UPDATE

To update the NDU (pre-flight), proceed as follows:

Power On

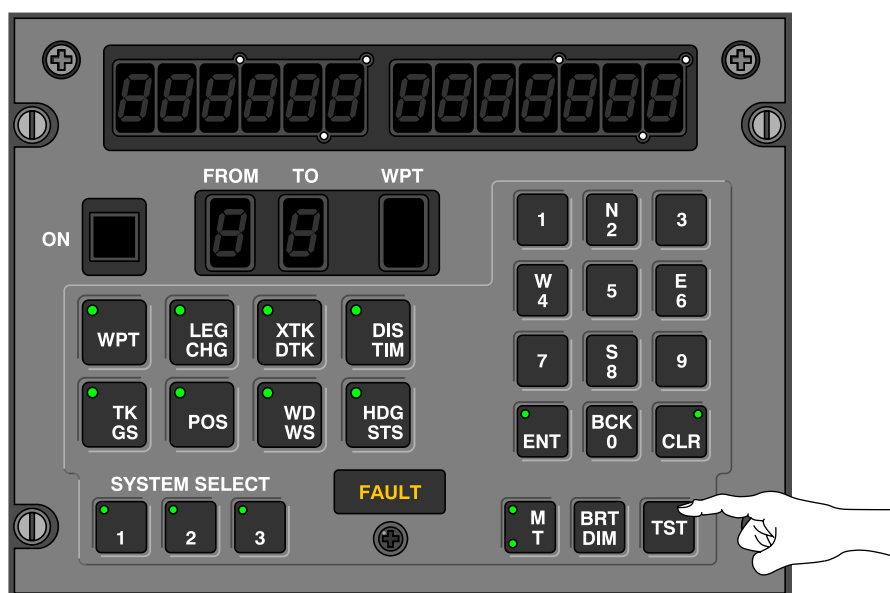
- Power the NDU on.



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Test

- Test the NDU displays, annunciators and cue lights.



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NDU UPDATE (CONT'D)

Position Entry

The following procedures can be used for position entry (initialization), during IRS alignment and align downmode.

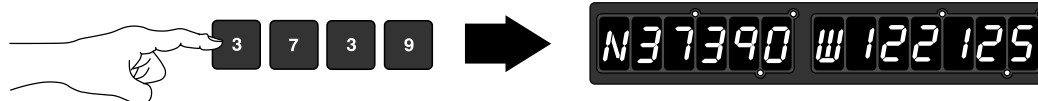
- ① Press POS key.



- ② Press N/2 or S/8.



- ③ Enter Latitude (example KICT).



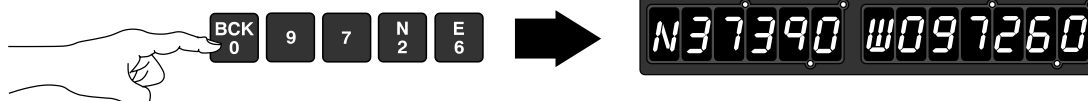
- ④ Press ENT key to transmit latitude to all IRUs.



- ⑤ Press W/4 or E/6.



- ⑥ Enter Longitude (example KICT).



- ⑦ Press ENT key to transmit longitude to all IRUs.



- ⑧ Press HDG STS key and observe time to complete alignment in right display.



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NDU UPDATE (CONT'D)

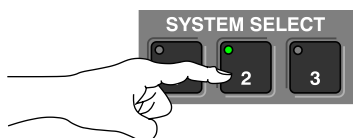
Position Entry (Cont'd)

Enter the magnetic heading when the latitude mode has been selected.

Ensure IRS mode selector is set to ATT.



- ① Press appropriate SYSTEM SELECT key.



- ② Press HDG STS.



- ③ Enter magnetic heading (example KICT).



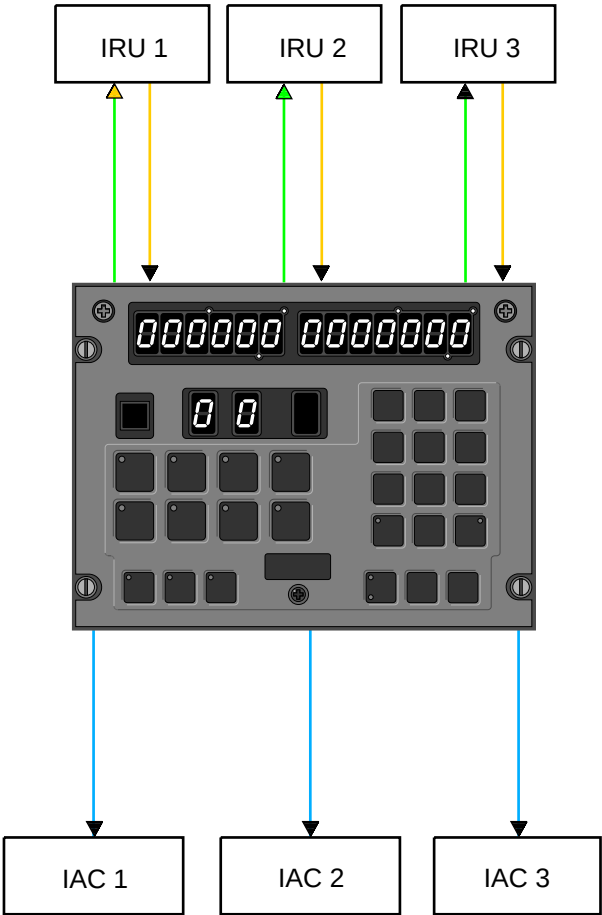
- ④ Press ENT key to transmit heading to all IRUs.

**NOTE**

For more information, refer to the LASERTRACK Navigation Display Unit Pilot's Manual

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NDU SCHEMATIC



GF1710_173

GLOBAL POSITIONING SYSTEM (GPS)

The GPS is used to determine airplane position and provides supplementary information to FMS and EGPWS. The GPS calculates the latitude, longitude, altitude, accurate time, date, true heading and ground speed.

The Global Navigation System Sensor Unit (GNSSU), is a GPS receiver that receives satellite signals from the NAVSTAR GPS satellite constellation (21 operational satellites and 3 active spares) and uses the satellite data to compute the airplane position.

The GNSSU has a Receiver Autonomous Integrity Monitor (RAIM) function. The RAIM monitors the status of the satellites that are used for calculations. The output of the RAIM function is an estimate of GPS position error. The RAIM value is sent to the FMS and the FMS uses this data to determine if it can use the GPS for navigation.

MODES OF OPERATION:

The GNSSU operational modes are as follows:

- Self-Test Mode – The GNSSU is in the self-test mode for approximately 5 seconds. When the self-test mode is complete, the GNSSU enters the initialization mode.
- Initialization Mode – The GNSSU automatically enters the initialization mode to initialize its hardware. When the hardware is initialized, the GNSSU enters the acquisition mode.
- Acquisition Mode – The GNSSU enters the acquisition mode to acquire satellites (minimum 4), or from other modes (NAV or Aided), when it does not have sufficient satellite and/or aiding data to remain in either the NAV or the Aided mode. From the acquisition mode, the GNSSU enters the NAV mode.
- Navigation (NAV) Mode – The GNSSU enters the NAV mode when it has computed a navigation solution that provides position, velocity, and time measurements. The GNSSU sends GPS position data to the FMS. From the NAV mode the GNSSU enters the acquisition mode or aided mode.
- Aided Mode – The GNSSU enters the aided mode when there is insufficient satellite and/or altitude information, but external-aided data (inertial velocities from the FMS) is available to continue to update the NAV filter. While in this mode, the GNSSU provides valid time outputs. From this mode, the GNSSU enters the NAV or acquisition mode.
- Altitude Aiding Mode – The GNSSU enters the altitude aiding mode if satellite measurements (less than 4) are not sufficient to maintain integrity or remain in the NAV mode. This mode uses altitude data from the ADC to aid the navigation solution and integrity monitoring during extended periods of insufficient satellite coverage and geometry. When the calibrated pressure altitude deviation estimate is out of limits, it reverts to the aided mode. From this mode, the GNSSU enters the NAV or aided modes.
- Fault Mode – The GNSSU enters the fault mode when any faults in the GNSSU is detected. This mode supersedes all other modes. Any faults will be reported on the FMS CDU. The FMS MSG indicator  will illuminate and GPS 1 (2) FAILED message will appear in the FMS scratchpad.

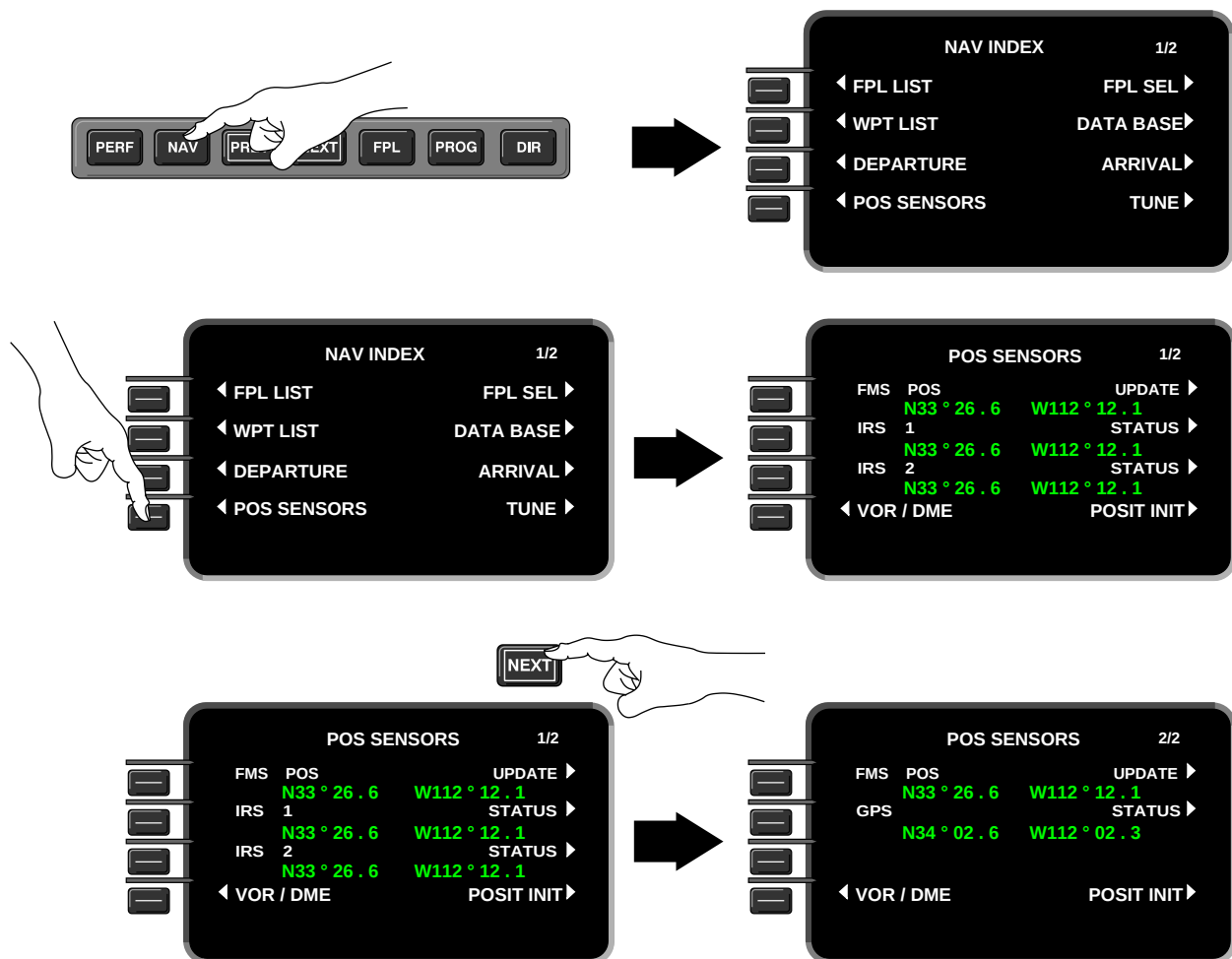


The control stations that continuously track and monitor the satellites, are located in Ascension Island, Diego Garcia, Hawaii, Kawajalein Island and Colorado Springs. GPS has an accuracy of 100 meters in 95% of the position fixes.

MODES OF OPERATION: (CONT'D)

GPS Access

To access the GPS on the FMS CDU, proceed as follows:



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GPS Status

GPS STATUS 1/2 displays the following information:

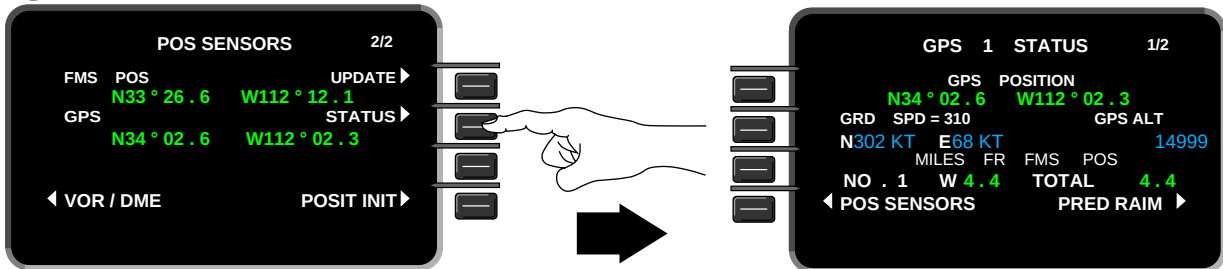
- GPS position
- Groundspeed
- Altitude
- Miles from FMS position

MODES OF OPERATION: (CONT'D)

GPS Status (Cont'd)

To view the GPS STATUS 1/2 on the FMS CDU, proceed as follows:

- ① Press STATUS key.



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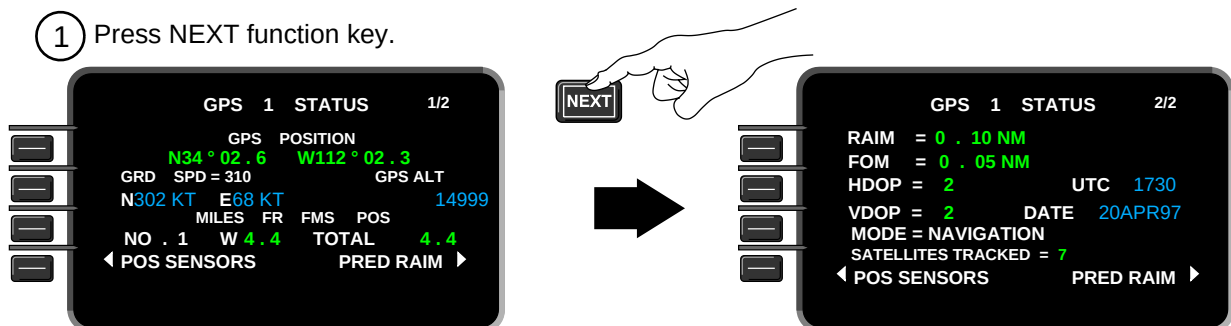
GPS STATUS 2/2 displays the following information:

- Receiver Autonomous Integrity Monitor (RAIM).
- Figure of Merit (FOM).
- Horizontal Dilution of Precision (HDOP).
- Vertical Dilution of Precision (VDOP).
- Time (UTC) and Date.
- Operating Mode.
- Satellites Tracked.

RAIM and FOM indicate current uncertainty of position expressed in nautical miles. HDOP and VDOP are numbers that rate current satellite geometry in the horizontal and vertical axis with 1 being the best geometry. Normally HDOP and VDOP numbers are below 10.

To view the GPS STATUS 2/2 on the FMS CDU, proceed as follows:

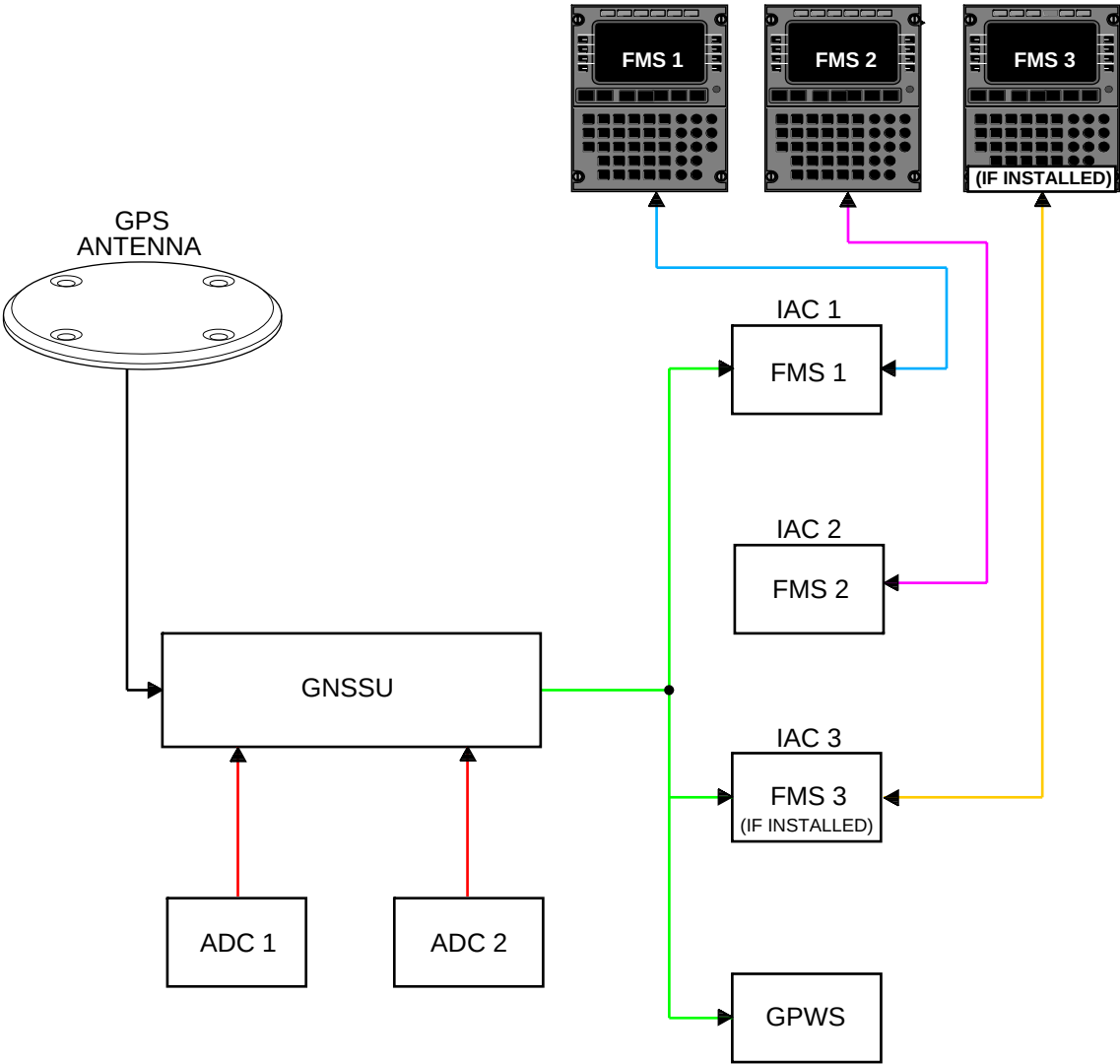
- ① Press NEXT function key.

**NOTE**

For more information, refer to the Flight Management System Pilot's Guide.

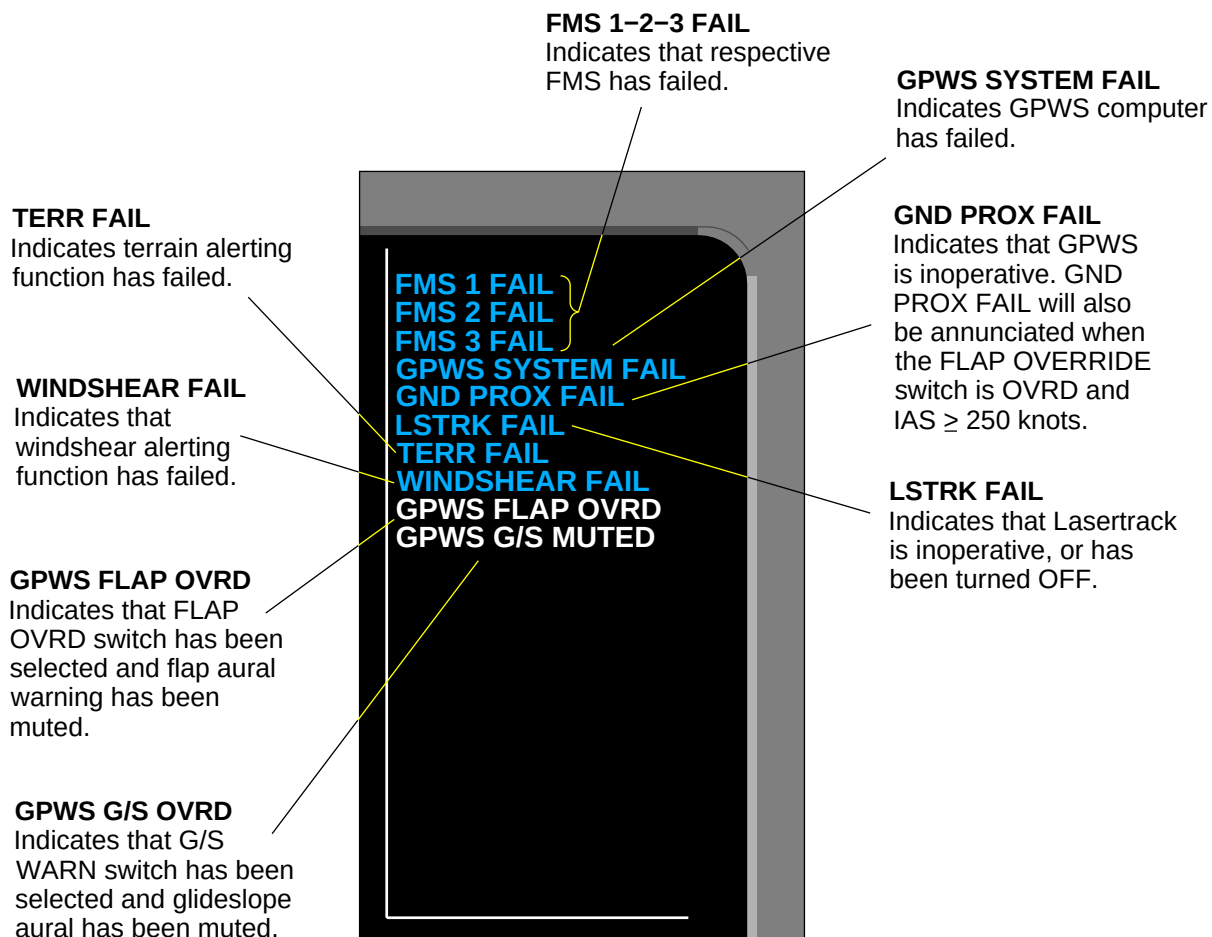
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GPS SCHEMATIC



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NAVIGATION SYSTEM EICAS MESSAGES

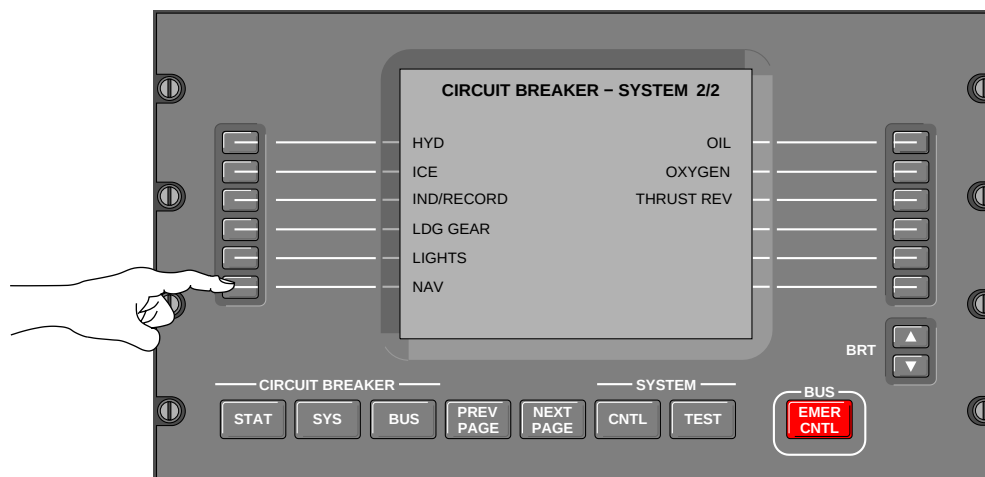


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NAVIGATION
EMS CIRCUIT PROTECTION

CB - NAV SYSTEM



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

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

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

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

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

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

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NAVIGATION
EMS CIRCUIT PROTECTION

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