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G5000® Integrated Avionics System
Pilot's Guide

Textron Citation 560XL/XLS
System Software Version 3343.02 or later

This manual reflects the operation of System Software version 3343.02 or later for the Textron Citation 560XL/XLS. Some differences in operation may be observed when comparing the information in this manual to earlier or later software versions.

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WARNING: *Do not operate this equipment without first obtaining qualified instruction.*

WARNING: *Always refer to current aeronautical charts and NOTAMs for verification of displayed aeronautical information. Displayed aeronautical data may not incorporate the latest NOTAM information.*

WARNING: *Do not use geometric altitude for compliance with air traffic control altitude requirements. The primary barometric altimeter must be used for compliance with all air traffic control altitude regulations, requirements, instructions, and clearances.*

WARNING: *Do not use basemap information (land and water data) as the sole means of navigation. Basemap data is intended only to supplement other approved navigation data sources and should be considered only an aid to enhance situational awareness.*

WARNING: *Do not rely solely upon the display of traffic information to accurately depict all of the traffic within range of the aircraft. Due to lack of equipment, poor signal reception, and/or inaccurate information from aircraft or ground stations, traffic may be present that is not represented on the display.*

WARNING: *Do not use data link weather information for maneuvering in, near, or around areas of hazardous weather. Information contained within data link weather products may not accurately depict current weather conditions.*

WARNING: *Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be older than the indicated weather product age.*

WARNING: *Do not use terrain avoidance displays as the sole source of information for maintaining separation from terrain and obstacles. Garmin obtains terrain and obstacle data from third party sources and cannot independently verify the accuracy of the information.*

WARNING: *Do not rely on the displayed minimum safe altitude (MSAs) as the sole source of obstacle and terrain avoidance information. Always refer to current aeronautical charts for appropriate minimum clearance altitudes.*

WARNING: *Do not use GPS to navigate to any active waypoint identified as a 'NON WGS84 WPT' by a system message. 'NON WGS84 WPT' waypoints are derived from an unknown map reference datum that may be incompatible with the map reference datum used by GPS (known as WGS84) and may be positioned in error as displayed.*

⚠️ **WARNING:** Do not rely on the autopilot to level the aircraft at the MDA/DH when flying an approach with vertical guidance. The autopilot will not level the aircraft at the MDA/DH even if the MDA/DH is set in the altitude preselect.

⚠️ **WARNING:** Do not rely on the accuracy of attitude and heading indications in the following geographic areas (due to variations in the earth's magnetic field): North of 72° North latitude at all longitudes; South of 70° South latitude at all longitudes; North of 65° North latitude between longitude 75° W and 120° W. (Northern Canada); North of 70° North latitude between longitude 70° W and 128° W. (Northern Canada); North of 70° North latitude between longitude 85° E and 114° E. (Northern Russia); South of 55° South latitude between longitude 120° E and 165° E. (Region south of Australia and New Zealand).

⚠️ **WARNING:** Use appropriate primary systems for navigation, and for terrain, obstacle, and traffic avoidance. Garmin SVT is intended as an aid to situational awareness only and may not provide either the accuracy or reliability upon which to solely base decisions and/or plan maneuvers to avoid terrain, obstacles, or traffic.

⚠️ **WARNING:** Do not use the Garmin SVT runway depiction as the sole means for determining the proximity of the aircraft to the runway or for maintaining the proper approach path angle during landing.

⚠️ **WARNING:** Do not operate the weather radar in a transmitting mode when personnel or objects are within the MPEL boundary.

⚠️ **WARNING:** Always position the weather radar gain setting to Calibrated for viewing the actual intensity of precipitation. Changing the gain in weather mode causes precipitation intensity to be displayed as a color not representative of the true intensity.

⚠️ **WARNING:** Do not consider the overflight of thunderstorms to be safe, as extreme turbulence may exist significantly above observed returns.

⚠️ **WARNING:** Do not assume weather radar transmission is disabled unless all display panes displaying weather radar are set to Standby Mode, and are displaying 'STANDBY' in the center of each weather radar display. Transmission is also disabled by touching the Radar On Button or pressing the Radar On Softkey to set the weather radar system to Off Mode, as indicated by a gray annunciator.

⚠️ **WARNING:** Do not rely on information from the reactive windshear detection system display as the sole basis for detecting windshear conditions. The system cannot predict the conditions in which windshear is likely to develop.

⚠️ **WARNING:** Do not rely only on the Turbulence Detection function for hazardous weather avoidance, or to maneuver in, near, or around areas of hazardous weather.

⚠ **WARNING:** Do not rely on information from a lightning detection system display as the sole basis for hazardous weather avoidance. Range limitations and interference may cause the system to display inaccurate or incomplete information. Refer to documentation from the lightning detection system manufacturer for detailed information about the system.

⚠ **WARNING:** Do not use TAWS information for primary terrain or obstacle avoidance. TAWS is intended only to enhance situational awareness.

⚠ **WARNING:** Do not rely solely upon the display of traffic information for collision avoidance maneuvering. The traffic display does not provide collision avoidance resolution advisories and does not under any circumstances or conditions relieve the pilot's responsibility to see and avoid other aircraft.

⚠ **WARNING:** Always use traffic information shown on system displays only as an aid to visually acquiring traffic. Traffic avoidance maneuvers are based upon TCAS II Resolution Advisories , ATC guidance, or positive visual acquisition of conflicting traffic.

⚠ **WARNING:** Do not use QFE altimeter setting outside of the terminal environment for the corresponding issuing airport to ensure adequate obstacle clearance.

⚠ **WARNING:** Do not fly QFE procedures above the Transition Altitude or when navigating to a waypoint that contains a QNE (flight level) altitude constraint.

⚠ **WARNING:** Always fly a procedure that provides terrain and obstacle clearance from the reference airfield when operating in IMC while conducting QFE procedures.

⚠ **WARNING:** Do not use SurfaceWatch™ information as the primary method of flight guidance during airborne or ground operations. SurfaceWatch does not have NOTAM or ATIS information regarding the current active runway, condition, or information about the position of hold lines.

⚠ **CAUTION:** Do not clean display surfaces with abrasive cloths or cleaners containing ammonia. They will harm the anti-reflective coating.

⚠ **CAUTION:** Do not allow repairs to be made by anyone other than an authorized Garmin service center. Unauthorized repairs or modifications could void both the warranty and affect the airworthiness of the aircraft.

⚠ **CAUTION:** Never disconnect power to the system when loading a database. Power interruption during the database loading process could result in maintenance being required to reboot the system.

⚠️ **CAUTION:** *Avoid areas on the radar display that appear "shadowed" (gray). The accuracy of the intensity of returns in the shaded areas should be treated as suspect. Exercise extreme caution, making maneuvering decisions with this information in mind.*

⚠️ **CAUTION:** *When all display panes displaying weather radar are set to Standby Mode, the antenna is parked at the center line. It is always a good idea to put the radar in Standby Mode before taxiing the aircraft to prevent the antenna from bouncing on the bottom stop and possibly causing damage to the radar assembly.*

✓ **NOTE** *All visual depictions contained within this document, including screen images of the system panel and displays, are subject to change and may not reflect the most current system and aviation databases. Depictions of equipment may differ slightly from the actual equipment.*

✓ **NOTE:** *Do not rely solely upon data link services to provide Temporary Flight Restriction (TFR) information. Always confirm TFR information through official sources such as Flight Service Stations or Air Traffic Control.*

✓ **NOTE:** *The United States government operates the Global Positioning System and is solely responsible for its accuracy and maintenance. The GPS system is subject to changes which could affect the accuracy and performance of all GPS equipment. Portions of the system utilize GPS as a precision electronic NAVigation AID (NAVAID). Therefore, as with all NAVAIDs, information presented by the system can be misused or misinterpreted and, therefore, become unsafe.*

✓ **NOTE:** *This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

✓ **NOTE:** *Use of polarized eyewear may cause the flight displays to appear dim or blank.*

✓ **NOTE:** *This product, its packaging, and its components contain chemicals known to the State of California to cause cancer, birth defects, or reproductive harm. This notice is being provided in accordance with California's Proposition 65. If you have any questions or would like additional information, please refer to our web site at www.garmin.com/prop65.*

✓ **NOTE:** *Operating the system in the vicinity of metal buildings, metal structures, or electromagnetic fields can cause sensor differences that may result in nuisance miscompare annunciations during start up, shut down, or while taxiing. If one or more of the sensed values are unavailable, the annunciation indicates no comparison is possible.*

✓ **NOTE:** *The system responds to a terminal procedure based on data coded within that procedure in the Navigation Database. Differences in system operation may be observed among similar types of procedures due to differences in the Navigation Database coding specific to each procedure.*

NOTE: *The FAA has asked Garmin to remind pilots who fly with Garmin database-dependent avionics of the following:*

- *It is the pilot's responsibility to remain familiar with all FAA regulatory and advisory guidance and information related to the use of databases in the National Airspace System.*

- *Garmin equipment will only recognize and use databases that are obtained from Garmin or Jeppesen. Databases obtained from Garmin or Jeppesen that have a Type 2 Letter of Authorization (LOA) from the FAA are assured compliance with all data quality requirements (DQRs). A copy of the Type 2 LOA is available for each applicable database and can be viewed at flygarmin.com by selecting 'Aviation Database Declarations.'*

- *Use of a current Garmin or Jeppesen database in your Garmin equipment is required for compliance with established FAA regulatory guidance, but does not constitute authorization to fly any and all terminal procedures that may be presented by the system. It is the pilot's responsibility to operate in accordance with established pertinent aircraft documents and regulatory guidance or limitations as applicable to the pilot, the aircraft, and installed equipment.*

NOTE: *The pilot/operator must review and be familiar with Garmin's database exclusion list as discussed in SAIB CE-14-04 to determine what data may be incomplete. The database exclusion list can be viewed at flygarmin.com by selecting 'Database Exclusions List.'*

NOTE: *The pilot/operator must have access to Garmin and Jeppesen database alerts and consider their impact on the intended aircraft operation. The database alerts can be viewed at flygarmin.com by selecting 'Aviation Database Alerts.'*

NOTE: *If the pilot/operator wants or needs to adjust the database, contact Garmin Product Support.*

NOTE: *Garmin requests the flight crew report any observed discrepancies related to database information. These discrepancies could come in the form of an incorrect procedure; incorrectly identified terrain, obstacles and fixes; or any other displayed item used for navigation or communication in the air or on the ground. Go to flygarmin.com and select 'Aviation Data Error Report'.*

NOTE: *Electronic aeronautical charts displayed on this system have been shown to meet the guidance in AC 120-76D as a Type B Electronic Flight Bag (EFB) for FliteCharts and ChartView. The accuracy of the charts is subject to the chart data provider. Own-ship position on airport surface charts cannot be guaranteed to meet the accuracy specified in AC 120-76D. Possible additional requirements may make a secondary source of aeronautical charts, such as traditional paper charts or an additional electronic display, necessary on the aircraft and available to the pilot. If the secondary source of aeronautical charts is a Portable Electronic Device (PED), its use must be consistent with the guidance in AC 120-76D.*

NOTE: *The navigation databases used in Garmin navigation systems contain Special Procedures. Prior to flying these procedures, pilots must have specific FAA authorization, training, and possession of the corresponding current, and legitimately-sourced chart (approach plate, etc.). Inclusion of the Special Procedure in the navigation database DOES NOT imply specific FAA authorization to fly the procedure.*

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NOTE: *Terrain and obstacle alerting is not available north of 89º North latitude and south of 89º South latitude. This is due to limitations present within the Terrain database and the system's ability to process the data representing the affected areas.*

NOTE: *The nose of the 'own ship' symbol represents the location of the aircraft. The center of any traffic symbol represents the location of that traffic. The traffic and own ship symbols are an abstract representation and do not reflect the physical extent of the aircraft/traffic, and should not replace other methods for identifying traffic.*

NOTE: *When using Stormscope, there are several atmospheric phenomena in addition to nearby thunderstorms that can cause isolated discharge points in the strike display mode. However, clusters of two or more discharge points in the strike display mode do indicate thunderstorm activity if these points reappear after the screen has been cleared.*

NOTE: *Intruder aircraft at or below 500 ft. AGL may not appear on the Garmin SVT display or may appear as a partial symbol.*

NOTE: *Interference from GPS repeaters operating inside nearby hangars can cause an intermittent loss of attitude and heading displays while the aircraft is on the ground. Moving the aircraft more than 100 yards away from the source of the interference should alleviate the condition.*

NOTE: *Operate system power through at least one cycle in a period of four days of continuous operation to avoid an autonomous system reboot.*

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Record of Revisions				
Part Number	**Revision**	**Date**	**Page Range**	**Description**
190-02537-00	A	06/05/2019	All	Production Release for GDU 21.17
190-02537-01	A	07/8/2020	All	Production Release for GDU 21.40.1
	B	07/16/2020	All	Revised to correct Database Deletion procedure
190-02537-02	A	02/18/21	Al	Revision: - Add FANS 1/A - Clerical updates

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SECTION 1 SYSTEM OVERVIEW

1.1 SYSTEM DESCRIPTION

This section provides an overview of the G5000® Integrated Avionics System as installed in the Textron Citation 560XL/XLS aircraft. The system is an integrated flight control system that presents flight instrumentation, position, navigation, communication, and identification information to the flight crew using flat-panel color displays and Touchscreen Controllers. The system consists of the following Line Replaceable Units (LRUs):

- **GDU 1450W** (3) – The Display Unit features a 14-inch light emitting diode Widescreen Ultra Extended Graphics Array (WUXGA) 1920 x 1200 resolution backlit display. The unit installed on the left/pilot side is designated as the L PFD. In normal operations, it shows a Primary Flight Display (PFD), and may also show a pane. The center unit is designated as the Multi-Function Display (MFD). In normal operations it shows the Engine Indication and Crew Alerting System (EICAS) display, in addition to one or two panes. The unit installed on the right/copilot side is designated as the R PFD. In normal operations, it shows a PFD, and may also show a pane. The GDUs communicate with each other, Touchscreen Controllers, and the on-side Integrated Avionics Unit (IAU) through a High-Speed Data Bus (HSDB) Ethernet connection.

- **GTC 575** (2) – The Touchscreen Controller provides GDU Display Pane control, in addition to Flight Management System (FMS) functions, data entry capability, and communications control to the system. The unit installed on the left/pilot side is designated as L GTC, and the one installed on the right/copilot side is designated as R GTC. Each touchscreen controller communicates with its respective on-side PFD and GMA, as well as the MFD, using an HSDB connection.

- **GCU 275** (2) – The PFD Controller is a panel-mounted user interface which enables the flight crew to control the on-side PFD and radio tuning. The unit installed on the left/pilot side is designated as GCU1, and the one installed on the right/copilot side is designated as GCU2. Each unit is connected to the on-side PFD and to the MFD.

- **GMA 36B** (2) – The Remote Audio Controller integrates navigation/communication radio (NAV/COM) digital audio, intercom, and marker beacon audio thru the GIAs. The Remote Audio Controller also functions to provide SELCAL receiver and decoder. Both units are connected to one other and also to their on-side Touchscreen Controller.

- **GDR 66** (1) (Optional) – The Digital Radio is a transceiver for sending and receiving Controller Pilot Data Link Communications (CPDLC) messages by using the Touchscreen Controllers. It also supports analog voice communication as COM 3. It communicates via the #2 Data Concentrator. The GDR 66 is powered via the DATALINK COM 3 circuit breaker on the right circuit breaker panel.

- **GIA 64E** (2) – The Integrated Avionics Unit (IAU) functions as the main communications hub, linking several LRUs with each on-side PFD. Each IAU contains a GPS Satellite-Based Augmentation System (SBAS) receiver, a very high frequency (VHF) communication/navigation/glideslope (COM/NAV/GS) receiver, a Flight Director (FD) and system integration microprocessors.

- **GDC 7400** (2) – The Air Data Computer processes data from the pitot-static system as well as the Total Air Temperature (TAT) probe. This unit provides pressure altitude, airspeed, vertical speed and OAT information to the system, and it communicates with both GIAs and the on-side PFD. The GDC is designed to operate in Reduced Vertical Separation Minimum (RVSM) airspace.

- **GEA 7100** (2) – The Engine Airframe Unit receives and processes signals from the engine and airframe sensors. This unit communicates with both IAUs.

- **GSD 41** (2) – The Data Concentrator is used to expand the input and output capabilities of the system.

- **GRS 79** (2) – (Optional) The Attitude and Heading Reference System (AHRS) provides aircraft AHRS information to the on-side IAU, the on-side PFD, the MFD (#1 AHRS only). The AHRS contains advanced sensors (including

accelerometers and rate sensors) and interfaces with the Magnetometer to obtain magnetic field information, with the air data computers to obtain air data, and with both IAUs to obtain GPS information. AHRS operation is discussed in System Operation, later in this section.

- **GMU 44B** (2) – (Optional) The Magnetometer measures local magnetic field and sends data to the AHRS for processing to determine aircraft magnetic heading. The magnetometer receives power directly from the AHRS.
- **GTX 3000** (2) – Solid-state Transponder provides Modes A/C/S capability, 1090 MHz Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B Out transmissions), and communicates with both IAUs. Both transponders are for use with TCAS II option. ADS-B In functionality is provided with the addition of the optional GTS 8000.
- **GDL 59** (1) (Optional) – The unit is connected to the #2 Data Concentrator and the GSR 56 #1.
- **GMC 7200** (1) – The AFCS Controller provides AFCS control and connects to the PFDs.
- **GRA 5500** (1) (Optional)– The Radar Altimeter provides Above Ground Level (AGL) altitude information and Rate of Change of AGL altitude information via ARINC 429 or RS-422 connections.
- **GSA 9000** (4) and **GSM 9100** (4) – The GSA servo and GSM gearbox are used for automatic control of pitch, roll, yaw, and pitch trim. These units interface with each IAU.
- **GWX 75** (1) – The Airborne Weather Radar is an all-digital, high definition radar that automatically performs multiple scan/sweep angles to help determine the actual size and shape of hazardous storm cell activity. It has zero blind range for close-in returns and ground clutter suppression. It provides data to the MFD and PFDs via the #1 Data Concentrator.
- **GSR 56** (2) (Optional) – One or two GSR 56 Iridium transceivers may be installed. GSR 56 #1 provides telephone voice communication by means of pilot and copilot headsets, short message service (SMS) text messages, and connext datalink weather. GSR 56 #2 provides SATCOM capability for FANS 1/A + and ACARS functions. The GSR 56 #1 and GSR 56 #2 may be installed independently, i.e. GSR 56 #2 may be installed even if GSR 56 #1 is not installed, and vice-versa. GSR 56 #1 is powered via the DATALINK IRIDIUM circuit breaker. GSR 56 #2 is powered via the IRIDIUM ATS circuit breaker. Both are located on the right circuit breaker panel.
- **GTS 8000** (1) (Optional) – The GTS 8000 Traffic Alert and Collision Avoidance System (TCAS) uses active interrogations of Mode S and Mode C transponders to provide traffic data to the pilot independent of the air traffic control system.
- **Flight Stream 510** (1) (Optional) – Provides wireless Bluetooth® connectivity between a compatible mobile device and the avionics system.

A top-level system block diagram is shown in Figure 1-1.

The system is capable of interfacing with the following non-Garmin major components:

- **LCR-93** (2) or **LCR-100** (2) – Northrop Grumman LITEF AHRS
- **TPU-67** (1) (Optional) – Honeywell TCAS II
- **DME 4000** (2) (Optional) – Collins Aerospace DME
- **ADF 4000** (2) (Optional) – Collins Aerospace ADF

- **ALT 55B** (1) (Optional) – Collins Aerospace Radar Altimeter
- **RT 300** (1) (Optional) – Honeywell Radar Altimeter
- **TCAS 2000** (1) (Optional) – ACSS TCAS II
- **FA2100** (1) (Optional) – L-3 Cockpit Voice Recorder

- **WX 500** (1) (Optional) – L-3 Stormscope Lightning Detection System
- **F1000** (1) (Optional) – L-3 Flight Data Recorder
- **HF-1050** (1) (Optional) – Honeywell Radar Altimeter
- **WX 1000E** (1) (Optional) – L-3 Stormscope Lightning Detection System

> **NOTE:** For information on non-Garmin equipment, consult the applicable user's guide. This document assumes the reader is already familiar with the operation of this additional equipment

The aircraft is also equipped with a Garmin Automated Flight Control System (AFCS), providing the Flight Director (FD), Autopilot (AP), and manual electric trim functions of the Integrated Avionics System.

> **NOTE:** Refer to the Automatic Flight Control System (AFCS) Section for details on the Garmin AFCS.

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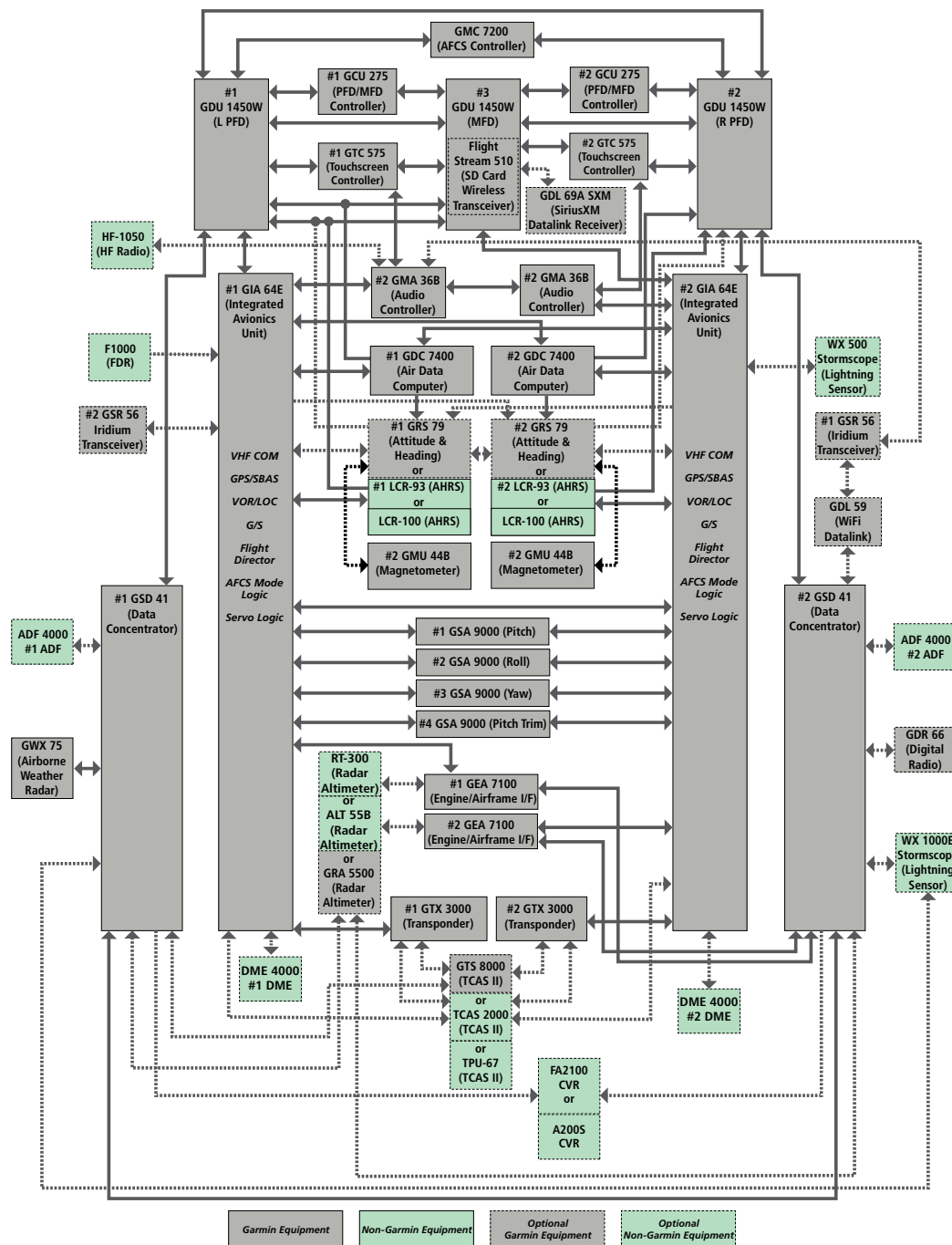
Figure 1-1 System (LRU Configuration)

1.2 SYSTEM CONTROLS

The system controls have been designed to simplify operation of the system and minimize workload and the time required to access sophisticated functionality. Controls are located on the PFD bezels, the Touchscreen Controllers, and the AFCS Controller. PFD controls and the Touchscreen Controllers are discussed in this section. AFCS controls are described in the AFCS section. See the Audio and CNS Section for more information about NAV/COM controls.

Figure 1-2 System Controls

PFD CONTROLS
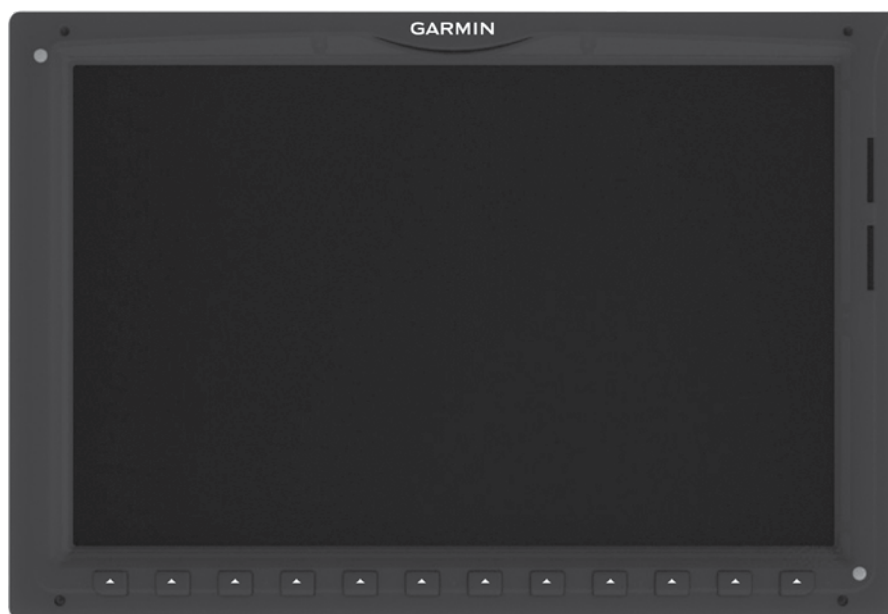
Figure 1-3 Garmin Display Unit 1450W

Selection softkeys are located along the bottom of L PFD and R PFD. The softkeys available are different between the PFD Full Mode and Split Mode (when the PFD screen is split between the normal PFD display and a chosen Display Pane). The next two figures show these differences. The softkeys shown depend on the softkey level previously selected. The bezel keys below the softkey labels can be used to select the appropriate softkey. There are three types of softkeys. One selects a simple on/off state, indicated by an annunciator on the softkey label displayed as green (on) or gray (off). The next type of softkey selects among several options, indicated by the softkey label changing (with the exception of the Map Range keys) to reflect the name of the chosen option. The last type of softkey, when pressed displays another set of softkeys available for the selected function. Also, these softkeys revert to the previous level after 45 seconds of inactivity. When a softkey function is disabled, the softkey label is subdued (dimmed).
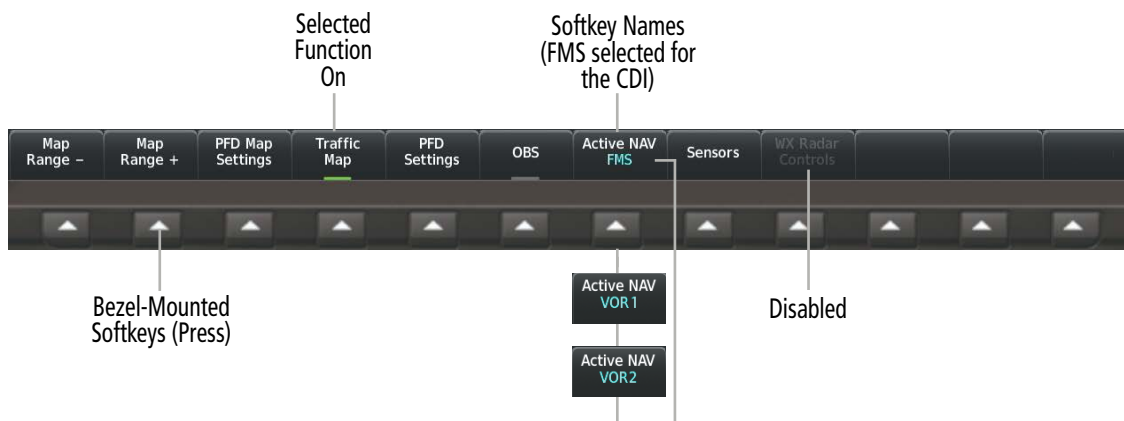
Figure 1-4 Top Level PFD Softkeys - Full Mode

Figure 1-5 Top Level PFD Softkeys - Split Mode

Each softkey sublevel has a **Back** Softkey which can be selected to return to the previous level. Full Mode softkey hierarchy and descriptions:

Level 1	Level 2	Level 3	Level 4	Description
Map Range -				Decreases the PFD Map display range.
Map Range +				Increases the PFD Map display range.
PFD Map Settings				Displays the PFD Map display settings softkeys.
	Map Layout			Displays the PFD Map selection softkeys.
		Map Off		Removes the PFD Map from the display.
		Inset Map		Displays the Inset Map.
		HSI Map		Displays the HSI Map.
		Inset Traffic		Displays traffic within Inset Map.
		HSI Traffic		Displays traffic within the HSI Map.

Level 1	Level 2	Level 3	Level 4	Description
	Detail			Selects desired amount of map detail; cycles through declutter levels: - **All** (No Declutter): All map features visible. - **DCLTR 1**: Declutters land data. - **DCLTR 2**: Declutters land and SUA data. - **Least**: Removes everything except for the active flight plan.
	Weather Legend			Displays/removes the name of the selected data link weather provider and the weather product icon and age box (for enabled weather products).
	Traffic			Adds or removes the display of traffic on the PFD Map.
	Stormscope			Adds or removes the display of Stormscope on the PFD Map.
	Terrain			Selects the display of terrain information on the PFD Map: - **Off**: Removes terrain information from the PFD Map. - **Absolute**: Displays absolute terrain information on the PFD Map. - **Relative**: Displays relative terrain information on the PFD Map.
	Data Link Settings			Displays the PFD Map data link settings softkeys.
		Data Link		Selects the data link weather source for the PFD Map: - **SiriusXM**: PFD Map data link weather source is SiriusXM. - **Connext**: PFD Map data link weather source is Connext. - **ACARS:** Selects ACARS Weather as the weather source on the PFD Map.
		Storm Cell Movement		This softkey is available when SiriusXM is selected as the data link weather source. Adds or removes the display of Storm Cell Movement information on the PFD Map.
		NEXRAD Animation		Animates NEXRAD weather and coverage information on the PFD Map when SiriusXM is selected for Data Link.
		NEXRAD		Displays NEXRAD weather and coverage information on the PFD Map when SiriusXM is selected for Data Link: - **CMP**: Displays the composite cloud reflectivity. - **BAS**: Displays the base cloud reflectivity.
	WX Overlay			Selects the display of weather information on the PFD Map: - **Off**: Removes weather information from the PFD Map. - **WX Radar**: Displays airborne weather radar information on the HSI Map only. Not available if Inset Map displayed. - **ACARS:** Selects ACARS Weather as the weather source on the PFD Map.
	SiriusXM or **Connext Lightning**			Adds/removes the display of SiriusXM or Connext lightning information (based on data link weather source selection) on the PFD Map.

Level 1	Level 2	Level 3	Level 4	Description
	METAR			Adds or removes the display of data link METAR data on the PFD Map.
Traffic Map				Replaces the PFD Map with a dedicated traffic display.
PFD Settings				Displays the PFD settings softkeys.
	Attitude Overlays			Displays the softkeys for enabling or disabling Synthetic Vision features.
		Synthetic Terrain		Enables synthetic terrain depiction.
		Horizon Heading		Displays compass heading along the Zero-Pitch line.
		Airport Signs		Displays position markers for airports within approximately 15 nm of the current aircraft position. Airport identifiers are displayed when the airport is within approximately 9 nm.
		FPM Settings		Displays Flight Path Marker symbol on the ADI to indicate the current relative flight path.
			FPM Enable	Enables Flight Path Marker symbol.
		SVT Traffic		Displays traffic information on Synthetic Vision Display.
		FPA Ref Settings		Displays the softkeys for changing the Flight Path Angle pitch.
			-1	Decreases the pitch reference angle by one degree.
			-0.1	Decreases the pitch reference angle by 0.1 degree.
			FPA X.X°	Displays the Flight Path Reference line on the pitch scale at the selected angle (0 to ±9.9 degrees).
			+0.1	Increases the pitch reference angle by 0.1 degree.
			+1	Increases the pitch reference angle by one degree.
	Bearing 1			Cycles the Bearing 1 Information Window through NAV1, NAV2, FMS/waypoint identifier and GPS-derived distance information, ADF/frequency, and Off.
	Bearing 2			Cycles the Bearing 2 Information Window through NAV1, NAV2, FMS/waypoint identifier and GPS-derived distance information, ADF/frequency, and Off.
	Other PFD Settings			Displays additional PFD settings softkeys.
		Wind		Displays the wind option softkeys.
			Option 1	Headwind/Tailwind and crosswind components.
			Option 2	Wind direction arrow and speed.
			Option 3	Wind direction arrow with direction and speed.
			Off	Wind information not displayed.

Level 1	Level 2	Level 3	Level 4	Description
		AOA		Changes settings for displaying Angle of Attack (AOA) Indicator. - **Auto**: Automatically displays AOA indicator. - **On**: Always displays AOA indicator. - **Off**: Never displays AOA indicator.
		Altitude Units		Displays softkeys to select altitude unit parameters.
			Meters	When enabled, displays altimeter in meters.
			IN	Press to display the BARO setting as inches of mercury.
			HPA	Press to display the BARO setting as hectopascals.
OBS				Selects OBS mode on the CDI when navigating by FMS (only available with active leg).
Active NAV				Cycles through FMS, NAV1, and NAV2 navigation modes on the CDI.
Sensors				Displays the sensor selection softkeys.
	ATT/HDG Settings			Accesses the softkeys where the Attitude and Heading reference system can be manually selected.
		ATT/HDG1		Selects Attitude and Heading Reference system 1.
		ATT/HDG2		Selects Attitude and Heading Reference system 2.
WX Radar Controls				Displays the Weather Radar Control softkeys (only available if HSI Map is enabled).
	Mode			Selects weather radar power mode: - **Standby**: Radar is on, but not transmitting. - **On:** Radar is on and transmitting.
	Display			Selects the weather radar operational mode: - **Weather**: Normal operating mode for weather detection. - **Ground**: Operating mode for ground returns.
	Tilt Down			Press the softkey once to adjust the antenna tilt angle down in 0.25º increments. Press and hold the softkey for continuous adjustment downward.
	Tilt Up			Press the softkey once to adjust the antenna tilt angle up in 0.25º increments. Press and hold the softkey for continuous adjustment upward.
	Gain -			Press the softkey once to decrease the gain by 0.5, or press and hold the softkey for continuous adjustment. A manual setting of "0.0" is equivalent to the calibrated gain setting.
	Gain +			Press the softkey once to increase the gain by 0.5, or press and hold the softkey for continuous adjustment. A manual setting of "0.0" is equivalent to the calibrated gain setting.
	Features			Displays Radar Features softkeys.

Level 1	Level 2	Level 3	Level 4	Description
		Altitude COMP Tilt		Activates Altitude Compensated Tilt feature.
		Stabilizer		Activates antenna stabilization feature.
CAS Up				Scrolls up the list of CAS alerts.
CAS Dn				Scrolls down the list of CAS alerts.

Table 1-1 PFD Softkeys

Level 1	Level 2	Level 3	Level 4	Description
CAS Up				Scrolls up the list of CAS alerts.
CAS Dn				Scrolls down the list of CAS alerts.

Table 1-2 MFD Softkeys

Split Mode softkey hierarchy and descriptions:

Level 1	Level 2	Level 3	Level 4	Level 5	Description
Traffic					Switches the Map Pane to the Traffic Map display.
PFD Settings					Displays the PFD settings softkeys.
	Attitude Overlays				Displays the softkeys for enabling or disabling Synthetic Vision features.
		SVT Settings			Displays additional SVT overlay softkeys.
			Airport Signs		Displays position markers for airports within approximately 15 nm of the current aircraft position. Airport identifiers are displayed when the airport is within approximately 9 nm.
			SVT Traffic		Displays traffic information on Synthetic Vision Display.
		Synthetic Terrain			Enables synthetic terrain depiction.
		Horizon Heading			Displays compass heading along the Zero-Pitch line.
		FPM Settings			Displays Flight Path Marker symbol on the ADI to indicate the current relative flight path.
			FPM Enable		Enables Flight Path Marker symbol.
		FPA Ref Settings			Displays FPA Reference softkeys.
			-1		Decreases the pitch reference angle by one degree.
			-0.1		Decreases the pitch reference angle by 0.1 degree.

Level 1	Level 2	Level 3	Level 4	Level 5	Description
			FPA X.X		Displays the Flight Path Reference line on the SVT pitch scale at the selected angle (0 to ±9.9 degrees). - **Auto**: Automatically displays Flight Path Reference line. - **On**: Always displays Flight Path Reference line. - **Off**: Never displays Flight Path Reference line.
			+0.1		Increases the pitch reference angle by 0.1 degree.
			+1		Increases the pitch reference angle by one degree.
	Bearing 1				Cycles the Bearing 1 Information Window through NAV1, NAV2, FMS/waypoint identifier and GPS-derived distance information, ADF1/frequency, ADF2/frequency, and Off.
	Bearing 2				Cycles the Bearing 2 Information Window through NAV1, NAV2, FMS/waypoint identifier and GPS-derived distance information, ADF1/frequency, ADF2/frequency, and Off.
	Other PFD Settings				Displays additional PFD settings softkeys.
		Wind			Displays the wind option softkeys
			Option 1		Headwind/Tailwind and crosswind components.
			Option 2		Wind direction arrow and speed.
			Option 3		Wind direction arrow with direction and speed.
			Off		Wind information not displayed.
		AOA			Changes settings for displaying Angle of Attack (AOA) Indicator. - **Auto**: Automatically displays AOA indicator. - **On**: Always displays AOA indicator. - **Off**: Never displays AOA indicator.
		Altitude Units			Displays softkeys to select altitude unit parameters.
			Meters		Displays softkeys to select altitude unit parameters.
			IN		Press to display the BARO setting as inches of mercury.
			HPA		Press to display the BARO setting as hectopascals.
		Sensors			Displays the sensor selection softkeys.
			ATT/HDG Settings		Accesses the softkeys where the Attitude and Heading Reference system can be manually selected.
				ATT/HDG1	Selects Attitude and Heading Reference system 1.
				ATT/HDG2	Selects Attitude and Heading Reference system 2.
OBS					Selects OBS mode on the CDI when navigating by FMS (only available with active leg).
Active NAV					Cycles through FMS, NAV1, and NAV2 navigation modes on the CDI.

Level 1	Level 2	Level 3	Level 4	Level 5	Description
PFD Map Settings					Displays the PFD Map display settings softkeys.
	HSI Map Layout				Displays the HSI Map layout settings softkeys.
		Map Off			Hides the HSI Map.
		HSI Map			Displays the HSI Map.
		HSI Traffic			Displays traffic within the HSI.
	Map Range -				Decreases the HSI Map display range (only available if HSI Map is enabled).
	Map Range +				Increases the HSI Map display range (only available if HSI Map is enabled).
	WX Radar Controls				Displays the Weather Radar Control softkeys (only available if HSI Map is enabled).
		Mode			Selects weather radar power mode: - **Standby**: Radar is on, but not transmitting. - **On:** Radar is on and transmitting.
		Display			Selects the weather radar operational mode: - **Weather**: Normal operating mode for weather detection. - **Ground**: Operating mode for ground returns.
		Tilt Down			Press the softkey once to adjust the antenna tilt angle down in 0.25° increments. Press and hold the softkey for continuous adjustment downward.
		Tilt Up			Press the softkey once to adjust the antenna tilt angle up in 0.25° increments. Press and hold the softkey for continuous adjustment upward.
		Gain -			Press the softkey once to decrease the gain by 0.5, or press and hold the softkey for continuous adjustment. A manual setting of "0.0" is equivalent to the calibrated gain setting.
		Gain +			Press the softkey once to increase the gain by 0.5, or press and hold the softkey for continuous adjustment. A manual setting of "0.0" is equivalent to the calibrated gain setting.
		Features			Displays Radar Features softkeys.
			Altitude COMP Tilt		Activates Altitude Compensated Tilt feature.
			Stabilizer		Activates antenna stabilization feature.

Level 1	Level 2	Level 3	Level 4	Level 5	Description
	Map Overlays				Displays the Map Overlay softkeys (only available if HSI Map is enabled).
		Terrain			Selects the display of terrain information on the HSI Map: - **Off**: Removes terrain information from the HSI Map. - **Absolute**: Displays absolute terrain information on the HSI Map. - **Relative**: Displays relative terrain information on the HSI Map.
		Data Link Settings			Displays the HSI Map data link settings softkeys.
			Data Link		Selects the data link weather source for the HSI Map: - **SiriusXM**: PFD Map data link weather source is SiriusXM. - **Connext**: PFD Map data link weather source is Connext. - **ACARS:** Selects ACARS Weather as the weather source on the HSI Map.
			NEXRAD		Displays NEXRAD weather and coverage information on the PFD Map when SiriusXM is selected for Data Link: - **CMP**: Displays the composite cloud reflectivity. - **BAS**: Displays the base cloud reflectivity.
			Storm Cell Movement		This softkey is available when SiriusXM is selected as the data link weather source. Adds or removes the display of Storm Cell Movement information on the HSI Map.
		WX Overlay			Selects the display of weather information on the HSI Map: - **Off**: Removes weather information from the HSI Map. - **WX Radar**: Displays airborne weather radar information on the HSI Map. - **ACARS:** Selects ACARS Weather as the weather source on the PFD Map.
		SiriusXM or **Connext Lightning**			Adds/removes the display of SiriusXM or Connext lightning information (based on data link weather source selection) on the HSI Map.
		More			Displays more Map Overlay softkeys.
			METAR		Adds or removes the display of Connext METAR data on the HSI Map.
			Detail		Selects desired amount of map detail; cycles through declutter levels: - **All** (No Declutter): All map features visible. - **DCLTR 1**: Declutters land data. - **DCLTR 2**: Declutters land and SUA data. - **Least**: Removes everything except for the active flight plan.

GARMIN

Level 1	Level 2	Level 3	Level 4	Level 5	Description
			Weather Legend		Displays/removes the name of the selected data link weather provider and the weather product icon and age box (for enabled weather products).
			Traffic		Adds or removes the display of traffic on the HSI Map.

Table 1-3 PFD Split Mode Softkeys

PFD CONTROLLERS

The optional PFD Controllers are a panel-mounted user interface allowing for ease of data entry, PFD operation, and NAV/COM tuning (refer to the Audio and CNS Section for more information about NAV/COM tuning). Many procedures in this Pilot's Guide can be performed using the PFD Controller. The pilot's side PFD Controller controls L PFD and the copilot's PFD controller controls R PFD.

Figure 1-6 PFD Controller

① **Joystick** — Turn to change PFD Map range
Push to activate Map Pointer for map panning, and move vertically and laterally to move map pointer

② **CLR Key** — Erases information, cancels entries, or removes menus

③ **PFD Knob** — Push to turn the selection cursor ON/OFF.
Data Entry: With cursor ON, turn to enter data in the highlighted field (large knob moves cursor location; small knob selects character for highlighted cursor location)
Scrolling: When a list of information is too long for the window/box, a scroll bar appears, indicating more items to view. With cursor ON, turn large knob to scroll through the list.

④ **Direct-to Key** (⟿) — Activates the direct-to function and allows the user to enter a destination waypoint and establish a direct course to the selected destination (specified by identifier, chosen from the active route)

⑤ **COM/NAV Key** — Selects/deselects COM/NAV radio tuning mode on the PFD Controller

⑥ **BARO Knob** — Turn knob for altimeter barometric pressure setting

⑦ **ENT Key** — Validates or confirms a menu selection or data entry

⑧ **FPL Key** — Displays flight plan information

⑨ **PROC Key** — Gives access to IFR departure procedures (DPs), arrival procedures (STARs), and approach procedures (IAPs) for a flight plan or selected airport

TOUCHSCREEN CONTROLLER

The two Touchscreen Controllers, designated as L GTC and R GTC, are a pedestal-mounted user interface allowing for ease of data entry, Display Pane operation, and NAV/COM tuning. Many procedures in this Pilot's Guide are performed using the Touchscreen Controller.

The touchscreen uses a grid of infrared beams to determine the location of the touch, even when the operator is wearing gloves. Objects or debris on the touchscreen can interfere with these infrared beams and cause unintended activation of buttons. Radio tuning can be accomplished using the CNS Bar at the top of the Touchscreen Controller screen (refer to the Audio Panel and CNS Section for more information about NAV/COM tuning).
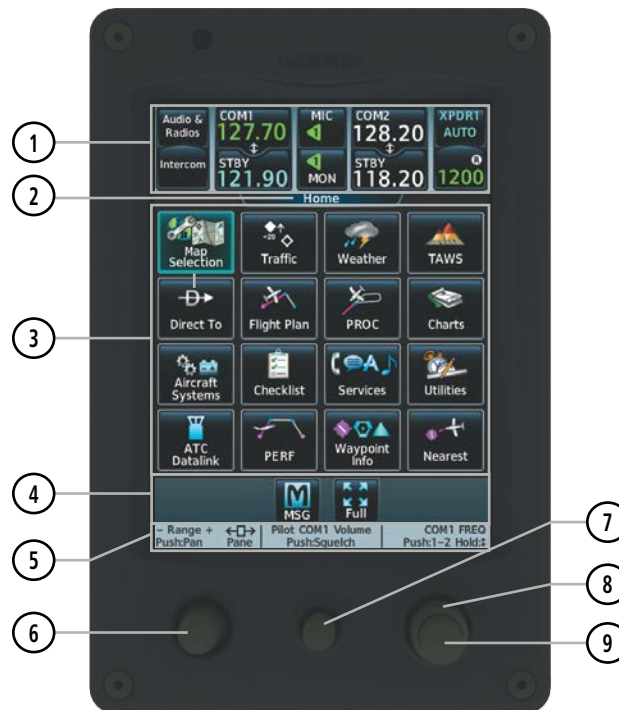
Figure 1-7 GTC (Touchscreen Controller)

①	**CNS Bar**	Displays/controls COM, NAV, XPDR (MFD), Traffic Map (PFD) and ICS functions
②	**Screen Title**	Displays the title of the current screen
③	**Screen**	Displays set of context sensitive controls and data
④	**Button Bar**	Displays System level buttons (e.g. Home, Next, INIT, MSG, CPDLC, TEL, SMS, ACARS, CNXT, Full/Half/Split, Scroll Up/Down, Back, Enter, Cancel)
⑤	**Label Bar**	Displays labels to show status and current functions of joystick and knobs
⑥	**Joystick**	Provides functions as labeled on the screen (e.g. Map Panning, Map Range)
⑦	**Middle Knob**	Provides functions as labeled on the screen (e.g. COM volume/squelch)
⑧	**Large Right Knob**	Provides functions as labeled on the screen (e.g. COM Freq/switching, Data Entry)
⑨	**Small Right Knob**	Provides functions as labeled on the screen (e.g. COM Freq/switching/Hold, Data Entry)

The Touchscreen Controller's functions are arranged by screen. Each screen has a title which appears at the top of the screen area (and below the CNS bar). The contents of each screen change dynamically in response to pilot or system input.

All of the Touchscreen Controller's available functions are accessible from the 'Home' Screen on the MFD or the 'PFD Home' Screen on the PFD. The Home screens are also accessed any time by touching the **Home** Button in the Button Bar below the screen area. Procedures in this Pilot's Guide generally begin from the Home Screen as a reference point; however it is not necessary to return to the 'Home' Screen before performing each procedure if the appropriate screen is already displayed.

As the Touchscreen Controller is used, certain selections will cause another screen to be displayed. To return to the previous screen, touch the **Back** or **Cancel** Button (as applicable) in the Button Bar, or touch the **Home** Button to return to the 'Home' Screen. If the 'Home' Screen was the previous screen, pushing either the **Back** or **Home** Button will also return to the 'Home' Screen.

The CNS Bar, positioned above the screen area, is always displayed during system operation and is accessible at any time. Some functions on the CNS Bar will cause another screen to be displayed (in the screen area below the CNS Bar); however, touching the Back or Cancel Button will return to the previous screen.

Figure 1-8 Accessing Screens with the CNS Bar

The Button Bar, displayed below the screen area, displays the system-level buttons which are context-sensitive. For example, if scrolling is available on a screen, the Button Bar includes corresponding **Up** and **Down** Scroll Arrow buttons.

Figure 1-9 Button Bar Displays System-Level Buttons

The Button Bar is also where the **Home**, **Cancel**, and **Back** buttons are displayed. If the system issues a message, the **MSG** Button is shown. Touching this button will display the 'Notifications' Screen. The Button Bar also contains buttons for controlling the size of map displays on the MFD (discussed later in this section) and various other functions.

Icon	Function	Icon	Function
Home	Returns to the 'Home' Screen	CNXT	Displays the 'Connext Notification' Window on the Touchscreen Controller. Flashes when a new Connext message is received.
Back	Returns to the previous screen	SMS	Displays the 'SMS Text Inbox' Window on the Touchscreen Controller. Flashes when a new SMS message is received.
Next	During Initialization, selects the next Task in the Initialization process.	Half	Selects half-display mode on the MFD.
INIT	After Initialization Tasks are completed, touching this button completes Initialization.	Full	Selects full-display mode on the MFD
CPDLC	Displays the 'CPDLC Messages' Window on Touchscreen Controller. Flashes when a new CPDLC message is received.	Up	Scrolls up in a list
MSG	Displays the 'Notifications' Screen, 'System Messages' Tab on the Touchscreen Controller. Flashes when a new system message is issued.	Down	Scrolls down in a list
TEL	Displays the 'Telephone' Window on the Touchscreen Controller. Flashes when a new telephone call is received.	Cancel	Cancels data entry and returns to the previous screen
ACARS	Displays the ACARS message list on the Touchscreen Controller.	Enter	Accepts entered data into the system.

Table 1-4 Button Bar Buttons with Functions

The Label Bar, near the bottom of the Touchscreen Controller and above the Joystick and Knobs displays the current function of each control as a reference. These functions include Map Range adjustment, pane selection, radio volume/squelch adjustment, COM radio tuning, and alphanumeric data entry.

| – Range +   ←□→ | Pilot COM1 Volume | COM1 FREQ |
| Push:Pan   Pane | Push:Squelch | Push:1–2 Hold:↕ |

Joystick Functions   Middle Knob Functions   Large and Small Right Knob Functions
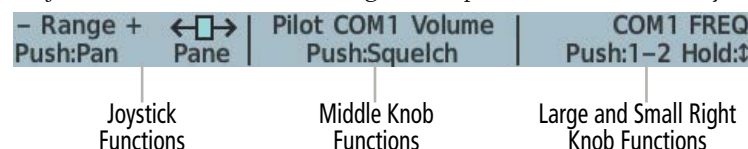
Figure 1-10 Label Bar Indicates Context-Sensitive Joystick and Knob Functions

The labels change based on the context of the options being performed. If a Touchscreen Controller Knob cannot be used because of a failure in a system component (COM, NAV, Audio, etc.), the Label Bar will also indicate this status; refer to the Audio and CNS Section for more information about radio failures.

The Touchscreen Controller recognizes input based on a touch, a gesture (such as sliding a finger), or by pushing or turning the Knobs or Joystick.

On-screen buttons can be 'pressed' by momentarily touching them with a finger and then releasing. It is not necessary to apply pressure, as the infrared touchscreen surface detects only the presence and movement of the finger, not pressure. When touched, the button background is highlighted in cyan until the finger is released. If enabled, an aural 'click' sound is also issued to confirm the button has been touched. When releasing the finger, make sure it released within the boundary of the button, otherwise the input is considered invalid. If enabled, an aural 'doink' is heard to indicate the touch input was not accepted.

Some adjustments are made using horizontal or vertical sliders. To use, simply touch within the slider box and slide the finger in the desired slider bar direction, then release the finger. The finger may move outside of the slider box during adjustment; slider movement stops when either the finger is released or the slider has reached its maximum travel.

Volume Adjustment Slider

Map Detail Adjustment Slider
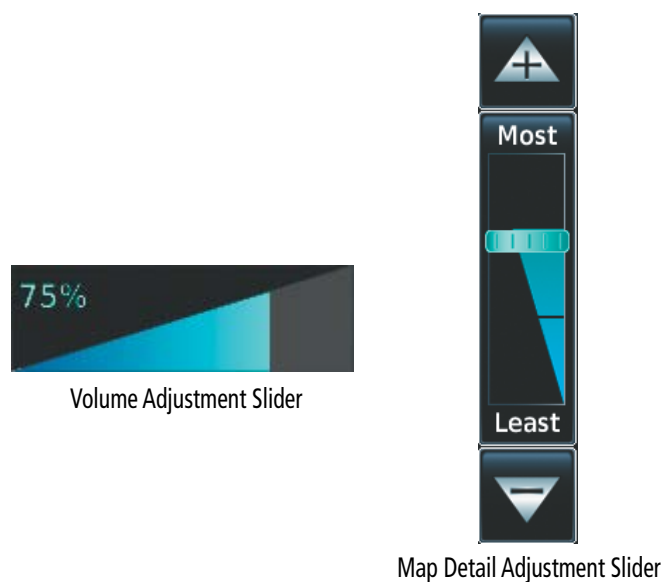
Figure 1-11 Sliders on the Touchscreen Controller

When a Touchscreen Controller contains more information than the screen can currently show, a scroll bar and scroll buttons appear. To scroll inside of a window, touch the controller while moving the finger up or down accordingly or touch and drag the finger up or down. To scroll more quickly, move the finger up or down rapidly in a scrolling motion. Scrolling can also be performed by pressing the **Up** or **Down** scroll Buttons, each touch of the scroll button will display one 'page' of information. Press and hold the **Up** or **Down** scroll Buttons for a continuous scroll.

Some screens provide tabs as a means to group multiple categories of information or buttons. Touch the desired tab to display its contents and manage settings or information. The selected tab is highlighted.
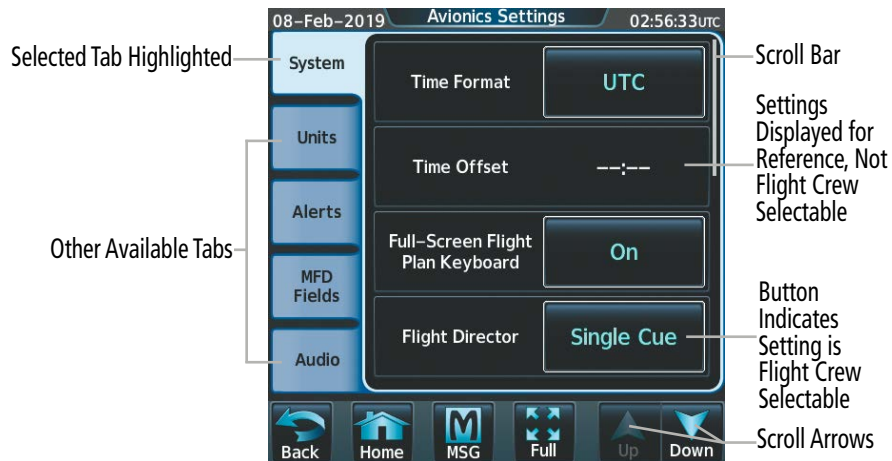
Figure 1-12 Touchscreen Controller with Tabs, Scroll Arrows, and selectable Buttons

Elements on the Touchscreen Controller screens (such as buttons and sliders) appear subdued (dimmed) to indicate their functions are currently not available. Generally pilot editable or configurable fields are displayed in cyan.
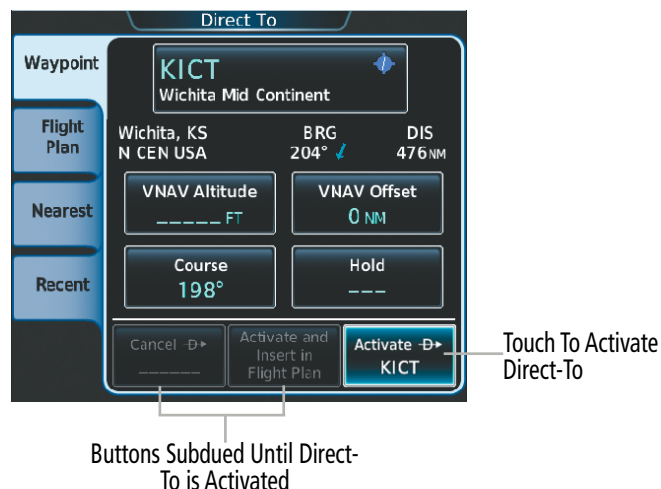
Figure 1-13 Subdued Buttons on Touchscreen Controller

BUTTON TYPES

Annunciator Buttons operate in an on/off state. An "on" or enabled button displays a green annunciator; an "off" or disabled button displays a subdued annunciator. Touch the annunciator button to change its state.

On or Enabled   Off or Disabled

Figure 1-14 Touchscreen Controller Annunciator Buttons

Datafield Buttons can be modified based on information the pilot can enter or change, and often contain cyan alphanumeric text. Touching datafield buttons will either display a pop-up window from which a selection can be made, or display a keypad to supply the data. See the Data Entry discussion in this section for more information.

Figure 1-15 Touchscreen Controller Datafield Buttons

If a system failure causes a button's function to be inaccessible, an amber "X" appears over the button. These buttons will not respond if touched.

TOUCHSCREEN CONTROLLER JOYSTICK AND KNOBS

The functions of the Joystick and Knobs on the Touchscreen Controller are context-sensitive. The Label Bar, shown above each corresponding control, indicates which function(s) currently apply to each control.

The Joystick may be turned to increase or decrease map range, or to increase or decrease detail on certain system displays. When the Joystick is pushed, the Map Pointer is activated for Map Panning (push again to deactivate Map Pointer). In addition, when the 'Weather Radar' Pane is active, pushing the Joystick will display the weather radar controls. A subsequent push will remove the weather radar controls.

The middle knob is turned to increase or decrease the selected audio source volume. If a COM radio is selected, pushing the middle knob activates/deactivates squelch. If a NAV radio is selected (on the 'Audio & Radios' Screen), pushing the middle knob enables NAV audio to be heard for identification.

The large and small right knobs are used for radio tuning and selection, frequency transfer, and data entry. Turning the large right knob tunes the selected radio frequency in 1 MHz increments; the small right knob adjusts the frequency in 1 KHz increments. Push the small right knob momentarily to change the selected COM radio source (COM 1 or COM 2) for tuning. Push and hold the small right knob for 1.5 seconds to transfer the selected Standby COM frequency to the active COM frequency.
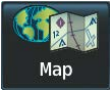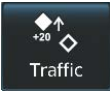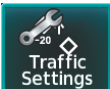
During data entry, turn the large right knob to move the cursor position. Turn the small right knob to select a character for the highlighted cursor position. Push the small right knob to enter the data (see the Data Entry discussion later in this section for more information about Data Entry methods.)

SCREENS

> ✓ *NOTE:* Screen appearance varies based on the installed options.

HOME SCREEN

Map **or** Map Selection	The **Map** Button shows a 'Navigation Map' Pane in the selected pane. When the Navigation Map is displayed, the button becomes the **Map Selection** Button. Touch the **Map Selection** Button again to access the 'Map Selection' Screen on the Touchscreen Controller.
Traffic **or** Traffic Settings	Shows a 'Traffic Map' Pane in the selected pane. When the 'Traffic Map' Pane is displayed, the button becomes the **Traffic Settings** Button. Touch the **Traffic Settings** Button to access the 'Traffic Settings' Screen on the Touchscreen Controller.
Weather **or** Weather Selection	Shows a 'Weather... (SiriusXM, Connext, or Radar)' Pane in the selected pane. When the weather pane is displayed, the button becomes the **Weather Selection** Button. Touch the **Weather Selection** Button to access the 'Weather Selection' Screen on Touchscreen Controller.
TAWS **or** TAWS Settings	Shows the 'TAWS' Pane in the selected pane. When the 'TAWS' Pane is displayed, the button becomes the TAWS Settings Button. Touch the **TAWS Settings** Button to access the 'TAWS Settings' Screen on Touchscreen Controller.

Direct To	Accesses 'Direct To' Screen on Touchscreen Controller.
Flight Plan	Accesses 'Active Flight Plan' Screen on the Touchscreen Controller. A Flight Plan display is shown on the selected pane.
PROC	Accesses 'Procedures' Screen on Touchscreen Controller. Additional map displays may be shown as procedures are selected.
Charts	Accesses 'Charts' Screen on Touchscreen Controller. Charts are shown on the selected pane.
Aircraft Systems	Accesses 'Aircraft Systems' Screen on Touchscreen Controller. Systems data can be selected for display on the Touchscreen Controller, and displayed on a pane. Also provides means to set controls and monitor performance and system tests.
Checklist	Accesses the Checklists for display in the selected pane.
Services	Accesses 'Services' Screen on Touchscreen Controller. Includes phone and text messaging services, SiriusXM Satellite Radio controls, and Contacts.
Utilities	Accesses Trip Statistics, Timer, Scheduled Messages, GPS Status, Initialization, Electronic Documents, Screen Cleaning, Crew Profile, and Setup.
ATC Datalink	Displays 'ATC Datalink' Screen. Provides ATC Datalink status, controls for managing CPDLC connections, and message management features.
PERF	Accesses 'Takeoff/Landing Data' (when SurfaceWatch or TOLD is installed), 'Speed Bugs', and 'Weight and Fuel', on the Touchscreen Controller.
Waypoint Info	Provides information about Airports, Intersections, VORs, NDBs, VRPs, and User Waypoints. Also allows creation of User Waypoints.
Nearest	Provides information about the nearest Airports, Intersections, VORs, NDBs, VRPs, User Waypoints, Airspace, ARTCC facilities, Flight Service Stations, and Weather reporting stations.

'Map Selection' Screen
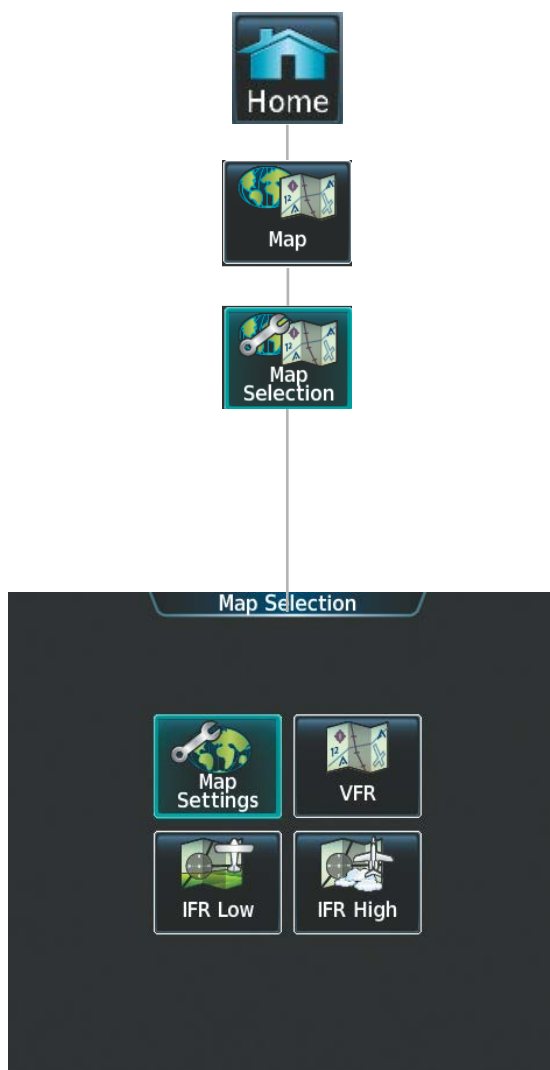
Touching the **Map** Button on the 'Map Selection' Screen displays the 'Navigation Map' Pane and the button name will change to **Map Settings**.

'WEATHER SELECTION' SCREEN
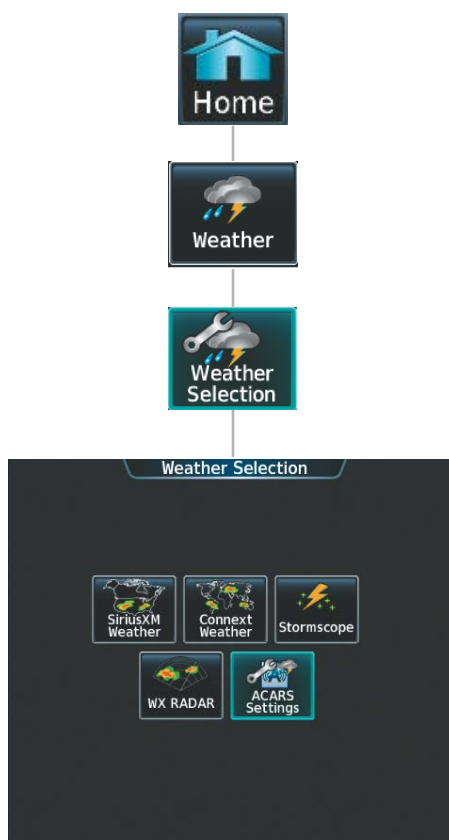
Touching a button within the 'Weather Selection' Screen (shown above) will display a respective 'SiriusXM Weather', 'Connext Weather', 'Weather Radar' Pane or 'ACARS Weather Settings'. Additionally, once touched, the button name will change to a 'Settings' syntax. Touching any of these 'settings' buttons will open a settings screen which are each discussed in the Hazard Avoidance Section.

'AIRCRAFT SYSTEMS' SCREEN
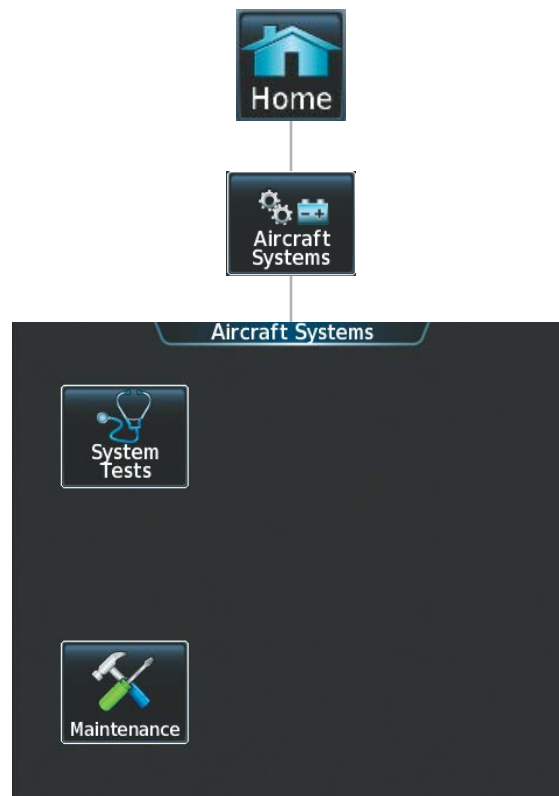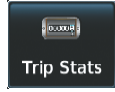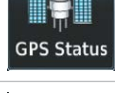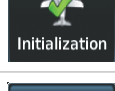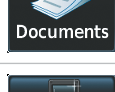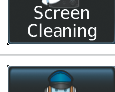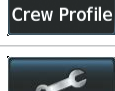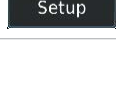
The 'Aircraft Systems' Screen shows the **Maintenance** and **System Tests** buttons. Touching the **System Tests** Button will open the 'System Tests' Screen which shows **Radio Altimeter** and **TCAS** test buttons. Details are discussed in the Engine Indication and Crew Alerting Systems (EICAS) Section. The **Maintenance** Button provides functions accessible to maintenance personnel with password.

'SERVICES' SCREEN
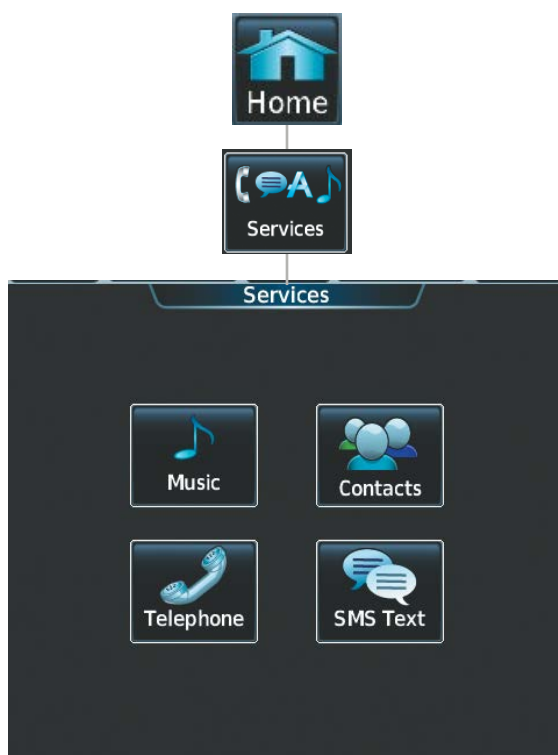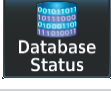
Communication functions, settings, and processes for the buttons within the 'Services' Screen are discussed in the Audio and CNS Section.

'UTILITIES' SCREEN

Trip Planning	Shows the 'Trip Planning' Pane in the selected Display Pane, and accesses the 'Trip Planning' Screen on the Touchscreen Controller.
Minimums Off _ _ _ _ _ FT	Accesses the Minimums 'Screen' on the Touchscreen Controller. Provides controls for the Minimum Descent Altitude/Decision Height alerting function. Button displays the current minimums altitude and source if provided.
Trip Stats	Accesses the 'Trip Statistics' Screen on the Touchscreen Controller. Shows information regarding Flight Time, Departure Time, Arrival Time, Odometer, Trip Odometer, Fuel Used, Average Ground Speed, Maximum Ground Speed, Trip Air Odometer, Average Wind Speed, and Average Wind Direction.
Timer	Accesses the 'Timer' Screen on the Touchscreen Controller. Controls the timer on the PFD.
Scheduled Messages	Used to create custom messages to be displayed one-time or periodically. The Touchscreen Controller displays these messages on the 'Notifications' Screen on the Touchscreen Controller.
GPS Status	Displays the 'GPS1...' or 'GPS2 Status' Pane.
Initialization	Displays the 'Initialization' Screen.
Documents	Shows controls for viewing electronic documents on the Touchscreen Controller, and displays documents in the selected pane.
Screen Cleaning	Feature temporarily disables touchscreen glass input to allow for manual cleaning. Turn or push any knob on the Touchscreen Controller to exit Screen Cleaning Mode.
Crew Profile	Accesses the 'Crew Profile' Screen to access controls for activating and managing crew profiles.
Setup	Accesses Avionics Settings and Status, Data Link Services registration and status, WiFi Setup, ATC Settings, Database Status, and ADS-B Status.

'SETUP' SCREEN
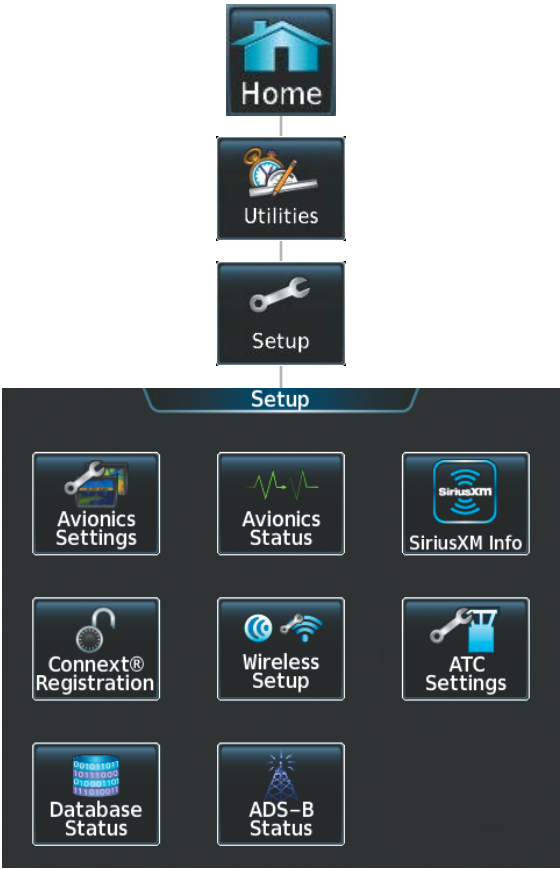
	Provides controls for changing system avionics settings, such as, time format, units of measure, various alert settings, MFD Data Bar Fields, and audio.
	Displays information on the Touchscreen Controller for installed LRUs, airframe, system software, databases, and data links.
	Displays information on data/audio radio status and weather products.
	Used to register with Garmin Connext. Also provides information on current Connext registration.
	Provides access to the Networks and displays signal security status.
	Provides access to the 'Database Status' Screen for checking database cycle information.
	Provides access to the optional 'ADS-B' Status Screen for information on the reception of ADS-B services.

'PERF' (PERFORMANCE) SCREEN
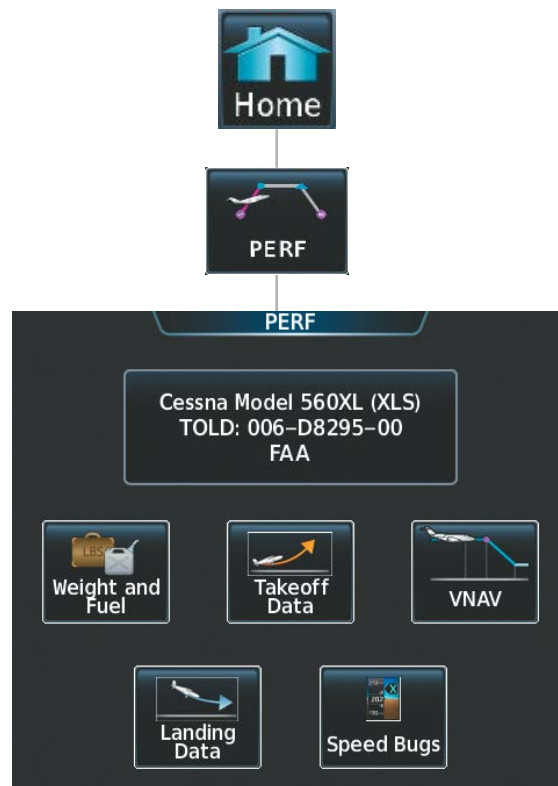
Aircraft performance related functions, settings, and processes for the buttons within the 'PERF' Screen are discussed in the Flight Management Section.

'WAYPOINT' INFO SCREEN

Functions, settings, and processes for the buttons within the 'Waypoint Info' Screen are discussed in the Flight Management Section.

'NEAREST' SCREEN
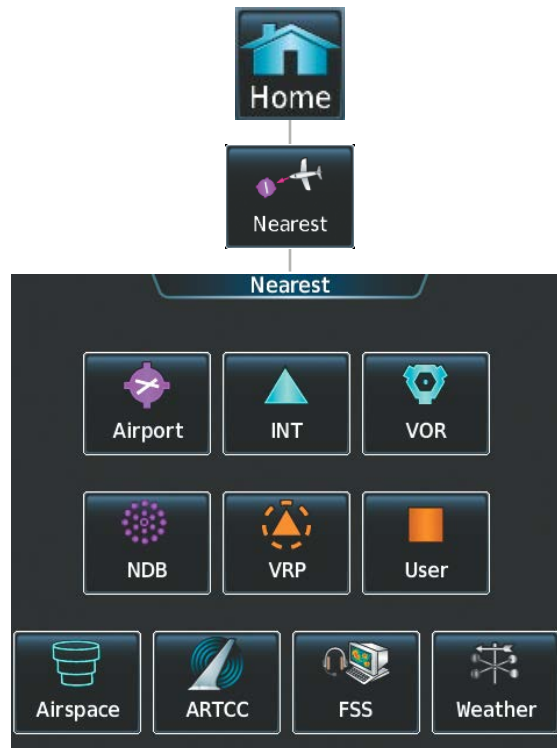
Functions, settings, and processes for the buttons within the 'Nearest' Screen are discussed in the Flight Management Section.

CONTROLLING PFD AND MFD PANES

The Touchscreen controllers provide a means to select and control Display Panes. The Joystick on each Touchscreen Controller moves the Pane Selector left or right on the display to highlight the Display Pane in the location to be controlled. The Pane Selector is cyan for L GTC and dark purple for R GTC. The Pane Selector outlines the border of the Display Pane presently being controlled.

In normal operations, L GTC controls the L PFD Split Mode Display Pane and the left MFD Display Pane (in Half Mode). R GTC controls the R PFD Split Mode Display Pane and the right MFD Display Pane (in Half Mode). Either Touchscreen Controller may also select and control a Full Mode Display Pane on the MFD, although both Touchscreen Controllers cannot control an MFD Full Mode Display Pane simultaneously.

L PFD in Split Mode with a Pane   MFD in Half Mode with Two Panes   R PFD in Split Mode with a Pane

L GTC   R GTC
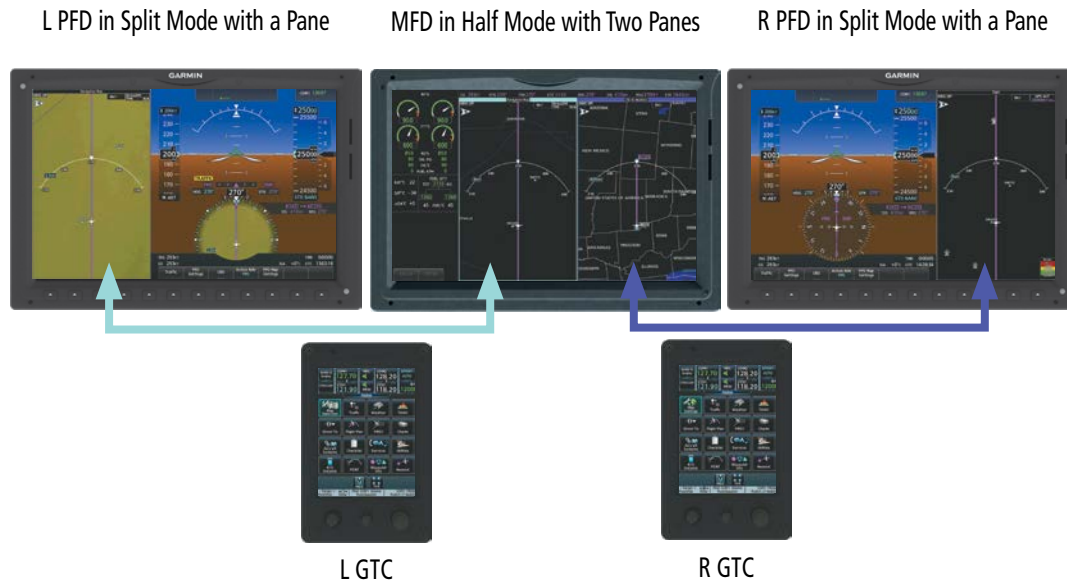
Figure 1-16 Pane Control (Normal Operations, MFD in Half Mode)

Some buttons on the Touchscreen Controllers are associated with showing a pane. For example, touching the **Map** Button on the 'Home' Screen shows the 'Navigation Map' Pane on the selected pane.

Each pane location has a currently designated pane. When the Pane Selector highlights a pane, the Touchscreen Controller shows the button associated with the designated pane in cyan (when the 'Home' Screen is shown on the Touchscreen Controller). This indicates the system will resume display of the designated pane should another (non-designated) pane be shown subsequently in the same pane location. However, if another designated pane is selected instead, the new selection then becomes the designated pane for the pane location, and its associated button border is highlighted in cyan. The system designates the following panes when they are selected:

- Navigation Map Pane
- Charts Pane
- Checklist Pane

- Weather Panes
- Traffic Pane
- TAWS Pane

- Document Reader Pane

MFD Full and Half Modes

The MFD provides the capability to show panes in either Full Mode or Half Mode, provided the selected pane is capable of being shown in a Full Mode format. In Full Mode, the MFD shows the EIS and a single, enlarged pane. In Half Mode, the MFD shows the EIS and two panes (mode selections do not affect the EIS display formatting).

When the system is powered-up on the ground the MFD begins operation in Half Mode with each Touchscreen Controller able to control its respective pane on the MFD.

When the Pane Selector highlights the MFD Pane in Half Mode, and Full Mode is available for that Pane, the Touchscreen Controller shows a **Full** Button in the Button Bar (see following figure).

MFD in Half Mode

Cyan Pane Selector shows L GTC is controlling Display Pane

Dark purple Pane Selector shows R GTC is controlling Display Pane

Button indicates Full Mode available for selected Pane

Figure 1-17 Controlling Half Mode Panes

Touch the **Full** Button to show the selected Display Pane in Full Mode. Touch the **Half** Button to return to Half Mode.

The Touchscreen Controller which enabled a Full Mode has control of the Full Mode Display Pane. For example, if L GTC enabled Full Mode on the Navigation Map Pane, L GTC then controls the settings for this Display Pane (e.g. map range, overlays) while in Full Mode. The cross-side Touchscreen Controller cannot control the same Full Mode Display Pane at the same time, but may select Half Mode as necessary. The cross-side Touchscreen Controller displays a message when attempting to control a Full Mode Display Pane currently controlled by the other Touchscreen Controller .

MFD in Full Mode

Cyan Pane Selector shows L GTC is controlling Full Mode Display Pane

Map Settings

Button indicates Half Mode available for selected Pane

Figure 1-18 Controlling Full Mode MFD Pane

The Touchscreen Controller which enabled Full Mode automatically continues to select the MFD panes in Full Mode until any of the following occur:

- The Touchscreen Controller which enabled Full Mode subsequently selects a pane which is only available in Half Mode (for example, panes associated with the **Aircraft Systems Summary** Button on the 'Home' Screen).

- The Touchscreen Controller which did **not** enable Full Mode subsequently selects the **Half** Button, or selects a button with an associated pane while the **Half** Button is shown. If the **Half** Button is not shown, the Pane Selector may be on another display. Move the Joystick left or right, as appropriate, toward the MFD, and the **Half** Button appears. Then Touch the **Half** Button, or touch any button with an associated pane, to enter Half Mode on the MFD. The on-side pane selector will be visible once **Half** Mode is selected.

    MFD Full and Half Modes are not available when the MFD is operating in Reversionary Mode.

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DATA ENTRY

Two methods exist for directly entering alphanumeric data (e.g., waypoint identifiers, barometric minimum descent altitude) into the system: using the Touchscreen Controller's alphanumeric keypad, or the large and small right knob on the bottom of the Touchscreen Controller. In some instances, such as when entering an identifier, the system will try to predict the desired identifier based on the characters being entered. In this case, if the desired identifier appears, use the **Enter** Button to confirm the entry without entering the rest of the identifier manually. This can save the pilot from entering all the characters of the identifier.

Besides character-by-character data entry, the system also provides a shortcut for entering waypoint identifiers. When the cursor is on a field awaiting entry of a waypoint identifier, touching the **Find** Button accesses four different lists of waypoint identifiers for quick selection: Recent, Nearest, Flight Plan (if active flight plan waypoints are available), and a Favorite waypoints list. In addition, the system provides the ability to search by Facility Name or by City. The system will automatically fill in the identifier, facility, and city fields with the information for the selected waypoint.

Using the Touchscreen Controller keyboard to enter alphanumeric data:

1) Select a datafield button the Touchscreen Controller for which data entry is required (i.e. waypoint, radio frequency, etc.). A keypad will appear, and the datafield Button will be highlighted in cyan.

2) Touch the desired letters or numbers, one at a time.

3) If an alphabetic keypad is displayed and numbers are desired, touch the **123...** Button.

4) If the numeric keypad is displayed and letter are desired, touch the **ABC...** Button.

5) To accept the entry, touch the **Enter** Button. Otherwise, touch the **Back, Cancel,** or **Home** Button (on the Button Bar) to exit the datafield without saving the entry.

Figure 1-19 Full-screen Flight Plan Alphanumeric Keypad

Touch to use Numeric Buttons   Touch to use Alphabetic Buttons

Figure 1-20 Entering a Direct-To Waypoint on the Alphanumeric Keypads

It is not necessary to touch the **Enter** Button to complete certain data fields for which a specific number of characters is always required. For example, after entering four digit transponder squawk code, the system automatically accepts this data 1.5 seconds after the fourth button has been pressed (if the entry has not been cancelled).

Using the Touchscreen Controller's large and small right knob to enter data:

1) Select a datafield button on the Touchscreen Controller for which data entry is required (i.e. waypoint, radio frequency, etc.). A keypad will appear, and the data field will be highlighted in cyan.

2) Begin entering data by turning the small right knob to select a character for the first placeholder.

   Turning the knob to the right scrolls through the alphabet (where appropriate) toward the letter Z, starting in the middle at K and then digits zero through nine. Turning the knob to the left scrolls in the opposite direction. Both directions will wrap around the characters.

3) Turn the large right knob to the right to move the cursor to the next placeholder in the field.

4) Repeat, using the small right knob to select a character and turning the large right knob to the right to move the cursor into the next placeholder or left to edit a previous placeholder, until the field is complete.

5) Push the right knob to confirm entry. Otherwise, touch the **Back** Button or the **Home** Button to exit the field without saving the entry.

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1.3 SYSTEM OPERATION

> ✓ *NOTE: See the current version of the pertinent flight manual for specific procedures concerning avionics power application and emergency power supply operation.*

The system is integrated with the aircraft electrical system and receives power directly from electrical busses. The GDUs, Touchscreen Controllers, and supporting sub-systems include both power-on and continuous built-in test features that exercise the processors, memory, external inputs, and outputs to provide safe operation.

During system power-on, the system momentarily displays test annunciations which all should be extinguished typically within the first minute of power-on. Upon power-on, annunciator lights on the AFCS Controller illuminate momentarily.

On L PFD and R PFD, the AHRS begins to initialize and displays "AHRS ALIGN: Keep Wings Level". The AHRS should display valid attitude and heading fields typically within the first minute of power-on. The AHRS can align itself both while taxiing in a straight line and during level flight.

When the system has acquired a sufficient number of satellites to determine a position, the system displays the aircraft's current position on the Navigation Map Pane.

NORMAL OPERATION

In normal operations, L PFD and R PFD present graphical flight instrumentation (such as heading, airspeed, altitude, vertical speed) on Primary Flight Displays (PFD) in either Full Mode or Split Mode. PFD Full and Split modes are controlled by the appropriate Display Format Knob located on the center pedestal. In Full Mode, the PFD (including its softkeys) occupies the entire display portion of the GDU. In Split Mode, the PFD is condensed to accommodate a Display Pane on the outboard portion of the GDU.

Figure 1-21 Normal Operation - PFD Full Mode

The MFD shows Engine Indications on the left portion of the MFD. It also shows either a single pane in Full Mode, or two panes side-by-side in Half Mode. Either MFD Touchscreen Controller selects the Full and Half Modes for the MFD.

Figure 1-22 Normal Operation - MFD Full Mode

For example illustrations on Split and Half screen for the PFD and MFD, see the previously discussed Controlling Panes.

REVERSIONARY DISPLAY OPERATION

> **NOTE:** *The system alerts the pilot when the LRUs are communicating using backup paths. Refer to the Appendices for further information regarding system-specific alerts.*

Reversionary mode for each display is activated manually by turning a dedicated Display Format knob installed in the Display Format and Dimming Panel in the center pedestal. When a display unit is put in reversionary mode, it will show the PFD, an EICAS display, and a Display Pane.

If the MFD is operating in Reversionary Mode, the Touchscreen Controller on the failed display side controls the Reversionary Mode Display Pane. If L PFD or R PFD is in Reversionary Mode, the on-side Touchscreen Controller controls the Reversionary Mode Display Pane.

If both L PFD and R PFD fail or are off-line, L GTC will control the Reversionary Mode Display Pane on the MFD. R GTC functions will continue to be available, with the exception of Display Pane controls.

PFD1 Failure   MFD in Reversionary Mode with Pane controlled by GTC #1   PFD2 Normal (currently in Split Mode)

Figure 1-23 Display Pane Control (PFD1 Failure Reversionary Example)

TOUCHSCREEN CONTROLLER FAILURE

If either Touchscreen Controller fails or is off-line, the operating Touchscreen Controller controller controls the Display Panes for all displays. In addition, the single Touchscreen Controller provides audio and CNS control for both the pilot and copilot.

AHRS OPERATION (GRS 79 OPTION)

> ✓ **NOTE:** *Refer to Appendix A for specific AHRS alert information.*

> ⚠ **NOTE:** *Aggressive maneuvering while AHRS is not operating normally may degrade AHRS accuracy.*

In addition to using internal sensors, the AHRS uses GPS information, magnetic field data and air data to assist in attitude/heading calculations. In normal mode, the AHRS relies upon GPS and magnetic field measurements. If either of these external measurements is unavailable or invalid, the AHRS uses air data information to assist in attitude determination. Five AHRS modes of operation are available and depend upon the combination of available sensor inputs. Loss of air data, GPS, or magnetometer sensor inputs is communicated to the pilot by message advisory alerts.

The AHRS corrects for shifts and variations in the Earth's magnetic field by applying the Magnetic Field Variation Database. The Magnetic Field Variation Database is derived from the International Geomagnetic Reference Field (IGRF). The IGRF is a mathematical model that describes the Earth's main magnetic field and its annual rate of change. The database is updated approximately every five years. See the Appendices for information on updating the Magnetic Field Variation Database. The system will prompt the pilot on startup when an update is available. Failure to update this database could lead to erroneous heading information being displayed to the pilot.
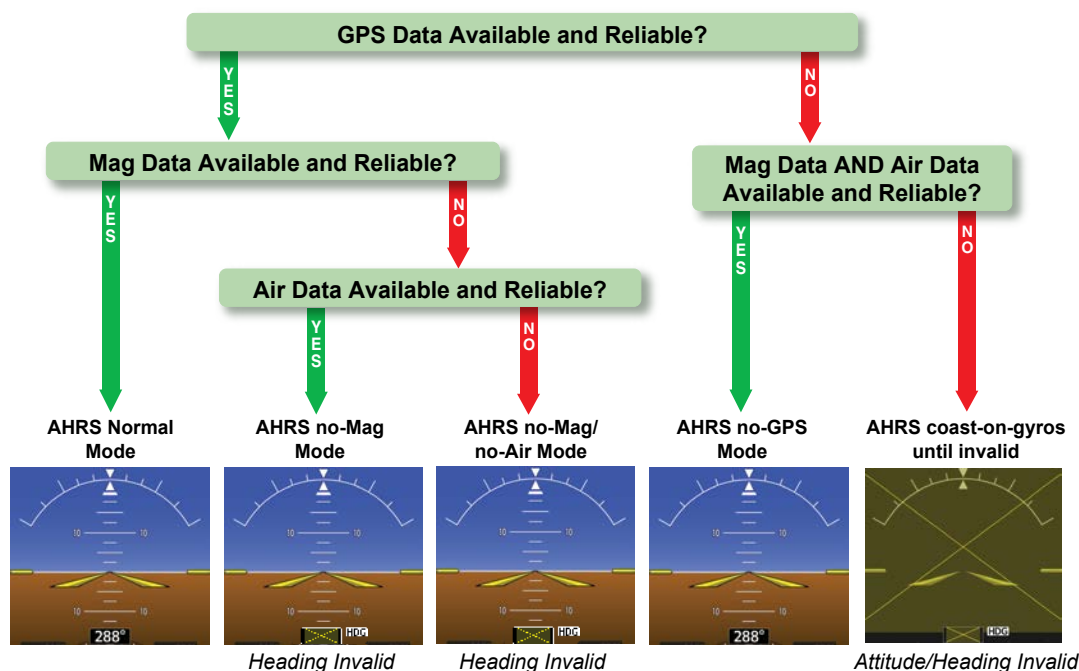
Figure 1-24 AHRS Operation

GPS INPUT FAILURE

> ✓ **NOTE:** *In-flight initialization of AHRS, when operating without any valid source of GPS data and at true air speed values greater than approximately 200 knots, is not guaranteed. Under these rare conditions, it is possible for in-flight AHRS initialization to take an indefinite amount of time which would result in an extended period of time where valid AHRS outputs are unavailable.*

Two GPS inputs are provided to the AHRS. If GPS information from one of the inputs fails, the AHRS uses the operating GPS input and an alert message is issued to inform the flight crew. If both GPS inputs fail, the AHRS can continue to provide AHRS information to the PFDs as long as magnetometer and airspeed data are available and valid.

MAGNETOMETER FAILURE

If the magnetometer input fails, the AHRS transitions to one of the reversionary No-Magnetometer modes and continues to output valid attitude information. However, if the aircraft is airborne, the heading output on the PFD does become invalid (as indicated by an amber "X").

AIR DATA INPUT FAILURE

Failure of the air data input has no affect on the AHRS output while AHRS is receiving valid GPS information. Invalid/unavailable airspeed data in addition to GPS failure results in loss of all AHRS information.

GPS RECEIVER OPERATION

Each Integrated Avionics Unit (IAU) contains a GPS receiver. Information collected by the specified receiver (GPS 1 for the #1 IAU or GPS 2 for the #2 IAU) may be viewed on the 'GPS 1…' or 'GPS 2 Status' Pane and the 'GPS Status' Screen on the Touchscreen Controller.

NOTE: *A sensor "Check Position" System Message may be displayed due to sensor differences resulting from interference when taxiing around hangers or other structures.*
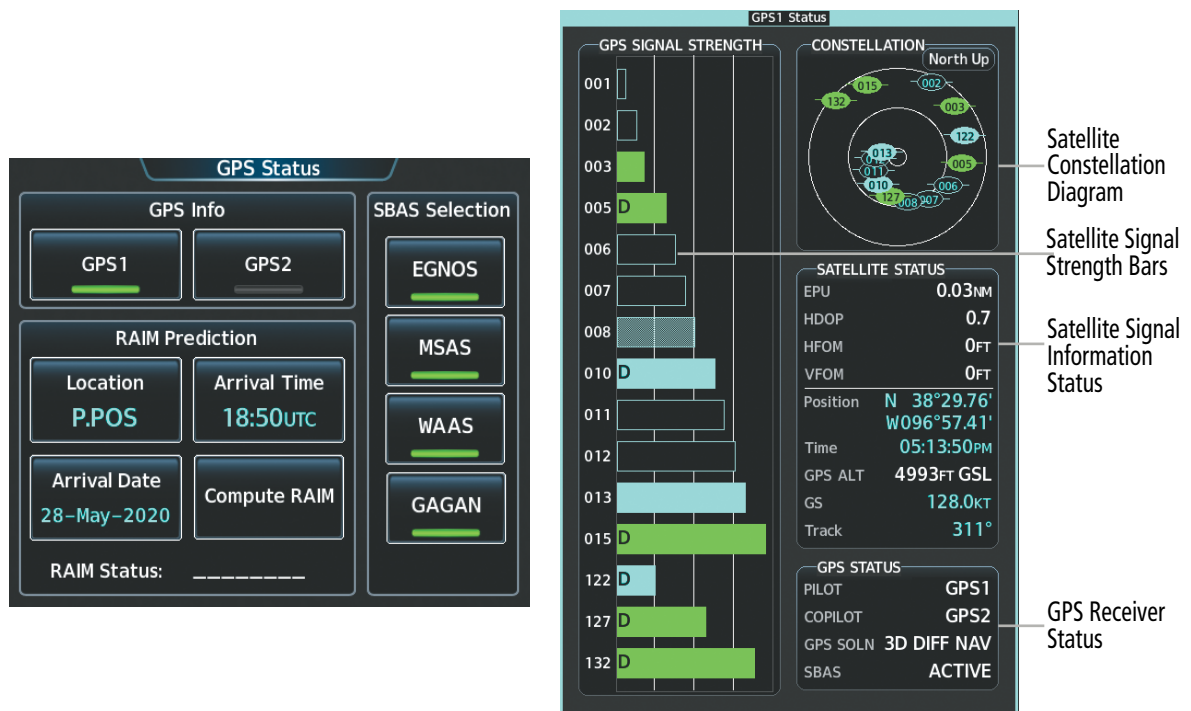
Figure 1-25 GPS Receiver Information

Selecting the GPS receiver information to display on the highlighted pane:

1) From Home, touch **Utilities** > **GPS Status**.

2) Touch the **GPS1** Button to select the #1 GPS receiver. The button annunciator is green when enabled, gray when disabled. The system displays the 'GPS1 Status' Pane.

3) Touch the **GPS2** Button to select the #2 GPS receiver. The button annunciator will be green when selected on. The system displays the 'GPS2 Status' Pane.

GPS1 provides information to the pilot-side PFD and GPS2 provides data to the copilot-side PFD. Internal system checking is performed to ensure both GPS receivers are providing accurate data to the PFDs. In some circumstances, both GPS receivers may be providing accurate data, but one receiver may be providing a better GPS solution than the other receiver. In this case the GPS receiver producing the better solution will be automatically coupled to both PFDs. "BOTH ON GPS 1" or "BOTH ON GPS 2" will then be displayed on the PFD (see Appendix A) indicating which GPS receiver is being used. Both GPS receivers are still functioning properly, but one receiver is performing better than the other at that particular time.

These GPS sensor annunciations are most often seen after system power-on when one GPS receiver has acquired satellites before the other, or one of the GPS receivers has not yet acquired an SBAS (Satellite Based Augmentation System) signal. While the aircraft is on the ground, the SBAS signal may be blocked by obstructions causing one GPS receiver to have difficulty acquiring a good signal. Also, while airborne, turning the aircraft may result in one of the GPS receivers temporarily losing the SBAS signal.

If the sensor annunciation persists, check for a system failure message by touching the **MSG** Button on Touchscreen Controller. If no failure message exists, check the GPS Status Pane and compare the information for GPS 1 and GPS 2. Discrepancies may indicate a problem.

SATELLITE CONSTELLATION DIAGRAM

Satellites currently in view are shown at their respective positions on a sky view diagram. The sky view is always in a north-up orientation, with the outer circle representing the horizon, the inner circle representing 45° above the horizon, and the center point showing the position directly overhead.

Each satellite is represented by an oval containing the Pseudo-random noise (PRN) number (i.e., satellite identification number). Satellites whose signals are currently being used are represented by solid ovals.

SATELLITE SIGNAL STATUS

The accuracy of the aircraft's GPS fix is calculated using Estimated Position Uncertainty (EPU), Dilution of Precision (DOP), and horizontal and vertical figures of merit (HFOM and VFOM). EPU is the radius of a circle centered on an estimated horizontal position in which actual position has 95% probability of laying. EPU is a statistical error indication and not an actual error measurement.

DOP measures satellite geometry quality (i.e., number of satellites received and where they are relative to each other) on a range from 0.0 to 9.9, with lower numbers denoting better accuracy. HFOM and VFOM, measures of horizontal and vertical position uncertainty, are the current 95% confidence horizontal and vertical accuracy values reported by the GPS receiver.

The current calculated GPS position, time, altitude, ground speed, and track for the aircraft are displayed below the satellite signal accuracy measurements.

GPS RECEIVER STATUS

The GPS solution type (ACQUIRING, 2D NAV, 2D DIFF NAV, 3D NAV, 3D DIFF NAV) for the active GPS receiver (GPS 1 or GPS 2) is shown in the right center of the GPS 1 and GPS 2 Status Display. When the receiver is in the process of acquiring enough satellite signals for navigation, the receiver uses satellite orbital data (collected continuously from the satellites) and last known position to determine the satellites that should be in view. ACQUIRING is indicated as the solution until a sufficient number of satellites have been acquired for computing a solution.

When the receiver is in the process of acquiring a 3D navigational GPS solution, 3D NAV is indicated as the solution until the 3D differential fix has finished acquisition. SBAS (Satellite-Based Augmentation System) indicates INACTIVE. When acquisition is complete, the solution status indicates 3D DIFF NAV and SBAS indicates ACTIVE.

GPS SATELLITE SIGNAL STRENGTHS

The GPS1 and GPS2 Status Panes can be helpful in troubleshooting weak (or missing) signal levels due to poor satellite coverage or installation problems. As the GPS receiver locks onto satellites, a signal strength bar is displayed for each satellite in view, with the appropriate satellite PRN number (01-32 or 120-138 for WAAS) below each bar. The progress of satellite acquisition is shown in three stages, as indicated by signal bar appearance:

» No bar—Receiver is looking for the indicated satellite

» Hollow bar—Receiver has found the satellite and is collecting data

» Cyan bar—Receiver has collected the necessary data and the satellite signal can be used

» Green bar—Satellite is being used for the GPS solution

» Checkered bar—Receiver has excluded the satellite (Fault Detection and Exclusion)

» "D" indication—Denotes the satellite is being used as part of the differential computations

Each satellite has a 30-second data transmission that must be collected (signal strength bar is hollow) before the satellite may be used for navigation (signal strength bar becomes solid).

SBAS SELECTION

In certain situations, such as when the aircraft is outside or on the fringe of the WAAS, EGNOS, or MSAS coverage area, it may be desirable to disable the reception of the applicable SBAS signal (although it is not recommended). When enabled, the annunciator on the applicable button shows green.

Enabling/Disabling Individual SBAS Providers:

1) From Home, touch **Utilities** > **GPS Status**.

2) Touch the **EGNOS**, **MSAS**, or **WAAS** (any combination) Annunciator Button(s) to enable or disable. A green annunciation indicates an enabled SBAS selection, disabled selections are gray.

RAIM (RECEIVER AUTONOMOUS INTEGRITY MONITORING) PREDICTION

In most cases performing a RAIM prediction is not necessary. However, in some cases, the selected approach may be outside the SBAS coverage area and it may be necessary to perform a RAIM prediction for the intended approach.

Receiver Autonomous Integrity Monitoring (RAIM) is a GPS receiver function that performs a consistency check on all tracked satellites. RAIM ensures the available satellite geometry allows the receiver to calculate a position within a specified RAIM protection limit (2.0 nautical miles for oceanic and enroute, 1.0 nm for terminal, and 0.3 nm for non-precision approaches). During oceanic, enroute, and terminal phases of flight, RAIM is available nearly 100% of the time.

The RAIM prediction function also indicates whether RAIM is available at a specified date and time. RAIM computations predict satellite coverage within ±15 min of the specified arrival date and time.

Because of the tighter protection limit on approaches, there may be times when RAIM is not available. The system automatically monitors RAIM and warns with an alert message when it is not available. If RAIM is not predicted to be available for the final approach course, the approach does not become active, as indicated by the messages "Approach is not active" and "RAIM not available from FAF to MAP". If RAIM is not available when crossing the FAF, the missed approach procedure must be flown.

> **NOTE:** *The system RAIM prediction capability does not meet all RAIM prediction requirements. Reference the RAIM/Fault Detection and Exclusion (FDE) Prediction Tool at flygarmin.com as required.*

> **NOTE:** *The GPS STATUS Pane cannot be viewed in a reversionary display pane. Use the Joystick to highlight the PFD to access RAIM prediction, or highlight a non-reversionary display pane to view the GPS STATUS Pane and/or access RAIM prediction.*
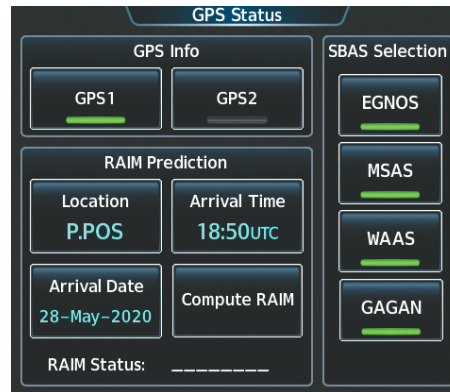
Figure 1-26 GPS Status

Predicting RAIM availability:

1) From Home, touch **Utilities** > **GPS Status**.

2) Touch the **Location** Button to enter the location for which RAIM will be predicted. Touch the **Present Position** Button to enter the aircraft's current position as the prediction location or touch the **Waypoint** Button to enter waypoint information.

3) If the **Waypoint** Button was touched in step 2, enter the waypoint identifier using the alphanumeric buttons. If the **Present Position** Button was touched in step 2, proceed to step 5.

4) Touch the **Enter** Button.

5) The location selected for RAIM prediction is now displayed on the **Location** Button.

6) Touch the **Arrival Time** Button.

7) Enter the planned arrival time for the selected location using the numeric buttons

8) Touch the **Enter** Button. The time is now displayed on the **Arrival Time** Button.

9) Touch the **Arrival Date** Button.

10) Touch the button for the desired year. If necessary, touch and drag in the window, or use the **Up** and **Down** Buttons to display the desired year.

11) Touch the button for the desired month. If necessary, touch and drag in the window, or use the **Up** and **Down** Buttons to display the desired month.

12) Touch the button for the desired day. If necessary, touch and drag in the window, or use the **Up** and **Down** Buttons to display the desired day. The selected date is now displayed on the **Arrival Date** Button.

13) Touch the **Compute RAIM** Button. One of the following will be displayed in the 'RAIM Status' Field.

   • "Computing" — RAIM calculation in progress

   • "Available" — RAIM is predicted to be available for the specified waypoint, time, and date

   • "Not Available" — RAIM is predicted to be unavailable for the specified waypoint, time, and date

   • "_____" — RAIM has not been computed for the specified waypoint, time, and date combination

ANNUNCIATIONS

When an LRU or an LRU function fails, a large "X" is typically displayed on windows associated with the failed data. Depending on the LRU, the "X" may be amber or red. Upon system power-on, certain instruments remain invalid as equipment begins to initialize. All windows should be operational within one minute of power-on. If any window remains flagged, the system should be serviced by a Garmin-authorized repair facility.

NOTE: For a detailed description of all annunciations and alerts, refer to Appendix A. Refer to the current version of the pertinent flight manual for additional information regarding pilot responses to these annunciations.
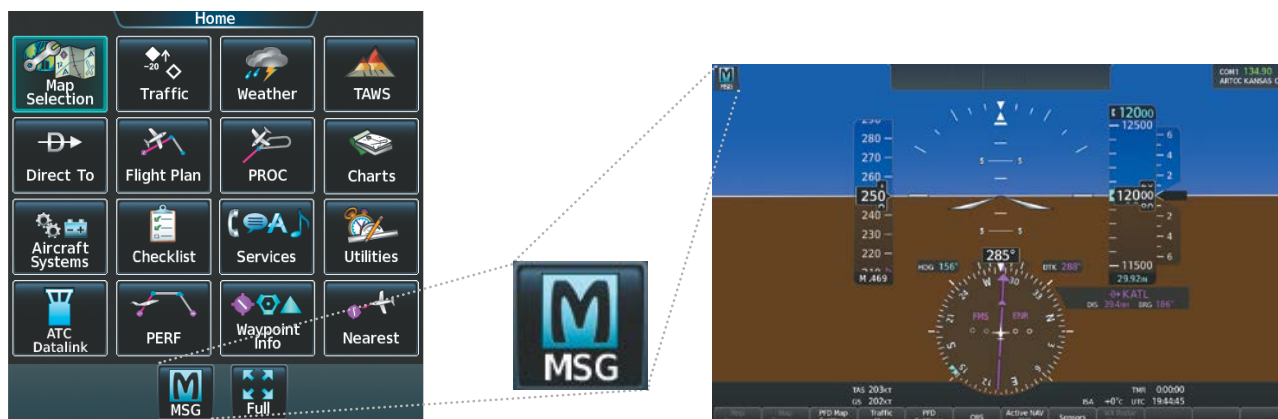
Figure 1-27 Message Annunciation on Touchscreen Controller and PFD

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System Annunciation	Comment	System Annunciation	Comment
	Display system is not receiving attitude information from the AHRS.		Display system is not receiving vertical speed input from the air data computer.
	AHRS System is aligning.		Display system is not receiving valid heading input from the AHRS or magnetometer.
	GPS information is either not present or is invalid for navigation use.		Display system is not receiving altitude input from the air data computer.
	Display system is not receiving airspeed input from the air data computer.	XPDR 1 FAIL	Display system is not receiving valid transponder information.
		Other Various Red or Amber X Indications	A red or amber 'X' through any other display field (such as GTC and engine instrumentation fields) indicates the field is not receiving valid data.

Table 1-5 System Annunciations

1.4 FMS INITIALIZATION

FMS Initialization is a process that prompts the flight crew to perform system checks and enter data to enable FMS functions and is completed prior to each flight using the Touchscreen Controllers. The 'Initialization' Screen that appears on the Touchscreen Controllers upon power-on includes tasks prompting the crew to select a Crew Profile, set weight and fuel values, set speed bug values, enter flight plan and takeoff data, and perform system tests.

Before Initialization   After Initialization
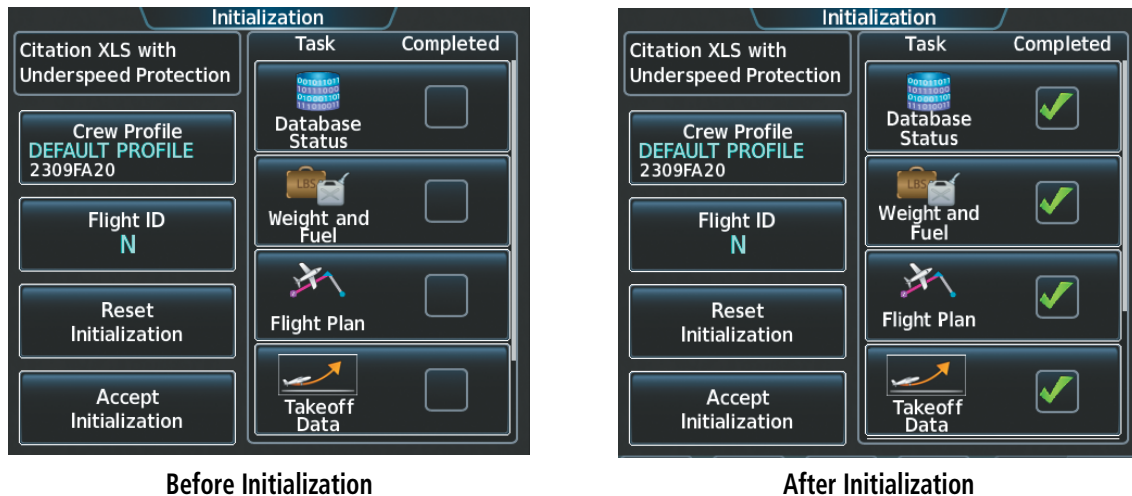
Figure 1-28 'Initialization' Screen

Each Initialization Task is represented on the 'Initialization' Screen by a button, which includes a descriptive icon and a check box. Each button provides a shortcut to the Touchscreen Controller screen represented by the button's icon. Upon successful completion of each Initialization Task, a green check mark will appear in the corresponding check box on the 'Initialization' Screen.

Once all Initialization Tasks are marked complete, touch the **Accept Initialization** Button to exit the 'Initialization' Screen and open the 'Home' Screen. Touching the **Accept Initialization** Button prior to the completion of all Initialization Tasks will cause a pop-up screen which states, "Init process not completed. Confirm the initialization process should be exited." Touching the **OK** Button on the pop-up screen acknowledges the incomplete initialization and opens the 'Home' Screen; touching the **Cancel** Button removes the pop-up.

Failure to complete each Initialization Task may result in degraded FMS performance, but any of these tasks may be completed or revised at any time during the same power cycle. The system will even work in the background to apply check marks to completed Initialization Tasks that are accessed via the 'Home' Screen. The 'Initialization' Screen may also be accessed at any time via **Home** > **Utilities** > **Initialization**.

FMS Initialization may be accomplished multiple times within the same power cycle by accessing the 'Initialization' Screen and touching the **Reset Initialization** Button. This removes the green check marks and arms the "Init process not completed…" pop-up warning.

Initializing the FMS:

1) Touch **Crew Profile** and select a Crew Profile from the list of available profiles (see the discussion on Crew Profiles later in this section for more information on creating, importing, and exporting Crew Profiles).

2) Touch the **Flight ID** Button to enter Flight ID. See the Audio and CNS Section for details.

3) Touch the **Database Status** Button to view the cycle number and the effective/expiration dates for all databases. See the Appendix for details on updating databases.

4) Touch the **Weight and Fuel** Button to access the 'Weight and Fuel' Screen to enter values for Operating Weight, Payload, Takeoff, and Landing. See the Flight Management Section for details.

5) Touch the **Next** Button to proceed to the 'Active Flight Plan' Screen to add the origin airport, enroute waypoints, and the destination airport. See Flight Management Section for details.

6) (With TOLD option) Touch the **Next** Button to proceed to the 'Speed Bugs' Screen to specify Takeoff, Landing, and N1% Speed Bugs. See the Flight Instruments Section for details.

7) Touch the **Next** Button to proceed to the 'Takeoff Data' Screen to input values for the origin runway.

8) Touch the **Next** Button to proceed to the 'System Tests' Screen to perform system tests. See the EICAS Section for system testing details.

9) Touch the **INIT** Button to return the 'Initialization' Screen. As each task is completed a green checkmark appears in the Completed column on the 'Initialization' Screen.

10) Touch **Accept Initialization** to accept the initialization values and proceed to the 'Home' Screen. Or Touch **Reset Initialization** to reset initialization values.

1.5 SYSTEM MANAGEMENT

The Touchscreen Controllers allow management of various system parameters, in addition to providing status and database information for the system.

Restoring default avionics settings:

1) From Home, touch **Utilities** > **Crew Profile** > **Restore Defaults**.

2) Touch the **OK** Button to reset most settings to the OEM default values, or touch the **Cancel** Button.

AVIONICS SETTINGS

Avionics settings on the MFD Touchscreen Controllers are categorized into five Tabs (**System**, **Units**, **Alerts**, **MFD Fields,** and **Audio**) on the 'Avionics Settings' Screen.

SYSTEM SETTINGS

- Time Format (local 12 hour, local 24 hour, or UTC)
- Time Offset
- Full-Screen Flight Plan Keyboard (On or Off)
- Flight Director (Single Cue or Dual Cue)
- GPS CDI 2.0 NM (0.30 NM, 1.00 NM, 2.00 NM, or AUTO)
- COM Channel Spacing (25.0 kHz or 8.33 kHz)
- Nearest Airport Runway Surface (Any, Hard Only, or Hard/Soft)
- Nearest Airport Min Rwy Length
- Show Airport Chart on Landing (On or Off)

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Figure 1-29 System Time (UTC Format)

Date   'Time Format' Datafield   Time   'Time Format' Options
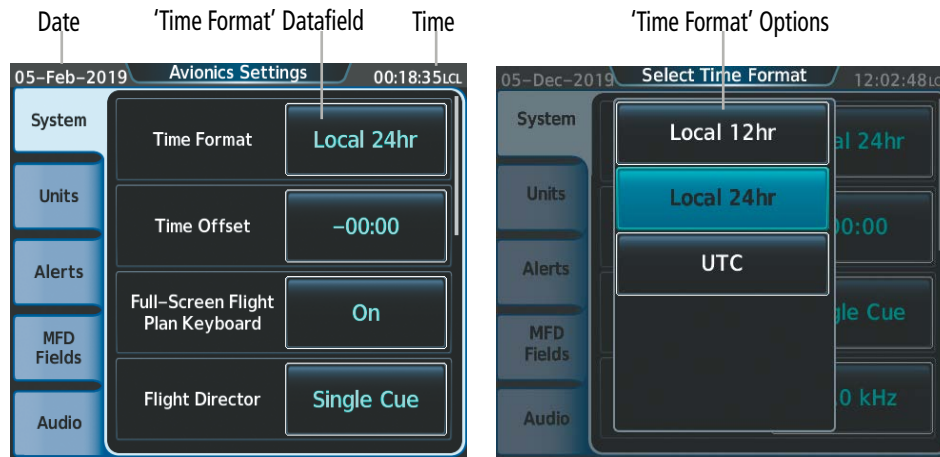
Figure 1-30 Time Format Settings

> **NOTE:** The time offset is used to define current local time. UTC (also called GMT or Zulu) date and time are calculated directly from the GPS satellite signals and cannot be changed.

Setting the Time Format:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**. The **System** Tab is highlighted.

2) Touch the Time Format setting Button (displays currently selected time format in cyan).

3) Touch a time format option button (**Local 12hr**, **Local 24hr**, or **UTC**).

Setting the Time Offset Value (not available if time format is UTC):

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**. The **System** Tab is highlighted.

2) Touch the Time Offset setting Button (currently selected time offset shown in cyan).

3) Input the desired value using the numeric keypad or the large and small right knobs and touch the **Enter** Button.

Enabling/Disabling the Full-Screen Flight Plan Keyboard:

1) From Home, touch **Utilities > Setup > Avionics Settings**. The **System** Tab is highlighted.

2) Touch the Full-Screen Flight Plan Keyboard (button displays Off or On in cyan).

Setting the Flight Director:

1) From Home, touch **Utilities > Setup > Avionics Settings**. The **System** Tab is highlighted.

2) Touch the Flight Director Button to display a list of flight director formats (button displays currently selected Flight Director format in cyan).

3) Touch the **Single Cue** or **Dual Cue** Button.

GPS CDI

The GPS CDI setting controls range scale of the CDI when GPS is the active nav source. The flight crew can specify a range to use, or allow the system to automatically determine the CDI range based on the phase of flight or navigation database information. Refer to the Flight Instruments Section for more information on the range of the CDI.

Setting the GPS CDI Range:

1) From MFD Home, touch **Utilities > Setup** > **Avionics Settings**.

2) If necessary, touch the **System** Tab.

3) Touch the GPS CDI range button.

4) Touch a button to select a specific distance used for the CDI range, or touch the **AUTO** Button for the system to adjust the CDI range automatically based on flight parameters.

COM CHANNEL SPACING

The 'COM Channel Spacing' datafield allows the pilot to select 8.33 kHz or 25.0 kHz COM frequency channel spacing.

NOTE: *8.33 kHz VHF communication frequency channel spacing is not normally used in the United States. Select the 25.0 kHz channel spacing option for use in the United States.*

Setting COM Channel Spacing:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**. The **System** Tab is highlighted.

2) Scroll as needed and touch the **COM Channel Spacing** Button (button displays the current spacing setting in cyan).

3) Touch either the **8.33 kHz** Button or the **25.0 kHz** Button.

Nearest airport matching criteria (such as minimum runway length and/or surface type) can be entered to prevent airports with small runways or runways that are not of the appropriate surface from being displayed in the list as nearest airports . Default settings are '3000FT' for runway length and 'Hard Only' for runway surface type.

Setting the Nearest Airport surface matching criteria:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**. The **System** Tab is highlighted.

2) Scroll to and touch the **Nearest Airport Runway Surface** Button (button displays current runway surface selection in cyan).

3) Touch one of the following runway surface buttons: **Any**, **Hard Only**, **Hard/Soft**.

Setting the Nearest Airport Minimum Runway Length matching criteria:

1) From Home, touch **Utilities > Setup > Avionics Settings**. The **System** Tab is highlighted.

2) Scroll as needed and touch the **Nearest Airport Min Rwy Length** Button (button displays current length setting in cyan).

3) Input a minimum runway surface distance using the keypad or the large and small right knobs, then touch the **Enter** Button to accept the entry.

Showing the airport chart on landing:

1) From Home, touch **Utilities > Setup > Avionics Settings**. The **System** Tab is highlighted.

2) Scroll as needed and touch the **Show Airport Chart on Landing** Button (button displays Off or On in cyan).

3) Touch the **On** Button to enable the display of the airport chart on landing.

Or:

Touch the **Off** Button to disable the display of the airport chart on landing.

UNITS SETTINGS

- Nav Angle (Magnetic or True)
- Magnetic Variance
- BARO QFE
- Distance/Speed (Nautical)
- Altitude/Vertical Speed (Feet)
- External Temperature (Celsius)
- Fuel (Pounds)
- Weight (Pounds or Kg)
- Position Format (HDDD° MM.MM' or HDDD° MM' SS.S")

The **Units** Tab allows for configuration of the measurement units. A button appears next to the current unit setting only for those units which the flight crew can modify. Measurement units without an associated button are shown only for informational purposes and cannot be modified by the flight crew.

NAV ANGLE (MAGNETIC, TRUE)

- When set to 'Magnetic (°)', magnetic variation is calculated into the displayed value. When 'True (°T)' is selected, no magnetic variation is calculated and a 'T' is displayed next to the value.
- Affects Current Heading, Selected Heading, and Selected Course.
- Affects the BRG, DTK, TKE, TRK, and XTK fields.

NOTE: *Radial DME waypoints created in the flight plan always default to magnetic. See the Flight Management Section for changing radial DME waypoints settings to a True Nav angle.*

BARO QFE

- When activated, the system requires input for the Reference Elevation.
- Affects all altitude/vertical speed displays.

DISTANCE/SPEED

- Affects all distance and speed displays.

ALTITUDE/VERTICAL SPEED

- Affects all altitude/vertical speed displays.

EXTERNAL TEMPERATURE

- Affects displayed OAT display.

FUEL

- ▪ Affects all fuel displays.

WEIGHT

- ▪ Affects all weight displays.

POSITION FORMAT (HDDD°MM.MM', HDDD°MM'SS.S")

- ▪ Affects all position displays.

   Changing unit settings:

   1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**.

   2) Touch the **Units** Tab.

   3) Scroll as needed and touch button corresponding to the units to be changed (current units selection displayed in cyan).

   4) Touch a unit's button from the list.

ALERTS SETTINGS

System
Units
Alerts
MFD Fields
Audio

- • BARO Transition ALT Climb (On/Off/Setting)
- • BARO Transition LVL Descent (On/Off/Setting)
- • SurfaceWatch Inhibit (On/Off) (if installed)
- • Stabilized APPR Inhibit
- • Airspace Alert Alt Buffer (Setting)
- • Arrival Alert (On/Off/Setting)
- • CL B/TMA/Awy (On/Off)
- • CL C/CTA (On/Off)
- • CL A/D (On/Off)
- • Restricted (On/Off)
- • MOA (Military) (On/Off)
- • Other (On/Off)
- • Touchdown Callouts (On/Off/Setting)

The **Alerts** Tab allows configuration of the following alert settings:

- » Baro transition alert (climb and descent)
- » SurfaceWatch alert inhibit
- » Stabilized approach alert inhibit
- » Altitude buffer distance alert
- » Arrival alerts
- » Airspace alerts

BARO TRANSITION ALERT SETTINGS

   The Baro Transition Alert flashes the barometric pressure setting. The Baro Transition Alert serves as a reminder to the pilot to change the barometric pressure setting to standard when climbing through the barometric transition altitude, or to change the barometric pressure setting from standard to the local altimeter setting when descending through the barometric transition altitude. Refer to the Flight Instruments Section for more information about the Baro Transition Alert.

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Configuring the Baro Transition Alerts:

1) From Home, touch **Utilities > Setup** > **Avionics Settings**.

2) Touch the **Alerts** Tab.

3) Touch the **Baro Transition ALT Climb** Button. Button annunciator is green when alert is enabled, subdued when disabled.

4) Touch the Baro Transition ALT Climb datafield button. Use the keypad or large and small right knobs to select the desired altitude at which the system will issue an alert if the aircraft climbs through this altitude while the altimeter setting has **not** been set **to** standard. Touch the **Enter** Button or push the right knob to accept the selection.

5) Touch the **Baro Transition LVL Descent** Button. Button annunciator is green when alert is enabled, subdued when disabled.

6) Touch the Baro Transition LVL Descent datafield button. Use the keypad or large and small right knobs to select the desired flight level at which the system will issue an alert if the aircraft descends through this flight level while the altimeter setting has **not** been changed **from** standard. Touch **Enter** or push the right knob to accept the selection.

SURFACEWATCH INHIBIT

The optional SurfaceWatch™ feature alerts the flight crew in certain potentially unsafe conditions during taxi, takeoff, and landing. SurfaceWatch also displays an Information Box on the PFD. The flight crew can inhibit the SurfaceWatch alerts and displays using the 'Avionics Settings' Screen. Refer to the Additional Features Section for more information on the SurfaceWatch feature.

Inhibiting/enabling SurfaceWatch:

1) From Home, touch **Utilities > Setup** > **Avionics Settings**.

2) Touch the **Alerts** Tab.

3) Touch the **SurfaceWatch Inhibit** Button. SurfaceWatch is inhibited when button annunciator is green, enabled when subdued.

STABILIZED APPROACH INHIBIT

The Stabilized Approach functionality provides aural and visual annunciations to notify the flight crew of unstable conditions during an approach. The flight crew can inhibit the alerts and displays using the 'Avionics Settings' Screen. Refer to the Additional Features Section for more information on the Stabilized Approach feature.

ARRIVAL AND AIRSPACE ALERT SETTINGS

For Airspace Alert Altitude Buffer settings, Arrival Alerts, and Airspace specific Alerts, see the Flight Management Section.

TOUCHDOWN CALLOUTS SETTINGS

Touchdown Callouts provide AGL aural alerts to the pilot while landing the aircraft. Several alerts of varying height can be enabled/disabled by the pilot. See the Hazard Avoidance Section for further details.

Enabling/Disabling Touchdown Callouts:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) If necessary, touch the Alerts Tab.

3) Scroll down as required and touch the Touchdown Callouts Button. Button annunciator is green when alert is enabled, gray when disabled.

4) Touch the Settings Button to open the 'Touchdown Callouts' Window.

5) Touch any of the available altitude Buttons as required. Button annunciator is green when alert is enabled, gray when disabled.

MFD FIELDS SETTINGS

- MFD Data Bar Field 1
- MFD Data Bar Field 2
- MFD Data Bar Field 3
- MFD Data Bar Field 4
- MFD Data Bar Field 5
- MFD Data Bar Field 6
- MFD Data Bar Field 7
- MFD Data Bar Field 8
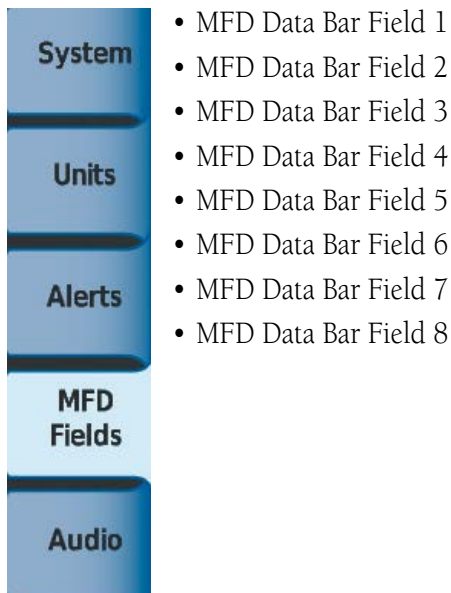
   The MFD Navigation Data Bar can display up to eight navigation data bar fields. By default, the Navigation Data Bar displays Ground Speed (GS), Desired Track (DTK), Track (TRK), Estimated Time Enroute (ETE), Bearing (BRG), Distance (DIS), Minimum Safe Altitude (MSA), and Estimated Time of Arrival (ETA). The system assigns each data bar field a corresponding number, 1 though 8, as displayed from left-to-right in the MFD Navigation Data Bar.

Changing a field in the MFD Navigation Data Bar:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings.**

2) Touch the **MFD Fields** Tab.

3) Scroll as needed and touch the MFD Data Bar Field Number to be changed (1 through 8); current selection for each data bar field displayed in cyan.

4) Scroll as needed and touch the button corresponding to the desired data to be shown in the selected MFD 'Data Bar' Field.

The following data may be selected for display in each of the eight fields of the Navigation Data Bar:

- Bearing (BRG)
- Current Climb Gradient (CCG)
- Destination Airport Identifier (DEST)
- Distance (DIS)
- Density Altitude (DNALT)
- Distance to Destination (DTG)
- Desired Track (DTK)
- Endurance (END)
- ETE to Final Destination (ENR)
- Enroute Safe Altitude (ESA)
- Estimated Time of Arrival (ETA)
- Estimated Time Enroute (ETE)
- Flight Timer (FLT)

- Fuel On Board (FOB)
- Fuel Over Destination (FOD)
- GPS AGL Altitude (GAGL)
- Ground Speed (GS)
- ETA at Final Destination (LDG)
- Minimum Safe Altitude (MSA)
- True Air Speed (TAS)
- Track Angle Error (TKE)
- Time to Top of Descent (TOD)
- Track (TRK)
- Vertical Speed Required (VSR)
- Cross-Track Error (XTK)

AUDIO SETTINGS

- Audio Alert Voice (Male or Female)
- COM Frequency Changed Tone (On/Off)

From the **Audio** Tab the audio alert voice gender can be set to male or female. A tone may be enabled or disabled which alerts the flight crew that a COM frequency has been changed. Pilot and Copilot 3D audio may be enabled or disabled. Also, the 3D audio left/right reference may be changed so that audio is heard in the ear as desired.

Changing the audio alert voice:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings.**

2) Touch the **Audio** Tab.

3) Touch the Audio Alert Voice button (current voice gender displayed in cyan).

4) Touch the audio alert voice gender button (**Male** or **Female**).

Enabling/disabling the COM Frequency Changed Tone:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings.**

2) Touch the **Audio** Tab.

3) Touch the **COM Frequency Changed Tone** Button. A green annunciator indicates the feature is enabled.

AVIONICS STATUS

The 'Avionics Status' Screen provides information about installed LRUs, airframe system software, and databases.

LRU INFO

The **LRU Info** Tab on the 'Avionics Status' Screen displays the status, serial numbers, and software version numbers for all detected system LRUs. The system displays a green checked box for each active LRU. An amber 'X' box indicates a failed LRU. Inform a service center or Garmin dealer if an LRU has failed.

Viewing LRU information:

1) From Home, touch **Utilities** > **Setup** > **Avionics Status.** The **LRU** Tab is highlighted.

2) Scroll as needed and touch an LRU button to display a pop-up window with additional information for the selected LRU.

3) When finished, touch the pop-up window (if displayed), or touch the **Back** Button or the **Home** Button.
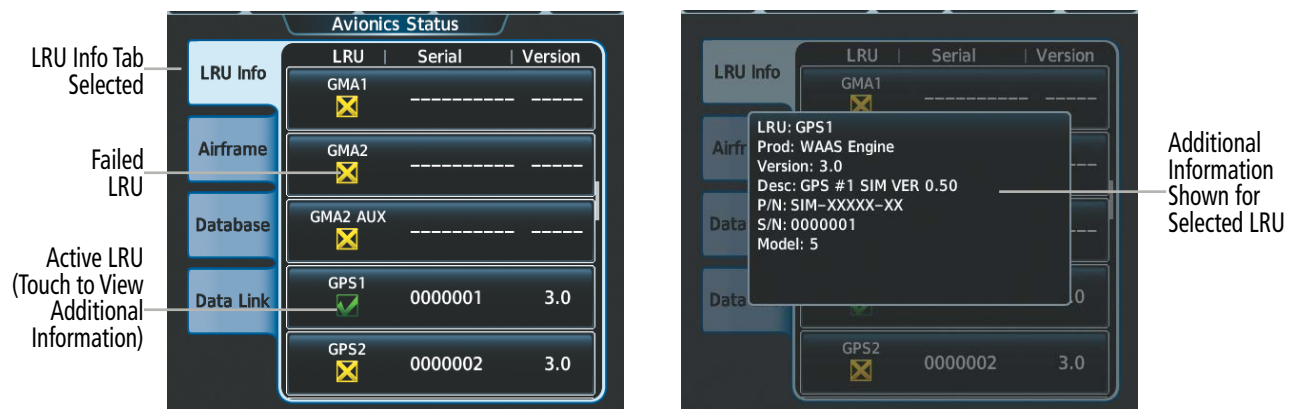
Figure 1-31 Viewing LRU Info Information on the Touchscreen Controller

AIRFRAME

The Airframe Tab of the 'Avionics Status' Screen displays pertinent information about the airframe including the Airframe, System ID number, System Software Version number, Fleet ID, Aircraft ID, Cockpit Reference Guide part number, and Checklist information.

Viewing airframe information:

1) From Home, touch **Utilities** > **Setup** > **Avionics Status**.

2) Touch the **Airframe** Tab.

3) Scroll as needed to view the airframe information.

DATABASE

The Database Tab of the 'Avionics Status' Screen displays pertinent information on all system databases.

Viewing database information:

1) From Home, touch **Utilities** > **Setup** > **Avionics Status**.

2) Touch the **Database** Tab.

3) Touch desired LRU button to view database information for the selected LRU.

4) Scroll as needed to view the database information for the selected LRU, then touch the **Back** Button or the **Home** Button.

DATA LINK

The **Data Link** Tab of the 'Avionics Status' Screen provides access to view diagnostic information of system data link connections (VHF, Router, ACARS, SATCOM).

Viewing data link information:

1) From Home, touch **Utilities** > **Setup** > **Avionics Status**.

2) Touch the **Data Link** Tab.

3) Touch the desired data link buttons to view diagnostic information for the selected connection.

4) When finished, touch **Back** or **Home.**

ADDITIONAL SETUP FEATURES

SIRIUSXM INFO

Information regarding SiriusXM services may be found in the Audio and CNS Section, Hazard Avoidance Section, and Additional Features Section.

CONNEXT REGISTRATION

For more information on setting up a Connext Weather account, refer to the Hazard Avoidance Section.

WIRELESS SETUP

The system is capable of connecting to a wireless network. For more information on Connext and WiFi Setup, see the Additional Features Section.

ATC SETTINGS

For more information on ATC Settings, see the CNS & Audio Section.

DATABASE STATUS

For more information on Database Status, see the Appendices.

ADS-B STATUS

For more information on ADS-B Status, see the Hazard Avoidance Section.

1.6 UTILITIES

System utilities may be accessed for performing routine tasks and calculations. This section will cover Trip Stats, Timer, Scheduler, Screen Cleaning, and Crew Profile utilities. Other system utilities are discussed in later sections throughout this guide.

TRIP PLANNING

See the Flight Management Section for information on the Trip Planning feature.

MINIMUMS

See the Flight Instrument Section and the Flight Management Section for information on setting Baro Minimums.

TIMER

The generic timer can be set to count up or down from a specified time (HH:MM:SS). When the countdown on the timer reaches zero the digits begin to count up from zero. If the timer is reset before reaching zero on a countdown, the digits are reset to the initial value. If the timer is counting up when reset, the digits are zeroed.

Setting the generic timer:

1) From Home, touch **Utilities** > **Timer**.

2) Touch the **Time** Button.

3) Input the desired time using the numeric keypad or the large and small right knobs.

4) Touch the **Enter** Button or push the right knob.

5) Touch the **Start** Button. The button changes to "Stop".

6) To stop the timer, touch the **Stop** Button.

7) To reset the timer, touch the **Reset** Button.
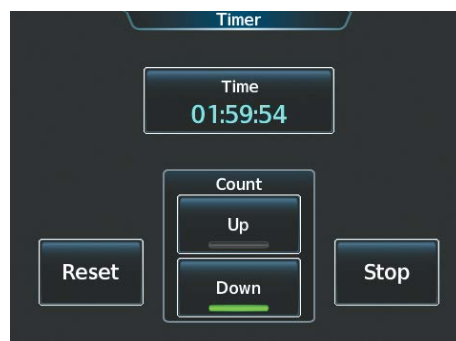
Figure 1-32 Timer (Touchscreen Controller)

TRIP STATS

Flight Time and Departure Time may each be set to begin either at Power-On or at the time the aircraft lifts off ('In-Air' setting). Both the Flight Time and the Departure time may be reset at any time. Resetting the Flight Time returns the timer to zero. Resetting the Departure Time inputs the current time at the point of reset.

The system records the time at which arrival occurs. The Arrival Time may be set up to reset when the system is powered-on, when the aircraft becomes airborne, or manually.

The Odometer presents a total distance traveled since the last reset. The Trip Odometer presents a total distance traveled for the active flight plan since the last reset.

The Hour Meter shows accumulated engine time. It begins counting when N1 is above 5 percent on either engine. It stops counting when N1 drops below 5 percent. This is a system timer and is not pilot adjustable.

Fuel Used presents the fuel used since the last reset. Average Ground Speed, Maximum Ground Speed, Average Wind Speed, and Average Wind Direction present the given information as measured since the last reset. Each may be set up to reset at the time of Power-On, lift off, or manually.

Figure 1-33 Trip Statistics Screen

Setting the Flight Time and Departure Time start criterion:

1) From Home, touch **Utilities** > **Trip Stats.**

2) Touch the **Start At** Button for either the Flight Time or the Departure Time.

3) Touch either the **Power On** or **In-Air** Button to select the Start At time and return to the 'Trip Statistics' Screen.

Resetting the Flight Time and Departure Time:

1) From Home, touch **Utilities** > **Trip Statistics.**

2) Touch the desired Time button (cyan text in button displays flight time).

3) Touch the **Reset** Button to reset the flight timer or touch the **Cancel** Button.

Setting the reset criterion for arrival time, odometer, ground speed, or wind statistics:

1) From Home, touch **Utilities** > **Trip Stats.**

2) If necessary, scroll to reveal the desired statistic. Touch the corresponding **Reset** Button.

3) Touch either the **Power On**, **In-Air** or **Manually** Button to select the reset mode and return to the 'Trip Statistics' Screen.

Resetting the arrival time, odometer, ground speed, or wind statistics:

1) From **Home**, touch **Utilities** > **Trip Stats**.

2) If necessary, scroll to reveal the desired statistic. Touch the corresponding Datafield button (button displays the statistic measurement in cyan).

3) Touch the **Reset** Button to reset the arrival time or touch the **Cancel** Button.

SCHEDULED MESSAGES

The Scheduled Messages feature can be used to enter and display reminder messages (e.g., Change oil, RVSM checks, or Altimeter-transponder check) on the 'Notifications' Screen of the Touchscreen Controller with an associated flashing **MSG** Button. Messages can be set to display based on a specific date and time (Event), once the message timer reaches zero (One Time), or recurrently whenever the message timer reaches zero (Periodic). Message timers set to periodic alerting automatically reset to the original timer value once the message is displayed. When power is cycled, all messages are retained until deleted, and message timer countdown is resumed. Event messages triggered when the system is powered off will be displayed the next time the system is powered on.

Entering a scheduled message:

1) From Home, touch **Utilities** > **Scheduled Messages**.

2) Touch the **Add Message** Button.

3) Touch the **Message** Button.

4) The keypad is displayed. Enter the message name using the keypad or large and small right knobs

5) Touch the **Enter** Button. The message name is displayed on the **Message** Button.

6) Touch the **Frequency** Button.

7) Touch the **Event**, **One Time**, or **Periodic** Button. The selection is displayed on the **Frequency** Button.

8) Touch the **Time** Button.

9) Enter the time value using the keypad. If the **Event** Button was selected in step 7, time is entered in a clock format (HH:MM LCL) as local time. If the **One Time** or **Periodic** Buttons were selected in step 7, the time is entered in a HH:MM:SS format.

10) Touch the **Enter** Button. The time is displayed on the **Time** Button.

11) If the **Event** Button was selected in step 7, touch the **Date** Button. The **Date** Button is subdued and disabled if the **One Time** or **Periodic** Buttons were selected in step 7.

12) Touch the desired year, then the month, followed by the day.

13) Touch **Create** Button to activate.

Entering a scheduled message:

1) From Home, touch **Utilities** > **Scheduled Messages**.

2) Touch the **Add Message** Button.

3) Touch the **Message** Button.

4) The keypad is displayed. Enter the message name using the keypad or large and small upper knobs

5) Touch the **Enter** Button. The message name is displayed on the **Message** Button.

6) Touch the **Frequency** Button.

7) Touch the **Event**, **One Time**, or **Periodic** Button. The selection is displayed on the **Frequency** Button.

8) Touch the **Time** Button.

9) Enter the time value using the keypad. If the **Event** Button was selected in step 7, time is entered in a clock format (HH:MM LCL) as local time. If the **One Time** or **Periodic** Buttons were selected in step 7, the time is entered in a HH:MM:SS format.

10) Touch the **Enter** Button. The time is displayed on the **Time** Button.

11) If the **Event** Button was selected in step 7, touch the **Date** Button. The **Date** Button is subdued and disabled if the **One Time** or **Periodic** Buttons were selected in step 7.

12) Touch the desired year, then the month, followed by the day.

Editing a scheduled message:

1) From Home, touch **Utilities** > **Scheduled Messages**.

2) Touch the button with the name of the message to be edited. The 'Message Options' Window is displayed.

3) Touch the **Edit Message** Button.

4) Select the desired message parameter to be edited and perform the needed steps as discussed previously for entering a scheduled message.

Resetting the time for an existing scheduled message:

1) From Home, touch **Utilities** > **Scheduled Messages**.

2) Touch the button with the name of the message to reset its time. The scheduled message time is immediately reset and begins the count-down.

Deleting a scheduled message:

1) From Home, touch **Utilities** > **Scheduled Messages**.

2) Touch the name of the message to be deleted. The 'Message Options' Window is displayed.

3) Touch the **Delete Message** Button. Touch the **Delete All Messages** Button to delete all saved messages.
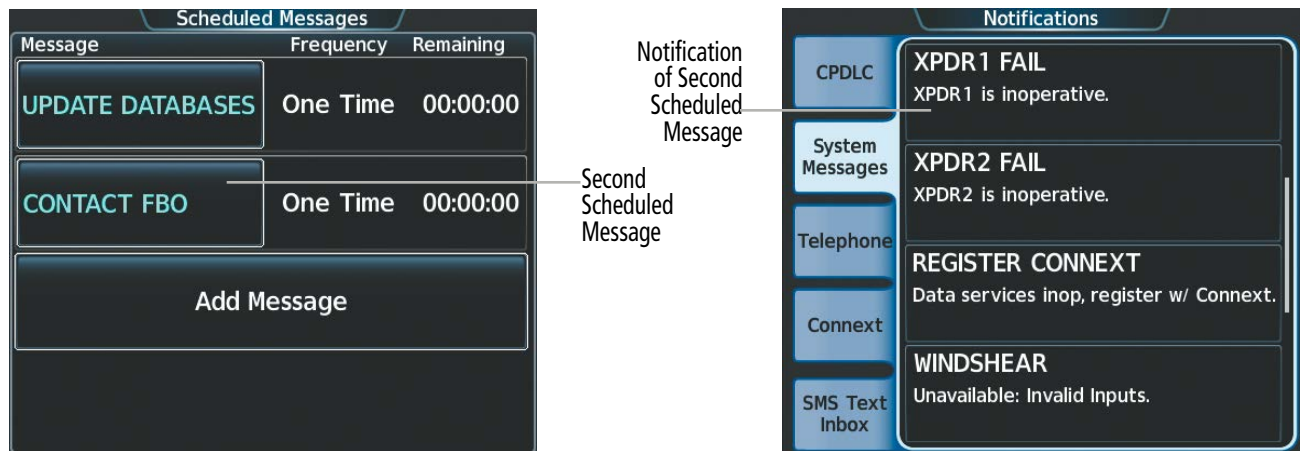
Figure 1-34 Scheduled Message Example

CREW PROFILES

The system automatically stores various settings and selections within crew profiles. These include a wide range of parameters for both the pilot and copilot including (but not limited to) map settings, avionics settings, radar settings and PFD settings.

After system power-on, the 'Initialization' Screen on the Touchscreen Controller shows the currently active crew profile, which was active during the previous power cycle. If needed, the flight crew may activate a different crew profile on the 'Initialization' Screen or the 'Crew Profile' Screen.

The 'Crew Profile' Screen provides additional capabilities for managing crew profiles. The system can store up to 25 crew profiles. From here, crew profiles may be added, renamed, activated, copied, or deleted. In addition, crew profiles can be imported from an SD card, or exported to an SD card on the 'Crew Profile' Screen. By default, "DEFAULT PROFILE" is the active crew profile. This profile cannot be deleted or renamed.
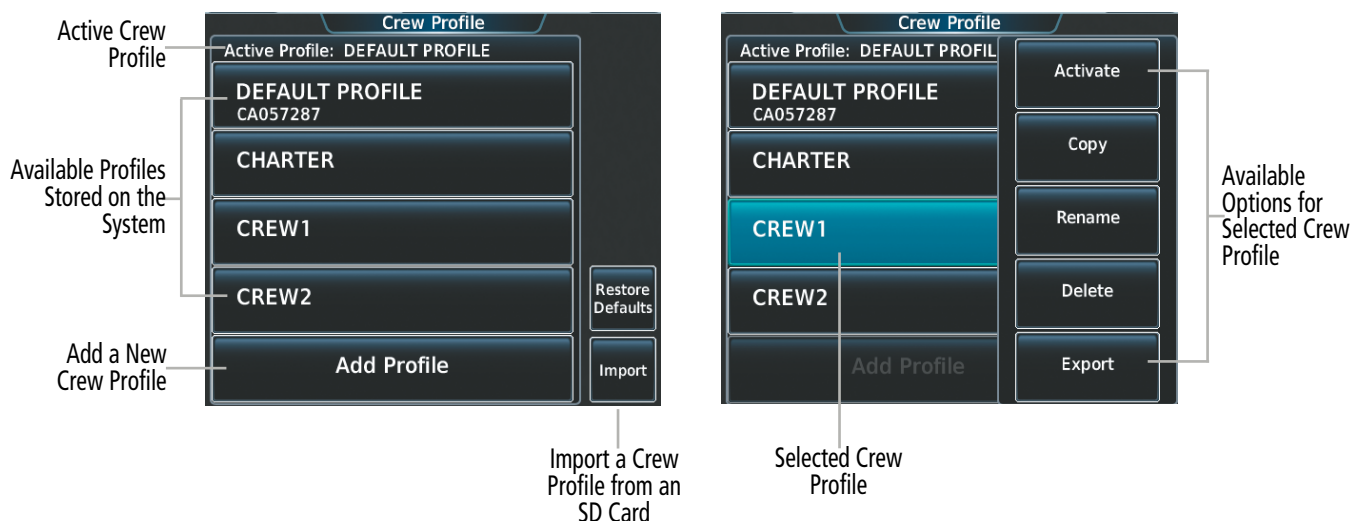
Figure 1-35 Managing Crew Profiles on the 'Crew Profile' Screen

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Adding a new crew profile:

1) From Home, touch **Utilities > Crew Profile**.

2) Scroll as needed and touch the **Add Profile** Button.

3) Input the name to assign to the crew profile using the keypad or the large and small right knobs. Crew Profiles may be up to 16 characters long, and cannot share the exact name of another crew profile.

4) Touch the **Enter** Button or push the right knob.

Activating a crew profile:

1) From Home, touch **Utilities > Crew Profile**.

2) Scroll as needed, and touch the button for the crew profile to be activated.

3) Touch the **Activate** Button. When finished, the system displays the name of the selected crew profile in the 'Active Profile' Window.

Copying an existing crew profile:

1) From Home, touch **Utilities > Crew Profile**.

2) Scroll as needed, and touch the button for the crew profile to be copied.

3) Touch the **Copy** Button.

4) Input the name to assign to the copied crew profile using the keypad or the large and small right knobs. Crew Profiles may be up to 16 characters long, and cannot share the exact name of another crew profile.

5) Touch the **Enter** Button or push the right knob. The 'Crew Profile' Screen displays the name of the copied profile in the list.

Renaming an existing crew profile:

1) From Home, touch **Utilities > Crew Profile**.

2) Scroll as needed, and touch the button for the crew profile to be renamed.

3) Touch the **Rename** Button.

4) Input the new name to assign to the selected crew profile using the keypad or the large and small right knobs. Crew Profiles may be up to 16 characters long, and cannot share the exact name of another crew profile.

5) Touch the **Enter** Button or push the right knob. The 'Crew Profile' Screen displays the name of the renamed crew profile in the list.

Deleting a crew profile:

> NOTE: *The system cannot delete the currently active crew profile. If necessary, activate another crew profile prior to deletion.*

---

1) From Home, touch **Utilities > Crew Profile**:

2) Scroll as needed, and touch the button for the profile to be deleted.

3) Touch the **Delete** Button.

4) Touch the **OK** Button to confirm and delete the profile, or touch the **Cancel** Button.

Importing a crew profile from an SD card:

1) If necessary, insert an SD card containing a crew profile into the top card slot on the MFD.

2) From Home, touch **Utilities > Crew Profile**.

3) Touch the **Import** Button.

4) Scroll as needed, and touch the button for the crew profile to be imported.

Exporting a crew profile to an SD card:

1) If necessary, insert an SD card to store a crew profile into the top card slot on the MFD.

2) From Home, touch **Utilities > Crew Profile**.

3) Scroll as needed, and touch the button for the crew profile to be exported from the list.

4) Touch the **Export** Button.

CREW PROFILE IMPORT/EXPORT MESSAGES

In some circumstances, some messages may appear in conjunction with others:

Crew Profile Import/Export Results	Description
'No crew profile plan files found to import.'	Displayed if the SD card does not have one or more valid crew profile filenames.
'Overwrite existing profile?'	Displayed if the profile name matches the name of existing profile.
'Profile name invalid. Enter a different profile name.'	Displayed if the profile name is invalid.
'All available crew profiles in use. Delete a profile before importing another.'	Displayed if the maximum number for crew profiles has been reached.
'Crew profile import failed.'	Displayed if the importing operation fails for any other reason.
'Crew profile import succeeded.'	Displayed if the importing operation succeeds.
'Overwrite existing file?'	Displayed if the filename matches the name of an existing file on the SD card.
'Crew profile export failed.'	Displayed if the export operation fails.
'Crew profile export succeeded.'	Displayed if the export operation succeeds.

Table 1-6 Crew Profile Import/Export Messages

SCREEN CLEANING

Screen Cleaning mode temporary deactivates touch input on the Touchscreen Controller screen to facilitate cleaning. The screen can be cleaned using a microfiber or soft cotton cloth lightly dampened with clean water. Do not use chemical cleaning agents, as these may damage the coating on the glass surface.

Cleaning the Touchscreen Controller screen:

1) From Home, touch **Utilities** > **Screen Cleaning**.

2) The Touchscreen Controller indicates the screen may be cleaned. Clean the screen as needed.

3) Push or turn any knob to return to the 'Utilities' Screen.

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1.7 SECURE DIGITAL CARDS

NOTE: *DO NOT use the database SD cards for any purpose other than database storage.*

NOTE: *Refer to the Appendices for instructions on updating databases.*

NOTE: *Ensure the system is powered off before inserting the SD card.*

The data card slots use Secure Digital (SD) cards and are located on the top right portion of the display bezels. Each display bezel is equipped with two SD card slots. SD cards are used for various databases, system software updates, recording flight data, and storing electronic documents and checklist files.

Not all SD cards are compatible with the system. Use only SD cards supplied by Garmin or the aircraft manufacturer.

Inserting and Removing an SD card

Insert the SD card in the SD card slot, pushing the card in until the spring latch engages. The front of the card should remain flush with the face of the display bezel. To remove, gently press on the SD card to release the spring latch and eject the card.
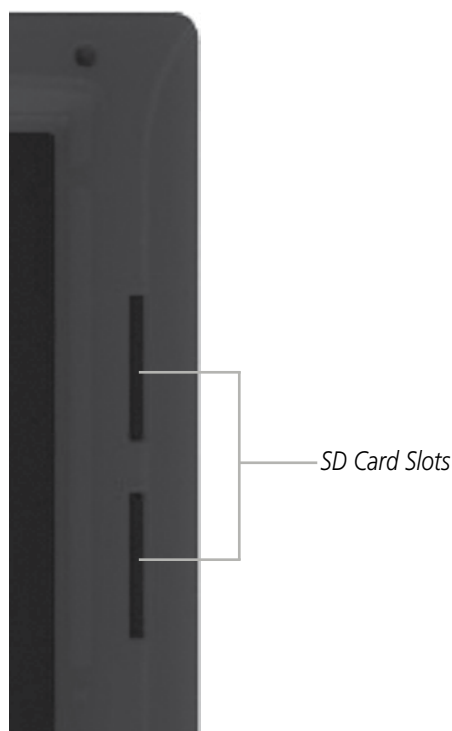
SD Card Slots

Figure 1-36 Display Bezel SD Card Slots

SECTION 2 FLIGHT INSTRUMENTS

> **NOTE:** *The Automatic Flight Control System (AFCS) provides additional indications such as bugs and annunciations on selected flight instruments during certain AFCS flight director modes. Refer to the AFCS section for more information about these indications.*

The system increases pilot situational awareness by providing easy-to-scan Primary Flight Displays (PFDs) featuring a large horizon, airspeed, attitude, vertical speed, and course deviation information. In addition to the flight instruments, navigation, communication, terrain, traffic, and weather information are also presented on the PFDs and are explained in other sections of this Pilot's Guide.

The following flight instruments and supplemental flight data are displayed on each PFD:

- Airspeed Indicator, including
  - Trend vector
  - Indicated airspeed
  - Overspeed awareness
  - Vspeed reference bugs
  - Mach number
- Groundspeed
- True airspeed
- Attitude Indicator, including
  - Slip/skid indication
  - Pitch Limit Indication
- Altimeter, including
  - Trend vector
  - Barometric setting
  - Selected Altitude

- Vertical Deviation, Glideslope, and Glidepath Indicators
- Vertical Speed Indicator (VSI)
- Vertical Navigation (VNAV) indications
- Horizontal Situation Indicator, including
  - Turn Rate Indicator
  - Bearing pointers
  - Navigation source
  - Course Deviation Indicator (CDI)
- Generic Timer
- Wind data
- Radar Altimeter (RA)
- Time
- Angle of Attack (AOA) Indicator
- International Standard Atmosphere Temperature (ISA)

The PFDs also display various alerts and annunciations.

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Figure 2-1 Primary Flight Display (Default)
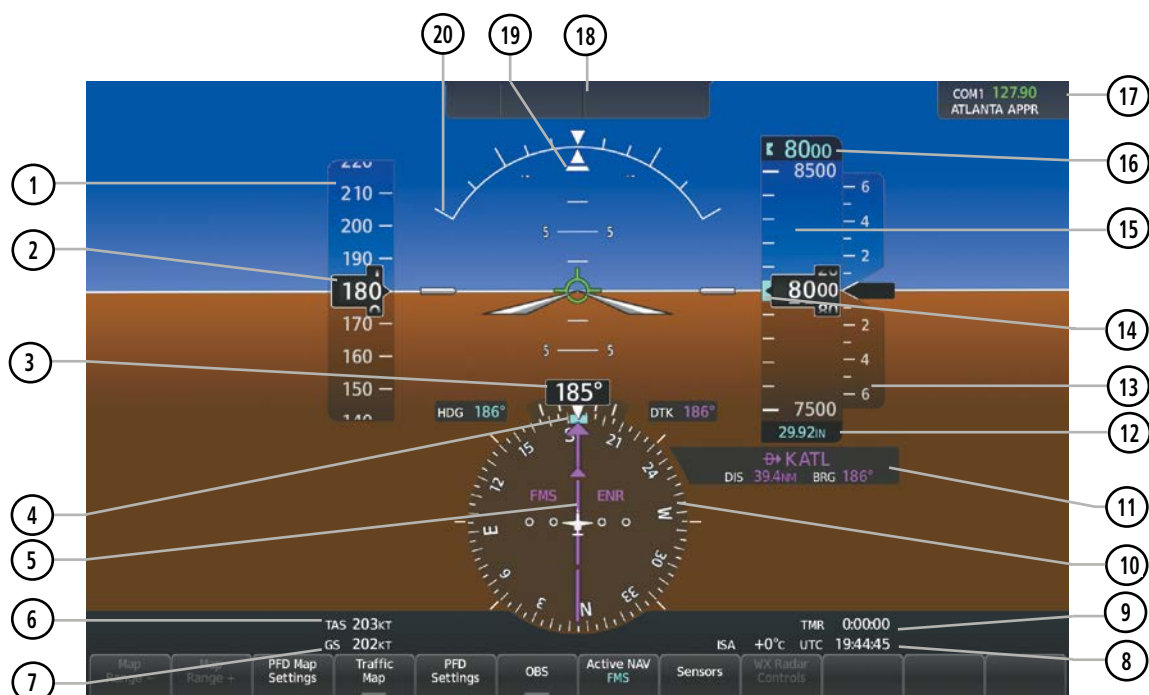
1	Airspeed Indicator	11	Navigation Status Box
2	Indicated Airspeed	12	Barometric Altimeter Setting
3	Current Heading	13	Vertical Speed Indicator (VSI)
4	Heading Bug	14	Selected Altitude Bug
5	Course Deviation Indicator (CDI)	15	Altimeter
6	True Airspeed	16	Selected Altitude
7	Ground Speed	17	COM Frequency Box
8	System Time	18	AFCS Status Box
9	Timer	19	Slip/Skid Indicator
10	Horizontal Situation Indicator (HSI)	20	Attitude Indicator

①	New Message Annunciation	⑨	PFD Settings Softkey
②	Reversionary Sensor Window	⑩	Map Range Softkey
③	Aircraft Symbol	⑪	Navigation Status Box
④	Vspeeds	⑫	Minimum Descent Altitude/Decision Height
⑤	Navigation Source	⑬	Selected Course
⑥	Selected Heading	⑭	Current Vertical Speed
⑦	Angle of Attack Indicator	⑮	Glidepath Indicator
⑧	HSI Map	⑯	Flight Path Marker

Figure 2-2 Additional PFD Information

2.1 FLIGHT INSTRUMENTS

AIRSPEED INDICATOR

> **NOTE:** *Refer to the current version of the pertinent flight manual for speed criteria and Vspeed values.*

The Airspeed Indicator displays airspeed on a moving tape rolling number gauge. The numeric labels and major tick marks on the moving tape represent intervals of 10 knots. Speed indication starts at 40 knots, with 80 knots of airspeed scale viewable at any time. The indicated airspeed is displayed inside the black pointer. The pointer remains black until reaching maximum operating speed (V_{MO}/M_{MO}), at which point it appears red along with the Mach number indication.

The Mach number is displayed below the Airspeed Indicator for airspeeds at or above Mach 0.4. The color of the indication is the same as the color of the airspeed pointer.
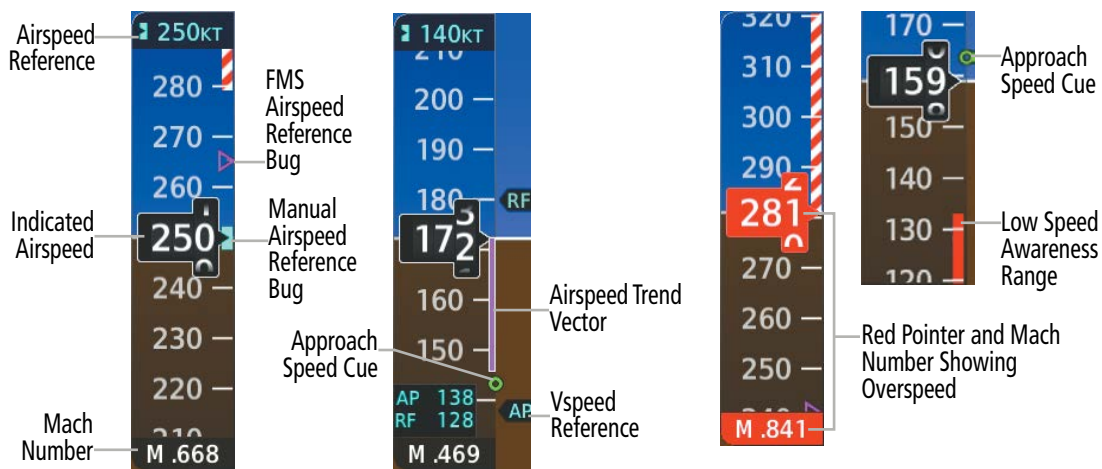
Figure 2-3 Airspeed Indicator

Speeds above the maximum operating speed, V_{MO} or M_{MO} depending on aircraft altitude, appear in the high speed awareness range, shown on the airspeed tape by a red/white barber pole. An aural overspeed warning tone is generated if the airspeed exceeds the high airspeed limit. If the indicated airspeed is within this range, the airspeed pointer is displayed in red. The solid red Low Speed Awareness band represents 1.1 V_{S1} and is provided by the AOA computer.

The Approach Speed Cue is a hollow green circle on the airspeed tape derived from the Low Speed Awareness band. It indicates an approximate airspeed of 1.3 times the stall speed for the current weight, g loading, and aircraft configuration. The Approach Reference may be used as a general reference for Vref. It is not actually Vref, but will indicate approximately what Vref is. The Approach Speed Cue will move based on aircraft altitude and flap position.

The Airspeed Trend Vector is a vertical magenta line that appears to the right of airspeed indicator when airspeed is either accelerating or decelerating. One end of the magenta line is anchored to the tip of the airspeed pointer while the other end moves continuously up or down corresponding to the rate of acceleration or deceleration. For any constant rate of acceleration or deceleration, the moving end of the line shows approximately what the indicated airspeed value will be in ten seconds. If the trend vector crosses V_{MO}/M_{MO}, the airspeed or Mach indication changes to amber. The trend vector is absent if the aircraft is on the ground, speed remains constant, or if any data needed to calculate airspeed is not available due to a system failure.

The Airspeed Reference is displayed above the Airspeed Indicator in magenta (FMS speed mode) or cyan (MAN speed mode). A bug corresponding to this speed is shown on the tape.

While in MAN speed mode if the Airspeed Reference or Mach Reference exceeds the range shown on the tape, the cyan selection bug appears at the corresponding edge of the tape. See the AFCS Section for more information about the Airspeed Reference.

The flight crew can enable or disabled the display of Vspeed reference bugs, that are displayed at their respective locations to the right of the airspeed. By default, all Vspeed values are reset and all bugs disabled during intialization.

	Vspeed	Crew-Supplied Bug
Takeoff	V_1	**1**
	V_R	**R**
	V_2	**2**
	V_{enr}	**ENR**
Landing	**Vspeed**	**Crew-Supplied Bug**
	V_{REF}	**RF**
	V_{APP}	**AP**

Table 2-1 Vspeed Bug Labels

The 'Speed Bugs' Screen provides controls for the flight crew to enable, disable, or modify Vspeed reference values as well as the target N1% value. On this screen, Vspeed references are grouped into Takeoff and Landing Tabs. When the flight crew accesses this screen on the ground, the Takeoff Tab is selected; the Landing Tab is selected if the screen is accessed when the aircraft is in the air. If the system does not have a value for a Vspeed reference, cyan dashes ('---') appear for the reference on the 'Speed Bugs' Screen, the enable/disable button for the Vspeed is subdued, and the corresponding bug will not be displayed on the airspeed tape.

If the flight crew manually provides a Vspeed reference value, a pencil icon appears next to the Vspeed reference value in the active tab, and the Vspeed reference will be displayed in cyan. In cases where a given takeoff Vspeed must be equal to or higher than another Vspeed, the system automatically enters a minimum possible value for the related Vspeed in cyan.

If TOLD is enabled, then the system generated Vspeeds will appear in magenta.

The system automatically removes takeoff Vspeed bugs when indicated airspeed is above 200 knots.

> **NOTE:** *With TOLD enabled, Vspeeds have a default value that is generated by the system. These speeds can be changed if the pilot manually enters new values. See the Flight Management Section for more information about TOLD.*

Figure 2-4 'N1%' Screen

Setting the target N1% value:

1) From Home, touch **PERF > Speed Bugs.**

2) Touch the **N1%** Button.

3) Enter a value using either the Keypad or the large and small right knobs. When finished, touch **Enter** or push the right knob.

Disabling the target N1% value:

1) From Home, touch **PERF > Speed Bugs.**

2) Touch the **N1%** Button.

3) Touch the **Target N1 Off** Button.

Selected Vspeed
Reference
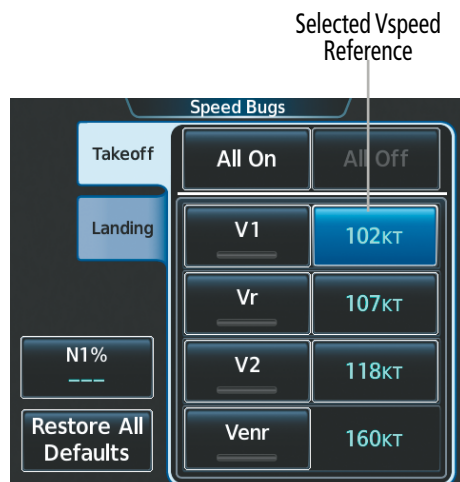
Figure 2-5 'Speed Bugs' Screen

Figure 2-6 Entering a new value manually for the selected reference

Manually changing Vspeeds and enabling/disabling Vspeed bugs:

1) From Home, touch **PERF > Speed Bugs.**

2) If necessary, touch the **Takeoff** or **Landing** Tab.

3) Scroll as necessary, and touch the enable/disable button for the corresponding Vspeed.

4) To change a Vspeed value, touch the datafield button for the corresponding Vspeed. Then enter a value for the selected Vspeed using either the Keypad or the large and small right knobs. When finished, touch **Enter** or push the right knob. The pencil icon next to the Vspeed value indicates the Vspeed is a crew-entered value.
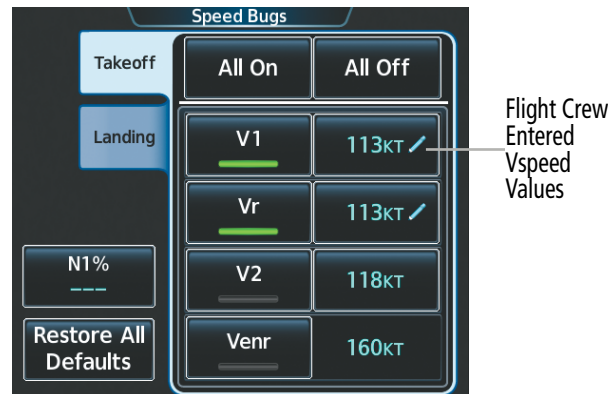
Figure 2-7 Crew-Entered Vspeed

Enabling/disabling all Takeoff or Landing Vspeed bugs:

1) From Home, touch **PERF > Speed Bugs.**

2) Touch either the **Takeoff** or **Landing** Tab.

3) To enable all Vspeed bugs in the selected tab, touch the **All On** Button. To disable all Vspeed bugs in the selected tab, touch the **All Off** Button.

Restoring all Vspeed defaults:

1) From Home, touch **PERF > Speed Bugs.**

2) Touch the **Restore All Defaults** Button. The system restores all takeoff and landing Vspeed reference settings to their default values, and disables the display of all Vspeed bugs.

ATTITUDE INDICATOR

Attitude information is displayed over a virtual blue sky and brown ground with a white horizon line. The Attitude Indicator displays the pitch, roll, and slip/skid information.
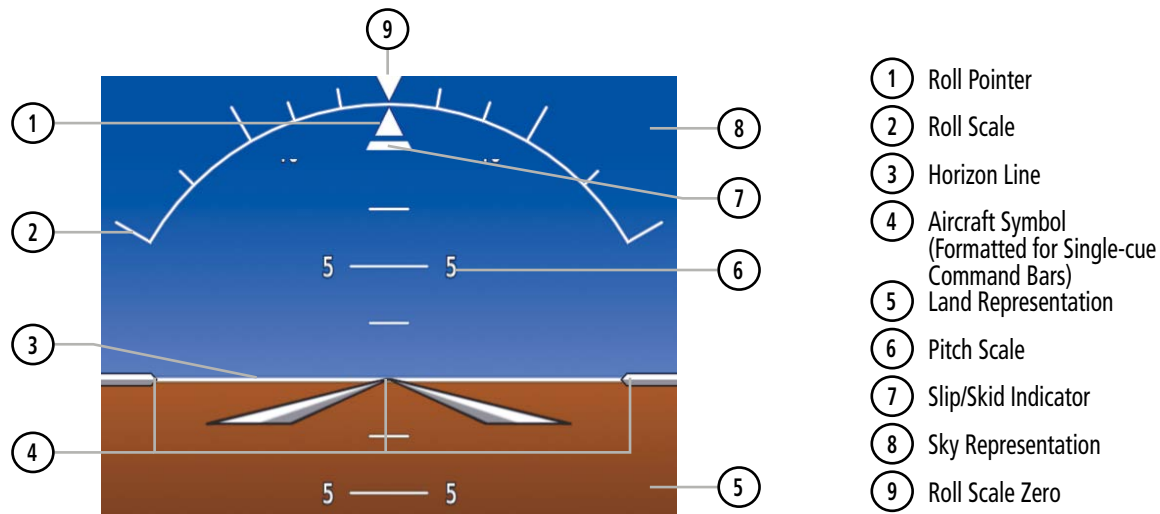
Figure 2-8 Attitude Indicator

1	Roll Pointer
2	Roll Scale
3	Horizon Line
4	Aircraft Symbol (Formatted for Single-cue Command Bars)
5	Land Representation
6	Pitch Scale
7	Slip/Skid Indicator
8	Sky Representation
9	Roll Scale Zero

The horizon line is part of the pitch scale. Above and below the horizon line, major pitch marks and numeric labels are shown every 5°. Between 20° below to 20° above the horizon line, minor pitch marks occur every 2.5°.

The inverted white triangle indicates zero on the roll scale. Major tick marks at 30° and 60° and minor tick marks at 10°, 20°, and 45° are shown to the left and right of the zero. Angle of bank is indicated by the position of the pointer on the roll scale.

The Slip/Skid Indicator is the bar beneath the roll pointer. The indicator bar moves with the roll pointer and moves laterally away from the pointer to indicate uncoordinated flight (Figure 2-9). Slip (inside the turn) or skid (outside the turn) is indicated by the location of the bar relative to the pointer.

The Attitude Indicator also provides pitch cues to comply with TCAS II Resolution Advisories; see the Hazard Avoidance Section for details.

The Pitch Limit Indicator appears on the pitch scale if the aircraft is near a stall condition; refer to the Angle of Attack discussion later in this section for more information.

Figure 2-9 Slip/Skid Indication

The symbolic aircraft on the Attitude Indicator changes appearance based on selection of AFCS Flight Director Command Bar format (see the AFCS Section for details). Both PFDs show the same Flight Director/Aircraft Symbol. The Flight Director/Aircraft Symbol format (single cue or dual cue) is crew-selectable on the 'Avionics Settings' Screen.

Single Cue Symbolic Aircraft   Dual Cue Symbolic Aircraft

Figure 2-10 Flight Director/Symbolic Aircraft Format Settings

Changing the Flight Director/Aircraft Symbol format:

1) From Home, touch Utilities > Setup > Avionics Settings.

2) Touch the System Tab.

3) Touch the Flight Director Active Format data field.

4) Touch desired setting (Single Cue or Dual Cue).

ALTIMETER

The Altimeter displays 1000 feet of barometric altitude values at a time on a moving tape rolling number gauge. Numeric labels and major tick marks are shown at intervals of 500 feet. Minor tick marks are at intervals of 100 feet. The current altitude is displayed in the black pointer.

The Selected Altitude is displayed above the Altimeter in the box indicated by a selection bug symbol. A bug corresponding to this altitude is shown on the tape. If the Selected Altitude exceeds the range shown on the tape, the bug appears at the corresponding edge of the tape. When the metric value is selected it is displayed in a separate box below the Selected Altitude.

A magenta Altitude Trend Vector extends up or down the left of the altitude tape, the end resting at the approximate altitude to be reached in 6 seconds at the current vertical speed. The trend vector is not shown if altitude remains constant or if data needed for calculation is not available due to a system failure.

ALTIMETER SETTING

Turning the **BARO** Knob changes the altimeter barometric pressure setting. Pushing the **BARO** Knob will set standard barometric pressure (29.92 in Hg), displayed as 'STD BARO'. If 'STD BARO' has been set prior to turning the **BARO** Knob, an Altimeter Setting Preview Window is displayed upon turning the knob. This feature allows setting the altimeter prior to descending below the standard barometric transition altitude. Pushing the **BARO** Knob after descending through the transition sets the previewed value to the current altimeter setting.
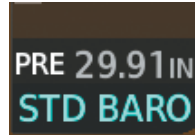
Figure 2-11 Altimeter Setting Preview

> **NOTE:** *Adjusting the altimeter barometric setting creates discontinuities in VNAV vertical deviation, moving the descent path. For large adjustments, it may take several minutes for the aircraft to re-establish on the descent path. If the change is made while nearing a waypoint with a VNAV Target Altitude, the aircraft may not re-establish on the descent path in time to meet the vertical constraint.*

Selecting the altimeter barometric pressure setting:

1) Turn the **BARO** Knob to select the desired setting. If the setting is entered into the 'Altimeter Setting Preview' Window, proceed to step 2.

2) Push the **BARO** Knob after descending past the barometric transition altitude.

Selecting standard barometric pressure:

Push the **BARO** Knob to select standard pressure; STD BARO is displayed in the 'Barometric Setting' Box.
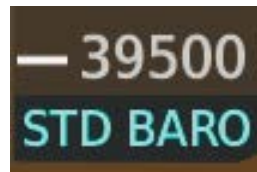
Figure 2-12 Standard Barometric Altimeter Setting

Changing altimeter barometric pressure setting units:

1) Press the **PFD Settings** Softkey to display the second-level softkeys

2) Press the **Other PFD Settings** Softkey.

3) Press the **Altitude Units** Softkey.

4) Press either the **IN** (Inches) or **HPA** (Hectopascals) Softkey.

If the barometric altimeter settings differ between PFDs, the indications turn amber.

Figure 2-13 Barometric Setting on PFDs not Synchronized

Syncing Altimeter BARO Pressure::

1) From Home, touch **Utilities > Setup > Avionics Settings**.

1) If necessary, touch the **System** Tab.

3) Touch the **Sync Altimeter BARO Pressure Settings** Button.

4) Touch the **On** Button.

If either PFD controller fails, the copilot-side barometric pressure setting will automatically synchronize with the pilot-side barometric pressure setting.

SELECTED ALTITUDE

Setting the Selected Altitude:

Turn the **ALT** Knob on the AFCS Controller to update the Selected Altitude in 1000-ft increments or push and hold the **ALT** Knob to update the Selected Altitude in 100-ft increments.

If set, the Minimum Altitude Alert value is also available for the Selected altitude.
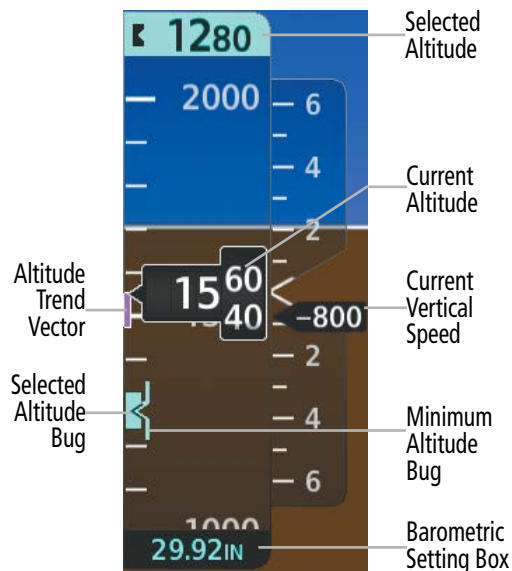
Figure 2-14 Altimeter
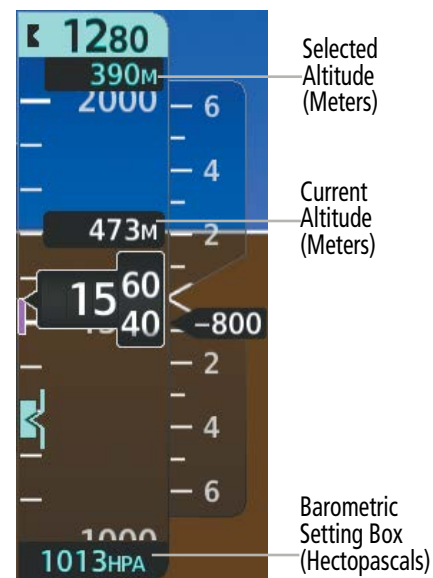
Figure 2-15 Altimeter (Metric)

ALTITUDE DISPLAY UNITS

The Altimeter displays the current altitude and Selected Altitude in feet. If desired, the system may also display metric overlay boxes for these values on the altitude tape. The altitude tape does not change scale when the metric overlay feature is enabled.

Enabling/disabling metric overlays on the Altimeter:

1) Press the **PFD Settings** Softkey to display the second-level softkeys

2) Press the **Other PFD Settings** Softkey.

3) Press the **Altitude Units** Softkey.

4) Press the **Meters** Softkey to toggle the metric altitude overlay.

BAROMETRIC TRANSITION ALTITUDE ALERT

A Baro Transition Alert is provided to alert the pilot to change the barometric pressure setting when crossing the transition altitude in either direction. This is displayed by the flashing cyan barometric pressure setting when crossing the transition altitude.

Setting the Baro Transition Alert:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **Alerts** Tab.

   - To turn the alert on or off, touch the **BARO Transition ALT Climb** Button or the **BARO Transition LVL Descent** Button.

   - To set or change the BARO Transition ALT Climb or LVL Descent Altitude, touch the data field. Enter the desired altitude on the keypad, and touch **Enter**.

   - To revert to the published altitude, touch the **Revert to Published** Button and touch **OK** on the confirmation screen.

Figure 2-16 Baro Transition Alert

BARO QFE ALTIMETER SETTING

⚠️ *WARNING: Do not use a QFE altimeter setting outside of the terminal environment for the corresponding issuing airport to ensure adequate obstacle clearance.*

BARO QFE is the isobaric surface pressure at the airfield reference point. With BARO QFE set, the altimeter will read zero at the airfield reference point or the touch-down zone of the runway in use. At other altitudes the altimeter will read an indication of the height above the reference point. Refer to PFD Annunciations and Alerting Functions in this section for QFE annunciations.

QFE mode should be enabled and the Baro setting should be set to the QFE setting in conjunction with each other. This can be done automatically by arming QFE while the baro setting is still set to STD BARO ahead of time; at the appropriate time set the baro setting on the PFD to the QFE setting when QFE operation is required. When both baro settings are set to something other than STD BARO with QFE armed, BARO QFE mode will automatically become active.

When entering QFE VNAV altitude constraints, it is important to note the only current QFE reference is used. It is not possible to enter a QFE constraint for the destination while the origin is the current reference. Therefore, while QFE is active and the QFE reference is the origin:

» QFE constraints cannot be entered for the destination airport/runway

» QFE constraints cannot be entered for any arrival/approach waypoints

» Entering an MSL/AGL constraint for any departure/enroute waypoints displays a message clarifying the constraint will be shown as a converted QFE value relative to the origin

---

NOTE: *'FMS Origin' and 'FMS Destination' references do not dynamically update with flight plan changes. Always verify QFE settings when changing the QFE reference (airfield, runway, etc.) or flight plan and re-enter settings within the Avionics Settings.*

NOTE: *VPTH changes and VSD and/or VNV discontinuities may occur when switching from QNH to QFE Baro settings.*

Setting BARO QFE:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **Units** Tab.

3) Touch the **BARO QFE** or **Reference ELEV** Button to display the keypad.

4) Manually enter the QFE Altitude using the Keypad or large and small right knobs.

   Or:

   Touch the **Use FMS Origin** Button or **Use FMS Destination** Button to use the field elevation for the respective origin or destination airport as the reference field elevation value. If the flight plan does not contain an origin or destination airport, the respective button(s) are subdued.

VERTICAL SPEED INDICATOR (VSI)

The Vertical Speed Indicator (VSI) displays the aircraft vertical speed on a fixed scale with labels at 2000, 4000, and 6000 fpm and minor tick marks every 1000 fpm. Digits appear in the pointer when the climb or descent rate is greater than 100 fpm. If the rate of ascent/descent exceeds 6000 fpm, the pointer appears at the edge of the tape and the rate appears inside the pointer.

A magenta chevron is displayed on the VSI to indicate the Required Vertical Speed for reaching a VNAV target altitude once the "TOD [Top of Descent] within 1 minute" alert has generated. See the Flight Management and AFCS sections for details on VNAV features. Refer to VNAV Indications in this section for more information. The VSI also provides vertical speed guidance during TCAS II Resolution Advisories; see the Hazard Avoidance section for details.

VERTICAL DEVIATION

When Vertical Navigation (VNAV) is being used, the Vertical Deviation Indicator (VDI) appears to the left of the altimeter and is displayed with a magenta 'V' at the top of the scale and a magenta chevron indicating the vertical deviation. The VDI appears in conjunction with the "TOD within 1 minute" alert. The VDI is removed from the display if vertical deviation becomes invalid. See the Flight Management Section for details on VNAV features, and refer to VNAV Indications in this section for more information.

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The Glideslope Indicator appears to the left of the Altimeter whenever an ILS frequency is tuned in the active NAV field. A green diamond acts as the Glideslope Indicator, like a glideslope needle on a conventional indicator. The Glideslope Preview, a hollow gray diamond, is displayed when the navigation source is set to FMS, in addition to a localizer frequency being tuned on the navigation receiver and receiving glideslope information. When the system auto-switches the active navigation source to the localizer frequency the Glideslope Indicator is displayed as a solid green diamond. If a localizer frequency is tuned and there is no glideslope, "NO GS" is displayed in place of the diamond.

Figure 2-17 Vertical Speed and Deviation Indicators (VSI and VDI)

Figure 2-18 Glideslope Indicator

> **NOTE:** *The Glidepath Indicator appears on the display as soon as the Final Approach Fix (FAF) becomes the active waypoint. Depending on procedure design, pilot action, and/or ATC clearance, the aircraft may be centered on or above the glidepath when the Glidepath Indicator appears.*

> **NOTE:** *When the temperature is warmer than a standard day, the system-generated glidepath guidance for a non-precision approach may cross below the FAF minimum altitude restriction.*

The Glidepath Indicator is a vertical deviation scale for GPS approaches supporting SBAS vertical guidance (L/VNAV, LPV) or advisory vertical guidance (LNAV+V, LP+V, Visual). The Glidepath Indicator, a magenta diamond appears on the display as soon as the Final Approach Fix (FAF) becomes the active waypoint, and FMS is the selected navigation source. Full-scale deflection (two dots), is angular with upper and lower limits. The upper limit is ±492 feet (150 meters) and lower limits depend on approach service level to as follows:

- LNAV/VNAV, LNAV+V, LP+V and Visual is ±148 feet (45 meters).
- LPV is ±49 feet (15 meters).

If the approach downgrades past the final approach fix (FAF), "NO GP" is displayed in place of the diamond.

While executing an LNAV/VNAV approach, and between the FAF and MAP, the Vertical Deviation Limit Indicators appear as vertical white lines indicating the area where deviation exceeds allowable limits for the glidepath. The Vertical Deviation Limit Indicator provides a scaled representation of ±75 feet of the calculated glidepath. The "window" between the lines represents the area of acceptable deviation. The length of the lines

will change while progressing through the final approach. When the Glidepath Indicator enters an excessive deviation area, the Glidepath and Vertical Deviation Limit Indicators are amber.

When the AFCS is coupled to the VNAV Path Descent Mode (V PATH) while inbound to the FAF waypoint, a hollow gray diamond or solid gray pentagon (if baro VNAV is used for vertical guidance) is displayed to indicate the Glidepath Preview. The glidepath preview remains displayed until the AFCS captures the glidepath. At this point, the glidepath indicator will change from the gray (preview) to the active (magenta) diamond or pentagon depending on the approach being flown.

If the AFCS is not coupled to the V PATH, the magenta glidepath indicator will be displayed as soon as the approach becomes active and the FAF is the next active waypoint. For more information on V PATH refer to AFCS section for further details.

While executing an LNAV/VNAV approach and SBAS is unavailable or disabled, baro VNAV (barometric vertical navigation) is used for vertical guidance. This occurs due to any of the following conditions:

- SBAS fails or becomes unavailable prior to the FAF.
- The aircraft is outside of SBAS coverage.
- SBAS is manually disabled on the 'GPS Status' Screen of the Touchscreen Controller.

Baro VNAV is also the source of vertical approach guidance if the LNAV/VNAV procedure does not support SBAS vertical guidance.

While baro VNAV is being used, the Glidepath Indicator appears as a magenta pentagon. If the approach downgrades past the final approach fix (FAF), "NO GP" is displayed in place of the pentagon.
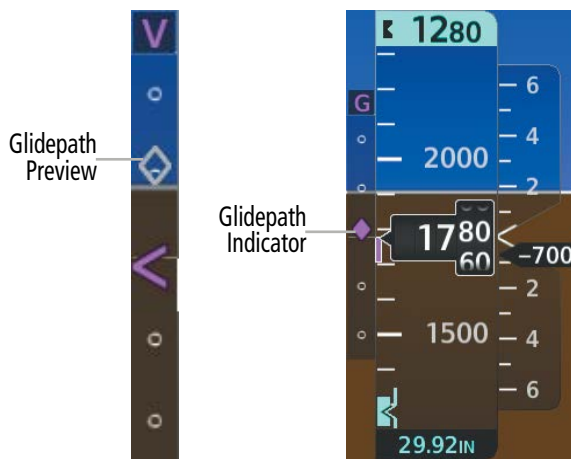
Figure 2-19 Glidepath Indicator
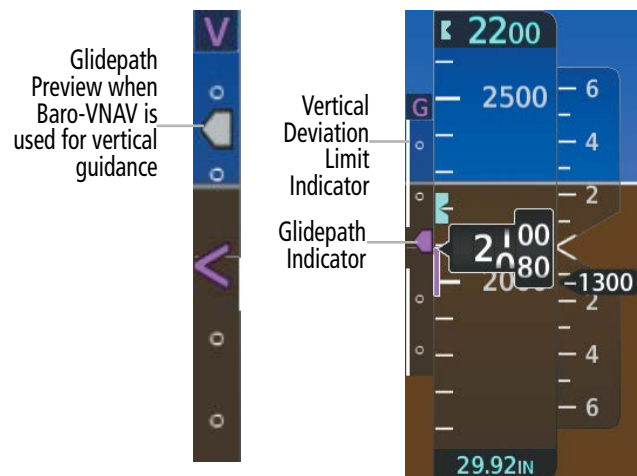
Figure 2-20 Glidepath Indicator (Baro-VNAV) and Vertical Deviation Limit Indicators
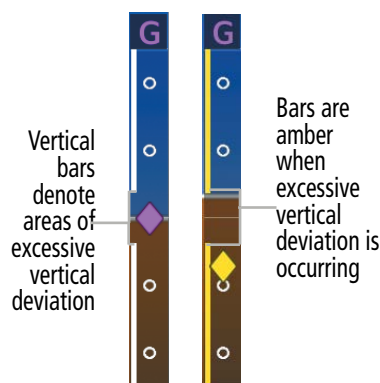
Figure 2-21 Glidepath With Excessive Vertical Deviation

VERTICAL NAVIGATION (VNAV) INDICATIONS

When a VNAV flight plan has been activated, VNAV indications (VNAV Target Altitude, RSVI, VDI) appear on the PFD in conjunction with the "TOD within 1 minute" message and double chime aural alert. See the Flight Management section for details on VNAV features. VNAV indications are removed from the PFD according to the criteria listed in the following table.

Criteria	VNAV Indication Removed		
	Required Vertical Speed (RSVI)	**Vertical Deviation (VDI)**	**VNAV Target Altitude**
Aircraft > 1 min before the next TOD due to flight plan change	X	X	X
VNAV cancelled	X	X	X
Distance to active waypoint cannot be computed due to unsupported flight plan leg type (see Flight Management Section)	X	X	X
Aircraft > 250 feet below active VNAV Target Altitude	X	X	X
Current crosstrack or track angle error has exceeded 90° limit	X	X	X
Active altitude-constrained waypoint can not be reached within maximum allowed flight path angle and vertical speed	X	X	

Table 2-2 VNAV Indication Removal Criteria

HORIZONTAL SITUATION INDICATOR (HSI)

The Horizontal Situation Indicator (HSI) displays a rotating compass card in a heading-up orientation. Letters indicate the cardinal points and numeric labels occur every 30°. Major tick marks are at 10° intervals and minor tick marks at 5° intervals. A digital reading of the current heading appears on top of the HSI, and the current track is represented on the HSI by a magenta diamond. The HSI also presents turn rate, course deviation, bearing, and navigation source information.

The HSI with the HSI Map disabled contains a Course Deviation Indicator (CDI), with a Course Pointer, To/From Indicator, and a sliding deviation bar and scale. The course pointer is a single line arrow (FMS, VOR1, and LOC1) or a double line arrow (VOR2 and LOC2) which points in the direction of the set course. The To/From arrow rotates with the course pointer and is displayed when the active NAVAID is received.

1	Heading Bug	7	Course Deviation Indicator (CDI)
2	Selected Heading	8	Rotating Compass Card
3	Current Track Indicator	9	Lateral Deviation Scale
4	To/From Indicator	10	Approach Service Level
5	Navigation Source	11	Desired Track/Selected Course
6	Aircraft Symbol	12	Current Heading
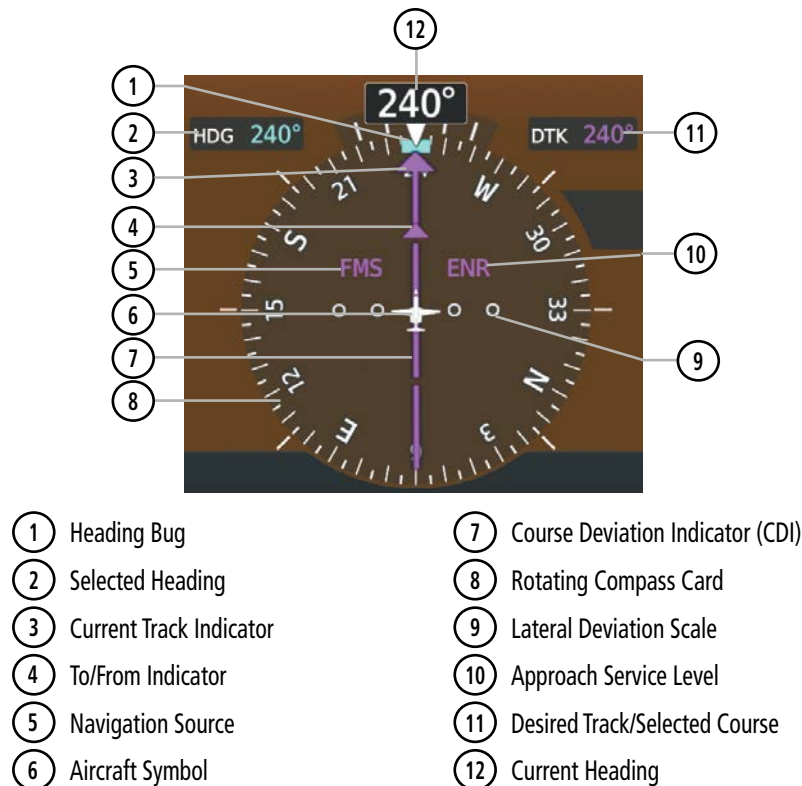
Figure 2-22 Horizontal Situation Indicator

A digital reading of the current heading appears above the rotating compass card. A magenta diamond on the HSI represents the current track over the ground the aircraft is flying. To the upper left of the HSI, the Selected Heading is shown, which corresponds to the cyan heading bug on the compass rose. While the HSI is displayed in HSI Map format, if the Selected Heading Bug is adjusted off the shown portion of the compass rose, the Selected Heading Bug will appear at the edge of the HSI Map.

The Desired Track (DTK) is shown in magenta to the upper right of the HSI when the selected navigation source is FMS. The Selected Course (CRS) is shown to the upper right of the HSI when the selected navigation source is VOR or LOC and in magenta when the selected navigation source is FMS. Upon station passage, the To/From Indicator flips and points to the tail of the aircraft, just like a conventional To/From flag. Depending on the navigation source, the CDI can appear in two different ways: an arrowhead (FMS or VOR) or a diamond (LOC).

When the pilot enables the HSI Map, the HSI is formatted to show a navigation map on the rotating compass card. The following information appears above the Current Heading when the HSI Map is enabled:

» A sliding deviation indicator (the To/From and deviation indicators are combined)

» Deviation scale

» Navigation Source

» Flight Phase

» Dead Reckoning (DR) Mode Annunciation

» Crosstrack Error (XTK)

The HSI Map is a 210 ° expanded compass rose which also includes a navigation map with overlay capabilities such as topographical, weather, and land information. The HSI Map contains a Course Pointer, a combined To/From Indicator with a sliding deviation indicator, and a lateral deviation scale. Upon passing a station, the To/From Indicator points to the tail of the aircraft. Depending on the navigation source, the CDI on the HSI Map can appear either as an arrowhead (FMS, or VOR) or as a diamond (LOC). Refer to the Flight Management Section for information about using HSI Map overlays.

Figure 2-23 HSI Map

Enabling/disabling the HSI Map:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Map Layout** Softkey.

3) Press the **HSI Map** Softkey to display the HSI Map.

Adjusting the selected heading:

Turn the **HDG** Knob to set the Selected Heading on both PFDs.

Or:

Push the **HDG** Knob to synchronize the bug to the current heading.

Adjusting the Selected Course:

Turn the **CRS** Knob to set the Selected Course (for each PFD).

Push the **CRS** Knob to re-center the CDI and return the course pointer to the bearing of the active waypoint or navigation station.
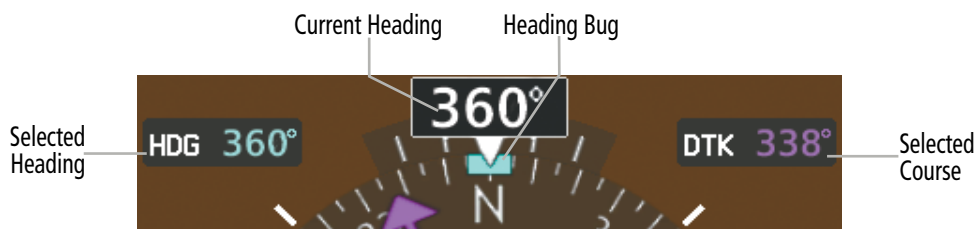
Figure 2-24 Heading and Course Indications (Magnetic)

Navigation angles (track, heading, course, bearing) are corrected to the computed magnetic variation or referenced to true north (denoted 'T'), and are set on the Touchscreen Controller Avionics Settings Screen. When an approach referenced to true north has been loaded into the flight plan, the system generates a message to change the navigation angle setting to 'True' at the appropriate time.
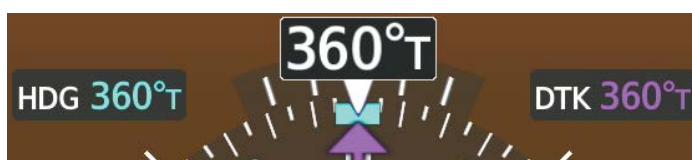
Figure 2-25 Heading and Course Indications (True)

Changing the navigation angle setting:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **Units** Tab.

3) Touch the **Nav Angle** Button.

4) Touch either the **Magnetic (°)** or **True (°т)** Button.

Figure 2-26 Navigation Angle Settings

TURN RATE INDICATOR

The Turn Rate Indicator is located directly above the rotating compass card. Tick marks to the left and right of the lubber line denote half-standard and standard turn rates. A magenta Turn Rate Trend Vector shows the current turn rate. The end of the trend vector gives the heading predicted in six seconds, based on the present turn rate. A standard-rate turn is shown on the indicator by the trend vector stopping at the standard turn rate tick mark, corresponding to a predicted heading of 18° from the current heading. At rates greater than 4 deg/sec, an arrowhead appears at the end of the magenta trend vector and the prediction is no longer valid.
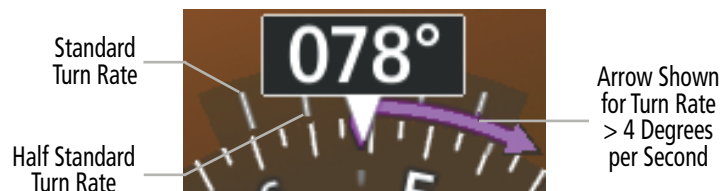
Figure 2-27 Turn Rate Indicator and Trend Vector

BEARING POINTERS

Two bearing pointers and associated information can be displayed on the HSI for NAV and FMS sources by touching the **Bearing 1** Softkey or the **Bearing 2** Softkey on the PFD. The bearing pointers are cyan and are single-line (Bearing 1) or double-line (Bearing 2). A pointer symbol is shown in the NAV/DME Information Windows to indicate the navigation source. The bearing pointers never override the CDI and are visually separated from the CDI by a white ring. Bearing pointers may be selected but not necessarily visible due to data unavailability.

Figure 2-28 HSI with Bearing and Distance Information

When a bearing pointer is displayed, the information associated with it is also appears. The following information is displayed below the HSI:

» Bearing source (NAV, FMS, or ADF)

» Pointer icon (Bearing 1 = single line, Bearing 2 = double line)

» Frequency (NAV)

» Station/waypoint identifier (NAV, FMS)

» GPS-derived great circle distance to bearing source

When the NAV radio is tuned to an ILS frequency, the bearing source and bearing pointer are removed from the HSI. When NAV1 or NAV2 is the selected bearing source, the frequency is replaced by the station identifier when the station is within range. If FMS is the bearing source, the active waypoint identifier is displayed in lieu of a frequency.

The bearing pointer is removed from the HSI and dashes are displayed in place of the frequency or waypoint identifier if the NAV radio is not receiving the tuned VOR station or if FMS is the bearing source and there is no active waypoint.

If the GPS-derived great circle distance to the bearing source is not available, dashes appear instead of the distance.

> **Selecting bearing display and changing sources:**

1) Press the **PFD Settings** Softkey.

2) Press the **Bearing 1** or **Bearing 2** Softkey to display the desired bearing pointer and information window with a NAV source.

3) Press the **Bearing 1** or **Bearing 2** Softkey again to change the bearing source to FMS, NAV, or ADF.

4) To remove the bearing pointer and information window, press the **Bearing 1** or **Bearing 2** Softkey again.

COURSE DEVIATION INDICATOR (CDI)

The Course Deviation Indicator (CDI) moves left or right from the course pointer along a lateral deviation scale to display aircraft position relative to the course. If the course deviation data is not valid, the CDI is not displayed.
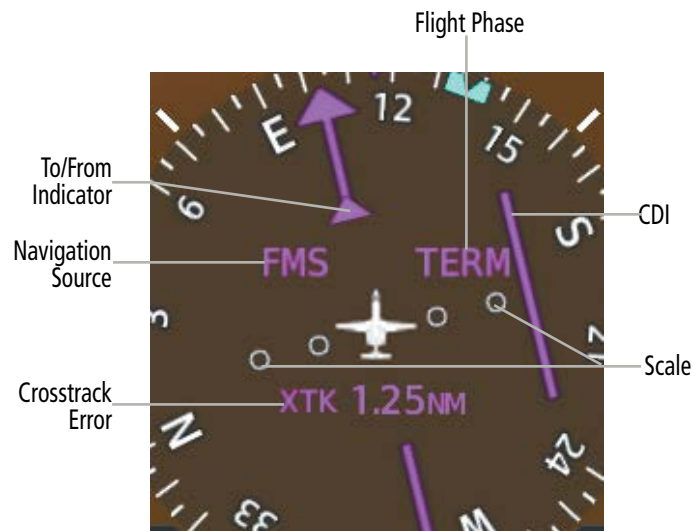
Figure 2-29 Course Deviation Indicator

The CDI can show FMS, VOR, or LOC as the navigation source. Color indicates the current navigation source, magenta for FMS and green for VOR and LOC. The full scale limits for the CDI are defined by an FMS-derived distance when coupled to the FMS. If the CDI exceeds the maximum deviation on the scale (two dots) while navigating with FMS, the crosstrack error (XTK) is displayed below the white aircraft symbol. When navigating using a VOR or localizer (LOC), the CDI scale indicates five degrees for the first dot and 10 degrees for the second dot.

When navigating with the FMS, and a NAVAID-based approach is activated (excluding an NDB), a preview of the approach course is indicated by the dashed gray pointer on the HSI. As the aircraft approaches the final approach course, the two course pointers converge. When the system auto-switches to the localizer NAV source, the pointer and CDI will change to green.

The system supports the use of GPS as a substitute to fly any VOR, VOR/DME or NDB approach. When flying the approach using the FMS, a preview of the VOR final approach course is displayed on the HSI for situational awareness. The system will display "LNAV" or "LNAV+V" after the approach title on the selection page and make vertical deviation available as appropriate for both VOR and NDB approaches.

Preview CRS Pointer and CDI

Localizer Approach Course Preview

Figure 2-30 Navigation Sources

Changing navigation sources:

1) Press the **Active NAV** Softkey to change from FMS to VOR1/LOC1.

2) Press the **Active NAV** Softkey again to change from VOR1/LOC1 to VOR2/LOC2.

3) Press the **Active NAV** Softkey a third time to return to FMS.

FMS Selected

VOR1 Selected

VOR2 Selected

Figure 2-31 Selecting a Navigation Source

The system automatically switches from FMS to LOC navigation source and changes the CDI scaling accordingly when all of the following occur:

- A localizer or ILS approach has been loaded into the active flight plan
- The final approach fix (FAF) is the active waypoint, the FAF is less than 15 nm away, and the aircraft is moving toward the FAF
- A valid localizer frequency has been tuned
- The FMS CDI deviation is less than 1.2 times full-scale deflection

If the AFCS LOC mode has been armed either automatically or by the crew using the APPR button, the system will automatically switch from FMS to LOC navigation source once the AFCS captures the LOC mode.

Activating a Vector-to-Final (VTF) on an ILS or VOR approach causes the CDI to switch to LOC navigation source. FMS steering guidance is not provided after this switch.

When navigating with FMS and a VOR +V or NDB +V approach is activated, the HSI may indicate 'LNAV+V' or 'LNAV' depending on the availability of advisory vertical guidance.

On some ILS approaches where the glideslope intercept point is at or in close proximity to the fix prior to the FAF, it is possible to be above the glideslope when the navigation source automatically switches from FMS to LOC. The probability of this occurring varies based on air temperature.

If the same VOR/LOC navigation source is selected on both PFDs, the navigation source annunciation is amber on both displays if not synchronized. If the CDIs are synchronized ('Sync CDI' enabled), they indicate the same thing. When powering on the system for use, it recalls the last CDI synchronization setting.

Synchronizing the CDIs:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **System** Tab.

3) Scroll and touch the Sync CDI Datafield.

4) Touch a button for the desired setting (**On** or **Off**).
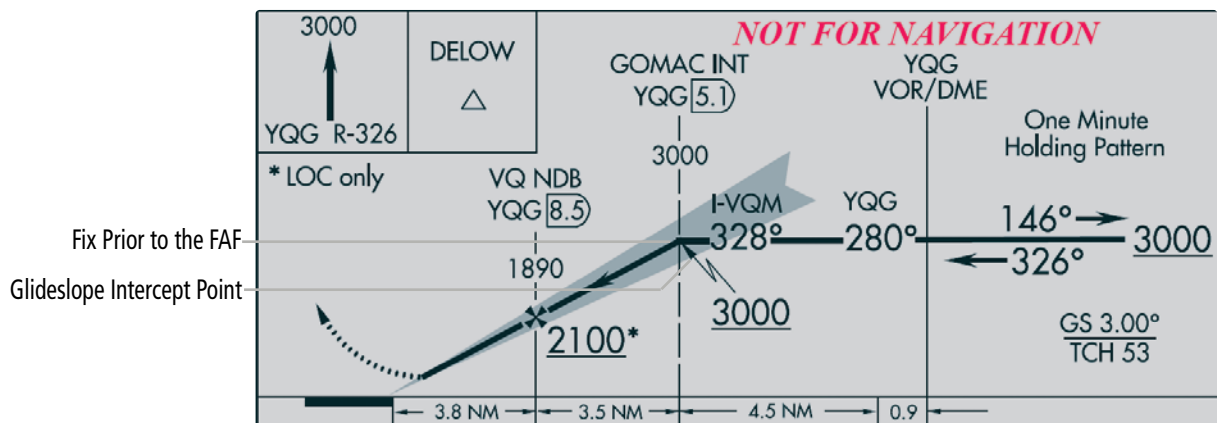
Figure 2-32 ILS Approach with Glideslope Intercept Point at Fix Prior to the FAF

FMS (GPS) CDI SCALING

When FMS is the selected navigation source, the flight plan legs are sequenced automatically and annunciations appear on the HSI for the flight phase. Flight phase annunciations are normally shown in magenta, but when cautionary conditions exist the color changes to amber. If the current leg in the flight plan is a heading leg, 'HDG LEG' is annunciated in magenta beneath the aircraft symbol.

The current FMS CDI scale setting is displayed on the 'Avionics Settings' Screen and the full-scale deflection setting may also be changed on this screen. If the selected scaling is smaller than the automatic setting for enroute and terminal phases, the CDI is scaled accordingly and the selected setting is displayed rather than the flight phase annunciation.

Changing the selected FMS CDI setting:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **System** Tab.

3) Scroll if necessary and touch the 'GPS CDI' Datafield.

4) Touch a button for the desired setting (**0.30NM, 1.00NM, 2.00NM,** or **AUTO**).

When set to 'AUTO' (default), the FMS CDI scale automatically adjusts to the desired limits based upon the current phase of flight (Table 2-3).
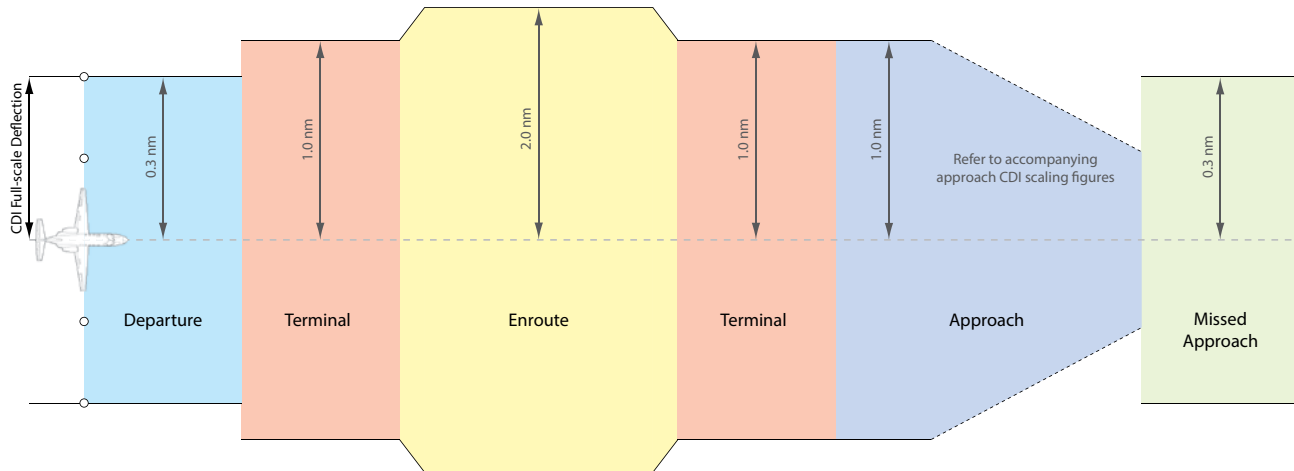
Figure 2-33 Automatic CDI Scaling

» Once a departure procedure is activated, the CDI is scaled for departure (0.3 nm).

» The system switches from departure to terminal CDI scaling (1.0 nm) under the following conditions:
  § The next leg in the departure procedure is not aligned with the departure runway
  § The next leg in the departure procedure is not a CA, CD, CF, CI, CR, DF, FA, FC, FD, FM, IF, or TF (see Glossary for leg type definitions)
  § After any leg in the departure procedure that is not a CA or FA

» At 30 nm from the departure airport, the enroute phase of flight is automatically entered and CDI scaling changes to 2.0 nm over a distance of 1.0 nm, except under the following conditions:
  § When navigating with an active departure procedure, the flight phase and CDI scale does not change until the aircraft arrives at the last departure waypoint (if more than 30 nm from the departure airport) or the leg after the last departure waypoint has been activated or a direct-to waypoint is activated.

» If after completing the departure procedure the nearest airport is more than 200 nm away from the aircraft and the approach procedure has not yet commenced, the CDI is scaled for oceanic flight (4.0 nm).

» Within 31 nm of the destination airport (terminal area), the CDI scale gradually ramps down from 2.0 nm to 1.0 nm over a distance of 1.0 nm; except under the following conditions:
  § Upon reaching the first waypoint of an arrival route that is more than 31 nm from the destination airport, the flight phase changes to terminal and the CDI scale begins to transition down from 2.0 nm to 1.0 nm over a distance of 1.0 nm.

» During approach, the CDI scale ramps down even further. This transition normally occurs within 2.0 nm of the final approach fix (FAF). The CDI switches to approach scaling automatically once the approach procedure is activated or if Vectors-To-Final (VTF) are selected.

    ▪ If the active waypoint is the FAF, the ground track and the bearing to the FAF must be within 45° of the final approach segment course.

    ▪ If the active waypoint is part of the missed approach procedure, the active leg and the preceding missed approach legs must be aligned with the final approach segment course and the aircraft must not have passed the turn initiation point.
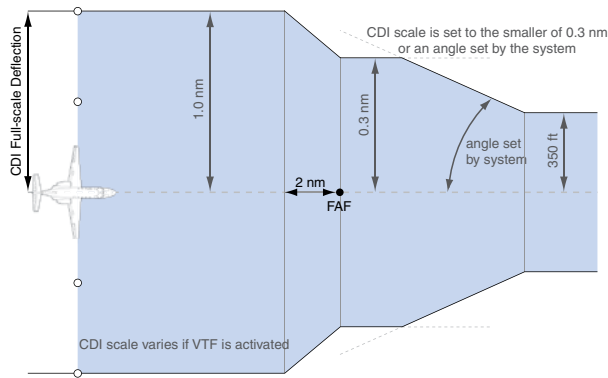
Figure 2-34 Typical LNAV and LNAV+V Approach Service Level CDI Scaling
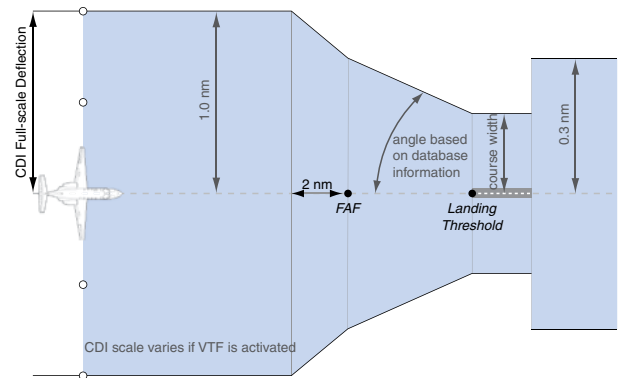
Figure 2-35 Typical LNAV/VNAV, LP, LPV, and LP+V Approach Service Level CDI Scaling

» When a missed approach is activated, the CDI scale changes to 0.3 nm.

» The system automatically switches back to terminal mode under the following conditions:

    ▪ The next leg in the missed approach procedure is not aligned with the final approach path

    ▪ The next leg in the missed approach procedure is not a CA, CD, CF, CI, CR, DF, FA, FC, FD, FM, IF, or TF

    ▪ After any leg in the missed approach procedure that is not a CA or FA

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Flight Phase	Annunciation*	Automatic CDI Full-scale Deflection
Departure	**DPRT**	0.3 nm
Terminal	**TERM**	1.0 nm
Enroute	**ENR**	2.0 nm
Oceanic	**OCN**	4.0 nm
Approach (Non-precision)	**LNAV**	1.0 nm decreasing to 350 feet depending on variables (see Figure 2-33)
Approach (Non-precision with Advisory Vertical Guidance)	**LNAV + V**	
	VISUAL	
Approach (LNAV/VNAV)	**L/VNAV**	1.0 nm decreasing to a specified course width, then 0.3 nm, depending on variables (see Figure 2-34)
Approach (LP)	**LP**	
Approach (LP+V)	**LP+V**	
Approach (LPV)	**LPV**	
Missed Approach	**MAPR**	0.3 nm

* Annunciations are normally shown in magenta, but when cautionary conditions exist the color changes to amber.

Table 2-3 Automatic GPS CDI Scaling

OBS MODE

> **NOTE:** *VNAV is inhibited while automatic waypoint sequencing has been suspended.*

Enabling Omni-bearing Selector (OBS) Mode suspends the automatic sequencing of waypoints in a GPS flight plan (FMS must be the selected navigation source), but retains the current "active-to" waypoint as the navigation reference even after passing the waypoint. OBS is annunciated to the lower right of the aircraft symbol when OBS Mode is selected on the HSI, or to the right of the HSI Map.

While OBS Mode is enabled, a course line is drawn through the Active-to waypoint on the moving map. If desired, the course to/from the waypoint can now be adjusted. When OBS Mode is disabled, the flight plan returns to normal operation with automatic sequencing of waypoints, following the course set in OBS Mode. The flight path on the moving map retains the modified course line.

OBS Mode Enabled   OBS Mode Disabled

Figure 2-36 Omni-bearing Selector (OBS) Mode on the HSI Map

Enabling/disabling OBS Mode while navigating a GPS flight plan:

1) Press the **OBS** Softkey to select OBS Mode.

2) Turn a **CRS** Knob to select the desired course to/from the waypoint. Push the **CRS** Knob to synchronize the Selected Course with the bearing to the next waypoint.

3) Press the **OBS** Softkey again to return to automatic waypoint sequencing.

As the aircraft crosses the missed approach point (MAP), automatic approach waypoint sequencing is suspended. SUSP appears on the HSI at the lower right of the aircraft symbol. The **OBS** Softkey label changes to indicate the suspension is active as shown in the following figure. Selecting the **SUSP** Softkey deactivates the suspension and resumes automatic sequencing of approach waypoints.

SUSP Annunciation

Figure 2-37 Suspension of Automatic Waypoint Sequencing

2.2 GARMIN SVT (SYNTHETIC VISION TECHNOLOGY)

⚠ *WARNING: Use appropriate primary systems for navigation, and for terrain, obstacle, and traffic avoidance. Garmin SVT is intended as an aid to situational awareness only and may not provide either the accuracy or reliability upon which to solely base decisions and/or plan maneuvers to avoid terrain, obstacles, or traffic.*

✓ *NOTE: Do not use the flight path marker as a flight director.*

Garmin SVT™ (Synthetic Vision Technology) is a visual enhancement to the system. SVT depicts a forward-looking attitude display of the topography immediately in front of the aircraft. The field of view is 35.5 degrees to the left and to the right if the PFD is operating in Full Mode, or 25 degrees to the left and to right in Split Mode. SVT information is shown on the Primary Flight Display (PFD), or on the Multifunction Display (MFD) in Reversionary Mode. The depicted imagery is derived from the aircraft attitude, heading, GPS three-dimensional position, and a 4.9 arc-second database of terrain, obstacles, and other relevant features. The terrain data resolution of 4.9 arc-seconds, meaning the terrain elevation contours are stored in squares measuring 4.9 arc-seconds on each side, is required for the operation of SVT. Loss of any of the required data, including temporary loss of the GPS signal, will cause SVT to be disabled until the required data is restored.

The SVT terrain display shows land contours (colors are consistent with those of the topographical map display), large water features, towers, and other obstacles over 200' AGL that are included in the obstacle database. Cultural features on the ground such as roads, highways, railroad tracks, cities, and state boundaries are not displayed even if those features are found on the MFD map. The terrain display also includes a north–south east–west grid with lines oriented with true north and spaced at one arc-minute intervals to assist in orientation relative to the terrain.

The Terrain Awareness and Warning System (TAWS) is integrated within SVT to provide visual and auditory alerts to indicate the presence of terrain and obstacle threats relevant to the projected flight path. Terrain alerts are displayed in red and yellow shading on the PFD.

The terrain display is intended for situational awareness only. It may not provide the accuracy or fidelity on which to base decisions and plan maneuvers to avoid terrain or obstacles. Navigation must not be predicated solely upon the use of the TAWS terrain or obstacle data displayed by the SVT.

The following SVT enhancements appear on the PFD:

- Flight Path Marker
- Horizon Heading Marks
- Traffic Display
- Airport Signs
- Runway Display
- Terrain Alerting
- Obstacle Alerting
- Flight Path Angle Reference

Figure 2-38 Synthetic Vision Imagery

SVT OPERATION

SVT is activated from the PFD using the softkeys located along the bottom edge of the display. Pressing the softkeys turns the related function on or off.

SVT functions are displayed on three levels of softkeys. The **PFD Settings** Softkey leads into the PFD function Softkeys, including synthetic vision. Pressing the **Attitude Overlays** Softkey displays the SVT feature softkeys. The softkeys are labeled **Synthetic Terrain**, **Horizon Heading**, **Airport Signs**, and **FPA Ref Settings**. The **Back** Softkey returns to the previous level of softkeys. Synthetic Terrain must be active before any other SVT feature may be activated. A green annunciator on the softkey label indicates the feature is activated.

The **Airport Signs** Softkey is only available when the **Synthetic Terrain** Softkey is activated. When the **Synthetic Terrain** Softkey is activated the Flight Path Marker is automatically displayed on the PFD.

- **Synthetic Terrain** Softkey enables synthetic terrain depiction.
- **Horizon Heading** Softkey enables the display of heading marks and digits on the zero pitch line.
- **Airport Signs** Softkey enables airport signposts.
- **FPA Ref Settings** Softkey enables flight path angle reference selection.

The crew profile defines the state (on or off) of these features.

> **Enabling SVT depiction:**
>
> 1) Press the **PFD Settings** Softkey.
>
> 2) Press the **Attitude Overlays** Softkey.
>
> 3) Press the **Synthetic Terrain** Softkey.

Enabling the display of Horizon Headings:

1) Press the **PFD Settings** Softkey.

2) Press the **Attitude Overlays** Softkey.

3) Press the **Horizon Heading** Softkey.

Enabling the display of Airport Signs:

1) Press the **PFD Settings** Softkey.

2) Press the **Attitude Overlays** Softkey.

3) If the PFD is in Split Mode, press the **SVT Settings** Softkey.

4) Press the **Airport Signs** Softkey.

Enabling Flight Path Angle Reference Settings:

1) Press the **PFD Settings** Softkey.

2) Press the **Attitude Overlays** Softkey.

3) If the PFD is in Split Mode, press the **FPA Ref Settings** Softkey.

4) Press the **FPA MANUAL** Softkey which displays the current Flight Path Angle Reference setting in cyan.

5) Press the appropriate **-1°, -0.1°, +0.1°,** or **+1°** Softkeys as needed to select the desired reference angle.

6) Press the **FPA MANUAL** Softkey to toggle the Flight Path Angle Reference display.

SVT FEATURES

Figure 2-39 SVT on the Primary Flight Display

> ✓ **NOTE:** *The terrain feature is not a substitute for standard course and altitude deviation information provided by the altimeter, CDI, and VDI.*

FLIGHT PATH MARKER

The Flight Path Marker (FPM), also known as a Velocity Vector, is displayed on the PFD at groundspeeds above 30 knots. The FPM depicts the approximate projected path of the aircraft accounting for wind speed and direction relative to the three-dimensional terrain display.

When enabled, the FPM is restricted to an imaginary region on the PFDs known as the boundary box. Horizontally, the boundary box extends from the right side of the airspeed tape to the left side of the altitude tape. The vertical dimensions extend from the top of the roll arc to the top of the HSI.

Figure 2-40 Flight Path Marker Position is Affected by Wind

FLIGHT PATH ANGLE REFERENCE

Flight Path Angle Reference provides a visual indication of the desired climb/descent angle on the SVT pitch scale. When activated, the Flight Path Angle Reference will serve as a guide for the Flight Path Marker to aid achieving a proper vertical flight profile. The Flight Path Angle Reference can be set between -9.9 and +9.9 degrees of pitch using softkeys. AUTO mode uses the active VNAV profile to determine the flight path angle.

Enabling Flight Path Marker with Synthetic Vision disabled:

1) Press the **PFD Settings** Softkey.

2) Press the **Attitude Overlays** Softkey.

3) Press the **FPM Settings** Softkey.

4) Press the **FPM Enable** Softkey to Enable/Disable Flight Path Marker. (This button is subdued when Synthetic Terrain is enabled.)

ZERO PITCH LINE

The Zero Pitch Line is drawn completely across the display and represents the horizon when the terrain horizon is difficult to distinguish from other terrain being displayed. It may not align with the terrain horizon, particularly when the terrain is mountainous or when the aircraft is flown at high altitudes.

HORIZON HEADING

The Horizon Heading is synchronized with the HSI and shows approximately 60 degrees of compass heading in 30-degree increments on the Zero Pitch Line. Horizon Heading tick marks and digits appearing on the zero pitch line are not visible behind either the airspeed or altitude display. Horizon Heading is used for general heading awareness.

TRAFFIC

⚠ *WARNING: Intruder aircraft at or below 500 ft. AGL may not appear on the SVT display or may appear as a partial symbol.*

Traffic symbols are displayed in their approximate locations as determined by the related traffic systems. Traffic symbols are displayed in three dimensions, appearing larger as they are getting closer, and smaller when they are further away. Traffic within 250 feet laterally of the aircraft will not appear on the SVT display. Traffic symbols and coloring are consistent with that used for traffic displayed on the navigation maps and the 'Traffic Map' Pane. If the traffic altitude is unknown, the traffic will not be displayed on the SVT display. For more details refer to the traffic system discussion in the Hazard Avoidance section.

AIRPORT SIGNS

Airport Signs provide a visual representation of airport location and identification on the synthetic terrain display. When activated, the signs appear on the display when the aircraft is approximately 15 nm from an airport and disappear at approximately 4.5 nm. Airport signs are shown without the identifier until the aircraft is approximately eight nautical miles from the airport. Airport signs are not shown behind the airspeed or altitude display.

Figure 2-41 Airport Signs

RUNWAYS

⚠️ **WARNING:** *Do not use Garmin SVT runway depiction as the sole means for determining the proximity of the aircraft to the runway or for maintaining the proper approach path angle during landing.*

✔️ **NOTE:** *Not all airports have runways with endpoint data in the database, therefore, these runways are not displayed.*

Runway data provides improved awareness of runway location with respect to the surrounding terrain. All runway thresholds are depicted at their respective elevations as defined in the database. In some situations, where threshold elevations differ significantly, crossing runways may appear to be layered. As runways are displayed, those within 45 degrees of the aircraft heading are displayed in white. Other runways will be gray in color. When an approach for a specific runway is active, that runway will appear brighter and be outlined with a white box, regardless of the runway orientation as related to aircraft heading. As the aircraft gets closer to the runway, more detail such as runway numbers and centerlines will be displayed.

Figure 2-42 Airport Runways

TRAFFIC

⚠️ **WARNING:** *Intruder aircraft at or below 500 ft. AGL may not appear on the SVT display or may appear as a partial symbol.*

Traffic symbols are displayed in their approximate locations as determined by the related traffic systems. Traffic symbols are displayed in three dimensions, appearing larger as they are getting closer, and smaller when they are further away. Traffic within 250 feet laterally of the aircraft will not be displayed on the SVT display. Traffic symbols and coloring are consistent with the non-directional symbols shown on navigation maps and traffic maps. If the traffic altitude is unknown, the traffic will not be displayed on the SVT display. For more details refer to the traffic system discussion in the Hazard Avoidance section.

TAWS ALERTING

Terrain alerting on the synthetic terrain display is triggered by Forward-looking Terrain Avoidance (FLTA) alerts, and corresponds to the yellow terrain shading for a caution alert and the red shading for a warning alert on the navigation maps and 'TAWS' Pane. For more detailed information regarding TAWS, refer to the Hazard Avoidance Section.

In some instances, a terrain or obstacle alert may be issued with no conflict shading displayed on the synthetic terrain. In these cases, the conflict is outside the SVT field of view to the left or right of the aircraft.

Figure 2-43 Terrain Alert

Obstacles are represented on the synthetic terrain display by standard two-dimensional tower symbols found on map displays. Obstacle symbols appear in the perspective view with relative height above terrain and distance from the aircraft. Unlike the map displays, which color obstacles relative to the aircraft's altitude, obstacles on the synthetic terrain display do not change colors to warn of potential conflict with the aircraft's flight path until the obstacle is associated with an actual FLTA alert. Obstacles greater than 1000 feet below the aircraft altitude are not shown. Obstacles are shown behind the airspeed and altitude displays.

Figure 2-44 Obstacle

FIELD OF VIEW

The PFD field of view can be represented on the MFD Navigation Map Page. Two dashed lines forming a V-shape in front of the aircraft symbol on the map, represent the forward viewing area shown on the PFD.

> **Toggling the SVT field of view depiction:**

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If not already selected, touch the **Other** Tab.

3) Scroll to display the **Field of View** Annunciator Button.

4) Touch the **Field of View** Button to enable or disable the field of view indication.

The following figure compares the PFD forward looking depiction with the MFD plan view and Field of View turned on. When the PFD is in Split Mode, the of view representation on the 'Navigation Map' Pane changes to reflect the narrow field of view.

Lines depict PFD Field of View

Figure 2-45 PFD and 'Navigation Map' Pane Field of View Comparison

2.3 SUPPLEMENTAL FLIGHT DATA

In addition to the flight instruments, the PFDs also display various supplemental information, including an AOA indicator, wind data, and a generic timer.

ANGLE OF ATTACK (AOA) INDICATOR

The Angle of Attack (AOA) Indicator appears on the PFD below the airspeed indicator and displays the normalized angle of attack. White, amber, and red arcs indicate AOA ranges. The pointer color matches the color of the arc associated with the current AOA value.

The pilot can enable the display of the AOA Indicator on the PFD, or select the auto mode. The default setting for the AOA Indicator is auto mode. In auto mode, the AOA Indicator appears when the landing gear is down and locked, or the flaps are 'not up'. Otherwise, the AOA Indicator is removed.

Figure 2-46 Angle of Attack (AOA) Indicator

Selecting the AOA Indicator display mode:

1) Press the **PFD Settings** Softkey to display the second-level softkeys.

2) Press the **Other PFD Settings** Softkey.

3) Press the **AOA** Softkey to cycle through AOA Indicator display modes.

WIND DATA

Wind direction (relative to aircraft heading) and speed in knots can be displayed on the upper left of the HSI. When the window is selected for display, but wind information is invalid or unavailable, the system shows "NO WIND DATA". Wind data can be displayed in three different ways:
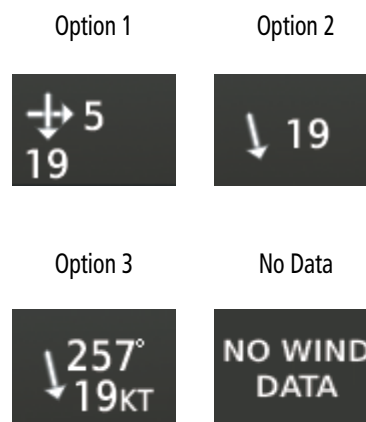
Figure 2-47 Wind Data

Displaying wind data:

1) Press the **PFD Settings** Softkey.

2) Press the **Other PFD Settings** Softkey.

3) Press the **Wind** Softkey to display wind data display options.

4) Press one of the **Option** Softkeys to change how wind data is displayed:

- **Option 1**: Headwind/tailwind and crosswind arrows with numeric speed components.

- **Option 2**:Total wind direction arrow with numeric speed.

- **Option 3**: Total wind direction arrow with direction (°) and speed (KT) components.

5) To remove the window, press the **Off** Softkey.

GENERIC TIMER

The generic timer can be accessed on the 'Timer' Screen of the Touchscreen Controller.   It allows for quick access for timing functions (either counting up or down) for the pilot.

Setting the generic timer:

1) From Home, touch **Utilities > Timer**.

2) Touch the **Time** Button.

3) Input the desired time using the Keypad or large and small right knobs, then touch the **Enter** Button or push the right knob.

4) Touch either the **Up** Button to count up or the **Down** Button to count down.

5) To start the timer, touch the **Start** Button. The button changes to a **Stop** Button.

6) To stop the timer, touch the **Stop** Button.

7) To reset the timer, touch the **Reset** Button.

2.4 PFD ANNUNCIATIONS AND ALERTING FUNCTIONS

The following annunciations and alerting functions are displayed on the PFD. Refer to Appendix A for more information on alerts and annunciations.

MARKER BEACON ANNUNCIATIONS

Marker Beacon Annunciations are displayed on the PFD to the left of the Selected Altitude. Outer marker reception is indicated in blue, middle in amber, and inner in white. Refer to the Audio and CNS Section for more information on Marker Beacon Annunciations.
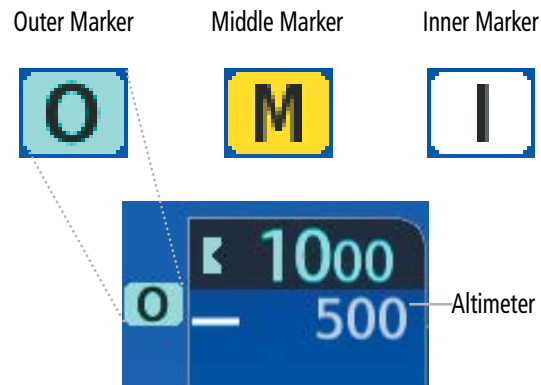
Figure 2-48 Marker Beacon Annunciations

ALTITUDE ALERTING

Altitude Alerting provides the pilot with visual and aural alerts when approaching the Selected Altitude. Whenever the Selected Altitude is changed, the Altitude Alerter is reset. The following occur when approaching the Selected Altitude:

- Upon passing through 1000 feet of the Selected Altitude, the Selected Altitude changes to black text on a cyan background and flashes for five seconds.
- When the aircraft passes within 200 ft of the Selected Altitude and the Selected Altitude changes to cyan text on a black background and flashes for five seconds.
- After reaching the Selected Altitude, if the pilot flies outside the deviation band (±200 feet of the Selected Altitude) an aural tone is heard. The Selected Altitude changes to black text on a amber background and flashes for five seconds.

Figure 2-49 Altitude Alerting Visual Annunciations

LOW ALTITUDE ANNUNCIATION

> ✓ **NOTE:** *The Low Altitude Annunciation requires SBAS. Terrain alerts from the TAWS system will appear instead of the Low Altitude Annunciation when TAWS is operating and not inhibited.*

When the Final Approach Fix (FAF) is the active waypoint in a GPS SBAS approach using vertical guidance, a Low Altitude Annunciation may appear if the current aircraft altitude is at least 164 feet below the prescribed altitude at the FAF. A black-on-amber 'LOW ALT' annunciation appears to the middle left of the Altimeter, flashing for several seconds then remaining displayed until the condition is resolved.

LOW ALT

Figure 2-50 Low Altitude on GPS SBAS Approach

MINIMUM ALTITUDE ALERTING

For altitude awareness, a barometric Minimum Altitude Alert can be set in the References Window and is reset if the current approach is deleted, another approach is loaded, or the system power is operated off then on. For example, while enroute, the crew may choose to set the MEA. When the crew loads an approach, the set minimum altitude alert is removed, and the crew may enter approach minimums. When active, the altitude setting is displayed to the lower left of the Altimeter. The function serves only as an alert and does not couple to the autopilot. Once the altitude is within the range of the tape, a bug appears at the reference altitude on the Altimeter. The following visual annunciations occur when approaching the minimum altitude alert:

- When the aircraft altitude is over 100 ft above the minimum altitude alert setting, the BARO MIN or COMP MIN box appears with the altitude in cyan text. The bug appears on the altitude tape in cyan (or magenta for COMP MIN) once in range.
- When the aircraft passes through 100 feet of the altitude alert, the bug and text turn white.
- Once the aircraft reaches the alert value, the bug and text become amber and a "Minimums. Minimums" voice alert occurs.

Cyan Within 2500 ft   White Within 100 ft   Amber When Altitude Reached

Minimum Altitude Bug

Figure 2-51 Barometric Minimum Altitude Alerting Visual Annunciations

Alerting is inhibited while the aircraft is on the ground and until the aircraft reaches 150 feet above the set value. If the aircraft proceeds to climb after having reached the alerting altitude, once it reaches 50 feet above the value, alerting is disabled. The function is reset when the power is cycled or a new approach is activated.

Setting the Minimum Altitude Alert and bug:

1) From Home, touch **Utilities > Minimums > Minimums**.

2) Touch the **Baro,** or **Temp Comp** Button (**Off** is selected by default.)

   • If **Temp Comp** is selected, touch **Temp at Dest**. Use the keypad to enter desired temperature, and touch the **Enter** Button.

3) Use the keypad to enter the desired altitude from zero to 16,000 feet (zero to 2,500 feet for RA) and touch the **Enter** Button.

Figure 2-52 Baro and Temp Comp Minimum Altitude Alerting

NOTE: *The previously entered minimums values remain when a different minimums source is selected, until the system is powered off.*

NOTE: *For temperature compensated minimums to be displayed on the PFDs, the active flight plan must contain an airport.*

2.5 ABNORMAL OPERATIONS

ABNORMAL GPS CONDITIONS

The annunciations listed in Table 2-5 can appear on the HSI when abnormal GPS conditions occur.

Annunciation	Location	Description
GPS LOI	Left of the HSI	Loss of Integrity Monitoring–GPS integrity is insufficient for the current phase of flight
GPS INTEG OK	Left of HSI	FMS integrity has been restored to within normal limits (annunciation displayed for five seconds)
DR	Lower left of aircraft symbol	Dead Reckoning–System is using projected position rather than FMS position to compute navigation data and sequence active flight plan waypoints

Table 2-4 Abnormal GPS Conditions Annunciated on HSI
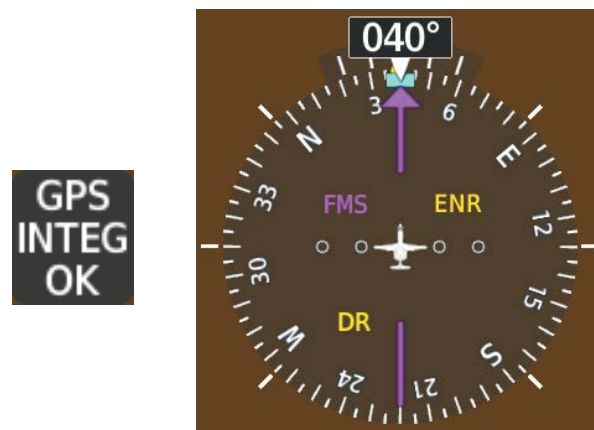
Figure 2-53 Abnormal GPS Condition Annunciations

In Dead Reckoning Mode the following items on the PFD are then shown in amber:

- CDI
- Current Track Indicator
- Wind Data
- Distances to bearing sources displayed in the NAV/DME Information Bar
- GPS bearing pointers

These items should be verified when operating in Dead Reckoning Mode and they become increasingly inaccurate over time.

COMPARATOR ANNUNCIATIONS

The Comparator monitors critical values generated by redundant sensors. If differences in the sensors exceed a specified amount, a comparator annunciation is displayed in black text on an amber background. If one or both of the sensed values are unavailable, the comparator annunciation is black text on a white background. PFD annunciations flash again as if they were new when a display mode change occurs on the PFD. The following is a list of the possible annunciations:
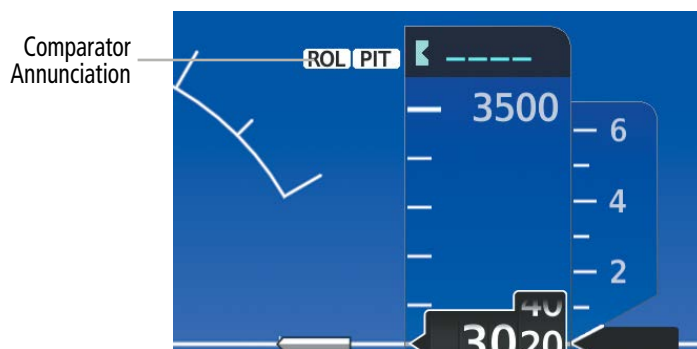
Figure 2-54 Sensor Comparator Annunciations on the PFD

The following is a list of the possible annunciations:

Annunciation		Condition
ALT	MISCOMPARE	Difference in altitude sensors is ≥ 200 ft.
IAS	MISCOMPARE	If either airspeed sensor detects ≥ 35 knots, and the difference in sensors is > 10 knots.
		If either airspeed sensor detects ≥ 80 knots, and the difference in sensors is > 7 knots.
HDG	MISCOMPARE	Difference in heading sensors is > 6 degrees.
PIT	MISCOMPARE	Difference in pitch sensors is > 5 degrees.
ROL	MISCOMPARE	Difference in roll sensors is > 6 degrees.
VDI	MISCOMPARE	Difference in temperature compensated altitudes is > 50 ft.
ALT	NO COMP	No data from one or both altitude sensors.
IAS	NO COMP	No data from one or both airspeed sensors.
HDG	NO COMP	No data from one or both heading sensors.
PIT	NO COMP	No data from one or both pitch sensors.
ROL	NO COMP	No data from one or both roll sensors.
VDI	NO COMP	No temperature compensated altitude data available from one or both sources.

Table 2-5 Sensor Comparator Annunciations

REVERSIONARY SENSOR ANNUNCIATIONS

Reversionary sensor selection for attitude/heading, air data, and GPS is annunciated on the PFDs. These annunciations reflect reversionary sensors selected on one or both PFDs. Selecting the **Sensors** Softkey gives access to **ADC 1**, **ADC 2**, **ATT/HDG 1**, and **ATT/HDG 2 Softkeys**. These softkeys allow manual switching of the ADC and AHRS sensors. In the case of certain types of sensor failures (e.g. GPS), the system may make some sensor selections automatically.

Figure 2-55 Reversionary Sensor Annunciations on the PFD

Reversionary Sensor Window Text	Condition
BOTH ON ADC 1	Both PFDs are displaying data from the #1 Air Data Computer.
BOTH ON ADC 2	Both PFDs are displaying data from the #2 Air Data Computer.
BOTH ON AHRS 1	Both PFDs are displaying data from the #1 Attitude & Heading Reference System.
BOTH ON AHRS 2	Both PFDs are displaying data from the #2 Attitude & Heading Reference System.
BOTH ON GPS 1	Both PFDs are displaying data from the #1 GPS.
BOTH ON GPS 2	Both PFDs are displaying data from the #2 GPS.
USING ADC 1	PFD2 is displaying data from the #1 Air Data Computer.
USING ADC 2	PFD1 is displaying data from the #2 Air Data Computer.
USING AHRS 1	PFD2 is displaying data from the #1 AHRS.
USING AHRS 2	PFD1 is displaying data from the #2 AHRS.
USING GPS1	PFD2 is displaying data from the #1 GPS.
USING GPS2	PFD1 is displaying data from the #2 GPS.

Table 2-6 Reversionary Sensor Annunciations

GARMIN SVT TROUBLESHOOTING

Garmin SVT™ is intended to be used with traditional attitude, heading, obstacle, terrain, and traffic inputs. SVT is disabled when valid attitude or heading data is not available for the display. In case of invalid SVT data, the PFD display reverts to the standard blue-over-brown attitude display.

SVT becomes disabled without the following data resources:

- Attitude data
- Heading data
- GPS position data
- 4.9 arc-second terrain data
- Obstacle data
- TAWS function is not available, in test mode, or failed

UNUSUAL ATTITUDES

When the aircraft enters an unusual pitch attitude, red chevrons pointing toward the horizon warn of extreme pitch. The chevrons are displayed on the Attitude Indicator, starting at 50° above and 30° below the horizon line. The display shows either a brown colored band at the bottom or blue colored band at the top of the screen to represent earth or sky. This is intended to prevent losing sight of the horizon during extreme pitch attitudes.
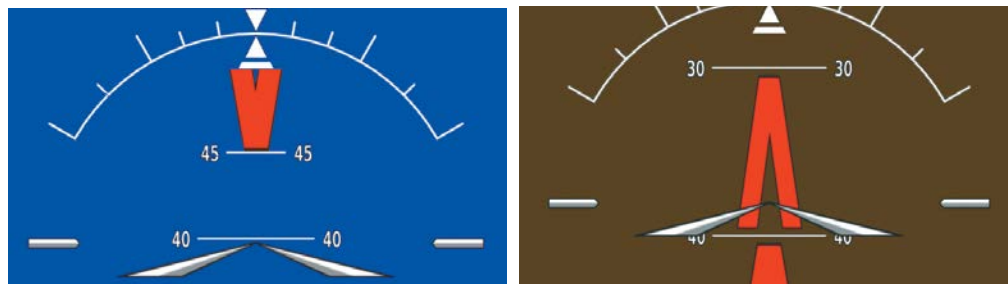
Figure 2-56 Unusual Attitude Display

The blue colored band is also displayed when terrain gradient is great enough to completely fill the display.

If pitch exceeds +30°/-20° or bank exceeds 65°, some information displayed on the PFD is removed. The Altimeter, Airspeed, Attitude, Vertical Speed, and Horizontal Situation indicators remain on the display and the Bearing Information, Alerts, and Annunciation windows can be displayed during such situations. The following information is removed from the PFD (and corresponding Touchscreen Controller buttons are disabled) when the aircraft experiences unusual attitudes:

- Traffic Annunciations
- AFCS Annunciations
- Flight director Command Bars
- Inset Map
- ISA Temperature Deviation
- DME Information
- Wind data
- Selected Heading indication
- Selected Course indication
- System Time
- Windows displayed on the PFD with the exception of CAS
- Minimum Altitude Alert setting
- Vertical Deviation, Glideslope, and Glidepath Indicators
- Altimeter Barometric Setting
- Selected Altitude
- VNAV Target Altitude

SVT UNUSUAL ATTITUDES

During extreme pitch attitudes, the display shows either a brown or blue colored band at the top or bottom of the screen to represent earth or sky. The blue colored band is also displayed when terrain gradient is great enough to completely fill the display. This is intended to prevent losing sight of the horizon during extreme pitch attitudes.

Figure 2-57 Blue Sky Bar with Full Display Terrain

SECTION 3 ENGINE INDICATION AND CREW ALERTING SYSTEM

> **NOTE:** *Refer to the current version of the pertinent flight manual for limitations.*

The system offers improved flight operations and reduces crew workload by automatically monitoring critical system parameters during all phases of flight using the following:

- The **Engine Indication & Crew Alerting System** (EICAS) displays electrical, fuel, oil, engine, CAS and OAT information on the left side of the Multi Function Display (MFD).
- The 'Aircraft Systems' Screen on the Touchscreen Controller provides access to perform system tests and functions accessible to maintenance personnel with password.
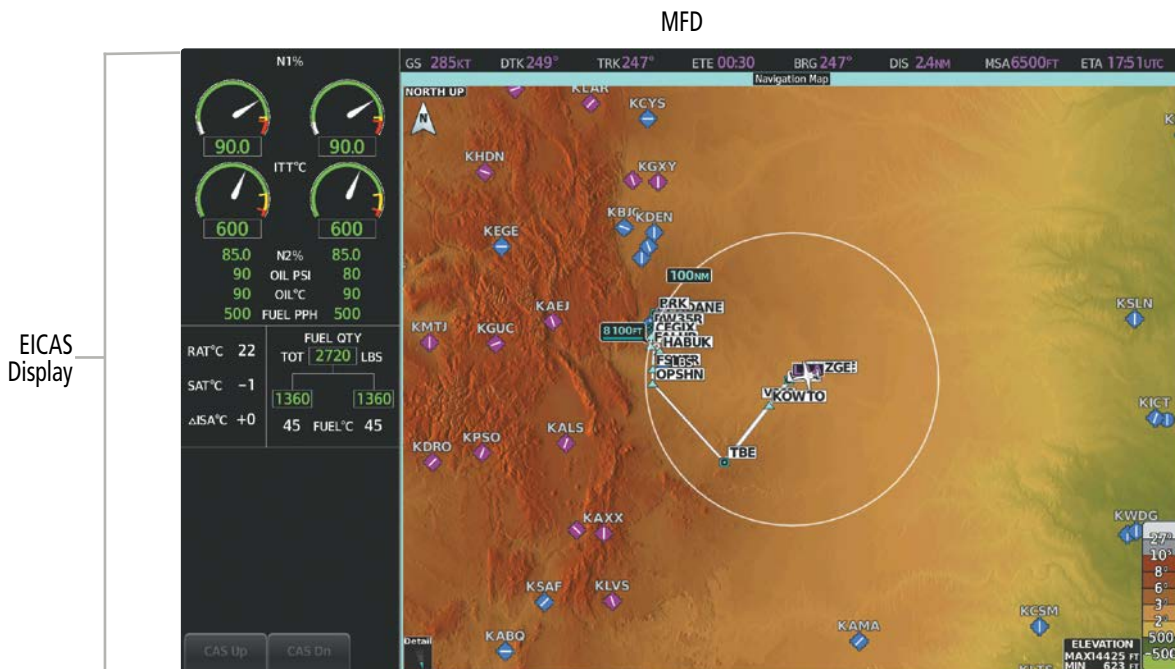
Figure 3-1 EICAS (Normal)

GARMIN.

3.1 ENGINE INDICATION & CREW ALERTING SYSTEM

> **NOTE:** *The gauges displayed and the values shown in this section are taken from the Textron Citation XLS configuration. Refer to the current version of the pertinent flight manual for specific values and operating limitations for all configurations.*

Engine Indication & Crew Alerting System (EICAS) information is presented using gauges and digital displays. During normal operating conditions, gauge pointers appear in white and display text appears in green. When unsafe operating conditions occur, gauge pointers and display change color to indicate caution (amber) or warning (red). Refer to each indicator description for additional details on display behavior.

Parameters out of the range of the display are shown as white dashes. If sensor data for a parameter becomes invalid or unavailable, an amber "X" is displayed across the indicator and/or display.
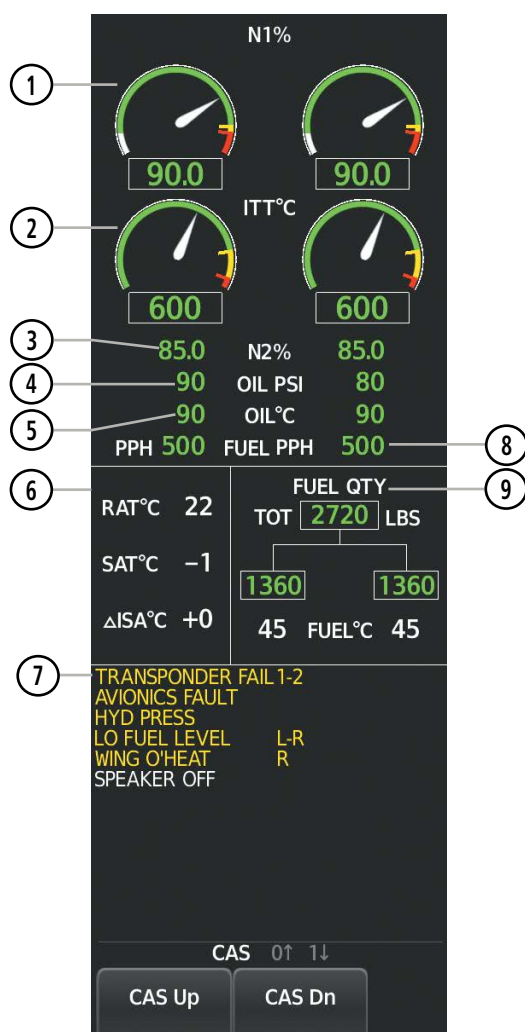
Figure 3-2 EICAS Display (Normal)

(2) **Interstage Turbine Temperature** Displays Interstage Turbine Temperature (ITT) in degrees Celsius (°C). The ITT indication consists of a digital display as well as an analog arc display. When the ITT digital display is active, it is displayed in degrees Celsius. The analog arc color band will change during an engine start.

ITT Start Display

 'START' is displayed in green text outside of the corresponding engine ITT value when the starter is engaged for the respective engine, or black on amber background when the starter is engaged above 45% N2.

Fire Indication

Red 'FIRE' indications are provided to compliment the existing 'ENGINE FIRE' annunciators in the firetray in the event an engine fire is detected. The 'FIRE' indications are displayed when the existing 'ENGINE FIRE' annunciators in the firetray are active.
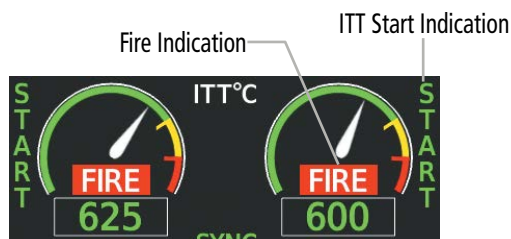
(3) **N2%** N2% displays turbine/high pressure spool speed as a percentage. N2% digits are green during normal operation (including engine start).

Ignitor Display

'IGN' is displayed in green text outside of the corresponding engine N2% digital value when power is being supplied to the exciter unit.

N2% Synchronization Display

'SYNC' is displayed in green text above 'N2%' to denote N2% fan synchronization.

(4) **Oil Pressure** Displays pressure of oil supplied to the engines in pounds per square inch (PSI)

(5) **Oil Temperature** Displays oil temperature in degrees Celsius (°C)

⑥ **OAT**   The following OAT are displayed: Ram Air Temperature (RAT), Static Air Temperature (SAT), Delta ISA

Ram Air Temperature (RAT) is the static air temperature plus the compressive effect of the aircraft airspeed. RAT data is supplied by the right Engine Electronic Controller (EEC).

Static Air Temperature (SAT) is the temperature of the air that would be measured by a stationary thermometer. It is calculated from Total Air Temperature (TAT) and Mach.

Delta ISA is the deviation from International Standard Atmosphere (ISA). Since Delta ISA is a difference, the sign is always shown, even if it is positive.

RAT, SAT, and Delta ISA are displayed in increments of 1°C. The digits are always white. Amber dashes are shown across the display when the RAT value is invalid and the bus is not powered.

⑦ **CAS Display**   Displays Crew Alerting System (CAS) messages. See Crew Alerting System (CAS) in this section for more information.

⑧ **Fuel Flow**   Displays current fuel flow in pounds per hour (PPH)

⑨ **Fuel Quantity**   Displays total fuel quantity in pounds
Displays left and right fuel tank quantities
Displays fuel temperature in degrees Celsius (°C)

3.2 AIRCRAFT SYSTEMS

SYSTEM TESTS

System tests are required for FMS Initialization and should be completed prior to dispatch. The 'System Tests' Screen on the touchscreen controller provides testing functions for the radio altimeter and TCAS.

Touching a button for a specific test activates that particular system test. While a test is active, 'Test In Progress' in will display in the 'Status' Field. The selected button displays "In Progress" in cyan. The "In Progress" text pulses so the crew can quickly identify which test is currently in progress. When the test is complete, the button displays 'Done' (in cyan), or 'Fail' (in amber). See Table 3-1 for a list of expected results for each system test.

All tests are mutually exclusive. If a system test is selected while another test is already running, the currently active test is cancelled and the new test is activated. Pressing an active system test shall deactivate that test.

Accessing the System Tests:

1) From Home, touch **Aircraft Systems > System Tests**.

   Or:

   Touch the **System Tests** Button on the 'Initialization' Screen of either Touchscreen Controller.

2) Touch the desired system test.

System Test	Expected Results
Radio Altimeter	• Radio Altimeter indication changes to a 'test' value • RA TEST annunciation displays on PFDs • Altimeter value increases to 40 feet above current altitude for GRA 5500, 50 feet for Collins ALT-55B, or 100 feet above the current altitude for Honeywell RT-300.
TCAS	• If the test passes, a "TCAS System Test passed" aural message is heard • If the test fails, a "TCAS System Test failed" aural message is heard •'TCAS TEST' indications are shown on the PFDs and on the MFD traffic map. • Red RA visual pitch cues will display on the Vertical Speed Indicator (VSI) and pitch scale.

Table 3-1 System Tests
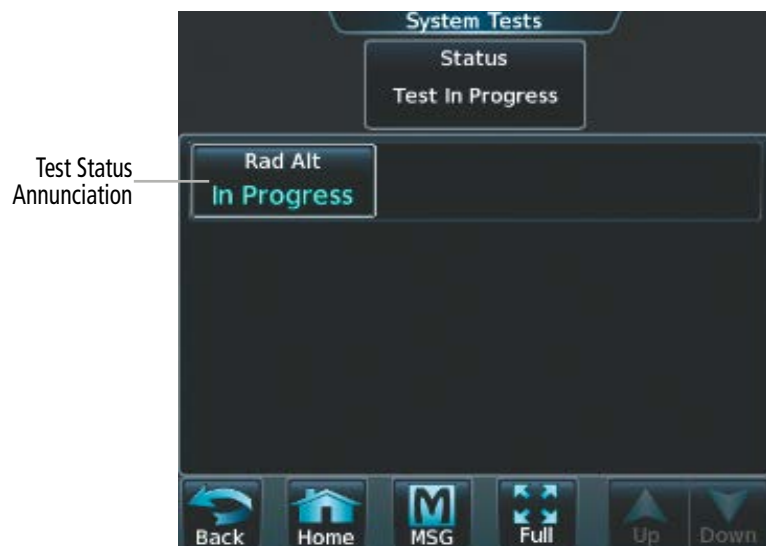
Figure 3-4 'System Tests' Screen

3.3 CREW ALERTING SYSTEM (CAS)

CAS DISPLAY

CAS display shows Master Caution (amber) and Master Warning Messages (red), as well as Advisory Messages (White). Messages flash inverse video until acknowledged by depressing the Master Caution or Master Warning switches respectively. Red warning messages cannot be scrolled through and remain at the top of the CAS display. Some alerts include an aural or voice alert. Up to 13 messages can be displayed. Use the **CAS Up** and **CAS Down** Softkeys to scroll through the messages not shown on the display. In Reversionary Mode, press the **CAS** Softkey to access the **CAS Up** and **CAS Down** Softkeys. Caution (amber) and Advisory (white) messages can be scrolled through anytime. A number with an arrow pointer indicates the number of messages currently out of view either up or down.

Scrollable CAS Messages

CAS UP
CAS Dn
Softkeys
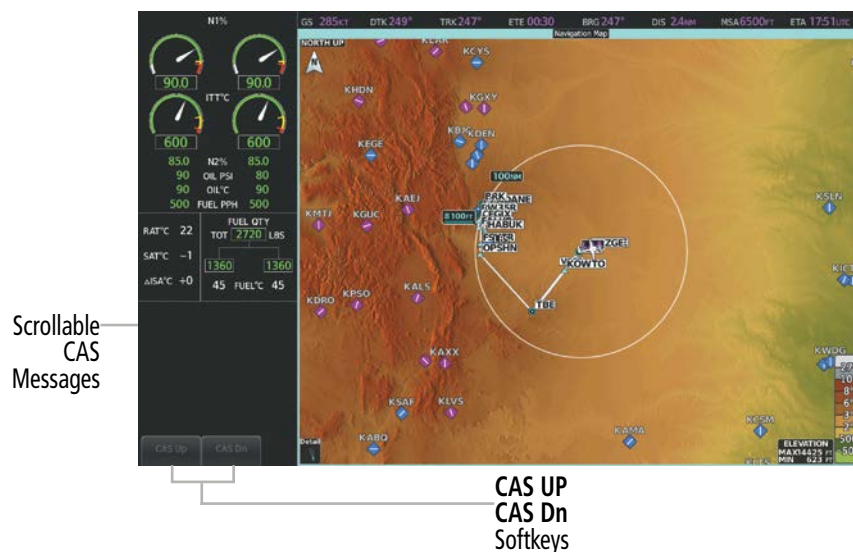
Figure 3-5 CAS Display - Normal Mode

Scrollable CAS Messages

CAS UP
CAS Dn
Softkeys

Figure 3-6 CAS Display - Reversionary Mode

CAS MESSAGE PRIORITIZATION

CAS messages are grouped by criticality (Warning, Caution, Advisory) and sorted by order of appearance (most recent messages on top). The color of the message is based on its urgency and on required action:

» **Warning** (red) – Immediate crew awareness and action required; Master Warning triggered

» **Caution** (amber) – Immediate crew awareness and possible future corrective action required; Master Caution triggered

» **Advisory** (white) – Crew awareness required and subsequent action may be required

Any CAS messages that appears when the system is first powered on are considered already acknowledged (except the 'LO BRK PRESS' message). They do not flash or trigger the Master Warning or Master Caution.

Two momentary switch/indicators are located above L PFD and R PFD for CAS message acknowledgment: Master Warning and Master Caution.

When a new Master Warning (red) message appears, it flashes in conjunction with the flashing Master Warning Switch/Indicators. Pressing a Master Warning Switch/Indicator acknowledges all flashing red messages, extinguishes the master warning lights, and stops the message flashing. Messages are displayed until the issue has been corrected.

When a new Master Caution (amber) message appears on the CAS display, it flashes in conjunction with the Master Caution Switch/Indicators. Pressing a Master Caution Indicator acknowledges all flashing amber messages, extinguishes the master caution lights, and stops the message flashing. Messages are displayed until a Master Caution Switch/Indicator has been pressed, and the issue is corrected.

Advisory messages do not flash (except the GND IDLE and FUEL XFEED messages, which can flash under certain conditions).

Figure 3-7 Panel Layout

A CAS message does not appear more than once at a given time. If signals are received that justify multiple priorities for a certain message, the message is displayed for the higher priority condition. When graduating to a higher priority, the message flashes and requires new acknowledgment. When degrading to a lower priority condition, the message moves to the top of the appropriate grouping, but does not require new acknowledgment.

3.4 REVERSIONARY MODE

In the event of a display failure (or in manual reversionary mode), depending on the failed display(s), the operating display(s) may be re-configured to present Primary Flight Display (PFD) symbology together with condensed EICAS and MFD information (refer to the System Overview for more information about Reversionary Mode).

EICAS Display

Figure 3-8 EICAS (Reversionary Mode)

SECTION 4 AUDIO AND CNS

4.1 OVERVIEW

The Communication/Navigation/Surveillance (CNS) system includes the Audio Controller, communication radios, navigation radios, datalink communication options, and Mode S transponders. The System Overview Section provides a block diagram description of the Audio and CNS system interconnection.

Both the Left and Right MFD GTCs provide primary tuning of the communication transceivers and microphone and receiver audio selection. The Audio Controller includes an intercom system (ICS) between the pilot and copilot, a marker beacon receiver, and a COM clearance recorder. The PFD Controller is used as a secondary means of COM/NAV radio control.

The Mode S transponder is controlled with the Left or Right MFD GTCs only.
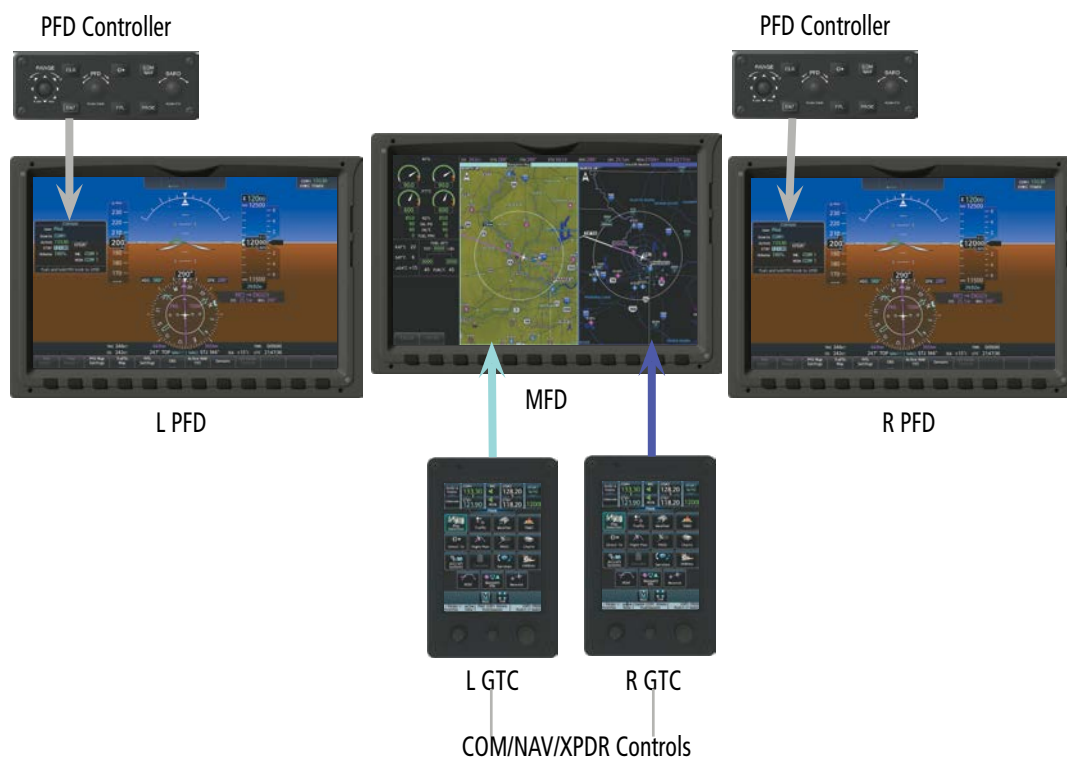
Figure 4-1 G5000 System Controls

GARMIN.

PFD COM/NAV DISPLAY AND CONTROLS
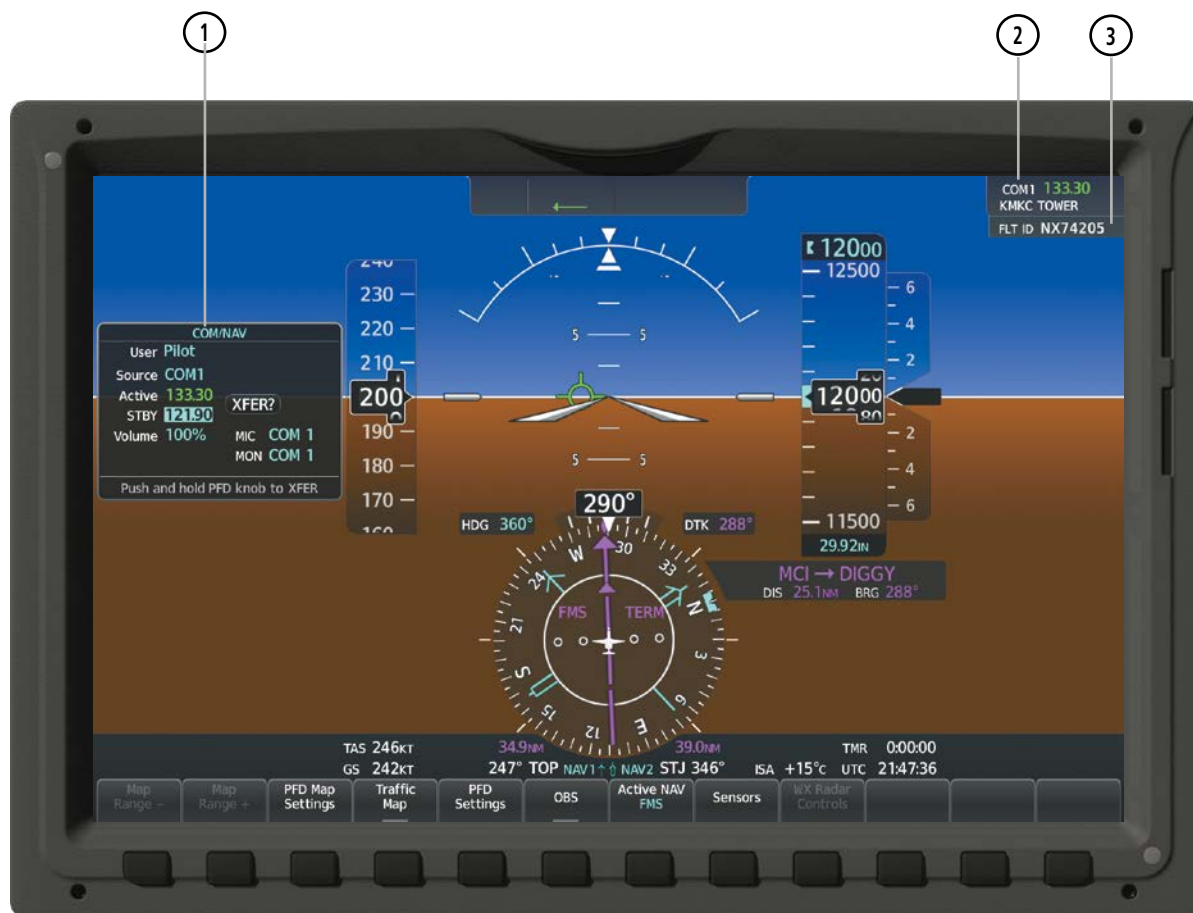
Figure 4-2 COM/NAV Window and Active COM Frequency Box
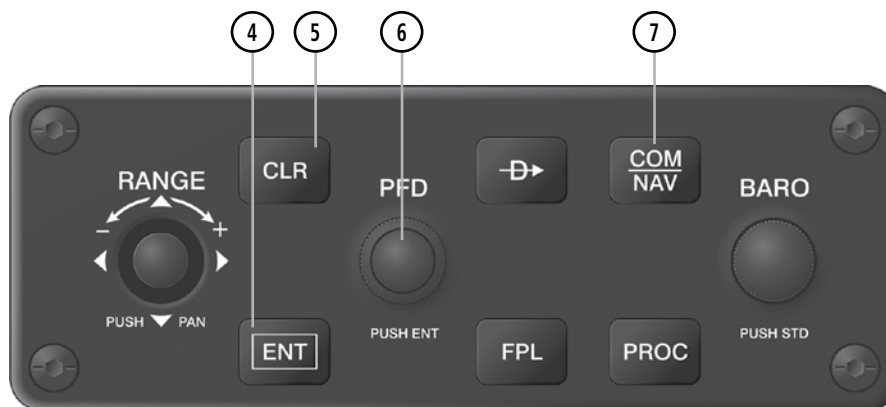
Figure 4-3 PFD Controller COM/NAV Controls

(1) 'COM/NAV' Window – Using the PFD Controller provides COM/NAV active and standby frequency selection, volume adjustment for each COM/NAV, COM MIC selection, and COM MON selection. The selected COM transceiver frequency is displayed in green.

(2) Source/Frequency Box – Displays selected communication source, frequency, and the communication source description (if available). A + sign next to the communication source description indicates there is more than one facility in the area that shares the same frequency. In this case, the closest facility name will be displayed.

(3) Flight ID Box – Displays the optional Flight ID\Tail number.

(4) **ENT** Key – Confirms a selection and moves the cursor to the next data field in the 'COM/NAV' Window.

(5) **CLR** Key – Cancels entries or removes menus in the 'COM/NAV' Window.

(6) **PFD** Knob – Large PFD Knob moves the cursor from field to field in the 'COM/NAV' Window. Small PFD Knob activates menus, makes selections, or activates the flashing editing cursor when the cursor is on the standby frequency. When the cursor is flashing on the standby frequency, the PFD Knob tunes the standby frequency for the selected source (large knob for MHz; small knob for kHz). Press the PFD Knob to confirm the frequency and move the cursor to the next data field. Press and hold to transfer the standby frequency to the active frequency.

(7) **COM/NAV** Key – Displays/removes the COM/NAV Window on the PFD.

MFD TOUCHSCREEN CONTROLLER AUDIO AND CNS CONTROLS
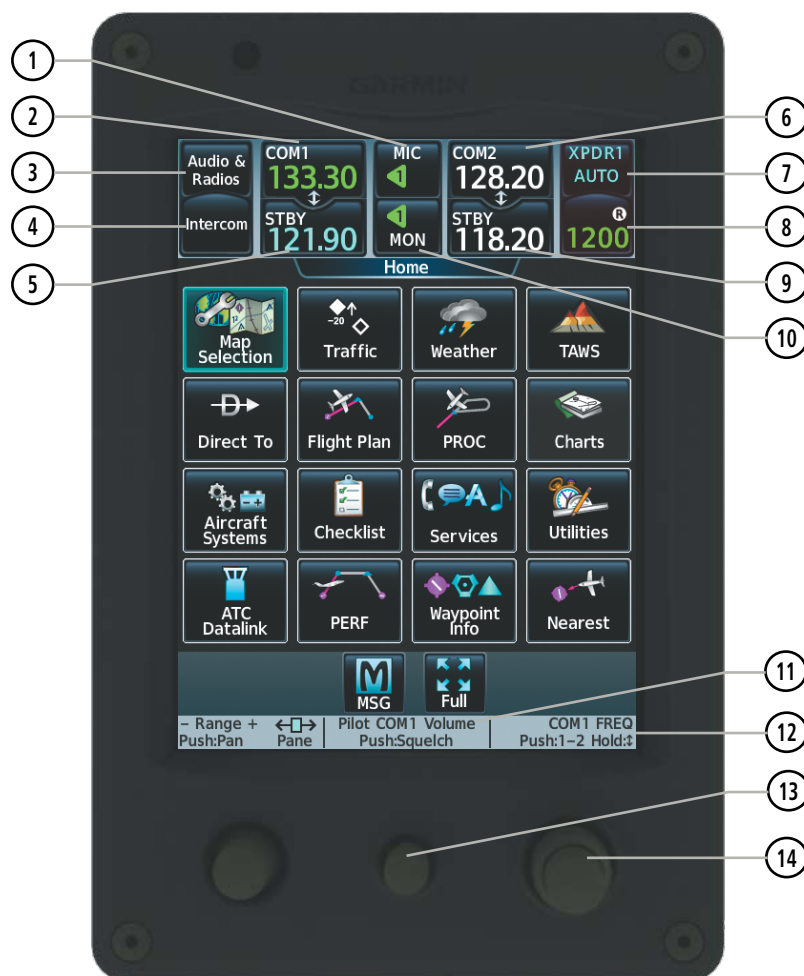
Figure 4-4 Left/Right MFD Touchscreen Controller CNS Bar Controls

(1) **MIC** Button – Switches between the #1 COM transceiver and the #2 COM transceiver.

(2) **COM1** Button – Transfers the standby and active COM1 frequencies.

(3) **Audio & Radios** Button – Displays/removes the 'Audio & Radios' Screen. The 'Audio & Radios' Screen is used to control the Communication/Navigation/Surveillance (CNS) and Audio settings for the pilot and copilot.

(4) **Intercom** Button – Displays/removes the 'Intercom' Screen. The 'Intercom' Screen is used to control the intercom isolation, volume, and squelch settings for the pilot, copilot, and passengers.

(5) **STBY** Button (COM1) – Displays/removes the 'COM1 Standby' Screen. The 'COM1 Standby' Screen is used to enter and transfer COM1 frequencies.

(6) **COM2** Button– Transfers the standby and active COM2 frequencies.

(7) Transponder Mode Button – Displays/removes the 'Transponder' Screen. The 'Transponder' Screen is used to select the transponder modes and the active transponder if equipped with more than one.

(8) Transponder Code Button – Displays/removes the Transponder Screen. The Transponder Screen is used to select the transponder code using the keypad or by selecting the VFR Button. The Transponder Screen is also used to send a distinct identity indication to Air Traffic Control (ATC), by pressing the IDENT Button. When selected,the word IDENT is displayed on the button in green and pulsates for the duration of the transmission. While the transponder is replying to an interrogation, an R is displayed on the button.

(9) **STBY** Button (COM2) – Displays/removes the 'COM2 Standby' Screen. The 'COM2 Standby' Screen is used to enter and transfer COM2 frequencies.

(10) **MON** Button – Controls which receivers are being explicitly monitored.

(11) Function Label – Indicates middle knob function. *Typical:* Pilot COM1/COM2 Volume, Push: Squelch.

(12) Function Label – Indicates right large and small knob function. *Typical Frequency Entry:* COM1/COM2 FREQ, Push:1-2, Hold:↕   *Typical Data Entry:* Data Entry, Push: Enter, Hold:↕

(13) Middle Knob – Function as labeled (see #11)

(14) Large/Small Right Knob – Function as labeled (see #12). *Data Entry:* Large knob moves the cursor from field to field. Small knob edits character by character. *Frequency Entry:* Large knob increases/decreases MHz; Small knob increases/decreases kHz. Push the small knob to confirm the frequency. Push and hold to transfer the standby frequency to the active frequency.

4.2 COM OPERATION

COM TRANSCEIVER SELECTION AND ACTIVATION

> **NOTE:** When turning on the G5000 for use, the system remembers the last frequencies used and the active COM transceiver state prior to shutdown.

The COM1 and COM2 Frequencies are shown on the CNS Bar. The COM1, COM2 and COM3 frequencies are also shown on the 'Audio & Radios' Screen. The COM transceiver can be selected for transmitting on the Touchscreen Controllers. During transmission of audio from the COM radio, reception from other monitored COM radio(s) are muted. If enabled, changing an active or monitored COM source or frequency will be accompanied with an aural tone.

The active COM frequency is displayed in green. The standby frequency of the COM selected for tuning is cyan. When the standby frequency of the COM selected for tuning is being tuned with the right knobs, the entire standby frequency button is highlighted in cyan. The other standby frequency is white.

> **Selecting a COM Radio for transmission:**
>
> Touch the **MIC** Button in the CNS Bar to switch between COM1 and COM2 radios until the desired COM is selected.
>
> **Or**:
>
> 1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.
>
> 2) Touch the desired **MIC** Button on the 'Audio & Radios' Screen to select the COM radio for transmission.
>
> **Or**:
>
> 1) On the PFD Controller, press the **COM/NAV** Key to display the COM/NAV Window on the PFD.
>
> 2) Turn the large **PFD** Knob to move the cursor to the MIC field.
>
> 3) Turn the small **PFD** Knob to select COM1 or COM2.
>
> 4) Push the small right knob.
>
> 5) Press the **COM/NAV** Key to hide the 'COM/NAV' Window.

Selecting a COM Radio for monitoring:

> Touch the **MON** Button in the CNS Bar to monitor the COM not selected for transmission.
>
> **Or**:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the **COM1** Button, **COM2** Button, or **COM3** Button to select the COM radio for monitoring.

> **Or**:

1) On the PFD Controller, press the **COM/NAV** Key to display the 'COM/NAV' Window on the PFD.

2) Turn the large **PFD** knob to move the cursor to the MON field.

3) Turn the small **PFD** Knob to select COM1 or COM2.

4) Press the **ENT** Key to accept the selection.

> **Or**:
>
> Push the small **PFD** Knob to accept the selection.

5) Press the **COM/NAV** Key to hide the 'COM/NAV' Window.

Enabling COM3 voice communication:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) If necessary, scroll to find COM3.

3) Touch the **Datalink** Button.

4) Touch the **OK** Button in response to "Disable Datalink Mode?". To cancel the request, touch the **Cancel** Button.

Disabling COM3 voice communication:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) If necessary, scroll to find COM3.

3) Touch the COM3 Frequency Button.

4) Touch the **Datalink** Button to disable COM3 voice communication.

CNS Bar   **MIC** Button (COM1 selected for transmission)

COM1 Active Frequency (selected for transmission)

COM1 Standby Frequency

'Audio & Radios' Screen

COM2 Primary Frequency

COM2 Standby Frequency

MIC Button (COM1 selected for transmission)

MIC Button(COM2)

COM1 Active Frequency

COM1 Standby Frequency

COM2 Primary Frequency

COM2 Standby Frequency

Communication Source/Primary Frequency (COM1 selected for transmission)

COM/NAV Window

COM1 Active Frequency (selected for transmission)

COM1 Standby Frequency

COM1 selected for transmission

PFD Knob   **COM/NAV** Key

Figure 4-5 Selecting a COM Radio for Transmission

CNS Bar Symbol	Meaning of Symbol
	COM1 selected for transmission/monitoring
	COM2 selected for transmission/monitoring
HF	HF COM selected for transmission/monitoring
COM3	COM3 selected for transmission/monitoring
MULTI	An additional audio source is manually selected for monitoring
PA	Public Address is selected for transmission

Table 4-1 CNS Bar MIC/MON Button Symbols

TRANSMIT/RECEIVE INDICATIONS

During COM transmission, a white TX appears by the active COM frequency. During COM signal reception, a white RX appears by the active COM frequency.

Figure 4-6 COM Radio Transmit and Receive Indications

COM FREQUENCY TUNING

Selecting a COM1 or COM2 frequency using the Touchscreen Controller:

1) Touch the COM1 **STBY** Button or COM2 **STBY** Button in the CNS Bar to display the COM1/COM2 Standby Screen.

2) Use the keypad to select the frequency.

3) Touch the **Enter** Button to accept the new frequency as the COM1/COM2 standby frequency.

   Or:

   Touch the **XFER** Button to accept the new frequency as the COM1/COM2 active frequency and transfer the previously active frequency to the standby frequency.

   Or:

1) Push the small right knob to select the COM desired for tuning (selected standby frequency field is cyan).

2) Turn the large and small right knobs to tune the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz).

3) Push the small right knob to enter the new frequency as the standby frequency.

Or:

Push and hold the small right knob to transfer the new standby frequency to the active frequency.

Frequency selected for tuning

Find Button

XFER Button (Frequency Transfer)

Enter Button

Knob function labels

Figure 4-7 COM Frequency Tuning Keypad

Or:

1) Touch the **Audio & Radios** Button. to display the 'Audio & Radios' Screen.

2) Touch the COM1/COM2/COM3 volume slider to select COM for tuning.

    Or:

    Push the small right knob to select COM1/COM2 for tuning.

3) Turn the large and small right knobs to select the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz).

4) Push the small right knob to accept the new frequency as the standby frequency.

    Or:

    Push and hold the small right knob to accept the new frequency as the COM1/COM2 active frequency and transfer the previously active frequency to the standby frequency.

COM1 selected for tuning (cyan border)

COM1 Volume Slider

COM2 Frequency Button

Figure 4-8 'Audio & Radios' Screen - COM1/COM2/COM3 Frequency Tuning

Or:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the COM1/COM2/COM3 frequency button to display the COM1/COM2/COM3 Standby screen.

3) Use the keypad to select the desired frequency.

4) Touch the **Enter** Button to accept the new frequency as the COM1/COM2/COM3 standby frequency.

   Or:

   Touch the **XFER** Button to accept the new frequency as the COM1/COM2/COM3 active frequency and transfer the previously active frequency to the standby frequency.

Selecting a COM frequency using the PFD Controller:

1) On the PFD Controller, press the **COM/NAV** Button to display the 'COM/NAV' Window on the PFD.

2) Turn the large **PFD** Knob to move the cursor to the Source field.

3) Turn the small **PFD** Knob to select the desired COM.

4) Press the **ENT** Key to accept the selection and move the cursor to the STBY frequency field.

   Or:

   Push the small **PFD** Knob to accept the selection and move the cursor to the STBY frequency field.

5) Turn the small **PFD** Knob one click to activate the editing cursor (flashing).

6) Turn the large and small **PFD** Knobs to select the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz)

7) Press the **ENT** Key to accept the selection and move the cursor to the 'XFER?' field.

   Or:

   Push the small **PFD** Knob to accept the selection and move the cursor to the 'XFER?' field.

8) Press the **ENT** Key to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.

   Or:

   Push the small **PFD** Knob to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.

Figure 4-9 Frequency Tuning from the PFD Controller

Finding and selecting a COM frequency using the Find Button:

1) From Home, touch the COM1 **STBY** Button or the COM2 **STBY** Button on the CNS Bar to display the COM1/2 Standby Screen.

   Or:

   From Home, touch the **Audio & Radios** Button and the COM1, COM2, or COM3 Frequency Button to display the COM1/2/3 Standby Screen.

2) Touch the **Find** Button to display the Find COM1/2/3 Frequency Screen.

3) Touch the tab for the desired type of frequency (Recent, Nearest, Dest, Flight Plan, or Favorite).

4) Scroll the list to find the desired frequency.

5) Touch the frequency button to accept the new frequency as the COM1/COM2/COM3 standby frequency.

Figure 4-10 Find Button and the 'Find COM Frequency' Screen

Adding a COM frequency to favorites using the CNS bar:

1) From Home, touch **STBY > Find > Favorite > Add Favorite Frequency > Name**.

   Or:

   From Home, touch **Audio & Radios > Any COM Frequency Button > Find > Favorite > Add Favorite Frequency > Name**.

2) Enter the desired frequency name.

3) Touch the **ENTER** Button.

4) Touch the **Frequency** Button.

5) Use the keypad to select the frequency.

   Or:

   Turn the large and small right knobs to tune the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz).

6) Touch the **Enter** Button.

Or:

Push the small right knob.

7) Touch the **Add Favorite** Button.

Name Button

Frequency Button

Add Favorite Frequency Button

Favorite Tab

Add Favorite Button

Enter Button

Enter Button

Figure 4-11 Adding a COM Frequency to Favorites

Adding a COM frequency to favorites from any 'Load Frequency' Screen:

1) Touch the **Add to Favorites** Button.

2) If desired, touch the **Name** Button to change the name.

3) Touch the **Add Favorite** Button.

Add to Favorites Button

Add Favorite Button

Figure 4-12 Adding a COM Frequency to Favorites from a 'Load Frequency' Screen

Selecting a COM frequency from favorites:

1) From Home, touch **STBY > Find > Favorite**.

   Or:

   From Home, touch **Audio & Radios > Any COM Frequency Button > Find > Favorite**.

2) Touch the desired frequency button.

3) Touch the **Enter** Button to accept the new frequency as the standby frequency.

   Or:

   Push the small upper knob to accept the new frequency as the standby frequency.

   Or:

   Touch the **XFER** Button to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.

   Or:

   Push and hold the small upper knob to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.
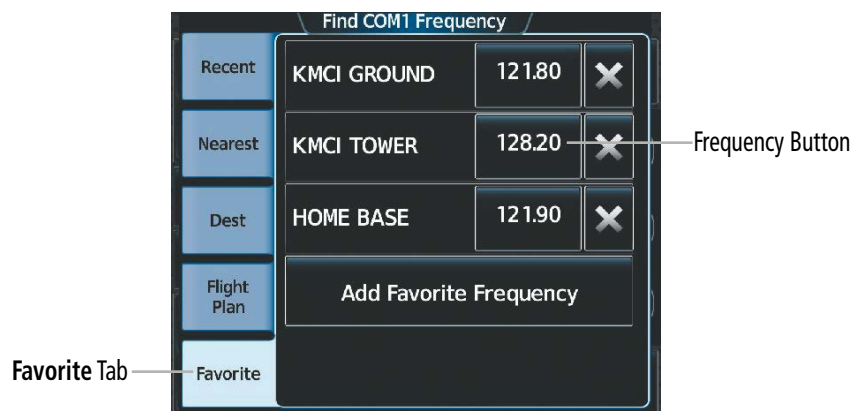
Figure 4-13 Selecting a COM Frequency from Favorites

Removing a COM frequency from Favorites:

1) From Home, touch **STBY > Find > Favorite**.

   Or:

   From Home, touch **Audio & Radios > Any COM Frequency Button > Find > Favorite**.

2) Touch the **X** Button next to the frequency to be deleted.

3) Touch the **OK** Button to confirm.
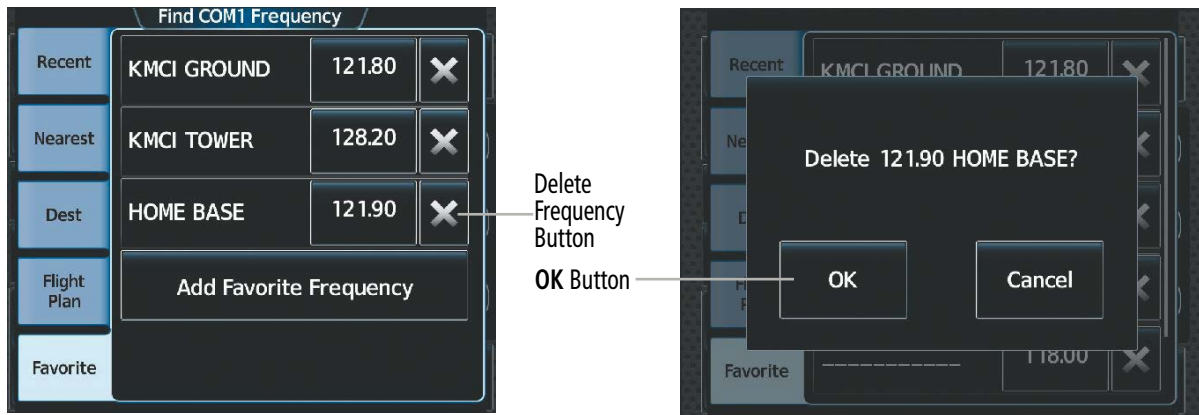
Figure 4-14 Deleting a COM Frequency from Favorites

Finding and selecting a COM frequency from the 'Airport Information' Screen:

1) From Home, touch **Waypoint Info** > **Airport** to display the 'Airport Information' Screen.

2) If needed, touch the airport button to enter/find the desired airport.

3) Touch the **Freqs** Tab to display the 'Airport Frequencies' Screen.

4) Scroll the list to find the desired frequency.

5) Touch the frequency button to display the 'Load Frequency' Screen.

6) Touch the location button to load the frequency to COM1/2 Active/Standby or Favorites.

Figure 4-15 Airport Info Screen Tuning

Finding and selecting a COM frequency from the 'Nearest Airport' Screen:

1) From Home, touch **Nearest** > **Airport** to display the 'Nearest Airport' Screen.

2) Scroll the list to find the desired airport.

3) Touch the airport button to display the 'Waypoint Options' Window.

4) Touch the **Airport Info** Button to display the 'Airport Information' Screen.

5) Touch the **Freqs** Tab to display the 'Airport Frequencies' Screen.

6) Scroll the list to find the desired frequency.

7) Touch the frequency button to display the 'Load Frequency' Screen.

8) Touch the location button to load the frequency to COM1/2 Active/Standby or Favorites.
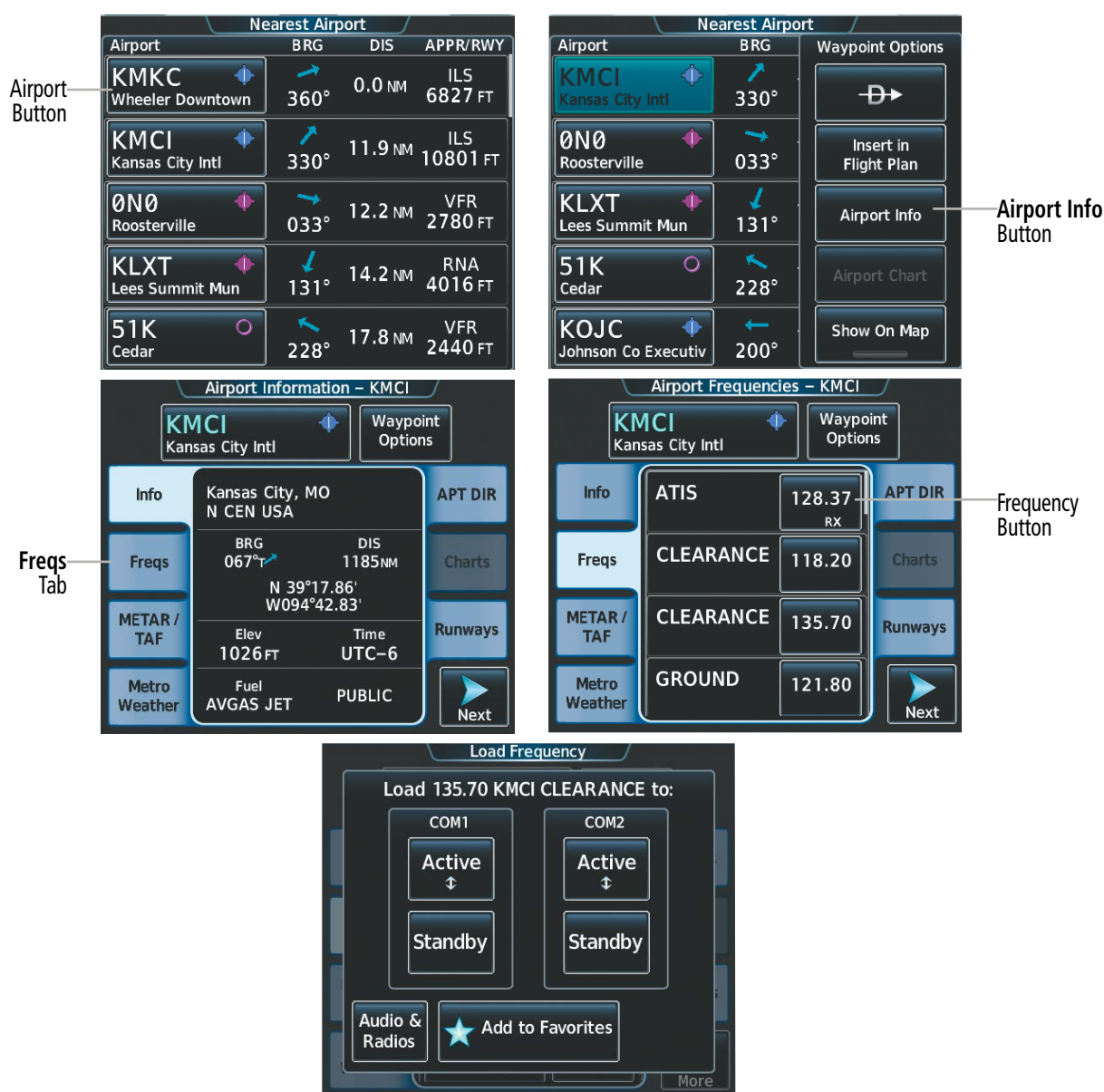
Figure 4-16 Nearest Airport Tuning

Finding and selecting a COM frequency from the Nearest Airspace/ARTCC/FSS/Weather screen:

1) From Home, touch the **Nearest** > (**Airspace** or **ARTCC** or **FSS** or **Weather**) to display the Nearest Airspace/ARTCC/FSS/Weather screen.

2) Scroll the list to find the desired frequency.

3) Touch the frequency button to display the 'Load Frequency' Screen.

4) Touch the location button to load the frequency to COM1/2 Active/Standby or Favorites.
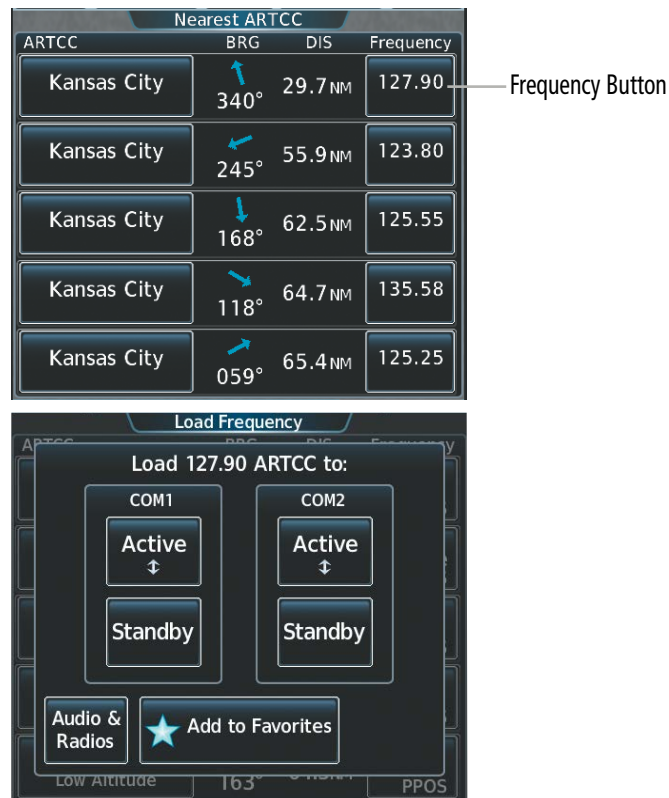
Figure 4-17 Nearest Airspace/ARTCC/FSS/Weather Tuning

FREQUENCY SPACING

The COM radios can tune either 25-kHz spacing (118.000 to 136.975 MHz) or 8.33-kHz spacing (118.000 to 136.990 MHz) for 760-channel or 3040-channel configuration. When 8.33-kHz channel spacing is selected, all of the 25-kHz channel spacing frequencies are also available in the complete 3040-channel list.

8.33-kHz Channel Spacing   25-kHz Channel Spacing

Figure 4-18 COM Channel Spacing

Changing COM frequency channel spacing:

1) From Home, touch **Utilities** >**Setup** > **Avionics Settings**.

2) Scroll the list to show the **COM Channel Spacing** Button.

3) Touch the COM Channel Spacing button to display the choice of **25.0 kHz** or **8.33 kHz**.

4) Touch the desired channel spacing button.
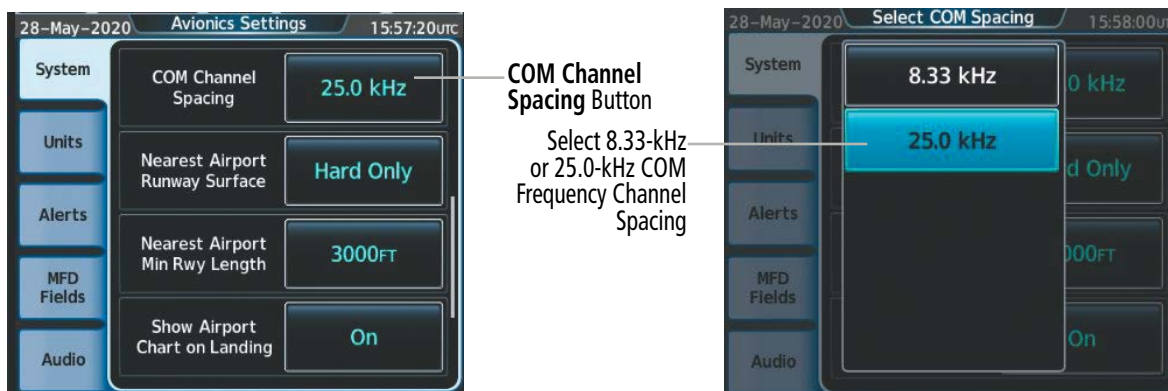
Figure 4-19 Changing COM Frequency Channel Spacing

NOTE: *When changing channel spacings, rounding discrepancies may result in an unexpected frequency. Verify the tuned frequency is correct.*

AUTOMATIC SQUELCH

Automatic Squelch quiets unwanted static noise when no audio signal is received, while still providing good sensitivity to weak COM signals. To disable Automatic Squelch for the selected transceiver, push the middle knob. When Automatic Squelch is disabled, COM audio reception is always on. Continuous static noise is heard over the headsets and speaker, if selected. Pushing the middle knob again enables Automatic Squelch. When Automatic Squelch is disabled, a white SQ appears next to the active COM frequency.

Figure 4-20 COM Radio Automatic Squelch Disable/Enable

VOLUME

The selected COM radio volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left on the COM volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume. When adjusting volume, the level is displayed in place of the active frequency in the CNS Bar, and remains for two seconds after the change. When the 'Audio & Radios' Screen is displayed, the volume changes are not shown in the CNS Bar.

The volume can also be adjusted on the PFD using the PFD Controller. With the COM/NAV Window displayed, turn the large right knob to select the Volume field. Turn the small right knob to adjust the volume (Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume).

Figure 4-21 COM Volume Level

HF COM TRANSCEIVER SELECTION AND ACTIVATION (OPTIONAL)

The HF COM transceiver can be selected for transmitting on the Touchscreen Controller. During transmissions from the HF COM radio, audio from the other COM radios is muted.

Selecting HF COM Radio for transmission:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the HF **MIC** Button on the 'Audio & Radios' Screen to select the HF COM radio for transmission.

Selecting an HF COM Radio for monitoring:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the **HF** Button to select the HF COM radio for monitoring.

CNS Bar   **MIC** Button (HF selected for transmission)

MIC Button (HF selected for transmission)

Transmit Indication

'Audio & Radios' Screen

Communication Source (HF selected for transmission)
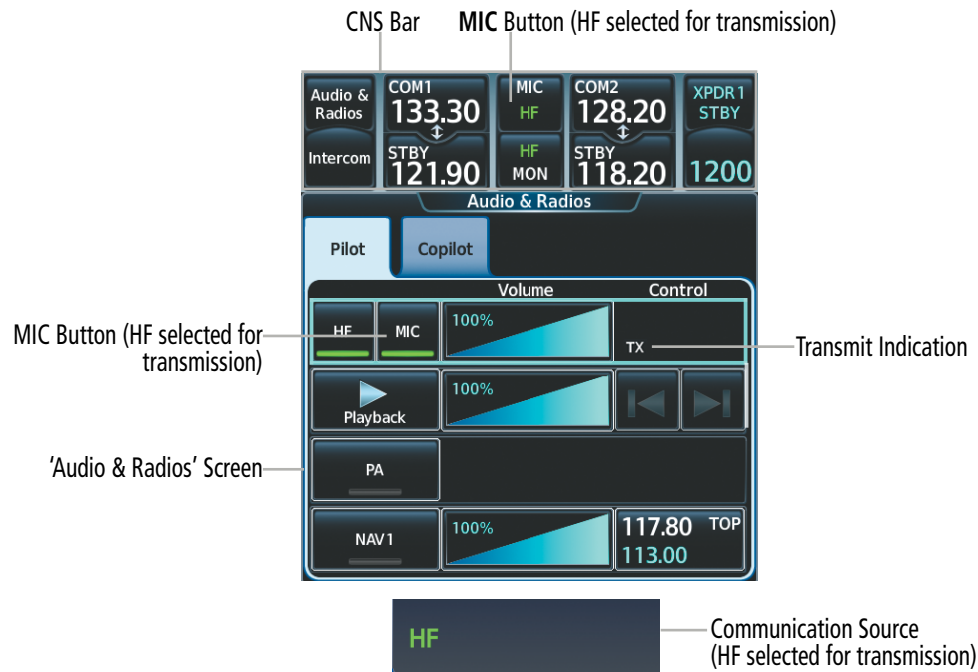
Figure 4-22 Selecting an HF COM Radio for Transmission

HF COM VOLUME

The HF COM radio volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left on the COM volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

Selected HF COM Volume

Middle Knob - Turn to adjust COM volume

Figure 4-23 COM Volume Level

SELECTIVE CALLING

Selective Calling (SELCAL) allows a crew to enter a previously assigned 4 character code, which when received by the SELCAL decoder, will provide the crew with an annunciation of an incoming call. Incoming calls will be accompanied by an aural alert and a visual annunciation. This feature allows the crew to stop monitoring the radio until the decoder indicates a call is incoming. This feature is generally used on lengthy flights or oceanic flights.

A SELCAL code consists of two pairs of letters (e.g. 'GQ-EF") within the range of A through S. The characters 'I', 'N', and 'O' are excluded. Within each pair, the letters must be ordered alphabetically (GQ, not QG) and no letters may be repeated. If an invalid SECAL code is entered, a pop up window will notify the flight crew of the error and the code will be rejected. SELCAL detection can be used for COM3, HF1, and HF2.

Entering the SELCAL Code:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find **SELCAL**.

3) Touch the **SELCAL ID** Button.

4) Enter the assigned 4 character SELCAL code and touch the **ENTER** Button. The 'Update SELCAL code?' confirmation window appears.

5) Touch the **OK** Button to confirm.

Selecting/deselecting SELCAL:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find **SELCAL**.

3) Touch the **SELCAL** Button.
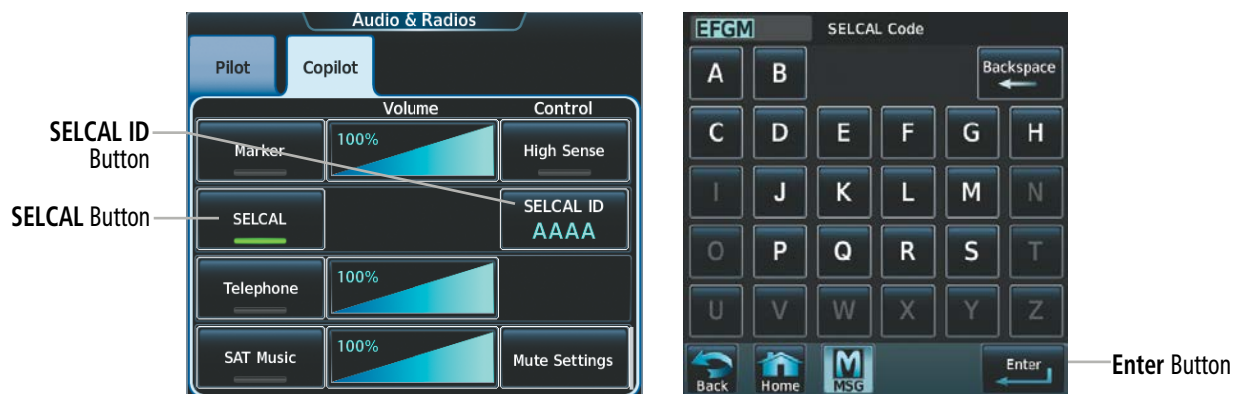
Figure 4-24 SELCAL Controls

RECEIVING AND ACKNOWLEDGING SELCAL TRANSMISSIONS

Incoming SELCAL transmissions are accompanied by an aural alert and a visual annunciation. If SELCAL visual annunciations are not acknowledged, subsequent aural alerts for incoming SELCAL transmissions will be inhibited. If a SELCAL transmission is received while not viewing the Audio & Radios Touchscreen Controller screen, a flashing **SELCAL** Button will display over the **Audio & Radios** Button on the CNS bar.
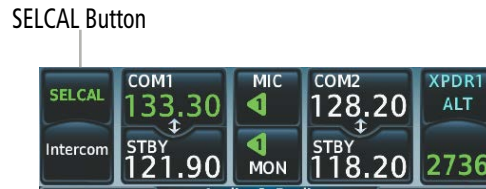
Figure 4-25 SELCAL Button on the CNS Bar

Pressing the **SELCAL** Button on the CNS bar will open the 'Audio & Radios' Screen. If a SELCAL transmission is received while already viewing the 'Audio & Radios' Screen, there will be no **SELCAL** Button displayed over the **Audio & Radios** Button on the CNS bar.

Once the 'Audio & Radios' Screen is displayed a **SELCAL ACK** Button will display over the **SELCAL ID** Button of the associated radio (COM3 or HF).

Figure 4-26 SELCAL Acknowledge Annunciation

If multiple SELCAL transmissions are received at the same time, the **SELCAL ID** Button will display a **SELCAL ACK ALL** Annunciation/Button (Figure 4-133). Touch the **SELCAL ACK ALL** Annunciation/Button to simultaneously acknowledge all incoming SELCAL transmissions.

Figure 4-27 SELCAL Acknowledge All Annunciation/Button

Touching the **SELCAL ACK** or **SELCAL ACK ALL** Annunciations/Buttons will clear the annunciations for the applicable incoming SELCAL transmissions.

Receiving and Acknowledging a SELCAL transmission:

1) If necessary, touch the **SELCAL** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the **SELCAL ACK** or **SELCAL ACK ALL** annunciations/buttons.

3) Touch the **SELCAL ACK** Button or the **SELCAL ACK ALL** Button.

4) Touch the appropriate Radio Button (COM3 or HF) to transmit and receive on that radio.

4.3 NAV OPERATION

NAV RADIO SELECTION AND ACTIVATION

The active NAV frequency selected for navigation is shown on the PFD. Active and Standby NAV frequencies are shown on the Touchscreen Controller.

A NAV radio is selected for navigation by selecting the **Active NAV** Softkey located on the PFD. The NAV frequency selected for navigation is displayed in green. Selecting the **Active NAV** Softkey once selects NAV1 as the navigation radio. Selecting the **Active NAV** Softkey a second time selects NAV2 as the navigation radio. Selecting the **Active NAV** Softkey a third time activates FMS mode. Selecting the **Active NAV** Softkey again cycles back to NAV1.

The three navigation modes that can be cycled through are:

- VOR1 (or LOC1) – If NAV1 is selected, a green single line arrow (shown) labeled either VOR1 or LOC1 is displayed on the HSI and the active NAV1 frequency is displayed in green.
- VOR2 (or LOC2) – If NAV2 is selected, a green double line arrow (not shown) labeled either VOR2 or LOC2 is displayed on the HSI and the active NAV2 frequency is displayed in green.
- FMS – If FMS Mode is selected, a magenta single line arrow (not shown) appears on the HSI and neither NAV radio is selected. Both active NAV frequencies are displayed in white on the Touchscreen Controller.

> **NOTE:** If both PFDs have the same NAV source selected, the VOR1 and VOR2 (or LOC1 and LOC2) and associated CDI will change color from green to amber.

NAV1 Active Frequency and ID

The NAV Radio is selected by pressing the **Active NAV** Softkey
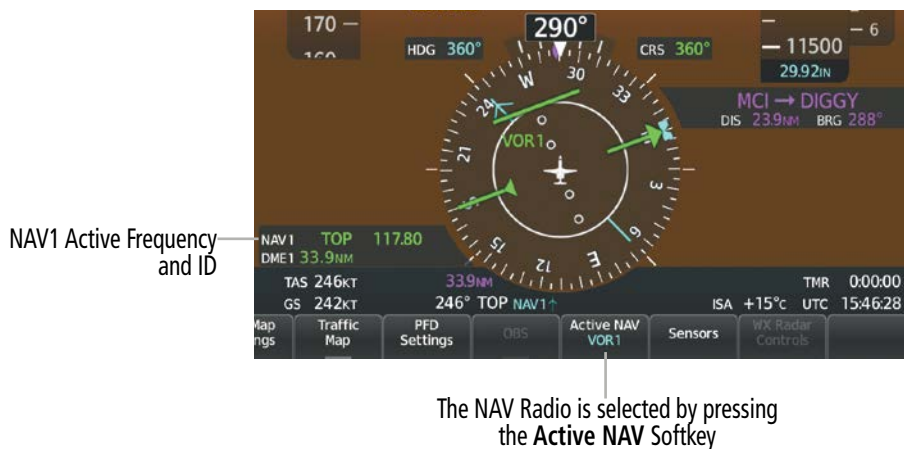
Figure 4-28 Selecting a NAV Radio for Navigation

See the Flight Instruments Section for selecting the DME and Bearing Information windows and using VOR or ADF as the source for the bearing pointer.

NAV radios are selected for listening by pressing the corresponding buttons on the Touchscreen Controller. Touching the **NAV1** or **NAV2** Button selects and deselects the navigation radio source. Selected audio can be heard over the headset and the speaker (if selected). All radios can be selected individually or simultaneously.

NAV1 Button (selected for monitoring) — NAV1 Active Frequency/ID
NAV1 Standby Frequency
NAV2 Button (not selected) — NAV2 Active Frequency/ID
NAV2 Standby Frequency

Figure 4-29 Selecting a NAV Radio for Monitoring

Selecting/deselecting a navigation radio for monitoring:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the **NAV1** or **NAV2** Button on the 'Audio & Radios' Screen to select/deselect the radio for monitoring.

NAV RECEIVER TUNING

The NAV frequencies are tuned from the Touchscreen Controller and the PFD Controller.

NAV1 selected for tuning (cyan border) — NAV1 Volume Slider

NAV2 Frequency Button

Knob function labels

Figure 4-30 'Audio & Radios' Screen - NAV Frequency Tuning

Selecting a NAV frequency using the Touchscreen Controller:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find **NAV1** or **NAV2**.

3) Touch the NAV1/NAV2 frequency button to display the NAV1/NAV2 Standby screen.

4) Use the keypad to select the desired frequency.

5) Touch the **Enter** Button to enter the new frequency as the NAV1/NAV2 standby frequency.

Or:

Touch the **XFER** Button to enter the new frequency as the NAV1/NAV2 standby frequency and transfer it to the active frequency.

Figure 4-31 NAV Frequency Tuning Screen

> **Or:**

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Touch the NAV1/NAV2 volume slider to select NAV1/NAV2 for tuning.

3) Turn the large and small right knobs to tune the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz).

4) Push the small right knob to enter the new frequency as the NAV1/NAV2 standby frequency.

> **Or:**

> Push and hold the small right knob to transfer the new standby frequency to the active frequency.

Transferring the active and standby NAV frequencies:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find NAV1 or NAV2.

3) Touch the NAV1 or NAV2 volume slider to select the radio for frequency transfer.

4) Push and hold the small right knob to transfer the frequencies.

Selecting a NAV frequency using the PFD Controller:

1) On the PFD Controller, press the **COM/NAV** Key to display the 'COM/NAV 'Window.

2) Turn the large **PFD** Knob to move the cursor to the Source field.

3) Turn either **PFD** Knob to select the desired NAV.

4) Press the **ENT** Key or push the small **PFD** Knob to accept the selection and move the cursor to the STBY frequency field.

5) Turn the small **PFD** Knob one click to activate the editing cursor (flashing).

6) Turn the large and small **PFD** knobs to tune the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz)

7) Press the **ENT** Key or push the small **PFD** Knob to accept the selection and move the cursor to the XFER? field.

8) Press the **ENT** Key or push the small **PFD** Knob to transfer the standby frequency to the active frequency.

Figure 4-32 Frequency Tuning from the PFD Controller

NOTE: *The frequency shown in the 'COM/NAV' Window may be briefly displayed in amber after a frequency transfer.*

Viewing Current NAV selections from any NAV 'Load Frequency' Screen:

1) From any NAV 'Load Frequency' Screen, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen with the current NAV selections in view.

2) Touch the **Back** Button to return to the 'Load Frequency' Screen.
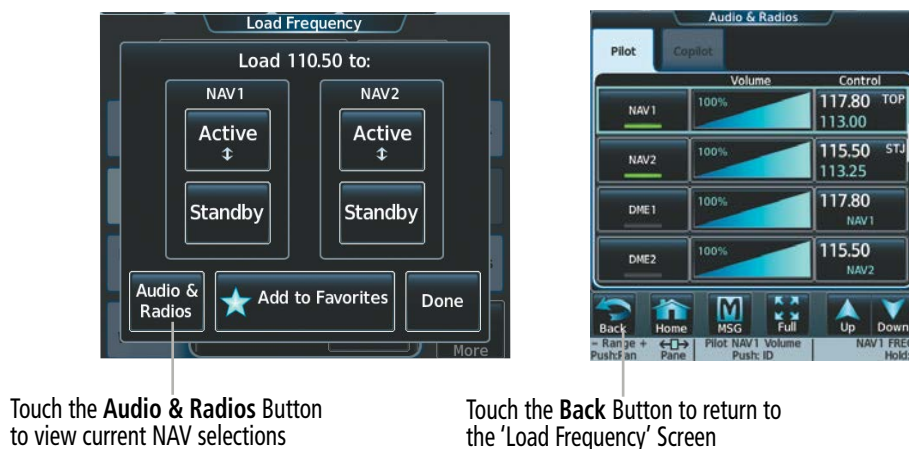
Touch the **Audio & Radios** Button to view current NAV selections

Touch the **Back** Button to return to the 'Load Frequency' Screen

Figure 4-33 Switching between 'Load Frequency' Screen and 'Audio & Radios' Screen

Adding a NAV frequency to favorites using the CNS bar:

1) From Home, touch **STBY > Find > Favorite > Add Favorite Frequency > Name**.

   Or:

   From Home, touch **Audio & Radios > Any Nav Frequency Tuning Button > Find > Favorite > Add Favorite Frequency > Name**.

2) Enter the desired frequency name.

3) Touch the **ENTER** Button.

4) Touch the **Frequency** Button.

5) Use the keypad to select the frequency.

   Or:

   Turn the large and small right knobs to tune the frequency (Large knob increases/decreases MHz; Small knob increases/decreases kHz).

6) Touch the **Enter** Button.

   Or:

   Push the small right knob.

7) Touch the **Add Favorite** Button.

Figure 4-34 Adding a NAV Frequency to Favorites

Adding a NAV frequency to favorites from any 'Load Frequency' Screen:

1) Touch the **Add to Favorites** Button.

2) If desired, touch the **Name** Button to change the name.

3) Touch the **Add Favorite** Button.
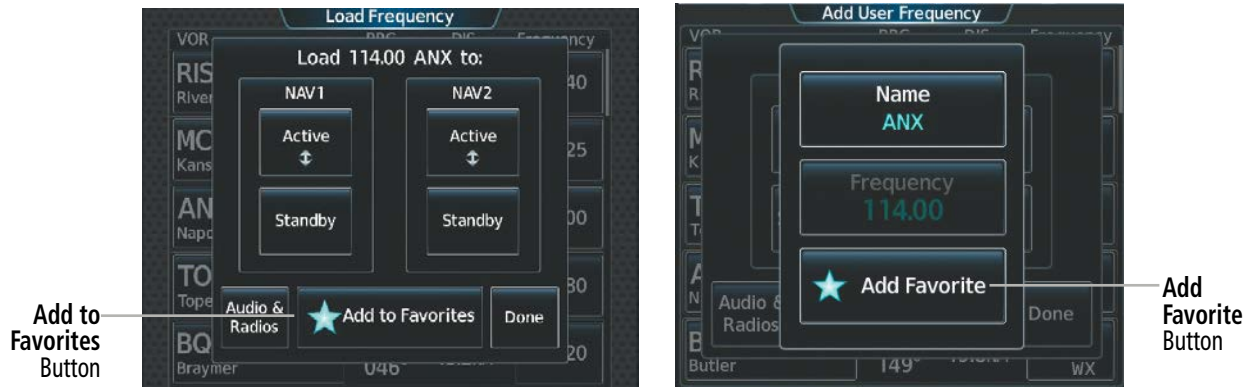
Figure 4-35 Adding a NAV Frequency to Favorites from a 'Load Frequency' Screen

Selecting a NAV frequency from favorites:

1) From Home, touch the **Audio & Radios** Button.

2) Touch any NAV Frequency Button.

3) Touch the **Find** Button.

4) Touch the **Favorite** Tab.

5) Touch the desired frequency button.

6) Touch the **Enter** Button to accept the new frequency as the standby frequency.

   Or:

   Push the small upper knob to accept the new frequency as the standby frequency.

   Or:

   Touch the **XFER** Button to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.

   Or:

   Push and hold the small upper knob to accept the new frequency as the active frequency and transfer the previously active frequency to the standby frequency.
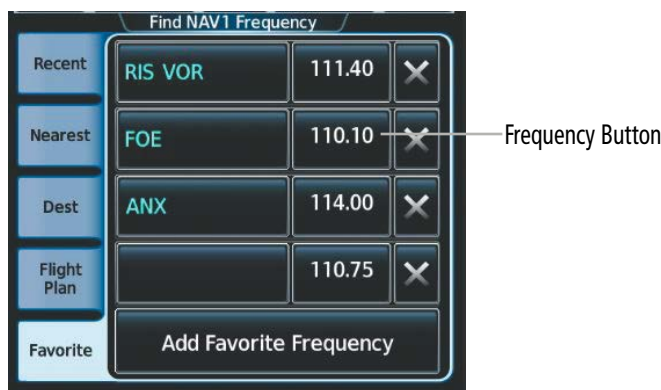
Frequency Button

Figure 4-36 Selecting a NAV Frequency from Favorites

Removing a NAV frequency from favorites:

1) From Home, touch the **Audio & Radios** Button.

2) Touch any NAV Frequency Button.

3) Touch the **Find** Button.

4) Touch the **Favorite** Tab.

5) Touch the **X** Button next to the frequency to be deleted.

6) Touch the **OK** Button to confirm.

Delete
Button

OK Button
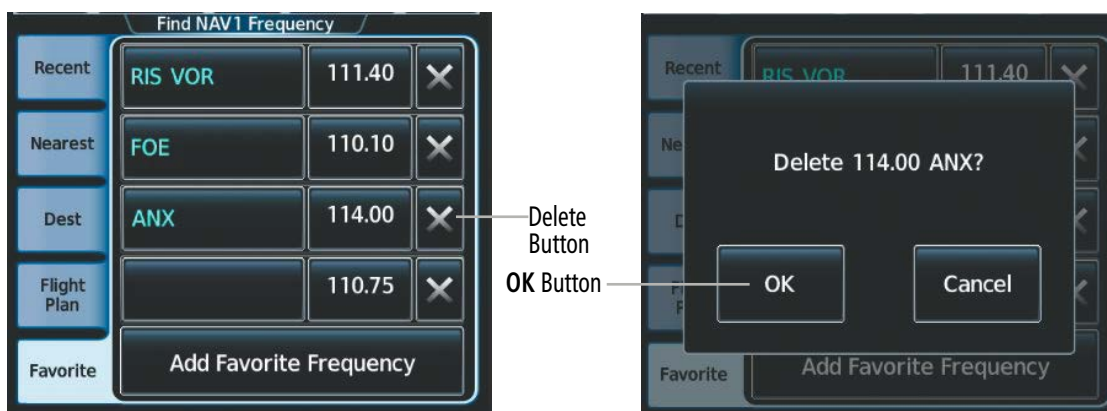
Figure 4-37 Deleting a NAV Frequency from Favorites

Finding and selecting a NAV frequency from the 'Airport Information' Screen:

1) From Home, touch **Waypoint Info** > **Airport** to display the 'Airport Information' Screen.

2) If needed, touch the airport button to enter/find the desired airport.

3) Touch the **Freqs** Tab to display the 'Airport Frequencies' Screen.

4) Scroll the list to find the desired frequency.

5) Touch the frequency button to display the 'Load Frequency' Screen.

6) Touch the desired location button to load the frequency to NAV1/2 Active/Standby or Favorites.

7) Touch the **Done** Button to return to the 'Airport Frequencies' Screen.
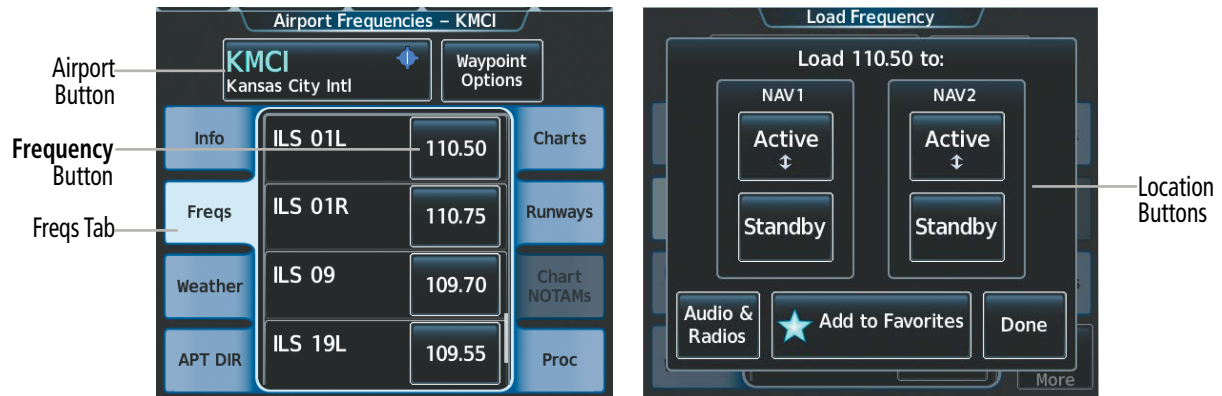
Figure 4-38 Airport Info Screen NAV Tuning

Finding and selecting a NAV frequency from the 'VOR Information' Screen:

1) From Home, touch **Waypoint Info** > **VOR** to display the 'VOR Information' Screen.

2) If needed, touch the VOR button to enter/find the desired airport.

3) Touch the **Frequency** Button to display the 'Load Frequency' Screen.

4) Touch the desired location button to load the frequency to NAV1/2 Active/Standby or Favorites.

5) Touch the **Done** Button to return to the 'VOR Information' Screen.
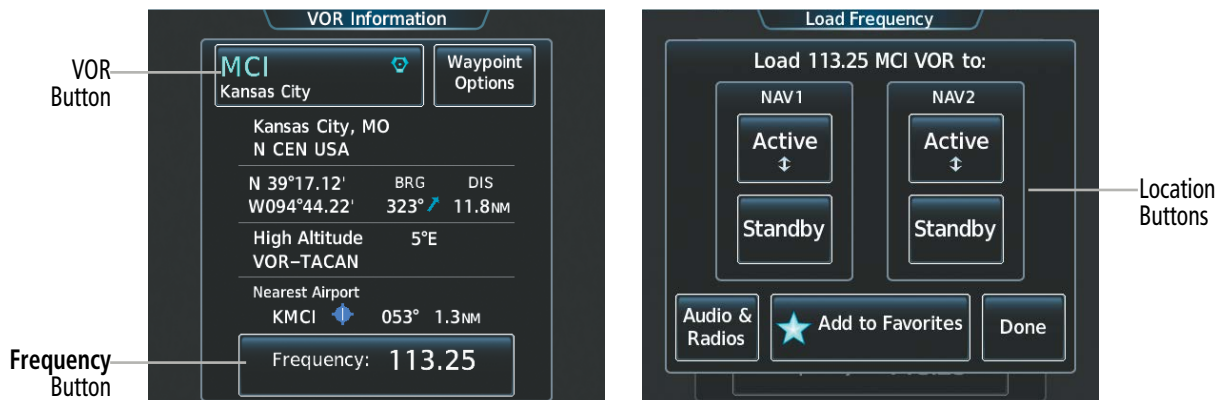
Figure 4-39 VOR Info Screen Tuning

Finding and selecting a NAV frequency from the 'Nearest Airport' Screen:

1) From Home, touch **Nearest** > **Airport** to display the 'Nearest Airport' Screen.

2) Scroll the list to find the desired airport.

3) Touch the airport button to display the Waypoint Options Window.

4) Touch the **Airport Info** Button to display the 'Airport Information' Screen.

5) Touch the **Freqs** Tab to display the 'Airport Frequencies' Screen.

6) Scroll the list to find the desired frequency.

7) Touch the frequency button to display the 'Load Frequency' Screen.

8) Touch the desired location button to load the frequency to NAV1/2 Active/Standby or Favorites.

9) Touch the **Done** Button to return to the 'Airport Frequencies' Screen.

Figure 4-40 Nearest Airport Tuning

Finding and selecting a NAV frequency from the 'Nearest VOR' Screen:

1) From Home, touch the **Nearest** > **VOR** to display the 'Nearest VOR' screen.

2) Scroll the list to find the desired frequency.

3) Touch the frequency button to display the 'Load Frequency' Screen.

4) Touch the desired location button to load the frequency to NAV1/2 Active/Standby or Favorites.

5) Touch the **Done** Button to return to the 'Nearest VOR' screen.
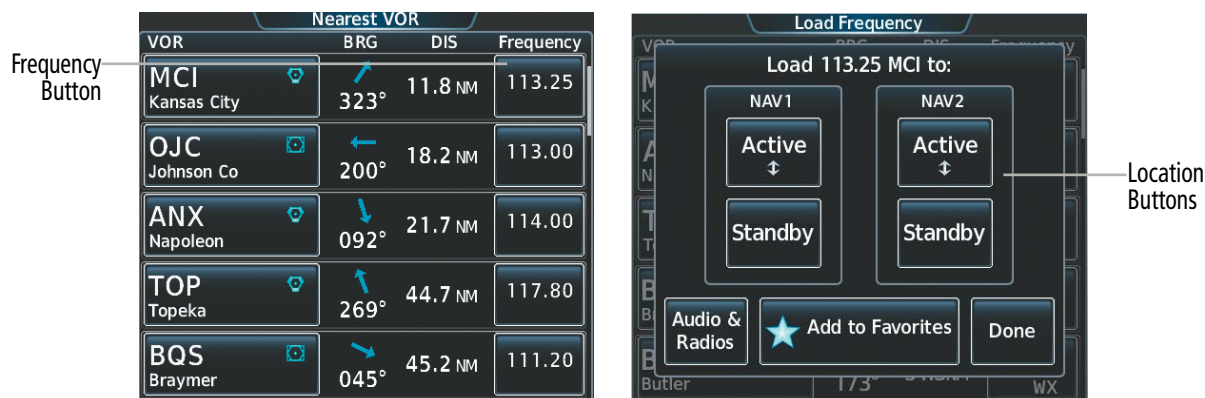
Figure 4-41 Nearest VOR Tuning

VOR/LOC ID

When the Morse code identifier audio is selected for a NAV radio, a white ID appears to the right of the active NAV frequency. Pushing the middle knob turns off the Morse code audio only for the selected radio. To turn off both NAV IDs, select each NAV in turn and push the middle knob to turn the Morse code off.

The decoded Morse code identifier received from the navigation source is displayed on the PFD in the Active Frequency and ID field, and also on the Touchscreen Controller on the NAV Frequency Button.

PFD   Touchscreen Controller

Decoded Station Identifier   Decoded Station Identifier   Morse Code audio ID
                                                                  is selected On

Figure 4-42 VOR/LOC ID Locations

VOLUME

The selected NAV radio volume level can be adjusted from 0 to 100% on the Touchscreen Controller by turning the middle knob or by sliding your finger right or left on the NAV volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

Selected NAV Volume

Middle knob -
Turn to adjust NAV
volume
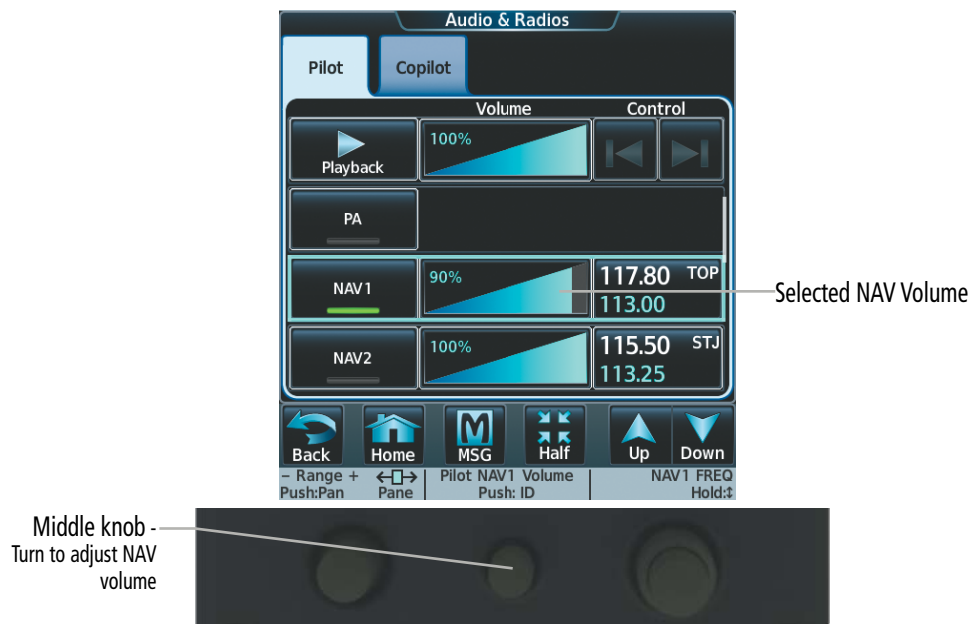
Figure 4-43 NAV Volume Level

AUTO-TUNING NAV FREQUENCIES ON APPROACH ACTIVATION

> ✅ **NOTE:** *The primary NAV frequency is auto-tuned upon loading a VOR or ILS/Localizer approach.*

> ✅ **NOTE:** *When an ILS/LOC approach has been activated in FMS Mode, the system switches to NAV Mode as the final approach course is intercepted (within 15 nm of the FAF). See the Flight Management Section for details.*

When loading or activating a VOR or ILS/LOC approach, the approach frequency is automatically transferred to a NAV frequency field as follows:

» If the current CDI navigation source is FMS, the approach frequency is transferred to the NAV1 active frequency field. The frequency that was previously in the NAV1 active frequency field is transferred to standby.

» If the current CDI navigation source is FMS, and if the approach frequency is already loaded into the NAV1 standby frequency field, the standby frequency is transferred to active.

» If the current CDI navigation source is NAV1 or NAV2 and the approach is activated, the approach frequency is transferred to the active frequency fields of the selected CDI NAV radio.

» If the current CDI navigation source is NAV1 or NAV2 and the approach is loaded, the approach frequency is transferred to the standby frequency fields of the selected CDI NAV radio.

MARKER BEACON RECEIVER

> ✅ **NOTE:** *The marker beacon indicators operate independently of marker beacon audio and cannot be turned off.*

The marker beacon receiver is used as part of the ILS. The marker beacon receiver is always on and detects any marker beacon signals within the reception range of the aircraft. The receiver detects the three marker tones – outer, middle, and inner – and provides the marker beacon annunciations located to the left of the Altimeter on the PFD.
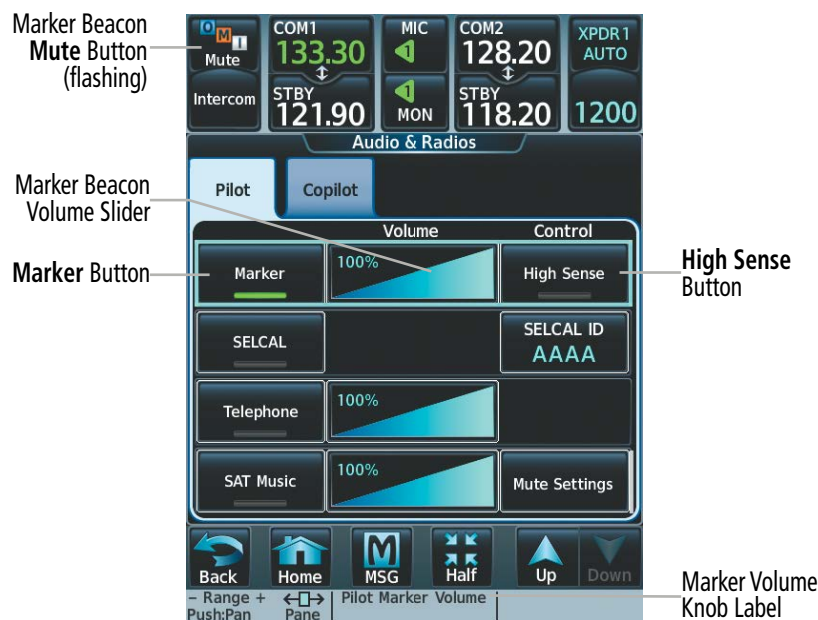
Figure 4-44 Marker Beacon Keys

The Touchscreen Controller provides three different states of marker beacon audio operation; Selected, Muted, and Deselected. Pressing the **Marker** Button selects/deselects marker beacon audio. The button annunciation indicates when marker beacon audio is selected.

During marker beacon audio reception, pressing the flashing **Mute** Button mutes the audio but does not affect the marker annunciations. The marker tone is silenced, then waits for the next marker tone. The flashing **Mute** Button is also removed during audio muting. The audio returns when the next marker beacon signal is received.

Pressing the **High Sense** Button switches between high and low marker beacon receiver sensitivity. The High Sense function (annunciator illuminated) is used to provide an earlier indication when nearing a marker during an approach. The Low Sense function (annunciator extinguished) results in a narrower marker dwell while over a station.

The Marker Beacon volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left on the Marker Beacon Volume Slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

ADF/DME TUNING

See the Flight Instruments Section for displaying the DME and bearing information windows (ADF) and using the ADF as the source for the bearing pointer.

ADF1 and ADF2 are optional equipment. The system tunes the ADF receiver and DME transceiver. The ADF is tuned by entering the frequency in the ADF standby frequency field of the 'Audio & Radios' Screen on the Touchscreen Controller.

The UHF DME frequency is tuned by pairing with a VHF NAV frequency. DME frequency pairing is automatic and only the VHF NAV frequency is shown.

The following ADF/DME information is displayed on the Touchscreen Controller:
- Active and standby ADF frequencies
- ADF receiver mode
- ADF receiver volume
- DME tuning mode (DME transceiver pairing)
- DME receiver volume
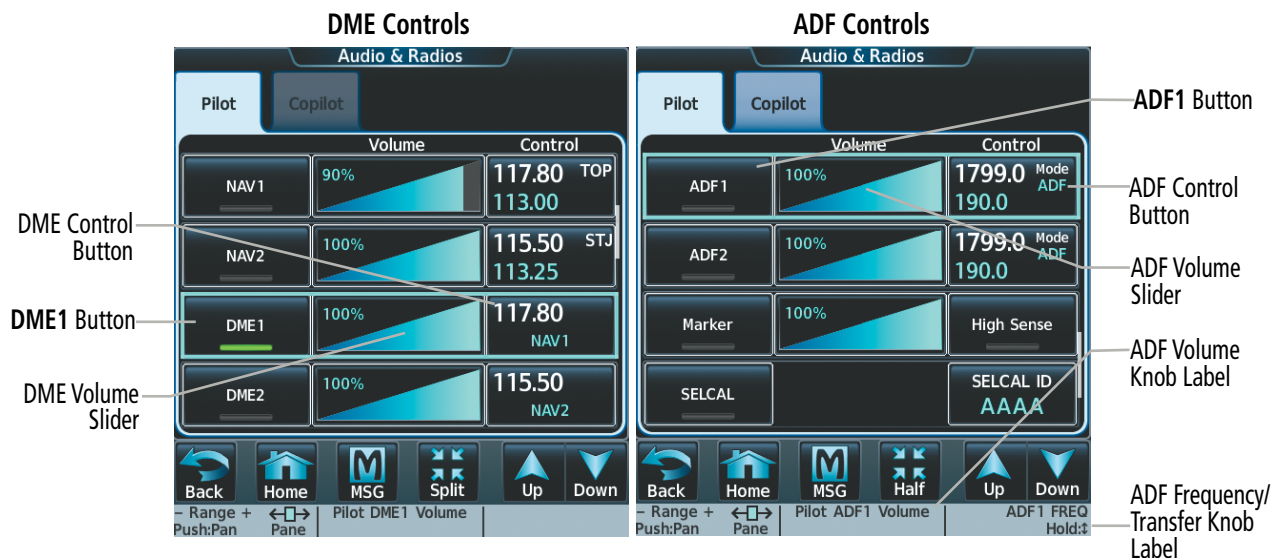
Figure 4-45 ADF/DME Tuning

The selected ADF/DME volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left on the NAV volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

ADF TUNING

ADF frequencies in the 190.0-kHz to 1799.5-kHz range are entered in the standby ADF frequency field. The system does not tune the ADF emergency frequency, 2182.0-kHz.

Selecting an ADF frequency:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the ADF.

3) Touch the ADF Control Button to display the 'ADF' Screen.

4) Use the keypad to select the desired frequency.

5) Touch the **Enter** Button to enter the new frequency as the ADF standby frequency.

   Or:

   Touch the **XFER** Button to transfer the new frequency to the active frequency.
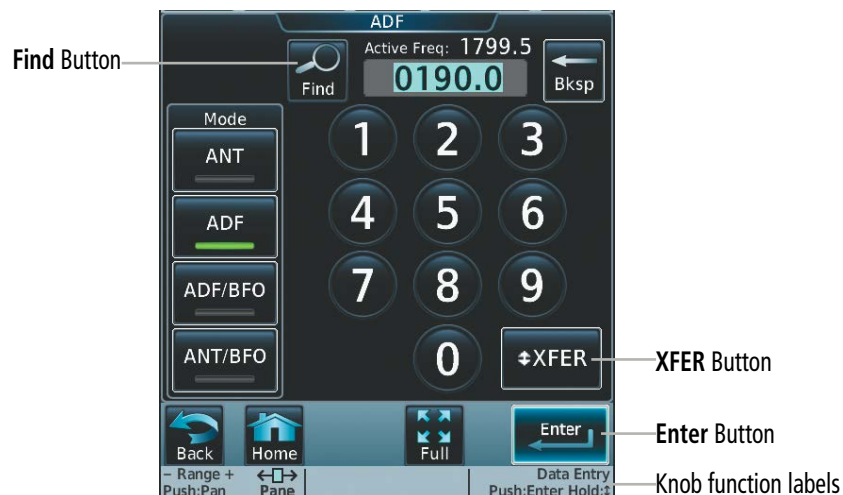
Figure 4-46 ADF Mode/Tuning Screen

   Or:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the ADF.

3) Touch the ADF Control Button to display the 'ADF' Screen.

4) Turn the large and small right knobs to tune the frequency (Large knob increases/decreases kHz; Small knob selects .5 kHz).

5) Push the small right knob to enter the new frequency as the ADF standby frequency.

   Or:

   Push and hold the small right knob to transfer the new standby frequency to the active frequency.

Finding and selecting an ADF frequency:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the ADF.

3) Touch the ADF Control Button to display the 'ADF' Screen.

4) Touch the **Find** Button to display the 'Find ADF Frequency' Screen.

5) Touch the tab for the desired type of frequency (Recent, Nearest, Dest, Flight Plan, or Favorite).

6) Scroll the list to find the desired frequency.

7) Touch the frequency button to enter the new frequency as the ADF standby frequency.

Figure 4-47 Finding an ADF Frequency

Transferring the active and standby ADF frequencies:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the ADF.

3) Touch the ADF volume slider to select the ADF for transfer.

4) Push and hold the small right knob to transfer the frequencies.

Figure 4-48 ADF Frequency Transfer

SELECTING ADF RECEIVER MODE

The following modes can be selected: (In all modes NDB audio can be heard by selecting the **ADF1** Button or **ADF2** Button on the Touchscreen Controller.)

» ANT (Antenna) – The ADF bearing pointer is removed. Best mode for listening to NDB audio.

» ADF (Automatic Direction Finder) – The ADF pointer points to the relative bearing of the NDB station.

» ADF/BFO (ADF/Beat Frequency Oscillator) – The ADF pointer points to the relative bearing of the NDB station and an audible tone confirms signal reception. This mode allows identification of the interrupted carrier beacon stations used in various parts of the world.

» ANT/BFO (Antenna/Beat Frequency Oscillator) – The ADF bearing pointer is removed and an audible tone is provided when a signal is received. This mode also allows identification of the interrupted carrier beacon stations and confirms signal reception.

Selecting an ADF receiver mode:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the ADF.

3) Touch the ADF Control Button to display the 'ADF' Screen.

4) Touch the **ANT**, **ADF**, **ADF/BFO**, or **ANT/BFO** Button to select the ADF mode.

Figure 4-49 ADF Mode Selection

> **NOTE:** The ADF frequency field on the PFD will not populate when the ADF is in ANT or ANT/BFO receiver modes.

DME TUNING

The system remembers the last frequency used for DME tuning and the NAV1, NAV2, or HOLD state prior to shutdown.

The following DME transceiver pairings can be selected:

» NAV1 – Pairs the DME frequency from the selected NAV1 frequency.

» NAV2 – Pairs the DME frequency from the selected NAV2 frequency.

» HOLD – When in the HOLD position, the DME frequency remains paired with the last selected NAV frequency.

Figure 4-50 DME Mode Selection

Selecting DME transceiver pairing:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the DME.

3) Touch the DME Mode Control Button to display the DME1/DME2 Screen.

4) Touch the **NAV1**, **NAV2**, or **HOLD** Button to select desired DME mode. DME information will be displayed on the PFD in the Active NAV Source/Frequency Box. An 'H' next to the frequency indicates DME Hold mode.

4.4 MODE S TRANSPONDER

> **NOTE:** *The XPDR/TCAS Mode on the 'Transponder' Screen always shows the default or pilot selected mode and does not necessarily correspond with the traffic system if it is in a lower mode due to other constraints.*

> **NOTE:** *Refer to the Hazard Avoidance section for more information about TCAS II alerts.*

The GTX 3000 Mode S Transponder provides Mode A, Mode C, and Mode S interrogation and reply capabilities. Selective addressing or Mode Select (Mode S) capability includes the following features:

- Level-2 reply data link capability (used to exchange information between aircraft and ATC facilities)
- Surveillance identifier capability
- Flight ID (Flight Identification) reporting – The Mode S Transponder reports aircraft identification as the aircraft registration.
- Altitude reporting
- Airborne status determination
- Transponder capability reporting
- Mode S Enhanced Surveillance (EHS) requirements
- Acquisition squitter – Acquisition squitter, or short squitter, is the transponder 24-bit identification address. The transmission is sent periodically, regardless of the presence of interrogations. The purpose of acquisition squitter is to enable Mode S ground stations and aircraft equipped with a Traffic Avoidance System (TAS) to recognize the presence of Mode S-equipped aircraft for selective interrogation.
- Extended squitter – The extended squitter is transmitted periodically and contains information such as altitude (barometric and GPS), GPS position, and aircraft identification. The purpose of extended squitter is to provide aircraft position and identification to ADS-B Ground-Based Transceivers (GBTs) and other aircraft.

The Hazard Avoidance Section provides more details on traffic avoidance systems.

TRANSPONDER CONTROLS

Active transponder selection, transponder mode selection, code entry, Flight ID entry, and IDENT activation are controlled and displayed on the Touchscreen Controller.
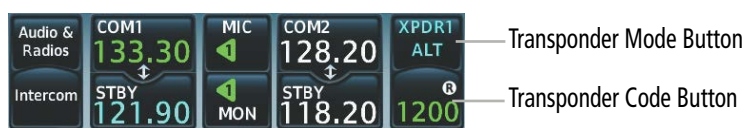
Figure 4-51 Transponder Display and Controls

TRANSPONDER SELECTION

The active transponder is selected by touching the **Active** Button.

Selecting the active transponder:

1) Touch the Transponder Mode Button to display the 'Transponder' Screen.

2) Touch the **Active** Button to display 'Select Active Transponder' Screen.

3) Touch the **XPDR1** or **XPDR2** Button.
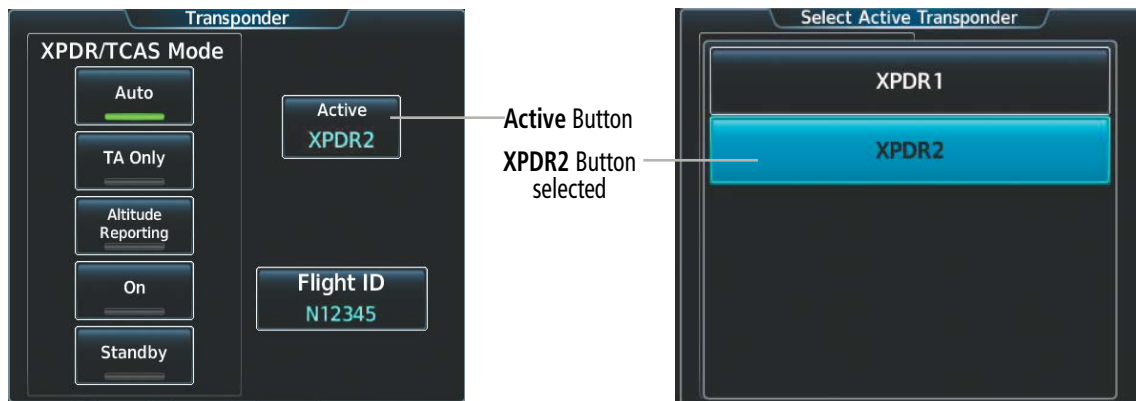
Figure 4-52 Active Transponder Selection

TRANSPONDER MODE SELECTION

Mode selection can be automatic (Altitude Reporting modes) or manual (Standby, On, and Altitude Reporting modes). Mode Selection Buttons are accessed by touching the Transponder Mode Button

> **NOTE:** *The operating mode of the TCAS II system is annunciated on the Traffic Map Pane and Traffic Inset Map.*

Selecting a transponder mode:

1) Touch the Transponder Mode Button to display the 'Transponder' Screen.

2) Touch desired Transponder Mode Button.
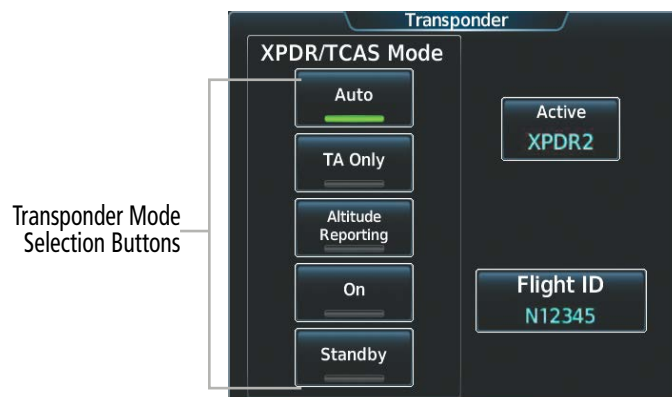
Figure 4-53 Transponder Mode Selection

TCAS II TRANSPONDER MODES

> ✓ *NOTE: The XPDR/TCAS Mode on the 'Transponder' Screen always shows the default or pilot selected mode and does not necessarily correspond with the traffic system if it is in a lower mode due to other constraints.*

> ✓ *NOTE: Refer to the Hazard Avoidance section for more information about TCAS II alerts.*

The following table describes the transponder and traffic system operating modes for each XPDR/TCAS Mode selection:

XPDR/TCAS Mode Selection	Indication (XPDR Mode Button)	Transponder Mode	Available TCAS II Mode(s)
Auto (default)	AUTO	Altitude Reporting	TA/RA or TA Only
TA Only	TA ONLY	Altitude Reporting	TA Only
Altitude Reporting	ALT	Altitude Reporting	Standby
On	ON	On	Standby
Standby	STBY	Standby	Standby

Table 4-2 Transponder and TCAS II Modes

AUTO MODE

Auto Mode is the default XPDR/TCAS mode. The pilot can also manually select the mode by touching the **Auto** Button on the 'Transponder' Screen. While in Auto XPDR/TCAS mode, the transponder is in ALT mode.   When the transponder is operating on the ground, it replies to all selective Mode S interrogations, including Mode A identity requests and Mode C altitude requests. Replies to ATCRBS/Mode-S All-Call and Mode-S Only all-call interrogations are inhibited. Auto Mode automatically selects the appropriate mode for the current conditions, including traffic advisory (TA) and resolution advisory (RA) aural and visual alerts (if applicable). All transponder replies requesting altitude information are provided with pressure altitude information.

In Auto Mode, a cyan AUTO indication appears in the Transponder Mode Button.

Auto Mode - Cyan

Figure 4-54 Auto Mode (Cyan)

TA ONLY MODE

The pilot can manually select TA Only Mode by touching the **TA Only** Button on the 'Transponder' Screen. TA Only mode inhibits resolutions advisory (RA) aural and visual alerts (if applicable). While in TA Only XPDR/TCAS mode, the transponder is in ALT mode. This mode generates Mode A, Mode C, and Mode S replies as well as transmissions of acquisition and extended squitters including ADS-B out.

In TA Only Mode, a cyan TA ONLY indication appears in the Transponder Mode Button.

TA Only Mode - Cyan

Figure 4-55 TA Only Mode (Cyan)

ALTITUDE REPORTING MODE

Altitude Reporting Mode is selected manually by touching the **Altitude Reporting** Button. TCAS II is in Standby, when the Altitude Reporting XPDR/TCAS Mode is selected. Altitude Mode generates Mode A, Mode C, and Mode S replies as well as transmissions of acquisition and extended squitters including ADS-B out.

If Altitude Mode is selected, a cyan ALT indication appears in the Transponder Mode Button, and all transponder replies requesting altitude information are provided with pressure altitude information.

On the ground, the Altitude Reporting Mode generates Mode A replies and to directly addressed Mode S interrogations, including interrogations for altitude.

Altitude Reporting Mode
(Mode C Altitude Reporting)

Figure 4-56 Altitude Reporting Mode (Green)

MANUAL ON MODE

ON Mode can be selected at any time by selecting the **ON** Button. ON Mode generates Mode A and Mode S replies as well as transmission of acquisition and extended squitters, including ADS-B out on the ground and in the air. Mode C altitude reporting is inhibited. TCAS II is in Standby, when the ON Mode is selected.

In ON Mode, a cyan ON indication appears in the Transponder Mode Button.

ON Mode (No
Altitude Reporting)

Figure 4-57 On Mode

STANDBY MODE

> ✓ **NOTE:** In Standby Mode, the IDENT function is inoperative.

Standby Mode can be selected at any time by selecting the **Standby** Button. In Standby Mode, the transponder does not reply to interrogations or transmit squitters, but new codes can be entered. TCAS II is also in Standby Mode, when Standby Mode is selected.

In Standby Mode, a cyan STBY indication appears in the Transponder Mode Button, the transponder code is displayed in cyan, and a white TRANSPONDER STANDBY CAS message is displayed.

Standby Mode

Figure 4-58 Standby Mode

REPLY STATUS

When the transponder sends replies to interrogations, a white R indication appears momentarily in the Transponder Code Button.

Figure 4-59 Altitude Reporting Mode

ENTERING A TRANSPONDER CODE

Entering a transponder code with the keypad:

1)   Touch the Transponder Code Button to display the 'Transponder 1' Screen or the 'Transponder 2' Screen.

2)   Use the keypad to select the desired code.

3)   Touch the **Enter** Button to enter the new code.

Or:

Push the small right knob to enter the new code.
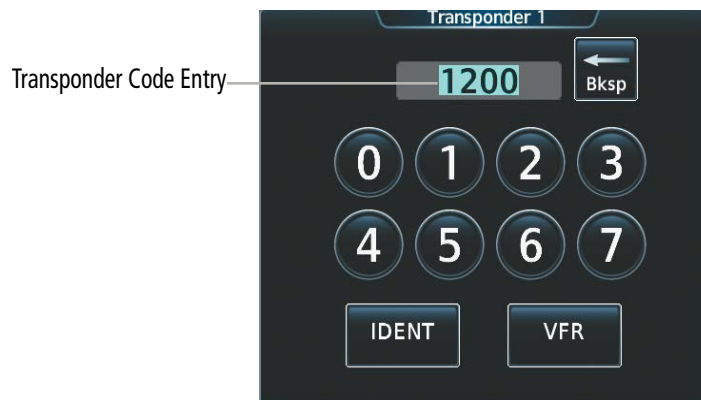
Figure 4-60 Transponder Code Entry

Entering a transponder code with the knobs:

1)   Touch the Transponder Code Button to display the 'Transponder 1' Screen or the 'Transponder 2' Screen.

2)   Turn the large right knob one click left or right to place the editing cursor on the first digit of the existing code.

3)   Turn the small right knob to enter the first digit.

4)   Turn the large right knob to move the cursor to the next digit.

5)   Turn the small right knob to enter the next digit, repeat steps 4 and 5 until complete.

6)   Touch the **Enter** Button to enter the new code.

Or:

Push the small right knob to enter the new code.

Pressing the **Cancel** Button before code entry is complete cancels code entry and restores the previous code.

VFR CODE

The VFR code can be entered manually or by touching the **VFR** Button. Touching the **VFR** Button automatically loads the pre-programmed VFR code into the Transponder Code Entry Field. Touch the **Enter** Button or push the small right knob to enter the new code.

The pre-programmed VFR Code is set at the factory to 1200. If a VFR code change is required, contact a Garmin-authorized service center for configuration.
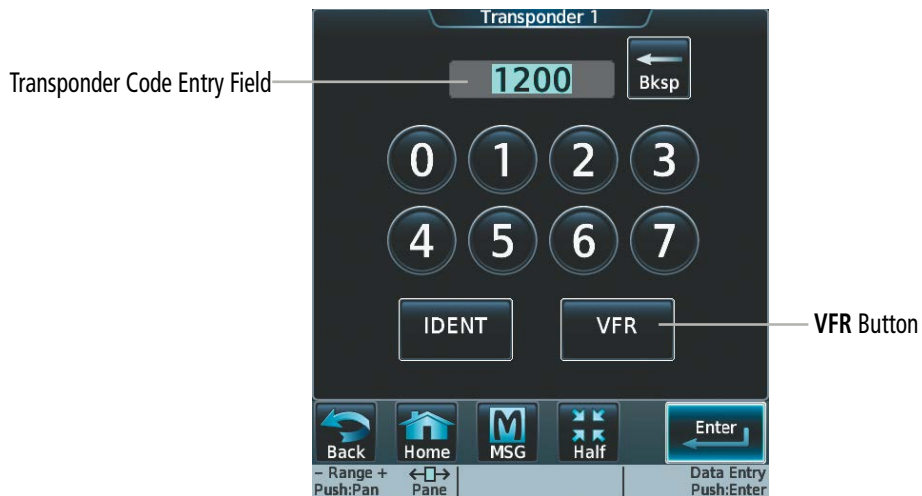
Figure 4-61 Transponder VFR Button

IDENT FUNCTION

> **NOTE:** In Standby Mode, the **IDENT** Button is inoperative.

> **NOTE:** With transponders in Standby, activation of IDENT from either control wheel mounted switch will result in annunciation of IDENT on the Touchscreen Controller, even though no IDENT signal is being transmitted.

Selecting the **IDENT** Button on the 'Transponder 1' Screen' or the 'Transponder 2' Screen sends a distinct identity indication to Air Traffic Control (ATC). The indication distinguishes the identing transponder from all the others on the air traffic controller's screen. When the **IDENT** Button is selected, the word IDENT appears in the Transponder Code Button and pulsates for the duration of the identity indication.

IDENT Button

Transponder IDENT Active

Figure 4-62 Transponder IDENT Button and Indication

FLIGHT ID REPORTING

When the Flight ID must be entered before flight operation, the identifier is placed on the Transponder Screen on the Touchscreen Controller. The Flight ID field can hold up to eight characters.

Entering a Flight ID:

1) From Home, touch the Transponder Mode Button.

2) Touch the **Flight ID** Button to display the keypad.

3) Use the keypad to select the desired flight ID.

4) Touch the **Enter** Button to enter the new flight ID.

Flight ID Button
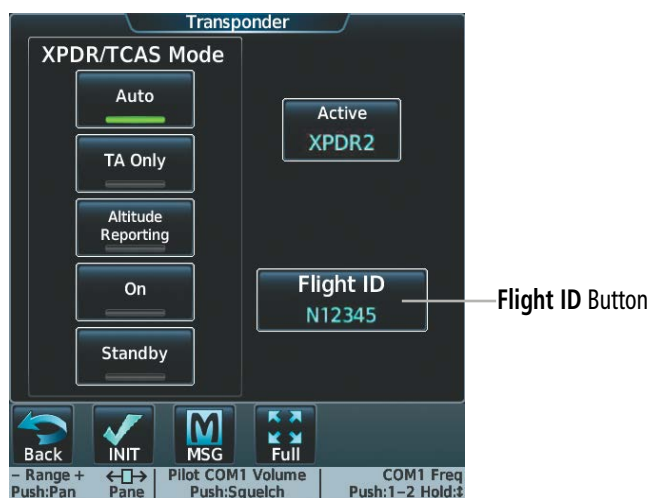
Figure 4-63 Flight ID Entry

4.5 CONTROLLER PILOT DATA LINK COMMUNICATIONS

Controller Pilot Data Link Communications (CPDLC) provides data link communication between the flight crew and Air Traffic Control (ATC) facilities. Communication is normally in the form of text message elements that resemble phraseology used in voice communications with ATC.

CPDLC is an application that runs within three systems. The systems are Link 2000+, FANS 1/A+, and FAA Data Comm. Link 2000+ and FANS 1/A+ are conceptually similar but differ substantially in implementation. FAA Data Comm is a reduced function option of FANS 1/A+.

Component	Link 2000+	FANS 1/A+	FAA Data Comm
Applications	CM CPDLC	AFN CPDLC ADS-C	Departure clearances (DCL) and enroute services
Network Used	ATN	ACARS	ACARS
Operational Area	Continental Europe	Continental United States Oceanic and Remote Airspace	Continental United States
Radio Datalink	VHF	SATCOM VHF if in range	VHF

LINK 2000+

Europe uses the Link 2000+ system which communicates through the Aeronautical Telecommunications Network (ATN). Eurocontrol is responsible for the technical coordination and integration of all airborne and ground based components using the Link 2000+ Programme.

Link 2000+ runs two applications, Context Management (CM) and CPDLC. Context Management is responsible for establishing communication between the aircraft and the ground network. This application must be run before a CPDLC session can be conducted and is referred to as "network logon".

FANS 1/A+

The Future Air Navigation System (FANS) communicates through the Aircraft Communications Addressing and Reporting System (ACARS) Network and is intended for use in oceanic and remote airspaces, including the North Atlantic Tracks System (NATS). Additionally, FANS 1/A+ can be used in the Continental United States for departure and enroute services.

FANS 1/A+ runs three applications, Air Traffic Services (ATS) Facilities Notification (AFN), CPDLC, and Automatic Dependent Surveillance - Contract (ADS-C). AFN is responsible for establishing communication between the aircraft and the ground network. This application must be run before a CPDLC session can be conducted and is referred to as "network logon". ADS-C allows automated reports from the aircraft to be sent based on contracts requested by ATC.

FAA DATA COMM

FAA Data Comm is a reduced function set of FANS 1/A+. This option allows operators to take advantage of the FAA's NextGen Data Comm program offered in the United States for departure clearances (DCL) and en route services without the need to equip their aircraft with the full FANS 1/A+ system.

FAA Data Comm operates over the Aircraft Communications Addressing and Reporting System (ACARS) network using VHF only and does not support Automatic Dependent Surveillance - Contract (ADS-C). For this reason, FAA Data Comm cannot be used in oceanic or remote airspaces, but instead relies on ATC towers in the continental U.S. using only the KUSA-FANS facility. The GDR 66 VHF Data Link Transceiver provides the line-of-sight link between the aircraft and ground systems. The 'ATC Datalink' Screen will not have an **ADS-C** Tab.

CPDLC SESSION OVERVIEW

The system manages CPDLC sessions with ATC facilities. Once a successful logon has been completed by the flight crew, the system will go into a CPDLC waiting state. In this state, the system is waiting for a CPDLC session to be initiated by the ATC facility. When the ATC facility sends a CPDLC session start command and it is accepted by the system, the flight crew will have the ability to send and receive CPDLC messages. The ATC facility that sent the session start command is identified as the Current Data Authority (CDA).

CPDLC downlink messages are messages initiated by the flight crew and sent to ATC. CPDLC uplink messages are messages initiated by ATC and sent to the flight crew.

CPDLC MANAGEMENT

Handoffs between ATC facilities are managed by the ground system. When the aircraft is nearing the coverage boundary of the CDA, the system is assigned a Next Data Authority (NDA) from the CDA. The NDA is the ATC facility that is waiting to take control of the aircraft. Upon crossing the boundary between the 2 ATC facilities, a transfer instruction is sent by the CDA which removes the CDA and makes the NDA the new CDA.

In the event the CPDLC session is lost and the logon is still active, the system will accept future CPDLC start commands from ATC.

ENABLING THE CPDLC SYSTEM

The Data Link Transceiver must be in data mode in order to use CPDLC. If the 'ATC Datalink' Screen is accessed with the Data Link Transceiver in voice mode, a prompt screen will ask if you want to switch to data mode. Touch the **OK** Button to switch to data mode. The Data Link Transceiver can be set to data mode prior to accessing the 'ATC Datalink' Screen. When the VHF Data Link is not available, FANS 1/A+ will use the Iridium Satellite Transceiver (GSR2) if it is available.
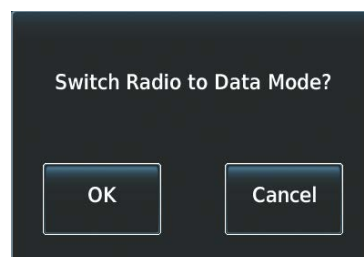
Figure 4-64 Data Mode Switch Prompt

NOTE: *Datalink and COM3 voice communication cannot be used at the same time.*

Enabling the Datalink from the 'Audio & Radios' Screen:

1) Touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) If the COM3 Frequency is enabled, touch the COM3 Frequency Button.

3) Touch the **Datalink** Button.

Enabling/disabling ACARS: (FANS 1/A+ and FAA Data Comm)

1) From Home, touch **Services > ACARS > ACARS Settings > ACARS Enabled**.

2) Touch the **ACARS Enabled** Button to enable (green annunciation).

3) Touch the **ACARS Enabled** Button again to disable. A confirmation screen is displayed.

4) Touch the **OK** Button to disable (gray annunciation).
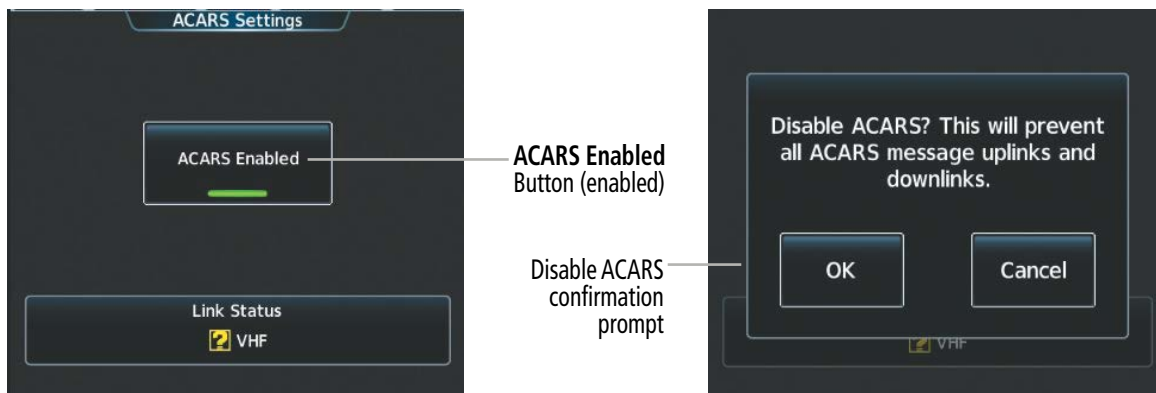
Figure 4-65 Enable/Disable ACARS

CPDLC SYSTEM CONNECTION AND STATUS

> ✔ **NOTE:** *The Connection and Connection Status that appears on the 'ATC Datalink' Screen is contingent upon the current ATC Datalink Connection. Link 2000+ connection and status will display as ATN. FANS 1/A+ and FAA Data Comm connection and status will display as FANS.*

The system will reflect the connection status at all times in the Status Tab on the 'ATC Datalink' Screen. A connection line (green dash or solid) behind the wing of the airplane symbol indicates an ATN link and a connection line in front of the wing indicates a FANS connection.

Figure 4-66 Link 2000+ Connection and Status
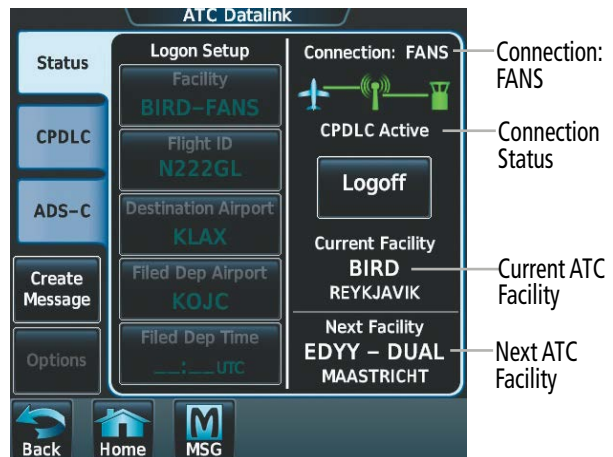
Figure 4-67 FANS 1/A+ Connection and Status

Figure 4-68 FAA Data Comm Connection and Status

The following is a list of possible system states:
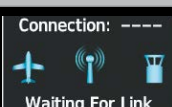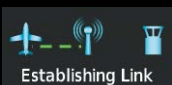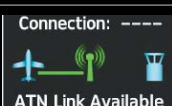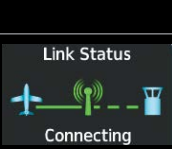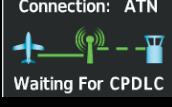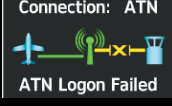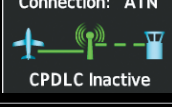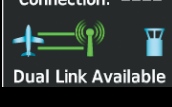
CPDLC Connection Status	Displayed Connection Status	Description
Waiting for Link	Connection: ---- ✈ ((•)) 🏢 Waiting For Link	The system has initialized the router but does not have an air-ground connection.
Establishing Link	✈-- ((•)) 🏢 Establishing Link	The system has detected a viable ground station and is attempting to establish an air-ground connection.
ATN Link Available	Connection: ---- ✈—((•)) 🏢 ATN Link Available	The system has established a connection capable of supporting ATN (Aeronautical Telecommunications Network) traffic. This state indicates that a network logon can be attempted to establish CPDLC communications.
Connecting	Link Status ✈—((•))-- 🏢 Connecting	The system has initiated a network logon with an ATC facility.
Waiting for CPDLC	Connection: ATN ✈—((•))-- 🏢 Waiting For CPDLC	The system has successfully completed the network logon procedure. During this state the system is waiting for an ATC facility to initiate a CPDLC session. This state will exist during initial connection or if a CPDLC session has been closed and the network logon is still valid.
CPDLC Active	Connection: ATN ✈—((•))—🏢 CPDLC Active	The system has successfully established a CPDLC session with a ground facility. CPDLC messages can be exchanged in this state.
Logon Failed	Connection: ATN ✈—((•))-x-🏢 ATN Logon Failed	The system was unable to establish a network logon..
CPDLC Inactive	Connection: ATN ✈—((•)) --🏢 CPDLC Inactive	The system has disconnected from a CPDLC connection. If the network logon is still valid, the system will accept another CPDLC session from an ATC facility.
DUAL Link Available	Connection: ---- ✈—((•)) 🏢 Dual Link Available	The system has established both an ACARS connection and a VHF Data Link Mode connection that supports ATN traffic. It also indicates that an AFN network logon can be attempted by the system to establish either FANS 1/A+ CPDLC or a Context Management (CM) logon for ATN CPDLC.

Table 4-3 Link 2000+ Connection Status
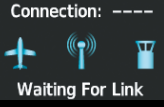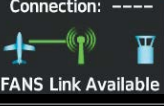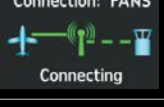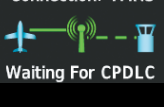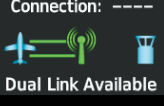
Connection Status	Displayed Connection Status	Description
Waiting for Link	Connection: ---- Waiting For Link	The system is waiting for an ACARS connection or has initialized the VHF Data Link router but does not have an air-ground connection.
FANS Link Available	Connection: ---- FANS Link Available	The system has established ACARS communication. This state indicates that an AFN (ATS Facilities Notification) logon can be attempted to establish CPDLC communications.
Connecting	Connection: FANS Connecting	The system has initiated a network logon with an ATC facility.
Waiting for CPDLC	Connection: FANS Waiting For CPDLC	The system has successfully completed the network logon procedure. During this state the system is waiting for an ATC facility to initiate a CPDLC session. This state will exist during initial connection or if a CPDLC session has been closed and the network logon is still valid.
CPDLC Active	Connection: FANS CPDLC Active	The system has successfully established a CPDLC session with a ground facility. CPDLC messages can be exchanged in this state.
Logon Failed	Connection: ---- FANS Logon Failed	The system was unable to establish a network logon..
CPDLC Inactive	Connection: FANS CPDLC Inactive	The system has disconnected from a CPDLC connection. If the network logon is still valid, the system will accept another CPDLC session from an ATC facility.
DUAL Link Available	Connection: ---- Dual Link Available	The system has established both an ACARS connection and a VHF Data Link Mode connection that supports ATN traffic. It also indicates that an AFN network logon can be attempted by the system to establish either FANS 1/A+ CPDLC or a Context Management (CM) logon for ATN CPDLC.

Table 4-4 FANS 1/A+ and FAA Data Comm Connection Status

> **NOTE:** *Though the system is capable of a "DUAL Link Available" connection status, it is not currently an option because there is no ATN network in U.S. territory.*

CPDLC MESSAGE TAB

The CPDLC message tab on the 'ATC Datalink' Screen contains a combination of status icons and text to indicate the current status of each message.

> **NOTE:** Messages might not display in order if the message has not been acknowledged by the ground network.

> **NOTE:** CPDLC messages that have not been viewed will have a blue highlight on the 'Notifications' Screen. There is no blue highlighting of an unviewed message on the 'ATC Datalink' Screen.
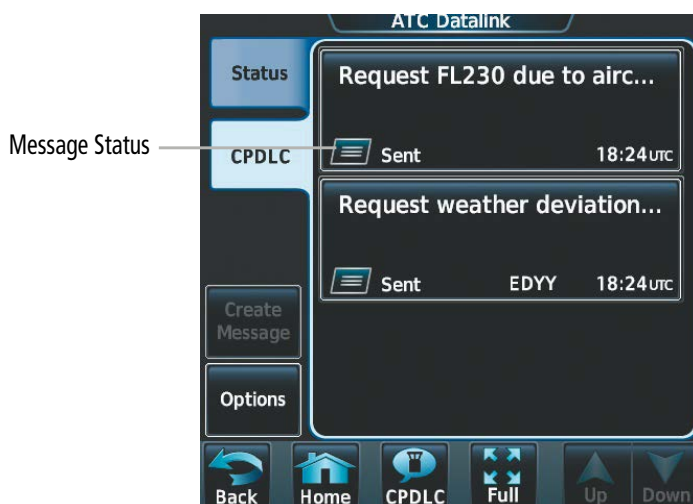
Figure 4-69 Message Dialog List

The CPDLC message tab displays the number of pending messages in parenthesis. A message is considered pending if it has not been opened or if the message requires pilot action that is not complete.

Figure 4-70 CPDLC Message Tab

CPDLC MESSAGE STATUS ICONS

Icon	Text	Description
	Sent	Message sent to ATC.
	Standby	'Standby' message response sent to ATC. The exclamation point notifies the flight crew that an action is needed to close the message.
	Send Failed / Expired	Message failed to send or the message timed out (270 seconds).
	Closed	Message sent to ATC and message thread closed.

Table 4-5 Downlink (Aircraft to ATC) Status Icons

Icon	Text	Description
	Standby (message not opened)	Unopened 'Standby' message response sent by ATC.
	Standby (message opened)	Opened 'Standby' message response sent by ATC.
	Need Response (message not opened)	Unopened message that requires a response to ATC.
	Need Response (message opened)	Opened message that requires a response to ATC.
	Expired (message not opened)	Unopened expired message sent by ATC (100 seconds).
	Expired (message opened)	Opened expired message sent by ATC (100 seconds).
	Closed (message not opened)	Unopened message that closed the message thread.
	Closed (message opened)	Opened message that closed the message thread.

Table 4-6 Uplink (ATC to Aircraft) Status Icons

CONNECTING TO THE CPDLC SYSTEM

Prior to logging on to CPDLC, an ICAO flight plan must have been filed for the system to reference and the information entered into the Log-on display must match the filed flight plan. However, it is not necessary to have the flight plan loaded into the FMS to perform CPDLC logon.

If an active flight plan is already loaded in the FMS, the "Destination Airport" and "Filed Dep Airport" fields on the 'ATC Datalink' Screen will automatically populate. After entering information in the required Logon Setup fields and successfully logging on to the system, messages may be sent and received.

The following parameters are used to log on to the system:

- Facility
- Flight ID or Aircraft Registration as filed (populated from the transponder screen)
- Destination Airport (populated from the active flight plan)
- Filed Departure Airport (populated from the active flight plan)
- Filed Departure Time (Optional - used for Link 2000+ when flying multiple flights with the same departure and destination pairing)

Setting up Logon:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Status** Tab to display the Logon Setup buttons.

3) Touch the **Facility** Button to display the 'ATC Facilities Lookup' Screen.

4) Enter the desired facility using the keypad and touch the **Enter** Button.

   Or:

   Touch the **Find** Button to display the 'Find Facility' Screen. A list of available ATN and FANS facilities are displayed. Touch the desired facility and the **Enter** Button.

In this case, EDYY-ATN was selected. The selected facility is now displayed in the Facility field.

Figure 4-71 Logon Setup Display
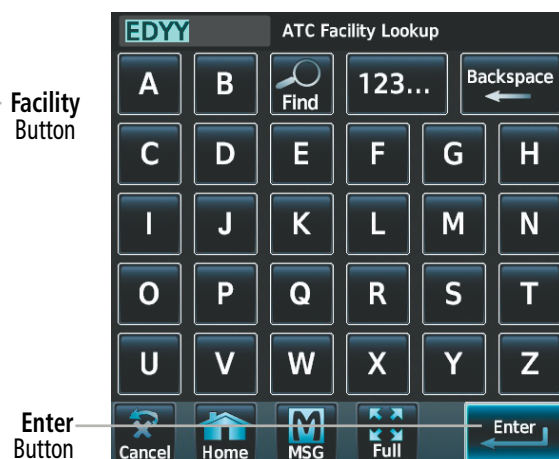
Figure 4-72 'ATC Facility Lookup' Screen
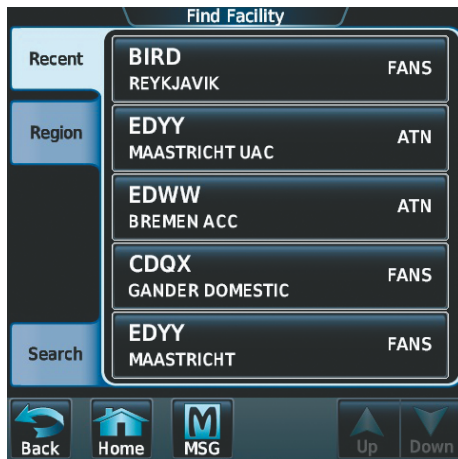
Figure 4-73 'Find Facility' Screen

EDYY-ATN selected and displayed in the **Facility** Button

Figure 4-74 Logon Facility Set

5) Touch the **Flight ID** Button to display the 'Flight ID' Screen.

6) Enter the Flight ID or aircraft registration number.

7) Touch the **Enter** Button. The Flight ID number is displayed in the **Flight ID** Button.
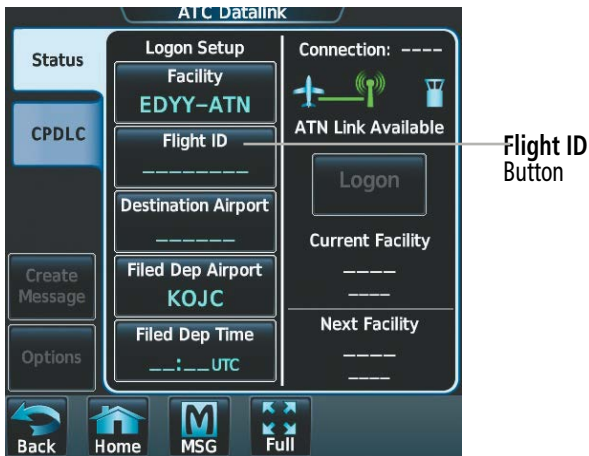
Figure 4-75 Logon Setup Display

Flight ID Button

Figure 4-76 'Flight ID' Screen

Figure 4-77 Entering Flight ID (Tail Number Shown)

Flight ID is displayed

Enter Button

Figure 4-78 Flight ID is displayed in the Flight ID Button

8)   Touch the **Destination Airport** Button to display the 'Destination Airport' Screen.

9)   Enter the airport identifier for the destination airport used in the filed flight plan.

10) Touch the **Enter** Button. The airport identifier is displayed in the **Destination Airport** Button.
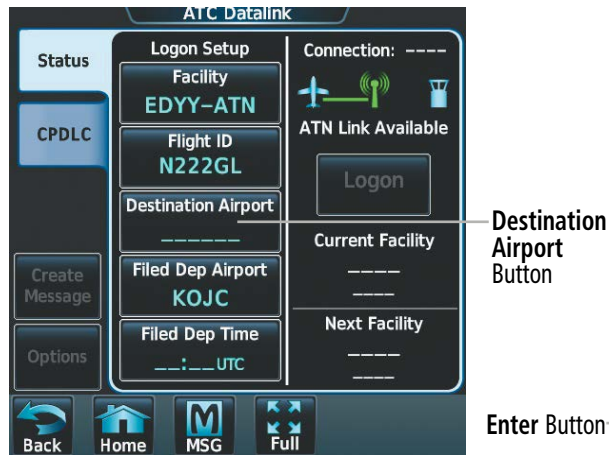
Figure 4-79 Destination Airport Button

Figure 4-80 Entering Destination Airport
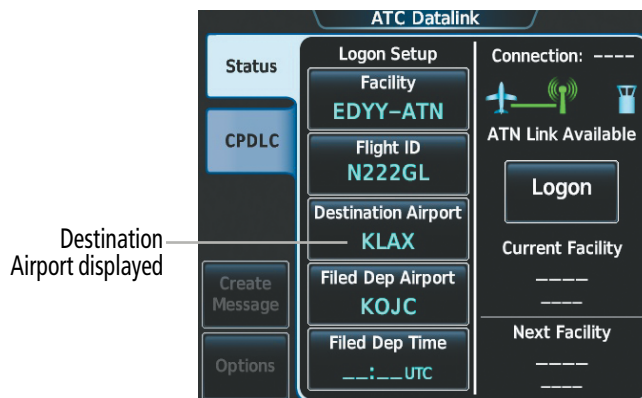
Figure 4-81 Destination Airport Set

11) The Filed Departure Airport Button is populated with the airport identifier corresponding to the current aircraft location, in this case KOJC. If the flight plan was filed using a different airport identifier, touch the **Filed Dep Airport** Button and enter the appropriate airport identifier.

12) Touch the **Filed Dep Time** Button to display the 'Filed Departure Time' Screen.

13) Enter the departure time used in filing the flight plan.

14) Touch the **Enter Button**.

15) Touch the **OK** Button when prompted to confirm departure time. The departure time is displayed in the **Filed Dep Time** Button.

Figure 4-82 Filed Dep Airport Set

Figure 4-83 'Filed Departure Time' Screen
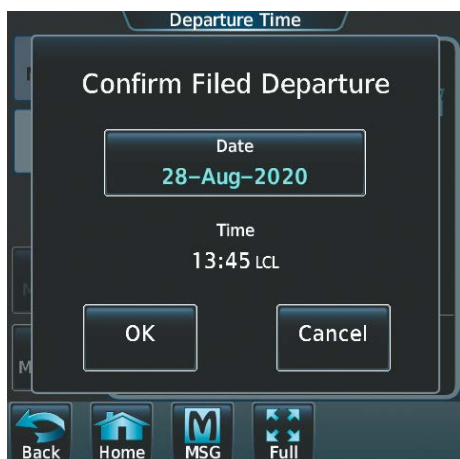
Figure 4-84 Confirming Departure Time
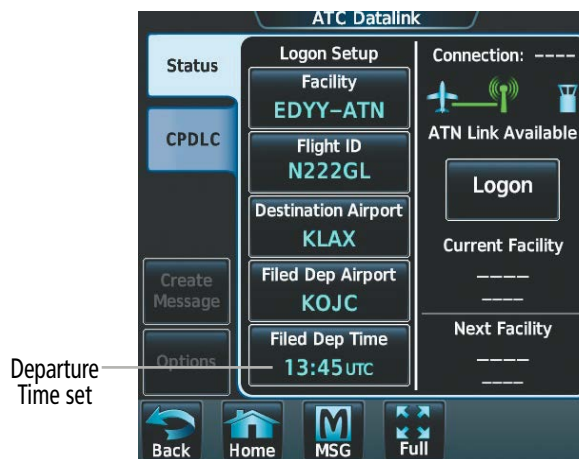
Figure 4-85 Departure Time Set

Performing the system log-on:

1) After performing the previous Logon Setup procedure, verify the link status display indicates a link with a ground station is available. An available link is indicated by a solid green line between the aircraft symbol and the ground station antenna symbol.

2) Touch the **Logon** Button. The link status display indicates 'Connecting' with an animated dashed green line between the ground station antenna symbol and the ATC facility symbol. Touching the **Cancel** Button will terminate the logon process. When connection is complete, the display indicates 'Connected' with a solid green line between the ground station antenna symbol and the ATC facility symbol. The 'Next Facility' field will be automatically populated by the Current Data Authority at a later time.
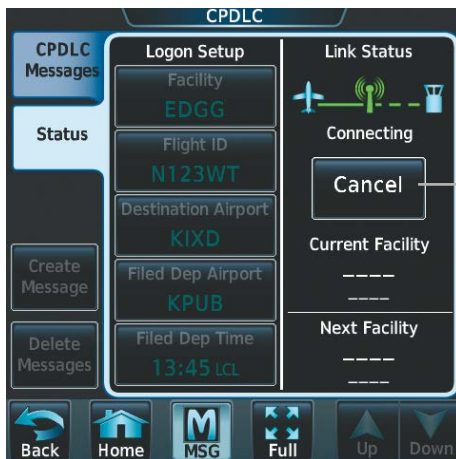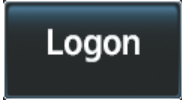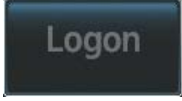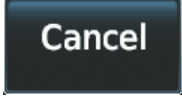
Figure 4-86 Connecting to the ATC Facility
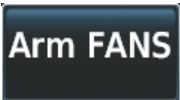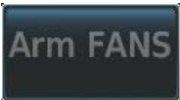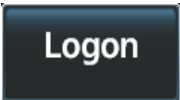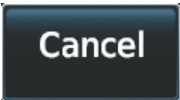
Figure 4-87 System is Connected and Active

Logon Button State	Conditions
Arm ATN	All essential parameters* for a Context Management (CM) logon have been entered, there is a GPS connection, but there is no ATN connection. Touch the button to arm ATN.
Arm ATN (subdued)	All essential parameters for a Context Management (CM) logon have been entered, but there is no ATN connection and no GPS connection. The button is subdued, indicating that arming of ATN is unavailable.
Logon	An ATN connection exists, there is a GPS connection, and all essential parameters for a CM Logon have been entered. Touch the button to begin the logon process.
Logon (subdued)	An ATN connection is present as well as a GPS connection but the essential parameters for a CM logon have not been entered. The button is subdued, indicating that logon is unavailable.
Cancel	All essential parameters have been entered, there is an ATN connection, a GPS connection, and a CM Logon has been sent to the ATC facility and no acknowledgement of the logon has been received by the aircraft. Or: The system has been Armed and is waiting for an ATN connection. Touch the button to cancel the logon process.
Logoff	The CM logon has been acknowledged by the ATC facility. Touch the button to begin the logoff process.

Note: Essential parameters for CM Logon are Facility, Flight ID, Destination Airport, and Filed Departure Airport

Table 4-7 Link 2000+ Logon Button Conditions

Logon Button State	Conditions
Arm FANS	All essential parameters* for an AFN logon have been entered, there is a GPS connection, but there is no ACARS connection. Touch the button to arm ATN.
Arm FANS (subdued)	All essential parameters for an AFN Logon have been entered, but there is no ACARS connection and no GPS connection. The button is subdued, indicating that arming of ATN is unavailable.
Logon	An ACARS connection exists, there is a GPS connection, and all essential parameters for an AFN Logon have been entered. Touch the button to begin the logon process.
Logon (subdued)	An ACARS connection is present as well as a GPS connection but the essential parameters for an AFN logon have not been entered. The button is subdued, indicating that logon is unavailable.
Cancel	All essential parameters have been entered, there is an ACARS connection, a GPS connection, and an AFN Logon has been sent to the ATC facility and no acknowledgement of the logon has been received by the aircraft. **Or:** The system has been Armed and is waiting for an ACARS connection. Touch the button to cancel the logon process.
Logoff	The AFN logon has been acknowledged by the ATC facility. Touch the button to begin the logoff process.

Note: Essential parameters for AFN Logon are Facility, Flight ID, Destination Airport, and Filed Departure Airport

Table 4-8 FANS 1/A+ and FAA Data Comm Logon Button Conditions

RECEIVING A MESSAGE

Incoming CPDLC messages are accompanied by an aural alert. In addition, the System Message button on the Touchscreen Controller Button Bar will change to a flashing CPDLC Icon Button and a flashing CPDLC icon will appear in the top left corner of the PFD. The PFD icon will flash five times and will then remain on the PFD until all messages have been viewed and a downlink response has been provided for messages that require a response. A CPDLC message takes priority over a System Message. If a CPDLC message is received, the button on the Touchscreen Controller button bar will flash "CPDLC" until the CPDLC message has been viewed. The aural alert and the PFD icon are inhibited during critical phases of flight.

Incoming CPDLC message icons

Touchscreen Controller Button Bar

PFD
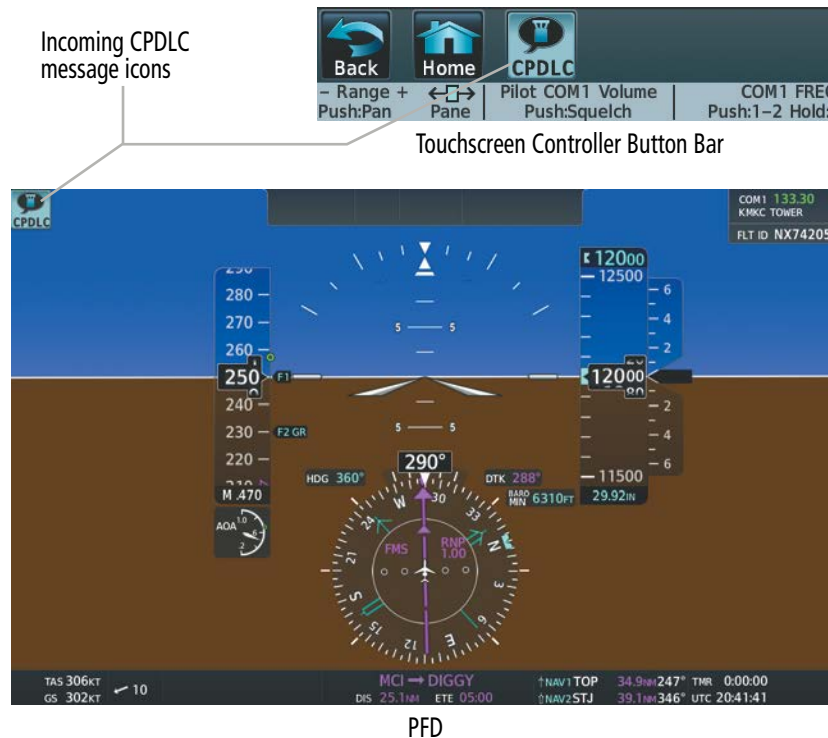
Figure 4-88 Incoming CPDLC Message Icons

When an uplink CPDLC message that requires a response from the flight crew is received, a 100 second timer is started. If the timer expires and no response has been received by ATC, the message icon will indicate the message has expired. In this case, the avionics will automatically send a CPDLC Error message to ATC indicating the message has expired on the flight deck and ATC will consider the message dialogue closed. The uplink message dialog can now be deleted.

INITIATING/RESPONDING TO A MESSAGE

> **NOTE:** *Any message threads closed by a means other than a WILCO response that have importable message elements should not be imported.*

Initiating or responding to an ATC message consists of choosing from a pre-determined list of initiation or response messages, and then sending the message.

When a downlink CPDLC message that requires a response from ATC is sent from the flight crew, a 270 second timer is started. If the timer expires and no response is received from ATC, the message icon will indicate the message has expired. An expired message does not necessarily indicate the dialog between the flight crew and ATC has ended. Operational procedures dictate that ATC should not respond to an expired downlink message but technical provisions do not prevent it. As a result, the expired message dialog cannot be deleted while the CPDLC session remains active.

CREATING A MESSAGE

Creating a message consists of choosing from a pre-determined list of requests, entering the required information, and sending the request. For discussion purposes an altitude change will be requested.

Creating a CPDLC Message from a pre-determined list of requests:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Create Message** Button to display the 'Select Message Group' Screen.
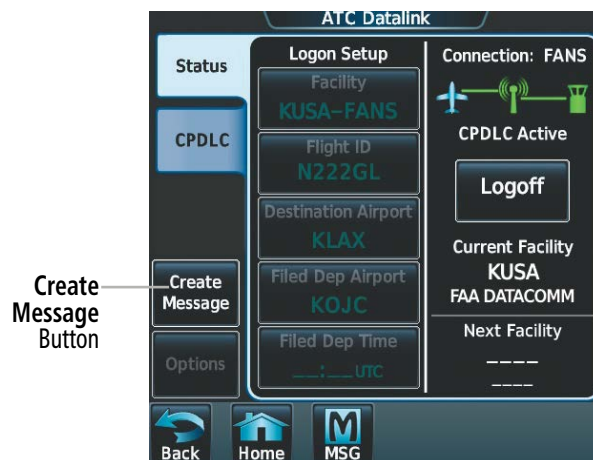
Figure 4-89 Create Message Button

3) Touch the **Vertical Requests** Button to display the 'Select Message' Screen.

4) Touch the **Request Level** Button to display the 'New CPDLC Message' Screen.

Figure 4-90 Select Message Group
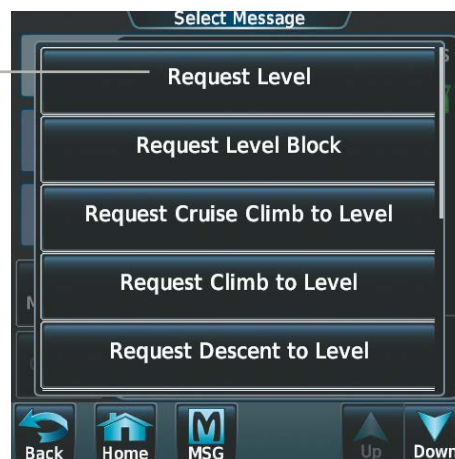
Figure 4-91 Select Message

5) Touch the **Request Level** Button to display the "Altitude Entry" Screen.

6) Touch the desired altitude mode button. Link 2000+ has two altitude modes (Flight Level and FT). FANS 1/A+ and FAA Data Comm have three altitude modes (Flight Level, MSL, and AGL). A green annunciation indicates the selected mode.

7) Use the keypad to enter the requested altitude.

8) Touch the **Enter** Button and the requested altitude is displayed in the **Request Level** Button..
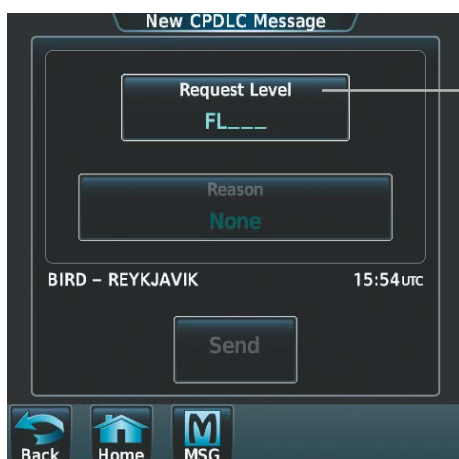
Figure 4-92 'New CPDLC Message' Screen
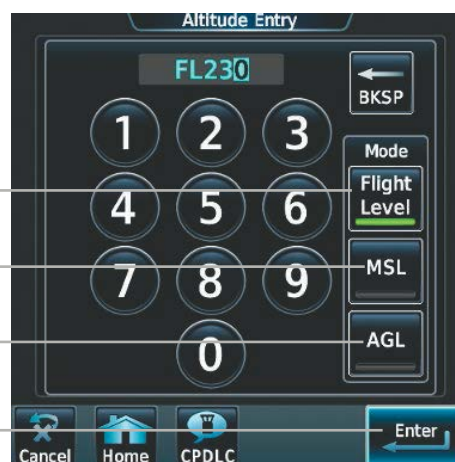
Figure 4-93 FANS 1/A+ 'Altitude Entry' Screen

9) Touch the **Reason** Button (optional information, the message can be sent without it). A list of pertinent reasons is presented.

Figure 4-94 Reason for request

Figure 4-95 Request is Ready to Send

10) Touch the desired reason.

11) Touch the **Send** Button.

Creating a Message using the free text format: (FANS 1/A+ only)

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Create Message** Button to display the 'Select Message Group' Screen.

3) Touch the **Additional Messages** Button to display the 'Select Message' Screen.

Figure 4-96 Select Message Group

4) Touch the **Free Text - Normal** or **Free Text - Distress** Button to display the 'New CPDLC Message' Screen.

5) Touch the **Free Text Message** Button to display the 'New CPDLC Message' Screen.
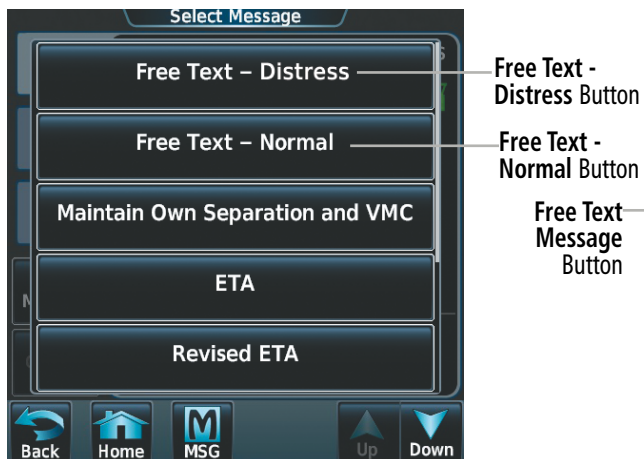
Figure 4-97 Select Message Type
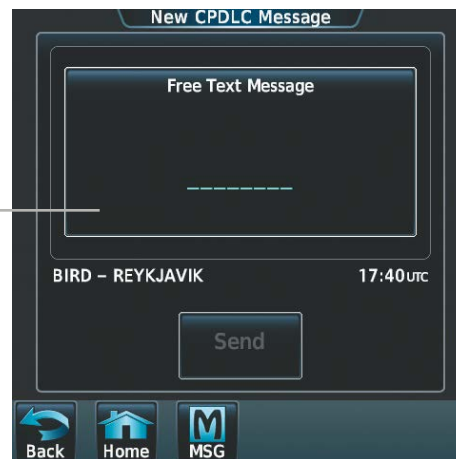
Figure 4-98 Free Text Message Screen

6) Enter the desired text message.

7) Touch the **Enter** Button.

8) Touch the **Send** Button.
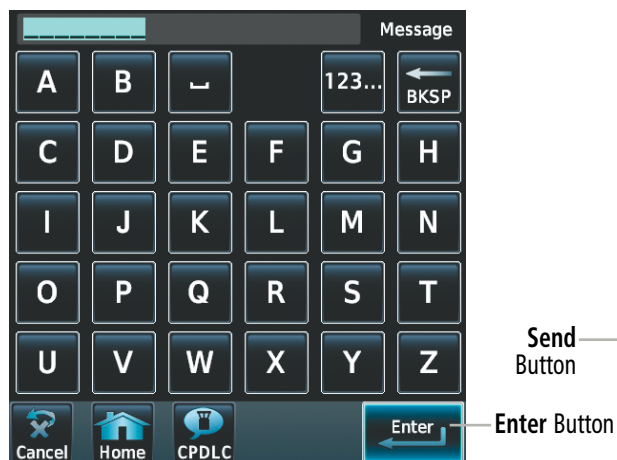
Figure 4-99 Message Entry Screen

Figure 4-100 Free Text Message Displayed

ARMED MESSAGES (FANS 1/A+ AND FAA DATA COMM ONLY)

Some message reports that are required by ATC can be armed to automatically send when the appropriate conditions are met. A report that can be armed must be based on an event during the flight that is measurable and able to be monitored. The system automatically designates responses that can be armed. If a response can be armed, the Arm Report Button will appear at the bottom of the 'CPDLC Thread' Screen.

Message Description	Trigger Conditions
REPORT BACK ON ROUTE	This report is triggered when the parallel (i.e. offset) track is cancelled and the aircraft returns to within 0.5 nm of the original flight path.
REPORT LEAVING [altitude]	This report is triggered when the aircraft has left within 150 feet of the specified altitude. This condition will only latch of the aircraft entered within +/- 150 feet of the specified altitude and the ascended or descended beyond +/- 150 of the specified altitude. If the aircraft is beyond +/- 150 feet of the specified altitude when the report is armed, the aircraft must first fly within the +/- 150 foot range and then depart for the report to be triggered.
REPORT LEVEL [altitude]	This report is triggered when the aircraft has ascended or descended to within +/- 150 feet of the specified altitude. The report will not trigger if the aircraft is currently within +/- 150 feet of the specified altitude when the report is armed.
REPORT PASSING [position]	This report is triggered when the aircraft has sequenced past the specified position in the Active Flight Plan.
REPORT REACHING [altitude]	This report is triggered when the aircraft has ascended or descended to within +/- 150 feet of the specified altitude. The report will not trigger if the aircraft is currently within +/- 150 feet of the specified altitude when the report is armed.
REPORT REACHING BLOCK [altitude] TO [altitude]	This report is triggered when the aircraft is within the specified altitude range.

Only one of each type of message is allowed to be armed at a time.

Table 4-9 Flight Crew Armed Uplink Messages

Arming a message report to send automatically:

1) From Home, touch the **ATC Datalink** Button.

2) If necessary, touch the **CPDLC** Tab. A list of message dialogs is displayed.

3) Touch the appropriate message dialog box to display the message thread.

Figure 4-101 Message Dialog List

Figure 4-102 Message Thread With Armed Response

4)	Touch the **Arm Report** Button. A confirmation prompt appears with the conditions that will trigger the message to be sent.

5)	Touch the **OK** Button to arm the report. The message report will be automatically sent when the specified conditions are met.

Figure 4-103 Arm Report Confirmation Prompt

ARMED MESSAGE STATUS

The armed message feature allows the crew to create a message that will be sent at a future time. The armed Message button will allow the crew to view and cancel messages that have been armed.

Viewing Armed Messages:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Options** Button to display the 'CPDLC Options' Screen

3) Touch **Armed Message Status** to display the 'Armed Message Status' Screen.
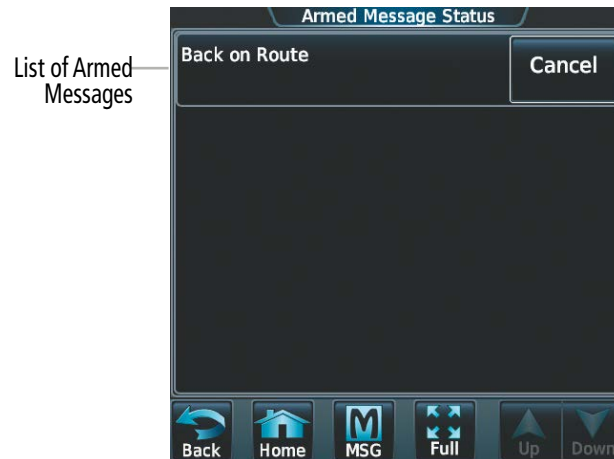
Figure 4-104 Armed Message Status

Cancelling Armed Messages:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Options** Button to display the 'CPDLC Options' Screen.

3) Touch **Armed Message Status** to display messages that are currently armed.

4) Touch the **Cancel** Button on the message that is to be cancelled. A confirmation window is displayed.

5) Touch **OK** to cancel the armed message.
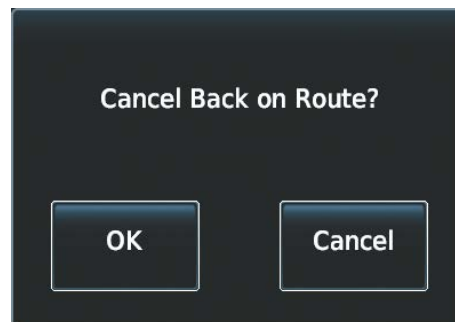
Figure 4-105 Cancel Armed Message Prompt

DEPARTURE CLEARANCE (FANS 1/A+ AND FAA DATA COMM ONLY)

When a departure clearance is received, a CPDLC message is generated.

Responding to a departure clearance:

1) From Home, touch the **ATC Datalink** Button.

2) If necessary, touch the **CPDLC** Tab.

3) Touch the message dialog box to view the departure message thread.

4) Touch the **Standby** Button to send the Standby message to ATC.

   Or:

   Touch the **Preview** Button to view the preview flight plan screen with the included clearance waypoints.

   Touch the **Show on Map** Button to preview the clearance waypoints on the map.

   Or:

   Touch the **Copy to Standby** Button to copy it to the standby flight plan.

   Or:

   Touch the **Send** Button to respond to the clearance. A negative response, such as 'Unable', will send the negative response to ATC. If the response is positive, such as 'WILCO', a prompt window will be shown.

Figure 4-106 Departure Message Received

Figure 4-107 Departure Message Thread

5) Touch the **Yes** Button to choose the individual elements of the DCL to import. Touch the **No** Button to return to the 'CPDLC Thread' Screen with no change. The 'Select Element to Import' Screen will only popup when concatenated messages are sent all together, which is not common.
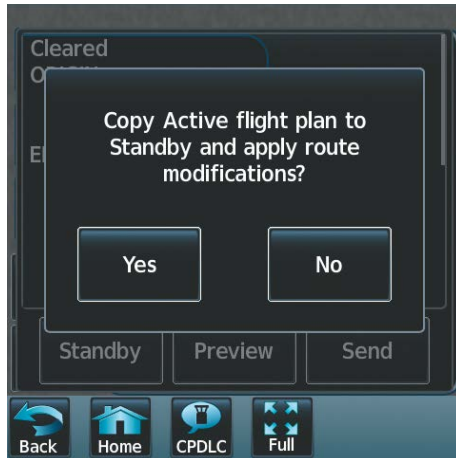
Figure 4-108 Flight Plan Modification Prompt

Figure 4-109 Select Element to Import

VIEWING MESSAGE DIALOGS

The status of a string of messages and responses, or dialog, may be checked and past message dialogs viewed. When the system power is cycled, the list of message dialogs is deleted.

When sending downlink messages, network latency can delay when the ground station receives the message. When the system has received acknowledgement the message was received by the ground network, the current ATC facility identifier and a time stamp showing when the message was received will be displayed at the bottom of the message in the **CPDLC** Tab.

Viewing messages:

1) From Home, touch the **ATC Datalink** Button.

2) If necessary, touch the **CPDLC** Tab. A list of message dialogs is displayed.

3) Touch a message dialog box to display the message thread.

Figure 4-110 Message Dialog List
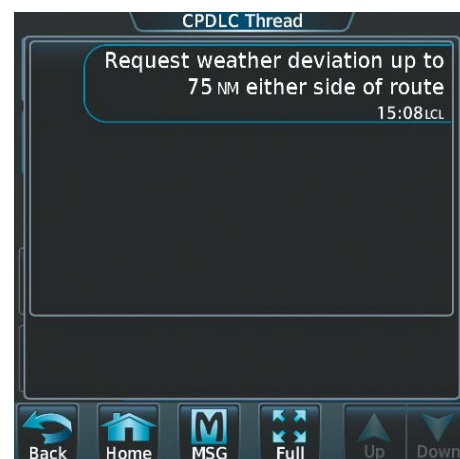
Figure 4-111 Message Dialog Thread

Or:

1) Touch the **CPDLC** Button on the Button Bar.

2) If necessary, touch the **CPDLC Messages** Tab. A list of message dialogs is displayed.

Figure 4-112 CPDLC Button on the Button Bar

DELETING MESSAGE DIALOGS

While the system deletes the list of message dialogs when power is turned off, individual message dialogs may also be deleted manually. Message dialogs considered closed may also be deleted.

Deleting a single message dialog:

1) From Home, touch the **ATC Datalink** Button.

2) If necessary, touch the **CPDLC** Tab.

3) Touch the message dialog to open the message thread.

4) Touch the **Delete** Button. A confirmation window is displayed.

5) Touch the **OK** Button to delete the message dialog.
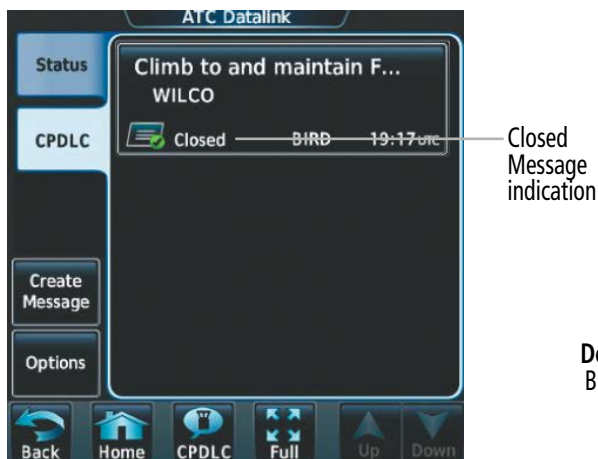
Figure 4-113 Closed Message
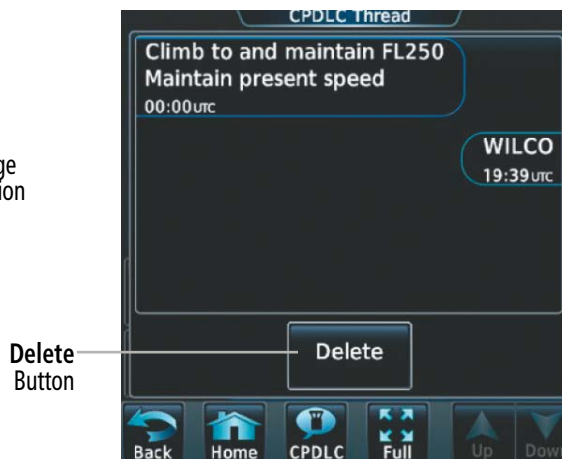
Figure 4-114 Deleting a Single Closed Message

Deleting all closed message dialogs:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Option** Button to display the 'CPDLC Options' Screen.

3) Touch the **Delete Closed Messages** Button. A confirmation window is displayed.

4) Touch the **OK** Button. All closed message dialogs are deleted.
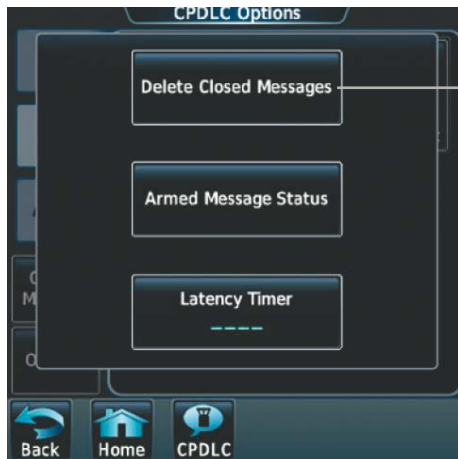
Figure 4-115 Delete Closed Messages
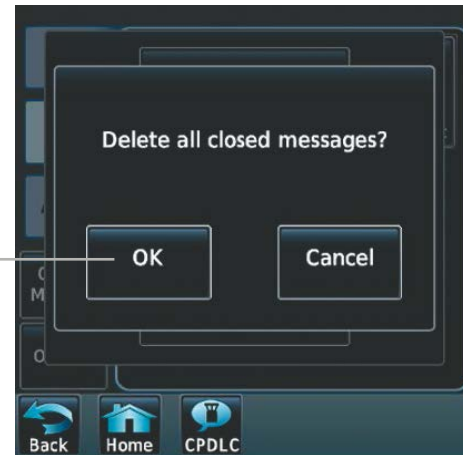
Figure 4-116 Delete Confirmation

LATENCY TIMER (FANS 1/A+ ONLY)

FANS 1/A+ uses a number of timers to ensure connectivity is maintained and loss of connectivity is quickly recognized. A message latency timer is available on the 'CPDLC Options' Screen. The system is also able to import the latency timer. Once the flight crew responds to the message, they can open it back up and import the latency timer settings**.**

Flight crew should only set the message latency timer based upon instructions received from ATC. If FANS 1/A+ receives a CPDLC uplink message where the sent and received timestamps differ by more than the time set by the flight crew, FANS 1/A+ will discard the message. The airborne system will automatically send, without flight crew interaction, a free text message indicating to ATC that the uplink message was delayed in the network and the message should be resent by ATC or ATC should contact the flight crew by voice.

Setting Latency Timer:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **Options** Button to display the 'CPDLC Options' Screen.

3) Touch the **Latency Timer** Button to display the keypad.

4) Enter the desired time for message latency and touch the **Enter** Button.

5) Touch the **Clear Timer** Button to reset the time value to zero.
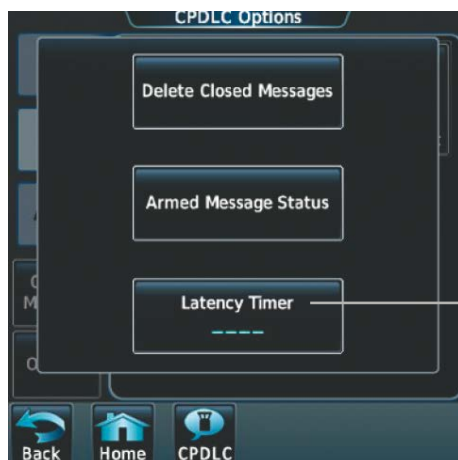
Figure 4-117 Latency Timer Button

Figure 4-118 Latency Timer Keypad

ADS-C SESSION OVERVIEW (FANS 1/A+ ONLY)

After performing system logon, the system will manage ADS-C contracts established with ATC end systems. An ADS-C connection is established when the first ADS-C contract request from an ATC end system is received. Up to sixteen facilities can receive a sent ADS-C report for each ADS-C connection. The system supports up to four simultaneous ADS-C connections. ATC controls all ADS-C contracts and the crew should have no action.

A connection will only be cancelled if the pilot or copilot disables ADS-C, no valid contracts have been established for sixteen minutes, or the ATC end system cancels the connection.

The three types of contracts are periodic, event and demand. The periodic contract requests the transmission of a report at a specific time interval defined when the contract is established. An event contract requests the transmission of a report when a defined event occurs. A demand contract requests a report as soon as the contract is received and is only sent once.

Enabling ADS-C connections:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **ADS-C** Tab to display the ADS-C Connections Screen.

3) Touch the **ADS-C Enabled** Button.

Figure 4-119 Connections Screen With No Connections   **Figure 4-120 Connections Screen With Connections**

Details of each ADS-C connection with ATC end systems can be viewed by selecting any of the connection buttons. At the top of the 'Connection Details' Screen either Normal Mode or Emergency Mode is displayed. The next section shows which facilities are receiving the reports for this ADS-C Connection instance.

The other sections that follow display the types of contracts established with the aircraft and other associated details depending on the types of contracts. This page can be scrolled for viewing all the details associated with the ADS-C Connection.

Viewing ADS-C connection details:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **ADS-C** Tab to display the ADS-C Connections Screen.

3) Touch the desired Connection Button to display the 'Connection Details' Screen.

Figure 4-121 ADS-C Connection Details

ADS-C EMERGENCY MODE (FANS 1/A+ ONLY)

The system provides a control to enable or disable an emergency mode. In the emergency mode, each connection is modified to contain a default emergency periodic contract. A default emergency periodic contract is defined as a periodic contract containing the basic data group and the flight identification and earth reference groups included with every fifth report, beginning with the first report.

The Emergency mode will automatically be enabled if the flight crew sends the CPDLC message "MAYDAY MAYDAY MAYDAY". Conversely, the emergency mode will be automatically disabled if the flight crew sends the CPDLC message "CANCEL EMERGENCY".

Initiating the ADS-C Emergency Mode:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **ADS-C** Tab to display the ADS-C Connections Screen.

3) Touch the **Emergency Mode** Button.

4) An "Initiate ADS-C Emergency Mode" prompt will appear. Press the **OK** Button.
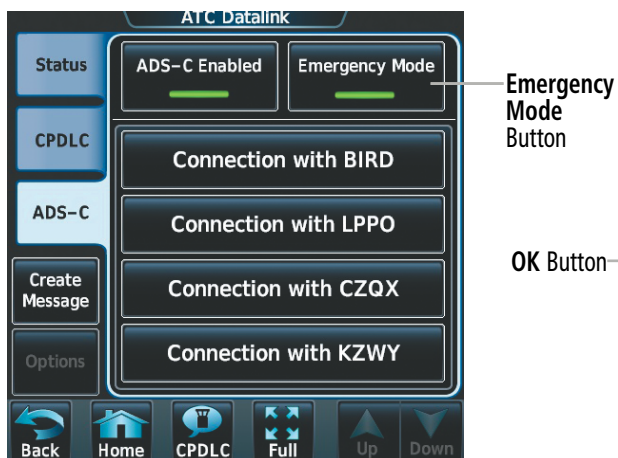
Figure 4-122 ADS-C Emergency Mode Button

Figure 4-123 Initiate ADS-C Emergency Mode

DISABLING ADS-C (FANS 1/A+ ONLY)

The crew may choose to disable ADS-C connections.

Disabling ADS-C connections:

1) From Home, touch the **ATC Datalink** Button.

2) Touch the **ADS-C** Tab to display the ADS-C Connections Screen.

3) Touch the **ADS-C Enabled** Button to disable ADS-C connections.

4) A "Terminate all ADS-C connections and contracts" prompt will appear. Press the **OK** Button.

Figure 4-124 Disable ADS-C Connection Prompt

DISCONNECTING FROM THE CPDLC SYSTEM

The **Logoff** Button on the **Status** Tab of the 'ATC Datalink' Screen is used to disconnect the CPDLC session from the ATC end system.

If a message thread contains importable elements, and positive closure of those elements has not occurred prior to logging off, the importable elements will not have been cleared and the import function will be disabled.

Disconnecting from the CPDLC System:

1) From Home, touch the **ATC Datalink** Button.

2) If necessary, touch the **Status** Tab.

3) Touch the **Logoff** Button.

CPDLC TEST MODE

The CPDLC test mode is a maintenance function and is not applicable to the operation of the system. Test Mode should not be activated for normal flight operations, but is accessible to the crew for troubleshooting purposes.

The CPDLC test mode is accessible using the following procedure:

Activating/Deactivating CPDLC Test mode:

1) From Home, touch the **Utilities** Button.

2) Touch the **Setup** Button.

3) Touch the **ATC Settings** Button.

4) Touch the **CPDLC Test Mode** Button to activate/deactivate the CPDLC Test Mode.

5) When activating the CPDLC Test Mode, a prompt screen will ask if you want to enter CPDLC test mode. Press the **OK** Button.

When power is removed, the system automatically clears all recorded blocks.

4.6 ADDITIONAL AUDIO FUNCTIONS

MONO/STEREO HEADSETS

Stereo headsets are recommended for use in this aircraft.

Using a monaural headset in a stereo jack shorts the right headset channel output to ground. While this does not damage the Audio Controller, a person listening on a monaural headset hears only the left channel in both ears.

SPEAKER

All of the radios can be heard over the cabin speaker. Pressing the **Speaker** Button selects and deselects the cabin speaker. Speaker audio is muted when the PTT is pressed.

The speaker volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left using the Speaker volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

Figure 4-125 Speaker Audio Selection

INTERCOM

The G5000 includes an eight-mode intercom system (ICS) that connects or isolates the pilot, copilot, and passengers. Touch the **Intercom** Button on the CNS Bar to display the 'Intercom' Screen. Touch the intercom links between the Pilot, Copilot, and Passengers to enable (green) or disable (gray) the connections. When a connecting arrow between two positions is green, the audio between those positions is open. When the arrow is gray, the audio is isolated to each position.
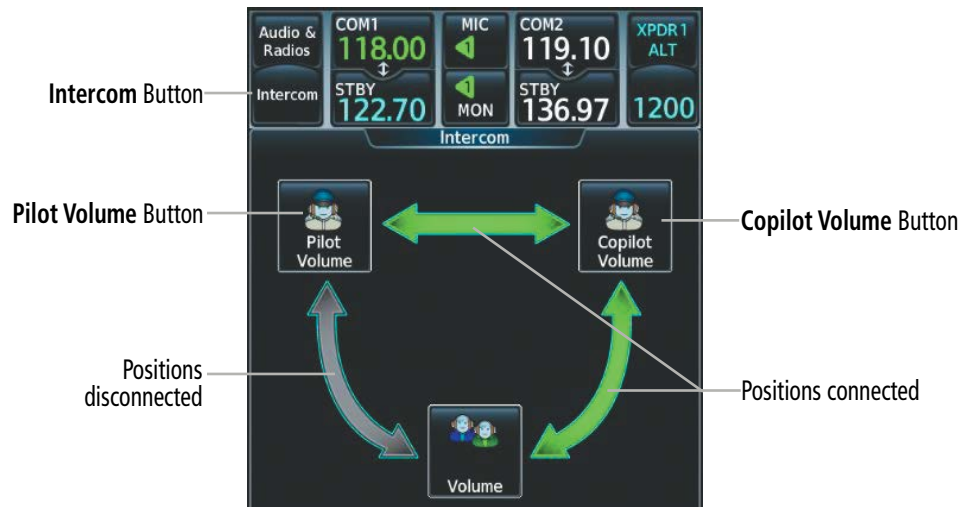
Figure 4-126 Intercom Controls

INTERCOM VOLUME AND VOX MIC

The Touchscreen Controller controls the volume and VOX Mic for the pilot and copilot independently. VOX Mic is similar to squelch except that VOX Mic is muted while the pilot is not speaking, and automatically unmutes when the pilot speaks.

The selected intercom volume and VOX Mic, or squelch level can be adjusted from 0 to 100% on the Touchscreen Controller by turning the middle knob or by sliding your finger right or left on the slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.

Adjusting the intercom volume:

1) From Home, touch the **Intercom** Button to display the 'Intercom' Screen.

2) Touch the Pilot/Copilot Volume Button to display the Pilot/Copilot Intercom Settings Screen.

3) Adjust the volume by using the middle knob or by sliding your finger on the volume slider.

Adjusting the intercom VOX Mic for the Pilot and Copilot:

1) From Home, touch the **Intercom** Button to display the 'Intercom' Screen.

2) Touch the **Pilot Volume** or **Copilot Volume** button to display the Pilot or Copilot Intercom Settings Screen.

3) Touch the VOX Mic **Manual** Button.

4) Adjust the VOX Mic by using the middle knob or by sliding your finger on the squelch slider.

Setting the intercom VOX Mic to Auto for the Pilot and Copilot:

1) From Home, touch the **Intercom** Button to display the 'Intercom' Screen.

2) Touch the **Pilot Volume** or **Copilot Volume** Button to display the Pilot or Copilot Intercom Settings Screen.

3) Touch the VOX Mic **Auto** Button.
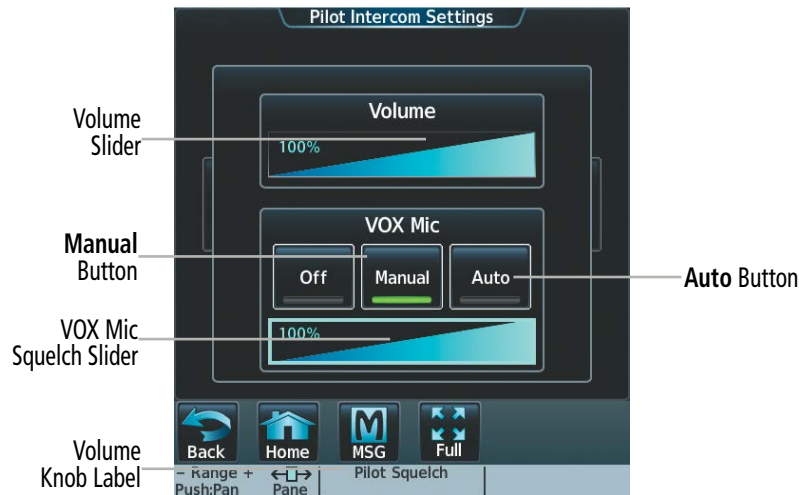
Figure 4-127 Intercom Volume/VOX Mic/Squelch Controls

PASSENGER ADDRESS (PA) SYSTEM

> ✓ *NOTE: When selecting the Passenger Address (PA) System, COM monitoring is retained only when the COM is manually monitored.*

A passenger address system is available for delivering voice messages over the cabin speaker. When the **PA** Button is selected on the Touchscreen Controller, the MIC Annunciator is replaced with a green PA, and the active COM frequency changes to white, indicating that there is no COM selected. The active COM frequency on the PFD is replaced by a white PA annunciation. A Push-to-Talk (PTT) must be pressed to deliver PA announcements. The PA Annunciator flashes about once per second while the PTT is depressed.

Selecting the PA system for transmission:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the PA.

3) Touch the **PA** Button on the 'Audio & Radios' Screen to select the PA for transmission.
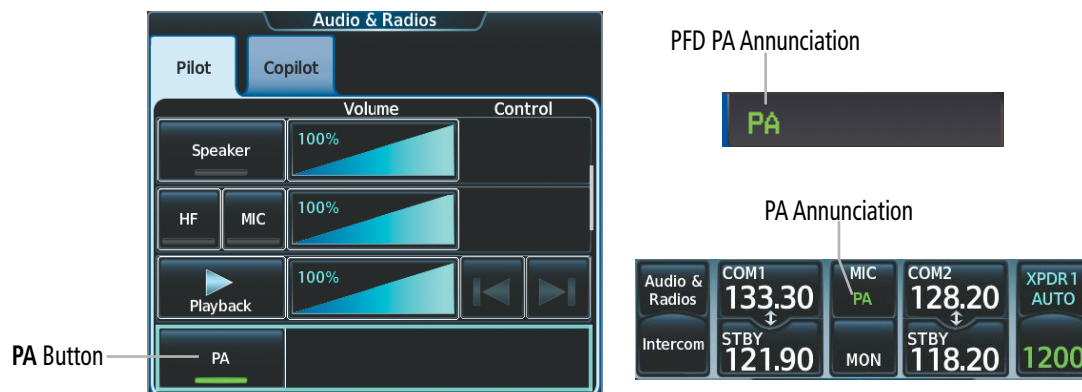
Figure 4-128 PA Controls

CLEARANCE RECORDER AND PLAYER

The Audio Controller contains a digital clearance recorder that records up to 2.5 minutes of the selected COM radio signal. Recorded COM audio is stored in separate memory blocks. Once 2.5 minutes of recording time have been reached, the recorder begins recording over the stored memory blocks, starting from the oldest block.

Touching the **Playback** (Play) Button plays the latest recorded memory block. The **Playback** (Stop) Button is displayed while the audio is playing. When the present memory block has finished playing the **Playback** (Play) Button is displayed again.

Touching the **Playback** (Stop) Button during play of a memory block stops play. If a COM input signal is detected during play of a recorded memory block, play is halted.

Touching the Play Previous Button begins playing the previously recorded memory block. Each subsequent press of the Play Previous Button selects the previously recorded memory block, if any more exist. Touching the Play Next Button begins playing the next recorded memory block. Each subsequent press of the Play Next Button selects the next recorded memory block, if any more exist.

Powering down the system automatically clears all recorded blocks.
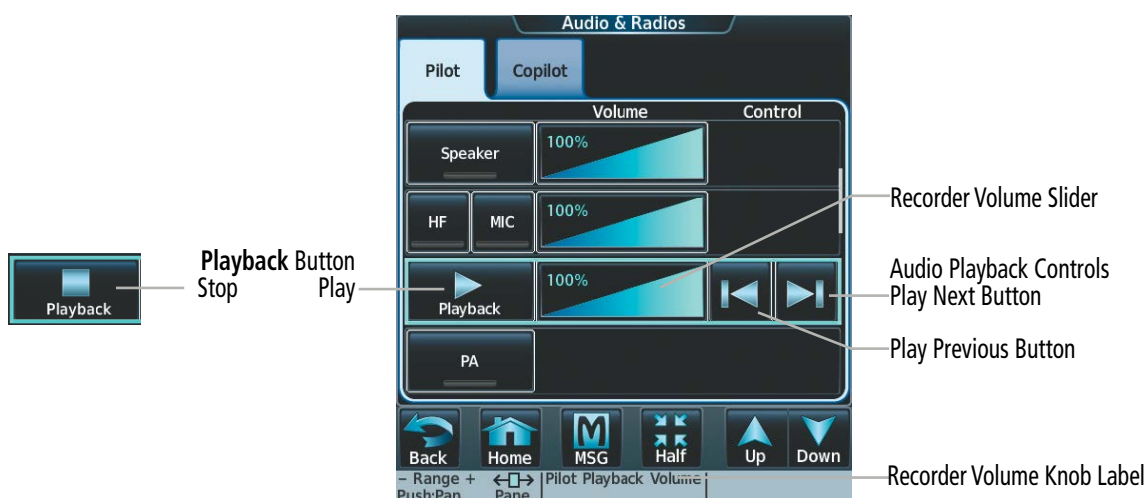
Figure 4-129 Recorder Controls

3D AUDIO

3D Audio is useful when multiple audio sources are present while using COM1 or COM2. By using different responses in each ear, 3D audio processing creates spatial separation from each audio source, aiding in the distinction of which audio source the pilot is hearing.

Because this feature uses different signals for left and right channels, it requires wiring for stereo intercom and stereo headsets. If an aircraft is not wired to support stereo headsets, or the crew does not use stereo headsets, then COMs audio will be distributed to both ears regardless of the 3D audio functionality selection.

With a single COM selected and 3D Audio enabled, the listener hears the audio source at the 12 o'clock position. If both COMs are selected, the listener hears COM1 at 11 o'clock and COM2 at the 1 o'clock position.

The scope of 3D Audio is limited to COM audio for pilot and copilot stations. All other audio (alerts, sidetones, intercom, etc.) will be distributed equally to both ears.

ENABLE/DISABLE 3D AUDIO

Pilot and Copilot 3D audio may be enabled or disabled. Also, the 3D audio left/right reference may be changed so that audio is heard in the ear as desired.

Enabling/disabling 3D Audio on the Pilot or Copilot Touchscreen Controller:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**.

2) Touch the **Audio** Tab.

3) Touch the 3D Audio Button. A green annunciation indicates the feature is enabled.

Enabling/disabling Left-Right Swap on the Pilot or Copilot Touchscreen Controller:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**.

2) Touch the **Audio** Tab.

3) Touch the L-R Swap Button. A green annunciation indicates the feature is enabled.
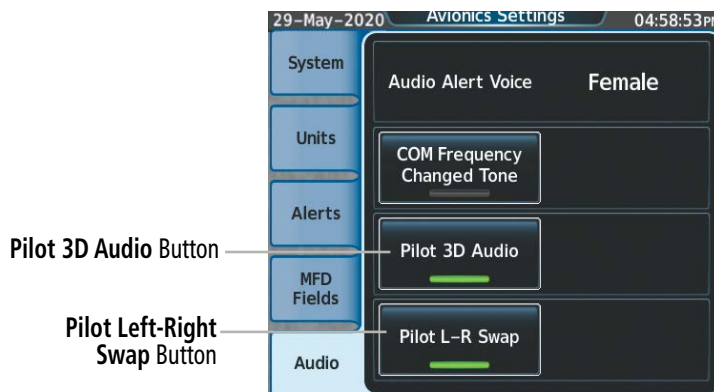
Figure 4-130 3D Audio Menus

SIMULTANEOUS COM OPERATION

Both the pilot and the copilot can transmit and receive simultaneously over separate COM radios. The selected COM MIC Annunciator flashes when either pilot's microphone PTT is pressed.

If both pilots select the same COM radio, the pilot has priority on COM1 and the copilot has priority on COM2.

NOTE: *During transmission on the active COM frequency, attenuation may occur affecting reception of the second COM audio (if monitored).*
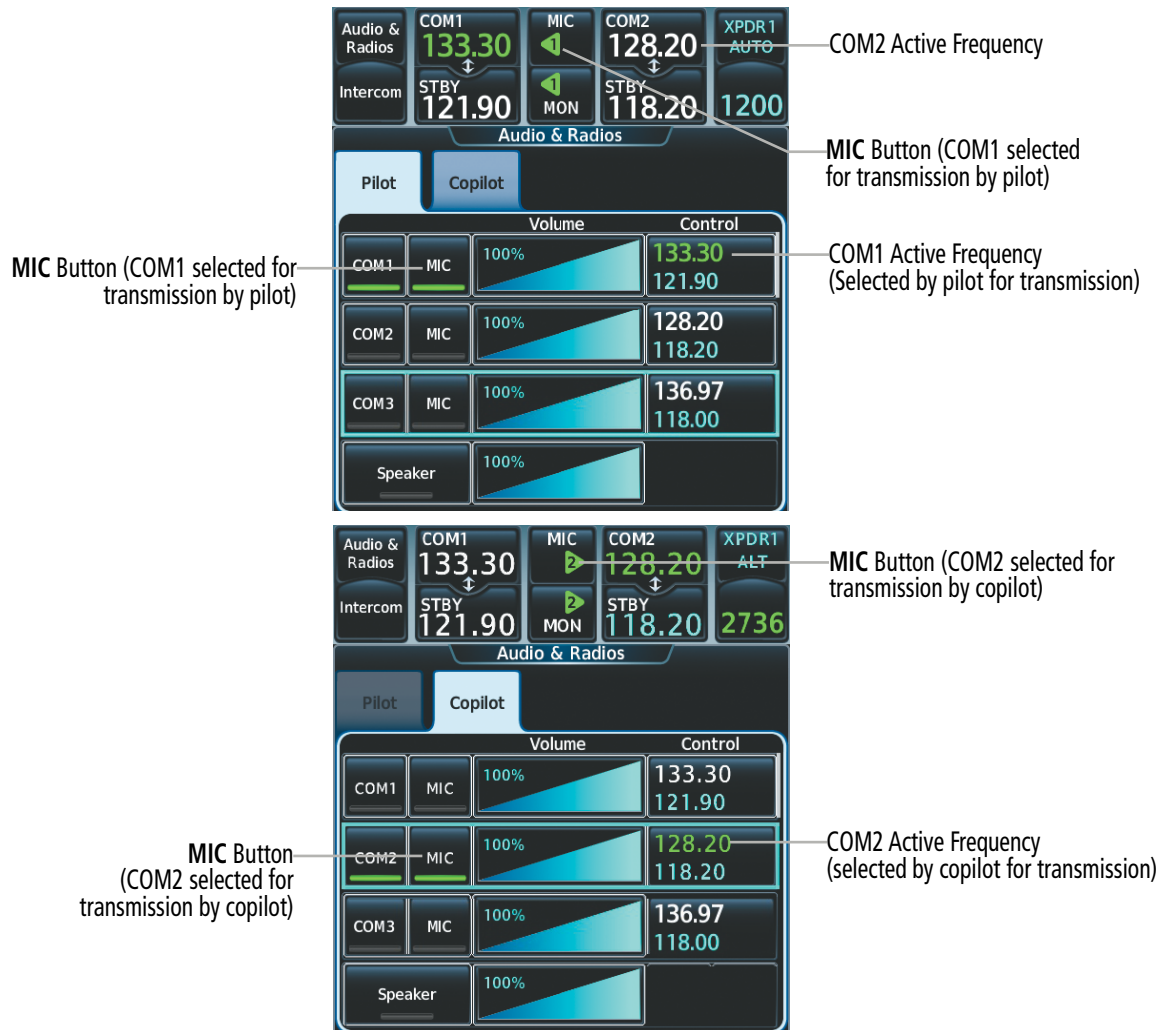
Figure 4-131 Simultaneous COM Operation

TELEPHONE

The pilot and copilot headset can be used for telephone communication. Pressing the **Telephone** Button selects and deselects the telephone for use with the corresponding headset. Active radios can still be monitored on the headset while it is being used for telephone communication. Telephone communication is muted when the PTT is pressed.

The telephone volume level can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left using the Telephone volume slider. Turning the knob clockwise increases volume, turning the knob counterclockwise decreases volume. Sliding to the right increases volume, sliding to the left decreases volume.
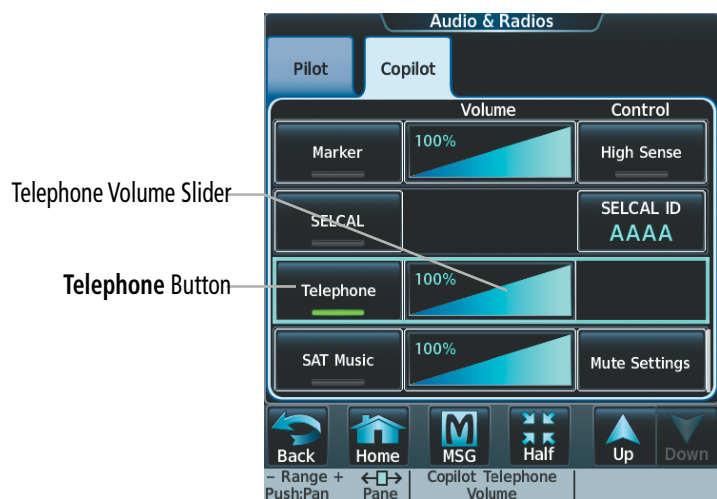
Figure 4-132 Speaker Audio Selection

SIRIUSXM RADIO ENTERTAINMENT

Refer to the Additional Features Section for more details on SiriusXM Radio Audio from the Data Link Receiver.

Selecting/Deselecting SiriusXM Audio:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find the **SAT Music** Button.

3) Touch the **SAT Music** Button to select/deselect the SiriusXM Radio input for the selected position (pilot or copilot).

The SiriusXM audio volume can be adjusted from 0 to 100% on the touchscreen controller by turning the middle knob or by sliding your finger right or left on the volume slider.

SIRIUSXM AUDIO MUTING

SiriusXM audio muting occurs when the configured activity (intercom or radio inputs) is heard. SiriusXM audio is always soft muted when an interruption occurs from these sources. Soft muting is the gradual return of SiriusXM audio to its original volume level. The time required for SiriusXM audio volume to return to normal is between one-half and four seconds.

Configuring SiriusXM audio Mute Settings:

1) From Home, touch the **Audio & Radios** Button to display the 'Audio & Radios' Screen.

2) Scroll the list to find **SAT Music**.

3) Touch the **Mute Settings** Button to display the 'SAT Music Mute Settings' Screen.

4) Select the **Intercom** and/or the **Radio Inputs** Button to select which items will mute SiriusXM audio.

Figure 4-133 SAT Music Controls

4.7 ABNORMAL OPERATION

Abnormal operation of the G5000 includes equipment failures of the system components and failure of associated equipment, including switches and external devices.

STUCK MICROPHONE

If the push-to-talk (PTT) Key becomes stuck, the COM transmitter stops transmitting after 35 seconds of continuous operation. An alert appears on the Touchscreen Controller to advise the pilot of a stuck microphone.
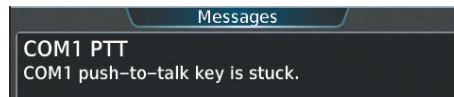
Figure 4-134 Stuck Microphone Alert

COM TUNING FAILURE

In case of a COM system tuning failure, the radio will remain tuned to the active frequency. The emergency frequency (121.500 MHz) can be tuned by selecting either the COM 1 TUNE or COM 2 TUNE switch on the instrument panel. Depending on the failure mode, an amber X may appear on the frequency display.
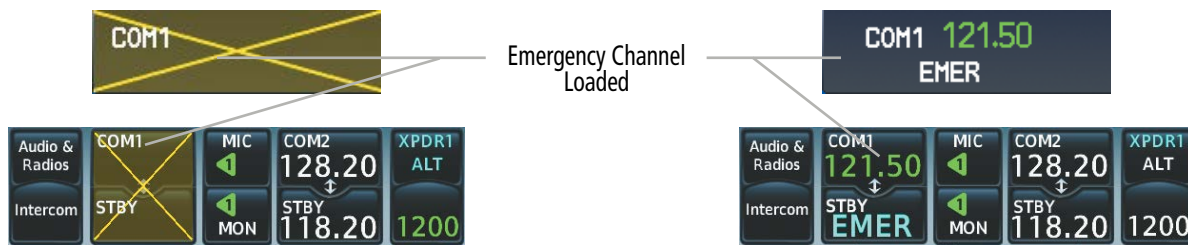
Figure 4-135 COM Tuning Failure

AUDIO CONTROLLER FAIL-SAFE OPERATION

If there is a failure of the Audio Controller, a fail-safe circuit connects the pilot's headset and microphone directly to the COM1 transceiver. Audio will not be available on the speaker, but the intercom continues to work.

TOUCHSCREEN CONTROLLER FAILURE

In case of a Touchscreen Controller failure, the operational Touchscreen Controller will control the pilot and co-pilot audio and radios.

AMBER COM FREQUENCY DIGITS

A discrepancy between the active COM frequency on the Touchscreen Controller, and the actual tuned frequency reported by the controlling Integrated Avionics Unit (IAU), causes the active COM frequency digits on the Touchscreen Controller and PFD to turn amber.
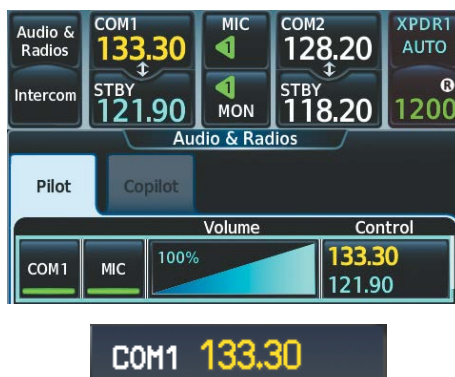
Figure 4-136 Active COM Frequency Discrepancy

CPDLC UNAVAILABLE

An amber X over the link status field of the 'CPDLC' Screen, or an amber X over the Connection field of the 'ATC Datalink' Screen, indicates the air-ground connection and/or the CPDLC system is not available for use.

Figure 4-137 CPDLC Unavailable

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SECTION 5 FLIGHT MANAGEMENT

5.1 INTRODUCTION

The system is an integrated flight, engine, communication, navigation and surveillance system. This section of the Pilot's Guide explains flight management using the system.

The most prominent part of the system are the full color displays. The information to successfully navigate the aircraft using the GPS sensors is displayed on the PFD and the MFD. A brief description of the GPS navigation data on the PFD and MFD follows.

Navigation mode indicates which sensor is providing the course data (e.g., FMS, VOR), the active flight phase RNP level (OCN, TERM, APR, MAPR), and approach service level (LNAV, LNAV+V, L/VNAV, LP, LP+V, LPV, VISUAL).

A smaller version of the Navigation Map may be displayed on the PFD as the Inset Map or the HSI Map. The Inset Map is displayed in the lower left corner of the PFD. The Inset Map cannot be displayed when the PFD is in Split Mode or when the system is in Reversionary Mode. The HSI Map is displayed in the center of the HSI. The Inset Map and the HSI Map may each be referred to as the PFD Map.

The PFD Map is displayed by pressing the **PFD Map Settings** Softkey, pressing the **Map Layout** Softkey, then pressing either the **Inset Map** Softkey or the **HSI Map** Softkey. Desired settings for map overlays on the PFD Map may be selected; overlays not available for selection are in sync with selections on the corresponding map display. Pressing the **Map Off** Softkey removes the PFD Map.

The 'Navigation Map' Pane displays aviation data (e.g., airports, VORs, airways, airspaces), geographic data (e.g., cities, lakes, highways, borders), absolute terrain data (map shading indicating elevation), and hazard data (e.g., traffic, terrain, weather). The amount of displayed data can be adjusted based on the selected map settings, detail level, and range. The 'Navigation Map' Pane can be oriented three different ways: North Up, Track Up, or Heading Up.

Aviation data and flight plan data may also be viewed on other display panes, such as a terrain or weather pane. Hereafter, references to "map displays" implies the 'Navigation Map' Pane and all other panes capable of displaying a map with aviation or flight plan data. An aircraft icon is placed on the map display at the location corresponding to the calculated present position. The aircraft position and the flight plan legs are accurately based on GPS calculations. The basemap upon which these are placed are from a source with less resolution, therefore the relative position of the aircraft to map features is not exact. The leg of the active flight plan currently being flown is shown as a magenta line on the map display. The other legs are shown in white.

Figure 5-1 GPS Navigation Information on the PFD Inset Map

Current Track Indicator

Navigation Status Box

Navigation Mode

Inset Map

Figure 5-2 GPS Navigation Information on the PFD HSI Map

Navigation Mode

Current Track Indicator

Navigation Status Box

HSI Map
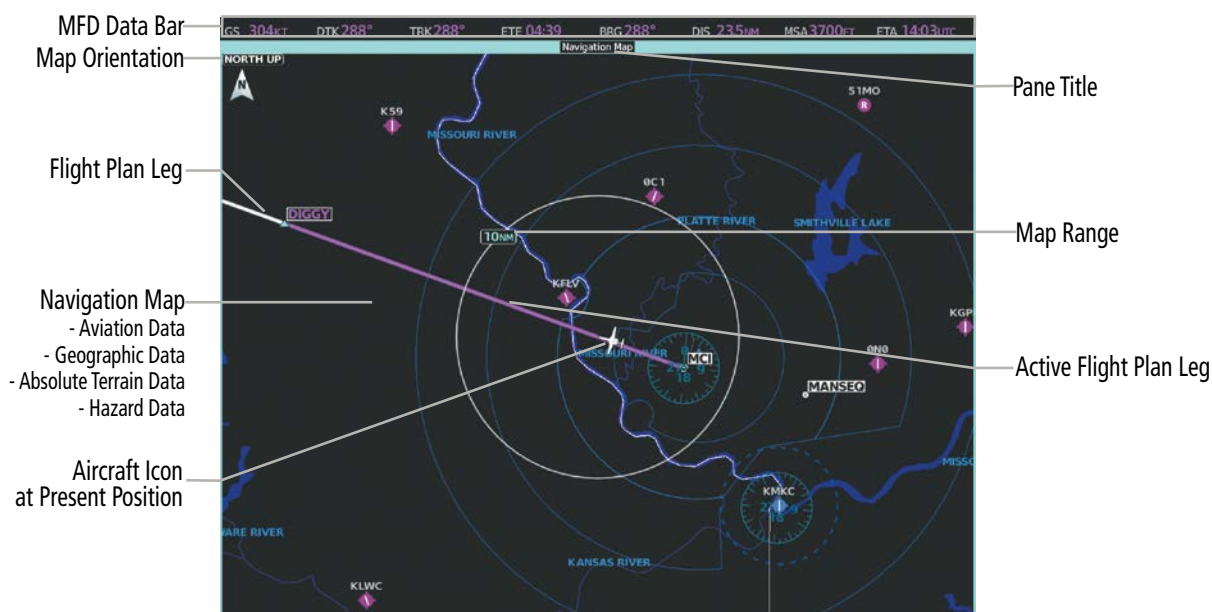
Figure 5-3 GPS Navigation Information on the MFD Navigation Map

MFD Data Bar
Map Orientation

Flight Plan Leg

Navigation Map
- Aviation Data
- Geographic Data
- Absolute Terrain Data
- Hazard Data

Aircraft Icon
at Present Position

Pane Title

Map Range

Active Flight Plan Leg

PFD NAVIGATION STATUS BOX / MFD NAVIGATION DATA BAR

The PFD Navigation Status Box, located to the right of the HSI, contains two fields displaying the following information:

Figure 5-4 PFD Navigation Status Box

- Active flight plan leg (e.g., '⤴ KICT' or 'KIXD ➜ KCOS') **or** flight plan annunciations (e.g., 'Turn right to 021° in 8 seconds')
- Distance (DIS) and Estimated Time Enroute (ETE) to the next waypoint **or** flight plan annunciations (e.g., 'TOD within 1 minute')

The symbols used in the PFD Status Box are:

Symbol	Description	Symbol	Description
➜	Active Leg	⬭	Right Holding Pattern
⤴	Direct-to	⬭	Left Holding Pattern
⤻	Right Procedure Turn	⤵	Right DME Arc / Radius to Fix Leg
⤺	Left Procedure Turn	⤴	Left DME Arc / Radius to Fix Leg
vtf	Vector to Final		

Table 5-1 PFD Navigation Status Box Symbols

GS 243KT   DTK 230°   TRK 360°   ETE 42:02   BRG 231°   DIS 170NM   MSA 3200FT   ETA 13:29UTC

Figure 5-5 MFD Navigation Data Bar

The Navigation Data Bar located at the top of the MFD contains eight magenta data fields, each displaying one of the following items:

- **BRG**	(Bearing)	- **FLT**	(Flight Timer)
- **CCG**	(Current Climb Gradient)	- **FOB**	(Fuel on Board)
- **DEST**	(Destination Airport)	- **FOD**	(Fuel Over Destination)
- **DIS**	(Distance)	- **GAGL**	(GPS AGL Altitude)
- **DNALT**	(Density Altitude)	- **GS**	(Groundspeed)
- **DTG**	(Distance to Go to destination)	- **LDG**	(ETA at final destination)
- **DTK**	(Desired track)	- **MSA**	(Minimum Safe Altitude)
- **END**	(Endurance)	- **TAS**	(True Airspeed)
- **ENR**	(ETE to final destination)	- **TKE**	(Track Angle Error)
- **EOD**	(Endurance Over Destination)	- **TOD**	(Time of Top of Descent)
- **ESA**	(Enroute Safe Altitude)	- **TRK**	(Track)
- **ETA**	(Estimated Time of Arrival)	- **VSR**	(Vertical Speed Required)
- **ETE**	(Estimated Time Enroute)	- **XTK**	(Cross-track error)

The navigation information displayed in the MFD data fields can be changed through the 'Avionics Settings' Screen. The default selections (in order left to right) are GS, DTK, TRK, ETE, BRG, DIS, MSA, and ETA.

> **NOTE:** *The MSA altitude displayed will equal the highest grid MORA (Minimum Off Route Altitude) within a 10 mile square, surrounding the aircraft. The square is aligned to the cardinal directions and provides 1,000 ft separation (2,000 ft in designated mountainous terrain within the U.S.). Grid MORA data (or its equivalent) must be present in the database to provide an MSA value.*

Changing a field in the MFD Navigation Data Bar:

1) From Home, touch **Utilities** > **Setup > Avionics Settings.**

2) Touch the **MFD Fields** Tab.

3) Touch the desired MFD Data Bar Field button. The respective 'Select MFD Data Bar Field' Screen will open.

4) Scroll as required and touch the desired field description to replace the previous information.

5) Repeat Steps 3 and 4, as necessary.

5.2 USING MAP DISPLAYS

Map displays are used extensively to provide situational awareness in flight. Most maps can display the following information:

- Airports, NAVAIDs, airspaces, airways, land data (highways, cities, lakes, rivers, borders, etc.) with names
- Map range
- Wind direction and speed
- Map orientation
- Icons for enabled map features
- Aircraft icon (representing present position)
- Obstacle data

- Map Pointer information (distance and bearing to pointer, location of pointer, name, and other pertinent information)
- Fuel range ring
- Flight plan legs
- User waypoints
- Track vector
- Terrain

Map Settings are available when the 'Navigation Map' Pane is displayed. Map Settings may be accessed from the 'Home' Screen or from the 'Flight Plan Options' Window for the active flight plan.

Viewing the map settings:

1) From Home, touch **Map**.

2) Touch the **Map Selection** Button, if necessary. This button is only available if IFR/VFR charts are installed.

3) Touch the **Map Settings** Button. The 'Map Settings' Screen is displayed.

Or:

1) From Home, touch **Flight Plan**.

2) Touch the **Flight Plan Options** Button.

3) Touch the **Map Settings** Button. The 'Map Settings' Screen is displayed.

MAP SETTINGS SYNCHRONIZATION

Map settings can be synchronized with the settings of any display, and will keep them synchronized when changes are made to the settings. The synchronization can be for the onside or offside independently, or for all displays.

Enabling/disabling map settings synchronization:

1) From Home, touch **Map** > **Map Selection** > **Map Settings** > **Map Sync**.

2) Touch the **Onside** Button or the **All** Button.

3) Touch the **L PFD**, **MFD Left**, **R PFD**, or **MFD Right** Button to initially synchronize the onside map settings or all map settings with the selected display.

Or:

Touch the **Off** Button to disable synchronization.

Figure 5-6 Map Settings Synchronization

MAP ORIENTATION

Three different orientation options are available for most system map display panes. This allows flexibility in determining aircraft position relative to other items on the map (North Up) or for determining where map items are relative to where the aircraft is going (Track Up or Heading Up). The map orientation is shown in the upper left corner of the map display pane.
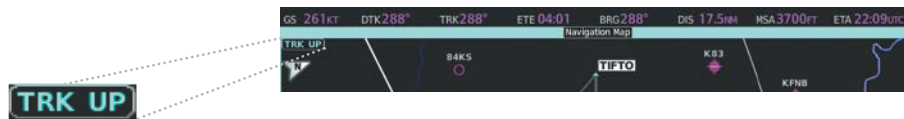
Figure 5-7 Map Orientation

- North up ('NORTH UP') aligns the top of the map display to north.
- Track up ('TRK UP') aligns the top of the map display to the current ground track.
- Heading up ('HDG UP') aligns the top of the map display to the current aircraft heading (default setting).

Changing the map display orientation:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Orientation** Button.

3) Touch the **Heading Up**, **Track Up**, or **North Up** Button to select the orientation.

The map can be configured to switch automatically to a north up orientation when the map range reaches a minimum range.

Enabling/disabling North Up Above and selecting the minimum switching range:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) If necessary, touch the **Other** Tab to display the options list.

3) Touch the **North Up Above** Button to enable/disable the function.

4) Touch the North Up Above range button to display the 'Map North Up Above' Window.

5) Scroll the list if necessary to find the desired range, and touch the range button.

Figure 5-8 Map Orientation Selection

The range arcs include tick marks indicating compass directions. Track Up indicates current track with a tick mark on the outside of the arc. Heading Up indicates current heading with a heading lubber line, and the heading bug and reference line are displayed while the heading is being adjusted, and remain displayed for three seconds after the last adjustment.

MAP RANGE

There are 28 different map ranges available, from 250 feet to 1000 nm. Range is indicated in the upper left quadrant of the range ring shown around the aircraft icon. This indicated range is the range from the aircraft icon to the range ring, and roughly half the range to the top edge of the displayed map. To change the map range on any map: (1) turn the corresponding **Joystick** counter-clockwise to decrease the range, or clockwise to increase the range; (2) pressing the **Map Range –** Softkey to decrease the range, or the **Map Range +** Softkey to increase the range; or (3) push the **Joystick**, touch two fingers on the **Touchpad,** and move them apart to decrease range, or pinch using two fingers to increase range.

Auto Zoom On

Auto Zoom Off
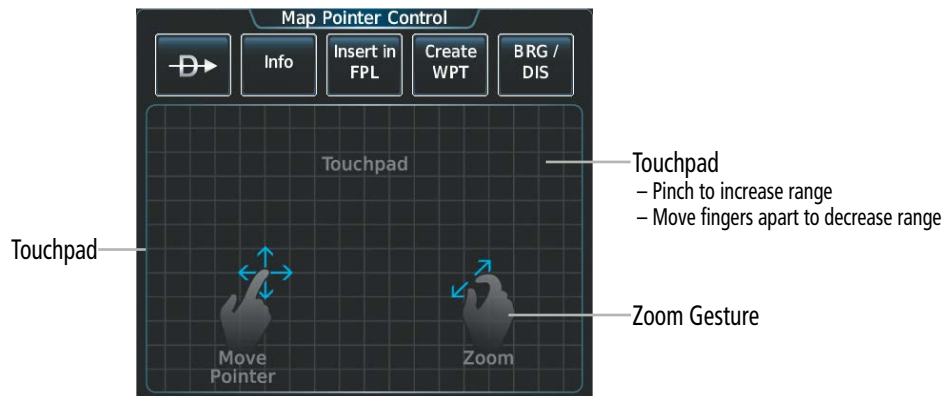
Figure 5-9 Map Range

Figure 5-10 Touchpad Map Range Control

AUTO ZOOM

Auto zoom allows the system to change the map display range to the smallest range clearly showing the active waypoint. Auto zoom can be overridden by manually adjusting the range, and remains until the active waypoint changes, a terrain or traffic alert occurs, the aircraft takes off, or the manual override times out (timer set on the Touchscreen Controller 'Map Settings' Screen). Auto zoom is suspended while the map pointer is active.

If a terrain caution or warning occurs, all map displays automatically adjust to the smallest map range clearly showing the potential impact areas. If a new traffic advisory alert occurs, any map capable of displaying traffic advisory alerts automatically adjusts to the smallest map range clearly showing the traffic advisory. When terrain or traffic alerts clear, the map displays return to the previous auto zoom range based on the active waypoint.

The auto zoom function can be turned on or off. Control of the ranges at which the auto zoom occurs is done by setting the minimum and maximum 'look forward' times (set on the Touchscreen Controller 'Map Settings' Screen). These settings determine the minimum and maximum distance to display based upon the aircraft's ground speed.

» Waypoints that are long distances apart cause the map range to increase to a point where many details on the map are decluttered. If this is not acceptable, lower the maximum look ahead time to a value that limits the auto zoom to an acceptable range.

» Waypoints that are very short distances apart cause the map range to decrease to a point where situational awareness may not be what is desired. Increase the minimum look ahead time to a value that limits the auto zoom to a minimum range that provides acceptable situational awareness.

» Flight plans that have a combination of long and short legs cause the range to increase and decrease as waypoints sequence. To avoid this, auto zoom can be disabled or the maximum/minimum times can be adjusted.

» The 'Auto Zoom Time Out' time determines how long auto zoom is overridden by a manual adjustment. At the expiration of this time, the auto zoom range is restored. Setting the 'Auto Zoom Time Out' value to zero causes the manual override to never time out.

» When the 'Auto Zoom Max Look Fwd' time is set to zero, the upper limit becomes the maximum range available (1000 nm).

» When the 'Auto Zoom Min Look Fwd' time is set to zero, the lower limit becomes 0.75 nm.

Configuring automatic zoom:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) If necessary, touch the **Other** Tab to display the options list.

3) Touch the **Auto Zoom** Button to enable/disable auto zoom.

4) Touch the Auto Zoom **Settings** Button to display the 'Auto Zoom Settings' Screen.

5) Touch the **Auto Zoom Max Look Fwd** Button to display the numeric keyboard.

6) Use the keypad to enter the maximum look forward time. Times are from zero to 999 minutes.

7) Repeat Steps 5 and 6 for 'Auto Zoom Min Look Fwd' (zero to 99 minutes) and 'Auto Zoom Time Out' (zero to 99 minutes) functions using the corresponding button names.
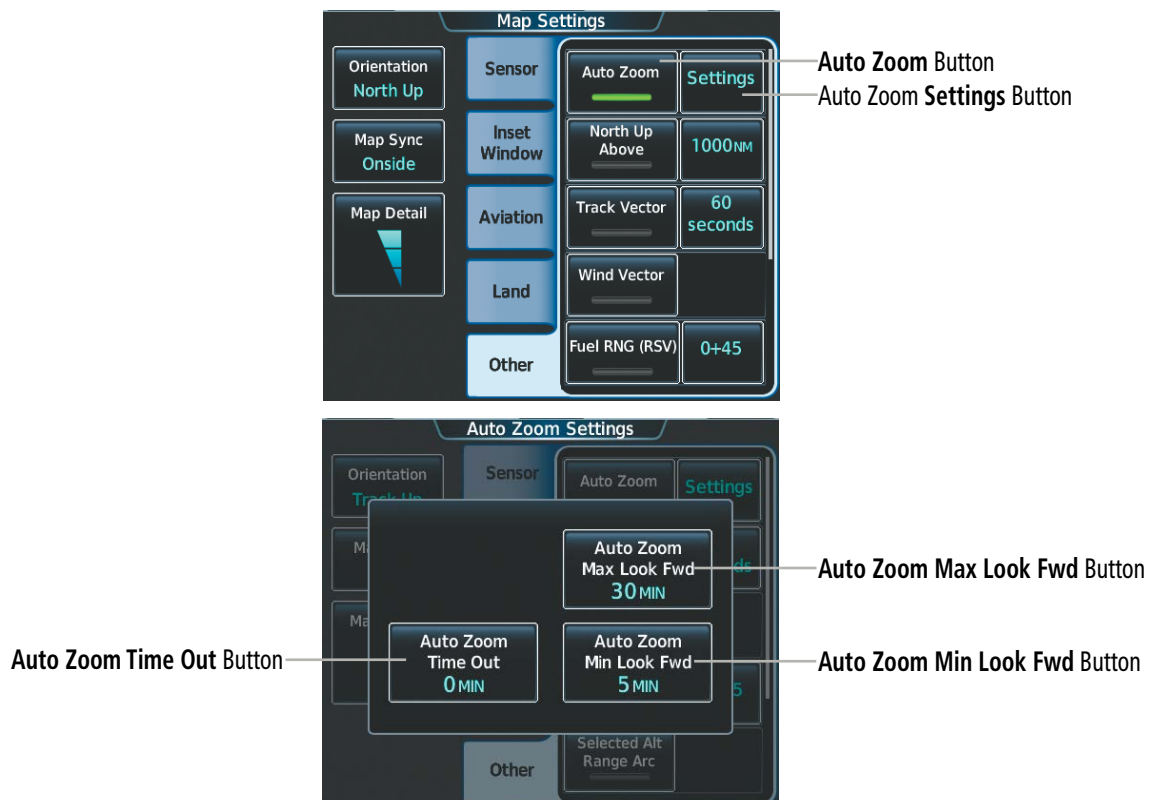
Figure 5-11 Auto Zoom Setup

MAP PANNING

The 'Map Pointer Control' Screen allows the pilot to:

- View parts of the map outside the displayed range without adjusting the map range by panning the map (the **Joystick** or **Touchpad**)
- Highlight and select locations on the map (the **Joystick** or **Touchpad**)
- Graphically initiate a Direct To a selected airport, NAVAID (VOR, Intersection, NDB), VRP, or user waypoint (**Đ►** Button)
- Display an information screen for a selected airport, NAVAID (VOR, Intersection, NDB), VRP, user waypoint, or airspace (**Info** Button)
- Designate locations for use in flight planning (**Insert in FPL** Button)
- Graphically create user waypoints (**Create WPT** Button)
- Measure the bearing and distance from the aircraft present position to any location on the map display, or between any two points on the map display (**BRG/DIS** Button)
- View obstacle, airspace, and airway information

When the Map Pointer function is selected by pushing the **Joystick**, the Map Pointer flashes on the map display, and the 'Map Pointer Control' Screen is displayed on the Touchscreen Controller. A window also appears at the upper left of the map display showing the latitude/longitude of the pointer, the bearing and distance to the pointer from the aircraft's present position, and the elevation of the land at the position of the pointer.

Map Panning functionality is not available for traffic and terrain panes.
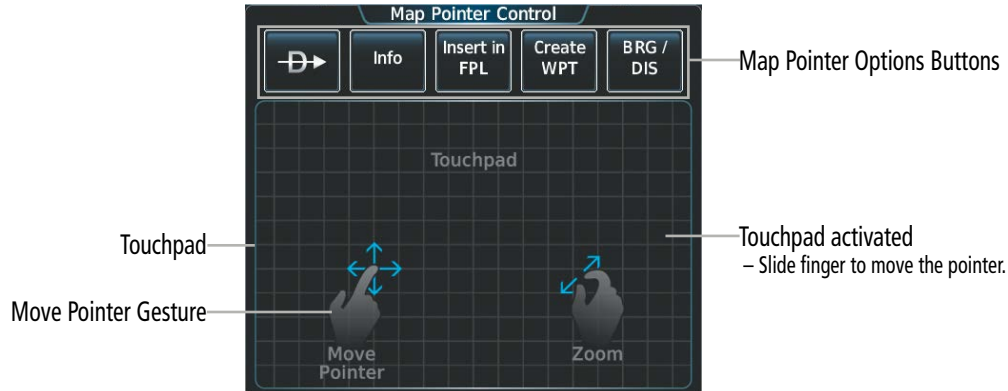
Figure 5-12 Touchpad Map Pointer Control
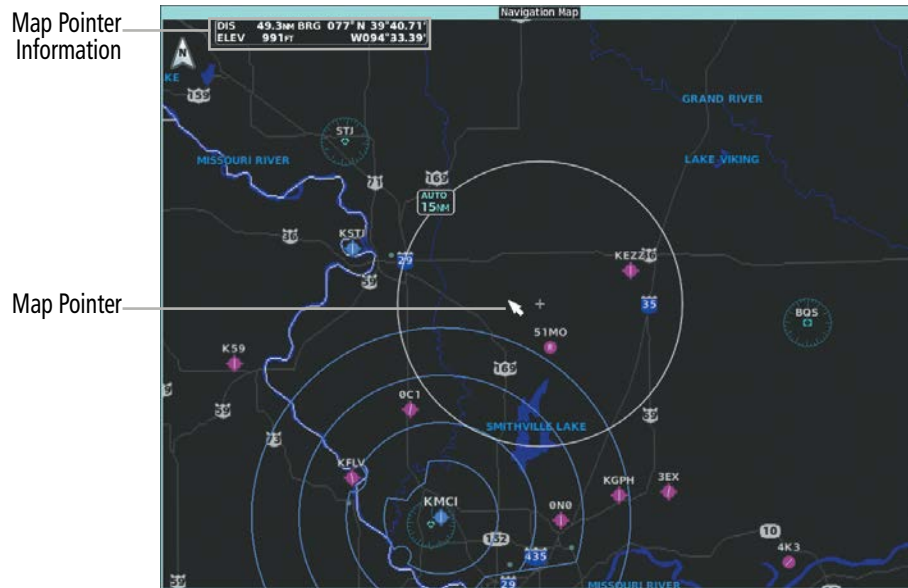
Figure 5-13 Navigation Map – Map Pointer Activated

Panning the map:

1) Push the **Joystick** to display the Map Pointer.

2) Move the **Joystick,** or slide your finger on the **Touchpad**, to move the Map Pointer on the map. The map will pan when the pointer approaches the edge of the map.

3) Push **Joystick** to remove the Map Pointer and recenter the map on the aircraft's current position.

   Or:

   Touch the **Back** Button on the Touchscreen Controller to remove the Map Pointer and recenter the map on the aircraft's current position.

   When the Map Pointer is placed on a waypoint (airport, intersection, NAVAID, VRP, or user waypoint), airway, or airspace boundary, the name is highlighted (even if the name was not originally displayed on the map). When placed on an airspace boundary, the name, class, ceiling and floor are shown in feet MSL. When placed on an airway, the name, Minimum Enroute Altitude, and defining waypoints and length for that airway segment are shown. When highlighting waypoints and airspace on the map display, additional pertinent information is available by touching the **Info** Button on the Touchscreen Controller.
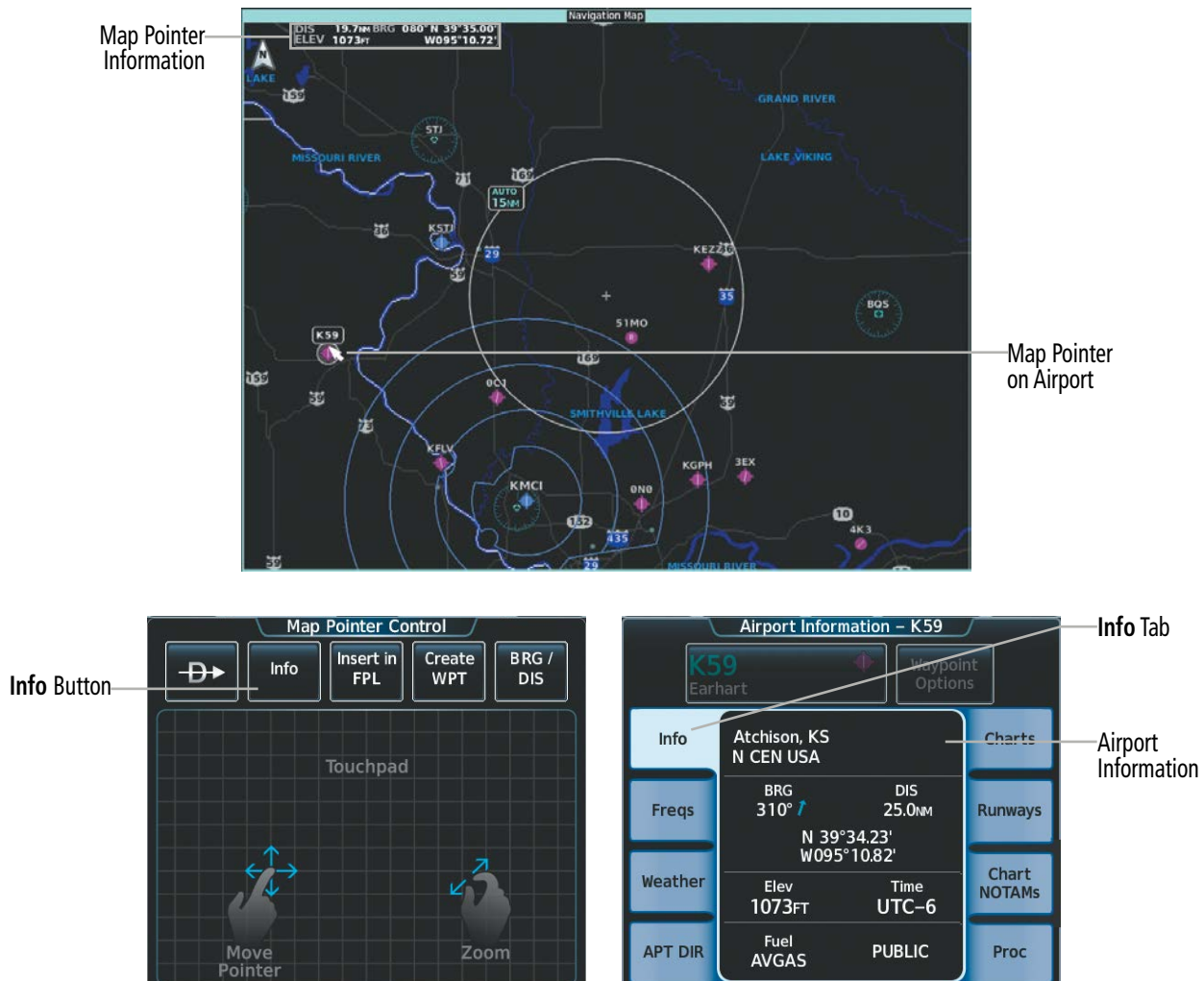
Figure 5-14 Navigation Map – Map Pointer on Airport

Figure 5-15 Navigation Map – Map Pointer on Airspace

Reviewing information for a waypoint or airspace:

1) Place the Map Pointer on an airport, intersection, NAVAID, VRP, user waypoint, or airspace.

2) Touch the **Info** Button to display the respective information screen.

3) Touch the **Back** Button on the Touchscreen Controller to return to the 'Map Pointer Control' Screen without removing the Map Pointer from the map.

Or:

Push the **Joystick** to exit the waypoint information screen, remove the Map Pointer and recenter the map on the aircraft's current position.

MEASURING BEARING AND DISTANCE

Distance and bearing can be measured on map displays using the **Joystick** or the **Touchpad**. Measurement can be from the aircraft's present position to any point, or between any two points. The bearing and distance tool displays a dashed Measurement Line and a Measure Pointer to aid in graphically identifying the points to measure. Latitude/Longitude, distance, bearing and elevation data of the Measure Pointer is provided in a window at the top left of the map. Measure Pointer functionality is not available for traffic and terrain panes.

Measuring bearing and distance between the aircraft present position and any other point:

1) Push the **Joystick**. (Measure Pointer functionality is not available for traffic and terrain panes.)

2) Touch the **BRG/DIS** Button. A Measure Pointer is displayed on the map at the aircraft's present position.

3) Move the pointer using the **Joystick** or the **Touchpad** to the desired location. A dashed Measurement Line is drawn from the aircraft present position to the location of the Measure Pointer. The latitude/longitude, distance, bearing and elevation data of the Measure Pointer are displayed at the top left of the map. Move the pointer again to measure to any other point.

4) To exit the Measure Bearing/Distance function, push the **Joystick** or touch the **Back** Button.
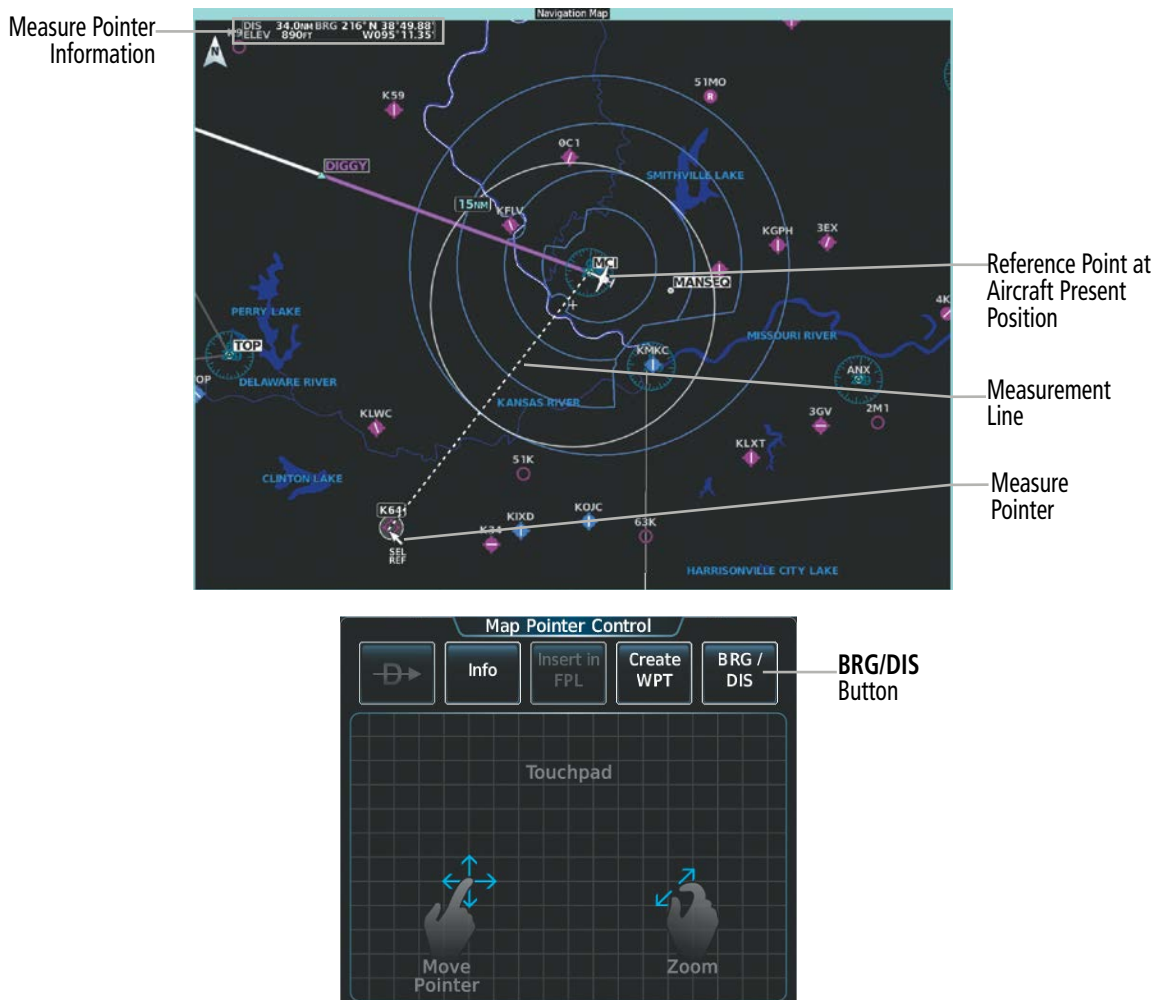
Figure 5-16 Navigation Map - Measuring Bearing/Distance from Aircraft Present Position

Measuring bearing and distance between any two points:

1) Push the **Joystick**. (Measure Pointer functionality is not available for traffic and terrain panes.)

2) Touch the **BRG/DIS** Button. A Measure Pointer is displayed on the map at the aircraft's present position.

3) Move the pointer using the **Joystick**, or the **Touchpad** to the desired reference location. A dashed Measurement Line is drawn from the aircraft present position to the location of the Measure Pointer. The latitude/longitude, distance, bearing and elevation data of the Measure Pointer are displayed at the top left of the map.

4) Touch the **Select Ref** Button to set the Measure Pointer location as the new reference point for measurement. The dashed Measurement Line is erased.

5) Move the pointer using the **Joystick**, or the **Touchpad** to the desired location. A dashed Measurement Line is drawn from the reference point to the location of the Measure Pointer. The latitude/longitude, distance, bearing and elevation data of the Measure Pointer are displayed at the top left of the map.

6) Repeat Steps 3 through 5 to measure between other points.

7) To exit the Measure Bearing/Distance function, push **Joystick**, or touch the **Back** Button.
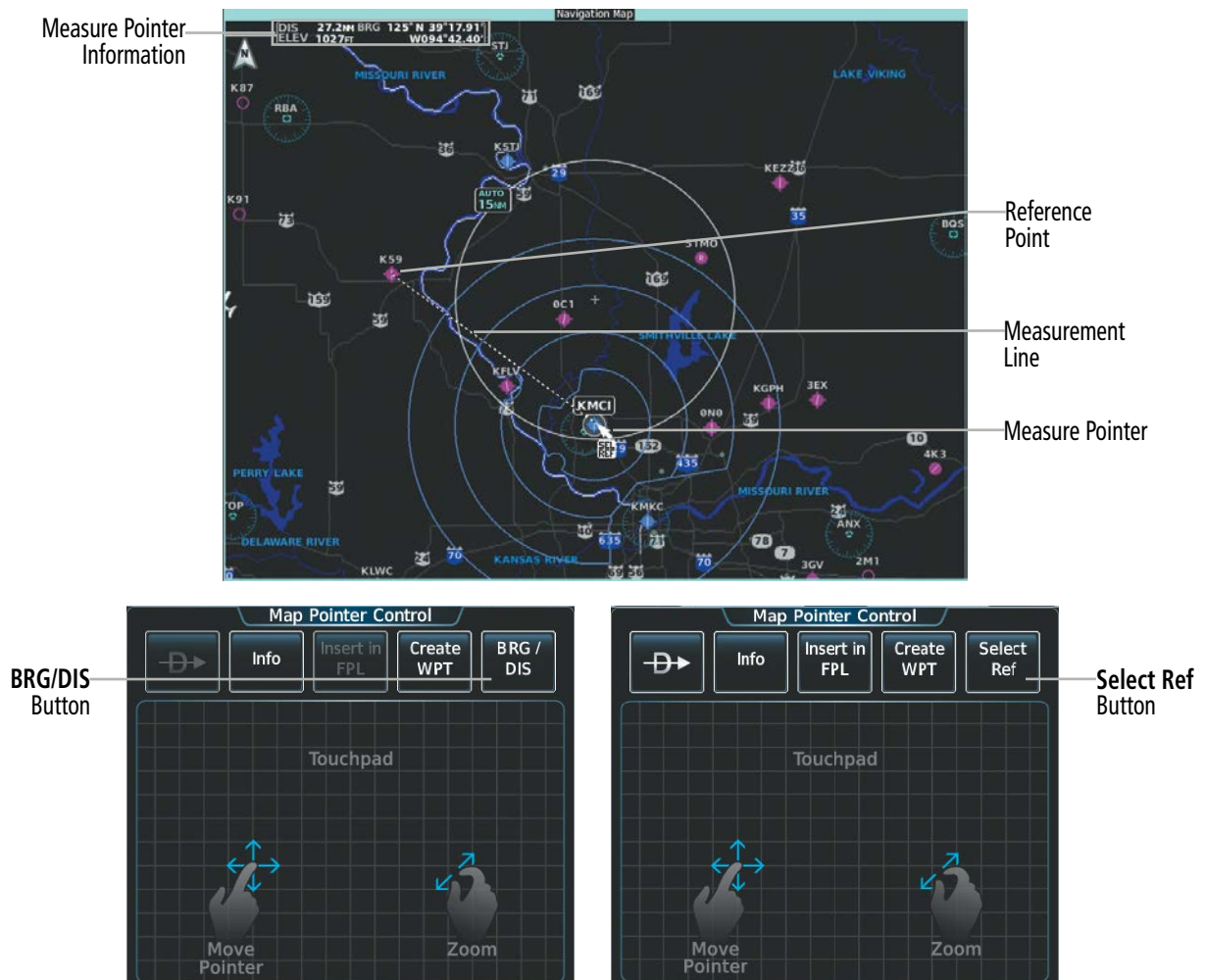
Figure 5-17 Navigation Map – Measuring Bearing/Distance between Two Points

ABSOLUTE TERRAIN

Map displays can show various shades of absolute terrain colors representing land elevation, similar to aviation sectional charts. Absolute terrain data can be displayed or removed as described in the following procedures; however, absolute terrain data and the absolute terrain scale can not be displayed on traffic or terrain panes.

Relative terrain discussion can be referenced in the Hazard Avoidance Section.

Navigation Map Black Background

Navigation Map Absolute Terrain Data

Absolute Terrain Off

Absolute Terrain On
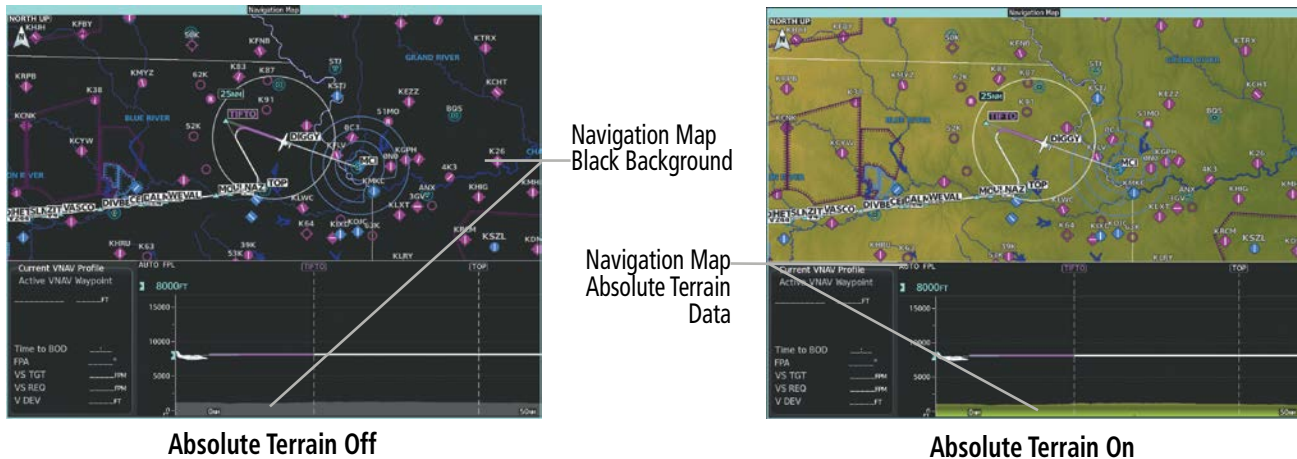
Figure 5-18 Navigation Map - Absolute Terrain Data On/Off

Displaying/removing absolute terrain data:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Sensor** Tab, if necessary.

3) Touch the **Terrain** Button to display the 'Map Terrain Displayed' Window.

4) Touch the **Absolute** Button to display absolute terrain data, or touch the **Off** Button to remove absolute terrain data.

Absolute Terrain On

Terrain Off
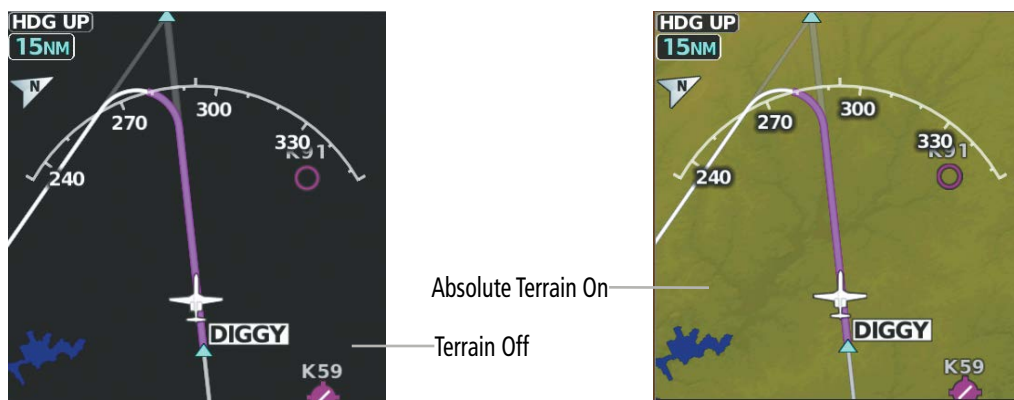
Figure 5-19 PFD Inset Map - Absolute Terrain Data
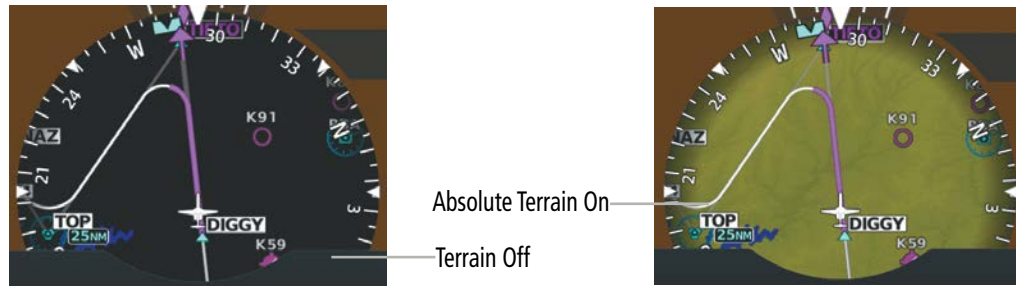
Figure 5-20 HSI Map - Absolute Terrain Data

Displaying/removing absolute terrain data on the PFD Map:

1) Press the **PFD Map Settings** Softkey on the PFD.

2) Display or remove absolute terrain data:

> Press the **Terrain** Softkey until **Absolute** is selected to display absolute terrain data.

> **Or**:

> Press the **Terrain** Softkey until **Off** is selected to remove absolute terrain data.

Selecting an absolute terrain data range:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Sensor** Tab, if necessary.

3) Touch the Terrain **Settings** Button. A window is displayed providing terrain functions allowed by the system.

4) Touch the **Map Settings** Button. A window is displayed providing terrain settings.

5) Touch the **Terrain** Button to display the 'Map Terrain Range' Window.

6) Scroll the list if necessary to find the desired range, and touch the range button.

In addition, the map displays can show an absolute terrain scale (located in the lower right hand side of the map) showing a scale of the terrain elevation. The minimum and maximum terrain elevations on the Absolute Terrain Scale represent the terrain displayed within the 'Navigation Map' Pane.
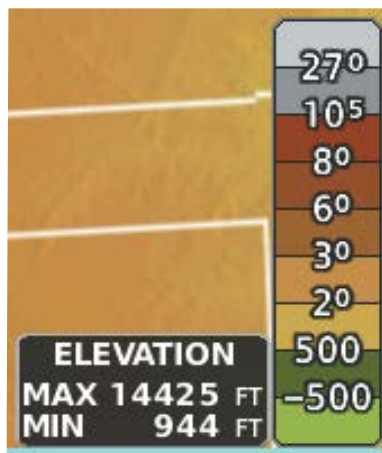
Figure 5-21 Navigation Map – Absolute Terrain Scale

Displaying/removing the absolute terrain scale:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Sensor** Tab, if necessary.

3) Touch the Terrain **Settings** Button. A window is displayed providing terrain functions allowed by the system.

4) Touch the **Map Settings** Button. A window is displayed providing terrain settings.

5) Touch the **Absolute Terrain Scale** Button to display/remove the absolute terrain scale.

MAP SYMBOLS

This section discusses the types of land and aviation symbols that can be displayed. Each listed type of symbol can be turned on or off, and the maximum range to display each symbol can be set. The maximum range is based upon the range ring setting, not distance from the aircraft. The decluttering of the symbols from the PFD Map and MFD map displays using the Map Detail Slider are also discussed.

LAND SYMBOLS

The following table describes items that are configured on the **Land** Tab on the 'Map Settings' Screen. See the Hazard Avoidance Section for more information on Obstacles.
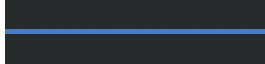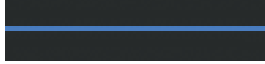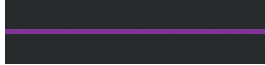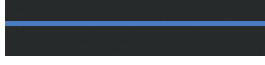
Land Symbols	Symbol	Default Range (nm)	Maximum Range (nm)
Obstacles (Point)	See Hazard Avoidance Section	10	25
Roads		see below	
- Interstate Highway (Freeway)		50	150
- International Highway (Freeway)		50	150
- US Highway (National Highway)		15	100
- State Highway (Local Highway)		10	15
- Local Road (Local Road)	N/A	4	10
- Railroad		7.5	15
Large City (> 200,000)		100	1000
Medium City (> 50,000)		50	75
Small City (> 5,000)		25	50
State/Province		750	1000
Rivers and Lakes (River/Lake)		75	75

Table 5-2 Land Symbol Information

AVIATION SYMBOLS

The following items are configured on the **Aviation** Tab of the 'Map Settings' Screen.

Aviation Symbols	Symbol	Default Range (nm)	Maximum Range (nm)
Low Altitude Airways (V and T Routes)		50	50
High Altitude Airways (J and Q Routes)		50	75
Class B Airspace Altitude Label (ceiling/floor)		Label placement and ranges are variable, in order to provide the best representation and minimal clutter	
Class C Airspace Altitude Label (ceiling/floor)			
Class D Airspace Altitude Label (ceiling)			
CL B/TMA/AWY	(see below)		
- Class B (CL B) and Terminal Manoeuvring Area (TMA) [1]		50	100
- Airway (AWY) [1]			
CL C/CTA	(see below)		
- Class C Airspace (CL C)		50	75
- Control Area (CTA) [1]			
CL A/D	(see below)		
- Terminal Radar Service Area (TRSA), Controlled Traffic Region (CTR) [1], and Class A (CL A) [1]		10	50
- Class D			
- Aerodrome Traffic Zone (ATZ) [1]			
- Traffic Information Zone (TIZ) [1]			
Restricted and Prohibited Areas (Restricted)		50	75
Military Operations Areas (MOA (Military))		50	75

Aviation Symbols	Symbol	Default Range (nm)	Maximum Range (nm)
Other	(see below)		
- ADIZ		50	75
- Alert			
- Class E [1]			
- Class G [1]			
- Temporary [1]			
- Danger, Warning, Unknown, Special Rules [1], and Training [1]			
Large Airport (Longest Runway ≥ 8100 ft)		100	250
Medium Airport (8100 ft > Longest Runway ≥ 5000 ft, or Longest Runway < 5000 ft with control tower)		50	75
Small Airport (Longest Runway < 5000 ft without control tower)		25	50
VOR Waypoint		50	150
- VOR Compass Rose On/Off		N/A	N/A
INT Waypoint		10	25
NDB Waypoint		25	50
VRP Waypoint		25	40
User Waypoint	(Route) / (Airport)	50	50
SafeTaxi	See Additional Features	1.5	5
Runway Extension		7.5	75
Missed Approach Preview On/Off		N/A	N/A
Altitude/Speed Constraints		1000	1000

[1] *Not located in the United States*

Table 5-3 Aviation Symbol Information

SYMBOL SETUP

Aviation and land symbol types (e.g. runway extensions, railroads) can be removed individually. Runway Extensions, when enabled, will be depicted under the following conditions:

» The enroute waypoint after the active leg is an airport.

» The off-route ⟿ waypoint is an airport.

» The destination airport has a loaded arrival or loaded/activated approach.

If a loaded arrival or loaded/activated approach is subsequently removed from the active flight plan, the system removes the runway extensions from the map.

> **NOTE:** *The HSI Map does not display Intersections, Cities, Roads, or Lat/Lon lines.*

Displaying/removing a land or aviation symbol type:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Aviation** Tab or the **Land**, Tab, if necessary.

3) Scroll the list to find the desired item.

4) Touch the annunciator button to display/remove the symbol type.

The preceding procedure can be used for selecting which Land or Aviation symbols (roads, cities, airspaces, etc) should be shown on the map display. In addition to displaying airspace boundaries, airspace altitude labels may also be shown, as explained in the following procedure.

Displaying and removing airspace altitude labels:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Aviation** Tab.

3) Touch the Airspaces **Settings** Button to display the 'Airspace Settings' Screen.

4) Touch the **Airspace Altitude Labels** Button to display/remove the labels.
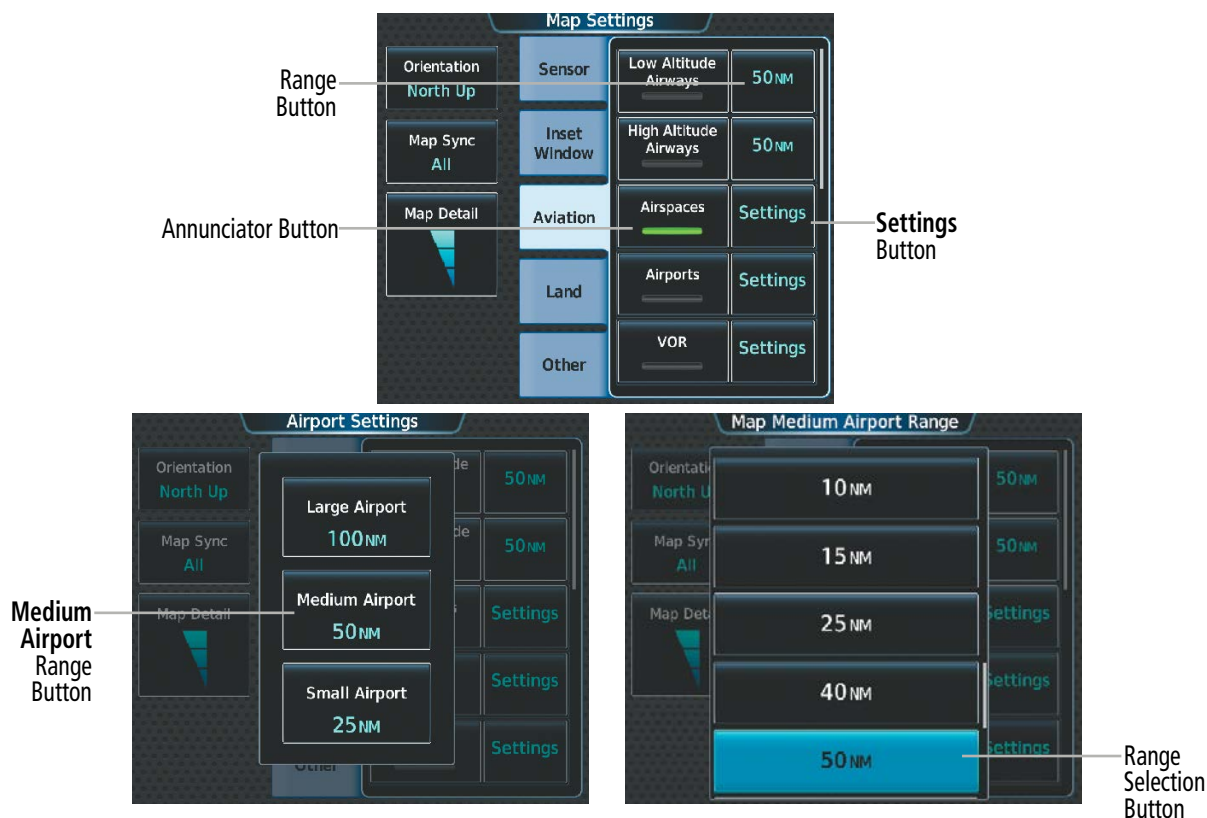
Figure 5-22 Map Settings - Aviation Data Setup

Figure 5-23 Map Settings - Land Data Setup

The range button sets the maximum range at which these items will be displayed.

Selecting an Aviation or Land item maximum range:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Aviation** Tab or **Land** Tab, if necessary.

3) Scroll the list to find the desired item.

4) If necessary, touch the **Settings** Button to display the range buttons.

5) Touch the range button to display the range choices.

6) Touch a range selection button to select the maximum range.

7) Repeat Steps 3 through 6 as necessary.

Displaying/removing the VOR compass rose:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Aviation** Tab, if necessary.

3) Scroll the list to find the VOR buttons.

4) Touch the VOR **Settings** Button to display the 'VOR Settings' Window.

5) Touch the **Compass Rose** Button to display/remove the VOR compass rose.

MAP DETAIL

The declutter feature allows the pilot to progressively step through four levels of map detail. Map detail level is adjusted using the Touchscreen Controller and shown on the map displays.
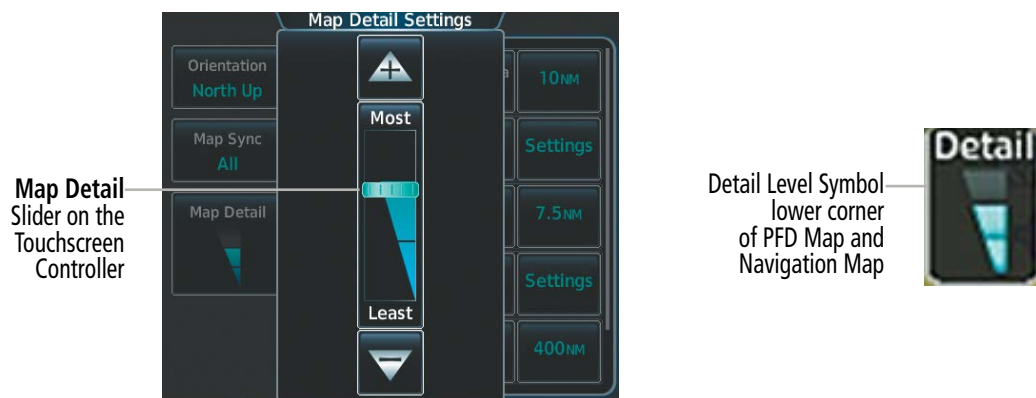
Figure 5-24 Navigation Map – Map Detail
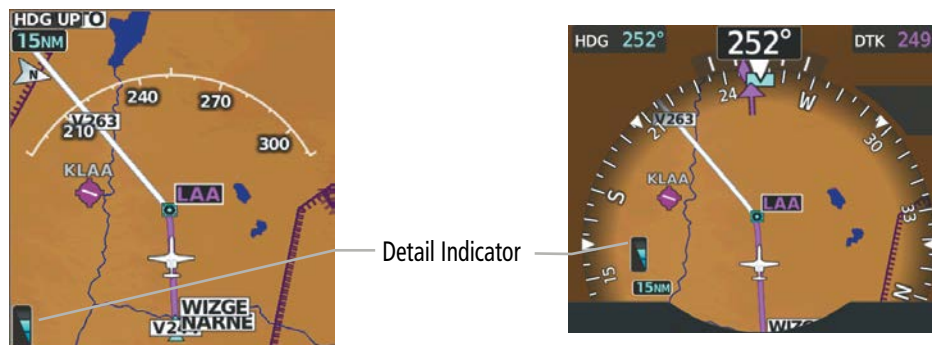
Figure 5-25 PFD Map Detail

Adjusting the map detail:

1) From Home, touch **Map** > **Map Selection** > **Map Settings > Map Detail**.

2) Slide up or down on the Map Detail Slider to adjust the map detail.

Adjusting the PFD Map Detail:

1) Press the **PFD Map Settings** Softkey on the PFD.

2) Press the **Detail** Softkey, as required, to cycle to the desired PFD Map detail.

The following table lists the items that are decluttered at each map detail level. The 'X' represents map items decluttered for each level of detail.

Item	DCLTR 1	DCLTR 2	Least
Data Link Radar Precipitation			X
Data Link Lightning			X
Graphical METARs			X
Airports			X
Safe Taxi			X
Runway Labels			X
TFRs			X
Restricted			X
MOAs (Military)			X
Intersections (does not declutter if used to define airway)		X	X
NAVAIDs (does not declutter if used to define airway)		X	X
User Waypoints		X	X
VRPs		X	X
Latitude/Longitude Grid		X	X
Class B / TMA / AWY airspaces		X	X
Class C / CTA airspaces		X	X
Class A / D airspaces		X	X
Other Airspaces		X	X
Obstacles		X	X
Cities	X	X	X
Roads	X	X	X
Railroads	X	X	X
State/Province Boundaries	X	X	X

Table 5-4 Map Items Decluttered for each Detail Level

AIRWAYS

This airways discussion is based upon the North American airway structure. The airway structure in places other than North America vary by location, etc. and are not discussed in this book. Low Altitude Airways are drawn in gray (the same shade used for roads). High Altitude Airways are drawn in green. When both types of airways are displayed, High Altitude Airways are drawn on top of Low Altitude Airways. When airways are selected for display on the map, the airway waypoints (VORs, NDBs and Intersections) are also displayed.

Low Altitude Airway (Victor Airway)

Low Altitude Airway (T-Route)

High Altitude Airway (Jet Route)

High Altitude Airway (Q-Route)
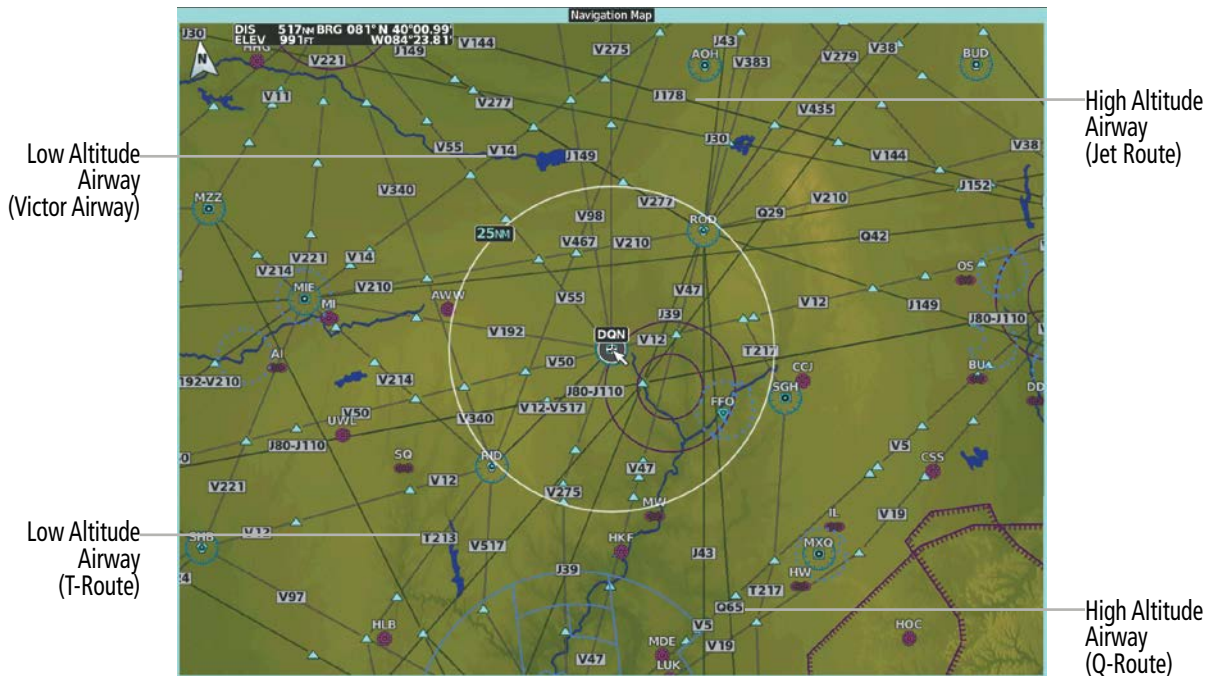
Figure 5-26 Airways on MFD Navigation Map

ADDITIONAL MAP DISPLAY ITEMS

Maps displays can show some additional items. Some items can be displayed through the use of the nearest frequency, map panning, and map measuring functions. Other items (e.g. track vector, wind vector, fuel range ring, selected altitude range arc, SVT field of view, and latitude/longitude lines) can be displayed/removed individually through the 'Map Settings' Screen. Refer to the Hazard Avoidance Section for information on displaying obstacles (Point Obstacle) on the map.

The icons in the following table will be displayed when specific map functions are conducted or the heading or GPS solution is invalid:

Symbol Name	Description	Symbol
ARTCC Frequency or FSS Frequency	Displayed when using the Nearest Frequencies function	
Map Pointer	Displayed when panning	
Measuring Pointer	Displayed when measuring bearing and distance	
No heading aircraft icon	Replaces the normal aircraft icon when aircraft GPS location is valid, but the heading is invalid.	
Dead reckoning aircraft icon	'DR' text displayed over the aircraft icon when the GPS solution is invalid	

Table 5-5 Miscellaneous Map Symbols

Displaying/removing other map items:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Other** Tab, if needed.

3) Scroll as required and touch the desired button to display/remove Map Items:

TRACK VECTOR

Map displays can show a track vector that is useful in minimizing track angle error. The track vector is a solid cyan line segment extended to a predicted location. The track vector look-ahead time is selectable (30 sec, 60 sec (default), 2 min, 5 min, 10 min, 20 min) and determines the length of the track vector. The track vector shows up to 90 degrees of a turn for the 30 and 60 second time settings. It is always a straight line for the 2 min, 5 min, 10 min and 20 min settings.

Track Vector

Figure 5-27 Navigation Map - Track Vector

Selecting track vector look-ahead time:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Other** Tab, if needed.

3) Touch the Track Vector Time Button to display the time selection buttons in the 'Map Track Vector Time' Window.

4) Scroll the list, if needed, and touch a time selection button to select the look-ahead time.

WIND VECTOR

Map displays can show a wind vector arrow in the upper right-hand portion of the screen. Wind vector information is displayed as a white arrow pointing in the direction in which the wind is moving for wind speeds greater than or equal to 1 kt.
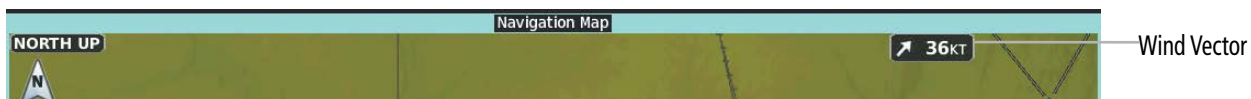
Wind Vector

Figure 5-28 Navigation Map - Wind Vector

> **NOTE:** *The wind vector is not displayed until the aircraft is moving.*

FUEL RANGE RING

Map displays can show a fuel range ring which shows an estimate of the remaining flight distance. A dashed green circle indicates the selected range to reserve fuel. A solid green circle indicates the total endurance range. If only reserve fuel remains, the range is indicated by a solid amber circle. Calculations are based on current fuel flow and ground speed.

NOTE: *If fuel reserves are set to zero, the Range to Reserve Fuel Ring may not completely overlay the Total Endurance Range Ring.*

Time to Reserve Fuel

Range to Reserve Fuel

Total Endurance Range
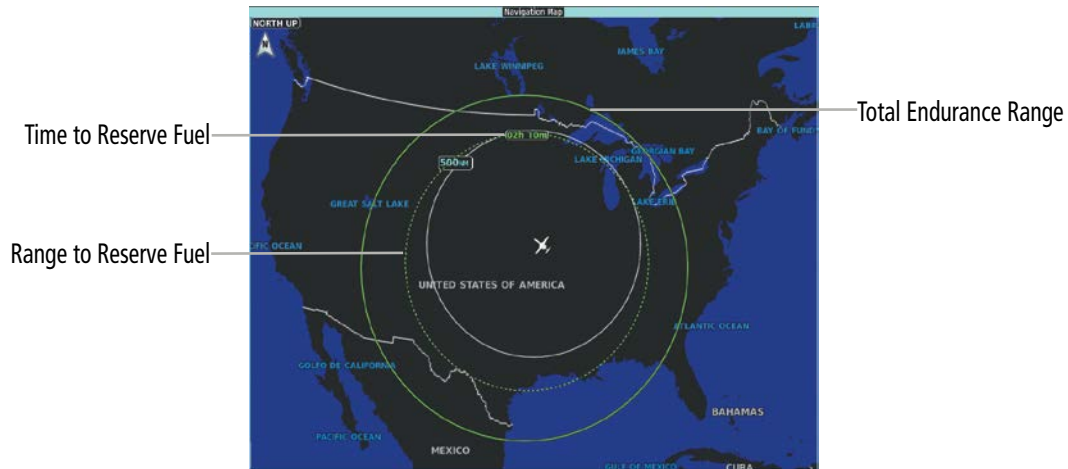
Figure 5-29 Navigation Map - Fuel Range Ring

Selecting fuel reserve time:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Other** Tab, if needed.

3) Touch the Fuel RNG (RSV) Time Button to display the keypad.

4) Use the keypad to enter the fuel reserve time.

SELECTED ALTITUDE RANGE ARC

The map can display the location along the current track where the aircraft will intercept the selected altitude. The location will be shown as a cyan arc when the aircraft is actually climbing or descending.

Range to Altitude Arc
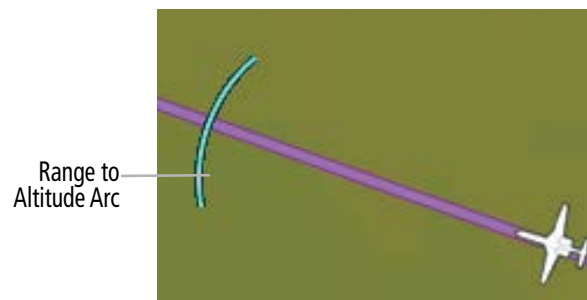
Figure 5-30 Navigation Map - Range to Altitude Arc

FIELD OF VIEW (SVT)

Map displays can show the boundaries of the PFD Synthetic Vision Technology (SVT) lateral field of view. The field of view is shown as two dashed lines forming a V shape in front of the aircraft symbol on the map.

Figure 5-31 Navigation Map Field of View Comparison

LATITUDE/LONGITUDE LINES

Map displays can show the latitude and longitude lines. They are shown as cyan dashed lines. The range button sets the maximum range at which the lines will be displayed on the map. The default setting is 1 nm, while the maximum range is 1000 nm.

Figure 5-32 Navigation Map – Latitude/Longitude Lines

The range button sets the maximum range at which the lines will be displayed on the map.

Selecting the lat/lon line maximum range:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Other** Tab, if necessary.

3) Touch the latitude/longitude lines range button to display the range selection buttons.

4) Touch a range selection button to select the maximum map display range.

5.3 WAYPOINTS

Waypoints are published geographical positions (internal database) or pilot-entered positions, and are used for all phases of flight planning and navigation.

Communication and navigation frequencies can be found and tuned from waypoint data. Refer to the Audio and CNS section for details

Waypoints can be selected by entering the ICAO identifier, entering the name of the facility, or by entering the city name. See the System Overview section for detailed instructions on entering data in the system.

Figure 5-33 'Waypoint Info' Screen

If duplicate entries exist for an identifier, a 'Waypoint Duplicates' Screen is displayed when touching the **Enter** Button or pushing the lower right knob.
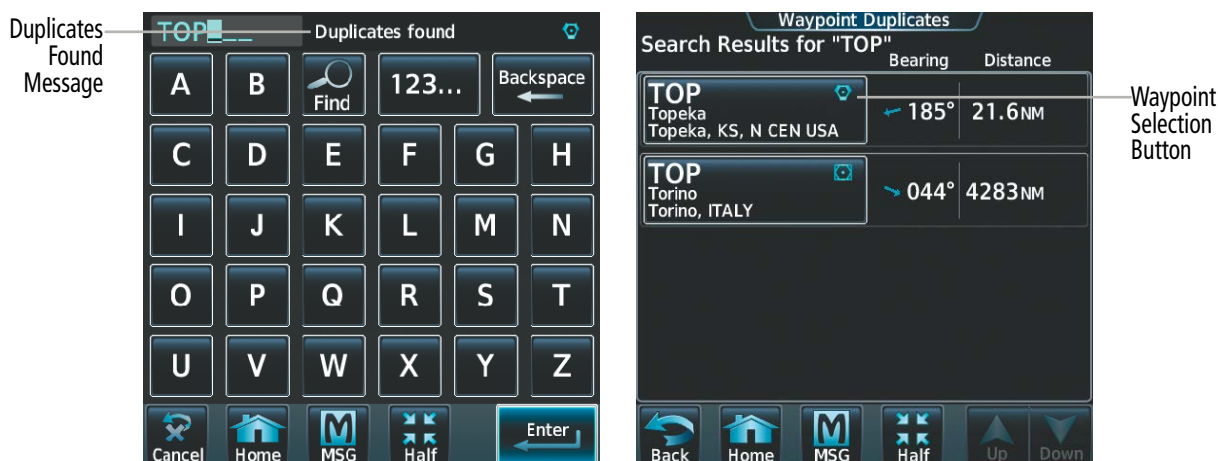
Figure 5-34 'Waypoint Duplicates' Screen

AIRPORTS

> **NOTE:** North Up orientation on the 'Airport Information' Pane cannot be changed; the pilot needs to be aware of proper orientation if the map display orientation is different from the 'Airport Information' Pane.

The 'Airport Information' Pane displays a map of the currently selected airport and surrounding area, and the 'Airport Information' Screen on the Touchscreen Controller allows the pilot to view airport information, load frequencies, review runways, and review instrument procedures that may be involved in the flight plan. For airports with multiple runways, information for each runway is available. See the Audio and CNS Section for more information on finding and tuning frequencies. After applying power to the system, and when the aircraft position is known, the 'Airport Information' Pane defaults to the airport where the aircraft is located. After a flight plan has been loaded, it defaults to the destination airport. On a flight plan with multiple airports, it defaults to the airport which is the current active waypoint.
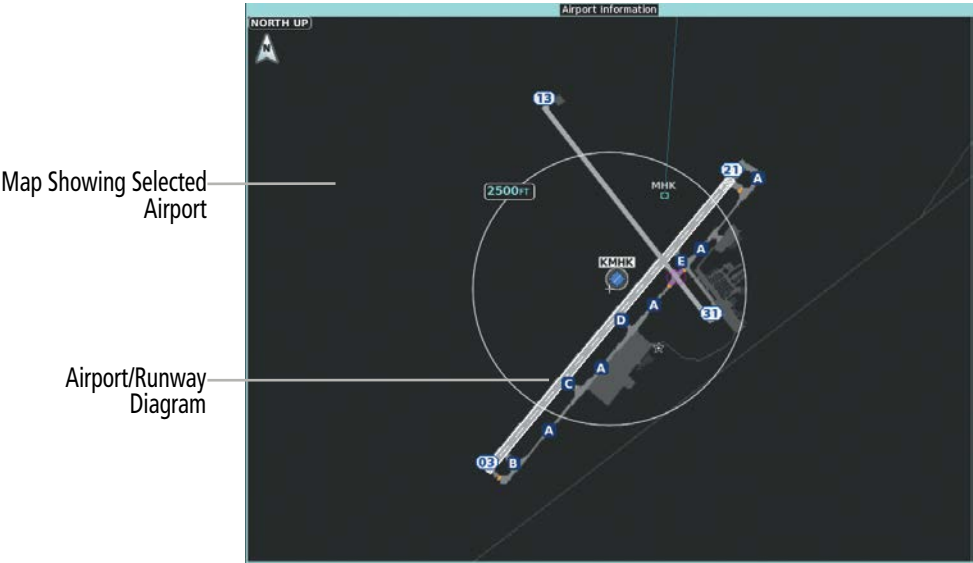
Figure 5-35 'Airport Information' Pane on MFD

Figure 5-36 'Airport Information' Screen

The following descriptions and abbreviations are used on the 'Airport Information' Screen:

Usage type: PUBLIC, MILITARY, PRIVATE, or HELIPORT	
Fuel Available: AVGAS, JET	
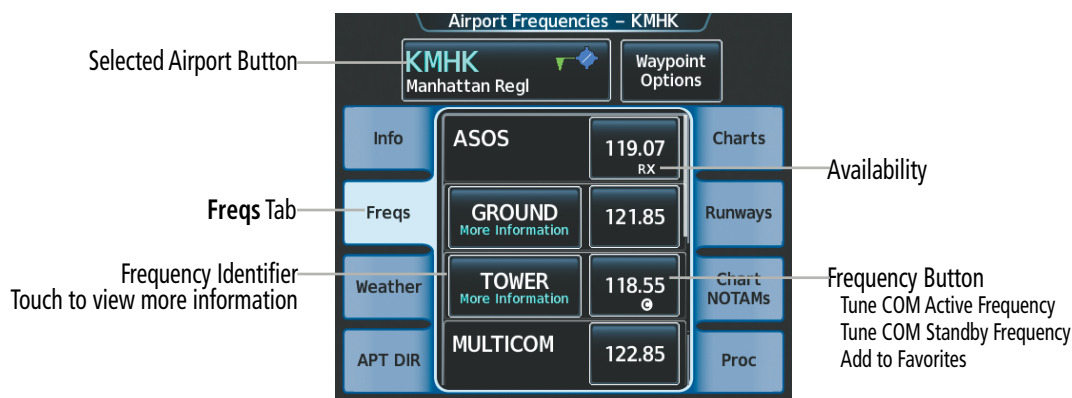
Figure 5-37 'Airport Frequencies' Screen

The following descriptions and abbreviations are used on the 'Airport Frequencies' Screen:

COM Availability: TX (transmit only), RX (receive only), PT (part time), More Information (additional information available)
COM Frequencies [1]**:** Approach, Arrival, ASOS, ATIS, AWOS, Center, Class B, Class C, Clearance, Control, CTA, Departure, Director, Emergency, FSS, Gate, Ground, Helicopter, Military, Multicom, Other, Pre-Taxi, Radar, Radio, Ramp, Terminal, TMA, Tower, TRSA, Unicom
NAV Frequencies: ILS, LOC

[1] *When 'More Information' is displayed on the button, touching the button will display additional information.*
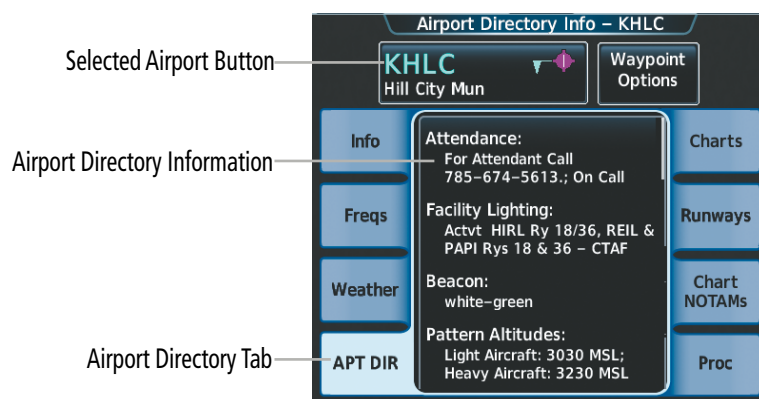
Figure 5-38 'Airport Directory Info' Screen

The Airport Directory Tab provides AC-U-KWIK® airport and FBO directory information for public airfields across the world. Information includes listings of airfield and FBO data, charter companies, fuel suppliers, ground transportation, maintenance, catering services, and much more.
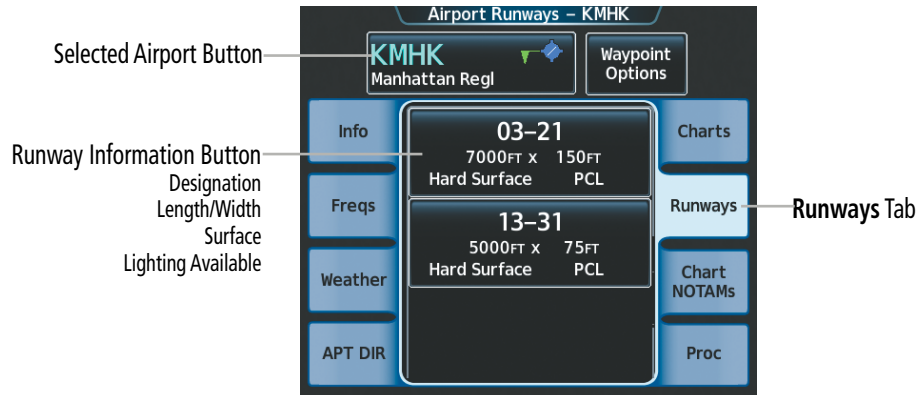
Figure 5-39 'Airport Runways' Screen

The **Runways** Tab brings up the 'Airport Runways' Screen with a Runway Information button for each runway at the selected airport. The Runway Information button contains information about each runway, and selects the runway, which scales the 'Airport Information' Pane to focus on the selected runway.

The following descriptions and abbreviations are used on the 'Airport Runways' Screen:

Runway surface type: Hard, Turf, Sealed, Gravel, Dirt, Soft, Unknown	
Runway lighting type: No Lights, Part Time, Full Time, Unknown, or PCL (for pilot-controlled lighting)	

See the Hazard Avoidance Section for the description of the information shown on the **Weather** Tab. See the Additional Features section for the description of the information shown on the **Charts** Tab and the **Chart NOTAMs** Tab. See the discussion later in this section about loading procedures from the **Proc** Tab.

Selecting an airport for review by identifier:

1) From Home, touch **Waypoint Info** > **Airport**.

2) Touch the **Info** Tab, if necessary.

3) Touch the Selected Airport Button to display the keypad.

4) Use the keypad to enter the airport identifier.

5) Touch the **Enter** Button to accept the identifier and display the airport information on the Touchscreen Controller.

6) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the 'Airport Information' Pane, if necessary.

Finding and selecting an airport for review by facility name or city name:

1) From Home, touch **Waypoint Info** > **Airport**.

2) Touch the **Info** Tab, if necessary.

3) Touch the Selected Airport Button to display the keypad.

4) Touch the **Find** Button to display the 'Find Waypoint' Screen.

5) Touch the **Search** Tab to display the **Search By** Button.

6) If necessary, touch the **Search By** Button to choose Search by City or Search by Facility.

7) Touch the **Facility Name** Button or the **City Name** Button to display the keypad.

8) Use the keypad to enter the name.

9) Touch the **Enter** Button to accept the entry and display the search results.

10) Touch an airport selection button to display the airport information on the Touchscreen Controller.

11) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the 'Airport Information' Pane, if necessary.

Finding and selecting an airport for review by category (Recent, Nearest, Flight Plan, or Favorites):

1) From Home, touch **Waypoint Info** > **Airport**.

2) Touch the **Info** Tab, if necessary.

3) Touch the Selected Airport Button to display the keypad.

4) Touch the **Find** Button to display the 'Find Waypoint' Screen.

5) Touch the **Recent** Tab, **Nearest** Tab, **Active Flight Plan** Tab, or the **Favorites** Tab to display a list of airports in the selected category.

6) Touch an airport selection button to display the airport information on the Touchscreen Controller.

7) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the 'Airport Information' Pane, if necessary.

Selecting a runway:

1) From Home, touch **Waypoint Info** > **Airport**.

2) Touch the **Runways** Tab to display the runway information buttons.

3) Touch a Runway Information Button to select the runway.

4) Touch the **Waypoint Options** Button, then the **Show on Map** Button to view the runway on the active display pane, if necessary.

NEAREST AIRPORT

The 'Nearest Airport' Pane shows a map of the nearest airport and surrounding area, and the 'Nearest Airport' Screen on the Touchscreen Controller allows the pilot to view airport information, load frequencies, review runways, and review instrument procedures that may be involved in the flight plan. For airports with multiple runways, information for each runway is available. See the Audio and CNS Section for more information on finding and tuning frequencies.

The 'Nearest Airports' Screen displays a list of up to 25 nearest airports (five entries can be displayed at one time). If there are more than five, they are displayed in a scrollable list. The list only includes airports that are within 200 NM; the system will indicate when none are available within 200 NM.

A dashed white line is drawn on the 'Nearest Airport' Pane from the aircraft position to the selected nearest airport.
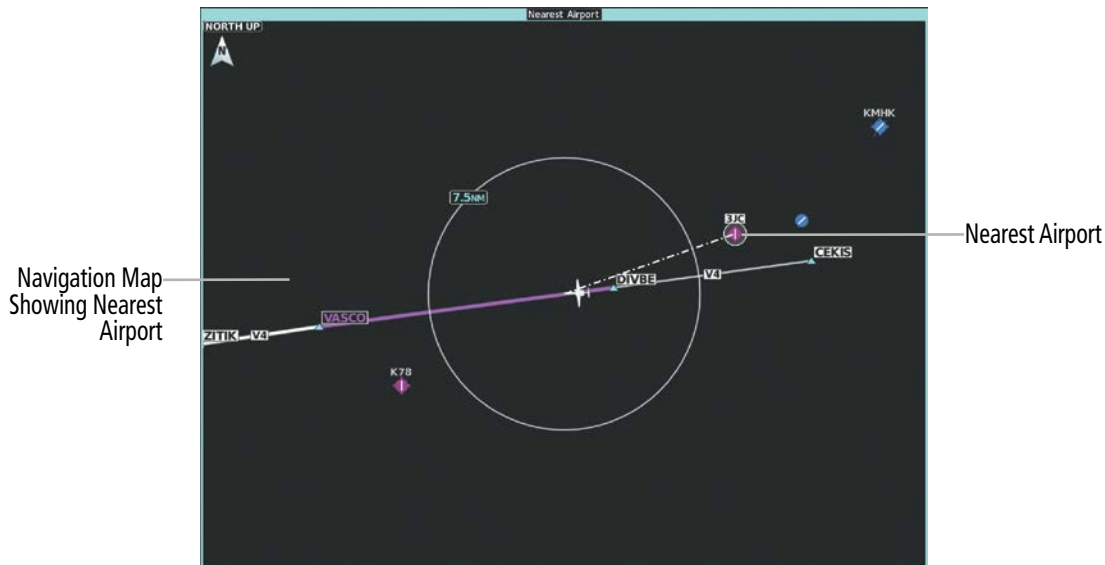
Figure 5-40 'Nearest Airport' Pane

Figure 5-41 'Nearest Airport' Screen

Viewing information for a nearest airport:

1) From Home, touch **Nearest** > **Airport**.

2) Touch a nearest airport button to display the 'Waypoint Options' Window. If necessary, touch the **Show On Map** Button to highlight the airport on the 'Nearest Airport' Pane.

3) Touch the **Airport Info** Button to display the 'Airport Information' Screen.

4) Touch any tab to display the desired information on the Touchscreen Controller.

The minimum runway length and surface type used when determining the 25 nearest airports to display on the 'Nearest Airports' Screen are set on the 'Avionics Settings' Screen under the **System** Tab. A minimum runway length and/or surface type can be entered to prevent airports with small runways or runways that are not appropriately surfaced from being displayed. Default settings are 3000 feet (or meters) for runway length and "Hard Only" for runway surface type.

Selecting nearest airport surface matching criteria:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**.

2) Touch the **System** Tab, if necessary.

3) Scroll the list to display the Nearest Airport Runway Surface Button.

4) Touch the Nearest Airport Runway Surface Button to display the surface choices.

5) Touch a Surface Selection Button to set the surface criteria.

Selecting nearest airport minimum runway length matching criteria:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**.

2) Touch the **System** Tab, if necessary.

3) Scroll the list to display the Nearest Airport MIN RWY Length Button.

4) Touch the Nearest Airport MIN RWY Length Button to display the keypad.

5) Use the keypad to enter the minimum length.

6) Touch the **Enter** Button to accept the length criteria.

NON-AIRPORT AND USER CREATED WAYPOINTS

WAYPOINT INFORMATION

Non-Airport Waypoints are considered to be Intersections, VRPs, VORs, and NDBs. Non-airport waypoints and User Waypoints have respective Information Panes which show a map of the currently selected waypoint and surrounding area and the Touchscreen Controller shows waypoint information.

The 'VOR Information' Screen can be used to view information about VOR and ILS signals (since ILS signals can be received on a NAV receiver), or to quickly tune a VOR or ILS frequency. If a VOR station is combined with a TACAN station, it is listed as a VOR-TACAN on the 'VOR Information' Screen, and if it includes only DME, it is displayed as VOR-DME.
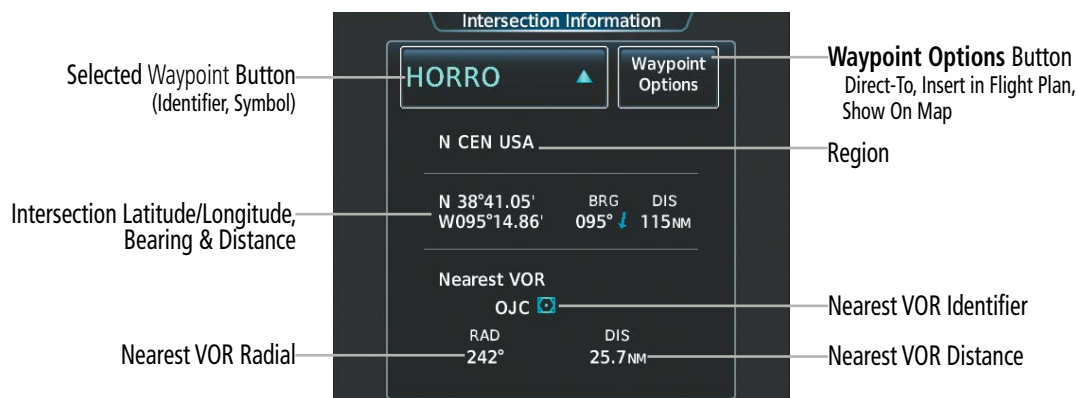
Figure 5-42 'Intersection Information' Screen

Selected Waypoint Button
(Identifier, Name, Symbol)

City, Region

Lat/Lon, Bearing Distance, Class, Type, Mag Var

Nearest Airport
Identifier, Symbol, and Bearing/Distance

Frequency Button
Tune, Active/Standby, Add to Favorites
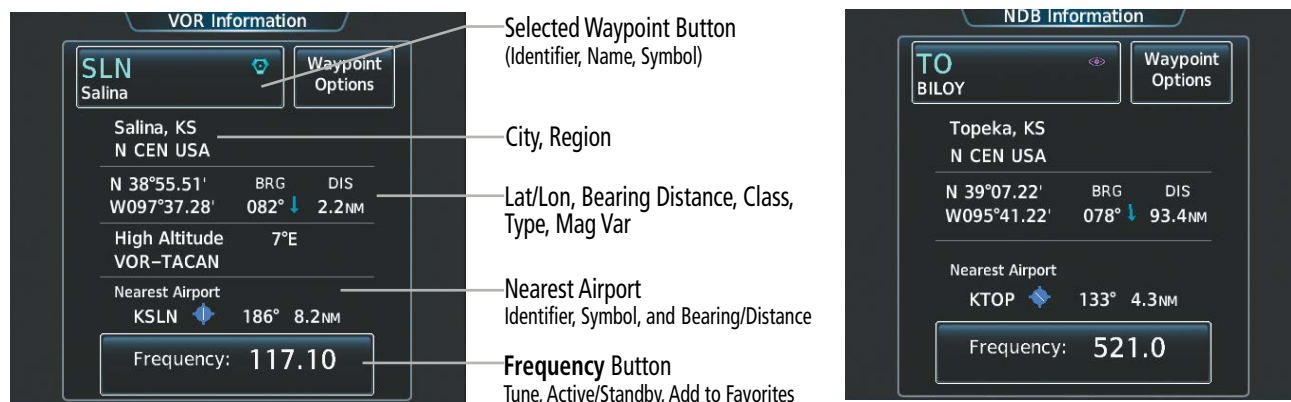
Figure 5-43 VOR and NDB Information Screens

Selected Waypoint Button
(Identifier, Name, Symbol)

Selected Waypoint Button
(Name, Comment, Symbol)

User Waypoint Definition
Location Type: LAT/LON
RAD/DIS, or RAD/RAD

Waypoint Options Button
Direct To, Insert in Flight Plan, Edit,
Delete, Delete All, Show On Map
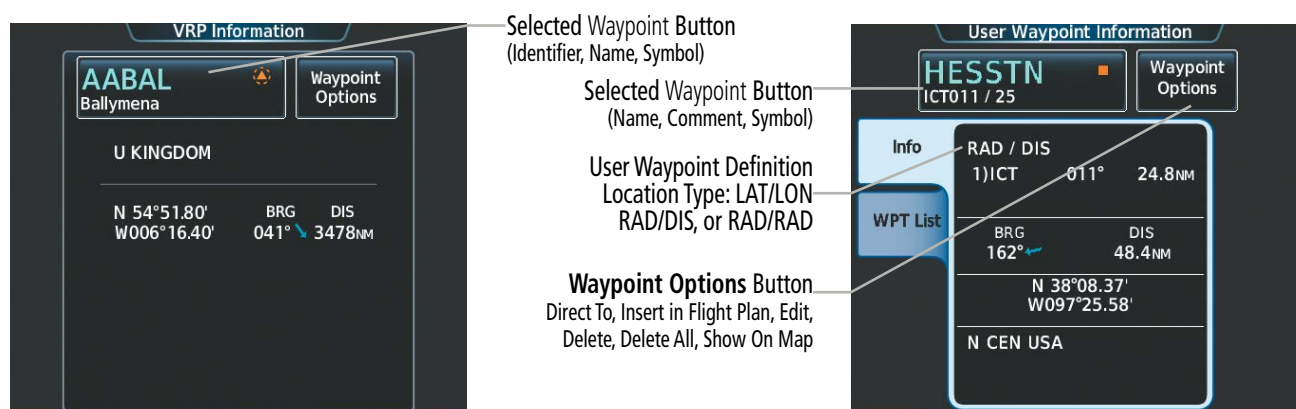
Figure 5-44 VRP and User Waypoint Information Screens

Navigation Map
Example: Selected
Intersection

Selected Waypoint:
-Intersection
-NDB,
-VOR,
-VRP, or
-User Waypoint
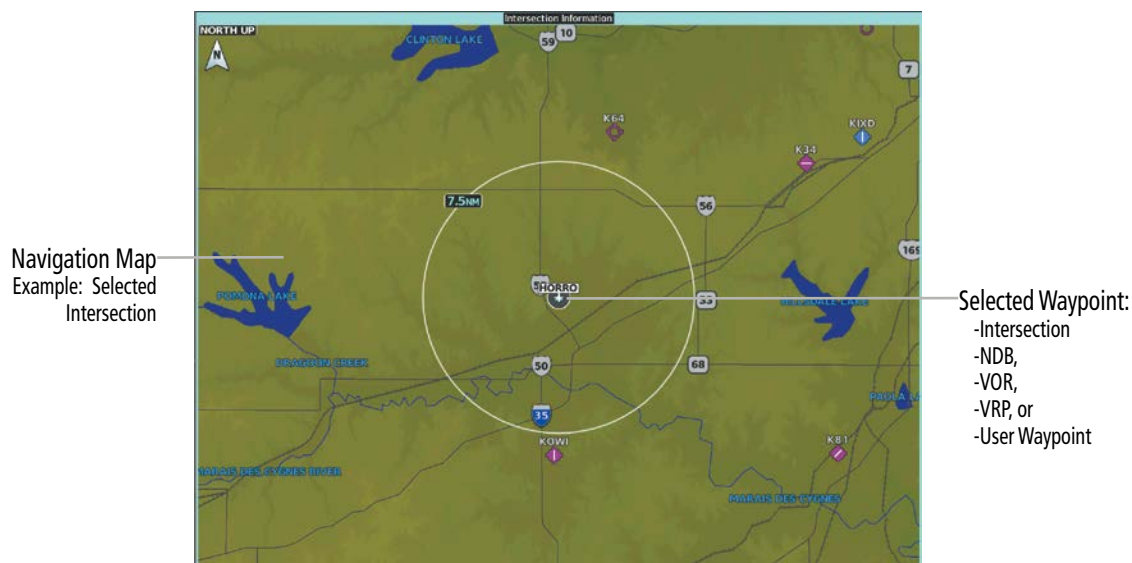
Figure 5-45 Non-Airport Waypoint Information (shown via "Show on Map")

Selecting a non-airport waypoint or User Waypoint:

1) From Home, touch the **Waypoint Info** Button**.**

2) Select the **INT, VRP, VOR, NDB,** or **User Waypoint** Button**.**

3) Choose the desired waypoint:

    a) Touch the Selected Waypoint or available user waypoint button to display the keypad.

    b) Use the keypad to enter the identifier or name.

    c) Touch the **Enter** Button to accept the identifier and display the waypoint's information on the Touchscreen Controller.

    Or:

    a) For choosing a User Waypoint, touch the **WPT List** Tab.

    b) Touch the desired waypoint button.

4) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the Intersection, VRP, VOR, NDB, or User Waypoint Information Pane, if needed.

Finding and selecting a non-airport or User Waypoint by category (Recent, Nearest, Flight Plan, or Favorites):

1) From Home, touch **Waypoint Info > INT, VRP, VOR, NDB** or **User Waypoint.**

2) Touch the Selected Waypoint Button to display the keypad.

3) Touch the **Find** Button to display the 'Find Waypoint' Screen.

4) Touch the **Recent** Tab, **Nearest** Tab, **Active Flight Plan** Tab, or the **Favorites** Tab to display a list of waypoints in the selected category.

5) Touch a Waypoint Selection Button to display that waypoint's information on the Touchscreen Controller.

6) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the Intersection, VRP, VOR, NDB, or User WPT Information Pane, if needed.

> *NOTE: The VOR displayed on the 'Intersection Information' Screen is the nearest VOR, not necessarily the VOR used to define the intersection.*

Finding and selecting a non-airport waypoint for review by facility name or city name:

1) From Home, touch **Waypoint Info > INT, VRP, VOR,** or **NDB.**

2) Touch the Selected Waypoint Button to display the keypad.

3) Touch the **Find** Button to display the 'Find Waypoint' Screen.

4) Touch the **Search** Tab to display the **Search By** Button.

5) If needed, touch the **Search By** Button to choose Search by City or Search by Facility.

6) Touch the **Facility Name** Button or the **City Name** Button to display the keypad.

7) Use the keypad to enter the name.

8) Touch the **Enter** Button to accept the entry and display the search results.

9) Touch a Waypoint Selection Button to display the waypoint information on the Touchscreen Controller.

10) Touch the **Waypoint Options** Button, then the **Show on Map** Button to display the Intersection, VRP, VOR, NDB, or User WPT Information Pane, if needed.

NEAREST WAYPOINTS

The Nearest Intersection/VRP/VOR/NDB/User panes show a map of the nearest waypoint selected and surrounding area, and the Touchscreen Controller shows the selected waypoint information, plus an ability to initiate a direct-to or insert the waypoint into the flight plan.

The Nearest Intersection/VRP/VOR/NDB/User screen shows a list of up to 25 waypoints (five entries can be displayed at one time). If there are more than five, they are displayed in a scrollable list. Each list only includes waypoints that are within 200 NM; the system will indicate when none are available within 200 NM. When shown on a map, a dashed white line is drawn on the Nearest (Intersection/VRP/VOR/NDB/User) pane from the aircraft position to the selected nearest waypoint.

> **NOTE:** *Each list only includes waypoints that are within 200 nm.*

Figure 5-46 Nearest non-Airport Waypoint Display (Example: NDB)

Figure 5-47 Nearest VOR/NDB Screen Layouts (Example: NDB)

Figure 5-48 Nearest Intersection/VRP/User Screen Layouts (Example: Intersection)

Viewing information for nearest Intersection, VRP, VOR, NDB, or User Waypoint:

1) From Home, touch **Nearest > INT, VRP, VOR, NDB,** or **User.**

2) Touch a Nearest Waypoint Button to display the 'Waypoint Options' Window.

3) Touch the **Show on Map** Button to display the Nearest Intersection/VRP/VOR/NDB/User pane, if needed.

4) Touch the **Intersection**, **VRP**, **VOR**, **NDB**, or **User Waypoint Info** Button to display the selected waypoint's information screen.

USER WAYPOINTS

The system can create, manage, and store up to 1,000 user-defined waypoints. Waypoints can be created as Route or Airport waypoints using the **Type** Button. Once a waypoint has been created, it can be renamed, deleted, or moved. Temporary user waypoints are erased upon system power down.

Any on of the following parameters may be used for defining the location of a user waypoint: Radial/Distance, Radial/Radial, Latitude/Longitude, or Present Position.

Radial and Distance

Radial to Radial

Type Button: Route, or Airport

Temporary Button

User Waypoint Name

Mode Button:
RAD/DIS
RAD/RAD
LAT/LON
P. POS

Waypoint data/input buttons

If Airport Type is chosen, the **Elevation** Button is displayed.

Comment Button

Latitude/Longitude

Present Position
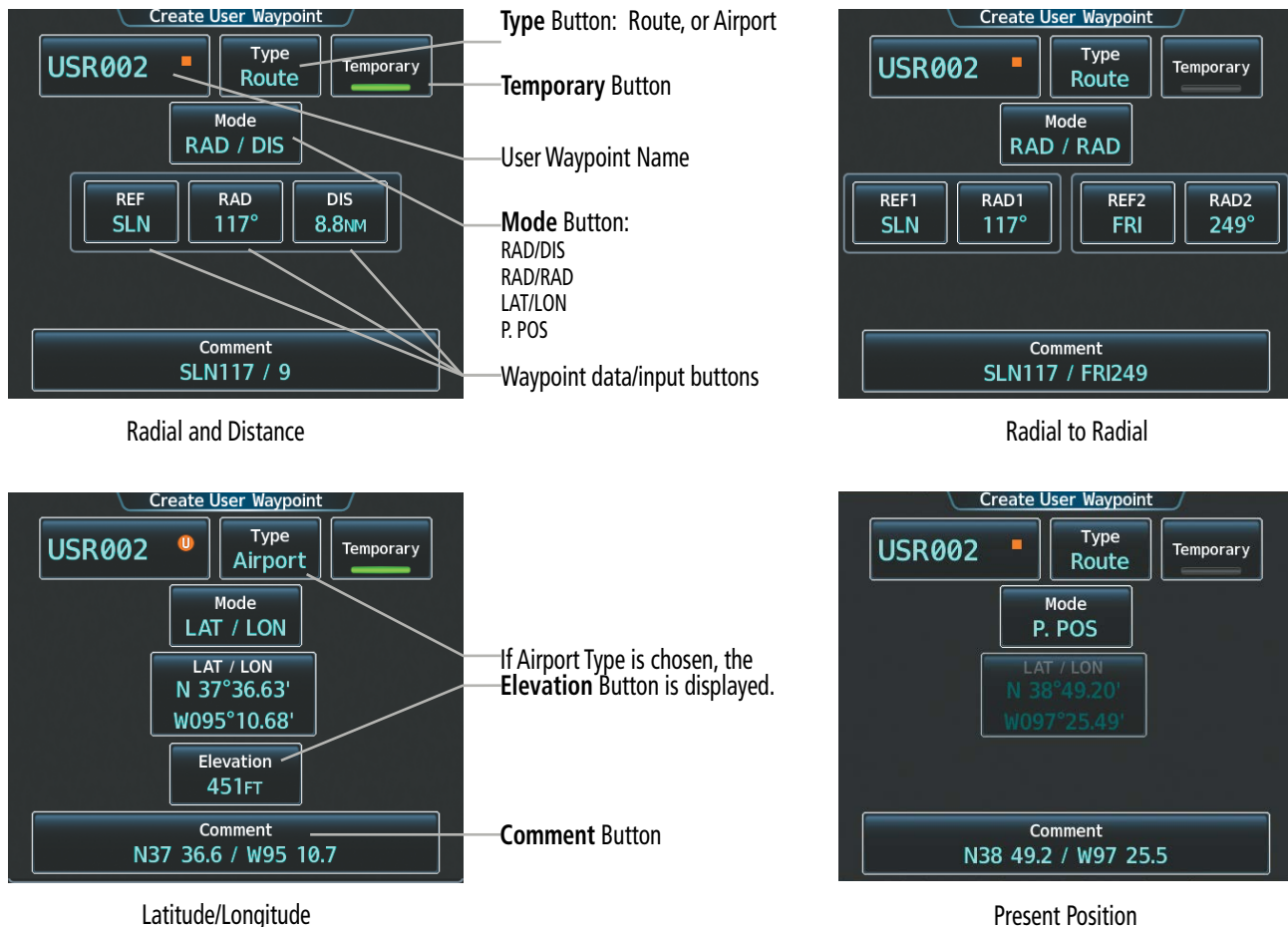
Figure 5-49 'Create User Waypoint' Screens – Mode Options

Creating user waypoints from the 'Create User Waypoint' Screen:

1) From Home, touch **Waypoint Info**.

2) Access the 'Create User Waypoint' Screen:

    Touch the **Create Waypoint** Button.

    Or:

    a) Touch the **User Waypoint** Button.

    b) Touch the **WPT List** Tab.

    c) Touch the **Add User Waypoint** Button.

3) Touch the User Waypoint Name Button to display the keypad.

4) Use the keypad and the **Enter** Button to select a User Waypoint Name (up to six characters).

5) If desired, touch the **Type** Button to open the 'Select User Waypoint Type' Screen to change the setting from Route to Airport.

    a) Touch the **Airport** Button.

    b) Touch the **Elevation** Button.

    c) Use the keypad and the **Enter** Button to select the airport elevation.

6) If desired, define the location parameters of the waypoint in one of the following ways:

   a) Touch the **Mode** Button to display the 'Select User Waypoint Mode' Screen.

   b) Touch the **RAD/DIS** Button to select the bearing/distance from a waypoint.

   c) Touch the **REF** Button to display the keypad.

   d) Use the keypad and the **Enter** Button, or the Find function, to select the reference waypoint.

   e) Touch the **RAD** Button to display the keypad.

   f) Use the keypad and the **Enter** Button to select the radial.

   g) Touch the **DIS** Button to display the keypad.

   h) Use the keypad and the **Enter** Button to select the distance.

   Or:

   a) Touch the **Mode** Button to display the 'Select User Waypoint Mode' Screen.

   b) Touch the **RAD/RAD** Button to select the bearings from two waypoints.

   c) Touch the **REF1** Button to display the keypad.

   d) Use the keypad and the **Enter** Button, or the Find function, to select the waypoint.

   e) Touch the **RAD1** Button to display the keypad.

   f) Use the keypad and the **Enter** Button to select the radial.

   g) Repeat Steps C through F for the second reference waypoint (**REF2** Button) and radial (**RAD2** Button).

   Or:

   a) Touch the **Mode** Button to display the 'Select User Waypoint Mode' Screen.

   b) Touch the **LAT/LON** Button to select the latitude/longitude mode.

   c) Touch the **LAT/LON** Button to display the keypad.

   d) Use the keypad and the **Enter** Button to select the latitude and longitude.

   Or:

   a) Touch the **Mode** Button to display the 'Select User Waypoint Mode' Screen.

   b) Touch the **P. POS** Button to select the present position type as defined by latitude/longitude values.

7) If desired, change the waypoint comment:

   a) Touch the **Comment** Button to display the keypad.

   b) Use the keypad and the **Enter** Button to select the comment.

8) If desired, touch the **Temporary** Button to change the waypoint storage method. When the annunciator on the button is green, the waypoint is only stored until the next power cycle. When the annunciator is subdued, the waypoint is stored until manually erased.

9) Touch the **Create** Button to accept the new user waypoint. If RAD/RAD was used to define the waypoint, and the radials do not intersect, a message "The radials entered do not intersect" will be displayed. Touch the **OK** Button to return to the 'Create User Waypoint' Screen.

Creating user waypoints from map displays:

1) Push the **Joystick** to activate the panning function and display the 'Map Pointer Control' Screen on the Touchscreen Controller.

2) Use the **Joystick** or the **Touchpad** to pan to the map location of the desired user waypoint.

3) Touch the **Create WPT** Button. The 'Create User Waypoint' Screen is displayed with the captured position.

4) Touch the user waypoint name button to display the keypad.

5) Use the keypad and the **Enter** Button to select a user waypoint name (up to six characters).

6) If desired, touch the **Type** Button to open the 'Select User Waypoint Type' Screen to change the setting from Route to Airport:

   a) Touch the **Airport** Button.

   b) Touch the **Elevation** Button

   c) Use the keypad and the **Enter** Button to select the airport elevation.

7) If desired, change the waypoint comment:

   a) Touch the **Comment** Button to display the keypad.

   b) Use the keypad and the **Enter** Button to select the comment.

8) Touch the **Create** Button to create the new waypoint.

9) Touch the **Back** Button to deactivate the panning function and return to the previous display on the Touchscreen Controller.

Editing a user waypoint comment:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) If needed, touch the **WPT List** Tab to display the list of user waypoints, and touch the desired User Waypoint Selection Button.

3) Touch the **Waypoint Options** Button to display the 'Waypoint Options' Window.

4) Touch the **Edit** Button to display the 'Edit User Waypoint' Screen.

5) Touch the **Comment** Button to display the keypad.

6) Use the keypad and the **Enter** Button to select a user waypoint comment (up to 25 characters).

7) Touch the **Save** Button to accept the new comment.

8) Touch the **OK** Button in response to the question "Are you sure you want to modify this waypoint?".

Editing a user waypoint name:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) If needed, touch the **WPT List** Tab to display the list of user waypoints, and touch the desired User Waypoint Selection Button.

3) Touch the **Waypoint Options** Button to display the 'Waypoint Options' Window.

4) Touch the **Edit** Button to display the 'Edit User Waypoint' Screen.

5) Touch the user waypoint name button to display the keypad.

6) Use the keypad and the **Enter** Button to select a user waypoint name (up to six characters).

7) Touch the **Save** Button to accept the new name.

8) Touch the **OK** Button in response to the question "Are you sure you want to modify this waypoint?".

Editing a user waypoint type, mode, elevation, and location:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) If needed, touch the **WPT List** Tab to display the list of user waypoints, and touch the desired User Waypoint Selection Button.

3) Touch the **Waypoint Options** Button to display the 'Waypoint Options' Window.

4) Touch the **Edit** Button to display the 'Edit User Waypoint' Screen.

5) To edit the type of User Waypoint:

a) Touch the **Type** Button to display the 'User Waypoint Type' Window.

b) Touch the **Route** Button to select the type and return to the previous screen.

Or:

a) Touch the **Type** Button to display the 'User Waypoint Type' Window.

b) Touch the **Airport** Button or the **Heliport** Button to select the type and return to the previous screen.

c) Touch the **Elevation** Button.

d) Use the keypad and the **Enter** Button to select the airport elevation and return to the previous screen.

6) To edit the mode of User Waypoint:

a) Touch the **Mode** Button to display the 'Select User Waypoint Mode' Window.

b) Touch the **RAD/DIS** Button, the **RAD/RAD** Button, the **LAT/LON** Button, or the **P. POS** Button to select the mode and return to the previous screen.

7) If the P. POS Mode is selected, skip to step 8. Otherwise, perform the following to edit the location parameters of the waypoint:

a) Touch the **REF** Button, the **RAD** Button, the **DIS** Button, or the **LAT/LON** Button to bring up the keypad.

b) Use the keypad and the **Enter** Button to select the user waypoint location.

c) Repeat as necessary until the location changes are complete (Reference Waypoint, Radial, Distance, or Latitude and Longitude).

8) Touch the **Save** Button to accept the changes.

9) Touch the **OK** Button in response to the question "Are you sure you want to modify this waypoint?".

Deleting a single user waypoint:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) If needed, touch the **WPT List** Tab to display the list of user waypoints, and touch the desired User Waypoint Selection Button.

3) Touch the **Waypoint Options** Button to display the 'Waypoint Options' Window.

4) Touch the **Delete** Button.

5) Touch the **OK** Button in response to the question "Would you like to delete the user waypoint <waypoint>?".

Deleting all user waypoints:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) If needed, touch the **WPT List** Tab to display the list of user waypoints, and touch any Waypoint Selection Button.

3) Touch the **Waypoint Options** Button to display the 'Waypoint Options' Window.

4) Touch the **Delete All** Button.

5) Touch the **OK** Button in response to the question "Would you like to delete all user waypoints?".

Importing user waypoints:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) Touch the **Waypoint Options** Button**.**

3) Touch the **Import** Button.

4) Touch the **OK** Button.

Exporting user waypoints:

1) From Home, touch **Waypoint Info** > **User Waypoint**.

2) Touch the **WPT List** Tab to display the list of user waypoints.

3) Scroll the list, if needed, and touch a User Waypoint Button Information for the selected waypoint is displayed.

4) Touch the **Waypoint Options** Button**.**

5) Touch the **Export** Button.

6) Touch the **OK** Button in response to the question, 'Would you like to export user waypoints?'.

5.4 AIRSPACES

The system can display many types of airspaces. See the Map Symbols portion of this section for a complete listing of all airspaces, their associated symbols, and default and maximum map display ranges. Temporary Flight Restrictions (TFRs) are discussed in the Hazard Avoidance Section.

Figure 5-50 Airspaces

NEAREST AIRSPACE

SETTING AIRSPACE ALERTS

The **Alerts** Tab on the 'Avionics Settings' Screen allows the pilot to turn the controlled/special-use airspace alerts on or off. This does not affect the airspaces listed on the 'Nearest Airspace' Screen or the airspace boundaries depicted on map displays. It simply turns on/off the alert provided when the aircraft is approaching or near an airspace. Alerts for the following airspaces can be enabled/disabled. For information on enabling/disabling arrival alerts and setting the arrival alert distance, see the Flight Planning portion of this section.

Figure 5-51 Alerts Tab – Airspace/Arrival Alerts

An altitude buffer is also provided which "expands" the vertical range above or below an airspace. For example, if the buffer is set at 500 feet, and the aircraft is more than 500 feet above/below an airspace, an alert message is not generated, but if the aircraft is less than 500 feet above/below an airspace and projected to enter it, the pilot is notified with an alert message. The default setting for the altitude buffer is 200 feet.

Setting the altitude buffer distance:

1) From Home, touch **Utilities > Setup** > **Avionics Settings**.

2) Touch the **Alerts** Tab.

3) Touch the Airspace Alert Alt Buffer altitude button (displays current selection in cyan).

4) Enter the desired altitude buffer value and touch the **Enter** Button.

Enabling/disabling an airspace alert:

1) From Home, touch **Utilities > Setup** > **Avionics Settings**.

2) Touch the **Alerts** Tab.

3) Scroll as needed and touch any of the of the following buttons to enable/disable the corresponding alert: **CL B/TMA/AWY**, **CL C/CTA**, **CL A/D**, **Restricted**, **MOA (Military)**, **Other**. The button annunciator is green when alert is enabled, subdued when disabled.

VIEWING NEAREST AIRSPACE INFORMATION

The 'Nearest Airspace' Screen and the 'Nearest Airspace' Pane can be used to quickly find airspaces close to the aircraft and its projected current ground track. The 'Nearest Airspace' Pane shows a map of airspace boundaries and surrounding area. The 'Nearest Airspace' Screen displays airspace information. In addition, a selected frequency associated with the airspace can be loaded from the 'Nearest Airspace' Screen.
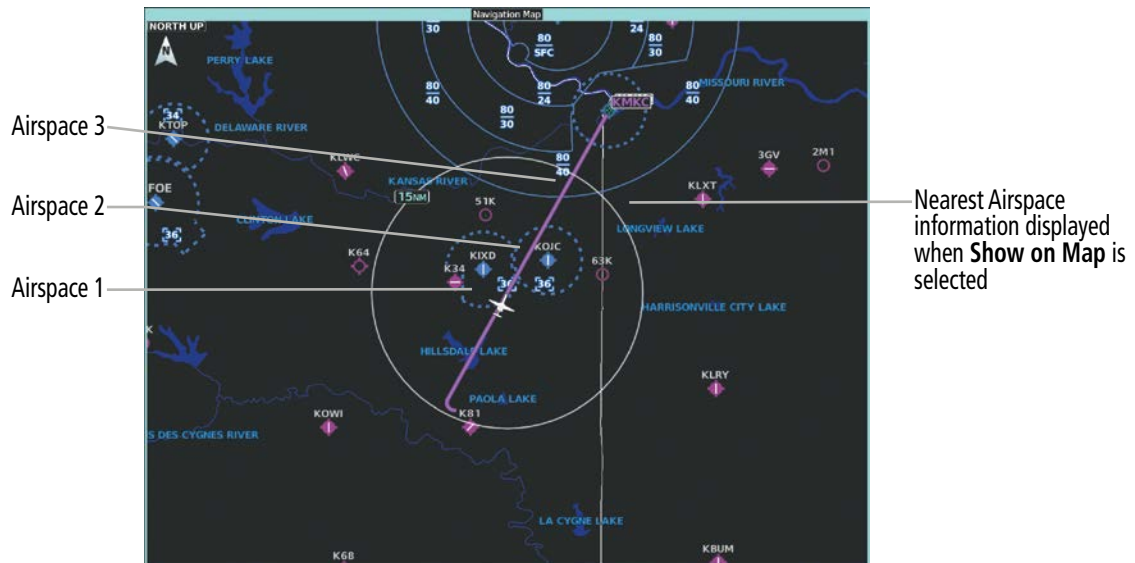
Figure 5-52 'Nearest Airspace' Pane

Figure 5-53 Nearest Airspace

[1] *Proximity: Ahead, Inside, Ahead<2nm, Within 2nm*
[2] *Intercept Time: Only if Ahead or Ahead < 2nm*

Viewing information for the Nearest Airspace:

1) From Home, touch **Nearest** > **Airspace**.

2) Touch a Nearest Airspace button to display the 'Airspace Options' Window. If no airspace is projected, the 'Nearest Airspace' Screen will read "No Results Found".

3) Touch the **Show on Map** Button to display the selected airspace, if needed.

4) Touch the **Details** Button to display the selected 'Nearest Airspace' Screen information.

When an airspace alert occurs, the MSG Button on the Touchscreen Controller begins flashing. Touch the flashing button to view the list of alerts. The following airspace alerts are displayed in the 'Notifications' Screen:

Message	Comments
'INSIDE ARSPC' – Inside airspace.	The aircraft is inside the airspace.
'ARSPC AHEAD' – Airspace ahead – less than 10 minutes.	Special use airspace is ahead of aircraft. The aircraft current ground track penetrates the airspace within 10 minutes.
'ARSPC NEAR' – Airspace near and ahead.	Special use airspace is near and ahead of the aircraft position.
'ARSPC NEAR' – Airspace near – less than 2 nm.	Special use airspace is within 2 nm of the aircraft position.

Table 5-6 Airspace Alert Messages

SMART AIRSPACE

The Smart Airspace function de-emphasizes airspaces above or below the current aircraft altitude. The function does not require the aircraft present position or flight path to enter the lateral boundaries of the airspace. If the current aircraft altitude is within 1500 feet of the vertical boundaries of the airspace, the airspace boundary is shown normally. If the current aircraft altitude is not within 1500 feet of the vertical boundaries of the airspace, the airspace boundary is shown subdued.

> **NOTE:** Smart Airspace function will not de-emphasize airspaces on the HSI Map when the MFD is in reversionary mode.
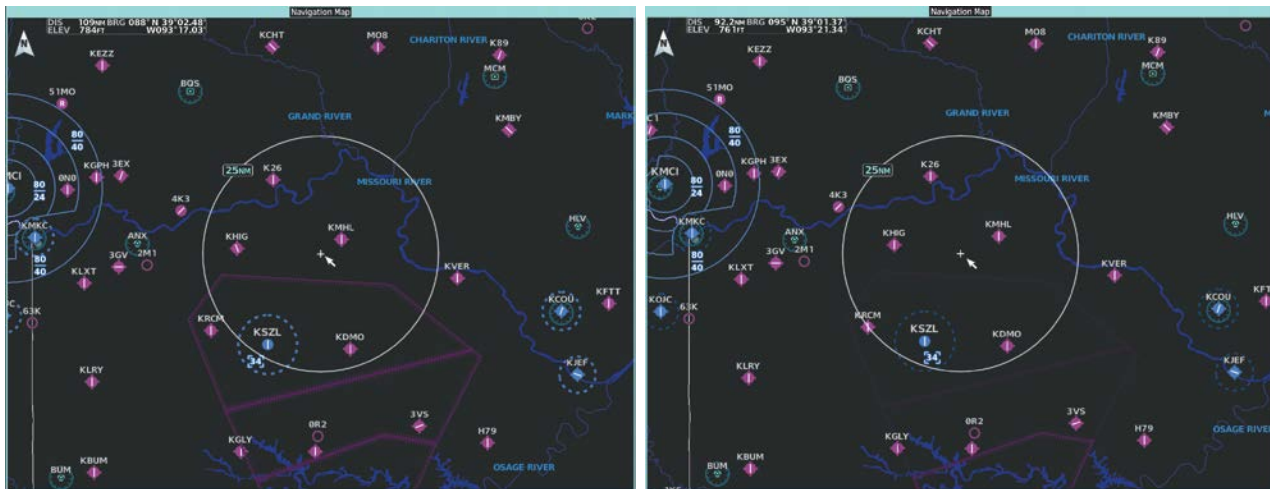
Smart Airspace Off   Smart Airspace On

Figure 5-54 Smart Airspace

Enabling/disabling the Smart Airspace function:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Aviation** Tab, if necessary.

3) Touch the Airspaces **Settings** Button to display the 'Airspace Settings' Screen.

4) Touch the **Smart Airspace** Button to enable/disable the Smart Airspace function.

5.5 FLIGHT PLANNING

GENERAL INFORMATION

Flight planning consists of building a flight plan by entering waypoints one at a time, adding waypoints along airways, and inserting departures, airways, arrivals, or approaches as needed. The system allows flight planning information to be entered using the Touchscreen Controller or the PFD Controller. The flight plan is displayed on maps using different line widths, colors, and types, based on the type of leg and the segment (departure, enroute, arrival, approach, or missed approach) of the flight plan currently being flown.

The system displays a calculated turn anticipation arc, and provides guidance to follow the arc. When the aircraft reaches the beginning of the arc, the guidance will prompt a turn, and the course pointer and desired track will indicate the course for the next flight plan leg. The CDI will indicate the cross track error relative to the arc for the duration of the turn. The flight plan leg will sequence to the next leg at the apex of the arc, indicated by the To/From Indicator momentarily switching to From, and the displayed FMS information updating to the new active leg.

Symbol Name	Description	Symbol
Course Leg	Course leg currently flown	
	A future course leg in the current phase of flight	
	A course leg in either a previously flown course leg, or a future course leg not in the current phase of flight	
Heading Leg	Heading leg currently flown	
	Future heading leg	
Roll Steering Path [1]	Turning path currently flown	
	Turning path for the next flight plan leg	
	Turning path beyond the next flight plan leg	
Turn Anticipation Arc	Displayed when sequencing to the next flight plan leg via a fly-by waypoint, a lead turn is created, adjusting for groundspeed	
Fly-Over Waypoint	Displayed as a fly-over waypoint	
Along Track Waypoint	Displayed when an along track offset waypoint is created	
Flight Path Fix	A fix that terminates: manually, at a specified altitude, or at a specified distance or radial when flying a heading	
Top of Descent (TOD) and Bottom of Descent (BOD)	When vertically navigating, the system will display where the aircraft will begin complete the descent	
Parallel Track Waypoint	Displayed when a parallel track is created	

[1] *Roll Steering Path transitions between two disconnected legs (i.e. holding), some procedure turn segments, parallel track segments, or after some fly-over waypoints (discussed later in this section).*

Table 5-7 Flight Plan Symbols

✓ **NOTE:** See the AFCS Section for information on lateral guidance and course deviation per flight plan leg types.

✓ **NOTE:** A flight plan leg with manual termination projects the path ahead of the aircraft for five nautical miles.

The system allows creation, modification, and/or viewing of a flight plan as follows:

- 'Active Flight Plan' Screen on the Touchscreen Controller (create/modify/view the active flight plan)
- 'Standby Flight Plan' Screen on the Touchscreen Controller (create/modify/view the standby flight plan)
- 'Flight Plan Catalog' Screen on the Touchscreen Controller (create/modify/view a stored flight plan)
- 'Flight Plan' Window on the PFD (create/modify/view the active flight plan)
- 'Active Flight Plan' Inset Window on the 'Navigation Map' Pane (view the active flight plan)
- 'Flight Plan Progress' Inset Window on the 'Navigation Map' Pane (view the active flight plan)
- Vertical Situation Display on the 'Navigation Map' Pane (view upcoming vertical profile of the active flight plan)

The 'Active Flight Plan' Screen and the 'Standby Flight Plan' Screens are shown in the following figures. The Climb, Cruise, and Descent (CCD) VNAV allows the pilot to create manual flight path angle and speed constraints utilizing the buttons provided. More information on CCD VNAV is discussed later.

Figure 5-55 'Active Flight Plan' Screen
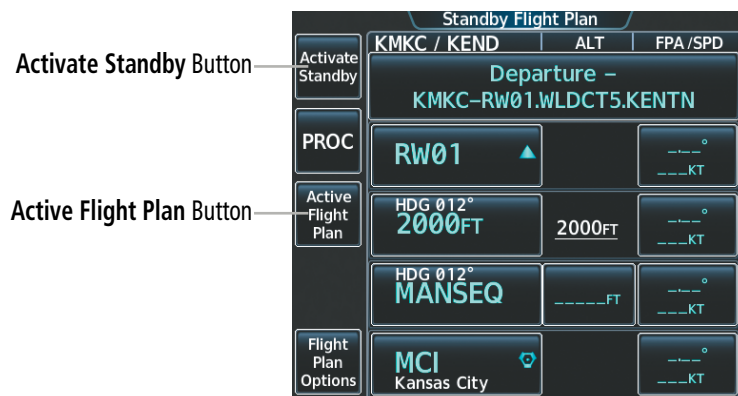
Figure 5-56 'Standby Flight Plan' Screen

Number of Flight Plans Stored

Stored Flight Plan Options Button

Departure Airport Identifier/Symbol

Destination Airport Identifier/Symbol

Number of Available Storage Spots

Cumulative Flight Plan Distance

Create New Catalog Flight Plan Button

Figure 5-57 'Flight Plan Catalog' Screen

Active Flight Plan Leg

Active Flight Plan Info

Active Flight Plan Leg

Current VNAV Profile
 - Active VNAV WPT ID/Alt
 - Time to TOD, BOD,   TOC, or BOC
 - Flight Path Angle
 - Vertical Speed Target
 - Vertical Speed Required
 - Vertical Deviation
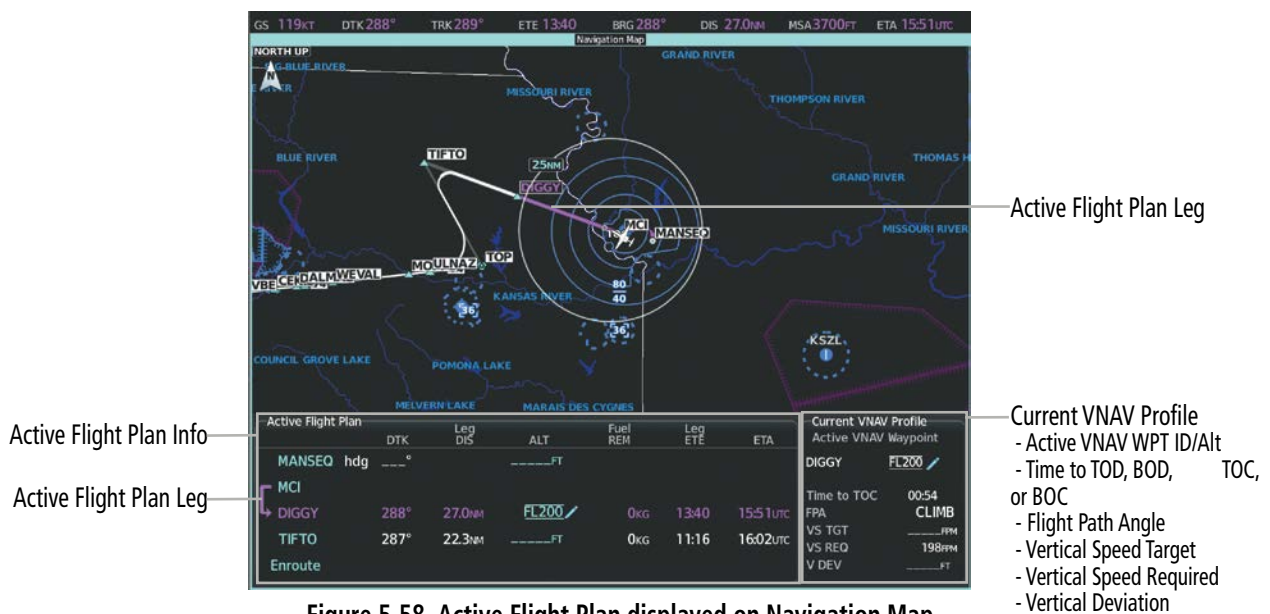
Figure 5-58 Active Flight Plan displayed on Navigation Map

FLIGHT PLAN DISPLAY

An active, standby or stored flight plan can be previewed on the 'Navigation Map' Pane by selecting the **Show on Map** Button. When a waypoint in a flight plan is selected, the 'Waypoint Options' Window is displayed, and the page up/page down buttons are replaced by the previous/next waypoint buttons. This allows easier previewing of the flight plan on the active display pane.

Displaying/removing the flight plan preview:

1) For the active flight plan: From Home, touch **Flight Plan > Flight Plan Options**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan > Flight Plan Options**.

Or:

For the stored flight plan:

a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

d) Touch the **Flight Plan Options** Button.

2) Touch the Show on Map Button. A preview of the flight plan is shown on the active display pane.

3) To view a flight plan segment:

a) Touch the **Back** Button.

b) Scroll as needed, and touch the selection button corresponding to the desired segment of the flight plan.

c) Touch the **Back** Button to return to the flight plan preview.

4) Touch the Show on Map Button again or return to the 'Home' Screen to disable the Show on Map Button and remove the preview from the display.

Displaying/removing the Flight Plan Text Inset:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Inset Window** Tab.

3) Touch the **Flight Plan Text** Button to display/remove the active flight plan text on the 'Navigation Map' Pane.

4) Waypoint distances shown on the Flight Plan Text Inset may be set as leg to leg distances or cumulative distance by selecting the **CUM** Button or **Leg-Leg** Button next to the **Flight Plan Text** Button.

Displaying/removing the Flight Plan Progress Inset:

1) From Home, touch **Map** > **Map Selection** > **Map Settings**.

2) Touch the **Inset Window** Tab.

3) Touch the **Flight Plan Progress** Button to display/remove the flight plan progress inset.

DIRECT-TO NAVIGATION

The Direct-to method of navigation allows quick selection of a destination and provides guidance to the selected point. Initiate a direct-to by touching the **-Ð►** Button on the Touchscreen Controller , or by pressing the **-Ð►** Key on the PFD Controller.

Once a direct-to is activated, the system establishes a course from the present position to the selected direct-to destination, with initial turn as needed. Course guidance is provided until the direct-to is cancelled, replaced with a new direct-to, or a new flight plan leg or sequence is activated.

The 'Direct To' Screen on the Touchscreen Controller allows selection and activation of direct-to navigation, and displays selected direct-to waypoint data. Any waypoint can be entered as a direct-to destination.

The choice to "Activate and Insert in Flight Plan" is given on the 'Direct To' Screen when selecting a waypoint that is not already within the active flight plan (if direct-to navigation has already been activated, the choice to "Insert in Flight Plan" is given instead). If this action is selected, the system will provide direct-to navigation to the waypoint, and the waypoint will be inserted in the active flight plan before the waypoint selected. After arriving at the waypoint, guidance is resumed to the next flight plan waypoint.
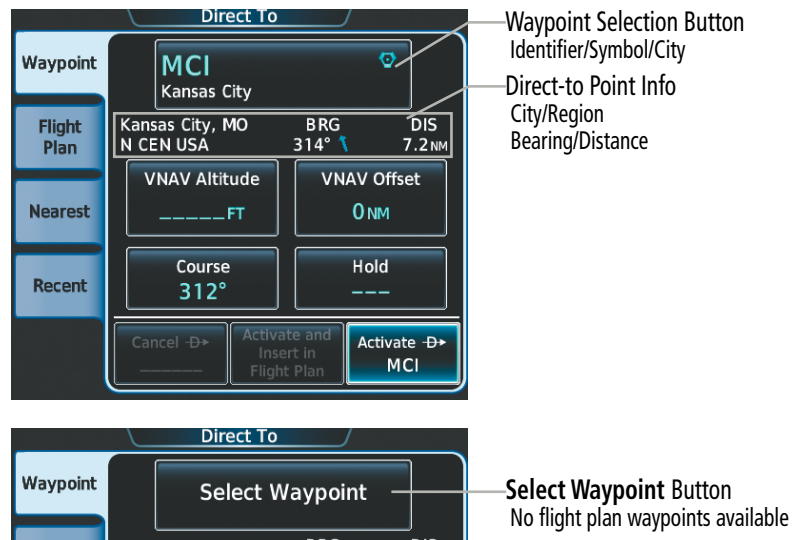
Figure 5-59 'Direct To' Screen

✓ **NOTE:** *The FMS enters SUSP mode whenever direct-to is selected to a waypoint that is nearby but slightly behind the airplane. A short magenta segment is drawn preceding the selected waypoint, on the course defined by the next leg. The FMS remains in SUSP until the pilot unsuspends the FMS, or selects a new flight plan course.*

The direct-to function can be accessed from any waypoint information screen (Airport Information, Intersection Information, VOR Information, NDB Information, VRP Information, or User Waypoint Information), and from some of the nearest waypoint screens (Nearest Airport, Nearest Intersection, Nearest VOR, Nearest NDB, Nearest VRP, Nearest User, or Nearest Weather). If the direct-to is initiated from the 'Active Flight Plan' Screen when no waypoint has been selected, the default waypoint is either the active flight plan waypoint (if a flight plan is active) or no waypoint (**Select Waypoint** Button is active). Direct-to requests on waypoint information screens or nearest waypoint screens default to the displayed waypoint.

Selecting a nearby airport as a direct-to destination:

1) From Home, touch **Nearest** > **Airport**.

2) Touch a Nearest Airport Button to display the 'Waypoint Options' Window. If desired, highlight the airport on the active display pane by touching the **Show On Map** Button.

3) Touch the ⎯Ð➤ Button to choose the waypoint as the direct-to destination, and display the 'Direct To' Screen.

4) To activate direct-to navigation:

Touch the **Activate** ⎯Ð➤ Button to activate the direct-to.

Or:

a) Touch the **Activate and Insert in Flight Plan** Button or the **Insert in Flight Plan** Button (only available if the selected waypoint is not in the flight plan) to display the 'Insert and Activate ⎯Ð➤ <waypoint> Before?' Window.

b) Touch the Waypoint Selection Button to select the flight plan location to insert the direct to waypoint, and to activate the direct-to.

Selecting any waypoint as a direct-to destination:

1) Select the screen containing the desired waypoint and select the desired waypoint.

2) If necessary, touch the **Waypoint Options** Button.

3) Touch the ⇥ Button to choose the waypoint as the direct-to destination, and display the 'Direct To' Screen.

4) To activate direct-to navigation:

Touch the **Activate** ⇥ Button to activate the direct-to.

Or:

a) Touch the **Activate and Insert in Flight Plan** Button or the **Insert in Flight Plan** Button (only available if the selected waypoint is not in the flight plan) to display the 'Insert and Activate ⇥ <waypoint> Before?' Window.

b) Touch the Waypoint Selection Button to select the flight plan location to insert the direct to waypoint, and to activate the direct-to.

Selecting any waypoint as a direct-to destination using the PFD Controller:

1) On the PFD Controller, press the ⇥ Key.

2) Turn the large **PFD** Knob to move the cursor to the identifier field, if necessary.

3) Turn the small **PFD** Knob one click to activate the editing cursor (flashing).

4) Turn the large and small **PFD** Knobs to select the identifier (large knob moves the cursor; small knob selects the character).

5) Press the **ENT** Key or the small **PFD** Knob to accept the selection and move the cursor.

6) Press the **ENT** Key or the small **PFD** Knob to activate the direct-to.

Selecting a waypoint as the direct-to destination by identifier, facility, or city name:

1) From Home, touch ⇥ .

2) Touch the Waypoint Selection Button to display the keypad (available waypoints in flight plan).

Or:

Touch the **Select Waypoint** Button to display the keypad.

3) Select a waypoint as a direct-to destination:

Input the waypoint identifier using the keypad and touch the **Enter** Button to accept the identifier, and return to the 'Direct To' Screen.

Or:

a) Touch the **Find** Button to display the 'Find Waypoint' Screen.

b) Touch the **Search** Tab to display the **Search By** Button.

c) If needed, touch the **Search By** Button to choose Search by City or Search by Facility.

d) Touch the **Facility Name** Button or the **City Name** Button to display the keypad.

e) Use the keypad to select the name.

f) Touch the **Enter** Button to accept the entry and display the search results.

g) Touch a Waypoint Selection Button to choose the waypoint as the direct-to destination, and return to the 'Direct To' Screen.

4) To activate direct-to navigation:

Touch the **Activate** -**Ɗ**► Button to activate the direct-to.

Or:

a) Touch the **Activate and Insert in Flight Plan** Button or the **Insert in Flight Plan** Button (only available if the selected waypoint is not in the flight plan) to display the 'Insert and Activate -**Ɗ**► <waypoint> Before?' Window.

b) Touch the Waypoint Selection Button to select the flight plan location to insert the direct to waypoint, and to activate the direct-to.

Selecting a waypoint as the direct-to destination by facility or city name using the PFD Controller:

1) On the PFD Controller, press the -**Ɗ**► Key.

2) Turn the large **PFD** Knob to move the cursor to the facility name or city name field.

3) Turn the small **PFD** Knob one click to activate the editing cursor (flashing).

4) Turn the large and small **PFD** Knobs to select the facility or city (large knob moves the cursor; small knob selects the character).

5) Press the **ENT** Key or the small **PFD** Knob to accept the selection and move the cursor.

6) Press the **ENT** Key or the small **PFD** Knob to activate the direct-to.

Selecting a waypoint as the direct-to destination by category (Nearest or Recent):

1) From Home, touch -**Ɗ**► .

2) Touch the **Nearest** Tab or the **Recent** Tab, as necessary.

3) Touch a Waypoint Selection Button to choose the waypoint as the direct-to destination, and return to the 'Direct To' Screen.

4) Touch the **Activate** -**Ɗ**► Button to activate the direct-to.

Or:

a) Touch the **Activate and Insert in Flight Plan** Button or the **Insert in Flight Plan** Button (only available if the selected waypoint is not in the flight plan) to display the 'Insert and Activate -**Ɗ**► <waypoint> Before?' Window.

b) Touch the Waypoint Selection Button to select the flight plan location to insert the direct to waypoint, and to activate the direct-to.

Selecting a waypoint as the direct-to destination by category (Flight Plan, Nearest, Recent, or User) using the PFD Controller:

1) On the PFD Controller, press the -**Ɗ**► Key.

2) Turn the large **PFD** Knob counter-clockwise one click to display the Waypoint Submenu. Then, turn the small knob clockwise to view a list of nearest waypoints. Turn the small knob clockwise again to view a list of recent waypoints.

3) If necessary, turn the small **PFD** Knob clockwise to display the 'Flight Plan', 'Nearest', 'Recent', or 'User' list.

4) Turn the large **PFD** Knob clockwise to select the desired item.

5) Press the **ENT** Key or the small knob to accept the selection and move the cursor.

6) Press the **ENT** Key or the small **PFD** Knob again to activate the direct-to.

Selecting an active flight plan waypoint as the direct-to destination:

1) From Home, touch **Flight Plan.**

2) Touch a Waypoint Selection Button to display the 'Waypoint Options' Window.

3) Touch the **-D→** Button to choose the waypoint as the direct-to destination and display the 'Direct To' Screen.

4) Touch the **Activate -D→** Button to activate the direct-to.

Or:

1) From Home, touch **-D→** .

2) Touch the **Flight Plan** Tab.

3) Touch a Waypoint Selection Button to choose the waypoint as the direct-to destination, and return to the **Waypoint** Tab of the 'Direct To' Screen.

4) Touch the **Activate -D→** Button to activate the direct-to.

Or:

1) From Home, touch the **-D→** Button to display the 'Direct To' Screen with the active flight plan waypoint selected as the direct-to destination.

2) Touch the **Activate -D→** Button to activate the direct-to.

Or:

1) From Home, touch **Flight Plan.**

2) Touch the **-D→** Button to display the 'Direct To' Screen with the active flight plan waypoint selected the direct-to destination.

3) Touch the **Activate -D→** Button to activate the direct-to.

Selecting an active flight plan waypoint as the direct-to destination using the PFD Controller:

1) On the PFD Controller, press the **-D→** Key.

2) Turn the large **PFD** Knob to move the cursor, if necessary, and highlight the desired waypoint.

3) Press the **ENT** Key or the small **PFD** Knob to accept the selection and move the cursor.

4) Press the **ENT** Key or the small **PFD** Knob again to activate the direct-to.

Direct-to destinations may also be selected by using the Map Pointer on the map display (Map Pointer functionality is not available for traffic or terrain panes).

Selecting a waypoint as a direct-to destination using the Map Pointer:

1) Push the **Joystick** to display the pointer.

2) Use the **Joystick or Touchpad** on the Touchscreen Controller to place the pointer at the desired destination location.

3) If the pointer is placed on an existing airport, NAVAID, or user waypoint, the waypoint ID is highlighted, and the **-D→** Button is activated.

4) Touch the **-D→** Button to display the 'Direct To' Screen with the selected point entered as the direct-to destination.

5) To activate direct-to navigation:

> Touch the **Activate -D→** Button to activate the direct-to.

> **Or:**

a) Touch the **Activate and Insert in Flight Plan** Button or the **Insert in Flight Plan** Button (only available if the selected waypoint is not in the flight plan) to display the 'Insert and Activate **-D→** <waypoint> Before?' Window.

b) Touch the Waypoint Selection Button to select the flight plan location to insert the direct to waypoint, and to activate the direct-to.

Cancelling a Direct To:

1) From Home, touch **-D→** .

2) Touch the **Cancel -D→** Button.

3) Touch the **OK** Button in response to the question "Cancel **-D→** <waypoint>".

> **Or**:

1) On the PFD Controller, press the **-D→** Key.

2) Turn the large **PFD** Knob to move the cursor to the **Cancel** or **Remove -D→** Field.

3) Press the **ENT** Key or the small **PFD** Knob to cancel the direct-to.

When navigating a direct-to, the system sets a direct great circle course to the selected destination. The course to a destination can also be manually selected.

Selecting a manual direct-to course:

1) From Home, touch **-D→** .

2) If necessary, touch the Waypoint Selection Button to enter the waypoint as the direct-to destination. Then, touch the **Course** Button to display the keypad.

3) Use the keypad to select the course.

4) Touch the **Enter** Button to accept the course, and return to the 'Direct To' Screen.

5) Touch the **Activate -D→** Button to activate the direct-to using the manually selected course.

Selecting a manual direct-to course using the PFD Controller:

1) On the PFD Controller, press the **-D→** Key.

2) Turn the large **PFD** Knob to move the cursor to the course input field.

3) Turn the small **PFD** Knob one click to activate the editing cursor (flashing).

4) Turn the large and small **PFD** Knobs to select the course (large knob moves the cursor; small knob selects the character)

5) Press the **ENT** Key or the small **PFD** Knob to accept the selection and move the cursor.

6) Press the **ENT** Key or the small **PFD** Knob to activate the direct-to using the manually selected course.

Figure 5-60 Direct To – Selecting a Manual Course

Reselecting the direct course from the current position:

1) From Home, touch **-D→**.

2) Touch the **Activate -D→** Button to activate the direct-to using the direct course.

Reselecting the direct course from the current position using the PFD Controller:

1) On the PFD Controller, press the **-D→** Key.

2) Press the **ENT** Key or the small **PFD** Knob to accept the selection and move the cursor.

3) Press the **ENT** Key or the small **PFD** Knob to activate the direct-to using the direct course.

A direct-to with an altitude constraint designated for VNAV guidance creates a vertical path and provides guidance to stay on the path) from the aircraft's current altitude to the altitude of the direct-to waypoint. The altitude is reached at the waypoint, or at the specified distance along the flight path if an offset distance has been entered. Direct-to vertical navigation and offset distances (along track offsets) are discussed later in this section.

FLIGHT PLAN KEYPAD OPERATION

OVERVIEW

This overview will discuss the overall format and functionality of the Flight Plan Keypad. More information on creating a flight plan, and entering airway and waypoint data into the flight plan will be discussed later in this section.

Operating the Flight Plan Keypad is essentially the same as operating other keypads that are exclusive to either alphabetical or numeric buttons. Two significant differences are the Flight Plan Keypad provides the ability to create User Waypoints while inserting them into the Active Flight Plan, and the ability to combine and enter multiple waypoints and airways as a continuous route into the flight plan.

Each character selection on the Flight Plan Keypad will be entered in the Route Entry Field. However, after 15 characters are entered, the entry field will begin to shift characters to the left away from view as additional characters are added.
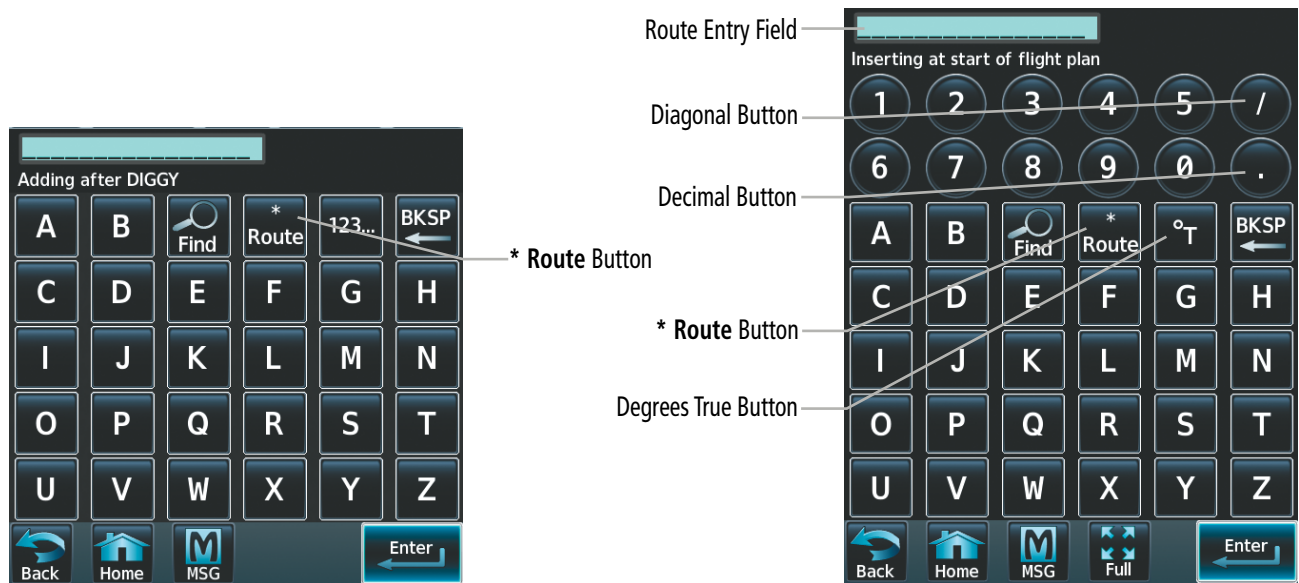
Figure 5-61 Flight Plan Alphanumeric Keypad – Route Entry Unique Buttons

Flight plan route entry can be used with the full screen keyboard on or off. When the full screen keyboard is on, more functionality is provided with access to the buttons shown in the previous figure.

Enabling/Disabling the Full-Screen Flight Plan Keypad:

1) From Home, touch **Utilities** > **Setup** > **Avionics Settings**. The System Tab is highlighted.

2) Touch the Full-Screen Flight Plan Keyboard Button to enable/disable (button displays 'Off' or 'On' in cyan).

When creating a User Waypoint while adding it to the flight plan, the 'Create User Waypoint' Screen will be displayed to allow the flight crew to review the information before accepting entry into the flight plan. See the Waypoints portion of this section for information on User Waypoints.

Four buttons unique to this particular keypad include the Diagonal (**/**), Decimal (**.**), Route (*****), and Degrees True (**°T**) buttons. These buttons provide flexibility when entering flight plan data. The Diagonal button is used in many types of User Waypoint entries. The Decimal button is used to provide more fidelity in numeric User Waypoint entries (bearings and distance specifically). The ***** Button is used to create route segments and the ability to enter them directly into the flight plan. The **°T** Button allows radial/distance user waypoints to be entered using true radial degrees instead of magnetic.

ROUTE ENTRY

The Flight Plan Keypad is utilized when editing the enroute portion of a flight plan which consists of waypoints and potentially airways. The **Route** Button is used to delimit a route entry by displaying a * symbol in the Route Entry Field. All airways must have an entry and exit waypoint derived from the database. Therefore, the * is required before and after airway entry as shown in the table below.

The following table shows acceptable forms of route segment entry:

Route Entry	Description
"<entry wpt>*<airway>*<exit wpt>" Or "*<airway>*<exit wpt>"	Basic Airway Segment with a specified exit waypoint.
"<entry wpt>*<airway1>*<airway2>*" Or "*<airway1>*<airway2>*"	Airway-to-airway transition. Airways must meet at a transition waypoint recognized by the system.
"<wpt1>*<wpt2>"	Direct routing (back-to-back waypoint entry)

Table 5-8 Acceptable Route Entry Patterns

Patterns for entering routes and waypoints are context sensitive. For example, in the sequence "ABC*V15", "V15" looks like it might be an airway, but it could easily be a waypoint. The system uses context to interpret the string. If "ABC" is a waypoint on airway V15, then the system will interpret "V15" as an airway. If "ABC" waypoint does not occur on airway V15, then the system will interpret "V15" as a waypoint.

Basic Airway Segment Entry

There are two forms of Basic Airway Segment entry, as shown in the following table:

Airway to Airway Route Entry	Description
"<entry wpt>*<airway>*<exit wpt>"	The entry waypoint is specified.
"*<airway>*<exit wpt>"	The entry waypoint already exists in the flight plan and is selected as the insertion point for the route entry.

Table 5-9 Acceptable Airway to Airway Route Entry Patterns

Entry for airways is dependent upon the following general rules:

- If the Airway Segment entry starts with "*", the system will pull the entry waypoint from the flight plan at the insertion point. The insertion point is defined based on how the Flight Plan Keypad was launched ("Insert Before", "Insert After" or "Add Waypoint or Route").

- The entry and exit waypoints must both exist on the specified airway segment.

- As entry progresses, auto-fill for waypoint identifiers are shown with subdued characters in the route entry field and waypoint name to the right of the route entry field.

- The 'Airway Selection' Screen will be used to confirm the selected waypoint sequence.

- Incomplete Airway Segments will be resolved on the 'Airway Selection' Screen (entry will be completed by selecting from lists).

- In the database, it is not uncommon to have multiple airway segments with the same airway identifier. However, specification of the entry waypoint (which must happen first) always identifies a unique segment. In similar fashion, duplicates will not exist for exit waypoint identifiers since the specification of the entry waypoint, airway, and exit waypoint identifier will always select a unique exit waypoint even if the exit waypoint identifier would otherwise be a duplicate.

- Duplicates can exist for the entry waypoint identifier (if not loaded from the flight plan insertion point). Resolution of duplicates must be provided upon the first touch of the **Route** Button.

The scenario provided below illustrates the entry of airway segment "TOP*V4*SLN". Entering "TOP" into the Route Entry Field, followed by touching the **Route** Button finishes the selection of the entry waypoint and starts the entry of the airway identifier "V4". A second touch of the **Route** Button ends the selection of the airway identifier. Then, an exit waypoint is determined.

Figure 5-62 Route Entry Process – Route Entry Field and Airway Entry Waypoint
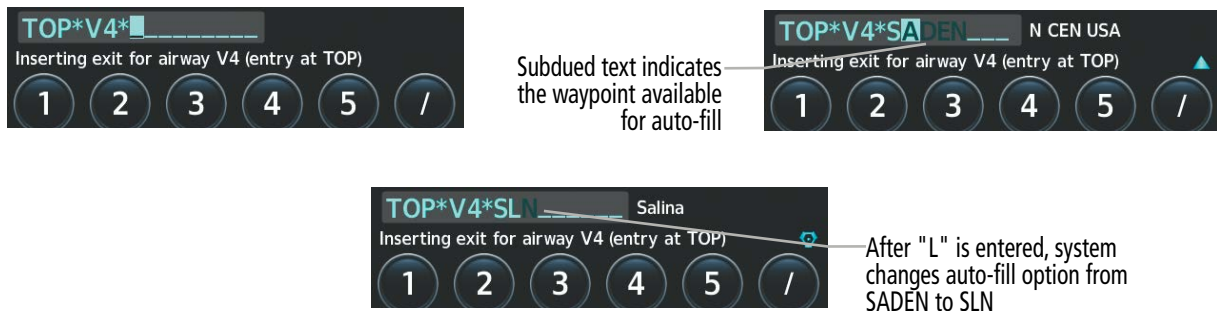
Figure 5-63 Route Entry Process – Airway and Exit Waypoint with Auto-Fill

Alternatively, if the airway entry point already exists in the flight plan and is selected as an insertion point for the route entry, the airway segment entry can be started by touching the **Route** Button. Doing that, automatically pulls the entry waypoint from the flight plan ("TOP" in this case). The system will detect and avoid duplication of waypoint identifiers once the route entry is entered into the flight plan.

As the entry of the exit waypoint identifier starts, auto-fill is supported based on the list of waypoints that pass through the selected airway. The system will seek and auto-fill an exit waypoint based on this list in alphabetic order.

In the previous example, the first result of entering an "S" for the exit waypoint is "SADEN" (with the "ADEN" portion shown in subdued text). After an "SL" is entered, the auto-fill option changes to "SLN" (the "N" is subdued). Touching the **Enter** Button confirms the auto-fill entry.
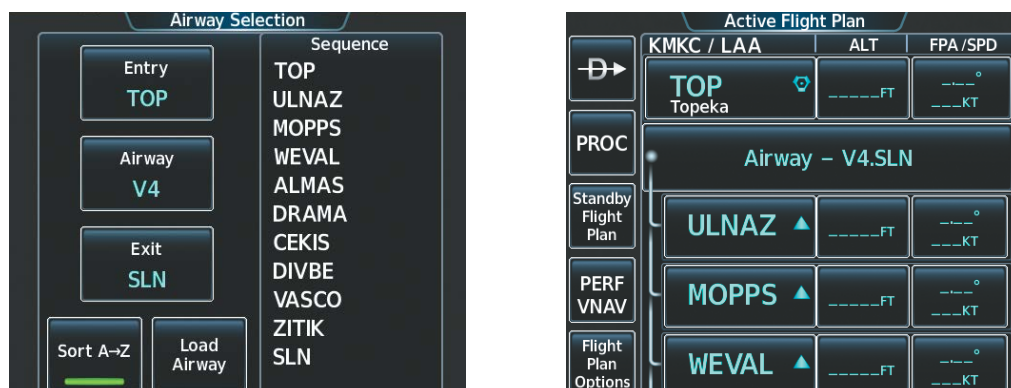
Figure 5-64 Route Entry Process – Confirmation and Loading of Selected Airway Segment

After the airway segment entry is complete ("TOP*V4*SLN") touching the **Enter** Button opens the 'Airway Selection' Screen which allows the pilot to review and confirm the selected waypoint sequence. Touching the **Load Airway** Button completes the action with the system returning to the flight plan screen (now showing the loaded airway segment).

The system will recognize incomplete or incorrect entries and will provide either a popup prompt or the 'Airway Selection' Screen to resolve the issue. For the two issues explained below, a 'Waypoint <waypoint> not found on airway <airway>. Open airway selection page?' Window will appear, prompting the pilot to either touch the **OK** or **Cancel** Button.

▪ The selected airway identifier does not include the selected entry waypoint.

▪ The selected exit waypoint is not found on the selected airway segment (identified by the entry waypoint and the airway identifier).
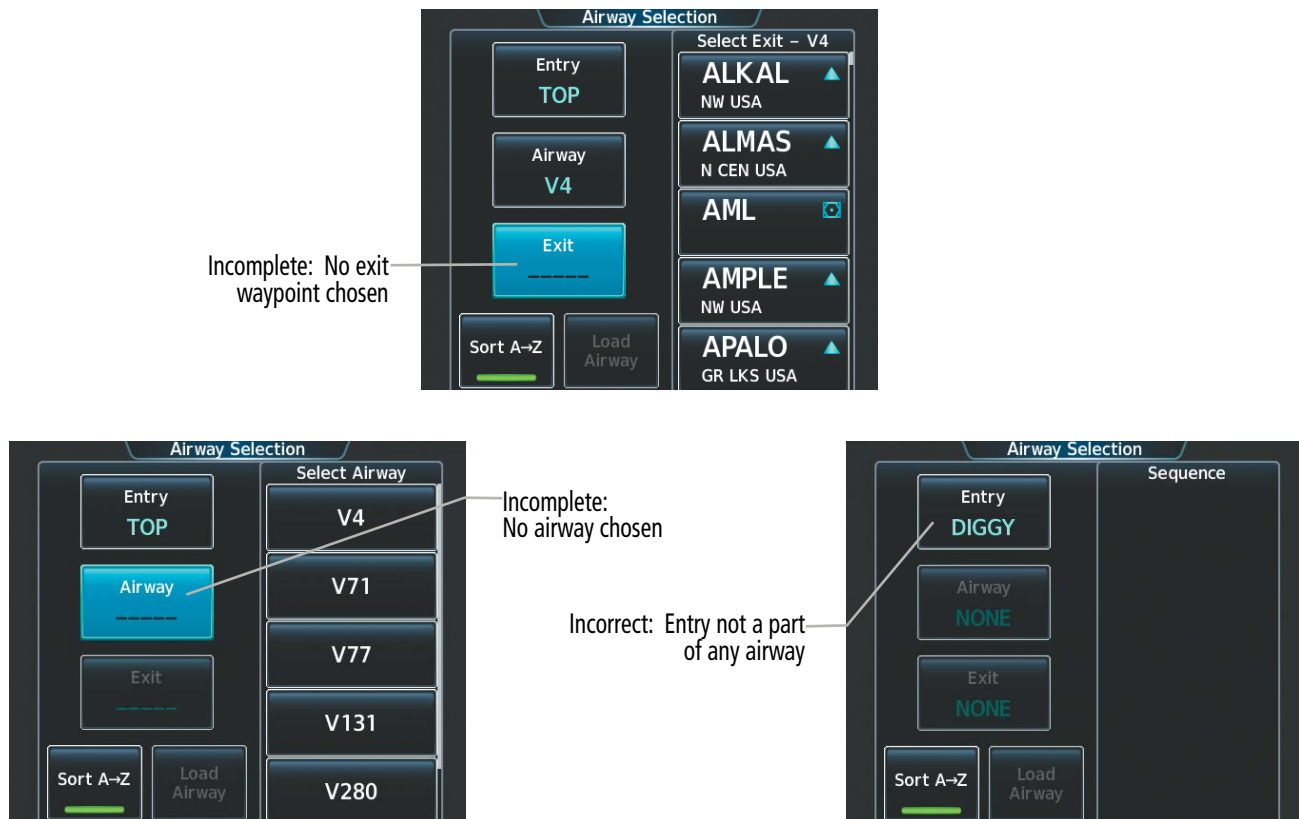
Figure 5-65 Route Entry Process – Incomplete or Incorrect Airway Segment Resolution

The 'Airway Selection' Screen can be used to resolve incomplete airway segment entries or highlight or incorrect entries as shown in the three examples above. In either an incomplete or incorrect case, the 'Airway Selection' Screen will be launched, showing the list of waypoints or airways to select (no options are provided for incorrect entries). For the three cases above:

▪ The first is incomplete since the **Enter** Button was touched after the airway identifier was entered, but the exit waypoint was not specified or does not match any connecting airway name or any waypoint on the selected airway.

▪ The next is incomplete since the **Enter** Button was touched after the **Route** Button was touched but no airway identifier was entered.

▪ The last example is incorrect since the route identifier does not uniquely match any airway passing through the entry waypoint.

Airway-To-Airway Entry with Implied Transition Waypoint

Route entry can be done with Airway-to-Airway route segments where a published transition waypoint is implied by the specification of two intersecting airways. This can be done two ways as shown in the following table:

Airway to Airway Route Entry	Description
"<entry wpt>*<airway1>*<airway2>*"	The entry waypoint is specified.
"*<airway1>*<airway2>*"	The entry waypoint is implied (already in the flight plan) by the insertion point.

Table 5-10 Airway to Airway Route Entry Descriptions

Entry for an airway-to-airway route is dependent upon the following general rules:

- The two airways must have at least one published waypoint in common.
- It is not uncommon that two airways will have more than one waypoint in common. In that case, the system will use the transition waypoint closest to the entry waypoint in the sequence for the first airway.
- If the entry waypoint is on both airways, only the second airway will be loaded (airway segments must use at least two waypoints).
- The 'Airway Selection' Screen will be used to confirm each airway segment that will be loaded. When the first airway segment is reviewed, the connection to the second airway will be identified in the waypoint sequence list.

The scenario provided below illustrates the entry of two airway segments "ORF*J121*J4*FLO". The implied transition waypoint (not entered) is BARTL. The selection of the entry waypoint and the first airway follows the same scheme as described in Basic Airway Segment Entry previously described. Instead of entering an exit waypoint for the first airway, a second connecting airway is entered.

After the second airway is entered the system will determine the common waypoint for transition.

Figure 5-66 Airway to Airway Entry – Initial Entry

Another touch of the **Route** Button (*****) ends the selection of the second airway identifier, and the 'Airway Selection' Screen is displayed to review and confirm the waypoint sequence for the first airway segment.
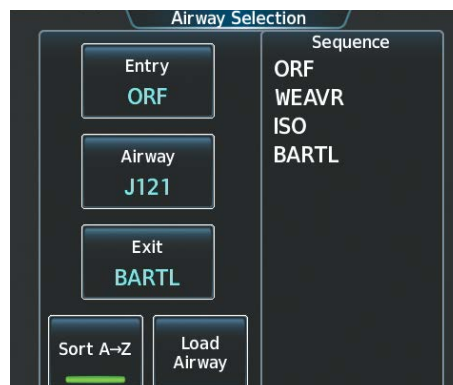
Figure 5-67 Airway to Airway Entry – Confirmation/Loading of First Airway Segment

Touching the **Load Airway** Button loads the first airway segment into the flight plan. Then, the system returns to the keypad in order to complete entry of the second airway segment ("J4").   Since the system has already loaded the first airway segment ("ORF*J121*BARTL") into the flight plan, the Route Entry Field will be populated with the second airway identifier. Then, the exit waypoint of the second airway can be entered ("FLO"). Touching the **Enter** Button brings up the 'Airway Selection' Screen for the second airway segment. Touching the **Load Airway** Button completes the action with the system returning to the flight plan screen (now showing the loaded airway segment).
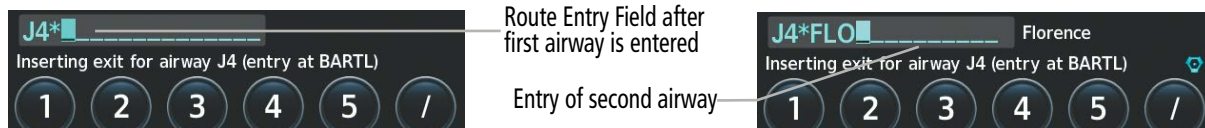
Figure 5-68 Airway to Airway Entry – After the First Airway Segment in the Flight Plan; Completing the Second Segment
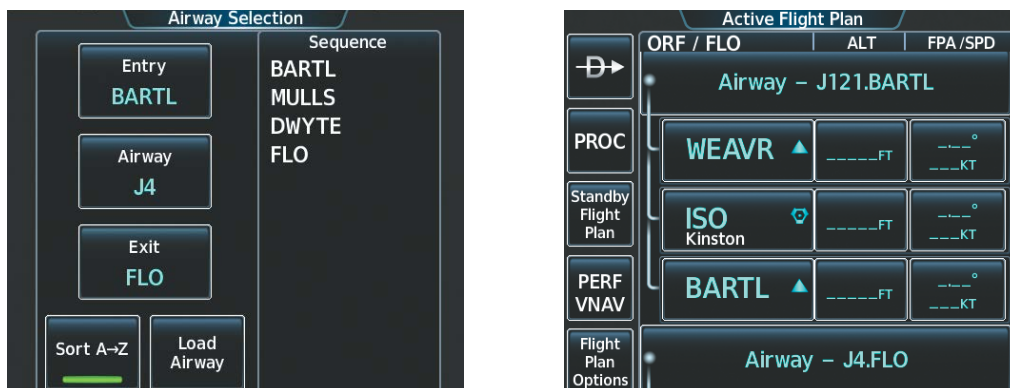
Figure 5-69 Airway to Airway Entry – Confirmation/Loading of Second Airway Segment and Resulting Flight Plan

If there is no common waypoint between the two selected airways, a popup window will appear that states, "Unable to find common waypoint between airways <airway1> and <airway2>. Open airway selection page?" Touch the **OK** or **Cancel** Button.

BACK-TO-BACK ROUTE ENTRIES AND DIRECT ROUTES

If a whole clearance is being entered into the flight plan, it is not desirable to keep returning to the flight plan screen after each route segment is confirmed. Therefore, the **Route** Button may be utilized for entering the clearance in Route Entry Field.

Direct routing is assumed whenever a waypoint is followed by another waypoint (separated by the Route(*****) character).

Back-to-back route entries may also be sequentially entered using the **Route** Button. Entering a route segment and then touching the **Route** Button prompts the system to move the data into the flight plan, leaving the entry waypoint for the next route segment pre-filled in the Route Entry Field. For example, an entire route clearance may consist of an airway route segment with entry and exit waypoints, followed by a direct route segment from waypoint to waypoint.

The following table shows how each how each route segment is to be entered into the Route Entry Field and the expected outcome from the system.

Keypad Entry of Route Segment (In Sequential Order)	Flight Plan Action	Characters Displayed in the Route Entry Field After the Flight Plan Action
"MCI*J24*WELTS*"	Review and load J24 airway with entry point "MCI" and exit point "WELTS" into flight plan.	WELTS*
WELTS* "JIGSY*"	WELTS to JIGSY leg added into flight plan.	JIGSY*
JIGSY* "J134*FLM*"	Review and load J134 airway with entry point "JIGSY" and exit point "FLM" into flight plan.	FLM*
FLM* "J24*BIGAL*	Review and load J24 airway with entry point "FLM" and exit point "BIGAL" into flight plan.	BIGAL*
BIGAL* "AML" Enter Key	BIGAL to AML leg added into flight plan. The flight plan is displayed showing all route segments that were added.	

Table 5-11   Example Sequence of Entries for Flight Plan

ADDING USER WAYPOINTS USING ROUTE ENTRY

By entering Lat/Lon, Radial/Distance, or Radial/Radial characters into the Route Entry Field, the system recognizes this data as a user defined waypoint and will display the 'Create User Waypoint' Screen for editing and reviewing purposes. Touching the **Create** Button will save the User Waypoint and simultaneously add it to the flight plan.

For more information on creating and storing user waypoints, refer the Creating User Waypoints discussion previously in this Flight Management Section.

LAT/LON WAYPOINT ENTRY:

Entry for latitude/longitude waypoint information is dependent upon the following general rules:

▪ The **/** Button can be used to separate the latitude and longitude but is not required.

▪ "N" or "S" designates the latitude. "E" or "W" designates the longitude.

▪ A decimal point and up to two digits to the right can be used to enter latitude or longitude to the nearest 0.01 minute. Example: N3945.06W11215.93

▪ If a decimal point is not used, the first two digits of the latitude is degrees and additional digits (1 or 2) are interpreted as minutes. In similar fashion the first 3 digits of longitude are degrees and additional digits (1 or 2) are interpreted as minutes. If only one minute digit is entered, a trailing zero is implied. Example N203 is the same as N2030.00.

▪ If a decimal point is used, the first two digits left of the decimal point will be interpreted as arc minutes. Example: N4.4 is the same as N0004.40 while N4 is the same as N0400.00.

▪ Lat/Lon designators can be prefixes or suffixes. However, if the latitude designator is a prefix, the longitude designator must also be a prefix unless the **/** Button is used. Examples of allowed prefix/suffix combinations include: N38W094, 38N094W, N38/094W.

▪ A full lat/lon entry could use as many as 18 characters.

Lat/Lon with decimal usage. Characters shift left as the field fills

Figure 5-70 Latitude/Longitude Entry Example

After entering the Lat/Lon data into the Route Entry Field, touching the **Enter** Button opens the 'Create User Waypoint' Screen (LAT/LON Mode) with the LAT/LON and Comment portion pre-filled. Also by default, the 'Route' Type is selected for the waypoint, and the storage method will be selected as temporary. The pilot can make any needed corrections/additions (perhaps changing the user waypoint name, or storage method) before touching the **Create** Button.

User waypoint name

LAT/LON and Comments auto-filled

Create Button
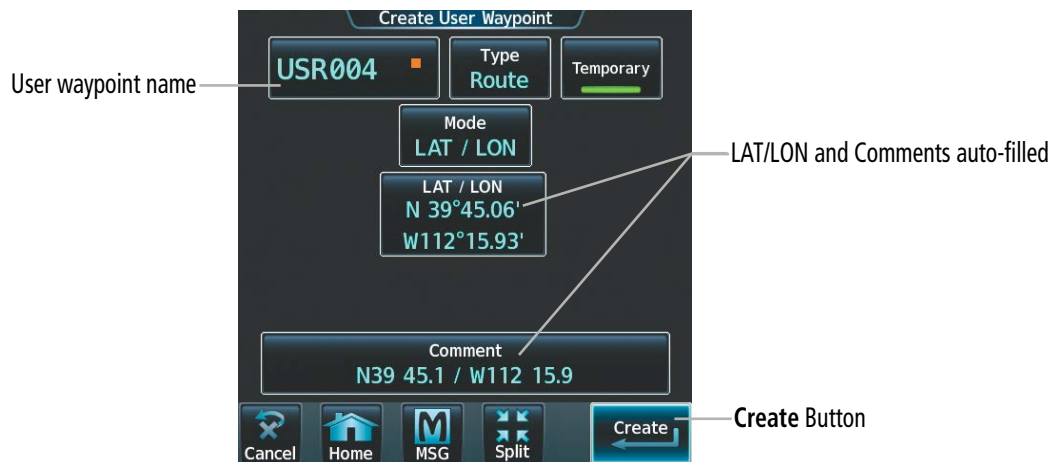
Figure 5-71 Latitude/Longitude Confirmation – Create User Lat/Lon Waypoint

Oceanic Lat/Lon waypoints can be added to a flight plan as geographical coordinates, using a five character identifier. Any latitude and longitude can be entered by typing the identifier in the Route Entry Field. Touching the **Enter** Key adds the oceanic lat/lon waypoint to the flight plan without the intermediate step of creating a user waypoint.

The table below provides shortcuts for Oceanic Lat/Lon Waypoints. The system recognizes when a whole degree lat/lon has been entered:

Latitude	Longitude	Identifier
N 38º 00'	W 94º 00'	3894N
N 38º 00'	E 94º 00'	3894E
S 38º 00'	E 94º 00'	3894S
S 38º 00'	W 94º 00'	3894W
N 38º 00'	W 104º 00'	38N04
N 38º 00'	E 104º 00'	38E04
S 38º 00'	E 104º 00'	38S04
S 38º 00'	W 104º 00'	38W04

Table 5-12 Latitude/Longitude – Oceanic Shortcuts

Lat/Lon shortcut entry —— 3894S▮_____ S38 00 E094 00 —— System recognizes/displays Lat/Lon
Inserting after USR004
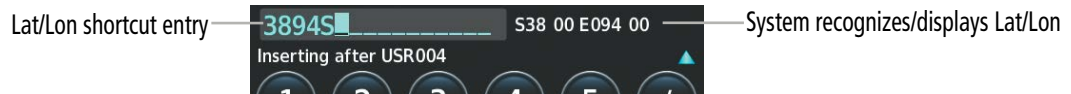
Figure 5-72 Latitude/Longitude Shortcut Entered and Recognized

When a Lat/Lon entry is not recognized as a pattern that can be accepted, the following pop-up boxes will be shown which explain the error.

▪ When minutes are entered with a value greater than 59.9: "Invalid User Waypoint Latitude Minutes Must Be Between 0 and 59. Open User Waypoint Page?"

▪ When an entered latitude value (including minutes) is greater than 90: "Invalid User Waypoint: Latitude Degrees Must Be Between 00 and 89. Open User Waypoint Page?"

▪ When an entered longitude value (including minutes) is greater than 180: "Invalid User Waypoint: Longitude Degrees Must Be Between 000 and 180. Open User Waypoint Page?

▪ When an entered Lat/Lon has a missing or misplaced N/S or E/W designator, or misplaced use of the decimal point: "Waypoint or airway not found: <waypoint>. Open create user waypoint page?"

RADIAL/DISTANCE WAYPOINT ENTRY

Entry for Radial/DIS (place/bearing/distance) is dependent upon the following general rules:

▪ Place, bearing and distance must be entered in that order.

▪ The **/** Button can be used to delimit the entry elements. A "/" may be used to denote the bearing and distance. In the example, MZZ344/033, MZZ is place, 344 is bearing and 033 is distance. MZZ/344/033 is another acceptable form of entry. Since waypoints can also have numbers, use of the "/" between the waypoint name and bearing can prevent ambiguity.

▪ Place is 1 to 6 characters which will be recognized as a waypoint identifier.

▪ Bearing is a numeric value between 000 and 360 degrees. The decimal point can be used to specify tenths of degrees.

▪ The **°T** Button can be used as a suffix to the bearing numeric value to force it to be considered as a true bearing. If the **°T** Button is not used, the bearing is interpreted as a radial when "place" is a VOR (or TACAN) and as magnetic bearing otherwise.

NOTE: *The °T Button represents a departure from previous Garmin convention where bearing entries follow the "Nav Angle" setting made on the **Units** Tab of the 'Avionics Settings' Screen. Magnetic (or radial) is always assumed unless the pilot specifically selects true (regardless of the current setting for "Nav Angle").*

▪ Distance is a numeric value between 0 and 9999.9 nautical miles. Use of the decimal point is optional.

▪ Beginning the entry with "/" will cause the system to use a flight plan waypoint as the place.
  ✈ If "Insert After" or "Insert Before" is selected, the highlighted flight plan waypoint will be used as the place.
  ✈ If "Add Waypoint or Route" is selected, the last enroute waypoint will be used as the place.

▪ A place/bearing/distance entry could use as many as 20 characters.

Entry begins like the entry of an individual waypoint. When sufficient characters have been entered to uniquely identify a waypoint, touching the "/" ends the entry of "place" and starts the entry of "bearing" which is followed by "distance".

Figure 5-73 Radial/Distance – Initial Waypoint Name
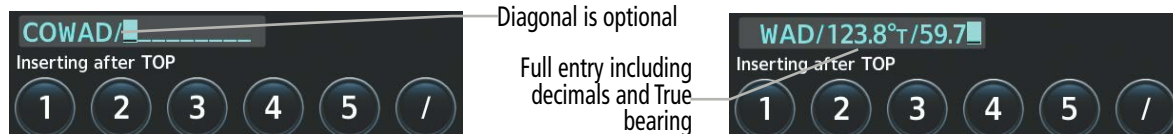
Figure 5-74 RAD/DIS – Full Entry with True Bearing Example

Touching the **Enter** Button opens the 'Create User Waypoint' Screen (RAD/DIS Mode) with the REF, RAD and DIS, plus the Comment portion pre-filled. The pilot can make any needed corrections/additions (perhaps changing the identifier). By default, a temporary, Route-Type waypoint will be created.
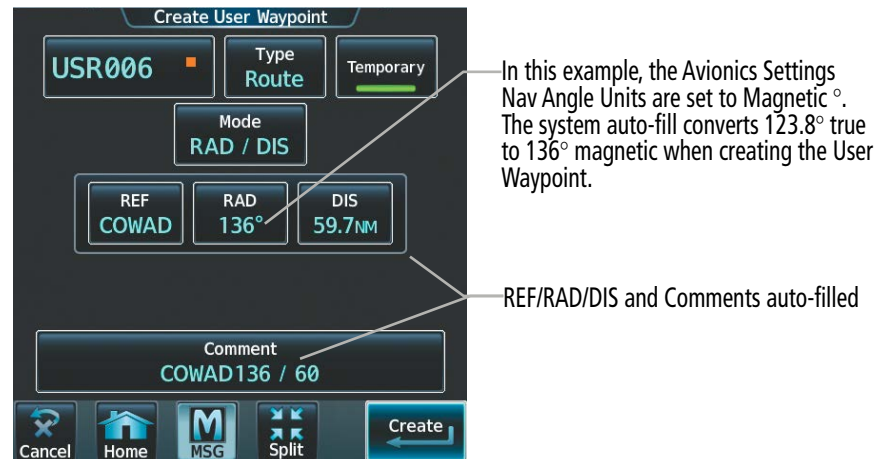
Figure 5-75 RAD/DIS – Confirmation and Creating User RAD/DIS Waypoint

When the Radial/Distance entry is not recognized as a pattern that can be accepted, the following pop-up boxes will be shown which explain the error.

- A bearing that is not in the range 0-360: "Invalid User Waypoint: Degrees Must Be Between 0 and 360. Open User Waypoint Page?"

- Distance that is not in the range 0-9999.9: "Invalid User Waypoint: Distance Must Be Between 0 and 9999.9. Open User Waypoint Page?"

- The system will attempt to interpret the intended waypoint entry when misplacing the entry of the decimal point or "°T". However, in some cases, an error message will appear: "Invalid user waypoint entered: <waypoint> Please use format: WPT/BRG/DIS Open create user waypoint page?"

RADIAL/RADIAL WAYPOINT ENTRY

A place/bearing/place/bearing entry is similar to the Radial/Distance place/bearing/distance entry (as discussed previously. Entry for Radial/Radial (place/bearing/place/bearing) is dependent upon the following general rules:

- Place1, bearing1, place2 and bearing2 must be entered in that order.

- The **/** Button is optional between a place and a bearing, but must be used consistently for both radials. The **/** Button is required before starting the entry of place2. There are two general formats for valid entries: DDC/200/HUT/240 and DDC200/HUT240. Since waypoints can also have numbers, use of the "/" between the waypoint name and bearing can prevent ambiguity.

- A place/bearing/place/bearing entry could use as many as 27 characters.
- Bearing1 and Bearing2 are numeric values between 000 and 360 degrees. The decimal point can be used to specify tenths of degrees.
- The °**T** Button can be used as a suffix to either or both bearing numeric values to force it to be considered as a true bearing. If the °**T** Button is not used, the bearing is interpreted as a radial when the associated "place" is a VOR (or TACAN) and as magnetic bearing otherwise.
- Beginning the entry with "/" will cause the system to use a flight plan waypoint as place1.
  - ✈ If "Insert After" or "Insert Before" was selected, the highlighted flight plan waypoint will be used as the place1.
  - ✈ If "Add Waypoint or Route" was selected, the last enroute waypoint will be used as the place1.

Radial/Radial Entry
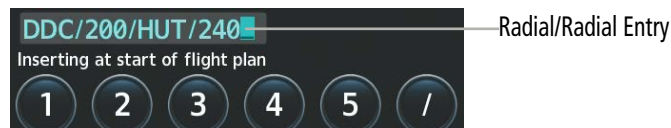
Figure 5-76 RAD/RAD – Full Entry

After inputting the information, touching the **Enter** Button opens the 'Create User Waypoint' Screen (RAD/RAD Mode) with the REF1, RAD1, REF2, RAD2 and Comment portion pre-filled. The place1 and bearing1 data will fill the REF1 and RAD1 Fields respectively, and likewise for place2/bearing2. Also by default, the 'Route' Type is selected for the waypoint, and the storage method will be selected as temporary. The pilot can make any needed corrections/additions (perhaps changing the user waypoint name, or storage method).

REF/RAD Fields and Comments auto-filled

User Waypoint added to Flight Plan.
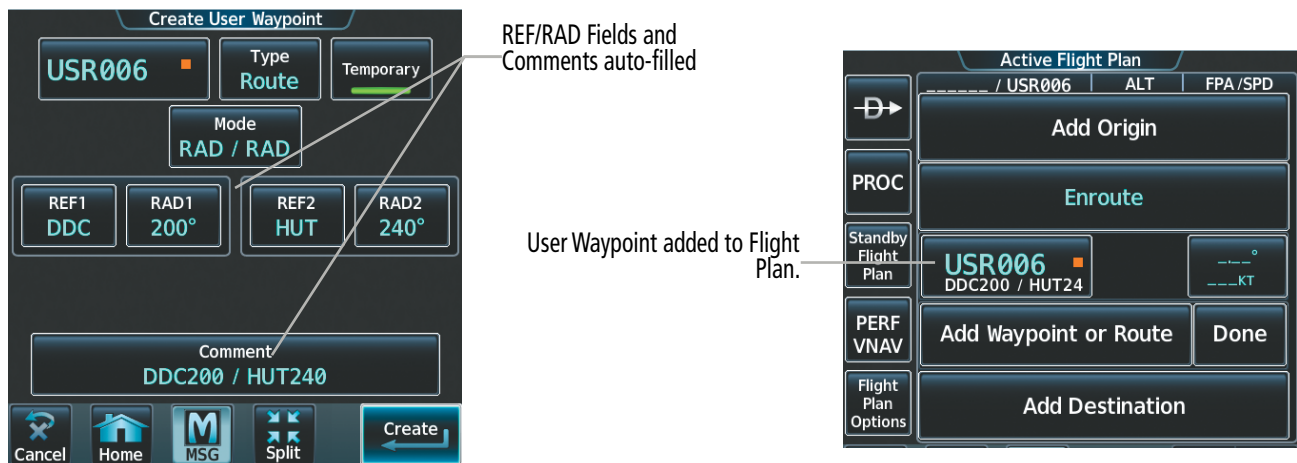
Figure 5-77 RAD/RAD – Confirmation and Creation of User RAD/RAD Waypoint

When the Radial/Radial entry is not recognized as a pattern that can be accepted, the following pop-up boxes will be shown which explain the error.

- A bearing that is not in the range 0-360: "Invalid User Waypoint: Degrees Must Be Between 0 and 360. Open User Waypoint Page?"
- The system will attempt to interpret the intended waypoint entry when misplacing the entry of the decimal point or "°T". However, in some cases, an error message will appear: "Invalid user waypoint entered: <waypoint> Please use format: WPT/BRG/DIS Open create user waypoint page?"
- When defining a place/bearing/place/bearing waypoint, it is possible the given bearings (radials) do not intersect. That condition is detected on the 'Create User Waypoint' Screen when the **Create** Button is touched. "The radials entered do not intersect"

USER WAYPOINTS WITHIN A ROUTE ENTRY

Direct routing and back-to-back route segment entries containing a user defined waypoint may be sequentially entered using the **Route** Button. For example, an entire route clearance may consist of an airway route segment with entry and exit waypoints, followed by a direct route from the exit waypoint to a user defined waypoint, and then a direct route from the user defined waypoint to another waypoint.

The following table shows how each how each route segment is to be entered into the Route Entry Field and the expected outcome from the system. In this example, a Radial/Distance entry, "MZZ344/033", is used create a user waypoint within the route. "MZZ" is a place, "344" is the bearing, and "033" is the distance. ("MZZ/344/033" is another acceptable form of entry.)

Keypad Entry of Route Segment (In Sequential Order)	Flight Plan Action	Characters Displayed in the Route Entry Field After the Flight Plan Action
"**GLAZR*Q118*MZZ***"	Review and load Q118 airway with entry point "GLAZR" and exit point "MZZ" into flight plan.	MZZ*
MZZ* "**MZZ344/33***"	Edit and review the new user waypoint. "\<waypoint name\>" is created and placed into flight plan.	MZZ344/33*
MZZ344/33* "**OXI***" **Enter** Key	"\<waypoint name\>" to "OXI" leg is added into flight plan. The flight plan is displayed showing all route segments that were added.	

Table 5-13 Example Sequence of Entries, Creating and Adding a User Waypoint into Route Segment

CREATING A BASIC FLIGHT PLAN

The active flight plan is the flight plan to which the system is currently providing guidance, and is shown on the map displays. One flight plan can be activated at a time and becomes the active flight plan. The active flight plan is overwritten when another flight plan is activated.

The standby flight plan is available for activation (becomes the active flight plan). The standby flight plan may be used as a means to create a flight plan for future use. Once an active or standby flight plan is created, it can be stored to the Flight Plan Catalog.

Auto-designation will determine the most likely airport of origin and auto-populate the Active Flight Plan. Once determined, the airfield identifier automatically appears in the 'Origin' Field and the line immediately below Origin while keeping the runway ('RW') field empty. The line below the origin line serves as the first point in the flight plan.

Auto-designation occurs between 15 and 60 seconds after applying power to the system under the following conditions:

- Aircraft position is known
- Aircraft is on the ground
- Nearest airport is within 200NM
- Flight plan is empty

If the pilot manually enters the origin, or any other leg of the flight plan before auto-nomination occurs, nothing gets inserted automatically. The automatic insertion logic only runs once, so the pilot can edit the origin if the nearest airport is not the desired origin.

If the pilot enters a different airport into the first point of the flight plan, the origin will change to this entry, and the pilot will be prompted to enter the departure runway.

Both the origin airport/runway and the first point of the flight plan will be the same unless a departure is entered and a manual leg is inserted at the beginning of the loaded departure. Loading a departure locks in the origin information.

Flight plans are limited to 100 waypoints (including waypoints within airways and procedures). If the number of waypoints in the flight plan exceeds 100, the message "Flight plan is full. Remove unnecessary waypoints." will appear and the new waypoint(s) will not be added to the flight plan.

The following procedure is intended to provide an example that best captures a basic flight plan. It will create a flight plan from the origin runway to the destination runway, to include enroute waypoints for which lateral navigation will be provided. Information on airways, waypoint constraints, and vertical navigation is discussed later in this section. Departures, arrivals, approaches, and missed approaches are discussed later in the Procedures portion of this section.
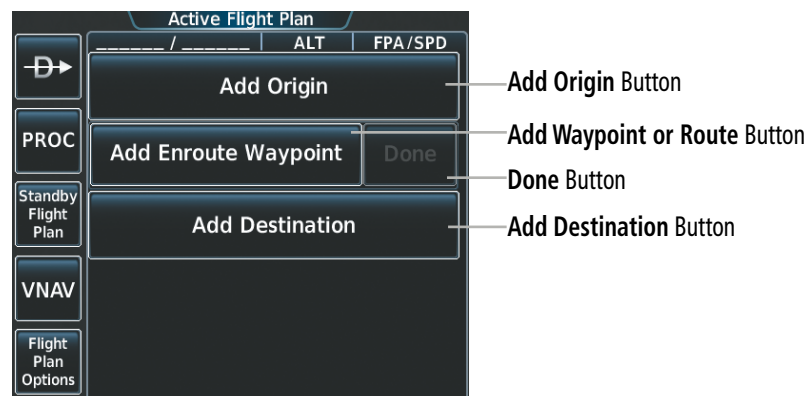
Figure 5-78 Active Flight Plan – Empty

Origin and Destination Loaded   Origin Runway Selection

Figure 5-79 Active Flight Plan – Origin and Destination Loaded

Enroute Button

Figure 5-80 Active Flight Plan – Adding a Waypoint to the beginning of the Enroute Segment of the Flight Plan

Insert Before Button

Insert After Button

Selected Waypoint Button

Activate Leg to Waypoint

Waypoint Info Button

Remove WPT(s) Button

Prev Button

Next Button

Figure 5-81 Active Flight Plan – 'Waypoint Options' Window

Add Enroute Waypoint Button

Done Button
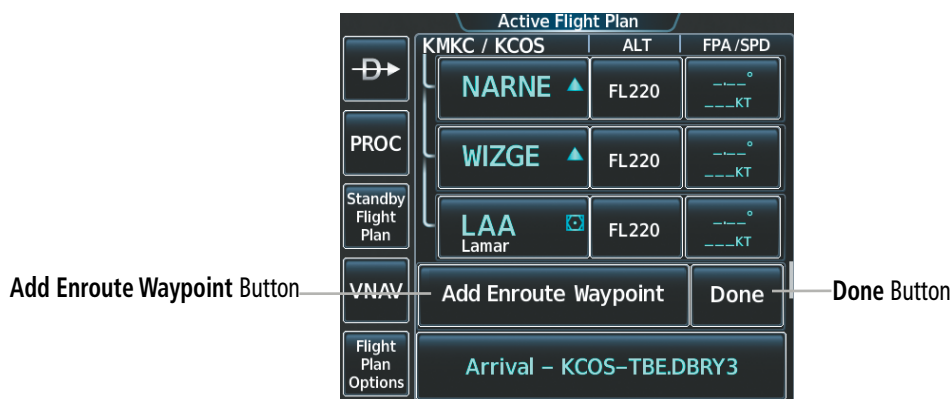
Figure 5-82 Active Flight Plan – Adding a Waypoint to the end of the Enroute Segment of the Flight Plan

Creating an active, standby or stored flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan.**

Or:

For a stored flight plan:

a) From Home, touch **Flight Plan > Flight Plan Options**.

b) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

c) Touch the **Create New Catalog Flight Plan** Button to display the 'Edit Stored Flight Plan' Screen.

2) If no change is necessary to the Origin auto-designated by the system, proceed to Step 4.

Or:

To input or change the departure runway, proceed to Step 4.

Or:

To change the Origin, touch the **Origin** Button. Then, touch the **Select Origin Airport** Button.

Or:

When there is no Origin in the flight plan, touch the **Add Origin** Button.

3) Enter the origin waypoint:

Use the right knobs, or the keypad to enter the origin waypoint.

Or:

Touch the **Find** Button to display the 'Find Waypoint' Screen. Then, touch the **Nearest**, **Recent**, **Flight Plan**, or **Favorites** Tab and select the waypoint from the list of waypoints.

Or:

a) Touch the **Find** Button to display the 'Find Waypoint' Screen. Then, touch the **Search** Tab to display the **Search By** Button.

b) If necessary, touch the **Search By** Button to choose Search by City or Search by Facility.

c) Touch the **Facility Name** Button or the **City Name** Button to display the keypad.

d) Use the keypad to select the name, and the **Enter** Button to accept the entry and display the search results.

e) Touch a Waypoint Selection Button to choose the waypoint.

4) To input the departure runway, touch the **Origin** Button to display the 'Select Runway' Screen. Touch a Runway Selection Button to select the departure runway and return to the flight plan.

Or:

To change the departure runway, touch the **Origin** Button to display the 'Origin Options' Window. Then, touch the **Select Departure Runway** Button. Touch a Runway Selection Button to select the runway and return to the flight plan.

5) Touch the **Add Destination** Button to display the keypad.

6) Select the identifier of the destination waypoint using one of the Step 3 procedures.

7) If needed, touch the **Destination** Button to display the 'Destination Options' Window. Touch the **Select Arrival Runway** Button to display the 'Select Runway' Screen. Touch a runway selection button to select the destination runway and return to the flight plan.

8) Enter the enroute waypoints:

> If adding a waypoint to the end of the enroute segment of te flight plan, touch the **Add Waypoint or Route** Button to display the keypad

> **Or:**

a) Touch a Waypoint Selection Button to display the 'Waypoint Options' Window.

b) Touch the **Insert Before** Button or the **Insert After** Button to select where the new waypoint or route will be placed in relation to the selected waypoint. The keypad is displayed.

> **Or:**

a) If adding a waypoint or route to the beginning of the enroute segment of the flight plan, touch the **Enroute** Button to display the 'Enroute Options' Window.

b) Touch the **Insert Waypoint** Button to display the keypad.

9) Use the keypad and the Enter Button to enter the waypoint or route into the flight plan.

10) Repeat Steps 8 and 9 until finished adding enroute waypoints.

11) If you are finished adding enroute waypoints, touch the **Done** Button to remove the **Add Waypoint or Route** Button and the **Done** Button (This step is only necessary if creating a flight plan on the 'Active Flight Plan' Screen).

12) If needed, touch the **Origin** Button to display the 'Origin Options' Window to select a new origin airport, departure runway, departure procedure or to remove the origin airport.

13) If needed, touch the **Destination** Button to display the 'Destination Options' Window to select a new destination airport, arrival runway, arrival procedure, approach procedure, or to remove the destination airport.

'Origin Options' Window   'Destination Options' Window
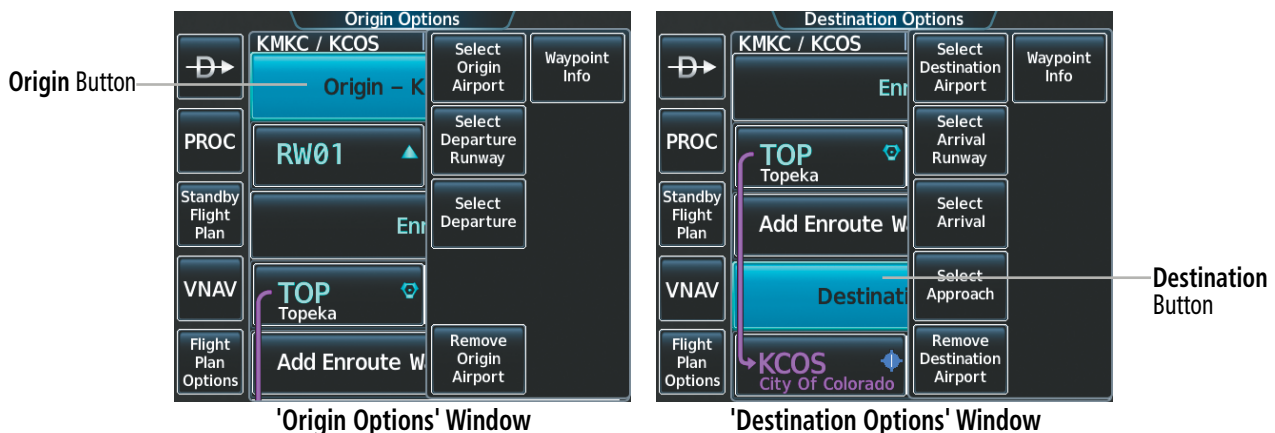
Figure 5-83 Active Flight Plan – Origin and Destination Options

> **NOTE:** *The origin and destination airports cannot be entered or modified using the PFD Controller. The following procedure can be used to enter the origin and destination airports as waypoints. If desired, loading a procedure at the origin or destination waypoint will place the correct airport in the Origin/Destination field in the active flight plan shown on the Touchscreen Controller.*

Creating an active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the small **PFD** Knob to display the 'Waypoint Information' Window. (Turning it clockwise displays a blank 'Waypoint Information' Window, turning it counter-clockwise displays the 'Waypoint Information' Window with a waypoint selection submenu allowing selection of active flight plan waypoints, recent waypoints, user waypoints, or nearest airports).

3) Enter the identifier, city name, or facility name of the departure waypoint (as the small PFD Knob is turned, the system displays a waypoint matching the characters entered), or select a waypoint from the submenu of waypoints and press the **ENT** Key or the small **PFD** Knob. The active flight plan is modified as each waypoint is entered.

4) Repeat step numbers 2 and 3 to enter the destination waypoint and each additional flight plan waypoint.

5) When all waypoints have been entered, press the **FPL** Key or hold down the **CLR** Key to remove the 'Waypoint Information' Window.

FLIGHT PLAN MODIFICATION AND NAVIGATION

Active, standby, and stored flight plans can be edited at any time. Waypoints and airways can be added, modified, or removed from any flight plan. Edits made to an active flight plan affect navigation as soon as they are entered. Modifications to flight planned departures, arrivals, approaches, and missed approaches are discussed later in the Procedures portion of Flight Management.

WAYPOINTS

ADDING AND REMOVING WAYPOINTS

Adding a waypoint to a flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan.**

   Or:

   For the stored flight plan:

   a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

   b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

   c) Touch the **Edit** Button.

2) Enter waypoints in the flight plan:

> Input a route entry using the Flight Plan Keypad (process previously discussed in this section).
>
> **Or:**
>
> If adding a waypoint to the end of the enroute segment of the flight plan, touch the **Add Waypoint or Route** Button to display the keypad.
>
> **Or:**

a) Touch a waypoint selection button to display the 'Waypoint Options' Window.

b) Touch the **Insert Before** Button or the **Insert After** Button to select where the new waypoint or route will be placed in relation to the selected waypoint. The keypad is displayed.

> **Or:**

a) If adding a waypoint or route to the beginning of the enroute segment of the flight plan, touch the **Enroute** Button to display the 'Enroute Options' Window.

b) Touch the **Insert Waypoint** Button to display the keypad.

3) Use the keypad, right knobs, or the Find function to select the new waypoint; or use the keypad to create a route entry.

4) Touch the **Enter** Button to accept the waypoint or route and place it in the flight plan.

5) If you are finished adding waypoints and routes, touch the **Back** Button to return to the previous screen.

Adding a waypoint to the active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large **PFD** Knob to highlight the waypoint.

3) Press the **CLR** Key. The 'Remove <waypoint name>' window is displayed.

4) With 'OK' highlighted, press the **ENT** Key or the small **PFD** Knob to remove the waypoint.

Adding waypoints to a flight plan using the Map Pointer:

1) For the active flight plan: Go to Step 2.

> **Or:**
>
> For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.
>
> **Or:**
>
> For the stored flight plan:

a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

c) Touch the **Edit** Button.

2) Push the **Joystick** to the display 'Map Pointer Control' Screen on the Touchscreen Controller, and to activate the Map Pointer. Use the **Joystick or the Touchpad** to move the pointer to the map location of the desired waypoint. When the pointer highlights a map location that can be added to the flight plan, the **Insert in FPL** Button is activated.

3) Touch the **Insert In FPL** Button. The 'Insert Before Waypoint' Screen is displayed.

4) Touch the Waypoint Selection Button to select where to insert the new waypoint. The waypoint is inserted into the flight plan before the selected waypoint, and the Touchscreen Controller returns to the 'Map Pointer Options' Screen. Push the **Joystick** to deactivate the map pointer and return to the previous screen.

Figure 5-84 Active Flight Plan - Map Pointer Active

Figure 5-85 Inserting Waypoint in Active Flight Plan

KTOP Inserted
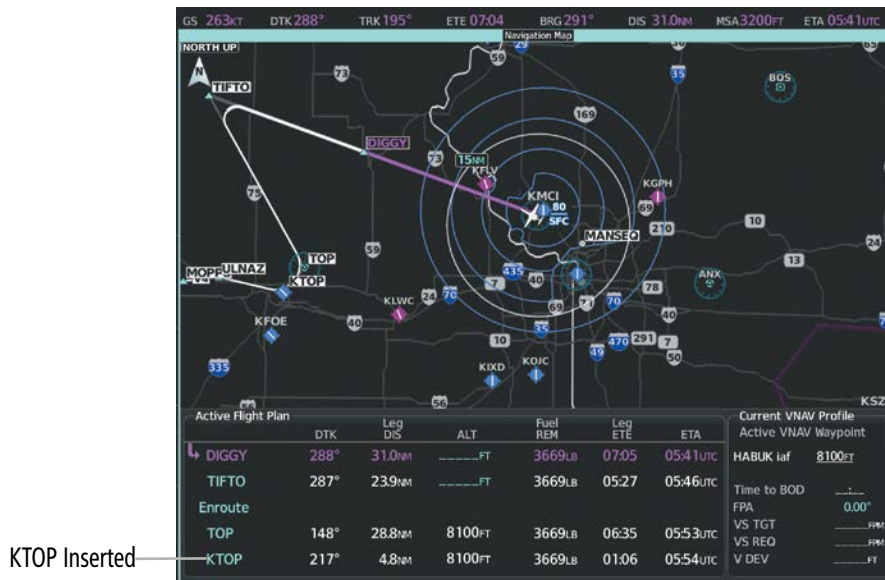
Figure 5-86 KTOP Added to the Active Flight Plan

Adding a waypoint to the active flight plan using the Waypoint Info Button:

1) From Home, touch **Waypoint Info.**

2) Touch the **Airport** Button, **INT** Button, **NDB** Button, **VRP** Button, or the **User Waypoints** Button.

3) Choose the desired waypoint:

   a) Touch the Selected Waypoint Button to display the keypad.

   b) Use the keypad to enter the identifier or name of the desired waypoint.

   c) Touch the **Enter** Button to accept the entry and display the waypoint's information on the Touchscreen Controller.

   Or:

   a) To display the list of user waypoints, touch the **WPT List** Tab.

   b) Scroll the list as necessary and touch the desired User Waypoint Button.

4) Touch the **Waypoint Options** Button.

5) Touch the **Insert in Flight Plan** Button. The 'Insert Before Waypoint' Window is displayed

6) Scroll the list as necessary, and touch the waypoint selection button to select where to insert the new waypoint. The waypoint is inserted into the active flight plan before the selected waypoint.

   Or:

   Touch the **Insert at End** Button. The waypoint is inserted as the last waypoint in the active flight plan.

Adding a waypoint into the active flight plan using the Nearest Button:

1) From Home, touch **Nearest**.

2) Touch the **Airport**, **INT**, **VOR**, **NDB**, **VRP**, or **User** Button.

3) Scroll as necessary and touch the desired waypoint button.

4) Touch the **Insert in Flight Plan** Button.

5) Scroll the list as necessary, and touch the Waypoint Selection Button to select where to insert the new waypoint. The waypoint will be inserted into the active flight plan before the selected waypoint.

Or:

Touch the **Insert at End** Button. The waypoint is inserted as the last waypoint in the active flight plan.

Individual waypoints, airways, and entire procedures can be deleted from a flight plan. Some waypoints in the final approach segment (such as the FAF or MAP) can not be deleted individually. Attempting to delete a waypoint that is not allowed results in a window displaying 'Invalid flight plan modification.'

> **NOTE:** When a flight plan contains multiple instances of the same waypoint, editing any occurrence may affect the active leg. Verify all flight plan edits result in the desired active waypoint.

> **NOTE:** If removal of a flight plan item (waypoint, procedure, etc.) results in deletion of the end waypoint of the active leg, an off-route direct-to to the deleted waypoint is created and activated.

Removing an individual waypoint or multiple waypoints from a flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

Or:

For the stored flight plan:

a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

c) Touch the **Edit** Button.

2) Scroll the list if necessary and touch a waypoint options button to display the 'Waypoint Options' Window. Then, touch the **Remove WPT(s)** Button.

3) To remove an individual waypoint, touch the **OK** Button in response to 'Remove <waypoint name>?'. The waypoint is removed. To cancel the request, touch the **Cancel** Button.

Or:

To remove a series of multiple waypoints:

a) Touch the **Remove Multiple** Button to display the 'Remove From <waypoint> Through' Window.

b) Touch a waypoint button that is sequenced before or after the previously selected waypoint. The confirmation window 'Remove <waypoint> Through <waypoint>?'.

c) Touch the **OK** Button to confirm the removal of the two selected waypoints and all waypoints sequenced between them, the **Edit** Button to return to the previous step, or the **Cancel** Button.

Removing a waypoint from the active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large **PFD** Knob to highlight the waypoint.

3) Press the **CLR** Key. The 'Remove <waypoint name>' window is displayed.

4) With 'OK' highlighted, press the **ENT** Key or the small **PFD** Knob to remove the waypoint.

FLY-OVER WAYPOINTS

Waypoints entered in the enroute segment may be treated as either fly-by waypoints or fly-over waypoints. For both types of waypoints, the system will transition using a precisely calculated turn on course to the next waypoint.

If the system determines the flight plan leg geometry cannot support fly-by navigation for a waypoint sequence in the current flight plan, it will change a fly-by waypoint to a fly-over waypoint automatically. A roll steering path or future roll steering path may be displayed after the fly-over waypoint until the roll steering path aligns with the course leg connecting the fly-over waypoint and the following waypoint in the flight plan. This system generated fly-over waypoint will not display the fly-over symbol.

Fly-over Waypoint
 No Fly-over symbol

Roll Steering to next leg
 Roll Steering until path aligns with
 course leg (PNH to ILOZA)

Active Leg to PNH
 Geometry cannot support fly-by to
 the following leg (PNH to ILOZA)
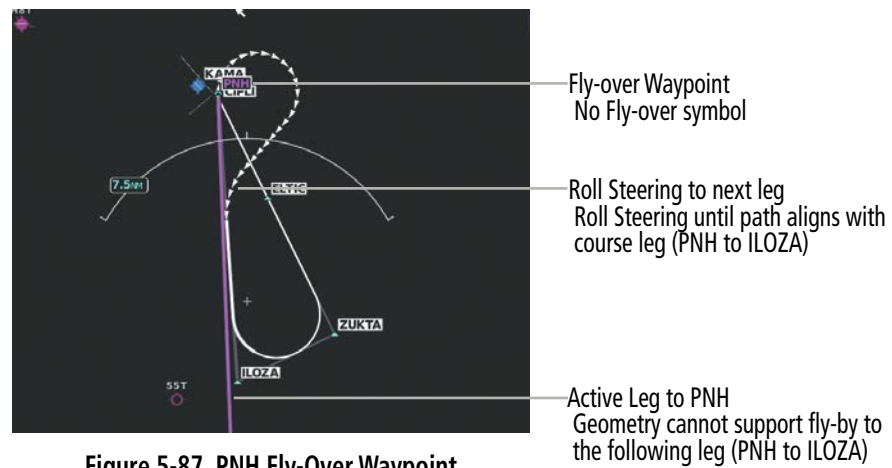
Figure 5-87 PNH Fly-Over Waypoint

A fly-over waypoint may also be manually designated by the pilot, in which case, the fly-over waypoint symbol is displayed.

Selected Waypoint

Fly Over Waypoint Button Disabled

Figure 5-88 Waypoint Options, Fly-Over Waypoint Disabled (Fly-By)

Active Leg to TOP
TOP as Fly-by Waypoint
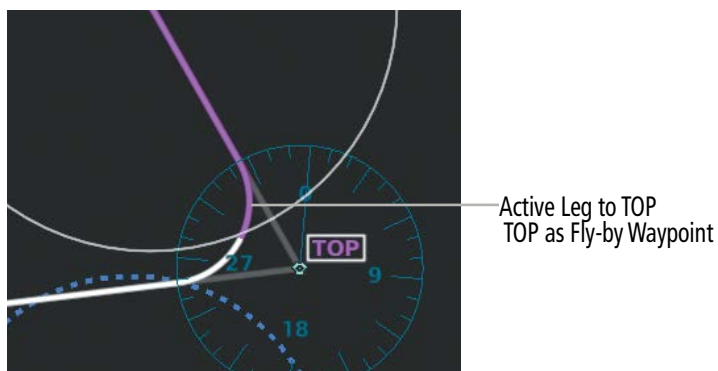
Figure 5-89 Active Flight Plan Display, Fly-By Waypoint

Fly-over Waypoint Symbol

Fly Over Waypoint Button Enabled

Figure 5-90 Waypoint Options, Fly-Over Waypoint Enabled

Active Leg to TOP
TOP as fly-over Waypoint
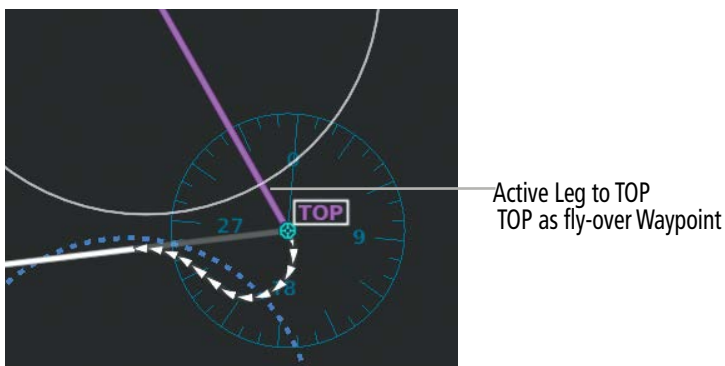
Figure 5-91 Active Flight Plan Display, Fly-Over Waypoint

Enabling/disabling a fly over waypoint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

   Or:

   For the stored flight plan:

   a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

   b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

   c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Touch a Waypoint Selection Button to display the 'Waypoint Options' Window.

3) Touch the **Fly Over Waypoint** Button to enable/disable the waypoint as a fly-over waypoint.

AIRWAYS

Airways can be added, removed, and collapsed/expanded from any flight plan. For information on how to add multiple airways using the route entry process, see the Route Entry discussion given previously in this section.

When the database is updated, stored flight plan airways may need to be reloaded also. Each airway segment is reloaded from the database given the entry waypoint, the airway identifier and the exit waypoint. This reloads the sequence of waypoints between the entry and exit waypoints (the sequence may change when the database is updated). The update of a flight plan airway can fail during this process. If that happens, the airway waypoints are changed to regular (non-airway) flight plan waypoints, and an alert is displayed (see the System Messages portion of the Appendices).

The following could cause the airway update to fail:

» Airway identifier, entry waypoint or exit waypoint not found in the new database.

» Airway entry/exit waypoint is not an acceptable waypoint for the airway – either the waypoint is no longer on the airway, or there is a new directional restriction that prevents it being used.

» Loading the new airway sequence would exceed the capacity of the flight plan.

ADDING AND REMOVING AIRWAYS

An airway can only be added if there is a waypoint in the flight plan that is part of the desired airway and is not part of an arrival or approach procedure. The system also anticipates the desired airway based on the selected waypoint and the flight plan.

Some airways have directional restrictions on all or part of the route. Airway "A2" in Europe has a directional restriction over the whole route that can be flown only in the direction MTD-ABB-BNE-DEVAL.

Airway "UR975" in North Africa has more complicated directional restrictions within the list of airway waypoints AMANO, VAKOR, LIBRO, NELDA, DIRKA, GZO, KOSET, and SARKI:

- Starting from AMANO, the airway can be flown only to LIBRO.
- Starting from SARKI, the airway can be flown only to LIBRO.
- Between NELDA and GZO, the airway can be flown in either direction.

In the US, airways that are "one-way" for specified hours of operation are not uncommon. These airways are always bidirectional in the system database.

The system only allows correct airway sequences to be inserted. If the pilot subsequently inverts the flight plan, the system inverts the airway waypoint sequence and removes the airway header.

Adding an individual airway to a flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

    Or:

    For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

    Or:

    For the stored flight plan:

    a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

    b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

    c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Scroll the list if necessary and touch a waypoint options button to display the 'Waypoint Options' Window.

3) Touch the **Load Airway** Button to display the 'Airway Selection' Screen.

4) Touch the **Sort A->Z** Button to select/deselect alphabetical sorting of the airway waypoints.

5) Scroll the list if necessary and touch an airway selection button to select the airway and display the 'Select Exit' Window (if Sort A->Z is selected, the exit points are displayed in alphabetical order, not the order they appear in the airway).

6) Scroll the list if necessary and touch an airway exit point selection button to select the airway exit point. The airway waypoint sequence is now show on the 'Airway Selection' Screen.

7) Touch the **Show on Map** Button to preview the airway on the active display pane.

8) Touch the **Load Airway** Button to insert the airway into the active or standby flight plan.

Figure 5-92 Adding an Airway to the Active Flight Plan
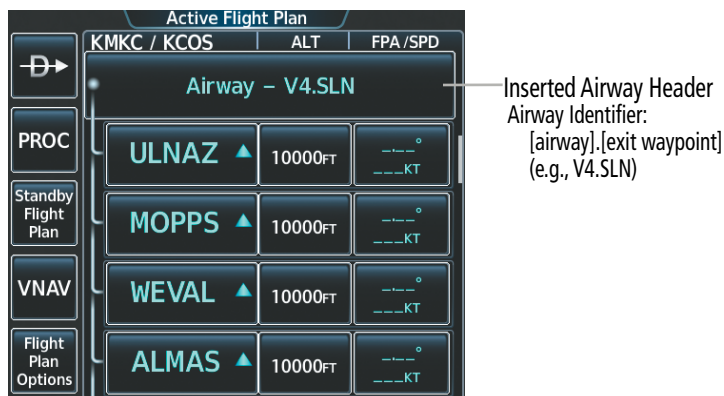
Figure 5-93 Active Flight Plan – V4 Airway Loaded

Removing an entire airway from the flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

 Or:

 For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

 Or:

 For the stored flight plan:

 a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

 b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

 c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Scroll the list if necessary and touch an airway selection button to display the 'Airway Options' Window.

3) Touch the **Remove Airway** Button.

> **NOTE:** The **Remove Multiple** Button will have no affect on airways within a flight plan. Only one airway may be removed at a time.

4) Touch the **OK** Button in response to "Remove Airway – <airway name> from flight plan?". The airway is removed, but the starting and ending waypoints remain in the flight plan. To cancel the request, touch the **Cancel** Button.

Removing an entire airway from the active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large **PFD** Knob to highlight the airway header.

3) Press the **CLR** Key. The 'Remove <airway name> from flight plan?' window is displayed.

4) With 'OK' highlighted, press the **ENT** Key or the small **PFD** Knob. To cancel the request, press the **CLR** Key, or highlight 'Cancel' and press the **ENT** Key or the small **PFD** Knob.

COLLAPSING AND EXPANDING AIRWAYS

The system allows airways to be displayed as collapsed or expanded within an active or standby flight plan. When airways have been collapsed, it is indicated on the airway heading.

When airways are collapsed, leg-to-leg computed values such as DIS or ETE shown for the exit waypoint reflect the total of all the legs on the airway that have been hidden in the collapsed display. The DTK value is inhibited because it is not usable in this context.

The 'Active Flight Plan' Screen always keeps the following three waypoints visible: "From" waypoint, "To" waypoint, and the "Next" waypoint. To prevent one or more of these waypoints from being hidden in a collapsed airway segment, the airway segment that contains either the "To" or the "Next" waypoint is automatically expanded. By default, the system will collapse all airways as they are loaded into the flight plan. If instead, it is preferred to have airways expanded within the flight plan as they are loaded, this setting may be changed.

Figure 5-94 Expanded/Collapsed Airways

Collapsing/expanding the airways in the flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

Or:

For the stored flight plan:

a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Scroll the list if necessary and touch an airway selection button to display the 'Airway Options' Window.

3) Touch the desired selection button to collapse/expand an individual airway, or collapse/expand all airways.

4) Touch the **Back** Button to return to the flight plan.
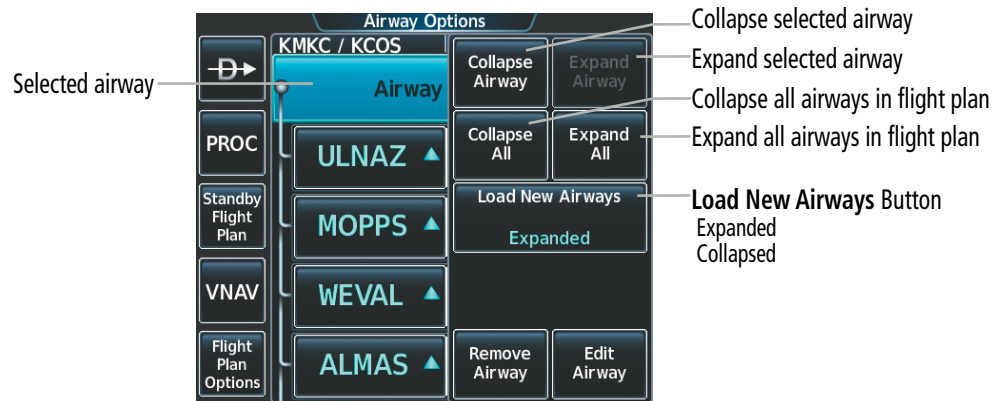
Figure 5-95 'Airway Options' Window

Changing Collapsed/Expanded settings for newly loaded airways:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

   (Not available for stored flight plans)

2) Scroll the list if necessary and touch an airway selection button to display the 'Airway Options' Window.

3) Touch the **Load New Airways** Button.

4) Touch the selection button for the desired setting.

ALTITUDE CONSTRAINTS

✓ *NOTE: The system supports vertical path guidance and altitude constraints for the following leg types: AF, CD, CF, CI, CR, DF, FC, FD, HF, PI, RF, and TF. Vertical constraints are not retained in stored flight plans.*

✓ *NOTE: Manually specifying an FPA to the FAF, or manually creating an altitude constraint at the FAF inhibits the Transition to Approach (TTA) function.*

The system can use MSL or AGL altitude constraints associated with lateral waypoints to give guidance for vertical navigation. These altitudes are, depending on the specific instance, manually entered or retrieved from the published altitudes in the navigation database. See the following figure for an example of how different Altitude Constraint Types are displayed in the active flight plan.

When a procedure is loaded, the system will auto-designate (automatically enter and enable) altitude constraints to be used for vertical speed and deviation guidance. An altitude constraint which has been auto-designated by the system will be displayed as cyan text.

An altitude constraint may be manually designated for procedure waypoints and enroute waypoints by touching the desired VNAV Alt button and entering the desired altitude. An altitude constraint may be manually designated only if it is selectable and available for vertical guidance. Altitudes that are not available for vertical guidance are shown in white text and are not selectable.

✓ *NOTE: If the Final Approach Fix (FAF) is available for vertical guidance, the system will auto-designate the FAF altitude constraint when loading the procedure. If necessary, the FAF altitude constraint may be modified and set above or below the published FAF altitude.*

The system is capable of providing vertical navigation for any altitude constraint designated for use. Vertical navigation is provided to the AT portion of the AT or ABOVE / AT or BELOW constraint types. Vertical navigation will be provided to the lower altitude of a BETWEEN altitude constraint.

For all designated altitudes, the system will automatically calculate advisory altitudes prior to the designated altitude constraint. These advisory altitudes are not auto-designated and are displayed as white text.

Altitudes that have been designated for use in vertical guidance can be "un-designated" by removing the altitude constraint. The altitude will not be used for vertical guidance and the text displayed will be shown in white. The system will recalculate advisory altitudes (white text) once any altitude constraint is designated, modified, or un-designated.

An altitude constraint may be entered as a flight level (FL), height above mean sea level (MSL), QFE, or height above ground level (AGL). AGL format is only available for airport waypoints. If an altitude constraint is created as an "AT or ABOVE" or "AT or BELOW" restriction, the "AT" portion of the restriction will be designated for vertical guidance.

> **NOTE:** After an approach procedure has been loaded into the flight plan, any altitude constraint programmed at the airport reference point (on the flight plan just ahead of the approach procedure) will be removed if the approach procedure is changed or removed.

VNAV guidance is only provided for valid climb and descent altitude constraints which have been designated for use. An altitude constraint that is crossed out indicates the system has determined this constraint to be invalid based on logical sequencing of the altitude constraint within the flight plan.

Altitude Constraints within a Flight Plan

Altitude Constraint Types

Cross AT or ABOVE 5,000 ft

Cross AT or BELOW 3,000 ft

Cross AT 2,300 ft

Cross BETWEEN 3,000 ft & 5,000 ft

Manual Input of Temperature Compensation

Figure 5-96 Active Flight Plan – Waypoint Altitude Constraints
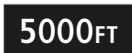
White Text	Cyan Text
5000FT	**5000**FT
Advisory altitudes calculated by the system estimating the altitude of the aircraft as it passes the navigation point.	Altitude is designated for use in determining vertical guidance. A pencil icon indicates manual designation or manual data entry.
5000FT	~~5000FT~~
Altitude retrieved from the navigation database. White line above and/or below indicates the type of constraint, as shown in the preceding figure. These altitudes are provided as a reference, and are not designated for vertical guidance.	The system cannot use this altitude in determining vertical guidance because of an invalid constraint condition.

Table 5-14 Altitude Constraint Color Coding

Entering or modifying an altitude constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if necessary, and touch the desired VNAV ALT Button. If the desired altitude is already displayed, skip to Step 8 to designate the altitude constraint for vertical guidance.

3) If the 'Enter Altitude' Window is not automatically displayed, touch the VNAV Constraint Button to display it. Then, use the keypad to input the altitude.

4) If necessary, touch the **Flight Level** Button or the **MSL** Button to select the altitude mode.

5) Touch the **Enter** Button to accept the altitude entry and return to the 'VNAV Constraint' Window.

6) If necessary, touch the **Phase** Button, then touch the **Climb** Button or the **Descent** Button.

7) If necessary, touch the **Type** Button, then touch the **At**, **At or Above**, **At or Below** or **Between** Button. If the **Between** Button is selected, use the keypad to enter the second altitude.

8) Touch the **Create** or **Save** Button to designate the new altitude constraint. The altitude is now shown in cyan, indicating it is designated for vertical guidance.

> *NOTE: When creating an altitude constraint, the **Phase** Button will default to **Climb** or **Descent** based upon the location in the flight plan of the waypoint being modified. If the waypoint is prior to the last climb constraint, the phase will default to **Climb**. If the waypoint is after a descent constraint, the phase will default to **Descent**. If the waypoint is located between the last climb constraint and the first descent constraint, the default will be determined based on the aircraft altitude, length of the flight plan, and existing constraints.*

Figure 5-97 Active Flight Plan – Adding an Altitude Constraint

Altitude constraints can be modified or deleted after having been added to the flight plan. If an altitude constraint is removed and the navigation database contains an altitude restriction for the lateral waypoint, the system will display that altitude restriction in white text. The system also provides a way to reinstate a published altitude constraint that has been modified.

Removing/undesignating an altitude constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if necessary, and touch the desired VNAV ALT Button.

3) Touch the **Remove Constraint** Button. A 'Remove Altitude Constraint?' window is displayed.

4) Touch the **OK** Button. The altitude is now shown in white (or possibly as white dashes if there are no other constraints in the flight plan), indicating it is not usable for vertical guidance. To cancel the request, touch the **Cancel** Button.

Reverting a manually entered altitude constraint back to the navigation database value:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2)   Scroll the list, if necessary, and touch the desired VNAV ALT Button.

3)   Touch the **Remove Constraint** Button. A 'Remove or Revert to published VNAV altitude of nnnnnFT?' confirmation window is displayed.

4)   Touch the **Revert** Button. The altitude is now the database altitude and is shown in cyan, indicating it is usable for vertical guidance.

VERTICAL NAVIGATION DIRECT-TO

The system allows a vertical navigation (VNAV) direct-to for any waypoint in the active flight plan with an altitude descent constraint designated (cyan text) for vertical guidance. Initiating the VNAV direct-to allows the flight plan to be flown, while vertical guidance based on the altitude constraint at the VNAV direct-to waypoint is provided. The altitude change begins on the current leg and is spread along the flight plan from current position to the vertical direct-to waypoint, not just along the leg for the direct-to waypoint. A TOD point is computed based on this altitude change; guidance for descent begins once the TOD is reached.

Once VNAV direct-to is activated, all VNAV altitude constraints prior to the VNAV direct-to waypoint are removed from the active flight plan. All VNAV altitude constraints following the VNAV direct-to waypoint are retained.

A lateral direct-to with an altitude constraint (activated by using the ⟿ Key or Button) also provides vertical guidance, but would bypass flight plan waypoints between the current position in the flight plan and the direct-to waypoint.

Adjusting the active Vertical Speed Target and Flight Path Angle for the active VNAV waypoint is discussed later in this section.

Figure 5-98 VNAV Constraint – Initiating a VNAV Direct-To

Figure 5-99 Active Flight Plan – VNAV Direct To Active

Activating a vertical navigation direct-to for an existing altitude constraint:

1) From Home, touch **Flight Plan**.

2) Scroll the list, if necessary, and touch a VNAV Waypoint Selection Button.

3) Touch the **VNAV** ⤳ Button to activate the vertical navigation direct-to. Vertical guidance begins to the altitude constraint for the selected waypoint.

Removing an altitude constraint when vertical navigation direct-to is active:

1) From Home, touch **Flight Plan**.

2) Scroll the active flight plan list and touch the VNAV ALT Button for the waypoint receiving VNAV direct-to guidance.

3) Touch the **Remove Constraint** Button.

4) Touch the **OK** Button in response to the question "Remove Altitude Constraint?". Vertical navigation direct-to guidance for the altitude constraint is canceled, and the altitude constraint is removed from the flight plan.

QFE CONSTRAINTS

Baro QFE settings may be enabled within the Avionics Settings (see Flight Instruments Section) so the altimeter will read zero at the selected airfield reference point (Origin or Destination airfield). Once QFE is enabled, altitude constraints based on Baro QFE may be entered or modified in the flight plan. All former QNH altitude constraints in the flight plan will be displayed as the height above the reference airfield and will be in parenthesis. QNE altitudes in the flight plan will continue to appear as "FLXXX" in white or cyan text without parenthesis. If a flight plan with QFE altitude constraints is saved, the altitude constraints will be stored as MSL altitudes into the catalog.

> ⚠ **WARNING:** Do not fly QFE procedures above the Transition Altitude or when navigating to a waypoint that contains a QNE (flight level) altitude constraint.

> ⚠ **WARNING:** Always fly a procedure that provides terrain and obstacle clearance from the reference airfield when operating in IMC while conducting QFE procedures.

> ✓ **NOTE:** The system will generate a system message and inhibit VNAV guidance when the aircraft is vertically approaching a flight level altitude constraint with QFE active. The system will automatically resume VNAV guidance if QFE is disabled or the flight level altitude constraint is bypassed.

> ✓ **NOTE:** 'FMS Origin' and 'FMS Destination' references do not dynamically update with flight plan changes. Always verify QFE settings when changing the QFE reference (airfield, runway, etc.) or flight plan and re-enter settings within the Avionics Settings.

Entering, modifying, or designating an altitude constraint with Baro-QFE enabled:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if necessary, and touch the desired VNAV ALT Button. If the desired altitude is already displayed, skip to Step 4 to designate the altitude constraint for vertical guidance.

3) If the 'Enter Altitude' Window is not automatically displayed, touch the VNAV Constraint Button to display it. Then, use the keypad to input the altitude.

4) Touch the **Flight Level, MSL** or **QFE** Button to select the altitude mode.

5) Touch the **Enter** Button to accept the altitude entry and return to the 'VNAV Constraint' Window.

6) If necessary, touch the **Phase** Button, then touch the **Climb** Button or the **Descent** Button.

7) If necessary, touch the **Type** Button, then touch the **At**, **At or Above**, **At or Below** or **Between** Button. If the **Between** Button is selected, use the keypad to enter the second altitude.

8) Touch the **Create** or **Save** Button to designate the new altitude constraint. The altitude is now shown in cyan, indicating it is designated for vertical guidance.

Figure 5-100 Figure QFE Altitude Constraints – in parenthesis

SPEED CONSTRAINTS

The system can use speed constraints associated with lateral waypoints to give guidance for navigation. These speeds are, depending on the specific instance, manually entered or retrieved from the navigation database.
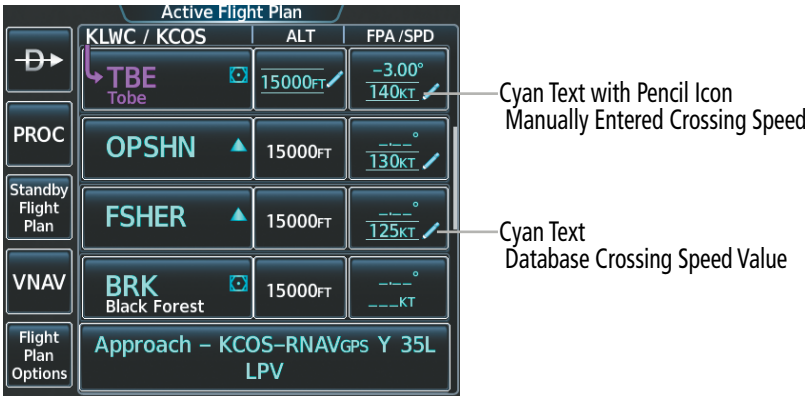
Figure 5-101 Active Flight Plan – Waypoint Speed Constraints

If the system determines that meeting a manually entered constraint would require maximum speeds to be exceeded, or minimum speeds to not be met, or the constraint requires speed to decrease in a climb segment or speed to increase in a descent segment, then the speed constraint will be rendered invalid in the flight plan.

Cyan Text
Speed is designated in the flight plan for crossing speed guidance. A pencil icon indicates manual data entry.
The system cannot use this speed because of an invalid constraint condition.

Table 5-15 Speed Constraint Color Coding

Constraint Type	Departure or Missed Approach	Arrival or Approach
190KT AT or BELOW	Do not exceed PRIOR	Do not exceed AT and AFTER
150KT AT	Do not exceed PRIOR, do not go below AFTER, cross AT	Do not go below PRIOR, do not exceed AFTER, cross AT
130KT AT or ABOVE	Do not go below AT and AFTER	Do not go below PRIOR to and AT

Table 5-16 Speed Constraint Application

> **NOTE:** When At-or-Below speed constraints are encountered on Arrival and Approach procedures, the system will start slowing the aircraft on the leg prior to the constraint. If the aircraft speed is too high, to slow within the available leg distance, flight crews should be prepared to manually slow the aircraft, as necessary.

Entering or modifying a flight plan waypoint speed constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if needed, and touch an FPA/SPD Button.

3) Touch the **Speed Constraint** Button to display the 'Enter Speed' Window.

4) Use the keypad to select the speed.

5) If needed, touch the **IAS** Button or the **Mach** Button to select the speed units.

6) If needed, touch the **At**, **Above**, or **Below** Button to select the constraint type.

7) Touch the **Enter** Button to accept the new speed constraint.

Figure 5-102 Active Flight Plan – Adding a Speed Constraint

Speed constraints can be modified or deleted after having been added to the flight plan.

Removing a flight plan waypoint speed constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if needed, and touch a FPA/SPD Button.

3) Touch the **Speed Constraint** Button. The 'Enter Speed' Window is displayed.

4) Touch the **Remove Speed** Button. A 'Remove Speed Constraint?' confirmation window is displayed.

5) Touch the **OK** Button. The speed constraint is removed. To cancel the request, touch the **Cancel** Button.

Reverting a manually entered waypoint speed constraint back to the navigation database value:

1) For the active flight plan: From Home, touch **Flight Plan**.

> **Or:**

> For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if needed, and touch a FPA/SPD Button to display the **Speed Constraint** Button.

3) Touch the **Speed Constraint** Button. The 'Enter Speed' Window is displayed.

4) Touch the **Remove Speed** Button. A 'Remove or Revert to published speed of nnnKT?' confirmation window is displayed.

5) Touch the **Revert** Button.

FLIGHT PATH ANGLE CONSTRAINTS

The system can use descending Flight Path Angle (FPA) constraints associated with lateral waypoints to give guidance for navigation. These flight path angles are, depending on the specific instance, manually entered or computed by the FMS. In the later case, the FMS shall use a default FPA value within the flight plan.

The system will calculate a descent path that adheres to the designated VNAV altitude constraints. The calculated Flight Path Angle (FPA) will be displayed in the column next to a designated VNAV descent altitude constraint. The crew may optionally define a specific Flight Path Angle (FPA) constraint for a waypoint with a VNAV descent altitude constraint. FPA constraints are displayed and entered to the nearest 0.01 degree. The system will automatically convert the altitude to an AT constraint when a crew specified FPA is entered.

Figure 5-103 Active Flight Plan – Waypoint Flight Path Angle Constraints

Entering or modifying a flight path angle constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

> **Or:**

> For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if needed, and touch a FPA/SPD Button to display the **Flight Path Angle** Button.

3) Touch the **Flight Path Angle** Button. The 'VNAV Flight Path Angle' Screen is displayed.

4) Use the keypad to select the angle.

5) Touch the **Enter** Button to accept the new FPA constraint.

Figure 5-104 Active Flight Plan – Adding an FPA Constraint

Manually entered FPA constraints can be modified or deleted after having been added to the flight plan. These modifications will redefine the calculated vertical path and may result in movement of the Top of Descent (TOD).

Removing a flight path angle constraint:

1) For the active flight plan: From Home, touch **Flight Plan**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if needed, and touch a FPA/SPD Button.

3) Touch the **Flight Path Angle** Button. The 'VNAV Flight Path Angle' Screen is displayed.

4) Touch the **Remove FPA** Button.

5) Touch the **OK** Button. The FPA reverts to the FMS computed value, or to dashes. To cancel the request, touch the **Cancel** Button.

VNAV ENABLEMENT

The system Vertical Navigation (VNAV) feature provides vertical guidance for the flight plan during the enroute and terminal phases of flight (does not affect final approach segment VNAV). Guidance based on specified altitude constraints in the active flight plan or for a VNAV direct-to is provided. VNAV guidance is based on barometric altitudes, not on GPS altitude.

Descent VNAV guidance is displayed as a linear deviation from the desired path. The desired path is defined by a line joining two waypoints with designated altitude constraints. Additionally, the desired path may be defined by specifying a Flight Path Angle (FPA) or Vertical Speed (VS) Target from the desired waypoint and designated altitude constraint.

Other displays of VNAV guidance may include the active VNAV waypoint identifier, Target Altitude, VS Required, Bottom of Climb (BOC), Top of Climb (TOC), Top of Descent (TOD), Bottom of Descent (BOD), and descent vertical deviation. The appropriate guidance to be displayed depends upon the associated flight phase and VNAV profile parameters (such as FPA). The system determines the flight phase used for VNAV guidance, depending logical sequencing of the flight plan and aircraft location relative to the VNAV profile.

VNAV guidance may be viewed on the PFD, Touchscreen Controller, and on the MFD within the 'Current VNAV Profile' Box (this box is displayed when an inset window is enabled on 'Navigation Map' Pane, and the MFD is in Full Mode).

The **VNAV Enabled** Button must be enabled (annunciator bar is green when enabled and grey when inhibited), to allow VNAV guidance to be displayed. VNAV can be enabled or disabled anytime. Disabling VNAV cancels active waypoint vertical guidance, and VNAV guidance is no longer displayed. VNAV remains disabled until manually enabled.

Refer to the AFCS Section for information on the display and use of VNAV guidance using the autopilot or flight director.

> **NOTE:** Adjusting the altimeter barometric setting creates discontinuities in VNAV vertical deviation, moving the path. For large adjustments, it may take several minutes for the aircraft to re-establish on the path. If the change is made while nearing a waypoint with a VNAV Target Altitude, the aircraft may not re-establish on the path in time to meet the vertical constraint.

> **NOTE:** If the aircraft is within 1 minute of an upcoming vertical track change (Top of Descent, Bottom of Descent, etc.) and the CDI is changed from a non-FMS source to FMS, the audio and visual alert for the vertical track change may not be provided.

FPA not specified for Climb Constraints

Designated Altitude Constraint (Cyan Text)

Target Altitude for Active VNAV Waypoint

Selected Altitude

Vertical Speed Required Indicator

Active VNAV Waypoint and Target Altitude

Time to Top of Climb

Vertical Speed Required

Green Annunciator Bar Indicates VNAV is Enabled

Figure 5-105 Active Climb VNAV Waypoint and Target Altitude – VNAV Enabled

Cruise Altitude

Time to Top of Descent

Green Annunciator Bar Indicates VNAV is Enabled
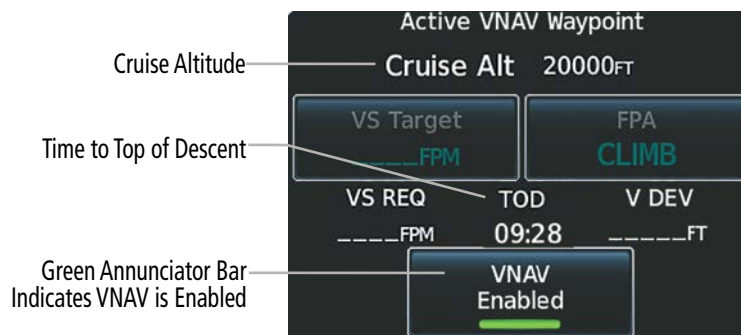
Figure 5-106 Cruise Altitude – VNAV Enabled

Figure 5-107 Descent to Target Altitude for Active VNAV Waypoint – VNAV Enabled

Enabling/disabling VNAV guidance:

1) From Home, touch **Flight Plan** > **VNAV.**

    Or:

    From Home, touch **PERF** > **VNAV.**

2) Touch the **VNAV Enabled** Button to enable/disable vertical navigation.

ACTIVE VERTICAL SPEED TARGET AND FLIGHT PATH ANGLE

The active VNAV waypoint is either the current VNAV waypoint for which VNAV direct-to guidance is being provided, or, when VNAV direct-to is not active, the system determines the next waypoint in the flight plan with a designated altitude constraint to be the active VNAV waypoint.

The vertical speed (VS) target and flight path angle (FPA) for the active VNAV waypoint can be modified by directly entering either a vertical speed target (VS Target) or a flight path angle (FPA) on Touchscreen Controller. When VNAV direct-to is not active, these entry of a VS Target of a FPA is inhibited until the aircraft is within 10 nm of TOD or if the selected altitude is adjusted below the active VNAV waypoint.

Modifying the VS Target and FPA:

1) From Home, touch **Flight Plan** > **VNAV.**

    Or:

    From Home, touch **PERF** > **VNAV.**

2) Touch the **VS Target** Button or the **FPA** Button to display the keypad.

3) Use the keypad and the **Enter** Button to select the vertical speed target or the flight path angle.

VERTICAL SITUATION DISPLAY

A Vertical Situation Display (VSD) can be shown on the bottom of the 'Navigation Map' Pane. The terrain, obstacles, vertical track vector, selected altitude, and active flight plan information (active flight plan information consists of waypoints, associated altitude constraints, current VNAV profile, BOC/TOC, TOD/BOD, and destination runway) can be displayed on the VSD, depending on the selected mode. See the Hazard Avoidance section for information about winds aloft, obstacles, and relative terrain on the VSD.

The VSD horizontal range is equal to the map range when the VSD is in Track mode. When the VSD is in Flight Plan mode, the horizontal range is the lower of twice the indicated range or the lowest range that displays all of the remaining active flight plan. The VSD altitude range automatically changes when the map range is changed to keep a constant ratio of altitude range to horizontal range, until both minimum and maximum display limits have been met. At ranges above the maximum, the altitude range remains constant at the maximum.

The aircraft symbol is displayed on the left side of the VSD window. The position of the aircraft symbol on the vertical scale is at the bottom for climb-out, in the middle while at cruise or if the phase is unknown, and close to the top during a descent.

If two waypoints are close together, and their labels or constraint values overlap enough to obscure any text, one waypoint label/constraint value is removed and the vertical dashed line for that waypoint is displayed as darker gray. The priority for which waypoint remains displayed is: (1) the current TO waypoint, (2) waypoint with an altitude constraint, and (3) waypoint closer to the aircraft.

The numeric constraint values are displayed below the waypoint label, using the same color and format as on the 'Active Flight Plan' Screen. See the Altitude Constraints discussion earlier in this section for more information.

Additionally, a constraint icon is displayed on the VSD along the vertical profile path for each altitude constraint, as shown in the following figure. The tip of each constraint icon represents the AT portion of an AT-or-ABOVE / AT-or-BELOW constraint type, pointing up / down, respectively. Two opposing icons pointing to the same barometric altitude represent an AT constraint type. Two opposing icons pointing at different barometric altitudes represent a BETWEEN constraint type.

> **NOTE:** *VSD can display a descent path that is different than the vertical deviation if the aircraft is deviating from the expected vertical path beyond one minute from TOD.*

> **NOTE:** *It is possible for the displayed vertical path on Vertical Situation Display (VSD) to show an intercept of the descent path at a lower altitude than where the aircraft will actually intercept the descent path. This can occur if a vertical direct-to is commanded when the aircraft is climbing (positive vertical speed) or a second vertical direct-to is re-initiated to the same altitude constraint from a higher altitude.*

> **NOTE:** *If the VSD is displayed on the MFD half panes, the pilot side's navigation source will be used to display the approach descent path for both panes.*

> **NOTE:** *It is possible for the baro-VNAV descent path to not be shown on the Vertical Situation Display (VSD) even though the descent path itself is valid. The VSD path is not shown beyond the FAF waypoint. However, the baro-VNAV descent path could remain valid beyond the FAF if the transition to approach feature adjusts the path to be beyond the FAF in order to intercept a vertical approach path. Baro-VNAV descent guidance is accurate and honors all altitude constraints. Neither vertical deviation nor VNAV data is affected.*

✅ **NOTE:** *It is possible for VSD to display a disconnected descent path that is inconsistent with the path that will be followed by VNAV guidance. This can occur if a valid BELOW descent constraint is higher in altitude than the previous valid descent constraint, and there is an unsupported VPTH leg (e.g., user-enter hold) before and after the BELOW constraint.*

✅ **NOTE:** *The system will invalidate a VNAV altitude constraint published for a procedure based waypoint (SID, STAR, Approach, etc) when the flight plan has a waypoint that precedes the procedure and is collocated with the waypoint published in the procedure. The VSD will not display VNAV constraints that cannot be used by the system due to invalid constraint conditions. All VNAV altitude constraints will only be displayed on the 'Flight Plan Progress' Inset, Active Flight Plan' Screen, and the 'Active Flight Plan' Text Inset.*

✅ **NOTE:** *When flying to the first descent while in cruise flight phase, the VSD will display the level segment that intercepts the descent at the VNAV cruise altitude. The VNAV cruise altitude may appear above the current aircraft altitude since cruise altitude is defined as the highest of the current altitude, highest constraint in the flight plan, or selected altitude.*

✅ **NOTE:** *The TOD point can be incorrectly depicted on the VSD if the aircraft climbs or descends prior to TOD on a programmed level leg.*

✅ **NOTE:** *The BOD depiction indicates the point at which the VNAV path levels off. This will not always be coincident with the FAF altitude as the VNAV path could intersect the final approach path before the FAF altitude.*

Climb and descent icons are shown on the VSD when the aircraft altitude meets a condition shown in the following table.
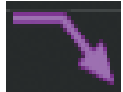
Condition	Climb/Descend Icon
If the active leg's flight plan line is above the highest altitude shown on the VSD, a magenta climb icon will be displayed to the right of the ownship symbol	
If a future leg's flight plan line is above the highest altitude shown on the VSD during the climb phase of flight, a white climb icon will be displayed to the right of the last leg visible on the VSD	
If the active leg's flight plan line is below the lowest altitude shown on the VSD, a magenta descend icon will be displayed to the right of the ownship symbol	

Table 5-17 VSD Climb/Descent Icons

VSD Mode (FPL)
Selected Alt. (12,000ғт)
Vertical Situation Display (VSD)
Obstacle

Active FPL Waypoints
Approach Glidepath
Destination Runway
Absolute Terrain

Figure 5-108 VSD Inset on 'Map - Navigation Map' Pane

Top of Descent (TOD)
Vertical Profile Path

Altitude Constraint, Published (White Text)
Altitude Constraint, Designated (Cyan Text)
Constraint Icon, Designated Altitude (Cyan Icon)
Constraint Icon, Published Altitude (White Icon)
-Tip of icon indicates barometric altitude of the constraint
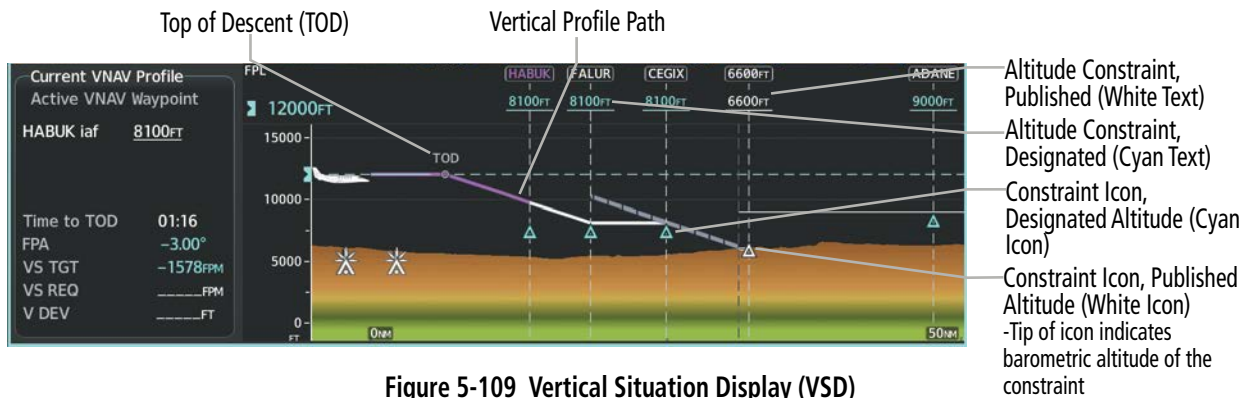
Figure 5-109 Vertical Situation Display (VSD)

Terrain/obstacles are available on the VSD, and will be shown if the aircraft altitude is low enough for the terrain/obstacles to be in view (terrain will be subdued if the terrain is selected Off under Map Settings). Obstacles will be shown if the navigation map zoom is within the Map Obstacle Range settings. The depicted terrain profile represents an approximate forward-looking contour of the terrain based upon the highest reported terrain elevations, measured at intervals defined by the terrain database resolution, within a predefined width along the active flight plan between the aircraft present position and the end of the map range or active flight plan. The predefined width is determined by the flight phase.

Flight Phase	Width of Swath
Approach, Departure	0.6 nm
Terminal	2.0 nm
En Route, Oceanic	4.0 nm

Table 5-18 Swath Width

VSD Mode Button	Displayed Mode	FPL Criteria	Items available on VSD
Auto	AUTO FPL	Available active FPL & aircraft within FPL swath	Terrain/obstacles along the active flight plan route, vertical track vector, selected altitude, and active flight plan information [1]
	AUTO TRK	(1) Active FPL available & aircraft not within FPL swath, or (2) Active FPL not available	Terrain/obstacles along the current track, vertical track vector, and selected altitude
Flight Plan	FPL	Active FPL available	Terrain/obstacles along the active flight plan route, vertical track vector, selected altitude, and active flight plan information [1]
		Active FPL not available	Only shows message 'Flight Plan Not Available'
Track	TRK	NA	Terrain/obstacles along the current track, vertical track vector, and selected altitude

[1] *Active flight plan information consists of waypoints, associated altitude constraints, current VNV profile, TOD/BOD, TOC/BOC, and destination runway*

Table 5-19 VSD Mode Descriptions

Enabling/disabling the VSD:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) Touch the **Inset Window** Tab.

3) Touch the **VERT Situation Display** Button to enable/disable display of the VSD.

Changing the VSD Mode:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) Touch the **Inset Window** Tab.

3) Touch the VERT Situation Display **Settings** Button.

4) Touch the **Mode** Button to display the 'Mode Selection' Window.

5) Touch a Mode button to select the mode and return to the 'Vertical Situation Display Settings' Window.

VSD MESSAGES

Under certain conditions, some messages may appear in conjunction with others:

Message	Description
'Loading…'	VSD is loading data due to a range change, full/half switch, or first being selected for display.
'Flight Plan Not Available'	Flight Plan mode is selected and there is not a flight plan loaded with at least one leg.
'Flight Plan mode unavailable because aircraft off course and active leg over 200 NM'	All of the following are true: – Flight Plan mode is selected – The active leg is greater than 200 nm – The aircraft is outside the swath
'Aircraft Beyond Active Leg'	Flight Plan mode is selected and the aircraft's position, as projected on the flight plan, is past the end of the active leg.

Message	Description
'VSD Not Available'	At least one of the following is true: – Valid terrain database not available – Current barometric altitude not available – Current track is not available – Current heading is not available – GPS position not available
'VSD Data is old, disable and enable VSD'	The system has encountered a delay and VSD data has failed to update for 2 seconds or more. This message may be momentarily displayed and then removed as the delay is overcome. In the event the message persists, it is recommended to disable and enable VSD.

Table 5-20 VSD System Messages

FLIGHT PLAN OPERATIONS

This section will discuss using the FANS CPDLC function, activating a flight plan leg, conducting enroute operations such as creating a parallel track, along track offset, or user defined holds, inverting a flight plan, and utilizing the standby flight plan.

In-flight, the system automatically sequences through the active flight plan, with the exception of manually terminated legs (such as FM, HM, or VM) that can occur within procedures. For information on departures, arrivals, and approaches, refer to the Procedures Section later in the Flight Management Section. For information on OBS and SUSP Modes, refer to the Flight Instruments Section.

FLIGHT PLAN OPERATIONS WITH FANS CPDLC

The Future Air Navigation System (FANS) provides a means of direct datalink communication between the pilot and Air Traffic Control (ATC). This means of communication is achieved using the Controller Pilot Data Link Communications (CPDLC) feature of the system. The following section will discuss how CPDLC may be used to assist flight management, such as route clearance and route modifications. For more information regarding CPDLC, including ATC Datalink connection and how to create CPDLC messages, refer to the Audio and CNS section.

ROUTE CLEARANCE WITH CPDLC

Data from the Active Flight Plan or Standby Flight Plan may be sent to ATC using CPDLC for the purpose of requesting a route clearance. This can be done by using the **Create Message** Button from the 'ATC Datalink' Screen, or through the 'Flight Plan Options' Window.

NOTE: When copying a standby flight and the active leg is off-route or part of an airway, the aircraft's present position must be first linked to the standby flight plan. Reference the procedure in the Utilizing the Standby Flight Plan discussion for linking aircraft present position (Join from P. Pos) to the standby flight plan.

Copying a flight plan to FANS CPDLC to request route clearance:

1) For the active flight plan: From Home, touch **Flight Plan > Flight Plan Options**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan > Flight Plan Options**.

2) Touch the **Copy to FANS CPDLC** Button. The 'Select Message' Window appears listing reasons for the request.

3) Touch the desired reason from the list that best explains the request.

4) The applicable message builder will open showing the chosen parameters for the message verifying the contents of either the Active or Standby Flight Plan and the Reason.

5) Touch the **Send** Button.

Standby Flight Plan Options   List of Reasons for Request

Message Builder for Request

Figure 5-110 Copy Flight Plan to FANS CPDLC to request route clearance

ROUTE MODIFICATIONS WITH CPDLC

The system has the capability to import data from a CPDLC message for route modifications. The type of data received in the message determines the import procedure as discussed in the following examples.

If the received CPDLC message contains data that would create direct changes to the Active Flight Plan, the changes may be previewed, denied, or accepted. If accepted, the system allows those changes to be imported without affecting the active flight plan in use. The system achieves this by first copying the Active Flight Plan to the Standby Flight Plan and then importing the data to the Standby Flight Plan.

Previewing route modifications from a CPDLC message:

1) To view the CPDLC message:

   a) From Home, touch **ATC Datalink.**

   b) If necessary, touch the **CPDLC** Tab, and select the message dialog box to open the message thread.

   Or:

   a) Touch the **CPDLC** Button on the Button Bar to view the message on the 'Notifications' Screen.

   b) Select the message dialog box to open the message thread.

2) Touch the **Preview** Button. The 'Clearance Preview' Screen is displayed, showing a preview of the modified flight plan. The route modifications will be highlighted as shown in the following figure.

3) Touch the **Show on Map** Button to view a preview on the active display pane.

4) If desired, touch the **Copy to Standby** Button to copy the data from the 'Clearance Preview' Screen to the Standby Flight Plan. Otherwise, touch the **Back** Button to return to the message thread.

Open Message Thread   Clearance Preview

Figure 5-111 Preview Route Modification

After previewing the data, changes may be accepted and directly applied to the Standby Flight Plan from the 'Clearance Preview' Window by touching the **Copy to Standby** Button. Please note, that if the data is copied to the Standby Flight plan in this way, a response will still be required by returning the CPDLC message thread. Data may also be accepted by returning to the message thread and sending a "WILCO" (Will Comply) response. For details on the activation of the standby flight plan, refer to the Utilizing the Standby Flight Plan discussion in this Flight Management Section.

Accepting and activating route modifications from a CPDLC message:

1) To view the CPDLC message:

   a) From Home, touch **ATC Datalink.**

   b) If necessary, touch the **CPDLC** Tab, and select the message dialog box to open the message thread.

   Or:

   a) Touch the **CPDLC** Button on the Button Bar to view the message on the 'Notifications' Screen.

   b) Select the message dialog box to open the message thread and read the message.

2) If necessary, touch the **Response** Button to display the different responses and touch the **WILCO** Button. Confirm that a WILCO response has been generated in the message thread and touch the **Send** Button.

3) 'Copy Active flight plan to Standby and apply applicable route modifications?' Window is displayed. Touch the **Yes** Button. The system copies the Active Flight Plan to the Standby and applies the accepted route modifications.

4) The 'Standby Flight Plan' Screen is displayed. To begin navigation guidance for this flight plan, touch the **Activate Standby** Button.
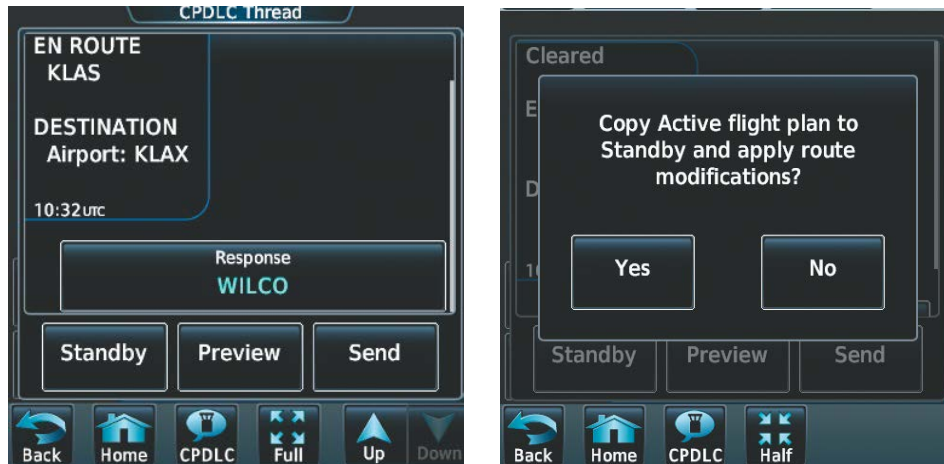
Send WILCO Response to Accept

Prompt to Copy Data to Standby Flight Plan
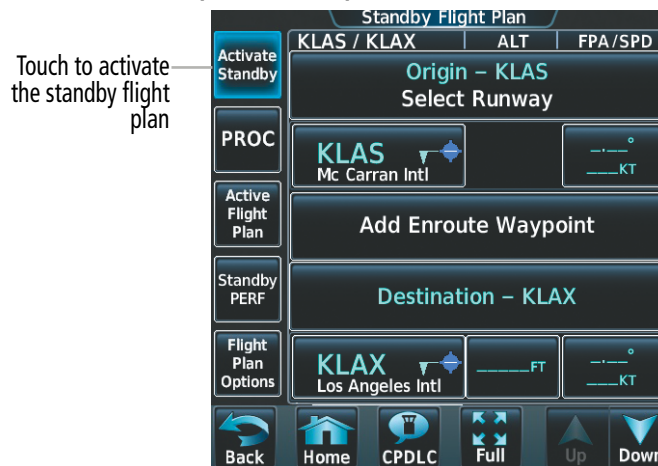
Standby Flight Plan

Figure 5-112 Accepting and Activating Route Modification

As previously explained, sending a WILCO response in the message thread will generate a pop up box asking to import the data received. If it is desirable to import the data at a later time instead, touching the **No** Button closes the popup box and closes the messaged thread. Similarly, selecting the **Standby** Button on the message thread also closes the message thread. The data may still be imported at a later time from the message thread by touching the **Import** Button, or if the message is for a direct-to clearance, by touching the ➔ Button.

Importing route modifications from a previously closed CPDLC message:

1) To view the CPDLC message:

   a) From Home, touch **ATC Datalink.**

   b) If necessary, touch the **CPDLC** Tab, and select the desired message dialog box to open the message thread.

2) Touch the **Import** Button, or for a direct to clearance, touch the ⎯Ð► Button.

Figure 5-113 Importing Route Modification from previously closed message thread

The CPDLC message(s) may contain data which can be imported and will indirectly change the active flight plan by importing data to a screen that is specific to the changes being imported. For example, adding a direct-to waypoint is achieved by importing the waypoint information into the 'Direct-To' Screen. The same is true for importing parallel track information to the 'Parallel Track' Screen, and importing a procedure to the 'Procedures' Screen.

Importing data from a CPDLC message into the 'Direct To', 'Parallel Track', or 'Procedures' Screen:

1) To view the CPDLC message:

   a) From Home, touch **ATC Datalink.**

   b) If necessary, touch the **CPDLC** Tab, and select the message dialog box to open the message thread.

      Or:

   a) Touch the **CPDLC** Button on the Button Bar to view the message on the 'Notifications' Screen.

   b) Select the message dialog box to view the open message thread.

2) After reading the message, touch the **Response** Button to send a WILCO response. The system then displays a pop up asking to import the data to the applicable screen.

3) Touch the **Yes** Button. The appropriate screen opens and the data to be imported will be filled in. Please refer to the Direct To, Parallel Track, and Procedures description in this section for specific instructions for completing task necessary.

'Direct To' Screen

Waypoint imported from CPDLC

Touch to activate imported changes
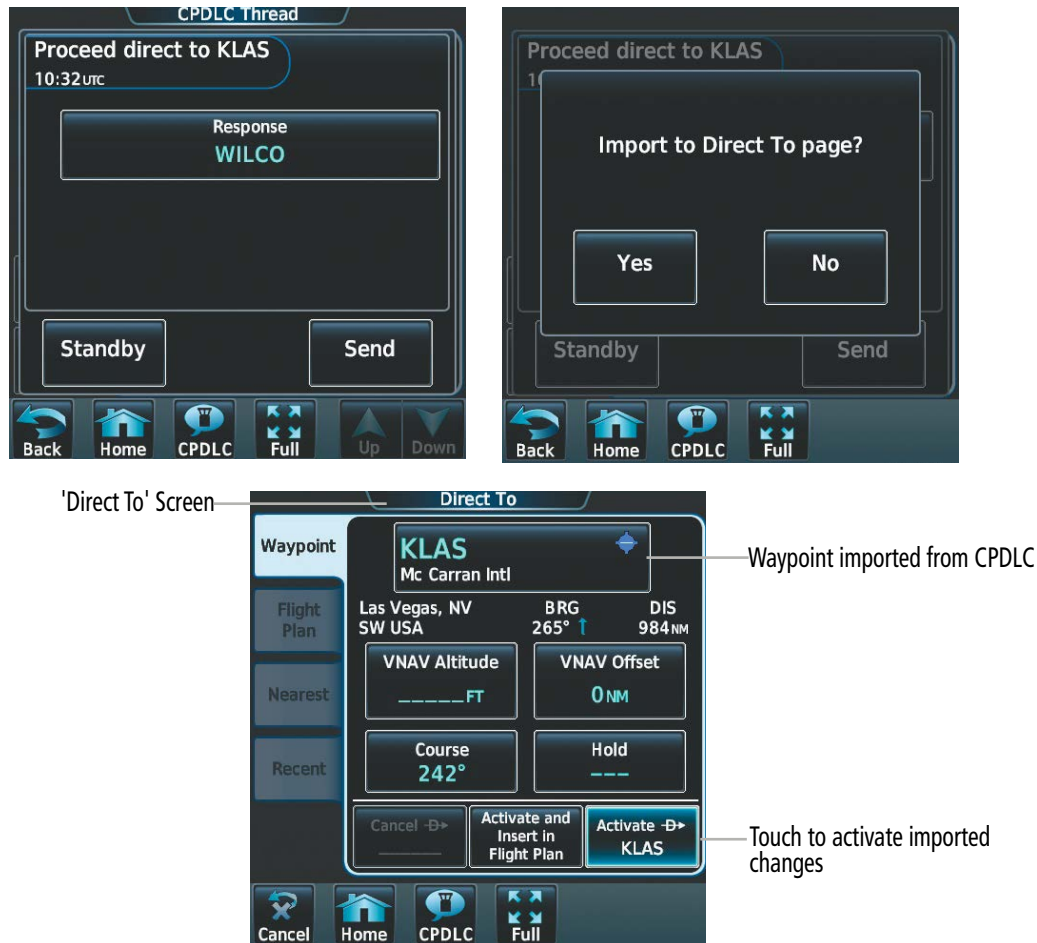
Figure 5-114 Importing data from CPDLC to the 'Direct To' Screen

If for some reason, the data from the CPDLC message cannot be accepted, a negative response may be chosen and sent. For example, an altitude constraint clearance may need to be denied due to weather or aircraft performance. If a negative response is sent, the data will not be imported. Sending a negative response also disables the **Import** Button on the message dialog window disallowing this data to be entered at a later time.

Sending a negative response to deny route modifications from a CPDLC message:

1) To view the CPDLC message:

   a) From Home, touch **ATC Datalink.**

   b) If necessary, touch the **CPDLC** Tab, and select the message dialog box to open the message thread.

      Or:

   a) Touch the **CPDLC** Button on the Button Bar to view the message on the 'Notifications' Screen.

   b) Select the message dialog box to view the open message thread.

2) Touch the **Response** Button. The 'Response' Window opens listing the different response messages which can be generated.

3) Touch the button for the desired negative response. After selecting a response, a return to the CPDLC message thread is made, showing the chosen response.

4) Touch the **Send** Button.

Figure 5-115 Rejecting Route Modification

ACTIVATING A FLIGHT PLAN LEG

The system allows selection of a highlighted leg as the "active leg" (the flight plan leg which is currently used for navigation guidance).

Activating a flight plan leg:

1) From Home, touch **Flight Plan**.

2) Scroll the list, if necessary, and touch the waypoint options button to select the destination waypoint for the desired leg. The 'Waypoint Options' Window is displayed.

3) Touch the **Activate Leg to Waypoint** Button.

4) Touch the **OK** Button in response to "Activate Leg?". The new active flight plan leg is activated. To cancel the request, touch the **Cancel** Button.

Figure 5-116 Active Flight Plan – Activating a Flight Plan Leg

ALONG TRACK OFFSETS

A waypoint having an "along track offset" distance from an existing waypoint can be entered into a flight plan. Along track offset waypoints lie along the path of the existing flight plan, and can be used to make the system reach a specified altitude before or after reaching the specified flight plan waypoint. Offset distances can be entered from 1 to 999 nm in increments of 1 nm.

Offset distance is calculated as a radial distance from the reference waypoint rather than a direct distance. The system will place the offset waypoint in the flight plan leg for which the radial distance intersects, regardless of distance between preceding flight plan legs. If the system is unable to determine a point for which the radial offset distance intersects the flight path, the message 'Unable to place <offset waypoint and distance> on the existing Flight Plan' will be displayed.

Entering a negative offset distance results in an along track offset waypoint inserted before the selected waypoint, whereas entering a positive offset distance results in an along track offset waypoint inserted after the selected waypoint. Offset waypoints can span multiple flight plan legs, and multiple offset waypoints are allowed on each leg.

> **NOTE:** Initiating a Direct-to may remove the along track offset waypoint symbol from the map display if the along track offset waypoint is prior to the end of the direct-to segment. However, the along track offset waypoint will still remain in the flight plan. If it's desired to have the along track offset waypoint re-displayed on the map, recreate the along track offset waypoint.

The system limits the along track offset distance so the along-track offset falls between the first and last waypoints in the flight plan. Assigning an along track offset to a leg with indeterminate length is not permitted. An along track offset is not allowed between the final approach fix and missed approach point of an approach.

An along track offset distance cannot be modified once entered. If the along track offset distance must be changed, the existing along track offset waypoint must be deleted and a new one created with the new offset distance.

Altitude constraints can also be entered for the along track offset waypoint within the flight plan or as part of a VNAV Direct-to. Altitude constraints and VNAV Direct-to are discussed previously in this section.

An along track offset waypoint can also be used for lateral navigation, such as the creation of a direct-to destination (discussed previously in this section), or as a part of a user-defined hold (discussed later in this section).

Figure 5-117 Inserting an Along Track Offset Waypoint

Inserting an along track offset waypoint into the active or standby flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch a waypoint options button to display the 'Waypoint Options' Window.

3) Touch the **Along Track Waypoint** Button to bring up the 'Along Track Waypoint Offset' Window.

4) Enter a positive or negative offset distance in the range of ±1 to 999 nm (offset must fall between the first and last waypoint within the flight plan).

5) Touch the **(Before) –** Button or the **(After) +** Button to select the offset waypoint direction.

6) Touch the **Enter** Button to insert the offset waypoint into the flight plan.

Removing an along track offset waypoint from the active or standby flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch the along track offset waypoint options button to display the 'Waypoint Options' Window.

3) Touch the **Remove WPT(s)** Button.

4) Touch the **OK** Button to delete the waypoint from the flight plan.

PARALLEL TRACK

The Parallel Track feature allows creation of a parallel course offset of 1 to 50 nm left or right of the current flight plan. When Parallel Track is activated, the course line drawn on the map pages shows the parallel course, and waypoint names have a lower case "-p" placed after the identifier.

While flying a parallel track:

» Initiating a direct-to will cancel the parallel track and fly direct-to the selected waypoint.

» Initiating a hold at the present position will cancel the parallel track and fly the holding pattern.

» Initiating a hold at a waypoint will result in the aircraft flying the parallel track until a turn is required to fly to the hold waypoint. If the hold is removed prior to reaching the hold waypoint, the parallel track will be resumed. Once the holding pattern is active, the parallel track will not be resumed upon exiting the hold.

Parallel Track is also cancelled if a course change occurs greater than 120° or the parallel tracks overlap as a result of the course change.

> **NOTE:** *Vertical navigation is unavailable while the Parallel Track feature is active.*

Figure 5-118 Active Flight Plan - Prior to Activating Parallel Track
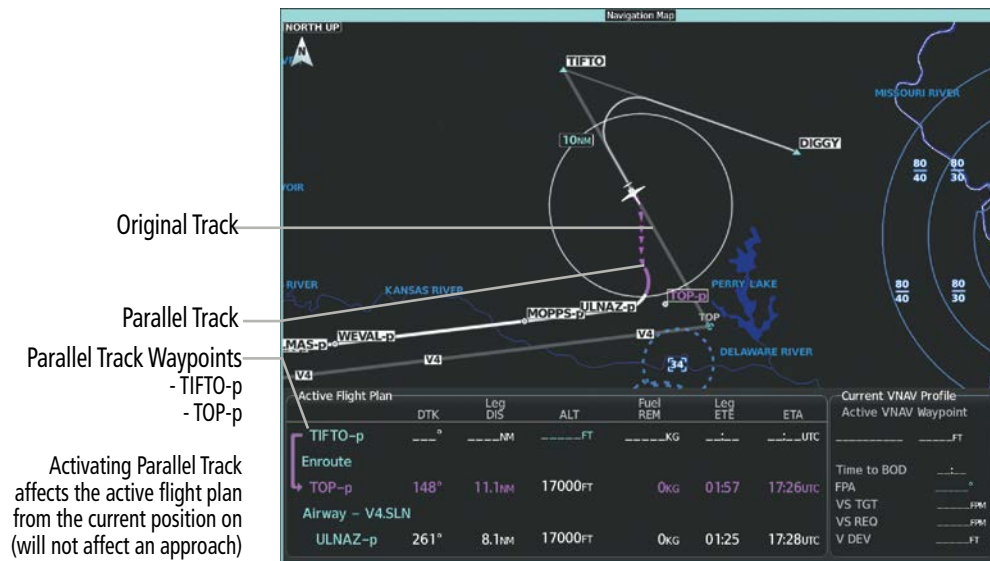
Figure 5-119 Active Flight Plan - Parallel Track Active

Activating parallel track:

1) From Home, touch **Flight Plan** > **Flight Plan Options > Parallel Track**.

2) Touch the **Left** Button or the **Right** Button to choose the offset direction.

3) Touch the **Offset Distance** Button to display the keypad.

4) Use the keypad to select the distance.

5) Touch the **Enter** Button to accept the distance, and return to the 'Parallel Track' Screen.

6) Touch the **Activate Parallel Track** Button to activate the parallel track function.

If the parallel track proposed by the offset direction and distance is not allowed by the system, the activation prompt is displayed, but disabled. If an approach leg is active, the status indicates the system is unable to activate the parallel track with the message 'Parallel Track Unavailable Approach Leg Active'. If the offset direction and distance results in an unreasonable route geometry, the status indicates the system is unable to activate the parallel track because of invalid geometry ('Parallel Track Unavailable Invalid Route Geometry'). If the active leg is not a track between two fixes (TF) or a course to a fix (DF) leg, the status indicates the system is unable to activate the parallel track because parallel track is not available for the active leg type ('Parallel Track Unavailable Not Allowed for Active Leg').

Cancelling parallel track:

1) From Home, touch **Flight Plan** > **Flight Plan Options > Parallel Track**.

2) Touch the **Cancel Parallel Track** Button to cancel the parallel track function.

CLOSEST POINT OF FLIGHT PLAN

The Closest Point of Flight Plan feature calculates the bearing and closest distance at which a flight plan passes a selected reference waypoint, and will create an FMS generated waypoint along the flight plan location closest to a chosen reference waypoint. The default name of the new user waypoint will be that of the selected reference waypoint followed by the numeral '1' (selecting KLBL for example will produce the name 'KLBL1'). Future closest point waypoints created from the same selected waypoint will produce a similar default name with an incremental numeric value (example: KLBL2).

Determining the closest point along the flight plan to a selected waypoint:

1) For the active flight plan: From Home, touch **Flight Plan**.

    Or:

    For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

    Or:

    For the stored flight plan:

    a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

    b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

    c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

3) Touch the **Closest Point of Flight Plan** Button to display the 'Closest Point of Flight Plan' Screen.

4) Touch the **From** Waypoint Button to display the keypad.

5) Use the keypad and the **Enter** Button to select the "From" waypoint.

6) Touch the **Insert Point into Flight Plan** Button to add the calculated waypoint into the flight plan. The name for the new waypoint is derived from the identifier of the From waypoint.
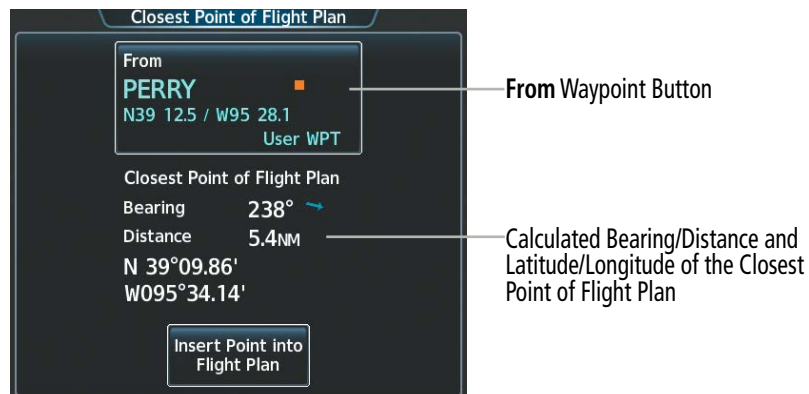
Figure 5-120 Closest Point of Flight Plan

Figure 5-121 Closest Point of Flight Plan inserted in Active Flight Plan

USER-DEFINED HOLDING PATTERNS

A holding pattern can be defined at any active or standby flight plan waypoint, at the aircraft present position, or at a direct-to waypoint. Creating and editing user-defined holding patterns is allowed for the active and standby flight plan. A user-defined holding pattern at a flight plan waypoint is retained as part of the flight plan when storing the active or standby flight plan. The user-defined holding pattern can be removed from the active, standby, or stored flight plan.

Creating or Editing a user-defined hold at an active or standby flight plan waypoint:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Scroll the list, if necessary, to display the waypoint at which to define the holding or edit the existing holding:

   a) To create holding, touch the Waypoint Selection Button to select the waypoint at which to define the holding pattern. The 'Waypoint Options' Window is displayed.

   b) Touch the **Hold at Waypoint** Button. The 'Hold at Waypoint' Screen is displayed.

   Or:

   a) To edit, touch the Hold Waypoint Selection Button. The 'Waypoint Options' Window is displayed.

   b) Touch the **Edit Hold** Button. The 'Hold at Waypoint' Screen is displayed.

3) Touch the **Turn** Button, and touch the **Right** Button or the **Left** Button to select the turn direction.

4) Touch the Course Direction (Inbound or Outbound) Button, and touch the **Inbound** Button or the **Outbound** Button to select the course direction.

5) Touch the **Course** Button to display the keypad. Use the keypad and the **Enter** Button to select the inbound or outbound course.

6) Touch the Leg Length Mode Button, and touch the **Distance** Button or the **Time** Button to select the length mode.

7) Touch the **Leg Time** Button or the **Leg Distance** Button to display the keypad. Use the keypad and the **Enter** Button to select the length of the leg.

8) Touch the **Expect Further Clearance** Button to display the keypad. Use the keypad and the **Enter** Button to select the time for a reminder. A system message (HOLD EXPIRED Holding EFC time expired.) will be triggered at the selected time.

9) Touch the **Create** Button to create and add the hold into the flight plan.

   Or:

   Touch the **Save** Button to save the changes and return to the flight plan.

NOTE: *The HOLD EXPIRED message only remains active for approximately 30 seconds before being removed.*
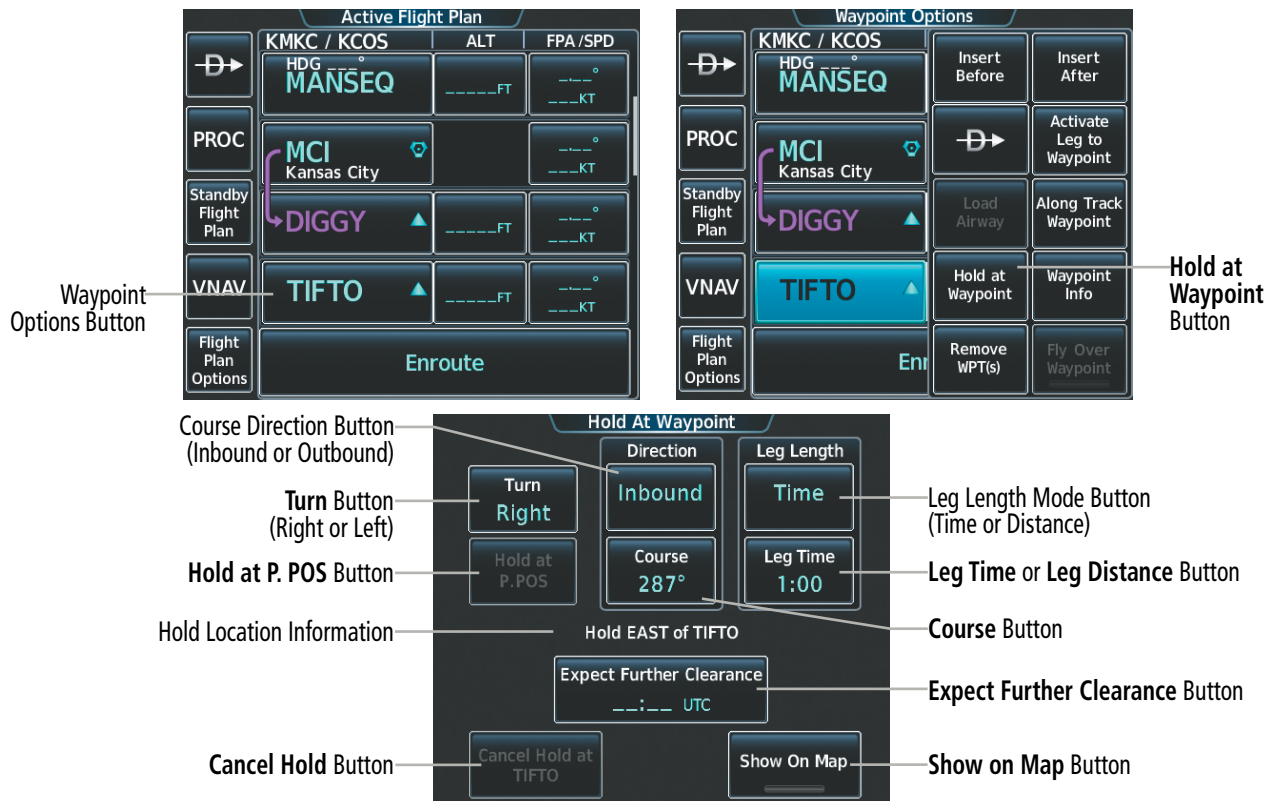
Figure 5-122 Creating a User Defined Holding Pattern at an Active Flight Plan Waypoint

Creating a user-defined hold at the aircraft present position:

1) From Home, touch **Flight Plan > Flight Plan Options**.

2) Touch the **Hold at P**. **POS** Button. The 'Hold at Waypoint' Screen is displayed.

3) Touch the **Turn** Button, and touch the **Right** Button or the **Left** Button to select the turn direction.

4) Touch the Course Direction (Inbound or Outbound) Button, and touch the **Inbound** Button or the **Outbound** Button to select the course direction.

5) Touch the **Course** Button to display the keypad. Use the keypad and the **Enter** Button to select the inbound or outbound course.

6) Touch the Leg Length Mode Button, and touch the **Distance** Button or the **Time** Button to select the length mode.

7) Touch the **Leg Time** Button or the **Leg Distance** Button to display the keypad. Use the keypad and the **Enter** Button to select the length of the leg.

8) Touch the **Expect Further Clearance** Button to display the keypad. Use the keypad and the **Enter** Button to select the time for a reminder.

9) Touch the **Create** Button to create an Offroute Direct-to hold waypoint at the aircraft present position.

10) If desired, to enter the hold into the flight plan, touch the PPOS-H Waypoint Selection Button to display the 'Direct To' Screen.

11) Touch the **Insert in Flight Plan** Button. The 'Insert ⇌ PPOS-H Before?' Window is displayed.

12) Touch the desired Waypoint Selection Button, and the hold is inserted in the flight plan before the selected waypoint.

> **NOTE:** When a user-defined hold is created at the aircraft present position (shown as "Offroute ⇌", "→PPOS-H", at the top of the 'Active Flight Plan' Screen), the hold is the only part of the active flight plan shown on the map display. The hold must be canceled using the 'Removing a user-defined hold at the aircraft present position' procedure, which immediately removes the hold from the active flight plan, provides guidance to the active leg, and resumes automatic waypoint sequencing. The system will not follow the hold to the inbound course before resuming automatic waypoint sequencing. Following the steps in the procedure to insert the hold into the active flight plan will enable the Exit Hold capability.

> **NOTE:** If a user-defined hold has been created at the aircraft present position and then is edited, the preview shown on the map will reflect the new position of the holding pattern, but the PPOS-H waypoint (orange square) may not be accurately depicted. When the edited holding pattern is created, the PPOS-H waypoint is shown correctly.

> **NOTE:** When a user-defined hold is created at the aircraft present position, the hold fix is placed slightly in front of the aircraft to allow the aircraft time to prepare for the upcoming turn.
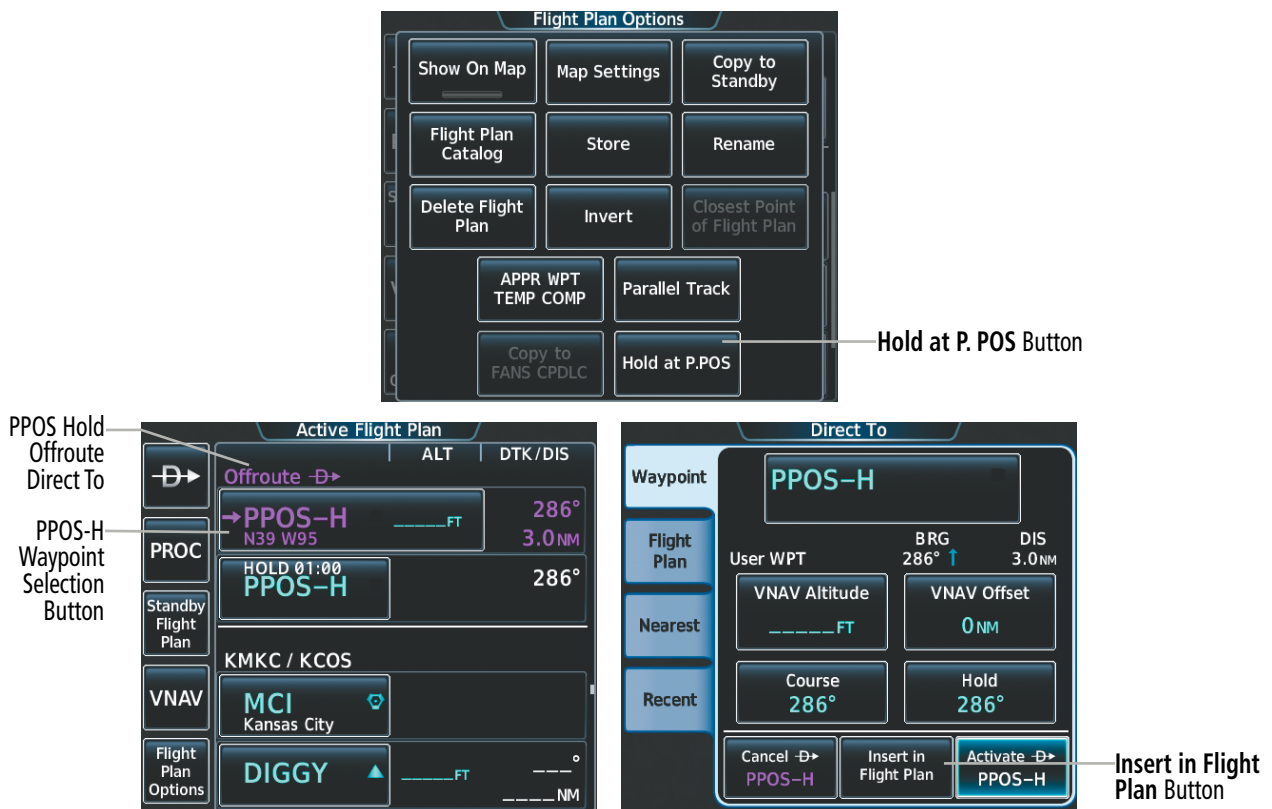
Figure 5-123 Creating a User Defined Holding Pattern at the Aircraft Present Position

Creating a user-defined hold at a direct-to waypoint:

1) From Home, touch **Flight Plan**.

2) Touch the ↦Đ Button and set up the Direct To waypoint as desired.

3) Touch the **Hold** Button. The 'Direct To Hold' Screen is displayed.

4) Touch the **Turn** Button, and touch the **Right** Button or the **Left** Button to select the turn direction.

5) Touch the Course Direction (Inbound or Outbound) Button, and touch the **Inbound** Button or the **Outbound** Button to select the course direction.

6) Touch the **Course** Button to display the keypad. Use the keypad and the **Enter** Button to select the inbound or outbound course.

7) Touch the Leg Length Mode Button, and touch the **Distance** Button or the **Time** Button to select the length mode.

8) Touch the **Leg Time** Button or the **Leg Distance** Button to display the keypad. Use the keypad and the **Enter** Button to select the length of the leg.

9) Touch the **Expect Further Clearance** Button to display the keypad. Use the keypad and the **Enter** Button to select the time for a reminder.

10) Touch the **Enter** Button to return to the 'Direct To' Screen.

11) Touch the **Activate** ↦Đ Button to activate the Direct To and add the hold into the flight plan.
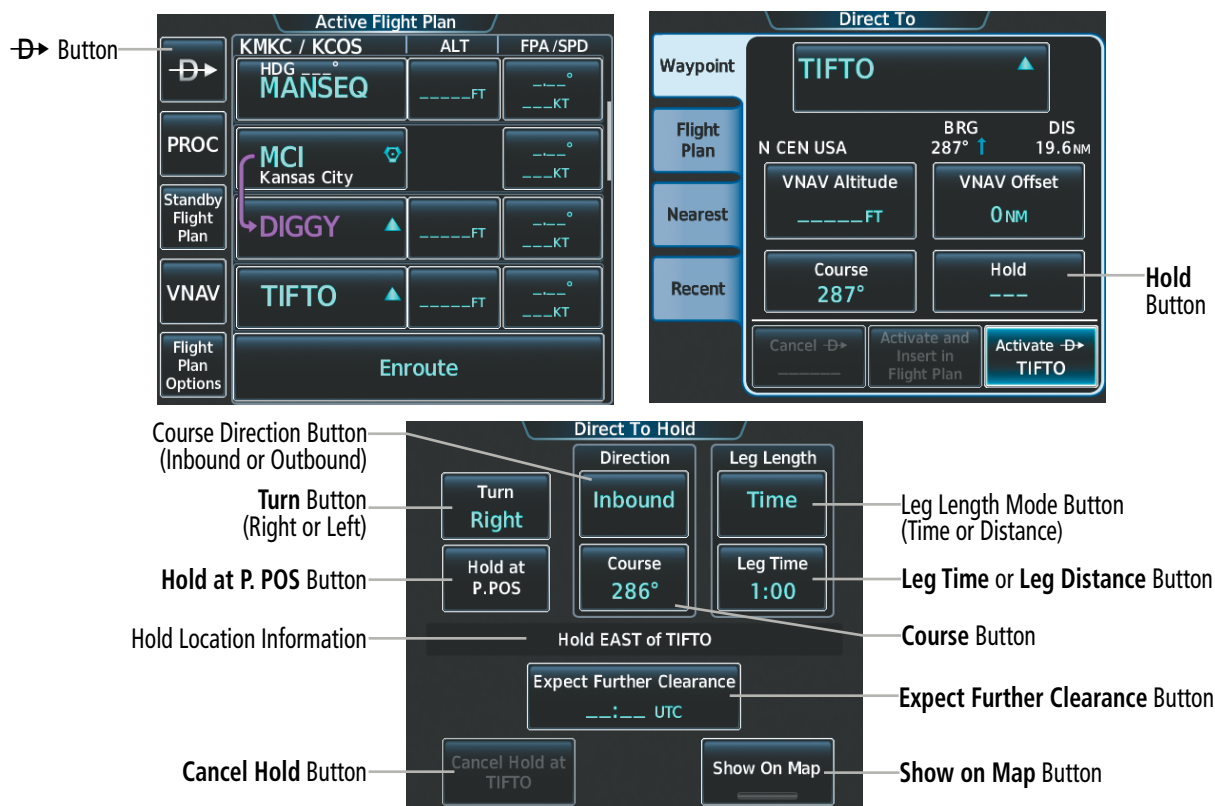
Figure 5-124 Creating a User Defined Holding Pattern at a Direct-To Waypoint

Removing a user-defined hold at an active flight plan waypoint or at a direct-to waypoint (hold not active):

1) From Home, touch **Flight Plan**.

2) Scroll the list, if necessary, and touch the Hold Waypoint Selection Button. The 'Waypoint Options' Window is displayed.

3) Touch the **Remove Hold** Button.

4) Touch the **OK** Button in response to "Remove Holding Pattern?" The holding pattern is removed. To cancel the request, touch the **Cancel** Button.

Exiting a user-defined hold at an active flight plan waypoint or at a direct-to waypoint (hold active):

1) From Home, touch **Flight Plan**.

2) Scroll the list, if necessary, and touch the Hold Waypoint Selection Button. The 'Waypoint Options' Window is displayed.

3) Touch the **Exit Hold** Button.

4) Touch the **OK** Button in response to "Exit Hold at <identifier>?" The holding pattern will be exited at the hold waypoint. To cancel the request, touch the **Cancel** Button.

> *NOTE: Removing the hold from an active flight plan waypoint or canceling a hold for a direct-to waypoint will immediately remove the holding pattern from the flight plan, provide guidance to the active leg, and resume automatic waypoint sequencing. If the hold is already active, the system will be in Suspend (SUSP) Mode until the pilot disables SUSP Mode, or uses the Exit Hold function, at which point guidance along the hold to the inbound course is provided and automatic waypoint sequencing is resumed. For more information on SUSP Mode, see the Flight Instruments Section.*

Removing a user-defined hold at the aircraft present position:

1) From Home, touch **Flight Plan**.

2) Scroll the list, if necessary, and touch the PPOS-H waypoint options button, or touch the ⎯Ɗ➔ Button. The 'Direct To' Window is displayed.

3) Touch the **Cancel PPOS-H** Button.

4) Touch the **OK** Button in response to "Cancel ⎯Ɗ➔ PPOS-H?". The holding pattern is removed. To cancel the request, touch the **Cancel** Button.
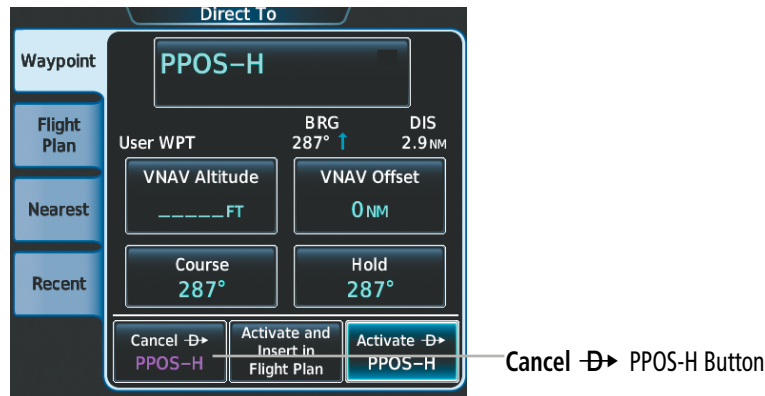
Figure 5-125 Removing a User Defined Holding Pattern at the Aircraft Present Position

ARRIVAL ALERT SETTINGS

An arrival alert can be set to notify the pilot with a message upon reaching a user-specified distance from the final destination (the direct-to waypoint or the last waypoint in a flight plan).

Changing the Arrival Alert settings:

1) From Home, touch **Utilities > Setup > Avionics Settings**.

2) Touch the **Alerts** Tab. Scroll to view the Arrival Alert settings.

3) Touch the **Arrival Alert** Button to enable/disable the alert.

4) Touch the Arrival Alert Distance Button to display the keypad.

5) Enter the arrival alert distance and touch the **Enter** Button.

INVERTING A FLIGHT PLAN

Any flight plan may be inverted (reversed) for navigation back to the original origin point.

Inverting the active or standby flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

　Or:

　For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

3) Touch the **Invert** Button.

4) Touch the **OK** Button in response to "Invert flight plan?". The flight plan is inverted. To cancel the request, touch the **Cancel** Button.

Inverting a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if necessary and touch a flight plan selection button to display the 'Catalog Options' Window.

4) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

5) Touch the **Flight Plan Options** Button.

6) Touch the **Invert** Button. Touch the **OK** Button to continue. The flight plan and flight plan comment is inverted (all procedures are removed). Touch the **Back** Button to save the changes and return to the 'Flight Plan Catalog' Screen.

USING THE STANDBY FLIGHT PLAN

The standby flight plan is listed on the 'Standby Flight Plan' Screen on the Touchscreen Controller, and is available for activation (becomes the active flight plan). A standby flight plan can be created by copying the active flight plan or by manual entry. The standby flight plan may be used as a means to create a flight plan for future use. Once a standby flight plan is created, it can be stored to the Flight Plan Catalog.

Switching between the active and standby flight plan screen:

1) From Home, touch **Flight Plan**.

2) Touch the **Standby Flight Plan** Button to display the 'Standby Flight Plan' Screen.

3) Touch the **Active Flight Plan** Button to return to the 'Active Flight Plan' Screen.

Figure 5-126 Switching between Active and 'Standby Flight Plan' Screen

Activating the standby flight plan:

1) From Home, touch **Flight Plan** > **Standby Flight Plan.**

2) Touch the **Activate Standby** Button.

3) Touch the **OK** Button in response to "Activate Standby Flight Plan and Replace Current Active Route?". To cancel the request, touch the **Cancel** Button.

The standby flight plan may also be used for diversion planning purposes by linking the standby flight plan to the aircraft's present position (**Join from P. POS** Button). Once linked, or "joined", the 'Standby Flight Plan' Screen will show a white arrow indicating the link from the aircraft present position to a specified waypoint in the standby flight plan. When the Show on Map option is chosen for the standby flight plan, the 'Standby Flight Plan' Pane will depict a white line between the aircraft present position and the standby flight plan waypoint for which it is currently linked to.

As the aircraft continues navigating the active flight plan, the P. POS link between the aircraft present position and the standby flight plan will continuously update and sequence to the next waypoint, as necessary, to provide a best point of diversion from the active flight plan.

> **NOTE:** *The **Join from P. Pos** Button is for planning purposes only. It does not create any changes to the active flight plan, nor does it provide navigation guidance to the selected waypoint in the standby flight plan.*

Linking aircraft present position (Join From P. POS) to the standby flight plan:

1) From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch a waypoint options button desired for linking the aircraft present position.

3) Touch the **Join From P. POS** Button.

4) A **P. POS** Button is added to the standby flight plan with a white arrow drawn to indicate the link created. To change the waypoint that P. POS is linked to, repeat steps 2-4 for the desired waypoint.
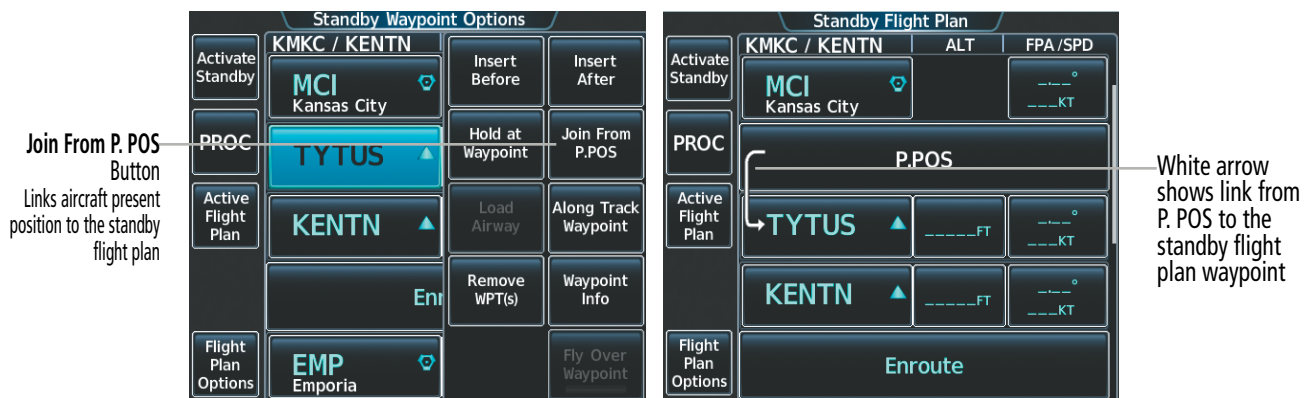
Figure 5-127 Standby Flight Plan - Join From P. POS

Figure 5-128 Standby Flight Plan - Join From P.POS link active (Show on Map Button is active)

Updated link from P. POS to KENTN

P.POS link sequenced to KENTN
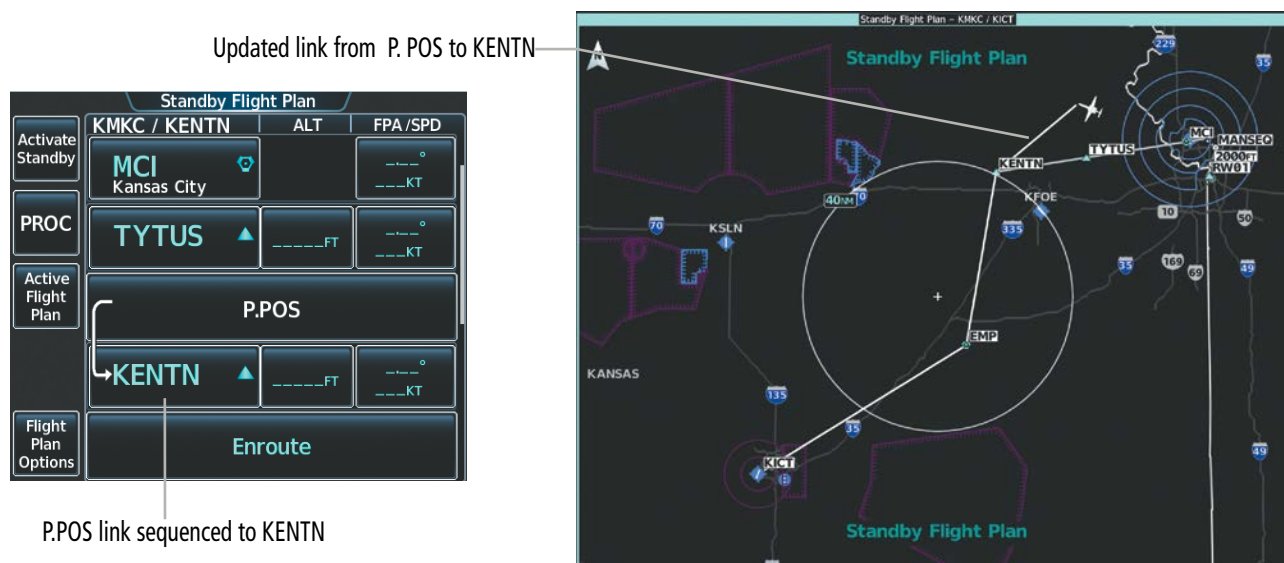
Figure 5-129 P. POS link sequenced to next waypoint in standby flight plan

Removing P. POS link from the standby flight plan:

1) From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch the **P. POS** Button.

3) Touch the **Remove Link** Button.

4) Touch the **OK** Button in response to "Remove link from P. POS?". To cancel the request, touch the **Cancel** Button.

Remove Link Button
Touch to remove link
between P. POS and the
standby flight plan
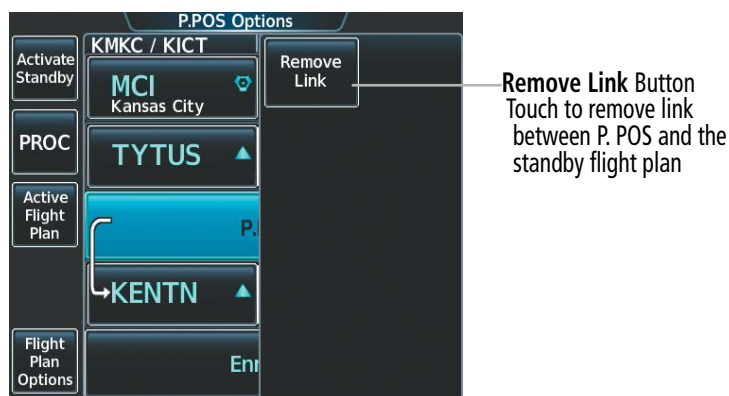
Figure 5-130 Standby Flight Plan – Remove link from P. POS

MANAGING FLIGHT PLANS

The pilot can manage flight plans by importing/exporting via SD Card or the optional Wireless Transceiver (FS 510), and by storing, copying, inverting, and deleting. Also, the comment field (name) of each flight plan can be changed to something that is useful for identification and sorting.

IMPORTING AND EXPORTING FLIGHT PLANS

Flight plans can be transferred to or from a wireless connection via the optional Wireless Transceiver. Wireless transfer of a flight plan to a mobile device is controlled by the mobile device. When a wireless connection is attempting to transfer a flight plan to the system, the pending flight plan may be ignored, previewed, stored, or activated by the pilot.
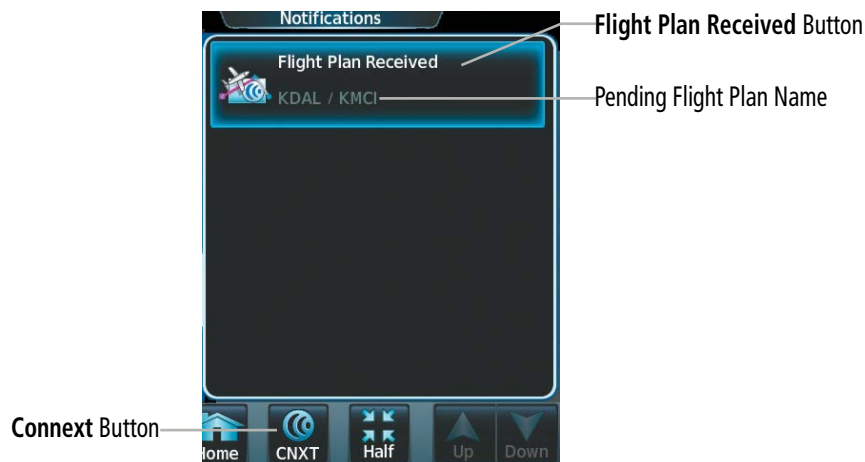
Figure 5-131 Notifications Screen - Pending Flight Plan Received

Ignoring a pending flight plan transfer from a wireless connection:

1) When a flight plan transfer has been initiated from a mobile device, the notification button will change to a flashing **Connext** Button on the Touchscreen Controller, and a Connext annunciation appears on the PFD.

2) Touch the **Connext** Button to see the notification of the pending flight plan on the 'Notifications' Screen.

3) Touch the **Connext** Button again to ignore the pending flight plan and return to the previous screen. The pending flight plan is not loaded into the system, though the notification message will still remain on the 'Notifications' Screen under the **Connext** Tab for future use.

Touching the **Flight Plan Received** Button previews the pending flight plan while simultaneously adding it to the 'Standby Flight Plan' Screen. The pending flight plan is also automatically added to the 'Flight Plan Catalog' Screen for future use.
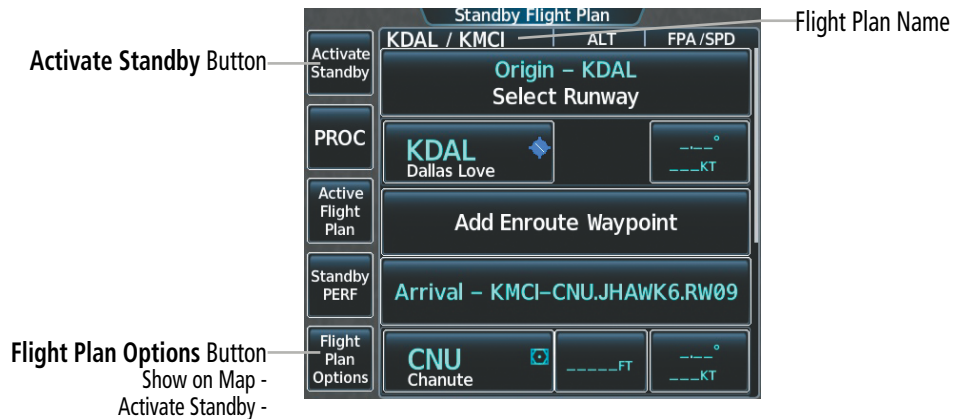
Figure 5-132 Standby Flight Plan Screen

Viewing and activating a pending flight plan from a wireless connection:

1) When a flight plan transfer has been initiated from a mobile device, the notification button will change to a flashing **Connext** Button on the Touchscreen Controller, and a Connext annunciation appears on the PFD.

2) Touch the **Connext** Button to see the notification of the pending flight plan on the 'Notifications' Screen.

3) Touch the **Flight Plan Received** Button to preview and add the pending flight plan to the standby flight plan. If there is already a loaded standby flight plan, a pop up window will confirm 'Replace Standby Flight Plan?'. Touch **OK** to continue.

4) The 'Standby Flight Plan' Screen is now shown on the Touchscreen Controller containing the flight plan which was transferred from the mobile device.

5) To activate the standby flight plan, touch the **Activate Standby** Button.

A stored flight plan can be imported from an SD Card or exported to an SD Card.

Importing a Flight Plan from an SD Card:

1) Insert the SD card containing the flight plan in the top card slot on the MFD.

2) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog > Create New Catalog Flight Plan > Flight Plan Options.**

3) Touch the **Import** Button to display the 'Import Flight Plan' Screen.

4) Touch a flight plan selection button to display the flight plan information and activate the **Import** Button.

5) Touch the **Import** Button.

6) Touch the **OK** Button to return to the 'Edit Stored Flight Plan' Screen.

If the import fails, a 'Flight Plan Import Failed' message will be displayed. Touch the **OK** Button to return to the 'Edit Stored Flight Plan' Screen.

NOTE: *The imported flight plan will not contain any procedures or airways, and will not have an origin or destination airport.*

Figure 5-133 Flight Plan Import

> NOTE: If the imported flight plan contains a waypoint with a name that duplicates the name of a waypoint already stored on the system, the system compares the coordinates of the imported waypoint with those of the existing waypoint. If the coordinates are different, the imported waypoint is automatically renamed by adding characters to the end of the name.

Exporting a stored Flight Plan to an SD Card:

1) Insert the SD card for storing the flight plan in the top card slot on the MFD.

2) From Home, touch **Flight Plan > Flight Plan Options**.

3) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

4) Touch a flight plan selection button to display the 'Catalog Options' Window.

5) Touch the **Export** Button to display the 'Export Flight Plan' Screen.

6) Touch the **File Name:** Button to rename the exported flight plan using the keypad or right knobs, if necessary.

7) Touch the **Export** Button.

8) Touch the **OK** Button in response to the "Flight Plan Successfully Exported." prompt to return to the 'Flight Plan Options' Window.

NOTE: *The exported flight plan will not contain any procedures or airways. The flight plan origin/destination airport will be exported, but as the first and last waypoint, not the origin and destination.*
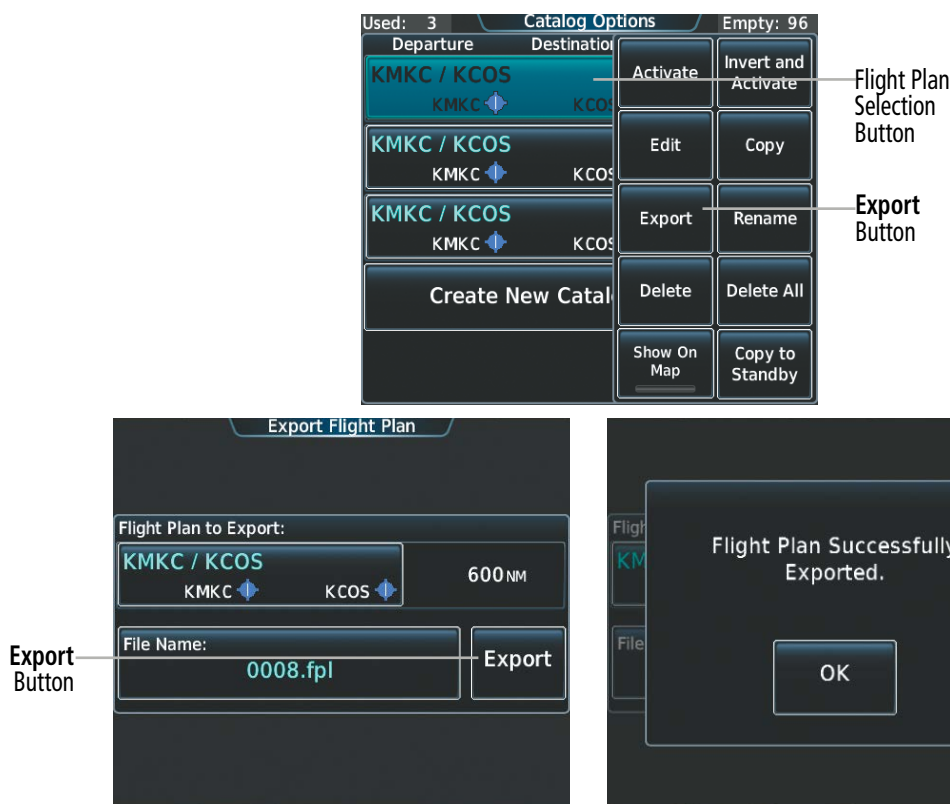
Figure 5-134 Stored Flight Plan Export

If the export fails, a 'Flight Plan Export Failed' message will be displayed. Touch the **OK** Button to return to the 'Flight Plan Catalog' Screen.

In some circumstances, flight plan import or export messages may appear in a pop-up window in conjunction with others.

Flight Plan Import/Export Results	Description
'Flight plan successfully imported.'	A flight plan file stored on the SD card was successfully imported as a stored flight plan.
'File contained user waypoints only. User waypoints imported successfully. No stored flight plan data was modified.'	The file stored on the SD card did not contain a flight plan, only user waypoints. These waypoints have been saved to the system user waypoints. No flight plans stored in the system have been modified.
'No flight plan files found to import.'	The SD card contains no flight plan data.
'Flight plan import failed.'	Flight plan data was not successfully imported from the SD card.
'Flight plan partially imported.'	Some flight plan waypoints were successfully imported from the SD card, however others had errors and were not imported. A partial stored flight plan now exists in the system.
'File contained user waypoints only.'	The file stored on the SD card did not contain a flight plan, only user waypoints. In addition, one or more of these waypoints may not have imported successfully.
'Too many points. Flight plan truncated.'	The flight plan on the SD card contains more waypoints than the system can support. The flight plan was imported with as many waypoints as possible.
'Some waypoints not loaded. Waypoints locked.'	The flight plan on the SD card contains one or more waypoints the system cannot find in the navigation database. The flight plan has been imported, but must be edited within the system before it can be activated for use.
'User waypoint database full. Not all loaded.'	The flight plan file on the SD card contains user waypoints. The quantity of stored user waypoints has exceeded system capacity, therefore not all the user waypoints on the SD card have been imported. Any flight plan user waypoints that were not imported are locked in the flight plan. The flight plan must be edited within the system before it can be activated for use.
'One or more user waypoints renamed.'	One or more imported user waypoints were renamed when imported due to naming conflicts with waypoints already existing in the system.
'Flight plan successfully exported.'	The stored flight plan was successfully exported to the SD card.
'Flight plan export failed.'	The stored flight plan was not successfully exported to the SD card. The SD card may not have sufficient available memory or the card may have been removed prematurely.

Table 5-21 Flight Plan Import/Export Messages

DELETING THE ACTIVE OR STANDBY FLIGHT PLAN

The system allows deleting the active or standby flight plan. Deleting the active flight plan suspends navigation by the system. For information on deleting stored flight plans, see the Stored Flight Plan Functions discussion in this section.

Deleting the active or standby flight plan:

1) For the active flight plan: From Home, touch **Flight Plan** > **Flight Plan Options**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan** > **Flight Plan Options**.

2) Touch the **Delete Flight Plan** Button.

3) Touch the **OK** Button in response to "Delete all waypoints in flight plan?". The flight plan is deleted. To cancel the request, touch the **Cancel** Button.

ACTIVE FLIGHT PLAN RETENTION

After applying power to the system, the previously active flight plan is retained and automatically repopulated if the aircraft position is at the origin airport and the aircraft is on the ground. If, however, the aircraft is not at the origin, on the ground, or if more than 12 hours have passed since the last active flight plan modification, the previously active flight plan is not retained.

STORED FLIGHT PLAN FUNCTIONS

Stored flight plans are listed on the 'Flight Plan Catalog' Screen. Each stored flight plan can be copied to the standby flight plan, and are available for activation (becomes the active flight plan). Up to 99 flight plans with up to 100 waypoints each can be created and stored in memory. If the flight plan memory is full and a flight plan is imported, it will overwrite the last flight plan in the catalog. Details about each stored flight plan can be viewed on the 'Flight Plan Catalog' Screen.

Viewing information about a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen. The flight plan information is displayed showing departure, destination, and total distance information for the stored flight plans.

3) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

4) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen to view the waypoints in the stored flight plan.
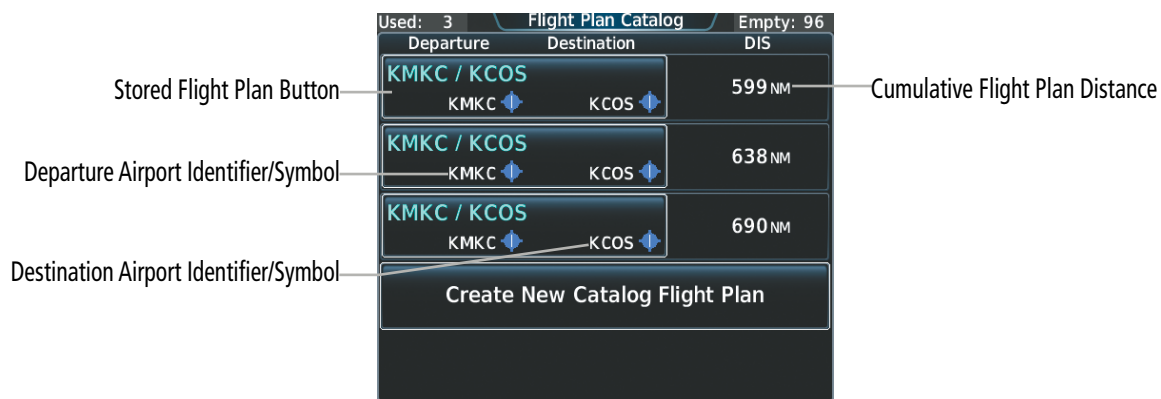
Figure 5-135 'Flight Plan Catalog' Screen

Figure 5-136 'Edit Stored Flight Plan' Screen

Storing a Flight Plan from the Active or Standby Flight Plan

The standby flight plan may be used as a means to create a flight plan for future use. Once a standby flight plan is created, it can be stored to the Flight Plan Catalog.

Storing a flight plan:

1) For the active flight plan: From Home, touch **Flight Plan** > **Flight Plan Options**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan** > **Flight Plan Options**.

2) Touch the **Store** Button.

3) Touch the **OK** Button in response to the question "Store <origin>/<destination> into catalog?".

Activating a Stored Flight Plan

Activating a stored flight plan erases the active flight plan and replaces it with the flight plan being activated. Inverting and activating a stored flight plan reverses the waypoint order, erases the active flight plan, and replaces it with the flight plan being activated (the stored flight plan is not changed).

Activating a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

4) Touch the **Activate** Button.

5) Touch the **OK** Button in response to "Activate Selected Flight Plan and Replace Current Active Route?". To cancel the request, touch the **Cancel** Button.

Inverting and activating a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if necessary and touch a flight plan selection button to display the 'Catalog Options' Window.

4) Touch the **Invert and Activate** Button.

5) Touch the **OK** Button in response to "Invert and Activate Selected Flight Plan and Replace Current Active Route?". The stored flight plan is inverted (all procedures are removed) and becomes the active flight plan. The stored flight plan is not modified. To cancel the request, touch the **Cancel** Button.

Copying a Stored Flight Plan

The system allows copying a stored flight plan into a new flight plan memory slot, allowing editing, etc., without affecting the original flight plan. This can be used to duplicate an existing stored flight plan for use in creating a modified version of the original stored flight plan. A stored flight plan can also be copied to the standby flight plan.

Copying a stored flight plan to another flight plan memory slot:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

4) Touch the **Copy** Button.

5) Touch the **OK** Button in response to "Copy Flight Plan <flight plan name>?". The copied flight plan is placed in the list of stored flight plans. To cancel the request, touch the **Cancel** Button.

Copying a stored flight plan to the standby flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

4) Touch the **Copy to Standby** Button. If the standby flight plan is empty, the selected flight plan is copied to the standby flight plan. If there is already a standby flight plan, then a confirmation message is displayed.

5) If necessary, touch the **OK** Button in response to "Copy Selected Flight Plan and Replace Current Standby Flight Plan?". The selected flight plan is copied to the standby flight plan. To cancel the request, touch the **Cancel** Button.

Deleting a Stored Flight Plan

Individual flight plans can be deleted from the system memory.

Deleting a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

4) Touch the **Delete** Button.

5) Touch the **OK** Button in response to "Delete Flight Plan <flight plan name>?". The flight plan is deleted, and any flight plans following it in the list are shifted up. To cancel the request, touch the **Cancel** Button.

CHANGING FLIGHT PLAN COMMENTS (NAMES)

The 'Comment' Field (or name) of each flight plan can be changed to something that is useful for identification and sorting.

Renaming the active flight plan is possible via the 'Flight Plan' Window on the PFD when using the PFD Controller.

Changing a flight plan comment:

1) For the active flight plan: From Home, touch **Flight Plan** > **Flight Plan Options**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan** > **Flight Plan Options**.

   Or:

   For the stored flight plan:

   a) From Home, touch **Flight Plan** > **Flight Plan Options**.

   b) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

   c) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

2) Touch the **Rename** Button to display the keypad.

3) Use the keypad to select the comment.

4) Touch the **Enter** Button to accept the comment, and return to the flight plan.

Changing a flight plan comment using the PFD Controller:

> ✓ *NOTE: Changing the comment using the PFD Controller does not update the comment on the 'Active Flight Plan' Screen unless something else in the flight plan has changed.*

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large **PFD** Knob to move the cursor to the comment field at the top of the flight plan (e.g. KMKC/ KCOS), if necessary.

3) Turn the small **PFD** Knob one click to activate the editing cursor.

4) Turn the large and small **PFD** Knobs to select the comment (large knob moves the cursor; small knob selects the character).

5) Press the **ENT** Key or the small **PFD** Knob to accept the selection.

5.6 PROCEDURES

The system can access departures, arrivals, and approaches that are stored within the database using the Touchscreen Controller or the PFD Controller. Selected procedures can be added to the active, standby, or stored flight plan.

The process of loading procedures into the active flight plan and standby flight plan are similar (except the standby flight plan can only be modified on the Touchscreen Controller, not on the PFD Controller). Waypoints are not required to be in the flight plan to load procedures. When a selected procedure is added to a flight plan, the airfield identifier for that procedure will fill the origin or destination field. If the origin or destination airport (or runway) is already loaded, the procedure selection screen defaults to the appropriate airport.

> **NOTE:** *The origin airport/runway remains when removing a departure; the destination airport/runway remains if after deleting the procedure, there is no longer a procedure at the destination airport. A procedure replaces the respective destination/runway waypoint.*

Whenever an approach, departure, or arrival procedure is loaded into the active flight plan, a set of approach, departure, or arrival waypoints is inserted into the flight plan along with a header line describing the instrument procedure the pilot selected. The original enroute portion of the flight plan remains active (unless an instrument procedure is activated) when the procedure is loaded.

The system adds procedures to the flight plan based on the leg types coded within that procedure in the navigation database. Terminal procedures may contain unique characteristics, such as specifically coded leg segments like '2000FT', which indicates a leg that requires manual termination by the pilot when the specified altitude (2000 feet) has been exceeded. A heading leg in the flight plan displays 'hdg' or 'HDG' preceding the DTK (e.g. 'hdg 008°'). A flight plan leg requiring the pilot to manually initiate sequencing to the next leg displays 'MANSEQ' as the identifier.

Figure 5-137 Procedure Leg Identifiers

Viewing available procedures at an airport:

1) From Home, touch **Waypoint Info** > **Airport**.

2) If necessary, touch the Airport Selection Button to display the keypad and use it to select the airport.

3) Touch the **Proc** Tab to display the 'Airport Procedures' Screen.

4) Scroll the list if necessary and touch a procedure selection button. The procedure selection screen is displayed on the Touchscreen Controller for the selected procedure.

5) Touch the **Preview** Button, then the **Show on Map** Button to show the procedure on the active display pane or touch the **Show Chart** Button to show the chart instead.

6) Touch the **Cancel** Button to return to the 'Airport Procedures' Screen to view another procedure.

7) Repeat Steps 4 through 6 as necessary.

Loading a procedure into the active flight plan from the 'Airport Information' Screen:

1) From Home, touch **Waypoint Info** > **Airport**.

2) If necessary, touch the Airport Selection Button to display the keypad and use it to select the airport.

3) Touch the **Proc** Tab to display the 'Airport Procedures' Screen.

4) Scroll the list, if necessary, and touch a procedure selection button. The procedure selection screen is displayed on the Touchscreen Controller for the selected procedure.

5) Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the procedure on the active display pane or touch the **Show Chart** Button to show the procedure chart instead.

6) Select a different procedure, if desired.

7) Touch the **Load** Button to insert the procedure into the active flight plan.

Loading a procedure into the active flight plan from the 'Nearest Airport' Screen:

1) From Home, touch **Nearest** > **Airport**.

2) If necessary, scroll the list to find the airport and touch the airport selection button to display the 'Waypoint Options' Window for the selected airport. If the airport is not listed, touch any airport selection button to display the 'Waypoint Options' Window.

3) Touch the **Airport Info** Button to display the 'Airport Information' Screen. If in the previous step, the airport was not listed, touch the airport button and use the keypad to select the destination airport.

4) Touch the **Proc** Tab to display the 'Airport Procedures' Screen.

5) Scroll the list, if necessary, and touch a procedure selection button. The procedure selection screen is displayed on the Touchscreen Controller for the selected procedure.

6) Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the procedure on the active display pane or touch the **Show Chart** Button to show the procedure chart instead.

7) Select a different procedure, if desired.

8) Touch the **Load** Button to insert the procedure into the active flight plan.

NOTE: The system responds to a terminal procedure based on data coded within that procedure in the Navigation Database. Differences in system operation may be observed among similar types of procedures due to differences in the Navigation Database coding specific to each procedure.

Removing an entire procedure from a flight plan:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

   Or:

   For the stored flight plan:

   a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

   b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

   c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

2) Scroll the list if necessary and touch a departure, arrival, or approach selection button to display the 'Departure Options', 'Arrival Options', or 'Approach Options' Window.

3) Touch the **Remove Departure** Button, the **Remove Arrival** Button, or the **Remove Approach** Button.

4) Touch the **OK** Button in response to "Remove <procedure> – <procedure name> from flight plan?". The procedure is removed. To cancel the request, touch the **Cancel** Button.

Removing an entire procedure from the active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large **PFD** Knob to highlight the procedure header.

3) Press the **CLR** Key. The 'Remove <procedure name> from flight plan?' window is displayed.

4) With 'OK' highlighted, press the **ENT** Key or the small knob to remove the procedure.

PREVIEW ONLY PROCEDURES

Certain procedures that are provided by the charts database but are not supported for navigation guidance by the system may be listed on the 'Select <Procedure>' Screen. These procedures are selectable for Preview Only.
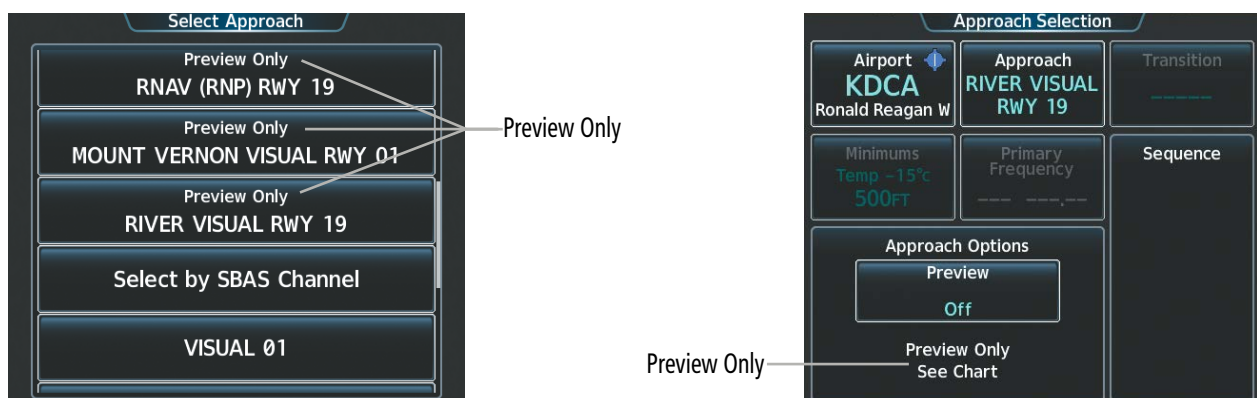
Figure 5-138 Procedure Selection – Preview Only (Approach example)

DEPARTURES

A Departure can be loaded at any airport that has one available. When loaded, a departure procedure is placed at the origin airport in the flight plan. Only one departure can be loaded at a time in a flight plan. If a departure is loaded when another departure is already in the flight plan, the new departure replaces the previous departure. The departure sequence is defined by selection of a departure, the runway, and transition waypoints.

Loading a departure into the flight plan using the Touchscreen Controller:

1) For the active flight plan:

   a) From Home, touch **PROC**.

   b) Touch the **Departure** Button to display the 'Departure Selection' Screen.

   Or:

   For the standby flight plan:

   a) From Home, touch **Flight Plan** > **Standby Flight Plan > PROC**.

   b) Touch the **Departure** Button to display the 'Departure Selection' Screen.

   Or:

   For the stored flight plan:

   a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

   b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

   c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

   d) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

   e) Touch the **Load Departure** Button to display the 'Departure Selection' Screen.

2) To access the 'Select Departure' Screen for the departure airport:

   If the desired departure airport is already selected, touch the **Departure** Button. The 'Select Departure' Screen is displayed.

   Or:

   a) Touch the **Airport** Button.

   b) Use the keypad and the **Enter** Button to select the departure airport. The 'Select Departure' Screen is displayed.

3) Scroll the list if needed and touch a Departure Selection Button to select a departure. The 'Select Transition' Screen may open.

4)   Scroll the list if needed and available. Touch a Transition Selection Button to select the transition if necessary. The 'Select Runway' Screen will open.

5)   Scroll the list if needed and touch a Runway Selection Button to select the runway and return to the 'Departure Selection' Screen.

6)   Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the departure on the active display pane or touch the **Show Chart** Button to show the departure chart instead.

7)   Touch the **Load** Button to insert the departure into the flight plan.

The **Filter by** Button on the 'Departure Selection' Screen changes the selection order between Filter by Departure – selecting the departure first, then showing only the transitions and runways available for that departure; or Filter by Runway – selecting the runway first, then showing only the departures and transitions available for that runway. Any of the buttons can still be selected in any order. The Filter by Departure setting is always active when using the PFD Controller.

Loading a departure into the active flight plan using the PFD Controller:

1)   Press the **PROC** Key. The 'Procedures' Window is displayed.

2)   Highlight 'Select Departure'.

3)   Press the **ENT** Key or the small knob. The 'Select Departure' Window is displayed.

4)   Select an airport and press the **ENT** Key or the small knob.

5)   Select a departure from the list and press the **ENT** Key or the small knob.

6)   Select a runway (if required) and press the **ENT** Key or the small knob.

7)   Select a transition (if required) and press the **ENT** Key or the small knob. 'Load?' is highlighted.

8)   Press the **ENT** Key or the small knob to load the departure procedure.
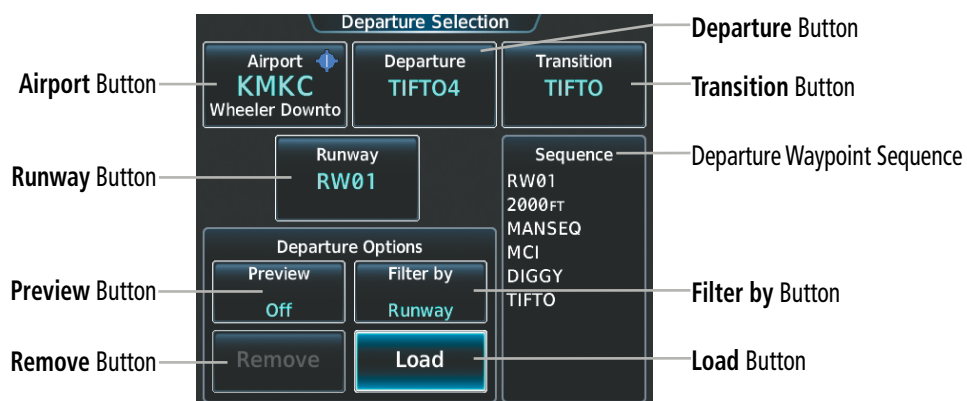
Figure 5-139 Departure Selection

Preview of Selected Departure

Origin Airport
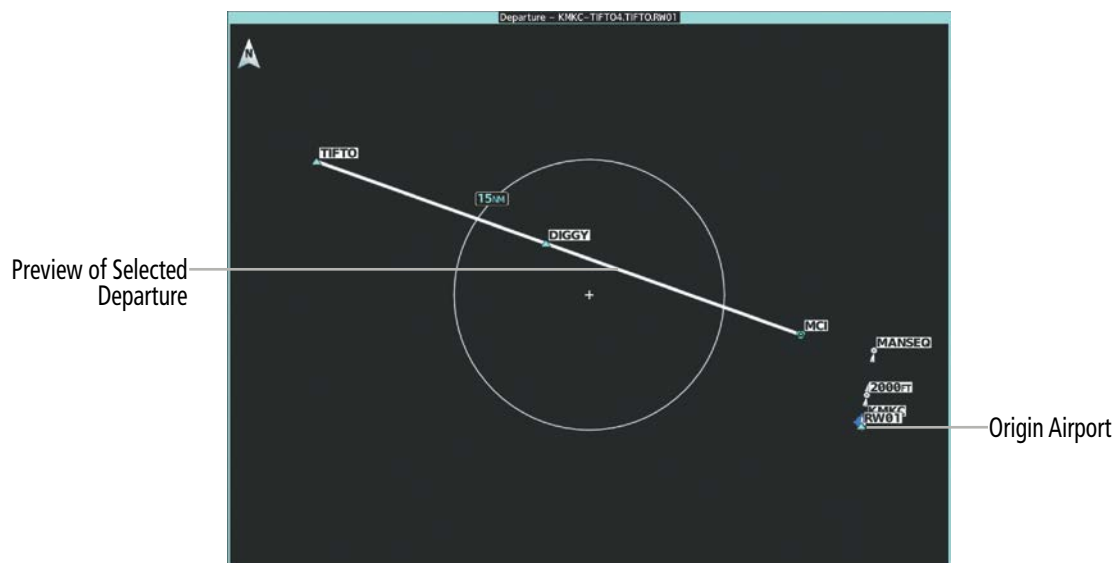
Figure 5-140 Preview of the Selected Departure

Stored Flight Plan Name

Stored Flight Plan Waypoint List

Load Departure Button

Load Arrival Button

Load Approach Button

Figure 5-141 Loading a Procedure into a Stored Flight Plan – 'Flight Plan Options' Window

When plans change while flying IFR, departures can be easily removed from the flight plan.

Removing a departure from a flight plan using the Touchscreen Controller:

1) For the active flight plan:

   a) From Home, touch **PROC**.

   b) Touch the **Departure** Button to display the 'Departure Selection' Screen.

   c) Touch the **Remove** Button. A 'Remove Departure – <departure identifier> from flight plan?' Window is displayed.

   Or:

   a)   From Home, touch **Flight Plan**.

   b)   Touch the Departure Header Button to display the 'Departure Options' Window.

   c)   Touch the **Remove Departure** Button. A 'Remove Departure – <departure identifier> from flight plan?' Window is displayed.

Or:

For the standby flight plan:

   a)   From Home, touch **Flight Plan** > **Standby Flight Plan > PROC**.

   b)   Touch the **Departure** Button to display the 'Departure Selection' Screen.

   c)   Touch the **Remove** Button. A 'Remove Departure – <departure identifier> from flight plan?' Window is displayed.

   Or:

   a)   From Home, touch **Flight Plan** > **Standby Flight Plan**.

   b)   Touch the Departure Header Button to display the 'Departure Options' Window.

   c)   Touch the **Remove Departure** Button. A 'Remove Departure – <departure identifier> from flight plan?' Window is displayed.

Or:

For the stored flight plan:

   a)   From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

   b)   Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

   c)   Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

   d)   Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

   e)   Touch the **Load Departure** Button to display the 'Departure Selection' Screen.

   f)   Touch the **Remove** Button. A 'Remove Departure – <departure identifier> from flight plan?' Window is displayed.

2)   Touch the **OK** Button. The departure is removed from the flight plan.

Removing a departure from the active flight plan using the PFD Controller:

1)   On the PFD Controller, press the **FPL** Key.

2)   Turn the large knob to highlight the departure header in the active flight plan.

3)   Press the **CLR** Key. The 'Remove <departure name> from flight plan?' window is displayed.

4)   With 'OK' highlighted, press the **ENT** Key or the small knob to remove the departure.

ARRIVALS

A Standard Terminal Arrival can be loaded at any airport that has one available. When loaded, an arrival is placed at the destination airport in the flight plan. Only one arrival can be loaded at a time in a flight plan. If an arrival is loaded when another arrival is already in the flight plan, the new arrival replaces the previous arrival. The arrival sequence is defined by selection of an arrival, the transition waypoints, and a runway.

Loading an arrival into the flight plan using the Touchscreen Controller:

1) For the active flight plan:

    a) From Home, touch **PROC**.

    b) Touch the **Arrival** Button to display the 'Arrival Selection' Screen.

    Or:

    For the standby flight plan:

    a) From Home, touch **Flight Plan** > **Standby Flight Plan > PROC**.

    b) Touch the **Arrival** Button to display the 'Arrival Selection' Screen.

    Or:

    For the stored flight plan:

    a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

    b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

    c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

    d) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

    e) Touch the **Load Arrival** Button to display the 'Arrival Selection' Screen.

2) To access the 'Select Arrival' Screen for the arrival airport:

    If the desired arrival airport is already selected, touch the **Arrival** Button. The 'Select Arrival' Screen is displayed.

    Or:

    a) Touch the **Airport** Button.

    b) Use the keypad and the **Enter** Button to select the arrival airport. The 'Select Arrival' Screen is displayed.

3) Scroll the list if needed and touch an Arrival Selection Button to select the arrival. The 'Select Transition' Screen may open.

4) Scroll the list if needed and available. Touch a Transition Selection Button to select the transition. The 'Select Runway' Screen will open.

5) Scroll the list if needed and touch a Runway Selection Button to select the runway and return to the 'Arrival Selection' Screen.

6) Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the arrival on the active display pane or touch the **Show Chart** Button to show the arrival chart instead.

7) Touch the **Load** Button to insert the arrival into the flight plan.

The **Filter by** Button on the 'Arrival Selection' Screen changes the selection order between Filter by Arrival – selecting the arrival first, then showing only the transitions and runways available for that arrival; or Filter by Runway – selecting the runway first, then showing only the arrivals and transitions available for that runway. Any of the buttons can still be selected in any order. The Filter by Departure setting is always active when using the PFD Controller.

Loading an arrival into the active flight plan using the PFD Controller:

1) Press the **PROC** Key. The 'Procedures' Window is displayed.

2) Highlight 'Select Arrival'.

3) Press the **ENT** Key or the small knob. The 'Select Arrival' Window is displayed.

4) Select an airport and press the **ENT** Key or the small knob.

5) Select an arrival from the list and press the **ENT** Key or the small knob.

6) Select a transition (if required) and press the **ENT** Key or the small knob.

7) Select a runway (if required) and press the **ENT** Key or the small knob. 'Load?' is highlighted.

8) Press the **ENT** Key or the small knob to load the arrival procedure.
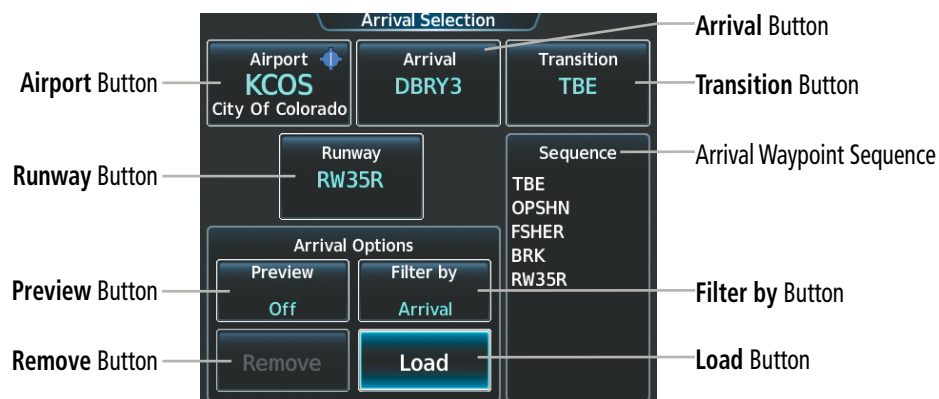
Figure 5-142 Arrival Selection
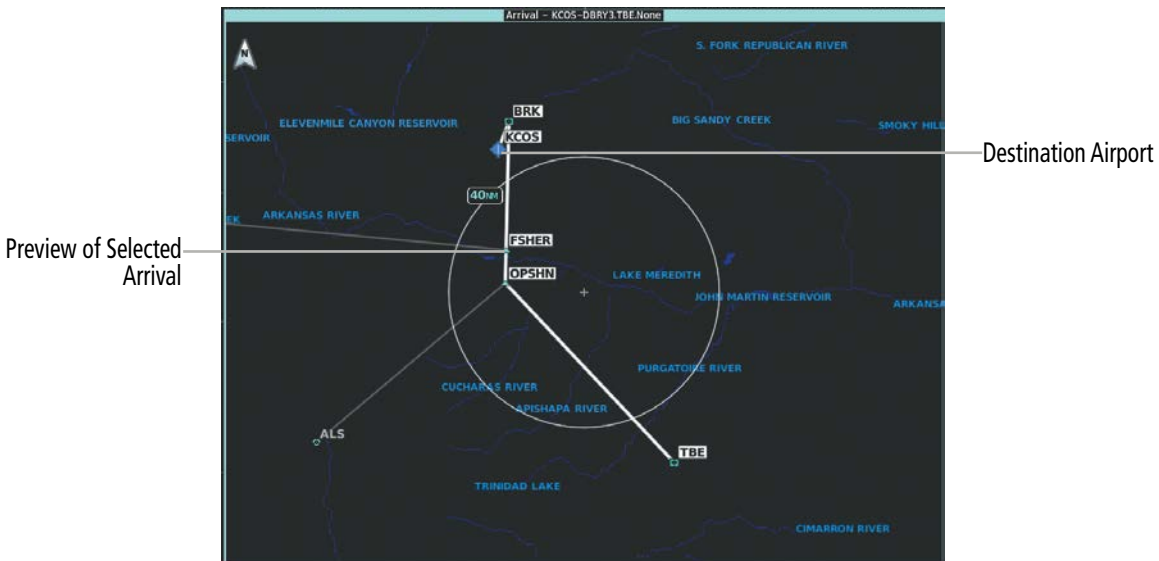
Figure 5-143 Arrival – Preview of the Selected Arrival

Removing an arrival from a flight plan using the Touchscreen Controller:

1) For the active flight plan:

    a) From Home, touch **PROC**.

    b) Touch the **Arrival** Button to display the 'Arrival Selection' Screen.

    c) Touch the **Remove** Button. A 'Remove Arrival – <arrival identifier> from flight plan?' Window is displayed.

    Or:

    a) From Home, touch **Flight Plan**.

    b) Touch the Arrival Header Button to display the 'Arrival Options' Window.

    c) Touch the **Remove Arrival** Button. A 'Remove Arrival – <arrival identifier> from flight plan?' Window is displayed.

Or:

For the standby flight plan:

    a) From Home, touch **Flight Plan** > **Standby Flight Plan > PROC**.

    b) Touch the **Arrival** Button to display the 'Arrival Selection' Screen.

    c) Touch the **Remove** Button. A 'Remove Arrival – <arrival identifier> from flight plan?' Window is displayed.

    Or:

    a) From Home, touch **Flight Plan** > **Standby Flight Plan**.

    b) Touch the Arrival Header Button to display the 'Arrival Options' Window.

    c) Touch the **Remove Arrival** Button. A 'Remove Arrival – <arrival identifier> from flight plan?' Window is displayed.

Or:

For the stored flight plan:

    a) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

    b) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

    c) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

    d) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

    e) Touch the **Load Arrival** Button to display the 'Arrival Selection' Screen.

    f) Touch the **Remove** Button. A 'Remove Arrival – <arrival identifier> from flight plan?' Window is displayed.

2) Touch the **OK** Button. The arrival is removed from the flight plan.

Removing an arrival from the active flight plan using the PFD Controller:

1) On the PFD Controller, press the **FPL** Key.

2) Turn the large knob to highlight the arrival header in the active flight plan.

3) Press the **CLR** Key. The 'Remove <arrival name> from flight plan?' window is displayed.

4) With 'OK' highlighted, press the **ENT** Key or the small knob to remove the arrival.

APPROACHES

The system can provide navigation guidance for GPS and NAVAID instrument approach procedures. Visual Approach guidance is also available. This section will discuss loading, activating, and removing approaches designated for navigation. For information on changing the navigation source of the CDI, and for information on the display of vertical guidance on the PFD, see the Flight Instruments Section. See the Audio and CNS Section for information on selecting and tuning a NAV receiver.

INSTRUMENT APPROACHES

> ✓ *NOTE: If certain GPS parameters (SBAS, RAIM, etc.) are not available, some published approach procedures for the desired airport may not be displayed in the list of available approaches.*

The system provides guidance for non-precision and precision approaches to airports with published instrument approach procedures. Only one approach can be loaded at a time in a flight plan. If an approach is loaded when another approach is already in the active flight plan, the new approach replaces the previous approach. The route is defined by selection of an approach and the transition waypoints.

> ✓ *NOTE: The Baro-VNAV approach feature is a compensated Baro-VNAV system, which automatically uses the outside air temperature (OAT) to adjust the approach glidepath. Temperature compensation values entered by the pilot will have no effect on the Baro-VNAV approach glidepath.*

> ✓ *NOTE: When flying Direct-to the Final Approach Fix (FAF), the system will suspend (SUSP) leg sequencing if the approach intercept angel exceeds 45 degrees.*

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> ✓ **NOTE:** When Vectors to Final is selected, the system will display an extended centerline, but guidance is not provided to the Final Approach Course.

> ✓ **NOTE:** When Steep Approach is enabled under the TAWS settings, TOLD must be calculated manually and the 'CHK STEEP' message is displayed on the 'Landing Data' Screen. See the Hazard Avoidance Section for information on the Steep Approach function.

PUBLISHED APPROACHES USING GPS

RNAV/GPS approach procedures require GPS and can be selected for use. When the Touchscreen Controller displays 'GPS' after a NAVAID prefix (such as VORGPS 17L), this indicates the procedure is an Overlay Approach. The procedure may be flow either as a conventional, ground-based approach procedure or may be flown with GPS. When the Touchscreen Controller displays an approach listed with"+V", this indicates the system will provide advisory vertical guidance when using GPS to fly the approach.

Just as the system supports navigating an airway using GPS, and using GPS instead of DME, the system also supports using GPS as an alternate means of navigation for NAVAID exclusive approaches (not including localizer based approaches).

Refer to the current, pertinent flight manual and regulations for information on alternatively using GPS navigation for NAVAID exclusive approaches.
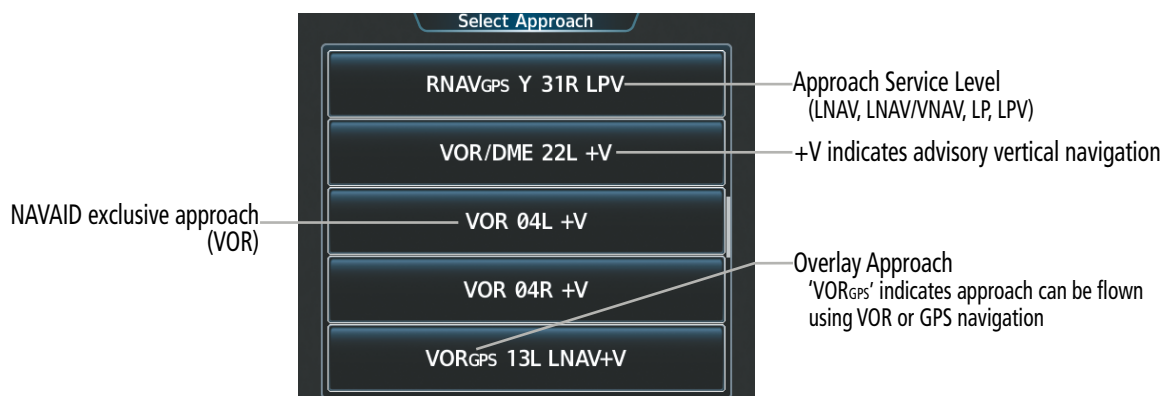
Figure 5-144 Example of Available Approaches with GPS Guidance

HSI Annunciation	Description	Example on HSI
LNAV	Approach to the published MDA	
LP		
LNAV+V	Approach with advisory vertical guidance to the published MDA	
LP+V		
L/VNAV	Approach with approved vertical guidance to the published DA	
LPV		

Approach Service Level
– LNAV, LNAV+V, L/VNAV, LP, LP+V, LPV

Table 5-22 Approach Service Levels

> ✓ **NOTE:** *The system requires 30 seconds of valid SBAS integrity monitoring prior to selecting an approach that requires SBAS vertical guidance.*

The system GPS receivers will use Satellite Based Augmentation (SBAS) when available. Some approaches require the use of SBAS for lateral and/or vertical GPS navigation. However, the system will provide Barometric Vertical Navigation (Baro-VNAV) if SBAS is not available. For information on how lateral and vertical guidance is depicted on the PFD, see the Flight Instruments Section.

Approach Service Level	Lateral Navigation Source	Vertical Navigation Source
LNAV	GPS	N/A
LNAV+V	GPS	GPS (advisory only)
LNAV/VNAV	GPS	GPS [1] or Baro VNAV [2]
LP	GPS [1]	N/A
LP+V	GPS [1]	GPS [1] (advisory only)
LPV	GPS [1]	GPS [1]

[1] *SBAS required*
[2] *See Approach Downgrade Behavior Table*

Table 5-23 Source of Lateral and Vertical Navigation per Approach Service Level

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Loss of SBAS

Due to the high level of precision required by some approach service levels, losing SBAS may require the pilot to acknowledge a downgrade of approach service level, or to abort the approach. See the following table for approach degradation behavior:

> **NOTE:** *Refer to the current, pertinent flight manual for additional information regarding crew responses for loss of SBAS and approach downgrade procedures.*

Approach	SBAS Becomes Unavailable	Description	Action Required	Downgrade
LNAV	Approach phase not specified	SBAS not required. The approach is continued.	None	N/A
LNAV+V				
LNAV/ VNAV	Prior to the FAF	HSI displays approach service level in amber; VDI displays 'NO GP'. [2]	Acknowledge message to display Baro VNAV Glidepath	N/A
	At/after the FAF	HSI displays downgraded approach service level in magenta; VDI displays 'NO GP'.	None	LNAV [1]
LP	More than 1 min prior to the FAF	HSI displays approach service level in amber.	None	N/A
	Within 1 min prior to the FAF	HSI displays downgraded approach service level in magenta; CDI is removed. [2]	Acknowledge message to redisplay CDI with LNAV	LNAV [1]
	At/after the FAF	CDI is removed. [2]	Acknowledge ABORT APR message to redisplay CDI	N/A
LP+V	More than 1 min prior to the FAF	HSI displays approach service level in amber; VDI displays 'NO GP'.	None	N/A
	Within 1 min prior to the FAF	HSI displays downgraded approach service level in magenta; CDI is removed. VDI displays 'NO GP'. [2]	Acknowledge message to redisplay CDI with LNAV	LNAV [1]
	At/after the FAF	CDI is removed; VDI displays 'NO GP'. [2]	Acknowledge ABORT APR message to redisplay CDI	N/A

Approach	SBAS Becomes Unavailable	Description	Action Required	Downgrade
LPV	More than 1 min prior to the FAF	HSI displays approach service level in amber;	None	N/A
	Within 1 min prior to the FAF	HSI displays downgraded approach service level in amber; VDI displays 'NO GP'. [2]	Acknowledge message to display Baro VNAV Glidepath	LNAV/ VNAV [1]
	At/after the FAF	HSI displays downgraded approach service level in magenta; VDI displays 'NO GP'.	None	LNAV [1]

[1] *If there are no LNAV minimums available for the approach, abort.*
[2] *System message is generated.*

Table 5-24 Approach Degradation Behavior

Loss of GPS

When GPS sensors no longer have sufficient integrity while on the final segment of a GPS approach, the approach service level on the HSI will turn amber, and the annunciation 'GPS LOI' will be displayed on the PFD, and the 'Notifications' Screen will display a 'LOI' message. If the aircraft is at or beyond the FAF when the condition occurs, the 'ABORT APR' message is displayed, and the CDI deviation bar is removed from the HSI. The CDI deviation bar will reappear when the 'ABORT APR' message is acknowledged.

If a total loss of GPS positioning occurs while on the final segment of a GPS approach, the approach service level on the HSI will turn amber, and the annunciation 'GPS LOI' will be displayed on the PFD, and the 'Notifications' Screen will display a 'LOSS OF GPS NAVIGATION' message. If the aircraft is at or beyond the FAF when the condition occurs, the 'ABORT APR' message is displayed. The CDI deviation bar is removed from the HSI and cannot be restored when GPS positioning is unavailable.

VISUAL APPROACHES

The system provides a visual approach feature. Unlike instrument approaches, visual approaches are not defined in the navigation database and do not follow a precise prescribed path. Instead, the system calculates the lateral and vertical path for the chosen runway and creates visual approach waypoints based on runway position and course as specified in the navigation database.

> **NOTE:** *The charts database may contain Charted Visual Flight Procedures (CVFPs) for certain airports. CVFPs follow a precise prescribed path and are classified as Instrument Approach Procedures (IAPs). See the Additional Features Section for more information on Charts.*

Each visual approach will have two transitions, the straight in transition (STRAIGHT) and the Vectors-to-Final transition (VECTORS). The visual approach waypoints (fixes) consist of the initial fix (STRGHT), the final approach fix (FINAL), and the missed approach point (RWxx).

> **NOTE:** *When flying direct-to the 'FINAL' waypoint, the system will suspend (SUSP) leg sequencing if the approach intercept angle exceeds 45 degrees. For visual approaches only, if leg sequencing is subsequently unsuspended, turn anticipation from 'FINAL' will be provided.*

For visual approaches, the pilot is responsible for avoiding terrain, obstacles and traffic. Therefore, when a visual approach is selected, the "Obstacle clearance is not provided for visual approaches" window is displayed and must be acknowledged before the visual approach is loaded into the flight plan.
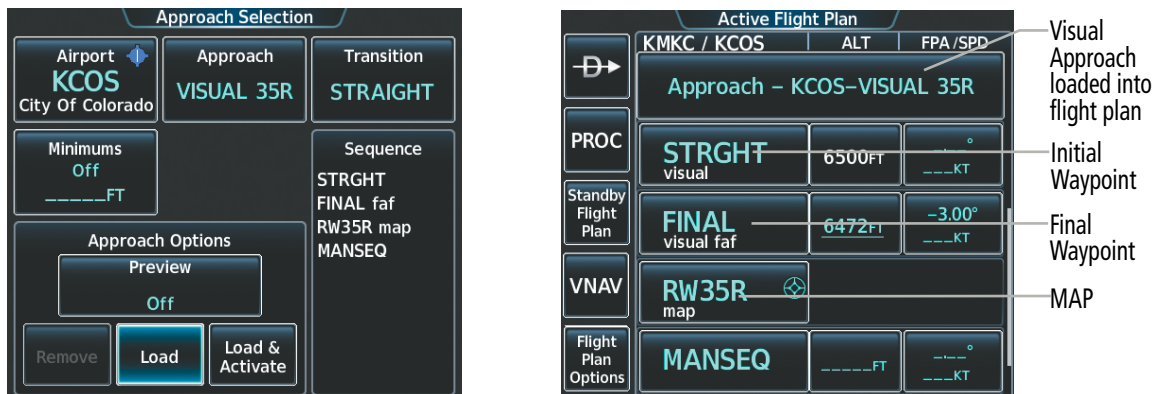
Figure 5-145 Loading a Visual Approach
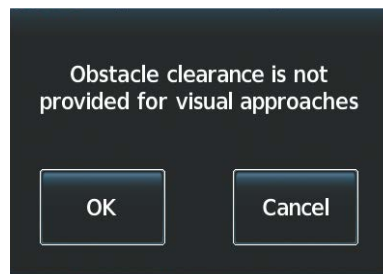
Figure 5-146 Visual Approach Advisory

LOADING AND ACTIVATING AN APPROACH

Whenever an approach is selected, the choice to either 'Load' or 'Activate' is given. 'Load' adds the approach to the end of the flight plan without immediately using it for navigation guidance. This allows continued navigation via the intermediate waypoints in the original flight plan, but keeps the procedure available for quick activation when needed. 'Activate' also adds the procedure to the end of the flight plan but immediately begins to provide guidance to the first waypoint in the approach.

In many cases, it may be easiest to load the full approach while still some distance away, enroute to the destination airport. Later, if vectored to final, use the steps below to select 'Activate Vector-To-Final' — which makes the inbound course to the FAF waypoint active.

> **NOTE:** Loading (only) an approach, to follow after the destination airport, can cause loss of VPath tracking.

> **NOTE:** If there is no arrival procedure in the active flight plan, loading an approach to a flight plan in which the destination airport has already been entered, will result in the previously entered destination airport becoming a fly-over waypoint followed by the newly loaded approach.
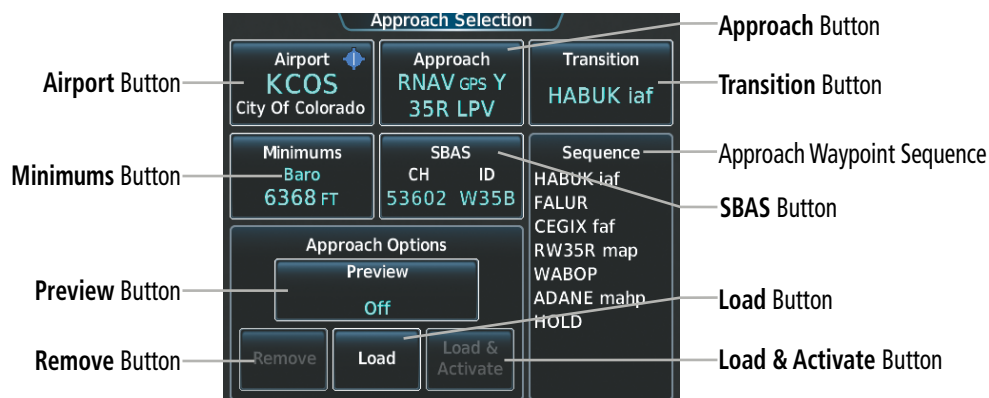
Figure 5-147 Approach Selection

Labels around figure:
- Airport Button
- Minimums Button
- Preview Button
- Remove Button
- Approach Button
- Transition Button
- Approach Waypoint Sequence
- SBAS Button
- Load Button
- Load & Activate Button
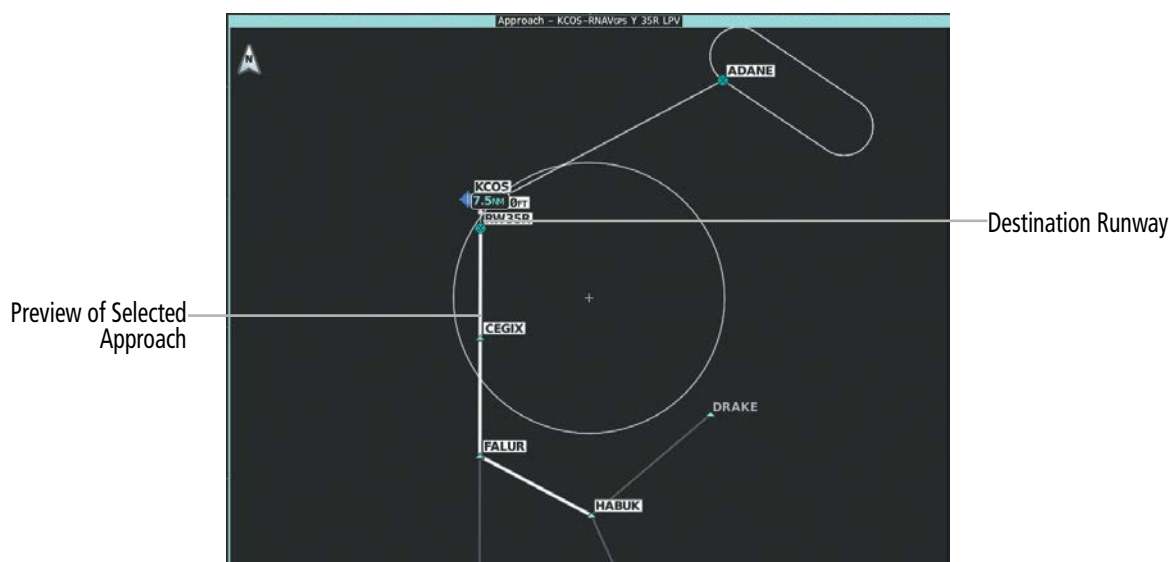
Figure 5-148 Approach – Preview of the Selected Approach

Labels:
- Preview of Selected Approach
- Destination Runway
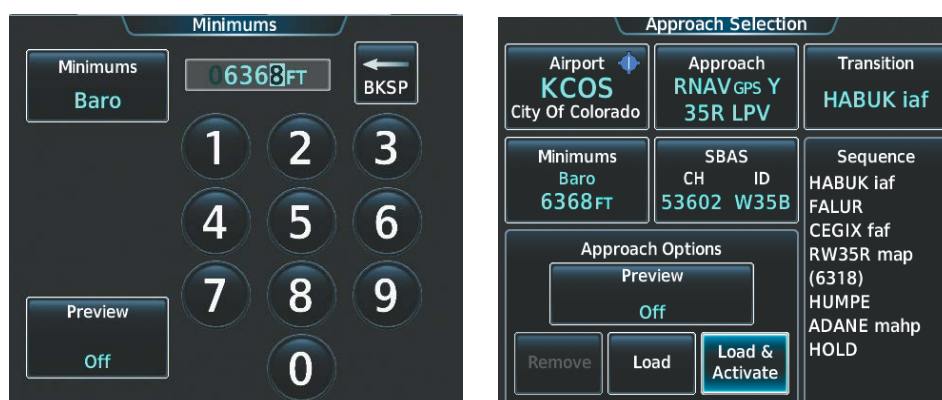
Figure 5-149 Loading an Approach – Setting Minimums

Loading an approach into the active/standby flight plan using the Touchscreen Controller:

1) For the active flight plan: From Home, touch **PROC**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan** > **PROC**.

2) Touch the **Approach** Button to display the 'Approach Selection' Screen.

3) To select the approach:

   a) If the desired approach airport is already selected, touch the **Approach** Button. The 'Select Approach' Screen is displayed.

   b) Scroll the list, if needed, and touch the desired Approach Selection Button.

   c) The 'Select Transition' Screen is automatically displayed after selecting an approach from the 'Select Approach' Screen. Touch the desired Transition Selection Button to select the transition.

      Or:

   a) Touch the **Airport** Button.

   b) Use the keypad and the **Enter** Button to select the approach airport. The 'Select Approach' Screen is displayed.

   c) Scroll the list, if needed, and touch the desired Approach Selection Button.

   d) The 'Select Transition' Screen is automatically displayed after selecting an approach from the 'Select Approach' Screen. Touch the desired Transition Selection Button to select the transition.

      Or:

   a) If the **SBAS** Button is available, touch the **SBAS** Button to display the keypad and use it to select the SBAS channel number (The SBAS channel Button is only available when an RNAV, GPS, or no approach is selected).

      If the **SBAS** Button is not available, touch the **Approach** Button to display the 'Select Approach' Screen. Scroll as needed and touch the **Select by SBAS Channel** Button to display the keypad, and use it to select the SBAS channel number.

   b) Touch the **Enter** Button to accept the SBAS channel and return to the 'Approach Selection' Screen with the airport and approach selected.

   c) Touch the **Transition** Button to display the 'Select Transition' Screen.

4) Scroll the list, if needed, and touch a Transition Selection Button to select the transition.

5) To set the minimums, touch the **Minimums** Button to display the 'Minimums' Screen.

   a) If Baro is desired, touch the **Minimums** Button to display the 'Minimums Source' Window.

   b) Touch the **Baro** Button to select barometric minimums and return to the 'Minimums' Screen.

   c) Use the keypad to select the minimums altitude.

   d) Touch the **Enter** Button to accept the barometric minimum altitude and return to the 'Approach Selection' Screen.

      Or:

a) If temperature compensated minimum is desired, touch the **Minimums** Button to display the 'Minimums Source' Window.

b) Touch the **Temp Comp** Button. The first time temperature compensation is enabled, the 'Destination Temp' Screen is displayed. Use the keypad and the **Enter** Button to select the temperature at the airport. If temperature compensation was previously enabled, the previous entry for destination temperature is automatically entered.

c) Use the keypad to select the minimums altitude.

d) Touch the **Enter** Button to accept the temperature compensated minimums and return to the 'Approach Selection' Screen.

6) Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the approach on the active display pane or touch the **Show Chart** Button to show the approach chart instead.

7) Touch the **Load** Button to insert the approach into the flight plan.

If a visual approach was selected, the message 'Obstacle clearance is not provided for visual approaches' is displayed. Touch the **OK** Button to continue.

> **NOTE:** *If the desired IAF is also an entry waypoint to a hold in leu of procedure turn, and the option to load the course reversal is accepted, the altitude constraint for this IAF may not be loaded.*

An Approach Procedure can be loaded into a stored flight plan. Only one approach can be loaded at a time in a stored flight plan.

Loading an approach procedure into a stored flight plan:

1) From Home, touch **Flight Plan** > **Flight Plan Options**.

2) Touch the **Flight Plan Catalog** Button to display the 'Flight Plan Catalog' Screen.

3) Touch a flight plan selection button to display the 'Catalog Options' Screen.

4) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

5) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

6) Touch the **Load Approach** Button to display the 'Approach Selection' Screen.

7) Select the airport and approach:

a) If needed, touch the **Airport** Button to display the keypad and use it to select the approach airport.

b) Touch the **Enter** Button to accept the approach airport.

c) If needed, touch the **Approach** Button to display the 'Select Approach' Screen with a list of available approaches.

d) Scroll the list if needed and touch a approach selection button to select the approach and display the 'Select Transition' Screen.

e) Scroll the list if needed and touch a transition selection button to select the transition and return to the 'Approach Selection' Screen.

Or:

a) If the **SBAS** Button is available , touch the **SBAS** Button to display the keypad and use it to select the SBAS channel number (The **SBAS** channel Button is only available when an RNAV or GPS based approach is selected, or no approach is selected).

Or:

If the **SBAS** Button is not available , touch the **Approach** Button to display the 'Select Approach' Screen. Scroll as needed and touch the **Select by SBAS Channel** Button to display the keypad, and use it to select the SBAS channel number.

b) Touch the **Enter** Button to accept the SBAS channel and return to the 'Approach Selection' Screen with the airport and approach selected.

c) Touch the **Transition** Button to display the 'Select Transition' Screen with a list of available transitions.

d) Scroll the list if needed and touch a transition selection button to select the transition and return to the 'Approach Selection' Screen.

8) Touch the **Preview** Button, then the **Show on Map** Button to show the preview of the approach on the active display pane or touch the **Show Chart** Button to show the approach chart instead.

9) Touch the **Load** Button to insert the approach into the stored flight plan.

NOTE: The **SBAS** Button may change to an approach **Primary Frequency** Button for NAVAID-based approaches. For more information, see the Audio & CNS Section.

Stored Flight Plan Name

Inserted Approach Header
– Approach Identifier: [destination airport]-[runway and approach type]. (e.g., KCOS-RNAV GPS Y 35R LPV)

Figure 5-150 Edit Stored Flight Plan – Approach Inserted

"Activate Approach" creates a direct path to the first approach waypoint. The approach mode will not become active until the first leg of the approach becomes active. A previously loaded approach can be activated from the 'Procedures' Screen or the 'Active Flight Plan' Screen on the Touchscreen Controller.

Activating a previously loaded approach using the Touchscreen Controller:

1) From Home, touch **PROC**.

2) Touch the **Activate Approach** Button to activate the approach.

Or:

1) From Home, touch **Flight Plan**.

2) Touch the Approach Header Button to display the 'Approach Options' Window.

3) Touch the **Activate Approach** Button to activate the approach.

Activating a previously loaded approach using the PFD Controller:

1) Press the **PROC** Key. The 'Procedures' Window is displayed.

2) Highlight 'Activate Approach'.

3) Press the **ENT** Key or the small **PFD** Knob. The approach is activated.

In many cases, it may be easiest to "load" the full approach while still some distance away, enroute to the destination airport. Later, if vectored to final, activate Vectors To Final, which makes the inbound course to the FAF waypoint active.

Activating a previously loaded approach with vectors to final using the Touchscreen Controller:

1) From Home, touch **PROC**.

2) Touch the **Activate Vectors To Final** Button to activate vectors to final.

Or:

1) From Home, touch **Flight Plan**.

2) Touch the Approach Header Button to display the 'Approach Options' Window.

3) Touch the **Activate Vectors To Final** Button to activate vectors to final.

Activating a previously loaded approach with vectors to final using the PFD Controller:

1) Press the **PROC** Key. The 'Procedures' Window is displayed.

2) Highlight 'Activate Vector-To-Final'.

3) Press the **ENT** Key or the small **PFD** Knob. Vector to final is activated.

REMOVING AN APPROACH

Removing an approach from the active/standby flight plan using the Touchscreen Controller:

1) For the active flight plan: From Home, touch **PROC**.

Or:

For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan** > **PROC**.

2) Touch the **Approach** Button to display the 'Approach Selection' Screen.

3) Touch the **Remove** Button. A 'Remove approach <approach> from flight plan?' Window is displayed.

4) Touch the **OK** Button. The approach is removed from the active flight plan. To cancel the request, touch the **Cancel** Button.

Or:

1) For the active flight plan: From Home, touch **Flight Plan**.

   Or:

   For the standby flight plan: From Home, touch **Flight Plan** > **Standby Flight Plan**.

2) Touch the Approach Header Button to display the 'Approach Options' Screen.

3) Touch the **Remove Approach** Button. A 'Remove Approach – <approach> from flight plan?' Window is displayed.

4) Touch the **OK** Button. The approach is removed from the active flight plan. To cancel the request, touch the **Cancel** Button.

Removing an approach from a stored flight plan using the Touchscreen Controller:

1) From Home, touch **Flight Plan > Flight Plan Options > Flight Plan Catalog** to display the 'Flight Plan Catalog' Screen.

2) Scroll the list if needed and touch a Stored Flight Plan Button to display the 'Catalog Options' Window.

3) Touch the **Edit** Button to display the 'Edit Stored Flight Plan' Screen.

4) Select the approach to remove:

   a) Touch the Approach Header Button to display the 'Approach Options' Window.

   b) Touch the **Remove Approach** Button. A 'Remove Approach – <approach identifier> from flight plan?' Window is displayed.

      Or:

   a) Touch the **Flight Plan Options** Button to display the 'Flight Plan Options' Window.

   b) Touch the **Load Approach** Button to display the 'Approach Selection' Screen.

   c) Touch the **Remove** Button. A 'Remove Approach – <approach identifier> from flight plan?' Window is displayed.

5) Touch the **OK** Button. The approach is removed from the stored flight plan. To cancel the request, touch the **Cancel** Button.

MISSED APPROACH

> *NOTE: When changing the destination while navigating on a missed approach, delete the arrival (if loaded) or the approach prior to changing the destination in order to preserve the missed approach guidance.*

The system is capable of providing guidance for the approach as well as the missed approach. Once the missed approach is activated, MAPR will be displayed on the HSI next to the CDI. If the missed approach is activated prior to the Missed Approach Point (MAP), waypoint sequencing will continue along the approach to the missed approach. If the missed approach is not activated prior to the MAP, the system will enter SUSP Mode once the aircraft crosses the MAP until the missed approach is activated or SUSP Mode is disabled. See the Flight Instruments, Course Deviation Indicator section for more information on SUSP Mode.

See the Using Map Displays, Map Symbols discussion previously given in this section for information on displaying the missed approach preview on map displays.

Activate Missed Approach Button

Figure 5-151 Activating a Missed Approach on the Touchscreen Controller

In the missed approach procedure shown in the following figure, the altitude immediately following the MAP may or may not be part of the published procedure. Regardless, it represents a Course to Altitude (CA) leg along the runway centerline. The altitude shown must be achieved before turning safely toward the MAHP. If the aircraft altitude is below the specified altitude after crossing the MAP, a direct-to is established to provide a course on runway heading until the altitude is reached. After reaching the altitude, a direct-to is established to the next published waypoint. If the aircraft altitude is above the specified altitude after crossing the MAP, a direct-to is established to the published fix to begin the missed approach procedure.

Course to Altitude Leg

Figure 5-152 Course to Altitude

Activating a missed approach in the active flight plan:

Press the TO/GA Button. The system begins automatic sequencing through the missed approach waypoints to the MAHP. See the AFCS Section for more details.

Or:

Fly past the MAP and press the **SUSP** Softkey on the PFD.

Or:

1) From Home, touch **PROC**.

2) Touch the **Activate Missed Approach** Button to activate the missed approach. The system begins automatic sequencing through the missed approach waypoints to the MAHP. (The **Activate Missed Approach** Button is available after the leg to the FAF becomes active and FMS is the active NAV source on the PFD.)

Or:

1) From Home, touch **Flight Plan**.

2) Touch the **Approach Header** Button to display the 'Approach Options' Screen.

3) Touch the **Activate Missed Approach** Button to activate the missed approach. The system begins automatic sequencing through the missed approach waypoints to the MAHP. (The **Activate Missed Approach** Button is available after the leg to the FAF becomes active and FMS is the active NAV source on the PFD.)

Or:

1) Press the **PROC** Key on the PFD Controller. The 'Procedures' Window is displayed.

2) Highlight 'Activate Missed Approach'.

3) Press the **ENT** Key or the small **PFD** Knob to activate the missed approach. The system begins automatic sequencing through the missed approach waypoints to the MAHP.

TRANSITION TO APPROACH FUNCTION

When utilizing Baro-VNAV to descend to the FAF on an approach, the system utilizes the Transition to Approach (TTA) function to calculate and adjust the descent path between the FAF and the waypoint preceding the FAF so that a seamless capture of and transition to approach vertical guidance occurs. The time and location of the Bottom of Descent (BOD) may change once any TTA adjustments are made.

TEMPERATURE COMPENSATION

TEMPERATURE COMPENSATION FOR APPROACH ALTITUDES

If desired, the system can calculate temperature compensation for waypoint crossing altitudes loaded as part of an approach procedure. The pilot must manually enable temperature compensation and then enter the destination airport temperature. The system adjusts the altitudes accordingly, and the snowflake icon ( ) is displayed next to those altitudes.

> **NOTE:** *Manually enabling temperature compensation for approach altitudes inhibits the Transition to Approach (TTA) function.*

Manually enabling/disabling temperature compensation for approach waypoint altitudes:

1) From Home, touch **Flight Plan > Flight Plan Options**.

2) Touch the **APPR WPT TEMP COMP** Button to display the 'Temp Compensation' Screen.

3) Touch the **Temp Compensation** Annunciator Button to enable/disable temperature compensation.

4) The first time temperature compensation is enabled, the 'Destination Temp' Screen is displayed. Use the keypad and the **Enter** Button to select the temperature at the airport. Touch the **Back** Button to return to the 'Temp Compensation' Screen. If temperature compensation was previously enabled, the previous entry for destination temperature is automatically entered.

5) To edit the airport temperature, touch the **Temp at Dest** Button and use the keypad and the **Enter** Button to select the temperature at the airport.

NOTE: *Activating/canceling temperature compensation for the loaded approach altitudes does not select/ deselect temperature compensated minimums (MDA/DH), nor does selecting/deselecting temperature compensated minimums activate/cancel temperature compensated approach altitudes.*

NOTE: *Regardless of when the destination temperature setting is entered (when enabling temperature compensation for approach waypoint altitudes, or when enabling temperature compensation for approach minimums), the system will use the same temperature setting for all temperature compensation calculations.*

Figure 5-153 Temperature Compensation for Approach Waypoints

Temperature Compensation for Approach Minimums

A temperature compensated minimum descent altitude can be entered for the approach. Once this is entered on the touchscreen controller, the altitude is also displayed on the PFD.

Entering a temperature compensated minimum into an approach:

1) From Home, touch **PROC** > **Approach** to display the 'Approach Selection' Screen.

   Or:

   a) From Home, touch **Flight Plan**.

   b) Touch the Approach Header Button to display the 'Approach Options' Window.

   c) Touch the **Edit Approach** Button to display the 'Approach Selection' Screen.

2) Touch the **Minimums** Button to display the 'Minimums' Screen.

3) Touch the **Minimums** Button to display the 'Minimums Source' Window.

4) Touch the **Temp Comp** Button. If necessary, use the keypad and touch the **ENT** Button to enter the destination airport temperature. If temperature compensation was previously enabled, the previous entry for destination temperature is automatically entered.

5) If not already entered, use the keypad to select the minimums altitude.

6) Touch the **Enter** Button to return to the 'Approach Selection' Screen.

Touchscreen Controller – 'Approach Selection' Screen   PFD – COMP MIN Shown
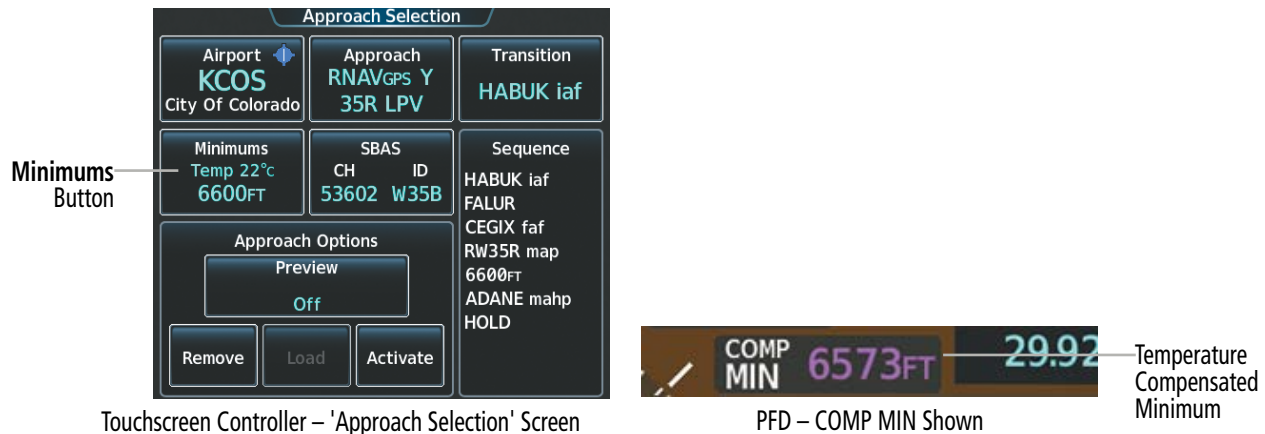
Figure 5-154 Entering Temp Comp Minimums on the Touchscreen Controller

Entering a temperature compensated minimum into an approach using the PFD Controller:

1) Press the **PROC** Key. The 'Procedures' Window is displayed.

2) Use the large **PFD** Knob to highlight 'Select Approach'.

3) Press the **ENT** Key or the small **PFD** Knob. The 'Select Approach' Window is displayed.

4) Press the **CLR** Key to close the approach selection window.

5) Use the large **PFD** Knob to highlight the 'Minimums' Field.

6) Use the small **PFD** Knob to select 'TEMP COMP', then press the **ENT** Key or the small **PFD** Knob. The altitude field is highlighted.

7) If not already entered, use the **PFD** knobs to select the minimums altitude, then press the **ENT** Key or the small **PFD** Knob. The "TEMP AT DEST' Field is highlighted.

8) Use the small **PFD** Knob to select the temperature at the destination, then press the **ENT** Key or the small **PFD** Knob. The temperature compensated altitude is computed and displayed.

5.7 WEIGHT AND FUEL PLANNING

The system includes a weight and fuel planning function. The weight and fuel planning function allows the pilot to enter weight and fuel data, which is used with the active or standby flight plan to estimate takeoff and landing weights, landing fuel, and excess fuel.

Weight planning is done on the 'Weight and Fuel' Screen by entering data on each of the tabs. The basic operating weight is shown on the **Operating Weight** Tab and is calculated by adding the basic empty weight to the crew and stores weight.

Figure 5-155   Weight and Fuel - Operating Weight

Calculating basic operating weight for the active flight plan:

1) From Home, touch **PERF** > **Weight and Fuel**.

   Or:

   From Home, touch **Utilities** > **Weight and Fuel.**

2) Touch the **Set Empty Weight** Button to display the keypad.

3) Use the keypad to enter the basic empty weight.

4) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

5) Touch the **Crew & Stores** Button to display the keypad.

6) Use the keypad to enter the crew and stores weight.

7) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

Total passenger weight is calculated by multiplying the number of passengers by the average passenger weight. Zero Fuel Weight is calculated by adding the basic operating weight, total passenger weight, and cargo weight.

Figure 5-156 Weight and Fuel - Payload

Calculating zero fuel weight:

1) From Home, touch **PERF** > **Weight and Fuel**.

   Or:

   From Home, touch **Utilities** > **Weight and Fuel.**

2) Touch the **Payload** Tab to display the zero fuel weight calculation.

3) Touch the **Passengers** Button to display the keypad.

4) Use the keypad to enter the number of passengers.

5) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

6) Touch the **WT Each** Button to display the keypad.

7) Use the keypad to enter the average passenger weight.

8) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

9) Touch the **Cargo** Button to display the keypad.

10) Use the keypad to enter the cargo weight.

11) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

Aircraft weight is calculated by adding the zero fuel weight to the fuel on board weight. Both the fuel on board and aircraft weight decrease as fuel is burned, providing the current value for each.
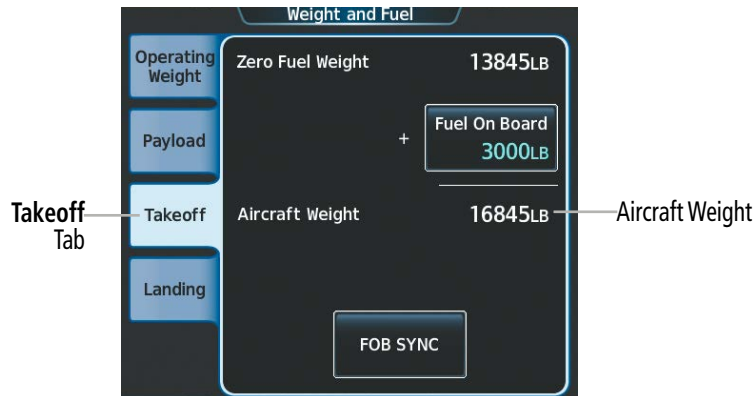
Figure 5-157 Weight and Fuel - Takeoff

Calculating aircraft weight:

1) From Home, touch **PERF** > **Weight and Fuel**.

 Or:

 From Home, touch **Utilities** > **Weight and Fuel.**

2) Touch the **Takeoff** Tab to display the aircraft weight calculation.

3) Touch the **Fuel On Board** Button to display the keypad.

4) Use the keypad to enter the fuel on board.

5) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

 Or:

1) From Home, touch **PERF** > **Weight and Fuel**.

2) Touch the **Takeoff** Tab to display the aircraft weight calculation.

3) Touch the **FOB SYNC** Button to insert the fuel weight from the fuel sensors.

When the aircraft is in the air and a destination waypoint has been entered, the fuel calculations can be completed.

• Estimated landing weight = zero fuel weight + estimated landing fuel weight
• Estimated landing fuel weight = fuel on board weight - (fuel flow x ETE) - estimated holding fuel weight
• Estimated holding fuel weight = fuel flow x estimated holding time
• Excess fuel weight = estimated landing fuel weight - fuel reserves weight

Figure 5-158 Weight and Fuel - Landing

If the aircraft is on the ground or a destination waypoint has not been entered, Est. Landing Weight, Est. Landing Fuel, Holding Fuel Weight, and Excess Fuel display invalid values consisting of five dashes.

Entering fuel reserve and estimated holding time:

1) From Home, touch **PERF** > **Weight and Fuel**.

   Or:

   From Home, touch **Utilities** > **Weight and Fuel.**

2) Touch the **Landing** Tab to display the landing weight and fuel calculations.

3) Touch the **Fuel Reserves** Button to display the keypad.

4) Use the keypad to enter the fuel reserves weight.

5) Touch the **Holding Time** Button to display the keypad.

6) Use the keypad to enter the estimated holding time.

7) Touch the **Enter** Button to accept the entry, and return to the 'Weight and Fuel' Screen.

Weight and fuel planning for the standby flight plan may be linked to the active weight and fuel planning from the aircraft's present position.

WEIGHT CAUTION AND WARNING CONDITIONS

If the zero fuel weight is greater than the maximum allowable zero fuel weight, then the zero fuel weight is displayed in amber.

If the takeoff weight is greater than the maximum allowable takeoff weight, then the takeoff weight is displayed in amber.

If the estimated landing weight is greater than the maximum allowable landing weight, then the estimated landing weight is displayed in amber.

If the estimated landing fuel weight is positive, but less than or equal to the fuel reserves weight, the following values are displayed in amber:

- Estimated landing fuel weight   - Holding fuel weight   - Excess fuel weight

If the estimated landing fuel weight is zero or negative, then the following values are displayed in amber:

- Estimated landing fuel weight   - Holding fuel weight   - Excess fuel weight

5.8 GENERAL PERFORMANCE AND TRIP PLANNING

This section shall discuss general performance data, entering climb, cruise, and descent parameters into the system, FMS Speed information, and using the Trip Planning feature. Flight plan constraints, VNAV guidance, flight planning, weight, and fuel planning are discussed previously in this Flight Management Section. Speed bugs, and any accompanying Vspeeds, are discussed in the Flight Instruments Section.

General performance data such as endurance, estimated time enroute, and fuel over destination (shown in the MFD Navigation Data Bar) is estimated based on flight plan information, weight and fuel data, and climb, cruise, descent parameters.

CLIMB / CRUISE / DESCENT MANAGEMENT

The system will use planned climb, cruise, and descent parameters for calculating general performance data.

Additionally, the speed schedules and speed settings are used by the system for determining the FMS Speed. The terminal speeds for climb and descent are implied accordingly within the flight plan. FMS Speed is discussed later in this section.

After every power cycle, all settings previously entered on the **Climb** Tab, **Cruise** Tab, and the **Descent** Tab are restored.

CLIMB

The system allows the selection of the anticipated climb schedule, transition altitude, and speeds.
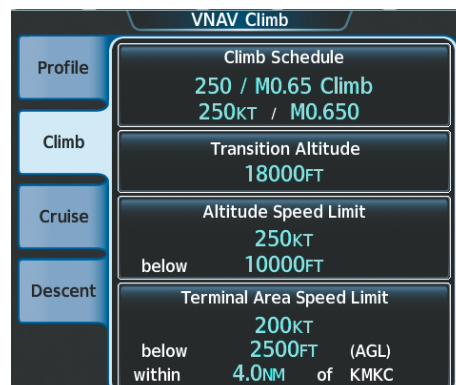
Figure 5-159 'VNAV Climb' Screen – Climb Schedule

Entering the climb schedule:

1) From Home, touch **Flight Plan > VNAV.**

    Or:

    From Home, touch **PERF > VNAV.**

2) Touch the **Climb** Tab.

3) To enter a Pilot-Defined climb schedule, skip to Step 5. Otherwise, touch the **Climb Schedule** Button to bring up a list of already defined climb schedules.

4) Touch the button for the desired climb schedule to select it and return to the previous screen.

5) To enter Pilot-Defined values for the climb schedule, touch the **Climb Schedule** Button to display a list of climb schedule options.

6) Touch the **Pilot-Defined Climb** Button. Then, use the keypad and the **Enter** Button, as necessary, to input the desired climb schedule values.

> *NOTE: The speed selected for a Pilot-Defined Climb is used to estimate time enroute and to calculate the active speed target. If the performance database does not have representative climb data corresponding to the selected speed, the performance calculation may produce overly pessimistic values or underestimated enroute fuel use values. A Pilot-Defined Climb speed schedule may also lead to a miscalculation of ceiling altitude.*

Modifying the climb transition altitude:

1) From Home, touch **Flight Plan > VNAV.**

Or:

From Home, touch **PERF > VNAV.**

2) Touch the **Climb** Tab.

3) Touch the **Transition Altitude** Button to display the keypad.

4) Use the keypad and the **Enter** Button to select the desired transition altitude.

Or:

Touch the **Revert to Published** Button. Then, touch the **OK** Button to revert the transition altitude to the published altitude.

Entering climb speed limits:

1) From Home, touch **Flight Plan > VNAV.**

Or:

From Home, touch **PERF > VNAV.**

2) Touch the **Climb** Tab.

3) Touch the **Altitude Speed Limit** Button or the **Terminal Area Speed Limit** Button to display the keypad for the selected setting.

4) Use the keypad and the **Enter** Button to select the desired values and return to the previous screen.

5) Repeat Steps 3 and 4, as necessary, to enter the speed, altitude, and distance values.

CRUISE

The Cruise Schedule for the active flight plan can be modified by directly entering speeds on **Cruise** Tab on the 'VNAV Cruise' Screen.

Figure 5-160 'VNAV Cruise' Screen – Cruise Schedule

Entering the cruise schedule:

1) From Home, touch **Flight Plan > VNAV.**

   Or:

   From Home, touch **PERF > VNAV.**

2) Touch the **Cruise** Tab.

3) To enter a Pilot-Defined cruise schedule, skip to Step 5. Otherwise, touch the **Cruise Schedule** Button to bring up a list of already defined cruise schedules.

4) Touch the button for the desired cruise schedule to select it and return to the previous screen.

5) To enter Pilot-Defined values for the cruise schedule, touch the **Cruise Schedule** Button to display a list of cruise schedule options.

6) Touch the **Pilot-Defined Cruise** Button. Then, use the keypad and the **Enter** Button, as necessary, to input the desired cruise schedule values.

> **NOTE:** The speed selected for a Pilot-Defined Cruise is used to estimate time enroute and to calculate the active speed target. Pilot-defined cruise speed schedules may not affect the accuracy of performance calculations provided the selected speeds are supported by the performance database (the correct fuel flow for the given speed can be interpolated).

DESCENT

The system allows the selection of the anticipated descent schedule, transition level, and speed limits.

> **NOTE:** *Changing the Descent Schedule does not affect an active VNAV descent (indicated by an Active VNAV Waypoint on the 'VNAV Profile' Screen – **Profile** Tab) or a user-defined waypoint VNAV constraint. In this case, the active Flight Path Angle does not change, thus the Top of Descent is not redefined.*
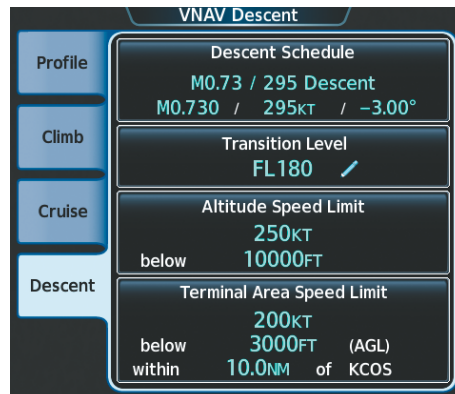
Figure 5-161 'VNAV Descent' Screen – Descent Schedule

Entering the descent schedule:

1) From Home, touch **Flight Plan > VNAV.**

    Or:

    From Home, touch **PERF > VNAV.**

2) Touch the **Descent** Tab.

3) To enter a Pilot-Defined descent schedule, skip to Step 5. Otherwise, touch the **Descent Schedule** Button to bring up a list of already defined descent schedules.

4) Touch the button for the desired descent schedule to select it and return to the previous screen.

5) To enter Pilot-Defined values for the descent schedule, touch the **Descent Schedule** Button to display a list of descent schedule options.

6) Touch the **Pilot-Defined Descent** Button. Then, use the keypad and the **Enter** Button as necessary to input the desired descent schedule values.

Modifying the descent transition level:

1) From Home, touch **Flight Plan > VNAV.**

    Or:

    From Home, touch **PERF > VNAV.**

2) Touch the **Descent** Tab.

3) Touch the **Transition Level** Button to display the keypad.

4) Use the keypad and the **Enter** Button to select the desired transition level.

Or:

Touch the **Revert to Published** Button. Then, touch the **OK** Button to revert the transition level to the published altitude.

Entering descent speed limits:

1) From Home, touch **Flight Plan > VNAV.**

Or:

From Home, touch **PERF > VNAV.**

2) Touch the **Descent** Tab.

3) Touch the **Altitude Speed Limit** Button or the **Terminal Area Speed Limit** Button to display the keypad for the selected setting.

4) Use the keypad and the **Enter** Button to select the desired value and return to the previous screen.

5) Repeat Steps 3 and 4, as necessary, to enter the speed, altitude, and distance values.

FMS SPEED

The FMS system is designed to fly the FMS Speed, displayed in magenta on the 'VNAV Profile' Screen. This airspeed will change during normal flight by using target speeds for different phases of flight, configurations, and pilot inputs. The different target speeds vary due to phase of flight speed schedules, altitude-based speeds, terminal area speeds, speed constraints from the flight plan, and speeds designed to avoid exceeding airframe limits. The system will define some of these parameters and prioritize their use, but the pilot can also modify some of the speed parameters.

SYSTEM-DEFINED SPEED TARGETS

The system is designed to avoid exceeding all airframe speed limits. Specifically, aircraft configuration speed targets have been defined by the system to provide a buffer from overspeeding as the aircraft fully configures while decelerating:

» Gear Down: 190 knots
» Flaps 1/2: 165 knots
» Flaps 3: 135 knots

PILOT-DEFINED SPEED TARGETS

Climb and Descent Tab Items

As discussed previously in this section, the pilot can modify the climb, cruise, and descent schedules, in addition to altitude-based speeds, flight plan speed constraints, and terminal area speeds.

The speed programmed as the Terminal Area Speed Limit on the VNAV page, **Descent** Tab is also used as an implied speed limit for waypoints on the approach procedure starting with the IAF waypoint and continuing through the end of the missed approach. Once activated, this speed limit remains in effect while any approach waypoint is active, even if the airplane has climbed above the Terminal Area Speed Limit AGL altitude. Any waypoint manually inserted into the flight plan after the displayed approach header is also considered to be part of the approach procedure. This includes any waypoint inserted after the end of the published missed approach procedure.

> ✓ *NOTE: In order to remove the Terminal Area Speed Limit for waypoints inserted into the active flight plan anywhere after the flight plan Approach Header: 1) Activate the direct-to function to an off-route waypoint (i.e., by changing the destination airport to the alternate destination or activating a leg to an off-route waypoint), 2) Activate the standby flight plan, or 3) Delete the active flight plan and activate another flight plan.*

FMS SPEED PRIORITIZATION

The system will use the most appropriate speed target for the current conditions. If there are conflicting targets, the system will prioritize as follows (highest priority first):

» All airframe speed limits

» Departure terminal area speed

» Altitude-based speed (separate speeds apply to climb and descent)

» Flight plan speed constraints (defined at flight plan waypoints via database or pilot-entered)

» Arrival terminal area speed

» Speed schedule per mode of flight

The prioritized target speed information will be shown on the 'VNAV Profile' Screen, **Profile** Tab, in the field under 'Active Speed Target'.
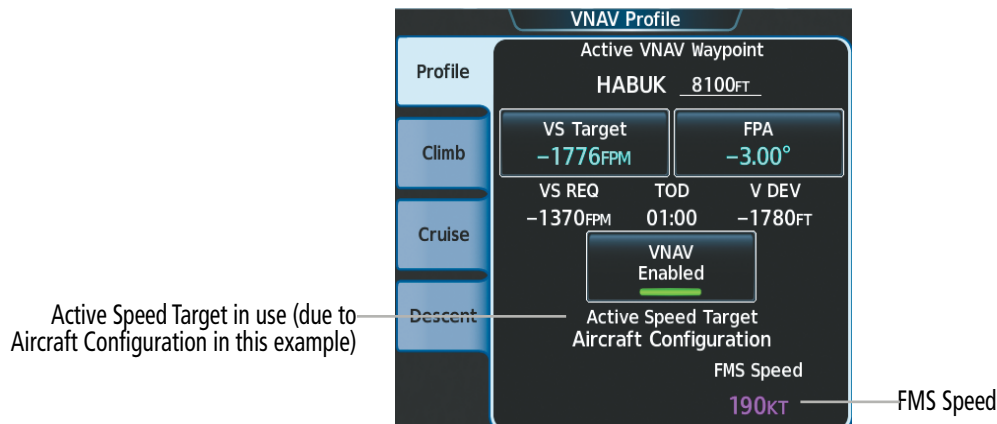
Figure 5-162 'VNAV Profile' Screen – FMS Speed

As the flight proceeds and the phases of flight and the flight plan are sequenced, the FMS Speed will change targets. In the climb, the speed initially will be limited by some type of departure speed or flight plan speed constraint. The FMS Speed will step up to higher speeds as the airplane flies out of the departure speed terminal area, and as speed constraints are sequenced. For example, during climb, the change (to a higher speed) will start after passing the constraint. In descent, FMS Speed changes to a slower target speed in a similar fashion but in reverse order (the speed steps down to slower values). For descent, the change (to a slower speed) will start in advance of the slower speed so the airplane has sufficient time to slow to the new speed prior to arriving at the altitude or waypoint.

TRIP PLANNING

The trip planning function allows the pilot to view trip statistics, fuel statistics, and other statistics for a specified flight plan or for a flight plan leg. The statistics can be based on automatic data, or based on manually entered data.

All of the input of data needed for calculation and viewing of the statistics is done on the 'Trip Planning' Screen on the Touchscreen Controller.

Figure 5-163 Trip Planning - Automatic Mode
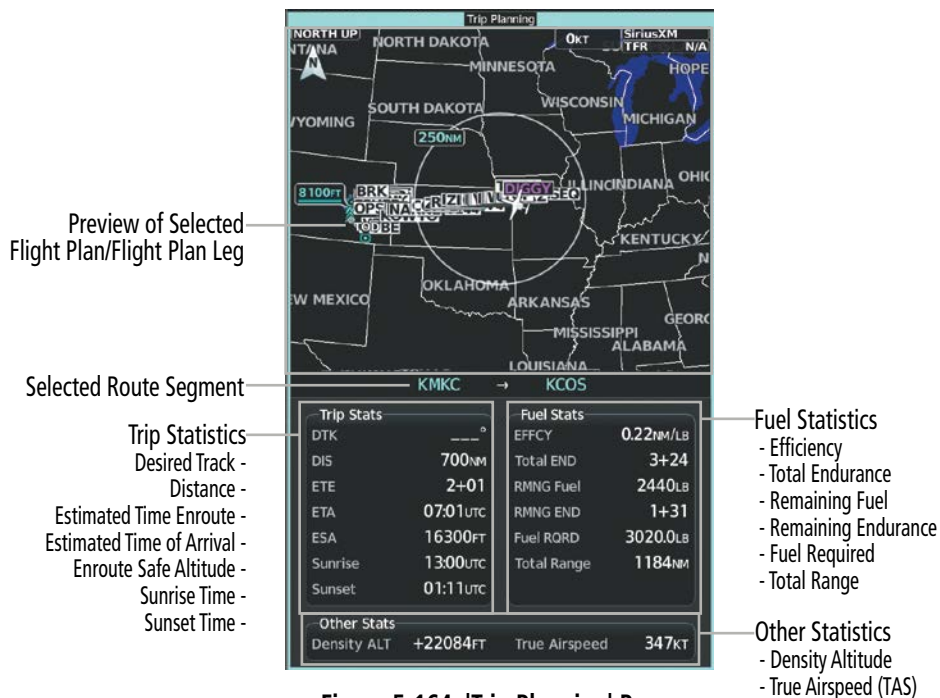
Figure 5-164 'Trip Planning' Pane

The trip planning inputs are based on sensor inputs (automatic mode) or on pilot inputs (manual entry mode). Some additional explanation of the sources for some of the inputs is as follows:

- Departure time (Depart Time) – This defaults to the current time in automatic page mode. The computations are from the aircraft present position, so the aircraft is always just departing.

- Calibrated airspeed (Cal Airspeed) – The primary source is from the air data system, and the secondary source of information is GPS ground speed.

- Indicated altitude (Indicated Alt) – The primary source is the barometric altitude, and the secondary source of information is GPS altitude.

TRIP STATISTICS

The trip statistics are calculated based on the trip route selected and the trip planning inputs.
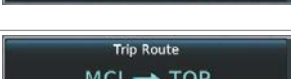
Trip Route Mode	Trip Route Button	Description
Stored Flight Plan - Cumulative Mode	Trip Route Stored Flight Plan – Cumulative KMKC → KCOS	Waypoints are the starting and ending waypoints of the selected flight plan.
Stored Flight Plan - Leg Mode	Trip Route Stored Flight Plan – Leg MCI → TIFTO	Waypoints are the endpoints of the selected leg.
Active Flight Plan - Remaining Mode	Trip Route Active Flight Plan – Remaining P.POS → KCOS	The 'from' waypoint is the aircraft present position, and the 'to' waypoint is the endpoint of the active flight plan.
Active Flight Plan - Leg Mode	Trip Route Active Flight Plan – Leg P.POS → TOP	The 'from' waypoint is the aircraft present position or a selected waypoint, and the 'to' waypoint is the endpoint of the selected leg. In automatic mode, the 'from' waypoint is always present position.
Waypoint Mode	Trip Route MCI → TOP	Manually selected waypoints (if there is an active flight plan, these default to the endpoints of the active leg).

Table 5-25 Trip Route Modes

Some of the calculated trip statistics are dashed when the selected leg of the active flight plan has already been flown.

» Desired Track (DTK) – DTK is shown as nnn° and is the desired track between the selected waypoints. It is dashed unless only a single leg is selected.

» Distance (DIS) – The distance is shown in tenths of units up to 99.9, and in whole units up to 9999.

» Estimated time enroute (ETE) – ETE is shown as hours:minutes until less than an hour, then it is shown as minutes:seconds.

» Estimated time of arrival (ETA) – ETA is shown as hours:minutes and is the local time at the destination.

   ▪ If in waypoint mode then the ETA is the ETE added to the departure time.

   ▪ If a stored flight plan is selected it shows the ETA by adding to the departure time all of the ETEs of the legs up to the selected leg. If the entire flight plan is selected, then the ETA is calculated as if the last leg of the flight plan was selected.

   ▪ If the active flight plan is selected the ETA reflects the current position of the aircraft and the current leg being flown. The ETA is calculated by adding to the current time the ETEs of the current leg up to and including the selected leg. If the entire flight plan is selected, then the ETA is calculated as if the last leg of the flight plan was selected.

» Enroute safe altitude (ESA)

» Destination sunrise and sunset times – These times are shown as hours:minutes and are the local time at the destination.

FUEL STATISTICS

The fuel statistics are calculated based on the selected starting and ending waypoints and the trip planning inputs. Some of the calculated trip statistics are dashed when the selected leg of the active flight plan has already been flown.

» Fuel efficiency (EFFCY) – This value is calculated by dividing the current ground speed by the current fuel flow.

» Time of fuel endurance (Total END) – This time is shown as hours+minutes. This value is obtained by dividing the amount of fuel on board by the current fuel flow.

» Fuel on board upon reaching end of selected leg (RMNG Fuel) – This value is calculated by taking the amount of fuel onboard and subtracting the fuel required to reach the end of the selected leg.

» Fuel endurance remaining at end of selected leg (RMNG END) – This value is calculated by taking the time of fuel endurance and subtracting the estimated time enroute to the end of the selected leg.

» Fuel required for trip (Fuel RQRD) – This value is calculated by multiplying the time to go by the fuel flow.

» Total range at entered fuel flow (Total Range) – This value is calculated by multiplying the time of fuel endurance by the ground speed.

OTHER STATISTICS

These statistics are calculated based on the system sensor inputs or the manual trip planning inputs.

» Density altitude (Density ALT)

» True airspeed

Selecting the Stored Flight Plan – Cumulative trip route mode:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Trip Route** Button to display the 'Input Selection' Window.

3) Touch the **Select from Flight Plan** Button to display the 'Select Flight Plan' Screen.

4) Scroll the list, if necessary, and touch a stored flight plan button to display the 'Select Flight Plan Leg' Screen.

5) Touch the **Cumulative Flight Plan** Button to select the mode and return to the 'Trip Planning' Screen.

Selecting the Stored Flight Plan – Leg trip route mode:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Trip Route** Button to display the 'Input Selection' Window.

3) Touch the **Select from Flight Plan** Button to display the 'Select Flight Plan' Screen.

4) Scroll the list, if necessary, and touch a stored flight plan button to display the 'Select Flight Plan Leg' Screen.

5) Scroll the list, if necessary, and touch a flight plan leg selection button to select the mode and return to the 'Trip Planning' Screen.

Selecting the Active Flight Plan – Remaining trip route mode:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Trip Route** Button to display the 'Input Selection' Window.

3) Touch the **Select from Flight Plan** Button to display the 'Select Flight Plan' Screen.

4) Scroll the list, if necessary, and touch the active flight plan button to display the 'Select Flight Plan Leg' Screen.

5) Touch the **Remaining Flight Plan** Button to select the mode and return to the 'Trip Planning' Screen.

Selecting the Active Flight Plan – Leg trip route mode:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Trip Route** Button to display the 'Input Selection' Window.

3) Touch the **Select from Flight Plan** Button to display the 'Select Flight Plan' Screen.

4) Scroll the list, if necessary, and touch the active flight plan button to display the 'Select Flight Plan Leg' Screen.

5) Scroll the list, if necessary, and touch a flight plan leg selection button to select the mode and return to the 'Trip Planning' Screen.

Selecting the waypoints trip route mode:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Trip Route** Button to display the 'Input Selection' Window.

3) Touch the **Select Starting and Ending Waypoints** Button to display the 'Select Starting and Ending Locations' Window.

4) Touch the starting waypoint button to display the 'Select Starting Location' Window.

5) Touch the **Present Position** Button to use the present position of the aircraft and return to the 'Select Starting and Ending Locations' Window.

Or:

Touch the **Waypoint** Button to select a waypoint using the keypad and return to the 'Select Starting and Ending Locations' Window.

6) Touch the ending waypoint button to select a waypoint using the keypad and return to the 'Select Starting and Ending Locations' Window.

7) Touch the **Accept** Button to select the mode and return to the 'Trip Planning' Screen.

When the manual entry mode is selected, the other eight trip input data fields must be entered by the pilot, in addition to flight plan and leg selection.

Entering manual data for trip statistics calculations:

1) From Home, touch **Utilities > Trip Planning.**

2) Touch the **Manual Entry** Button to enable the manual entry data field buttons.

3) Touch an input data field button and use the keypad to select the value.

4) Touch the **Enter** Button to accept the value and return to the 'Trip Planning' Screen.

5) Repeat Steps 3 and 4 for each of the data fields.

5.9 TAKEOFF AND LANDING

TAKEOFF AND LANDING DATA (OPTIONAL)

The optional Takeoff and Landing Data (TOLD) function allows the pilot to enter the airport, runway, the runway conditions, and aircraft configuration data necessary to compute required speeds and required field length. A valid TOLD database is required to access any of the TOLD screens.

The TOLD Table part number is displayed in white along with the certification rules type (FAA). If the system determines the TOLD database is invalid or missing, this information is displayed in amber and the TOLD Buttons are unavailable.
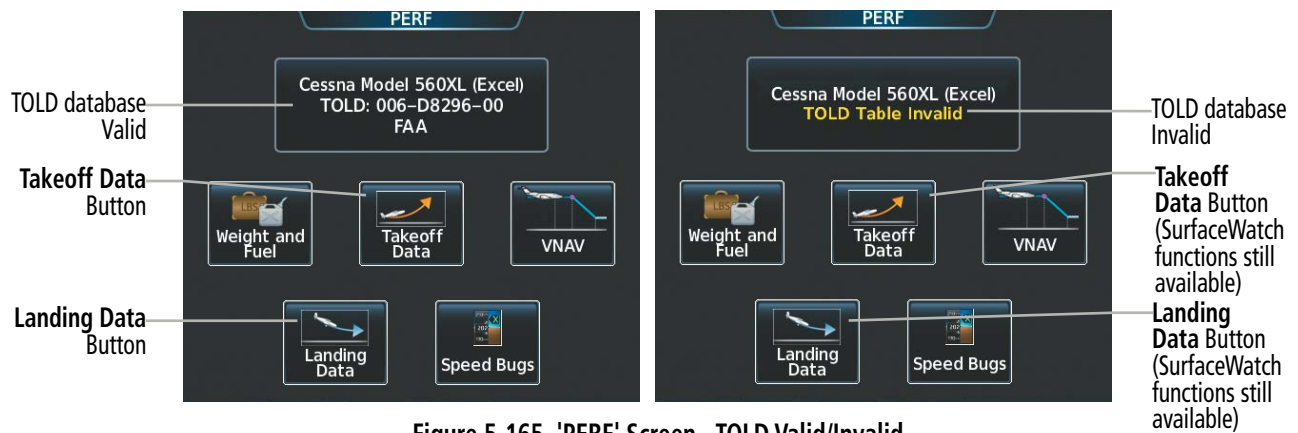
Figure 5-165 'PERF' Screen - TOLD Valid/Invalid

ACCESSING TOLD

After applying power to the system, the 'Initialization' Screen allows entry of Takeoff Data, and then primary access to the 'Takeoff Data' Screen and the 'Landing Data' Screen is from the 'PERF' Screen, as indicated by the procedures throughout this section. Access to the 'Takeoff Data' Screen and the 'Landing Data' Screen is also available from the active flight plan.

Accessing the 'Takeoff Data' Screen from the 'Home' Screen:

From Home, touch **PERF** > **Takeoff Data**.

Accessing the 'Takeoff Data' Screen from the active flight plan:

1) From Home, touch **Flight Plan**.

2) Touch the **Origin** Button to display the 'Origin Options' Window.

   Or:

   Touch the **Departure** Button to display the 'Departure Options' Window.

3) Touch the **Takeoff Data** Button.

4) To return to the active flight plan, touch the **Flight Plan** Button.

Accessing the 'Landing Data' Screen from the 'Home' Screen:

From Home, touch **PERF** > **Landing Data**.

Accessing the 'Landing Data' Screen from the active flight plan:

1) From Home, touch **Flight Plan**.

2) Touch the **Arrival** Button to display the 'Arrival Options' Window.

    Or:

    Touch the **Approach** Button to display the 'Approach Options' Window.

    Or:

    Touch the **Destination** Button to display the 'Destination Options' Window.

3) Touch the **Landing Data** Button.

4) To return to the active flight plan, touch the **Flight Plan** Button.

TAKEOFF DATA

ORIGIN TAB

The origin airport, origin airport runway, takeoff weight, and center of gravity, are entered on the **Origin** Tab. Entries may be automatically retrieved and auto filled by the system, as follows:

▪ Origin airport and runway is retrieved from the active flight plan.

▪ Takeoff weight is retrieved from the Weight and Fuel function.

The **Takeoff Weight** Button value is defaulted to the takeoff weight calculated in the 'Weight and Fuel' Screen (only upon initial powering the avionics, system restart or initialization reset). If the takeoff weight is manually changed using the **Takeoff Weight** Button, the pencil icon is displayed on the **Takeoff Weight** Button, the **Reload Weight** Button becomes available, v-speeds are deselected, and the Touchscreen Controller screen title changes from 'Takeoff Data' to 'Takeoff Data - Planning Mode'. While the 'Takeoff Data - Planning Mode' title is displayed, and Takeoff Speeds cannot be accepted. Touching the **Reload Weight** Button will import the Takeoff Weight from the 'Weight and Fuel' Screen into the **Takeoff Weight** Button on the 'Takeoff Data' Screen, recalculate the takeoff data, and change the screen title back to 'Takeoff Data'.

> **NOTE:** The default selections for the takeoff data are only applied the first time the 'Takeoff Data' Screen is displayed after initial application of power, a system restart, or initialization reset.

> **NOTE:** If the origin airport and/or runway is changed in the active flight plan, the TOLD takeoff data will be updated and the takeoff v-speeds deselected. Changing the origin airport will also reset the weather data to cyan dashes and reset the barometric pressure to match the PFD setting.
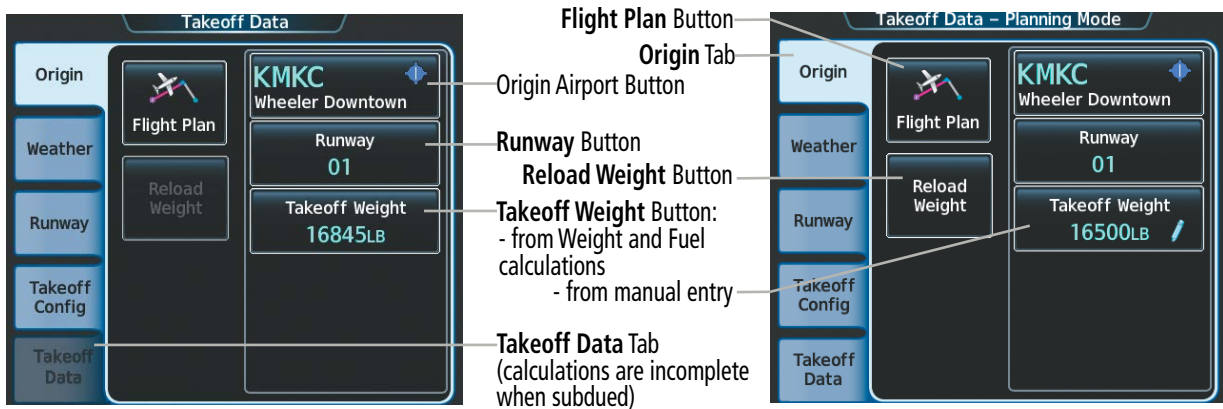
Figure 5-166 Origin Tab

Manually selecting an origin airport and runway on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Origin** Tab, if necessary, to display the origin airport data.

3) Touch the origin airport button to display the keypad.

4) Use the keypad to enter the origin airport.

5) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

6) Touch the **Runway** Button to display the 'Select Runway' Window.

7) Touch the desired runway selection button.

> **NOTE:** If the calculated takeoff weight on the 'Weight and Fuel' Screen changes after the first access of the 'Takeoff Data' Screen following an initialization, the TOLD Takeoff Weight is not automatically updated to the newly calculated takeoff weight. Prior to calculating TOLD takeoff data for each takeoff, the **FOB SYNC** Button must be touched or Fuel On Board must be manually entered on the 'Weight and Fuel' Screen, **Takeoff** Tab.

Importing the planned takeoff weight to the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Origin** Tab, if necessary, to display the **Reload Weight** Button.

3) Touch the **Reload Weight** Button (if enabled) to select the weight from the 'Weight and Fuel' Screen.

WEATHER TAB

The **Weather** Tab on the 'Takeoff Data' Screen manual entry or sourced data for the runway surface conditions, wind, temperature, and barometric pressure.

The origin airport on the **Weather** Tab is the same as the one selected on the **Origin** Tab. If there is a METAR available for the selected origin airport, the **Load METAR Data** Button and the **Show METAR** Button are available. If there is not a METAR available for the selected origin airport, the **Load METAR Data** Button and the **Show METAR** Button are subdued. Touching the **Show METAR** Button displays a window showing the Raw METAR data. Touching the **Load METAR Data** Button will load the origin airport METAR data into the **Wind** Button.

Touching the **Sync Temp** Button replaces the temperature value in the TOLD calculations with the current ram air temperature (RAT). The current RAT will either replace a manually entered temperature or an old RAT value.

Before accepting takeoff speeds, the TOLD temperature is automatically updated to the current RAT if RAT is currently being used for TOLD calculations and the measured temperature changes by more than 5°C.

After speeds are accepted, if the difference between the sensor temperature and the temperature in TOLD is at least 5 degrees, the **Sync Temp** Button will change from subdued to active. Before touching the **Sync Temp** Button, should the temperature deviation go back down to 3 degrees Celsius or less, the **Sync Temp** Button will return to subdued.

Touching the **Sync Baro** Button places the selected-side PFD barometric pressure setting into the TOLD data. When the barometric pressure in TOLD differs from the selected-side PFD barometric pressure setting, the **Sync Temp** Button will change from subdued to active.

> **NOTE:** If the METAR reports wind direction as variable, touching the **Load METAR Data** Button will result in dashes displayed on the **Wind** Button. In this case, wind data must be manually entered to perform TOLD calculations.

> **NOTE:** Touching the **Load METAR Data** Button inputs the reported wind speed, not including gust values. For example, if the METAR reports winds at 12 knots, gusting to 20 knots, the wind speed displayed on the **Wind** Button defaults to 12 knots.

> **NOTE:** The system will display the wind direction on the **Wind** Button as either True or Magnetic North based the current system settings. For example, if the METAR reports wind direction in True North, and Magnetic North is the selected system setting, the system automatically resolves the difference and displays the wind direction in Magnetic North after touching the **Load METAR Data** Button.

> **NOTE:** The system will provide takeoff data for dry and wet runways only. Refer to the current version of the pertinent flight manual for contaminated runway takeoff data.

Figure 5-167 Takeoff Data - Weather Tab
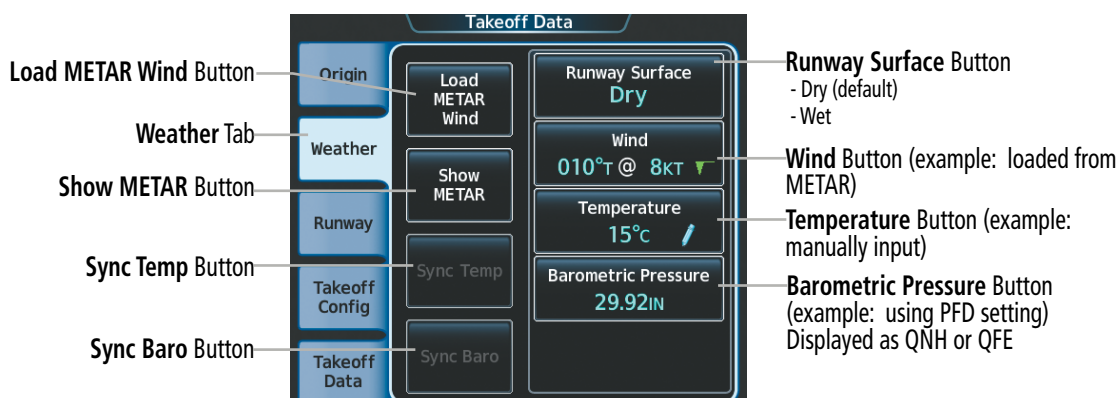
Selecting the runway surface condition on the Takeoff Data Screen:

1) From **Home**, touch **PERF** > **Takeoff Data**.

2) Touch the **Weather** Tab, if necessary, to display the runway surface data.

3) Touch the **Runway Surface** Button to display the Runway Condition window.

4) Touch the desired runway condition button to select the runway condition.

5) The system returns to the 'Takeoff Data' Screen.

Selecting wind value on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Weather** Tab, if necessary, to display the wind data.

3) Select the wind value:

Touch the **Load METAR Wind** Button to use METAR winds for the Origin airport.

Or:

a) To enter winds manually, touch the **Wind** Button to display the keypad.

b) Touch the desired Mode Button for magnetic or true winds.

c) Use the keypad to enter the wind direction.

d) Touch the **Enter** Button to accept the entry, and display the Wind Speed keypad.

e) Use the keypad to enter the wind speed.

f) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

Selecting temperature value on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Weather** Tab, if necessary, to display the wind data.

3) Select the temperature value:

Touch the **Sync Temp** Button to use the aircraft RAT.

Or:

a) To enter manually, touch the **Temperature** Button to display the keypad.

b) Use the keypad to enter the temperature.

c) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

Selecting barometric pressure value on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Weather** Tab, if necessary, to display the wind data.

3) Select the pressure value:

> Touch the **Sync Baro** Button to use the aircraft setting for the selected PFD.
>
> **Or**:

a) To enter manually, touch the **Barometric Pressure** Button to display the keypad.

b) Use the keypad to enter the pressure.

c) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

RUNWAY TAB

The **Runway** Tab on the 'Takeoff Data' Screen enables manual entry or sourced data for the takeoff run available, runway elevation, runway heading, and runway gradient for the selected runway at the origin airport.

The origin airport on the **Runway** Tab is the same as the one selected on the **Origin** Tab. Takeoff Run Available, and Runway Elevation, Heading, and Gradient values are pulled from the system database. For the 'Takeoff Run Available' (TORA) Field, the system displays and uses the lesser of TORA and Accelerate-Stop Distance Available (ASDA).

Optionally, these values may be manually adjusted. The takeoff run available is limited to values less than the database value. To repopulate the data from the database again, touch the **Reload From Database** Button.
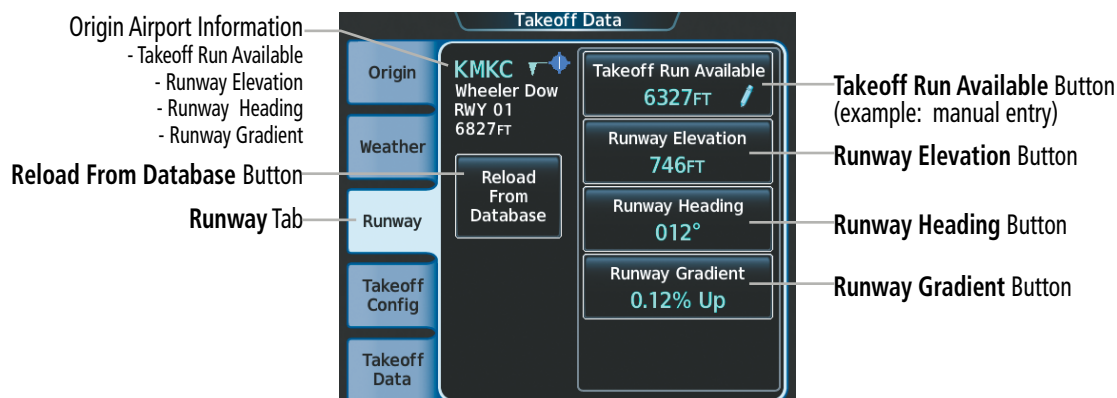
Figure 5-168 Takeoff Data - Runway Tab

Selecting runway elevation, heading, or gradient on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Runway** Tab, if necessary, to display the runway data.

3) Touch a runway data button to display the keypad.

4) Use the keypad to enter the value.

5) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

Returning to the **Origin** Tab and selecting a runway will restore the runway data from the database.

The takeoff run available distance can be manually entered, or the database takeoff run available distance can be manually reduced specifically at the approach and/or departure end.

Figure 5-169 Takeoff Run Available – No Origin Selected

Figure 5-170 Takeoff Run Available – Normal

Figure 5-171 Takeoff Run Available – Corrected

Entering takeoff run available:

1)   From Home, touch **PERF** > **Takeoff Data**.

2)   Touch the **Runway** Tab.

3)   Touch the **Takeoff Run Available** Button to display the 'Takeoff Run Available' Screen.

4)   Enter or change the takeoff run available distance:

   a)   Touch the **Shorten DEP End** Button to display the keypad.

   b)   Use the keypad to enter the reduction distance from the departure end of the runway.

   Or:

   a)   Touch the **Takeoff Run Available** Button to display the keypad.

   b)   Use the keypad to enter the shortened takeoff run available distance.

   c)   If an Origin runway had been selected, touch the **DEP** Button or **APPR** Button to shorten the distance from the approach or departure end.

   Or:

   a)   Touch the **Shorten APPR End** Button to display the keypad.

   b)   Use the keypad to enter the reduction distance from the approach end of the runway.

5)   Repeat Step 4 until the takeoff run data is displayed correctly.

6)   Touch the **Save** Button to make the changes and return to the 'Takeoff Data' Screen.

TAKEOFF CONFIG TAB

The **Takeoff Config** Tab on the 'Takeoff Data' Screen displays the following takeoff configuration settings: Takeoff Flaps, Anti-Ice, Thrust Reversers, Takeoff Factor, and Rolling Takeoff.
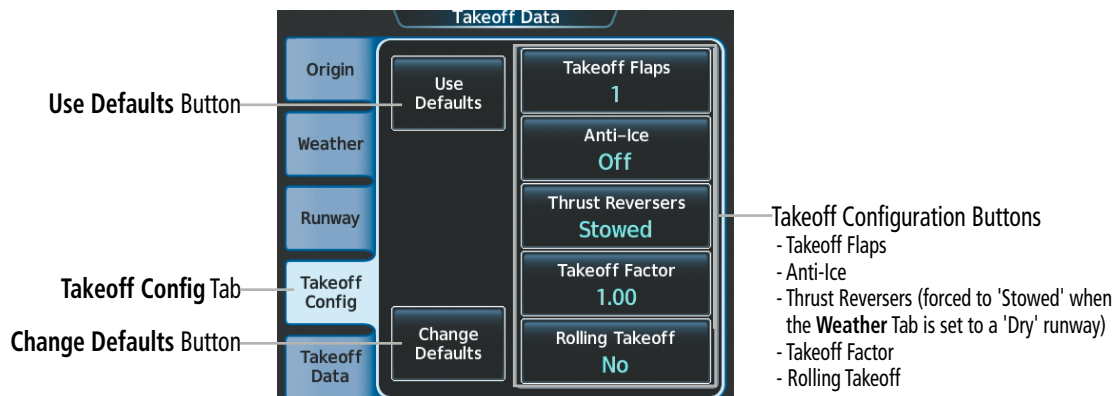
Figure 5-172 Takeoff Data - Takeoff Config Tab

Selecting a takeoff configuration setting on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Takeoff Config** Tab.

3) Input the configuration settings:

    a) Touch a takeoff configuration button to display a list of settings.

    b) Touch the desired setting button to choose the setting and return to the 'Takeoff Data' Screen.

    Or:

    a) Touch a takeoff configuration button to display the keypad.

    b) Use the keypad to enter the value.

    c) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

Touching the **Use Defaults** Button will set all the takeoff configuration items to the default value.

Touching the **Change Defaults** Button will display the Defaults window, allowing the pilot to change the default value for each of the displayed items. These defaults are stored in the crew profile.
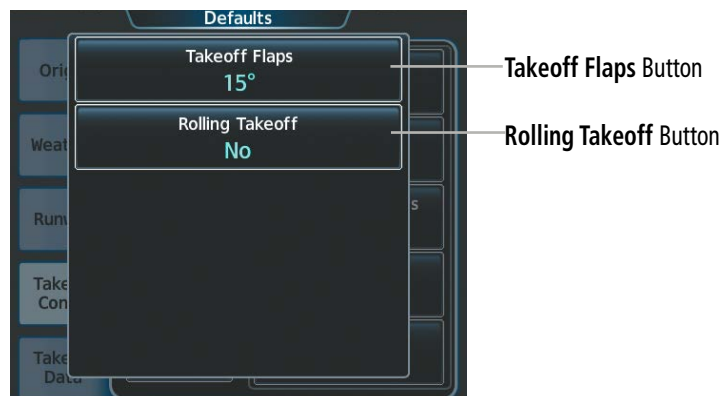
Figure 5-173 Takeoff Data Configuration Defaults

Selecting a default value for a takeoff configuration item on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Takeoff Config** Tab.

3) Touch the **Change Defaults** Button to display the 'Defaults' Screen.

4) Touch a default takeoff configuration button to display a list of settings.

5) Touch the desired setting button to choose the setting and return to the 'Defaults' Screen. Repeat steps 4 and 5 as desired.

6) Touch the **Back** Button to return to the 'Takeoff Data' Screen.

TAKEOFF DATA TAB

Takeoff Data

The **Takeoff Data** Tab on the 'Takeoff Data' Screen displays the calculated takeoff data, and provides a button to accept the takeoff speeds for use on the airspeed tape. The **Takeoff Data** Tab is not available until all required data has been entered on the other tabs.
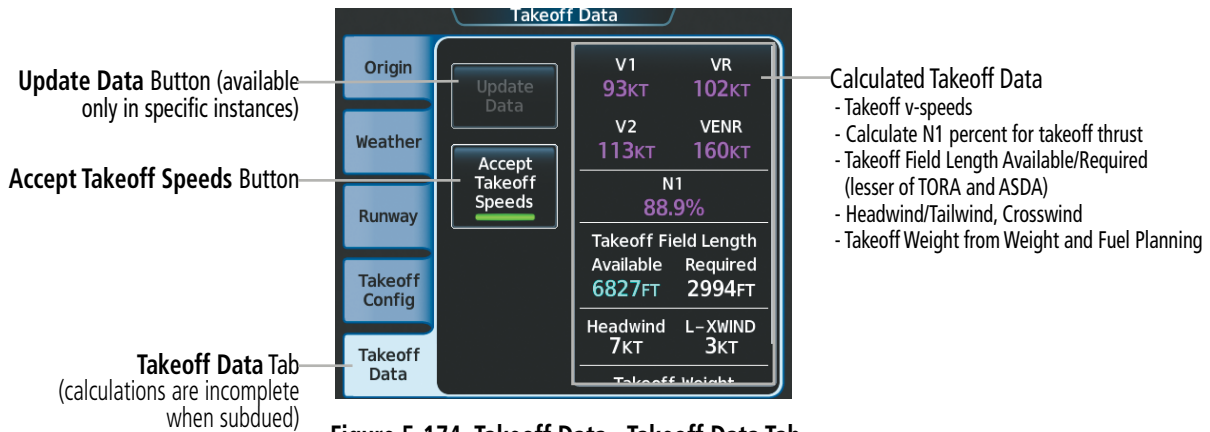
Figure 5-174 Takeoff Data - Takeoff Data Tab

The following will occur after touching the **Update Data** Button:
- → The Barometric Pressure and temperature are updated within TOLD
- → The takeoff v-speeds, N1, and required takeoff field length are re-calculated
- → The **Accept Takeoff Speeds** Button is set to inactive, if previously active, and the takeoff v-speeds are removed from the airspeed tape on the PFD.

The **Update Data** Button is available when any of the following occurs after the **Accept Takeoff Speeds** Button is pressed:
- → The Barometric Pressure setting on the PFD is different than the pressure used in the TOLD, and the difference in measured pressure altitude and the pressure altitude calculated by TOLD is at least 200 feet.
- → The temperature difference is at least 5 °C between the RAT and the temperature used in the TOLD.

Touching the **Accept Takeoff Speeds** Button will cause the green annunciator on the button to illuminate and the system to use the calculated speeds as v-speed Reference Bugs. If takeoff data is insufficient, a certain takeoff limit is exceeded, or if still in Planning Mode, the **Accept Takeoff Speeds** Button will be subdued and not available for selection.

In the case of single Touchscreen Controller operation, the system will display a window to acknowledge the calculations are from a single source and should be checked with the pertinent flight manual. Touch the **OK** Button to accept and use the calculated v-speeds, or touch the **Cancel** Button to return to the 'Takeoff Data' Screen without accepting the calculated v-speeds.
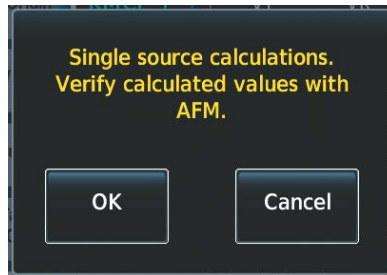
Figure 5-175 Takeoff Data - Verify Data with AFM

Takeoff Limits

When a takeoff limit is exceeded, the **Accept Takeoff Speeds** Button is greyed out and all TOLD output data on the MFD is amber dashed.

This is an example of the field length being too short for the conditions.
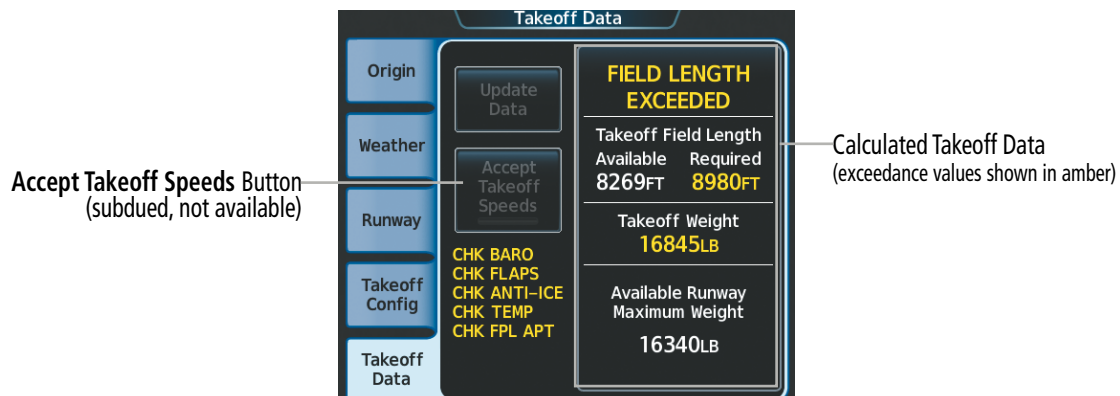
Figure 5-176 Takeoff Data - Field Length Limit Exceeded

There are also limits for weight, pressure altitude, temperature, wind, runway gradients and internal system errors:
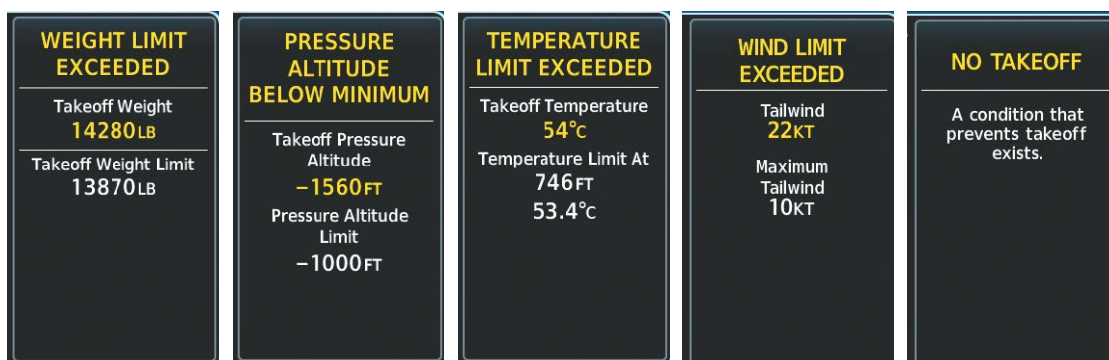
Figure 5-177 Takeoff Data - Some Examples for Takeoff Limits Exceeded
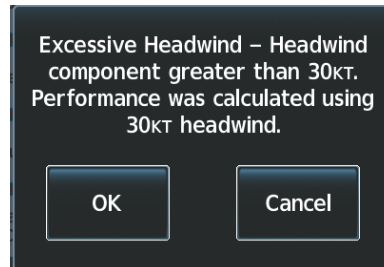
Figure 5-178 Takeoff Data - AFM Data Range Exceeded for Headwind

If a headwind exceeds 30 knots for any runway condition, the system will use 30 knots for TOLD calculations and display the 'WIND LIMIT EXCEEDED' message. If a tailwind exceeds 10 knots for any runway condition, a similar confirmation window will be displayed, but system TOLD calculations cannot be accepted.

If an abnormal error occurs within the system or the TOLD database contains insufficient files, the 'NO TAKEOFF' message will appear. The condition can be resolved by a technician or by reloading another database. If the condition cannot be resolved, TOLD must be calculated manually.

TOLD Consistency Monitor

The TOLD consistency monitor compares the live configuration of the airplane and environment (weight, flaps, temperature, barometric pressure, and anti-ice selections) against the settings chosen when the TOLD calculations was performed. The TOLD consistency monitor will display an amber message ('CHK WEIGHT', 'CHK FLAPS', etc.) on the 'Takeoff Data' Screen for each item that is currently set differently than as defined for the calculated takeoff data. The TOLD consistency monitor is active when: (1) the aircraft is on the ground, and (2) the aircraft is not at takeoff thrust.
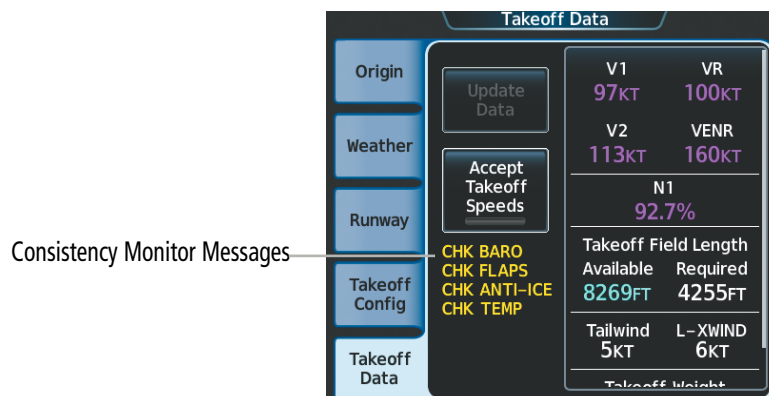
Figure 5-179 Takeoff Data - TOLD Consistency Monitor Messages

Message	Condition
CHK FLAPS	The current aircraft flap setting is not the same as the Takeoff Flaps selection on the **Takeoff Config** Tab, or the flap position data is invalid.
CHK ANTI-ICE	The current ice protection is not the same as the ice protection selection on the **Takeoff Config** Tab, or a loss of both GEAs while anti-ice is selected on.
CHK WEIGHT	The current aircraft weight is greater than the Takeoff Weight on the **Origin** Tab.
CHK BARO	The current sensed pressure altitude is not within 200 ft. of the pressure altitude calculated by the system.
CHK FPL RWY	The flight plan departure runway is not the same as the Runway selection on the **Origin** Tab.
CHK FPL APT	The flight plan departure airport is not the same as the airfield on the **Origin** Tab.
CHK TEMP	The current RAT temperature is not within 5 degrees Celsius of the 'Temperature' value on the **Weather** Tab, or the RAT data is invalid.

Table 5-26 TOLD consistency monitor messages - Takeoff

'Takeoff Data' Pane

When the 'Takeoff Data' Screen is displayed on the Touchscreen Controller, a corresponding 'Takeoff Data' Pane is shown on the highlighted MFD Pane. The 'Takeoff Data' Pane element fields, as shown in the following figure, will contain values when the **Takeoff Data** Tab is no longer subdued.

Figure 5-180 Takeoff Data Pane

Takeoff data is automatically recalculated when takeoff speeds are not yet accepted and the temperature measured by the aircraft sensor changes by more than 5 degrees than the temperature in TOLD.

LANDING DATA

DESTINATION TAB

The **DEST** Tab on the 'Landing Data' Screen enables manual entry of the destination airport, the destination airport runway, emergency return airfield, and the aircraft landing weight. The TOLD destination airport and runway default to an active flight plan airport. If a destination airport and/or destination runway is not present in the active flight plan, the destination airport and/or runway are shown as dashes, allowing manual entry.. To check or adjust the flight plan, touching the **Flight Plan** Button will display the 'Active Flight Plan' Screen.

Figure 5-181 Landing Data - DEST Tab

The TOLD destination airport and runway default to the flight plan destination airport, the TOLD origin airport, or to dashes.

If the **Landing Weight** Button value is manually changed, the pencil icon is displayed on the **Landing Weight** Button, the Touchscreen Controller screen title changes from 'Landing Data' to 'Landing Data - Planning Mode', the v-speeds are deselected, and the **Reload Weight** Button on the **DEST** Tab becomes available. While the 'Landing Data - Planning Mode' title is displayed, Landing Speeds cannot be accepted.

When the **Landing Weight** Button on the 'Landing Data' Screen is defaulted to the landing weight from the 'Weight and Fuel' Screen, and the weight changes more than 100 lbs., the **Reload Weight** Button becomes available. Touching the **Reload Weight** Button will import the landing weight from the 'Weight and Fuel' Screen into the TOLD **Landing Weight** Button, recalculate the landing data, allow selection of the **Accept V-speeds** Button, and change the screen title back to 'Landing Data' if previously in planning mode.

The **Load Emergency Return** Button can be used to quickly load origin data for a return to land scenario. If the Takeoff Data calculations were completed with no errors on the 'Takeoff Data' Screen, pressing the **Load Emergency Return** Button will copy the takeoff data to the landing data. If there is no takeoff input data present, or if the calculation resulted in an error, the **Load Emergency Return** Button will be subdued.

> **NOTE:** The default selections for destination airport, runway, landing weight, and other landing data are only applied the first time the 'Landing Data' Screen is displayed after a system restart, or initialization reset.

> **NOTE:** *If the destination airport is changed in the active flight plan (directly or by loading an approach), the destination airport and runway will be updated on the 'Landing Data' Screen. Weather data is reset to cyan dashes, barometric pressure is reset to the PFD setting, estimated landing weight is updated, and v-speeds will be deselected.*

Selecting a destination airport and runway on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **DEST** Tab, if necessary, to display the destination airport and runway data.

3) Touch the destination airport button to display the keypad.

4) Use the keypad to enter the destination airport.

5) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

6) Touch the **Runway** Button to display the 'Select Runway' Window.

7) Touch the desired runway selection button.

Selecting the landing weight:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **DEST** Tab, if necessary.

3) Enter a weight:

   Touch the **Reload Weight** Button to select the estimated landing weight from the 'Weight and Fuel' Screen.

   Or:

   a) Touch the **Landing Weight** Button.

   b) Enter the weight on the keypad and touch the **Enter** Button.

WEATHER TAB

The **Weather** Tab on the 'Landing Data' Screen enables manual entry of the runway surface, wind, temperature, and barometric pressure for the destination airport. The runway surface defaults to 'Dry'.

The origin airport on the **Weather** Tab is the same as the one selected on the **Origin** Tab. If there is a METAR available for the selected origin airport, the **Load METAR Data** Button and the **Show METAR** Button are available. If there is not a METAR available for the selected origin airport, the **Load METAR Data** Button and the **Show METAR** Button are subdued. Touching the **Show METAR** Button displays a window showing the Raw METAR data. Touching the **Load METAR Data** Button will load the origin airport METAR data into the **Wind, Temperature, and Barometric Pressure** Buttons.

The temperature defaults to the aircraft temperature sensor.

The barometric pressure defaults to the value set on the PFD corresponding to the Touchscreen Controller on which TOLD is first accessed (e.g. L PFD for GTC1).

> **NOTE:** *If the METAR includes variable winds, it may not include a wind direction and thus, the pilot must enter a numeric value for wind direction within the Weather Tab.*

NOTE: *The system will provide landing data for a dry runway only. Refer to the current version of the pertinent flight manual for wet or contaminated runway landing data.*
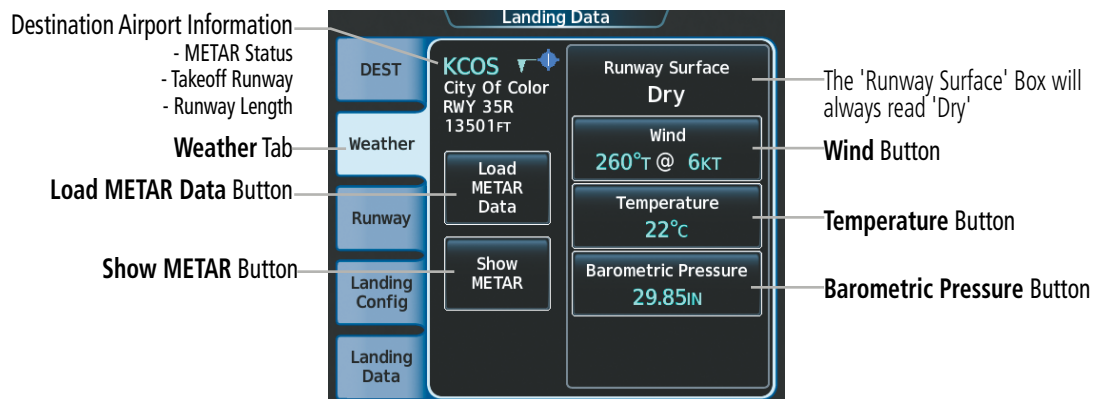
Figure 5-182 Landing Data - Weather Tab

Selecting a manual wind value on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Weather** Tab, if necessary, to display the wind data.

3) Touch the **Wind** Button to display the 'Wind Direction' keypad.

4) Touch the desired Mode Button for magnetic or true winds.

5) Use the keypad to enter the wind direction.

6) Touch the **Enter** Button to accept the entry, and display the 'Wind Speed' keypad.

7) Use the keypad to enter the wind speed.

8) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

Selecting a manual temperature value on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Weather** Tab, if necessary, to display the temperature data.

3) Touch the **Temperature** Button to display the keypad.

4) Use the keypad to enter the temperature.

5) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

Selecting a manual barometric pressure value on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Weather** Tab, if necessary, to display the barometric pressure data.

3) Touch the **Barometric Pressure** Button to display the keypad.

4) Use the keypad to enter the barometric pressure.

5) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

RUNWAY TAB

The **Runway** Tab on the 'Landing Data' Screen enables manual entry of the landing distance available (LDA), runway elevation, runway heading, and runway gradient for the selected runway at the destination airport.

The destination airport on the **Runway** Tab is the same as the one selected on the **DEST** Tab. When a runway is selected on the **DEST** Tab, the landing distance available, runway elevation, runway heading, and runway gradient are set to the database values for that runway. If any database value has been manually overridden, the **Reload From Database** Button is enabled. Touching the **Reload From Database** Button will load the selected runway data from the database into the runway landing data.
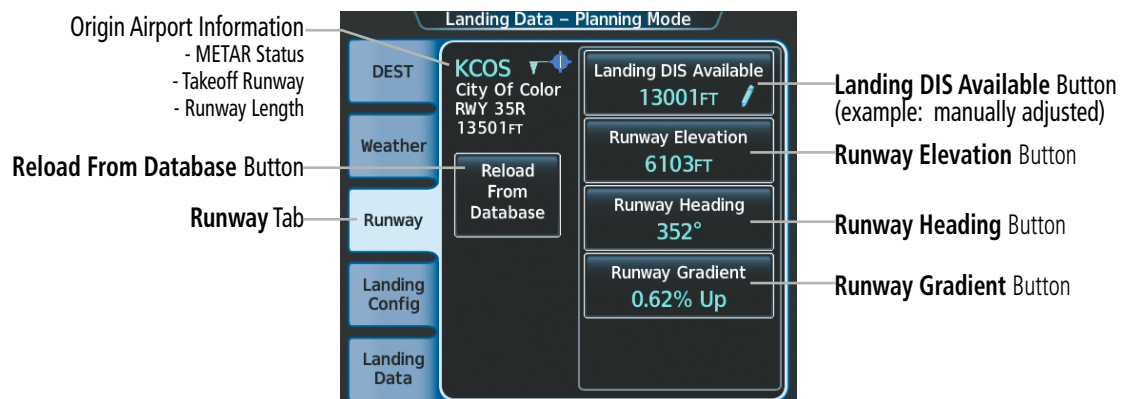
Figure 5-183 Landing Data - Runway Tab

The landing distance available can be manually entered, or the database landing distance available can be manually reduced specifically at the approach and/or departure end.

Figure 5-184 Landing Distance Available – No Destination Selected

Figure 5-185 Landing Distance Available – Normal
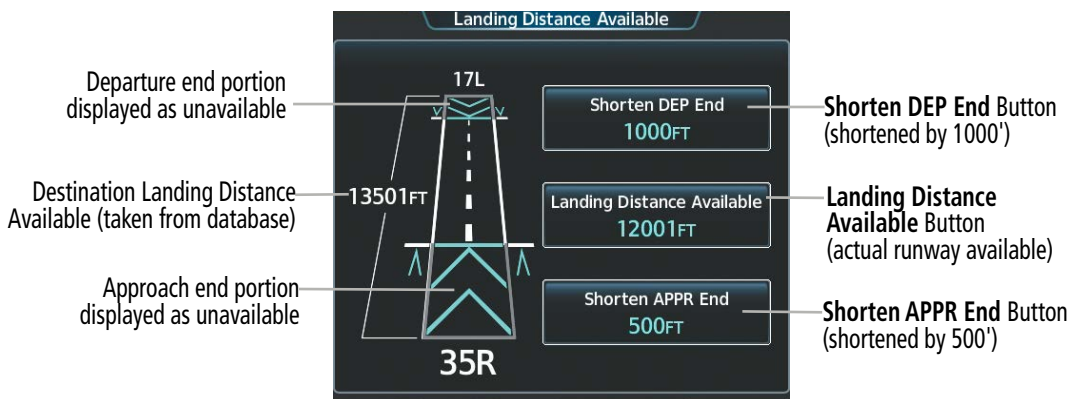
Figure 5-186 Landing Distance Available – Corrected

Entering landing distance available:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Runway** Tab.

3) Touch the **Landing DIS Available** Button to display the 'Landing Distance Available' Screen.

4) Enter or change the landing distance available:

   a) Touch the **Shorten DEP End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the departure end of the runway.

   Or:

   a) Touch the **Landing Distance Available** Button to display the keypad.

   b) Use the keypad to enter the shortened available landing distance.

   c) If an Destination runway had been selected, touch the **DEP** or **APPR** Button to shorten the distance from the approach or departure end.

   Or:

   a) Touch the **Shorten APPR End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the approach end of the runway.

5) Touch the **Save** Button to make the changes and return to the 'Landing Data' Screen.

Selecting landing runway elevation, heading, or slope:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Runway** Tab, if necessary, to display the runway data.

3) Touch a runway data button to display the keypad.

4) Use the keypad to enter the value.

5) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

LANDING CONFIG TAB

The **Landing Config** Tab on the 'Landing Data' Screen enables manual entry of the landing configuration settings for Anti-Ice and the Landing Factor.
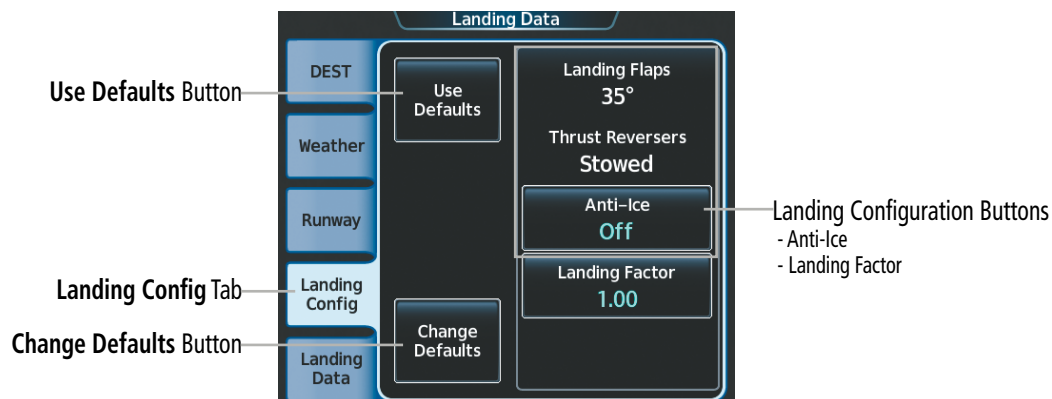
Figure 5-187 Landing Data - Landing Config Tab

> **NOTE:** *The system will provide landing data using 35 degree flaps and stowed thrust reversers only. Reference the landing data in the current version of the pertinent flight manual when landing outside this configuration.*

Selecting a landing configuration setting on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Landing Config** Tab, if necessary, to display the landing configuration settings.

3) Input the configuration settings:

Touch the desired setting button to choose the setting and return to the 'Landing Data' Screen.

Or:

a) Touch a landing configuration button to display the keypad.

b) Use the keypad to enter the value.

c) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

Touching the **Use Defaults** Button will set all the Landing configuration items to the default value.

Touching the **Change Defaults** Button will display the Defaults window, allowing the pilot to change the default value for the Landing Factor. These defaults are stored in the crew profile.
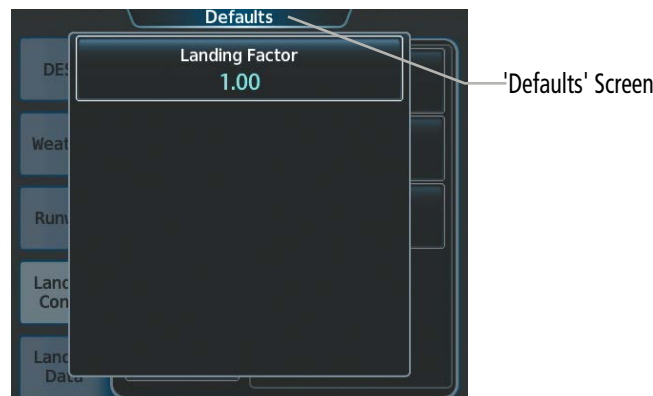
Figure 5-188 Landing Data - Landing Configuration Defaults

Selecting a default value for a landing configuration item on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Landing Config** Tab, if necessary, to display the landing configuration settings.

3) Touch the **Change Defaults** Button to display the 'Defaults' Screen.

4) Touch a default landing configuration button to display a list of settings or keypad.

5) Enter the desired value and touch the **Enter** Button or touch the desired setting button, and return to the 'Defaults' Screen. Repeat steps 4 and 5 as desired.

6) Touch the **Back** Button to return to the 'Landing Data' Screen.

LANDING DATA TAB

Landing Data

As the flight progresses, the system will continuously update the Est. Landing Weight in the 'Weight and Fuel' Screen using actual fuel burn rates. When the **Landing Weight** Button within the 'Landing Data' Screen is defaulted to the Est. Landing Weight and the Est. Landing Weight changes more than 100 lbs. from the previous Est. Landing Weight, the **Reload Weight** Button on the **Landing Data** Tab becomes available. Touching the **Reload Weight** Button will import the current Est. Landing Weight from the 'Weight and Fuel' Screen into the TOLD **Landing Weight** Button Field, recalculate the landing data, allow selection of the **Accept V-speeds** Button, and change the screen title back to 'Landing Data' if previously in planning mode.

Landing distances may be calculated as actual ('Actual Landing DIS') or factored ('Factored Landing DIS'). The 'Factored Landing DIS' values are displayed when the **Landing Factor** Button on the **Landing Config** Tab is set to any value other than 1.0.

The **Landing Data** Tab on the 'Landing Data' Screen displays the calculated landing data and provides a button to accept the landing speeds (shown as v-speed reference bugs) for use on the airspeed tape. The **Landing Data** Tab is not available until all required data has been entered on the other tabs. If all of the data is within safe parameters and do not exceed certain limitations, the **Accept Landing Speeds** Button will be enabled (the button is no longer subdued). Touch the button to accept the landing data and enable the computed v-speeds. When enabled, the annunciator bar on the button will turn green. A subsequent push of the **Accept Landing Speeds** Button will cancel the acceptance and remove the calculated v-speeds from the airspeed tape.
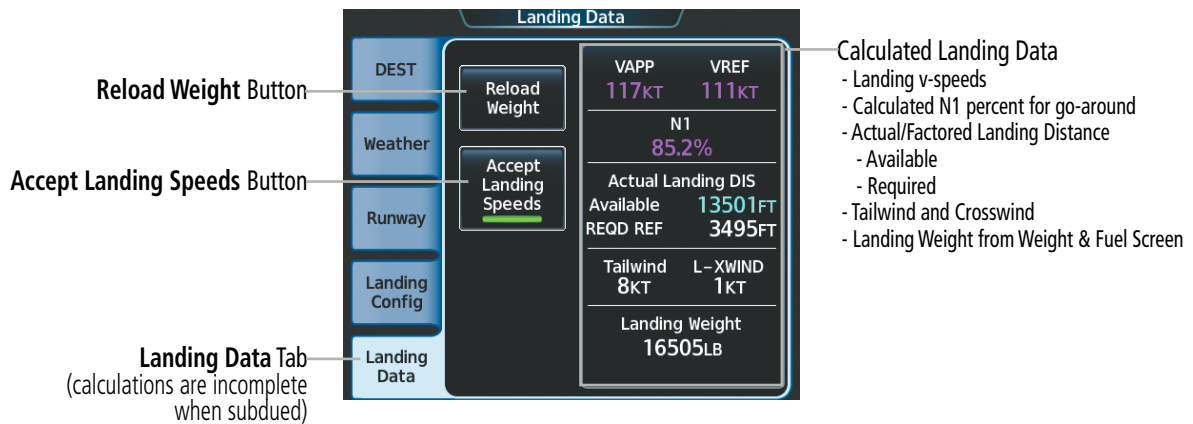
Figure 5-189 Landing Data - Landing Data Tab

When touching the **Accept Landing Speeds** Button, in the case of single Touchscreen Controller operation, the system will display a window to acknowledge the calculations are from a single source and should be checked with the pertinent flight manual. Touch the **OK** Button to accept and use the calculated v-speeds, or touch the **Cancel** Button to return to the 'Landing Data' Screen without accepting the calculated v-speeds.
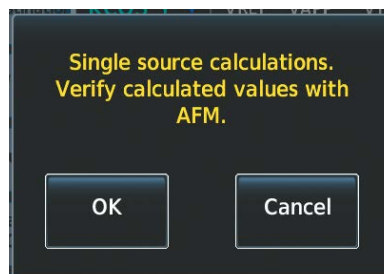
Figure 5-190 Landing Data - Verify Data with AFM

Landing Data Limits

When a landing limit is exceeded, touching the **Accept Landing Speeds** Button (if available) may display a confirmation window. If the landing speeds can be still be calculated during a landing limit exceedance, the **Accept Landing Speeds** Button will be available. Touching the **OK** Button will allow the system to use the speeds. Touching the **Cancel** Button will return to the 'Landing Data' Screen without accepting the speeds. If a landing limit is exceeded that prevents the landing speeds from being computed, the **Accept Landing Speeds** Button is greyed out.

This is an example of the field length being too short for the conditions.
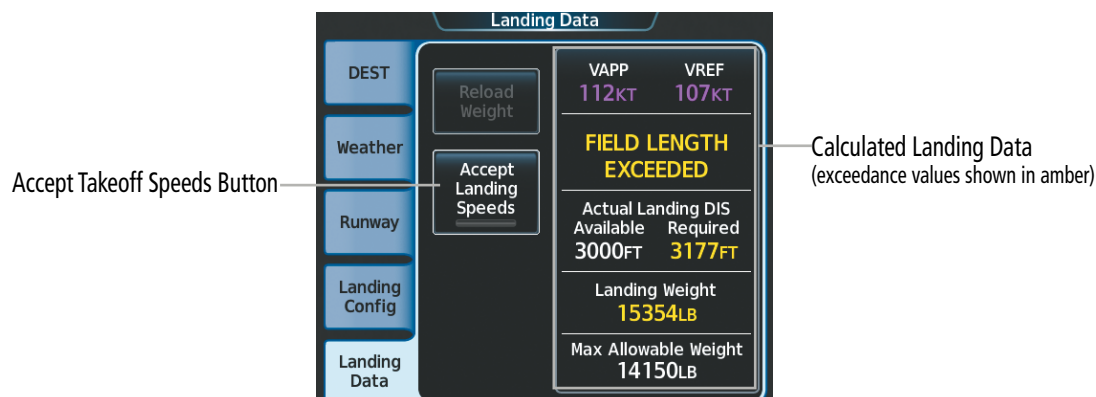
Figure 5-191 Landing Data - Field Length Limit Exceeded
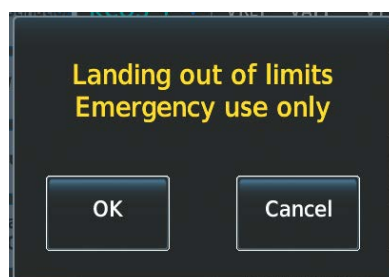
Figure 5-192 Accepting an Exceedance - Emergency Use Only

There are also limits for weight, pressure altitude, temperature, wind, and runway gradient.
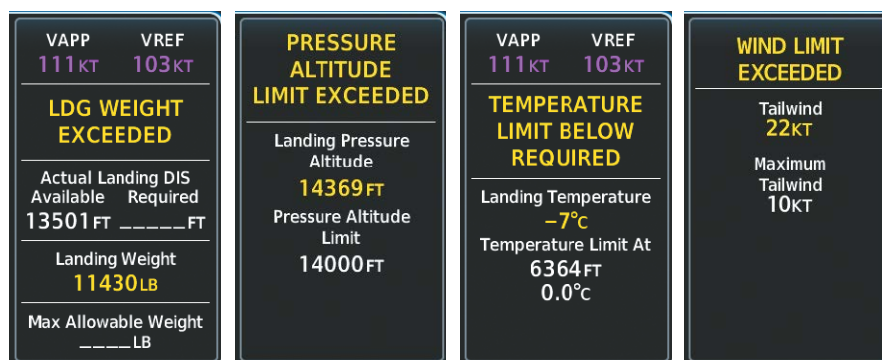
Figure 5-193 Landing Data - Examples of Landing Limits Exceeded
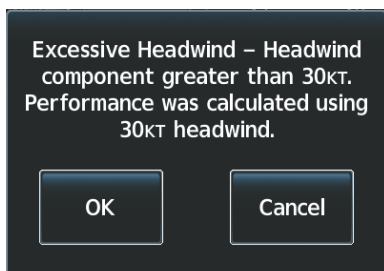
Figure 5-194 Landing Data - AFM Data Range Exceeded for Headwind

If a headwind exceeds 30 knots for any runway condition, the system will use 30 knots for TOLD calculations and display the 'WIND LIMIT EXCEEDED' message. If a tailwind exceeds 10 knots for any runway condition, a similar confirmation window will be displayed, but system TOLD calculations will use the actual winds.

TOLD Consistency Monitor

When the airplane is in the air, the system will display a white message (example: 'CHK WEIGHT', 'CHK FLAPS') on the 'Landing Data' Screen for each item that is currently set differently than as defined for the calculated landing data.

The TOLD consistency monitor will display an amber message CHK STEEP on the 'Landing Data' Screen when the **Steep Approach** Button is enabled within the 'TAWS Settings' Screen. When displayed, TOLD must be calculated manually. See the Hazard Avoidance Section to enable/disable steep approaches.
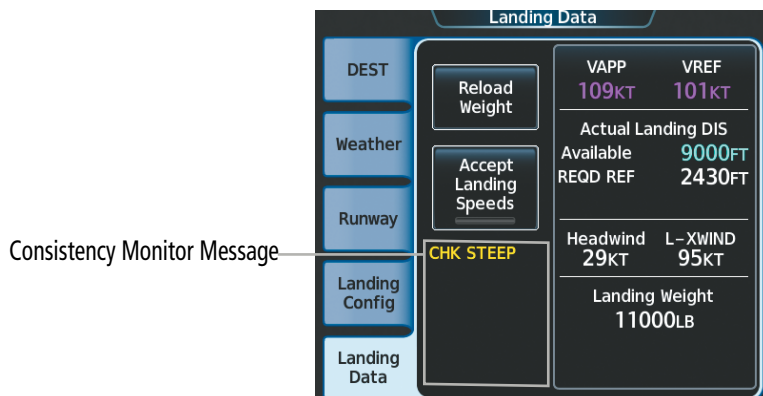
Figure 5-195 Landing Data - TOLD Consistency Monitor Message

Message	Condition
CHK WEIGHT	The estimated landing weight used for TOLD is different from a newly calculated estimated landing weight by 2000 lbs.
CHK STEEP	Steep Approach has been selected by the flight crew; TOLD must be calculated manually.

Table 5-27 TOLD consistency monitor messages – Landing Data Tab

'Landing Data' Pane

When the 'Landing Data' Screen is displayed on the Touchscreen Controller, a corresponding 'Landing Data' Pane is shown on the highlighted MFD Pane. The 'Landing Data' Pane element fields, as shown in the following figure, will contain values when the **Landing Data** Tab is no longer subdued.
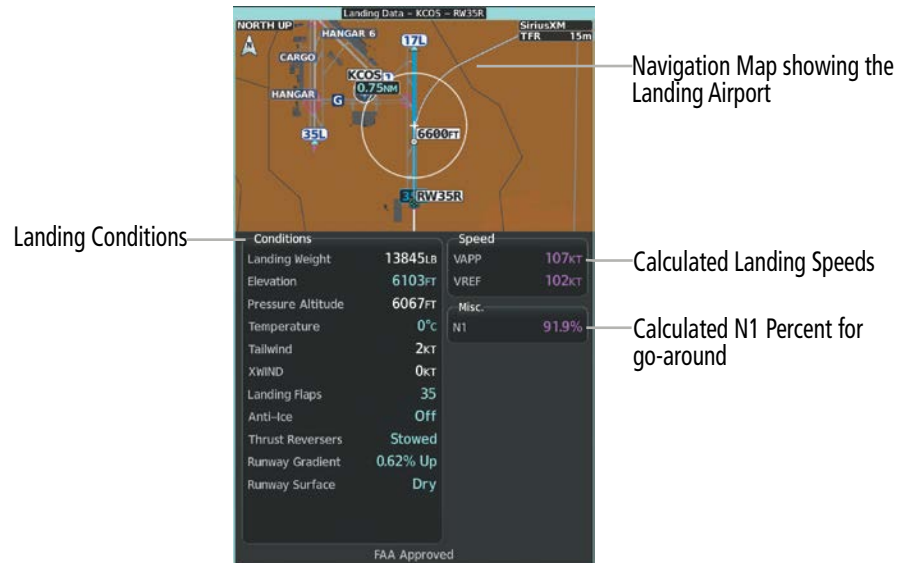
Figure 5-196 Landing Data Pane

SURFACEWATCH (OPTIONAL)(TOLD NOT INSTALLED)

When TOLD is not configured, the optional SurfaceWatch function allows the pilot to enter the airport, runway, and required takeoff/landing distances in order to increase situational awareness and avoid potential runway incursions and excursions.
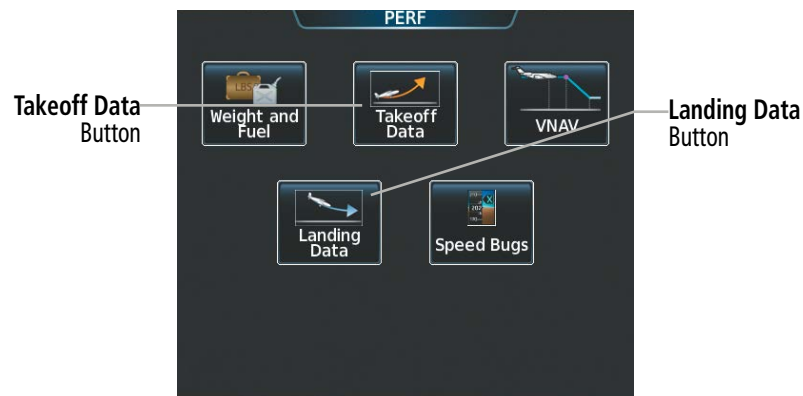
Figure 5-197 PERF – SurfaceWatch Installed (no TOLD)

TAKEOFF DATA

The 'Takeoff Data' Screen allow entry of the origin airport, origin runway, required takeoff distance, and takeoff run available. The origin airport and runway default to the active flight plan selections, if available.
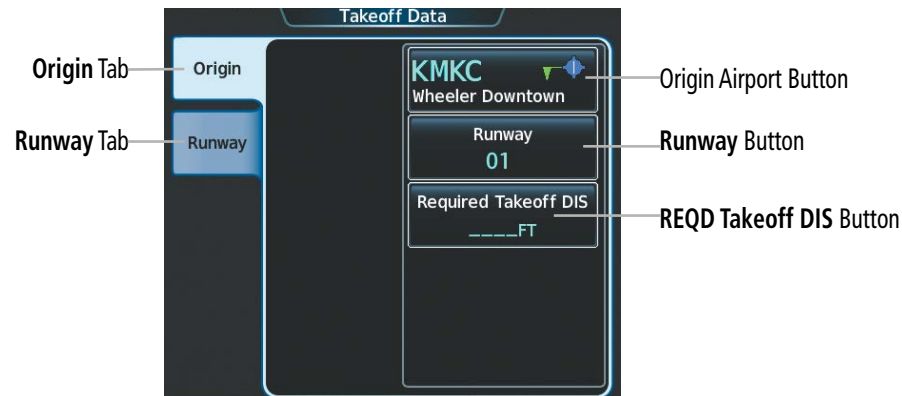
Figure 5-198 Takeoff Data – Origin Tab

Selecting an origin airport, runway, and required takeoff distance on the 'Takeoff Data' Screen:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Origin** Tab, if necessary, to display the origin airport and runway data.

3) Touch the origin airport button to display the keypad.

4) Use the keypad to enter the origin airport.

5) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

6) Touch the **Runway** Button to display the 'Select Runway' Window.

7) Touch the desired runway selection button, and return to the 'Takeoff Data' Screen.

8) Touch the **Required Takeoff DIS** Button to display the keypad.

9) Use the keypad to enter the required takeoff distance.

10) Touch the **Enter** Button to accept the entry, and return to the 'Takeoff Data' Screen.

Origin runway information can be viewed on the **Runway** Tab.
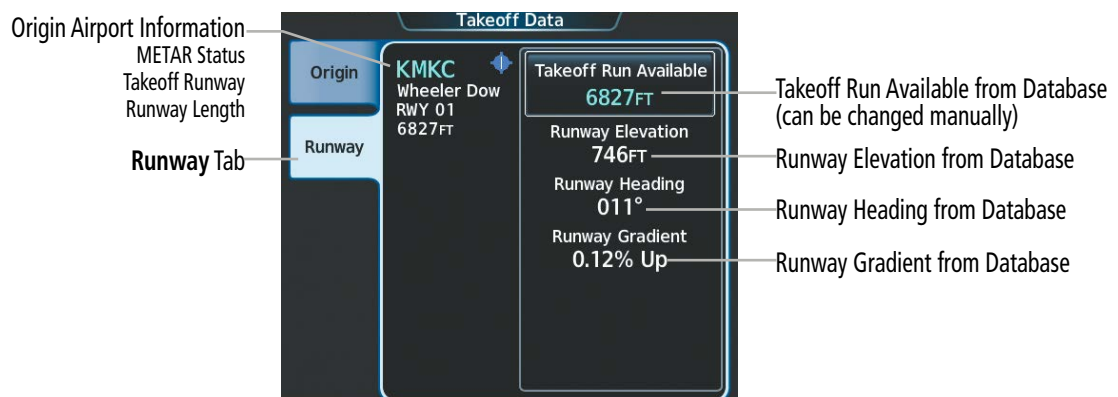
Figure 5-199 Takeoff Data – Runway Tab

The takeoff run available can be manually entered, or the database takeoff run available distance can be manually reduced specifically at the approach and/or departure end.

No Origin runway distance shown

Takeoff Run Available Button

Departure end distance unchangeable

Approach end distance unchangeable

Figure 5-200 Takeoff Run Available – No Origin Selected

Origin Takeoff Run Available (taken from database)

Takeoff Run Available Button (actual runway available)

Shorten DEP End Button (unchanged)

Entire runway displayed as available

Shorten APPR End Button (unchanged)

Figure 5-201 Takeoff Run Available – Normal

Departure end portion displayed as unavailable

Origin Takeoff Run Available (taken from database)

Approach end unchanged

Shorten DEP End Button (shortened by 600')

Takeoff Run Available Button (actual runway available)

Shorten APPR End Button (unchanged)

Figure 5-202 Takeoff Run Available – Corrected

Entering takeoff run available:

1) From Home, touch **PERF** > **Takeoff Data**.

2) Touch the **Runway** Tab.

3) Touch the **Takeoff Run Available** Button to display the 'Takeoff Run Available' Screen.

4) Enter or change the takeoff run available distance:

   a) Touch the **Shorten DEP End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the departure end of the runway.

      Or:

   a) Touch the **Takeoff Run Available** Button to display the keypad.

   b) Use the keypad to enter the shortened takeoff run available distance.

   c) If an Origin runway had been selected, touch the **DEP** Button or the **APPR** Button to shorten the distance from the approach or departure end.

      Or:

   a) Touch the **Shorten APPR End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the approach end of the runway.

5) Repeat Step 4 until the takeoff run data is displayed correctly.

6) Touch the **Save** Button to make the changes and return to the 'Takeoff Data' Screen.

LANDING DATA

The 'Landing Data' Screen allows entry of the destination airport, destination runway, required landing distance, and landing distance available. The destination airport and runway default to the active flight plan selections, if available.
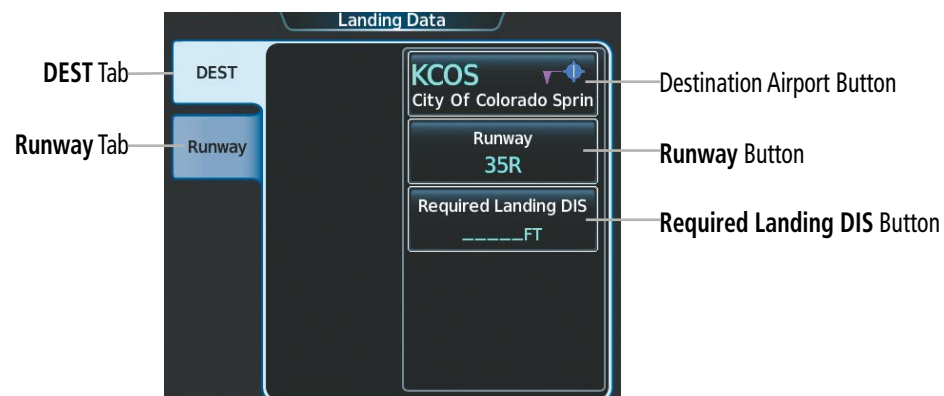
Figure 5-203 Landing Data – Destination Tab

Selecting a destination airport, runway, and required landing distance on the 'Landing Data' Screen:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **DEST** Tab, if necessary, to display the destination airport and runway data.

3) Touch the destination airport button to display the keypad.

4) Use the keypad to enter the origin airport.

5) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

6) Touch the **Runway** Button to display the 'Select Runway' Window.

7) Touch the desired runway selection button, and return to the 'Landing Data' Screen.

8) Touch the **Required Landing DIS** Button to display the keypad.

9) Use the keypad to enter the required landing distance.

10) Touch the **Enter** Button to accept the entry, and return to the 'Landing Data' Screen.

Destination runway information can be viewed on the **Runway** Tab.

Origin Airport Information
– METAR Status
– Takeoff Runway
– Runway Length

Runway Tab

Landing Distance Available from Database (can be changed manually)

Runway Elevation from Database

Runway Heading from Database

Runway Gradient from Database
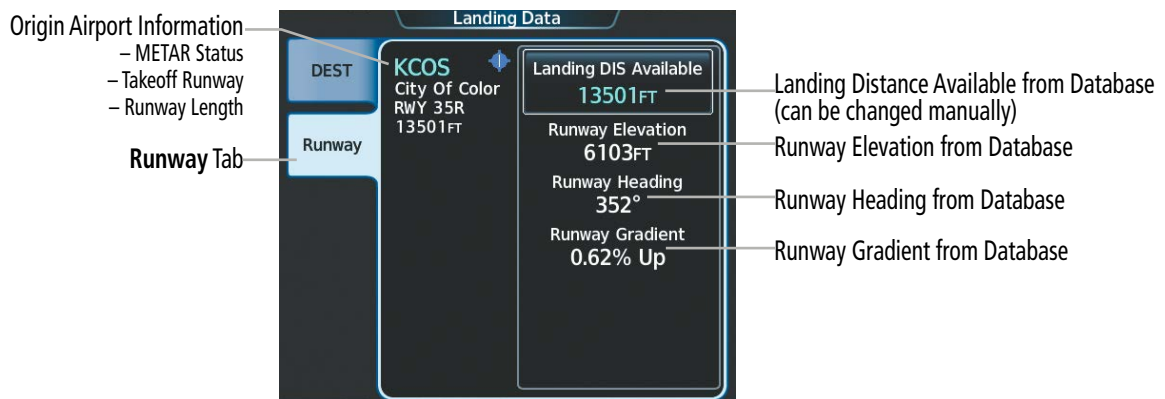
Figure 5-204 Landing Data – Runway Tab

The landing distance available can be manually entered, or the database landing distance available can be manually reduced specifically at the approach and/or departure end.

No Destination runway distance shown

Departure end distance unchangeable

Landing Distance Available Button

Approach end distance unchangeable

Figure 5-205 Landing Distance Available – No Destination Selected

Figure 5-206 Landing Distance Available – Normal
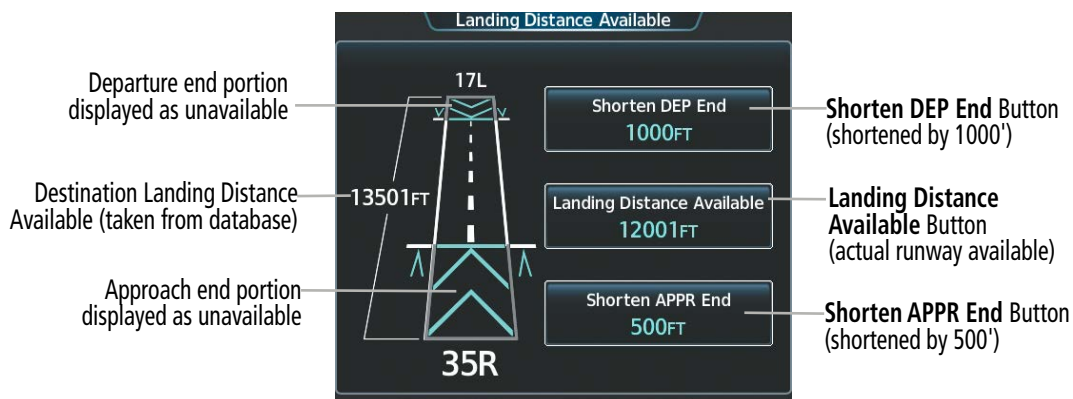
Figure 5-207 Landing Distance Available – Corrected

Entering landing distance available:

1) From Home, touch **PERF** > **Landing Data**.

2) Touch the **Runway** Tab.

3) Touch the **Landing DIS Available** Button to display the 'Landing Distance Available' Screen.

4) Enter or change the landing distance available:

   a) Touch the **Shorten DEP End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the departure end of the runway.

   Or:

   a) Touch the **Landing Distance Available** Button to display the keypad.

   b) Use the keypad to enter the shortened available landing distance.

   c) If an Destination runway had been selected, touch the **DEP** Button or the **APPR** Button to shorten the distance from the approach or departure end.

   Or:

   a) Touch the **Shorten APPR End** Button to display the keypad.

   b) Use the keypad to enter the reduction distance from the approach end of the runway.

5) Touch the **Save** Button to make the changes and return to the 'Landing Data' Screen.

GARMIN.

5.10 ABNORMAL OPERATION

This portion of the guide discusses enroute and terminal Flight Management System (FMS) degradation and Dead Reckoning (DR). For information on final approach downgrade behavior, see the Procedures portion given earlier in this section.

FMS DEGRADATION

> **NOTE:** *Once inhibited, sensors will not be monitored or used by the system, and the system will not uninhibit those sensors in the event of a failure. The system will revert to Dead Reckoning or no position until an uninhibited sensor with a valid position is available.*

The FMS will operate in either the GPS or the DR position fixing mode, depending on the available sensors. If enabled and available for use, GPS1/GPS2 will have priority, and SBAS will be used if available If one GPS sensor fails, the system will automatically transition to the other GPS sensor.

If GPS is lost and the system is unable to recover a signal, or if both GPS sensors fail, the "GPS LOI" (Loss of Integrity) annunciation is displayed in amber on the PFD. Also, a "LOSS OF GPS NAVIGATION Poor Satellite Coverage.", or "GPS NAV LOST Loss of GPS navigation. GPS fail." alert message will appear on the Touchscreen Controller.

DEAD RECKONING NAVIGATION

> **NOTE:** *Dead Reckoning Mode only functions in the Enroute or Oceanic phase of flight. In all other phases, an invalid GPS solution produces a "NO FMS POSITION" annunciation on the map and the system stops using GPS.*

The system will revert to Dead Reckoning (DR) mode if the system is no longer fully using any GPS sensor for position fixing, even if airspeed and heading data are unavailable. In DR Mode, the system will use its last-known position combined with continuously updated airspeed and heading data (when available) to calculate and display the aircraft's current estimated position. It is important to note that estimated navigation data supplied by the system in DR mode will become increasingly unreliable and must not be used as a sole means of navigation.

DR mode is inherently less accurate than the standard GPS/SBAS mode due to the lack of satellite measurements needed to determine a position. Changes in wind speed and/or wind direction compound the relative inaccuracy of DR mode. Because of this degraded accuracy, other navigation equipment must be relied upon for position awareness until GPS position data is restored.

DR mode will be indicated on the system by the appearance of the letters "DR" displayed in amber on the HSI, and on top of the aircraft symbol on navigation maps. The CDI deviation bar will be displayed in amber, and the GPS LOI annunciation will also be displayed on the PFD. The autopilot can be coupled in DR mode, as long as the lateral deviation guidance is available.

> **NOTE:** *GPS derived information will remain displayed in magenta (not amber) on the Flight Plan Text and Flight Plan Progress inset when operating in Dead Reckoning mode. However, this information shall still be considered as degraded navigation source information.*

As a result of operating in DR mode, all data that is dependent upon GPS is displayed as amber text to denote degraded navigation source information. If the VSD Inset is enabled, 'VSD Not Available' will be displayed. Airspace alerts continue to function, but with degraded accuracy. Also, while the system is in DR mode, SVT and terrain alerting functions are disabled.

Touchscreen Controller Message Annunciator

Bearing Pointer

Wind Data
"NO WIND DATA" shown if wind arrow was active

GPS Loss Of Indication Annunciation

Dead Reckoning Annunciation

Ground Speed

Current Track Indicator and reading

Navigation Mode

Distance & Bearing

Course Deviation Indicator

Navigation Data Bar
All Information in Amber

Dead Reckoning Annunciation

GPS NAV LOST Message

All Bearing/Distance Info on Nearest Screens in Amber

All Bearing/Distance Info on Airport Information Screens in Amber

Figure 5-208 Dead Reckoning Mode - GPS Derived Data Shown in Amber

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SECTION 6 HAZARD AVOIDANCE

Hazard Avoidance features available for the G5000 are designed to aid situational awareness and provide advisory information with regard to potential hazards to flight safety associated with weather, terrain, and air traffic.

- **Weather**
  - GDL 69A/69A SXM SiriusXM Weather (Subscription Optional).
  - GSR 56 Garmin Connext Weather (Subscription Optional).
  - GDR 66 ACARS Weather (Subscription Optional).
  - L-3 Stormscope® WX-500 Lightning Detection System (Optional).
  - GWX 75 Airborne Color Weather Radar.
  - Reactive Windshear Detection System.
- **Terrain Avoidance**
  - Terrain Awareness and Warning System Class-A (TAWS-A).
- **Traffic**
  - Honeywell TPU-66® Traffic Alert and Collision Avoidance System I (TCAS I) (Optional).
  - ACSS TCAS 2000™ Traffic Alert and Collision and Avoidance System II (TCAS II) (Optional).
  - Honeywell TPU-67® Traffic Alert and Collision Avoidance System II (TCAS II) (Optional).
  - Garmin GTS 8000 Traffic Alert and Collision Avoidance System II (TCAS II) (Optional).
  - Automatic Dependent Surveillance-Broadcast (ADS-B) Traffic (Optional).

6.1 DATA LINK WEATHER

⚠️ **WARNING:** Do not use data link weather information for maneuvering in, near, or around areas of hazardous weather. Information contained within data link weather products may not accurately depict current weather conditions.

⚠️ **WARNING:** Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be older than the indicated weather product age.

✅ **NOTE:** The availability of specific Garmin Connext Weather products varies by region and by subscription type. For Garmin Connext weather product coverage information, refer to flygarmin.com.

✅ **NOTE:** Do not rely on data link weather information to discern precise values for any weather-related measurements. Data link weather information is presented for informational purposes only, and should never be used as a replacement for official sources of in-flight weather information.

The Data Link Weather feature enables the system to receive weather information from a variety of weather sources, depending on the equipment installed in the aircraft. These sources may include SiriusXM Weather and Garmin Connext Weather. For each source, a ground-based system processes the weather information collected from a network of sensors and weather data providers.

The SiriusXM Weather service, available with the optional Garmin GDL 69A SXM SiriusXM Datalink Receiver and an active service subscription, updates its weather data periodically and automatically, and transmits this information to the aircraft's receiver via satellite on the S-Band frequency. This service provides continuous reception capabilities at any altitude throughout North America.

The optional Garmin Connext Weather service, available when equipped with the Garmin GSR 56 Iridium Transceiver and an active service subscription, provides data link weather information to the aircraft after the pilot defines a geographic area and subsequently selects a manual or automatically recurring Connext Data Request. The transceiver then contacts the Garmin Connext Weather service using the Iridium Satellite telephone system and retrieves the weather data for the specified area. The Garmin Connext Weather service offers worldwide weather coverage, but the availability of individual weather products, such as radar precipitation, varies by region.

In order to receive Connext Weather data, an account must first be established with Garmin Connext customer service. Refer to the Additional Features section for more information.

ACTIVATING DATA LINK WEATHER SERVICES

ACTIVATING THE SIRIUSXM WEATHER SERVICE

Before SiriusXM Weather and SiriusXM Satellite Radio can be used, the services must be activated by providing SiriusXM's customer service the coded IDs unique to the installed receiver. SiriusXM Satellite Radio (audio) and SiriusXM Weather (data) services each have coded IDs. The Data and Audio Radio IDs must be provided to activate the weather service and entertainment subscriptions, respectively. These IDs are in the following locations:

» The SiriusXM Info Screen on the Touchscreen Controller.

» The label on the back of the data link receiver.

» The GDL 69A SiriusXM Satellite Radio Activation Instructions included with the unit.

Contact the installer if the Audio and Data Radio IDs cannot be located.

SiriusXM uses the coded IDs to send an activation signal to enable the system to receive weather data and/or entertainment programming. Note that weather product softkeys and enable/disable buttons are not shown or available

Establishing a SiriusXM Weather Data account:

1) From Home, touch **Utilities > Setup** > **SiriusXM Info**.

2) Note the ID shown in the 'Data Radio' Window.

3) Contact SiriusXM customer service through the telephone number listed on its website, www.siriusxm.com. Follow the instructions provided by SiriusXM customer service.

Activating SiriusXM Weather services:

1) Position the aircraft so the GDL 69A antenna has an unobstructed view of the sky, away from buildings.

2) From Home, touch **Utilities > Setup** > **SiriusXM Info**.

3) Touch the **Start** Button in the Activation Window. The Activation Window shows 'ACTIVATING' while processing the activation.

4) In the Weather Products Window, scroll as needed to view available weather products. Available weather products appear as white text; unavailable weather products appear in subdued (gray) text. It may take several minutes before all subscribed-to weather products become available.

5) When the available weather products match all the weather products in the SiriusXM weather subscription, touch the **Lock** Button to save the activation changes, or touch the **Cancel**, **Back**, or **Home** Buttons to exit without saving changes.

ACTIVATING GARMIN CONNEXT WEATHER

Garmin Connext weather requires an active Iridium satellite network account and an active subscription to the Garmin Connext Weather service.

Registering the system to receive Garmin Connext Weather:

1) Ensure the aircraft is outside and has a clear view of the sky (if connecting via the Iridium network), or a WiFi Internet connection has been established (using the GDL 59). Refer to the Additional Features section for more information about using the GDL 59.

2) From Home, touch **Utilities > Setup > Connext Registration**. If the Registration Information Window indicates 'Not Registered', continue with this procedure.

3) Touch the **Register** Button.

4) Use the Touchscreen Controller **Keypad** or large and small right knobs to supply the access code provided from Garmin Connext customer service.

5) Touch the **Enter** Button or push the right knob. The system contacts the Garmin Connext Weather service. Registration is complete when the Registration Information Window displays the name of the airframe, tail number, and the serial numbers for the airframe and Iridium unit.

Figure 6-1 Connext Registration Screen Prior to Registration
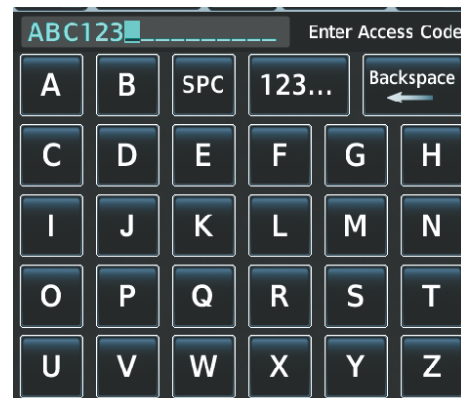
Figure 6-2 Enter Access Code Provided by Garmin Connext Customer Service

WEATHER PRODUCT AGE

> ⚠ **WARNING:** *Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be older than the indicated weather product age.*

Unlike real-time weather information collected directly from weather sensors on-board an aircraft, such as an airborne weather radar or a lightning detection system, data link weather by contrast relies on service providers to collect, process, and transmit weather information to the aircraft. This information can come from a variety of sources such as government agencies. Due to the time it takes to collect, process, and distribute data link weather information, it is imperative for pilots to understand that data link weather information is not real-time information and may not accurately depict the current conditions.

For each data link weather product which can be displayed as a map overlay, such METARs, the system can also show a weather product age. This age represents the elapsed time, in minutes, since the weather service provider compiled the weather product and the current time. It does not represent the age of the information contained within the weather product itself. For example, a single mosaic of radar precipitation is comprised data from multiple radar sites providing data at differing scan rates or intervals. The weather service provider periodically compiles this data to create a single composite image, and assigns one time to this image which becomes the basis of the product age. The service provider then makes this weather product available for data link transmission at the next scheduled update time. The actual age of the weather data contained within the mosaic is therefore older than its weather product age and should never be considered current.

SiriusXM weather products are broadcast automatically on a repeating cycle without pilot intervention. For the Garmin Connext service, the pilot schedules a one-time or repeating data request at regular intervals.

Each data link weather product age has an expiration time. The weather product age is shown in white if it is less than half of this expiration time, otherwise it is shown in amber until reaching its expiration time. After a weather product has expired, the system removes the expired weather product from the displays, and shows white dashes instead of the age. If the data link receiver has not yet received a weather product 'N/A' appears instead of the age to show the product is currently not available for display. This may occur, for example, after powering on the system but before the data link receiver has received a complete weather data transmission. It could also indicate a possible outage of a weather product.

The weather product age is shown automatically for weather products displayed on MFD maps. For PFD maps, the pilot can manually enable/disable the age information.

Displaying/Removing Weather Product Age Information on the PFD Navigation Maps:

1) With the PFD Inset Map or HSI Map displayed, press the **PFD Map Settings** Softkey.

2) Press the **WX Overlay** Softkey until the cyan SiriusXM is displayed.

Tables 6-1 show the weather product symbols where applicable, and expiration times, for SiriusXM Weather. The data link weather service providers and their respective weather data vendors define and control the data update intervals, which are subject to change. These update intervals represents the interval at which the service provider transmits new signals that may or may not contain updated weather product information. It does not represent the rate at which the weather information is updated or when the Data Link Receiver receives new data.

SiriusXM Weather Product	Product Symbol	Expiration Time (Minutes)
Next-generation Radar (NEXRAD)		30
Cloud Tops		60
Echo Tops		30
SiriusXM Lightning		30
Storm Cell Movement		30
SIGMETs	SIGM	60
AIRMETs	AIRM	60
METARs		90
City Forecast		90
Surface Analysis		60
Freezing Levels		120
Winds Aloft		90
County Warnings		60
Cyclone (Hurricane) Warnings		60
Icing Potential (CIP and SLD)		90
Pilot Weather Report (PIREPs)		90
Air Report (AIREPs)		90
Turbulence		180
No Radar Coverage	No product symbol	30
Temporary Flight Restrictions (TFRs)	TFR	60
Terminal Aerodrome Reports (TAFs)	No product symbol	60

Table 6-1 SiriusXM Weather Product Symbols and Data Timing

The following table shows the Garmin Connext Weather product symbols and expiration times. The flight crew chooses how often to contact the Garmin Connext Weather service in order to retrieve weather data through the Connext Data Request. This data link weather request rate represents the interval at which Garmin Connext Weather Service makes available the most current known weather data. It does not necessarily represent the rate at which the service receives new data from various weather sources.

> **NOTE:** *The availability of specific Garmin Connext Weather products varies by region and by subscription type. For Garmin Connext weather product coverage information, refer to flygarmin.com.*

Garmin Connext Weather Product	Product Symbol	Expiration Time (Minutes)
Connext Radar		30
IR Satellite		60
Connext Lightning		30
SIGMETs	SIGM	60
AIRMETs	AIRM	60
Meteorological Aerodrome Report (METARs)		90
Winds Aloft		90
Pilot Weather Reports (PIREPs)		90
Temporary Flight Restrictions (TFRs)	TFR	60
Terminal Aerodrome Reports (TAFs)	No product symbol	60

Table 6-2 Garmin Connext Weather Product Symbols and Data Timing

DISPLAYING DATA LINK WEATHER PRODUCTS

WEATHER DATA LINK PANE

The Weather Data Link (SiriusXM/Connext) Pane is the principal map pane for viewing data link weather information.

This pane provides the capability for displaying the most data link weather products of any map on the system. The Weather Data Link Pane also provides system-wide controls for selecting the data link weather source, if more than one source has been installed. The pane title indicates the selected data link weather source (e.g., "SiriusXM" or "Connext").
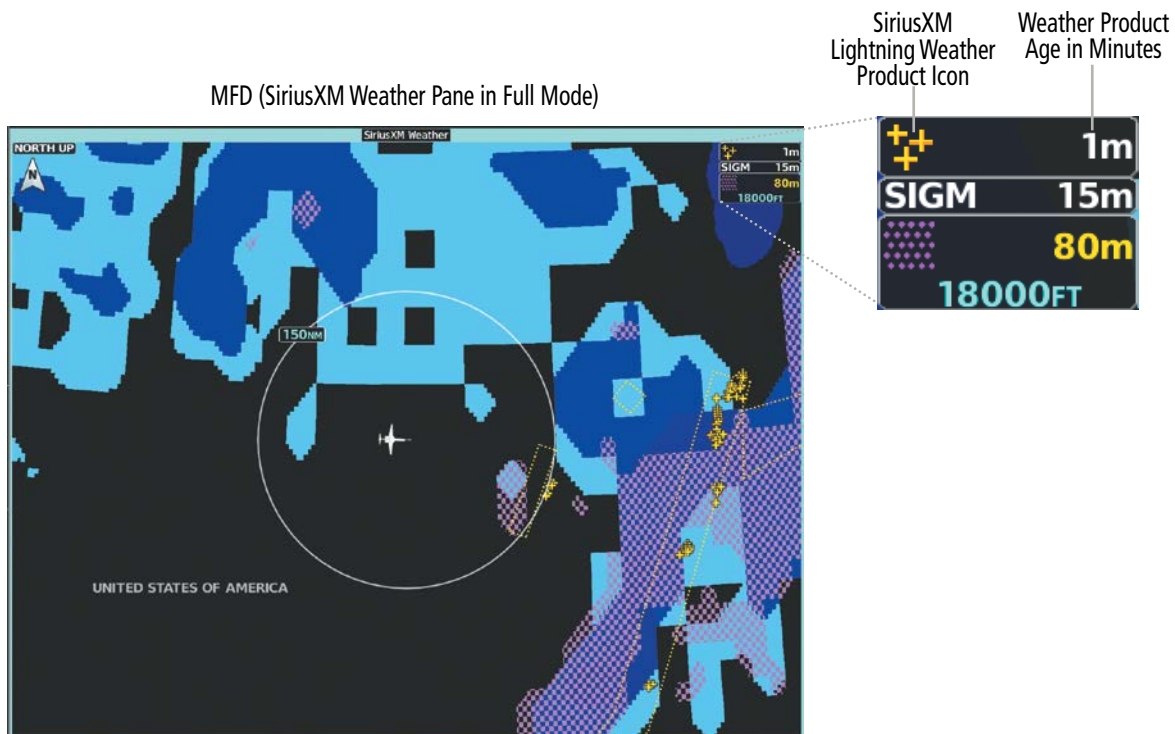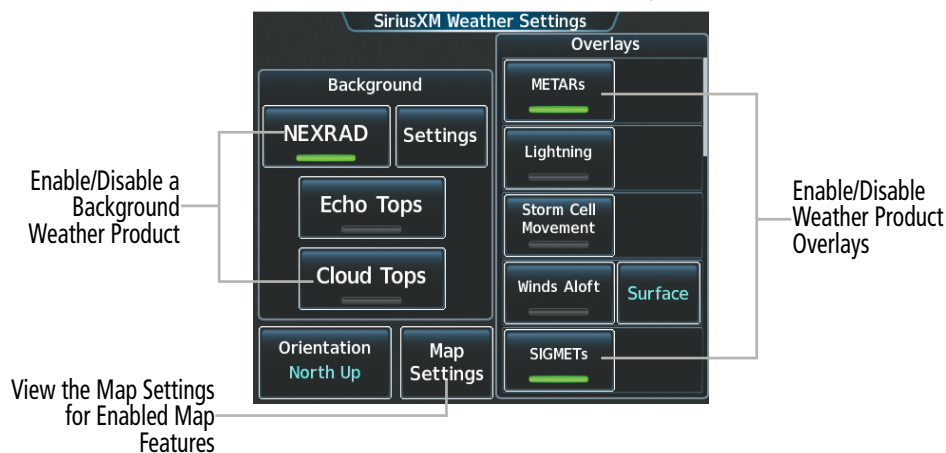
Figure 6-3 Viewing SiriusXM Weather Products on the 'SiriusXM Weather' Pane

Viewing the Weather Data Link Pane and changing the data link weather source, if applicable:

1) From Home, touch the **Weather** Button. Button is highlighted and becomes **Weather Selection** Button. Selected display pane shows a weather pane. If a weather pane other than 'Data Link Weather' is shown (such as 'Weather Radar' in the pane title), continue with the procedure to view the desired Weather Pane. (SiriusXm or Connext).

2) Touch the **Weather Selection** Button. The 'Weather Selection' Screen appears.

3) Touch either **SiriusXM or Connext Weather** Button. Button is highlighted and becomes **SiriusXM or Connext Settings** Button. The system shows the selected weather pane.

4) If necessary, touch either the **SiriusXM or Connext Settings** Button to access controls for the selected weather pane.

Figure 6-4 Weather Selection Screen

If more than one weather data link weather source has been installed (such as Garmin Connext Weather), the system provides the option to select a source of weather information for each 'Navigation Map' Pane and PFD Map.

Selecting a Data Link Weather Source for 'Navigation Map' Panes:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** tab.

3) Scroll if necessary to view the **WX Source** Button. Cyan text on the button indicates currently selected weather data link weather source.

4) Touch the **WX Source** Button.

5) Touch the button for the data link weather source to be used (such as **SiriusXM or Connext**).

Navigation Maps displaying data link weather products show the name of the selected source ('SiriusXM' or 'Connext WX') in the upper-right corner of the Inset map or lower right of the HSI map while data link weather products are enabled for display.

Selecting a Data Link Weather source for the (PFD Inset Map or HSI Map):

1) Press the **PFD Map Settings** Softkey.

2) Press the **Data Link Settings** Softkey.

3) Press the **Data Link** Softkey. Each selection of the softkey changes the source, which is displayed in cyan on the softkey.

Table 6-3 shows which Datalink Weather products can be displayed (indicated with a '+' symbol) on specific maps.

Data Link Weather Product	PFD Inset/HSI Map	Navigation Map Pane	Weather Data Link Pane	VSD Inset Window
NEXRAD	+	+	+	
Cloud Tops			+	
Echo Tops			+	
Data Link Lightning	+	+	+	
Cell Movement	+	+	+	
SIGMETs/AIRMETs			+	
METARs	+	+	+	
City Forecast			+	
Surface Analysis			+	
Freezing Levels			+	
Winds Aloft		+[1]	+	+
County Warnings			+	
Cyclone Warnings			+	
Icing Potential			+	
PIREPs			+	
AIREPs			+	
Turbulence			+	
No Radar Coverage	+	+	+	
TFRs	+	+	+	
TAFs			+	

[1] *Winds Aloft data is available inside the VSD when VSD is enabled on the 'Navigation Map' Pane.*

Table 6-3 Weather Product Display Maps

Softkeys control which weather products are shown on the PFD Inset or HSI Map Navigation Maps. The Touchscreen Controller controls the display of weather information on other map display panes such as the Navigation Map and Data Link Weather Panes. When most weather products are enabled for display, the corresponding button annunciator or softkey annunciator changes from gray (disabled) to green (enabled). For the NEXRAD weather product, pressing the 'Source' Softkey cycles through the various coverage sources (USA, Canada, or Off), indicated by cyan text on the Softkey.

The Data Link Weather Settings Screen controls the enabling/disabling of weather products for the Data Link Weather Pane The Map Settings Screen controls the enabling/disabling of weather products for the Navigation Map Panes.
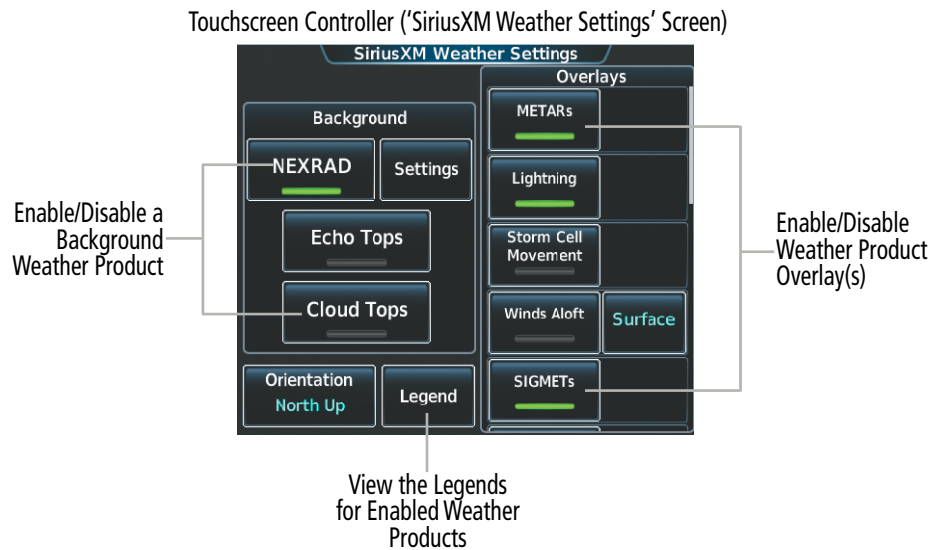
Figure 6-5 Map Settings Screen (Sensor Tab Selected)

> **NOTE:** *The availability of specific Garmin Connext Weather products varies by region and by subscription type. For Garmin Connext weather product coverage information, refer to refer to flygarmin.com.*

For Navigation Maps (including the Inset Map and HSI Map), the flight crew can select the maximum map range to display each Data Link Weather product. The Map Settings Screen on the Touchscreen Controller controls the maximum map range at which the system displays a weather product on a map; selecting a map range higher than this range will declutter the weather product from the map. The selected maximum map ranges apply to all onside navigation maps, regardless of which screen was used to make the maximum map range selections.

Selecting Maximum Navigation Map Range for Data link Weather Products:

1) From Home, touch **Map > Map Selection > Map Settings.**

2) If necessary, touch the **Sensor** Tab.

3) Scroll through the list to view the available weather products.

4) Touch a range button next to the corresponding weather product, then touch to select the maximum navigation map range at which the system will display the selected weather product.

Weather information displayed on maps other than the Data Link Weather Pane use settings based on those selected on the Map Settings Screen.

The Data Link Weather Settings Screen on the Touchscreen Controller can display a legend for each weather product currently enabled on the Data Link Weather Pane.

Viewing legends for weather products enabled on the 'Data Link' (SiriusXM or Connext,) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings.**

2) Scroll as necessary and touch the **Legend** Button. The 'Weather Legends' Window appears on the Touchscreen Controller.

3) Scroll as needed to view the weather legends in the 'Weather Legends' Window.

4) To remove the 'Weather Legends' Window, touch the **Back** Button or the **Home** Button**.**

Scroll to view legends for enabled SiriusXM Weather products
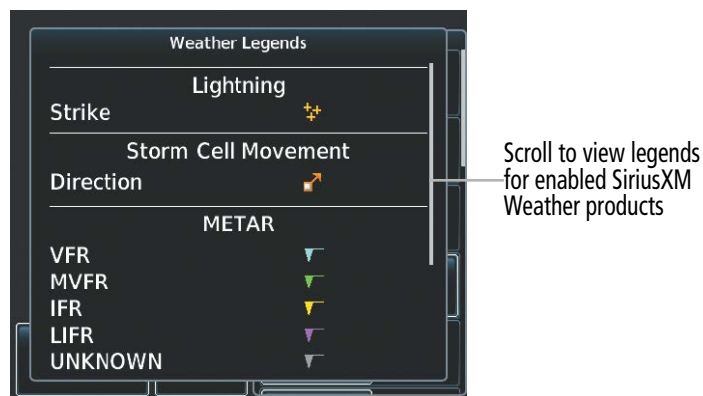
Figure 6-6 Weather Legends Window (SiriusXM)

The system displays additional information about the following weather products by panning over the product on the map with the map pointer.

- Echo Tops (SiriusXM)
- Storm Cell Movement (SiriusXM)
- SIGMETs
- AIRMETs
- METARs

- County Warnings (SiriusXM)
- TFRs
- PIREPSs
- AIREPs
- Infrared (IR) Satellite (Connext)

The **Joystick** or **Touchpad** control the Map Pointer. These controls also adjust the map range. If the map range is adjusted while panning is enabled, the map is re-positioned on the Map Pointer.

Original METAR Text

KFOA 141315Z AUTO
18010KT 1 3/4SM TSRA
OVC007 15/14 A2960 RMK
AO2 VIS 1V5 LTG DSNT
ALQS P0024 T01470143

Airport with METAR Flag Selected with Map Pointer
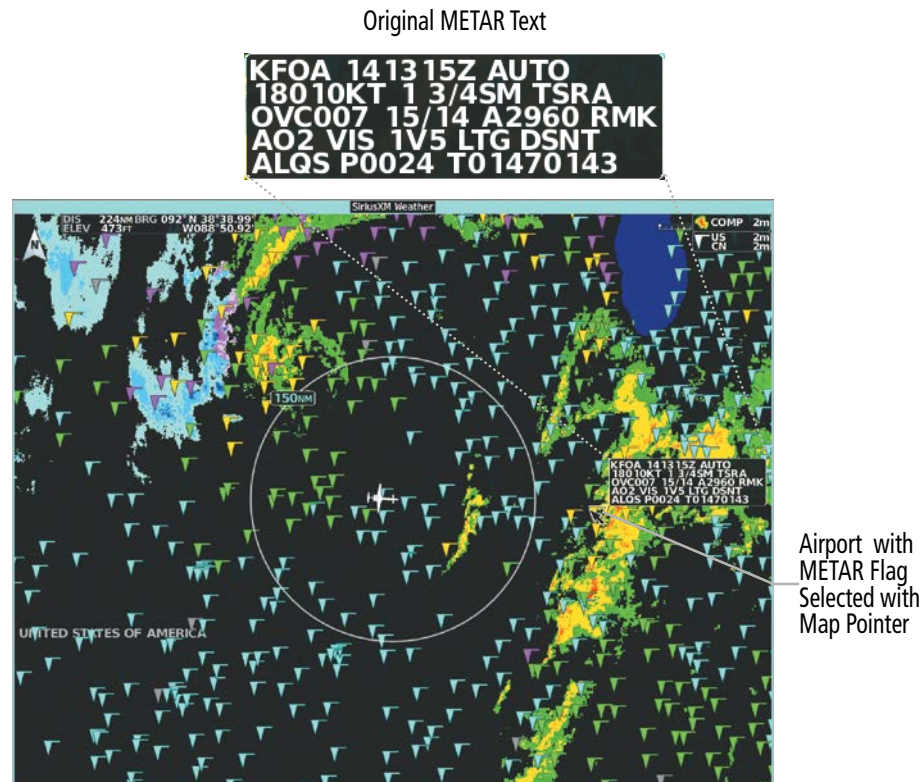
Figure 6-7 Panning on the 'SiriusXM Weather' Pane

The system provides the ability to select a map orientation for the Data Link Weather Pane for the selected display pane location on the GDU. In addition to the Heading Up, Track Up, and North Up display options, the system can also synchronize the Data Link Weather Pane orientation to the Navigation Map Pane orientation.

Selecting a map orientation for the Data Link (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Touch the **Orientation** Button to change the selected map orientation (displayed in cyan).

3) Touch the desired map orientation button (**Heading Up, Track Up, North Up, Sync to Nav Map**).

Button selects map orientation for the selected 'SiriusXM Weather' Pane
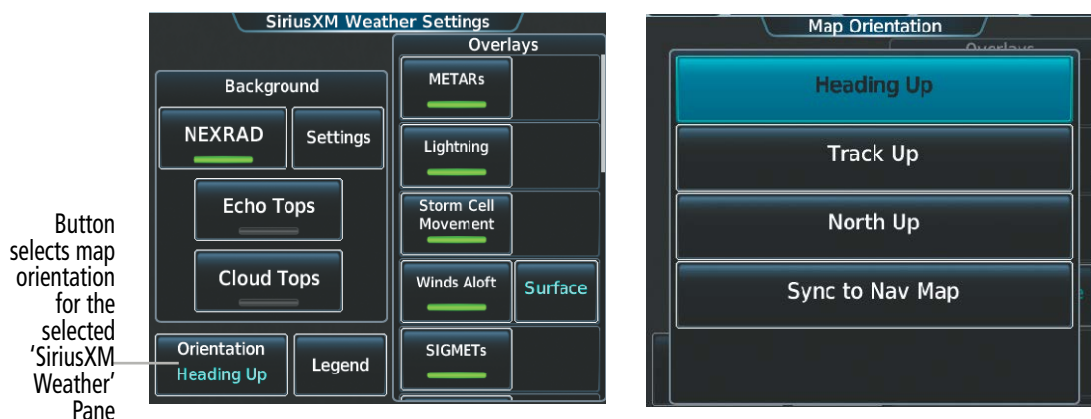
Figure 6-8 Selecting a Map Orientation for the 'SiriusXM Weather' Pane

The weather product age and availability information appears automatically when a weather product is shown on the Data Link Weather Pane. The pilot can manually enable/disable the display of this information on the PFD Inset Map.

Displaying/Removing Weather Product Age Information on the (PFD Inset Map or HSI Map):

1) Press the **PFD Map Settings** Softkey.

2) Select the **Weather Legend** Softkey to enable/disable the weather product age information.
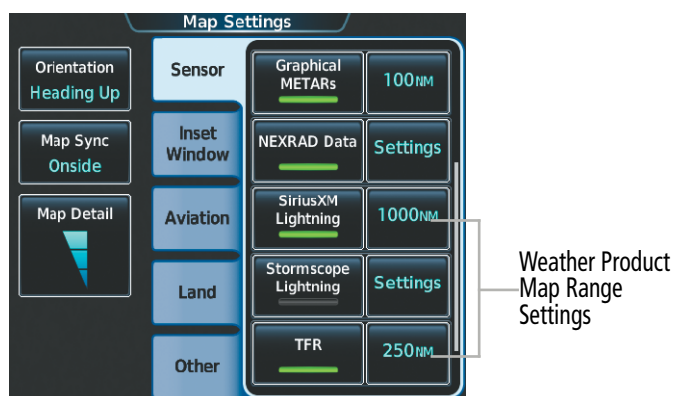
Figure 6-9 Map Settings Screen (Sensor Tab Selected)

CONNEXT WEATHER DATA REQUESTS

The Data Request Window on the Connext Weather Settings Screen provides the flight crew with the options to define weather data request coverage areas, select automatic weather data request intervals, and provides the ability to send a manual data request immediately. The Data Request Window also displays the status of the Connext Data Request process.

Before the system can retrieve weather information, a valid coverage area must be defined from which all available Garmin Connext Weather products will be retrieved (regardless of which weather products are currently enabled for display). The flight crew may define the coverage area by enabling/disabling one or more of the following buttons at any time:

- **P.POS** (Present Position)
- **Destination** (as part of the active flight plan)
- **Flight Plan** (active)
- **Waypoint**

It is not necessary to provide the system with the destination, flight plan, or waypoint prior to enabling these buttons. However, if none of this information is supplied, the present position must be included in the Connext Data Request. Otherwise, the Data Request Window indicates 'INVALID COVERAGE AREA' when performing a data request, because the system has insufficient information to define the coverage area.

Defining Weather Data Request Coverage Area:

1) From Home, touch **Weather > Weather Selection > Connext Weather > Connext Settings**.

2) Touch the **Define Coverage** Button.

3) To change the diameter and route width of the weather data request coverage area, touch the **Diameter/ Width** Button. Scroll as needed and touch the desired distance button in the pop-up window.

4) To include/remove the present position in the weather data request, touch the **P.POS** Button.

5) To include/remove the destination of the active flight plan in the weather data request, touch the **Destination** Button.

6) To include/remove any portion of the active flight plan route in the weather data request, touch the **Flight Plan** Button.

7) To change distance of the flight plan to be used in the data request, touch the Flight Plan Distance Button. Scroll as needed and touch the desired distance of the flight plan to be used ('Remaining FPL' uses the remainder of the flight plan, or select a specified look-ahead distance from the list).

8) To include/remove a specific waypoint to be used in the weather data request, touch the **Waypoint** Button.

   a) Touch the waypoint entry Button (to the right of the **Waypoint** Button).

   b) Use Touchscreen Controller keypad or knobs to enter a waypoint to include in the weather data request, then touch the **Enter** Button or press the small knob.

9) When finished, touch the **Back** Button to return to the Connext Weather Settings Screen, or touch the **Home** Button.

Sending/Cancelling an Immediate Weather Data Request:

1) From Home, touch **Weather > Weather Selection > Connext Weather > Connext Settings**.

2) Touch the **Send Immediate Request** Button. The system contacts Garmin Connext services and displays the status in the 'Data Request' Window. System displays 'Completed' when finished.

3) If desired, touch the **Cancel Immediate Reques**t Button while a request is occurring. Data Request Window displays 'Cancelled'.

Data Request Window
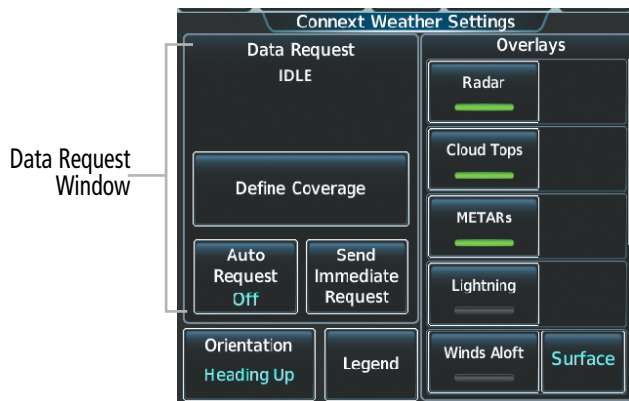
Figure 6-10 'Connext Weather Settings' Screen

Figure 6-11 Selecting coverage area for Connext Data Request

During a weather data request, the Data Request Window initially displays "Contacting Connext...". Once a connection is established, the Data Request Window displays "Receiving Wx Data... Time Remaining:" with an estimated data transfer time (either minutes or seconds). Connext Data Requests typically take between one to four minutes to complete depending on the size of the selected weather coverage area and the data link signal strength. If the system cannot complete the data request, the Data Request Window displays an error; see the Abnormal Operations discussion later in this section for more information.

The system retrieves all available Connext Weather products within the selected coverage area during an initial weather data request, regardless of which products (if any) are currently enabled for display. On subsequent weather data requests, previously retrieved textual products (such as METARs and TAFS) are retained if not expired, while new textual weather data matching the current coverage area and all graphical weather data is downloaded during every data request.

Present Position Selected, 200 nm Diameter
Requested

Destination Selected,
200 nm Diameter Requested
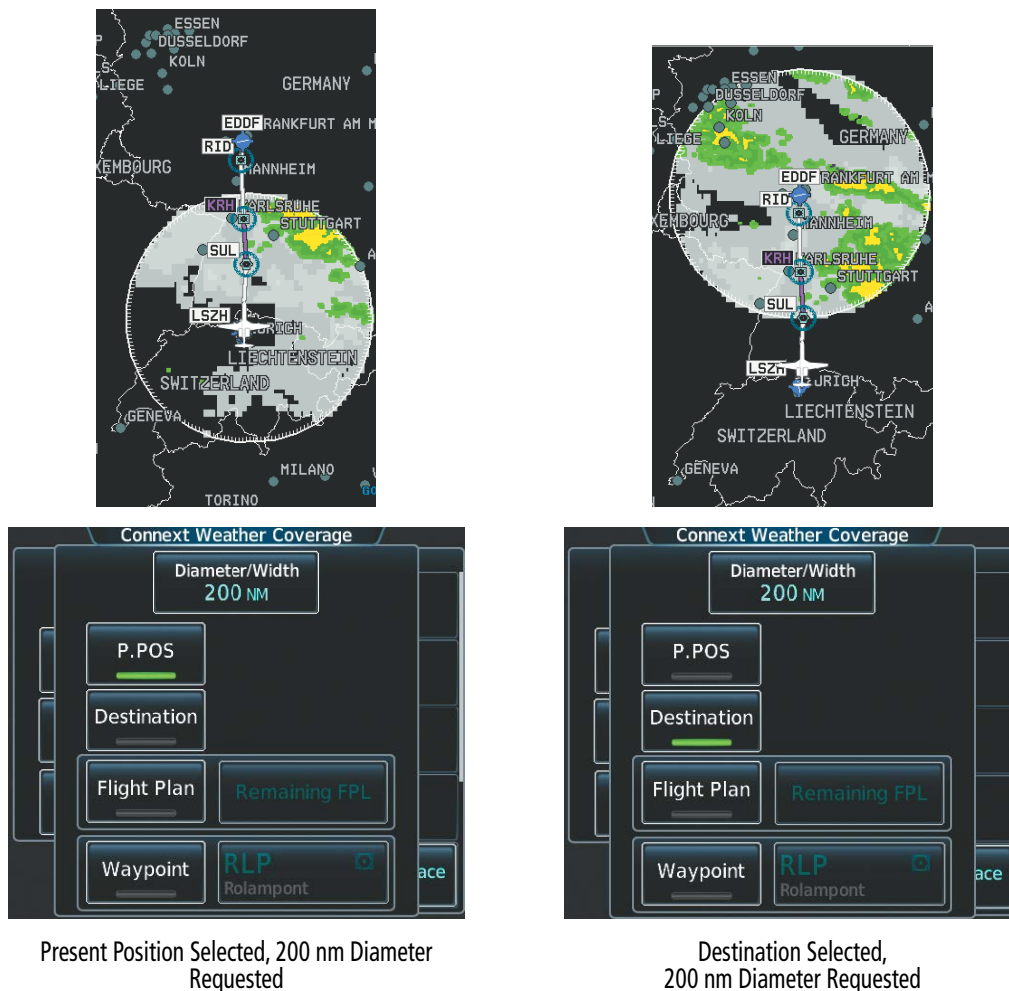
Figure 6-12 Connext Weather Coverage Options for Present Position and Destination

Next 80 nm of Flight Plan Selected, 200 nm Route Width Requested

Waypoint Selected, 200 nm Diameter Requested
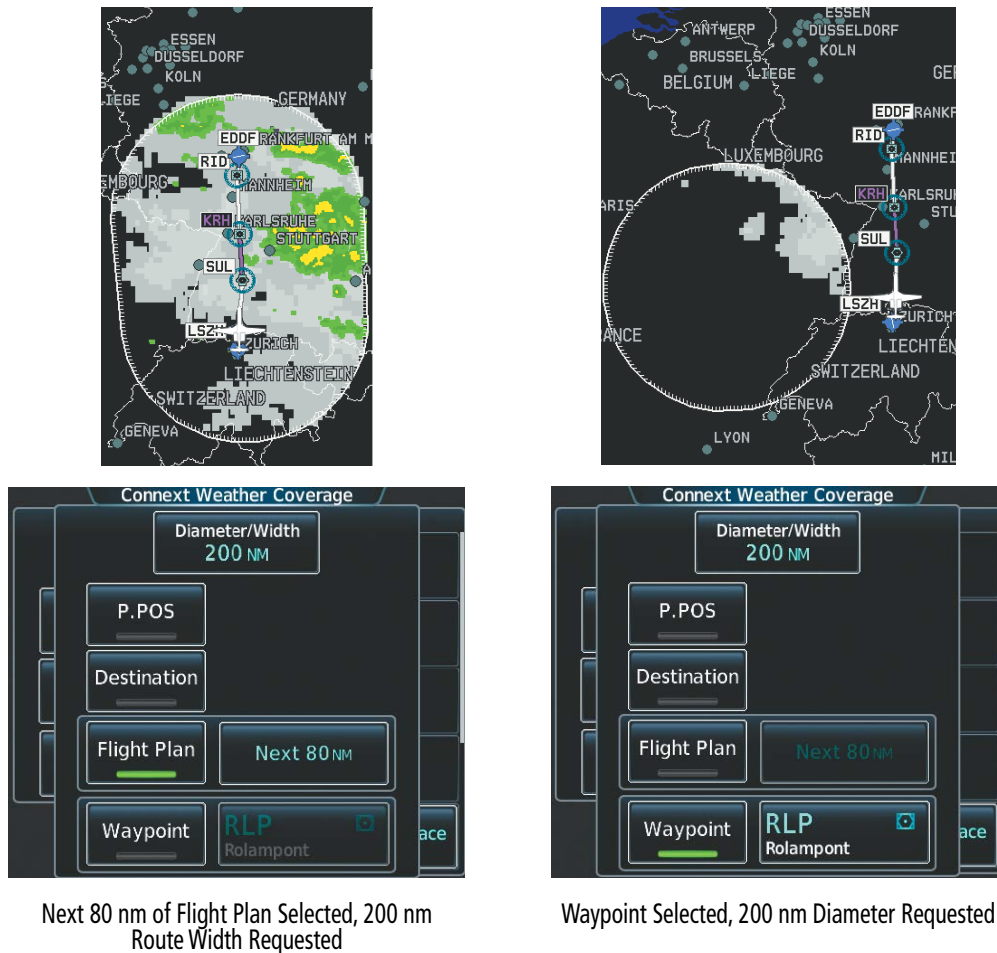
Figure 6-13 Connext Weather Coverage Options based on Flight Plan and Waypoint Selections

The flight crew can schedule Connext Data Requests to recur automatically. Automatic requests remain enabled until the flight crew disables them, or the system power is cycled. The Data Request Window will indicate a countdown timer until the next automatic Connext Data Request occurs. Performing an immediate data request resets the timer unto the next Automatic data request occurs.

Enabling/disabling automatic Connext Data Requests:

1) From Home, touch **Weather > Weather Selection > Connext Weather > Connext Settings**.

2) Touch the **Auto Request** Button.

3) From the pop-up window, touch an Auto Update Request Rate Button to select the desired weather request update interval in minutes or touch the **Off** Button to disable automatic Connext Data Requests.

WEATHER PRODUCT OVERVIEW

The following is an overview of data link weather products the system can display.

NEXRAD (SIRIUSXM)

⚠️ **WARNING:** *Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be older than the indicated weather product age.*

✓ **NOTE:** *The NEXRAD weather product cannot be displayed at the same time as terrain, echo tops, turbulence, or icing data.*

The National Weather Service (NWS) operates the WSR-88D, or NEXRAD (NEXt-generation RADar) system, an extensive network of 160 high-resolution Doppler radar systems. The NEXRAD network provides centralized meteorological information for the continental United States and selected overseas locations. The maximum range of a single NEXRAD site is 250 nm.

Individual NEXRAD sites supply the network with radar images, and the images from each site may arrive at the network at different rates and times. Periodically, the weather data provider compiles the available individual site images from the network to form a composite image, and assigns a single time to indicate when it created the image. This image becomes the NEXRAD weather product. Individual images--gathered from each NEXRAD site--differ in age, and are always older than the displayed NEXRAD weather product age. The data provider then sends the NEXRAD data to the SiriusXM Weather service, whose satellites transmit this information during the next designated broadcast time for the NEXRAD weather product.

Because of the time required to detect, assemble, and distribute the NEXRAD weather product, the displayed weather information contained within the product may be significantly older than the current radar synopsis and may not depict the current weather conditions. The NEXRAD weather product should never be used as a basis for maneuvering in, near, or around areas of hazardous weather regardless of the information it contains.

For radar sites in the United States, the NEXRAD weather product shows a composite reflectivity image. This shows the *highest* radar energy received from multiple antenna tilt angles at various altitudes. For radar sites based in Canada, the NEXRAD weather product shows radar returns from the lowest antenna tilt angle, known as base reflectivity. The display of the information is color-coded to indicate the intensity of the echoes and the type of precipitation, if known.

No Radar Coverage
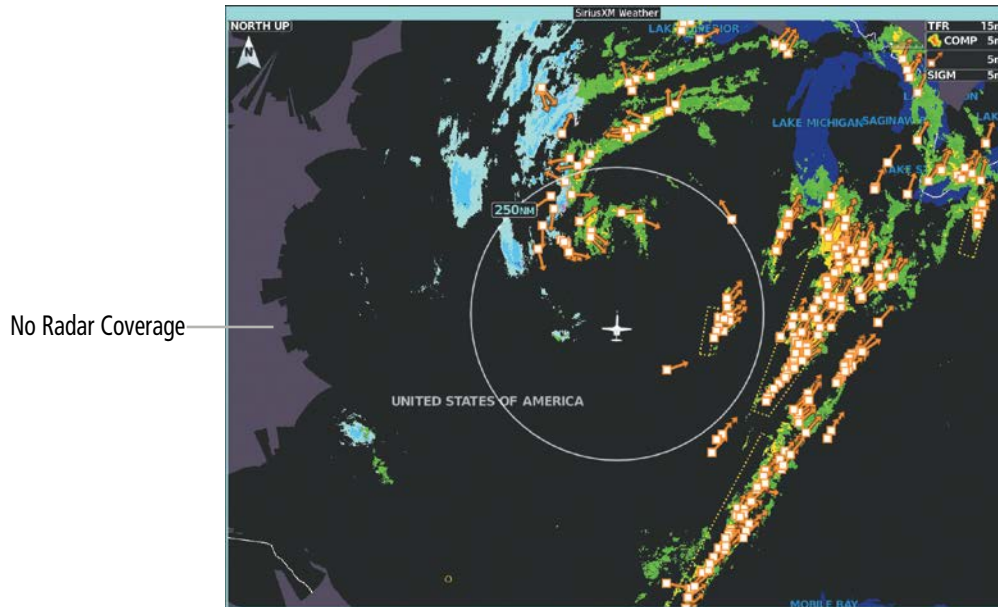
Figure 6-14 NEXRAD Data on the 'SiriusXM Weather' Pane

Displaying NEXRAD weather information ('SiriusXM Weather' Pane):

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings.**

2) Touch the **NEXRAD** Button in the Background Window to enable/disable the display of NEXRAD information.

Displaying NEXRAD weather information ('Navigation Map' Pane)

1) From Home, touch **Map > Map Selection** > **Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the **NEXRAD Data** Button in the Overlays Window to enable/disable the display of the NEXRAD weather product on the 'Navigation Map' Pane.

Changing the NEXRAD coverage area ('Navigation Map' Pane):

1) From Home, touch **Map > Map Selection** > **Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the NEXRAD Data **Settings** Button.

4) Touch the **NEXRAD Data** coverage Button (displaying either '**Composite Reflectivity CONUS**' or '**Base Reflectivity All Regions**' in cyan).

5) Touch the '**Composite Reflectivity CONUS**' or '**Base Reflectivity All Regions**' Button, or touch **Back** or **Home** to exit without changing the coverage area.

Displaying NEXRAD weather information (PFD Inset Map or HSI Map):

1) If necessary, enable the Inset Map or HSI Map.

2) Press the **PFD Map Settings Softkey.**

3) Press the **WX Overlay** Softkey to enable/disable the display of NEXRAD Data.

Changing the NEXRAD coverage area (PFD Inset Map or HSI Map):

1) Press the **PFD Map Settings** Softkey.

2) Press the **Data Link Settings** Softkey.

3) Press the **Data Link** Softkey as needed to cycle among the options (SiriusXM, Connext, and ACARS) until 'SiriusXM' appears on the softkey.

4) Press the **Source** Softkey. Each selection of the softkey changes the source 'CMP' or 'BAS', which is displayed in cyan on the softkey.

Changing the NEXRAD coverage area ('SiriusXM Weather' Pane):

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) If necessary, touch the **NEXRAD** Button in the Background Window to enable the display of NEXRAD.

3) Touch the NEXRAD **Settings** Button.

4) Touch the **Composite Reflectivity** Button.

5) Touch either **Composite Reflectivity CONUS** or **Base Reflectivity All Regions** Button.

6) When finished, touch the **Back** Button or the **Home** Button.

The **Composite Reflectivity CONUS** display shows composite data from all available NEXRAD radar sites within the Continental United States. This data is composed of the maximum reflectivity from the individual radar sweeps. The display of the information is color-coded to indicate the strength of the radar returns. All weather product legends can be viewed on the Touchscreen Controllers. For the NEXRAD legend, touch the **Legend** Button on the SiriusXM Weather Settings Screen when NEXRAD is enabled for display.
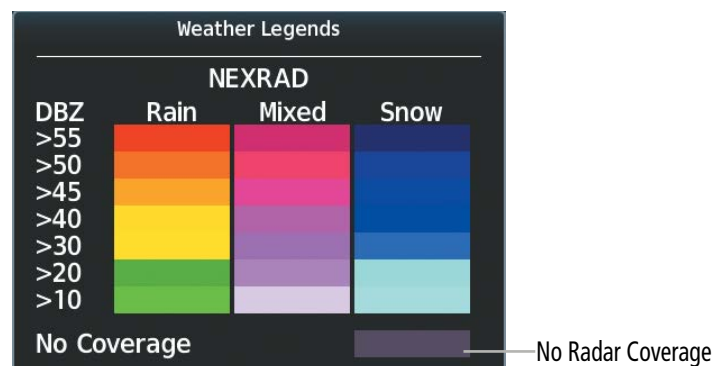
Figure 6-15 NEXRAD Legend

The system can animate a loop of NEXRAD information on the SiriusXM Weather Pane. Animation begins after the system has received at least two NEXRAD images since the system was powered on. When animation is enabled, a timeline appears to the left of the NEXRAD weather product age display. The large square on the timeline indicates the relative position of the displayed frame of animation, from oldest to newest. The NEXRAD weather product age corresponds to the displayed frame. The system can show up to six frames of NEXRAD animation when the Composite Reflectivity CONUS coverage option is selected, and up to three frames of animation when Base Reflectivity All Regions is selected. Due to the time it takes to accumulate successive frames, allow approximately 30 minute for the maximum number of frames to be available for animation.

Displaying Time-Lapse NEXRAD Animation on the 'SiriusXM Weather' Pane:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) If necessary, touch the **NEXRAD** Button in the Background Window to enable the display of NEXRAD.

3) Touch the NEXRAD **Settings** Button.

4) Touch the **Animation** Button to enable/disable NEXRAD animation.

5) When finished, touch the **Back** Button or the **Home** Button.

Displaying Time-Lapse NEXRAD Animation on the 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll if necessary and touch the NEXRAD Data **Settings** Button.

4) Touch the **NEXRAD Animation** Button to enable/disable the animated NEXRAD information.

5) When finished, touch the **Back** Button or the **Home** Button.

The display of No Radar Coverage is always active when either the NEXRAD or Echo Tops weather products are enabled for display. Areas where NEXRAD radar coverage and Echo Tops information is not currently available, or outside of the selected coverage source area, or is not being collected are indicated in a gray shade of purple.

REFLECTIVITY

The role of radar is essentially to detect moisture in the atmosphere. Simply put, certain types of weather reflect radar better than others. The intensity of a radar reflection is not necessarily an indication of the weather hazard level. For instance, wet hail returns a strong radar reflection, while dry hail does not. Both wet and dry hail can be extremely hazardous.

The different NEXRAD echo intensities are measured in decibels (dB) relative to reflectivity (Z). NEXRAD measures the radar reflectivity ratio, or the energy reflected *back to* the radar receiver (designated by the letter Z). The value of Z increases as the returned signal strength increases.

Reflectivity is the amount of transmitted power returned to the radar receiver. Colors on the NEXRAD display are directly correlative to the level of detected reflectivity. Reflectivity as it relates to hazardous weather can be very complex. Radar reflectivity can be separated into two elements: Base or Composite.

The base reflectivity precipitation weather product shows the radar returns from the perspective of a single antenna tilt angle. The composite reflectivity precipitation weather product shows the *highest* radar energy received from multiple antenna tilt angles. The display of the information is color-coded to indicate the intensity of the echoes and the type of precipitation.

NEXRAD LIMITATIONS

NEXRAD radar images may have certain limitations:

- NEXRAD base reflectivity does not provide sufficient information to determine cloud layers or precipitation characteristics (wet hail vs. rain). For example, it is not possible to distinguish between wet snow, wet hail, and rain.
- NEXRAD base reflectivity is sampled at the minimum antenna elevation angle. An individual NEXRAD site cannot depict high altitude storms at close ranges. It has no information about storms directly over the site.
- When zoomed in to a range of 30 nm, each square block on the display represents an area of four square kilometers. The intensity level reflected by each square represents the *highest* level of NEXRAD data sampled within the area.
- Colors displayed from NEXRAD and airborne weather radar systems are not interchangeable. Refer to the applicable legends based on the weather source.
  The following may cause abnormalities in displayed NEXRAD radar images:
- Ground clutter.
- Strobes and spurious radar data.
- Sun strobes (when the radar antenna points directly at the sun).
- Interference from buildings or mountains, which may cause shadows.
- Metallic dust (chaff) from military aircraft, which can cause alterations in radar scans.

NEXRAD LIMITATIONS (CANADA)

- Radar coverage extends to 55ºN.
- Any precipitation displayed between 52ºN and 55ºN is displayed as mixed regardless of actual precipitation type.

PRECIPITATION (GARMIN CONNEXT)

> ✓ **NOTE:** *The Garmin Connext weather product cannot be displayed simultaneously on the same map with relative terrain or airborne weather radar information. When one item is enabled the other is disabled.*

The Garmin Connext Radar weather product, where available, shows a mosaic of weather radar images compiled from individual radar sites. Images may arrive at ground-based collection systems at different rates and times.

Periodically, the Garmin Connext Weather service collects these images, and assigns a single time to indicate when it created the image. This composite image becomes the Garmin Connext Radar product. Images from individual radar sites differ in age, and are always older than the displayed Precipitation weather product age.

Because of the time required to detect, assemble, and distribute this weather product, the displayed weather information contained within the product may be significantly older than the current radar synopsis and may not depict the current weather conditions. Information from the Garmin Connext Radar weather product should never be used as a basis for maneuvering in, near, or around areas of hazardous weather regardless of the information it contains.
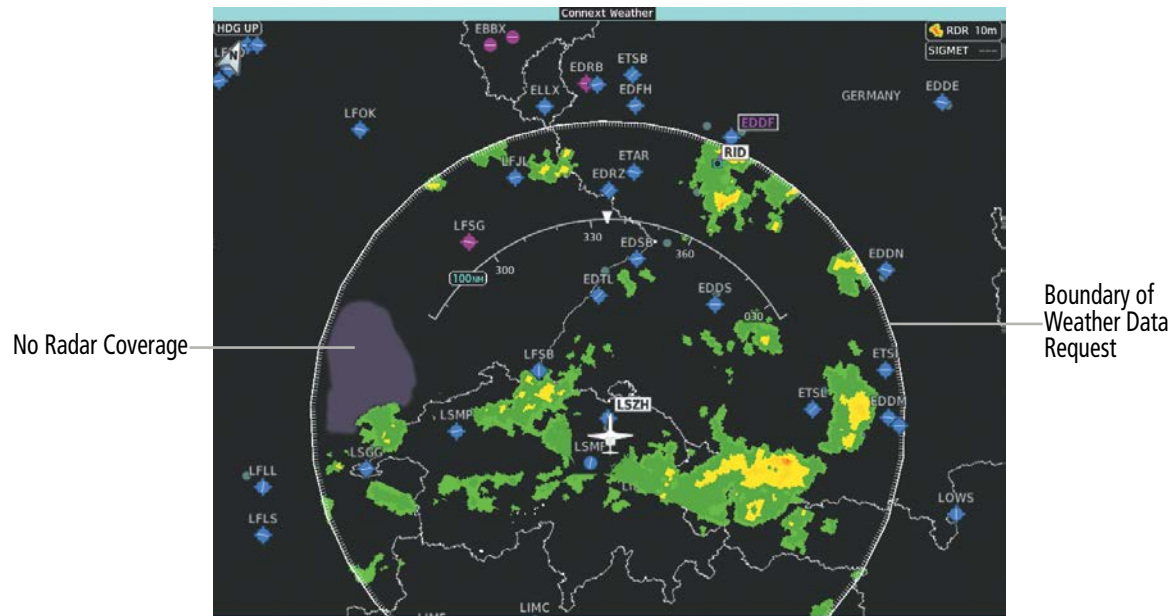
Figure 6-16 Connext Weather Pane with Connext Radar Enabled

Displaying Garmin Connext Radar information ('Navigation Map' Panes):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll if needed and touch the **Connext Radar** Button.

Displaying Garmin Connext Radar information ('Connext Weather' Pane):

1) From Home, touch **Weather** > **Weather Selection** > **Connext Weather** > **Connext Settings.**

2) Touch the **Radar** Button in the 'Overlays' Window.

Displaying Garmin Connext Radar information (PFD Inset Map or HSI Map):

1) Press the **PFD Map Settings** Softkey.

2) Press the **WX Overlay** Softkey as needed to cycle among the options until the desired data link weather source is displayed.

For radar sites in the United States, the Connext Radar weather product shows a composite reflectivity image. This shows the *highest* radar energy received from multiple antenna tilt angles at various altitudes. For radar sites based outside of the United States, the Connext Radar weather product shows radar returns from the lowest antenna tilt angle, known as base reflectivity. The display of the information is color-coded to indicate the intensity of the echoes and the type of precipitation, if known.

Region	Radar Reflectivity Type
United States	Composite Reflectivity
Canada, Europe, Australia	Base Reflectivity
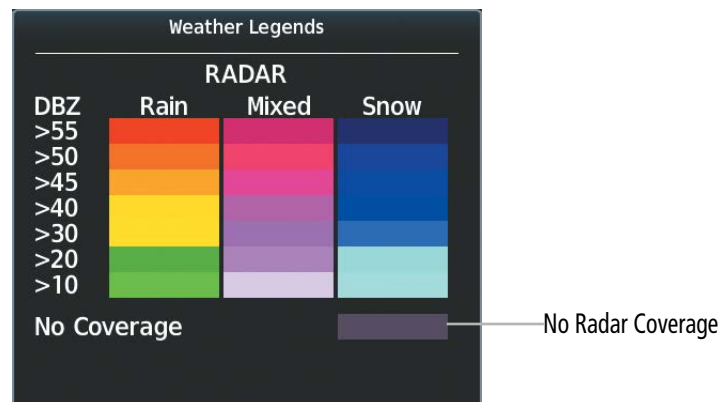
Figure 6-17 Connext Weather Radar Legend

The display of no radar coverage is enabled when Garmin Connext Radar is enabled for display. Areas where radar coverage is not currently available or is not being collected are indicated in a gray shade of purple. A white boundary line with white tick marks depicts the selected coverage area of the Connext Data Request (as defined in the Data Request Window). This boundary encloses the precipitation data when this weather product is displayed. This boundary assists the flight crew in differentiating an area without precipitation from an area outside of the Connext Data Request coverage area.

REFLECTIVITY

The role of radar is essentially to detect moisture in the atmosphere. Simply put, certain types of weather reflect radar better than others. The intensity of a radar reflection is not necessarily an indication of the weather hazard level. For instance, wet hail returns a strong radar reflection, while dry hail does not. Both wet and dry hail can be extremely hazardous.

The different radar echo intensities are measured in decibels (dB) relative to reflectivity (Z). Weather radars measure the reflectivity ratio, or the energy reflected *back to* the radar receiver (designated by the letter Z). The value of Z increases as the returned signal strength increases.

Reflectivity is the amount of transmitted power returned to the radar receiver. Colors on the Precipitation display directly correlate to the level of detected reflectivity. Reflectivity as it relates to hazardous weather can be very complex.

RADAR LIMITATIONS

Radar images may have certain limitations:

- Radar base reflectivity does not provide sufficient information to determine cloud layers or precipitation characteristics (wet hail vs. rain). For example, it is not possible to distinguish between wet snow, wet hail, and rain.

- Radar base reflectivity is sampled at the minimum antenna elevation angle. An individual radar site cannot depict high altitude storms at close ranges. It has no information about storms directly over the site.

- When zoomed in to a range of 30 nm, each square block on the display represents an area of four square kilometers.

- Colors displayed from NEXRAD and airborne weather radar systems are not interchangeable. Refer to the applicable legends based on the weather source.

The following may cause abnormalities in displayed radar images:

- Ground clutter.
- Strobes and spurious radar data.
- Sun strobes (when the radar antenna points directly at the sun).
- Interference from buildings or mountains, which may cause shadows.
- Metallic dust (chaff) from military aircraft, which can cause alterations in radar scans.

DATALINK WEATHER PRODUCT OVERLAYS

If equipped, the following optional data link weather products will be available to the flight crew.

ECHO TOPS (SIRIUSXM)

> **NOTE:** *When the Echo Tops weather product is enabled on the SiriusXM Weather Pane, the system disables the NEXRAD and Cloud Tops weather products.*

The Echo Tops weather product shows the location and elevation of the highest radar echo. The highest radar echo does not indicate the actual top of a storm or clouds. It indicates the highest altitude at a which NEXRAD radar was able to detect precipitation. Note this Echo Tops altitude may be higher than the highest altitude airborne weather radar was able to detect precipitation, particularly at longer ranges from the airborne weather radar antenna. See section 6.2 for more information on airborne weather radar. The Echo Tops weather product, like all data link weather products, does not provide real-time weather information.

Figure 6-18 Echo Tops Weather Product

Enabling/Disabling Echo Tops information:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Touch the **Echo Tops** Button in the Background Window.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display the Echo Tops legend when Echo Tops is enabled. Since Echo Tops and Cloud Tops use the same color scaling to represent altitude, only one of these products may be displayed at a time. When Echo Tops is enabled, the system disables NEXRAD and Cloud Tops information.
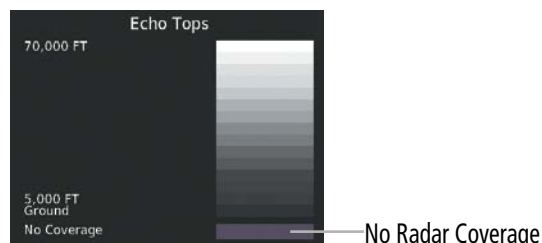
Figure 6-19 Echo Tops Legend

The display of No Radar Coverage is always active when either Echo Tops or NEXRAD is enabled. Areas where NEXRAD radar coverage and Echo Tops information is not available, or is not being collected are indicated in gray shade of purple.

CLOUD TOPS (SIRIUSXM)

> **NOTE:** The Cloud Tops and Echo Tops weather products cannot be displayed at the same time on the 'SiriusXM Weather' Pane.

The Cloud Tops weather product depicts cloud top altitudes as determined from satellite imagery. When the Cloud Tops weather product is enabled, the system removes the Echo Tops weather product. When the Map Pointer is activated, the system displays the altitude of the selected Cloud Top.
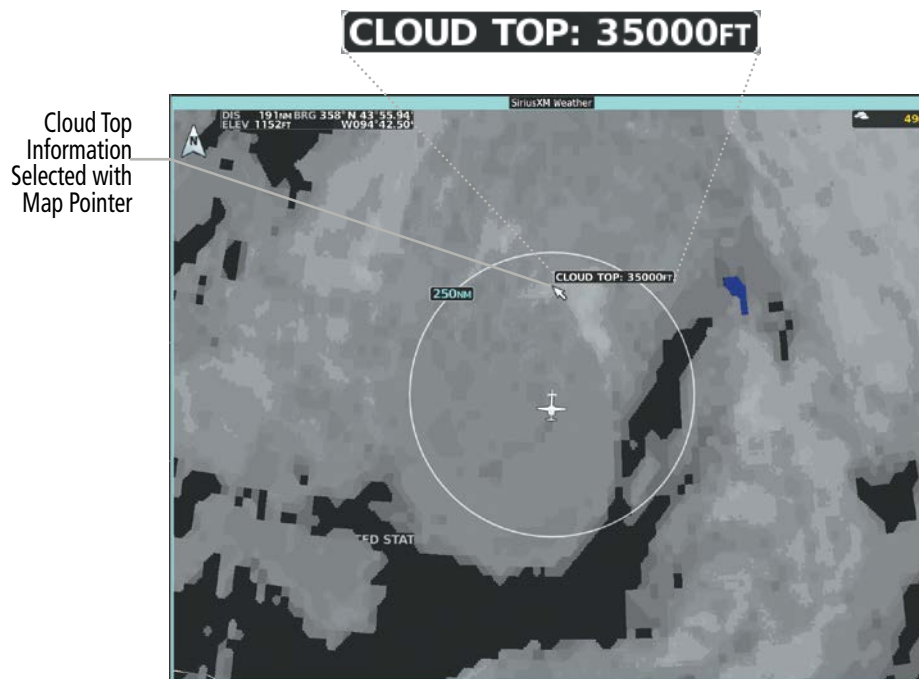
Figure 6-20 Cloud Tops Weather Product

Enabling/Disabling Cloud Tops information:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Touch the **Cloud Tops** Button in the Background Window.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-21 Cloud Tops Legend

DATA LINK LIGHTNING (SIRIUSXM, GARMIN CONNEXT)

> *NOTE: Lightning from a data link source cannot be displayed simultaneously on the same map as information from an optional on-board lightning detection system.*

The Lightning weather product shows the approximate location of cloud-to-ground lightning strikes. A strike icon represents a strike has occurred within a two-kilometer region. The exact location of the lightning strike is not displayed.

Figure 6-22 SiriusXM Lightning Weather Product

Enabling/Disabling Data Link Lightning information (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Touch the **Lightning** Button in the 'Overlays' Window.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-23 SiriusXM Lightning Legend

Displaying 'Data Link' Lightning information (SiriusXM or Connext on 'Navigation Map' Panes):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the **'Data Link' Lightning** Button.

Displaying Data Link Lightning information on PFD maps:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Data Link Setting** Softkey.

3) Press the **Data Link** Softkey until "SiriusXM" or "Connext" options are displayed.

4) Press the **Back** Softkey.

5) Press the **SiriusXM Lightning** or **Connext Lightning** Softkey to enable/disable display lightning information.

6) Press the **Back** Softkey to return to the top-level softkeys.

CELL MOVEMENT (SIRIUSXM)

The Cell Movement weather product shows the location and movement of storm cells as identified by the ground-based system. Orange squares represent cells, with short arrows indicating direction of cell movement. When the Map Pointer is panned over a Storm Cell, the system displays the path, speed, and altitude range of the Storm Cell, as determined by the NEXRAD system.

> **NOTE:** *The Storm Cell base height is not available if a GDL 69A SiriusXM Datalink Receiver is installed. In this case, the Storm Cell base height is displayed as 0 feet when the map pointer selects a storm cell.*
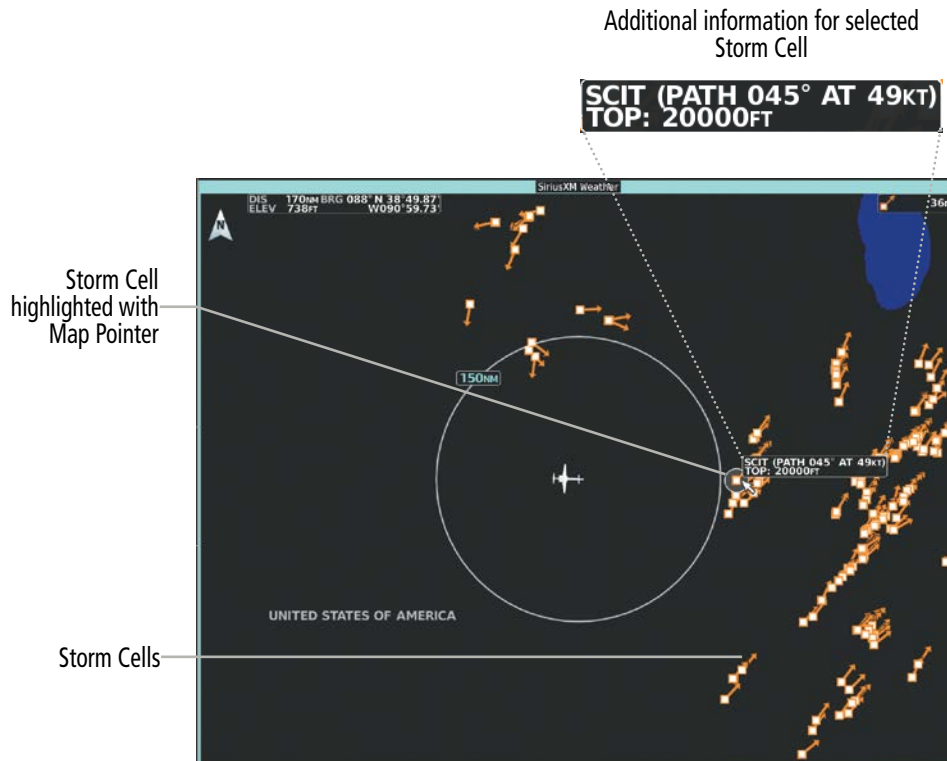
Figure 6-24 Storm Cell Movement Weather Product

Enabling/Disabling Storm Cell Movement Information (SiriusXM Weather Pane):

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Touch the **Storm Cell Movement** Button in the 'Overlays' Window.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.
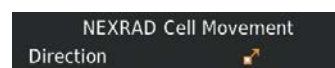
Figure 6-25 Cell Movement Legend

Displaying Storm Cell Movement Information (Navigation Map Panes):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the NEXRAD Data **Settings** Button.

4) Touch the **Storm Cell Movement** Button. When button annunciator is green, the system shows Storm Cell Movement with the NEXRAD weather product on navigation map panes. When button annunciator is gray, system will not show the Storm Cell Movement weather product on navigation map panes.

Displaying Storm Cell Movement on PFD maps:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Data Link Settings** Softkey.

3) Press the **Data Link** Softkey until "SiriusXM" option is displayed.

4) Press the **Storm Cell Movement** Softkey.

INFRARED SATELLITE (GARMIN CONNEXT)

The Infrared (IR) Satellite weather product depicts cloud top temperatures, as determined from infrared satellite imagery. Darker colors indicate warmer cloud tops typically associated with lower altitudes; lighter colors indicate cooler cloud tops typically associated with higher altitudes. When panning over a Cloud Top with the Map Pointer, the system displays an estimated temperature range for the selected Cloud Top.

Figure 6-26 Cloud Tops Weather Product on 'Connext Weather' Pane

Displaying Cloud Tops information (Connext Weather Pane):

1) From Home, touch **Weather > Weather Selection > Connext Weather > Connext Settings.**

2) Touch the **IR Satellite** Button in the 'Overlays' Window.

To display the IR Satellite legend, touch the **Legend** Button on the Connext Weather Settings Screen when the Cloud Tops weather product is enabled for display.
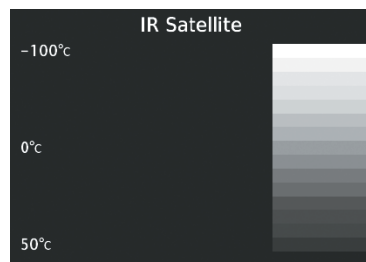
Figure 6-27 Infrared Satellite Legend

SIGMETS AND AIRMETS

The National Weather Service issues SIGMETs (SIGnificant METeorological Information) and AIRMETs (AIRmen's METeorological Information) for potentially hazardous weather. Convective SIGMETs are issued for hazardous convective weather. Dashed lines enclose a SIGMET or AIRMET occurring over a large geographic area. If a SIGMet OR AIRMET exists only for a small geographic area, a diamond shape may appear; both are shown in the legend.

> **NOTE:** If a GDL 69A SiriusXM Datalink Receiver is installed, then the SIGMET and AIRMET weather products are not available unless at least one SIGMET or AIRMET has been received. The weather product age indicates 'N/A' when no SIGMET or AIRMET is available.
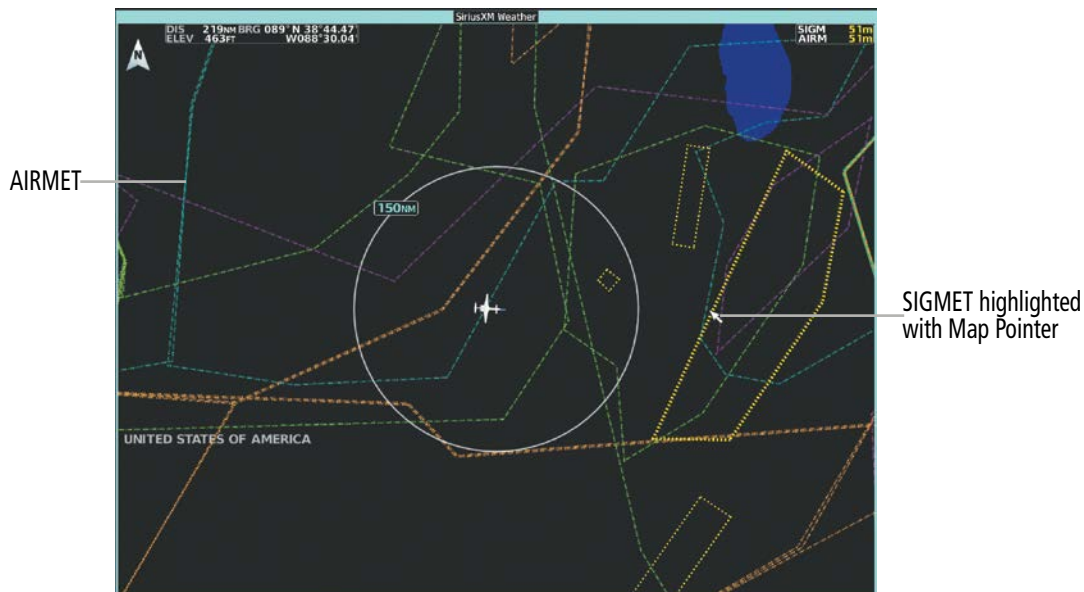
Figure 6-28 AIRMET and SIGMET Weather Products

Enabling/Disabling AIRMET and SIGMET information (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Scroll as needed and touch the **AIRMETs** and/or **SIGMETs** Buttons in the 'Overlays' Window.

3) To view the text of an AIRMET or SIGMET, press the **Joystick** and move the map pointer with the **Joystick** or **Touchpad** over the SIGMET or AIRMET until it is highlighted.

4) Touch the **Info** Button to show the AIRMET / SIGMET Information Screen with the selected AIRMET or SIGMET.

5) Scroll as needed to view full text of the report, then touch the **Back** Button or the **Home** Button.

Touch the **Legend** Button on the 'Data Link' Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

View
Selected
AIRMET
or SIGMET
Text
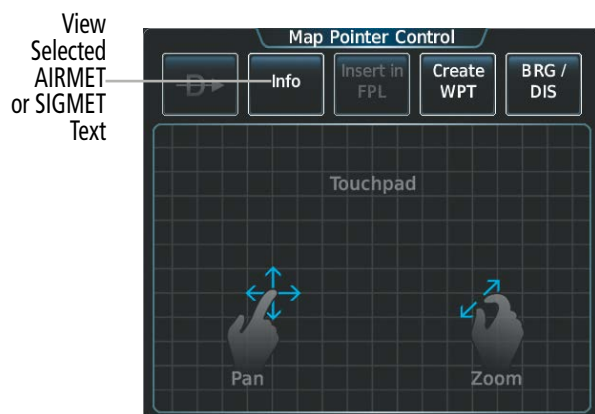
Figure 6-29 Map Pointer Control Screen

Figure 6-30 AIRMET/SIGMET Information Screen

Figure 6-31 SIGMET/AIRMET Legend

METARS AND TAFS

> ✓ **NOTE:** *Atmospheric pressure as reported for METARs is given in hectopascals (hPa), except for in the United States, where it is reported in inches of mercury (in Hg). Temperatures are reported in Celsius.*

> ✓ **NOTE:** *METAR information is only displayed within the installed navigation database service area.*

METARs typically contain information about the temperature, dewpoint, wind, precipitation, cloud cover, cloud base heights, visibility, and barometric pressure at an airport or observation station. They can also contain information on precipitation amounts, lightning, and other critical data. METARs reflect hourly observations; non-routine updates include the code "SPECI" in the report. METARs are shown as colored flags at airports which have a requested METAR available.

TAFs (Terminal Aerodrome Forecasts) are weather predictions for specific airports within a 24- hour period, and may span up to 36 hours. TAFs typically include forecast wind, visibility, weather phenomena, and sky conditions using METAR codes.

Figure 6-32 Displaying METARS on the 'SiriusXM Weather' Pane

Showing METAR text (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Touch the **METARs** Button in the 'Overlays' Window. The system displays METAR flags at available reporting stations when METARs are enabled (button annunciator is green).

3) To view METAR text, press the **Joystick** and move the map pointer with the **Joystick** or **Touchpad** over a METAR flag. The system displays the original METAR text near the METAR flag. If the display has not yet received the METAR text associated with the selected flag, it displays "Waiting for METAR text," until it receives this information.

Showing METAR information ('Navigation Map' Pane):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the **Graphical METARs** Button. The system displays METAR flags at available reporting stations when METARs are enabled (button annunciator is green).

4) To view METAR text, press the **Joystick** and move the map pointer with the **Joystick** or **Touchpad** over a METAR flag. The system displays the original METAR text near the METAR flag. If the GDU has not yet received the METAR text associated with the selected flag, it displays "Waiting for METAR text." until it receives this information.

Textual METAR information is also available on the Airport Information screens on the Touchscreen Controllers. When viewing the Airport Information screen for an airport, touch the Weather Tab and scroll as needed to view the METAR text.

The graphical METAR flag color shown on the maps is determined by the information in the METAR text. The system displays a gray METAR flag when the METAR text does not contain adequate information to determine the METAR category, as shown in the legend.

Showing METAR information PFD Maps:

1) Press the **PFD Map Settings**.

2) Press the **METAR** Softkey.

Textual METAR/TAF information is available on the Airport Information Screen on the Touchscreen Controller for airports with a requested METAR available. This textual METAR/TAF information may come from any data link weather source available to the system (such as SiriusXM, or Garmin Connext), if more than one source is installed. In this case, the system automatically displays the newest available METAR. If the METAR age is identical from all available data link sources, the system selects one METAR to display in the following order of source priority: SiriusXM, Garmin Connext.

The textual display of METAR information on the GTCs begins with the decoded version, followed by the original METAR text. Note the original METAR text may contain additional information not present in the decoded version. The TAF, if available for the selected airport, appears below the original METAR text. The system displays the data link weather source of the displayed METAR/TAF at the end of the report.

Viewing textual METAR/TAF information on the 'Airport Information' Screen:

1) From Home, touch **Waypoint Info > Airport**.

2) If the desired airport identifier and name already appears in the airport button near the top of the screen, go to step 5.

3) Touch the airport button.

4) Input the airport identifier using the keypad or the large and small right knobs, then touch **Enter** or push the right knob.

5) Touch the **Weather** Tab.

6) Touch a button for an available weather product (**METAR Raw**, **METAR Decoded**, **TAF Raw**, **TAF Decoded**). If a button is subdued, that weather product is currently unavailable for the selected airport.

7) Scroll as necessary to view the weather text. Note raw weather products may provide additional information not present in the decoded version.

Figure 6-33 METAR information on the Airport Weather Screen

> ✓ *NOTE: METAR/TAF data is not automatically updated on the Airport Weather Screen when new data is received. Due to this, it is possible for the Touchscreen Controllers to show different METAR timestamps, depending on when the METAR/TAF Tab was selected. In order to see the latest METAR/TAF, touch another tab, then touch the METAR/TAF Tab again.*

Touch the **Legend** Button on the 'Data Link' Weather Settings Screen to display weather legend(s) for weather product(s) enabled on the 'Data Link' Weather Pane. Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

The graphical METAR flag color shown on the maps is determined by the information within the METAR. The system displays a gray METAR flag when the SiriusXM Weather service was unable to categorize the METAR.

Figure 6-34 METAR Legend

SURFACE ANALYSIS AND CITY FORECAST (SIRIUSXM)

The Surface Analysis and City Forecast weather products are available for current and forecast weather conditions. Forecasts are available for intervals of 12, 24, 36, and 48 hours.

Figure 6-35 Current Surface Analysis Weather Product

Displaying Surface Analysis and City Forecast information:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll as needed in the Overlays Window and touch the **Surface Analysis** Button.

3) If needed, touch the Surface Analysis forecast period button (to the right of the **Surface Analysis** Button)and select from **Current**, **12 Hours**, **24 Hours**, **36 hours**, or **48 Hours** forecast periods from the pop-up selection window.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-36 Surface Analysis and City Forecast Legend

FREEZING LEVEL (SIRIUSXM)

Freezing Level data shows the color-coded contour lines for the altitude and location at which the first isotherm is found. When no data is displayed for a given altitude, the data for that altitude has not been received, or is out of date and has been removed from the display.
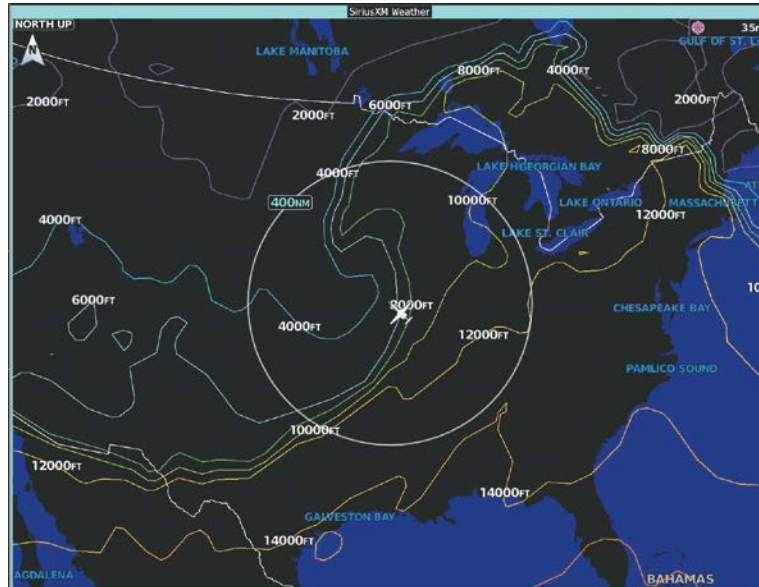
Figure 6-37 Freezing Level Weather Product

Displaying Freezing Level information:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll as needed and touch the **Freezing Level** Button.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-38 Freezing Level Legend

WINDS ALOFT

The Winds Aloft weather product shows the predicted wind speed and direction at the surface and at selected altitudes. Altitude can be displayed in 3,000-foot increments from the surface up to 42,000 feet MSL.

Displaying Winds Aloft data:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Scroll as needed in the 'Overlays' Window and touch the **Winds Aloft** Button.

3) To change the selected winds aloft altitude, touch the Winds Aloft altitude button and select the desired winds aloft altitude from Surface to 42,000 feet MSL from the pop-up Window.

Winds Aloft Overlay at 30,000 Feet

Data Age (US and Canada)

Selected Winds Aloft Altitude

Selects Winds Aloft Altitude

Touch to Enable/ Disable Winds Aloft Overlay
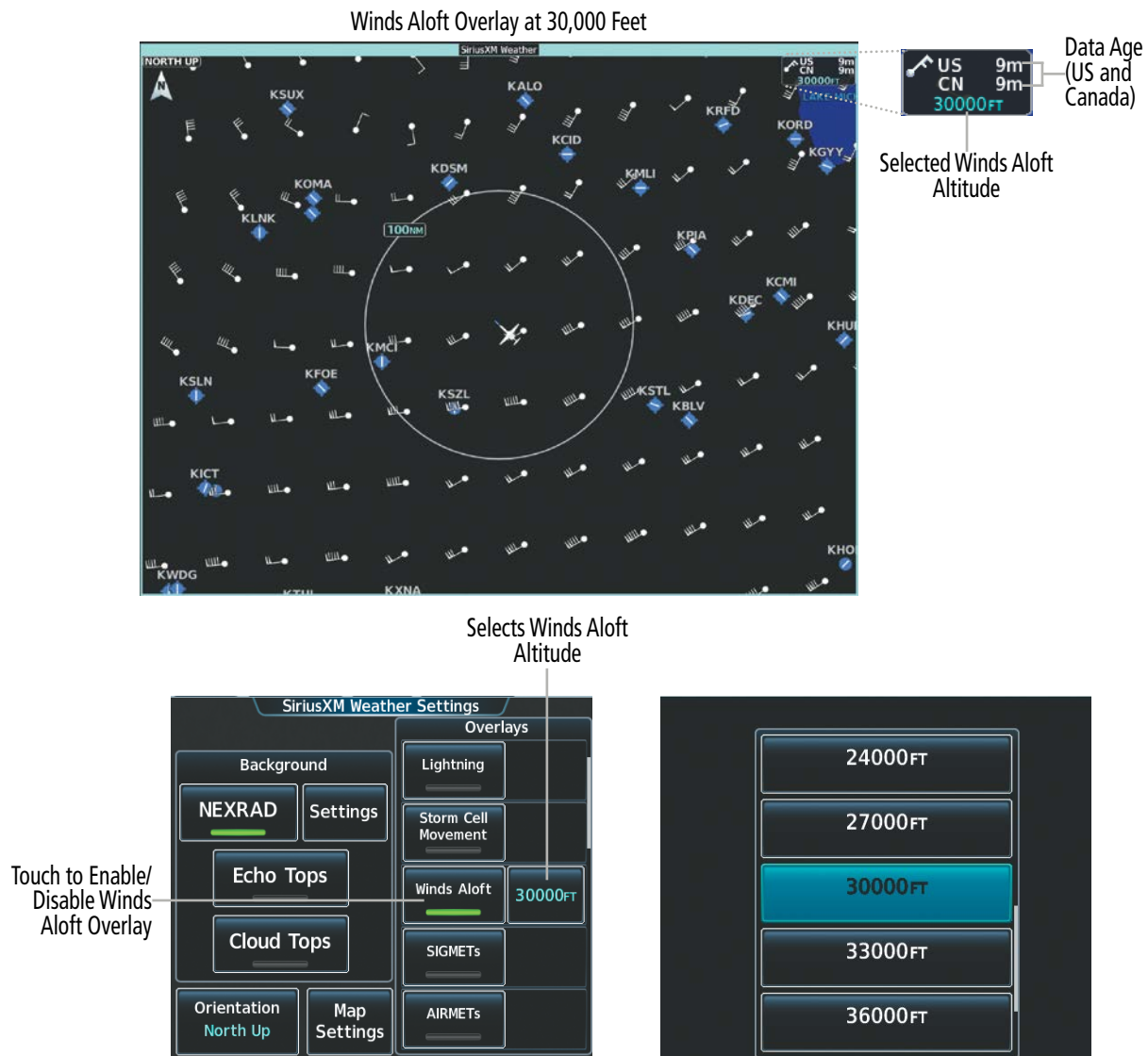
Figure 6-39 Selecting a Winds Aloft Altitude on the SiriusXM Weather Settings Screen

Touch the **Legend** Button on the 'Data Link' Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.
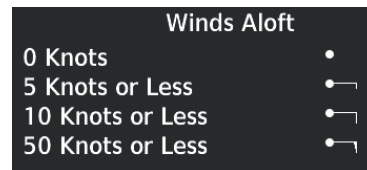

Figure 6-40 Winds Aloft Data Legend

Headwind and tailwind components aloft are available inside the Vertical Situation Display (VSD) Inset Window on the 'Navigation Map' Pane. The displayed wind components are relative to current aircraft altitude and track or flight plan, depending on the selected VSD Mode, but not relative to aircraft speed.
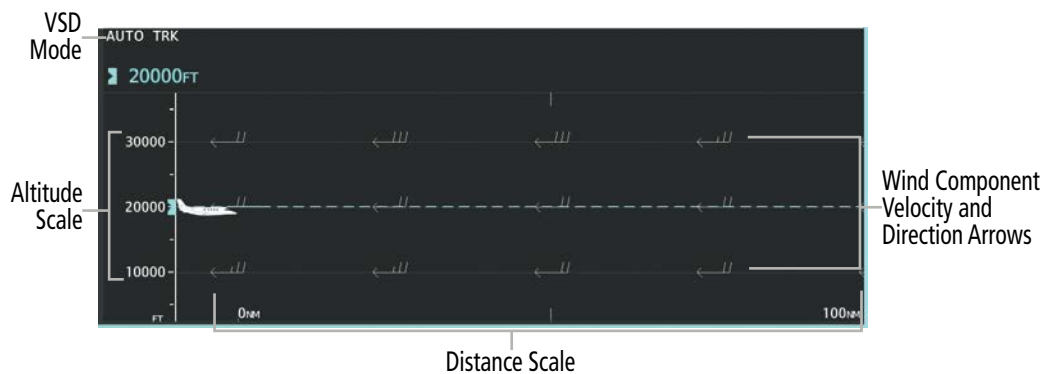
Figure 6-41 VSD Inset Window with Winds Aloft Information

Enabling/Disabling VSD (containing winds aloft data):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Inset Window** Tab.

3) Touch the **VERT Situation Display** Button to enable/disable the VSD Inset Window. If the winds aloft weather product icon does not appear in the inset window, continue with this procedure to enable winds aloft information.

4) Touch the VERT Situation Display **Settings** Button.

5) Touch the **Winds** Button. When enabled, the system displays the winds aloft weather product inside the Vertical Situation Display.
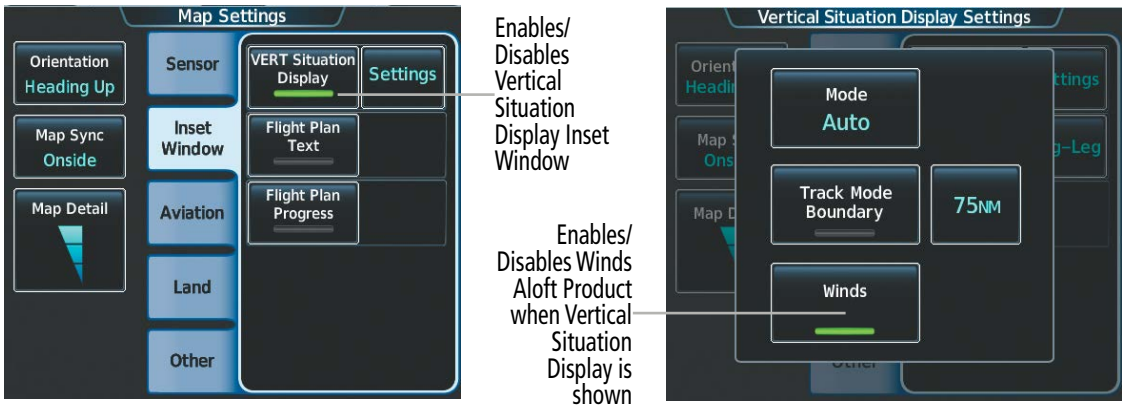
Figure 6-42 Controlling the display of Winds Aloft information for VSD Inset Window

Arrows pointing to the left indicate headwind components; tailwind component arrows point to the right, as shown in Table 6-4.

Headwind Symbol	Tailwind Symbol	Headwind/Tailwind Component
None	None	Less than 5 knots
		5 knots
		10 knots
		50 knots

Table 6-4 Profile View Headwind/Tailwind Component Symbols

COUNTY WARNINGS (SIRIUSXM)

County data provides specific public awareness and protection weather warnings from the National Weather Service (NWS). This can include information on severe thunderstorms, tornadoes, and flood conditions.
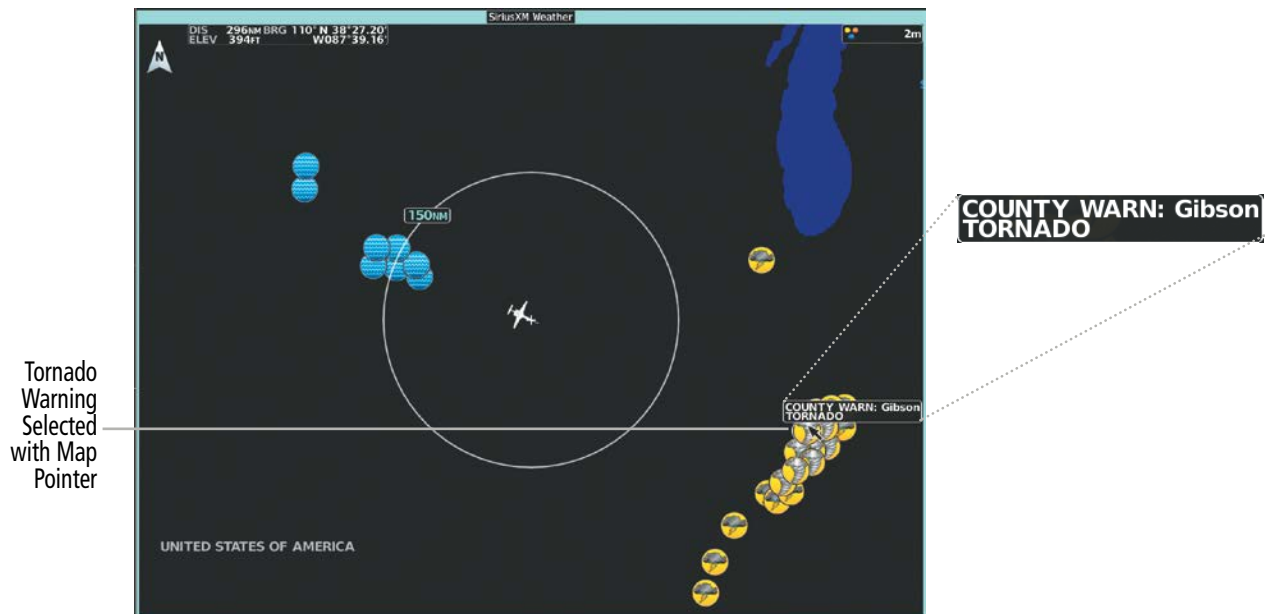
Figure 6-43 County Warnings Weather Product

Displaying County Warning information:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll as needed in the 'Overlays' Window and touch the **County Warnings** Button.

3) To view additional information (such as county name), press the **Joystick** to activate the map pointer and move the **Joystick** or **Touchpad** to highlight a selected County Warning. County Warning information appears in a box near the map pointer.

4) When finished, press the Joystick to deactivate the map pointer.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-44 County Warnings Legend

CYCLONE (SIRIUSXM)

The Cyclone weather product shows the current location of cyclones (hurricanes), tropical storms, and their projected tracks. The track consists of a two digit date, followed by the estimated time of arrival.
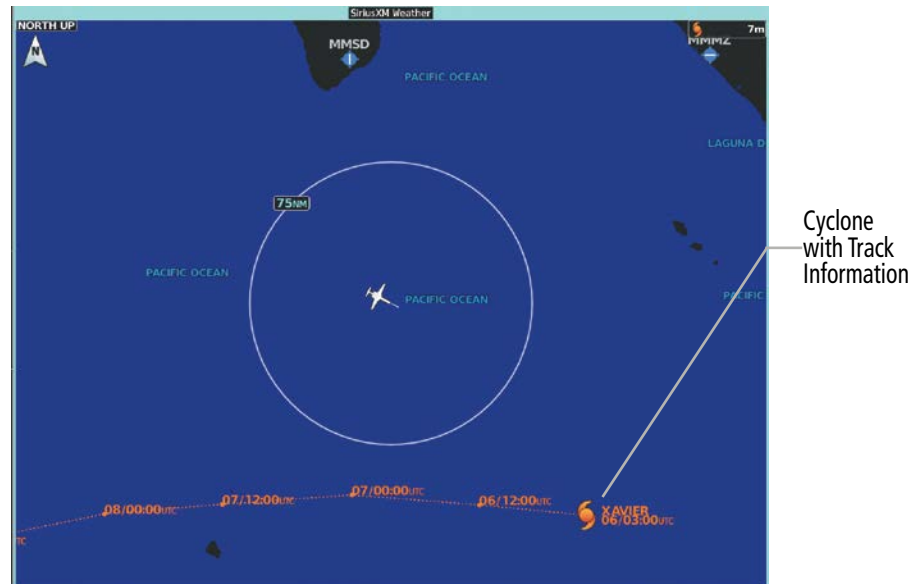
Figure 6-45 Cyclone (Hurricane) Weather Product

NOTE: *If a GDL 69A SiriusXM Datalink Receiver is installed, then the Cyclone weather product is not available unless at least one cyclone or tropical storm has been received. The weather product age indicates 'N/A' when no cyclone or tropical storm has been received.*

Enabling/Disabling cyclone (hurricane) weather product:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll as needed in the 'Overlays' Window and touch the **Cyclone Warnings** Button.

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-46 Cyclone Legend

ICING (CIP & SLD) (SIRIUSXM)

> ✓ *NOTE: Icing data cannot be displayed at the same time as NEXRAD data.*

The Current Icing Potential (CIP) weather product shows a graphical view of the icing environment. Icing severity is displayed in four categories: light, moderate, severe, and extreme (not specific to aircraft type). The CIP product is not a forecast, but a presentation of the current conditions at the time of the analysis.

Supercooled Large Droplet (SLD) icing conditions are characterized by the presence of relatively large, super cooled water droplets indicative of freezing drizzle and freezing rain aloft. SLD threat areas are depicted as magenta dots over the CIP colors.

Displaying Icing data:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll as needed in the 'Overlays' Window and touch the **Current Icing Potential** Button to enable/disable icing information.

3) Touch the altitude button (to the right of the **Current Icing Potential** annunciator Button) and scroll to and touch the desired altitude Button (from 1,000 feet up to 30,000 feet).
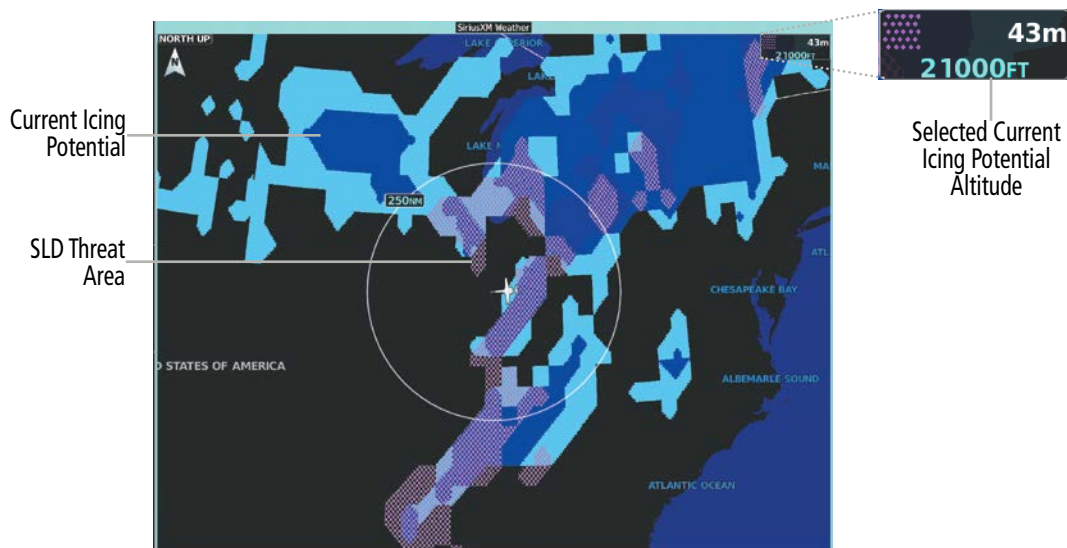
Figure 6-47 Current Icing Potential Overlay at 21,000 Feet

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-48 Icing Legend

TURBULENCE (SIRIUSXM)

✓ **NOTE:** *The Turbulence weather product cannot be displayed at the same time as NEXRAD weather product.*

The Turbulence weather product identifies the potential for erratic movement of high-altitude air mass associated winds. Turbulence is classified as light, moderate, severe or extreme, at altitudes between 21,000 and 45,000 feet. Turbulence data is intended to supplement AIRMETs and SIGMETs.

Displaying Turbulence data:

1) From Home, touch **Weather > Weather Selection > SiriusXM Weather > SiriusXM Settings**.

2) Scroll in the 'Overlays' Window and touch the **Turbulence** Button.

3) Touch the Turbulence altitude button (to the right of the **Turbulence** annunciator button) and touch to select an altitude from which to display turbulence data (from 21,000 feet up to 45,000 feet).
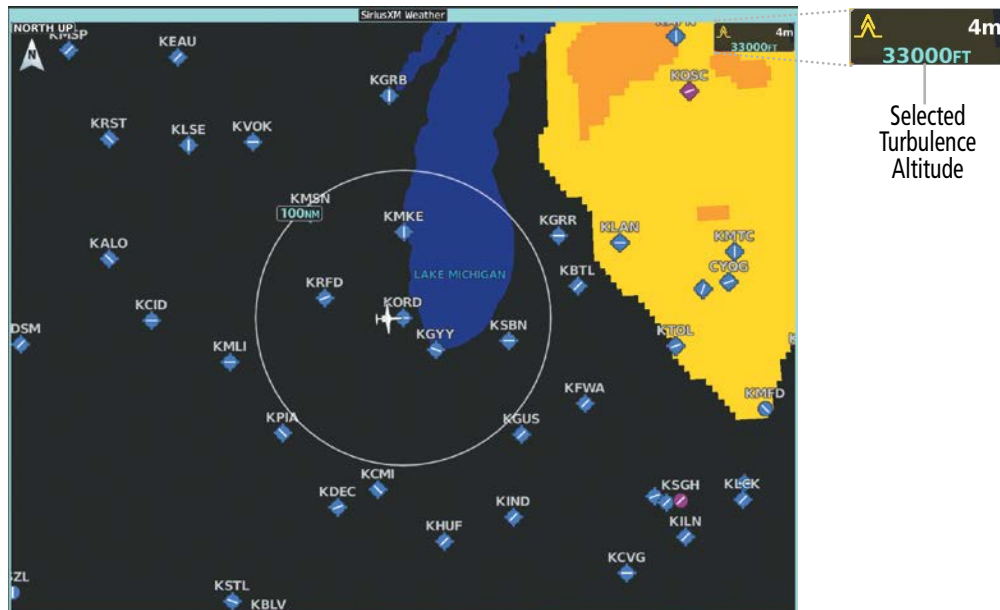
Figure 6-49 Turbulence Weather Product at 33,000 Feet

Touch the **Legend** Button on the SiriusXM Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.
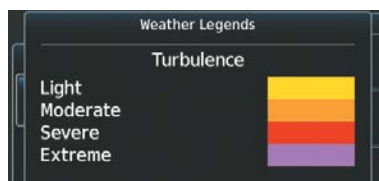
Figure 6-50 Turbulence Legend

PIREPS AND AIREPS

Pilot Weather Reports (PIREPs) provide weather observations collected from pilots. When significant weather conditions are reported or forecast, Air Traffic Control (ATC) facilities are required to solicit PIREPs. A PIREP may contain adverse weather conditions, such as low in-flight visibility, icing conditions, windshear, and turbulence. PIREPs are issued as either Routine (UA) or Urgent (UUA).

Another type of PIREP is an Air Report (AIREP). Commercial airlines are typically the source of AIREPs.
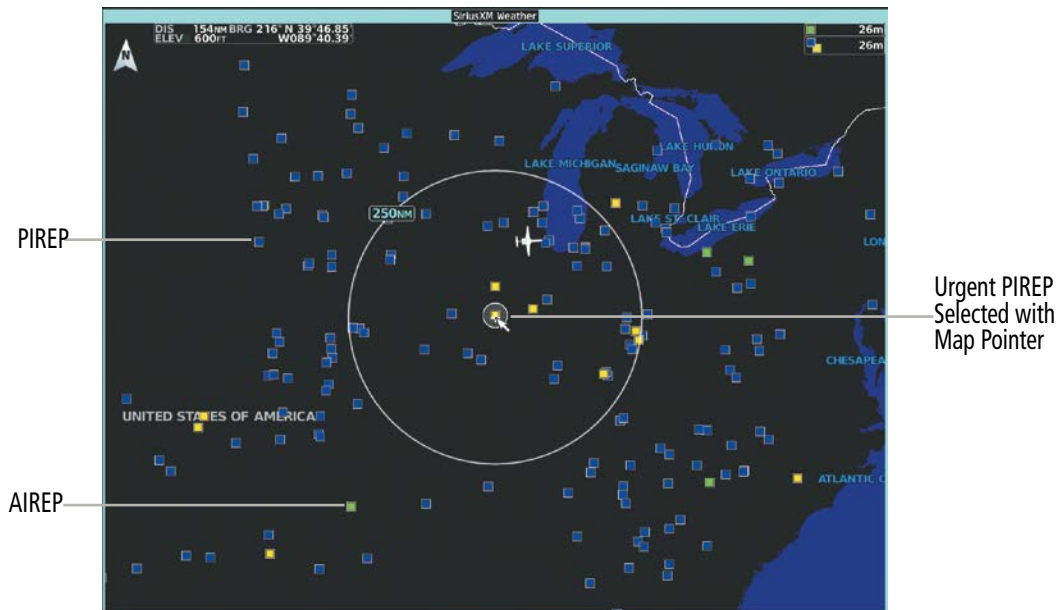
Figure 6-51 AIREPs and PIREPs on the 'SiriusXM Weather' Pane

Displaying PIREP or AIREP information (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Scroll in the 'Overlays' Window as needed and touch the **AIREPs** or **PIREPs** Buttons.

3) To view PIREP/AIREP text, push the joystick to activate the map pointer and move the pointer with the joystick until the selected report is highlighted, then touch the **PIREP Info** or **AIREP Info** Button.

4) Scroll as needed through the report text, then touch the **Back** Button or the **Home** Button.

Touch to Display Information
for Selected AIREP/PIREP

AIREP Information Screen
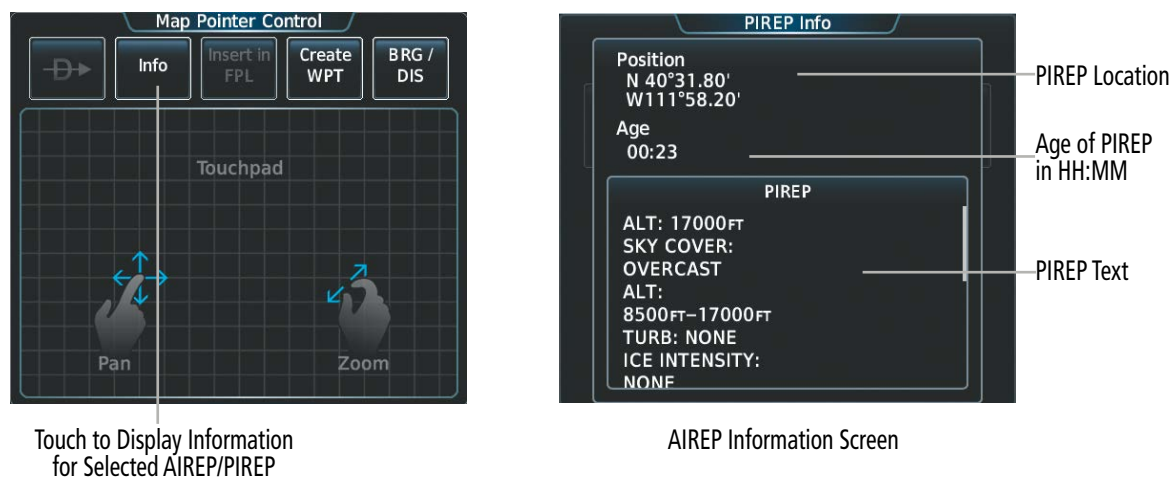
Figure 6-52 Displaying PIREPS/AIREPS on the Touchscreen Controller

Touch the **Legend** Button on the 'Data Link' Weather Settings Screen to display weather legend(s) for enabled weather product(s). Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

The PIREP color is determined by the type (routine or urgent).
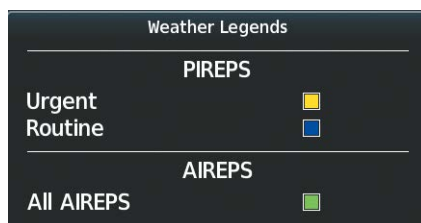
Figure 6-53 AIREPs & PIREPs Legend

TEMPORARY FLIGHT RESTRICTIONS (TFRS)

> **NOTE:** Do not rely solely upon data link services to provide Temporary Flight Restriction (TFR) information. Always confirm TFR information through official sources such as Flight Service Stations or Air Traffic Control.

The Federal Aviation Administration (FAA) issues TFR's to designate areas where flight is restricted. TFR's are issued to restrict flight for a variety of reasons including national security, law enforcement, fire suppression efforts, air shows, and large sporting events. TFR's may be issued at any time, and TFR data displayed on the system is only intended to supplement TFR information obtained from official sources including Flight Service Stations (FSS), and air traffic control.

If the TFR product is not available or has expired, the system displays 'TFR N/A' in the upper-right corner of maps on which the display of TFR's is enabled.
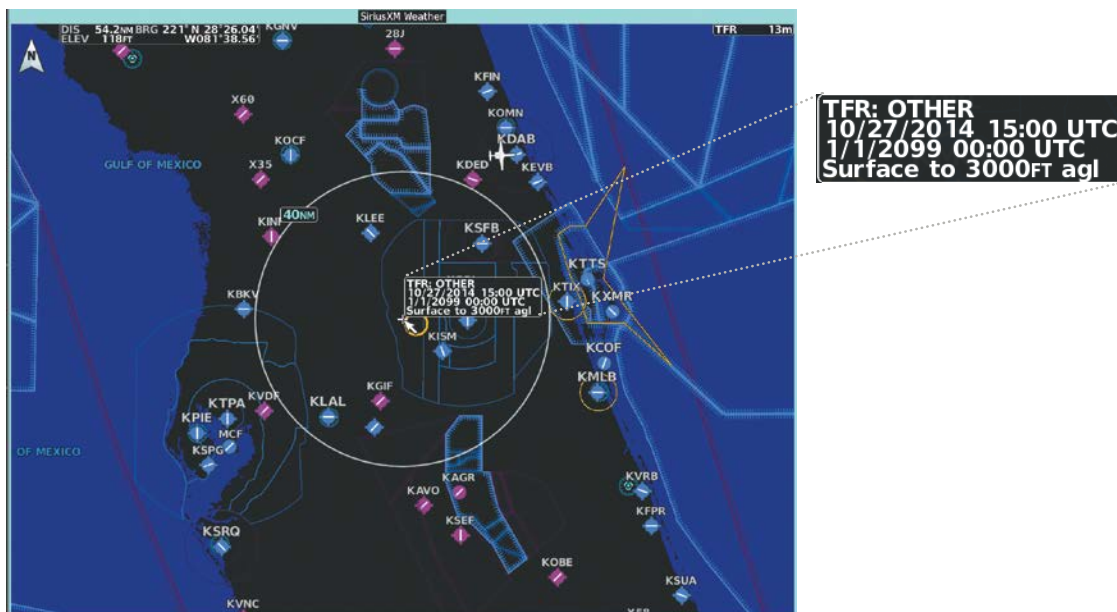
Figure 6-54 TFR Text for TFR Selected with Map Pointer

Enabling/disabling TFR information (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > 'Data Link' Weather > 'Data Link' Weather Settings**.

2) Scroll as needed and touch the **TFRs** Button.

3) To view TFR text, push the **Joystick** to activate the map pointer and move the pointer with the **Joystick** or **Touchpad** until the selected TFR is highlighted. The TFR text appears near the map pointer for the selected TFR.

4) When finished, push the **Joystick**, or touch **Back** Button or the **Home** Button.

The Map Settings Screen provides controls for enabling/disabling the display of TFR information on navigation maps, in addition to selecting the maximum map range for the system to display TFR information. If the crew selects a map range above this setting, the system declutters TFR information from the selected pane.

Maps other than the 'Navigation Map' Pane use settings based on those selected on the Map Settings Screen. To control the display of TFR information on the PFD Inset Map, enable Split Mode on the PFD, then refer to the following procedures.

Enabling/disabling TFR information (Navigation Maps):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll to find the **TFR** Button, and touch to enable/disable TFR information.

Setting up and customizing TFR data for maps on which TFR data can be displayed:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the TFR Range Button.

4) Scroll as necessary and touch the maximum navigation map range to display TFR information.

Figure 6-55 Customizing TFR display settings for Navigation Maps

ABNORMAL OPERATIONS FOR GARMIN CONNEXT WEATHER

If the system cannot complete a Connext Data Request, one or more messages will appear in the Data Request Window and an amber 'WEATHER DATA LINK FAIL' banner will be displayed on the MFD 'Connext Weather' Pane.

Weather Request Status Message	Description
Auto requests inhibited Send manual request to reset.	The system has disabled automatic weather data requests due to excessive errors. Automatic weather data requests have stopped. Send a manual weather data request to resume automatic updates.
Auto update retry: ## Seconds	The system will attempt another automatic weather data request after an error occurred during the previous request. Timer counts down until the next automatic request occurs.
Connext Comm Error [2]	A communications error has occurred with the GIA or GDL 59. The system should be serviced.
Connext Comm Error [4]	This occurs if multiple automatic weather data requests have recently failed, or the GIA is off-line.
Connext Comm Error [5]	The Iridium or Garmin Connext services are not accessible. Check Iridium signal strength. If this error persists, the system should be serviced.
Connext Comm Error [6]	A communications error has occurred. If this error persists, the system should be serviced.
Connext Comm Error [7]	A weather data transfer has timed out. Check Iridium signal strength and re-send the Connext Data Request.
Connext Comm Error [8]	A server error has occurred or invalid data received.
Connext Login Invalid	There is a problem with the Garmin Connext registration. Please contact Garmin Aviation Support through the phone number listed on its website, flygarmin.com.
Connext Server Temporarily Inop	The Garmin Connext weather data server is temporarily out of service, but is expected to return to service in less than 30 minutes.
Connext Server Inop	The Garmin Connext weather data server will be out of service for at least 30 minutes.
Invalid Coverage Area	The Connext Data Request does not sufficiently define a coverage area on which to retrieve weather data. Verify the selections in the Connext Weather Coverage Window, then issue another Connext Data Request.
No Connext Subscription	The system is not currently subscribed to the Garmin Connext Weather service, or the access code is incorrect. Verify the access code. Please contact Garmin Aviation Support through the phone number listed on its website, flygarmin.com.
Reduce Request Area	The weather data request area exceeds size limits. Reduce weather coverage area and re-send data request.
Request Cancelled	The user has cancelled a weather data request.
Request Failed - Try Again	The weather data request timed-out. Re-send data request.
Transfer Preempted	The data link is busy. Retry request later.

Table 6-5 Abnormal Weather Data Request Status Messages

6.2 ACARS WEATHER

⚠️ ***WARNING:*** *Do not use data link weather information for maneuvering in, near, or around areas of hazardous weather. Information contained within data link weather products may not accurately depict current weather conditions.*

⚠️ ***WARNING:*** *Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be older than the indicated weather product age.*

☑️ ***NOTE:*** *Do not rely on data link weather information to discern precise values for any weather-related measurements. Data link weather information is presented for informational purposes only, and should never be used as a replacement for official sources of in-flight weather information.*

☑️ ***NOTE:*** *When the selected datalink weather source is ACARS, and map syncing is set to Onside or All, changing the NEXRAD source does not change the NEXRAD source on the synced side.*

The optional Aircraft Communications Addressing and Reporting System (ACARS) provides line-of-sight data link weather information to the system through the GDR 66 Digital Radio Unit.

ACARS Weather information appears graphically on map displays and in textual form on the Touchscreen Controllers, depending on the type of weather content.

In order for the system to display ACARS Weather information, the flight crew must first define the weather data request area, and select which weather products to request. Then the flight crew then selects either an immediate or automatically recurring weather data request.

ACARS weather data comes from third-party data service providers, and coverage and weather product availability may vary from one provider to another. ACARS weather information, like all data link weather information, is not considered real-time due to delays inherent in the processing, transmission, and reception of weather data.

ACCESSING ACARS WEATHER PRODUCTS

The 'ACARS Weather' Pane is the principal map display for viewing ACARS Weather information.

Viewing the 'ACARS Weather' Pane:

1) From Home, touch the **Weather** Button. Button is highlighted and becomes **Weather Selection** Button. Selected display pane shows a weather pane. If a weather pane other than 'ACARS Weather' is shown (such as 'Weather Radar' in the pane title), continue with the procedure to view the 'ACARS Weather' Pane.

2) Touch the **Weather Selection** Button. The Weather Selection Screen appears.

3) Touch the **ACARS Weather** Button. Button is highlighted and becomes **ACARS Settings** Button. The system shows the 'ACARS Weather' Pane.

4) If necessary, touch the **ACARS Settings** Button to access controls for the 'ACARS Weather' Pane, viewing weather legends, as well as controls for defining and sending ACARS Weather Data Requests.

Figure 6-56 Weather Selection Screen

In order for the system to display ACARS Weather information, the flight crew must first send an ACARS Weather Data Request using the 'ACARS Weather Settings' Screen on the Touchscreen Controller. This is discussed in further detail later in this section.
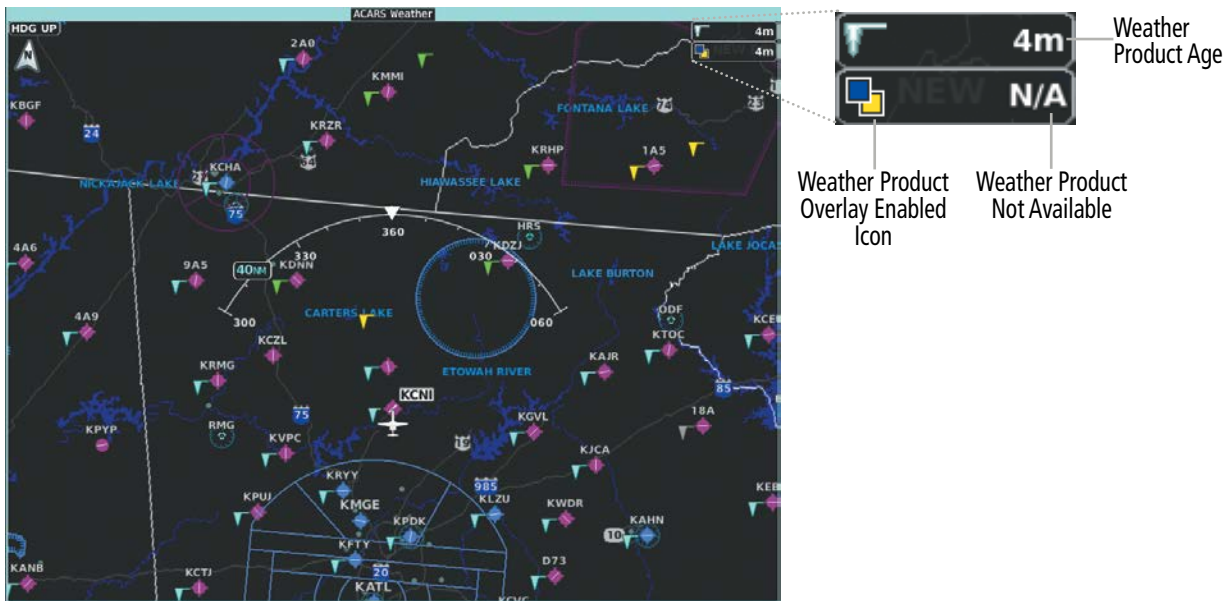
Figure 6-57 'ACARS Weather' Pane
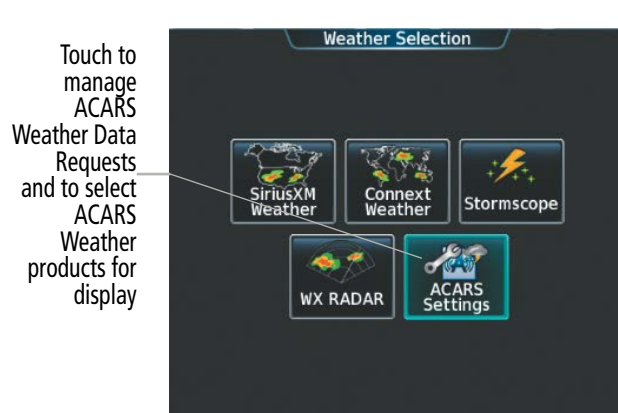
Figure 6-58 'Weather Selection' Screen
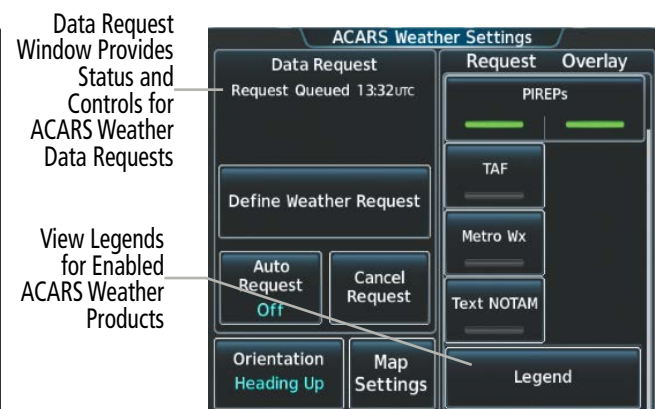
Figure 6-59 'ACARS Weather Settings' Screen

When a weather product overlay is enabled for display on the 'ACARS Weather' Pane, a box containing the icon for the product and its age (in minutes) appears in the upper right of the pane. If weather data has not been requested, has not been received, or is not currently available from the service provider, 'N/A' is shown next to the product symbol instead of an age. The age of the weather product is based on the time difference between when the data was assembled on the ground and the current GPS time. Third-party weather data providers define and control how often weather data updates become available for retrieval via ACARS.

If for any reason, a weather product is not refreshed within the defined **Expiration Time** intervals (see Table 6-6), the data is considered expired and is removed from the display. The age of the expired product is replaced by dashes. If more than half of the expiration time has elapsed, the color of the product age changes to amber.

The weather product age and availability information can also be displayed for ACARS Weather products enabled on the PFD Inset/HSI Map.

GARMIN.

Displaying/Removing Weather Product Age Information on the PFD Inset Map:

1) With the PFD Inset Map displayed, press the **PFD Map Settings** Softkey.

2) Press the **Weather Legend** Softkey to show/remove the weather product age information for PFD Inset Map.

Table 6-6 shows the ACARS Weather product symbols and expiration times.

ACARS Weather Product	Product Symbol	Expiration Time (Minutes)
Meteorological Aerodrome Report (METARs)		90
Metro Weather	no product image	Not Applicable
Pilot Weather Reports (PIREPs)		90
Terminal Aerodrome Forecast (TAFs)	no product image	540 (9 hours)
Terminal Weather Information for Pilots (TWIP)	no product image	Not Applicable

Table 6-6 ACARS Weather Product Symbols and Data Timing

Table 6-7 shows which ACARS Weather products can be displayed (indicated with a '+' symbol) on specific maps.

ACARS Weather Product	PFD Inset Map	Navigation Map Pane	ACARS Weather Pane
METARs	+	+	+
PIREPs			+

Table 6-7 ACARS Weather Product Display Maps

Softkeys control the enabling/disabling of ACARS Weather information on the Inset Map. The Touchscreen Controllers enable/disable ACARS Weather information on the display panes. The 'ACARS Weather Settings' Screen controls the enabling/disabling of weather information on the 'ACARS Weather' Pane.

> **NOTE:** *The Map Settings Button found on the Datalink Weather Settings page of the GTC allows the flight crew to change settings for Aviation, Land and Other tabs. These changes will also affect what is displayed on other maps and will sync across multiple display panes if the Map Sync Option is selected.*

The Map Setting Screen controls the Aviation, Land, and Other details displayed on the map. Changing these settings will affect what is displayed on other maps and will sync across multiple displays if Map Sync is selected.
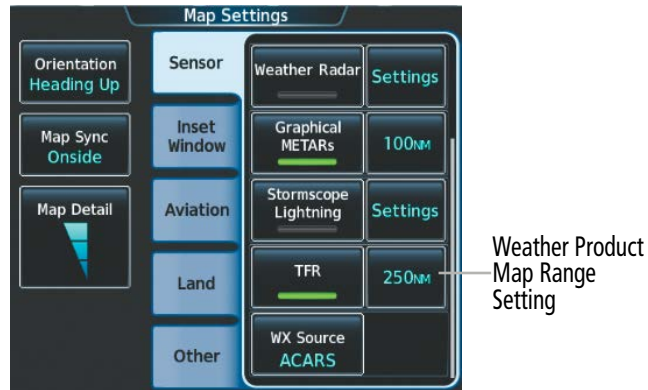
Figure 6-60 'Map Settings' Screen
(Sensor Tab Selected)

For Navigation Maps (including the Inset/HSI Maps), the flight crew can select the maximum map range to display graphical METAR information. If the flight crew increases the map range beyond the selected maximum map range, the system removes the Graphical METAR the map. The maximum map range settings are accessible using the 'Map Settings' Screen. The selected maximum map ranges apply to all onside navigation maps, regardless of which screen was used to make the maximum map range selections.

Selecting Maximum Navigation Map Range for ACARS Weather Products:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll through the list to view the available weather products (Graphical METARs, TFR).

4) Touch a range button next to the corresponding weather product, then touch to select the maximum navigation map range at which the system will display the selected weather product.

The system provides the ability to select a map orientation for the 'ACARS Weather' Pane. In addition to the Heading Up, Track Up, and North Up display options, the system can also synchronize the 'ACARS Weather' Pane orientation to the 'Navigation Map' Pane orientation.

Selecting a map orientation for the Data Link (SiriusXM or Connext) Weather Pane:

1) From Home, touch **Weather > Weather Selection > ACARS Weather > ACARS Settings**.

2) Touch the **Orientation** Button to change the selected map orientation (displayed in cyan).

3) Touch the desired map orientation button (**Heading Up, Track Up, North Up, Sync to Nav Map**).

Button selects map orientation for the selected 'ACARS Weather' Pane

Figure 6-61 Selecting a Map Orientation for the 'ACARS Weather' Pane

If more than one data link weather source has been installed besides ACARS (such as SiriusXM Weather or Garmin Connext Weather), the system provides the option to select a source of weather information for each 'Navigation Map' Pane and PFD Inset/HSI Map.

Selecting a 'Data Link' Weather Source for Navigation Maps Panes:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll if necessary to view the **WX Source** Button. Cyan text on the button indicates currently selected weather data link weather source.

4) Touch the **WX Source** Button.

5) Touch the button for the data link weather source to be used.

Navigation Maps displaying data link weather products show the name of the selected source ('SiriusXM', 'Connext WX', or 'ACARS') in the upper-right corner of the Inset map or lower right of the HSI map while data link weather products are enabled for display and are within the maximum map range setting limits.

Selecting a Data Link Weather source for the (PFD Inset Map or HSI Map):

1) Press the **PFD Map Settings** Softkey.

2) Press the **Data Link Settings** Softkey.

3) Press the **Data Link** Softkey. Each selection of the softkey changes the source, which is displayed in cyan on the softkey.

NOTE: *In order to display ACARS weather overlays on the Inset or HSI Map, NEXRAD Data and Connext Radar must be deselected prior to changing the weather data source.*

The weather overlays buttons for the 'Navigation Map' Pane and Inset/HSI Map correspond to the selected data link weather source.

Navigation maps displaying data link weather products show the name of the selected source ('ACARS WX', 'Connext WX' or 'SiriusXM') in the upper-right corner of the map while data link weather products are enabled for display and are within the maximum map range setting limits.

The 'ACARS Weather Settings' Screen on the Touchscreen Controller can display a legend for each weather product currently enabled on the selected 'ACARS Weather' Pane.

Viewing legends for weather products enabled on the 'ACARS Weather' Pane:

1) From Home, touch **Weather > Weather Selection > ACARS Weather > ACARS Weather Settings.**

2) Scroll to the bottom of the 'Overlays' Window and touch the **Legend** Button. The 'Weather Legends' Window appears on the Touchscreen Controller.

3) To remove the 'Weather Legends' Window, touch the **Back** Button or the **Home** Button.

The system provides METAR and PIREP text when panning over the weather product on the map with the Map Pointer

The **Joystick** or **Touchpad** controls the Map Pointer. These controls also adjust the map range. If the map range is adjusted while panning is enabled, the map is re-positioned on the Map Pointer.
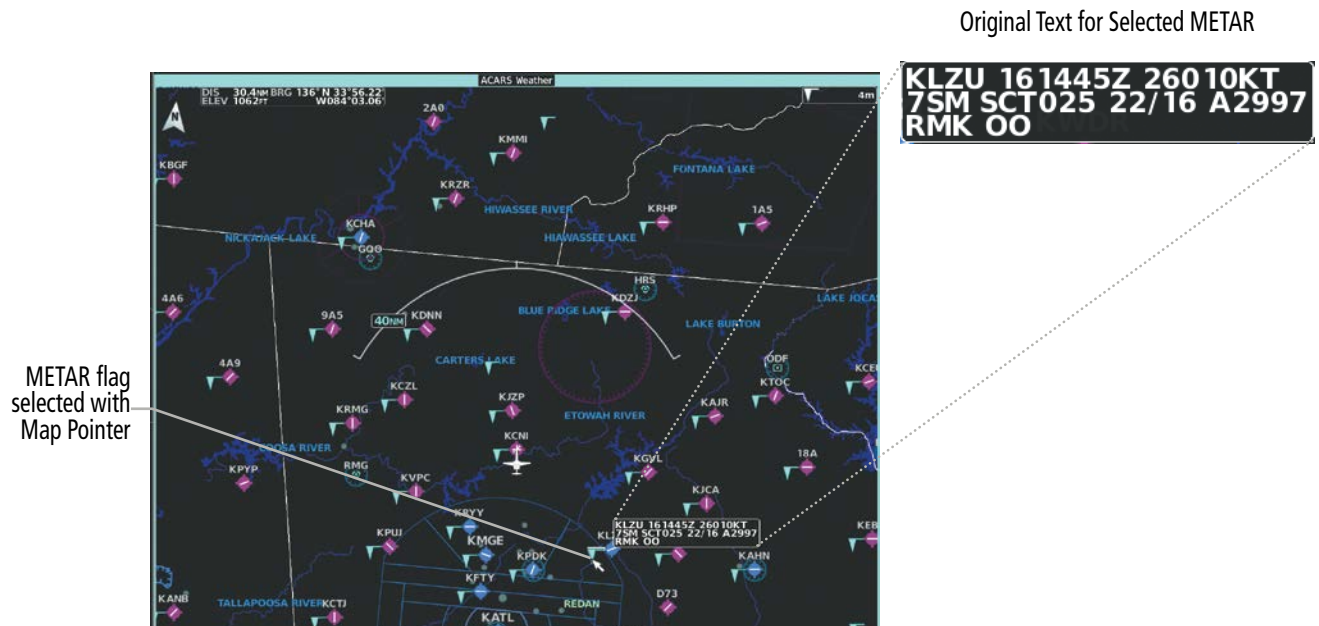
Figure 6-62 METAR Weather Product on the 'ACARS Weather' Pane

REQUESTING ACARS WEATHER DATA

In order for the system to display ACARS Weather information, the flight crew must first send an ACARS Weather Data Request using the ACARS Weather Settings Screen on the Touchscreen Controller.

The flight crew uses the ACARS Weather Settings Screen to request the following ACARS Weather products:

- TAF
- Metro Weather
- METAR
- PIREP
- Text NOTAM

NOTE: *The TWIP weather product is requested using a different procedure, and is discussed later in this section.*

An ACARS Weather Data Request consists of at least one selected ACARS Weather product, and at least one waypoint upon which to retrieve weather information (if available for that waypoint, as determined by the weather data provider). The flight crew defines the data request, and may execute it either manually, or automatically on a recurring schedule.

The Data Request Window indicates the status of the request. The following messages appear in this window, where <time> indicates the time when the most recent message appeared.

Data Request Window Message	Description
No requests made	The flight crew has not executed an ACARS Weather data request. No weather data from ACARS is displayed.
Request queued <time>	A connection to the ACARS system was not available at the displayed time. When a connection becomes available, the system will attempt to send the request.
Last request was cancelled <time>	The flight crew cancelled the ACARS Weather Data request at the given time.
Request sent <time>	The system successfully transmitted the ACARS Weather Data Request at the given time.
Request error <time>	An error occurred while either sending or receiving the ACARS Weather Data Request at the given time.

Table 6-8 ACARS Data Request Window Status Messages

Figure 6-63 Defining ACARS Weather Data Request Area
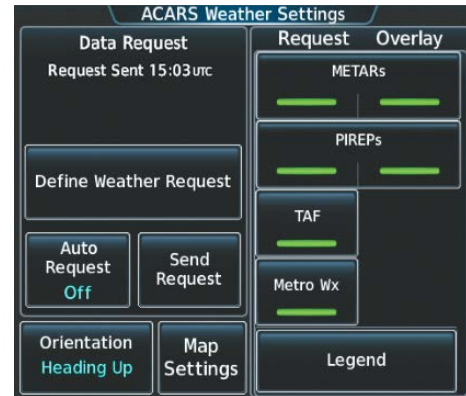
Figure 6-64 Sending an ACARS Weather Data Request

Defining an ACARS Weather Data Request area:

1) From Home, touch **Weather > Weather Selection > ACARS Weather > ACARS Settings**.

    Or:

    From Home, touch **Services > ACARS > Weather Settings**.

2) On the 'ACARS Weather Settings' Screen, touch the **Define Weather Request** Button. The 'ACARS Weather Coverage' Screen appears.

3) Touch the **Origin** Button to include the active flight plan origin in the request.

4) Touch the **P.POS** Button to include the present position in the request.

5) Touch the **Destinatio**n Button to include the active flight plan destination in the request.

6) Touch the **FPL** Button to include the active flight plan in the request.

7) Touch the **MAX Data PTS** Button to change the maximum number of waypoints to include in the request. Scroll as necessary, and touch a button for the desired number.

8) Touch the **Flight Plan Distance** Button to select how much of the flight plan is included in the request.

    a) Touch the **Remaining FPL** Button to only include upcoming waypoints in the request.

    b) Touch the **Entire FPL** Button to include the entire flight plan in the request.

9) Touch the **Add Waypoint** Button to include additional waypoints in the request.

    a) Use the **Keypad** or large and small right knobs to enter a waypoint.

    b) When finished, touch **Enter** or push the right knob. The waypoint appears in the Additional Waypoints Window. Repeat this step to add additional waypoints to the request.

10) When finished defining the request, touch the **Back** Button or the **Home** Button.

Removing additional waypoints from an ACARS weather data request:

1) From Home, touch **Weather > Weather Selection > ACARS Weather > ACARS Settings**.

Or:

From Home, touch **Services > ACARS > Weather Settings**.

2) Touch the desired waypoint button in the 'Additional Waypoints' Window.

3) Touch either the **Remove** Button to remove the selected additional waypoint, or touch the **Remove All** Button to remove all additional waypoints from the request.

4) Touch the **OK** Button to confirm waypoint removal or touch the **Cancel** Button to exit without removing.

After an ACARS Weather Data Request area has been defined, the flight crew can issue either a manual or automatically recurring data request.

Sending an ACARS Weather Data Request:

1) From Home, touch **Weather > Weather Selection > ACARS > ACARS Settings**.

Or:

From Home, touch **Services > ACARS > Weather Settings**.

2) On the 'ACARS Weather Settings' Screen, touch the annunciator button in the Request column corresponding to the weather product to include/exclude from the data request. The button annunciator is green if a weather product is included, gray when excluded.

3) For automatically recurring weather requests, touch the **Auto Request** Button.

    a) Scroll as needed and touch a button for the desired number of between requests.

    b) To disable automatically recurring weather requests, touch the **Off** Button.

4) Touch the **Send Request** Button.

Enabling/disabling automatic ACARS Weather Data Requests:

1) From Home, touch **Weather > Weather Selection > ACARS > ACARS Settings**.

Or:

From Home, touch **Services > ACARS > Weather Settings**.

2) Touch the **Auto Request** Button.

3) Scroll and touch a button to select the rate at which the automatic data request to recur, or touch the **Off** Button to disable the automatic data request.

ACARS WEATHER PRODUCTS

METARS AND TAFS

METARs typically contain information about the temperature, dewpoint, wind, precipitation, cloud cover, cloud base heights, visibility, and barometric pressure at an airport or observation station. They can also contain information on precipitation amounts, lightning, and other critical data. METARs reflect hourly

observations; non-routine updates include the code "SPECI" in the report. METARs are shown as colored flags at airports which have a requested METAR available.

TAFs (Terminal Aerodrome Forecasts) are weather predictions for specific airports within a 24- hour period, and may span up to 36 hours. TAFs typically include forecast wind, visibility, weather phenomena, and sky conditions using METAR codes.

Original Text for Selected METAR

Figure 6-65 METAR Weather Product on the 'ACARS Weather' Pane

Showing METAR information 'ACARS Weather' Pane:

1) From Home, touch **Weather > Weather Selection > ACARS Weather > ACARS Settings**.

2) Touch the **METARs** Button in the 'Overlay' Window.

3) To view METAR text, push the **Joystick** and move the Map Pointer with the **Joystick** or **Touchpad** over a METAR flag.

Showing METAR information 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If needed, touch the **Sensor** Tab.

3) Touch the **Graphical METARs** Button.

Showing METAR information (PFD Inset/HSI Map)

1) With the PFD Inset/HSI Map displayed, press the **PFD Map Settings** Softkey.

2) Select the **METAR** Softkey. The system displays METAR flags at available reporting stations when METARs are enabled (button annunciator is green).

3) To view METAR text, press the GTC Controller **Joystick** and move the map pointer with the **Joystick** over a METAR flag. The system displays the original METAR text near the METAR flag. If the GDU has not yet received

the METAR text associated with the selected flag, it displays "Waiting for METAR text." until it receives this information.

The METAR flag color is determined by the information contained in the METAR text. The system displays a gray METAR flag when the METAR text does not contain adequate information to determine the METAR category.

Scroll to the bottom of the 'Overlays' Window and touch the **Legend** Button on the 'ACARS Weather Settings' Screen to display weather legend(s) for weather product(s) enabled on the 'ACARS Weather' Pane. Scroll as necessary to view the information, then touch the **Back** Button or the **Home** Button.

Figure 6-66 METAR Legend

Textual METAR/TAF information is available on the Airport Information Screen on the Touchscreen Controller for airports with a requested METAR available. This textual METAR/TAF information may come from any data link weather source available to the system (such as ACARS, SiriusXM, or Garmin Connext), if more than one source is installed. In this case, the system automatically displays the newest available METAR. If the METAR age is identical from all available data link sources, the system selects one METAR to display in the following order of source priority: SiriusXM, ACARS, Garmin Connext.

The textual display of METAR information on the Touchscreen Controllers begins with the decoded version, followed by the original METAR text. Note the original METAR text may contain additional information not present in the decoded version. The TAF, if available for the selected airport, appears below the original METAR text. The system displays the data link weather source of the displayed METAR/TAF at the end of the report.

Viewing textual METAR/TAF information on the 'Airport Information' Screen:

1) From Home, touch **Waypoint Info > Airport**.

2) If the desired airport identifier and name already appears in the airport button near the top of the screen, go to step 5.

3) Touch the **Airport** Button.

4) Input the airport identifier using the keypad or the large and small right knobs, then touch **Enter** or push the right knob.

5) Touch the **METAR/TAF** Tab.

6) Touch a button for an available weather product (**METAR Raw**, **METAR Decoded**, **TAF Raw**, **TAF Decoded**). If a button is subdued, that weather product is currently unavailable for the selected airport.

7) Scroll as necessary to view the weather text. Note raw weather products may provide additional information not present in the decoded version.
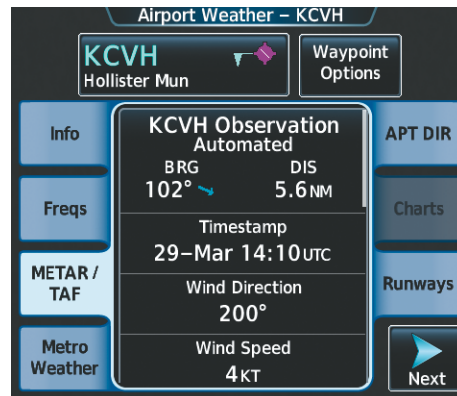
Figure 6-67 METAR information on the 'Airport Weather' Screen

PIREPS

Pilot Weather Reports (PIREPs) describe in-flight weather collected from pilots. A PIREP may contain adverse weather conditions, such as low in-flight visibility, icing conditions, windshear, turbulence, and type of aircraft flown. PIREPs are issued as either Routine (UA) or Urgent (UUA). PIREPs appear graphically on the ACARS Weather Pane, and the associated text for the selected PIREP appears on the Touchscreen Controllers.
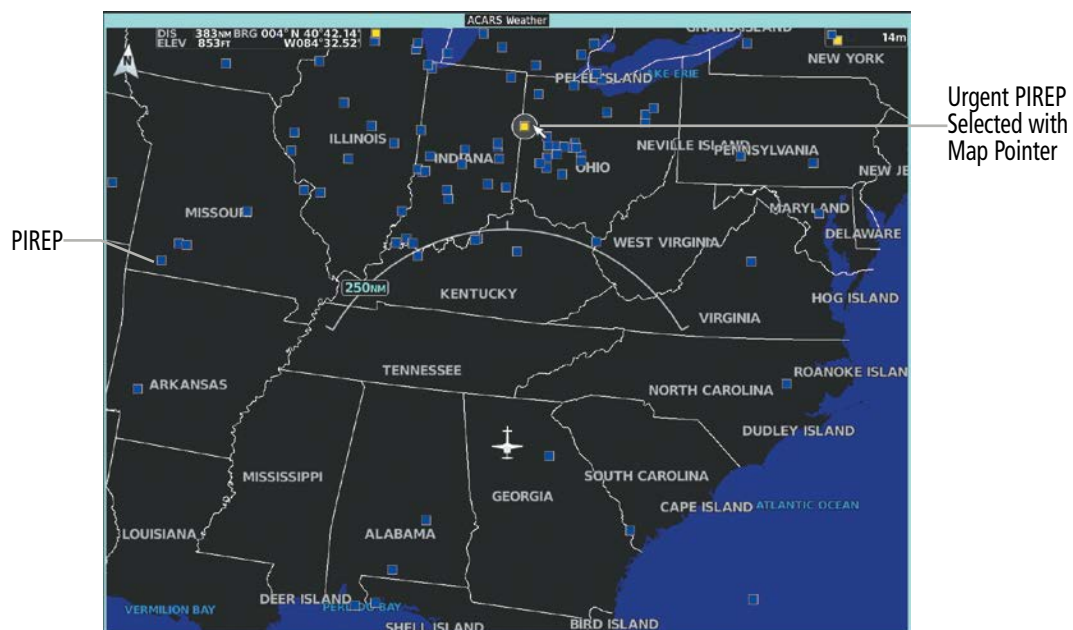
Figure 6-68 PIREPs on the 'ACARS Weather' Pane

Displaying PIREP information on the 'ACARS Weather' Pane:

1) From Home, touch **Weather** > **Weather Selection** > **ACARS Weather** > **ACARS Settings**.

   Or:

   From Home, touch **Services** > **ACARS** > **Weather Settings**.

2) In the 'Overlay' Window, touch the **PIREPs** Button.

3) To view PIREP text, push the **Joystick** to activate the map pointer and move the pointer with the **Joystick** or **Touchpad** until the selected report is highlighted, then touch the **Info** Button.

4) Scroll as needed through the report text, then touch the **Back** Button or the **Home** Button.

Touch to Display Information for Selected PIREP   'PIREP Info' Screen
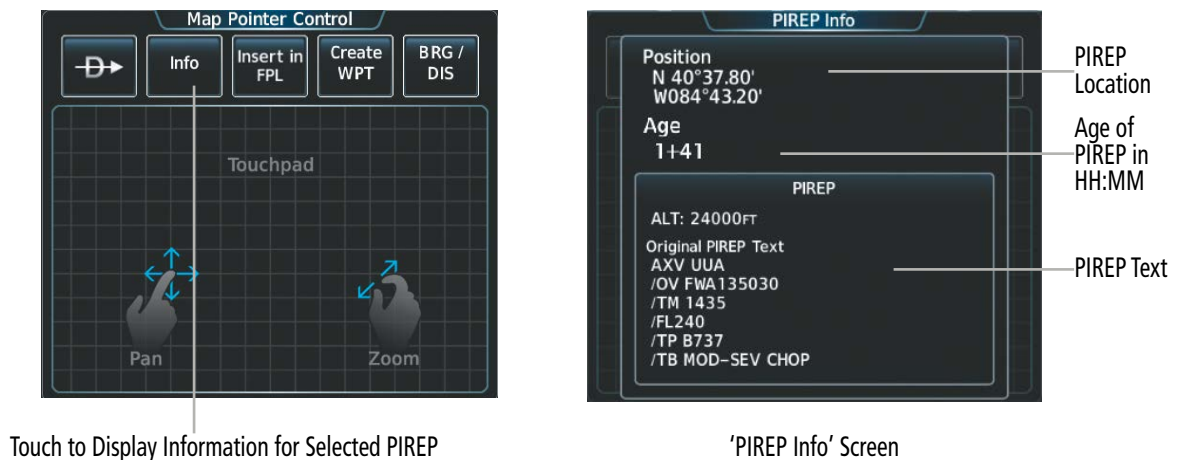
Figure 6-69 Displaying PIREPs on the Touchscreen Controller

To display the PIREPs legend, scroll to the bottom of the 'Overlays' Window and touch the **Legend** Button on the 'ACARS Weather Settings' Screen when the PIREPs weather product is enabled on the 'ACARS Weather' Pane. Scroll as needed to view the legend information, then touch the **Back** Button or the **Home** Button.

Figure 6-70 AIREPs & PIREPs Legend

METRO WEATHER (METRO WX)

The Metro Weather product is a textual forecast for a metropolitan area surrounding an airport. It is shown only on the Touchscreen Controllers. The format of the text may vary by location and weather data provider, but typically includes weather information of interest to the general public, such as expected high/low temperature, sky condition, and chance of precipitation. When the Metro Weather Product is available, it appears on the 'Airport Information' Screen on the 'Metro Weather' Tab.

Viewing Metropolitan Weather:

1) From Home, touch **Waypoint Info > Airport**.

2) If necessary, touch the airport identifier button and enter the desired airport.

3) Touch the **Metro Weather** Tab.

4) Scroll if necessary to view the weather text. Otherwise, 'No Metro Weather data available' appears.

Figure 6-71 Metro Weather on the 'Airport Metro Weather' Screen

TERMINAL WEATHER INFORMATION FOR PILOTS (TWIP)

The TWIP weather product, available at selected airports in the United States, provides information about microbursts, windshear, significant precipitation, and convective activity occurring within 30 nm of a terminal area. The TWIP weather product is requested separately from all other ACARS weather products, and must be manually requested each time an update is desired.

The system displays up to five TWIPs for the requested airport, from newest to oldest, after which, the oldest TWIP is removed. Unlike other data link weather products, the on-board system does not expire the display of a TWIP based on a pre-determined weather product age.

Figure 6-72 Requesting and Displaying a TWIP on the 'ACARS TWIP' Screen

Requesting a TWIP:

1) From Home, touch **Services > ACARS > TWIP**.

   Or:

   From Home, touch **Waypoint Info > Airport**.

2) If the **ACARS TWIP** Tab is not displayed, touch the **More** button.

3) Touch the **ACARS TWIP** Tab.

4) If necessary, touch the airport identifier button and enter the desired airport.

5) Touch the **Request** Button. The system processes the request. An ACARS message notification icon appears on the PFD when the requested TWIP becomes available.

6) If a TWIP is available, scroll to view the TWIP, if available. Otherwise, 'No TWIP data available' appears.

TEXT NOTICES TO AIRMEN (NOTAM)

> **NOTE:** The availability of the Text NOTAM feature is dependent on the ACARS service provider.

Text NOTAMs contain important information about aviation facilities, services, or procedures. Text NOTAMS may also advise of hazards in the National Airspace System. The flight crew defines the waypoints to request Text NOTAMS on the 'ACARS Weather Settings' Screen. When the system receives a Text NOTAM, a message appears on the Notifications Screen on the 'ACARS' Tab.

The system can display up to two Text NOTAMs for an airport, which is retained until the next avionics power cycle. If a Text NOTAM is not available or has not been requested for an airport, 'No NOTAMs available' appears on the Text NOTAM tab for the selected airport.

Figure 6-73 Viewing an ACARS Text NOTAM

Viewing Text NOTAMs:

1) From Home, touch **Waypoint Info > Airport**.

2) If the desired airport name is shown is already shown in the screen title, skip to step 3.

    a) Touch the airport button.

    b) Enter the airport identifier using the **Keypad** or large and small right knobs.

    c) When finished, touch the **Enter** Button or push the right knob.

3) Touch the **More** Button.

4) Touch the **Text NOTAMs** Tab.

5) Scroll as needed to view the Text NOTAM, then touch the **Back** Button or the **Home** Button.

6.3 AIRBORNE COLOR WEATHER RADAR

SYSTEM DESCRIPTION

The Garmin GWX 75 Airborne Weather Radar is a solid-state pulsed Doppler radar. It combines excellent range, sensitivity, and adjustable scanning profiles with high-definition, real-time target information.

The Textron Citation 560 XL/XLS uses a 12-inch antenna that is fully stabilized to accommodate 30º of pitch and roll.

To focus radar scanning on specific areas, Sector Scanning offers crew-adjustable horizontal scan angles of 20º, 40º, 60º, 90º, or select a full 120º scan. A vertical scanning function helps to analyze storm tops, gradients, and cell buildup activity at various altitudes.

Radar features include:

- Independent weather radar settings for each Display Pane.
- Turbulence Detection presents areas of turbulence associated with precipitation using Doppler measurements.
- WATCH® (Weather ATtenuated Color Highlight) helps to identify possible shadowing effects of short-range cell activity, identifying areas where radar return signals are weakened or attenuated by intense precipitation (or large areas of lesser precipitation) and may not fully indicate the weather behind a storm.
- Weather Alert that looks ahead for intense cell activity in the 80-320 nm range, even if these ranges are not being monitored.
- Extended Sensitivity Time Constant (STC) logic automatically correlates distance of the return echo with intensity, so cells do not suddenly appear to get larger as they get closer.
- Altitude-Compensated Tilt (ACT) management, which automatically adjusts the antenna tilt angle as the aircraft altitude changes.
- Ground Clutter Suppression (GCS), to remove ground clutter from the displays.

> **NOTE:** *Garmin recommends the user obtain instruction in the effective operation of airborne weather radar.*

PRINCIPLES OF AIRBORNE WEATHER RADAR

The term RADAR is an acronym for RAdio Detecting And Ranging. Pulsed radar locates targets by transmitting a microwave pulse beam that, upon encountering a target, is reflected back to the radar receiver as a return echo. The microwave pulses are focused and radiated by the antenna, with the most intense energy in the center of the beam and decreasing intensity near the edge. The same antenna is used for both transmitting and receiving.

Radar detection is a two-way process that requires 12.36 μs for the transmitted microwave pulses to travel out and back for each nautical mile of target range. It takes 123.6 μs for a transmitted pulse to make the round trip if a target is ten nautical miles away.

The airborne weather radar has the capability to detect the velocity of precipitation moving toward or away from the radar antenna. As the radar pulse beam strikes a moving object, the frequency of the returned echo shifts in relation to the speed at which the object is moving. This effect is analogous to the audible pitch change observed when an emergency vehicle's siren gets closer or moves away. Doppler radar employs this effect to detect areas of precipitation moving at a high rate of speed (indicative of turbulence), and to determine when an object, such as the ground, is stationary. The system can use this information to suppress the display of ground clutter.

Airborne weather radar should be used to avoid severe weather. The decision to fly into an area of radar targets depends on target intensity, spacing between the targets, aircraft capabilities, and crew experience. Airborne weather radar is efficient at detecting wet precipitation such as rain, wet snow, and water coated hail, however it will not detect clouds or mist. The display may indicate clear areas between intense returns, but this does not necessarily mean it is safe to fly between them, as these areas may contain severe turbulence or other hazards such as hail. In addition, Doppler radar measurement of precipitation velocity only occurs when rain or hail is moving along the radar beam and either toward or away from the antenna. Airborne weather radar systems cannot detect Clear Air Turbulence (CAT) as there are no particulate for the radar to detect.

Airborne weather radar has other capabilities beyond weather detection. It also has the ability to detect and provide distance to cities, mountains, coastlines, rivers, lakes, and oceans.

NEXRAD AND AIRBORNE WEATHER RADAR

Both Airborne Weather Radar and NEXRAD measure weather reflectivity in decibels (dB). A decibel is a logarithmic expression of the ratio of two quantities. Airborne Weather Radar measures the ratio of power against the gain of the antenna, while NEXRAD measures the energy reflected back to the radar, or the radar reflectivity ratio.

Although both radar systems use colors to identify the different echo intensities, the thresholds and colors are not interchangeable. Airborne color radar values from the installed weather radar system must not be confused with NEXRAD radar values. In addition, NEXRAD depicts lower intensity returns than airborne weather radar. Airborne weather radar return images will not appear the same as NEXRAD return images.

Convective weather activity is known to develop rapidly, with cell growth capable of exceeding several thousand feet per minute. Airborne weather radar provides the flight crew with real-time weather avoidance information for precipitation detected within the airborne weather radar's beam. NEXRAD information is **not** real-time. It is intended to assist the flight crew with hazardous weather avoidance planning. NEXRAD images are comprised of individual radar scans arriving at a network at different rates and times, which are periodically compiled into a mosaic (the NEXRAD weather product) and transmitted via data link. Due to inherent delays in this process, it is common for the displayed NEXRAD images to be significantly older than the current weather situation, and may also differ from information the airborne weather radar presents.

Because NEXRAD operates from an extensive network of ground-based radar antennas performing 360**°** scans, it is capable of providing information on large-scale weather patterns such as precipitation associated with significant frontal activity from multiple radar locations. Airborne weather radar can perform up to 120**°** scan, but is more affected by distance and precipitation attenuation discussed earlier in this section. Other factors including curvature of the earth (particularly at map ranges greater than 150 miles), antenna tilt setting, and aircraft altitude may also cause the airborne weather radar's antenna beam to miss areas of precipitation which are detected by NEXRAD. In addition, since the airborne weather radar's beam often produces ground returns, it may be difficult to distinguish precipitation from ground returns, especially stratus rain when the aircraft is above the precipitation.

Both airborne weather radar and the NEXRAD system can detect a radar top of a storm cell. Airborne weather radar can display this information in vertical scan mode, while NEXRAD radar top information appears in the Echo Tops SiriusXM Weather Product (Refer to Section 6.1 for more information about SiriusXM Weather). Because airborne weather radar and NEXRAD use different detection thresholds, a radar top from airborne weather radar may appear 5,000 feet or more below the NEXRAD-derived Echo Top. Furthermore, radar top information provided from either source is not the actual or true top of the storm, which is only observable with the eyes in clear air and may be much higher than the radar top detected by either system.

Because airborne weather radar and NEXRAD present information using similar (but not interchangeable colors), only one radar source may be shown on a map Display Pane at a time. Pilots should carefully consider information from airborne and data link weather sources, in addition to other available resources to avoid flight into hazardous weather conditions.

ANTENNA BEAM ILLUMINATION

Radar beams are much like the beam of a flashlight, in that they will illuminate targets within the beam. Just as with a flashlight, the further the beam travels, the wider it becomes and the less effective it is at illuminating targets. The certified beam width contains 90% of the energy of the radar signal, with the strongest part of the beam in the center. Pointing the center of the beam at targets to investigate provides the best returns for a particular target.

The remaining 10% of beam energy (outside the certified beam) has sufficient strength and the antenna has the sensitivity to display highly reflective targets, including additional weather and ground returns. Weather returns from this portion of the beam energy will most likely be under representative of the true intensity of the hazards, because they are so far from the center of the beam (and outside of the certified beam width). The strong reflective nature of terrain features will cause the display of ground clutter well short of where the certified beam width intersects the ground. For the 12-inch antenna this additional beam energy represents approximately four additional degrees at the top and bottom of the certified beam width of 8 degrees.

The following figure depicts the radar beam as seen from the side, with both the certified beam width and the additional beam energy illustrated. With the aircraft at 30,000 ft. AGL and a radar tilt angle of zero degrees, ground clutter may be observed starting at approximately 36 NM. The cell located 20 NM from own ship would be over-scanned by the beam, and as a result would not be represented on the radar display. The cell located 80 NM from own ship displays radar tops of 22,000 ft. AGL which is relatively close to the beam center, so this cell would be represented on the display. However, utilizing a lower radar tilt angle would better depict the precipitation intensities of this cell. The cell located at approximately 190 NM displays radar tops of 28,000 ft. AGL, while the center of the beam is at about 65,500 ft. AGL (due to the Earth's curvature at that distance). While this particular cell may appear on the display due to being within the certified beam width, it would most likely be under-represented due to being so distant from the beam center. The radar tilt angle would need to be adjusted downwards to properly explore this cell's precipitation intensity.
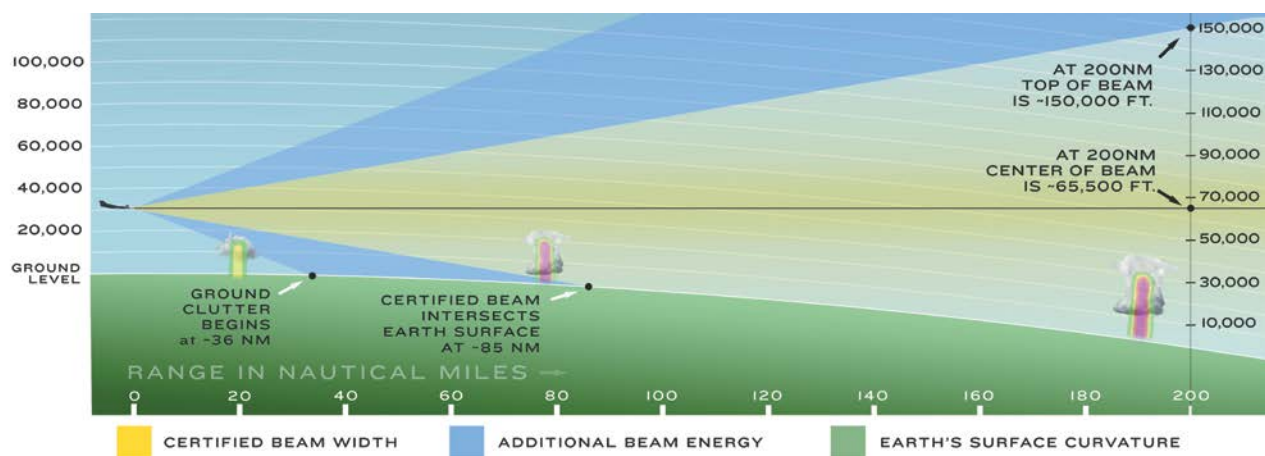
Figure 6-74 Radar Beam in Relation to the Curvature of the Earth from a 12 inch Antenna

RADAR SIGNAL ATTENUATION

The phenomenon of radar signal attenuation affects the operation of weather radar. When the radar signal is transmitted, it is progressively absorbed and scattered, making the signal weaker. This weakening, or attenuation, is caused by two primary sources, distance and precipitation.

Distance attenuation occurs due to the fact the radar energy leaving the antenna is inversely proportional to the square of the distance. The reflected radar energy from a target 40 miles away that fills the radar beam is one fourth the energy reflected from an equivalent target 20 miles away. This would appear to the operator the storm is gaining intensity as the aircraft gets closer. Internal signal processing within the equipped weather radar system compensates for much of this distance attenuation.

Attenuation due to precipitation is not as predictable as distance attenuation. It is also more intense. As the radar signal passes through moisture, a portion of the radar energy is reflected back to the antenna. However, much of the energy is absorbed. If precipitation is very heavy, or covers a large area, the signal may not reach completely through the area of precipitation. The weather radar system cannot distinguish between an attenuated signal and an area of no precipitation. If the signal has been fully attenuated, the radar displays a radar shadow. This appears as an end to the precipitation when, in fact, the heavy rain may extend much further. A cell containing heavy precipitation may block another cell located behind the first, preventing it from being displayed on the radar. Never fly into these shadowed areas and never assume that all of the heavy precipitation is being displayed unless another cell or a ground target can be seen beyond the heavy cell. The WATCH® feature of the installed weather radar system can help to identify these shadowed areas. Areas in question appear as shadowed or gray on the radar display. Proper use of the antenna tilt control can also help detect radar shadows.

Attenuation can also be due to poor maintenance or degradation of the radome. Even the smallest amount of wear and scratching, pitting, and pinholes on the radome surface can cause damage and system inefficiency.

RADAR SIGNAL REFLECTIVITY

PRECIPITATION

Precipitation or objects more dense than water, such as the surface of the earth or solid structures, are detected by the weather radar. The weather radar does not detect clouds, thunderstorms, or turbulence directly. It detects precipitation associated with clouds, thunderstorms, and turbulence. The best radar signal reflectors are raindrops, wet snow, or wet hail. The larger the raindrop, the better the reflectivity. The size of the precipitation droplet is the most important factor in radar reflectivity. Because large drops in a small concentrated area are characteristic of a severe thunderstorm, the radar displays the storm as a strong return. Ice crystals, dry snow, and dry hail have low levels of reflectivity as shown in the illustration, and often are not displayed by the radar. Additionally, a cloud that contains only small raindrops, such as fog or drizzle, does not reflect enough radar energy to produce a measurable target return.

Reflective Levels
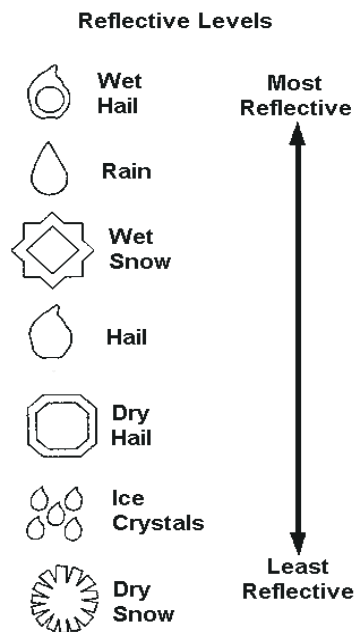
Figure 6-75 Precipitation Type and Reflectivity
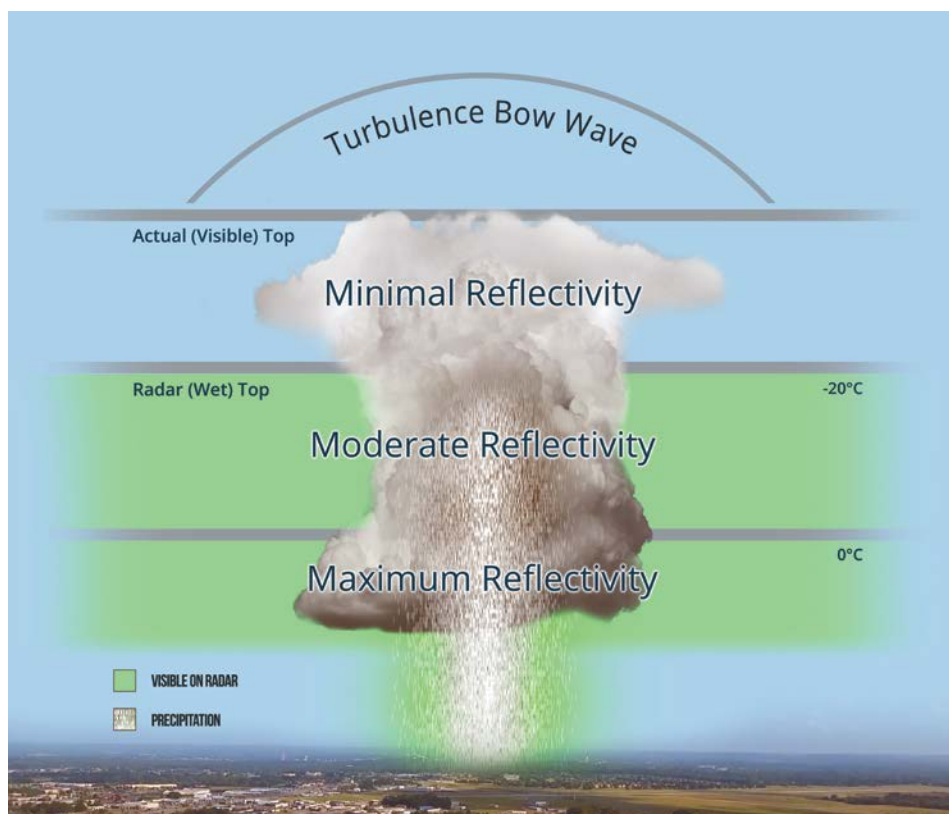
Figure 6-76 Precipitation Reflectivity by Temperature as Related to Altitude

When using the airborne weather radar to explore a more intense thunderstorm cell, it is critical to understand where radar returns can be expected to be intense, and where they can be expected to decrease to a point where no returns will be displayed. Since wet precipitation reflects radar energy far better than dry precipitation, strong radar returns can be expected at lower altitudes, with the strongest radar returns found near the melting level. At higher altitudes, precipitation becomes frozen, and reflectivity is significantly reduced. At a certain altitude within in a thunderstorm cell, returns will begin to diminish. This is the "echo top" of a cell, where radar can no longer detect the frozen precipitation, but this is not the actual top of the cell, which could extend significantly further into the atmosphere. Since it is difficult to detect the actual tops of a thunderstorm cell with radar, and invisible bow waves may extend beyond visible tops, overflight of thunderstorms should never be attempted.

Ground Returns

The intensity of ground target returns depends upon the angle at which the radar beam strikes the ground target (Angle of Incidence) and the reflective properties of that target. The gain can be adjusted so shorelines, rivers, lakes, and cities are well defined. Increasing the gain too much causes the display to fill in between targets, thus obscuring some landmarks.

Cities normally provide a strong return signal. While large buildings and structures provide good returns, small buildings can be shadowed from the radar beam by the taller buildings. As the aircraft approaches and shorter ranges are selected, details become more noticeable as the highly reflective regular lines and edges of the city become more defined.

Bodies of water such as lakes, rivers, and oceans are not good reflectors and normally do not provide good returns. The energy is reflected in a forward scatter angle with inadequate energy being returned. They can appear as dark areas on the display. However, rough or choppy water is a better reflector and provides stronger returns from the downwind sides of the waves.

Mountains also provide strong return signals to the antenna, but also block the areas behind. However, over mountainous terrain, the radar beam can be reflected back and forth in the mountain passes or off canyon walls, using up all or most of the radar energy. In this case, no return signal is received from this area, causing the display to show a dark spot which could indicate a pass where no pass exists.

Ground Clutter Suppression

Ground Clutter Suppression (GCS) enhances the flight crews ability to differentiate precipitation returns from ground clutter, by suppressing most, but not all, returns from ground objects. The optional feature is most effectively used by first obtaining the desired tilt and range settings, and then activating GCS. For normal surveillance of an air mass, tilt angle and range should be adjusted to obtain minimal ground clutter prior to activation of the GCS feature. This ensures the radar beam is functioning and tilt is set to observe the air above the ground clutter before that clutter is suppressed. The same holds true for investigating suspected precipitation returns. Tilt angle and range should be set to maximize the precipitation return image prior to activation of GCS to suppress clutter.

ANGLE OF INCIDENCE

The angle at which the radar beam strikes the target is called the Angle of Incidence. The figure illustrates the incident angle ('A'). This directly affects the detectable range, the area of illumination, and the intensity of the displayed target returns. A large incident angle gives the radar system a smaller detectable range and lower display intensity due to minimized reflection of the radar energy.
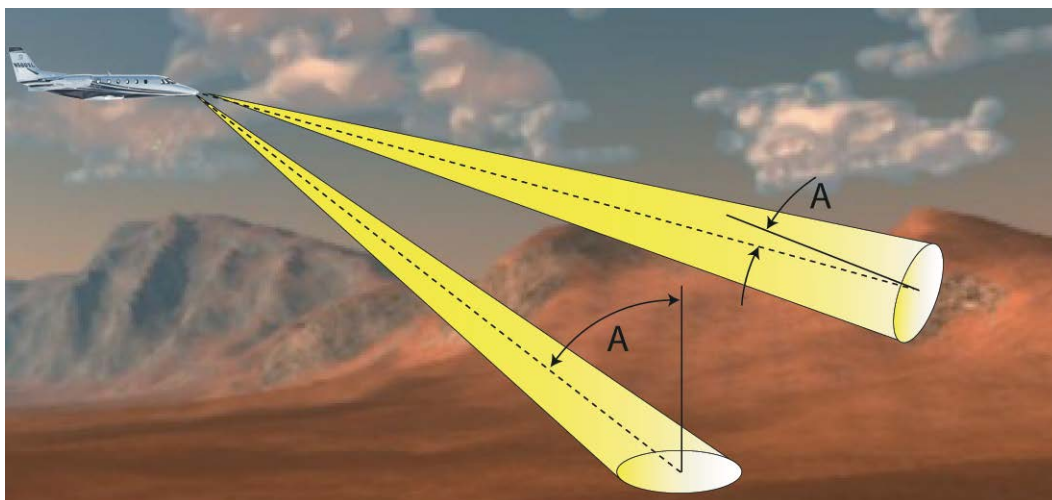
Figure 6-77 Angle of Incidence

A smaller incident angle gives the radar a larger detectable range of operation and the target display shows a higher intensity. Since more radar energy is reflected back to the antenna with a low incident angle, the resulting detectable range is increased for mountainous terrain.

SAFE OPERATING DISTANCE

⚠️ **WARNING:** *Do not operate the weather radar in a transmitting mode when personnel or objects are within the MPEL boundary.*

The following information establishes a minimum safe distance from the antenna for personnel near operating weather radar. The minimum safe distance is based on the FCC's exposure limit at 9.3 to 9.5 GHz for general population/uncontrolled environments, which is 1 mW/cm2. See Advisory Circular 20-68B for more information on safe distance determination.

MAXIMUM PERMISSIBLE EXPOSURE LEVEL (MPEL)

The recommended minimum safe distance between personnel and an operating weather radar antenna is 14 feet from the 12-inch antenna. All personnel must remain outside of this zone. With a scanning or rotating beam, the averaged power density at the MPEL boundary is significantly reduced. This distance recommendation slightly exceeds the calculation methods defined in Advisory Circular 20-68B.

Approximate MPEL Boundary

14' for 12" antenna
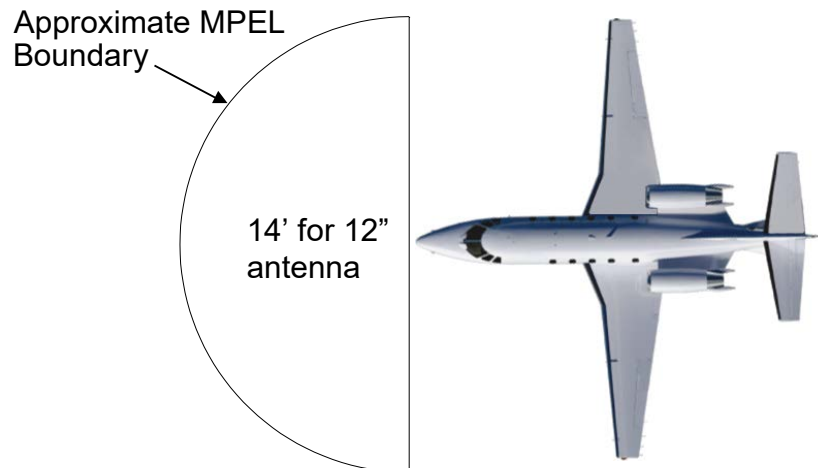
Figure 6-78 MPEL Boundary

✓ **NOTE:** *The previously published MPEL values are still valid and beyond the minimum safe distances as determined by AC 20-68B. For elevated safety margins, Garmin recommends minimum safe distance values that exercise further caution than those determined in AC 20-68B.*

BASIC ANTENNA TILT AND RANGE SETUP

Proper antenna tilt management techniques are a major factor for the successful use of any airborne weather system. If the antenna tilt angle is set too low, the radar display will show excessive ground returns, making it difficult for the pilot to distinguish adverse weather phenomena from ground clutter. If the antenna tilt angle is set too high, the radar beam will overscan the top of the adverse weather. In either of these examples, the flight crew would be unable to adequately recognize critical weather information.

The following discussion is a simple method for setting up the weather radar antenna tilt for most situations. It is not to be considered an all encompassing setup that works in all situations, but this method does provide good overall parameters for the monitoring of intense weather threats. Correct application of tilt angle is directly dependent on the storms height and intensity and its relative distance from own ship. Adjusting the airborne weather radar tilt angle setting until minimal ground clutter is displayed is the simplest setup method for general surveillance of precipitation returns. For ranges of up to 80 NM this ground clutter should appear on the outer portion of the radar display. At ranges greater than 80 NM, the displayed ground clutter will move lower on the radar display due to the curvature of the earth. By displaying a minimal amount of ground clutter on the installed weather radar system the flight crew can ensure the system is operating and the air mass above the ground clutter is being scanned.

When a strong a weather return is detected within the ground clutter it must be further investigated to determine the source of this return. Further tilt angle adjustment of the airborne radar may be required to explore this return. Adjusting the radar tilt angle upwards can reveal the radar tops of this return, while adjusting the tilt angle downwards may be necessary to investigate the strongest intensity of a particular return.

Effective airborne weather radar range management during all phases of flight should be based on the volume of air to be scanned for returns ahead of own aircraft, to allow sufficient time needed to investigate, analyze, decide, and tactically maneuver around these hazardous weather returns. Longer ranges may be used to tactically identify intense weather returns that may warrant further investigation, and closer ranges may be used during the investigation process.

There is no one tilt or range setting that works for all situations. It is best to remember that active tilt and range management is necessary to identify and then investigate returns.

> **NOTE:** When a strong weather return is displayed on the weather radar, the tilt angle may be adjusted to explore return intensities at various altitudes to aid in determination of radar tops.

> **WARNING:** Overflight of thunderstorms should not be considered safe, as extreme turbulence may exist significantly above observed returns.

> **NOTE:** It is the sole responsibility of the flight crew to avoid areas of hazardous weather by adequate margins.

MANAGING TILT ANGLE AND RANGE

There are many factors to be considered in order to become proficient at using airborne weather radar in all situations. The following setup provides a good starting point for the practical application of radar tilt management.

Radar tilt management can easily be remembered by use of the 1-10-1000 rule. The summary of this rule is the fact that when the flight crew changes the radar tilt angle by 1 degree the resulting change will displace the center of the beam 1000 feet vertically at a range of 10 nautical miles. Applying the 1-10-1000 rule to various distances provides the flight crew with the ability to determine how much a 1-degree change in tilt will move the beam vertically. The radar tilt angle is capable of being adjusted in one-quarter degree increments, allowing for greater accuracy in the placement of the beam center at desired altitudes.
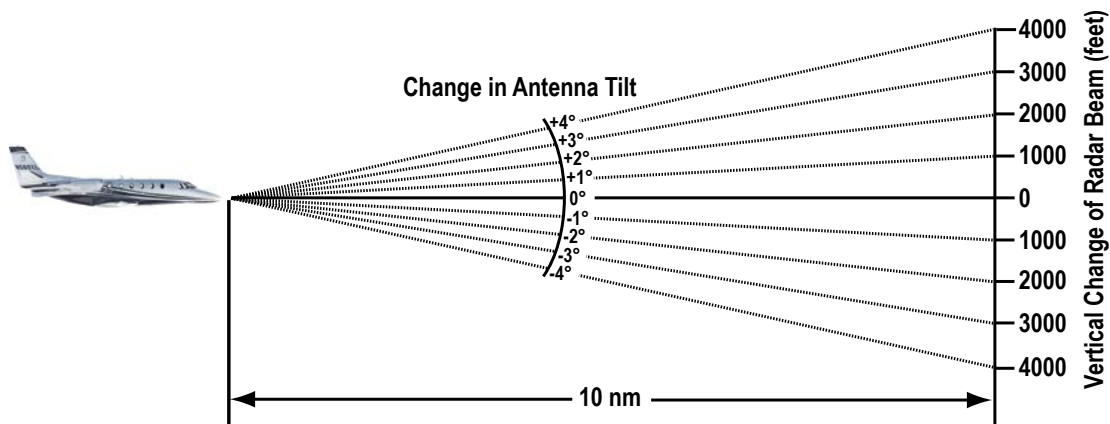
Figure 6-79 Vertical Change in Radar Beam per Nautical Mile

The 12-inch antenna has a certified beam width of 8 degrees, which means the beam is 8,000 feet in height (and width) at 10 NM and 80,000 feet in height (and width) at 100 NM.

» At 20 NM range the beam height changes by 2,000 ft. per degree of tilt change.

» At 40 NM range the beam height changes by 4,000 ft. per degree of tilt change.

» At 100 NM range the beam height changes by 10,000 ft. per degree of tilt change.

Additionally, setting the tilt to UP 4.00 degrees places the bottom of the certified beam at the same altitude as the aircraft, which is a technique used to determine whether radar tops reach your current altitude.

Phase of Flight	Tilt Angle	Range Setting	Notes
Taxi	Up 7.50° to 10.00°	20 NM	Activate weather mode when clear of ramp area.
Takeoff / Initial Climb	Up 7.50° to 10.00° Altitude Compensated Tilt On	60 NM	If precipitation is observed in the departure path, gain can be reduced to aid in identification of intense returns.
10,000 Ft. AGL	Up 5.00° Altitude Compensated Tilt On	60 - 80 NM	Range setting is dependent upon ground speed and time available for deviations.
Cruise	Tilt to Minimize Clutter Altitude Compensated Tilt On	60 - 120 NM	Range setting is dependent upon ground speed and time available for deviations. Tilt angle set to show minimal ground clutter.
Descent To 10,000 FT	Tilt to Minimize Clutter Altitude Compensated Tilt On	60 - 120 NM	Range setting is dependent upon ground speed and time available for deviation.
Descent Below 10,000 FT	Up 7.50° to 10.00° Altitude Compensated Tilt On	40 - 60 NM	Range setting is dependent upon ground speed and time available for deviation. Tilt angle set to show ground clutter in outer 1/3 of radar display.
Approach	Up 7.50° to 10.00° Altitude Compensated Tilt On	20 NM	These settings allow for observation of the approach area and the missed approach holding area.

Table 6-9 Typical Tilt Settings by Phase of Flight

> **NOTE:** *Garmin recommends the user obtain instruction in the proper operation of airborne weather radar.*

ALTITUDE COMPENSATED TILT (ACT)

The Altitude Compensated Tilt feature of the GWX 75 enables the system to automatically adjust the antenna beam tilt angle setting based on aircraft altitude changes. For example, if the ACT feature is enabled and the aircraft climbs, the system compensates by adjusting the tilt downward. As the aircraft descends with ACT enabled, the system adjusts the antenna tilt upward.

WEATHER DISPLAY AND INTERPRETATION

When evaluating various target returns on the weather radar displays, the colors denote precipitation intensity and rates shown in the following table.

Weather Mode Color	Intensity (in dBz)
Black	< 23 dBZ
Green	23 dBZ or 24 dBZ
Green	25 dBZ or 26 dBZ
Green	27 dBZ or 28 dBZ
Green	29 dBZ or 30 dBZ
Green	31 dBZ or 32 dBZ
Yellow	33 dBZ or 34 dBZ
Yellow	35 dBZ or 36 dBZ
Yellow	37 dBZ or 38 dBZ
Yellow	39 dBZ or 40 dBZ
Red	41 dBZ or 42 dBZ
Red	43 dBZ or 44 dBZ
Red	45 dBZ or 46 dBZ
Red	47 dBZ or 48 dBZ
Magenta	49 dBZ to 50 dBZ
Magenta	51 dBZ to 53 dBZ
Magenta	> 54 dBZ
White	TURB- Turbulence Detection uses the color white to show areas of rain or hail that may also contain turbulence

Table 6-10 Precipitation Intensity Levels

THUNDERSTORMS

Updrafts and downdrafts in thunderstorms carry water through the cloud. The more severe the drafts, the greater the number and size of the precipitation droplets. With this in mind, the following interpretations can be made from what is displayed on the weather radar. Avoid these areas by an extra wide margin.

- In areas where the displayed target intensity is red or magenta (indicating large amounts of precipitation), the turbulence (areas of white) is considered severe.

- Areas that show steep color gradients (intense color changes) over thin bands or short distances suggest irregular rainfall rate and strong turbulence.

- Areas that show red or magenta are associated with hail, as well as heavy precipitation. While areas of turbulence will be displayed as white. Vertical scanning and antenna tilt management may be necessary to identify areas of maximum intensity.

- Areas of radar shadowing which can result from an attenuated (weakened) signal from a nearby storm, hiding a larger and more dangerous storm which may exist in the apparently benign area directly behind the nearby return.

Along squall lines (multiple cells or clusters of cells in a line) individual cells may be in different stages of development. Areas between closely spaced, intense targets may contain developing clouds not having enough moisture to produce a return. However, these areas could have strong updrafts or downdrafts. Targets showing wide areas of green are generally precipitation without severe turbulence.

Irregularities in the target return may also indicate turbulence, appearing as hooks, fingers, or scalloped edges. These irregularities may be present in green areas with no yellow, red, or magenta areas and should be treated as highly dangerous areas. Avoid these areas as if they are red or magenta.

Squall Line

Steep Gradient   Hook or Finger   Scalloped Edge
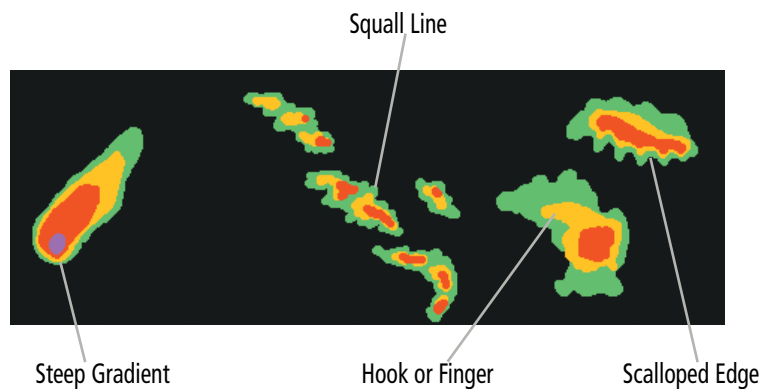
Figure 6-80 Cell Irregularities

Thunderstorm development is rapid. A course may become blocked within a short time. When displaying shorter ranges, periodically select a longer range to see if problems are developing further out. That can help prevent getting trapped in a blind alley or an area that is closed at one end by convective weather.
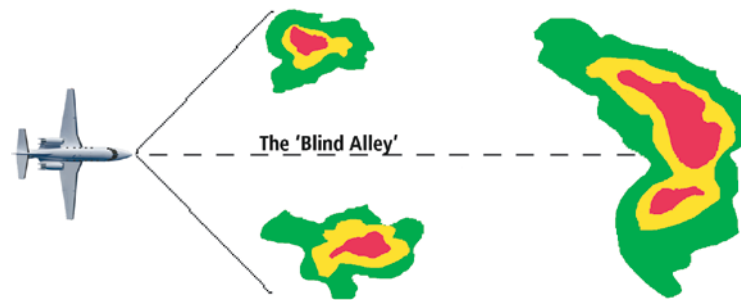
Figure 6-81 The Blind Alley - Horizontal Scan

In areas of multiple heavy cells, use the Vertical Scan feature along with antenna tilt management and higher and lower radar ranges to examine the area. A possible course change while using a lower radar range may seem safe, however this new course may reveal adverse weather just beyond the scanned area. These techniques will help prevent flight crew from entering the "Blind Alley" scenario. Remember to avoid shadowed areas behind targets.
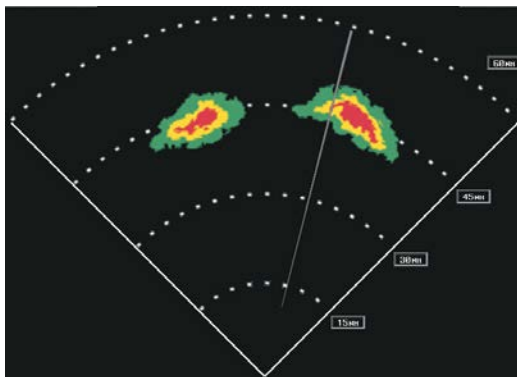
The Blind Alley at Close Range
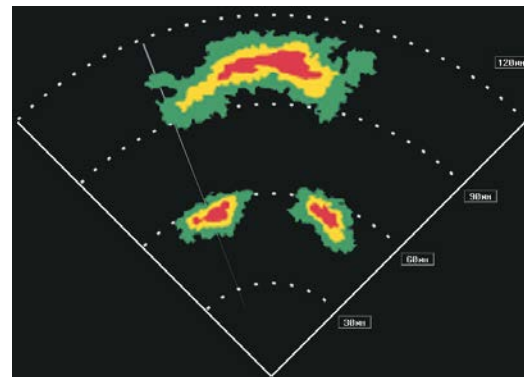
The Large Storm Behind

Figure 6-82 The Blind Alley

Tornadoes

There are no conclusive radar target return characteristics which identify a tornado. However, tornadoes may be present if the following characteristics are observed:

- A narrow, finger-like portion extends and in a short time curls into a hook and closes on itself.
- A hook, which may be in the general shape of the numeral 6 (numeral 9 in the southern hemisphere), especially if bright and projecting from the southwest quadrant (northeast quadrant in the southern hemisphere) of a major thunderstorm.
- V-shaped notches.
- Doughnut shapes.

These shapes do not always indicate tornadoes, and tornado returns are not limited to these characteristics. Confirmed radar observations of tornadoes most often have not shown shapes different from those of a normal thunderstorm display.

Hail and Radar Tops

Hail results from updrafts carrying water high enough to freeze. Therefore, the higher the top of a thunderstorm, the greater the probability the thunderstorm will contain hail. Vertically scanning the target return can give the radar top of a thunderstorm that contains hail. Radar top is the top of a storm cell as detected by radar. It is not the actual top, or true top of the storm. The actual top of a storm cell is seen with the eyes in clear air and may be much higher than the radar top. Neither the radar top nor the actual top necessarily indicate the top of the hazardous area, which may be much higher.

Hail can fall below the minimum reflectivity threshold for radar detection. It can have a film of water on its surface, making its reflective characteristics similar to a very large water droplet. Because of this film of water, and because hail stones usually are larger than water droplets, thunderstorms with large amounts of wet hail return stronger signals than those with rain. Some hail shafts are extremely narrow (100 yards or less) and make poor radar targets. In the upper regions of a cell where ice particles are dry (no liquid coating), target returns are less intense.

Hail shafts are associated with the same radar target return characteristics as tornados. U-shaped cloud edges three to seven miles across can also indicate hail. These target returns appear quite suddenly along any edge of the cell outline. They also change in intensity and shape in a matter of seconds, making vigilant monitoring essential.

Stratus Precipitation

Detecting areas of low altitude, stratus precipitation while the aircraft altitude is significantly above the precipitation is difficult to accomplish with airborne weather radar. This is because as the radar beam detects the low altitude precipitation, it also receives significant ground returns which are displayed with the precipitation. Raising the antenna tilt angle may reduce the ground returns, however the radar beam is likely to overshoot the low-altitude precipitation when the aircraft is at a high altitude above the precipitation.
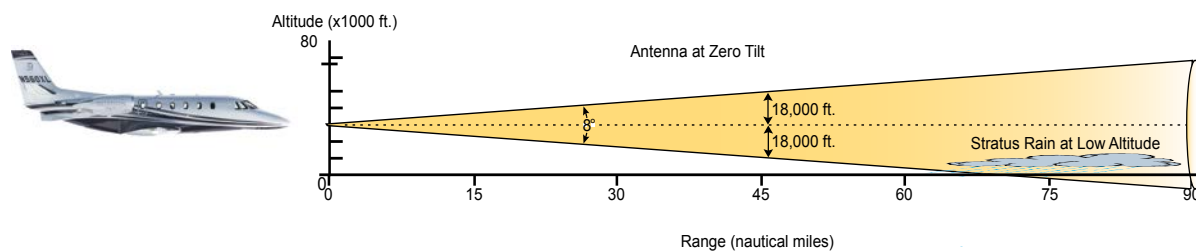
Figure 6-83 Stratus Rain Combines with Ground Returns when Aircraft is at Higher Altitudes

As the aircraft descends to a lower altitude, increasing the antenna tilt angle may help to reduce unwanted ground returns and make the display of stratus precipitation more apparent.

> **NOTE:** *The Ground Clutter Suppression (GCS) feature of the GWX 75 may remove the display of low-intensity precipitation in addition to ground returns when the feature is enabled.*

WEATHER RADAR OPERATION

⚠️ **WARNING:** *Do not operate the weather radar in a transmitting mode when personnel or objects are within the MPEL boundary.*

⚠️ **CAUTION:** *When all display panes displaying weather radar are set to Standby Mode, the antenna is parked at the center line. It is always a good idea to put the radar in Standby Mode before taxiing the aircraft to prevent the antenna from bouncing on the bottom stop and possibly causing damage to the radar assembly.*

⚠️ **WARNING:** *The use of Radar Trim in flight is prohibited unless a part of maintenance action.*

The airborne weather radar allows the flight crew to display weather radar information on multiple display panes, and to customize each radar display independently. For example, if three radar map displays are shown (including map overlays or Weather Radar Panes), the flight crew may select Standby Mode for the first map display, Weather Mode with a vertical scan for the second map display, and Ground Mode with a horizontal scan for the third map display. The weather radar updates each map display as it performs a scan with the given parameters for that map display. If more than one map display has identical scan parameters, the system uses information from the same antenna sweep to update the applicable maps simultaneously. Otherwise, the antenna performs multiple scans, one at a time, in a repeating cycle. This results in longer duration between scans for a given map until the next available scan refreshes that map.

For discussion purposes, it may be helpful to think of the weather radar system as having up to six separate radars. Each radar has an independent display and controls, therefore, operating independently of one another. All radar functions and operations may be performed on any, or all radar displays. As stated previously, since scanning is "shared" between radar displays, the greater the number of radars displayed, the slower the scan update for each display. The remaining discussions regarding the GWX 75 Airborne Weather Radar System apply to each of the possible radar displays.

When the pilot enables (green annunciator) the Radar Mode **On** Button, all display panes showing weather radar enter Standby Mode and the weather radar performs an antenna clearance check to ensure proper antenna movement within the radome. When the **Standby** Button is enabled (green annunciator), all display panes showing weather radar are placed in Standby Mode.

When the weather radar system is in the Weather or Ground Map mode, the system automatically places the radar in Standby mode on landing.

In Reversionary Modes, the weather radar system continues to operate as long as at least one Touchscreen Controller is able to provide weather radar controls, otherwise the radar system automatically changes to Standby Mode and cannot be controlled.

⚠️ **WARNING:** *Do not assume weather radar transmission is disabled unless **all** displays displaying weather radar are set to Standby Mode, and are displaying 'STANDBY' in the center of each weather radar display. Transmission is also disabled by touching the **Radar On** Button to set the weather radar system to Off Mode, as indicated by a gray annunciator.*
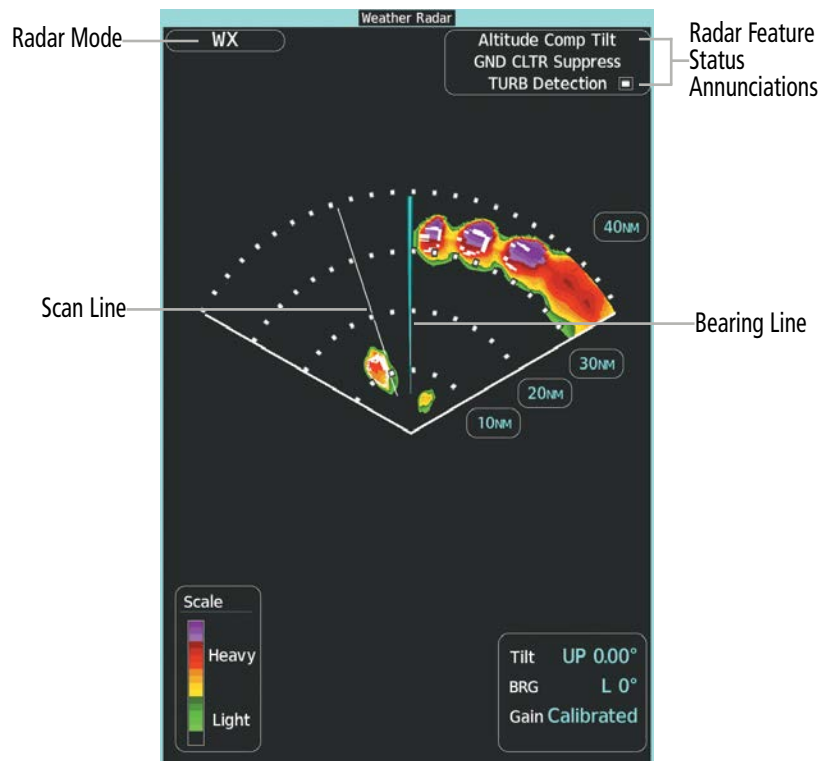
Figure 6-84 'Weather Radar' Pane with a Horizontal Scan

Showing Weather Radar Information on the 'Weather Radar' Pane:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings.**

2) Touch the **Radar On** Button. Radar options are enabled when button annunciator is green, off when gray.

3) Touch the **Display Mode** Button.

4) Touch the **Weather** Button. If the aircraft is airborne, the radar begins transmitting, and the Radar Mode indicates 'Weather'.

5) If the aircraft is on the ground, the Touchscreen Controller displays a prompt to confirm radar activation. Touch the **OK** Button to begin transmitting, or touch the **Cancel** Button to return to the Weather Radar Settings screen, and the radar remains in Standby Mode.

6) Turn the **Joystick** to select the desired map range.

7) The system displays a horizontal scan. To change to a vertical scan, refer to the following procedure, "Vertically scanning a storm cell."

CAUTION: Activating radar on ground. Read and follow all safety precautions.
Continue activating radar?

OK   Cancel

Figure 6-85 Confirm Activating Radar while on Ground

NOTE: Vertical scanning of a storm cell should be done with the aircraft wings level to avoid constant adjustment of the Bearing Line.

Scanning a storm cell vertically:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings.**

2) While on a Horizontal Scan view, touch the **Bearing Line** Button if necessary to show the Bearing Line on the 'Weather Radar' Pane.

3) Press the **Joystick**. This enables the **Joystick** to set the Bearing Line position and displays a bearing and tilt **Joystick** legend.

4) Move the **Joystick** left or right to place the Bearing Line on the desired storm cell or other area to be vertically scanned.

5) Touch the **Scan Mode** Button.

6) Touch the **Vertical** Button. The 'Weather Radar' Pane shows a vertical scan.

7) Move the **Joystick** left or right as needed to move the bearing line a few degrees left or right. When finished, push the **Joystick** to disable bearing line adjustment.

8) Turn the **Joystick** to adjust the map range as needed.

9) To select a new area to be vertically scanned, return to the Horizontal scan mode.

   a) Touch the **Scan** Button.

   b) Touch the **Horizontal** Button.

   c) Return to Step 2 of this procedure.
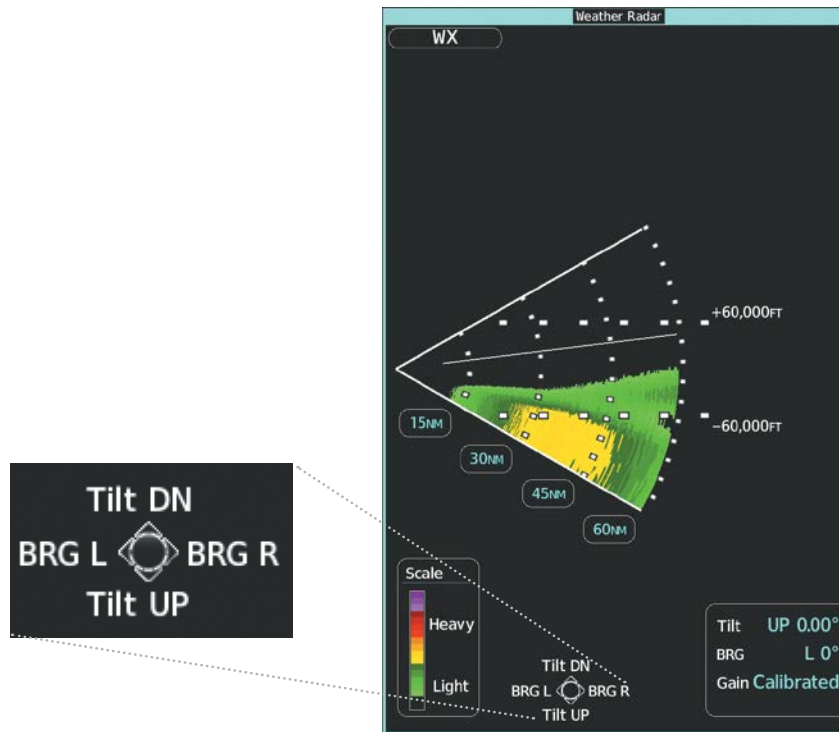
Figure 6-86 Weather Radar Display with Vertical Scan Mode Selected

ADJUSTING ANTENNA TILT ANGLE

In order to make an accurate interpretation of a storm cell, the radar beam should be pointed at the wet part of the weather cell to record the proper rainfall intensity (color level). The ideal aiming point is just below the freezing level of the storm. The best way to find this point is to use the Vertical Scan feature. The antenna tilt angle can be centered on the strongest return area in the vertical scan to get a more accurate view of the coverage and intensity of the target in the horizontal scan.

Adjusting antenna tilt on the Weather Radar Pane in Horizontal Scan Mode:

1) Push the **Joystick** to activate the tilt adjustment function of the **Joystick**. The Weather Radar displays a bearing and tilt **Joystick** legend.

2) Move the **Joystick** to adjust the antenna tilt angle.

3) Push the **Joystick** again to disable the tilt adjustment function of the **Joystick** and remove the legend.

Adjusting antenna tilt on the Weather Radar Display in Vertical Scan Mode:

1) Push the **Joystick** to activate the tilt and bearing adjustment functions.

2) Move the **Joystick** to adjust the tilt angle.

3) Push the **Joystick** to disable the tilt adjustment function of the **Joystick**.

The selected tilt angle will apply when Horizontal Scan Mode is enabled again.

Altitude Compensated Tilt (ACT) Angle Adjustment

The Altitude Compensated Tilt feature enables automatic management of the antenna tilt angle as the aircraft altitude changes. With ACT enabled, the antenna beam position remains centered at the set position for the current map range. The system automatically decreases the tilt angle as the aircraft climbs, and increases the tilt angle as the aircraft descends. ACT is available in the Horizontal Scan Mode when the system is operating in Weather Mode and GPS altitude is available.

Enabling/Disabling Altitude Compensated Tilt (ACT):

1) If necessary, refer to the previous procedures to initially set the antenna tilt angle to the desired setting.

2) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings.**

3) Touch the **Altitude Comp Tilt** Button. The Radar Status indicator shows 'Altitude Comp Tilt On'.

Figure 6-87 Enabling Altitude Compensated Tilt

Adjusting Gain

⚠️ **WARNING:** *Always position the weather radar gain setting to Calibrated for viewing the actual intensity of precipitation. Changing the gain in weather mode causes precipitation intensity to be displayed as a color not representative of the true intensity.*

The Weather Radar Gain is set to the calibrated gain setting when the Weather Radar is powered on.

Manually adjusting gain:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) If the **Calibrated Gain** button annunciator is green (enabled), touch the **Calibrated Gain** Button to disable Calibrated Gain. **Calibrated Gain** Button annunciator is gray when disabled.

3) Touch and slide the Gain slider.

   Or:

   Touch the **+** pointer to increase gain, or **-** pointer to decrease gain. Each touch increases or decreases the gain by one increment. A gray bar across the slider bar serves as a reference to the calibrated gain setting position.

4) To return to the calibrated gain setting, touch the **Calibrated Gain** Button.
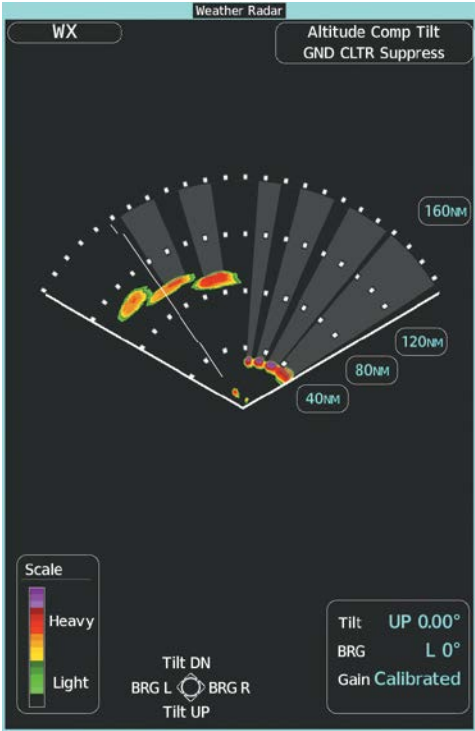
'Weather Radar' Pane with Calibrated Gain Setting

Calibrated Gain Enabled

Manual Gain Adjustment Unavailable when Calibrated Gain is Enabled
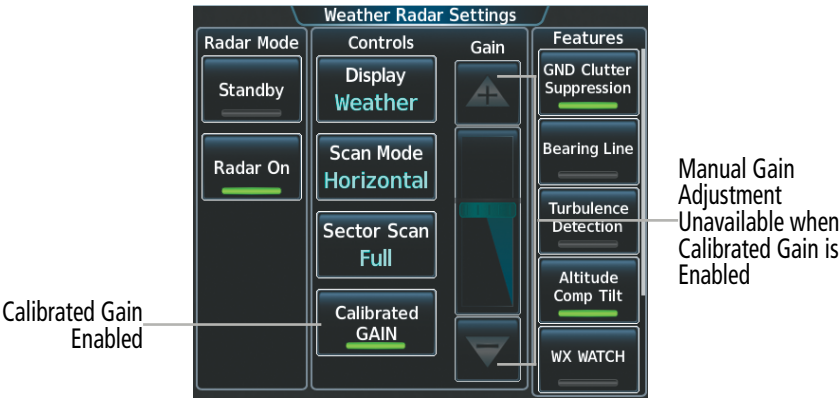
Touchscreen Controller with Calibrated Gain Setting Enabled

Figure 6-88 Calibrated Gain
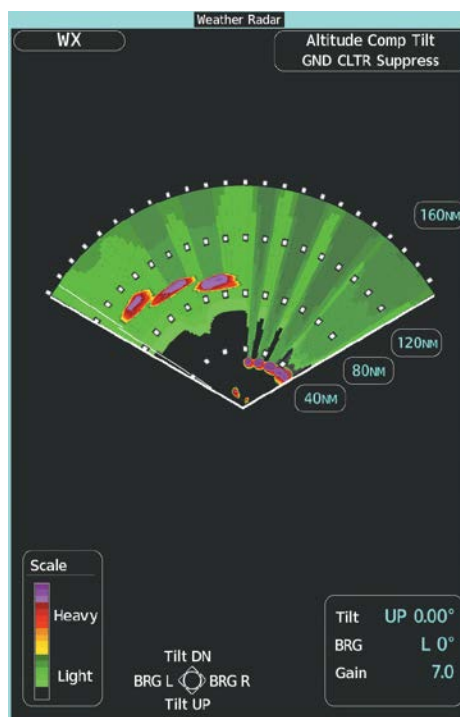
'Weather Radar' Pane set Above Calibrated Gain Setting

Current Manual Gain Setting

Reference to Calibrated Gain Setting Position

Calibrated Gain Disabled
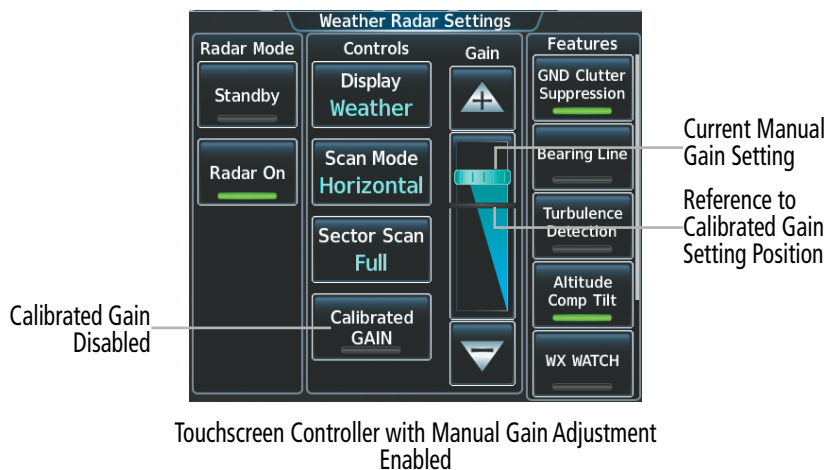
Touchscreen Controller with Manual Gain Adjustment Enabled

Figure 6-89 Manual Gain

Enabling Sector Scan:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) While in Horizontal Scan Mode, touch the **Sector Scan** Button.

3) Touch a button to select a 20°, 40°, 60°, 90°, or touch the **FULL** Button to resume a 120° degree scan.

4) Move the **Joystick** left or right to place the Bearing Line in the desired position. The location of the Bearing Line will become the center point of the Sector Scan.

5) If desired, readjust the Bearing Line as discussed previously to change the center of the Sector Scan.

6) Press the **Joystick** again to remove the bearing selection function of the Joystick.

Figure 6-90 'Weather Radar' Pane on a 60 Degree Sector Scan

ANTENNA STABILIZATION

The automatic antenna stabilization feature uses pitch and roll information to keep the antenna tilt angle setting level with the horizon as the aircraft maneuvers. The system can stabilize the antenna within the mechanical limits of antenna tilt, 30º up an down from the aircraft centerline. High pitch and or roll angles can result in exceedance of the stabilization limits of the antenna.

TURBULENCE DETECTION

The Turbulence Detection feature identifies areas of turbulence associated with precipitation using the color white during a horizontal scan. These white areas represent precipitation moving at a high rate of speed either toward or away from the radar antenna, using Doppler radar measurements. This feature cannot detect areas of Clear Air Turbulence.

The Turbulence Detection feature is only available in Weather Mode while a horizontal scan is selected. The system can detect turbulence up to 40 nm in front of the aircraft. If the system is missing information needed to detect turbulence, a 'TURB Detection Unavailable' annunciation appears on the 'Weather Radar' Pane.

> **WARNING:** Do not rely only on the Turbulence Detection function for hazardous weather avoidance, or to maneuver in near, or around areas of hazardous weather.

Enabling/Disabling Turbulence Detection during a Horizontal Scan:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) To activate or deactivate the turbulence detection feature, touch the **Turbulence Detection** Button. Turbulence detection is enabled when button annunciator is green; turbulence detection is disabled when button annunciator is gray. The system indicates the current turbulence detection feature status in the upper right of the 'Weather Radar' Pane.
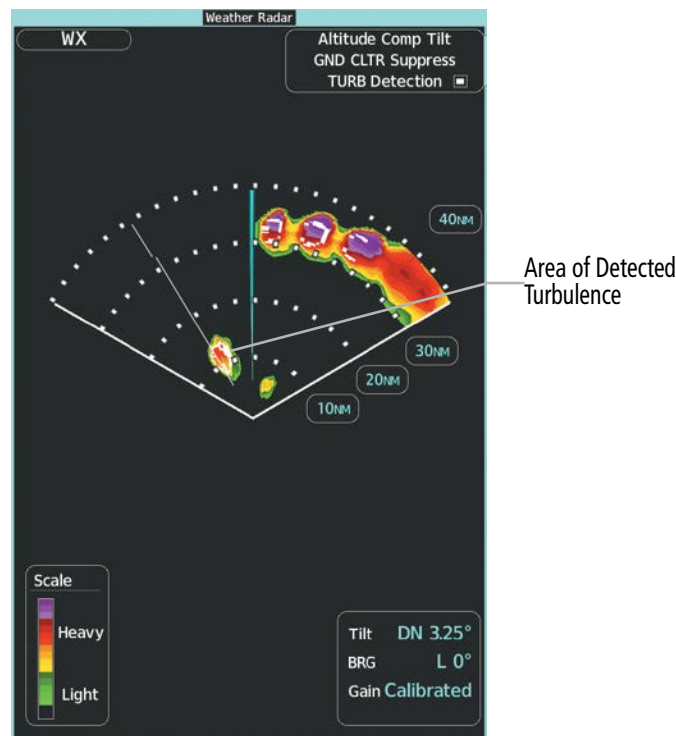
Figure 6-91 Weather Radar Pane displaying Turbulence Detection

Weather Attenuated Color Highlight (WATCH®)

WATCH® identifies deceptively strong or unknown intensity parts of a storm. While in horizontal scan mode, this feature can be used as a tool to determine areas of possible inaccuracies in displayed intensity due to weakening of the radar energy. This weakening is known as attenuation. The radar energy weakens as it passes through areas of intense precipitation, large areas of lesser precipitation, and distance. Issues with the radome attenuates the radar energy. All these factors have an effect on the return intensity. The more energy that dissipates, the lesser the displayed intensity of the return. Accuracy of the displayed intensity of returns located in the shaded areas are suspect. Make maneuvering decisions with this information in mind. Proper antenna tilt management should still be employed to determine the extent of attenuation in a shaded area.

> **NOTE:** *The WATCH feature is also available on the Navigation Map Pane and the HSI Map with the Radar Overlay enabled.*

Enabling/disabling WATCH display feature:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) To activate or deactivate the WATCH feature, touch the **WX Watch** Button.

Figure 6-92 Horizontal Scan with WATCH® Enabled

REMOVING GROUND CLUTTER

The system can distinguish between reflected ground returns (such as terrain features and buildings) and airborne weather phenomena. Ground clutter may be most pronounced when using a low antenna tilt angle, or when approaching mountainous terrain.

The Ground Clutter Suppression (GCS) feature is available in Weather Mode while the weather radar Sector Scan is set to **FULL**. When Ground Clutter Suppression is enabled, the system removes echoes determined to be ground clutter from the display. While viewing a map with GCS enabled, adjustment of the map range or antenna tilt angle momentarily causes the display of ground clutter to return.

> *NOTE: The GCS feature of the airborne weather radar may remove the display of low-intensity precipitation in addition to ground returns when the feature is enabled.*

Enabling/disabling Ground Clutter Suppression:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) To enable or disable the ground clutter suppression feature, touch the **GND Clutter Suppression** Button. Ground clutter suppression is enabled when button annunciator is green; ground clutter suppression is disabled when annunciator is gray.

An annunciation appears in the upper right of the 'Weather Radar' Pane to indicate the status of the GCS feature, such as 'GND CLTR Suppress On'. If GCS is enabled (on), but the weather radar is not receiving data identified as ground clutter, the annunciation 'GND CLTR Suppress Inactive' appears. If the system is missing information needed to determine if radar data meets the criteria for ground clutter, a 'GND CLTR Suppress Unavailable' annunciation appears.

WEATHER ALERT INDICATION AND SYSTEM MESSAGE

The Weather Alert feature indicates the presence of heavy precipitation between the ranges of 80 and 320 NM regardless of the currently displayed radar map range. Weather Alerts s appear as red bands along the outer range ring at the approximate azimuth of the detected returns on the 'Weather Radar' Pane.

If a Weather Alert is detected within ±10° of the aircraft heading, and the **WX Alert** Button is enabled on the 'Weather Radar Settings' Screen, a System Message appears on the Touchscreen Controllers. The red Weather Alert target bands appear on the 'Weather Radar' Pane regardless of whether the **WX Alert** Button is enabled or disabled. The bands do not appear on navigation maps overlays.

If the antenna tilt is adjusted too low, ground returns may also trigger a Weather Alert System Message. To avoid unwanted Weather Alert System Messages, ensure the **WX Alert** Button is disabled (button annunciator is gray.)

Figure 6-93 Weather Alerts on the 'Weather Radar' Pane
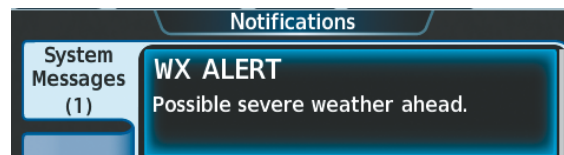
Figure 6-94 WX Alert System Message on the Notifications Screen

Enabling/disabling Weather Alert System Message:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

   Or:

   a) From Home, touch **Map > Map Selection > Map Settings**.

   b) If necessary, touch the **Sensor** Tab.

   c) Touch the Weather Radar **Settings** Button.

2) Touch the **WX Alert** Button in the Features Window. Weather Alert System Message enabled when button annunciator is green, disabled when gray.

> **NOTE:** The **WX Alert** Button enable/disable setting is synchronized on both Touchscreen Controllers.

GROUND MAPPING AND INTERPRETATION

A secondary use of the weather radar system is for the presentation of terrain. This can be a useful tool for verifying aircraft position. A picture of the ground is represented much like a topographical map that can supplement terrain information shown on a navigation map.

Ground Map mode uses a different gain range than Weather mode. Different colors represent the intensity levels. The displayed intensity of ground target returns are defined in the following table. Use of the Gain and Tilt controls help improve contrast so that specific ground targets can be recognized more easily. As previously discussed, the type and orientation of the target in relation to the aircraft affects the intensity displayed.

When the weather radar system is in either the Weather or Ground Map mode, the system automatically switches to Standby mode upon landing.

Ground Map Mode Color	Intensity
Black	0 to 2 dB
Cyan	3 dB to < 13 dB
Yellow	13 dB to less than 21 dB
Magenta	21 dB to less than 29 dB
Blue	29 dB and greater

Table 6-11 Ground Target Return Intensity Levels

Operation in Ground Map Mode:

1) From Home, touch **Weather > Weather Selection > WX RADAR > WX RADAR Settings**.

2) Touch the **Display Mode** Button.

3) Touch the **Map** Button to place the radar in Ground Map mode.

4) Press the **Joystick** to activate the antenna tilt selection function.

5) Use the **Joystick** to select the desired antenna tilt angle.

6) When ground returns are shown at the desired distance, press the **Joystick** to disable the tilt adjustment function of the **Joystick**.
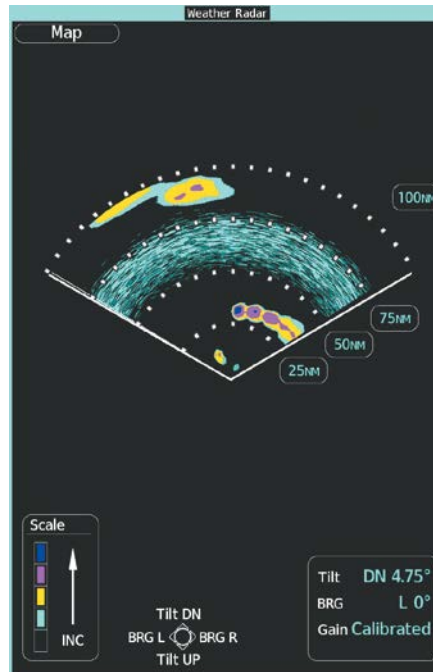
Figure 6-95 'Weather Radar' Pane with Ground Map Mode Enabled

ADDITIONAL RADAR DISPLAYS

> **NOTE:** The NEXRAD weather product cannot be displayed simultaneously on the 'Navigation Map' Pane with weather radar information.

The 'Weather Radar' Pane is the principal map for viewing weather radar information. It is the only map display pane capable of showing information for all airborne weather radar features. Airborne weather radar information is also available as an overlay on the navigation maps (with the exception of the Inset Map) as an additional reference to the 'Weather Radar' Pane. The radar range increases or decreases automatically as the map range increases or decreases. When the pilot initially enables Weather Radar information for a 'Navigation Map' Pane, the system shows the weather radar in Standby mode for that display pane.

The weather radar mode ('Ground', 'Standby', 'Weather') appears in a radar status box on the selected navigation map, in addition to the antenna tilt direction, tilt angle, and radar range. For the HSI Map, the radar status box appears momentarily while the radar range or settings are adjusted on the HSI Map, and then the system declutters the status box from the HSI Map. The radar range increases or decreases as the 'Navigation Map' Pane's range is adjusted using the **Joystick**.

The pilot may enable airborne weather radar information with other map overlays on navigation maps, such as traffic, absolute terrain information, and aviation data. However, relative terrain and data link weather radar (such as NEXRAD) cannot be enabled simultaneously with airborne weather radar information on the same navigation map. If relative terrain or data link radar is enabled, the system automatically disables the airborne weather radar overlay for the selected map.

Enabling/Disabling display of Weather Radar information on 'Navigation Map' Panes:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the Sensor Tab.

3) Touch the **Weather Radar** Button to enable or disable the display of weather radar information on the selected navigation map pane.

4) To access controls for weather radar information on the 'Navigation Map' Pane, touch the Weather Radar **Settings** Button.

Controlling weather radar settings on the 'Navigation Map' Pane is similar to controls on the 'Weather Radar' Pane discussed previously. However, the viewable bearing line and WATCH attenuation features are not available on the 'Navigation Map' Pane. In addition, the Horizontal Scan mode is the only scan mode available on the 'Navigation Map' Pane (Vertical Scan mode remains available on the 'Weather Radar' Pane).

Bearing and antenna tilt angle are adjustable on the 'Navigation Map' Pane.

Adjusting bearing and antenna tilt angle on the 'Navigation Map' Pane (MFD GTC):

1) With the 'Navigation Map' Pane highlighted, push the **Joystick** twice. The Bearing and Tilt Legend appears on the Navigation Map Pane and the Touchscreen Controller shows the Weather Radar Settings Screen.

2) Move the **Joystick** up o down to adjust the antenna tilt as needed. The selected tilt setting appears in the upper right of the pane.

3) Move the **Joystick** left or right to adjust the bearing as needed. The bearing line is not shown on the 'Navigation Map' Pane, however, moving the Joystick during a sector scan adjusts the center.

4) When finished, push the **Joystick** or touch the **Back** Button or the **Home** Button.

If the PFD is in Split Mode and showing the 'Navigation Map' Pane with the weather radar overlay enabled, the on-side Touchscreen Controller can also adjust the bearing and antenna tilt angle.
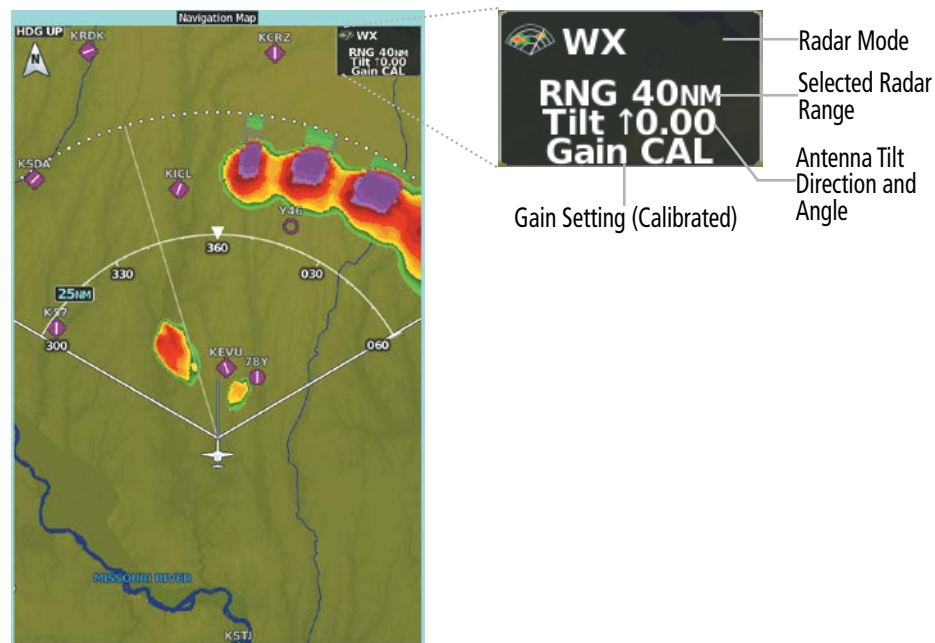
Weather Radar information shown on the 'Navigation Map' Pane
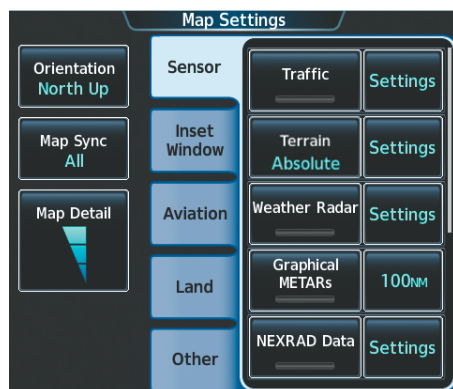
'Map Settings' Screen with Weather Radar on Navigation Maps Enabled
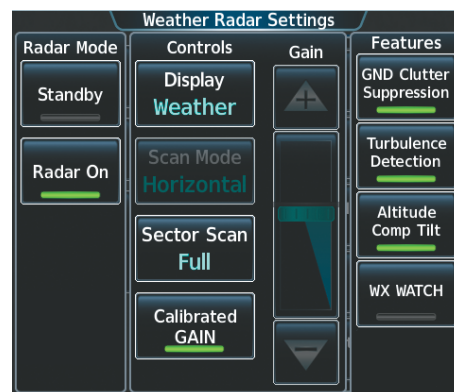
Weather Radar Settings for the Navigation Maps

Figure 6-96 Displaying Weather Radar Information on the 'Navigation Map' Pane

If the aircraft is in the air, PFD Map Settings buttons control the airborne weather radar overlay for the HSI Map. These buttons are subdued if the aircraft is on the ground. The pilot and copilot can select a weather radar mode for each PFD (Standby, Weather, Ground), make adjustments to antenna gain, antenna tilt angle, or Altitude Compensated Tilt features. Weather radar settings on the HSI Map are independent for each PFD. For example, the pilot's PFD may have Weather Mode selected while the copilot's PFD may have Ground Mode selected. The installed weather radar performs multiple scans as necessary to accommodate displays of weather radar data among the PFDs and MFD.

The HSI weather radar overlay uses the same colors as those shown on the 'Weather Radar' Pane to indicate the intensity of radar returns. Because data link radar precipitation and relative terrain present information using similar colors, enabling the airborne weather radar overlay on the navigation maps disables the display of the data link radar and relative terrain information for this pane.
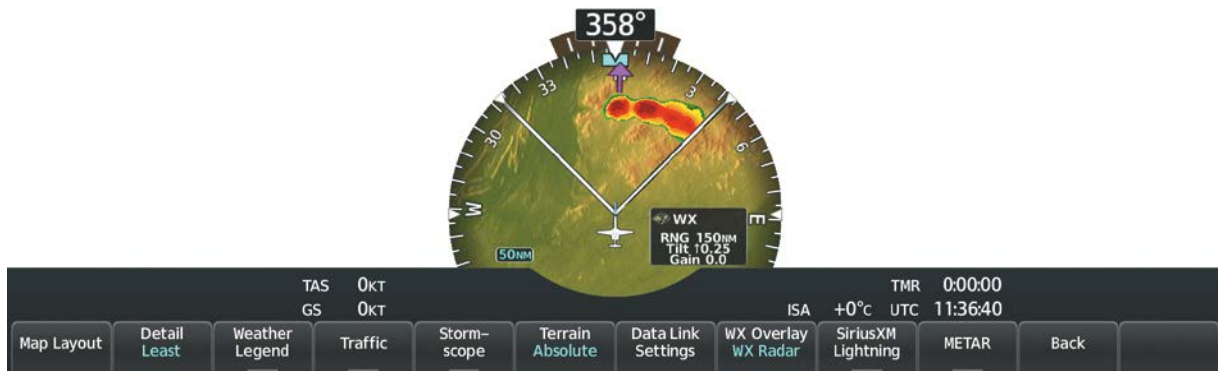
Figure 6-97 HSI Map with Airborne Weather Radar Overlay

Enabling/disabling the weather radar map overlay on the HSI Map:

1) With the HSI Map enabled, press the **PFD Map Settings** Softkey.

2) Press the **WX Overlay** Softkey as needed to cycle among the options (Off, SiriusXM) until 'WX Radar' appears on the softkey.

Selecting weather radar Standby or On Mode on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) To select between 'Standby' or 'On' Modes, press the **Mode** Softkey.

Selecting weather radar Weather or Ground (Map) Mode on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) To select between 'Weather' and 'Map' Modes, press the **Display** Softkey to cycle among the options until 'Map' appears on the softkey.

Adjusting the antenna tilt angle on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press either the **Tilt Up** or **Tilt Down** Softkey to adjust the antenna tilt angle in the respective direction. The current antenna tilt angle setting appears on the HSI Map.

Adjusting weather radar gain on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press the **Gain +** or **Gain -** Softkeys to adjust the gain setting. Each softkey press adjusts the gain in 0.5 increments.

Enabling/disabling Ground Clutter Suppression on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press the **GND Clutter Suppression** Softkey to enable/disable Ground Clutter Suppression.

Enabling/disabling Turbulence Detection on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press the **Features** Softkey.

3) Press the **Turbulence Detection** Softkey to enable/disable **Turbulence Detection** feature.

Enabling/disabling Altitude Compensated Tilt on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press the **Features** Softkey.

4) Press the **Altitude COMP Tilt** Softkey to enable/disable the **Altitude Compensated Tilt** feature.

Enabling/disabling Weather Attenuated Color Highlight (WATCH®) on the HSI Map:

1) With the weather radar in the 'On' Mode on the HSI Map, press the **WX Radar Controls** Softkey.

2) Press the **Features** Softkey.

4) Press the **WX WATCH** Softkey to enable/disable the **Weather Watch** feature.

SYSTEM STATUS

The system displays the radar mode annunciation in the upper left corner of the 'Weather Radar' Pane. Additional information may be displayed in the center of the 'Weather Radar' Pane as a center banner annunciation. Refer to the following tables for a list of annunciations and their locations for airborne weather radar.
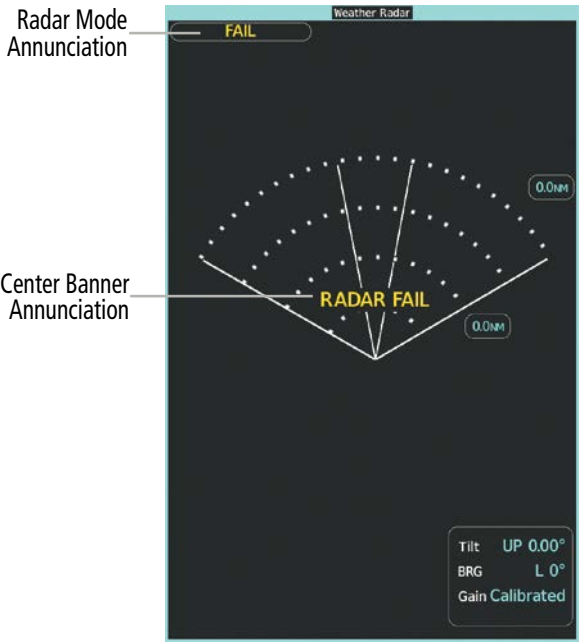
Figure 6-98 Radar System Status Indications on 'Weather Radar' Pane

Radar Mode	Radar Mode Annunciation Box	Center Banner Annunciation
Standby	**Standby**	**STANDBY**
Weather	**WX**	None
Ground Mapping	**Map**	None
Radar Failed [1]	**FAIL**	**RADAR FAIL**

[1] *See Table 6-13 for additional failure annunciations.*

Table 6-12 Radar Modes on the 'Weather Radar' Pane

NOTE: *If the 'RADAR FAIL' annunciation persists, the system should be serviced.*

The system displays the status of the weather radar features in the upper-right corner of the 'Weather Radar' Pane.

Radar Feature Status	Description
STAB INOP	The radar is not receiving pitch and roll information. The antenna stabilization feature is inoperative.
ALTITUDE COMP TILT	The altitude-compensated tilt feature is selected on.
GND CLTR SUPPRESS	The ground clutter suppression feature is selected on.
GND CLTR SUPPRESS INACTIVE	The ground clutter suppression feature is enabled, but the radar is in a mode which cannot support ground clutter suppression (e.g. vertical scan or sector scan).
GND CLTR SUPPRESS UNAVAILABLE	The radar is missing data needed to suppress ground clutter.
TURB DETECTION ▣	The turbulence detection feature is selected on.
TURB DETECTION INACTIVE	Turbulence detection is inactive when the radar is in a mode which cannot support turbulence detection.
TURB DETECTION UNAVAILABLE	The radar is missing data needed to detect turbulence.

Table 6-13 Radar Feature Status Annunciations on the 'Weather Radar' Pane

If the radar unit fails, an annunciation as to the cause of the failure is shown as a banner in the center of the 'Weather Radar' Pane.

Weather Radar Pane Center Banner Annunciation	Description
BAD CONFIG	The radar configuration is invalid. The radar should be serviced.
RDR FAULT	The radar unit is reporting a fault. The radar should be serviced.
RADAR FAIL	The system is not receiving valid data from the radar unit. The system should be serviced.

Table 6-14 Abnormal Radar Status Annunciations on the 'Weather Radar' Pane

6.4 REACTIVE WINDSHEAR DETECTION

> ⚠️ **WARNING:** *Do not rely on information from the reactive windshear detection system display as the sole basis for detecting windshear conditions. The system cannot predict the conditions in which windshear is likely to develop.*

The Reactive Windshear Detection system contributes to flight safety by providing the flight crew with caution or warning alerts while the aircraft is encountering conditions associated with the presence of windshear. This airborne system is active when the aircraft is operating between 50 and 1000 feet above ground level, as determined by the radar altimeter. It does not predict or scan ahead of the aircraft's position to determine when windshear may occur, nor does it provide windshear escape guidance maneuvers.

The Reactive Windshear detection system requires the following information from sensors in order to calculate the effects of windshear conditions on aircraft performance and to issue alerts:

- True Airspeed
- Angle of Attack
- Pitch
- Roll
- Heading

- Groundspeed
- Vertical Speed
- Track Angle
- Height above ground (Radar Altimeter, when available, or GPS-GSL altitude)

WINDSHEAR ALERTING

The system issues either a caution or warning windshear alert, and may issue both during a windshear encounter (though not simultaneously). The type of alert issued is dependent on how greatly the windshear is affecting the aircraft's performance.

A windshear caution alert provides crew awareness of likely windshear conditions as the aircraft performance is increasing or decreasing. This may be due to an updraft, increasing headwind, or decreasing tailwind. A windshear caution alert is accompanied by an amber 'WINDSHEAR' caution annunciation on the PFDs, and a single *'Caution, Windshear'* voice alert. The system displays a windshear caution annunciation for at least three seconds, or until a windshear warning alert occurs. The windshear caution alert indicates subsequent corrective action from the flight crew may be necessary.

A windshear warning alert notifies the crew of the presence of likely windshear conditions as the aircraft performance is decreasing, for immediate corrective action. A windshear warning alert is accompanied by a red 'WINDSHEAR' annunciation on the PFDs, and a *'Windshear, Windshear, Windshear'* voice alert. The system displays a windshear warning alert annunciation for at least three seconds.
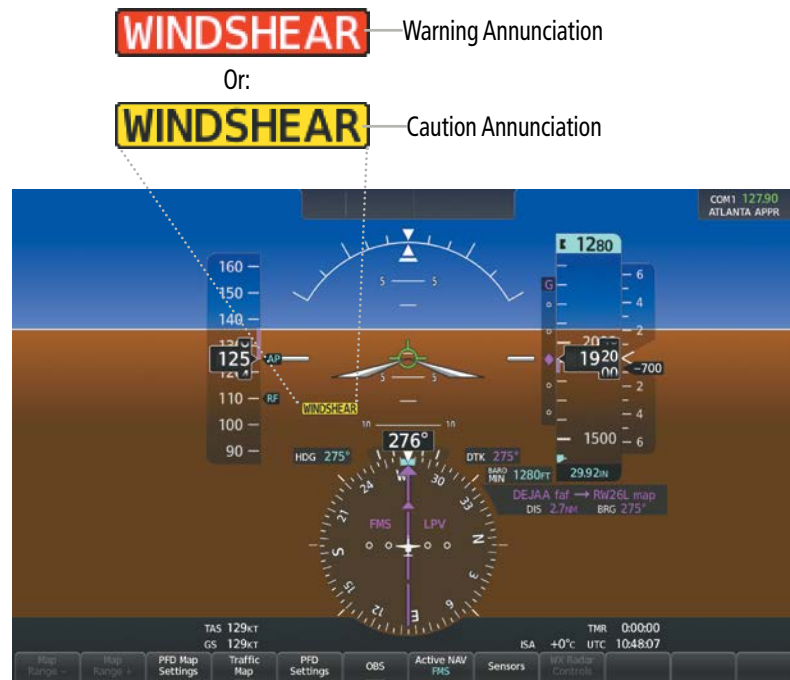
Figure 6-99 Windshear Annunciation on the PFD

SYSTEM TEST

During power application, the system automatically conducts a test of the Reactive Windshear system. During the test a '**WNDSHR TEST**' annunciation is displayed on both PFD's. When the system test is complete the '**WNDSHR TEST**' annunciation is removed.

If the system test fails, or if the system can no longer perform windshear alerting functions, a 'WINDSHEAR FAIL' annunciation CAS message appears on the PFDs, and a '**WINDSHEAR** Unavailable: Invalid Inputs.' System Message will appear on the Touchscreen Controllers indicating the Reactive Windshear Detection System is unavailable.

Figure 6-100 Windshear Detection System Test Annunciated on the PFD

REACTIVE WINDSHEAR ANNUNCIATIONS

Alert Type	PFD Annunciation	Voice Alert
Caution	WINDSHEAR	"Caution, Windshear"
Warning	WINDSHEAR	" Windshear, Windshear, Windshear"
Test	WNDSHR TEST	None

Table 6-15 Reactive Windshear Alert Annunciations

6.5 STORMSCOPE LIGHTNING

⚠️ **WARNING:** *Do not rely on information from a lightning detection system display as the sole basis for hazardous weather avoidance. Range limitations and interference may cause the system to display inaccurate or incomplete information. Refer to documentation from the lightning detection system manufacturer for detailed information about the system.*

✅ **NOTE:** *Stormscope® lightning information cannot be displayed simultaneously with data link lightning weather products on the same map.*

The system can display the optional L-3 WX-500 or WX-1000E Stormscope lightning detection systems display lightning cell and strike information on the 'Stormscope®' Pane and navigation maps using the symbology shown in the table below.

Lightning Age	Symbol
Strike is less than 6 seconds old	⚡
Strike is between 6 and 60 seconds old	⚡
Strike is between 1 and 2 minutes old	✚
Strike is between 2 and 3 minutes old	✚

Table 6-16 Lightning Age and Symbols (WX-500)

Lightning Cell Symbol	Intensity	Approximate Strikes Per Minute
⚡	Light	Up to 8
⚡	Moderate	9 to 25
⚡	Heavy	26 or more

Table 6-17 Lightning Cell Symbols and Intensity Information (WX-1000E)

USING THE STORMSCOPE PANE

The 'Stormscope®' Pane shows lightning information in relation to the aircraft's current location, with simplified map details to reduce clutter and to allow for easier identification of lightning cells and strikes. It is the principal map pane for viewing Stormscope lightning information. The 'Stormscope®' Pane map orientation is heading up, with an arrow pointing North, unless there is no valid heading. The 'Stormscope®' Pane displays the selected Stormscope operating mode and lightning strike rate in the upper right corner of the pane. The selected map range appears in cyan a box on the range arc. The 'Stormscope®' Pane also displays the active flight plan, when one exists.
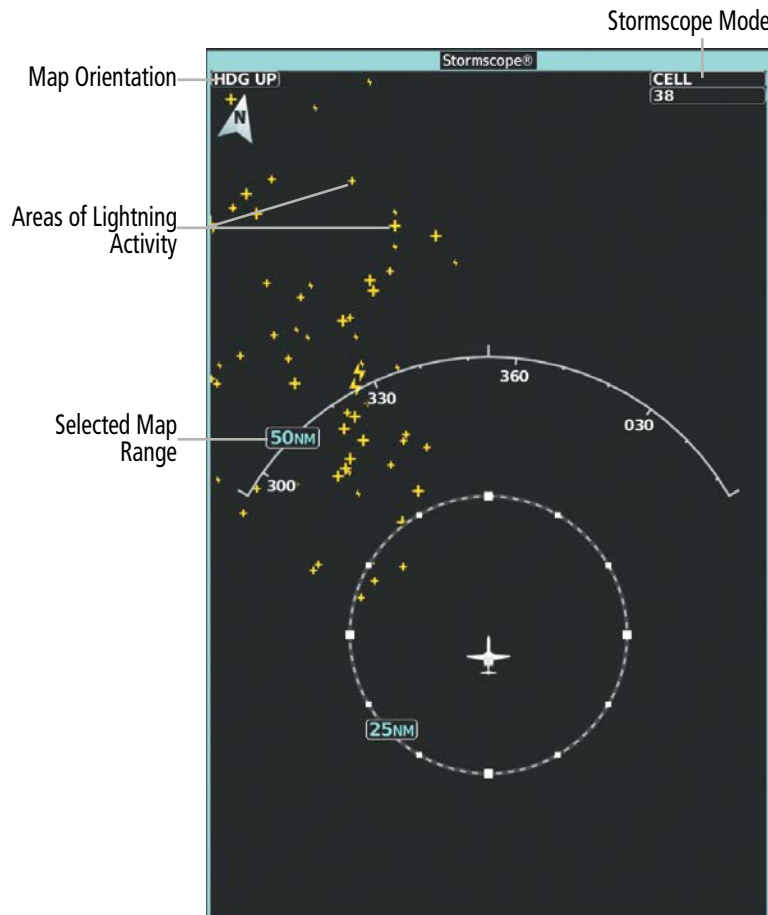
'Stormscope®' Pane

Stormscope Settings Screen for the 'Stormscope®' Pane

Figure 6-101 Displaying Stormscope Lightning on the 'Stormscope®' Pane (WX-500)

Displaying the 'Stormscope®' Pane:

From Home, touch **Weather > Weather Selection > Stormscope**.

Selecting a Stormscope Operating Mode on the 'Stormscope®' Pane:

1) From Home, touch **Weather > Weather Selection > Stormscope > Stormscope Settings.**

2) Touch either the **Cell** Button or the **Strike** Button. Button annunciator is green for currently selected mode.

Figure 6-102 'Weather Selection' Screen

The **Joystick** on the Touchscreen Controller controls the map range shown on the 'Stormscope®' Pane. Turn the **Joystick** clockwise to increase the map range shown, or counter-clockwise to decrease the map range. Map ranges of 25 NM to 200 NM are available.

The flight crew can manually clear previous lightning cells or strikes on the Stormscope Settings® Screen on the Touchscreen Controller. Clearing the Stormscope pane removes any previously displayed cell or lightning strike information from the 'Stormscope' pane. Clearing lightning information affects all maps or display panes showing Stormscope lightning.

Clearing Stormscope Information:

1) From Home, touch **Weather > Weather Selection > Stormscope > Stormscope Settings**.

    Or:

    a) From Home, touch **Map > Map Selection > Map Settings**.

    b) If necessary, touch the **Sensor** Tab.

    c) Scroll and touch the Stormscope Lightning **Settings** Button.

2) Touch the **Clear Stormscope Lightning** Button.

STORMSCOPE INFORMATION ON NAVIGATION MAPS

Stormscope lightning information is available as an overlay on navigation maps. When the Stormscope overlay is enabled, and the map range is within maximum range setting to display Stormscope lightning, an icon appears in the lower right corner of the map.

Enabling/disabling Stormscope information on the Inset Map or HSI Map:

1) With the Inset Map or HSI Map displayed, press the **PFD Map Settings** Softkey.

2) Press the **Stormscope** Softkey.

Enabling/disabling Stormscope information on 'Navigation Map' Panes:

1) From **Home**, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the **Stormscope Lightning** Button.

Stormscope Navigation Map Overlay Enabled Icon
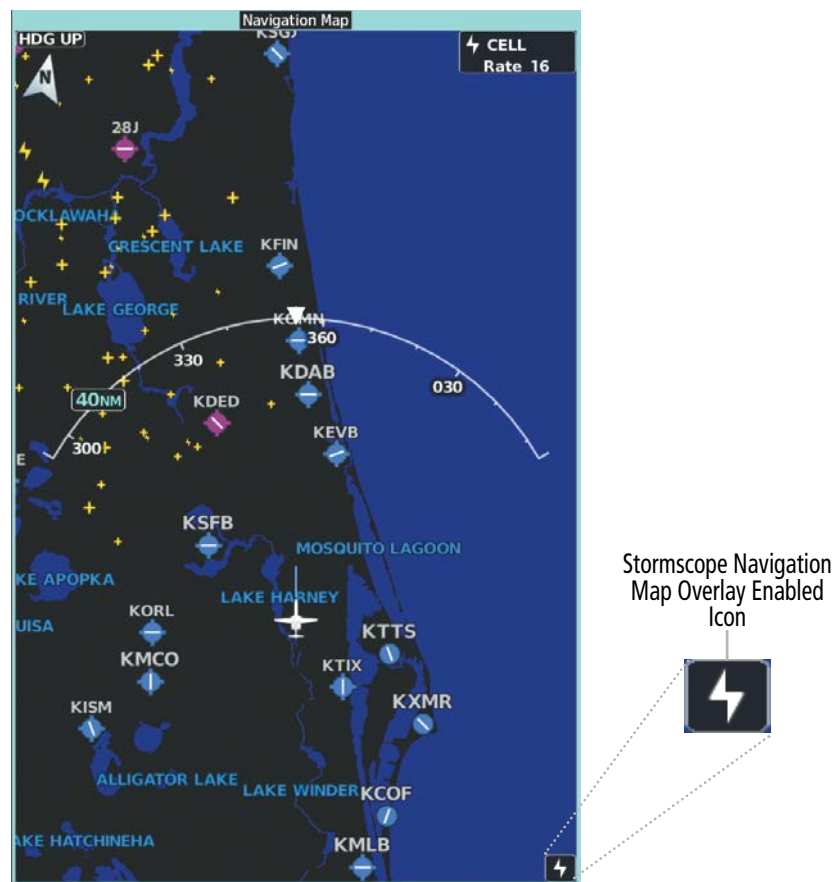
Figure 6-103 Stormscope Information on the 'Navigation Map' Pane (WX-500)

Selecting a maximum Stormscope map range on the 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Scroll as needed and touch the Stormscope Lightning **Settings** Button.

4) Touch the **Stormscope** Button.

5) Touch the Stormscope range button (current range setting displayed in cyan).

6) Scroll as needed and touch a desired map range setting from the list.

ABNORMAL OPERATIONS

If heading input is lost, strikes and/or cells must be cleared manually after the execution of each turn. This is to ensure the strike and/or cell positions are depicted accurately in relation to the nose of the aircraft. Refer to the procedure 'Clearing Stormscope Information', discussed earlier in this section, for more information.

SYSTEM STATUS

If the Stormscope system detects a failure, an amber 'STORMSCOPE FAILED' banner annunciation appears in the center of the 'Stormscope®' Pane. A system message appears on the Touchscreen Controllers; refer to the Appendices for more information about System Messages. If the Stormscope map overlay is enabled on a navigation map, the Stormscope overlay icon displays with a white 'X'.
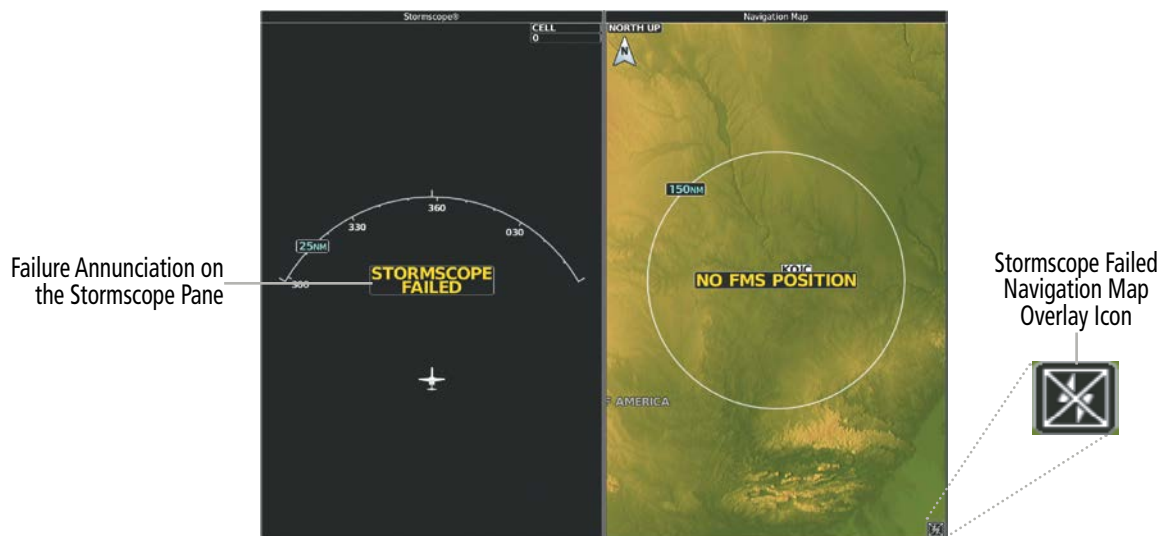
Figure 6-104 Stormscope Failure Indications on Display Panes

6.6 VERTICAL SITUATION DISPLAY TERRAIN

The system offers a Vertical Situation Display (VSD), which includes a profile of terrain and obstacles in an inset window on the bottom of the 'Navigation Map' Pane. Although the VSD does not display TAWS alerts and potential impact areas, the VSD does use many of the same colors and symbols as TAWS to depict relative terrain and obstacles within the VSD. Refer to the TAWS discussion for more information about relative terrain and obstacle color correlation and symbols.

> **NOTE:** Only one inset window may be shown per display pane. If another inset window is selected, it replaces the previously selected inset window.

> **NOTE:** Individual obstacles may be depicted more than once on the VSD. This can occur, for example, during turns as the projected path in front of the aircraft changes.

Enabling/disabling VSD Inset Window:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Inset Window** Tab.

3) Touch the **VERT Situation Display** Button to enable/disable the VSD Inset Window.
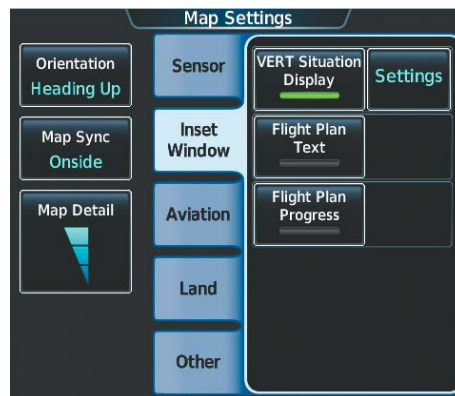
Figure 6-105 Enabling Vertical Situation Display Inset Window on the Map Settings Screen

The same controls which enable/disable the display of relative terrain and obstacles on the 'Navigation Map' Pane also control the display of this information in the VSD.

Enabling/disabling Relative Terrain information in the VSD and 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the **Terrain** Button.

4) Touch the **Relative** Button to enable the display of Relative Terrain information on the 'Navigation Map' Pane and VSD, or touch the **Off** Button to remove this information.

Figure 6-106 Enabling Relative Terrain for the Profile View Inset Window and Navigation Map Pane

Enabling/disabling Obstacle information in the VSD and 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Land** Tab.

3) Touch the **Point Obstacle** Button to enable the display of Obstacle information on the 'Navigation Map' Pane and VSD, or touch the **Off** Button to remove this information.

> **NOTE:** In some cases, the VSD may not automatically update. If the message 'VSD Data is old, disable and enable VSD' appears, refer to the previous procedure to disable/enable VSD to update the VSD.
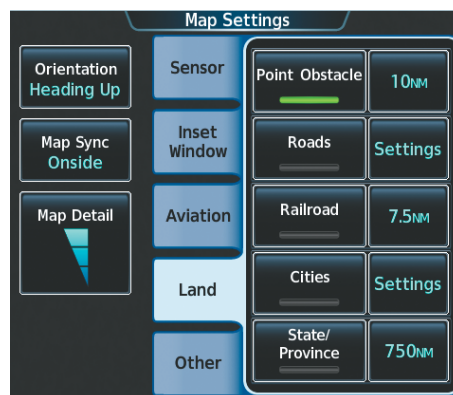
Figure 6-107 Enabling Obstacle information for the VSD and Navigation Map Pane

When enabled, terrain and obstacles on the VSD will be shown if the aircraft altitude is low enough or the VSD altitude range is high enough for the terrain to be in view. The terrain colors shown on the VSD are the same as the colors shown on the 'Navigation Map' Pane, except terrain depicted as black on the 'Navigation Map' Pane is shown as gray on the VSD.

The depicted terrain profile represents an approximate forward-looking contour of the terrain based upon the highest reported terrain elevations, measured at intervals defined by the terrain database resolution, within a predefined width along the active flight plan or aircraft track (depending on the mode selected by the flight crew) between the aircraft present position and the end of the map range or active flight plan. The predefined width is twice the RNP value displayed on the HSI, measured in nautical miles.

The forward looking swath of terrain is based on the selected VSD Mode, annunciated in the top-left corner of the VSD Inset Window. In Flight Plan Mode, the contour follows the active flight plan, and if no active flight plan is present, the VSD Inset Window displays 'Flight Plan Not Available'. In Track Mode, the contour is based on the aircraft ground track. In Auto Mode, the contour is based on the active flight plan, when available, otherwise, it is based on the ground track.

VSD Mode Selected	Annunciation
Flight Plan	FPL
Track	TRK
Auto	AUTO FPL or AUTO TRK

Changing the Vertical Situation Display Mode:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) Touch the **Inset Window** Tab

3) Touch the VERT Situation Display **Settings** Button.

4) Touch the **Mode** Button.

5) Touch one of the following buttons to select a mode:

- **Auto:** VSD automatically selects either Flight Plan Mode or Track Mode. Flight Plan Mode is selected when the aircraft is within the RNP value of the active flight plan leg. Otherwise, Track Mode is selected.

- **Flight Plan:** VSD shows terrain along the active flight plan route. VSD is unavailable if there is no active flight plan.

- **Track:** VSD shows terrain along the current track.

6) When finished, touch the **Back** Button or the **Home** Button.

VSD INSET WINDOW

The VSD Inset Window appears below the Navigation Map. Aircraft altitude appears along a vertical scale, with an aircraft icon positioned at the current altitude. Distance is represented horizontally along the bottom of the Inset Window, and increases from left (present position) to right.

The horizontal distance is the same as the Navigation Map Pane Range distance displayed on the map range arc or circle when in Track Mode. When in Flight Plan Mode, the distance displayed is 2x that shown on the map range arc or circle. Adjusting the map range with the **Joystick** or **Touchpad** also adjusts the VSD horizontal and vertical distance accordingly. At map ranges below 1 nm or when the FMS position is unavailable (the system displays "VSD Not Available").
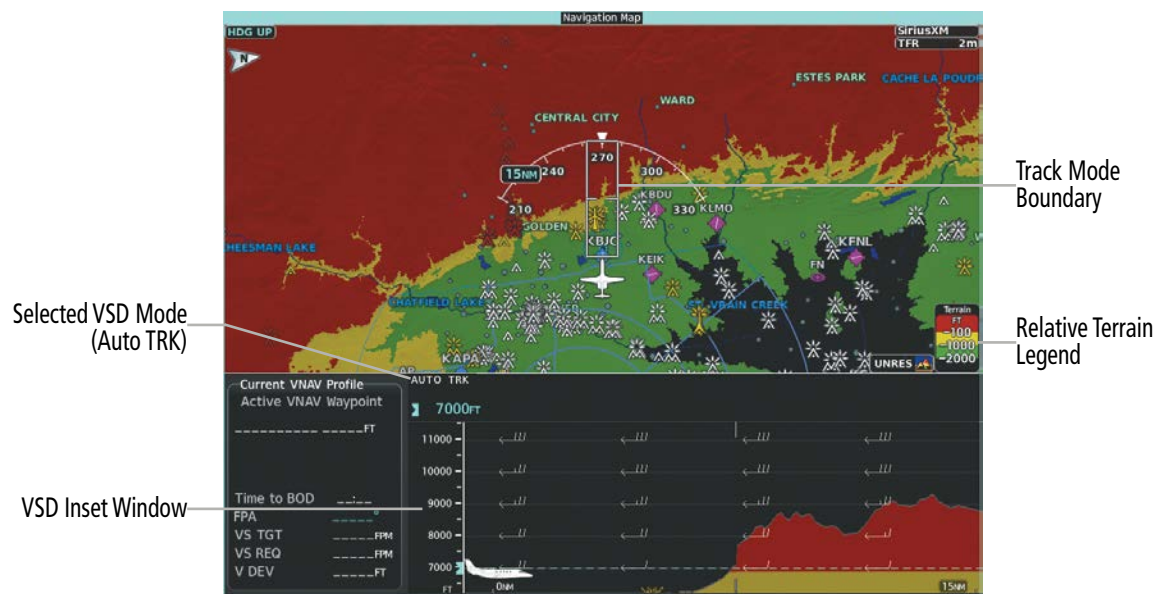
Figure 6-108 'Navigation Map' Pane with VSD Inset Window and Relative Terrain Enabled

TRACK MODE BOUNDARY

The Track Mode Boundary displays the horizontal and lateral boundaries of the information shown in the VSD. The boundary is a white rectangle on the Navigation Map Pane and is only available when the VSD is operating in Track Mode. The two white range references inside the boundary rectangle match the range references along the distance scale inside the VSD whenever the profile range is at least five nm.

The Track Mode Boundary rectangle may be enabled or disabled, and the 'Navigation Map' Pane range at which the Track Mode Boundary rectangle is removed from 'Navigation Map' Pane can be changed.

Figure 6-109 Customizing the Track Mode Boundary Navigation Maximum Map Range

Enabling/disabling the Track Mode Boundary:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Inset Window** Tab.

3) Touch the VERT Situation Display **Settings** Button.

4) If the **Track Mode Boundary** Button is subdued, it will be necessary to change the Mode to either Auto or Track before continuing to the next step; refer to the procedure 'Changing the VSD Mode' for more information.

5) Touch the **Track Mode Boundary** Button to enable/disable the display of the boundary on the Navigation Map Pane.

6) Touch the Track Mode Boundary range button.

7) Scroll as needed and touch a button for the desired maximum 'Navigation Map' Pane range for the system to display the Profile Boundary (above this selection, the system will remove the Profile Boundary from the pane.).

8) When finished, touch the **Back** Button or the **Home** Button.

6.7 TAWS-A

⚠️ **WARNING:** *Do not use TAWS information for primary terrain or obstacle avoidance. TAWS is intended only to enhance situational awareness.*

✓ **NOTE:** *Government agencies provide data for the TAWS databases. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

✓ **NOTE:** *Terrain or obstacle information is not available if the aircraft is outside of the installed terrain or obstacle database coverage area.*

✓ **NOTE:** *The TAWS system may not operate reliably north of 89° North latitude and south of 89° South latitude. This is due to limitations present within the Terrain database and the system's ability to process the data representing the affected areas.*

✓ **NOTE:** *TAWS auto-zoom does not always zoom to the highest priority FLTA potential impact point when a higher priority alert is also in progress. The flight crew can manually set the map zoom range to an appropriate scale to estimate the range/bearing to the potential impact point.*

TAWS-A (Terrain Awareness and Warning System - Class A) is a feature that provides increased situational awareness and aids in reducing controlled flight into terrain (CFIT) and obstacles. TAWS-A provides visual annunciations and voice alerts when terrain and obstacles are within the given altitude threshold from the aircraft.

TAWS-A satisfies TSO-C151b Class A and TSO-92c requirements for certification.

TAWS-A requires information from the following sources:

- A valid terrain and obstacle database.
- A valid 3-D GPS position solution.
- Valid flap and landing gear status inputs.
- A valid radar altimeter.

TAWS-A uses terrain and obstacle information supplied by government sources. Terrain information is based on terrain elevation information in a database that may contain inaccuracies. Individual obstructions may be shown if present in the database. Garmin verifies the data, per TSO-C151b. However, the displayed information should never be understood as being all-inclusive and the data may be still contain inaccuracies.

TAWS-A uses information from the GPS receiver to provide a horizontal position and altitude, along with additional altitude input from the radar altimeter, when radar altitude is available. GPS altitude is derived from satellite measurements. GPS altitude is then converted to a height above geodetic sea level (GSL), which is the height above mean seal level (MSL) calculated geometrically. GSL altitude accuracy is affected by factors such as satellite geometry, but it is not subject to variations in pressure and temperature that normally affect pressure altitude devices. GSL altitude does not require local altimeter settings to determine MSL altitude. Therefore, GSL altitude provides a highly accurate and reliable altitude to calculate terrain and obstacle alerts.

The terrain and obstacle databases are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, the system displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the system uses GPS position and GSL altitude to calculate and project the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, TAWS-A can provide advanced alerts of predicted dangerous terrain and obstacle conditions.

TAWS-A incorporates radar altimeter input with the GSL altitude to provide enhanced accuracy when at lower altitudes for certain alert types, and to retain a level of ground proximity warning capability in the event of a terrain or obstacle database failure, or loss of GPS position.

Baro-corrected altitude (or indicated altitude) is derived by adjusting the altimeter setting for local atmospheric conditions. The most accurate baro-corrected altitude can be achieved by frequently updating the altimeter setting to the nearest reporting station along the flight path. However, because actual atmospheric conditions seldom match the standard conditions defined by the International Standard Atmosphere (ISA) model (where pressure, temperature, and lapse rates have fixed values), it is common for the baro-corrected altitude (as read from the altimeter) to differ from the displayed GPS-GSL altitude. This variation results in the aircraft's true altitude differing from the baro-corrected altitude.

TAWS-A provides the following types of alerts:

Forward Looking Terrain Avoidance (FLTA) Alerting, which consists of:

• Required Terrain Clearance (RTC) / Required Obstacle Clearance (ROC) Alerting.
• Imminent Terrain Impact (ITI) / Imminent Obstacle Impact (IOI) Alerting.
• Premature Descent Alerting (PDA).

Ground Proximity Warning System (GPWS) Alerting, which consists of:

• Excessive Descent Rate (EDR) Alerting.
• Excessive Closure Rate (ECR) to Terrain Alerting.
• Flight Into Terrain (FIT) Alerting.
• Negative Climb Rate (NCR) after takeoff Alerting.
• Excessive below Glideslope/Glidepath Deviation (GSD) Alerting.
• Altitude Voice Call Out (VCO) Alerting.

RELATIVE TERRAIN SYMBOLOGY

TAWS-A uses colors and symbols to represent terrain and obstacles (with heights greater than 200 feet above ground level, AGL) present in the databases relative to aircraft altitude. The system dynamically adjusts these colors as the aircraft altitude changes, and after takeoff and landing.

While the aircraft is on the ground, the system displays relative terrain 400 feet or more above the aircraft altitude using red, and terrain at less than 400 feet above aircraft altitude using black, as shown on the TAWS On-Ground Legend shown in Figure 6-110. When the aircraft is in the air, the system displays relative terrain information using red, yellow, green, and black, as shown on the TAWS In-Air Legend shown in Figure 6-110. As the aircraft transitions from on-ground to in-air, or from in-air to on-ground, the display of relative terrain momentarily fades into the corresponding colors. If any type of TAWS/GPWS alert occurs, the relative terrain colors transition to the TAWS In-Air Legend if in the TAWS On-Ground Legend was shown in order to provide the flight crew with the most information possible.

TAWS On-Ground Legend   TAWS In-Air Legend

Figure 6-110 TAWS Relative Terrain Legends

During an alert, the system shows potential impact areas over terrain or obstacles using bright yellow (caution) or bright red (warning) on navigation maps and on the 'TAWS' Pane.

The colors and symbols in Figure 6-111 and Tables 6-18, 6-19, and 6-20 represent terrain, obstacles, and potential impact areas.
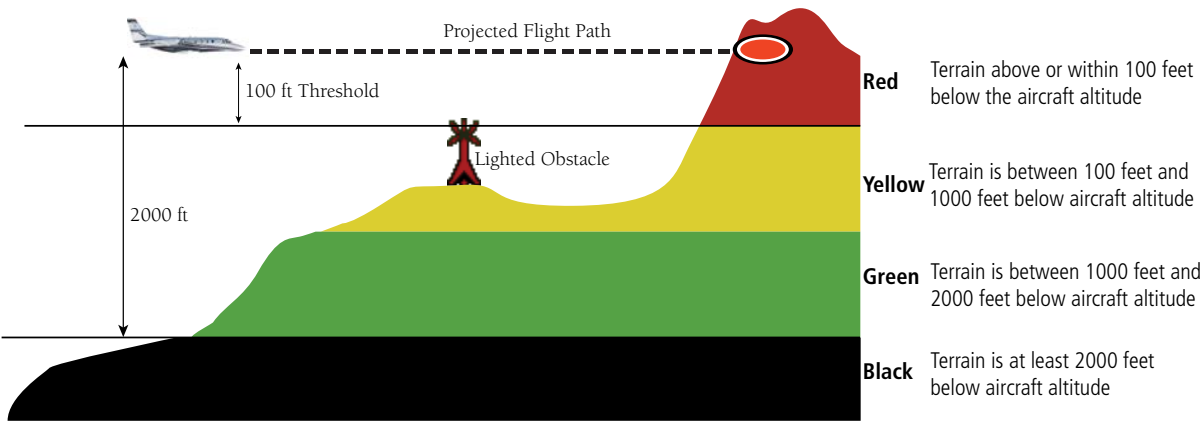
Figure 6-111 In-Air Terrain Altitude/Color Correlation for TAWS

Unlighted Obstacle		Lighted Obstacle		Obstacle Location
< 1000' AGL	> 1000' AGL	< 1000' AGL	> 1000' AGL	
				Red obstacle is above or within 100 ft below the aircraft altitude.
				Yellow obstacle is between 100 ft and 1000 ft below the aircraft altitude.
				White obstacle is more than 1000 ft below aircraft altitude.

Table 6-18 TAWS Relative Obstacle Symbols and Colors

Potential Impact Area Examples	Alert Type	Example Annunciation
or	Warning	PULL UP
or	Caution	TERRAIN

Table 6-19 TAWS Potential Impact Point Areas with Annunciations

Unlighted Wind Turbine Obstacle	Lighted Wind Turbine Obstacle	Wind Turbine Obstacle Location
		Red obstacle is above or within 100 ft below the aircraft altitude.
		Yellow obstacle is between 100 ft and 1000 ft below the aircraft altitude.
		White obstacle is more than 1000 ft below aircraft altitude.

Table 6-20 Wind Turbine Obstacles and Colors

DISPLAYING RELATIVE TERRAIN INFORMATION

The 'TAWS' Pane is the principal map pane for viewing relative terrain information. Relative Terrain information is also available for display on navigation maps.

TAWS PANE

The 'TAWS' Pane shows terrain, obstacle, and potential impact area information in relation to the aircraft's current altitude, without clutter from the basemap. If terrain or obstacles and the projected flight path of the aircraft intersect, the system automatically adjusts the map range if necessary to emphasize the display of the potential impact area(s).

Aircraft orientation on the 'TAWS' Pane is heading up unless there is no valid heading. A box on the map range arc indicates the selected map range. Turn the **Joystick** clockwise to increase the map range, or counter-clockwise to decrease the map range.

The 'TAWS' Pane also displays annunciations in the lower-left corner of the pane, in addition to banner annunciations in the center of the pane.

NOTE: *TAWS auto zoom does not always zoom to the highest priority FLTA potential impact point when a higher priority alert (Excessive Descent Rate or Excessive Closure Rate Warning) is also in progress.*

Showing the TAWS Pane:

From Home, touch the **TAWS** Button.

The TAWS Pane can also show aviation information such as airports, VORs, NDBs, and intersections for additional reference, using the map settings chosen for the 'Navigation Map' Pane.

Enabling/disabling aviation data on the TAWS Pane:

1) From Home, touch **TAWS** > **TAWS Settings**.

2) Touch the **Show Aviation Data** Button to display/remove aviation data (including airports, VORs, NDBs, Intersections) on the 'TAWS' Pane.

NOTE: *When the TAWS Setting 'Hide Aviation Data' option is selected, runways will still be depicted at map range settings below 5NM.*
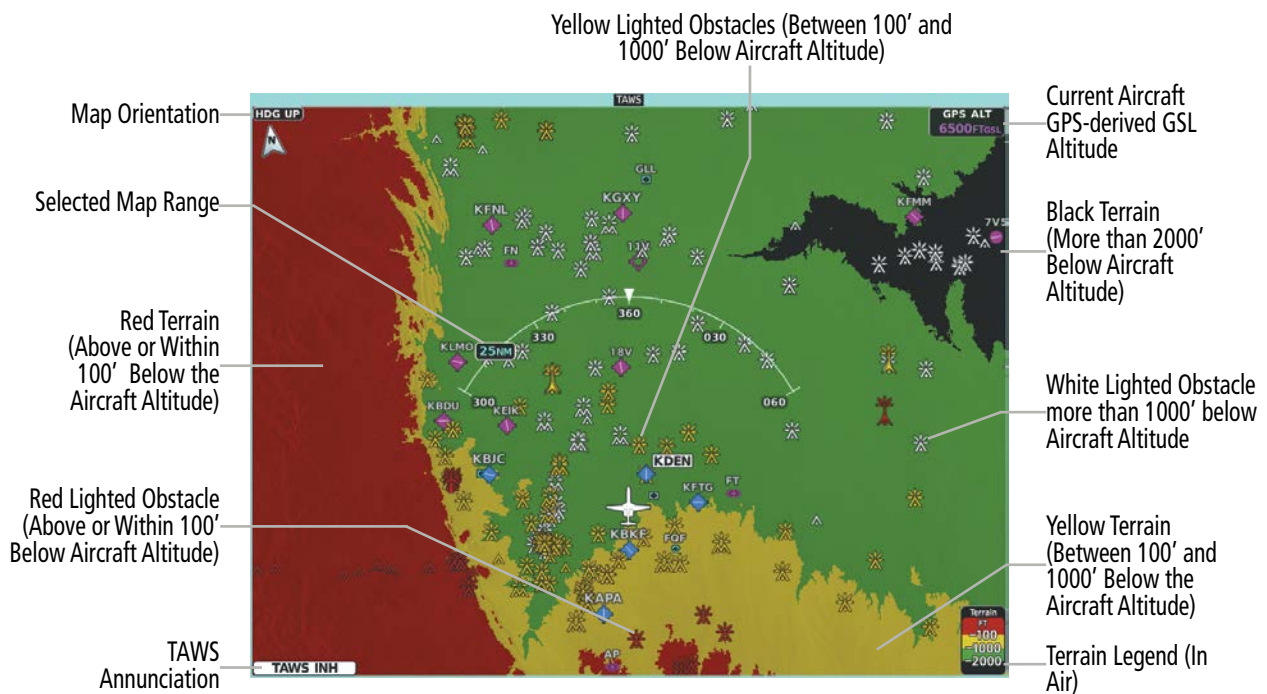
Figure 6-112 'TAWS' Pane with Aircraft in the Air (TAWS-A)
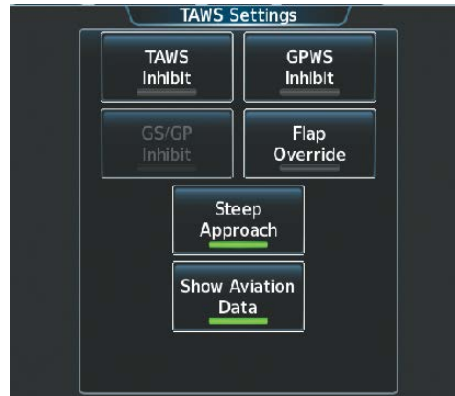
Figure 6-113 TAWS Settings Screen (TAWS-A)

RELATIVE TERRAIN ON THE NAVIGATION MAPS

TAWS provides relative terrain information for the navigation maps. This includes the display of relative terrain, obstacles, and potential impact areas. When relative terrain information is enabled on a navigation map, the system displays a TAWS icon and legend (with the exception of the Inset Map, which displays the icon without the legend). If TAWS is not available or has failed, a white 'X' appears over the TAWS Icon. If the system calculates a potential impact area, it appears on any navigation map, independent of whether relative terrain information is enabled/disabled.

Enabling/disabling relative terrain information (PFD Maps):

1) On the PFD, press the **PFD Map Settings** Softkey.

2) Press the **Terrain** Softkey.

3) Press the **Terrain** Softkey until '**Relative'** is displayed, continue pressing the **Terrain** Button to remove relative terrain from the Inset/HSI Maps.

Controlling Relative Terrain Information (Navigation Map Panes):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the **Terrain** Button.

4) Touch the **Relative** Button to enable Relative Terrain, or **Off** to remove terrain information.

> **NOTE:** *Relative terrain information cannot be displayed simultaneously on the same map with weather radar information.   When one item is enabled the other is disabled.*

The Touchscreen Controllers control the display of relative obstacle information on the 'Navigation Map' Pane and the on-side Inset Map.

Controlling Point Obstacle Information on Navigation Maps:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Land** Tab.

3) Touch the **Point Obstacle** Button to enable/disable the display of relative obstacle information.

4) To change the maximum map range to display obstacle information, touch the Obstacle Data Range Button, then scroll and select a maximum map range from the list.

5) If necessary, touch the **Map Sync** Button to enable map synchronization. This is used to synchronize map settings (including obstacle settings) with other navigation maps

6) Touch the **Onside** Button to synchronize the selected Navigation Map settings to onside Navigation Maps, then touch either the **L PFD** or **MFD Left** Buttons to select which navigation map settings should be initially be applied to onside Navigation Maps.

Or:

Touch the **All** Button to synchronize all navigation maps, then touch a button to select which Navigation Map settings should initially be applied to all Navigation Maps (**MFD Left**, **MFD Right**, **L PFD**).

TAWS-A TERRAIN AND OBSTACLE ALERTS

The system issues alerts when flight conditions meet parameters that are set within TAWS-A software algorithms. The system issues TAWS-A terrain/obstacle alerts as a caution or warning severity level. Alerts include visual annunciations and voice alerts.

When the system issues an alert, annunciations appear on the PFDs, the 'TAWS' Pane (if displayed), and on the Touchscreen Controllers. The PFD shows the annunciation to the left of the altitude tape. The 'TAWS' Pane shows the alert in the lower-left corner of the pane. In addition, a pop-up alert appears on each Touchscreen Controller. To acknowledge the pop-up alert:

» Touch the **TAWS** Button (displays the 'TAWS' Pane).

» Touch the **Inhibit TAWS** Button to inhibit TAWS-A alerting.

» Touch the **OK** Button acknowledge the alert and return to the previous screen on the Touchscreen Controller. Acknowledging the alert on either Touchscreen Controller acknowledges the alert for the TAWS-A system.

Potential Impact Area with Synthetic Terrain enabled on PFD

PFD Alert Annunciation

'TAWS' Pane Alert Annunciation

Potential Impact Area

Touchscreen Controller Pop-Up Alert Annunciation

Shows TAWS Pane

Removes Pop-Up Alert

Inhibits TAWS FLTA alerts
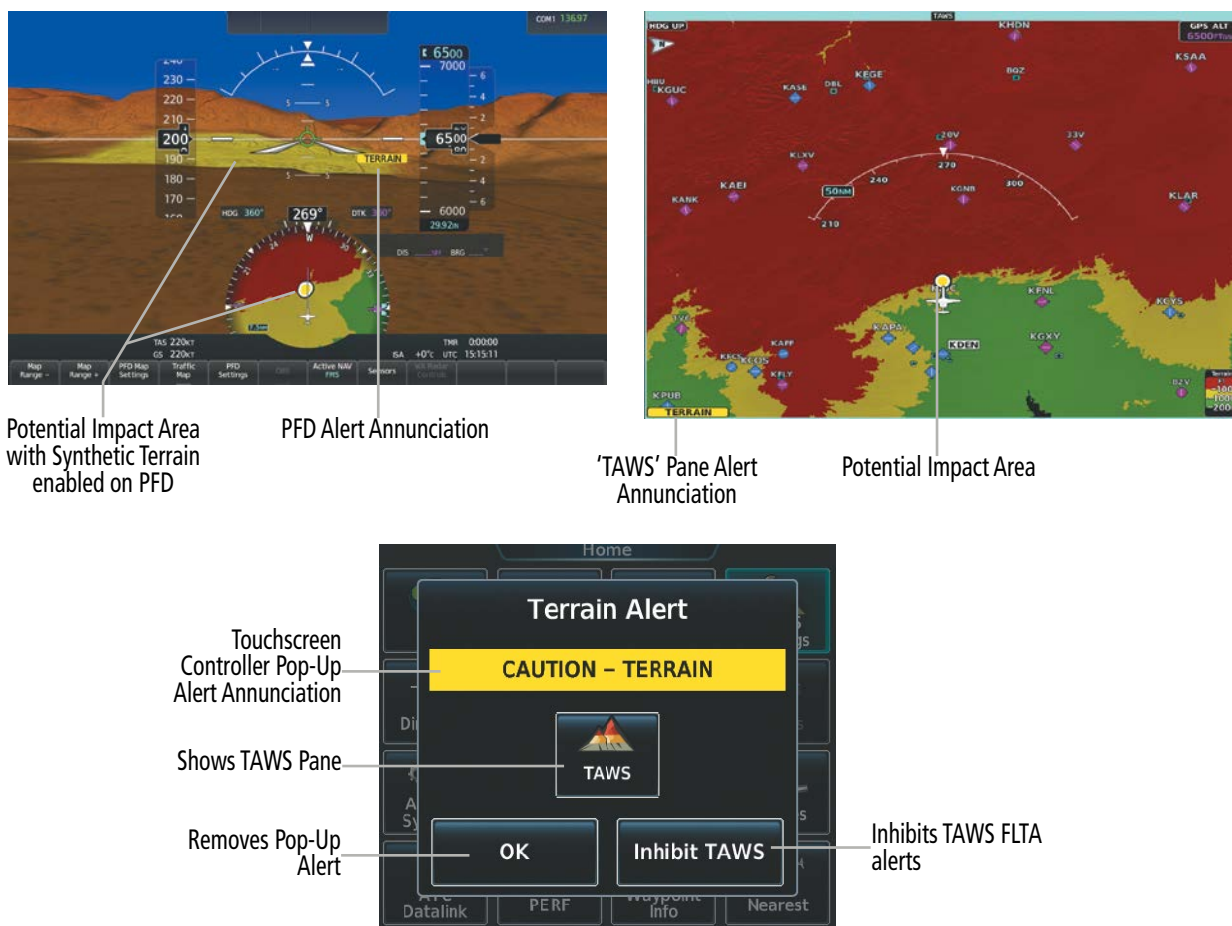
Figure 6-114 TAWS-A Alert Annunciations

Alert Type	PFD/TAWS Pane Annunciation	Touchscreen Controller Pop-Up Alert	Voice Alert
Reduced Required Terrain Clearance Warning (RTC)	PULL UP	TERRAIN – PULL–UP	"Terrain, Terrain; Pull Up, Pull Up"
Imminent Terrain Impact Warning (ITI)	PULL UP	TERRAIN AHEAD – PULL–UP	Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Reduced Required Obstacle Clearance Warning (ROC)	PULL UP	OBSTACLE – PULL–UP	"Obstacle, Obstacle; Pull Up, Pull Up"
Imminent Obstacle Impact Warning (IOI)	PULL UP	OBSTACLE AHEAD – PULL–UP	"Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"
Excessive Descent Rate Warning (EDR)	PULL UP	PULL–UP	"<whoop> <whoop> Pull Up"
Excessive Closure Rate Warning (ECR)	PULL UP	PULL–UP	"<whoop> <whoop> Pull Up"
Reduced Required Terrain Clearance Caution (RTC)	TERRAIN	CAUTION – TERRAIN	"Caution, Terrain; Caution, Terrain"
Imminent Terrain Impact Caution (ITI)	TERRAIN	TERRAIN – AHEAD	"Terrain Ahead; Terrain Ahead"
Reduced Required Obstacle Clearance Caution (ROC)	TERRAIN	CAUTION – OBSTACLE	"Caution, Obstacle; Caution, Obstacle"
Imminent Obstacle Impact Caution (IOI)	TERRAIN	OBSTACLE AHEAD	"Obstacle Ahead; Obstacle Ahead"
Premature Descent Alert Caution (PDA)	TERRAIN	TOO LOW – FLAPS	"Too Low, Flaps"
Excessive Descent Rate Caution (EDR)	TERRAIN	SINK RATE	"Sink Rate"
Excessive Closure Rate Caution (ECR)	TERRAIN	TERRAIN	"Terrain, Terrain"
Negative Climb Rate Caution (NCR)	TERRAIN	DONT SINK	"Don't Sink"
Flight Into Terrain High Speed Caution (FIT)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"
Flight Into Terrain Gear Caution (FIT)	TERRAIN	TOO LOW – GEAR	"Too Low, Gear"
Flight Into Terrain Flaps Caution (FIT)	TERRAIN	TOO LOW – FLAPS	"Too Low, Flaps"
Flight Into Terrain Takeoff Caution (FIT)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"
Glide Slope Deviation Caution (GSD) (depends on approach type)	GLIDESLOPE or GLIDEPATH	GLIDESLOPE or GLIDEPATH	"Glideslope" or "Glidepath"
Altitude Voice Callout (VCO)	None	None	"Five Hundred"

Table 6-21 TAWS-A Alerts Summary

FORWARD LOOKING TERRAIN AVOIDANCE (FLTA)

The Forward Looking Terrain Avoidance (FLTA) feature of TAWS-A compares the projected flight path as derived from GPS data with terrain features and obstacles from the databases. The system issues FLTA alerts when the projected flight path conflicts with terrain or obstacles.

The projected flight path is a calculated area ahead of, to the sides, and below the aircraft. The size of the projected flight path varies based on factors including ground speed (the path ahead is larger when the ground speed is higher), whether the aircraft is level, turning, or descending, and the proximity to the nearest usable runway along the current track. As the aircraft approaches the runway, the projected flight path becomes narrower until the system automatically disables FLTA alerts or the flight crew manually inhibits them.

There are two types of FLTA alerts, Reduced Required Terrain/Obstacle Clearance (RTC or ROC respectively) and Imminent Terrain/Obstacle Impact (ITI or IOI respectively).

The system issues **Reduced Required Terrain Clearance (RTC)** and **Reduced Required Obstacle Clearance (ROC)** alerts when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values. When an RTC alert is issued, the system displays a potential impact area on navigation maps and the TAWS Pane.

Imminent Terrain Impact (ITI) and **Imminent Obstacle Impact (IOI)** alerts occur when the aircraft is below the elevation of a terrain or obstacle in the aircraft's projected path. ITI and IOI alerts are accompanied by a potential impact area on navigation maps and the 'TAWS' Pane. The alert occurs when the projected vertical flight path is calculated to come within minimum clearance altitudes.
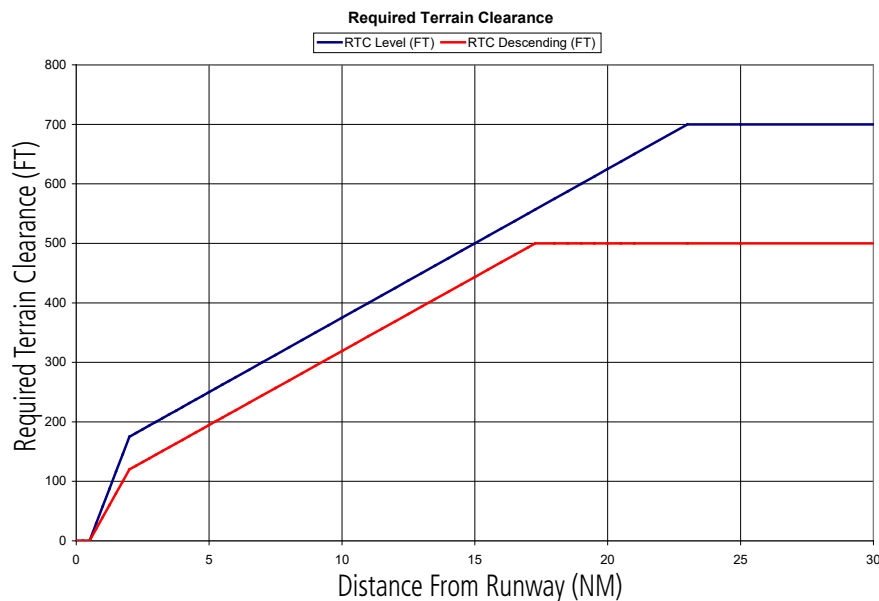
Figure 6-115 FLTA Alert Minimum Terrain and Obstacle Clearance Values

The system automatically disables FLTA alerts when the aircraft is less than 200 feet above the destination runway elevation while within 0.5 nm of the approach runway, or the aircraft is between runway ends.

PREMATURE DESCENT ALERTING

A **Premature Descent Alert (PDA)** occurs when the system detects the aircraft is significantly below the normal approach path to a runway.

PDA alerting begins when the aircraft is below 700 feet AGL within 15 nm of the destination airport and ends when the aircraft is 0.5 nm from the runway threshold.
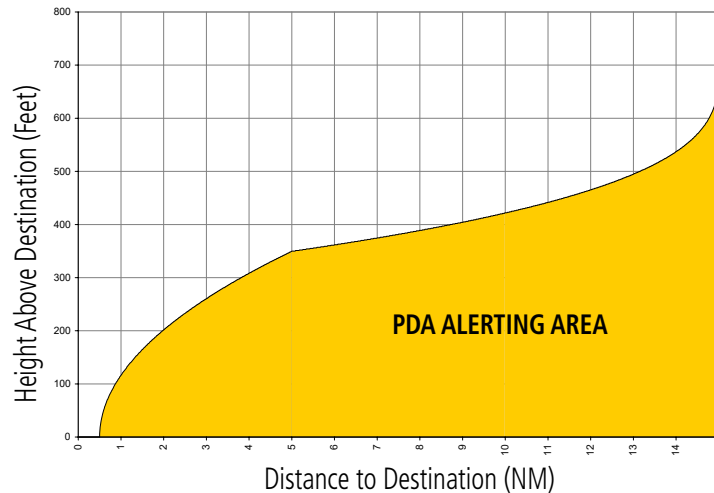
Figure 6-116 PDA Alerting Threshold

INHIBITING FLTA AND PDA ALERTS

NOTE: The 'Inhibit TAWS' function only inhibits FLTA and PDA alerts. Alerting for GPWS alerts (EDR, ECR, NCR, FIT) and GSD is controlled independently from FLTA and PDA alerts.

The flight crew can manually inhibit FLTA and PDA visual annunciations and voice alerts. Discretion should be used when inhibiting alerts and the system should be enabled when appropriate. When PDA and FLTA alerts are inhibited, the alert annunciation 'TAWS INH' is shown on the PFDs and on the TAWS Pane.

Figure 6-117 TAWS Alerting Disabled (TAWS Inhibited) Pane Annunciation

Inhibiting/enabling TAWS-A FLTA and PDA alerting:

1) From Home, touch **TAWS** > **TAWS Settings**.

2) Touch the **TAWS Inhibit** Button. When the annunciator on the button is green, TAWS-A alerting is inhibited. When the button annunciator is gray, TAWS-A alerting is enabled.

   Or:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the Terrain **Settings** Button.

4) Touch the **TAWS Inhibit** Button. TAWS-A alerting is inhibited when the button annunciator is green, enabled when gray.

Inhibiting TAWS-A alerting while an alert is occurring:

Touch the **Inhibit TAWS** Button on the Terrain Alert pop-up window on either Touchscreen Controller.

While TAWS alerting is manually inhibited (or the TAWS system is not available or has failed), the system may display a 'LOW ALT' annunciation on the PFDs next to the altitude tape if the following conditions are met:

» The aircraft is on a GBAS SBAS approach.

» The Final Approach Fix is the active waypoint.

» The aircraft is at least 164 feet below the prescribed altitude at the Final Approach Fix.

See the Flight Instruments Section for more details about the 'LOW ALT' annunciation.

GROUND PROXIMITY WARNING SYSTEM (GPWS) ALERTING

EXCESSIVE DESCENT RATE ALERT

The **Excessive Descent Rate (EDR)** alert occurs when the system determines the aircraft is closing (descending) upon terrain at an excessive speed. The following figure shows the parameters for the alert as defined by TSO-C151b.
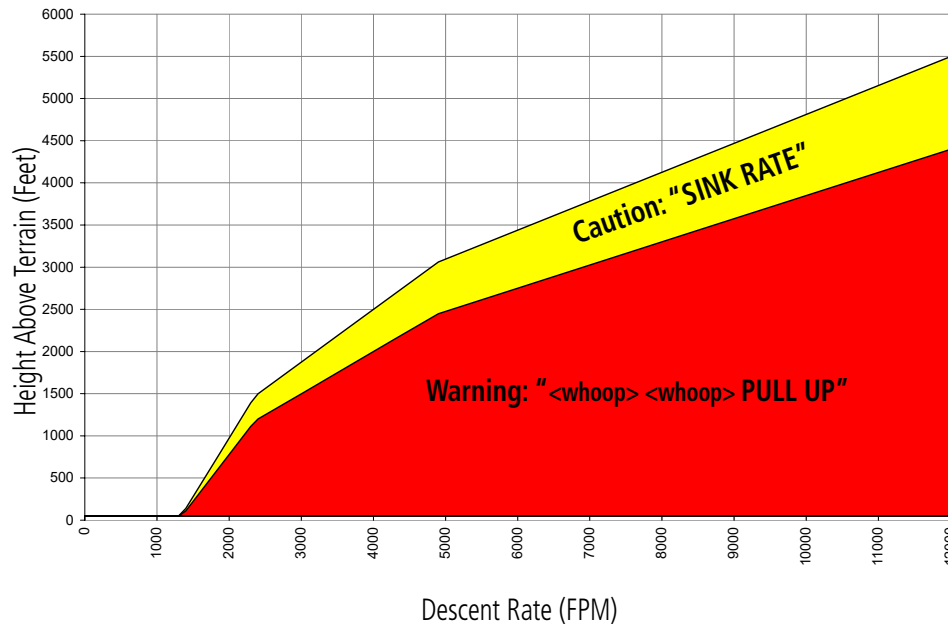
Figure 6-118 Excessive Descent Rate Alert Criteria

The flight crew can manually decrease the sensitivity of EDR alerting, if desired, by enabling Steep Approach Mode. This may reduce the occurrence of undesired EDR alerts when conducting steep approaches. When this mode is enabled, the system uses the criteria shown in Figure 6-119 to determine when to issue EDR alerts.
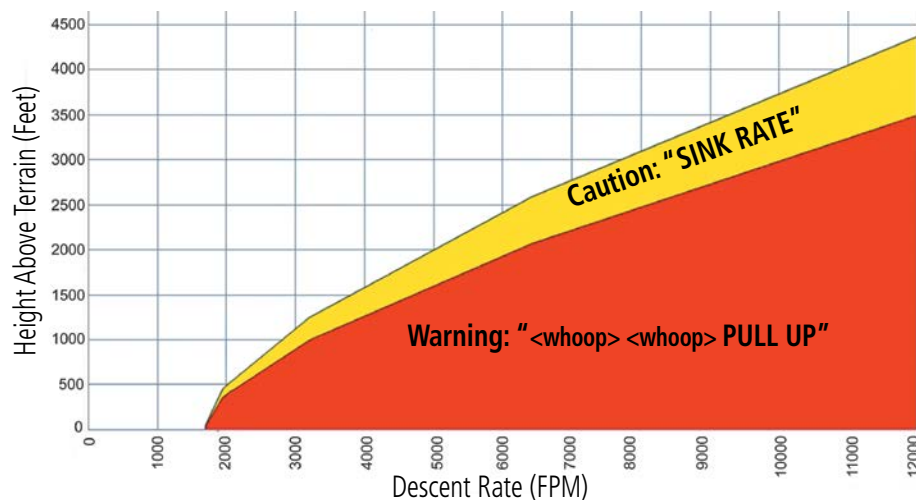
Figure 6-119 Excessive Descent Rate Alert Criteria with Steep Approach Mode Enabled

—

Enabling/disabling Steep Approach Mode:

1) From Home, touch **TAWS > TAWS Settings**.

   Or:

   a) From Home, touch **Map > Map Selection > Map Settings**.

   b) If necessary, touch the **Sensor** Tab.

   c) Touch the Terrain **Settings** Button.

2) Touch the **Steep Approach** Button to enable/disable Steep Approach Mode.

When Steep Approach Mode is enabled, a "STEEP APR" annunciation appears on the 'TAWS' Pane, and a "STEEP APR" annunciation appears on the PFDs.

PFD Steep Approach Annunciation

'TAWS' Pane Steep Approach Annunciation

Touch to enable/disable Steep Approach Mode
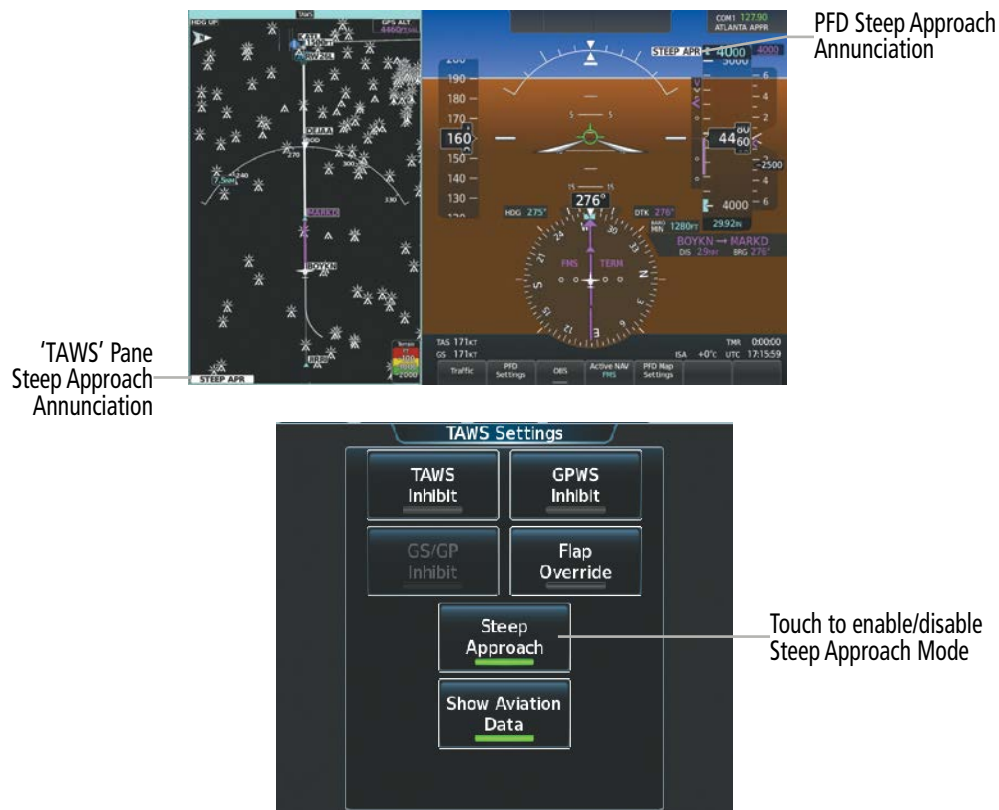
Figure 6-120 Enabling Steep Approach Mode

EXCESSIVE CLOSURE RATE ALERT

The **Excessive Closure Rate (ECR)** alert provides suitable notification when the aircraft is determined to be closing upon terrain at an excessive speed for a given aircraft gear and flap configuration.

Figure 6-121 shows the ECR alerting criteria with the flaps up or in takeoff configuration. Figure 6-122 shows ECR alerting criteria when the flaps are in the landing configuration.

ECR alerts are automatically disabled when the aircraft is 5 nm from the nearest airport, except when FLTA is not available (causing the TAWS N/A or TAWS FAIL annunciation to be displayed), in which case ECR alerting will remain active until landing.
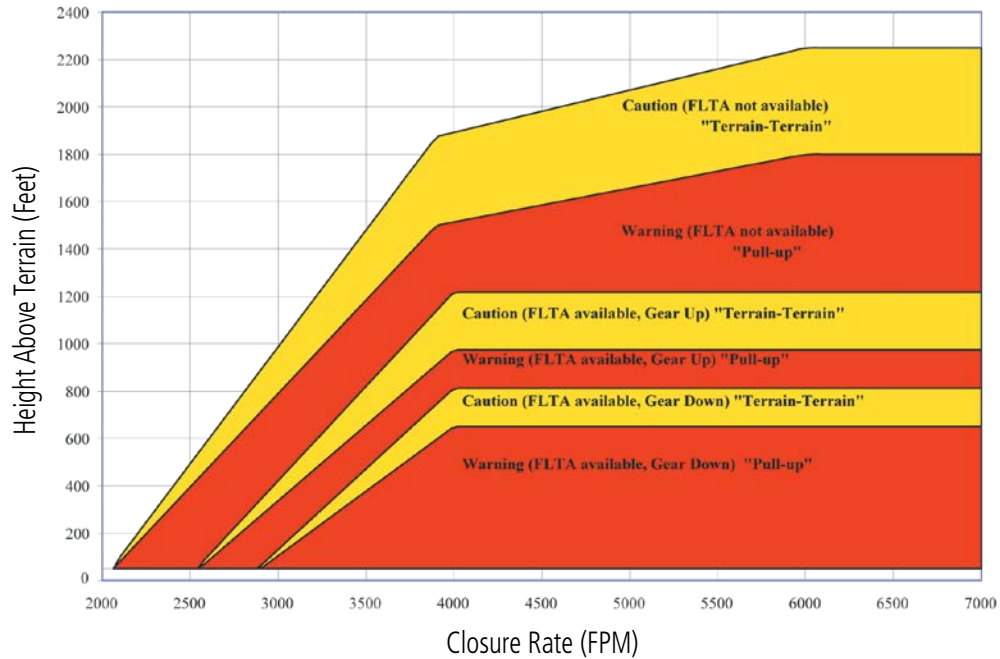
Figure 6-121 Excessive Closure Rate Alert Criteria (Flaps Up or Takeoff Configuration)
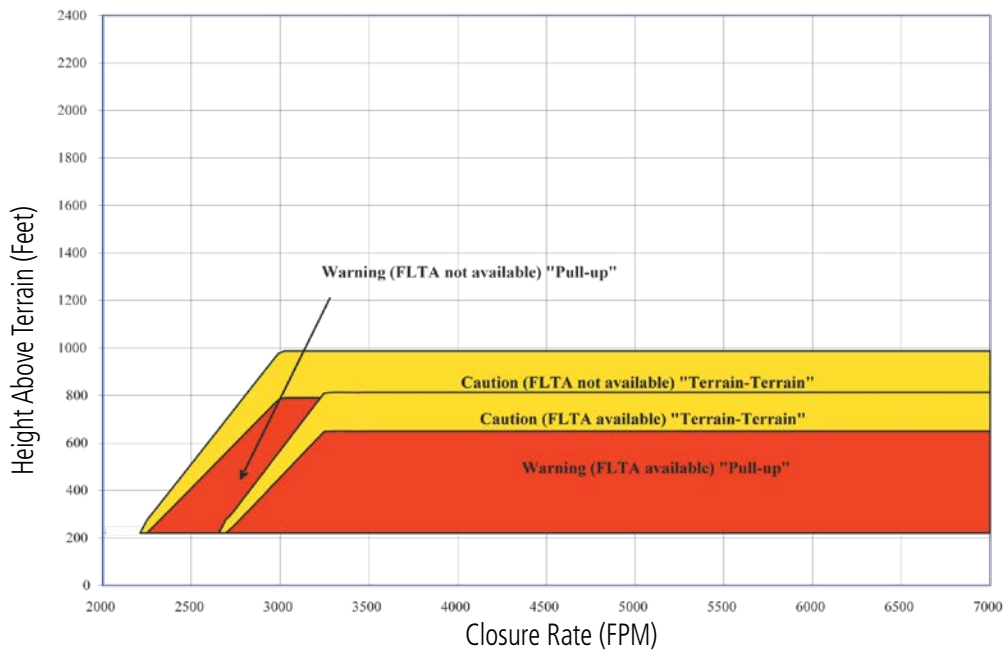
Figure 6-122 Excessive Closure Rate Alert Criteria (Flaps in Landing Configuration)

FLIGHT INTO TERRAIN ALERT

Flight Into Terrain (FIT) alerts occur when the aircraft is too low with respect to terrain based on landing gear position, flap position, and groundspeed. FIT caution alerts are issued when flight conditions meet the criteria shown in the following figure.
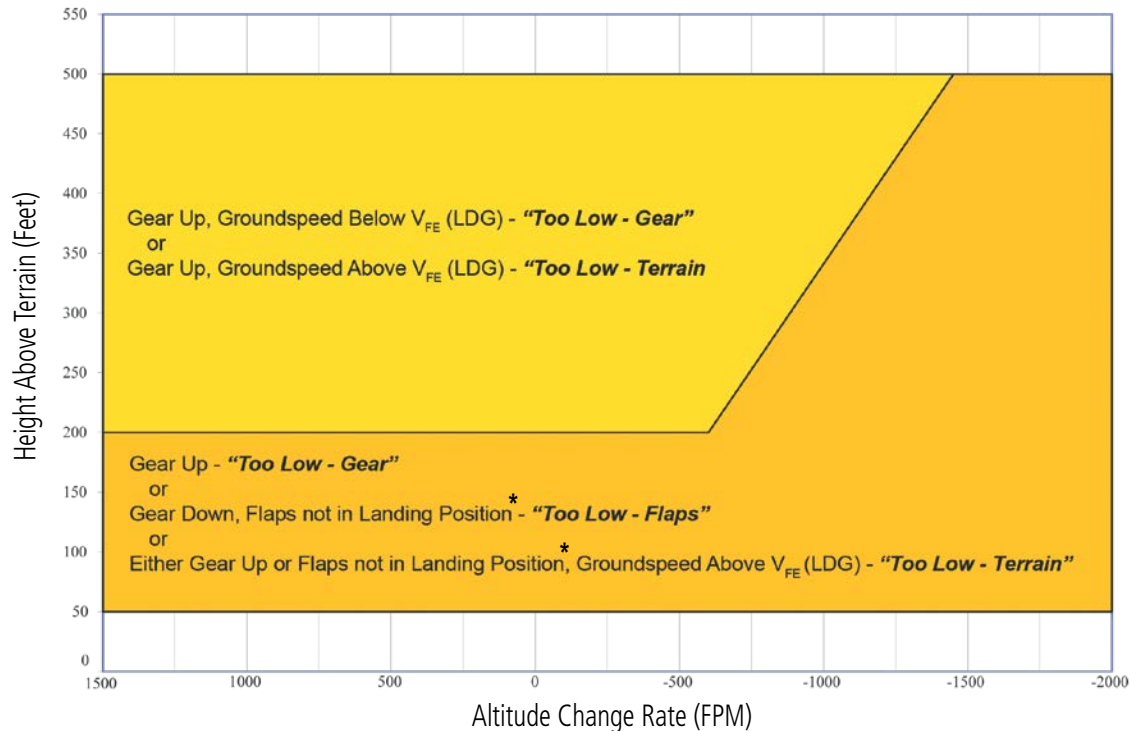
* Flap position will not trigger alert if Flap Override option is enabled; see discussion below.

Figure 6-123 Flight Into Terrain Caution Alert Criteria

To reduce nuisance FIT alerts on approaches where flap extension is not desired (or is intentionally delayed), the flight crew may override FIT alerting based on the flap position, while all other FIT alerting remains in effect.

PFD TAWS FLAP
OVERRIDE
Annunciation

'TAWS' Pane
Flap Override
Annunciation

"Too Low - Flaps"
Alert Inhibited when
Flap Override Button is
Enabled
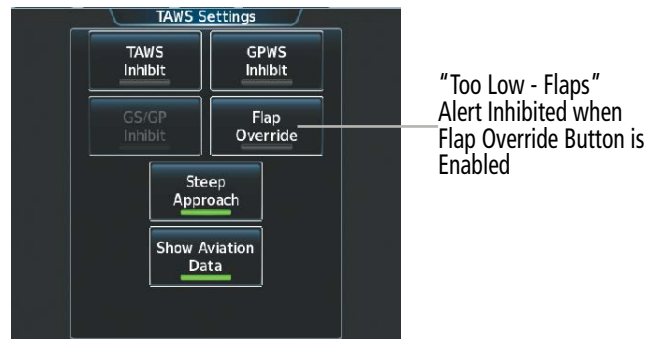
Figure 6-124 Overriding Flaps Configuration-Based FIT Alerts

Overriding Flaps-based FIT alerting:

1) From Home, touch **TAWS > TAWS Settings**.

> **Or**:

a) From Home, touch **Map > Map Selection > Map Settings**.

b) If necessary, touch the **Sensor** Tab.

c) Touch the Terrain **Settings** Button.

2) Touch the **Flap Override** button. FIT alerts based on flap position are overridden (disabled) when button annunciator is green, available when gray.

When the Flaps Override option is enabled, the TAWS Pane annunciates 'FLAP OVR' and the CAS Window displays a 'TAWS FLAP OVERRIDE' annunciation.   If GPWS alerts are also inhibited (which include FIT), the GPWS inhibit annunciations supercede the flap override annunciations.

FIT alerts also occur during takeoff or go-around if the aircraft's height above ground level (as determined by the radar altimeter) is too close to rising terrain. TAWS-A will issue the voice alert *"Too Low, Terrain"* and visual annunciations when conditions enter the caution alert area.
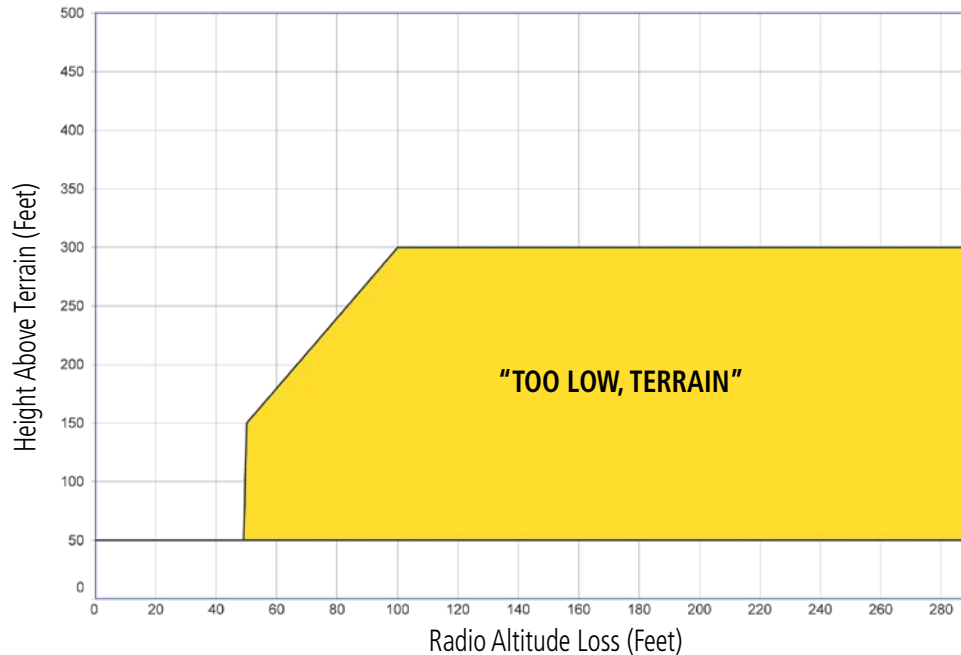
Figure 6-125 FIT Alerting After Takeoff

NEGATIVE CLIMB RATE AFTER TAKEOFF ALERT

The **Negative Climb Rate (NCR) After Takeoff** alert (also referred to as "Altitude Loss After Takeoff") provides alerts when the system determines the aircraft is losing altitude (closing upon terrain) after takeoff. The voice alert *"Don't Sink"* is given for NCR alerts, accompanied by an annunciation and a pop-up terrain alert on the Touchscreen Controllers. NCR alerting for TAWS-A is only active when departing from an airport and when the following conditions are met:

» Height above the terrain is less than 700 feet.

» Distance from the departure airport is 5 nm or less.

» Heading change from the departure heading is less than 110 degrees.

» Landing gear or flaps are configured for takeoff.

» NCR alerts can be triggered by either altitude loss or sink rate.

GARMIN
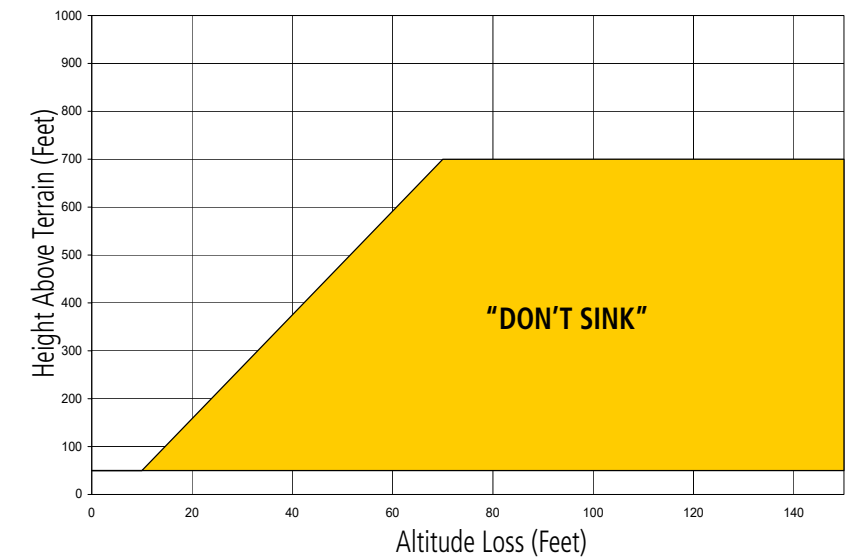
Figure 6-126 Negative Climb Rate (NCR) Altitude Loss
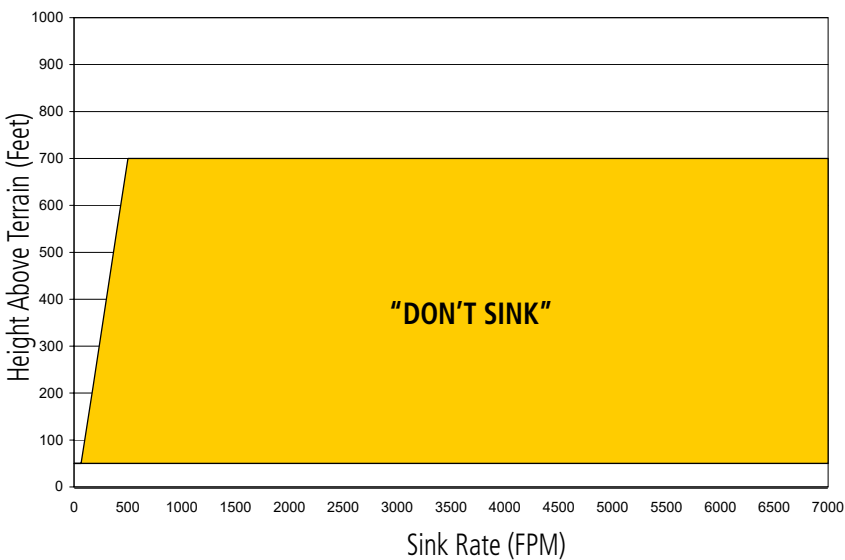
Figure 6-127 Negative Climb Rate (NCR) Sink Rate

INHIBITING GPWS ALERTS (EDR, ECR, FIT, AND NCR)

> **NOTE:** The 'Inhibit GPWS' function only affects GPWS alerts (EDR, ECR, NCR, and FIT). Alerting for FLTA, PDA, and GSD is controlled independently from the GPWS alerts.

EDR, ECR, FIT, and NCR visual annunciations and voice alerts can be manually inhibited as a group. Discretion should be used when inhibiting alerts and the GPWS system should be enabled when appropriate. When these alerts are inhibited, the CAS annunciation 'GROUND PROX INHIBIT' appears on the PFDs and a 'GPWS INH' annunciation appears on the TAWS Pane.

PFD GROUND PROX INHIBIT Annunciation

'TAWS' Pane GPWS Inhibit Annunciation

GPWS Alerting Inhibited when Button is Enabled
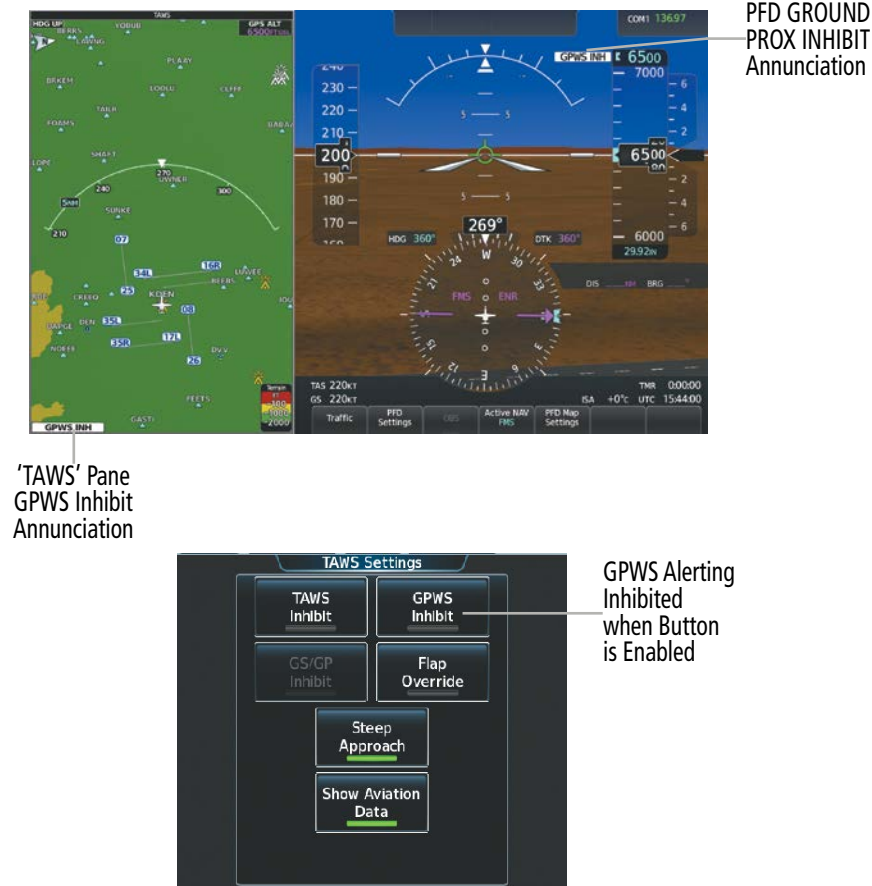
Figure 6-128 Overriding Flaps Configuration-Based FIT Alerts

Inhibiting/enabling GPWS alerting:

1) From Home, touch **TAWS > TAWS Settings**.

   Or:

   a) From Home, touch **Map > Map Selection > Map Settings**.

   b) If necessary, touch the **Sensor** Tab.

   c) Touch the Terrain **Settings** Button.

2) Touch the **GPWS Inhibit** button. Button annunciator is green when GPWS alerts are inhibited, gray when alerting is enabled.

EXCESSIVE BELOW GLIDESLOPE/GLIDEPATH DEVIATION ALERT

A **Glideslope Deviation** or **Glidepath Deviation (GSD)** caution alert is issued when the system detects the aircraft is significantly below the glidepath for the selected approach in relation to the aircraft's height above terrain.
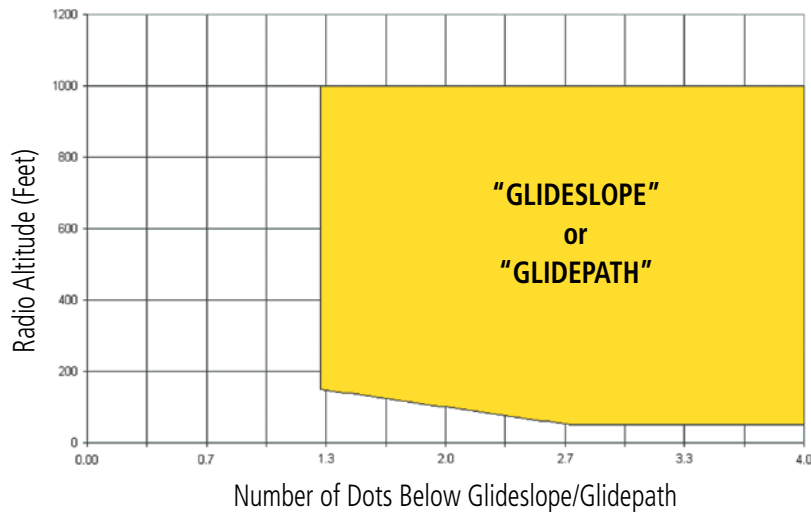
Figure 6-129 Excessive Below Glideslope/Glidepath Deviation Alert Criteria

GSD alerting is only active after departure and the following conditions are met:

» An ILS approach is active or an FMS approach is active with one of the following SBAS approach service levels: LPV or LNAV/VNAV.
» Aircraft is below 1000 feet AGL.
» Gear is configured for landing.

> ✓ **NOTE:** If full flaps are extended and subsequently retracted while the GSD alerting conditions are met, a GSD alert may not occur.

A GSD caution alert consists of a 'GLIDESLOPE' or 'GLIDEPATH' visual annunciation and voice alert.

'TAWS' Pane Glideslope or Glidepath Annunciation

PFD Glideslope or Glidepath Annunciation

Inhibits Glideslope/ Glidepath Alerts
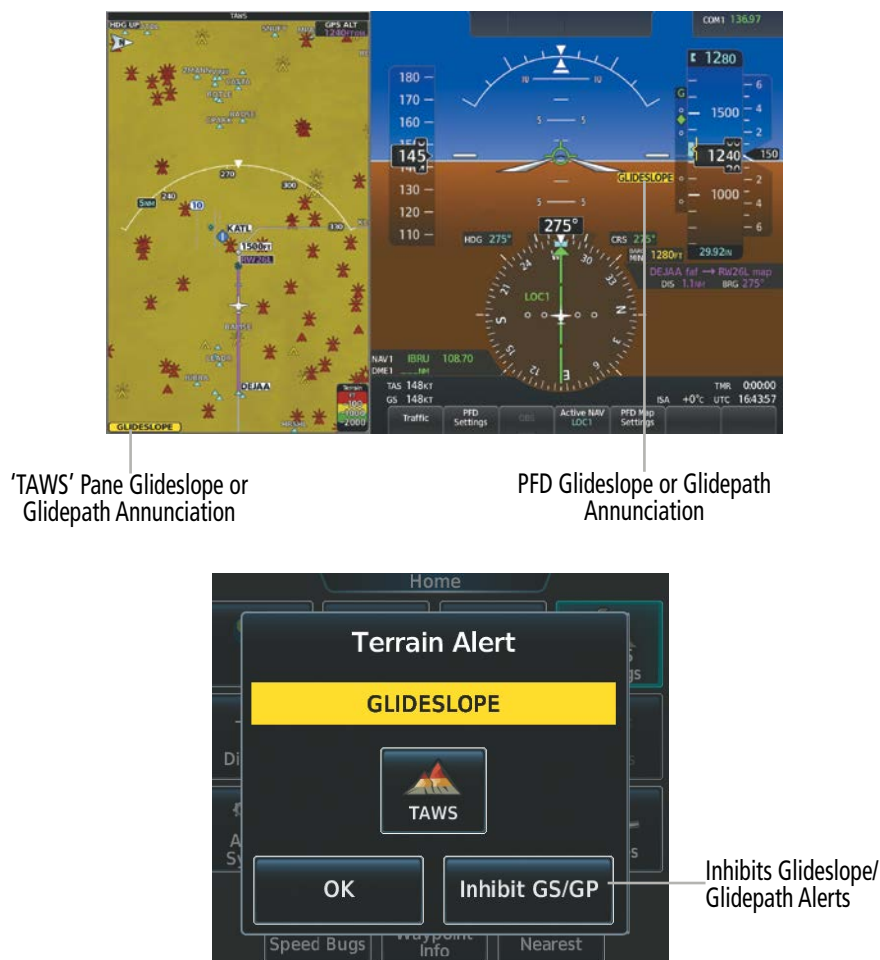
Figure 6-130 Inhibiting GSD Alerts (Pop-Up Alert shown)

INHIBITING GSD ALERTS

> **NOTE:** *GSD alerting may only be inhibited while a GSD alert is occurring. GSD alerts are inhibited independently from FLTA, PDA, and other GPWS alerts.*

The Touchscreen controllers provides controls to inhibit GSD alerting. When the Touchscreen Controller is displaying a pop-up GSD alert window, touch the **Inhibit GS/GP** Button. GSD alerting may also be inhibited on the 'TAWS Settings' screen while a GSD alert is occurring. If a GSD alert is not occurring, the **GS/GP Inhibit** Button is subdued.

Inhibiting an active GSD Pop-Up alert:

1) Touch the **Inhibit GS/GP** Button.

2) Touch the **OK** Button to confirm and inhibit Glideslope and Glidepath alerts, or touch **Cancel**.

Inhibiting an active GSD alert (TAWS Settings Screen):

1) From Home, touch **TAWS > TAWS Settings**.

   Or:

   a) From Home, touch **Map > Map Selection > Map Settings**.

   b) If necessary, touch the **Sensor** Tab.

   c) Touch the Terrain **Settings** Button.

2) Touch the **GS/GP Inhibit** Button. GSD alerting is inhibited when button annunciator is green, enabled when gray.

ALTITUDE VOICE CALLOUT (VCO)

TAWS-A provides a voice alert as the aircraft descends to 500 feet above the terrain, as determined by the radar altimeter (if greater than five nm from the nearest airport) or 500 feet above the nearest runway threshold elevation (if less than 5 nm from the nearest airport). Upon descent to this altitude, TAWS-A issues the voice alert *"Five Hundred"*. There are no display annunciations or pop-up alerts that accompany the VCO alert. The flight crew cannot inhibit the VCO alert.

Additional flight crew selectable VCO alerts occur corresponding at 400, 300, 200, 100, 50, 40, 30, 20, and 10 feet.

> **NOTE:** *The TAWS-A "Five Hundred" feet voice alert is inhibited if the Flight Director is set to Glideslope or Glidepath Mode.*

SYSTEM STATUS

When applying system power, TAWS-A conducts a system test of its alerting capabilities. A voice alert occurs at test completion.

Alert Type	'TAWS' Pane Annunciation	'TAWS' Pane Center Banner Annunciation	Voice Alert
GPWS System Fail	GPWS FAIL	None	"GPWS System Failure"
GPWS Alerting Inhibited	GPWS INH	None	None
'Too Low - Flaps' FIT alerting inhibited	FLAP OVR	None	None
Steep Approach Mode Enabled	STEEP APR	None	None
Steep Approach Mode Enabled and 'Too Low - Flaps' FIT alerting inhibited	FLP/STEEP	None	None
GSD Alerting Inhibited	GS INH or GP INH	None	None
System Test in progress	TAWS TEST	TAWS TEST	None
TAWS PDA/FLTA Alerting Inhibited	TAWS INH	None	None
TAWS System Fail	TAWS FAIL	TAWS FAIL	"TAWS System Failure"
TAWS Not Available	TAWS N/A	NO FMS POSITION (if FMS position lost)	"TAWS Not Available"
TAWS System Test pass	None	None	"TAWS System Test OK"

Table 6-22 TAWS-A System Status Annunciations

TAWS-A ABNORMAL OPERATIONS

During system operation, TAWS-A continually monitors several system-critical items such as database validity, flap and landing gear position, radar altimeter input, and GPS status.

If no PFD or MFD contains Terrain or Obstacle databases (or the databases are invalid), the voice alert *"TAWS System Failure"* is generated along with the 'TAWS FAIL' alert annunciation.

TAWS-A requires a 3-D GPS navigation solution along with specific vertical accuracy minimums. Should the navigation solution become degraded or if the aircraft is out of the database coverage area, the annunciation 'TAWS N/A' is generated in the annunciation window and on the TAWS-A Pane. The voice alert *"TAWS Not*

Available" is also generated if airborne, and some TAWS-A terrain alerts will not be issued, while GPWS alerting (which are not dependent on GPS position) will continue to operate.

TAWS-A also requires radar altimeter input. Should the radar altimeter input fail or become degraded, the annunciation 'GPWS FAIL' is generated in the annunciation window and on the 'TAWS-A' Pane. The voice alert *"GPWS System Failure"* is also generated. The 'GPWS FAIL' annunciation will also occur if both GPS altitude and barometric altitude are unavailable. If only the GPWS system has failed, GPWS-type alerts will not be available, while other TAWS-A alerting remains unaffected.

Alert Cause	TAWS Pane Annunciation(s)	TAWS Alert Types Not Available
TAWS System Test Fail; Terrain or Obstacle database unavailable or invalid on all PFDs and MFD; software mismatch among PFDs/MFD; TAWS audio fault	**TAWS FAIL** and **TAWS FAIL**	FLTA, PDA
MFD Terrain or Obstacle database unavailable or invalid. TAWS operating with PFD Terrain or Obstacle databases	**TERRAIN DATABASE FAILURE**	
No FMS position	**TAWS N/A** and **NO FMS POSITION**	FLTA, PDA, GSD[2], VCO[1]
Excessively degraded GPS signal, or out of database coverage area	**TAWS N/A**	FLTA, PDA
Sufficient GPS signal reception restored	None	
Radar Altimeter invalid, Vertical Speed Invalid, GPS and Baro Altitude invalid, Software mismatch among PFDs/MFD, TAWS configuration mismatch among PFDs/MFD, TAWS audio fault	**GPWS FAIL**	EDR, ECR, NCR, FIT, GSD

[1] VCO alerts are not issued if both TAWS and GPWS systems have failed or are not available.

[2] GSD alert will be available if a valid ILS is being used for navigation, even in no valid GPS signal is being received.

Table 6-23 TAWS-A Abnormal Status Alerts

If the aircraft bank angle exceeds 30°, TAWS-A will disable ECR alerts. ECR alert availability returns when the bank angle is reduced for at least eight seconds.

6.8 TCAS I TRAFFIC

⚠️ **WARNING:** Do not rely solely upon the display of traffic information for collision avoidance maneuvering. The traffic display does not provide collision avoidance resolution advisories and does not under any circumstances or conditions relieve the pilot's responsibility to see and avoid other aircraft.

⚠️ **WARNING:** Do not rely solely upon the display of traffic information to accurately depict all of the traffic information within range of the aircraft. Due to lack of equipment, poor signal reception, and/or inaccurate information from other aircraft, traffic may be present but not represented on the display.

✅ **NOTE:** Pilots should be aware of traffic system limitations. Traffic systems require transponders of other aircraft to respond to system interrogations. If the transponders do not respond to interrogations due to phenomena such as antenna shading or marginal transponder performance, traffic may be displayed intermittently, or not at all. Aircraft without altitude reporting capability are shown without altitude separation data or climb descent indication. Pilots should remain vigilant for traffic at all times.

✅ **NOTE:** Refer to the documentation from the manufacturer for a complete discussion of the TCAS I system.

✅ **NOTE:** If the optional radar altimeter is installed and subsequently fails, the TCAS I system will also fail.

If installed the TCAS I system is designed to help in the detection and avoidance of other aircraft`. It enhances flight crew situational awareness by monitoring the airspace for transponder-equipped aircraft.   The system also provides visual annunciations and voice alerts to assist the flight crew with the visual acquisition of traffic.

The TCAS I system is capable of tracking up to 45 intruding aircraft equipped with Mode A or C transponders, and up to 30 intruding aircraft equipped with Mode S transponders. The system can display a maximum of 30 aircraft with the highest threat potential simultaneously. The system provides no surveillance information for aircraft without operating transponders.

THEORY OF OPERATION

When the traffic system is in Operating Mode, the system interrogates the transponders of other aircraft while monitoring for transponder replies. The system uses this information to derive the distance, relative bearing, and if reported, the altitude and vertical trend for each aircraft within its surveillance range.

The system then calculates a closure rate to each intruder based on the projected Closest Point of Approach (CPA). If the closure rate meets the threat criteria for a Traffic Advisory (TA), the system provides visual and voice alerting.

TCAS I SURVEILLANCE VOLUME AND SYMBOLOGY

The TCAS I system monitors the airspace within ±9,000 feet of own altitude, and up to 40 nm in the forward direction. Traffic system range is somewhat reduced to the sides and aft of own aircraft due to the directional interrogation signal patterns.

The symbols in the following table depict TCAS I traffic.

Symbol	Description
⬤	Traffic Advisory without directional information.
◖	Traffic Advisory out of the selected display range without directional information. Displayed at outer range ring at proper bearing.
◆	Proximity Advisory without directional information.
◇	Other Non-Threat traffic without directional information.

Table 6-24 Traffic Symbols with TCAS I

A Traffic Advisory (TA), displayed as an amber circle, alerts the crew to a potentially hazardous intruding aircraft, if the closing rate, distance, and vertical separation meet TA criteria. A Traffic Advisory occurring beyond the selected display range (off scale) is indicated by a half TA symbol at the edge of the range ring at the relative bearing of the intruder.

A Proximity Advisory (PA), displayed as a solid white diamond, indicates the intruding aircraft is within ±1200 feet and is within a 6 nm range, but is still not considered a TA threat.

Other, Non-Threat traffic, shown as an open white diamond, is displayed for traffic beyond 6 nm that is neither a TA or PA.

Relative altitude, when available, is labeled above or below the corresponding intruder symbol in hundreds of feet. When this altitude is above own aircraft, it is preceded by a '+' symbol; a minus sign '-' indicates traffic is below own aircraft.

A vertical trend arrow to the right of the intruder symbol indicates traffic is climbing or descending at least 500 feet per minute with an upward or downward-pointing arrow respectively.
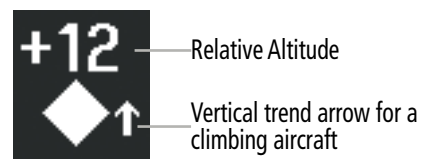
Figure 6-131 Intruder Altitude and Vertical Trend Arrow

The TCAS I automatically suppresses the display of other altitude-reporting aircraft on the ground under either of the following conditions:

» On-ground aircraft is equipped with a Mode S transponder.

» On-ground aircraft is equipped with a Mode C transponder, and own aircraft's radar altimeter is displaying 1700' AGL or less.

TA ALERTING CONDITIONS

The TCAS I system automatically adjusts its TA sensitivity level to reduce the likelihood of nuisance TA alerting during flight phases likely to be near airports. Level A (less) TA sensitivity is used when the aircraft's landing gear is extended, or when the radar altimeter (if equipped) indicates own aircraft altitude is below 2000' AGL. In all other conditions, Level B (greater) TA sensitivity is used to assess TA threats.

Sensitivity Level	Intruder Altitude Available	TA Alerting Conditions
A	Yes	Intruder closing rate provides less than 20 seconds of vertical and horizontal separation. Or: Intruder closing rate provides less than 20 seconds of horizontal separation and vertical separation is within 600 feet. Or: Intruder range is within 0.2 nm and vertical separation is within 600 feet.
A	No	Intruder closing rate provides less than 15 seconds of separation or intruder range is within 0.2 NM.
B	Yes	Intruder closing rate provides less than 30 seconds of vertical and horizontal separation. Or: Intruder closing rate provides less than 30 seconds of horizontal separation and vertical separation is within 800 feet. Or: Intruder range is within 0.55 nm and vertical separation is within 800 feet.
B	No	Intruder closing rate provides less than 15 seconds of separation or intruder range is less than 0.55 NM.

Table 6-25 TA Sensitivity Level and TA Alerting Criteria

TRAFFIC ALERTS

> ✓ **NOTE:** *TCAS I traffic voice alerts do not occur at or below 400' AGL (if a radar altimeter is installed) or when the landing gear is extended (if a radar altimeter is not installed). Only visual traffic annunciations are issued under these conditions.*

When the traffic system detects a new TA, the following occur:

- The system issues a single *"Traffic!"* voice alert, followed by additional voice information about the bearing, relative altitude, and approximate distance from the intruder that caused the TA. The voice alert *"Traffic! 12 o'clock, high, four miles,"* would indicate the traffic is in front of own aircraft, above own altitude, and approximately four nautical miles away.

- A 'TRAFFIC' Annunciation appears above the Selected Heading display on the PFDs, flashes for five seconds and remains displayed until no TAs are detected in the area.

- If the system cannot determine the bearing of TA traffic, an amber text banner appears in the center of the 'Traffic Map' Pane instead of a TA symbol. The text indicates 'TA' followed by the distance, relative altitude, and vertical trend of '<UP>' or '<DN>', if a vertical trend of at least 500 fpm is detected.

The system displays a TA traffic symbol and traffic annunciation for at least eight seconds, even if the alerting condition(s) that initially triggered the TA are no longer present.

Figure 6-132 Traffic Annunciation (PFD)

Bearing	Relative Altitude	Approximate Distance (nm)
"One o'clock" through "Twelve o'clock" or "No Bearing"	"High", "Low", "Same Altitude" (if within 200 feet of own altitude), or "Altitude not available"	"Less than one mile", "One Mile" through "Ten Miles", or "More than ten miles"

Table 6-26 TA Descriptive Voice Alert

Selecting an operating mode:

1) From Home, touch **Traffic > Traffic Settings**.

 Or:

 a) From Home, touch **Map > Map Selection > Map Settings**.

 b) If necessary, touch the **Sensor** Tab.

 c) Touch the Traffic **Settings** Button.

2) In the **TCAS Mode** Window, touch one of the following buttons:

 • **On:** System interrogates other aircraft transponders and displays traffic.

 • **Standby:** Traffic system does not interrogate other aircraft transponders or display traffic.

'TRAFFIC MAP' PANE

The 'Traffic Map' Pane shows surrounding traffic data in relation to the aircraft's current position and altitude, without basemap clutter. It is the principal map pane for viewing traffic information. Aircraft orientation is always heading up unless there is no valid heading. Range rings indicate map ranges. Turn the **Joystick** counter-clockwise to decrease the map range, or clockwise to increase the range.

Traffic is displayed up to the outer range ring of the traffic map. If a TA is occurring beyond the range of the outer range ring, a half-TA symbol is positioned on the outer ring at the bearing of the intruder.

The traffic operating mode and altitude display mode appear in the upper right corner of the 'Traffic Map' Pane.
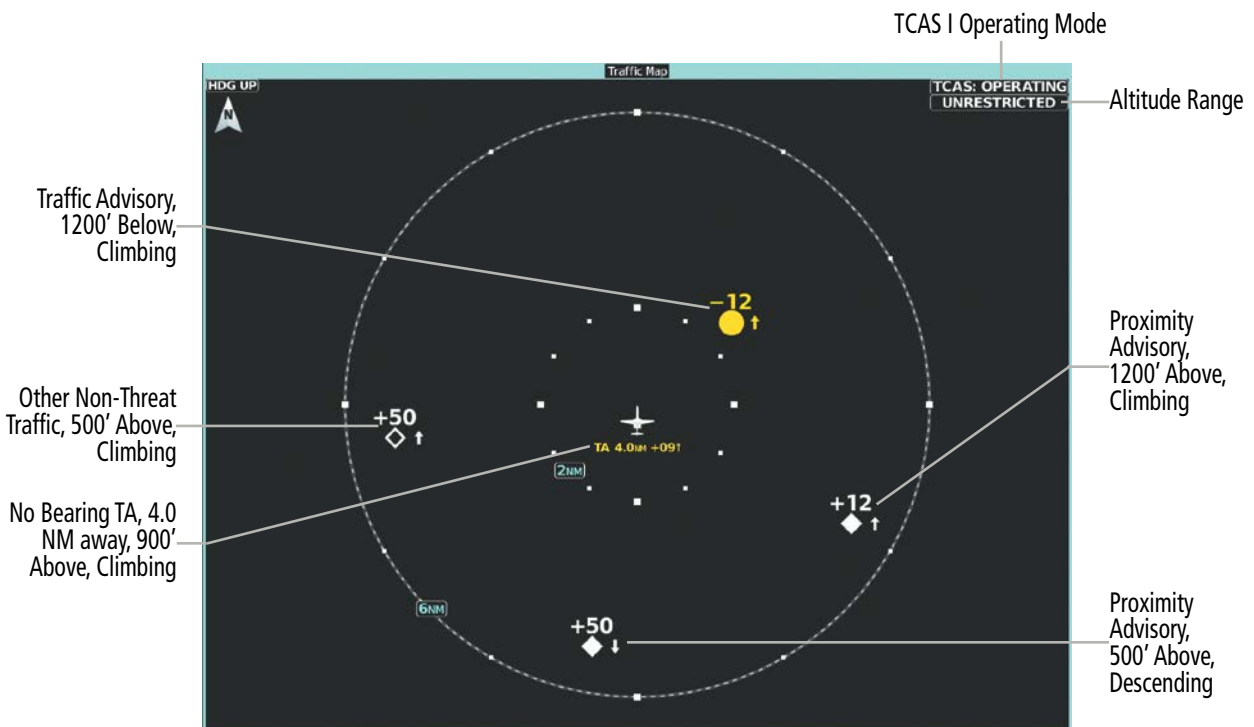
Figure 6-133 'Traffic Map' Pane with TCAS I Display Enabled

Displaying the 'Traffic Map' Pane:

From Home on the Touchscreen Controller, touch the **Traffic** Button.

Or:

On the PFD, press the **Traffic Map** Softkey.

ALTITUDE RANGE

The flight crew can select the volume of airspace in which Proximity Advisory and Other, Non-Threat traffic is displayed. Note the system will still show TAs occurring outside of these limits regardless of the altitude mode chosen.

Changing the altitude range:

1) From Home, touch **Traffic > Traffic Settings**.

Or:

From Home, touch **Map > Map Selection > Map Settings >** Traffic **Settings** Button.

2) Touch the **Altitude Range** Button:

3) Touch one of the following buttons from the list:

- **Unrestricted:** All traffic is displayed from 9900 feet above and 9900 feet below the aircraft.

- **Above:** Displays non-threat and proximity traffic from 9900 feet above the aircraft to 2700 feet below the aircraft. Typically used during climb phase of flight.

- **Normal:** Displays non-threat and proximity traffic from 2700 feet above the aircraft to 2700 feet below the aircraft. Typically used during enroute phase of flight.

- **Below:** Displays non-threat and proximity traffic from 2700 feet above the aircraft to 9900 feet below the aircraft. Typically used during descent phase of flight.
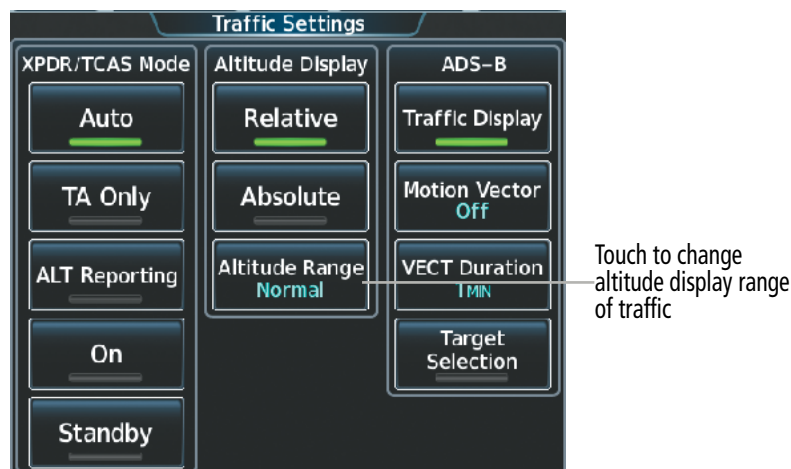
Figure 6-134 Selecting an Altitude Display Range on the 'Traffic Settings' Screen

ADDITIONAL TRAFFIC DISPLAYS

The system can overlay traffic information on the 'Navigation Map' Pane. Traffic information is also available on the PFD when the Synthetic Vision Technology (SVT) terrain display is enabled. See the Flight Instruments section for details about SVT traffic.

Enabling/disabling display of traffic information ('Navigation Map' Pane):

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the **Traffic** Button.

When the display of traffic is enabled on navigation maps, the system shows a traffic status icon in the lower right corner of the map.
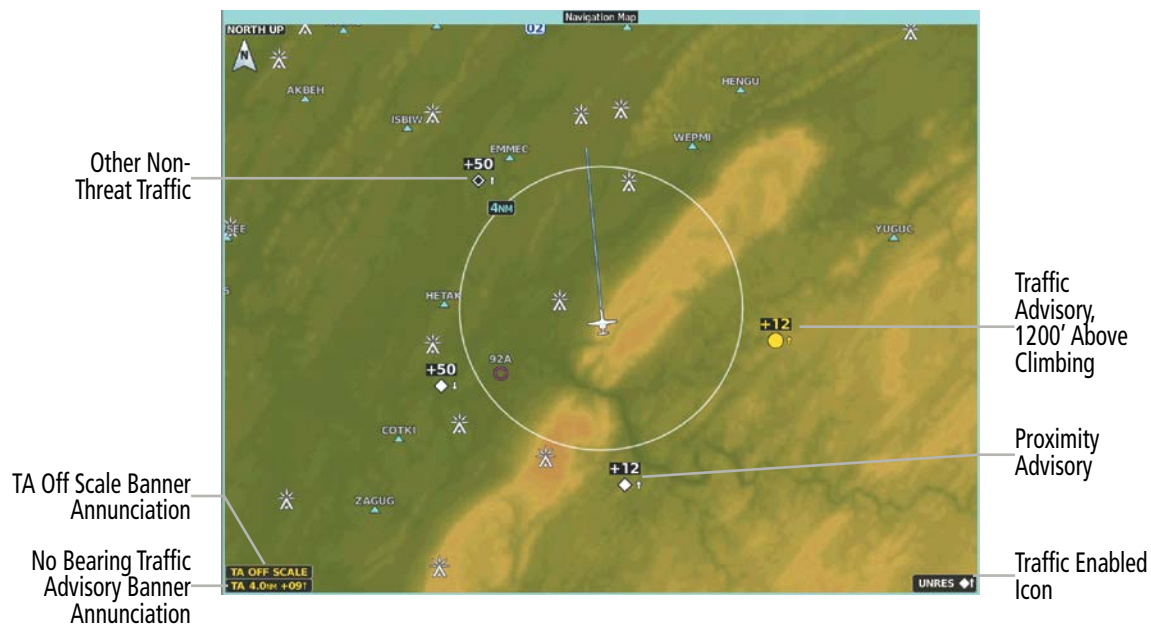
Figure 6-135 Traffic on 'Navigation Map' Pane

The system provides controls to customize the display of traffic information on navigation maps. Traffic symbols and labels (such as up or down arrows and relative altitudes) can be decluttered from the display when the map range exceeds a specified distance. In addition, traffic labels may also be enabled or disabled, regardless of map range.

Customizing the display of traffic on the navigation maps:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the Traffic **Settings** Button.

4) Touch the **Map Settings** Button.

5) Touch the **Labels** Button to enable/disable the display of labels on traffic (such as relative altitude).

6) To change the map range above which the system removes traffic symbols from the display, touch the **Symbols** Button, then scroll to and touch to select a map range above which the system will remove the traffic symbols.

7) To change the map range at which the system removes traffic labels from the display (such as, touch the Labels range button, then scroll to and touch to select a map range above which the system removes traffic labels from the display.

8) When finished, touch the **Back** Button or the **Home** Button.

The HSI can also present a version of the Traffic Map. Traffic operating mode information is not present on this map. Refer to the Flight Instruments section for more information about displaying maps on the HSI.

Figure 6-136 HSI Map with TCAS I Traffic

Showing the HSI Traffic Map:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Map Layout** Softkey.

3) Press the **HSI Traffic** Softkey.

4) Press the **Back** Softkey.

SYSTEM STATUS

When the system is powered up on the ground, the system performs an automatic test of its traffic alerting capabilities. The system issues the voice alert *"TCAS One System Test Passed"* or *"TCAS One System Test Failed,"* depending on test outcome.

The traffic system mode appears in the upper right corner of the 'Traffic Map' Pane.

Operating Mode	Traffic Map Mode Annunciation	Traffic Overlay Status Icon
Operating	**OPERATING**	
TCAS I Standby	**STANDBY** (also shown in white in center of 'Traffic Map' Pane)	
TCAS I Failed [1]	**UNIT FAILED**	

[1] *See Table 6-28 for additional failure annunciations.*

Table 6-27 TCAS I Modes

If the traffic unit fails, the system shows an annunciation as to the cause of the failure in the center of the 'Traffic Map' Pane. During a failure condition, the Operating Mode is not available.

'Traffic Map' Pane Center Annunciation	Description
NO DATA	System is not receiving any data from the traffic unit.
DATA FAILED	System is receiving data from the traffic unit, but the unit is reporting a failure.
FAILED	The traffic unit is sending invalid data to the system.

Table 6-28 TCAS I Failure Annunciations

Traffic Status annunciations appear in banners at the lower left corner of navigation map panes.

Traffic Status Banner Annunciation	Description
TA OFF SCALE	A Traffic Advisory is outside the selected display range .[1] Annunciation is removed when traffic comes within the selected display range.
TA X.X ± XX ↕	System cannot determine bearing of Traffic Advisory. [2] Annunciation indicates distance in nm, altitude separation in hundreds of feet, and altitude trend arrow (climbing/descending).
TRFC FAIL	The traffic unit has failed (unit is self-reporting a failure or sending incorrectly formatted data). [2]
NO TRFC DATA	Data is not being received from the traffic unit.

[1] *Shown as symbol on 'Traffic Map' Pane.*
[2] *Shown in center of 'Traffic Map' Pane.*

Table 6-29 TCAS I Traffic Status Annunciations

6.9 TCAS II TRAFFIC

⚠️ **WARNING:** *Traffic information shown on system displays is provided as an aid in visually acquiring traffic. Traffic avoidance maneuvers are based upon TCAS II Resolution Advisories , ATC guidance, or positive visual acquisition of conflicting traffic.*

⚠️ **WARNING:** *Do not rely solely upon the display of traffic information to accurately depict all of the traffic information within range of the aircraft. Due to lack of equipment, poor signal reception, and/or inaccurate information from other aircraft, traffic may be present but not represented on the displays.*

✅ **NOTE:** *Degraded bearing accuracy may occasionally cause displayed traffic symbols to rapidly shift bearing position until bearing accuracy has been established. The system's ability to issue Traffic Advisory and Resolution Advisory alerts remains unaffected if this occurs.*

✅ **NOTE:** *Refer to the Automatic Dependent Surveillance-Broadcast (ADS-B) Traffic discussion for more information about ADS-B traffic displays and alerting.*

✅ **NOTE:** *Refer to the documentation from the manufacturer for a complete discussion of the TCAS II system.*

✅ **NOTE:** *If the optional radar altimeter is installed and subsequently fails, the TCAS II system will also fail.*

✅ **NOTE:** *The TCAS system does not generate traffic alerts for an aircraft which reports an on-ground state. However, an on-ground aircraft may generate a traffic alert if it is reporting airborne and otherwise meets the conditions of a traffic alert.*

The optional Traffic Alert and Collision Avoidance System II (TCAS II). It improves flight safety by monitoring the airspace for other aircraft with operating transponders in the vicinity. The TCAS II system provides traffic information to the displays, and if separation from other aircraft is within certain limits, the system issues Traffic Advisories (TAs) to assist the flight crew in the visual acquisition of traffic, or Resolution Advisories (RAs) to provide recommended vertical guidance maneuvers to resolve a traffic conflict with one or more aircraft.

THEORY OF OPERATION

When the TCAS II system is operating in TA/RA or TA Only Mode, the system interrogates the transponders of other aircraft in the vicinity, and monitors for replies from these transponders. Based on successive replies, the system tracks the range, bearing, and if reported, the altitudes of other aircraft. For each detected aircraft transponder, the system calculates the time to, and separation at, the closest point of approach (CPA) around potential collision area surrounding own aircraft. Based on this time, the own aircraft altitude, and the selected TCAS II operating mode, the system determines if a TA or RA should be issued for the detected intruder traffic.

Altitude in Feet [1]	TA Time to CPA in Seconds	RA Time to CPA in Seconds
Up to 1000	20	*RA Not Issued below 1000'*
1000-2350	25	15
2350-5000	30	20
5000-10000	40	25
10000-20000	45	30
20000 and above	48	35

[1] *System uses pressure altitude except when Radar Altimeter altitude is displayed on the PFDs, in which case Radar Altitude takes precedence.*

Table 6-30 Altitude-based TCAS II TA and RA Alert Thresholds

The TCAS II system categorizes detected traffic into four groups:

- Non-Threat traffic, is displayed as an open white diamond or arrow.
- Proximity Advisory (PA) traffic, displayed as a filled white diamond or arrow, is not currently a threat, but is within six nm and ±1200 feet of own-aircraft altitude.
- A Traffic Advisory (TA), displayed as either a filled amber circle or a circle with an arrow inside of it, indicates traffic is within 20-48 seconds of a potential collision area. If a Traffic Map is shown, and the TA traffic is beyond the selected map range, the system displays a half-TA symbol at the edge of the map at the approximate relative bearing of the TA traffic. If TA traffic subsequently meets the criteria for an RA, and the system is operating in TA/RA Mode, the system will issue an RA.
- A Resolution Advisory (RA), displayed as a filled red square, indicates traffic is within 15-35 seconds of a potential collision area. If a Traffic Map is shown, and the RA traffic is beyond the selected map range, the system displays a half-RA symbol at the edge of the map at the approximate relative bearing of the RA traffic.

The symbols in the following table depict TCAS II traffic, and include Automatic Dependent Surveillance-Broadcast (ADS-B) traffic symbols. Refer to the ADS-B Traffic discussion later in this section for more information.

Symbol	Description
	Resolution Advisory (RA) without directional information.
	Resolution Advisory Off Scale beyond the selected map display range.
	Resolution Advisory (RA) with ADS-B directional information.
	Resolution Advisory Off Scale.
	Traffic Advisory with ADS-B directional information. Arrow points in the direction of the intruder aircraft track.
	Traffic Advisory without directional information.
	Traffic Advisory with ADS-B directional information is beyond the selected display range. Displayed at outer range ring at proper bearing. Arrow points in the direction of the intruder aircraft track.
	Traffic Advisory out of the selected display range without directional information. Displayed at outer range ring at proper bearing.
	Proximity Advisory with ADS-B directional information. Arrow points in the direction of the aircraft track.
	Proximity Advisory without directional information.
	Other Non-Threat traffic with ADS-B directional information. Arrow points in the direction of the intruder aircraft track.
	Other Non-Threat traffic without directional information.
	Traffic located on the ground with ADS-B directional information. Arrow points in the direction of the aircraft track. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.
	Ground traffic without ADS-B directional information. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.
	Non-aircraft ground traffic with ADS-B directional information. Pointed end indicates direction of travel. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.
	Non-aircraft ground traffic without ADS-B directional information. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.

Table 6-31 Traffic Symbols with TCAS II and ADS-B

Garmin G5000 Pilot's Guide for the Textron Citation 560XL/XLS

TCAS II ALERTS

When the TCAS II unit issues a TA or RA, the following occur:

- The traffic system issues a voice alert.
- A 'TRAFFIC' annunciation appears above the Selected Heading display on the PFDs, flashes for 5 seconds and remains displayed until no TAs or RAs are detected in the area. RA 'TRAFFIC' annunciations are white text with red backgrounds; TA 'TRAFFIC' annunciations are black text with amber backgrounds. If a TA and RA occur simultaneously, only the red and white RA 'TRAFFIC' annunciation is shown.
- If the PFD is operating in FULL mode, the PFD automatically displays an inset map. If no inset map was enabled prior to the TA or RA, the system displays the PFD Inset Traffic Map. If the PFD Inset Navigation Map was enabled prior to the TA or RA, the system displays the PFD Inset Navigation Map with the traffic overlay enabled.
- During a TA only, the system issues a single *"Traffic, Traffic"* voice alert each time the system detects a new TA.
- During an RA only, voice alert(s) provide vertical guidance to resolve the traffic conflict. The Vertical Speed Indicator displays a range of vertical speeds to fly to or avoid as applicable. The Attitude Indicator shows a range of pitch attitudes to fly to or avoid. Additional voice alerts occur to denote changes in the RA status or when the aircraft is clear of the conflict.
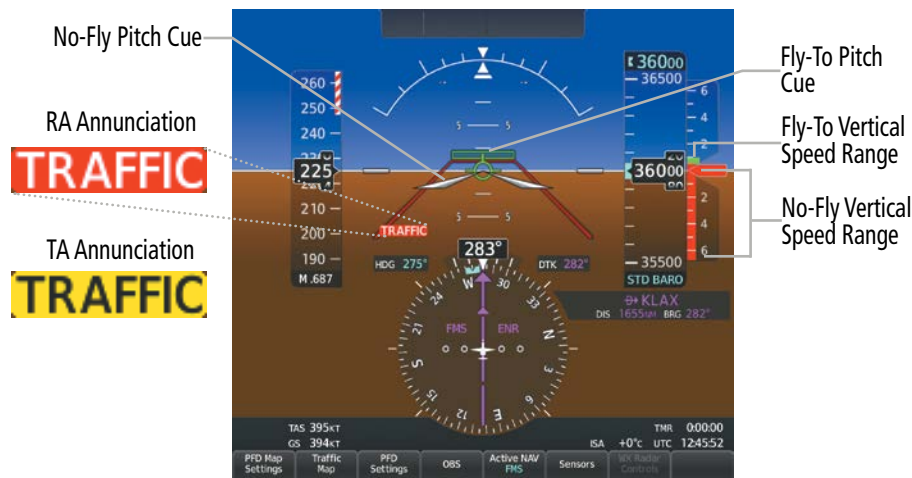
Figure 6-137 Traffic Annunciation with Resolution Advisory (PFD)

RESOLUTION ADVISORIES

Resolution Advisories (RAs) include recommended vertical guidance maneuvers to be flown in order to resolve a traffic conflict. If other aircraft involved in the RA encounter are also equipped with a TCAS II system, the systems coordinate the recommended maneuvers using the Mode S data link in order to produce complimentary responses to resolve the RA. While an RA is occurring, the system monitors the status, and if necessary, strengthens, weakens, reverses the RA, or declares the aircraft is clear of the traffic conflict.

While an RA is occurring, the Vertical Speed Indicator (VSI) shows a range of vertical speeds required to resolve the traffic conflict. A red vertical bar appears on the VSI scale to indicate the range of vertical speeds to be avoided during the RA, if applicable to the RA. If the current aircraft vertical speed is within this red range, the pointer on the VSI appears red. The vertical speed display appears in white when shown within the red VSI range. When an RA directs the flight crew to fly to (or maintain) a vertical speed range, a green vertical bar appears on the VSI scale at the recommended vertical speed range.

The Attitude Indicator depicts a range of pitch attitudes to avoid using one or two no-fly pitch cues positioned on the pitch scale. The no-fly pitch cues are indicated by red open trapezoid-shaped areas encompassing the range of pitch attitudes to be avoided during an RA. If an RA requires a change in existing pitch attitude, a green rectangular fly-to pitch cue appears above or below the no-fly pitch cue to indicate a recommended pitch attitude. If multiple intruding aircraft limit available pitch travel in both directions, two no-fly pitch cues appear on the pitch scale, indicating the appropriate pitch attitude is between the two no-fly pitch cues.

The system removes the pitch cues on the Attitude Indicator and vertical bars on the Vertical Speed Indicator when the RA condition has been resolved. The TCAS II system issues a voice alert when the aircraft is clear of the RA conflict.

The TCAS II system considers uses own aircraft performance capabilities, configuration, and other factors in order to determine the most appropriate RA to issue for a given set of conditions.

RAs are categorized into the preventive and corrective types.

PREVENTIVE RAS

The system issues a Preventive RA to indicate the present vertical speed will resolve the traffic conflict. The system indicates a range of vertical speeds to be avoided, indicated by one or more red bands inside the VSI. The current vertical speed is outside of the avoidance area during a Preventive RA.

Preventive RA Type	Required Vertical Speed (fpm)
Do Not Climb	< 0
Do Not Climb > 500 fpm	< 500
Do Not Climb > 1000 fpm	< 1000
Do Not Climb > 2000 fpm	< 2000
Do Not Descend	> 0
Do Not Descend > 500 fpm	> -500
Do Not Descend > 1000 fpm	> -1000
Do Not Descend > 2000 fpm	> -2000

Table 6-32 Preventive RA Types with Required Vertical Speeds

CORRECTIVE RA

A Corrective RA indicates the current vertical speed must be changed to resolve a traffic conflict. The VSI indicates a range of vertical speeds to be avoided on the VSI, and the current vertical speed appears in white with a red background. The VSI also indicates a green "fly to" vertical speed range to be flown in order to resolve the RA conflict. In some cases, the TCAS II system logic determines it will be necessary to for own aircraft to cross through the intruder aircraft's altitude to resolve the traffic conflict.

Corrective RA Type	Required Vertical Speed (fpm)
Climb	1500 to 2000
Crossing Climb	
Crossing Maintain Climb	1500 to 4400
Maintain Climb	
Reduce Descent	0
Descend	-1500 to -2000
Crossing Descend	
Crossing Maintain Descent	-1500 to -4400
Maintain Descent	
Reduce Climb	0

Table 6-33 Corrective RA Types with Required Vertical Speeds

TCAS II Voice Alerts for Traffic

Table 6-34 lists the voice alerts the TCAS II system issues in the course of a TA or RA.

Alert Type	Voice Alert
TA	"Traffic, Traffic"
Climb RA	"Climb, Climb"
Descend RA	"Descend, Descend"
Altitude Crossing Climb RA	"Climb, Crossing Climb, Climb, Crossing Climb"
Altitude Crossing Descend RA	"Descend, Crossing Descend, Descend, Crossing Descend"
Reduce Climb RA	"Level Off, Level Off"
Reduce Descent RA	"Level Off, Level Off"
RA Reversal to Climb RA	"Climb - Climb NOW, Climb - Climb NOW"
RA Reversal to Descend RA	"Descend - Descend NOW, Descend - Descend NOW"
Increase Climb RA	"Increase Climb, Increase Climb"
Increase Descent RA	"Increase Descent, Increase Descent"
Maintain Rate RA	"Maintain Vertical Speed, Maintain"
Altitude Crossing, Maintain Rate RA (Climb and Descend)	"Maintain Vertical Speed, Crossing Maintain"
Preventive RA	"Monitor Vertical Speed"
RA Removed	"Clear of Conflict"

Table 6-34 TCAS II Voice Alerts

Corrective Climb

Corrective Descend

Preventive Don't Climb

Preventive Don't Descend

Preventive Don't Climb and Don't Descend

Corrective Increase Descent

Figure 6-138 Example Resolution Advisory Displays (PFD)

OPERATION

The TCAS II operating mode controls are integrated with the transponder controls, and are available on the Traffic Settings Screen and on the Transponder Screen. The Traffic Settings Screen also provides additional controls for testing the traffic system and for displaying other aircraft. Refer to the Audio & CNS Section of this Pilot's Guide for a discussion regarding transponder mode selection and operation. The flight crew makes selections in the XPDR/TCAS Mode Window, which is shown on either screen.
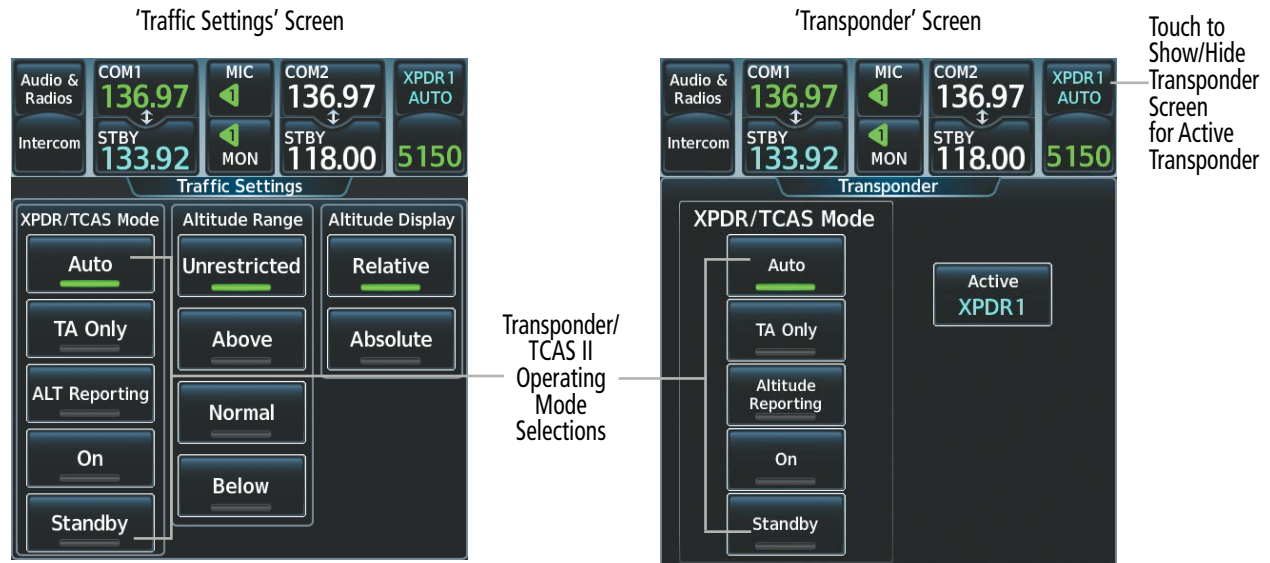
Figure 6-139 Controlling TCAS II Operating Modes on the Traffic Settings and Transponder Screens

Accessing TCAS II Operating Modes on the Traffic Settings Screen:

1) From Home, touch **Traffic > Traffic Settings**.

   Or:

   From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the Traffic **Settings** Button.

Accessing TCAS II Operating Modes on the Transponder Screen:

Touch the **XPDR1** or **XPDR2** Button in the CNS Bar (button name dependent on current active transponder.

The XPDR/TCAS Mode Window offers the selections shown in the following table.

XPDR/TCAS Mode Selection	Transponder Mode	Available TCAS II Modes	Traffic System Behavior
Auto	Altitude Reporting	TA/RA or TA Only	The system automatically selects TCAS II operating modes. When powered up on the ground, and below 1000' AGL in the air, the traffic system is in TA Only Mode, and displays traffic and issues TAs, but does not issue RAs. Above 1000' AGL, the traffic system selects TA/RA Mode, and the system issues TAs and RAs as applicable.
TA Only	Altitude Reporting	TA Only	The system displays traffic and issues TAs, but does not issue RAs.
Altitude Reporting	Altitude Reporting	Standby	In these modes, the Traffic System is in Standby Mode, and does not display traffic or issue TAs or RAs.
On	On	Standby	
Standby	Standby	Standby	

Table 6-35 Transponder and TCAS II Mode Interaction

> **NOTE:** *The operating mode of the TCAS II system is annunciated on the Traffic Map Pane and Traffic Inset Map. When the crew selects the Auto XPDR/TCAS Mode, Auto remains annunciated on the XPDR1 / XPDR2 Button, while the traffic maps indicate the operating mode of the TCAS II system (TA/RA, TA Only, Standby), as determined by the conditions noted in the previous table.*

Testing the Traffic System:

1) From Home, touch **Traffic** to display the 'Traffic Map' Pane.

2) Turn the **Joystick** as necessary to set the 'Traffic Map' Pane range so the outer ring indicates '6 NM'. This will allow the system to show all traffic symbols in the traffic test pattern.

3) From Home, touch **Aircraft Systems > System Tests**.

4) Touch the **TCAS** Button. Button indicates 'In Progress' while test is occurring, 'Pass' or 'Fail' when complete. If system test is successful, system displays a test pattern of traffic symbols and provides the voice alert, **'TCAS II System Test Passed'**, and the traffic system returns to the previously selected mode. If the test fails, the system issues the voice alert, **'TCAS II System Test Failed'** and enters Standby Mode.
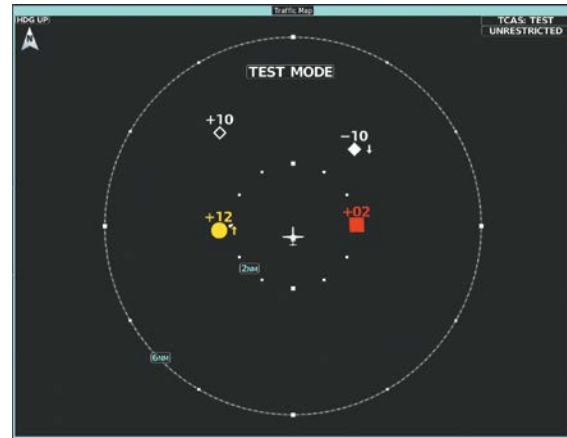
PFD   MFD 'Traffic Map' Page

Figure 6-140 Testing the TCAS II System

'TRAFFIC MAP' PANE

The 'Traffic Map' Pane shows surrounding traffic data in relation to the aircraft's current position and altitude, without basemap clutter. It is the principal map pane for viewing traffic information. Aircraft orientation is always heading up unless there is no valid heading. Range rings indicate map ranges. Turn the *Joystick* on the Touchscreen Controller counter-clockwise to decrease the map range, or clockwise to increase the range. If the 'Traffic Map' Pane is displayed on the PFD in Split Mode, turning the **Joystick** on the Touchscreen Controller also adjusts the range on the 'Traffic Map' Pane.

The traffic operating mode and altitude display mode appear in the upper right corner of the 'Traffic Map' Pane.

To show the 'Traffic Map' Pane, touch the **Traffic** Button on the Home Screen of the Touchscreen Controller. In addition, when the PFD is operating in Split Mode, pressing the **Traffic** Softkey also displays the 'Traffic Map' Pane on the PFD.
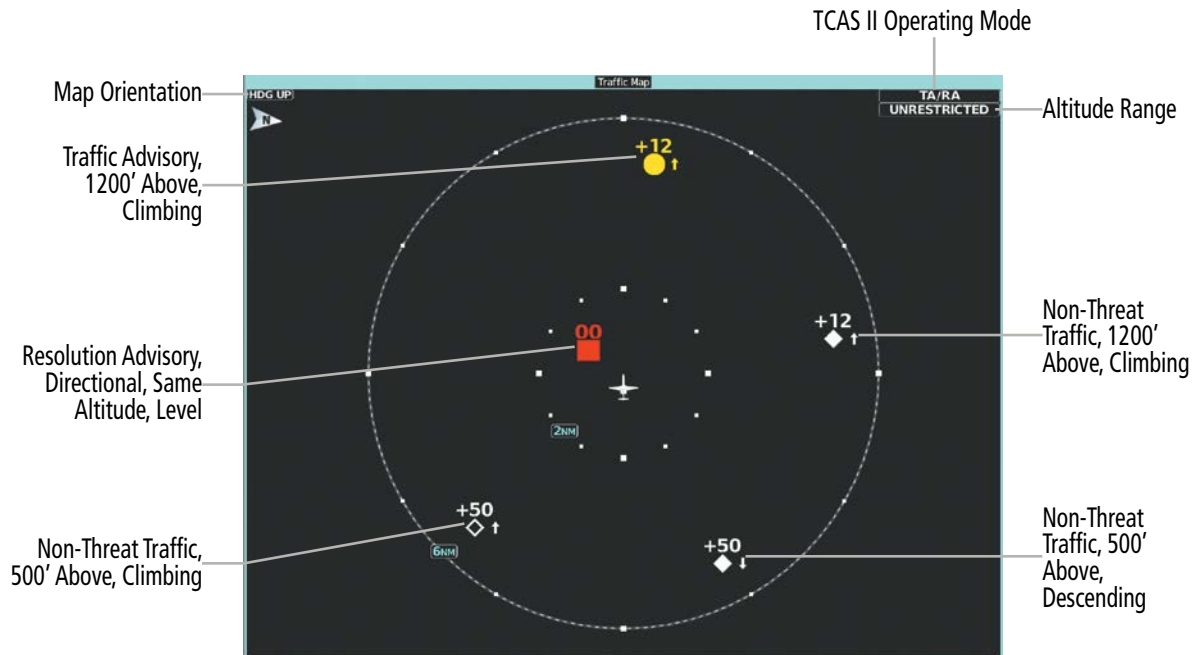
Figure 6-141 'Traffic Map' Pane (TCAS II)

ALTITUDE RANGE

The flight crew can select the volume of airspace in which Proximity Advisory and Other, Non-Threat traffic is displayed. Note the system will still show RAs and TAs occurring outside of these limits regardless of the altitude mode chosen.

Changing the altitude range:

1) From Home, touch **Traffic > Traffic Settings**.

   Or:

   From Home, touch **Map > Map Selection > Map Settings** > Traffic **Settings** Button.

2) Touch the **Altitude Range** Button:

3) Touch one of the following Altitude Range Buttons:

   • **Unrestricted:** All traffic is displayed from 9900 feet above and 9900 feet below the aircraft.

   • **Above:** Displays non-threat and proximity traffic from 9900 feet above the aircraft to 2700 feet below the aircraft. Typically used during climb phase of flight.

   • **Normal:** Displays non-threat and proximity traffic from 2700 feet above the aircraft to 2700 feet below the aircraft. Typically used during enroute phase of flight.

   • **Below:** Displays non-threat and proximity traffic from 2700 feet above the aircraft to 9900 feet below the aircraft. Typically used during descent phase of flight.

Displays other aircraft altitude relative to own altitude

Selects an Altitude Range of Traffic to be displayed

Displays other aircraft altitude as absolute altitude
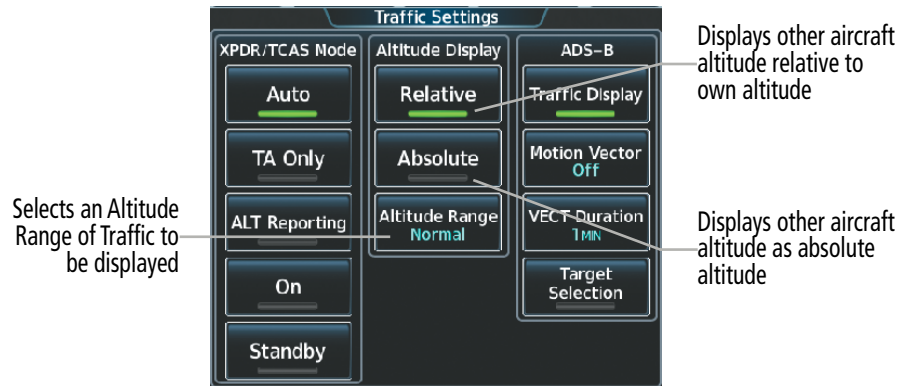
Figure 6-142 Selecting an Altitude Mode and Altitude Display on the 'Traffic Settings' Screen

Changing the display of Intruding Traffic Altitude:

1) From Home, touch **Traffic > Traffic Settings**.

Or:

From Home, touch **Map > Map Selection > Map Settings** > Traffic **Settings**.

2) Touch the **Relative** Button to display the altitude of intruding aircraft relative to own aircraft altitude, or touch the **Absolute** Button to display the absolute altitude of intruding aircraft.

ADDITIONAL TRAFFIC DISPLAYS

The system can overlay traffic information on the navigation map panes as well as the PFD Navigation Maps. Traffic information is also available on the PFD when the Synthetic Vision System (SVT) Terrain is enabled. See the Flight Instruments Section for details.

Enabling/disabling display of traffic information on the 'Navigation Map' Pane:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the **Traffic** Button to enable/disable overlay of traffic information.

When the display of traffic is enabled on maps other than the 'Traffic Map' Pane, the system shows a traffic status icon in the lower right corner of the map as well as the selected altitude range of traffic to show.

Figure 6-143 TCAS II Traffic on 'Navigation Map' Pane

Traffic information can also be overlaid on PFD navigation maps.

A Traffic Map is available on the PFD by pressing the **Traffic Map** Softkey. If no previous maps were displayed on the PFD, a Inset Traffic map will be displayed. If a PFD navigation map was previously displayed either Inset or HSI, pressing the **Traffic Map** Softkey will display a traffic map in that location. When a traffic map is displayed the map will be displayed in heading up orientation. Traffic information can also be overlaid with navigation, topographic and optional datalink weather information on navigation maps.

The flight crew can change the PFD Traffic Map display range by pressing either the Map Range - or Map Range + Softkeys to decrease or increase respectively.

Displaying/removing the Traffic Inset Map on the PFD:

Press the **Traffic Map** Softkey to show or hide the PFD Traffic Inset Map.

Enabling/disabling display of traffic information on the PFD Inset Navigation Map:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Traffic** Softkey to enable/disable the overlay of traffic information on the map.

Traffic Inset Map
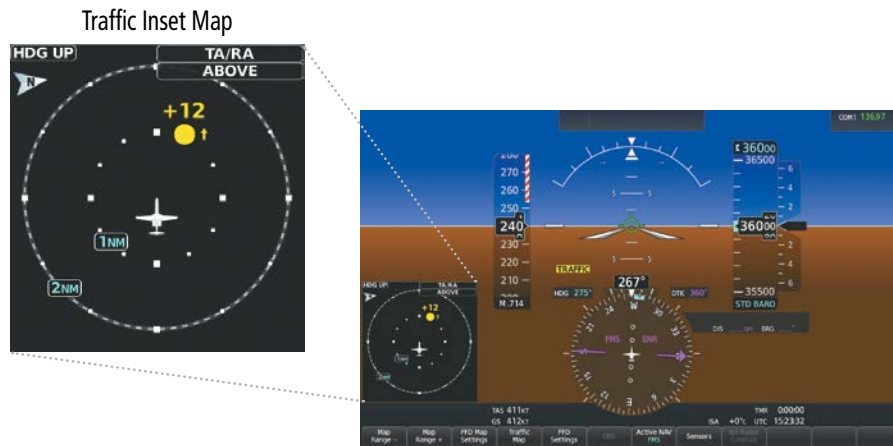
Figure 6-144 Displaying the PFD Inset Traffic Map

The HSI can also present a version of the Traffic Map. Traffic operating mode information is not present on this map. Refer to the Flight Instruments section for more information about displaying maps on the HSI.

Figure 6-145 HSI Map with TCAS II Traffic

Showing the HSI Traffic Map:

1) Press the **PFD Map Settings** Softkey.

2) Press the **Map Layout** Softkey.

3) Press the **HSI Traffic** Softkey.

4) Press the **Back** Softkey.

Customizing the display of traffic on the Navigation Map Panes:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If necessary, touch the **Sensor** Tab.

3) Touch the Traffic **Settings** Button.

4) Touch the **Map Settings** Button.

5) To change the map range above which the system removes traffic symbols from the display, touch the **Symbols Button,** then scroll to and touch to select a map range above which the system removes traffic symbols from the display pane.

6) Touch the **Labels** Annunciator Button to enable/disable the display of labels on traffic (such as altitude).

7) To change the map range at which the system removes traffic labels from the display, touch the Labels range button, then scroll to and touch to select a map range above which the system removes traffic labels from the display pane.

8) When finished, touch the **Back** Button or the **Home** Button.
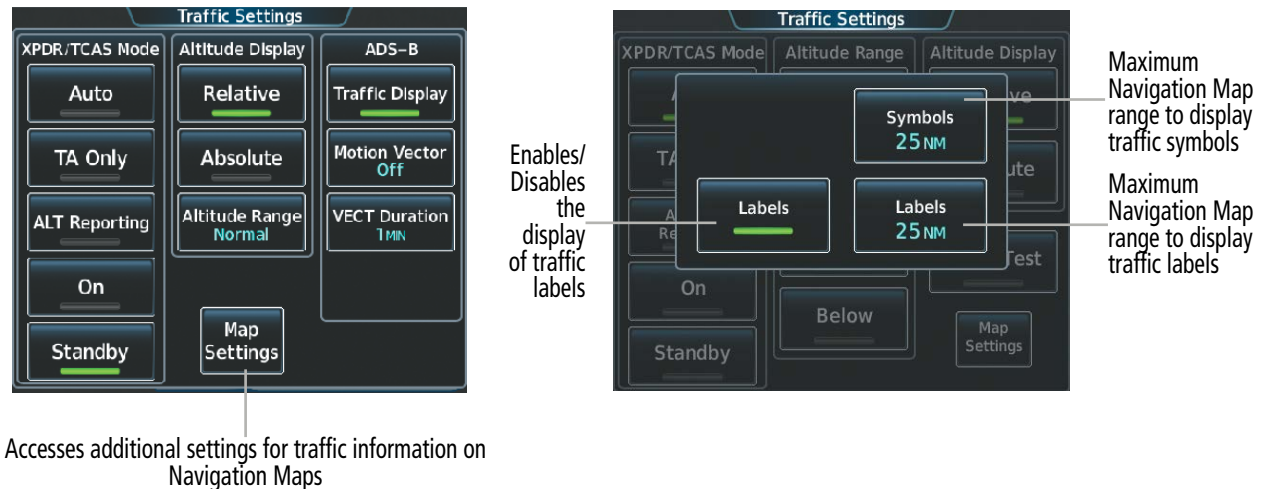
Figure 6-146 Adjusting the settings for traffic information on Navigation Maps

SYSTEM STATUS

The traffic mode is annunciated in the upper right corner of the 'Traffic Map' Pane.

Operating Mode	PFD Annunciation	Traffic Map Mode Annunciation	Traffic Display Status Icon (Other Maps)
TCAS II Self-test Initiated (TEST)	None	**TEST** ('TEST MODE' also shown in white on top center of pane)	
Traffic Advisory and Resolution Advisory (TA/RA)	None	**TA/RA**	
Traffic Advisory Only (TA ONLY)	**TA ONLY**	**TA ONLY**	
TCAS II Standby (Shown if Altitude Reporting, On, or Standby Mode Selected), or after landing or on-ground when apllying power.	None	**STANDBY** (also shown in white in center of Pane on ground, amber in the air)	
TCAS II Standby	None	**STANDBY** (also shown in white in center of Pane on ground, amber in the air)	
TCAS II Failed*	None	**TCAS: FAIL**	

[1] *See Table 6-37 for additional failure annunciations.*

Table 6-36 TCAS II Modes

If the traffic system fails, an annunciation as to the cause of the failure is shown in the center of the 'Traffic Map' Pane.

Traffic Map Center Banner Annunciation	Description
NO DATA	Data is not being received from the TCAS II unit.
DATA FAILED	Data is being received from the TCAS II unit, but the unit is self-reporting a failure.
FAILED	TCAS II unit self-reporting a failure or no data received after applying system power.

Table 6-37 TCAS II Failure Annunciations on the 'Traffic Map' Pane

When the display of traffic information is enabled on navigation maps, the following annunciations may appear in the lower left corner of these maps.

Traffic Status Banner Annunciation	Description
RA OFF SCALE	A Resolution Advisory is outside the selected display range. [1] Annunciation is removed when traffic comes within the selected display range.
TA OFF SCALE	A Traffic Advisory is outside the selected display range. [1] Annunciation is removed when traffic comes within the selected display range.
RA X.X ± XX ↕	System cannot determine bearing of Resolution Advisory. [2] Annunciation indicates distance in nm, altitude separation in hundreds of feet, and altitude trend arrow (climbing/descending), if altitude trend is available.
TA X.X ± XX ↕	System cannot determine bearing of Traffic Advisory. [2] Annunciation indicates distance in nm, altitude separation in hundreds of feet, and altitude trend arrow (climbing/descending), if altitude trend is available.
TCAS FAIL	TCAS II unit has failed (unit is self-reporting a failure or sending incorrectly formatted data).
TRFC UNAVAIL	Data is not being received from the TCAS II unit.

[1] *Shown as symbol on 'Traffic Map' Pane.*
[2] *Shown in center of 'Traffic Map' Pane.*

Table 6-38 TCAS II Traffic Status Annunciations on Navigation Maps

6.10 ADS-B TRAFFIC

⚠ **WARNING:** *Do not rely solely upon the display of traffic information for collision avoidance maneuvering. The traffic display does not provide collision avoidance resolution advisories and does not under any circumstances or conditions relieve the pilot's responsibility to see and avoid other aircraft.*

⚠ **WARNING:** *Do not rely solely upon the display of traffic information to accurately depict all of the traffic information within range of the aircraft. Due to lack of equipment, poor signal reception, and/or inaccurate information from other aircraft, traffic may be present but not represented on the display.*

ADS-B SYSTEM OVERVIEW

Automatic Dependent Surveillance-Broadcast (ADS-B) is a core technology in the FAA NextGen air traffic control system. It offers improved surveillance services, both air-to-air and air-to-ground, especially in areas where radar coverage is ineffective due to terrain, or where it is impractical or cost prohibitive. ADS-B is comprised of three segments for the purposes of providing traffic information: ADS-B (Broadcast), ADS-R (Rebroadcast), and Traffic Information Service-Broadcast (TIS-B).

ADS-B includes the automatic broadcast of position reports by aircraft, surface vehicles, and transmitters on fixed objects. These broadcasts contain information such as GPS position, identity (Flight ID, Call Sign, Tail Number, ICAO registration number, etc.), ground track, ground speed, pressure altitude, and emergency status.
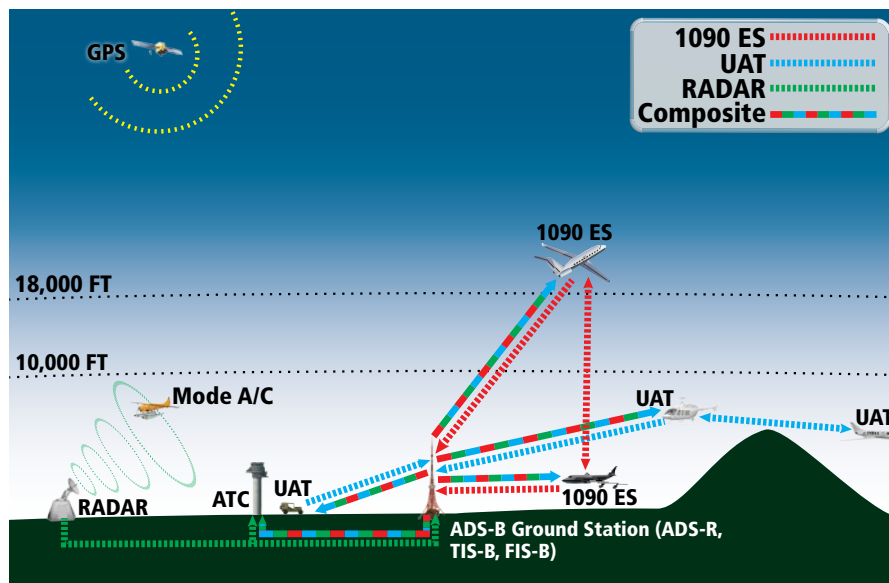
Figure 6-147 ADS-B System

For the purpose of distinguishing between levels of ADS-B service, there are three classifications of aircraft or system capability: ADS-B In, ADS-B Out, and ADS-B participating. ADS-B In refers to the capability to receive ADS-B information. ADS-B Out refers to the capability to transmit ADS-B information. ADS-B participating refers to the capability to both send and receive ADS-B information. Aircraft lacking either ADS-In, ADS-B Out, or both ADS-B capabilities may also be referred to as ADS-B nonparticipating aircraft.

The ADS-B system operates on two frequencies: 1090 MHz and 978 MHz. Both frequencies provide the same traffic information. An aircraft may be ADS-B In, Out, or participating on one or both frequencies, depending on the installed equipment. The 1090 MHz frequency portion of ADS-B is known as 1090 Extended Squitter (1090 ES). The 978 MHz portion of ADS-B is known as Universal Access Transceiver (UAT).

The transponder(s) provides ADS-B Out functions using the 1090 ES data link. The Garmin GTS 8000 TCAS II system provides ADS-B In information using the 1090 ES data link.

AUTOMATIC DEPENDENT SURVEILLANCE-REBROADCAST (ADS-R)

Because it is not required that ADS-B In capable aircraft be able to receive ADS-B data on both the 1090 MHz and 978 MHz data links, a method exists to get data from one data link to the other. ADS-R is the rebroadcast of ADS-B data by FAA ground stations, which provide this service by taking traffic data from one link and rebroadcasting it on the other. For example, if two aircraft are in the service volume for a ground station, and one is transmitting on the 1090 MHz frequency and the other is transmitting on the 978 MHz frequency, the ground station retransmits the data from each aircraft on the other link to ensure the two aircraft can "see" each other as traffic.

If another aircraft can only receive 978 MHz UAT information, it cannot directly 'see' another aircraft sending only 1090 ES information aircraft unless an ADS-R ground station in the vicinity rebroadcasts the 1090 ES data over the 978 MHz UAT frequency. This is also true for an aircraft which can only receive 1090 ES data; it would need an ADS-R ground station to 'see' another aircraft operating on the UAT frequency.

TRAFFIC INFORMATION SERVICE-BROADCAST (TIS-B)

TIS-B provides a link between the secondary surveillance radar (SSR)-based system ATC uses and the ADS-B-based system. When an ADS-B In or Out capable aircraft is within the service volume of an FAA ADS-B ground station, the ground station broadcasts a portion of the ATC radar data to the aircraft. This aircraft is then included in the list of aircraft being provided TIS-B service and is then considered a "TIS-B participant."

TIS-B coverage is available when the aircraft is within ground station and SSR coverage, and the other aircraft is also in SSR coverage, and is transmitting its altitude.

The ground station provides ATC radar information for other aircraft within ±3,500 feet and 15 NM of the participant, to include altitude, position, ground speed, and ground track. TIS-B broadcasts occur once every three to thirteen seconds, depending on the characteristics of the ground station providing the TIS-B service.

The following table describes the aircraft that are observed by an aircraft with a GTS 8000 traffic system and a GTX 3000 transponder:

Other Aircraft Equipment	Viewable by GTS 8000 Equipped Aircraft
1090ES Out Equipped	Yes
UAT Receive Only Equipped	No
UAT Transmit Only Equipped	Yes, if both aircraft are within ADS-R coverage, or when provided from TIS-B
No Transponder, No ADS-B	No
Non ADS-B Equipped, but with Mode C or S Transponder	Yes, if other aircraft is within active TCAS surveillance range, or when provided from TIS-B.

Table 6-39 Aircraft Available for Viewing by an ADS-B Equipped Own Aircraft

ADS-B WITH TCAS II

When the display of ADS-B traffic is enabled, and the TCAS II system is in an operating mode (i.e. actively interrogating the transponders of other aircraft, the system attempts to match (or "correlate") data from the two traffic sources. When a correlation is made, the system displays the traffic information for the tracked aircraft determined to be the most accurate. Any traffic that is not correlated (i.e., only detected by one system but not the other) is also displayed for the flight crew. This may occur, for example, if another aircraft is beyond the active surveillance range of the TCAS II system, but own aircraft is receiving information via ADS-B for the other aircraft. The traffic correlation feature improves the accuracy of the traffic displayed, while reducing the occurrence of displaying the same traffic for a given aircraft twice.

> **NOTE:** *In certain situations, a single aircraft may be depicted as two aircraft on the display if the system is unable to correlate the traffic. This may occur, for example, when operating on the edges of ATC radar coverage, or the TCAS II system is receiving intermittent data. This may also occur if TIS-B traffic data does not closely match the traffic data from other sources, especially while the traffic tracked by ATC radar is turning.*

> **NOTE:** *The TCAS II system issues alerts for traffic it is tracking using TCAS II alerting criteria. The ADS-B system issues alerts for traffic it is tracking using the ADS-B Traffic Advisory System (ATAS) criteria.*

> **NOTE:** *The optional TCAS II system does not use ADS-B information for the purposes of determining when to issue Resolution Advisories (RA).*

ADS-B TRAFFIC ADVISORY SYSTEM (ATAS)

ADS-B Traffic Advisory System (ATAS) is an alerting algorithm which provides ADS-B traffic alerts to the flight crew which are similar in nature to the TCAS II Traffic system discussed previously.

When a TA occurs, the system displays an amber 'TRAFFIC' annunciation on the PFDs and provides a voice alert. The TA voice alert corresponds to the installed traffic system. For example, if a TCAS I system is installed, the voice alert is *"Traffic"*, followed by additional voice information about the bearing, relative altitude, and approximate distance from the intruder that caused the TA. When a TCAS II system is installed, the TA voice alert is *"Traffic, Traffic"* for traffic meeting conditions. The own aircraft altitude above terrain determines the sensitivity of the ATAS algorithm to minimize nuisance alerts to the flight crew.

> **NOTE:** *The system mutes TA voice alerts from ADS-B sources when own aircraft is below 400 feet AGL.*

Sensitivity Level	Height Above Airport Reference Point (Feet)	Radar Altitude (Feet)	Height Above Terrain (HAT)	Own Altitude (Feet)	Look-ahead time (sec)	Vertical Threshold for Alert (Feet)	Protected Volume (NM)
4	< = 1500 and within 5 NM of airport reference point	Any	Any	Any	30	400	0.20
4	Unavailable	< = 1500	Any	Any	30	400	0.20
4	Unavailable	Unavailable	< = 1500	Any	30	400	0.20
5	Unavailable or > 1500	Unavailable or > 1500	Unavailable or > 1500	< = 5000	35	700	0.35
6	Unavailable or > 1500	Unavailable or > 1500	Unavailable or > 1500	> 5000 < = 10,000	40	700	0.55
7	Unavailable or > 1500	Unavailable or > 1500	Unavailable or > 1500	> 10,000 < = 20,000	45	700	0.80
8	Unavailable or > 1500	Unavailable or > 1500	Unavailable or > 1500	> 20,000	48	700	1.10

Table 6-40 ATAS Alerting Thresholds for ADS-B Traffic

AIRBORNE AND SURFACE APPLICATIONS

ADS-B traffic can help the pilot visually acquire traffic both in the air and on-the-ground. There are two ADS-B applications or modes: Airborne Situational Awareness (AIRB) and Surface Situational Awareness (SURF). The system automatically selects the appropriate application based on conditions.

The AIRB application is on when the aircraft is more than five NM and 1,500 feet above the nearest airport. When the AIRB application is active, the system only displays traffic which is airborne.

The SURF application is on when the aircraft is within five NM and less than 1,500 feet above field elevation. When the SURF applications is on, the system displays airborne and on the ground traffic. At a Traffic Map Pane range of one NM or less, the airport environment (including taxiways and runways) appears in addition to traffic. The airport displays are derived from the SafeTaxi database. Refer to the Additional Features section for more information about SafeTaxi displays.

> **NOTE:** *Do not rely on the solely on the traffic display to determine the runway alignment of traffic, especially when runways are in close proximity to each other.*

Due to the varying precision of the data received via ADS-B, ADS-R, and TIS-B services, not all traffic symbols may not be depicted on the traffic display. Because higher data precision is required for traffic to be displayed in the SURF environment, some traffic eligible for AIRB will not be displayed while SURF is on. Availability for AIRB and SURF is depicted on the ADS-B Status Screen, discussed later in this section.
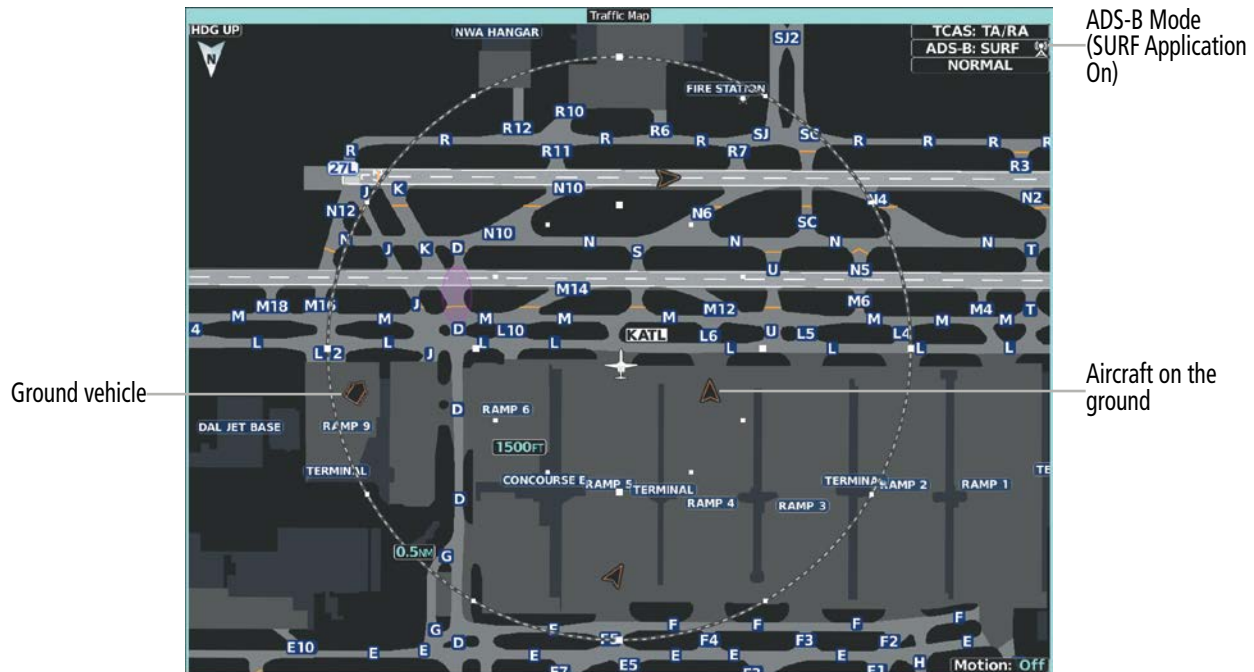
Figure 6-148 'Traffic Map' Pane with SURF Mode On

> **NOTE:** *Refer to the previous traffic sections in this Pilot's Guide for a table of traffic symbols the system can display.*

OPERATION

TRAFFIC MAP PANE

The 'Traffic Map' Pane shows surrounding traffic data in relation to the aircraft's current position and altitude, without basemap clutter. Aircraft orientation is always heading up unless there is no valid heading. Map range is adjustable with the **Joystick**, as indicated by the map range rings.

The traffic mode and altitude display range are annunciated in the upper right corner of the pane.

Figure 6-149 'Traffic Map' Pane with ADS-B Traffic Enabled

Enabling/disabling the display of ADS-B traffic:

1) From Home, touch **Traffic > Traffic Settings**.

 Or:

 a) From Home, touch **Map > Map Selection > Map Settings**.

 b) Touch the Traffic **Settings** Button on the **Sensor** Tab.

2) Touch the ADS-B **Traffic Display** Button.

DISPLAYING MOTION VECTORS

When Absolute Motion Vectors are selected, the vectors extending from the traffic symbols depict the traffic's reported track and speed over the ground. When Relative Motion Vectors are selected, the vectors extending from the traffic symbols display how the traffic is moving relative to own aircraft. These vectors are calculated using the traffic's track and ground speed and own aircraft's track and ground speed. These two values are combined to depict where the traffic is moving purely with respect to own aircraft, and provide a forecast of where the traffic will be, relative to own aircraft, in the near future. If the system does not have sufficient information to calculate motion vectors, they are not shown.

Figure 6-150 'Traffic Map' Pane with Absolute Motion Vectors Enabled

Figure 6-151 'Traffic Map' Pane with Relative Motion Vectors Enabled

Selecting a Motion Vector display:

1) From Home, touch **Traffic > Traffic Settings**.

   Or:

   a) From Home, touch **Map > Map Selection > Map Settings**.

   b) Touch the Traffic **Settings** Button.

2) Touch the ADS-B **Motion Vector** Button.

3) Touch a button to select the desired Motion Vector display mode: **Off**, **Absolute**, or **Relative**.

4) To change the duration of time used to forecast motion vectors, touch the **VECT Duration** Button.

5) Touch a button for the desired duration: **30SEC**, **1MIN**, **2MIN**, or **5MIN**.

DISPLAYING ADDITIONAL TRAFFIC INFORMATION

The 'Traffic Map' Pane can display additional information for a selected aircraft symbol. This may include the aircraft tail number/Flight ID, type of aircraft (e.g., glider, small/medium/large aircraft, service vehicle, unmanned airborne vehicle (UAV), course, track, groundspeed, and other information.

Showing additional traffic information:

1) From Home, touch **Traffic > Traffic Settings**.

2) Touch the ADS-B **Target Selection** Button.

3) Turn the right knob. A cyan border appears on the first selected traffic symbol. Additional information appears in a window in the lower-left corner of the 'Traffic Map' Pane.

4) To select a different aircraft symbol, turn the right knob.

5) When finished, touch the **Target Selection** Button again to disable the button.

TRAFFIC MAP PANE DISPLAY RANGE

The pilot can adjust the range of traffic displayed on the 'Traffic Map' Pane. Range indications appear on rings shown on the pane. The minimum map range is 750 feet. A maximum map range of 40 nautical miles is available.

Selecting the Traffic Map Display Range:

1) From Home, touch the **Traffic > Traffic Settings** Button.

2) Turn the **Joystick** clockwise to increase map range, or counter-clockwise to decrease map range.

> **NOTE:** ADS-B traffic can be displayed as an overlay to navigation maps. Refer to the previous TCAS discussions discussion for information about these additional traffic displays.

ADS-B SYSTEM STATUS

The traffic mode is annunciated in the upper right corner of the 'Traffic Map' Pane.

ADS-B Mode	Traffic Mode Annunciation ('Traffic Map' Pane)	'Traffic Map' Pane Center Banner Annunciation	Traffic Display Status Icon (Other Maps)
ADS-B System Test Initiated	ADS–B: TEST	TEST MODE	
ADS-B Operating in Airborne Mode	ADS–B: AIRB	None	
ADS-B Operating in Surface Mode	ADS–B: SURF	None	
ABS-B Traffic Off	ADS–B: OFF	ADS–B TRFC OFF	
ADS-B Traffic Not Available	ADS–B: N/A	ADS–B TRFC N/A	
ADS-B Failed*	ADS–B: FAIL	ADS–B TRFC FAIL	

[1] *See Table 6-43 for additional failure annunciations.*

Table 6-41 ADS-B Modes

The 'Traffic Map' Pane displays a white antenna icon to indicate the successful reception of ADS-B traffic services from a ground station. If the system has no TCAS system installed, a white-X over this icon indicates that there is a potential incomplete traffic picture surrounding the aircraft at this time and reception of ADS-B services is unavailable. For systems with an installed and operating TCAS system, a white-X over this icon indicates the status of the TIS-B/ADS-R coverage is irrelevant and not required.

ADS-B Ground Station Reception Status	Traffic Map Pane Icon
Receiving ADS-B traffic services from a ground station.	
Not receiving ADS-B traffic services from a ground station.	

Table 6-42 ADS-B Modes

If the traffic unit fails, an annunciation as to the cause of the failure is shown in the center of the 'Traffic Map' Pane. During a failure condition, the Operating Mode cannot be selected.

Traffic Map Pane Center Annunciation	Description
NO DATA	Data is not being received from the traffic unit.
DATA FAILED	Data is being received from the traffic unit, but the unit is self-reporting a failure.
FAILED	Incorrect data format received from the traffic unit.

Table 6-43 Traffic Failure Annunciations

The annunciations to indicate the status of traffic information appear in a banner at the lower left corner of maps on which traffic can be displayed.

Traffic Status Banner Annunciation	Description
TA OFF SCALE	A Traffic Advisory is outside the selected display range. [1] Annunciation is removed when traffic comes within the selected display range.
TA X.X ± XX ↕	System cannot determine bearing of Traffic Advisory. [2] Annunciation indicates distance in nm, altitude separation in hundreds of feet, and altitude trend arrow (climbing/descending).
TRFC FAIL	The traffic unit has failed (unit is self-reporting a failure or sending incorrectly formatted data). [2]
NO TRFC DATA	Data is not being received from the traffic unit.

[1] *Shown as symbol on 'Traffic Map' Pane.*
[2] *Shown in center of 'Traffic Map' Pane.*

Table 6-44 Traffic Status Annunciations

Additional information about the status of ADS-B traffic products is available on the 'ADS-B Status' Screen.

Viewing ADS-B Traffic Status:

1) From Home, touch **Utilities > Setup > ADS-B Status**.

2) View the status of the traffic applications, then touch the **Back** Button or the **Home** Button when finished.

Figure 6-152 Viewing ADS-B Traffic Status on the 'ADS-B Status' Screen

ADS-B Status Screen Item	Status Message	Description
Airborne (AIRB), Surface (SURF), Airborne Alerts (ATAS)	On	Traffic application is currently on. Required input data is available, and it meets performance requirements.
	Available to Run	Traffic application is not currently active, but application is ready to run when condition(s) determine the application should be active. Required input data is available, and it meets performance requirements.
	Not Available	Traffic application is not available. Required input data is available, but it does not meet performance requirements.
	Fault	Traffic application is not available. Required input data is not available or the application has failed.
	Not Configured	Traffic application is not available, because it has not been configured. If this annunciation persists, the system should be serviced.
	----------------	Traffic application status is invalid or unknown.

Table 6-45 ADS-B Status Screen Messages for ADS-B Traffic

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SECTION 7 AUTOMATIC FLIGHT CONTROL SYSTEM

7.1 OVERVIEW

> **NOTE:** *The current version of the pertinent flight manual always supersedes the information in this Pilot's Guide.*

The Garmin Automatic Flight Control System (AFCS) is fully integrated within the system avionics architecture. The System Overview Section provides a block diagram to support this system description. The AFCS can be divided into these main operating functions:

- **Flight Director (FD)** — The Garmin AFCS Flight Director function can be coupled to either the pilot-side or copilot-side PFD data. The **CPL** Key selects the PFD source for the flight director. Commands for the selected flight director source are displayed on both PFDs. The flight director provides:
- Vertical/lateral mode selection and processing.
  - Command bars showing pitch and roll guidance.
  - Pitch and roll commands to the autopilot.
- **Autopilot (AP)** — Autopilot operation occurs within the pitch and roll servos. It provides automatic flight control in response to flight director steering commands, Attitude and Heading Reference System (AHRS) attitude and rate information, and airspeed.
- **Yaw Damper (YD**) — The yaw servo provides Dutch roll damping and turn coordination in response to yaw rate, roll angle, lateral acceleration, and airspeed.
- **Automatic Pitch Trim (APT)** — The pitch trim system provides automatic pitch trim when the autopilot is engaged.
- **Manual Electric Pitch Trim (MEPT)** — The pitch trim system provides manual electric pitch trim capability.

BASIC AUTOPILOT OPERATION

This section provides an overview for autopilot engagement and disengagement. A more detailed description follows in the Autopilot and Yaw Damper Section.

- **Autopilot Engagement** — The autopilot may be engaged by pushing the **AP** Key on the AFCS Controller. Annunciations regarding the engagement are indicated on the PFDs. Engaging the autopilot also engages the yaw damper.
- **Autopilot Engagement with Flight Director Off** — Upon engagement, the autopilot will be set to hold the current attitude of the airplane, if the flight director was not previously on. In this case, 'PIT' and 'ROL' will be annunciated.
- **Autopilot Engagement with Flight Director On** — If the flight director is on, the autopilot will smoothly pitch and roll the airplane to capture the FD command bars. The prior flight director modes remain unchanged.

- **Autopilot Disengagement** — The most common way to disconnect the autopilot is to press and release the **AP YD DISC/TRIM INT** Switch, which is located on the control wheel. When disengaged an 'autopilot' voice alert will be heard and annunciated on the PFDs. Other ways to disconnect the autopilot include:

  » Pressing the **AP** Key on the AFCS Controller

  » Pressing the **GA** Switch (located on each throttle)

  » Operating either or both halves of the **Pitch Trim** Switch (located on each control wheel)

  » Pulling the AFCS CTRL circuit breaker.

  In the event of unexpected autopilot behavior, pressing and holding the **AP YD DISC/TRIM INT** Switch will disconnect the autopilot and remove all power to the servos.

7.2 AFCS CONTROLS

AFCS CONTROLLER

The AFCS Controller has the following controls:

①⑩	**FD** Keys	Activates/deactivates the flight director only
		- Pressing once turns on the selected flight director in the default PIT and ROL modes.
		- Pressing again on the coupled side deactivates the flight director, pressing again on the non-coupled side removes the FD display only from the non-Coupled PFD. On the coupled side only, the flight director cannot be deactivated when the autopilot is engaged.
②	**VS** Key	Selects/deselects Vertical Speed Mode
③	**VNAV** Key	Selects/deselects the FMS Vertical Navigation Mode
④	**FLC** Key	Selects/deselects Flight Level Change Mode
⑤	**AP** Key	Engages/disengages the autopilot
⑥	**NAV** Key	Selects/deselects Navigation Mode
⑦	**HDG** Key	Selects/deselects Heading Select Mode
⑧	**APPR** Key	Selects/deselects Approach Mode
⑨	**ALT** Key	Selects/deselects Altitude Hold Mode
⑪㉑	**CRS** Knobs	Adjusts the Selected Course in 1° increments on the Horizontal Situation Indicator (HSI) of the corresponding PFD or both PFDs
		- Press the **CRS** Knob to re-center the Course Deviation Indicator (CDI) and return the course pointer directly to the bearing of the active waypoint/station.
⑫	**UP/DN** Wheel	Adjusts the reference in Pitch Hold and Vertical Speed modes
⑬	**FMS/MAN** Switch	Activates FMS or MAN speed reference
⑭	**SPD** Knob	Turning the **SPD** Knob controls Selected Speed reference when in MAN Speed Mode
		- Press the **SPD** Knob to toggle the Airspeed Reference units between IAS and Mach.
⑮	**CPL** Key	Transfers the PFD source for the flight director.
⑯	**YD** Key	Engages/disengages the yaw damper.
⑰	**BANK** Key	Manually selects/deselects Low Bank Mode
⑱	**HDG** Knob	Adjusts the Selected Heading and bug in 1° increments on the HSI (both PFDs)
		- Press to synchronize the Selected Heading to the current heading or to activate HDG SYNC Mode
⑲	**B/C** Key	Selects/deselects Backcourse Mode
⑳	**ALT** Knob	Turning the **ALT** Knob changes the Selected Altitude in 1,000 ft increments or 100 ft increments when simultaneously pushing and turning the knob.

Figure 7-1 GMC 7200 AFCS Controller

ADDITIONAL AFCS CONTROLS

The following AFCS controls are located separately from the AFCS Controller:

AP YD DISC/TRIM INT Switch (Autopilot Yaw Damper Disconnect/Trim Interrupt)	Disengages the autopilot and nosewheel steering operation as well as, interrupts pitch trim operation - An **AP YD DISC/TRIM INT** Switch is located on each control wheel. - This switch may be used to acknowledge an autopilot disconnect alert and mute the associated aural alert.
CWS Button (Control Wheel Steering)	While pressed, allows manual control of the aircraft while the autopilot is engaged and synchronizes the command bars with the current aircraft vertical speed and airspeed (if in Manual Speed Mode) pitch, altitude or roll - A **CWS** Button is located on each control wheel. - Upon release of the **CWS** Button, the flight director may establish new pitch and roll references, depending on the current vertical and lateral modes. CWS operation details are discussed in the respective mode sections of this manual.
GA Switch (Takeoff/Go Around)	Selects flight director Takeoff Mode (on ground) or Go Around Mode (in air) and disengages the autopilot if previously engaged - A **GA** Switch is located on each throttle handle. - This switch also activates the missed approach when the selected navigation source is FMS or VOR/LOC and the FMS flight plan has a corresponding approach procedure activated.
Pitch Trim Switch	Used to command manual pitch trim - A **Pitch Trim** Switch is located on each control wheel. - The pilot side **Pitch Trim** Switch has priority over the copilot side **Pitch Trim** Switch. - This composite switch is split into left and right sides. The left switch is the ARM contact and the right switch controls the DN (forward) and UP (rearward) contacts. Manual trim commands are generated only when both sides of the switch are operated simultaneously. Pushing either **Pitch Trim Switch** disengages the autopilot, if engaged. This switch may be used to acknowledge an autopilot disconnect alert and mute the associated aural alert.

7.3 FLIGHT DIRECTOR OPERATION

The flight director function provides pitch and roll commands to the AFCS and displays them on the PFDs. With the flight director active, the aircraft can be hand-flown to follow the path shown by the command bars. Maximum commanded pitch (±20°) and roll (27°) angles, vertical acceleration, and roll rate are limited to established values. The flight director also provides commands to the autopilot.

ACTIVATING THE FLIGHT DIRECTOR

An initial press of a key listed in the following table (when the flight director is not active) activates the flight director in the listed modes. The flight director may be turned off and the command bars removed from the display by pressing the **FD** Key again. The **FD** Key is disabled when the autopilot is engaged.

Control Pressed	Modes Selected			
	Lateral		**Vertical**	
FD Key (pilot-side)[1]	Roll Hold (default)	ROL	Pitch Hold (default)	PIT
FD Key (copilot-side)[1]	Roll Hold (default)	ROL	Pitch Hold (default)	PIT
AP Key	Roll Hold (default)	ROL	Pitch Hold (default)	PIT
GA Switch	Roll Hold (default) Roll Hold (default)[2]	TO GA[2]	Takeoff (on ground) Go Around (in air)	TO GA
ALT Key	Roll Hold (default)	ROL	Altitude Hold	ALT
VS Key	Roll Hold (default)	ROL	Vertical Speed	VS
VNAV Key	N/A	N/A	[3]	V
NAV Key	Navigation[4]	FMS VOR LOC	Pitch Hold (default)	PIT
B/C Key	Backcourse[4]	B/C	Pitch Hold (default)	PIT
APPR Key	Approach[4]	FMS VAPP LOC	Pitch Hold (default)[5]	PIT
HDG Key	Heading Select	HDG	Pitch Hold (default)	PIT

[1] *Pressing the **FD** Key on the non-coupled flight director will only remove the command bars from the corresponding display. The **FD** Key on the coupled side is disabled when the autopilot is engaged, but pressing the non-coupled side **FD** Key will still display or remove the command bars.*

[2] *If airborne and the FMS flight plan has an active approach procedure, the FMS lateral mode will be selected.*

[3] *It should be noted that pressing the **VNAV** Key does not activate the FD, rather it activates the VNAV function of the AFCS which can subsequently automatically arm PATH, FLC, and ALTV as required by the FMS VNAV altitude constraints.*

[4] *The selected navigation receiver must have a valid VOR or LOC signal or active FMS course before **NAV** or **APPR** Key press activates flight director.*

[5] *GS or GP is armed if available.*

Table 7-1 Flight Director Activation

AFCS STATUS BOX

Flight director mode annunciations are displayed on the PFDs when the flight director is active. Flight director selection, autopilot, and yaw damper status are shown in the center of the AFCS Status Box. Lateral flight director modes are displayed on the left and vertical modes on the right. Armed modes are displayed in white. Active modes are displayed in green.
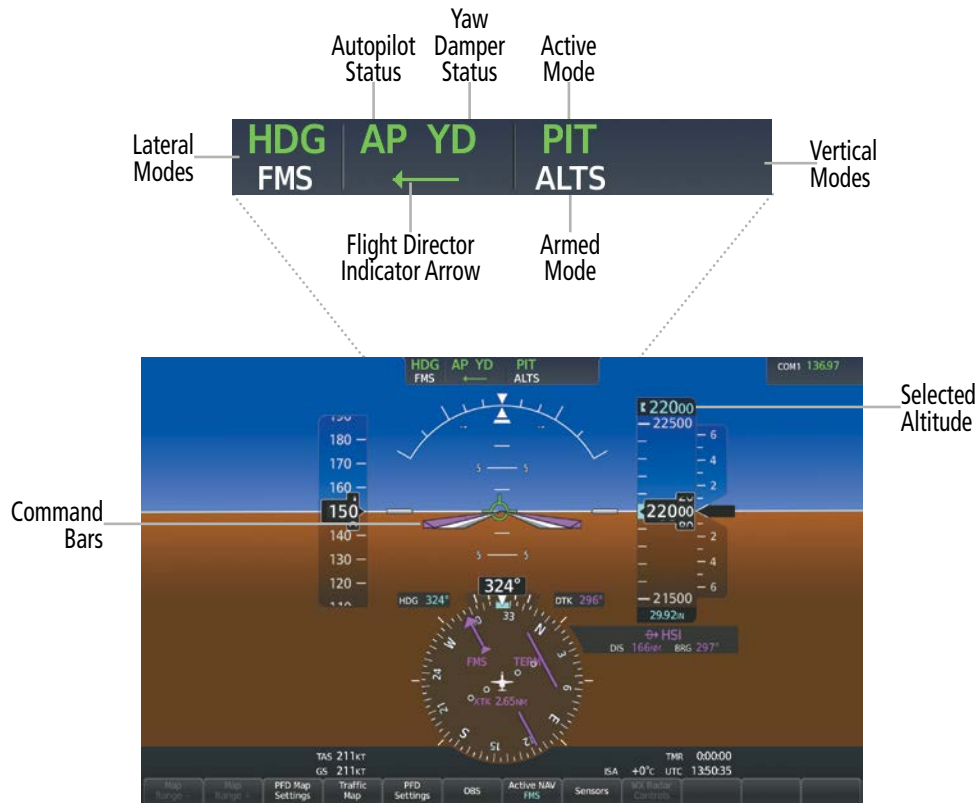
Figure 7-2 PFD AFCS Display

FLIGHT DIRECTOR MODES

Flight director modes are normally selected independently for the pitch and roll axes. Unless otherwise specified, all mode keys are alternate action (i.e., press on, press off). In the absence of specific mode selection, the flight director reverts to the default pitch and/or roll modes(s).

Armed modes are annunciated in white and active in green in the AFCS Status Box. Under normal operation when the flight director is activated by pressing the **FD** Mode Button, the flight director activates the default mode(s) for the axis(es). Automatic transition from armed to active mode is indicated by the white armed mode annunciation moving to the green active mode field and flashing for 10 seconds.

If the information required to compute a flight director mode becomes invalid or unavailable, the flight director automatically reverts to the default mode for that axis. A flashing amber mode annunciation indicates loss of sensor (ADC) or navigation data (VOR, LOC, FMS) required to compute commands. When such a loss occurs: an amber FD MODE OFF CAS message appears and depending on the affected axis, flight director either enters Roll Hold Mode (command bars give guidance to roll wings level) or maintains the pitch angle (enters Pitch Hold Mode). The flashing annunciation stops when Master Caution is pressed, the affected mode key is pressed or another mode for the axis is selected.

Figure 7-3 Loss of FMS Signal

The flight director is automatically disabled if the attitude information required to compute the flight director modes becomes invalid or unavailable.

FLIGHT DIRECTOR SELECTION

The AFCS provides flight director functionality. The PFD providing data to the flight directors may be switched by pressing the **CPL** Key. Both PFDs display the selected flight director, indicated by an arrow pointing toward either the pilot or copilot side, in the center of the AFCS Status Box. The annunciator light arrow for the selected flight director is also illuminated beside the **CPL** Key. When the flight directors are switched, the vertical and lateral modes remain engaged. The coupled flight director can be deactivated and the command bars removed from the PFD by pressing the **FD** Key. On the non-coupled side, pressing the **FD** Key will only remove or display the command bars. When the autopilot is engaged, the flight director on the coupled side cannot be deactivated; however, the command bars on the non-coupled side can still be removed or displayed by pressing the **FD** Key.

Pilot-side Flight Director Selected

Copilot-side Flight Director Selected

Figure 7-4 Flight Director Selection Indications

COMMAND BARS

> NOTE: The command bar settings can be selected independently between pilot and copilot.

SINGLE-CUE

Upon activation of the flight director, command bars are displayed in magenta on the PFDs as single cue or dual cue. The aircraft symbol changes to accommodate the command bar format. The single cue command bars move together vertically to indicate pitch commands and bank left or right to indicate roll commands.
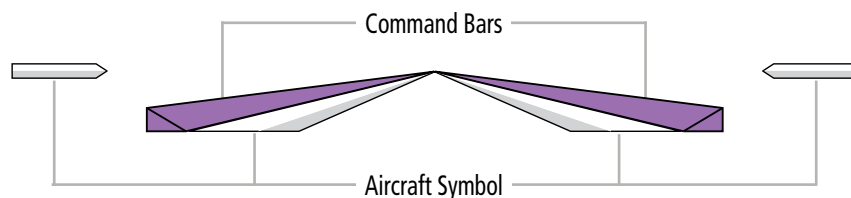
Figure 7-5 Single Cue Command Bars

DUAL-CUE

Command bars displayed as a dual cue (cross pointer) move independently to indicate pitch (horizontal bar) and roll (vertical bar) commands.
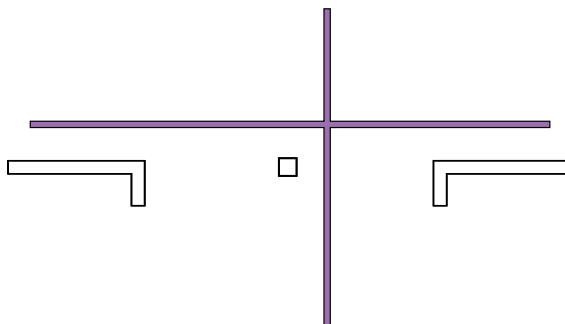
Figure 7-6 Dual Cue Command Bars

> *NOTE: When using the flight director for guidance, the commands must be followed precisely to achieve desired performance. The flight director format cannot be changed with the MFD GTCs.*

Changing the flight director/aircraft symbol format:

1) From the Home, touch **Utilities** > **Setup** > **Avionics Settings**.

2) Touch the **System** Tab.

3) While viewing the 'Flight Director' Field, touch desired setting (**Single Cue** or **Dual Cue**).
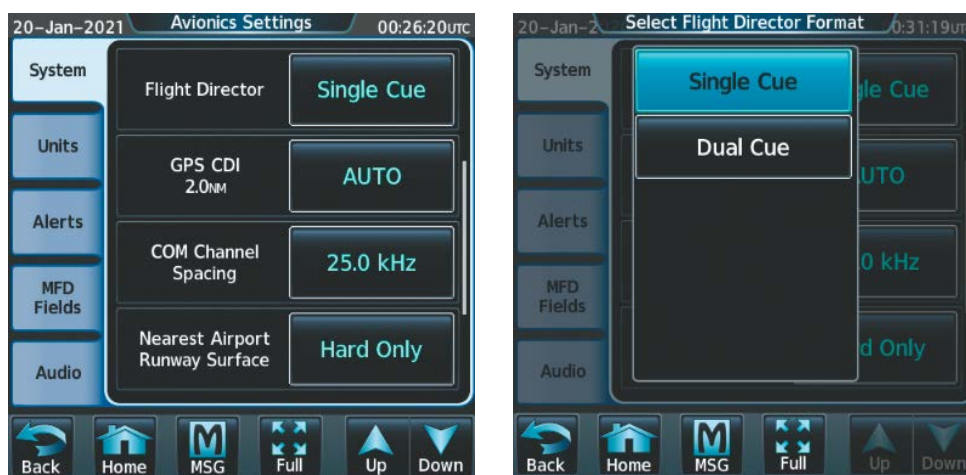
Figure 7-7 Flight Director Format Settings

7.4 AFCS MODES

The AFCS is capable of operating in a variety of independent Vertical Modes, Lateral Modes and Combination of both the Lateral and Vertical Modes.

VERTICAL MODES

The following table lists the vertical modes with their corresponding controls and annunciations. The mode reference (Altitude, Vertical Speed, Air Speed, or FMS Speed Target) is displayed next to the active mode annunciation for Flight Level Change, Altitude Hold and Vertical Speed modes. The **UP/DN** Wheel can be used to change the vertical mode reference while operating under Pitch Hold or Vertical Speed Mode. Increments of change and acceptable ranges of values for each of these references using the **UP/DN** Wheel are also listed in the table where applicable. Turning the **SPD** Knob controls Selected Speed reference when in MAN speed. Pressing it toggles the Airspeed Reference units between IAS and Mach.

Vertical Mode	Description	Control	Annunciation		Reference Range	Reference Change Increment
Pitch Hold	Holds aircraft pitch attitude; may be used to climb/descend to the Selected Altitude	(default)	PIT		-20° to +20°	0.5°
Selected Altitude Capture	Captures the Selected Altitude	[1]	ALTS		-1,000 to +45,000	
Altitude Hold	Holds current Altitude Reference	**ALT** Key	ALT	xx,xxx FT		
Vertical Speed	Holds aircraft vertical speed; may be used to climb/descend to the Selected Altitude	**VS** Key	VS	x,xxx FPM	+/-6,000 FPM	100 FPM
Flight Level Change	Holds aircraft airspeed while aircraft is climbing/descending to the Selected Altitude	**FLC** Key	FLC	M .xxx XXX KT	80 KTS to V$_{MO}$ or M$_{MO}$[2]	1 KT or .01 M

[1] *ALTS is armed automatically when the Selected Altitude is to be captured instead of the VNAV Target Altitude.*

[2] *Reference Range is displayed as Mach for specified speeds and altitudes shown in Table 7-3*

Table 7-2 Flight Director Vertical Modes

PITCH HOLD MODE (PIT)

When the flight director is activated (the **FD** Key is pressed), Pitch Hold Mode is selected by default. Pitch Hold Mode is indicated as the active pitch mode by the green annunciation 'PIT'. This mode may be used for climb or descent to the Selected Altitude (shown above the Altimeter), since Selected Altitude Capture Mode is automatically armed when Pitch Hold Mode is activated.

In Pitch Hold Mode, the command bars give guidance for constant pitch attitude, which is the pitch reference. The pitch reference is set to the aircraft pitch attitude at the moment of mode selection. If the aircraft pitch attitude exceeds the flight director pitch limitations, the flight director displays a pitch angle equal to the nose-up/down limit.

Changing the Pitch Reference

When operating in Pitch Hold Mode, the pitch reference can be adjusted by:

- Using the **UP/DN** Wheel
- Pressing the **CWS** Button, hand-flying the aircraft to establish a new pitch reference, then releasing the **CWS** Button
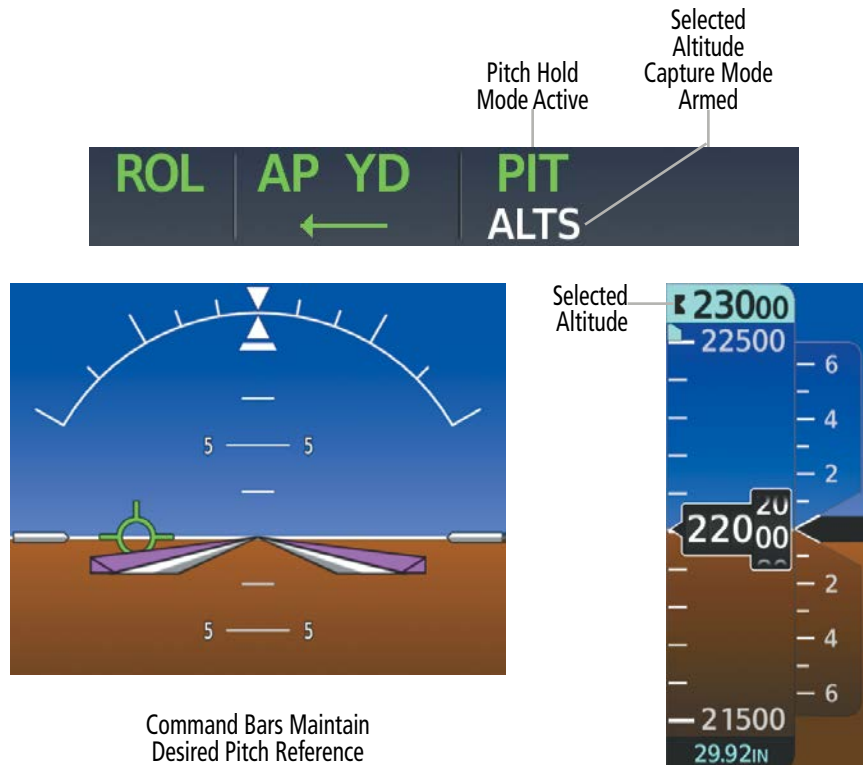
Figure 7-8 Pitch Hold Mode

SELECTED ALTITUDE CAPTURE MODE (ALTS)

Selected Altitude Capture Mode is automatically armed with activation of the following modes:

» Pitch Hold

» Vertical Speed

» Flight Level Change

» Takeoff

» Go Around

» VNAV Path Descent

- While active, ALTS indicates the Selected Altitude is to be captured instead of the VNAV Target Altitude

The white 'ALTS' annunciation indicates Selected Altitude Capture Mode is armed (see previous figure for example). The **ALT** Knob is used to set the Selected Altitude (shown above the Altimeter) until Selected Altitude Capture Mode becomes active.

At 50 feet from the Selected Altitude, the flight director begins an automatic transition from Selected Altitude Capture to Altitude Hold Mode and holds the Selected Altitude. As Altitude Hold Mode becomes active, the white 'ALT' annunciation moves to the active vertical mode field and flashes green for 10 seconds to indicate the automatic transition.

Altitude Reference
(in this case, equal to
Selected Altitude)
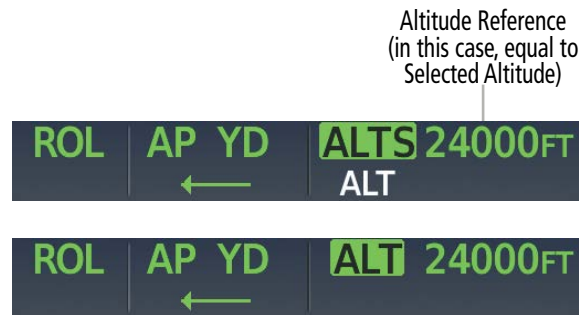
Figure 7-9 Automatic Mode Transitions During Altitude Capture

Changing the selected Altitude

> ✓ *NOTE: Pressing the **CWS** Button while in Selected Altitude Capture Mode does not cancel the mode.*

> ✓ *NOTE: While ALTS is active, the reference altitude must be changed prior to re-selecting a vertical mode. Changing the selected reference altitude will allow re-engagement of the FD in VS or FLC mode.*

Use of the **ALT** Knob to change the Selected Altitude while Selected Altitude Capture Mode is active causes the flight director to revert to Pitch Hold Mode with Selected Altitude Capture Mode armed for the new Selected Altitude.

ALTITUDE HOLD MODE (ALT)

Altitude Hold Mode can be activated by pressing the **ALT** Key; the flight director maintains the current aircraft altitude (to the nearest 10 feet) as the Altitude Reference. The flight director's Altitude Reference, shown in the AFCS Status Box, is independent of the Selected Altitude, displayed above the Altimeter. Altitude Hold Mode active is indicated by a green 'ALT' annunciation in the AFCS Status Box. Altitude Hold Mode is automatically armed when the flight director is in Selected Altitude Capture Mode. Selected Altitude Capture Mode automatically transitions to Altitude Hold Mode when the altitude error is less than 50 feet. In this case, the Selected Altitude becomes the flight director's Altitude Reference.

If a climb will be resumed at the next Bottom of Climb (BOC) point, FLC will be shown as the armed mode and will automatically activate after the BOC has been reached. VS must be manually activated if that mode is desired. If a descent will be resumed at the next Top of Descent (TOD) point, PATH will be shown as the armed mode.

Changing the Altitude Reference

> ✓ *NOTE: Turning the **ALT** Knob while in Altitude Hold Mode changes the Selected Altitude, but not the flight director's altitude reference, and does not cancel the mode.*

With the **CWS** Button pressed, the aircraft can be hand-flown to a new altitude reference. When the **CWS** Button is released at the desired altitude, the new altitude is established as the altitude reference.

GARMIN.
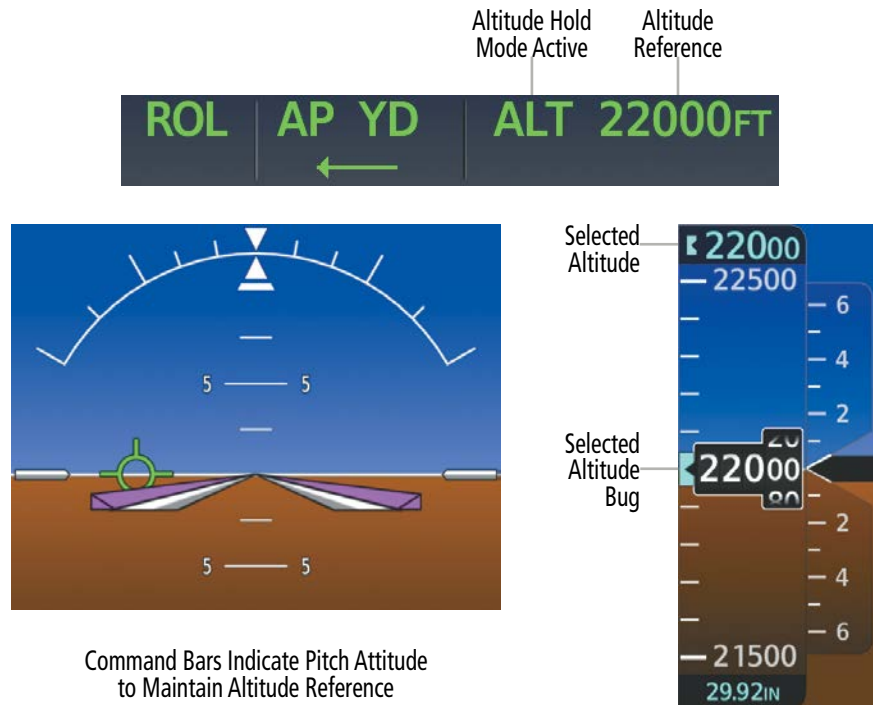
Figure 7-10 Altitude Hold Mode

VERTICAL SPEED MODE (VS)

In Vertical Speed Mode, the flight director acquires and maintains a Vertical Speed Reference (shown above the Vertical Speed Indicator). Current aircraft vertical speed (to the nearest 100 fpm) becomes the Vertical Speed Reference at the moment of Vertical Speed Mode activation. This mode may be used for climb or descent to the Selected Altitude (shown above the Altimeter) since Selected Altitude Capture Mode is automatically armed when Vertical Speed Mode is selected. When Vertical Speed Mode is used in conjunction with VNAV (VS), VNAV Target Altitude Capture is also enabled.

When Vertical Speed Mode is activated by pressing the **VS** Key, 'VS' is annunciated in green in the AFCS Status Box. The Vertical Speed Reference is displayed above the Vertical Speed Indicator. A Vertical Speed Reference Bug corresponding to the Vertical Speed Reference is shown on the indicator.

CHANGING THE VERTICAL SPEED REFERENCE

The Vertical Speed Reference (shown above the Vertical Speed Indicator) may be changed by:

- Using the **UP/DN** Wheel
- Pressing the **CWS** Button, hand-flying the aircraft to attain a new Vertical Speed Reference, then releasing the **CWS** Button
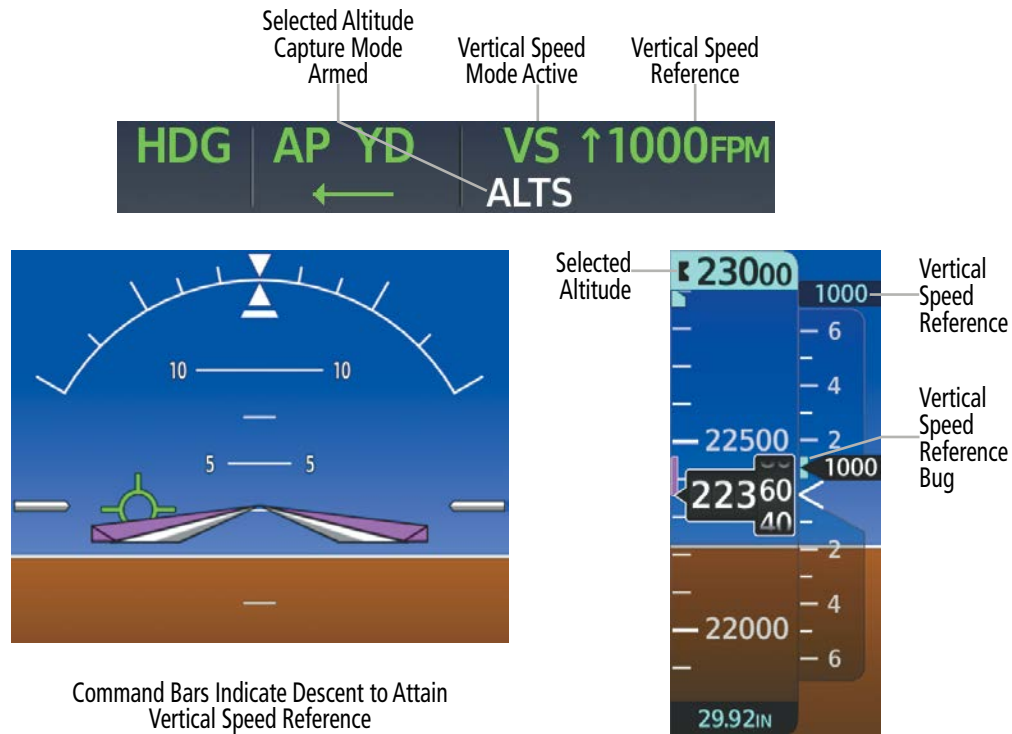
Figure 7-11 Vertical Speed Mode

FLIGHT LEVEL CHANGE MODE (FLC)

> *NOTE: The Selected Altitude must be set before selecting Flight Level Change Mode.*

Flight Level Change Mode is selected by pressing the **FLC** Key. This mode acquires and maintains the Airspeed Reference (in IAS or Mach) while climbing or descending to the Selected Altitude (shown above the Altimeter). When Flight Level Change Mode is active, the flight director continuously monitors Selected Altitude, airspeed/Mach, and altitude. When Flight Level Change Mode is used in conjunction with VNAV (V FLC), VNAV Target Altitude Capture is also enabled.

When in Manual Airspeed Mode, the Airspeed Reference (cyan Airspeed Reference Bug) is set to the current airspeed upon mode activation. In this case, the Airspeed Reference is set to the previously selected Airspeed Reference. When in FMS Airspeed Mode, the Airspeed Reference (magenta Airspeed Reference Pointer) is set to the value programmed in the FMS. Flight Level Change Mode is indicated by a green 'FLC' annunciation in the AFCS Status Box. The Airspeed Reference is displayed directly above the Airspeed Indicator and next to the FLC mode annunciator in the AFCS Status Box, along with an Airspeed Reference Bug corresponding to the Airspeed Reference along the tape. The Airspeed Reference source (MAN or FMS) is selected via the **FMS/MAN** Switch on the AFCS controller.

The autopilot adjusts the aircraft pitch attitude to maintain the Speed Reference based on the engine thrust setting. The command bars maintain a vertical speed reference of 0 fpm until either engine thrust or the Speed Reference are adjusted and does not allow the aircraft to climb or descend away from the Selected Altitude.

Selected Altitude Capture Mode Armed

Flight Level Change Mode Active

Airspeed Reference

HDG | AP YD | FLC | 150KT
ALTS

Airspeed Reference

Airspeed Reference Bug

Command Bars Indicate Climb to Attain Selected Speed
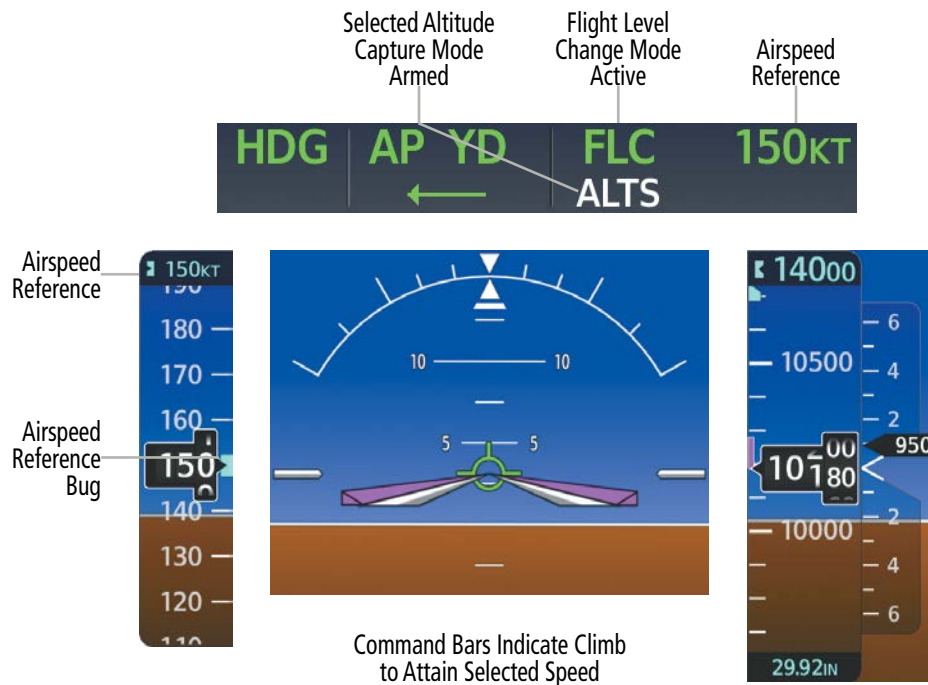
Figure 7-12 Flight Level Change Mode

When VNAV is active, the target airspeed is dictated by the FMS, therefore the Airspeed Reference is set to the FMS Speed Target. The FMS Speed Target is displayed in magenta directly above the Airspeed Indicator, along with a magenta FMS Speed Target Pointer corresponding to the FMS Speed Target along the airspeed tape, as shown in the next figure. The FMS Speed Target is also displayed in green in the AFCS Status Box. When descending, the system anticipates the time required to achieve the targeted airspeed, therefore, the FMS Speed Target and FMS Speed Target Pointer will be reduced prior to sequencing the active leg of the flight plan if an upcoming speed constraint requires the aircraft to slow down. As the aircraft gets closer to the waypoint, the FMS Speed Target will adjust the required speed.

> *NOTE: The FMS Speed Target may fluctuate while the system tries to meet altitude and airspeed constraints. This is most likely to occur where speed limits apply, such as, when descending through 10,000 feet, entering a hold, or in the vicinity of an airport.*

Selected Altitude Capture Mode Armed — VNAV Active — Flight Level Change Mode Active — FMS Speed Target

ROL | AP YD V | FLC | 250KT
ALTV

FMS Speed Target

Command Bars Indicate Climb to Attain Selected Altitude
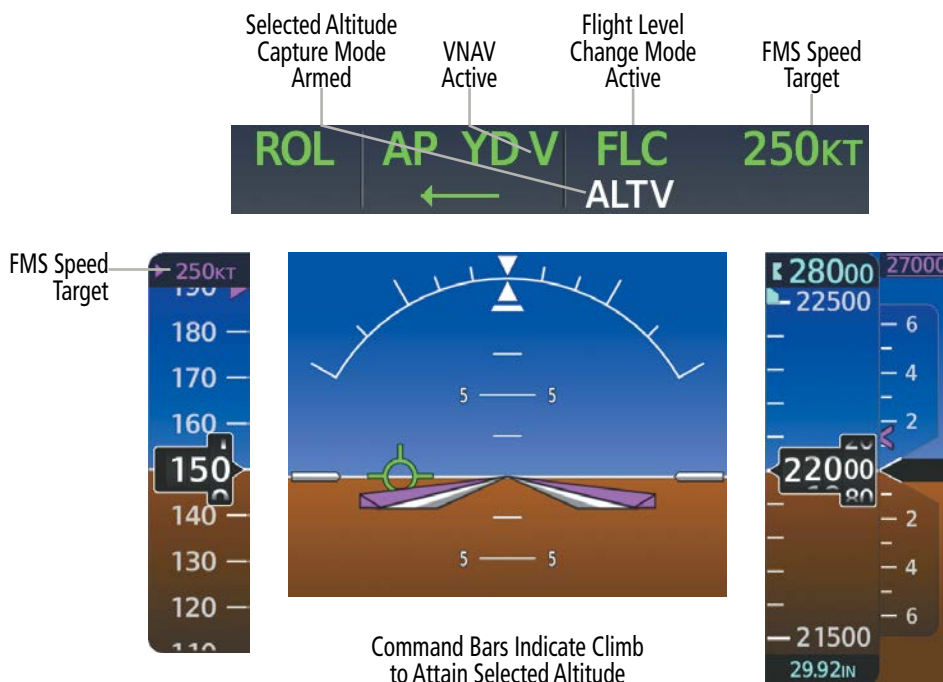
Figure 7-13 Flight Level Change Mode, VNAV Active

CHANGING THE AIRSPEED REFERENCE (FLC MODE)

During climb, the Speed Reference units automatically change from IAS to Mach when the altitude and airspeed listed in the following table is attained. For descent, the units switch back at the specified altitude and airspeed. The system determines aircraft climb or descent by the relationship between the current altitude and the Selected Altitudes.

	Airspeed Reference Units		Unit Type Changes At:	
	Default Units	**Change To:**	**Airspeed**	**Altitude**
Climb	IAS	Mach	.65 M	> 28,800 ft
Descent	Mach	IAS	295 kts	< 25,8000 ft

Table 7-3 FLC Mode Unit Changes

While in MAN SPD mode, the Speed Reference units can be manually toggled between IAS and Mach units by pressing the **SPD** Knob at any time. When the Speed Reference is displayed in Mach, the Speed Reference Bug is displayed on the Airspeed Indicator at the IAS corresponding to the selected Mach target speed and the current Mach number is shown below the Airspeed Indicator.

VNAV Not Active

The Airspeed Reference, shown above the Airspeed Indicator, (cyan for Manual Speed Mode or magenta for FMS Speed Mode) may be adjusted by:

- Manual Speed Mode selected:
  → Using the **SPD** Knob
  → Pressing the **CWS** Button (when Manual Speed Mode is selected), hand-flying the aircraft to attain a new Speed Reference, then releasing the **CWS** Button.

- FMS Speed Mode selected:
  → Entering a different FMS Speed on the **Climb**, **Cruise**, or **Descent** Tab on the Touchscreen Controller

VNAV Active

The Airspeed Reference (shown above the Airspeed Indicator in magenta) may be viewed on the 'VNAV Profile' Screen via **Home > Flight Plan > VNAV**. FMS airspeeds can be adjusted on the **Climb**, **Cruise**, or **Descent** Tabs. See the Vertical Navigation discussion in the Flight Management Section for a detailed explanation of entering and changing FMS Speed Targets.
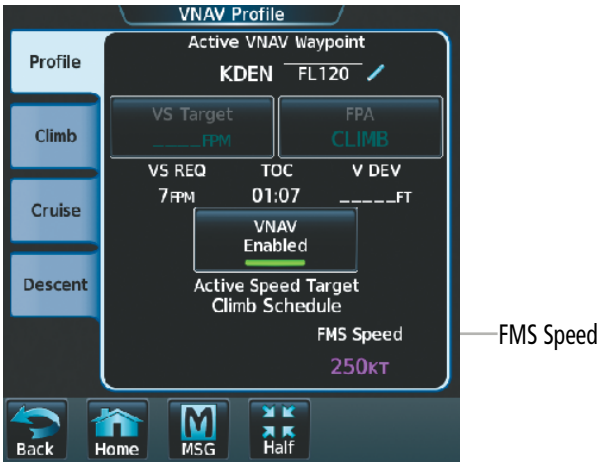
Figure 7-14 'VNAV Profile' Screen

LATERAL MODES

The following table relates each AFCS lateral mode to its respective control and annunciation.

Lateral Mode	Description	Control	Annunciation	Maximum Roll Command Limit
Roll Hold	Holds the current aircraft roll attitude or rolls the wings level, depending on the commanded bank angle	(default)	ROL	27°
Low Bank	Limits the maximum commanded roll angle	**BANK** Key	[1]	15°
Heading Select[2]	Captures and tracks the Selected Heading	**HDG** Key	HDG	27°

Lateral Mode	Description	Control	Annunciation	Maximum Roll Command Limit
Navigation Mode				
FMS[2]	Captures and tracks the selected navigation source (FMS, VOR, LOC)	**NAV** Key	FMS	30°
VOR Enroute/Capture/Track[2]			VOR	27° Capture 10° Track
LOC Capture/Track (No Glideslope)			LOC	27° Capture 10° Track

The AFCS limits turn rate to 3 degrees per second (standard rate turn).

[1] *No annunciation appears in the AFCS Status Box. The acceptable bank angle range is indicated in green along the Roll Scale of the Attitude Indicator.*

[2] *The Heading, Navigation FMS and Navigation VOR mode maximum roll command limit will be limited to the Low Bank mode value (15°) if it is engaged.*

Table 7-4 Flight Director Lateral Modes

The **CWS** Button does not change lateral references for Heading Select, Navigation, Backcourse, or Approach modes. The flight director/autopilot guides the aircraft back to the Selected Heading/Course upon release of the **CWS** Button.

ROLL HOLD MODE (ROL)

> *NOTE: If Roll Hold Mode is activated as a result of a mode reversion such as a result of deselecting another lateral mode, the flight director rolls the wings level.*

When the flight director is activated, Roll Hold Mode is selected by default. This mode is annunciated as 'ROL' in the AFCS Status Box. The current aircraft bank angle is held, subject to the bank angle conditions listed in the following table.

Figure 7-15 Roll Hold Mode Annunciation

Bank Angle	Flight Director Response
< 6°	Rolls wings level
6° to 27°	Maintains current aircraft roll attitude
> 27°	Limits bank to 27°

Table 7-5 Roll Hold Mode Responses

LOW BANK MODE
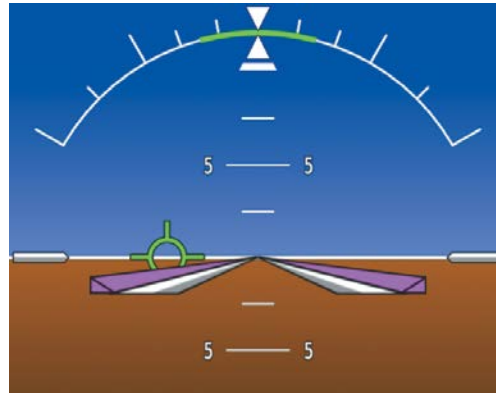
Figure 7-16 Low Bank Mode

When in Low Bank Mode, the flight director limits the maximum commanded roll angle to 15°. Low bank arc limits are displayed in green along the Roll Scale. Low Bank Mode can be manually engaged/disengaged by pressing the **BANK** Key while in Heading Select or Navigation Modes (FMS or VOR). Low Bank Mode is automatically engaged if while in Heading Select or a Navigation Mode (FMS or VOR) the aircraft climbs through 33,800' MSL. Low Bank Mode is automatically disengaged if the aircraft descends through 33,600' MSL or is no longer in Heading Select or a Navigation Mode (FMS or VOR).

When Low Bank Mode is engaged, and a STEEP TURN AHEAD System Message is displayed, the computed bank angle will exceed the Low Bank limit during the next turn.

HEADING SELECT MODE (HDG)

Heading Select Mode is activated by pressing the **HDG** Key. Heading Select Mode acquires and maintains the Selected Heading. The Selected Heading is shown by a cyan bug on the HSI and in the box to the upper left of the HSI.

CHANGING THE SELECTED HEADING

The Selected Heading is adjusted using the **HDG** Knob. Pressing the **HDG** Knob synchronizes the Selected Heading to the current heading. When the **HDG** Knob is pressed while the aircraft is in a turn, the Heading Bug moves to the current heading, but continues to adjust as heading changes until the airplane rolls to wings level. Pressing the **CWS** Button and hand-flying the aircraft does not change the Selected Heading. The flight director/autopilot guides the aircraft back to the Selected Heading upon release of the **CWS** Button.

When NAV is the active lateral AFCS mode (FMS or a short range NAV source), pressing **HDG** Knob activates HDG SYNC MODE, which automatically keeps the HDG bug centered until 1) NAV is no longer the active lateral mode, 2) **HDG** Knob is pressed again, or 3) a different heading is selected by turning the **HDG** Knob. When active, SYNC MODE is annunciated on the PFD next to the HDG indication.

Turns are commanded in the same direction as Selected Heading Bug movement, even if the Bug is turned more than 180° from the present heading (e.g., a 270° turn to the right). However, Selected Heading changes of more than 330° at a time, from the current aircraft heading, result in turn reversals.

Heading Select
Mode Active

ALT Mode
Active

HDG   AP YD   ALT 28000FT

Selected
Heading

Selected
Heading
Bug

Command Bars Capture and Track
Selected Heading
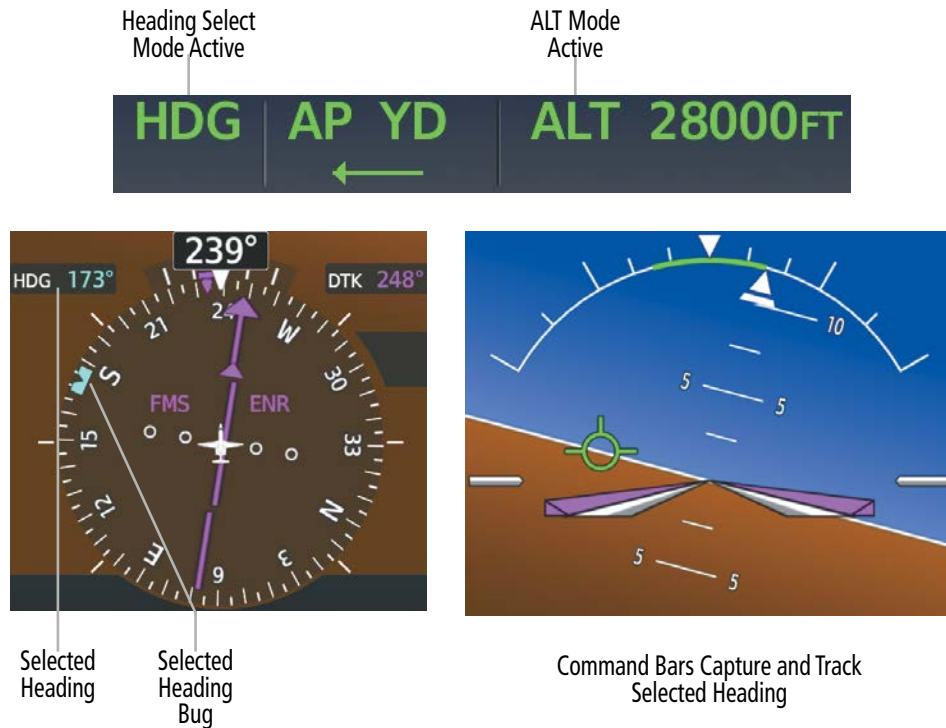
Figure 7-17 Heading Select Mode

NAVIGATION MODE

> **NOTE:** *The selected navigation receiver must have a valid VOR or LOC signal or active FMS course for the flight director to enter Navigation Mode.*

> **NOTE:** *When intercepting a flight plan leg in Navigation Mode, the flight director gives commands to capture the active leg at approximately a 45° angle to the track between the waypoints defining the active leg. The flight director does not give commands to fly to the starting waypoint of the active leg.*

Pressing the **NAV** Key selects Navigation Mode. Navigation Mode acquires and tracks the selected navigation source (FMS, VOR, LOC). The flight director follows FMS roll steering commands when FMS is the selected navigation source. When the navigation source is VOR or LOC, the flight director creates roll steering guidance from the Selected Course and deviation. Navigation Mode may be used to fly non-precision FMS and LOC approaches where glideslope/glidepath capture is not required.

If the Course Deviation Indicator (CDI) shows greater than ½ dot when the **NAV** Key is pressed, the selected mode is armed. If the CDI is less than ½ dot, the active leg or course is automatically captured when the **NAV** Key is pressed. The armed annunciation appears in white below the active lateral mode.

HDG   AP YD   PIT
FMS   ←   ALTS

Figure 7-18 FMS Navigation Mode Armed

If Navigation Mode is active and any of the following occur, the flight director reverts to Roll Hold Mode (wings rolled level):

» Different VOR/LOC tuned while in VOR/ILS Navigation Mode (VOR/LOC Navigation Mode reverts to armed)

» Navigation source manually switched

» During a LOC/ILS approach, FMS Navigation Mode is active and the FAF is crossed before the automatic navigation transition from FMS to LOC

CHANGING THE SELECTED COURSE

If the navigation source is VOR or LOC, or OBS Mode has been enabled when using FMS, the Selected Course is controlled using the **CRS** Knob corresponding to the selected flight director (**L CRS** for the pilot side, **R CRS** for the copilot side).

When both flight directors are using the same navigation source (both on VOR1/VOR2 or both on LOC1/LOC2), adjusting the **L CRS** Knob or **R CRS** Knob will affect the Course Pointer on L PFD and R PFD. When each flight director is using a different navigation source (e.g., pilot side on VOR1/LOC1 and copilot side on VOR2/LOC2), each **CRS** Knob affects only the respective side.

Pressing the **CWS** Button and hand-flying the aircraft does not change the Selected Course while in Navigation Mode. The autopilot guides the aircraft back to the Selected Course (or FMS flight plan) when the **CWS** Button is released.

> **NOTE:** *Using the CWS while in VOR/LOC may result in S-turning or slow return to course.*

FMS Navigation
Mode Active

FMS   AP YD   ALT 27000FT

FMS is Selected
Navigation
Source

FMS
Course

Command Bars Track FMS Course
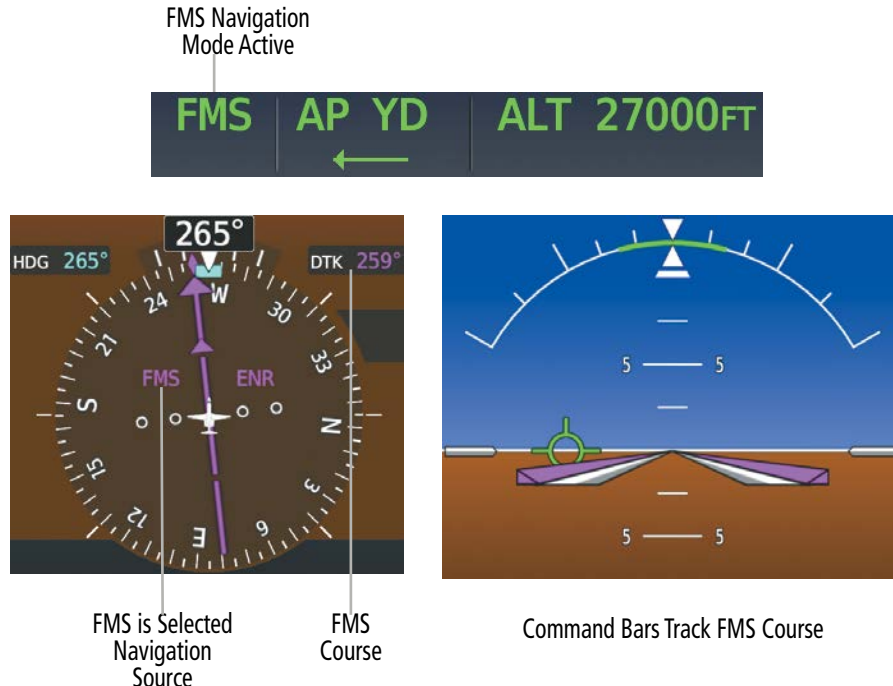
Figure 7-19 Navigation FMS Mode

COMBINATION MODES

The following table lists the modes that operating by using both Vertical and Lateral Modes with their corresponding controls and annunciations.

Mode	Description	Control	Annunciation	Maximum Roll Command Limit	Reference Range
Vertical Navigation Modes					
VNAV Path Descent	Captures and tracks descent legs of an active vertical profile	**VNAV** Key	PATH		
VNAV Target Altitude Capture	Captures the Vertical Navigation (VNAV) Target Altitude	[1]	ALTV		
VOR Approach Mode					
VOR Capture/Track	Captures and tracks VOR navigation source	**APPR** Key	VAPP	27˚ Capture 10˚ Track	
FMS Approach Mode					
FMS	Captures and tracks FMS navigation source	**APPR** Key	FMS	30˚	
Glidepath	Captures and tracks the FMS glidepath on approach		GP		
LOC Approach Mode					
LOC Capture/Track (GS Mode automatically armed)	Captures and tracks LOC navigation source	**APPR** Key	LOC	27˚ Capture 10˚ Track	
Glideslope	Captures and tracks the ILS glideslope on approach		GS		
Backcourse Arm/Capture/Track	Captures and tracks the LOC source for backcourse approaches	**B/C** Key	BC	27˚ Capture 10˚ Track	
Additional Modes					
Takeoff	Commands a constant pitch angle on the ground in preparation for takeoff	**GA** Switch	TO		10°
Go Around	Commands a constant pitch angle and wings level	**GA** Switch	GA		10°

[1] *ALTV is armed automatically when the VNAV Target Altitude is to be captured instead of the Selected Altitude.*

Table 7-6 Flight Director Combination Modes

VERTICAL NAVIGATION MODES (V)

Climb, Cruise, Descent (CCD) Vertical Navigation is a standard feature on this aircraft.

> ✓ **NOTE:** *VNAV is disabled when parallel track or dead reckoning mode is active.*

Vertical Navigation (VNAV) flight control is available for enroute/terminal climb, cruise, and descent operations when VNAV flight planning is available. Refer to the Flight Management Section for more information on VNAV flight plans.

The flight director may be armed for VNAV at any time. However, VNAV may not become active until certain conditions for VNAV availability are satisfied. Conditions for availability include, but are not limited to:

» The selected navigation source is valid and active

» A VNAV flight plan (with at least one altitude-constrained waypoint) or vertical direct-to is active

» VNAV is enabled

» Crosstrack error is valid and within limits

» Desired/actual track are valid and track angle error not exceeding 75 degrees off the desired track for the current leg

» Parallel track is not active

The command bars provide vertical profile guidance based on specified altitudes (entered manually or loaded from the database) at waypoints in the active flight plan or vertical direct-to. The appropriate VNAV flight control modes are sequenced by the flight director to follow the path defined by the vertical profile. Upon reaching the last waypoint in the VNAV flight plan, the flight director transitions to Altitude Hold Mode and cancels any armed VNAV modes.

Pressing the **VNAV** Key will display either a white 'V' in the lower field (indicating VNAV is armed) or a green 'V' in the upper field (indicating VNAV is active). The VNAV indication may change between armed and active indications depending on the conditions for VNAV availability. When an AFCS mode is armed, pressing the **VNAV** Key displays a white 'V' to the left of the armed mode, indicating VNAV is also armed. The following figure shows examples of active and armed VNAV annunciations.
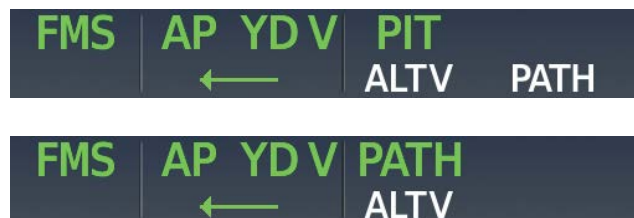
Figure 7-20 VNAV Annunciations

VNAV can be active in combination with any flight director vertical mode except for Glidepath (GP) and Glideslope (GS). There are also two additional vertical modes, PATH and ALTV, which can be active only in combination with VNAV.

VNAV Climb (V FLC)

Prior to starting a VNAV climb, the Selected Altitude must be set above the current aircraft altitude by at least 75 feet. ALTV will be armed to capture the next AT or AT-or-BELOW VNAV Climb Target Altitude.

ROL	AP YD V	FLC	250ᴋᴛ
	←	**ALTV**	

Figure 7-21 V FLC Mode Active with ALTV Mode Armed

✓ **NOTE:** *The system does not level off at "AT-or-ABOVE" Target Altitudes while climbing.*

✓ **NOTE:** *For small altitude changes, FLC mode commands a small vertical rate to avoid excessive pitch changes. If a small altitude climb is required over a short distance, this vertical rate may be insufficient to meet a vertical constraint. This may lead to an "UNABLE VNAV ALTITUDE" system message. It is the pilot's responsibility to add enough thrust manually to ensure the altitude constraint is met.*

If the active VNAV Target Altitude is defined as "AT" or "AT-or-ABOVE", the vertical speed required to make the target altitude prior to the VNAV waypoint is provided on the vertical speed indicator. If the current vertical speed is insufficient to make the target altitude, the UNABLE VNAV ALTITUDE system message will be shown.

Climb to "AT" or "AT-or-ABOVE" Target Altitude, Required Vertical Speed is displayed

Climb to "AT-or-BELOW" Target Altitude, Required Vertical Speed is not shown
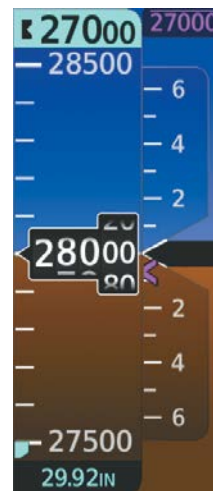
Figure 7-22 Required Vertical Speed in Climb

When the aircraft is to level off at a VNAV Target Altitude at the end of the climb, the Navigation Status Box provides the 'TOC (top of climb) within 1 minute' annunciation and the Vertical Track Alert double tone is heard as the aircraft approaches the VNAV Target Altitude.

After leveling off at the VNAV Target Altitude, FLC mode is armed to resume the climb when the VNAV waypoint is sequenced. The Navigation Status Box provides the 'BOC (Bottom of Climb) within 1 minute' annunciation and the Vertical Track Alert double tone is heard as the aircraft approaches the VNAV waypoint. This annunciation will not occur if it is a repeat alert or if an alert happened in the last 90 seconds.

As the waypoint is crossed, FLC Mode becomes active automatically. If the Selected Altitude was not set appropriately prior to crossing the waypoint, the climb must be resumed manually.

Vertical modes other than FLC (e.g., PIT or VS) can also be used for VNAV climbs, but must be selected manually.

VNAV Path Descent Mode (V PATH)

NOTE: *If another pitch mode key is pressed while VNAV Path Descent Mode is selected, VNAV Path Descent Mode reverts to armed.*

NOTE: *Pressing the **CWS** Button while VNAV Path Descent Mode is active does not cancel the mode. The autopilot guides the aircraft back to the descent path upon release of the **CWS** Button.*

When a VNAV flight plan is active and the **VNAV** Key is pressed, a green "V" will appear on the display to indicate the VNAV is active in preparation for the descent path capture. If the system is not set up to continue the upcoming descent, a white "V" will appear when the **VNAV** Key is pressed.

When descending, the appropriate altitude capture mode is armed for capture of the next VNAV Target Altitude (ALTV) or the Selected Altitude (ALTS), whichever is greater. If the next target altitude has an "AT or BELOW" constraint, no level off is required, therefore, no target altitude is to be captured. ALTS is then armed and the Selected Altitude is captured. If an "AT-or-BELOW" altitude is used to define bottom-of descent, it will be treated as an "AT" altitude (arming ALTV). Intermediate "AT-or-BELOW" altitudes in the descent do not arm ALTV.

Prior to descent path interception, the Selected Altitude must be set below the current aircraft altitude by at least 75 feet.

In conjunction with the 'TOD (top of descent) within 1 minute' annunciation in the Navigation Status Box and the Vertical Track Alert double tone, VNAV indications (VNAV Target Altitude, Vertical Deviation Indicator, Required Vertical Speed Indicator, and green 'V' in the AFCS Mode annunciation field) appear on the PFDs.

While on an approach and transitioning from FMS to short range navigation, Enroute VNAV guidance and PATH Mode continue to be available until the Final Approach Fix (FAF). At the FAF, this vertical guidance is removed.

VNAV Target
Altitude Capture
Armed

VNAV Path Descent
Armed

FMS | AP YD V PIT
ALTV   PATH

Selected Altitude

VNAV Target Altitude

FMS is
Selected
Navigation
Source

Vertical
Deviation
Indicator

Required
Vertical
Speed
Indicator
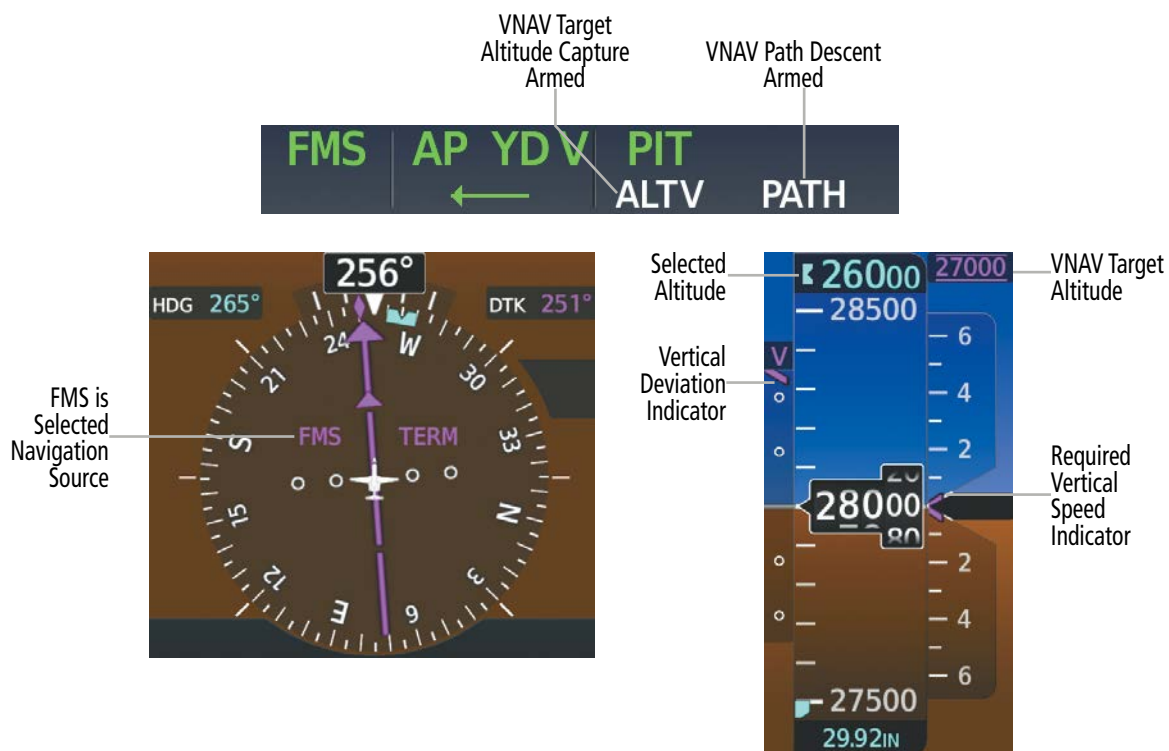
Figure 7-23 Vertical Path Capture

When a descent leg is captured, VNAV Path Descent becomes active and tracks the descent profile. An altitude capture mode ('ALTS' or 'ALTV') is armed as appropriate. In the following figure, the VNAV Target Altitude (25,000') will be captured.

FMS | AP YD V PATH
ALTV

FMS is
Selected
Navigation
Source

Command Bars Indicate Descent to
Maintain Vertical Path

VNAV Target Altitude

Vertical
Deviation
Indicator

Required
Vertical
Speed
Indicator
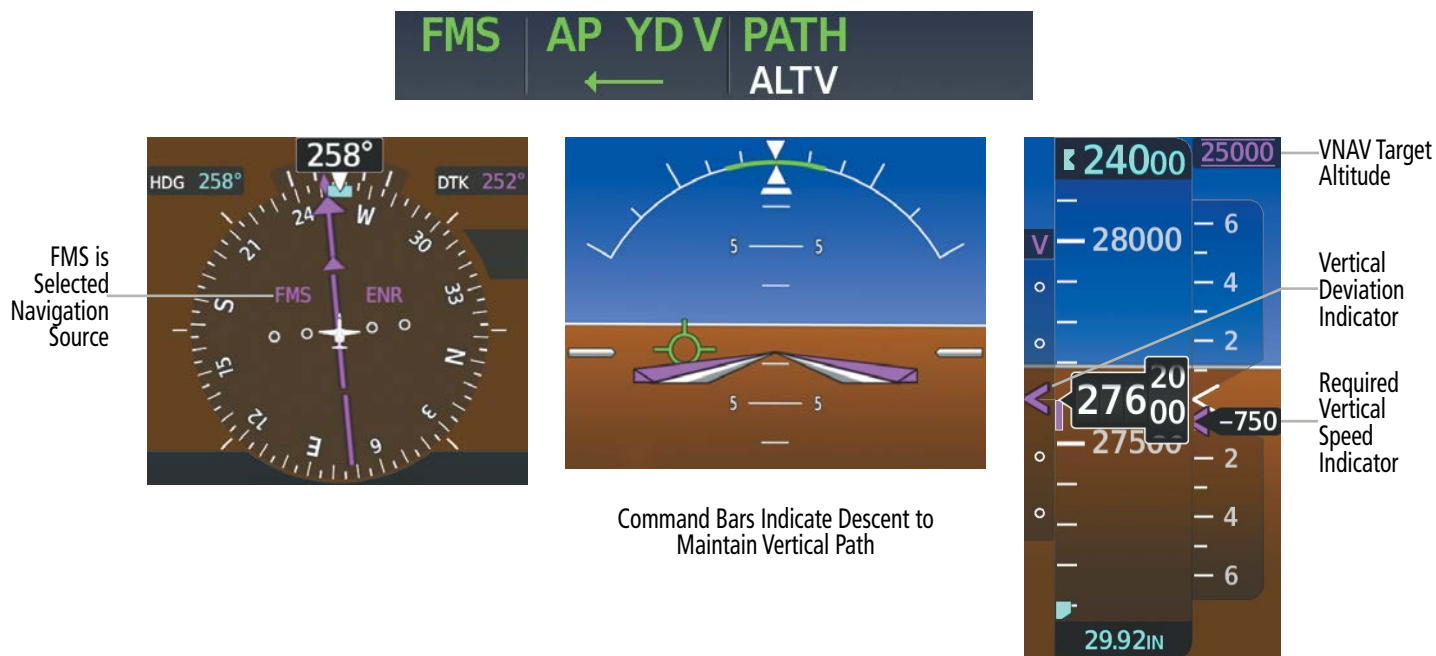
Figure 7-24 VNAV Path Descent Mode

If the Altimeter's barometric setting is adjusted while VNAV Path Descent is active, the flight director increases/decreases the descent rate by up to 500 fpm to re-establish the aircraft on the descent path (without commanding a climb). Adjusting the altimeter barometric setting creates discontinuities in VNAV vertical deviation, moving the descent path. For large adjustments, it may take several minutes for the aircraft to re-establish on the descent path. If the change is made while nearing a waypoint with a VNAV Target Altitude, the aircraft may not re-establish on the descent path in time to meet the vertical constraint.

Automatic Reversion to Pitch Hold Mode

Several situations can occur while VNAV Path Descent Mode is active which cause the flight director to revert to Pitch Hold Mode this will be accompanied by an FD MODE OFF amber CAS message:

✈ Vertical deviation exceeds 200 feet during an overspeed condition.

✈ Vertical deviation experiences a discontinuity that both exceeds 200 feet in magnitude and results in the vertical deviation exceeding 200 feet in magnitude. Such discontinuities are usually caused by flight plan changes that affect the vertical profile.

✈ Vertical deviation becomes invalid (the Vertical Deviation Indicator is removed from the PFD).

✈ A display enters Reversionary Mode (this does not apply to an active vertical direct-to).

Unless VNAV is disabled, VNAV Path Descent Mode and the appropriate altitude capture mode become armed following the reversion to Pitch Hold Mode to allow for possible profile recapture.

Non-Path Descents

Pitch Hold, Vertical Speed, and Flight Level Change modes can also be used to fly non-path descents while VNAV is selected. If the **VS** or **FLC** Key is pressed while VNAV Path Descent Mode is selected, VNAV Path Descent Mode reverts to armed along with the appropriate altitude capture mode to allow profile re-capture.

Figure 7-25 Vertical Speed VNAV Non-Path Descent

To prevent immediate profile re-capture, the following must be satisfied prior to profile re-capture:

✈ At least 10 seconds have passed since the non-path transition was initiated

✈ Vertical deviation from the profile has exceeded 250 feet, but is now less than 200 feet

Pressing the **VNAV** Key twice re-arms VNAV Path Descent for immediate profile re-capture.

VNAV Target Altitude Capture Mode (ALTV)

✓ *NOTE: Armed VNAV Target Altitude and Selected Altitude capture modes are mutually exclusive. However, Selected Altitude Capture Mode is armed implicitly (not annunciated) whenever VNAV Target Altitude Capture Mode is armed.*

VNAV Target Altitude Capture is analogous to Selected Altitude Capture Mode and is armed automatically after the **VNAV** Key is pressed and the next VNAV Target Altitude is to be intercepted before the Selected Altitude. The annunciation 'ALTV' indicates the VNAV Target Altitude is to be captured. VNAV Target Altitudes are shown in the active flight plan or vertical direct-to, and can be entered manually or loaded from a database (see the Flight Management Section for details).

A VNAV Target Altitude can be specified in one of several different ways which will have different behavior depending on whether the airplane is climbing or descending to the target altitude as shown in the following table.

VNAV Target Altitude Type	VNAV Target Altitude Indication	Climb Behavior	Descent Behavior
"AT"	22000	Arms ALTV	Arms ALTV
"AT or BELOW"	22000	Arms ALTV	Arms ALTV only if the displayed VNAV Target Altitude is the Bottom of Descent (BOD) altitude[1,2]
"AT or ABOVE"	22000	Does not arm ALTV[1]	Arms ALTV

[1] *Even if ALTV is not armed, the UNABLE VNAV ALTITUDE system message will be shown if the airplane vertical speed is not sufficient to meet the targeted altitude prior to crossing the waypoint.*

[2] *Normally "AT-or-BELOW" altitudes are not used to define the bottom-of-descent. However, if an "AT-or-BELOW" altitude is used in this way, it will be treated as an "AT" altitude (arming ALTV). Intermediate "AT-or-BELOW" altitudes in the descent do not arm ALTV.*

Table 7-7 ALTV and VNAV Target Altitudes

The flight plan can also define a VNAV Target Altitude as a BETWEEN constraint which effectively defines both an "AT-or-ABOVE" and a higher "AT-or-BELOW" target altitude at the same waypoint. ALTV will be armed for one of these target altitudes based on the context of climbing ("AT-or-BELOW") or descending ("AT-or-ABOVE").

At the same time as "TOD within 1 minute" is annunciated in the Navigation Status Box when VNAV is active, the active VNAV Target Altitude is displayed above the Vertical Speed Indicator.

As the aircraft nears the VNAV Target Altitude, the flight director automatically transitions to VNAV Target Altitude Capture Mode with Altitude Hold Mode armed. This automatic transition is indicated by the green 'ALTV' annunciation flashing for up to 10 seconds (before changing to solid green) and the appearance of the white 'ALT' annunciation. The VNAV Target Altitude is shown as the Altitude Reference beside the 'ALTV' annunciation and remains displayed above the Vertical Speed Indicator. The Required Vertical Speed Indicator (RVSI) is removed once VNAV Target Altitude Capture Mode becomes active.

At 50 feet from the VNAV Target Altitude, the flight director automatically transitions from VNAV Target Altitude Capture to Altitude Hold Mode and tracks the level leg. As Altitude Hold Mode becomes active, the white 'ALT' annunciation moves to the active vertical mode field and flashes green for 10 seconds (before changing to solid green) to indicate the automatic transition. The flight director automatically arms VNAV Path Descent, allowing upcoming descent legs to be captured and subsequently tracked.
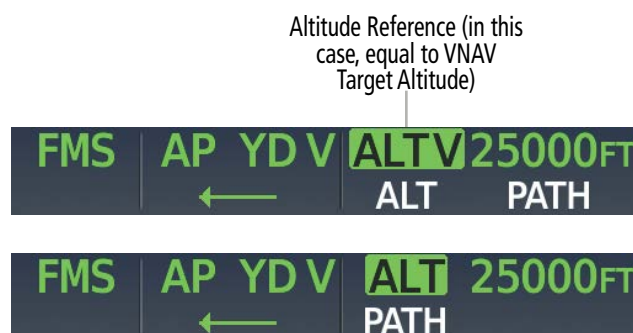
Figure 7-26 Automatic Mode Transitions During Altitude Capture

Changing the VNAV Target Altitude

Changing the current VNAV Target Altitude while VNAV Target Altitude Capture Mode is active causes the flight director to revert to Pitch Hold Mode. VNAV Path Descent and the appropriate altitude capture mode are armed in preparation to capture the new VNAV Target Altitude or the Selected Altitude, depending on which altitude is to be intercepted first.

VNAV Target Altitudes can be changed while editing the active flight plan (see the Flight Management Section for details).

APPROACH MODES

> **NOTE:** The selected navigation receiver must have a valid VOR or LOC signal or active FMS course for the flight director to enter Approach Mode.

Approach Mode is armed/activated when the **APPR** Key is pressed. Approach Mode acquires and tracks the selected navigation source (FMS, VOR, or LOC), depending on the loaded approach. This mode uses the selected navigation receiver deviation and desired course inputs to fly the approach. Pressing the **APPR** Key when the CDI is greater than one dot arms the selected approach mode (annunciated in white below the active lateral mode). If the CDI is less than one dot, the LOC, FMS, or VAPP is automatically captured when the **APPR** Key is pressed.

VOR Approach Mode (VAPP)

VOR Approach Mode (VAPP) provides greater sensitivity for signal tracking than VOR Navigation Mode.

Selecting VOR Approach Mode:

1) Ensure a valid VOR frequency is tuned.

2) Ensure that VOR is the selected navigation source.

3) Press the **APPR** Key. Ensure the correct approach course is selected.

Figure 7-27 Navigation/Approach Mode Armed

FMS Approach Mode

FMS Approach Mode can be utilized to fly non-precision and precision approaches (Glidepath Mode).

Selecting FMS Approach Mode without a glidepath:

1) Ensure a GPS approach is loaded into the active flight plan. The active waypoint must be part of the flight plan (cannot be a direct-to a waypoint not in the flight plan).

2) Ensure that FMS is the selected navigation source.

3) Press the **NAV** Key. Ensure the correct approach course is selected.

GLIDEPATH MODE (GP)

Glidepath Mode is used to track the glidepath when executing an approach procedure with FMS as the navigation source. When Glidepath Mode is armed, 'GP' is annunciated in white in the AFCS Status Box.

> ✓ **NOTE:** *Pressing the **CWS** Button while Glidepath Mode is active does not cancel the mode. The autopilot guides the aircraft back to the glidepath upon release of the **CWS** Button.*

Selecting FMS Approach Mode with a glidepath:

1) Ensure an GPS approach is loaded into the active flight plan. The active waypoint must be part of the flight plan (cannot be a direct-to a waypoint not in the flight plan).

2) Ensure that FMS is the selected navigation source.

3) Press the **APPR** Key. Ensure the correct approach course is selected.

Figure 7-28 Glidepath Mode Armed

> ⚠ **WARNING:** *Do not rely on the autopilot to level the aircraft at the MDA/DH when flying an approach with vertical guidance. The autopilot will not level the aircraft at the MDA/DH even if the MDA/DH is set in the altitude preselect.*

> ✓ **NOTE:** *Some RNAV (GPS) approaches provide a vertical descent angle as an aid in flying a stabilized approach. These approaches are NOT considered Approaches with Vertical Guidance (APV). Approaches that are annunciated on the HSI as LNAV or LNAV+V are considered Nonprecision Approaches (NPA). These approaches are flown to an MDA, until visual contact is made with the runway environment, even though vertical glidepath (GP) information may be provided. If it is desired for the AFCS to capture the MDA, it is recommended another vertical mode be selected to arm ALTS.*

> ✓ **NOTE:** *When flying an LNAV approach (with vertical descent angle) with the autopilot coupled in GP, the aircraft will not level off at the MDA even if the MDA is set in the altitude preselect. A different vertical mode (VS, FLC, PIT) must be selected prior to MDA (as altitude preselect) to arm ALTS.*

Upon reaching the glidepath there is a transition to Glidepath Mode, and the flight director gives command bar guidance to capture and track the glidepath.

Once the following conditions have been met, the glidepath can be captured:

▪ An RNAV approach with vertical guidance (LPV, LNAV/VNAV, LNAV+V, LP+V) is loaded into the active flight plan

▪ The active waypoint is at or after the final approach fix (FAF)

▪ Vertical deviation is valid

▪ FMS is the active lateral mode and the CDI is at less than full scale deviation

▪ Automatic sequencing of waypoints has not been suspended (no 'SUSP' annunciation on the HSI)

Figure 7-29 FMS Navigation/Approach Mode Armed

LOCALIZER APPROACH MODE

LOC/GS Approach Mode allows the autopilot to fly an ILS approach with a glideslope. When LOC/GS Approach Mode is armed, Glideslope Mode is also armed automatically. LOC captures are inhibited if the difference between aircraft heading and localizer course exceeds 105°.

Selecting LOC Only Approach Mode:

1) Ensure a valid localizer frequency is tuned.

2) Ensure that LOC is the selected navigation source (use the **Active NAV** Softkey to cycle through navigation sources if necessary).

3) Press the **NAV** Key. Ensure the correct approach course is set.

Figure 7-30 LOC Only Approach Mode Active

The flight director will provide commands to track the FMS flight plan to intercept the localizer. When approaching the localizer, the navigation source will automatically switch to LOC with the final approach course set.

When the CDI has automatically switched from FMS to LOC, making LOC navigation mode active during an LOC/ILS approach, FMS Navigation Mode remains active and provides FMS steering guidance until the localizer signal is captured. If the **APPR** Key is pressed prior to the automatic navigation source switch, LOC Navigation Mode and GS mode are armed.

If the following occurs, the flight director reverts to Roll Hold Mode (wings rolled level):

- Different VOR/LOC tuned while in VOR/ILS Navigation Mode (VOR/LOC Navigation Mode reverts to armed)
- FMS Navigation is active and a Vectors-To-Final is activated
- Approach Mode is active and Navigation source is manually switched
- During a LOC/ILS approach, FMS Navigation Mode is active and the FAF is crossed after the automatic navigation source transition from FMS to LOC

GLIDESLOPE MODE (GS)

Glideslope Mode is available for ILS approaches to capture and track the glideslope. When Glideslope Mode is armed (annunciated as 'GS' in white), LOC Approach Mode is armed as the lateral flight director mode.

Selecting Glideslope Mode:

1) Ensure a valid localizer frequency is tuned.

2) Ensure that LOC is the selected navigation source (use the **Active NAV** Softkey to cycle through navigation sources if necessary).

3) Press the **APPR** Key. Ensure the correct approach course is set.

   Or:

1) Ensure that FMS is the selected navigation source (use the **Active NAV** Softkey to cycle through navigation sources if necessary).

2) Ensure a ILS approach is loaded into the active flight plan.

3) Ensure the corresponding LOC frequency is tuned.

4) Press the **APPR** Key. Ensure the correct approach course is set.

Figure 7-31 Glideslope Mode Armed

Once LOC is the navigation source, the localizer and glideslope can be captured. Upon reaching the glideslope, the flight director transitions to Glideslope Mode and gives command bar guidance for intercepting and tracking the glideslope.
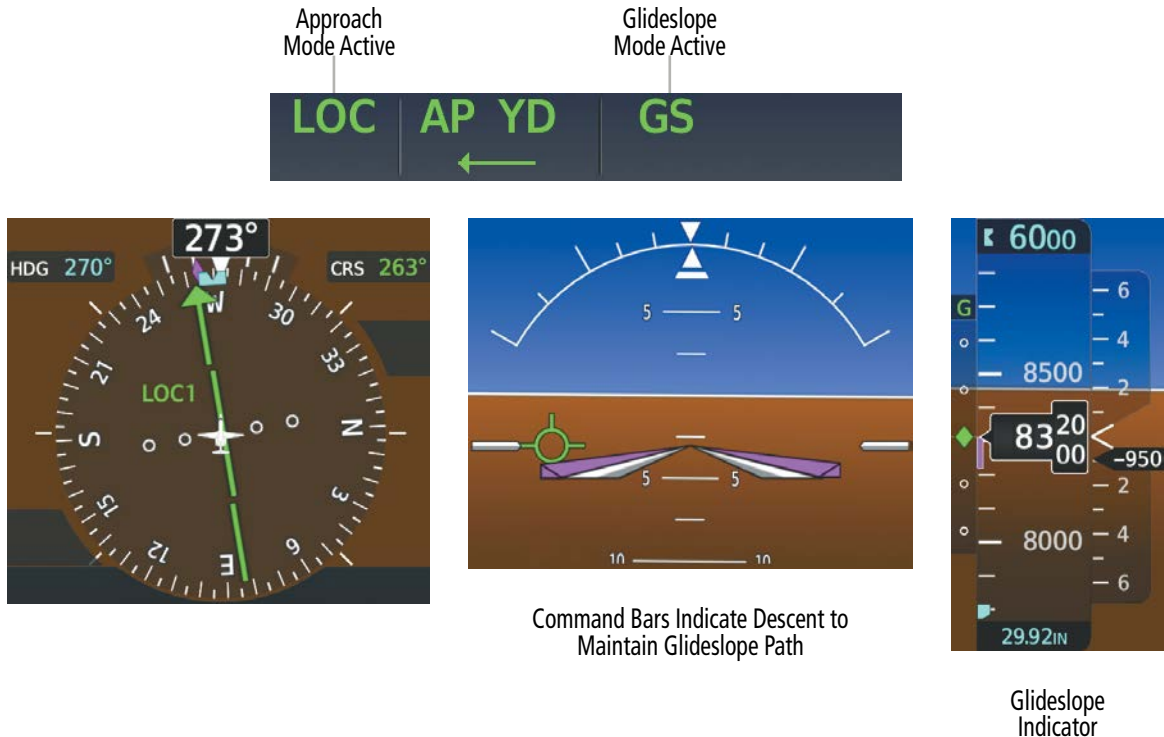
Figure 7-32 Glideslope Mode

GARMIN.

Once the following conditions have been met, the glideslope can be captured:

- An ILS approach with vertical guidance is loaded into the active flight plan
- A valid ILS frequency is tuned on the NAV radio
- A glideslope signal is being received
- The active waypoint is at or after the final approach fix (FAF)
- Vertical deviation is valid
- The CDI is at less than full scale deviation
- LOC is the active lateral mode
- Automatic sequencing of waypoints has not been suspended (no 'SUSP' annunciation on the HSI)

Backcourse Mode (BC)

> ✓ *NOTE: With a loss of FMS data, aircraft may exhibit poor LOC or BC lateral tracking capability.*

> ✓ *NOTE: When flying a backcourse approach, verify the Selected Course is the localizer front course.*

Backcourse Mode captures and tracks a localizer signal in the backcourse direction. The mode may be selected by pressing the **B/C** Key. When making a backcourse approach, set the Selected Course to the localizer front course. The flight director creates roll steering commands from the Selected Course and deviation.

Backcourse Mode is armed if the CDI is greater than one dot when the mode is selected. If the CDI is less than one dot, Backcourse Mode is automatically captured when the **B/C** Key is pressed. The flight director creates roll steering guidance from the Selected Course and deviation when in Backcourse Mode.

Selecting LOC Backcourse Mode (BC):

1) Ensure the correct localizer frequency is tuned.

2) Ensure that LOC is the selected navigation source (use the **Active NAV** Softkey to cycle through navigation sources if necessary).

3) Set the Selected Course to the localizer front course.

4) Press the **B/C** Key.

Backcourse Mode Active

LOC1 is Selected Navigation Source

Command Bars Capture and Track Localizer Back Course
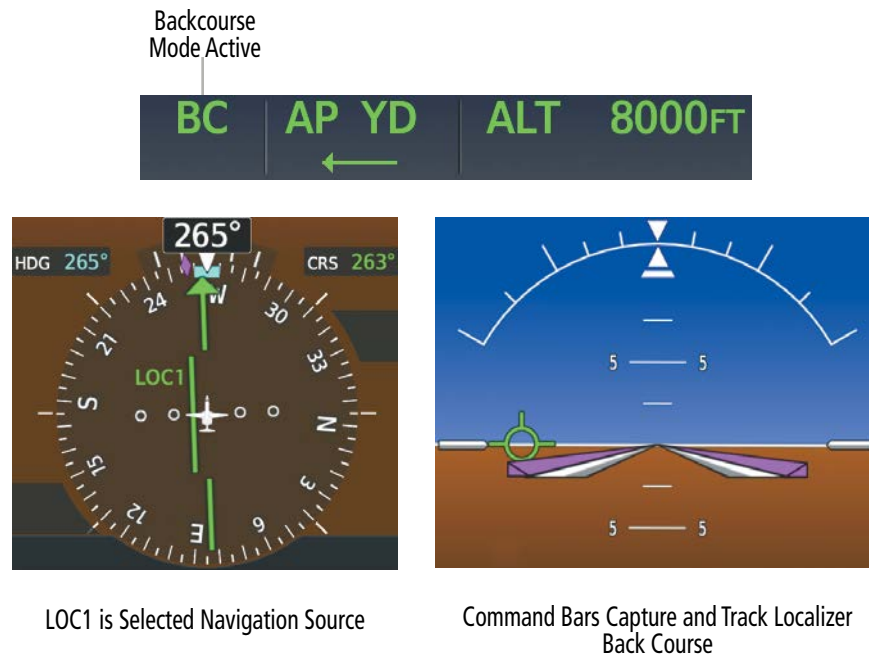
Figure 7-33 Navigation Backcourse Mode

CHANGING THE SELECTED COURSE

When both flight directors are using the same navigation source (both on VOR1/VOR2, LOC1/LOC2 or FMS), adjusting the **L CRS** Knob or **R CRS** Knob will affect the Course Pointer on L PFD and R PFD. When each flight director is using a different navigation source (e.g., pilot side on VOR1/LOC1/FMS and copilot side on VOR2/LOC2/FMS), each **CRS** Knob affects only the respective side.

Pressing the **CWS** Button and hand-flying the aircraft does not change the Selected Course while in Approach Mode. The autopilot guides the aircraft back to the Selected Course (or FMS flight plan) when the **CWS** Button is released.

INTERCEPTING AND FLYING A DME ARC

The AFCS will intercept and track a DME arc that is part of the active flight plan provided that FMS Navigation Mode is engaged, FMS is the active navigation source, and the DME arc segment is the active flight plan leg. It is important to note that automatic navigation of DME arcs is based on FMS. Thus, even if the **APPR** Key is pressed and LOC or VOR Approach Mode is armed prior to reaching the Initial Approach Fix (IAF), Approach Mode will not activate until the arc segment is completed.

If the pilot decides to intercept the arc at a location other than the published IAF (i.e., ATC provides vectors to intercept the arc) and subsequently selects Heading Mode or Roll Mode, the AFCS will not automatically intercept or track the arc unless the pilot activates the arc leg of the flight plan and arms FMS Navigation Mode. The AFCS will not intercept and fly a DME arc before reaching an IAF that defines the beginning of the arc segment. Likewise, if at any point while established on the DME arc the pilot deselects FMS Navigation Mode, the AFCS will no longer track the arc.

TAKEOFF AND GO AROUND MODES

In Takeoff and Go Around modes, the flight director command bars assume a constant set pitch attitude. The **GA** Switch (located on both throttle levers) is used to select both modes. The mode entered by the flight director depends on whether the aircraft is on the ground or in air.

TAKEOFF MODE (TO)

Takeoff Mode provides an attitude reference during rotation and takeoff. This mode can be selected only while on the ground by pushing the **GA** Switch. The flight director command bars assume a wings-level, pitch-up attitude. Autopilot engagement while Takeoff Mode is active is inhibited while the aircraft is on the ground.

Takeoff
Mode Active

TO   YD   TO
ALTS
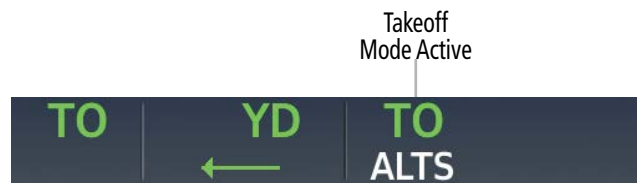
Figure 7-34 Takeoff Mode

GO AROUND MODE (GA)

Pressing the **GA** Switch while the aircraft is in the air activates the flight director command bars to assume a wings-level, pitch-up attitude, allowing the execution of a missed approach or a go around. If there is a valid flight plan loaded with FMS lateral guidance, FMS Mode becomes the active lateral mode in preparation for proceeding to the Missed Approach Hold Point. If no approach has been loaded, or if there is no FMS lateral guidance, GA will be the active lateral mode.

Selecting Go Around Mode disengages the autopilot; however, subsequent autopilot engagement is allowed. Attempts to modify the aircraft attitude (i.e., with the **CWS** Button) result in reversion to Pitch Hold Mode.

Go Around
Mode Active

GA   YD   GA
ALTS
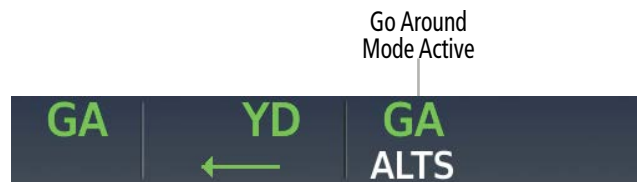
Figure 7-35 Go Around Mode

7.5 AUTOPILOT AND YAW DAMPER OPERATION

> **NOTE:** *Refer to the current version of the pertinent flight manual for specific instructions regarding emergency procedures.*

The autopilot and yaw damper operate the flight control surface servos to provide automatic flight control. The autopilot controls the aircraft pitch and roll attitudes following commands received from the flight director. Automatic Pitch Trim (APT) provides trim commands to the pitch trim actuator to relieve any sustained effort required by the pitch servo.

The yaw damper reduces Dutch roll tendencies and coordinates turns. It can operate independent of the autopilot and may be used during normal hand-flight maneuvers. Yaw rate commands are limited by the yaw damper.

FLIGHT CONTROL

Pitch and roll commands are provided to the servos based on the active flight director modes. Yaw damping is provided by the yaw servo. Servo motor control limits the maximum servo speed and torque. The servo gearboxes allow the servos to be overridden in case of an emergency.

PITCH AXIS AND TRIM

The autopilot pitch axis uses pitch rate to stabilize the aircraft pitch attitude during upsets and flight director maneuvers. Flight director pitch commands are rate- and attitude-limited, combined with pitch damper control, and sent to the pitch servo motor.

When the autopilot is engaged, the Automatic Pitch Trim (APT) function commands the pitch trim actuator to reduce the average pitch servo effort.

Manual Electric Pitch Trim (MEPT) functionality is available at any time via the pilot and copilot **Pitch Trim** Switch. Manual trim commands are generated only when both halves of the **Pitch Trim** Switch are operated simultaneously. Operating the **Pitch Trim** Switch when the autopilot is engaged will cause the autopilot to disconnect.

The pilot side **Pitch Trim** Switch has priority over the copilot side **Pitch Trim** Switch.

ROLL AXIS

The autopilot roll axis uses roll rate to stabilize aircraft roll attitude during upsets and flight director maneuvers. The flight director roll commands are rate- and attitude-limited, combined with roll damper control, and sent to the roll servo motor.

YAW AXIS

The yaw damper uses yaw rate and roll attitude to dampen the aircraft's natural Dutch roll response. It also uses lateral acceleration to coordinate turns.

ENGAGING THE AUTOPILOT AND YAW DAMPER

> **NOTE:** *Autopilot engagement/disengagement is not equivalent to servo engagement/disengagement. Use the **CWS** Button to disengage the pitch and roll servos while the autopilot remains active.*

When the **AP** Key is pressed, the autopilot, yaw damper, and flight director (if not already active) are activated. The flight director remains in the selected modes or engages in Pitch and Roll Hold Modes if no modes are selected. When the **YD** Key is pressed, the system engages the yaw damper independently of the autopilot. Autopilot and yaw damper status are displayed in the center of the AFCS Status Box. Engagement is indicated by green 'AP' and 'YD' annunciations, respectively.

Autopilot Engaged

Figure 7-36 Autopilot Engaged

CONTROL WHEEL STEERING (CWS)

During autopilot operation, the aircraft may be hand-flown without disengaging the autopilot. Pressing and holding the **CWS** Button disengages the pitch and roll servos from the flight control surfaces and allows the aircraft to be hand-flown. At the same time, the flight director is synchronized to the aircraft attitude during the maneuver. Autopilot automatic pitch trim (APT) operation is interrupted during CWS activity; yaw damper engagement is unaffected.

The 'AP' annunciation is temporarily replaced by 'CWS' in white for the duration of CWS maneuvers.

Control Wheel Steering

Figure 7-37 CWS Annunciation

DISENGAGING THE AUTOPILOT AND YAW DAMPER

MANUAL DISENGAGEMENT

NOTE: Pressing the AP Key does not disengage the yaw damper.

The autopilot is manually disengaged by pushing the **AP** Key on the AFCS Controller, either **GA** Switch, the **Pitch Trim** Switch, or the **AP YD DISC/TRIM INT** Switch.

Manual autopilot disengagement is indicated by a flashing amber and black 'AP' annunciation and an autopilot disconnect aural alert, "autopilot."

Figure 7-38 Manual AP Disengagement

Pressing the **YD** Key disengages the yaw damper. Upon disengagement, the 'YD' annunciation flashes amber for five seconds and is then removed.

Figure 7-39 Manual Yaw Damper Disengagement

After disengagement, the autopilot disconnect aural alert and flashing 'AP' annunciation may be cancelled by pushing the **AP YD DISC/TRIM INT** Switch or **Pitch Trim** Switch.

AUTOMATIC DISENGAGEMENT

Automatic autopilot disengagement is indicated by a flashing red and white 'AP' annunciation and an autopilot disconnect aural alert, "autopilot". The autopilot disconnect aural alert, continues until acknowledged by pushing the **AP YD DISC/TRIM INT** Switch or **Pitch Trim** Switch. Automatic autopilot disengagement occurs due to:

- Stall warning (see note below)
- System failure
- Invalid sensor data
- Flight Control Disconnect

- Inability to compute default flight director modes (FD also disengages automatically)
- Stabilizer trim activation

NOTE: *Stall warning is only an automatic autopilot disengagement criteria for aircraft that do not have the optional underspeed protection.*

Figure 7-40 Automatic Disengagement

Automatic yaw damper disengagement is indicated by a five-second flashing amber 'YD' annunciation. Automatic yaw damper disengagement occurs when autopilot disengagement is caused by failure in a parameter also affecting the yaw damper. This means the yaw damper can remain operational in some cases where the autopilot automatically disengages. A localized failure in the yaw damper system or invalid sensor data also cause yaw damper disengagement.

7.6 AFCS ANNUNCIATIONS AND ALERTS

AFCS STATUS ALERTS

The annunciations in the following table (listed in order of increasing priority) can appear on the PFDs above the Airspeed and Attitude indicators. Only one annunciation may occur at a time, and messages are prioritized by criticality.

Alert Condition	Annunciation	Description
Rudder Mistrim Right/Left	RUD→ / ←RUD	Yaw servo providing sustained force in the indicated direction. Aircraft rudder re-trim after substantial pitch and power changes required.
	RUD→ / ←RUD	High (or excessive) sustained forces in the indicated direction.
Aileron Mistrim Right/Left	AIL→ / ←AIL	Roll servo providing sustained force in the indicated direction
	AIL→ / ←AIL	High (or excessive) sustained forces in the indicated direction.
Elevator Mistrim Down/Up	↓ELE / ↑ELE	Pitch servo providing sustained force in the indicated direction
	↓ELE / ↑ELE	High (or excessive) sustained forces in the indicated direction.
Preflight Test	PFT	Performing preflight system test; aural alert sounds at completion - Do not press the **AP DISC** Switch during servo initialization and preflight system tests as this may cause the preflight system test to fail or never to start (if servos fail their initialization tests). - Power must be cycled to the servos to remedy the situation.
	PFT	Preflight system test failed; aural alert sounds at failure

Table 7-8 AFCS Status Alerts

OVERSPEED PROTECTION

While Pitch Hold, Vertical Speed, Flight Level Change, VNAV Path Descent, or an altitude capture mode is active, airspeed is monitored by the flight director and pitch commands are limited for overspeed protection. When an overspeed condition is detected the flight director will compute a pitch up command to the autopilot resulting in a reduction in the aircraft's speed. The pitch up command will remain until the aircraft's airspeed falls below the overspeed limit. Overspeed protection is provided in situations where the flight director cannot acquire and maintain the mode reference for the selected vertical mode without exceeding the certified maximum aircraft airspeed.

When an autopilot overspeed condition occurs, a flashing amber 'MAXSPD' annunciation appears above the Airspeed Indicator. Engine power should be reduced and/or the pitch reference adjusted to slow the aircraft. The annunciation disappears when the overspeed condition is resolved.
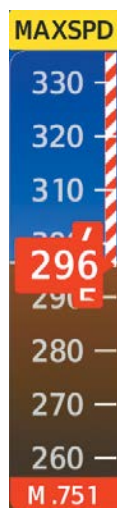
Figure 7-41 Overspeed Annunciation

UNDERSPEED PROTECTION (OPTIONAL)

Underspeed Protection (USP) is designed to discourage aircraft operation below minimum established airspeeds and is available when the flight director is on.

When the aircraft triggers stick shaker activation, an amber MINSPD annunciation (see following figure) will appear above the airspeed indicator. When the airspeed trend vector reaches a predetermined airspeed, a single aural "AIRSPEED" will sound, alerting the pilot to the impending underspeed condition.

Figure 7-42 Underspeed Annunciation

7.7 ABNORMAL OPERATION

OVERPOWERING AUTOPILOT SERVOS

In the context of this discussion, "overpowering" refers to any pressure or force applied to the pitch controls when the autopilot is engaged. A small amount of pressure or force on the pitch controls can cause the autopilot automatic pitch trim (APT) to run to an out-of-trim condition. Therefore, any application of pressure or force to the controls should be avoided when the autopilot is engaged.

Overpowering the autopilot during flight will cause the APT to run, resulting in an out-of-trim condition or cause the trim to hit the stop if the action is prolonged. In this case, larger than anticipated control forces are required after the autopilot is disengaged.

EMERGENCY DESCENT MODE (EDM)

EDM is an autopilot mode that, when initiated, will fly the aircraft to a safe altitude in response to cabin depressurization at altitude. The system is available during autopilot operations above 30,000' MSL. While activation requires no crew action, the EDM does require flight crew action for speed brake and thrust control. EDM will activate if the flight crew misses the red 'CABIN ALT' CAS Message adding a complementary function for the EDM Maneuver.

Flight Level Change (FLC) Mode will automatically be selected to track the new target airspeed to the new target altitude. EDM will remain active and all other FD modes will be inhibited until the pilot disconnects the autopilot. Re-activating the AP will allow other modes to be selected. When EDM is active, Selected Altitude, heading, and airspeed target can be adjusted but the AFCS modes cannot be changed until the autopilot is disconnected. The following AFCS modes are activated automatically:

- Flight Level Change Mode with the speed reference set below V$_{MO}$/M$_{MO}$ and Selected Altitude set to 15,000 feet
- Heading Select Mode with the selected heading set to 90° left of the current heading

ACTIVATION

Emergency Descent Mode (EDM) consists of a descent to 15,000 ft followed by leveling off. EDM is automatically activated when the:

» Aircraft is at or above 30,000' MSL,
   AND

» Cabin pressure altitude is 14,500' or above,
   AND

» Autopilot is engaged.

When EDM is activated, the autopilot will conduct a normal descent maneuver within normal acceleration limits (+/- 0.3g). The autopilot shall maintain speed target below V$_{MO}$/M$_{MO}$ with pitch angle limited to a maximum of -22 degrees to avert an overspeed condition. As the aircraft altitude changes, the airspeed target shall continuously track the airspeed profile. The autopilot will execute a turn of 90° left of the current aircraft heading and will automatically set the preselected altitude to 15,000 feet. Upon activation, a red 'EDM' annunciation will be displayed to the left of the AFCS Status Box, above the attitude display on both PFDs. In addition to the annunciations provided on the PFDs, the AFCS Mode Controller also displays the selected flight director mode by illuminating a green annunciator light above each push-button on the GMC 7200.

At EDM activation, flight crew must immediately retard the throttles manually and deploy the speed brakes.

> ✓ **NOTE:** *If flight crew does not manually manipulate the throttles and speed brake, the airplane will not meet the emergency descent profile and will instead descend at a slower rate. A reduction in thrust is required to allow rapid descent.*

When EDM is activated:

1) Manually retard the throttles.

2) Deploy the speed brakes.

At the end of the EDM Maneuver, the flight director and autopilot will initiate a level off at 15,000 feet. The flight director will transition to Selected Altitude Capture (ALTS) Mode and Heading (HDG) Mode will be maintained. Flight crew action is required to increase thrust and retract the speed brakes.

When EDM level off is complete at 15,000' MSL:

1) Manually increase the throttles to maintain level flight.

2) Retract the speed brakes.

Figure 7-43 Emergency Descent Mode
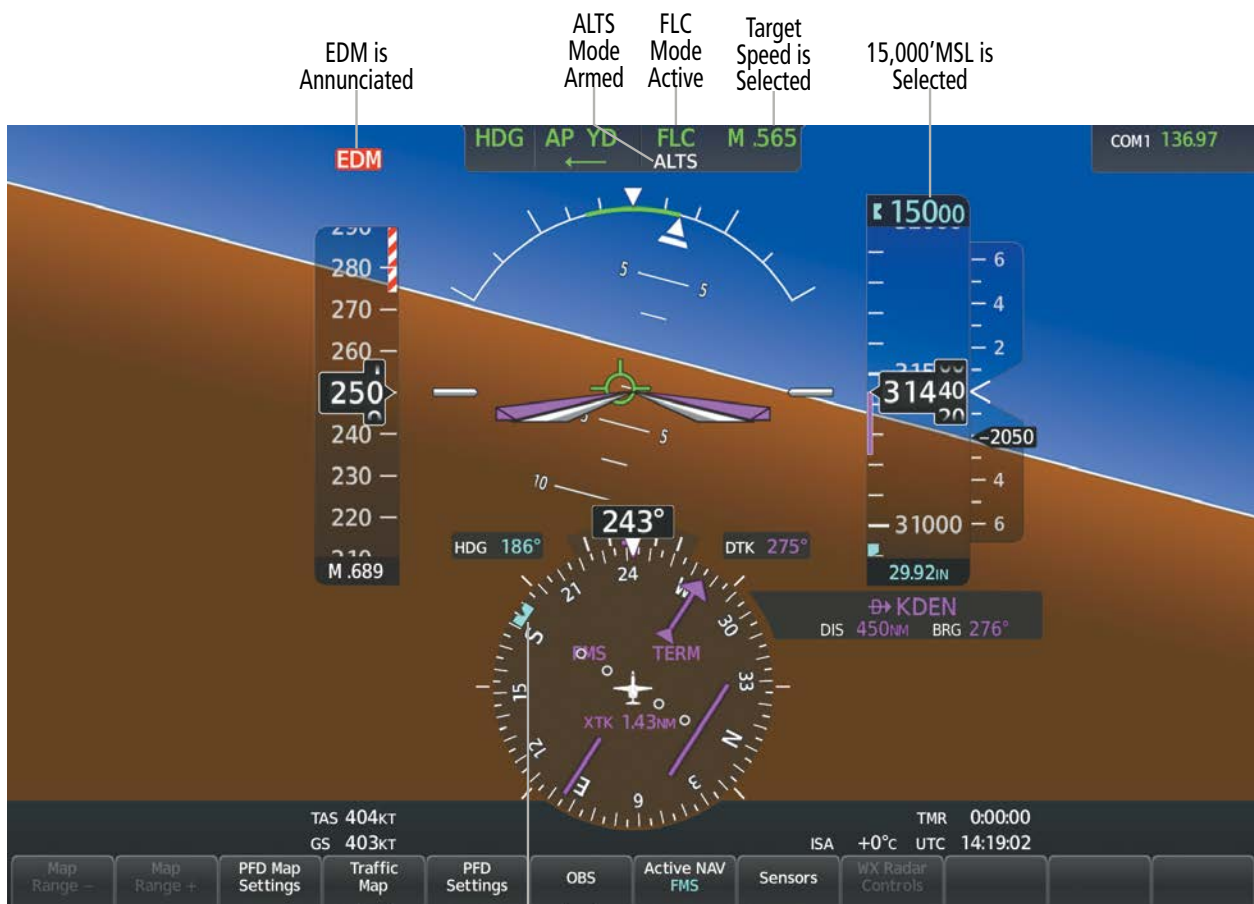
EDM OVERRIDE

Once active, the pilot can always choose to abort the emergency descent at any time by pressing the **AP YD DISC/TRIM INT** Switch. FD mode changes are precluded while EDM is active.

Disabling EDM after activation:

Press the **AP YD DISC/TRIM INT** Switch.

> **NOTE:** *Refer to the current version of the pertinent flight manual for specific instructions regarding emergency procedures.*

SECTION 8 ADDITIONAL FEATURES

8.1 OVERVIEW

> *NOTE: Regardless of the availability of SafeTaxi® or ChartView, it may be necessary to carry another source of charts on-board the aircraft.*

Additional features of the Integrated Avionics System include the following:

- SafeTaxi® Diagrams
- SurfaceWatch™
- Electronic Charts
  - FliteCharts
  - ChartView (Optional)
  - IFR/VFR Charts
- Satellite Telephone & Datalink Services (Optional)
- ACARS (Optional)
- Connext® (Optional)
- WiFi Connections (Optional)
- SiriusXM® Satellite Radio (Optional)
- Flight Data Logging
- Electronic Checklists
- Electronic Documents
- Stabilized Approach (Optional)
- Database Management

SafeTaxi diagrams provide detailed taxiway, runway, and ramp information at more than 1,400 airports in North America, South America, and Europe. By decreasing range on an airport that has a SafeTaxi diagram available, a close up view of the airport layout can be seen.

The SurfaceWatch feature provides voice and visual annunciations to aid in maintaining situational awareness and avoid potential runway incursions during ground and air operations in the airport environment.

FliteCharts and ChartView (optional) provide on-board electronic terminal procedures charts. Electronic charts offer the convenience of rapid access to essential information. IFR/VFR Charts provide electronic low altitude IFR charts, high altitude IFR charts, and VFR charts for navigation.

The optional Iridium Transceiver provides an airborne low speed datalink, Iridium Satellite Telephone service, and Short Message Service (SMS).

The optional ACARS (Aircraft Communications Addressing and Reporting System) feature provides a continuous datalink with the ACARS provider to maintain data exchange capabilities with Air Traffic Service (ATS), Aeronautical Operational Control (AOC) systems, and ACARS Weather services.

The optional Connext feature allows for setting up the installed optional Flight Stream device for a Bluetooth connection between the system and a mobile device running the Garmin Pilot™ application.

The optional WiFi Connections feature allows for the transmission of data recorded by the Maintenance Logs feature as well as weather information while aircraft is on ground. The recording of this data is not visible to the pilot and requires no pilot interaction, other than setting up WiFi connections where applicable.

The optional SiriusXM Satellite Radio entertainment audio feature of the SiriusXM Datalink Receiver handles more than 170 channels of music, news, and sports. SiriusXM Satellite Radio offers more entertainment choices and longer range coverage than commercial broadcast stations.

The Flight Data Logging feature automatically stores critical flight and engine data on an SD data card. Approximately 1,000 flight hours can be recorded for each 1GB of available space on the card.

The Electronic Checklists feature helps to quickly find the proper checklist procedure on the ground or during flight.

The optional Stabilized Approach feature provides aural and visual annunciations to notify the flight crew of unstable conditions during an approach.

The database management feature provides a comprehensive means to view and manage all databases installed on the system.

8.2 SAFETAXI

⚠️ **WARNING:** *Always refer to current aeronautical charts and NOTAMs for verification of displayed aeronautical information. Displayed aeronautical data may not incorporate the latest NOTAM information.*

SafeTaxi is an enhanced feature that gives greater map detail when viewing airports at close range on the 'Navigation Map' Page or the Inset Map on the PFD. The maximum map ranges for enhanced detail are pilot configurable. When viewing at ranges close enough to show the airport detail, the map reveals taxiways with identifying letters, numbers, airport Hot Spots, and airport landmarks including ramps, buildings, control towers, and other prominent features. Resolution is greater at lower map ranges. When the aircraft's current position is within the SafeTaxi view, the airplane symbol on the airport provides enhanced position awareness. To view the full capability of the SafeTaxi feature, 'Airports' must be enabled on the 'Map Settings' Page through the **Aviation** Tab on the Touchscreen Controller.

✅ **NOTE:** *When obstacles are displayed on the 'Navigation Map' Page in the vicinity of an airport being viewed with SafeTaxi, the obstacle symbols may be obscured by SafeTaxi feature labels.*

Designated Hot Spots are recognized at airports with many intersecting taxiways and runways, and/or complex ramp areas. Airport Hot Spots are outlined to caution pilots of areas on an airport surface where positional awareness confusion or runway incursions happen most often. Hot Spots are defined with a magenta circle or outline around the region of possible confusion.

✅ **NOTE:** *Hot Spot areas and land hold short lines may be obscured by runways which overlap them.*

Any map display that shows the navigation view can also show the SafeTaxi airport layout within the maximum configured range. The following is a list of displays where the SafeTaxi feature can be seen:

- 'Navigation Map' Page
- Inset Map
- Weather Panes
- 'Trip Planning' Pane

During ground operations the aircraft's position is displayed in reference to taxiways, runways, and airport features. In the example shown, the aircraft is on the active runway approaching a designated Airport Hot Spot boundary on KSFO airport. Airport Hot Spots are outlined in magenta. When panning over the airport, features such as runway holding lines and taxiways are shown at the cursor.
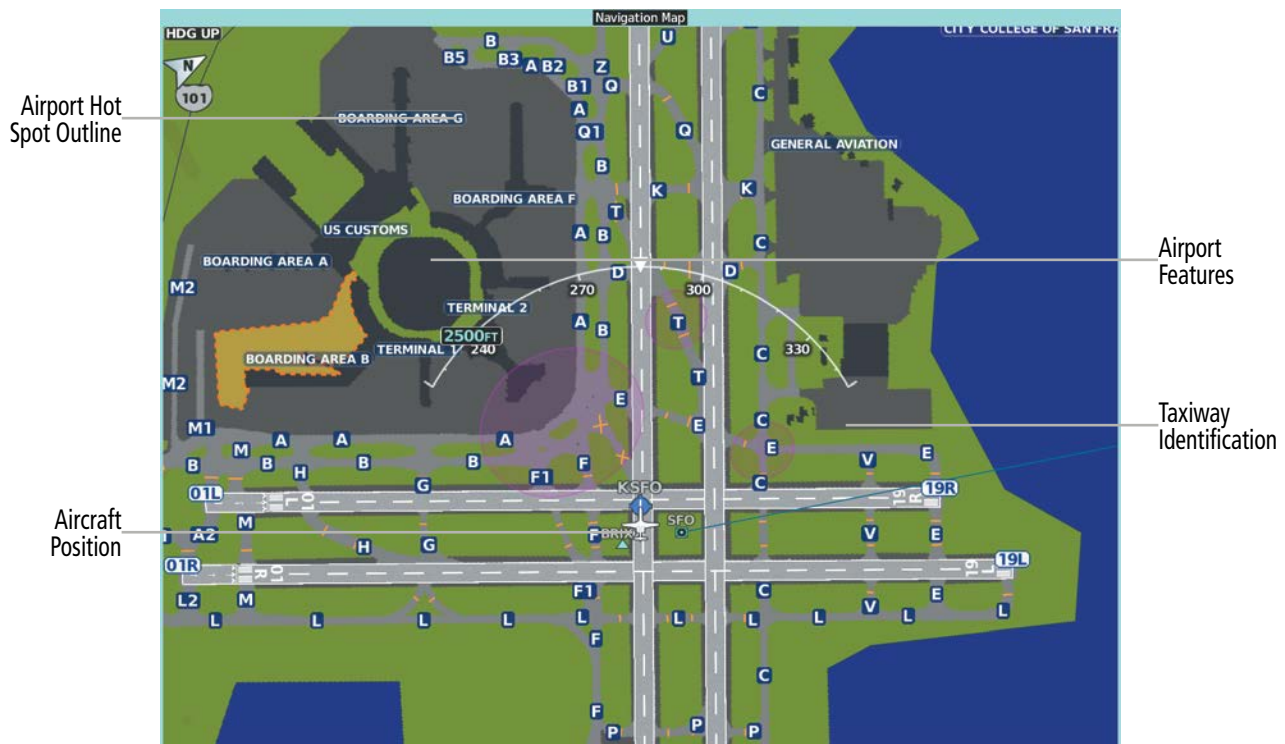
Figure 8-1 SafeTaxi Depiction on the Navigation Map Display

Enabling/disabling SafeTaxi:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If not already selected, touch the **Aviation** Tab.

3) If necessary, scroll to display the **SafeTaxi** Annunciator Button.

4) Touch the **SafeTaxi** Button to enable or disable the display of SafeTaxi on the Navigation and inset maps. A green annunciator on the button indicates SafeTaxi is enabled.

Configuring SafeTaxi range:

1) From Home, touch **Map > Map Selection > Map Settings**.

2) If not already selected, touch the **Aviation** Tab.

3) If necessary, scroll to display the **SafeTaxi** Range Button.

4) Touch the **SafeTaxi** Range Button. A selection of ranges are displayed.

5) Touch the desired range. In the following figure, 1.5 NM has been selected. With this setting, SafeTaxi will be displayed on the 'Navigation Map' Page for range settings up to and including 1.5 NM.

Figure 8-2 SafeTaxi Map Settings

8.3 SURFACEWATCH

⚠️ *WARNING: Do not use SurfaceWatch™ information as the primary method of flight guidance during airborne or ground operations. SurfaceWatch does not have NOTAM or ATIS information regarding the current active runway, condition, or information about the position of hold lines.*

✅ *NOTE: When the flight plan is modified, data manually entered on the 'FPL - SurfaceWatch' Page will be cleared.*

The SurfaceWatch feature provides aural and visual annunciations to help the pilot maintain situational awareness and avoid potential runway incursions during ground and air operations in the airport environment. The SurfaceWatch feature is not available in Reversionary Mode. The SurfaceWatch feature is comprised of the following key components:

- Alert Annunciations
  - Taxiway Takeoff
  - Runway Too Short (during takeoff or landing)
  - Check Runway (during takeoff or landing)
  - Taxiway Landing
- Provides information on the Primary Flight Display (PFD) that contains runway and taxiway information that changes as the aircraft moves through the airport environment

Figure 8-3 SurfaceWatch Information on the PFD

Enabling/disabling SurfaceWatch:

1) From Home, touch **Utilities > Setup** > **Avionics Settings.**

2) If not already selected, touch the **Alerts** Tab and scroll to view the **SurfaceWatch Inhibit** Button.

3) Touch the **SurfaceWatch Inhibit** Button to enable or disable SurfaceWatch. A green annunciator indicates SurfaceWatch is inhibited, or disabled. The inhibit setting will be canceled after a power cycle.

> **NOTE:** *If SurfaceWatch is disabled, the origin runway will not be displayed with distinguishing cyan coloring.*

INFORMATION DISPLAY

The SurfaceWatch Information Box is displayed on the PFD to the left of the HSI. It contains runway and taxiway information that dynamically changes as the aircraft moves through the airport environment. The information that is displayed in the Information Box is the aircraft's relative position to nearby aprons, taxiways, and runways.

There are three components to the SurfaceWatch Information Box as shown in the following figure. These components are Currently Occupied, Approaching, and Crossing Runways.
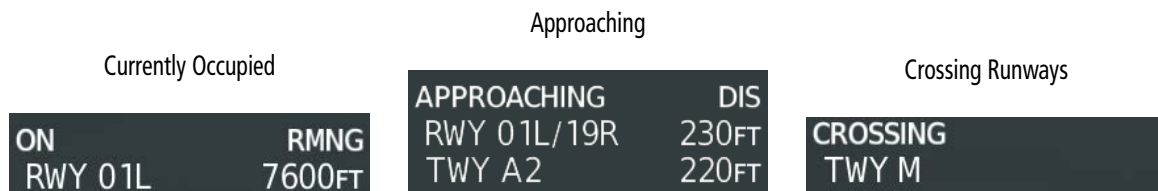
Figure 8-4 Information Types Displayed in the Information Box

CURRENTLY OCCUPIED

This component indicates the aircraft is 'ON' the indicated apron, taxiway, or runway. In the previous figure, the aircraft is currently 'ON' RWY 01L. The remaining runway distance is also shown when the aircraft is situated on and aligned with a runway.

If the aircraft is airborne and approaching an airport, 'AIRBORNE TO' and the destination airport identifier will be displayed.

Information is displayed only for objects labeled on the SafeTaxi diagram.

APPROACHING COMPONENT

This component indicates the aircraft is 'APPROACHING' the indicated apron, taxiway, or runway. In the previous figure, the aircraft is currently 'APPROACHING' RWY 01L/19R and TWY A2. The distance to each is also shown.

> **NOTE:** *When approaching a runway, the distance displayed does not take into account the position of Hold Line for the runway. Do not cross the Hold Line until authorized.*

When the aircraft is taxiing and approaching an intersection of multiple taxiways, the taxiway identifiers will be listed in order of proximity and the distance to the nearest is displayed.

When the aircraft is taxiing and crossing an intersection of multiple taxiways, 'CROSSING' will be displayed and no distance will be shown.

CROSSING RUNWAYS

This component lists the runways, from closest to furthest, that are 'CROSSING' the runway the aircraft currently occupies, as seen in the previous figure. The distance to each runway is also shown in order of closest distance. Runways behind the aircraft are not depicted.

The Crossing Runways component is shown in conjunction with the Currently Occupied component of the Information Box.

ALERTS

The SurfaceWatch alert annunciations are displayed in the central portion of the PFD. The alert annunciations are accompanied by a corresponding voice alert. Other associated information is presented in the SurfaceWatch Information Box.

The following is a descriptive list of the SurfaceWatch alerts.

SurfaceWatch Alert Annunciation	Associated Voice Alert	Description
TWY TAKEOFF	"Taxiway"	Issued when the aircraft is taking off from a non-runway (e.g., a taxiway)
RWY TOO SHORT	"Runway Too Short"	Issued when the aircraft is taking off/landing from a runway with a length less than needed as calculated by the PERF function.
CHECK RUNWAY	"Check Runway"	Issued when the aircraft is taking off/landing from a runway different than that entered in PERF.
TWY LANDING	"Taxiway"	Issued when the aircraft is taking off on a non-runway (e.g., a taxiway).

Table 8-1 SurfaceWatch Alert Annunciations

TAKEOFF ALERTS

The takeoff phase-of-flight, as determined by the system, must be valid in order for the system to issue Takeoff Alerts. Takeoff Alerts will be issued when the thrust levers are advanced to near the TO position.

TAXIWAY TAKEOFF

The Taxiway Takeoff Alert is issued when the aircraft attempts to takeoff from a non-runway (e.g., a taxiway). The system determines this when the takeoff phase-of-flight is valid, the thrust levers are advanced, and the aircraft is not aligned with a runway.

In addition to the visual and voice alert, the Information Box contains a textual description of the currently occupied taxiway (or other maneuvering area) and potentially the next area (apron or maneuvering area) to be occupied (based on aircraft heading and the airport geometry) and the distance to that area.

RUNWAY TOO SHORT

The Runway Too Short (during takeoff) alert is issued when the aircraft attempts to takeoff from a runway and the remaining runway length is less than the required length. The system determines this when the takeoff phase-of-flight is valid, the thrust levers are advanced while the aircraft is aligned with a runway and the remaining runway length is less than the required takeoff distance calculated by PERF.

NOTE: While the Runway Too Short alert may be issued for any runway from which the aircraft is taking off, the system will always calculate the runway length for the specific runway entered in PERF.

In addition to the visual and voice alert, the Information Box will contain a textual description of the currently occupied runway and the remaining runway length as shown in the following figure.

CHECK RUNWAY

The Check Runway alert is issued when the aircraft attempts to takeoff from a runway that does not match the departure runway in PERF or the active flight plan when PERF is not used. The system determines this when the Takeoff phase-of-flight is valid and the thrust levers are advanced while the aircraft is aligned with a runway that is not the departure runway entered in PERF or the active flight plan.

In addition to the visual and voice alert, the Information Box contains a textual description of the currently occupied runway as shown in the previous figure.

LANDING ALERTS

The On-Final phase-of-flight, as determined by the system, must be valid in order for the system to issue Landing Alerts. The system will issue Landing Alerts when the aircraft is below 250 feet AGL and within one nautical mile of the runway threshold. Landing alerts are removed when the pilot initiates a climb during a go-around.

TAXIWAY LANDING

The Taxiway Landing alert is issued when the aircraft attempts to land on a non-runway (e.g., a taxiway). The system determines this when the On-Final phase-of-flight is valid, the aircraft is below 250 feet AGL, within one nautical mile of the runway threshold, and the aircraft is not aligned with a runway.

In addition to the visual and voice alert, the Information Box will display the destination airport identifier and the text "APPROACHING TWY" to indicate a non-runway landing is being attempted.

RUNWAY TOO SHORT

The Runway Too Short alert is issued when the aircraft attempts to land on a runway where the remaining runway length is less than the required landing runway length as calculated by PERF. The system determines this when the On-Final phase-of-flight is valid and the aircraft is aligned with a runway PERF has calculated to be too short.

NOTE: While the Runway Too Short alert may be issued for any runway with which the aircraft is aligned, the system will always calculate the runway length for the specific runway entered in PERF.

In addition to the visual and voice alert, the Information Box will display the destination airport identifier and the text "APPROACHING" above the runway designation and the text "RMNG" above the indicated remaining runway length as indicated in the following figure.

CHECK RUNWAY

The Check Runway alert is issued when the aircraft attempts to land on a runway that does not match the arrival runway specified in PERF. The system determines this when the On-Final phase-of-flight is valid while the aircraft is aligned with a runway that is not the arrival runway entered in the PERF function.

Additionally, the Information Box will display the destination airport identifier, the runway with which the aircraft is aligned, and the distance to the runway.

GARMIN.

SURFACEWATCH SETUP

Origin/destination airport, runway, and distance data entered integrates with SurfaceWatch technology to alert the flight crew to a runway too short for takeoff/landing, or to advise of a potential taxiway takeoff/landing. The runway selected in SurfaceWatch Setup appears on the airport diagram in cyan and appears outlined in cyan on the synthetic vision representation of the runway on the PFD.

Entering origin/destination airport when no flight plan has been entered:

1) From Home, touch **Flight Plan > Add Origin** or **Add Destination** as appropriate.

2) Use the keypad to enter the Airport Identifier and touch **Enter**.

Selecting origin runway:

1) From Home, touch **Flight Plan > Origin**.

2) On the 'Select Runway' Screen, scroll down as required and select the appropriate runway.

Selecting destination runway:

1) From Home, touch **Flight Plan > Destination > Select Arrival Runway**.

2) On the 'Select Runway' Screen, scroll down as required and select the appropriate runway.

Selecting required takeoff distance:

1) From Home, touch **PERF > Takeoff Data.**

2) Touch the **Origin** Tab (if not already selected).

3) Touch the **Runway** Button and select the takeoff runway (If not already selected).

4) Touch the **Runway** Tab. The 'Takeoff Run Available' Distance is automatically populated for runways supported with PERF data.

5) Touch the **Takeoff Run Available** Button and adjust the required takeoff distance as required.

Selecting required landing distance:

1) From Home, touch the **PERF > Landing Data.**

2) Touch the **DEST** Tab (if not already selected).

3) Touch the **Runway** Button and select the landing runway (if not already selected).

4) Touch the **Runway** Tab. 'The Landing DIS Available' is automatically populated for runways supported with PERF data.

5) Touch **Landing DIS Available** Button and adjust the required landing distance as required.

8.4 ELECTRONIC CHARTS

⚠️ **WARNING:** *Always refer to current aeronautical charts and NOTAMs for verification of displayed aeronautical information. Displayed aeronautical data may not incorporate the latest NOTAM information.*

⚠️ **WARNING:** *Do not rely on the displayed minimum safe altitude (MSAs) as the sole source of obstacle and terrain avoidance information. Always refer to current aeronautical charts for appropriate minimum clearance altitudes.*

✅ **NOTE:** *Electronic aeronautical charts displayed on this system have been shown to meet the guidance in AC 120 76D as a Type 'B' Electronic Flight Bag (EFB) for ChartView. The accuracy of the charts is subject to the chart data provider. Own-ship position on airport surface charts cannot be guaranteed to meet the accuracy specified in AC 120-76D. Possible additional requirements may make a secondary source of aeronautical charts, such as traditional paper charts or an additional electronic display, necessary on the aircraft and available to the pilot. If the secondary source of aeronautical charts is a Portable Electronic Device (PED), its use must be consistent with the guidance in AC 120-76D.*

✅ **NOTE:** *The pilot/operator must have access to database alerts and consider their impact on the intended aircraft operation. The database alerts can be viewed at flygarmin.com by selecting 'Aviation Database Alerts.'*

✅ **NOTE:** *Do not rely solely upon datalink services to provide Temporary Flight Restriction (TFR) information. Always confirm TFR information through official sources such as Flight Service Stations or Air Traffic Control.*

Electronic charts that resemble the paper versions of AeroNav Services terminal procedures charts (FliteCharts) and Jeppesen terminal procedures charts (ChartView) can be displayed on the MFD or PFD.

When the databases for both chart types are purchased and loaded in the system, the desired charts brand, or source, can be selected for viewing. The active chart source for a particular procedure is shown on the 'Charts Options' Screen under Preferred Source.

Selecting the preferred charts source:

1) From Home, touch **Charts > Chart Selection** > **Charts Options.**

2) Ensure the desired chart source is available (indicated by a green checkmark in the 'Dual Charts Status' Window). When the database age is beyond the disable date, an amber exclamation mark is displayed.

3) Touch the **Preferred Source** Button.

4) Touch either **ChartView** or **FliteCharts** to set the preferred chart source. The current selection is then displayed on the **Preferred Source** Button.

Figure 8-5 Charts Options Preferred Source Button
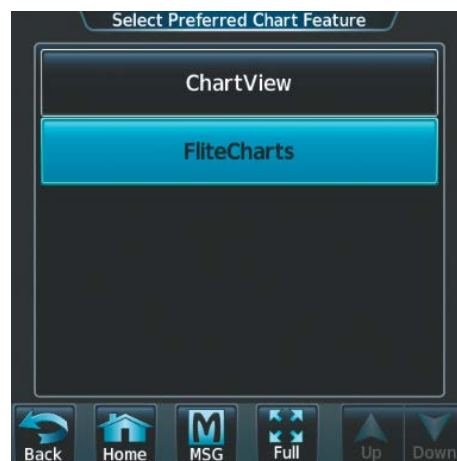
Figure 8-6 'Select Preferred Chart Feature' Screen

FLITECHARTS

FliteCharts are electronic charts that resemble the paper version of AeroNav Services Terminal Procedures Charts. The charts are displayed with high-resolution and in color for applicable charts. The display pane depiction shows the aircraft position on the moving map and on airport diagrams.

The geo-referenced aircraft position is indicated by an aircraft symbol displayed on the chart when the current position is within the boundaries of the chart. Inset boxes are not considered within the chart boundaries. Therefore, when the aircraft symbol reaches a chart boundary line, or inset box, the aircraft symbol is removed from the display.

The following figure shows examples of off-scale areas, indicated by the grey shading. Note, the grey shading is for illustrative purposes only and will not appear on the published chart or display pane. These off-scale areas appear on the chart to convey supplemental information. However, the depicted geographical position of this information, as it relates to the chart plan view, is not the actual geographic position. Therefore, when the aircraft symbol appears within one of these areas, the aircraft position indicated is relative to the chart plan view, not to the off-scale area.

> **NOTE:** *Do not maneuver the aircraft based solely upon the geo-referenced aircraft symbol.*

The FliteCharts database subscription is available from Garmin. Available data includes:

- Arrivals (STAR)
- Departure Procedures (DP)
- Approaches
- Airport Diagrams
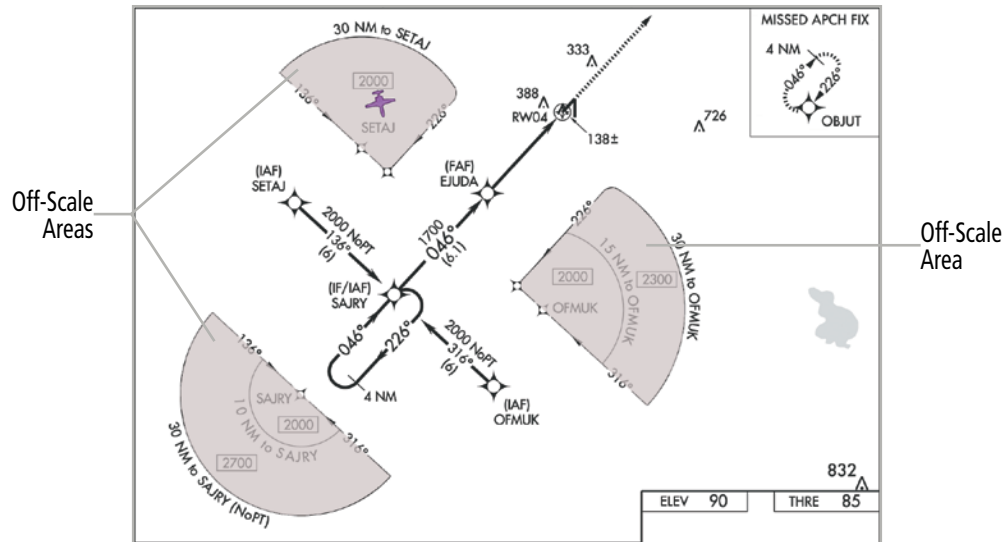
Figure 8-7 Sample Chart Indicating Off-Scale Areas

CHART SELECTION

When a flight plan is active, or when flying direct-to a destination, the initial set of charts made available pertains to the departure airport. After departing the airport environment, the initial chart set made available pertains to the destination airport. When no flight plan is active, or when not flying to a direct-to destination, the initial chart set is made available for the nearest airport. If the charts pane is displayed when landing, the chart will automatically change to the airport diagram upon landing.

Additionally, pressing the **SYNC POF** Button on the 'Charts' Page will cause the chart for the current phase of flight (POF) to be displayed.

Selecting charts using the 'Charts' Screen:

1) From Home, touch **Charts > Chart Selection**.

2) The airport for which charts will be displayed is shown at the top of the 'Charts' Screen. Touch the **Airport** Button to enter another airport.

3) Touch the **Info** Tab to display the airport information selection buttons for the selected airport.

    a) Touch the **Departure** Tab to display a list of possible departures for the selected airport.

    b) Touch the **Arrival** Tab to display a list of possible arrivals for the selected airport.

    c) Touch the **Approach** Tab to display a list of possible approaches for the selected airport.

4) Touch the desired information button in any of these lists to display the applicable chart on the selected display pane.

Figure 8-8 'Charts' Screen
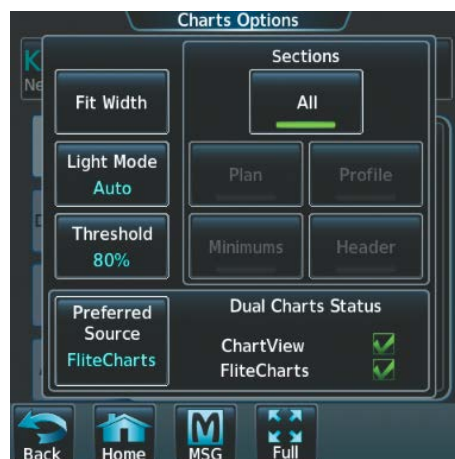
Figure 8-9 'Charts Options' Screen

5) Touch the **Charts Options** Button to select the desired display option for the selected chart.

6) Touch **Fit Width** to display the full width of the chart.

7) Touch the **Back** Button to return to the 'Charts' Screen.

Zooming-in, zooming-out, rotating, and panning the displayed chart:

1) From Home, touch **Charts > Chart Selection**.

2) Select the desired chart for display in the selected pane.

3) Push the **Joystick**. The 'Charts Pan/Zoom Control' Screen is displayed on the Touchscreen Controller.

Figure 8-10 Pan and Zoom Touchpad

4) Turn the **Joystick**, or use the pinch-and-zoom feature on the Touchpad to adjust the chart zoom.

5) Move the **Joystick** left, right, up, or down, or touch and move a finger along the Touchpad to pan the displayed chart.

6) Touch the **Rotate** Left Button or the **Rotate** Right Button above the Touchpad to rotate the page respectively.

Selecting airport diagrams from the 'Nearest Airports' Screen:

1) From Home, touch **Nearest** > **Airport**.

2) Touch the desired airport button. KCOS is selected in the following figure. The Waypoint Options Buttons are now displayed.

Figure 8-11 Airport Diagram Selection

3) Touch the **Airport Chart** Button. The **Info** Tab selections are displayed on the Touchscreen Controller (see previous figure) and the Airport Diagram is displayed on the selected display pane.
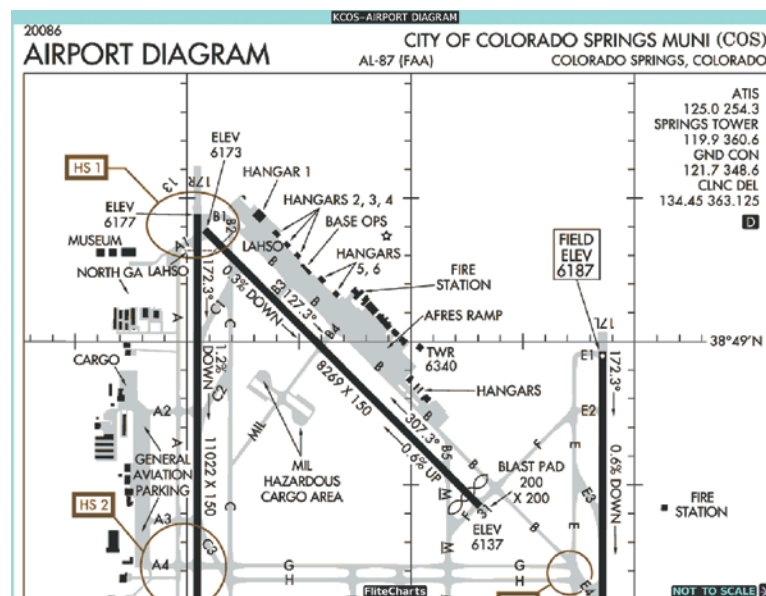
Figure 8-12 Airport Chart for Selected Airport

The aircraft symbol is shown on the chart only if the chart is to scale and the aircraft position is within the boundaries of the chart. The aircraft symbol is not displayed when the Aircraft Not Shown Icon appears. If the Chart Scale Box displays a banner 'NOT TO SCALE', the aircraft symbol is not shown. The Aircraft Not Shown Icon may appear at certain times, even if the chart is displayed to scale.

When no terminal procedure chart is available for the nearest airport or the selected airport, the banner 'No Available Charts' appears on the screen. The 'No Available Charts' banner refers the availability of a particular airport chart selection or procedure for a selected airport.

No Available Charts

Figure 8-13 No Available Charts Banner

If there is a problem in rendering the data (e.g., a data error or a failure of an individual chart), the banner 'Unable To Display Chart' is then displayed.

Unable To Display Chart

Figure 8-14 Unable To Display Chart Banner

DAY/NIGHT VIEW

FliteCharts can be displayed on a white or black background for day or night viewing. The day view offers a better presentation in a bright environment. The night view gives a better presentation for viewing in a dark environment.

Selecting Day, Night, or Auto View:

1) From Home, touch **Charts > Chart Selection** > **Charts Options**.

2) Touch the **Light Mode** Button (see following figure).

3) Touch the **Day**, **Night**, or **Auto** Button. When **Auto** is selected, the display will change to the appropriate day or night setting, dependent on ambient lighting.

Figure 8-15 Selecting Day, Night, or Auto View

4) With 'Auto' selected, touch the **Threshold** Button. The 'Auto Light Mode Threshold' Window is displayed.
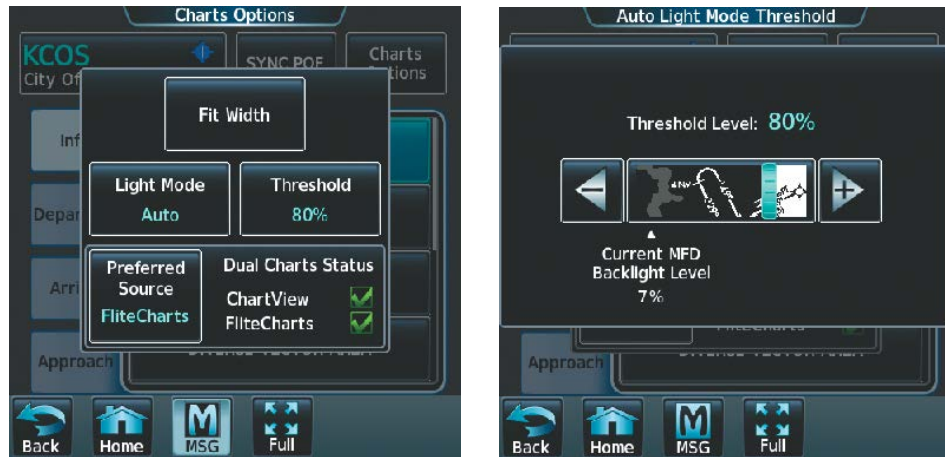
Select Charts Options   Adjust Threshold Setting

Figure 8-16 Setting Day/Night Switching Threshold

5) Move the slider left or right to set the desired threshold. Setting the Threshold Level percentage to the same percentage shown as the Current MFD Backlight Level will cause the Day/Night view to switch at the current backlight setting. Adjusting the Threshold Level setting larger than the Current MFD Backlight Level will cause the display to remain in Night Mode longer. Adjusting the Threshold Level setting smaller than the Current MFD Backlight Level will cause the display to change to Day Mode sooner.
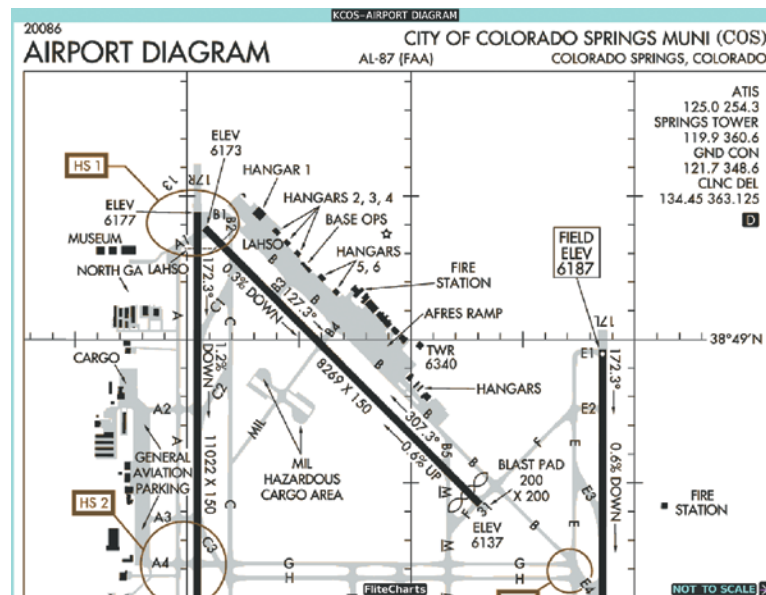
Figure 8-17 Airport Diagram, Day View
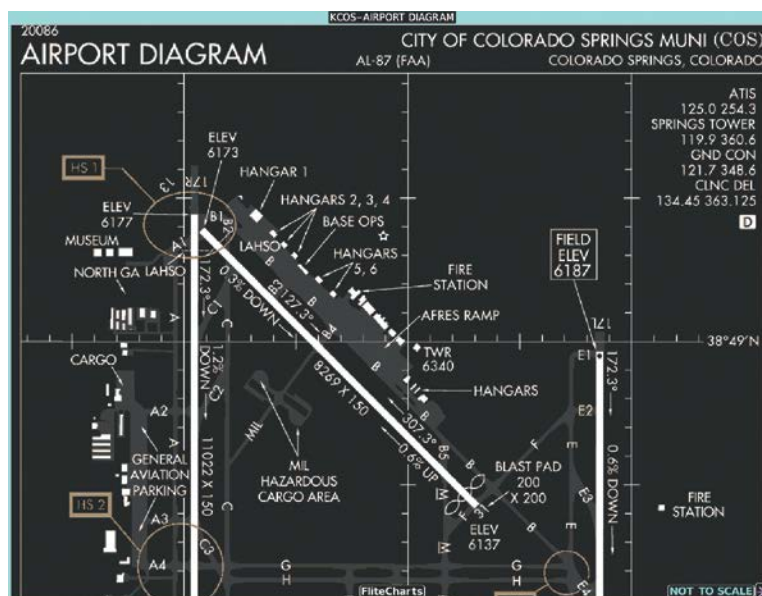
Figure 8-18 Airport Diagram, Night View

CHARTVIEW (OPTIONAL)

ChartView Electronic Charts resemble the paper version of Jeppesen Terminal Procedures Charts and can be viewed on the MFD or PFD. The charts are displayed in full color with high-resolution. The display pane depiction shows the aircraft position on the moving map in the plan view of approach charts and on airport diagrams.

The geo-referenced aircraft position is indicated by an aircraft symbol displayed on the chart when the current position is within the boundaries of the chart. Inset boxes are not considered within the chart boundaries. Therefore, when the aircraft symbol reaches a chart boundary line, or inset box, the aircraft symbol is removed from the display.

The following figure shows examples of off-scale areas, indicated by the grey shading. Note, the grey shading is for illustrative purposes only and will not appear on the published chart or display pane. These off-scale areas appear on the chart to convey supplemental information. However, the depicted geographical position of this information, as it relates to the chart plan view, is not the actual geographic position. Therefore, when the aircraft symbol appears within one of these areas, the aircraft position indicated is relative to the chart plan view, not to the off-scale area.

Figure 8-19 Sample Chart Indicating Off-Scale Areas

> ✓ **NOTE:** *Do not maneuver the aircraft based solely upon the geo-referenced aircraft symbol.*

The ChartView database subscription is available from Jeppesen, Inc. Available data includes:

- Arrivals (STAR)
- Airport Diagrams
- Departure Procedures (DP)
- Chart NOTAMs
- Approaches

> ✓ **NOTE:** *Only NOTAMs applicable to specific information conveyed on the displayed Jeppesen chart are available. There may be other NOTAMs available pertaining to the flight that may not be displayed. Contact Jeppesen for more information regarding Jeppesen database-published NOTAMs.*

CHART SELECTION

When a flight plan is active, or when flying direct-to a destination, the initial set of charts made available pertain to the departure airport. After departing the airport environment, the initial chart set made available pertains to the destination airport. When no flight plan is active, or when not flying to a direct-to destination, the initial chart set is made available for the nearest airport. If the charts pane is displayed when landing, the chart will automatically change to the airport diagram upon landing.

Additionally, pressing the **SYNC POF** Button on the 'Charts' Page will cause the chart for the current phase of flight (POF) to be displayed.

Selecting charts using the 'Charts' Screen:

1) From Home, touch **Charts > Chart Selection**.

2) The airport for which charts will be displayed is shown at the top of the 'Charts' Screen. Touch the **Airport** Button to enter another airport.

3) Touch the **Info** Tab to display the airport information selection buttons for the selected airport.

   a) Touch the **Departure** Tab to display a list of possible departures for the selected airport.

   b) Touch the **Arrival** Tab to display a list of possible arrivals for the selected airport.

   c) Touch the **Approach** Tab to display a list of possible approaches for the selected airport.

4) Touch the desired information button in any of these lists to display the applicable chart on the selected display pane.

Figure 8-20 Airport Info Selection   Figure 8-21 'Charts Options' Screen
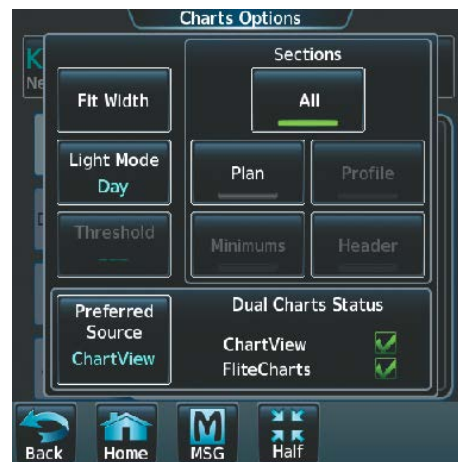
5) Touch the **Charts Options** Button to select the desired display option for the selected chart.

6) Touch **All** to display the complete Airport Diagram. **Fit Width** displays the full width of the Airport Diagram. **Plan** displays only the diagram portion of the chart. **Minimums** displays only the approach minimums on an approach chart. **Profile** displays only the descent profile on the approach chart. **Header** displays the chart header. Only appropriate views are available for the selected chart.

7) Touch the **Back** Button to return to the 'Charts' Screen.

Zooming-in, zooming-out, rotating, and panning the displayed chart:

1) From Home, touch **Charts > Chart Selection**.

2) Select the desired chart for display in the selected pane.

3) Push the **Joystick**. The 'Charts Pan/Zoom Control' Screen is displayed on the Touchscreen Controller.
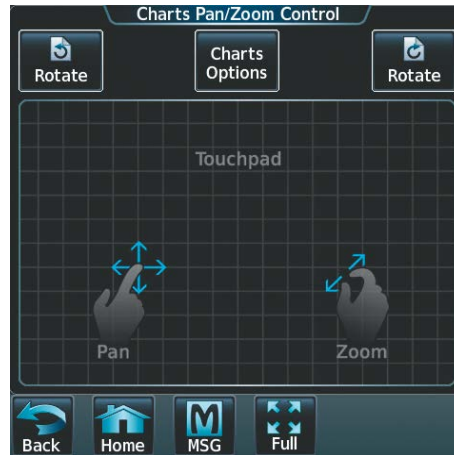
Figure 8-22 Pan and Zoom Touchpad

4)   Turn the **Joystick**, or use the pinch-and-zoom feature on the Touchpad to adjust the chart zoom.

5)   Move the **Joystick** left, right, up, or down, or touch and move a finger along the Touchpad to pan the displayed chart.

6)   Touch the **Rotate** Left Button or the **Rotate** Right Button above the Touchpad to rotate the page respectively.

Selecting airport diagrams from the 'Nearest Airports' Screen:

1)   From Home, touch **Nearest** > **Airport**.

2)   Touch the desired airport button. KCOS is selected in this example. The **Waypoint Options** Buttons are displayed.

Figure 8-23 Airport Diagram Selection

3)   Touch the **Airport Chart** Button. The **Info** Tab selections are displayed on the Touchscreen Controller and the Airport Diagram is displayed on the selected display pane.
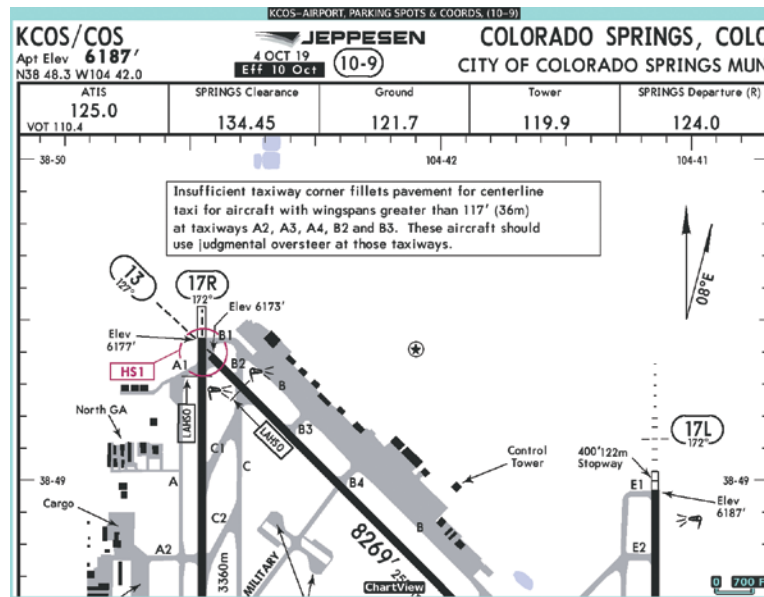
Figure 8-24 Airport Chart for Selected Airport

The aircraft symbol is shown on the chart only if the chart is to scale and the aircraft position is within the boundaries of the chart. The aircraft symbol is not displayed when the Aircraft Not Shown Icon appears. If the Chart Scale Box displays a banner 'NOT TO SCALE', the aircraft symbol is not shown. The Aircraft Not Shown Icon may appear at certain times, even if the chart is displayed to scale.

When no terminal procedure chart is available for the nearest airport or the selected airport, the banner 'No Available Charts' appears on the screen. The 'No Available Charts' banner does not refer to the Jeppesen subscription, but rather the availability of a particular airport chart selection or procedure for a selected airport.

Figure 8-25 No Available Charts Banner

If there is a problem in rendering the data (e.g., a data error or a failure of an individual chart), the banner 'Unable To Display Chart' is then displayed.

Figure 8-26 Unable To Display Chart Banner

DAY/NIGHT VIEW

ChartView can be displayed on a white or black background for day or night viewing. The Day View offers a better presentation in a bright environment. The Night View gives a better presentation for viewing in a dark environment.

Selecting Day, Night, or Auto View:

1) From Home, touch **Charts** > **Chart Selection** > **Charts Options**.

2) Touch the **Light Mode** Button.

3) Touch the **Day**, **Night**, or **Auto** Button. When **Auto** is selected, the display will change to the appropriate day or night setting, dependent on ambient lighting.
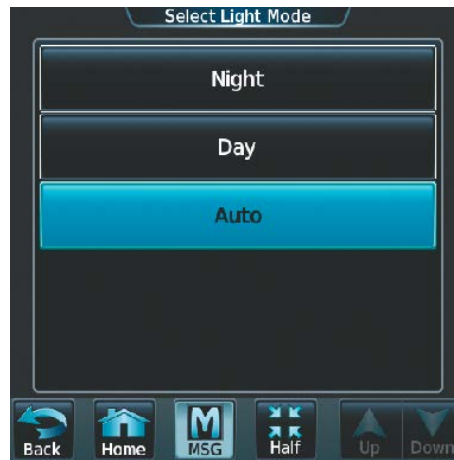
Figure 8-27 Selecting Day, Night, or Auto View

4) With 'Auto' selected, touch the **Threshold** Button. The 'Auto Light Mode Threshold' Window is displayed.
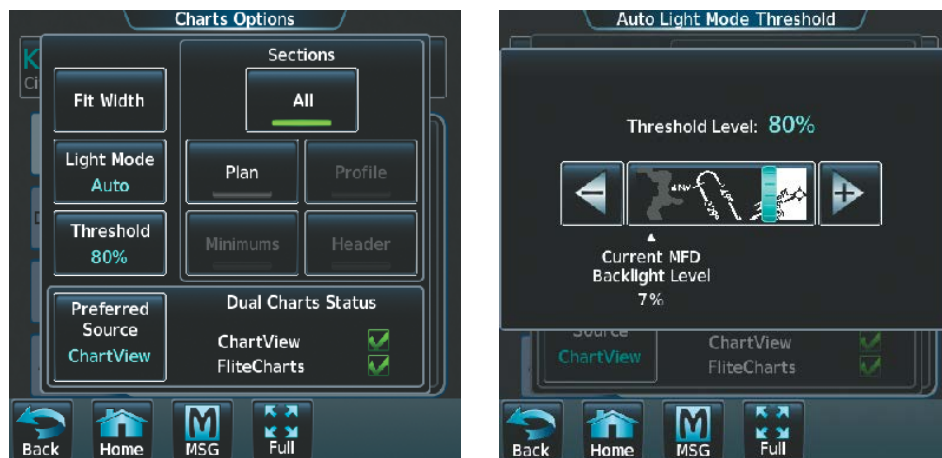
Select Charts Options   Adjust Threshold Setting

Figure 8-28 Setting Day/Night Switching Threshold

5) Move the slider left or right to set the desired threshold. Setting the Threshold Level percentage to the same percentage shown as the Current MFD Backlight Level will cause the Day/Night view to switch at the current backlight setting. Adjusting the Threshold Level setting larger than the Current MFD Backlight Level will cause the display to remain in Night Mode longer. Adjusting the Threshold Level setting smaller than the Current MFD Backlight Level will cause the display to change to Day Mode sooner.
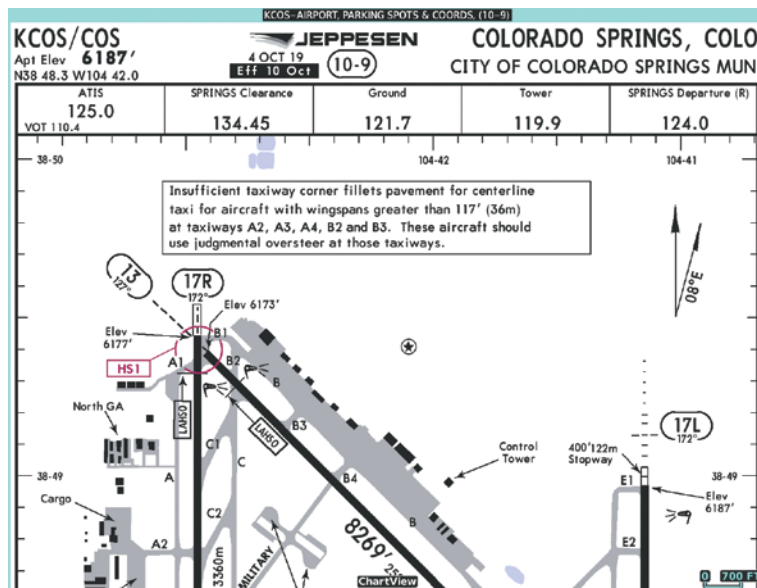
Figure 8-29 Airport Diagram, Day View

Figure 8-30 Airport Diagram, Night View

IFR/VFR CHARTS

The system can display GPS navigation information on a VFR chart, a low altitude IFR chart, or a high altitude IFR chart, if installed. The information overlaid on the IFR/VFR Charts is selected and setup on the Navigation Map, but the IFR/VFR charts will not display some of the selected items. Only the following items will be overlaid on the chart:

- Map Pointer (distance and bearing to pointer, location of pointer, name, and other pertinent information)
- Map Range (17 range choices from 1 nm to 150 nm)
- Map Orientation (always North Up for IFR/VFR Charts)
- Aircraft Icon (representing present position)
- Wind Direction and Speed
- Icons for enabled map features
- Flight Plan Legs
- Track Vector
- Runway Extension
- Missed Approach Preview
- Intersections (only as part of active flight plan)
- Visual Reporting Points
- VNAV Constraints
- Selected Altitude Intercept Arc

Map panning on the IFR/VFR Charts works the same as on the Navigation Map. Map range selected on either the Navigation Map or the IFR/VFR Charts applies to both. However, if the range selected on the Navigation Map it is not a valid chart range, the chart is shown with a range of 2.5 nm.

When different VFR charts exist for the same area the chart type will automatically display according to the range chosen. For example, in an area where both a Sectional and a Terminal Area Chart (TAC) are available, a range greater than 7.5 nm or more will show the Sectional chart. Once the range is decreased to 7.5 nm or below, the system will automatically change the displayed chart from the Sectional to the TAC.

Due to the potential error involved with the electronic depiction of maps, charts will display a gray 'circle of uncertainty' centered upon the aircraft icon. The aircraft's actual position can be anywhere within the range of the gray circle. The range of the circle will change based on the chart displayed and current zoom range.

Map Orientation

Aircraft Icon at Present Position

Map Range

Active Flight Plan Leg

Circle of Uncertainty
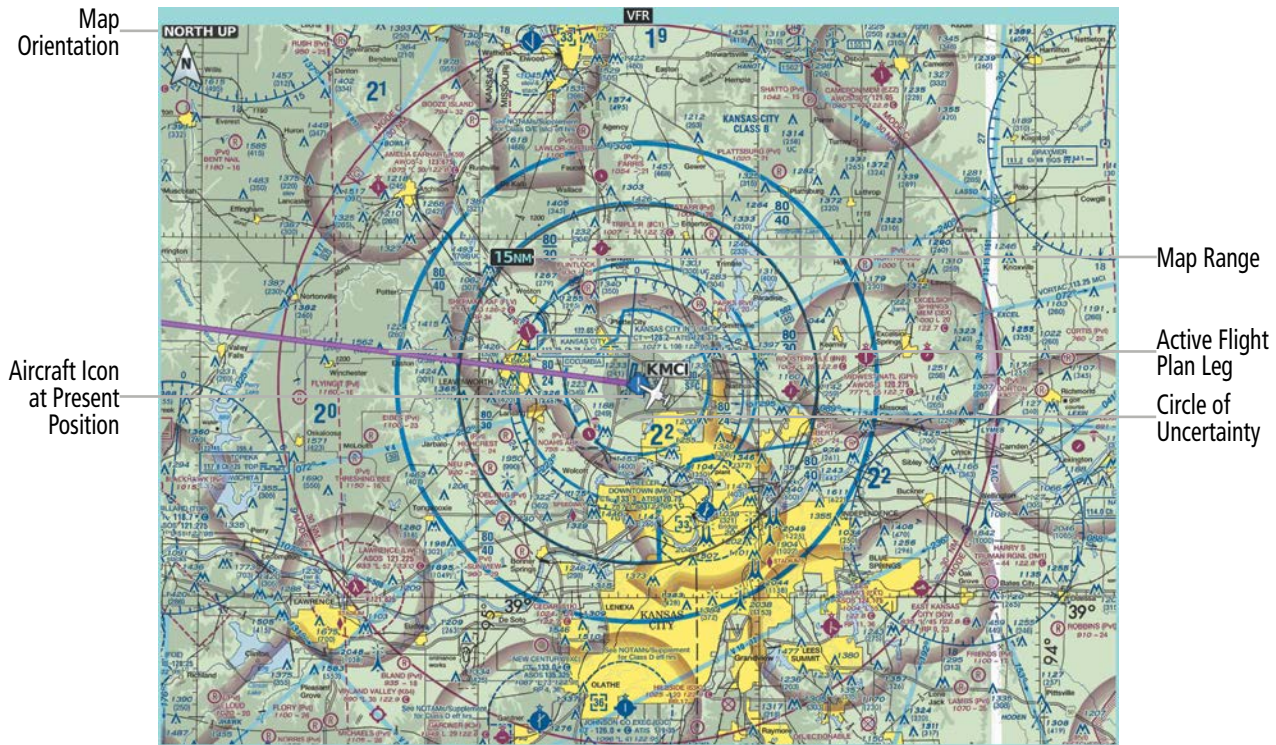
Figure 8-31 FMS Navigation Information on the VFR Chart

Selecting the chart to display:

1) From Home, touch **Map > Map Selection**.

2) Touch the desired Chart Button (**VFR**, **IFR Low**, or **IFR High**).

Modifying the VFR, IFR Low, and IFR High chart settings:

1) From Home, touch **Map > Map Selection**.

2) Touch the desired Chart Button. The selected chart is displayed on the active display pane, and the button on the Touchscreen Controller becomes the Chart Settings Button (**VFR Settings** Button**, IFR Low Settings** Button, or **IFR High Settings** Button).

3) Touch the Chart Settings Button to display the applicable settings screen ('VFR Charts Settings' Page or 'IFR Charts Settings' Page.

4) Touch the desired Light Mode Button (**Auto** Button, **Day** Button, or **Night** Button). If the **Auto** Button is selected, the Threshold Level for the light mode may be adjusted by moving the slider left or right, or by touching the **+** Button, or the **-** Button.

Map Orientation

Circle of Uncertainty

Aircraft Icon at Present Position

Map Range

Active Flight Plan Leg

Figure 8-32 IFR Low Altitude Chart

Map Orientation

Circle of Uncertainty

Aircraft Icon at Present Position

Map Range

Active Flight Plan Leg

Figure 8-33 IFR High Altitude Chart

8.5 SATELLITE TELEPHONE AND DATALINK SERVICES (OPTIONAL)

> **NOTE:** *Do not rely solely upon datalink services to provide Temporary Flight Restriction (TFR) information. Always confirm TFR information through official sources such as Flight Service Stations or Air Traffic Control.*

> **NOTE:** *Separate accounts must be established to access the Iridium Satellite Network for voice and Garmin Connext for data transmission of maintenance reports.*

If installed, the WiFi Datalink (GDL 59) provides an aircraft systems data logger for communication of potential maintenance issues and, while the aircraft is on the ground, a high speed (IEEE 802.11g) WiFi datalink between the aircraft and a ground computer network. The WiFi Datalink can also be paired with an Iridium Transceiver (GSR 56) providing an airborne low speed datalink, Iridium Satellite Telephone service and SMS text messaging.

REGISTERING THE SYSTEM WITH GARMIN CONNEXT

A subscriber account must be established prior to using the Iridium Satellite System. Before setting up an Iridium account, obtain the System ID and serial number of the Iridium Transceiver (GSR1) by performing the following procedure. Contact Garmin Connext at flygarmin.com.

Registering the system for datalink services:

1) From Home, touch **Utilities > Setup** > **Avionics Status**.

2) If necessary, touch the **Airframe** Tab. Note the System ID as seen in the following figure. This number will be needed when contacting Garmin Connext to establish the account.

Figure 8-34 System ID Number
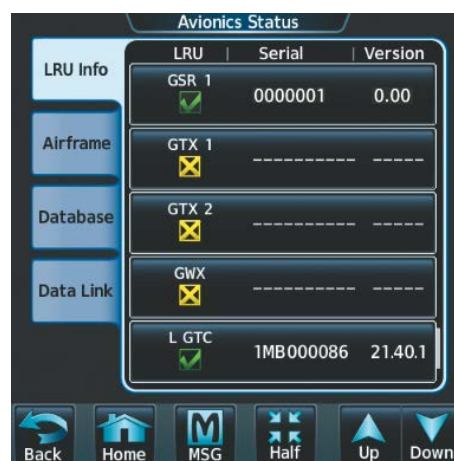
Figure 8-35 Iridium Transceiver Serial Number (GSR1)

3) Touch the **LRU Info** Tab. Scroll to view 'GSR1.' Note the serial number of each will also be needed when contacting Garmin Connext.

4) Contact Garmin Connext to establish an account and receive an access code.

5) From Home, touch **Utilities > Setup** > **Connext Registration**.

6) Press the **Register** Button (see following figure).

Figure 8-36 'Connext Registration' Display

Figure 8-37 Entering the Access Code

7) Enter the access code as shown in the previous figure.

8) Touch the **Enter** Button.

CONTACTS

Names, telephone numbers, email addresses, and ACARS contact information may be entered and stored. These contacts may be used to place telephone calls or send email and text messages.

Creating a new contact:

1) From Home, touch **Services** > **Contacts**.

2) The 'Contacts' Screen is displayed.

Figure 8-38 'Services' Page
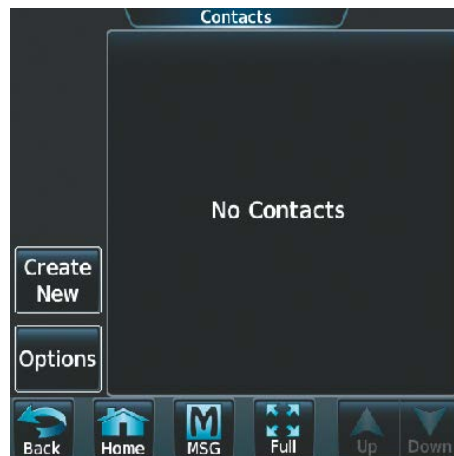
Figure 8-39 Contacts List

3) Touch the **Create New** Button.

4) Touch the **Name** Button, shown in the following figure. The 'Contact Name' Screen is displayed.

Figure 8-40 Enter New Contact Information

Figure 8-41 Enter Name

5) Enter the name of the new contact as the example shows in the previous figure.

6) Touch the **Enter** Button.

7) If desired, touch the **Favorite** Button to designate the new contact as a favorite. A green annunciator indicates the contact is now designated as a favorite.

8) Touch the **Telephone Number** Button. The telephone number entry screen is displayed.

Figure 8-42 Select Telephone Number

Figure 8-43 Enter Telephone Number

9) Enter the telephone number of the new contact as the example shows in the previous figure.

10) Touch the **Enter** Button.

11) Touch the **Email Address** Button (scroll down as required). The 'Email Address' Entry Screen is displayed.

Figure 8-44 Select Email Address

Figure 8-45 Enter Email Address

12) Enter the email address of the new contact as the example shows in the previous figure.

13) Touch the **Enter** Button.

14) Touch the **ACARS Alias** Button (scroll down as required). The 'Alias Entry' Screen is displayed.
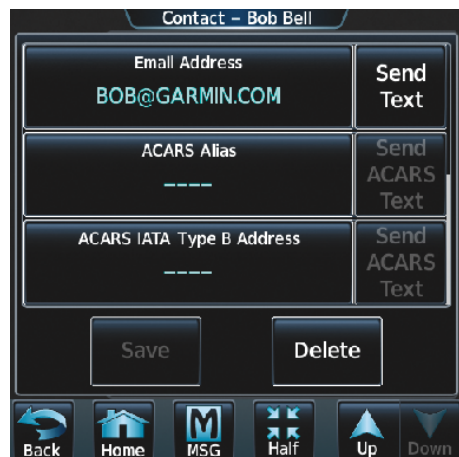
Figure 8-46 Select ACARS Alias

Figure 8-47 Enter Alias

TELEPHONE COMMUNICATION

> **NOTE:** *Iridium transceiver setup may differ based on aircraft configuration.*

The pilot or copilot can place and answer calls on the Iridium satellite network. Ensure telephone audio is enabled for the pilot and/or copilot when using the satellite telephone feature. See the Audio & CNS section for information regarding enabling and disabling the telephone audio.

Viewing the Telephone Status:

1) From Home, touch **Services** > **Telephone**.

2) The 'Telephone' Screen is displayed.
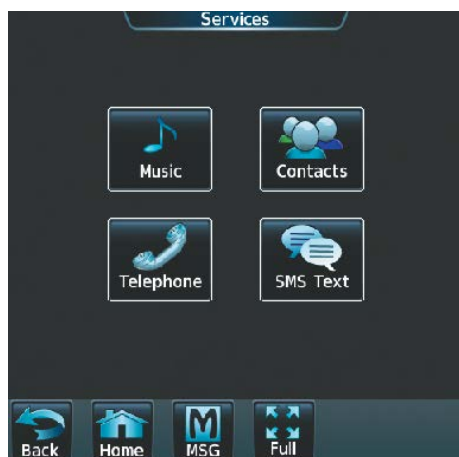
Figure 8-48 Telephone Service Selection

Figure 8-49 Telephone Status Information

ENABLE/DISABLE THE IRIDIUM TELEPHONE SYSTEM

The Iridium Satellite Telephone System may be disabled by the flight crew. When disabled, incoming calls will not be received and outgoing calls will not be possible from the cockpit or cabin.

Enabling/disabling the Iridium telephone system:

1) From Home, touch **Services** > **Telephone**.

2) Touch the **Iridium #1** Button to display the 'Iridium #1 Transceiver' Screen.

3) Touch the **Disable Iridium Transmission** Annunciator Button to disable (green annunciator as in the following figure) the transceiver. Touch the button again to enable (gray annunciator) the transceiver.
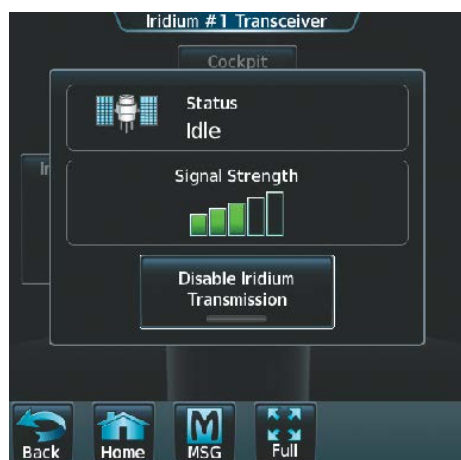
Figure 8-50 Iridium Transceiver Enabled

Figure 8-51 Iridium Transceiver Disabled

INCOMING CALLS

Incoming voice calls from an external telephone phone through the Iridium Satellite Network are annunciated by a ring tone and flashing **TEL** Button on the Touchscreen Controller Button Bar, as well as a flashing TEL annunciation in the upper left corner of the PFD display.

Answering a call:

1) Touch the flashing **TEL** Button. The 'Notifications' Screen is displayed.

2) Touch the **Answer** Button. The call is now connected as indicated. Touching the **Ignore** Button extinguishes the new call annunciation and the call remains disconnected.

Figure 8-52 Incoming Call Notification

Figure 8-53 Telephone Notification Selected

3) When the call is finished, touch the **End Call** Button to disconnect the call.

NOTE: When calling the Iridium Telephone, if the initiator of the call hangs up, the annunciation does not disappear for approximately 1 minute.

Figure 8-54 Call Answered

OUTGOING CALLS

Voice calls can be made from the cockpit to an external telephone through the Iridium Satellite Network.

Making a call:

1) From Home, touch **Services** > **Telephone**.

2) Touch the **Cockpit** Phone Button. The 'Cockpit Phone' Screen is displayed.

3) Touch the **Dial** Button. The 'Phone Number' Screen is displayed.

Figure 8-55 Cockpit Telephone Status   **Figure 8-56 Telephone Number Entry**

4) Using the number keys, enter the phone number. Touch the **Find** Button to select a phone number from the Contact List.

The International dialing sequence is necessary to place a call from the cockpit to an external phone: Country Code + City/Area Code (if any) + Telephone Number. The following country codes may be used when calling other satellite telephone systems.

Satellite System	Country Code
Inmarsat	870
ICO	8810 or 8811
Ellipso	8812 or 8813
Iridium	8816 or 8817
Globalstar	8818 or 8819

Table 8-2 International Calling Codes

5) Touch the **Enter** Button. The system now begins establishing a connection. The system will indicate a completed connection, when the telephone to which the call is made is answered.

Figure 8-57 Establishing a Connection

Figure 8-58 Telephone Connected

Ending a call:

1) From Home, touch **Services** > **Telephone**.

2) Touch the **Cockpit** Phone Button. The 'Cockpit Phone' Screen is displayed.

3) Touch the **End Call** Button.
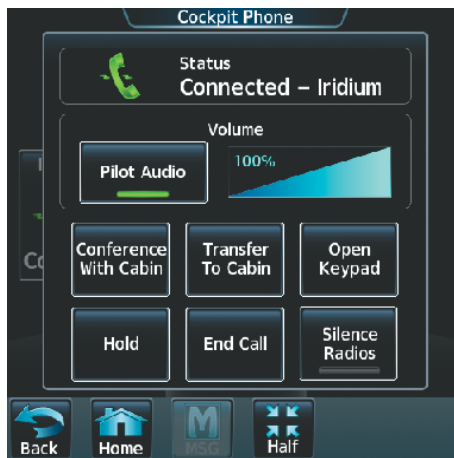
Figure 8-59 Ending the Call

Figure 8-60 System is Idle After Ending Call

OPTIONS DURING A COCKPIT PHONE CALL: SILENCE RADIOS OR KEYPAD

During a Call:

1) From Home, touch **Services** > **Telephone**.

2) Touch the **Cockpit** Phone Button. The 'Cockpit Phone' Screen is displayed.

3) Touch **Open Keypad** if you need to enter numbers during a call (i.e., for entering a PIN).

Or:

Touch **Silence Radios**.

Figure 8-61 Keypad During Call

Figure 8-62 Silence Radio Engaged

MANAGING TELEPHONE AUDIO

> **NOTE:** The **Push-to-Talk** Switch is not utilized for telephone communication. The microphone is active whenever a call is connected and telephone audio is enabled.

When an incoming call is received, or an outgoing call is made, telephone audio (which includes headset and microphone) is automatically enabled for either the pilot or copilot, depending on which Touchscreen Controller was used to make or answer the call. If the pilot or copilot wishes to join an existing call, the telephone audio must be enabled manually on the appropriate Touchscreen Controller. When the call is ended, telephone audio is automatically disabled. The green **Pilot Audio** Annunciator Button indicates the enabled pilot audio on the pilot-side Touchscreen Controller. The copilot-side controller will, likewise, indicate a green **Copilot Audio** Annunciator Button. Pilot and copilot telephone audio can be enabled and disabled manually by performing the following steps.

Enabling/disabling telephone audio and adjust volume:

1) From Home, touch **Services** > **Telephone**.

2) Touch the **Cockpit** Phone Button. The 'Cockpit Phone' Screen is displayed.
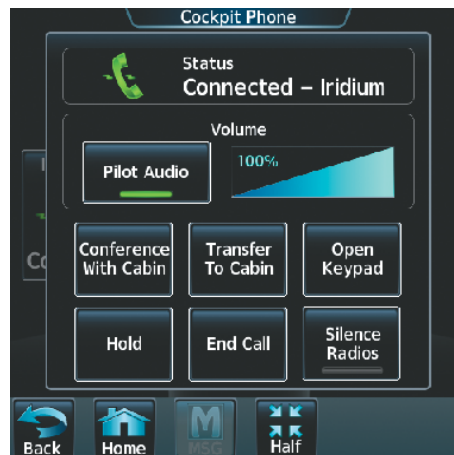
Figure 8-63 Cockpit Phone Options

3) Touch the **Pilot Audio** or **Copilot Audio** Annunciator Button to disable telephone audio, including microphone (gray annunciator).

4) Touch the Annunciator Button again to enable telephone audio, including microphone (green annunciator).

5) Touch and move the **Volume** Slider on the appropriate Touchscreen Controller to adjust the telephone volume.

TEXT MESSAGING (SMS)

The pilot or copilot can send and receive text messages on the Iridium satellite network. Messages may be sent to an email address or text message capable cellular telephone. Message length is limited to 160 characters, including the email address.

Incoming SMS messages are annunciated by a flashing **SMS** Button on the Touchscreen Controller Button Bar, as well as a flashing SMS annunciation in the upper left corner of the PFD display.

Viewing a text message when received:

1) Touch the flashing **SMS** Button. The **SMS Text Inbox** Tab is automatically selected and the newly received text message is shown at the top of the list.
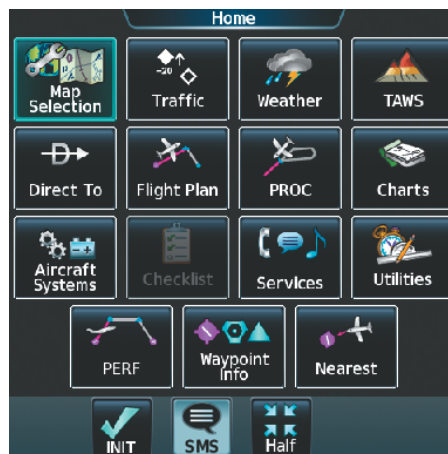
Figure 8-64 New SMS Text
Message Annunciation
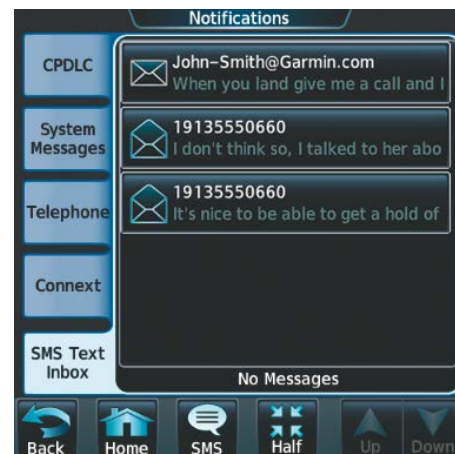
Figure 8-65 New Text
Message at Top of List

2) Touch the desired message to display its contents.

Figure 8-66 New Text Message Contents

3) If desired, touch the **Reply** Button to create a reply to the message.

4) Touch the **Delete** Button to delete the message from the list.

5) Touching the **Save Contact** Button saves the contact information in the system contact list.

Replying to a text message:

While viewing the text message content, touch the **Reply** Button.

Or:

1) From Home, touch **Services** > **SMS Text**.

Figure 8-67 SMS Text Services Selection
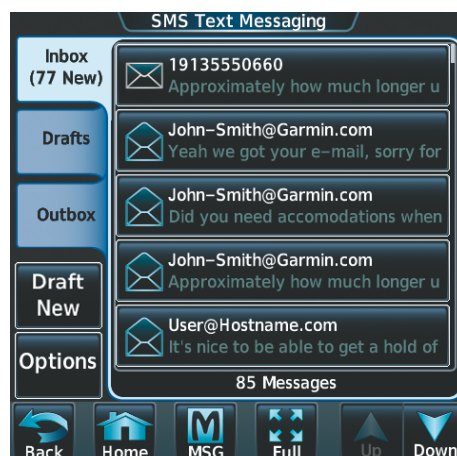
Figure 8-68 Touch Desired Message

2) Touch the desired text message in the Inbox list. If necessary, scroll to the desired message. The text message is displayed.

3) Touch the **Reply** Button. The 'Opened SMS Text Message' Screen is displayed.

Figure 8-69 Message Content

Figure 8-70 New Reply Message Screen

4) Touch the 'Message' Window to display the alphanumeric buttons.

Figure 8-71 Message Content

Figure 8-72 Reply Message

5) Enter the reply text.

6) Touch the **Enter** Button. The reply message is displayed.

7) Touch the **Send** Button. The 'SMS Message Replied To' Screen is displayed.

Figure 8-73 Reply Message Sent

8) If desired, touch the **Reply Again** Button to resend the reply.

9) Touch the **Delete** Button to delete the message from the list.

10) Touching the **Save Contact** Button saves the contact information in the system contact list.

Sending a text message:

1) From Home, touch **Services** > **SMS Text**.

Figure 8-74 SMS Text Services Selection   **Figure 8-75 Select Options**
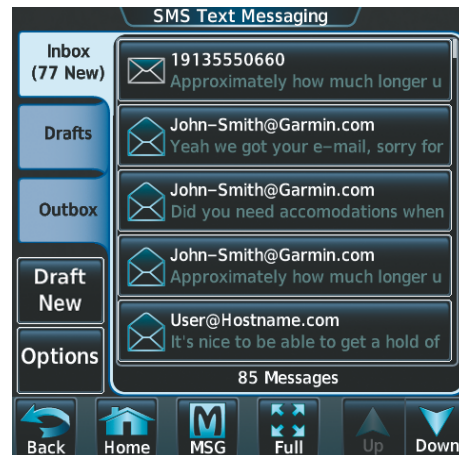
2) Touch the **Draft New** Button. The 'Opened SMS Text Message Draft' Screen is displayed. The **Draft New Message** Button is also available from within the **Drafts** and **Outbox** tabs.
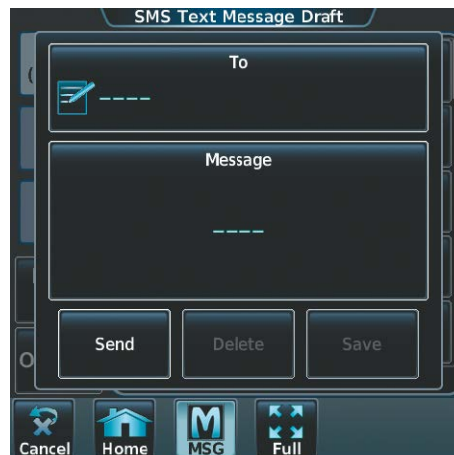
Figure 8-76 Touch the 'To' Window

3) Touch the 'To' Window. A selection screen is displayed. If the text message is to be sent to SMS compatible telephone, touch the **Phone** Button. If the message is to be sent to an email address, touch **Email**.

Alpha Buttons are displayed when the **Email** Button is touched

Numeric Buttons are displayed when the **Phone** Button is touched
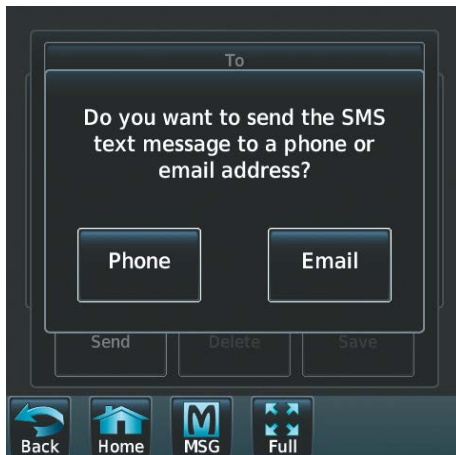
Figure 8-77 Select Message Destination   **Figure 8-78 Enter Number or Address**

4) Enter the telephone number or email address. The number or address may be obtained from the Contacts by touching the **Find** Button.

5) Touch the **Enter** Button. The number or address is now displayed.

6) Touch the 'Message' Window. The alphanumeric buttons are displayed.
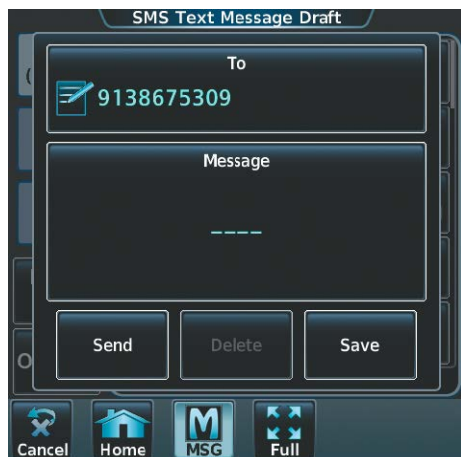
Figure 8-79 Touch Message Window   **Figure 8-80 Reply Message**

7) Enter the message text.

8) Touch the **Enter** Button. The message text is displayed in the 'Message' Window.
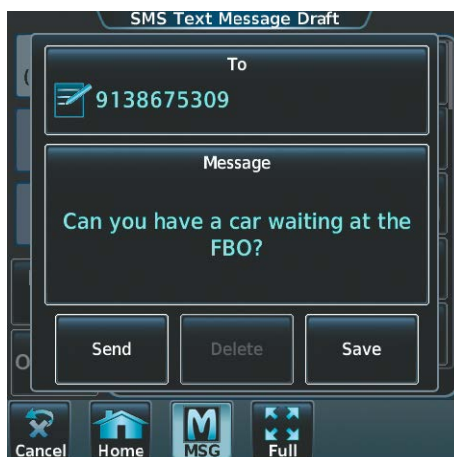
Figure 8-81 Message Ready to Send

9) Touch the **Send** Button.

TEXT MESSAGE BOXES

Received text messages reside in the Inbox as 'Read' or 'Unread' messages. The Outbox contains 'Sent" and 'Unsent' text messages. Saved messages that are meant to be sent later are stored as Drafts.

Viewing Inbox messages:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Inbox** Tab. A list of received messages is displayed. The **Inbox** Tab is selected by default when accessing the 'SMS Text Messaging' Screen.

Figure 8-82 SMS Text Inbox

Viewing Draft messages:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Drafts** Tab. A list of draft messages is displayed, provided messages have been previously saved.

3) Touch a message to access the **Send** or **Delete** buttons.

Figure 8-83 SMS Text Drafts

Viewing Outbox messages:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Outbox** Tab. A list of sent or unsent messages is displayed.

3) Touch a message to access the **Send Again**, **Delete,** and **Save Contact** Buttons.

Figure 8-84 SMS Text Outbox

MANAGING TEXT MESSAGES

The following table illustrates the various message status icons.

Message Symbol	Description
	Received text message that has not been opened
	Received text message that has been opened
	A reply has been sent for this text message

Message Symbol	Description
	Saved text message, draft not sent
	System is sending text message
	Text message has been sent
	System failed to send text message

Table 8-3 Text Message Symbols

The viewed messages in the Inbox, Outbox, or Drafts may be listed according to the date/time the message was sent or received or by message address.

Viewing messages sorted by message date/time:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Options** Button. The 'Sort Messages By' selections are displayed.
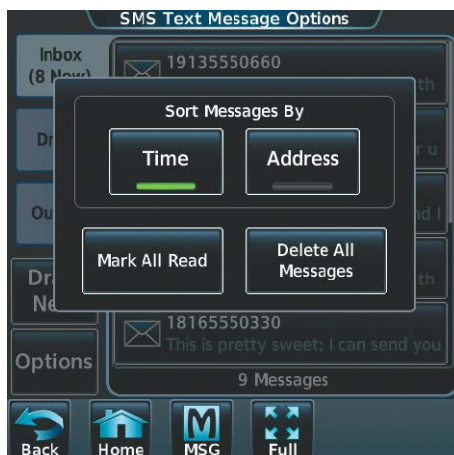
Figure 8-85 Message Sort Options

3) Touch the **Time** Button. A green annunciator indicates an active selection.

4) Touch the **Back** Button to return to the previously selected message box.

Viewing messages sorted by address:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Options** Button. The 'Sort Messages By' selections are displayed.

3) Touch the **Address** Button. A green annunciator indicates an active selection.

4) Touch the **Back** Button to return to the previously selected message box.

Marking all messages as read:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Options** Button. The selection buttons are displayed.

3) Touch the **Mark All Read** Button.

4) Touch the **Back** Button to return to the Inbox. All messages in the Inbox now indicate they have been opened.

Deleting all messages:

1) From Home, touch **Services** > **SMS Text**.

2) Touch the **Options** Button. The selection buttons are displayed.

3) Touch the **Delete All Messages** Button. A confirmation screen is displayed.
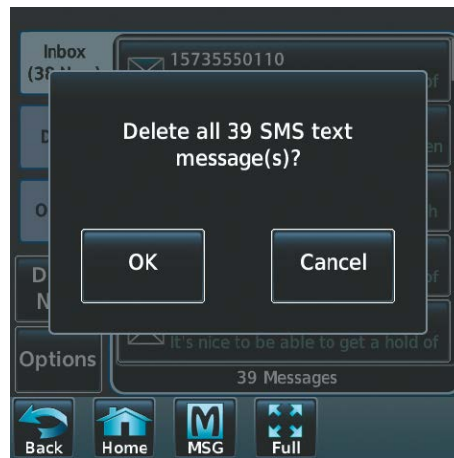
Figure 8-86   Deleting All Messages

4) Touch the **OK** Button.

GARMIN.

8.6 ACARS (OPTIONAL)

The Aircraft Communications Addressing and Reporting System (ACARS) is a datalink system used for sending information and messages between the aircraft and ground facilities. There are two parts to the ACARS, an airborne (aircraft) component and a ground component. The airborne component consists of the avionics and the datalink system (DLS). The ground component of the network consists of everything from the ground stations and satellites to the end systems used by operation centers including airlines and hosts.

The ACARS network component can be divided into three major subcomponents; network stations, Datalink Service Provider (DSP), and Air Traffic Services (ATS) / Aeronautical Operational Control (AOC) end systems. These are summarized as follows:

- The network stations provide a means to route data to and from the aircraft via ground stations and satellites.
- The DSP manages data received from the aircraft and network systems to ensure proper routing.
- ATS and AOC end systems collect data transmitted from the aircraft and generate reports and data that are sent back to the aircraft.

AIR-GROUND COMMUNICATION LINK

The ACARS DLS is linked to the ATS and AOC through an analog (POA, Plain Old ACARS) and digital (AOA, ACARS over AVLC) VHF radio connection or Iridium Satellite.

The analog VHF Datalink or VDL Mode A (POA) communicates at a 2,400 Bd data rate when in line of sight of a supporting VHF ground station. Effective data rates may be significantly lower in congested airspaces.

The digital VHF Datalink or VDL Mode 2 (AOA) communicates at a 31,500 bps data rate when in line of sight of a supporting VDL Mode 2 ground station.

The Iridium Satcom link communicates at a 2,400 bps data rate when in coverage of an Iridium Satellite.

Following is a test procedure to ensure the ACARS Iridium Transceiver Unit (GSR 56 #2) is properly communicating over the Iridium Network and displaying a valid (green) checkmark for the communications status. For assistance contact Garmin at flygarmin.com.

Verifying connection with the ACARS Host Provider:

Once able to maintain a green check in the SATCOM status box, verify the avionics can send and receive data with the ACARS Host provider.

1) From Home, touch **Services > ACARS > Weather Settings.**

2) Touch the **Define Weather Request** Button. On the 'ACARS Weather Coverage' Page, press the **Add Waypoint** Button. Since not all airports will have weather data available, select a few major airports such as KORD, KJFK, KLAX, EGLL, etc.

Figure 8-87 Touch Define Weather Request

Figure 8-88 'ACARS Weather Coverage' Page

3) After selecting airports, navigate back to the 'ACARS Weather Settings' Page. On the right side of the screen, select some weather products by toggling the Request / Overlay buttons. Recommended products are TAFs, METARs and METRO Wx.

4) When ready to send the request, press the **Send Request** Button.

At the top of the 'ACARS Weather Settings' Page, there is a Data Request text box. After pressing the **Send Request** Button there will be text that states 'Request Queued [time].' The state will change to 'Request Sent [time]' if the downlink is able to be sent.
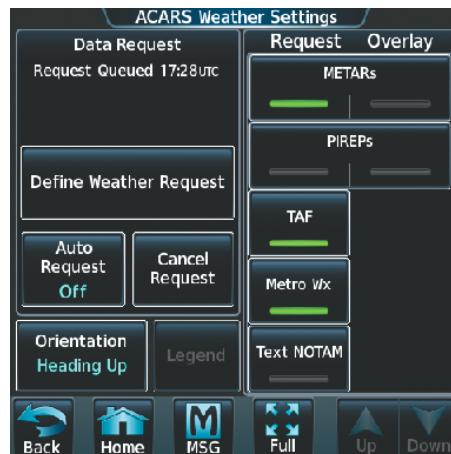
Figure 8-89 'Request Queued 17:28 UTC'

5) From Home, touch **Waypoint Info** > **Airport**. Navigate to the airports that were requested in the weather request and view the **METAR/TAF** and **Metro Weather** Tabs. There will be data, as reported by the ACARS Host Provider, filled in these tabs.

6) As a secondary test, from Home touch **Services > ACARS > Messages**.

    a) Press the **Draft New** Button.

    b) Press the **To** Button and press the **Email Address** Button from the list. Type in a destination email address and touch the **Enter** Button.

    c) Next press the **Message** Button, type 'TEST' and press **Enter**.

    d) Press the **Send** Button. An email should be received by the destination email address. The sender will be identified by the sending aircraft's tail number and ACARS Host Provider's domain.
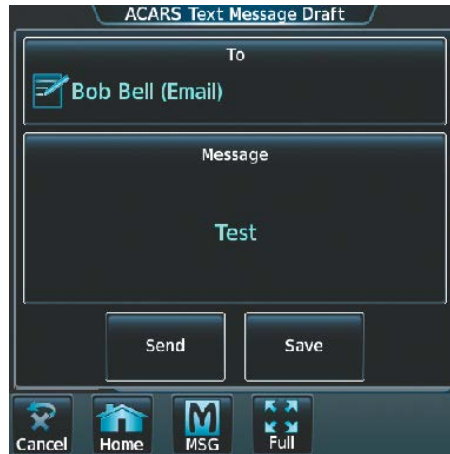
**Figure 8-90 Sending an ACARS
Test Message**

If these tests are successful it will indicate proper configuration of the GSR 56 #2 Iridium account. If the request for weather data does not get out of the 'Request Queued' state and if the email does not get delivered to the destination email, it is possible the Iridium account has not been configured correctly. Troubleshooting with the ACARS Host Provider will be needed to ensure GSR 56 #2 has been configured to route correctly.

DATALINK SERVICE PROVIDER

The Datalink Service Provider (DSP) connects the network stations to AOC and ATS end systems. The DSP also provides a means for ground facilities to communicate with each other through ground-ground message formats.

Currently, there are two primary DSPs: ARINC and SITA. These two networks maintain ACARS coverage in most areas around the globe. There are four regional providers that provide ACARS coverage in areas where ARINC and SITA lack coverage. The four regional providers are ADCC of China, AEROTHAI of Thailand, AVICOM of Japan, and DECEA of Brazil. While ARINC and SITA do not have direct control over the regional networks, contractual agreements exist between the primary providers and the regional providers such that ARINC and SITA customers may route ACARS data through the regional providers as though they were part of the primary networks.

Each primary DSP offers identical VHF capabilities, although they differ in coverage areas around the world. It is important to point out that ARINC and SITA maintain separate ground stations. This means that ARINC does not have access to data routed to SITA and vice versa.

END SYSTEM SERVICES

ACARS end system services are divided into two categories: Air Traffic Services (ATS) and Aeronautical Operational Control (AOC). ATS services are restricted by formats and operational guidance outlined in standards. AOC services are built around custom requirements from operation centers and customers. All ATS services are protected by logic that prevents undetected data corruption, whereas only a select number of AOC services offer additional data corruption protection due to the data being less critical than ATS services. AOC services can be further broken down into subcategories consisting of general services and weather products.

The following sections describe the services offered by each category.

AIR TRAFFIC SERVICE (ATS)

ACARS provides the following for communicating directly with air traffic facilities:

» **D-ATIS** – Digital Automatic Terminal Information Service (D-ATIS) provides the ability to request and receive digital ATIS information from supported airports around the world over the ACARS datalink.

» **TWIP** – Terminal Weather Information for Pilots (TWIP) allows for requesting and receiving text-based terminal weather conditions from supported airports.

» **Departure Clearance** – Pre-Departure Clearances (PDC) and Departure Clearances (DCL) provide the ability to request and receive clearances from supported airports over the ACARS datalink. This supports the world wide (DCL) in addition to the US (PDC) clearance formats. The primary difference between DCL and PDC is DCL is directly requested from airport ATC while PDC is requested from the aircraft's operation center. PDC's are delivered to the aircraft's operation center from ATC prior to departure time.

AERONAUTICAL OPERATIONAL CONTROL (AOC)

ACARS provides the following for communicating directly with operation centers:

» **Flight Plan Upload** – The Flight Plan Upload application allows the crew to request and upload flight plans from the operation center. With the Flight Plan Upload application, the crew is provided with an interface to query for a list of all available flight plans within the next 24 hours. The crew subsequently has the option to select a flight plan from the list to initiate datalink upload. When upload of a flight plan is initiated, the ACARS DLS retrieves the flight plan from the operation center via ACARS datalink. Fight Management System (FMS) importing is built into the application to eliminate the need for manual entry of flight plans.

» **ACARS Messages** – ACARS Messages encompasses a collection of services involving generating and receiving free text messages. With ACARS Messages, the crew has the ability to exchange free text messages with operation centers (including hosts), phone numbers (if supported by operation center), fax machines, emails, and AFTN/IATA Type 'B' addresses. When supported by the operation center, requests for concierge service can be initiated through the ACARS Messages application.

» **Flight System Messages (FSM)** – FSMs are actually provided by the Air Traffic Service and are displayed as an ACARS Message. These messages provide feedback on pending ATS service requests and read backs. The messages do not require confirmation and only provide status updates or rejections.

» **Weather Applications** - The following list of weather products are available from the AOC. Weather products expire 60 to 90 minutes after the message timestamp, depending on the product. Expired weather data is periodically purged from the displays.

▪ **METAR** – Aviation Routine Weather Report. Request and receive METARs from the operation center for observed surface weather conditions at airports around the world.

- **TAF** – Terminal Aerodrome Forecast. Request and receive TAFs from the operation center for airports around the world.

- **PIREP** – Pilot Report. Request PIREPs from the operation center using waypoints and airport identifiers. Generally, PIREP's are associated with nearby airports; however, availability may vary depending on the contracted operation center. PIREP reports generally consist of weather conditions and observations recorded between pilots and ATC facilities. Each report is assigned a location based on bearing and distance from known waypoint identifiers.

- **Metro Wx** – Metropolitan Weather. Request Metro Wx reports from the operation center using airport identifiers. While there is not a standardized format for Metro Wx reports, they generally summarize the weather conditions and forecasts associated with metropolitan areas surrounding airports. The availability of Metro Wx is dependent on the operation center and the airport requested.

- **NOTAM -** Notice to Airmen. The ACARS Weather application allows the flight crew to request NOTAMs specific to one or more airport identifiers. When NOTAMs are received they are shown in textual format using the preexisting 'Airport Information' Screen. NOTAMS do not expire and will clear upon power cycle of the flight deck. Up to 40 total NOTAMs can be stored at once and up to 2 per airport.

» **Position Reports** – When enabled and supported by the operation center, ACARS automatically generates periodic position reports which are transmitted to the operation center at intervals determined by the flight crew.

» **Out/Off/On/In (OOOI) Reports** – When enabled by the crew, ACARS automatically sends Out-of-the Gate, Off-the-Ground, On-the-Ground, and In-the-Gate Reports to the operator's AOC. Each of these reports contain various data fields ranging from departure and destination airports to fuel on board. The reports are used by the ACARS networks to manage traffic and by the operation centers to generate notification emails and alerts for recipients associated with each aircraft. See the Out/Off/On/In (OOOI) Reporting Section at the end of this chapter for additional details.

ACARS CONNECTION

When ACARS is enabled, the system automatically attempts to establish communication with the ground networks after power is applied to the system. A link test is generated by the system to check for network availability once the system receives permission to send. Permission to send is derived from either previous knowledge of a VHF frequency or from detecting a valid network on a current frequency. Once the ground acknowledges the reception of the link test message, Datalink System (DLS) communication is established.

The ACARS Link Status is shown on the 'ACARS' Screen on the Touchscreen Controller. When the system is initially powered on and a connection has not yet been established, a question mark is displayed in the Link Status check box.

Figure 8-91 Unknown ACARS Link Status

When a connection is established, a check mark is displayed in the Link Status check box. The type of connection is also shown to the right of the check box. This indication may aid in deciding the type of products to request due to the significant uplink speed difference between analog POA, digital AOA and Iridium Satellite.
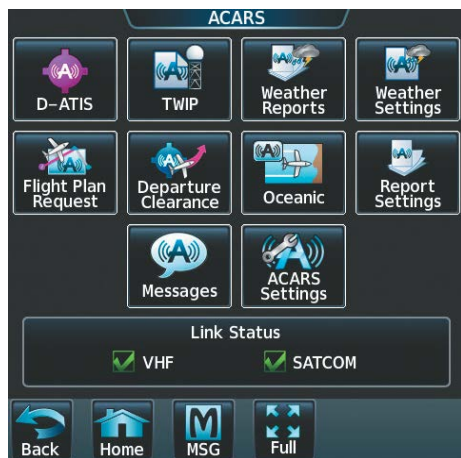
Figure 8-92 ACARS Connected to VHF Network and SATCOM
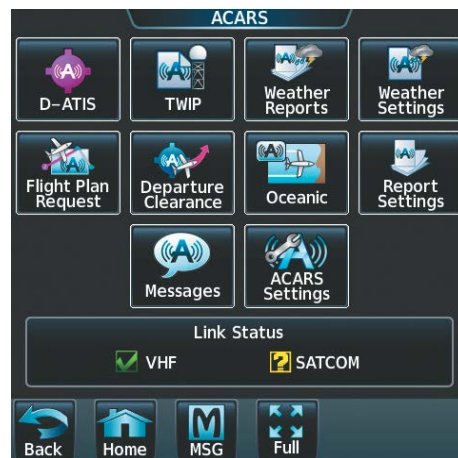
Figure 8-93 ACARS Connected to VHF Network without SATCOM

When the DLS has lost network connection, a System Message indicating loss of connectivity is displayed. The lack of an established connection is referred to as a NOCOMM condition.

Figure 8-94 ACARS Connection Lost

In this condition, the Link Status check box displays 'Scanning Digital' for a VDLM2 AOA digital connection (see following figure). When the system is scanning an analog POA station, 'Scanning Analog' is displayed as seen in the following figure.

Figure 8-95 ACARS Scanning Digital VHF

Figure 8-96 ACARS Scanning Analog VHF

Messages generated for the various services are queued in the ACARS and transmitted once communication is resumed.

> **Enabling/disabling ACARS:**

> **NOTE:** *If the Digital Radio (GDR 66) is off, the VHF link status shows as "VHF - Searching Analog."*

1) From Home, touch **Services > ACARS > ACARS Settings.**

2) Touch the **ACARS Enabled** Button. A green annunciator indicates the ACARS is enabled. When disabling ACARS, a confirmation screen is displayed.

3) Touch the **OK** Button to disable ACARS. A gray annunciator indicates the ACARS is disabled.
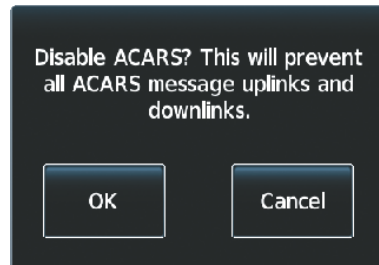
Figure 8-98 ACARS Disable Confirmation

Figure 8-97 ACARS Disabled

Accessing ACARS host information:

1) From Home, touch **Utilities > Setup** >**Avionics Status**.

2) From the 'Avionics Status' Screen, touch **Data Link** > **ACARS**.

    The 'ACARS Diagnostics' Screen is displayed. For reference, frequencies may be accessed by scrolling down and pressing the **Analog Frequency Reference Table** Button.

Figure 8-99 'Avionics Status' Screen
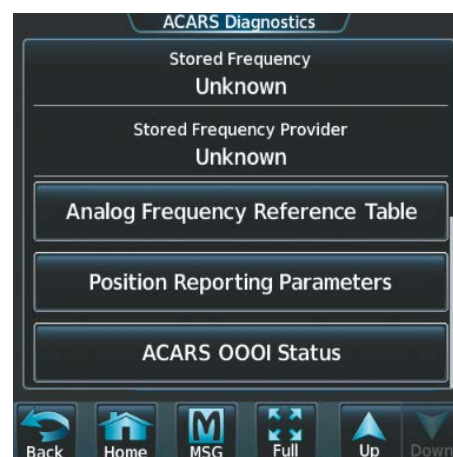
Figure 8-100 'ACARS Diagnostics' Screen

ATS SERVICES

   In addition to the following ATS services, the Flight System Message (FSM) Service can send text messages referencing open ATS requests. ATC facilities can provide message rejection or feedback on message processing. For example, a message could specify that a Departure Clearance request was rejected because the flight plan was not submitted to ATC and the crew must revert to voice procedures. FSM messages are displayed on the ACARS Messaging display.

FSM only supports feedback for D-ATIS and Departure Clearances (DCL). TWIP is not included as part of the FSM response types. FSM messages do not require confirmation and can only be used to extend the waiting period or to reject a message. In addition, any FSM uplink containing a message not formatted as specified in EUROCAE ED-85A and ED-89A are automatically rejected. Rejection of an FSM uplink triggers a System Message indicating the uplink has been rejected. This makes the pilot aware of the issue, allowing for possible reversion to voice procedures.

D-ATIS

The Digital Automatic Terminal Information Service (D-ATIS) feature provides the ability to request and receive textual ATIS information for a specific airport on the 'ACARS D-ATIS' Screen on the Touchscreen Controller. Each D-ATIS report indicates the report is an Arrival or Departure D-ATIS and provides the ATIS version identifier (ATIS Indicator) required for requesting clearances. Each report is also accompanied by a timestamp to allow for verification. The report may contain information such as runway surface conditions, transition levels, presence of obstacles, and airport weather conditions. Multiple reports may be listed, with the most current report displayed at the top of list.

The ACARS does not provide automatic updates of D-ATIS information. To get the most current information, make a new request.

Requesting/viewing D-ATIS for a specific airport:

1) From Home, touch **Services > ACARS > D-ATIS**.

Figure 8-101 'ACARS D-ATIS' Screen for Last Selected Airport

Figure 8-102 Change Airport for KDEN D-ATIS

2) The 'ACARS D-ATIS' Screen is displayed with the last airport selected displayed. To change airports, touch the **Airport Selection** Button to display the alphanumeric keys.

   a) Enter the desired airport using the alphanumeric keypad.

   b) Touch the **Enter** Button.

3) Touch the **Request** Button.

Figure 8-103 Request KDEN D-ATIS

Figure 8-104 D-ATIS Request Options

4) Touch the **Departure** or **Arrival** Button, as appropriate.

Figure 8-105 D-ATIS Request Sent
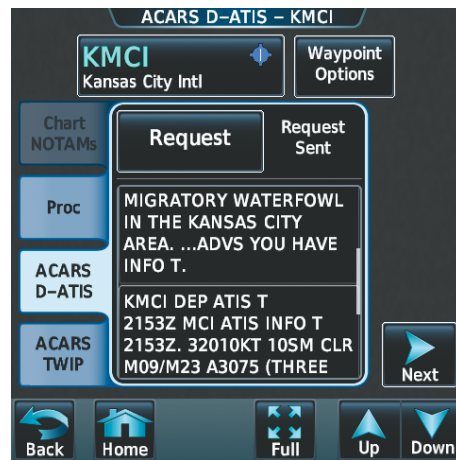
Figure 8-106 D-ATIS Message

5) When the selected ATIS request is received by the D-ATIS service, 'Request Sent' is displayed. When the ATIS message is received from the D-ATIS service, it is displayed in the window below the **Request** Button. A message is also displayed on the 'Notifications' Screen and can be viewed by touching the **ACARS Message** Button.

Figure 8-107 D-ATIS Received Notification

In the image above, notice a cyan box that surrounds the message. This indicates a new message has been received and is distinguished from an older message which would not have outline. For further discussion on notifications, see the Touchscreen Controller Section in System Overview.

TWIP

The TWIP feature provides the ability to request, receive, and view TWIP information on the Touchscreen Display. Similar to D-ATIS, each TWIP report originates from an airport ATS server and provides the crew with free text descriptions of weather conditions near an airport.

The ACARS does not provide automatic updates of TWIP reports. To get the most current information, make a new request.

Refer to the Hazard Avoidance section for a more detailed discussion of the TWIP feature.

PRE-DEPARTURE CLEARANCES (PDC) / DEPARTURE CLEARANCES (DCL)

The Departure Clearance feature provides the ability to request and receive departure clearances from ATC via datalink, instead of via voice communication. This service is available when departing an airport that supports PDC or DCL service. Since only one departure clearance is relevant at any given time, the ACARS shows only the most recent pending or accepted clearance uplink. From the PDC/DCL service, the ability to request clearances, accept or reject pending clearances, and view previously accepted clearances are provided. When making a new request, additional information is required. Some of the information required, such as flight identification, is automatically populated from other parts of the system (if present) while other information such as Gate Number requires manual entry. A request cannot be sent unless all of the required information is present. When a valid clearance uplink is received by ACARS, the clearance is placed in the 'Pending' Window on the 'ACARS Departure Clearance' Screen. When the pending clearance is accepted, the ACARS generates a readback downlink confirming the acceptance of the clearance to ATC. When a clearance is rejected, the clearance uplink is deleted from view, and operational guidelines state reversion to voice communication is required. General Aviation operators are limited to one PDC/DCL per terminal per day.

Requesting, viewing, accepting and/or rejecting a departure clearance:

1) From Home, touch **Services > ACARS** > **Departure Clearance**.

2) Touch the **Request** Button. The 'Request Departure Clearance' Screen is displayed.
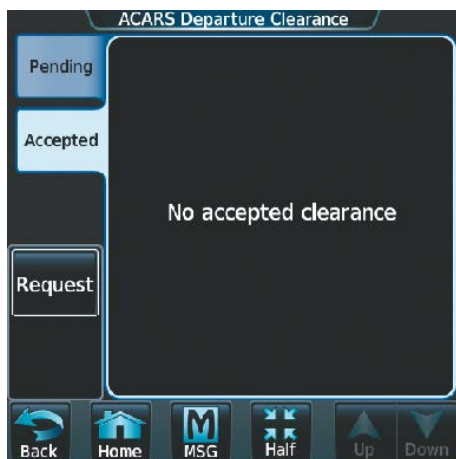
Figure 8-108 Request Departure Clearance

Figure 8-109 Enter Clearance Request Information

3) Touch each of the information buttons, and, if necessary, enter the appropriate information using the alphanumeric keys. Some entries may be pre-filled by the System.

4) Touch the **Send** Button to send the request. When the requested is successfully received "Request Sent" is displayed.

Figure 8-110 Departure Clearance Sent
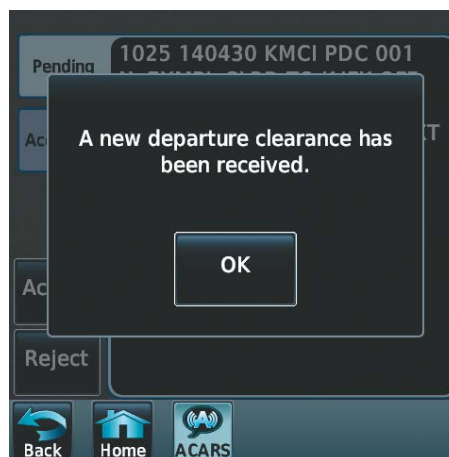
Figure 8-111 New Clearance is Received

5) When the departure clearance is received by the ACARS, a confirmation screen is displayed. Touch the **OK** Button. An FSM message notification is also displayed on the 'Notifications' Screen. Touch the **Notification** Button to display the status.

Figure 8-112 Request Received FSM Message
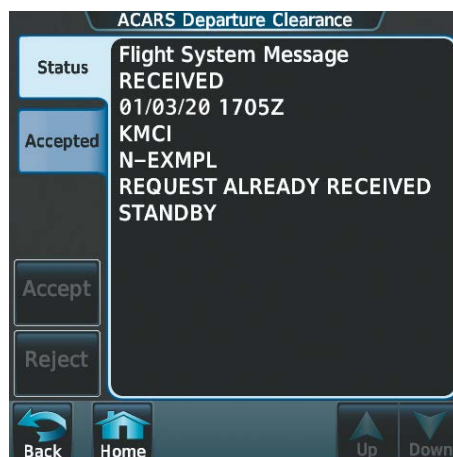
Figure 8-113 Clearance Request Status Message

6) When the DCL or PDC is received by the ACARS, it is displayed as a 'Pending' clearance. If necessary, touch the **Pending** Tab to view the clearance.

Figure 8-114 New Clearance is Pending
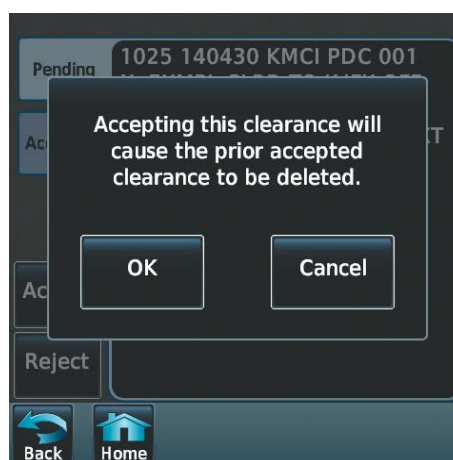
Figure 8-115 Accept Clearance

7) To accept the clearance, touch the **Accept** Button. A confirmation window is displayed.

8) Touch the **OK** Button. Any previously accepted clearances are deleted and the newly accepted clearance is displayed from the **Accepted** Tab.

Figure 8-116 Accepted Clearance Displayed

9) Touch the **Reject** Button to reject the clearance. An FSM Notification Message is displayed. Touch the **Notification** Button to display the status message. Establish voice communication with ATC.
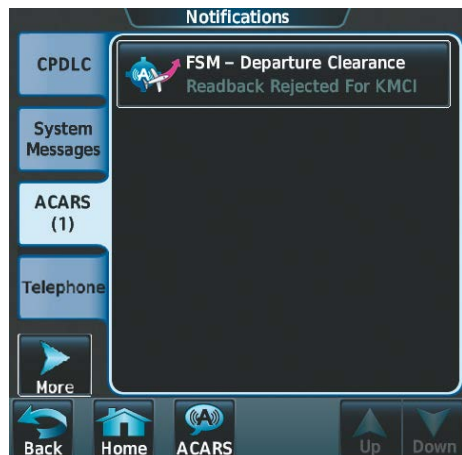
Figure 8-117 Clearance Rejected FSM Notification
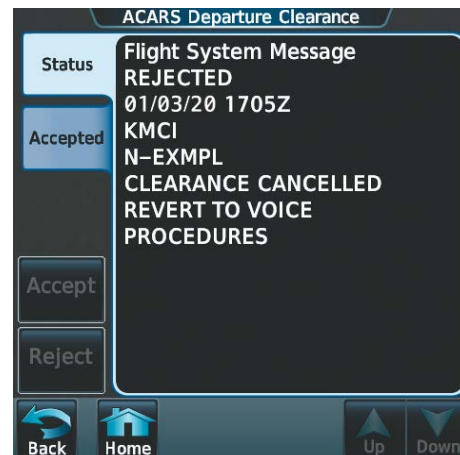
Figure 8-118 Clearance Status - Rejected

OCEANIC CLEARANCES (OCL)

When transitioning between certain Continental and Oceanic airspace, the flight crew must obtain an Oceanic Clearance (OCL). The OCL application provides the flight crew with the ability to request and receive an OCL from ATC using the ACARS datalink in place of voice communication. From the OCL service, the ability to request clearances, accept or reject pending clearances, and view previously accepted clearances are provided. Some of the information required, such as flight identification, is automatically populated from other parts of the system (if present) while other information will require manual entry. A request cannot be sent unless all of the required information is present. When a valid clearance uplink is received by the ACARS, the clearance is placed in the 'Pending' Window on the 'ACARS Oceanic Clearance' Screen. When the pending clearance is accepted, the ACARS generates a readback downlink confirming the acceptance of the clearance to ATC. When a clearance is rejected, the clearance uplink is deleted from view, and operational guidelines state reversion to voice communication is required.

Requesting viewing, accepting and/or rejecting an Oceanic Clearance:

1) From Home, touch **Services > ACARS** > **Oceanic** .

2) The 'ACARS Oceanic Clearance' Screen is displayed. To request an Oceanic Clearance , touch the **Accepted** Tab and then touch **Request Clearance.**
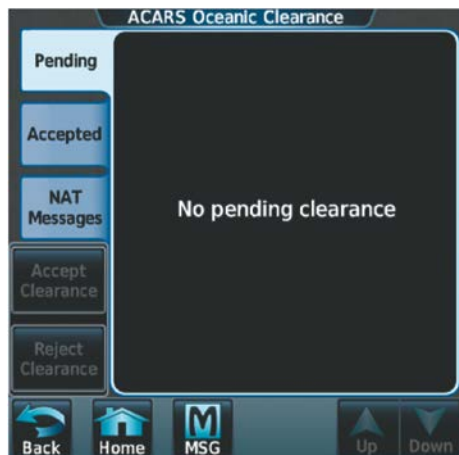
Figure 8-119 Pending Clearance Screen
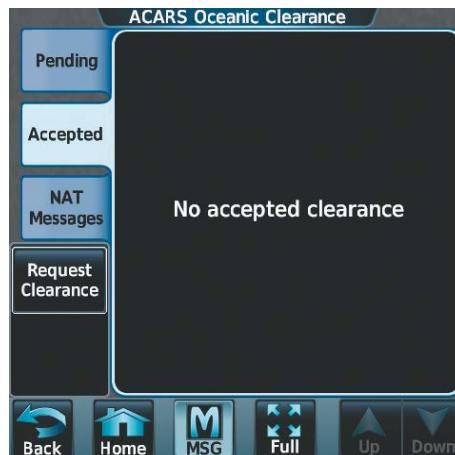
Figure 8-120 Accepted Clearance Screen

3) Touch each of the information buttons, and, if necessary, enter the appropriate information using the alphanumeric keys.

NOTE: Although some of the fields are pre-filled by the system, each field must still be touched and the information verified and entered before the OCL request can be sent to ATC.

NOTE: The "Flight ID" Field is pre-filled automatically from the Transponder Flight ID.

4) Touch the **Send** Button to send the request. When the requested is successfully received 'FSM - Oceanic Clearance Request Received' is displayed.

Figure 8-121 Enter Clearance Request Information

Figure 8-122 OCL Request Received

5) When the OCL clearance is received, a message notification is displayed on the 'Notifications' Screen. Touch the **ACARS** Button to display the status.

Figure 8-123 ACARS Message Received

Figure 8-124 ACARS OCL Clearance Received

6) When the OCL is received by the ACARS, it is displayed as a 'Pending' clearance. If necessary, touch the **Pending** Tab to view the clearance.

7) To accept the clearance, touch the **Accept Clearance** Button. A confirmation window is displayed.
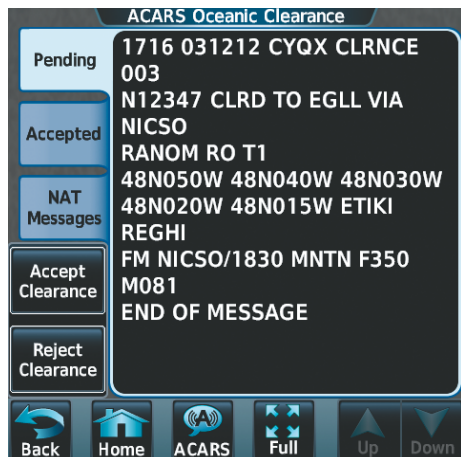
Figure 8-125 OCL in Pending Status
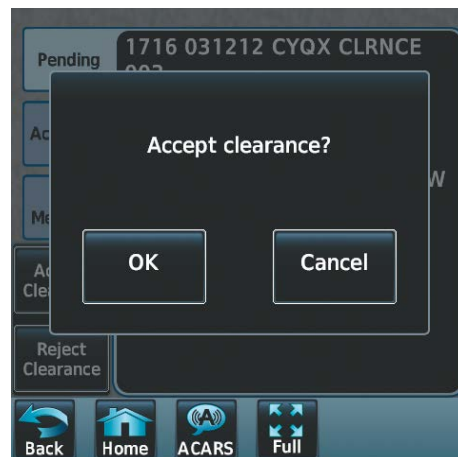
Figure 8-126 Accept OCL Confirmation

8) Touch the **OK** Button. Any previously accepted clearances are deleted and the newly accepted clearance is displayed from the **Accepted** Tab.
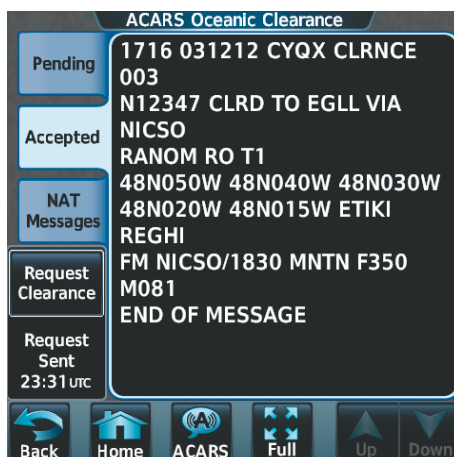
Figure 8-127 Accepted Clearance Displayed

9) Touch the **Reject Clearance** Button to reject the clearance. An FSM Notification Message is displayed. Touch the **Notification** Button to display the status message. Establish voice communication with ATC.

AOC SERVICES

The following services are provided through ACARS AOC providers or hosts. The availability of these applications are dependent upon which host is used.

FLIGHT PLAN REQUEST

To make a flight plan available for upload to ACARS, the flight plan must first be submitted to the host. The Flight Plan Request is then made through ACARS to upload a list of the previously submitted flight plans available for the next 24 hours and request individual flight plans using recall numbers provided by the list. The flight plan list provided by the host may contain up to ten flight plans; each identified by a recall number as well as a brief description.

UPLOADING FLIGHT PLANS

Each flight plan has an associated request button that also serves as indication of whether a flight plan was requested or successfully received. When a flight plan is successfully received it may be imported to the FMS as a standby flight plan.

Requesting a list of available flight plans:

1) From Home, touch **Services > ACARS** > **Flight Plan Request**.
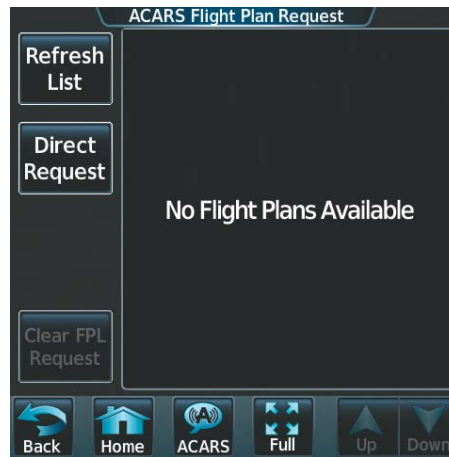
Figure 8-128 'ACARS Flight Plan Request' Screen

2) Touch the **Refresh List** Button. The message 'Refreshing Flight Plan List...' will be displayed while the list is being uploaded. When the list is successfully uploaded the available flight plans are displayed. This list will update automatically as more flight plans become available.
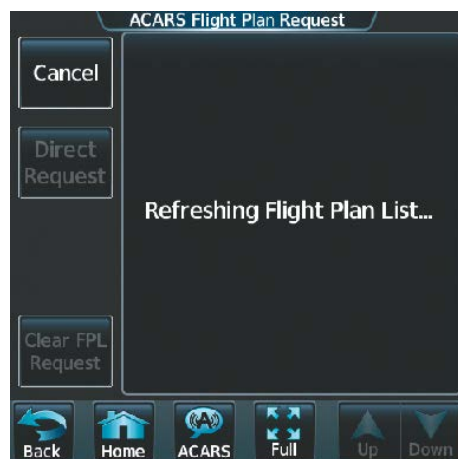
Figure 8-129 Refreshing List of Available Flight Plans

Figure 8-130 Request the Desired Flight Plan

3) Touch the **Request** Button associated with the desired flight plan. When the upload is complete, the **Import** Button is displayed. A 'Flight Plan Received' message is also displayed on the 'Notifications' Screen.

Figure 8-131 Requested Flight Plan is Uploading
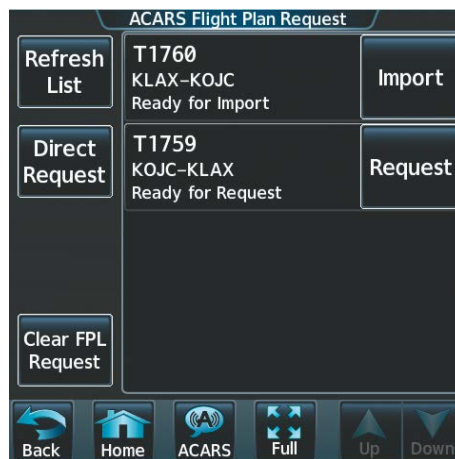
Figure 8-132 Requested Flight Plan Available for Import

4) Touch the **Import** Button to import the flight plan as the current Standby Flight Plan. An 'Importing...' message will display while the FMS is importing the flight plan. Refer to the discussion on Standby Flight Plans in the Flight Management Section.

When flight plans containing departure/arrival procedures and transitions are received without specifying runway information, a runway selection screen is displayed to complete the importing of the flight plan.

Figure 8-133 Accepted Clearance Displayed

Flight Plan Upload Errors

When a flight plan contains invalid data such as a non-existent waypoint identifier, a loading error message is displayed. A different flight plan may be requested or a new flight plan list may be uploaded if the previously listed flight plan options have been exhausted.

If the flight plan contains syntax errors detected during the process of receiving and processing the upload, an error message is displayed.

Figure 8-134 Invalid Flight Plan Data

Figure 8-135 Flight Plan Syntax Error

After touching **OK** on either of these error displays, a 'Failed' indication is displayed on the associated flight plan button. A different flight plan may be requested or imported.
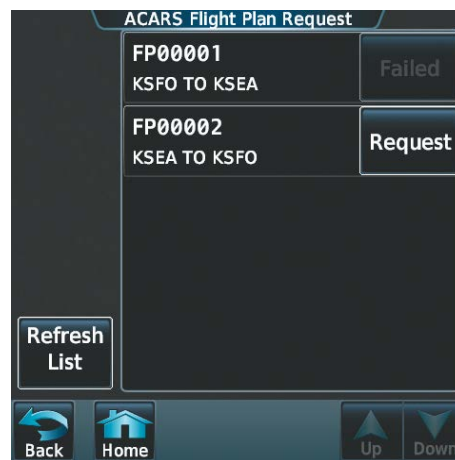
Figure 8-136 Flight Plan Upload Failed

NORTH ATLANTIC TRACK (NAT) MESSAGES

NAT Messages provide the flight crew with the ability to request and receive the current active NAT routes. NAT messages are requested using the 'Oceanic' Screen. When on this screen, an option to request an Eastbound or Westbound NAT Message is given. The ATC operations center is responsible for sourcing the data and will uplink the applicable NAT Message. The NAT Messages will be displayed as text of the published NAT routes that are currently active.

Requesting and viewing a NAT Message:

1) From Home, touch **Services > ACARS** > **Oceanic** .

2) The 'ACARS Oceanic Clearance' Screen is displayed. To request an Oceanic Clearance , touch the **NAT Messages** Tab and then touch **Request Message.**
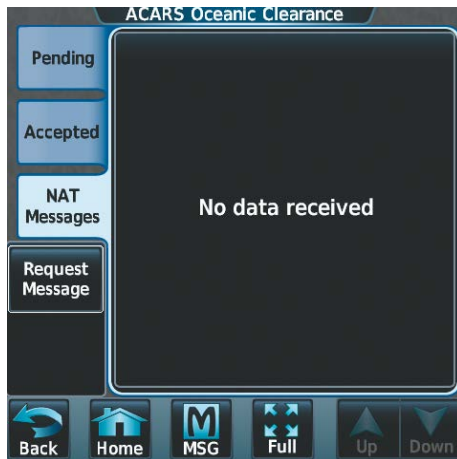
Figure 8-137 NAT Message Request Screen

Figure 8-138 NAT Message Choose Message Type

3) Touch either the **Eastbound** or **Westbound** Button. When the requested is successfully received "Request Sent" is displayed.

4) When the NAT Message is received by the ACARS, a message notification is displayed on the 'Notifications' Screen. Touch the **ACARS** Button to view the message status.

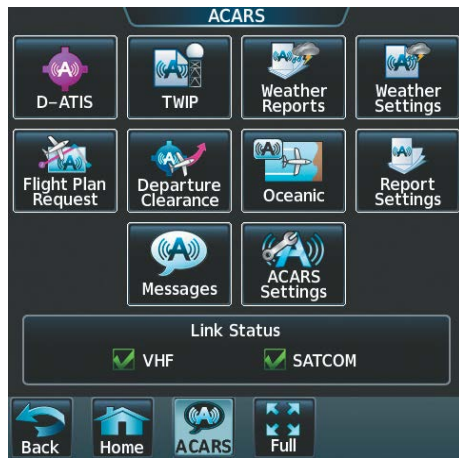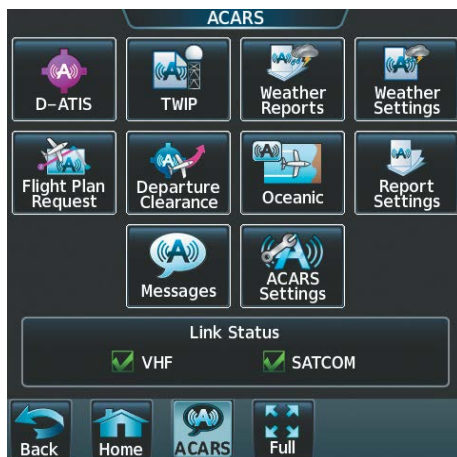**Figure 8-139 ACARS Message Received**

Figure 8-140 NAT Message Received

5) Touch the **NAT Message Received** Button and then touch the **NAT Messages** Tab. The text of the NAT Message will be displayed in the 'NAT Messages' Window.
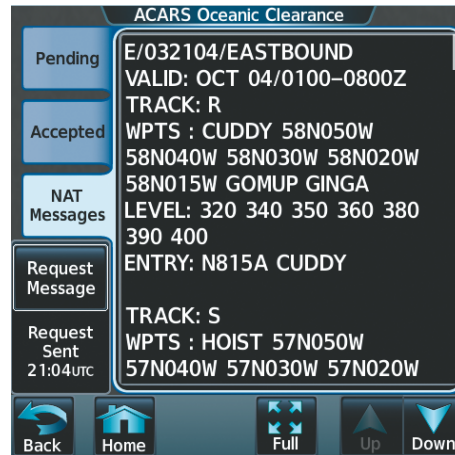
Figure 8-141 NAT Message Accepted

ACARS MESSAGES

ACARS Messages combines multiple types of ACARS messaging into a single feature for creating text messages designated for different types of recipient addresses. The ACARS provides address type identification to the AOC for ACARS messages and does not directly contact the intended recipient.

Messages received from ACARS applications will be annunciated by an "Incoming Message" aural alert. If power is interrupted to the MFD or to a Touchscreen Controller, then upon LRU power initialization, the system will annunciate "Incoming Message" if there are any unviewed messages from ACARS applications or SMS Messages in the Inbox.

Certain datalink messages are stored in memory that persists after a full avionics power cycle. If these messages remain stored in the system, they may cause an "Incoming Message" aural when power is applied to the system. This can be prevented by removing in the following procedure.

ADDRESSING TYPES

The ACARS supports the following address types, however, each AOC/host may offer different levels of support for each address type.

Phone Numbers

Addressing by phone number allows for voice relay sponsored by the ACARS host to deliver messages. The availability of this feature is dependent on the host configured.

Alias

Aliases are used to replace lengthy addresses, such as email distribution lists, with a shortened representation of the address or list. A mapping/list of aliases must be established with the host prior to operation to ensure proper interpretation. Example aliases may be terms such as "Delivery Code" or "Distribution Code."

Email Address

Addressing by email address allows the host to route messages to email addresses.

Tail Number

Addressing by tail number allows the host to send text messages to other aircraft. The availability of this feature is dependent on the configured host.

Host Request/Concierge

When using the Host Request/Concierge option, the message is automatically addressed for the operation center. The 'To' Field is then used to represent the intended recipient of the request while a 'From' Field is added to identify the origin of the request.

Generally, when concierge service is requested, the 'From' Field represents the passenger/crew requesting the concierge service while the 'To' Field represents the target for the concierge request such as a hotel or a taxi company. The following is an example of a concierge request:

Message Type:	Concierge
To:	KMCI FBO
From:	John Smith (Pilot)
Message:	Please check fuel pricing at KMCI FBO

As shown, the concierge message format allows for the designation of a target and destination of a request. The request would subsequently be fulfilled by the operation center, if supported.

Aeronautical Fixed Telecommunication Network (AFTN)

Addressing by AFTN address allows for using the host to route messages directly to airport facilities. The AFTN Network consists of end systems at various airports identified by eight-character addresses. The first four characters of the address represents the associated ICAO airport identifier while the latter four characters designate the destination end system within all of the addresses associated with the airport. This allows for sending messages directly to facilities such as airline offices and control towers associated with an airport. The availability of this feature is dependent on the configured host.

IATA Type 'B'

Addressing by IATA Type 'B' allows for using the host to send messages directly to end systems on the ground-ground network associated with ACARS. IATA Type 'B' connectivity is maintained by ARINC and SITA to allow various ground facilities to pass messages to one another. When a message generated and designated for an IATA Type 'B' address, the associated operation center is responsible for forwarding the message to the intended recipient. IATA Type 'B' addresses consist of seven characters, each representing a different private entity on the ground-ground network. The availability of this feature is dependent on the configured host.

Fax

Addressing by fax machine numbers allows for the use of the host to send faxes. Note that destinations for fax machines are distinguished from phone numbers to provide clarity for the host when downlinks are received. This feature is only available if routing is supported by the operation center.

Viewing an ACARS message when received:

1) Touch the flashing **ACARS** Button. The **ACARS Inbox** Tab is automatically selected and the newly received ACARS message is shown.
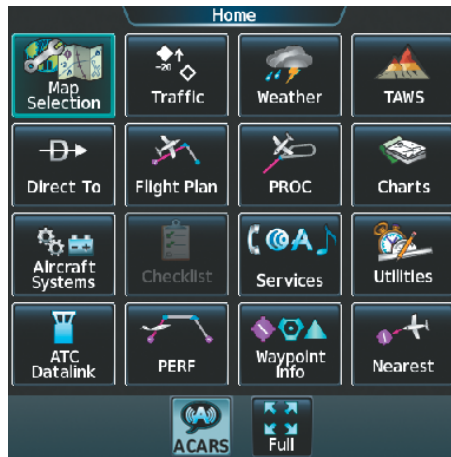
Figure 8-142 New ACARS Message Annunciation
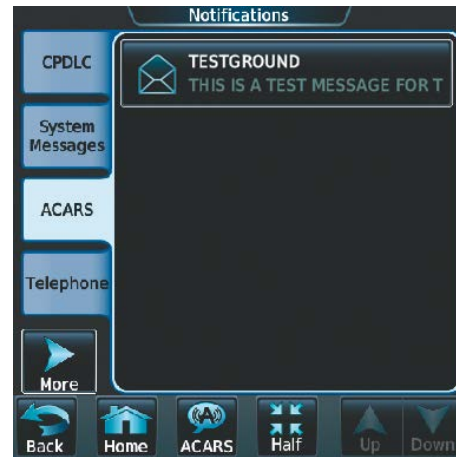
Figure 8-143 New Message Example

2) Touch the message to display its contents.
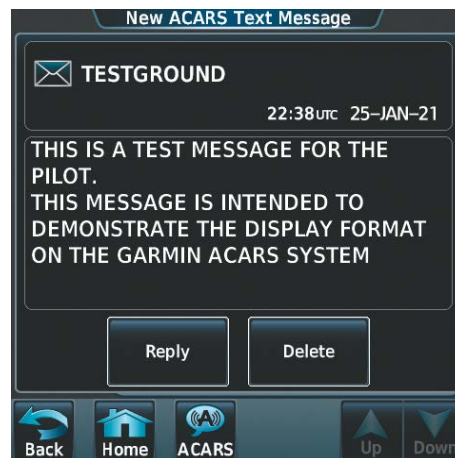
Figure 8-144 New ACARS Message Contents

3) If desired, touch the **Reply** Button to create a reply to the message.

4) Touch the **Delete** Button to delete the message from the list.

Replying to an ACARS message:

While viewing the text message content, touch the **REPLY** Button.

Or:

1) From Home, touch **Services** > **ACARS** > **Messages**.
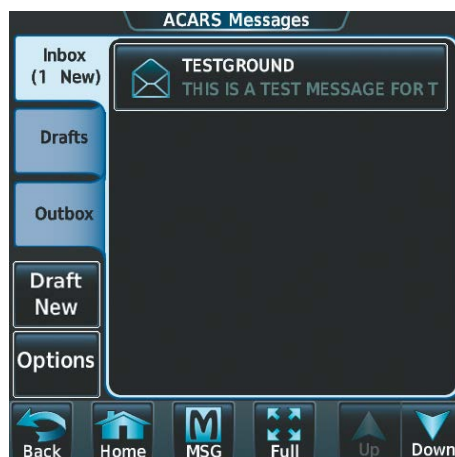
Figure 8-145 Touch Desired Message

2) Touch the message in the Inbox list. If necessary, scroll to the desired message. The ACARS message is displayed.

3) Touch the **REPLY** Button. The 'ACARS Text Message Draft' Screen is displayed.
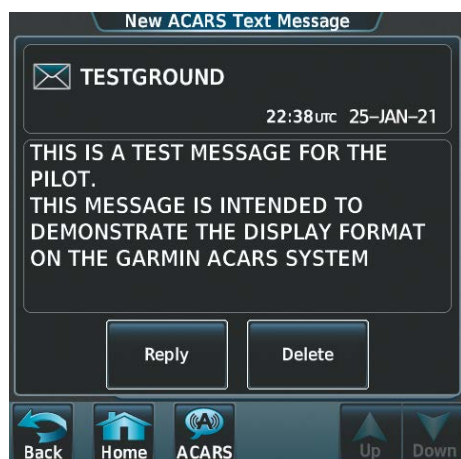
Figure 8-146 New ACARS Message Contents   **Figure 8-147 New Reply Message Screen**
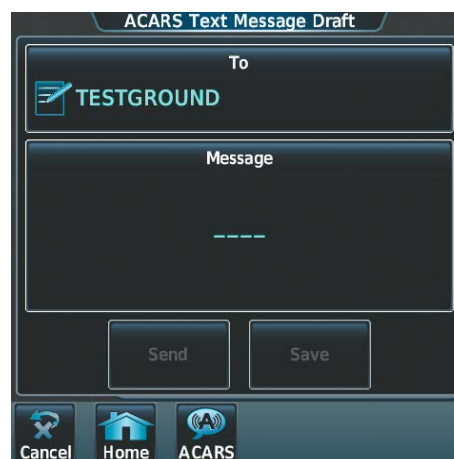
4) Touch the 'Message' Window to display the alphanumeric buttons.
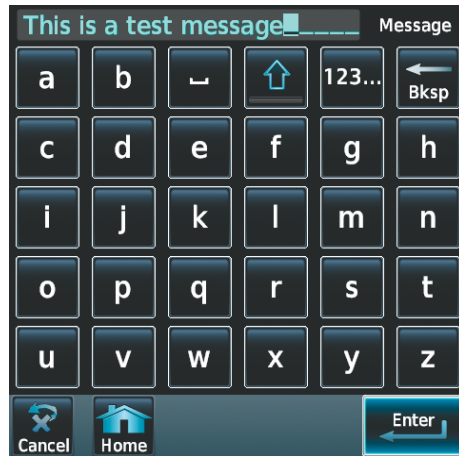
Figure 8-148 Enter Message

Figure 8-149 Reply Message Content

5) Enter the reply text.

6) Touch the **Enter** Button. The reply message is displayed.

7) Touch the **Send** Button.

Sending an ACARS message:

1) From Home, touch **Services** > **ACARS** > **Messages**.
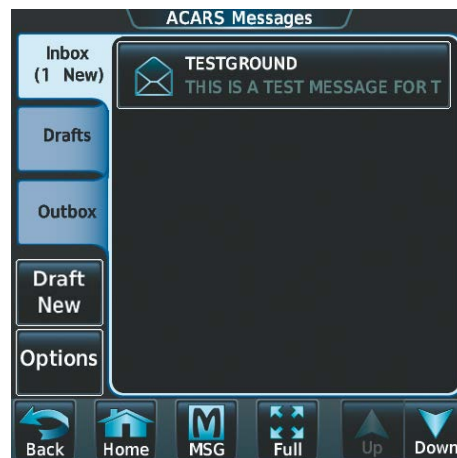
Figure 8-150 Select Draft New

2) Touch the **Draft New** Button. The 'ACARS Text Message Draft' Screen is displayed. The **Draft New** Button is also available from within the **Drafts** and **Outbox** Tabs.
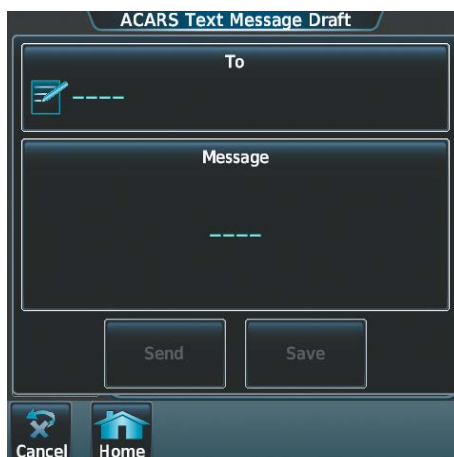
Figure 8-151 Touch 'To' Window

3) Touch the **To** Window. A selection screen is displayed. If necessary, scroll through the list of available address types for sending the message.
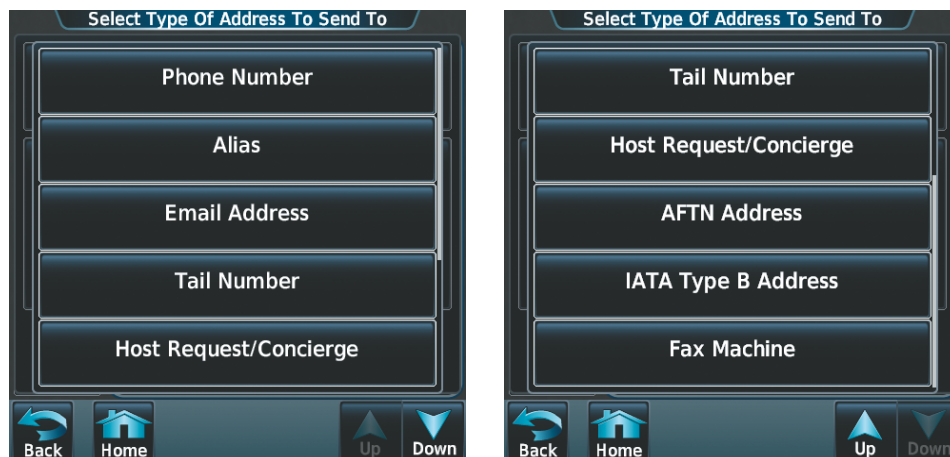
Figure 8-152 Address Type Selection

4) Touch the button corresponding to the desired address type. An entry screen suitable to the address type selected is displayed.

Alpha buttons are displayed when the **Alias** Button is touched

Numeric buttons are displayed when the **Phone Number** Button is touched

Alpha buttons are displayed when the **Host Request/Concierge** Button is touched and the 'From' address is entered

Alpha buttons are displayed when the **Host Request/Concierge** Button is touched and the 'To' address is entered

Numeric buttons are displayed when the **Fax Machine** Button is touched

Alpha buttons are displayed when the **IATA Type B Address** Button is touched

Alpha buttons are displayed when the **Tail Number** Button is touched

Alpha buttons are displayed when the **Email Address** Button is touched

Alpha buttons are displayed when the **AFTN Address** Button is touched and the Facility Code is entered

Alpha buttons are displayed when the **AFTN Address** Button is touched and the Location Indicator is entered

Figure 8-153 Address Type Entry Screens

5) Enter the pertinent information using the alphanumeric keys.

6) Touch the **Enter** Button. The address is now displayed.

7) Touch the **Message** Window. The alphanumeric buttons are displayed.
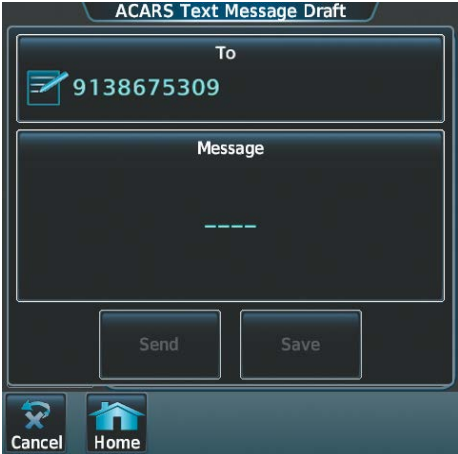
Figure 8-154 Touch 'Message' Window

Figure 8-155 Reply Message

8) Enter the message text.

9) Touch the **Enter** Button. The message text is displayed in the **Message** Window.

Figure 8-156 Message Ready to Send

10) Touch the **Send** Button.

Managing ACARS Messages

The following table illustrates the various message status icons.

Message Symbol	Description
	Received ACARS message that has not been opened
	Received ACARS message that has been opened
	A reply has been sent for this ACARS message

Message Symbol	Description
	Saved ACARS message, draft not sent
	System is sending ACARS message
	ACARS message has been sent
	System failed to send ACARS message

Table 8-4 ACARS Message Symbols

The viewed messages in the Inbox, Outbox, or Drafts may be listed according to the date/time the message was sent or received or by message address.

Viewing messages sorted by message date/time:

1) From Home, touch **Services** > **ACARS** > **Messages**.

2) Touch the **Options** Button. The 'Sort Messages By' selections are displayed.
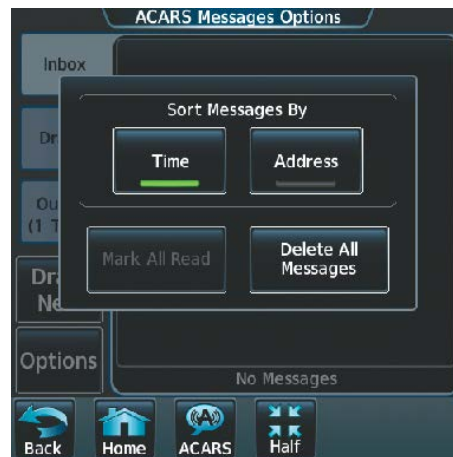
Figure 8-157 Message Sort Options

3) Touch the **Time** Button. A green annunciator indicates an active selection.

4) Touch the **Back** Button to return to the previously selected message box.

Viewing messages sorted by address:

1) From Home, touch **Services** > **ACARS** > **Messages**.

2) Touch the **Options** Button. The 'Sort Messages By' selections are displayed.

3) Touch the **Address** Button. A green annunciator indicates an active selection.

4) Touch the **Back** Button to return to the previously selected message box.

Marking all messages as read:

1) From Home, touch **Services** > **ACARS** > **Messages**.

2) Touch the **Options** Button.

3) Touch the **Mark All Read** Button.

4) Touch the **Back** Button to return to the Inbox. All messages in the Inbox now indicate they have been opened.

Deleting all messages:

1) From Home, touch **Services** > **ACARS** > **Messages**.

2) Touch the **Options** Button.

3) Touch the **Delete All Messages** Button. A confirmation screen is displayed.
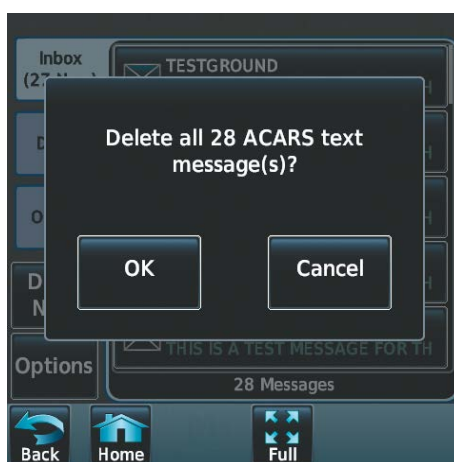
Figure 8-158 Confirm Deletion of Messages

ACARS WEATHER

ACARS weather data includes TAF's, METAR's, PIREP's, NOTAMs, and Metropolitan Weather (Metro Wx). All are presented in a textual format on the Touchscreen Controller. In addition, METAR and PIREP flags are displayed as overlays on the ACARS Weather Map.

The ACARS provides an interface to request the type of weather data and the desired airport identifiers for weather reports. The user interface also provides for setting the frequency of periodic requests.

Refer to the Hazard Avoidance section for a more detailed discussion of the ACARS Weather feature.

OUT/OFF/ON/IN (OOOI) REPORTING

OOOI reporting provides for generating OOOI Reports for use by the operator. OOOI Reports or 'Out of the Gate', 'Off the Ground', 'On the Ground', and 'In the Gate' Reports, are generated when the appropriate triggering events occur on the aircraft.

The following illustrates the events required to trigger the generation of each report:

» **Out of the Gate** - Left engine running, cabin door locked, and aircraft on ground

» **Off the Ground** - Weight on Wheels Sensor detects the aircraft is off the ground

» **On the Ground** - Weight on Wheels Sensor detects the aircraft is on the ground subsequent to the aircraft being off the ground

» **In the Gate** - Aircraft is on the ground and the left engine is not running OR cabin door unlocked.

The system provides the ability to enable/disable each report type. If OOOI Reports are generated while ACARS connectivity is lost, the messages are queued such that when ACARS connectivity is established, the reports are sent using their original recorded timestamps.

Enabling/disabling OOOI Reports:

1) From Home, touch **Services** > **ACARS** > **Report Settings**.

2) Touch the desired report button to enable or disable the report. A green annunciator indicates an enabled selection. A gray annunciator indicates a disabled selection.
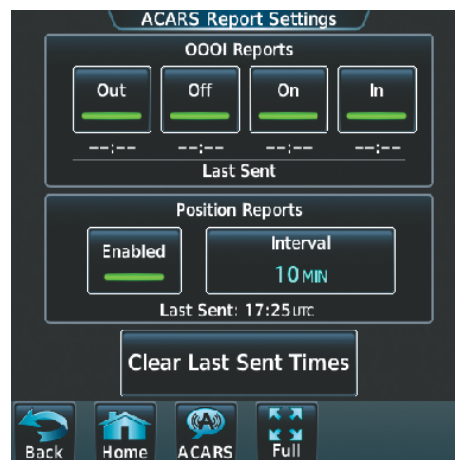
Figure 8-159 Enabled/Disabled OOOI Reports

ACARS POSITION REPORTING

When enabled, ACARS Position Reporting generates and sends position reports at a fixed time interval utilizing the ACARS System. Each position report consists of latitude/longitude, cruise speed (Mach), true heading, flight level, destination airport, final estimated time of arrival (ETA), fuel on board, fuel burn rate, and ETAs for other waypoints in the flight plan.

The crew has the ability to enable or disable the feature and to set the reporting interval. The interval between each report can be set from 1 to 99 minutes.

ACARS provides the ability to begin transmitting position reports once airborne.

Enabling/disabling ACARS Position Reports:

1) From Home, touch **Services** > **ACARS** > **Report Settings**.

2) In the 'Position Reports' Window, touch the **Enabled** Button to disable Position Reports. Touch the **Enabled** Button again to enable Position Reports. A green annunciator indicates an enabled selection. A gray annunciator indicates a disabled selection.
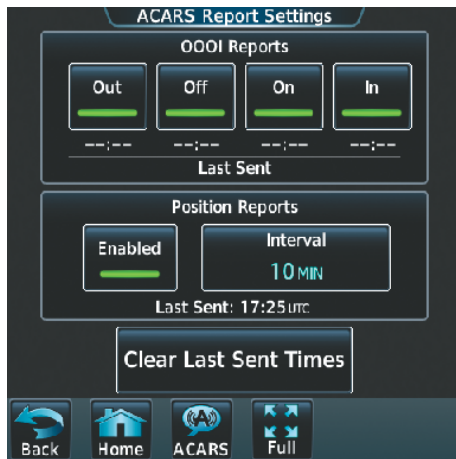
Figure 8-160 Position Reports Enabled   **Figure 8-161 Enter a Value**

Setting ACARS Position Reporting Intervals:

1) From Home, touch **Services** > **ACARS** > **Report Settings**.

2) Touch the **Interval** Button in the 'Position Reports' Window. The numeric keypad is then displayed.

3) Enter the desired time interval (1-99) using the numeric keys.

4) Touch the **Enter** Button. The time interval is displayed in the **Interval** Button.

8.7 CONNEXT (OPTIONAL)

Connext seamlessly brings together people, flight information, and hardware to create a connected environment. This section will discuss how to setup the optional wireless transceiver (FS 510) with a mobile device running the Garmin Pilot™ application. Data shared is dependent upon the hardware installed on your aircraft and whether you are operating Garmin Pilot™ on an iOS System or an Android System.

The following section will be presented from the flight deck point of view. See the Garmin Pilot™ for iOS Manual or the Garmin Pilot for Android Manual for discussion in detail on how to use the below features from the Garmin Pilot application point of view.

Upon successful connection, the Garmin Pilot application and the wireless transceiver enable an array of features:

- **Database Concierge**: enables wireless transfer of databases to select avionics
- **Flight Plan Transfer**: supports two-way flight plan transmission
- **Garmin Pilot Interface:**
  - **Iridium Communications**: provides satellite voice and SMS message capability
  - **SiriusXM Music**: delivers audio remote control of SiriusXM audio entertainment
    » Requires GDL 69/69A satellite datalink receiver and a SiriusXM subscription
- **Flight Deck Data Streaming to Mobile Device:**
  - **Attitude & Heading Reference System (AHRS)**: displays attitude information including roll, pitch, and yaw
  - **Traffic**: displays traffic targets
  - **GPS Information**: shares position, velocity, and time with Garmin Pilot
  - **SiriusXM Weather**: displays SiriusXM aviation weather for the U.S. and Canada
    » Requires GDL 69/69A satellite datalink receiver and a SiriusXM subscription
  - **Flight Data Logging**: streamed in real time to Garmin Pilot and saved as a log for each flight in Garmin Pilot on your portable electronic device

The mobile device must be 'paired' with the system in order to use the various functions. Pairing is accomplished by first placing the system in pairing mode by displaying the 'Connext Setup' Screen. The system is 'discoverable' whenever this screen is displayed. The pairing operation is completed from the mobile device and the Garmin Pilot application. See the device Bluetooth pairing instructions and the connection instructions in the Garmin Pilot application.

> **Viewing the 'Connext Setup' Screen:**
>
> 1) From Home, touch **Utilities > Setup > Wireless Setup.**
>
> 2) Touch **Connext.**
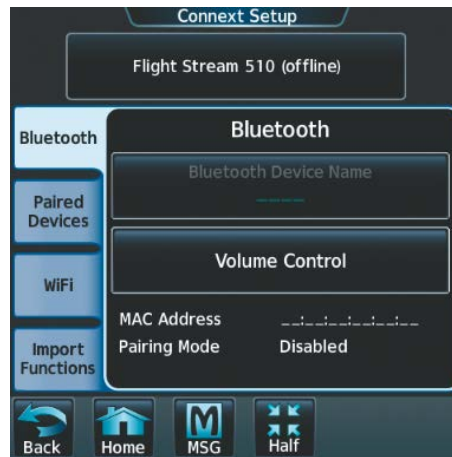
Figure 8-162 'Connext Setup' Screen

Changing the Bluetooth Name:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) From the 'Connext Setup' Screen, touch the **Bluetooth** Tab.

3) Touch the **Bluetooth Device Name** Window to display the alphanumeric buttons.

4) Enter the desired name using the alphanumeric buttons.

5) Press the **Enter** Button upon completion.

Figure 8-163 Connext Setup Bluetooth Device Info

Figure 8-164 Edit Bluetooth Device Name

NOTE: *When selecting crew position for the first time or after clearing user data, volume control defaults to having no crew position selected (i.e., no green annunciator). After the initial selection, the last selected crew position (indicated by a green annunciator) will become the default position.*

Selecting crew position for Garmin Pilot control of Connext Bluetooth volume:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) From the 'Connext Setup' Screen, touch the **Bluetooth** Tab.

3) In the center of the GTC Touchscreen, touch the **Volume Control** Button.

4) Touch **Pilot**, or **Copilot** (indicated by a green annunciator) to enable SiriusXM remote volume control on a mobile device running Garmin Pilot.

   In the following figure, the **Copilot** Button has been selected. A mobile device running Garmin Pilot can now control the copilot's SiriusXM volume.

Figure 8-165 Bluetooth Volume Control

5) Once a selection has been made, press the **Back** Button to return to the previous screen.

Enabling/Disabling Flight Plan Importing from Garmin Pilot:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) While viewing the 'Connext Setup' Screen, touch the **Import Functions** Tab**.**

3) Touch the **Enable** Button to enable (green annunciator) Flight Plan Import from Garmin Pilot (see following figure).
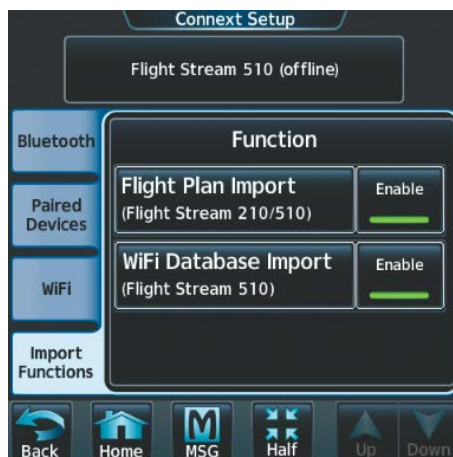
**Figure 8-166 Enable/Disable Database
and/or Flight Plan Import**

Enabling/Disabling WiFi Database Importing from Garmin Pilot:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) While viewing the 'Connext Setup' Screen, touch the **Import Functions** Tab**.**

3) Touch the **Enable** Button to enable (green annunciator) WiFi Database Import from Garmin Pilot (see previous figure).

Enabling/disabling automatic reconnection of a specific paired device:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) While viewing the 'Connext Setup' Screen, touch the **Paired Devices** Tab.

3) Touch the **Enable** Button to enable (green annunciator) auto reconnect to the desired paired device (see following figure).

Figure 8-167 Bluetooth Device Info.

Removing a specific paired device from the list of paired devices:

1) From Home, touch **Utilities > Setup > Wireless Setup > Connext.**

2) While viewing the 'Connext Setup' Screen, touch **Paired Devices** Tab.

3) Touch the Bluetooth device name to be removed.

4) A confirmation screen is displayed asking to remove the paired Bluetooth device.

5) Touch **OK** to remove the device from the list of paired devices (see previous figure).

8.8 WIFI CONNECTIONS (OPTIONAL)

WiFi connections are used for transferring maintenance data to the aircraft manufacturer. The system can connect to an IEEE 802.11g compatible network provided the aircraft is on the ground and located within range of a network. The system is capable of WEP64, WEP128, WPA-PSK, and WPA2-PSK encryption formats. WPA-Enterprise and WPA2-Enterprise are not supported. Connections that require web proxies, captive portals, or other elements that require user credentials (e.g., a username and password, a redemption code, or access code) are not supported. Also such actions that require accepting a user agreement, are not supported.

Connecting to a WiFi network:

1) From Home, touch **Utilities** > **Setup** > **Wireless Setup > WiFi Setup**.

2) A list of available WiFi networks is displayed. If necessary, scroll the displayed list of networks to find the desired network. If a specific network is expected to be present in the list, but is not displayed, try rescanning networks by performing the following steps:

   a) Touch the **WiFi Options** Button.

   b) Touch the **Rescan** Button.

Figure 8-168 WiFi Networks Available for Connection

Figure 8-169 Rescan Networks

3) Touch the network to be connected. In the following figure, the 'DemoNetwork1' network is selected. A confirmation screen is displayed.

Figure 8-170 Confirm Network Connection

Figure 8-171 Confirm Favorite Selection

4) Touch the **OK** Button.

> If there is not an airport already associated with this network, the system will ask if an airport should be associated with this network. Answer **Yes** to associate the closest airport to the current position to the network, or **No** to not associate an airport.

5) The system now asks if it is desired to make the connected network a favorite network.

6) Touch the **OK** Button to place the network in the Favorites List, or touch the **Cancel** Button to connect to select the network without making it a favorite network. Networks shown in the Available Networks List which have been designated as a favorite network are indicated by a star. Connected networks are indicated by a green antenna symbol.

Figure 8-172 Favorite Network Indication

Figure 8-173 Connected Network Indication

Disconnecting a WiFi network:

1) From Home, touch **Utilities** > **Setup** > **Wireless Setup > WiFi Setup**.

2) Touch the **WiFi Options** Button.

3) Touch the **Disconnect** Button.

Making changes to a favorite network:

1) From Home, touch **Utilities** > **Setup** > **Wireless Setup > WiFi Setup**.

2) Touch the **Favorites** Tab to display the favorite networks list.

3) Touch the network to which changes will be made. The 'Network Options' Panel is displayed.

Figure 8-174 Favorite Networks List

Figure 8-175 Network Options

4) Touch the **Auto Connect** Button, to enable (green annunciator) an automatic connection to this network whenever the aircraft is on the ground and in range of the network.

5) Touch the **Edit** Button to edit network details as seen in the following figure.

Figure 8-176 'Edit WiFi Network' Page

6) Touch the desired parameter and make edits as required.

7) When finished making desired changes, touch the **Save** Button.

8.9 SIRIUSXM SATELLITE RADIO (OPTIONAL)

> **NOTE:** *Refer to the Hazard Avoidance Section for information and activation of SiriusXM Weather Products.*

The SiriusXM Satellite Radio entertainment feature of the SiriusXM Datalink Receiver (GDL 69A) provides audio entertainment for passengers and crew. The SiriusXM Datalink Receiver can receive SiriusXM Satellite Radio entertainment services at any altitude throughout the Continental United States.

SiriusXM Satellite Radio offers a variety of radio programming over long distances without having to constantly search for new stations. Based on signals from satellites, coverage far exceeds land-based transmissions. SiriusXM Satellite Radio services are subscription-based. For more information on specific service packages, visit www.siriusxm.com.

For added convenience, when paired with a wireless transceiver (FS 510), SiriusXM audio can be remotely controlled using a compatible iOS or Android device running the Garmin Pilot App. Additional information is available at flygarmin.com.

ACTIVATING SIRIUSXM SATELLITE SERVICES

The SiriusXM Radio services are activated by first establishing an account with SiriusXM Satellite Radio. The Audio Radio ID and/or Data Radio ID must be provided to SiriusXM Satellite Radio to activate the entertainment subscription.

SiriusXM Satellite Radio uses the coded radio ID to send an activation signal that, when received by the SiriusXM Datalink Receiver, allows it to play entertainment programming.

These radio IDs are located:

- On the label on the back of the Datalink Receiver.
- On the 'SiriusXM Info' Screen on the Touchscreen Controller (see following figure).

Contact the installer if the radio ID cannot be located.

Establishing a SiriusXM Satellite Radio account:

1) From Home, touch **Utilities > Setup** > **SiriusXM Info**.

2) Note the Audio Radio ID and/or Data Radio ID as seen in the following figure.

3) Contact SiriusXM Satellite Radio. Follow the instructions provided by SiriusXM Satellite Radio services.

Figure 8-177 'SiriusXM Info' Display

> **NOTE:** *The **LOCK** Button on the 'SiriusXM Info' Screen is used to save GDL 69A SXM activation data when the SiriusXM services are initially set up. It is not used during normal SiriusXM Radio operation, but there should be no adverse effects if inadvertently selected during flight.*

Activating SiriusXM satellite services:

1) After contacting SiriusXM in the above procedure, from Home, touch **Utilities > Setup** > **SiriusXM Info**.

2) Verify the Data Radio and/or Audio Radio show a signal strength, indicating the system is communicating with the satellite.

3) Touch the **Start Activation** Button in the 'Activation' Field.

Figure 8-178 Activating Radios

4) Touch the **LOCK Activation** Button in the 'Activation' Field as seen in the following figure. The system is now activated and ready for use.

Figure 8-179 Locking Activation Settings

USING SIRIUSXM RADIO

The 'Music' Screen provides information and control of the audio entertainment features of the SiriusXM Satellite Radio. Cabin audio entertainment is a separate system and is not controlled through the Garmin System.

Figure 8-180 SiriusXM Satellite Radio Controls

SELECTING CHANNELS

The 'Channel' Field on the 'Music' Screen shows the available channels for the selected audio entertainment category. The 'Now Playing' Field shows information for the currently active channel.

Selecting a channel from the channel list:

1) From Home, touch **Services > Music** to access the 'Music' Screen as in the previous figure.

2) Touch the desired channel in the channel list. The selected channel is now shown in the 'Now Playing' Field.

Selecting a channel directly:

1) From Home, touch **Services > Music** > **Channel**.

2) The numeric keypad is displayed. Enter the desired channel number.

3) Press the **Enter** Button. The selected channel is now shown in the 'Now Playing' Field.

ENTERTAINMENT CATEGORIES

The 'Category' Field on the 'Music' Screen shows the currently selected entertainment category. Categories of audio entertainment (e.g., jazz, rock, talk, news, sports, etc.) can be selected to list the available channels for a type of music or other contents.

Selecting a category:

1) From Home, touch **Services > Music** > **Category**.

2) The list of categories is displayed as shown in the following figure.
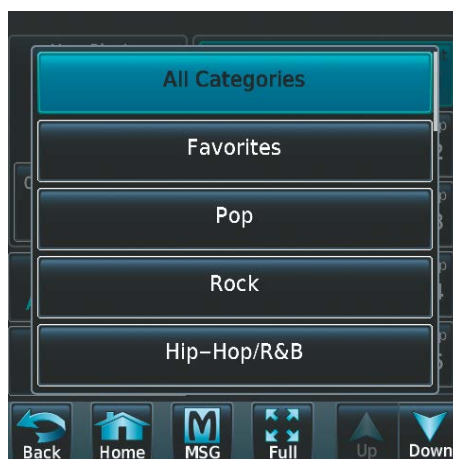
Figure 8-181 Channel Categories

3) Scroll to view the available categories.

4) Touch the desired category to select. The selected category is displayed on the **Category** Button and the channel list displays channels available for the selected category.

FAVORITES

Channels can be saved to a list of favorites and recalled for listening later.

Saving a channel to favorites list:

1) From Home, touch **Services > Music** to access the 'Music' Screen.

2) Select a desired channel as the 'Now Playing' Channel.

3) Touch the **Favorite** Annunciator Button. The current channel is placed in the favorites list. Note, a green annunciator indicates a favorite channel is 'Now Playing.'

Selecting a favorite channel for listening:

1) From Home, touch **Services > Music** > **Category**.

2) The list of categories is displayed as shown in the previous figure.

3) If necessary, scroll to view the **Favorites** Button.

4) Touch the **Favorites** Button to view the 'Favorites' Channel List.

5) Touch the desired channel in the list. The channel is now displayed in the 'Now Playing' Field.

ADJUSTING VOLUME

Pilot SiriusXM audio volume is shown in the 'Music Volume' Field (see following figure) as a percentage of full volume. Volume can be muted manually, or muting may be initiated automatically when other audio, such as radio, intercom, or aural alerts, is present. Entertainment audio adjustment may also be accessed by touching the **Audio & Radios** Button on the Touchscreen Controller, then scrolling to display the **SAT Music** Button.

Adjusting SiriusXM pilot volume:

1) From Home, touch **Services > Music** > **Volume**.

2) The **Volume** Slider is displayed as shown in the following figure.

3) Touch and drag the slider to the right or left to adjust the volume. Dragging to the right increases volume. Dragging to the left to decrease the volume.

Or:

Turn the **Volume** Knob on the Touchscreen Controller.

Figure 8-182 Adjusting Volume

Muting or unmuting the volume:

1) From Home, touch **Services > Music** > **Volume**.

2) Touch the **Music** Annunciator Button to mute or unmute the volume. Muted volume is indicated by a gray annunciator. Unmuted volume is indicated by a green annunciator.

3) Touch the **Back** Button to return to the 'Music' Screen. When the volume is muted, 'Muted' is displayed in the 'Music Volume' Field.

AUTOMATIC MUSIC MUTING

Cockpit music is automatically muted when power is applied to the system. Music may be unmuted by the pilot or copilot at any time, but the system will again mute cockpit music when any of the following occur:

» Aircraft is on the ground and accelerates to greater than 40 KIAS

» Aircraft descends below 10,000' MSL or 5,000' AGL

» Aircraft decelerates to less than 135 KIAS

» Aircraft enters an unusual pitch or roll attitude sufficient to cause PFD display decluttering

» A flight display enters reversionary mode

SOFT MUTING

When soft muting is enabled, the system will decrease music volume to a very low level (soft mute) when the following occur:

- **Push-To-Talk** Button is pressed for COM radio transmission
- COM radio audio is received
- Intercom is active
- L or R Engine N1 >70% and On Ground (i.e., takeoff condition)
- Stick shakers activated
- Engine fire
- Overspeed aural annunciation
- Gear warning aural annunciation
- TCAS RA or TA
- Cockpit music will always be soft muted during aural and voice alerts

Enabling/disabling soft mute settings:

1) From Home, touch **Services > Music** > **Volume** > **Mute Settings**.

2) Touch the **Intercom** Annunciator Button (see following figure) to select/deselect automatic soft muting of entertainment audio when intercom audio is present. This function is active when the annunciator is green.

Figure 8-183 Mute Settings

3) Touch the **Radio Inputs** Annunciator Button to allow automatic soft muting of entertainment audio when COM, NAV, ADF, etc. audio is present. This function is active when the annunciator is green.

4) Touch the **Back** Button to return to the 'Music' Screen.

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8.10 FLIGHT DATA LOGGING

> **NOTE:** *Some aircraft installations may not provide all aircraft/engine data capable of being logged by the system.*

> **NOTE:** *When a wireless transceiver (FS 510) is installed, Flight Data Logging parameters can be streamed to a mobile device running the Garmin Pilot application and the log file is available in Garmin Pilot.*

The Flight Data Logging feature will automatically store critical flight and engine data on a SD data card (up to 16GB) inserted into the top card slot of the MFD. Approximately 600 flight hours can be recorded for each 1GB of available space on the card. The data recorded by the Flight Data Logging feature is separate from data recorded by the Central Maintenance Computer (CMC).

Data is written to the SD card once each second while the MFD is powered on. All flight data logged on a specific date is stored in a file named in a format which includes the date, time, and nearest airport identifier. The file is created automatically each time the system is powered on, provided an SD card has been inserted. The .csv file may be viewed with Microsoft Excel® or other spreadsheet applications.

When a wireless transceiver (FS 510) is installed, logged data from the current flight plan and from past flights can be streamed via a Bluetooth connection. This requires a wireless transceiver to be inserted in the bottom slot of the GDU, and a the Garmin Pilot application running on a mobile device.

Once the data has been transferred to Garmin Pilot, the app can transfer the flight log to the pilot's flygarmin.com account for archiving and analysis once the mobile device connects to the internet.

> **NOTE:** *Past flights cannot be viewed directly on Garmin Pilot and need to be pushed to flygarmin.com to access them.*

The following is a list of data parameters the system is capable of logging.

- Date
- Time
- FMS altitude (MSL)
- FMS altitude (WGS84 datum)
- Baro-Corrected altitude (feet)
- Baro Correction (in/Hg)
- Indicated airspeed (kts)
- Vertical speed (fpm)
- FMS vertical speed (fpm)
- OAT (degrees C)
- True airspeed (knots)
- Pitch Attitude Angle (degrees)
- Roll Attitude Angle (degrees)
- Lateral and Vertical G Force (g)
- Ground Speed (kts)
- Ground Track (degrees magnetic)

- Latitude (degrees; geodetic; +North)
- Longitude (degrees; geodetic; +East)
- Magnetic Heading (degrees)
- HSI source
- Selected course
- Com1/Com2 frequency
- Nav1/Nav2 frequency
- CDI deflection
- VDI/GP/GS deflection
- Wind Direction (degrees)
- Wind Speed (knots)
- Active Waypoint Identifier
- Distance to next waypoint (nm)
- Bearing to next waypoint (degrees)
- Magnetic variation (degrees)
- Autopilot On/Off

- AFCS roll/pitch modes
- AFCS roll/pitch commands
- FMS fix
- FMS horizontal alert limit
- FMS vertical alert limit
- SBAS FMS horizontal protection level
- SBAS FMS vertical protection level
- Fuel Qty (lbs)
- Fuel Flow (pph)
- Fuel Temperature (deg. C)
- Oil Pressure (psi)
- Oil Temperature (deg. C)
- N1, N2 (percent)
- ITT (deg. C)

The file containing the recorded data will appear in the format shown in the following figure. This file can be imported into most computer spreadsheet applications.

Nearest Airport
Local Date   Local 24hr Time   (A blank will be inserted if no airport is found)

log_YYMMDD_HHMMSS_KIXD.csv

Figure 8-184 Flight Data Log File Format

8.11 ELECTRONIC CHECKLISTS

> **NOTE:** *The checklists shown in the following figures are examples only.*

> **NOTE:** *If utilizing multiple touchscreen controllers while completing a checklist(s), the touchscreen controllers will not be synchronized and will scroll independently.*

The Electronic Checklists feature allows the pilot to view and interact with aircraft checklists on the ground and during each phase of flight. Checklist contents are displayed on the PFD and the MFD. Checklist controls are provided on the Touchscreen Controller. The crew can upload a checklist file to the system by placing it on a Secure Digital (SD) card hosted in the top card slot or bottom slot of each GDU. Once the checklist file is synced across the system, the SD card with the checklist file is no longer required.

The following colors are used for checklist items:

- **Cyan** - Used for checklist titles and links to other checklists
- **White** - Item not checked
- **Green** - Item has been checked

- **Gray** - General notes
- **Amber** - Caution item
- **Red** - Warning item

CHECKSET TOOL

A checklist file can be created or edited by the pilot without involvement from Garmin. Garmin provides a CheckSet Tool which is used to generate and edit enhanced electronic checklist files. These files are saved in the .gcl format. Previous files in the .ace format should be converted to .gcl using the CheckSet Tool. Visit flygarmin.com to download the CheckSet Tool.

> **NOTE:** *Garmin does not provide a checklist file required for flight operation. The file is expected to be authored and certified by the OEM.*

Accessing and navigating checklists:

1) From Home, touch the **Checklist** Button. The checklist structure is displayed as shown in the following figure.

Figure 8-185 'Home' Screen
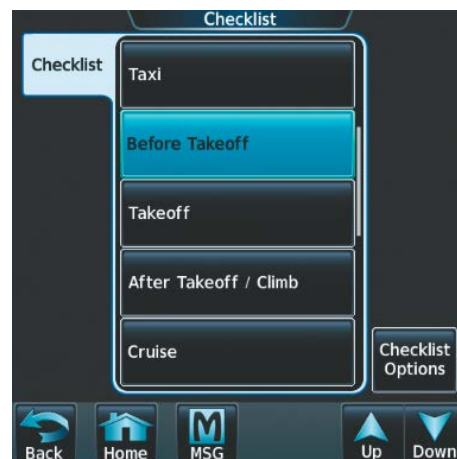
Figure 8-186 List of Checklists

2) Touch the desired checklist from the list. If necessary, scroll through the list to see all the available checklists for the selected group. In the previous figure, the **Before Takeoff** checklist is selected and is displayed in the previously selected display pane. The first checklist item is selected as indicated by the white text surrounded by a cyan box.
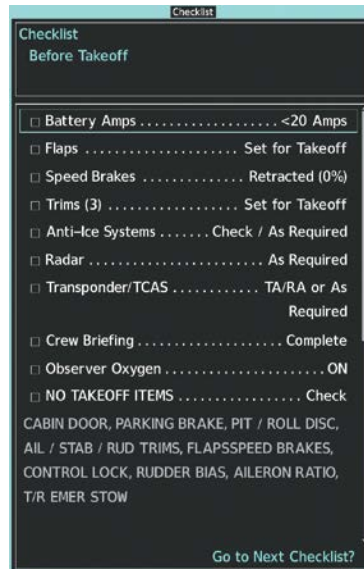
Figure 8-187 First Checklist Item Selected

3) Press the small right knob on the Touchscreen Controller to check the selected checklist item. The line item turns green and a checkmark is placed in the associated box as shown in the following figure. The next line item is automatically selected for checking.
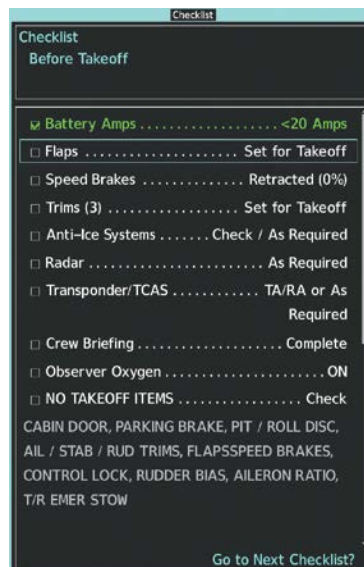
Figure 8-188 First Checklist Item Completed and Checked

Turn either of the right knobs on the Touchscreen Controller to scroll through the checklist and select the desired checklist item.

Selecting a checked item and pressing the small right knob on the Touchscreen Controller will return the item to the unchecked state.

4) When all checklist items have been checked, '*Checklist Finished*' is displayed in green text at the bottom left of the checklist window and 'Go to Next Checklist?' is highlighted as in the following figure. If 'Go to Next Checklist?' is selected prior to checking all the checklist items, '*Checklist Not Finished*' will be displayed in amber text.
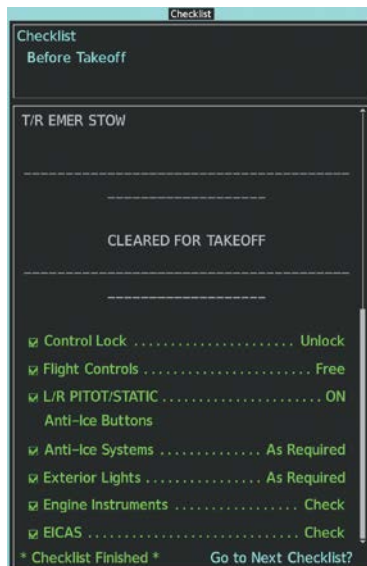
Figure 8-189 Checklist Finished

5) While the 'Go to Next Checklist?' text is highlighted, press the small right knob on the Touchscreen Controller to display the next checklist in the group or choose another by touching the desired checklist on the Touchscreen Controller.

Resetting a specific checklist:

1) From Home, touch **Checklist**.

2) Touch the desired checklist to reset. The **Before Start** checklist is selected in the following figure.

3) Touch the **Checklist Options** Button.

4) Touch the **Reset Checklist** Button as seen in the following figure.
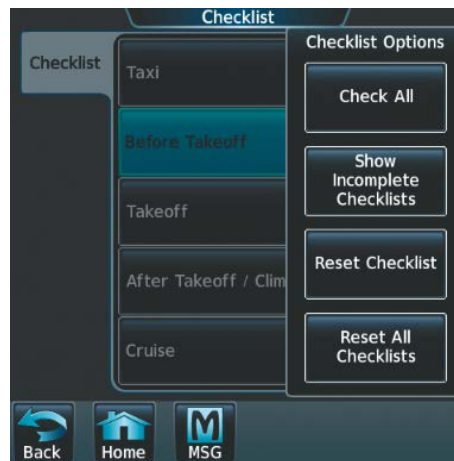
Figure 8-190 'Checklist Options' Pane

Resetting all checklists:

1) From Home, touch the **Checklist** Button.

2) Touch the **Checklist Options** Button.

3) Touch the **Reset All Checklists** Button as seen in the previous figure.

8.12 ELECTRONIC DOCUMENTS

The Electronic Document function allows viewing of electronic documents on the selected display pane. The system allows the display of electronic documents from two sources. These sources are Installed Documents and User Documents.

INSTALLED DOCUMENTS

'Installed' Documents are typically provided by the aircraft manufacturer. These documents are stored on the Supplemental Data Cards, along with the databases, located in the bottom SD Card slot of each display. Each Supplemental Data Card contains identical document files.

USER DOCUMENTS

User Documents are those loaded by the crew. User Documents must be in .pdf format and reside on an SD Card no larger than 16GB. The Maximum document file size is 1.5GB. The maximum number of pages per document is limited to 9,999. Pages that contain large and/or numerous images may exceed RAM memory limits and therefore may not be displayed correctly or may not be displayed at all.

An SD card must be inserted into the top card slot of each display on which it is desired to view the user documents. Each display can only access electronic documents on the SD Cards that are inserted in that display. User Documents are unique to the display on which they are viewed.

SUPPORTED PDF FEATURES

User Documents must be in .pdf format. The following .pdf features are not supported. If a file contains any of these features, the system will ignore the feature and display the document.

» Embedded files (attachments)

» Alternate images (using a different image for display and printing)

» Page labels (alternate page numbers; e.g., i, ii, iii, iv for Table of Contents)

» Additional annotations, including file attachment annotation, sound annotation, movie annotation, widget annotation, and trap network annotation

» Digital signatures

» JavaScript

» Logical structure (structuring documents into chapters, paragraphs, headings, footnotes)

» Web capture information (annotations for search engines)

» Prepress support (annotations for newspapers, etc.)

SD CARD FILE STRUCTURE FOR USER DOCUMENTS

User document files must reside on the SD card in a directory named "Documents." The list of available User Documents is limited to 100 documents and are shown in alphabetical order based on filename.

VIEWING ELECTRONIC DOCUMENTS

Selecting a document:

1) From Home, touch **Utilities > Documents**. The 'Document Viewer' Screen is now displayed as in the following figure.

Figure 8-191 Electronic Document Viewer
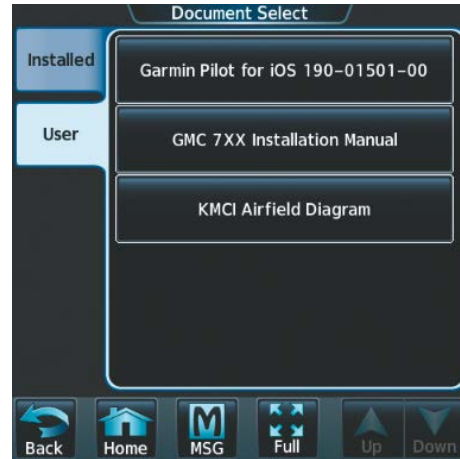
Figure 8-192 Document Selection

2)   Touch the **Selected Document** Button.

3)   Touch the **Installed** or **User** Tab to select the desired document source. In this example, User documents are selected.

4)   Touch the desired document button. The selected document name is displayed in the **Selected Document** Button. The document is displayed in the selected pane.

Figure 8-193 Selected Document Indicated
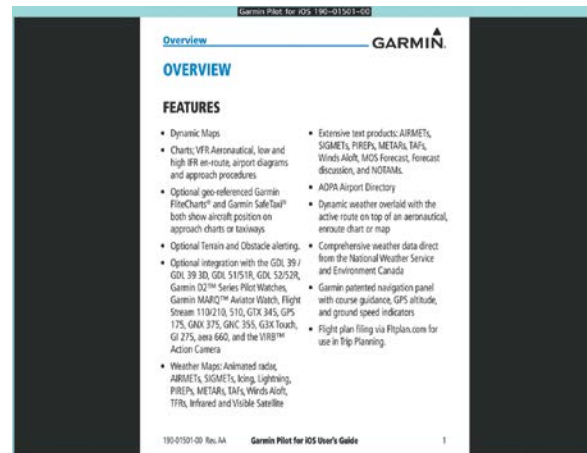
Figure 8-194 Document Viewed on Selected Display Pane

Changing Document Viewer options:

1)   From Home, touch **Utilities > Documents > Options**. The 'Document Viewer Options' Screen is displayed.

2)   Touch the **Document Info** Button to view information pertaining to the document, such as files size and creation date.

Figure 8-195 Document Viewer Options

Figure 8-196 Document Information

3) After touching the **Back** Button, touch the **Fit Page** Button to view the complete page in the selected pane.

4) Touch the **Fit Width** Button to enlarge the displayed page to fill the width of the selected pane.

5) Touching the **Rotate Page** buttons will rotate the displayed page 90 degrees to the right or left (depending on button touched) within the selected pane. Each subsequent touch will rotate the page another 90 degrees.

6) Touch the **Brightness** Slider to adjust the brightness of the displayed page.

Or:

Touch the **+** Button to increase brightness, or the **-** Button to decrease brightness. Each touch increases or decreases the brightness by approximately five percent.

Browsing the document:

1) After selecting the desired document, touch the **Next Page** and **Prev Page** buttons to increment and decrement one page with each touch.

2) The page select button (see following figure) shows the number of pages contained in the document and the page currently being displayed. Touch the page select button to jump to a specific page number. The 'Enter Page Number' Screen is displayed, as in the following figure.
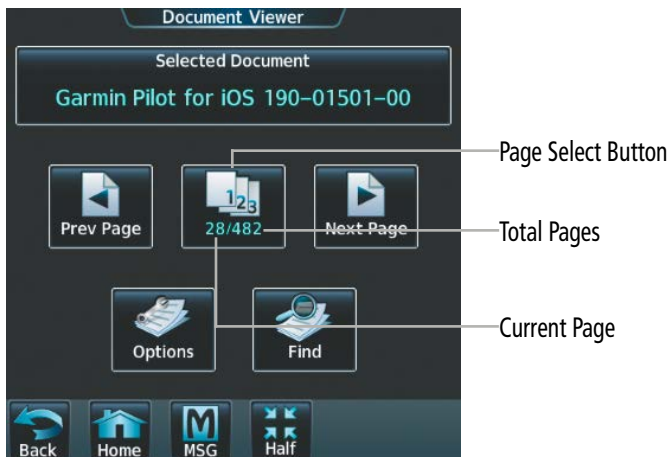
Figure 8-197 Document Browsing Options

Figure 8-198 Enter Document Page Number

3) Touch the **Find** Button to display the 'Document Viewer Find' Screen.

Figure 8-199 Table of Contents
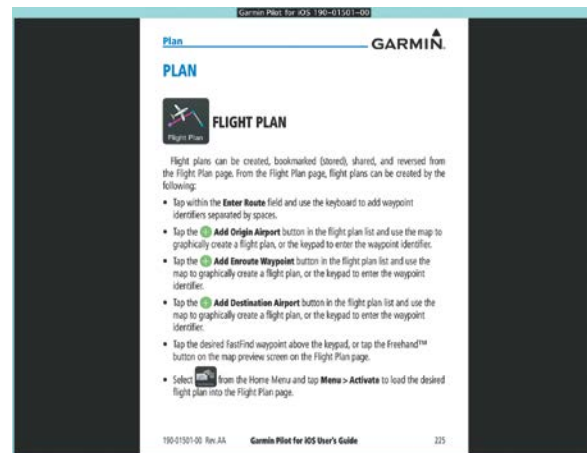
Figure 8-200 Flight Plan Section Displayed

4) If necessary, touch the **Table of Contents** Tab to display the document Table of Contents.

5) Touch **[+]** to expand a topic. Touch **[–]** to return to the collapsed view of the topic.

6) Touch the desired topic to jump to that portion of the document. In this example, Flight Instruments is selected and the Flight Instruments section is displayed.

Zooming in and out on a document page:

1) With the document displayed, press the **Joystick**. The 'Document Pointer Options' Screen is now displayed on the Touchscreen Controller. Also, a flashing pointer is shown on the document display.

2) Turn the **Joystick**, or use the pinch-and-zoom feature on the Touchpad to zoom in or zoom out on the document page display.

3) Move the **Joystick**, or move a finger across the Touchpad to move the pointer within the document. When the pointer reaches the edge of the display, the display will scroll to show more the document page.
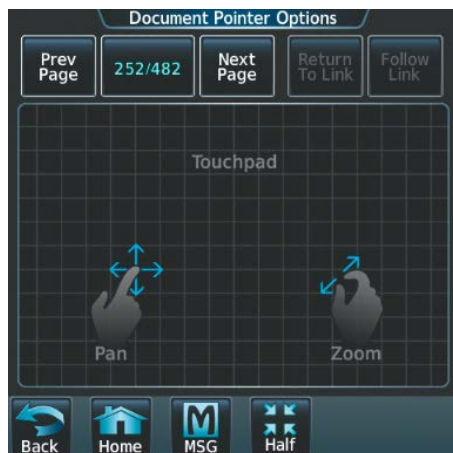
Figure 8-201 Touchpad

Figure 8-202 Page Zoom

Navigating links within the document:

1) With the document displayed, press the **Joystick**. The 'Document Pointer Options' Screen is now displayed on the Touchscreen Controller. Also, a flashing pointer is shown on the document display.

2) Move the **Joystick**, or move a finger across the Touchpad to move the pointer to the desired document link.
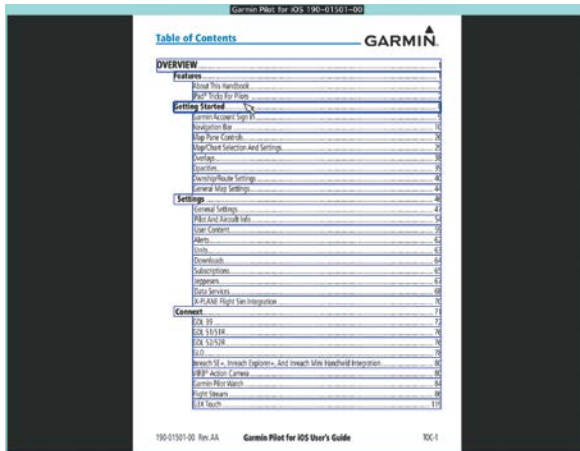
Figure 8-203 Link Selected
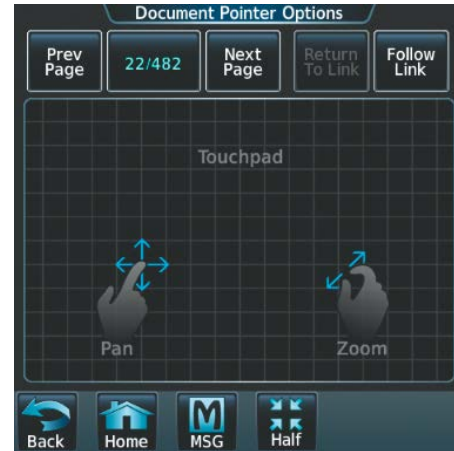
Figure 8-204 Follow Link

3) With the link highlighted, touch the **Follow Link** Button. The selected link destination is now displayed in the selected pane.

Figure 8-205 Link Displayed
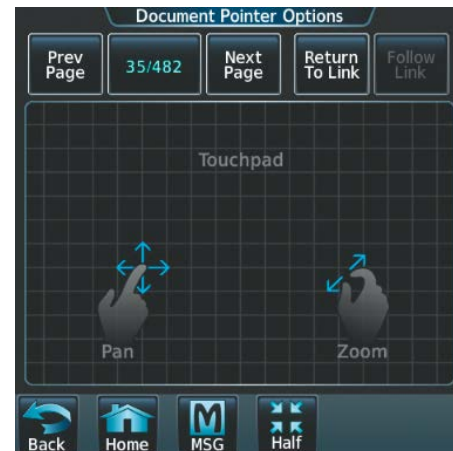
Figure 8-206 Return To Link

4) Touch the **Return To Link** Button to return to the link origin.

5) Touch the **Back** Button or press the **Joystick** to remove the pointer from the display.

Creating bookmarks in the document:

1) While viewing the page to bookmark, touch the **Find** Button on the appropriate Touchscreen Controller.

2) Touch the **Bookmark** Tab to display the 'Bookmark' Window.
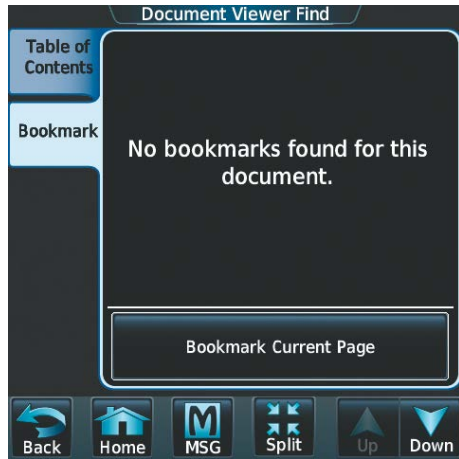
Figure 8-207 Select Bookmark Tab

Figure 8-208 Enter Bookmark Name

3) Touch the **Bookmark Current Page** Button. The 'Enter Bookmark Name' Screen is displayed.

4) Touch the **Enter** Button. A confirmation screen is displayed.
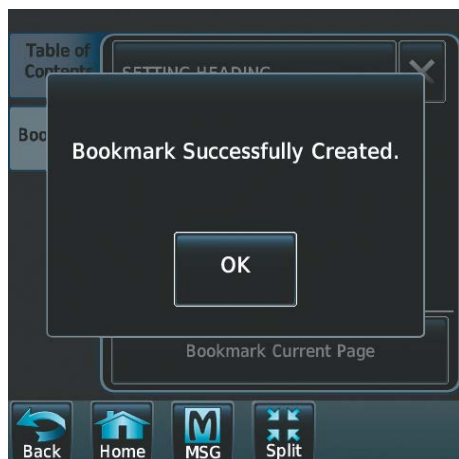
Figure 8-209 Create Bookmark
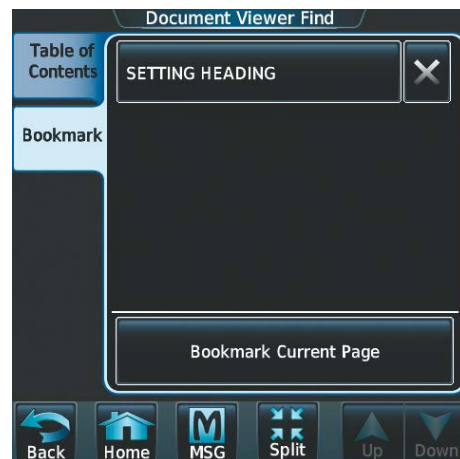
Figure 8-210 Bookmark Created

5) Touch the **OK** Button. The newly created bookmark is displayed.

Deleting document bookmarks:

1) With the desired document displayed, touch the **Find** Button to display the 'Document Viewer Find' Screen.

2) Touch the **Bookmark** Tab to display the 'Bookmark' Window.

3) Touch the **X** Button next to the bookmark to be deleted.
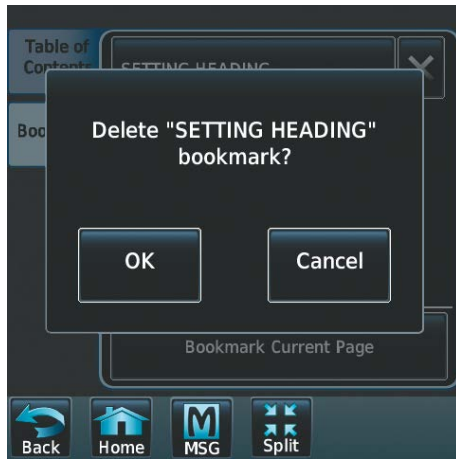
Figure 8-211 Delete Bookmark
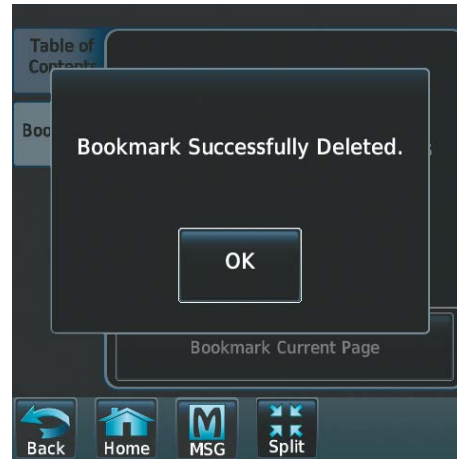
Figure 8-212 Bookmark Deleted

4) Touch the **OK** Button on the confirmation screen.

5) Again, touch the **OK** Button.

8.13 STABILIZED APPROACH (OPTIONAL)

The Stabilized Approach functionality provides aural annunciations to notify the flight crew of unstable conditions during an approach. Stabilized Approach uses airframe and position data including aircraft location, heading, track, groundspeed and altitude in order to function.

The Stabilized Approach feature is intended to monitor certain parameters to ensure the aircraft is operated in a "stabilized approach" envelope. Typically, the copilot would monitor these parameters and alert the pilot flying that stabilized approach criteria are not met, which may necessitate a go-around. This feature automates this monitoring and provides real-time guidance to crew members that corrections need to be made to bring the aircraft back into the stabilized approach envelope.

ALERT TYPES

> **NOTE:** *All visual Stabilized Approach alerts have been disabled so as not to conflict with existing TAWS related visual annunciations.*

APPROACH SPEED ALERT

> **NOTE:** *If V$_{REF}$ is not defined, the system will use the green circle reference to trigger the speed alert.*

This alert indicates airspeed is less/greater than the V$_{REF}$ Approach Speed (+20 kts / -3 kts). This is to allow for adding a "gust factor" to the approach speed of up to 20 knots, and to allow for a reduction in aircraft speed of 3 knots when trying to fly V$_{REF}$. This alert is applicable to IFR and VFR approaches and the aural annunciation is "Speed."

FLAPS NOT IN LANDING CONFIGURATION ALERT

This alert indicates the flaps are not in a landing configuration. This alert is applicable to IFR and VFR approaches and the aural annunciation is "Flaps." For VFR approaches, the annunciation is a Warning; for IFR approaches, the annunciation is a Caution.

GEAR NOT IN LANDING CONFIGURATION ALERT

This alert indicates the gear is not in a landing configuration. This alert is only applicable to the caution zone. The gear alert for the warning zone is handled by TAWS.

LATERAL DEVIATION ALERT

This alert is applicable to IFR approaches and is set when the magnitude of the lateral course deviation is greater than 1 dot. The aural annunciation is "Course."

VERTICAL DEVIATION ALERT

This alert is applicable to IFR approaches and is set when the magnitude of the vertical deviation is greater than 1 dot. The aural annunciation is "Glidepath" or "Glideslope" as applicable to the type of approach being flown.

DESCENT SPEED ALERT

The VFR Warning is triggered when the vertical velocity is greater than 1,000 fpm. The IFR alert is triggered at +500 FPM above the typical approach sink rate based on flight path angle and true airspeed.

ALERT PRIORITIZATION

If more than one alert condition occurs at the same time, only one annunciation will be heard in the priority listed below and is dependant upon whether the alert is a Warning or a Caution:

- **For a Caution:**

  » Gear

  » Sink Rate

  » Glidepath

  » Glideslope

  » Course

  » Flaps

  » Speed

- **For a Warning:**

  » Sink Rate

  » Glidepath

  » Glideslope

  » Course

  » Flaps

  » Speed

> ✓ **NOTE:** *Upon system restart, all alerts are made available regardless of previous in-flight configuration.*

Inhibiting all stabilized approach alerts:

1) From Home, touch **Utilities > Setup > Avionics Settings.**

2) Touch the **Alerts** Tab.

3) Touch the **Stabilized APPR Inhibit** Button to enable or disable Stabilized Approach Alerts.

Figure 8-213 Stabilized Approach Alerts Inhibited

RUNWAY ALERTING ZONES

Stabilized Approach caution alerts will be issued only while the aircraft is situated vertically within the Vertical Alerting Zone and within the Horizontal Alerting Zone.

VERTICAL ALERTING ZONE

The Vertical Alerting Zone accounts for IFR and VFR conditions with respective alert zones. Vertical IFR Caution Approach Alerts will be issued between the altitudes of 1,000 ft AGL and 500 ft AGL. Vertical IFR Warning Approach Alerts will be issued between the altitudes of 500 ft AGL and 100 ft AGL. An active instrument approach procedure must be loaded to the flight plan for the system to issue IFR Stabilized Approach Alerts.

Figure 8-214 Stabilized Approach IFR Alerting Zone

Vertical VFR Warning Approach Alerts will be issued between 500 ft AGL and 100 ft AGL. There is no caution alerting zone for the VFR vertical envelope.

Figure 8-215 Stabilized Approach VFR Alerting Zone

HORIZONTAL RUNWAY ALERTING ZONE

The Stabilized Approach function considers the aircraft to be within a runway alerting zone when the following conditions are met:

» A landing runway has been established by the flight plan (see the Flight Management Section for details).

» The aircraft is horizontally situated within the Horizontal Runway Alerting Zone limits (see the following figure).
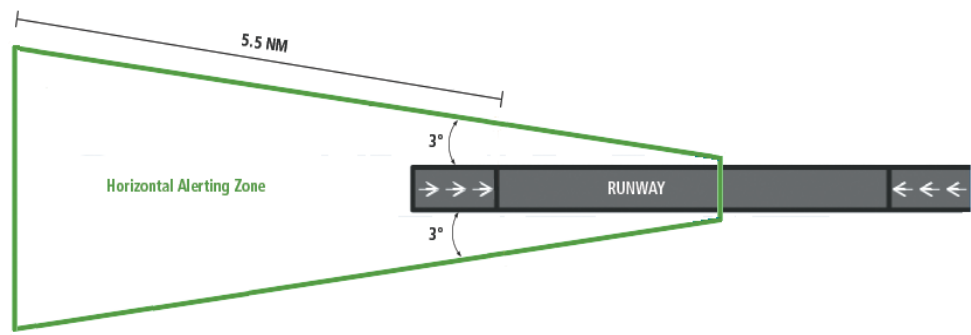
Figure 8-216 Stabilized Approach IFR/VFR Horizontal Alerting Zone

STABILIZED APPROACH CLASSIFICATIONS

The Stabilized Approach function classifies the various aviation database approach types as an IFR Approach or a VFR Approach as outlined in the following table.

Approach Type	Stabilized Approach Classification
ILS, LOC, GPS, BC, RNAV, VOR, VOR DME, SDF, LDA, NDB[1]	IFR
Visual, Invalid, or Circling	VFR

[1] *When not a circling approach*

Table 8-5 Stabilized Approach Alert Classifications

8.14 DATABASE MANAGEMENT

⚠️ *CAUTION: Never disconnect power to the system when loading a database. Power interruption during the database loading process could result in maintenance being required to reboot the system.*

✓ *NOTE: If the pilot/operator wants or needs to adjust the database, contact Garmin Product Support.*

✓ *NOTE: Garmin requests the flight crew report any observed discrepancies related to database information. These discrepancies could come in the form of an incorrect procedure, incorrectly identified terrain, obstacles and fixes, or any other displayed item used for navigation or communication in the air or on the ground. Go to flygarmin.com and select 'Aviation Data Error Report.'*

✓ *NOTE: The navigation databases used in Garmin navigation systems contain Special Procedures. Prior to flying these procedures, pilots must have specific FAA authorization, training, and possession of the corresponding current, and legitimately-sourced chart (e.g., approach plate, etc.). Inclusion of the Special Procedure in the navigation database DOES NOT imply specific FAA authorization to fly the procedure.*

✓ *NOTE: The pilot/operator must review and be familiar with Garmin's database exclusion list as discussed in SAIB CE-14-04 to determine what data may be incomplete. The database exclusion list can be viewed at flygarmin.com by selecting 'Database Exclusions List.'*

CYCLE NUMBER AND REVISION

Databases that may be available include Terrain, Obstacle, Navigation, Basemap, SafeTaxi, Checklist, Airport Directory, IFR/VFR Charts, ChartView, and FliteCharts. Data is revised and expiration dates vary. The 'Avionics Status' Page displays the current status of the databases. As an example, see the table below for the various displays and the definition of each. The expiration date and disables date varies for each database.

The 'Effective' date is the beginning date for this database cycle. The 'Effective' date appears in amber when the current date is before the effective date. The 'Expires' date is the revision date for the next database cycle. The 'Expires' date appears in amber when expired. 'Not Available' indicates the database is not available on the database card or no database card is inserted.

An expired SafeTaxi and Airport Directory database is not disabled and will continue to function indefinitely.

Charts are still viewable during a period that extends from the cycle expiration date to the disables date. ChartView is disabled 70 days after the expiration date and is no longer available for viewing. Also, the **Charts** Button on the home screen appears subdued and is disabled until a new issue of ChartView is installed.

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Database Condition	SafeTaxi	FliteCharts	Airport Directory
Current date is before Effective Date	**Safetaxi** Region US / Version 2.71 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / GARMIN LTD. AND ITS SUBSIDIARIES	Not Applicable	**Airport Directory** Region WORLDWIDE / Version 1.01 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / Copyright YYYY AC–U–KWIK® – Penton Media, Inc
Database is current	**Safetaxi** Region US / Version 2.71 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / GARMIN LTD. AND ITS SUBSIDIARIES	**Chart** Chart FliteCharts / Region US / Cycle YYII / Expires DD–MMM–YYYY / Disables DD–MMM–YYYY / Copyright YYYY Garmin Ltd. or its subsidiaries	**Airport Directory** Region WORLDWIDE / Version 1.01 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / Copyright YYYY AC–U–KWIK® – Penton Media, Inc
Database has expired	**Safetaxi** Region US / Version 2.71 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / GARMIN LTD. AND ITS SUBSIDIARIES	**Chart** Chart FliteCharts / Region US / Cycle YYII / Expires DD–MMM–YYYY / Disables DD–MMM–YYYY / Copyright YYYY Garmin Ltd. or its subsidiaries	**Airport Directory** Region WORLDWIDE / Version 1.01 / Cycle YYTI / Effective DD–MMM–YYYY / Expires DD–MMM–YYYY / Copyright YYYY AC–U–KWIK® – Penton Media, Inc
Database is disabled	Not Applicable	**Chart** Chart FliteCharts / Region US / Cycle YYII / Expires DD–MMM–YYYY / Disables DD–MMM–YYYY / Copyright YYYY Garmin Ltd. or its subsidiaries	Not Applicable
Database is not installed	**Safetaxi** Region NOT AVAILABLE / Version / Cycle / Effective / Expires / GARMIN LTD. AND ITS SUBSIDIARIES	**Chart** Chart NOT AVAILABLE / Region / Cycle / Expires / Disables / Copyright	**Airport Directory** Region NOT AVAILABLE / Version / Cycle / Effective / Expires / Copyright YYYY AC–U–KWIK® – Penton Media, Inc

Table 8-6 Database Status Examples

Viewing Database Information:

1) From Home, touch **Utilities > Setup** > **Avionics Status**.

2) Touch the **Database** Tab.

3) Touch the button corresponding to the display **(MFD, L PFD, R PFD, L GTC,** or **R GTC)** for which the database information will be viewed.

4) Scroll to display the appropriate database information.

Refer to the Database Management Section in Appendix 'B' for instructions on revising databases. Database cycle numbers are in a format such as YYTI or YYII, which are deciphered as follows:

YYTI

- » YY – Indicates the last two digits of the year (e.g., 21 represents 2021)
- » T – Indicates the database type (e.g., 'S' is for SafeTaxi, 'D' is for Airport Directory, etc., as seen in the following table)
- » I – Indicates the numerical issue of the database for the year (e.g., 05 is the fifth issue of the year)

YYII

- » YY – Indicates the last two digits of the year (e.g., 21 represents 2021)
- » II – Indicates the numerical issue of the database for the year (e.g., 05 is the fifth issue of the year)

Refer to Updating Garmin Databases in the Appendices for instructions on revising databases.

Database	Database Cycle Number Format	Revision Cycle
Navigation	YYII	28 days
Basemap	YYMI	Not Applicable
Terrain	YYTI	Not Applicable
Obstacle	YYBI	56 days
SafeTaxi	YYSI	56 days
Airport Directory	YYDI	56 days
ChartView	YYII	14 days

Table 8-7 Database Cycle Number Format and Revision Cycle

GARMIN.

8.15 ABNORMAL OPERATION

DATALINK TROUBLESHOOTING

For troubleshooting purposes, check the LRU Information Box on the 'Avionics Status' Page for Iridium Receiver (GSR 56), the WiFi Datalink (GDL 59), or the XM Datalink Receiver (GDL 69) status, serial number, and software version number. If a failure has been detected in the GDL 69 the status is marked with a red X.

Viewing the 'Avionics Status' Screen:

1) From Home, touch **Utilities > Setup** > **Avionics Status**.

2) Touch the **LRU Info** Tab.

3) Scroll to display the appropriate LRU information.

4) Touch an LRU to view further information.
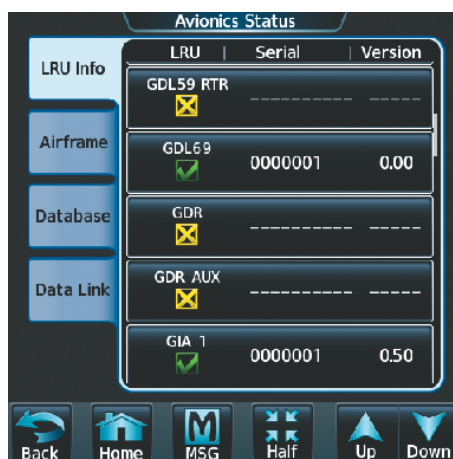
Figure 8-217 'Avionics Status' Screen

QUICK TROUBLESHOOTING

Some quick troubleshooting steps listed below can be performed to find the possible cause of a failure.

» Ensure the installed hardware has an active subscription or account (e.g., Iridium subscription, XM subscription)

» Perform a quick check of the circuit breakers to ensure that power is applied to the applicable hardware

» If a failure still exists, the following messages may provide insight as to the possible problem:

Message	Message Location	Description
CHECK ANTENNA	'XM Information' Screen (Touchscreen Controller)	Datalink Receiver antenna error; service required
UPDATING	'XM Information' Screen (Touchscreen Controller)	Datalink Receiver updating encryption code
NO SIGNAL	'XM Information' Screen (Touchscreen Controller) Weather Datalink Display (selected display pane)	Loss of signal; signal strength too low for receiver
LOADING	'Music' Screen (Touchscreen Controller)	Acquiring channel audio or information
OFF AIR	'Music' Screen (Touchscreen Controller)	Channel not in service
---	'Music' Screen (Touchscreen Controller)	Missing channel information
WEATHER DATA LINK FAILED	Weather Datalink Display (selected display pane)	No communication from Datalink Receiver within last 5 minutes
ACTIVATION REQUIRED	'XM Information' Screen (Touchscreen Controller) Weather Datalink Display (selected display pane)	SiriusXM subscription is not activated

Table 8-8 SiriusXM Datalink Receiver Messages

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ANNUNCIATIONS AND ALERTS

SYSTEM MESSAGE ANNUNCIATIONS

When the system issues a message, the **MSG** Button flashes on the Touchscreen Controllers and a similar annunciator icon flashes in the upper left corner of the PFDs to alert the pilot of a new message. The annunciator and button continue to flash until acknowledged by touching the **MSG** Button on either Touchscreen Controller, after which, the button no longer flashes and the annunciator on the PFD extinguishes. The number of active messages is shown on the **System Messages** Tab. Active messages are highlighted by a cyan box. When messages have become inactive, the cyan box is removed.

When an LRU or an LRU function fails, a large red or amber 'X' (depending on the LRU) is typically displayed on items associated with the failed data. The following section describes various system annunciations. Refer to the current version of the pertinent flight manual for additional information regarding pilot responses to these annunciations.

> **NOTE:** *Upon applying power to the system, certain windows remain invalid as the equipment begins to initialize. All windows should be operational within one minute of applying power. If any window continues to remain flagged, the system should be serviced by a Garmin-authorized repair facility.*
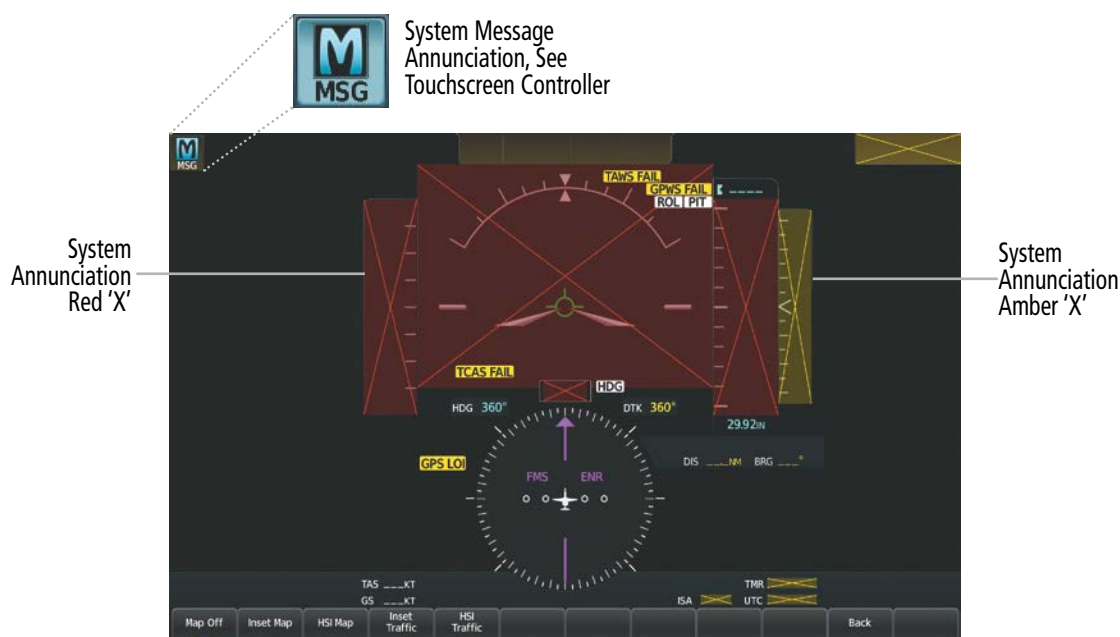
Figure A-1 System Annunciations (PFD)

Touch to View
System Messages
Screen
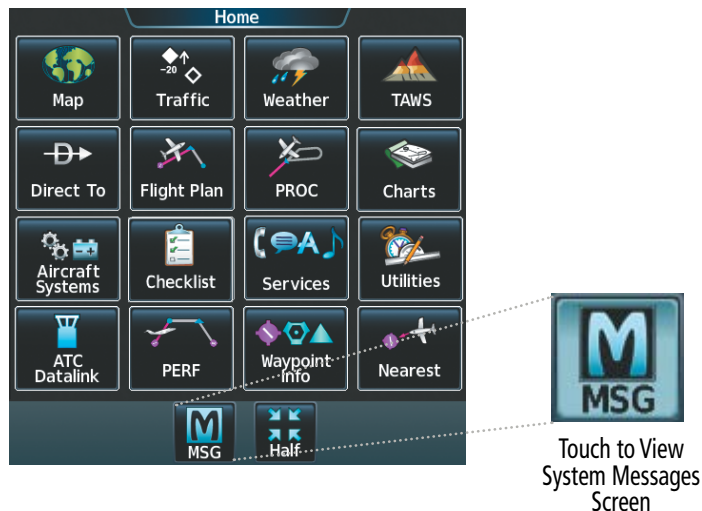
Figure A-2 System Messages Annunciation (Touchscreen Controller)

Figure A-3 System Messages Screen After MSG Button Touched (Touchscreen Controller)

AVIONICS FAULT SYSTEM MESSAGES

The 'Avionics Fault' amber CAS message will post when any number of the associated Avionics Fault system messages are displayed on the Touchscreen Controller 'Notifications' Screen. When any of these messages is active, the 'MSG' icon will not display on the PFD.

'Avionics Fault' CAS Message

Figure A-4 'Avionics Fault' Amber CAS Message

'Avionics Fault' System Messages
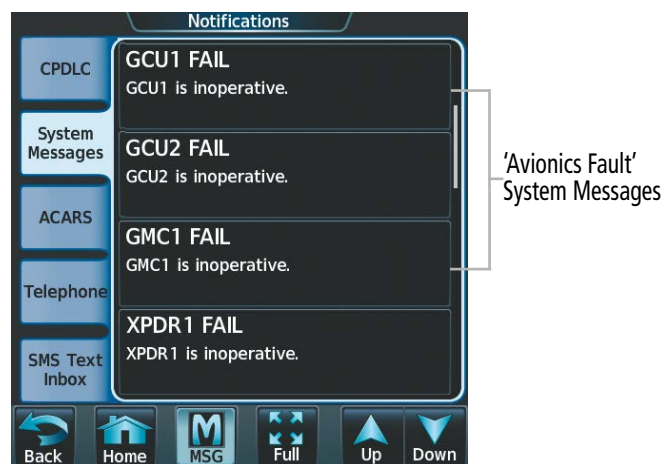
Figure A-5 'Avionics Fault' System Message Examples

SYSTEM MESSAGES

> **NOTE:** *This Section provides information regarding message advisories that may be displayed by the system. Knowledge of the aircraft, systems, flight conditions, and other existing operational priorities must be considered when responding to a message. Always use sound pilot judgment. The current version of the pertinent flight manual takes precedence over any conflicting guidance found in this section.*

This section describes various system messages. Certain messages are issued due to an LRU or LRU function failure. Such messages are normally accompanied by a corresponding red or amber 'X' annunciation as shown previously in the system annunciations section.

System Message	Comments
ABORT APR – Loss of GPS navigation. Abort approach.	Abort approach due to loss of GPS navigation. This message may also be displayed if the flight plan is deleted while an RNAV approach that requires SBAS is active.
ACARS CONFIG – ACARS config error. Config service req'd.	Indicates incorrect ACARS configuration of the IATA Airline Code associated with an ACARS AOC. Communication is halted. **
ACARS DISCONNECT – Loss of ACARS connectivity.	Loss of ACARS connectivity on all configured ACARS communication options. **
ACARS FAIL – ACARS data transmission inoperative.	Indicates loss of the MFD function, possibly detected at power-on prior to the MFD being ready to function. Communication is halted **
ACARS INVALID ATS UPLINK – FRMT error, use voice procedures.	Indicates that an ATS message has been sent to the aircraft that has invalid contents.
ACARS MSG MEM LIMIT – Oldest MSG will be deleted when MSG received.	Indicates that ACARS message memory limit has been reached and from this point on, the oldest message will be deleted with each new message stored.
ADC1 ALT EC – ADC1 altitude error correction is unavailable.	GDC1 is reporting the altitude error correction is unavailable.
ADC1 AS EC – ADC1 airspeed error correction is unavailable.	GDC1 is reporting the airspeed error correction is unavailable.
ADC1 SERVICE – ADC1 needs service. Return unit for repair.	A failure has been detected in the #1 GDC. The system should be serviced.
ADC2 ALT EC – ADC2 altitude error correction is unavailable.	GDC2 is reporting the altitude error correction is unavailable.
ADC2 AS EC – ADC2 airspeed error correction is unavailable.	GDC2 is reporting the airspeed error correction is unavailable.
ADC2 SERVICE – ADC2 needs service. Return unit for repair.	A failure has been detected in the #2 GDC. The system should be serviced.
AHRS MAG DB – AHRS magnetic model database version mismatch.	The #1 AHRS and #2 AHRS magnetic model database versions do not match.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
AHRS1 CONFIG – AHRS1 config error. Config service req'd.	AHRS configuration settings do not match those of backup configuration memory. The system should be serviced.
AHRS1 GPS – AHRS1 using backup GPS source.	The #1 AHRS is using the backup GPS path. Primary GPS path has failed. The system should be serviced when possible.
AHRS1 GPS – AHRS1 not receiving any GPS information.	The #1 AHRS is not receiving any or any useful GPS information. Check the current version of the pertinent flight manual for limitations. The system should be serviced.
AHRS1 GPS – AHRS1 not receiving backup GPS information.	The #1 AHRS is not receiving backup GPS information. The system should be serviced.
AHRS1 GPS – AHRS1 operating exclusively in no-GPS mode.	The #1 AHRS is operating exclusively in no-GPS mode. The system should be serviced.
AHRS1 SRVC – AHRS1 Magnetic-field model needs update.	The #1 AHRS earth magnetic field model is out of date. Update magnetic field model when practical.
AHRS1 TAS – AHRS1 not receiving airspeed.	The #1 AHRS is not receiving true airspeed from the air data computer. The AHRS relies on GPS information to augment the lack of airspeed. The system should be serviced.
AHRS2 CONFIG – AHRS2 config error. Config service req'd.	AHRS configuration settings do not match those of backup configuration memory. The system should be serviced.
AHRS2 GPS – AHRS2 using backup GPS source.	The #2 AHRS is using the backup GPS path. Primary GPS path has failed. The system should be serviced when possible.
AHRS2 GPS – AHRS2 not receiving any GPS information.	The #2 AHRS is not receiving any or any useful GPS information. Check AFMS limitations. The system should be serviced.
AHRS2 GPS – AHRS2 not receiving backup GPS information.	The #2 AHRS is not receiving backup GPS information. The system should be serviced.
AHRS2 GPS – AHRS2 operating exclusively in no-GPS mode.	The #2 AHRS is operating exclusively in no-GPS mode. The system should be serviced.
AHRS2 SRVC – AHRS1 Magnetic-field model needs update.	The #2 AHRS earth magnetic field model is out of date. Update magnetic field model when practical.
AHRS2 TAS – AHRS2 not receiving airspeed.	The #2 AHRS is not receiving true airspeed from the air data computer. The AHRS relies on GPS information to augment the lack of airspeed. The system should be serviced.
APR ADVISORY – GPS VNAV not available. Using Baro VNAV.	SBAS not available. The system is calculating the VNAV profile using BARO VNAV.
APR ADVISORY – SBAS VNAV not available. Using BARO VNAV.	SBAS VNAV not available. The system is calculating the VNAV profile using BARO VNAV.
APR DWNGRADE – Apr downgraded.	Vertical guidance generated by SBAS is unavailable. Use Baro LNAV/VNAV or LNAV minimums.
APR INACTV – Approach is not active.	The system notifies the pilot the loaded approach is not active. Activate approach when required.
ARM VNAV CLIMB – Reset altitude preselect to arm climb.	Adjust altitude preselect value to enable VNAV climb.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
ARM VNAV DESCENT – Reset altitude preselect to arm descent.	Adjust altitude preselect value to enable VNAV descent.
ARSPC AHEAD – Airspace ahead - less than 10 minutes.	Special use airspace is ahead of aircraft. The aircraft will penetrate the airspace within 10 minutes.
ARSPC NEAR – Airspace near - less than 2 nm.	Special use airspace is within 2 nm of the aircraft position.
ARSPC NEAR – Airspace near and ahead.	Special use airspace is near and ahead of the aircraft position.
ATC MESSAGE	ATC message received.
ATT/HDG1 FAIL – ATT/HDG 1 has an internal failure.	Internal sensor failure. The system should be serviced.
ATT/HDG1 HDG – ATT/HDG 1 slaved heading is available.	ATT/HDG1 is currently in Free Mode but a more accurate slaved heading is available.
ATT/HDG2 FAIL – ATT/HDG 2 has an internal failure.	Internal sensor failure. The system should be serviced.
ATT/HDG2 HDG – ATT/HDG 1 slaved heading is available.	ATT/HDG2 is currently in Free Mode but a more accurate slaved heading is available.
*AUDIO MANIFEST – Audio software mismatch, communication halted.	The GIA has incorrect software installed. The system should be serviced.
BARO QFE – Confirm reference ELEV matches DEST before landing	Baro QFE Reference Elevation May No Longer Be Valid.
CHECK ARRIVAL SPEED – [Arrival Speed] M AT [LOC ID] exceeds Mmo	The arrival speed loaded exceeds Mmo.
CHECK ARRIVAL SPEED – [Arrival Speed] KT AT [LOC ID] exceeds Vmo	The arrival speed loaded exceeds Vmo.
CHECK CRS – Database course for LOC 1 / <LOC ID> <LOC ID Course>	Selected course for LOC1 differs from published localizer course by more than 10 degrees.
CHECK CRS – Database course for LOC2 / <LOC ID> <LOC ID Course>	Selected course for LOC2 differs from published localizer course by more than 10 degrees.
CHECK DEPARTURE SPEED – [Departure Speed] KT AT [LOC ID] exceeds Vmo	The departure speed loaded exceeds Vmo.
CHECK NAV – Approach ID mismatch / <LOC>	Selected course for LOC2 differs from published localizer course by more than 10 degrees.
*CNFG MODULE – PFD1 configuration module is inoperative.	The PFD1 configuration module backup memory has failed. The system should be serviced.
COM #[1, 2] INOP - CAL – Factory COM Calibration Lost or Corrupted.	COM 1 and/or COM 2 calibration version error. Check COM calibration.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
COM #[1, 2] INOP - CRNT – Check COM current.	COM 1 and/or COM 2 current is low. Check COM current.
COM #[1, 2] INOP - INTRL – Com internal fault.	COM 1 and/or COM 2 has an internal fault.
COM #[1, 2] INOP - SYNTH – COM synthesizer lock fault.	The COM 1 and/or COM 2 has a synthesizer lock fault.
*COM #[1, 2] INOP - VOLT – Check COM voltage.	COM 1 and/or COM 2 has low voltage.
COM #[1, 2] REDUCED TX POWER – Reduced COM transmit power.	COM 1 and/or COM 2 has a reduced transmission power.
*COM1 MANIFEST – COM1 software mismatch, communication halted.	The COM 1 has incorrect software installed. The system should be serviced.
COM1 PTT – COM1 push-to-talk key is stuck.	The COM1 external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
COM2 MANIFEST – COM2 software mismatch, communication halted.	The COM 2 has incorrect software installed. The system should be serviced.
COM2 PTT – COM2 push-to-talk key is stuck.	The COM2 external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
COPILOT PRIM PTT KEYSTK – Copilot primary push-to-talk key is stuck.	The GMA external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
COPILOT SEC PTT KEYSTK – Copilot secondary push-to-talk key is stuck.	The GMA external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
CPDLC SEND FAIL – CPDLC position report failed to send.	Indicates that an automatic CPDLC position report failed to send.
CPDLC – CPDLC facility logon failed.	Logon failed. Check pertinent entries for accuracy. Additionally, voice communications may be used to verify with ATC that CPDLC is currently being offered by the facility.
CPDLC – CPDLC session terminated.	The CPDLC session was unexpectedly terminated by the avionics or ATC. If CPDLC usage is to be continued, ATC must re-establish a new session. It may be necessary to logoff/logon again before ATC can establish a new session.
DATA LOST – Pilot stored data was lost. Recheck settings.	The system was unable to save pilot data. Verify settings.
DATABASE CHANGE – Verify stored airways.	This occurs when a stored flight plan contains an airway that is no longer consistent with the navigation database. This alert is issued only after a navigation database update. Verify use of airways in stored flight plans and reload airways as needed.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.
**All FANS 1/A + and FAA DATA COMM functions are inoperative.

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
DATABASE CHANGE – Verify user modified procedures.	This occurs when a stored flight plan contains procedures that have been manually edited. This alert is issued only after a navigation database update. Verify the user-modified procedures in stored flight plans are correct and current.
DATABASES EXPIRED – Restart avionics to activate standby databases.	The databases in the system have expired. Restart the system to move the standby databases to active status.
*DATABASES MISMATCHED – Restart displays to correct mismatch.	The GDUs have different database versions or regions. Restart the system to move the standby databases to active status.
*DB MISMATCH – Obstacle database mismatch.	The GDUs have different obstacle database versions or regions installed. Check the 'Database Status' Screen to determine versions or regions. Also, check the Avionics Status Screen for a database synchronization function not completed. After synchronization is complete, power must be turned off, then on.
*DB MISMATCH – Terrain database mismatch.	The GDUs have different terrain database versions or regions installed. Check the 'Database Status' Screen to determine versions or regions. Also, check the Avionics Status Screen for a database synchronization function not completed. After synchronization is complete, power must be turned off, then on.
*DB MISMATCH – Navigation database mismatch. Xtalk is off.	The GDUs have different navigation database versions or regions installed. Crossfill is off. Check the 'Database Status' Screen to determine versions or regions. Also, check the Avionics Status Screen for a database synchronization function not completed. After synchronization is complete, power must be turned off, then on.
DB UPDATE IN PROGRESS – See Database Page for more information.	Databases are updating. See the "Database Status' Screen on the Touchscreen Controller.
*DIG GMA1 MANIFEST – DIG GMA 1 software mismatch, communication halted.	The digital audio controller has incorrect software installed. The system should be serviced.
*DIG GMA2 MANIFEST – DIG GMA 2 software mismatch, communication halted.	The digital audio controller has incorrect software installed. The system should be serviced.
DISABLE GP TO ARM CLIMB – Press NAV button to enable VNAV track change.	Disable AFCS Navigation mode to enable VNAV.
DISABLE GS TO ARM CLIMB – Press NAV button to enable VNAV track change.	Disable AFCS Navigation mode to enable VNAV.
DOC VIEWER MISMATCH – See Document Viewer Screen for detailed info.	The installed documents found on the bottom card of each GDU do not match. Ensure each card has the appropriate documents.
FAILED PATH – A data path has failed.	A data path connecting two or more LRU has failed. If the problem persists, the system should be serviced.
FLIGHT ID CHANGE – CPDLC logged off due to Flight ID change.	CPDLC has been logged of because of a change to Flight ID.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
FPL TRUNC – Flight plan has been truncated.	This occurs when a newly installed navigation database eliminates an obsolete approach or arrival used by a stored flight plan. The obsolete procedure is removed from the flight plan. Update flight plan with current arrival or approach.
FPL WPT LOCK – Flight plan waypoint is locked.	Upon power-on, The system detects that a stored flight plan waypoint is locked. This occurs when an aviation database update eliminates an obsolete waypoint. The flight plan cannot find the specified waypoint and flags this message. This can also occur with user waypoints in flight plans that are deleted. Remove the waypoint from the flight plan if it no longer exists in any database, or update the waypoint name/identifier to reflect the new information.
FPL WPT MOVE – Flight plan waypoint moved.	The system has detected that a waypoint coordinate has changed due to a new navigation database update. Verify that stored flight plans contain correct waypoint locations.
FS510 CARD ERROR – FS510 not detected in MFD Bottom Slot.	The wireless transceiver (FS 510) multimedia card for the wireless transceiver (FS 510) was removed from the bottom card slot of the MFD. The multimedia card needs to be reinserted.
FS510 MANIFEST – FS 510 software mismatch.	Incorrect software version. The system should be serviced.
***GCU1 CONFIG** – GCU1 config error. Config service req'd.	GCU1 configuration settings do not match those of backup configuration memory. The system should be serviced.
***GCU1 FAIL** – GCU1 is inoperative.	The GCU1 has failed. The system should be serviced when practical.
GCU1 KEYSTK – GCU1 [key name] key is stuck.	Multiple keys stuck on the GCU1 bezel. Attempt to free the stuck key by pressing it several times. The system should be serviced if the problem persists.
***GCU1 MANIFEST** – GCU1 software mismatch, communication halted.	The GCU1 has incorrect software installed. The system should be serviced.
***GCU2 CONFIG** – GCU2 config error. Config service req'd.	GCU2 configuration settings do not match those of backup configuration memory. The system should be serviced.
***GCU2 FAIL** – GCU2 is inoperative.	The GCU2 has failed. The system should be serviced when practical.
GCU2 KEYSTK – GCU2 [key name] key is stuck.	Multiple keys stuck on the GCU bezel. Attempt to free the stuck key by pressing it several times. The system should be serviced if the problem persists.
***GCU2 MANIFEST** – GCU2 software mismatch, communication halted.	The GCU2 has incorrect software installed. The system should be serviced.
***GDC1 MANIFEST** – GDC1 software mismatch, communication halted.	The GDC1 has incorrect software installed. The system should be serviced.
***GDC2 MANIFEST** – GDC2 software mismatch, communication halted.	The GDC2 has incorrect software installed. The system should be serviced.
GDL59 CONFIG – GDL 59 config error. Config service req'd.	GDL 59 configuration settings do not match those of backup configuration memory. The system should be serviced.
GDL59 FAIL – GDL 59 has failed.	A failure has been detected in the GDL 59. The receiver is unavailable. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
GDL59 MANIFEST – GDL59 software mismatch, communication halted.	The GDL 59 has incorrect software installed. The system should be serviced.
GDL59 RTR FAIL – The GDL 59 router has failed.	A failure has been detected in the GDL 59 router. The system should be serviced.
GDL59 SERVICE – GDL 59 needs service. Return unit for repair.	A failure has been detected in the GDL 59. The system should be serviced.
GDL69 CONFIG – GDL 69 config error. Config service req'd.	GDL 69A SXM configuration settings do not match those of backup configuration memory. The system should be serviced.
GDL69 FAIL – GDL 69 has failed.	A failure has been detected in the GDL 69A SXM. The receiver is unavailable. The system should be serviced.
GDL69 MANIFEST – GDL69 software mismatch, communication halted.	The GDL 69A SXM has incorrect software installed. The system should be serviced.
GDR CONFIG – GDR config error. Config service req'd.	GDR configuration settings do not match those of backup configuration memory. The system should be serviced.
GDR FAIL – GDR is inoperative.	A failure has been detected in the GDR. The system should be serviced. ***
GDR MANIFEST – GDR software mismatch, communication halted.	The GDR has incorrect software installed. The system should be serviced.***
GDR PTT – GDR push-to-talk key is stuck.	The GDR push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
GDR SERVICE – GDR needs service. Return unit for repair.	The GDR should be serviced when practical.
GDR TEMP – GDR over temp. Reducing transmitter power.	The system has detected an over temperature condition in the GDR. The transmitter operates at reduced power. If the problem persists, the system should be serviced.
GDR TX FAIL – GDR transmitter is inoperative.	If GDR service is not set then check antenna for faults and unit for extreme temperatures
***GEA1 CONFIG** – GEA1 config error. Config service req'd.	The GEA1 configuration settings do not match those of backup configuration memory. The system should be serviced.
***GEA1 MANIFEST** – GEA1 software mismatch, communication halted.	The GEA1 7100 has incorrect software installed. The system should be serviced.
***GEA2 CONFIG** – GEA2 config error. Config service req'd.	The GEA2 configuration settings do not match those of backup configuration memory. The system should be serviced.
***GEA2 MANIFEST** – GEA2 software mismatch, communication halted.	The GEA2 7100 has incorrect software installed. The system should be serviced.
GFC MANIFEST – GFC software mismatch, communication halted.	Incorrect servo software is installed, or gain settings are incorrect.
***GIA #[1, 2] INOP - CRNT** – Check GIA current.	The GIA 1 and/or GIA 2 current is low. The current should be checked.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
*GIA #[1, 2] INOP - SERL – Internal GIA Serial Communication Fault.	GIA 1 and/or GIA 2 serial communication fault. Check GIA serial communication.
GIA #[1, 2] TEMP – Check GIA temperature.	GIA 1 and/or GIA 2 is reporting an over-temperature condition.
*GIA #[1, 2] INOP - VOLT – Check GIA voltage.	GIA 1 and/or GIA 2 low voltage. Check voltage.
*GIA1 MANIFEST – GIA1 software mismatch, communication halted.	The GIA1 has incorrect software installed. The system should be serviced.
*GIA2 MANIFEST – GIA2 software mismatch, communication halted.	The GIA 2 has incorrect software installed. The system should be serviced.
*GMA XTALK – GMA crosstalk error has occurred.	The GMA Audio Controllers are not communicating with each other. The system should be serviced.
*GMA1 AUX MANIFEST – Software mismatch, communication halted.	The digital audio controller has incorrect software installed. The system should be serviced.
*GMA1 CONFIG – GMA1 config error. Config service req'd.	The audio controller configuration settings do not match backup configuration memory. The system should be serviced.
*GMA1 FAIL – GMA1 is inoperative.	The audio controller has detected a failure. The audio controller is unavailable. The system should be serviced.
GMA1 INSPECTION REQUIRED – Redundant power supply is not present.	GMA1 backup power source is not connected. The system should be serviced.
*GMA1 SERVICE – GMA1 needs service. Return unit for repair.	The audio controller self-test has detected a problem in the unit. Certain audio functions may still be available, and the audio controller may still be usable. The system should be serviced when practical.
*GMA2 AUX MANIFEST – Software mismatch, communication halted.	The digital audio controller has incorrect software installed. The system should be serviced.
*GMA2 CONFIG – GMA2 config error. Config service req'd.	The audio controller configuration settings do not match backup configuration memory. The system should be serviced.
*GMA2 FAIL – GMA2 is inoperative.	The audio controller has detected a failure. The audio controller is unavailable. The system should be serviced.
GMA2 INSPECTION REQUIRED – Redundant power supply is not present.	GMA2 backup power source is not connected. The system should be serviced.
*GMA2 SERVICE – GMA2 needs service. Return unit for repair.	The audio controller self-test has detected a problem in the unit. Certain audio functions may still be available, and the audio controller may still be usable. The system should be serviced when practical.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
*GMC CONFIG – GMC Config error. Config service req'd.	Error in the configuration of the GMC.
*GMC FAIL – GMC is inoperative.	A failure has been detected in the GMC. The GMC is unavailable.
GMC KEYSTK – GMC [key name] key is stuck.	A key is stuck on the GMC bezel. Attempt to free the stuck key by pressing it several times. The system should be serviced if the problem persists.
*GMC MANIFEST – GMC software mismatch. Communication halted.	The GMC has incorrect software installed. The system should be serviced.
GPS #[1, 2] INSPECT RQRD - BATT – GPS battery needs replacement.	The GPS battery needs to be replaced.
GPS #[1, 2] INSPECT - CAL – Factory GPS calibration lost or corrupted.	GPS 1 and/or GPS 2 factory calibration lost or corrupted. Check GPS calibration. Check GPS calibration.
GPS NAV LOST – Loss of GPS navigation. GPS fail.	Loss of GPS navigation due to GPS failure.
GPS NAV LOST – Loss of GPS navigation. Position error.	Loss of GPS navigation due to position error.
GPS NAV LOST – Loss of GPS navigation. Enable GPS sensors.	Enable GPS sensors to continue to use GPS.
GPS NAV LOST – Loss of GPS navigation. Insufficient satellites.	Loss of GPS navigation due to insufficient satellite coverage.
GPS1 CHECK POSITION – Position difference. Check position sensors.	Check GPS1. From the 'GPS Status' Screen on the Touchscreen Controller, disable then enable GPS1 to clear the alert. If the alert persists, the system should be serviced.
GPS1 FAIL – GPS1 is inoperative.	A failure has been detected in GPS1 receiver. The system should be serviced.
GPS1 SERVICE – GPS1 needs service. Return unit for repair.	A fault has been detected in the GPS1 receiver. The receiver may still be available. If the message persists through a normal power cycle, the system should be serviced when practical.
GPS2 CHECK POSITION – Position difference. Check position sensors.	Check GPS2. From the 'GPS Status' Screen on the Touchscreen Controller, disable then enable GPS2 to clear the alert. If the alert persists, the system should be serviced.
GPS2 FAIL – GPS2 is inoperative.	A failure has been detected in GPS2 receiver. The system should be serviced.
GPS2 SERVICE – GPS2 needs service. Return unit for repair.	A fault has been detected in the GPS2 receiver. The receiver may still be available. If the message persists through a normal power cycle, the system should be serviced when practical.
GRA1 CAL – GRA1 calibration. Service req'd.	GRA1 has improper calibration. The system should be serviced.
GRA1 CONFIG – GRA1 config error. Config service req'd.	The GRA and GDU have incompatible configurations.
GRA1 MANIFEST – GRA1 software mismatch, communication halted.	The GRA has incorrect software installed. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

GARMIN.

System Message	Comments
GRA1 SERVICE – GRA1 needs service. Return unit for repair	The GRA self-test has detected a problem in the unit. The system should be serviced.
GRA1 TEMP – GRA1 over temperature.	The system has detected an over temperature condition in GRA1.
***GSD1 CONFIG** – GSD1 config error. Config service req'd.	GSD1 and the CDU have different copies of the GSD1 configuration.
GSD1 COOLING – GSD1 over temperature.	GSD1 is reporting an over-temperature condition.
GSD1 COOLING – GSD1 temperature too low.	GSD1 is reporting a low temperature condition.
***GSD1 MANIFEST** – GSD1 software mismatch. Communication halted.	GSD1 has incorrect software installed. The system should be serviced.
***GSD1 SERVICE** – GSD1 needs service. Return unit for repair.	GSD1 is reporting an internal error condition. The GSD may still be usable.
***GSD2 CONFIG** – GSD2 config error. Config service req'd.	GSD2 and the CDU have different copies of the GSD2 configuration.
GSD2 COOLING – GSD2 over temperature.	GSD2 is reporting an over-temperature condition.
GSD2 COOLING – GSD2 temperature too low.	GSD2 is reporting a low temperature condition.
***GSD2 MANIFEST** – GSD2 software mismatch. Communication halted.	GSD2 has incorrect software installed. The system should be serviced.
***GSD2 SERVICE** – GSD2 needs service. Return unit for repair.	GSD2 is reporting an internal error condition. The GSD may still be usable.
GSR1 FAIL – GSR1 has failed.	A failure has been detected in GSR1. When GSR1 is operated below -20°C, the GSR56 may be non-operational for up to 30 minutes while the heater warms the system. During this non-operational period, the system will post a GSR1 FAIL message. When GSR1 reaches a sufficient temperature, the failure message is removed from the display. If the failure message persists, the system should be serviced.
GSR2 FAIL – GSR2 has failed.	A failure has been detected in GSR2. When GSR2 is operated below -20°C, the GSR56 may be non-operational for up to 30 minutes while the heater warms the system. During this non-operational period, the system will post a GSR2 FAIL message. When GSR2 reaches a sufficient temperature, the failure message is removed from the display. If the failure message persists, the system should be serviced.
GTS CONFIG – GTS Config error. Config service req'd.	The GTS and GDU have different copies of the GTS configuration, or the Mode S address is invalid. The system should be serviced.
GTS MANIFEST – GTS software mismatch, communication halted.	The GTS has incorrect software installed. The system should be serviced.
GTX1 MANIFEST – GTX1 software mismatch, communication halted.	The transponder has incorrect software installed. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

****All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
GTX2 MANIFEST – GTX2 software mismatch, communication halted.	The transponder has incorrect software installed. The system should be serviced.
GWX CONFIG – GWX config error. Config service req'd.	GWX configuration settings do not match those of the GDU configuration. The system should be serviced.
GWX FAIL – GWX is inoperative.	The GDU is not receiving status packet from the GWX or the GWX is reporting a fault. The radar system should be serviced.
GWX MANIFEST – GWX software mismatch, communication halted.	The GWX has incorrect software installed. The system should be serviced.
GWX SERVICE – GWX needs service. Return unit for repair.	A failure has been detected in the GWX. The GWX may still be usable.
HOLD EXPIRED – Holding EFC time expired.	Expect Further Clearance (EFC) time has expired for the User Defined Hold.
*HW PLATFORM MISMATCH – Hardware platform mismatch for GDU or GTC. Service required.	GDU or GTC models do not match. The system should be serviced.
INSIDE ARSPC – Inside airspace.	The aircraft is inside the airspace.
INVALID ADM – Invalid ADM: ATN communication halted.	Data link avionics were not configured correctly and therefore will not be able to communicate with the ground network.
L GTC CARD1 ERR – L GTC card 1 is invalid.	The internal SD card in the GTC contains invalid data. The system should be serviced.
L GTC CARD1 REM – L GTC card 1 was removed. Reinsert card.	The internal SD card in the GTC was removed. The system should be serviced.
L GTC CONFIG – L GTC config error. Config service req'd.	GTC configuration settings do not match those of backup configuration memory. The system should be serviced.
L GTC COOLING – L GTC has poor cooling. Reducing power usage.	The GTC has insufficient cooling. If the problem persists, the system should be serviced.
L GTC DB ERR – L GTC database missing.	The GTC detected a failure in one or more databases. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
L GTC DB ERR – MFD Obstacle database missing.	The specified GTC detected a failure in the Obstacle database. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
L GTC DB ERR – MFD Terrain database missing.	The specified GTC detected a failure in the Terrain database. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
L GTC FAN FAIL – L GTC internal fan failure. Unit needs service.	The internal fan in the GTC has failed. The system should be serviced.
L GTC KEYSTK – L GTC [key name] key is stuck.	A knob or joystick is stuck on the GTC bezel. Attempt to free the stuck control by pushing or turning it several times. The system should be serviced if the problem persists.
*L GTC MANIFEST – L GTC software mismatch, communication halted.	The GTC has incorrect software installed. The system should be serviced.
L GTC SERVICE – L GTC needs service. Return unit for repair.	The GTC should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.
**All FANS 1/A + and FAA DATA COMM functions are inoperative.
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
L GTC TOLD TABLE ERR – Airframe mismatch.	Airframe identifier mismatch. The system should be serviced.
L GTC TOLD TABLE ERR – CRC Failure.	TOLD files inaccessible. The system should be serviced.
L GTC TOLD TABLE ERR – Unable to read table.	TOLD files missing. The system should be serviced.
L GTC TOLD TABLE ERR – Unable to read table header.	The Table-of-Contents file is missing from the PERF files, is corrupted, or otherwise cannot be read. The system should be serviced.
L GTC TOLD TABLE ERR – Software compatibility error.	Software incompatibility error. The system should be serviced.
L GTC TOLD TABLE ERR – Table mismatch.	PERF file mismatch. The system should be serviced.
L PFD CARD1 ERR – L PFD card 1 is invalid.	The SD card in the top card slot of the specified GDU is invalid.
L PFD CARD1 REM – L PFD card 1 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
***L PFD CARD2 ERR** – L PFD card 2 is invalid.	The SD card in the top card slot of the specified GDU is invalid.
L PFD CARD2 REM – L PFD card 2 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
L PFD CARD3 ERR – L PFD card 3 is invalid.	The SD card in the top card slot of the specified GDU is invalid.
L PFD CARD3 REM – L PFD card 3 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
***L PFD CONFIG** – L PFD config error. Config service req'd.	The specified GDU's configuration settings do not match backup configuration memory. The system should be serviced.
L PFD COOLING – L PFD has poor cooling. Reducing power usage.	The specified GDU is overheating and is reducing power consumption by dimming the display. If problem persists, the system should be serviced.
L PFD DB ERR – L PFD database missing.	The specified GDU detected a failure in one or more databases. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
L PFD DB ERR – L PFD Obstacle database missing.	The specified GDU detected a failure in the Obstacle database. Reload database with new data card. If problem persists, delete database and reload with a new card.
L PFD DB ERR – L PFD Terrain database missing.	The specified GDU detected a failure in the Terrain database. Reload database with new data card. If problem persists, delete database and reload with a new card.
***L PFD INOP - ECC ERROR** – Internal memory unstable - needs repair.	The internal memory of the specified GDU is unstable. The system should be serviced.
***L PFD INOP: HTR CRNT** – Heater Current Error.	The specified GDU has a heater current error. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
*L PFD INOP - LED STR FAULT – Reduced backlight level - needs repair.	The specified GDU has reduced backlight levels. The system should be serviced.
*L PFD INOP TEMP – Check external cooling fans.	The specified GDU is over-temperature. The system should be serviced.
L PFD INSPECT RQRD - BTM SD – Bottom SD Card Unstable - Install new card.	The bottom SD card is unstable and should be replaced.
L PFD INSPECT RQRD - INTERN SD – Internal Micro SD Unstable - Install new card.	The internal SD card is unstable and should be replaced.
L PFD INSPECT RQRD - TOP SD – Top SD Card Unstable - Install new card.	The top SD card is unstable and should be replaced.
*L PFD MANIFEST – L PFD software mismatch, communication halted.	The specified GDU has incorrect software installed. The system should be serviced.
*L PFD SERVICE – L PFD needs service. Return unit for repair.	The specified GDU's self-test has detected a problem. The system should be serviced.
*L PFD SOFTWARE – L PFD mismatch, communication halted.	The specified GDU has different software versions installed. The system should be serviced.
L PFD TERRAIN DSP – L PFD Terrain awareness display unavailable.	One of the terrain, or obstacle databases required for TAWS in the specified GDU is missing or invalid.
*L PFD VOLTAGE – L PFD has low voltage. Reducing power usage	The specified GDU's voltage is low. The system should be serviced.
LOI – GPS integrity lost. Crosscheck with other NAVS.	GPS integrity is insufficient for the current phase of flight.
LOSS OF GPS NAVIGATION – Insufficient Satellite Coverage.	Loss of GPS navigation due to insufficient/poor satellite coverage.
LOW BANK ACTIVE – Disengage for approach.	Low Bank mode active, disengage Low Bank Mode to continue the approach.
LOW BANK ACTIVE – Disengage for RNP less than 1.0.	Low Bank mode active, disengage Low Bank Mode to continue the approach.
LRU REPLACEMENT – LRU replacement detected.	The system has detected an LRU replacement. Perform LRU replacement software or full configuration loading procedure.
MFD CARD1 ERR – MFD card 1 is invalid.	The SD card in the top card slot of the GDU is invalid.
*MFD CARD1 REM – MFD card 1 was removed. Reinsert card.	The SD card was removed from the top card slot of the GDU. The SD card needs to be reinserted.
MFD CARD2 ERR – MFD card 2 is invalid.	The SD card in the top card slot of the GDU is invalid.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
*MFD CARD2 REM – MFD card 2 was removed. Reinsert card.	The SD card was removed from the top card slot of the GDU. The SD card needs to be reinserted.
*MFD CARD3 ERR – MFD card 3 is invalid.	The SD card in the top card slot of the GDU is invalid.
MFD CARD3 REM – MFD card 3 was removed. Reinsert card.	The SD card was removed from the top card slot of the GDU. The SD card needs to be reinserted.
*MFD CONFIG – MFD config error. Config service req'd.	The specified GDU's configuration settings do not match backup configuration memory. The system should be serviced.
MFD COOLING – MFD has poor cooling. Reducing power usage.	The specified GDU is overheating and is reducing power consumption by dimming the display. If problem persists, the system should be serviced.
MFD DB ERR – MFD database missing.	The specified GDU detected a failure in one or more databases. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
MFD DB ERR – MFD Obstacle database missing.	The specified GDU detected a failure in the Obstacle database. Reload database with new data card. If problem persists, delete database and reload with a new card.
MFD DB ERR – MFD Terrain database missing.	The specified GDU detected a failure in the Terrain database. Reload database with new data card. If problem persists, delete database and reload with a new card.
*MFD INOP - ECC ERROR – Internal memory unstable needs repair.	The internal memory of the specified GDU is unstable. The system should be serviced.
*MFD INOP: HTR CRNT – Heater Current Error.	The specified GDU has a heater current error. The system should be serviced.
*MFD INOP - LED STR FAULT – Reduced backlight level - needs repair.	The specified GDU has reduced backlight levels. The system should be serviced.
*MFD INOP - TEMP – Check external cooling fans.	The specified GDU is over-temperature. The system should be serviced.
MFD INSPECT RQRD - BTM SD – Bottom SD Card Unstable - Install new card.	The bottom SD card is unstable and should be replaced.
MFD INSPECT RQRD - INTERN SD – Internal Micro SD Unstable - Install new card.	The internal SD card is unstable and should be replaced.
MFD INSPECT RQRD - TOP SD – Top SD Card Unstable - Install new card.	The top SD card is unstable and should be replaced.
*MFD MANIFEST – MFD software mismatch, communication halted.	The specified GDU has incorrect software installed. The system should be serviced.
*MFD SERVICE – MFD needs service. Return unit for repair.	The specified GDU's self-test has detected a problem. The system should be serviced.
*MFD SOFTWARE – MFD mismatch, communication halted.	The specified GDU has different software versions installed. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
MFD TERRAIN DSP – MFD Terrain awareness display unavailable.	One of the terrain, or obstacle databases required for TAWS in the specified GDU is missing or invalid.
***MFD VOLTAGE** – MFD has low voltage. Reducing power usage	The specified GDU's voltage is low. The system should be serviced.
NAV #[1, 2] INOP - CAL – Factory NAV Calibration Lost or Corrupted.	NAV 1 and/or NAV 2 calibration lost or corrupted. Check COM calibration.
NAV #[1, 2] INOP - CONFIG – Check NAV software and config.	There is a problem with the NAV 1 and/or NAV 2 software configuration. Check the configuration. If the problem persists, the system should be serviced.
NAV #[1, 2] INOP - INTRL – NAV internal fault.	NAV 1 and/or NAV 2 has an internal fault.
NAV #[1, 2] INOP - SERL – Internal NAV serial communication fault.	NAV 1 and/or NAV 2 serial communication fault. Check NAV serial communication.
NAV #[1, 2] INOP - SYNTH – NAV synthesiser lock fault.	NAV 1 and/or NAV 2 has a synthesizer lock fault.
***NAV DB UPDATED** – Active navigation database updated.	System has updated the active navigation database from the standby navigation database.
***NAV1 MANIFEST** – NAV1 software mismatch, communication halted.	The NAV 1 and/or NAV 2 has incorrect software installed. The system should be serviced.
NAV2 MANIFEST – NAV2 software mismatch, communication halted.	The NAV 2 has incorrect software installed. The system should be serviced.
NON-MAGNETIC UNITS – Non-magnetic NAV ANGLE display units are active.	Navigation angle is not set to MAGNETIC at power-on.
NON WGS84 WPT – Do not use GPS for navigation to [xxxx]	The position of the selected waypoint [xxxxx] is not calculated based on the WGS84 map reference datum and may be positioned in error as displayed. Do not use GPS to navigate to the selected non-WGS84 waypoint.
PFD POSITIONS DIFFERENT – PFD positions mismatch. Check position sensors.	There is a mismatch in the position sensed by the PFDs. Check position sensor settings. If message persists the system should be serviced.
PILOT PRIM PTT KEYSTK – Pilot primary push-to-talk key is stuck.	The GMA external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
PILOT SEC PTT KEYSTK – Pilot secondary push-to-talk key is stuck.	The GMA external push-to-talk switch is stuck in the enable (or "pressed") position. Press the PTT switch again to cycle its operation. If the problem persists, the system should be serviced.
RAIM UNAVAIL – RAIM is not available from FAF to MAP waypoints.	GPS satellite coverage is insufficient to perform Receiver Autonomous Integrity Monitoring (RAIM) from the FAF to the MAP waypoints.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.
**All FANS 1/A + and FAA DATA COMM functions are inoperative.
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
R GTC CARD1 ERR – R GTC card 1 is invalid.	The internal SD card in the GTC contains invalid data. The system should be serviced.
R GTC CARD1 REM – R GTC card 1 was removed. Reinsert card.	The internal SD card in the GTC was removed. The system should be serviced.
R GTC CONFIG – R GTC config error. Config service req'd.	GTC configuration settings do not match those of backup configuration memory. The system should be serviced.
R GTC COOLING – R GTC has poor cooling. Reducing power usage.	The GTC has insufficient cooling. If the problem persists, the system should be serviced.
R GTC DB ERR – R GTC database missing.	The GTC detected a failure in one or more databases. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
R GTC DB ERR – MFD Obstacle database missing.	The specified GTC detected a failure in the Obstacle database. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
R GTC DB ERR – MFD Terrain database missing.	The specified GTC detected a failure in the Terrain database. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
R GTC FAN FAIL – R GTC internal fan failure. Unit needs service.	The internal fan in the GTC has failed. The system should be serviced.
R GTC KEYSTK – R GTC [key name] key is stuck.	A knob or joystick is stuck on the GTC bezel. Attempt to free the stuck control by pushing or turning it several times. The system should be serviced if the problem persists.
***R GTC MANIFEST** – R GTC software mismatch, communication halted.	The GTC has incorrect software installed. The system should be serviced.
R GTC SERVICE – R GTC needs service. Return unit for repair.	The GTC should be serviced.
R GTC TOLD TABLE ERR – Airframe mismatch.	Airframe identifier mismatch. The system should be serviced.
R GTC TOLD TABLE ERR – CRC Failure.	TOLD files inaccessible. The system should be serviced.
R GTC TOLD TABLE ERR – Unable to read table.	TOLD files missing. The system should be serviced.
R GTC TOLD TABLE ERR – Unable to read table header.	The Table-of-Contents file is missing from the PERF files, is corrupted, or otherwise cannot be read. The system should be serviced.
R GTC TOLD TABLE ERR – Software compatibility error.	Software incompatibility error. The system should be serviced.
R GTC TOLD TABLE ERR – Table mismatch.	PERF file mismatch. The system should be serviced.
R PFD CARD1 ERR – R PFD card 1 is invalid.	The SD card in the top card slot of the specified GDU is invalid.
R PFD CARD1 REM – R PFD card 1 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
***R PFD CARD2 ERR** – R PFD card 2 is invalid.	The SD card in the top card slot of the specified GDU is invalid.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.
**All FANS 1/A + and FAA DATA COMM functions are inoperative.
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
*R PFD CARD2 REM – R PFD card 2 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
R PFD CARD3 ERR – R PFD card 3 is invalid.	The SD card in the top card slot of the specified GDU is invalid.
R PFD CARD3 REM – R PFD card 3 was removed. Reinsert card.	The SD card was removed from the top card slot of the specified GDU. The SD card needs to be reinserted.
*R PFD CONFIG – R PFD config error. Config service req'd.	The specified GDU's configuration settings do not match backup configuration memory. The system should be serviced.
R PFD COOLING – R PFD has poor cooling. Reducing power usage.	The specified GDU is overheating and is reducing power consumption by dimming the display. If problem persists, the system should be serviced.
R PFD DB ERR – R PFD database missing.	The specified GDU detected a failure in one or more databases. Reload databases with new data card. If problem persists, delete databases and reload with a new card.
R PFD ERR – MFD Obstacle database missing.	The specified GDU detected a failure in the Obstacle database. Reload database with new data card. If problem persists, delete database and reload with a new card.
R PFD ERR – MFD Terrain database missing.	The specified GDU detected a failure in the Terrain database. Reload database with new data card. If problem persists, delete database and reload with a new card.
*R PFD INOP - ECC ERROR – Internal memory unstable - needs repair.	The internal memory of the specified GDU is unstable. The system should be serviced.
*PFD1 INOP: HTR CRNT – Heater Current Error.	The specified GDU has a heater current error. The system should be serviced.
*R PFD INOP - LED STR FAULT – Reduced backlight level - needs repair.	The specified GDU has reduced backlight levels. The system should be serviced.
*R PFD INOP – TEMP – Check external cooling fans.	The specified GDU is over-temperature. The system should be serviced.
R PFD INSPECT RQRD - BTM SD – Bottom SD Card Unstable - Install new card.	The bottom SD card is unstable and should be replaced.
R PFD INSPECT RQRD - INTERN SD – Internal Micro SD Unstable - Install new card.	The internal SD card is unstable and should be replaced.
R PFD INSPECT RQRD - TOP SD – Top SD Card Unstable - Install new card.	The top SD card is unstable and should be replaced.
*R PFD MANIFEST – R PFD software mismatch, communication halted.	The specified GDU has incorrect software installed. The system should be serviced.
*R PFD SERVICE – R PFD needs service. Return unit for repair.	The specified GDU's self-test has detected a problem. The system should be serviced.
*R PFD SOFTWARE – R PFD mismatch, communication halted.	The specified GDU has different software versions installed. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
R PFD TERRAIN DSP – R PFD Terrain awareness display unavailable.	One of the terrain or obstacle databases required for TAWS in the specified GDU is missing or invalid.
*R PFD VOLTAGE – R PFD has low voltage. Reducing power usage	The specified GDU's voltage is low. The system should be serviced.
REGISTER CONNEXT – Data services are inoperative, register w/ Connext.	The system is not registered with Connext, or its current registration data has failed authentication.
SCHEDULER [#] – <message>.	Message criteria entered by the user.
SLCT FREQ – Select appropriate frequency for approach.	The system notifies the pilot to load the approach frequency for the appropriate NAV receiver. Select the correct frequency for the approach.
SELCAL ID MISMATCH – Selected SELCAL ID does not match reported ID.	The manually selected SELCAL ID does not match the ID reported by the system.
SLCT MAG – Select MAGNETIC NAV ANGLE display units.	The system notifies the pilot to set the Nav Angle units on the Avionics Settings Screen to Magnetic.
SLCT NAV – Select NAV on CDI for approach.	The system notifies the pilot to set the CDI to the correct NAV receiver. Set the CDI to the correct NAV receiver.
SLCT NON-MAG – Select alternate NAV ANGLE display units.	The system notifies the pilot to set the Nav Angle units on the Avionics Settings Screen to True.
SMS TEXT MSG MEM LIMIT – Oldest MSG will be deleted when MSG received.	The memory limit for SMS text messaging has been reached. The oldest text message will automatically be deleted when a new SMS text message is received.
STRMSCP FAIL – Stormscope has failed.	The system is no longer receiving data from the lightning detection system. The device should be serviced.
STABILIZED APPR DISABLED – Too far north/south	The Stabilized Approach functionality is DISABLED if the aircraft is positioned in latitude higher than 87°.
STABILIZED APPR FLAP OVRD – Stabilized Approach flaps overridden	The Flaps Alert is INHIBITED
STABILIZED APPR GS/GP INHIB – Stabilized APPR Vertical Deviation alerts inhibited.	Stabilized approach glidepath/glideslope alerts are inhibited.
STABILIZED APPR INHIBIT – Stabilized Approach inhibited	The Stabilized Approach functionality system is in the INHIBITED operation mode.
STABILIZED APPR WIND – No DEST METAR data. Nearest data in use.	No destination METAR data is available. Nearest data in use.
STABILIZED APPR WIND DSBLD – Stabilized Approach inhibited	Stabilized approach glidepath/glideslope alerts are inhibited.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.
**All FANS 1/A + and FAA DATA COMM functions are inoperative.
***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

System Message	Comments
STABILIZED APPR WIND INHIB – Stabilized APPR wind alerts inhibited.	Stabilized approach wind alerts are inhibited.
STABILIZED APPROACH FAIL – Invalid audio configuration	The Stabilized Approach functionality stabilized approach audio configuration is invalid.
STABILIZED APPROACH FAIL – One or more inputs invalid	The GPS/WAAS position is invalid for more than 3 seconds or is insufficient due to RAIM position warning or loss of integrity; GPS/WAAS horizontal protection level exceeds the LNAV/VNAV horizontal alert limit (556.0 meters); or the heading, track, groundspeed, vertical velocity, or on-ground input data is invalid for more than 3 seconds.
SURFACEWATCH DISABLED – Too far north/south.	The SurfaceWatch system has been disabled.
SURFACEWATCH FAIL – Invalid audio configuration.	The SurfaceWatch system has failed due to an invalid audio configuration.
SURFACEWATCH FAIL – Invalid configurable alerts.	The SurfaceWatch system has failed due to invalid configurable alerts.
SURFACEWATCH FAIL – One or more inputs invalid.	The SurfaceWatch system has failed due to one or more invalid inputs.
SURFACEWATCH INHIBITED – Surfacewatch inhibited.	The SurfaceWatch system has been inhibited.
STEEP TURN – Steep turn ahead.	The computed bank angle needed to execute the turn may exceed the current bank angle limit.
SVT DISABLED – Out of available terrain region.	Synthetic Vision is disabled because the aircraft is not within the boundaries of the installed terrain database.
SVT DISABLED – Terrain DB resolution too low.	Synthetic Vision is disabled because a terrain database of sufficient resolution is not currently installed.
***SYSTEM CONFIG** – SYSTEM config error. Config service req'd.	The system configuration has changed unexpectedly. The system should be serviced.
TERRAIN AUD CFG – Trn Awareness audio config error. Service req'd.	TAWS is disabled because the audio configuration is invalid. The system should be serviced.
TIMER EXPIRD – Timer 1 has expired.	The system notifies the pilot Timer 1 has expired.
TIMER EXPIRD – Timer 2 has expired.	The system notifies the pilot Timer 2 has expired.
TOLD – TOLD computation miscompare.	There is a mismatch in TOLD computation between GTC1 and GTC2.
TRAFFIC FAIL – Traffic device has failed.	The system is no longer receiving data from the traffic system. The traffic device should be serviced.
TRN AUD FAIL – Trn Awareness audio source unavailable.	TAWS is disabled because an aural alert audio source is unavailable.
UNABLE V WPT – Can't reach current vertical waypoint.	The current vertical waypoint can not be reached within the maximum flight path angle and vertical speed constraints. The system automatically transitions to the next vertical waypoint.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
UNABLE VNAV – Excessive cross-track error.	The current cross-track exceeds the limit, causing vertical deviation to go invalid.
UNABLE VNAV – Excessive track angle error.	The current track angle error exceeds the limit, causing the vertical deviation to go invalid.
UNABLE VNAV – Reverted to PIT.	The current VNAV is not supported, the Flight Director has reverted to PIT mode.
UNABLE VNAV – Parallel course selected.	A parallel course has been selected, causing the vertical deviation to go invalid.
UNABLE VNAV – Unsupported leg type in flight plan.	The lateral flight plan contains a procedure turn, vector, or other unsupported leg type prior to the active vertical waypoint. This prevents vertical guidance to the active vertical waypoint.
UNABLE VNAV – QFE mode conflicts with VNAV altitude.	The aircraft is vertically approaching a flight level altitude constraint with QFE mode active.
UNABLE VNAV ALTITUDE – Cannot meet VNAV altitude constraint.	The current vertical speed is insufficient to make the active flight plan altitude constraint prior to crossing the waypoint.
UNABLE VNAV SPEED – Flight plan speed constraint will not be met.	While descending to a speed constraint at a flight plan waypoint that requires the airplane to slow down, the system has determined that deceleration is insufficient to meet the speed constraint prior to passing the waypoint.
VNAV CONFIG – VNAV config error Config service req'd.	VNAV configuration error. The system should be serviced.
VNAV SPEED/ALTITUDE – Speed/altitude limit will not be met.	While descending to a speed restriction defined at an altitude (e.g. the 250 kt speed limit below 10,000 ft) the system has determined the airplane's deceleration is insufficient to meet the speed restriction prior to crossing the altitude.
WINDSHEAR – Unavailable: invalid inputs.	The windshear detection capability is not available. The system should be serviced.
WPT ARRIVAL – Arriving at waypoint - [xxxx]	Arriving at waypoint [xxxx], where [xxxx] is the waypoint name.
WX ALERT – Possible severe weather ahead.	The GWX indicates severe weather within ±10 degrees of the aircraft heading at a range of 80 to 320 nm.
XPDR1 ADS-B NO TX – Transponder: ADS-B out has failed.	ADS-B is inoperative. The transponder may not be receiving a valid GPS position. Other transponder functions may be available. Service when possible.
XPDR1 CONFIG – XPDR1 config error. Config service req'd.	The transponder configuration settings do not match those of backup configuration memory. The system should be serviced.
XPDR1 FAIL – XPDR1 is inoperative.	There is no communication with the #1 transponder.
XPDR1 SERVICE – XPDR1 needs service. Return unit for repair.	The #1 transponder should be serviced when practical.
XPDR2 ADS-B NO TX – Transponder: ADS-B out has failed.	ADS-B is inoperative. The transponder may not be receiving a valid GPS position. Other transponder functions may be available. Service when possible.
XPDR2 CONFIG – XPDR2 config error. Config service req'd.	The transponder configuration settings do not match those of backup configuration memory. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.*

****All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.*

System Message	Comments
XPDR2 FAIL – XPDR2 is inoperative.	There is no communication with the #2 transponder.
XPDR2 SERVICE – XPDR2 needs service. Return unit for repair.	The #2 transponder should be serviced when practical.
XTALK ERROR – A flight display crosstalk error has occurred.	The GDUs and/or GTCs are not communicating with each other. The system should be serviced.

*'Avionics Fault' related System Message. Does not trigger the **MSG** *Button on the Touchscreen Controller.*
**All FANS 1/A + and FAA DATA COMM functions are inoperative.

***All FAA DATA COMM and Link 2000+ functions are inoperative. FANS 1/A + can only use SATCOM.

AIRFRAME ALERTS

The following airframe related messages, when generated, cause the **MSG** Button flashes on the Touchscreen Controllers and the MSG annunciator icon to flash in the upper left corner of the PFDs. They are displayed in the Touchscreen Controller 'Notifications' Window with system messages.

Airframe Message	Comments
AUTOPILOT STUCK CLUTCH – Stuck clutch detected in the pitch servo.	Autopilot stuck clutch. The system should be serviced.
AUTOPILOT STUCK CLUTCH – Stuck clutch detected in the roll servo.	Autopilot stuck clutch. The system should be serviced.
TAWS GEAR FAULT – Landing gear input fault. Check gear position.	Landing gear input fault. Check gear position.
TAWS FLAP FAULT – Flap input miscompare. Check flap position.	Flap input miscompare. Check flap position.
YAW DAMPER STUCK CLUTCH – Stuck clutch detected in the yaw servo.	Yaw damper stuck clutch. The system should be serviced.

VOICE ALERTS

Refer to the Hazard Avoidance section for all traffic and terrain related voice alerts.

Voice Alert	Priority	Alert	Description
"Autopilot"	Warning	Autopilot disconnect	Autopilot automatically disconnected. In some situations, the Flight Director may still be available.
"Course, Course"	Warning	Gear Not in Landing Configuration	This alert is applicable to IFR approaches and is set when the magnitude of the lateral course deviation is greater than 1 dot.
"Flaps, Flaps"	Warning	Flaps Not in Landing Configuration	Flaps are not in landing configuration.
"Glidepath, Glidepath"	Warning	Vertical Deviation	This alert is applicable to IFR approaches and is set when the magnitude of the vertical deviation is greater than 1 dot.
"Minimums Minimums"	Warning	Minimums	At MDA or DH.
"Sink Rate, Sink Rate"	Warning	Decent Speed	Decent speed too high.
"Speed, Speed"	Warning	Approach Speed	Airspeed is less/greater than the Vref speed minus/plus the configurable approach speed lower/upper threshold.

Voice Alert	Priority	Alert	Description
"Windshear, Windshear, Windshear"	Warning	Windshear	Windshear warning.
"Course"	Caution	Lateral Deviation	This alert is applicable to IFR approaches and is set when the magnitude of the lateral course deviation is greater than 1 dot.
"Flaps"	Caution	Flaps Not in Landing Configuration	Flaps are not in landing configuration.
"Gear"	Caution	Gear Not in Landing Configuration	Gear is not in landing configuration.
"Glidepath"	Caution	Vertical Deviation	This alert is applicable to IFR approaches and is set when the magnitude of the vertical deviation is greater than 1 dot.
"Speed"	Caution	Approach speed	Airspeed is less/greater than the Vref speed minus/plus the configurable approach speed lower/upper threshold.
"Caution, Windshear"	Caution	Windshear	Windshear caution.

AURAL ALERTS

Alert	Priority	Aural Alert	Description
ACARS Message	Alert	1000 Hz chime followed by a 850 Hz chime	Air Traffic Service datalink message.
Altitude	Alert	Single Tone	Aircraft deviates from or approaches the selected altitude.
CPDLC Message	Alert	1000 Hz chime followed by a 850 Hz chime	CPDLC message. Action required.
Overspeed	Warning	Repeating Tone	MMO or VMO exceeded.
Phone Call	Alert	Phone ringer	Incoming phone call.
SELCAL Message	Alert	1000 Hz chime followed by a 850 Hz chime	Incoming SELCAL message.
Vertical track	Alert	Double Tone	VNAV waypoint.

DATABASE MANAGEMENT

Database information is obtained from third party sources. Inaccuracies in the data may be discovered from time to time. Garmin communicates this information by issuing a Database Alert. These notifications are available on flygarmin.com.

Garmin requests the flight crew report any observed discrepancies related to database information. These discrepancies could come in the form of an incorrect procedure; incorrectly identified terrain, obstacles and fixes; or any other displayed item used for navigation or communication in the air or on the ground. Go to flygarmin.com and select Aviation Data Error Report.

A 32 GB Supplemental Data (SD) card (including FS 510 Wireless Transceiver card when used as a storage device) is required to perform database updates. Only cards provided by Garmin or the OEM should be used. In the event there is a file corruption problem with the SD card or Wireless Transceiver card, it may be necessary to reformat the card. This can cause an issue when formatting using Mac OS, where the newly formatted device will not be recognized by the avionics system. When using a Macintosh computer to format the SD card or Wireless Transceiver card, Garmin recommends using the SD Memory Card Formatter application made available by the SD Association as a download from sdcard.org. When running the application, use the Quick Format option.

> ✓ **NOTE:** *Use of SD cards that are not Garmin or OEM provided may cause system malfunctions when left in the MFD after the databases are loaded.*

In addition to SD card loading, databases may be loaded through Garmin Pilot™ and FS 510 Wireless Transceiver. When loading databases through Garmin Pilot™ and the Wireless Transceiver, it must be enabled on the system and the Wireless Transceiver card inserted in the bottom SD slot of the GDU.

> ⚠ **CAUTION:** *Never disconnect power to the system when loading a database. Power interruption during the database loading process could result in maintenance being required to reboot the system.*

> ✓ **NOTE:** *When loading database updates, the 'DB Mismatch' system message will be displayed until database synchronization is complete, followed by turning system power off, then on. Synchronization can be monitored on the 'Database Status' Screen.*

> ✓ **NOTE:** *Loading a database in the system prior to its effective date will result in the expiration date on the Power-up Display and the effective date on the 'Database Status' Screen being displayed in amber.*

> ✓ **NOTE:** *The FAA has asked Garmin to remind pilots who fly with Garmin database-dependent avionics of the following:*
> - *It is the pilot's responsibility to remain familiar with all FAA regulatory and advisory guidance and information related to the use of databases in the National Airspace System.*
> - *Garmin equipment will only recognize and use databases that are obtained from Garmin or Jeppesen. Databases obtained from Garmin or Jeppesen are assured compliance with all data quality requirements (DQRs) by virtue of a Type 2 Letter of Authorization (LOA) from the FAA. A copy of the Type 2 LOA is available for each database and can be viewed at flygarmin.com by selecting 'Type 2 LOA Status.'*
> - *Use of a current Garmin or Jeppesen database in your Garmin equipment is required for compliance with established FAA regulatory guidance, but does not constitute authorization to fly any and all terminal procedures that may be presented by the system. It is the pilot's responsibility to operate in accordance with established AFM(S) and regulatory guidance or limitations as applicable to the pilot, the aircraft, and installed equipment.*

> ✓ **NOTE:** *The pilot/operator must review and be familiar with Garmin's database exclusion list as discussed in SAIB CE-14-04 to determine what data may be incomplete. The database exclusion list can be viewed at flygarmin.com by selecting 'Database Exclusions List.'*

> ✓ **NOTE:** *The pilot/operator must have access to Garmin and Jeppesen database alerts and consider their impact on the intended aircraft operation. The database alerts can be viewed at flygarmin.com by selecting 'Aviation Database Alerts.'*

> ✓ **NOTE:** *If the pilot/operator wants or needs to adjust the database, contact Garmin Product Support to coordinate the revised DQRs.*

> ✓ **NOTE:** *Garmin requests the flight crew report any observed discrepancies related to database information. These discrepancies could come in the form of an incorrect procedure; incorrectly identified terrain, obstacles and fixes; or any other displayed item used for navigation or communication in the air or on the ground. Go to flyGarmin.com and select 'Report An Aviation Data Error Report.'*

LOADING UPDATED DATABASES

Databases may be loaded through Garmin Pilot™ and the Wireless Transceiver. When loading databases through Garmin Pilot and the Wireless Transceiver, it must be enabled on the system and the multimedia card inserted in the bottom SD slot of the MFD.   The wireless transceiver multi-media card may be used as a SD card, but only if using the reader supplied with the card.

The cycles and dates for both standby and active databases are displayed on the "Database Status' Screen on the touchscreen controller. Any active databases with expiration dates in the past will be highlighted with amber text. When an expired active database has a standby database that is ready to become effective, a cyan double-sided arrow will be displayed between the database cycles. When this arrow is visible, it indicates the standby and active databases in that row will be switched on the next power cycle, activating the current standby database. Databases can also be manually selected (or deselected) by touching the database list item, then touching the **Swap** Button.

When utilizing The Wireless Transceiver, multiple regional databases (e.g. North America and Europe) may available to be loaded to the system depending on the database type. Some databases offer only one region. Only one database region may be active on the system at any time for each database. If desired, a database compatible with the aircraft's current region of operation may be loaded as the active database through the preferred mobile device, replacing the existing region specific database. The regions loaded become the 'Preferred Region' for each database.

In some cases it may be necessary to obtain an unlock code from Garmin in order to make the database product functional. It may also be necessary to have the system configured by a Garmin authorized service facility in order to use some database features.

The navigation database contains the aeronautical data used by the system for the flight management and flight planning functions. Included is detailed data for waypoints, procedures (arrivals, departures, approaches), and airways. The navigation database is updated every 28 days. Navigation databases are available for multiple regions. Refer to flygarmin.com for a list of navigation databases available.

The basemap database contains data for the topography and land features, such as rivers, lakes, and towns. It is updated only periodically, with no set schedule. There is no expiration date. The basemap database is only available in a "Worldwide' version.

The terrain database contains the terrain mapping data. These databases are updated periodically and have no expiration date. The terrain database is only available in a "Worldwide' version.

The obstacle database contains data for obstacles, such as towers, that pose a potential hazard to aircraft. Obstacles 200 feet and higher are included in the obstacle database. It is very important to note that not all obstacles are necessarily charted and therefore may not be contained in the obstacle database. This database is updated on a 56-day cycle. The obstacle database is only available in a "US/Canada/Europe' version.

> **NOTE:** *The data contained in the terrain and obstacle databases comes from government agencies. Garmin accurately processes and cross-validates the data, but cannot guarantee the accuracy and completeness of the data.*

The AOPA or AC-U-KWIK Airport Directory provides data on airports and heliports throughout the U.S. or worldwide, respectively. The AOPA Directory offers detailed information for over 5,300 U. S. airports, along with the names and phone numbers of thousands of FBOs. These databases are updated every 56 days. The AC-U-KWIK Directory offers detailed information for more than 8,000 airports with runways longer than 3,000 feet worldwide. A 'Worldwide' Airport Directory database is available as well as Airport Directory databases for multiple regions. Refer to flygarmin.com for a list of Airport Directory databases available.

The SafeTaxi database contains detailed airport diagrams for selected airports. These diagrams aid in following ground control instructions by accurately displaying the aircraft position on the map in relation to taxiways, ramps, runways, terminals, and services. This database is updated on a 56-day cycle. A 'Full Coverage' SafeTaxi database is available as well as SafeTaxi databases for multiple regions. Refer to flygarmin.com for a list of SafeTaxi databases available.

The ChartView database is updated on a 14-day cycle. If the ChartView database is not updated within 70 days of the expiration date, ChartView will no longer function. The ChartView database must be purchased directly from Jeppesen but can be updated at jeppesen.com or flygarmin.com. The ChartView database is available for multiple regions. Refer to jeppesen.com for a list of ChartView databases available.

The IFR/VFR charts database contains VFR and IFR raster charts. The VFR Charts are digital representations of the Sectional Aeronautical Charts and Terminal Area Charts. The IFR Charts include both IFR High (designed for navigation at or above 18,000 ft) and IFR Low (designed for navigation below 18,000 ft). IFR/VFR Charts are updated every 28 days except for Canadian IFR/VFR Charts which are updated every 56 days. The IFR/VFR charts database is available for multiple regions. Refer to flygarmin.com for a list of IFR/VFR charts databases available.

The Checklist database is a custom configured database. Refer to the Additional Features Section for details.

UPDATING DATABASES WITH SD CARD OR WIRELESS TRANSCEIVER CARD

All databases are updated through a single SD card or Wireless Transceiver Card in the bottom slot of the MFD. When the card is inserted, the databases on the card will be copied to standby and synchronized across all powered, configured units. After update, the card is removed and the databases are stored on the system. When in standby, databases are not immediately available for use, but stored to be activated at a later time.

Database updates can be obtained by following the instructions detailed in the 'Aviation Databases' section of the Garmin website (flygarmin.com). Once the updated files have been downloaded from the website, a

personal computer equipped with an appropriate card reader is used to unpack and program the new databases onto an existing card. When database files are loaded to the card, any previously loaded database files of the same type residing on the card will be overwritten. This includes loading a database of a different coverage area or data cycle than the currently residing on the card. Equipment required to perform the update is as follows:

- PC with Window Vista or later/Mac with OS X 10.9 or later
- SD card Reader: SanDisk SDDR-93, SanDisk SDDR-99, Verbatim #96504, or equivalent.
- Garmin SD card Reader for Wireless Transceiver cards.
- Updated databases obtained from the Garmin website.
- Garmin or OEM provided 32 GB SD card or Wireless Transceiver card.

Updating Databases using an SD or Wireless Transceiver card:

1) Download and install the databases on the SD card or Wireless Transceiver card.

2) Put the card in the bottom SD card slot of the MFD.

3) Turn the system ON.

4) Press the right most softkey on MFD display to acknowledge the start-up screen.

5) Touch **Database Status** on the 'Initialization' Screen of either Touchscreen Controller.

   Or:

   From Home, touch **Utilities > Setup > Database Status**
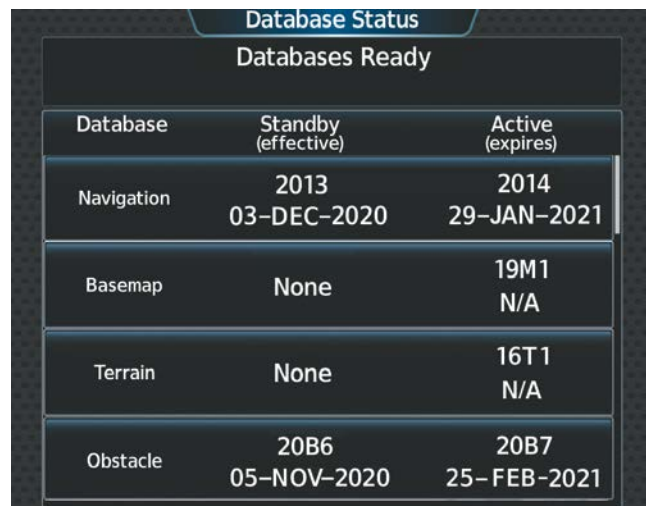
6) Monitor the Sync Status on the 'Database Status' Screen. Wait for all databases to complete syncing, indicated by 'Sync Complete' being displayed.

7) The database update status will appear in the status window at the top of the screen. The load is complete when 'Databases Ready' is displayed.

8) A cyan double-arrow will appear between the 'Standby' and 'Active' columns to show which standby databases will be transferred to 'Active' at the next power cycle. For any databases not selected to load with cyan double-arrows, or if Inhibit Automatic Swap is selected, touch the database title and then touch **Swap** > **OK.**

Figure B-1 'Database Status' Screen before Activation of Standby Databases

9) The system will display the message 'Activate databases with on ground restart.' Touch **Database Options > Restart Displays**.

10) Touch the **Restart** Button in the display window to continue with the restart of the system.

11) Press the right most softkey on MFD display to acknowledge the start-up screen.

12) Touch **Database Status** on the 'Initialization' Screen of either Touchscreen Controller.

    Or:

    From Home, touch **Utilities > Setup > Database Status.**

13) Verify the standby databases transferred and are now in the 'Active' Column.

Figure B-2 'Database Status' Screen after Activation of Standby Databases

14) To manually activate any databases that did not transfer to the 'Active' Column:

    a) Touch **Database Status** on the 'Initialization' Screen of either Touchscreen Controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

    b) Scroll down and touch the database title.

    c) Touch **Swap** > **OK**. The cyan double-arrows will now appear beside the selected databases. Repeat steps b) and c) for any additional databases.

    d) Remove and reapply power to the system.

    e) Press the right most softkey on MFD display to acknowledge the start-up screen.

    f) Touch **Database Status** on the 'Initialization' Screen of either Touchscreen Controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

    g) Verify the standby databases transferred and are now in the 'Active' Column.

15) To view database status:

    a) Touch **Database Status** on the 'Initialization' Screen on the MFD Touchscreen Controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

b) To view database status for an individual display, touch **Database Options > LRU Database Info.**

Or:

To view database status from 'Avionics Status' Screen, touch **Utilities > Setup > Avionics Status**. Touch the **Database** Tab**.**

c) Touch a button from the list to view database information associated with that display.

d) Scroll through the database information to view database status.

UPDATING DATABASES WITH GARMIN PILOT / WIRELESS TRANSCEIVER

In order to load databases through Garmin Pilot™ and the Wireless Transceiver, the Wireless Transceiver must be enabled on the system with the Wireless Transceiver card inserted in the bottom SD slot of the MFD. A mobile device with Garmin Pilot™ must be paired with the Wireless Transceiver over Bluetooth. The system's preferred mobile device may be selected on the Touchscreen Controller 'Database Status' Screen from a menu list of devices that have been paired to the system. When the system is enabled it will automatically connect to the preferred device. If the preferred device has not been selected or is not available, the system will automatically connect to the first of any available, paired devices.

Once a Bluetooth connection to the paired mobile device is made, Garmin Pilot™ makes available databases that can be transferred via WIFI to the Wireless Transceiver. If any of these databases is more recent than the respective standby database on the system, (or if there is no standby database on the system) those databases will be automatically selected to load. The database updates may be initiated from the 'Database Status' Screen on either Touchscreen Controller.

> ✓ **NOTE:** The system will only provide a WIFI connection if new databases have been detected for download on Garmin Pilot™ via a valid Bluetooth connection. If their are no database updates required, the system will not provide a WIFI signal.

> ✓ **NOTE:** If the mobile device has previously connected to the Wireless Transceiver, and is not connected to another Bluetooth device, the mobile device should connect automatically to the Wireless Transceiver. If the mobile device is connected to another Bluetooth device, then the Wireless Transceiver will not automatically connect.

Updating Databases using the Wireless Transceiver:

1) With the system OFF, insert the Wireless Transceiver card in the bottom slot of the MFD if not already inserted.

2) Turn the system on.

> ✓ **NOTE:** The Wireless Transceiver card should not be removed while the system is powered on. If the card is removed while the system is powered on, reinsert the card after the 'FS510 Card Error' System Message appears on the 'Notifications' Screen of the Touchscreen Controller.

3) Press the right-most softkey on MFD display to acknowledge the start-up screen.

4) From Home, touch **Utilities** > **Setup** > **Wireless Setup** > **Connext.**

5) Touch the **Import Functions** Tab and ensure the WiFi Database Import **Enable** Button is selected.

Figure B-3 Wifi Enabled

6) Touch the Bluetooth Tab to ensure bluetooth is enabled.

Figure B-4 Bluetooth Setup

7) On the mobile device, connect via Bluetooth to the Wireless Transceiver.

8) Touch the **Database Status > Device Databases** on the 'Initialization' Screen on the MFD touchscreen controller.

 Or:

From Home, touch **Utilities > Setup > Database Status > Device Databases.**

9) The 'Database Status' Screen will show the databases connected to the mobile device in place of the active databases on the system. Databases selected to load will be indicated by a cyan arrow.
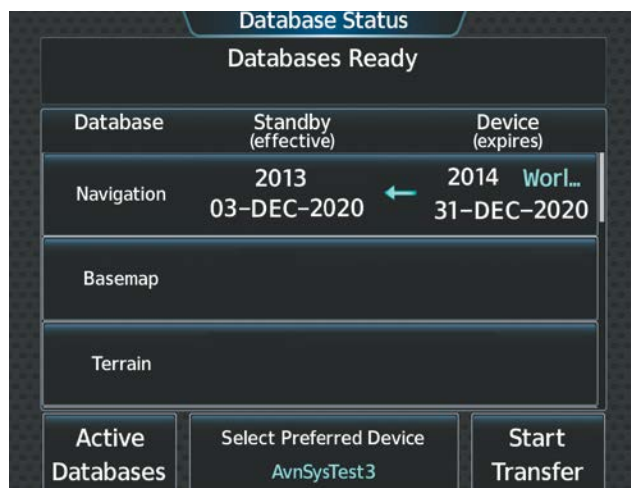
Figure B-5 Database Start Transfer

10) If required, select the preferred device.

    a) Touch **Select Preferred Device** Button.

    b) Touch the button for the desired mobile device from the list.

11) If desired, change the Preferred Region for the database.

    a) Touch a database button from the list.

    b) Touch **Select Preferred Region** Button.

    c) Touch the button for the desired database region from the list. The database for the region selected will be loaded at the next power cycle.

    d) Touch **Load > OK**.

    e) Repeat steps **a)** through **d)** above for additional databases.
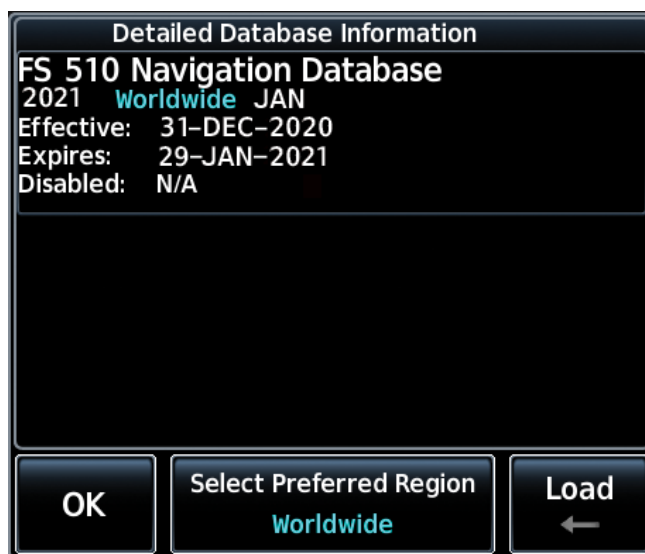
Figure B-6 Selecting Preferred Region

12) Touch the **Start Transfer** Button on the 'Database Status' Screen.

13) On the mobile device, connect to the indicated SSID Wi-Fi network shown on the **WiFi** Tab of the 'Connext Setup' Screen.

Figure B-7 Bluetooth Setup

14) On the mobile device, start Garmin Pilot and touch **Home** > **Connext** > **Database Concierge**.

15) Monitor the Sync Status on the 'Database Status' Screen. Wait for all databases to complete syncing, indicated by 'Sync Complete' being displayed.

16) The database update status will appear in the status window at the top of the screen. The load is complete when 'Databases Ready' is displayed.

17) A cyan double-arrow will appear between the Standby and Active columns to show which standby databases will be transferred to Active at the next power cycle. For any databases not selected to load with cyan double-arrows, touch the database title and then touch **Swap** > **OK.**
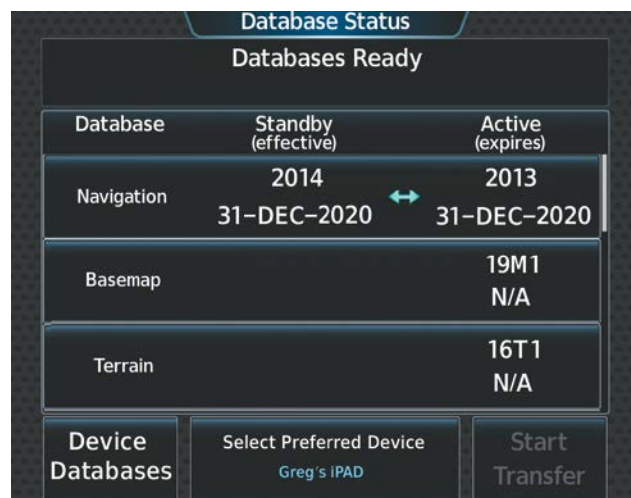
Figure B-8 'Database Status' Screen before Activation of Standby Databases

18) The system will display the message 'Activate databases with on ground restart.' Touch **Back > Database Options > Restart Displays**.

19) A 10 second restart countdown will appear. Touch the **Restart** Button in the display window to continue with he restart of the system.

20) Touch **Database Status** on the 'Initialization' Screen on the MFD touchscreen controller.

 Or:

From Home, touch **Utilities > Setup > Database Status.**

Figure B-9 'Database Status' Screen after Activation of Standby Databases

21) Verify the standby databases transferred and are now in the 'Active' database column.

22) To manually activate any databases that did not transfer to the Active column:

    a) Touch **Database Status** on the 'Initialization' Screen of either touchscreen controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

    b) Scroll down and touch the database title.

    c) Touch **Swap** > **OK**. The cyan double-arrows will now appear beside the selected databases.

    d) Remove and reapply power to the system.

    e) Touch **Database Status** on the 'Initialization' Screen of either Touchscreen Controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

    f) Verify the standby databases transferred and are now in the Active database column.

23) To view database status:

    a) Touch **Database Status** on the 'Initialization' Screen on the MFD Touchscreen Controller.

        Or:

        From Home, touch **Utilities > Setup > Database Status.**

    b) To view database status for an individual display, touch **Database Options > LRU Database Info.**

        Or:

        To view database status from 'Avionics Status' Screen, touch **Utilities > Setup > Avionics Status**. Touch the **Database** Tab**.**

    c) Touch a button from the list to view database information associated with that display.

    d) Scroll through the database information to view database status.

DATABASE SYNCHRONIZATION FEATURE

When a PFD or MFD is failed, any database updates will not be automatically synchronized to the other displays. When this occurs, the database synchronization feature allows synchronizing to be completed on the remaining powered displays.

Synchronizing databases:

1) Follow the procedures for loading databases in this section. The databases will not sync to any of the displays when a display is not powered.

2) Touch the **Database Status** Button on the 'Initialization' Screen on the MFD Touchscreen Controller.

   Or:

   From Home, touch **Utilities > Setup > Database Status.**

3) Scroll down and touch **Database Options** > **Sync Databases**.
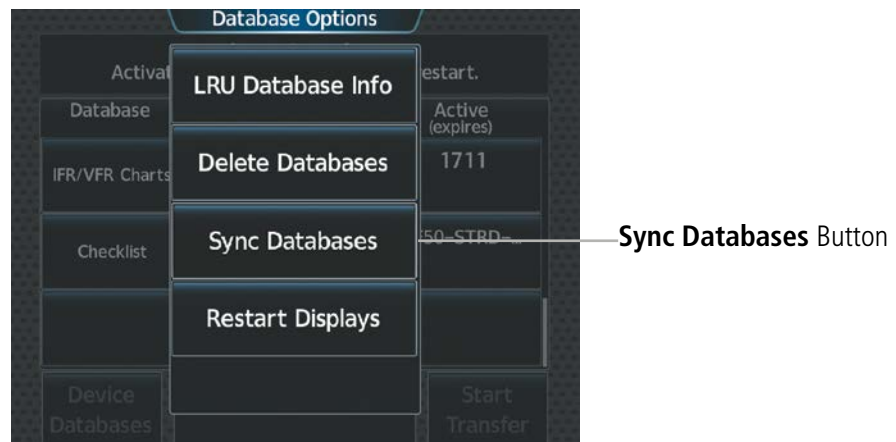
Figure B-10 Sync Databases

4) From the 'Sync From Display' Screen, touch the button for the display the databases will be synced from (this will be the display containing the SD Card or multimedia card).

5) The database sync process will begin. Follow the procedures for loading databases in this section to complete the database updates.

DATABASE DELETION FEATURE

If databases are not properly loading or functioning, and an attempt has been made to load the databases using new SD card or Wireless Transceiver card,, it may be necessary to delete the databases from the system.

Deleting the databases:

1) Touch the **Database Status** Button on the 'Initialization' Screen on the Touchscreen Controller.

   Or:

   From Home, touch **Utilities > Setup > Database Status.**

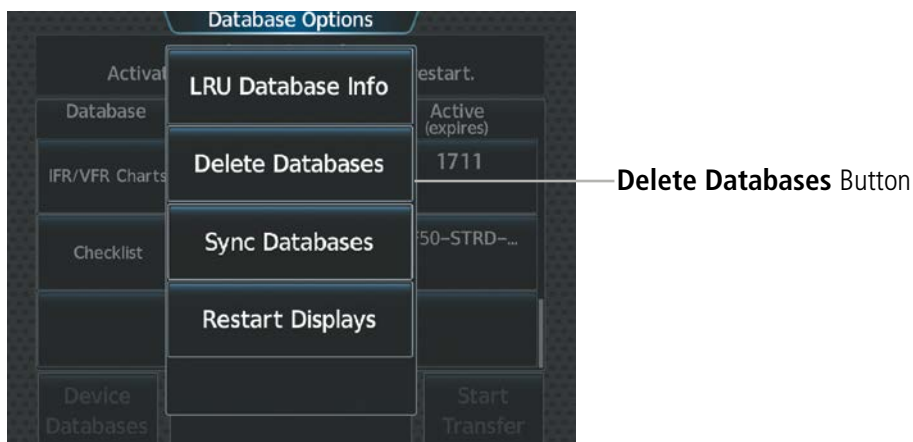2) Scroll down and touch **Database Options > Delete Databases.**

GARMIN.

Delete Databases Button

Figure B-11 Delete Databases

3) A prompt will appear to confirm deletion of selected databases. Touch the **OK** Button.
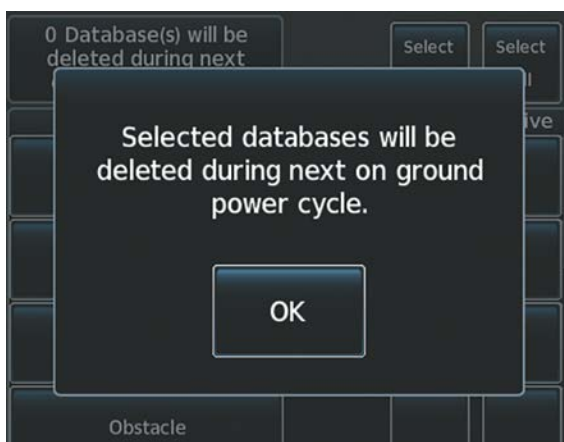

Figure B-12 Ground Power Cycle

4) Delete all or selected active databases:

To delete all active databases, touch the **Select All** button in the 'Active' Column.

Or:

To delete selected active database(s), touch the desired database button(s) in the 'Active' Column.

5) Delete all or selected standby databases:

To delete all standby databases, touch the **Select All** Button in the 'Standby' Column.

Or:

To delete selected database(s), touch the desired database button(s) in the 'Standby' Column.

Figure B-13 Select Databases

6) Remove and reapply power to the system.

7) Touch the **Database Status** Button on the 'Initialization' Screen of the Touchscreen Controller.

   Or:

   From Home, touch **Utilities > Setup > Database Status.**

8) Confirm that all databases or selected databases have been deleted from the system.

MAGNETIC FIELD VARIATION DATABASE UPDATE FOR OPTIONAL GRS 79

The Magnetic Field Variation Database is loaded as part of the navigation database, but is copied to, and resides within each AHRS (GRS1 and GRS2). At startup, the system compares the MV DB within the navigation database to that presently residing in each AHRS (GRS1 and GRS2). When a new navigation database is loaded, the system may determine the newly loaded MV DB within the navigation database is newer than that residing in each AHRS. In this case, the system will prompt for an update. This prompt is displayed on the Touchscreen Controller (GTC), as shown in Figure B-14. Note, in this example, GRS1 is the first AHRS to indicate an update is available. In actuality, this is dependent on which AHRS is the first to report status to the system. GRS2 may be displayed before GRS1. The order is not important, only that both AHRS be updated.

Figure B-14 GRS1 Magnetic Field Variation Database Update Prompt (Touchscreen Controller)

Loading the Magnetic Field Variation Database update:

1) With the MV DB prompt displayed, as shown in Figure B-14, touch the **OK** Button. A progress monitor is displayed as shown in Figure B-15.
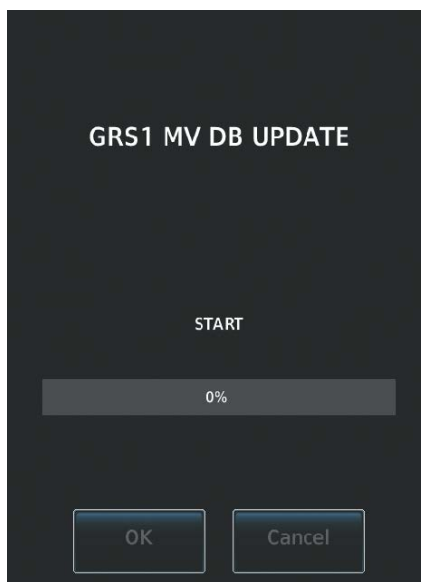

Figure B-15 Uploading Database to GRS1

2) When the upload is complete, the prompt for the next GRS upload is displayed, as seen in Figure B-16. A database mismatch message, as seen in Figure B-17, indicates the second GRS has not yet been updated.

Figure B-16 GRS2 Magnetic Field Variation Database Update Prompt
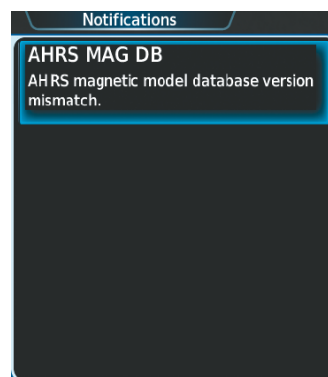
Figure B-17 Database Mismatch Message is Annunciated Before Second GRS is Updated

3) Touch the **OK** Button. A progress monitor for the next GRS is displayed. When the upload is complete, the system is ready for use.

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AVIATION TERMS AND ACRONYMS

A	Amps, Amperes
ABN	Abnormal
AC	Advisory Circular, Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Accuracy
ACFT	Aircraft
ACK	Acknowledge
ACT, ACTV	Active, Activate, Altitude Compensated Tilt
ADAHRS	Air Data, Attitude and Heading Reference System
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Direction Indicator
ADIZ	Air Defense Identification Zone
ADM	Administrative Domain
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
ADS-R	Automatic Dependent Surveillance-Rebroadcast
AEA	Aircraft Electronic Association
AF	Arc to Fix Leg
AFCS	Automatic Flight Control System
AFM	Airplane Flight Manual
AFMS	Airplane Flight Manual Supplement
AFN	ATS Facilities Notification
AFRM	Airframe
AFTN	Aeronautical Fixed Telecommunication Network
A/G	Air-to-Ground
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
AIM	Aeronautical Information Manual
AIRB	Airborne
AIRMET, AIRM	Airman's Meteorological Information
AIRREP	Air Reports
ALRT	Alert, Alerting
ALT	Altitude
ALT, ALTN	Alternator, Alternate
ALTM	Altimeter
ALTS	Altitude Select, Selected Altitude Capture Mode
ALTV	VNAV Altitude Capture Mode
AM	Amplitude Modulation
AMP	Amplifier, Ampere
AMPS	Amperes
ANN/ANNUNC	Annunciation/Annunciator
ANSP	Air Navigation Service Provider
ANT	Antenna
AOA	Angle of Attack, ACARS Over AVLC
AOC	Aeronautical Operational Control
AOG	Aircraft On Ground
AOPA	Aircraft Owners and Pilots Association
AP	Autopilot
AP DISC	Autopilot Disconnect
APPR, APR	Approach, Approach Control
APT	Airport, Aerodrome, Automatic Pitch Trim
APTSIGNS	Airport Signs
APU	Auxiliary Power Unit
APV	Approaches with Vertical Guidance
ARINC	Aeronautical Radio Incorporated
ARM	Arm, Armed
ARSPC	Airspace
ARTCC	Air Route Traffic Control Center
ARV	Arrival
AS	Airspeed
ASB	Aviation Support Branch
ASI	Airspeed Indicator
ASOS	Automated Surface Observing System
AT	Auto Throttle
ATAS	ADS-B Traffic Advisory System
ATC	Air Traffic Control
ATCRBS	ATC Radar Beacon System
ATD	Along-Track Distance
ATE	Along-Track Error, Automatic Test Equipment
ATIS	Automatic Terminal Information Service

ATK	Along Track	**CLB**	Climb
ATN	Aeronautical Telecommunications Network	**CB**	Circuit Breaker
ATS	Air Traffic Services	**CCG**	Current Climb Gradient
ATT	Attitude	**CD**	Course to DME Distance Leg
AUD	Audio	**CDA**	Current Data Authority
AUTO	Automatic	**CDI**	Course Deviation Indicator
AUTOSEQ	Automatic Sequence	**CDU**	Control Display Unit
AUX	Auxiliary	**CF**	Course to Fix Leg
AVAIL	Available	**CFG**	Configuration
AVG	Average	**CFIT**	Controlled Flight into Terrain
AVLC	Aviation VHF Link Control	**CG**	Center of Gravity
AWOS	Automated Weather Observing System	**CH, CHNL**	Channel
AZ	Azimuth	**CHKLIST**	Checklist
B	Both Runways	**CHRG**	Charge
B ALT	Barometric Altitude	**CHT**	Cylinder Head Temperature
BC, B/C	Back Course	**CI**	Course to Intercept Leg
BARO	Barometer, Barometric Setting	**CIP**	Current Icing Potential
BATT	Battery	**CL**	Class, Centerline
Bearing	The compass direction from the present position to a destination waypoint.	**CLB**	Climb
		CLD	Cloud
BFO	Beat Frequency Oscillator	**CLG**	Ceiling
BKLT	Backlight	**CLR**	Clear
BKSP	Backspace	**CLS**	Close
BLKHD	Bulkhead	**CLTR**	Clutter
Bluetooth	Wireless standard for data exchange over short distances	**CM**	Centimeter, Context Management
		CMC	Central Maintenance Computer
BOC	Bottom of Climb	**CMPRTR**	Comparator
BOD	Bottom of Descent	**CN**	Canada
BRG	see also Bearing	**CNCL**	Cancel
BRK	Brake	**CNFM**	Confirm
BTM	Bottom	**CNI**	Communication, Navigation, & Identification
°C	Degrees Celsius		
C	Center Runway	**CNS**	Communication, Navigation, & Surveillance
CA	Course to Altitude Leg		
CAL	Calibrated	**CO**	Carbon Monoxide
CALC	Calculator	**COM**	Communication Radio
Calibrated Airspeed	Indicated airspeed corrected for installation and instrument errors.	**COMP**	Compensated, Compensation
		CONFIG	Configuration
CAS	Crew Alerting System	**CONUS**	Continental United States
CAT	Clean Air Turbulence	**COOL**	Coolant
		COPLT	Copilot

CORR	Correct, Corrected, Correction	**dBZ**	Decibels 'Z' (Radar Return)
Course	The line between two points to be followed by the aircraft.	**DCL**	Departure Clearance
		DCLTR, DECLTR	Declutter
Course to Steer	The recommended direction to steer in order to reduce course error or stay on course. Provides the most efficient heading to get back to the desired course and proceed along the flight plan.	**DEC**	Declination
		DEC FUEL	Decrease Fuel
		DEG	Degree
		DEIC, DEICE	De-icing
		DEL	Delete
CP	Copilot, Control Panel	**DEP**	Departure, Departure Control
CPDLC	Controller Pilot Datalink Communications	**DESC**	Descent
CPL	Couple	**Desired Track**	The desired course between the active "from" and "to" waypoints.
CR	Course to Radial Leg		
CRG	Cockpit Reference Guide	**DEST, DES**	Destination, Destination Airport Identifier
CRNT	Current	**DET**	Detect, Detected, Detection, Detector
Crosstrack Error	The distance the aircraft is off a desired course in either direction, left or right.	**DEV**	Deviation
CRS	see also Course, Course to Steer	**DF**	Direction Finder, Direct to Fix Leg
CRSR	Cursor	**DFLT**	Default
CRU, CRZ	Cruise	**DG**	Directional Gyro
CSA	Conflict Situational Awareness	**DGPS**	Differential GPS
CSC	Current Speed Control	**DGRD**	Degrade
CSTR	Constraint	**DH**	Decision Height
CTA	Control Area	**DIFF**	Differential
CTAF	Common Traffic Advisory Frequency	**Dilution of Precision**	A measure of GPS satellite geometry quality on a scale of one to ten (lower numbers equal better geometry, where higher numbers equal poorer geometry).
CTR	Center		
CTRL	Control		
Cumulative, CUM	The total of all legs in a flight plan.	**DIR**	Direction
		DIS	Distance
CVDR	Cockpit Voice Data Recorder	**DISENG**	Disengage
CVFP	Charted Visual Flight Procedure	**Distance**	The 'great circle' distance from the present position to a destination waypoint.
CVR	Cockpit Voice Recorder		
CVRG	Coverage		
CWS	Control Wheel Steering	**DIV**	Divert, Diversion
CYC CTR	Cyclic Centering	**DL LTNG**	Datalink Lightning
CYL	Cylinder	**DLS**	Data Link System
CZ	Control Zone	**DME**	Distance Measuring Equipment
D->, D►	Direct-To	**DN**	Down
D/A	Digital to Analog Converter	**DNALT**	Density Altitude
D ALT	Density Altitude	**DNGR**	Danger
D-ATIS	Digital Automatic Terminal Info Service	**DNLK**	Downlink
DA	Decision Altitude, Drift Angle	**DOD**	Department of Defense
DB, DBASE	Database	**DOP**	see also Dilution of Precision

DOPP	Doppler		**ENGD**	Engaged
DP	Departure Procedure, Differential Pressure		**ENR**	Enroute; ETE to Final Destination
DPRT	Departure		**Enroute Safe Altitude (ESA)**	Uses Grid MORAs to determine a safe altitude within ten miles left or right of the desired course on an active flight plan or direct-to.
DQR	Data Quality Requirements			
DR	Dead Reckoning			
DSBL	Disabled			
DSP	Display, Datalink Service Provider, Digital Signal Processor		**ENT**	Enter
			EP	Envelope Protection
DTG	Distance To Go, Remaining distance to last active FPL waypoint		**EPE**	see also Estimated Position Error
			EPU	Estimated Position Uncertainty
DTK	see also Desired Track		**ERR**	Error
DWNGRADE	Downgrade		**ES**	Extended Squitter
E	Empty, East		**ESA**	Emergency Safe Altitude, see also Enroute Safe Altitude
EAS	Engine and Airframe Systems			
EC	Error Correction		**ESP**	Electronic Stability and Protection
ECC	Error Correcting Code		**Estimated Position Error (EPE)**	A measure of horizontal GPS position error derived by satellite geometry conditions and other factors.
ECL	Eledtronic Checklist			
ECR	Excessive Closure Rate			
ECS	Environmental Control System		**Estimated Time Enroute (ETE)**	The estimated time it takes to reach the destination waypoint from the present position, based upon current groundspeed.
ECU	Engine Control Unit			
EDM	Emergency Descent Mode			
EDR	Excessive Descent Rate			
EFC	Expected Further Clearance		**Estimated Time of Arrival (ETA)**	The estimated time at which the aircraft should reach the destination waypoint, based upon current speed and track.
Efficiency	A measure of fuel consumption, expressed in distance per unit of fuel.			
			ET	Elapsed Time
EGNOS	European Geostationary Navigation Overlay Service		**ETA**	see also Estimated Time of Arrival
			ETE	see also Estimated Time Enroute
EGT	Exhaust Gas Temperature		**EVS**	Enhanced Vision System
EICAS	Engine Indication and Crew Alerting System		**EXP**	Expand
			EXPIRD	Expired
EIS	Engine Indication System		**EXT**	External
ELEC	Electrical		**EXTD**	Extend
ELEV	Elevation, Elevator		**EXTING**	Extinguish, Extinguisher
ELT	Emergency Locator Transmitter		**EXTR**	Extract, Extraction
EMER, EMERG, EMERGCY	Emergency		**°F**	Degrees Fahrenheit
			FA	Course From Fix to Altitude Leg
EMI	Electromagnetic Interference		**FAA**	Federal Aviation Administration
END, ENDUR	Endurance		**FADEC**	Full Authority Digital Engine Control
Endurance	Flight endurance, or total possible flight time based on available fuel on board.		**FAF**	Final Approach Fix
			FAIL	Failure
ENG	Engine		**FANS**	Future Air Navigation System
ENGA	Engage		**FAP**	Final Approach Point

FAPP	Final Approach	**Fuel On Board**	The total amount of usable fuel on board the aircraft.
FAR	Federal Aviation Regulations	**Fuel Over Destination**	The estimated fuel remaining when the aircraft reaches the destination waypoint, based upon current fuel flow.
FBO	Fixed Base Operator		
F/C	Flight Crew		
FC	Course From Fix to Distance Leg		
FCC	Federal Communication Commission	**FWD**	Forward
FCST	Forecast	**G/A**	Ground to Air
FCTN	Function	**G/S**	Glideslope
FD	Flight Director, Course From Fix to DME Distance Leg	**GA**	Go-Around
		GAGAN	GPS Aided GEO Augmented Navigation
FDE	Fault Detection and Exclusion	**GAGL**	GPS AGL Altitude
FDR	Flight Data Recorder	**GAL, GL**	Gallon(s)
FF, FFLOW	see also Fuel Flow	**GBAS**	Ground Based Augmentation System
FIS-B	Flight Information Services-Broadcast	**GBOX**	Gearbox
FISDL	Flight Information Service Data Link	**GBT**	Ground Based Transceiver
FIT	Flight Into Terrain	**GCS**	Ground Clutter Suppression
FL	Flight Level	**GCSS**	Garmin Connext Satellite Services
FLC, FLCH	Flight Level Change	**GCU**	Garmin Control Unit
FLT	Flight, Flight Timer	**GDC**	Garmin Air Data Computer
FLTA	Forward Looking Terrain Avoidance	**GDL**	Garmin Satellite Data Link
FLW	Follow, Following	**GDR**	Garmin Data Radio
FM	Course From Fix to Manual Termination Leg	**GDU**	Garmin Display Unit
		GEA	Garmin Engine/Airframe Unit
FMS	Flight Management System	**GEAR**	Landing Gear
FOB	see also Fuel On Board	**GEN**	Generator
FOD	see also Fuel Over Destination	**GEO**	Geographic
FPA	Flight Path Angle	**GFC**	Garmin Flight Control
FPL	Flight Plan	**GHz**	Gigahertz
FPM	Feet Per Minute, Flight Path Marker	**GIA**	Garmin Integrated Avionics Unit
FR	From	**GLONASS**	Global Orbiting Navigation Satellite Landing System
FREQ	Frequency		
FRMT	Format	**GLS**	Global Navigation Satellite Landing System
FRT	Front		
FRZ	Freezing	**GMA**	Garmin Audio Panel System
FSD	Full-Scale Deflection	**GMC**	Garmin Mode Controller
FSM	Flight System Messages	**GMT**	Greenwich Mean Time
FSS	Flight Service Station	**GMU**	Garmin Magnetometer Unit
FT	Foot/Feet	**GND**	Ground
Fuel Flow	The fuel flow rate, expressed in units of fuel per hour.	**GOLD**	Global Operational Data Link
		GP	Glidepath
		GPH	Gallons per Hour

GPN	Garmin Part Number	**HM**	Hold with Manual Termination Leg
GPS	Global Positioning System	**HNS**	Hybrid Navigation Sensor
GPWS	Ground Proximity Warning System	**Horizontal Figure of Merit**	A measure of the uncertainty in the aircraft's horizontal position.
Grid MORA (Minimum Off-Route Altitude)	One degree latitude by one degree longitude in size and clears the highest elevation reference point in the grid by: a) 1,000 feet where the highest elevation is <5001MSL or b) 2,000 feet where the highest elevation is >5000MSL	**HOV**	Hover
		HOV-P	Hover Prediction
		HP	High Pressure, Horsepower
Ground Track	See Track	**hPa**	Hectopascal
Groundspeed	The velocity the aircraft is travelling relative to a ground position.	**HPI**	Hover Power Indicator
		HPL	Horizontal Protection Level
GRP	Geographic/Ground Reference Point	**HR**	Hour
GRS	Garmin Reference System	**HRZN HDG**	Horizon Heading
GS	Ground Speed, Glideslope	**HSDB**	High-Speed Data Bus
GSA	Garmin Servo Adapter	**HSI**	Horizontal Situation Indicator
GSD	Glideslope/Glidepath Deviation, Garmin Data Concentrator	**HT**	Heat, Height
		HTR	Heater
GSL	Geometric/Geodetic Sea Level	**HUL**	Horizontal Uncertainty Level
GSR	Garmin Satellite Radio	**HWND**	Headwind
GSU	Garmin Sensor Unit	**HYD**	Hydraulic
GTC	Garmin Touchscreen Controller	**Hz**	Hertz (cycles per second)
GTS	Garmin Traffic System	**HZN**	Horizon
GTX	Garmin Transponder	**I**	Inner Marker
GW	Gross Weight	**IAF**	Initial Approach Fix
GWX	Garmin Weather Radar	**IAP**	Instrument Approach Procedure
H	Hours	**IAS**	Indicated Air Speed
H+MM	Hours and Minutes	**IAT**	Indicated Air Temperature
HA	Hold Terminating at Altitude Leg	**IATA**	International Air Transport Association
HAL	Horizontal Alert Limit	**IAU**	Integrated Avionics Unit
HAT	Height Above Threshold	**IBD, INBD**	Inboard
HDG	see also Heading	**ICAO**	International Civil Aviation Organization
HDOP	Horizontal Dilution of Precision	**ICE**	Icing
Heading	The direction an aircraft is pointed, based upon indications from a magnetic compass or a properly set directional gyro.	**ICS**	Intercom System
		ID	Identification/Morse Code Identifier
HF	High Frequency, Hold Terminating at Fix Leg	**IDENT, IDNT**	Identification
		IEEE	Institute of Electrical & Electronics Engineers
HFOM	see also Horizontal Figure of Merit	**IF**	Initial Fix
Hg	Mercury	**IFR**	Instrument Flight Rules
HI	High	**IG**	Imperial Gallon
HI SENS	High Sensitivity	**IGE**	In Ground Effect
HLD	Hold, Holding, Holding Pattern		

ILI	Imminent Line Impact		**LB**	Pound
ILS	Instrument Landing System		**LBL**	Label
IM	Inner Marker		**LCD**	Liquid Crystal Display
IMC	Instrument Meteorological Conditions		**LCL**	Local
IN	Inch		**LDA**	Landing Distance Available
IN Hg, "HG	Inches of Mercury		**LDG**	ETA at Final Destination
INACTV	Inactive		**LED**	Light Emitting Diode
INBD	Inboard		**Left Over Fuel On Board**	The amount of fuel remaining on board after the completion of one or more legs of a flight plan or direct-to.
INBND	Inbound			
INC FUEL	Increase Fuel			
IND	Indicator, Indicated		**Left Over Fuel Reserve**	The amount of flight time remaining, based on the amount of fuel on board after the completion of one or more legs of a flight plan or direct-to, and a known consumption rate.
Indicated	Information provided by properly calibrated and set instrumentation on the aircraft panel.			
INDX	Index			
INFO	Information		**Leg**	The portion of a flight plan between two waypoints.
INH, INHIB	Inhibit			
INOP	Inoperative		**LEN**	Length
INS	Inertial Navigation System		**LGND**	Legend
INSTR	Instrument		**LIFR**	Low Instrument Flight Rules
INT	Intersection(s)		**LI-ION**	Lithium Ion
INTEG	Integrity (RAIM unavailable)		**LIM**	Limit
INTERN, INTRL	Internal		**LMM**	Location Middle Marker
INV	Invalid		**LNAV**	Lateral Navigation
IOI	Imminent Obstacle Impact		**LO**	Low
IR	Infrared		**LOA**	Letter of Authorization
IrDA, IRDA	Infrared Data Association		**LOC**	Localizer
IRST	Infrared Surveillance and Tracking		**LOI**	Loss of Integrity (GPS)
ISA	International Standard Atmosphere; ISA Relative Temperature		**LOM**	Location Outer Marker
			LON, LONG	Longitude, Longitudinal
ISO	International Standards Organization		**LP**	Localizer Performance, Low Pressure
ISOL	Isolation		**LPV**	Localizer Performance with Vertical Guidance
ITI	Imminent Terrain Impact			
ITT	Inter-Turbine Temperature, Interstage Turbine Temperature		**LRU**	Line Replaceable Unit
			LSB V	Lower Sideband Voice
KEYSTK	Key Stuck		**LT**	Left, Light
KG	Kilogram		**LTNG**	Lightning
kHz	Kilohertz		**LVL**	Level
KM	Kilometer		**M**	Meter, Middle Marker, Mach
KT	Knot		**Mach Number**	Mach number is the ratio of the true airspeed to the speed of sound.
L	Left, Left Runway			
LAT	Latitude, Lateral		**MAG**	Magnetic
			MAG VAR	Magnetic Variation

MAHP	Missed Approach Hold Point
MAINT	Maintain
MAL	Malfunction
MAN	Manual
MAN IN	Manifold Pressure (inches Hg)
MAN SQ	Manual Squelch
MANSEQ	Manual Sequence
MAP	Missed Approach Point
MAPROC	Missed Approach Procedure
MASQ	Master Avionics Squelch
MAX	Maximum
MAXSPD	Maximum Speed (overspeed)
MB	Marker Beacon, Millabar(s)
MCDU	Multifunction Control and Display Unit
MCLB	Maximum Climb Thrust
MCP	Maximum Continuous Power
MCRZ	Maximum Cruise Thrust
MDA	Barometric Minimum Descent Altitude
MEA	Minimum Enroute Altitude
MEM	Memory
MEPT	Manual Electric Pitch Trim
MET	Manual Electric Trim
METAR	Aviation Routine Weather Report
METRO	Metropolitan
MFD	Multi Function Display
MGRS	Military Grid Reference System
MGT	Measured Gas Temperature
MHz	Megahertz
MIC	Microphone
MID	Middle
MIN	Minimum, Minute
Minimum Safe Altitude (MSA)	Uses Grid MORAs to determine a safe altitude within ten miles of the aircraft present position.
MKR	Marker Beacon
MM	Middle Marker
MMO (VMO)	Maximum Speed
MOA	Military Operations Area
MOD	Modification, Modify
MON	Monitor, Monitored, Monitoring
MORA	Minimum Off-Route Altitude

MOV	Movement
MPEL	Maximum Permissible Exposure Level
MPM	Meters per Minute
MSA	see also Minimum Safe Altitude
MSAS	Multi-functional Satellite Augmentation System
MSG	Message
MSL	Mean Sea Level
MT, M	Meter
MTG	Mounting
MTN	Mountain
MTOGW	Maximum Takeoff Gross Weight
MTOW	Maximum Takeoff Weight
mV	Millivolt(s)
MVFR	Marginal Visual Flight Rules
N	North
NATS	North Atlantic Tracks System
NAV	Navigation
NAVAID	Navigation Aid
NCR	Negative Climb Rate
NDA	Next Data Authority
NDB	Non-Directional Beacon
NEG	Negative
NEXRAD	Next Generation Radar
NG	Gas Producer Rotation Speed
NM	Nautical Mile(s)
NMPG	Nautical Miles per Gallon
NoPT	No Procedure Turn Required (procedure shall not be executed without ATC clearance)
NORM	Normal
NOTAM	Notice To Airman
NP	Power Turbine Speed
NPA	Non-Precision Approach
NR	Rotor Speed
NRST	Nearest
NWHL	Nosewheel
NWS	National Weather Service, Nosewheel Steering
O	Outer Marker
OAT	Outside Air Temperature

OBD, OUTBD	Outboard		**PIREP**	Pilot Report
OBS	Omni Bearing Selector, Observation, Observe, Observed		**PIT, PTCH**	Pitch
			PLT	Pilot
OBSCR	Obscuration		**PNR**	Prior Notice Required
OCL	Oceanic Clearance		**POA**	Plain Old ACARS
OEM	Original Equipment Manufacturer		**POB**	Persons (Souls) on Board
OFST	Offset		**POF**	Phase of Flight
OGE	Out of Ground Effect		**POH**	Pilot's Operating Handbook
OM	Outer Marker		**POHS**	Pilot's Operating Handbook Supplement
OOOI	Out of the gate, Off the ground, On the ground, and In the gate		**POS, POSN**	Position
			POSS	Possible
OROCA	Off Route Obstacle Clearance Altitude		**PPH**	Pounds per Hour
OUTBD	Outboard		**PPM**	Parts per Million
OUTBND	Outbound		**PPOS, P. POS**	Present Position
OVBD	Overboard		**PREFLT**	Preflight
OVFL	Overflow		**PRES, PRESS, P**	Pressure
OVFLY	Overfly, Overflying		**PREV**	Previous
OVHD	Overhead		**PRI**	Primary
OVHT	Overheat		**PRL**	Parallel
OVLIM	Overlimit		**PRN**	Pseudo Random Noise
OVLD	Overload		**PROC**	Procedure(s), Procedure Turn
OVPR	Overpressure		**PROP**	Propeller
OVR, OVRD	Override		**PROX**	Proximity
OVRN	Overrun		**PSI**	Pounds per Square Inch, Power Situation Indicator
OVSPD	Overspeed			
OVTMP	Overtemperature		**PT**	Procedure Turn
OXY	Oxygen		**PTK**	Parallel Track
P ALT	Pressure Altitude		**PTT**	Push-to-Talk
P-ATT	Pitch Attitude		**PWR**	Power
PA	Precision Approach, Passenger Address, Proximity Advisory		**Q**	Engine Torque
			QFE	Field Elevation Pressure
PB	Push Button		**QNE**	Pressure Altitude
PASS, PAX	Passenger(s)		**QNH**	Sea Level Pressure
PC	Personal Computer		**QTY**	Quantity
PDA	Premature Descent Alerting		**R**	Right, Right Runway
PDC	Pre-Departure Clearance		**RA**	Resolution Advisory, Radio Altimeter, Radar Altimeter
PED	Personal Electronic Device			
PERF	Performance		**RAD**	Radial
PFD	Primary Flight Display		**RAD ALT**	Radio Altimeter, Radar Altimeter
PG	Pilot's Guide		**RAIM**	Receiver Autonomous Integrity Monitoring
PI	Procedure Turn to Course Intercept Leg		**RAM**	Random Access Memory

RAT	Ram Air Temperature	**RTR**	Router
RCVR	Receiver	**RUDICS**	Router-Based Unrestricted Digital Interworking Connectivity Solution
R/D	Radial/Distance		
RDR	Radar	**RVRSNRY**	Reversionary
REC	Record, Recorder	**RVSI**	Required Vertical Speed Indicator
RECIRC	Recirculate/Recirculating	**RVSM**	Reduced Vertical Separation Minimums
REF	Reference	**RX**	Receive
REGL	Regulator	**S**	South
REM	Remaining (fuel remaining), Reminder, Removed, Remote	**SA**	Selective Availability
		SAIB	Special Airworthiness Information Bulletin
REQ	Request	**SAR**	Search and Rescue
REQD	Required	**SAT**	Static Air Temperature
RES	Reserve (fuel reserve entered by pilot)	**SATCOM**	Satellite Communication
REST	Restricted, Restriction	**SBAS**	Satellite-Based Augmentation System
RET	Return	**S-CLB**	Step Climb
REV	Reverse, Revision, Revise	**SC**	Short Circuit
RF	Radio Frequency, Constant Radius Turn to Fix Leg	**SCIT**	Storm Cell Identification and Tracking
		S-DES	Step Descent
RFM	Rotorcraft Flight Manual	**SD**	Secure Digital
RLC	Required Line Clearance	**SEC**	Second(s)
RMI	Radio Magnetic Indicator	**SECT**	Section
RMT	Remote	**SEG**	Segment
RNAV	Area Navigation	**SEL, SLCT**	Select
RNG	Range	**SELCAL**	Selective Calling
RNP	Required Navigation Performance	**SENS**	Sense, Sensitivity
RNWY, RWY	Runway	**SEQ**	Sequence, Sequencing
ROASS	Runway Overrun Awareness and Alerting System	**SERV**	Service, Servicing, Served
		SET	Setup
ROC	Required Obstacle Clearance, Rate of Cllmb	**SFC**	Surface
		SHT	Short
ROD	Rate of Descent	**SIAP**	Standard Instrument Approach Procedures
ROL	Roll	**SID**	Standard Instrument Departure
ROM	Read Only Memory	**SIG**	Signal
ROT	Rotary	**SIG/AIR**	SIGMET/AIRMET
RPM	Revolutions Per Minute	**SIGM**	SIGMET
RQRD	Required	**SIGMET**	Significant Meteorological Information
RST FUEL	Reset Fuel	**SIM**	Simulator
RSV	Reserve (fuel reserve entered by pilot)	**SITA**	Societe Internationale de Telecommunications
RT	Right		
RTC	Required Terrain Clearance	**SLD**	Supercooled Large Droplet
RTE	Route		

SLP/SKD	Slip/Skid		**SYNTH**	Synthesizer
SLW	Slow		**SYS**	System
SM	Statute Mile		**T**	True
SMBL	Symbol		**T HDG**	True Heading
SMK	Smoke		**T/R**	Thrust Reverser
SMS	Short Message System		**TA**	Traffic Advisory, Transition Altitude
SNGL	Single		**TAC**	Tactical
SOB	Souls on Board		**TACAN, TCN**	Tactical Air Navigation System
SPBK	Speed Brake		**TAF**	Terminal Aerodrome Forecast
SPC	Space		**TAS**	True Airspeed, Traffic Advisory System
SPD	Speed		**TAT**	Total Air Temperature
SPI	Special Position Identification		**TAWS**	Terrain Awareness and Warning System
SPKR	Speaker		**TCA**	Terminal Control Area
SQ, SQL	Squelch		**TCAS**	Traffic Alert Collision Avoidance System
SRVC, SVC	Service		**TCH**	Threshold Crossing Height
SSEC	Static Source Error Correction		**TD**	Touchdown
SSID	Wireless Service Set Identifier		**TEL**	Telephone
STAB	Stabilization		**TEMP**	Temperature
STAL	Stall		**TERM**	Terminal
STAR	Standard Terminal Arrival Route		**TERR**	Terrain
STAT	Status		**T/F**	To/From
STATS	Statistics		**TF**	Track Between Two Fixes Leg
STBY	Standby		**TFR**	Temporary Flight Restriction
STC	Sensitivity Time Constant, Supplemental Type Certificate		**TGT**	Target
			TH	True Heading
STD	Standard		**THLD**	Threshold
STN	Station		**THR**	Thrust
STR	Strip		**TIS**	Traffic Information Service
STRMSCP	Stormscope		**TIS-B**	Traffic Information Service-Broadcast
SUA	Special Use Airspace		**TIT**	Turbine Inlet Temperature
SUB	Substitute		**TKE**	see also Track Angle Error
SUPPRESS	Suppression		**TL**	Transition Level
SURF	Surface		**TLA**	Throttle Lever Angle, Thrust Lever Angle
SUSP	Suspend		**TMA**	Terminal Maneuvering Area
SVBL	Serviceable		**TMR/REF**	Timer/Reference
SVT	Synthetic Vision Technology		**TNK**	Tank
SW	Software		**TO**	To, Takeoff
SYN TERR	Synthetic Terrain		**TOC**	Top of Climb
SYN VIS	Synthetic Vision		**TOD**	Top of Descent, Time to TOD
SYNC	Synchronize			

TOGA, TO/GA	Take-Off, Go-Around		**UTC**	Coordinated Universal Time
TOLD	Takeoff and Landing Data		**UTM/UPS**	Universal Transverse Mercator/ Universal Polar Stereographic Grid
TOPO	Topographic		**UUA**	Urgent PIREP
TORA	Takeoff Run Available		**V**	Volts, Vertical
TOT	Total		**V DEV**	Vertical Deviation
TPA	Traffic Pattern Altitude		**V, Vspeed**	Velocity (airspeed)
Track	Direction of aircraft movement relative to a ground position; also 'Ground Track'.		V_1	Takeoff Decision Speed
			V_2	Takeoff Safety Speed
Track Angle Error	The angle difference between the desired track and the current track.		V_A	Maneuvering Speed
			VA	Heading Vector to Altitude Leg
TRFC	Traffic		**VAC**	Volts Alternating Current
TRK	see also Track		**VAL**	Vertical Alert Limit
TRN	Terrain		**VAPP**	VOR Approach Mode
TRSA	Terminal Radar Service Area		V_{APP} , V_{AC}	Approach Climb Speed
TRUNC	Truncated		**VAR**	Variable, Variation
TSO	Technical Standard Order		**VCO**	Voice Call Out
TST	Test		**VD**	Heading Vector to DME Distance Leg
TTA	Time-to-Alert		**VDC**	Volts Direct Current
TTK	True Track		**VDI**	Vertical Deviation Indicator
TTL	Total		**VDL**	VHF Datalink
TTS	Text to Speech		**VECT**	Vector
TUR	Turbine		**VERT**	Vertical
TURB	Turbulence		**Vertical Figure of Merit**	A measure of the uncertainty in the aircraft's vertical position.
TURN	Procedure Turn			
TWND	Tailwind		**Vertical Speed Required**	The vertical speed necessary to descend/climb from a current position and altitude to a defined target position and altitude, based upon current groundspeed.
TWIP	Terminal Weather Information for Pilots			
TWR	Tower			
TWY	Taxiway			
TX	Transmit		V_{FE}	Maximum Flap Extended Speed
UA	Routine PIREP		**VFOM**	see also Vertical Figure of Merit
UAT	Universal Access Transceiver		**VFR**	Visual Flight Rules
UHF	Ultra-High Frequency		**VHF**	Very High Frequency
UNABL	Unable		**VI**	Heading Vector to Intercept Leg
UNAVAIL	Unavailable		**VIB**	Vibration
UNLIM	Unlimited		V_{LE}	Maximum Landing Gear Extended Speed
UPLK	Uplink		V_{LNDx}	Approach Speed (Flaps at x°)
US	United States		V_{LO}	Maximum Landing Gear Operating Speed
USB V	Upper Sideband Voice		**VLD**	Valid
USR	User		**VLOC, VOR/L**	VOR/Localizer Receiver

VM	Heading Vector to Manual Termination Leg
V$_{MC}$	Minimum Control Speed
VMC	Visual Meteorological Conditions
V$_{MO}$ (M$_{MO}$)	Maximum Operating Speed
VNAV, VNV	Vertical Navigation
V$_{NE}$	Never-Exceed Speed
VOL	Volume
VOR	VHF Omnidirectional Range
VOR/D	VOR/DME
VOR/I	VOR/ILS
VORTAC	VHF Omnidirectional Range Station and Tactical Air Navigation
VPATH, VPTH	Vertical Path
VPL	Vertical Protection Level
VPROF	VNAV Profile, Vertical Profile
V$_{R}$	Takeoff Rotate Speed
VR	Heading Vector to Radial Leg
V$_{REF}$	Landing Approach Speed, Reference Landing Speed
VRP	Visual Reporting Point
VS	Vertical Speed
V$_{SB}$	Maximum Speedbrake Speed
VSD	Vertical Situation Display
VSI	Vertical Speed Indicator
V$_{SR}$	Stall Speed
VSR, VS REQ	see also Vertical Speed Required
V$_{T}$	Takeoff Flap Retraction Speed
VTE	Vertical Track Error
VTF	Vector to Final
VTK	Vertical Track
V$_{TIRE}$	Maximum Tire Speed
V$_{X}$	Best Angle of Climb Speed
V$_{Y}$	Best Rate of Climb Speed
V$_{YSE}$	Best Single-Engine Rate of Climb Speed
W	Watt(s), West
WAAS	Wide Area Augmentation System
WARN	Warning
WATCH	Weather Attenuated Color Highlight

WDIR	Wind Direction
WEP	Wired Equivalent Privacy
WSPD	Wind Speed
WGS-84	World Geodetic System - 1984
WI-FI, WIFI	Wireless Local Area Network based on IEEE 802.11
WILCO	Will Comply
WNDSHR, WSHEAR	Windshear
WL	Wings Level
WOG	Weight on Gear
WOW	Weight on Wheels
WPA	Wi-Fi Protected Access
WPT	Waypoint(s)
WT	Weight
W/V	Wind Velocity
WW	World Wide
WX	Weather
WXR	Weather Radar
XFD	Crossfeed
XFER, XFR	Transfer
XFLOW	Crossflow
XM LTNG	SiriusXM Lightning
XMIT	Transmit
XMSN	Transmission
XPDR	Transponder
XTALK	Cross-Talk
XTE	Crosstrack Error
XTK	Cross-Track, Crosstrack Error
YD	Yaw Damper
Z	Reflectivity Factor

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Garmin G5000 Pilot's Guide for the Textron Citation 560XL/XLS

FREQUENTLY ASKED QUESTIONS

If a particular aspect of G5000 operational capability is not addressed by these commonly asked questions or in the index, contact Garmin (see the copyright page or back cover for contact information) or a Garmin-authorized dealer. Garmin is dedicated to supporting its products and customers.

WHAT IS SBAS?

The Satellite Based Augmentation System (SBAS) uses a system of ground stations to correct any GPS signal errors. These ground stations correct for errors caused by ionospheric disturbances, timing, and satellite orbit errors. It also provides vital integrity information regarding the health of each GPS satellite. The signal correction is then broadcast through geostationary satellites. -This correction information can then be received by any SBAS-enabled GPS receiver.

SBAS is designed to provide the additional accuracy, availability, and integrity necessary to enable users to rely on GPS for all phases of flight.

There are several SBAS systems serving different parts of the world. The Wide Area Augmentation System (WAAS) is currently available in the United States, including Alaska. The European Geostationary Navigation Overlay Service (EGNOS) offers coverage of Europe, parts of the middle east and northern Africa. The Multi-functional Satellite Augmentation System (MSAS) covers mainly Japan.

HOW DOES SBAS AFFECT APPROACH OPERATIONS?

LNAV/VNAV and LPV RNAV approaches use the accuracy of SBAS to include vertical (glide path) guidance capability. The additional accuracy and vertical guidance capability allows improved instrument approaches to an expanded number of airports throughout the U.S.

The implementation of RNAV LP and LPV approaches further improves approach capabilities. RNAV LPV approaches are designed to make full use of the improved GPS signal from the SBAS. This approach combines localizer precision lateral guidance with vertical guidance similar to the typical Instrument Landing System (ILS). RNAV LPV approaches allow lower approach minimums.

WHAT IS RAIM AND HOW DOES IT AFFECT APPROACH OPERATIONS?

RAIM is an acronym for Receiver Autonomous Integrity Monitoring. RAIM is a GPS receiver function that performs the following functions:

- Monitors and verifies integrity and geometry of tracked GPS satellites
- Notifies the pilot when satellite conditions do not provide the necessary coverage to support a certain phase of flight
- Predicts satellite coverage of a destination area to determine whether the number of available satellites is sufficient to satisfy requirements

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NOTE: *If RAIM is not predicted to be available for the final approach course, the approach does not become active, as indicated by the "RAIM not available from FAF to MAP" message and the LOI annunciation flagging on the HSI.*

For RAIM to work correctly, the GPS receiver must track at least five satellites. A minimum of six satellites is required to allow RAIM to eliminate a single corrupt satellite from the navigation solution.

RAIM ensures that satellite geometry allows for a navigation solution calculation within a specified protection limit (2.0 nm for oceanic and en route, 1.0 nm for terminal, and 0.3 nm for non-precision approaches). The G5000 System monitors RAIM and issues an alert message when RAIM is not available (see Appendix A). Without RAIM, GPS position accuracy cannot be monitored. If RAIM is not available when crossing the FAF, the pilot must fly the missed approach procedure.

WHY MIGHT THERE BE NO APPROACHES AVAILABLE FOR A FLIGHT PLAN?

Approaches are available for the final destination airport in a flight plan or as a direct-to (keep in mind some VOR/VORTAC identifiers are similar to airport identifiers). If a destination airport does not have a published approach, the G5000 indicates "NONE" for the available procedures.

WHAT HAPPENS WHEN AN APPROACH IS SELECTED? CAN A FLIGHT PLAN WITH AN APPROACH, A DEPARTURE, OR AN ARRIVAL BE STORED?

When an approach, departure, or arrival is loaded into the active flight plan, a set of approach, departure, or arrival waypoints is inserted into the flight plan, along with a header line showing the title of the selected instrument procedure. The original enroute portion of the flight plan remains active, unless the instrument procedure is activated. This may be done either when the procedure is loaded or at a later time.

Flight plans can also be stored with an approach, a departure, or an arrival. Note the most recent active flight plan is restored when the system is turned on, if the aircraft position is the same as the origin airport in the most recent active flight plan. Also, the active flight plan is overwritten when another flight plan is activated. When storing flight plans with an approach, a departure, or an arrival, the system uses the waypoint information from the current database to define the waypoints. If the database is changed or updated, the system automatically updates the information, provided the procedure has not been modified. Should an approach, departure, or arrival procedure no longer be available, the flight plan becomes locked until the procedure is deleted from the flight plan

WHY MIGHT THE G5000 NOT AUTOMATICALLY SEQUENCE TO THE NEXT WAYPOINT?

The G5000 only sequences flight plan waypoints when automatic sequencing is enabled (i.e., no 'OBS' or 'SUSP' annunciation on the HSI). For automatic sequencing to occur, the aircraft must also cross the *bisector* of the turn being navigated. The bisector is a line passing through the waypoint common to two flight plan legs at an equal angle from each leg.

HOW CAN A WAYPOINT BE SKIPPED IN AN APPROACH, A DEPARTURE, OR AN ARRIVAL?

The G5000 allows the pilot to manually select any approach, departure, or arrival leg as the active leg of the flight plan. This procedure is performed from the Touchscreen Controller's 'Active Flight Plan' Screen by touching the desired waypoint button, followed by the **Activate Leg To Waypoint** Button. After confirming the activation, the GPS then provides navigation along the selected flight plan leg.

WHEN DOES TURN ANTICIPATION BEGIN?

The G5000 smooths adjacent leg transitions based on a normal 15° bank angle (with the ability to roll up to 30°) and provides three pilot cues for turn anticipation:

- A waypoint alert ('Next DTK ###° in # seconds' or 'Next HDG ###° in # seconds') appears on the PFD 10 seconds before the turn point and flashes as it counts down to zero.

- A flashing turn advisory ('Turn [right/left] to ###° in # seconds') appears on the PFD 10 seconds before the turn and flashes as it counts down to zero. 'Turn [right/left] to ###° now' or 'Next [DTK/HDG] to ###° now' is displayed when the pilot is to begin the turn and the HSI (GPS mode) automatically sequences to the next DTK or HDG value.
- The To/From indicator on the HSI flips momentarily to indicate the midpoint of the turn has been crossed.

WHEN DOES THE CDI SCALE CHANGE?

Once a departure is activated, the Course Deviation Indicator (CDI) full scale deflection is set to 0.3 nm. The CDI scale changes to 1.0 nm then ramps up to 2.0 nm at 30 nm from the departure airport. When 31 nm from the active waypoint, the CDI scale smoothly transition from 2.0 nm back to 1.0 nm. At 2.0 nm before the FAF during an active approach, the CDI scale transitions down further based on the service level of the active approach (LNAV, LNAV/VNAV, LP, and LPV). When a missed approach is activated, the CDI is set to 0.3 nm. See the Flight Instruments Section for more details on CDI scaling.

WHAT IS THE CORRECT MISSED APPROACH PROCEDURE? HOW IS THE MISSED APPROACH HOLDING POINT SELECTED?

To comply with TSO specifications, the G5000 does not automatically sequence past the MAP. The first waypoint in the missed approach procedure becomes the active waypoint when the **TO/GA** Button or **SUSP** Button is selected *after* crossing the MAP. All published missed approach procedures must be followed, as indicated on the approach plate.

AFTER A MISSED APPROACH, HOW CAN THE SAME APPROACH BE RE-SELECTED? HOW CAN A NEW APPROACH BE ACTIVATED?

> **NOTE:** *Do not attempt to reactivate the current approach prior to crossing the missed approach point (MAP). The G5000 directs the pilot back to the transition waypoint and does not take into consideration any missed approach procedures, if the current approach is reactivated.*

After flying the missed approach procedure, the pilot may reactivate the same approach for another attempt by touching the **PROC** Button on the 'Home' Screen, followed by the **Activate Approach** Button. The G5000 provides navigation along the desired course to the waypoint and rejoins the approach in sequence from that point.

To activate a new approach for the same airport, select the new procedure by touching the **PROC** Button, then touch the **Approach** Button to access the 'Approach Selection' Screen. Then touch the **Approach** Button. The Touchscreen Controller displays a list of approaches as buttons. Scroll as needed and touch the desired approach button, then touch a transition button. The Touchscreen Controller returns to the 'Approach Selection' Screen. To activate the selected approach, touch the **Load & Activate** Button.

To activate a new approach to a different airport, touch the **Direct To** Button to access the 'Direct To' Screen. Then touch the waypoint point and enter the desired airport using the keypad or large and small right knobs. Touch the **Enter** Button or push the right knob to accept the selected airport, then follow the steps in the preceding paragraph to select an approach for the new airport.

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