GARMIN

G1000™

hazard avoidance pilot's guide for the Cessna Citation Mustang

Preliminary

Record of Revisions			
Revision	**Date of Revision**	**Revision Page Range**	**Description**
Draft	03/01/05	7-1 – 7-53	Initial release.

7.1 WEATHER

This document describes the Hazard Avoidance features of the G1000 system. The main hazards to flight safety are flying in or near weather, flying in close proximity to the terrain and other flight traffic in close proximity.

The information contained in this section assumes understanding of the G1000 Multi Function Display.

This section is divided into groups as follows:

Weather

- GDL 69A (XM Weather)
- GWX 68
- WX 500 Stormscope

TAWS/Terrain

- Terrain Proximity
- TAWS (Terrain Awareness Warning System)

Traffic

- TIS (Traffic Information System)
- TAS (Traffic Advisory System)

CAUTION: *GDL 69A NEXRAD weather data is to be used for long-range planning purposes only. Due to inherent delays and relative age of the data that can be received, NEXRAD weather data should not be used for short-range avoidance of weather.*

WARNING: *Use of any GDL 69A Weather Product for thunderstorm penetration is prohibited. Weather information provided by the GDL 69 is approved only for weather avoidance, not penetration.*

GDL 69A WEATHER AND DIGITAL AUDIO ENTERTAINMENT

The GDL 69A is a remote sensor that is capable of receiving XM Weather and displaying it on the G1000 Multi Function Display and the Primary Flight Display Inset Map. The GDL 69A is also capable of receiving XM Radio Services. XM Weather and XM Radio operate in the S-band frequency range to provide continuous uplink capabilities at any altitude throughout North America.

NOTE: *Before the GDL 69A can be used, the unit must be activated by XM Satellite Radio. The XM Satellite Radio Activation Instruction Sheet contains important information required to initiate XM Satellite Radio Subscription for the GDL 69A. This sheet was given to the aircraft owner at the time of delivery.*

NOTE: *Refer to the G1000 Option pilot's guide for information on the XM entertainment radio segment of the GDL 69A.*

Radio IDs

The GDL 69A are shipped with a Data Radio ID and an Audio Radio ID. You must obtain the Radio IDs of your receiver(s) before subscribing to XM services. The IDs are attached to the XM Satellite Radio Activation Instructions sheet included with the unit. They are also printed on a label on the back of the unit and are displayed on the XM Information Page. Contact the installer if you are unable to locate the Radio IDs.

Activating XM Radio Services

To activate the XM Radio Weather Service:

1. Turn the **large FMS** knob to select the Auxiliary Page Group. Turn the **small FMS** knob to display the AUX - XM Page.
2. Press the **INFO** softkey to display the XM Information Page.
3. Contact XM Satellite Radio through the Internet or by telephone. Follow the directions provided by XM Satellite Radio.
4. Verify that the desired services are activated and press the **DONE** softkey.
5. Turn the **large FMS** knob to highlight 'YES' or 'NO.' Press the **ENT** key to complete activation.

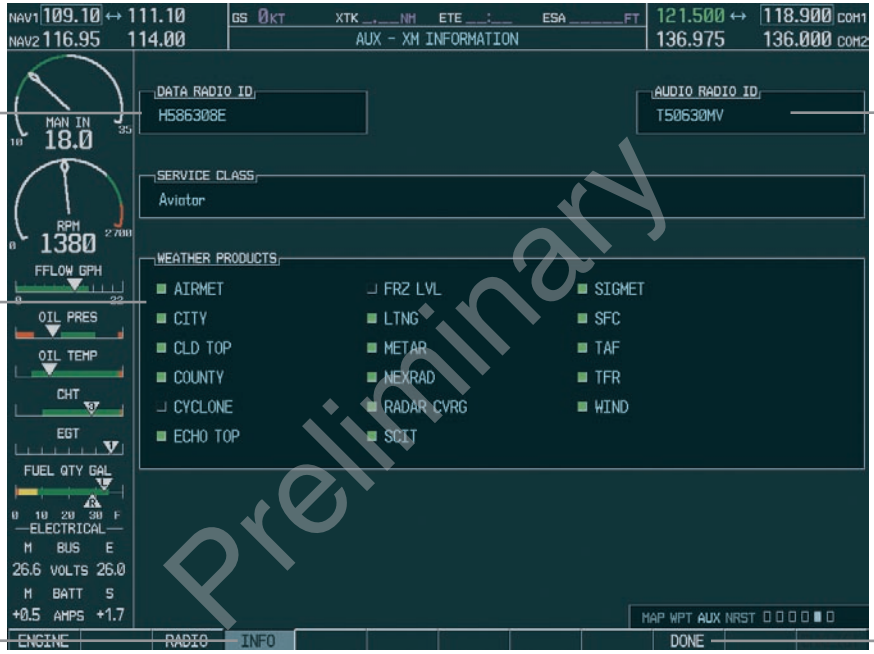


Figure 7.1.1 XM Information Page

GDL 69 WEATHER

Flight Information Services (FIS) weather information provided by the GDL 69 is displayed on the following MFD Maps and Pages:

- Navigation Map Page (NEXRAD and XM Lightning only)
- Weather Data Link Page (complete GDL 69 capability)
- Nearest Pages (NEXRAD and XM Lightning only)
- Airport Information Page (NEXRAD and XM Lightning only)
- Flight Planning Maps (NEXRAD and XM Lightning only)
- AUX - Trip Planning Map (NEXRAD and XM Lightning only)
- WPT - Weather Information Page - part of the WPT - Airport Information Page (METAR and TAF information only)

FIS weather information is also displayed on the Primary Flight Display Inset Map. See the G1000 PFD Pilot's Guide for more information.

NOTE: *Temporary Flight Restrictions (TFRs) are displayed on all pages. Cell Movement is always displayed with NEXRAD data.*

Complete GDL 69 capabilities include:

- Graphical NEXRAD Data (NEXRAD)
- Graphical METAR Data (METAR)
- Textual METAR Data
- Textual Terminal Aerodrome Forecasts (TAF)
- City Forecast Data
- Graphical Wind Data (WIND)
- Graphical Echo Tops (ECHO TOP)
- Graphical Cloud Tops (CLD TOP)
- Graphical Lightning Strikes (XM LTNG)
- Graphical Storm Cell Movement (CELL MOV)
- NEXRAD Radar Coverage (displayed with NEXRAD data)
- SIGMETs/AIRMETs (SIG/AIR)
- Surface Analysis including City Forecasts (SFC)
- County Warnings (COUNTY)
- Freezing Levels (FRZ LVL)
- Hurricane Track (CYCLONE)
- Temporary Flight Restrictions (TFR)

NOTE: *FIS (also known as Flight Information Services - Broadcast, or FIS-B) supplies real-time weather information and other flight advisory information for enhanced situational awareness, 24 hours a day, 7 days a week.*

Displaying Weather Data on the Navigation Map Page

When appropriately configured, the Navigation Map Page displays NEXRAD, Cell Movement, TFRs and XM Lightning data. This capability improves situational awareness, which makes it easier to relate storm activity to airports, navaids, obstacles and other ground references.

Navigation Map Page Weather Control Softkeys

The following softkeys control the display of GDL 69 weather data on the Navigation Map Page:

NEXRAD – pressing the **NEXRAD** softkey displays NEXRAD weather and coverage information. The NEXRAD option is mutually exclusive with the TOPO, TERRAIN and STORMSCOPE options. That is, when NEXRAD is activated, TOPO and/or TERRAIN and/or STORMSCOPE are turned off.

XM LTNG – pressing the **XM LTNG** softkey displays XM lightning information. XM Lightning is mutually exclusive with the STORMSCOPE option.

To display weather data on the Navigation Map Page:

1. Press the **MAP** softkey.
2. Press the **NEXRAD** or **XM LTNG** softkey to display the desired weather. Press the applicable softkey again to remove weather data from the Navigation Map Page.

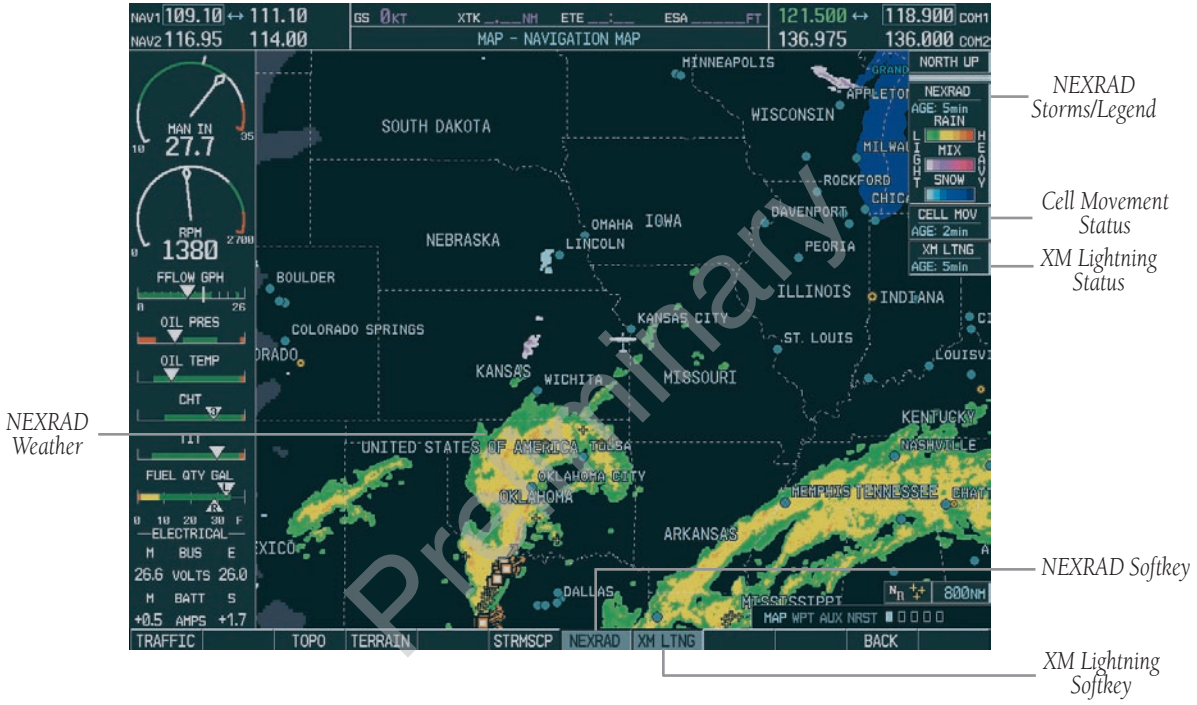


Figure 7.1.2 Navigation Map Page Displaying NEXRAD Weather

Navigation Map Setup Options

The crew can customize the display of GDL 69 weather data on the Navigation Map Page by using the Map Setup Weather Group Options Menu. The following options are available:

- **NEXRAD DATA** - Turns the display of NEXRAD data and radar coverage on or off and selects the desired display range.
- **XM LTNG** - Turns the display of XM Lightning on or off and selects the desired display range.

NOTE: *Stormscope (when installed) and all GDL 69 Weather Products are mutually exclusive. Stormscope is not a GDL 69 Weather Product.*

- **CELL MOVEMENT** - Turns the display of storm cell movement on or off. The Cell Movement option is only shown when NEXRAD is turned on.

NOTE: *In Figure 7.1.3, the Stormscope menu options are only shown when the Stormscope unit is installed.*

Figure 7.1.3 Map Setup Options

To customize the Navigation Map Page:

1. On the Navigation Map page, press the **Menu** key.
2. While the 'Map Setup' selection is highlighted on the Page Menu, press the **ENT** key.
3. Turn the **small FMS** knob to display the group selection window. Turn the **FMS** knob to select the 'Weather Group' and press the **ENT** key.
4. While the Map Setup menu is displayed, turn the **large FMS** knob to highlight and move between the product selections. When an item is highlighted, turn the **small FMS** knob to select the desired option and press the **ENT** key.

Displaying Weather Data on the Nearest Pages

In addition to the Navigation Map Page, the Nearest Pages displays Stormscope, NEXRAD and XM Lightning data.

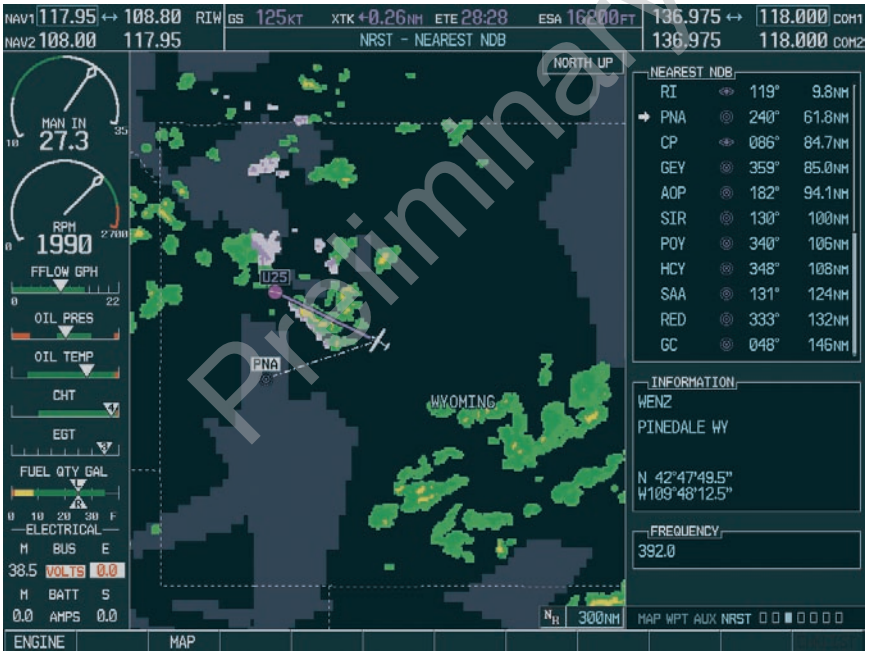


Figure 7.1.4 Weather Display on the Nearest NDB Page

Displaying METAR and TAF on the Airport Information Page

METAR and TAF text is displayed on the Airport Information Page when the **WX** softkey is pressed. ***Once the WX softkey is pressed the page title changes from 'WPT - Airport Information' to 'WPT - Weather Information'.*** The METAR data is first displayed in a decoded fashion, then the raw text is displayed. TAF information is only displayed in its raw form.

NOTE: *METAR is the Aviation Routine Weather Report, generally standard around the world. Temperatures are given in Celsius. The atmospheric pressure is reported in hecto pascals everywhere but the US where it is reported in inches of mercury. Standard temperature and atmospheric pressure are 59° F (15°C) and 29.92 in. Hg (1013.2 hPa).*

NOTE: *TAF is an airport forecast, generally standard around the world. TAF forecasts significant weather changes, temporary changes, probable changes and expected changes in weather conditions.*

To display METAR and TAF text on the Airport Information Page:

1. Turn the **large FMS** knob to select the WPT Page Group.
2. Turn the **small FMS** knob to select the Airport Information Page.
3. Press the **WX** softkey to display METAR and TAF text (METAR and TAF information is updated every 12 minutes).

Figure 7.1.5 METAR and TAF Text Displayed on the Airport (Weather) Information Page

Displaying Weather Data on the AUX – Trip Planning Page Map

NEXRAD and XM Lightning Data can be displayed on the AUX - Trip Planning Page Map by pressing the **NEXRAD** and **XM LTNG** softkeys.

Displaying Weather Data on the Flight Plan Page Maps

NEXRAD and XM Lightning Data can be displayed on the Flight Plan Page Maps by pressing the **NEXRAD** and **XM LTNG** softkeys.

Figure 7.1.6 AUX - Trip Planning Page Map Displaying NEXRAD Weather

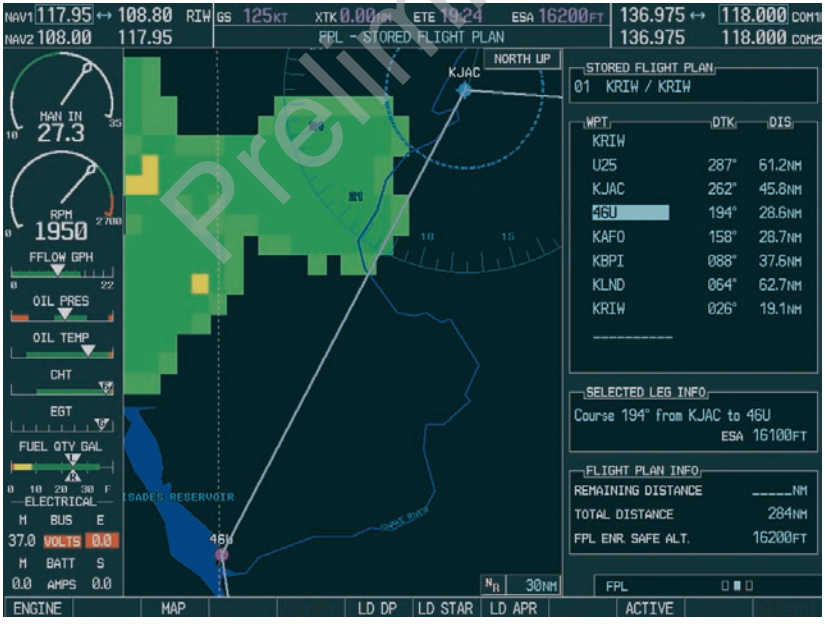


Figure 7.1.7 Stored Flight Plan Page Map Displaying Weather Data

Displaying Weather on the Weather Data Link Page

The Weather Data Link Page displays all available weather products. The display of the weather data can either be selected by softkeys located at the bottom of the display or through the Weather Data Link Setup menu.

To select the Weather Data Link Page:

1. Turn the **large FMS** knob to select the Map Page Group.
2. Turn the **small FMS** knob to select the Weather Data Link Page.

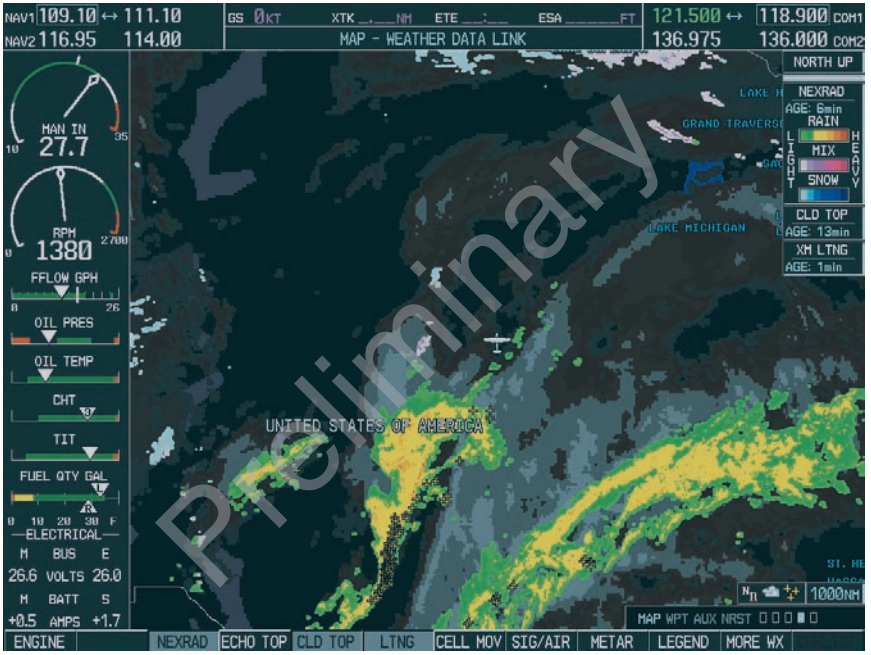


Figure 7.1.8 Weather Data Link Page

Weather Data Link Page Softkeys

The following softkeys perform the GDL 69A weather functions on the Weather Data Link Page:

NEXRAD – press the **NEXRAD** softkey to show NEXRAD weather and radar coverage information (both are activated at the same time). Composite data from all of the NEXRAD radar sites in the United States is shown. This data is composed of the maximum reflectivity from the individual radar sweeps. The display of the information is color-coded to indicate the weather level severity. The update rate is every five minutes. Refer to the legend for a description of the color code.

NOTE: *WSR-88D weather surveillance radar or NEXRAD (NEXt generation RADar) is a Doppler radar system that has greatly improved the detection of meteorological events such as thunderstorms, tornadoes and hurricanes. An extensive network of NEXRAD stations provides almost complete radar coverage of the continental United States, Alaska and Hawaii. The unobstructed range of each NEXRAD is 124 nautical miles.*

NEXRAD Abnormalities

There are possible abnormalities regarding displayed NEXRAD images. Some, but not all, of those include:

- 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
- Military aircraft deploy metallic dust which can cause alterations in radar scans

NEXRAD Limitations

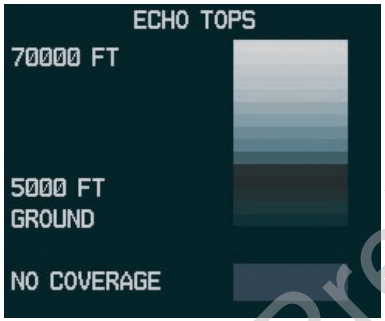
Certain limitations exist regarding the NEXRAD radar displays. Some, but not all, are listed here for the crew's awareness:

- NEXRAD base reflectivity does not provide sufficient information to determine cloud layers or precipitation characteristics (hail vs. rain, etc).
- NEXRAD base reflectivity is sampled at the minimum antenna elevation angle. An individual NEXRAD site cannot depict high altitude storms at close ranges, and has no information about storms directly over the site.
- The resolution of displayed NEXRAD data is 2 kilometers. Therefore, when zoomed in on the display, each square block is 2 kilometers. The intensity level reflected by the square will be the highest level sampled within the 2 kilometer square area.

NEXRAD Intensity

Colors are used to identify the different NEXRAD echo intensities (reflectivity) measured in dBZ (decibels of Z). "Reflectivity" is the amount of transmitted power returned to the radar receiver. Reflectivity (designated by the letter Z) covers a wide range of signals (from very weak to very strong). So, a more convenient number for calculations and comparison, a decibel (or logarithmic) scale (dBZ), is used. The dBZ values increase as the strength of the signal returned to the radar increases.

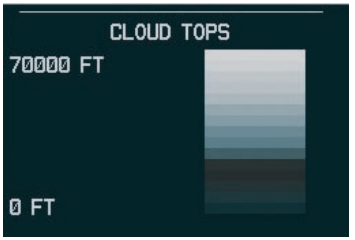
ECHO TOP – press the **ECHO TOP** softkey to show the location, elevation and direction the highest radar echo. This may not indicate the top of a storm or clouds, only the highest radar return echo. The information is derived from NEXRAD information and indicates the highest altitude at which precipitation is falling. ECHO TOPS and Radar coverage are activated at the same time. ECHO TOPS are mutually exclusive from both NEXRAD and CLOUD TOPS, that is, when ECHO TOPS is activated, NEXRAD and CLOUD TOPS are removed. Refer to the Legend for a description of the ECHO TOPS coding. The update rate is every 7.5 minutes.



NOTE: Cloud Tops and Echo Tops use the same color scaling to represent altitude. Turning on both products at the same time is not allowed.

RADAR COVERAGE – The display of Radar Coverage is always active when NEXRAD and ECHO TOPS are selected and indicates the currently available NEXRAD Radar coverage and ECHO TOPS areas by showing the area in a grayish-purple color where information is not being collected. Areas where radar capability exists, but is not active or is off-line, will not be shown as available. Areas where radar coverage is not available will be shown in grayish-purple. The update rate is every five minutes.

CLD TOP – press the **CLD TOP** softkey to show the cloud top altitude determined from satellite imagery. Refer to the legend for a description of the CLOUD TOPS color coding. The update rate is every 15 minutes.



LTNG – pressing the **LTNG** softkey shows the location of cloud-to-ground lightning strikes. The update rate is every five minutes.

***NOTE:** Strike location falls within a 2 km region. Therefore, the exact location of the strike is not displayed.*

CELL MOV – pressing the **CELL MOV** softkey shows the storm cells identified by the ground-based system. The movement is depicted by an arrow. The update rate is every 12 minutes.

SIG/AIR – pressing the **SIG/AIR** softkey shows SIGMET and AIRMET information to advise the crew of potentially hazardous weather. The advisory covers an area of at least 3,000 square miles at any one time. The update rate is every 12 minutes.

NOTE: *SIGMETs are broadcasted for hazardous weather that is considered of extreme importance to all aircraft. SIGMETs (acronym for "SIGnificant METeorological information") warn of the following weather hazards: severe icing, severe and extreme turbulence, dust storms, sandstorms or volcanic ash lowering visibility to less than 3 miles. A Convective SIGMET (WST) is issued for hazardous convective weather (such as tornadoes, thunderstorms, hail) and covers severe or greater turbulence, severe icing and low-level wind shear. A localized SIGMET is a significant weather condition occurring at a localized geographical position.*

NOTE: *AIRMETs are broadcast for weather phenomena that potentially affect all aircraft. AIRMET (acronym for "AIRman's METeorological information) gives valuable information about the following conditions: moderate icing, moderate turbulence, sustained winds 30 knots or greater at the surface, widespread area with a ceiling of less than 1,000 feet and/or visibility less than 3 miles and extensive obscurement of mountains. These are important to light aircraft, that have limited flight capabilities due to lack of equipment and/or instrumentation.*

When enabled, the following AIRMETs can be displayed:

- Icing
- Turbulence
- IFR conditions
- Mountain obscuration
- Surface winds

Refer to the legend for a description of the color coding.

METAR – press the **METAR** softkey to display METARs (METeorological Aviation Reports). METARS are shown as colored flags at airports providing METAR reports. Refer to the legend for a description of the color code. The update rate is every 12 minutes.

LEGEND – press the **LEGEND** softkey to display the Weather Legend Window. Turn the **FMS** knob to scroll up or down through the legend list. Press the **FMS** knob or the **ENT** key to remove the legend display. The Weather Legends Window describes the graphic symbols and color coding of the information for each product that is active.

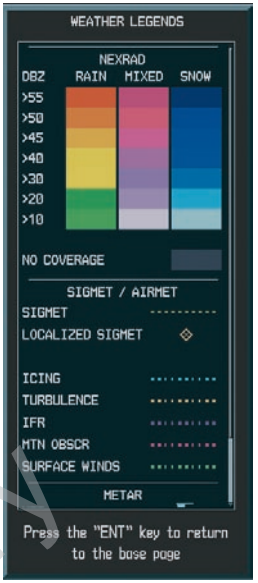


Figure 7.1.9 Weather Legends Window

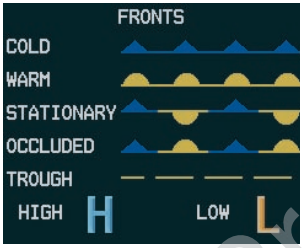
To view the available legends:

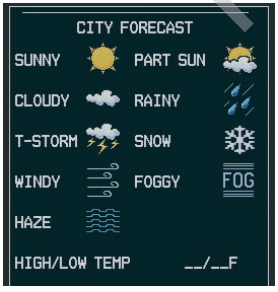
1. Press the **LEGEND** softkey to display the available legends.
2. Turn either the small or large **FMS** knob to scroll through the legends if more are available than fit in the window.
3. To return to the previous page and remove the legend window, press the **LEGEND**, **ENT, CLR** key, or the **FMS** knob. OR
4. On the Weather Data Link Page, press the LEGEND softkey which displays the Page Menu Options. Turn either the large or small FMS knob to select 'Weather Legend' and press the **ENT** key.

MORE WX – press the **MORE WX** softkey to display the following group of softkeys for additional weather control:

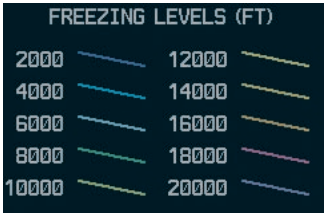
NOTE: *City Forecast and METAR information is only displayed within the installed Aviation Database service area.*

SFC – pressing the **SFC** softkey for Surface Analysis shows current or forecast conditions. The city forecasts information is combined with the surface conditions. The **SFC** softkey label changes to reflect the forecast time selected. Forecasts are available for intervals of 12, 24, 36 and 48 hours. The update rate is every 12 minutes.



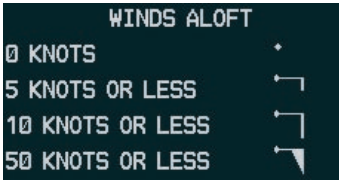


FRZ LVL – press the **FRZ LVL** softkey to display contour lines for freezing levels. The update rate is every 12 minutes.

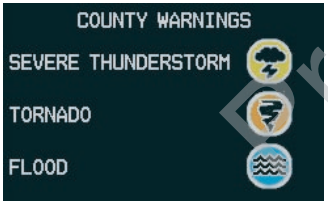


NOTE: *When no data is shown at a given altitude for any of the weather features, the data for that altitude has not been received or the data is out of date and has been removed from the display. Wait for the next update. The update rate is every 12 minutes.*

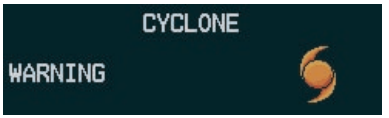
WIND – press the **WIND** softkey to show wind speed and direction at a selected altitude from the ground up to 42,000 feet in 3,000 foot increments. The **WIND** softkey label changes to reflect the winds aloft altitude selected. The update rate is every 12 minutes.



COUNTY – pressing the **COUNTY** softkey provides specific public awareness and protection weather warnings for Tornado, Severe Thunderstorm and Flood conditions provided by the National Weather Service (NWS). Refer to the Legend for a description of the county warning icon. The update rate is every 5 minutes.



CYCLONE – pressing the **CYCLONE** softkey shows the current location of cyclones (hurricanes) and their projected track at various time intervals. The update rate is every 12 minutes.



Weather Data Link Page Setup

The crew can customize the display of XM Weather data on the Weather Data Link Page using the Weather Setup Menu.

To customize the display of weather data on the Weather Data Link Page:

1. On the Weather Data Link Page, press the **Menu** key.
2. While the Weather Setup selection is highlighted on the Page Menu, press the **ENT** key. If necessary, turn the **small FMS** knob to select 'Weather Setup' and then press the **ENT** key.
3. While the Weather Data Link Setup Menu is displayed, turn the **large FMS** knob to highlight and move between the product selections. Turn the **small FMS** knob to select an option for each selection and press the **ENT** key.

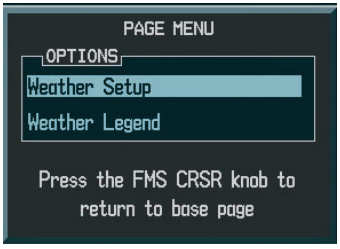


Figure 7.1.10 Weather Data Link Page Menu

Map Panning Information-Weather Data Link Page

Map panning moves the map beyond its current limits without adjusting the map range. When the panning function is selected by pushing the joystick, a panning arrow flashes on the Weather Data Link Page. Panning over AIRMETs, County Warnings, TFRs, Echo Tops, METARs, SIGMET's and Cell Movement displays text information for the selection. This information is displayed in the same location as the "map pointer information" on the Navigation Map Page.

To display information for selected weather products:

1. Push in the **joystick** to display the panning arrow.
2. Move the **joystick** to place the panning arrow on AIRMETs, TFRs, METARs or SIGMETs. Press the **ENT** key to display pertinent information for the selected product.

Note that pressing the **ENT** key when panning over an AIRMET or a SIGMET displays an information box that gives the actual text of that alert. Panning over an airport with METAR information does not display more information but allows the crew to press the **ENT** key and select that Airport's Information Page and displays the actual text. Pressing the **ENT** key when panning over a TFR displays TFR specific information for the panned TFR.

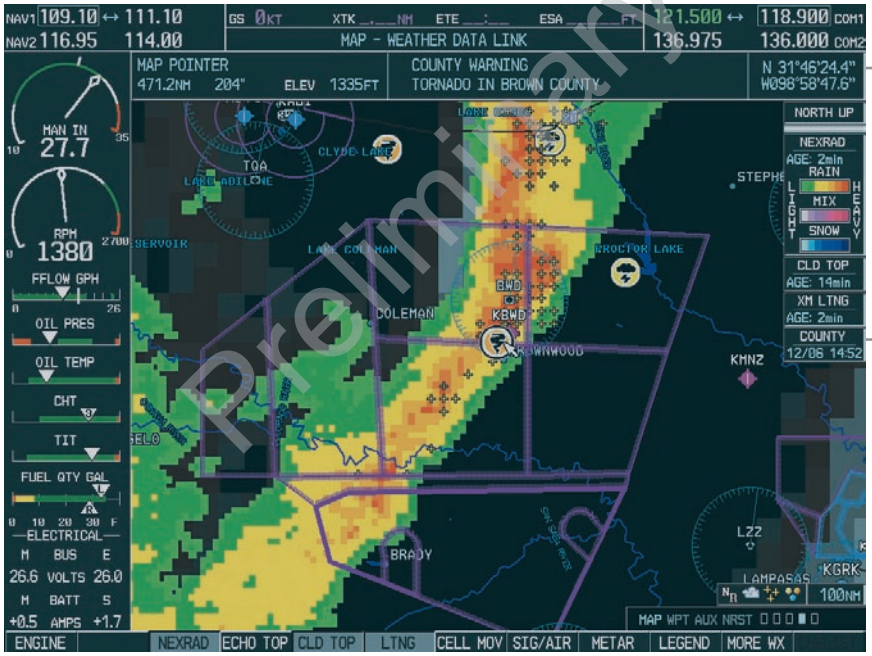


Figure 7.1.11 Panning on the Weather Data Link Page

Weather Product Symbols

Figure 7.1.12 depicts the symbol for each weather product (read from left to right). When a weather product is active, the product symbol is displayed in the lower right of the screen.

- NEXRAD
- Cloud Top/Echo Top
- XM Lightning
- Cell Movement
- SIGMETs/AIRMETs
- METARs
- City Forecast
- Surface Analysis
- Freezing Levels
- Winds Aloft
- County Warnings
- Cyclone Warnings

Figure 7.1.12 Weather Product Symbols

Weather Product Age

The times for each of the enabled products are displayed on the right side of the display. Times are based on Zulu times when the data was assembled on the ground, not the time the data was received by the FIS sensor. When the age of a weather product is greater than half of the expiration time, the product time will change from cyan to amber in color.

Current weather products use an age stamp, 'Age: _ _ _' in minutes. Reported (forecasted) weather products use a date/time stamp; '_ _/_ _/_ _:_ _'.

Weather Product	Expires After "n" Minutes
SIGMETs/AIRMETs	60
City Forecasts	60
County Warnings	60
Cyclone Warnings	60
Echo Tops	30
Freezing Levels	60
METARs	90
Lightning	30
NEXRAD	30
Radar Coverage	30
Cell Movement	30
Surface Analysis	60
TFRs	60
Winds Aloft	60
TAFs	60
Clouds Tops	60

GDL 69 Troubleshooting

Although it is the responsibility of the facility that installed the GDL 69A to correct any hardware problems, the crew can perform some quick troubleshooting steps to find the possible cause of a failure.

First, ensure that the owner/operator of the aircraft in which the GDL 69A is installed has subscribed to XM Radio and that it has been activated. Perform a quick check of the circuit breakers to ensure the GDL 69A has power applied. If a failure still exists, review the messages listed in the table at the end of this section. The advisory messages may provide insight to a possible failure.

For troubleshooting purposes, the Status, Serial Number and Software Version numbers for the GDL 69A are displayed in the LRU Information Window on the System Status Page.

To select the System Status Page:

1. Turn the **large FMS** knob to select the AUX Page Group.
2. Turn the **small FMS** knob to select the System Status Page.

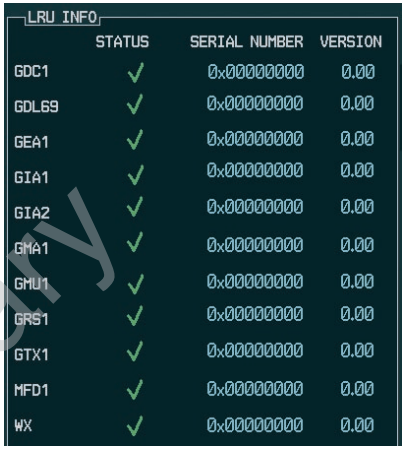


Figure 7.1.19 LRU Information Window

Message	Description
CHECK ANTENNA – XM Radio Page, the active channel is replaced with this message	Antenna is not connected
UPDATING – XM Radio Page, the active channel is replaced with this message	Updating encryption code
NO SIGNAL – XM Radio Page, the active channel is replaced with this message ; also displayed on the Weather Data Link Page when the signal strength is too low for the receiver	Loss of signal
LOADING – XM Radio Page, the active channel is replaced with this message	Acquiring channel audio or information
OFF AIR – XM Radio Page, the active channel is replaced with this message	Channel not in service
--- (XM Radio Page, the active channel is replaced with this message)	Missing channel information
WEATHER DATA LINK FAILURE – Weather Data Link Page, displayed in the center of the screen in yellow	No communication with the GDL 69 within the last five minutes
ACTIVATION REQUIRED – Weather Data Link Page, displayed in the center of the screen in yellow	XM Data receiver is not activated

Table 7.1.1 Advisory Messages

GWX 68 AIRBORNE WEATHER RADAR

The GWX 68 Airborne Weather Radar System provides weather detection and ground mapping capability. The primary function of the weather radar system is to find storms along the flight path. Weather detection gives the crew the ability to recognize potentially dangerous thunderstorm cells.

The GWX 68 weather radar system also provides ground mapping, giving the ability to distinguish landscape features and bodies of water.

Weather radar return strength is shown in six different colors to show intensities of rainfall (black, green, yellow, red, magenta, and white).

Table 7.1.2 shows six different colors associated with the levels of rainfall or storm intensity.

Rainfall Rate	Color
Very Heavy Rainfall	Magenta
Heavy Rainfall	Red
Medium Rainfall	Yellow
Light Rainfall	Green
No Rainfall	Black
TBS	White

Table 7.1.2 Weather Radar Rainfall Rate Colors

Ground mapped radar return strength is shown using the colors black, cyan, yellow, magenta, and blue. In the ground mapping mode, internal parameters are selected to increase returns from ground targets and decrease returns from weather targets.

Table 7.1.3 shows six different colors associated with levels of ground mapping return intensity.

Ground Mapping Return	Color
None	Black
Least Reflective	Cyan
Moderate Return	Yellow
Heavy Return	Magenta
Very Heavy Return	Red
TBS	Blue

Table 7.1.3 Ground Mapping Colors

Operating Modes

The G1000 controls and softkeys supply all the controls and functions to operate the weather radar. The radar antenna is automatically stabilized in pitch and roll axes. The crew can manually adjust the radar tilt, gain and range.

The crew selects the different weather radar modes.

OFF – Deenergizes the weather radar subsystem.

STBY – The radar is in standby, the antenna scan stopped, the transmitter inhibited. **STBY** is shown on the PFD and MFD. The RT (Receiver Transmitter) has a warm-up period of approximately 60 seconds. If any active mode is selected before this period, the WAIT legend will be shown on the PFD and MFD.

WX – When selected, the radar is in the weather detection mode. Weather data is shown on the MFD.

GMAP (GROUND MAPPING) **–** In this mode, returns from ground targets and decrease returns from weather targets are shown.

TEST – In this mode, a test pattern is shown on the MFD to verify system operation. A TEST legend is shown on the MFD. The transmitter radiates microwave energy because it is on.

Figure 7.1.20 Radar Initializing

When TEST mode is selected, a test pattern is shown on the MFD to verify system operation.

Figure 7.1.21 Radar Test Pattern

Figure 7.1.22 Radar Fail

Figure 7.1.23 Sector Scan at +26 Degrees

7.2 TAWS/TERRAIN

TAWS/TERRAIN PROXIMITY PAGE

CAUTION: *Terrain and obstacle data are provided only as an aid to situational awareness. Aural messages or textual annunciations are displayed to the crew during flight operations regarding the presence of terrain or obstacles.*

The TAWS/Terrain Proximity Page displays the following information:

- Current aircraft location.
- Range marking rings (1 nm, 1/2 nm, 2.5/5 nm, 5/10 nm, 12.5/25 nm, 25/50 nm, 50/100 nm and100/200 nm).
- Heading Box (North Up, Track Up, DTK Up, HDG Up). Heading on the TAWS/Terrain Proximity Page displays 'HDG Up' map data unless there is no valid heading.

Additional TAWS only information:

- TAWS annunciator box – terrain alerts for both warnings/caution situations and TAWS status information.
- North arrow indicator, when not orientated in North-Up display.

TAWS/Terrain Proximity Page Operations

There are two terrain/obstacle viewing options available (relative to the position of the aircraft), an ARC (120°) display and a 360° default display.

To change the viewing mode between 360° and ARC:

1. Select the TAWS/Terrain Proximity Page
2. Press the **VIEW** softkey. Then press the **ARC** softkey.
3. To return to the 360 degree viewing display press the **360** softkey, OR:
4. Press the **MENU** key. The page menu is displayed with 'View Arc' or 'View 360°' highlighted. Press the **ENT** key on the desired selection.

To change the map range on the TAWS/Terrain Proximity Page:

1. Turn the **joystick** clockwise to zoom out or turn the **joystick** counter-clockwise to zoom in. Map ranges are 1 nm, 1/2 nm, 2.5/5 nm, 5/10 nm and 12.5/25 nm, 25/50 nm, 50/100 nm and 100/200 nm.

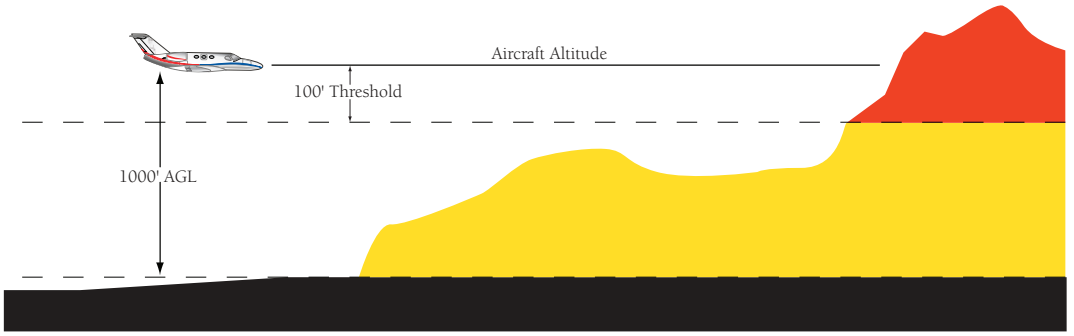


Figure 7.2.1 Terrain Scale

Displaying Obstacle Data

The TAWS/Terrain Proximity Page displays obstacle data with heights greater than 200 feet Above Ground Level (AGL) located at their geographical position throughout the world. Obstacles are displayed in two levels:

- CAUTION
- WARNING

Each level is associated with a color. The G1000 will adjust colors on the TAWS/Terrain Proximity Page automatically as the aircraft altitude changes.

Obstacle Color	Indication
RED	WARNING: Obstacle height is at or above 100' below the current aircraft altitude.
YELLOW	CAUTION: Obstacle height is between 100' and 1000' below the current aircraft altitude.

Obstacle Shapes

Unlighted Obstacle (Height is less than 1000' AGL)	Lighted Obstacle (Height is less than 1000' AGL)	Unlighted Obstacle (Height is greater than 1000' AGL)	Lighted Obstacle (Height is greater than 1000' AGL)
			

Navigation Map Display Conditions

The Map Setup Page Menu has 'OBSTACLE DATA' and 'TERRAIN DATA' feature On/Off options. The Terrain Obstacle features are summarized in the table below:

Terrain Feature	Obstacle Feature	Navigation Map Page
OFF	OFF	NO OBSTACLES DISPLAYED
OFF	ON	CAUTION AND WARNING OBSTACLES DISPLAYED
ON	OFF	CAUTION AND WARNING OBSTACLES DISPLAYED
ON	ON	SAFE, CAUTION, AND WARNING OBSTACLES DISPLAYED

NOTE: *Obstacles are only displayed at certain map zoom ranges, on certain map fields, and will only be displayed if an obstacle database is loaded in the system.*

NOTE: *The table above is only for the Navigation Map Page. The Terrain Proximity Page always shows ONLY caution and warning obstacles.*

NOTE: *Terrain data can also be displayed by using the 'On/Off' Navigation Map Page option. See the Navigation Map Page setup section for details.*

Displaying Terrain Data on the Navigation Map Page

Terrain data can be displayed on the Navigation Map Page by pressing the **TERRAIN** softkey. Terrain symbology (mountain icon) appears next to the map range in the bottom right corner of the page indicating the presence of terrain data on the map.

To display terrain data on the Navigation Map Page:

1. Press the **MAP** softkey.
2. Press the **TERRAIN** softkey. Press the **TERRAIN** softkey again to remove terrain data from the Navigation Map Page.

TERRAIN softkey

Figure 7.2.2 TERRAIN Softkey

TAWS

Garmin's Terrain Awareness Warning System (TAWS) satisfies TSO-C151b Class B requirements for certification. Class B TAWS is required for all Part 91 aircraft operations with 6 or more seats and for Part 135 turbine aircraft operations with 6 to 9 passenger seats (FAR Parts 91.223, 135.154). Garmin TAWS greatly increases situational awareness and aids in reducing accidental Controlled Flight Into Terrain (CFIT).

Figure 7.2.3 shows the Navigation Map Page with terrain features.

In order to operate properly, the Garmin TAWS/Terrain system requires a valid 3D GPS position solution and a valid terrain/airport terrain/obstacle database.

***CAUTION**: It is always the ultimate responsibility of the crew to navigate safely throughout the course of flight. Garmin TAWS is designed to be an aid to situational awareness, not to be relied on as a primary source of terrain and obstacle avoidance.*

Figure 7.2.3 Obstacles on Navigation Map Page

System Compairison

Garmin TAWS and TERRAIN share several common operational characteristics. Table 7.2.1 compares the features and abilities of the two systems:

Function	TAWS	Terrain
TSO-C151b Class B Certified	Yes	No
TAWS/TERRAIN Display (Shows terrain elevations relative to the aircraft)	Yes	Yes
Visual Alerting (Includes popup alerting)	Yes	Yes
Aural Alerting	Yes	No
External Visual Alerting Capability	Yes	No
Reduced Terrain Clearance (RTC) Avoidance (Forward Looking Terrain Avoidance (FLTA) sub-function)	Yes	Yes
Imminent Terrain Impact (ITI) Avoidance (Forward Looking Terrain Avoidance (FLTA) sub-function)	Yes	Yes
Premature Descent Alert (PDA)	Yes	Yes
Excessive Rates of Descent (Ground Proximity Warning System (GPWS) Alerting sub-function)	Yes	No
Negative Climb Rate/Altitude Loss After Takeoff (Ground Proximity Warning System (GPWS) Alerting sub-function)	Yes	No
"Five Hundred" Voice Callout (Ground Proximity Warning System (GPWS) Alerting sub-function)	Yes	No
Inhibit Capability (Inhibits FLTA and PDA visual and aural alerting)	Yes	Yes
Manual System Test Capability	Yes	No
Worldwide Terrain Database	Yes	Yes
Airport Layer Database	Yes	Yes
Obstacle Database	Yes	Yes

Table 7.2.1 TAWS/TERRAIN Feature Comparison

Basic Operation

Power Up

During power-up of the G1000 unit, terrain/airport terrain/obstacle database versions and area of coverage are displayed along with a disclaimer. At the same time, the TAWS/TERRAIN system self-test begins. An aural message plays upon test completion:

- "***TAWS System Test, OK***", if the system passes the test.
- "***TAWS System Failure***", if the system fails the test.

A failure of the test is annunciated for both TAWS and TERRAIN, if the self-test fails.

Database Updates

Terrain/airport terrain/obstacle databases are updated periodically with the latest terrain/airport terrain/obstacle data. Visit the Garmin website to check for newer versions of terrain/airport terrain/obstacle databases. Updated terrain data cards may be obtained from the Garmin website or by calling Garmin at one of the numbers listed in the front of this document.

Display Page Operation

TAWS and TERRAIN appears in the Navigation Map.

To display terrain data on the Navigation Map Page:

1. Press the **MAP** softkey.
2. Press the **TERRAIN** softkey. Press the **TERRAIN** softkey again to remove terrain data from the Navigation Map Page.

TAWS/TERRAIN/PROXIMITY Page

Terrain information, aircraft ground track and GPS-derived MSL altitude are displayed on the screen. Altitude is shown in increments of 20 feet or in increments of 10 meters, depending on unit configuration. The 'G' to right of the MSL altitude display is a reminder that altitude is GPS-derived.

There are two main display settings from which the crew can choose:

- **360˚ View —** Bird's eye view from above aircraft depicts surrounding terrain on all sides.
- **120˚ View** — Bird's eye view of terrain ahead of and 60˚ to either side of the aircraft flight path.

NOTE: *The TAWS/TERRAIN/PROXIMITY Page gives a Heading Up display orientation, as indicated by the 'HDG' label shown on the display.*

To change the TAWS/TERRAIN display viewing angle between 360° and 120˚:

1. Select the TAWS/Terrain Proximity Page
2. Press the **VIEW** softkey. Then press the **ARC** softkey.
3. To return to the 360 degree viewing display press the **360** softkey, OR:
4. Press the **MENU** key. The page menu is displayed with 'View Arc' or 'View 360º' highlighted. Press the **ENT** key on the desired selection.

Terrain/Obstacle Database Areas of Coverage

The following areas of coverage are available in each database. Regional definitions may change without notice.

TAWS/TERRAIN database versions may be viewed by going to AUX System Status Page.

Pop-up terrain alerts are displayed only when the TERRAIN Page is not being viewed. Pop-up terrain alerts do not appear on the TERRAIN Page.

Worldwide (WW):
Latitudes: S60 to N75
Longitudes: W180 to E180
Americas (AME):
Latitudes: S60 to N75
Longitudes: W180 to W30
Atlantic (ATL):
Latitudes: S60 to N75
Longitudes: W30 to E90

Pacific (PAC):
Latitudes: S60 to N75
Longitudes: E60 to E180
United States (US):
Limited to the United States plus some areas of Canada, Mexico, Caribbean, and the Pacific.

TAWS/TERRAIN Failure Alert

The TAWS/TERRAIN system continually monitors several system-critical items, such as database validity, hardware status and GPS status. Should the system detect a failure, one of the following messages is issued:

No Alert or Status

Terrain Not Available

Terrain Test

Terrain Inhibited

Terrain Failure

Figure 7.2.4 TAWS Failure Messages

The TAWS/TERRAIN Page displays "TERRAIN FAILED". For TAWS units, the aural message "***TAWS System Failure***" is issued along with the "TER FAIL" annunciation.

TAWS/TERRAIN Not Available Alert

Garmin TAWS/TERRAIN requires a 3D GPS navigation solution along with specific vertical accuracy minimums. Should the navigation solution become degraded, if the terrain/airport terrain/obstacle databases are not available, or if the aircraft is out of the database coverage area, the annunciation 'TER N/A' is given in the annunciation window.

The aural message "***Terrain Not Available***" is issued along with the 'TER N/A' annunciation.

Forward Looking Terrain Avoidance

The Forward Looking Terrain Avoidance alert (FLTA) is used by TAWS and is composed of two sub-functions:

Reduced Required Terrain Clearance (RTC) Avoidance — Provides alerts when the aircraft flight path is above terrain, yet is projected to come within minimum clearance values shown in Table 7.2.2. When an RTC alert is issued, a potential impact point is displayed on the TAWS/TERRAIN Proximity Page.

Imminent Terrain Impact (ITI) Avoidance — Provides alerts when the aircraft is below the elevation of a terrain cell in the aircraft's projected path. ITI alerts are accompanied by a potential impact point displayed on the TAWS/TERRAIN Proximity Page. The alert is given when the projected vertical flight path is calculated to come within minimum clearance altitudes in Table 7.2.2.

During the final approach phase of flight, RTC/ITI alerts are automatically inhibited when the aircraft is below 200' AGL while within 0.5 nm of the approach runway or is below 125' AGL while within 1 nm of the runway.

Phase Of Flight	Level Flight	Descending
Enroute	700 ft.	500 ft.
Terminal	350 ft.	300 ft.
Approach	150 ft.	100 ft.
Departure	100 ft.	100 ft.

Table 7.2.2 Minimum Terrain Clearance Values for RTC/ITI Alerts

RTC/ITI Severity Levels

TERRAIN

CAUTION: *Estimated potential impact in approximately 60 seconds after pop-up alert and annunciation. For TAWS, RTC/ITI caution alerts are accompanied by the aural message* ***"Caution Terrain; Caution Terrain"*** *OR* ***"Terrain Ahead; Terrain Ahead".***

PULL UP

WARNING: *Estimated potential impact in approximately 30 seconds after pop-up alert and annunciation. For TAWS, RTC/ITI warning alerts are accompanied by the aural message* ***"Terrain, Terrain; Pull Up, Pull Up"*** *OR* ***"Terrain Ahead, Pull Up; Terrain Ahead, Pull Up".***

***CAUTION**: The above annunciation and pop-up terrain alert are displayed during a PDA alert. For TAWS, the PDA alert is accompanied by the aural message "**Too Low, Terrain**".*

Premature Descent Alerting (PDA)

Garmin TAWS/TERRAIN issues a Premature Descent alert when the system detects that the aircraft is significantly below the normal approach path to a runway. The PDA alert mode is functional only during descent to land. There are three different scenarios to consider with PDA:

- **No Approach Loaded —** PDA alerting begins when the aircraft is within 15 nm of the destination airport and ends when the aircraft is either 0.5 nm from the runway threshold OR is at an altitude of 125' AGL while within 1 nm of the threshold. During the final descent, algorithms will set a threshold for alerting based on speed, distance and other parameters.
- **Non-Precision Approach Loaded —** PDA alerting begins when FAF is the active waypoint AND the aircraft is within 15 nm of the destination airport. Again, algorithms are used to set a threshold for alerting based upon various parameters. PDA alerting ends at 0.5 nm from the runway threshold OR at an altitude of 125' AGL while within 1 nm of the threshold.
- **ILS Approach Loaded —** PDA alerting begins when FAF is the active waypoint AND the aircraft is within 15 nm of the destination airport. Once the aircraft intercepts the glideslope, PDA will alert the crew if the aircraft descends 0.7 degrees below the glideslope. PDA alerting ends 0.5 nm from the runway threshold OR at an altitude of 125' AGL while within 1 nm of the threshold.

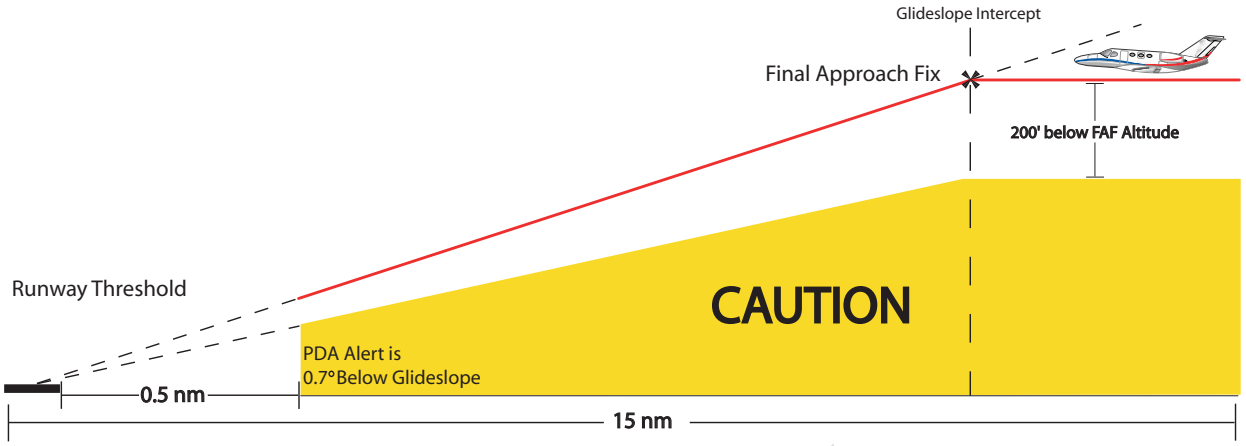


Figure 7.2.5: Example of PDA alert threshold for ILS approach

The threshold for the Non-Precision Approach PDA descent is computed by algorithms based on varying flight conditions.

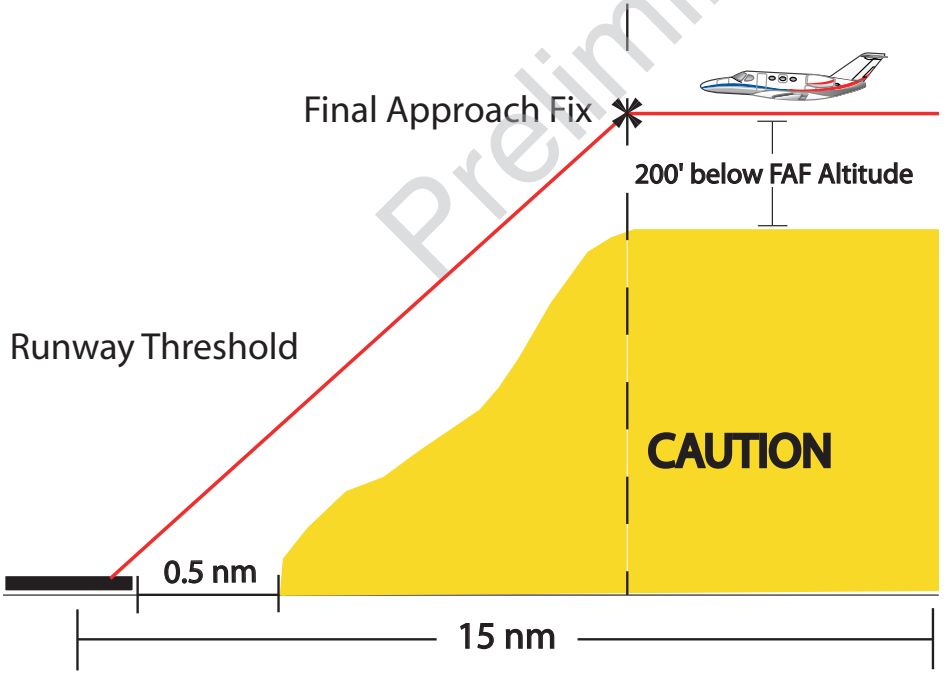


Figure 7.2.6: Example of Non-Precision Approach PDA alert threshold.

TAWS Alerts

The following features are required to meet Class B requirements for a TAWS system per TSO-C151b. TAWS provides aural voice alerts along with regular display annunciation. With each alert type shown is an accompanying aural alert as well.

Excessive Descent Rate Alert (EDR)

The purpose of the Excessive Descent Rate alert is to provide suitable alerts when the aircraft is determined to be closing (descending) upon terrain at an excessive speed. Figure 7.2.7 shows the parameters for the alert as defined by TSO-C151b.

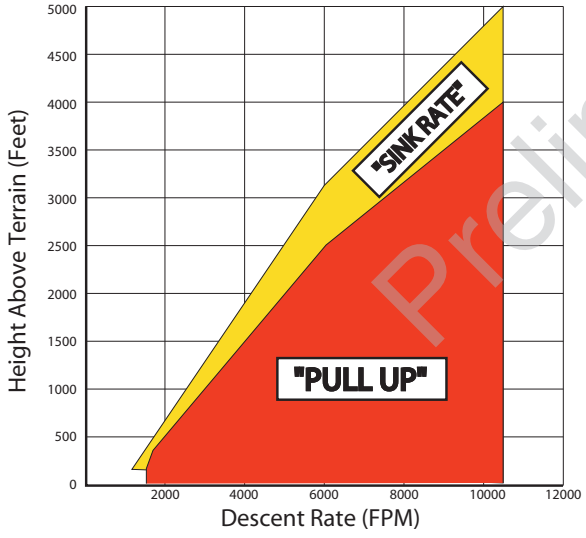


Figure 7.2.7: Excessive Descent Rate Graph

Excessive Descent Rate Severity Levels

CAUTION: *The annunciation and pop-up terrain alert are accompanied by the aural message "Sink Rate".*

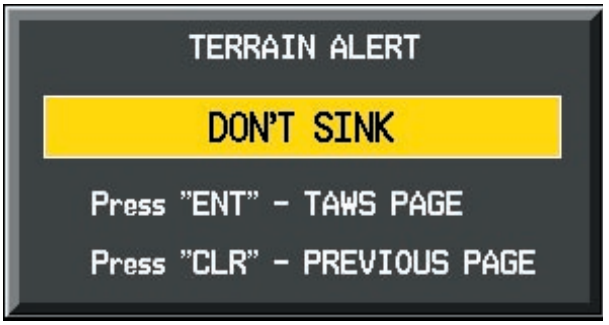
TERRAIN

WARNING: *The annunciation and pop-up terrain alert are accompanied by the aural message "Pull Up".*

PULL UP

Negative Climb Rate After Takeoff Alert (NCR)

The purpose of the Negative Climb Rate After Takeoff alert is to provide suitable alerts to the crew when the system determines that the aircraft is losing altitude (closing upon terrain) after takeoff. The aural message "***Don't Sink***" is given for NCR alerts, accompanied by an annunciation and a pop-up terrain alert on the display.



TERRAIN

"Five-Hundred" Aural Alert

The purpose of the aural alert message "Five-hundred" is to provide an advisory alert to the crew that the aircraft is five-hundred feet above terrain. When the aircraft descends within 500 feet of terrain, the aural message "***Five-hundred***" is heard. There are no display annunciations or pop-up alerts that accompany the aural message.

Alert Priority and Aural Alert Message Summary

TSO-C151b requires the establishment of an internal priority scheme for alerts. In this way, the more important alerts will override lesser alerts. Table 7.2.3 shows the alert priority level in the Garmin TAWS system and gives a summary of the aural messages.

The aural alert is configurable for either male or female voice. Different alert text phrases are available for several alerts. Contact a Garmin authorized service center for further information on configuring the alert system.

TAWS System Test

Garmin TAWS provides a manual test for the flight crew. With this feature, the crew can verify proper operation of the aural and visual system annunciation.

To manually test the TAWS system:

1. At the TAWS Page, press **MENU**.
2. Select the "Test Terrain?" option.
3. Press **ENT** to confirm the selection.

An aural message is played giving the test results:

- "***TAWS System Test, OK***", if the system passes the test.
- "***TAWS System Failure***", should the system fail the test.

NOTE: *TAWS System Testing is disabled during flight.*

Priority	Alert Type	Aural Message
1	Excessive Descent Rate Alert Warning	"Pull Up"
2	Terrain Awareness Warning: RTC ITI Alerts	"Terrain, Terrain; Pull-Up, Pull-Up" Or "Terrain Ahead, Pull-Up; Terrain Ahead, Pull-Up"
3	Obstacle Awareness Warning: ROC, IOI	"Obstacle, Obstacle; Pull-Up, Pull-Up" Or "Obstacle Ahead, Pull-Up; Obstacle Ahead, Pull-Up"
4	Terrain Awareness Caution: RTC, ITI Alerts	"Caution, Terrain; Caution, Terrain" Or "Terrain Ahead; Terrain Ahead"
5	Obstacle Awareness Caution: ROC, IOI	"Caution, Obstacle; Caution, Obstacle" Or "Obstacle Ahead; Obstacle Ahead"
6	PDA Caution Alert	"Too Low, Terrain"
7	Altitude Callout "500"	"Five-hundred"
8	Excessive Descent Rate Alert Caution	"Sink Rate"
9	Negative Climb after Takeoff Alert	"Don't Sink" or "Too Low, Terrain"

Table 7.2.3: TAWS Alert Summary

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7.3 TRAFFIC

TIS (TRAFFIC INFORMATION SYSTEM)

TIS is a system used for detecting and tracking aircraft in the vicinity of your own aircraft. When ATC radar interrogates aircraft transponders, the replies are analyzed to determine range, bearing and the relative altitude of the intruder. The traffic is then displayed to the flight crew on the MFD.

CAUTION: *TIS is unable to detect any intruding aircraft without an operating transponder.*

NOTE: *Traffic Information Service (TIS) is not available in all areas.*

TRANSPONDER STATUS BAR

TIS surveillance data is up-linked by Air Traffic Control (ATC) radar through the GTX 33 Mode S Transponder. The Transponder Status Bar displays the transponder code, reply symbol and mode of operation on the Inset Map (PFD) and the Navigation and Traffic Map Pages on the MFD (refer to the MFD Pilot's Guide).

In order to receive and display TIS traffic information, the GTX 33 must not be in GND mode or STBY mode.

Figure 7.3.1 Transponder Status Bar

When traffic is displayed within the TIS volume, the word TRAFFIC appears on the PFD. Figure 7.3.2 shows the Traffic Annunciation on the PFD.

TRAFFIC MAP PAGES

The Traffic Map Page displays the following information:

- Current aircraft location, surrounding TIS traffic, and range marking rings.
- The current traffic mode (OPERATE, STANDBY).
- A traffic alert message (FAILED, DATA FAILED, NO DATA, UNAVAILABLE).
- Traffic display banner (AGE 00:, TRFC COAST, TA OFF SCALE, TRFC RMVD, TRFC FAIL, NO TRFC DATA, TRFC UNAVAIL, TRAFFIC).

To select the Traffic Map Page:

1. Select the MAP group of pages. Turn the **small FMS** knob to select the Traffic Map Page.

To display traffic on the Navigation Map Page:

1. Press the **MAP** softkey.
2. Press the **TRAFFIC** softkey. Press the **TRAFFIC** softkey again to remove traffic.

NOTE: *Traffic and terrain data can also be displayed by using the 'On/Off' Navigation Map Page option. See the Navigation Map Page setup section for details.*

Figure 7.3.3 shows the Traffic Map Page on the MFD.

Traffic symbols are similarly displayed on the Navigation map page. The traffic symbols are shown relative to other displayed features.

Figure 7.3.2 Traffic Annunciation on PFD

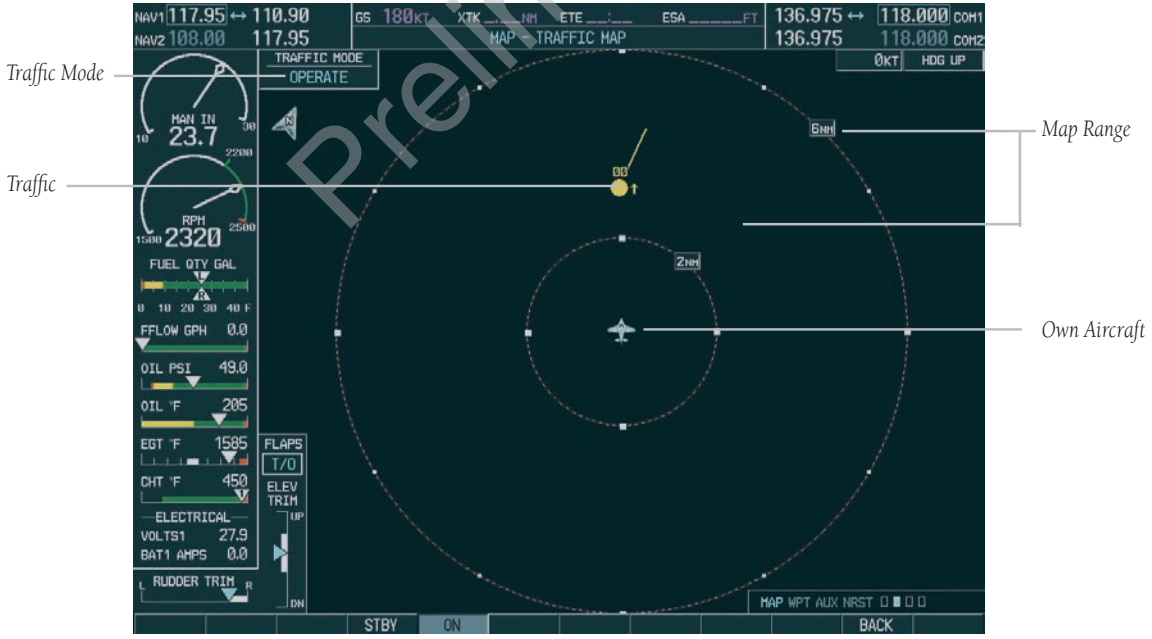

Figure 7.3.3 Traffic Map Page

TIS Symbology

TIS traffic is displayed on the Traffic Map Page similarly to TCAS symbology. The main difference between TIS and TCAS is the source of surveillance data. TCAS uses an airborne interrogator with a half-second update rate. TIS uses the terminal Mode S ground interrogator and its Data Link to provide approximately a five-second update rate. The range accuracy of TIS and TCAS is similar. Appendix E describes the Traffic Information Service in detail.

The Traffic Advisory (TA) solid yellow circle indicates that traffic meets the TA advisory criteria. The presence of TA traffic beyond the selected display range is indicated by one half of a yellow circle at the edge of the display. The position of the half-symbol represents the bearing of the traffic.

Altitude separation from your aircraft is displayed above the target symbol if the traffic is above your altitude or below the symbol if they are below. Altitude trend is displayed as an up arrow (+500 ft/min), down arrow (-500 ft/min) or no symbol if less than 500 ft/min rate in either direction.

Traffic Ground Track is indicated on the Traffic Map Page by a "Track Vector". The track vector line is projected from the TA symbol at the angle of the TA relative track.

Proximate traffic is shown as a white diamond with a solid box inside. Other traffic is displayed as a hollow white diamond. Proximate traffic and other traffic symbols indicate that traffic is not yet considered a threat, so no Traffic Advisory is generated.

Category	Symbol
Other Traffic	
Proximate Traffic	
Traffic Advisory, Out of Range	
Traffic Advisory	

Traffic Map Page Operations

Power-Up Test

The TIS interface performs an automatic test during power-up. If the system passes the power-up test, the standby screen is displayed on the Traffic Map Page. If the system passes the power-up test while the aircraft is airborne, traffic is immediately displayed on the Traffic Page in the operating mode.

If the system fails the power up test, the 'NO DATA', 'DATA FAILED' or 'FAILED' message is displayed.

- The 'FAILED' message indicates the GTX 33 transponder has failed.
- The 'DATA FAILED' message indicates data is being received from the GTX 33 but a failure was detected in the data stream.
- The 'NO DATA' message indicates that data is not being received from the GTX 33.

Contact a Garmin authorized service center for repair.

Changing the Map Range

To change the map range:

1. Turn the joystick clockwise to zoom out or turn the joystick counter-clockwise to zoom in. Map ranges are 2 nm, 6 nm and 12 nm.

NOTE: *If the intruder aircraft is non-altitude reporting only the range and bearing will be displayed.*

Operating Mode

Once the aircraft is airborne the system switches from ground or standby mode to operating mode. The G1000 displays 'OPERATE' in the upper left hand corner of the display and begins to display traffic on the Traffic or Map Page.

The TIS Traffic Advisory (TA) should alert the crew to look for intruding aircraft any time a yellow circle traffic symbol appears and voice warning is announced. Conduct a visual search for the intruder. Maintain visual contact to ensure safe separation.

When the aircraft is on the ground the system switches from operating mode to ground or standby mode. The Traffic Map Page displays 'GND' or 'STANDBY'.

- STANDBY – when the Traffic Map Page displays 'STANDBY' in the status box on the Traffic Map Page, the TIS system is in standby mode and cannot display traffic data.
- GND – when the Traffic Map Page displays 'GND' in the status box on the Traffic Map Page, the TIS system does not display traffic data. The GTX 33 does not reply to Mode A or Mode C interrogations but does send Mode S acquisition replies. The ground mode is entered automatically. It is not a crew selectable mode.
- OPERATE – when the Traffic Map Page displays 'OPERATE' in the status box on the Traffic Map Page, the TIS system is operational and displays traffic on the Traffic and Map Pages.

The crew can switch between the standby (STBY) and operate (ON) modes to manually override automatic operation using the page menu or softkeys.

To switch between operating modes:

1. Press the **MODE** softkey.
2. Press the **STBY** or **ON** softkey to switch between modes. 'STANDBY' or 'OPERATE' is displayed in the status box located in the upper left corner of the Traffic Map Page, OR:
3. Press the **MENU** key. The page menu is displayed with 'Standby Mode' or 'Operate Mode' highlighted. Press the **ENT** key on the desired selection.

TIS Audio Alert

A TIS audio alert is generated whenever the number of TAs on the Traffic Map Page display increases. Limiting audio to TAs only reduces the amount of nuisance alerting due to proximate aircraft. For example, when the first TA is displayed, the crew is alerted audibly. As long as a single TA aircraft remains on the TIS display, no further audio alert is generated. If a second TA aircraft appears on the display, a new audio alert is sounded. If the number of TAs on the TIS display decreases and then increases, a new audio alert is sounded. The TIS audio alert is also generated whenever TIS service becomes unavailable. The volume of the audio alerts and the choice between a male or female voice is configured during installation. The following TIS audio alerts are available:

- "Traffic" - TIS traffic alert is received.
- "Traffic Not Available" - TIS service is not available or out of range.

TIS Traffic Status

The MFD indicates the following TIS traffic status to the flight crew.

Traffic Banner

- AGE - if traffic data is not refreshed within 6 seconds, an age indicator (i.e., 'AGE 00:06') is displayed in the lower left corner of the display, when displaying traffic. After another 6 seconds, if data is still not received, the traffic is removed from the display. The quality of displayed traffic is reduced as the traffic data becomes stale.
- TRFC COAST - the 'TRFC COAST' (traffic coasting) banner located above the AGE timer indicates that displayed traffic is held even though the data is stale. The quality of displayed traffic is reduced.
- TRFC RMVD - the 'TRFC RMVD' banner indicates that traffic has been removed from the display due to the age of the data. Data is too old to "coast" when the time period is 12-60 seconds from the last receipt of a TIS message. The crew should be aware that traffic may be present but not shown.
- TA OFF - the 'TA OFF' scale banner displayed in the lower left corner of the display indicates that a traffic advisory is outside the selected display range. The traffic advisory off-range banner is removed when the traffic advisory is within the selected display range.
- TRAFFIC - on the PFD, when the system receives a traffic advisory a flashing 'TRAFFIC' alert is displayed in the upper left hand portion of the display. The PFD inset map also automatically displays traffic data.

***CAUTION**: TIS warns the crew with voice and visual traffic advisories whenever it predicts an intruder to be a threat. The display and advisories are intended only for assistance in visually locating the traffic and lack the resolution and coordination ability necessary for evasive maneuvering. Always attempt to visually clear the airspace before maneuvering your aircraft in response to a TA. See Appendix E for detailed TIS information.*

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190-00498-00 Rev. A