8.4 VOR

The VOR page of the Waypoint Info function provides a variety of detailed information about the VOR. The top left area of the page displays the VOR identifier, name, city and state, and region. The top center area shows the lat/lon coordinates of the VOR and the bearing (with direction arrow) and distance to the VOR from your present position. The top right area shows the frequency in a key. Select another Waypoint by touching the **Waypoint Identifier** key, entering the characters for the desired name with the alphanumeric keypad, and then touching the **Enter** key. You may also search through the list by touching the **Find** key and then choosing from the existing list of waypoints by touching the desired waypoint from the list.

The center area of the page shows a map with the VOR in the center.

1. While viewing the Waypoint Info page, touch the **VOR** key.

Figure 8-16 Waypoint Info - VORs

2. Use the **In** and **Out** keys to zoom in and out on the map. You may touch the map window and while lightly pressing the display, drag your finger to move the map view.

3. Touch the **Frequency** key next to load it as the Nav standby frequency.

8.5 NDB

The NDB page of the Waypoint Info function provides a variety of detailed information about the NDB. The top left area of the page displays the NDB identifier, name, city and state, and region. The top center area shows the lat/lon coordinates of the NDB and the bearing (with direction arrow) and distance to the NDB from your present position. The top right area shows the frequency in a key.

Select another Waypoint by touching the **Waypoint Identifier** key, entering the characters for the desired name with the alphanumeric keypad, and then touching the **Enter** key. You may also search through the list by touching the **Find** key and then choosing from the existing list of waypoints by touching the desired waypoint from the list.

The center area of the page shows a map with the NDB in the center.

1. While viewing the Waypoint Info page, touch the **NDB** key.

Figure 8-17 Waypoint Info for NDBs

2. Use the **In** and **Out** keys to zoom in and out on the map. You may touch the map window and while lightly pressing the display, drag your finger to move the map view.

8.6 User Waypoints (User)

In addition to the airport, VOR, NDB and intersection information contained in your Jeppesen NavData® card, the GTN 7XX allows you to store up to 1,000 user-defined waypoints. The User Waypoint Page displays the waypoint name (up to six characters long), identifier and radial from two reference waypoints, distance from one reference waypoint, along with the user waypoint's lat/lon position.

The following descriptions and abbreviations appear on the User Waypoint Page:

- Ref Wpt — Reference waypoint identifier (name)
- Radial — Radial from reference waypoint, in degrees magnetic or degrees true (depending upon unit configuration)
- Distance — Distance from reference waypoint, in nautical miles/statute miles/kilometers (depending upon unit configuration)
- Lat/Lon — Latitude/Longitude (degrees/minutes)

Figure 8-18 Waypoint Info for a User Waypoint

Select another Waypoint by touching the **Waypoint Identifier** key, entering the characters for the desired name with the alphanumeric keypad, and then touching the **Enter** key. You may also search through the list by touching the **View All** key and then choosing from the existing list of User waypoints by touching the desired waypoint from the list.

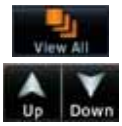
8.6.1 Select User Waypoint By Name

1. While viewing the User Waypoint page, touch the User Waypoint Name.

2. Use the keypad to select the characters for the name and then touch **Enter**.

8.6.2 Select User Waypoint From A List

1. While viewing the Waypoint Info page, touch the **User Waypoint** key.



2. Touch the **View All** key and then use the **Up** and **Down** keys to view the waypoints on the list.

Figure 8-19 Waypoint Info User Waypoint List

8.6.3 Edit User Waypoint

1. Select the desired User Waypoint and touch the **Edit** key.
2. Touch the key for the desired information and make changes as needed.

8.6.4 Delete User Waypoint

1. Select the desired User Waypoint and touch the **Delete** key.
2. Touch the **OK** key to confirm deleting the selected waypoint.

8.7 Create Waypoint

User waypoints are created from the Create User Waypoint page. To create a new user waypoint, simply enter its name (identifier) and position, or reference another waypoint by radial and distance.

Figure 8-20 Waypoint Info - Create User Waypoint

1. From the Waypoint Info page, touch the **Create Waypoint** key.

2. Touch the **User Identifier** key.

3. Use the alphanumeric keypad to make the waypoint name (up to six characters) and then touch the **Enter** key.

Figure 8-21 Waypoint Info - Create User Waypoint Name

4. Touch the **Comment** key to add a short comment for the new waypoint.

5. Touch the **Position Type** key and then **Lat/Lon**, **Radial/Radial**, or **Radial/Distance** to assign the type. See the following instructions for more detail.

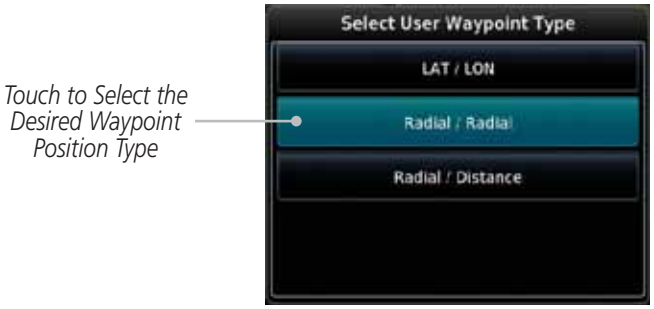


Figure 8-22 Waypoint Info - Create User Position Type

6. If desired, touch the **Temporary?** key to create the waypoint for only temporary use. Temporary waypoints will be removed when the power is cycled.

7. When finished with all selections, touch the **Create** key to create the new waypoint.

8.7.1 Mark On Target

If an external Mark On Target (MOT) switch is installed, pressing that switch will result in the creation of a User waypoint called MOTxxx at the point in space where the MOT switch was pushed. The waypoints are created in increasing numeric order up to number 999, at which point they will start replacing existing waypoints at the beginning of the list.

When a Mark on Target waypoint is created, it may not be immediately visible on the moving map page because the ownship icon will be directly on top of the waypoint. Creation of the waypoint can be verified by changing zoom scales on the map or viewing the User Waypoints page.

***NOTE:** This feature is available in software version 4.00 and later.*

8.7.2 Waypoint Location Based on Lat/Lon Coordinates

1. From the Create User Waypoint page, touch the **Position Type** key and then the **Lat/Lon** key. Then, touch the **Latitude/ Longitude** value key.

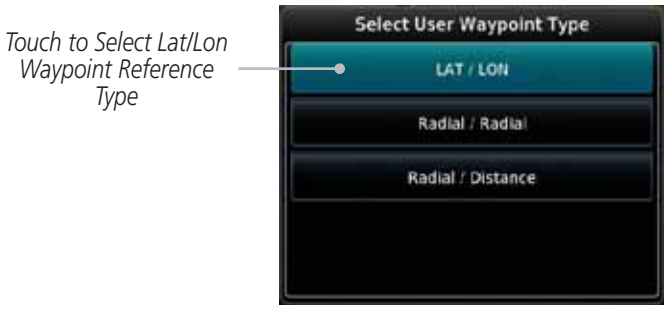


Figure 8-23 Waypoint Info - Create User Waypoint Type - Lat/Lon

2. The Lat/Lon coordinate values will be highlighted. Touch the **Lat** or **Lon** key to toggle selection of the hemisphere values and highlight the selected value.

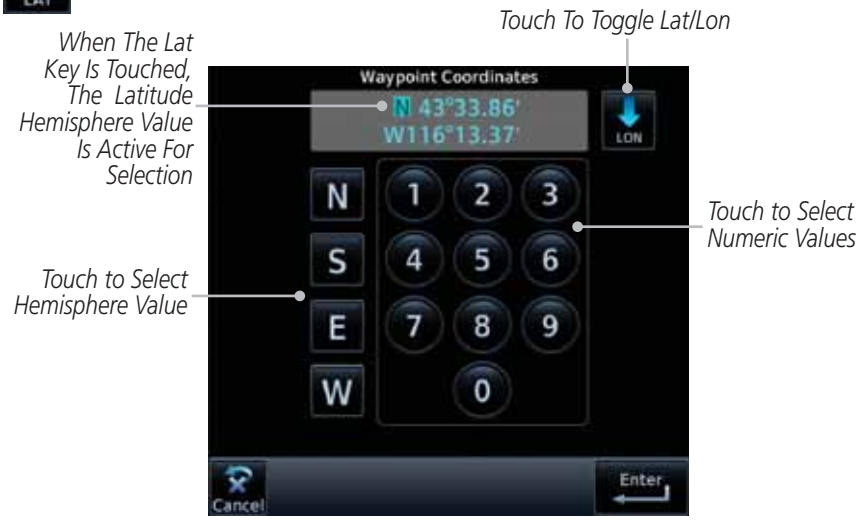


Figure 8-24 Lat/Lon Coordinate Selection

3. Touch the desired hemisphere keys to select the desired values. After selecting the hemisphere value, the cursor will advance to the first character of the adjacent numeric value for selection.

Even when the hemisphere values are highlighted, touching the numeric keys will always place the cursor at the first numeric value. The **Large** knob may also be used for cursor movement and characters are selected with the **Small** knob.

***NOTE:** When editing values, turn the Large knob counter-clockwise to backspace or move the cursor to the left.*

4. As each value is selected, the cursor will advance to the next character. Touch the necessary key for the desired values.

5. When finished with the Lat/Lon selections, touch the **Enter** key.

6. When finished with all selections, touch the **Create** key to create the new waypoint.

8.7.3 Waypoint Location Based on Two Radials

1. From the Create User Waypoint page, touch the **Position Type** key and then the **Radial/Radial** key.

Figure 8-25 Waypoint Info - Create User Waypoint Type - Radial/Radial

2. Touch the **Ref Wpt** key and use the alphanumeric keypad to select the desired identifier.

3. Touch the upper **Radial** key and use the alphanumeric keypad to select the desired value.

4. Touch the **Enter** key.

5. When finished with all selections, touch the **Create** key to create the new waypoint.

8.7.4 Waypoint Location Based on Radial and Distance

1. From the Create User Waypoint page, touch the **Position Type** key and then the **Radial/Distance** key.

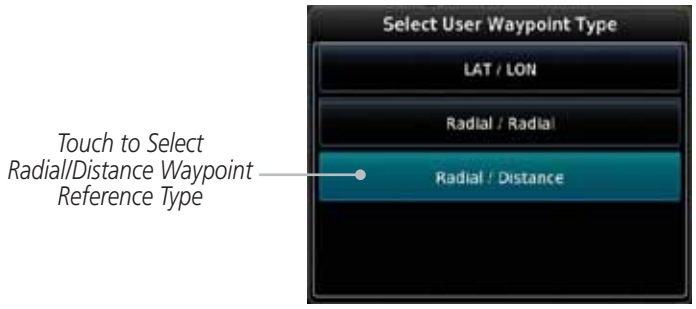


Figure 8-26 Waypoint Info - Create User Waypoint Type - Radial/Distance

2. From the Create User Waypoint page, touch the **Ref Wpt** key and use the alphanumeric keypad to select the desired identifier.

3. Touch the upper **Radial** key and use the alphanumeric keypad to select the desired value.

4. Touch the upper **Distance** key and use the alphanumeric keypad to select the desired value.

5. Touch the **Enter** key.

6. Touch the **Create** key to save the new waypoint.

8.8 Import User Waypoints (SD Card)

The GTN can import user generated waypoints from a file on the SD card. The created waypoints will be at the latitude and longitude specified in the file with the specified name and comment.

NOTE: *This feature is available in software version 5.10 and later.*

When a user waypoint file is on the SD card, a key will be available on the Waypoint Info page for importing user waypoints.

1. Insert an SD card with the User waypoints into the the GTN.
2. From the Waypoint Info page, touch the **Import Waypoints** key.
3. Touch **OK** to acknowledge the pop-up to import all of the user waypoints in the file.

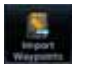


Figure 8-27 Start User Waypoint Import

4. The pilot is informed of the status of the user waypoint import via one of the following system messages.

Message	Description
USER WAYPOINT IMPORT - User waypoints were imported successfully.	All user waypoints were imported successfully.
USER WAYPOINT IMPORT - User waypoint import failed.	User waypoint import failed due to improper file format.
USER WAYPOINT IMPORT - User waypoint import failed. User waypoint database is full.	User waypoint catalog is full and the requested user waypoints could not be imported.
USER WAYPOINT IMPORT - User waypoints imported successfully - existing waypoints reused.	User waypoints imported and existing waypoints are used instead of creating duplicate waypoints. This occurs when a waypoint to be imported is within 0.001° latitude and longitude of an existing user waypoint (roughly a few hundred feet, depending on latitude).

Table 8-1 User Waypoint Import Messages

9 MAP

The Map page is used to provide situational awareness in flight. The Map page can display the following information:

- Airports, NAVAIDs, airspace, airways, land data (highways, cities, lakes, rivers, borders, etc.) with names
- Wind direction and speed
- Icons for enabled map features
- Aircraft icon (with the nose representing present position)
- Nav range ring
- Flight plan legs
- Topography scale
- Topography data
- NEXRAD (or Precip) Weather (Opt.)
- ChartView or FliteChart Overlay
- Terrain Overlay
- Traffic Overlay
- Radar Overlay
- Fuel Range Ring (SW V 6.00 or later)

Figure 9-1 Map Page Description

The following information describes the ownship symbol behavior in a helicopter that does not have a source of magnetic heading information connected to the GTN. When greater than 15 knots groundspeed the map is oriented either north up with ownship oriented to its current track or track up. When less than

15 kts groundspeed, the directional ownship icon is replaced with a non-directional icon because it can't be determined if the rotorcraft is going sideways or backwards. The map will continue to orient to the current track if the map is selected for Track Up. If the map is oriented to track up, then below 5 kts groundspeed the map orientation will "latch" to the last valid track prior to the groudspeed going below 5 kts. The map will reorient when the groundspeed again exceeds 5 kts. The position of the ownship icon over the map is always the current GPS position of the aircraft.

NOTE: *The electronic map is an aid to navigation and is designed to facilitate the use of authorized government charts, not replace them. Land and water data is provided only as a general reference. The accuracy of the land and water data is not suitable for use as a primary source of navigation and should only be used to supplement official government charts and notices.*

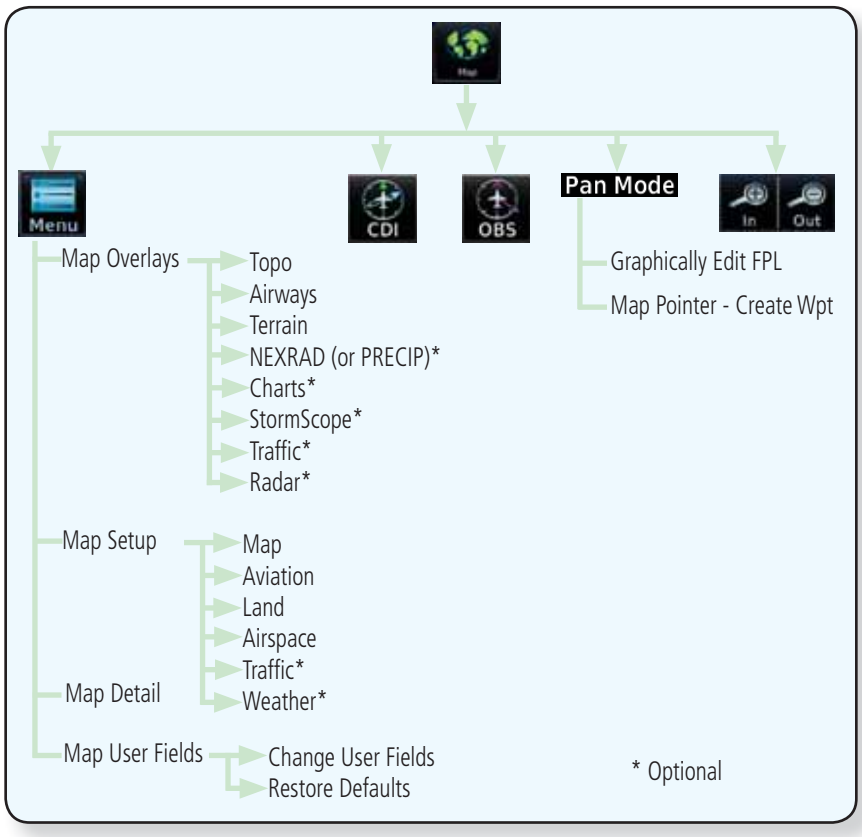


Figure 9-2 Map Page Functional Diagram

NOTE: *NEXRAD (or PRECIP) and Radar may not be shown at the same time.*

9.1 Map Menu

The Map Menu provides the ability to modify and control the information displayed on the Map page.

- Map Overlays are selected to overlay various types of information over the base map.
- Map Setup modifies the display of other map features.
- Map User Fields determines whether or not the fields in the corners of the Map page are displayed and the data shown in each corner.
- Map Detail lets you control the amount of information displayed at different map ranges.
- Restore Defaults lets you start all over again with the default values for the settings for the Map User Fields.

NOTE: *Changes made in the Map Menu take effect immediately on the map display.*

1. From the Home page, touch **Map** to reach the Map page, or press and hold the **HOME** key to go to the Map page from any function. On the Map page, touch the **Menu** key.

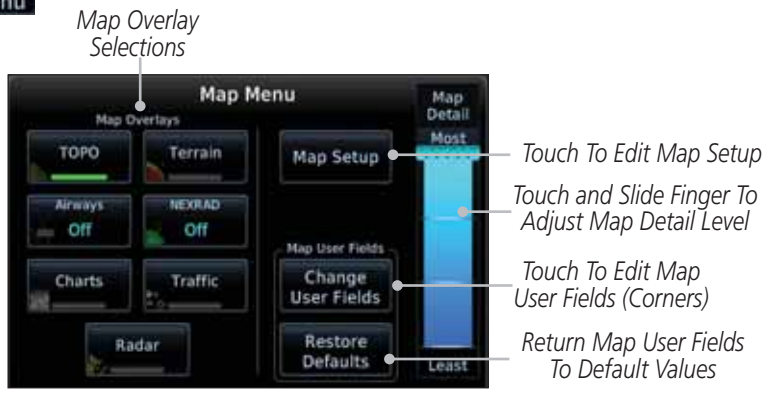


Figure 9-3 Map Menu

2. Touch the key for the desired option to access its settings.

3. Touch the **Back** key to return to the Map page. Any changes made will be retained until changed.

9.1.1 Map Overlays

Map Overlays are layers of information that are referenced to geographic location and are overlayed on the base map. A green bar will appear below the Map Overlay key text when the overlay is selected, except for Airways and NEXRAD.

NOTE: *Data linked weather (SiriusXM / FIS-B / Connext) is displayed below the chart overlay, Active onboard RADAR overlay is displayed above the chart overlay.*

NOTE: *Map overlay keys do not turn on or activate equipment necessary for the overlay to function. Map overlay keys may remain available even if the information necessary for the overlay is not available. For example: the Radar overlay key is available even if the radar is turned off.*

NOTE: *Map overlays for StormScope, Traffic, or Radar are prevented from being overlaid on the main map without a heading source or while User Navigation Angles are selected.*

9.1.1.1 Overlay Priority

The data overlayed on the map is displayed according the following priorities (from highest to lowest):

1 - Traffic	10 - TFRs	19 - County Warning	28 - Icing Potential
2 - Ownship	11 - Freezing Levels	20 - PIREPs	29- Echo Tops
3 - Flight Plan	12 - Cell Movement	21 - AIREPS	30 - NEXRAD
4 - TAWS Alerts	13 - Lightning	22 - City Forecast	31 - Cloud Tops
5 - Weather Radar	14 - METARs	23 - Surface Analysis	32 - IR Satellite
6 - Charts	15 - Winds Aloft	24 - Airspace	33 - SafeTaxi
7 - Stormscope	16 - SIGMETs	25 - Waypoints	34 - Terrain
8 - Obstacles	17 - AIRMETs	26 - Airways	35 - Base Map
9 - Fuel Range Ring	18 - Cyclone Warning	27 - Turbulence	36 - Topo

Table 9-2 Data Overlay Priority

9.1.1.2 Topo

The Topo Data option selects whether the colored topographical features are displayed. Traffic, Land Data, Terrain, and Obstacles will still be displayed even with Topo Data turned off.

1. While viewing the Map Menu, touch the **TOPO** Map Overlay key to toggle the Topo setting.

Topo Map Overlay Off **Topo Map Overlay On**

Figure 9-4 Topo Map Overlay Selections

2. When the Topo Map Overlay is toggled off, all topographic color features are removed.

9.1.1.3 Airways

The Airways option allows you to select the airways that are shown on the Map page. All, Low only, and High only Airways may be selected. When Off is selected, airways will not be shown.

1. While viewing the Map Menu, touch the **Airways** Map Overlay key to select the Airways viewed. Selections are: Off, Low, High, and All.

Figure 9-5 Map Menu Airways Map Overlay Selection

2. Low Airways are shown as grey lines. High Airways are shown as green lines.

9.1.1.4 Terrain

The Terrain Data option selects whether Terrain Data is shown on the Map page. Terrain and NEXRAD weather may not be displayed at the same time. Selecting one will disable the other. A Terrain icon will indicate that the Terrain overlay has been selected. Terrain overlay colors may or may not be shown depending on the altitude of the aircraft.

1. While viewing the Map Menu, touch the **Terrain** Map Overlay key to toggle the view of Terrain data.

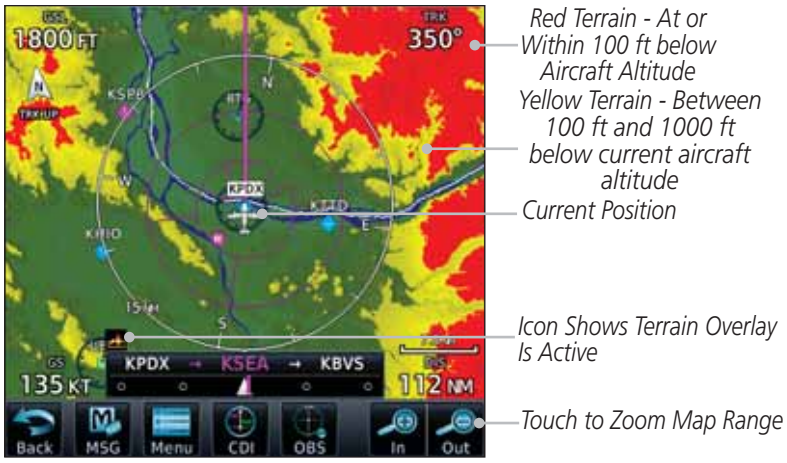


Figure 9-6 Map Menu Terrain Map Overlay "On" Selection

2. The colors of the terrain are referenced to your aircraft altitude.

9.1.1.5 NEXRAD (Optional)

The NEXRAD menu option allows the display of NEXRAD Precip weather information overlayed on the Map page. Terrain and NEXRAD Precip weather may not be displayed at the same time. Selecting one will disable the other. NEXRAD Precip weather is an optional feature that requires the installation of a GDL 69/69A, GDL 88, or GSR 56 and an appropriate Weather subscription. Only one weather source can be displayed at a time (i.e. FIS-B and XM cannot be displayed on the map simultaneously. See the Weather section for more detail.

While viewing the Map Menu, touch the **NEXRAD** Map Overlay key to toggle the view of NEXRAD weather data.

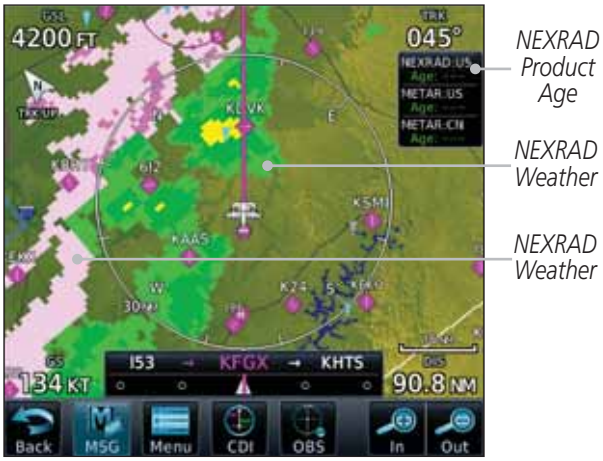


Figure 9-7 Map Menu NEXRAD Map Overlay "On" Selection

9.1.1.6 Charts (Optional)

The Charts menu option allows the display of Charts overlayed on the Map page. The Charts Map Overlay option selects whether Chart data is shown on the Map page. Charts may or may not be shown depending on the other aircraft's location. The ownship icon will be shown over an available chart. See the Charts section for more detail.

A chart will be displayed on the map if all of the following are true:

- A charts database is a valid database.
- The system date is prior to the disable date of the charts database.
- The Charts Overlay Setting is active.
- The aircraft is In Air.

The chart displayed on the map will be chosen based on:

- The approach chart for the approach in the active flight plan, if an approach exists in the active flight plan.
- The airport surface chart for the nearest airport, if no approach exists in the active flight plan and an airport exists within 200NM of the aircraft's current position.

NOTE: *Features that are selectable on the main map page, such as obstacles, airports, airspace, and other waypoint types that are not visible beneath the overlaid chart, remain selectable even when an approach chart is overlaid on the main map.*

NOTE: *If the chart for the loaded approach procedure is not overlaid on the map page with the Chart Overlay active, ensure the correct chart is selected on the dedicated Charts page.*

NOTE: *If two GTN 7XX units are crossfilled, then the same type (ChartView or FlightCharts) and version (cycle number and effective dates) for the chart database must be installed on both units in order for the correct chart to be overlaid on the main map page.*

While viewing the Map Menu, touch the **Charts** Map Overlay key to toggle the view of the Charts overlay.

Chart Overlay Selected In The Map Menu

Ownship Located on Chart Overlay

Figure 9-8 Map Menu Charts Map Overlay "On" Selection

9.1.1.7 StormScope® (Optional)

The WX-500 StormScope Weather Mapping Sensor is a passive weather avoidance system that detects electrical discharges associated with thunderstorms within a 200 NM radius of the aircraft. The StormScope measures relative bearing and distance of thunderstorm-related electrical activity and reports the information to the display. Stormscope and XM Lightning are mutually exclusive.

***NOTE:** Refer to the WX-500 Pilot's Guide for a detailed description of the WX-500 StormScope.*

Stormscope

1. While viewing the Map Menu, touch the **StormScope** Map Overlay key to show the menu for selecting the StormScope radar weather data display mode (Cell, Strike, Off, or Clear Strikes).

Figure 9-9 Map Menu StormScope Map Overlay Selection

2. StormScope data will be overlayed on the Map page when Cell or Strike is selected. See the Weather section for more details.

Figure 9-10 Map Menu StormScope Map Overlay On Selection

9.1.1.8 Radar (Optional)

The Radar setting set on the Weather Radar page, such as Tilt, Range, etc., will be used for the radar overlay on the Map page. NEXRAD/PRECIP and the Radar overlay may not be shown at the same time.

While viewing the Map Menu, touch the **Radar** Map Overlay key to toggle the view of airborne Radar data.

Figure 9-11 Map Menu Radar Map Overlay On Selection

9.1.1.9 Traffic (Optional)

The Traffic Map Overlay option selects whether Traffic data is shown on the Map page. A Traffic icon will indicate that the Traffic overlay has been selected. Traffic may or may not be shown depending on the other aircraft's location and equipment. See the Traffic section for more detail.

While viewing the Map Menu, touch the **Traffic** Map Overlay key to toggle the view of Traffic data.

Figure 9-12 Map Menu Traffic Map Overlay On Selection

9.1.2 Map Setup

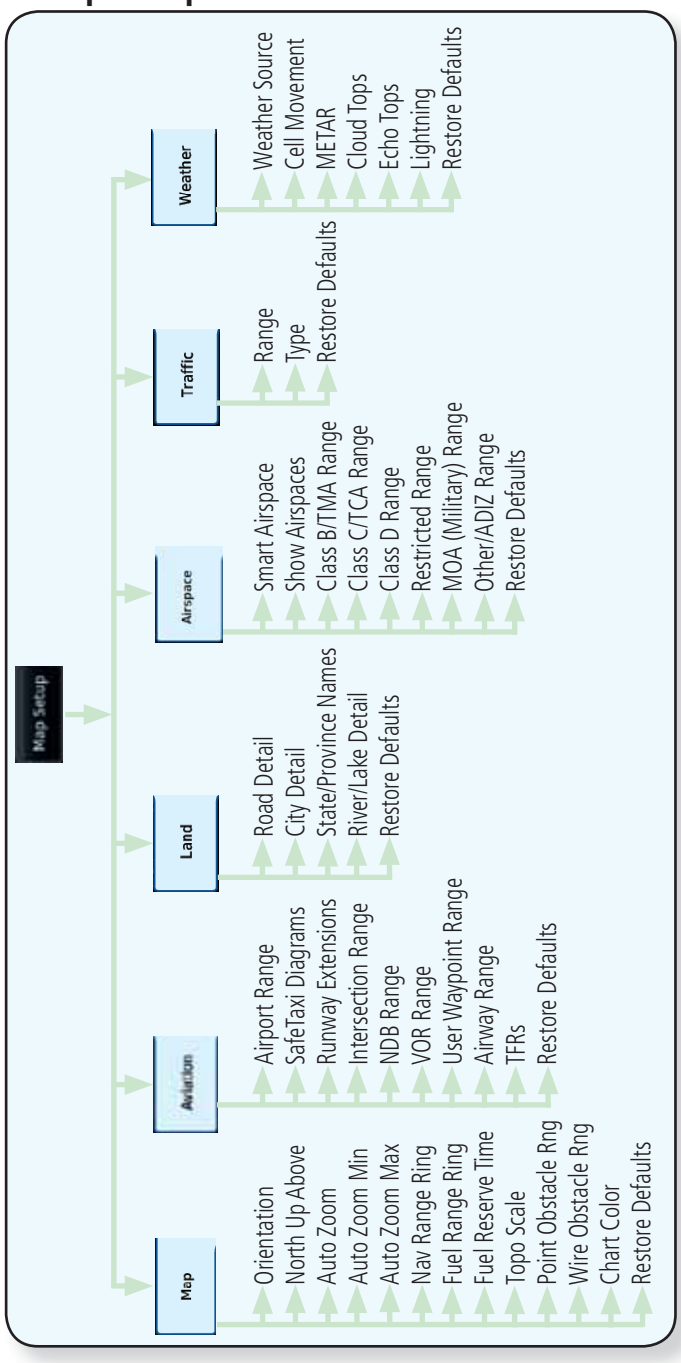


Figure 9-13 Map Setup Functional Diagram

The Map page is customized by selecting groups from the Map Menu. The Map Menu groups include choices for Map, Aviation, Land, Airspace, Traffic, and Weather groups depending on the installed equipment of a given aircraft. Each group has a list of options that vary with the group.

1. While viewing the Map page, touch the **Menu** key. Then, touch the **Map Setup** key. The Map Setup page will be displayed.

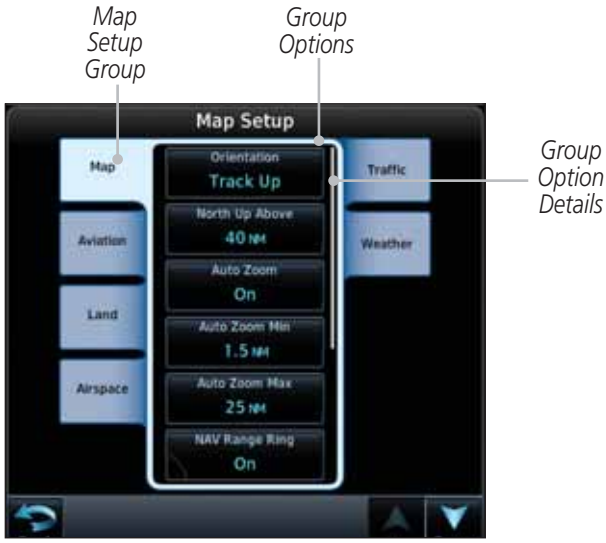


Figure 9-14 Map Setup Page

2. Touch the desired Map Setup Group tab (Map, Aviation, Airspace, Land, Traffic, or Weather) to display the set of group options.

3. Touch the desired group key. A list of options for the selected group will be shown. (i.e. Map - Orientation, North Up Above, Auto Zoom, etc.) Touch the **Up** or **Down** keys as needed to scroll through the list.
4. Touch the key for the selected option.

5. Touch the **Restore Defaults** key to return to the original default values for the selected option.

9.1.2.1 Map

The Map option defines the behavior and display of information on the Map page such as: Orientation, North Up Above, Auto Zoom, Nav Range Ring, Topo Scale, Obstacle Range, and Restore Defaults. The default values are shown in **bold** type.

Feature	Selection
Orientation	North Up, **Track Up**, Heading Up
North Up Above	Off, 10 NM, 15 NM, 25 NM, **40 NM**, 50 NM, 75 NM, 100 NM, 150 NM, 250 NM
Auto Zoom	Off, **On**
Auto Zoom Min	250 ft, 400 ft, 500 ft, 750 ft, 1000 ft, 1500 ft, 2500 ft, 0.5 NM, 0.75 NM, 1 NM, **1.5 NM**, 2.5 NM, 4 NM, 5 NM, 7.5 NM, 10 NM, 15 NM, 25 NM, 40 NM, 50 NM, 75 NM, 100 NM, 150 NM, 250 NM, 400 NM
Auto Zoom Max	250 ft, 400 ft, 500 ft, 750 ft, 1000 ft, 1500 ft, 2500 ft, 0.5 NM, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, 4 NM, 5 NM, 7.5 NM, 10 NM, 15 NM, **25 NM**, 40 NM, 50 NM, 75 NM, 100 NM, 150 NM, 250 NM, 400 NM
Nav Range Ring	Off, **On**, Enhanced
Fuel Range Ring	Off, **On**
Fuel Reserve Time	30 Min, **45 Min**, 60 Min, 90 Min
Topo Scale	**Off**, On
Point Obstacle Range	Off, 4 NM, **5 NM**, 7.5 NM, 10 NM, 15 NM
Wire Obstacle Range	Off, 1 NM, **1.5 NM**, 2.5 NM
Chart Color Scheme	**Day**, Night
Restore Defaults	Returns values to original factory settings

Table 9-1 Map Setup Map Options

Map Orientation

The Map Orientation selection sets the orientation of the Map page. Selections are North Up, Track Up, and Heading Up. A Map Orientation label is shown below the North indicator (reference to True North) in the top left corner of the Map page.

Figure 9-15 Map Orientation Label

North Up Above

The North Up Above option allows you to select the map range where at and above the selected value the Map Orientation will automatically change to North Up as a default. When the map range is 500 NM or more, the map orientation will automatically become North Up.

Auto Zoom

With a valid flight plan, the Auto Zoom feature will automatically change the Map page range depending on the distance to the next waypoint in the flight plan. If enabled, it will also automatically zoom to the SafeTaxi zoom range when the aircraft is on the ground. Auto Zoom can be overridden at any time by manually zooming with the **In** and **Out** keys. The Auto Zoom Min selection sets the minimum range that the display will Zoom in. The Auto Zoom Max value sets the maximum range the display will Zoom out.

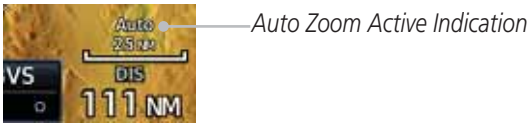


Figure 9-16 Auto Zoom Active Indication

Auto Zoom is re-enabled once one of the following conditions is met:

- A waypoint is sequenced
- The aircraft transitions from “on ground” to “in air”
- A point is reached where the Auto Zoom range matches the manual override range (known as auto-sync) and will be noted as “Auto” above the map range value on the map page
- Auto Zoom is toggled off and back on in the Map Setup page

NOTE: *Rotorcraft use a Local Auto Zoom function where Auto Zoom will remain at the 1500 ft zoom scale until the rotorcraft is above 400 ft GSL or 40 kts.*

Auto Zoom Min

Set the limit that the display will zoom in automatically.

Figure 9-17 Map Setup Minimum Auto Zoom Range

Auto Zoom Max

Set the limit that the display will zoom out automatically.

Figure 9-18 Map Setup Maximum Auto Zoom Range

Nav Range Ring

When turned on, the Nav Range Ring option will show a ring with a compass rose oriented to magnetic north around your present position on the Map page. When selected ON, the Enhanced Range Ring function provides a second ring at 1/2 the distance of the primary ring to allow the pilot to acccurately judge distance to objects depicted on the map.

Figure 9-19 Nav Range Ring

Fuel Range Ring

NOTE: *This feature is available in software version 6.00 and later.*

When interfaced with a fuel computer, the GTN can display a Fuel Range Ring which shows an estimate of the remaining flight distance at the current fuel consumption rate and groundspeed. If either fuel quantity or fuel flow sensor data is not received, the GTN will use the Fuel on Board or Fuel Flow values on the Utilities – Fuel Planning page. If both fuel quantity and fuel flow are not received by the GTN, the Fuel Range Ring will be removed. A dashed green circle indicates the selected Range to Reserve Fuel. A solid yellow circle indicates the Total Endurance Range.

Figure 9-20 Fuel Range Ring

TOPO Scale

The Topo Scale option selects whether the elevation scale for topographical features on the Map page is displayed. The scale will be located on the left side of the display.

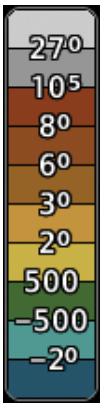


Figure 9-21 Map Page Topo Scale

Point Obstacle Range

The Point Obstacle Range option selects whether the Point Obstacle Data is shown on the Map page at and below the selected Point Obstacle range. Map ranges above this value will not show the Point Obstacle Data. An obstacle with an asterisk indicates a group of the same obstacle type.

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

Table 9-2 Navigation Map Point Obstacle Icons by Elevation

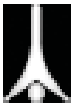
Tower	Windmill	Windmill in Group	Power Line
			

Table 9-3 Obstacle Icon Types

Color	Description
None	Lines are removed when they are more than 2000 ft below the aircraft.
White	Lines are white when they are within 2000 ft below the aircraft.
Amber	Lines are amber when they are within 1000 ft below the aircraft.
Red	Lines are red when they are within 100 ft below or above the altitude of the airplane.

Table 9-4 Fixed Wing Color Scheme for Obstacles and Wires

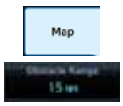
Color	Description
None	Lines are removed when they are more than 500 ft below the rotorcraft.
White	Lines are white when they are within 500 ft below the rotorcraft.
Amber	Lines are amber when they are within 250 ft below the rotorcraft.
Red	Lines are red when they are at or above the altitude of the rotorcraft.

Table 9-5 Rotorcraft Color Scheme for Obstacles and Wires

Grouped obstacles are shown with an asterisk. The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

1. While viewing the Map function, touch the **Menu** key.

2. Touch the **Map Setup** key.



3. Under the **Map** tab touch the **Point Obstacle Range** key and select the maximum range where obstacles will be displayed.

Figure 9-22 Navigation Map Point Obstacles

* The icon on the left shows that the point obstacle overlay is active. The icon on the right shows that the wire obstacle overlay is active. These icons are available in software version 5.12 or later.

4. Touch an obstacle on the map and the elevation will be shown. If there are nearby or overlayed objects (obstacle, airspace, airport, etc), touch the **Next** key to step through the nearby objects. Touch the **Back** key to return to the normal map view.

Figure 9-23 Point Obstacle Detail

Wire Obstacle Range

The Wire Obstacle Range option selects whether the power lines are shown on the Map page at and below the selected Wire Obstacle range. Map ranges above this value will not show the Wire Obstacle Data.

NOTE: *This feature is available in software version 5.10 and later and requires the use of obstacle databases that contain wire obstacle data.*

Figure 9-24 Wire Obstacles

Chart Color Scheme

The Chart Color Scheme setting changes the day and night view of the Chart Overlay colors on the Map page.

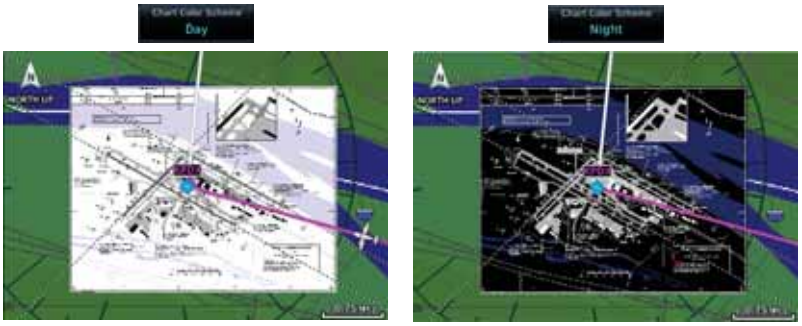


Figure 9-25 Chart Color Scheme Settings

Restore Defaults

Returns values to the original factory settings.

9.1.2.2 Aviation

The Aviation group selection from the Map Setup Page Menu allows you to customize the display of Active Flight Plan, Active Flight Plan Waypoints, Airport size range, SafeTaxi information, Runway Extensions, Intersection/NDB locations, VOR locations, Airspace Detail, and TFR icons on the Map page. The feature will be shown at map ranges of the selected value and lower. The options for each feature are shown in the following table. The default values are shown in **bold** type.

Feature	Selection
Airport Range	Off, 7.5 NM, 10 NM, 15 NM, **25 NM**, 40 NM, 50 NM, 75 NM, 100 NM, 150 NM
Heliports (Optional)	Off, **On**
SafeTaxi Diagrams	Off, 1000 ft, 1500 ft, 2500 ft, 0.5 NM, 0.75 NM, **1 NM**, 1.5 NM
Runway Extensions	Off, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**
Intersection Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, **4 NM**, 5 NM, 7.5 NM, 10 NM
NDB Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**, 7.5 NM, 10 NM

Feature	Selection
VOR Range	Off, **10 NM**, 15 NM, 25 NM, 40 NM, 50 NM, 75 NM, 100 NM
User Wpt Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**, 7.5 NM, 10 NM, 15 NM, 25 NM, 40 NM, 50 NM, 75 NM, 100 NM
Airway Range	2.5 NM, 4 NM, 5 NM, 7.5 NM, 10 NM, 15 NM, **25 NM**
TFR	**Off**, On
Restore Defaults	Returns values to original factory settings

Table 9-6 Map Setup Aviation Options

NOTE: *The term "intersection range" means any GPS waypoint included in the navigation database, and includes waypoints that may not be intersections of two VOR radials.*

Airport Size	Size Criteria	Display Criteria
Small	Longest runway length is less than 5000 feet, unless it has a tower frequency, in which case it is a Medium Airport.	Small airports and heliports are displayed on the map when the Map Range is less than or equal to 1/4 times the Airport Range Setting.
Medium	Longest runway length is less than 8100 feet but greater than or equal to 5000 feet or less than 8100 feet and has a tower frequency.	Medium airports are displayed on the map when the Map Range is less than or equal to 1/2 times the Airport Range Setting.
Large	Longest runway length is greater than or equal to 8100 feet.	Large airports are displayed on the map when the Map Range is less than or equal to the Airport Range Setting.

Table 9-7 Airport Display Range Setting

NOTE*: The Airport Range Setting of "Off" means airports are never displayed.*

Heliports are displayed on the map page if the Heliport Display Setting is "On" and the Map Range is less than or equal to 1/4 times the Airport Range Setting.

9.1.2.3 Land

The Land Data option selects whether detailed land features, such as Freeways, National Highways, Local Roads, Cities, States/Provinces, and Rivers/Lakes are displayed. Topo features, traffic, terrain, and obstacles will still be displayed, even with Land Data turned off. The options for each feature are shown in the following table. The default values are shown in **bold** type.

Feature	Selection
Road Detail	None, Least, Less, **Normal**, More, Most
City Detail	None, Least, Less, **Normal**, More, Most
State/Province Names	Off, **On**
River/Lake Detail	None, Least, Less, **Normal**, More, Most
Restore Defaults	Returns values to original factory settings

Table 9-8 Map Setup Land Options

9.1.2.4 Airspace

The Airspace viewing range options select whether the Airspaces are shown on the Map and at and below the selected map ranges. The Smart Airspaces selection filters airspaces to show the ones appropriate for your altitude.

Feature	Selection
Airspace Label Range	Off, 7.5 NM, 10 NM, 15 NM, **25 NM**, 40 NM, 50 NM
Smart Airspace	**Off**, On
Show Airspaces	**All**, Below 18000 ft, Below 15000 ft, Below 12000 ft, Below 9000 ft, Below 6000 ft, Below 3000 ft
Class B/TMA Range	Off, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**
Class C/TCA Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, **4 NM**, 5 NM, 7.5 NM, 10 NM
Class D Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**, 7.5 NM, 10 NM
Restricted Range	Off, **10 NM**, 15 NM, 25 NM, 40 NM, 50 NM, 75 NM, 100 NM
MOA (Military) Range	Off, 0.75 NM, 1 NM, 1.5 NM, 2.5 NM, 4 NM, **5 NM**, 7.5 NM, 10 NM, 15 NM, 25 NM, 40 NM, 50 NM, 75 NM, 100 NM
Other/ADIZ Range	None, Least, Less, **Normal**, More, Most
Restore Defaults	Returns values to original factory settings

Table 9-9 Map Setup Airspace Options

Airspace Labels

NOTE: *This feature is available in software version 5.10 and later when configured by the installer.*

The Airspace Label feature shows the airspace altitude limits within the selected range.

Figure 9-26 Display of Airspace Labels

Smart Airspaces:

Garmin's Smart Airspace™ feature aids visual clarity on-screen by de-emphasizing airspace that's well above or below the aircraft's current altitude. The vertical separation is 1,000 feet at sea level and the vertical separation will gradually increase to 2,000 feet until the aircraft reaches 10,000 feet. Anything above 10,000 feet keeps the 2,000 feet vertical separation.

NOTE: *Smart Airspace only changes the depiction of the airspace on the moving map display. It does not alter the Airspace Alerts that can be set on the System-Alerts portion of the system.*

Figure 9-27 Display of Smart Airspaces (Airspace Borders Grayed)

To control the display of European airway airspaces:

1. While viewing the Map Setup Airspaces option, touch the **Other/ADIZ Range** key and select a value.

2. Select **Off** for the Other/ADIZ Range to turn off the display of airway airspaces.

Airway Airspaces - On

Airway Airspaces - Off

Airway Airspaces - On

Figure 9-28 Selecting the Display of European Airway Airspaces

9.1.2.5 Traffic (Optional)

The Traffic group selection from the Map Setup Page Menu allows you to customize the display of traffic on the Map page. The Traffic function requires the installation of the appropriate traffic device. Only one traffic source can be configured for the GTN and this traffic source will be overlaid on the main map. Coverage follows the airplane. In the Navigation Map page setup you can select the maximum range at which traffic symbols are shown. Once outside of the selected range, traffic will be decluttered. The default values are shown in **bold** type.

Traffic Selection	Display Result
Range	1 NM, 1.5 NM, 2.5 NM, 4 NM, 5 NM, 7.5 NM, 10 NM, 15 NM, **25 NM**
Traffic	**All Traffic**, Alerts & Advisories, Alerts Only
Restore Defaults	Returns values to original factory settings

Table 9-10 Map Page Traffic Display Options

9.1.2.6 Weather (Optional)

The Weather group selection from the Map Setup Page Menu allows you to customize the overlay of the available weather information on the Map page. Weather is an optional feature that requires an external weather source, which must be selected to allow the overlay.

Feature	Selection
Weather Source	SiriusXM, Connext, or FIS-B
Cell Movement	**Off**, On
METAR	**Off**, On
Cloud Tops	**Off**, On
Echo Tops	**Off**, On
Lightning	**Off**, On
Restore Defaults	Returns values to original factory settings

Table 9-11 Map Setup SiriusXM Weather Options

NOTE: *Map overlay keys may remain available even if the information necessary for the overlay is not available. For example: the Radar overlay key is available even if the radar is turned off.*

Feature	Selection
Weather Source	SiriusXM, Connext, or FIS-B
METAR	**Off**, On
IR Satellite	**Off**, On
Lightning	**Off**, On
Restore Defaults	Returns values to original factory settings
Connext Settings	Selectable Connext Settings

Table 9-12 Map Setup Connext Weather Options

Feature	Selection
Weather Source	SiriusXM, Connext, or FIS-B
METAR	**Off**, On
Restore Defaults	Returns values to original factory settings

Table 9-13 Map Setup FIS-B Weather Options

9.1.3 Change User Fields

The Change User Fields selection allows you to configure the Data, Function, and Page field type shown in each of the four corners of the Map page. The information shown in each field may be selected from a list after *Change User Fields* is selected.

1. While viewing the Map page, touch the **Menu** key.

2. From the Map Menu screen, touch the **Change User Fields** key.

Touch To Select Data Field (TRK Currently Shown)

Touch To Select Data Field (DIS Currently Shown)

Touch To Cancel Any Changes

Figure 9-29 Map Data Fields Selection

NOTE: *Map Data Field Types that use the term "Destination" refer to the missed approach point (if an approach is loaded) or the final airport in the flight plan.*

NOTE: *In software version 5.13 and earlier, ETE to Destination is not available when a procedure is loaded and there are waypoints in the Enroute section of the flightplan.*

3. Touch the corner data field key you want to select. Touch the **Data, Function,** or **Page** keys to select the User Field type. A list of information types will be displayed.

Figure 9-30 Map Data Field Type Selections

4. Touch the **Up** or **Down** keys or touch the display and drag your finger to scroll through the list. Touch the desired item to select it or touch the **Back** key to cancel selection.

Map Data Field Type	
ACTV WPT - Active Waypoint	MSA - Minimum Safe Altitude
B/D APT - BRG/DIS from Dest APT [1]	OAT (static) - Static Air Temperature
BRG - Bearing to Current Waypoint	OAT (total) - Total Air Temperature
DIS - Distance to Current Waypoint	RAD ALT - Radar Altimeter
DIS to Dest - Distance to Destination [2]	Time - Current Time
DTK - Desired Track	Time to TOD - Time to Top of Descent
ESA - Enroute Safe Altitude	TKE - Track Angle Error
ETA - Estimated Time of Arrival	TRK - Track
ETA at Dest - ETA at Destination	Trip Timer - Timer Display
ETE - Estimated Time Enroute	VOR/LOC - Tuned VOR/LOC Info
ETE to Dest - ETE to Destination	VSR - Vertical Speed Required
Fuel Flow - Total Fuel Flow	Wind - Wind Speed and Direction
GS - GPS Ground Speed	XTK - Cross Track Error
GSL - GPS Altitude	OFF - Do Not Display Data Field
Generic Timer - Timer Display	

Table 9-14 Map Data Field Types of Information

Note 1: B/D APT is the straight line distance.

Note 2: Dist to DEST is the distance along the flight plan.

Function Field Type	
CDI - Course Deviation Indicator	Passenger Address - PA Toggle
Flap Override - Flap Override [1]	Playback - Play Last Recording
GPWS Inhibit - GPWS Inhibit [1]	TAWS Inhibit - TAWS Inhibit
G/S Inhibit - G/S Inhibit [1]	Gen Timer - Generic Timer Control
HTAWS RP Mode - HTAWS RP Mode [2]	WX RDR Controls - Weather Radar Controls
OBS/Suspend/Unsuspend Button	OFF - Do Not Display Data Field
On Scene - "On Scene" Mode Toggle	

Table 9-15 Map Function Field Types of Information

Note 1: With TAWS-A enabled

Note 2: With HTAWS enabled

Map Page Field Type	
Charts - Charts Page	Fuel PLAN - Fuel Planning Page
Flight Plan - Flight Plan Page	SCHED MSG - Scheduled Messages
Map - Map Page	Trip PLAN - Trip Planning Page
Nearest - Nearest Page	VCALC - VCALC Page
NEAR APT - Nearest Airport Page	User FREQ - User Frequencies
PROC - Procedures Page	WPT INFO - Waypoint Information
Approach - Approach Page	Weather - Weather Page
Arrival - Arrival Page	CNXT WX - Connext WX Page
Departure - Departure Page	FIS-B WX - FIS-B Weather Page
Services - Services Page	Stormscope - Stormscope Page
Traffic - Traffic Page	WX Radar - Weather Radar Page
Terrain - Terrain Page	SiriusXM WX - Sirius XM WX Page
Utilities - Utilities Page	OFF - Do Not Display Page Field
Checklist - Checklist Page	

Table 9-16 Map Page Field Types of Information

9.1.4 Map Detail

The Map Detail feature allows four levels of decluttering to remove map information. The declutter level is displayed in the **DCLTR** key. There are four levels of decluttering. Level 0 shows the most detail and level 3 shows the least detail.

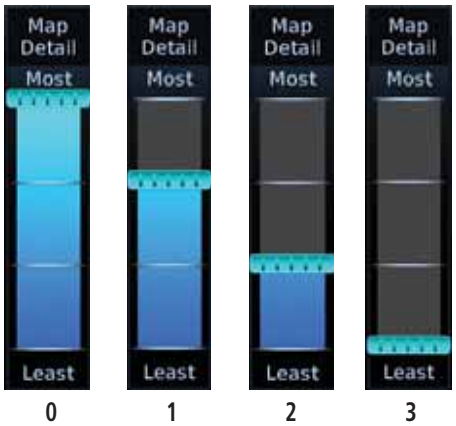


Figure 9-31 Map Detail Levels

1. While viewing the Map page, touch the **Menu** key.
2. While viewing the Map Menu, touch the **Map Detail** scale and slide your finger to adjust the level. Features marked with a • are shown at the indicated Map Detail Level.

Feature	0	1	2	3	Feature	0	1	2	3
River/Lake Names	•				TRSA	•	•		
Land/Country Text	•				ADIZ	•	•		
Large City	•				Alert Areas	•	•		
Medium City	•				Caution Areas	•	•		
Small City	•				Danger Areas	•	•		
Small Town	•				Warning Areas	•	•		
Freeways	•				Large Airports	•	•	•	
Highways	•				Medium Airports	•	•	•	
Roads	•				Restricted Areas	•	•	•	
Railroads	•				Prohibited Areas	•	•	•	
Political Boundaries	•				MOAs	•	•	•	
User Waypoints	•	•			Runway Labels	•	•	•	
VORs	•	•			Lightning Strike Data	•	•	•	
NDBs	•	•			NEXRAD Data	•	•	•	
Intersections	•	•			Traffic Symbols	•	•	•	
Class B Airspace	•	•			Traffic Labels	•	•	•	
Class C Airspace	•	•			Water Detail	•	•	•	•
Class D Airspace	•	•			Active FPL Legs	•	•	•	•
Tower	•	•			Airways	•	•	•	•

Table 9-17 Features Shown at Each Map Detail Level

9.2 Map Panning

In the Map Page function, panning allows you to move the map beyond its current limits without adjusting the map scale. The panning function is selected by simply touching the Map display. The **In** and **Out** keys at the lower right corner of the page control the map range. Touching the display momentarily switches the display to Map Pan Mode. While in Map Pan Mode, touch the display gently and drag your finger to pan around the map.

1. Touch the Map page display.

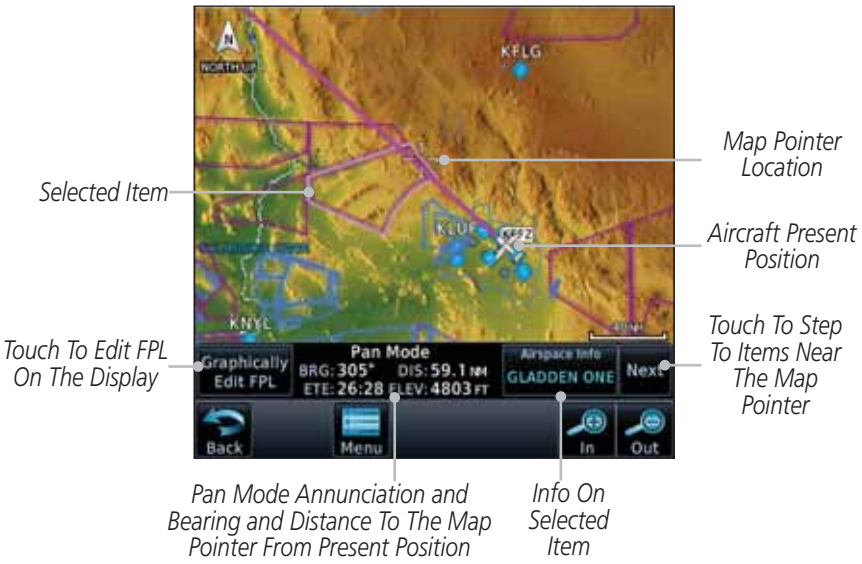


Figure 9-32 Map Panning With Airspace Highlighted

***NOTE**: It is possible that multiple airspaces can be stacked vertically and be difficult to visually identify them. Touching the **Next** key will step through the airpaces.*

2. If you touch an item on the display (waypoint, airspace, obstacle) there may be other items very close that are difficult to see at a given zoom level. Touch the **Next** key to annunciate and highlight the next item. Each touch of the **Next** key steps to another item near the Map Pointer.

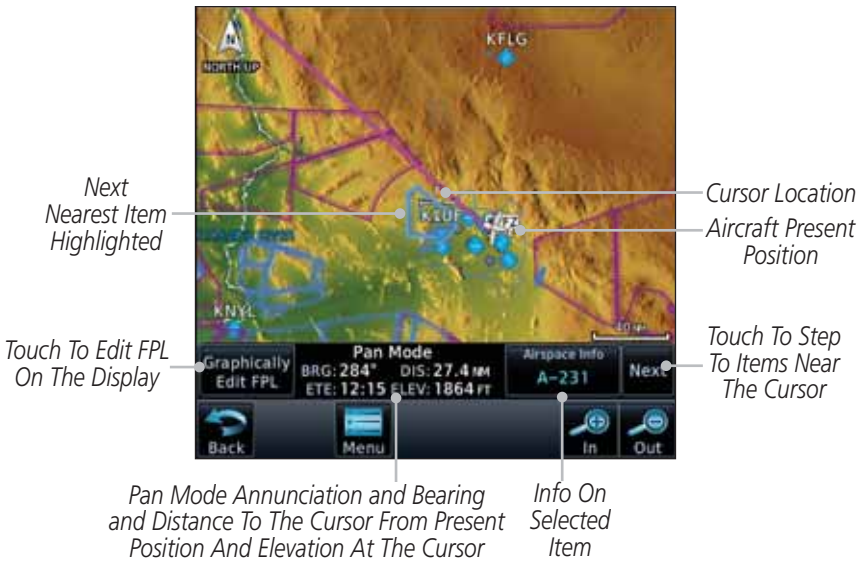


Figure 9-33 Map Panning With Next Airspace Shown

3. Touch the **Airspace Info** (Item) key for more information about the selected item. Touch the **Back** key to return to the Map Panning display.

Figure 9-34 Map Panning Selected Item Information

4. While pressing your finger gently against the display, drag your finger across the display to scroll the display in the direction of your finger movement. The Map Pointer cross hair location is based on where your finger touches the display, but after dragging your finger the Map Pointer will be centered on the map when your finger is lifted from the display.

Figure 9-35 Map Panning With Map Pointer

NOTE: *Pressing the Direct-To key will use the Map Pointer location as the destination.*

5. Touch the **Back** key to return to the normal map display.

9.3 Map Controls

While in the Map page function, several controls are available to manage the view and display of information. The **In** and **Out** keys at the lower right corner of the page control the map range. Touching the display momentarily switches the display to Map Pan Mode.

While in any of the Map function pages, touching the display starts **Pan Mode.** Options are available to Create a waypoint at the Map Pointer position and to Graphically Edit Flight Plan.

9.3.1 Pan Map Mode

The Pan Map mode allows you to move the map display to view the surrounding area.

1. Touch the Map page display.
2. See the description in the Map Panning section for details of using this feature. Touch the **Back** key to return to the normal Map display.

9.3.2 Create Waypoint

The Create Waypoint function will create a User Waypoint at the Map Pointer location when that location is not an already named object, such as an airport or airspace.

1. In Pan Mode, touch the **Create Waypoint** key.
2. Follow the directions in the Waypoint Info section for Creating User Waypoints.

Figure 9-36 Create User Waypoint While Map Panning

9.3.3 Graphically Edit Flight Plan Mode

The Edit Flight Plan Mode allows making quick changes to the active flight plan directly on the display. The process is simply touching the display to start Map Pan Mode, touching the **Graphically Edit FPL** key, dragging the desired leg to a new waypoint or airway, and touching the **Done** key. At any point, a step may be removed by touching the **Undo** key or the whole process ended by touching the **Cancel** key. The **Undo** key will remove up to nine steps.

9.3.3.1 Adding a Waypoint Within an Existing Flight Plan

1. Touch the Map page display. The Map Mode selection keys will appear. Touch the **Graphically Edit FPL** key.

Figure 9-37 Edit Flight Plan Mode

2. Touch and hold the desired leg of the flight plan.

Figure 9-38 Select Leg of Flight Plan to Change

3. Drag the flight plan leg to a new waypoint, or airway, to add a waypoint, or airway, to the active flight plan. The flight plan leg being edited will turn cyan.

Figure 9-39 Drag Selected Leg of Flight Plan to New Waypoint

4. Touch the **Done** key. The aircraft will now navigate according to the new flight plan.

Figure 9-40 Completed Flight Plan with New Waypoint

NOTE: *Parallel track will be cancelled when graphically editing a flight plan.*

NOTE: *It is not possible to graphically add an intermediate waypoint between the current position and a direct-to waypoint unless that waypoint is in the flight plan. Garmin recommends deleting any flight plan prior to graphically editing a direct to waypoint.*

9.3.3.2 Adding a Waypoint to the End of an Existing Flight Plan

Graphically Edit FPL

1. Touch the Map page display. The Map Mode selection keys will appear. Touch the **Graphically Edit FPL** key.
2. Touch a waypoint that you want to add to the end of the flight plan.

Done

3. Touch the **Done** key to accept the changes and return to the Map page.

9.3.3.3 Removing a Waypoint from an Existing Flight Plan

Graphically Edit FPL

1. Touch the Map page display. The Map Mode selection keys will appear. Touch the **Graphically Edit FPL** key.
2. Touch a waypoint, or airway, on the flight plan that you want to remove.
3. Drag the flight plan line away from the waypoint, or airway, and release the line. The waypoint, or airway, will be removed from the flight plan.

Done

4. Touch the **Done** key to accept the changes and return to the Map page.

9.3.3.4 Creating a Flight Plan Without an Existing Flight Plan

Graphically Edit FPL

1. Touch the Map page display. The Map Mode selection keys will appear. Touch the **Graphically Edit FPL** key.
2. Touch a waypoint on the map to set the first waypoint in the flight plan. If there are several nearby waypoints, touch the desired waypoint to select it.

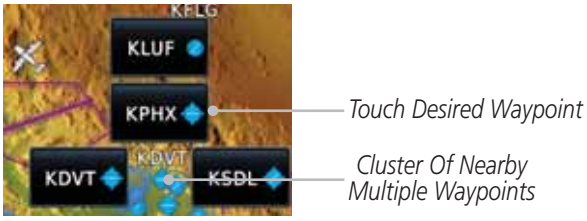


Figure 9-41 Select the Desired Waypoint From Multiple Waypoints

Figure 9-42 Start New Flight Plan with Origin Waypoint

3. Touch a waypoint, or airway, on the map for the next waypoint, or airway, in the flight plan. Continue adding waypoints, or airways, as needed.

Figure 9-43 Add New Waypoint to Flight Plan

4. Touch the **Done** key to accept the changes and return to the Map page.

9.4 CDI (GTN 750 only)

The GTN 750's **CDI** key is used to select data that is sent from the GPS or VLOC receiver to the external CDI (or HSI). When the external CDI (or HSI) is connected to the GPS receiver, "GPS" appears below the **CDI** key in the annunciation bar. When the external CDI (or HSI) is being driven by the VLOC receiver, "VLOC" appears instead.

NOTE: *The VLOC receiver must be selected for display on the external CDI/ HSI for approaches which are not approved for GPS. See the ILS example in the Procedures section for more information.*

NOTE*: GPS phase of flight annunciations (LPV, ENR, etc.) are not applicable to the external CDI (or HSI) when VLOC is active.*

NOTE: *The internal on-screen CDI information is based on GPS data and cannot be used for primary navigation.*

NOTE: *If the unit is not configured for a CDI key, then the "activate GPS missed approach" will only resume automatic waypoint sequencing. The user must switch to GPS navigation, if desired, by using their external source selection method (this is typical an EFIS system).*

1. The navigation source is annunciated under the **CDI** key.

Figure 9-44 Navigation Source Selection

2. Touch the **CDI** key to toggle between sources.

9.5 OBS

The **OBS** key is used to select manual or automatic sequencing of waypoints. Touching this key selects OBS mode, which retains the current "active to" waypoint as your navigation reference even after passing the waypoint (i.e., prevents sequencing to the next waypoint). Touching the **OBS** key again returns to normal operation, with automatic sequencing of waypoints. Whenever OBS mode is selected, you may set the desired course To/From a waypoint using the pop-up window on the GTN 7XX or with the external OBS selector on your HSI or CDI. For leg types that do not support OBS, this key will be shown as a **SUSP** key. This key will then also function as an **Unsuspend** key for legs that auto-suspend, such as holds, missed approaches, etc.

NOTE: *In dual GTN installations with crossfill on, the OBS course will only be updated real time on the GTN that is receiving the new OBS course. The course will be transferred to the other GTN when OBS is exited.*

1. Touch the **OBS** key to enable the OBS function.

2. Enter the desired OBS heading using the keypad and touch **Enter**.
3. The OBS heading will be shown in the flight plan annunciation above the CDI in the lower portion of the display. The OBS function annunciation will show.

Figure 9-45 OBS Course Selection

9.6 Map Symbols

Various symbols are used to distinguish between waypoint types. The identifiers for any on-screen waypoints can also be displayed. Special-use and controlled airspace boundaries appear on the map, showing the individual sectors in the case of Class B, Class C, or Class D airspace. The following symbols are used to depict the various airports and navaids on the Map Page:

Symbol	Description
	Airport with hard surface runway(s); Serviced, Primary runway shown
	Airport with hard surface runway(s); Non-Serviced, Primary runway shown
	Airport with soft surface runway(s) only, Serviced
	Airport with soft surface runway(s) only, Non-Serviced
	Unknown Airport
	Restricted (Private) Airfield
	Intersection
	VOR
	VORTAC
	VOR/DME
	TACAN
	DME
	NDB
	Locator Outer Marker
	Heliport

Table 9-18 Map Symbols

10 TRAFFIC

The Traffic function displays available traffic information depending on your installed equipment to assist in situational awareness. The features and operation depend on the capabilities and options of each type of traffic system.

NOTE: *The reference point for the ownship is the nose of the ownship aircraft symbol (either miniature aircraft or triangle). The reference point for all traffic icons is the center of the depicted traffic.*

1. From the Home page, touch the **Traffic** key.
2. Use the active areas on the display and the Menu options to set up the Traffic display.

10.1 Traffic Pop-Up

When the GTN 7XX is displaying any page (other than the Traffic page) and a traffic alert becomes active, the Traffic Warning pop-up will be displayed.

NOTE: *The traffic pop-up will not appear when your aircraft is on the ground.*

1. The traffic pop-up will appear on pages other than the Traffic page when a traffic alert occurs.

Figure 10-1 Traffic Pop-Up On the Map Page

2. Touch the **Go to Traffic** key to view the Traffic page.

OR

3. Touch the **Close** key to close the pop-up. The pop-up will return if the traffic alert persists.

10.2 Traffic Test

The Traffic Test function is only available on some traffic systems. The aircraft must be on the ground and Traffic Status must be in Standby.

1. Touch the **Test** key to activate the test function in the Traffic equipment.

Figure 10-2 Traffic Test Mode

2. The unit will return to normal operation mode after the test process is successfully completed.

10.3 Traffic Information Service (TIS) (Optional)

***WARNING**: The Traffic Information Service (TIS) is intended for advisory use only. TIS is intended to help the pilot locate traffic visually. It is the responsibility of the pilot to see and maneuver to avoid traffic.*

***NOTE:** TIS is available only when the aircraft is within the service volume of a TIS-capable terminal radar site. Aircraft without an operating transponder are invisible to both Traffic Advisory Systems (TAS) and TIS. Aircraft without altitude reporting capability are shown without altitude separation data or climb/descent indication.*

***NOTE:** TIS and Traffic Advisory System (TAS) may not both be configured at the same time.*

***NOTE:** GDL 88 equipped aircraft only: When the radio tower symbol is crossed out, the aircraft is not a participant in the TIS-B system – i. e. not visible to other TIS-B clients. The GDL 88 will, however, continue to receive available TIS-B and FIS-B ground station up-links and continue to display TIS-B and FIS-B data along with available ADS-B and ADS-R data.*

***NOTE:** Except for GDL 88 equipped aircraft, TIS, and Traffic Advisory System (TAS) may not both be displayed at the same time.*

***NOTE:** More information is available about the GDL 88 in the "Garmin GDL 88 ADS-B Transceiver Pilot's Guide."*

Traffic Information Service (TIS) is designed to help in detection and avoidance of other aircraft. TIS uses the Mode S transponder for the traffic data link. TIS receives traffic information from ground stations, and is updated every five seconds. The GTN 7XX displays up to eight traffic targets within a 7.5 NM radius, from 3000 feet below to 3500 feet above the requesting aircraft.

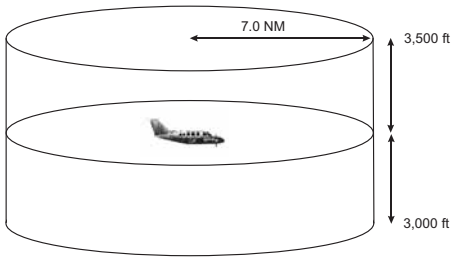


Figure 10-3 TIS Coverage Volume (not to scale)

10.3.1 TIS Symbology

Traffic is displayed according to TCAS symbology using three different symbols.

TIS Symbol	Description
	Non-Threat Traffic
	Traffic Advisory (TA)
	Traffic Advisory Off Scale

Table 10-1 TIS Traffic Symbols

Traffic Advisories (TA) alert the crew to intruding aircraft. When traffic meets the advisory criteria for the TA, a solid yellow circle symbol is generated. A Non-threat Advisory, shown as an open white diamond, indicates that an intruding aircraft is at greater than ±1200 feet relative altitude or the distance is beyond five NM. A Traffic Advisory that is beyond the selected display range is indicated by a half TA symbol at the edge of the screen at the relative bearing of the intruder.

TIS also provides a vector line showing the direction in which the traffic is moving, to the nearest 45°. Traffic information for which TIS is unable to determine the bearing (non-bearing traffic) is displayed in the center of the Traffic Page or in a banner on maps other than the Traffic Map Page on which traffic can be displayed.

The altitude difference between the requesting aircraft and other intruder aircraft is displayed above/below the traffic symbol in hundreds of feet. If the other aircraft is above the requesting aircraft, the altitude separation appears above the traffic symbol with a "+" sign; if below, the altitude separation appears below. Altitude trend is displayed as an up/down arrow (for speeds greater than 500 fpm in either direction) to the right of the target symbol. Traffic symbols for aircraft without altitude reporting capability appear without altitude separation or climb/descent information.

Always remember that TIS cannot alert you to the presence of aircraft that are not equipped with transponders, nor can it alert you to aircraft that may be nearby, but obscured from the ground surveillance radar by interfering terrain.

10.3.2 Traffic Page

The Traffic Map Page is configured to show surrounding TIS traffic data in relation to the aircraft's current position and altitude, without clutter from the basemap. Aircraft orientation on this map is always heading up unless there is no valid heading.

The traffic mode is annunciated in the upper left corner of the Traffic Map Page. When the aircraft is on the ground, TIS automatically enters Standby Mode. Once the aircraft is airborne, TIS switches from Standby to Operating Mode and the GTN 7XX begins to display traffic information.

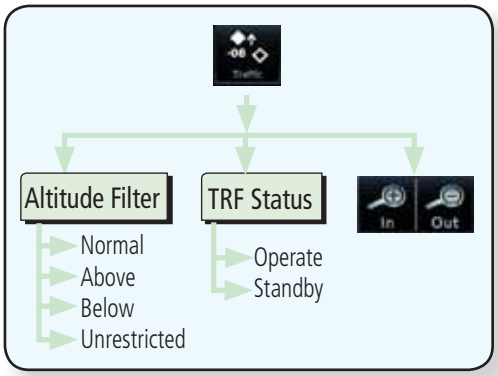


Figure 10-4 Traffic Page Functional Diagram

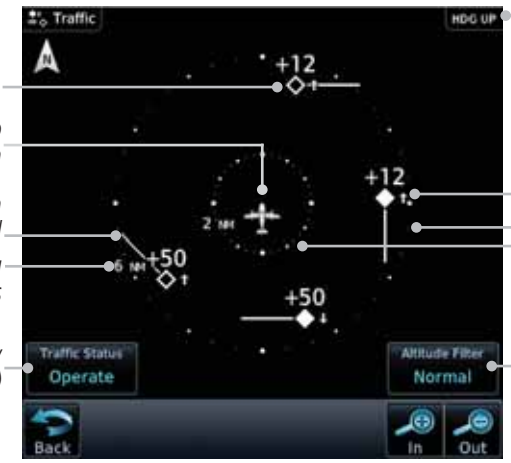
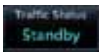


Figure 10-5 Traffic Page

10.3.3 Displaying Traffic on the Traffic Page

1. From the Home page, touch the **Traffic** key.

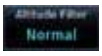
2. Confirm TIS is in Operating Mode.



3. Touch the **Traffic Status** key to toggle between Operate and Standby mode.

10.3.4 Altitude Display

1. While viewing the Traffic page, touch the **Operate** key to begin displaying traffic. "Operate" is displayed in the Traffic Status field.



2. The Altitude Filter limits the traffic displayed to the Below, Normal, Above or Unrestricted altitude block as listed in the "Displayed Traffic Range" table. The filter altitudes are relative to ownship altitude. Touch the **Altitude Filter** key to change the altitude filter value. Select the desired altitude filter by touching the **BELOW**, **NORMAL**, **ABOVE**, or **UNRESTRICTED** keys. The selection is displayed in the Altitude mode field.

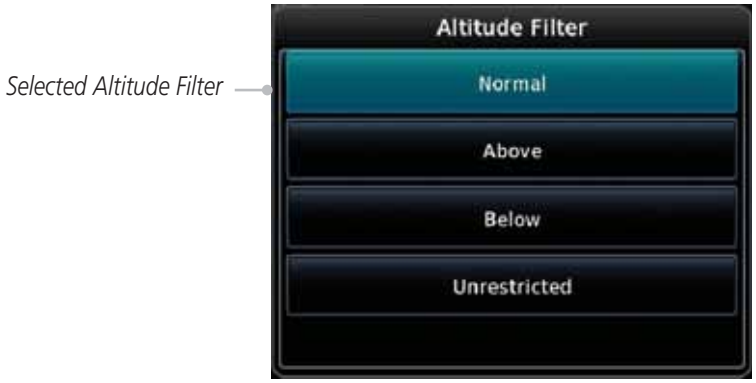


Figure 10-6 Traffic Altitude Filter Page

Altitude Mode	Displayed Traffic Range
Below	-9900 ft to 2700 ft
Normal	-2700 ft to 2700 ft
Above	-2700 ft to 9900 ft
Unrestricted	All Traffic Shown

Table 10-2 Displayed Traffic Range

10.3.5 TIS Limitations

NOTE: *This section on TIS Limitations is not comprehensive. Garmin recommends the user review the TIS Limitations section of the Aeronautical Information Manual, Section 1-3-5.*

TIS is NOT intended to be used as a collision avoidance system and does not relieve the pilot of responsibility to "see and avoid" other aircraft. TIS should not be used for avoidance maneuvers during IMC or other times when there is no visual contact with the intruder aircraft. TIS is intended only to assist in visual acquisition of other aircraft in VMC. No recommended avoidance maneuvers are provided for, nor authorized, as a direct result of a TIS intruder display or TIS advisory.

While TIS is a useful aid to visual traffic avoidance, it has some system limitations that must be fully understood to ensure proper use. Many of these limitations are inherent in secondary radar surveillance. In other words, the information provided by TIS will be no better than that provided to ATC. TIS will only display aircraft with operating transponders installed.

TIS relies on surveillance of the Mode S radar, which is a "secondary surveillance" radar similar to the Air Traffic Control Radar Beacon System (ATCRBS). TIS operation may be intermittent during turns or other maneuvering. TIS is dependent on two-way, "line-of-sight" communication between the aircraft and the Mode S radar. Whenever the structure of the client aircraft comes between the transponder antenna (usually located on the underside of the aircraft) and the ground-based radar antenna, the signal may be temporarily interrupted. Other limitations and anomalies associated with TIS are described in the AIM, Section 4-5-6.

Garmin is not responsible for Mode S geographical coverage. Operation of the ground stations is the responsibility of the FAA. Refer to the Aeronautical Information Manual for a Terminal Mode S Radar Site Map covering the U.S.

NOTE: *TIS will be unavailable at low altitudes in many areas of the U.S., particularly in mountainous regions. Also, when flying near the "floor" of radar coverage in a particular area, intruders below the client aircraft may not be detected by TIS.*

TIS information is collected one radar scan prior to the scan during which the uplink occurs. Therefore, the surveillance information is approximately five seconds old. In order to present the intruders in a "real time" position, the TIS ground station uses a "predictive algorithm" in its tracking software. This algorithm uses track history data to extrapolate intruders to their expected positions consistent with the time of display in the cockpit. Occasionally, aircraft maneuvering will cause this algorithm to induce errors in the display. These errors primarily affect relative bearing information and traffic target track vector (it will lag); intruder distance and altitude will remain relatively accurate and may be used to assist in "see and avoid." Some of the more common examples of these errors follow:

- When client or intruder aircraft maneuvers excessively or abruptly, the tracking algorithm may report incorrect horizontal position until the maneuvering aircraft stabilizes.
- When a rapidly closing intruder is on a course that crosses the client aircraft course at a shallow angle (either overtaking or head on) and either aircraft abruptly changes course within 0.25 NM, TIS may display the intruder on the opposite side of the client than it actually is.

These are relatively rare occurrences and will be corrected in a few radar scans once the course has stabilized.

10.3.6 TIS Alerts

When the number of Traffic Advisories (TAs) on the Traffic Map Page increases from one scan to the next, the following occur:

- A single "Traffic" voice alert is generated.
- A TRAFFIC Annunciation appears at the bottom of the display, flashing for 5 seconds and remaining displayed until no TAs are detected in the area.

To reduce the number of nuisance alerts due to proximate aircraft, the "Traffic" voice alert is generated only when the number of TAs increases. For example, when the first TA is displayed, a voice and visual annunciation are generated. As long as a single TA remains on the display, no additional voice alerts are generated. If a second TA appears on the display or if the number of TAs initially decreases and then subsequently increases, another voice alert is generated.

A "Traffic Not Available" (TNA) voice alert is generated when the TIS service becomes unavailable or is out of range.

Traffic may not be displayed in the radar coverage area due to the following:

- Radar site TIS Mode S sensor is not operational or is out of service.
- Traffic or requesting aircraft is beyond the maximum range of the TIS-capable Mode S radar site.
- Traffic or requesting aircraft is above the radar site in the cone of silence and out of range of an adjacent site.
- Traffic or requesting aircraft is below radar coverage. In flat terrain, the coverage extends from about 3000 feet upward at 55 miles. Terrain and obstacles around the radar site can further decrease radar coverage in all directions.
- Traffic does not have an operating transponder.

10.3.7 TIS System Status

The GTN 7XX performs an automatic test of TIS during power-up. If TIS passes the test, TIS enters Standby Mode on the ground or Operating Mode in the air. If TIS fails the power up test, an annunciation is shown in the center of the Traffic Map Page. Contact a service center or Garmin dealer for corrective action for a failure message.

Traffic Page Annunciation	Description
No Data	Data is not being received from the transponder
Failed	The transponder has failed
Unavailable	TIS is unavailable or out of range

Table 10-3 TIS Failure Annunciations

The Traffic mode is annunciated in the bottom left corner of the Traffic Page. When the aircraft is on the ground, TIS automatically enters Standby Mode. Once the aircraft is airborne, TIS switches to Operating Mode and traffic information is displayed. The mode can be changed manually using the **Traffic Status** key.

Traffic Status	Traffic Mode Annunciation (Traffic On Map Page)	Traffic Display Enabled Icon (Other Maps)
TIS Operating	Operate	
TIS Standby	Standby	
TIS Failed*	TIS Fail	

** Contact a service center or Garmin dealer for corrective action*

Table 10-4 TIS Modes Shown on the Map Page

The annunciations that indicate the status of traffic information appear in a banner at the bottom center of maps on which traffic can be displayed.

Traffic Status Banner Annunciation	Description
Traffic Coast 9 SEC	The displayed data is not current (6 to 12 seconds since last message). The quality of displayed traffic information is reduced when this message is displayed.
Traffic Removed	Traffic is removed because it is too old for coasting (12 to 60 seconds since last message). Traffic may exist within the selected display range, but it is not displayed.

Table 10-5 TIS Traffic Status Annunciations

10.4 TAS Traffic (Optional)

NOTE: *TIS and Traffic Advisory System (TAS) may not both be configured at the same time.*

TAS data comes from a TAS unit such as a Garmin GTS 800 or 820, Skywatch 497, KTA 810, or other unit.

Refer to the appropriate Traffic Advisory System's Pilot's Guides for a detailed discussion of the respective traffic advisory system.

The type of traffic systems that is installed is described by the Traffic Page keys. If a Traffic Advisory System (TAS) is configured, a **Traffic Mode** and **Altitude Filter** key will be displayed.

NOTE: *Pilots should be aware of TAS system limitations. TAS 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.*

WARNING: *The Traffic Advisory System (TAS) is intended for advisory use only to aid the pilot in visually acquiring traffic. No avoidance maneuvers should be based solely upon TAS traffic information. It is the responsibility of the pilot in command to see and maneuver to avoid traffic.*

A Traffic Advisory System (TAS) enhances flight crew situational awareness by displaying traffic information for transponder-equipped aircraft. The TAS also provides visual and aural traffic alerts including voice announcements to assist in visually acquiring traffic.

When the TAS is in Operating Mode, the unit interrogates the transponders of intruding aircraft while monitoring transponder replies. The TAS 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 TAS 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), visual and aural alerting is provided.

10.4.1 TAS Symbology

Traffic Advisory System (TAS) is designed to help in detection and avoidance of other aircraft. TAS uses an on-board interrogator-processor to detect traffic. Only aircraft with operating transponders will be detected. Traffic is displayed according to TCAS symbology using four different symbols.

TAS Symbol	Description
	Non-Threat Traffic (intruder is beyond 5 NM and greater than 1200 ft vertical separation)
	Proximity Advisory (PA) (intruder is within 5 NM and less than 1200 ft vertical separation)
	Traffic Advisory (TA) (closing rate, distance, and vertical separation meet TA criteria)
	Traffic Advisory Off Scale

Table 10-6 TAS Intruder Symbol Description

Figure 10-7 Intruder Type, Altitude, and Vertical Trend

10.4.2 Displaying and Operating Traffic (TAS Systems)

The unit must be in Operating mode for traffic to be displayed. The ability to switch from Standby to Operating mode on the ground is especially useful for scanning the airspace around the airport before takeoff.

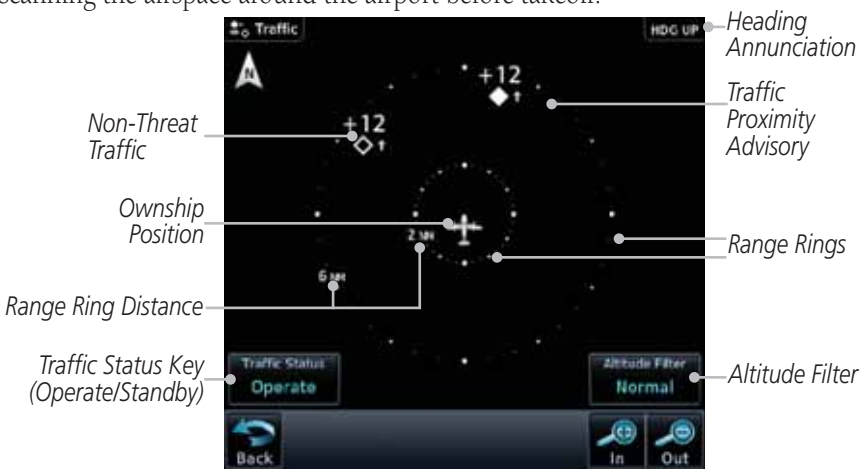
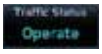


Figure 10-8 Traffic Page

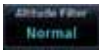
10.4.2.1 Switching from Standby Mode to Operating Mode

1. From the Home page, touch the **Traffic** key.



2. Confirm TAS is in Operating Mode.

3. Touch the **Traffic Status** key to toggle between Operate and Standby mode.



4. The Altitude Filter limits the traffic displayed to the Below, Normal, Above or Unrestricted altitude block as listed in the "Displayed Traffic Range" table. The filter altitudes are relative to ownship altitude. Touch the **Altitude Filter** key to change the altitude filter value.

NOTE: *Not all TAS systems can be set to "Standby" mode while in the air.*

The Traffic Page shows surrounding TAS traffic data in relation to the aircraft's current position and altitude without basemap clutter. Aircraft orientation is always heading up unless no valid heading is received. The Traffic Status is annunciated in the lower left corner and the Altitude Filter is annunciated in the lower right corner.

10.4.2.2 Range Ring

Touching the **In** and **Out** keys will zoom in and out in preset steps depending on the installed equipment as shown in the following table.

Traffic Device	Map Ranges
Garmin GTS 800, Skywatch (SKY497/SKY889)	2 NM, 6 NM, 12 NM
Garmin GTS 820 and 850, Honeywell KTA 810 TAS, KTA 910 TAS, KMH 820 IHAS, KMH 920 IHAS, and Avidyne TAS 620 (Ryan 9900BX)	2 NM, 6 NM, 12 NM, 24 NM, 40 NM

Table 10-7 Available Traffic Range Ring Steps

10.4.3 Altitude Display

1. While viewing the Traffic page, touch the **Traffic Status** key to begin displaying traffic. "TAS OPERATING" is displayed in the Traffic mode field.

2. Touch the **Altitude Filter** key to change the altitude filter value. The filter altitudes are relative to ownship altitude. Select the desired altitude filter by touching the **BELOW**, **NORMAL**, **ABOVE**, or **UNRESTRICTED** keys. The selection is displayed in the Altitude mode field.

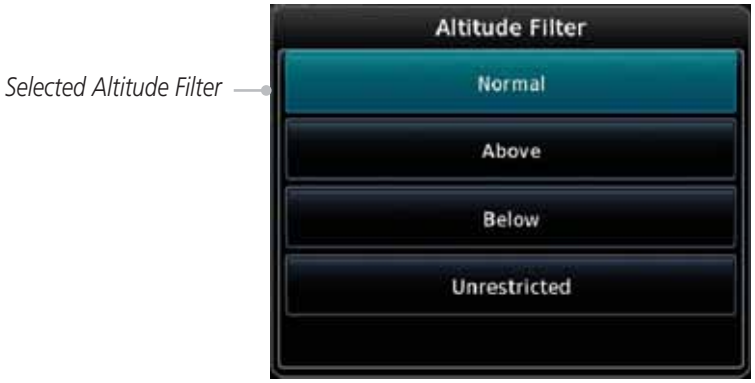


Figure 10-9 Traffic Altitude Filter Page

Altitude Mode	Displayed Traffic Range
Below	-9900 ft to 2700 ft
Normal	-2700 ft to 2700 ft
Above	-2700 ft to 9900 ft
Unrestricted	All Traffic Shown

Table 10-8 Displayed Traffic Range

10.4.4 Traffic System Status

NOTE: *Refer to the equipment documentation for information on the self-test and operating modes.*

The Traffic Status is indicated in the lower left corner of the Traffic Page.

Mode	Traffic Mode Annunciation (Traffic Page)	Traffic Display Enabled Icon (Other Maps)
TAS Self-test Initiated	Test	
TAS Operating	Operate	
TAS Standby	Standby	
TAS Failed	TAS Fail	

Table 10-9 TAS Modes

If the unit fails, an annunciation as to the cause of the failure is shown in the center of the Traffic Page.

Traffic Page Annunciation	Description
No Data	Data is not being received from the TAS unit
Data Failed	Data is being received from the TAS unit, but the unit is self-reporting a failure
Failed	Incorrect data format received from the TAS unit

Table 10-10 TAS 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 6.0 + 03 ↓	System cannot determine bearing of Traffic Advisory. Annunciation indicates distance in NM, altitude separation in hundreds of feet, and altitude trend arrow (climbing/descending).
Failed	Traffic data has failed.
Data Fail	Data is being received from the transponder, but a failure is detected in the data stream.
No Data	Traffic has not been detected.

Table 10-11 TAS Traffic Status Annunciations

10.5 ADS-B Traffic

ADS-B technology is an important part of the FAA's Next Generation Air Transportation System (NextGen), allowing for enhanced safety, efficiency, and the ability of the system to handle greater numbers of aircraft. ADS-B In allows a properly-equipped aircraft to access FAA broadcast services such as TIS-B and FIS-B. With ADS-B Out, the avionics transmit an aircraft's precise location, as well as specific information about that aircraft, to ground stations and other aircraft.

If more than one target is occupying the same area of the screen, the GTN will combine the two traffic targets into one traffic group. The group symbol maintains the iconology of the highest priority traffic target in the group and indicates a grouped symbol by the presence of an asterisk to the left of the grouped traffic target.

Traffic targets displayed on the dedicated traffic page may be selected in order to obtain additional information about a traffic target or to view all targets in a grouped target. When a grouped target is selected, the **Next** key on the dedicated traffic page will cycle through all targets located in close proximity to where the screen has been touched.

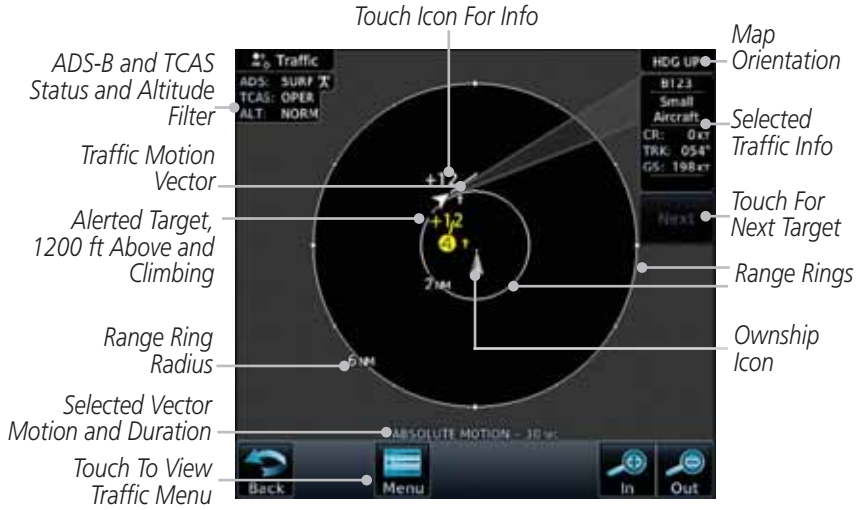


Figure 10-10 ADS-B Traffic Page

NOTE: *The "Next" key on the dedicated traffic page will cycle through all targets located in close proximity to where the pilot has touched the screen.*

Symbol	Description
	Basic Non-Directional Traffic
	Basic Directional Traffic
	Basic Off-scale Selected Traffic
	Proximate Non-Directional Traffic
	Proximate Directional Traffic
	Proximate Off-scale Selected Traffic
	Non-Directional Alerted Traffic
	Off-Scale Non-Directional Alerted Traffic
	Directional Alerted Traffic
	Off-Scale Directional Alerted Traffic
	Non-Directional Surface Vehicle
	Directional Surface Vehicle

Table 10-12 ADS-B Traffic Symbols

NOTE: *Color of basic and proximate traffic is dependent on configuration (cyan or white) and airborne/on-ground status of target (target is brown when on the ground, see the surface vehicles).*

10.5.1 Traffic Applications - SURF, AIRB, etc.

The GTN ADS-B traffic display is capable of running in two "modes:" Airborne Situational Awareness (AIRB) and Surface Situation Awareness (SURF).

AIRB is in operation in the en route environment, outside of five NM from and 1,500 feet above the nearest airport.

SURF is in operation within the terminal environment (within five NM and less than 1,500 feet above field elevation). When SURF is running, and the zoom scale on the traffic display is less than two NM, the airport environment (including taxiways and runways) is displayed in addition to traffic. This is to aid in situational awareness of runway occupancy/availability, etc.

Due to the varying precision of the data received via ADS-B, ADS-R, and TIS-B, all traffic targets may not be depicted on the traffic display. Because higher data precision is required for display in the SURF environment, some targets eligible for AIRB will not be displayed while SURF is active. Individual eligibility for AIRB and SURF is depicted in the selected traffic data on the traffic page.

10.5.2 ADS-B Traffic Menu

The Traffic Menu allows control of the traffic information display.

Figure 10-11 ADS-B Traffic Menu

10.5.2.1 ADS-B Status

ADS-B Status displays the current status of traffic application: Off, Surface, or Airborne.

Touch the **ADS-B Status** key to toggle the ADS-B Status.

10.5.2.2 TCAS Status

This shows the current status of the TCAS system. The modes reported by the traffic device are "Operate" while in the air and "Standby" while on the ground. This control allows the pilot to manually select the TCAS Status.

Touch the **TCAS Status** key to toggle the TCAS Status.

10.5.2.3 Test

The Traffic Test function is only available on some TAS traffic systems. The aircraft must be on the ground and Traffic Status must be in Standby.

1. Touch the **Test** key to activate the test function in the Traffic equipment.
2. The unit will return to normal operation mode after the test process is successfully completed.

10.5.2.4 Motion Vector

When Absolute Motion Vectors are selected, the vectors extending from the traffic targets depict the target reported track and speed over the ground. When Relative Motion Vectors are selected, the vectors extending from the traffic targets display how the traffic target is moving relative to your aircraft. These vectors are calculated using the traffic targets track and ground speed and your aircraft's track and ground speed. These two values are combined to depict where the traffic target is moving purely with respect to your aircraft and give a forecast of where the traffic target will be, relative to your aircraft, in the near future.

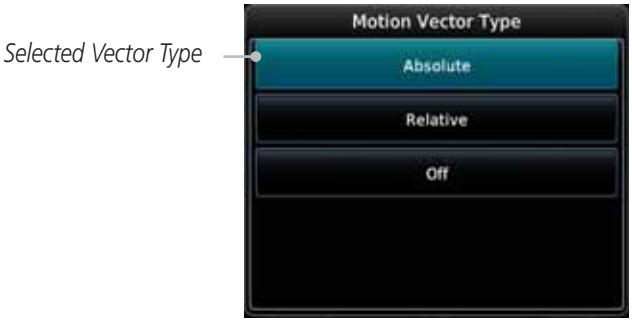


Figure 10-12 Traffic Motion Vector Type Selection

NOTE: *Absolute motion vectors are colored either white or cyan. Relative motion vectors are always green. The annunciation on the bottom of the dedicated traffic page indicates which vector type is selected and their length.*

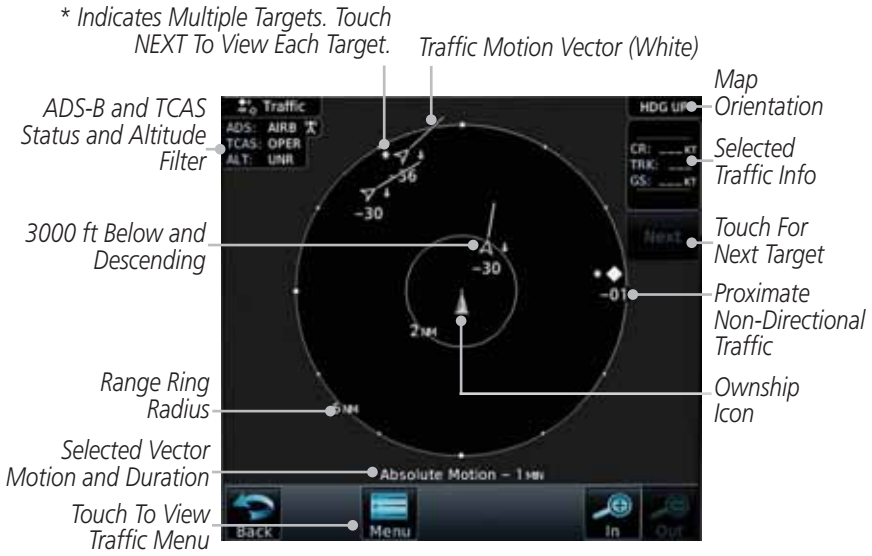


Figure 10-13 Absolute Motion (White Vectors)

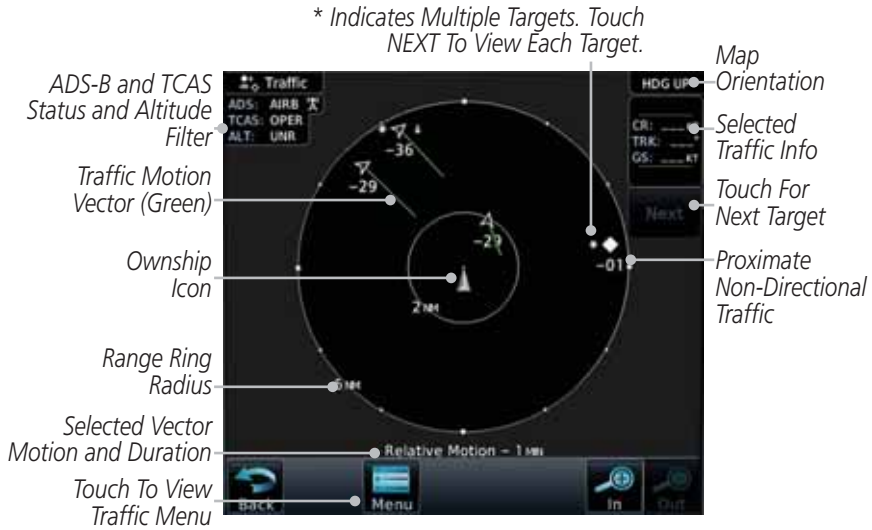


Figure 10-14 Relative Motion (Green Vectors)

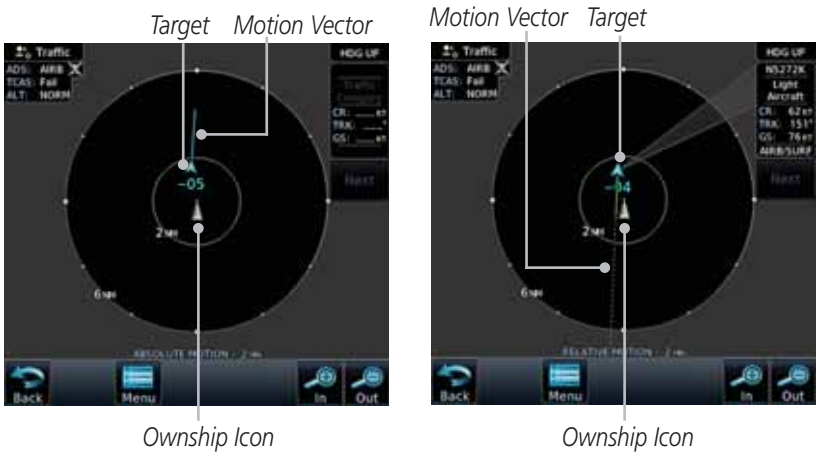


Figure 10-15 Comparison of Absolute and Relative Motion Vectors With a Single Target

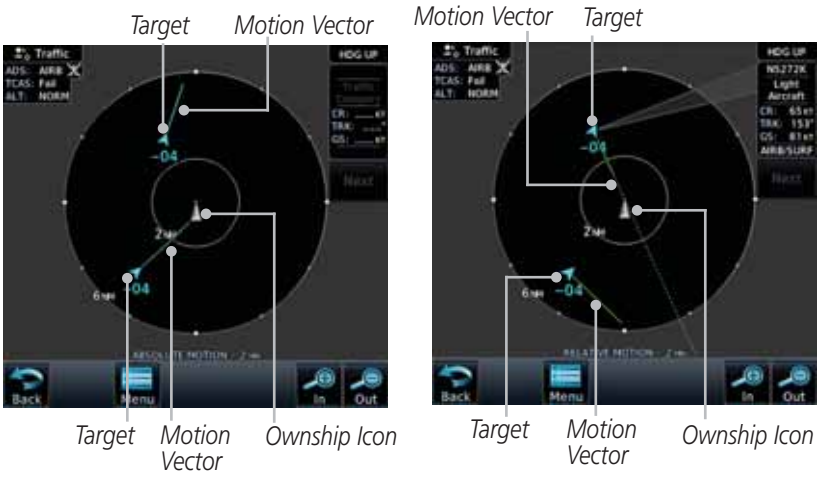


Figure 10-16 Comparison of Absolute and Relative Motion Vectors With a Two Targets

10.5.2.5 Vector Duration

The Vector Duration selection sets the time that the vector will show the calculated distance and direction of the traffic target. A longer duration will result in a longer vector.

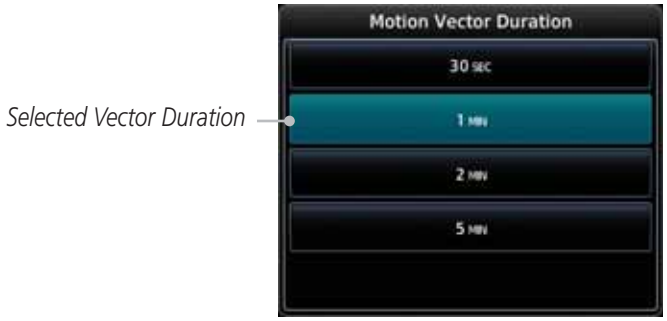


Figure 10-17 Traffic Motion Vector Duration Selection

10.5.2.6 Altitude Filter

1. The Altitude Filter limits the traffic displayed to the Below, Normal, Above or Unrestricted altitude block as listed in the "Displayed Traffic Range" table. The filter altitudes are relative to ownship altitude. Touch the **Altitude Filter** key to change the altitude filter value.
2. Select the desired altitude filter by touching the **BELOW**, **NORMAL**, **ABOVE**, or **UNRESTRICTED** keys. The selection is displayed in the Altitude mode field.

Figure 10-18 Traffic Altitude Filter Selection

Altitude Mode	Displayed Traffic Range
Below	-9900 ft to 2700 ft
Normal	-2700 ft to 2700 ft
Above	-2700 ft to 9900 ft
Unrestricted	All Traffic Shown

Table 10-13 Displayed Traffic Range

10.5.2.7 On Scene Mode

When a GDL 88 (with software version 3.00, or later) is installed with a GTN in a helicopter, the GTN provides controls for enabling/disabling "On Scene" mode in the GDL 88. "On Scene" mode decreases traffic alerts when operating near other helicopters (e.g., news reporting).

1. While viewing the Traffic page, touch the **Menu** key.

2. Touch the **On Scene** key to enable/disable On Scene mode.

10.5.3 Rotorcraft Traffic Page Orientation

NOTE: *Rotorcraft Traffic Page Orientation functionality is available in software version 5.12 or later.*

When flying at low speeds in a helicopter, heading may not always be closely aligned with track (it could easily be up to 180 degrees different). If the GTN is interfaced with a heading source, the ADS-B traffic page will remain fixed with the ownship heading pointed up. However, if heading is not being received by the GTN, the display of ADS-B traffic will be unavailable.

When one of the following conditions is true, the ADS-B traffic page will be unavailable:

- Ownship directionality is invalid (no valid heading or track)
- GPS ground speed is less than 15 knots and ownship heading is not available

While the traffic display is unavailable due to these conditions, traffic alerts will be provided in a non-bearing textual form at the top of the traffic page.

10.6 RYAN TCAD 9900BX with the GDL 88

Ryan TCAD is a system that provides audio and visual alerts for traffic near your aircraft. The information from this system can be interfaced through the GTN series. Operating instructions and details on the modes of operation are described in the Ryan TCAD operator's handbooks.

- TCAS-like symbols are used in the 9900BX.
- Altitude modes are available (normal, look up, look down, unrestricted).
- Ranges are manually controlled for the current shield.
- Traffic display range selections:
  - Ryan 9900BX — 1 NM, 1 and 2 NM, 2 and 6 NM, 6 and 12 NM, and 12 and 24 NM.

10.6.1 Ryan TCAD Description

***NOTE:** Refer to the Ryan TCAD Pilot's Guide for a detailed description of the Ryan TCAD System.*

The Ryan TCAD (Traffic and Collision Alert Device) is an on-board air traffic display used to identify potential collision threats. TCAD computes relative altitude and range of threats from nearby Mode C and Mode S-equipped aircraft. TCAD will not detect aircraft without operating transponders or those that are beyond radar coverage. TCAD, within defined limits, creates a "shield" of airspace around the aircraft that detected traffic cannot penetrate without triggering an alert.

TA: Traffic Advisory. This is traffic with 500 feet, or less, of altitude separation that is converging or maintaining altitude separation.

PA: Proximity Advisory. This is traffic with 500 feet of altitude separation that is not a TA.

TRFC: Other traffic.

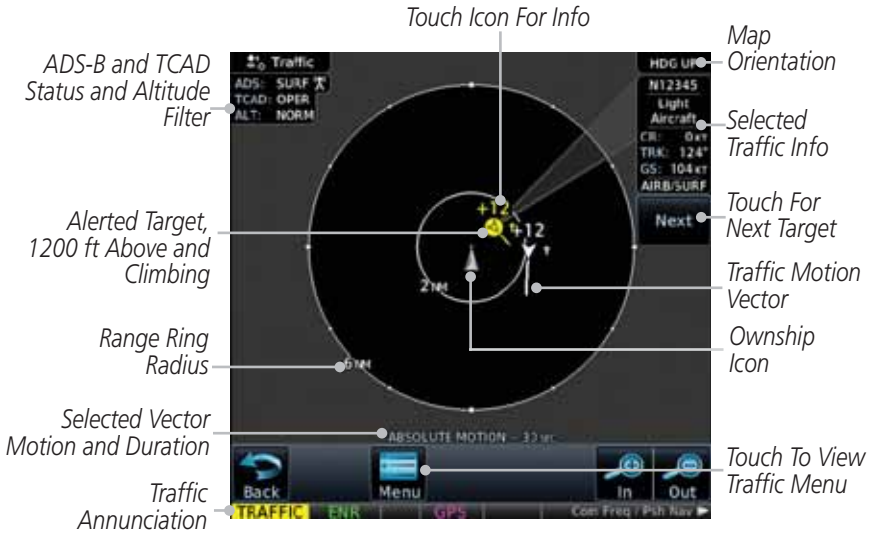


Figure 10-19 Traffic Page for Ryan TCAD with GDL 88

10.6.2 Altitude Mode

The GDL 88 has four altitude display modes: Normal (±2,700 feet, Above (-2,700 feet to +9,000 feet), Below (-9,000 feet to +2,700 feet), and Unrestricted (±9,900 feet). The GDL 88 continues to track up to 30 intruder aircraft within its maximum surveillance range, regardless of the altitude display mode selected.

The selected altitude display mode is displayed in the upper left-hand corner of the Traffic page.

The Altitude Filter limits the traffic displayed to the Below, Normal, Above or Unrestricted altitude block as listed in the "Displayed Traffic Range" table. The filter altitudes are relative to ownship altitude. While viewing the Traffic page, touch the **Altitude Filter** key to change the altitude filter value. Select the desired altitude filter by touching the **BELOW**, **NORMAL**, **ABOVE**, or **UNRESTRICTED** keys. The selection is displayed in the Altitude mode field.

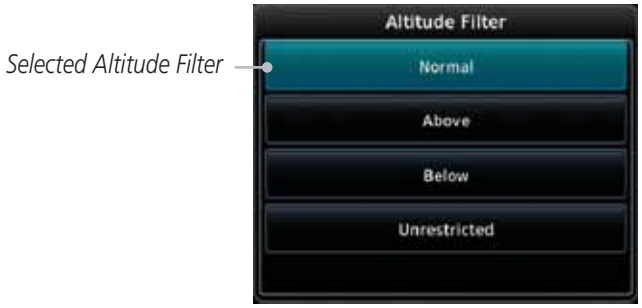


Figure 10-20 Traffic Altitude Filter Selection

Altitude Mode	Displayed Traffic Range
Below	-9900 ft to 2700 ft
Normal	-2700 ft to 2700 ft
Above	-2700 ft to 9900 ft
Unrestricted	All Traffic Shown

Table 10-14 Displayed Traffic Range

10.6.3 TCAD Control Menu

The TCAD Control Menu allows control over the settings for the TCAD Traffic display.

Figure 10-21 TCAD Traffic Menu

1. While viewing the Traffic menu, touch the **TCAD Control** key.

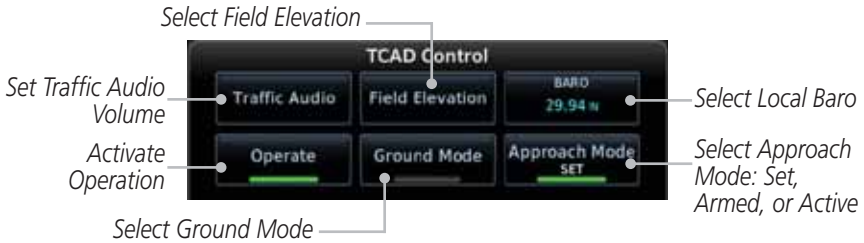


Figure 10-22 TCAD Control Menu

2. Touch the desired key from the menu to make any settings.

10.6.3.1 Traffic Audio

1. While viewing the TCAD Control menu, touch the **Traffic Audio** key.

Figure 10-23 TCAD Traffic

2. Touch the arrow keys to raise or lower the TCAD Traffic Audio level. The selected volume will be shown as a percentage value and graphically with a bar graph.

3. Touch the **Back** key to return to the TCAD Control menu.

10.6.3.2 Field Elevation

1. While viewing the TCAD Control menu, touch the **Field Elevation** key.

Figure 10-24 TCAD Traffic Field Elevation Selection

2. With the **Use DEST APT** key deactivated (no green bar), touch the **Field Elevation** key to manually select the Field Elevation for traffic reporting. Use the keypad to select the elevation value.

3. Touch the **Enter** key to accept the selected value. The selected value will be shown in the **Field Elevation** key.

4. Touch the **Use DEST APT** key to automatically use the field elevation of the destination airport of the active flight plan for traffic reporting.

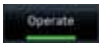
NOTE: *Activating the Use DEST APT feature automatically uses the elevation for the current destination airport for the TCAD. If no destination airport is present in the GTN system, the TCAD will not receive a field elevation and therefore not automatically enter approach mode.*

10.6.3.3 Baro

1. While viewing the TCAD Control menu, touch the **BARO** key to manually select the barometric pressure.
2. Use the keypad to select the barometric pressure value.

3. Touch the **Enter** key to accept the selected value. The selected value will be shown in the **BARO** key.

10.6.3.4 Operate



1. While viewing the TCAD Control menu, touch the **Operate** key to activate TCAD traffic.
2. Touching the **Operate** key toggles TCAD traffic operation on and off.

10.6.3.5 Ground Mode

1. While viewing the TCAD Control menu, touch the **Ground** key to activate Ground Mode TCAD traffic.
2. Touching the **Ground** key toggles Ground Mode on and off.

10.6.3.6 Approach Mode

1. While viewing the TCAD Control menu, touch the **Approach** key to activate Approach Mode TCAD traffic.
2. Touching the **Approach** key toggles Approach Mode on and off.

10.7 TCAD 9900B Operation

The TCAD 9900B provides a passive system that uses transponder replies from other aircraft to acquire traffic information.

Figure 10-25 Traffic Page for Ryan TCAD 9900B

Symbol		Description
Imminent Traffic (Traffic within ±500 feet AND 1.0 NM; OR no altitude AND within 1.0 NM)	Non-Imminent Traffic	
		Traffic Closing Vertically
		Traffic Diverging Vertically
		Traffic not Closing or Diverging Vertically

Table 10-15 9900B TCAD Symbols

10.7.1 Select Local Barometric Pressure

1. While viewing the TCAD display, touch the **Baro** key to select the local barometric pressure.

2. Use the keypad to select the values and touch **Enter** to save the values.

10.7.2 Select Active Shield

1. While viewing the TCAD display, touch the **Active Shield** key to select the Active Shield values (Departure, Enroute, or Ground).

2. Touch the desired setting to save the values.

10.7.3 TCAD 9900B Traffic Menu

The TCAD 9900B Menu allows control over the settings for the TCAD Traffic display.

1. While viewing the Traffic page, touch the **Menu** key.

Figure 10-26 TCAD 9900B Traffic Menu

2. Touch the desired key from the menu to make any settings.

10.7.3.1 Traffic Audio

1. While viewing the TCAD Control menu, touch the **Traffic Audio** key.

Figure 10-27 TCAD Traffic Audio

2. Touch the arrow keys to raise or lower the TCAD Traffic Audio level. The selected volume will be shown as a percentage value and graphically with a bar graph.

3. Touch the **Back** key to return to the TCAD Control menu.

10.7.3.2 Shield Setup

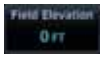
The Shield Setup function allows you to select the Shield Type (mode of operation) and the size of the shield volume that will provide alerts when entered by aircraft.

Approach Shield Type

1. While viewing the TCAD Control menu, touch the **Shield Type** key and touch the Approach Shield Type.

Figure 10-28 TCAD 9900B Shield Setup for Approach

2. Touch the **Field Elevation** key.



3. With the **Use DEST APT** key deactivated (no green bar), touch the **Field Elevation** key to manually select the Field Elevation for traffic reporting. Use the keypad to select the elevation value.

4. Touch the **Enter** key to accept the selected value. The selected value will be shown in the **Field Elevation** key.

5. Touch the **Use DEST APT** key to automatically use the field elevation of the destination airport of the active flight plan for traffic reporting.

NOTE: *Activating the Use DEST APT feature automatically uses the elevation for the current destination airport for the TCAD. If no destination airport is present in the GTN system, the TCAD will not receive a field elevation and therefore not automatically enter approach mode.*

En Route, Standard, or Terminal Shield Type

1. While viewing the TCAD Control menu, touch the **Shield Type** key and touch the desired Shield Type: Enroute, Standard, or Terminal.

Figure 10-29 TCAD 9900B Shield Setup for En Route, Standard, and Terminal

2. Touch the **Shield Height** key and use the keypad to select the Shield Height value. The selected value will be shown in the **Shield Range** key.

3. Touch the **Shield Range** key and use the keypad to select the Shield Range value. The selected value will be shown in the **Shield Range** key.

10.7.3.3 Approach Mode

1. While viewing the TCAD Control menu, touch the **Approach** key to activate Approach Mode TCAD traffic.
2. Touching the **Approach** key toggles Approach Mode between Set, Armed, or Active.

10.8 TCAD 9900BX Operation

The TCAD 9900BX provides an active system that interrogates other aircraft to acquire traffic information.

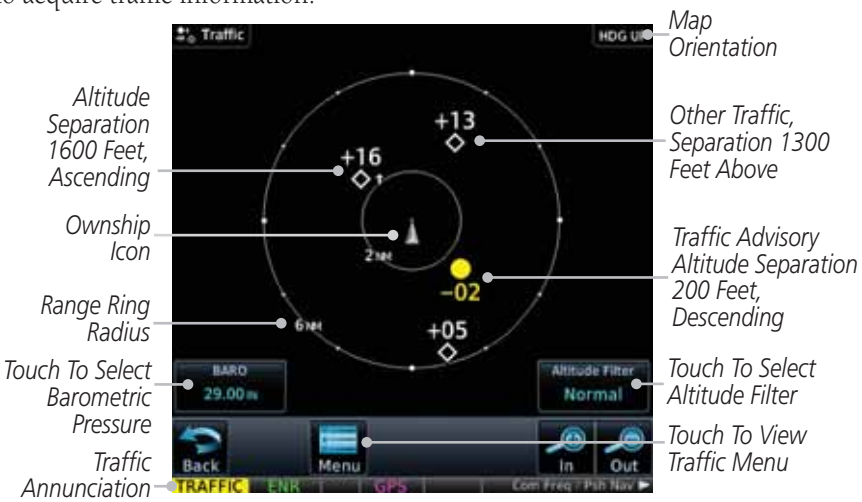


Figure 10-30 Traffic Page for Ryan TCAD 9900BX

Symbol	Description
	Traffic Advisory
	Proximity Advisory (color may be configured as cyan)
	Other Traffic (color may be configured as cyan)
	Out-of-Range Traffic Advisory

Table 10-16 9900BX (TCAS) Symbols

10.8.1 Select Local Barometric Pressure

1. While viewing the TCAD display, touch the **Baro** key to select the local barometric pressure.

2. Use the keypad to select the values and touch **Enter** to save the values.

10.8.2 Select Altitude Filter

The Altitude Filter limits the traffic displayed to the Below, Normal, Above or Unrestricted altitude block as listed in the "Displayed Traffic Range" table. The filter altitudes are relative to ownship altitude. While viewing the Traffic page, touch the **Altitude Filter** key to change the altitude filter value. Select the desired altitude filter by touching the **Normal**, **Above**, **Below**, or **Unrestricted** keys. The selection is displayed in the Altitude Filter field.

Figure 10-31 Traffic Altitude Filter Selection

Altitude Mode	Displayed Traffic Range
Below	-9900 ft to 2700 ft
Normal	-2700 ft to 2700 ft
Above	-2700 ft to 9900 ft
Unrestricted	All Traffic Shown

Table 10-17 Displayed Traffic Range

10.8.3 TCAD 9900BX Traffic Menu

The TCAD 9900BX Menu allows control over the settings for the TCAD Traffic display.

1. While viewing the Traffic page, touch the **Menu** key.

Figure 10-32 TCAD 9900BX Traffic Menu

2. Touch the desired key from the menu to make any settings.

10.8.3.1 Traffic Audio

1. While viewing the TCAD Control menu, touch the **Traffic Audio** key.

Figure 10-33 TCAD Traffic Audio

2. Touch the arrow keys to raise or lower the TCAD Traffic Audio level. The selected volume will be shown as a percentage value and graphically with a bar graph.

3. Touch the **Back** key to return to the TCAD Control menu.

10.8.3.2 Shield Setup

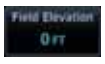
The Shield Setup function allows you to select the Shield Type (mode of operation) and the size of the shield volume that will provide alerts when entered by aircraft.

Approach Shield Type

1. While viewing the TCAD Control menu, touch the **Shield Type** key and touch the Approach Shield Type.

Figure 10-34 TCAD 9900BX Shield Setup for Approach

2. Touch the **Field Elevation** key.



3. With the **Use DEST APT** key deactivated (no green bar), touch the **Field Elevation** key to manually select the Field Elevation for traffic reporting. Use the keypad to select the elevation value.

4. Touch the **Enter** key to accept the selected value. The selected value will be shown in the **Field Elevation** key.

5. Touch the **Use DEST APT** key to automatically use the field elevation of the destination airport of the active flight plan for traffic reporting.

NOTE: *Activating the Use DEST APT feature automatically uses the elevation for the current destination airport for the TCAD. If no destination airport is present in the GTN system, the TCAD will not receive a field elevation and therefore not automatically enter approach mode.*

En Route, Standard, or Terminal Shield Type

1. While viewing the TCAD Control menu, touch the **Shield Type** key and touch the desired Shield Type: Enroute, Standard, or Terminal.

Figure 10-35 TCAD 9900BX Shield Setup for En Route, Standard, and Terminal

2. Touch the **Shield Height** key and use the keypad to select the Shield Height value. The selected value will be shown in the **Shield Range** key.

3. Touch the **Shield Range** key and use the keypad to select the Shield Range value. The selected value will be shown in the **Shield Range** key.

10.8.3.3 Approach Mode

1. While viewing the Traffic menu, touch the **Approach** key to activate Approach Mode TCAD traffic.
2. Touching the **Approach** key toggles Approach Mode between Set, Armed, or Active.

10.8.3.4 Ground Mode

1. While viewing the Traffic menu, touch the **Ground** key to activate Ground Mode TCAD traffic.
2. Touching the **Ground** key toggles Ground Mode between On and Off.

11 TERRAIN

11.1 Terrain Configurations

During power-up of the GTN 7XX, the terrain/obstacle database versions are displayed along with a disclaimer. At the same time, the Terrain system self-test begins. A failure message is issued if the terrain test fails.

Garmin provides the following terrain awareness solutions within the GTN 7XX environment:

- Terrain Proximity - This is the standard Terrain function and refers to the display of the relative terrain elevations on the moving map. No aural alerts of any type are provided by a Terrain Proximity configuration.
- TAWS-B (Optional) - A system developed to meet the terrain alerting and ground proximity requirements for Class B TAWS systems as defined in TSO-C151c. Garmin's GTN 7XX Terrain Awareness and Warning System (TAWS-B) is an optional feature and is intended to provide the flight crew with both aural and visual alerts to aid in preventing inadvertent Controlled Flight Into Terrain (CFIT).
- HTerrain Proximity - This is the standard Terrain function and refers to the display of the relative terrain elevations on the moving map. No aural alerts of any type are provided by a Terrain Proximity configuration.
- HTAWS - (HTAWS) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain. Garmin TAWS satisfies TSO-C194 requirements for certification.
- TAWS-A (Optional) - A system to increase situational awareness and aid in reducing controlled flight into terrain (CFIT) as defined in TSO-C151c. TAWS-A provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

NOTE: *Obstacles are removed from the Terrain and TAWS pages at ranges greater than 10 NM.*

11.2 General Database Information

Garmin TAWS and HTAWS use terrain and obstacle information supplied by government and private sources. The data undergoes verification by Garmin to confirm accuracy of the content. ***However, the displayed information should never be understood as being all-inclusive. Pilots must familiarize themselves with the appropriate charts for safe flight.***

NOTE: *The data contained in the terrain and obstacle databases comes from government and private agencies. Garmin accurately processes and cross-validates the data, but cannot guarantee the accuracy and completeness of the data.*

The terrain database is contained on the datacard.

11.2.1 Database Versions

The version and area of coverage of each terrain/obstacle database is shown on the System-System Status page. Databases are checked for integrity at power-up. If a database is found to be missing and/or deficient, the TAWS/HTAWS system fails the self-test and displays the TAWS/HTAWS system failure message.

11.2.2 HTAWS Database Requirements

To function properly, HTAWS requires the use of databases specific to helicopters and HTAWS. The databases required are:

- 2.5 arc-second Terrain Database
- Helicopter Obstacle Database
- Helicopter Navigation Database

11.2.3 Database Updates

Terrain and obstacle databases are updated periodically with the latest terrain and obstacle data. Visit the Garmin website to check for newer versions of terrain/obstacle databases. Compare database cycle numbers to determine if a newer version is available.

The database update process includes either reprogramming or replacing the database card and inserting the updated card in the card slot on the unit front panel. The terrain/obstacle database may be downloaded via the internet and the card reprogrammed using a USB programmer available from Garmin. Contact Garmin at 866-739-5687 or at www.garmin.com or http://fly.garmin.com for more information.

To update your terrain/obstacle databases:

1. Prepare the card with new terrain data.
2. Turn off the power to the unit.
3. Remove the old terrain data card and insert the new card into the unit.
4. Turn on the unit and verify that the Terrain Database verification is succesful.
5. Verify that TAWS/HTAWS passes the self-test (if configured for TAWS or HTAWS).

11.2.4 Terrain Database Areas of Coverage

The fixed-wing terrain database provides worldwide coverage. The following describes the area of coverage available in each helicopter terrain database. Regional definitions may change without notice.

Database	Coverage Area
Americas - North	Latitudes: 0° to N90° Longitudes: W180° to W30°
Americas - South	Latitudes: N30° to S90° Longitudes: W180° to W30°
Atlantic - North	Latitudes: 0° to N90° Longitudes: W30° to E90°
Atlantic - South	Latitudes: N30° to S90° Longitudes: W30° to E90°
Pacific - North	Latitudes: 0° to N90° Longitudes: E60° to E180°
Pacific - South	Latitudes: N30° to S90° Longitudes: E60° to E180°

Table 11-1 Terrain Database Coverage

NOTE: *Because of higher resolution helicopter terrain data, the world-wide data won't fit on the terrain database card. Therefore, data is regionalized. If you have the wrong region database for your present position, then you get the message that terrain is unavailable for the current location and a crosshatched pattern on the terrain display.*

11.2.5 Obstacle Database Areas of Coverage

The following describes the area of coverage available in each database. Regional definitions may change without notice.

Database	Coverage Area
United States (US)	Limited to the United States plus some areas of Canada, Mexico, Caribbean, and the Pacific.
US/Europe	Alaska, Austria, Belgium, Canada*, Caribbean*, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hawaii, Iceland, Ireland, Italy, Latvia, Lithuania, Mexico*, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United Kingdom, United States
* Indicates partial coverage	

Table 11-2 Obstacle Database Coverage

NOTE: *It is very important to note that not all obstacles are necessarily charted and therefore may not be contained in the Obstacle Database.*

Obstacle databases created for GTN software version 5.10 or later include all power lines or only HOT lines depending on the type of obstacle database installed. Hazardous Obstacle Transmission (HOT) Lines are those power lines that are co-located with other FAA-identified obstacles. The installed obstacle database type can be verified on the System Status page. Power line data is available for the contiguous United States as well as small parts of Canada and Mexico.

11.3 Terrain Proximity

Garmin Terrain Proximity is a non-TSO-C151c-certified terrain awareness system provided as a standard feature of GTN 7XX to increase situational awareness and help reduce controlled flight into terrain (CFIT). Terrain may be displayed on the Map and Terrain pages.

Terrain Proximity uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a Mean Sea Level (MSL)-based altitude (GSL altitude) and is used to determine Terrain alerts. 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, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

Terrain utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, Terrain displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. In this manner, Terrain Proximity can provide advanced alerts of predicted dangerous terrain conditions.

Terrain requires the following to operate properly:

- The system must have a valid 3-D GPS position solution.
- The system must have a valid terrain/obstacle database.

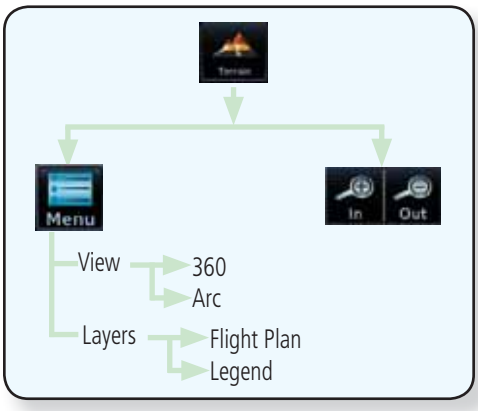


Figure 11-1 Terrain Proximity Page Functional Diagram

11.3.1 Displaying Terrain Proximity

The Terrain page is in the Terrain function.

1. Touch the **Terrain** key on the Home page.

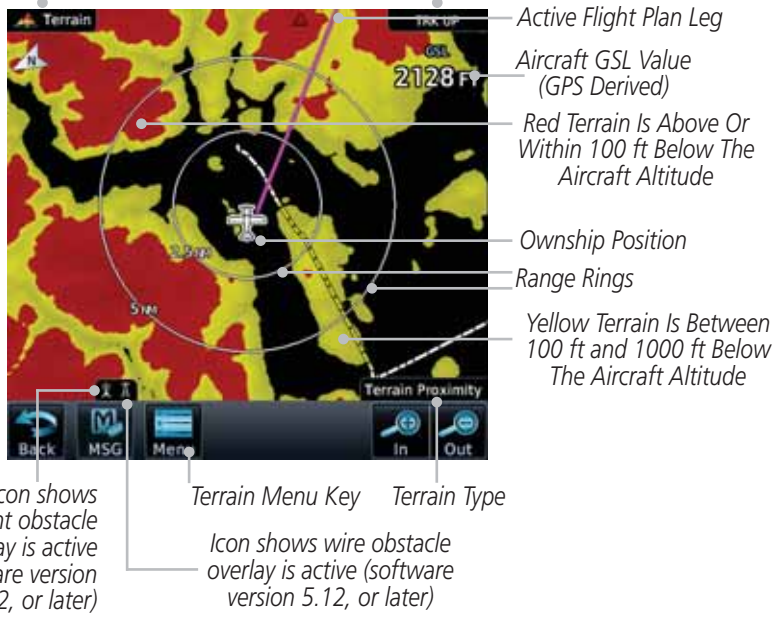


Figure 11-2 Terrain Page

2. Touch the **Menu** key for options.

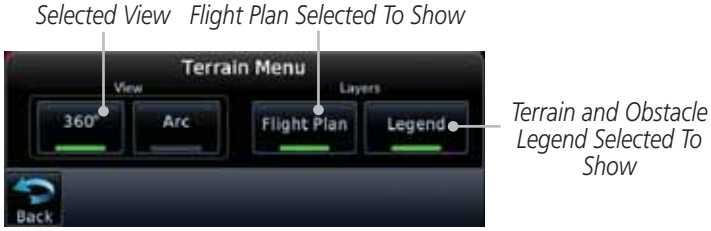
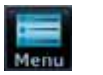


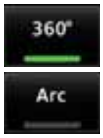
Figure 11-3 Terrain Menu Options

11.3.1.1 Terrain Page 120° Arc or 360° Rings

Select the 120º Arc or 360º rings overlay for the Terrain page with either the **360** or **Arc** keys from the Menu.



1. While viewing the Terrain page, touch the **Menu** key.



2. Touch the **360º** or **Arc** key.

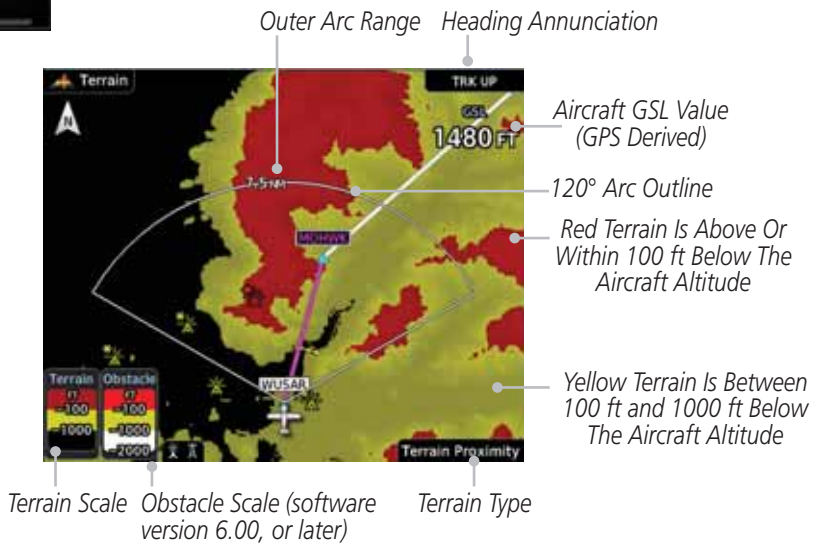


Figure 11-4 Terrain 120° Arc View

11.3.1.2 Display Flight Plan on Terrain Page

Select the display of the active flight plan on the Terrain page.

Touch the **Flight Plan** key to toggle the display of active flight plan on or off.

11.3.1.3 Display Terrain and Obstacle Legend

Select the display of the Terrain Legend on the Terrain page.

Touch the **Legend** key to toggle the display of the Terrain Legend on or off.

11.3.2 Terrain Limitations

Terrain Proximity displays terrain and obstructions relative to the altitude of the aircraft. The displayed alerts are advisory in nature only. Individual obstructions may be shown if available in the database. However, all obstructions may not be available in the database and data may be inaccurate. Terrain information should be used as an aid to situational awareness. Never use this information for navigation or to maneuver to avoid obstacles.

Terrain Proximity uses terrain and obstacle information supplied by government sources. The displayed information should never be understood as being all-inclusive.

NOTE: *The data contained in the Terrain databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

NOTE: *TERRAIN, TAWS-A, TAWS-B, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software version 4.00, or later. TAWS-A is available in software version 5.00, or later.*

11.4 Terrain Awareness and Warning System (TAWS-B) Optional

TAWS (Terrain Awareness and Warning System) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain (CFIT). TAWS provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

TAWS satisfies TSO-C151c Class B requirements for certification. Class B TAWS is required for all Part 91 turbine aircraft operations with six or more passenger seats and for Part 135 turbine aircraft operations with six to nine passenger seats (FAR Parts 91.223, 135.154).

11.4.1 TAWS-B Requirements

TAWS requires the following to operate properly:

- A valid terrain/obstacle database
- A valid 3-D GPS position solution

11.4.2 TAWS-B Limitations

NOTE: *The data contained in the TAWS databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

TAWS displays terrain and obstructions relative to the altitude of the aircraft. Compliance with TAWS B alerts and warnings is MANDATORY. When a TAWS B "pull up" annunciation is issued, the pilot is required to pull up.

TAWS 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 available in the database. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151c.

11.4.3 Computing GPS Altitude for TAWS

TAWS uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a Mean Sea Level (MSL)-based altitude (GSL altitude) and is used to determine TAWS alerts. 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, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

The terrain and obstacle databases used by TAWS are referenced to Mean Sea Level. Using the GPS position and GSL altitude, TAWS displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the GPS position and GSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, TAWS can provide advanced alerts of predicted dangerous terrain conditions.

11.4.4 Baro-Corrected Altitude Versus GSL Altitude

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 GSL altitude. This variation results in the aircraft's true altitude differing from the baro-corrected altitude.

11.4.5 Using TAWS-B

During unit power-up, the terrain/obstacle database versions are displayed. At the same time, TAWS self-test begins. One of the following aural messages is generated:

- *"TAWS System Test OK"*
- *"TAWS System Failure"*

TAWS information can be displayed on the Map page. Terrain and obstacles with heights greater than 200 feet Above Ground Level (AGL) are displayed in yellow and red. The GTN 7XX adjusts colors automatically as the aircraft altitude changes.

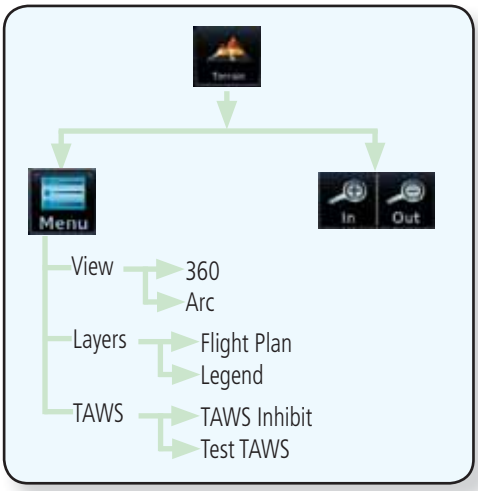


Figure 11-5 TAWS-B Page Functional Diagram

11.4.6 Displaying TAWS-B Data

TAWS uses yellow (caution) and red (warning) to depict terrain and obstacles alerts relative to aircraft altitude. Colors are adjusted automatically as the aircraft altitude changes. The colors and symbols shown below are used to represent terrain, obstacles, and threat locations. Obstacles are removed when more than 2000 ft below the aircraft.

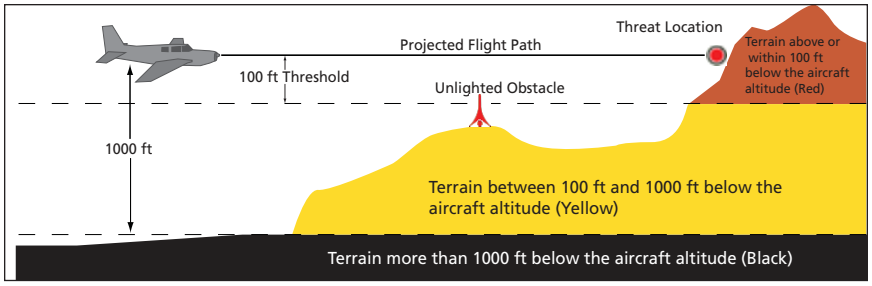


Figure 11-6 Terrain Altitude/Color Correlation for TAWS-B

Obstacle Symbol	Unlighted Obstacle		Lighted Obstacle		Threat Location Indicator	Terrain Color	Terrain/ Obstacle Location	Alert Level
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL				
						Red	Terrain/ Obstacle at or within 100 ft below current aircraft altitude	WARNING (Red)
						Yellow	Terrain/ Obstacle between 100 ft and 1000 ft below current aircraft altitude	CAUTION (Yellow)
						White	Terrain/ Obstacle between 1000 ft and 2000 ft below current aircraft altitude	

Table 11-3 TAWS-B Terrain/Obstacle Colors and Symbology

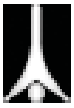
Tower	Windmill	Windmill in Group	Power Line
			

Table 11-4 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

11.4.7 TAWS-B Page

TAWS information is displayed on the Map and Terrain pages. The TAWS Page is specialized to show terrain, obstacle, and threat location data in relation to the aircraft's current altitude, without clutter from the basemap. Flight plan information (airports, VORs, and other NAVAIDs) included in the flight plan are displayed for reference. If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest threat location on the TAWS Page.

Aircraft orientation on this map is always heading up unless there is no valid heading. If orientation is not heading up, it will be track up. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the **In** and **Out** keys from 1 to 200 NM, as indicated by the map range rings (or arcs).

11.4.7.1 Terrain Page Layers

1. While viewing the Terrain page, touch the **Menu** key.

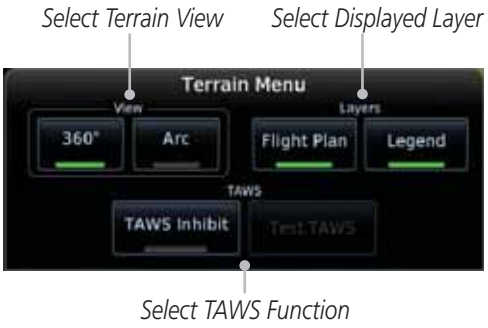


Figure 11-7 Terrain Page TAWS-B Menu

2. Touch the **Flight Plan** key to toggle the display of the active flight plan.

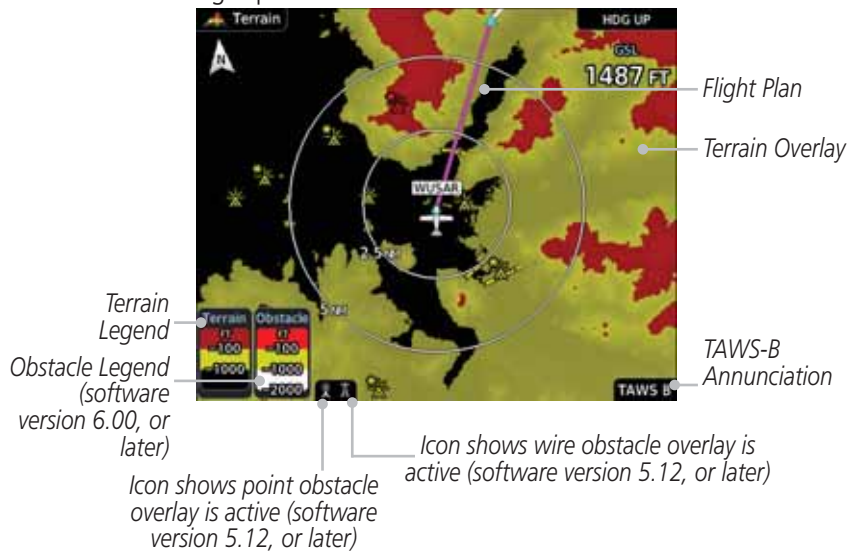


Figure 11-8 Flight Plan and Legend Shown On TAWS-B Terrain Page

3. Touch the **Legend** key to toggle the display of the Terrain and Obstacle legend.

11.4.7.2 Terrain Page View

Select the 120º Arc or 360º rings overlay for the Terrain page with either the **360** or **Arc** keys from the Menu.

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **360º** or **Arc** key.

11.4.7.3 Terrain Page TAWS-B Selections

The TAWS selections allow you to inhibit aural TAWS alerts and to send a request to the TAWS equipment to run its internal tests. After cycling power, TAWS will no longer be inhibited.

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **TAWS Inhibit** key to toggle the inhibiting of TAWS alerts.

Figure 11-9 TAWS-B Alerts Inhibited Selected

3. Touch the **Test TAWS** key to test the TAWS system. This function is not available when the aircraft is in the air.

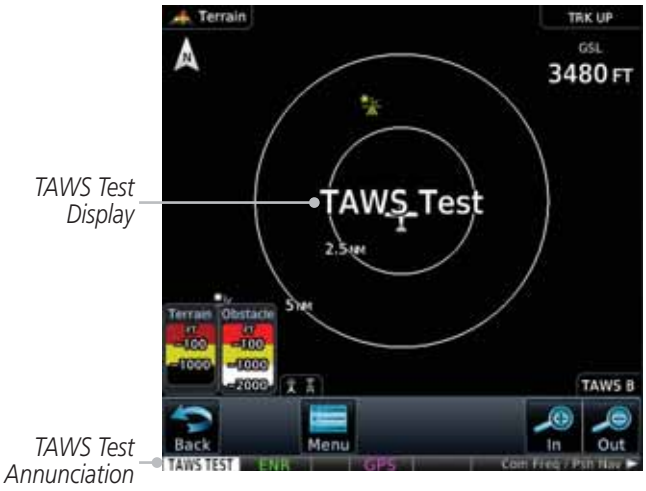


Figure 11-10 TAWS-B Test Selected

11.4.8 TAWS-B Alerts

Alerts are issued when flight conditions meet parameters that are set within TAWS software algorithms. When an alert is issued, visual annunciations are displayed and aural alerts are simultaneously issued. TAWS alert types are shown in the TAWS Alerts Summary with corresponding annunciations and aural messages.

When an alert is issued, annunciations appear on the TAWS page. If the TAWS page is not displayed at the time, a pop-up alert appears on the page being viewed.

Figure 11-11 Terrain Alert Pop-Up

To acknowledge the pop-up alert:

Go to Terrain — Touch the **Go to Terrain** key (accesses the TAWS Page)

OR

Close — Touch the **Close** key to remove the pop-up alert

If the pilot takes no action, the pop-up will be removed when the alert is no longer active.

11.4.8.1 TAWS-B Alerting Colors and Symbology

Color and symbols are also associated with TAWS alerts. The alert annunciations show in the bottom left corner of the display. The three TAWS alert levels and their associated text coloring as well as any associated symbology are shown in the following table.

Alert Level	Annunciator Text	Threat Location Indicator	Example Visual Annunciation
Warning	White text on red background		PULL UP
Caution	Black text on yellow background		TERRAIN
Informational	Black text on white background	Not Applicable	TAWS INHB

Table 11-5 TAWS-B Alert Colors and Symbology

Alert Type	Alert Annunciation	Aural Message
Excessive Descent Rate Warning (EDR-W)	PULL UP	"Pull Up"
FLTA Terrain Warning (RTC-W, ITI-W)	PULL UP	"Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"* or "Terrain, Terrain; Pull Up, Pull Up"
FLTA Obstacle Warning (ROC-W, IOI-W)	PULL UP	"Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"* or "Obstacle, Obstacle; Pull Up, Pull Up"
FLTA Wire Warning (ILI-W, RLC-W)	PULL UP	"Wire Ahead Pull Up, Wire Ahead Pull Up"
FLTA Terrain Caution (RTC-C, ITI-C)	TERRAIN	"Terrain Ahead; Terrain Ahead"* or "Caution, Terrain; Caution, Terrain"
FLTA Obstacle Caution (ROC-C, IOI-C)	OBSTCL	"Obstacle Ahead; Obstacle Ahead"* or "Caution, Obstacle; Caution, Obstacle"
FLTA Wire Caution (ILI-C, RLC-C)	WIRE	"Wire Ahead"
Premature Descent Alert Caution (PDA)	TERRAIN	"Too Low, Terrain"
Excessive Descent Rate Caution (EDR-C)	TERRAIN	"Sink Rate"
Negative Climb Rate Caution (NCR-C)	TERRAIN	"Don't Sink"* or "Too Low, Terrain"
Voice Call Out (VCO-500)	None	"Five-Hundred"

** Alerts with multiple messages are configurable at installation and are installation-dependent. Alerts for the default configuration are indicated with asterisks.*

Table 11-6 TAWS-B Alerts Summary

11.4.8.2 Excessive Descent Rate Alert

The purpose of the **Excessive Descent Rate (EDR)** alert is to provide notification when the aircraft is determined to be descending upon terrain at an excessive rate. The parameters for the alert as defined by TSO-C151c are shown below.

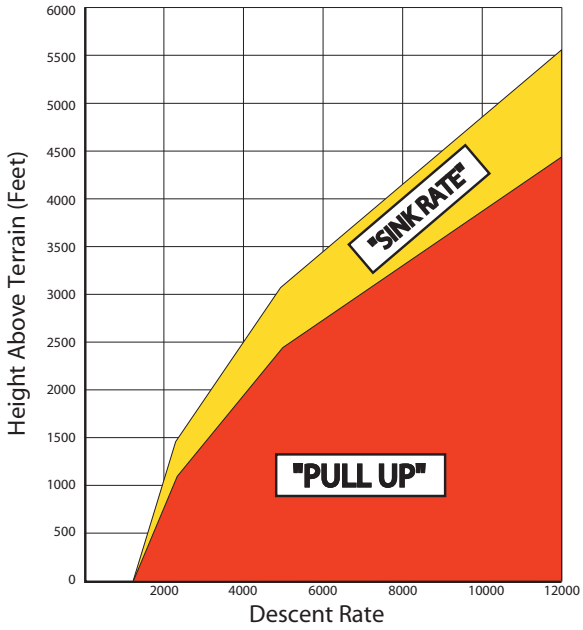


Figure 11-12 Excessive Descent Rate Alert Criteria

11.4.8.3 Forward Looking Terrain Avoidance

Reduced Required Terrain Clearance (RTC), Reduced Required Line Clearance (RLC), and **Reduced Required Obstacle Clearance (ROC)** alerts are issued when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values in the FLTA Alert Minimum Terrain and Obstacle Clearance Values table. When an RTC, RLC, and/or a ROC alert is issued, a threat location indicator is displayed on the TAWS Page.

Imminent Terrain Impact (ITI), Imminent Line Impact (ILI), and **Imminent Obstacle Impact (IOI)** alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. ITI, ILI, and IOI alerts are accompanied by a threat location indicator displayed on the TAWS Page. The alert is annunciated when the projected vertical flight path is calculated to come within minimum clearance altitudes in the following table.

Flight Phase	Minimum Clearance Altitude (feet)	
	Level Flight	Descending
En Route	700	500
Terminal	350	300
Approach	150	100
Departure	100	100

Table 11-7 FLTA Alert Minimum Terrain and Obstacle Clearance Values

During final approach, FLTA alerts are automatically inhibited when the aircraft is below 200 feet AGL while within 0.5 NM of the approach runway or below 125 feet AGL while within 1.0 NM of the runway threshold.

11.4.8.4 Premature Descent Alerting

A Premature Descent Alert (PDA) is issued when the system detects that the aircraft is significantly below the normal approach path to a runway.

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 feet AGL while within 1.0 NM of the threshold. During the final descent, algorithms set a threshold for alerting based on speed, distance, and other parameters.

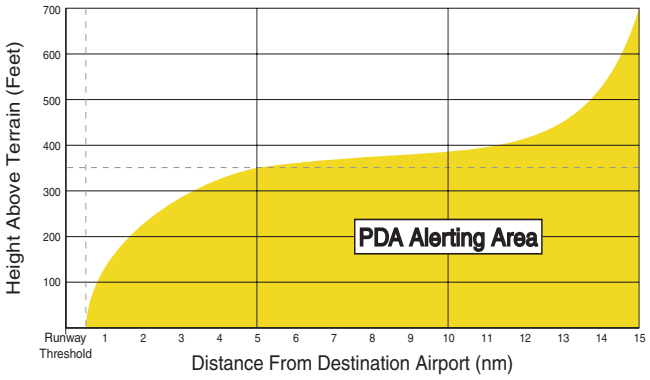


Figure 11-13 PDA Alerting Threshold

PDA and FLTA aural and visual alerts can be manually inhibited. Discretion should be used when inhibiting TAWS and the system should be enabled when appropriate. When TAWS is inhibited, the alert annunciation "TER INHB" is shown.

11.4.8.5 Inhibiting/Enabling TAWS-B PDA/FLTA Alerting

TAWS also has an inhibit mode that deactivates the PDA/FLTA aural and visual alerts. Pilots should use discretion when inhibiting TAWS and always remember to enable the system when appropriate. Only the PDA and FLTA alerts are disabled in the inhibit mode. After cycling power, TAWS will no longer be inhibited.

Figure 11-14 TAWS-B Alerting Disabled (TAWS Inhibited) Annunciation

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **TAWS Inhibit** key to inhibit or enable TAWS (choice dependent on current state). A green bar in the key indicates the TAWS is inhibited.

11.4.8.6 Negative Climb Rate After Take-Off Alert (NCR)

The **Negative Climb Rate (NCR) After Take-Off** alert (also referred to as "Altitude Loss After Take-Off") provides alerts when the system determines 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. NCR alerting 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 2 NM or less
- Heading change from the departure heading is less than 110º

The NCR alerting parameters as defined by TSO-C151c are shown below.

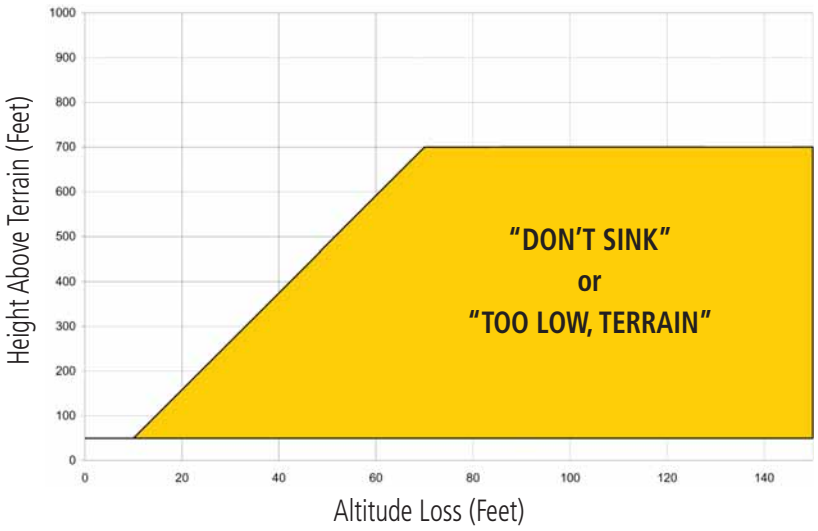


Figure 11-15 Negative Climb Rate (NCR) Altitude Loss

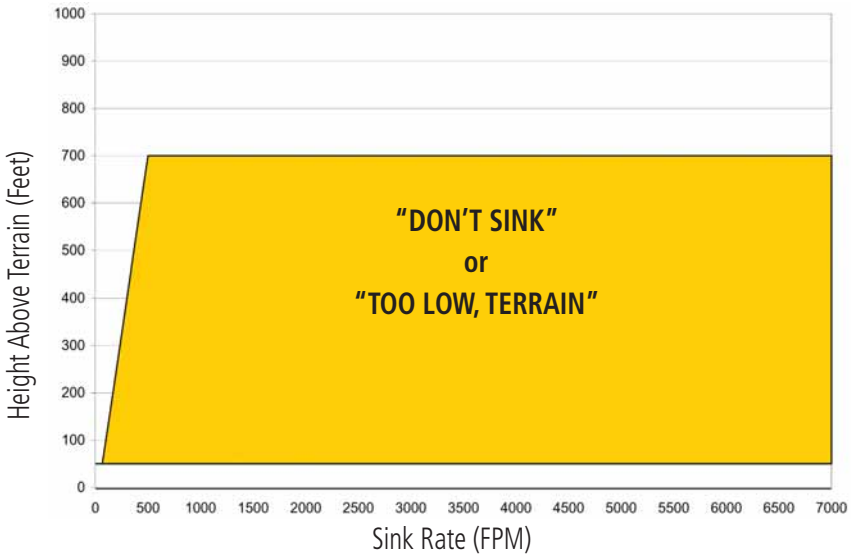


Figure 11-16 Negative Climb Rate (NCR) Sink Rate

11.4.8.7 Altitude Voice Call Out (VCO)

TAWS-B provides aural advisory alerts as the aircraft descends, beginning at 500 feet above the terrain, as determined by the radar altimeter (if greater than 5 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-B issues the aural alert message "Five-hundred".

11.4.8.8 TAWS-B Not Available Alert

TAWS-B requires a 3-D GPS position solution along with specific vertical accuracy minimums. Should the position 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-B page. The aural message "TAWS Not Available" is generated. When the GPS signal is re-established and the aircraft is within the database coverage area, the aural message "TAWS Available" is generated (when the aircraft is airborne).

11.4.8.9 TAWS-B Failure Alert

TAWS-B continually monitors several system-critical items such as database validity, hardware status, and GPS status. If the terrain/obstacle database is not available, the aural message "TAWS System Failure" is generated along with a "TAWS FAIL" annunciation.

11.4.9 TAWS-B System Status

During power-up, TAWS-B conducts a self-test of its aural and visual annunciations. The system test can also be manually initiated. An aural alert is issued at test completion. TAWS System Testing is disabled when ground speed exceeds 30 knots.

Alert Type	Alert Annunciation	Aural Message
TAWS Available	None	"TAWS Available"
TAWS System Test in Progress	TAWS TEST	None
TAWS System Test Pass	None	"TAWS System Test OK"
TAWS N/A	TAWS N/A	TAWS Not Available
TAWS Alerting is Disabled	TAWS INHB	None
TAWS System Test Fail	TAWS FAIL	"TAWS System Failure"

Table 11-8 TAWS-B System Test Status Annunciations

11.5 HTAWS (Optional)

11.5.1 Introduction

NOTE: *TERRAIN, TAWS, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software version 4.00, or later.*

11.5.1.1 Overview

Garmin's Helicopter Terrain Awareness Warning System (HTAWS) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain. Garmin HTAWS is TSO-C194 authorized. Units installed in helicopters that do not have HTAWS installed will display HTerrain Proximity. This is noted by the five color terrain scale which is appropriate to the low altitude operating environment for helicopters.

HTAWS provides visual and aural annunciations when terrain and obstacles are a hazard to the aircraft.

Figure 11-17 Map Page with Terrain

NOTE: *HTAWS-enabled units can be identified by going to the Terrain page and checking the lower right-corner for "HTAWS."*

11.5.1.2 Operating Criteria

Garmin HTAWS requires the following to operate properly:

- The system must have a valid 3D GPS position solution
- The system must have a valid terrain/obstacle database.

11.5.1.3 Limitations

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.*

HTAWS displays terrain and obstructions relative to the flight path of the aircraft. Individual obstructions may be shown if available in the database. However, all obstructions may not be available in the database and data may be inaccurate. Never use this information for navigation.

NOTE: *Terrain databases do not consistently represent foliage. Some trees may extend above HTAWS protection limits in some operating modes.*

Terrain information is based on terrain elevation data contained in a database that may contain inaccuracies. Terrain information should be used as an aid to situational awareness. Never use it for navigation or to maneuver to avoid terrain.

HTAWS uses terrain and obstacle information supplied by government sources. The data undergoes verification by Garmin to confirm accuracy of the content. However, the displayed information should never be understood as being all-inclusive.

11.5.2 HTAWS Operation

11.5.2.1 HTAWS Alerting

HTAWS uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a mean sea level (MSL)-based altitude (GSL altitude) and is used to determine HTAWS alerts. 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, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

HTAWS utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, HTAWS displays a 2-D picture of the surrounding terrain and obstacles relative to the position and

altitude of the aircraft. The GPS position and GSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, HTAWS can provide advanced alerts of predicted dangerous terrain conditions. Detailed alert modes are described later in this section.

11.5.2.2 Power Up

During power-up of the unit, the terrain/obstacle database versions are displayed along with a disclaimer to the pilot. At the same time, HTAWS self-test begins. HTAWS gives the following aural messages upon test completion:

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

A test failure is also annunciated visually for HTAWS, as shown in the HTAWS Alert Summary table.

11.5.3 HTAWS Page

HTAWS is shown on the Terrain page when HTAWS is available.

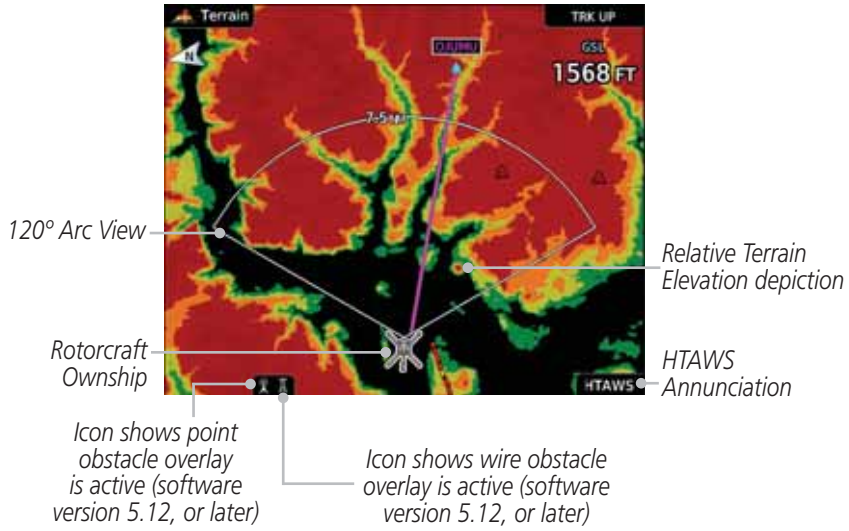


Figure 11-18 Terrain/HTAWS Page

Terrain information, aircraft ground track, and GPS-derived MSL altitude are displayed on the page. The "GSL" above altitude display in the top right corner of the display reminds the pilot that altitude is GPS-derived.

The HTAWS page menu provides options to acknowledge caution alerts, reduce protection, or inhibit alerting.

Figure 11-19 HTAWS Terrain Menu

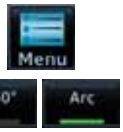
11.5.3.1 View Selection

The HTAWS Page has two selectable view settings:

Figure 11-20 Terrain Page with HTAWS - 360° View

- 360° View—View from above aircraft depicting surrounding terrain on all sides.
- Arc (120°) View—View of terrain ahead of and 60° to either side of the aircraft flight path.

NOTE: *If a heading source is available the HTAWS page will be oriented heading up. If no heading source is available the HTAWS page will be oriented track up.*



1. While viewing the Terrain/HTAWS Page, touch **MENU**. Touch **Arc** or **360°**.

2. Touch **Back** to return to the Terrain/HTAWS display. The HTAWS Page displays the selected view. Repeat step 1 to select the alternate view, and touch **Back**.

11.5.3.2 HTAWS Inhibit

HTAWS provides an "inhibit mode." This mode deactivates aural and visual alerts when they are deemed unnecessary by the aircrew. Pilots should use discretion when inhibiting the HTAWS system and always remember to enable the system when appropriate. VCO's are not inhibited in Inhibit Mode. See section 3 for more information on HTAWS alerts. When alerting is inhibited, all FLTA aural and visual alerting is suppressed. HTAWS should only be inhibited when in visual contact with terrain and when the pilot can be assured of maintaining clearance from terrain and obstacles. When conducting en route operations and operations from published airports and heliports, HTAWS should be operated in Normal mode. HTAWS configured units will always start up with HTAWS alerts uninhibited.

To inhibit HTAWS alerts:

1. While viewing the Terrain/HTAWS page, touch **MENU**.

2. Touch **HTAWS Inhibit**. The green bar will show when HTAWS Inhibit is active.

3. Touch **Back** to return to the Terrain/HTAWS display. The HTAWS alerts are inhibited. The HTAWS INHB annunciation is displayed in the terrain annunciator field whenever HTAWS is inhibited.

NOTE: *When the ground speed is less than 30 knots HTAWS will automatically display the "HTAWS INHB" annunciation. This indicates that HTAWS is no longer providing protection.*

This automatic "TAWS INHB" cannot be removed by menu option selection. Menu selections for INHIBIT HTAWS and RP Mode remain available when HTAWS is automatically inhibited due to groundspeed. If the pilot selects a mode on the menu while HTAWS is auto inhibited because it is less than 30 knots then the unit will enter that mode once ground speed exceeds 30 knots. Hence, the presence of these selections on the Menu.

11.5.3.3 External HTAWS Inhibit Control

An optional installation is allowed for providing an external HTAWS Inhibit switch. Touching the external HTAWS Inhibit switch toggles the HTAWS inhibit on and off in the same manner as using the Terrain Menu selection.

11.5.3.4 Reduced Protection Mode

The Reduce Protection (RP) functionality allows operating with a reduction in the alerting thresholds, and suppresses visual and aural annunciation of caution alerts. Reduced protection allows low level operations and landings off airport with a minimum number of alerts while continuing to provide protection from terrain and obstacles. Reduced Protection should only be selected when operating in visual contact with the terrain as alerting times are significantly less than in normal mode. There is support for an external RP Mode switch and an external Alert Acknowledge switch.

To toggle protection:

1. While viewing the Terrain/HTAWS Page, touch **MENU**.

2. Touch the **RP Mode** key to toggle the RP mode on and off. The green bar will show when RP mode is active.

3. Touch **Back** to return to the Terrain/HTAWS display. The "RP Mode" annunciation is displayed in the terrain annunciator field and in the lower right corner of the terrain page whenever protection is reduced.

11.5.3.5 HTAWS Manual Test

Garmin HTAWS provides a manual test capability which verifies the proper operation of the aural and visual annunciations of the system prior to a flight.

To manually test the HTAWS system:

1. While viewing the Terrain/HTAWS Page, touch **MENU**.
2. Touch the **Test HTAWS** key.
3. Touch **Back** to return to the Terrain/HTAWS display.

An aural message is played giving the test results:

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

NOTE: *HTAWS System Testing is disabled when in the air so as not to impede HTAWS alerting.*

11.5.3.6 HTAWS Legend

1. While viewing the Terrain/HTAWS page, touch **MENU**.
2. Touch the **Legend** key to toggle the legend on or off. The green bar will show when the Legend is active.
3. Touch **Back** to return to the Terrain/HTAWS display.

Figure 11-21 HTAWS Terrain and Obstacle Legend

Color	Description
Red	Terrain is more than 250 ft above the aircraft.
Orange	Terrain is between 0 ft and 250 ft above the aircraft.
Yellow	Terrain is between 250 ft and 0 ft below the aircraft.
Green	Terrain is between 250 ft and 500 ft below the aircraft.
Black	Terrain is more than 500 ft below the aircraft.

Table 11-9 HTAWS Terrain Altitude Color Description

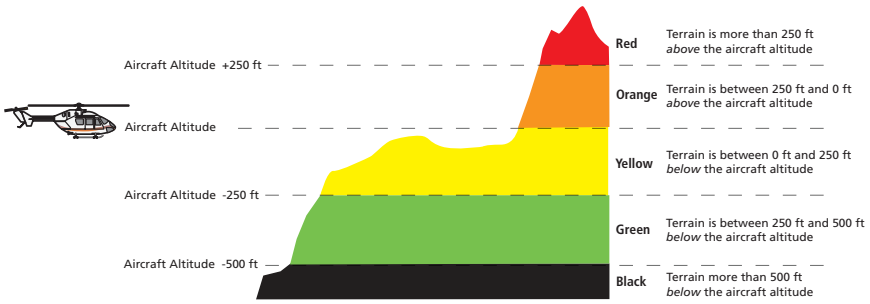


Figure 11-22 HTAWS Terrain Altitude Colors

11.5.3.7 Flight Plan Overlay

1. While viewing the Terrain/HTAWS page, touch **MENU**.

2. Touch the **Flight Plan** key to toggle the overlay of the active flight plan on or off. The green bar will show when the Flight Plan overlay is shown.

3. Touch **Back** to return to the Terrain/HTAWS display.

11.5.4 HTAWS Symbols

The symbols and colors in the following figures and table are used to represent obstacles and the location of terrain threats on the HTAWS Page. Each color is associated with a height above terrain.

Obstacles are ALWAYS shown on the TAWS page at 10 NM and below.

NOTE: *If an obstacle or terrain cell and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest threat location on the HTAWS Page.*

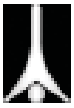
Tower	Windmill	Windmill in Group	Power Line
			

Table 11-10 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

Obstacle Symbol	Unlighted Obstacle		Lighted Obstacle		Obstacle Color	Obstacle Location
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL		
					Red	Obstacle is at or above current aircraft altitude
					Yellow	Obstacle is between 250 ft and 0 ft below current aircraft altitude
					White	Obstacle is 250 ft, or more, below current aircraft altitude. Obstacles are removed when more than 500 ft below the helicopter.

Table 11-11 HTAWS Obstacle Colors and Symbology

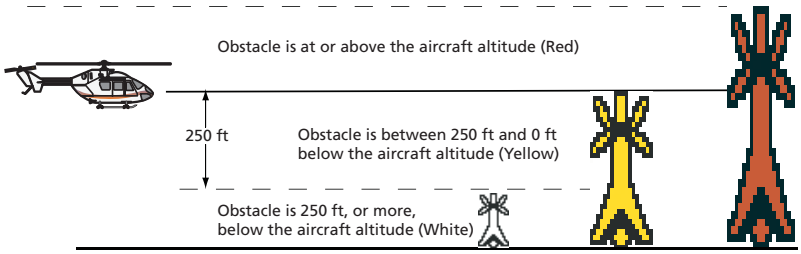


Figure 11-23 HTAWS Obstacle Altitude Colors and Symbology

Threat Location Indicator	Alert Level
	WARNING (Red)
	CAUTION (Yellow)

Table 11-12 HTAWS Alert Coloring and Symbology

11.5.5 HTAWS Alerts

Alerts are issued when flight conditions meet parameters that are set within HTAWS software algorithms. HTAWS alerts employ either a CAUTION or a WARNING alert severity level. When an alert is issued, visual annunciations are displayed. Aural alerts are simultaneously issued. Annunciations appear in a dedicated field in the lower left corner of the display.

Annunciations are color-coded according to the HTAWS Alert Summary table. Pop-up terrain alerts will occur if an HTAWS alert is activated while not on the HTAWS page. There are two options when an alert is displayed:

To acknowledge the pop-up alert and return to the currently viewed page:

Touch the **Close** key.

To acknowledge the pop-up alert and quickly access the HTAWS Page:

Touch the **ENT** key.

NOTE: *To further capture the attention of the pilot, HTAWS issues aural (voice) messages that accompany visual annunciations and pop-up alerts. For a summary of aural messages, see the HTAWS Alert Summary table.*

NOTE: *HTAWS Caution Alerts are displayed as constant black text on a yellow background; HTAWS Warning Alerts are displayed as constant white text on a red background.*

11.5.5.1 Forward Looking Terrain Avoidance

The unit will issue terrain alerts not only when the aircraft altitude is below the terrain elevation but also when the aircraft is projected to come within minimum clearance values of the terrain. This alerting, called Forward Looking Terrain Avoidance (FLTA), is also provided for obstacles.

The FLTA functionality looks ahead of the aircraft using GPS position information and the terrain and obstacle databases to provide alerts when the predicted flight path does not clear the terrain or obstacle by the required clearance. The amount of clearance required varies depending on position relative to airports and heliports, in order to reduce the occurrence of nuisance alerting.

Any threat locations are depicted on the display. There are 2 levels of severity for FLTA alerts. They are cautionary (amber) and warning (red) in nature and are described in further detail below.

FLTA CAUTION—Estimated potential impact in approximately 30 seconds after a caution pop-up alert and annunciation. FLTA caution alerts are accompanied by the aural message "*Caution Terrain; Caution Terrain*". Similarly, a "*Caution Obstacle; Caution Obstacle*" alert is also provided. The time to an alert can vary with conditions, therefore there is no guarantee of a 30 second caution alert being issued.

FLTA WARNING—Warning pop-up alerts are issued 15 seconds prior to an estimated potential impact in normal mode and approximately 10 seconds in RP Mode. FLTA warning alerts are accompanied by the aural message "*Warning - Terrain, Terrain*". Similarly, a "*Warning - Obstacle, Obstacle*" alert is also provided. The time to an alert can vary with conditions, therefore there is no guarantee of a 15/10 second warning alert being issued.

The alerts are annunciated visually through the annunciator status bar, a pop-up alert box, and the red and yellow areas on the HTAWS page. The alerts are annunciated aurally through a voice message indicating the potential threat, such as "Caution - Terrain, Terrain" or "Warning - Obstacle, Obstacle".

11.5.5.2 HTAWS Voice Call Out Aural Alert

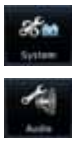
The purpose of the Voice Call Out (VCO) aural alert messages are to provide an advisory alert to the pilot that the aircraft is between 500 feet and 100 feet above terrain in 100 foot increments. When the aircraft descends within the selected distance from the terrain, the aural message for the selected height above terrain is generated. There are no display annunciations or pop-up alerts that accompany the aural message. HTAWS allows an additional 50 foot VCO alert with radar altimeter input.

11.5.5.3 HTAWS Voice Call Out Selection

The Voice Call Out (VCO) selection is available when HTAWS is installed. The VCO functionality provides a voice annunciation of the aircraft's height above terrain or the nearest airport, heliport, runway, or helipad when that threshold is first crossed. The available call outs include "Five Hundred" through "One Hundred" in one hundred foot intervals. The voice call outs can be enabled and disabled through the Voice Call Outs Selection option on the System - Audio page.

***NOTE**: VCOs are available down to 100 feet above terrain when HTAWS is installed and use GSL above terrain to generate call outs (no radar altimeter required). If a radar altimeter is interfaced to the GTN, alerts are available down to 50 feet and the height above terrain when the radar altimeter is used to generate the callouts.*

To select the Voice Call Out choices in the System - Audio page, select the Voice Call Out Selection item and then select the desired value.



1. From the Main page, touch **System** and then **Audio**.

2. Touch the **Voice Callouts** key to view the Voice Call Outs page.

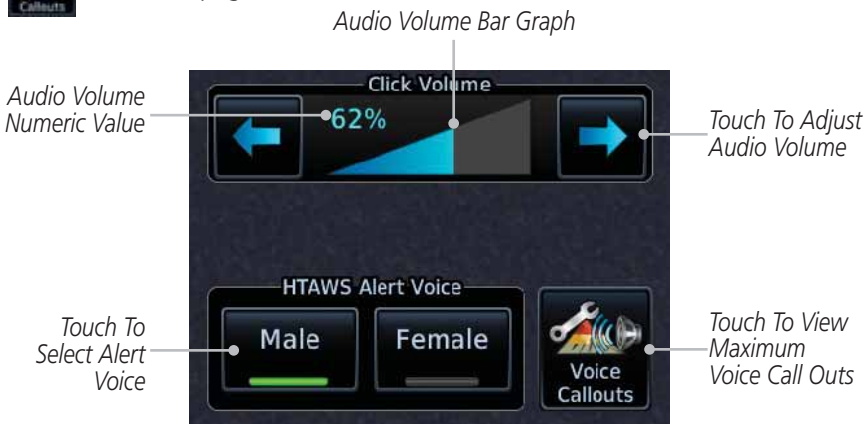


Figure 11-24 Select Voice Call Outs from the System Audio Page

3. Touch the **MAX Voice Callout** key to select the Voice Call Outs.

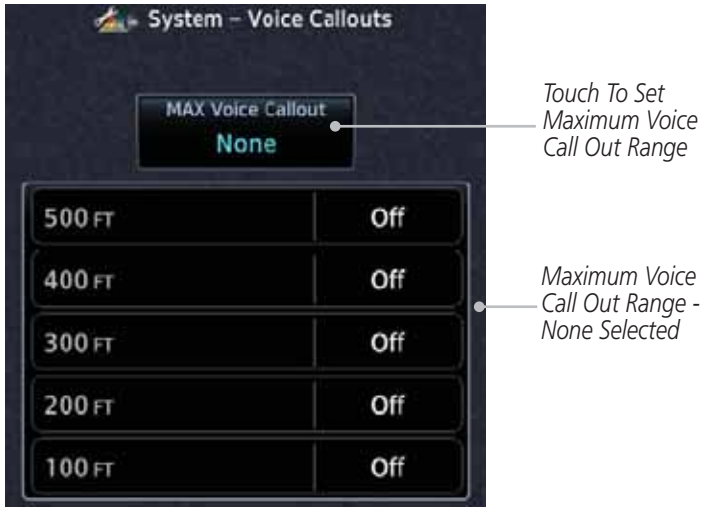


Figure 11-25 View the Maximum Voice Call Out Range (None Selected)

4. The values above the selected value will be disabled (Off).

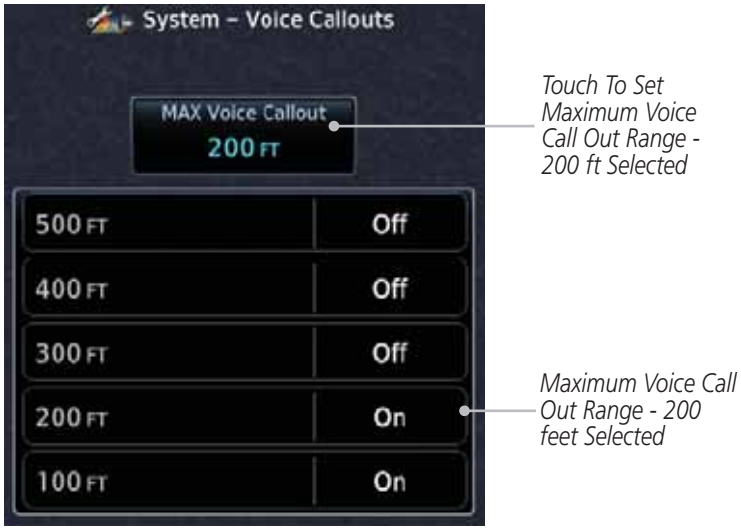


Figure 11-26 View the Maximum Voice Call Out Range (200 ft Selected)

11.5.5.4 HTAWS Not Available Alert

Garmin HTAWS 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 "HTAWS N/A" is shown in the annunciation window. When the GPS signal is re-established and the aircraft is within the database coverage area, the "HTAWS N/A" annunciation is removed.

11.5.5.5 HTAWS Failure Alert

HTAWS continually monitors several system-critical items, such as database validity, hardware status, and GPS status. If the terrain/obstacle database is not available, the aural message *"HTAWS System Failure"* is issued along with the "HTAWS FAIL" annunciation.

11.5.5.6 HTAWS Alert Summary

The aural alert voice gender is configurable to be either male or female. See your Garmin installer for further information on configuring the alert system.

HTAWS Annunciation	Pop-Up Alert	Aural Message	Description
HTAWS FAIL	None	"HTAWS System Failure"	HTAWS has failed
HTAWS INHB	None	None	HTAWS has been inhibited by the crew, or the aircraft ground-speed is below 30 knots (automatic inhibiting).
HTAWS N/A	None	"HTAWS Not Available"	HTAWS not available.
TERRAIN	CAUTION - TERRAIN	"Caution - Terrain, Terrain"	Forward Looking Terrain Avoidance Caution for Terrain
TERRAIN	WARNING - TERRAIN	"Warning - Terrain, Terrain"	Forward Looking Terrain Avoidance Warning for Terrain

HTAWS Annunciation	Pop-Up Alert	Aural Message	Description
OBSTACLE	CAUTION - OBSTACLE	"Caution - Obstacle, Obstacle"	Forward Looking Terrain Avoidance Caution for Obstacle
OBSTACLE	WARNING - OBSTACLE	"Warning - Obstacle, Obstacle"	Forward Looking Terrain Avoidance Warning for Obstacle
RP MODE	None	None	Alerting thresholds are reduced. Visual and aural annunciation of caution alerts are suppressed.
WIRE	CAUTION – WIRE	"Wire Ahead"	Forward Looking Terrain Avoidance Caution for Wire.
WIRE	WARNING – WIRE	"Wire Ahead Pull Up, Wire Ahead Pull Up"	Forward Looking Terrain Avoidance Warning for Power Lines
None	None	"Five Hundred" "Four Hundred" "Three Hundred" "Two Hundred" "One Hundred" "Fifty"	HTAWS provides optional 500 ft through 100 ft (in 100 ft increments) altitude call out alerts. An additional value of 50 ft is available if a radar altimeter is installed.

Table 11-13 HTAWS Alert Summary

NOTE: *HTAWS Caution Alerts are displayed as constant black text on a yellow background; HTAWS Warning Alerts are displayed as constant white text on a red background.*

11.5.6 Pilot Actions

If an HTAWS warning and associated aural are received, the pilot should immediately maneuver the rotorcraft in response to the alert unless the terrain or obstacle is clearly identified visually and determined by the pilot not to be a factor to the safety of the operation.

A HTAWS caution alert indicates terrain or obstacle nearby. If possible visually locate the terrain or obstacle for avoidance. A HTAWS warning alert may follow a HTAWS caution unless the aircraft's path towards the terrain or obstacle is changed.

NOTE: *Display of terrain and obstacles on the display is supplemental data only. Maneuvering solely by reference to the terrain and obstacle data is not recommended or authorized.*

11.6 TAWS-A (Optional)

11.6.1 Introduction

NOTE: *TERRAIN, TAWS-A, TAWS-B, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software version 4.00, or later. TAWS-A is available in software version 5.00, or later.*

NOTE: *The data contained in the TAWS databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

TAWS-A (Terrain Awareness and Warning System - Class A) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain (CFIT). TAWS-A provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

TAWS-A satisfies TSO-C151c Class A and TSO-92c requirements for certification.

Class A TAWS requires the following components and will not work properly without them:

- A valid terrain/obstacle/airport terrain 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 available in the database. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151c. However, the displayed information should never be understood as being all-inclusive and data may be inaccurate.

TAWS-A uses information from the GPS receiver to provide a horizontal position and altitude, along with additional altitude input from the radar altimeter. 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 sea 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 MSL altitude source to calculate terrain and obstacle alerts.

The terrain and obstacle databases used by TAWS-A are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, TAWS-A displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the GPS position and GSL altitude are used to calculate and "predict" 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 conditions.

Class A TAWS incorporates radar altimeter input with the GSL altitude to provide a more accurate position reference when at lower altitudes for certain alert types, and to retain a level of ground proximity warning capability in the unlikely event of an airport, terrain or obstacle database failure.

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 GPS-MSL altitude. This variation results in the aircraft's true altitude differing from the baro-corrected altitude.

TAWS-A provides the following alert types:

- Forward Looking Terrain Avoidance (FLTA) Alerting, which consists of:
  - Required Terrain Clearance (RTC) / Required Line Clearance (RLC) / Required Obstacle Clearance (ROC) Alerting
  - Imminent Terrain Impact (ITI) / Imminent Line Impact (ILI) / 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

11.6.1.1 Displaying TAWS-A Data

TAWS-A uses yellow (caution) and red (warning) to depict terrain and obstacle (with a height greater than 200 feet above ground level, AGL) alerts relative to aircraft altitude. Depictions of obstacles more than 200 feet below the aircraft are removed. Colors are adjusted automatically as the aircraft altitude changes. The colors and symbols in Figure 11-28 and Tables 11-11 and 11-12 are used to represent terrain, obstacles, and threat locations.

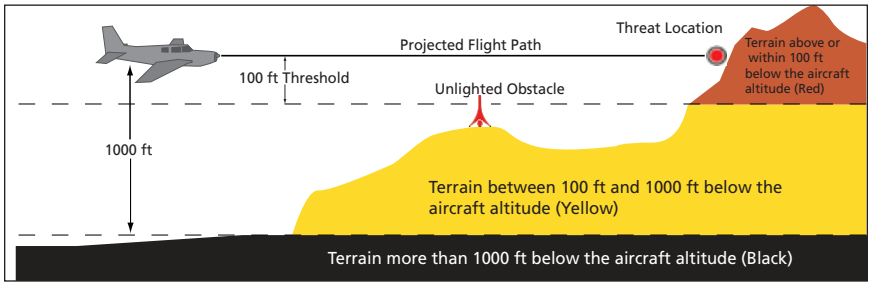


Figure 11-27 Terrain Altitude/Color Correlation for TAWS-A

Alert Level	Annunciator Text	Threat Location Indicator	Example Visual Annunciation
Warning	White text on red background		PULL UP
Caution	Black text on yellow background		TERRAIN
Informational	Black text on white background	Not Applicable	TAWS INHB

Table 11-14 TAWS-A Alert Colors and Symbology

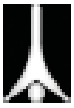
Tower	Windmill	Windmill in Group	Power Line
			

Table 11-15 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

Obstacle Symbol	Unlighted Obstacle		Lighted Obstacle		Threat Location Indicator	Terrain Color	Terrain/ Obstacle Location	Alert Level
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL				
						Red	Terrain/ Obstacle above or within 100 ft below current aircraft altitude	WARNING (Red)
						Yellow	Terrain/ Obstacle between 100 ft and 1000 ft below current aircraft altitude	CAUTION (Yellow)

Table 11-16 TAWS-A Terrain/Obstacle Colors and Symbology

11.6.2 TAWS-A Display

The TAWS-A Page shows terrain, obstacle, and threat location data in relation to the aircraft's current altitude, without clutter from the basemap. Aviation data (airports, VORs, and other NAVAIDs) can be displayed for reference. If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest potential point of impact on the TAWS-A Page.

Aircraft orientation on this map is always heading up unless there is no valid heading. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the **In** and **Out** keys from 1 to 200 NM, as indicated by the map range rings (or arcs).

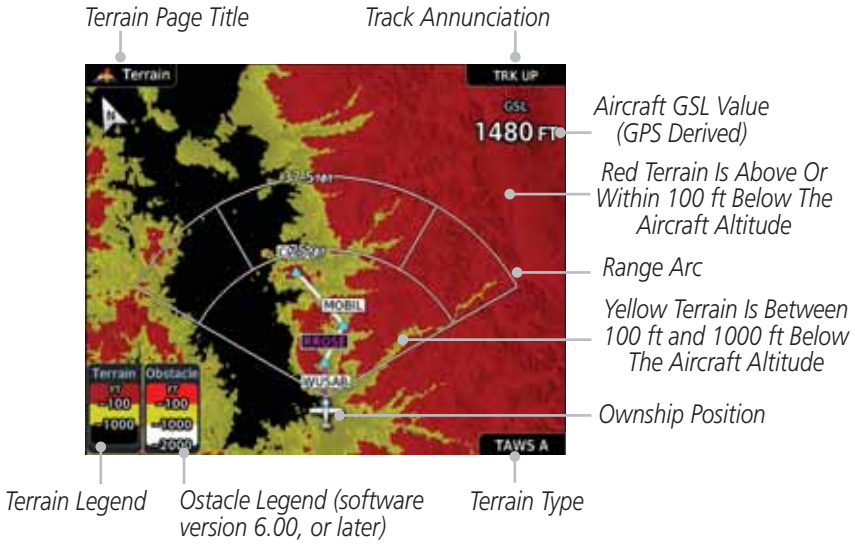


Figure 11-28 TAWS-A Page with Arc View

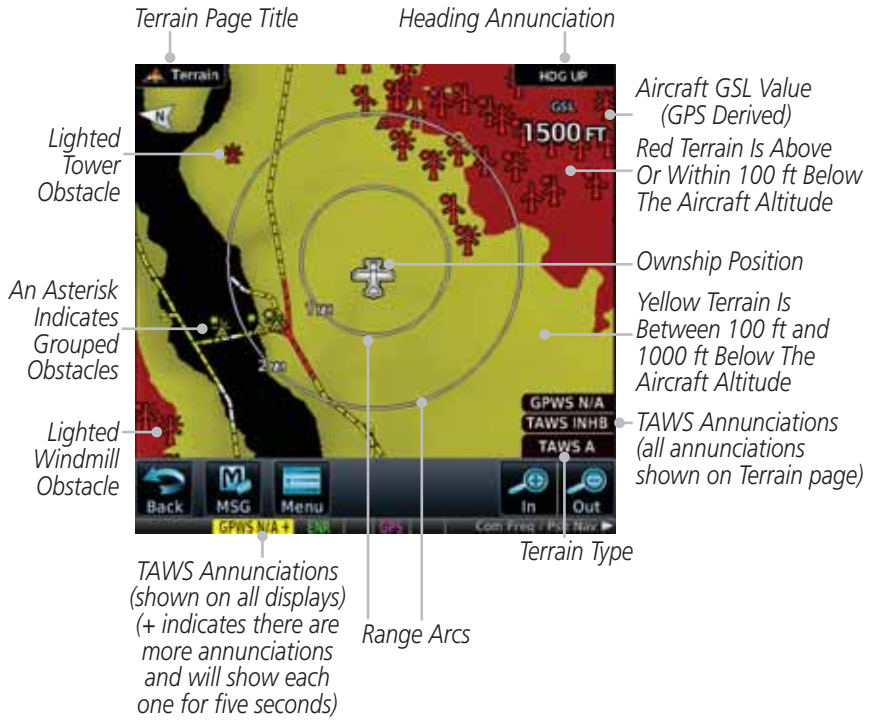


Figure 11-29 TAWS-A Page with 360° View

1. While viewing the Terrain page, touch the **Menu** key.

2. Selections are grouped by function: View, Layers, and TAWS.

Figure 11-30 TAWS-A Menu

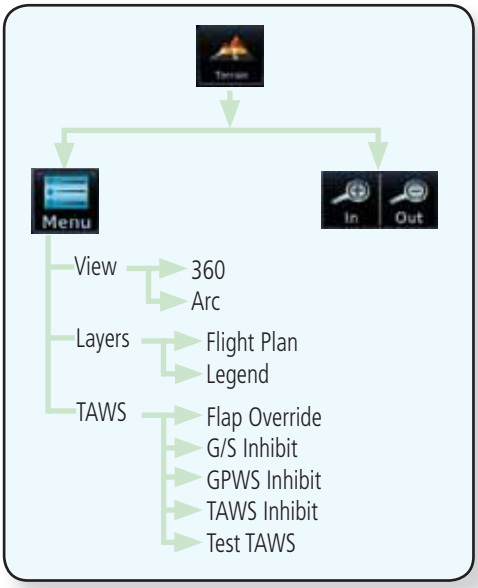


Figure 11-31 TAWS-A Page Functional Diagram

11.6.3 TAWS-A Alerts

Alerts are issued when flight conditions meet parameters that are set within TAWS-A software algorithms. TAWS-A alerts employ a CAUTION or a WARNING alert severity level. When an alert is issued, visual annunciations are displayed and aural alerts are simultaneously issued. TAWS-A alert types with corresponding annunciations and aural messages are shown in Table 11-13.

When an alert is issued, annunciations appear on the display. The TAWS-A Alert Annunciation is shown on the lower left part of the display. If the TAWS-A Page is not already displayed, a pop-up alert appears while an alert is active.

Figure 11-32 Terrain Alert Pop-Up

To acknowledge the pop-up alert:

Close — Touch the **Close** key (returns to the currently viewed page), or

Go to Terrain — Touch the **Go to Terrain** key (accesses the TAWS-A Page)

11.6.3.1 TAWS-A Alerts Summary

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Reduced Required Terrain Clearance Warning (RTC)	PULL UP	TERRAIN – PULL–UP * or TERRAIN AHEAD – PULL–UP	"Terrain, Terrain; Pull Up, Pull Up" * or "Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Imminent Terrain Impact Warning (ITI)	PULL UP	TERRAIN – PULL–UP * or TERRAIN AHEAD – PULL–UP	"Terrain, Terrain; Pull Up, Pull Up"* or "Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Reduced Required Obstacle Clearance Warning (ROC)	PULL UP	OBSTACLE – PULL–UP * or OBSTACLE AHEAD – PULL–UP	"Obstacle, Obstacle; Pull Up, Pull Up"* or "Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"
Imminent Obstacle Impact Warning (IOI)	PULL UP	OBSTACLE – PULL–UP * or OBSTACLE AHEAD – PULL–UP	"Obstacle, Obstacle; Pull Up, Pull Up"* or "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"
Imminent Line Impact Warning (ILI)	PULL UP	WIRE AHEAD – PULL–UP	"Wire Ahead, Pull Up; Wire Ahead, Pull Up" or "Wire, Wire; Pull Up, Pull Up"

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Reduced Line Clearance Warning (RLC)	PULL UP	WIRE AHEAD – PULL-UP	"Wire Ahead, Pull Up; Wire Ahead, Pull Up" or "Wire, Wire; Pull Up, Pull Up"
Reduced Required Terrain Clearance Caution (RTC)	TERRAIN	CAUTION – TERRAIN * or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain"* or "Terrain Ahead; Terrain Ahead"
Imminent Terrain Impact Caution (ITI)	TERRAIN	CAUTION – TERRAIN * or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain" or "Terrain Ahead; Terrain Ahead"
Reduced Required Obstacle Clearance Caution (ROC)	OBSTCL	CAUTION – OBSTACLE * or OBSTACLE AHEAD	"Caution, Obstacle; Caution, Obstacle"* or "Obstacle Ahead; Obstacle Ahead"
Imminent Obstacle Impact Caution (IOI)	OBSTCL	CAUTION – OBSTACLE * or OBSTACLE AHEAD	"Obstacle Ahead; Obstacle Ahead"* or "Caution, Obstacle; Caution, Obstacle"
Imminent Line Impact Caution (ILI)	WIRE	WIRE AHEAD	"Wire Ahead; Wire Ahead"* or "Caution, Wire; Caution, Wire"
Reduced Line Clearance Caution (RLC)	WIRE	WIRE AHEAD	"Wire Ahead; Wire Ahead"* or "Caution, Wire; Caution, Wire"
Premature Descent Alert Caution (PDA)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
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	DON'T SINK * or TOO LOW – TERRAIN	"Don't Sink"* or "Too Low, Terrain"
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)	GLIDESLOPE	GLIDESLOPE	"Glideslope"
Altitude Voice Call Out (VCO)	None	None	"Five-Hundred", "Four-Hundred"*, "Three-Hundred"*, "Two-Hundred"*, "One-Hundred"*
TAWS Available	None	N/A	"TAWS Available"
TAWS System Test in Progress	TAWS TEST	N/A	None
TAWS System Test Pass	None	N/A	"TAWS System Test OK"
TAWS N/A	TAWS N/A	N/A	TAWS Not Available
TAWS Alerting is Disabled	TAWS INHB	N/A	None
TAWS System Test Fail	TAWS FAIL	N/A	"TAWS System Failure"

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Incorrect TAWS configuration, invalid/missing terrain, airport, or obstacle database, or TAWS audio fault.	TAWS FAIL**	N/A	"TAWS System Failure"
No GPS position	TAWS N/A	N/A	"TAWS Not Available"
GPS position unavailable/ degraded, outside of terrain database coverage	TAWS N/A	N/A	"TAWS Not Available"
Sufficient GPS signal reception restored	None	N/A	"TAWS Available" (aural message only in flight)
Incorrect TAWS configuration, radar altimeter unavailable, GPS position unavailable/ degraded, TAWS audio fault	GPWS FAIL*	N/A	"GPWS System Failure"
GPWS Inhibit	GPWS INHB	N/A	"GPWS System Failure"
GPWS Not Available. Incorrect TAWS configuration, radar altimeter unavailable, GPS position unavailable/ degraded, TAWS audio fault.	GPWS N/A	N/A	None

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Glideslope Inhibit	G/S INHB	N/A	None
FLAP Override	FLAP OVRD	N/A	None

* Alerts with multiple messages are configurable. Alerts for the default configuration are indicated with asterisks.

** VCO alerts are not issued if both TAWS and GPWS systems have failed or are not available

† GSD alert will be available if a valid ILS is being used for navigation, even in no valid GPS signal is being received.

Table 11-17 TAWS-A Alerts Summary

11.6.3.2 Excessive Descent Rate Alert

The purpose of the **Excessive Descent Rate (EDR)** alert is to provide notification when the aircraft is determined to be descending upon terrain at an excessive rate. The parameters for the alert as defined by TSO-C151c are shown below.

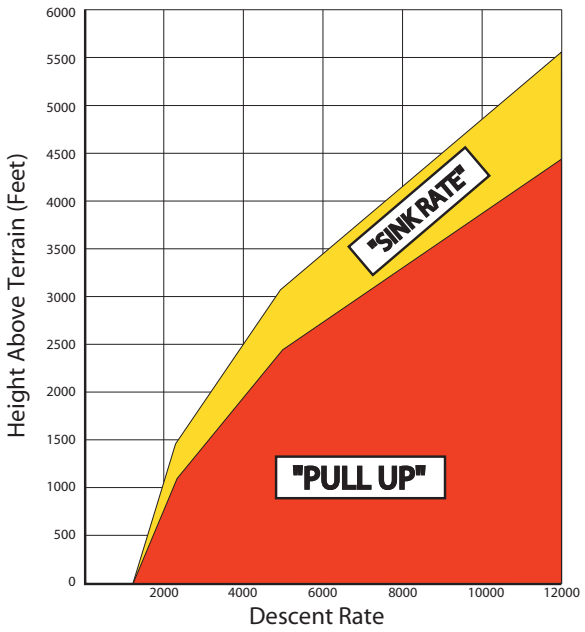


Figure 11-33 Excessive Descent Rate Alert Criteria

11.6.3.3 Forward Looking Terrain Avoidance

Reduced Required Terrain Clearance (RTC), Reduced Required Line Clearance (RLC), and **Reduced Required Obstacle Clearance (ROC)** alerts are issued when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values in the FLTA Alert Minimum Terrain and Obstacle Clearance Values table. When an RTC, RLC, and/or a ROC alert is issued, a threat location indicator is displayed on the TAWS Page.

Imminent Terrain Impact (ITI), Imminent Line Impact (ILI), and **Imminent Obstacle Impact (IOI)** alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. ITI, ILI, and IOI alerts are accompanied by a threat location indicator displayed on the TAWS Page. The alert is annunciated when the projected vertical flight path is calculated to come within minimum clearance altitudes in the following table.

Flight Phase	Minimum Clearance Altitude (feet)	
	Level Flight	Descending
En Route	700	500
Terminal	350	300
Approach	150	100
Departure	100	100

Table 11-18 FLTA Alert Minimum Terrain and Obstacle Clearance Values

During final approach, FLTA alerts are automatically inhibited when the aircraft is below 200 feet AGL while within 0.5 NM of the approach runway or below 125 feet AGL while within 1.0 NM of the runway threshold.

11.6.3.4 Premature Descent Alerting

A Premature Descent Alert (PDA) is issued when the system detects that the aircraft is significantly below the normal approach path to a runway.

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 feet AGL while within 1.0 NM of the threshold. During the final descent, algorithms set a threshold for alerting based on speed, distance, and other parameters.

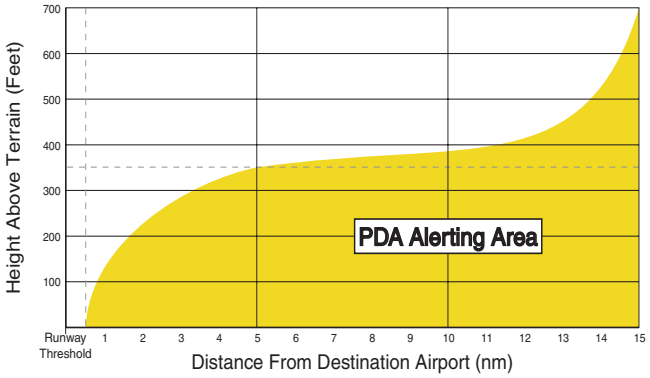


Figure 11-34 PDA Alerting Threshold

PDA and FLTA aural and visual alerts can be manually inhibited. Discretion should be used when inhibiting TAWS and the system should be enabled when appropriate. When TAWS is inhibited, the alert annunciation "TER INHB" is shown.

11.6.3.5 Inhibiting/Enabling TAWS-A PDA/FLTA Alerting

TAWS-A also has an inhibit mode that deactivates the PDA/FLTA aural and visual alerts. Pilots should use discretion when inhibiting TAWS-A and always remember to enable the system when appropriate. Only the PDA and FLTA alerts are disabled in the inhibit mode. After cycling power, TAWS-A will no longer be inhibited.

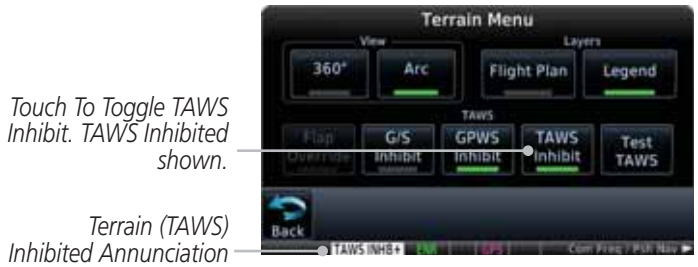


Figure 11-35 TAWS-A Alerting Disabled (TAWS Inhibited) Annunciation

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **TAWS Inhibit** key to inhibit or enable TAWS (choice is dependent on current state). A green bar in the key indicates the TAWS is inhibited.

11.6.3.6 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.

The following figures show the ECR alerting criteria for flaps in the landing configuration and for all other flight phases respectively.

ECR alerts are automatically inhibited 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.

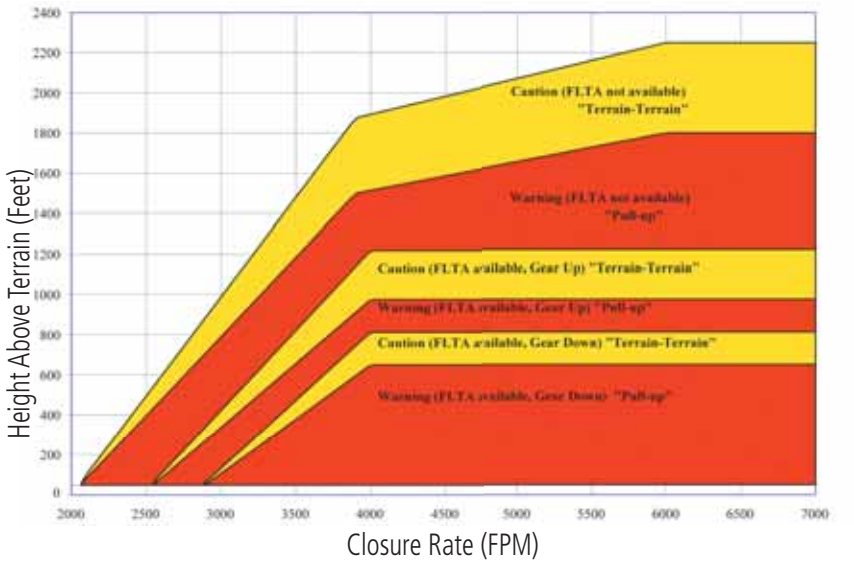


Figure 11-36 Excessive Closure Rate Alert Criteria (Flaps Up or Takeoff Configuration)

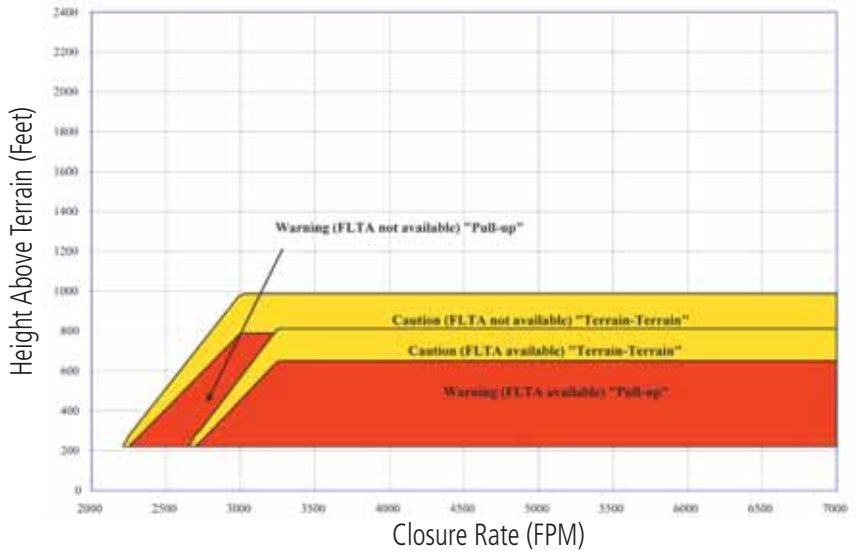
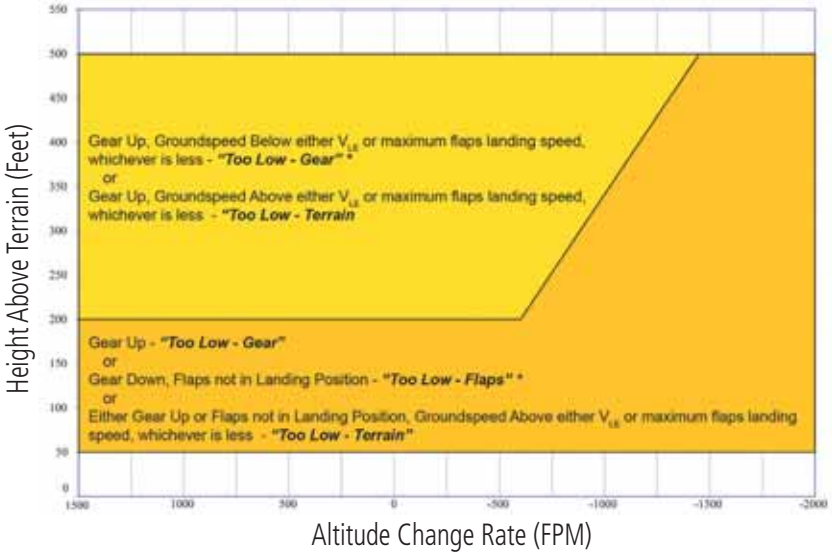


Figure 11-37 Excessive Closure Rate Alert Criteria (Flaps in Landing Configuration)

11.6.3.7 Flight Into Terrain Alert

Flight Into Terrain (FIT) alerts occur when the aircraft is too low with respect to terrain based on landing gear status, flap position, and groundspeed. FIT caution alerts are issued when flight conditions meet the criteria shown below.



** Flap position will not trigger alert if Flap Override option is enabled; see discussion below.*

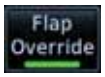
Figure 11-38 Flight Into Terrain Caution Alert Criteria

To reduce nuisance FIT alerts on approaches where flap extension is not desired (or is intentionally delayed), the pilot may override FIT alerting based on the flap position, while all other FIT alerting remains in effect.

Figure 11-39 TAWS-A Page Menu and FIT Flap Override Annunciation

11.6.3.7.1 Overriding Flaps-based FIT alerting

1. While viewing the TAWS-A Page, touch the **MENU** key.



2. Touch the **Flap Override** key to toggle the override state.

When the Flaps Override option is enabled, the annunciation "FLAP O/R" is annunciated on the TAWS-A Page. If GPWS alerts are also inhibited (which include FIT), the "FLAP O/R" annunciation is not shown.

NOTE: *The FLAP O/R (Flap Override) should be activated when an approach without flaps is going to be performed.*

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 aural message **"Too Low - Terrain"** and visual annunciations when conditions enter the caution alert area.

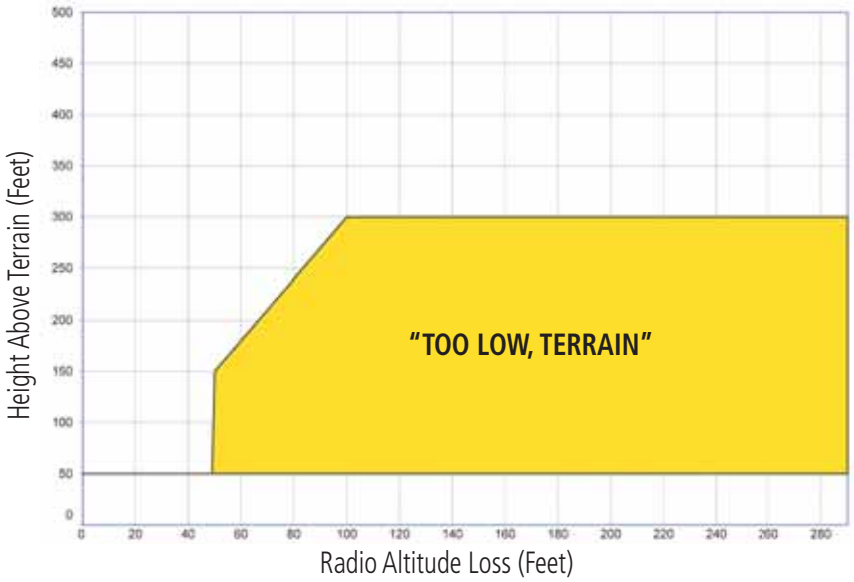


Figure 11-40 FIT Alerting After Takeoff

11.6.3.8 Negative Climb Rate After Take-Off Alert (NCR)

The **Negative Climb Rate (NCR) After Take-Off** alert (also referred to as "Altitude Loss After Take-Off") provides alerts when the system determines 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. NCR alerting 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 2 NM or less
- Heading change from the departure heading is less than 110º

The NCR alerting parameters as defined by TSO-C151c are shown below.

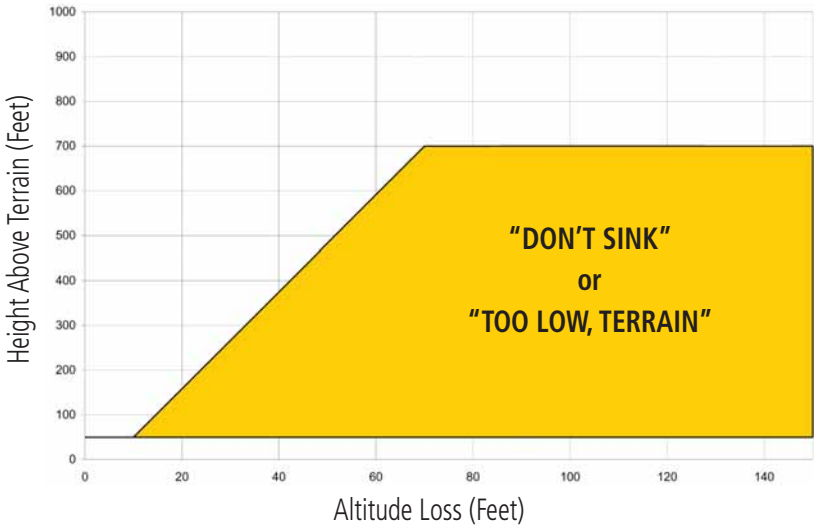


Figure 11-41 Negative Climb Rate (NCR) Altitude Loss

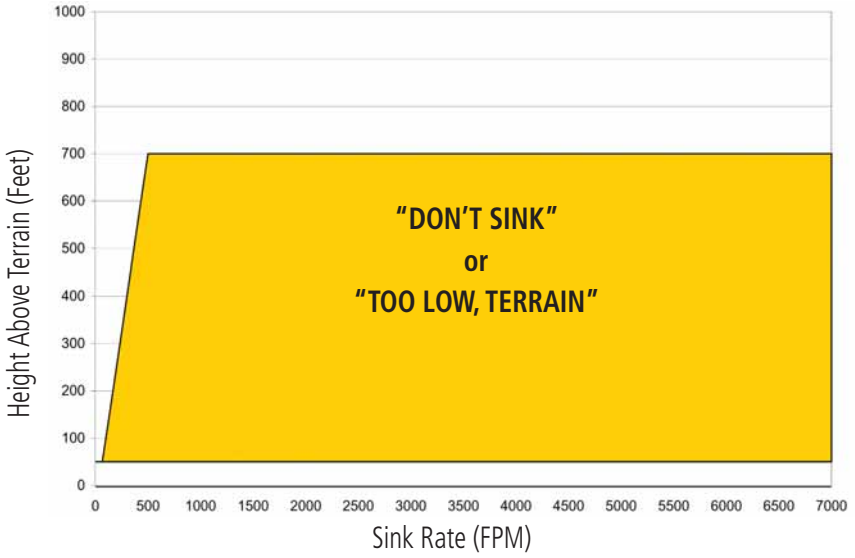


Figure 11-42 Negative Climb Rate (NCR) Sink Rate

11.6.3.9 Excessive Below Glideslope/Glidepath Deviation Alert

A **Glideslope Deviation** or **Glidepath Deviation (GSD)** caution alert is issued when the system detects that the aircraft is significantly below the glidepath for the selected approach.

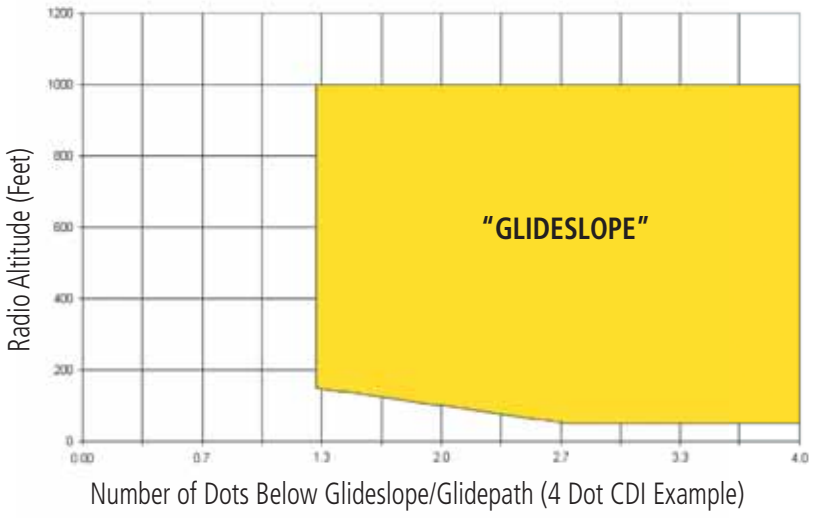


Figure 11-43 Excessive Below Glideslope/Glidepath Deviation Alert Criteria

GSD alerting is only active after departure and the following conditions are met:

- An ILS, LPV, LNAV/VNAV, or LNAV+V approach is active and vertical navigation indications are being displayed.
- Aircraft is below 1000 feet AGL.
- Gear is configured for landing.

When a GSD caution alert occurs, the aural and visual annunciation "GLIDESLOPE" is issued. If a GSD caution alert occurs on an LPV, LNAV/VNAV, or LNAV+V approach, the aural and visual annunciation "GLIDESLOPE" is issued.

11.6.3.9.1 Inhibiting Glideslope Deviation (GSD) Alerts

NOTE: *The Glideslope (G/S) Inhibit function should be activated when flying a localizer backcourse approach to prevents nuisance GSD alerts. GSD alerts are inhibited independent from all other FLTA, PDA, and GPWS alerts.*

1. While viewing the TAWS-A Page, touch the **MENU** key.

2. Touch the **G/S Inhibit** key to inhibit or enable glideslope or glidepath alerts (choice dependent on current state).

NOTE: *The G/S Inhibit function will only be active for a single approach and the inhibit function will not remain active for subsequent approaches. When G/S alerts are inhibited, they are only inhibited for a single approach. To inhibit G/S alerts on the next approach, the G/S Inhibit function must be activated again between the first and second approaches.*

NOTE: *Glideslope Deviation alerts will not be available if the G/S INHB function is activated.*

11.6.3.10 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 listed below.*

EDR, ECR, FIT, and NCR aural and visual 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 alert annunciation "GPWS INH" is shown on the TAWS-A Page annunciation window.

1. While viewing the TAWS-A Page, touch the **MENU** key.

2. Touch the **GPWS Inhibit** key to inhibit or enable GPWS alerts (choice dependent on current state).

Figure 11-44 GPWS Inhibit Annunciation

11.6.4 Altitude Voice Call Out (VCO)

TAWS-A provides aural advisory alerts as the aircraft descends, beginning at 500 feet above the terrain, as determined by the radar altimeter (if greater than 5 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 aural alert message **"***Five-hundred***"**.

11.6.5 TAWS-A System Status

During power-up, TAWS-A conducts a self-test of its aural and visual annunciations. The system test can also be manually initiated. An aural alert is issued at test completion. TAWS-A System Testing is disabled when ground speed exceeds 30 knots.

11.6.6 TAWS-A Abnormal Operations

TAWS-A continually monitors several system-critical items such as database validity, flap and landing gear position, radar altimeter input, and GPS status.

If the GTN does not contain Terrain, Airport Terrain, and Obstacle databases (or the databases are invalid), the aural message **"***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 page, the aural message **"***TAWS Not Available***"** is generated if airborne, some TAWS-A terrain alerts will not be issued, and GPWS alerting (which are not dependent on GPS position) will continue to operate. When the GPS signal is re-established and the aircraft is within the database coverage area, the aural message "TAWS Available" is generated.

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 Page. The aural message **"***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-based alerts will not be available, while other TAWS-A alerting remains unaffected.

Multiple TAWS or GPWS annunciations cannot be displayed at the same time. When multiple annunciations exist, an asterisk will be present next to the annunciation. The display of each annunciation will alternate with each being displayed for approximately five seconds.

12 WEATHER

Weather data are displayed by the Weather function when an optional weather source is installed. The Wx Weather pages may be oriented to Track Up, Heading Up, or North Up.

When more weather products are installed, a key for each product will be shown. Touch the key for the desired weather product. When a single weather product is installed, touching the **Weather** key will go directly to the Weather page.

Figure 12-1 Weather Product Selection

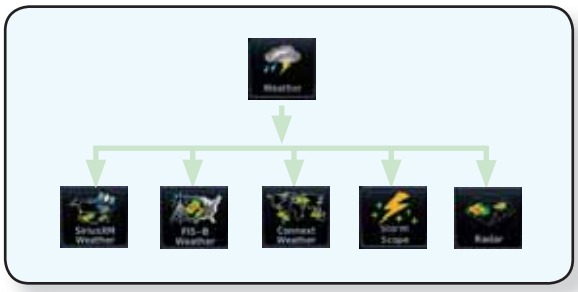


Figure 12-2 Weather Page Functional Diagram

NOTE: *In data link weather, Temporary Flight Restrictions (TFRs) and Notices to Airmen (NOTAMs) that do not have geographical locations cannot be viewed on the GTN.*

NOTE: *Stormscope and XM Lightning are mutually exclusive.*

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.*

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.*

12.1 SiriusXM Weather Products (Optional)

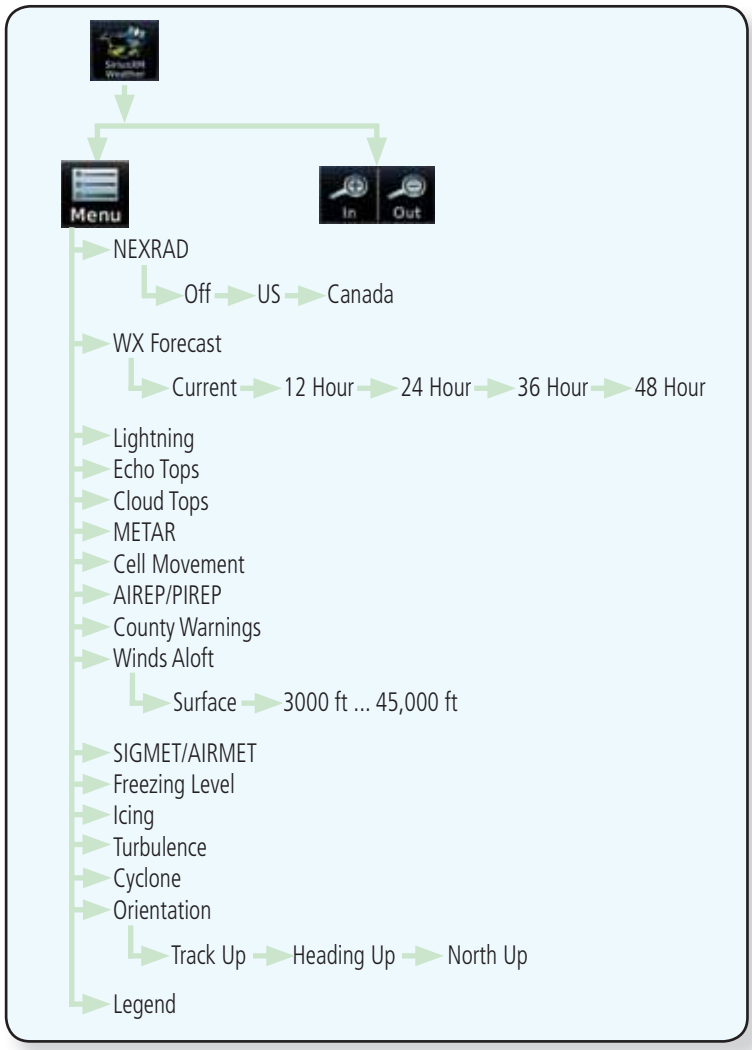


Figure 12-3 SiriusXM Weather Functional Diagram

12.1.1 Displaying SiriusXM Weather

To display SiriusXM Weather touch the **Weather** key on the Home page.

1. Touch the **Weather** key on the Home page and then touch the **SiriusXM** key.

Figure 12-4 SiriusXM Weather Page

2. While viewing the Data Link weather page, touch the **Menu** key to configure the Data Link Weather page.

Figure 12-5 SiriusXM Weather Menu

3. Once you selected what items you want to display, touch **BACK** to return to the Data Link Weather page.

12.1.2 Weather Legend

The **Legend** key displays a pop-up legend of the currently displayed weather products.

1. While viewing the Data Link Weather menu, touch the **Legend** key.

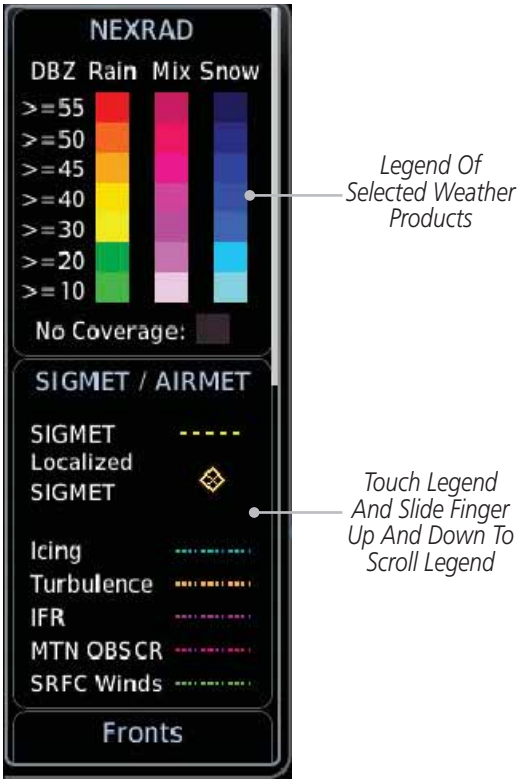


Figure 12-6 Weather Legend Display

2. Touch the Legend area of the display and while maintaining light pressure against the display, drag your finger up or down to scroll through the legend display for the selected weather products, or use the **Up/Down** keys.

3. Touch the **Legend** key again to remove the Legend.

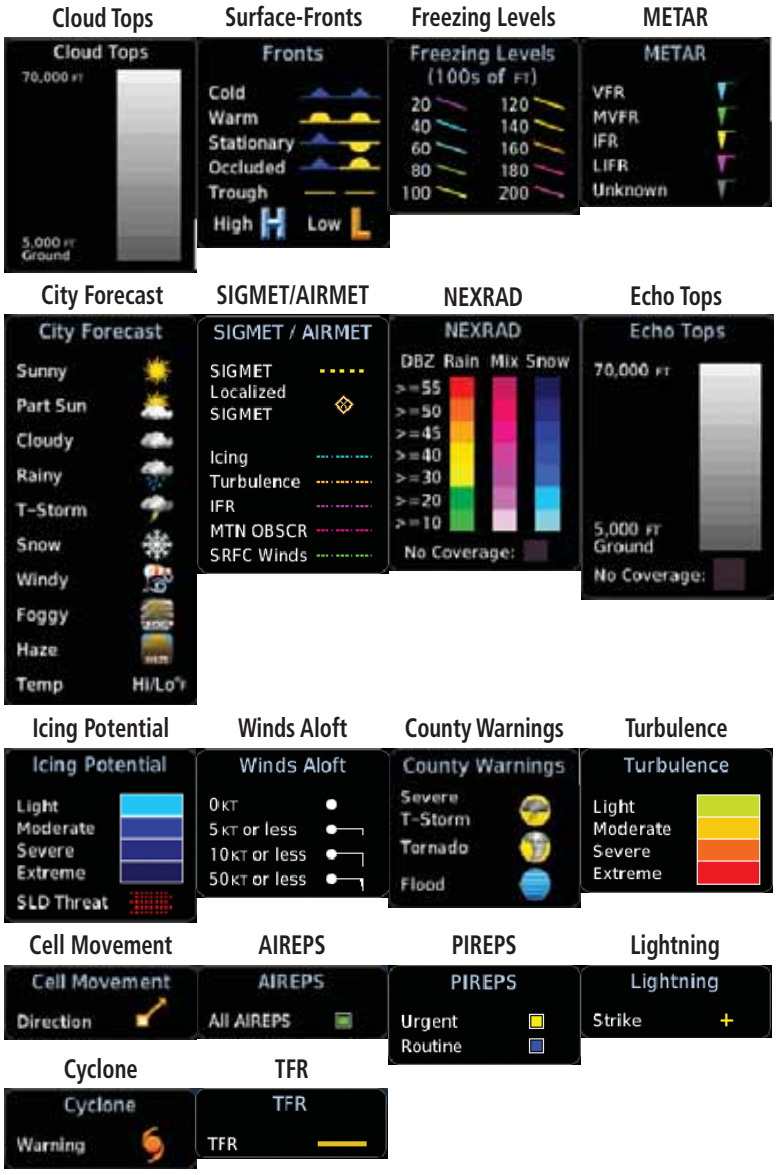


Figure 12-7 Available Weather Legends

12.1.3 Weather Map Orientation

1. While viewing the Weather Data Link function, touch the **Menu** key.

2. Touch the **Orientation** key to toggle the map view orientation choices of North Up, Track Up, and Heading Up.

12.1.4 SiriusXM Weather Symbols and Product Age

When a weather product is active on the Map function or the Weather Data Link function is selected, the age of the data is displayed on the screen. The age of the data may not indicate the time between the current GPS time and the time when the data is assembled, but rather a general indication of the time elapsed from when the data is received by the GTN.

Updated weather data may or may not contain new weather data. Weather data is refreshed at intervals that are defined and controlled by SiriusXM Satellite Radio and its data vendors.

If for any reason, a weather product is not refreshed within the designated intervals, the data is considered expired and is removed from the display. This ensures that the displayed data is consistent with what is currently being broadcast by SiriusXM Satellite Radio services. If more than half of the designated time has elapsed from the time the data is received, the color of the product age displayed changes to yellow.

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 significantly older than the indicated weather product age.*

The following table contains the expiration time and XM broadcast interval.

The expiration time is an elapsed time after which the data is considered expired and is removed from the display. This ensures that the displayed data is consistent with what is currently being broadcast by SiriusXM Satellite Radio services. If more than half of the expiration time has elapsed from the time the data is received, the color of the product age displayed changes to yellow.

The SiriusXM Weather broadcast interval is the time interval when SiriusXM Satellite Radio broadcasts new signals that may or may not contain new weather data. Weather data is broadcast at intervals that are defined and controlled by SiriusXM Satellite Radio.

NOTE: *SiriusXM Weather does not provide a timestamp for AIRMETs, SIGMETs, City Forecasts, County Warnings, Cell Movement and TFR products. Therefore, the unit does not display a product age indication for these products.*

NOTE: *The unit displays valid times on the weather map in lieu of product age indications for SiriusXM Weather Icing Potential, Winds Aloft, and Turbulence weather products.*

NOTE: *The unit displays product age for SiriusXM Weather Freezing Level and Canada Winds Aloft weather products. The product age indication represents the number of minutes that have elapsed since the weather product was created by SiriusXM Weather. The unit does not display the valid times assigned to the information within these products.*

Weather Product	Expiration Time (Minutes)	Broadcast Rate (Minutes)
NEXRAD (NEXRAD and Echo Top are Mutually Exclusive)	30	5 (U.S.) 10 (Canada)
Echo Top (Cloud Top and Echo Top Mutually Exclusive) (NEXRAD and Echo Top Mutually Exclusive)	30	7.5
Cloud Top (Cloud Top and Echo Top Mutually Exclusive)	60	15
SiriusXM Lightning	30	5
Cell Movement	30	1.25
SIGMETs / AIRMETs	60	12
METARs	90	12
WX Forecast	60	12
Freezing Levels	120	12
Winds Aloft	90	12
City Forecast	90	12
County Warnings	60	5
Cyclone Warnings	60	12
Icing Potential (Icing) (SLD)	90	22
Pilot Weather Report (PIREP) (Blue - Regular, Yellow - Urgent)	90	12

Weather Product	Expiration Time (Minutes)	Broadcast Rate (Minutes)
Air Report (AIREP)	90	12
Turbulence	180	12
Radar Coverage	30	5
Temporary Flight Restriction (TFR)	60	12
Terminal Aerodrome Forecast (TAF)	60	12

Table 12-1 SiriusXM Weather Products and Data Timing

Symbol	Description
	Flood
	Severe Thunderstorm
	Tornado
	Sunny
	Part Sun
	Cloudy
	Rainy
	T-Storm
	Snow
	Windy
	Foggy
	Haze
	High/Low Temp

Table 12-2 Weather Symbols

12.1.5 NEXRAD

WSR-88D, or NEXRAD (NEXt-generation RADar), is a network of 158 high-resolution Doppler radar systems that are operated by the National Weather Service (NWS). NEXRAD data provides centralized meteorological information for the continental United States and selected overseas locations. The maximum range of a single NEXRAD radar site is 250 NM. The NEXRAD network provides important information about severe weather for air traffic safety.

NEXRAD data is not real-time. The lapsed time between collection, processing, and dissemination of NEXRAD images can be significant and may not reflect the current radar synopsis. Due to the inherent delays and the relative age of the data, it should be used for long-range planning purposes only. Never use NEXRAD data for maneuvering in, near, or around areas of hazardous weather. Instead, use it in an early-warning capacity of pre-departure and en route evaluation.

Composite data from all 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 severity level.

NOTE: *Due to similarities in color schemes, the display of Echo Tops cannot be shown with Cloud Tops and NEXRAD.*

1. While viewing the SiriusXM Weather menu, touch the **NEXRAD** key to display the NEXRAD selections.

Figure 12-8 SiriusXM NEXRAD Weather Selection

2. Touch the desired **NEXRAD** source selection and then the **Back** key to view the weather information.

Figure 12-9 SiriusXM NEXRAD Weather

Figure 12-10 NEXRAD Weather Legend

12.1.5.1 Reflectivity

Reflectivity is the amount of transmitted power returned to the radar receiver. Colors on the NEXRAD display directly correlate to the level of detected reflectivity. Reflectivity as it relates to hazardous weather can be very complex.

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.

12.1.5.2 NEXRAD Limitations

NEXRAD radar images may have certain limitations:

- NEXRAD base reflectivity does not provide sufficient information to determine cloud layers or precipitation characteristics. 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.
- In the Cell Movement function, "Base" height is actually the height of maximum radar reflection and that the "Base" and "Top" heights are based on radar height and not MSL or AGL.
- Each square block on the display represents an area of four square kilometers (2.15 NM). The intensity level reflected by each square represents the highest level of NEXRAD data sampled within the area.

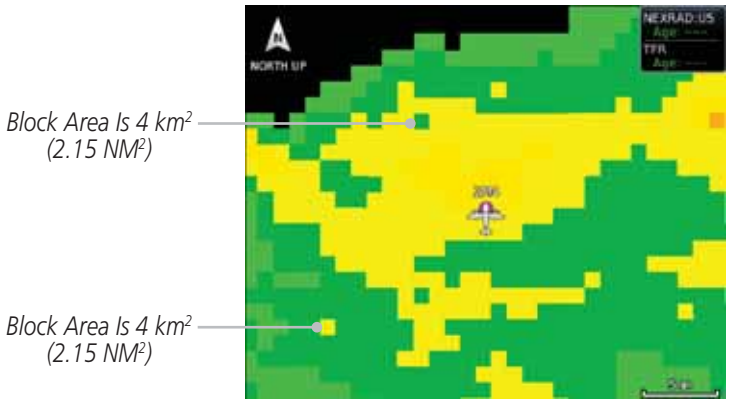


Figure 12-11 NEXRAD Data Blocks

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 from military aircraft, which can cause alterations in radar scans

NEXRAD Limitations (Canada)

- Radar coverage extends to 55°N.
- Any precipitation displayed between 52°N and 55°N is displayed as mixed because it is unknown.

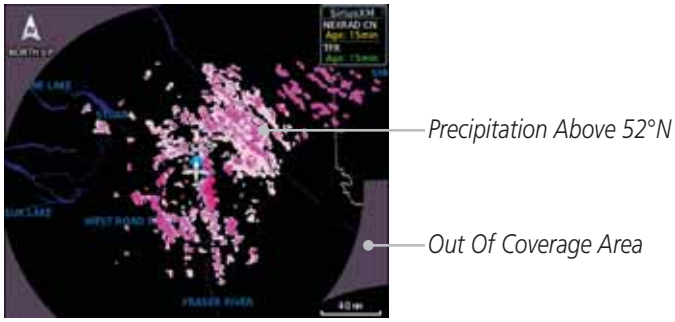


Figure 12-12 NEXRAD Data - Canada

12.1.5.3 Animating NEXRAD

NOTE: *Animated NEXRAD functionality is available in software version 6.00 and later.*

When US or Canada NEXRAD is enabled for display and more than two NEXRAD images have been received by the GTN, the NEXRAD display can be animated on the SiriusXM Weather page. As new NEXRAD images are received, the GTN will automatically store them for future animation. The GTN can animate up to six NEXRAD images from oldest to newest, showing each for one second and the newest for two seconds.

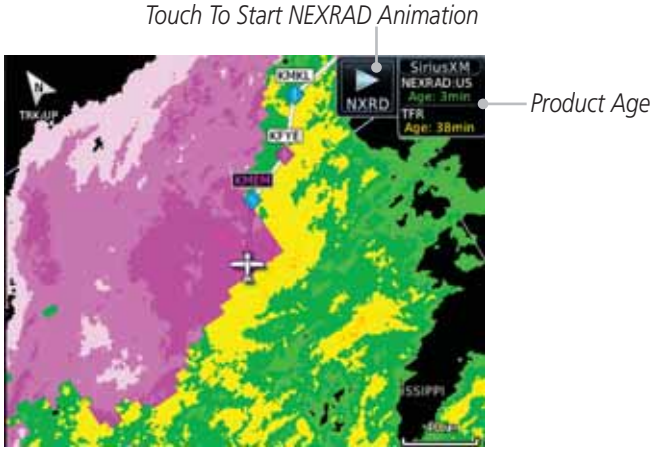


Figure 12-13 Start NEXRAD Animation

1. While viewing the SiriusXM Weather page with NEXRAD enabled for display, touch the **NXRD** key to start the NEXRAD animation.

NOTE: *Weather Forecast, Cloud Tops, and Cell Movement will automatically be turned off while NEXRAD is animating.*

2. Touch the **NXRD** key to stop the NEXRAD animation. The animation will also stop when leaving the page or turning off NEXRAD on the SiriusXM weather page.

Figure 12-14 Start NEXRAD Animation

12.1.6 Echo Tops

Echo Tops data shows the location, elevation, and direction of the highest radar echo. The highest radar echo does not indicate the top of a storm or clouds; rather it indicates the highest altitude at which precipitation is detected. This information is determined from NEXRAD data.

NOTE: *Due to similarities in color schemes, the display of Echo Tops cannot be shown with Cloud Tops and NEXRAD.*

1. While viewing the Data Link Weather menu, touch the **Echo Tops** key.

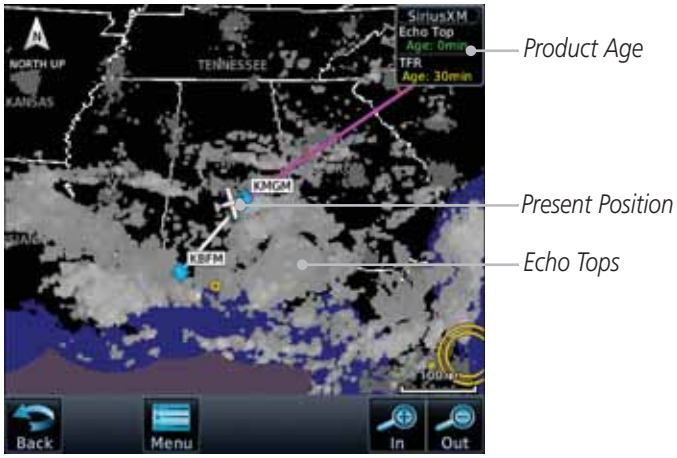


Figure 12-15 Echo Tops

2. Touch the **Echo Tops** key again to turn it off.

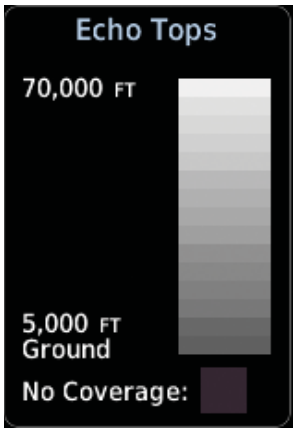


Figure 12-16 Echo Tops Legend

12.1.7 Cloud Tops

NOTE: *Due to similarities in color schemes, it is not possible to display Echo Tops and Cloud Tops at the same time.*

Cloud tops data depicts cloud top altitudes as determined from satellite imagery.

1. While viewing the Data Link Weather menu, touch the **Cloud Tops** key.

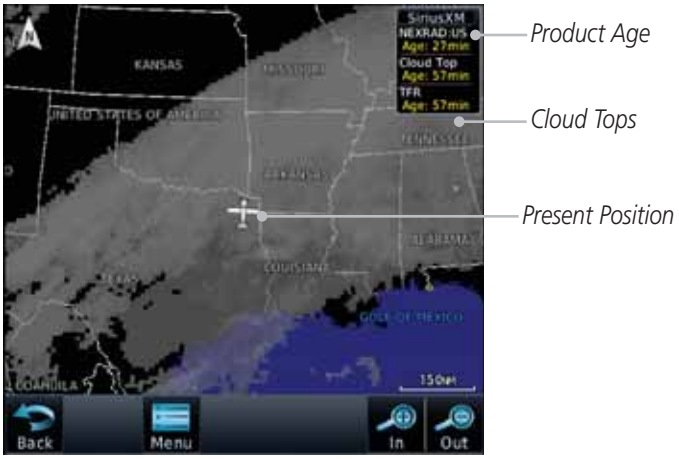


Figure 12-17 Cloud Tops

2. Touch the **Cloud Tops** key again to turn it off.

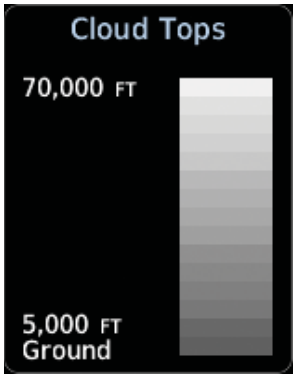


Figure 12-18 Cloud Tops Legend

12.1.8 Cell Movement

Cell Movement data shows the location and movement of storm cells as identified by a ground-based system. Cells are represented by yellow squares, with direction of movement indicated with short, orange arrows.

NOTE: In the Cell Movement function, "Base" height is actually the height of maximum radar reflection and that the "Base" and "Top" heights are based on radar height and not MSL or AGL.

1. While viewing the Data Link Weather menu, touch the **Cell Movement** key.

Figure 12-19 Cell Movement

2. Touch a Cell Movement icon to view cell details.

Figure 12-20 Cell Movement Detail

3. In the Menu, Touch the **Cell Movement** key again to turn it off.

Figure 12-21 Cell Movement Legend

12.1.9 SIGMETs and AIRMETs

SIGMETs (SIGnificant METerological Information) and AIRMETs (AIRmen's METerological Information) are broadcast for potentially hazardous weather considered of importance to aircraft.

1. While viewing the Data Link Weather menu, touch the **SIGMET/AIRMET** key.

Figure 12-22 SIGMETs and AIRMETs

2. Touch the **SIGMET/AIRMET** key again to turn it off.

Figure 12-23 SIGMET/AIRMET Legend

12.1.10 County Warnings

County Warnings data provides specific public awareness and protection weather warnings from the National Weather Service. This can include information on fires, tornadoes, severe thunderstorms, flood conditions, and other natural disasters.

1. While viewing the Data Link Weather menu, touch the **County Warnings** key. Touch the County Warnings symbol for detailed information.

Figure 12-24 County Warnings Data

2. Touch the **County Warnings** key again to turn it off.

Figure 12-25 County Warnings Legend

12.1.11 Freezing Level

Freezing Level data shows the color-coded contour lines for the altitude and location at which the Freezing Level 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. New data appears on the next update.

1. While viewing the Data Link Weather menu, touch the **Freezing Level** key.

Figure 12-26 Freezing Level

2. Touch the **Freezing Level** key again to turn it off.

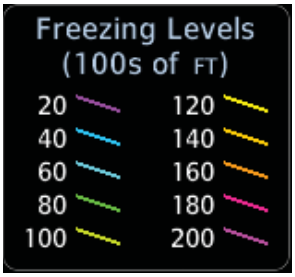


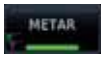
Figure 12-27 Freezing Level Legend

12.1.12 METARs

METAR (METeorological Aerodrome Report), known as an Aviation Routine Weather Report, is the standard format for current weather observations. METARs are updated hourly and are considered current. METARs typically contain information about the temperature, dew point, wind, precipitation, cloud cover, cloud heights, visibility, and barometric pressure. They can also contain information on precipitation amounts, lightning, and other critical data. METARs are shown as colored flags at airports that provide them.

1. While viewing the Data Link Weather menu, touch the **METAR** key. Touch an airport symbol for more METAR detail.

Figure 12-28 METARs



2. Touch the **METAR** key in the Menu again to turn it off.

METAR Symbol	Description
	VFR (ceiling greater than 3000 ft. AGL and visibility greater than five miles)
	Marginal VFR (ceiling 1000–3000 ft. AGL and/or visibility three to five miles)
	IFR (ceiling 500 to below 1000 ft. AGL and/or visibility one mile to less than three miles)
	Low IFR (ceiling below 500 ft. AGL or visibility less than one mile)
	Unknown

Table 12-3 METAR Symbols

12.1.13 Cyclone

The current location of the cyclone is shown along with its projected path with the date and time.

1. While viewing the Data Link Weather menu, touch the **Cyclone** key.

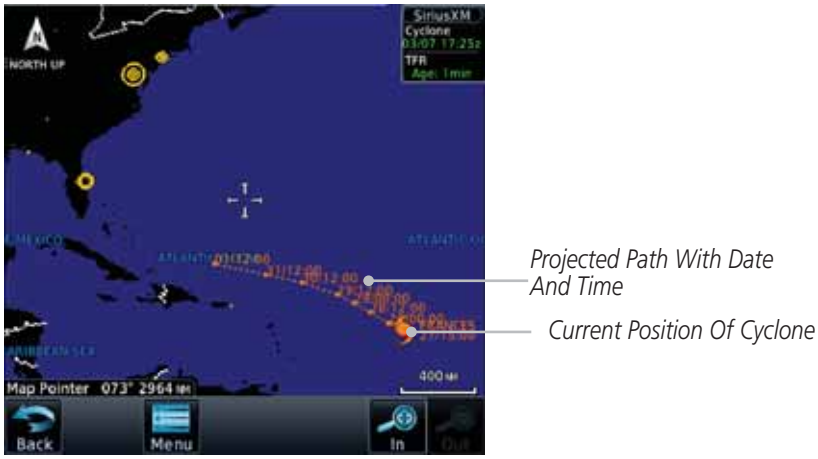


Figure 12-29 Cyclone

2. Touch the **Cyclone** key again to turn it off.

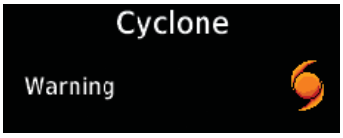


Figure 12-30 Cyclone Legend

12.1.14 Lightning

Lightning data shows the approximate location of cloud-to-ground lightning strikes. A yellow cross icon represents a strike that has occurred within a 2 kilometer (approx. 1 NM) region. The exact location of the lightning is not displayed.

1. While viewing the Data Link Weather menu, touch the **Lightning** key.

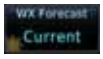
Figure 12-31 Lightning

2. Touch the **Lightning** key again to turn it off.

Figure 12-32 Lightning Legend

12.1.15 Weather Forecast

The Weather Forecast data provides Surface Analysis and City Forecast information for current and forecast weather conditions. The Surface Analysis forecast shows frontal lines indicating weather fronts and the direction they are moving. High and Low pressure centers are noted with a large H or L. A Cold Front is a front where cold air replaces warm air. A blue line with blue triangles will point in the direction of cold air flow. A Warm Front is where warm air replaces cold air. A red line with red half moons will point in the direction of the warm air flow.

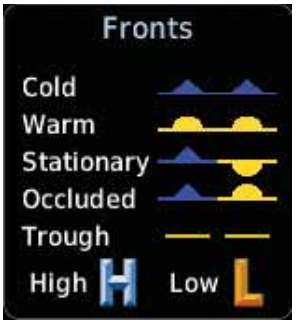


1. While viewing the Data Link Weather menu, touch the **WX Forecast** key. Touch a Wx Forecast symbol for more detail.

Figure 12-33 Surface

2. Touch the desired time increment for the forecast period.

Figure 12-34 Select Surface Forecast Time Period



City Forecast **Fronts**

Figure 12-35 Surface Legends

12.1.16 Winds Aloft

Winds Aloft data shows the forecast wind speed and direction at the surface and at selected altitudes. Altitudes can be selected in 3000 foot increments from the surface up to 45,000 feet.

1. While viewing the Data Link Weather menu, touch the **Winds Aloft** key.

Figure 12-36 Winds Aloft

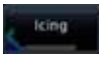
2. Touch the **WX Aloft ALT** − or + keys to increase or decrease the reporting altitude of the winds aloft in 3,000 foot increments. The selected altitude is shown in a window above the altitude keys.

3. Touch the **Winds Aloft** key again to turn it off.

Figure 12-37 Winds Aloft Legend

12.1.17 Icing

The Icing product shows a graphic view of the current icing environment in four categories: light, moderate, severe, and extreme (not specific to aircraft type). The Icing 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 black and red blocks over the Icing colors. Icing and SLD data are shown between 1,000 feet and 30,000 feet in 3,000 foot increments.



1. While viewing the Data Link Weather menu, touch the **Icing** key.

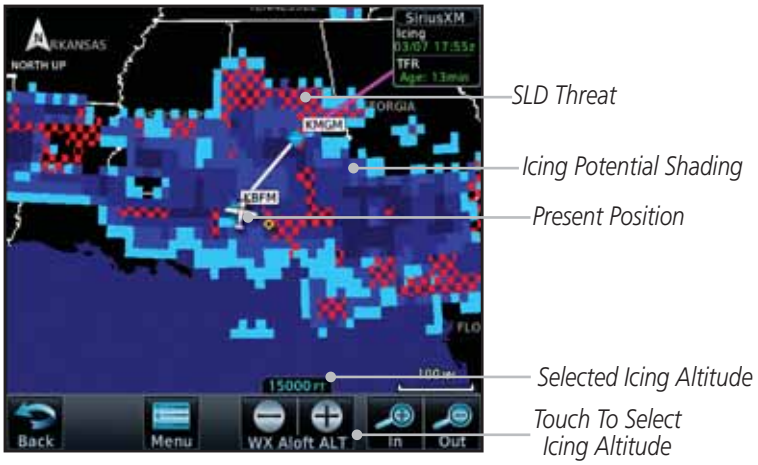
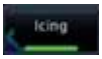


Figure 12-38 Icing and SLD

2. Touch the **WX Aloft ALT** − or + keys to increase or decrease the reporting altitude of icing in 3,000 foot increments. The selected altitude is shown in a window above the altitude keys.



3. Touch the **Icing** key again to turn it off.

Figure 12-39 Icing Legend

12.1.18 Turbulence

Turbulence data 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.

1. While viewing the Weather Data Link menu, touch the **Turbulence** key.

Figure 12-40 Turbulence

2. Touch the **WX Aloft ALT** − or + keys to increase or decrease the reporting altitude for turbulence in 3,000 foot increments. The selected altitude is shown in a window above the altitude keys.

3. Touch the **Turbulence** key again to turn it off.

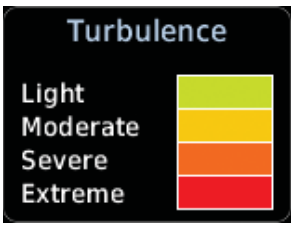


Figure 12-41 Turbulence Legend

12.1.19 AIREP/PIREP

Pilot Weather Reports (PIREPs) provide timely weather information for a particular route of flight. When significant weather conditions are reported or forecast, Air Traffic Control (ATC) facilities are required to solicit PIREPs. A PIREP may contain non-forecast adverse weather conditions, such as low in-flight visibility, icing conditions, wind shear, and turbulence. PIREPs are issued as either Routine (UA) or Urgent (UUA).

1. While viewing the Data Link Weather menu, touch the **AIREP/ PREP** key.

Figure 12-42 Weather Display With AIREP/PIREP Information Active

2. Touch a weather information symbol to view details for that item.

Figure 12-43 AIREP/PIREP Information Detail

3. Touch the **Back** key to remove the detailed information.

4. Touch the **AIREP/PREP** key again to turn it off.

12.2 StormScope® Weather

12.2.1 StormScope® (Optional)

NOTE: *Refer to the WX-500 Pilot's Guide for a detailed description of the WX-500 StormScope.*

The WX-500 StormScope Weather Mapping Sensor is a passive weather avoidance system that detects electrical discharges associated with thunderstorms within a 200 NM radius of the aircraft. The StormScope measures relative bearing and distance of thunderstorm-related electrical activity and reports the information to the display. ***Interfaces are currently only available for the WX-500 StormScope System***.

For lightning display interpretation, study the examples in the WX-500 Pilot's Guide that are designed to help you relate the cell or strike patterns shown on the display to the size and location of thunderstorms that may be near your aircraft.

Symbol	Time Since Strike (Seconds)
	6
	60
	120
	180

Table 12-4 Stormscope Symbols

1. From the Home page, touch the **Weather** key (and then the **StormScope** key if present) to reach the StormScope function.

Figure 12-44 StormScope Display (360° Display View Shown)

2. Touch the **Menu** key to setup the StormScope display.

Figure 12-45 StormScope Menu

3. Touch the **360°** or **Arc** to select the display view.

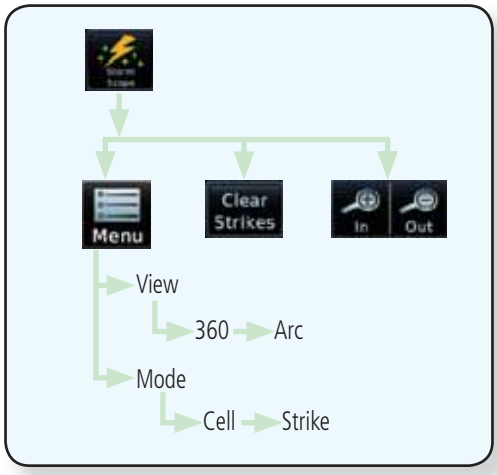


Figure 12-46 StormScope Functional Diagram

12.2.2 Clearing the StormScope® Page

Routinely clearing the StormScope Page of all discharge points is a good way to determine if a storm is building or dissipating. In a building storm discharge points reappear faster and in larger numbers. In a dissipating storm discharge points appear slower and in smaller numbers.

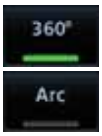
1. While viewing the Weather StormScope page, touch the **Clear Strikes** key to clear lightning strikes.
2. Lightning strikes will be cleared from the display and the Rate value will be reset.

***NOTE**: When Heading is not available (N/A), the pilot must clear the strikes after each turn.*

12.2.3 Changing the StormScope® Display View

The Lightning Page displays either a 360° or a 120° viewing angle.

1. While viewing the Weather StormScope page, touch **MENU.**



2. Touch the **360°** or **Arc** to select the display view.

Figure 12-47 StormScope 360° and Arc Display Views

12.2.4 Changing the Storm Data Display Range

Storm data can be displayed on the Map page 2000 NM zoom scale, but the data only goes out as far as the StormScope can report (200 NM). The

500 NM zoom scale will display all lightning data. Scales greater than 500 NM do not display any additional StormScope data.

While viewing the StormScope page touch the **In** and **Out** keys to display a larger or smaller area.

***NOTE:** Cell mode uses a clustering program to identify clusters of electrical activity that indicate cells. Cell mode is most useful during periods of heavy storm activity. Displaying cell data during these periods frees the user from sifting through a screen full of discharge points and helps to better determine where the storm cells are located.*

12.2.5 Displaying StormScope® Data on the Map Page

The Map Page displays cell or strike information using yellow lightning strike symbology overlaid on a moving map. This added capability improves situational awareness, which in turn makes it much easier for the pilot to relate storm activity to airports, NAVAIDs, obstacles and other ground references.

1. On the Home page, touch the **Map** key.

2. Touch the **Menu** key.

3. Touch the **StormScope** key to enable StormScope lightning display on the Map page. Repeated touches toggle between Off, Cell, and Strike.

***NOTE:** The selected lightning display type, cell or strike, will be shown the same on both the StormScope and the Map pages.*

***NOTE:** StormScope data is displayed on the Map Page only if aircraft heading is available.*

***NOTE:** The GTN will display StormScope data with or without a heading source. If no heading source is available, the display will indicate this by placing "HDG N/A" in the upper right portion of the display. If no heading is available, the pilot must clear the strikes after each heading change.*

12.3 Weather Radar

The GTN 7XX can display weather radar from a Garmin GWX system or from selected 3rd party radars. Only one weather radar system may be interfaced to the system. For detailed information on the operation of 3rd party radars, refer to their specific documentation.

12.3.1 Garmin GWX Radar Description

The Garmin GWX 68 and GWX 70 Airborne Color Weather Radars combine excellent range and adjustable scanning profiles with a high-definition target display.

To focus radar scanning on specific areas, Sector Scanning offers pilot-adjustable horizontal scan angles of 20º, 40º, 60º, or 90º (up to 120º with the GWX 70). A vertical scanning function helps to analyze storm tops, gradients, and cell buildup activity at various altitudes.

See the documentation of each radar for specific features.

12.3.1.1 Principles of Pulsed 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 then 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. The returned signal is then processed and displayed on the GTN 7XX.

Radar detection is a two-way process that requires 12.36 micro-seconds for the transmitted microwave pulses to travel out and back for each nautical mile of target range. It takes 123.6 micro-seconds for a transmitted pulse to make the round trip if a target is 10 NM away.

The GWX weather radar should be used to avoid severe weather, not for penetrating severe weather. The decision to fly into an area of radar targets depends on target intensity, spacing between the targets, aircraft capabilities and pilot experience. Pulse type weather radar detects only precipitation, not clouds or turbulence. The display may indicate clear areas between intense returns, but this does not necessarily mean it is safe to fly between them. Only Doppler radar can detect turbulence.

Airborne weather radar has other capabilities beyond weather detection. It also has the ability to detect and provide distance to objects on the ground, such as, cities, mountains, coastlines, rivers, lakes, and oceans.

12.3.1.2 Antenna Beam Illumination

It is important to understand the concept of the antenna beam illumination. The radar beam is much like the beam of a spotlight. The farther the beam travels, the wider it gets. The radar is only capable of "seeing" what is inside the boundaries of the beam.

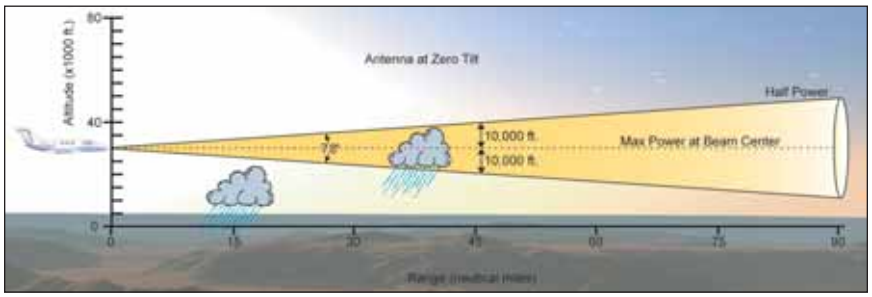


Figure 12-48 Radar Beam from 12 inch Antenna

The vertical dimensions of the radar beam are shown in the figure above and the same holds true for the horizontal dimensions. In other words, the beam will be as wide as it is tall. Note that it is possible not to see areas of precipitation on the radar display because of the antenna tilt setting. With the antenna tilt set to zero in this illustration, the beam overshoots the precipitation at 15 NM. The curvature of the earth can also be a factor, especially at range settings of 150 NM or more.

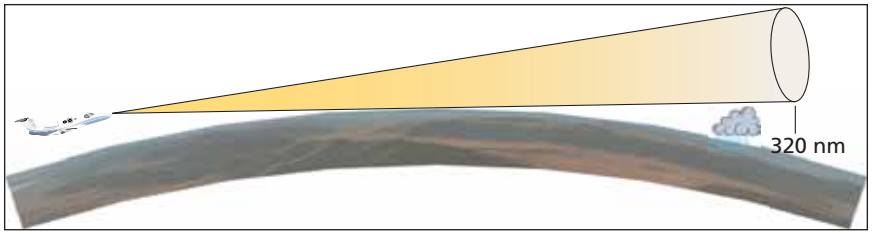


Figure 12-49 Radar Beam in Relation to the Curvature of the Earth

12.3.1.3 Radar Signal Attenuation

The phenomena of weather attenuation needs to be kept in mind whenever operating the 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.

Attenuation because of distance is due to the fact that the amount of radar energy at a distance from 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 will be one fourth the energy reflected from an equivalent target 20 miles away. This would appear to the operator that the storm is gaining intensity as the aircraft gets closer. Internal circuitry within the GWX 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 area of no precipitation. If the signal has been fully attenuated, the radar will display 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 GWX Weather Radar system can help in identifying these shadowed areas. Areas in question will appear as "shadowed" or gray area 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 tear, pitting, and pinholes on the radome surface can cause damage and system inefficiency.

12.3.2 Radar Signal Reflectivity

12.3.2.1 Precipitation

Precipitation or objects more dense than water, such as earth or solid structures, will be detected by the weather radar. The weather radar will 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 it reflects. 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, dry snow, and dry hail have low reflective levels and often will not be displayed by the radar. A cloud that contains only small raindrops, such as fog or drizzle, will not reflect enough radar energy to produce a measurable target return.

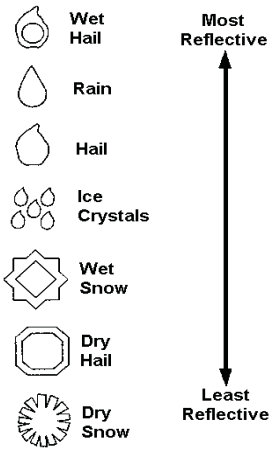


Figure 12-50 Precipitation Type and Reflectivity

12.3.2.2 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 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 will provide 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.**

12.3.2.3 Angle of Incidence

The angle at which the radar beam strikes the target is called the Angle of Incidence. Incident angle ("A") is illustrated below. 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.

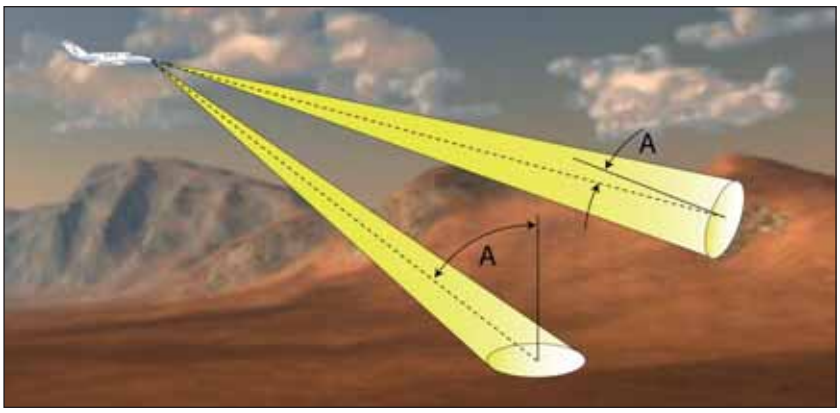


Figure 12-51 Angle of Incidence

A smaller incident angle gives the radar a larger detectable range of operation and the target display will show 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.

12.3.3 Operating Distance

The following information establishes a minimum safe distance from the antenna for personnel near an operating airborne weather radar. The minimum safe distance is based upon the FCC's exposure limit at 9.3 to 9.5 GHz for general population/uncontrolled environments which is 1 mW/cm^2. See Advisory Circular 20-68B for more information on safe distance determination.

12.3.3.1 Maximum Permissible Exposure Level (MPEL) (GWX 68)

The zone in which the radiation level exceeds the US Government standard of 1 mW/cm^2, is the semicircular area of at least 11 feet from the 12 inch antenna as indicated in the illustration below. 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.

12.3.3.2 Maximum Permissible Exposure Level (MPEL) (Other Radars)

See the appropriate documentation for MPEL.

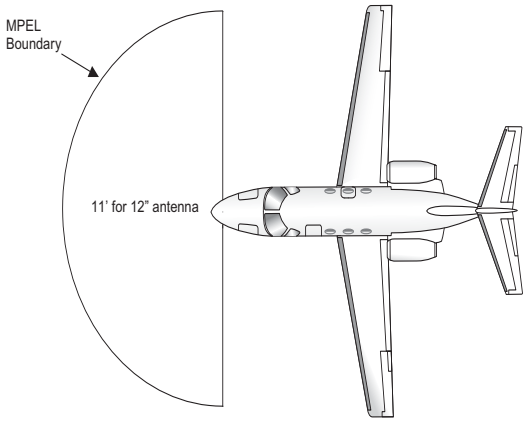


Figure 12-52 MPEL Boundary

12.3.4 Basic Antenna Tilt Setup

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 will work in all situations, but this method does provide good overall parameters for the monitoring of threats. Ultimately, it is desired to have the antenna tilted so that the bottom of the radar beam is four degrees below parallel with the ground. The following discussion explains one way of achieving this.

With the aircraft flying level, adjust the antenna tilt so ground returns are displayed at a distance that equals the aircraft's current altitude (AGL) divided by 1,000. For example, if the aircraft is at 14,000 feet, adjust the tilt so the front edge of ground returns are displayed at 14 NM. Note this antenna tilt angle setting. Now, raise the antenna tilt 6º above this setting. The bottom of the radar beam is now angled down 4º from parallel with the ground.

Practical Application Using the Basic Tilt Setup

At this point, when flying at altitudes between 2,000 and 30,000 feet AGL, any displayed target return should scrutinized. If the displayed target advances on the screen to 5 NM of the aircraft, avoid it. This may be either weather or ground returns that are 2,000 feet or less below the aircraft. Raising the antenna tilt 4º can help separate ground returns from weather returns in relatively flat terrain. This will place the bottom of the radar beam level with the ground. Return the antenna tilt to the previous setting after a few sweeps.

If the aircraft is above 29,000 feet, be cautious of any target return that gets to 30 NM or closer. This is likely a thunderstorm that has a top high enough that the aircraft cannot fly over it safely.

If the aircraft altitude is 15,000 feet or lower, set the displayed range to 60 NM. Closely monitor anything that enters the display.

Also, after setting up the antenna tilt angle as described previously, ground returns can be monitored for possible threats. The relationship between antenna tilt angle, altitude, and distance is one degree of tilt equals 100 feet of altitude for every one nautical mile.

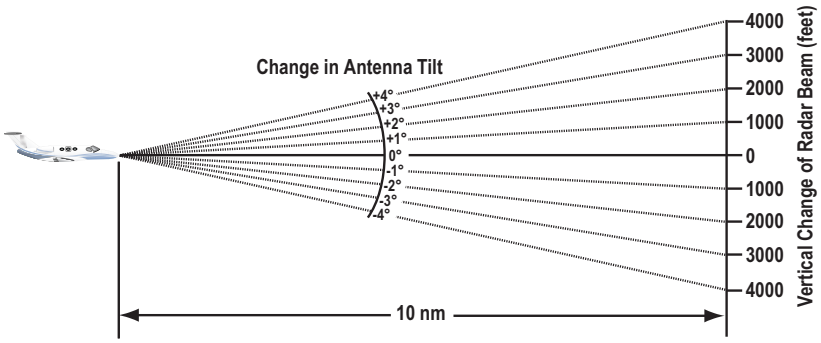


Figure 12-53 Vertical Change in Radar Beam per Nautical Mile

Therefore, with the antenna tilt set so that the bottom of the beam is four degrees below parallel with the ground, a target return at 10 NM is approximately 4,000 feet below the aircraft; at 20 NM, 8,000 feet; at 50 NM, 20,000 feet. In other words, at this tilt setting, a ground return (such as a mountain peak) being displayed at 10 NM would have a maximum distance below the aircraft of 4,000 feet. If that ground target return moves to 5 NM, maximum distance below the aircraft will be 2,000 feet.

This setup will provide a good starting point for practical use of the GWX radar. There are many other factors to consider in order to become proficient at using weather radar in all situations.

12.3.5 Weather Mapping and Interpretation

12.3.5.1 Weather display Interpretation

When evaluating various target returns on the weather radar display, the colors denote approximate rainfall intensity and rates as shown in the table below.

Weather Mode Color	GWX 68 Radars		GWX 70 Radars	3rd Party Radars
	Approximate Intensity	Approximate Rainfall Rate (in/hr)	Approximate Intensity	Radar Return Level (see radar documentation for details)
BLACK	< 23 dBZ	< .01	< 23 dBZ	0
GREEN	23 dBZ to < 33 dBZ	.01 - 0.1	23 dBZ to < 33 dBZ	1
YELLOW	33 dBZ to < 41 dBZ	0.1 - 0.5	33 dBZ to < 41 dBZ	2
RED	41 dBZ to < 50 dBZ	0.5 - 2	> 41 dBZ	3
MAGENTA	50 dBZ and greater	> 2	Turbulence Detection	4

Table 12-5 Precipitation Intensity Levels

12.3.5.2 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 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 or turbulence, as well as heavy precipitation. Vertical scanning and antenna tilt management may be necessary to identify areas of maximum intensity.

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 were red or magenta areas.

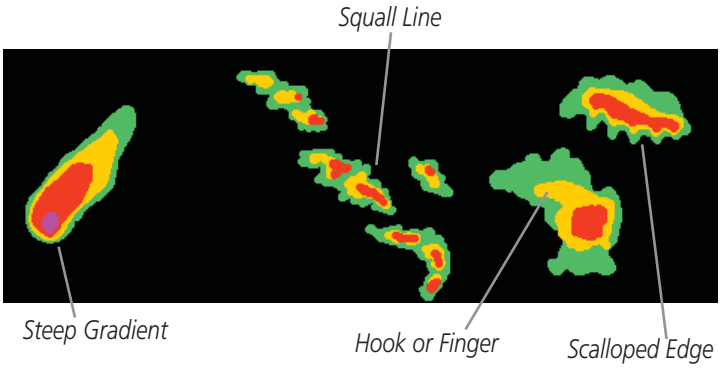


Figure 12-54 Cell Irregularities

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 12-55 The "Blind Alley" Overhead View

In areas of multiple heavy cells, use the Vertical Scan feature along with antenna tilt management to examine the areas. Remember to avoid shadowed areas behind targets.

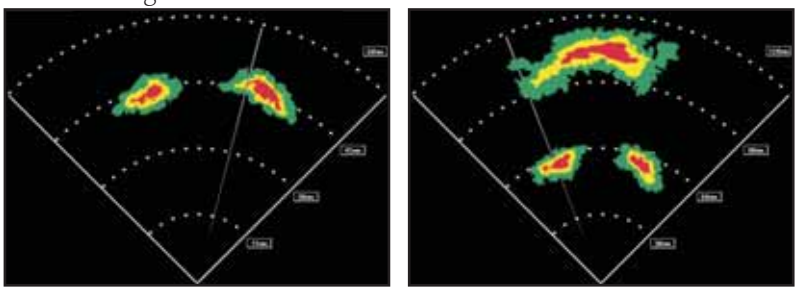


Figure 12-56 The "Blind Alley" Vertical Scan

12.3.5.3 Tornadoes

There is no conclusive radar target return characteristics which will identify a tornado, however, tornadoes may be present if the following characteristics are observed:

- A narrow, finger-like portion, as shown on the previous page, 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," 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, nor are tornado returns limited to these characteristics. Confirmed radar observations of tornadoes most often have not shown shapes different from those of a normal thunderstorm display.

12.3.5.4 Hail

Hail results from updrafts carrying water high enough to freeze. Therefore, the higher the top of a thunderstorm, the greater the probability that it contains 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. The actual top does not indicate the top of the hazardous area.

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 3 to 7 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.

12.4 GWX Radar Operation in Weather Mode

WARNING: *Begin transmitting only when it is safe to do so. When transmitting while the aircraft is on the ground, no personnel or objects should be within 11 feet of the antenna.*

CAUTION: *In 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.*

When the weather radar system is in the Weather or Ground Map mode, the system automatically switches to Standby mode on landing.

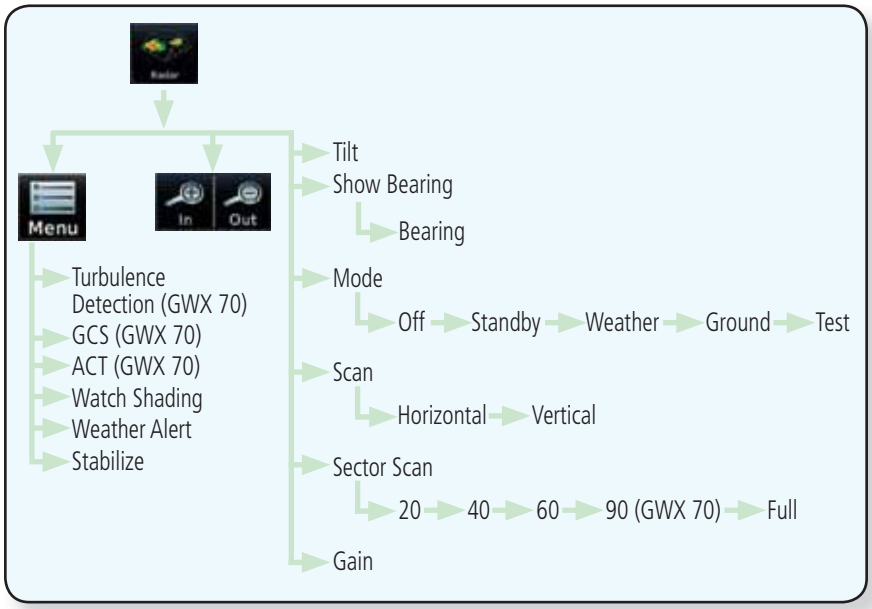


Figure 12-57 Weather Radar Functional Diagram

12.4.1 Viewing Weather on the Weather Radar Page

1. From the Home page, touch the **Weather** key on the Home page and then touch the **Radar** key (if necessary).

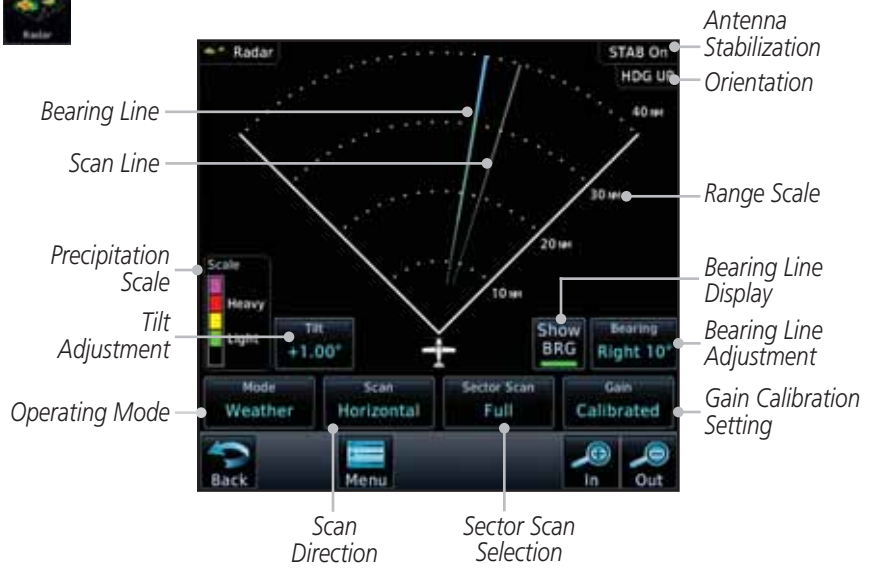


Figure 12-58 Weather Radar Page (Horizontal Scan)

2. Touch the **MODE** key and then touch the function desired.

3. The color-coded precipitation scale is shown on the left side of the display. A table describing the precipitation intensity levels is in section 12.3.5.1.

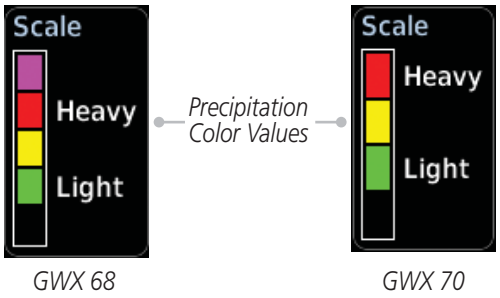


Figure 12-59 Weather Radar Precipitation Scale

4. Touch the **IN** and **OUT** keys to select the desired range. Touch the desired keys to set any required values as described below.

12.4.2 Configuring Weather Radar Page

To configure the WX Radar page, the Radar Mode must be in Ground, Weather, or Test mode. When one of these modes is selected, a warm-up period is initiated (countdown is displayed on the screen). After the warm-up is complete, the selected mode will be available.

1. While on the ground, touch **MODE**.

2. In the Weather Radar Mode window, touch **STANDBY**.

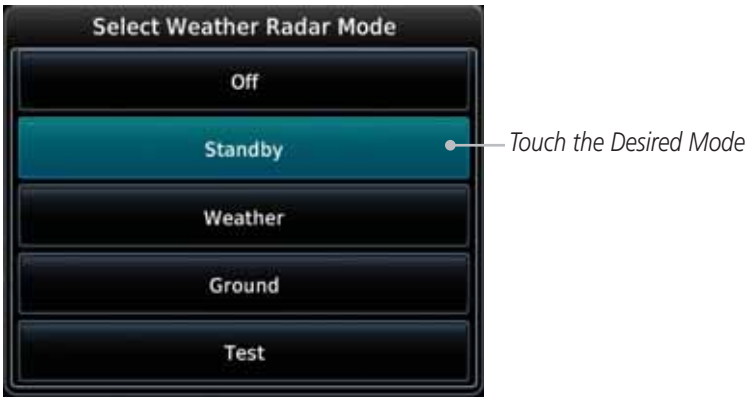


Figure 12-60 Weather Radar Mode Selection

3. Touch **MODE** and select Weather, Ground, or Test. A caution window is displayed.

Figure 12-61 Caution for Radar Activation Confirmation

4. Touch **OK** to acknowledge the selected mode will be activated.

   If Weather or Ground is selected, a warm-up period is initiated (countdown is displayed on the screen). After the warm-up is complete, the radar begins transmitting.

12.4.3 Vertically Scanning a Storm Cell

When vertically scanning with stabilization ON, the actual physical area that the radar is sweeping may not match the vertical scan display. This occurs whenever the aircraft pitch is not at 0 degrees. To compensate for this, the vertical display will "erase" the portion of the vertical display that is no longer being scanned. It will appear that the vertical sweep "wraps around" when reaching the end of the GTN vertical display. The radar is simply "erasing" the portion of the vertical display that is not currently being scanned.

***NOTE:** Vertical scanning of a storm cell should be done with the aircraft wings level to avoid constant adjustment of the Bearing Line.*

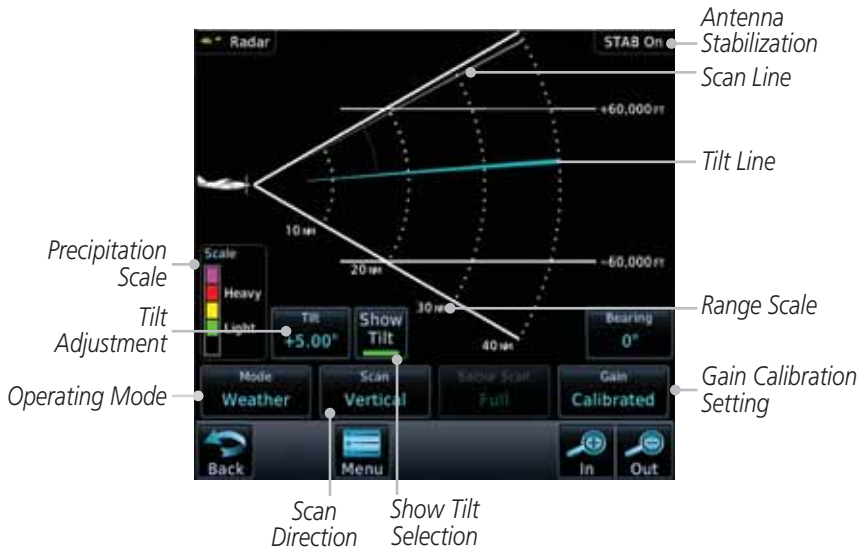


Figure 12-62 Weather Radar Page (Vertical Scan)

12.4.4 Adjusting the 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.

1. While viewing the WX Radar page touch the **TILT** key. An adjustment window will be displayed.

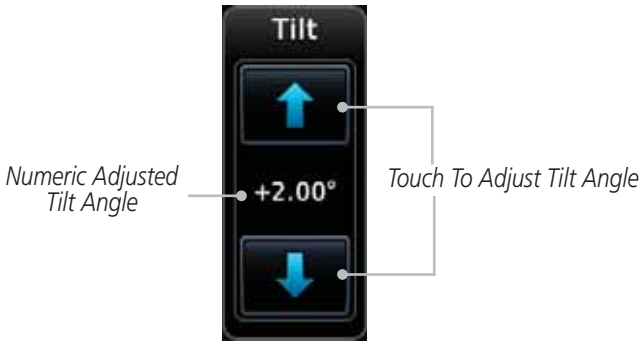


Figure 12-63 Adjusting Tilt

2. Touch the **Up and Down Arrow** keys to adjust the Tilt. The range is DN 15° to UP 15°.

3. Touch **Back** to save the values and return to the Radar display.

12.4.5 Adjusting the Bearing Line

1. Touch the **SHOW BRG** key. This displays the Bearing Line in Horizontal Scanning mode.
2. To adjust the Bearing Line, touch the **BEARING** key. An adjustment window will be displayed.

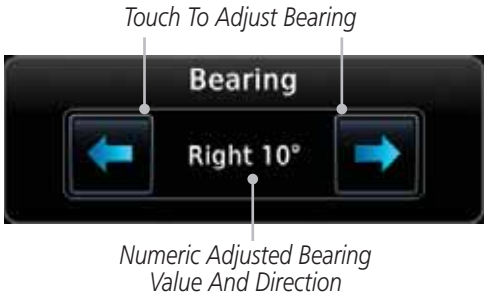


Figure 12-64 Bearing Line Adjustment

3. Touch the Gain Adjustment arrow keys to change the gain.

4. Touch **Back** to save the values and return to the Radar display.

12.4.6 Adjusting Gain

Gain is used to adjust the sensitivity of the radar receiver. It can be used to adjust the characteristics of the returns from the surface.

***WARNING**: Changing the gain in weather mode will cause precipitation intensity to be displayed as a color not representative of the true intensity. Remember to return the gain setting to : "Calibrated" for viewing the actual intensity of precipitation.*

1. While viewing the WX Radar page touch the **GAIN** key. The Gain Adjustment Bar will be displayed.

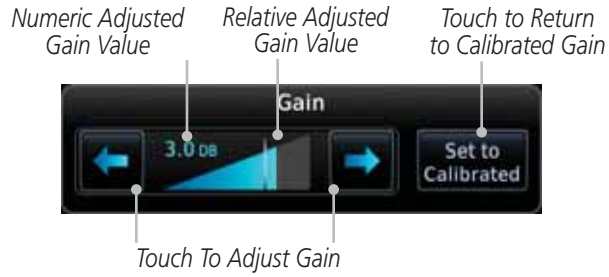


Figure 12-65 Gain Adjustment

2. Touch the Gain Adjustment arrow keys to change the gain.

3. Touch **Back** to save the values and return to the Radar display.

Restore Calibrated Gain

1. While viewing the WX Radar page touch **GAIN** to display the Gain adjustment window.

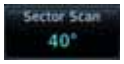
2. Touch the **SET TO CALIBRATED** key. This will restore the calibrated gain.

12.4.7 Sector Scan

Adjusting the Sector Scan reduces the scan angle from Full in increments of ±20°, ±40°, and ±60° in horizontal or vertical scanning.

1. While viewing the WX Radar page, touch **Sector Scan** to display the Sector Scan Mode window.

Figure 12-66 Sector Scan Mode



2. Touch the desired mode. After selection, you are returned to the Weather Radar Menu screen.

3. Touch **Back** again to return to the Weather Radar screen.

Figure 12-67 Selected Sector Scan Range

12.4.8 Weather Radar Menu

Touch **Menu** to view the Weather Radar Menu.

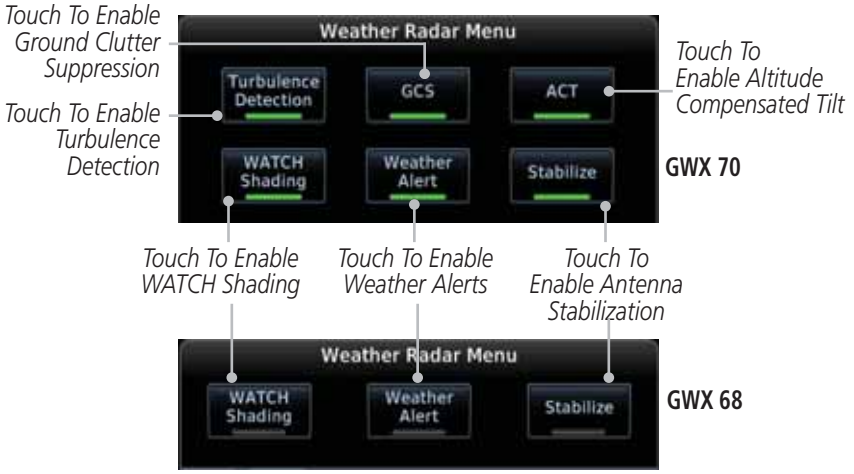
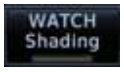


Figure 12-68 Weather Radar Menu Selections

NOTE: *Ground Clutter Suppression (GCS) and Turbulence Detection is only supported for 12" or larger RADAR antennas. Turbulence Detection is only supported out to a range of 40 NM and is disabled at display ranges greater than 160 NM.*

12.4.8.1 Weather Attenuated Color Highlight (WATCH™)

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 will also attenuate 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.



1. While viewing the Weather Radar Menu, touch **WATCH Shading** to toggle WATCH Shading.

2. To deactivate Watch Mode, repeat sequence.

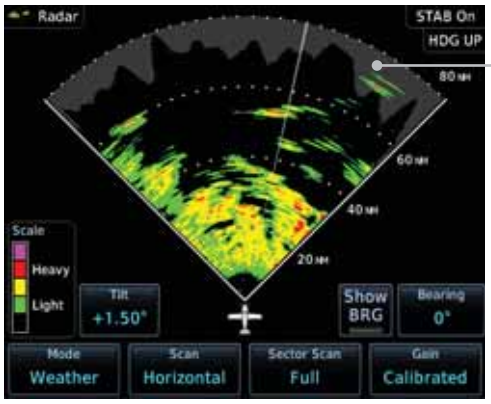


Figure 12-69 Horizontal Scan with WATCH

12.4.8.2 Weather Alert

The Weather Alert feature may be used to indicate the presence of heavy precipitation beyond the currently displayed range and 80 to 320 NM from the aircraft's present position. Weather Alert targets appear as red bands along the outer range ring at the approximate azimuth of the detected returns.

If a Weather Alert is detected within ±10° of the aircraft heading, a message will be displayed in the Messages page. Touch the **MSG** key to view messages.

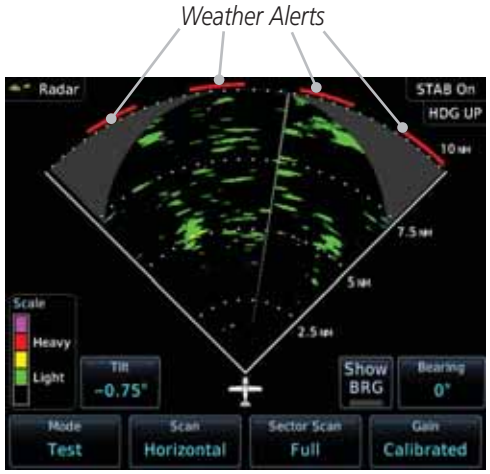


Figure 12-70 Weather Alert Display

If the antenna tilt is adjusted too low, a weather alert can be generated by ground returns. To avoid this issue, set the display range to less than 80 NM in the terminal area. Weather alerts can also be deactivated in the terminal area.

1. While viewing the Weather Radar Menu, touch **Weather Alert** to toggle Weather Alerts.
2. To deactivate Weather Alerts, repeat sequence.

12.4.8.3 Antenna Stabilization

1. While viewing the Weather Radar Menu, touch **Stabilize** to toggle Antenna Stabilization.
2. To deactivate Antenna Stabilization, repeat sequence. The current stabilization condition is shown in the top right of the weather radar display.

12.4.8.4 Altitude Compensated Tilt (ACT) - GWX 70 only

Altitude Compensated Tilt (ACT) automatically adjusts the tilt to compensate for altitude changes as you climb or descend.

1. While viewing the Weather Radar Menu, touch **ACT** to toggle ACT.
2. To deactivate ACT, repeat sequence.

12.4.8.5 Turbulence Detection - GWX 70 only

Turbulence Detection activates a feature that detects and displays severe turbulence. Turbulence Detection is inactive at ranges greater that 160 NM. If Turbulence Detection is enabled and available, Turbulence Detection will be reported as Inactive in any of the following conditions:

- Scan orientation is not Horizontal
- Scan range is greater than 160 NM
- Radar mode is not Weather

1. While viewing the Weather Radar Menu, touch **Turbulence Detection** to toggle Turbulence Detection.
2. To deactivate Turbulence Detection, repeat sequence.

12.4.8.6 Ground Clutter Suppression (GCS) - GWX 70 only

Ground Clutter Suppression reduces the amount of returns as a result of highly reflective objects on the ground, such as buildings or cities, while maintaining the intensity and size of weather returns.

1. While viewing the Weather Radar Menu, touch **GCS** to toggle Ground Clutter Suppression.
2. To deactivate Ground Clutter Suppression, repeat sequence.

12.5 Connext Weather

Connext Weather is an optional feature available with the Iridium® satellite system that is interfaced through the optional Garmin GSR 56. Connext Weather may be viewed in the Weather and Map functions. The Weather pages may be oriented to either Track Up, Heading, or North Up. Both Connext and XM Weather may be installed and selected individually. Connext Weather coverage is available throughout most of Europe, Canada and the U.S. Additional radar coverage areas are being added continuously.

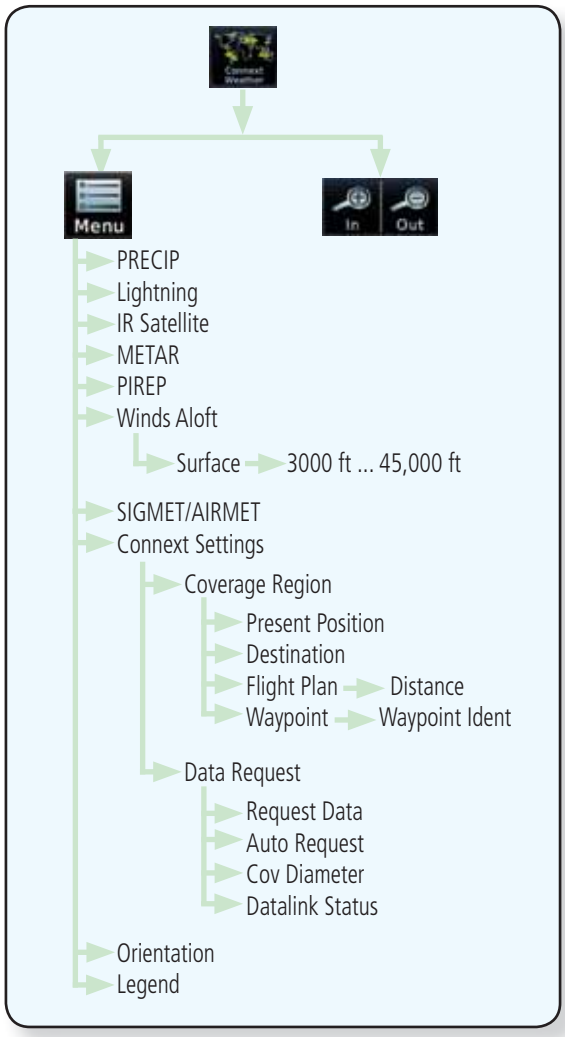


Figure 12-71 Connext Weather Functional Diagram

More detail on Connext weather products and coverage can be found at: http://fly.garmin.com/fly-garmin/gfds-weather/

NOTE: *A system can be configured for multiple weather products, but only one may be selected for viewing in the Weather or map pages at a given time.*

1. While viewing the Connext Weather page, press the **MENU** key to display the Connext Weather Menu.

Figure 12-72 Select Connext Weather

2. Touch the desired key to access the settings. The settings will affect the display on both the Weather and Map pages.

12.5.1 Using Connext Satellite Weather Products

When a weather product is active on the Weather Data Link Page or the Navigation Map Page, the age of the data is displayed on the screen. The age of the product is based on the time difference between when the data was assembled on the ground and the current GPS time. Weather products are refreshed at selectable intervals.

Weather products expire at intervals based on each product. When the data expires, it is removed from the display. This ensures that the displayed data is consistent with what is currently being broadcast by Connext Satellite Radio services. If more than half of the expiration time has elapsed from the time the data is received, the color of the product age displayed changes to yellow.

12.5.2 Connext Weather Menu

The Connext Weather page is customized by selecting options from the Connext Weather and the Connext Settings Menus. The Connext Weather Menu options include choices for Weather Setup and displaying selected weather products. The Connext Settings Menu makes settings for the Coverage Region and Data Request frequency.

1. While viewing the Connext Weather page, touch the **MENU** key to display the Connext Weather Menu. Touch the desired keys to toggle the weather product.

Figure 12-73 Connext Weather Menu

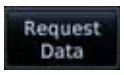
2. Touch the **Connext Settings** key to make detailed settings for the Connext Weather display.

12.5.3 Connext Settings

Figure 12-74 Connext Settings Menu

12.5.3.1 Connext Data Request

It is necessary to request the downloading of weather products. Requests can be sent manually or set to automatically update at a selected rate. The Connext weather data may be updated at any time regardless of the automatic update timing by selecting a Manual Request. When multiple requests are made, some products are merged with the old data (SIGMETs/AIRMETs, TAFs, TFRs, and METARs), but the old data of other products is discarded.



1. While viewing the Connext Settings Menu, touch the **Request Data** key to manually request data.

2. Touch the **Auto Request** key to set the Auto Request Period.

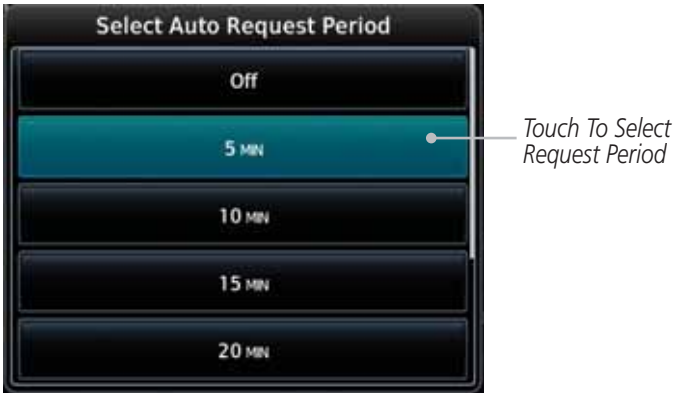
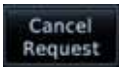


Figure 12-75 Select Auto Request Period



3. Touch the **Cancel Request** key to cancel a request in progress.

Figure 12-76 Cancelling A Request

12.5.3.2 Connext Data Request Coverage Region

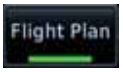
Present Position Data Request

Touch the **Present Position** key to request that weather information will be shown around your present position.

Destination Connext Data Request

Touch the **Destination** key to request that weather information will be shown around the destination waypoint in the flight plan.

Flight Plan Data Request



Touch the **Flight Plan** key to request that weather information will be shown around the active flight plan.

Flight Plan Distance Data Request

Touch the **Distance** key to request that weather information will be shown for the selected distance along the active flight plan.

Waypoint Connext Data Request

1. Touch the **Waypoint** key to request that weather information will be shown around the selected waypoint.

2. Select the waypoint and then press **ENT.**

Diameter/Route Width Connext Data Request

After selecting a coverage option in the previous section, select the desired **Diameter** and then press **ENT.**

12.5.3.3 Connext Weather Map Orientation

1. While viewing the Connext Weather Menu, touch the **Orientation** key.
2. Touch the orientation choices of North Up, Track Up, and Heading Up and to accept the displayed value and return to the Connext Weather Menu.

Figure 12-77 Connext Weather Map Orientation

12.5.4 Register With Connext

It is necessary to register the GTN with Connext to utilize the weather products.

1. Call Garmin Customer Service to create a Connext account. Provide the GTN System ID and airframe info (model, tail number, etc).
2. Customer Service will issue an access code to enter on the Connext Registration page.
3. While viewing Connext Settings Menu, touch the **Datalink Status** key.

Figure 12-78 GSR 56 Status

4. Touch the **Connext Registration** key to display the Connext Registration display.

Figure 12-79 Connext Registration Page

5. Touch the Access Code key to enter the appropriate code and then touch the **Enter** key.

6. Touch the **Register** key to complete the process. The GTN will contact the Connext servers using the GSR 56 transceiver. If the access code and system ID are correct, it will download and display the airframe info.

Deactivate Unit Registration With Connext

Registration of the GTN unit with Connext can be deactivated so that the unit can no longer make requests to Connext. This does not cancel the subscription.

1. While viewing the Connext Registration display, touch the Access Code field and enter an invalid access code to deactivate the Connext registration.
2. Any weather requests will now fail and the system will no longer be linked to the Connext account.

12.5.5 Connext Weather Product Age

The weather product expiration time and the refresh rate are shown in the following table. The refresh rate represents the interval at which Connext Satellites broadcast new signals that may or may not contain new weather data. It does not represent the rate at which weather data is updated or new content is received by the Data Link Receiver. Weather data is refreshed at intervals that are defined and controlled by Connext and its data vendors.

Weather Product	Expiration Time (Minutes)
PRECIP	30
Lightning	30
IR Satellite	60
SIGMETs / AIRMETs	60
METARs	90
Winds Aloft	90
Pilot Weather Report (PIREP) (Blue - Regular, Yellow - Urgent)	90
Temporary Flight Restriction (TFR)	60

Table 12-6 Connext Weather Products and Aging Times

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 significantly older than the indicated weather product age.*

12.5.6 TFRs

Temporary Flight Restrictions (TFRs) provide detailed information for local short term restrictions.

Figure 12-80 Connext TFR Legend

1. Touch a TFR symbol on the Weather page to view details.

Figure 12-81 Connext TFR Detail

2. Touch the **Back** key to return to the Weather display.

12.5.7 Precipitation (PRECIP) Data

Graphical data is overlaid on the map indicating the rainfall detected by ground based radar for a specific area. The colors indicating increasing levels of rainfall progresses from light green for light rainfall to red for heavy rainfall. Review the Limitations section in the front of this guide for the limitations that apply to the Connext data. Rainfall data is color coded as follows:

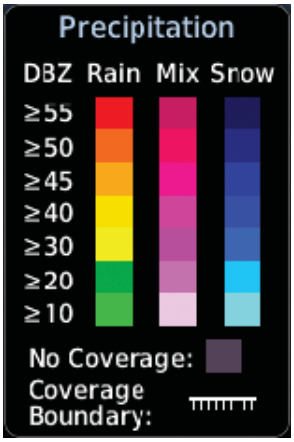


Figure 12-82 Connext PRECIP Weather Map Display and Legend

The "No Coverage" color indicates that no data is available for that area, and rainfall in that area is unknown.

When weather data is received, the airborne system will display that data for 20 minutes. If no new data has been received for a given area, the rainfall will be removed after 20 minutes and the area will revert back to the "No Coverage" color.

The Connext Weather Function is based on a ground-to-air data link and requires that the appropriate ground systems are broadcasting weather data and the aircraft is within reception range of the Ground Broadcast Transceiver (GBT).

12.5.7.1 Animating Precipitation Data

NOTE: *Animated Precipitation functionality is available in software version 6.00 and later.*

When Precipitation Data is enabled for display and more than two Precipitation images have been received by the GTN, the Precipitation display can be animated on the Connext Weather page. As new Precipitation images are