

400W / 500W Series



Garmin Optional Displays Pilot's Guide Addendum For:

- GDL 69/69A XM Satellite Datalink
- GDL 88 ADS-B Transceiver
- GTX 330/330D TIS
- GTX 335/345
- Garmin TAWS (GPS 500W & GNS 530W)
- Garmin HTAWS (Helicopter Installations)
- Terrain Proximity (Helicopter Installations)
- Garmin GTS 8XX Series TAS
- Connex

This Pilot's Guide Addendum is written for:

- Garmin GPS 400W, GNC 420W/420AW, and GNS 430W/430AW Main System Software Version 2.00, 3.00, 3.30, 4.00, 5.00, 5.10, 5.20, 5.30, or later
- Garmin GPS 500W & GNS 530W/530AW Main System Software Version 2.00, 3.00, 3.30, 4.00, 5.00, 5.10, or later
- GTX 330/330D Main Software Version 4.05
- GDL 69/69A Main Software Version 3.02 or later

Some differences in operation may be observed when comparing the information in this manual to earlier or later software versions.

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The screen display examples shown in this addendum are taken from the GNS 430W and GNS 530W. TIS and Weather Data Link Display Interface functionality is the same for the 400W and 500W Series Units. TIS Traffic Display and Weather Data Link are available only when the 400W/500W units are configured with the GTX 330 Mode S Transponder and GDL 69/69A Data Link Transceiver, respectively.



WARNING: Terrain data are obtained from third party sources. Garmin is not able to independently verify the accuracy of this data which should be used only as an aid for situational awareness. Terrain data must not be used as the sole basis for decisions or maneuvers to avoid terrain or obstacles. Terrain data must not be used for navigation.



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



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



CAUTION: Use the 400W/500W Series Units at your own risk. To reduce the risk of unsafe operation, carefully review and understand all aspects of the Owner's Manual and the Flight Manual Supplement, and thoroughly practice basic operation prior to actual use.



CAUTION: The Global Positioning System is operated by the United States government, which is solely responsible for its accuracy and maintenance. The system is subject to changes which could affect the accuracy and performance of all GPS equipment. Although Garmin 400W/500W Series Units are precision electronic NAVigation AIDS (NAVAID), any NAVAID can be misused or misinterpreted and therefore become unsafe.



CAUTION: The Jeppesen database incorporated in the Garmin 400W/500W Series Units must be updated regularly in order to ensure that its information is current. Updates are released every 28 days. A database information packet is included in your Garmin 400W/500W Series Unit package. Pilots using an out-of-date database do so entirely at their own risk.



CAUTION: The Weather Data Link, TIS, TAWS, HTAWS, and TERRAIN information contained in this Pilot's Guide Addendum is not intended to replace the documentation that is supplied with the applicable Garmin 400W/500W Series Unit and the GTX 330 Transponder. The user must know how to operate the 400W/500W Series Unit and be knowledgeable of the information in the 400W/500W Pilot's Guide.



TIS CAUTION: TIS is NOT intended to be used as a collision avoidance system and does not relieve pilot 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. Avoidance maneuvers are not recommended, nor authorized, as a direct result of a TIS intruder display or TIS alert.

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.



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



NOTE: For software version 4.00 and later: when configured for helicopters (the helicopter icon will be displayed), black, circular or oblong "cutouts" will be displayed on the Terrain Page around airports and heliports, to enhance viewing of the information displayed for those locations. The Terrain legend (shown in the lower right of the display on the Terrain Page) defines the color black as -500 ft. However, this does not apply to the black cutouts surrounding the airports and heliports. The cutouts are for display purposes only and do not affect the performance of HTAWS.

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Part One: Traffic Information Service (TIS) Interface

Section 1: TIS Operation and Symbology

TIS Operation



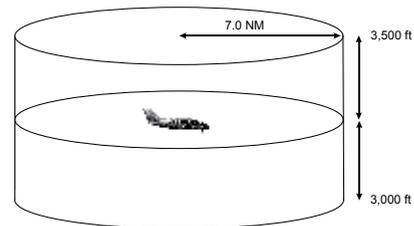
NOTE: *Part One of this Addendum assumes the user has experience operating the 400W/500W Series units and the Garmin GTX 3xx Transponder.*

The Traffic Information Service (TIS) provides a graphic display of traffic advisory information in the cockpit for non-TCAS (Traffic alert and Collision Avoidance System) equipped aircraft. TIS is a ground-based service providing relative location of all ATCRBS (Air Traffic Control Radar Beacon System) Mode A and Mode C transponder-equipped aircraft within a specified service volume. The TIS ground sensor uses real-time track reports to generate traffic notification. TIS Traffic display is available to aircraft equipped with a Mode S Data Link such as a Garmin GTX 3xx Transponder. TIS Traffic from a GTX 3xx Transponder can then be displayed on a Garmin 400W/500W Series unit. Surveillance data includes all transponder-equipped aircraft within the coverage volume. Aircraft without an operating transponder are invisible to TIS. TIS displays up to eight traffic targets within seven nautical miles horizontally from 3000 feet below to 3500 feet above the requesting aircraft.

The TIS is a ground-based service that displays nearby aircraft on your 400W/500W-series display. For the TIS feature to inform you of a nearby aircraft's presence, several conditions must be met:

- Your aircraft must be equipped with a Mode S data link transponder.
- You must be within range of a Mode S radar that provides the TIS service. Not all Mode S ground radars provide TIS service.
- The “intruder” aircraft must be equipped with a transponder, and that transponder must be turned on. Aircraft that are not equipped with operating transponders will not be visible to the Mode S surveillance radar.
- The “intruder” aircraft must be within the TIS coverage volume for your aircraft. TIS displays up to eight traffic targets within seven nautical miles horizontally from the requesting aircraft, and from 3,000 feet below to 3,500 feet above the requesting aircraft.
- Both your aircraft and the intruder aircraft must be visible to the Mode S surveillance radar on the ground.

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 intervening terrain.



TIS Coverage Volume (not to scale)

How TIS differs from TCAS

The main difference between TIS and TCAS is the source of surveillance data. TCAS uses an airborne interrogator with a one-second update rate, while TIS uses the terminal Mode S ground interrogator and its Data Link to provide about a five-second update rate. The range accuracy of TIS and TCAS is similar.

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, Sections 4-5-6 and 4-5-8.

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 ATRBS. 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, Sections 4-5-6 and 4-5-8.



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 400W/500W 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 $\frac{1}{4}$ 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.

Improving TIS

Users of TIS can render valuable assistance in the correction of malfunctions by reporting their observations of undesirable performance. Reporters should identify the time of observation, location, type and identity of aircraft, and describe the condition observed; the type of transponder processor and software in use can also be useful information. Since TIS performance is monitored by maintenance personnel other than ATC, it is suggested that malfunctions be reported in the following ways:

- By telephone to the nearest Flight Service Station (FSS) facility.
- By FAA Form 8000-7, Safety Improvement Report, a postage-paid card designed for this purpose. These cards may be obtained at FAA FSSs, General Aviation District Offices, Flight Standards District Offices, and General Aviation Fixed Based Operations.

TIS Symbology

TIS traffic is displayed on the 400W/500W Series unit according to TCAS symbology, graphically displayed on a dedicated graphical page (Traffic Page; see below), and on the moving Map Page. A Traffic Advisory (TA) symbol appears as a solid yellow circle (or half circle on the outer range ring if the traffic is outside the range of the dedicated Traffic Page). Proximity Advisories (PA) are displayed as a solid diamond, and other traffic is displayed as an open diamond. PA and other traffic is normally displayed in white, or it may be alternatively configured for display in cyan. When configured for cyan, the traffic page range rings and markings are displayed in white. Altitude deviation from own aircraft altitude is displayed above the target symbol if traffic is above own aircraft altitude, and below the symbol if they are below own aircraft altitude. Altitude trend is displayed as an up arrow ($> +500$ ft/min), down arrow (< -500 ft/min), or no symbol if less than 500 ft/min rate in either direction.



- Traffic Advisories (TA)—Yellow



- Proximity Advisories (PA)—White (may be configured as Cyan)



- Other—White (may be configured as Cyan)



The TIS audio alert is generated from the GTX 3xx whenever the number of Traffic Advisories on the 400W/500W display increases from one scan to the next. Limiting Traffic Advisories only reduces the “nuisance” alerting due to proximate aircraft. For example, when the first Traffic Advisories appears on the TIS display, the user is alerted audibly. So long as a single aircraft remains on the TIS display, no further audio alert is generated. If a second (or more) aircraft appears on the display, a new audio alert is sounded.

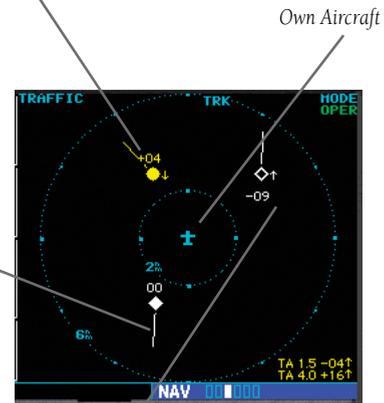
If the number of Traffic Advisories on the TIS display decreases and then increases, a new audio alert is sounded. The TIS audio alert is also generated whenever TIS service becomes unavailable. The volume, pitch, and duration of the audio alert (including the choice between a male or female voice) is configured during installation.

The following TIS audio alerts are available:

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

Traffic Advisory (TA)—This symbol is generated when traffic meets the advisory criteria described in TIS Operational Procedures.

Traffic Ground Track is indicated on the 400W/500W display by a “target track vector”, a short line displayed in 45-degree increments. This vector shows the flight direction of the traffic.



“Other” Traffic—This symbol represents traffic detected within the selected display range that does not generate a TA.

Section 2: Control and Display

TIS Traffic Display Status and Pilot Response

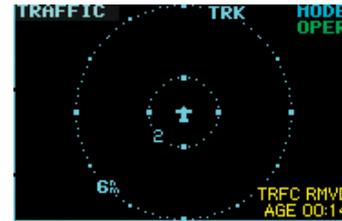
- STBY — When the 400W/500W displays STBY in the upper right hand corner of the display the TIS system is in standby mode and cannot display traffic data.
- OPER — When the 400W/500W displays OPER in the upper right hand corner of the display the TIS system is in operational mode and available to display traffic on the Traffic or Map Page.
- AGE — If traffic data are not refreshed within 6 seconds, an age indicator (e.g., “AGE 00:06”) is displayed in the lower right corner of the display (when displaying traffic). The pilot should be aware that the quality of displayed traffic is reduced in this condition.
- TRFC CST — If data are still not received between six and twelve seconds, the “TRFC CST” (traffic coasting) banner located above the AGE timer will indicate that displayed traffic is held even though the data are not current. The pilot should be aware that the quality of displayed traffic is reduced in this condition.



Traffic Age Indication showing “traffic coasting”.

- TRFC RMVD — If data are still not received after twelve seconds, the “TRFC RMVD” banner will indicate that traffic has been removed from the display due to the age of the data being too old

to “coast” (for the time period after 12 seconds from the last receipt of a TIS message). The pilot should be aware that traffic may be present but not shown.



Traffic Page displaying “TRFC RMVD” banner.

- UNAVAIL — After a 60 second period elapses with no data, TIS is considered to be unavailable. This state is indicated by the text “UNAVAIL”. The pilot should be aware that “UNAVAIL” could indicate a TIS coverage limitation due to a line-of-sight situation, a low altitude condition, no TIS service, or a result of flying directly over the radar site providing coverage (cone of silence).
- NO DATA — “NO DATA” is displayed when no data are being received from the GTX 3xx. The pilot should be aware that this status may be a normal mode of operation in a dual transponder installation where the GTX 3xx with TIS is not the selected transponder. The GTX 3xx may not be powered on.
- DATA FAIL — “DATA FAIL” is displayed when data are being received from GTX 3xx, but there was a failure detected in the data stream. The pilot should see the dealer for corrective action.
- FAILED — “FAILED” is displayed when the GTX 3xx has indicated it has failed. The pilot should see the dealer for corrective action.

Traffic Ground Track

Traffic ground track is indicated in the 400W/500W display by a “target track vector”, a short line displayed in 45° increments, **extending in the direction of target movement**.



Traffic Target Track Vector.

Traffic Warning Window

When the unit is on any page (other than the NAV Traffic Page or when a TAWS/Terrain, or Dead Reckoning pop-up is displayed) and a traffic threat is imminent, the Traffic Warning Window is displayed. The Traffic Warning Window shows a small thumbnail map which can take the user to the Traffic Page by pressing **ENT**, or go back to the previous page by pressing **CLR**.



Traffic Warning Window



NOTE: The Traffic Warning Window is disabled when the aircraft ground speed is less than 30 knots or when an approach is active.

Traffic Page

TIS Traffic data are displayed on two 400W/500W Series unit pages, the Traffic Page and the Map Page. The 500W Series unit can also be configured to display a traffic thumbnail window below the VLOC frequency window. Unlike other forms of traffic, TIS traffic does not require heading data to be valid on the map. The only difference between TIS and other traffic data occurs on the Traffic Page. If heading is available, then the traffic data are compensated and displayed as heading-up. If it's not available, the Traffic Page is a track-up display. It is labeled on the upper portion of the Traffic Page.

Traffic Page Display Range

Various display ranges can be selected for optimal display of TIS traffic information.

To change the display range on the Traffic Page:

Press **RNG** to zoom through the range selections which are: 12/6 NM, 6/2 NM, and 2 NM.

Map Page

TIS traffic is displayed on the Map Page in addition to the Traffic Page.



The Map Page displaying traffic.

Configuring TIS Traffic Data on the Map Page

To configure TIS traffic on the Map Page:

1. Turn the **small right** knob to select the Map Page.
2. Press the **MENU** key.
Turn the **small right** knob to select "Setup Map?"
3. The flashing cursor highlights the GROUP field.
Turn the **small right** knob to select "Traffic" and press **ENT**.
4. Turn the **large right** knob to select the desired Traffic group option. Turn the **small right** knob to select the desired option and press **ENT**. Repeat the step for Traffic Symbol and Traffic Label.
5. Press **CLR** to return the Map Page.



The Traffic group selection menu allows the user to choose from the following:

- All trfc - All traffic is displayed on the Map Page.
- TA/PA - Only traffic advisories and proximity advisories are displayed on the Map Page.
- TA only - Only traffic advisories are displayed on the Map Page.

From the Map Page you can display traffic in a thumbnail format in any of the top three (400W Series) or four (500W Series) data fields on the right side of the Map Page.



Thumbnail Traffic displayed on the GNS 430W.

NOTE: The thumbnail will display traffic coasting "TRFC CST" or traffic removed "TRFC RMVD" in the lower right when TIS messages have been missed.

To display Thumbnail Traffic on the Map Page:

1. Turn the **small right** knob to select the Map Page.
2. Press the **MENU** key and display the Page Menu.
3. Turn the **small right** knob to select "Change Fields?" and press **ENT**.
4. Select one of the top three (400W Series) or four (500W Series) configurable fields. Select "TRFC" from the Select Field Type List and press **ENT**. Note that the thumbnail range defaults to 6 NM and cannot be changed.

Highlighting TIS Traffic Using Map Page Panning

Another Map Page feature is panning, which allows you to move the map beyond its current limits without adjusting the map scale. When you select the panning function — by pressing the **small right knob** — a target pointer will flash on the map display. A window also appears at the top of the map display showing the latitude/longitude position of the pointer, plus the bearing and distance to the pointer from your present position.



Displaying traffic range and altitude separation using the Map Panning feature.

To activate the panning feature and pan the map display:

1. Press the **small right knob** to activate the panning target pointer.
2. Turn the **small right knob** to move up (turn clockwise) or down (counterclockwise).
3. Turn the **large right knob** to move right (turn clockwise) or left (counterclockwise).
4. To cancel the panning function and return to your present position, press the **small right knob**.

When the target pointer is placed on traffic, the traffic range and altitude separation are displayed.

Section 3: TIS Operational Procedures

Introduction

TIS warns the user with voice and visual traffic advisories whenever it predicts an intruder to be a threat (see illustration). Voice and visual data are sent from the GTX 3xx. The user should not start evasive maneuvers using information from the 400W/500W display or on a traffic advisory only. The display and advisories are intended only for assistance in visually locating the traffic, due to the lack in resolution and coordination ability. The flight crew should attempt to visually acquire the intruder aircraft and maintain a safe separation in accordance with the regulatory requirements and good operating practice. If the flight crew cannot visually acquire the aircraft, they should contact ATC to obtain any information that may assist concerning the intruder aircraft. Based on the above procedures, minor adjustment to the vertical flight path consistent with air traffic requirements are not considered evasive maneuvers.

Power-Up Test

The TIS interface performs an automatic test during power-up.

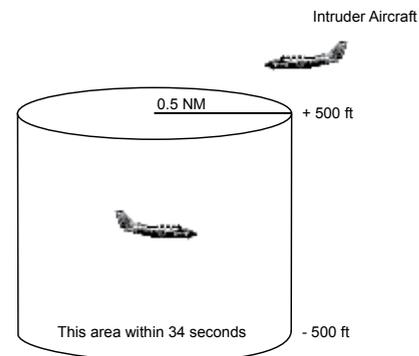
- If the system passes the power-up test, the Standby Screen appears on the Traffic Page.
- If the system passes the power-up test and the aircraft is airborne (as determined by system configuration at the time of installation, see your installer for detailed criteria information), traffic is displayable on the Traffic Page in operating mode.
- If the system fails the power-up test, the “NO DATA”, “DATA FAIL”, or “FAILED” message is displayed. See your installer for corrective action if the “DATA FAIL”, or “FAILED” message is displayed. The “FAILED” message indicates

the GTX 3xx has failed. The “DATA FAIL” message indicates data are being received from the GTX 3xx but a failure was detected in the data stream. The “NO DATA” message indicates that data are not being received from the GTX 3xx.



NOTE: “NO DATA” may be a normal mode of operation in a dual transponder installation where the GTX 3xx with TIS is not the selected transponder.

- UNAVAIL — When a 60 second period elapses with no data, TIS is considered to be unavailable. This state is indicated by the text “UNAVAILABLE” (500W Series) and “UNAVAIL” (400W Series). The pilot should be aware that “UNAVAIL” could indicate a TIS coverage limitation due to a line-of-sight situation, a low altitude condition, no TIS service, or a result of flying directly over the radar site providing coverage (cone of silence).



Conditions for Traffic Advisories

The following condition causes TIS to display a Traffic Advisory (TA) on the 400W/500W Series unit:

- **The intruder aircraft approaches your aircraft on a course that will intercept (defined by a 0.5 NM horizontal radius and a relative altitude of ± 500 feet) your course within 34 seconds.**

Manual Override

The user can manually switch between standby (STBY) and operating (OPER) mode of operation to manually override automatic operation.

To place the display into operating mode from the standby mode (to display TIS traffic):

1. Turn the cursor on and highlight "STBY".
2. Turn the **small right knob** to select "OPER?".
3. Press **ENT** to confirm.

To place the display into standby mode from operating mode (to stop displaying TIS traffic):

1. Turn the cursor on and highlight "OPER".
2. Turn the **small right knob** to select "STBY?".
3. Press **ENT** to confirm.



"DATA FAIL" Message



The "NO DATA" message indicates that data are not being received from the GTX 330. **NOTE:** This may be a normal mode of operation in a dual transponder installation where the GTX 330 with TIS is not the selected transponder.

Flight Procedures

Once the aircraft is airborne (determined by system configuration at the time of installation) the system switches from standby mode to operating mode. The 400W/500W Series unit displays OPER in the upper right hand corner of the display and begins to display traffic on the Traffic or Map Page.

The TIS Traffic Advisory (TA) should alert the crew to use additional vigilance to identify the intruding aircraft. Any time the traffic symbol becomes a yellow circle or a voice warning is announced, conduct a visual search for the intruder. If successful, maintain visual contact to ensure safe operation. See Section 2: Control and Display for a description of pilot responses to TIS display messages.

After Landing

Once the aircraft is "ground-borne" (determined by system configuration at the time of installation) the system switches from operating mode to standby mode. The 400W/500W Series unit displays "STBY". As described previously, both the standby and operating modes can be manually overridden by the display controls.

Part Two: XM Radio Interface Section 1: Introduction

Overview

The GDL 69™ is a remote sensor that receives broadcast weather data from a data service of SiriusXM Satellite Radio Inc. The GDL 69A™ is similar to the GDL 69, but also receives audio entertainment broadcasts from another service of SiriusXM Satellite Radio. The 400W and 500W series units serve as the display and control head for your remotely mounted GDL 69/69A radio.

Before the GDL 69/69A can be used, the unit must be activated by SiriusXM Satellite Radio with a service subscription through SiriusXM Satellite Radio. Please note that the GDL 69 is a weather data link. The GDL 69A is a weather data link and audio receiver. The data link service and the audio entertainment services must be activated separately.

Your GDL 69 or GDL 69A is shipped with one or two radio hardware identifications, respectively. These IDs serve as identification codes for your SiriusXM Satellite Radio-equipped GDL 69/69A and are needed in the activation process. The ID(s) is (are) attached to the Activation Instructions and printed on a label on the back of the unit. The IDs can also be retrieved through your unit in the SiriusXM Satellite Radio Information page of the Aux function. Contact your dealer or customer service if you are unable to locate the radio hardware IDs.

Weather and/or audio data from your GDL 69/69A are provided by SiriusXM Satellite Radio, a company separate and independent from Garmin Corporation. Have your radio hardware IDs ready before contacting SiriusXM Satellite Radio. During the process, you can select services for subscription. Keep in mind that the GDL 69 has no audio capability, audio services will not be available with the unit.

Follow the *GDL 69/69A XM Satellite Radio Activation Instructions (190-00355-04)* enclosed with your GDL 69/69A unit to activate the XM products.

The latest subscription information is available at:
<http://www.garmin.com/xm/>

SiriusXM Satellite Radio Pages

To reach the SiriusXM Satellite Radio pages:

1. From any page, press and hold **CLR** to select the Default NAV Page. (You may skip this step if you are already viewing any of the main pages.)
2. Turn the **large right** knob to select the AUX page group. "AUX" appears in the lower right corner of the screen.
3. Turn the **small right** knob to select the SiriusXM Audio, SiriusXM Satellite Radio Information, or XM WX Timestamps pages.

XM Weather page is displayed in the NAV page group. The XM Audio function pages are displayed in the AUX page group.

XM NAV Pages

When a GDL 69 or GDL 69A is installed, the following XM-related pages appear in the NAV group of pages:

- Map Page. The Map page (the second page in the NAV page group) becomes capable of displaying weather data and the boundaries of areas with Temporary Flight Restrictions (TFRs).
- XM Weather Page. The XM Weather page is inserted in the NAV page group, immediately before the Terrain page. This page is like the map page, but can show NEXRAD weather data, colored flags showing which airports have METARs (current weather observations—Meteorological Aerodrome Reports), Lightning (LTNG) reports, Cell Movement, or Winds Aloft.

XM WPT Pages

When a GDL 69 or GDL 69A is installed, two SiriusXM Weather-related pages are added to “airport” pages in the WPT page group:

- **Textual METAR Page.** The Textual METAR page shows the text of the most recent METAR (Meteorological Aerodrome Report) that has been received for an airport.
- **TAF Page.** The TAF page shows the text of the most recent TAF (Terminal Aerodrome Forecast) that has been received for an airport.

XM AUX Pages

When a GDL 69 or GDL 69A is installed, the following XM pages appear in the AUX group of pages:

- **XM Audio Page** (GDL 69A only). See Section 4 below for a description of this page.
- **XM Information Page.** This page contains information that you will use when activating your XM satellite radio subscription. It also reports the GDL 69/69A's software version number. SiriusXM Satellite Radio and SiriusXM Weather subscriptions are sold separately.
- **XM Weather Timestamp Pages.** This page show timestamp data for the most recently received XM weather data.

Section 2: SiriusXM Weather

The SiriusXM Weather Function is capable of displaying graphical weather information through the SiriusXM Satellite Radio Service when activated in the optional installation of the GDL 69/69A. Next Generation Weather Radar (NEXRAD), METARs symbols (METAR), Lightning (LTNG), Cell Movement (CELL MOVE), and Winds Aloft (WINDS) are displayed on the NAV pages. The types of products available depend on the subscription service with XM Satellite Radio.

Once you have activated an aviation weather service from SiriusXM Weather, the 400W/500W series unit can display the following aviation-related data:

- **NEXRAD.** An indication of the intensity of weather radar echoes from the National Weather Service's network of NEXRAD (NEXt generation RADar) sites can be shown on the SiriusXM Weather Page and can optionally be overlaid on the Map page. (Both these pages are in the NAV page group.) Canadian Radar may also be available.
- **Radar Coverage.** Whenever NEXRAD is shown, a cross-hatch pattern indicates the limits of NEXRAD radar coverage. The cross-hatched area shows where NEXRAD information is unavailable.
- **Lightning (LTNG).** When enabled, lightning strikes and cells are shown as yellow “+” signs. Lightning information indicates the location of cloud-to-ground lightning strikes.
- **Cell Movement (CELL MOVE).** When enabled, Cell Movement shows the storm cells identified by the ground-based system. The movement is depicted by an arrow. The tip of the arrow represents where the cell is expected to be in 10 minutes from the time the cell location was determined.

- **Winds Aloft (WINDS).** The Winds Aloft selection provides the pilot with wind speed and direction. The winds at a given altitude are selected in the Winds Aloft Alt below the WINDS selection. The selected altitude is shown along with the product time.
- **Textual Meteorological Aerodrome Reports (METARs).** When you zoom in to show the airport symbol associated with the colored flag for a graphical METAR, and move the Map Pointer to highlight that airport, you can then press **ENT** to see the Textual METAR page for that airport. The Textual METAR page is one of the airport pages of the WPT page group.
- **Graphical Meteorological Aerodrome Reports (METARs).** The XM Weather page (in the NAV page group) can show colored flags to indicate the level of current weather conditions at those airports for which textual METAR reports are available. The flags are color-coded to indicate the severity of the current weather at the airport: cyan for VFR conditions, green for Marginal VFR conditions, yellow for IFR conditions, or magenta of Low IFR conditions.
- **Terminal Aerodrome Forecast (TAFs).** A TAF page is added among the airport pages of the WPT page group. The TAF page differs from the Textual METAR page in that it describes forecast future weather conditions rather than current conditions.
- **Temporary Flight Restrictions (TFRs).** The boundaries of areas with TFRs are outlined in yellow on the Map and XM Weather pages of the NAV page group. In the 500W-series, TFR boundaries are also shown on the NAV main page. You can obtain more information about a

TFR by bringing up the map cursor, moving the map cursor to within the yellow outlined area, and pressing the **ENT** key.

Weather Product Age

The age of the displayed weather product—or the effective time of Winds Aloft predictions—is shown in the upper right corner of the display. For example, if NEXRAD is displayed, “0:05” indicates that the data are five minutes old. If Winds Aloft predictions are being displayed, “10:00” indicates the effective time for the displayed prediction is 10:00 AM.

The data for each XM Weather product are updated regularly from the GDL 69/69A. XM Weather products expire after the following intervals:

Product	Expiration Interval
METARs	90 minutes
NEXRAD/Radar Coverage	30 minutes
TFRs	60 minutes
TAFs	60 minutes
Lightning	30 minutes
SCITs	30 minutes
Winds Aloft Predictions	90 minutes

When the age of the displayed XM Weather product reaches one half of its expiration time, the color of the displayed time changes from green to amber. Expired XM Weather products are never displayed. In the unlikely event that the data should expire before a fresh update is received, the time will be dashed out and the data removed from the display.



NOTE: Product age for individual reports of XM AIRMETS, SIGMETs, City Forecasts, County Warnings, Cell Movement and TFRs are not provided by XM Weather Service.

Product age indication for XM Icing Potential and Turbulence is not included on the weather map. The valid time for these products is displayed on the weather map in place of the generation time.

The valid time indication for XM Freezing Level, Winds Aloft and Canada Winds Aloft is not displayed. Instead, the generation time for these is displayed.

SiriusXM Weather

The National Weather Service's network of WSR-88D Doppler weather surveillance radars—also called NEXRAD, for Next Generation Radar—has greatly improved the detection of meteorological events such as thunderstorms, tornados, and hurricanes. An extensive network of NEXRAD weather radars provides almost complete coverage of the continental United States, Alaska, and Hawaii. The unobstructed range of each NEXRAD is up to 250 nautical miles.

When enabled, composite data from all the NEXRAD radar sites in the United States is shown. This data are composed of the maximum reflectivity from the individual radar sweeps. Canadian radar may also be displayed. The display is color-coded to indicate the weather level severity. Information about with sites are operational or off-line is also available.

To display NEXRAD weather on the Map page:

1. With the Map page (second page of the NAV page group) displayed, press the **MENU** key. The Page Menu for the Map page appears. NEXRAD is also available on the Nav 1 page of the 500W series.
2. Turn the **large right** knob to highlight "Display US NEXRAD?" or "Display CN NEXRAD?," and then press **ENT**. (If "Hide US NEXRAD?" or

"Hide CN NEXRAD?") appears, NEXRAD radar data are already enabled; just press **MENU** again to exit the Page Menu.)



NOTE: US and Canadian radar may not be displayed simultaneously.

To display NEXRAD weather on the XM Weather page:

1. With the XM Weather page (the third page of the NAV page group) displayed, look at the upper left corner of the page. Under the page title ("XM Weather") either "NEXRAD-US," "NEXRAD-CN," or another weather product appears. If the word is "NEXRAD-US" or "NEXRAD-CN," do nothing; NEXRAD weather is already being displayed.
2. If the word in the upper left corner of the page is another weather product (rather than "NEXRAD-US" or "NEXRAD-CN"), press the **small right (CRSR)** knob to highlight that word. Then turn the **small right** knob to change to "NEXRAD-US" or "NEXRAD-CN."
3. Press the **small right** knob again to bring down the cursor (that is, to stop the blinking highlighting of "NEXRAD-US" or "NEXRAD-CN") and retain the selection.



NEXRAD U.S. and Canadian Coverage

SW Version 3.30 adds the ability to display Canadian NEXRAD on the moving map pages and the XM Weather page. The display has been modified to specify whether the NEXRAD displayed is U.S. or Canadian.

NEXRAD Intensity

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

To display the NEXRAD Intensity Legend:

1. While viewing the XM Weather page, press the **MENU** key to display the Page Menu.
2. Turn the **large** or **small** knob to select “Display legend?”



3. Press **ENT** to display the NEXRAD Intensity Legend.



4. Turn the **large** or **small** knob to scroll through the full table. Press **CLR** to return to the normal view.

NEXRAD Abnormalities

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

- Ground Clutter
- Strokes and spurious radar data
- Sun strobes, when the radar antenna points directly at the sun
- Military aircraft deploy metallic dust which can cause alterations in radar scans
- Interference from buildings or mountains, which may cause shadows
- Scheduled maintenance may put a radar off-line



NOTE: The only weather products available for Canada are Canadian NEXRAD, METARS, and TAFs. METARS and TAFs will be shown when available.

NEXRAD Limitations

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

- NEXRAD base reflectivity does not provide sufficient information to determine cloud layers or precipitation characteristics (hail vs. rain, etc).
- NEXRAD base reflectivity is sampled at the minimum antenna elevation angle. An individual NEXRAD site cannot depict high altitude storms at close ranges, and has no information about storms directly over the site.
- Neither NEXRAD weather data nor the age of the NEXRAD weather data are displayed at a zoom range of less than 10 NM. The resolution of displayed NEXRAD data is 2 kilometers. Therefore, when zoomed in on the display, each square block is 2 kilometers. The intensity level reflected by the square will be the highest level sampled within the 2 kilometer square area.



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.

SiriusXM Weather METARs

SiriusXM Weather METARs (Meteorological Aerodrome Reports) are available on the XM Weather page. When enabled (that is, when “METAR” is shown in the upper left corner of the page), airports with METAR information above a certain severity level are marked with colored flags on the display. Refer to the XM Weather legend for a description of the color code. The update rate is every 12 minutes.

SW Version 5.00 adds the ability to display Canadian METARs and TAFs.

To display METARs on the XM Weather page:

1. While viewing the XM Weather page, check the upper left corner to see whether “METAR” or another weather product is displayed in the upper left corner.
2. If another weather product (rather than “METAR”) is shown, press the **small right (CRSR)** knob to highlight the product name, such as “NEXRAD”. Turn the **small right** knob to change to “METAR,” and press that **small right** knob again to bring down the cursor (stop the highlighting) and retain the “METAR” selection.
3. Now, colored flags will be displayed at those airports that have METARs above a certain severity level. (If there are no colored flags visible, you may have to search a wider area—zoom out with the **RNG** key—before you see some METAR flags.)



To display the METAR Legend:

1. Press the **MENU** key to display the Page Menu.
2. Turn the **large** or **small right** knob to select “Display legend?”
3. Press **ENT** to display the METAR symbols legend. Press the **CLR** key to remove the METAR Symbols legend.



XM Weather METAR Symbols	
VFR - Ceiling > 3000 ft and visibility > 5 statute miles	Cyan
MVFR (Marginal VFR) - Ceiling 1000 to 3000 ft, and/or visibility 3 to 5 statute miles	Green
IFR - Ceiling 500 to 1000 ft, and/or visibility 1 to 3 statute miles	Yellow
LIFR (Low IFR) - Ceiling less than 500 ft and/or visibility less than 1 statute mile	Magenta

Textual METAR Page

When the GDL 69/69A is installed, a Textual METAR page is added among the APT (airport) pages of the WPT page group. This page can be accessed from the XM Weather page as well as from the WPT page group.

To display Textual METARs from the Nav XM Weather page:

1. While viewing the Nav XM Weather page, press the **MENU** key to display the Page Menu.
2. Turn the **large** or **small right** knob to highlight "Show Map Pointer?" and then press **ENT**.



3. Turn the **large** or **small right** knob to move the Map Pointer to highlight an airport with a METAR flag.



4. Press **ENT** to display the METAR text. With "Done?" highlighted, press **ENT** to return to the map view.



To view any airport's Textual METAR page:

1. If not viewing the WPT page group, press **CLR** and turn the **large right** knob to select the WPT page group.
2. Turn the **small right** knob until the Textual METAR page appears.



- To select another airport, press the **small right (CRSR)** knob to highlight the airport ID (in the "APT" field).
- Turn the **small** and **large right** knobs to edit the airport identifier for the desired airport. Then, press **ENT** to confirm the airport name.
- Press the **small right (CRSR)** knob again to remove the cursor (that is, to stop highlighting the APT field).

Textual METAR/TAF Code

The current airport weather reports on the Textual METAR page (and the airport weather forecasts on the TAF page, too) use a rather cryptic format originally devised for teleprinters. You can find information about this format in an FAA publication, Aviation Weather Formats: METAR/TAF, which can be downloaded from the FAA Web site.

You may see the following codes, which differ slightly from the codes described in the FAA publication referenced above, at the start of a METAR on the Textual METAR page:

- SA = METAR — a standard hourly METAR report.
- SP = SPECI — a Special Report inserted between regular hourly METARs to provide late-breaking weather news.

TAF Page

When a GDL 69/69A is installed, the TAF (Terminal Aerodrome Forecast) page is inserted into the WPT page group, immediately after the Textual METAR page.

This page shows a text message giving a weather forecast for a particular airport. The format is similar to that used for METARs, but describes a weather forecast rather than current weather at the particular airport.



TFR Information

Areas with TFRs (Temporary Flight Restrictions) are shown outlined in yellow on the NAV main page of the 500W-series and on the Map and XM Weather page of both the 400W and 500W-series. More information about Temporary Flight Restrictions can be seen on the TFR Information page, which can be accessed from the Map page or the XM Weather page.

- 1a. With the Map page (the second page of the NAV page group) displayed, press the **small right** knob to bring up the map pointer.

or

- 1b. With the XM Weather page (the third page of the NAV page group) displayed, press the **MENU** key to bring up the Page Menu. Then, turn the **large right** knob to highlight "Show Map Pointer" and press **ENT** to bring up the map pointer.

- Turn the **large** and **small right** knobs to move the map pointer to the yellow boundary of a TFR region. When the map pointer is within the TFR region, its boundary will be highlighted with a wider yellow line.



- Press **ENT**. The first item is the pop-up Page Menu will be "Review TFR?".



- Press **ENT** again to see the TFR Information page.



- Press **ENT** when done viewing the TFR Information page.

The fields of the TFR Information page are as follows:

- Type.** A brief description of the reason for the temporary flight restriction appears here. Some examples of the text that might appear here are: "Fire," "Miscellaneous," "National Security Area," "Natural Disaster," and "Sports Event."
- Facility/NOTAM.** This field contains a code for the name of the FAA facility that issued the NOTAM (Notice to Airmen) announcing the TFR, followed by the NOTAM number. For instance, "ZSE 6/9507" would mean NOTAM number 6/9507 from the Seattle ARTCC (KZSE).



NOTE: The full text of the NOTAM may be obtained from a local FSS or from the FAA web site, using the contents of this field as a reference to locate the particular NOTAM. However, the information shown on the TFR Information page is sufficient to let you comply with the Temporary Flight Restriction by avoiding the affected area.

- Active Time.** This field is for the beginning and ending times of the temporary flight restriction. It may be blank, in which case the TFR is active "until further notice."
- Vert Limits.** This field gives the upper and lower limits of the airspace to which the TFR applies.

Lightning (LTNG)

When enabled, lightning strikes and cells are shown. Lightning information indicates the location of cloud-to-ground lightning strikes. Lightning strikes are noted by yellow plus (+) signs.

To view XM Weather Lightning Strikes:

1. While viewing the XM Weather page, check the upper left corner to see whether "LTNG" or another weather product is displayed.
2. If another weather product (rather than "LTNG") is shown, press the **small right (CRSR)** knob to highlight the product name, such as "NEXRAD". Turn the **small right** knob to change to "LTNG," and press that **small right** knob again to bring down the cursor (stop the highlighting) and retain the "LTNG" selection.



Cell Movement (CELL MOVE)

When enabled, Cell Movement shows the storm cells identified by the ground-based system. The movement is depicted by an arrow. The tip of the arrow represents where the cell is expected to be in 10 minutes from the time the cell location was determined. Cell Movement is noted by a yellow box with an arrow showing reported the direction of travel.

To view XM Weather Cell Movement:

1. While viewing the XM Weather page, check the upper left corner to see whether "CELL MOVE" or another weather product is displayed.
2. If another weather product (rather than "CELL MOVE") is shown, press the **small right (CRSR)** knob to highlight the product name, such as "NEXRAD". Turn the **small right** knob to change to "CELL MOVE," and press that **small right** knob again to bring down the cursor (stop the highlighting) and retain the "CELL MOVE" selection.



To view XM Weather Cell Movement details:

1. While viewing the XM Weather page with Cell Movement active, activate the Map Pointer by pressing the **MENU** key, highlighting "Show Map Pointer," and press **ENT**.
2. Turn the **large right** knob to move the cursor left and right. Turn the **small right** knob to move the cursor up and down.
3. Move the cursor into the Cell Movement symbol to view details about the Cell.



Winds Aloft

The Winds Aloft selection provides the pilot with a graphic display of predicted winds at any one of 15 selectable altitudes. The winds at a given altitude are selected in the Winds Aloft Alt selection. The selected altitude is shown along with the product effective time. Winds Aloft predictions are updated every hour and are made available via the GDL 69/69A at a more frequent interval.

The display includes:

- Wind barbs, representing wind speed, and direction
- The selected altitude
- The effective time for the prediction.

Winds Aloft are represented by meteorological symbols known as “wind barbs”. A wind barb consists of an arrow-like line that indicates the direction in which the wind is blowing, with marks (“barbs”) along one side of the line to indicate wind speed. The barbed end of the symbol points in the direction from which the wind is coming. Barbs, which are used singly and in combinations, have the following values:

- A short line: 5 knots
- A long line: 10 knots
- A pennant (triangle): 50 knots



For example, a vertically oriented wind barb with a pennant, two long lines and a short line at its upper end would denote a 75-knot wind blowing from the north.

To view XM Weather Winds Aloft:

1. While viewing the XM Weather page, check the upper left corner of the display. If a weather product other than “WINDS” is shown, press the **small right (CRSR)** knob to highlight the product name. Turn the **small right** knob until “WINDS” is displayed.
2. Turn the **large right** knob to move the cursor down to the Altitude field, then use the **small right** knob to select an altitude from ground level up to 42,000 feet (in 3,000-foot increments). Note that you can move up and down the atmosphere, comparing wind predictions at different altitudes.



- When done, press the **small right (CRSR)** knob again to remove the cursor (remove highlighting from the altitude field).

Winds Aloft Altitude

The Winds Aloft Altitude selection provides the pilot with the ability to select any wind altitude from the ground up to 42,000 feet in 3,000 foot increments. When no data are shown at a given altitude, the data for that altitude has not been received. Wait for the next update. The selected altitude is depicted below the WINDS label.

To change the XM Weather Winds Aloft altitude:

- With the “WINDS” product selected, turn the **large right** knob to highlight the altitude value.



- Turn the **small right** knob to change the value.
- When done, press the **small right (CRSR)** knob again to remove the cursor (remove highlighting from the altitude field).

Section 3: XM AUX Pages

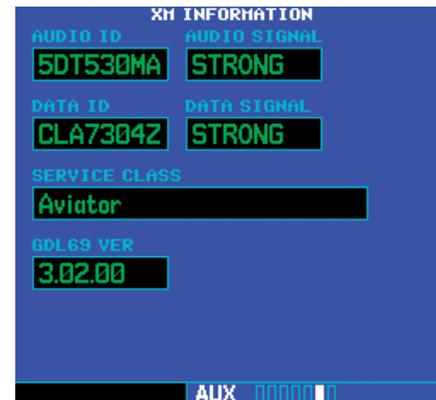
When a GDL 69 (or GDL 69A) is installed, three (or four) pages are inserted into the 500W/500W's AUX page group. Here we discuss the two pages that are inserted regardless of whether the SiriusXM Satellite Radio receiver is a GDL 69 or GDL 69A:

- **XM Information Page.** This page contains information that you will use when activating your SiriusXM Satellite Radio satellite radio subscription.
- **XM Weather Timestamp Pages.** These pages show timestamp data for the most recently received XM weather data.

The other AUX page, which is installed only if the SiriusXM Satellite Radio receiver is a GDL 69A, is the XM audio page.

XM Information Page

The XM Information page in the AUX page group is the page you will refer to when activating your subscription to the SiriusXM Satellite Radio services.



- **Audio ID.** The Audio ID contains the eight-character identification code of the XM Audio radio built into the GDL 69A. Provide this ID to SiriusXM Satellite Radio when activating an SiriusXM Satellite Radio audio subscription. (In the case of a GDL 69, this field shows eight hyphens)

instead of an audio ID, because the GDL 69 is a data-only receiver.)

- **Audio Signal.** The Audio Signal field indicates the signal strength of the GDL 69A's audio signal. (In the case of a GDL 69, this field shows “antenna” rather than a signal strength indication.)
- **Data ID.** The Data ID field contains the eight-character ID code of the XM data radio built into the GDL 69 or GDL 69A. Provide this ID to SiriusXM Satellite Radio when activating your XM aviation data subscription.
- **Data Signal.** The Data Signal field displays an indication of the XM data signal strength.
- **Service Class.** Once you have activated your SiriusXM Satellite Radio service, the Service Class field will show the XM subscription plan you have purchased. Typical values would be “Aviator LT” or “Aviator.” Currently, the 400W and 500W-series only support a subset of the Aviator LT service from SiriusXM Satellite Radio.

Product	Aviator LT	Aviator
US NEXRAD	●	●
CN NEXRAD		●
Radar Coverage	●	●
Precipitation Type (at surface)	●	●
TFRs	●	●
METARs	●*	●
TAFs	●*	●
US Winds Aloft		●
Cell Movement		●
Lightning		●

* Canadian METARs and TAFs are not available in the Aviator LT service.



NOTE: If an unrecognized service class is detected, “Activated” will be displayed along with a service class code.

- **GDL 69 Version.** This field shows the version number of the software in your GDL 69 or GDL 69A XM radio receiver.

XM WX Timestamps

The XM WX Timestamp pages, like the XM Information page, is added to the 400W/500W's AUX page group when a GDL 69/69A is installed. These pages display date/time stamps showing when the various items of SiriusXM Weather data were most recently downloaded.



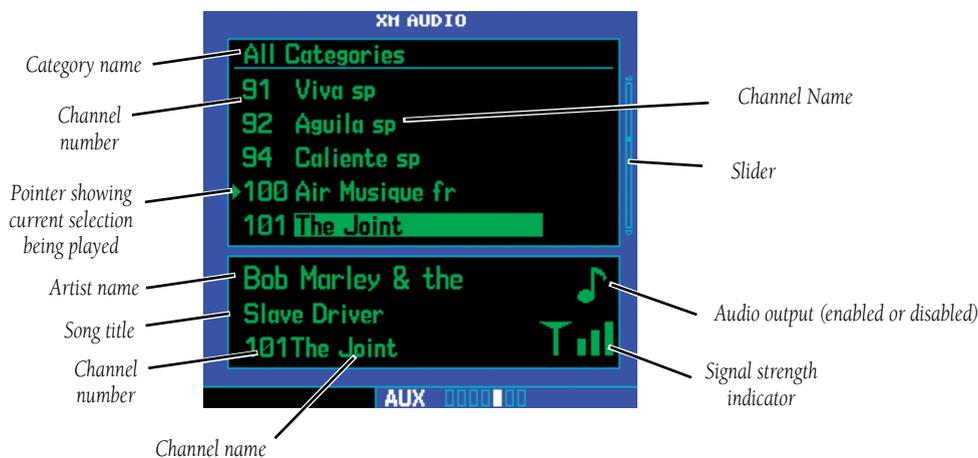
Each of these time stamps is a date-time group in “DDHHMMZ” format, where:

- **DD** is the day of the month
- **HH** is the hour of the day
- **MM** is the minute of the hour
- **Z** is a time zone designator indicating that the date and time are for standard time on the Greenwich meridian: that is, UTC (Coordinated Universal Time).

Section 4: SiriusXM Satellite Radio Audio

Audio entertainment is available through the SiriusXM Satellite Radio Service when activated in the optional installation of the GDL 69A. The 400W and 500W series units serve as the display and control head for your remotely mounted GDL 69A. SiriusXM Satellite Radio allows you to enjoy a variety of radio programming over long distances without having to constantly search for new stations. Based on signal from satellites, coverage far exceeds land-based transmissions. When enabled, the SiriusXM Satellite Radio audio entertainment is accessible in the AUX function.

The information on the SiriusXM Satellite Radio display is composed of four areas: the Active channel, available Channels, Category of the highlighted channel, and the Volume setting. The Active Channel window shows the Channel Name and Number, Artist, Song Title, Category, and provides an indication of signal strength. A bar graph next to the antenna symbol describes the signal strength. Maximum signal strength is shown by three full bars.



XM Audio Page Description

The XM Audio page allows you to control the functions of the SiriusXM Satellite Radio Audio receiver in the GDL 69A, such as, category and channel selection, artist selection, and volume. Pressing the **MENU** key displays the Page Menu selections.



Selecting categories

1. Press the **small right (CRSR)** knob to highlight the category names. The categories will be listed below in numeric order.
2. Turn the **small right** knob to scroll through the list of categories. Categories are shown in the upper section of the display. The channels for each category are shown in the list below the category title.



3. Press **ENT** to select the highlighted category. The first channel in the selected category will now be highlighted and the current song being played in that channel will be shown in the lower window.



4. Turn the **large right** knob counterclockwise to move the highlight back up to the category name window.

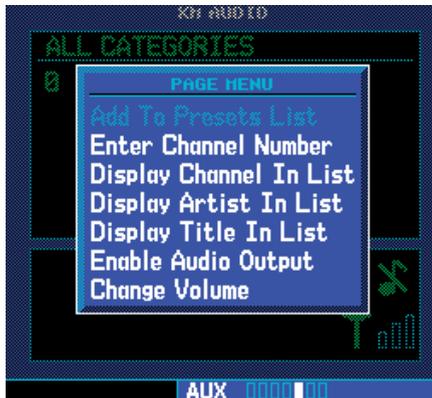
Selecting channels

1. Press the **small right (CRSR)** knob to highlight the category names.
2. Turn the **large right** knob clockwise, or press **ENT**, to move the highlight into the channel selections.
3. Turn the **small right** knob to highlight a channel.
4. Press **ENT** to select the highlighted channel for listening. A triangle will point to the song currently being played.

XM Audio Menu

The XM Audio Menu provides choices for selecting a channel, displaying the channel, artist, or title, enabling audio output, and controlling the volume.

1. While viewing the XM Audio page, press the **MENU** key.



2. Turn the **large** or **small right** knobs to highlight the choices. Press the **ENT** key to make a selection.

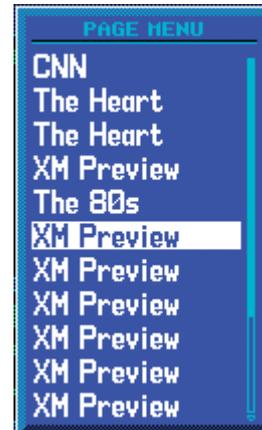
Add to Presets List

Up to fifteen channels may be saved as presets to easily return to your favorite channels.

1. While viewing the XM Audio page, selected the desired channel.
2. While the desired channel is highlighted, press the **MENU** key. With "Add to Presets List?" highlighted, press **ENT**.



3. Turn the **large right** knob clockwise to move the highlight into the presets list. Turn the **small right** knob to highlight the position where you want to place the preset.



4. Press **ENT** to replace the previous preset channel with the newly selected channel.



Enter Channel Number

You may directly select a specific channel by using the “Enter Channel Number” item from the Page Menu.

1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight “Enter Channel Number.”
2. Turn the **large right** knob to move the highlight and the **small right** knob to select a number.



3. Press the **ENT** key to make a selection. The selected channel will now play and is displayed in the window at the bottom of the display.



Display Channel In List

Channels can be shown in a list of channels in the middle pane by using the “Display Channel In List” item from the Page Menu.

1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight “Display Channel In List.”



2. Press the **ENT** key.



Display Artist In List

The name of the artists in the range of displayed channels can be shown in the middle pane by using the “Display Artist In List” item from the Page Menu.

1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight “Display Artist In List.”



2. Press the **ENT** key.



Display Title In List

The Titles of the songs in the range of displayed channels can be shown in the middle pane by using the “Display Title In List” item from the Page Menu.

1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight “Display Title In List.”



2. Press the **ENT** key.



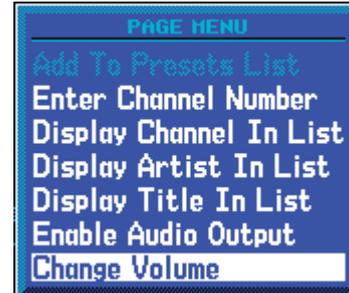
Enable/Mute Audio Output

The Enable/Mute Audio Output selection of the Page Menu allows you to toggle the audio output On or Off. When Audio Output is muted, a green slash will cross over the music symbol in the song pane.

1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight "Enable Audio Output" or "Disable Audio Output."
2. Press the **ENT** key to perform the highlighted action. Pressing the **CLR** key toggles the audio output.

Change Volume

The XM Audio volume may be changed in two ways: directly with the **Range** keys or through the Page Menu.



1. While viewing the XM Audio page, press the **MENU** key. Turn the **large right** knob to highlight "Change Volume."
- 2a. Press the **ENT** key and then turn the **small right** knob to change the volume.



or

- 2b. Press the **Range** keys to adjust the volume.

Part Three: TAWS Interface

Section 1: Introduction



NOTE: Either the TERRAIN, TAWS (500W-series only), HTAWS, or Terrain Proximity functionality will be available via the Terrain page, depending on the installed hardware and configuration.

Overview

Garmin's Terrain Awareness Warning System (TAWS) is an optional feature (500W-series only) to increase situational awareness and aid in reducing controlled flight into terrain. Garmin TAWS satisfies TSO-C151b Class B requirements for certification. Class B TAWS is required for all Part 91 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).

TAWS provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.



Garmin TAWS satisfies TSO-C151b Class B requirements for certification



NOTE: TAWS-enabled units can be identified by observing the power-up screens. TAWS-enabled units will display "TAWS" after the model number. TAWS-enabled units can also be identified by going to the Terrain page and checking the upper left-corner for "TAWS."

Operating Criteria

Garmin TAWS requires the following to operate properly:

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

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.

TAWS displays terrain and obstructions relative to the altitude 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.

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.

TAWS uses terrain and obstacle information supplied by government sources. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151b. However, the displayed information should never be understood as being all-inclusive.

Section 2: TAWS Operation

TAWS Alerting

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.

TAWS utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). 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. Detailed alert modes are described later in this section.

Baro-Corrected 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 atmosphere 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.

Power Up

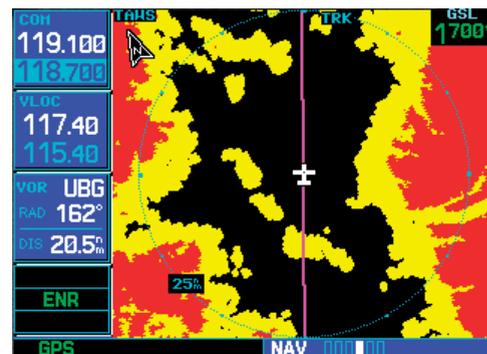
During power-up of the 500W Series unit, the terrain/obstacle database versions are displayed along with a disclaimer to the pilot. At the same time, TAWS self-test begins. During this self-test all external TAWS annunciator lamps are lighted for a visual check by the pilot that they are operating. TAWS gives the following aural messages upon test completion:

- **“TAWS System Test, OK”**, if the system passes the test
- **“TAWS System Failure”**, if the system fails the test

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

TAWS Page

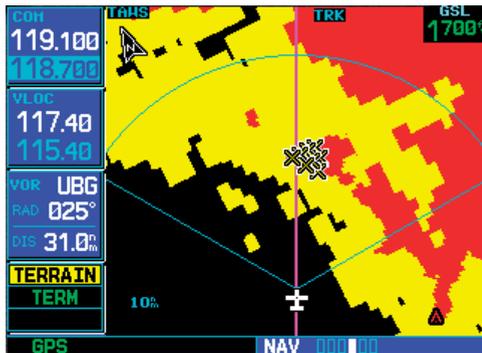
The TAWS Page is in the NAV group of pages (see the 500W Series Pilot’s Guide for detailed information regarding page groups and pages).



The TAWS Page

To display the TAWS Page, select the NAV group and turn the **small right** knob until the TAWS Page is displayed. Terrain information, aircraft ground track, and GPS-derived MSL altitude are displayed on the page.

Altitude is shown in increments of 20 feet or in increments of 10 meters, depending on unit configuration. The “GSL” above the MSL altitude display reminds the pilot that altitude is GPS-derived. The TAWS Page has two selectable view settings:



120° Viewing Angle on the TAWS Page

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



NOTE: The TAWS Page gives a “Track Up” display orientation, as indicated by the “TRK” label shown on the display. This is the only orientation available for the TAWS Page.

To display a 120° view:

1. Select the TAWS Page and press **MENU**. Select “View 120?”.
2. Press **ENT**. The TAWS Page displays the 120° view. To change to a 360° view, repeat step 1, select “View 360?”, and press **ENT**.

Seven display ranges are available, allowing for a more complete view of the surrounding area.

To change the display range:

Select the TAWS Page and press up or down on the **RNG** key to select the desired range:

- 1 NM, 2 NM, 5 NM, 10 NM, 25 NM, 50 NM, 100 NM.

Aviation information such as airports, VORs, and other nav aids can be turned on or off on the TAWS Page.

To show or hide aviation information:

1. Press **MENU**.
2. Select “Show (or Hide) Aviation Data?” and press **ENT**. Pressing the **CLR** key when the TAWS Page is displayed can also be used to toggle aviation information on or off.



Aviation Data

To show or hide Legend:

1. Press **MENU**.
2. Select “Show (or Hide) Legend?” and press **ENT**.



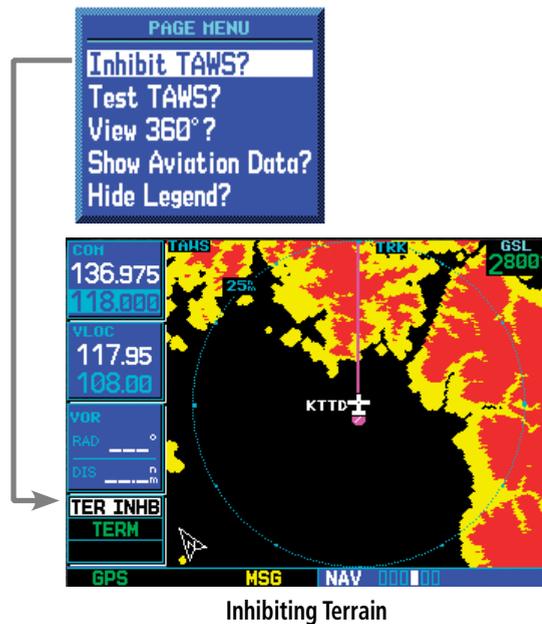
Select Show/Hide Legend

Inhibit Mode

TAWS provides an “inhibit mode”. This mode is designed to deactivate PDA/FLTA aural and visual alerts when they are deemed unnecessary by the aircrew. Flying VFR into an area where unique terrain exists could cause

the system to annunciate a nuisance alert. Pilots should use discretion when inhibiting the TAWS system and always remember to enable the system when appropriate. Only the PDA and FLTA alerts are disabled in the inhibit mode. See section 3 for more information on TAWS alerts.

TERRAIN configured units will restore the “inhibit state” at startup to the last pilot-selected setting. TAWS configured units will always start up with TAWS alerts uninhibited.



Inhibiting Terrain

To inhibit PDA and FLTA alerts:

1. Select the TAWS Page and press **MENU**. “Inhibit Terrain?” is selected by default.
2. Press **ENT**. The PDA/FLTA alerts are inhibited. The **TER INHB** annunciation is displayed in the terrain annunciator field whenever TAWS is inhibited.

To enable PDA and FLTA alerts:

1. Select the TAWS Page and press **MENU**. “Enable Terrain?” is selected by default.

2. Press **ENT**. The PDA/FLTA alerts are functional again.

External TAWS Inhibit Control

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

TAWS Manual Test

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



“Test TAWS” selection

To manually test the TAWS system:

1. Select the TAWS Page and press **MENU**.
2. Select the “Test TAWS?” option.
3. Press **ENT** to confirm the selection.

An aural message is played giving the test results:

- “**TAWS System Test, OK**” if the system passes the test
- “**TAWS System Failure**” if the system fails the test



NOTE: TAWS System Testing is disabled when ground speed exceeds 30 knots so as not to impede TAWS alerting.

TAWS Symbols

The symbols and colors in the following figure and table are used to represent obstacles and potential impact points on the TAWS Page. TAWS uses yellow and red to depict terrain information relative to aircraft altitude.

Each color is associated with an alert severity level. Terrain graphics and visual annunciations also use these color assignments.

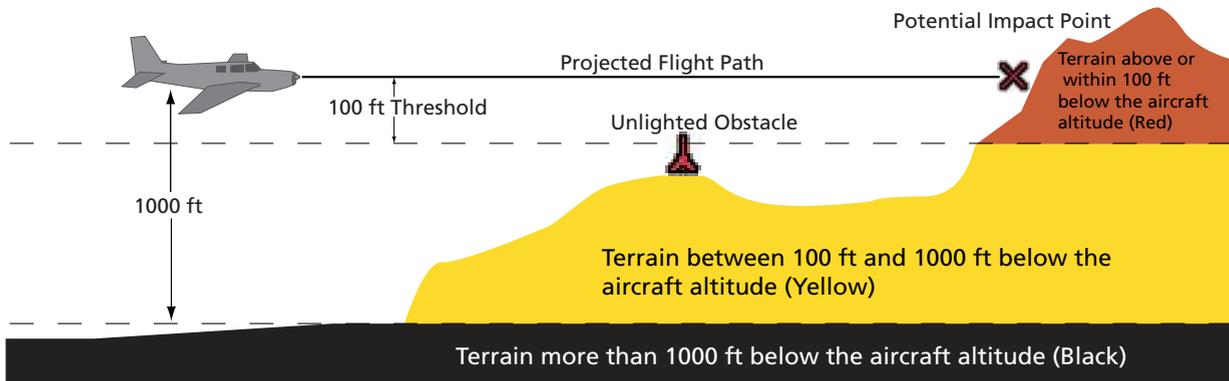
The zoom range of obstacles (on the TAWS and NAV pages) is controlled by the NAV map's "Setup Map" menu option in the "Terrain" group under the "Obstacles" option. Obstacles can be shown up to the maximum zoom range on the TAWS page. However, obstacles are ALWAYS shown on the TAWS page at 10 NM and below. Gray/White obstacles are shown on the Nav Map pages, but not on the TAWS page.



NOTE: 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 Page.

Potential Impact Point	Alert Level
	WARNING (Red)
	CAUTION (Yellow)

TAWS Alert Coloring and Symbology



TAWS Terrain Colors

Obstacle Symbol	Unlighted Obstacle		Lighted Obstacle		Color	Obstacle Location
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL		
				Red	Obstacle at or within 100 ft below current aircraft altitude	
				Yellow	Obstacle between 100 ft and 1000 ft below current aircraft altitude	

TAWS Obstacle Colors and Symbology

General Database Information

Garmin TAWS uses terrain and obstacle information supplied by government sources. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151b. **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 agencies. Garmin accurately processes and cross-validates the data, but cannot guarantee the accuracy and completeness of the data.

The terrain/obstacle databases are contained on a datacard which is inserted in the right-most slot of the 400W/500W Series units.

Database Versions

The version and area of coverage of each terrain/obstacle database is shown on the Terrain Database Versions Page, located in the AUX Page Group. Databases are checked for integrity at power-up. If a database is found to be missing and/or deficient, the TAWS system fails the self-test and displays the TAWS system failure message.



Terrain Database Information

Database Updates

Terrain/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 right 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 800-800-1020 or at www.garmin.com for more information.

To update your terrain/obstacle databases:

1. Acquire a new terrain data card from Garmin.
2. Turn off the power to the 500W Series unit.
3. Remove the old terrain data card and insert the new card into the right-most slot of the 500W Series unit.
4. Turn on the 500W Series unit and verify that the TAWS system passes self-test.

Terrain/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
Worldwide (WW)	Latitudes: N75° to S60° Longitudes: W180° to E180° Cycle 09T1 and later: Latitudes: N90° to S90° Longitudes: W180° to E180°
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

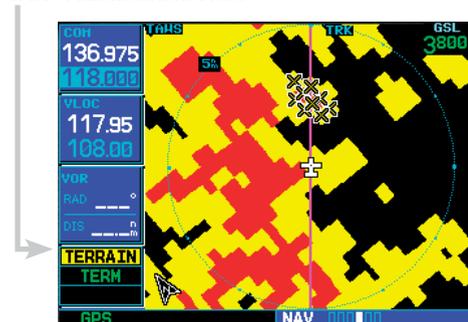


NOTE: It is very important to note that not all obstacles are necessarily charted and therefore may not be contained in the Obstacle Database.

Section 3: TAWs Alerts

Alerts are issued when flight conditions meet parameters that are set within TAWs software algorithms. TAWs alerts typically employ either a **CAUTION** or a **WARNING** alert severity level, or both. 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.

TAWs Annunciation Field



TAWs Annunciation Field

Annunciations are color-coded according to the TAWs Alert Summary table. Pop-up terrain alerts can also appear during an alert, but **only when the TAWs Page is not displayed**. There are two options when an alert is displayed:

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

Press the **CLR** button.

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

Press the **ENT** button.



NOTE: To further capture the attention of the pilot, TAWs issues aural (voice) messages that accompany visual annunciations and pop-up alerts. Some aural messages are configurable during installation of the system. For a summary of aural messages, see the TAWs Alert Summary table.



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

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. Any potential impact points 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.



TERRAIN

CAUTION—Estimated potential impact in approximately 30 seconds after a FLTA Caution pop-up alert and annunciation. FLTA caution alerts are accompanied by the aural message "Caution Terrain; Caution Terrain" OR "Terrain Ahead; Terrain Ahead". Similarly, a "Caution Obstacle; Caution Obstacle" or "Obstacle Ahead; Obstacle Ahead" 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.



PULL UP

WARNING— Estimated potential impact in approximately 15 seconds after a FLTA warning pop-up alert. FLTA warning pop-up alerts are accompanied by the aural message “*Terrain, Terrain; Pull Up, Pull Up*” or “*Terrain Ahead, Pull Up; Terrain Ahead, Pull Up*”. Similarly, a “*Obstacle, Obstacle; Pull Up, Pull Up*” or “*Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up*” alert is also provided. The time to an alert can vary with conditions, therefore there is no guarantee of a 15 second warning alert being issued.

Phase of Flight	Level Flight	Descending
En Route	700 ft.	500 ft.
Terminal	350 ft.	300 ft.
Approach	150 ft.	100 ft.
Departure	100 ft.	100 ft.

Minimum TERRAIN Clearance Values for FLTA Alerts



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

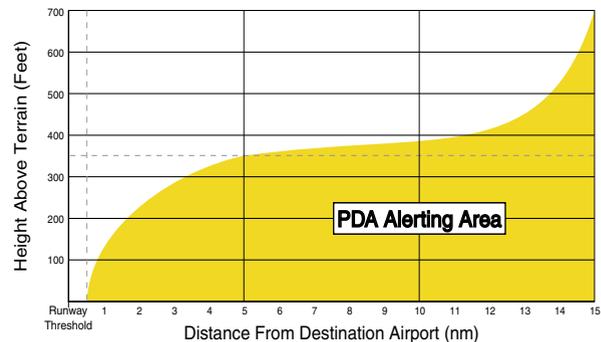
Premature Descent Alerting (PDA)

The TAWS system issues a Premature Descent Alert (PDA) when the system detects that the aircraft is significantly below the normal approach path to a runway. PDA begins when the aircraft is within 15 NM of the destination airport.



PDA ends when the aircraft is either:

- 0.5 NM from the runway threshold
- OR
- is below an altitude of 125 feet AGL while within 1.0 NM of the threshold.

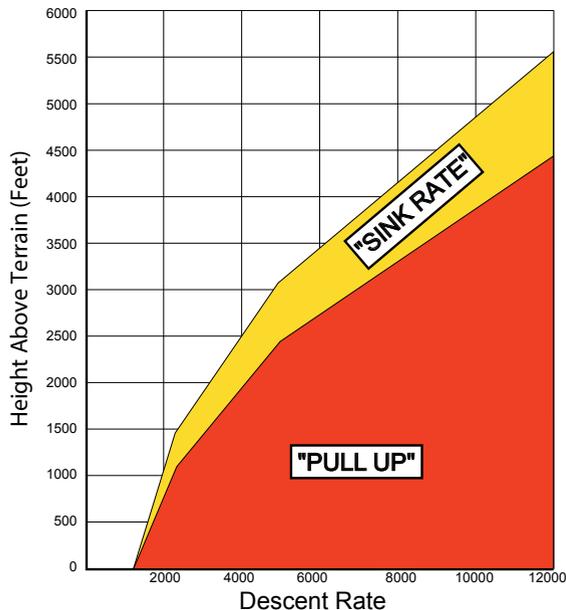


TERRAIN

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

Excessive Descent Rate Alert (EDR)

The purpose of the Excessive Descent Rate alert is to provide suitable notification when the aircraft is determined to be closing (descending) upon terrain at an excessive speed. The parameters for the alert as defined by TSO-C151b are shown in the Descent Rate graph.



Excessive Descent Rate Graph

Excessive Descent Rate Severity Levels



TERRAIN

CAUTION—The annunciation and pop-up terrain alert are accompanied by the aural message “Sink Rate”.



PULL UP

WARNING—The annunciation and pop-up terrain alert are accompanied by the aural message “Pull Up”.

Negative Climb Rate After Takeoff Alert (NCR)

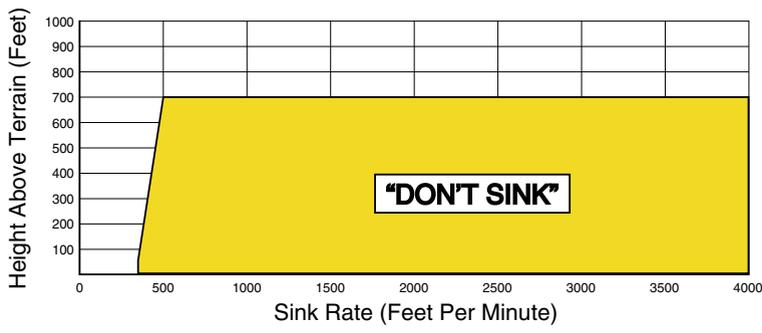
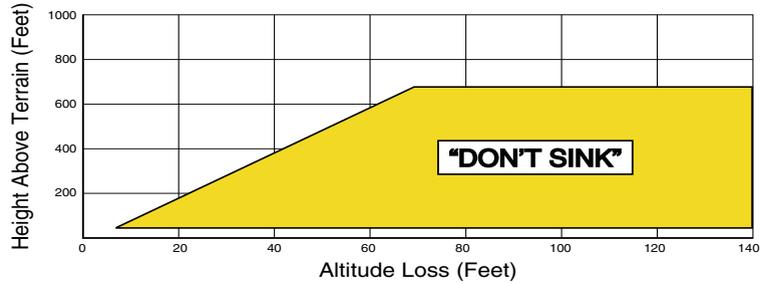
The purpose of the Negative Climb Rate After Takeoff alert (also referred to as “Altitude Loss After Takeoff”) is to provide suitable alerts to the pilot when the system determines that the aircraft is losing altitude (closing upon terrain) after takeoff. The aural message “Don’t Sink” is given for NCR alerts, accompanied by an annunciation and a pop-up terrain alert on the display.



NOTE: NCR alerting is only active when departing from an airport and when the following conditions are met:

- The height above the terrain is less than 700 feet
- The distance from the departure airport is 2 NM or less
- The heading change from the heading at the time of departure is less than 110 degrees

The NCR alerting parameters as defined by TSO-C151b are shown in the Negative Climb Rate Alert Criteria figures below. The NCR alert is issued when the altitude loss and height are within the range in the first figure, or when the sink rate (negative vertical speed) and height are within the range in the second figure.



Negative Climb Rate (NCR) Alert Criteria

“Five-Hundred” Aural Alert

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

TAWS Not Available Alert

Garmin TAWS 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 “TER N/A” is generated in the annunciation window. When the GPS signal is re-established and the aircraft is within the database coverage area, the “TER N/A” annunciation is removed.



No GPS Position

TAWS Failure Alert

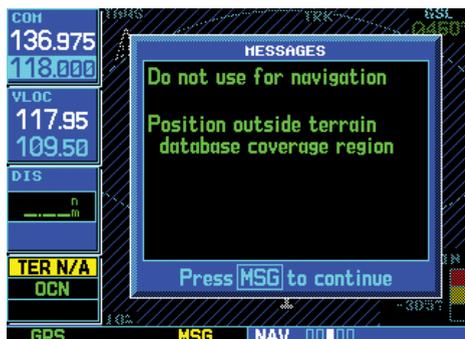
TAWS continually monitors several system-critical items, such as database validity, hardware status, and GPS status. If the terrain/obstacle database is not available, the aural message “TAWS System Failure” is issued along with the “TER FAIL” annunciation.



“TERRAIN NOT AVAILABLE” Display



TAWS FAILED Display



Position Outside Terrain Database Coverage

TAWS Alert Summary

The aural alert voice gender is configurable to be either male or female. Also, there are different alert text phrases available for several of the alerts, as shown below. See your Garmin installer for further information on configuring the alert system.

TAWS Alerts Summary

TAWS Annunciation	Pop-Up Alert	Aural Message	Description
TER FAIL	None	"TAWS System Failure"	TAWS has failed
TER INHB	None	None	TAWS has been inhibited by flight crew
TER N/A	None	"Terrain Not Available"	TAWS not available
TERRAIN	SINK RATE	"Sink Rate"	Excessive Descent Rate Caution
PULL UP	PULL-UP	"Pull Up"	Excessive Descent Rate Warning
TERRAIN	CAUTION - TERRAIN or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain" or "Terrain Ahead; Terrain Ahead"	Forward Looking Terrain Avoidance Caution for Terrain
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"	Forward Looking Terrain Avoidance Warning for Terrain
TERRAIN	OBSTACLE AHEAD or CAUTION - OBSTACLE	"Obstacle Ahead; Obstacle Ahead" or "Caution, Obstacle; Caution, Obstacle"	Forward Looking Terrain Avoidance Caution for Obstacle
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"	Forward Looking Terrain Avoidance Warning for Obstacle
TERRAIN	TOO LOW - TERRAIN	"Too Low, Terrain"	Premature Descent Alert Caution
TERRAIN	DON'T SINK or TOO LOW - TERRAIN	"Don't Sink" or "Too Low, Terrain"	Negative Climb Rate Caution
None	None	"Five-Hundred"	500 ft. AGL Altitude Callout



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

Pilot Actions

If a TAWS warning and associated aural are received, the pilot should immediately respond to the aural and pull up with maximum power and climb rate unless the terrain or obstacle is clearly identified visually and determined to not be a safety of flight factor. Reference FAR 91.223.

A TAWS caution indicates terrain or obstacle nearby. If possible visually locate the terrain or obstacle for avoidance. A TAWS warning may follow a TAWS 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.*

Part Four: HTAWS Interface

Section 1: Introduction



NOTE: Either the TERRAIN, TAWS (500W-series only), HTAWS, or Terrain Proximity functionality will be available via the Terrain page, depending on the installed hardware and configuration.

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 TAWS satisfies TSO-C194 requirements for certification.

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



HTAWS Page with Terrain Alert



NOTE: HTAWS-enabled units can be identified by observing the power-up screens. HTAWS-enabled units will display "HTAWS" after the model number. HTAWS-enabled units can also be identified by going to the Terrain page and checking the upper left-corner for "HTAWS."

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.

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.

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.

Section 2: HTAWS Operation

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.

Baro-Corrected 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 atmosphere 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.

Power Up

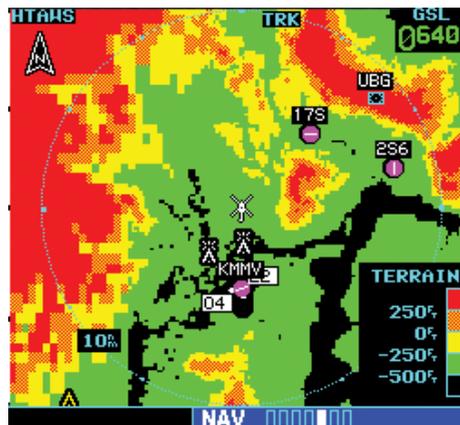
During power-up of the unit, the terrain/obstacle database versions are displayed along with a disclaimer to the pilot. At the same time, HTAWS self-test begins. HTAWS gives the following aural messages upon test completion:

- “**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.

HTAWS Page

The HTAWS Page is in the NAV group of pages (see the Pilot’s Guide for detailed information regarding page groups and pages).



HTAWS Page

To display the HTAWS Page, select the NAV group and turn the **small right** knob until the HTAWS Page is displayed. Terrain information, aircraft ground track, and GPS-derived MSL altitude are displayed on the page.

Altitude is shown in increments of 20 feet or in increments of 10 meters, depending on unit configuration. The “GSL” above altitude display in the top right corner of the display reminds the pilot that altitude is GPS-derived.

Page Menu

The HTAWS page menu provides options to acknowledge caution alerts, reduce protection, or inhibit alerting. The acknowledge caution alert functionality suppresses the issuance of caution aural messages, while still displaying the visual annunciations, but allows warnings to remain annunciated both visually and aurally.

The HTAWS Page has two selectable view settings:



120° Viewing Angle on the HTAWS Page

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



NOTE: The HTAWS Page gives a “Track Up” display orientation, as indicated by the “TRK” label shown on the display. This is the only orientation available for the HTAWS Page.

To display 120° or 360° view:

1. Select the HTAWS Page and press **MENU**. Select “View 120°?” or “View 360°?”.
2. Press **ENT**. The HTAWS Page displays the selected view. Repeat step 1 to select the alternate view, and press **ENT**.

Seven display ranges are available, allowing for a more complete view of the surrounding area.

To change the display range:

Select the HTAWS Page and press up or down on the **RNG** key to select the desired range: 1 NM, 2 NM, 5 NM, 10 NM, 25 NM, 50 NM, 100 NM.

Aviation information such as airports, VORs, and other nav aids can be turned on or off on the HTAWS Page.

To show or hide aviation information:

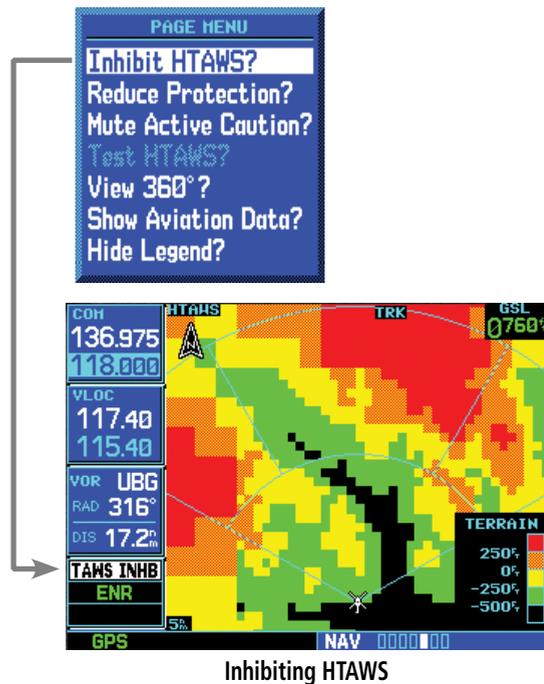
1. Press **MENU**.
2. Select “Show (or Hide) Aviation Data?” and press **ENT**. Pressing the **CLR** key when the HTAWS Page is displayed can also be used to toggle aviation information on or off.



Aviation Data

Inhibit Mode

HTAWS provides an “inhibit mode”. This mode is designed to deactivate 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. Select the HTAWS Page and press **MENU**. “Inhibit HTAWS?” is selected by default.
2. Press **ENT**. The HTAWS alerts are inhibited. The **TAWS INHB** annunciation is displayed in the terrain annunciator field whenever HTAWS is inhibited.



NOTE: When the ground speed falls below 30 knots HTAWS will automatically display the “TAWS INHB” annunciation. This indicates that HTAWS is no longer providing CFIT protection.

This automatic “TAWS INHB” cannot be removed by menu option selection. In fact, the menu option can still list the “Inhibit HTAWS” option when HTAWS is automatically inhibited due to speed.

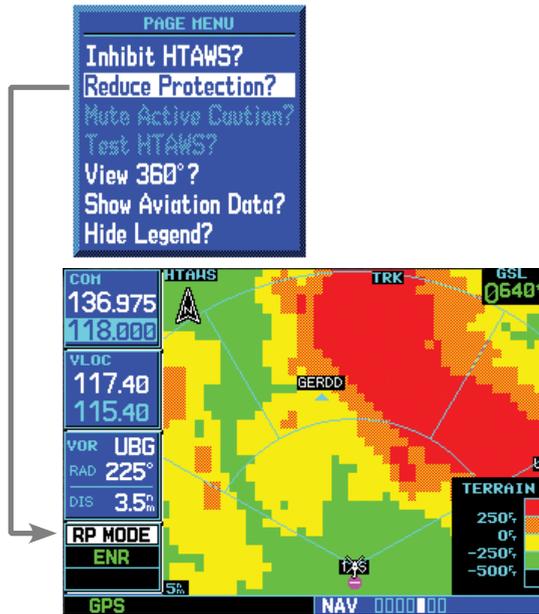
If the pilot selects any mode on the Menu while the unit is Auto-Inhibited because it is less than 30 knots then the unit will enter that mode once ground speed exceeds 30 knots. Hence the presence of these selections on the Menu.

External HTAWS Inhibit Control

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

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 Mute Caution switch.



Reducing HTAWS Protection

To reduce protection:

1. Select the HTAWS Page and press **MENU**. Turn the **large** or **small right** knob to highlight “Reduce Protection?”.
2. Press **ENT**. Protection is reduced. The “RP Mode” annunciation is displayed in the terrain annunciator field whenever protection is reduced.

To enable full protection:

1. Select the HTAWS Page and press **MENU**. Turn the **large** or **small right** knob to highlight “Enable Full Protection?”.



“Enable Full Protection” selection

2. Press **ENT**. Full protection is functional again.

Mute Active Caution

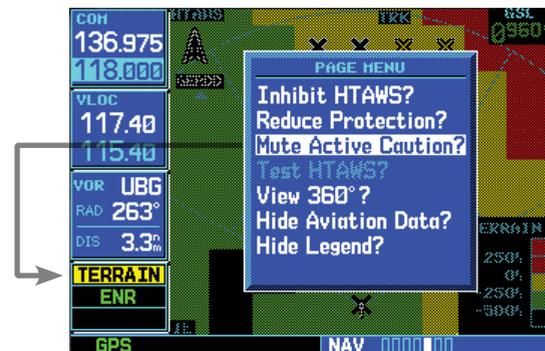
When an HTAWS Caution occurs, the “Mute Active Caution?” selection will be available on the Page Menu.



NOTE: 1) Selecting this only mutes the caution that is presently active - if the caution goes away, then the next caution will be heard, 2) It does not mute warnings, only cautions., 3) Mute Caution functionality via a remote switch may be installed.

To mute a caution:

1. Select the HTAWS Page and press **MENU**. Turn the **large** or **small right** knob to highlight “Mute Active Caution?”.



Mute HTAWS Caution

2. Press **ENT**. The caution will be muted.

To unmute active caution:

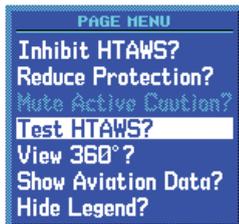
1. Select the HTAWS Page and press **MENU**. Turn the **large** or **small right** knob to highlight “Unmute Active Caution?”.



2. Press **ENT**. The active cautions will be unmuted.

HTAWS Manual Test

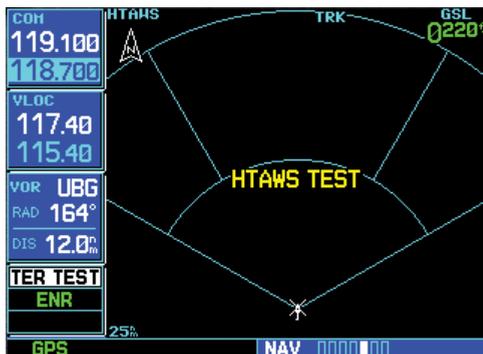
Garmin HTAWS provides a manual test capability which verifies the proper operation of the aural and visual annunciations of the system prior to a flight.



"Test HTAWS" selection

To manually test the HTAWS system:

1. Select the HTAWS Page and press **MENU**.
2. Select the "Test HTAWS?" option.
3. Press **ENT** to confirm the selection.



HTAWS Test Display

An aural message is played giving the test results:

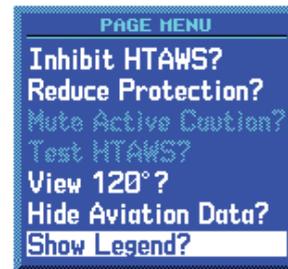
- "**HTAWS System Test, OK**" if the system passes the test
- "**HTAWS System Failure**" if the system fails the test



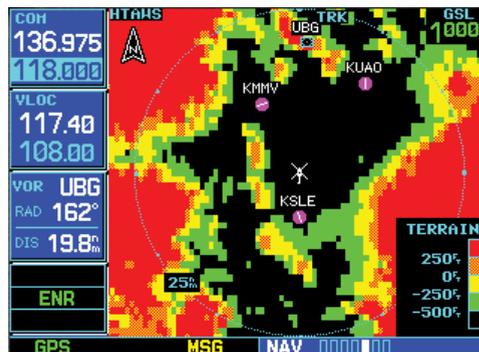
NOTE: HTAWS System Testing is disabled when ground speed exceeds 30 knots so as not to impede HTAWS alerting.

HTAWS Legend

1. Select the HTAWS Page and press **MENU**. Turn the **large** or **small right** knob to highlight "Hide Legend?" or "Show Legend?."



2. Press **ENT**. The legend will be hidden or shown as selected.



HTAWS Display with 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.

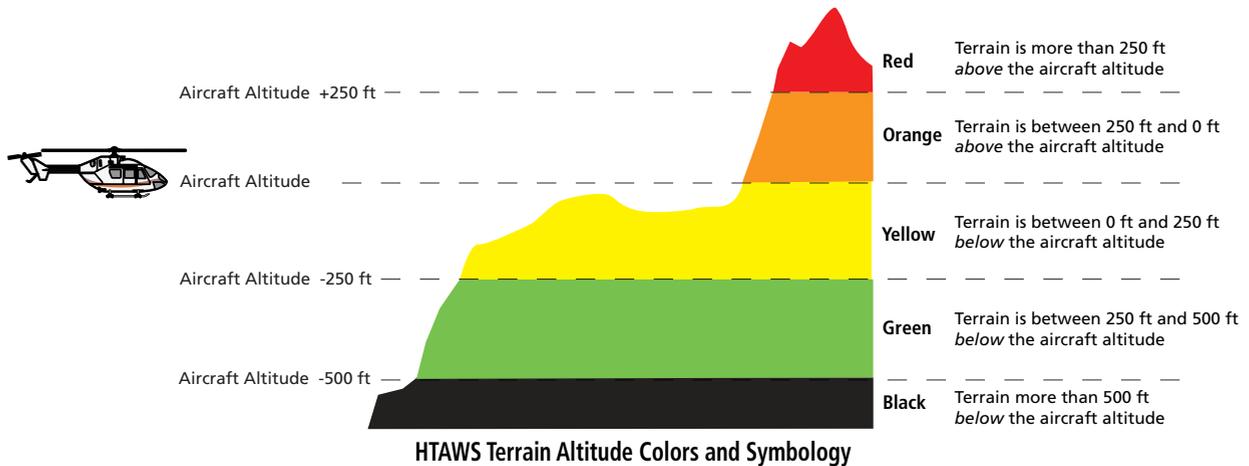
HTAWS Symbols

The symbols and colors in the following figures and table are used to represent obstacles and potential impact points 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.

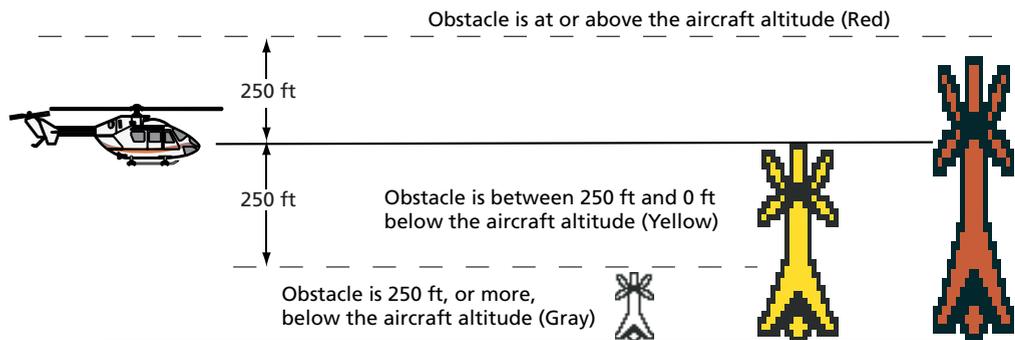


NOTE: If an obstacle or terrain cell and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest potential point of impact on the HTAWS Page.



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	

HTAWS Obstacle Colors and Symbology



HTAWS Obstacle Altitude Colors and Symbology

Potential Impact Point	Alert Level
	WARNING (Red)
	CAUTION (Yellow)

HTAWS Alert Coloring and Symbology



NOTE: The cutouts are for display purposes only and do not affect the performance of HTAWS.

General Database Information

Garmin 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. Pilots must familiarize themselves with the appropriate charts for safe flight.**



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.

Airport/Heliport Terrain “Cutouts”

For software version 4.00 and later: when configured for helicopters (the helicopter icon will be displayed), black, circular or oblong “cutouts” will be displayed on the Terrain Page around airports and heliports, to enhance viewing of the information displayed for those locations. The Terrain legend (shown in the lower right of the display on the Terrain Page) defines the color black as -500 ft. However, this does not apply to the black cutouts surrounding the airports and heliports.



Airport and Heliport Cutouts

The terrain/obstacle databases are contained on a datacard which is inserted in the right-most slot of the 400W/500W Series units.

Database Versions

The version and area of coverage of each terrain/obstacle database is shown on the Terrain Database Versions Page, located in the AUX Page Group. Databases are checked for integrity at power-up. If a database is found to be missing and/or deficient, the HTAWS system fails the self-test and displays the HTAWS system failure message.



Terrain Database Information

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

- 6 arc-second Terrain Database
- Helicopter Obstacle Database
- Helicopter Aviation Database including Heliports

Database Updates

Terrain/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 right 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 800-800-1020 or at www.garmin.com for more information.

To update your terrain/obstacle databases:

1. Acquire a new terrain data card from Garmin.
2. Turn off the power to the unit.
3. Remove the old terrain data card and insert the new card into the right-most slot of the unit.
4. Turn on the unit and verify that the HTAWS system passes self-test.

Terrain Database Areas of Coverage

The following describes the area of coverage available in each 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°

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	

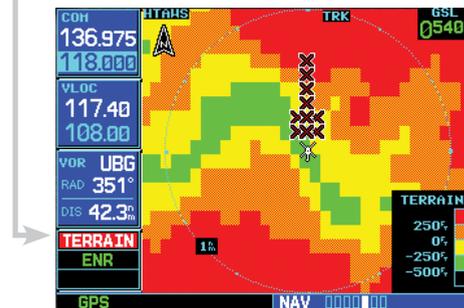


NOTE: It is very important to note that not all obstacles are necessarily charted and therefore may not be contained in the Obstacle Database.

Section 3: 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.

HTAWS Annunciation Field



HTAWS Annunciation Field

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:

Press the **CLR** button.

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

Press the **ENT** button.



NOTE: To further capture the attention of the pilot, HTAWS issues aural (voice) messages that accompany visual annunciations and pop-up alerts. Some aural messages are configurable during installation of the system. 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.

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 potential impact points 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.



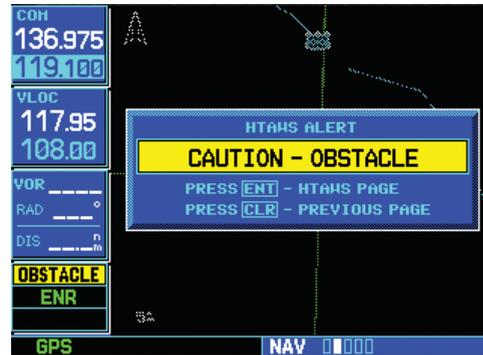
TERRAIN

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”* OR *“Terrain Ahead; Terrain Ahead”*. Similarly, a *“Caution Obstacle; Caution Obstacle”* or *“Obstacle Ahead; Obstacle Ahead”* 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 X's 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”*.



Voice Call Out Aural Alert

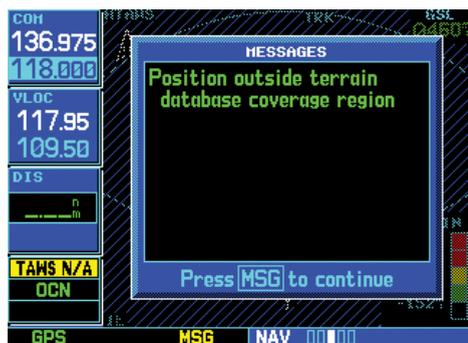
The purpose of the Voice Call Out aural alert messages are to provide an advisory alert to the pilot that the aircraft is between 500 feet and 100 feet above terrain in 100 foot increments. When the aircraft descends within the selected distance from the terrain, the aural message for the selected distance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

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 “TAWS N/A” is generated in the annunciation window. When the GPS signal is re-established and the aircraft is within the database coverage area, the “TAWS N/A” annunciation is removed.



“TAWS NOT AVAILABLE” Display



Position Outside Terrain Database Coverage



No GPS Position

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 “TAWS FAIL” annunciation.



HTAWS FAILED Display

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.

Pilot Actions

If a 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.

HTAWS Alerts Summary

HTAWS Annunciation	Pop-Up Alert	Aural Message	Description
TAWS FAIL	None	"HTAWS System Failure"	HTAWS has failed
TAWS INHB	None	None	HTAWS has been inhibited by the crew, or the aircraft groundspeed has fallen below 30 knots (automatic inhibiting).
TAWS 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
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.
None	None	"Five Hundred" "Four Hundred" "Three Hundred" "Two Hundred" "One Hundred"	HTAWS provides optional 500 ft through 100 ft (in 100 ft increments) altitude call out alerts.



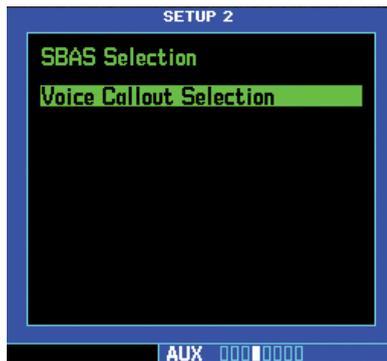
NOTE: HTAWS Caution Alerts are displayed as constant black text on a yellow background; HTAWS Warning Alerts are displayed as constant white text on a red background.

Voice Call Out Selection

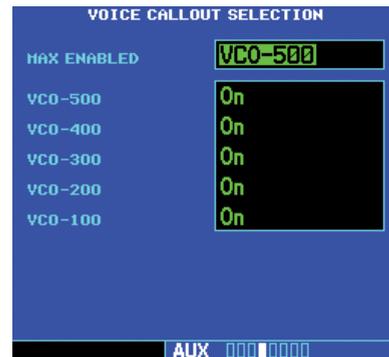
The Voice Call Out (VCO) selection is available where HTAWS is installed. The VCO functionality provides a voice annunciation of the aircraft's height above terrain or the nearest airport, heliport, runway, or helipad when that threshold is first crossed. The available call outs include "Five Hundred" through "One Hundred" in one hundred foot intervals. The voice call outs can be enabled and disabled through the Voice Call Out Selection option on the AUX - SETUP 2 page.

To select the Voice Call Out choices, in the Setup 2 page select the Voice Call Out Selection item and then select the desired options.

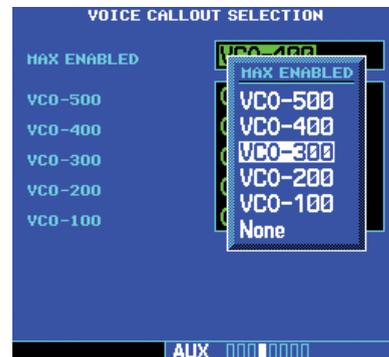
1. Select "Voice Callout Selection" from the Setup 2 Page and press **ENT**.



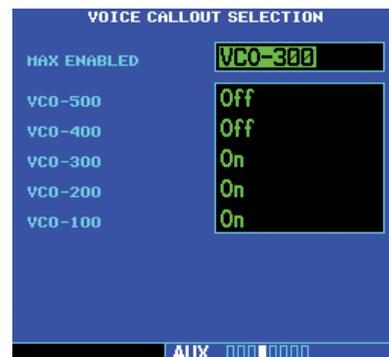
2. The flashing cursor highlights the VCO selection.



3. Turn the **small right** knob to highlight the desired VCO value.



4. Press **ENT**. The values above the selected value will be disabled.



Part Five: Terrain Proximity Interface



NOTE: Either the TERRAIN, TAWS (500W-series only), HTAWS, or Terrain Proximity functionality will be available via the Terrain page, depending on the installed hardware and configuration. .

Introduction

Garmin Terrain Proximity is an optional non-TSO-certified terrain awareness feature of the 400W/500W series available in helicopter configurations to increase situational awareness and help reduce controlled flight into terrain (CFIT). Terrain Proximity is available in the Nav page group Terrain pages. Terrain Proximity depicts nearby terrain and obstacles relative to the aircraft altitude, however it does not provide any alerts.

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 provide terrain coloring that depicts terrain elevation relative to the aircraft. 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.

Terrain Proximity utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, Terrain Proximity 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 increases awareness of the aircraft proximity to terrain and obstacles.

Terrain Proximity requires the following to operate properly:

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

Displaying Terrain Proximity

The Terrain Proximity page is in the Map page group.

1. Turn the **large right** knob to the Map function.
2. Then, the **small right** knob to the Terrain Proximity page.



Terrain Proximity Page

Terrain Proximity 120° Arc or 360° Rings

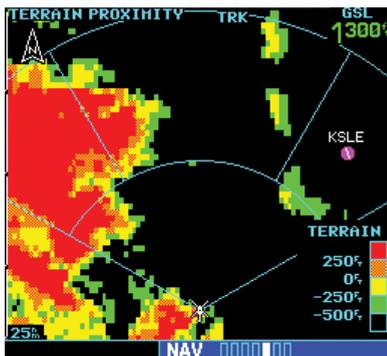
Select the 120° Arc or 360° rings overlay for the Terrain Proximity page with the Page Menu.

1. Press the **MENU** key to display the Page Menu. The "View 120°" or "View 360°" option will be highlighted.



Select 120° View

2. Press the **ENT** key to accept the displayed selection. Repeat these steps to toggle between the two selections.



120° View Selected

Terrain Proximity Aviation Data

Select the display of Aviation data on the Terrain Proximity page. The Page Menu selections allow you to hide or show aviation data overlay on the Terrain Proximity page.

1. Press the **MENU** key to display the Page Menu and turn the **small right** knob to highlight the Aviation Data selection.



Select "Show Aviation Data"

2. Press the **ENT** key to accept the displayed selection. Repeat these steps to toggle between the two selections.

Terrain Proximity Legend

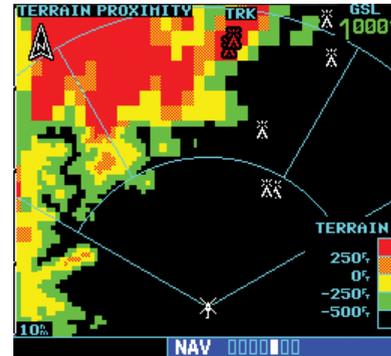
Select the display of the Terrain color legend on the Terrain Proximity page from the Page Menu.

1. Press the **MENU** key to display the Page Menu and turn the **small right** knob to highlight the Legend selection.

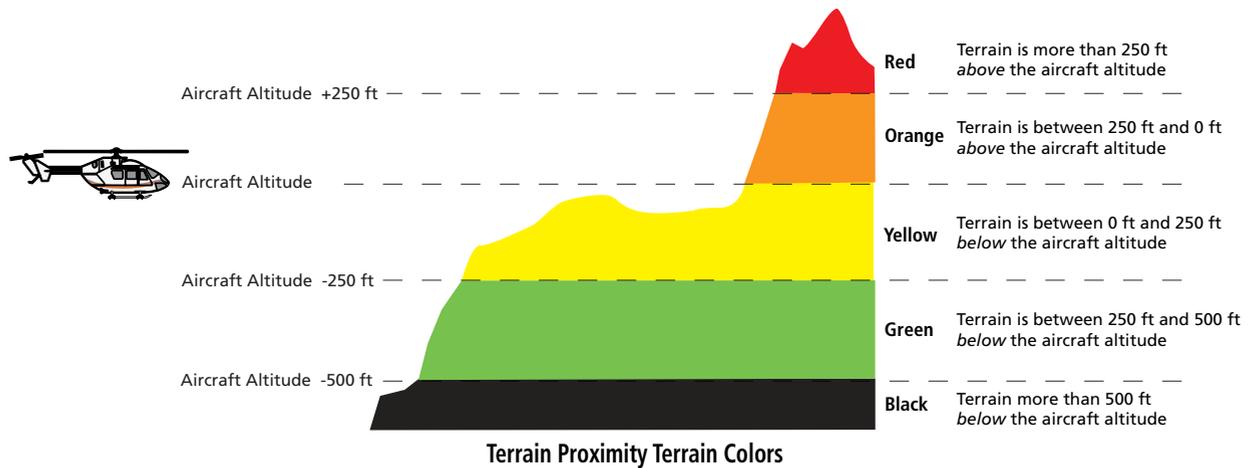


Select "Show Legend"

2. Press the **ENT** key to accept the displayed selection. Repeat these steps to toggle between the two selections.



Terrain Legend Shown in Lower Right Corner



Obstacle Symbol	Unlighted Obstacle		Lighted 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	

Terrain Proximity Obstacle Coloring and Symbology

Terrain Proximity Limitations

Terrain Proximity displays terrain and obstructions relative to the altitude 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 or to maneuver to avoid obstacles.

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

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 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.*

System Status

The Terrain Proximity system continually monitors several system-critical items, such as Terrain Proximity database validity, hardware status, and GPS status. The Terrain Proximity page will post the message “NO DATA” when the terrain database is not available.

A blue cross-hatching pattern is shown when out of the area of coverage, but no system message is posted.

Part Six: Garmin GTS 8XX Series Interface

Introduction

The Garmin GTS 8XX Series unit is a Traffic Advisory System (TAS - GTS 800 and GTS 820) or Traffic Alert and Collision Avoidance System (TCAS I - GTS 850). The GTS 8XX Series enhances flight crew situational awareness by displaying traffic information for transponder-equipped aircraft. The GTS 8XX Series also provides visual and aural traffic alerts including voice announcements to assist in visually acquiring traffic. The GTS 800 and GTS 820 are TAS systems, the GTS 850 is a TSO-approved TCAS I system. The GTS 8XX uses active interrogations of Mode A/C/S transponders to provide Traffic Advisories.



The Standby Screen appears when the GTS 8XX series passes the power-up test.

NOTE: when the system is in standby, the GTS 8XX series does not transmit, interrogate, or track intruders aircraft.

GTS 8XX Series Description

Please refer to the GTS 8XX Series Pilot's Guide for a complete description of the GTS 8XX Series Traffic system.



Traffic Page showing GTS 8XX series traffic near the 40 NM mile range, at 10 o'clock above.

Power-up Self-Test

Check for the following test criteria on the Traffic Page during power-up:

1. If the GTS 8XX series unit passes the power-up test and your aircraft has both a squat switch and is on the ground, the Standby Screen is displayed (see sidebar).
2. If the GTS 8XX series unit passes the power-up test and your aircraft has both a squat switch and is airborne, the Traffic Page is displayed on the 6-NM display range and in the normal altitude display mode.
3. If the GTS 8XX series unit passes the power-up test and your aircraft does not have a squat switch, the Standby Screen is displayed.
4. If the display indicates that the GTS 8XX series unit has failed, please refer to the failure response section in the GTS 8XX Series Pilot's Guide on actions to take.

To begin tracking intruder aircraft:

1. Press the **cursor** knob and highlight **STBY**.
2. Turn the **small right** knob to select **OPER**.
3. Press **ENT** to confirm operating mode and begin tracking intruder aircraft.



Operating Mode is confirmed by the display of "OPER" in the upper right-hand corner of the Traffic Page.



NOTE: The *FAILED* message occurs when the system detects an error and prohibits further traffic display operation as long as this message stays on the screen.

User-initiated Test



NOTE: A user-initiated test can only be performed when in standby or failed mode.

In addition to the power-up test, the GTS 800 series unit performs a continuous self-test. This continuous self-test is performed several times per minute. A user-initiated test of the GTS 8XX series unit interface can also be performed.

To perform a user-initiated test:

1. Turn the **small right** knob to select the Traffic Page.
2. From the Traffic Page, press **MENU** to display the Page Menu.
3. Turn the **small right** knob to select "Self Test?" and press **ENT**.

Voice Announcements

See the GTS 8XX Series Pilot's Guide for information on voice announcements.

Switching Between Standby and Operating Modes

The unit must be in operating mode for traffic to be displayed. The ability to switch out of standby into operating mode on the ground is especially useful for scanning the airspace around the airport before takeoff.

To switch into Operating Mode from Standby Mode:

1. Press the **cursor** knob and highlight "STBY". Turn the **small right** knob to select "OPER?".
2. Press **ENT** to confirm and place the GTS 8XX series unit in operating mode.



NOTE: The GTS 8XX series unit switches out of standby into the 6-NM display range. If your aircraft has a squat switch and you do not manually switch out of standby, the GTS 8XX series unit will automatically switch out of standby 8 to 10 seconds after takeoff.

To switch into Standby Mode from the Traffic Page:

1. Press the **cursor** knob and highlight "OPER".
2. Turn the **small right** knob to select "STBY?".
3. Press **ENT** to confirm and place the GTS 8XX series unit in standby mode.



NOTE: If your aircraft has a squat switch, *STBY* is not displayed while you are airborne but will go into standby 24 seconds after landing. This delay allows the GTS 8XX series unit to remain in the operating mode during a touch-and-go maneuver.

Altitude Display Mode

The GTS 8XX has four altitude display modes: Normal ($\pm 2,700$ feet), Above ($-2,700$ feet to $+9,000$ feet), Below ($-9,000$ feet to $+2,700$ feet), and Unrestricted ($\pm 9,900$ feet). The GTS 8XX 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 name of the selected altitude display mode (ABV: look up, NRM: normal, BLW: look down, or UNR: unrestricted) is displayed in the upper left-hand corner of the Traffic Screen. The GTS 8XX series continues to track up to 30 intruder aircraft within its maximum surveillance range, regardless of the altitude display mode selected.

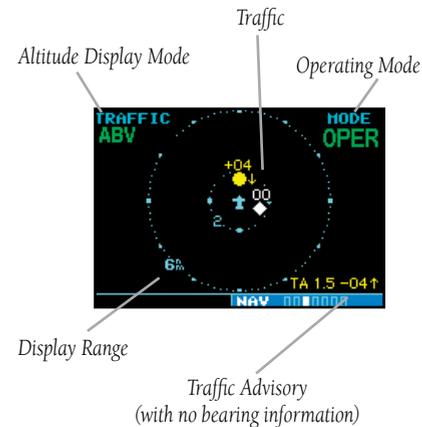
To change the Altitude Display Mode:

- From the Traffic Page, turn the **cursor** on, highlight the current mode and turn the **small right** knob to cycle through the options.
- With each turn of the knob, the screen changes to display the traffic detected within the selected altitude display range. The 400W/500W Series screen also displays unrestricted traffic (UNR) having a range of maximum specified by the GTS 8XX series unit Pilot's Guide. Please refer to the GTS 8XX series unit Pilot's Guide for information regarding altitude display ranges.

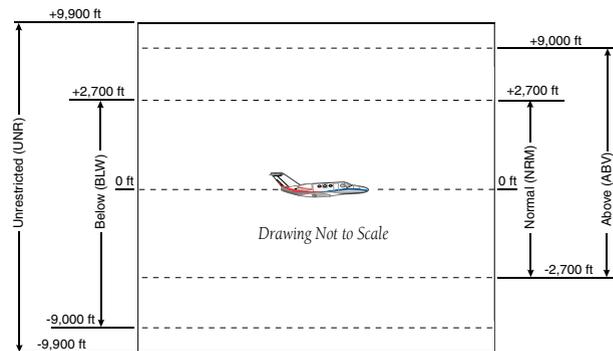
- Note that confirmation is not required. The mode is changed immediately when using the **small right** knob. Turn the **cursor** off when selection is made.

Traffic Page

Traffic can be displayed both on the Map Page (only if heading is available) and on the Traffic Page.



Traffic Page



Altitude Display Modes

TAS Symbol	Traffic Type	Description
	Other Traffic Symbol	The hollow white (may be configured as cyan) diamond represents traffic detected within the selected display range that does not meet the criteria for a TA or a PA and does not pose an immediate collision threat.
	Proximity Advisory (PA)	Proximity Advisories (PA) are displayed as solid white (may be configured as cyan) diamonds. PA's are defined as traffic within 6 NM, within 1200 feet of vertical separation, and are not a Traffic Advisory (TA)
	Traffic Advisory (TA)	A Traffic Advisory (TA) is generated when the GTS 8XX predicts that an intruder aircraft may pose a collision threat. A solid yellow circle represents an intruder aircraft that meets the TA criteria as described in the TA Alerting Conditions section. A TA consists of the traffic symbol and an aural alert (e.g., "traffic, 12 o'clock, high, 3 miles").
	Out-of-Range Traffic Advisory	This solid yellow half circle appears (on the outer range ring) under the same conditions and has the same urgency as a TA. Its appearance differs from the TA only to signify that the intruder is outside of the current range of the Traffic page.

TAS/TCAS Symbology

Traffic Warning Window

When the unit is not on the traffic page and a traffic threat is imminent, the Traffic Warning Window is displayed. The Warning Window shows a small map and can display the Traffic Page (if the user presses **ENT**) or return to the previous page (if the user presses **CLR**).



Traffic Warning Window



NOTE: The Traffic Warning Window is disabled when the aircraft ground speed is less than 30 knots or when an approach is active, unless the unit is configured for helicopter operation as noted by the helicopter ownership icon.



NOTE: GTS 8XX series unit data is only displayed on the Map Page if suitable aircraft heading data is available. See the Garmin 400W or 500W Series Installation Manuals available at your authorized Garmin service center for details.

Traffic Page Display Range

You can change the display range on the Traffic Page at any time.

Press the **RNG Key** to cycle through the following range options:

- GTS 800 - 2 NM, 2 and 6 NM, 6 and 12 NM, 12 and 24 NM.
- GTS 820 and 850 - 2 NM, 6 NM, 12 NM, 24 NM, and 40 NM.

Configuring Traffic Data on the Map Page

Traffic is only displayed on the Map Page if aircraft heading data is available. When heading is not available, Traffic Advisories are displayed as non-bearing banners on the Map Page.



Selections for configuring traffic data are made from the Map Setup Menu on the Map Page.

To configure traffic on the Map Page:

1. Turn the **small right** knob to select the Map Page.
2. Press **MENU** to display the Page Menu. Turn the **small right** knob to select "Setup Map?" and press **ENT**.
3. The flashing cursor highlights the **GROUP** field. Turn the **small right** knob to select Traffic and press **ENT**.
4. Turn the **large right** knob to select the desired Traffic group option. Turn the **small right** knob to select the desired option and press **ENT**. Repeat the step for Traffic Symbol and Traffic Label.
5. Return to the Map Page by pressing **CLR**.

The Traffic group allows the operator to choose which traffic is displayed (all traffic, traffic and proximity advisories, or traffic advisories only). The traffic symbol is the symbol used to depict the type of traffic:



NOTE: Proximity Advisories (PA) are displayed as solid white diamonds (may be configured as cyan). The GTS 800 shows these PAs as "other" (hollow diamonds). PAs are defined as traffic within the 6.0-NM range, with ± 1200 feet of altitude separation, and not a traffic advisory (TA).

The traffic label is the altitude separation above or below the symbol and the vertical speed sense arrow to the right of the symbol. From the Map Page, you can display traffic in a thumbnail format in any of the top three data fields (top four fields on the 500W Series) on the right side of the Map Page.



When a Traffic Advisory is active, the "Traffic" banner is displayed in the lower right corner of the Map Page.

To display Thumbnail Traffic on the Map Page

1. Turn the **small right** knob to select the Map Page.
2. Press **MENU** to display the Page Menu.
3. Turn the **small right** knob to select "Change Fields?" and press **ENT**.
4. Select one of the top three fields (top four fields on the 500W Series). Select TRFC from the Select Field Type List and press **ENT**. Note that the thumbnail range defaults to 6 NM and cannot be changed.

Highlighting Traffic Data Using Map Panning

Another map page function is panning, which allows you to move the map beyond its current limits without adjusting the map scale. When you select the panning function—by pressing the **small right** knob—a target pointer flashes on the map display. A window also appears at the top of the map display showing the latitude/longitude position of the pointer, plus the bearing and distance to the pointer from your present position.



When the target pointer is placed on traffic, the traffic range and altitude separation are displayed.

To select the panning function and pan the map display:

1. Press the **small right** knob to activate the panning target pointer.
2. Turn the **small right** knob clockwise to move up, or turn it counterclockwise to move down.
3. Turn the **large right** knob clockwise to move right, or turn it counterclockwise to move left.
4. To cancel the panning function and return to your present position, press the **small right** knob.

When the target pointer is placed on traffic, the traffic range and altitude separation are displayed. The traffic is identified as:

TA: Traffic Advisory, **PA:** Proximity Advisory,

TRFC: Other Traffic

Monitoring Traffic

See the information in the GTS 8XX Series Pilot's Guide regarding monitoring traffic on the display and the corresponding actions to take.

Failure Response

Errors indicated by a "FAILED" message on the screen prevent continued use of the GTS 8XX Series unit. Please see the GTS 8XX Series Pilot's Guide for detailed information on Failure Response.

Description of Traffic Advisory Criteria

For a description of Traffic Advisory criteria and display interpretation, please see the GTS 8XX Series Pilot's Guide.



The GTS 8XX Series Pilot's Guide contains detailed information on traffic advisory and display interpretation.

Part Seven: Garmin ADS-B Interface

Section 1: Introduction

The GNS has the ability to display ADS-B information from a variety of compatible Garmin sources. This includes ADS-B traffic information, FIS-B weather products, and traffic information from TIS-B as well as legacy TCAS/TCAD systems. The display output will vary slightly depending on the specific devices connected and the operating environment. Refer to specific device operating manuals for more detailed information.

Section 2: FIS-B Weather

Flight Information Services (FIS) Description

Review the Limitations section in the front of this guide for the limitations that apply to the FIS-B data.

The FIS-B 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). Low flying aircraft may not receive FIS-B weather updates due to terrain blocking the GBT broadcast.

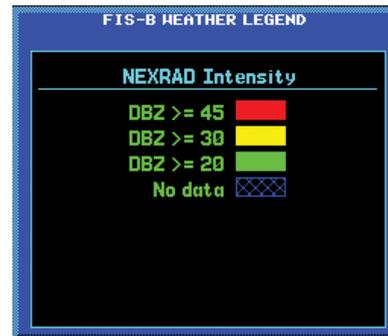
The Flight Information Services (FIS) function provides text and graphic weather information for aircraft equipped with a compatible device. No subscription is required for FIS-B services.

FIS-B weather data reception requires line-of-site communication between the receiver and the ADS-B ground station. Incomplete Regional and/or CONUS NEXRAD imagery displayed on the MAP and FIS-B Weather Pages of the affected products is an indicator of poor FIS-B reception.

Graphical Weather Display

NEXRAD

Graphical weather data is overlaid on the map indicating the precipitation (intensity) detected by ground based radar for a specific area. The colors indicating increasing levels of rainfall progresses from green for light precipitation to red for heavy precipitation. FIS-B weather does not differentiate between liquid and frozen precipitation. Precipitation data is color coded as follows:



FIS-B Weather Legend

A cyan checkerboard pattern indicates that no data is available for that area.

After weather data is received, the GNS will display that Region NEXRAD data for 30 minutes and CONUS NEXRAD for 60 minutes. After the expiration time the data will be removed, "NXRD: N/A" will be displayed.



UAT FIS-B Graphic Weather Info with the GDL 88
(or similar device)

Affected Areas

Any area in the continental United States (CONUS) or Alaska where the distance from ADS-B ground stations or the combined effect of distance and low altitude is sufficiently great to cause poor reception. A good source of information for ground station coverage can be found at <http://www.faa.gov/nextgen/flashmap/>

Reception will improve in some affected areas as the FAA completes the NextGen ADS-B ground station infrastructure. However, due to line-of-sight broadcast characteristics, operators with properly installed and functioning equipment may still receive incomplete FIS-B data when signal reception is limited by the distance from ground stations combined with a low altitude.

The example below displays an area where FIS-B data is degraded due to poor reception:



Example of Areas Where FIS-B Reception Is Incomplete

NEXRAD Description

WSR-88D weather surveillance radar or NEXRAD (NEXT generation RADar) is a Doppler radar system that has greatly improved the detection of meteorological events such as thunderstorms, tornadoes, and hurricanes. An extensive network of NEXRAD stations provides almost complete radar coverage of the continental United States, Alaska, and Hawaii. The unobstructed range of each NEXRAD is 124 nautical miles. The update rate is 2.5 minutes for Regional NEXRAD and 15 minutes for CONUS NEXRAD.

NEXRAD Abnormalities

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

- Ground Clutter
- Strokes and spurious radar data
- Sun strobes, when the radar antenna points directly at the sun
- Military aircraft deploy metallic dust which can cause alterations in radar scans
- Interference from buildings or mountains, which may cause shadows
- Scheduled maintenance may put a radar off-line

NEXRAD Limitations

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

- The (high resolution) Regional NEXRAD “pixels” are 1.5 minutes (1.5 nautical miles = 2.78 km) wide by 1 minute (1 nautical miles = 1.852 km) tall. The (medium resolution – 5 times larger than high resolution) CONUS NEXRAD “pixels” are 7.5 minutes (7.5 nautical miles = 13.89 km) wide by 5 minutes (5 nautical miles = 9.26 km) wide. Above 60 degrees of latitude the block widths double to

3 minutes/nautical miles for Regional (no CONUS above 60 degrees). The intensity level reflected by the pixel will be the highest level sampled within the area covered by each pixel.

NEXRAD Intensity

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

NEXRAD Options

When selected for display, NEXRAD precipitation intensity information is shown. Composite data from all of the NEXRAD radar sites in the United States for the selected area is shown. This data is composed of the maximum reflectivity from the individual radar sweeps. The display of the information is color-coded to indicate the weather level severity. Information about which sites are operational or off-line is also available (see coverage below). Refer to the legend for a description of the color code.

The NEXRAD option has selections of Regional, CONUS, or Combined NEXRAD. CONUS NEXRAD includes a composite of available NEXRAD radar imagery across the 48 states. Regional NEXRAD is a composite of available NEXRAD radar imagery in a local area, showing a more detailed image than CONUS NEXRAD.

To select CONUS NEXRAD, REGION NEXRAD, or graphic METARs on the Nav Weather page:

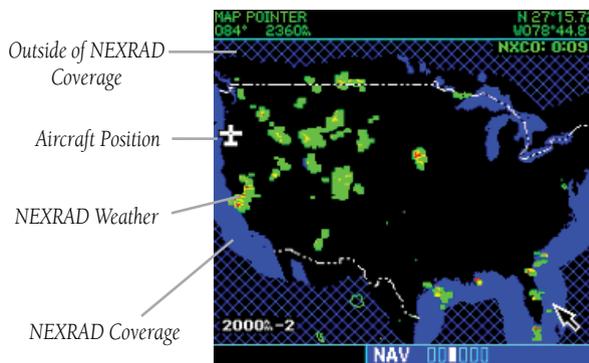
1. In the NAV group, turn the **small right** knob to the FIS-B Weather page.
2. Press the **small right** knob to activate selection.
3. Turn the **small right** knob to select CONUS NEXRAD, REGION NEXRAD, or METARs.
4. Press the **small right** knob to save the displayed selection.

To select CONUS NEXRAD or REGION NEXRAD on the Nav Map pages:

1. In the NAV group, turn the **small right** knob to the Nav Map page (Nav page 2).
2. Press the **MENU** key.
3. Turn the **small right** knob to select Display CONUS NEXRAD or Display RGN NEXRAD.
4. Press the **ENT** key to save the displayed selection.

Continental US NEXRAD (CONUS)

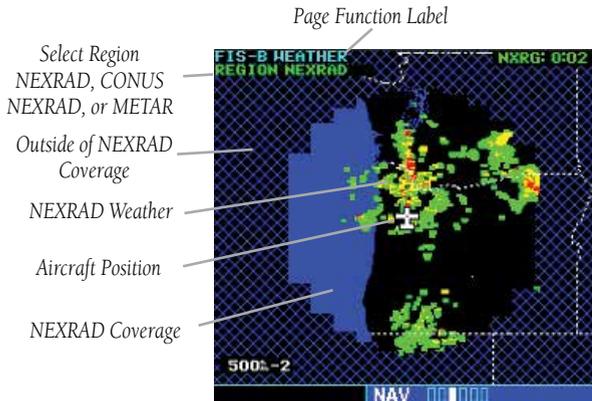
The Display CONUS NEXRAD selection shows NEXRAD radar information for the entire continental United States.



Weather Page With CONUS NEXRAD Displayed

Regional NEXRAD

The Display RGN NEXRAD selection shows NEXRAD radar information for the region near the aircraft location. Regional NEXRAD is a higher resolution display of the weather data.



Weather Page With Region NEXRAD Display

Graphical METARs

When selected for display, graphic METARs (METeorological Aviation Reports) are shown as colored flags at airports that provide METAR reports. Refer to the Legend for a description of the color code. The update rate is every five minutes and there is a 90 minute expiration time.



NOTE: If both a GDL 69 and ADS-B device are interfaced to the GNS then the textual METARS and TAF pages will show the most recent data and the source of the data will be indicated (FIS-B or XM).

METARs are shown as colored flags at airports that provide them.



1. Press **MENU** to display the Page Menu. Turn the **large** or **small right** knob to highlight "Display Legend?"



2. Press the **ENT** key to display the METAR legend.



Textual METARs:

1. In the WPT group, turn the **small right** knob to the FIS-B Textual METAR page. Textual METARs for the flight plan destination airport are shown by default.



2. To select a different airport, press the **small right** knob to activate the cursor. The Airport ident will blink.
3. Turn the **small** or **large right** knob to select the desired airport.



4. Press the **small right** knob again to turn the selection cursor off.
5. When more text is available than can be displayed, a scroll bar will be shown on the right side of the display. Press the **small right** knob to activate the cursor and turn the **large right** knob to scroll the text display.

Terminal Area Forecast (TAF)

1. In the WPT group, turn the **small right** knob to the TAF page. TAFs for the flight plan destination airport are shown.



2. To select a different airport, press the **small right** knob to activate the cursor. The Airport ident will blink.
3. Turn the **small right** knob to start airport selection. Use the **small** and **large right** knobs to select the desired airport.
4. Press the **small right** knob again to turn the selection cursor off.
5. When more text is available than can be displayed, a scroll bar will be shown on the right side of the display. Press the **small right** knob to activate the cursor and turn the **large right** knob to scroll the text display.

Section 3: Traffic

Introduction

The GDL 88 or ADS-B may receive traffic from several sources including external sources (ADS-B, ADS-R, and TIS-B) and onboard sources (TAS/TCAS) and creates a single, fused traffic picture to provide to the flight crew. Using relative altitude, relative bearing, range, directionality, ground track, and other identifying information (ICAO address, flight ID, call sign, tail number), the GDL 88 or ADS-B should determine when tracks from multiple sources represent a single traffic target, selects the most accurate position source for the target, and sends the data to the display.



ADS ON – in green
 ADS INC – in green
 ADS TEST – in white
 ADS OFF – in white
 ADS N/A – in white
 ADS FAIL – in yellow

ADS ON - ADS-B is functioning.

ADS INC - ADS Incomplete. When the GNS display an ADS operating mode of ADS-INC, this means that the aircraft is either not receiving data from the ground stations or is not on the address list for the ground stations. In either case the traffic picture observed by the pilot on the GNS display does not include some or all targets observed by ATC and is thus incomplete. Other participating ADS-B traffic will be displayed, TCAS/TCAD traffic (if installed) will be displayed, and targets sent by ground stations to other aircraft may be displayed.

ADS TEST - ADS-B self-test is running.

ADS OFF - ADS-B function is turned off.

ADS N/A. If the ADS-B with TCAD/TCAS or ADS-B is configured on the GNS and the ADS-B reports invalid heading, invalid track, and a valid GPS position, the ADS-B will be indicated as N/A (not available).

ADS FAIL - ADS-B system has failed.



The Standby Screen appears when the ADS-B passes the power-up test.

Power-Up Self-Test

Check for the following test criteria on the Traffic Page during power-up:

1. If the GDL 88/ADS-B series unit passes the power-up test, the Traffic Page is displayed on the 6-NM display range and in the normal altitude display mode.
2. If the display indicates that the GDL 88/ADS-B series unit has failed, please refer to the failure response section in the Pilot's Guide for actions to take.



NOTE: The FAILED message occurs when the system detects an error and prohibits further traffic display operation as long as this message stays on the screen.

User-initiated Test



NOTE: A user-initiated test can only be performed when in standby or failed mode.

To perform a user-initiated test:

1. In the Nav page group, turn the **small right** knob to select the Traffic Page.
2. From the Traffic Page, press **MENU** to display the Page Menu.
3. Turn the **small right** knob to select "Self Test?" and press **ENT**.

Altitude Display Mode

The altitude filter will change the traffic displayed to include only those targets within the vertical limits of the selected filter. There are four altitude display filters: Normal ($\pm 2,700$ feet), Above ($-2,700$ feet to $+9,000$ feet), Below ($-9,000$ feet to $+2,700$ feet), and Unrestricted ($\pm 9,900$ feet). The selected altitude display filter is displayed in the upper left-hand corner of the Traffic page. The GDL 88 continues to track up to 30 intruder aircraft within its maximum surveillance range, regardless of the altitude display filter selected and will display up to eight intruders.



The name of the selected altitude display filter (ABV: look up, NRM: normal, BLW: look down, or UNR: unrestricted) is displayed in the upper left-hand corner of the Traffic Screen.

To change the Altitude Display Mode:

1. From the Traffic Page, turn the **cursor** on, highlight the current filter and turn the **small right** knob to cycle through the options.
2. With each turn of the knob, the screen changes to display the traffic detected within the selected altitude display range.
3. Note that confirmation is not required. The mode is changed immediately when using the **small right** knob. Turn the **cursor** off when selection is made.

Switching Between Standby and Operating Modes

The GDL 88/ADS-B must be in operating mode for traffic to be displayed. The ability to switch out of standby into operating mode on the ground is especially useful for observing the airspace around the airport before takeoff.

To switch into Operating Mode:

To set the mode to Operating when the GDL 88/ADS-B is not connected to either TCAD or TCAS:

1. Press the **cursor** knob and highlight "ADS OFF". Turn the **small right** knob to select "ADS ON?".
2. Press **ENT** to confirm and place the GDL 88/ADS-B series unit in operating mode.
3. Press the **cursor** knob to exit the menu option and view the updated mode.

To set the mode to Operate on the GNS units connected to a GDL 88/ADS-B with TCAD or TCAS, the pilot will need to place either or both the GDL 88 (ADS) and TCAS/TCAD the Operating mode.



NOTE: *If no heading source is installed then the GDL 88/ADS-B and a TCAS/TCAD cannot both commanded ON while on the ground.*

1. Press the **cursor** knob and highlight "TCAD STBY" or "TCAS STBY". Turn the **small right** knob to select "TCAS OPER?" or "TCAD OPER?".
2. Press **ENT** to confirm.
3. Change the ADS to Operational mode, if it is not already set. Turn the **small right** knob to select "ADS ON?".
4. Press **ENT** to confirm.
5. Press the **cursor** knob to exit the menu option and view the updated mode.



NOTE: *Whenever switching out of Standby mode, the ADS-B unit goes to the 6-NM display range. If your aircraft has a squat switch and you do not manually switch out of standby, the ADS-B unit will automatically switch out of standby 8 to 10 seconds after takeoff.*

To switch into Standby Mode:

To set the mode to Standby when ADS-B unit is not connected to either TCAD or TCAS:

1. Press the **cursor** knob and highlight "ADS ON". Turn the **small right** knob to select "ADS OFF?".
2. Press **ENT** to confirm and place the ADS-B unit in Standby mode.
3. Press the **cursor** knob to exit the menu option and view the updated mode.

To set the mode to Standby on the GNS units connected to an ADS-B unit with TCAD or TCAS, the pilot will need to place either or both ADS and TCAS/TCAD to the Standby modes.

1. Press the **cursor** knob and highlight "TCAD OPER" or "TCAS OPER". Turn the **small right** knob to select "TCAS STBY?" or "TCAD STBY?".
2. Press **ENT** to confirm.
3. Change the ADS to Standby mode, if it is not already set. Turn the **small right** knob to select "ADS OFF?".
4. Press **ENT** to confirm.
5. Press the **cursor** knob to exit the menu option and view the updated mode.

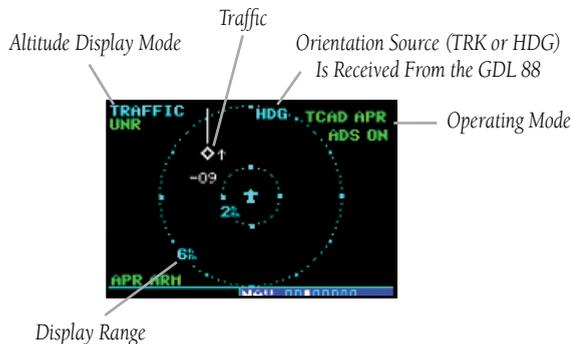


NOTE: *If your aircraft has a squat switch, STBY is not displayed while you are airborne but will go into standby 24 seconds after landing. This delay allows the ADS-B unit to remain in the operating mode during a touch-and-go maneuver.*

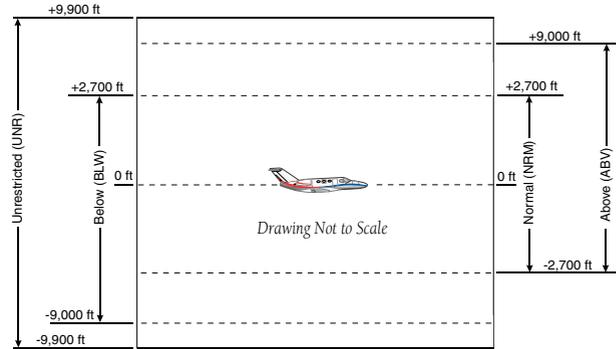
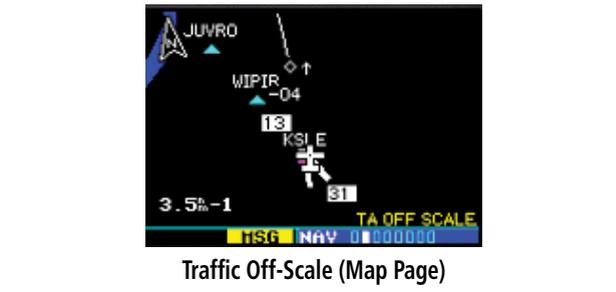
Traffic Page

Traffic can be displayed both on the Traffic Page and Nav Map page(s). When using TCAD or TCAS, traffic can only be displayed on a Nav Map page if heading is available.

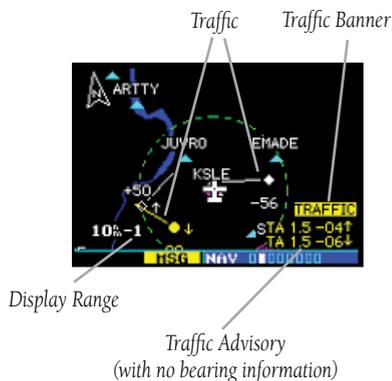
When interfaced to a GDL 88 or ADS-B Datalink Sensor, GNS 400W/500W series units can display ADS-B and TIS-B traffic on the Traffic and Nav Map Pages. When using TCAD or TCAS, ADS-B and TIS-B traffic may be overlaid on the Map Page, but only if a valid heading source is provided.



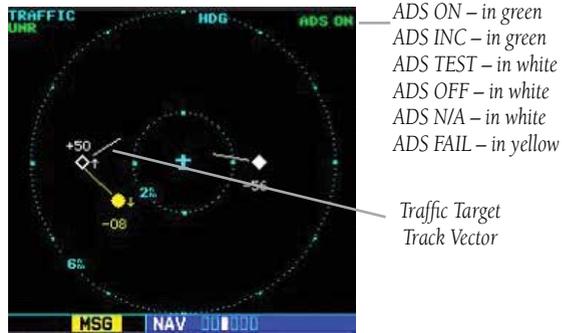
Traffic Page



Altitude Display Modes



Traffic On Map Page



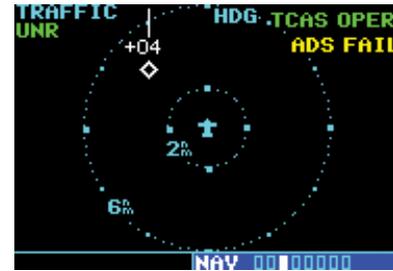
Traffic With GDL 88/ADS-B

The vectors extending from the traffic targets display how the traffic target is moving relative to the ground. The vector length is fixed and provides no indication of how a target is moving relative to the ownship and does not provide an indication of the threat posed by the target.



ADS ON – in green
 ADS INC – in green
 ADS TEST – in white
 ADS OFF – in white
 ADS N/A – in white
 ADS FAIL – in yellow

TCAS/TCAD modes:
 TCAS STBY – in white
 TCAS OPER – in green
 TCAS FAIL – in yellow
 TCAS TEST – in white



Traffic With GDL 88/ADS-B With TCAS Operating and ADS-B Failed

The yellow FAIL indication is shown in the center of the screen only when both ADS and TCAS/TCAD have failed.

Traffic With GDL 88/ADS-B With TCAS



ADS ON – in green
 ADS INC – in green
 ADS TEST – in white
 ADS OFF – in white
 ADS N/A – in white
 ADS FAIL – in yellow

TCAD modes:
 TCAD STBY – in white
 TCAD OPER – in green
 TCAD FAIL – in yellow
 TCAD TEST – in white
 TCAD APR – in green
 TCAD GND – in green



Traffic Failed

Traffic With GDL 88/ADS-B With TCAD

If the GDL 88 is configured (not integrated with TCAD/TCAS system) and it reports invalid heading, invalid track, and valid GPS position, “UNAVAIL” will be displayed in the center of the page.

Traffic Alert Pop-Up

When the unit is not on the traffic page and a traffic threat is imminent, the Traffic Alert Pop-Up is displayed. The Traffic Alert Pop-Up shows a small map and can display the Traffic Page (if the user presses **ENT**) or return to the previous page (if the user presses **CLR**).



Traffic With GDL 88/ADS-B and Invalid Heading or Track

If either TCAS or ADS is in failed state, valid data may still be available. Intruders may still be displayed from the operational device.



Traffic Alert Pop-Up



NOTE: The Traffic Alert Pop-Up is displayed only in normal operating conditions when the aircraft is airborne and there is no terrain alerting or dead reckoning alert.



NOTE: The Traffic Alert Pop-Up is disabled when the aircraft ground speed is less than 30 knots or when an approach is active, unless the unit is configured for helicopter operation as noted by the helicopter ownership icon.



NOTE: Traffic data will be shown on the Traffic and Nav Map pages even without heading. When using TCAD or TCAS, ADS-B unit traffic data is only displayed on the Map Page if suitable aircraft heading data is available. See the Garmin 400W or 500W Series Installation Manuals available at your authorized Garmin service center for details.

Traffic Page Display Range

You can change the display range on the Traffic Page at any time.

Press the **RNG Key** to cycle through the following range options (Inner Ring/Outer Ring):

- None/1 NM, 1/2 NM, 2/6 NM, 6/12 NM, 12/24 NM, and 24/40 NM.

Configuring Traffic Data on the Map Page

When using TCAD or TCAS, GDL 88/ADS-B series unit traffic data is only displayed on the Map Page if suitable aircraft heading data is available.



Selections for configuring traffic data are made from the Map Setup Menu on the Map Page.



When a Traffic Advisory is active, the "Traffic" banner is displayed in the lower right corner of the Map Page.

To configure traffic on the Map Page:

1. Turn the **small right** knob to select the Map Page.
2. Press **MENU** to display the Page Menu. Turn the **small right** knob to select "Setup Map?" and press **ENT**.
3. The flashing cursor highlights the **GROUP** field. Turn the **small right** knob to select Traffic and press **ENT**.
4. Turn the **large right** knob to select the desired Traffic group option. Turn the **small right** knob to select the desired option and press **ENT**. Repeat the step for Traffic Symbol and Traffic Label.
5. Return to the Map Page by pressing **CLR**.

The Traffic group allows the operator to choose which traffic is displayed (all traffic, traffic and proximity advisories, or traffic advisories only). The traffic symbol is the symbol used to depict the type of traffic:



NOTE: Proximity Advisories (PA) are displayed as solid white diamonds (may be configured as cyan). PAs are defined as traffic within the 6.0-NM range, with ± 1200 feet of altitude separation, and not a traffic advisory (TA).

From the Map Page, you can display traffic in a thumbnail format in any of the top three data fields (top four fields on the 500W Series) on the right side of the Map Page.



To display Thumbnail Traffic on the Map Page:

1. Turn the **small right** knob to select the Map Page.
2. Press **MENU** to display the Page Menu.
3. Turn the **small right** knob to select "Change Fields?" and press **ENT**.
4. Select one of the top three fields (top four fields on the 500W Series). Select TRFC from the Select Field Type List and press **ENT**. Note that the thumbnail range defaults to 6 NM and cannot be changed.

Highlighting Traffic Data Using Map Panning

The Panning, function allows you to view more information about traffic by highlighting the traffic symbol with the panning target pointer. The pointer will move from one target to another if left active as the traffic list provided by the ADS-B is resorted as targets change priority.



When the target pointer is placed on traffic, the traffic range and altitude separation are displayed.

To select the panning function and pan the map display:

1. Press the **small right** knob to activate the panning target pointer.
2. Turn the **small right** knob clockwise to move up, or turn it counterclockwise to move down.
3. Turn the **large right** knob clockwise to move right, or turn it counterclockwise to move left.
4. To cancel the Panning function and return to your present position, press the **small right** knob.

When the target pointer is placed on traffic, the traffic range and altitude separation are displayed. The traffic is identified as:

- TA:** Traffic Advisory, **PA:** Proximity Advisory,
TRFC: Other Traffic

ADS-B Status

The ADS-B Status page displays information about the ADS-B operating status and lists active faults, as well as selections for output to the ADS-B unit.



ADS-B STATUS page menu allows Arming/Disarming Anon mode and turning Pressure Altitude Reporting On/Off.

Pressure Altitude Report (PALT RPT)

The ADS-B unit requires the use of an ownship pressure altitude for transmission of required ADS-B Out data values and to calculate the vertical separation and vertical closure from target aircraft.

1. Turn the **large** knob to select AUX group.
2. Turn the **small** knob to select the ADS-B Status page.
3. Press **MENU** to display the menu.
4. Turn the **small** or **large right** knob to highlight the desired choice and then press **ENT**.

Anonymous (ANON) Mode

The Anonymous Mode, when armed, will replace the Flight ID with a temporary randomized number for privacy while the position information will still be provided. The call sign will be sent as “VFR.” To enable Anonymous Mode, the Squawk Code on the installed transponder must be set to the VFR code and the Anonymous Mode must be armed. Anonymous mode may not be available depending on the specific installation.

1. Turn the **large** knob to select AUX group.
2. Turn the **small** knob to select the ADS-B Status page.
3. Press **MENU** to display the menu.
4. Turn the **small** or **large right** knob to highlight the desired choice and then press **ENT**.

Failure Response

Errors indicated by a “FAILED” message on the screen prevent continued use of the ADS-B unit. If the unit is configured (not integrated with TCAD/TCAS system) and reports an invalid heading, invalid track, and valid GPS position, “UNAVAIL” will be displayed in the center of the page. See the ADS-B Status page for information on Failure Response.



ADS-B STATUS page, lists some of the problems with the ADS-B, that might cause the failure.

RYAN TCAD

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 ADS-B unit to the GNS 400W/500W series. Operating instructions and details on the modes of operation are described in the Ryan TCAD operator's handbooks.

Setting Altitude Display Mode

The TCAD has four altitude display modes: Normal ($\pm 2,700$ feet), Above ($-2,700$ feet to $+9,000$ feet), Below ($-9,000$ feet to $+2,700$ feet), and Unrestricted ($\pm 9,900$ 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.

1. While viewing the Traffic page, press the **small right** knob to activate the cursor and highlight the current mode. Turn the **small right** knob to cycle through the options.
2. With each turn of the knob, the screen changes to display the traffic detected within the selected altitude display range. The 400W/500W Series screen also displays unrestricted traffic (UNR) having a maximum range available.
3. Press **ENT** to confirm and save the selected value.

TCAD Traffic Page Menu

1. Press **MENU** to display the page menu. Turn the **small** or **large right** knob to highlight the desired choice of commands to send to the Ryan TCAD.



2. With the TCAD Approach (APR) Mode selected, pressing **ENT** toggles between Enabled and Disabled.
3. With TCAD GND Mode selected, pressing **ENT** toggles between Enter and Exit GND mode.
4. Select Setup? and press **ENT** to reach the Setup page.
5. Select Self Test? and press **ENT** to start the Self Test process. Self Test is also performed on unit start up.

Ryan TCAD Setup

1. From the Nav group Traffic page, press the **MENU** key. Turn the **small right** knob to highlight "Setup?" and then press **ENT**.
2. The RYAN TCAD Setup screen will now be displayed and the Baro Pressure selection will be activated for selection. Turn the **small** knob to select a numeric value and turn the **large right** knob to move the cursor and then press **ENT** to save the selected value.



3. The Ground/Field Elevation value is now activated for selection. Turn the **small** knob to select a numeric value and turn the **large right** knob to move the cursor and then press **ENT** to save the selected value.
4. The Volume field is now activated for selection. Turn the **small** knob to select a numeric value and turn the **large right** knob to move the cursor and then press **ENT** to save the selected value.

Traffic Watch

If your 400W/500W-series unit is connected to other equipment providing traffic alert information (e.g., L3 SKYWATCH™ or RYAN TCAD), a traffic alert pop-up is provided to display traffic information. This allows you to monitor traffic conditions from ANY page and quickly identify traffic hazards.



1. In the Aux group, select "Data Field Configuration" from the Setup 1 Page.



2. Turn the **small right** knob to select the desired data field option. The following options are available:



3. Press **ENT** to accept the selection.

Part Eight: Garmin Connex Interface

Section 1: Introduction

Garmin Connex™ is Garmin's in-cockpit wireless connectivity system that provides access to weather updates, text/voice communications, and other data-sharing capabilities both in the air and on the ground. Flight Stream 210 is one of the Garmin Connex™ flight connectivity solutions. It is a small remotely mounted wireless gateway that, when connected to your GNS 430W/530W series navigator, enables compatible tablets and smart phones to stream information to and from that navigator via Bluetooth®. This allows you to use your mobile device's touchscreen as a cockpit interface. With Flight Stream 210 and a compatible personal electronic device (PED) you can transfer flight plans from your PED to your GNS 430W/530W, plus you can display high-quality GPS and AHRS attitude information on your PED using Garmin Pilot, or other appropriate app. Traffic (TIS-B) and subscription-free graphical weather (FIS-B) from a GDL 88, or Sirius/XM weather from a GDL 69, can also be shared between the GNS and your PED.



NOTE: *Garmin Connex features are available in GNS software version 5.20, and later.*

Starting with Connex

To get ready to use Connex, you must do the following:

- Install Garmin Pilot, or other appropriate app, on your PED.
- Have Flight Stream 210 installed in your aircraft and connected to the GNS.
- Pair your PED to Flight Stream 210 using the Bluetooth utilities on your PED and GNS.

Section 2: Bluetooth Status

From the Bluetooth Status page, the pilot can change the Flight Stream Bluetooth name, manage paired devices, and determine if the portable electronic device is connected and communicating with Flight Stream.



NOTE: If the pilot removes a paired device from this page by selecting "Unpair Device," the device will have to be paired again before transferring data.

Pairing Your Devices

Before your GNS can interact with your PED, you must first "pair" them.



NOTE: New devices can only be paired with Flight Stream when the Bluetooth Status page is displayed on the GNS.

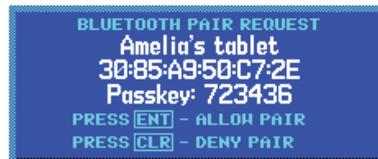
The pairing must be initiated from the PED. Pop-ups will be displayed on the PED and GNS to confirm the pairing.

1. On the GNS, go to the Aux - Connex page and select Bluetooth Status.



2. On the portable electronic device, go to the Settings - Bluetooth page. Select the Flight Stream device name.

3. On the GNS Bluetooth Status page, a pop-up will prompt you to Allow or Deny pairing. Press **ENT** to pair the devices.



4. After the units have paired, on the portable electronic device use Garmin Pilot (or other app) to connect to the GNS.
5. After pairing, the device names will show up in the Paired Devices section of the Bluetooth Status page. A filled-in square next to the device name signifies that the device is paired. An empty square signifies a device that is available (i.e., powered-up and in-range), but not paired.



In the above example, Amelia's tablet is paired while Wilbur's phone is not.

Editing the Bluetooth Name

The name of the Bluetooth connection can be edited on the Bluetooth Status page.

1. While viewing the Bluetooth Status page, press the **small right** knob to activate the cursor.
2. Use the **small** and **large right** knobs to edit the name and then press **ENT**.

View Device Details

The Device Details page shows information about the selected device.

1. While viewing the Bluetooth Status page, press the **small right** knob to activate the cursor. Turn the **large right** knob to select the desired device and press **ENT**.



2. Press **ENT** to return to the Menu.

Auto-Reconnect

The Auto-Reconnect function, when enabled, causes the GNS to automatically reconnect with the selected PED whenever it comes in range. PEDs are set to Auto-Reconnect by default. When this setting is disabled, the pilot must manually initiate the connection from the device.

To toggle the auto-reconnect status:

1. While viewing the Bluetooth Status page, press the **small right** knob to activate the cursor. Turn the **large right** knob to select the desired device and press **ENT**.
2. Press **MENU** and then turn the **small right** knob to select either "Enable Auto-Reconnect?" or "Disable Auto-Reconnect?".



3. Press **ENT** to enable Auto-Reconnect or push the **CRSR** to not make a selection.



4. To Disable Auto-Reconnect, turn the **small right** knob to select "Disable Auto-Reconnect?" and press **ENT**.



Unpair Device

This function will unpair the selected PED so that the GNS will no longer communicate with it. If the pilot removes a paired device from this page by selecting "Unpair Device," the device will have to be paired again before transferring data.



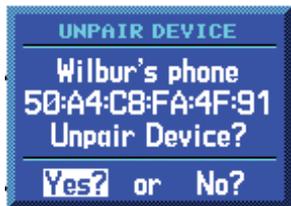
NOTE: If pairing is removed from either the PED or GNS, it must also be removed from the other device before a new pairing to that same device can be established again. That is, pairing must be removed from both devices before re-pairing can occur.

Method 1

1. While viewing the Bluetooth Status menu for a device, turn the **small right** knob to select "Unpair Device?" and press **ENT**.



- Turn the **small right** knob to select “Yes?” to Unpair the device and then press **ENT**.



Method 2

- While viewing the Bluetooth Status page, press the **small right** knob to activate the cursor.
- Turn the **small right** knob to select the desired device and press **CLR**.

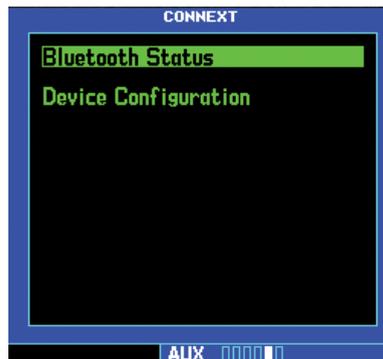
Section 3: Device Configuration

The Device Configuration page shows the name of the connected device, software version of the device, description of the device, and whether flight plan import is enabled.



NOTE: Turning Flight Plan Imports off will disable the ability of the GNS to receive flight plans from the Flight Stream 210. This could be desirable if, for example, there are repeated erroneous attempts by a portable electronic device application to send flight plans to the GNS.

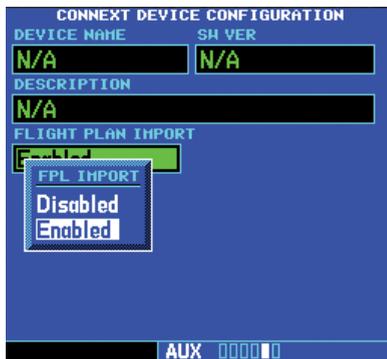
- In the Aux page group, turn the **small right** knob to reach the Connex page.



- Press the **small right** knob to activate the cursor. Then, turn the **small right** knob to select “Device Configuration.” Press **ENT** to display the Connex Device Configuration page.



- Turn the **small right** knob to select the Flight Plan Import status of “Enabled” or “Disabled.” Press **ENT** to select the desired setting.



Section 4: Flight Plan Import

When the GNS is interfaced with Flight Stream 210, flight plans can be wirelessly imported into the GNS from supported apps, such as Garmin Pilot. The imported flight plans can then be activated or stored in the flight plan catalog once they have been previewed by the pilot.



NOTE: Flight plans with over 100 waypoints are truncated at 100 waypoints. The last waypoint in the imported/uploaded flight plan may not be the destination airport.



NOTE: Whenever a User Waypoint is imported, it is compared against the existing waypoints in the User Waypoint catalog. New waypoints—that is, waypoints whose locations do not already exist in the catalog—are added to the catalog with a derived name of CX###, where ### represents the lowest available number in the catalog (e.g., CX001 or CX357). If the User Waypoint catalog already contains a waypoint with the same location, the existing name is retained. In either case, the imported name is discarded.

Importing a Flight Plan with Connex

When a flight plan is sent to the GNS from a PED using Connex, a message will appear on the GNS. After importing the flight plan, you can Activate, Store, or Scroll through that flight plan.

1. A message will appear on the GNS when a flight plan has been sent using Connex. Press **FPL** to go to the Connex Flight Plan Import page or press **MSG** to view the Message list.



2. The list of pending flight plans from Connex will be shown. Press the **small right** knob to activate the cursor and then turn the **small right** knob to highlight the desired flight plan. Then, press **ENT** to preview the flight plan or press **CLR** to remove the flight plan.



3. After selecting a flight plan, the Flight Plan Preview page will be shown with prompts to activate, store, or scroll through the selected flight plan. Turn the **large right** knob to highlight the desired action and press **ENT**.



Viewing the Connex Flight Plan Import Page

Pending flight plans available through Connex will be shown. After a flight plan is imported, it will not be shown in the list.

1. Press the **FPL** key to enter Flight Plan mode and then turn the **small right** knob to reach the Connex FPL Import page.

If there are any pending FPLs pressing the **FPL** key will default to the Connex FPL Import page.



2. Press the **Menu** key to display the Page Menu. Turn the **small right** knob to select the desired option and press **ENT**.

Deleting a Pending Flight Plan

The Delete Pending Flight Plan option deletes the currently highlighted flight plan.

1. While viewing the Connex FPL Import menu, turn the **small right** knob to select "Delete Pending Flight Plan?".



2. Press **ENT** to delete the pending flight plan and return to the Connex FPL Import page.

Delete All Pending Flight Plans

The Delete All Pending Flight Plan option deletes all of the pending flight plans in the list.

1. While viewing the Connex FPL Import menu, turn the **small right** knob to select "Delete All Pending Flight Plans?".



2. Press **ENT** to delete all pending flight plans and return to the Connex FPL Import page.

View User Waypoint List

The View User Waypoint List option displays all of the User Waypoints in the User Waypoint list.

1. While viewing the Connex FPL Import menu, turn the **small right** knob to select "View User Waypoint List?".



2. Press **ENT** to View the User Waypoint List.



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