# SANDEL®

## ST3453H *HeliTAWS*

## Pilot's Guide Effectivity and Errata

Insert this update ahead of the cover page of the Pilot's Guide referenced below.

| | |
|---|---|
| Date: | 24-JUL-2013 |
| Effectivity: | ST3453H Software Version 1.04<br>Pilots Guide 82050-PG-B |
| Errata: | With the exception of the superseding information contained in this document, operation of the ST3453H is as described in the ST3453H Pilot's Guide referenced above. |

1) Added the following text to section 1.3: Contact your maintenance provider for assistance with database updates.
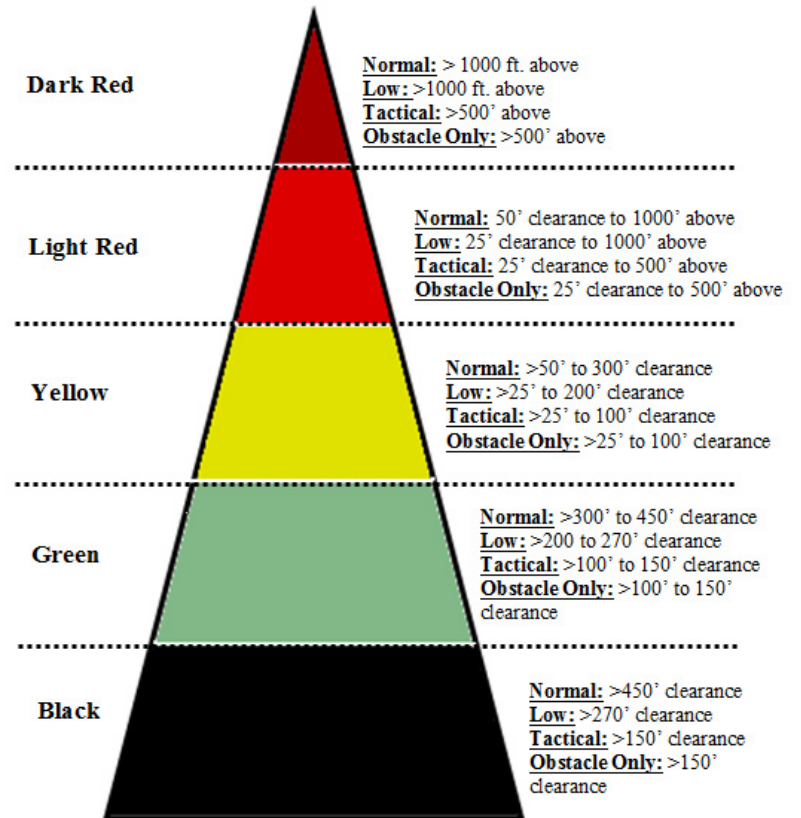
2) Figure 5.10: REL Display Color Banding updated.



| | |
|---|---|
| **Dark Red** | **Normal:** > 1000 ft. above<br>**Low:** >1000 ft. above<br>**Tactical:** >500' above<br>**Obstacle Only:** >500' above |
| **Light Red** | **Normal:** 50' clearance to 1000' above<br>**Low:** 25' clearance to 1000' above<br>**Tactical:** 25' clearance to 500' above<br>**Obstacle Only:** 25' clearance to 500' above |
| **Yellow** | **Normal:** >50' to 300' clearance<br>**Low:** >25' to 200' clearance<br>**Tactical:** >25' to 100' clearance<br>**Obstacle Only:** >25' to 100' clearance |
| **Green** | **Normal:** >300' to 450' clearance<br>**Low:** >200 to 270' clearance<br>**Tactical:** >100' to 150' clearance<br>**Obstacle Only:** >100' to 150' clearance |
| **Black** | **Normal:** >450' clearance<br>**Low:** >270' clearance<br>**Tactical:** >150' clearance<br>**Obstacle Only:** >150' clearance |

Figure 5-10 REL Display Color Banding Relative to Aircraft Altitude

3) Section 7 "GPWS ALERTING" note updated to read as follows:

**NOTE:** GPWS alerting is a variation of the fixed-wing performance specification described in RTCA document DO-161A. GPWS alerting, Modes 1, 3, and 4 require a radar altimeter to be installed, otherwise they are disabled. Each GPWS mode characteristic differs from the DO-161A specifications to be better suited for helicopter flight operations and these differences are detailed in each subsection to follow.

4) Section 7.1: Mode 1 description updated to read as follows:

GPWS Mode-1 ERD Alerts will be generated when the aircraft has a descent rate that exceeds 1200fpm and is below 1500' AGL. An ERD "SINK RATE" Caution Alert is generated to precede the ERD "PULL UP" Warning Alert by 3 seconds at current vertical rate. The ERD "PULL UP" Warning Alert will be generated at an AGL Level at which a 0.25G Level-off maneuver is performed with 1 second of Pilot delay allowance, plus the maneuver time itself, plus 100' of vertical clearance. This revised ERD envelope models the RTCA/DO-309 Descending Flight into Terrain Alerting criteria and allows for GPWS Mode-1 ERD to be a suitable back up to the FLTA function at speeds < 40kts or when FLTA has failed.

5) Section 7.3: Mode 3 description updated to read as follows:

A "DON'T SINK" Caution Alert is generated if the aircraft climbs above the arming altitude for the selected sensitivity and then descends such that the altitude lost exceeds 40% of the current AGL. If the aircraft climbs above the disarming altitude before the descent occurs, the Mode 3 alert will not be generated. This alert may be cancelled by pressing [MUTE].

*__Revision from prior Effectivity and Errata – Revision A__*

There were no errata for 82050-PG-ERR-A. The Effectivity was applicable to software version 1.04 only.

**SANDEL®**

# ST3453H

## HeliTAWS®

**Helicopter
Terrain Awareness
Warning System**



# Pilot's Guide

**Revision B**

**SANDEL®**

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## TABLE OF FIGURES

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# 1 INTRODUCTION

## 1.1 Pilot Information

This guide provides information on the use and operation of the ST3453H HeliTAWS.

The "Effectivity and Errata" inserted at the beginning of this manual specifically lists the software to which this Pilot's Guide applies and corrects any errors or omissions in this revision of the Pilot's Guide.

Information in this manual is current as of revision date. Specifications and operational details are subject to change without notice at the discretion of Sandel Avionics, Inc.

## 1.2 Copyright

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## 1.3 Operational and Legal Issues

The information displayed on the ST3453H uses data generated by external equipment including but not limited to GPS based position source. The ST3453H is subject to all legal and operational limitations of the equipment supplying data to it. Always refer to your approved Rotorcraft Flight Manual Supplement for operation and limitations on the use of installed equipment.

> Note: Because aircraft vary in their installed equipment, what is displayed on the ST3453H may vary depending on the presence or absence of equipment.

Please keep in mind that it is required by Federal Aviation Regulations to have on board current charts appropriate to the flight. The moving map on the ST3453H does not fulfill this requirement.

Keeping internal databases current is highly recommended. The internal databases supply wire, obstacle, terrain, water body, road, and airport data.

Database updates may be made available in accordance with the following schedule (based on availability from data sources):

| Database | Update Cycle |
|---|---|
| Terrain | |
| Roads | When available |
| Water Bodies | |
| Obstacles | Quarterly |
| Wires | Quarterly |
| Airport Data | Quarterly |

Flight plan waypoints may be supplied to the ST3453H by an associated approved GPS receiver or position source.

Displayed supplemental data is intended for positional awareness only.

## 1.4 Trademarks

Sandel, the Sandel Logo, HeliTAWS, the HeliTAWS Logo, and WireWatch are trademarks of Sandel Avionics, Inc.

## 1.5    Approvals

The FAA has approved the ST3453H under the following TSOs:

- TSO-C87:   Airborne Low-Range Radio Altimeter
- TSO-C113:  Airborne Multipurpose Electronic Displays
- TSO-C118:  Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment, TCAS I
- TSO-C194:  Helicopter Terrain Awareness and Warning System (HTAWS)

The following certifications also apply to this product:

- Environmental Certification Level:
    RTCA/DO-160F
    MIL-STD-810G
- Software Certification:
    RTCA/DO-178B Level C
- Complex Logic:
    RTCA/DO-254 Level C

Installation of the ST3453H in a type-certificated rotorcraft must be performed in accordance with the Sandel ST3453H Installation Manual, document number 82050-IM applicable revision.

## 1.6    Conventions Used In This Manual

The name of a button is placed within square brackets when the button is described in text.  For example, "…press the [VUE] selection button to …"

This manual uses terms, which should be familiar to aviation-minded readers, such as "Radar Altitude" and "Magnetic Heading".  Terms, which are specific to the ST3453H, will be placed in the glossary.

## 1.7    Revision History

| Revision History | | |
|---|---|---|
| Revision | Date | Comments |
| B | 26-APR-2013 | Updates for  A/R 1294<br>Section 1.3: Flight plan information updated. Airport data revision cycle updated.<br>Section 2: URL updated<br>Section 3.4: Internal data recording description updated.<br>Section 4.5.8: NVIS description updated.<br>Section 4.7: Chapter reference updated<br>Section 5.3: Bezel button softkey description added.<br>Section 5.4: Startup time updated.<br>Section 5.5: Startup screen description updated. Startup time updated.<br>Figure 5-10: Obstacle only clearance heights updated.<br>Section 5.18: High temperature automatic dimming description added.<br>Figure 6-4 Updated for multiple obstacles.<br>Section 6.8: TAWS INH description updated.<br>Section 7.7: TAWS INH description updated.<br>Section 10.6.1: Status Messages updated.<br>Section11: Added low power note.<br>Section 12: Messages updated.<br>Section 13: System Level Error Display deleted. Remaining sections renumbered.<br>Section 13.2 Updated recording description. |
| A | 14-DEC-2012 | INITIAL RELEASE A/R 1290 |

## 2    LIMITATIONS

The ST3453H is a display and alerting system. It is intended for use in rotorcraft for all phases of flight in VMC and in IMC while operating under instrument flight rules (IFR).

Due to data limitations it is NOT guaranteed that every actual wire, obstacle, or terrain conflict will produce an alert, and alerts generated may NOT guarantee successful recovery due to factors such as pilot response, aircraft performance and database limitations. No standardized recovery technique is defined as recovery maneuvers may vary.

The ST3453H Terrain and Obstacle displays shall NOT be used for navigation.

The course line and present aircraft position shall NOT be used for approach and departure navigation.

Low Sensitivity, Tactical, Obstacle Only, or Off Airport Modes must not be selected when operating under IMC conditions except as required when performing offshore platform IMC Approach Procedures or other Special Procedures.

The "CRC Self Test Failed" message must not appear on power-up if flight operations are predicated on the use of the ST3453H.

The ST3453H Pilots Guide, SPN 82050-PG (applicable revision) must be immediately available to the flight crew.

Data loading and maintenance mode operation are prohibited during normal flight operation.

> Note: The Terrain and Obstacle Displays are intended to serve as a situational awareness tool only. The display and corresponding database may not provide the accuracy or fidelity (including missing items) on which to base navigation decisions and to plan routes to avoid terrain or obstacles.

Transmission Line positional accuracy varies by geographic location. Visit the Sandel website at www.sandel.com/ST3400H_database for specific information related to the positional error in your coverage area.

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## 3 WELCOME TO THE ST3453H HELITAWS®

### 3.1 Description

Sandel HeliTAWS® is a self-contained Helicopter Terrain Awareness Warning System and which both meets the FAA C194 requirements and exceeds these requirements with additional display and protection modes and features. It includes an advanced FLTA computer, a GPWS computer, graphics symbol generator and Sandel's high brightness display engine built within a standard 3-inch instrument chassis. It includes Radar Altimeter features and can be used to directly replace an existing Radar Altimeter indicator. It has the optional capabilities of acting as a primary or secondary traffic indicator, showing traffic overlaid on terrain when connected to an external traffic detection system. Additionally

Terrain protection is available during all airborne phases of flight - Departure, Enroute, Terminal, and Approach and in any selected display mode.

Sandel's TruAlert ® technology combined with pilot selectable low-sensitivity, tactical, obstacles only, and off-airport operational modes, allows nuisance-free protection in very demanding missions.

The terrain display features a new plan-view 3D shaded format with industry leading terrain resolution, providing an unmatched understanding of the terrain surrounding the helicopter and its contours.

### 3.2 What it is

The ST3453H is a situational awareness tool and an alerting and warning device. It is designed to reduce the incidence of CFIT accidents by providing increased situational awareness of the surrounding terrain and obstacles, both in VMC and in IMC under Instrument Flight Rules.

The unit supports optional external caution and warning annunciators and optional external mounted momentary switches to control certain functions such as alert muting and modes.

The ST3453H uses Sandel's patented rear-projection display technology. This technology allows the displayed image to extend to the edges of the instrument's bezel. Therefore, even though the Sandel display is in a 3-inch form factor, its image is approximately the size of a 4" primary display.

### 3.3 What it isn't

The ST3453H is not the pilot. Remember: it is a tool, and it isn't perfect. Neither the terrain data nor the obstacle data on which alerting is based is guaranteed to be 100% accurate, nor are the sensors feeding the system. There is no substitution for good judgment by the pilot. The pilot should always exercise prudent caution, with or without the ST3453H.

Again, it is NOT designed for navigation.

### 3.4 What it does

During normal flight operations the system remains essentially silent. It uses GPS, radar altitude, barometric altitude, and other relevant data in combination with its internal database information to provide the pilot with a full-time terrain display. The look-ahead function compares the aircraft flight path to terrain and obstacle database information and distance to known runways and landing zones.

A built-in caution and warning system provides visual annunciation and aural alerts. Provided are downward-looking Ground Proximity Warning System (GPWS) alerts, Forward Looking Terrain Alerts (FLTA), and various advisories.

FLTA provides predictive "look ahead" warnings by comparing its internal terrain and obstacle database to position information provided by the GPS receiver or position source.

The internal terrain and obstacle databases provide the basis to detect terrain or obstacle conflicts. This is accomplished using the aircraft position, phase of flight, vertical speed, ground track, and ground speed relative to the terrain database image.

Through sophisticated look-ahead algorithms, alerts are generated if terrain or an obstacle conflict with the flight path of the aircraft. This potential conflict area projects forward of the aircraft. During enroute operations, a Caution alert typically occurs approximately 20 seconds ahead of the terrain or obstacle conflict. A Caution alert will turn into a Warning alert if evasive action is not taken approximately 10 seconds ahead of the conflict.

During other operations such as descending flight, the alert times may be shorter but Cautions are always designed to occur prior to Warnings. A Warning does not indicate a higher severity of threat, but simply that immediate action must be taken. Due to the variables involved, it may be possible to receive multiple "CAUTION" and/or "WARNING" alerts and not necessarily in typical "CAUTION", "WARNING" order.

A "CAUTION" alert may be interrupted by another "CAUTION" or a "WARNING" alert. A "WARNING" alert will never be interrupted.

> NOTE:  Alerts and display are de-sensitized near airports.  Do not expect any alerts during the landing phase.

> NOTE:  There are no Caution alerts on Terrain in Tactical mode, only Terrain Warnings. Obstacle and wire alerts are not inhibited.

The Topographic (TOPO) and Relative Altitude (REL) display modes provide the pilot with fast access to visual information to maximizing the pilot's understanding of the relationship between the aircraft and the ground.  An image of the surrounding terrain is represented in color.  Terrain and obstacles can be displayed along the forward path or completely around the aircraft, at distances up to 20nm.

An internal data and event recorder automatically records a minimum of the last twenty hours of flight data.  Oldest data is automatically overwritten with most recent data.  This data can be used by Sandel Customer Support to analyze recent alert and message activity.

## 3.5    Other Features

Display of Radar Altitude is provided along with a MINS setter. (Radar Altitude display features vary by P/N. See Chapter 8 for details.)

Display of Traffic from an external traffic processor is provided.

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# 4    SYSTEM OVERVIEW

## 4.1    "Design Cruise Altitude"

The ST3453H uses the Sandel concept of "Design Cruise Altitude" (DCA). This is the nominal cruise altitude at which the ST3453H is designed to give nuisance-free alerts with a black (no terrain showing) relative altitude display.

### 4.1.1    Sensitivity

To facilitate low altitude operations unique to helicopters, the ST3453H supports four pilot selectable alert sensitivity modes: Normal, Low, Tactical, and Obstacles Only.

| Sensitivity | DCA AGL Ft. |
|---|---|
| NORM | 500 |
| LOW | 300 |
| TACTICAL* | 150 |
| OBSTACLE ONLY | N/A |

All of the sensitivity selections other than 'NORM' allow standard operations closer to the ground.

In addition to changing the alerting criteria, the selected sensitivity adjusts the relative altitude display colors to provide a black display screen at the design cruise altitude to prevent color flooding.

> \* Terrain Warnings only - Terrain Caution alerts are inhibited. Obstacle and wire alerts are not inhibited.

## 4.2    Off Airport Landings

In addition, an Off Airport Mode is pilot selectable which operates at <u>any</u> Sensitivity.

Alerts are normally automatically suppressed during the landing phase at an airport or helipad.  OFF-APT mode further suppresses alerts for landing at random non-airport locations, such as for EMS operations.  When this mode has been selected, no further pilot action is required and no nuisance alerts will be generated when landing anywhere.  Normal alerting criteria are automatically established when not landing or in cruise flight.

## 4.3    Alerts, Warnings and Cautions

An Alert is defined as either a Caution or Warning, generated by the GPWS computer or the FLTA computer.  A Caution is defined as an alert which indicates that pilot action will be needed *shortly*; a Warning alert indicates that pilot action is required *immediately*.

If any alert occurs, the alert text is shown at the bottom of the screen and an audible alert message will occur on the cockpit audio system.  The REL (relative altitude) terrain display is automatically selected at an appropriate range to put the alerting terrain on-screen.

Pilots should train to react properly to all alerts, cautions and warnings, just as one would train to react to any other potential or actual emergency situation.

Pilot reactions to alerts and warnings differ according to weather conditions, visibility, types of warning, phase of flight and aircraft performance considerations.  Pilots should be thoroughly familiar with FAA, company, or other approved operational procedures as required by their aircraft and type of operation.

The ST3453H is not the pilot nor is it a substitute for the pilot's judgment; it is a display and computer.  However, because it is designed to only alert when the aircraft is outside normal flight envelopes in relation to terrain, we recommend that all alerts should result in immediate and appropriate action by the pilot.  A Warning should *always* result in an evasive maneuver.

## 4.4    TAWS Inhibit

A pilot selectable TAWS INH function allows the pilot to disable <u>all alerts</u>. When selected, all FLTA and GPWS alerts are inhibited. Terrain and obstacles continue to be displayed on the screen.   All altitude Callouts will still be enabled.

## 4.5    Display

### 4.5.1    Topographic Display

A pilot selectable TOPO (Topographic) view shows all terrain and bodies of water, in sectional-chart colors.    Terrain and Obstacles are shown RED when above the aircraft altitude.

### 4.5.2    Relative Altitude Display

A pilot selectable REL view shows only proximate terrain and obstacles.

### 4.5.3  Obstacle and Wire Display

The ST3453H displays obstacles in its database taller than 50' AGL and transmission lines higher than approx. 100'AGL using aviation chart standard obstacle symbol or transmission line/tower symbols as appropriate.  Obstacles taller than 500' are displayed using the tall tower symbol (see section on obstacle display).

### 4.5.4  Flight Plans

Flight plan display is optional on the ST3453H display.  The ST3453H overlays the flight plan over any terrain view, if a flight plan is available from the GPS/FMS/Position source and the installation supports this feature.

> NOTE:  The flight plan overlay is for position awareness only and the information in the flight plan has absolutely no effect or control over alerting.  For this reason, alerting works identically whether the aircraft is on-flight plan or off-flight plan – without pilot intervention.

> NOTE: Display of DME arcs, Holding Patterns, and Procedure Turns are not supported in the ST3453H.

### 4.5.5  Airports and Runways

For reference, airports are displayed with runways greater than 2500 feet within 20nm of the aircraft position.  In lower zoom ranges, the airport runways and runway numbers are depicted on-screen.

### 4.5.6  Radar Altimeter Display

The ST3453H can function as an optional primary or secondary Radar Altimeter indicator when interfaced to a compatible Radar Altimeter system.  Digital RADALT (Radar Altitude) and a MINS setting window are provided.

Radar Altitude will not be displayed when a Radar Altimeter is not installed; however the MINS display may be present and may be used by the pilot as a reference number.

In some configurations, the ST3453H does not display Radar Altitude, MINs setting window, or MINs annunciator.

### 4.5.7  Traffic

The ST3453H can optionally display nearby transponder equipped aircraft when interfaced with compatible TAS or TCAS.  Standard TAS/TCAS symbology is used to display the relative location and altitude of traffic.  The traffic information is displayed overlaid on terrain.

**Note**: If the ST3453H is interfaced to a TAS/TCAS, the TAS/TCAS processor itself generates the alerts and these are only displayed on the ST3453H.

### 4.5.8  NVIS

For missions requiring the use of night vision goggles, the ST3453H is equipped with Sandel's proprietary on-demand Class-B NVIS capability.  Sandel's unique NVIS feature does not degrade its brightness or daylight characteristics when NVIS is OFF.

NVIS is activated through the use of an external switch or push button.  Refer to the Rotorcraft Flight Manual Supplement for your specific ST3453H installation for details on NVIS operation.

If the system requires a restart, it will restart in the NVIS state selected by the external NVIS switch.

## 4.6  Sensors

Sensor data is the input data fed to the ST3453H that comes from external sources. There are no sensors inside the ST3453H.  Data is derived from the following sensors:

- GPS Position from GPS, FMS, or INS
- FMS Flight Plan
- Compass system (AHRS, DG) (optional)
- Radar Altimeter (optional)
- Traffic Computer (optional)
- Airdata Computer (optional)

Heading data from an AHRS or compass system is used to provide terrain display while hovering.

### 4.6.1  Primary and Secondary Sensors

Some functions may be interfaced to two sources of data, such as GPS position where there may be two independent receivers present.  These are referred to as "Primary" and "Secondary" sources and are selected at installation configuration.  The "Primary" source is the source that is always used unless a failure is detected, in which case the system will automatically fail-over to the Secondary source.

When a sensor source selection is automatically changed due to failover, an advisory message will be posted to the Pilot Menu and "MSG" will annunciate.  No pilot action is required.

In the case of the Position Source when both sources are available, an additional function is implemented which automatically selects the source providing the best vertical accuracy.

> NOTE:  See the RFM for a description of which specific equipment has been selected as Primary and Secondary (i.e. left primary/right secondary, etc) in the specific installation.

## 4.7    Database

Terrain and Obstacle Databases (excluding wires) are supplied by Jeppesen. See Chapter 16 for Terms and Conditions regarding the use of the Jeppesen databases contained within the ST3453H.

### 4.7.1    Items in the database

The ST3453H contains four databases:  Terrain, Obstacle (including wire) Airport data and Geo Overlays such as water bodies and roads. The Obstacle data contains man-made obstacles above 50' AGL.  The wire data includes transmission lines higher than 100' AGL.  The Airport data includes airports and runways. The presentation of coastlines, lakes, and rivers on the TOPO display is a close approximation and may not be current due to lake water levels, river channel locations, omitted islands, and other data artifacts. These will have no effect on the accuracy of the REL display and terrain alerting.

To reduce display clutter, some obstacles are not included in the obstacle database: Any obstacles below 50' AGL, trees, signs, fences, ground, hills, mountains, vegetation, and any records not tied to the WGS-84 datum.

### 4.7.2    Coverage area of the database

The terrain and airport database coverage is provided by geographical area.  Coverage is limited to those areas between 70°N and 70°S latitude.

Obstacle data is included for most countries.  Please contact Sandel for the most current coverage information.

**Note**:  There is no guarantee that all obstacles including transmission lines are charted or that every charted obstacle or transmission line is in the database.

### 4.7.3    Database updates

Updates are uploaded into the ST3453H through a USB port located on the front right corner of the display bezel.

# 5 TERRAIN DISPLAY AND OPERATION

The following section describes the appearance of the ST3453H display and identifies each functional element.

## 5.1 Control Overview

The ST3453H physical layout consists of a display screen, 9 backlit buttons, one push-pull rotary knob, and one USB connector.
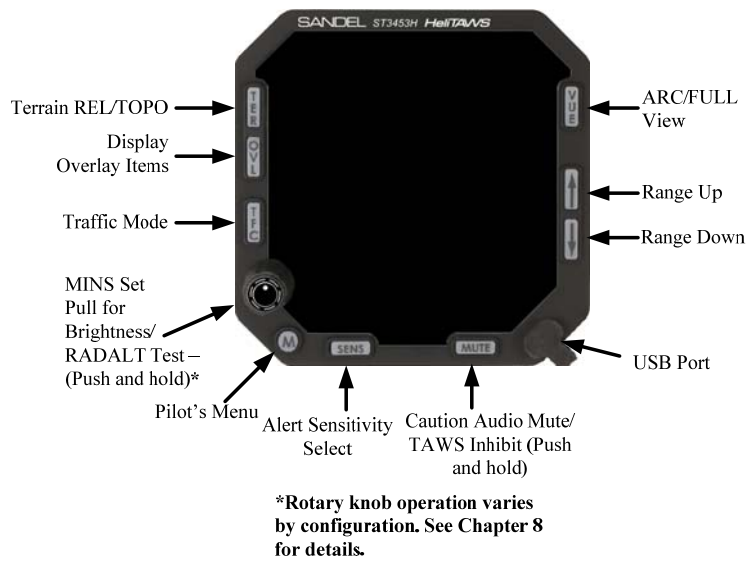


Figure 5-1 ST3453H Physical Features

## 5.2 Display Overview

The display is composed of underlying terrain, with symbol and text overlays.

The display is geometrically referenced to the tip of the symbolic aircraft
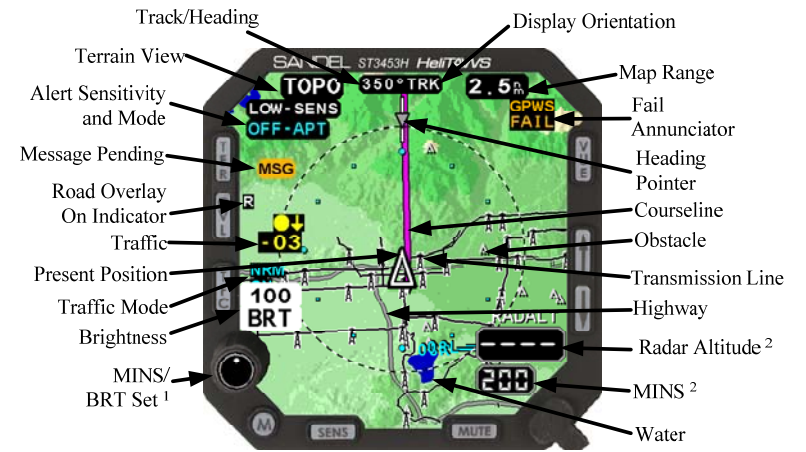


[1] Knob functionality varies by P/N. See Section 5.18 and Chapter 8 for details.

[2] Radar Altitude and MINS setting window display varies by P/N. See Chapter 8 for details.

Figure 5-2 Display Overview TOPO/FULL

## 5.3 Bezel Button Softkeys

The ST3453H incorporates bezel button softkeys to enhance the readability of the bezel button text during night and NVIS operations. To invoke the softkeys, momentarily press the rotary knob and the softkeys will appear. The softkeys will be removed from the display approximately 5 seconds after the last button or knob input. These softkeys can be viewed during all operations (day/night/NVIS). When active, the softkeys along the bottom edge of the bezel, [SENS] and [MUTE] will not be visible during CAUTION and WARNING alerts. The [VUE] softkey will be replaced with [ACK] if an acknowledgeable message is being displayed.
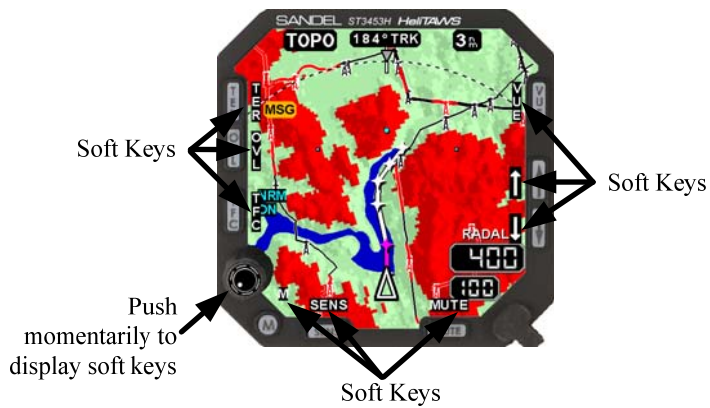


Figure 5-3 Bezel Button Softkeys

## 5.4 Splash Screen

At power-up there is no splash screen shown.  The [M] button will light at night brightness level when power is applied, and the display will be blank for approximately 60 seconds.

## 5.5 Initial Bootup Display

Approximately 60 seconds after initial power-up, a short introduction screen will be displayed which includes the software and database versions.



Figure 5-4 Startup Screen

The startup screen will indicate if a database is unavailable as shown in Figure 5-5.



Figure 5-5 Database Error Display

## 5.6 No-Sensor Display

After the power up display is removed, the operating screen will likely show sensors in the failed state until they become available:



Figure 5-6 Initial Display

As soon as sensor availability is established the terrain will immediately build on the screen and normal operation will start.

## 5.7    Loading of Database

While databases are loading, the message "GEO DBASE LOADING" and/or "OBS DBASE LOADING" will display. These messages will display on power on initialization while databases are loading, and may occur in flight if position data is lost and reacquired in a new position.
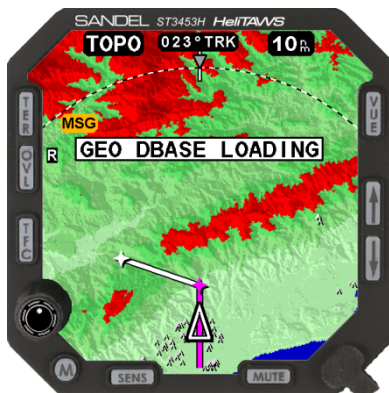


Figure 5-7 "OBS/GEO DBASE LOADING" Messages

## 5.8    FULL / ARC

Press [VUE] to switch between 360-degree and 70-degree ARC views.
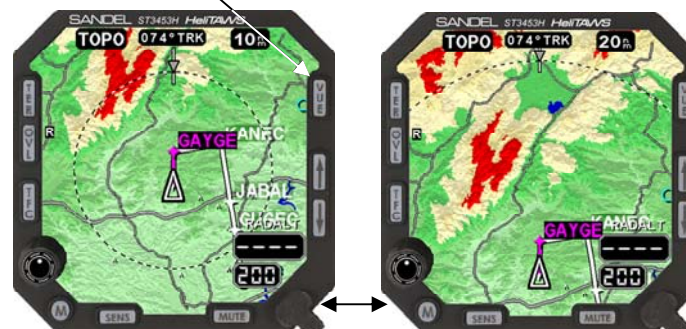


Figure 5-8 FULL and ARC Views

This action only affects the screen display – it has no effect on alerting. The ARC view maximizes the display of the ground track ahead of the aircraft and provides the greatest amount of screen area for map data.

## 5.9 REL/TOPO

Pressing the [TER] button will change the display from REL to TOPO. The current mode is annunciated at the top of the display.
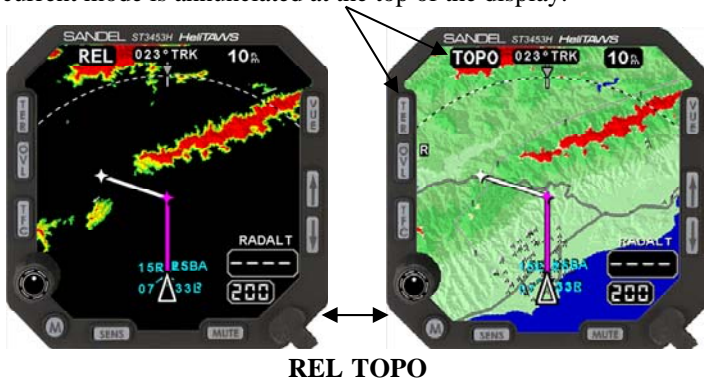


**REL TOPO**

Figure 5-9 REL and TOPO Displays

**NOTE:** Selecting REL/TOPO has no effect on alerting.

### 5.9.1 TOPO Details

TOPO shows all the terrain in sectional chart colors in shaded relief.

Any terrain that is above the current altitude overlays in RED. Terrain more than 1000' above the aircraft altitude is overlaid in Dark Red. Water is shown in blue.

### 5.9.2 REL Details

On the Relative Altitude display, only proximate terrain is shown. Terrain with adequate terrain clearance is black (i.e. not shown). Terrain progressively closer to the aircraft altitude is shown in green, then yellow, and finally red.

On an approach to the airport, the yellow/green bands will shrink as the aircraft gets closer to the runway. Within 1nm of the airport and when on the ground, green and yellow are suppressed. Red is then used to depict terrain above the aircraft.

**NOTE**: If an alert occurs while in TOPO, the display mode will change to REL, in ARC view, at an appropriate range to put the terrain conflict on the screen.

## 5.10 REL Color Banding

The REL colors graphically show the clearance between the current aircraft altitude and the terrain or obstacles. Colors depend on the selected SENSITIVITY. The following are the color band altitudes during cruise flight.



**Dark Red**
**Normal:** > 1000 ft. above
**Low:** >1000 ft. above
**Tactical:** >500' above
**Obstacle Only:** >500' above

**Light Red**
**Normal:** 50' clearance to 1000' above
**Low:** 25' clearance to 1000' above
**Tactical:** 25' clearance to 1000' above
**Obstacle Only:** 25' clearance to 1000' above

**Yellow**
**Normal:** >50' to 900' clearance
**Low:** >25' to 200' clearance
**Tactical:** >25' to 100' clearance
**Obstacle Only:** >25' to 100' clearance

**Green**
**Normal:** >900' to 450' clearance
**Low:** >200 to 270' clearance
**Tactical:** >100' to 150' clearance
**Obstacle Only:** >100' to 150' clearance

**Black**
**Normal:** >450' clearance
**Low:** >270' clearance
**Tactical:** >150' clearance
**Obstacle Only:** >150' clearance

Figure 5-10 REL Display Color Banding Relative to Aircraft Altitude

## 5.11 Display Orientation

The display orientation (HDG/TRK) is selected automatically and is shown within a box at the top of the display. When displaying TRK the lubber line shows exactly where the aircraft is going to be on its current ground track.



Display Orientation
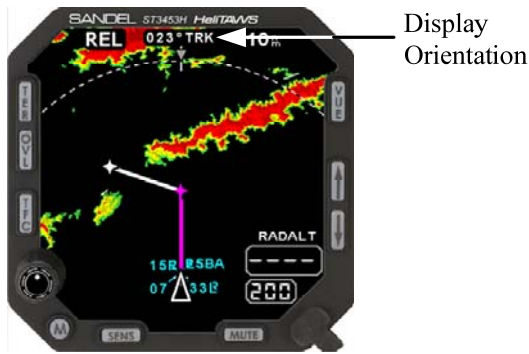
Figure 5-11 Display Orientation

**TRK** is used above 35Kts ground speed.

**HDG** is used below 30Kts ground speed.

**NOTE:** Traffic symbols are always referenced to the nose of the aircraft, even if the display directional source is TRK.

## 5.12 Display Range

The Display Range is the distance in nautical miles between the tip of the symbolic aircraft and the dashed range ring. Switching between FULL and ARC view maintains the terrain cell size during range changes.



Display Range

Range Up

Range Down
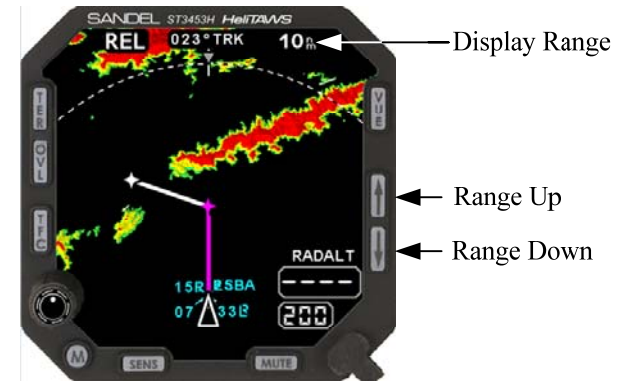
Figure 5-12 Display Ranging

The ARC and Full View displays are decluttered in the 20 and 10 mile range and the 10 and 5mile range respectively by preventing some of the wires from being displayed. This only affects the display, alerting is not affected. Wires causing alerts will always be displayed in the TOPO or REL displays. All wires above the aircraft altitude are shown. Figure 5-13 shows an example of decluttering. The display set for the 5nm range is not decluttered. The display set for the 10nm range is decluttered. Note that wires above the aircraft altitude are still displayed.

| AVAILABLE RANGES | | |
|---|---|---|
| **View** | **No Decluttering** | **Decluttering** |
| FULL | ½, 1, 1.5, 2.5 | 5,10 |
| ARC | 1, 2, 3, 5 | 10, 20 |

No Decluttering

Wires above aircraft altitude are displayed

Decluttered



Figure 5-13 Decluttering

## 5.13 Overlay

Press [OVL] to toggle the road overlay on or off. When selected ON, the road overlay displays major highways.

Road Overlay ON Indicator
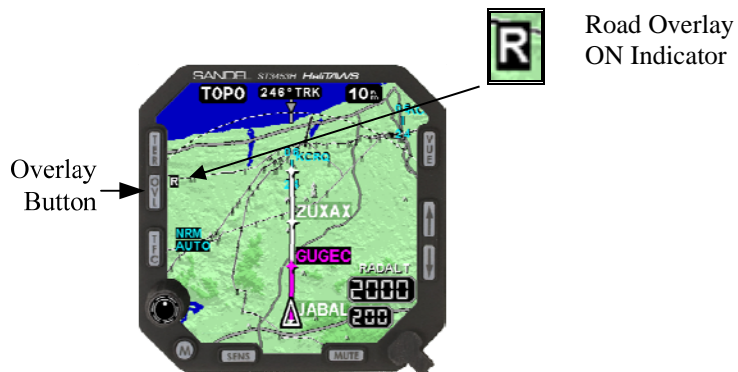
Overlay Button



Figure 5-14 Overlay Button

## 5.14 Heading Pointer

The Heading Pointer is the inverted gray triangle located at the top of the display when in TRK orientation. The Heading Pointer shows the magnetic heading of the aircraft (where it is pointed) and can be used for identifying the crab angle.

In the following illustration the wind is coming from the right and the aircraft is crabbed to the right. Its direction of travel is straight up towards the lubber line.

Heading Pointer (No Wind)

Heading Pointer (Crosswind)



Figure 5-15 Heading Pointer – FULL View

Heading Pointer (No Wind)

Heading Pointer (Crosswind)



Figure 5-16 Heading Pointer – ARC View

## 5.15   Sensitivity

Press the [SENS] button to toggle the Sensitivity between NORM, LOW-SENS, TACTICAL, and OBST-ONLY.  NORM has no screen annunciation.  LOW-SENS, TACTICAL, and OBST-ONLY display as shown in the Figure 5-17.

Sensitivity Mode Annunciator

SENS Button
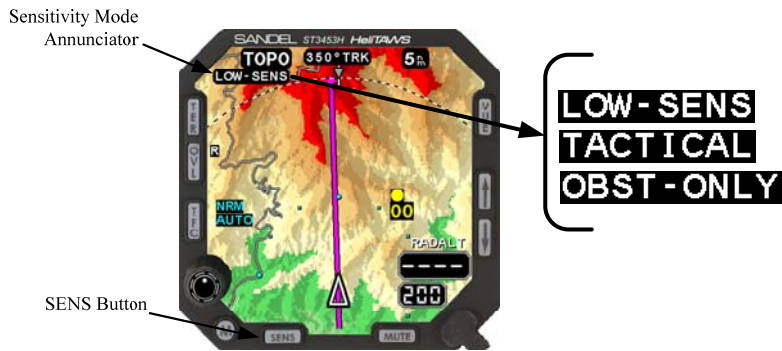
Figure 5-17 Alert Sensitivity Selection

**Note:**  This function may also be accessed by an optional external pushbutton.

### 5.15.1   NORMAL

While in Normal sensitivity mode a caution alert typically occurs approximately 20 seconds ahead of the terrain or obstacle conflict.  A caution alert will turn into a warning alert if evasive action is not taken approximately 10 seconds ahead of the conflict.

### 5.15.2   LOW-SENS

Low Sensitivity mode reduces the alerting time allowing the aircraft to get closer to terrain and obstacles before a Caution or Warning is provided.

### 5.15.3   TACTICAL

Tactical Sensitivity further reduces the alerting time from Low Sensitivity and generates only Terrain Warnings. Terrain Caution alerts are inhibited. Obstacle and wire alerts are not inhibited.

### 5.15.4   OBST-ONLY

Obstacles-Only provides obstacle and wire alerting protection only. All terrain alerts are inhibited.

## 5.16   Off Airport Mode

HOLD the [SENS] button to toggle the OFF-APT mode.  This annunciates OFF-APT in Cyan.

Off-Airport Mode Annunciator

SENS Button
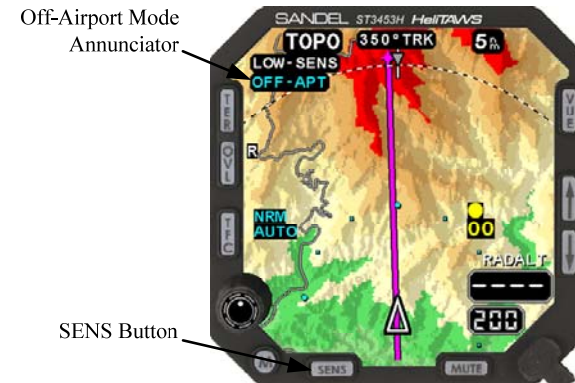
Figure 5-18 Off-Airport Mode Selection

**Note:**  This function may also be accessed by an optional mounted pushbutton.

## 5.17 Mute

An already occurring CAUTION alert may be muted for 15 seconds by pressing the [MUTE] button.  During Caution alerts the [MUTE] button will highlight with a white bar as an aid to locating the mute function.



MUTE Button and
Highlight

Figure 5-19 MUTE Button Highlighting



MUTE
Annunciator

Figure 5-20 MUTE Annunciator

**Notes**:
- In the special case of a GPWS Altitude Loss After Take-off alert ("DON'T SINK"), pressing [MUTE] will disarm the alert completely until the next takeoff.
- If the [MUTE] button is pressed when a CAUTION alert is not present, the text "NO ACTION" will display on the screen.
- This function may also be accessed by an optional mounted pushbutton.

WARNINGS <u>cannot</u> be muted.

## 5.18 Brightness



Brightness Setting Indicator

Pull knob and rotate to adjust brightness.

Figure 5-21 Brightness

Pull the knob and turn to adjust the brightness.

The brightness is shown above the knob as a number from 0-100.  100 is full brightness.

In some configurations, knob functionality may be for Brightness control only. To adjust brightness on these units, simply rotate the knob to the desired brightness setting with the knob in either position (in or out).

If the unit gets too hot, the display brightness will dim automatically to aid in reducing the temperature.

## 5.19 Flight Plan

If installed, each flight plan segments are overlaid on the display. The active flight plan segment is colored magenta and the balance of the flight plan segments are colored white.

> **NOTE**: Display of DME arcs, Holding Patterns, and Procedure Turns are not shown.



Active Flight Plan Waypoint

Active Flight Plan Segment

Flight Plan Waypoint

Flight Plan Segment
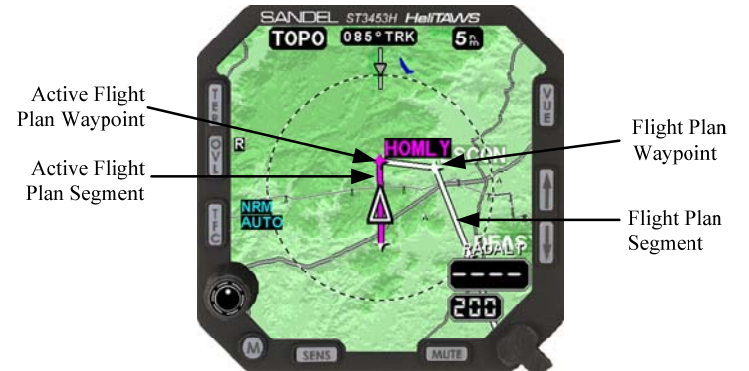
Figure 5-22 Flight Plan Line

## 5.20 MSG Annunciator

A Message annunciation is provided to alert the flight crew that a message is present that has not been viewed. To view the message, press the [M] button to enter the Pilot Menu. After viewing the message, exit the Pilot Menu by pressing the [M] button. The MSG annunciation will go out upon exiting the Pilot Menu. When a new message becomes active in the Pilot Menu, MSG will again be annunciated.

For details on the Pilot Menu, see chapter 10.

# 6    TERRAIN AND OBSTACLE ALERTING

## 6.1    Alert Generation

FLTA is an acronym for Forward Looking Terrain Alerting.  The FLTA Alerting Area is an area mostly in front of and to both sides of the aircraft.

Through sophisticated TruAlert ® look-ahead algorithms, alerts are generated if terrain or an obstacle conflict with the path of the aircraft.

Position and altitude of the aircraft are computed along the projected flight path twice per second.  The projected position is based on current aircraft location and the aircraft's ground speed.  The projected altitude is based on current aircraft altitude and the aircraft's vertical speed.  The aircraft's projected position and each terrain cell and obstacle elevations are then compared to check for conflicts.

The alert in question will be the closest cell or obstacle in which a threat is detected.
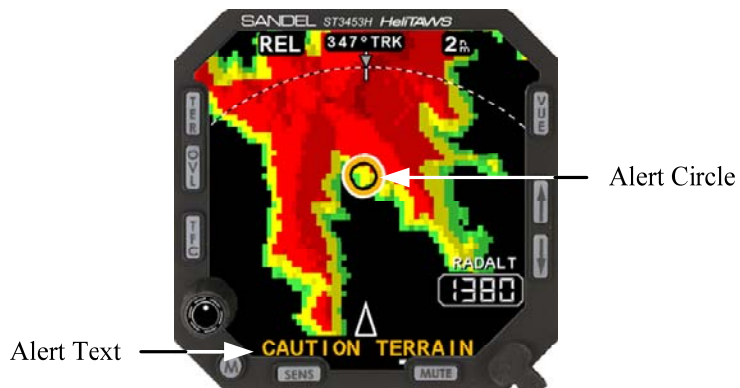


Figure 6-1 "CAUTION TERRAIN" Annunciation

Cautions are always designed to occur prior to warnings during steady-state flight.  There are exceptions such as initiating turns into terrain or initiating a descent when close to terrain.  Under these conditions a Warning may be received without a Caution.

> Note: Obstacle alerts which include wires have priority over terrain alerts.

## 6.2    Alert Display

When an alert occurs, REL is automatically selected, in ARC view, at an appropriate range to put the conflict on the screen.  After the alert occurs the pilot may select other display modes (such as TOPO) and/or other ranges if desired.

The terrain display shows all terrain – not only that which represents actual conflicts.  For instance if two cells are threats simultaneously, both cells will be visible on the ST3453H but only the closest one will be circled.  There may be other areas of conflict!

In Figure 6-1 note the alert is on a green cell and in Figure 6-2, the alert is on a yellow cell.  Both represent terrain below the aircraft.  This is occurring because the aircraft is descending, but the cell is still below the aircraft's *current* altitude.  In REL display any color cell may produce an alert, depending on the descent rate.   In level flight only yellow or red cells will produce an alert.



Figure 6-2 "WARNING TERRAIN" Annunciation

## 6.3    External Annunciation

If optional external annunciators are installed, they will display simultaneously with the on-screen annunciations in Amber or Red.

## 6.4    Responding to an Alert

Every alert should be considered valid and requires appropriate action.

- An AMBER CAUTION annunciation and requires *immediate pilot attention*.
- A RED WARNING annunciation and requires *immediate aggressive pilot action*.

Pilot reactions to alerts and warnings differ according to weather conditions, visibility, type of warnings, phase of flight, and aircraft performance considerations. Pilots should be thoroughly familiar with FAA, company, or other approved operational procedures as required by their aircraft and type of operation.

Pilots should train to react properly to all alerts, cautions and warnings, just as one would train to react to any other emergency situation.

## 6.5    Alert Circle

### 6.5.1    Terrain

The Alert Area Indicator Circle shows the general location of the current alert for FLTA alerts. Do not assume the terrain or obstacle threat is in the exact center of the circle. Also, remember the circle only represents the closest threat. Other threats may exist farther away, or to the side, but will not be circled. Since the exact location of the terrain is subject to uncertainties and tolerances, the terrain or obstacle threat may be anywhere inside the circle.

### 6.5.2    Obstacles

For obstacle alerts, the size of the Alert Circle displayed on the ST3453H depends on the 'horizontal extent' of the obstacle. This includes both the radius of the obstacle and the survey uncertainty of the obstacle as listed in the database. Tall obstacles are assumed to have guy wires and will have a radius equal to their height. This means the horizontal extent can be quite large for tall obstacles – for instance, more than half a mile in diameter for a 2000' tower.

An alert is generated to the obstacle horizontal extent, which may be larger than the obstacle icon on the screen. If you see a tall tower symbol the circle is a minimum of 1000' in diameter.

When an alert is generated, the alert caution/warning circle will be *the full diameter of the horizontal extent*. Stay completely out of the circle as you will likely not be able to see guy wires if they are present.

It is possible that a tall obstacle, while not precisely in the aircraft's flight path, will generate an alert with an alert circle that *will then be in the aircraft's flight path* unless corrective action is taken. See

Figure 6-3.
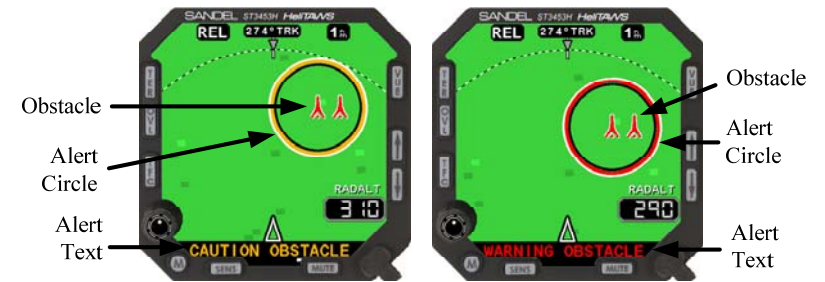


Figure 6-3 Obstacle Alert on a tall tower

## 6.6    Obstacle Symbology

Obstacles are depicted by two symbols. These symbols will be sized according to the relative height below the helicopter and the distance. There is no difference in meaning between the same symbols depicted at different sizes. Coloring of obstacles is in accordance with the REL Color Chart in Figure 5-10 with the exception that there is only one RED color band (i.e. red means above, there is no dark red).

| Obstacle Symbols | Single Obstacles | Multiple Obstacles |
|---|---|---|
| 500' AGL and taller: |  |  |
| Less than 500' AGL |  |  |

Figure 6-4 Obstacle Symbols

### 6.6.1    Obstacles in TOPO Display

In REL, only obstacles in the REL color bands are shown. In TOPO, *all* obstacles in the database are depicted, adding those obstacles to the display that are below the REL GRN color band. Any obstacles above the current helicopter altitude are shown in red. All other obstacles are

shown sized and highlighted to indicate their proximity to the helicopter. Note that obstacles far from the helicopter are shown very small - for situational reference / planning only. These will drop out of view in REL mode.



Figure 6-5 Obstacles in TOPO Display



Figure 6-6 Minimized Obstacles in TOPO Display

Figure 6-6 is the same depiction as Figure 6-5 except with the helicopter at a higher altitude. Note that all the obstacle symbols, including the 'tall tower' symbol are now minimized.

### 6.6.2 Obstacles in REL Display

The following figures show the same situation as Figure 6-5 after pressing the [TER] button. REL mode only obstacles near the helicopter

altitude where RED/YEL/GRN color coding is enforced. The obstacles below the 'green' altitude drop out of the display completely.



Figure 6-7 Obstacles in REL Display



Figure 6-8 Obstacles in REL Display

Figure 6-8 is the same as Figure 6-7 except with the helicopter at a higher altitude. There are no obstacles near the helicopter altitude so nothing is shown.

### 6.7 WireWatch ®

WireWatch ® is a proprietary wire alerting feature of the ST3453H. Alerting times and REL color coding are the same as for other obstacles.

### 6.7.1 Wire Segments

Alert segments are used for wire alerts. When a conflict with a wire exists, the wire segment nearest to the aircraft will highlight and flash. An amber "CAUTION WIRE" or red "WARNING WIRE" alert annunciation will appear on the display. The alert annunciation will be accompanied by an audible alert. Wire alerts display as shown in Figure 6-9.



Figure 6-9 Wire Alerts

### 6.7.2 No Wire Database

**No-wire database:** If a no-wire database is loaded in the ST3453H, the message "NO WIRE DATA" will appear on the display during power up. The pilot can clear this message (until the next HeliTAWS power cycle) by pressing the [ACK] softkey.



Figure 6-10 No-Wire Database Message

### 6.8 TAWS Inhibit - FLTA

FLTA alerts can be inhibited by pressing and holding the [MUTE] button on the display or an externally mounted* [MUTE] pushbutton for 2 seconds. This feature may be used for:

- Abnormal failure of GPS/Position Source resulting in erroneous data. A conventional (flagged) GPS/Position Source failure will automatically fail alerts and the terrain display.
- To stop alerts occurring because of unusual VFR mission requirements.
- A perceived nuisance alert. Any alert expected but not received should be brought to the attention of Sandel Avionics for analysis.

Be aware that the TAWS INH function cancels all alerts - FLTA and GPWS. Altitude Callouts remains active. Terrain and obstacles continue to be displayed on the screen.

*An externally mounted MUTE pushbutton is an installation option. TAWS Inhibit through the use of an external MUTE button may be enabled or disabled depending on the configuration of the unit installed in the aircraft. Consult the RFMS for details.

### 6.9 Simultaneous TAWS and TFC Alerts

If a TAWS alert occurs Traffic will be removed from the display.

If a traffic alert is also present during the terrain alert, a yellow or red "TFC" annunciator appears next to the [TFC] button. If it is desired to simultaneously view the traffic in this situation, pressing the [TFC] button will restore the TFC targets.

After the terrain alert ceases, the traffic display will always be restored automatically and the prior terrain display mode will be restored after a 5 second delay.
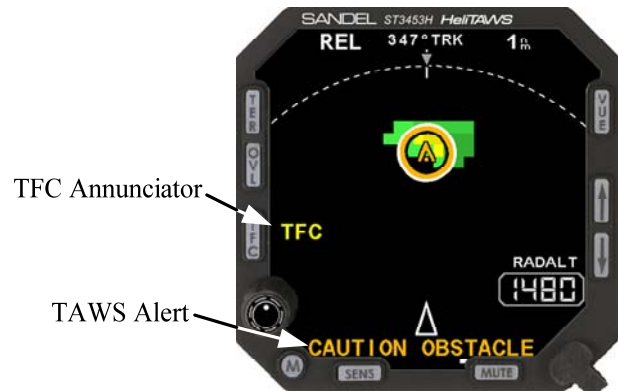
TFC Annunciator

TAWS Alert

Figure 6-11 Display During TAWS Alerts

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# 7    GPWS ALERTING

The ST3453H contains a Ground Proximity Warning System separate from the FLTA alert system.  The GPWS is a downward looking alert capability which generally uses the radar altimeter as an alerting source.

The GPWS alerts could be considered as a backup system if FLTA was not available (such as if GPS position was unavailable) or the helicopter was hovering.

All GPWS alerting except for Mode 6 are disabled when either Tactical or Obstacle Only sensitivity modes are selected.

**NOTE:** GPWS alerting, Modes 1, 3, and 4 require a Radar Altimeter to be installed. Without a Radar Altimeter they are disabled.

## 7.1    Mode 1 – Excessive Rate of Descent

A "SINK RATE" Caution Alert is generated when the aircraft height above terrain is below 1500' AGL and is accompanied by a high rate of descent. If the descent is not arrested a "PULL UP" Warning Alert is generated. Mode 1 is only available for alerting if FLTA is failed or GS is less than 40kts.



Figure 7-1 GPWS Mode 1 Alerts

## 7.2    Mode 2 – Not Implemented

This "Terrain Closure Rate" alert provides no useful information in a helicopter (is a fixed-wing mode) and not supported in Helicopter TAWS.

## 7.3    Mode 3 – Descent after Takeoff

A "DON'T SINK" Caution Alert is generated if the aircraft climbs above the arming altitude for the selected sensitivity and then descends to below 40% of the maximum altitude achieved. If the aircraft climbs above the disarming altitude before the descent occurs, the Mode 3 alert will not be generated. This alert may be cancelled by pressing [MUTE].



Figure 7-2 GPWS Mode 3 Alert

| Sensitivity | Arming Altitude | Disarming Altitude |
|---|---|---|
| Normal | 95' | 299' |
| Low | 75' | 149' |
| Tactical | N/A | N/A |
| Obstacles Only | N/A | N/A |

Table 7-1 Mode 3 Arming/Disarming

## 7.4    Mode 4 – Landing Gear

For retractable gear aircraft - A "TOO LOW GEAR" Caution Alert is generated if the aircraft descends below 125' while in the Normal Sensitivity mode (or below 50' while in the Low Sensitivity mode) and the landing gear is not down.
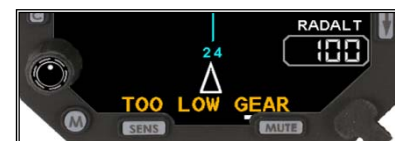


Figure 7-3 GPWS Mode 4 Alert

## 7.5    Mode 5 – Glideslope

A "GLIDESLOPE" Caution Alert is generated if the aircraft descends below the glideslope when the aircraft is 400' AGL or lower while in the Normal Sensitivity mode and 200' or lower while in the Low Sensitivity mode, while on an ILS approach.

> NOTE:  When in IMC conditions Normal Sensitivity always be used.  The Glideslope Alert will not be active at the beginning of the final approach segment as this will occur above the 400' enabling altitude.



Figure 7-4 GPWS Mode 5 Alert

## 7.6    Mode 6 – Altitude Callouts

Altitude callouts are generated depending on the selected Sensitivity. Optional Callouts are selected at installation.  See Table 7-2.

Table 7-2

| SENS / AGL | NORM | LOW | TACT | Obstacle Only |
|---|---|---|---|---|
| **With a Radar Altimeter Installed** | | | | |
| 300 ft. | **Mandatory** | Inhibited | Inhibited | Inhibited |
| 200 ft. | Option | Inhibited | Inhibited | Inhibited |
| 100 ft. | Option | **Mandatory** | Inhibited | Inhibited |
| 50 ft. | Option | Option | Option | Option |
| 40 ft. | Option | Option | Option | Option |
| 30 ft. | Option | Option | Option | Option |
| 20 ft. | Option | Option | **Mandatory** | Option |
| 10 ft. | Option | Option | Option | Option |

Mandatory callouts cannot be deconfigured.

## 7.7 TAWS INH – GPWS

GPWS alerts can be inhibited by pressing and holding the [MUTE] button on the display or an externally mounted* [MUTE] push button pushbutton for two seconds.

Be aware that the TAWS INH function cancels <u>all</u> alerts - FLTA and GPWS.  Altitude Callouts remains active. Terrain and obstacles continue to be displayed on the screen.

*An externally mounted MUTE pushbutton is an installation option. TAWS Inhibit through the use of an external MUTE button may be enabled or disabled depending on the configuration of the unit installed in the aircraft. Consult your RFMS for details.



Figure 7-5 TAWS INHIBIT

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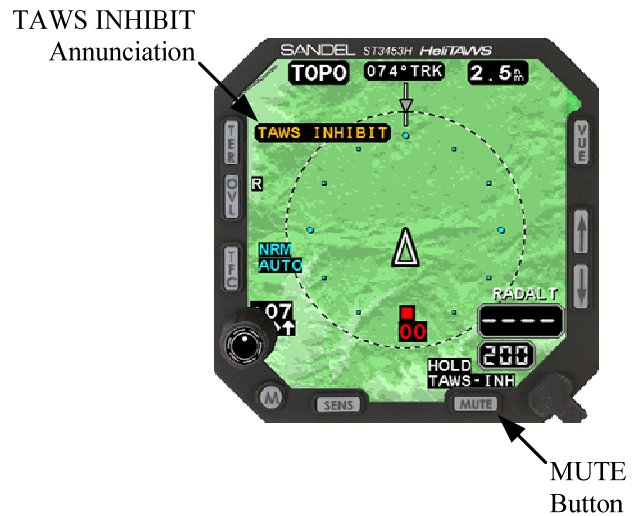
## 8 RADAR ALTIMETER FUNCTIONS

The ST3453H functions as an optional Radar Altimeter indicator when interfaced to a compatible Radar Altimeter system. A Radar Altitude display and a MINS setting window are provided.

The Radar Altitude will not be displayed if a Radar Altimeter is not installed. However the MINS setting window is retained and may be used by the pilot as a reference number.

Radar altitude displays in 5' increments below 200'; 10' increments below 1000'; and 20' increments below 2000'

The knob adjusts the MINS setting by rotating clockwise or counterclockwise, as needed.

When the aircraft Radar Altitude descends below the MINS setting, the MINS annunciator will flash and an audible MINS callout will occur.

The ST3453H may be configured during installation to not display Radar Altitude information and the MINS setting/display. Consult the RFM for details.



Figure 8-1 Radar Altimeter Functions

**Note:** The MINS function is disabled when the helicopter is on the ground.

.

## 8.1 Radar Altimeter Test

Pressing and holding the MINS knob will induce a Radar Altimeter test to the interfaced system. "RA TEST" will annunciate on the display next to the knob and "MINS" will annunciate above the Radar Altimeter readout. When testing a digital Radar Altimeter system, "RATEST" will display in amber in place of the text RADALT above the Radar Altimeter readout. Refer to the flight manual supplement applicable to the installed equipment for test details. If the knob is held longer than 10 seconds, the test will time-out.

In some configurations, the ST3453H RA TEST is set to be disabled. In this configuration, pressing the MINS knob has no effect.
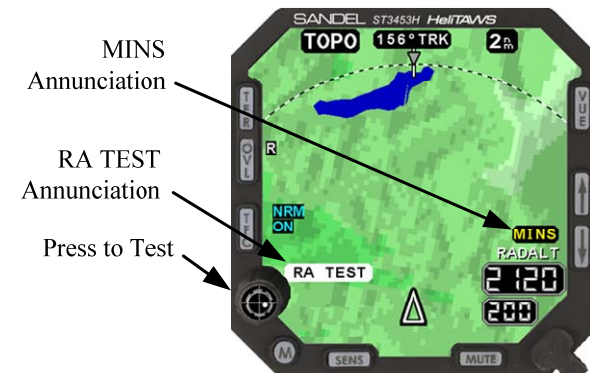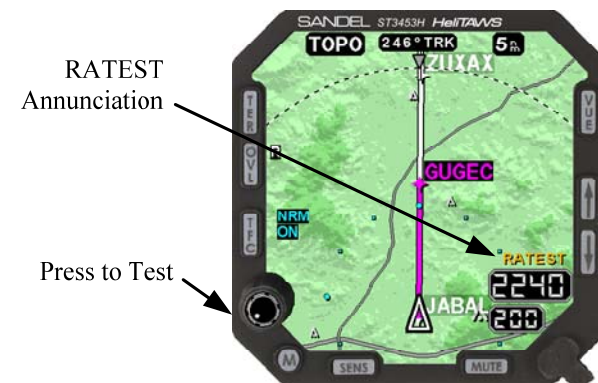


Figure 8-2 Radar Altimeter Test



Figure 8-3 Digital Radar Altimeter Test

# 9    TRAFFIC FUNCTION
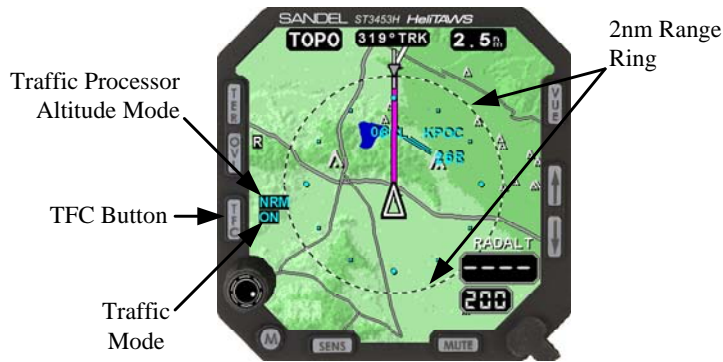
## 9.1    Traffic Display



Figure 9-1 ST3453H Traffic Overlay

Traffic will be overlaid on terrain when in REL and TOPO display views. The traffic is always shown relative to the nose of the aircraft – where you would see it if you looked out the window.

The [TFC] button is used to control the display of traffic data from nearby transponder equipped aircraft when the ST3453H is interfaced with a compatible TAS, TCAS, or ADS-B processor. Please refer to the Pilot's Guide of the specific traffic system installed in the aircraft for a complete description of the capabilities. When a traffic processor is not installed, pressing the [TFC] button will display a "NOT CONFIGURED" advisory.

## 9.2    TFC Button

Pressing the [TFC] button toggles between ON and AUTO modes, annunciated next to the [TFC] button.

Regardless of the selected mode, traffic alerts will always be shown

**ON**:Always displays all traffic targets within the selected map range.

**AUTO**:  Traffic will be displayed only when a traffic alert is present (TA's and RA's). When a traffic alert occurs, the map range will auto-scale to an appropriate range to ensure the traffic conflict is shown on the screen.   AUTO mode can be useful in busy terminal areas where the

display of traffic all the time may cause the screen to become too cluttered.

**Note**:  The traffic alert and its audio are provided by the TAS or TCAS system, not the ST3453H.

## 9.3    Traffic Processor Altitude Mode

The traffic processor's altitude display mode will be displayed above the TFC Display Mode indicator.

| NRM | Normal altitude display mode.  Target aircraft within +/-2,700 ft. of your aircraft are displayed. |
|-----|-----|
| ABV | Above altitude display mode.  Target aircraft within – 2,700 ft. and +9,000 ft. of your aircraft are displayed. |
| BLW | Below altitude display mode.  Target aircraft within – 9,000 ft. and + 2,700 ft. of your aircraft are displayed. |
| XTD | Extended altitude display mode.  Target aircraft within +/-9,000 ft. of your aircraft are displayed. |

**Note**:  With some TCAS equipment NORM is not annunciated. Please refer to the RFM for details on the specific traffic system installation in your aircraft.

## 9.4    TFC Range Ring

When traffic is being displayed a dotted 2nm range is shown.  The 12, 3, 6, and 9 o'clock positions are bolded.

## 9.5 Symbology

The ST3453H uses standard RTCA symbology to represent traffic.

| Alerting Traffic | | |
|---|---|---|
| **DISPLAY** | **CONDITION** | **DESCRIPTION** |
| ■ (red square) | Resolution Advisory (RA) (Available with TCAS II Only) | Immediate threat that requires evasive action. Note: Vertical guidance information is NOT shown on the ST3453H display. |
| ● (yellow circle) | Traffic Advisory (TA) | Traffic within 15-30 seconds of closure, or within 0.20 to 0.55nm and +/-600 to +/-800 ft of your aircraft. |
| TA 2.0nm | No Bearing / No Altitude Traffic Advisory | TA with no bearing and no altitude information available. |
| TA 2.0nm/+07↑ | No Bearing Traffic Advisory | TA with no bearing information available. |

| Non-Alerting Traffic | | |
|---|---|---|
| **DISPLAY** | **CONDITION** | **DESCRIPTION** |
| ◆ (white diamond) | Proximity Advisory | Traffic within 4nm and +/-1,200 ft of your aircraft |
| ◇ (hollow diamond) | Other Traffic | Traffic not representing an immediate threat |
| (half symbol on arc) | Out of Range Traffic | Alerts outside of the currently selected display range will be shown as a half symbol against the outer range ring at the corresponding bearing. |

## 9.6 Altitude Tags

### 9.6.1 Relative

Relative altitude in hundreds of feet and vertical trend information are given for each target aircraft. **Note**: Values greater than 9900 feet are shown as '99'.

| | |
|---|---|
| ◇↑ -02 | The '-02' indicates the target is 200 feet below your current aircraft altitude. The up arrow indicates the target is climbing at a vertical rate of greater than 500 fpm. |
| +05 ◇↓ | The '+05' indicates the target is 500 feet above your current aircraft altitude. The down arrow indicates the target is descending at a vertical rate greater than 500 fpm. |

### 9.6.2 Traffic Absolute Altitude

The traffic processor may have an option to change the display of altitude from relative to absolute. This is called 'Flight Level' mode by some manufacturers. When activated, the altitude shown for target aircraft will temporarily be shown in hundreds of feet MSL when below 18,000 feet and as a flight level when above 18,000 feet. The altitude of your aircraft will be shown on the ST3453H display.

### 9.6.3 Traffic Alert Priority

In the case of simultaneous GPWS/TAWS and TCAS alerts, GPWS/TAWS alerts have a higher alerting priority.

## 10 PILOT MENU

Press the [M] "Menu" button to access the Pilot Menu and to view messages when indicated by the MSG annunciation. When softkey selection has been made or messages have been viewed, exit the Pilot Menu by again pressing the [M] "Menu" button.

After accessing the Pilot Menu, MSG annunciation will only display when a new message occurs.

Figure 10-1 Pilot Menu

### 10.1 GS INHIBIT

[GS] soft key controls GPWS Mode 5 glide slope alerts NORM or INH (disabled). When in INH the glide slope warning is disabled.
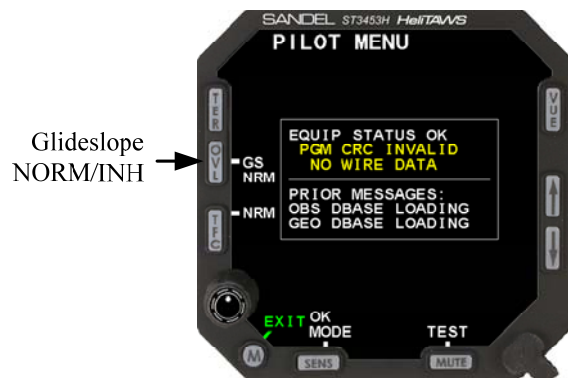
Figure 10-2 GS INHIBIT

### 10.2 ALERT TEST

The [TEST] softkey performs the following functions.

- Tests external annunciator lamps, if installed.
- Tests on-screen annunciation of CAUTION followed by WARNING.
- Tests audio system with CAUTION followed by WARNING audio.

This test should be performed before each flight.

NOTE: While in the Pilot Menu, the Mute button softkey [TEST] functions only to invoke the Alert Test - it will not mute a CAUTION.

Figure 10-3 TEST

### 10.3  TCAS TEST

Provides a TCAS TEST output discrete for BFG traffic systems. Press the knob to perform the TCAS TEST. Consult the Rotorcraft Flight Manual Supplement for the ST3453H installation for you aircraft and the traffic system pilot's guide for additional details.
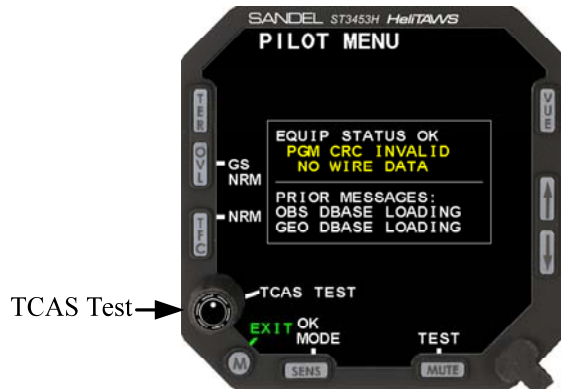
TCAS Test→

Figure 10-4 TCAS Test

### 10.4  Traffic System Altitude Mode

The ST3453H supports four altitude filtering modes: NORM (Normal), ABOVE, BELOW, and XTNDD (Extended). Depending on the model of traffic system interfaced to the ST3453H in your particular installation, these altitude filtering modes may be controllable through this soft key. Descriptions for these modes can be found in Chapter 6 – TRAFFIC DISPLAY. Consult the Rotorcraft Flight Manual Supplement for the ST3453H installation for your aircraft and the traffic system pilot's guide for additional details.

Traffic System Altitude Mode→

Figure 10-5 Traffic System Altitude Mode

## 10.5 Traffic Equipment Mode Control/Annunciation

The MODE soft key controls and annunciates the Standby/Operate status of BFG traffic systems. Press the [SENS] button to change the operating status of the traffic system. Consult the Rotorcraft Flight Manual Supplement for the ST3453H installation for you aircraft and the traffic system pilot's guide for additional details.
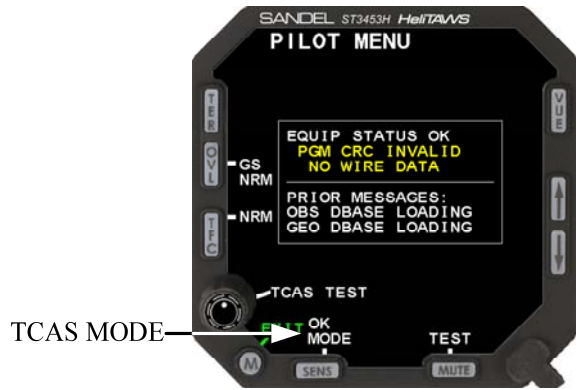


Figure 10-6 TCAS MODE

## 10.6 System Status Box

The System Status box contains an upper Active Message box and a lower Prior Message box. The [UP/DOWN] arrow buttons can be used to scroll through the Prior Message box.

During the first two minutes of operation after application of power to the ST3453H, in order to allow time for external sensors to initialize, the status of failed or inoperative equipment is not displayed.

After this two minute period, the status of failed or inoperative equipment will be displayed.
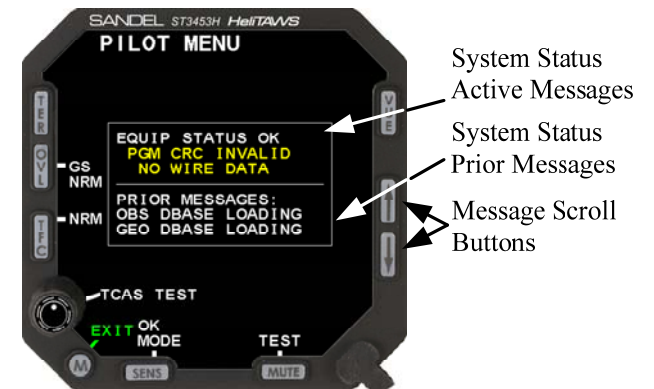


Figure 10-7 System Status

NOTE:  The loss of a piece of equipment may or may not fail the related function based on the availability of an alternate sensor.

### 10.6.1 Status Box Message List

| STATUS MESSAGES | | |
|---|---|---|
| **Text Message** | **Description** | **Comment** |
| EQUIP STATUS OK | Equipment is functional. | - |
| GEO DB CRC FAULT | Geo-overlay data cyclic redundancy check invalid | Geo-Overlay database not usable. No effect on alerting. Report to maintenance. |
| GEO INCOMPATIBLE | Geo-overlay database not compatible with this software version | Geo-overlay data not compatible. No effect on alerting. Report to maintenance. |
| GYRO XYZ LOST | Hdg Gyro XYZ signal lost. | May be reported during Hdg Gyro initialization. Report to maintenance if displayed in flight. |
| MAP INCOMPATIBLE | Airport database version incompatible | Airport data not compatible. During takeoff/departure/approach/landing use TAWS INH or OFF APT mode as appropriate. Report to maintenance. |
| OBS INCOMPATIBLE | Obstacle database version incompatible | Obstacle data not compatible. No obstacle or wire alerting. Report to maintenance. |
| PARAM CRC FAULT | Internal check of configuration storage CRC failed. | Cannot provide intended function. Report to maintenance. |
| PARAM FILE ERROR | Local configuration data mismatch | Cannot provide intended function. Report to maintenance. |
| PWR SUPPLY FAIL | Internal power supply fail. | Cannot provide intended function. Report to maintenance. |
| TERR HDR CONFLICT | Terrain database internal conflict | Terrain header not compatible. Terrain alerting not available. Report to maintenance. |
| TERR INCOMPATIBLE | Terrain database version compatibility failure | Terrain data not compatible. Terrain alerting not available. Report to maintenance. |
| POS PRI [INVALID/NO DATA] | GPS/FMS/INS Position | Equipment Status |
| POS SEC [INVALID/NO DATA] | GPS/FMS/INS Position | Equipment Status |
| PA PRI [INVALID/NO DATA] | Air Data Computer | Equipment Status |
| PA SEC [INVALID/NO DATA] | Air Data Computer | Equipment Status |
| RA PRI [INVALID/NO DATA] | Radio Altimeter | Equipment Status |
| RA SEC [INVALID/NO DATA] | Radio Altimeter | Equipment Status |
| HDG PRI [INVALID/NO DATA] | Heading System | Equipment Status |
| HDG SEC [INVALID/NO DATA] | Heading System | Equipment Status |
| LOC NO DATA | Localizer Receiver | Equipment Status |
| NO HDG SRC | Loss of all available heading sources | Equipment Status |
| NO NEW MESSAGE | No new messages | System Status |

## 11  EXTERNAL SWITCH AND ANNUNCIATORS

External annunciators and switches may be optionally installed.

The supported external annunciators are:

### TAWS CAUTION

Annunciates in amber whenever an amber caution is present on the ST3453H display.

### TAWS WARNING

Annunciates in red whenever a red warning is present on the ST3453H display.

### TAWS INHIBIT

Annunciates whenever TAWS INH is present on the ST3453H display.  It also illuminates when TAWS alerts are disabled for any other reason, such as loss of GPS signal, no terrain data, etc.  This will correspond with a flagged terrain display.

The supported external switch/ annunciators are:

### MUTE

Annunciates whenever the MUTE is displayed on the ST3453H.  Pressing the external MUTE switch has the same function as the front panel [MUTE] button.  If external TAWS Inhibit is configured to be enabled, holding the external MUTE switch for 2 seconds has the additional function of selecting the TAWS INH function as if TAWS INH was selected by pressing and holding the [MUTE] button on the display.

### REDUCED SENSITIVITY

Annunciates whenever TACTICAL, or OBST-ONLY is displayed on the ST3453H. Pressing the external SENSITIVITY switch has the same function as the front panel [SENS] button, including the HOLD function.

### GS INH

Annunciates when GS INH is selected.  Pressing external GS INH switch has the same function as the pilot's menu [GS INHIBIT] softkey.

NOTE: If power to the ST3453H drops below 20 volts, the external switches will not be operative.

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## 12   ON SCREEN ANNUNCIATIONS

Figure 12-1 (below) is an illustration of the various position and meanings of on-screen annunciations:

GPWS FAIL:   One or more GPWS modes are unavailable due to failed equipment, typically Radar Altimeter failure. When in NORM or LOW-SENS, all GPWS modes except mode 5 will be unavailable. When in TACTICAL or OBST-ONLY all GPWS modes will be unavailable.

GS INH:   Glide Slope Inhibit active.  No glide slope alerts will occur.

MSG:   A new message is waiting on the Pilot Menu.  Press the M button to view.

NO HDG:   Loss of heading information (or no heading system configured) when GPS / Position Source track is not available.

TAWS FAIL:   FLTA alerts and TOPO and REL displays are disabled due to lack of database or failed database.

TAWS INHIBIT: TAWS Inhibit active due to pilot action.  All alerts are suppressed.

(TCAS) FAIL:   Display of traffic is disabled due to lack of data communication from the TCAS processor.

TERR FAIL:   Loss of terrain data.
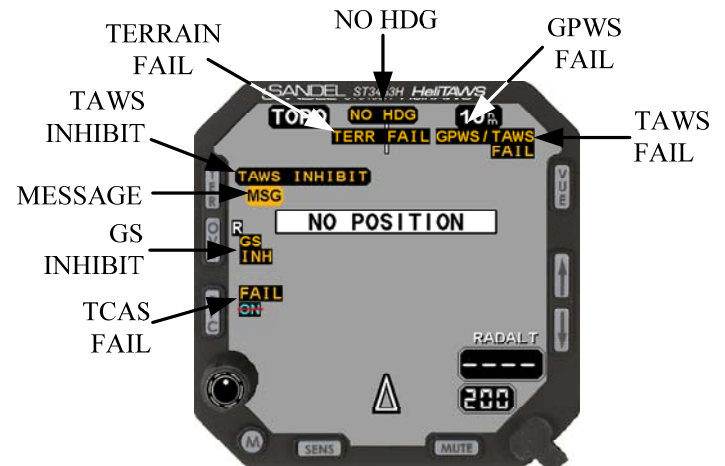


Figure 12-1 On-Screen Annunciation

These messages are displayed during Pilot's Menu test:

| ALERT TEST | |
|---|---|
| Text Message | Type |
| TEST CAUTION | Caution |
| TEST WARNING | Warning |

| ADVISORY MESSAGES REQUIRING ACKNOWLEDGE | | |
|---|---|---|
| Text Message | Description | Comment |
| AIRCRAFT POWER | Aircraft power | Check aircraft bus voltage.  It is low. |
| OVERTEMP | Over temperature | Dim the display. Pull CB if the message persists. If CB was disengaged, report to maintenance. |
| INTEGRITY FAIL | System Integrity Failure | System will not perform its intended function. Pull CB and report to maintenance. |
| PGM CRC INVALID | Program cyclic redundancy check invalid | Program code has an error – unit will not perform its intended function |
| COOLING FAN FAIL | RPM check of fan indicates a failure | May induce an OVERTEMP warning. Report to Maintenance. |
| GYRO INVALID | DG failure detected. | May be reported during Hdg Gyro initialization. Report to maintenance if displayed in flight. If two heading sources are interfaced to the ST3453H, this message indicates failure of both. |

| 400HZ FAILED | 400 Hertz failed | Aircraft inverter failure. May affect HDG operation |
|---|---|---|
| 400HZ LOW | 400 Hertz low | Aircraft inverter problem – low freq |
| 400HZ HIGH | 400 Hertz high | Aircraft inverter problem – high freq |
| DATABASE CONFLICT | Database files do not all have coverage for the same area. | Displayable data for current position may not all be presented. |
| TERRAIN CRC FAULT | Terrain data cyclic redundancy check invalid | Terrain data has an error – FLTA will not perform its intended function. Use TAWS INH if "TAWS FAIL" not displayed. |
| APT DB CRC FAULT | Airport data cyclic redundancy check invalid. | Airport data has an error. During takeoff/departure/approach/landing use TAWS INH or OFF APT mode as appropriate. |
| OBST DB CRC FAULT | Obstacle data cyclic redundancy check invalid | Obstacle database not usable. No obstacle or wire alerting. |

| ADVISORY MESSAGES | | |
|---|---|---|
| **Text Message** | **Description** | **Comment** |
| CHECK FAIL 'nnn' | System unusable, where nnn = error code. | If the message persist, system will not perform its intended function, pull CB and report to maintenance. |
| GEO DBASE LOADING | Displayed during initialization to current position. | Momentary message. |
| NO ACTION | MUTE button pressed with no caution alert active. | Momentary message. |
| NO POSITION | GPS is not indicating a valid position solution. | Message will remain until position solution is valid. |
| NO VERTICAL POS | GPS is not indicating a valid altitude solution. | Message will remain until altitude solution is valid. |
| NOT CONFIGURED | TFC button requires configuration of TCAS by installer | Momentary message. |
| NOT IMPLEMENTED | Button function not implemented | Momentary message. OVL button will indicate this when no overlay database is present. |
| OBS DBASE LOADING | Displayed during initialization to current position. | Momentary message. |

## 12.1 CM MOD FAIL

The ST3453H uses a rear mounted configuration module to customize to the aircraft installation. It cannot operate without a working configuration module.

If a configuration module error occurs during power up, the CM MOD FAIL screen will appear and will display one or more failure indications in yellow text as in **Error! Reference source not found.** below. This is considered a fatal error and the user cannot exit this screen.

If this screen appears, the unit is non-operational and must be serviced. The pilot should notate the message which appears and report the specific message to Maintenance.

Configuration Module
Error Message



Figure 12-2 CM MOD FAIL Display

| CM MOD FAIL MESSAGES |
| --- |
| READ FAILURE |
| WRITE FAILURE |
| HDR INVALID CRC |
| HDR INCOMPATIBLE |
| HDR CRC FAILURE |
| 1553 CRC FAILURE |
| 1553 CFG INVALID |
| ACFT CFG INVALID |
| ACFT CFG ITEM CRC |
| ACFT CFG ITEM MISMATCH |
| OUT OF SPACE |
| CM INCOMPATIBLE |
| CM CRC FAILURE |

Figure 12-3 CM MOD FAIL Messages

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## 12.2  FATAL SYSTEM ERROR

If the ST3453H displays a fatal error system message screen, the unit must be restarted. This message will occur only during startup and may be caused by one of the reasons listed in Figure 12-4.  If the message persists, the unit should not be used. Report the message to maintenance.

Fatal System Error
Message



Possible Causes:
SD CARD MOUNT FAIL
HARDWARE INTERNAL FAULT
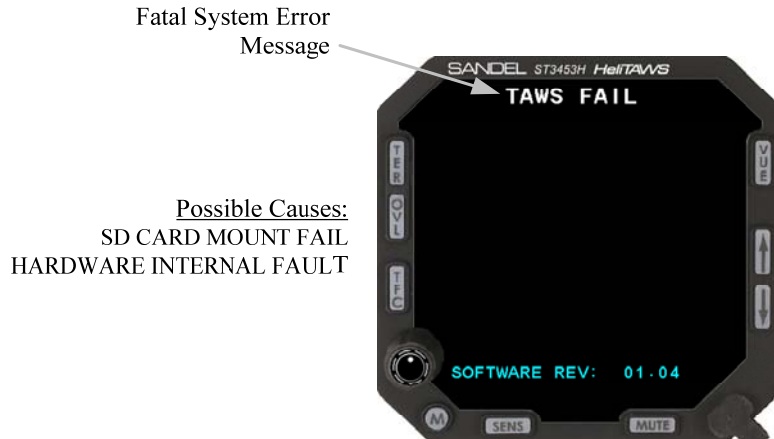
Figure 12-4 Fatal System Error Message Display

## 13  TROUBLESHOOTING

### 13.1  Nuisance Alerts

If an alert is previously determined to be erroneous, and is repetitive at a specific location, the alerting function can be inhibited through the use of TAWS INH.  A perceived nuisance alert should be brought to the attention of Sandel Avionics.

### 13.2  Flight Data

The ST3453H has an internal recorder that automatically records up to 100 record files of flight data and events (total maximum = 100MB).  The oldest files are automatically overwritten by the most recent files to keep the total file list limit at 100.  This data can be used by Sandel Avionics Customer Support to analyze recent alert and message activity. To avoid data being overwritten, minimize the number of power cycles until data is downloaded by maintenance personnel.

### 13.3  Gray Terrain Cells

Gray terrain cells will be drawn in cases where terrain data is unavailable. This may also be accompanied by a "TAWS FAIL" message.  One example of this is when flying beyond the coverage region of the currently loaded terrain database.

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## 14   SPECIFICATIONS

| TSO Compliance | |
|---|---|
| Technical Standard Order (TSO) | C87:   Airborne Low-Range Radio Altimeter<br>C113:  Airborne Multipurpose Electronic Displays<br>C118:  Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment, TCAS 1<br>C194:  Helicopter Terrain Awareness and Warning System (HTAWS) |
| Software Certification | RTCA/DO-178B, Level C |
| Programmable Logic | RTCA/DO-254, Level C |
| Environmental Category: | RTCA/DO-160F:<br>   [A2F1Z]BBBUXXXXXXZZAZ[ZW][YY]M[A3G33]XXAX<br>MIL-STD-810G:<br>   Altitude, Temperature, Rain, Humidity, Fungus, Sand, Dust, Explosive Atmosphere, Acceleration, Vibration, Shock/Crash Safety/Bench Handling, Electromagnetic Environment, Electrical Power |

| Physical Dimensions | |
|---|---|
| Form Factor: | 3ATI (ARINC 408) |
| Width: | 3.165 inches |
| Height: | 3.165 inches |
| Length: | 7.8 inches |
| Weight: | 3.0 lbs. |

| Operational Characteristics | |
|---|---|
| Temperature/Altitude: | -40º C to + 70º C up to 55,000 ft. |
| Power Inputs: | 22 to 33 VDC<br>30 watts maximum |
| 400 HZ Reference: | Max 1 ma. |

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## 15 ACRONYMS

| | |
|---|---|
| ACK | Acknowledge |
| ADS-B | Automatic Dependent Surveillance - Broadcast |
| AHRS | Attitude/Heading Reference System |
| BIT | Built-In-Test |
| CFIT | Controlled Flight Into Terrain |
| CM | Configuration Module |
| CRC | Cyclic Redundancy Check |
| ECRT | Excessive Closure Rate to Terrain |
| EDGSD | Excessive downward Glideslope Deviation |
| EMS | Emergency Medical Service |
| ERD | Excessive Rates of Descent |
| FAA | Federal Aviation Administration |
| FITNL | Flight Into Terrain Not in Landing Configuration |
| FLTA | Forward Looking Terrain Avoidance |
| FMS | Flight Management System |
| GPS | Global Positioning System |
| GPWS | Ground Proximity Warning System |
| GS | Glide Slope |
| HDG | Aircraft's magnetic heading |
| HTAWS | Helicopter Terrain Awareness Warning System |
| Hz | Hertz (cycles per second) |

| | |
|---|---|
| ILS | Instrument Landing System |
| IMC | Instrument Meteorological Conditions |
| INS | Inertial Navigation System |
| KTS | Knots |
| MINS | Minimums |
| NCAT | Negative Climb after Take-off |
| NVIS | Night Vision |
| NM | Nautical Miles |
| POST | Power-On Self-Test |
| RA | Resolution Advisory |
| RFM | Rotorcraft Flight Manual |
| RTCA | Radio Technical Commission on Aeronautics (rtca.org) |
| TA | Traffic Advisory |
| TAS | Traffic Advisory System |
| TFC | Traffic |
| TRK | Aircraft's ground track (usually magnetic) |
| TSO | Technical Standard Order |
| VMC | Visual Meteorological Conditions |
| USB | Universal Serial Bus |

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