



## ST3400H *HeliTAVS*

### Pilot's Guide Effectivity and Errata

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

Date:	19-AUG-2015
Effectivity:	ST3400H Software Version 1.05 & A1.06 Pilots Guide 82046-PG-F
Errata:	With the exception of the superseding information contained in this document, operation of the ST3400H is as described in the ST3400H Pilot's Guide referenced above.

There no errata applicable to this update.

ST3400H

*HeliTAVS™*

Helicopter  
Terrain Awareness  
Warning System

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Pilot's Guide

Revision F

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## 1 INTRODUCTION

### 1.1 Pilot Information

Publication Date 28-AUG-2014

This guide provides information on the use and operation of the ST3400H HeliTAWS.

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

### 1.2 Copyright

Copyright 2014 Sandel Avionics, Inc.

May be covered by one or more of the following US and foreign patents, including US patent nos. 6,259,378, 6,489,916, 6,670,288, 6,507,288, 6,750,788, 6,972,695, 7,187,304. Australia Patent No. 750,651. China Patent No. 1211639C. Israel Patent Nos. 135,174, 153,460, and 155,983.

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### 1.3 Pilot's Guide Effectivity and Errata Notice

"Pilot's Guide Effectivity and Errata" (Sandel document 82046-PG-ERR) allows the use of this Pilot Guide with a specific software release. The "Pilot's Guide Effectivity and Errata" 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. This document must be kept with the Pilot's Guide.

## 1.4 Operational and Legal Issues

The information displayed on the ST3400H uses data generated by external equipment including but not limited to GPS. The ST3400H 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, it is important to note that what is displayed on the ST3400H 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 ST3400H does not fulfill this requirement.

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

Flight plan waypoints are supplied to the ST3400H by the associated approved GPS receiver.

Displayed supplemental data is intended for positional awareness only.

## 1.5 Trademarks

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

## 1.6 Approvals

The FAA has approved the ST3400H under the following TSOs:

- TSO-C194: Helicopter Terrain Awareness and Warning System (HTAWS)
- 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

The following certifications also apply to this product:

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

Installation of the ST3400H in a type-certificated rotorcraft must be performed in accordance with the Sandel ST3400H Installation Manual, document number 82046-IM applicable revision.

1.7 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 ST3400H, will be placed in the glossary.

1.8 Revision History

Revision History		
Revision	Date	Comments
F	28-AUG-2014	AR 1416 Section 5.8.2: Note updated to clarify auto-ranging functionality.

E	25-AUG-2014	AR 1416 Previous errata incorporated. Section 1.3: Updated to reference Effectivity and Errata document. Section 1.8: Renamed. Errata information removed. Section 4.1.1: Table updated for HIGH-SENS and installation configurability. Note (*) for Tactical mode updated. Section 5.8.2: Note updated to clarify auto-ranging functionality. Figure 5-8: Updated to include HIGH SENS mode. Section 5.14: Updated to add HIGH-SENS mode and description of selective mode configuration. Section 5.15: Updated to add HIGH-SENS mode description. Section 5-16: Updated text to include OFF-APT mode use during hover taxi operations. Section 7.1: Updated SINK RATE CAUTION alert description to include HIG-SENS mode. Added alerting limits table and text. Section 7.3: Mode 3 description updated. Table updated to include HIGH SENS mode. Section 7.5: Mode 5 Glideslope alert description updated to include HIGH-SENS. Figure updated for clarity. Section 7-6: Table updated for HIGH-SENS mode and 400’ callout. Section 11: Added LOW to the description of the reduced sensitivity annunciator.
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D	21-JUL-2014	<p>AR 1520</p> <p>Section 2: Website address updated.</p> <p>Section 3.4: Note for Tactical mode updated.</p> <p>Section 4.5.4, 5.19: Updated note regarding display of DME arcs, Holding Patterns, and Procedure Turns.</p> <p>Section 4.6: added text to indicate that Flight Plan is optional.</p> <p>Section 4.7.1: Added note about accuracy of presentation of display of bodies of water.</p> <p>Section 5.11: Added clarification that decluttering occurs in the TOPO display.</p> <p>Section 5.15.3: Tactical mode description updated.</p> <p>Section 7.5: Updated altitude limits for low sensitivity mode.</p> <p>Section 10.7.1: Equipment Status table updated.</p> <p>Figure 12-1: Description for TERR FAIL updated. Updated message tables. Removed HTAWS System Level Error Display section. Remaining sections renumbered.</p>
C1	30-SEP-2011	AR 1198 S/W Version 1.03
C	06-SEP-2011	<p>Revised for S/W Version 1.02</p> <p>Chapter 2 updated to include power line display, and Tactical and Obstacles-Only modes.</p> <p>Chapter 2: Limitations updated to include Tactical and Obstacles-Only mode. Added note about positional error.</p> <p>3.1: Updated to include Tactical and Obstacles-Only modes. Updated TCAS display information.</p> <p>3.4: Updated description of alerting times.</p>

		<p>4.1.1: Updated to include Tactical and Obstacles-Only modes.</p> <p>4.4: Updated TAWS INH to display terrain and obstacles.</p> <p>4.5.1: Updated to include display of bodies of water.</p> <p>4.5.3: Updated to include transmission lines and towers.</p> <p>4.5.4: S/w ver. 1.02 added to note.</p> <p>4.6.3: Updated descriptions of obstacle heights.</p> <p>4.7: Power line data exclusion added to disclaimer.</p> <p>Chapter 5 images updated for overlay feature.</p> <p>5.6: Added description of "Database Loading" message. Remaining sections of chapter 5 renumbered.</p> <p>5.11 Added description of decluttering feature that occurs at upper range settings.</p> <p>5.12: Overlay description added.</p> <p>5.14: Updated for Tactical and Obstacles-Only modes.</p> <p>Fig. 5-8: Updated to include Tactical and Obstacles-Only mode.</p> <p>6.1: Removed figures 6-2, 6-3, and associated text. Added note.</p> <p>6.7: Wire alerting added. Remaining sections in Chapter 6 have been renumbered.</p> <p>6.8: TAWS INH enable method updated. Updated TAWS INH to display terrain and obstacles.</p> <p>Figures 6-1, 6-4, 6-12 updated.</p> <p>7.3: Updated GPWS Mode 3 arming description. Added table 7-1.</p> <p>7-6: Updated Mode 6 description. Added Table 7-2.</p> <p>Figures 7-2, 7-3, 7-4, 7.7: Updated.</p> <p>8.1 RA Test Description added.</p>
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		Figure 8-2 added for RA Test 10-2: TAWS INH enable method updated. Updated TAWS INH to display terrain and obstacles. Fig. 10-1 through 10-8: Updated screenshot – TAWS INH no longer enabled on Pilot Menu. 11: Updated TAWS INH enable method. 12: Updated Advisory Message tables.
B1	22-OCT-2010	A/R 1147 Updated Section 17 Jeppesen Terms and Conditions
B	10-SEP-2010	Revised for S/W Version 1.01
A	06-AUG-2010	Initial Release

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No errata applicable to this release

## 2 LIMITATIONS

The ST3400H 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 ST3400H 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.

Reduced sensitivity modes such as 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 ST3400H.

The ST3400H Pilots Guide, SPN 82046-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 error varies by geographic location. Visit the Sandel website at <http://www.sandel.com/st3400h/st3400h-database-information> for specific information related to the positional error in your coverage area.

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### 3 WELCOME TO THE ST3400H 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 HTAWS 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.

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

Sandel's TrueAlert® 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 ST3400H 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 ST3400H 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 ST3400H 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 ST3400H.

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.

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 the alert times may be shorter but Cautions are designed to occur prior to Warnings. A Warning does not indicate a higher severity of threat, but simply that immediate action must be taken.

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 maximize 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 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 activity.

### **3.5 Other Features**

Display of Radar Altitude is provided along with a MINS setter.

Display of Traffic from an external traffic processor is provided.

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## 4 SYSTEM OVERVIEW

### 4.1 “Design Cruise Altitude”

The ST3400H introduces the concept of “Design Cruise Altitude” (DCA). This is the nominal cruise altitude at which the ST3400H is designed to give nuisance-free alerts with a black (no terrain showing) relative altitude display.

#### 4.1.1 Sensitivity

To facilitate differing altitude operations unique to helicopters, the ST3400H supports five pilot selectable alert sensitivity modes: Normal, High, Low, Tactical, and Obstacle Only. All sensitivity modes except for NORM may be selectively inhibited during installation and therefore may or may not be available.

Sensitivity	DCA AGL Ft.	Installation Configurable
HIGH	1000	X
NORM	500	
LOW	300	X
TACTICAL*	150	X
OBSTACLE ONLY	n/a	X

Reduced sensitivity selections with a DCA lower than ‘NORM’ allow standard operations closer to the ground. While operating in reduced sensitivity, the alert protection may not offset errors that may exist in the database.

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 Caution Alerts are not inhibited.

### 4.2 Off Airport Landings

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

Alerts are normally automatically suppressed during the landing phase at an airport or helipad. OFF-APT mode also 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 ST3400H 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 all alerts. 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 ST3400H displays obstacles 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

The ST3400H overlays the GPS/FMS flight plan over any terrain view, if a flight plan is available from the GPS /FMS.

**NOTE:** The flight plan overlay is for positional 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 is not currently supported in the ST3400H. These flight plan segments will be supported in a future software release.

### 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 ST3400H 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 is always present and may be used by the pilot as a reference number.

### 4.5.7 Traffic

The ST3400H can optionally display nearby transponder equipped aircraft when interfaced with compatible TAS, TCAS. Standard TCAS symbology is used to display the relative location and altitude of traffic. The traffic information is displayed overlaid on terrain.

**Note:** If the ST3400H is interfaced to a TCAS, the TCAS processor itself generates the alerts and these are only displayed on the ST3400H.

### 4.5.8 NVIS

For missions requiring the use of night vision goggles, certain ST3400H models are equipped with Sandel's proprietary on-demand Class-B NVIS capability. Unlike aftermarket NVIS modifications, Sandel's unique NVIS feature employs no external filters and 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 ST3400H installation for details on NVIS operation.

## 4.6 Sensors

Sensor data is the input data fed to the ST3400H that comes from external sources. There are no sensors inside the ST3400H. Data is derived from the following sensors:

- GPS Position
- FMS Flight Plan (optional)
- 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.

## 4.7 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 ST3400H.

#### 4.7.1 Items in the database

The ST3400H 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. 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 correctness of the REL display and terrain alerting.

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#### 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 ST3400H 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 ST3400H display and identifies each functional element.

5.1 Control Overview

The ST3400H physical layout consists of a display screen, 9 backlit buttons, one push-pull rotary knob, and one USB connector.

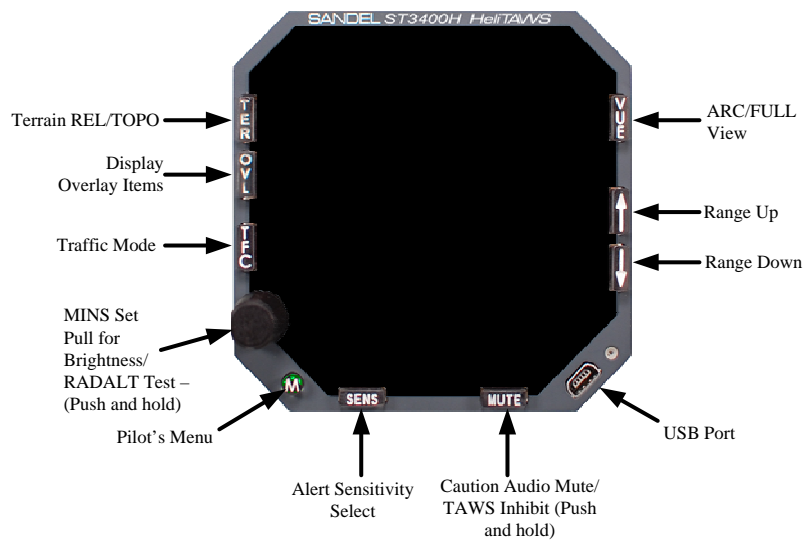


Figure 5-1 ST3400H Physical Features

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

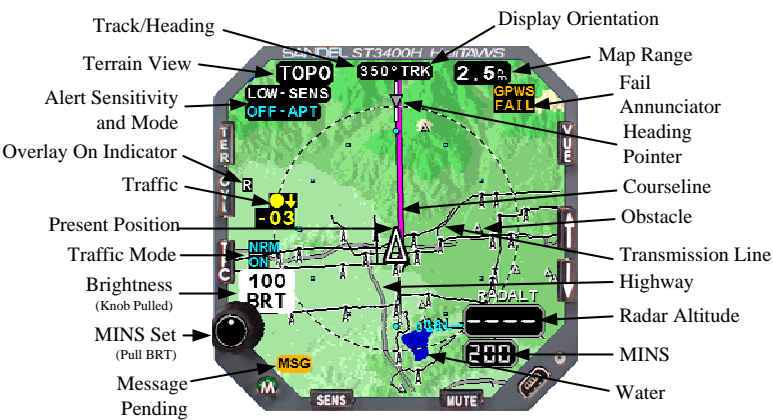


Figure 5-2 Display Overview TOPO/FULL

### 5.3 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 25 seconds.

### 5.4 Initial Bootup Display

Approximately 25 seconds after initial power-up, a short introduction screen will be displayed which includes the software and database versions.



Figure 5-3 Startup Screen

### 5.5 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 5-4 Initial Display

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

### 5.6 Loading of Database

While databases are loading, the message “DATABASE LOADING” will display. This message will display on power on initialization until all databases are loaded.

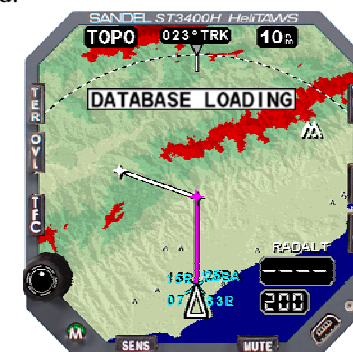


Figure 5-5 “DATABASE LOADING” Message

## 5.7 FULL / ARC

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



Figure 5-6 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.

## 5.8 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.

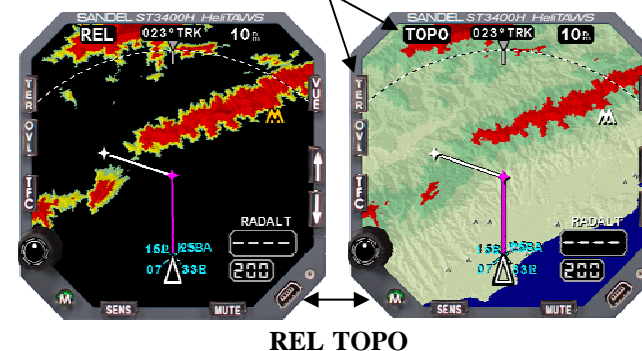


Figure 5-7 REL and TOPO Displays

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

### 5.8.1 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 shaded red. Water is shown in blue.

### 5.8.2 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.

## 5.9 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.

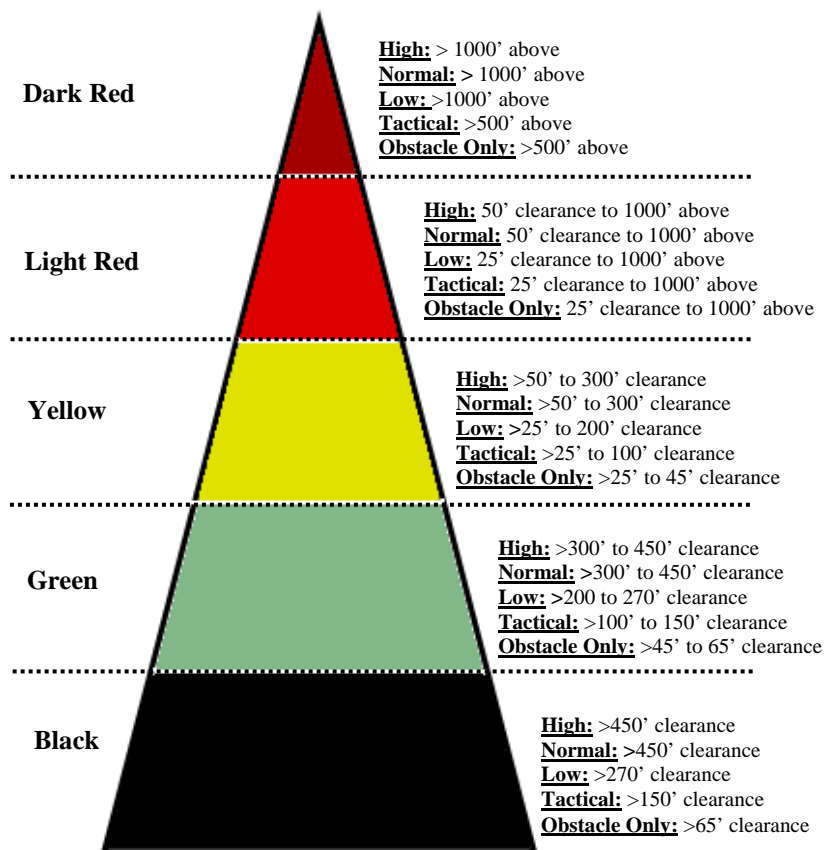


Figure 5-8 REL Display Color Banding relative to aircraft altitude

## 5.10 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.

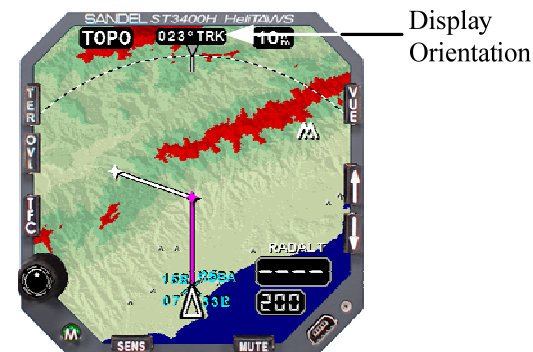


Figure 5-9 Display Orientation

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.

5.11 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.

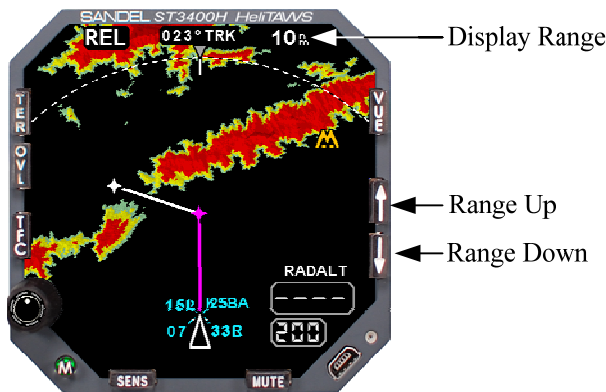


Figure 5-10 Display Ranging

In the TOPO display, the ARC and Full View displays are decluttered in the 20 and 10 mile range and the 10 and 5 mile 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 5-11 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

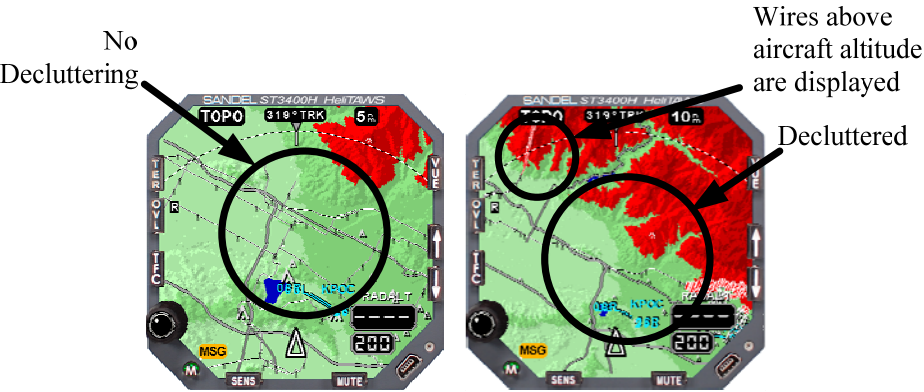


Figure 5-11 Decluttering

5.12 Overlay

Press the [OVL] button to toggle the display of roads on and off.

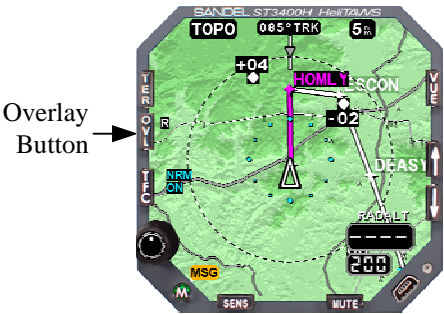


Figure 5-12 Overlay Button

### 5.13 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.



Figure 5-13 Heading Pointer – FULL View



Figure 5-14 Heading Pointer – ARC View

### 5.14 Sensitivity

Press the [SENS] button to toggle the Sensitivity between HIGH-SENS, NORM, LOW-SENS, TACTICAL, and OBST-ONLY. NORM has no screen annunciation. HIGH-SENS, LOW-SENS, TACTICAL, and OBST-ONLY display as shown in the Figure 5-15. All sensitivity modes except for NORM may be selectively inhibited during installation and therefore may or may not be available. In the event that all modes are inhibited during installation (other than NORM), pressing the [SENS] button will result in NO ACTION being displayed.

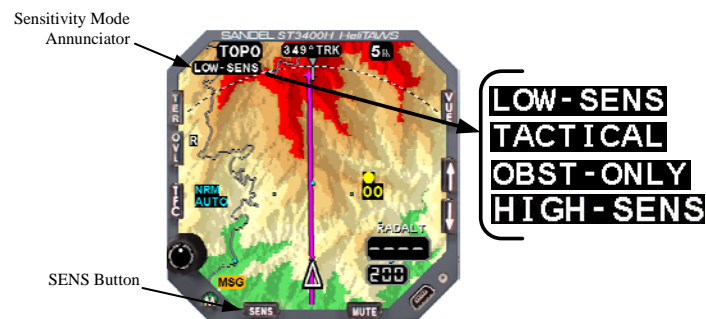


Figure 5-15 Alert Sensitivity Selection

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

### 5.15 Selections

#### 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 HIGH-SENS

High Sensitivity mode increases the alerting time from Normal Sensitivity. While in High Sensitivity, a Caution Alert typically occurs approximately 45 seconds ahead of the terrain or obstacle conflict. A Caution Alert will

turn into a Warning Alert if evasive action is not taken approximately 25 seconds ahead of the conflict.

### 5.15.3 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.

### 5.15.4 TACTICAL

Tactical mode 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.

### 5.15.5 OBST-ONLY

Obstacle-Only mode 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. During hover taxi operations at airports while not on a runway, it may be desirable to operate in the OFF-APT mode to reduce the likelihood of nuisance alerts.

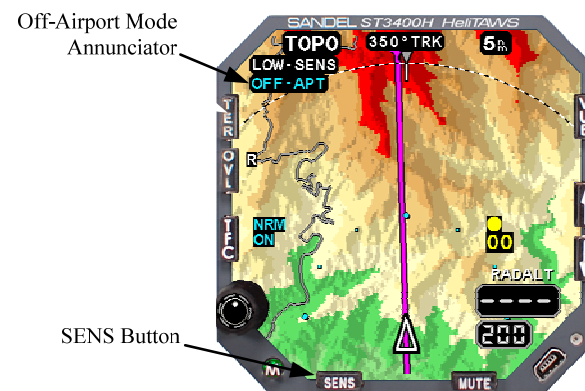
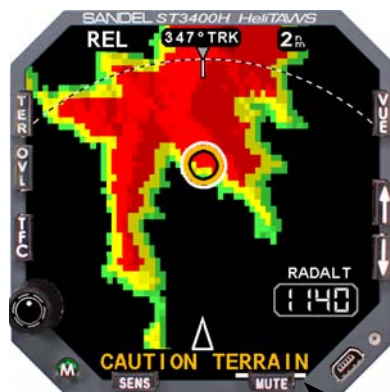


Figure 5-16 Off-Airport Mode Selection

**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.



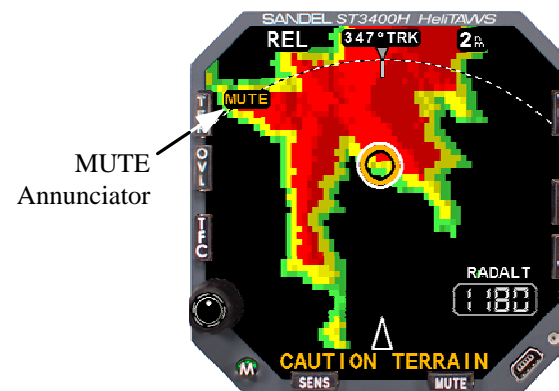
MUTE Button and Highlight

Figure 5-17 MUTE Button Highlighting

### 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 cannot be muted.



MUTE Annunciator

Figure 5-18 MUTE Annunciator

## 5.18 Brightness

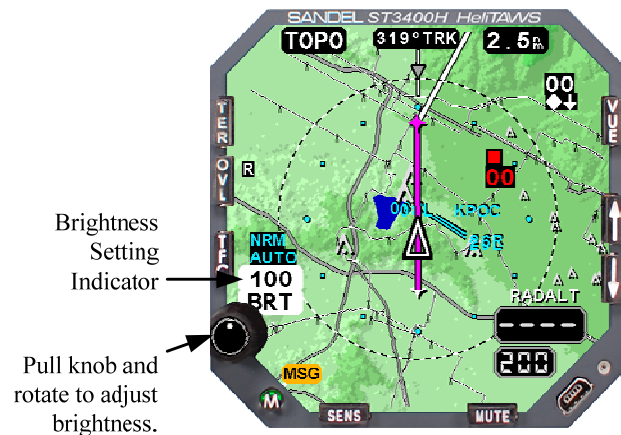


Figure 5-19 Brightness

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.

## 5.19 Flight Plan

If the FMS supplies a flight plan, each flight plan segment is displayed. 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 is not currently supported in the ST3400H. These flight plan segments will be supported in a future software release.

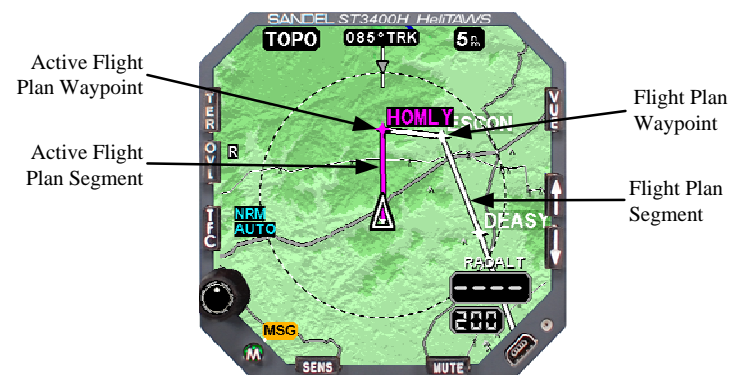


Figure 5-20 Flight Plan Line

## 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 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 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 ST3400H 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 ST3400H 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 Symbolology

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 5-8 with the exception that there is only one RED color band (i.e. red means above, there is no dark red).






Obstacle Symbols	
Obstacles 500’ AGL and taller:	 
Obstacles 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 ST3400H. 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 Expiration of Wire Data

Wire data is supplied by annual subscription.

**Prior to the wire data expiration:** A message will appear on the display indicating the approaching expiration: “WIRES EXPIRE nn D” (where nn is a number from 0-30 and indicates the number of days to the expiration of the wire data). The pilot can clear this message (until the next HTAWS power cycle) by pressing the ACK softkey.



Figure 6-10 Wire Data Approaching Expiration

**Grace period:** A grace period is allowed for renewal of the wire data during which time a message will appear on the display indicating the data is in the grace period: “WIRES EXPIRE -nn D” (where nn is a number from 0-30 and indicates the number of days into the grace period). The pilot can clear this message (until the next HTAWS power cycle) by pressing the ACK softkey.



Figure 6-11 Wire Data Grace Period

**Data expiration:** When the wire subscription grace period has passed, the wire data is not available for alerting or display. During power up of the HTAWS, the message “WIRES EXPIRED” will appear on the display. The pilot can clear this message by pressing the ACK softkey. The text “NO WIRE ALERTS” will appear on the display. This message cannot be cleared by the pilot.



Figure 6-12 Wire Data Expired

**No-wire database:** If a no-wire database is loaded in the ST3400H, the message “NO WIRE DATA” will appear on the display during power up. The pilot can clear this message (until the next HTAWS power cycle) by pressing the [ACK] softkey.

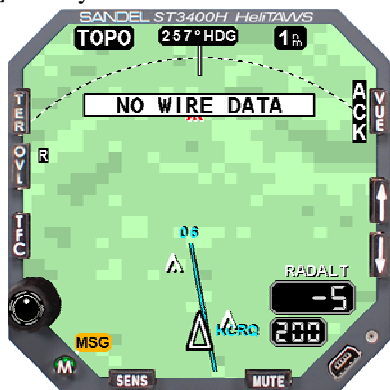


Figure 6-13 No-Wire Database Message

## 6.8 TAWS Inhibit - FLTA

FLTA alerts can be inhibited by pressing and holding the [MUTE] button (or if installed, holding the external mounted MUTE pushbutton for 2 seconds). This feature may be used for:

- Abnormal failure of GPS/FMS resulting in erroneous data. A conventional (flagged) GPS/FMS failure will automatically fail alerts and the terrain display.
- To stop alerts occurring because of unusual VFR mission requirements.
- A perceived nuisance alert, or an 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.

## 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.

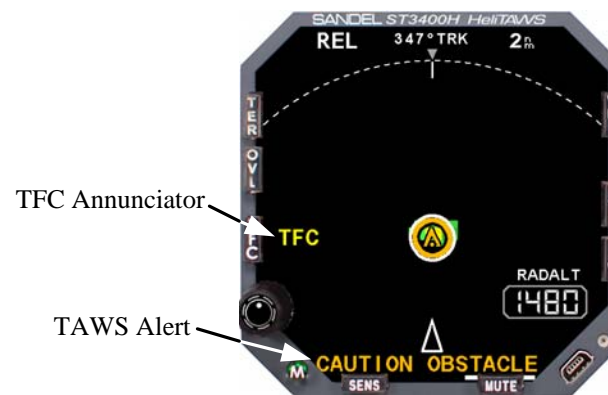


Figure 6-14 Display During TAWS Alerts

7 GPWS ALERTING

The ST3400H 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 is 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 (or 1800’ AGL when in HIGH-SENS mode) and is accompanied by a high rate of descent. If the descent is not arrested a “PULL UP” Warning Alert is generated.

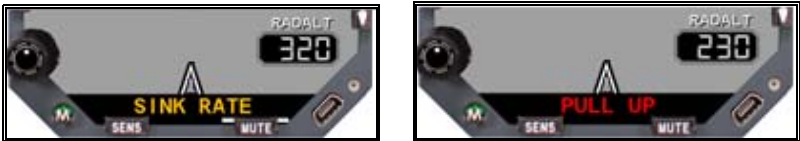


Figure 7-1 GPWS Mode 1 Alerts

7.2 Mode 2 – Not Implemented

This “Terrain Closure Rate” alert 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 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].



Figure 7-2 GPWS Mode 3 Alert

Sensitivity	Arming Altitude	Disarming Altitude
High	95’	299’
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 to more than approximately ¾ scale deflection below the glideslope when the aircraft is 950’ or lower when in High Sensitivity mode, 400’ AGL or lower while in the Normal Sensitivity mode, or 250’ or lower while in the Low Sensitivity mode while on an ILS approach.

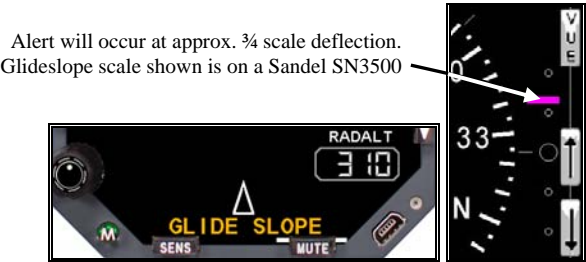


Figure 7-4 GPWS Mode 5 Alert

7.6 Mode 6 – Altitude Callouts

Altitude callouts are generated depending on the selected Sensitivity Mode, Radar Altimeter Installation and configuration option. See Table 7-2.

With a Radar Altimeter Installed					
AGL \ SENS	HIGH	NORM (DEFAULT)	LOW	TACT	Obstacle Only
400 ft.	Mandatory	Inhibited	Inhibited	Inhibited	Inhibited
300 ft.	Option	Mandatory	Inhibited	Inhibited	Inhibited
200 ft.	Option	Option	Inhibited	Inhibited	Inhibited
100 ft.	Option	Option	Mandatory	Inhibited	Inhibited
50 ft.	Option	Option	Option	Option	Option
40 ft.	Option	Option	Option	Option	Option
30 ft.	Option	Option	Option	Option	Option
20 ft.	Option	Option	Option	Mandatory	Option
10 ft.	Option	Option	Option	Option	Option

Without a Radar Altimeter Installed					
AGL \ SENS	HIGH	NORM (DEFAULT)	LOW	TACT	Obstacle Only
400 ft.	Mandatory	Inhibited	Inhibited	Inhibited	Inhibited
300 ft.	Inhibited	Mandatory	Inhibited	Inhibited	Inhibited
200 ft.	Inhibited	Inhibited	Inhibited	Inhibited	Inhibited
100 ft.	Inhibited	Inhibited	Mandatory	Inhibited	Inhibited
50 ft.	Inhibited	Inhibited	Inhibited	Mandatory	Mandatory
40 ft.	Inhibited	Inhibited	Inhibited	Inhibited	Inhibited
30 ft.	Inhibited	Inhibited	Inhibited	Inhibited	Inhibited
20 ft.	Inhibited	Inhibited	Inhibited	Inhibited	Inhibited
10 ft.	Inhibited	Inhibited	Inhibited	Inhibited	Inhibited

Table 7-2 Altitude Callouts

7.7 TAWS INH - GPWS

GPWS alerting, can be inhibited with the TAWS INH function. The TAWS INH function *also* cancels all FLTA alerts.

When TAWS INH is active, altitude callouts remain active.

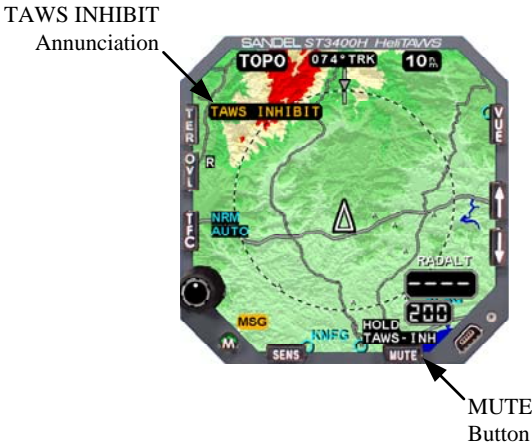


Figure 7-5 TAWS INHIBIT

## 8 RADAR ALTIMETER FUNCTIONS

The ST3400H functions as a 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.



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. 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.

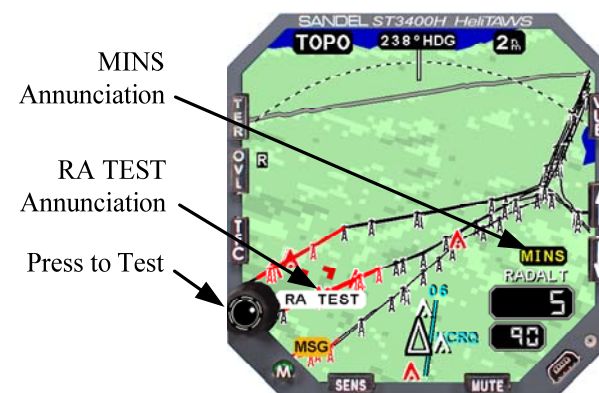


Figure 8-2 Radar Altimeter Test

9 TRAFFIC FUNCTION

9.1 Traffic Display

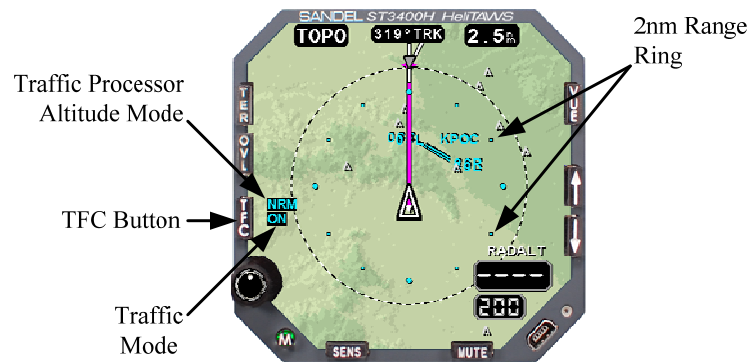


Figure 9-1 ST3400 Traffic Overlay

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 ST3400H 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 ST3400H.

9.3 Traffic Processor Altitude Mode

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

<b>NRM</b>	Normal altitude display mode. Target aircraft within +/-2,700 ft. of your aircraft are displayed.
<b>ABV</b>	Above altitude display mode. Target aircraft within – 2,700 ft. and +9,000 ft. of your aircraft are displayed.
<b>BLW</b>	Below altitude display mode. Target aircraft within – 9,000 ft. and + 2,700 ft. of your aircraft are displayed.
<b>XTD</b>	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 RFMS 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 ST3400H uses standard RTCA symbology to represent traffic.



Alerting Traffic		
DISPLAY	CONDITION	DESCRIPTION
	Resolution Advisory (RA) (Available with TCAS II Only)	Immediate threat that requires evasive action. Note: Vertical guidance information is NOT shown on the ST3400H display.
	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.
<b>TA 2.0nm</b>	No Bearing / No Altitude Traffic Advisory	TA with no bearing and no altitude information available.
<b>TA 2.0nm / +07↑</b>	No Bearing Traffic Advisory	TA with no bearing information available.

Non-Alerting Traffic		
DISPLAY	CONDITION	DESCRIPTION
	Proximity Advisory	Traffic within 4nm and +/-1,200 ft of your aircraft
	Other Traffic	Traffic not representing an immediate threat
	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'.

	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.
	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 ST3400H 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.



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.

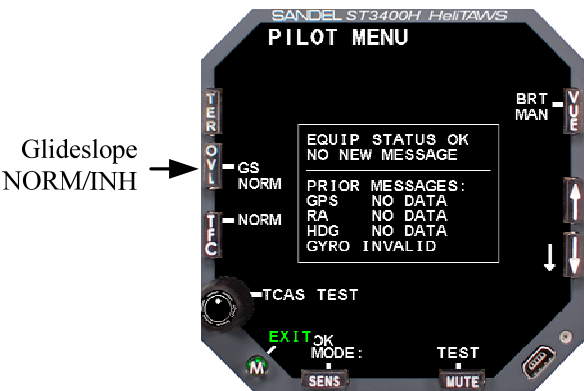


Figure 10-2 GS INHIBIT

10.2 TAWS INH

FLTA and GPWS alerting, can be inhibited by pressing and holding the [MUTE] button. This feature can also be operated by holding the external mounted MUTE button for 2 seconds, if installed. When active, terrain and obstacles continue to be displayed on the screen.

This feature is used for:

- Abnormal failure of GPS/FMS resulting in erroneous data. A conventional (flagged) GPS/FMS failure will automatically fail alerts and the terrain display.
- To eliminate nuisance alerts during unusual VFR missions.
- A perceived nuisance alert should be brought to the attention of Sandel Avionics for analysis.

Be aware that the TAWS INH function cancels all FLTA alerts and inhibits GPWS modes 1, 3, 4, and 5. When TAWS INH is active, altitude callouts remain active.

TAWS INHIBIT  
Annunciation



Figure 10-3 TAWS INHIBIT

### 10.3 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.



Figure 10-4 TEST

### 10.4 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 ST3400H installation for you aircraft and the traffic system pilot's guide for additional details.

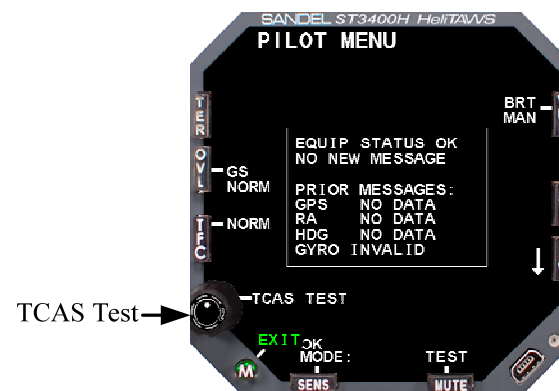


Figure 10-5 TCAS Test

10.5 Traffic System Altitude Mode

The ST3400H supports four altitude filtering modes: NORM (Normal), ABOVE, BELOW, and XTND (Extended). Depending on the model of traffic system interfaced to the ST3400H 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 ST3400H installation for your aircraft and the traffic system pilot’s guide for additional details.

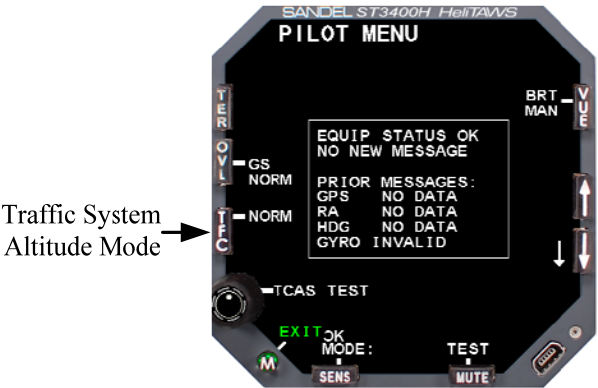


Figure 10-6 Traffic System Altitude Mode

10.6 Brightness

Manual Brightness is the only mode that is currently supported by the ST3400H.

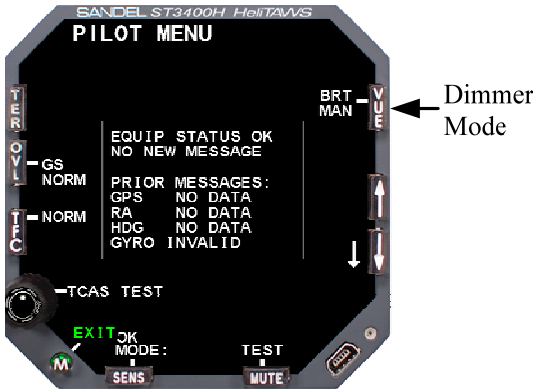


Figure 10-7 Dimmer Mode

10.7 System Status

The System Status box contains a list of failed or inoperative equipment. The [UP/DOWN] arrow buttons can be used to scroll through messages.

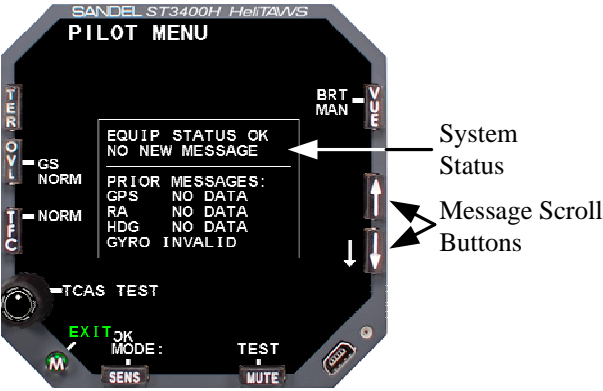


Figure 10-8 System Status

**10.7.1 Equipment List**

<b>EQUIPMENT STATUS</b>			
<b>Input</b>	<b>Equipment Description</b>	<b>Invalid Data</b>	<b>Data Time-Out</b>
ADC	Air Data Computer	"INVALID" *	"NO DATA" *
GPS	GPS Position	"INVALID"	"NO DATA"
HDG	Heading System, AHRS or Gyro	"INVALID"	"NO DATA"
LOC and/or GS	NAV Receiver	N/A	"NO DATA"
RA	Radio Altimeter	N/A	"NO DATA"
TFC	TCAS/TAS Traffic System	"FAILED"	"FAILED"

\* ADC equipment status messages are supported in S/W version 1.04 and later.

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## 11 EXTERNAL SWITCH AND ANNUNCIATORS

External annunciators and switches may be optionally installed.

The supported external annunciators are:

**TAWS CAUTION** annunciator illuminates in amber whenever an amber caution is present on the ST3400H display.

**TAWS WARNING** annunciator illuminates in red whenever a red warning is present on the ST3400H display.

**TAWS INH** annunciator illuminates whenever TAWS INH is present on the ST3400H 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.

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The supported external switch/ annunciators are:

**MUTE** illuminates whenever the MUTE is displayed on the ST3400H. Pressing the external MUTE switch has the same function as the front panel [MUTE] button. Holding the external MUTE switch for more than 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** annunciator illuminates whenever LOW, TACTICAL, or OBST-ONLY is displayed on the ST3400H. Pressing the external SENSITIVITY switch has the same function as the front panel [SENS] button, including the HOLD function.

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

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.
- GS INH: Glide Slope Inhibit active. No glide slope alerts will occur.
- MSG: A message is waiting on the Failed Equipment List.
- NO HDG: Loss of heading information (or no heading system configured) when GPS track is not available.
- TAWS FAIL: FLTA alerts and TOPO and REL displays are disabled due to lack of database or failed database.
- TAWS INH: TAWS Inhibit active. 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 (no terrain alerting).

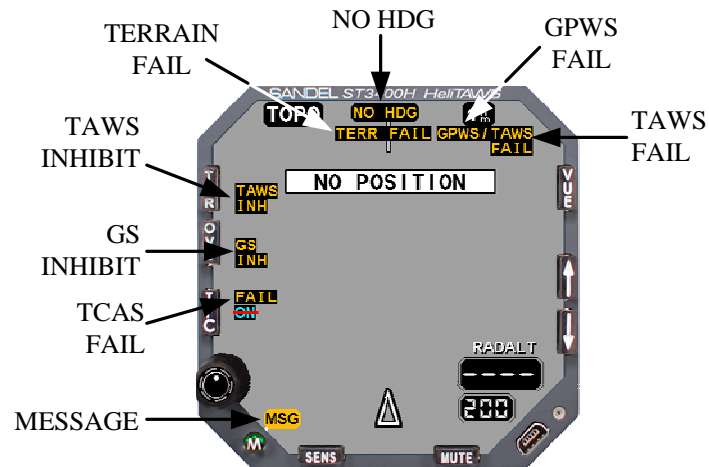


Figure 12-1 On-Screen Annunciation

PILOT MENU 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 SHTDWN	Over temperature	Pull CB and report to maintenance
400 HZ FAILED	400 Hertz failed	Aircraft inverter failure. May affect HDG operation
400 HZ LOW	400 Hertz low	Aircraft inverter problem
400 HZ HIGH	400 Hertz high	Aircraft inverter problem
TERRAIN CRC FAULT	Internal CRC of terrain database failed.	If this does not clear on restart, database is corrupted.
DATABASE CONFLICT	Database files do not all have coverage for the same area.	Data may be missing or may not display properly.
PGM CRC INVALID	Program cyclic redundancy check invalid	Program code has an error – unit not airworthy
AIRPORT DB CRC FAULT	Airport data cyclic redundancy check invalid	Airport data has an error - FLTA not airworthy (use TERR INH)
OBST DB CRC FAULT	Internal check of obstacle database CRC failed.	Obstacle database not available. No obstacle or wire alerting.
NO WIRE DATA	No subscription for database coverage area.	Wire alerts are disabled
WIRES EXPIRED	Subscription for wire database has expired. Will also indicate "NO WIRE ALERTS"	Wire alerts are disabled.

ADVISORY MESSAGES REQUIRING ACKNOWLEDGE		
Text Message	Description	Comment
WIRES EXPIRE nnn D	Indicates number of days remaining in wire database subscription.	Wire alerts are enabled.

ADVISORY MESSAGES		
Text Message	Description	Comment
NOT IMPLEMENTED	Button function not implemented	Momentary message. OVL button will indicate this when no overlay database is present or overlay database is damaged.
DATABASE LOADING	Displayed initial GPS Fix is established.	Momentary message.
NOT CONFIGURED	TFC button requires configuration of TCAS by installer	Momentary message.
NOT CONFIGURED	Press of knob function requires configuration of radar altimeter by installer.	Momentary message.
NO ACTION	MUTE button pressed with no alert active.	Momentary message.
NO POSITION	GPS is not indicating a valid latitude and longitude.	Permanent message during outage.
NO VERTICAL POS	GPS is not indicating a valid altitude	Permanent message during outage.
NO WIRE ALERTS	Permanent message associated with an expired wire database subscription	Permanent message.

PILOT MENU MESSAGES		
Text Message	Description	Action
UBAT MONITOR FAIL	Internal Integrity Check Failure	Report to Maintenance
PWR SUPPLY FAIL	2.5 Volt power supply	Report to Maintenance
PWR SUPPLY FAIL	6.0 Volt power supply	Report to Maintenance
PWR SUPPLY FAIL	15.5 Volt power supply	Report to Maintenance

PILOT MENU MESSAGES		
Text Message	Description	Action
PWR SUPPLY FAIL	-5 Volt power supply	Report to Maintenance
TERR INCOMPATIBLE	Terrain database version compatibility failure	Terrain data not available. FLTA on terrain not available. Generates TERR FAIL and TAWS FAIL messages. Report to maintenance.
TERR HDR CONFLICT	Terrain database internal conflict	Terrain data not available. FLTA on terrain not available. Generates TERR FAIL and TAWS FAIL messages. Report to maintenance.
MAP INCOMPATIBLE	Airport database version incompatible	Airport data not available. No FLTA reduction near airports. (Use TAWS INH when landing to eliminate nuisance alerts). Report to maintenance.
OBS INCOMPATIBLE	Obstacle database version incompatible	Obstacle database not available. No obstacle or wire alerting. Report to maintenance.
GEO INCOMPATIBLE	Geo-overlay database not compatible with this software version	Geo-Overlay database not available. No effect on alerting. Report to Maintenance.
PARAM FILE ERROR	Internal check of stored configuration failed	Report to Maintenance.
GEO DB CRC FAULT	Internal check of geo-overlay database CRC failed.	Geo-Overlay database not available. No effect on alerting. Report to Maintenance.
PARAM CRC FAULT	Internal check of configuration storage CRC failed.	Report to Maintenance.
COOLING FAN FAIL	RPM check of fan indicates a failure	May induce an OVERTEMP message. Report to Maintenance.
GYRO INVALID	DG failure detected	May be reported during Gyro initialization. Report to maintenance if displayed in flight.
GYRO XYZ LOST	XYZ gyro signal lost	Report to Maintenance.

## 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 ST3400H has an internal recorder that automatically records a minimum of twenty hours of flight data. (Oldest data is automatically overwritten with most recent data.) This data can be used by Sandel Avionics Customer Support to analyze recent alert activity.

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### 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.

## 14 SPECIFICATIONS

TSO Compliance	
Technical Standard Order (TSO)	C194: Helicopter Terrain Awareness and Warning System (HTAWS) C87: Airborne Low-Range Radio Altimeter C113: Airborne Multipurpose Electronic Displays C118: Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment, TCAS 1
Software Certification	RTCA/DO-178B, Level C
Programmable Logic	RTCA/DO-254, Level C
Environmental Category:	[A2F1Z]BBB[UU2]XXXXXXZZAZ[ZW][WW]M[A3G33]XXAX

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Physical Dimensions	
Form Factor:	3ATI (ARINC 408)
Width:	3.175 inches
Height:	3.175 inches
Length:	9.5 inches
Weight:	2.7 lbs.

Operational Characteristics	
Temperature/Altitude:	-20° C to + 70° C up to 55,000 ft.
Power Inputs:	22 to 33 VDC 40 watts maximum
400 HZ Reference:	Max 1 ma.

## 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
KTS	Knots
MINS	Minimums
NCAT	Negative Climb after Take-off
NVIS	Night Vision
NM	Nautical Miles
POST	Power-On Self-Test
RA	Resolution Advisory
RFMS	Rotorcraft Flight Manual Supplement
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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If an arbitration panel or court of competent jurisdiction determines that relevant laws in force may imply warranties and liabilities which cannot be excluded or limited or which can only partly be excluded or limited, then the limit on Jeppesen's liability set forth herein shall apply to the fullest extent permitted by law. If Jeppesen cannot exclude or limit a warranty or liability implied by law, this agreement shall be read and construed subject to such provisions of law.

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End-user shall be responsible for its compliance with any applicable export control restrictions, laws and regulations as may be modified from time to time, imposed by the governments of the U.S. and, if applicable, other

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This agreement will be interpreted under and governed by the law of the state of Colorado, U.S.A., except that Colorado's conflicts of laws rules will not be invoked for the purposes of applying the law of another jurisdiction. The United Nations convention on contracts for the international sale of goods will not apply to this agreement.