

# **NIGHTHAWK** **FLIGHT SYSTEMS, INC.**

## **ST3400H** ***HeliTAVS™***

Helicopter  
Terrain Awareness  
Warning System



## **Pilot's Guide**

Revision G

(This page intentionally left blank)

## TABLE OF CONTENTS

<b>1 INTRODUCTION</b> .....	<b>1-1</b>
1.1 Pilot Information .....	1-1
1.2 Copyright.....	1-1
1.3 Pilot’s Guide Effectivity and Errata Notice.....	1-1
1.4 Operational and Legal Issues.....	1-1
1.5 Trademarks.....	1-2
1.6 Approvals .....	1-2
1.7 Conventions Used in this Manual.....	1-3
1.8 Revision History.....	1-3
<b>2 LIMITATIONS</b> .....	<b>2-1</b>
<b>3 WELCOME TO THE ST3400H HELITAWS</b> .....	<b>3-1</b>
3.1 Description .....	3-1
3.2 What it is.....	3-1
3.3 What it isn’t.....	3-2
3.4 What it does.....	3-2
3.5 Other Features .....	3-3
<b>4 SYSTEM OVERVIEW</b> .....	<b>4-1</b>
4.1 “Design Cruise Altitude”.....	4-1
4.1.1 Sensitivity .....	4-1
4.2 Off Airport Landings.....	4-1
4.3 Alerts, Warnings, and Cautions.....	4-2
4.4 TAWS Inhibit .....	4-2
4.5 Display.....	4-2
4.5.1 Topographic Display.....	4-2
4.5.2 Relative Altitude Display.....	4-3
4.5.3 Obstacle and Wire Display .....	4-3
4.5.4 Flight Plans .....	4-3
4.5.5 Airports and Runways.....	4-3
4.5.6 Radar Altimeter Display .....	4-3
4.5.7 Traffic .....	4-3
4.5.8 NVIS .....	4-4
4.6 Sensors.....	4-4
4.7 Database .....	4-4
4.7.1 Items in the database.....	4-4
4.7.2 Coverage area of the database.....	4-5
4.7.3 Database updates.....	4-5
<b>5 TERRAIN DISPLAY AND OPERATION</b> .....	<b>5-1</b>
5.1 Control Overview .....	5-1
5.2 Display Overview .....	5-2
5.3 Splash Screen.....	5-3
5.4 Initial Bootup Display .....	5-3
5.5 No-Sensor Display.....	5-4

5.6	Loading of Database.....	5-4
5.7	FULL / ARC.....	5-5
5.8	REL/TOPO.....	5-6
5.8.1	TOPO DETAILS.....	5-6
5.8.2	REL DETAILS.....	5-6
5.9	REL Color Banding.....	5-6
5.10	Display Orientation.....	5-8
5.11	Display Range.....	5-9
5.12	Overlay.....	5-10
5.13	Heading Pointer.....	5-11
5.14	Sensitivity.....	5-12
5.15	Sensitivity Selections.....	5-12
5.15.1	Normal.....	5-12
5.15.2	HIGH-SENS.....	5-12
5.15.3	LOW-SENS.....	5-13
5.15.4	TACTICAL.....	5-13
5.15.5	OBST-ONLY.....	5-13
5.16	Off Airport Mode.....	5-14
5.17	Mute.....	5-15
5.18	Brightness.....	5-17
5.19	Flight Plan.....	5-18
<b>6</b>	<b>TERRAIN AND OBSTACLE ALERTING.....</b>	<b>6-1</b>
6.1	Alert Generation.....	6-1
6.2	Alert Display.....	6-2
6.3	External Annunciation.....	6-2
6.4	Responding to an Alert.....	6-2
6.5	Alert Circle.....	6-3
6.5.1	Terrain.....	6-3
6.5.2	Obstacles.....	6-3
6.6	Obstacle Symbology.....	6-4
6.6.1	Obstacles in TOPO Display.....	6-4
6.6.2	Obstacles in REL Display.....	6-5
6.7	WireWatch®.....	6-6
6.7.1	Wire Segments.....	6-7
6.7.2	Expiration of Wire Data.....	6-7
6.8	TAWS Inhibit - FLTA.....	6-9
6.9	Simultaneous TAWS and TFC Alerts.....	6-9
<b>7</b>	<b>GPWS ALERTING.....</b>	<b>7-1</b>
7.1	Generic GPWS.....	7-1
7.1.1	Mode 1 – Excessive Rate of Descent.....	7-1
7.1.2	Mode 2 – Not Implemented.....	7-1
7.1.3	Mode 3 – Descent after Take-off.....	7-1
7.1.4	Mode 4 – Landing Gear.....	7-2
7.1.5	Mode 5 – Glideslope.....	7-2

7.1.6	Mode 6 – Altitude Callouts.....	7-3
7.1.7	TAWS INH - GPWS.....	7-4
7.2	Offshore GPWS.....	7-5
7.2.1	Mode 1 – Excessive Rate of Descent.....	7-5
7.2.2	Mode 2 – Not Implemented.....	7-5
7.2.3	Mode 3.....	7-5
7.2.4	Mode 4.....	7-6
7.2.5	Mode 5 – Glideslope.....	7-7
7.2.6	Mode 6 – Altitude Callouts.....	7-7
7.2.7	Mode 7 – Not Implemented.....	7-8
7.2.8	TAWS INH – GPWS.....	7-8
7.2.9	Offshore GPWS Alert Envelopes.....	7-9
<b>8</b>	<b>RADAR ALTIMETER FUNCTIONS.....</b>	<b>8-1</b>
8.1	Radar Altimeter Test.....	8-2
<b>9</b>	<b>TRAFFIC DISPLAY INTERFACE.....</b>	<b>9-1</b>
9.1	Traffic Symbology.....	9-2
9.2	Relative Altitude.....	9-3
9.3	Absolute Altitude vs. Relative Altitude.....	9-4
9.4	Traffic Display Mode.....	9-5
9.5	Altitude Filter.....	9-5
9.6	TCAS Status.....	9-6
9.7	TCAS TEST.....	9-6
9.8	Traffic Overlay on TOPO or REL Display.....	9-7
9.9	ADS-B IN Traffic.....	9-7
9.10	ADS-B IN Traffic Symbology.....	9-7
9.11	ADS-B IN Aircraft Information.....	9-8
<b>10</b>	<b>PILOT MENU.....</b>	<b>10-1</b>
10.1	GS INHIBIT.....	10-1
10.2	TAWS INH.....	10-1
10.3	Offshore GPWS Pilot Options.....	10-3
10.4	TEST.....	10-4
10.5	Traffic Altitude Filter Selection.....	10-5
10.6	Brightness.....	10-6
10.7	System Status.....	10-6
10.7.1	Equipment List.....	10-7
<b>11</b>	<b>EXTERNAL SWITCH AND ANNUNCIATORS.....</b>	<b>11-1</b>
<b>12</b>	<b>ON SCREEN ANNUNCIATIONS &amp; MESSAGES.....</b>	<b>12-1</b>
12.1	On-Screen Annunciations.....	12-1
12.2	Special Alerts.....	12-2
12.3	Messages with ACK.....	12-2
12.4	Other Messages.....	12-3
12.5	Pilot Menu Messages.....	12-4
<b>13</b>	<b>TROUBLESHOOTING.....</b>	<b>13-1</b>

13.1 Nuisance Alerts ..... 13-1  
13.2 Gray Terrain Cells ..... 13-1  
**14 SPECIFICATIONS ..... 14-1**  
**15 ACRONYMS..... 15-1**  
**16 JEPPESEN TERMS AND CONDITIONS ..... 16-1**

## TABLE OF FIGURES

Figure 5-1 ST3400H Physical Features .....	5-1
Figure 5-2 Display Overview TOPO/FULL .....	5-2
Figure 5-3 Startup Screen .....	5-3
Figure 5-4 Initial Display .....	5-4
Figure 5-5 “DATABASE LOADING” Message.....	5-4
Figure 5-6 FULL and ARC Views.....	5-5
Figure 5-7 REL and TOPO Displays .....	5-6
Figure 5-8 REL Display Color Banding Relative to aircraft altitude .....	5-7
Figure 5-9 Display Orientation .....	5-8
Figure 5-10 Display Ranging.....	5-9
Figure 5-11 Decluttering.....	5-10
Figure 5-12 Overlay Button .....	5-10
Figure 5-13 Heading Pointer – FULL View .....	5-11
Figure 5-14 Heading Pointer – ARC View.....	5-11
Figure 5-15 Alert Sensitivity Selection.....	5-12
Figure 5-16 Off-Airport Mode Selection.....	5-14
Figure 5-17 MUTE Button Highlighting .....	5-15
Figure 5-18 MUTE Annunciator .....	5-16
Figure 5-19 Brightness.....	5-17
Figure 5-20 Flight Plan Line.....	5-18
Figure 6-1 “CAUTION TERRAIN” Annunciation .....	6-1
Figure 6-2 “WARNING TERRAIN” Annunciation.....	6-2
Figure 6-3 Obstacle Alert on a tall tower.....	6-4
Figure 6-4 Obstacle Symbols.....	6-4
Figure 6-5 Obstacles in TOPO Display .....	6-5
Figure 6-6 Minimized Obstacles in TOPO Display.....	6-5
Figure 6-7 Obstacles in REL Display .....	6-6
Figure 6-8 Obstacles in REL Display .....	6-6
Figure 6-9 Wire Alerts .....	6-7
Figure 6-10 Wire Data Approaching Expiration .....	6-7
Figure 6-11 Wire Data Grace Period .....	6-8
Figure 6-12 Wire Data Expired.....	6-8
Figure 6-13 No-Wire Database Message.....	6-9
Figure 6-14 Display During TAWS Alerts.....	6-10
Figure 7-1 Generic GPWS Mode 1 Alerts .....	7-1
Figure 7-2 Generic GPWS Mode 3 Alert .....	7-2
Figure 7-3 Generic GPWS Mode 4 Alert .....	7-2
Figure 7-4 Generic GPWS Mode 5 Alert .....	7-3
Figure 7-5 TAWS INHIBIT.....	7-4
Figure 7-6 Offshore GPWS Mode 1 Alerts .....	7-5
Figure 7-7 Offshore GPWS Mode 3A Alert .....	7-5
Figure 7-8 Offshore GPWS Mode 3B Alert .....	7-6
Figure 7-9 Offshore GPWS Mode 4A Gear Alert .....	7-6

Figure 7-10 Offshore GPWS Mode 4B Alert .....	7-6
Figure 7-11 Offshore GPWS Mode 5 Alert .....	7-7
Figure 7-12 TAWS INHIBIT .....	7-8
Figure 7-13 Offshore GPWS Mode 1 Caution Envelope .....	7-9
Figure 7-14 Offshore GPWS Mode 1 Warning Envelope .....	7-9
Figure 7-15 Offshore GPWS Mode 3-B Alert Envelope .....	7-10
Figure 7-16 Offshore GPWS Mode 4-A Alert Envelope .....	7-10
Figure 7-17 Offshore GPWS Mode 4-B Alert Envelope .....	7-11
Figure 7-18 Offshore GPWS Mode 5 Alert Envelope .....	7-11
Figure 8-1 Radar Altimeter Functions .....	8-1
Figure 8-2 Radar Altimeter Test .....	8-2
Figure 9-1 ST3400H with Traffic .....	9-1
Figure 9-2 Own Aircraft Absolute Altitude .....	9-4
Figure 9-3 TCAS Test .....	9-6
Figure 9-4 Traffic with TOPO .....	9-7
Figure 9-5 ADS-B In Traffic Symbology .....	9-7
Figure 9-6 Targets with Velocity Vector .....	9-8
Figure 9-7 Aircraft ID and Ground Speed Display .....	9-8
Figure 10-1 Pilot Menu .....	10-1
Figure 10-2 GS Soft Key .....	10-1
Figure 10-3 TAWS INHIBIT .....	10-2
Figure 10-4 OFFSHORE Soft Key .....	10-3
Figure 10-5 TEST .....	10-4
Figure 10-6 Traffic System Altitude Mode .....	10-5
Figure 10-7 Dimmer Mode .....	10-6
Figure 10-8 System Status .....	10-6
Figure 12-1 On-Screen Annunciation .....	12-1
Figure 12-2 Offshore GPWS Annunciations .....	12-2

## TABLE OF TABLES

Table 4-1 Sensitivity Selections.....	4-1
Table 5-1 Declutter View and Range.....	5-9
Table 7-1 Mode 3 Arming/Disarming .....	7-2
Table 7-2 Altitude Callouts with RADALT .....	7-3
Table 7-3 Altitude Callouts no RADALT .....	7-4
Table 7-4 Offshore GPWS Altitude Callouts .....	7-7
Table 9-1 Alerting Traffic Symbols.....	9-2
Table 9-2 Non-Alerting Traffic Symbols .....	9-3
Table 10-1 Offshore GPWS Options in Pilot Menu .....	10-3
Table 10-2 Equipment and Status Messages .....	10-7
Table 12-1 Alert Test Messages .....	12-2
Table 12-2 Messages Requiring ACK .....	12-3
Table 12-3 Advisory Messages.....	12-4
Table 12-4 Pilot Menu Messages.....	12-5

(This page intentionally left blank)

## 1 INTRODUCTION

### 1.1 Pilot Information

Publication Date 8-MAR-2023

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 Nighthawk Flight Systems, Inc. (“Nighthawk”).

### 1.2 Copyright

© 2023 Nighthawk Flight Systems, 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.

All rights reserved. No part of this manual may be reproduced, stored, or distributed without written permission of Nighthawk Flight Systems, Inc. Additional copies of this manual are available from:

**Nighthawk Flight Systems, Inc.**

[www.nighthawkfs.com](http://www.nighthawkfs.com)

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

“Pilot’s Guide Effectivity and Errata” (Nighthawk 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 REL or TOPO display 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**

Nighthawk, the Nighthawk Logo, HeliTAWS®, the HeliTAWS Logo, TrueAlert® and WireWatch® are trademarks of Nighthawk Flight Systems, 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
- TSO-C195b: Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)

The following certifications also apply to this product:

- RTCA/DO-376: Minimum Operational Performance Standard for Offshore Helicopter Terrain Awareness and Warning System (HTAWS)
- 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 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		
Rev	Date	Comments
G	8-MAR-2023	AR 5095, AR 5098 SW Version A1.08 & 1.07 Changed company references from Sandel to Nighthawk Flight Systems, Inc. ("Nighthawk"). Updated file type to Microsoft Word ".docx" format. Added table captions and list. Readability improvements were made throughout. Section 1.6: Added TSO listings: TSO-C195b (ADS-B IN display) and RTCA/DO-376 (Offshore GPWS) Section 7: GPWS Alerting was split into two Sections. Section 7.1 for original "Generic" GPWS and the new 7.2 Offshore GPWS. Section 9: Added ADS-B IN display functionality detail. Section 10: Added Offshore GPWS selections. Sections 11/12: Updated to include all existing and added switch inputs and annunciators. Section 14: Added TSO listings: TSO-TSO-C195b and RTCA/DO-376
F	28-AUG-2014	AR 1416 Section 5.8.2: Note updated to clarify auto-ranging functionality.

E	25-AUG-2014	<p>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.</p>
---	-------------	--

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> <p>Figure 8-2 added for RA Test</p> <p>10-2: TAWS INH enable method updated. Updated TAWS INH to display terrain and obstacles.</p> <p>Fig. 10-1 through 10-8: Updated screenshot – TAWS INH no longer enabled on Pilot Menu.</p> <p>11: Updated TAWS INH enable method.</p> <p>12: Updated Advisory Message tables.</p>
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
---	-------------	-----------------

No errata applicable to this release

(This page intentionally left blank)

## 2 LIMITATIONS

The ST3400H is a display and alerting system. It is intended for use in rotorcraft for all flight phases in VMC and 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.

When flying in IMC conditions, reduced sensitivity modes such as Low Sensitivity, Tactical, Obstacle Only, or Off Airport should not be selected.

When Offshore GPWS is available and flying offshore oilfield operations, the Offshore GPWS mode should be selected.

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 is 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) to base navigation decisions and plan routes to avoid terrain or obstacles.

Transmission Line positional error varies by geographic location. Visit the Nighthawk website at <https://www.nighthawkfs.com/st3400h-support/st3400h-database-information/> for specific information about the positional error in your coverage area.

(This page intentionally left blank)

## **3 WELCOME TO THE ST3400H HELITAWS**

### **3.1 Description**

The ST3400H HeliTAWS® is a self-contained Helicopter Terrain Awareness Warning System that both meets the FAA TSO-C194 requirements and exceeds these requirements with additional display and protection modes and features. It includes an advanced HTAWS computer, a GPWS computer, a graphics symbol generator, and Nighthawk's high-brightness display engine built within a standard 3-inch instrument chassis. It includes Radar Altimeter features and can be used to replace an existing Radar Altimeter indicator directly. In addition, it can act 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.

Nighthawk's TrueAlert® technology, combined with pilot-selectable low-sensitivity, tactical, obstacles-only, and off-airport operational modes, enables nearly nuisance-free protection during 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 in VMC and IMC under Instrument Flight Rules.

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

The ST3400H uses Nighthawk'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 ST3400H 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 are 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, the ST3400H is NOT designed for navigation.

### **3.4 What it does**

During normal flight operations, the system remains essentially silent. It uses GPS position, 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. Downward-looking Ground Proximity Warning System (GPWS) alerts, Forward Looking Terrain Alerts (FLTA), and various advisories are provided.

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 aircraft's flight path. 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 before 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.

### **3.5 Other Features**

When a Radar Altimeter is configured, a display of Radar Altitude is provided along with a MINS setter.

When a traffic computer or ADS-B IN transponder is configured, a display of Traffic from an external traffic processor is provided.

When a GPS or FMS is configured, and a flight plan has been entered, the flight plan legs will be displayed.

Nearby airports and runways are displayed depending on the display range scale. GPS position is used to locate these items in the Airport Database loaded into the HTAWS.

Major roadways may be selected to show on the display.

(This page intentionally left blank)

## 4 SYSTEM OVERVIEW

### 4.1 “Design Cruise Altitude”

The ST3400H introduces the “Design Cruise Altitude” (DCA) concept. DCA 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 be unavailable.

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

Table 4-1 Sensitivity Selections

Reduced sensitivity selections with a DCA lower than ‘NORM’ allow standard operations closer to the ground. However, 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 during EMS operations. No further pilot action is required when this mode has been selected, and no nuisance alerts will be generated when landing anywhere. Normal alerting criteria are automatically established when not landing or during cruise flight.

### **4.3 Alerts, Warnings, and Cautions**

An Alert is either a Caution or Warning generated by the GPWS or FLTA computer. A Caution is an alert indicating 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 appear on the cockpit audio system. In addition, 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 neither the Pilot nor a substitute for the Pilot's judgment; it is a display and computer. However, because it is designed only to 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 in 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 approximately 100' AGL using aviation chart standard obstacle symbols or transmission line/tower symbols as appropriate.

Obstacles taller than 500' are displayed using the tall tower symbol (see the section 6.6 on obstacle display symbology).

#### **4.5.4 Flight Plans**

The ST3400H overlays the GPS/FMS flight plan over any terrain view when 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 no effect or control over alerting. For this reason, alerting works identically whether the aircraft is on- or off-flight plan – without pilot intervention.

#### **4.5.5 Airports and Runways**

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

#### **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 ADS-B IN, TAS, or TCAS. Standard TCAS symbology is used to display the relative location and altitude of traffic. The traffic information is displayed overlaid on terrain.

**Note:** When the ST3400H is interfaced to a TCAS, the TCAS processor itself generates and annunciates

the alerts. Traffic symbols are displayed on the ST3400H.

#### **4.5.8 NVIS**

For missions requiring the use of night vision goggles, certain ST3400H models are equipped with Nighthawk's proprietary on-demand Class-B NVIS capability. Unlike aftermarket NVIS modifications, Nighthawk's unique NVIS feature employs no external filters and does not degrade its brightness or daylight characteristics when NVIS is OFF.

NVIS is activated using 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 or ADS-B IN Transponder (optional)
- Air Data 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 Geographic Overlay items 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.

#### **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 available for most countries. Please contact Nighthawk 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 bottom right corner of the display bezel.

(This page intentionally left blank)

## 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 includes a display screen, nine backlit buttons, one push-pull rotary knob, and one USB connector.

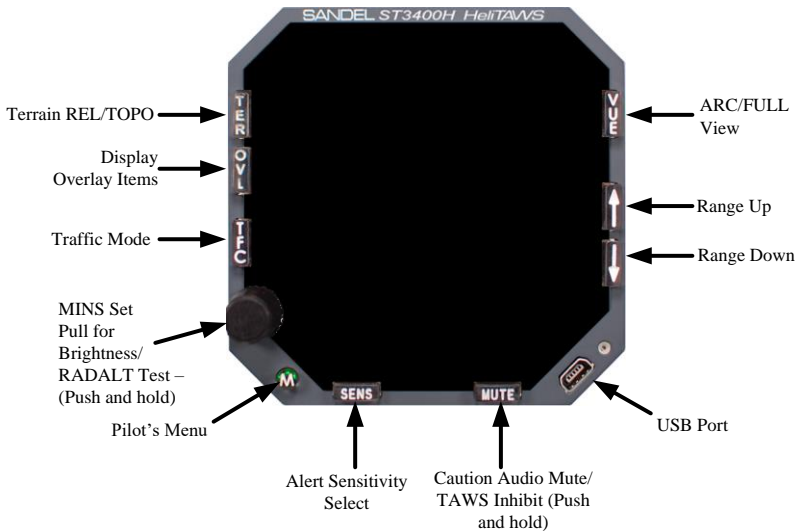


Figure 5-1 ST3400H Physical Features

These controls are discussed in detail below.

## 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

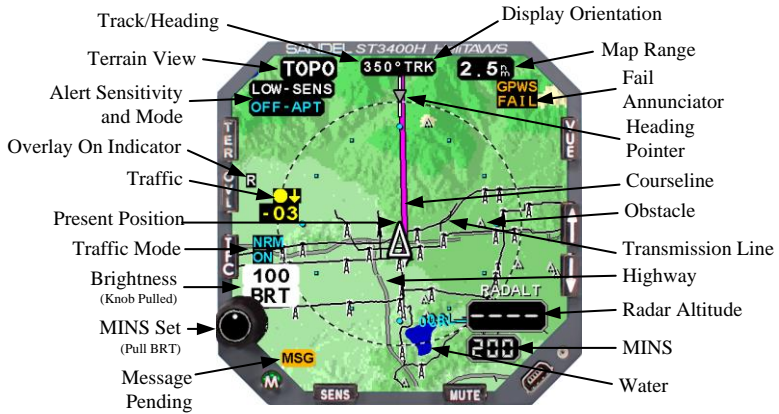


Figure 5-2 Display Overview TOPO/FULL

### 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 the 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:

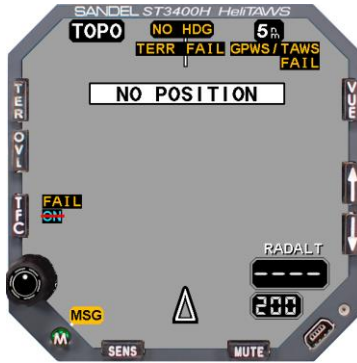


Figure 5-4 Initial Display

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 during 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.

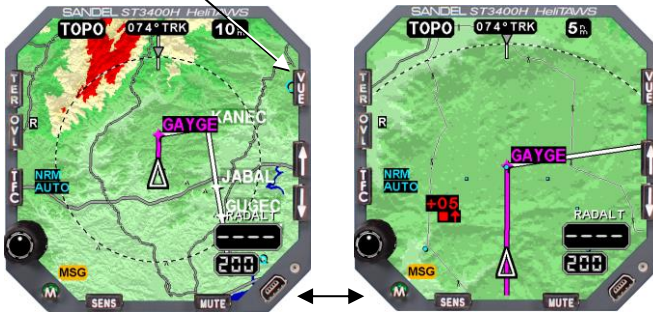


Figure 5-6 FULL and ARC Views

This action only affects the screen display – it does not affect 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.

The dashed line on the display is drawn at the range indicated at the top left of the display.

## 5.8 REL/TOPO

Pressing the [TER] button will cycle the terrain display between REL and TOPO. The Terrain View is announced at the top of the display.

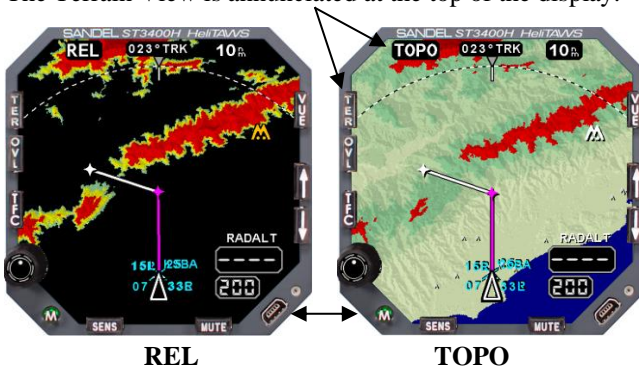


Figure 5-7 REL and TOPO Displays

**NOTE:** Selecting REL/TOPO does not affect 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 approaches the runway. Green and yellow are suppressed within 1nm of the airport and when on the ground. Red is used to depict the 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.

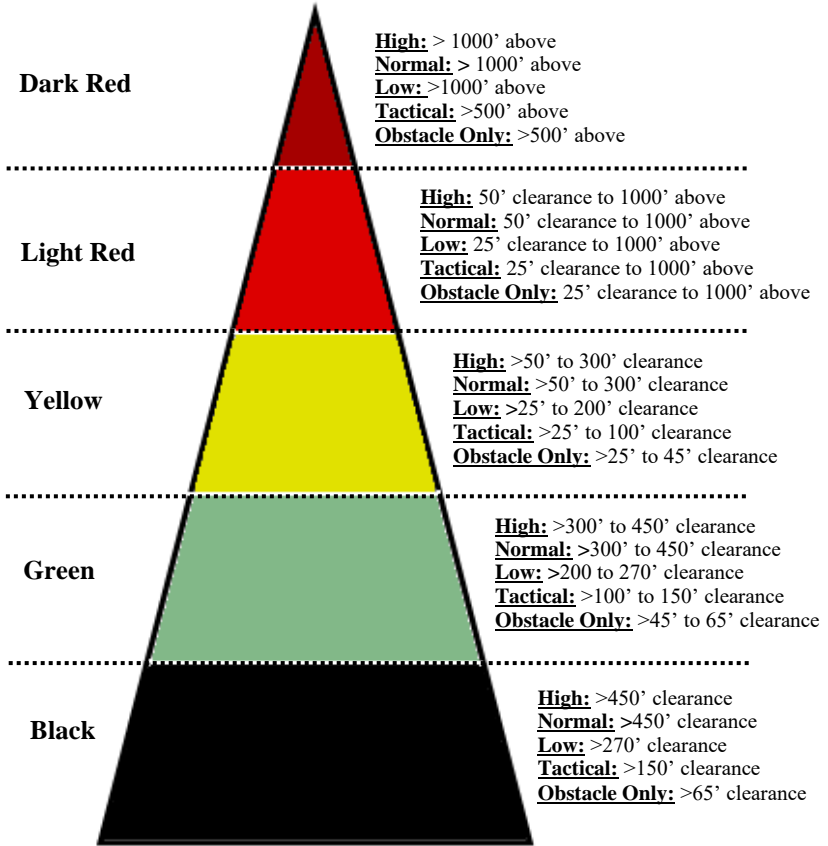


Figure 5-8 REL Display Color Banding Relative to aircraft altitude

## 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.

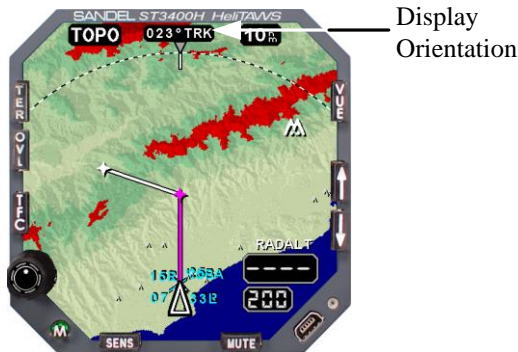


Figure 5-9 Display Orientation

The display will automatically switch to TRK when ground speed exceeds 35 knots. And then display will automatically switch to HDG when ground speed decreases below 30 knots.

**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 the FULL and ARC view maintains the terrain cell size. Pressing [VUE] will change the display range to maintain a constant terrain cell size.

Pressing [ $\uparrow$ ] and [ $\downarrow$ ] will change the range scale of the display.

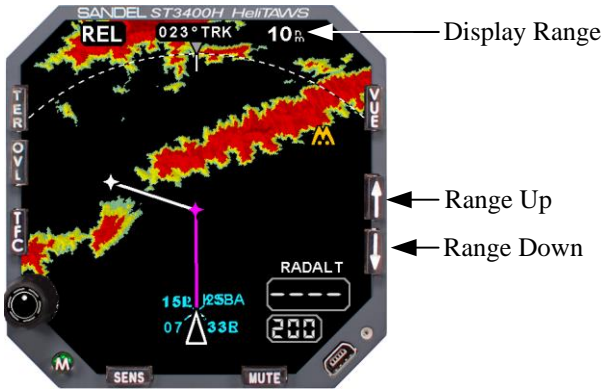


Figure 5-10 Display Ranging

In the TOPO display, the ARC / FULL View displays are decluttered in the 20 / 10-mile range and the 10 / 5-mile range, respectively, by preventing some of the wires from being displayed. This decluttering only affects the display. Alerting always uses all items in the database. Wires causing alerts will always be displayed in the TOPO or REL displays. All wires above the aircraft altitude are shown.

Selected View and Range		
View	No Decluttering	Decluttering
FULL	½, 1, 1.5, 2.5	5, 10
ARC	1, 2, 3, 5	10, 20

Table 5-1 Declutter View and Range

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 always displayed.

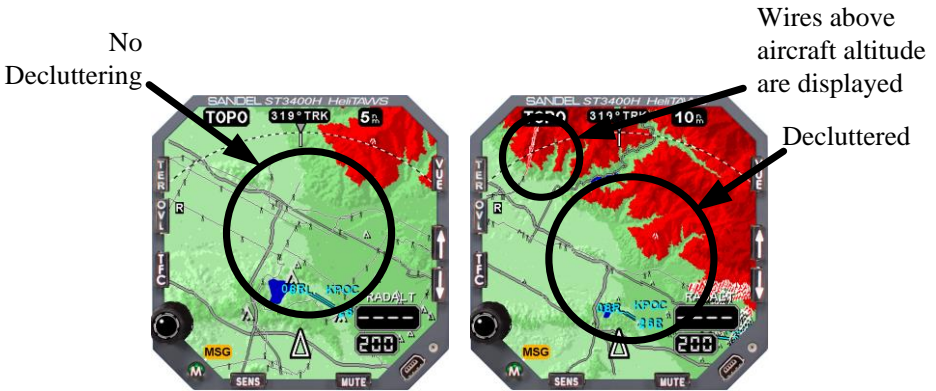


Figure 5-11 Decluttering

## 5.12 Overlay

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

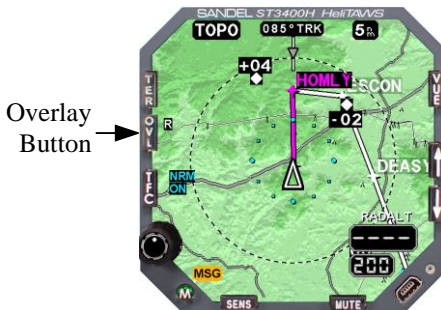


Figure 5-12 Overlay Button

**Note:** The database for roadways contains selected significant roads. Not all roads are present.

### 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 Figure 5-15. All sensitivity modes except for NORM may be selectively inhibited during installation and, therefore, may be unavailable. If all modes are inhibited during installation (other than NORM), pressing the [SENS] button will display NO ACTION.

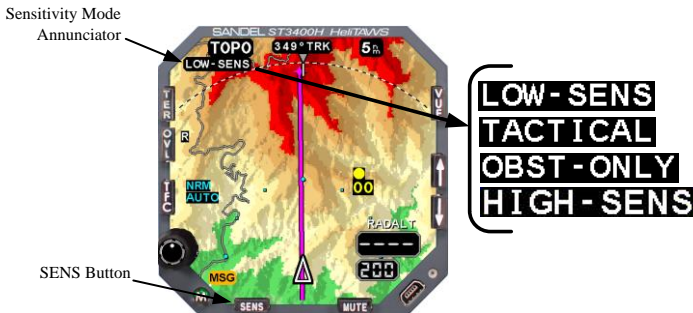


Figure 5-15 Alert Sensitivity Selection

**Note:** An optional external pushbutton may also access this function.

## 5.15 Sensitivity Selections

Press the [SENS] button to cycle through the available selections. Available selections are installation options and should be part of the Rotorcraft Flight Manual Supplement.

### 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 become 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. As a result, Terrain Caution alerts are inhibited. However, Obstacle and Wire alerts are not inhibited.

### **5.15.5 OBST-ONLY**

Obstacle-Only mode provides obstacle and wire alerting protection only. When this mode is selected, **all terrain alerts are inhibited.**

**Note:** Pilot selection of this mode may be disabled by an installation option.

## 5.16 Off Airport Mode

HOLD the [SENS] button to toggle the OFF-APT mode. This annunciates OFF-APT in Cyan. During hover and taxi operations at airports while not on a runway, operating in the OFF-APT mode may be desirable to reduce the likelihood of nuisance alerts.

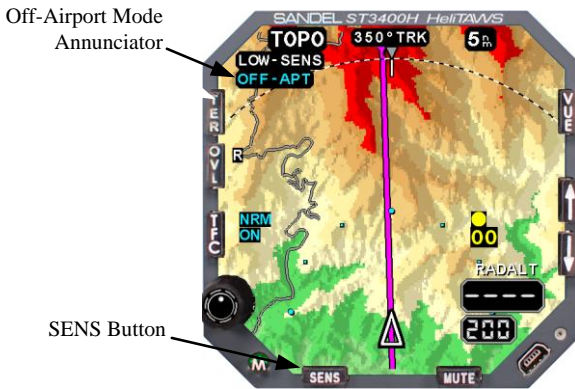


Figure 5-16 Off-Airport Mode Selection

**Note:** An optional externally mounted pushbutton may also access this function.

## 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 in locating the mute function.

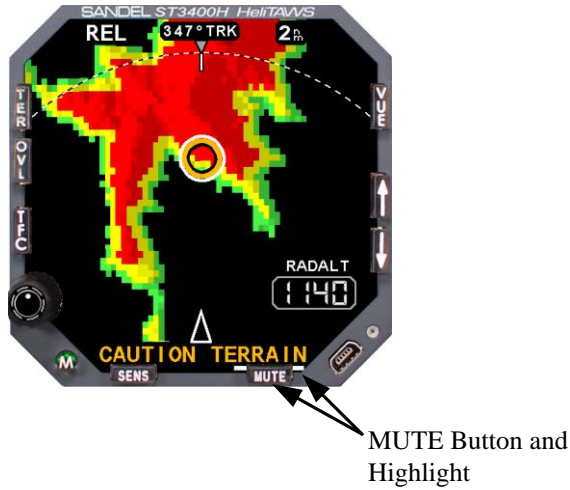


Figure 5-17 MUTE Button Highlighting

### Notes:

- In the particular case of a GPWS Altitude Loss After Take-Off alert (“DON’T SINK”), pressing [MUTE] will disarm the alert completely until the next take-off.
- If the [MUTE] button is pressed when a CAUTION alert is absent, the text “NO ACTION” will be displayed on the screen.
- An optionally mounted pushbutton may also access this function.

WARNINGS **cannot** be muted.

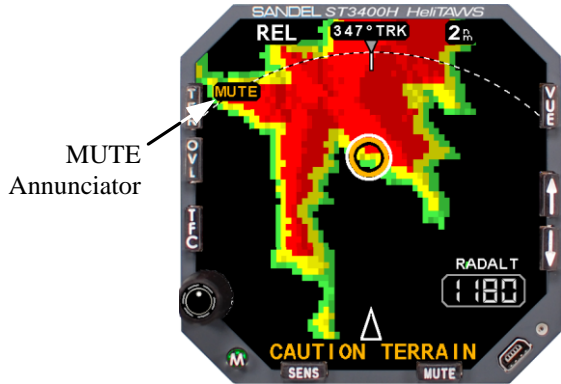


Figure 5-18 MUTE Annunciator

## 5.18 Brightness

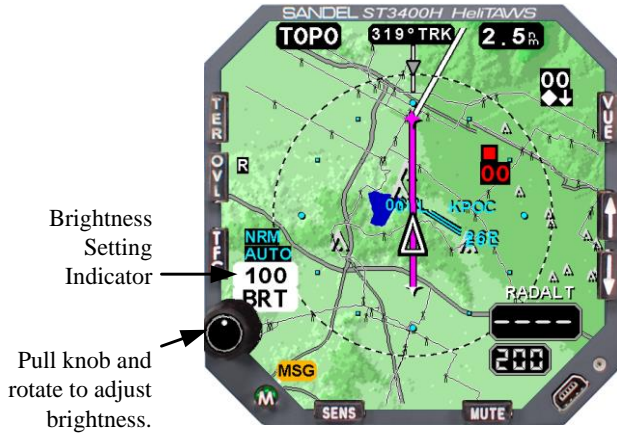


Figure 5-19 Brightness

Pull the knob and turn it to adjust the display brightness.

The display brightness is shown above the knob as a number from 0 to 100, where 100 is full brightness.

## 5.19 Flight Plan

If an FMS supplies a flight plan, each flight plan segment is displayed. The active flight plan segment is colored magenta, and the remaining flight plan segments are colored white.



Figure 5-20 Flight Plan Line

**Note:** Display of DME Arcs, Holding Patterns, and Procedure Turns are not supported in the ST3400H.

## 6 TERRAIN AND OBSTACLE ALERTING

### 6.1 Alert Generation

FLTA is an acronym for Forward Looking Terrain Alerting. The FLTA Alerting Area is 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.

The position and altitude of the aircraft are computed along the projected flight path twice per second. The projected position is based on the current aircraft location and ground speed. The projected altitude is based on the 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 before warnings during steady-state flight. However, 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 and ARC views are automatically selected. The display range may be changed as needed 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 as desired.

The terrain display shows all terrain – not only that representing actual conflicts. So, for instance, if two cells are threats simultaneously, both cells may be visible on the ST3400H, but only the closest one will be circled.

**Note:** While there will be only one circle drawn, more locations may **conflict** with the aircraft’s flight path!

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 the terrain below the aircraft. This occurs because the aircraft is descending, but the cell is still below the aircraft’s *current* altitude. Depending on the descent rate, any color cell may produce an alert in the REL display. However, only yellow or red cells will prompt an alert in level flight.



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 requires *immediate pilot attention*.
- A RED WARNING annunciation 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. Therefore, 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 respond to any other emergency.

## **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.

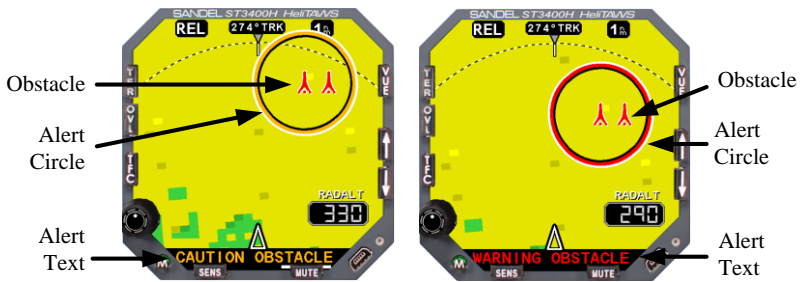


Figure 6-3 Obstacle Alert on a tall tower

## 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 Nighthawk Flight Systems, Inc. product support engineers for analysis.

Be aware that the TAWS INH function cancels all alerts - FLTA and GPWS. Altitude Callouts remain 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.

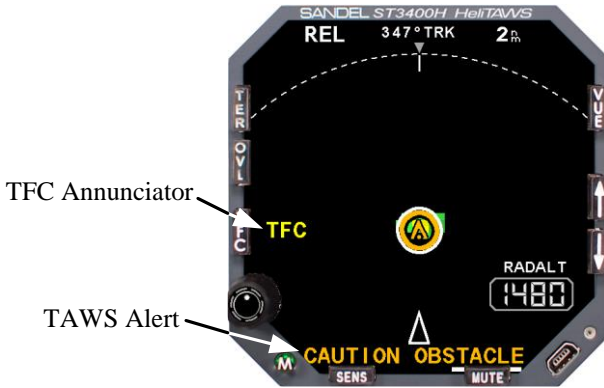


Figure 6-14 Display During TAWS Alerts

## 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 has been enhanced to provide alerts for one of two different sets of Active Alert Envelopes referred to here as Generic GPWS and Offshore GPWS. The first, Generic GPWS, alerting performs per RTCA DO-161A. The second, Offshore GPWS, provides alerting per RTCA DO-376 Offshore HTAWS requirements.

All Generic GPWS alerting Modes 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 Generic GPWS

#### 7.1.1 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 Generic GPWS Mode 1 Alerts

#### 7.1.2 Mode 2 – Not Implemented

This “Terrain Closure Rate” alert is a fixed-wing mode and not supported in Helicopter TAWS.

#### 7.1.3 Mode 3 – Descent after Take-off

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 Generic 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

### 7.1.4 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 Generic GPWS Mode 4 Alert

### 7.1.5 Mode 5 – Glideslope

A “GLIDESLOPE” Caution Alert is generated if the aircraft descends to more than approximately  $\frac{3}{4}$  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.

When ILS approach is not active and a GPS Approach with vertical guidance is detected, this alert will be generated by a similar vertical deviation from the GPS (i.e.,  $\frac{3}{4}$  scale deflection as observed on an HSI).

Alert will occur at approx. ¾ scale deflection.  
Glideslope scale shown is on a Nighthawk SN3500

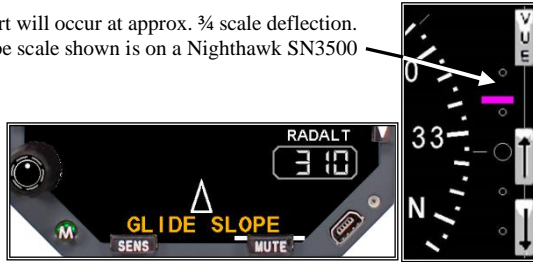


Figure 7-4 Generic GPWS Mode 5 Alert

### 7.1.6 Mode 6 – Altitude Callouts

Altitude callouts are generated depending on the selected Sensitivity Mode, Radar Altimeter Installation and configuration option. See Table 7-3 Generic GPWS Altitude Callouts.

With a Radar Altimeter Installed					
SENS AGL	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
150 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

Table 7-2 Altitude Callouts with RADALT

Without a Radar Altimeter Installed					
SENS AGL	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
150 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 7-3 Altitude Callouts no RADALT

### 7.1.7 TAWS INH - GPWS

Generic GPWS Mode 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.

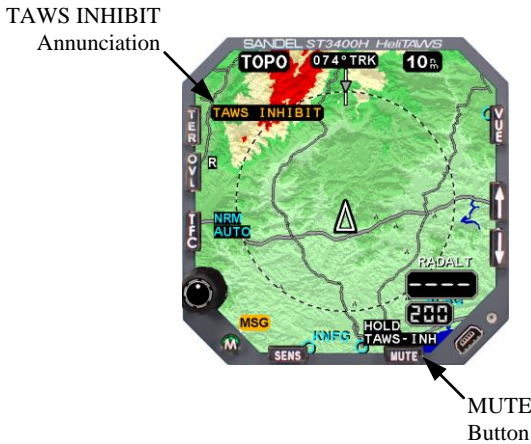


Figure 7-5 TAWS INHIBIT

## 7.2 Offshore GPWS

Offshore HTAWS per RTCA/DO-376 is supported in software version A1.08 and later and 1.07 and later.

The Offshore GPWS alerting feature is enabled by the installer and can be selected according to section **Error! Reference source not found.**. When Offshore mode is enabled by the installer there is also a switch input for AUTOROTATE that will inhibit Offshore GPWS alerting. Consult the Rotorcraft Flight Manual Supplement for details.

### 7.2.1 Mode 1 – Excessive Rate of Descent

A “SINK RATE” Caution Alert is generated when the aircraft height above terrain and rate of descent is inside the Mode 1 Caution Envelope. If the descent is not arrested and the aircraft height above terrain and rate of descent is inside the Mode 1 Warning Envelope a “PULL UP” Warning Alert is generated.



Figure 7-6 Offshore GPWS Mode 1 Alerts

### 7.2.2 Mode 2 – Not Implemented

This “Terrain Closure Rate” alert is a fixed-wing mode and not supported in Helicopter TAWS.

### 7.2.3 Mode 3

#### 7.2.3.1 Mode 3A – Altitude Loss during Take Off

A “DON’T SINK” Caution Alert is generated if the aircraft climbs without going above the Mode 3A Alert Envelope 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 7-7 Offshore GPWS Mode 3A Alert

### 7.2.3.2 Mode 3B – Loss of Airspeed during Take Off

A “CHECK AIRSPEED” Caution Alert is generated if the aircraft accelerates above the arming speed per the Mode 3B Alert Envelope and then decelerates such that the airspeed falls into the Caution envelope. If the aircraft climbs into the Must Not Alert altitude before the drop in airspeed occurs, the Mode 3 alert will not be generated. This alert may be cancelled by pressing [MUTE].



Figure 7-8 Offshore GPWS Mode 3B Alert

## 7.2.4 Mode 4

### 7.2.4.1 Mode 4A – Flight Near Terrain Not Landing Configuration

For retractable gear aircraft - A “TOO LOW GEAR” Caution Alert is generated if the aircraft descends into the Alert Envelope with airspeed lower than the configured Mode 3-B threshold and the landing gear is not down.

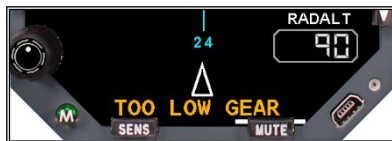


Figure 7-9 Offshore GPWS Mode 4A Gear Alert

### 7.2.4.2 Mode 4B – Flight Near Terrain Landing Configuration

For retractable gear aircraft - A “TOO LOW TERRAIN” Caution Alert is generated if the aircraft descends into the Alert Envelope with airspeed higher than the configured Mode 3-B threshold and the landing gear is down.



Figure 7-10 Offshore GPWS Mode 4B Alert

### 7.2.5 Mode 5 – Glideslope

A “GLIDESLOPE” Caution Alert is generated if the aircraft descends to more than approximately ¾ scale deflections below the glideslope when the aircraft is 950’ or lower while on an ILS approach.

When ILS approach is not active and a GPS Approach mode with vertical guidance is detected, the alert is generated by a similar ¾ scale deflection (observed on an HSI) vertical deviation from the GPS.

Alert will occur at approx. ¾ scale deflection.  
Glideslope scale shown is on a Nighthawk SN3500

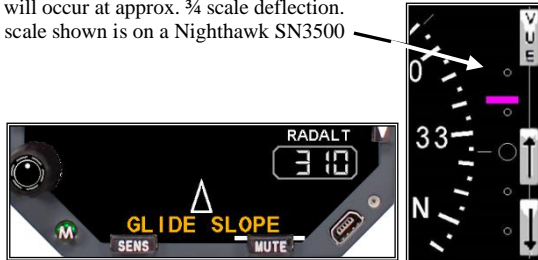


Figure 7-11 Offshore GPWS Mode 5 Alert

### 7.2.6 Mode 6 – Altitude Callouts

Altitude callouts are generated depending on Radar Altimeter Installation and configuration options. See Table 7-4 Generic GPWS Altitude Callouts  
**Error! Reference source not found.**

Radar Altimeter Configuration		
AGL	With RA	Without RA
300 ft.	Optional	Inhibited
200 ft.	Optional	Inhibited
150 ft.	Mandatory	Mandatory
100 ft.	Optional	Inhibited
50 ft.	Optional	Inhibited
40 ft.	Optional	Inhibited
30 ft.	Optional	Inhibited
20 ft.	Optional	Inhibited
10 ft.	Optional	Inhibited

Table 7-4 Offshore GPWS Altitude Callouts

### 7.2.7 Mode 7 – Not Implemented

The “Low Energy on Approach” alert is an optional Offshore HTAWS function which is not currently implemented in the ST3400H. This mode must be customized for each aircraft type and may be added in the future based on customer requirements.

### 7.2.8 TAWS INH – GPWS

Offshore GPWS Mode 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.

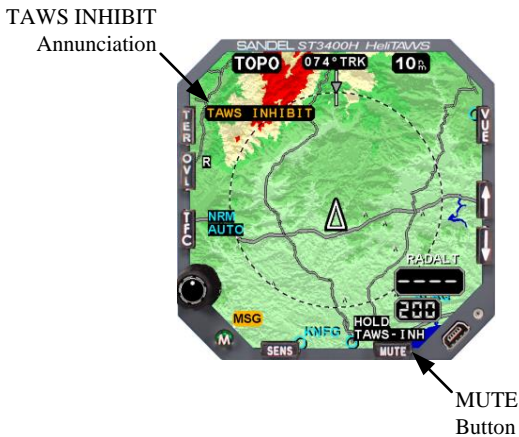


Figure 7-12 TAWS INHIBIT

**7.2.9 Offshore GPWS Alert Envelopes**

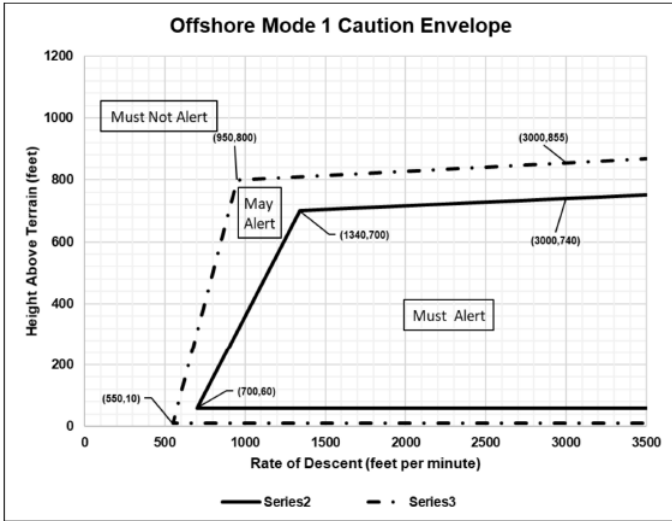


Figure 7-13 Offshore GPWS Mode 1 Caution Envelope

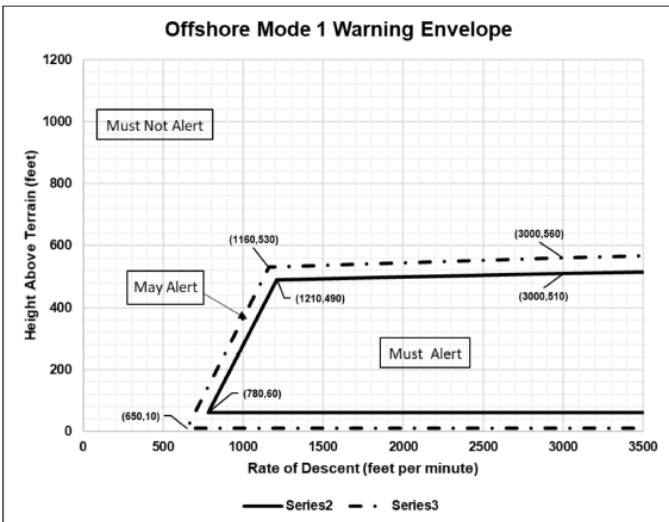


Figure 7-14 Offshore GPWS Mode 1 Warning Envelope

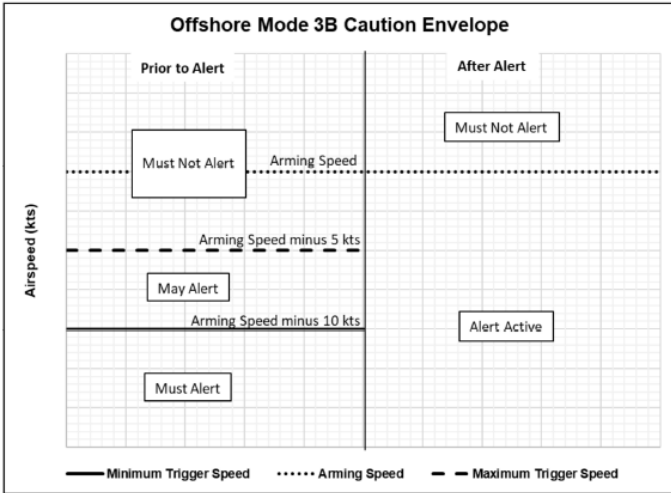


Figure 7-15 Offshore GPWS Mode 3-B Alert Envelope

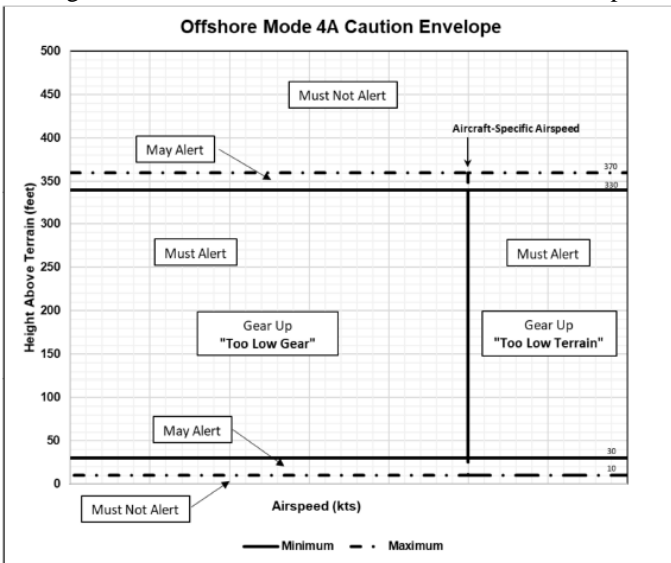


Figure 7-16 Offshore GPWS Mode 4-A Alert Envelope

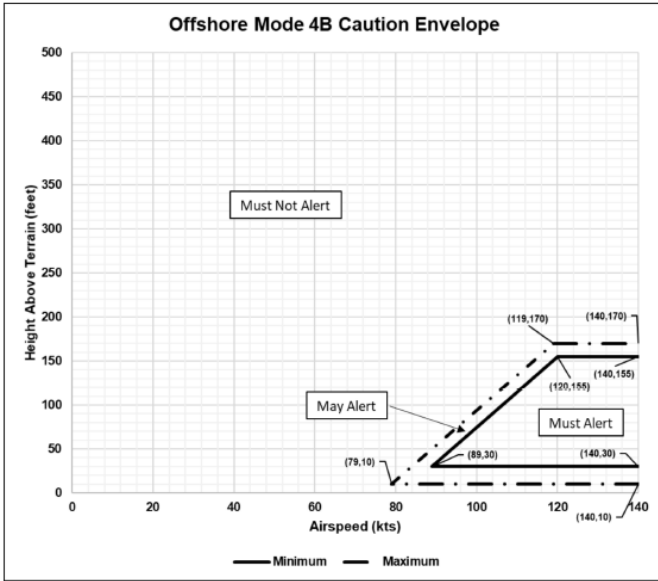


Figure 7-17 Offshore GPWS Mode 4-B Alert Envelope

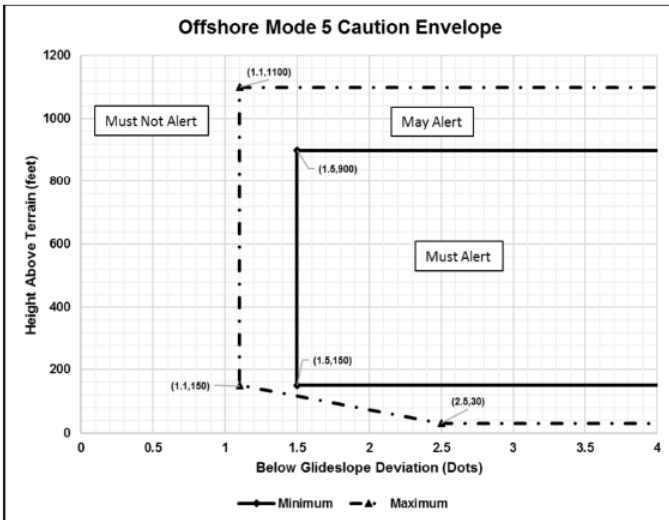


Figure 7-18 Offshore GPWS Mode 5 Alert Envelope

(This page intentionally left blank)

## 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. When the knob is held longer than 10 seconds, the test will still time-out.

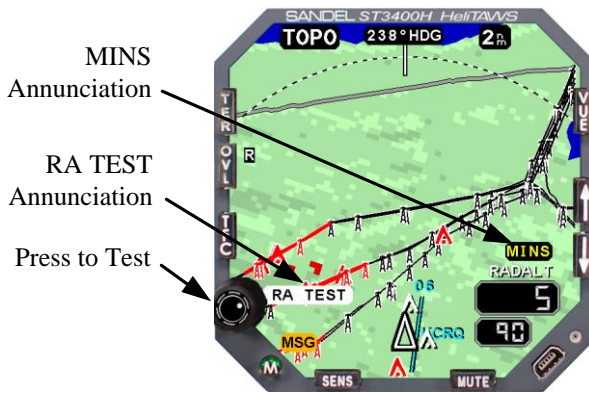


Figure 8-2 Radar Altimeter Test

## 9 TRAFFIC DISPLAY INTERFACE

The ST3400H can display nearby transponder equipped aircraft when interfaced with a compatible TAS, or TCAS processors or transponders capable of ADS-B In functions. Please refer to the Pilot's Guide for the specific traffic system installed in the aircraft for a complete description of the capabilities.

Note: The ST3400H can be interfaced to a TCAS II processor but functions only as a traffic display so vertical guidance information required for conflict resolution will not be displayed.



Figure 9-1 ST3400H with Traffic

## 9.1 Traffic Symbolology

The ST3400 uses standard RTCA symbology to represent 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>	Traffic Alert No Bearing / No Altitude	Alerting traffic with no bearing and no altitude information available.
<b>TA 2.0nm / +07↑</b>	Traffic Alert No Bearing	Alerting traffic with no bearing information available.

Table 9-1 Alerting Traffic Symbols

**Note:** The ST3400H does not annunciate traffic alerts, nor does it provide guidance.






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	RA and TA targets outside of the currently selected display range will be shown as a half symbol against the compass rose at the corresponding bearing.

Table 9-2 Non-Alerting Traffic Symbols

## 9.2 Relative Altitude

Relative altitude in hundreds of feet and vertical trend information are also given for each target aircraft.

**Note:** Target altitudes above or below you by more 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.

### 9.3 Absolute Altitude vs. Relative Altitude

Hold of [TERR] will enable display absolute altitudes for 30 seconds.

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 above 18,000 feet. The altitude of your aircraft will be shown in the top right of the ST3400H display.

Own-aircraft altitude is shown as either “FL” (at or above 18,000 ft) or “MSL” when below 18,000 ft. Target aircraft altitudes will similarly be FL or MSL.

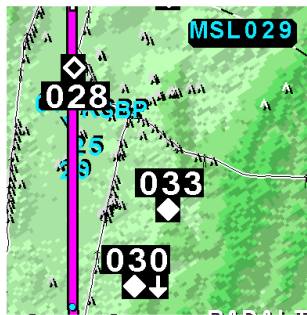


Figure 9-2 Own Aircraft Absolute Altitude

The target aircraft altitudes will be either above or below the symbol to indicate that the target is above or below your aircraft.

## 9.4 Traffic Display Mode

The traffic display mode is annunciated next to the [TFC] button. There are three different modes available which control how the targets are displayed on the ST3400H and are toggled by pressing the [TFC] button.

- ON: Enables display of all targets within the selected map range.
- M: Manual mode. Traffic will be displayed within the selected map range only when alerting traffic is present.
- A: Auto mode. Same as Manual mode except that map range will auto-scale to an appropriate range to show the traffic on-screen.

Selecting the Manual (M) or Auto (A) modes will suppress the display of non-alerting traffic (i.e., traffic other than RAs or TAs). This can be useful in busy terminal areas where the display of all traffic may cause the screen to become too cluttered.

When the traffic display mode is set to ON, pressing the [CLR] button will change the display mode to Auto. This has the effect of removing non-alerting traffic from the display. Pressing [CLR] again will toggle the traffic display mode back to ON. Note that alerting traffic will always be shown on the display.

## 9.5 Altitude Filter

The currently selected altitude filter mode will be displayed next to the [TFC] button.

- <none> Normal altitude filter. Target aircraft within +/- 2,700 ft. of your aircraft are displayed.
- ABV: Above aircraft altitude filter. Target aircraft within -2,700 ft. and +9,000 ft. of your aircraft are displayed.
- BLW: Below aircraft altitude filter. Target aircraft within -9,000 ft. and +2,700 ft. of your aircraft are displayed.
- XTD: Extended altitude filter. Target aircraft within +/- 9,000 ft. of your aircraft are displayed.

See Chapter 10.5 **Error! Reference source not found.** for details on changing the Altitude Mode.

## 9.6 TCAS Status

When traffic is not available, the following annunciations will be displayed next to the [TFC] button. The Traffic Display Mode annunciation will also be lined-out in red.

TEST: TCAS is currently in Test mode

OFF or STBY: TCAS is currently in Standby mode

FAIL: TCAS data communication not present

## 9.7 TCAS TEST

The ST3400H 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 your aircraft and the traffic system pilot's guide for additional details.



Figure 9-3 TCAS Test

## 9.8 Traffic Overlay on TOPO or REL Display

Traffic targets can be displayed simultaneously with underlying terrain information. Targets will be overlaid on the display with flight plan legs and icons as shown in the example below.



Figure 9-4 Traffic with TOPO

## 9.9 ADS-B IN Traffic

Optional display of traffic from compatible ADS-B In receivers is supported in software version A1.08 and later and 1.07 and later.

## 9.10 ADS-B IN Traffic Symbology

New symbology supported by ADS-B IN is shown in the table below. Display of Traffic Information File (DTIF) and GDL 88/90 are supported data format options for ADS-B IN transponders.








Protocol	Other	Other w/Dir	Prox	Prox w/Dir	TA	TA w/Dir	RA	RA w/Dir
Symbols								
TCAS	YES	--	YES	--	YES	--	YES	--
DTIF	YES	YES	YES	YES	YES	YES	YES	YES
GDL88/90	YES	YES	--	--	YES	YES	--	--

Figure 9-5 ADS-B In Traffic Symbology

A velocity vector may be displayed, which represents the path of the target for 60 seconds at its current direction and ground speed. The velocity vector is not displayed for targets without direction and ground speed information.

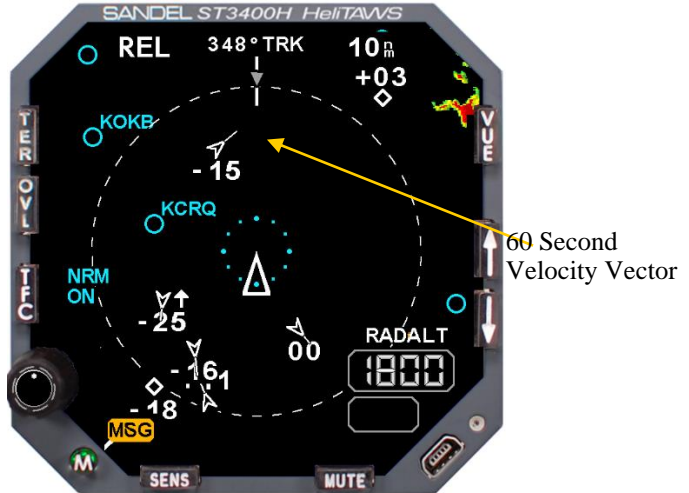


Figure 9-6 Targets with Velocity Vector

### 9.11 ADS-B IN Aircraft Information

Hold [TFC] to enable display of target aircraft ID and ground speed. Target ID will be tail number or airline flight ID as received by the ADS-B IN transponder.

When enabled, the information will be displayed for 30 seconds. The relative altitude field will be replaced by alternating aircraft ID and ground speed values for each target providing the data.



Figure 9-7 Aircraft ID and Ground Speed Display

## 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.

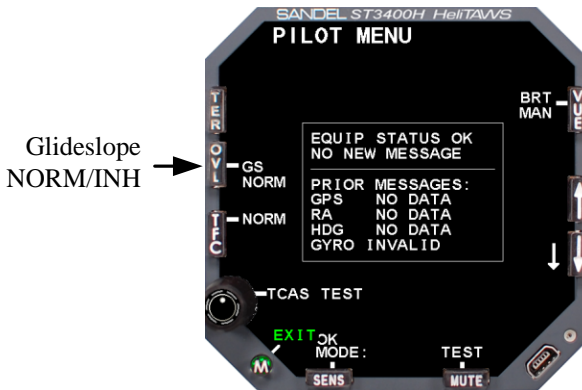


Figure 10-2 GS Soft Key

### 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 Nighthawk Flight Systems, Inc. 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



MUTE  
Button

Figure 10-3 TAWS INHIBIT

### 10.3 Offshore GPWS Pilot Options

The Pilot Options for controlling the Offshore GPWS are based on how this feature is configured by the installer. The installation selections are intended to provide flexibility for fleet operators to operate this feature in a consistent manner. Table 10-1 indicates the options available to the Pilot based on the Configuration settings on the Maintenance Page.

Installation Setting	Pilot Menu Options
Pilot	Offshore Off, On, and Auto
Disable	Offshore Off
Always	Offshore On
Ocean	Offshore Auto

Table 10-1 Offshore GPWS Options in Pilot Menu

The [OFFSHORE] soft key will cycle through the options as indicated in the table.

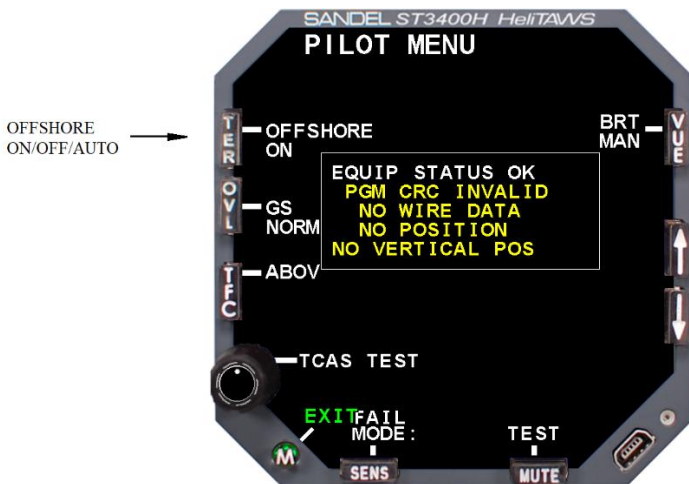


Figure 10-4 OFFSHORE Soft Key

**OFF** selects the normal HTAWS GPWS modes.

**ON** selects the OFFSHORE GPWS modes.

**AUTO** selects Offshore HTAWS when over Ocean and Generic GPWS otherwise.

## 10.4 TEST

The [TEST] soft key 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.

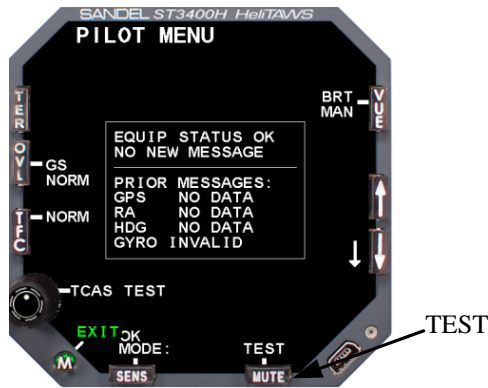


Figure 10-5 TEST

## 10.5 Traffic Altitude Filter Selection

The ST3400H supports four altitude filtering modes: NORM (Normal), ABOV, BELO, and XTND (Extended). Depending on the model of traffic system interfaced to the ST3400H in your particular installation, these altitude filters may be controllable through this soft optional key.

Descriptions for these modes can be found in Chapter 9 – Traffic Display Interface. Consult the Rotorcraft Flight Manual Supplement for the ST3400H installation for your aircraft and the traffic system pilot’s guide for additional details.

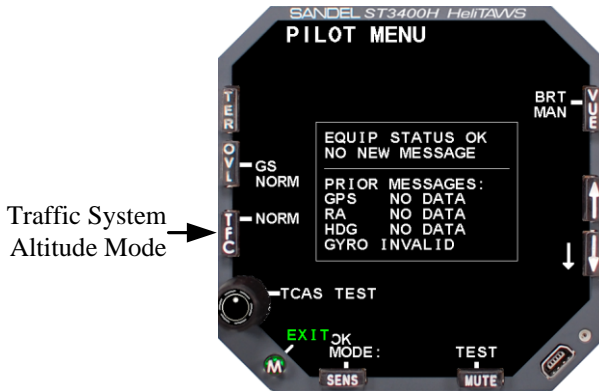


Figure 10-6 Traffic System Altitude Mode

The usage is as follows:

- 1.) Any ADS-B choice or Ryan 9900BX, soft key can select/display ABV, BLW, NRM, and XTD locally per above.
- 2.) Any TCAS device with (SW) in name we can make select/listen for ABV, BLW, NRM, and XTD per Plot Menu and 429 from traffic computer.
- 3.) All other TCAS devices we only listen for ABV, BLW, NRM, and XTD per 429 traffic computer and controls.

## 10.6 Brightness

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

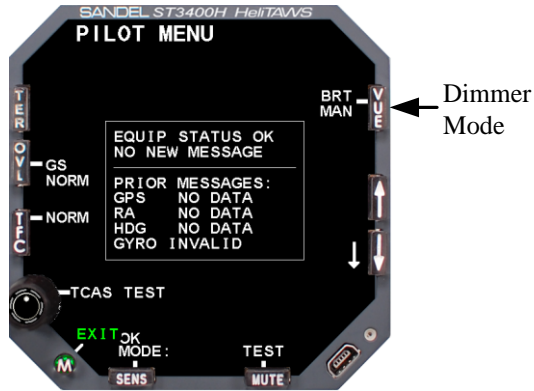


Figure 10-7 Dimmer Mode

## 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.

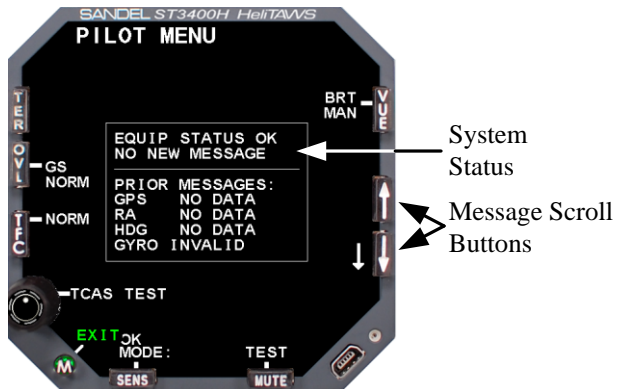


Figure 10-8 System Status

**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/ADS-B IN Traffic Information source	"FAILED"	"FAILED"

Table 10-2 Equipment and Status Messages

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

(This page intentionally left blank)

## 11 EXTERNAL SWITCH AND ANNUNCIATORS

External annunciators and switches may be optionally installed.

Consult the Rotorcraft Flight Manual Supplement for location and other details on installed annunciators and switches.

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 INHIBIT** 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.

**GPWS FAIL** annunciator illuminates when GPWS FAIL is present on the ST3400H display. When illuminated, GPWS alerting is failed due to missing required inputs.

**TAWS CAUTION or WARNING** annunciator/discrete output to inhibit TCAS annunciations when terrain alerts are being annunciated.

**RA MINS** annunciator illuminates when MINIMUMS is being annunciated.

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.

**AUTOROTATE** annunciator illuminates when Offshore GPWS alerting is inhibited by the Pilot. Pressing the external switch activate Offshore GPWS inhibit. The display also shows this status.

## 12 ON SCREEN ANNUNCIATIONS & MESSAGES

### 12.1 On-Screen Annunciations

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

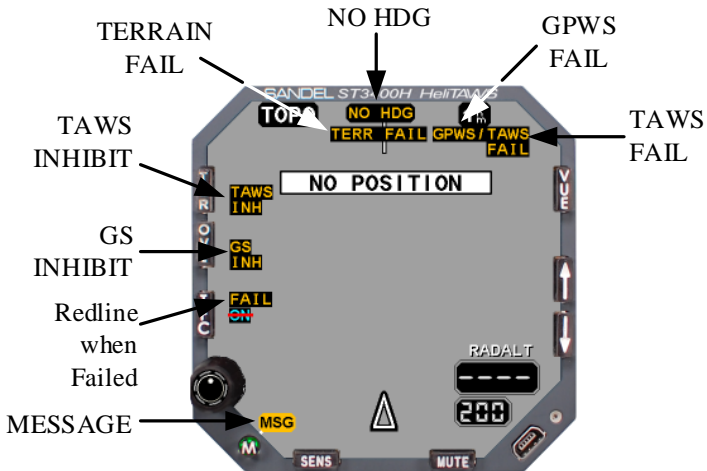


Figure 12-1 On-Screen Annunciation

- 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.
- TFC FAIL:** Display of traffic is disabled due to lack of data communication from the TCAS processor or ADS-B IN Transponder. Traffic status, ON/A/M, will also be redlined.
- TERR FAIL:** Loss of terrain data (no terrain alerting).



Figure 12-2 Offshore GPWS Annunciations

- OFFSH: Offshore GPWS modes are enabled. May be combined with FAIL or INH.
- OFFSH FAIL: One or more Offshore GPWS modes are unavailable due to failed equipment, typically Radar Altimeter failure.
- OFFSH INH: Offshore GPWS modes are unavailable due to inhibit. Typically, Autorotate active or TAWS Inhibit selected.

## 12.2 Special Alerts

These messages are activated by pressing the [TEST] soft key on the Pilot's Menu

PILOT MENU ALERT TEST	
Text Message	Type
TEST CAUTION	Caution
TEST WARNING	Warning

Table 12-1 Alert Test Messages

## 12.3 Messages with ACK

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

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

Table 12-2 Messages Requiring ACK

## 12.4 Other Messages

<b>ADVISORY MESSAGES</b>		
<b>Text Message</b>	<b>Description</b>	<b>Comment</b>
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.

<b>ADVISORY MESSAGES</b>		
<b>Text Message</b>	<b>Description</b>	<b>Comment</b>
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.

Table 12-3 Advisory Messages

## 12.5 Pilot Menu Messages

<b>PILOT MENU MESSAGES</b>		
<b>Text Message</b>	<b>Description</b>	<b>Action</b>
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
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.

<b>PILOT MENU MESSAGES</b>		
<b>Text Message</b>	<b>Description</b>	<b>Action</b>
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.

Table 12-4 Pilot Menu Messages

(This page intentionally left blank)

## **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 Nighthawk Flight Systems, Inc. product support engineers for analysis.

### **13.2 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.

(This page intentionally left blank)

## 14 SPECIFICATIONS

<b>TSO Compliance and Certifications</b>	
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 I C195b: Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)
Non-TSO Functions	RTCA/DO-376: Minimum Operational Performance Standard for Offshore Helicopter Terrain Awareness and Warning System (HTAWS)
Software Certification	RTCA/DO-178B, Level C
Programmable Logic	RTCA/DO-254, Level C
Environmental Category:	[A2F1Z]BBB[UU2]XXXXXXXXZZAZ[ZW][WWW]M[A3G33]XXAX
<b>Physical Dimensions</b>	
Form Factor:	3ATI (ARINC 408)
Width:	3.175 inches
Height:	3.175 inches
Length:	9.5 inches
Weight:	2.7 lbs.
<b>Operational Characteristics</b>	
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.

(This page intentionally left blank)

## 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 ( <a href="http://rtca.org">rtca.org</a> )
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

## 16 JEPPESEN TERMS AND CONDITIONS

**YOU (herein also “End-User”) HAVE LICENSED JEPPESEN’S NAVDATA, (the “Data”) FROM NIGHTHAWK FLIGHT SYSTEMS, INC. (“OEM”) UNDER AN AGREEMENT (herein “Agreement”). PLEASE READ THE FOLLOWING ADDITIONAL TERMS (“Additional Terms”) PROVIDED TO YOU BY OEM CAREFULLY BEFORE USING THE DATA. THESE ADDITIONAL TERMS ARE LEGALLY BINDING UPON YOU IN ADDITION AND AS AN INTEGRAL PART OF THE AGREEMENT. BY PURCHASING AND USING THE DATA, END- USER IS AGREEING TO EACH TERM OF THESE ADDITIONAL TERMS AS PART OF THE AGREEMENT INCLUDING THE RESTRICTIONS ON USE, DISCLAIMERS AND LIMITATION OF LIABILITIES. ANY USE OF THE DATA WILL ALSO CONSTITUTE YOUR AGREEMENT WITH THESE ADDITIONAL TERMS AS PART OF THE AGREEMENT. In case of a conflict between the Agreement and anything stated in these Additional Terms, these Additional Terms shall govern and prevail.**

### 1. ACKNOWLEDGMENTS.

- A. End-User confirms to have entered in a valid Agreement with OEM and End-User acknowledges that the Agreement is concluded solely between OEM and End-User, and not with Jeppesen. These Additional Terms survive the expiry and termination of the Agreement.
- B. End-User irrevocably acknowledges and agrees:
  - (i) Jeppesen GmbH and Boeing Digital Solutions, Inc. (f/k/a Jeppesen Sanderson Inc.) (“**Jeppesen**”), as licensor or owner of the Data, are each a third party beneficiary of these Additional Terms, and shall therefore have the right (and will be deemed to have accepted the right) to enforce the Additional Terms against End-User.
  - (ii) End-User acknowledges and agrees that OEM and not Jeppesen shall be responsible for addressing any claims of the End-User relating to the Data and such claims shall be addressed by OEM as per the terms of the Agreement. End-User acknowledges and agrees that each NavData database is effective for the specific 28-day AIRAC cycle period for which it was produced. Jeppesen has no liability or responsibility of any kind for the use of NavData by End-User after the expiration of its AIRAC effectivity cycle. End-User agrees that any use of the NavData

after the expiration date of the AIRAC effectivity cycle will be at the End-User's sole risk and responsibility.

- C. Information contained in NavData is independently available from publications of the appropriate governing authority. NavData are designed for use by experienced and knowledgeable (i) pilots who must be thoroughly familiar with and competent in, among other things, the navigation of aircraft and the air navigation equipment being used, and (ii) flight dispatchers, flight planners and others who must be thoroughly familiar with and competent in, among other things, the planning of flights and the computerized flight planning programs being used. The NavData does NOT contain all information necessary to independently conduct instrument or visual flight procedures or plan all aspects of a flight. The NavData must be used in conjunction with the appropriate aeronautical charts and other information available to pilots, flight dispatchers, flight planners and others through a variety of sources. Pilots must conduct flight procedures in accordance with the information depicted on aeronautical charts.
- D. Some information displayed by the system on which NavData is installed ("System") may be solely generated by the System, and may not be information derived from Jeppesen NavData. The NavData provided hereunder may not contain all of the navigation data existing worldwide, and End-User should make no assumption otherwise. The System may not utilize all NavData available from Jeppesen, and the data contained in End-User's NavData may be only a subset of the data available from Jeppesen.
- E. End-User is the "end user" of the data that is the subject of this Agreement, and Requirements and Technical Concepts for Aviation, Inc. (RTCA) document DO-200A and European Organization for Civil Aviation Equipment (EUROCAE) document ED-76, "Standards for Processing Aeronautical Data," Section 1.4, Application of Standard, state that, "The ultimate responsibility of ensuring that data [i.e. NavData] meets the quality for its intended application rests with the end user of that data.
- F. End-User is solely responsible for (i) thoroughly and appropriately training its users on the use of the System and the contents of any reformatted data derived from NavData, including, among other things, its limitations and differences from Jeppesen NavData, and (ii) training its users to confirm that the database information the user selects in the System is the database information the user intends to select.

- G. End-User is solely responsible for the design, adequacy, accuracy, reliability, safety, conformance with government standards or regulations, and content of any and all data directly or indirectly originating from End-User (“**End-User Data**”), including fitness for its intended purpose. End- User will, at its expense, indemnify, defend, and hold harmless Jeppesen and its licensors, contractors, subcontractors and agents from any and all claims and liabilities (including claims by third parties), and costs and expenses (including attorneys’ fees) in any way relating to End-User Data.
- H. OEM acknowledges, agrees and understands that (i) Jeppesen's Obstacle Data and Terrain Data are not to be used for navigation, but are for situational and/or positional awareness only; and (ii) such data may not be updated on a regular basis; and (iii) OEM assumes total responsibility to ensure OEM is using the most current data available at any given time.
2. **OWNERSHIP/COPYRIGHT.** Jeppesen is the owner or authorized licensor of the Data, which is protected by copyright. Material from the Australian Aeronautical Information Publication has been used by agreement with Airservices Australia. The Data provided hereunder may contain third party data provided by the avionics manufacturer in whose system the Data will be used and Jeppesen disclaims any and all responsibility and liability whatsoever for such third party data.
3. **RESTRICTIONS ON USE.** The Data may not be used for any other purpose, nor be sold or given by End-User to any third party for any use. Use of the Data by End-User to generate aviation charts or maps, whether for reference only or actual air navigation, is expressly prohibited. The Data cannot be used for performance based navigation procedure design (RNAV-RNP). End-User will NOT: (a) copy, reproduce, reverse engineer, decompile, disassemble or publish the Data; (b) electronically transfer the Data to multiple computers over a network system; (c) distribute copies of the Data or accompanying materials to others; (d) modify, adapt, or translate the Data or create derivative works based on the Data; or (e) assign, rent, lend, sell, transfer or sublease the Data.
4. **WARNINGS:**  
**DATA RELATED ALERTS AND NOTICES (“ALERTS”) ARE PUBLISHED ON JEPPESEN’S NOTICES AND ALERTS WEBPAGE ACCESSIBLE VIA WWW.JEPPESEN.COM. CHANGES MAY OCCUR AT ANY TIME AND END-USER AGREES TO REGULARLY MONITOR JEPPESEN’S NOTICES AND ALERTS WEBPAGE AS APPROPRIATE FOR ITS TYPE OF OPERATION.**

5. **NO WARRANTY.** END-USER ACKNOWLEDGES, AGREES AND UNDERSTANDS THAT THE DATA ARE PROVIDED “AS IS” WITHOUT WARRANTY OF ANY KIND WHATSOEVER.
6. **DISCLAIMER AND RELEASE.** THE CONDITIONS, REPRESENTATIONS, GUARANTEES, OBLIGATIONS, LIABILITIES AND WARRANTIES (IF ANY) OF JEPPESEN AND REMEDIES OF END-USER SET FORTH HEREIN ARE EXCLUSIVE AND IN SUBSTITUTION FOR, AND END-USER HEREBY WAIVES, RELEASES AND RENOUNCES, ALL OTHER WARRANTIES, CONDITIONS, REPRESENTATIONS, GUARANTEES, OBLIGATIONS AND LIABILITIES OF JEPPESEN, AND ANY OTHER RIGHTS, CLAIMS AND REMEDIES OF END-USER AGAINST JEPPESEN, EXPRESS OR IMPLIED, ARISING BY LAW, EQUITY OR OTHERWISE, WITH RESPECT TO THIS AGREEMENT, ANY END-USER-SUPPLIED INFORMATION, THE DATA PROVIDED HEREUNDER AND ANY NONCONFORMANCE OR DEFECT IN THE DESIGN, ADEQUACY, ACCURACY, RELIABILITY, SAFETY, OR CONFORMANCE WITH GOVERNMENT STANDARDS OR REGULATIONS OF SUCH DATA, INCLUDING BUT NOT LIMITED TO: (i) ANY IMPLIED WARRANTY OF MERCHANTABILITY, SATISFACTORY QUALITY, OR FITNESS; (ii) ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE; (iii) ANY OBLIGATION, LIABILITY, RIGHT, CLAIM OR REMEDY ARISING IN STRICT LIABILITY OR IN TORT, WHETHER OR NOT ARISING FROM THE NEGLIGENCE OF JEPPESEN; AND (iv) ANY OBLIGATION, LIABILITY, RIGHT, CLAIM OR REMEDY FOR LOSS OF OR DAMAGE TO ANY PROPERTY OF END-USER, INCLUDING WITHOUT LIMITATION ANY AIRCRAFT.
7. **EXCLUSION OF SPECIFIED LOSSES AND DAMAGES.** JEPPESEN WILL HAVE NO OBLIGATION OR LIABILITY WHATSOEVER, (i) WHETHER ARISING IN LAW, EQUITY, CONTRACT (INCLUDING BUT NOT LIMITED TO WARRANTY), TORT (INCLUDING BUT NOT LIMITED TO THE NEGLIGENCE OF JEPPESEN), STRICT LIABILITY, OR OTHERWISE AND (ii) WHETHER SUCH LOSSES OR DAMAGES ARE DIRECT, INDIRECT OR OTHERWISE, FOR: (i) LOSS OF USE, REVENUE, PROFIT, ANTICIPATED SAVINGS, BUSINESS VALUE, OPPORTUNITY OR GOODWILL; (ii) LOSS OR DAMAGES RESULTING FROM

**BUSINESS INTERRUPTION; (iii) LOSS OR DAMAGES RESULTING FROM DELAY IN PERFORMANCE AND COST OF SUBSTITUTE PROCUREMENT; (iv) LOSS OR DAMAGES RESULTING FROM REPRODUCTION OR RECOVERY OF DATA OR INFORMATION WHICH IS LOST, CORRUPTED OR DAMAGED IN ANY OTHER MANNER, WHETHER IN WHOLE OR IN PART; (v) ANY INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY OR PURE ECONOMIC LOSSES OR DAMAGES IN ANY WAY ARISING OUT OF OR RELATED TO THE AGREEMENT.**

- 8. LIMITATION OF LIABILITY. JEPPESEN’S ENTIRE LIABILITY IN RELATION TO THE AGREEMENT NOT OTHERWISE LIMITED OR EXCLUDED PURSUANT TO ANY RELEVANT PROVISIONS OF THE AGREEMENT, IS LIMITED TO AN AGGREGATE CAP OF ONE THOUSAND (1000) U.S. Dollars (USD), WHICH END-USER RECOGNIZES AS A REASONABLE LIMITATION OF LIABILITY BASED UPON THE NATURE OF THE DATA PROVIDED UNDER THE AGREEMENT. THE PARTIES ACKNOWLEDGE AND AGREE THAT THEY HAVE FULLY CONSIDERED THE FORGOING ALLOCATION OF RISK AND FIND IT REASONABLE, AND THAT THE FOREGOING LIMITATIONS ARE AN ESSENTIAL BASIS OF THE BARGAIN BETWEEN THE PARTIES.**
9. INDEMNIFICATION. End-User agrees to indemnify and hold harmless Jeppesen and its subcontractors from and against all claims and liabilities (including claims by third parties), and costs and expenses (including attorneys’ fees), incident thereto or incident to successfully establishing the right to indemnification, for injury to or death of any person or persons, including employees of End- User but not employees of Jeppesen, or for loss of or damage to any property, including any aircraft, arising out of or in any way relating to End-User’s utilization of the Data or any other things provided hereunder, whether or not arising in strict liability or tort or occasioned by the negligence of Jeppesen. End-User’s obligations under this indemnity will survive the expiration, termination, completion or cancellation of the Agreement.
10. For purposes of the “Disclaimer and Release”, “Exclusion of Specified Losses and Damages”, “Limitation of Liability”, and “Indemnification” Section, the term “Jeppesen” includes its parent companies (at any tier), its divisions, subsidiaries and affiliates, the assignees of each, and their respective directors, officers, employees and agents.

11. If a 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 in this Section shall apply to the fullest extent permitted by law. If Jeppesen cannot exclude or limit a warranty or liability implied by law, these Additional Terms shall be read and construed subject to such provisions of law.

12. EXPORT COMPLIANCE.

A. End-User is 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 countries. End-User shall not attempt to, or knowingly export or re-export the Data covered under the Agreement to any country, or national thereof, prohibited from obtaining Data, either directly or indirectly through affiliates, or subsidiaries of End-User. Each party shall, at its sole cost and expense, obtain and maintain in effect all permits, licenses and other consents necessary to conduct its respective activities hereunder. Nothing in this clause releases End-User from any obligation stated elsewhere in the Agreement not to disclose the Data.

**B. END-USER ACKNOWLEDGES AND AGREES NOT TO EXPORT OR RE-EXPORT ANY NAVDATA, OR ANYTHING ELSE PROVIDED IN RELATION TO THIS AGREEMENT, IN VIOLATION OF ANY APPLICABLE LAWS AND REGULATIONS. END-USER IS AWARE OF AND AGREES TO COMPLY WITH THE EUROPEAN UNION SANCTIONS AGAINST RUSSIA, INCLUDING WITHOUT LIMITATIONS THE COUNCIL DECISION (CFSP) 2022/327 OF 25 FEBRUARY 2022 AND COUNCIL REGULATION (EU) 2022/328 OF 25 FEBRUARY 2022. SHOULD END-USER BE IN BREACH OF THIS CLAUSE, JEPPESEN MAY TERMINATE ACCESS TO THE NAVDATA AND ANYTHING ELSE ORIGINATING FROM JEPPESEN IN RELATION TO THESE ADDITIONAL TERMS IMMEDIATE EFFECT WITHOUT NOTICE.**

13. GOVERNING LAW. ANY DISPUTE, CONTROVERSY OR CLAIM AGAINST JEPPESEN ARISING OUT OF OR RELATING TO THE DATA, WHETHER UNDER CONTRACT, TORT OR OTHERWISE, AND THESE ADDITIONAL TERMS ARE GOVERNED BY THE LAWS OF THE STATE OF COLORADO, UNITED STATES OF AMERICA, WITHOUT

**RECOURSE TO CHOICE OF LAW STATUTES OR PRINCIPLES THAT WOULD OTHERWISE RESULT IN THE APPLICATION OF THE LAW OF ANY OTHER JURISDICTION TO THIS AGREEMENT.**

14. DISPUTE RESOLUTION. Any dispute, claim or controversy of whatsoever kind or nature arising out of or in any way relating to the Data, whether under contract, tort or otherwise, and these Additional Terms will be prosecuted and resolved exclusively and finally in the state or federal courts located in Denver, Colorado and the parties hereby irrevocably and unconditionally consent to the exclusive in person and jurisdiction of such courts for the purpose of prosecuting and resolving such dispute, claim or controversy. The foregoing will not apply in the event a third party claims any injury, damage or loss against Jeppesen in a court or other proceeding wherein End-User is joined, interpleaded or impleaded by Jeppesen, or End-User is otherwise a necessary or indispensable party to the action or proceeding. Customer waives sovereign immunity and related defenses with respect to these Additional Terms of the Agreement.
- (i) Jury Trial Waiver. Jeppesen and End-User hereby knowingly, voluntarily, intentionally, and irrevocably waive any and all right to trial by jury in any legal proceeding arising out of or relating to this Additional Terms of the Agreement.
15. SEVERABILITY. If any term or provision of these Additional Terms is held invalid or unenforceable, such term or provision will be replaced by a valid and enforceable provision containing as close to the original intent of the parties as possible in light of the intent of this Additional Terms. The remainder of this Additional Terms will not be affected thereby and each remaining term and provision of this Additional Terms will be valid and enforceable to the fullest extent permitted by law.

(This page intentionally left blank)