SANDEL®

ST3453H

HeliTAWS®

Helicopter

Terrain Awareness

Warning System

Installation Manual

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Revision History

Revision	Date	Comments
C	26-APR-2013	Updated for AR 1294 Updated TOC. All references to 1553B have been updated to 1553. Section 1.1: Introduction updated. Section 1.4: Data recording description updated. Section 1.9: Installation Kit P/N added. Section 1.7: Updated for MIL-STD-1553 for Airdata and Radalt. Section 3.1.2: Updated to add overlay data. Windows OS version updated. Section 3.9.1: External switch description updated. Section 4.2: Cooling considerations updated. Section 4.4: AC 43-13 reference updated. Section 4.5: Pin U description updated. Section 5.2: Maintenance menu access instructions updated. Section 5.6 CM Failure information updated. Section 5.7: Fatal System Error message added. Section 6: Maintenance menu access instructions updated. Note added. Section 6.2: Image updated. Table updated. DB/SW conflict message table added. Section 6.3: Table updated. Section 6.4: Table updated. Section 6.6: Table updated. Section 6.11: TCAS Configuration description updated. Table updated. Table added. Section 6.13: Section title updated. Image updated. Table updated. Section 6.16: Image updated. Description updated. Message table added. Section 7.6: Table updated. Section 7.8: Air data test step updated. Section 8: Sensor Compatibility tables updated. ARINC 429 Master Label List updated. Section 10.4: Updated for data/event recording capability. Section 10.7: URL updated.

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A	21-AUG-2012	INITIAL RELEASE

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1 GENERAL INFORMATION

1.1 Introduction

The information contained within this Installation Manual describes the features, functions, technical characteristics, components, approval procedures, installation considerations, setup procedures, checkout procedures and instructions for continued airworthiness for the Sandel Avionics ST3453H Helicopter Terrain Awareness Warning System. For an explanation of the operating controls and operational details of the ST3453H, refer to the Pilot's Guide for the ST3453H, Sandel Avionics P/N 82050-PG.

The ST3453H has FAA TSO authorization and has been tested to RTCA DO-160F and MIL-STD-810G environmental standards.

Sandel Avionics ST3453H HTAWS may be covered by one or more U.S. and foreign patents and pending patent applications, including U.S. Patent Nos. 6,259,378, 6,489,916, 6,507,288, 6,591,170, 6,670,892, 6,683,556, 6,780,788, 6,889,124, 6,972,695, 6,999,023, 7,057,549, 7,187,304 and foreign counterparts.

1.2 LIMITATIONS

The following stipulation as presented is required by the Federal Aviation Administration for articles approved under Technical Standard Order. This statement does not preclude multiple installation and operational approvals in regard to specific aircraft make, model, or type:

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only according to 14 CFR Part 43 or applicable airworthiness requirements.

1.3 Radalt Indicator Replacement

The ST3453H Radalt function is provided to allow the ST3453H to replace an existing Radar Altitude display. Both the current Radar altitude and the selected Minimums alerting altitude are displayed in digital format.

If a Radar altimeter is not installed in the helicopter or is installed but display of the Radar Altimeter is not enabled, the Radar Altitude will not be displayed on the screen. The MINS display will be present (if display of the Radar altimeter is enabled) and may be used by the pilot as a reference.

1.4 Equipment Description

The Sandel ST3453H is a self-contained HTAWS (Terrain Awareness Warning System) solution specifically for helicopters that includes an advanced HTAWS computer and an integrated full-color screen built within a standard 3-inch instrument chassis.

The ST3453H uses Sandel's patented rear-projection display technology. The projector uses a miniature active-matrix LCD display that produces a high-resolution image that is rear-projected directly to the face of the instrument. This technology allows the displayed image to extend to the edges of the instrument's bezel. The advantage of this edge-to-edge technology is that it eliminates the unusable area surrounding conventional LCD and CRT displays. Even though the Sandel display is in a 3-inch form factor, its image is near the size of a 4" primary display, and can remain directly in the pilot's field-of-view.

It can be used as a direct replacement for a currently installed Radar altimeter indicator. It includes a MINS setter, MINS discrete output, and a Radalt Test discrete output. In some configurations, the ST3453H may not display a MINS setting window, Radalt display, and may not provide a MINS discrete output or Radalt Test discrete output.

The ST3453H includes built-in warning and caution annunciation. The unit also supports optional external warning or caution annunciation as well as optional collective mounted momentary switches to control certain functions such as alert muting and modes.

The ST3453H may be installed in a single or dual installation.

The ST3453H has an internal data and event recorder that automatically records up to 100 record files (total maximum = 100MB) of flight data and events. This data can be reviewed for content in the event of a system malfunction.

1.4.1 Features

HeliTAWS is the enhanced terrain warning technology for helicopters that uses GPS position along with databases of terrain and obstacles to reduce or eliminate CFIT accidents. It is similar to the Sandel ST3400 fixed-wing TAWS, with feature enhancements specific to helicopter operations close to the ground.

- Increased vertical accuracy
- Separate obstacle database
- On-screen obstacle display
- 3 arc-second terrain data
- Provision for user-defined obstacles and landing zones

The following 5 standard GPWS functional modes (modified for helicopter) are provided for when equipped with supported Radar altimeter and airdata computer:

- ERD (excessive rate of descent)
- ALAT (altitude loss after takeoff)
- FITNL (flight into terrain when not in landing configuration)
- EDGSD (excessive downward glide slope deviation).
- 300 feet and below Voice Callouts

1.4.2 FAA HTAWS Requirement

The ST3453H exceeds the FAA requirements for HTAWS alerting, annunciation, and display for installation in Part 27 and Part 29 helicopters

1.5 Databases

1.5.1 Coverage area

The internal Terrain and Obstacle databases include terrain, charted man-made obstacles, airports, and heliports.

The Terrain and Airport databases are provided by geographical area. The coverage area of the database installed in the ST3453H is shown as part of the sign-on screen after a power cycle.

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.

1.5.2 Keeping the databases current

Updated databases can be loaded into the equipment using a Sandel supplied Windows loader program, USB cable and a laptop computer. This is done through a high-speed USB port located on the front right corner.

The databases can be updated during normal maintenance to the helicopter.

1.6 Technical Specifications

The following section describes the technical characteristics, which include the appliance approval basis, physical and electrical properties, electrical connector pin allocation which details function and gradient or equipment protocol, and MIL1553 and ARINC label support. Also included is the description of the ST3453H installation components, other equipment and installation requirements. A review of the installation approval procedures is provided for filing with authorities.

1.6.1 Approval Data

Technical Standard Orders:	TSO-C87 Airborne Low-Range Radio Altimeter
	TSO-C113 Airborne Multipurpose Electronic Display
	TSO-C118 Traffic Alert and Collision Avoidance System (TCAS-I)
	TSO-C194 Helicopter Terrain Awareness and Warning System (HTAWS)
Non-TSO Functions:	NVIS Mode
	TOPO Display
	Selective Muting
	Flight Plan Display
	Airport Display
	Helicopter GPWS
	Data Recording
	WireWatch®
Software Certification:	DO-178B Level C
Environmental:	DO-160F / MIL-STD-810G
Databases:	DO-200A

1.6.2 Physical Dimensions

The ST3453H is enclosed in an ARINC 408, 3ATI form factor enclosure and is mounted to an instrument panel.

Form Factor:	3ATI (ARINC 408)
Width:	3.175 inches
Height:	3.175 inches
Length:	7.8 inches
ST3453H Weight:	3.0 lbs
Config Module Weight:	0.06 lbs

Connector Weight:	0.12 lbs
Mounting:	3 ATI Clamp
Display:	200dpi

1.6.3 Operational Characteristics

Temperature/Altitude:	-40° C to +55° C / up to 55,000 feet including display. CPU and alerting system temperature range operational to -40° C
Power Input:	28VDC nominal, 1.0A nominal at 100% brightness. Operating range 22VDC – 33VDC
Cooling Requirements:	None

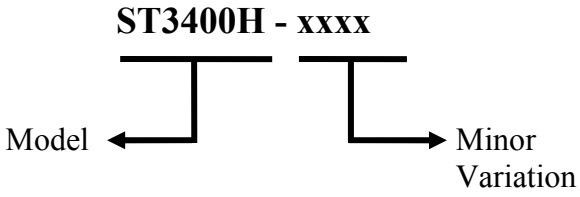
1.7 Interface Characteristics

The ST3453H is software configurable and configuration data is stored internally and in an airframe-resident configuration module.

Configuration Module:	Rear mounted MS38999 type 6 pin connector
Data Loading:	Front panel USB
GPS Position:	MIL-STD-1553
GPS Flight plan:	MIL-STD-1553 (Optional - Must be GAMA compliant)
Air Data:	MIL-STD-1553, ARINC 429, or Analog
Heading:	MIL-STD-1553, ARINC 429 or ARINC 407 (XYZ)
Gear:	Discrete: active high or low
Glideslope:	MIL-STD-1553, ARINC 429 or low-level deviation and flag
Localizer:	MIL-STD-1553, ARINC 429 or low-level deviation and flag
Audio Output:	500 ohm, 125mw
External Annunciators:	Open/GND (Open Drain) GND=Active 250ma maximum (installation optional)
External Switches:	Momentary action, Open/GND GND to activate (installation optional)
Radar Altimeter:	MIL-STD-1553, ARINC 429, or Analog
Traffic:	ARINC 429, RS232, RS422

1.8 System Part Number

The ST3453H HeliTAWS is part of the ST3400H HeliTAWS family. The part number for the Sandel HeliTAWS is comprised of two parts: The basic FAA model designation "ST3400H" and a dash number, ST3400H-xxxx. The dash number designates minor product variations, bezel color and/or NVIS support. The ST3453H is part of the -900 series.



- ST3400H-900N, ST3453H, Gray Bezel with NVIS support
- ST3400H-901N, ST3453H, Black Bezel with NVIS support

1.9 Installation Kit Part Number 90263-IK

Qty	Sandel P/N	Description
1	32116	CONN, PLUG, 38999 Series III, 25-61 Crimp Socket,
1	32117	CONN, BACKSHELL, Straight, D38999 Type III, Size 25
1	61062	3ATI Clamp
1	61044-A	HW, SHIM, FLUSH MTG

1.10 Configuration Module P/N

Varies by customer.

1.11 License Requirements

None.

1.12 Installation and Operational Approval Procedures - Commercial

The Environmental Qualification Form for the ST3453H included in section 9 of this Installation Manual should be referenced to the categories appropriate to the aircraft type and environment into which the ST3453H is to be installed. For commercial installations the environmental category for the ST3453H should be stipulated on the STC form.

A "Functional Ground Test Procedures/Report" included in section 7 of this manual should be used as a basis for validating the ST3453H equipment configuration and to verify proper installation and functional performance. A permanent copy of the STC form must be filed and

maintained by the installing agency. Another copy must be presented to the aircraft owner for entry into the aircraft maintenance records, as well as a copy forwarded to Sandel Avionics along with the Warranty Registration Form, to be filed after completion and installation acceptance.

If any difficulty is experienced with the functionality or operational performance of the ST3453H, contact Sandel for assistance.

2 INSTALLATION PLANNING

The ST3453H has been designed to ensure maximum interoperability with external avionics. Contact Sandel with any questions about interfacing to specific avionics equipment not covered in the installation drawings in this manual.

2.1 General Information

To simplify installation, after signals are wired to the ST3453H pins, on-screen setups are used in a post-installation procedure. Maintenance menu pages provide a function selection capability. For most equipment, selections are made by equipment make and model.

Refer to the installation schematics in section 11 of this manual for details on connecting required components.

2.2 Supported Sensor Configurations

2.2.1 Required Sensors

- GPS position
- Gear (only if the helicopter has retractable gear).
- Heading Display: Provides no-track terrain display
- Radar Altitude GPWS: Provides callouts;

2.2.2 Optional Sensors

- GPS Flight plan Display: displays flight plan line
- Airdata GPWS: improves accuracy of certain modes
- LOC/GS GPWS: adds Glideslope alert

2.3 Pre-installation Planning

The installation planning cycle is summarized as follows:

- Compile an equipment list for the helicopter. If the desired equipment is not listed in the installation manual diagrams, contact Sandel for interoperability
- Review the installation considerations given in the Installation Considerations section of this manual.
- Study the installation drawings to determine a basic interconnect scheme and check for conflicts.
- Develop the specific wiring diagrams unique to the aircraft.
- Assemble required tools.

2.4 Post Installation Procedures

Post installation procedures are summarized as follows:

- Prior to power-up, review correct wiring by using industry accepted ohmmeter and voltage checks. Pay particular attention to presence of +28V on only the correct pins; 0

ohm resistance check on ground pins to airframe ground; and presence of inverter 400Hz (if used) only on the appropriate pins.

- Review any special items particular to the subject helicopter installation.
- Power up the ST3453H in maintenance mode and sequentially access each maintenance page to select the installed equipment. In some cases, the ability to edit fields will be locked by the configuration module.
- Allow the unit to operate for 30 minutes.
- Perform Ground Test procedures.
- Perform Flight Test procedures if required.

3 INTERFACE FUNCTIONS

3.1 Power

The primary power is 28 volt dc on J1-P and is supplied from the aircraft avionics buss through a circuit breaker. Ground is provided on J1-R and should be attached to an approved airframe ground.

A 26 volt 400Hz excitation input is available at J1 - W. It is only used in the case of an XYZ heading source. If the installation of the ST3453H does not use an XYZ (ARINC407) signal source, the inverter input is not required and should be grounded.

3.2 GPS/FMS/INS

A position input is required. The port is configurable in the Maintenance Menu pages for MIL-STD-1553. A list of supported labels is listed in section 8.8 .

3.3 Heading System

A Heading input permits the terrain display to remain operational during hover operations. It is highly recommended. The port is configurable on the maintenance page for MIL-STD-1553, ARINC 429, or ARINC 407 (XYZ).

3.4 Radar Altimeter

The ST3453H has provisions for a Radar Altimeter input. Radar Altimeter input may be from MIL-STD-1553, ARINC 429 or DC analog sources. The Radar Altimeter input is used to obtain height above terrain for GPWS alerting and for altitude callouts.

The Radar Altimeter always produces a single ‘300’ or ‘100’ mandatory audio callout, depending on NORM/LOW sensitivity selected by the pilot. Optionally the installer may enable any or all of the following additional audio callouts:

300’, 200’, 100’, 50’, 40’, 30’, 20’, 10’

These callouts are a great safety feature and their use is encouraged.

When the Radar Altimeter is lower than the MINS setting a MINS discrete output is activated and an audio callout “MINIMUMS” occurs.

When the Radar Altimeter is not configured, the MINS setting may be retained on the display for use as a visual reference by the pilot. The MINS discrete and callout will be disabled.

The MINS setting knob on the front panel has a push button function. This operates the momentary discrete on J1-MM, RADALT TEST if enabled.

3.5 Glideslope

This input provides the GPWS mode-5 glideslope alert. MIL-STD-1553, ARINC 429 or low level analog inputs for Glideslope deviation, Glideslope flag status, and Localizer and Localizer Flag are provided.

An additional discrete input is available for Back Course from the HSI, which acts to disable Glideslope alerting while on a Back Course approach.

3.6 Air Data Computer

Airdata input is recommended. MIL-STD-1553, ARINC 429, and analog pressure altitude are supported.

3.7 Traffic

The ST3453H supports Traffic input via single ARINC 429 input. Traffic data is overlaid on terrain.

Some traffic processors require remote switches. See Traffic interface drawings in this manual for these requirements.

3.8 Landing Gear

The ST3453H has provisions on J1-FF for Gear Down input discrete to indicate that the gear is in the "DOWN" position for helicopters equipped with retractable landing gear.

The configuration is performed in the Maintenance Menu pages given in the Setup Procedures section of this manual. If the system is installed in a helicopter without retractable landing gear, select "NONE" on maintenance page configuration item.

3.9 External Switches and Annunciators

All external switches and annunciators are optional.

External switches are momentary contact OPEN/GND, normally open.

External annunciators, if used, must be properly labeled and colored.

Discrete outputs are OPEN/GND and capable of sinking a maximum of 250 milliamps to ground when active. They can drive incandescent lamps and/or relays. Dimming of external annunciators is accomplished by sourcing the annunciators from the helicopter day/night bus.

3.9.1 External Switch + Annunciator Functions

These switch/annunciator functions are available:

- GS Inh
- Mute Note: HOLD invokes TAWS INH function
- Sensitivity Note: HOLD invokes OFF APT function

The external switches perform the same functions as their related front panel switches. If power to the unit drops below 20VDC, external switch functions will be inoperative.

3.9.2 External Annunciator-Only Functions

These annunciator discrete outputs are available:

- Caution Alert
- Warning Alert
- TAWS Inhibit

3.9.3 External Control Discrete Outputs

These control outputs are available:

- Radalt Test
- TCAS Inhibit

3.9.4 Annunciator Default Functions

ANNUNCIATORS		
Marking	**Color**	**Description**
G/S INH	YELLOW	Same function as on-screen G/S INH annunciation.
MUTE	YELLOW	Same function as on-screen MUTE annunciation.
SENS	WHITE OR CYAN	Alert sensitivity is LOW SENSE.
TAWS	YELLOW	Same as on-screen TAWS Yellow Caution.
TAWS	RED	Same as on-screen TAWS Red Warning.
TAWS INH	YELLOW	TAWS INH function has been enabled or one or more alerts have been disabled due to a fault.

CONTROL OUTPUTS	
Signal	**Description**
RADALT TEST	GND when the RA TEST pushbutton has been activated (if enabled).
TCAS INH	GND when either CAUT or WARN are active. Used to mute the TCAS audio.

3.10 NVIS Control

The NVIS CTRL discrete is an OPEN/GND input which controls the NVIS mode and is intended to be connected to a sustained toggle or sustained pushbutton switch. In the default configuration GND=NVIS ON and OPEN=NVIS OFF. In this configuration a wire break to the switch would result in NVIS OFF.

The input configuration can be changed by the installer in the SYSTEM maintenance page to reverse the logic so that GND=NVIS OFF and OPEN=NVIS ON. In this configuration a wire break to the switch would result in NVIS ON.

3.11 Audio Output

The audio output produces all advisories and alerts which utilize audio.

A headphone output is provided. Connection to this output is required.

The headphone output, if used, must connect to the un-switched input of the helicopter audio system. A volume level trim adjustment is present on the AUDIO maintenance page.

3.12 Uploading Equipment

A USB interface is available on the front of the ST3453H to upload system software, terrain data, obstacle data, airport data, overlay data, and configuration data into memory and to download configuration data from memory.

Data is loaded from a PC or laptop computer with Microsoft Windows XP (or later) operating system software to the ST3453H. Drivers, the loader program, and loading instructions are supplied with the applicable software or data.

3.13 Display Dimming

The ST3453H screen dimmer is controlled from the front panel knob using the PULL position.

External annunciator dimming may be accomplished using the existing aircraft day/night buss by connecting the high-side of the annunciator lamps day/night buss.

4 INSTALLATION

The ST3453H should be installed in accordance with standards established by the customer's installing agency, and existing conditions as to unit location and type of installation.

4.1 Unpacking and Inspecting Equipment

Exercise extreme care when unpacking the equipment. Make a visual inspection of the unit for evidence of damage incurred during shipment. If a claim for damage is made, save the shipping container to substantiate the claim. The claim should be promptly filed with the carrier. It would be advisable to retain the container and packaging material after all equipment has been removed in the event that equipment storage or reshipment should become necessary.

4.2 Cooling Considerations

Cooling should be verified in the post-installation checkout by monitoring the temperature on the POWER maintenance page. For additional cooling or special requirements, air from an external avionics blower may be directed towards the unit.

In helicopter installations, it may be desirable to introduce a small amount of cooled (air conditioned) air into the avionics bay if it is completely sealed. In these installations it is not uncommon for the internal ambient temperature of the avionics bay to exceed the ratings of the equipment if cooling air is not supplied. In the unit gets too hot, the display will dim automatically.

4.3 Mechanical Installation Considerations

4.3.1 Instrument Location in the Cockpit

The Sandel ST3453H is a direct replacement for a currently installed 3ATI Radar altimeter indicator. Installation should conform to customer requirements and airworthiness standards affecting the location and type of installation.

4.3.2 Assembly and Mounting Instructions

Refer to the ST3453H Installation Diagrams for specific assembly and mounting instructions and appropriate notes.

4.4 Electrical Installation Considerations

The installing agency fabricates and supplies all wiring harnesses. Refer to the ST3453H Interconnect Wiring Diagrams for detailed wiring information and appropriate notes.

- Refer to the Functional Pinout Descriptions for explanations of pin functions.
- The length and routing of wires must be carefully planned before starting the installation.
- Avoid sharp bends in the harness.
- Do not locate the harness near aircraft controls.
- Observe all recommended wire sizes and types and subscribe to appropriate FAR Parts 23, 25, 27, and 29, as well as AC 43.13-1(B) and –2(B).
- MIL-C27500 shielded wire and MIL-W-22759 single conductor wire is recommended. The use of ferrules or grounding blocks for signal ground and digital ground returns is satisfactory; however, each ground return must be electrically separated.
- In order to ensure optimum performance, the ST3453H and associated wiring must be kept a minimum of three feet from high noise sources and not routed with cables from high power sources.
- Prior to installation, verify proper wiring by completing a point-to-point continuity check of the wiring harness.
- Use the Functional Pinout Descriptions to determine installation requirements.

Ground Bonding. In order to assure installation characteristics match the DO-160 RF and Lightning test conditions, ensure that two ground wires of at least the recommended size are installed in accordance with the installation drawings and these wires are connected to a bonded aircraft ground.

Power Wiring. To assure that the ST3453H will operate properly down to its rated minimum input voltage, ensure that power wires of at least the recommended size are connected in accordance with the installation drawings.

4.5 Connector P1

For electrical characteristics, see the table in section 4.7 by referencing the signal type indicated in *italics*. Signal types enclosed in parentheses indicate functionality that is reserved.

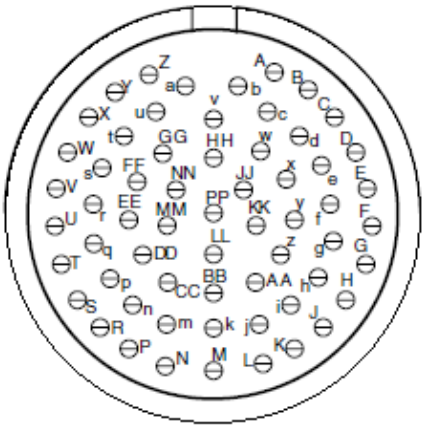
PIN #	Name	Signal Type (dependent on system configuration)	
A	**Radalt Fail In**	In *Discrete*	For Analog Radalt >9VDC nom = Radalt Valid
B	**NVIS Ctrl**	In *Discrete*	Only used when external NVIS switch used OPEN/GND. GND turns NVIS off
C	**1553 Bus A Negative**	In	Primary 1553 Data, B
D	**1553 Bus A Positive**	In	Primary 1553 Data, A
E	**1553 Bus B Negative**	In	Secondary 1553 Data, B
F	**1553 Bus B Positive**	In	Secondary 1553 Data, A
G	**Mute Switch In**	In *Discrete*	 *OPEN/GND Momentary Switch*
H	**GS INH Switch In**	In *Discrete*	 OPEN/GND Momentary Switch
J	**Air Data Valid**	In *Discrete*	For analog airdata Programmable OPEN/GND or OPEN/+28
K	**Vert LL Dev In** **+FLY UP**	In *Vert LL Dev* *(A407)*	For analog GS deviation DC+ Polarity: + indicates above glideslope, fly-down indication. Synchro X [Z grounded]
L	**Vert LL Dev In** **–FLY_UP**	In *Vert LL Dev* *(A407)*	For analog GS deviation DC- Polarity: + indicates below glideslope, fly-up indication Synchro Y [Z grounded]
M	**Vert LL Flag In+**	In *Vert LL Flag* *(A407)*	For analog GS flag DC+ Note: For use with external SUPERFLAG requires resistor Synchro X [Z grounded]
N	**Vert LL Flag In-**	In *Vert LL Flag* *(A407)*	For analog GS flag DC- Synchro Y [Z grounded]
P	**Aircraft Power**	In	Aircraft Power
R	**Aircraft Pwr Ground**	In	System Ground
S	**Lat LL Dev In** **+Right**	In *Lat LL Dev* *(A429)* *A429* *(R422)*	For analog localizer DC+ Polarity: + indicates left deviation; fly-right Also used as Nav A side 429 RADALT B High side 429 + side 422

PIN #	Name	Signal Type (dependent on system configuration)	
T	**Lat LL Dev In -Right**	In	For analog localizer
		Lat LL Dev	DC- Polarity: + indicates right deviation; flight left
		(A429)	Also used as Nav B side 429
		A429	RADALT B Low side 429
		(R422)	- side 422
U	**Lat LL Flag In+**	In	For analog localizer
		Lat LL Flag	DC+
			Note: For use with external SUPERFLAG requires resistor
		(A429)	A side 429
		A429	HDG B High side 429
		(R422)	+ side 422
V	**Lat LL Flag In-**	In	For analog localizer
		Lat LL Flag	DC-
		(429)	B side 429
		A429	HDG B Low side 429
		(R422)	- side 422
W	**Inverter Exc.**	In	Used when synchro heading is used
		Inverter	26Vac Hdg Excitation (optional)
X	**Hdg A**	In	
		*A429 **	A side 429
		A407	Synchro X [Z grounded]
		(R422)	+ side 422
		(R232)	Ground side
Y	**Hdg B**	In	
		*A429 **	B side 429
		A407	Synchro Y [Z grounded]
		(R422)	- side 422
		(R232)	Rx
Z	**Hdg Valid**	In	
		Discrete Valid	Programmable OPEN/GND or OPEN/+28 Note: Not used when 429 is data source.
a	**Radalt A**	In	For analog Radalt
		*A429***	A side 429
		Radalt	Analog DC+ [ALT 50/55, ARINC 552, RT220/300, RT200]
		*(R422**)*	+ side 422
		*(R232**)*	Ground side
b	**Radalt B**	In	For analog Radalt
		*A429***	B side 429
		Radalt	Analog DC- [ALT 50/55, ARINC 552, RT220/300, RT200]
		*(R422**)*	- side 422
		*(R232**)*	Rx

PIN #	Name	Signal Type (dependent on system configuration)	
c	**Radalt Valid**	In *Discrete Valid*	For analog Radalt Programmable OPEN/GND or OPEN/+28 Note: Not used when 1553/429 is data source
d	**TCAS A**	In *A429** *(R422*)* *(R232)* *Radalt Hi Res*	 A side 429 + side 422 Ground side Analog DC+
e	**Pri 1553 Gnd**	Case ground. Can be used as shield ground.	
f	**Sec 1553 Gnd**	Case ground. Can be used as shield ground.	
g	**TCAS B**	In *A429 ** *(R422*)* *(R232)* *Radalt Hi Res*	 B side 429 + side 422 Ground side Analog DC-
h	**Airdata A**	In *A429** *(R422*)* *(R232)* *(Ana)*	 A side 429 + side 422 Ground side DC+
i	**Airdata B**	In *A429** *(R422*)* *(R232)* *(Ana)*	 B side 429 - side 422 Rx DC-
j	**RS422+ Out** **Spare**	Out RS422	 +
k	**RS422- Out** **Spare**	Out RS422	 -
m	**Reserved**	Do not connect. Reserved for factory use.	
n	**Reserved**	Do not connect. Reserved for factory use.	
p	**Reserved**	Do not connect. Reserved for factory use.	
q	**Reserved**	Do not connect. Reserved for factory use.	
r	**Reserved**	Do not connect. Reserved for factory use.	
s	**Inverter Gnd**		
t	**Headphone Audio Out**	Out *500 Ohm Headphone Output*	
u	**429-1 Out A**	Out *A429*	 A Side - Alert output to FDR - High Speed (100Kbps)

PIN #	Name	Signal Type (dependent on system configuration)
v	**429-1 Out B**	Out *A429* B Side - Alert output to FDR - High Speed (100Kbps)
w	**429-2 Out A**	Out *A429* A side 429
x	**429-2 Out B**	Out *A429* B side 429
y	**Selectable Discrete*** **TCAS Inhibit (default)** **GPWS Fail Annunciator**	Out *Open Drain*
z	**Selectable Discrete*** **Mute Annunciator (default)** **Radalt Test**	Out *Open Drain*
AA	**Selectable Discrete*** **Caution Annunciator (default)** **TCAS Test Mode**	Out *Open Drain*
BB	**Selectable Discrete*** **Warning Annunciator (default)** **TCAS Operate Mode**	Out *Open Drain*
CC	**Selectable Discrete*** **TAWS INH Annunciator (default)** **Radalt MINS Annunciator**	Out *Open Drain*
DD	**Selectable Discrete*** **Glideslope INH Annunciator (default)** **TCAS Inhibit**	Out *(Open Drain)*
EE	**Audio Output Common**	*Audio Ground (Chassis)*
FF	**Gear In**	In *Discrete* Programmable OPEN/GND or OPEN/+28
GG	**BC In**	In *Discrete* Programmable OPEN/GND or OPEN/+28
HH	**Spare Sw Discr**	In *Discrete* OPEN/GND

PIN #	Name	Signal Type (dependent on system configuration)
JJ	**Sensitivity Switch In**	In *Discrete* *OPEN/GND Momentary Switch*
KK	**RS232TxD**	Out Spare *RS232*
LL	**Spare Discrete 1**	In n/c *Discrete* Programmable OPEN/GND or OPEN/+28
MM	**Selectable Discrete*** **Radalt Test (default)** **TCAS Test Mode**	Out *Open Drain*
NN	**Selectable Discrete*** **Reduced Sensitivity Annunciator (default)** **TCAS Altitude Mode**	Out *Open Drain*
PP	**Chassis Gnd**	



Outside View (Mating Connector)

Note: Selectable discrete outputs sink 50ua of current when off. If used as TCAS Inhibit to a TCAS processor, this connection may require an external 30k-50k pull-up resistor in order for the discrete input of the TCAS to be at the proper 'high' (unasserted) voltage. If necessary, check with a voltmeter during installation.

4.6 Configuration Module Connector

Accepts ST3453H Configuration Module.

The configuration module holds all installation data and is custom programmed specific to the aircraft. If the ST3453H is swapped, the airframe resident configuration module must be reconnected and will automatically reconfigure the new unit to the original aircraft configuration. The ST3453H will not operate without a configuration module connected.

4.7 Electrical Characteristics by Signal Type

Inputs

Signal Type	Nom Range	Absolute Max	Z (Ω – Power Off)
1553	18-27Vac	27Vac	≥ 100K
A429	+/- 5Vdc	5.5Vdc	>100K
A429*	+/- 5Vdc	14Vdc	>100K
A429**	+/- 5Vdc	33Vdc	>100K
RS232	+/- 10Vdc	14Vdc	>100K
RS232**	+/- 10Vdc	33Vdc	>100K
RS422	+/- 5Vdc	5.5Vdc	>100K
RS422*	+/- 5Vdc	14Vdc	>100K
RS422**	+/- 5Vdc	33Vdc	>100K
A407 (AC Synchro)	11.8Vac rms +/- 20%	14Vdc	>100K
Discrete Valid (High)	>14.0Vdc[Note 4]	33Vdc	>500K
Discrete Valid (Low)	<3.5Vdc [Note 4]	33Vdc	>500K
Discrete (High)	>1.2Vdc	33Vdc	50K
Discrete (Low)	<8Vdc	33Vdc	50K
Vert LL Dev	+/- 225mv FS	14Vdc	>300K[Note 2]
Lat LL Dev	+/- 225mv FS	5.5Vdc	>300K[Note 2]
Vert LL Flag	Unflagged > 225mv	14Vdc	>300K[Note 2]
Lat LL Flag	Unflagged > 225mv	5.5Vdc	>300K[Note 2]
Inverter	26Vac rms 400Hz nom 320Hz-480 Hz limits	42Vac	>50K
Power	+22 to +30.3Vdc[Note 1]	7Adc	NA
Radalt	+/- 30Vdc	33Vdc	>100K
Radalt Hi Res	+/- 10Vdc	14Vdc	>100K
Ana	+/- 13Vdc	14Vdc	>100K

Outputs

Signal Type	Nom Range	Absolute[Note 3] Max	Load (Ω)
A429	+/- 5Vdc	70mAdc	2K (Minimum)
RS232	+/- 5Vdc	70mAdc	500 (Minimum)
RS422	+/- 5Vdc	70mAdc	500 (Minimum)
Headphone Output	125mw	250mw	>500
Open Drain	1Ω or High Impedance (over current protected)	250mAdc	>350K

Notes:

1. At +28Vdc, nominal current is 1.25Adc +/- 10%, 1 minute after start up.

2. Power On Load = 60.4K. For Vert/Lat Deviation there may need to be a 1K load somewhere else in the system to meet the receiver load requirements. Check installation instructions for the interfaced receiver.
3. Outputs are protected against shorts to ground. Shorts to power supply may cause damage to components.
4. Discrete inputs actively pulled to 27.5v through 30k ohms when selected 'active low' or actively pulled to 0v through 30k ohms when selected 'active high' in the maintenance pages. This ensures the input is in the 'inactive' state if an external connection fails. If interfacing to discrete signals which do not supply a "hard" 0Vdc/27.5Vdc transition, any input network may be used that ensures that the discrete input pin is not within 1.0v from its nominal threshold shown in the table either in the active or inactive state.
5. All discrete outputs sink 50ua current when off.

5 SETUP PROCEDURES

5.1 General

Setup procedures for the ST3453H are described along with the Maintenance menu below. The Maintenance Menu is accessed and addressed through the use of pushbuttons and the BRT/MINs knob. No external connector programming is required.

5.2 Accessing Maintenance Menus

To access the Maintenance Menus perform the following operations:

- Prior to applying power to the ST3453H, depress and hold the [MUTE] and [SENS] pushbuttons, then apply power to the unit. Continue to hold until the first maintenance menu appears – this may take approximately 60 seconds.
- Once the Maintenance Menu is entered, press the [NEXT] or [PREV] soft-keys to cycle the MAINTENANCE MENU pages. To jump to a specific page, from the INDEX page, press the [UP] or [DOWN] soft-keys or rotate the BRT/MINS knob to move the cursor. Press the [SELECT] soft-key to jump to that page. On some menus additional soft-key legends will appear as prompts.
- Escape the maintenance menus by pressing and holding the "M" button. This will allow normal operation of the unit to test the effects of the settings. Re-enter the maintenance pages by pressing and holding the "M" button.

To disable the maintenance menu operation, power down and restart normally. All configured items are stored in non-volatile memory.

5.3 Locked Items

Items may be custom programmed from the factory and therefore are locked. Locked items on the maintenance pages are not editable. These locked items appear in gray text.

5.4 Equipment/Configuration Selections

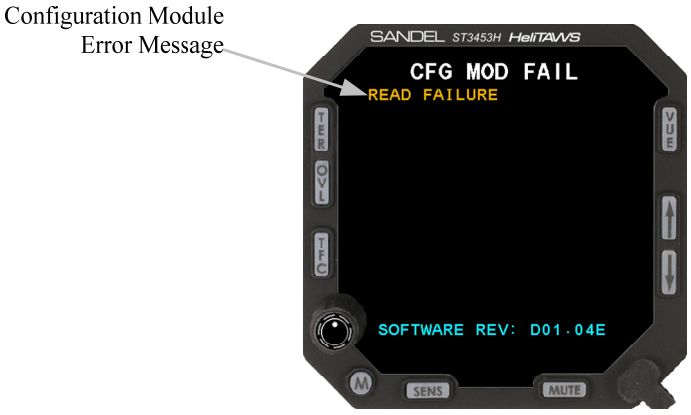
The choices of compatible equipment contained in the ST3453H menus are listed in section 6. For types not listed, consult the factory.

5.5 Configuration Module

The Configuration Module (CM) stores installation configurations. The physical Configuration Module is directly mounted to the rear of the instrument. A configuration module is required and must be used when installing a new ST3453H or replacing an existing ST3453H.

5.6 Configuration Module Failure

If a configuration module error occurs, the CM MOD FAIL screen will appear and will display one or more failure indications in yellow text.

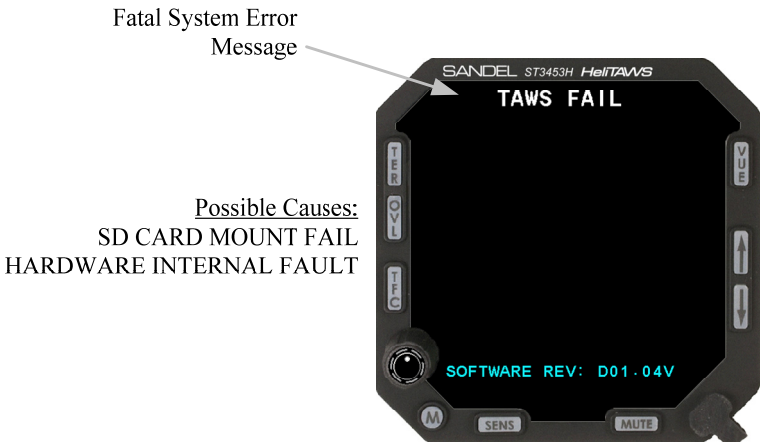


The user cannot exit this screen. If this screen appears, the unit is non-operational and must be serviced.

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

5.7 Fatal System Error

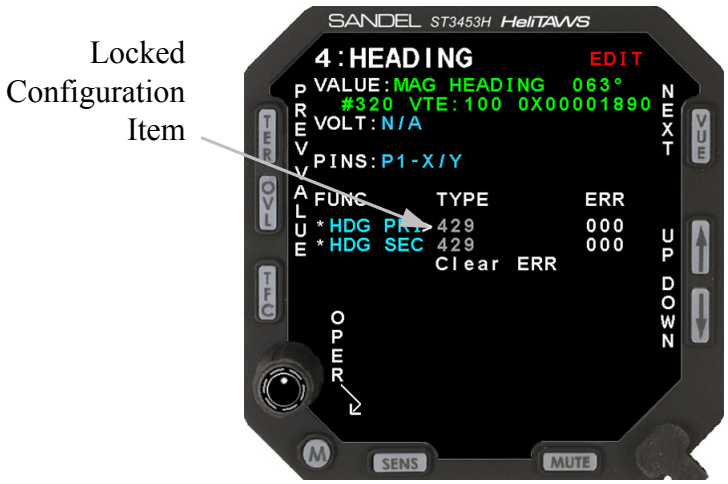
If the ST3453H displays a fatal system error message screen, the unit must be restarted. This message will occur only during startup and may be caused by one of the reasons listed below. If the message persists, the unit should not be used. Report the message and accompanying cause (if displayed) to maintenance.



6 POST INSTALLATION PROCEDURES

After all wiring has been verified and the ST3453H has been installed into the panel, the maintenance pages must be accessed to properly configure the ST3453H for the installed equipment. Prior to applying power to the ST3453H, press and hold the [MUTE] and [SENS] buttons, and then apply power to the unit. Continue to press the buttons until the first maintenance menu appears – this may take approximately 60 seconds.

Depending on the configuration module P/N, maintenance items may be locked (i.e. preconfigured source selection). Configuration items that are locked will appear in gray text and soft keys used for editing or setting the configuration item will be removed from the display.

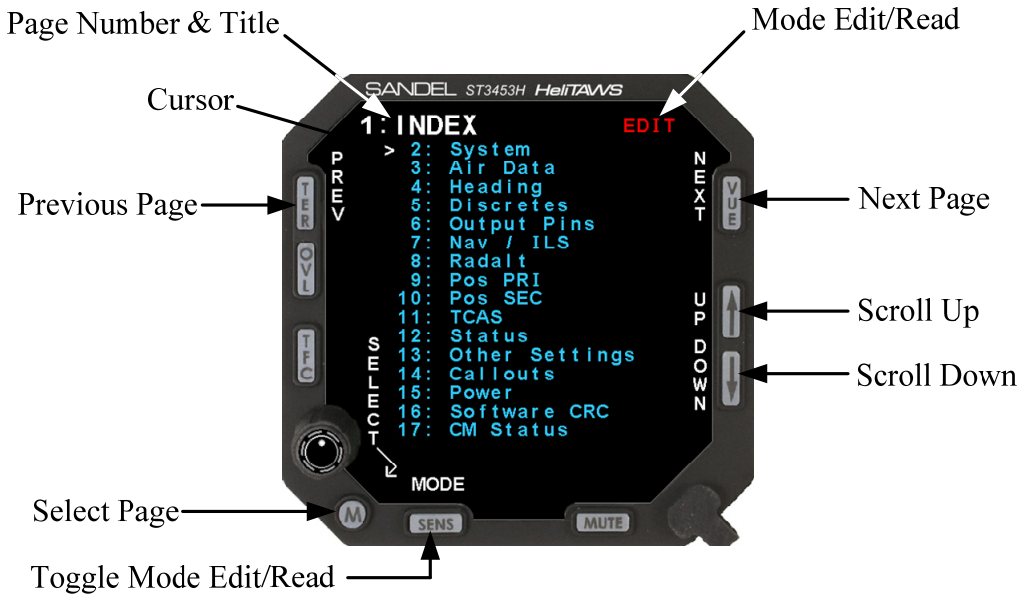


Once the Maintenance Menu is entered, press the [NEXT] or [PREV] soft-keys to cycle the MAINTENANCE MENU pages. To jump to a specific page, from the INDEX page, press the [UP] or [DOWN] soft-key or rotate the knob to move the cursor. Press the [SELECT] soft-key to jump to that page. On some menus additional soft-key legends will appear as prompts.

Escape the maintenance menus by pressing and holding the “M” button. This will allow normal operation of the unit to test the effects of the settings. Re-enter the maintenance pages by pressing and holding the “M” button.

To disable the maintenance menu operation, power down and restart normally. All configured items are stored in non-volatile memory.

NOTE: Maintenance page depictions shown in the following pages of section 6 are representative of the actual maintenance pages. Because of the presence or absence of equipment installed in your aircraft or the CM configuration specified at the time of your purchase, the maintenance pages in your ST3453H may be configured differently.



The Maintenance Page Number/Title is displayed on every maintenance page showing the maintenance page number and title.

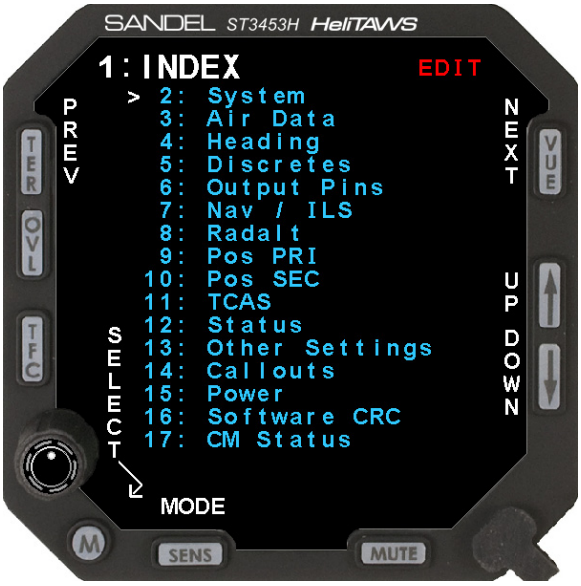
The Cursor points to the item, which may be modified or selected. If there are no selectable items on the currently displayed maintenance page, the Current Line Indicator is not displayed.

- The [UP] and [DOWN] soft-keys are used to move the through the list.
- The soft-keys are labeled to convey the context sensitive function of each button as required.

COMMON Maintenance Page Soft-Keys	
Name	**Description**
PREV	Returns to the prior maintenance page. When the first maintenance page is being displayed, moves to the last maintenance page.
NEXT	Advances to the next maintenance page. When the last maintenance page is being displayed, then moves to the first maintenance page.
SELECT	From the index page, jump directly to the indicated page.
OPER	From a maintenance page, When pressed once, will jump to the Maintenance Index page. When pressed and held in, will transition into the Flight Operation display.
MAINT	From a flight operations, return to the Maintenance Index page. The Cursor will point to the maintenance page listing that was displayed prior to transitioning to the Flight Operation display.
UP	Moves the Cursor to the previous (up) selectable item. Hold key down to automatically repeat. When there are no selectable items, the key is disabled.
DOWN	Moves the Cursor to the next (down) selectable item. Hold key down to automatically repeat. When there are no selectable items, the key is disabled.

COMMON Maintenance Page Soft-Keys	
Name	**Description**
VALUE	Provides access to read secondary data from a piece of equipment. The [DOWN]/[UP] soft-keys will scroll through each Data Value that is available. When secondary data is not available, the soft-key is not displayed.
TYPE	Returns function of [DOWN]/[UP] soft-keys back from VALUE selection monitoring into TYPE selection.
MODEL	Returns function of [DOWN]/[UP] soft-keys back from VALUE selection monitoring into Model selection.
MODE	Toggles the Edit/Read mode for all maintenance pages. Only displayed on the maintenance index page.
(-)	If the maintenance item is a numeric value, this key will decreases the value. When the maintenance item is a multiple-choice entry, then pressing the soft-key will move to the previous choice. Hold to repeat.
(+)	If the maintenance item is a numeric value, this key will increase the value. When the maintenance item is a multiple-choice entry, then pressing the soft-key will move to the next choice. Hold to repeat.

6.1 Page 1: INDEX



The Maintenance Index page is a multiple–choice list that provides an index of all other maintenance pages and allows the operator to jump to a particular page. First scroll the Cursor to point to the desired maintenance page listing using the [Up] soft-key or [Down] soft-key or the BRT/MINS. The [SELECT] soft-key is then pressed to jump to this page. When in the Maintenance pages, press the [OPER] soft-key to return to the Maintenance Index page. The [PREV] or [NEXT] soft-keys may also be used to reach a particular maintenance page sequentially.

The [MODE] soft-key is used to toggle the ST3453H between READ and EDIT mode.

Note: The ST3453H must be in the EDIT mode to make configuration changes on the following maintenance pages.

6.2 Page 2: SYSTEM

The System page provides information that identifies the unit.

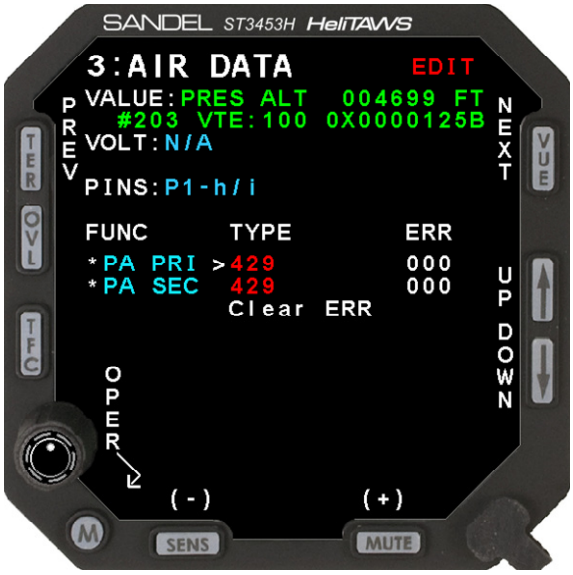
Databases that are unavailable are indicated by “NO DATA” shown in amber text below its respective database name.

Database and software conflicts will be indicated by a red text message at the bottom of the display. A list of possible conflict messages is shown below. If any of these messages are observed contact Sandel Avionics for assistance.

Configuration Field	Options	Comment
Serial Number	None	Displays unit serial number.
FPGA (cpu)	None	Displays CPU FPGA revision.
FPGA (bbrd)	None	Displays BBRD FPGA revision.
FPGA (rbrd)	None	Displays RBRD FPGA revision.
CPU CCA Rev	None	Displays CPU CCA revision.
Software Rev	None	Displays software revision number.
Terrain Rev	None	Displays terrain database revision number.
Obstacle Rev	None	Displays obstacle database revision number.
Overlay Rev	None	Displays airport database revision number.
Airport Rev	None	Displays overlay database revision number.
Aircraft Id	7 Characters	Enter aircraft identification for reference.

Database and Software Conflict Messages	TER SW CONFLICT
	TER HDR CONFLICT
	TER APT CONFLICT
	APT SW CONFLICT
	OBST SW CONFLICT
	OVLY SW CONFLICT
	DATABASE AREA CONFLICT

6.3 Page 3: AIR DATA

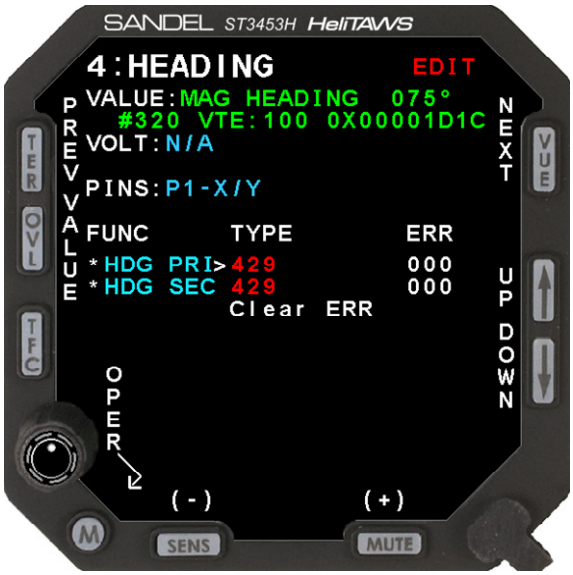


The Air Data page contains the setup information for the Airdata system. Use the [UP] or [DOWN] soft-keys to select a setup item. This will move the cursor to the appropriate line and display the current input data value, input voltage (if applicable) and pin-pairs of the selected signal.

Configuration Field	Options	Comment
PA PRI	NONE 429 429H TYPE 1* TYPE 2** TR-322/A 1553	Configures the air data PA source.
VALID	NONE HIGH LOW 2.5V HI	Not shown if NONE, 1553, 429, or 429H is selected for PA source.
PA SEC	NONE 429 429H 1553	Configures the air data PA source.

* DC Voltage inversely linear with pressure. Range: -1000’ to 41,000’. Scale: -0.3264 Vdc/inHg absolute (Ps) Reference: -0.766 Vdc @ 29.921 inHg.
** DC voltage linear with altitude. Range: -1500’ to 20,000 (0 to 10.00 volts). Scale: 0.4651 mv/foot.

6.4 Page 4: HDG



The HDG page contains the setup information for the HDG system. Use the [UP] or [DOWN] soft-keys to select a setup item. This will move the cursor to the appropriate line and display the current input data value, input voltage (if applicable) and pin-pairs of the selected signal.

When selecting analog inputs, a VALID select will be present. If no valid signal is available for the interconnected equipment, set this to NONE which will treat the signal inputs as always valid. If a VALID signal is available, set appropriately to VALID HIGH or VALID LOW. The effect of these settings will be immediately shown as a VALID or INVALID data value at the top of the screen.

Configuration Field	Options	Comment
HDG PRI	NONE 429 429H XYZ XYZ- 1553	Selects the heading input to the ST3453H.
VALID	NONE HIGH LOW 2.5V HI	Not shown if NONE, 429, 429H, or 1553 is selected for heading.
HDG SEC	NONE 429 429H 1553	Selects the heading input to the ST3453H.

6.5 Page 5: DISCRETES

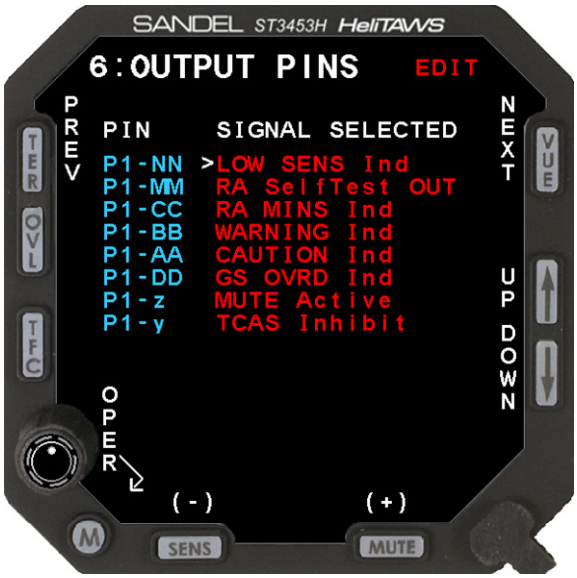
The Discretes page shows all the discrete inputs.

A Discrete may be VALID-LOW or VALID-HIGH. In either case a 30K resistor is connected to pull the signal to the invalid state (ground or aircraft power) as applicable unless the valid signal is applied.

Back Course (from the HSI) discrete input may be ACTIVE-LOW or ACTIVE-HIGH (Valid Sense). This is used to inhibit the Glideslope alert GPWS mode 5.

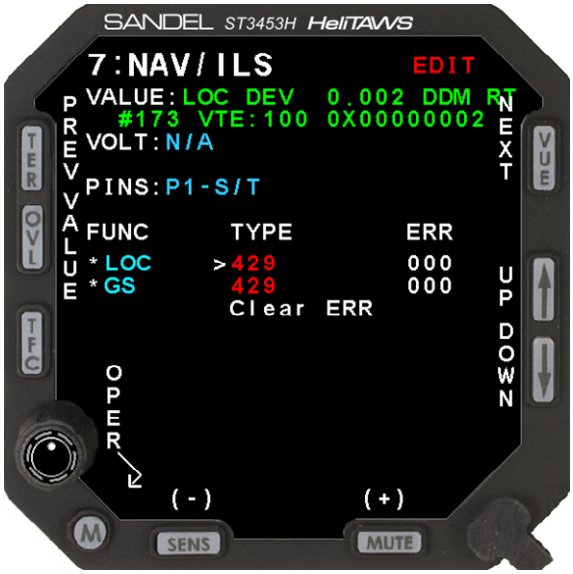
Configuration Field	Options	Comment
BCKCRS	NONE ACTIVE L ACTIVE H	Configures the back course input discrete.
GEAR	NONE DOWN L DOWN H	Configures the gear input discrete.
NVIS	NONE ACTIVE L ACTIVE H	Configures the NVIS enable discrete.

6.6 Page 6: OUTPUT PINS



Configuration Field	Options	Comment
P1-NN	NONE LOW SENS Ind TCAS ALT SEL SW	Configures the output pin.
P1-MM	NONE RA Self Test OUT TCAS S-Test SW	Configures the output pin.
P1-CC	NONE TAWS INH Ind RA MINS Ind	Configures the output pin.
P1-BB	NONE WARNING Ind TCAS Mode SW	Configures the output pin.
P1-AA	NONE CAUTION Ind TCAS S-Test SW	Configures the output pin.
P1-DD	NONE GS OVRD Ind TCAS Inhibit	Configures the output pin.
P1-z	NONE MUTE Active RA Self Test OUT	Configures the output pin.
P1-y	NONE TCAS Inhibit GPWS Fail Ind	Configures the output pin.

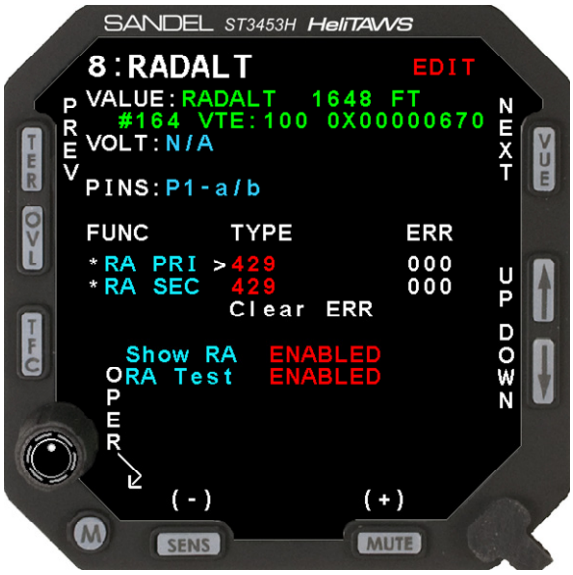
6.7 Page 7: NAV / ILS



The NAV/ILS page selects the configuration of NAV receiver Vertical/Lateral Deviation inputs. When the input is selected to 429, the glideslope uses the same 429 port as the NAV. When analog, these two signals are selected separately. Once a selection is made, the port configuration for NAV will be automatically made based on the selection chosen and data will appear in the data VALUE area. The data VALUE shows only a single data item. This page has an additional soft-key labeled [VALUE] which can be used to scroll through all of the NAV and ILS data coming from the receiver. Use the [UP]/[DOWN] soft-keys to scroll through the various data items. Press the [TYPE] soft-key to exit the "Value" scroll function.

Configuration Field	Options	Comment
LOC	NONE 429 429H ANALOG 1553	Selects localizer signal input
GS	NONE 429 429H ANALOG 1553	Selects glideslope signal input.

6.8 Page 8: RADALT



The Radalt page selects the configuration of Radar altimeter input. If no Radar altimeter is installed set configuration of RALT to NONE.

Radar altimeters are selected by equipment type, i.e. ALT55 for Collins ALT55 altimeter, etc.

Once the equipment is selected, the Radar altitude can be read from the data VALUE line to check for correct operation.

For analog inputs, a corresponding VALID input is present. Ensure that this item is VALID during normal operation and INVALID during TEST of the RA or when the RA is powered off.

For some configurations, RA and MINS indications are not displayed to the flight crew.

Configuration Field	Options	Comment
RA PRI	NONE 429 429H 552 ALT50 ALT55 KRA405 RT220/300 FF RA 429 FF RA 429H SIK 429 SIK 429H 1553	Selects the Radar Altimeter source.
	RT804	MIL-81296D(AS) -8mv/Ft Range: 0 to 5,000 ft. Flags @ < -46.7V
	RT805	MIL-81296D(AS) -40mv/Ft Range: 0 to 1,000 ft. Flags @ < -46.7V
	APN-209	
VALID	NONE HIGH LOW 2.5V HI	Not shown when 429, 429H, FF RA 429, FF RA 429H, 1553 or NONE is configured.
CAL		Displays below the RALT function when Radar altimeter is installed and configured. Adjustable from +25.0 to -25.0 feet. Not shown when 429, 429H, RT804, RT805, FF RA 429, FF RA 429H, 1553, or NONE is configured.
RA SEC	NONE 429 429H SIK 429 SIK 429H 1553	Selects the Radar Altimeter source.
SHOW RA	ENABLED DISABLED	Enables or disables display of the radar altimeter.
RA TEST	ENABLED DISABLED	Enables or disables the Radalt test function.

6.9 Page 9: POS PRI (Position/Flight plan)

The POS PRI input is used for position data and flight plan data. The multiple–choice list allows the operator to specify the type of GPS/FMS connected to the POS PRI position ports. Select the desired receiver using the [UP]/[DOWN] soft-keys and use the [SET] soft-key to make the selection. Once a selection is made, the port configuration will be automatically made based on the selection chosen and data will appear in the data VALUE area.

The data VALUE shows only a single data item. This page has an additional soft-key labeled VALUE which can be used to scroll through all of the GPS/FMS/INS DATA coming from the receiver. Use the [UP]/[DOWN] soft-keys to scroll through the various data items. Press the [MODEL] soft-key to exit the VALUE scroll function.

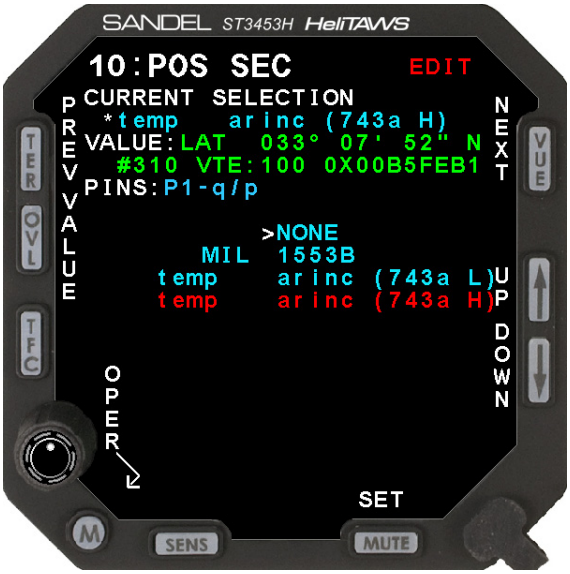
Note:

ARINC 429 selections are not supported for other than factory test.

The ST3453H will display flight plan data when GAMA compliant equipment is interfaced on POS PRI.

Configuration Field	Options	Comment
POS PRI	Select from list	Select the appropriate model of GPS from the list. Press the SET soft key (SENS button) to program.

6.10 Page 10: POS SEC (Position)



The POS SEC input is used for position data. The multiple–choice list allows the operator to specify the type of GPS/FMS connected to the POS SEC position ports. Select the desired receiver using the [UP]/[DOWN] soft-keys and use the [SET] soft-key to make the selection. Once a selection is made, the port configuration will be automatically made based on the selection chosen and data will appear in the data VALUE area.

The data VALUE shows only a single data item. This page has an additional soft-key labeled VALUE which can be used to scroll through all of the GPS/FMS/INS DATA coming from the receiver. Use the [UP]/[DOWN] soft-keys to scroll through the various data items. Press the [MODEL] soft-key to exit the VALUE scroll function.

Note:

ARINC 743a selections are not supported for other than factory test.

Configuration Field	Options	Comment
POS SEC	Select from list	Select the appropriate model of GPS from the list. Press the SET soft key (SENS button) to program.

6.11 Page 11: TCAS

The TCAS page shows selections available for Traffic.

The multiple–choice list allows the operator to specify the type of Traffic processor connected to the Traffic port. Select using the [UP]/[DOWN] soft-keys and use the [SET] soft-key to make the selection.

Once a selection is made, the port configuration for Traffic will be automatically made based on the selection chosen and data will appear in the data VALUE area. When the TCAS selection is set to NONE, the TCAS KEY text will not be displayed and the VALUE field will be blank.

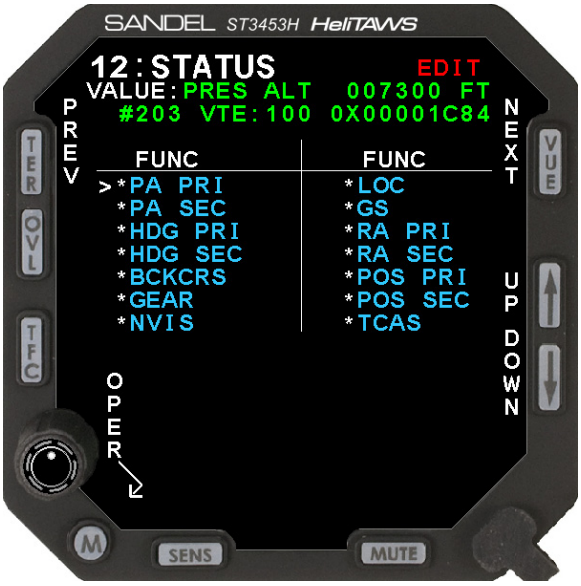
This page has an additional soft-key labeled VALUE which can be used to scroll through all of the TCAS DATA coming from the processor. Use the [UP]/[DOWN] soft-keys to scroll through the various data items. Press the [MODEL] soft-key to exit the VALUE scroll function.

The MORE indicator indicates more choices than the listings currently displayed on the screen. An arrow pointing down indicates that more choices exist below the last listing currently being displayed.

Configuration Field	Options	Comment
TCAS KEY	Blank by default	Enter the purchased 11 character key code to enable traffic. Use the MUTE and SENS keys to select the character and the OVLY and TFC keys to move the cursor. When the TCAS selection is set to NONE, the TCAS KEY field is not displayed.
TCAS Model	Collins TCAS 4000 Goodrich Skywatch Goodrich Skywatch (SW) Goodrich SkywatchHP Goodrich SkywatchHP (SW) Goodrich TCAS791/A Goodrich TCAS791/A (SW) Honeywell CAS-66 Honeywell CAS-67 Honeywell CAS-81 Ryan 9900BX TAS	Select the appropriate model of TCAS from the list. Press the SET soft key (TFC button) to program. (SW) indicates that the ST3453H may be used as an external switch controller through the use of softkeys on the Pilot Menu. When an (SW) selection is made, a corresponding discrete output must be configured on the OUTPUT PINS maintenance page in accordance with the table below.

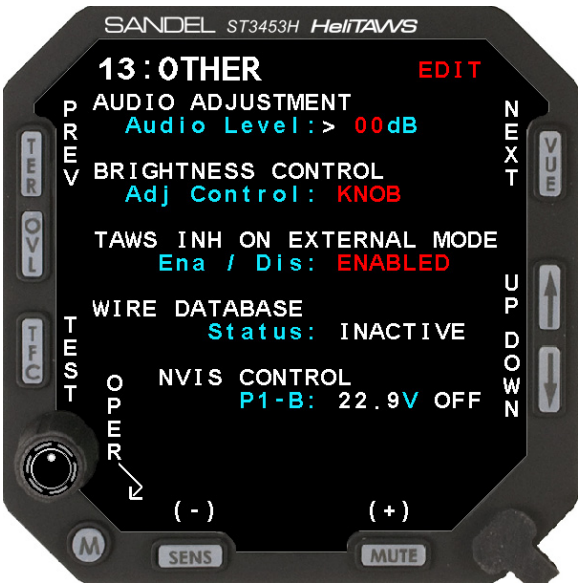
Equipment Make/Model	Type	Menu/Discrete			Pilot Menu Softkeys
		ALT RANGE	Test	Opr/Stby	
Goodrich Skywatch	TCAS-I	M/D	M/D	M/D	Test, ALT, Opr/Stby
Goodrich SkywatchHP	TCAS-I		M/D	M/D	Vert, Opr/Stby
Goodrich TCAS791/A	TCAS-I		M/D	M/D	Test, Opr/Stby
Ryan 9900BX TAS	TAS	M			Alt
Legend: M = Pilot Menu Softkey, TFC System D = Associated Discrete Output to TFC System (see Output Pins Configuration)					

6.12 Page 12: STATUS



The Status page shows a composite status of all the ST3453H inputs.

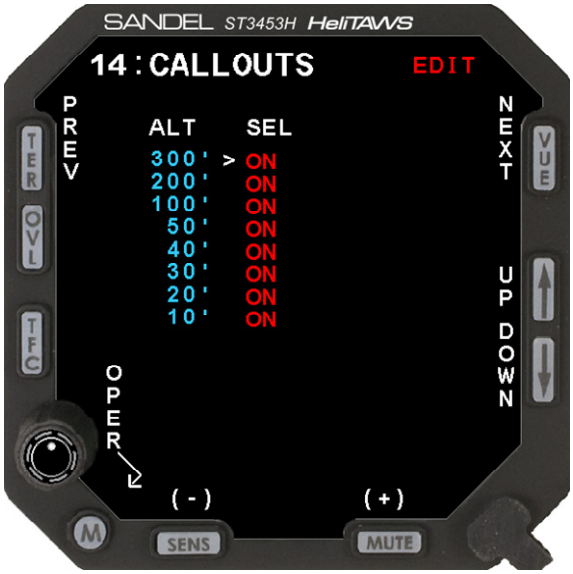
6.13 Page 13: OTHER SETTINGS



This page is used to allow the installer to specify the nominal and maximum audio levels for the low level audio output. The low level output acts as master gain. Initiate an audio level test by selecting the desired volume level and pressing the TEST soft-key. This may be used to show the result of changing the audio level adjustments.

Configuration Field	Options	Comment
AUDIO ADJUSTMENT Audio Level	-/+	Adjustable from -20 to +6 dB. Use to specify the nominal and maximum audio levels for the low level audio output. The low level acts as a master gain. Press TEST soft key to initiate an audio level test to show the result of changing the audio level adjustments.
BRIGHTNESS CONTROL Adj Control	KNOB	Use to select method of brightness control. Currently, brightness control using the knob is the only supported method.
TAWS INH ON EXTERNAL MODE	ENABLED DISABLED	Use to enable or disable the capability to select TAWS INH using external MUTE switch.
WIRE DATABASE		Indicates subscription status (ACTIVE or INACTIVE)
NVIS CONTROL		Indicates NVIS control status.

6.14 Page 14: CALLOUTS



The Callouts page allows enabling Radar Altitude audio callouts. Use the [UP] or [DOWN] soft-keys to select a setup item, this will move the Cursor to the appropriate line. [+] and [-] select “ON” or “OFF for each callout.

Radar Altimeter input is required for the Callouts to function.

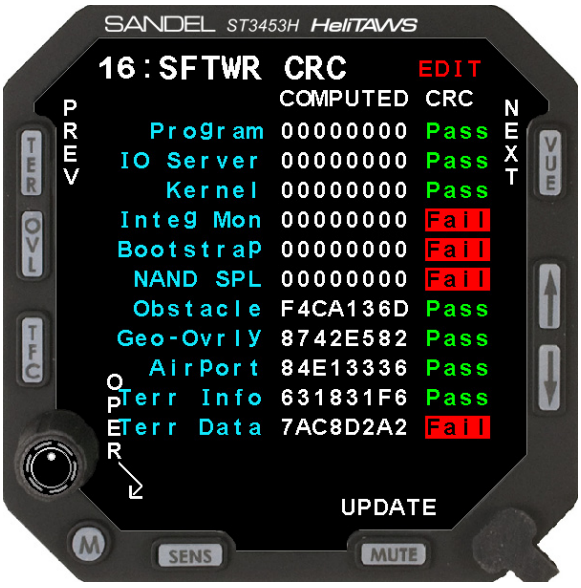
Configuration Field	Options	Comment
300’	ON / OFF	Used to turn callouts ON or OFF.
200’	ON / OFF	
100’	ON / OFF	
50’	ON / OFF	
40’	ON / OFF	
30’	ON / OFF	
20’	ON / OFF	
10’	ON / OFF	

6.15 Page 15: POWER

The Power maintenance page consists of readouts that monitor the unit's internal environment and the unit's power measurements for reference.

Any of these items that are outside normal operating limits will post an on-screen error by way of the systems built-in-test processes.

6.16 Page 16: SFTWR CRC



Displays CRC values for the software and databases. Press the [UPDATE] soft-key to recalculate. The PASS/FAIL status reflects the status of the last CRC update, therefore an

[UPDATE] must be done following the installation of any new software or databases. The CRC update process may take up to 60 minutes. This operation may be canceled if desired by pressing the cancel softkey. Contact Sandel if "**FAIL**" is annunciated for any of the values.

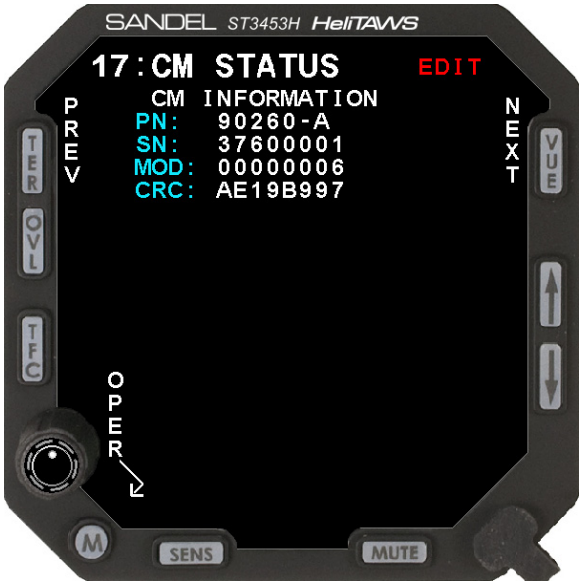
If any of the CRC related messages shown below appear when viewing the normal flight display while in the maintenance mode, contact Sandel Avionics for assistance.

Following a CRC update and a subsequent power cycle, the values in the "COMPUTED" column for databases will be shown as "--------". If the CRC operation is canceled for any reason the values in the CRC column for items that were not checked will be shown as "++++".

ADVISORY MESSAGES REQUIRING ACKNOWLEDGE		
Text Message	**Description**	**Comment**
TERRAIN FILE CRC	Database file CRC failure	Contact Sandel Avionics for assistance
AIRPORT FILE CRC	Database file CRC failure	Contact Sandel Avionics for assistance
OBSTACLE FILE CRC	Database file CRC failure	Contact Sandel Avionics for assistance

PILOT MENU ONLY MESSAGES		
Text Message	**Description**	**Comment**
GEO OVLY FILE CRC	Database file CRC failure	Contact Sandel Avionics for assistance

6.17 Page 17: CS STATUS



Displays information about the Configuration Module.

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7 CHECKOUT PROCEDURES

7.1 Power-On Self-Test

The Power-On Self-Test capability is an automatic test of equipment condition. It executes during the power-up sequence and reports any internal errors via on-screen readouts. The failure of the display itself is a major failure and will result in the inability to show further system-level error messages.

7.2 ST3453H HeliTAWS

Verify DC Power, AC Power and Ground inputs to the ST3453H connectors before installing the ST3453H.

7.3 Install ST3453H HeliTAWS into aircraft

Enter the maintenance mode by press and holding the SENS and MUTE buttons while applying power to the ST3453H. Continue to hold until the ST3453H screen is active.

7.4 Record the following Aircraft Information

Aircraft Make: _____ Aircraft Model: _____

Aircraft S/N: _____ Aircraft Registration: _____

7.5 Record the following system information:

Date:	
ST3453H S/N:	
Configuration Module P/N:	
Configuration Module S/N:	
Software Rev:	
Terrain Database Area and Rev:	
Obstacle Database Area and Rev:	
Airport Database Area and Rev	
Overlay Rev:	

7.6 ST3453H Configuration

Configure and record configuration information from the ST3453H Maintenance and Summary pages. Items that are preconfigured on the Configuration Module will be locked and not editable during installation.

Note: Meet all approved maintenance and safety conditions. Use of appropriate ground power for the aircraft is required.

Note: Aircraft must be in the view of the GPS satellites for a valid GPS Position. FMS may show invalid (depending on model) until valid Groundspeed is achieved.

RECORD ST3453H HeliTAWS CONFIGURATION

PAGE	EQUIPMENT		FUNCTION	DATA TYPE
2	SYSTEM		AIRCRFT ID	
3	AIRDATA	PA PRI	AIRDATA	
			VALID	
		PA SEC		
4	HEADING	HDG PRI	HDG	
			VALID	
		HDG SEC	HDG	
5	DISCRETES		BCKCRS	
			GEAR	
			NVIS	
6	OUTPUTS	P1-NN		
		P1-MM		
		P1-CC		
		P1-BB		
		P1-AA		
		P1-DD		
		P1-z		
		P1-y		
7	NAV/ILS		LOC	
			GS	
8	RADIO ALTIMETER	RA PRI	RALT	
			VALID	
			CAL VALUE	
		RA SEC	RALT	
		Show RA		
		RA Test		
9	POS PRI		SELECTION	

PAGE	EQUIPMENT		FUNCTION	DATA TYPE
10	POS SEC		SELECTION	
11	TCAS		SELECTION	
			TCAS KEY	
12	STATUS		N/A	N/A
13	OTHER SETTINGS	AUDIO ADJUSTMENT	Audio Level	
		BRIGHTNESS CONTROL	Adj Control	
		TAWS INH ON EXTERNAL MODE	Ena / Dis	
14	CALLOUTS		300’	
			200’	
			100’	
			50’	
			40’	
			30’	
			20’	
			10’	

7.7 Required Test Equipment:

- ILS Ramp Test Set (if ILS equipped)
- Multi-meter
- Radar Altimeter with Test button, or Radar Altimeter Test Set

7.8 Air Data Input

Follow Aircraft Manufacturer's instructions and connect Pitot/Static test box to the aircraft Pitot/Static system.

Select ST3453H to Maintenance Page 3: AIRDATA monitor the air data input.

	SIGNAL	FUNCTION	TOLERANCE	RECORD VALUE	PASS	FAIL
PRI	Pressure Altitude	PA	Verify pressure altitude is within +- 75 ' of current pressure altitude for 1000' change in altitude - tolerance +/- 100'			
SEC	Pressure Altitude	PA	Verify pressure altitude is within +- 75 ' of current pressure altitude for 1000' change in altitude - tolerance +/- 100'			

7.9 Heading Input

Select ST3453H to Maintenance Page 4: HEADING

	SIGNAL	FUNCTION	RESULT	PASS	FAIL
PRI	Check HDG PRI Value.	HDG	Verify the Mag Heading (HDG PRI) value is correct within +/-4 Degrees		
	HDG PRI Valid - pull HDG PRI circuit breaker to go invalid	HDG VALID	Verify value of Mag Heading Valid (HDG PRI) indicates, "INVALID DATA".		
	HDG PRI Valid - reset HDG PRI circuit breaker.	HDG VALID	Verify value of HDG PRI Valid indicates, "VALID".		
SEC	Check HDG SEC Value.	HDG	Verify the Mag Heading (HDG SEC) value is correct within +/-4 Degrees		
	HDG SEC Valid - pull HDG SEC circuit breaker to go invalid	HDG VALID	Verify value of Mag Heading Valid (HDG SEC) indicates, "INVALID DATA".		
	HDG SEC Valid - reset circuit breaker.	HDG VALID	Verify value of HDG SEC Valid indicates, "VALID".		

7.10 Discrete Inputs

Check all discrete inputs that are interfaced to Sandel ST3453H. See Sandel ST3453H installation wiring diagrams for aircraft.

Select ST3453H to Maintenance Page 5: DISCRETES.

SIGNAL	FUNCTION	RESULT	PASS	FAIL
NVIS	NVIS	Verify that the NVIS display annunciation goes on and off with operation of the switch		
Back Course	BCKCRS	Verify BCKCRS operates when back course is selected or the HSI course pointer is >90 degrees from the lubber line.		
Landing Gear	GEAR	Verify value indicates “GEAR DOWN” on ground. Test Gear up during flight test.		

7.11 NAV& ILS Input

Select ST3453H to Maintenance Page 7: NAV / ILS.

SIGNAL	FUNCTION	RESULT	PASS	FAIL
ILS Receiver, generate external Localizer signal, vary the input deviation. Test at 0, ± 0.046 and ± 0.093DDM	NAV	Nav value should indicate “ILS TUNED” and “LOC DEV DDM” deviation should match generated signal.		
ILS Receiver, generate external Glideslope signal, vary the input deviation. Test at 0, ± 0.046 and ± 0.093DDM	GS	GS value for “GS DEV DDM” deviation should match generated signal.		

7.12 Radar Altimeter

Note: The Radar Altimeter test may be performed by pressing the Radar Altimeter self test button, or by utilizing a Radar Altimeter test set. This manual references the use of the Radar Altimeter self test button and does not provide the information in the use of a Radar Altimeter test set. When using a Radar Altimeter Test Set, consult the Radar Altimeter Test Set manufacturer for Test Set operating instructions. The tests that will be performed to validate the ST3453H operation with the Radar Altimeter will be tests defined below.

Select ST3453H to Maintenance Page 8: RADALT

	SIGNAL	FUNCTION	RESULT	PASS	FAIL
PRI	Radar Altimeter R/T. Activate Radalt self test	RA	Radar Altimeter Value should indicate within +-5 feet of Radalt test output.		
	Radar Altimeter Fail, pull circuit breaker to go invalid.*	RA FAIL INPUT P1-c	Verify value of Radar Altimeter Fail indicates, "P1-c < +9VDC".		
	Radar Altimeter Fail reset circuit breaker.*	RA FAIL INPUT P1-c	Verify value of Radar Altimeter Fail indicates, "P1-c > +11VDC".		
	Radar Altimeter Valid	RA VALID	Verify value of Radar Altimeter Valid indicates, "INVALID DATA".		
	Radar Altimeter Valid reset circuit breaker.	RA VALID	Verify value of Radar Altimeter Valid indicates, "VALID".		
	Rotate the MIN Knob through Decision Height	Decision Height	Aural callout "MINIMUMS"		
SEC	Radar Altimeter R/T. Activate Radalt self Test	RA	Radar Altimeter Value should indicate within +-5 feet of Radalt test output.		
	Radar Altimeter Fail, pull circuit breaker to go invalid.*	RA FAIL INPUT P1-c	Verify value of Radar Altimeter Fail indicates, "P1-c < +9VDC".		
	Radar Altimeter Fail reset circuit breaker.*	RA FAIL INPUT P1-c	Verify value of Radar Altimeter Fail indicates, "P1-c > +11VDC".		
	Radar Altimeter Valid	RA VALID	Verify value of Radar Altimeter Valid indicates, "INVALID DATA".		
	Radar Altimeter Valid reset circuit breaker.	RA VALID	Verify value of Radar Altimeter Valid indicates, "VALID".		
	Rotate the MIN Knob through Decision Height	Decision Height	Aural callout "MINIMUMS"		

*Applies to analog Radar Altimeters only.

7.13 GPS/FMS/INS Position (POS PRI)

Select ST3453H to Maintenance Page 9: POS PRI

SIGNAL	FUNCTION	RESULT	PASS	FAIL
GPS position receiver locked on with valid signal	GPS POSITION	GPS Lat and Long value displayed should match position on GPS		
Turn off position GPS receiver.	GPS POSITION	GPS position value Lat and Long will not be displayed.		
GPS position receiver locked on with valid signal	GPS ALTITUDE	GPS Altitude should match altitude displayed on GPS receiver.		

Note: Press "VALUE" soft-key and then UP/DOWN soft-keys to access to additional parameters and GPS Altitude.

7.14 FMS Flight Plan (Optional)

Complete this section if a GAMA compliant position source is interfaced to the ST3453H.

Select ST3453H to Maintenance Page 9: POS PRI

SIGNAL	FUNCTION	RESULT	PASS	FAIL
Flight plan GPS receiver locked on with valid signal.	FLIGHT PLAN	Verify ST3453H flight plan matches navigator flight plan		

Note: May require ground speed greater than 5 knots to display flight plan.

7.15 GPS/FMS/INS Position (POS SEC)

Select ST3453H to Maintenance Page 10: POS SEC

SIGNAL	FUNCTION	RESULT	PASS	FAIL
GPS position receiver locked on with valid signal	GPS POSITION	GPS Lat and Long value displayed should match position on GPS		
Turn off position GPS receiver.	GPS POSITION	GPS position value Lat and Long will not be displayed.		
GPS position receiver locked on with valid signal	GPS ALTITUDE	GPS Altitude should match altitude displayed on GPS receiver.		

Note: Press "VALUE" soft-key and then UP/DOWN soft-keys to access to additional parameters and GPS Altitude.

7.16 Traffic

Check traffic if interfaced to ST3453H. Perform checkout per Traffic manufacturer's installation manual.

SIGNAL	FUNCTION	RESULT	PASS	FAIL
Put Traffic device in self test mode	TRAFFIC	Traffic test pattern should display on the ST3453H traffic page.		

7.17 MUTE switch

If installed, verify that the external MUTE pushbutton operates the mute function. Holding the MUTE pushbutton for 2 seconds will perform the TAWS INH function and terrain will be removed from the display

Pass / Fail:

Remarks: _____

7.18 Sensitivity switch

If installed, verify that the external Sensitivity pushbutton operates the Sensitivity mode function. Holding the Sensitivity pushbutton for 2 seconds will change the mode to "Off Airport".

Pass / Fail:

Remarks: _____

7.19 HTAWS self-test

Verify aural annunciations are acceptable in clarity and volume (both loudspeaker and headphone aural annunciations).

Pass / Fail:

Remarks: _____

7.20 External Annunciators

Check operation of any external annunciators.

Pass / Fail:

Remarks: _____

7.21 Display

Verify display is viewable under all expected cockpit ambient light conditions (this test should be performed in bright daylight, and again at night or in a simulated dark cockpit).

Pass / Fail:

Remarks: _____

7.22 Manual brightness

Verify manual display brightness lighting control is operating, and provides display brightness control over the full range for all normal cockpit lighting conditions.

Pass / Fail:

Remarks: _____

7.23 Visibility and Accessibility

Verify visibility and accessibility of the ST3453H display and controls from the pilot's seat. View the display from normal, expected viewing angles. This should include viewing the display from all viewing angles that might be encountered during normal cockpit operations.

Pass / Fail:

Remarks: _____

8 SENSOR COMPATIBILITY

Note: Current equipment list is being constantly updated. Please contact factory if equipment for your installation is not listed.

The following information may be added to and superseded by additional compatibility information in the future without invalidating the other information in this manual.

8.1 Air Data

MFG	MODEL	INTERFACE TYPE
Various	Per Configuration Module	MIL-STD-1553
Various		ARINC 429 Low Speed
Various		ARINC 429 High Speed
Honeywell	AZ-649	ANALOG (Type I) DC voltage inversely linear with pressure Range = -1,000 to 41,000 feet Scale = -0.3264 Vdc/inHg absolute (Ps) Reference = -9.766 Vdc at 29.92 inHg
AEL	MOD8, MOD10, MOD12	ANALOG (Type II) DC voltage linear with altitude Range = -1500 to 20,000 (0 to 10.00 volts) Scale = 0.4651mv / foot
MIL	TR-322/A	ANALOG DC Voltage linear with altitude Range = -1000 to 20,000 (0 to10.5 volts) Scale = 2ft / mv

8.2 Heading System / AHRS

MFG	MODEL	INTERFACE TYPE
Various	Per Configuration Module	MIL-STD-1553
Various	-	ARINC 429 High Speed
Various	-	ARINC 429 Low Speed
Various	-	XYZ
Various	-	XYZ-

8.3 Navigation Receiver

MANUFACTURER	MODEL	INTERFACE TYPE
Various	Per Configuration Module	MIL-STD-1553
Various		ARINC 429 Low Speed
Various		ARINC 429 High Speed
Various		ANALOG

8.4 Radar Altimeter

MANUFACTURER	MODEL	INTERFACE TYPE
Honeywell	Per Configuration Module	MIL-STD-1553
Bendix/King	KRA405	ANALOG
Collins	ALT50	ANALOG
Collins	ALT55	ANALOG
Sperry	RT-220/230	ANALOG
	APN-209	ANALOG
Free Flight	FF RA 429	ARINC 429 Low Speed
Free Flight	FF RA 429H	ARINC 429 Low Speed
Mil - 81296d (As)	RT804/805	ANALOG
Various	ARINC 552 Type	ANALOG
Various	ARINC 429 Type	ARINC 429 High & Low Speed

8.5 Position - Primary

MFG	MODEL	INTERFACE TYPE
Various	Per Configuration Module	MIL-STD-1553

8.6 Position - Secondary

MFG	MODEL	INTERFACE TYPE
Various	Per Configuration Module	MIL-STD-1553

8.7 Traffic

MFG	MODEL	INTERFACE TYPE
Goodrich L-3	TCAS 791/A	429
Goodrich L-3	Skywatch, Skywatch HP	429
Goodrich L-3	Sky 497	429
Honeywell	CAS 66, 67, 81	429
Avidyne/Ryan	9900BX	429
Collins	TCAS 4000	429

8.8 ARINC 429 Master Label List

When an interface uses ARINC 429 digital serial data, the following applicable labels are processed.

Label	Description
Airdata	
203	Uncorrected Altitude
Heading / AHRS	
270	Discrete
320	Magnetic Heading
NAV	
173	Localizer Deviation
174	Glideslope Deviation
Radar Altimeter	
164	Radio Altitude
GPS/FMS	**MIL-STD-1553 ONLY**
The following ARINC 429 labels are representative of the necessary position source content required from MIL-STD-1553. Consult with Sandel Avionics for details.	

310	Present Position Latitude
311	Present Position Longitude
076 or 370	MSL Alt –or- (HAE Alt w/ Optional MSL Correction)
155	MSL Correction (if not available, table look up by lat/long
247	HFOM
136	VFOM
150	Time HH:MM:SS
313 or 366	Ground Track or Velocity N-S
312 or 367	Ground Speed or Velocity E-W
165	GPS Vertical Speed
147	Magnetic Variation (Optional)
Traffic	
013	DITS Control
015	Altitude Select Limits
016	DITS Control
130	Intruder Range
131	Intruder Altitude
132	Intruder Bearing
203	Pressure Altitude
204	Corrected Barometric Altitude
320	Own Aircraft Heading
270	Vertical Resolution Advisory
350	Fault Summary
357	End of Transmission
377	Equipment ID

9 ENVIRONMENTAL QUALIFICATION FORM

NAMEPLATE NOMENCLATURE: [A2F1Z]BBBUXXXXXXZZAZ[ZW][YY]M[A3G33]XXAX

TYPE/MODEL NO: ST3453H/ST3400H-90XN **TSO NUMBERS:** C194, C113, C87, C118

MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:

MANUFACTURER: Sandel Avionics, Inc.

ADDRESS: 2401 Dogwood Way
Vista, CA 92081

REVISION & CHANGE NOS. OF D0-160: Revision F **DATE TESTED:**

CONDITIONS	SECTION	DESCRIPTION OF TESTS CONDUCTED
Temperature & Altitude	4.0	Equipment tested to Categories A2F1
Low Temperature	4.5.1 & 4.5.2	
Ground Survival		-55C, EUT Post-Operational
Operational		-40C, EUT Operational
High Temperature	4.5.3 & 4.5.4	
Ground Survival		+85C, EUT Post-Operational
Operational		+70C EUT Operational
In-Flight Loss of Cooling	4.5.5	Equipment tested to Category Z, >300 min
Altitude	4.6.1	Equipment tested to Category F1, 55k ft MSL
Decompression	4.6.2	Equipment tested to Category A2, 8K/55k ft MSL
Overpressure	4.6.3	Equipment tested to Category A2, -15k ft MSL
Temperature Variation	5.0	Equipment tested to Category B, 5 C/min
Humidity	6.3.2	Equipment tested to Category B, 65C, ≥95% RH
Operational Shock and Crash Safety	7.0	Equipment tested to Category B, DO-160F Table 7-1 Helicopters and all fixed wing Random Orientation
Vibration	8.0	Equipment tested to Category U, Helo SoR Vib test curve G, unknown Helo freq. Test Curves F, F1
Explosion	9.0	Equipment identified as category X, no test performed
Waterproofness	10.0	Equipment identified as category X, no test performed
Fluids Susceptibility	11.0	Equipment identified as category X, no test performed
Sand and Dust	12.0	Equipment identified as category X, no test performed
Fungus	13.0	Equipment identified as category X, no test performed
Salt Spray	14.0	Equipment identified as category X, no test performed
Magnetic Effect	15.0	Equipment tested to Category Z, less Than 0.3m, EUT Op
Power Input	16.0	Equipment tested to Category Z, VSG Systems, EUT Op; return to normal Op in less than 1 sec. after power interrupt
Voltage Spike	17.0	Equipment Tested to Category A, 600 Volts Protection, EUT Op

Audio Frequency Susceptibility	18.0	Equipment Tested to Category Z, DC System Protection, EUT Op
Induced Signal Susceptibility	19.0	Equipment Tested to Category ZW, VSG Systems Protection, EUT Op
Radio Frequency Susceptibility	20.0	Equipment tested to Category YY
Radio Frequency Emission	21.0	Equipment tested to Category M, EM Protection, EUT Op
Lightning Induced Transient Susceptibility	22.0	Equipment tested to category A3G33, Transient Protection, EUT Op, return to normal Op
Lightning Direct Effects	23.0	Equipment identified as Category X, no test performed.
Icing	24.0	Equipment identified as Category X, no test performed.
Electrostatic Discharge	25.0	Equipment tested to Category A, ESD Protection, EUT Op; return to normal Op
Fire, Flammability	26.0	Equipment identified as Category X, no test performed.

Additional Tests:

MIL-STD-810G

CATEGORY	METHOD
Temperature	501.3, I & II
Vibration	514.4, Cat 6
Shock	516.6, I, V, & VI
Rain	505.5, III
Humidity	507.5, I
Altitude	500.5, I & II
Explosive Atmosphere	511.5, I
Sand and Dust	510.5, I & II
Salt Spray	509.5
Rapid Decompression	500.5, III
Acceleration	513.6, II
Gunfire Shock	519.5, IV

MIL-STD-461E

Conducted Susceptibility
Conducted Emissions
Radiated Susceptibility
Radiated Emissions

MIL-STD-704A

Exported Transients, Notice 2

10 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

Normal maintenance activities performed on the ST3453H should follow standard industry practices. Re-programming the Configuration Module and updating the Databases, are addressed in specific sections of this installation manual.

10.1 Periodic Maintenance

The ST3453H is designed to detect some internal failures. A thorough self-test is executed automatically upon application of power to the unit, and Built-In-Test (BIT) is continuously executed. Detected errors are indicated on the equipment via failure messages and maintenance is on-condition. Operation of the ST3453H is not permitted unless an inspection as described in this section has been completed within the preceding 12 calendar months. Conduct a visual inspection on the ST3453H and its wire harness to insure installation integrity:

- Inspect the unit for security of attachment.
- Inspect buttons for legibility.
- Inspect condition of wiring, routing and attachment/clamping.
- Inspect knob operation.
- Inspect front panel and clean as necessary

10.2 Cleaning the Front Panel

The front bezel, keypad, and display can be cleaned with a soft cotton cloth dampened with "Edmund Scientific TECH SPEC Lens Cleaner" or equivalent. Care should be taken to avoid scratching the surface of the display.

10.3 Display Light Source

The display light source is rated by the manufacturer as having a usable life of 20,000 hours. This life may be more or less than the rated time depending on the operating conditions of the ST3453H. Over time, the light source may dim and the display may not perform as well in direct sunlight conditions. The user must determine by observation when the display brightness is not suitable for its intended use. Contact the Sandel Customer Service if the light source requires service.

10.4 Trouble Shooting Information

If the ST3453H fails to properly operate, consult a local authorized Sandel dealer for repair. The ST3453H has an internal data and event recorder that automatically records up to 100 record files (total maximum = 100MB) of flight data and events. This data can be used by Sandel Customer Support to analyze recent alert and failure message activity. The ST3453H does not contain any user serviceable components.

10.5 Removal and Replacement

If the ST3453H is removed for repair and reinstalled, or removed and replaced with a different ST3453H, follow Post Installation Configuration and Checkout Procedures contained in the manual.

If any work has been done on the aircraft that could affect the system wiring or interconnected equipment, verify the ST3453H operates properly, follow the Post Installation Configuration and Checkout Procedures contained in this manual.

To remove the ST3453H from the mounting clamp, use a standard #2 Philips screwdriver to loosen the clamping screws until the ST3453H can be freely pulled from the panel.

The ST3453H is installed by connecting the cable harnesses and then sliding it straight in the clamping mechanism until the front bezel meets the aircraft instrument panel. Tighten all four (4) clamp screws.

10.6 Database Updates

Database updates are not required. Information regarding new database releases and the content details of the databases may be obtained by visiting the Sandel website (www.sandel.com). Database updates may be ordered on-line. It is up to the ST3453H customer to determine if a specific database is applicable to their operations.

10.7 Software Updates

Software updates are released via a Service Information Letter (SIL) or a Service Bulletin (SB). The SIL or SB will contain links to the software and the related software installation files and instructions necessary to perform the update. Software updates must be performed by a Sandel authorized dealer or repair station.

It is the user/owners responsibility to periodically check for SIL's and or SB's relating to the ST3453H. SIL's and SB's can be found at: www.sandel.com/products/resources/ST3453H-documents.

11 LIST OF EFFECTIVE DRAWINGS AND ATTACHMENTS

Drawing	Rev	Title
82050-05	A	LAYOUT, ST3453H INSTALLATION
82050-07	D2	LAYOUT, ST3453H HeliTAWS
82050-10, Sheet 1	A	POWER & AUDIO
82050-10, Sheet 2	B	GPS INTERFACE 429/232
82050-10, Sheet 3	B	RADALT ANALOG
82050-10, Sheet 4	B	RADALT ARINC 429
82050-10, Sheet 5	B	HEADING ARINC 429
82050-10, Sheet 6	B	HEADING XYZ
82050-10, Sheet 7	A	NAV & LOC ANALOG
82050-10, Sheet 8	A	NAV & LOC ARINC 429
82050-10, Sheet 9	B	ANALOG AIRDATA
82050-10, Sheet 10	B	AIRDATA ARINC 429
82050-10, Sheet 11	B	ANNUNCIATORS
82050-10, Sheet 12	A	TCAS / TRAFFIC
82050-10, Sheet 13	A	DISCRETE INPUTS
82050-10, Sheet 14	A	MIL-STD-1553 INTERFACE

NOTES:

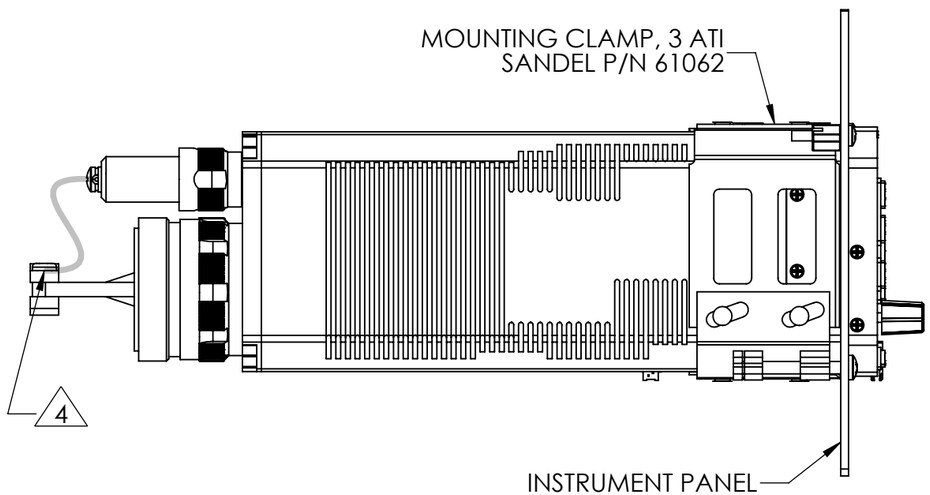
1. LOCATE PANEL CUTOUT/3ATI CLAMP WITH SUFFICIENT CLEARANCE ALL AROUND (REF. ARINC SPECIFICATION 408A

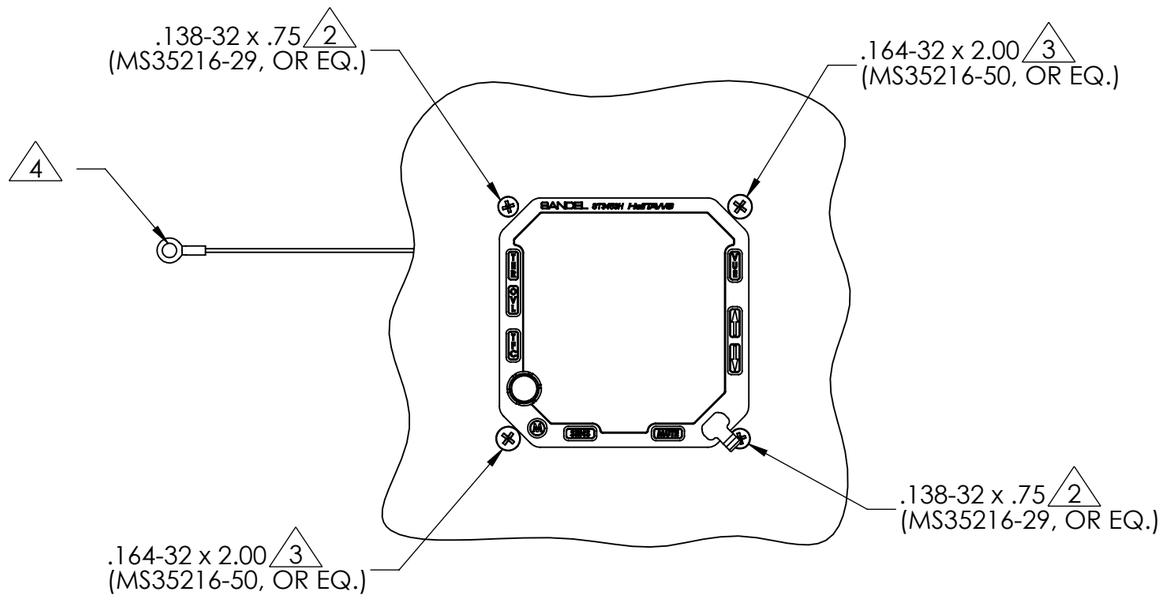
2. ATTACH CLAMP TO INSTRUMENT PANEL USING 2 EA .138-32 X .75 PAN HEAD MACHINE SCREW, CROSS RECESSED (MS35216-29, OR EQ)

3. INSTALL 2 EA ADJUSTING SCREWS, .164-32 X 2.00 PAN HEAD MACHINE SCREW, CROSS RECESSED (MS35216-50).

4. AFFIX STAKE EYE OF CONFIGURATION MODULE LANYARD TO P1 CABLE CLAMP OR SUITABLE AIRFRAME LOCATION.

5. COMPLETE INSTALLATION PER INSTALLATION MANUAL, SANDEL PART NUMBER 82050-IM (CURRENT REVISION).





REVISIONS

REV.	ZONE	DESCRIPTION	A/R	DATE	APPROVED
A		INITIAL RELEASE	1252	08/07/12	G. BLOCK

-	ST3453H
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS .XX ± .01 .XXX ± .005
ANGLES ±.5°

MATERIAL -

FINISH -

DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

APPROVALS	DATE
DRAWN T. MORRISON	08/07/12
CHECKED	
RESP ENG T. MORRISON	08/07/12
MFG ENG	
APPROVAL	

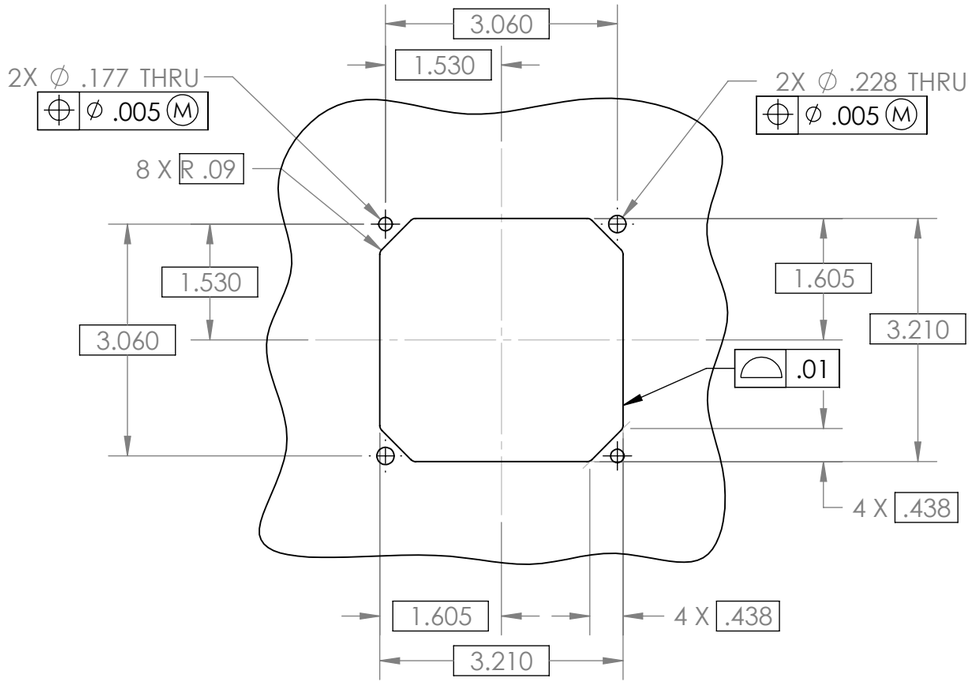
SANDEL® VISTA, CA

TITLE

LAYOUT, ST3453H INSTALLATION

SIZE	CAGE CODE	DWG. NO.	CATEGORY	REV.
B	3T1Z4	82050	05	A

SCALE 1:2 & NOTED | CAD FILE 82050-05 INSTALLATION, ST3453H | SHEET 1 OF 2



SUGGESTED PANEL CUT OUT
(REF. ARINC SPECIFICATION 408A)

SANDEL® VISTA, CA

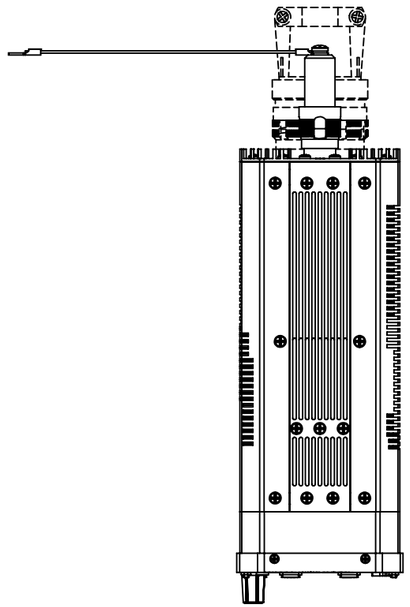
SIZE	CAGE CODE	DWG. NO.	CATEGORY	REV.
B	3T1Z4	82050	05	A

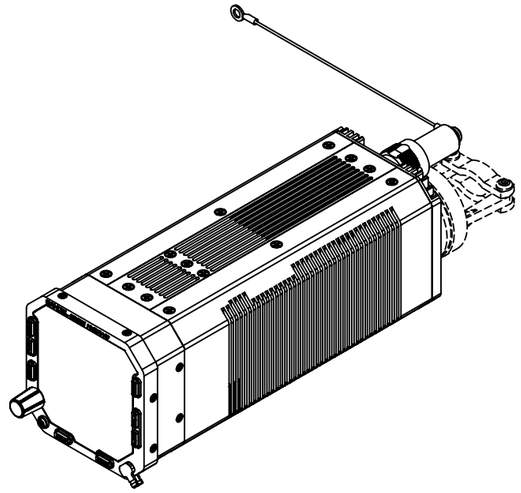
SCALE 1:2 & NOTED | CAD FILE: 82050-05 INSTALLATION, ST3453H | SHEET 2 OF 2

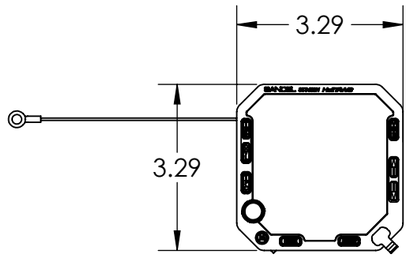
NOTES:

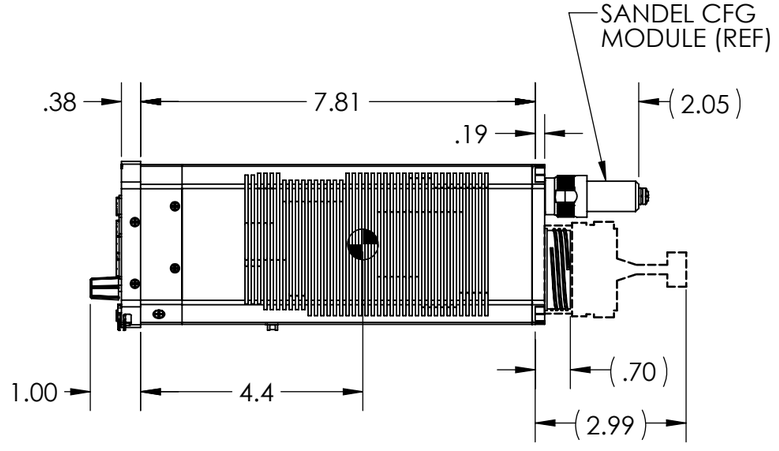
1. ASME Y14.5M-1994 APPLIES.
2. WEIGHT: 3.0 LBS.

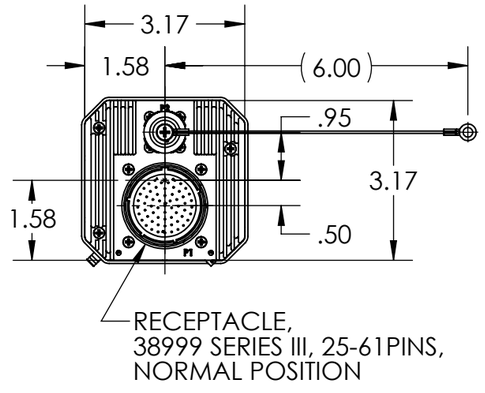
REVISIONS					
REV.	ZONE	DESCRIPTION	A/R	DATE	APPROVED
A		INITIAL RELEASE		11/16/11	
B		REVISED AND REDRAWN, WITH CHANGES		12/15/11	G. BLOCK
C		ADDED HEATSINK FINS AND CORRESPONDING DIMENSIONS		12/27/11	G. BLOCK
D		DELETED NOTES 3 & 4, REVISED TITLE		01/23/12	G. BLOCK
D1		UPDATED TO REFLECT REVISED CONFIG MODULE LENGTH	1250	07/27/12	T CM/MK
D2	NOTE 2 A-4	UPDATED WEIGHT TO REFLECT PRODUCTION CONFIGURATION, IS: 3.0 LBS., WAS: 3.5 LBS. (EST.) C.G. DIM IS: 4.4, WAS: 4.2 (EST.)	1262	08/21/12	G. BLOCK











-	ST3453H
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

DECIMALS	ANGLES
.X ± .1 .XX ± .03 .XXX ± .010	±.5°

MATERIAL: -

FINISH: -

DO NOT SCALE DRAWING

CAD GENERATED DRAWING.
DO NOT MANUALLY UPDATE

APPROVALS	DATE
DRAWN T. MORRISON	11/16/11
CHECKED	
RESP ENG T. MORRISON	11/16/11
MFG ENG	
APPROVAL	

SANDEL® VISTA, CA

TITLE

LAYOUT, ST3453H
HeliTAWS

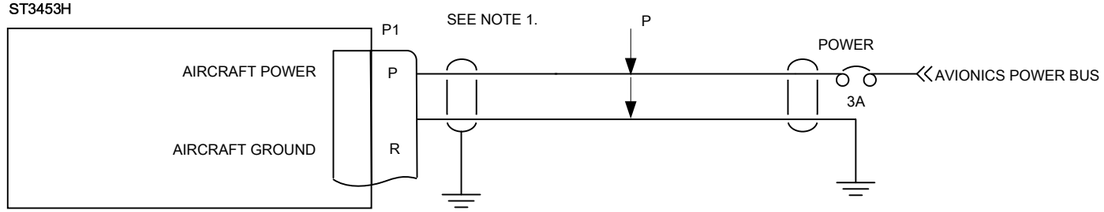
SIZE	CAGE CODE	DWG. NO.	CATEGORY	REV.
B	3T1Z4	82050	07	D2

SCALE 1:3 & NOTED | CAD FILE: 82050-07 LAYOUT, ST3453 | SHEET 1 OF 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB

Primary Power

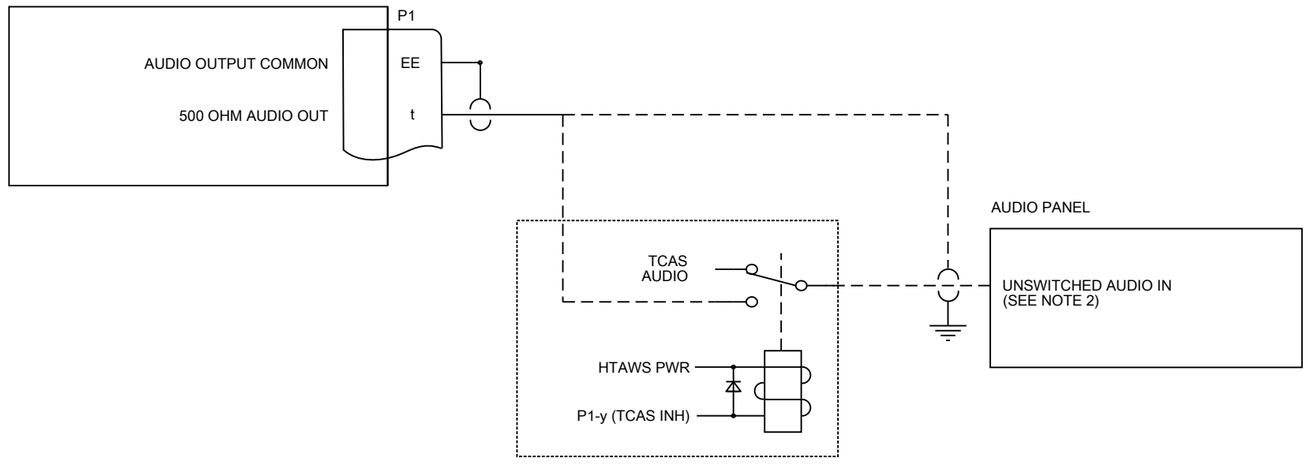
ST3453H



COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

Audio Output

ST3453H



THIS IS AN ACCEPTABLE MEANS
OF INHIBITING TCAS AUDIO AUDIO
WHEN REQUIRED BY SYSTEM
CONSIDERATIONS

NOTES:

1. USE 20AWG SHIELDED WIRE.

2. IF AIRCRAFT HAS ONLY ONE UNSWITCHED INPUT AND MULTIPLE SOURCES, ADD A 470-680 OHM RESISTOR IN SERIES WITH EACH SOURCE FOR ISOLATION OR USE RELAY.

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TITLE

ST3453H INSTALLATION DRAWING POWER & AUDIO

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

SCALE	MOD	SHEET
NONE		1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
ALL	B	ARINC 429 position sources not supported. Drawing removed. RFU	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

ARINC 429 POSITION SOURCES ARE NOT SUPPORTED.
THIS PAGE RESERVED FOR FUTURE USE

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TITLE
ST3453H INSTALLATION DRAWING
GPS INTERFACE 429/232

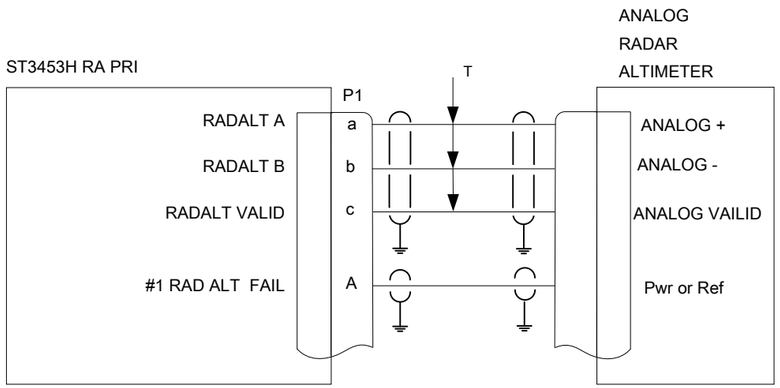
SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

SCALE	MOD	SHEET
NONE		2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
C4	B	Updated text to RA PRI	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

Radar Altimeter Analog



NOTE:

USE CAUTION IN SPECIFYING, CONFIGURING, AND TESTING ANALOG RADAR ALTIMETERS. ARINC 552 MAY PRODUCE THE SAME READINGS AS OTHER CONFIGURATIONS BELOW 480' AND DIFFERENT READINGS ABOVE 480'. THEREFORE, IF CONFIGURATION IS MIS-SET A SIMPLE GROUND TEST IS NOT A COMLETE TEST OF ALL ALTITUDES. IF ANY QUESTION EXISTS ABOUT THE SUITABILITY OF AN INSTALLATION, PERFORM A FLIGHT TEST IN VFR CONDITIONS A REVIEW THE RA ALTITUDE READOUT ON THE RA MAINTENANCE PAGE TO VERIFY THE DATA MATCHES THE PILOT'S RADAR ALTIMETER INDICATOR THROUGHOUT THE ENTIRE USEABLE RANGE OF 0-2000' OR 0-2500'.

SIGNALS MAY BE OBTAINED FROM R/T OR INDICATOR, AS REQUIRED.

CONNECT ANALOG SIGNALS AS REQUIRED

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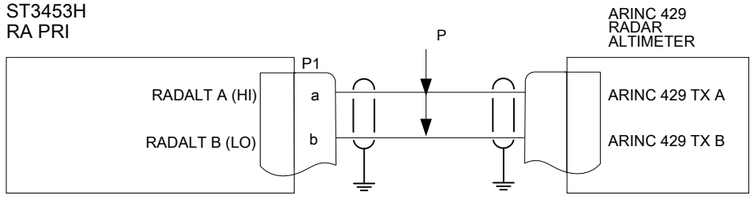
TITLE
ST3453H INSTALLATION DRAWING
RADALT ANALOG

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B
SCALE NONE	MOD	SHEET 3	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
B4, C4	B	Updated text to RA PRI and RA SEC	12/18/2012	GB

RADAR ALTIMETER 429

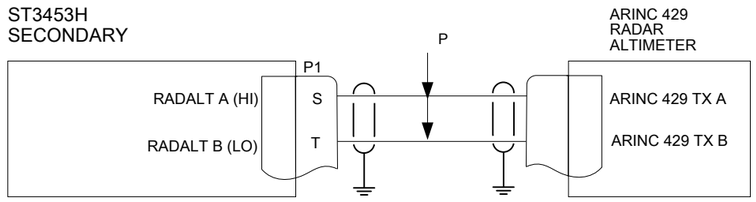
ST3453H
RA PRI



COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

RADAR ALTIMETER 429

ST3453H
SECONDARY



NOTES:

1. SIGNALS MAY BE OBTAINED FROM R/T OR INDICATOR, AS REQUIRED.

2. CONNECT DIGITAL SIGNALS AS REQUIRED.

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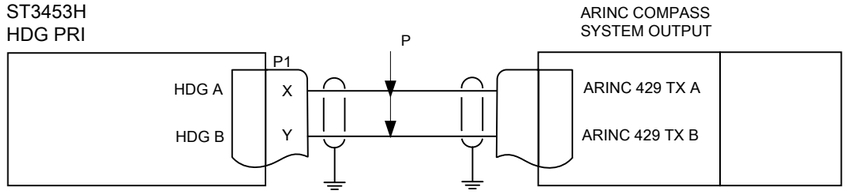
TITLE
ST3453H INSTALLATION DRAWING
RADALT ARINC 429

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

SCALE		SHEET
NONE		4

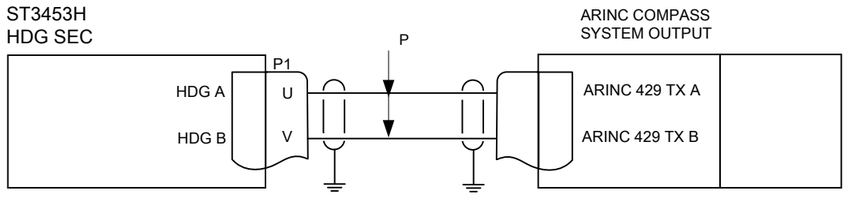
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
B4, D4	B	Updated text to HDG PRI and HDG SEC	12/18/2012	GB

HEADING 429



COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

HEADING 429



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VISTA, CA 92081 USA

TITLE
ST3453H INSTALLATION DRAWING
HEADING ARINC 429

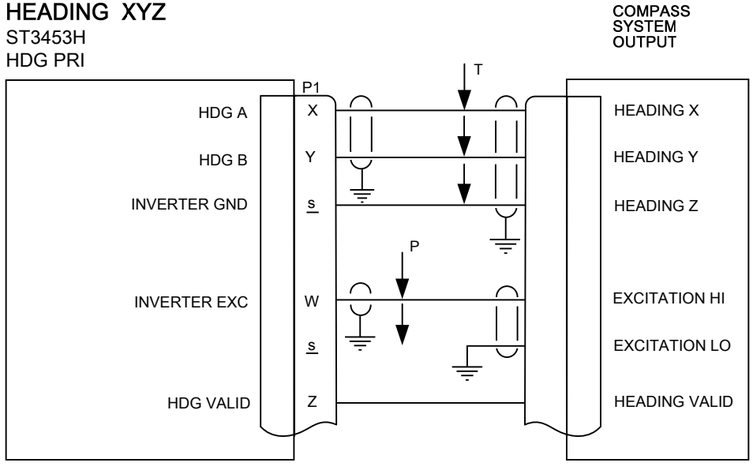
SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

SCALE		SHEET
NONE		5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
C4	B	Updated text to HDG PRI	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

HEADING XYZ
ST3453H
HDG PRI



REQUIRES AC REFERENCE INPUT

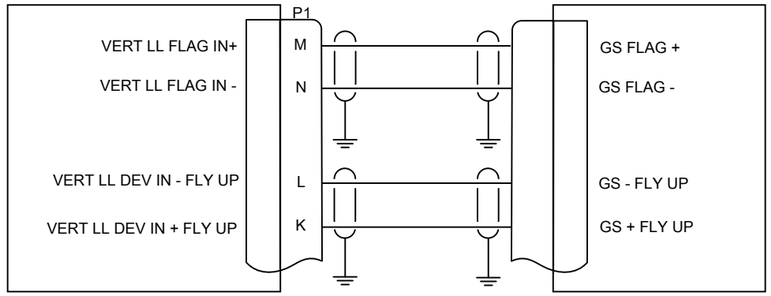
SANDEL®
2401 DOGWOOD WAY
VISTA, CA 92081 USA

TITLE			
ST3453H INSTALLATION DRAWING HEADING XYZ			
SIZE B	CAGE CODE 3T1Z4	DWG NO. 82050-10	REV B
SCALE NONE			SHEET 6

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB

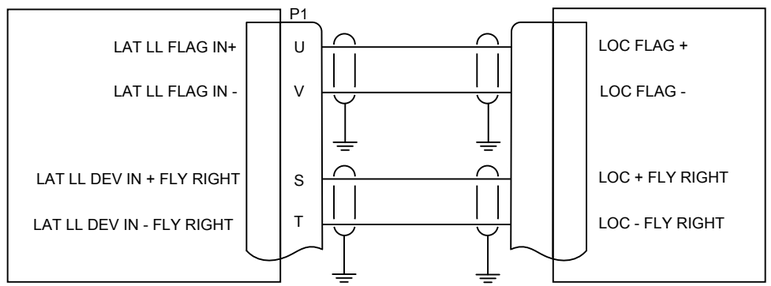
NAV/GS ANALOG

ST3453H



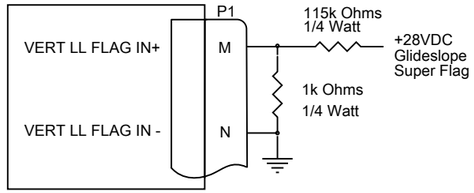
NAV/LOC ANALOG

ST3453H

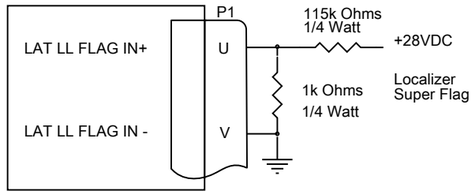


Superflag (Alternate)

ST3453H

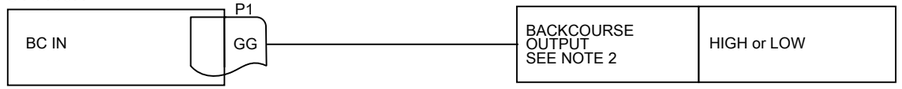


ST3453H



Back Course (Mode 5 Inhibit)

ST3453H



COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

NOTES:

1. ILS ENERGIZE IS NOT REQUIRED.
2. MAY COME FROM HSI OR FCS ANNUNCIATOR.

SANDEL®

2401 DOGWOOD WAY
VISTA, CA 92081 USA

TITLE

ST3453H INSTALLATION DRAWING NAV & LOC ANALOG

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

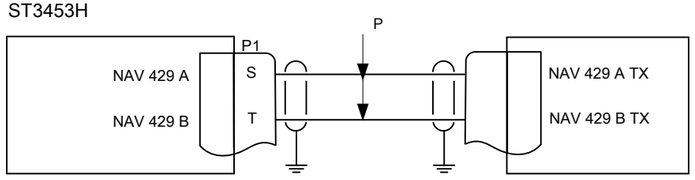
SCALE		SHEET
NONE		7

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

NAV/GS & LOC 429

ST3453H



SANDEL®
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VISTA, CA 92081 USA

TITLE
ST3453H INSTALLATION DRAWING
NAV & LOC ARINC 429

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

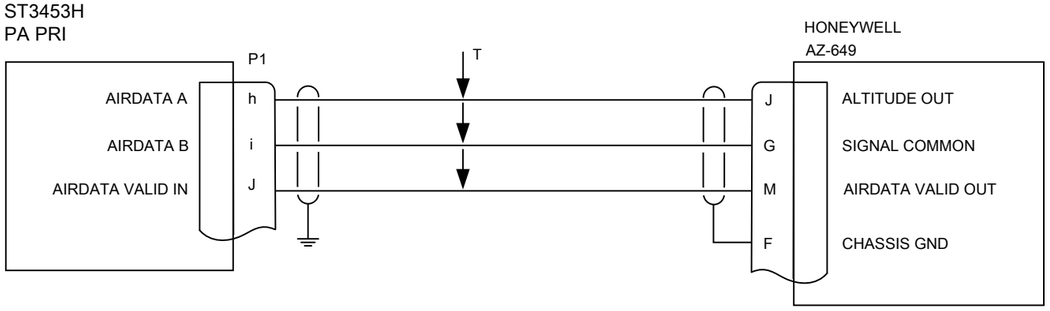
SCALE		SHEET
NONE		8

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
C4	B	Updated text to PA PRI	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

PRESSURE ALTITUDE ANALOG AIRDATA

ST3453H
PA PRI



SANDEL®
2401 DOGWOOD WAY
VISTA, CA 92081 USA

TITLE
ST3453H INSTALLATION DRAWING
ANALOG AIRDATA

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

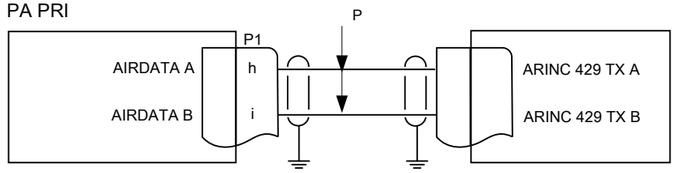
SCALE		SHEET
NONE		9

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
B4, C4	B	Updated text to PA PRI and PA SEC	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

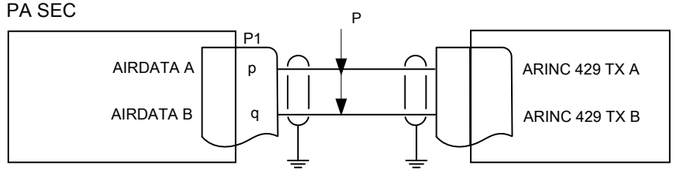
ST3453H

PA PRI



ST3453H

PA SEC



SANDEL®
2401 DOGWOOD WAY
VISTA, CA 92081 USA

TITLE
ST3453H INSTALLATION DRAWING
AIRDATA ARINC 429

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

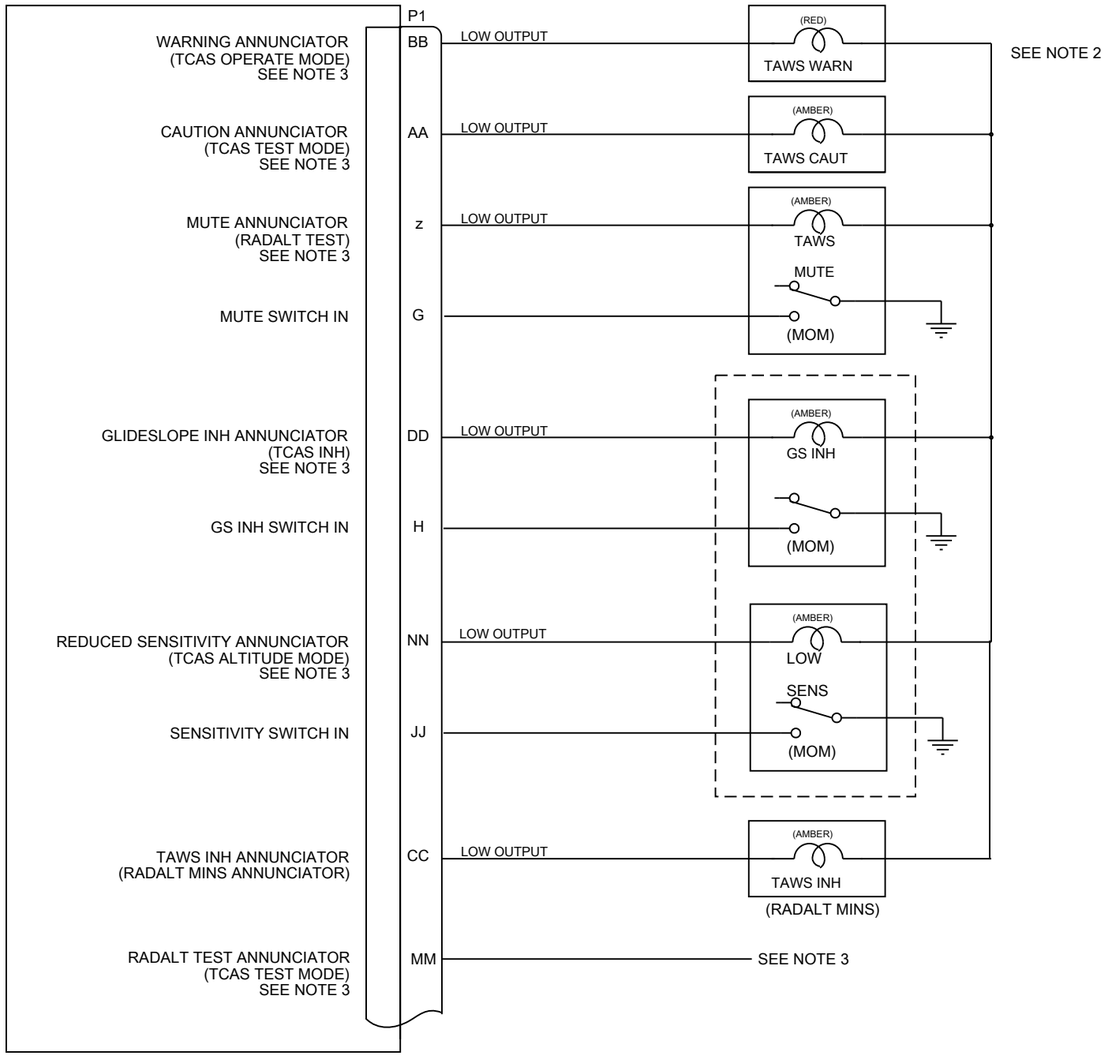
SCALE NONE SHEET 10

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB
C1	B	Removed P3 reference from Audio Enable Relay and updated associated *TCAS INH Software Select note.	12/18/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

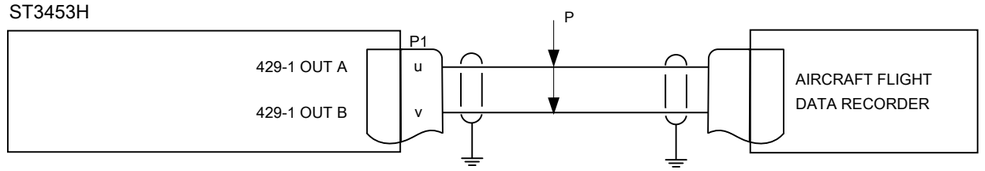
ANNUNCIATORS AND EXTERNAL SWITCHES

ST3453H



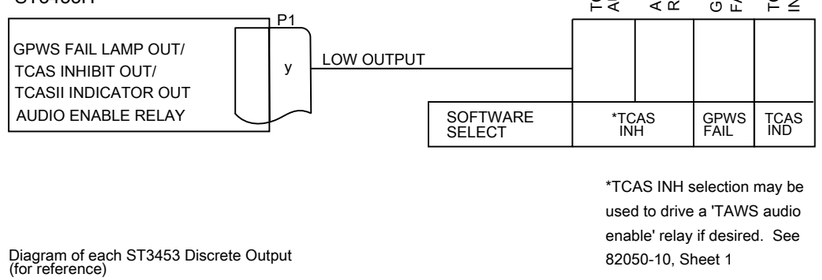
FLIGHT DATA RECORDER

ST3453H



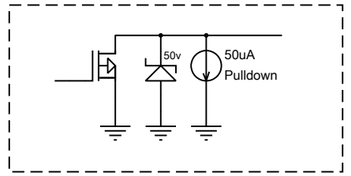
CONFIGURABLE DISCRETE OUT

ST3453H



*TCAS INH selection may be used to drive a 'TAWS audio enable' relay if desired. See 82050-10, Sheet 1

Diagram of each ST3453 Discrete Output (for reference)



NOTES:

1. Annunicators and switches are optional.
2. Annunicator power should be connected to Day/Light switch or photocell. Do not connect to panel lighting
3. Optional configurable output is for annunciator ground or signal ground for test or mode control.

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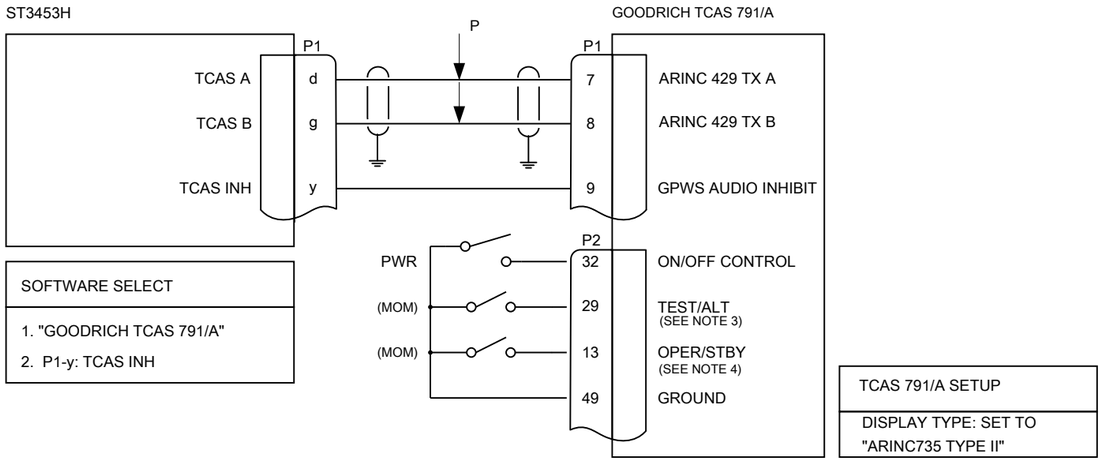
TITLE
ST3453H INSTALLATION DRAWING
ANNUNCIATORS (OPTIONAL)

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	B

SCALE NONE | SHEET 11

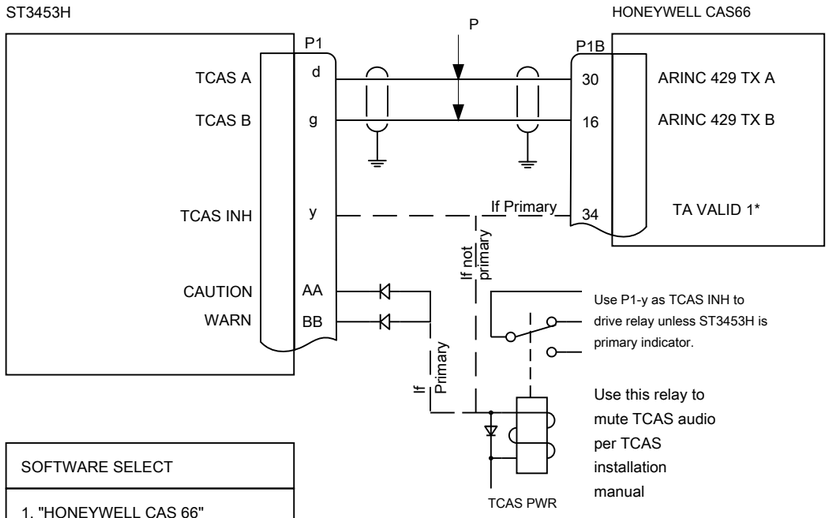
COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB



SOFTWARE SELECT
1. "GOODRICH TCAS 791/A" 2. P1-y: TCAS INH

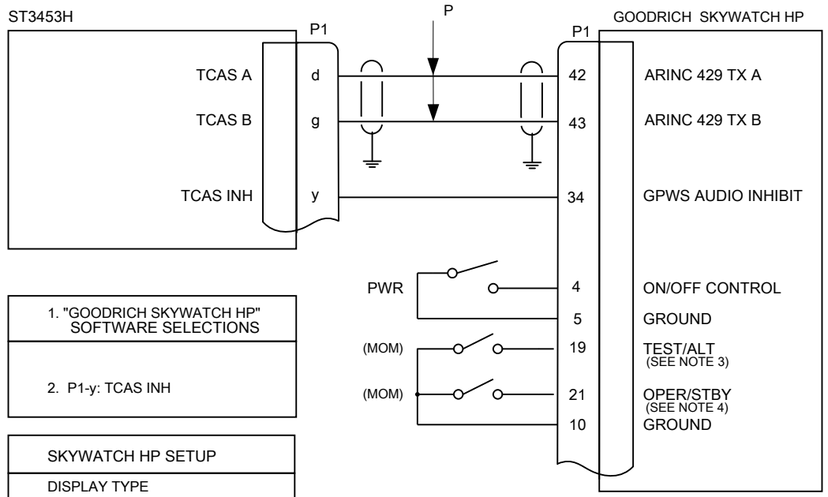
TCAS 791/A SETUP
DISPLAY TYPE: SET TO "ARINC735 TYPE II"



SOFTWARE SELECT
1. "HONEYWELL CAS 66" 2. SEE ABOVE

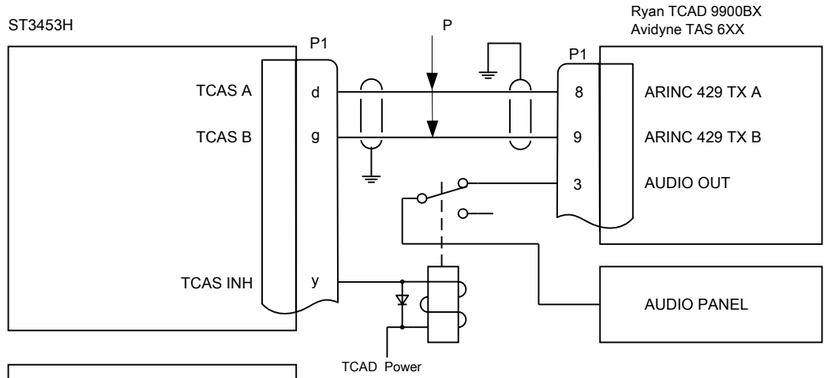
NOTES:

1. Interconnect shown with Sandel as primary Traffic display.
2. See Manufacturers Installation Manuals for complete wiring interface.
3. Optional external output P1-AA – configure as TCAS TEST MODE .
4. Optional external output P1-BB – configure as TCAS OPERATE MODE .



1. "GOODRICH SKYWATCH HP" SOFTWARE SELECTIONS
2. P1-y: TCAS INH

SKYWATCH HP SETUP
DISPLAY TYPE "STANDARD TYPE 5"



SOFTWARE SELECT
1. "RYAN 900BX TAS" 2. P1-y: TCAS INH

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TITLE
ST3453H INSTALLATION DRAWING
TCAS / TRAFFIC

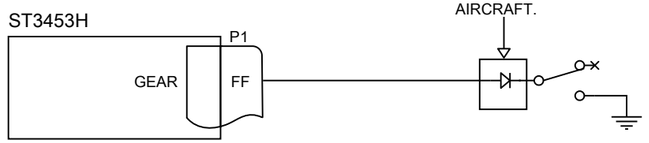
SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

SCALE NONE | SHEET 12

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB

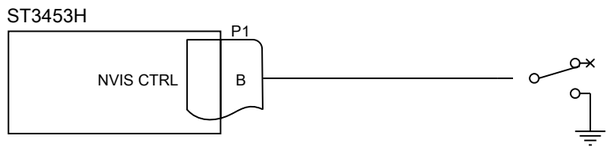
COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY

Gear/Discrete - Down Low



Gear/Discrete - Down High

NVIS CONTROL/Discrete - Active Low (OPTIONAL)



NVIS CONTROL/Discrete - Active High (OPTIONAL)

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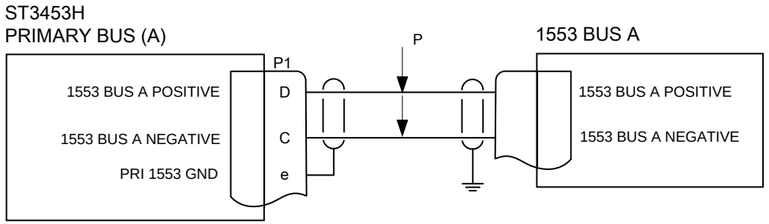
TITLE
ST3453H INSTALLATION DRAWING
DISCRETE INPUTS

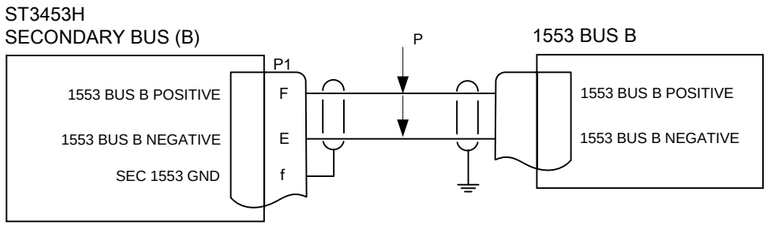
SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

SCALE		SHEET
NONE		13

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
X	A	Initial Release	8/21/2012	GB

COMPUTER CONTROLLED DRAWING
DO NOT REVISE MANUALLY





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TITLE
ST3453H INSTALLATION DRAWING
MIL-STD-1553 INTERFACE

SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82050-10	A

SCALE NONE SHEET 14