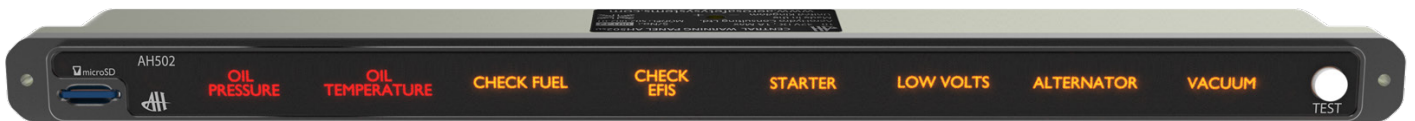




AERO SAFETY SYSTEMS

Install Manual

AH500SD and AH502SD



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Andrew Burrows - Managing Director
AeroHydro Conltants Ltd

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Introduction

Overview

This manual describes the installation, configuration and operation of the AH50xSD family which includes both the AH500SD and AH502SD annunciators along with the AH501 Master Warning/ Caution.

The AH50x can combine flight, engine, fuel and aircraft configuration data from multiple sources to generate intelligent voice and visual alerts. The AH50x can interface both to directly connected switches and sensors that monitor both switched and analogue inputs as well as indirectly through serial data connection to most common EFIS/EMS systems, as illustrated in the diagram below.

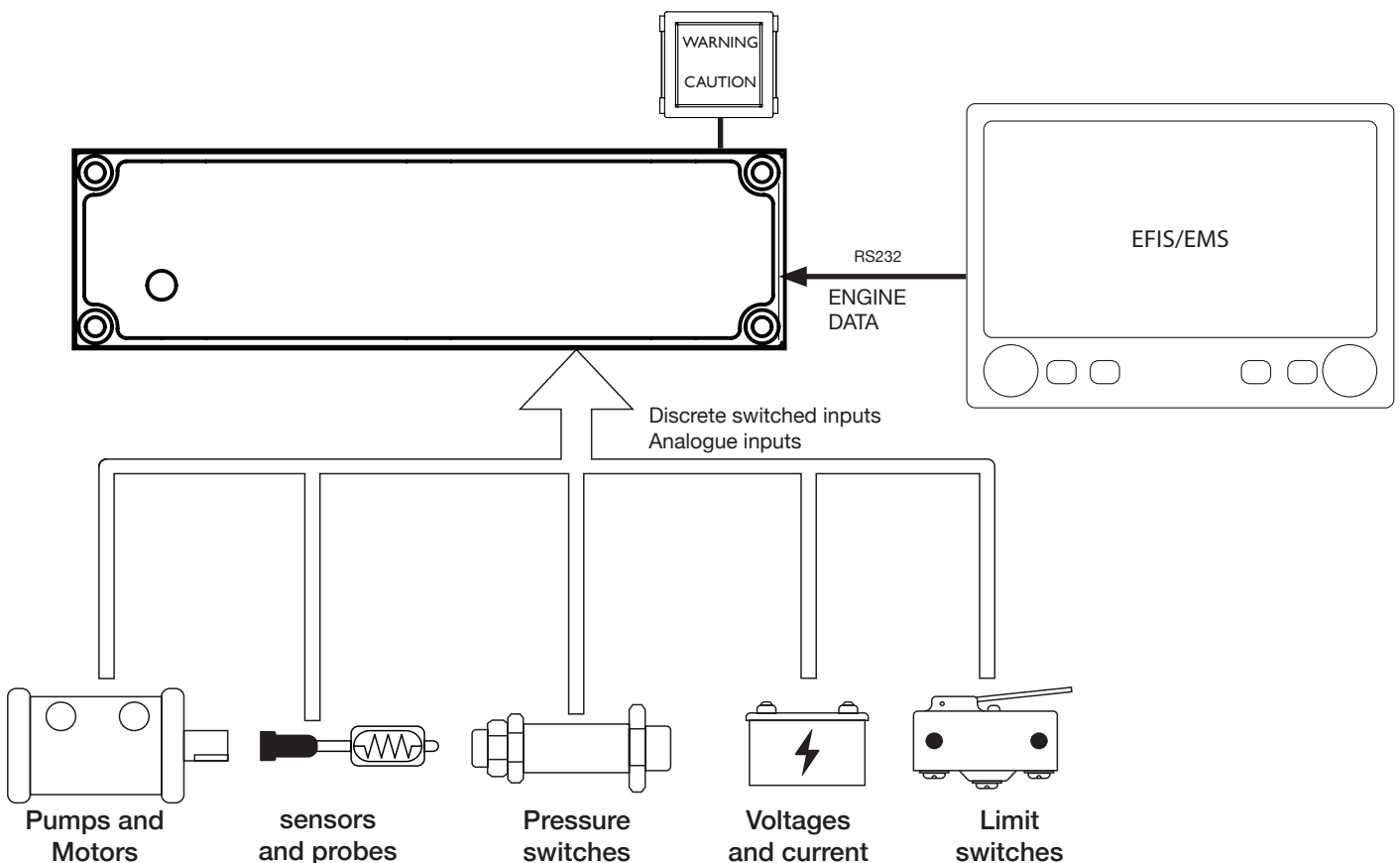
For aircraft already fitted with engine monitors and EFIS, alerts can easily be generated for any flight or engine parameter that is available on the 3rd party data bus.

For aircraft that are not fitted with engine monitors, the AH50x SD has sufficient discrete switched and analogue inputs to generate all critical engine and configuration alerts.

The AH501 Master Warning/ Caution provides a consolidated visual alert and also functions as an alert acknowledge / voice mute.

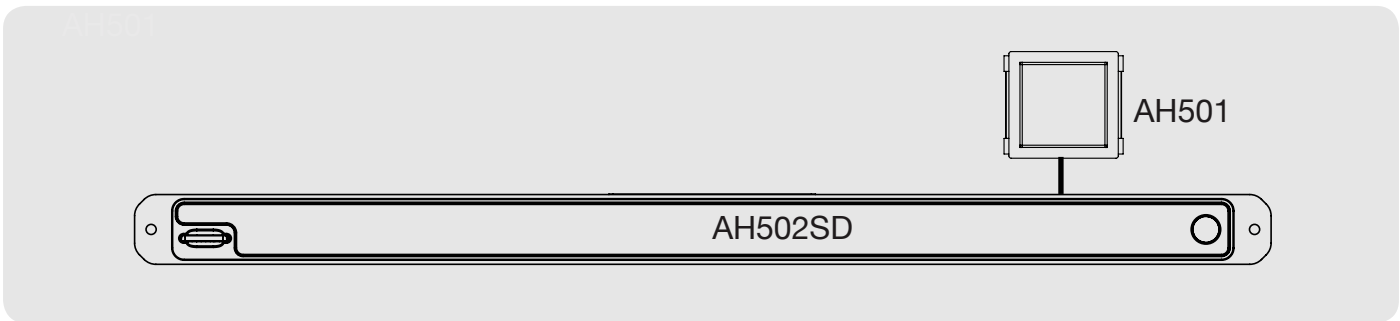
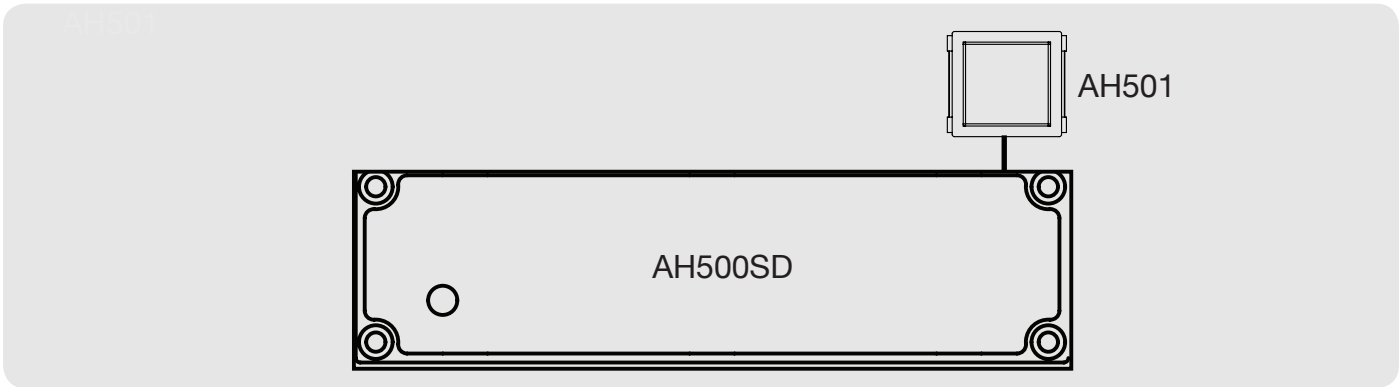
Alert logic is programmed using a user editable XML file which logically maps the inputs to the captions and voice alerts and can be updated using the SD card reader.

Voice/ audio clips can be user created and updated using the built-in SD card reader.

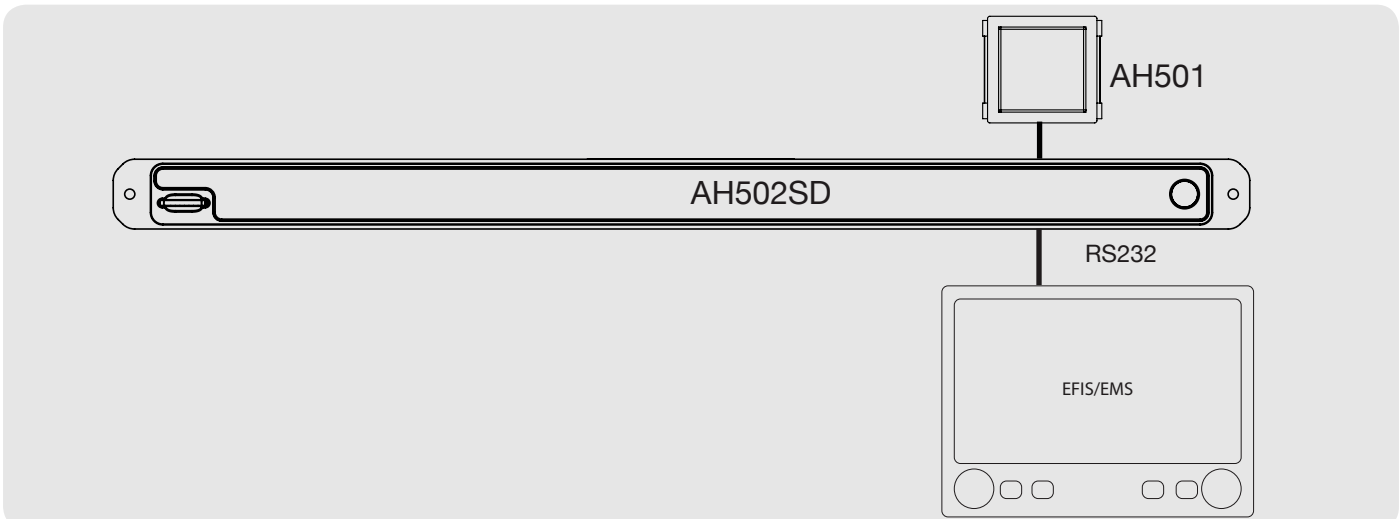
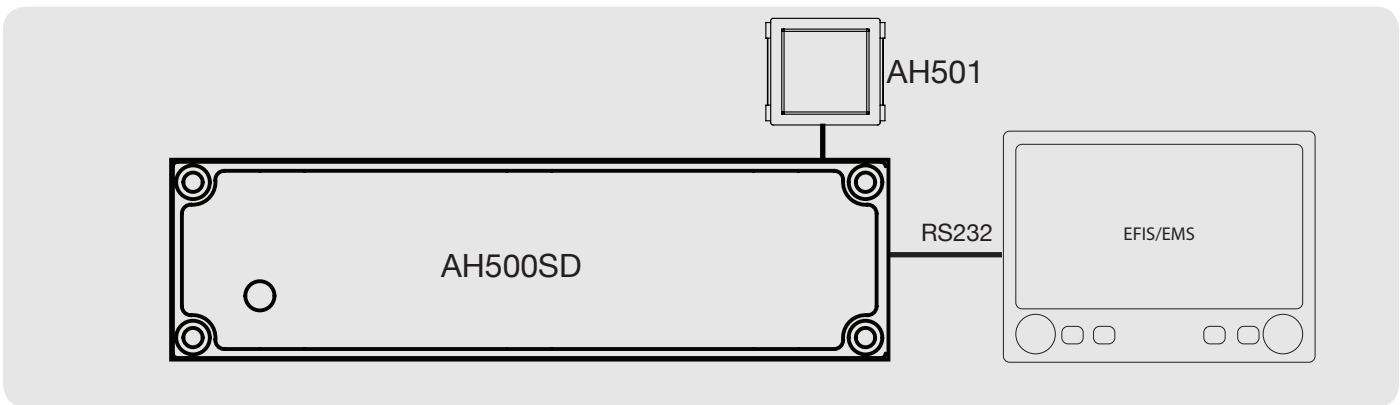


System Options

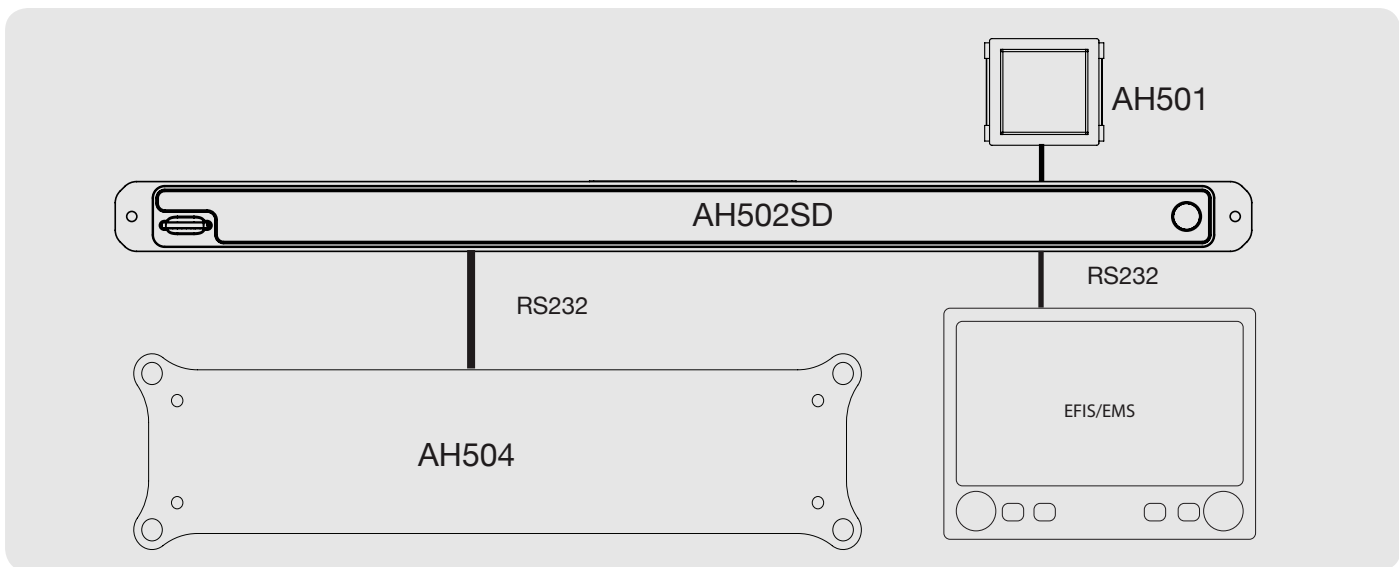
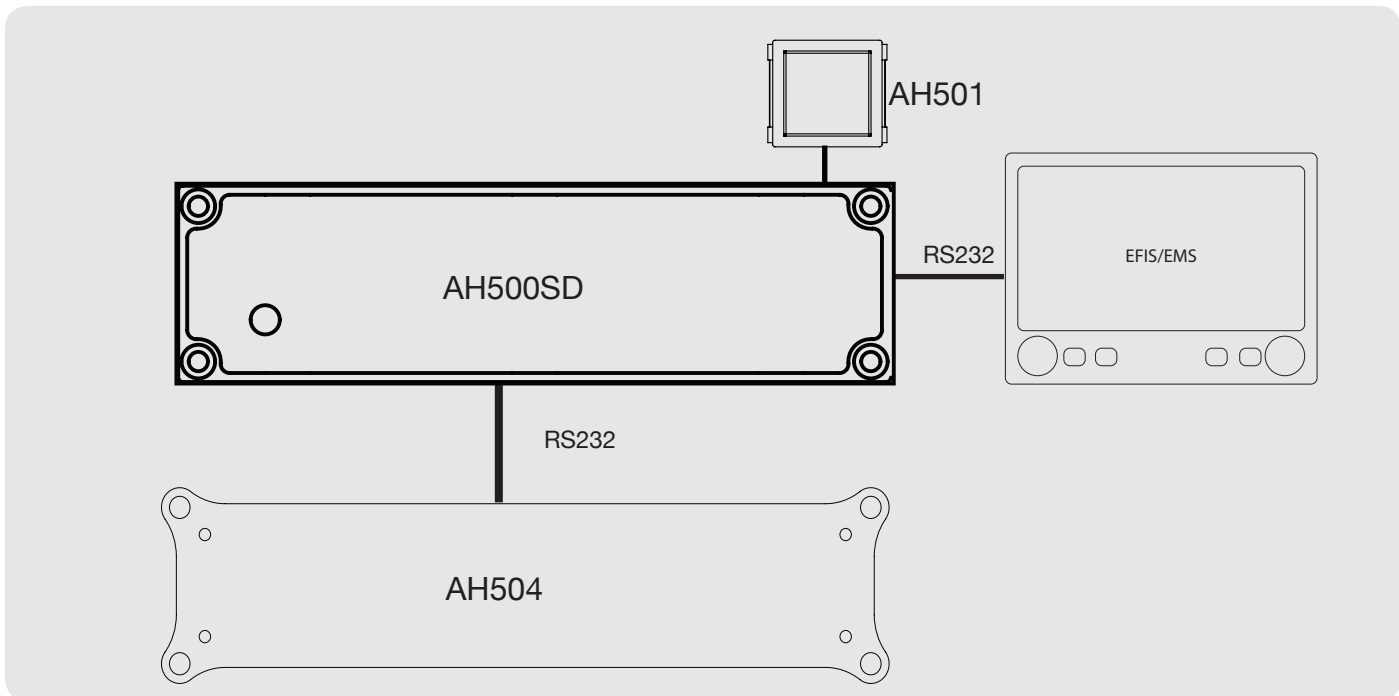
The AH50x SD can work stand-alone with directly connected discrete inputs and the AH501(Master Caution/Master Warning).



With an external RS-232 data feed from an EFIS or Engine monitor alerts can be generated using any parameter available on the data-bus.



With the second RS-232 data feed on the AH502SD or the optional configuration of twin RS-232 on the AH500SD (500-000-03), additional analogue and switched inputs can be monitored using the AH504 expansion unit.



AH500SD Versions

To meet different system requirements, two versions of the AH500SD are available, with single and dual RS232 support. With single RS232, 2 extra switched inputs are available. Note: AH502SD has two RS232 channels as standard.

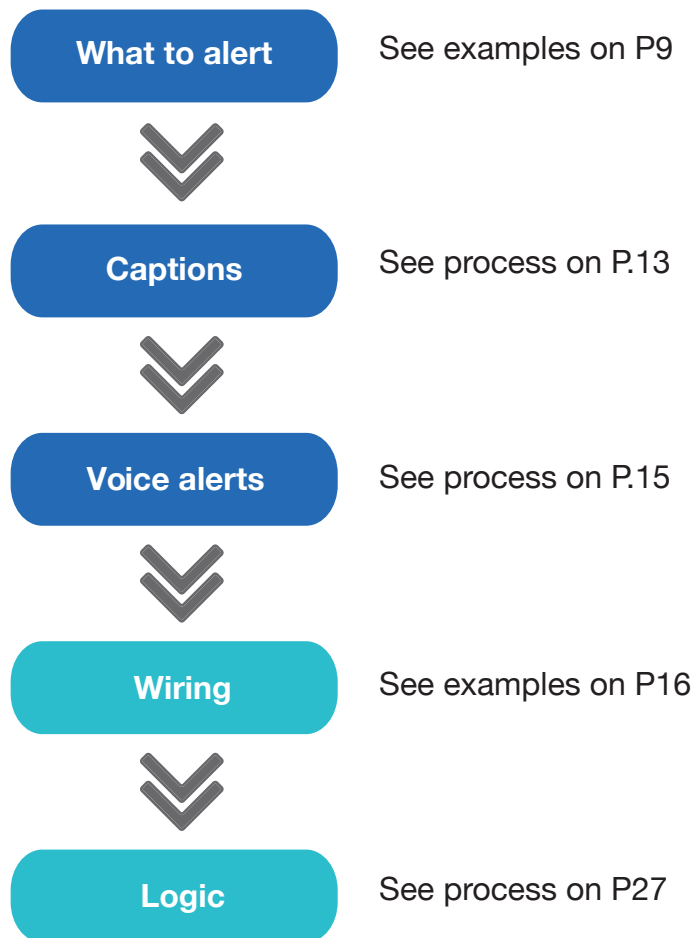
Part Number	Description
500-000-01	AH500SD 16 legend CWP with EFIS/EMS support only (single RS232)
500-000-03	AH500SD 16 legend CWP with EFIS/EMS & AH504 I/O expansion support (dual RS232)

AH50xSD Configuration Process

There are 5 steps to configuring the system.

Aero Safety Systems technical support can help you at each stage.

Templates and guides are also available on the website to assist in physical installation.



What To Alert

Overview

The first stage is to establish and document what to alert. Almost anything is possible given access to the data, but it is important to identify the most important alerts which are of immediate importance to protect the passengers, pilot and aircraft and not to alert excessively so as to unnecessarily distract the pilot.

Alerts are typically categorised into 'Warning' for conditions that require immediate pilot awareness and immediate pilot response, 'Caution' for conditions that require immediate pilot awareness and subsequent pilot response and 'Advisory' for conditions that require pilot awareness and may require subsequent pilot response.

The AH50xSD is fitted with red captions associated with Warning, Amber with Caution and optionally Green or White for Advisory.

Alerts are prioritised for Warnings, then Cautions, then Advisory. Highest priority should be positioned in the top left with reducing priority down each column to the right.

Input data

Alerts can be built using any available data from either directly connected sensors and switches or data-bus data.

Directly connected examples could be cabin door limit switches, landing gear limit switches, throttle position, gear position, flap position, fuel selector switches, pressure switches, temperature switches, voltages, current, state of starter motors and Pitot heaters, 0-10v pressure and temperature sensors and any switched alert output from a third party instrument.

Data-bus parameters can include any engine, fuel, flight parameter published on the EFIS/ EMS data bus, for example altitude, height, airspeed, g, OAT, fuel qty by tank, fuel flow, fuel pressure, oil pressure, oil temperature, EGT, CHT etc.

Voice and visual alert types

While the AH500SD has 16 captions and the AH502SD has 8 captions, it is possible to generate significantly more alerts by consolidating similar voice alerts with a single caption. An example could be a single 'CHECK GEAR' caption which is associated with different voice alerts for 'main gear not down', 'main gear not up', 'nose gear not down', 'nose gear not up', 'put gear down', 'put gear up', 'hydraulic pump still running' etc... similar examples could be listed for 'CHECK SPEED', 'CHECK FUEL', 'CHECK DOORS', 'CHECK EFIS' etc.

Alerts can be basic using a single parameter, or the unit can be programmed to generate sophisticated intelligent alerts by logically combining directly connected and EFIS/ EMS databus data. An example of a more sophisticated alert might be an oil pressure profile alert which can alert low oil pressure at different thresholds depending upon RPM, or flap over speed by linking flap position and airspeed etc.

Example alerts

Examples are divided into configuration, engine and flight categories and are provided for information only.

Configuration alert examples

Flaps

“FLAPS OVERSPEED” caption using combination alert with flap lever position and airspeed.

1. “Caution, Flaps overspeed”

Landing Gear

“CHECK GEAR” caption using combination alerts with landing gear selector position, airspeed, rate of descent, gear limit switch inputs, hydraulic pump power monitoring, hydraulic pressure switch and applying delay functions:

1. “Warning, Lower landing gear”
2. “Caution, Raise landing gear”
3. “Warning, Left gear not down”
4. “Warning, Right gear not down”
5. “Warning, Nose gear not down”
6. “Caution, Left gear not up”
7. “Caution, Right gear not up”
8. “Caution, Nose gear not up”
9. “Caution, Hydraulic pump running”
10. “Caution, Low hydraulic pressure”

Doors

“CHECK DOORS” caption using simple door limit switch inputs, and door seal pressure switches. Can be enhanced with RPM to re-activate acknowledged alert when power is applied.

1. “Caution, Pilot door not closed”
2. “Caution, Co-Pilot door not closed” (etc)
3. “Caution, Door seal pressure loss”

Pitot heat

“PITOT” caption using pitot power monitoring and OAT sensor or data feed.

1. “Caution, Turn pitot on”

Oxygen

“Oxygen” caption using altitude from EFIS data feed.

1. “Caution, Oxygen recommended above 10,000”

Parking Brake

“PARKING BRAKE” caption using brake lever limit switch

1. “Caution, Parking brake on”

External Power

“EXTERNAL POWER” caption using connector limit switch, can be enhanced with RPM to re-activate acknowledged alert when pilot attempts to taxi.

1. “Caution, External Power connected”

Flight data alert examples

Airspeed

No caption needed. Using EFIS airspeed and AOA data with delay function to avoid transient high speed alerts.

1. "Airspeed exceeds VNE"
2. "Stall, increase speed"

'g'

No caption needed. Using EFIS g data with delay to avoid transient high g alerts.

1. "Caution, g too high"

Engine alert examples

Oil Pressure

"OIL PRESSURE" caption using either basic oil pressure switch, oil pressure sender, EMS data feed. Can be enhanced to provide oil pressure RPM profile alerting with RPM feed.

1. "Warning, Low oil pressure"
2. "Caution, High oil pressure"

Oil Temperature

"OIL TEMPERATURE" caption using either basic oil temperature switch, oil temperature sender or EMS data feed. Can be enhanced to provide low oil temperature re-activation alert with RPM.

1. "Caution, Low oil temperature"
2. "Warning, High oil temperature"

Engine Overspeed

"RPM" caption using RPM from data feed.

1. "Caution, Engine overspeed"

CHT & EGT

"CHT", 'EGT', 'EHT' captions using EMS data feeds.

1. "Caution, Cylinder 1, High CHT" etc..
2. "Caution, Cylinder 1, High EGT" etc..

Turbine Alerts

ISOL, EHT state from EMS

1. "Caution, fuel control isolated"
2. "Caution, EHT, fuel limiting active"

Prop BETA

"BETA" caption using EMS data feeds.

1. "Caution, BETA"

FIRE

"FIRE" caption using switched input connected to digital heat cable.

1. "Warning FIRE FIRE"

Fuel system alert examples

Fuel alerts can use either directly connected sensor and level switches or use data available from MFD/EMS. A consolidating 'CHECK FUEL' caption could be used with multiple voice alerts.

Low Fuel

"LOW FUEL" caption using either basic fuel level switch or level transmitter or EMS data feed with delay function to avoid transient alerts.

1. "Caution, Low fuel, Left"
2. "Caution, Low fuel, Right"
3. "Caution, Low fuel, Centre"
4. "Caution, Low fuel, Sump"
5. "Caution, Fuel imbalance"

Fuel Pressure

"FUEL PRESSURE" caption using either basic fuel pressure switch or pressure transmitter or EMS data feed.

1. "Caution, Low fuel pressure"

Fuel Flow

"FUEL FLOW" caption using EMS data feed and delay function to avoid transient alerts.

1. "Caution, High fuel flow"

Fuel Pump

"FUEL PUMP" caption using fuel pump power monitoring and enhanced with airspeed to provide prompts to turn fuel pump on or off.

1. "Caution, Fuel pump is on"
2. "Caution, Turn fuel pump off"
3. "Caution, Turn fuel pump on"

Electrical system alert examples

Electrical system alerts can use either directly connected switched and sensor connections or use data available from MFD/EMS.

Volts

"LOW VOLTS" caption typically by direct connection to analogue input with delay function to avoid transient alerts.

1. "Caution, Low volts"

Alternator

"ALT 1", "ALT 2" caption(s) by direct connection of shunt to analogue input or EMS data feed.

1. "Caution, Alternator 1 Fail"
2. "Caution, Alternator 2 Fail"

Starter motor

"STARTER" caption using starter motor power monitoring with delay function.

1. "Caution, starter still engaged"

Captions

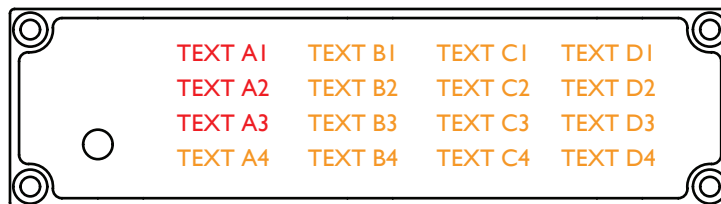
Overview

As standard the AH500SD is supplied with 3 red Warning captions and 13 amber Caution captions, but any custom combination of Red, Amber, Green and White can be provided as a special build.

As standard the AH502SD is supplied with 2 red Warning captions and 6 amber Caution captions, but any custom combination of Red, Amber, Green and White can be provided as a special build.

Captions locations are mapped using a grid of A, B, C, D columns and rows 1, 2, 3, 4.

Alerts are prioritised for Warnings, then Cautions, then Advisory. Highest priority should be positioned in the top left (A1) with reducing priority down the column (to A4) and then down the next column (B1 to B4), with D4 being the lowest priority alert. Prioritisation ensures that a voice warning associated with caption A1 is ahead of the next highest priority alert.



Caption text

Choose the captions you require from the standard range or request custom captions.

For standard captions, note the part number and location in the customer configuration form. Check the aerosafetysystems website for a full list.

Standard captions

For standard captions, note the part number and location in the customer configuration form. Check the aerosafetysystems website for a full list.

Avionics

581-001	CHECK EFIS	581-002	EFIS ALERT
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Doors

582-001	CHECK DOORS	582-002	DOORS	581-003	DOOR OPEN
582-004	DOOR SEAL PUMP	582-005	DOOR SEAL		

ENGINE

583-001	BETA	583-002	CHECK ENGINE	583-003	CHECK OIL
583-004	EGT	583-005	EHT	583-006	HIGH OIL TEMPERATURE
583-007	IGNITOR ON	583-008	ISOL	583-009	LOW OIL PRESSURE
583-010	OIL TEMPERATURE	583-011	OVER BOOST	583-012	OIL PRESSURE

FLIGHT

584-001	AIRSPED	584-002	CHECK AIRSPEED	584-003	FLAPS OVERSPEED
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GEAR

585-001	CHECK GEAR	585-002	GEAR DOWN	585-003	GEAR UNSAFE
585-004	N. GEAR DOOR				

SYSTEMS

586-001	ALTERNATOR	586-002	ALT 1	586-003	ALT 2
586-004	AUTOPILOT FAIL	586-005	AUTOPILOT TRIM FAIL	586-006	CABIN ALTITUDE
586-007	FIRE	586-008	FUEL PUMP	586-009	FUEL PUMP OFF
586-010	FUEL TRANSFER COMPLETE	586-011	GENERATOR FAIL	586-012	GEN FAIL
586-013	HYDRAULIC PUMP ON	586-014	HYD PUMP	586-015	ICE CONDITION
586-016	LOW CABIN ALTITUDE	586-017	LOW FUEL	586-018	LOW FUEL PRESSURE
586-019	LOW OAT	586-020	LOW VOLTS	586-021	OXYGEN
586-022	PARKING BRAKE	586-023	PITOT HEAT	586-024	STARTER
586-025	STARTER L	586-026	STARTER R	586-027	SUMP FUEL

OTHER

587-001	-----
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Custom captions

Aero Safety Systems routinely produce custom captions. Please contact our support team at support@aerosafetysystems.com.

Voice Alerts

Overview

The AH50xSD allows several different voice alerts to be associated with a single caption allowing consolidation of related alerts without unnecessarily using the available captions.

A voice alert does not have to have an associated caption, and some alerts such as stall, over-speed and ‘g’ warnings can be generated without need to utilise a caption.

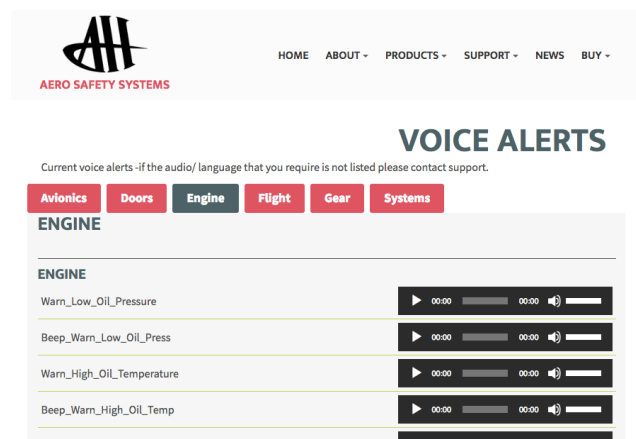
The AH50xSD has an internal memory capable of storing, typically, 64 different voice alerts which can be associated with different alert logic functions.

Voice alerts can be changed easily by the user or avionics engineer using the append function with the SD card. Please see the section ‘programming audio and logic into the unit’.

Standard voice alerts

For standard voice alerts, go to the aerosafetysystems.com website/support/voice alerts.

Select the voice alerts and note the file name in the customer configuration form.



Custom voice alerts.

Aero Safety Systems routinely produce custom voice and tone alerts. Please contact our support team at support@aerosafetysystems.com.

The default voice is English USA and female. Male voices, British English and other languages are available. It is also possible to use customer supplied .WAV clips.

Wiring

Wiring overview

In this section we describe the basic principles of wiring sensors, switches and data interfaces.

Responsibility for safety is the responsibility of the person who performs the installation and signs off the installation. This guidance is provided for information only.

Please also refer to example wiring diagrams within the documents section of our website to assist in planning your wiring diagram.

We recommend you use wire meeting Mil Standard MIL-W-22759/16 (Tefzel insulation) which is available from various suppliers.

The AH500SD is fitted with a high density D-SUB connector and accepts Gauges 22 through to 28 AWG wire. Recommended gauges are detailed in the sections that follow. We recommend you only use machined pin connectors.

The AH502SD is fitted with a standard density D-SUB connector and accepts Gauges 20 through to 26 AWG wire. Recommended gauges are detailed in the sections that follow. We recommend you only use machined pin connectors.

It is recommended to capture the wiring in a wiring diagram. Examples can be found in the documents section of the Aero Safety Systems website.



Make sure all wired circuits are protected with a suitable circuit breaker or fuse sized appropriate to the AWG wire you select. A circuit which is not appropriately protected by an MCB or fuse can lead to melting insulation, smoke and fire under fault conditions.

For all electrical connections, use correct splicing and swaging techniques.

Take care to properly insulate any exposed wire.

A short circuit between wires may also cause damage to equipment.

Make sure all connections are secure and all wires are routed and strain relieved to ensure the wires will not chafe against any other object in the aircraft.

Power connection

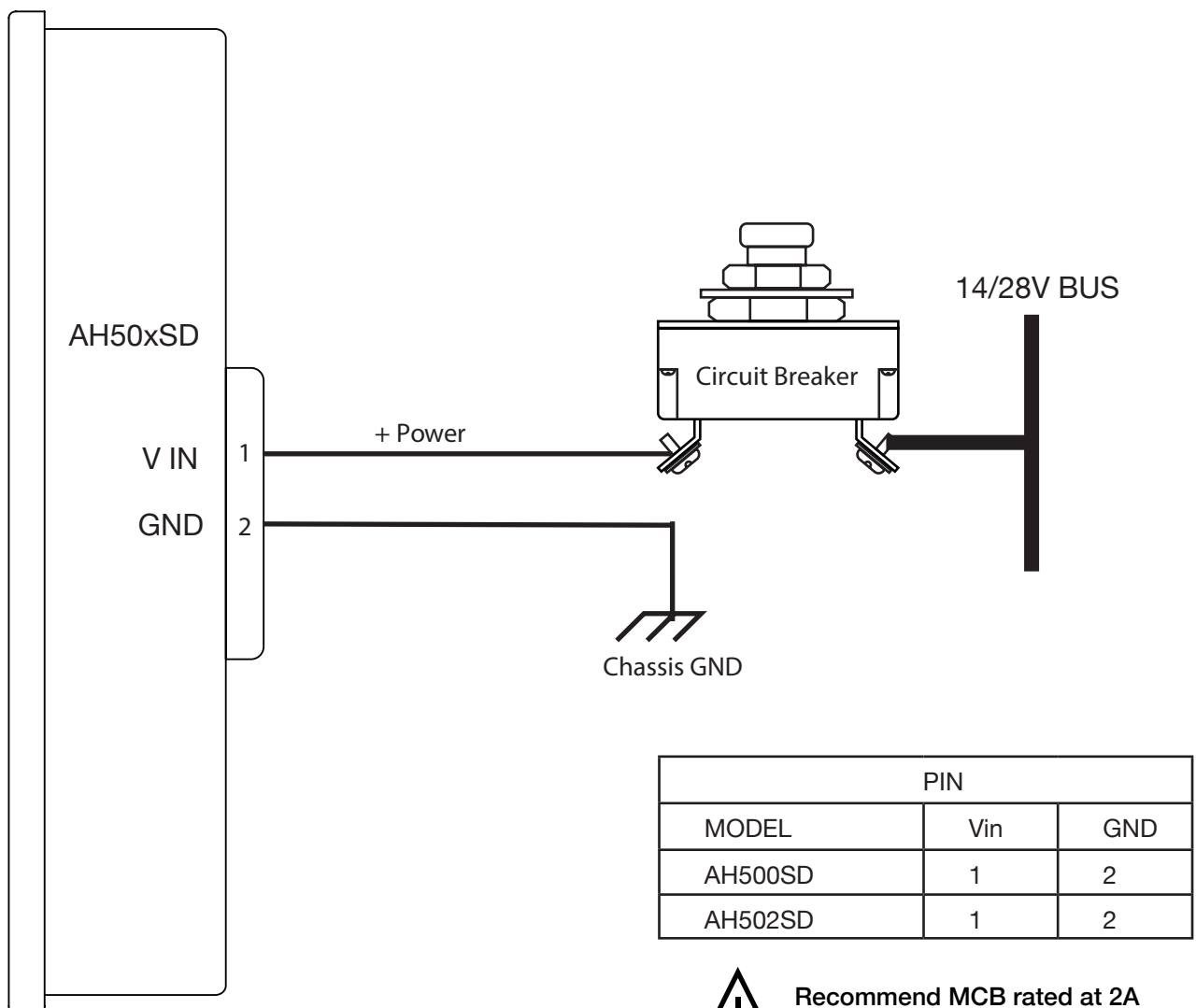
The central warning system should be wired with an MCB to the main master switched bus. It should be automatically switched on with the electrical master switch.



The AH50xSD accepts 10 to 32V DC input and is suitable for both 14 and 28V installations.

It is recommended that the warning panel and any associated and dedicated powered expansion units or dedicated powered sensors are fitted to a single dedicated MCB.

The MCB should be suitably rated to to the expected maximum load and to protect the power wiring.

Note, the AH50xSD also has a '0V' connection - this is a filtered ground used for interfacing and should not be connected to chassis ground.



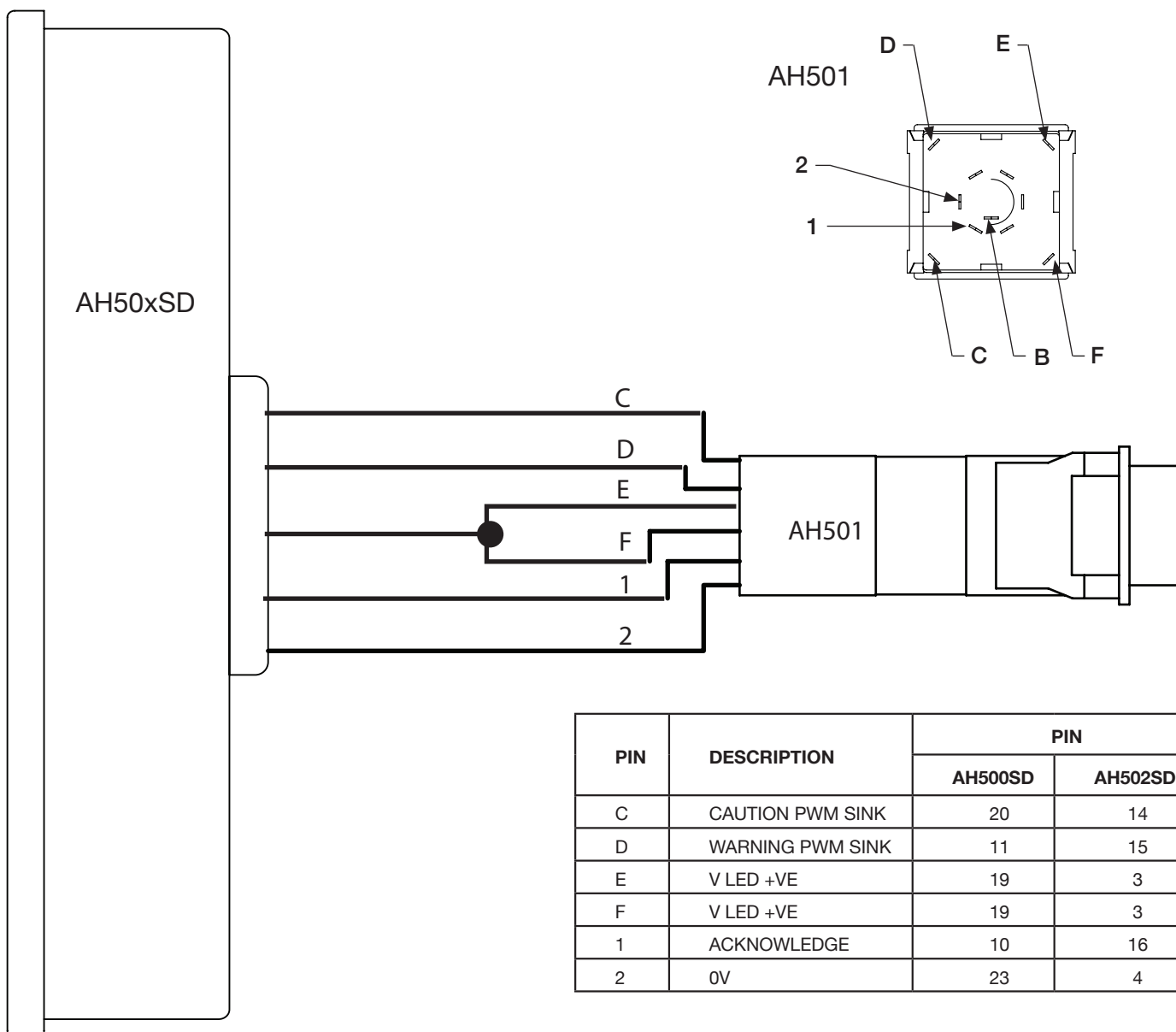
-  Recommend MCB rated at 2A
-  Power and Ground wires after the MCB should be 22AWG

AH501 Interface

The AH501 Master Caution/ Master Warning provides consolidated Warning and consolidated Caution alerts. It should be fitted in front of the pilot close to the top of the panel to attract attention.

The AH501 incorporates a high quality snap action switch to filtered ground (0V) which is used to acknowledge alerts - stopping unacknowledged alerts from flashing and muting voice alerts.

The two captions are supplied with a regulated voltage 'V LED' and brightness is controlled by the AH50xSD using constant current PWM sink pins.



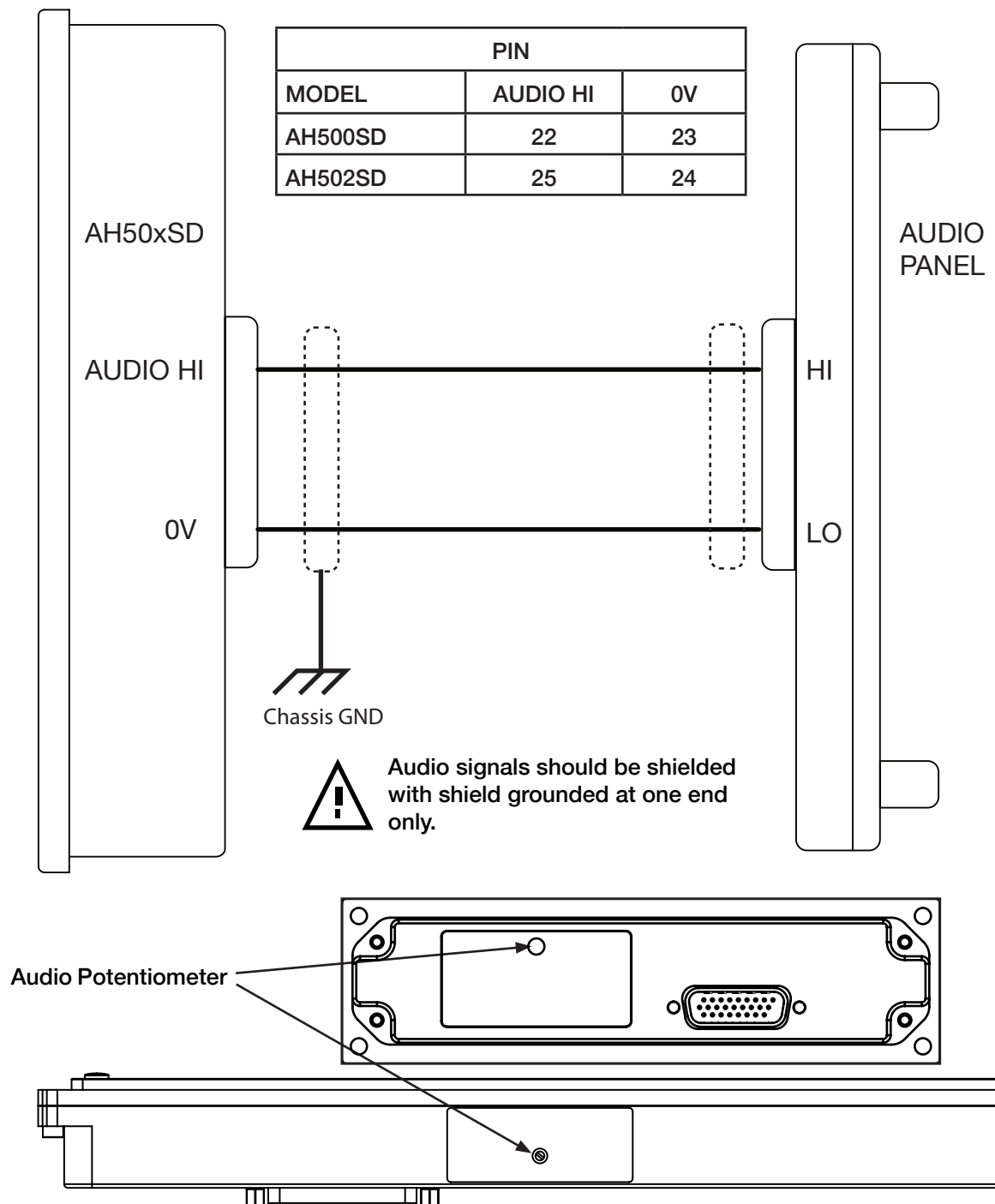
Audio interface

The AH500xD should be connected to an un-switched audio input.

Output volume can be adjusted using the miniature potentiometer exposed within the label and can be tested by pressing the TEST button to generate 'TEST TEST' voice audio.

Audio Wiring

Connect AUDIO HI to an available un-switched audio input Hi. Connect the filtered ground '0V' to the un-switched audio input Lo (if available), if not available, do not connect 0V and ensure both share a good local ground. Ensure shield is grounded to chassis at one end only.



EFIS/ EMS Data Interface

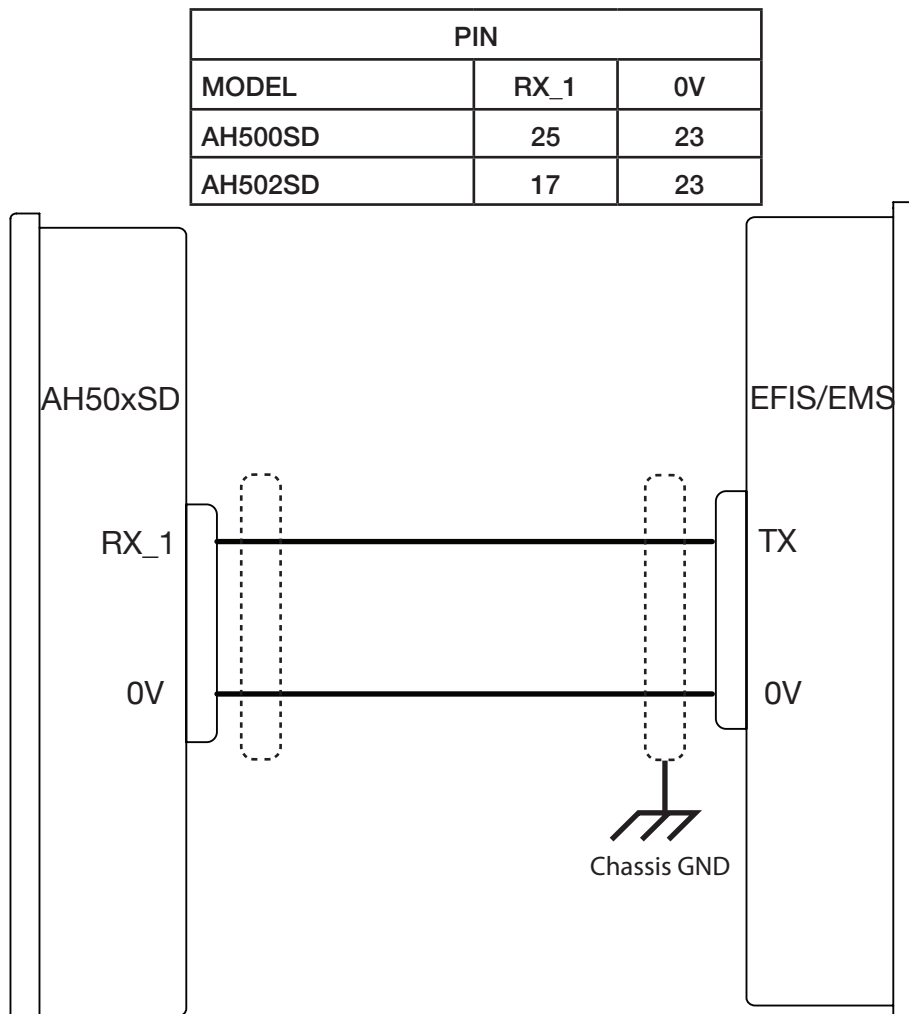
If required, the AH50xSD can interface to most EFIS/EMS using RS232 data. We are continuously increasing the number of supported protocols and will endeavour to support any popular flight or engine system provided the manufacturer publishes their protocol.

At the time of this document being published the system supports Dynon, Garmin, GRT/ Grand Rapids, MGL, Electronics International (EI), Vertical Power, VR Avionics.

Please contact support at support@aerosafetysystems.com if your system is not listed.

EFIS/ EMS Wiring

Connect the AH50xSD RS232 RX to the appropriate TX of the EFIS/EMS using shielded cable. If a filtered '0V' ground is available on the EFIS/EMS connect this to the 0V on the AH50xSD. If not, do not connect 0V and ensure that both units share a good, local chassis ground. Ensure shield is grounded to chassis ground at one end only.



Only connect 0V to EFIS filtered ground (0V). If a filtered ground is not available then do not connect pin 0V to the EFIS/EMS, but ensure the two units share a good local ground.

AH504 Expansion unit interface

The AH50xSD can connect to the AH504 expansion unit over an RS232 data connection.

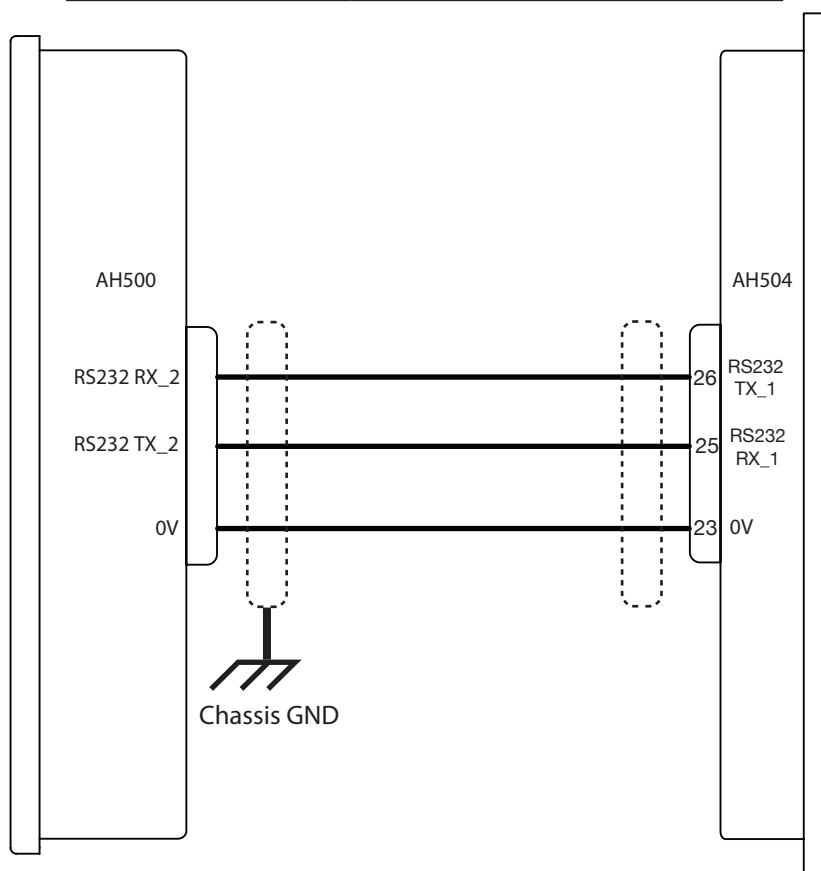
The AH504 provides additional switched and analogue inputs which may be necessary when monitoring aircraft which are not fitted with an EFIS/ EMS, or for complex aircraft where many limit switches and sensors need to be monitored.

AH504 Wiring

Connect AH50xSD RS232 RX to AH504 pin 26 (RS232 TX) with shielded cable. AH50xSD RS232 TX may optionally be connected to AH504 Pin 25 (RX) for potential future functionality enhancement. Ensure that the two units share their filtered ground '0V'.

Ensure the shield is grounded to chassis at one end only.

	PIN		
	RX_2	TX_2	0V
AH500SD	7	4	23
AH502SD	6	5	4



Direct Switched Inputs

Switched inputs overview

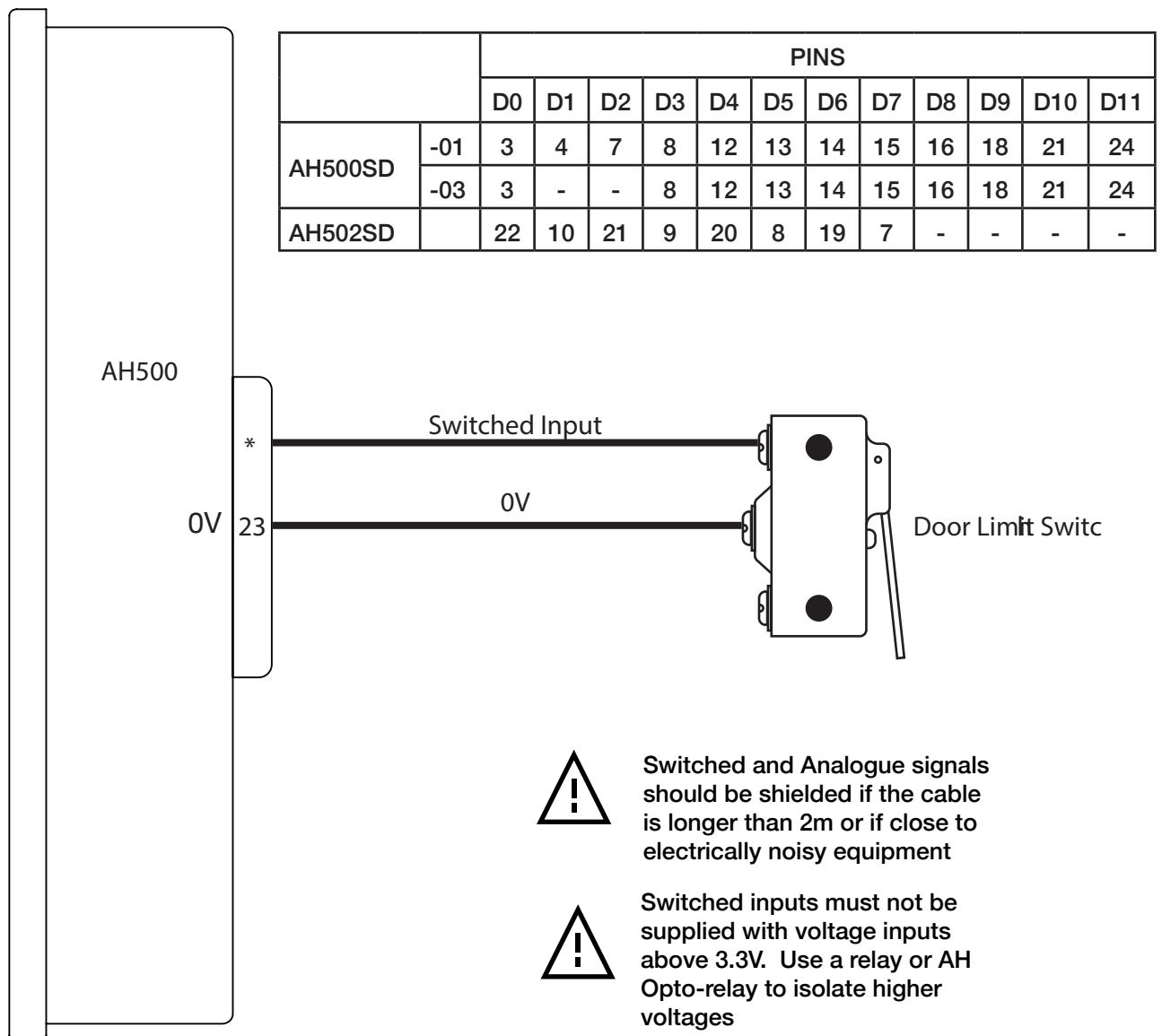
The AH500SD has either 12 or 10 discrete switched inputs depending on whether dual RS232 is supported. The AH502SD has 8 discrete switched inputs D0 to D7.

The switched inputs are designed to detect ‘floating’ open circuit or closed to ground and are ideally used to interface to limit switches and open collector outputs from 3rd party instruments.

By interfacing via a relay or the Aero Safety Systems Opto-Relay, these inputs can also be used to monitor the status of powered circuits, for example starter motors and pumps.

Wiring limit switches

Any available switched input can monitor a switch by connecting one side of the limit switch to filtered ground ‘0V’.

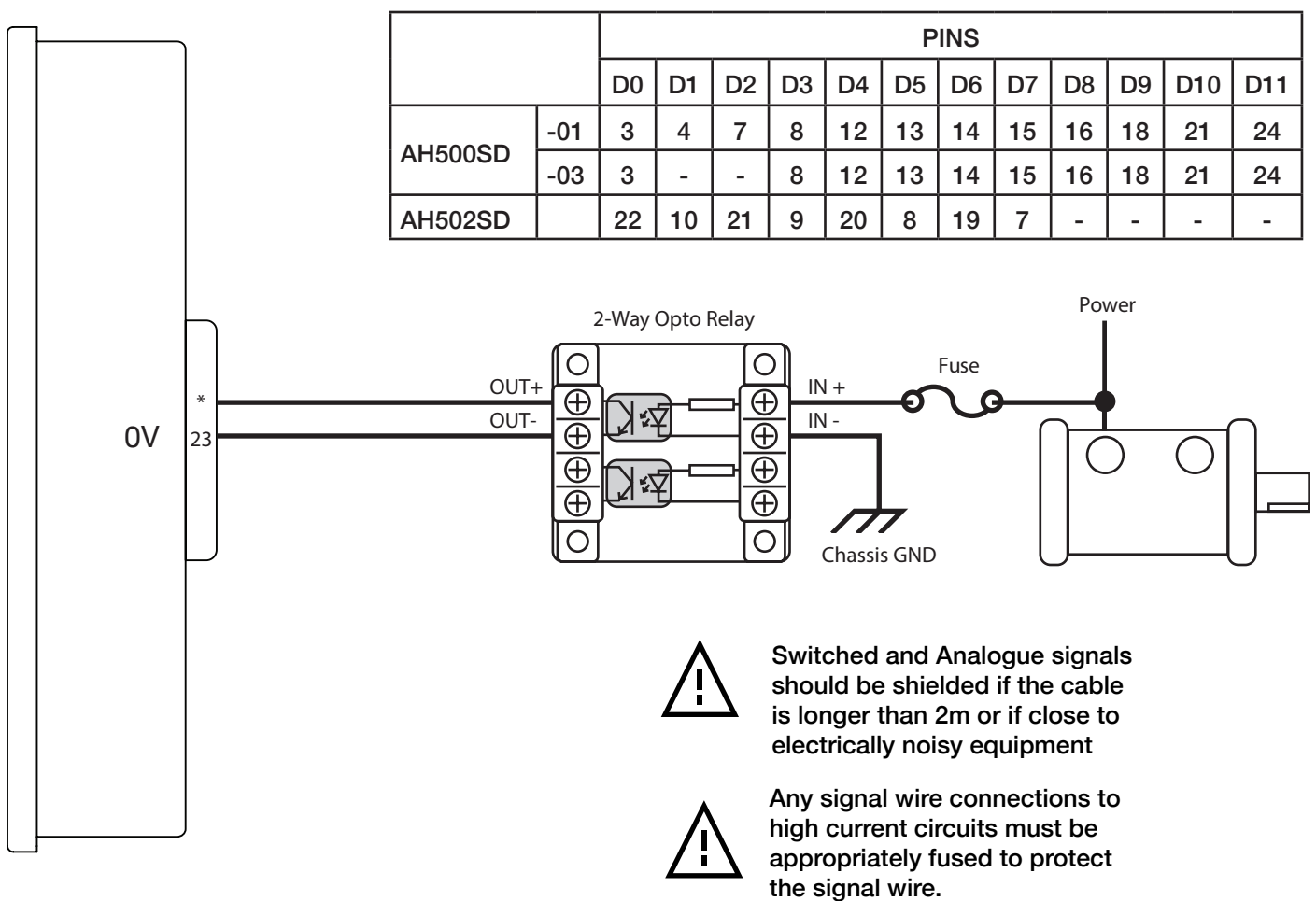


Wiring switched inputs to powered circuits

Any available switched input can monitor the status of a powered circuit using a relay or the Aero Safety Systems Opto-relay to provide full isolation between circuits.

The 2-way opto-relay board is shown in the below example, but any relay that switches the switched input to ground achieves the same objective.

The relay or Opto-Relay should be grounded to filtered ground '0V'.



Analogue Inputs

Analogue inputs overview

The AH500SD has four 0-32V and the AH502SD has two analogue inputs.

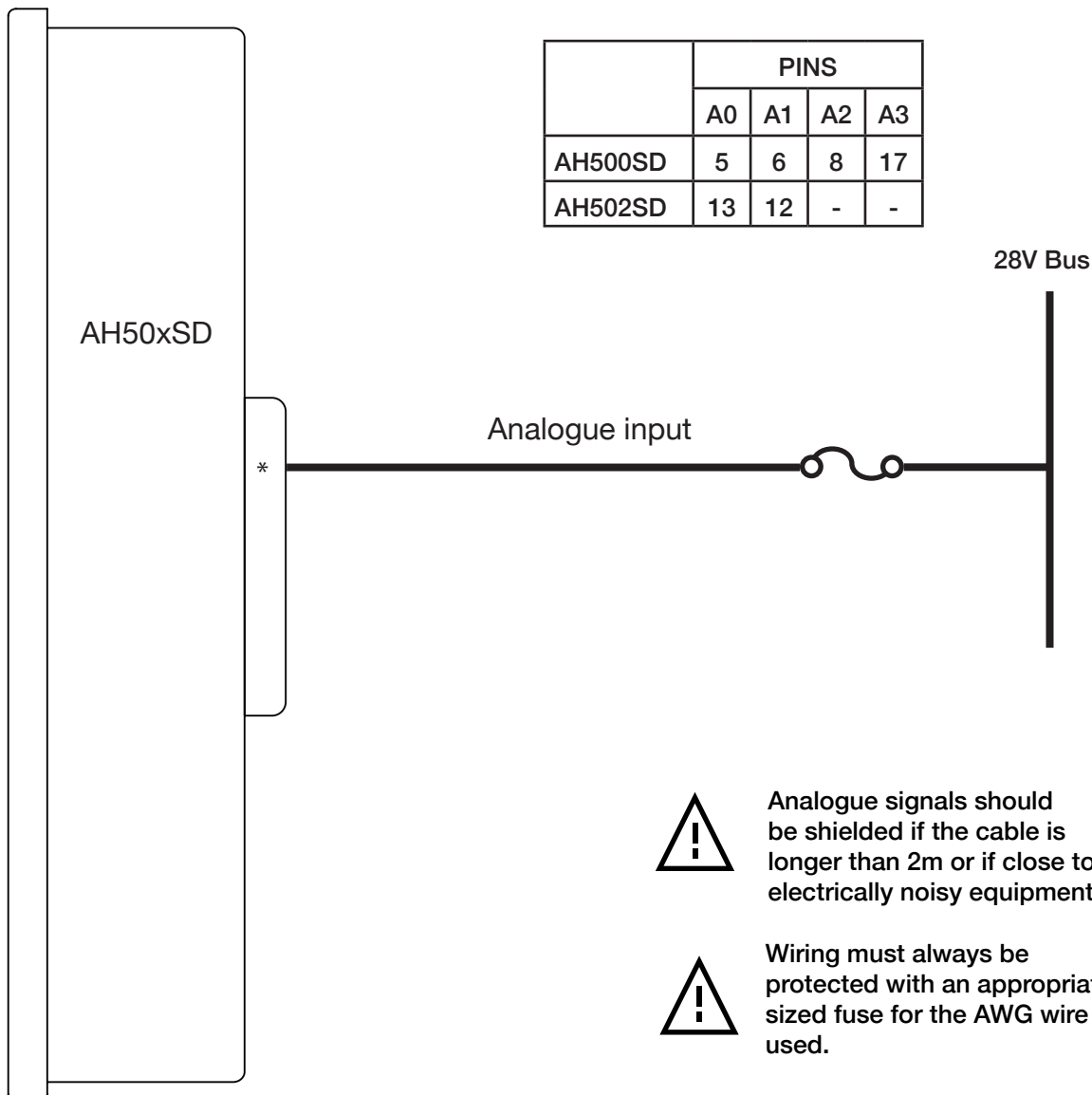
These inputs have a high 0.01V resolution across the input voltage range and can therefore be used to accurately interface to sensors with voltage outputs.

Using the XML configuration and logic file, analogue inputs can be easily calibrated using $y=Ax+B$ to convert voltage into a measured parameter. Examples include temperature senders, pressure senders etc. which can be converted to degrees F or C or PSI or Bar.

Wiring Analogue inputs

Any available analogue input can monitor a 0-32V input. Typically, chassis ground is used as the ground reference, so the filtered '0V' ground should not be connected.

Example - monitoring 28V bus:

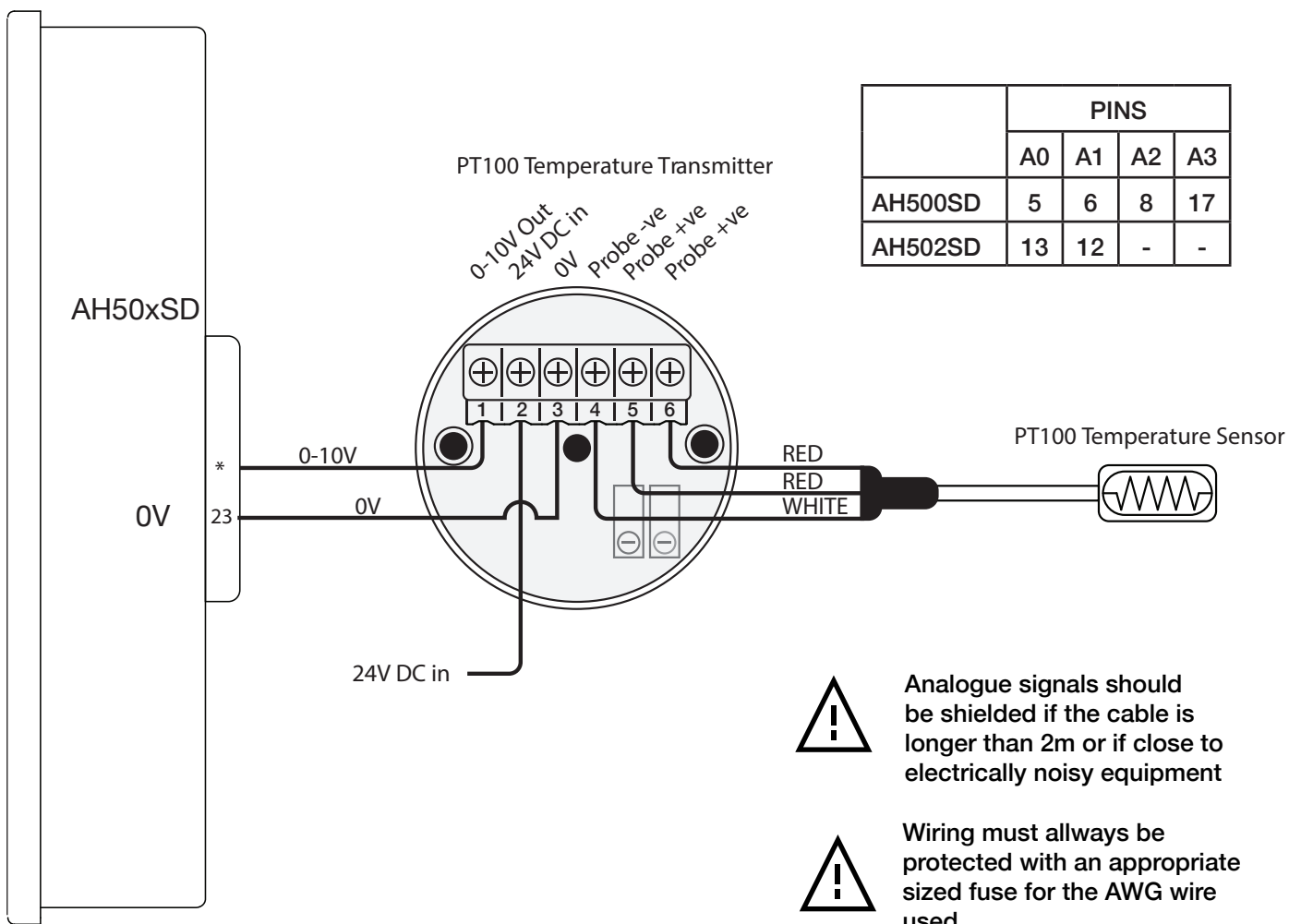


Direct analogue Input (Temperature Probe example)

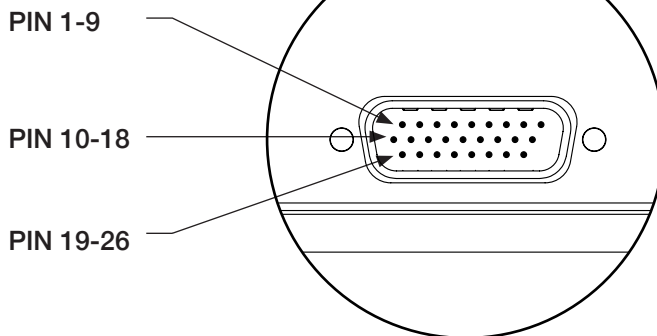
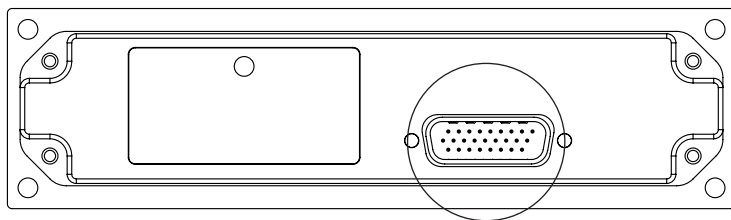
The analogue input can be used to monitor pressure, temperature or any other sensor that outputs a 0-5V or 0-10V output. Being high impedance and high resolution, these inputs can also be used to monitor inputs into ‘steam’ gauges to provide intelligent alerting in aircraft which lack any form of electronic instrumentation. Examples include fuel gauges, temperature gauges and voltage driven pressure gauges.

In most cases it is not necessary to connect filtered ground ‘0V’ since the aircraft chassis ground is the reference ground. In some instances, however, when a precision sensor or sender is connected and where the filtered ground can not be compromised by noise on chassis ground, connecting the filtered ground ‘0V’ to the instrument is recommended (as example below).

In the example below a PT100 temperature probe is used with a PT100 transmitter to output a calibrated 0-10V output of temperature. The XML configuration file is used to capture Ax+B parameters to convert the 0-10V output into degrees temperature.

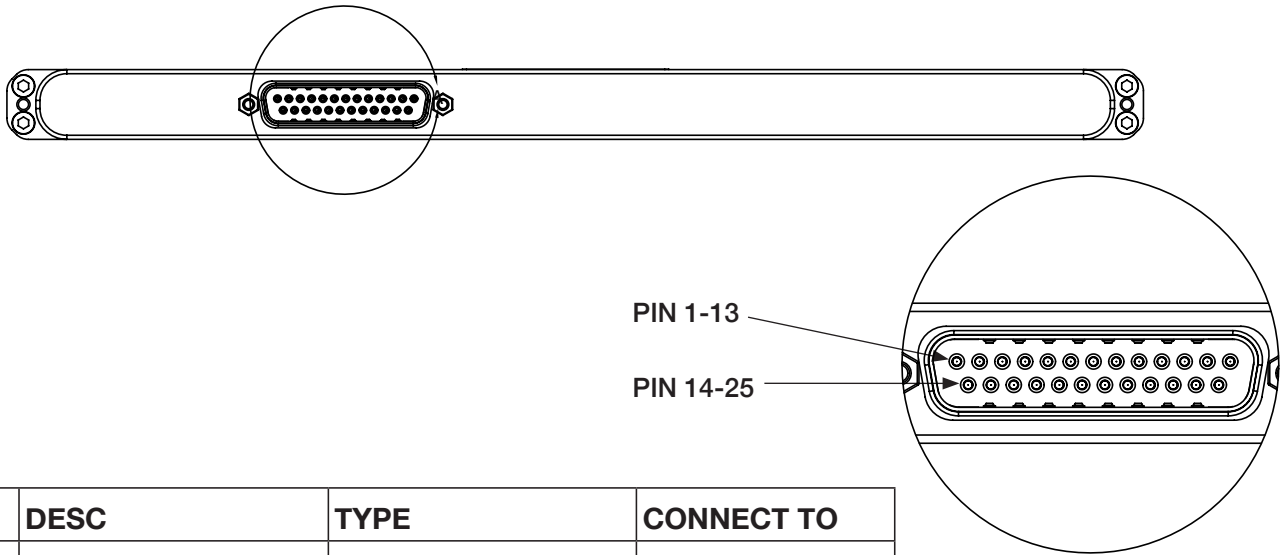


AH500SD Pin Assignment



PIN	DESC	TYPE	CONNECT TO
1	+ve Power	10 to 32V	Aircraft +ve bus
2	Ground	GND	Aircraft GND
3	Digital Input 0	Volt Free Digital Input	
4	Digital Input 1 / RS-232 TX	Volt Free Digital Input or (+/- 5V) EIA/TIA-232 *	AH504 RX Pin 25
5	Analogue Input 0	0 to 32V	
6	Analogue Input 1	0 to 32V	
7	Digital Input 2 / RS-232 RX	Volt Free Digital Input or (+/- 5V) EIA/TIA-232 *	AH504 TX Pin 26
8	Digital Input 3	Volt Free Digital Input	
9	Analogue Input 2	0 to 32V	
10	Acknowledge Input	Volt Free Digital Input	AH501 Pin 1
11	AH501 'Warning' Sink	LED AH501 PWM Current sink	AH501 Pin D
12	Digital Input 4	Volt Free Digital Input	
13	Digital Input 5	Volt Free Digital Input	
14	Digital Input 6	Volt Free Digital Input	
15	Digital Input 7	Volt Free Digital Input	
16	Digital Input 8	Volt Free Digital Input	
17	Analogue Input 3	0 to 32V	
18	Digital Input 9	Volt Free Digital Input	
19	V LED Out	AH501 VLED (10V)	AH501 Pin E & F
20	AH501 'Caution' Sink	LED AH501 PWM Current sink	AH501 Pin C
21	Digital Input 10	Volt Free Digital Input	
22	Audio Hi		
23	0V		
24	Digital Input 11	Volt Free Digital Input	
25	RS-232 RX	(+/- 5V) EIA/TIA-232	EFIS/EMS TX
26	RS-232 TX	(+/- 5V) EIA/TIA-232	EFIS/EMS RX

AH502SD Pin Assignment



PIN	DESC	TYPE	CONNECT TO
1	+ve Power	10 to 32V	Aircraft +ve bus
2	-ve Power	0V	Aircraft -ve bus
3	V LED	AH501 VLED +ve	AH501 Pin E & F
4	0V	0V	
5	RS-232 TX	(+/- 5V) EIA/TIA-232	AH504 RX Pin 25
6	RS-232 RX	(+/- 5V) EIA/TIA-232	AH504 TX Pin 26
7	Digital input 7	Floating or High Active	
8	Digital input 5	Floating or High Active	
9	Digital input 3	Floating or High Active	
10	Digital input 1	Floating or High Active	
11	0V	0V	
12	Analogue input 1	0 to 32V	
13	Analogue input 0	0 to 32V	
14	AH501 'Caution' Sink	LED AH501 PWM Current sink	AH501 Pin C
15	AH501 'Warning' Sink	LED AH501 PWM Current sink	AH501 Pin D
16	Acknowledge input	Low active	AH501 Pin 1
17	RS-232 TX	(+/- 5V) EIA/TIA-232	EFIS/EMS RX
18	RS-232 RX	(+/- 5V) EIA/TIA-232	EFIS/EMS TX
19	Digital input 6	Floating or High Active	
20	Digital input 4	Floating or High Active	
21	Digital input 2	Floating or High Active	
22	Digital input 0	Floating or High Active	
23	0V	0V	
24	AUDIO_RETURN	Audio -ve	
25	AUDIO_OUT	Audio +ve	

Alert Logic

Overview

The AH50xSD can easily be configured to suit any aircraft, can generate both simple and complex alerting logic and logic can easily be modified.



Aero Safety Systems are happy to provide a free service to support you creating the XML files. Please use the configuration form at the end of this section to document your requirements and email this to support.

For the more distributors and more technical customers, this section provides more detail on how the alerts are programmed. Programming the system can be done by writing or modifying a 'human readable' text file. The text file maps inputs to audio and visual outputs with logic and delay functions which enable both simple and complex alerts to be generated.

The text file is a structured format known as XML (eXtended Markup Language). The files can be viewed in web browsers, but it is best to edit the file using an XML editor of which there are many available.

In this section we explain XML logic creation using examples based on AH500 only. AH502 logic is the same, except reference inputs with 'AH502'.

Generating alerts with switched inputs

A caption "Low_Fuel" is in the Annunciator `visual_a` grid position "A1". It is associated with the AH501 Master Warning/ Caution `visual_b` grid position "M1" (Warning). The visual and audio alert is generated when a low fuel sensor closed "not" for more than `delay "10"` seconds. It plays audio file name "warning_low_fuel". The logic is applied by monitoring "input" "AH500_D0".

A second caption "Check_Doors" is in `visual_a` grid position "B3". It is associated with the AH501 Master Warning/ Caution `visual_b` Caution, grid position "M2". The visual and audio alert is generated when a door limit switch is open "pass" for more than `delay "1"` seconds. It plays audio file name "caution_canopy_open". The logic is applied by monitoring "input" "AH500_D3".

```
<legends>
  <legend name="Low_Fuel" visual_a="A1" visual_b="M1">
    <fn name="not" delay="10" audio="warning_low_fuel">
      <fn name="input" field="AH500_D0" />
    </fn>
  </legend>
  <legend name="Check_Doors" visual_a="B3" visual_b="M2">
    <fn name="pass" delay="1" audio="caution_canopy_open">
      <fn name="input" field="AH500_D3" />
    </fn>
  </legend>
</legends>
```

All XML files must start with `<legends>` and end with `</legends>`

Each individual caption alert must start with `<legend>` and end with `</legend>`

Each opening function `<fn` line must be matched with a closing `</fn>` line.

Generating analogue alerts with external data input

In this simple example a low oil pressure alert in caption "A2" with Master warning "M1" and audio file "Low_Oil_Pressure" is generated when G3X Oil Pressure "G3X_ENG_Oil_Pressure" is below the threshold constant `name="const" value="25"` PSI for longer than 10 seconds.

```
<legends>
  <legend name="Low_Oil_Pressure" visual_a="A2" visual_b="M1">
    <fn name="less" delay="10" audio="Low_Oil_Pressure">
      <fn name="input" field="G3X_ENG_Oil_Pressure" />
    </fn>
    <fn name="const" value="25" />
  </fn>
</legend>
</legends>
```

Generating analogue alerts with direct inputs

Directly connected analogue inputs require factoring since the device uses 'raw' Analogue to Digital (A:D) values.

To convert the A:D to voltage, use the multiply function `name="multiply"` to multiply the directly connected analogue input `name="input" field="AH500_A1"` by a factor `name="const" value="0.0078493"`. The factor must be the value 0.0078493 to compare voltage inputs with voltage thresholds.

```
<legends>
  <legend name="Low_Volts" visual_a="D2" visual_b="M2">
    <fn name="less" delay="10" audio="Low_Volts">
      <fn name="multiply" >
        <fn name="input" field="AH500_A1" />
        <fn name="const" value="0.0078493" />
      </fn>
    <fn name="const" value="24.5" />
  </fn>
</legend>
</legends>
```

Full $Ax + B$ conversion factors can be carried out to convert sensor and transmitter data into the correct units for applying human understandable threshold values. Examples are provided on the next page.

Please contact support for any clarification and assistance in writing XML files.

Applying conversion factors to analogue inputs

Some analogue values in external data is provided in units that need to be converted. For example the Garmin G3X airspeed `field="G3X_ENG_Airspeed"` is provided in units of 0.1Knots. In the first example below, the airspeed value is first multiplied by `value="0.1"` to convert to knots, before comparing to the threshold constant `value="180"` (kn). Note use of `"greater"` in this example.

In the second example below, a directly connected analogue input `field="AH500_A0"` needs to be scaled using both `"multiply"` and `"add"` functions to convert a PT100 temperature transmitter 0-10V output into degrees Fahrenheit. A 'pitot heat needed' alert is generated when temperature falls below 45.

```

<legends>
  <legend name="Speed" visual_a="C4" visual_b="M2">
    <fn name="greater" delay="10" audio="VNE_Exceeded">
      <fn name="multiply" >
        <fn name="input" field="G3X_ENG_Airspeed" />
        <fn name="const" value="0.1" />
      </fn>
      <fn name="const" value="180" />
    </fn>
  </legend>
  <legend name="Pitot_Heat" visual_a="D3" visual_b="M2">
    <fn name="less" delay="5" audio="Pitot_Heat_Needed">
      <fn name="add" >
        <fn name="multiply" >
          <fn name="input" field="AH500_A0" />
          <fn name="const" value="0.21193" />
        </fn>
        <fn name="const" value="31.3642" />
      </fn>
      <fn name="const" value="45" />
    </fn>
  </legend>
</legends>

```

Please contact support if you need help establishing the appropriate constants for conversion.

Using OR logic

Or logic `name="or"` can be used to allow one caption to be associated with multiple voice alerts.

In this example, OR is applied to generate different voice alerts for pilot door and co-pilot.

A common caption 'CHECK DOORS' caption in position B1 is associated with a common Master Caution for all alerts that follow. The function `name="or"` is used to trigger the caption and master warning if any logical test grouped below it is active. Each logical test has it's own audio file.

In this example a different voice alert is played when the pilot door is opened than when the co-pilot door is opened. If both are open, both voice alerts play in sequence. If one door is opened and acknowledged, opening the second door will re-activate the caption and master caution.

```
<legends>
  <legend name="Check_Doors" visual_a="B1" visual_b="M2">
    <fn name="or">
      <fn name="pass" delay="1" audio="caution_pilot_door_open">
        <fn name="input" field="AH500_D0" />
      </fn>
      <fn name="pass" delay="1" audio="caution_copilot_door_open">
        <fn name="input" field="AH500_D1" />
      </fn>
    </fn>
  </legend>
</legends>
```

Using AND logic

AND logic `name="and"` enables an alert to depend upon multiple input conditions using many different parameters. By example, a simple gear alert.

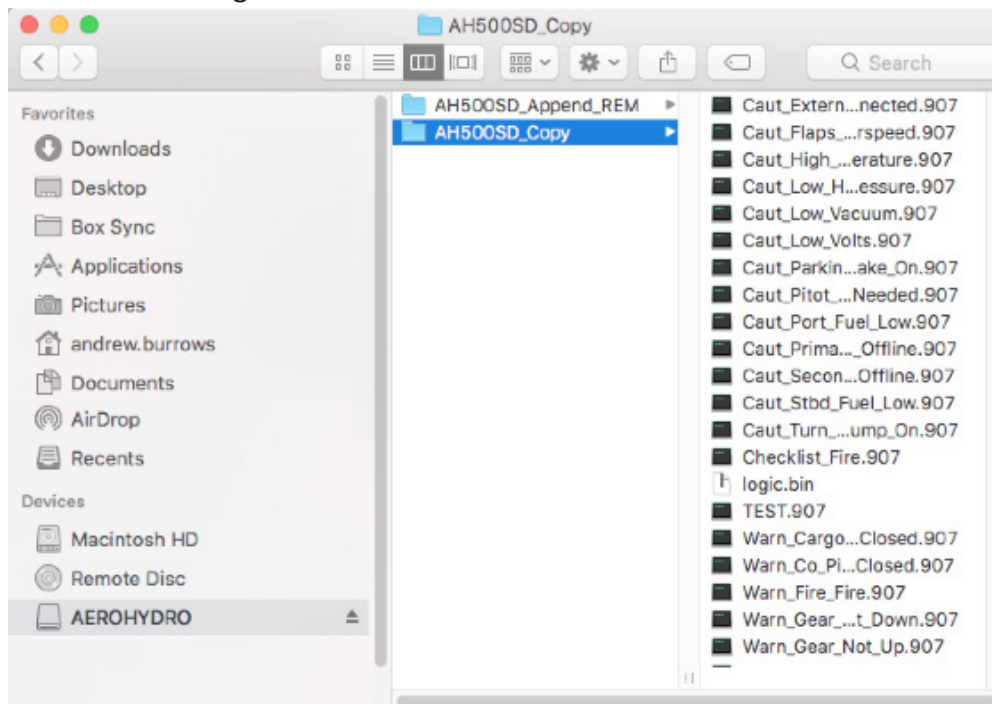
Alert and voice 'lower landing gear' is triggered if gear selector is not down (switched input D7) AND airspeed is less than 90knots.

```
<legends>
  <legend name="Check_Gear" visual_a="A3" visual_b="M1">
    <fn name="and" delay="3" audio="Lower_Landing_Gear" >
      <fn name="not" >
        <fn name="input" field="AH500_D7" />
      </fn>
      <fn name="less" >
        <fn name="multiply" >
          <fn name="input" field="G3X_ENG_Airspeed" />
          <fn name="const" value="0.1" />
        </fn>
        <fn name="const" value="90" >
      </fn>
    </fn>
  </legend>
</legends>
```

Programming logic and audio into the unit

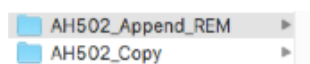
Initial logic and audio install AH500SD

1. Convert the XML into a 'logic.bin' file using the Aero Safety Systems utility software
2. Gather any new or modified .907 audio files
3. Create a directory 'AH500SD_Copy' in the root directory of a FAT16 formatted micro SD card (not SDHC) and remove or rename 'AH500SD_Append' if present
4. Put the logic.bin and all related .907 files into this directory
5. Without the SD card in the reader, the power should be cycled whilst holding the 'TEST' button until the red status light flashes slowly.
6. Release the TEST button.
7. Insert the SD card into the SD card holder located on the side of the unit carefully until it clicks into position.
8. The status LED flashes rapidly while files are copying. This can take several minutes if a large number of audio files are being transferred.
9. When the LED returns to slow flashing, remove the SD card
10. Power cycle.
11. The new logic and audio files are now in the device.
12. Thoroughly test and flight test the unit to ensure that all inputs are correctly wired and there are no errors in the logic



Initial logic and audio install AH502SD

The AH502SD process is the same except for stage 3 where the directory name AH502_Copy, and remove or rename AH502_Append.

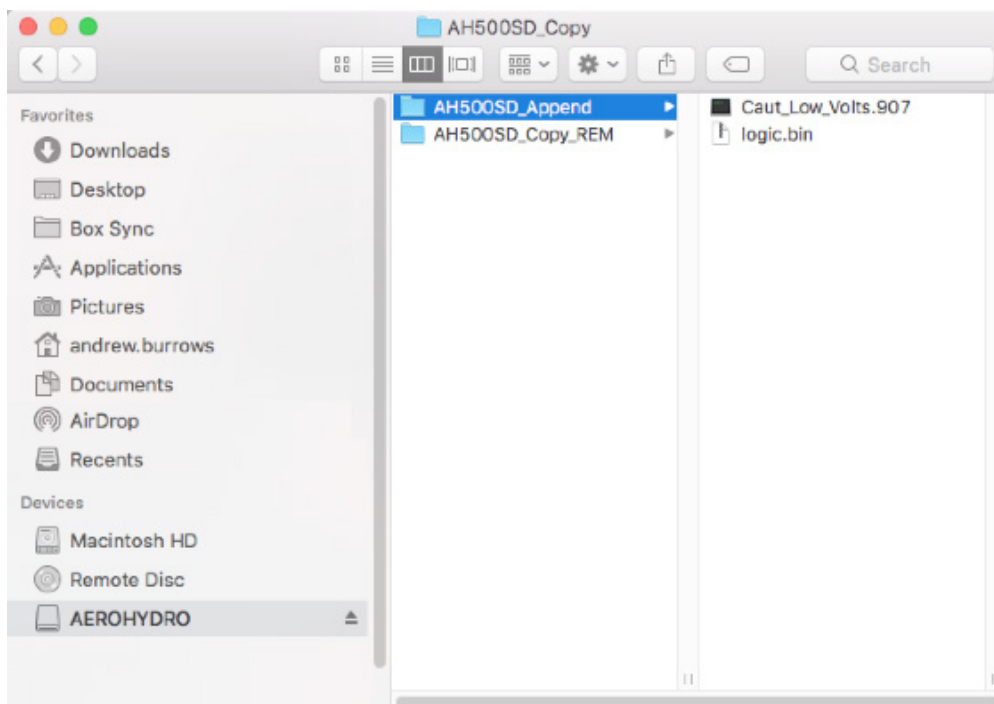


Note - The SD card holder is on the front of the AH502 - insert carefully until it clicks into position.

Append logic or audio AH500SD

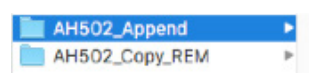
The logic and/or individual audio files can be modified without changing all files.

1. If modified, convert the XML into a 'logic.bin' using the utility software
2. Gather any new or modified .907 audio files
3. Create a directory 'AH500SD_Append' in the root directory of a FAT16 formatted micro SD card (not SDHC) and remove or rename 'AH500SD_Copy' if present
4. Put only modified logic.bin and/or .907 files into this directory
5. Without the SD card in the reader, power cycle while holding the 'TEST' button until the red status light flashes slowly.
6. Release the TEST button.
7. Insert the SD card into the SD card holder located on the side of the unit carefully until it clicks into position.
8. The status LED flashes rapidly while files are copying. This may be quick if it's just the logic.bin file.
9. When the LED returns to slow flashing, remove the SD card
10. Power cycle.
11. The new logic and audio files are now in the device.
12. Thoroughly test and flight test the unit to ensure that all inputs are correctly wired and there are no errors in the logic



Append logic or audio AH502SD

The AH502SD process is the same except for stage 3 where the directory name AH502_Append, and remove or rename AH502_Copy.



Note - The SD card holder is on the front of the AH502 - insert carefully until it clicks into position.

Customer support form

Name	Phone	Email	Aircraft	EFIS/EMS		Page	Revision

REF	Caption text	Caption location	MW/MC	Logic	Delay	Audio file
-	EXAMPLE	A1	WARN	AH500_D0 Open [AND] G3X_Airspeed <85KN	0s	Gear_not_down
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
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25						

Limited Warranty/Agreement

“Aero Safety Systems” by AeroHydro Consulting Ltd

AeroHydro Consulting Ltd (hereinafter referred to as “AH”) ‘Aero Safety Systems’ products are secondary safety enhancing information devices which are supplementary to primary engine, configuration and flight information controls and displays. They are designed for experimental aircraft and non-certified aircraft.

Limited Warranty and Agreement

1. Whilst AH devices have been carefully designed, manufactured and tested to AeroHydro Consulting Ltd high quality standards, they have not been subject to any official safety or durability testing, and thus do not conform to aeronautical standards or regulations prescribed by any governmental or certifying authority.
2. It is the responsibility of the aircraft owner to ensure that AH devices are installed, configured and operated such that all essential-for-safe-flight engine, configuration and flight information remain available to the pilot at all times. It is the responsibility of the aircraft owner to install and configure AH devices in such a way as to ensure that any failure of AH devices so fitted will not compromise safety.
3. The aircraft owner and pilots in command assume all risk of use and acknowledge by their operation of the aircraft so fitted that they understand that AH devices are supplementary and secondary advisory information systems, which complement but do not replace primary engine, flight and configuration information.
4. AH warrants its devices and system components to be free from defects in materials and workmanship for a period of two years from the Warranty Commencement Date. The Warranty Commencement Date is defined as:
 - The day the product is shipped to the end customer if purchased directly from AH.
 - The date of retail sale if purchased through an authorized AH dealer.
 - The date delivery is taken of an aircraft that comes factory-equipped with an AH instrument already installed.
5. AH will, at its sole discretion, repair, replace or fully refund the purchase price of any AH device or component that fails in normal use and operated within the specified operating limitations. Such repairs or replacement will be made at no charge to the customer for parts or labour supplied by AH. THIS WARRANTY DOES NOT COVER SHIPPING COSTS OR ANY REIMBURSEMENT FOR ANYONE’S TIME OR MATERIALS FOR INSTALLATION, REMOVAL, ASSEMBLY OR REPAIR.

5. This Warranty shall not apply to any device or component that has been repaired, modified, or altered in any way by any person other than an approved AH installer, or that has been subjected to misuse, abuse, accident, incorrect wiring, or improper or unprofessional installation by any person.
6. AH cannot be held liable for expenses incurred by the customer or installer resulting from replacement or repair of AH devices under warranty, or AH official updates, modifications, improvements, upgrades, changes, notices or alterations to the product.
7. The pilot and aircraft owner must be fully familiar with the operation and technical limitations of any installed AH device before flight. It is the aircraft owners responsibility to ensure that anyone who operates an aircraft with AH devices installed is fully familiar with the operation of such devices. The pilot operating manual for installed AH devices must be kept in the aircraft at all times.
8. INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THIS INSTRUMENT OR FROM ANY DEFECTS IN THE PRODUCT ARE NOT COVERED BY THIS WARRANTY, AND ARE SPECIFICALLY EXCLUDED.
9. CONSEQUENTIAL DAMAGES, SUCH AS DAMAGE TO THE ENGINE, AVIONICS OR AIRCRAFT, ARE NOT COVERED BY THIS WARRANTY, AND ARE SPECIFICALLY EXCLUDED.
10. DAMAGES FOR PHYSICAL INJURY TO PERSON OR PROPERTY ARE NOT COVERED BY THIS WARRANTY, AND ARE SPECIFICALLY EXCLUDED.
11. THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE, AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY LIABILITY ARISING UNDER WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE.
12. Warranties are transferable to subsequent owners of AH instruments, subject to the above conditions.
13. IF YOU DO NOT AGREE TO ACCEPT THE TERMS OF THIS WARRANTY, DO NOT INSTALL THE INSTRUMENT AND RETURN IT FOR A FULL REFUND.