H2scan
ADVANCED HYDROGEN SENSING

OPERATION MANUAL

GSAO-2

Control Hub

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IMPORTANT NOTICES

Read and understand this operation manual before installing or using the unit.

Use of this equipment in a manner not specified by H2scan may void the warranty.

LIMITATION OF LIABILITY - seller shall under no circumstances be liable for any incidental, consequential, special, punitive, or other damages, including, but not limited to, loss of business or profit, promotional or manufacturing expenses, injury to reputation, or loss of customer, based on any alleged negligence, breach of warranty, strict liability, breach of contract, or any other legal theory arising out of the use, misuse, purchase, sale or possession of its goods or its performance of this contract to the extent that such liability extends seller's obligations beyond the price paid by buyer to seller for the item on which such claim is based. Seller advises buyer to perform acceptable tests on all hardware prior to deployment and to perform maintenance as described in the seller's instruction guide. Under no circumstances shall the equipment provided hereunder be used in a manner where it is the sole protective system for facilities, equipment, and personnel safety; the equipment is intended for use in conjunction with other appropriate protective systems.

LIMITED WARRANTY

H2scan Limited Warranty: Each GSAO-2 Control Hub ("Product") will conform, as to all substantial operational features, to the Product specifications set forth in this Manual and will be free of defects which substantially affect such Product's performance for 36 months from the ship date for such Product.

Must Provide Notice of Defect: If you have a Product that you believe is defective, you must notify H2scan in writing, within the warranty period of your claim regarding any such defect.

Return Product to H2scan for Repair, Replacement or Credit: The customer is responsible for shipping and handling costs. If the Product is found defective by H2scan, H2scan's sole obligation under this warranty is to either (i) repair the Product, (ii) replace the Product, or (iii) issue a credit for the purchase price for such Product, the remedy to be determined by H2scan on a case-by-case basis. A valid RMA number must be assigned by H2scan and clearly marked on the package when the unit is returned.

Voided Warranty: H2scan's 36-Month Limited Warranty is void for any of the following:

- Unauthorized repair work of the GSAO-2 Control Hub performed at the customer's location or conducted by anyone other than H2scan's factory trained technicians.
- Equipment or parts that have been tampered with, misused, neglected, mishandled, improperly adjusted, or modified in any way without the written consent of H2scan.
- Equipment or parts that have been damaged due to shipping, misuse, accidents, mishandling, neglect, or problems with electrical power sources.
- Repair work performed during the warranty period does not prolong the warranty period past the original period.
- System operation in incorrect or inappropriate environments.
- Usage that is not in accordance with system guidelines or an operator's failure to follow manual instructions.

Limitation of Warranty: THE ABOVE IS A LIMITED WARRANTY AS IT IS THE ONLY WARRANTY MADE BY H2SCAN. H2SCAN MAKES NO OTHER WARRANTY EXPRESSED OR IMPLIED AND EXPRESSLY EXCLUDES ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. YOUR SOLE REMEDY HEREUNDER IS REPAIR OR REPLACEMENT OF THE PRODUCT OR A CREDIT FOR THE PURCHASE PRICE FOR SUCH PRODUCT, THE PARTICULAR REMEDY TO BE DETERMINED BY H2SCAN ON A CASE-BY-CASE BASIS. H2SCAN SHALL HAVE NO LIABILITY WITH RESPECT TO ITS OBLIGATIONS UNDER THIS AGREEMENT FOR CONSEQUENTIAL, EXEMPLARY, OR INCIDENTAL DAMAGES, EVEN IF IT HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE STATED EXPRESS WARRANTY IS IN LIEU OF ALL LIABILITIES OR OBLIGATIONS OF H2SCAN FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE DELIVERY, USE OR PERFORMANCE OF THE PRODUCTS.

1. INTRODUCTION

The H2scan GSAO-2 Control Hub serves as a unified alarm and power supply system for GRIDSCAN® hydrogen multi-sense monitors and sensors that detect other environmental conditions.

With four low-power alarm relays NO/NC or user-configurable to support hydrogen alarm, temperature alarm, moisture alarm, pressure alarm, and power status, the control hub supports one hydrogen sensor for transformer applications on the RS-485 loop. The GSAO-2 can be ordered with an AC or DC power supply.

The gasket-sealed, precision die-cast enclosure with its sealed, chemically strengthened, UV-resistant glass window and cable gland fittings comprises a system rated for IP66 for water and dust ingress.

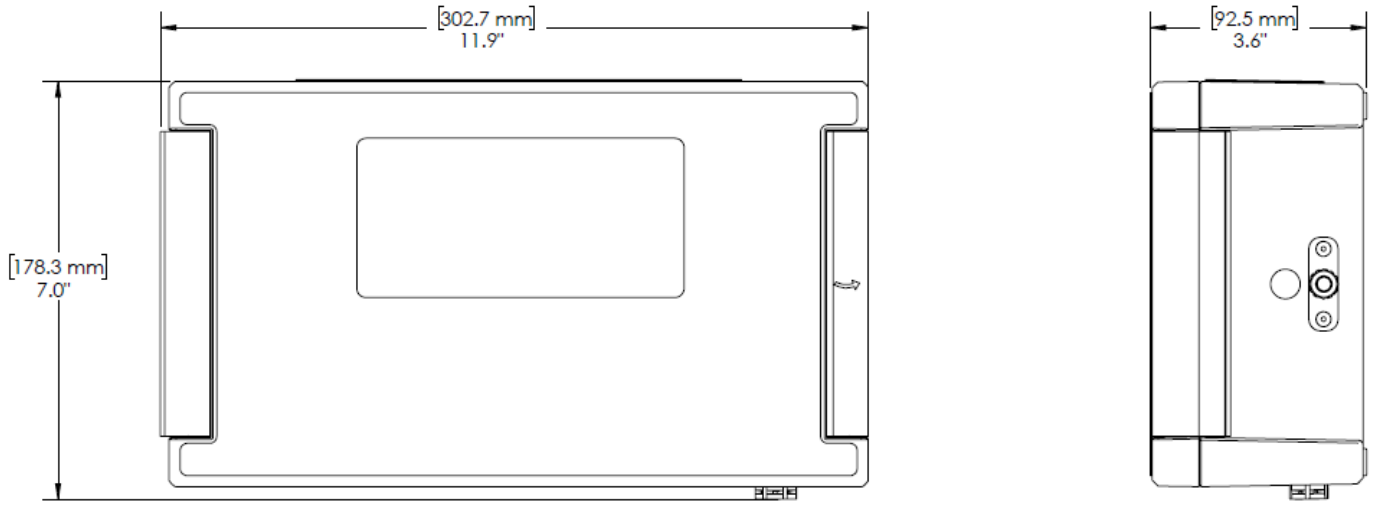


Figure 1: GSAO-2 Dimensions

2. PRE-INSTALLATION REQUIREMENTS

2.1 BOX CONTENTS

Every GSAO-2 Control Hub is shipped with the following:

- Seven Phoenix connectors that mate to the PCBA
- Six 0.5" NPT plugs
- Quick-Start Guide with drill hole template
- Four 0.5" lock nuts and o-rings
- Two 0.5" NPT cable glands
- One 3 mm hex L key
- One 3 m power cord
- One package containing four #10 stainless steel sheet metal screws and six star washers
- Thirteen cable ties for dressing wires

2.2 INSTALLATION TOOLS

The end user must provide the following tools:

- Portable drill for pilot holes and driving mounting screws
- 3 mm (0.125") drill bit for drilling pilot holes into metal
- Bit extender for driving mounting screws

- #2 Phillips head drive bit to drive the mounting screws with drill
- Adjustable wrench to tighten gland fittings
- Wire cutters to trim wires to length and trim cable ties
- Wire strippers to prepare wires for connection
- Marker or pencil to mark hole locations and wire cut lengths

2.3 OPTIONAL ACCESSORIES

Various accessories are available for purchase prior to installation. Please visit the H2scan GSAO-2 accessories page. For end user-supplied cables for specific operations, refer to section 3.5.

3. INSTALLATION

3.1 MOUNTING

The GSAO-2 Control Hub can easily be mounted to panels, plates, Unistrut, or wedge anchors into concrete and masonry. Alternately, H2scan provides a magnetic mounting plate as an accessory for purchase.

For installation, refer to the included Quick-Start Guide.

NOTE: Mount the GSAO-2 within ±10° of level.

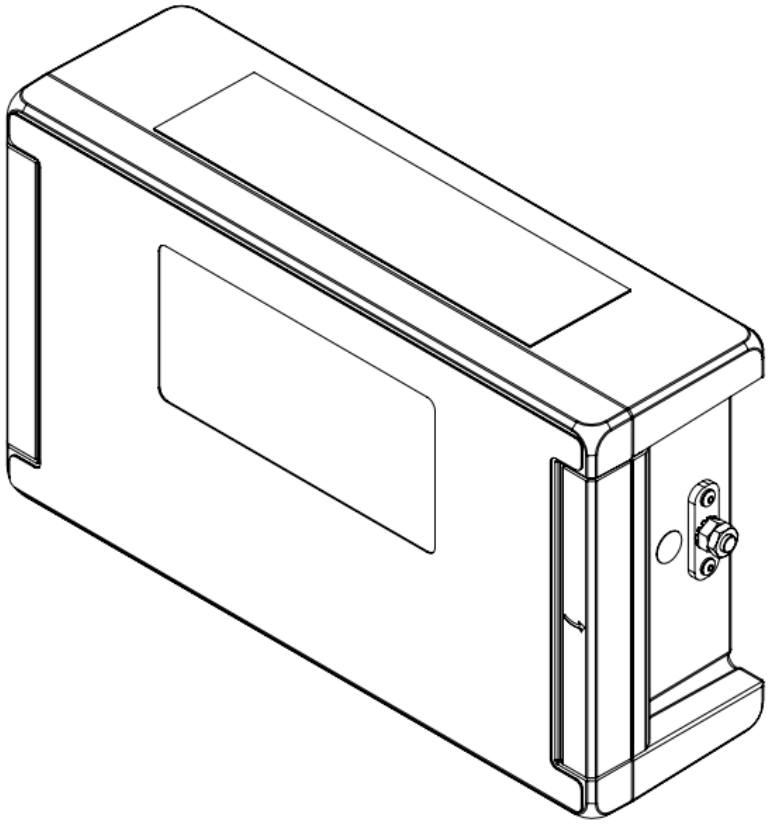


Figure 2: Standard Mounting

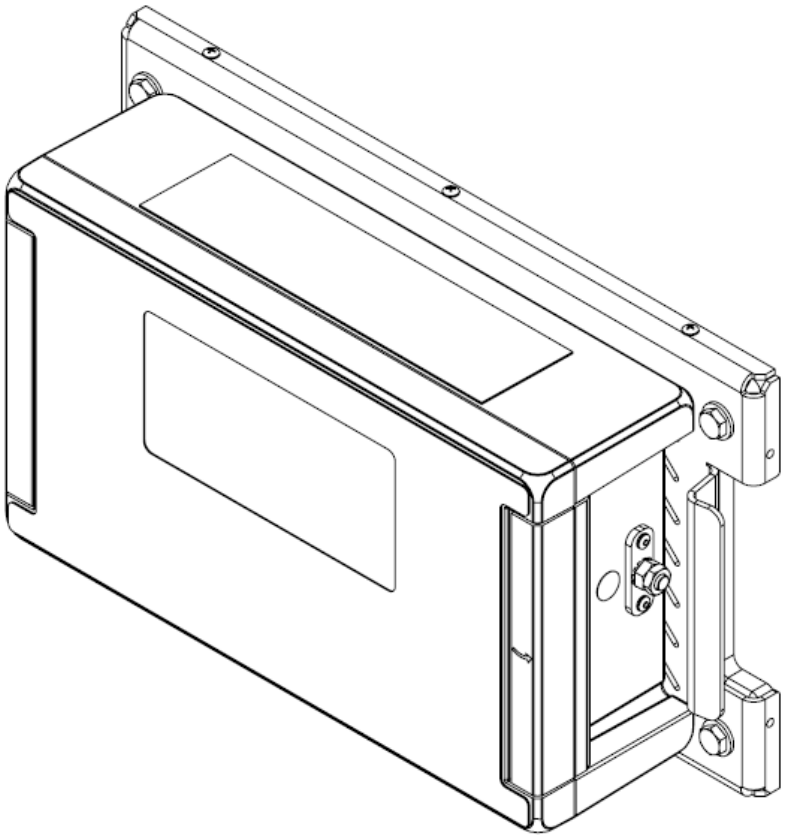


Figure 3: Magnetic Mounting Plate (optional accessory)

⚠ WARNING
The GSAO-2 Control Hub weighs 3.4 kg (7.5 lb) and could be hazardous if dropped. Make sure the mounting is secure.
CAUTION
Proper grounding of the GSAO-2 Control Hub varies by installation and is the responsibility of the end user.

3.2 ENCLOSURE ACCESS

Open the GSAO-2 Control Hub for installation and configuration.

3.2.1 Display Access Panel

Under the lid, the Display Access Panel includes:

- USB-C female port
- OLED display
- Secondary cover latch
- LED indicators
- Five-button keypad

3.2.2 Opening the Lid

1. Using a flat-edge tool, i.e., a flat-head screwdriver, pop open the hinge cover on the right side of the GSAO-2. The hinge is marked with an arrow.
2. Using the supplied 3 mm hex L-Key, loosen the screws until they unlock the lid from the base and it easily swings open to the left.

3. Open the lid to access the Display Access Panel.

3.2.3 Closing the Lid

1. Tightly secure the screws to torque of approximately 1.13 N*m (10 in*lbf). Failure to tighten the cover screws can compromise the sealing of the GSAO-2 and may compromise the IP rating of the system.
2. Latch the cover.

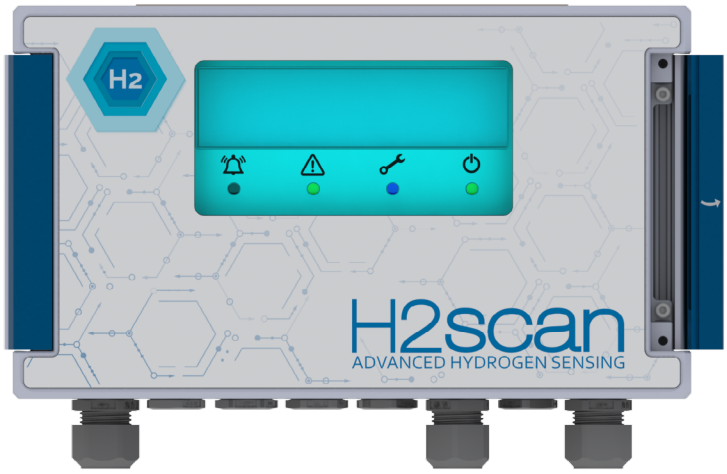


Figure 4: GSAO-2 Enclosure Access – Closed View

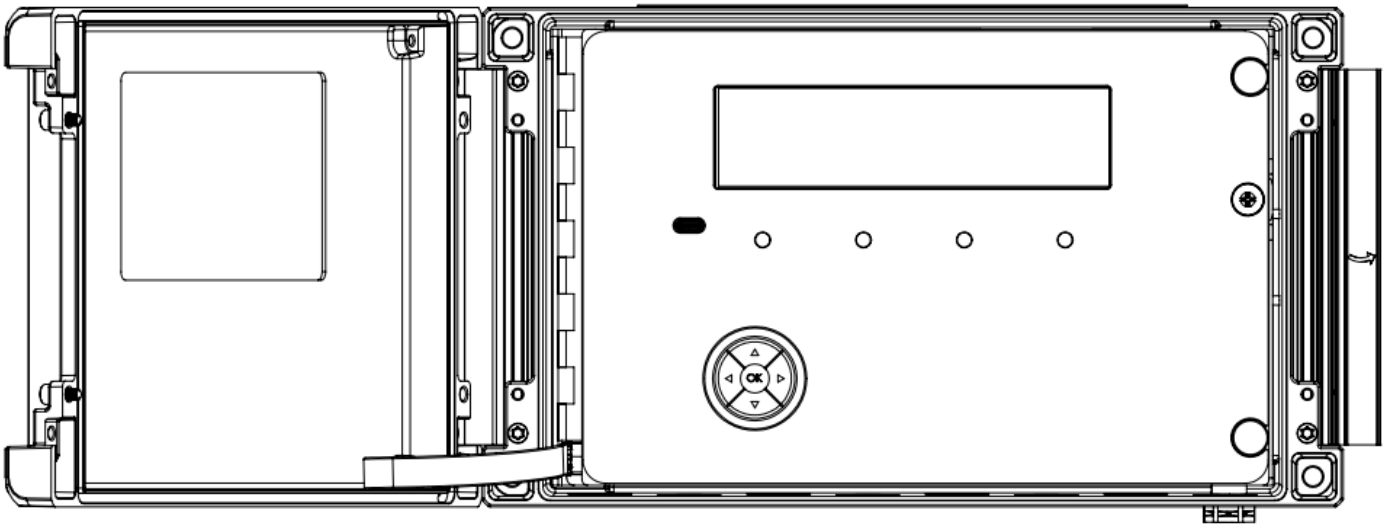


Figure 5: GSAO-2 Enclosure Access – Opened View

3.2.4 Connector and Wiring Compartment Access

Open the Display Access Panel to access the power switch, fuse, ethernet port, and other wired connections.

3.2.5 Opening the Display Access Panel

1. Using a #2 Phillips screwdriver, unscrew the quarter-turn retaining screw.
2. Open the Display Access Panel to reveal the Connector and Wiring Compartment.

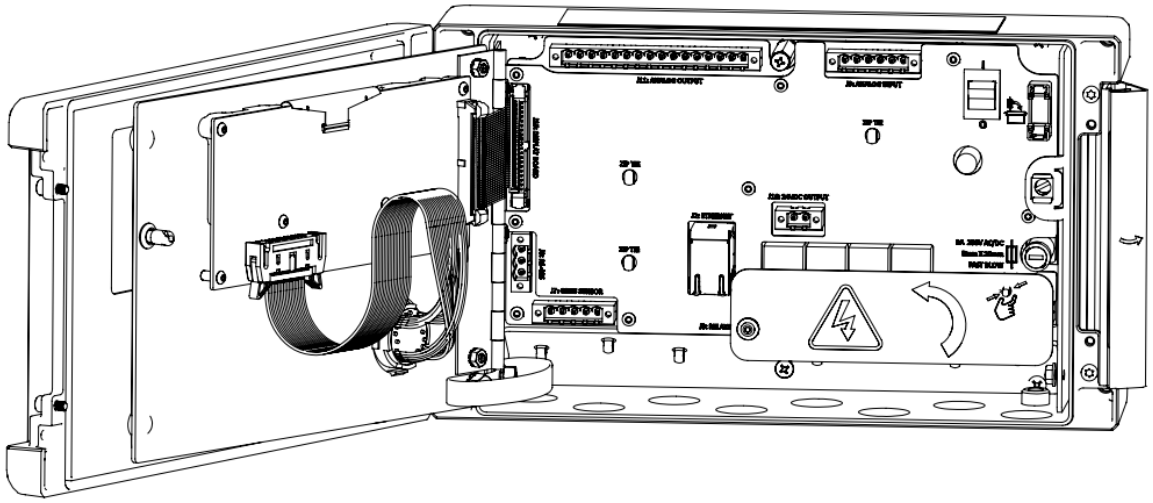


Figure 6: Connector and Wiring Compartment

3.2.6 Closing the Display Access Panel

1. Making sure that no wires interfere, close the cover.
2. Using the #2 Phillips screwdriver, turn the captive latch screw until it latches.

3.3 CABLE FITTINGS

The GSAO-2 Control Hub is supplied with two IP66 rated cable gland fittings that accommodate 5–12 mm (0.20–0.47") outside-diameter jacketed cables to support the minimum configuration of inlet power, a hydrogen sensor, and data out to the end user. The remaining ingress ports are fitted with IP66 or better rated plugs.

1. Remove the cable gland nut from the cable gland in the accessory kit. Ensure the mating rubber gasket is pushed all the way to the top of the threads.
2. Insert cable gland through preferred GSAO-2 hole.
3. Thread cable gland nut onto cable gland.
4. Wrench tight.
5. Ensure the gasket is not pinched such that it bulges out of the cable gland flange.

NOTE: If using conduit to route cables to and from the GSAO-2, the cable gland fittings and port plugs can be replaced by standard ½" conduit gland fittings without modification to the enclosure. As the IP rating of the GSAO-2 is dependent upon the rating and construction of the conduit gland fittings, only use IP66 or better rated conduit gland fittings. Use of lower-rated fittings can damage the GSAO-2 and void the warranty.

CAUTION
If conduit gland fittings are used, mounting the GSAO-2 where it will be submerged voids the warranty.

3.4 CABLES

While no communications cables are provided with the GSAO-2, cables that come with H2scan hydrogen monitors, and others sold separately by H2scan, connect to the monitor.

The standard communication cable is sold with the GRIDSCAN® 5000 and 6000 series hydrogen monitors.

All other cables for relays and power must be supplied by end user.

CAUTION
Use cables or wiring with minimum temperature rating of 105 °C or equivalent.

Do NOT pull secured cabling from the GSAO-2 as this can damage the connections.

3.5 WIRING

Connect the GSAO-2 Control Hub with a multi-conductor cable that supports the desired configurations.

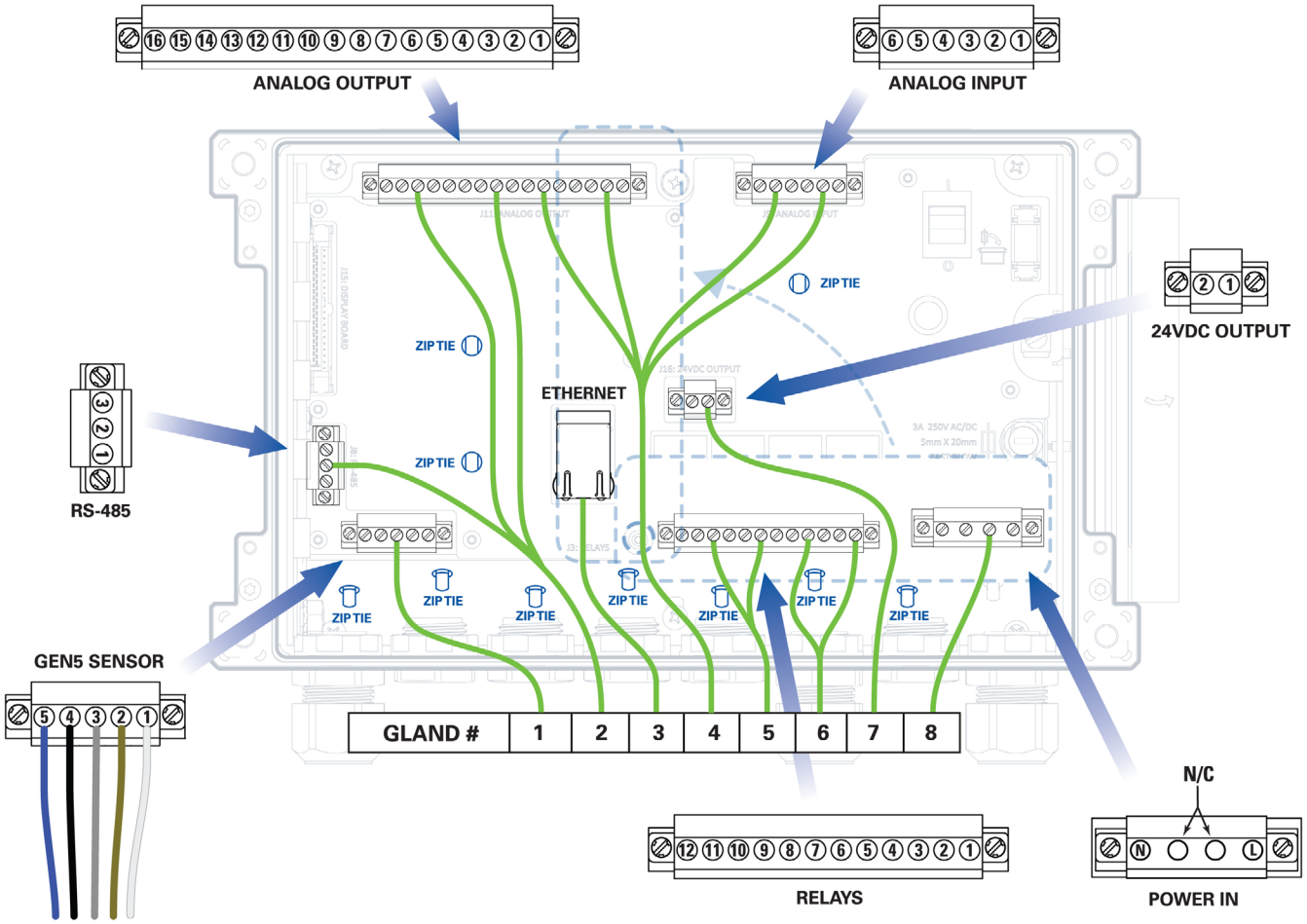


Figure 7: Gland Ingress Wiring

NOTE: While the diagram shows the connections for a five-wire GRIDSCAN® 6000 sensor, the GRIDSCAN® 5000 sensor system has four wires. The isolated ground is not connected at Pin-3 for the GRIDSCAN® 5000.

Table 1: Gland Ingress Wiring

Gland Position #	Wire To	Usage Detail
1	Hydrogen Monitor	Monitor interface (H2scan monitors only)
2	Serial RS-485	Modbus, DNP3 for real-time data, Isolated, 9600–19200 Baud
3	Ethernet	Outdoor UV-rated STP CAT6 recommended
4	Analog Inputs	Configured for 4–20 mA (external power; 0–24 mA), 1–5 VDC, 0–5 VDC. 16–24 bit A/D, Isolated

Gland Position #	Wire To	Usage Detail
2,4	Analog Outputs	4–20 mA (powered or not) (0–24 mA actually), 1–5 VDC, or 0–5 VDC for hydrogen level, moisture level, liquid temp, and pressure, 16-bit DAQ required, isolated.
5	Relays	Low Power: Hydrogen Caution, Hydrogen Alarm, Moisture Alarm, Power and Fault status
6	Relays	Low Power: Hydrogen Caution, Hydrogen Alarm, Moisture Alarm, Power and Fault status
7	Power	Power Output 24 VDC
8	Power	Power Input AC or DC

3.5.1 Connector Installation

1. Insert the wire into the gland position per Table 1.
2. Install the correct PCB connector.

Each connector is composed of two pieces; one mounted to the printed circuit board assembly (PCBA) and a mating connector terminating the input/output cables and are secured to the PCBA connector with two captive screws. Due to keying of the mating connectors, they can only be plugged into the PCBA portion of the connector one way.

3.5.2 Gland Fittings

1. Remove the cable gland nut from the cable gland in the accessory kit. Ensure the mating rubber gasket is pushed all the way to the top of the threads.
2. Insert cable gland through preferred GSAO-2 hole.
3. Thread cable gland nut onto cable gland.
4. Feed the cable through the gland position described in Table 1.
5. Find the connector for the desired function on the PCBA.
6. Find the mating Phoenix connector in the Accessory Kit.

NOTE: Refer to the Quick-Start Guide for pin locations.

7. Insert each bare wire — not the insulated portion of the conductor — into the slotted opening on the mating connector in accordance with the label on the connector and as illustrated in Figure 7.
8. Secure the wire by tightening the corresponding screw to maximum torque of 0.5 N*m (4.42 in*lbf). Do not over-tighten or strip the screws.
9. Install the Phoenix connector into the PCBA and tighten the connector locking screws to maximum torque of 0.4 N*m (3.54 in*lbf). Do not over-tighten.
10. Wrench tight.
11. Ensure the gasket is not pinched such that it bulges out of the cable gland flange.

CAUTION

Do not install more than one cable per cable gland fitting. Doing so will compromise the IP rating of the fitting and GSAO-2 Control Hub.

CAUTION

Modification of the GSAO-2 enclosure to increase the size of the gland fitting ports is not recommended. It can compromise the IP rating of the system and void the warranty.

3.5.3 Hydrogen Monitor Wiring

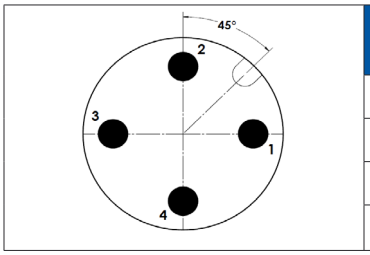
The cable used to connect to the GRIDSCAN® 5000 or GRIDSCAN® 6000 Hydrogen Multi-Sense Monitor ships with the GRIDSCAN® product in various lengths. If the cable is not ordered from H2scan, it must be rated for the environmental conditions it will be used in.

Cables not sourced from H2scan should meet the following criteria:

- Four-pin M12 female molded connector (GRIDSCAN® 5000)
- Five-pin M16 female molded connector (GRIDSCAN® 6000)
- IP66 rated connector (or applicable IP rating)
- Four- or five-conductor 1 mm (18 AWG) or 0.5 mm (20 AWG) wire
- Shielded cable with drain wire
- Outdoor, waterproof, UV-rated jacket

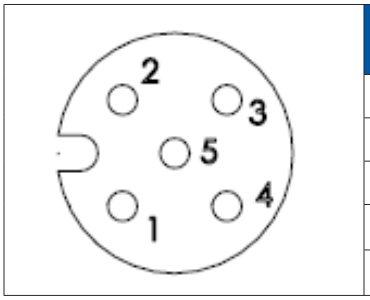
For cables not ordered from H2scan with the GSAO-2 or hydrogen monitor system, the key (notch) location and pin numbers are shown below.

Table 2: GRIDSCAN® 5000 Pin Out Looking into the Monitor



Pin	Signal Name	Wire Color
1	DC power	Brown
2	DC ground	White
3	RS-485 Data+	Blue
4	RS-485 Data-	Black

Table 3: GRIDSCAN® 6000 Pin Out Looking into the Monitor



Pin	Signal Name	Wire Color
1	DC power	Brown
2	DC ground	White
3	RS-485 Ground	Gray
4	RS-485 Data-	Blue
5	RS-485 Data	Black

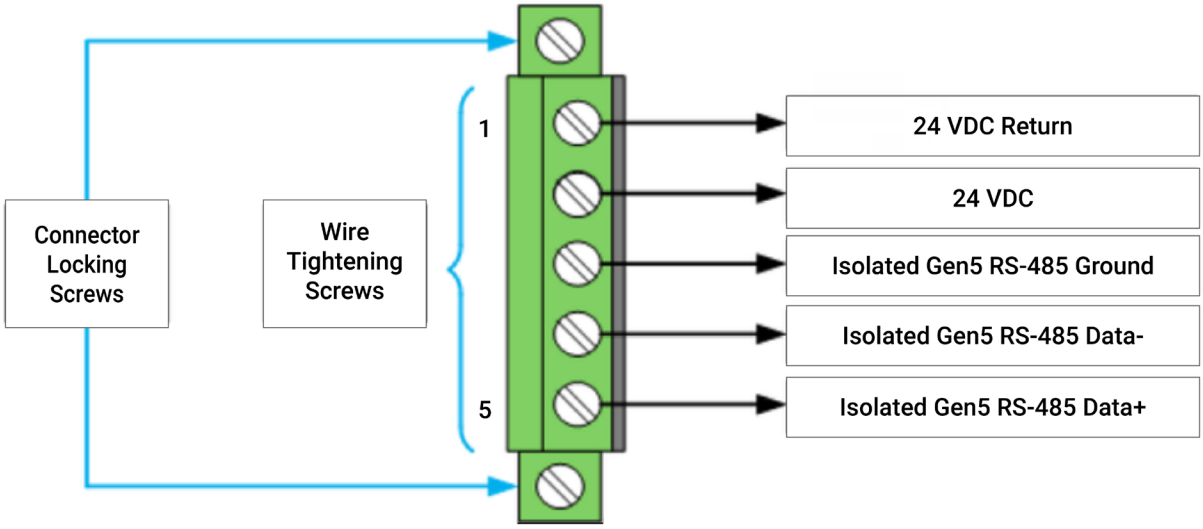


Figure 8: J7 Hydrogen Monitor Connector

3.5.4 Serial Communications (RS-485 or DNP3) Wiring Connections

The GSAO-2 serial communications connection to the end user's system uses Modbus protocol by default, but can be configured for DNP 3.0. The wiring connections are the same.

Use an appropriately rated cable that meets the following specifications:

- Three-conductor 18–at 22 AWG wire
- Outdoor, waterproof, UV-rated jacket
- Shielded with drain wire

When configuring the serial communications in the GSAO-2, the terminal resistor must be enabled only if the GSAO-2 is the last unit on the serial chain. Proper termination is required for the RS-485 communications to function properly.

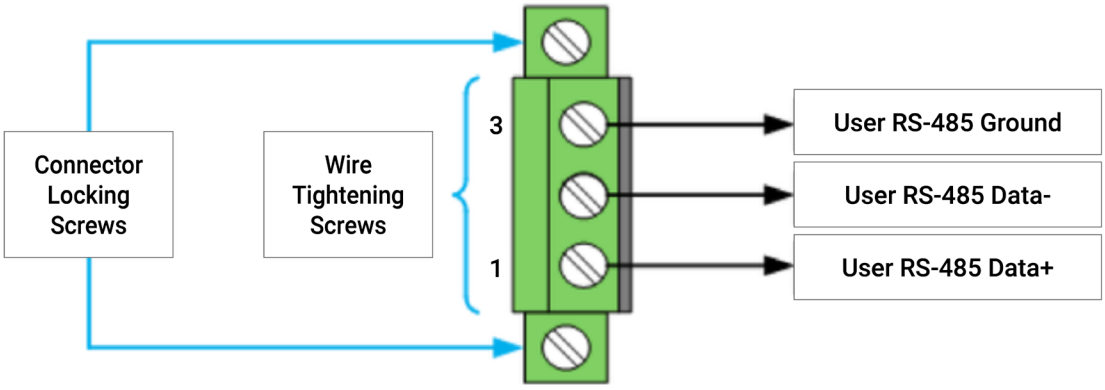


Figure 9: J8 Serial Communications Connector

NOTE: When configuring the serial communications in the GSAO-2, the terminal resistor must be enabled only if the GSAO-2 is the last unit on the serial chain. Proper termination is required for the RS-485 communications to function properly.

3.5.5 Relay Wiring Connections

The GSAO-2 Control Hub offers relay connections to the end user's SCADA system. The low-power relays can be used to actuate larger relays or to activate low-power devices, like warning lights, in control rooms.

Each of the four relays can be wired either normally open (NO) or normally closed (NC). The relays are only

contact closures and do not provide power to the connection. The relays can be configured to actuate on any parameter or power/service condition that can be alarmed. In most cases, when the alarm is exceeded and the relay actuated, it's desirable to have it power on a device, such as an indicator light. In this case, the relay should be wired NO.

Relay #1 is configured by default as a power indicator. It is typically wired NC and is in the open position when power is applied to the monitor. When power is lost, the contact closes and the light or indicator in the control room illuminates.

1. Use an appropriately rated cable that meets the following specifications:
   - Two conductors for each relay of at least 22 AWG wire
   - Outdoor, waterproof, UV-rated jacket
   - Shielded cable with drain wire
2. Ground the shield at the customer end, NOT within the GSAO-2.

When configuring relays in the GSAO-2, the designation of the parameter that actuates the relay is selected.

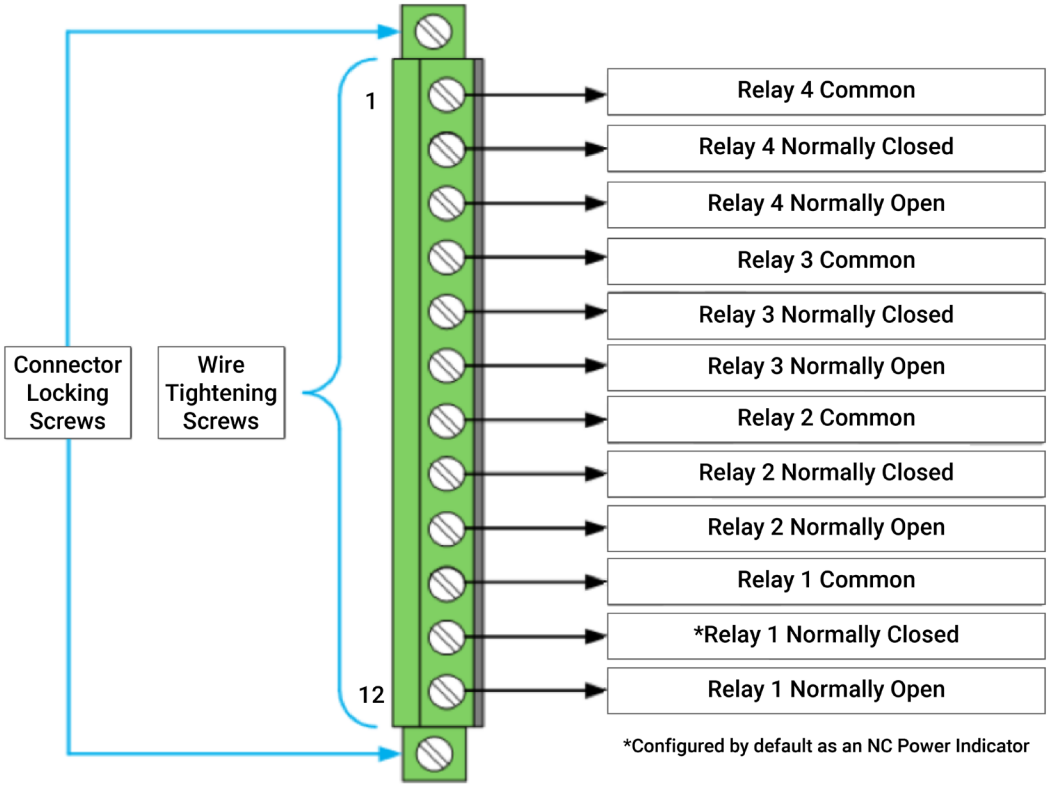


Figure 10: J3 Relay Output Connector

3.5.6 DC Power Output Wiring Connections

The GSAO-2 Control Hub offers a 24± 2.5 VDC output to provide power to end user devices, such as cell or data modems, radios, or data converters.

1. Use an appropriately rated cable that meets the following specifications:
   - Two-conductor 22–18 AWG wire, typically as a twisted pair. The red conductor is typically used for the +24 VDC and the black conductor is used for 24 VDC return.
   - Outdoor, waterproof, UV-rated jacket
   - Shielded cable with drain wire

2. For GSAO-2 DC configuration, DC output power is dependent on the end user supply power.

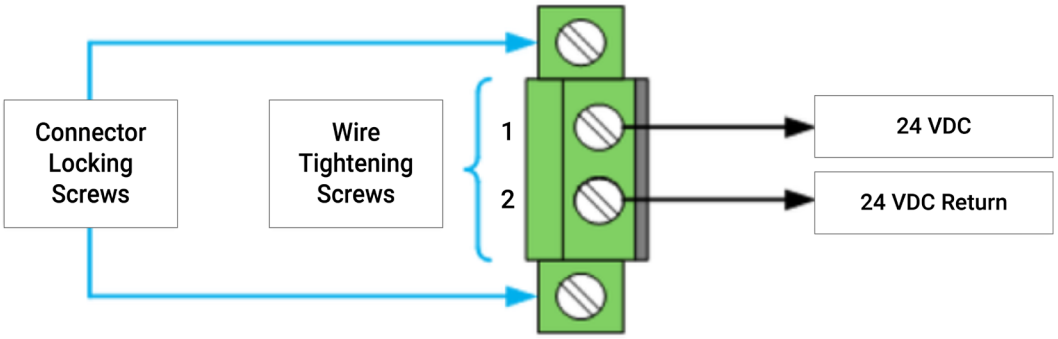


Figure 11: J16 24 VDC Power Output Connector

3.5.7 Power Input Wiring Connections

The GSAO-2 Control Hub is available in two configurations; one powered by AC and one powered by DC. The AC version can take universal AC power from 110–130 VAC (60 Hz). The DC version takes 18–24 VDC (15 Watts maximum).

⚠ WARNING

Do NOT apply DC power to a GSAO-2 Control Hub configured for AC voltage as damage to the GSAO-2 may occur.

⚠ WARNING

Do NOT apply AC voltage to a GSAO-2 Control Hub configured for DC voltage as damage to the GSAO-2 will occur. Failure to comply can cause a potentially hazardous condition, which will damage the unit and void the warranty.

Use an appropriately rated cable that meets the following specifications:

- Two stranded conductors 18–14 AWG. For AC applications, black and white or brown and blue are typically used. For DC applications, red and black are commonly used.
- Outdoor, waterproof, UV-rated jacket
- Shielded cable with drain wire

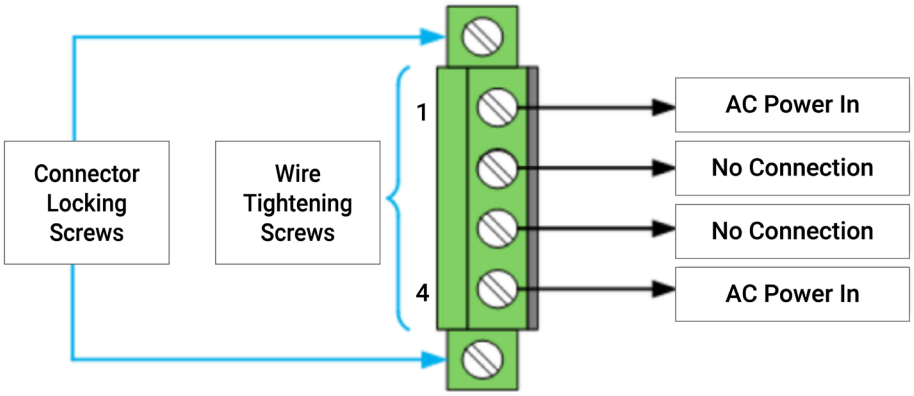


Figure 12: AC Power Inlet

NOTE: Earth Safety Ground (green wire) of the incoming AC power cable must be connected to the chassis screw near the bottom of the GSAO-2 between gland 4 and 5.

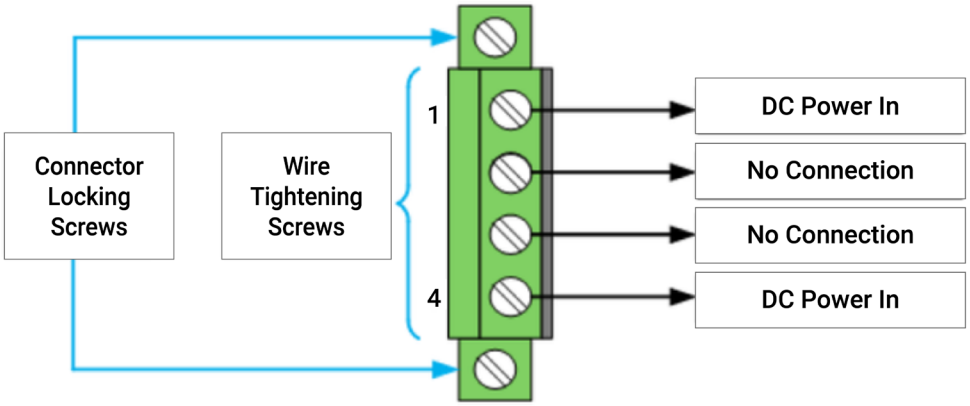


Figure 13: DC Power Inlet

NOTE: There is no accommodation for a ground wire with the line power cable within the GSAO-2 Control Hub. If the cable used has a ground wire, trim and do not connect it to the GSAO-2 Control Hub.

3.5.8 Earth Grounding Wiring Connection

The grounding stud on the right side of the GSAO-2 Control Hub must be connected for safe operation.

1. Use an appropriately rated external grounding strap with a crimped ring termination to connect to the ¼-20 UNF stainless steel grounding stud.
2. Apply the provided star washer, the ring termination, and the two stainless ¼-20 UNF nuts.
3. Using a 7/16" wrench, tighten the first nut to secure the grounding strap and using a second wrench, tighten the second nut into the first nut to prevent loosening (10 in*lbf minimum). Do not over-tighten.

⚠ WARNING

Failure to properly ground the GSAO-2 Control Hub will compromise performance, can damage the GSAO-2, and present a shock hazard.

⚠ WARNING

For transformer applications, the transformer neutral phase is not considered an adequate earth ground as potentials can be induced during transformer switching.

3.5.9 Circuit Protection

A 3 A, 250 VAC/DC replaceable fast-blow fuse is provided for over-current protection. This is appropriate for both AC and DC applications. A spare fuse is provided in the clip at the top right of the protective plate in the Connector and Wiring Compartment of the GSAO-2 Control Hub.

3.6 PLUGS

For all holes that do not need a cable gland, install one of the included plugs.

1. Remove the nut from the plug in the accessory kit. Ensure the mating rubber gasket is pushed all the way to the top of the threads.
2. Insert plug through preferred GSAO-2 hole.
3. Thread the nut onto the hole.
4. Wrench tight.
5. Ensure the gasket is not pinched such that it bulges out of the flange.

4. COMMISSIONING

4.1 STARTUP

After all connections are made, flip the power switch in the Connector and Wiring Compartment to power on the GSAO-2 Control Hub.

Upon startup, the GSAO-2 initiates its firmware and automatically detects the monitor. This could take up to 90 seconds. Upon detection, hydrogen monitor information appears on the display.

Use the up and down arrow buttons on the Display Access Panel to change screens.

4.2. CONFIGURATION

The GSAO-2 Control Hub can be configured to support communication to the customer network via Modbus SCADA interface, hydrogen sensor communication parameters, relays, alarm and caution thresholds, and delays in alarm clearance. Configure the GSAO-2 using the display and keypad.

4.2.1 Configuration Mode

The following steps detail the process to enter Configuration Mode and commit changes. Specific configurations are listed in subsections 4.2.2–4.2.5.

1. Open the lid to access the keypad.
2. Use the up and down arrow keys to find the information screen.
3. Press the OK button on the keypad. Flashing red and yellow LEDs indicate Configuration Mode is activated.
4. The Configuration items are displayed with their current value and status. Navigate by up and down keys.
5. Highlight the option desired and press the OK button to select that attribute and revert to the attribute status menu.
6. Commit the changes changes by entering the hardcoded passcode **10101**, using the up and down arrow keys to select numbers and the right and left keys to navigate to the fields.

NOTE: If using custom passcode from H2scan, enter that instead of 10101.

NOTE: The password is only required the first time changes are committed.

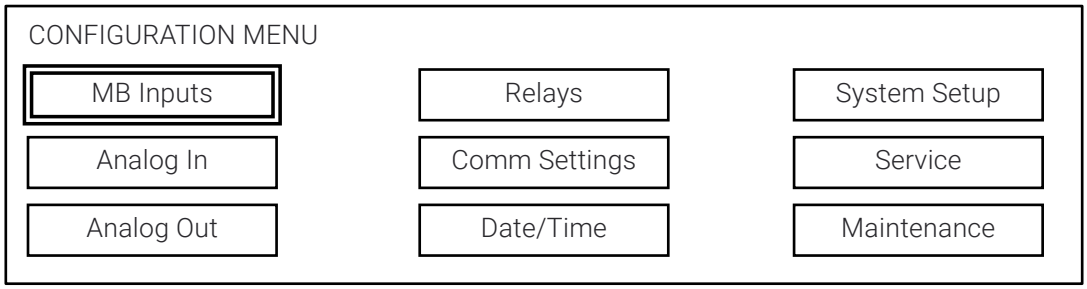


Figure 14: Configuration Mode

4.2.2 MB Inputs

When the hydrogen monitor is detected, it automatically populates in the MB Inputs menu. Use this menu to configure monitors and alarms.

1. From the configuration menu, click OK on MB Inputs.
2. Hydrogen monitor defaults to Input 1. If the monitor is not on Input 1, use the up and down arrow keys to find the hydrogen monitor from the INPUT dropdown.
3. Select a name from the Name dropdown based on where the monitor is positioned on the transformer.

4. Navigate to the enable/disable field next to H_2 Level.
5. Use the down arrow key to navigate to the Caution or Alarm enable/disable fields.
6. Click OK to enter the H_2 Level Alarm Configuration screen and enable or disable caution and alarm levels.
7. Use the up and down arrow keys to navigate to AlarmSet to enable, if desired.
8. Press the down arrow key to select Max to set an alarm. For cursor placement, press the left and right arrow keys. To select numbers, press the up and down arrow keys.
9. Use the up and down arrows to navigate to CautionSet to enable, if desired.
10. Press the down arrow to Max to set a caution. For cursor placement, use the left and right keys. To select numbers, up and down keys.

NOTE: The caution set point must be set lower than the alarm set point.

11. Use the up/down buttons to select an alarm delay from the dropdown under Hysteresis. Press the OK button.
12. Once the configuration is complete, press the left arrow key.
13. Enter 10101 in the password popup. Select confirm. Press the OK button.
14. Repeat this process for liquid temperature, moisture, and pressure, if applicable.

NOTE: For pressure, enter minimum and maximum set points.

15. Return to the Configuration Menu by pressing the left arrow key.

4.2.3 Relays

The GSAO-2 relays can be configured for system power or an alarm that is configured for H_2 level, temperature, moisture, or pressure.

1. From the configuration menu, press the up and down keys to navigate to Relays. Press the OK button.
2. Using the up and down keys, select the input device and alarm type from the dropdowns for each relay.
3. Once the configuration is complete, press the left arrow key.
4. Select Confirm in the popup. Press the OK button.

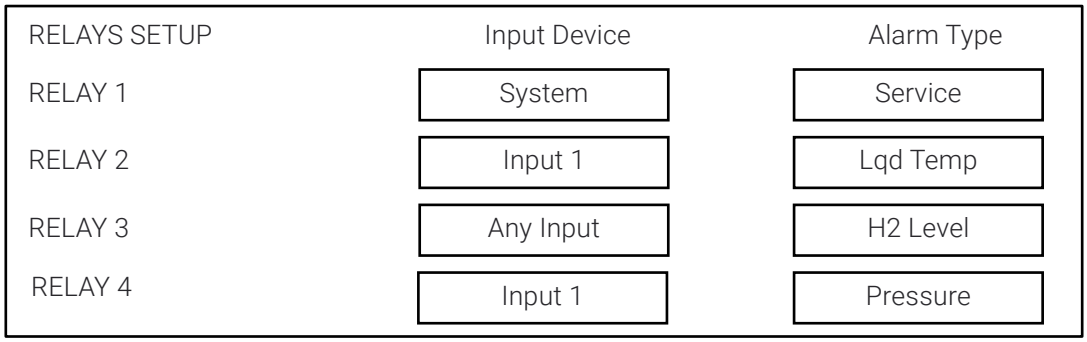


Figure 15: Relay Configuration

4.2.4 Comm Settings

Use this menu to configure the port used to communicate to the end user network and update any settings from the defaults:

- Baud Rate = 19200
- Data Bits = 8
- Stop Bits = 1

- Parity = None
- Flow Control = None

1. Navigate to Comm Settings with the up and down keys and select by pressing the OK button.
2. From the sub menu, select the Sensor Port and press the OK button.
3. Use the up and down keys to select communication settings from the dropdowns.
4. Press the left arrow key. Confirm changes. Press the OK button
5. Repeat steps 2–4 for the Host Port.

4.2.5 Date/Time

NOTE: The GSAO-2 uses military time. This process only configures the date/time shown on the GSAO-2 Display.

1. Navigate to Date/Time with the up and down keys and select by pressing OK.
2. Use the up and down keys to select the time and date.
3. Press the left arrow key. Confirm changes. Press the OK button.

4.2.6 Replacement Monitor Configuration

1. Power off the GSAO-2.
2. Remove the connection to the monitor.
3. Turn on the power switch to the GSAO-2 while holding the OK button until the default display page that shows the firmware version and serial number appears.
4. Press the up and down keys to confirm no existing monitor configuration is saved in the GSAO-2. If the up and down keys reveal more screens, perform steps 1 and 3 again.
5. Attach the new monitor.
6. After about a minute, press the up and down keys to confirm the new monitor is connected.

NOTE: Upon initial connection, hydrogen levels and temperature values will be listed as NR.

7. Perform configuration with the new monitor.

5. OPERATION

5.1 LED INDICATORS

The GSAO-2 Control Hub has three LEDs on the front panel to indicate status.

Table 4: LED Indications

Attribute	Color	Specification
Power	Green	Power is applied to the GSAO-2 and subsequently to the monitor.
Caution	Amber	Configurable to indicate any caution condition.
Alarm	Red	Configurable to indicate any alarm condition.

Blinking LED indicators in combination indicate non-operational states of the system.

Table 5: Non-Operational LED Indications

Description	Indication
Firmware Update	Blue, amber, and red LEDs will cycle from right to left with a period of 1 s.
Configuration Mode	Red and amber LEDs will cycle with a period of 500 ms.

5.2 DISPLAY

The GSAO-2 display is always on.

During normal operation, the GSAO-2 displays the following statuses with attribute, reading, and units of measure for approximately three seconds per screen before cycling to the next.

- Hydrogen concentration (ppm)
- Liquid temperature (°C)
- Moisture concentration (RS%), if enabled
- Pressure (ATM), if enabled
- Firmware version
- Serial number
- Status of configured sensor

Table 6: GSAO-2 Display Codes

GSAO-2 Display Code	Issue	Possible Cause	Solution
F	Failure reported from the GRIDSCAN® monitor	The sensor is faulty or the temperature is too high. Refer to the GRIDSCAN® operation manual for the complete list of causes.	Read registers 111, 112, and 113. Configure liquid type on the GS5000/GS6000. Remove the monitor from the GSAO-2 and configure using the ScanH2 app or Modbus interface, if necessary.
LC	Lost connection	Loose wires	Check and re-secure wires into the connectors.
NF	Not found	Loose wires	Check and re-secure wires into the connectors.
NR	Not ready	GRIDSCAN® monitor's hydrogen measurements are not available	Wait up to 30 minutes after power disruption, or up to 16 hours on new installations, for GRIDSCAN® monitor to report valid hydrogen measurements. Refer to the GRIDSCAN® operation manual for additional information.

APPENDIX A: SPECIFICATIONS

Table 7: Operating Conditions

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Environment – Ambient				
Operating Temperature	-40	25	70	°C
Cold Start	Within 1 hours after -40 °C cold soak			
Storage Temperature	-40		85	°C
Ingress Protection	IP66 (IEC 60529) with provided cable gland fittings and plugs			
Humidity	0–100 %RH, condensing			
Temperature Change	±24 °C/hour			
Altitude	Up to 2000 m (6560')			

Mechanical				
Vibration	Three-axis Sinusoidal, Wideband and Random (IEC 60068-2-6 table C.2, IEC 60068-2-64 paragraph A.2, category no. 2, IEC 61373: 2010 Cat 1B section 9)			
Shock	30 g, shock duration 18 ms (IEC 60068-2-27)			
Electrical				
AC Voltage Input, Absolute Maximum (50/60Hz)	110	120	130	VDC
DC Voltage Input, Absolute Maximum	18	24	31	VDC
Output Voltage (Auxiliary)	22	24	26	VDC
Power Consumption: GSAO-2 alone (no sensors or Aux devices) With one hydrogen monitor With two hydrogen monitors			5 **10 **15	W

**Depends on monitor type

NOTE: Do NOT exceed maximum voltage.

Table 8: GSAO-2 Physical Specifications

Parameter	Nominal Value
Product Height	203.7 mm (8.0")
Product Width	302.7 mm (11.9")
Product Depth	91.0 mm (3.6")
Product Weight	3.4 kg (7.5 lb)

Table 9: GSAO-2 Analog Input Specifications

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Number of Inputs		2		each
Power Requirements	The maximum rating of each input is 500 mW			
Current Accuracy	±0.02	±0.02	±0.02	mA
Normal Current	4		20	mA
High Current	20		24	mA
High Current Service	24			mA
Low Current Service	0		4	mA
Voltage Accuracy	±0.5	±0.5	±0.5	%
Normal Voltage	1		5	VDC

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Alt Normal Voltage	0.1		5	VDC
High Voltage	5.1		6	VDC
High Voltage Service	6			VDC
Low Voltage Service	0.2		0.8	VDC
Alt Low Voltage Service	N/A		N/A	VDC
*Scaling Moisture in Oil	4 mA /0.1 VDC / 1.0 VDC = 0 %RS 20 mA / 5 VDC = 100 %RS			
*Scaling Oil Temperature	4 mA /0.1 VDC / 1.0 VDC = 0 °C 20 mA / 5 VDC = 120 °C			
*Scaling Current Loop	4 mA /0.1 VDC / 1.0 VDC = 0 A 20 mA / 5 VDC = 2 or 5 A			
Calibration Interval	No periodic calibration of GSAO-2 Control Hub is required			

*Typical: Settings are adjustable in the configuration menus.

Table 10: GSAO-2 Analog Output Specifications

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Number of Outputs		4		each
Current Loop Power	Powered or not powered depending on wiring			
Current Load Resistance	Assumes 250 Ω			
Current Accuracy	±0.02	±0.02	±0.02	mA
Normal Current	4		20	mA
Voltage Accuracy	±0.5	±0.5	±0.5	%
Normal Voltage	1		5	VDC
Alt Normal Voltage	0.1		5	VDC
High Voltage	5.1		6	VDC
High Voltage Service	6			VDC
Low Voltage Service	0.2		0.8	VDC
Alt Low Voltage Service	N/A		N/A	VDC
*Scaling Oil Phase Hydrogen	4 mA /0.1 VDC /1.0 VDC = 0 ppm 20 mA / 5 VDC = 100 ppm (Default), 250 ppm, 500 ppm, 1000 ppm, 2000 ppm, 5000 ppm			
*Scaling Gas Phase Hydrogen	4 mA /0.1 VDC /1.0 VDC = 0 ppm 20 mA / 5 VDC = 2000 ppm (Default), 5000 ppm, 10000 ppm, 20000 ppm, 40000 ppm, 100000 ppm			
*Scaling Moisture in Oil	4 mA /0.1 VDC / 1.0 VDC = 0 %RS or 0 ppm 20 mA / 5 VDC = 100 %RS			

Parameter	Value			Units
	Minimum	Nominal	Maximum	
*Scaling Oil Temperature	4 mA /0.1 VDC / 1.0 VDC = 0 °C 20 mA / 5 VDC = 120 °C			
*Scaling Current Loop	4 mA /0.1 VDC / 1.0 VDC = 0 A 20 mA / 5 VDC = 2 or 5 A			
Calibration Interval	No periodic calibration of GSAO-2 Control Hub is required			

*Typical: Settings are adjustable in the configuration menus.

Table 11: GSAO-2 Relay Specifications

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Number of Relays		4		each
Form	Form C			
Power Rating	3 A at 120 VAC, 3 A at 28 VDC			
Life Ratings	>100,000 cycles			

APPENDIX B: COMPLIANCE & CERTIFICATIONS

STANDARDS

- Conducted & Radiated Emissions FCC CFR Title 47, Part 15 Subpart B and ANSI C63.4:2014; Class A Radiated Emissions
- Ingress Protection IEC 60529: 1989/AMD2:2013/Cor1:2019
- Dry Heat IEC 60068-2-2 & EN 50155 @80 ˚C
- Damp Heat IEC 60068-2-30 Clause 5.2 (b)
- Humidity and Corrosion Resistance IEC 60068-2-11, DIN EN ISO 12944
- Sinusoidal Vibration Scan IEC 60068-2-6 Table C.2; IEC 60068-2-64 Category no.2
- Shock Test IEC 60068-2-27; 30 g @18 ms
- Electrical Safety UL/CSA C22.2 No./ANSI/ISA-61010-1 Ed. 3-2012

DIRECTIVES

- Restriction of Hazardous Substances RoHS 3 Directive 2015/863 plus Category 11
- REACH EC No.197/2006
- Dodd- Frank Conflict Mineral Compliance Dodd – Frank Section 1502

Table 12: Standards

Attribute	Standard
Immunity Standards	
Conducted Emissions	Class A per FCC CFR Title 47, Part 15 Subpart B and ANSI C63.4: 2014
Radiated Emissions	Class A per FCC CFR Title 47, Part 15 Subpart B, ANSI C63.4: 2014
Safety Standards	
Electrical Safety	UL 61010-1 and CAN/CSA C22.2 No. 61010-1-12