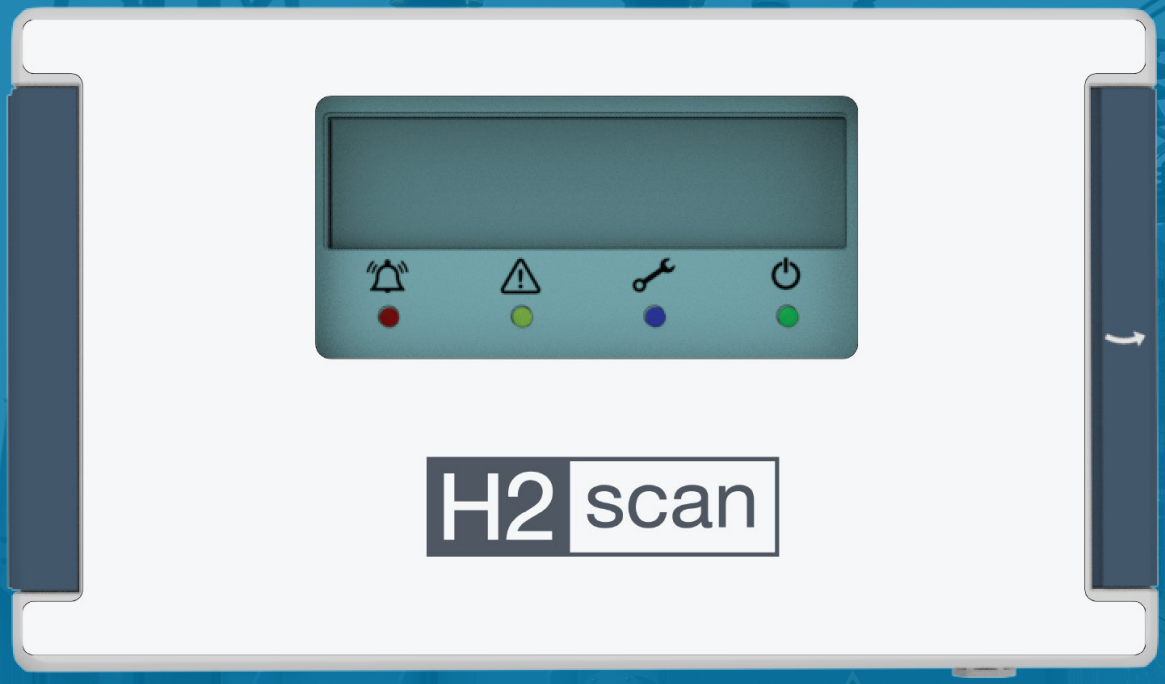
H2scan®

Advanced Hydrogen Sensing




OPERATION MANUAL

# GRIDSCAN® AO-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 two hydrogen monitors for transformer applications on the RS-485 loop.

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

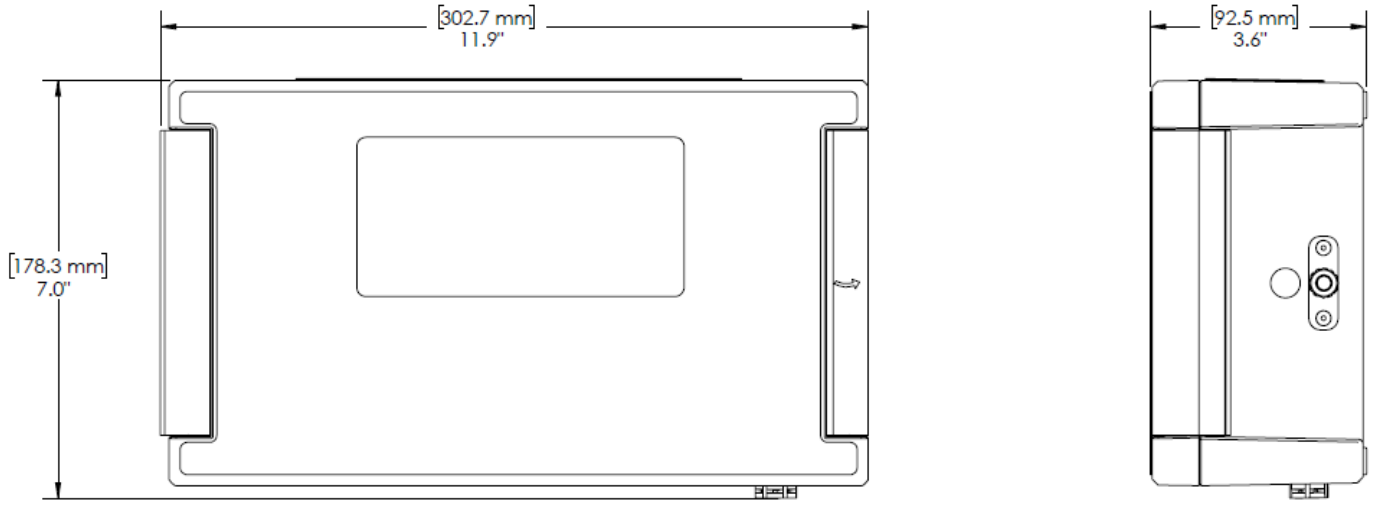



**Figure 1: GSAO-2 Dimensions**

# 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

## 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 (PN 52000423).

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

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

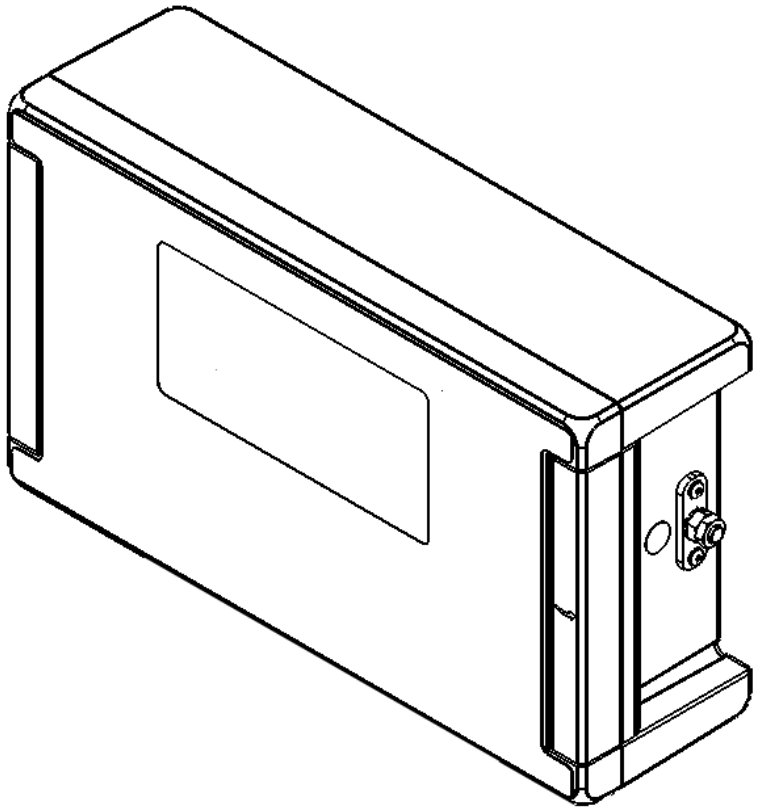


**Figure 2: Standard Mounting**

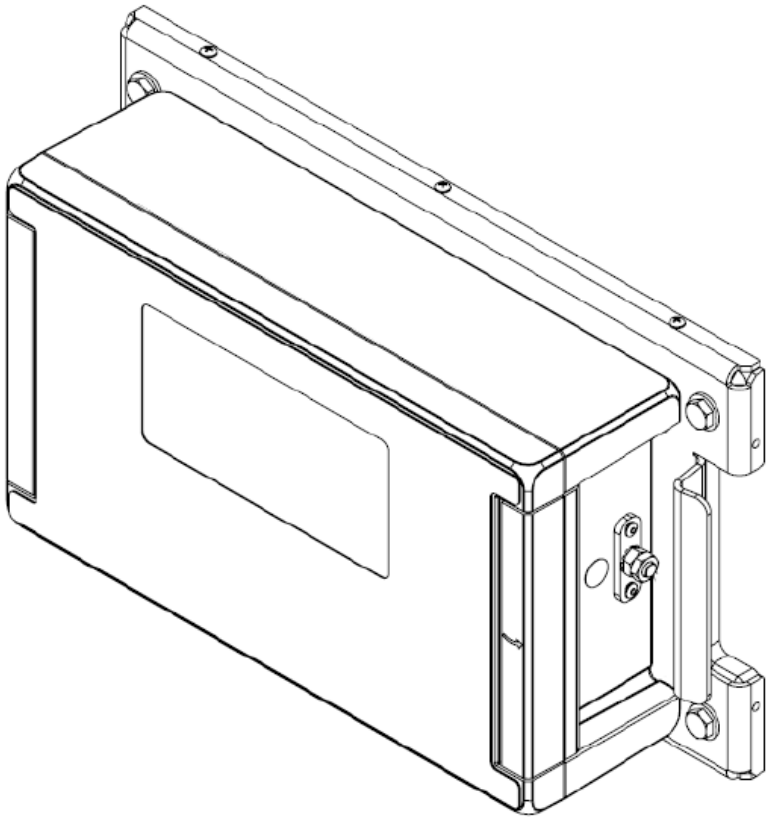


Figure 3: Magnetic Mounting Plate (optional accessory)

**⚠ 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.

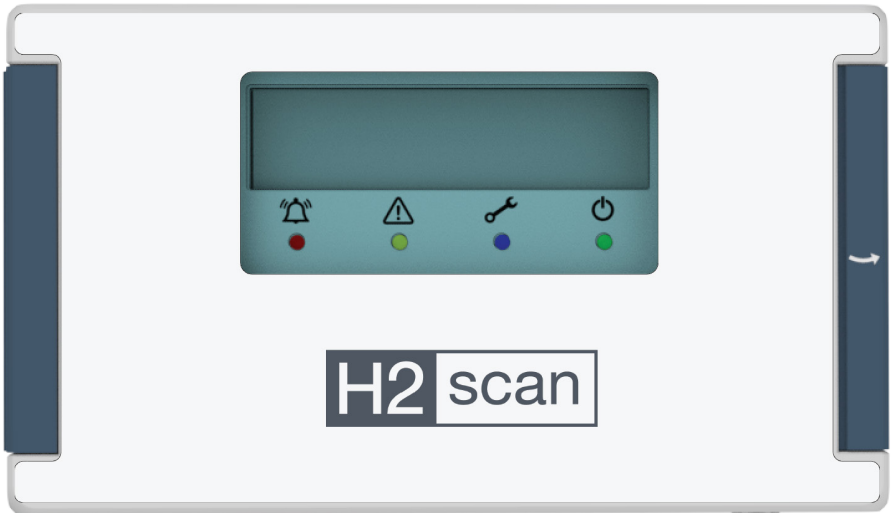



Figure 4: GSAO-2 Enclosure Access – Closed View

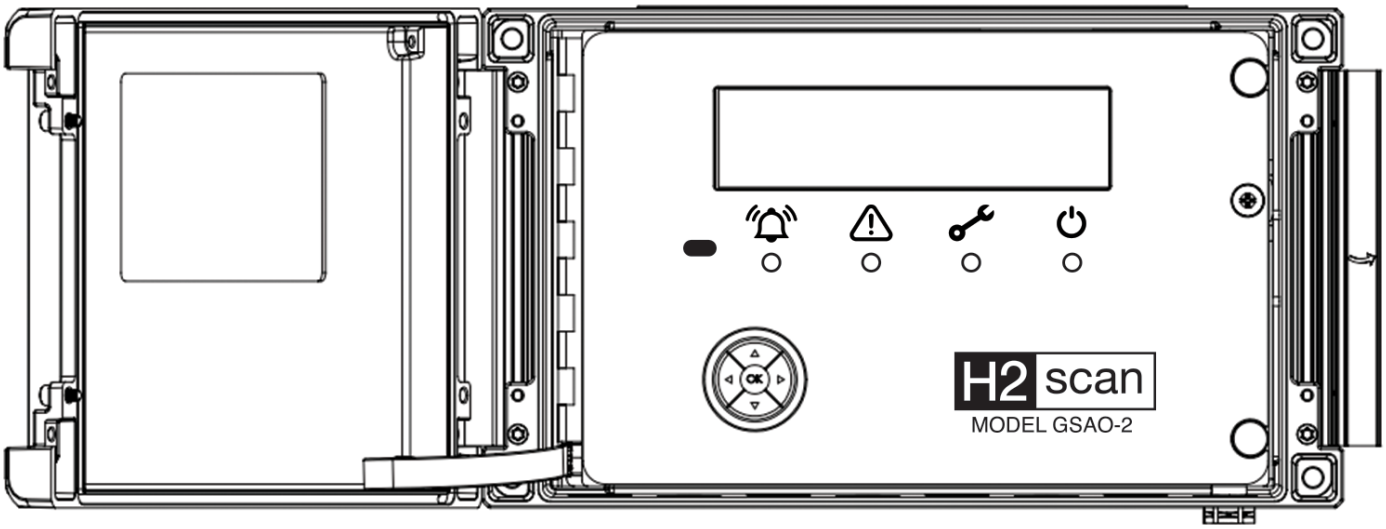



Figure 5: GSAO-2 Enclosure Access – Opened View

### 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.

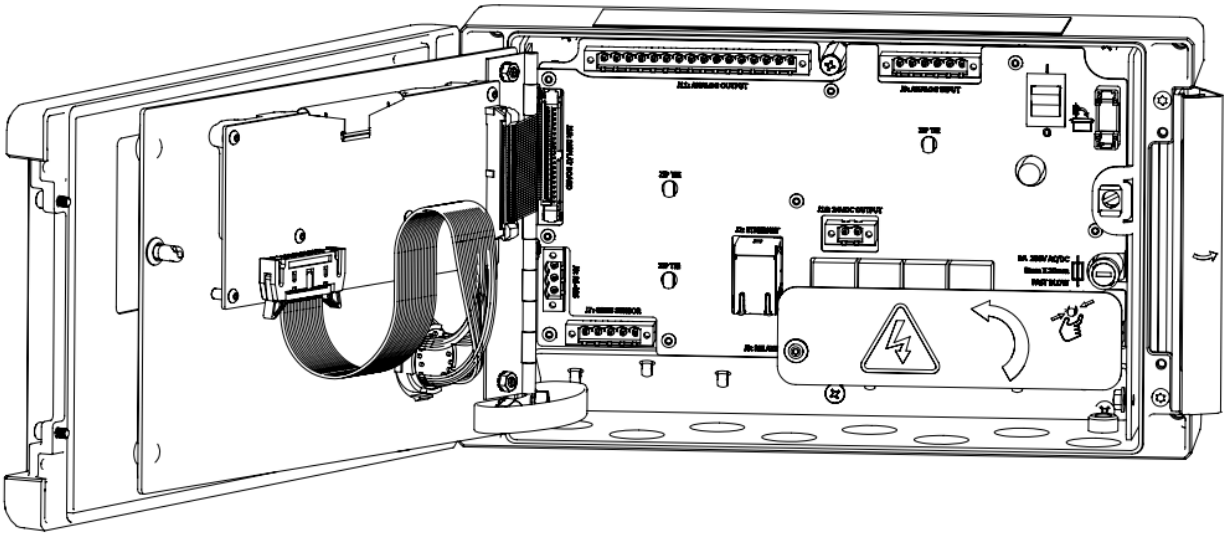


Figure 6: Connector and Wiring Compartment

### 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.**

## 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.<br><br>Do NOT pull cabling from the GSAO-2 as this can damage the connections. |

### 3.5 WIRING

Connect the GSAO-2 Control Hub with multi-conductor cables that support the desired configurations.

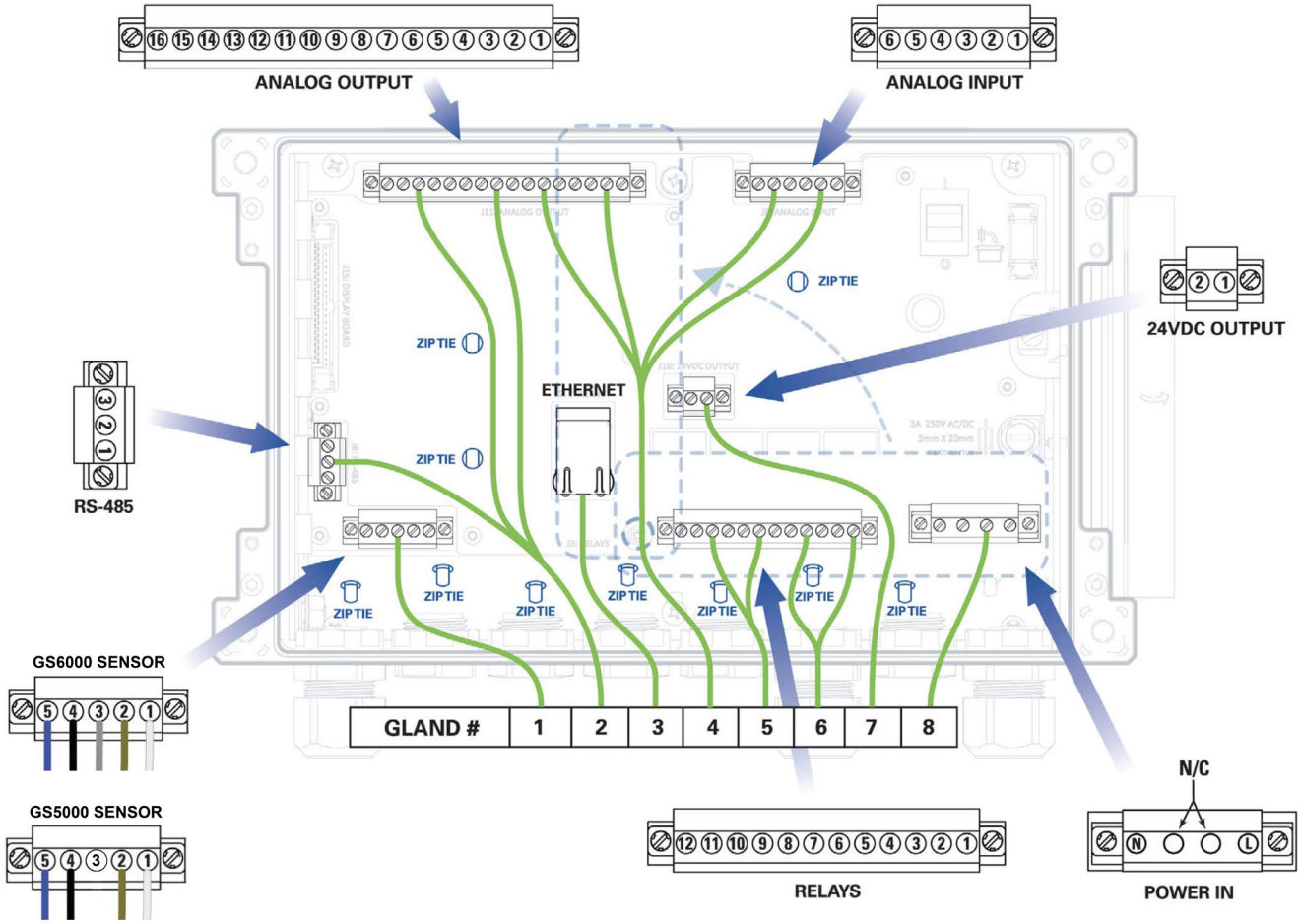



Figure 7: Gland Ingress Wiring

NOTE: While the diagram shows the connections for a five-wire GRIDSCAN 6000 monitor, the GRIDSCAN 5000 monitor system has four wires.

**Table 1: GSAO-2 Gland Ingress Wiring Suggestions**

| Gland Position # | Wire To: | Usage Detail |
|---|---|---|
| 1 | Hydrogen Monitor | Monitor interface (H2scan monitors only) |
| 2 | Serial RS-485 | Modbus RTU or DNP3, isolated, 9600–19200 Baud |
| 3 | Ethernet | Outdoor UV-rated STP CAT6 recommended |
| 4 | Analog Inputs | Configured for 4–20 mA, 1–5 VDC, 0–5 VDC, 16–24 bit A/D, isolated |
| 2,4 | Analog Outputs | 4–20 mA, 1–5 VDC, or 0.1–5 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 |

### 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

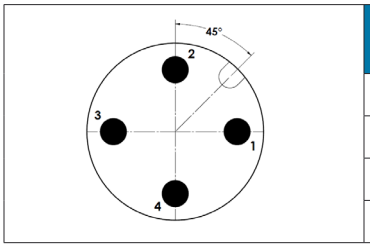
The cable used to connect to the GRIDSCAN 5000 or GRIDSCAN 6000 Hydrogen Multi-Sense Monitor ships with the GRIDSCAN product in various lengths. If the cable is not ordered from H2scan, it must be rated for the environmental conditions it will be used in.

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

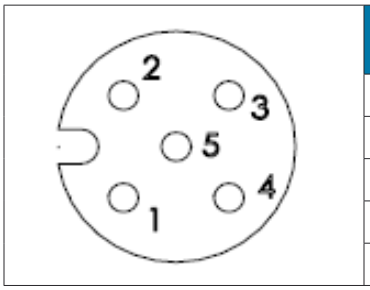
For cables not ordered from H2scan with the GSAO-2 or hydrogen monitor system, the key (notch) location and pin numbers are shown below.

**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 |

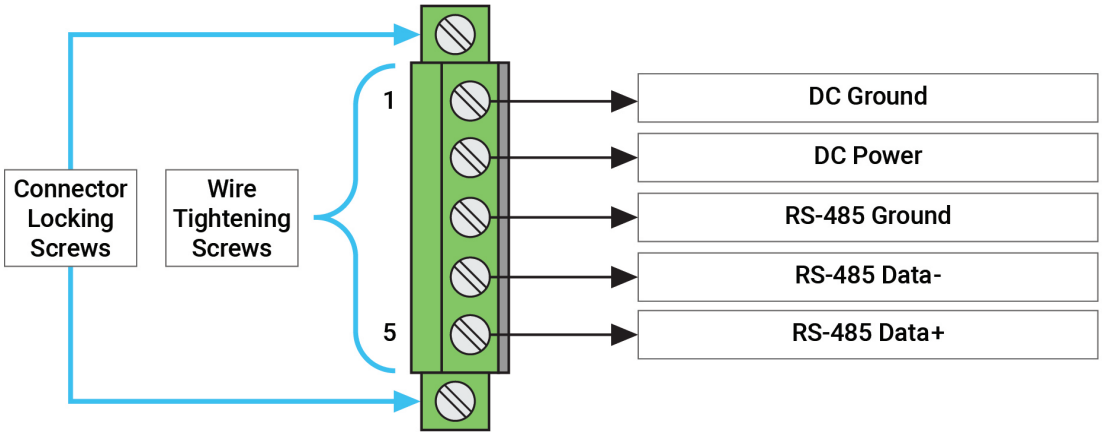



**Figure 8: J7 Hydrogen Monitor Connector**

### 3.5.4 SERIAL COMMUNICATIONS (RS-485) WIRING CONNECTIONS

The GSAO-2 serial communications connection to the end user's system using the Modbus RTU or DNP3 protocol.

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

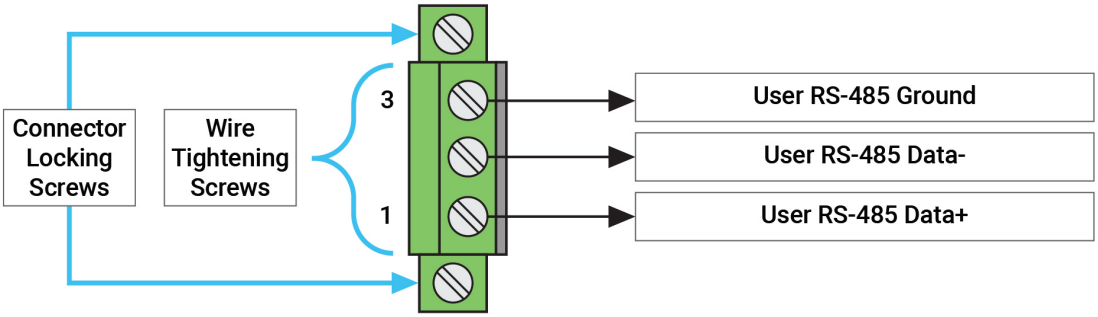



**Figure 9: J8 Serial Communications Connector**

**NOTE: When configuring the serial communications in the GSAO-2, the terminating 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 Form C type 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 typically configured as a power/service 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.

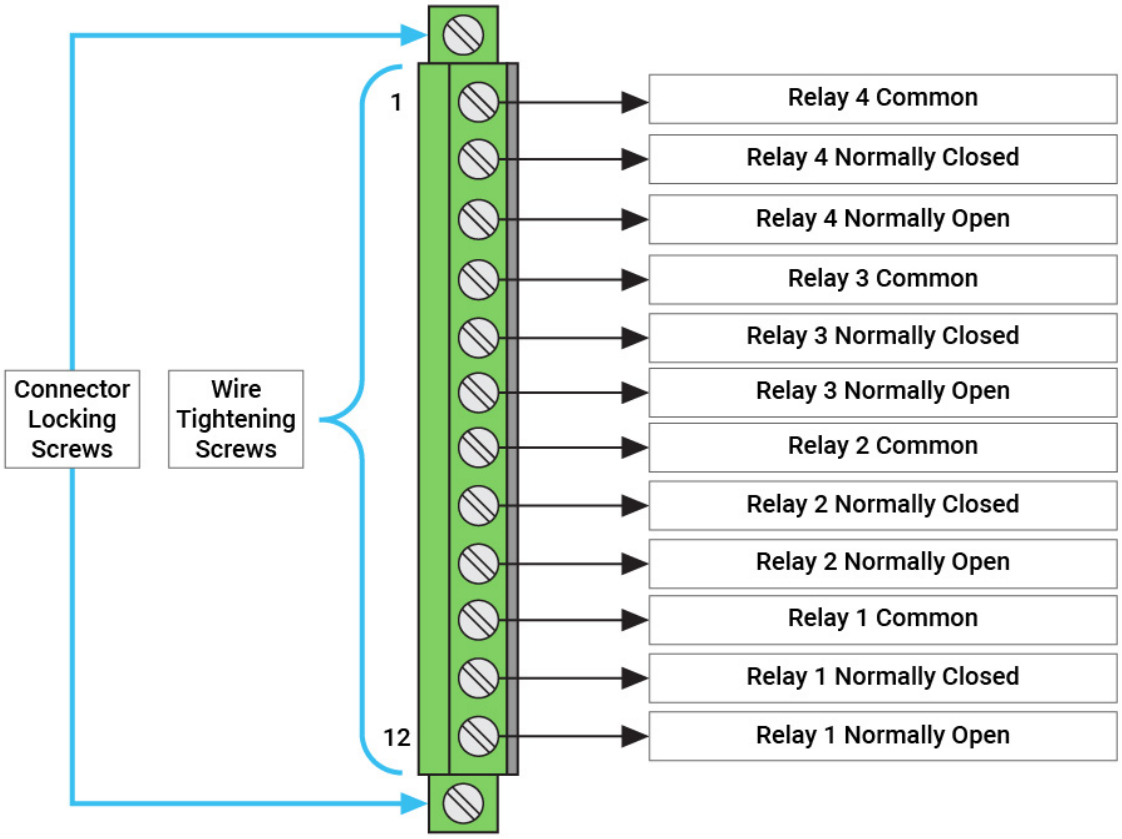



**Figure 10: J3 Relay Output Connector**

### 3.5.6 ANALOG INPUT WIRING INSTRUCTIONS

The GSAO-2 Control Hub provides two analog input channels, configurable for 4–20 mA, 1–5 VDC, or 0–5 VDC. Each channel can be individually configured for hydrogen (PPM), temperature, relative humidity (%RH), moisture (PPM), pressure (PSI), current (A), or a custom sensor.

Analog input devices can be powered using the 24 VDC output. Refer to the specific installation instructions provided by the analog input device manufacturer.

1. Use an appropriately rated cable that meets the following specifications:
   - Twisted pair for each analog input device of at least 22 AWG wire
   - Outdoor, waterproof, UV-rated jacket
   - Shielded cable with drain wire
2. Connect drain wire to Earth GND. Must only be connected at one end or the other, not both ends.

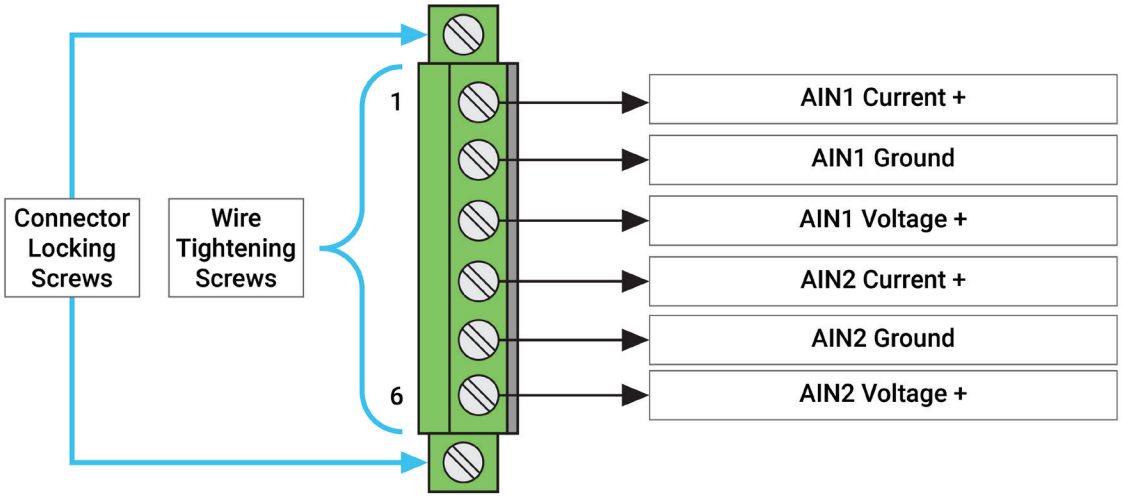



**Figure 11: Analog Input**

### 3.5.7 ANALOG OUTPUT WIRING INSTRUCTIONS

The GSAO-2 Control Hub provides four analog output channels, configurable for 4–20 mA, 1–5 VDC, or 0.1–5 VDC. These outputs can be assigned to hydrogen level, moisture level, liquid temperature, and pressure measurements.

1. Use an appropriately rated cable that meets the following specifications:
   - Twisted pair for each analog output connection of at least 22 AWG wire
   - Outdoor, waterproof, UV-rated jacket
   - Shielded cable with drain wire
2. Connect drain wire to Earth GND. Must only be connected at one end or the other, not both ends.
3. To meet EMC regulations, a ferrite bead is required on the analog output cable. Refer to Figure 13 for installation instructions.

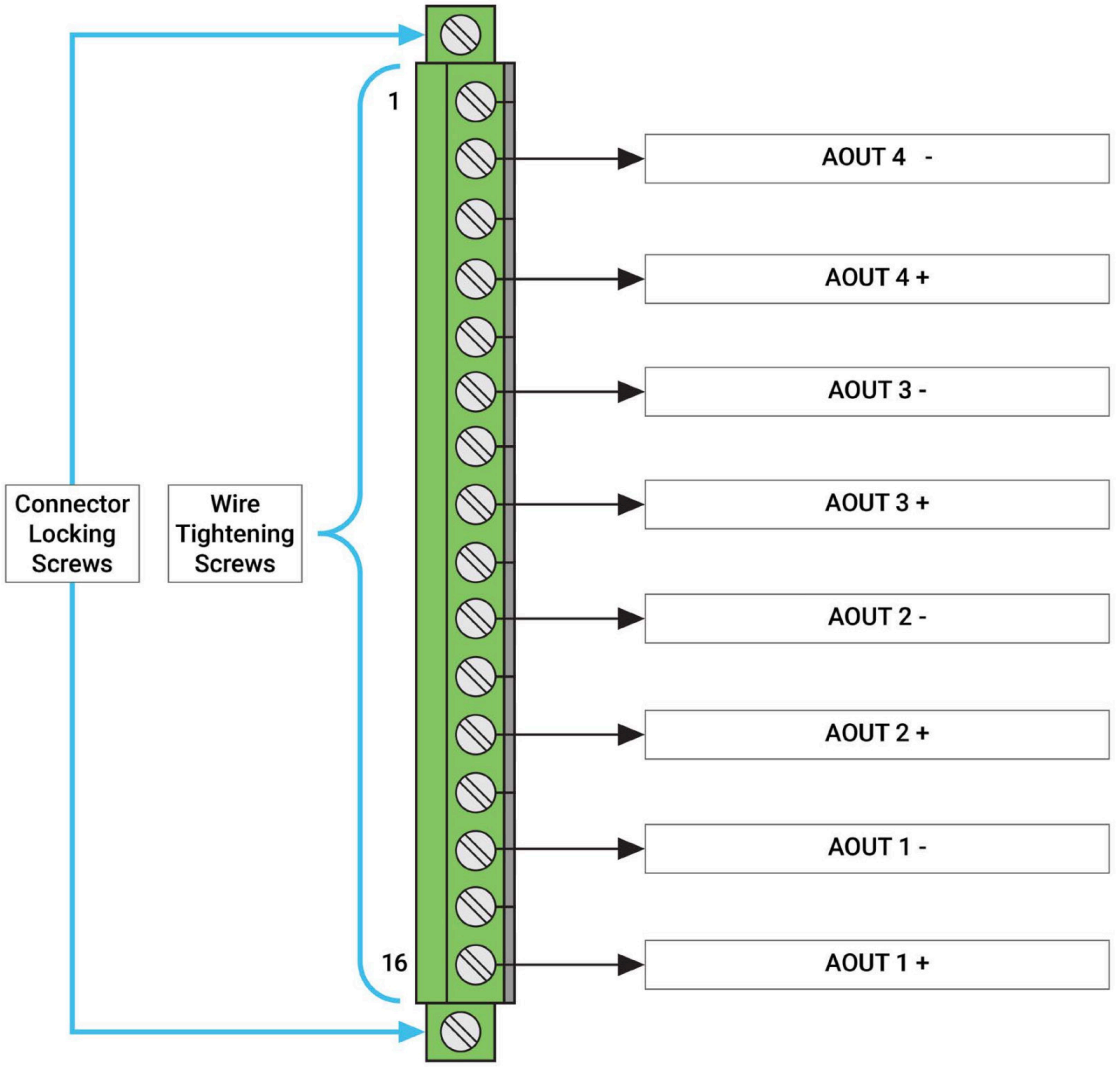



Figure 12: Analog Output

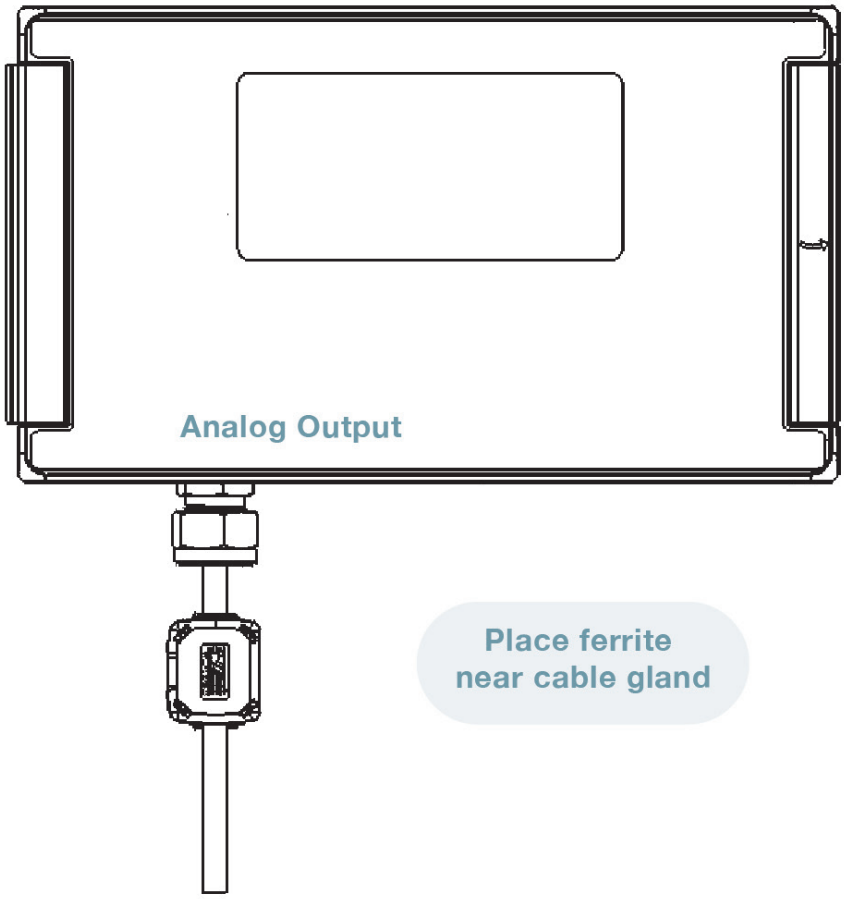



Figure 13: Ferrite Installation

### 3.5.8 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. DC maximum output power is 50 W with two hydrogen monitors and 60 W with no monitors.

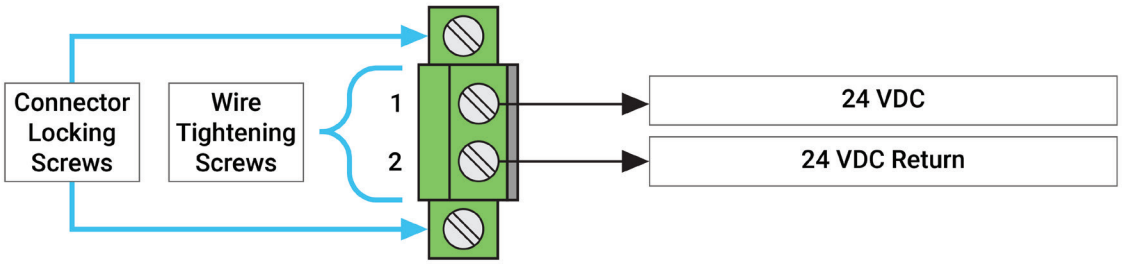



Figure 14: J16 24 VDC Power Output Connector

### 3.5.9 POWER INPUT WIRING CONNECTIONS

The AC power inlet can take universal AC power from 100–240 VAC (50–60 Hz).

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.
- Outdoor, waterproof, UV-rated jacket
- Shielded cable with drain wire

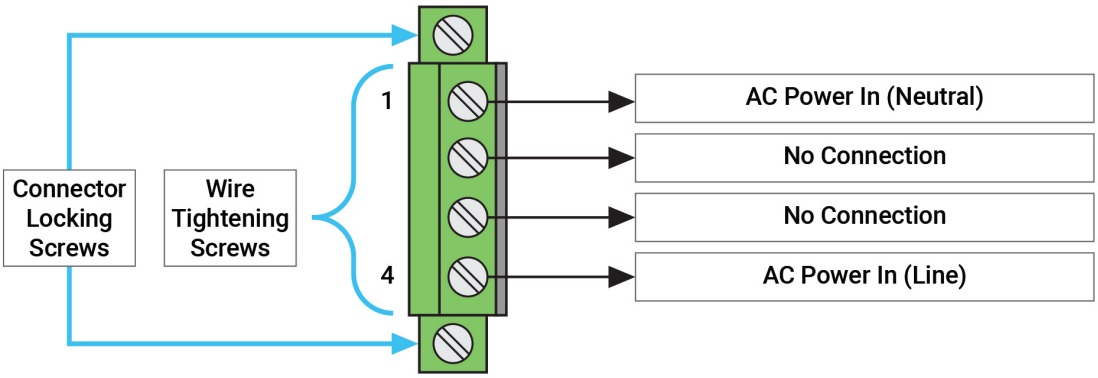



Figure 15: AC Power Inlet

**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.**

### 3.5.10 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-lbs 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.**

#### 3.5.11 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 hydrogen 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 with the customer network via Modbus RTU or DNP3 SCADA protocols, set hydrogen sensor communication parameters, manage relays, configure analog inputs and outputs, define alarm and caution thresholds, and adjust alarm clearance delays.

#### 4.2.1 CONFIGURATION MODE

The following steps detail the process to enter Configuration Mode and commit changes. Specific configurations are listed in subsections 4.2.2–4.2.9.

1. Open the lid to access the keypad.
2. Press and hold the OK button for three seconds to open the Configuration Menu. Flashing red and yellow LEDs indicate the Configuration Mode is activated.
3. Use the up and down arrow keys to navigate the menu.
4. Highlight the desired option and press the OK button to select.
5. When making changes, commit them by entering the passcode 10101. Use the up and down arrow keys to select numbers and the right and left arrow keys to navigate fields. Select Confirm and press OK to finalize the changes.

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

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

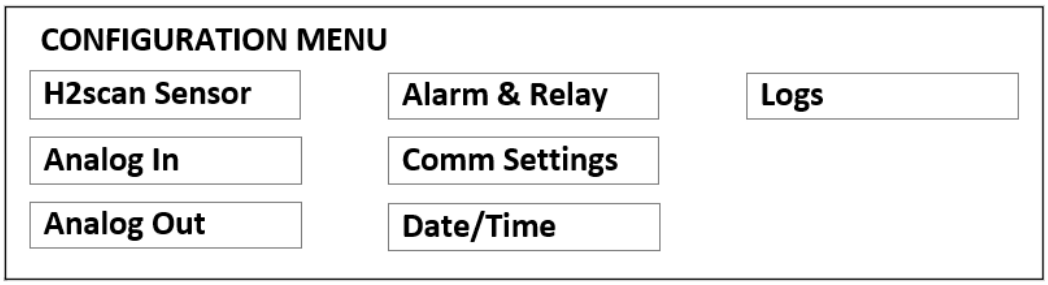



Figure 16: Configuration Menu

### 4.2.2 PROVISIONING

#### 4.2.2.1 Installing a Hydrogen Monitor

Newly installed GRIDSCAN hydrogen monitors are automatically detected when connected. The device initially reads the Modbus address, which is set to 1 by default, and assigns the next available address, typically 2.

When additional GRIDSCAN hydrogen monitors are connected, the device automatically assigns the next available address in sequence, typically 3.

1. Physically install a GRIDSCAN hydrogen monitor.
2. Once installed, the sensor measurement details will appear in the GSAO-2 scrolling screens. Use the up and down arrow keys to navigate to the screen for the newly added GRIDSCAN hydrogen monitor.
3. Repeat steps 1 and 2 to install a second GRIDSCAN hydrogen monitor.

**NOTE: GRIDSCAN hydrogen monitors' Modbus address must be set to 1 prior to installation.**

**NOTE: GRIDSCAN hydrogen monitors' communication settings must match Sensor Port communication settings in order to be detected when installed.**

**NOTE: The GSAO-2 supports up to two GRIDSCAN hydrogen monitors.**

#### 4.2.2.2 Removing a Hydrogen Monitor

1. Open the lid to access the keypad.
2. Press and hold OK until the red and yellow LEDs flash, indicating Configuration Mode.
3. Navigate to H2scanSensor and press OK.
4. Select Sensor Configuration > Eject Sensor, then press OK.
5. Enter the passcode when prompted, select Confirm, and press the OK button.
6. Physically disconnect and remove the hydrogen monitor.
7. Repeat steps 1–6 to remove additional GRIDSCAN hydrogen monitors, if necessary.

**NOTE: Complete all steps to remove one GRIDSCAN hydrogen monitor before attempting to remove another. Failure to do so may cause unexpected behavior.**

### 4.2.3 H2SCAN SENSOR

When the hydrogen monitor is detected, it automatically appears in the H2scanSensor menu. Use this menu to view sensor information, check sensor status, and update the sensor name.

### 4.2.4 ANALOG INPUT

GSAO-2 supports two analog inputs (AIN1 and AIN2) that can be configured for various sensors, including $H_2$ PPM, temperature, relative humidity (%RH), moisture PPM, pressure (PSI), current (A), and custom sensors. Follow the steps below to configure the analog input.

1. From the Configuration Menu, select Analog Input and press OK.
   - The AIN is disabled by default.
2. Use the up and down arrow keys to select the desired sensor type.
3. From the Name dropdown, select a name based on the monitor's position on the transformer.
4. Navigate to Inputs and use the up and down arrow keys to choose one of the following input signal types:
   - 4–20 mA
   - 0–5 V
   - 1–5 V
5. Set the Min scale values using the up and down arrow keys. To adjust cursor placement, use the left and right arrow keys.
6. Set the Max scale values using the up and down arrow keys. To adjust cursor placement, use the left and right arrow keys.
7. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press the OK button to save the changes.
8. If applicable, repeat the process for AIN2.

**NOTE: When configuring for Moisture PPM, set AIN1 to Temperature (°C) and AIN2 to Moisture RH. Ensure both inputs share the same name.**

### 4.2.5 ANALOG OUTPUT

GSAO-2 supports four analog outputs (AOUT1–AOUT4) that can be configured for a GRIDSCAN monitor or an analog input. Follow these steps to configure an Analog Output (AOUT):

1. Navigate to the Configuration Menu, select Analog Output, and press OK.
2. Use the up and down arrow keys to select the Analog Output channel (1–4) to configure.
3. Use the up and down arrow keys to select the source by name. All configured analog inputs and GRIDSCAN monitors will be listed.
4. From the Sensor dropdown menu, select a sensor type. All available sensors based on the selected input source will be listed.
5. From the Output dropdown menu, choose an output type:
   - 4–20 mA
   - 0.1–5 V
   - 1–5 V
6. Set the Min scale value using the up and down arrow keys. Use the left and right arrow keys to adjust cursor placement.

7. Set the Max scale value using the up and down arrow keys. Use the left and right arrow keys to adjust cursor placement.
8. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press OK to save the changes.
9. If necessary, repeat the process for additional analog outputs channels (2–4).

### 4.2.6 ALARM & RELAY

The GSAO-2 Control Hub allows up to four alarms and relays to be configured for Service, Alarm, or Caution.

When Service is selected, the relay remains energized during normal operation and de-energizes to indicate a fault condition. The blue Service LED illuminates if the GSAO-2 detects an internal error or a fault with a connected sensor or monitor.

When Alarm or Caution are selected, the relay remains de-energized until an alarm or caution condition occurs, at which point the relay energizes. All configured sensors and monitors will be available for selection. When sensor measurement values fall below the minimum alarm setpoint or rise above the maximum alarm setpoint, the GSAO-2 will report the alarm or caution condition based on the configuration.

1. From the configuration menu, use the up and down arrow keys to select Alarm & Relay, then press OK.
2. From the Relay Setup dropdown menu, select desired relay by number, then press OK.
3. From the LED dropdown, select the desired alarm and relay type.
4. To disable, select none.
5. From the Hysteresis (h) dropdown, select the desired alarm delay, in hours. There will be a delay when the alarm is triggered and when the alarm clears.
6. Choose up to four sources and sensor types per relay, and set the maximum value (for pressure, set both minimum and maximum values).
7. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press the OK button to save the changes.

**NOTE: Alarm and caution states are reset when confirming changes on the Alarm & Relay screen.**

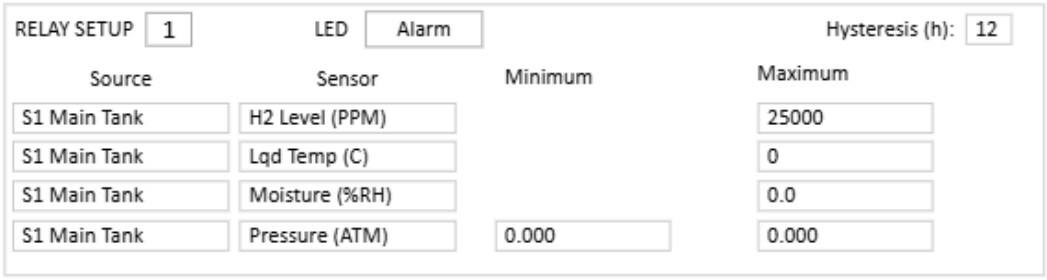



**Figure 17: Relay Configuration**

### 4.2.7 COMMUNICATION SETTINGS

Use this menu to configure the sensor port for GSAO-2-to-GRIDSCAN monitor communication, as well as the host port for communication with the end user network.

#### 4.2.7.1 Sensor Port

Use this menu option to configure the GSAO-2 sensor port. Ensure the communication settings of the connected GRIDSCAN monitors match those of the GSAO-2.

Default communication settings:

- Baud Rate: 19200
- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Terminate: Enabled

1. From the Configuration Menu, use the up and down arrow keys to select Comm Settings, then press OK.
2. In the Communication Setup menu, select Sensor Port and press OK.
3. Use the up and down arrow keys to select and update the desired communication settings.
4. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press OK to save the changes.

#### 4.2.7.2 Host Port

Use this menu option to configure the GSAO-2 host port, which is used to communicate with the end user network.

Default Communication Settings

- MB Address: 1 (Firmware versions prior to 2.5.1)
- Baud Rate: 19200
- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Terminate: Enabled

**Note: Beginning with firmware 2.5.1, protocol configuration options are available that allow enabling Modbus or DNP3 communication.**

##### 4.2.7.2.1 Protocol Settings (Firmware 2.5.1 and later)

Firmware version 2.5.1 and later adds a Protocol submenu that allows enabling and configuring either Modbus RTU or DNP3 communication on the host port.

Default Protocol Settings

- DNP3 Enable: Disabled
- DNP3 Source Address: 4
- DNP3 Destination Address: 3
- Modbus Enable: Enabled
- Modbus ID: 1

**Note: Only one protocol can be enabled for a given host port connection.**

Accessing Host Port Protocol Settings

1. From the Configuration Menu, use the up and down arrow keys to select Comm Settings, then press the OK button on the keypad.
2. From the Communication Setup menu, select Host Port and press the OK button.
3. Select Protocol and press OK.

4. Use the up and down arrow keys to select and update protocol settings.
5. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press OK to save the changes.

**NOTE: Units running firmware versions earlier than 2.5.1 will not display the Protocol menu and support Modbus RTU communication only.**

### 4.2.8 DATE/TIME

**NOTE: The GSAO-2 uses military time.**

#### 4.2.8.1 Set GSAO-2 Date and Time

1. From the Configuration Menu, use the up and down arrow keys to select Date/Time, then press the OK button.
2. Use the up and down arrow keys to adjust the time and date fields.
3. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press the OK button to save the changes.

#### 4.2.8.2 Synchronizing GRIDSCAN Monitor Date and Time

When new hydrogen monitors are installed, use the Sync Connected Sensors option to synchronize the GSAO-2 date and time with the monitors.

1. From the Configuration Menu, use the up and down arrow keys to select Date/Time, then press the OK button.
2. Use the up and down arrow keys to select Sync Connected Sensors, then press the OK button.
3. Enter the passcode when prompted, select Confirm, and press the OK button to complete synchronization.

### 4.2.9 LOGGING

Log frequency determines how often the GSAO-2 records data and saves it to a log file. Log frequency can be adjusted from the default to one of the following options:

- 5 minutes
- 15 minutes
- 30 minutes
- 1 hour (default)
- 24 hours

#### 4.2.9.1 Changing the Log Frequency

1. From the Configuration Menu, use the down arrow key to navigate to Logs, then press the OK button.
2. Select Log Configuration and press OK.
3. Use the up and down arrow keys to choose the desired log frequency.
4. Press the left arrow key to navigate back, enter the passcode when prompted, select Confirm, and press OK to save the changes.

# 5. OPERATION

## 5.1 LED INDICATORS

The front panel of the GSAO-2 Control Hub features four LEDs to indicate status.

### Table 4: LED Indications

| Attribute | Color | Specification |
|---|---|---|
| Power | Green | Power is applied to the GSAO-2 and subsequently to the hydrogen montior. |
| Caution | Amber | Configurable to indicate a caution condition. |
| Alarm | Red | Configurable to indicate an alarm condition. |
| Service | Blue | Indicates a service or fault condition in the GSAO-2, hydrogen monitors, or AIN sensors. |

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

### Table 5: Non-Operational LED Indications

| Description | Indication |
|---|---|
| Firmware Update | Blue, amber, and red LEDs cycle from right to left with a period of 1 s. |
| Configuration Mode | Red and amber LEDs 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
- $H_2$ Rate of Change (24-hour, week, and month)
- Analog input status

### Table 6: GSAO-2 Display Codes

| GSAO-2 Display Code | Issue | Possible Cause | Remedy |
|---|---|---|---|
| Fault | Failure reported from the GRIDSCAN monitor | Read the status and error status Modbus holding registers for specific error details | Refer to the GRIDSCAN Operation Manual for a complete list of causes and recommended recovery actions. |

| | | | |
|---|---|---|---|
| Comms Down | GRIDSCAN monitor lost connection with GSAO-2 | Loose wires | Check and re-secure wires into the connectors. |
| Not found | GRIDSCAN monitor not detected during GSAO-2 power-on | Loose wires | Check and re-secure wires into the connectors. |
| Not Ready | GRIDSCAN monitor hydrogen measurements are not available | Normal operation of the GRIDSCAN monitor after power disruption | 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. |

## 5.3 SERIAL COMMUNICATION

The GSAO-2 provides serial communication over its USB-C connection, allowing access to event and data logs via a terminal emulator. Any two-way serial communication software, such as Foxterm (used by H2scan), can be used to establish a connection with the GSAO-2. See Appendix C: Foxterm Setup for instructions on setting up a serial connection.

**NOTE: A USB-C to USB-A cable is required. Alternatively, a USB-C to USB-C cable can be used with a USB-C to USB-A adapter, as a direct USB-C to USB-C connection does not provide a COM port.**

### 5.3.1 EVENT LOG

The event log provides a comprehensive record of system activity and is accessible via the USB-C serial command-line interface. Logged data is stored in Comma-Separated Values (CSV) format and can hold up to 6,885 records. When the log reaches full capacity, it will roll over, automatically discarding the oldest entries while preserving the most recent data. To ensure data integrity, all event log entries are stored in non-volatile memory, allowing them to persist even in the event of a power loss.

To retrieve and display the event log, follow these steps:

1. Connect the USB-C to USB-A cable.
2. Insert the USB-C end into the GSAO-2 device.
3. Insert the USB-A end into the computer.
4. Set up the serial communication connection using the instructions in Appendix C: FoxTerm Setup.
5. Send the ‘cup’ command via the serial interface to display the event log.

**NOTE: Enable Foxterm logging to save event log.**

#### 5.3.1.1 Power-On/Reset

The power-on/reset captures essential system reset and power-on events. This information is crucial for diagnosing issues and tracking failures.

**Table 7: Event Log - Power Record ID**

| Record ID | Timestamp | Reset Reason | POST Status | Reset Status |
|---|---|---|---|---|
| PWR | yyyy/m/d h:mm:ss | 0=PowerOn<br>1=Soft Reset<br>2=Low Power<br>3=Watchdog<br>4=Button<br>5=BrownOut<br>15=Unknown | 0=No Error<br>A non-zero value indicates a POST error. | (future usage) |

#### 5.3.1.2 GSAO-2 State Change

This record logs transitions between different operational states of the GSAO-2 system. This log provides essential information for tracking system behavior, diagnosing issues, and ensuring reliable performance.

**Table 8: Event Log - State Record ID**

| Record ID | Timestamp | State | Next State | Identifier Code |
|---|---|---|---|---|
| STATE | yyyy/m/d h:mm:ss | 0=POWER_OFF<br>1=POST<br>2=STARTUP<br>3=RUN<br>4=CONFIGURATION<br>5=SERVICE<br>6=UPGRADE<br>7=DATA_DOWNLOAD | 0=POWER_OFF<br>1=POST<br>2=STARTUP<br>3=RUN<br>4=CONFIGURATION<br>5=SERVICE<br>6=UPGRADE<br>7=DATA_DOWNLOAD | (future usage) |

#### 5.3.1.3 GS/AIN Input State

This record logs changes in the state of GRIDSCAN (GS) and Analog Input (AIN) devices. This log is essential for monitoring device activity, diagnosing issues, and ensuring reliable system operation.

**Table 9: Event Log - Instate Record ID**

| Record ID | Timestamp | Device Name | State | Next State | Device Instance |
|---|---|---|---|---|---|
| INSTATE | yyyy/m/d h:mm:ss | AIN1<br>AIN2<br>GS Monitor Number | 0=POWER_OFF<br>1=NOT_READY<br>2=READY<br>3=LOST_COMMS<br>4=NEW_DEVICE<br>6=NOT_FOUND<br>8=FAULT | 0=POWER_OFF<br>1=NOT_READY<br>2=READY<br>3=LOST_COMMS<br>4=NEW_DEVICE<br>6=NOT_FOUND<br>8=FAULT | Numeric |

#### 5.3.1.4 Alarm Event

This record logs critical sensor alarm events, providing essential information for monitoring system status, identifying anomalies, and triggering necessary responses. Each entry in the log captures details about the alarm's source, severity, and current state.

### Table 10: Event Log - Limit Record ID

| Record ID | Timestamp | Source | Sensor | Level | Alarm Status |
|---|---|---|---|---|---|
| LIMIT | yyyy/m/d h:mm:ss | AIN1<br>AIN2<br>GS Serial Number | 1=$H_2$<br>2=Oil Temp<br>4 = ATM Temp<br>5=Moisture %RH<br>6=Pressure<br>7=Moisture PPM<br>8=Current<br>9=Custom | 1=CAUTION<br>2=ALARM<br>3=CAUTION and ALARM | 0=Clear<br>1=Active |

#### 5.3.1.5 Relay Event

This record logs state changes of system relays, providing essential data for monitoring relay operations, diagnosing issues, and ensuring proper system functionality. Each entry in the log captures details about which relay was activated or deactivated and the time of the event.

### Table 11: Event Log - Relay Record ID

| Record ID | Timestamp | Timestamp | State |
|---|---|---|---|
| RELAY | yyyy/m/d h:mm:ss | 1=Relay1<br>2=Relay2<br>3=Relay3<br>4=Relay4 | 0=Open<br>1=Closed |

#### 5.3.1.6 Firmware Upgrade

This record logs essential details of firmware updates, ensuring accurate tracking of system version changes and upgrade history.

### Table 12: Event Log - Upgrade Record ID

| Record ID | Timestamp | Config Version | Config Version |
|---|---|---|---|
| UPGRADE | yyyy/m/d h:mm:ss | Numeric | NULL terminated string up to 19 characters |

#### 5.3.1.7 Set Time/Date

This record logs changes made to the system's date and time settings. It is essential for tracking time adjustments, ensuring accurate event logging, and maintaining system synchronization.

### Table 13: Event Log - Time Record ID

| Record ID | Timestamp | Previous Date/Time | New Date/Time |
|---|---|---|---|
| TIME | yyyy/m/d h:mm:ss | yyyy/m/d h:mm:ss | yyyy/m/d h:mm:ss |

#### 5.3.1.8 Upload Log Data/Events

This record captures the process of uploading logged events or data from the system.

## Table 14: Event Log - Upload Record ID

| Record ID | Timestamp | Event/Data Type | End Point | Record # |
|---|---|---|---|---|
| UPLOAD | yyyy/m/d h:mm:ss | 0 = Event<br>1 = Data | 0 = Start<br>1 = Stop | Start has 0 records<br>Stop has the # of records |

#### 5.3.1.9 Configuration Update

The Record ID CONFIG logs configuration changes made to the GSAO-2 device settings. These details can be used by H2scan technical support.

### 5.3.2 DATA LOG

The GSAO-2 Control Hub logs valid sensor data from all connected GRIDSCAN monitors and analog input sensors. Data logs are accessible via the USB-C serial command-line interface and are stored in Comma-Separated Values (CSV) format. The Data Log can store up to 36,295 records. When two GRIDSCAN monitors are installed, this capacity allows for approximately one year of data at the default logging interval of one hour. When full, the log will roll over, discarding the oldest entries and retaining the most recent data. Logged data is stored in non-volatile memory, ensuring it is retained even if power is lost

Follow these steps to display the data log.

1. Connect USB-C to USB-A cable.
   a. Insert the USB-C end into the GSAO-2.
   b. Insert the USB-A end into the computer.
2. Set up serial communication connection, following the instructions in Appendix C: Foxterm Setup.
3. Send ‘dup’ command to display the data log.

NOTE: Enable Foxterm logging to save data log.

## Table 15: Data Log Headers

| Header | Description |
|---|---|
| Rec-Type | GRIDSCAN 5000 (GS5), GRIDSCAN 6000 (GS6), Analog Input 1 (AIN1), or Analog Input 2 (AIN2) |
| Time-Stamp | yyyy/m/d h:mm:ss |
| device-id | GRIDSCAN monitor serial number |
| PCB-Temp | GRIDSCAN monitor internal temperature |
| $H_2$ | GRIDSCAN monitor hydrogen sensor measurement (PPM) |
| Oil-Temp | GRIDSCAN monitor oil temperature sensor measurement (°C) |
| Pressure | GRIDSCAN monitor pressure sensor measurement (ATM) |
| Moisture-Rs | GRIDSCAN monitor moisture sensor measurement (%RH) |
| Moisture-PPM | GRIDSCAN monitor moisture sensor measurement (PPM) |
| AIN1-Sensor-Type | Analog input 1 configured sensor type |
| AIN1-Measurement | Analog input 1 measurement value, units are based on measurement type |
| AIN2-Sensor-Type | Analog input 2 configured sensor type |

| Header | Description |
|---|---|
| AIN2-Measurement | Analog input 2 measurement value, units are based on measurement type |
| R-O-C_Day | GRIDSCAN monitor daily $H_2$ Rate of Change |
| R-O-C_Week | GRIDSCAN monitor weekly $H_2$ Rate of Change |
| R-O-C_Month | GRIDSCAN monitor monthly $H_2$ Rate of Change |

#### 5.3.2.1 GRIDSCAN 5000

The logged data from the installed GRIDSCAN 5000 monitor includes Rec-Type, Time-Stamp, device-id, PCB-Temp, $H_2$, and Oil-Temp. Measurement values for $H_2$ and Oil-Temp will be "0" when the GRIDSCAN 5000 status is 'Not Ready' or reporting a fault.

#### 5.3.2.2 GRIDSCAN 6000

The logged data from the installed GRIDSCAN 6000 monitor includes Rec-Type, Time-Stamp, device-id, PCB-Temp, $H_2$, Oil-Temp, Pressure, Moisture-Rs, and Moisture-PPM. Measurement values for $H_2$ and Oil-Temp will be "0" when the GRIDSCAN 6000 status is 'Not Ready' or reporting a fault.

#### 5.3.2.3 Analog Input

The logged data from the installed analog input sensors includes Rec-Type, Time-Stamp, AIN1-Sensor-Type, AIN1-Measurement, AIN2-Sensor-Type, and AIN2-Measurement. Analog input data may not be logged if the sensor is reporting a fault or if the input is out of range.

**Table 16: Event Log - Analog Input**

| Sensor-Type | Measurement Units |
|---|---|
| $H_2$ Level | PPM |
| Moisture | %RH |
| Temp | °C |
| Pressure | PSI |
| Current | A |
| Custom | As configured |

#### 5.3.2.4 Rate of Change

The logged Rate of Change (ROC) data includes Rec-Type, Time-Stamp, device-id, R-O-C_Day, R-O-C_Week, and R-O-C_Month. The rate of change is logged for each installed GRIDSCAN monitor at the configured logging frequency. A value of -1,000,000 is logged after the GRIDSCAN monitor is power-cycled or when ROC values are unavailable.

# APPENDIX A: SPECIFICATIONS

## Table A1: 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) | 100 | | 240 | VAC |
| Output Voltage (Auxiliary) | 22 | 24 | 26 | VDC |
| Power Consumption:<br>GSAO-2 alone (no sensors or AUX devices)<br>With one hydrogen monitor<br>With two hydrogen monitors | | | 5<br><br>**10<br>**15 | W |

**Depends on hydrogen monitor type

NOTE: Do NOT exceed maximum voltage.

## Table A2: GSAO-2 Physical Specifications

| Parameter | Nominal Value |
|---|---|
| Product Height | 178.3 mm (7.0") |
| Product Width | 302.7 mm (11.9") |
| Product Depth | 92.5 mm (3.6") |
| Product Weight | 3.4 kg (7.5 lb) |

## Table A3: 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 |
| Alt Normal Voltage | 0 | | 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 VDC / 1.0 VDC = 0 %RS<br>20 mA / 5 VDC = 100 %RS | | | |
| *Scaling Oil Temperature | 4 mA /0 VDC / 1.0 VDC = 0 °C<br>20 mA / 5 VDC = 120 °C | | | |
| *Scaling Current Loop | 4 mA /0 VDC / 1.0 VDC = 0 A<br>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 A4: GSAO-2 Analog Output Specifications

| Parameter | Value | | | Units |
|---|---|---|---|---|
| | Minimum | Nominal | Maximum | |
| Number of Outputs | | 4 | | each |
| Current Loop Power | Internally powered | | | |
| 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 |

| Parameter | Value | | | Units |
|---|---|---|---|---|
| | Minimum | Nominal | Maximum | |
| 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<br>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<br>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<br>20 mA / 5 VDC = 100% RS | | | |
| *Scaling Oil Temperature | 4 mA /0.1 VDC / 1.0 VDC = 0 °C<br>20 mA / 5 VDC = 120 °C | | | |
| *Scaling Current Loop | 4 mA / 0.1 VDC / 1.0 VDC = 0 A<br>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 A5: 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 110 VDC | | | |
| Life Ratings | >50,000 Cycles | | | |

## APPENDIX B: COMPLIANCE & CERTIFICATIONS

### B.1 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

- Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-4 radio disturbance and immunity measuring apparatus – Ancillary Equipment – Radiated Disturbances CISPR 16-1-4 2008
- Information Technology Equipment (including Digital Apparatus) ICES-003 Issue 7 (2020)
- Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements EN 61326-1: 2013.

### B.2 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
- Directive 2014/30/EU

**Table B1: 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 |

### B.3 FCC / ISED COMPLIANCE STATEMENT

#### FCC PART 15, CLASS A DIGITAL DEVICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

#### ISED ICES-003 CLASS A DIGITAL APPARATUS

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

## APPENDIX C: FOXTERM SETUP

### C.1 INSTALLATION

These instructions refer to FoxTerm, but the concepts are the same in all terminal emulators.

1. Download FoxTerm from FoxTerm
2. Create a folder in “My Documents” called “H2scan”.
3. Unzip the FoxTerm files into the H2scan folder.

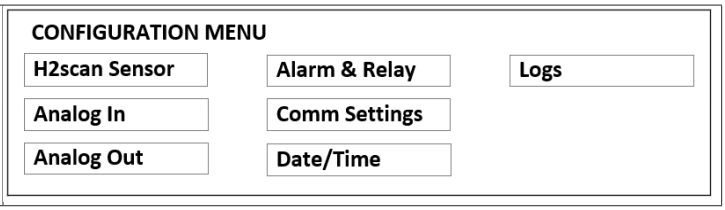
### C.2 SETUP

1. Double click FoxTerm.exe to Start FoxTerm.
2. Select File > new COM Port Connection.
3. Update the following settings:
   a. Select Port: as detected by PC
   b. Select Baud: 19200
   c. Select Data Bits: 8
   d. Select Parity: none
   e. Select Newline Behavior: CRLF
   f. Select Echo Characters: true
   g. Select a log file name and location.
4. Click OK.
5. Save the session as “H2scan.xml” in the FoxTerm program location.

**NOTE: Type command “uuuu” to verify connection. GSAO-2 firmware revision will be displayed.**

## APPENDIX D: GSAO-2 MENU TREE

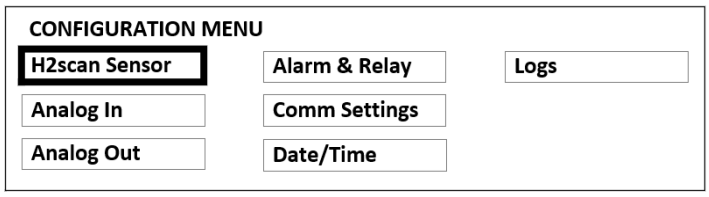
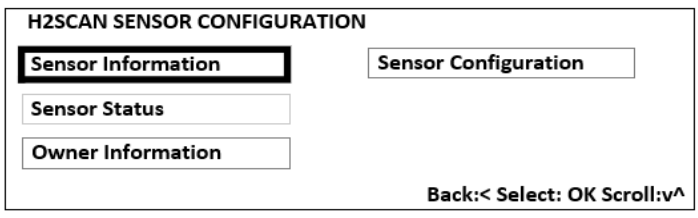
### D.1 ACCESSING THE MAIN MENU

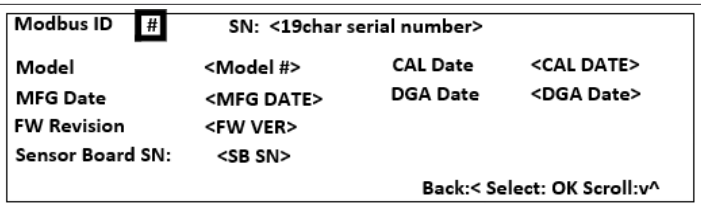
| | |
|---|---|
| 1. Press and hold OK for 3 seconds |  |

### D.2 H2SCAN SENSOR CONFIGURATION MENU

#### D.2.1 SENSOR INFORMATION

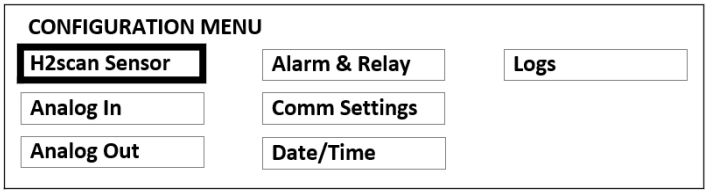
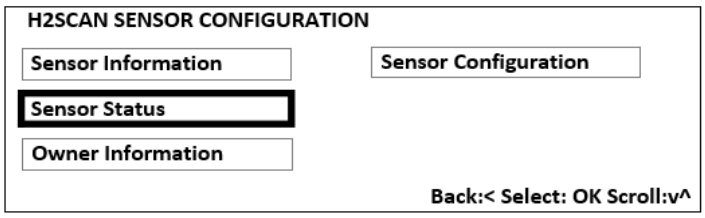
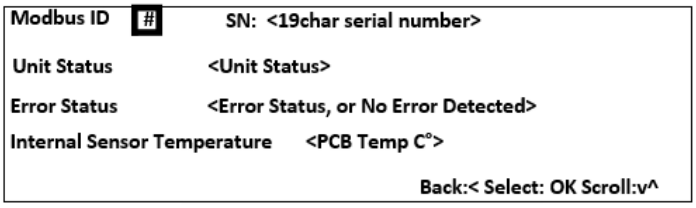
View hydrogen monitor model number, serial number, firmware version details.

| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select H2scan Sensor<br>3. Press OK |  |
| 4. Select Sensor Information<br>5. Press OK |  |

| | |
|---|---|
| 6. Select target hydrogen monitor using Modbus ID drop-down<br>7. Press OK |  |

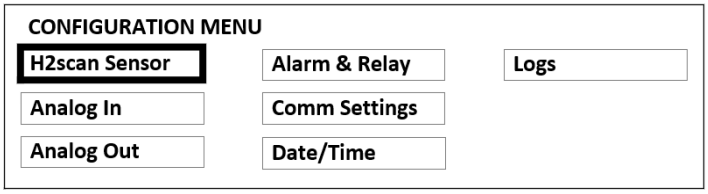
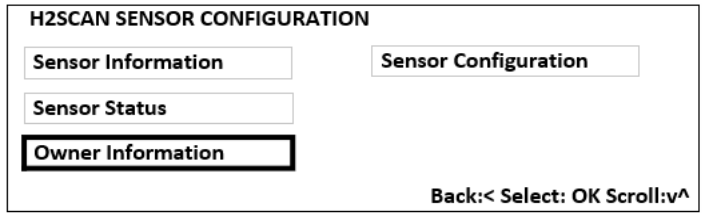
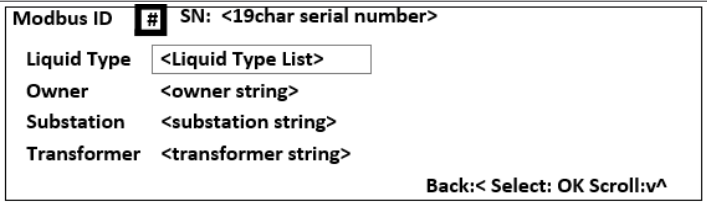
### D.2.2 SENSOR STATUS

View GRIDSCAN monitor unit status and error status.

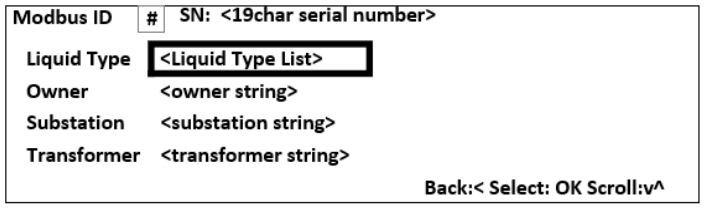
| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select H2scan Sensor<br>3. Press OK |  |
| 4. Select Sensor Status<br>5. Press OK |  |
| 6. Select target monitor using Modbus ID drop-down<br>7. Press OK |  |

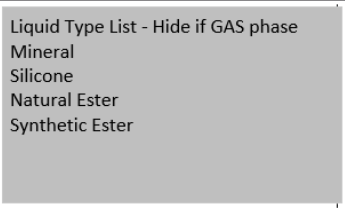
### D.2.3 OWNER INFORMATION

View configured liquid type and owner information details.

| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select H2scan Sensors<br>3. Press OK |  |
| 4. Select Owner Information<br>5. Press OK |  |
| 6. Select target hydrogen monitor using Modbus ID drop-down<br>7. Press OK |  |

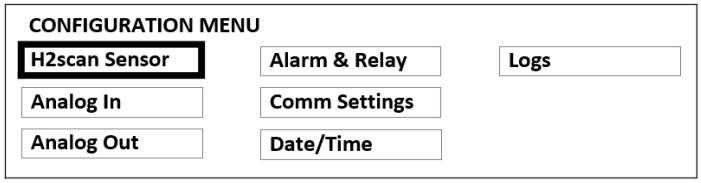
8. Select Liquid Type using Liquid Type List
9. Press OK



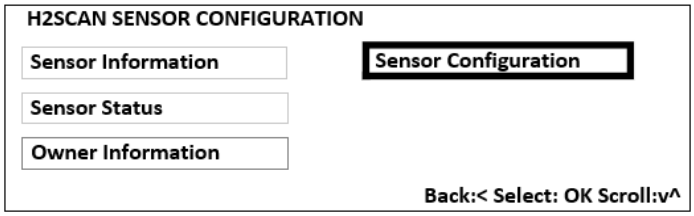




### D.2.4 SENSOR CONFIGURATION

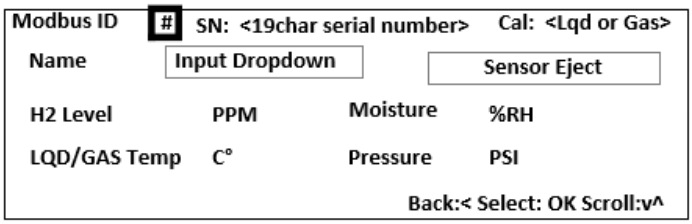
1. Access Configuration Menu
2. Select H2scan Sensor
3. Press OK



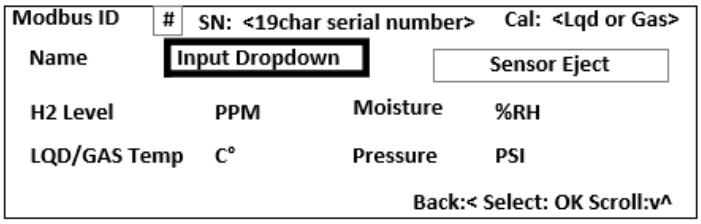

4. Select Sensor Configuration
5. Press OK

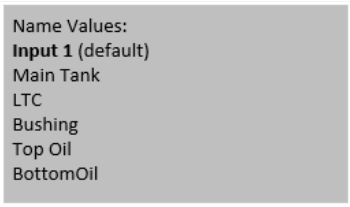



6. Select target hydrogen monitor using Modbus ID drop-down
7. Press OK

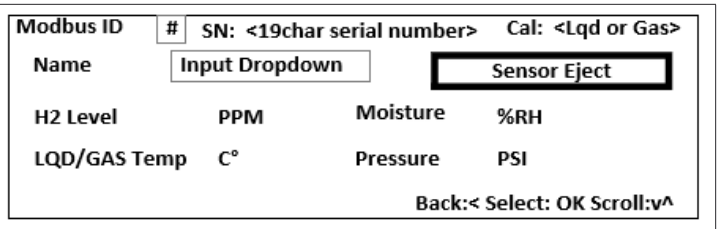



8. Select Name using input drop-down
9. Press OK



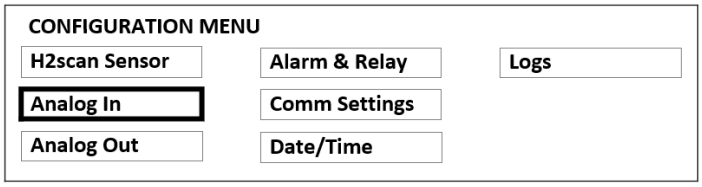



10. Select Sensor Eject to disconnect the sensor
11. Press OK

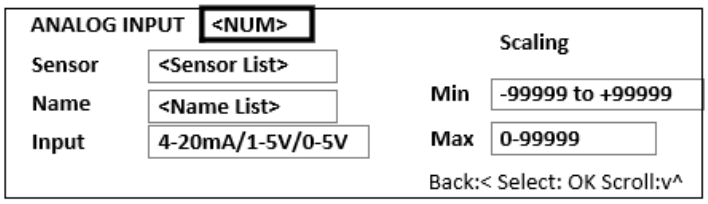



## D.3 ANALOG IN MENU

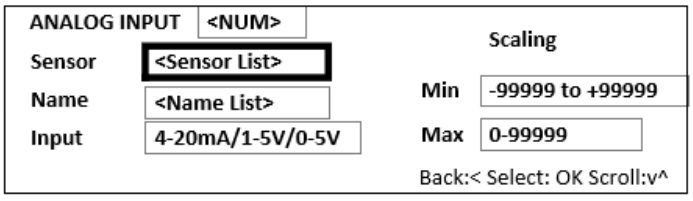
1. Access Configuration Menu
2. Select Analog In
3. Press OK

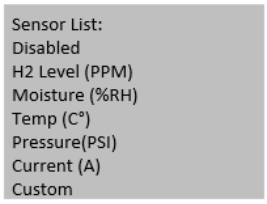



4. Select target Analog Input using NUM drop-down
5. Press OK

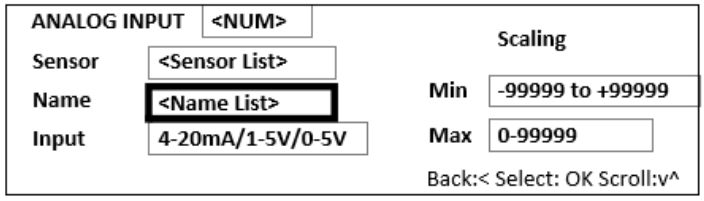


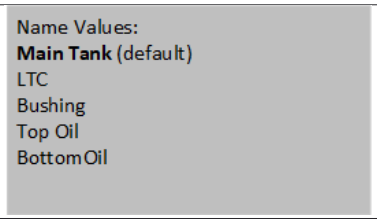

6. Select Sensor using Sensor List drop-down
7. Press OK



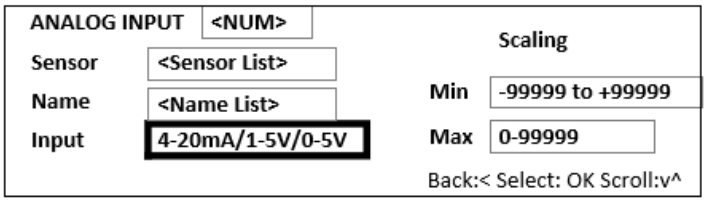




8. Select Name of the target sensor using Name List drop-down

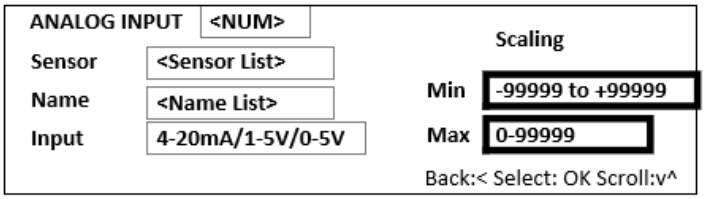


9. Select Input using Input drop-down
10. Press OK

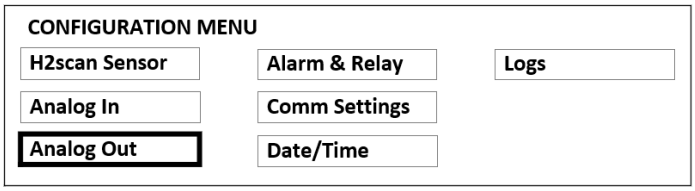



11. Select Scaling Min and Max using Min and Max drop-down
12. Press OK

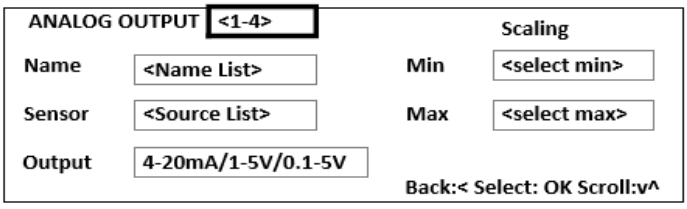



## D.4 ANALOG OUTPUT

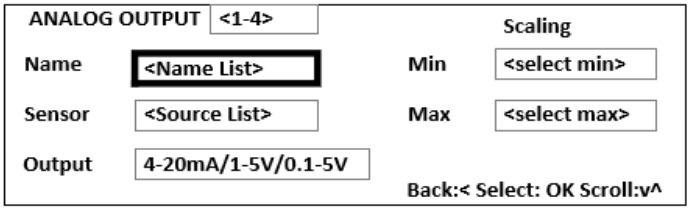
1. Access Configuration Menu
2. Select Analog Output
3. Press OK

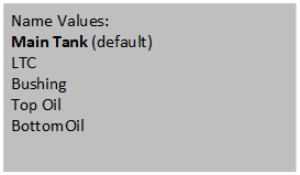



4. Select target Analog Output using Analog Output drop-down
5. Press OK

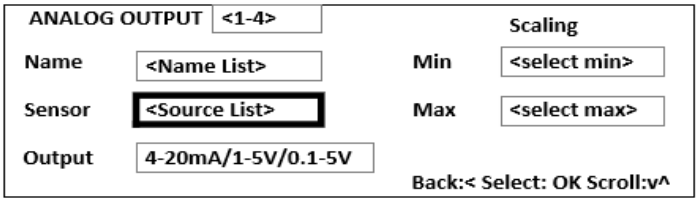



6. Select Name using Name List drop-down
7. Press OK

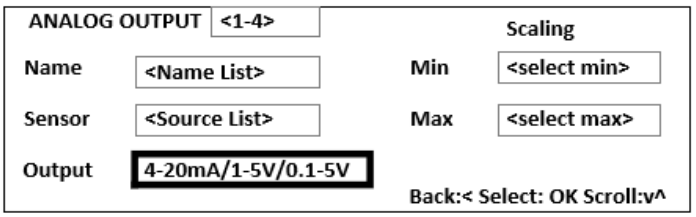


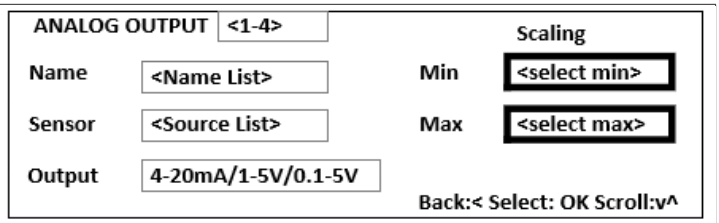

8. Select Source using Source List drop-down
9. Press OK




10. Select Output using Output drop-down
11. Press OK



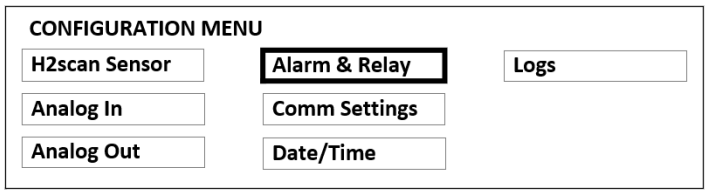
12. Select Scaling Min and Max using Min and Max drop-down
13. Press OK



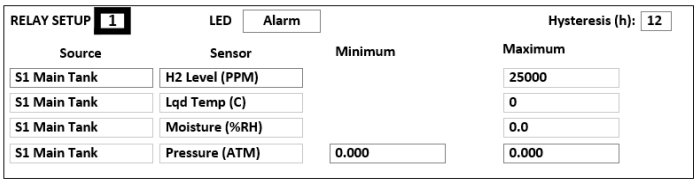

## D.5 ALARM AND RELAY

### D.5.1 ALARM AND CAUTION CONFIGURATION

1. Access Configuration Menu
2. Select Alarm & Relay
3. Press OK

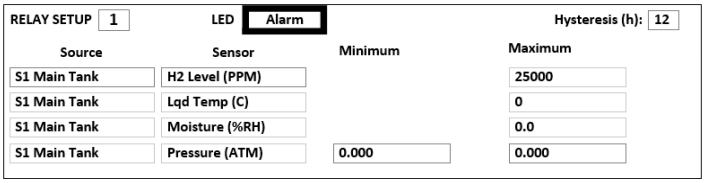



4. Select target Relay (1–4) using Relay Setup drop-down
5. Press OK



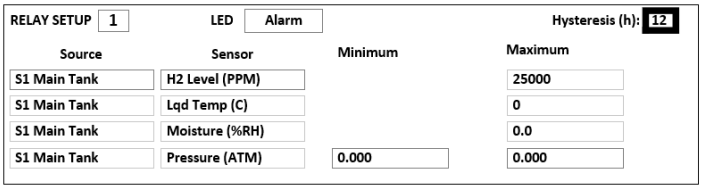

6. Select Alarm or Caution using LED drop-down
7. Press OK

NOTE: To disable, select None.



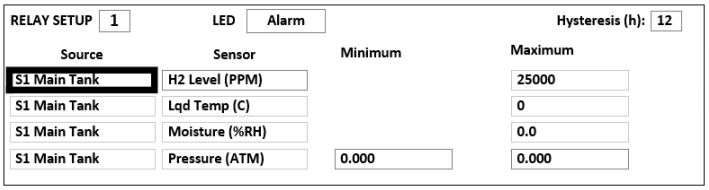

8. Select Hysteresis using Hysteresis drop-down
9. Press OK

NOTE: For best experience, set the same Hysteresis value for all relays.



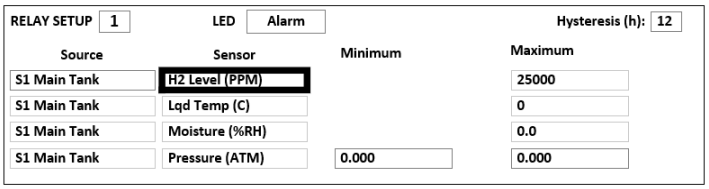

10. Select Source using Source drop-down
11. Press OK

NOTE: Only configured sources are listed.



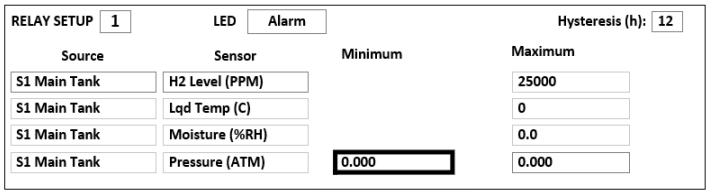
12. Select Sensor using Sensor drop-down
13. Press OK

NOTE: Only configured sources are listed.

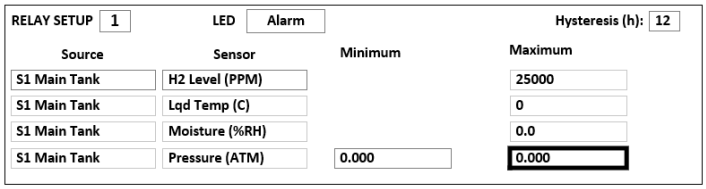



14. Select Minimum using Minimum drop-down
15. Press OK

NOTE: The minimum option is only available for pressure.

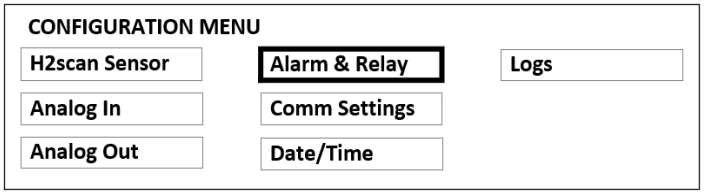



16. Select Maximum using Maximum drop-down
17. Press OK

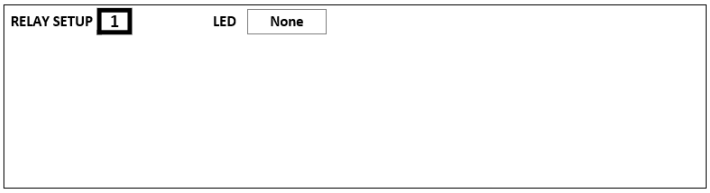



### D.5.2 SERVICE CONFIGURATION

1. Access Configuration Menu
2. Select Alarm & Relay
3. Press OK

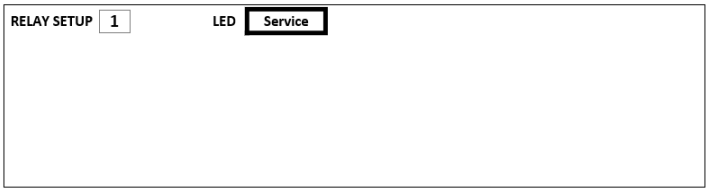



4. Select target Relay (1–4) using Relay Setup drop-down
5. Press OK




6. Select Service using LED drop-down
7. Press OK

NOTE: To disable, select None.

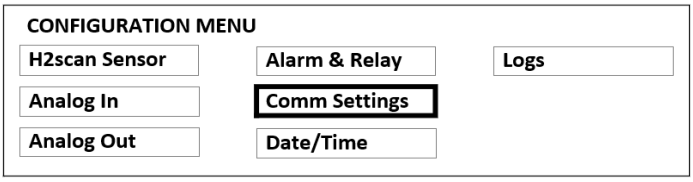



## D.6 COMM SETTINGS

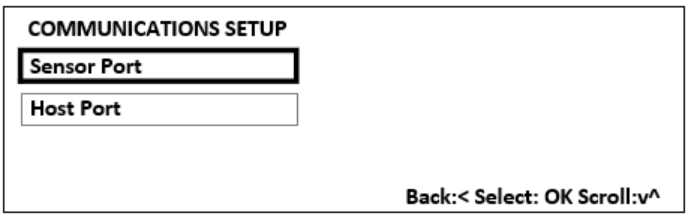
### D.6.1 SENSOR PORT

Configure GSAO-2 to GRIDSCAN monitor configuration. Default values match the GRIDSCAN monitor default settings. Changes to these settings will also need to be made on the connected GRIDSCAN monitor.

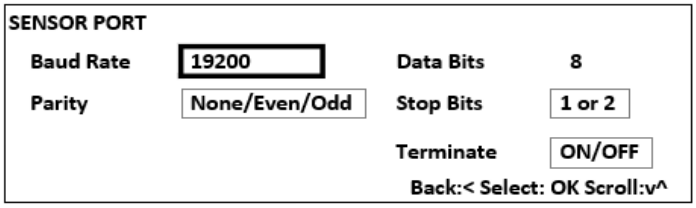
1. Access Configuration Menu
2. Select Comm Settings
3. Press OK



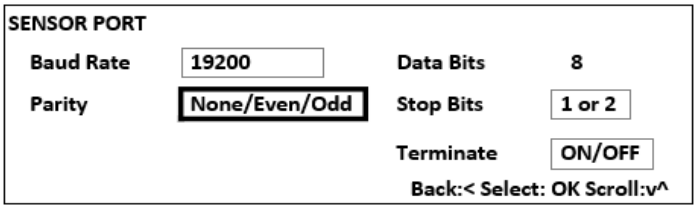

4. Select Sensor Port
5. Press OK



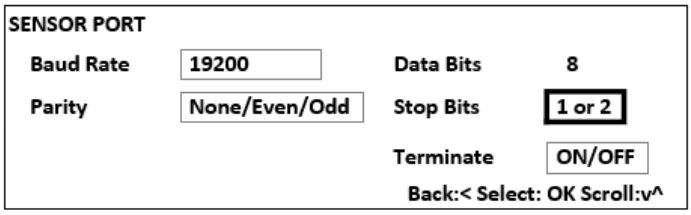

6. Select Baud Rate using Baud Rate drop-down
7. Press OK



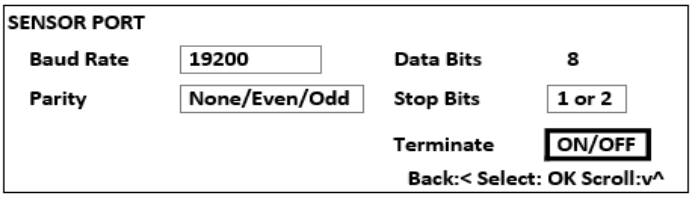

8. Select Parity using Parity drop-down
9. Press OK




10. Select Stop Bits using Stop Bits drop-down
11. Press OK




12. Select Terminate ON/OFF
13. Press OK

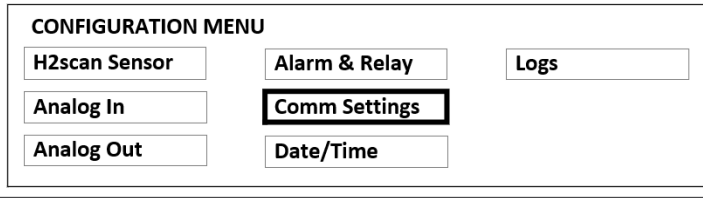



NOTE: Terminate will enable or disable the termination resistor.

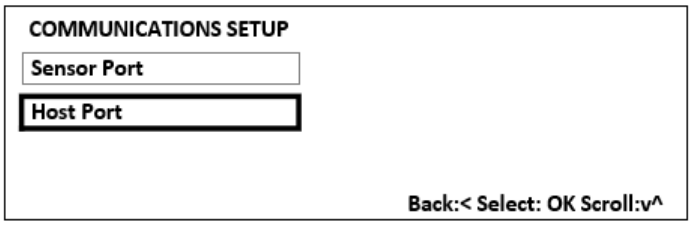
### D.6.2 HOST PORT

Configure GSAO-2 to end user SCADA network.

1. Access Configuration Menu
2. Select Comm Settings
3. Press OK

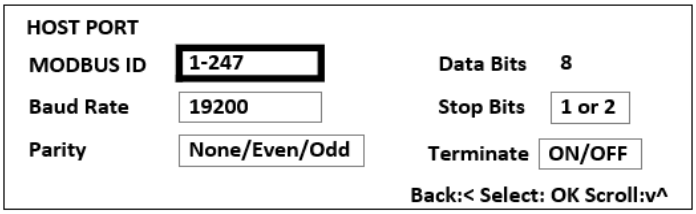


4. Select Host Port
5. Press OK

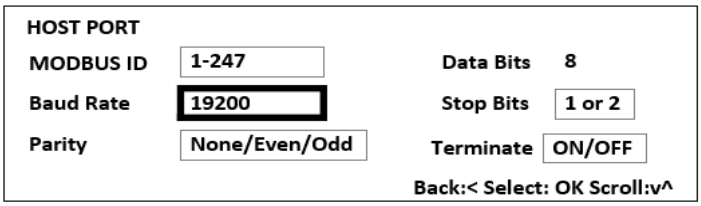



**Firmware V2.0.2 and Earlier Releases**

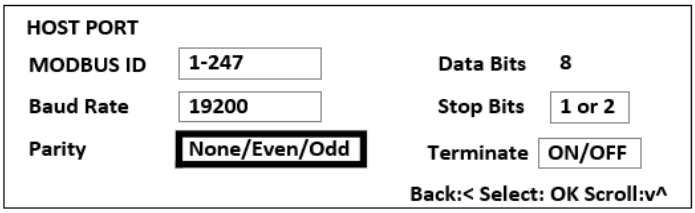
6. Select Modbus ID using Modbus ID drop-down
7. Press OK



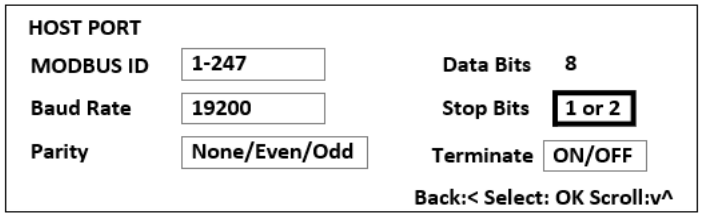

8. Select Baud Rate using Baud Rate drop-down
9. Press OK




10. Select Select Parity using Parity drop-down
11. Press OK

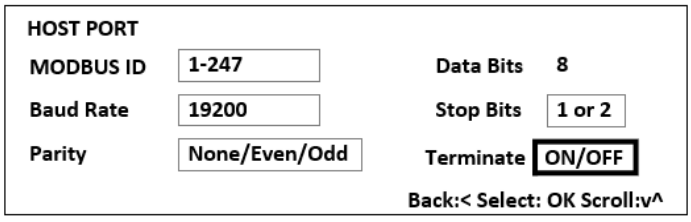


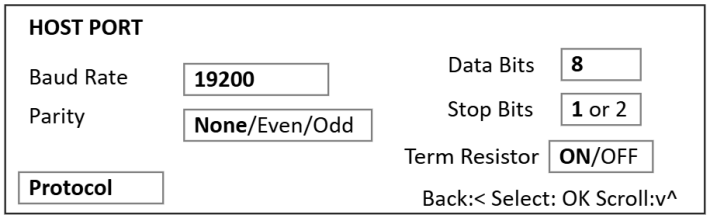
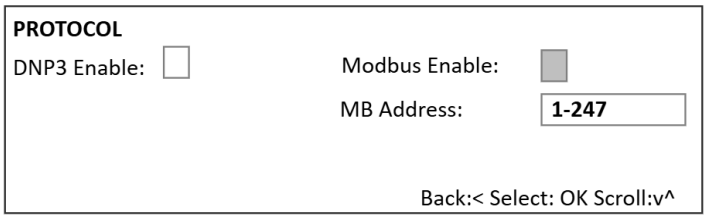
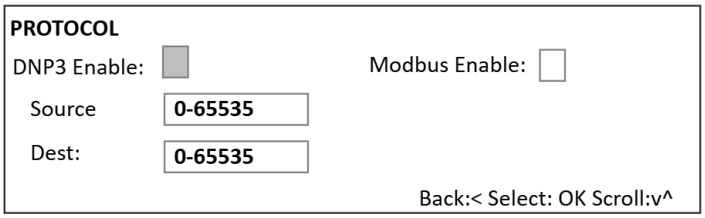

12. Select Stop Bits using Stop Bits drop-down
13. Press OK




14. Select Terminate ON/OFF
15. Press OK

NOTE: Terminate will enable or disable the termination resistor.

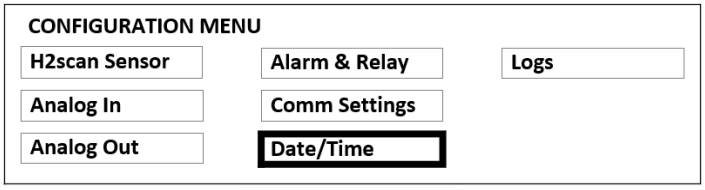
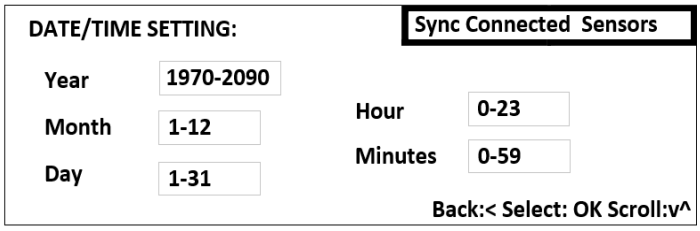
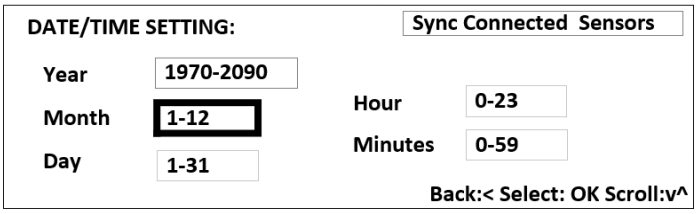
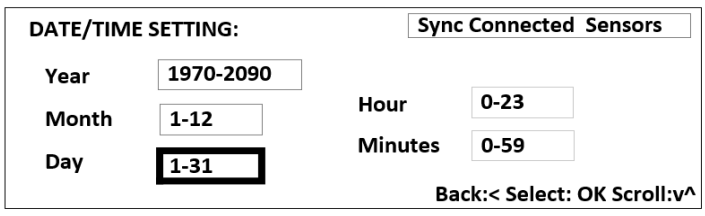


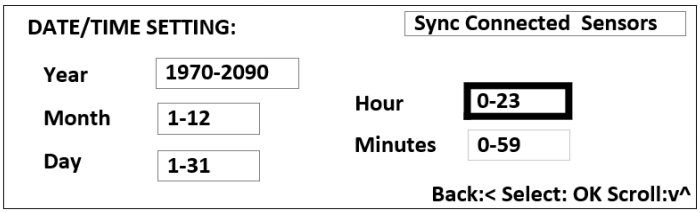
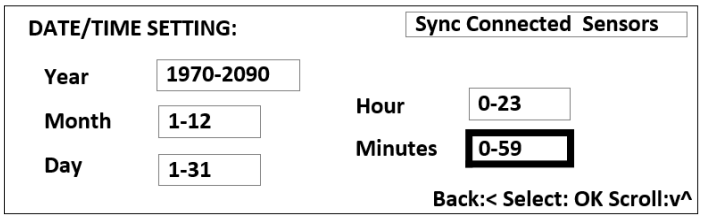
| | |
|---|---|
| **Firmware V2.5.1 and Future Releases**<br>Host Port Configuration |  |
| Protocol Selection Modbus RTU |  |
| Protocol Selection DNP3 Enable |  |

## D.7 DATE/TIME

### D.7.1 GSAO-2 DATE/TIME

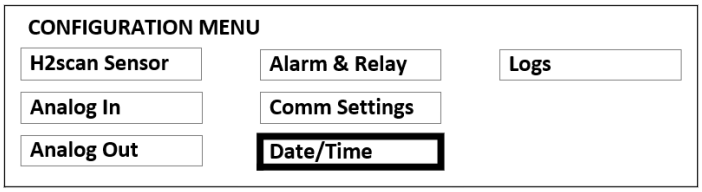
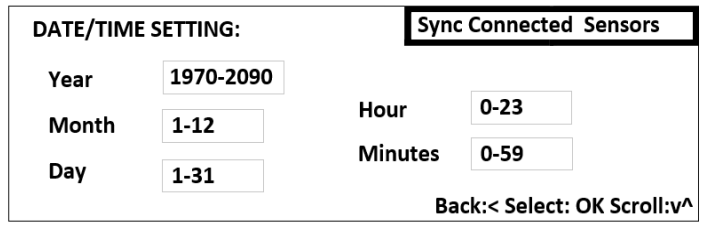
Set the GSAO-2 date and time for event log and data log timestamps.

| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select Date/Time<br>3. Press OK |  |
| 4. Select Year using the drop-down<br>5. Press OK |  |
| 6. Select Month using the drop-down<br>7. Press OK |  |
| 8. Select Day using the drop-down<br>9. Press OK |  |

| | |
|---|---|
| 10. Select Hour using the drop-down<br>11. Press OK |  |
| 12. Select Minutes using the drop-down<br>13. Press OK |  |

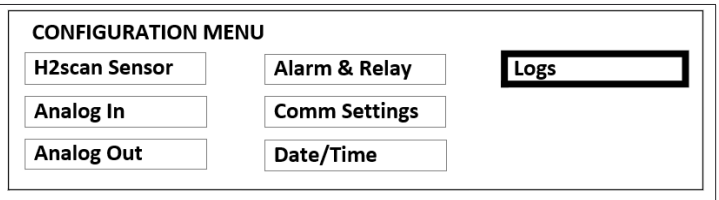
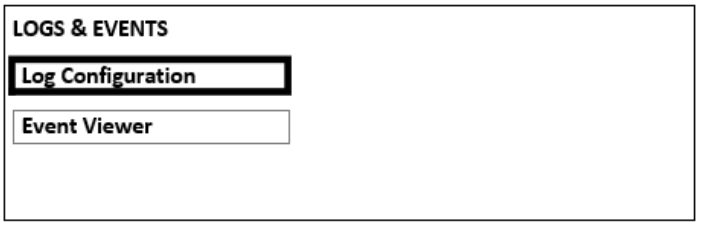
### D.7.2 GRIDSCAN MONITOR DATE/TIME CONFIGURATION

Configure the GRIDSCAN monitor Date/Time to be synchronized with the GSAO-2. This is used for data log timestamps.

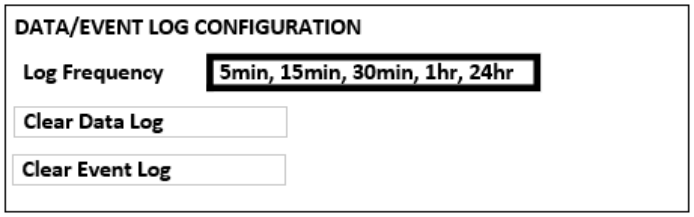
| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select Date/Time<br>3. Press OK |  |
| 4. Select Sync Connected Sensors to synchronize the sensor's date and time<br>5. Press OK |  |

## D.8 LOGS MENU

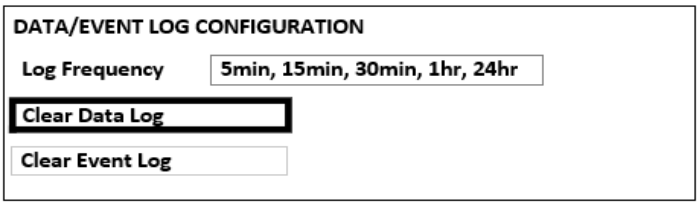
### D.8.1 LOG CONFIGURATION

| | |
|---|---|
| 1. Access Configuration Menu<br>2. Select Logs<br>3. Press OK |  |
| 4. Select Log Confirmation<br>5. Press OK |  |

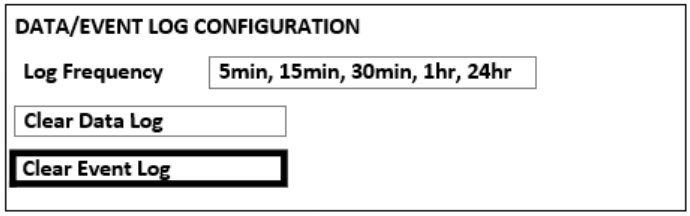
6. Select Log Frequency using drop-down
7. Press OK




8. Select Clear Data Log to delete all data log
9. Press OK

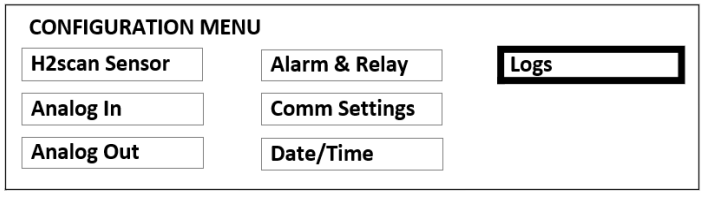



10. Select Clear Event Log to delete all event log
11. Press OK

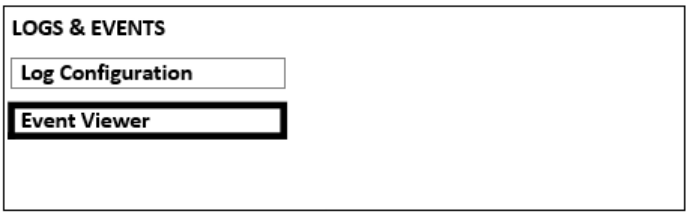



### D.8.2 EVENT VIEWER

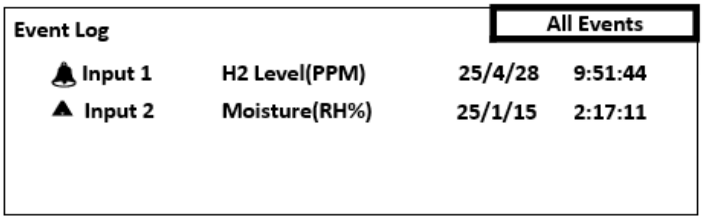
1. Access Configuration Menu
2. Select Logs
3. Press OK

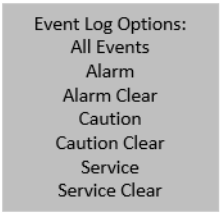



4. Select Event Viewer
5. Press OK



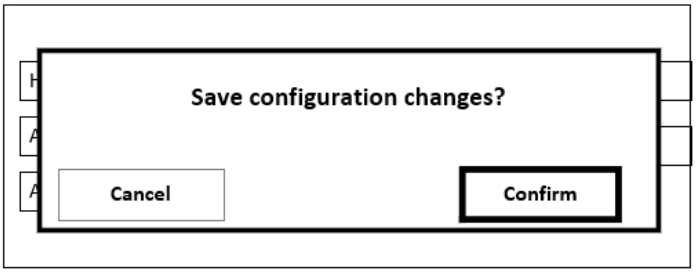

6. Select Event log using drop-down
7. Press OK



### D.9 SAVING CONFIGURATION CHANGES

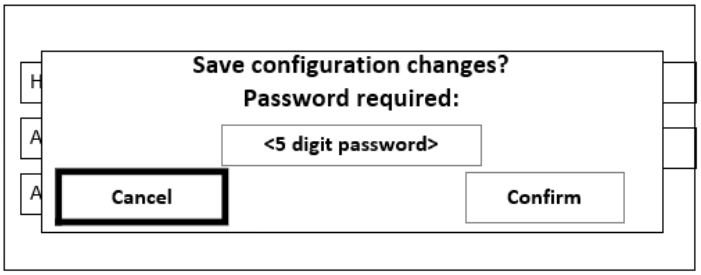
1. Select Confirm to save changes or select Cancel to disregard changes
2. Press OK




#### D.9.1 PASSWORD SCREEN

A password prompt appears when configuration is changed, if password has not been previously entered.

1. Enter password
2. Select Confirm to save changes or select Cancel to disregard changes
3. Press OK

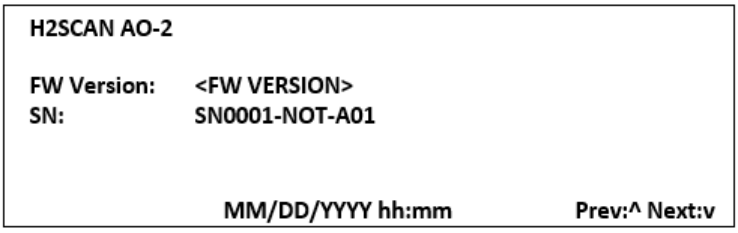



### D.10 SCROLLING STATUS SCREEN

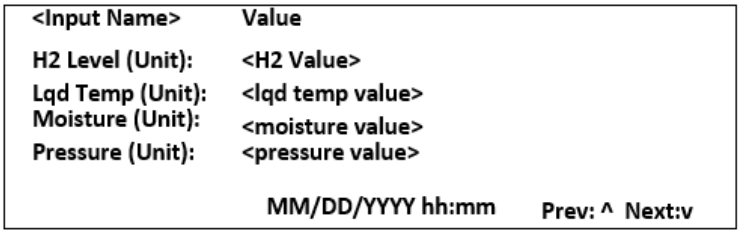
Scrolling status screens display automatically at power-on.

NOTE: Status and ROC screens only display for configured GRIDSCAN monitors. Analog Inputs screen only displays when there is a configured AIN sensor.

#### D.10.1 INFORMATION SCREEN




#### D.10.2 STATUS SCREEN



### D.10.3 H2 ROC SCREEN

| H2 ROC | Input 1 | Input 2 |
|---|---|---|
| 24Hr | <24hr Value> | <24hr Value> |
| Week | <Week value> | <Week value> |
| Month | <Month value> | <Month value> |
| | MM/DD/YYYY hh:mm | Prev: ^ Next:v |

### D.10.4 ANALOG INPUTS SCREEN

| Analog Inputs | Value | |
|---|---|---|
| Main Tank<br>H2 Level (Unit) | <H2 Value> | |
| LTC<br>Pressure (Unit) | <pressure value> | |
| | MM/DD/YYYY hh:mm | Prev: ^ Next:v |