H2scan®

Advanced Hydrogen Sensing

OPERATION MANUAL

HY-GUARD™

8000 Series Hydrogen Detector

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IMPORTANT NOTICES

Look over and understand this operation manual before installing or using the unit. If this equipment is used in a manner not specified by H2scan, the warranty may be void and the protection provided by the equipment may be impaired.

⚠ WARNING

If the product seems defective, DO NOT attempt to repair it. Immediately send the product back to H2scan for repairs.

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 HY-GUARD™ 8000 Series ("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 60 months from the ship date for such Product. The sensor within the HY-GUARD will be free of defects which substantially affect the Product's performance for 120 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 five-year Limited Warranty on the HY-GUARD and ten-year Limited Warranty on its sensor are void for any of the following:

- Unauthorized repair work 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 EXPRESS 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.

Symbol	Meaning
	Caution, possibility of electric shock
	Caution

1. GETTING STARTED

1.1 INTRODUCTION

HY-GUARD is an advanced solution designed to detect and monitor hydrogen, ensuring safety in critical environments.

All configurations of HY-GUARD contain two default alarm relays that activate at 1% and 2% hydrogen concentrations to warn of potential risks. Its patented solid-state sensor delivers accurate measurements while preventing false alarms for the duration of its ten-year, calibration-free lifespan.

While HY-GUARD continuously monitors for hydrogen, it performs real-time self-diagnostics. In the event of an internal error or an abnormality that prevents hydrogen detection, HY-GUARD triggers the fault relay to alert users.

1.2 MEET YOUR HY-GUARD

What's in the box:

- HY-GUARD
  - Mounting Hardware (4x 8-32 x 5/8" screws)
- Quick-Start Guide

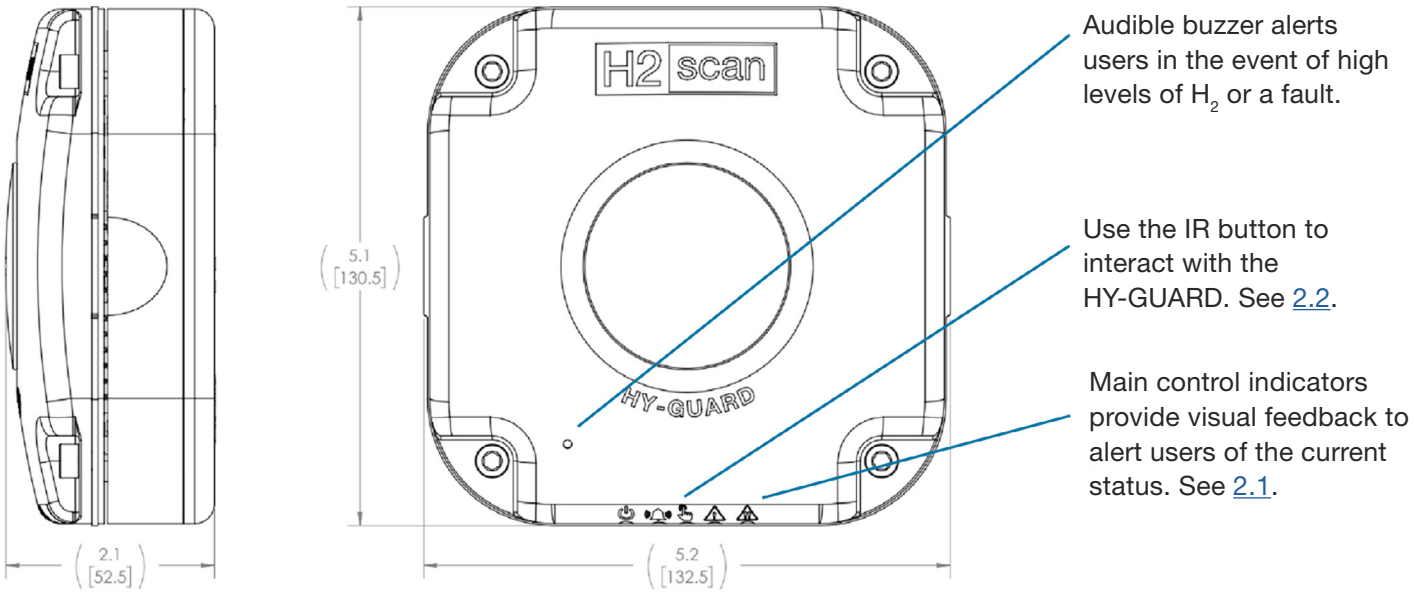

Figure 1: HY-GUARD Diagram

NOTE: Reference PN 50000124-LTDS for more information.

1.3 INSTALLATION OPTIONS

HY-GUARD has multiple installation options, including:

- Punch-Out: Mounts to a surface with wire feedthroughs
- Junction Box: Mounts to a standard 2100 junction box (4-11/16")
- DIN Rail: Universal adapter plate enables easy mounting directly to 35 mm DIN rail*
- Magnetic Mount: Universal adapter plate enables easy mounting directly to a magnetic surface*

*Requires additional universal adapter plate kit, not included with the unit (108-KIT).

NOTE: All necessary mounting screws (8-32 thread) are included with the unit.

1.4 INSTALLATION LOCATION

Hydrogen is a colorless, odorless, and extremely light gas that naturally rises. For this reason, HY-GUARD should be installed at the highest point within rooms, cabinets, or enclosures to effectively measure hydrogen in the surrounding air as it is intended for indoor use.

NOTE: H2scan recommends ceiling mounting only. Alternative mounting orientations, if chosen by the customer, are not evaluated or recommended by the manufacturer.

1.5 INSTALLATION GUIDE

1.5.1 RECOMMENDED TOOLS & WIRING FOR INSTALLATION

- Phillips #2 screwdriver
- Flathead screwdriver
- Wire gauge maximum length:
  - AC: 22–12 AWG = follow best practices for AC wiring
  - DC: 14–20 AWG = max 33' (10 m)
    - Modbus: 20–24 AWG = max 4000' (1219 m)

1.5.2 PRE-INSTALLATION

1. Identify communications. Determine which communications you need to wire to your HY-GUARD. Refer to 1.5.3 for wiring instructions.
2. Determine HY-GUARD mounting location. Double-check recommended installation locations in 1.4.
3. Determine wire path from power source, AC and DC power sources, as well as relays, Modbus and 4–20 mA Analog Output. You can connect AC, DC, or both AC and DC*.

*HY-GUARD supports both AC and DC power inputs. AC is used as the primary source by default. In the event of AC loss, HY-GUARD will automatically switch to DC when AC and DC are powered by separate power sources. *The green LED will remain illuminated to show that HY-GUARD is still operating from the DC power source.*

- Rated Voltage Input:
  - AC: 110–240 VAC, 50/60 Hz
  - DC: 15–60 V
- Optional Voltage Input**:
  - AC: 85–264 VAC, 50/60 Hz
  - DC: 90-250 V***

**Product not certified for these optional operating voltage inputs.

***NOTE: Reference alternate wiring instruction PN 90000307 for applications using 90-250 VDC.**

- 4–20 mA Analog Output
  - The Analog Output is a linearly scaled 4-20mA where:
    - 4 mA: 0% H_2
    - 7.2 mA: 1% H_2
    - 10.4 mA: 2% H_2

- 20 mA: 5% H_2
- There are additional Analog Outputs for different states:
  - 0 mA indicates the device is disconnected or not powered
  - 2 mA indicates the device is warming up and not ready
  - 3 mA indicates an error condition

- SPDT Relays
  - 12 A @ 125 VAC
  - 12 A @ 28 VDC
- Modbus
  - 1% = 10,000 ppm
  - 2% = 20,000 ppm

4. For Punch-Out, refer to the back side of the Quick-Start Guide for a mounting hole template.

1.5.3 WIRING

NOTE: The installation of the device depends on the mounting type and location.

⚠ WARNING

Before installation, ensure all power sources are completely disconnected. Verify no live wires are present to prevent electrical shock, equipment damage, and/or serious injury.

1. Feed wiring through the divided center of the HY-GUARD Power Board Assembly.
   - The large hole on the side of the lever-lock connectors is for AC wiring only.
   - The smaller hole on the opposite side is for DC wiring only (see Figure 2).

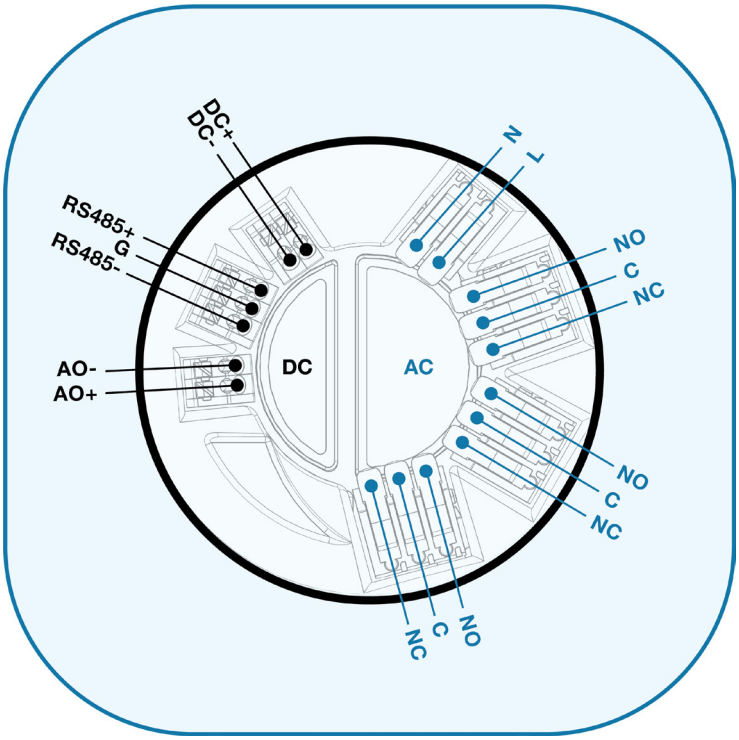

Figure 2: HY-GUARD Wiring

NOTE: Keep AC wires separate from DC.

2. Connect wires to the appropriate connector (see Figure 2).

NOTE: Ensure the device wiring matches the diagram provided in Figure 2. If you are uncertain if the device is functioning properly, use the Communication Test Mode (2.5) to validate the system.

3. Pull excess wires back.

NOTE: Ensure all wires are securely connected.

1.5.4 FINAL INSTALLATION

1. Install the Power Board Assembly onto surface (see Figure 3).
   - Secure the Power Board Assembly with four 8-32 Phillips head screws torqued to 20 in-lbs (2.3 Nm)

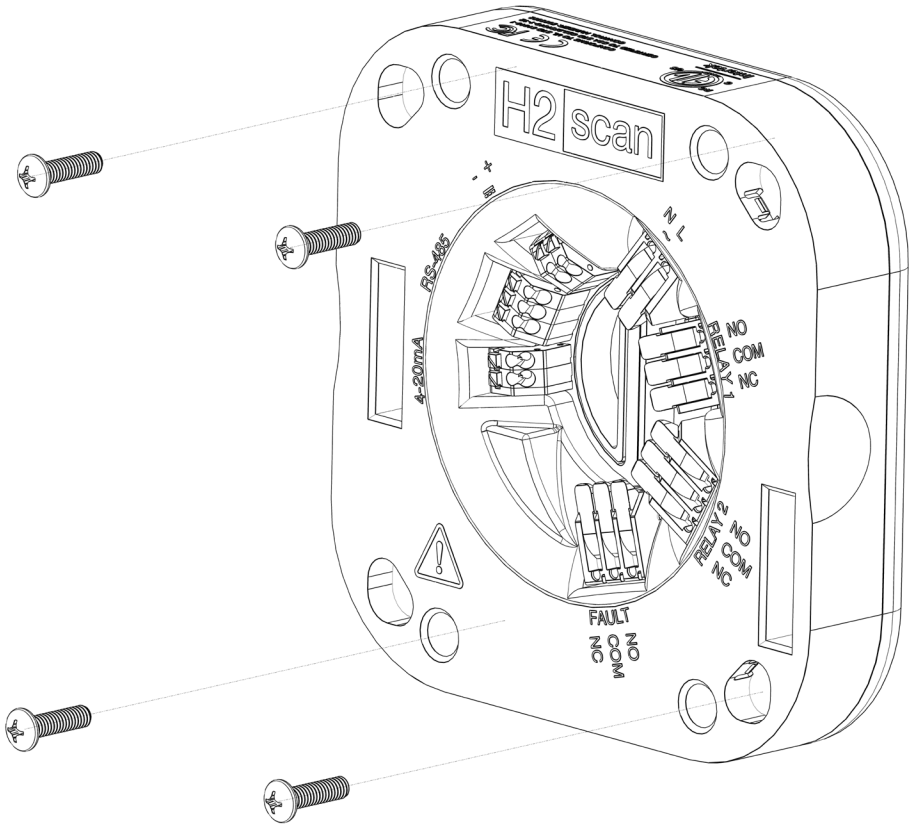

Figure 3: Secure Power Board Assembly

2. Secure the Sensor Assembly to the Power Board Assembly (see Figure 4).
   - Ensure the pins on the Sensor Assembly are aligned with the Power Board Assembly.

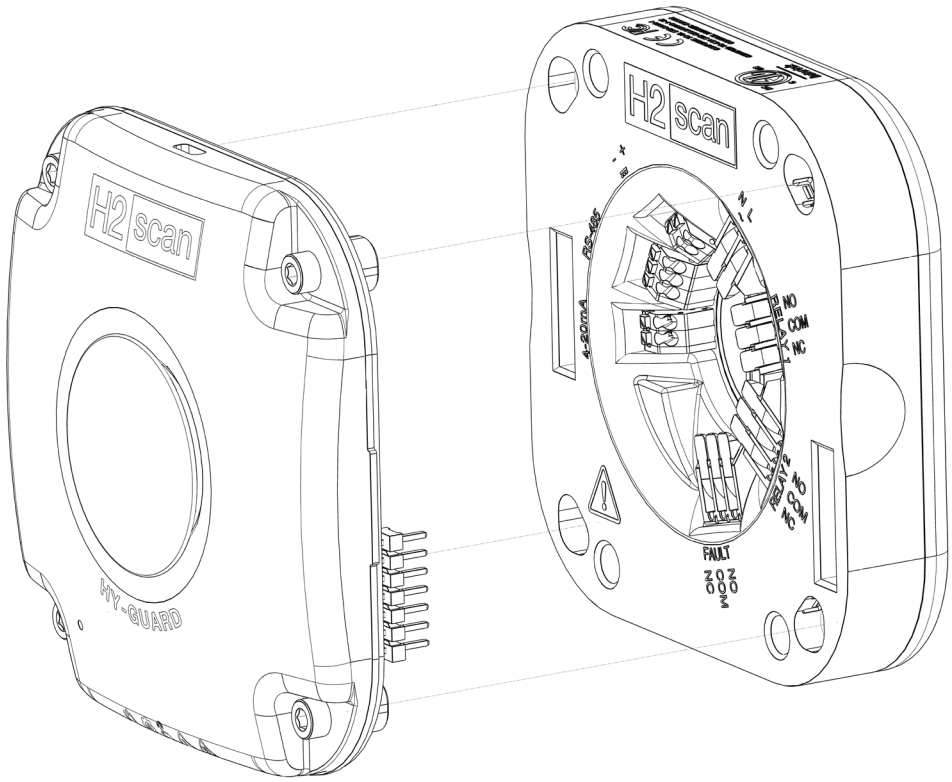

Figure 4: Connect Sensor Assembly to Power Board Assembly

NOTE: Ensure the Sensor Assembly and the Power Board Assembly snap together by pressing down on the two components.

⚠ WARNING

This is a sensitive safety device. If dropped, conduct a bump test to ensure device is functional. See 2.6.1.

3. HY-GUARD is installed and ready for self-test.
   - To initiate a self-test, tap the IR button located in the center of the Main Control Indicators, annotated by the finger icon. The audible buzzer will chirp to confirm the start of the self-test. See 2.4 for more information.

2. OPERATION

2.1 OPERATING INSTRUCTIONS

Upon initial power up, all LEDs will be solid for five seconds, and the audible buzzer will chirp. The HY-GUARD will then enter a warm-up period of up to six minutes. During this time, the green LED will flash to indicate it is in "Sensor Not Ready" mode. When HY-GUARD finishes initializing and enters "Normal Operation" mode, the 'Power On' LED will illuminate solid green. This means HY-GUARD is fully functional and actively monitoring hydrogen.

Refer to Table 1 for a description of HY-GUARD operating modes.

Table 1: HY-GUARD Operating Modes

Mode	Main Control Indicators (LEDs)				Audible Buzzer*
	⏻	⚙	⚠	⚠	
Power On	G	Y	R	R	🔕
Sensor Not Ready	G Flashing	○	○	○	🔕
Normal Operation	G	○	○	○	🔕
1% H_2	○	○	R	○	🔕
2% H_2	○	○	R	R	🔔 (tap IR button to silence)
Fault	Previous state**	Y	Previous state**	Previous state**	🔔 Pulse (tap IR button to silence)

* The buzzer is NOT intended for emergency notification or evacuation purposes. The buzzer is intended for local user feedback/status indication only.

**The Main Control Indicator (LED) shows the state the unit was in prior to the fault relay latching.

NOTE: The fault relay is energized when there is no fault present. (i.e., the NO contacts are closed, and the NC contacts are open). If a fault is detected, the fault relay will de-energize (i.e., the NO contacts will open and the NC contacts will close).

NOTE: The hydrogen threshold relays will activate when the measured hydrogen exceeds the threshold (e.g., when hydrogen exceeds 1% H_2, the 1% relay's NO contacts will close and the NC contacts will open).

NOTE: If HY-GUARD faults during 'Power On' mode, only the yellow LED will illuminate to indicate a fault.

2.2 INFRARED (IR) BUTTON

HY-GUARD features an IR button, located in the center of the Main Control Indicators (LEDs), annotated by the finger icon. Its functions include:

- A short tap during either "Sensor Not Ready" or "Normal Operation" mode will initiate a self-test (see 2.4), with a chirp from the audible buzzer as confirmation.
- A short tap during either "2% H_2" or "Fault" mode will silence the audible buzzer.

- A press and hold for five seconds during either “Sensor Not Ready” or “Normal Operation” mode will initiate a Communication Test Mode (see 2.5), with a chirp from the audible buzzer as confirmation.
- A press and hold for ten seconds during any mode will initiate a system reset, with a chirp from the audible buzzer as confirmation.

2.3 AUDIBLE BUZZER

The following description explains the audible buzzer logic for the HY-GUARD:

- The audible buzzer will activate when the HY-GUARD unit is in either a fault state or high alarm state. The audible buzzer will be active until the user silences it via tapping the IR button, or if the unit enters a different state which does not trigger audible buzzer.
  - High Alarm: Buzzer is always on
  - Fault Alarm: Buzzer will buzz at a cadence of 500ms (500ms ON, 500ms OFF, repeat)

The following description explains the logic for silencing the audible buzzer for the HY-GUARD:

- The user can silence the audible buzzer by tapping the IR button if the unit is in a fault state or high alarm state.
- Once the audible buzzer is silenced, it can only be re-activated in two scenarios:
  - The unit exits the state where the buzzer was silenced, and then re-enters it.
  - The unit exits the state where the buzzer was silenced, and enters a new state that causes the buzzer to activate.

2.4 SELF-TEST

Performing a self-test ensures your HY-GUARD’s Main Control Indicators (LEDs) are functioning normally. After installation, tap the IR button indicated with the finger icon. This will initiate the self-test, which is indicated by flashing all LEDs and turning the audible buzzer* on and off three times.

*Audible indications during self-test and test modes are for local confirmation only and are not intended as emergency alarms.

2.5 COMMUNICATION TEST MODE

The HY-GUARD has a Communication Test Mode that will cycle through the low, high, and fault alarms for five seconds each to ensure that the system is wired as intended.

1. Entering Test Mode
   - Press and hold the IR button on the unit for five seconds until you hear a chirp, and release the IR button.
2. Low Alarm - 1% H_2 Simulation (five seconds)
   - Relay 1 will trigger, the Analog Output will indicate 1% H_2 (outputs 7.2 mA), and the Modbus output will report 1% H_2, refer to Registers 0–1. For the Main Control Indicator behavior, reference Table 1 “1% H_2” mode.
3. High Alarm - 2% H_2 Simulation (five seconds)
   - Relay 1 will remain triggered, relay 2 will trigger, the Analog Output will indicate 2% H_2 (outputs 10.4 mA), and the Modbus output will report 2% H_2, refer to Registers 0–1. For the Main Control Indicator behavior, reference Table 1 “2% H_2” mode.
4. Fault Condition Simulation (five seconds)
   - Relay 1 and Relay 2 will reset to the default state, the fault relay will trigger, Analog Output will indicate fault (outputs 3.0 mA), and the Modbus output will report a fault, refer to Registers 111–113.

For the Main Control Indicator behavior, reference Table 1 “Fault” mode.

5. Exit and Return to Normal Operation
   - After the fault condition simulation, the unit will automatically return to normal state, thus completing the test cycle.

NOTE: At any time during the test, tapping the IR button will abort the Communication Test Mode and immediately return the unit to normal operating mode.

2.6 HEALTH & MAINTENANCE

2.6.1 BUMP TEST

To validate a HY-GUARD in the field, H2scan offers a Calibration Shield (50000201) as shown in Figure 5, as well as Standard Bump Kits (105923-KIT) and Gas Replacement Kits (105924-KIT).

The Bump Kit contains:

- 1x 5% H_2/N_2 bottle
- 1x regulator
- 1x 10’x tubing

The Gas Replacement Kit contains:

- 2x 5% H_2/N_2 bottle

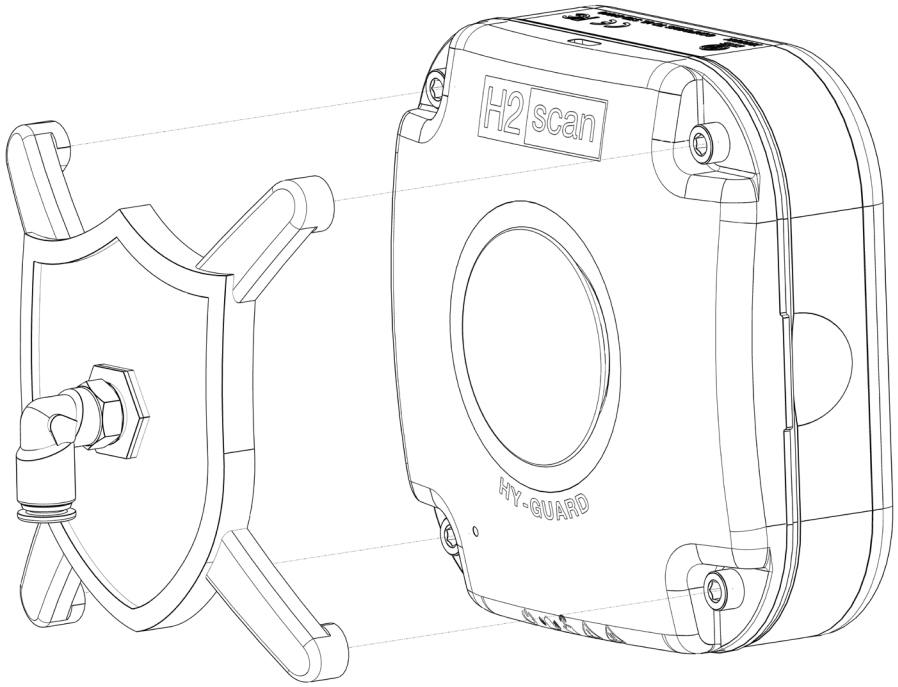

Figure 5: HY-GUARD Calibration Shield

1. Connect the tube from the calibration gas regulator to the calibration shield.
2. Attach the calibration shield such that it magnetically attaches to the screws on the corners of HY-GUARD.
3. Fully open the regulator such that gas begins flowing to the sensor at a flow rate at 0.5 LPM.
4. Verify 1% alarm activates.
5. Verify 2% alarm activates.

NOTE: If 1% and 2% relays do not trigger within 15 minutes, check the flow rate, check the connections, and repeat the test. If problems persist, contact H2scan for support.

6. Once bump test is complete, remove the calibration shield and continue using HY-GUARD as intended.

NOTE: If a hydrogen event happens where the unit has been exposed to >5% H_2, conduct a bump test and/or replace the unit.

2.6.2 TROUBLESHOOTING

- Ensure the sensor module and the back plate snap together by pressing down on the two components.
- If you are unsure whether the device is operating correctly, use the Communication Test Mode to verify wiring integrity (see 2.5).
- If you suspect a problem, conduct a bump test to confirm proper sensor response (see 2.6.1).

3. MODBUS REGISTER MAP

3.1 MODBUS HOLDING REGISTER DEFINITIONS

The Modbus Holding Register definitions for HY-GUARD are identified in Table 2.

Table 2: Modbus Holding Register Descriptions

Register	Parameter	Function	Data Type	Data Range	Access	Comments
Measurements						
0	Hydrogen, ppm H_2	High word	32-bit number	0–20,000,000	R	
1		Low word				
Information						
31–40	Model Number		ASCII String		R	
41–50	Product Serial Number		ASCII String		R	
89–98	Firmware Revision		ASCII String		R	
Status/Error Information						
111	Unit Status		16-bit flags		R	Table 3: Unit Status
112	Error Status	High word	32-bit flags		R	Table 4: Error Status
113		Low word				
Configuration Settings						
150	Set Unit ID		8-bit number	1–247	R/W	
159	Parity/Stop Bit Selection		16-bit number	1 = 8N1 2 = 8N2 3 = 8E1 4 = 8E2 5 = 8O1 6 = 8O2	R/W	

Register	Parameter	Function	Data Type	Data Range	Access	Comments
160	Baud Rate		8-bit number	1 = 9600 2 = 14400 3 = 19200 4 = 38400 5 = 57600 6 = 115200	R/W	
User Information						
201–210	User ID #1		ASCII String		R/W	Must start reading/ writing from low address to high address; all 10 registers need to be written to in order to save
211–220	User ID #2		ASCII String		R/W	Must start reading/ writing from low address to high address; all 10 registers need to be written to in order to save
221–230	User ID #3		ASCII String		R/W	Must start reading/ writing from low address to high address; all 10 registers need to be written to in order to save

3.2 STATUS AND ERROR INFORMATION

HY-GUARD provides status and error information for the user to determine if it is operating normally.

3.2.1 UNIT STATUS

Unit status information is maintained in Modbus register 111.

Table 3: Unit Status

Bit #	Description
15	Unit Ready, hydrogen readings are valid.
14	New measurement data available, auto-clear after register read
13	Unlisted bits are not used and may be 0 or 1.
12	Unrecoverable error occurred, read registers 112,113 for more information
11–0	Unlisted bits are not used and may be 0 or 1.

3.2.2 ERROR STATUS

When the error flag (bit 12) of the Unit Status register 111 is set, refer to the 32-bit register 112,113 for more information about the error cause.

Table 4: Error Status

Bit #	Hex Value	Description	Response
31	0x80000000	Monitor: Heater fault	Power off the monitor, wait five minutes, power on the monitor, and check status after 15 minutes to determine if error persists.
30	0x40000000	Monitor: Temperature sensor fault	
29	0x20000000	Monitor: Hydrogen sensor fault	
28-5	0x10000000–0x00000020	Unlisted bits are not used and may be 0 or 1	
4	0x00000010	Over temperature error	Power off for an hour and investigate area around the monitor for high temperature or lack of air flow. Turn power on and wait an hour to determine if error persists.
3	0x00000008	Error detected due to memory access, invalid configuration, sample error, auto-calibration expiring, analog output error, or Communication Test Mode fault sequence.	Contact help@h2scan.com for more information about this error.
2-0	0x00000004–0x00000001	Unlisted bits are not used and may be 0 or 1	

APPENDIX A: SPECIFICATIONS

Parameter	Value
Operating	
H_2 Range	0.4 - 5% H_2
Lower Detection Limit (LDL)	0.4% H_2
Accuracy*	±0.3% H_2 (absolute error)
Response Time**	60 seconds ±10 seconds
Ambient Temp	15 - 40° C
Storage Temp	-20 - 60°C
Humidity	0 - 95% RH (non-condensing)
Pressure Range	0.8 - 1.2 atm absolute
Operating Altitude	Up to 2000 m above sea level
Electrical	
Voltage Input AC (50/60 Hz)	110 - 240 VAC
Voltage Input DC	15 - 60 VDC
Power Consumption	10 W
Mechanical	
Vibration	ISTA 6-FEDEX-A Test

Shock	ISTA 6-FEDEX-A Test
Weight	1.1 lbs (0.5 kgs)
Dimensions	5.2” x 5.1” x 2.1” (132.5 mm x 130.5 mm x 52.9 mm)
Buzzer	Audible buzzer for local indication

*Concentrations >2% have an accuracy of ±1%. Prolonged exposure to hydrogen concentrations >5% may damage the sensor.

**The response time is the time until the measured H_2 exceeds 1% when transitioning from air to 3% H_2/Air.

This equipment is capable of withstanding Overvoltage Category: II.

Pollution Degree 2: Normally only nonconductive pollution occurs.

NOTE: HY-GUARD supports both AC and DC power inputs. AC is used as the primary source by default. In the event of AC loss, HY-GUARD will automatically switch to DC when AC and DC are powered by separate power sources.

APPENDIX B: CERTIFICATIONS & STANDARDS

B.1 COMPLIANCE & CERTIFICATION

- UL 61010-1 and CSA C22.2#61010-1*
- REACH
- RoHS
- IEC 60068-2-2 & EN 50155 Section 13.4.4
- IEC 60068-2-11 & DIN EN ISO 12944
- IEC 60068-2-6 table C.2
- IEC 60068-2-64 paragraph A.2, category no. 2
- IEC 60068-2-27
- FCC Part 15**
- IC, RSS-Gen and RSS-210

*For more information on certification reference ATM 106283728LAX-002.

**This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

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B.2 APPLICABLE STANDARDS

- OSHA 1926
- IFC 608/Chapter 12
- NFPA 1 & 855
- NFPA 68 & 69
- IEC 62933
- IEEE Standards - Stationary battery and energy storage