



Advanced Hydrogen Sensing



OPERATION MANUAL

GRIDSCAN® 5000

Hydrogen Monitor

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IMPORTANT NOTICES

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

If this equipment is used in a manner not specified by H2scan, the protection provided by this equipment may be impaired.

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 GRIDSCAN® 5000 Hydrogen Monitor ("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 thirty-six (36) months from the ship date for such Product.

Must Provide Notice of Defect: If you believe a Product that you believe is defective, you must notify H2scan in writing, within ten (10) days of receipt of such Product, of your claim regarding any such defect.

Return Product to H2scan for Repair, Replacement or Credit: 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.

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

- The unit is opened, and the manufacturing seal is broken.
- 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.

1. INTRODUCTION	5
2. FEATURES.....	5
2.1 SENSOR	5
2.2 MECHANICAL.....	5
2.3 PHYSICAL BARRIER.....	6
2.4 ELECTRICAL FEATURES	6
3. SPECIFICATIONS	6
3.1 TEMPERATURE SENSOR SPECIFICATIONS.....	7
3.2 CERTIFICATIONS.....	7
4. ELECTRICAL INTERFACE.....	8
4.1 CONNECTOR.....	8
4.2 WIRING.....	8
4.3 CABLE	9
4.4 POWER SUPPLY	9
4.5 RS-485.....	9
4.6 EXTERNAL GROUNDING	9
5. INSTALLATION.....	9
5.1 HANDLING PRECAUTIONS.....	9
5.2 MECHANICAL CONNECTION	10
5.2.1 BLEEDING AIR FROM THE INSTALLATION	12
5.3 ELECTRICAL CONNECTION	12
5.4 OPTIONAL ACCESSORIES.....	13
5.4.1 GROUNDING LUG.....	13
5.4.2 CONDUIT ADAPTER	13
5.4.3 ANALOG OUTPUT ADAPTER	13
6. OPERATION	13
6.1 STARTUP	13
6.2 MONITORING	14
6.3 ERROR/EXCEPTION HANDLING.....	14
7. FIRMWARE UPGRADE.....	14

1. INTRODUCTION

The GRIDSCAN 5000 Hydrogen Monitor is designed to detect and measure hydrogen as a component of transformer oil. The hydrogen-specific, solid-state sensing element is designed for ease of use and interface flexibility. The GRIDSCAN 5000 is an online hydrogen monitoring sensor for various classes of transformers and other oil-filled devices. The GRIDSCAN 5000 has a single electrical connection to provide DC power and two-wire, RS-485 communications using Modbus RTU protocol. Based on H2scan's fifth-generation electronics platform, the GRIDSCAN 5000 contains all the circuitry necessary to operate the hydrogen sensor and report calibrated hydrogen readings.

In Oil: The measured hydrogen is reported as ppm H₂ dissolved in oil that is comparable to industry standard DGA measurements. Oil temperature at the sensing element is measured and available through the digital interface.

In Gas: The measured hydrogen is reported as ppm H₂, expressed as an in-oil equivalent value in the headspace. The actual concentration in the headspace is approximately 20 times greater than the amount dissolved in the oil. The temperature of the headspace at the sensing element is measured and accessible through the digital interface. Note that this is the overall headspace temperature, not the oil temperature.

NOTE: The equipment must be installed in an application that is capable of producing an alarm when the ppm level reaches a configurable setpoint.

2. FEATURES

2.1 SENSOR

The GRIDSCAN 5000 hydrogen measurement is based on H2scan's solid state palladium alloy sensor. The H2scan patented autocalibration function will maintain accurate measurements over years of service without requiring periodic manual calibration.

- The monitor can be calibrated to measure hydrogen dissolved in transformer oil (25–5,000 ppm) or in headspace (25–5,000 ppm in oil equivalent).
- Periodic reference cycles are automatically performed to eliminate offsets that can affect long-term accuracy.
- The monitor requires no maintenance. It has a long-life sensing element that has been optimized for measuring hydrogen in power transformers and other oil-filled electrical equipment.

WARNING

The sensor element may be damaged if exposed to hydrogen concentrations in oil above 5,000 ppm or hydrogen concentrations in the headspace above 100,000 ppm.

2.2 MECHANICAL

The GRIDSCAN 5000 Hydrogen Monitor has a rugged, waterproof mechanical assembly design for various transformer applications. A 3/4"-14 NPT fitting is provided for attaching the sensor to a transformer. The GRIDSCAN 5000 is IP68 and saltwater corrosion-rated for vault and marine transformer applications (Exceeds C5M requirements).

Overall dimensions are shown in [Figure 1](#).

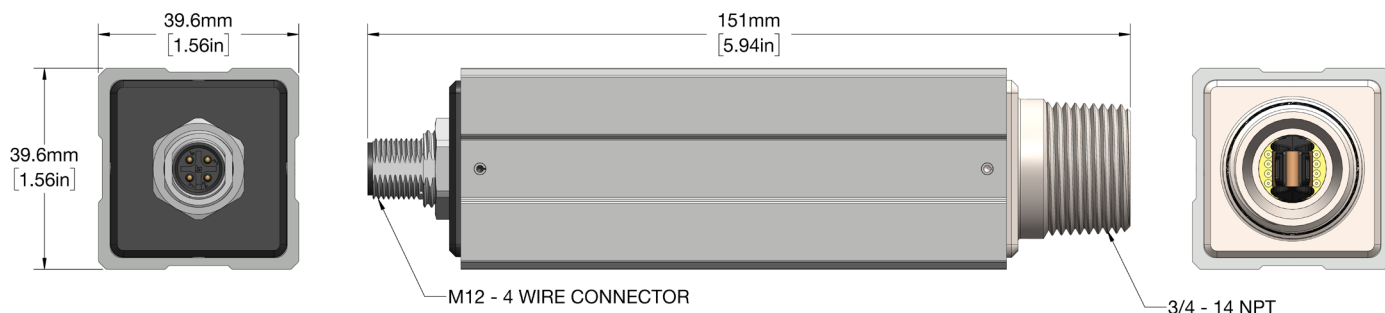


Figure 1: GRIDSCAN 5000 Dimensions

2.3 PHYSICAL BARRIER

A physical barrier between the hydrogen sensor and remainder of the GRIDSCAN 5000 assembly includes a hermetic glass-to-metal feedthrough for electrical connections and gaskets to complete the gas-tight seal.

2.4 ELECTRICAL FEATURES

The GRIDSCAN 5000 Hydrogen Monitor has a single four-pin M12 connector for power and communications.

- DC power input of 12–30 volts, 10 watts (12 VDC or 24 VDC power supply is recommended)
- Two-wire RS-485 for Modbus RTU communications (Communication ground must be connected to DC ground).

3. SPECIFICATIONS

Table 1: Hydrogen Measurement

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Oil Range	25		5,000	ppm
*Gas Range	25		5,000	ppm
**Response Time, T ₉₀			60	minutes
Accuracy	±20% of reading or ±25 ppm, whichever is greater			
Repeatability	±10% of reading or ±15 ppm, whichever is greater			
Cross Sensitivity	Less than 2% cross-sensitivity to other gases (CO, CO ₂ , Hydrocarbons)			
Calibration Interval	No periodic calibration is required			

*In oil equivalent

**Once hydrogen reaches the monitor, it will respond in 60 minutes or less

Table 2: Operating Conditions

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Environment – Insulating Liquid				
Operating	-40		105	°C
Survival	-40		135	°C
Rate of Change			24	°C/hour
Pressure	0.1 (10000)		10 (1000000)	Bar (Pa)
Environment – Ambient				
Operating Temperature	-40	25	70	°C
Storage Temperature	-40		85	°C
Ingress Protection	IP68; 25' water for 14 days (IEC 60529)			
Humidity	< 95 %RH (Non-Condensing)			
Corrosion Resistance	Class C5M Marine rated; salt-water condensing (IEC 60068-2-11 & DIN EN ISO 12944)			
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)			
Weight	0.85 lbs. (387 grams)			
Electrical				
Voltage Input	12	24	30	VDC
Power Consumption			10	W

3.1 TEMPERATURE SENSOR SPECIFICATIONS

The temperature sensor incorporated in the GRIDSCAN 5000 is a resistive temperature device (RTD).

Accuracy (in oil @20 °C) = + 3 °C

Repeatability (in oil over an oil temperature range of -40–+105 °C) = <1 °C

3.2 CERTIFICATIONS

List of standards:

- IEC 60068-2-2 & EN 50155 Section 13.4.4
- IEC 60068-2-11 & DIN EN ISO 12944
- IEC 60529
- IEC 60068-2-6 table C.2
- IEC 60068-2-64 paragraph A.2, category no. 2
- IEC 60068-2-27

- FCC Part 15
- EN 55011 Class A Group 1
- EN 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-6, and 61000-4-8
- ANSI/UL/IEC/EN 61010-1
- EN 61326-1
- FM 6520 [in oil version only]

4. ELECTRICAL INTERFACE

All electrical connections to the GRIDSCAN 5000 Hydrogen Monitor are supplied through a single four-pin M12 connector.

4.1 CONNECTOR

The key (notch) location and pin numbers are shown in Table 3.

Table 3: GRIDSCAN 5000 Pin Out

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

This view is looking at the connector on the GRIDSCAN 5000.

4.2 WIRING

A typical wiring diagram is shown in Figure 2.

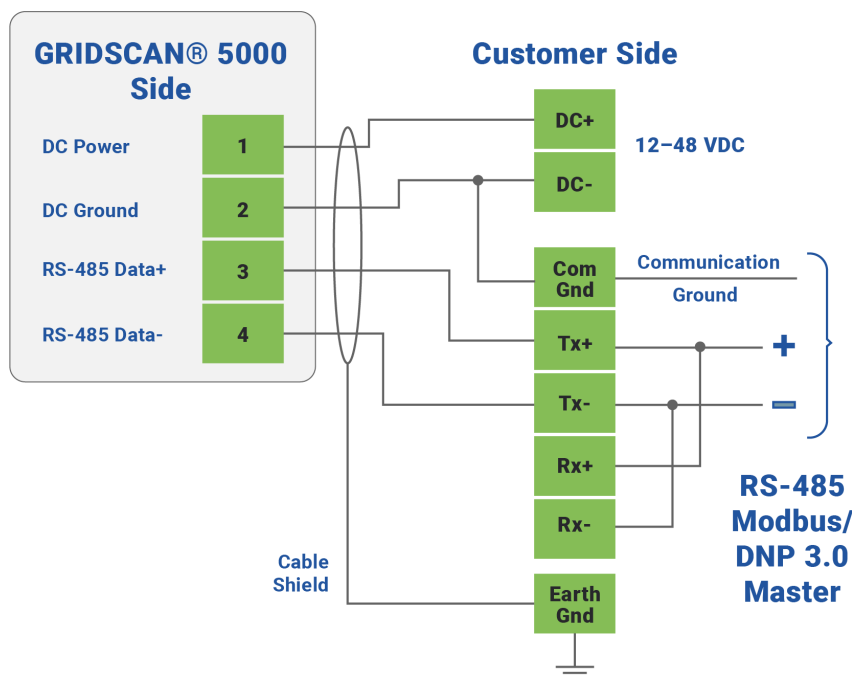


Figure 2: Typical Connection to Modbus RTU Master

4.3 CABLE

NOTE: A suitably rated cable assembly is required for most field applications.

Cable recommendations are:

- Four-pin M12 female molded connector
- IP68 rated, for substation environment
- 4/18 AWG wire, shielded (grounded at one end only)

NOTE: H2scan is not responsible for issues arising from the use of cabling and connectors that are not suited for the environment.

4.4 POWER SUPPLY

The GRIDSCAN 5000 incorporates an internal isolated voltage regulator for operation in harsh electrical conditions. The DC ground line is electrically isolated from the metal case. In most installations, the GRIDSCAN 5000 enclosure will be connected to earth ground through the mechanical connection to the transformer.

Use an industrial grade, substation-rated, fixed-output power supply that meets the following specifications.

- DC voltage output
- Output voltage: 12, 15, 24, or 30 VDC
- Output power: 10 watts minimum

NOTE: 12 or 24 VDC power supply is recommended.

4.5 RS-485

The RS-485 input is galvanically isolated inside the GRIDSCAN 5000 to improve noise immunity in harsh electrical environments.

The GRIDSCAN 5000 does not include bias resistors for the Data lines which may need to be added at the SCADA end of the cable. A 120 ohm termination resistor, between Data+ and Data- is installed in the GRIDSCAN 5000.

The following default communication settings are used for the RS-485, two-wire, half duplex connection.

- Baud rate: 19,200
- Data bits: 8
- Stop bits: 1 or 2
- Parity: None
- Flow control: None

4.6 EXTERNAL GROUNDING

The GRIDSCAN 5000 will normally be grounded through the NPT connection at the valve. However, if a separate, visible ground wire is desired to the unit itself, it should be connected at the ground clip, available as an accessory from H2scan.

5. INSTALLATION

5.1 HANDLING PRECAUTIONS

The following precautions must be followed to ensure the sensor assembly is not damaged during handling.

- Ensure nothing comes in contact with the sensor end of the device

- Keep the red protective cap in place until the time of installation.
- Place a wrench on the metal housing closest to the threaded end when tightening. The GRIDSCAN 5000 is designed to handle torque throughout the whole sensor assembly enclosure.
- Use standard torque for a ¾" NPT fitting, which is approximately 50 ft-lbs. Do not over tighten.

5.2 MECHANICAL CONNECTION

Attach the monitor to a ¾"-14 NPT fitting on the oil tank. Adapter bushings for larger ID fittings can be used, however, do not use adapters to smaller ID fittings or pipe. In oil, the monitor should be mounted in a horizontal position, per [Figure 5](#), to prevent an air bubble forming around the sensor element. Vertical or horizontal mounting is acceptable in gas.

NOTE: The use of galvanized fittings is not permitted, as this can produce inaccurate H₂ readings.

Any piping or valves between the monitor and oil tank should have an inner diameter of 1" or greater, with the sensor mounted as close to the transformer tank as possible as shown in Figure 3.

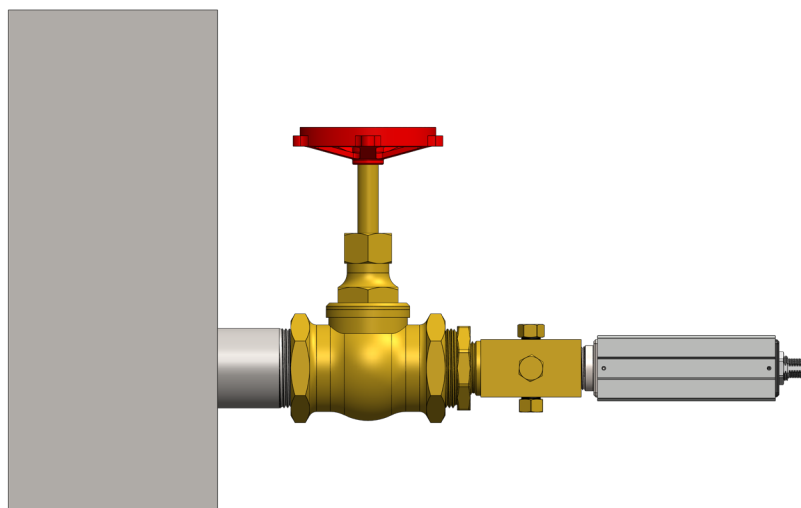


Figure 3: Recommended Installation in Oil

NOTE: Bleed assembly is not required for installation in gas space.

CAUTION

The GRIDSCAN 5000 is not to be used as a step.

Variables that affect the length of time for hydrogen to reach the sensor are:

- Pipe length
- Valve/pipe diameter
- Valve type (gate or ball valve recommended)
- Oil flow near install location
- Oil temperature (warmer oil will absorb higher concentrations of hydrogen)

Additional installation notes:

- Routine cleaning of the sensor element is not necessary. If any debris should accumulate around the sensor element, it can be rinsed with clean oil (oil-calibrated device only).

- Seal threads using appropriate liquid thread sealant or Teflon® tape. The use of the liquid thread sealant may provide a better ground connection to the transformer than the Teflon® tape.
- When installed in oil, the monitor must be mounted horizontally as shown in [Figure 5](#).
- When installed in oil, provide a method to bleed all air from pipe fittings between sensor and oil tank.
- Do not install monitor in turbulent oil flow. See Figure 4 for mounting locations.

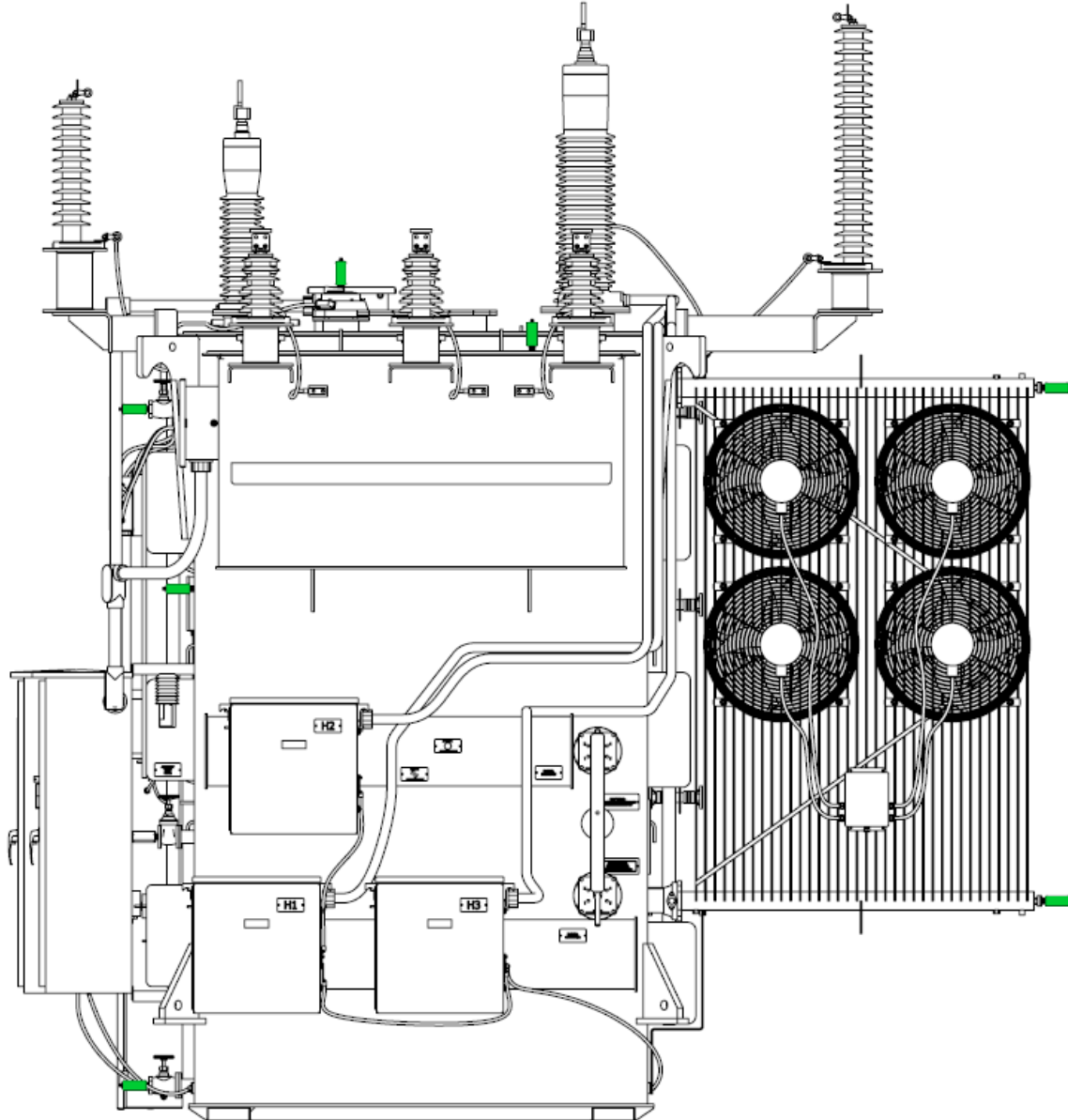


Figure 4: Typical Locations for GRIDSCAN 5000 Installation

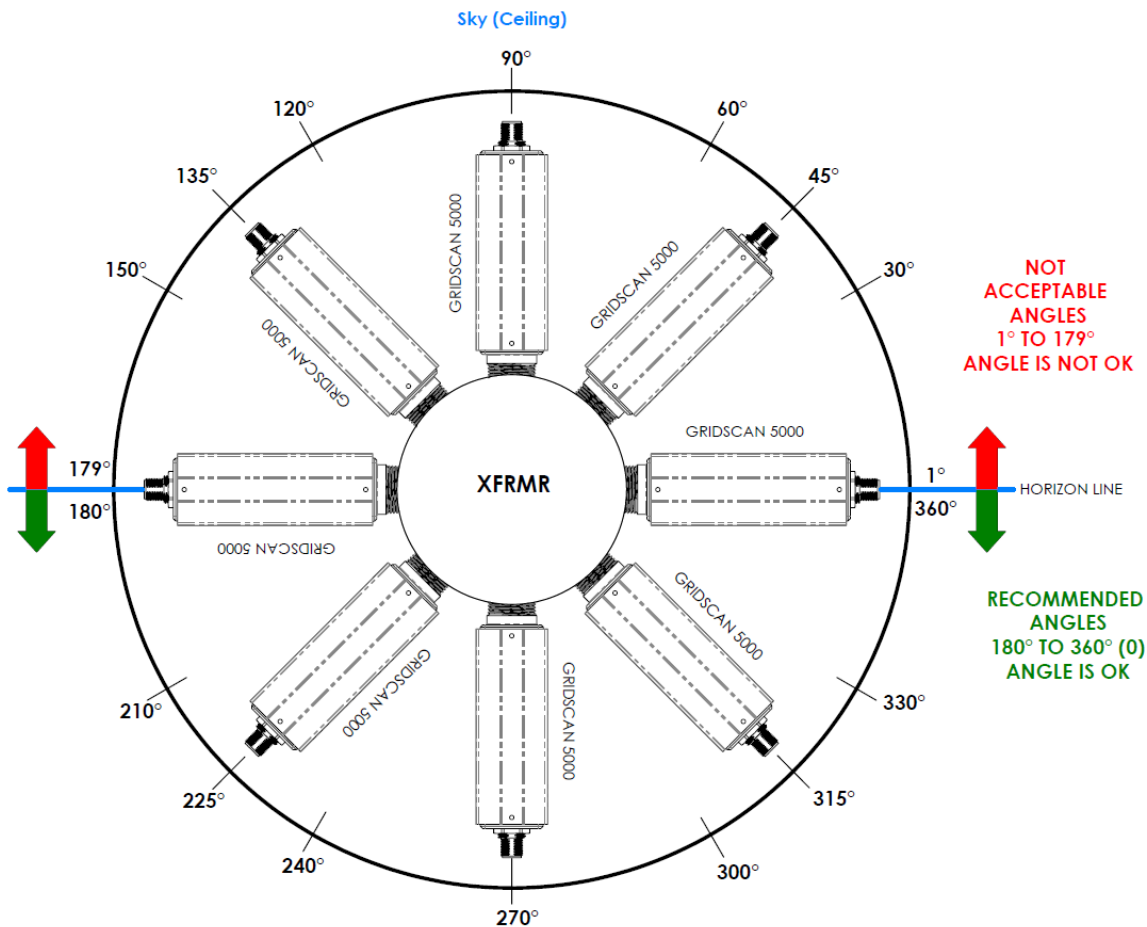


Figure 5: GRIDSCAN 5000 Recommended In-Oil Installation

5.2.1 Bleeding Air from the Installation

Once the GRIDSCAN 5000 has been installed onto the desired location, any air trapped in the assembly must be removed. The following steps are general in nature and will depend on the specific hardware being used.

- Ensure all fittings are tight, and all threads are sealed either with Teflon® tape or a suitable pipe-thread sealant.
- Ensure all valves and plugs are initially closed.
- Place a suitable container under the air-bleed assembly to catch any oil. Open the valve or plug on the air-bleed assembly.
- Slowly open the main transformer valve just enough to see a small stream of oil flow into the oil container. Once there is no air seen in the flow, close the valve or plug on the air-bleed assembly.
- Fully open the transformer valve. Check for any leaks.

5.3 ELECTRICAL CONNECTION

Before energizing the equipment:

- Install the cable between the GRIDSCAN 5000 and power/communication equipment.
- Connect the cable to the power/communication equipment.
- Connect the cable to the GRIDSCAN 5000.

NOTE: The connector to the GRIDSCAN 5000 must be fully tightened to ensure the IP68 rating.

Turn on power and check Modbus communications. The default communication settings are:

- RS-485, half duplex, 19200 baud, 8 data bits, 1 or 2 stop bits, no parity.
- Default Modbus ID is 1.

5.4 OPTIONAL ACCESSORIES

H2scan is developing accessories for the GRIDSCAN 5000 to assist with integration and installation of the hydrogen sensor. For more information about the accessories below and others, visit [H2scan.com](https://www.h2scan.com) and email sales@h2scan.com.

5.4.1 Grounding Lug

The grounding lug provides a secure earth ground connection to GRIDSCAN 5000 independent of the plumbing used to make an oil (or headspace) connection.

5.4.2 Conduit Adapter

The conduit adapter provides a method of installing the GRIDSCAN 5000 cable in conduit from the control panel to the sensor.

5.4.3 Analog Output Adapter

The analog output adapter converts the digital Modbus signal from the GRIDSCAN 5000 to a 4–20mA analog signal.

6. OPERATION

6.1 STARTUP

After connecting the cable and turning on the power supply, the monitor executes a startup sequence that can last up to 16 hours. The following operations are performed during the startup sequence:

- Power-on system self-test
- Configuration settings restoration from non-volatile memory
- Starting measurements of oil temperature and hydrogen
- Autocalibration sequence to stabilize monitor as needed (monitor may show initial value before autocalibration is complete)

Prior to placing the monitor in operation, perform the following steps:

1. Connect the monitor to power for at least five minutes to recharge the super capacitor, which may have discharged if the monitor has been without power for several months.
2. Reset the date/time. This is possible using the available ScanH2 utility, available by contacting technicalsupport@h2scan.com.
3. Cycle the power to clear any errors.

After a short power interruption, the monitor will report approximate hydrogen readings within 30 minutes after power is restored. On new installations and after long power interruptions, the monitor can take up to 16 hours to stabilize and report accurate hydrogen readings.

The Modbus status register **111**, bit **15** will indicate Ready when the first valid hydrogen measurement is available. After the startup sequence is completed, measured and calculated values will be available in the Modbus registers.

If an error is reported, turn off power to the monitor. Check the electrical connections and power supply voltage before restoring power again. If the error condition persists, contact H2scan customer service for assistance at technicalsupport@h2scan.com.

During normal operation, the monitor will measure oil temperature (approximately once per hour) to provide temperature-compensated dissolved gas readings. The unit will periodically go through an internal autocalibration check (reference cycle). These are automatic activities that do not require any user interaction as shown in Figure 6.

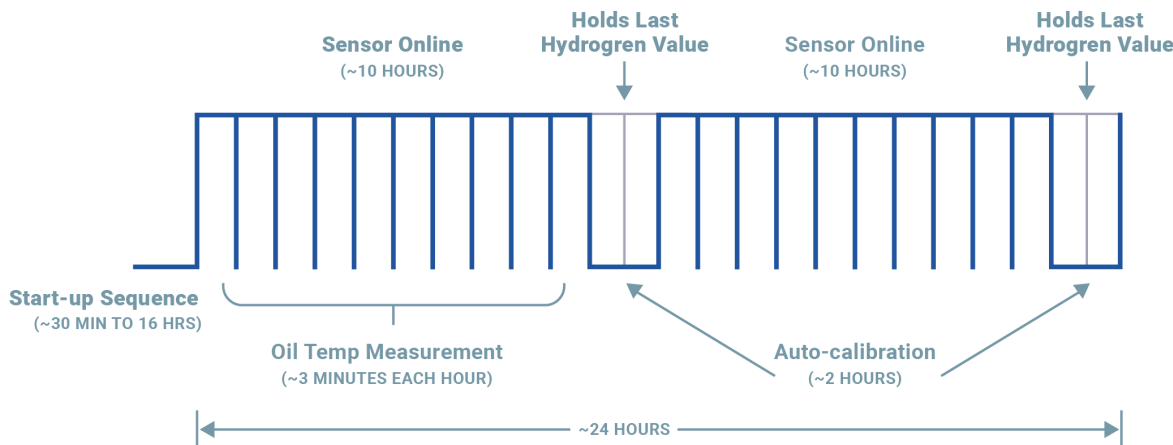


Figure 6: Normal Operation of GRIDSCAN 5000 Sensor

6.2 MONITORING

During normal operation, the GRIDSCAN 5000 Hydrogen Monitor measurements should be polled periodically for a measurement reading. The polling frequency can be from one second to several hours or days, depending on user requirements. Each reading should include the following Modbus holding registers.

- Status Register (**111**, bits **15** and **12**) – Bit **15** indicates the hydrogen measurement is available. Bit **12** indicates an error.
- Error Status Registers (**112,113**) – Indicates which error is detected. (These registers are active when register **111** bit **12** is high).
- Oil Temperature Register (**8**) – Provides the oil temperature at the monitor.

NOTE: An oil temperature above 105 °C is outside the calibration range. Oil temperature above 135 °C may cause permanent damage.

- Hydrogen Registers (**0,1**) – Provides the hydrogen ppm values.

NOTE: The high word (0) must be read in order to enable the low word (1) value to be available.

6.3 ERROR/EXCEPTION HANDLING

The GRIDSCAN 5000 is designed for continuous operation and will automatically recover from intermittent problems due to insufficient power, excessive electrical noise, excessive operating temperature, and excessive oil temperature.

If the sensor element is damaged and inoperable, the GRIDSCAN 5000 will shut down the measurement system and continue responding to Modbus requests for error reporting. This error will be reported via register **111** bit **12** and details specified in registers **112,113**. This type of error typically indicates a hardware fault that can only be repaired at H2scan. Power cycle the unit to attempt recovery. If the error condition repeats, contact H2scan for repair at technicalsupport@h2scan.com.

7. FIRMWARE UPGRADE

The GRIDSCAN 5000 Hydrogen Monitor firmware is field-upgradable. When a firmware update is available, H2scan will provide the files.

Firmware upgrade procedure

1. Copy the files to a local directory.
 - Firmware binary file (.exe)
 - Batch file (.bat)
 - Firmware update instructions (.pdf) (optional)

NOTE: If the files were sent via WeTransfer, unzip them before proceeding. If necessary, download a [free Zip file tool](#).

2. Connect the GRIDSCAN 5000 to your PC using a USB to RS-485 adapter to establish the connection
3. Right-click on Batch file (.bat) and select Edit.
4. Locate the port information in Table 4, then update the following settings:
 - COM port
 - Device address
 - Baud rate

Save the file after making the changes.

Table 4: Port Information

Port	Default	Change
ComPort	comX	change to the com port being used
Device Address	1	default address is 1
Device Baud Rate	19200	default baud rate is 19200

5. Double-click the batch file (.bat). You will see the following information as the firmware is being upgraded.

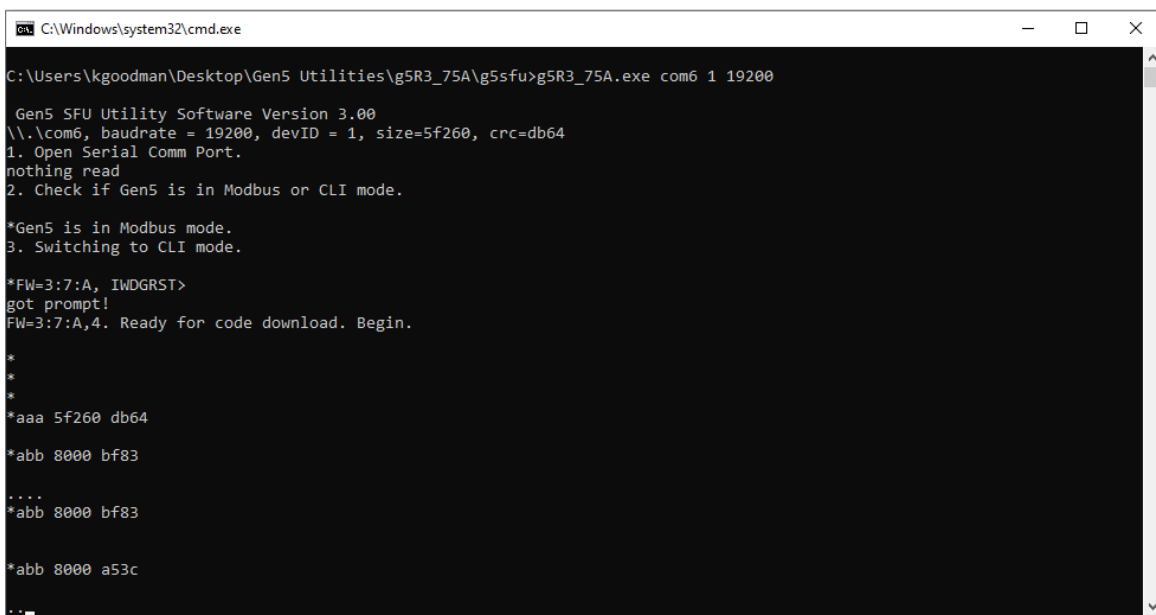


Figure 7: Download First

- The upgrade is complete when the command window displays a “Success” message.



Figure 8: Download Complete

- To complete the process, power cycle the GRIDSCAN 5000.