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SITRAM

H2Guard Lite

Installation and Commissioning Manual

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Document Revision History

	Revision-ID	Changes
☑	**1.1**	**Standard settings of serial connection and Modbus ID**
☐	1.0	Initial Version

Bold = Does apply for this document / Not Bold = Does not apply for this document

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Purpose

This manual is part of a documentation package for the Siemens Energy SITRAM Multisense 9

The package is subdivided in 3 different manuals with individual main focuses:

	Main Focuses	Topics
☑	**Installation**	**Provides a comprehensive overview and guidelines to work steps of onsite system installation, connection layouts, checkups, preparation and mounting of the hardware components depending on individual situations. Photo material from real installation environment makes it easier to understand settings and points out the essentials.**
☑	**Commissioning**	**Describes the approach of configuration and start of the system step-by-step. Possible upcoming problems during the process are addressed in the different sections.**
☑	**Communication & Software**	**Provides a detailed overview and guidelines in the context of the system communication capabilities (protocols, interfaces, separate and optional communication units etc.) as well as the system related set of user software and superior monitoring landscape.**
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Audience

See also “Qualified personnel“ section

	Main Focuses	Audience
☑	**Installation**	**Is intended for service technicians and installation staff with electrical background responsible for mounting the equipment and components.**
☑	**Commissioning**	**Is intended for normal operator users especially in context of standalone monitoring as well as commissioning engineers who are familiar with dealing with communication protocols and remote connection establishment for SCADA etc.**
☑	**Communication & Software**	**Is intended for normal operator users especially in context of standalone monitoring as well as commissioning engineers who are familiar with dealing with communication protocols and remote connection establishment for SCADA etc..**
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Legal Provisions

Warning notice Concept

This manual contains notices that you must observe in the interests of your own personal safety and in order to avoid damage to property. The notices relating to your personal safety are highlighted with a warning triangle. Those relating to the prevention of damage to property only do not have a warning triangle. The warning notices are presented in decreasing order of severity based on the hazard level involved.

⚠ DANGER
Death or serious personal injury will occur if the corresponding precautionary measure is not taken.

⚠ WARNING
Death or serious personal injury may occur if the corresponding precautionary measure is not taken.

⚠ CAUTION
-With a warning triangle- **Minor personal injury can occur if the corresponding precautionary measure is not taken.**

CAUTION
-Without a warning triangle- **Damage to property may occur if the corresponding precautionary measure is not taken.**

BEWARE
An undesirable result or state may occur if the corresponding notice is not observed.

NOTE
Provision of additional important information.

In cases where two or more hazard levels apply, it is always only the warning notice for the most severe level which is used alone. A warning notice with a warning triangle primarily involves possible personal injury. But it also can mean damage to property at the same time.

Qualified personell

The product/system associated with this documentation may only be installed, commissioned and operated by qualified personnel trained for the task concerned, in accordance with the documentation associated with the task concerned and in particular the safety and warning notices contained in this documentation. Qualified personnel are capable, on the basis of their training and experience, of recognizing risks and avoiding potential hazards in their work with these products/systems.

Use of the Product

Please give due consideration to the following:

⚠ WARNING
The Siemens Energy SITRAM H2Guard Lite product may only be used for the application it is provided for in the catalog and in the associated documentation. Using this product in a divergent way may have an impact on the protection provided by the system. Any third-party products and components used must be approved or recommended by Siemens Energy. Proper transportation, storage, assembly, installation, setup, commissioning, operation and maintenance are essential for the safe and effective operation of the products. The specified environmental requirements must be met. Notices in the associated documentation must be observed.

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Limitation of use

The equipment may only be used as secondary equipment at large stationary equipment as power transformers.

Trademarks

All other trademarks, registered trademarks, service marks, and trade names are the property of their respective owners.

Disclaimer of Liability

We have checked the contents of the document for compliance with the described hardware and software. However, discrepancies cannot be excluded and we accordingly do not guarantee absolute compliance. The information contained in this document is reviewed regularly and any corrections necessary are incorporated into subsequent editions. The data and illustrations in this document which refer explicitly to devices and equipment from third-party providers are not obligatory. Together with our partners or the third-party providers we reserve the right to modify our service and products in line with our policy of continuous service and product development. The information in this document is subject to change without notice and should not be construed as a commitment by Siemens Energy.

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Waste and Recycling

Due to the limitation of use, the device is not subject to WEEE regulation. When putting the device out-of-service, please ensure a proper disposal.

Siemens Energy aims to fulfilling all applicable legislation and regulations. This includes also among many others WEEE and in case any applicable exemptions apply for our products, we will continuously review and update our assessment.

The specific requirements are covered by our Zero Harm Framework as part of our certified Integrated Management System and referenced and implemented with the Building Blocks defined therein, e.g. Waste and Recyclability.

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Customer Support Center



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Website:
Please also visit our website for additional information:
www.siemens-energy.com/sitram-h2l-01

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1. General

The SITRAM H2Guard Lite Hydrogen Sensor is designed to detect and measure hydrogen as a component of transformer insulation fluid. The hydrogen-specific, solid-state sensing element is designed for ease of use and interface flexibility. The SITRAM H2Guard Lite is an online hydrogen monitoring sensor for various classes of transformers and other insulation fluid-filled devices. The SITRAM H2Guard Lite has a single electrical connection to provide DC power and 2-wire, RS-485 communications using Modbus RTU protocol. The SITRAM H2Guard Lite contains all the circuitry necessary to operate the hydrogen sensor and report calibrated hydrogen readings.

In Insulation fluid - The measured hydrogen is reported as ppm H_2 dissolved in insulation fluid that is comparable to industry standard DGA measurements. Insulation fluid temperature at the sensing element is measured and available through the digital interface.

In Gas - The measured hydrogen is reported as ppm H_2 in the headspace, which is approximately 20 times the value that is dissolved in insulation fluid. The headspace temperature at the sensing element is measured and available through the digital interface. This is not the insulation fluid temperature.

Autocalibration technology allows the SITRAM H2Guard Lite to maintain accuracy over years of continuous operation.

This document has been updated for use with firmware revision **3:1:A**.

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2. Features

2.1 Sensor

The SITRAM H2Guard Lite hydrogen measurement is based on solid state palladium alloy sensor. The autocalibration function will maintain accurate measurements over years of service without requiring periodic manual calibration.

- The sensor can be calibrated to measure hydrogen dissolved in transformer insulation fluid (0-5000 PPM) or in headspace (0-100,000 PPM).
- Periodic reference cycles are automatically performed to eliminate offsets that can affect long-term accuracy.
- The sensor requires no maintenance. It has a long-life sensing element that has been optimized for measuring hydrogen in power transformers and other insulation fluid-filled electrical equipment.

NOTICE
The installation position (in gas or in insulation fluid) affects the calibration process and the devices must be ordered accordingly. A device calibrated for usage in insulation fluid will **not** provide correct values when applied to gas-phase and vice versa. The sensor element may be damaged if exposed to hydrogen concentrations in insulation fluid above 5,000 ppm or hydrogen concentrations in the headspace above 100,000 ppm.

2.2 Mechanical

The SITRAM H2Guard Lite Hydrogen Sensor has a rugged waterproof mechanical assembly design for various transformer applications. A ¾”-14 NPT fitting is provided for attaching the sensor to a transformer. The SITRAM H2Guard Lite is IP68 and saltwater corrosion-rated for vault and marine transformer applications. (Exceeds C5M requirements)



Figure 1: SITRAM H2Guard Lite logo side

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Figure 2: SITRAM H2Guard Lite detail side

NOTICE
Colors of above drawings altered for better readability. Scale approx. 1:1 on paper size DINA4.

2.3 Physical Barrier

A physical barrier exists between the hydrogen sensor and remainder of the SITRAM H2Guard Lite assembly. This barrier includes a hermetic glass-to-metal feedthrough for electrical connections and gaskets to complete the gas-tight seal.

2.4 Electrical Features

The SITRAM H2Guard Lite Hydrogen Sensor has a single 4-pin M12 connector for power and communications.

- DC power input of 9 to 48 volts, 10 watts (12VDC, 24VDC or 48 VDC Power Supply is recommended)
- 2-wire RS485 for Modbus RTU communications. (Communication ground must be connected to DC ground)

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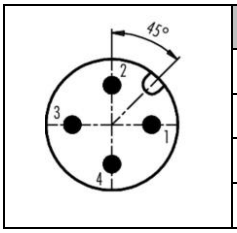
3. Electrical Interface

All electrical connections to the SITRAM H2Guard Lite Hydrogen Sensor are supplied through a single 4-pin M12 connector.

3.1 Connector

The key (notch) location and pin numbers are shown below.

Table 1: SITRAM H2Guard Lite Pin Out



Pin	Signal Name	Wire Color
1	DC power	Brown
2	DC ground	White
3	RS485 Data+	Blue
4	RS485 Data-	Black

NOTICE

This view is looking at the connector on the SITRAM H2Guard Lite.

3.2 Wiring Diagram

A typical wiring diagram is shown below.

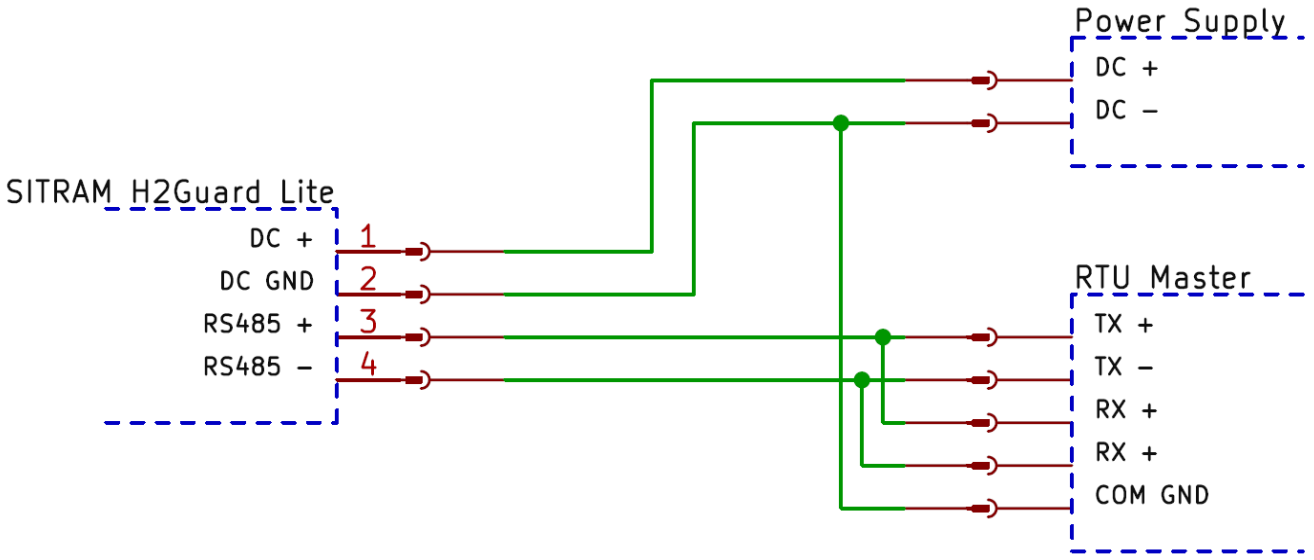


Figure 3: Typical Connection to Modbus RTU Master

3.3 Cable

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

Cable recommendations are:

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- 4-pin M12 Female molded connector
- IP68 rated, for substation environment
- 18 AWG , stranded wire
- RS485+ and RS485- preferably twisted-pair
- Shielded cable is recommended **(grounded at one end only)**

CAUTION
Siemens Energy is not responsible for issues arising from the use of cabling and connectors that are not suited for the environment or for the application.

3.4 Power Supply

The SITRAM H2Guard Lite 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 SITRAM H2Guard Lite 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: 9, 12, 15, 24, 30, 36 or 48 VDC nominal (8.55 to 50.4 VDC)
- Output power: 10 watts minimum

NOTICE
12 VDC,24VDC or 48 VDC Power Supply is recommended

3.5 RS485

The RS485 input is galvanically isolated inside the SITRAM H2Guard Lite to improve noise immunity in harsh electrical environments.

The SITRAM H2Guard Lite 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 SITRAM H2Guard Lite.

The following default communication settings are used for the RS485, 2-wire, half duplex connection.

Baud Rate:	9,600
Data bits:	8
Stop bits:	2
Parity:	None
Flow Control:	None

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4. Installation

4.1 Handling Precautions

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

- Ensure that nothing comes in contact with the sensor-end of the device
- The red protective cap should remain in place until the time of installation.
- Place a wrench on the metal housing closest to the threaded end when tightening. The SITRAM H2Guard Lite is designed to handle torque throughout the whole sensor assembly enclosure.
- Use standard torque for a ¾" NPT fitting, which is approximately 65Nm Do not over tighten.

4.2 Mechanical Connection

Attach the sensor to a ¾"-14 NPT fitting on the transformer tank. Adapter bushings for larger ID fittings can be used however, **do not use adapters to smaller ID fittings or pipe.**

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

Any piping or valves between the sensor and transformer tank **should have an inner diameter of 1" or greater,** with the sensor mounted as close to the transformer tank as possible.

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)
- Insulation fluid Flow near install location
- Insulation fluid Temperature (warmer insulation fluid 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 insulation fluid (insulation fluid-calibrated device only).
- Seal threads using appropriate liquid thread sealant or Teflon® tape.
- **When installed in insulation fluid**, the sensor must be mounted in a way, that no gas can be trapped in the hollow space around the sensor element thus the sensor element has direct contact to the insulation fluid. Mounting directions from horizontal to vertical

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(sensor element pointing upwards) are acceptable, as illustrated in (Figure 4Fehler! Verweisquelle konnte nicht gefunden werden.)

- **When installed in insulation fluid**, provide means to bleed all air from pipe fittings between sensor and transformer tank (Figure 5).
- Do not install sensor in turbulent insulation fluid flow. See showing mounting locations (Figure 6).

CAUTION
When installing in insulation fluid, take precautions that potential insulation fluid spill is contained. After installation clean sensor and assemblies from remaining insulation fluid. **Visually check if there is no insulation fluid leakage at the sensor or assemblies after installation.**

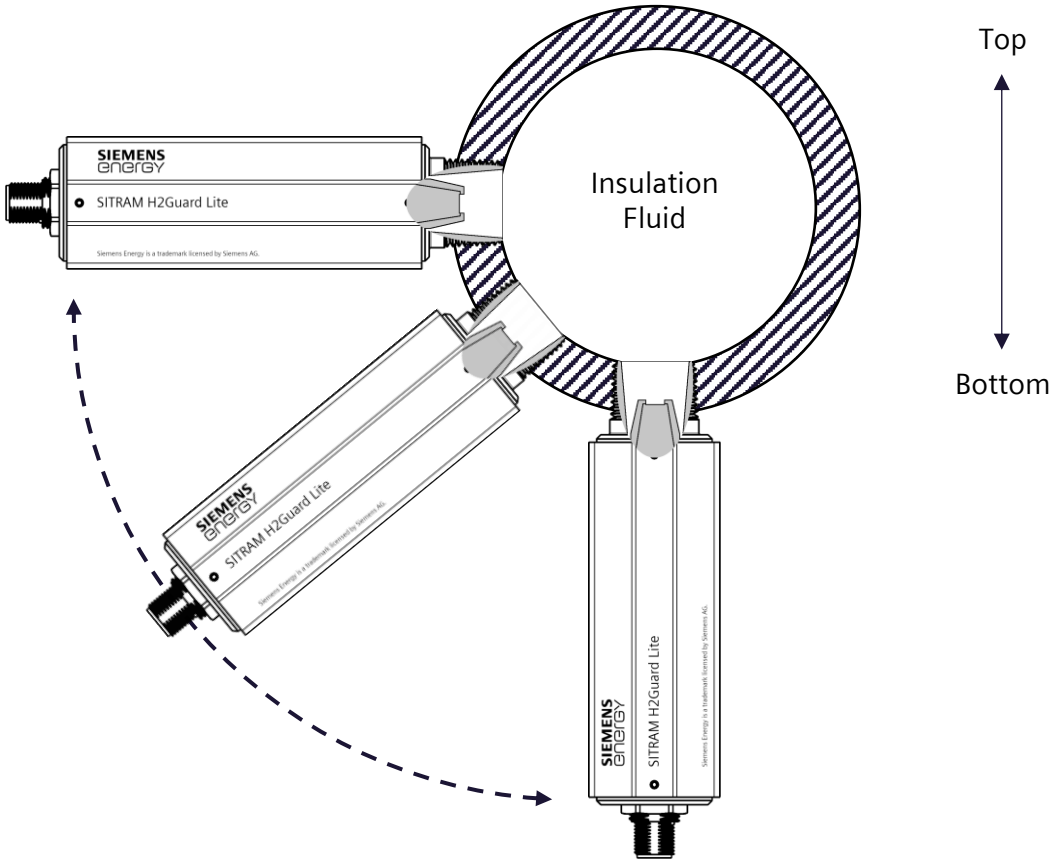


Figure 4: SITRAM H2Guard Lite allowed sensor orientation in Insulation fluid

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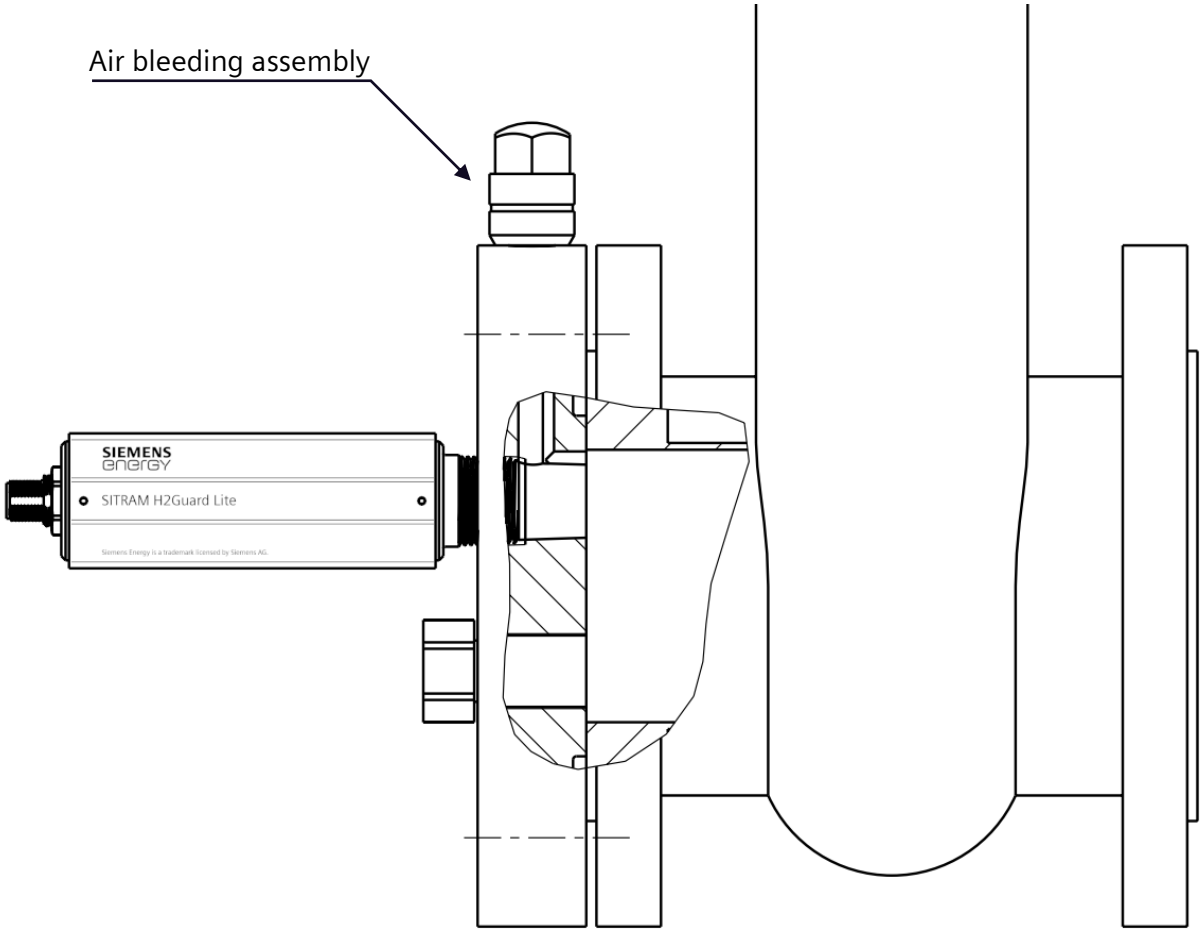
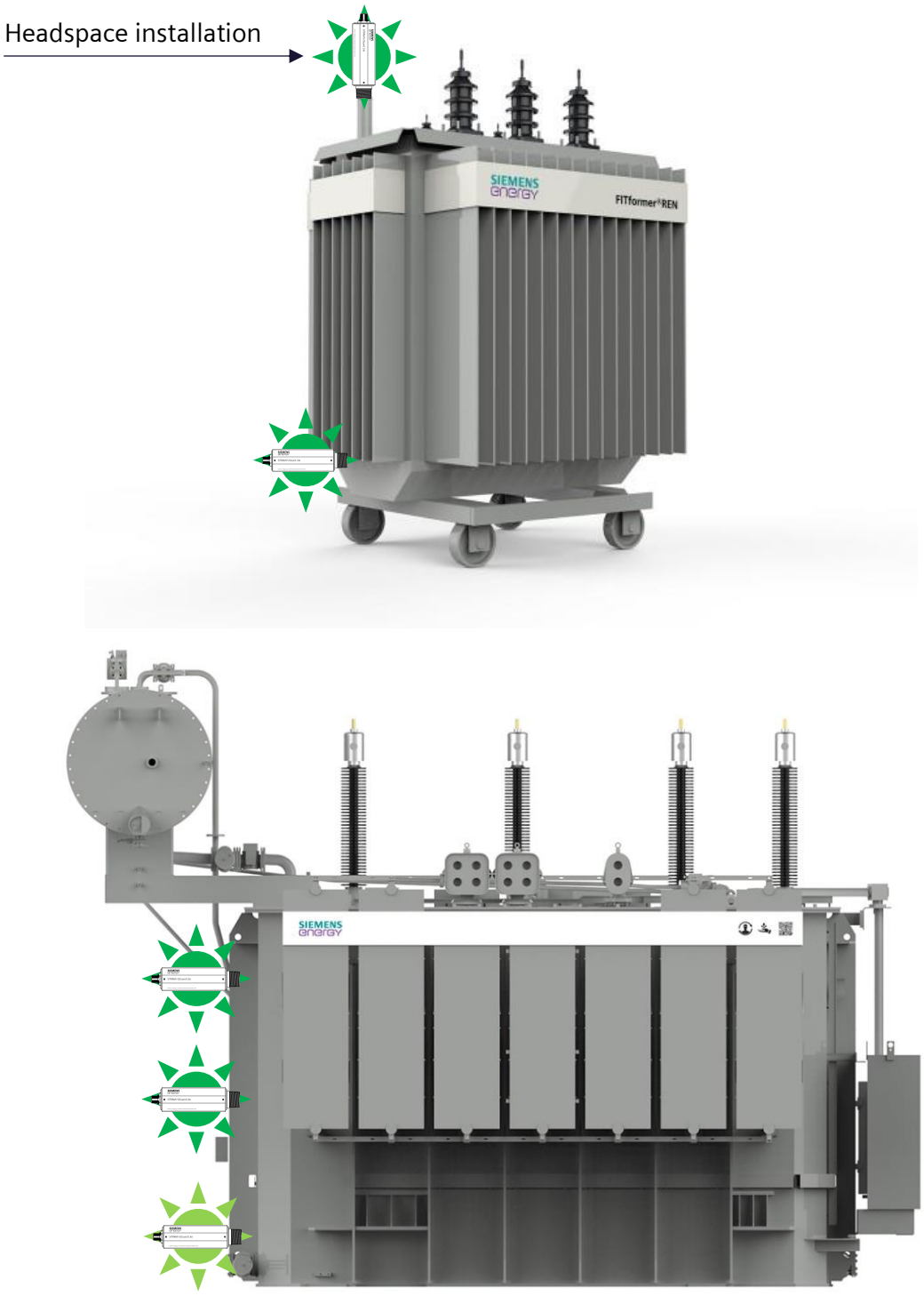


Figure 5: Recommended Installation in Insulation fluid, exemplary with DN80 bleeding flange
(Bleed assembly is not required for installation in Gas space)

WARNING
The SITRAM H2Guard Lite is not to be used as a step!

CAUTION
When measuring in insulation fluid it is highly recommended to apply the SITRAM H2Guard only to a connection point with a valve. Otherwise, when replacement of the sensor is needed, this would imply draining of the transformer.

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Recommended location

Recommended location – Hydrogen may take longer to reach sensor.

Figure 6: Typical Locations for SITRAM H2Guard Lite Installation

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4.3 Electrical Connection

Before energizing the equipment:

- Install the cable between the SITRAM H2Guard Lite and power/communication equipment.
- Connect the cable to the power/communication equipment.
- Connect the cable to the SITRAM H2Guard Lite.

NOTICE
The connector to the SITRAM H2Guard Lite must be fully tightened to ensure the IP68 rating.

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

- RS485, half duplex, 9600 baud, 8 data bits,2 stop bits, no parity.
- Default Modbus ID is 9.

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5. Operation

5.1 Startup

After connecting the cable and turning on the power supply, the sensor 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
- Restore configuration settings from non-volatile memory
- Start measuring insulation fluid temperature and hydrogen
- Autocalibration sequence is performed to stabilize sensor as needed (sensor may show initial value before autocalibration is complete)

Prior to placing the sensor in operation, please perform the following steps:

1. Connect the sensor to power for at least 5 minutes to recharge the super capacitor, which may have discharged if the sensor has been without power for several months.
2. Reset the date/time per the steps in section **6.2.16**.
3. Cycle the power to clear any errors.

After a short power interruption, the approximate hydrogen readings will be reported by the sensor within 30 minutes after power is restored. On new installations and after long power interruptions, the sensor 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 completes, measured and calculated values will be available in the Modbus registers.

If an error is reported, turn off power to the sensor; check the electrical connections and power supply voltage before restoring power again. If the error condition persists, contact Siemens Energy for assistance.

During normal operation, the sensor will measure insulation fluid 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 (**Figure 7**)

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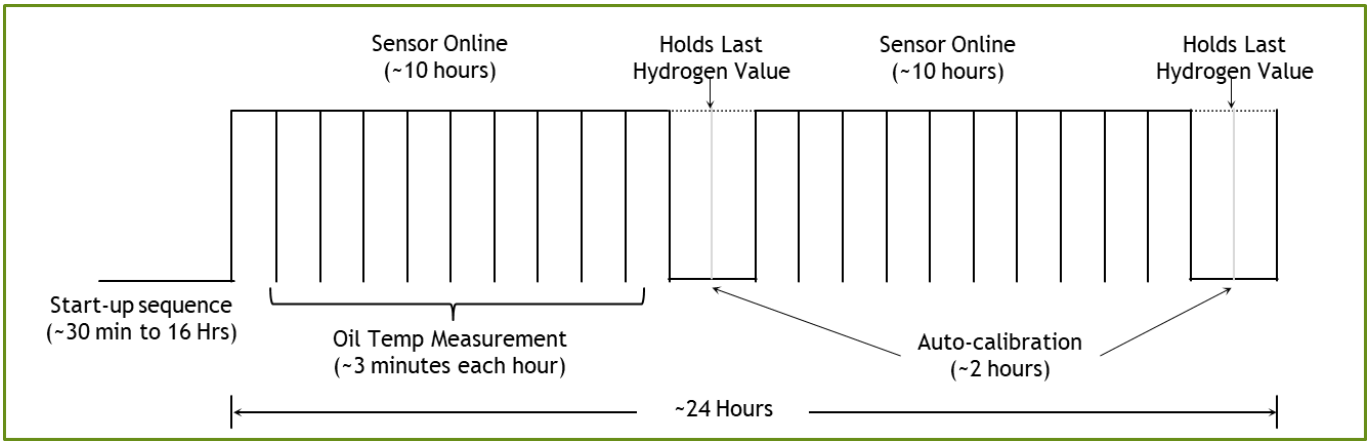


Figure 7: Normal Operation of SITRAM H2Guard Lite Sensor

5.2 Monitoring

During normal operation, the SITRAM H2Guard Lite Hydrogen Sensor measurements should be polled periodically for a measurement reading. The polling frequency can be from 1 second to several hours or days, depending on user requirements. Each reading should include the following Modbus holding registers.

- **Status Register** (**111**, bits **15** & **12**) – Bit 15 indicates that the hydrogen measurement is available. Bit 12 indicates that there is an error.
- **Error Status Registers** (**112,113**) – Indicates which error is detected. (These registers are active when register 111 bit 12 is high)
- **PCB Temperature Register** (**7**) – Provides the internal temperature of the SITRAM H2Guard Lite. **Note**: Operating temperatures above 105°C may cause permanent damage.
- **Insulation fluid Temperature Register** (**8**) – Provides the insulation fluid temperature at the sensor. Note that an insulation fluid temperature above 105°C is outside the calibration range. Insulation fluid 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.

5.1 Special Operation situations

There might be situations where vacuum is applied to a transformer, e.g. de-gassing, trying.

CAUTION
Vacuums applied to a transformer can exceed the pressure specification of the device. **Pressure outside the specification may damage the device.** **Close the valve of the connection point before pressure outside of device's specification is applied.**

BEWARE
Remember re-opening the valve when going back to operation with normal pressures. Otherwise the device can not observe the Hydrogen content within the transformer.

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5.2 Troubleshooting

5.2.1 Error/Exception Handling

The SITRAM H2Guard Lite is designed for continuous operation and will automatically recover from intermittent problems due to insufficient power, excessive electrical noise, excessive internal PCB temperature, and excessive insulation fluid temperature.

If the sensor element is damaged and inoperable, the SITRAM H2Guard Lite 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 then details specified in registers **112,113**. This type of error typically indicates a hardware fault that can only be repaired at Manufacturer Power cycle the unit to attempt recovery. If the error condition repeats, contact Siemens Energy for repair.

5.2.2 Damaged device

CAUTION
NEVER continue operating a device that shows physical signs of damage (bent device, big dents, lost parts, massive corrosion, etc.). **When attached to a connection point with valve, close the valve to avoid elusion of media to the environment.** **Plan a replacement of the device without delay to minimize the risk for environment (leakage) or humans (e.g. hazards due to sharp edges).** **Investigate the source of the damage and apply measures to prevent for the future.**

CAUTION
Keeping a damaged device in operation may damage further assets (e.g. power supply, communication counterpart).

BEWARE
A damaged device may not measure correctly.

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6. Modbus

The SITRAM H2Guard Lite Hydrogen Sensor uses Modbus RTU to communicate with external equipment. Modbus RTU is a popular industrial interface supported by many products.

6.1 Communication Settings

Modbus protocol communicates over RS485 and supports RTU packets. The SITRAM H2Guard Lite's default Modbus ID is **9**. The Modbus ID can be changed by writing to holding register **150**.

6.2 Protocol

The following tables comprise the list of Modbus packets, values, registers, and register definitions.

The maximum response time for the sensor is 10 seconds. Therefore, the master's timeout should be set to 10,000 milliseconds or greater.

Table 2: Modbus Read Request Packet

Byte	Modbus Parameter	Range	Meaning
1	Slave address	1 – 247	Unit ID Address
2	Function Code	03	Read Holding Register
3	Starting Address Hi	0x00 – 0xFF	Holding Register Hi Byte
4	Starting Address Lo	0x00 – 0xFF	Holding Register Lo Byte
5	Number of registers Hi	0	Limited by Modbus spec V1.1b
6	Number of Registers Lo	1 – 125	Number of 16-bit registers Lo Byte
7	CRC Lo	0x00 – 0xFF	CRC Low Byte
8	CRC Hi	0x00 – 0xFF	CRC High Byte

Table 3: Modbus Read Response Packet

Byte #	Modbus Parameter	Range	Meaning
1	Slave address	1 – 247	Unit ID Address
2	Function Code	03	Returning Holding Registers
3	Byte Count	7 – 255	Number of data bytes returned = N
4	1st Data Value Hi	0x00 – 0xFF	
5	1st Data Value Lo	0x00 – 0xFF	
6	2nd Data Value Hi	0x00 – 0xFF	
7	2nd Data Value Lo	0x00 – 0xFF	
…	…		
…	…		
2N+4	CRC Lo	0x00 – 0xFF	CRC Low Byte
2N+5	CRC Hi	0x00 – 0xFF	CRC High Byte
N is the number of bytes returned based on the number of registers requested. If N registers are requested, then 2N+5 bytes are returned.			

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Table 4: Modbus Write Request Packet

Byte	Modbus Parameter	Range	Meaning
1	Slave address	1 – 247	Unit ID Address
2	Function Code	06	Write Holding Registers
3	Register Address Hi	0x00 – 0xFF	Unit Register Address Hi byte
4	Register Address Lo	0x00 – 0xFF	Unit Register Address Lo byte
5	Data Value Hi Byte	0x00 – 0xFF	
6	Data Value Lo Byte	0x00 – 0xFF	
7	CRC Lo	0x00 – 0xFF	CRC Low Byte
8	CRC Hi	0x00 – 0xFF	CRC High Byte

Table 5: Modbus Write Response Packet

Byte	Modbus Parameter	Range	Meaning
1	Slave address	1 – 247	Unit ID Address
2	Function Code	06	
3	Register Address Hi Byte	0x00 – 0xFF	Unit Register Address Hi byte
4	Register Address Lo Byte	0x00 – 0xFF	Unit Register Address Lo byte
5	Data Value Hi Byte	0x00 – 0xFF	
6	Data Value Lo Byte	0x00 – 0xFF	
7	CRC Lo	0x00 – 0xFF	CRC Low Byte
8	CRC Hi	0x00 – 0xFF	CRC High Byte

6.2.1 Exception Response

In a normal communications query and response due to a communication error, the master device sends a query to the slave device. Upon receiving the query, the slave processes the request and returns a response to the master device. An abnormal communication between the two devices produces one of four possible events:

1. If the slave does not receive the query due to a communications error, then no response is returned from the slave and the master device will eventually process a timeout condition for the query.
2. If the slave receives the query but detects a communication error (UART or CRC), then no response is returned from the slave and the master device will eventually process a timeout condition for the query.
3. If the slave receives the query without a communications error, and takes longer than the master's timeout setting, then no response is returned from the slave. The master device eventually processes a timeout condition for the query. To prevent this condition, the master timeout must be set longer than the maximum response time of the slave (10,000 milliseconds).
4. If the slave receives the query without a communications error but cannot process it due to reading or writing to a non-existent slave command register, then the slave returns an exception response message informing the master of the error.

The exception response message has two fields that differentiate it from a normal response. The first is the function code – byte 2. This code will have the high order bit set to a one (i.e., 0x83

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for a read exception and 0x86 for a write exception). The second differentiating field is the exception code – byte 3. In addition, the total exception response length is 5 bytes rather than the normal message length.

Table 6: Exception Response Packet

Byte	Modbus Parameter	Range	Meaning
1	Slave Address	1 – 247	
2	Function Code	0x83 or 0x86	Read or Write
3	Exception Code	See Table Below	
4	CRC High	0x00 – 0xFF	
5	CRC Low	0x00 – 0xFF	

Table 7: Exception Response Codes

Code	Name	Description
1	Illegal Function Code	The function code received in the query is not an allowable action for the slave. This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the slave is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.
2	Illegal Data Address	The data address received in the query is not an allowable address for the slave. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 “Illegal Data Address” since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
3	Illegal Data Value	A value contained in the query data field is not an allowable value for slave. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance
4	Slave Device Failure	An unrecoverable error occurred while the slave was attempting to perform the requested action.

6.2.2 Modbus Command Register Definitions

The Command Register definitions for the SITRAM H2Guard Lite Hydrogen Sensor are identified in **Table 8**.

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NOTICE

When reading registers containing 32 or 64-bit integers the user must read the high order word first, then the lower order word(s). Reading of the high order word causes the low order word to be saved in a temporary location for the next register read. The second register is then automatically read from the temporary location by the firmware. Likewise, with a write, the high value is stored until the second value is received at which time both values are written to the instrument.

Table 8: Command Register Locations

Register	Parameter	Function	Data Type	Data Range	Access
Measurements					
0	Hydrogen, ppm H2	High word	32-bit binary number	0 to 20,000,000	R
1		Low word			
2-6	Reserved for future use				
7	PCB Temperature, Celsius	x100 scale; 100 offset (T=V/100-100)	16-bit binary number	-100 to +200	R
8	Insulation fluid Temperature, Celsius	x100 scale; 100 offset (T=V/100-100)	16-bit binary number	-100 to +200	R
9-12	Reserved for future use				
13	Rate of Change, ppm H_2 per Day +20,000,000 offset	High word	32-bit binary number	-20,000,000 to +20,000,000	R
14		Low word			
15	Rate of Change, ppm H_2 per Week +20,000,000 offset	High word	32-bit binary number	-20,000,000 to +20,000,000	R
16		Low word			
17	Rate of Change, ppm H_2 per Month +20,000,000 offset	High word	32-bit binary number	-20,000,000 to +20,000,000	R
18		Low word			
19-30	Reserved for future use				

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Information					
31-40	Model Number		ASCII String		R
41-50	Product Serial Number		ASCII String		R
51-60	Sensor Serial Number		ASCII String		R
61-70	Sensor Board Serial Number		ASCII String		R
71-80	Reserved for future use				
81	Manufacturing Date	high byte: Month low byte: Day	32-bit binary value		R
82		Year			
83	Factory Calibration Date	high byte: Month low byte: Day	32-bit binary value		R
84		Year			
85-86	Reserved for future use				
87	Dissolved Gas Calibration Date	high byte: Month low byte: Day	32-bit binary value		R
88		Year			
89-98	Firmware Revision		ASCII String		R
99-110	Reserved for future use				
Status/Error Information					
111	Status	Refer to section 6.2.3	16-bit binary flags	Table 9: Unit Status	R
112	Error Status	Refer to section 6.2.8.2 High word	32-bit binary flags	Table 10: Error Status	R
113		Low word			
114-120	Reserved for future use				

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Calibration Functions					
121	DA command		None		R/W
122	DB command	Write reg 126-129 first	None		R/W
123-124	Reserved for future use				
125	DC command	clear DGA calibration	None		R/W
126	Calibration Gas, ppm H2	High word	32-bit binary number	0 to 1,000,000	R/W
127		Low word			
128	Calibration Date	high byte: Month low byte: Day	32-bit binary value		R/W
129		Year			
130-135	Reserved for future use				
Configuration Settings					
136-143	User-define Insulation fluid Type name	Refer to section 6.2.10 for User-define Insulation fluid type Configuration Window descriptions.	ASCII String		R/W
144	Ostwald Slope, m		16-bit binary number		R/W
145			16-bit binary number		R/W
146	Ostwald Offset, b		16-bit binary number		R/W
147			16-bit binary number		R/W
148	Insulation fluid Type Operations		16-bit binary number	1 = open edit 2 = save close 3 = abort edit	R/W
149	Reserved for future use				
150	Set Unit ID		8-bit binary number	1 to 247	R/W
151	Operating Mode	Select between Field and Lab mode	16-bit binary number	0 = Field 1 = Lab	R/W
152	Insulation fluid Type Selection	Select Insulation fluid Type	16-bit binary number	0 = Mineral 1 = Silicone 2 = Nat Ester 3 = Syn Ester	R/W
153-158	Reserved for future use				
159	Stop Bit Selection	Select Stop Bit	16-bit binary number	1 (stop bit = 1) 2 (stop bit = 2)	R/W

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160	Baud Rate		8-bit binary number	1 = 9600 2 = 14400 3 = 19200 4 = 38400 5 = 57600 6 = 115200	R/W
161-174	Reserved for future use				
Diagnostics					
175	Month / Year	Date & Time; read register 175 first; order high-byte / low-byte; add 2000 to year (64-bit)	Two Bytes		R/W
176	Hour / Day		Two Bytes		R/W
177	Second / Minute		Two Bytes		R/W
178	Millisecond		16-bit binary number		R/W
179-200	Reserved for future use				
User Information					
201-210	Owner ID	Must start reading from low address; Must write low and high addresses to save string	ASCII String		R/W
211-220	Substation ID		ASCII String		R/W
221-230	Transformer ID		ASCII String		R/W
231-255	Reserved for future use				

6.2.3 Hydrogen Measurement

SITRAM H2Guard Lite reports the most recent hydrogen measurement in registers **0-1**. The 32-bit unsigned integer value is not scaled and reports the integer value of hydrogen in ppm H2.

NOTICE

Read the device status in register 111 bit 15 to determine if the device is ready. The hydrogen value is zero until the ready bit is set.

6.2.4 Hydrogen Trend

SITRAM H2Guard Lite calculates and maintains a daily, weekly, and monthly rate of change value.

An hourly trend is calculated at the end of every hour of operation. The value is the difference in hydrogen measured between the first and second hour. This difference is stored in a circular buffer of twenty-four (24) hourly values.

The daily trend is calculated as the average of the twenty-four (24) hourly values to give the amount of change over the last 24 hours.

The weekly trend is calculated as the average of the most recent seven (7) daily values to give the amount of change over the last seven (7) days.

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The monthly trend is calculated as the average of the most recent twenty-eight (28) daily values to give the amount of change over the last twenty-eight (28) days.

A positive trend indicates increasing hydrogen, a negative trend indicates a decreasing level of hydrogen. The rate of change is calculated as the change of hydrogen measured over time.

NOTICE
The trend values are reset to zero after a power cycle.

6.2.4.1 Rate of Change per Day

Rate of Change per Day is reported in registers **13,14**. The unsigned 32-bit integer value is scaled with an offset of 20,000,000 (0x0131 2D00), resulting in a signed 32-bit integer value in ppm H_2 per day.

The daily trend is the average of the last 24hourly measurements.

6.2.4.2 Rate of Change per Week

Rate of Change per week is reported in registers **15,16**. The unsigned 32-bit integer value is scaled with an offset of 20,000,000 (0x0131 2D00), resulting in a signed 32-bit integer value in ppm H_2 per day.

The weekly trend is the average of the last 7 daily measurements.

6.2.4.3 Rate of Change per Month

Rate of Change per month is reported in registers **17,18**. The unsigned 32-bit integer value is scaled with an offset of 20,000,000 (0x0131 2D00), resulting in a signed 32-bit integer value in ppm H_2 per day.

The monthly trend is the average of the last 28 daily measurements.

6.2.5 Temperature Measurement

SITRAM H2Guard Lite monitors insulation fluid temperature and internal electronics temperature. The temperature is reported as a scaled16-bit unsigned integer in degrees Celsius. Dividing the integer value by 100 and subtracting 100 will provide the measured temperature with 2 decimal places.

6.2.5.1 PCB Temperature

PCB temperature is reported in register **7**. This is the internal temperature of the electronics enclosure, which must not exceed 105°C.

This is a good register to read during installation and communication testing because the value is always valid and frequently changes.

6.2.5.2 Insulation fluid Temperature

Insulation fluid temperature is reported in register **8**. The sensor is calibrated for insulation fluid temperature up to 105°C; accuracy of the hydrogen measurement is unknown above this temperature; the sensor survives insulation fluid temperatures up to 135°C.

Zero is the power on default value for Insulation fluid Temperature.

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6.2.6 ASCII Strings

SITRAM H2Guard Lite information is available as ASCII strings terminated with a zero byte (0x00). Each string can be up to 19 characters long with 2 characters per Modbus register. Use the read holding register function and read ten registers, each byte is an ASCII character.

6.2.6.1 Model Number

The model number is in registers **31-40**.

6.2.6.2 Product Serial Number

The product serial number is in registers **41-50**.

6.2.6.3 Sensor Serial Number

The sensor serial number is in registers **51-60**.

6.2.6.4 Sensor Board Serial Number

The sensor board serial Number is in registers **61-70**.

6.2.6.5 Firmware Revision

The firmware revision is in registers **89-98**, using format x:y:z; example 3:18:A

- x is the major revision
- y is the minor revision
- z is the product designator

6.2.7 Date Register Format

Registers that report a date value are encoded as follows.

- High word, high byte is the Month
- High word, low byte is the Day
- Low word is the Year

6.2.7.1 Manufacturing Date

Original manufacturing date is in registers **81,82**

6.2.7.2 Factory Calibration Date

Last factory calibration date is in registers **83,84**

6.2.7.3 Dissolved Gas Calibration Date

Last DGA calibration date is in registers **87,88**

6.2.8 Status and Error Information

SITRAM H2Guard Lite provides status and error information for the user to determine if it is operating normally.

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6.2.8.1 Unit Status

Unit status information is maintained in Modbus register **111**. The bit map for this status word is described below:

Table 11: 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	Error, indicates an unrecoverable error occurred, read Reg 112,113 for more information
6-11	Unlisted bits are not used and may be 0 or 1.
5-3	Sensor A state Information: 001 – Hydrogen measurement cycle 010 – Insulation fluid temperature measurement cycle 011 – Autocalibration cycle 100 – Insulation fluid temperature too high
0-2	Unlisted bits are not used and may be 0 or 1.

For example:

`00x0 xxxx xx00 1xxx` – Unit not Ready – Hydrogen measurement cycle (**decimal 8***)

`00x0 xxxx xx01 0xxx` – Unit not Ready – Insulation fluid temperature measurement cycle (**decimal 16***)

`00x0 xxxx xx10 0xxx` – Unit not Ready – Insulation fluid temperature too high (**decimal 32***)

`xxx1 xxxx xxxx xxxx` – Unit Error – Error Bit 12 (**decimal 4,096***)

`10x0 xxxx xx01 0xxx` – Unit Ready – Insulation fluid temperature measurement cycle (**decimal 32,784***)

`10x0 xxxx xx00 1xxx` – Unit Ready – Hydrogen measurement cycle (**decimal 32,776***)

`10x0 xxxx xx01 1xxx` – Unit Ready – Autocalibration cycle (**decimal 32,792***)

`11x0 xxxx xx01 0xxx` – Unit Ready – Insulation fluid temperature cycle, new data (**decimal 49,168***)

`11x0 xxxx xx00 1xxx` – Unit Ready – Hydrogen measurement, new data (**decimal 49,160***)

`11x0 xxxx xx01 1xxx` – Unit Ready – Autocalibration cycle, new data (**decimal 49,176***)

* if x in the binary representation equals 0

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6.2.8.2 Error Status

When the error flag (bit **12**) of the Unit Status register **111** is set, the 32-bit register **112,113** has more information about what is causing the error. The bit map is shown below for error description.

Table 12: Error Status

Bit #	Hex Value	Description
31	0x8000 0000	Sensor – Heater fault
30	0x4000 0000	Sensor – Temperature Sensor Fault
29	0x2000 0000	Sensor – Hydrogen Sensor Fault
9-28	0x1000 0000 - 0x0000 0200	Unlisted bits are not used and may be 0 or 1.
8	0x0000 0100	Battery Backup Error
3-7	0x0000 0080 - 0x0000 0008	Unlisted bits are not used and may be 0 or 1.
2	0x0000 0004	PCB Temperature greater than 105C
1	0x0000 0002	Required data not available
0	0x0000 0001	Configuration data not valid

6.2.8.3 Error Response

Recommended response to these errors are:

- **Sensor faults** (heater, temperature, or hydrogen): power off the sensor, wait 5 minutes, power on the sensor, and check status after 15 minutes to determine if error is persistent. Contact Siemens Energy for more information about persistent sensor faults.
- **Battery backup error**: the internal rechargeable battery was drained while power was disconnected and will recharge when power is turned on. Setting the clock as described in section 6.2.16 will clear this error status. Cycling power will also clear this error. Contact Siemens Energy if this error does not clear after power cycling.
- **PCB temperature**: the internal temperature is too hot and may impact operation of the sensor and accuracy of the hydrogen measurement. Power off for an hour and investigate area around the sensor for high temperature or lack of air flow. Turn power on and wait an hour to determine if error is persistent. Contact Siemens Energy for more information about persistent PCB temperature error.
- **Required data not available**: indicates an error in internal microcontroller, contact Siemens Energy for more information.
- **Configuration data not valid**: indicates an error in the internal me

6.2.9 DGA Calibration

The reported hydrogen from the SITRAM H2Guard Lite can be adjusted to match a laboratory DGA test result using a two-command sequence. The first command (DA) is issued when an oil sample is taken for analysis. The second command (DB) is issued after the oil sample is analyzed. The sensor uses the DGA reported hydrogen value and internal data saved during the DA command to calculate a correction factor used in all future hydrogen measurements.

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NOTICE

Incorrect data entered for the DGA calibration will impede the measurement and monitoring capability of the sensor.

6.2.9.1 DA command

The DA command (write to Modbus register **121**) is the first step in making an adjustment to the SITRAM H2Guard Lite hydrogen measurement based on laboratory DGA test results. This command should be issued when an oil sample is taken so that certain internal values are saved to be used when the DGA results are entered later.

NOTICE

Do not issue the DA command less than 24 hours after installation or since the last DC command.

6.2.9.2 DB command

The DB command (write to Modbus register **122**) is the second step in adjusting the SITRAM H2Guard Lite hydrogen measurement based on laboratory DGA test results. Note that a DA command must have been executed prior to issuing a DB. The DB command uses data written in registers **126-129,** which must be written before writing to register **122**. The date in registers **128,129** must match the internal real time clock to be accepted. Recommended sequence of operations to execute the DB command is:

1) Read registers **175,176** to get the internal date
2) Write the date to registers **128,129**
3) Write the DGA results in ppm H_2 to registers **126,127**
4) Write to register **122**

The new hydrogen measurement may be different than the DGA value due to changes since the oil sample was taken.

Internal data from last DA command is erased when the DB command is completed.

Writing to Modbus register **122** will take up to 10 seconds to respond.

6.2.9.3 DC command

The DC command (write to Modbus register **125**) allows the user to clear the DGA adjustment set by a DB command.

NOTICE

Wait at least 24 hours before issuing a DA command.

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6.2.9.4 Calibration Gas, ppm H2

The actual hydrogen value in ppm is written to Modbus registers **126,127** for use with the DB command. This value must be written before the DB register is written.

6.2.9.5 Calibration Date

The calibration date (month, day, year) written to Modbus registers **128,129** must match the internal real time clock for the DB command to be accepted.

6.2.10 User-Defined Insulation fluid Type Configuration

SITRAM H2Guard Lite can operate in a variety of insulation fluid types and comes configured for four popular types: Mineral, Silicone, Natural Ester, and Synthetic Ester. The end user can select one of programmed insulation fluid types or modify the fourth, user-configurable insulation fluid type. The Insulation fluid Type Configuration Window registers are used to read and modify the user-defined Insulation fluid Type configuration data structure. This includes the name, and Ostwald values for slope and offset.

NOTICE
These values are a critical part of the hydrogen calculation. Incorrect values will impede the measurement and monitoring capability of the sensor.

For example: programming the Ostwald values for Synthetic Ester m=0.000093, b=0.039739 are used in the following instructions.

The sequence of operations to program a new insulation fluid type are:

1) Write register **148** with 0x0001 to open the user-configurable insulation fluid type for edit
2) Write registers **136-143** with the name of the insulation fluid
3) Write registers **144,145** with the Ostwald slope
4) Write registers **146,147** with the Ostwald offset
5) Write register **148** with 0x0002 to save the values and close

6.2.10.1 User-defined Insulation fluid Type name

The name of the user-defined insulation fluid type is accessed in registers **136-143**. Reading these registers will return the current value. Write these registers with a null terminated string to modify the name. The default value is "Synthetic Ester\0" for Synthetic Ester.

- A string length 15 characters
- Null-terminated with at least one bye of 0x00

6.2.10.2 Ostwald Slope, Slope (m)

The default value is 1093 (0x0000,0x0445) for Synthetic Ester. This is calculated using a scale factor of 1,000,000 and an offset of +1,000; Data32 = (m + 1,000) * 1,000,000.

- Register **144**, High 16-Bit value of Data32 (0x0000)
- Register **145**, Low 16-Bit value of Data32 (0x0445)

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6.2.10.3 Ostwald Offset, Offset (b)

The default value is 40,739 (0x0000, 0x9F23) for Synthetic Ester. This is calculated using a scale factor of 1,000,000 and an offset of +1,000; Data32 = (m + 1,000) * 1,000,000.

- Register **146**, High 16-Bit value of Data32 (0x0000)
- Register **147**, Low 16-Bit value of Data32 (0x9F23)

6.2.10.4 Insulation fluid Type Operations

Writing to register **148** is used to initiate operations to edit and save the user-defined insulation fluid type.

- Value = 1, starts configuration edit for user-defined Insulation fluid type.
- Value = 2, ends the edit and saves the new configuration settings
- Value = 3, aborts the operation and nothing is changed

6.2.11 Set Unit ID

The Modbus ID is reported or set in register **150**. Reading this register is used to confirm that the selected ID is in use. Writing desired ID to register 150 will set the unit to the specified ID. The device ID can range from 1 to 247 or as limited by the Modbus master. Note that if the current device ID is unknown then writing the desired ID to device 0 will broadcast the ID to all connected SITRAM H2Guard Lite devices.

Preparing multiple units to share a common RS485 bus is accomplished by connecting one unit at a time to a Modbus controller and writing the desired ID for that unit to register 150 at device ID 0.

The device must be power cycled for the new ID to take effect. It is recommended that each device is labeled with the new device ID.

A simple procedure to configure multiple units is as follows:

1) Disconnect all units from the RS485 cable
2) Connect first unit to the RS485 cable
3) Use Modbus Controller to write a single holding register (function 6) to register **150**, device 0, with the desired ID for the connected unit
4) Wait up to 10 seconds for the Modbus response
5) Disconnect this unit and connect the next one to the RS485 cable
6) Repeat steps 3, 4, and 5 until all units are configured
7) Attach all units to the RS485 cable and read register **150** from each of the configured devices

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6.2.12 Insulation fluid Type Selection

Selecting which insulation fluid type for SITRAM H2Guard Lite to use is accomplished by writing to Modbus register **152** with the number corresponding to the desired insulation fluid type from the table below.

Table 13: Insulation fluid Type

Number	Oil Type	Description in Modbus Map
0	Mineral Oil	Mineral
1	Silicone Oil	Silicone
2	Natural Ester Oil	Natural Ester
3	Synthetic Ester Oil	Synthetic Ester

Example: write register **152** with a value of 0x0003 to select synthetic ester oil.

6.2.13 Stop Bit Selection

To select which stop bit to use in the RS485 communication port settings, write a 1 or 2 to Modbus register **159** (default selection is **1**). **Note**: If changing to **2**, you **may** need to write a **3** to register **160** (baud rate – 19,200) as well and power-cycle the SITRAM H2Guard Lite.

6.2.14 Baud Rate

The SITRAM H2Guard Lite RS485 baud rate can be modified from the default 19,200 baud by writing to Modbus register **160** with the number corresponding to the desired value in the table below. The device must be power cycled for the new baud rate to take effect.

Table 14: Baud Rate

Number	Description
1	9,600 baud
2	14,400 baud
3	19,200 baud
4	38,400 baud
5	57,600 baud
6	115,200 baud

6.2.15 Operating Mode

The SITRAM H2Guard Lite is shipped from the factory for normal Field operation. **If it will be subjected to Laboratory testing, then the operating mode should be changed by writing a 1 to register 151.** The difference in operating modes is the frequency that the autocalibration is performed (every 12 hours in normal mode; every 4 hours in laboratory mode).

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6.2.16 Real time Clock

The SITRAM H2Guard Lite has an internal real-time clock with backup power provided by a super capacitor. Depending on temperature, the backup power will last a few months in storage. During installation or after long periods of no power to the SITRAM H2Guard Lite, the real time clock should be set to the current date and time.

6.2.16.1 Determine the correct starting date and time (Month/Year, Hour/Day, Sec/Min, Milliseconds (0)).

6.2.16.2 Convert each section of the date and time to hex, using the table below (or use a decimal-to-hex-converter).

Table 15: Date/Time Hex Table

Month	Hex	Year	Hex	Hour	Hex	Day	Hex	Seconds	Hex	Seconds	Hex	Minutes	Hex	Minutes	Hex	Milliseconds	Hex
Jan (01)	1	22	16	1	1	1	1	1	1	31	1F	1	1	31	1F	0	0
Feb (02)	2	23	17	2	2	2	2	2	2	32	20	2	2	32	20		
Mar (03)	3	24	18	3	3	3	3	3	3	33	21	3	3	33	21		
Apr (04)	4	25	19	4	4	4	4	4	4	34	22	4	4	34	22		
May (05)	5	26	1A	5	5	5	5	5	5	35	23	5	5	35	23		
Jun (06)	6	27	1B	6	6	6	6	6	6	36	24	6	6	36	24		
Jul (07)	7	28	1C	7	7	7	7	7	7	37	25	7	7	37	25		
Aug (08)	8	29	1D	8	8	8	8	8	8	38	26	8	8	38	26		
Sep (09)	9	30	1E	9	9	9	9	9	9	39	27	9	9	39	27		
Oct (10)	A	31	1F	10	A	10	A	10	A	40	28	10	A	40	28		
Nov (11)	B	32	20	11	B	11	B	11	B	41	29	11	B	41	29		
Dec (12)	C	33	21	12	C	12	C	12	C	42	2A	12	C	42	2A		
		34	22	13	D	13	D	13	D	43	2B	13	D	43	2B		
		35	23	14	E	14	E	14	E	44	2C	14	E	44	2C		
		36	24	15	F	15	F	15	F	45	2D	15	F	45	2D		
		37	25	16	10	16	10	16	10	46	2E	16	10	46	2E		
		38	26	17	11	17	11	17	11	47	2F	17	11	47	2F		
		39	27	18	12	18	12	18	12	48	30	18	12	48	30		
		40	28	19	13	19	13	19	13	49	31	19	13	49	31		
		41	29	20	14	20	14	20	14	50	32	20	14	50	32		
		42	2A	21	15	21	15	21	15	51	33	21	15	51	33		
		43	2B	22	16	22	16	22	16	52	34	22	16	52	34		
		44	2C	23	17	23	17	23	17	53	35	23	17	53	35		
		45	2D	24	18	24	18	24	18	54	36	24	18	54	36		
		46	2E			25	19	25	19	55	37	25	19	55	37		
		47	2F			26	1A	26	1A	56	38	26	1A	56	38		
		48	30			27	1B	27	1B	57	39	27	1B	57	39		
		49	31			28	1C	28	1C	58	3A	28	1C	58	3A		
		50	32			29	1D	29	1D	59	3B	29	1D	59	3B		
						30	1E	30	1E	60	3C	30	1E	60	3C		
						31	1F										

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6.2.16.3 Write the date and time sections (now in hex) to the proper registers, as shown below.

Register **175** – Month/Year
Register **176** – Hour/Day
Register **177** – Sec/Min
Register **178** – Milliseconds (0)

6.2.16.4 After register 178 is written, the date and time is automatically saved.

6.2.16.5 To confirm the correct date and time, read registers 175-178.

6.2.17 User Information

The SITRAM H2Guard Lite provides three ASCII strings that the user can program to indicate the owner, substation, and transformer that the sensor is monitoring. Each string can be up to 20 characters including null termination.

6.2.17.1 Owner ID

The owner string is saved in registers **201** through **210**.

6.2.17.2 Substation ID

The substation string is saved in registers **211** through **220**.

6.2.17.3 Transformer ID

The transformer string is saved in registers **231** through **230**.

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7. Firmware Upgrade

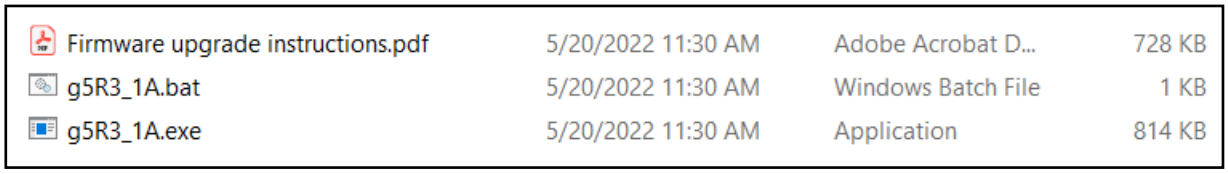
The SITRAM H2Guard Lite Hydrogen Sensor firmware is field-upgradable. Instructions and PC software will be provided by Siemens Energy as needed.

Copy the firmware upgrade files to a directory on the PC. (**NOTE**: The latest available firmware will be made available)

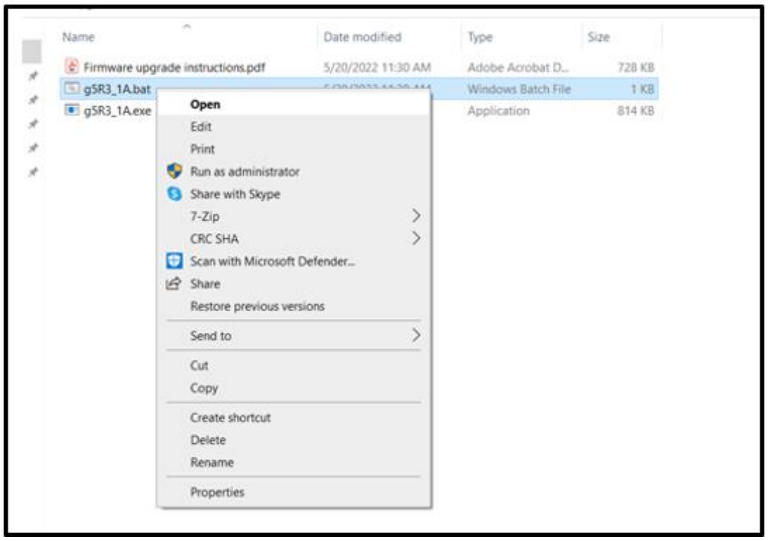
- **g5R3_1A.exe** – sensor firmware binary file
- **g5R3_1A.bat** – batch file

7-Step procedure to upgrade firmware:

1) Copy the files below to your local directory.



2) Connect the SITRAM H2Guard Lite to your PC using a USB to RS485 adapter.
3) Right-click on g5R3_1A.bat and then select Edit.



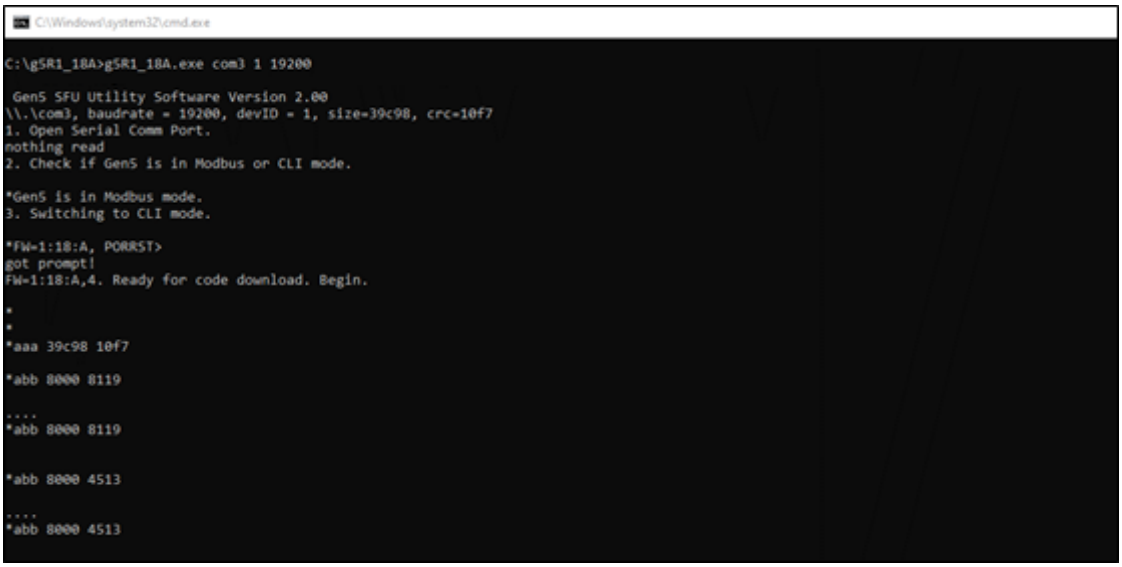
4) You will see the port information below. Update the com port, the device address and the baud rate you are using to connect to the SITRAM H2Guard Lite. Save the file.

ComPort	= comX	→ change to the com port being used
Device Address	= 9	→ default address is 9
Device Baud Rate	= 9600	→ default baud rate is 9600

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```
g5R3_1A.exe com3 9 9600
pause
```

5) Double-click on g5R3_1A.bat. You will see the following information as the firmware is being upgraded.



6) The upgrade process is complete when you see the window below.



7) To complete the process, please power cycle the SITRAM H2Guard Lite.

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BEWARE
Siemens Energy will potentially provide firmware updates / upgrades for this device. **In order to keep the device up to date and free from potential cyber security risks it is recommended to frequently check for new firmware at www.siemens-energy.com/sitram-dla or by reaching out to your local Siemens Energy partner.**

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8. Specifications

Table 16: Hydrogen Measurement

Parameter	Value			Units
	Minimum	Nominal	Maximum	
Oil Range	0		5,000	ppm
Gas Range	0		100,000	ppm
***Response Time, T_{90}**			60	minutes
Accuracy	In Oil - ±20% of reading or ±25 ppm, whichever is greater In Gas - ±20% of reading or ±500 ppm, whichever is greater			
Repeatability	In Oil - ±10% of reading or ±15 ppm, whichever is greater In Gas - ±10% of reading or ±300 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			

*once Hydrogen reaches the sensor, the sensor will respond in 60 minutes or less

Table 17: 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 feet water for 14 days (IEC 60529)			
Humidity	0 to 100% RH, condensing			
Corrosion Resistance	Class C5M Marine rated; salt-water condensing (IEC 60068-2-11 & DIN EN ISO 12944)			
Mechanical				
Vibration	3-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	30g, shock duration 18ms (IEC 60068-2-27)			
Weight	0.85 lbs. (387 grams)			
Electrical				
Voltage Input	8.1	24	52.8	VDC
Power Consumption			10	W

8.1 Temperature Sensor Specifications

The temperature sensor incorporated in the SITRAM H2Guard Lite is a resistive temperature device (RTD).

Accuracy (in insulation fluid @20°C) = **± 3°C**

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Repeatability (in insulation fluid over an insulation fluid temperature range of -40°C to 105°C) = **<1°C**

8.2 Certifications

List of standards:

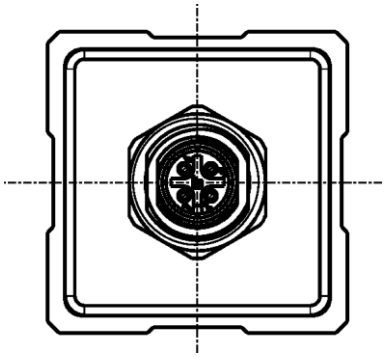
- IEC 60068-2-2 & EN 50155 Section 13.4.4
- IEC 60068-2-11 & DIN EN ISO 12944
- IEC 60529
- IEC 60068-2-6 table C.2
- IEC 60068-2-64 paragraph A.2, category no. 2
- IEC 60068-2-27
- FCC Part 15
- EN 55011 Class A Group 1
- EN 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-6, and 61000-4-8
- IEC/EN 61010-1
- EN 61326-1

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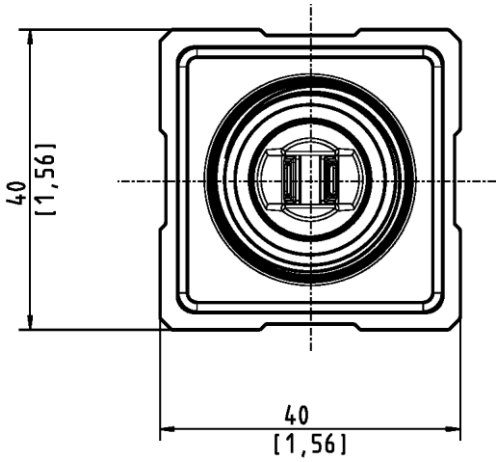
9. Dimensional drawings SITRAM H2Guard Lite



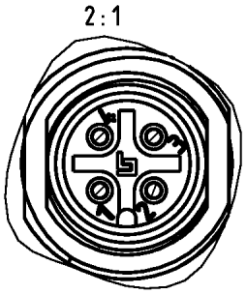
Side view



Left view: M12 – 4 wire connector



Right view: ¾ - 14 NPT



Detail view: M12 connector, 4Pins, male, A-coded

NOTICE
All dimensions in mm [inch]. Scale approx. 1:1 on paper size DINA4 if not noted otherwise.

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10. Customer Feedback formular

Please complete the Sign Off section at the bottom of form to confirm each page of this document has been read and complied with in full.

Originator – Name and initials		Date
Contact details (address / email)		Phone
Project Reference	Customer	Region
Product Type	Part Number	Serial Number
H2Guard Lite		
Please enter details below e.g. comments; complaints; evidence of good practice; incident reports; observations and recommendations, including any associated with health, safety or the environment, etc., also include any names/contact details of other relevant personnel.		

Sign off section

Name (CAPITALS BLOCK)	Signature	Date

Please send email completed to support@siemens-energy.com with the subject PLM – H2Guard Lite

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https://www.siemens-energy.com/gt-service

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