SIEMENS energy

SITRAM®
H2Guard

Installation and Operation Manual

siemens-energy.com

Any and all reference to or depictions of the Siemens name and/or logo in the documents provided herewith or during project execution (except if related to supplies and services sub-supplied by Siemens AG or its affiliates) shall be read and understood as reference to the Siemens Energy name and/or logo, and all such documents are copyright of Siemens Energy.

Siemens Energy is a trademark licensed by Siemens AG.

NOTICE

For your own safety, observe the warnings and safety instructions contained in this document, if available.

Security Information

Siemens Energy provides products and solutions with industrial security functions that support the secure operation of plants, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens Energy' products and solutions undergo continuous development. Siemens Energy recommends strongly that you regularly check for product updates. For the secure operation of Siemens Energy products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered.

Disclaimer of Liability

This document has been subjected to rigorous technical review before being published. It is revised at regular intervals, and any modifications and amendments are included in the subsequent issues. The content of this document has been compiled for information purposes only. Although Siemens Energy has made best efforts to keep the document as precise and up-to-date as possible, Siemens Energy shall not assume any liability for defects and damage which result through use of the information contained herein.

This content does not form part of a contract or of business relations; nor does it change these. All obligations of Siemens Energy are stated in the relevant contractual agreements.

The following disclaimer refers generally to SITRAM® H2Guard and to all of its related products and components. Please also respect the individual End User License Agreements (EULA) for the accompanying software products.

Siemens Energy reserves the right to revise this document from time to time.

Document version: H2_OM_RC_V2.2 -EN

Edition: 8.2022

Version of the product described: Model 4800-EE01

Disclaimer of Warranties

You expressly understand and agree that: Your use of the SITRAM® H2Guard is at your sole risk. The SITRAM® H2Guard is provided on an ""as is"" basis. Siemens Energy and its subsidiaries, affiliates, officers, employees, agents, partners and licensors expressly disclaim all warranties of any kind, whether express or implied, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Siemens Energy and its subsidiaries, affiliates, officers, employees, agents, partners and licensors make no warranty that (i) the SITRAM® H2Guard will meet your requirements"","" (ii) the SITRAM® H2Guard will be uninterrupted, timely, secure or error-free"", (iii) the results that may be obtained from the use of the SITRAM® H2Guard will be accurate or reliable enough,"" (iv) the SITRAM® H2Guard will detect, forecast, predict to any degree of accuracy the loading

Capability, the remaining life, the cause, or the probability of failure of a given transformer"", and (v) the SITRAM® H2Guard will provide the most prudent course of action to take to avoid transformer failure or damages to the transformer.

Any material downloaded or otherwise obtained through the use of the SITRAM® H2Guard is accessed at your own discretion and risk, and you will be solely responsible for any damage to your computer system or loss of data that results from the download of any such material.

SITRAM® H2Guard is a monitoring system and must not be used for grid or equipment protection purposes. No advice or information, whether oral or written, obtained by you from siemens or through or from the system shall create any warranty not expressly stated herein.

Warranty

Siemens Energy warrants this product for a period of twelve (12) months from the date of purchase, conditional upon the return to factory for maintenance during the warranty term. This product contains no user-serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void. The warranties set forth in this article are exclusive and are in lieu of all other warranties, performance guarantees and conditions whether written or oral, statutory, express or implied (including all warranties and conditions of merchantability and fitness for a particular purpose, and all warranties and conditions arising from course of dealing or usage or trade). Correction of nonconformities in the manner and for the period of time provided above shall constitute the Seller's sole liability and the Customer's exclusive remedy for defective or nonconforming goods or services whether claims of the Customer are based in contract (including fundamental breach), in tort (including negligence and strict liability) or otherwise.

Copyright

Copyright © Siemens Energy 2022. All rights reserved.

The disclosure, duplication, distribution and editing of this document, or utilization and communication of the content are not permitted, unless authorized in writing. All rights, including rights created by patent grant or registration of a utility model or a design, are reserved.

Registered Trademarks

SITRAM®, Assetguard®, Assetguard® GDM, PDM, CBM and ISCM are registered trademarks of Siemens Energy. Any unauthorized use is illegal. All other designations in this document can be trademarks whose use by third parties for their own purposes can infringe the rights of the owner.

Document Revision History

Current Version	Revision ID	Changes
☒	2.2	Removal of particular moisture sensor wiring and replacement with general instruction
☐	2.1	SE Branding, minor adjustments
☐	2.0	Template has been updated.
☐	1.6	Added an example for best practice for wiring and added reporting procedure.
☐	1.5	Added Moisture sensor and Analog input recommended connections.
☐	1.4	Added further liability items, Modbus Sequences.
☐	1.3	Added further instructions on mechanical and electrical installation details.
☐	1.2	Added further instructions on mechanical and electrical installation details.
☐	1.1	Added chapters related to Installation section (Drawings, Accessories, etc.).
☐	1.0	First official documentation status.
☐	0.5	Preliminary documentation status for the 1st production series.

© 2022 Siemens Energy

Preface

Purpose

This manual is part of a documentation package for the Siemens Energy SITRAM® H2Guard
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.**
Bold = Does apply for this document / Not Bold = Does not apply for this document		

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..**
In Bold = Does apply for this document / Not in Bold = Does not apply for this document		

© 2022 Siemens Energy

Scope

This manual applies to SITRAM® H2Guard Model 4800-EE01.

Indication of Conformity

The SITRAM® H2Guard Model 4800-EE01 product complies with the directive of the Council of the European Communities on harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2014/108/EC) and concerning electrical equipment for use within specified voltage limits (Low Voltage directive 2006/95/EC).

This conformity has been proved by tests performed according to the Council Directive in accordance with the product standard IEC 61326-1 : 2013 (for EMC directive), with the product standard EN 55011:1 2013 (for radio disturbance requirements) and with the product standard IEC 61010-1:2010 (for Product Safety) by Siemens Energy.

The device is designed and manufactured for application in an industrial environment.

Additional Support

For questions about the system, please contact your Siemens Energy sales partner.

Support

Our Customer Support Center provides a 24-hour service.

Phone: +49 911 6505-6505
(Charges depending on provider)

E-Mail:
support@siemens-energy.com

© 2022 Siemens Energy

Table of Contents

PREFACE 4
Purpose 4
Audience 4
Scope 5
Additional Support 5
Support 5

LEGAL PROVISIONS 9
Warning Notice Concept 9
Qualified personnel 9
Proper Use 10
System Requirements 10
License Conditions 10

1. INTRODUCTION 12
1.1 Feature Highlights 13
1.2 Application Scopes 15
1.2.1 Integration using Discrete and Analogue Interfaces 15
1.2.2 Integration using the Serial Interface 16
1.2.3 Ethernet Based Integration 16
1.3 Technical Specification 18
1.3.1 Power Supply Specifications 18
1.3.2 Environment and Mechanical Specifications 18
1.4 Required Tools and Materials 20
1.5 Decommissioning and Disposal 21

2. GETTING STARTED 22
2.1 Unpacking the Device 23
2.1.1 Incoming Inspection 23
2.2 Electrical Inspection 25

3. MECHANICAL INSTALLATION 27
3.1 Device Tube Fitting Instructions 29
3.1.1 Preconditions 29
3.1.2 Installation Steps 29
3.1.3 Disassembly / Reassembly Steps 31

4. ELECTRICAL INSTALLATION 34
4.1 Electrical Connections 37
4.2 Communication Interfaces 39
4.2.1 Mini-USB Port 39
4.2.2 RJ-45 Ethernet Port 39

© 2022 Siemens Energy

4.2.3 RS-232 Serial Ports 39
4.2.4 RS-485 Serial Port 40
4.3 Analog Inputs 43
4.4 Analog Outputs 45
4.5 Relay Contacts 46
4.6 Power Supply Connection 48

5. SETTING THE DEVICE UP 50
5.1 Establishing communication to the Device 53

5.1.1 Foxterm Terminal Emulator 53
5.1.2 Getting access to CLI 54
5.2 Configure Communication Settings 61

5.2.1 Serial Communication 61
5.2.2 TCP Interface Communication 61
5.2.3 Modbus Protocol Settings 62
5.3 Configure Device Settings 65

5.3.1 Time Settings 65
5.3.2 User and Device Information 65
5.3.3 Data Stream View Settings 66
5.3.4 Data Log Settings 67
5.4 Configure Analog Inputs 68
5.5 Configure internal FAULT status 70
5.6 Configure Frontal Display 74

6. HYDROGEN MEASUREMENT CONFIGURATION 75
6.1 Hydrogen Settings 76

6.1.1 Defining Oil Type 76
6.1.2 ALERT and ALARM Triggering Conditions 77
6.2 Submitting the Settings 79
6.3 Hydrogen Calibration based on DGA Results 80

7. GETTING DATA FROM THE DEVICE 81
7.1 Using Analog / Relay outputs 82

7.1.1 Reading the Analog Outputs 82
7.1.2 Reading the Relay Outputs 82
7.1.3 Testing the Integration (MTIO Command) 86
7.2 Using the CLI 87

7.2.1 Resume Streaming Data (G Command) 87
7.2.2 Display Data Log (LD Command) 88
7.3 Using the Modbus Protocol 90

7.3.1 Device and Measurement Status Registers 90
7.3.2 Hydrogen Measurement Parameters 93
7.3.3 User Information Registers 95
7.3.4 Device and Time Information Registers 95

© 2022 Siemens Energy

8. FIRMWARE UPDATES 97
8.1 Using CLI over USB serial 99
8.1.1 H2Guard Firmware Update Procedure 99
8.1.2 Display Board Firmware Update Procedure 102
9. CERTIFICATIONS 104
9.1 Approvals 105
9.1.1 European Union (EU) 105
9.1.2 FCC 105
9.2 EMC and Environmental Type Tests 106
9.2.1 Electromagnetic Type Tests 106
9.2.2 Environmental Type Tests 107
9.3 Maintenance 108
10. TROUBLESHOOTING 109
10.1 Device Measurements 110
10.2 Time Synchronization 111
11. APPENDIX 112
11.1 Assembly Types 113
11.1.1 DN80 Flange Arrangement - Recommended 113
11.1.2 ½" NTP Type with isolation valve 114
11.1.3 T-Shaped Fitting Arrangements 114
11.2 Recommended Cable 116
11.3 Recommended External Moisture Sensor 117
11.3.1 LDH100 - External Moisture Sensor 119
11.4 Overview User Commands 121
11.5 Modbus Protocol 123
11.5.1 Protocol Description 123
11.5.2 Writing Modbus Registers 126
CUSTOMER FEEDBACK FORMULAR 127

© 2022 Siemens Energy

Legal Provisions

Warning Notice Concept

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER

Indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING

Indicates that death or severe personal injury may result if proper precautions are not taken.

CAUTION

Indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

Without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by qualified personnel. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

© 2022 Siemens Energy

Proper Use

The equipment (device, module) may be used only for such applications as set out in the catalogues and the technical description, and only in combination with third-party equipment recommended and approved by Siemens Energy.

Problem-free and safe operation of the product depends on the following:

Proper transport.

Proper storage, setup and installation.

Proper operation and maintenance.

When electrical equipment is operated, hazardous voltages are inevitably present in certain parts. If proper action is not taken, death, severe injury or property damage can result:

The equipment must be grounded to earth at the grounding terminal before any connections are made.

All circuit components connected to the power supply may be subject to dangerous voltages.

Hazardous voltages may be present in equipment even after the supply voltage has been disconnected (capacitors can still be charged).

Operation of equipment with exposed current-transformer circuits is prohibited. Before disconnecting the equipment, ensure that the current-transformer circuits are short-circuited.

The limiting values stated in the document must not be exceeded. This must also be considered during testing and commissioning.

WARNING
Using the described devices and system components in a way that is not foreseen by the supplier the provided safety of the devices and systems may be compromised.

System Requirements

Each workstation i.e. computer used to connect to the SITRAM® H2Guard has to meet the following system requirements (recommended but not limited):

The ability to configure an IP address and netmask on the computer's Ethernet interface.

Processor: Core i5

Ram/NVRAM: 8GB

Operating system: Windows 10 64-bit Installation

Windows account with administrative access rights

License Conditions

© 2022 Siemens Energy

The Firmware (hereinafter referred to as "FW") may be licensed software, i.e. software which has not been developed by us itself, but which has been licensed to us by a third party (hereinafter referred to as the "Licensor"). In the event that the Licensee is then forwarded the terms and conditions stipulated by the relevant Licensor together with the FW, such terms and conditions shall apply with respect to the Licensor's liability vis-à-vis the Licensee. Our own liability vis-à-vis the Licensee shall be governed by these General License Conditions.

© 2022 Siemens Energy

1. Introduction

The Siemens Energy SITRAM® H2Guard Hydrogen Monitor is a device designed to detect and/or measure hydrogen as a component of transformer oil.

The hydrogen specific solid-state sensing element is designed for ease of use and interface flexibility. Based on 4th generation electronics, the H2Guard contains all the circuitry necessary to operate the device and present calibrated hydrogen readings to a variety of analog and digital outputs.

The measured hydrogen is reported as ppmH2 dissolved in oil and is comparable to industry standard DGA measurements. Oil temperature at the sensing element is measured and available through the digital interfaces.

For ordering purposes, the Siemens Energy SITRAM® H2Guard Hydrogen Monitor is Model 4800-EE01.

© 2022 Siemens Energy

1.1 Feature Highlights

Device Technology Details

SITRAM® H2Guard hydrogen measurement is based on a solid-state palladium alloy device, considering:

Calibrated to measure hydrogen dissolved in transformer oil

Periodic reference cycles are automatically run to eliminate offsets affecting long term stability

Low maintenance, long life sensing element

⚠ WARNING
The sensing element may be damaged if exposed to hydrogen concentrations above 5,000 ppm.

Mechanical Details

The H2guard mechanical assembly is a combination of a device probe and a special design housing. Other features are:

¾" diameter stainless steel probe

Compression fitting provides optimal orientation during installation

Thick wall tube will not distort or bend and securely holds the H2Guard to the transformer o Leak proof seal from 0.1mbar to 3bar

-40°C to +70°C ambient operating temperature, according to Thermal Environment: DIN EN 60068-2-2

IP67 ingress protection according to Ingress Protection IEC 60529 (IP 67 Rating)

C5M marine corrosion ratings, based on Marine/Corrosive Testing (DIN EN 60068-2-11 and DIN EN ISO 12944)

High resistance to shock and vibration as needed on power transformers (Shock and Vibration: DIN EN 60068-2-6, DIN EN 60068-2-64 and DIN EN 60068-2-27)

Product nameplate located on the top of the enclosure will include a QR code leading to Siemens Energy website

Serial and product number label located on the bottom of the enclosure also includes power rating and CE mark

Chevron label near cable gland

Electrical Details

Removable safety barrier in electrical wiring chamber to prevent accidental exposure to high voltage wiring

Four holes into the electrical wiring chamber are provided with M25 x 1.5 threads

A ground wire is provided to connect H2Guard chassis to the AC power ground. In a typical installation the H2Guard chassis is connected to earth ground at the transformer case through the device probe and metal compression fitting.

© 2022 Siemens Energy

110 to 240 VAC, 50-60Hz, 500mA max.

Four (4) communication ports (RS-232, RS-485, USB, and Ethernet)

Four (4) form C relays with NO, NC, and Com terminals are available for use

Three (3) software configurable analogue outputs (current or voltage) are available for use

Two (2) analogue inputs (current or voltage) are available for use

Three (3) discrete LEDs (Red, Yellow, Green)

OLED monochrome graphics display

SD card slot

Field upgradable firmware

Real Time Clock with battery backup

Data logging to internal / external memory (flash / SD card) is available through the CLI,

Command Line Interface supported on USB (default), RS-232, or RS-485.

Modbus protocol supported on Ethernet (default), RS-485, or RS-232.

© 2022 Siemens Energy

1.2 Application Scopes

Depending on the project requirements, the SITRAM® H2Guard can be integrated to other external systems using either discrete and analogue interfaces or employing more elaborated communication protocols like Modbus TCP (Ethernet based) or RTU (Serial based).

Additionally, in some cases and based on project requirements, external sensors that measure the moisture content in the oil can be acquired using the analogue inputs. This acquired data can be forwarded by means of the analog outputs or Modbus registers. If desired, the value of the analogue inputs' values can be configured as triggering conditions of the relay outputs.

1.2.1 Integration using Discrete and Analogue Interfaces

This type of integration is the most basic one, using only the discrete signals (i.e. Relay outputs) and the analogue outputs. Since these type signals are protocol-independent, it is required that the upper level system e.g. SCADA infrastructure, can receive discrete and analogue signals by means of PLC´s or RTU´s.

As displayed in Figure 1, in addition to the power cabling, the SITRAM® H2Guard will require the respective wire for the relay outputs and analogue outputs. If an external sensor for moisture is available, then the respective cabling will be required for its wiring.

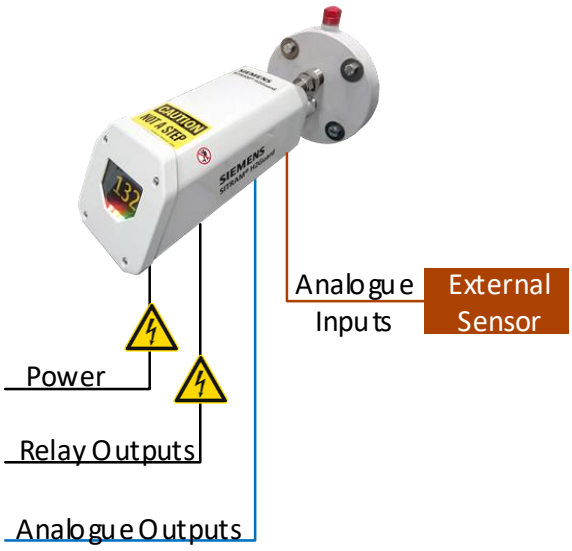


Figure 1.Integration Case – Using discrete signals (Relay Outputs) and analog Outputs.

© 2022 Siemens Energy

1.2.2 Integration using the Serial Interface

The USB and RS-232 connections allow a communication with the full range of any information transmission which is possible by the system for provision including the states of alarms, warnings, any device status, I/O readings and configuration.

The RS-485 is thought to be used for Modbus as standard field bus protocol communication only and gives a possibility of longer wiring.

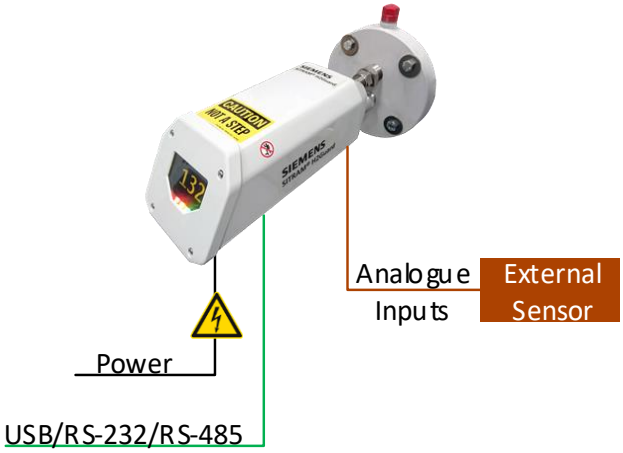


Figure 2.Integration Case – Using the Serial Interface

While the discrete and analogue signals are not displayed on the Figure 2, those signals can be still integrated in parallel to the Serial interface.

1.2.3 Ethernet Based Integration

This connection allows a communication with the full range of any information transmission which is possible by the system for provision including the states of alarms, warnings, any device status, I/O readings, configuration, via proprietary and standard field protocols at same time.

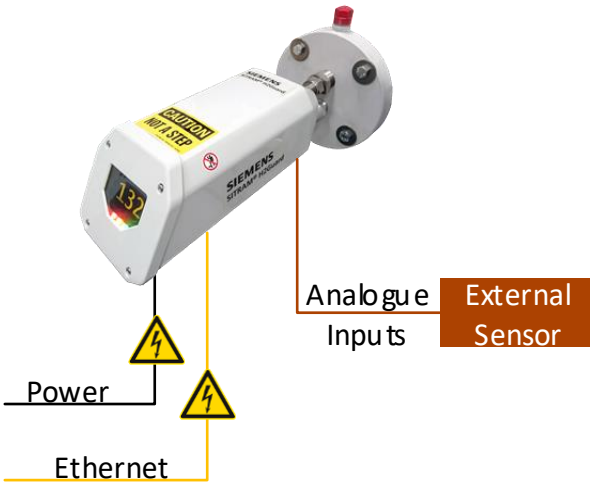


Figure 3.Integration Case – Using the Ethernet Interface.

© 2022 Siemens Energy

While the discrete and analogue signals are not displayed on the Figure 3, those signals can be still integrated in parallel to the Ethernet Interface.

© 2022 Siemens Energy

1.3 Technical Specification

This section provides important technical specifications related to the device and available modules

1.3.1 Power Supply Specifications

Voltage Range: 100-240V AC
Frequency range: 50-60 Hz
Current Rating: 500mA Max.

⚠ WARNING -TBW
Do not exceed the voltage ratings to avoid damage on the device. Recommended Miniature Circuit Breaker: From 10A Characteristic C.

1.3.2 Environment and Mechanical Specifications

Operating Conditions

Minimum: -40°C
Maximum: 70°C
Relative Humidity: Tested According to IEC 60068-2-30: 93% at 55°C

Mechanical Specifications

Weight: 6 kg (approx. 13.2 lbs)
Degree of Protection: IP67
C5M marine corrosion ratings

© 2022 Siemens Energy

Dimensions

The main dimensions of the H2Guard are displayed in Figure 4. All the measures are display in inches [in].

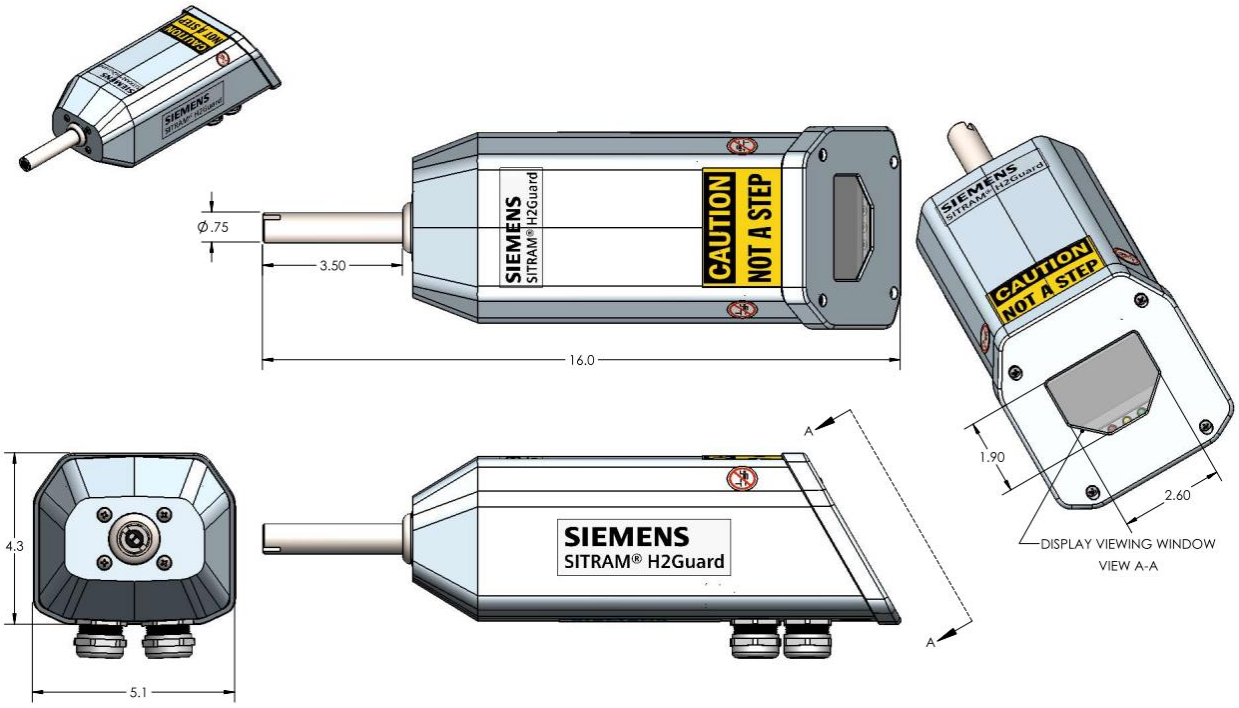


Figure 4. SITRAM® H2Guard Dimensions

© 2022 Siemens Energy

1.4 Required Tools and Materials

The following tools and materials are required to install the Device:

Tools/Materials	Purpose
Adjustable Pliers or Wrench	
Wire stripper	
Wire cutter	
Bucket and rags	
The thread seal tape, also known as Teflon tape or PTFE tape (Polytetrafluoroethylene)	
Henkel products LOCTITE® 7471 (activate) and LOCTITE® 577 (seal and fix) in combination	
Multimeter	
Crimping tool	
Crimp terminals	
Swagelok Gap Inspection Gauge	
Optional: RS485 Adaptor	
Ethernet cable	
USB to mini USB adaptor cable	
Adjustable Pliers or Wrench	
Wire stripper	
Wire cutter	

Table 1. Required Tools and materials.

© 2022 Siemens Energy

1.5 Decommissioning and Disposal

Proper decommissioning and disposal of this device is important to prevent malicious users from obtaining proprietary information and to protect the environment

Decommissioning

This device may include sensitive, proprietary data. Before taking the device out of service, either permanently or for maintenance by a third-party, make sure it has been fully decommissioned.

For more information, regarding deleting data refer to the associated Section 5.3.4, “Data Log Settings”.

Recycling and Disposal

For environmentally friendly recycling and disposal of this device and related accessories, contact a facility certified to dispose of waste electrical and electronic equipment. Recycling and disposal must be done in accordance with local regulations.

© 2022 Siemens Energy

2. Getting Started

In order to get the most of the SITRAM® H2Guard functionality, it is recommended that the following steps are followed. Missing or avoiding one of the steps could lead to undesired device performance.

General Procedure

The general procedure for installing the device is as follows:

NOTICE
The user is responsible for the operating environment of the device, including maintaining the integrity of all protective conductor connections and checking equipment ratings. Make sure to review all operating and installation instructions before commissioning or performing maintenance on the device.

1. Review the relevant certification information for any regulatory requirements. For more information, refer to Chapter 9, “Certifications”.
2. Unpack and inspect the device. For more information, refer to Section 2.1,” Unpacking the Device”.
3. Inspect the Device after being unpacked. For more information, refer to Section 2.1.1, “Incoming Inspection”.
4. Carry out an electrical inspection. Refer to Section 2.2, “Electrical Inspection”.
5. Mount the device, according to the recommendations given in the Chapter 3.1, “Device Tube Fitting Instructions”. If an external sensor needs to be connected to the H2Guard, please follow the indications given in 11.3, “External Moisture Sensor”.
6. Depending on the customer project constraints, connect the respective physical device interfaces (Contact Relays, Analog Outputs, Serial Port (RS232, RS485)). For more information, refer to the chapter 4, “Electrical Installation”.
7. Connect power to the device and ground the device to safety Earth. For more information, refer to Section 4.6, “Power Supply Connection”.
8. Depending on the physical connection interface, configure the respective device Settings according to the 5,”Setting the Device up”. (Testing See Chapter 5, ”Setting the Device up”)
9. Based on the customer requirements, configure the measurement settings. See Chapter 6,”Hydrogen Measurement Configuration” for more information.
10. Finally, get the measured data using the available interfaces. See Chapter 7,”Getting Data from the Device” for more information.

© 2022 Siemens Energy

2.1 Unpacking the Device

Unpacking

Check the packing for external transport damage. Damaged packing may indicate that the devices inside have also sustained damage.

Unpack devices carefully; do not use force.

Visually check the devices to ensure they are in perfect mechanical condition.

Check the enclosed accessories against the delivery note to make sure everything is complete.

Keep the packing in case the devices must be stored or transported elsewhere.

Return damaged devices to the manufacturer, stating the defect. Use the original packaging or transport packaging that meets the requirements of standard ISO 2248.

NOTICE
Devices are tested prior to delivery. The test document is part of the delivery.

Repacking

If you store devices after incoming inspection, they must be packed in appropriate storage packaging.

If devices are to be transported, pack them in transport packing.

Put the accessories supplied and the test certificate in the packing with the device.

Storing a Device

Only store devices on which you have carried out an incoming inspection, thus ensuring that the warranty remains valid. The incoming inspection is described in the Operating manual.

Devices must be stored in rooms, which are clean and dry. Devices or associated replacement modules must be stored at a temperature of -40 °C to +70 °C.

The relative humidity must be at a level where condensate and ice are prevented from forming.

Siemens Energy recommends that you observe a restricted storage temperature range of +10°C to +35°C, in order to prevent the electrolytic capacitors used in the power supply from aging prematurely.

If the device has been in storage for more than 2 years, connect it to an auxiliary voltage for 1 to 2 days. This will cause the electrolytic capacitors to form on the printed circuit-board assemblies again.

If devices are to be shipped elsewhere, you can reuse the transport packaging. When using different packaging, you must ensure that the transport requirements according to ISO 2248 are met. Storage packing of the individual devices is not adequate for transport purposes.

2.1.1 Incoming Inspection

Siemens Energy recommends that you check devices which are not assembled.

© 2022 Siemens Energy

Safety Notes

DANGER

Danger during incoming inspection. **Noncompliance with the safety notes, can result in death, severe injury or considerable material damage.**

Comply with all given safety notes when carrying out the incoming inspection.

Please note that hazardous voltages are present when you perform the incoming inspection.

If you identify a defect during the incoming inspection, do not rectify it yourself. Repack the device and return it to the manufacturer, stating the defect. Use the original packaging or transport packaging that meets the requirements of standard ISO 2248.

Performing a Follow-up Inspection on a Device

Visually check for external damage as soon as you have unpacked the devices; they must not show any signs of dents or cracks.

Checking the Rated Data and Functions

Check the rated data and functions using the complete order designation/the product code. The device manual contains all technical data and a description of the functions.

Check the information provided on the rating plate too. The device features a product label sticker, which contains the Technical data.

Make sure that the rated data of the device properly matches the power-system data. You can find the necessary information in the device manual.

© 2022 Siemens Energy

2.2 Electrical Inspection

Device Protection

DANGER

Danger when connecting the device. **Noncompliance with the safety notes, will result in death, severe injury or considerable material damage.**

The device must be situated in the operating area for at least 2 hours before you connect it to the power supply for the first time. This prevents condensate from forming in the device.

If the device has been in storage for more than 2 years, connect it to an auxiliary voltage for 1 to 2 days. This will cause the electrolytic capacitors on the printed circuit-board assemblies to form again.

Perform the electrical inspection

Grounding

On the device chassis, there is a brass screw. A connection between this point and the substation's ground must be made prior to powering on the unit.

Connecting a Device

Connect all cables and lines. Use the connection diagrams in the Hardware and Device manuals.

Tighten the terminal screws to the prescribed torques.

Safety Notes

DANGER

Danger during electrical inspection. **Noncompliance with the safety notes, will result in death, severe injury or considerable material damage**.

Comply with all given safety notes when carrying out the electrical inspection.

Please note that hazardous voltages are present when you perform the electrical inspection.

During the electrical inspection, check that the device becomes ready for operation once it has been connected to the power supply.

Performing the Electrical Inspection

Connect the power supply. Please follow the steps described in Section 4.6,"Power Supply Connection"

Activate the power supply

© 2022 Siemens Energy

On powering the device, the Device Display should start, and the Orange LED should be turned on.

Wait at least 15 minutes, until the Green LED is turned on.

Leave the device running for at least 24 hours to get a stable measurement.

Check that the Green LED is still turned on.

Evaluate that the Relay outputs should are not triggered and that he Hydrogen Measurement in the display is 0 ppm.

All analogue outputs should be 4mA (corresponding Hydrogen value for a 0-ppm concentration).

If the device does not assume the normal operating state, switch off the device. Disconnect the wiring and the grounding.

Pack this device and return it to the manufacturer, stating the defect. Use transport packaging that meets the requirements of standard ISO 2248.

© 2022 Siemens Energy

3. Mechanical Installation

Mounting is achieved by securing the device tube to the transformer with a tube adapter or flange arrangement that mates with a fitting on the transformer. The mounting location for oil units should be at a location that has a low level of oil circulation (convection or pump).

Location in the Transformer

To ensure the correct function of a SITRAM® H2Guard unit the installation position is very important. On a typical transformer three positions are possible:

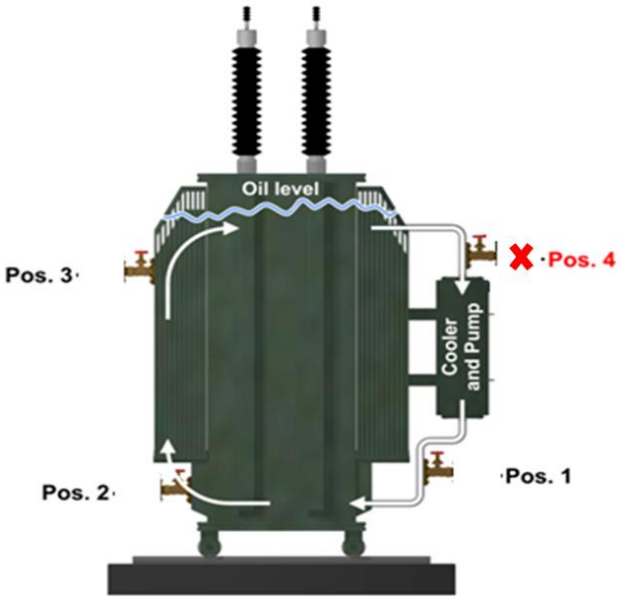


Figure 5. Recommended Installation of the Device on the Transformer.

Pos. 1 Output side of cooling unit:

Please install the unit on a straight piece of pipe on the cooler output between the cooler and the main oil tank. Please avoid placing tip of SITRAM® H2Guard in direct flow of oil and mount the unit on the output of the oil circulation pump.

Note: Choose this position only if a continuous oil flux through the cooler is guaranteed

Pos. 2 Draining valve on the transformer tank.

Pos. 3 Upper filling valve:

It is possible to mount SITRAM® H2Guard unit on this position, if the filling level of the oil is min. 100 cm higher than the centre of the connection thread.

Pos. 4 Input side of cooling unit:

This position is not recommended.

CAUTION
At the installation position a good and continuous oil circulation must be present.

© 2022 Siemens Energy

Flange Arrangement

Standard and individual flange solutions like the one displayed in Figure 6, generally are available or can be projected by Siemens Energy tailored to the according needs.

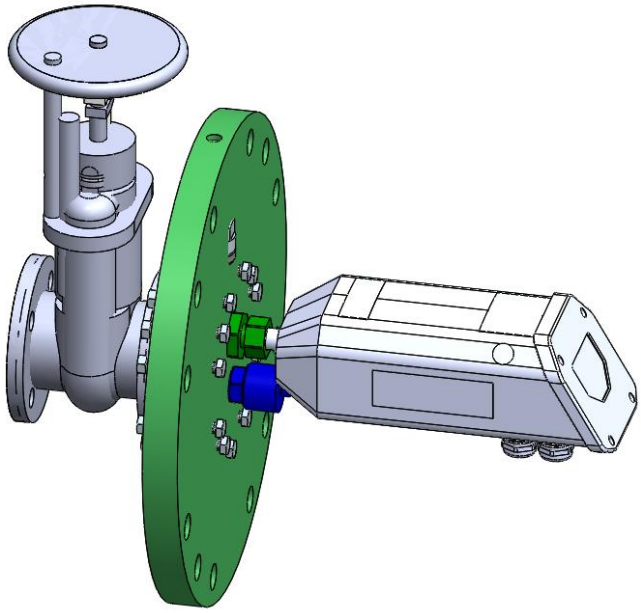


Figure 6. H2Guard Flange Arrangement (green) with external Moisture Sensor (highlighted in Blue) - All units are displayed in millimeters [mm].

For more information about the different type of flange arrangements please refer to Chapter 11.1, “Assembly Types”.

© 2022 Siemens Energy

3.1 Device Tube Fitting Instructions

A benefit of using following tube fitting types / Flange arrangements is their ability to be disassembled and reassembled many times while retaining the leak-tight seal. Especially ferrules made of Teflon (right picture in Figure 7) can provide this flexibility in a good way.

3.1.1 Preconditions

1. A ¾" bored through compression fitting (tube adapter) with stainless steel or Teflon ferrules is needed to attach the device probe to the transformer.

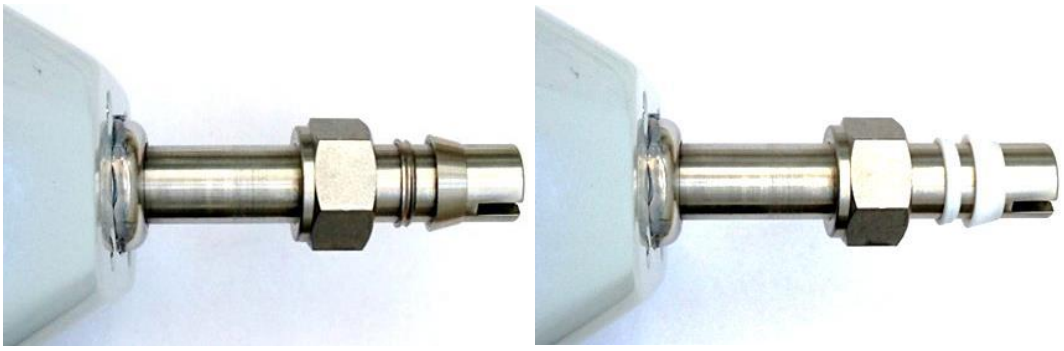


Figure 7. On the left side without Ferrules / On the right side with Teflon Ferrule

⚠ WARNING
Check always the condition of the Ferrule. In case of Teflon Ferrules, it is recommended to replace old Teflon Ferrules when the H2guard has been unmounted.

2. Insert the tube completely into the fitting.
3. Verify that less than 1" (2.54cm) of device tube is exposed before tightening the tube adapter.

NOTICE
The device tube must be immersed in at least ½" (1.27 cm) of oil.

4. The tube adapter must be bored-through, so the device tube slides far enough into the fittings.
5. The device tube should always be inserted as far as possible into the fitting.
6. When installing the device in oil it is important that any trapped air pockets are removed from the end of the device tube. Typically, this is accomplished by bleeding the air and some oil through a valve or fitting located such that the oil flow helps the air pocket to escape.

3.1.2 Installation Steps

These instructions apply to both traditional fittings and to fittings with the advanced back-ferrule geometry:

© 2022 Siemens Energy

1. Fully insert the tube into the fitting and against the shoulder; rotate the nut finger tight. See Figure 8.

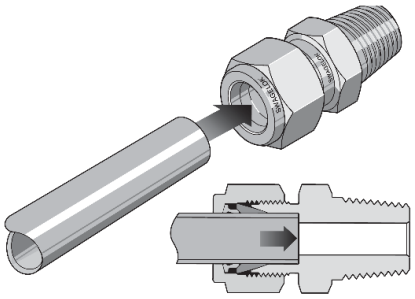


Figure 8. Installation Step 1

NOTICE
High-Pressure Applications and High Safety-Factor Systems: Further tighten the nut until the tube will not turn by hand or move axially in the fitting.

2. Mark the nut at the 6 o'clock position (see Figure 9). Marking the nut at six o'clock leaves no doubt as to the starting and ending positions.

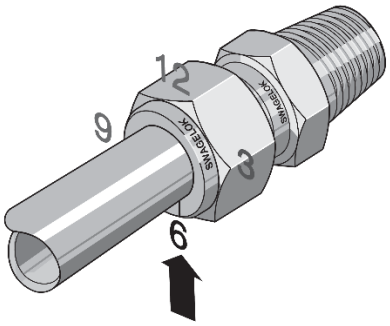


Figure 9. Installation Step 2.

3. While holding the fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position. Note: For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut three-quarters turn to the 3 o'clock position.

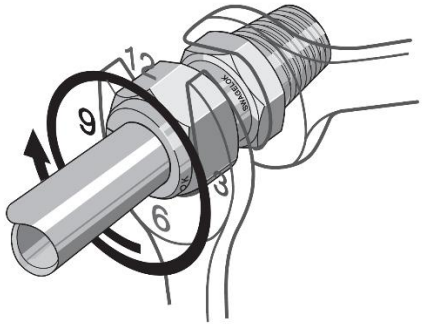


Figure 10. Installation Step 3.

© 2022 Siemens Energy

NOTICE

The following steps were taken directly from “SWAGELOK” fitting instructions. To get the latest version of the instructions, please refer to *www.swagelok.com* for more information.

Gaugeability

Gap-inspection gauge makes it easy to check whether you have tightened the fitting enough on initial installation:

1. Position the Swagelok gap inspection gauge next to the gap between the nut and the body.
2. Check that the Inspection gauge will not enter the gap (see Figure 11). If the inspection gauge will enter the gap, additional tightening is required.

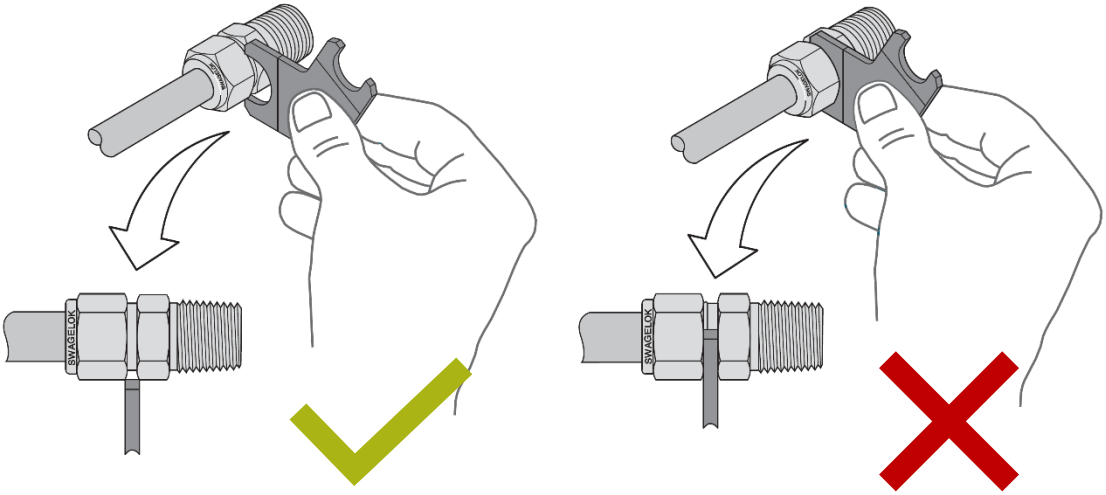


Figure 11. Inspection Gap.

Installation Check List

After installing the device please ensure that:

1. Open the Oil Valve.
2. Remove air pockets around sensing element.
3. Look for leaks.
4. Make a report of the current installation by making videos or pictures of the installation.

3.1.3 Disassembly / Reassembly Steps

Disassemble

WARNING

Always depressurize the system before disassembling a Swagelok tube fitting.

© 2022 Siemens Energy

1. Prior to disassembly, mark the tube at the back of the nut; mark a line along the nut and fitting body flats. Use these marks to ensure you return the nut to the previously pulled-up position.

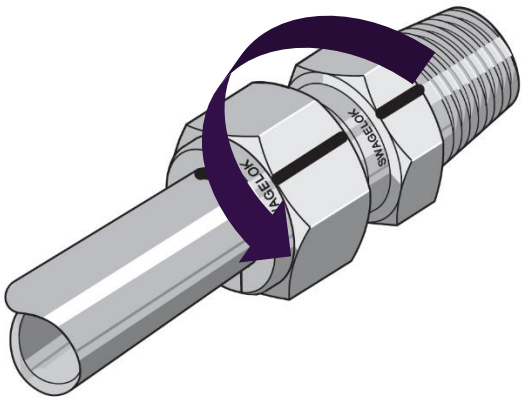


Figure 12. Marks over the tube.

Reassemble

1. Insert the tube with preswaged ferrules into the fitting body until the front ferrule seats against the fitting body. (see Figure 13).

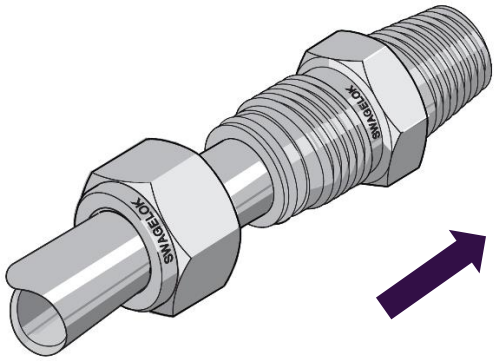


Figure 13. Inserting Tube on the fitting body.

5. While holding the fitting body steady, rotate the nut with a wrench to the previously pulled-up position as indicated by the marks on the tube and the flats; at this point you will feel a significant increase in resistance. See Figure 14.

© 2022 Siemens Energy

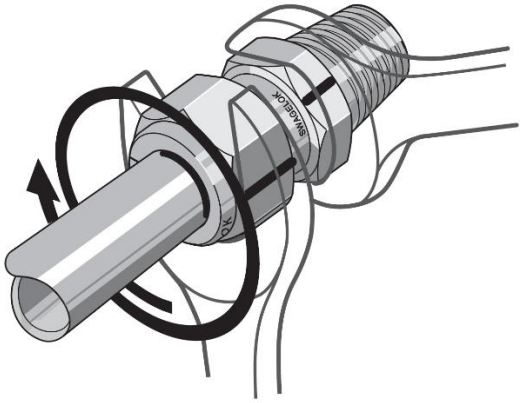


Figure 14. Tighting the nut.

6. Tighten the nut slightly.

CAUTION
Do not use the gap inspection gauge with reassembled fittings.

CAUTION
Do not mix or interchange parts with those of other manufacturers.

© 2022 Siemens Energy

4. Electrical Installation

In order to get access to the electrical connections available in the SITRAM® H2Guard it is necessary to open the frontal Lid. As displayed in Figure 15, four (4) screws (red circles) need to be removed.

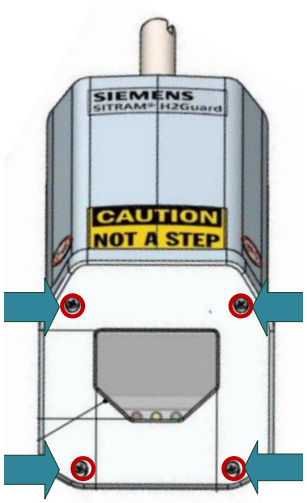


Figure 15. Four (4) screws are holding the frontal Lid to the Chassis.

Once the screws are removed, all the electrical connections are going to be accessible as seen in Figure 16.

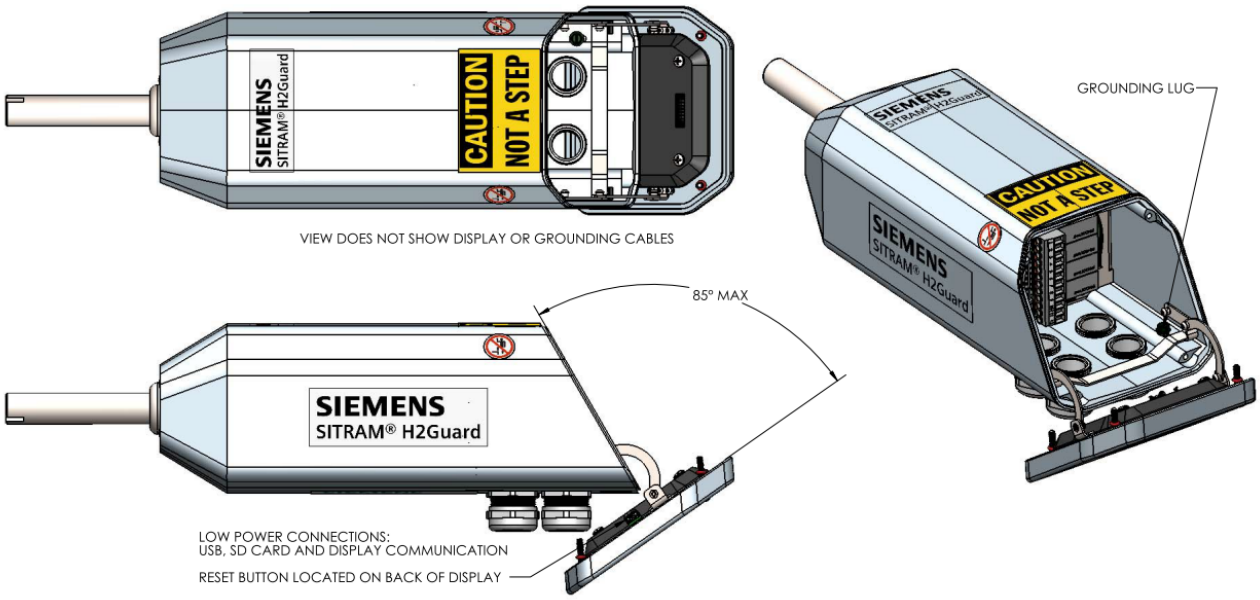


Figure 16. Opened Lid View

© 2022 Siemens Energy

Cabling Recommendations

The SITRAM® H2Guard will be pre-mounted with four (4) cable glands as displayed in Figure 18. The size of the glands is displayed in Figure 17 and described in Table 2.

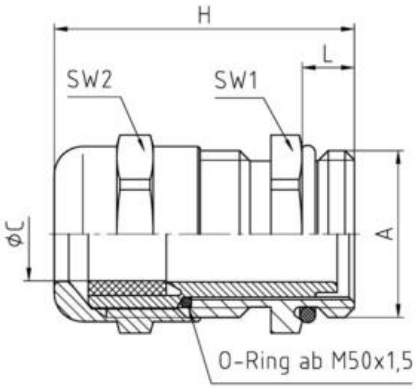


Figure 17. Pre-mounted cable glands.

A	øC [mm]	L [mm]	SW1 [mm]	SW2 [mm]	H [mm]
M25x1,5	11-16	7	27	27	36.5

Table 2. Pre-mounted glands size.

It is recommended that those cables are covered by a flexible conduit i.e. “Anaconda Sealtite®”. The required size should be ½ [in].

© 2022 Siemens Energy

Cabling Arrangement example

In order to use the space wisely inside the Device, it is recommended that the electrical connections are wired trough the cable glad's as follow (please refer to Figure 18) :

Glad 1: Conventional CAT5 Ethernet Cable, RS232/RS2485 Serial Cable.

Glad 2: Wiring of analogue Inputs

Glad 3: Wiring of System´s power and analogue outputs

Glad 4: Wiring of relay Contacts.

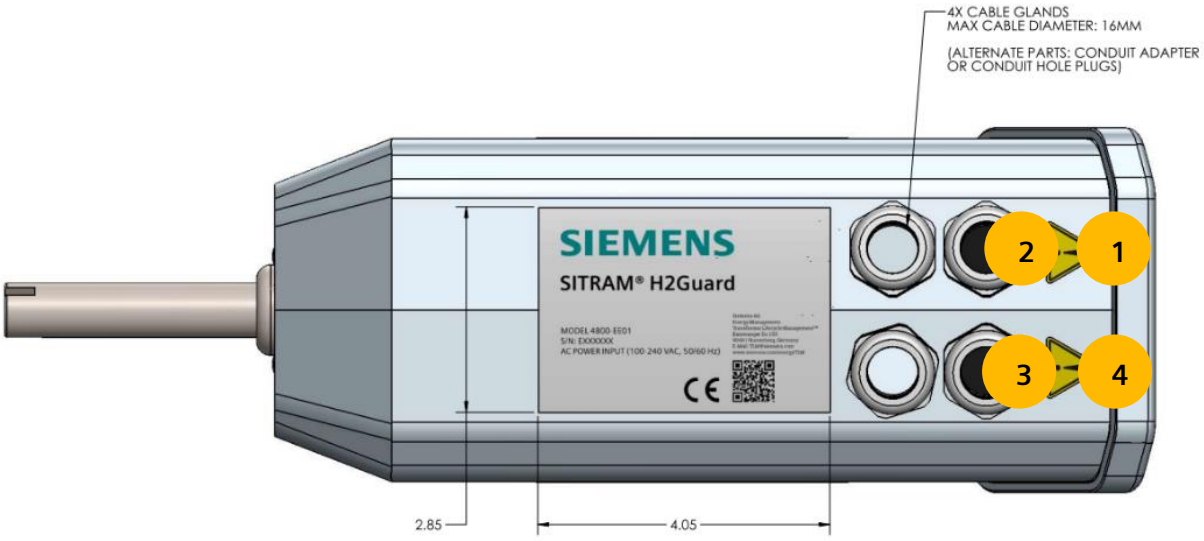


Figure 18. Cable Glands recommended Cabling arrangements.

© 2022 Siemens Energy

4.1 Electrical Connections

All the available electrical connections are displayed in Figure 19.

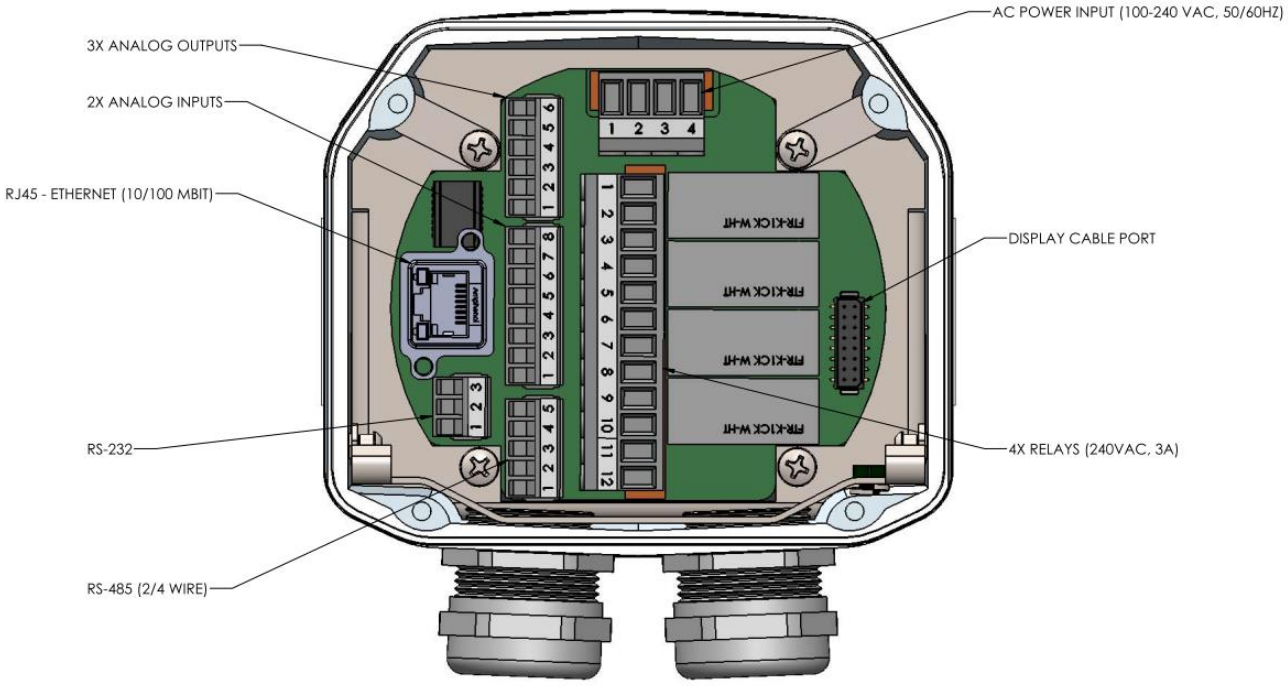


Figure 19. Connections View (Lid removed for View)

Display Cable Port

A custom cable provides electrical connection to the display module mounted in the end-cap assembly.

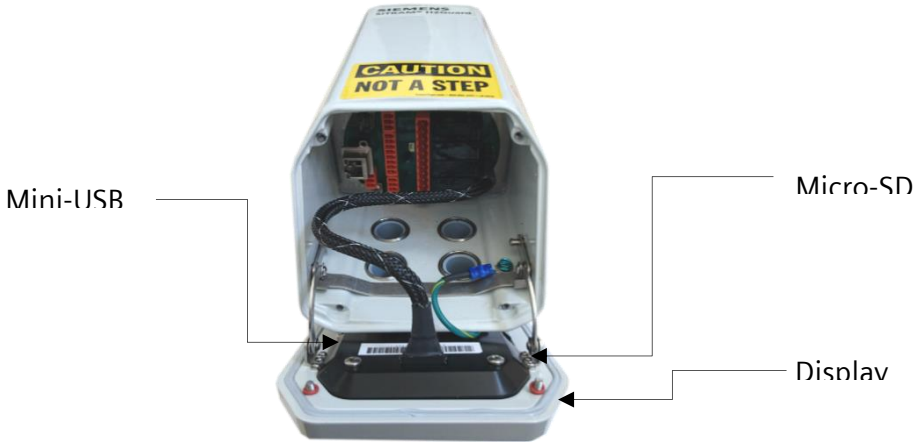


Figure 20. H2Guard with the Lid Open

CAUTION
Not proper wiring can cause damages to display cable. By opening the SITRAM® H2Guard enclosure make sure that display cable is secure. By closing the SITRAM® H2Guard make sure that display cable is under no mechanical pressure through other cables.

© 2022 Siemens Energy

Micro-SD Card

A micro-SD card slot is provided on the display board (see card slot location in Figure 20) for addition data storage and product maintenance. A Secure Digital High Capacity (SDHC) memory card with maximum storage capacity of 32GB is supported. For reliable operation, the SDHC card must also be rated for industrial use which supports an extended temperature (-40C to 85C).

NOTICE
Insert the SD Card only when the power supply is off.

NOTICE
Normal consumer grade cards are not recommended for long term use with the H2Guard.

NOTICE
Using the default configuration for data logging, the SD Card would be full in approximately 15 years. Still, the SITRAM® H2Guard will delete the old data based on the FIFO principle (First In, First out).

© 2022 Siemens Energy

4.2 Communication Interfaces

In order to communicate with the SITRAM® H2Guard, the device offer different type of interfaces. Still, by default, configuration routes the Command Line Interface (CLI) to the Mini-USB Port. For more information about stablishing communication to the SITRAM® H2Guard refer to the sections 5.1 "Establishing communication to the ".

4.2.1 Mini-USB Port

A mini-USB connection is provided on the display board for local serial communication. A device driver from FTDI is needed to communicate with the USB port.

Recommended Cable

It is recommended to use a Mini-USB cable with a very compact right-angled connector.

Driver Installation

Before connecting to the SITRAM® H2Guard, it is required that the proper driver is installed on the client side. Please follow the next steps:

1. Please visit http://www.ftdichip.com/FTDrivers.htm and get the latest version for the Driver D2XX.
7. In the same page from FTDI (link), please look for the Installation guide of the driver. Depending on the operating system, download the respective Installation guide.

4.2.2 RJ-45 Ethernet Port

An RJ-45 Ethernet port supports the Modbus and Telnet protocol. Default configuration enables this port for Modbus TCP operation on port 502 and uses DHCP to obtain IP address. Use the CLI commands to modify the Ethernet and Modbus settings.

Recommended Cable

The Device supports a 10/10Base -TX Ethernet port that allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cables with RJ45 male connectors. The RJ45 connectors are directly connected to the chassis ground on the device and can accept CAT-5 shielded twisted-pair (STP) cables.

4.2.3 RS-232 Serial Ports

J5 Pin Connection

The RS-232 communications port is intended for local serial communication.

J5, RS-232

Pin	Signal	Notes
1	TxD	Output data from this device
2	RxD	input data to this device
3	Ground	Isolated from other ground connections

Table 3. RS-232 Pin Connection.

© 2022 Siemens Energy

Recommended Cable

It is recommended to use a serial cable without connectors on one side of the cable, and a DB9 connector on the other side.

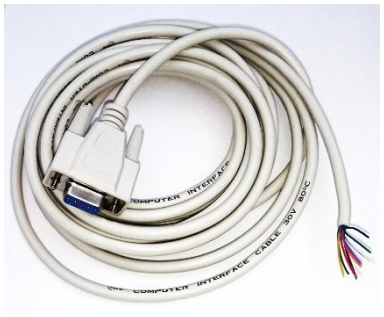


Figure 21. Recommended Cable for serial Communication

NOTICE
It is required that the computer on the client side has a DB9 port.

4.2.4 RS-485 Serial Port

The RS-485 communication port is intended for connection to remote equipment using the Modbus RTU protocol. For more information about the Modbus RTU Protocol Settings, please refer to the section 5.2.3,"Modbus Protocol Settings".

Depending on the Modbus Master, the SITRAM® H2Guard can be wired using 2-wire or a 4-wire connection.

J6 Pin Connection

The pin connection is available in Table 4.

J6, RS-485

Pin	Signal	Notes
1	TxD+	Output data from this device
2	TxD-	
3	RxD+	Input data to this device
4	RxD-	
5	Ground	Isolated from other ground connections

Table 4. RS-485 Pin Connection.

CAUTION
Ensure that the connection of the RS-485 is carried out as display in the next pictures. Not proper wiring can cause malfunction of the SITRAM® H2Guard, leading to interruption of the Modbus Communication.

© 2022 Siemens Energy

RS-485 2-Wire Connection

In case the required connection on the Modbus Master Side is a 2-Wire connection, please follow the connection diagram described in Figure 22.

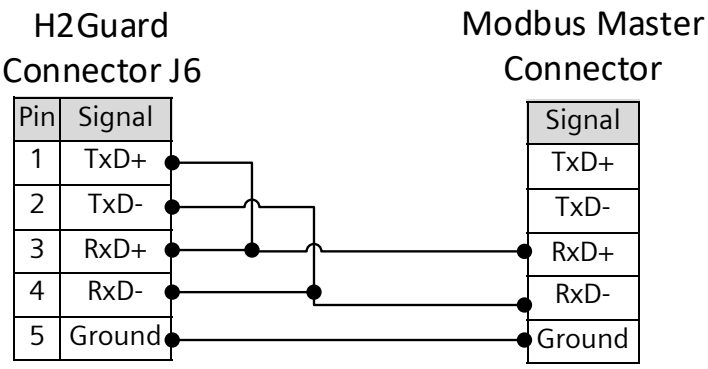


Figure 22. RS-485 2-Wire Connection

RS-485 4 Wire Connection

In case the required connection on the Modbus Master Side is 4-Wire connection, please follow the connection diagram described in Figure 25.

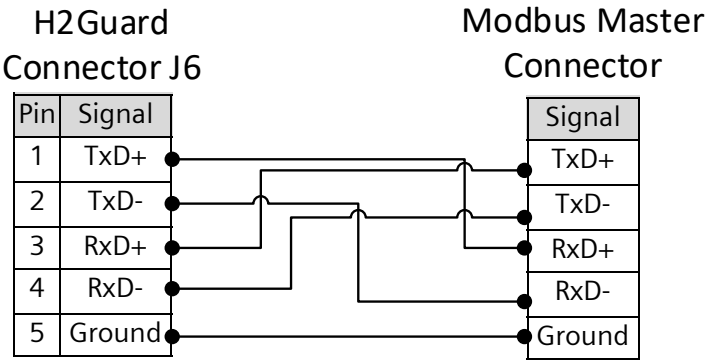


Figure 23. RS-485 2-Wire Connection

Recommended Cable Specification

It is recommended to use a cable with the following characteristics.

0.14 - 1.5mm2

AWG 26 – 16

shielded twisted pair

Impedance > 100Ω

© 2022 Siemens Energy

NOTICE

Please refer to section 11.2, “Recommended Cable”, for the recommended cable and the respective supplier.

© 2022 Siemens Energy

4.3 Analog Inputs

As displayed in Figure 19, Two (2) analog inputs are provided on J4, with an Input impedance of 75 Ohms. The analog inputs can be configured to read voltage values (0-5V) or current values (0-20mA). The default configuration has set both Analog Inputs for 0-20mA input.


WARNING

Turn off the power supply of the SITRAM® H2Guard before performing any activities on the Analog Inputs/Outputs connectors.

J4 Pin Connection

An overview of the available pins can be seen in Table 5.

J4, Analog Inputs			
Pin	Signal	Notes	Limits
1	Ain1-V	Voltage input	0-5V
2	Ain1-I	Current input	0-20mA
3	15V	Output supply voltage	33mA*
4	Ground	Isolated ground	
5	Ain2-V	Voltage input	0-5V
6	Ain2-I **	Current input	0-20mA
7	15V	Output supply voltage	33mA*
8	Ground	Isolated ground	

Table 5. J4 Pin Connection.

NOTICE

* Total load on the 15V supply voltage must be less than 66mA (0.99W) and may be from one pin or distributed between both pins. Overloading this output will affect the 0-20mA outputs on J3 that share a common isolated power source.

NOTICE

** Please Keep in mind that Analog input 2 of the H2Guard is related to moisture value presented on the H2Guard display. Please make sure that in case of having no moisture sensor, deactivate the second window on H2Guard display. Please keep in mind that H2Guard owner should change the H2Guard setting regarding to operational conditions. Valid for Firmware version >1:51

In order to change the Analog Inputs Settings, please refer to Section 5.4, “Configure Analog Inputs”.

© 2022 Siemens Energy

Wiring Examples

Example wiring diagrams for various device connections are shown in Figure 24:

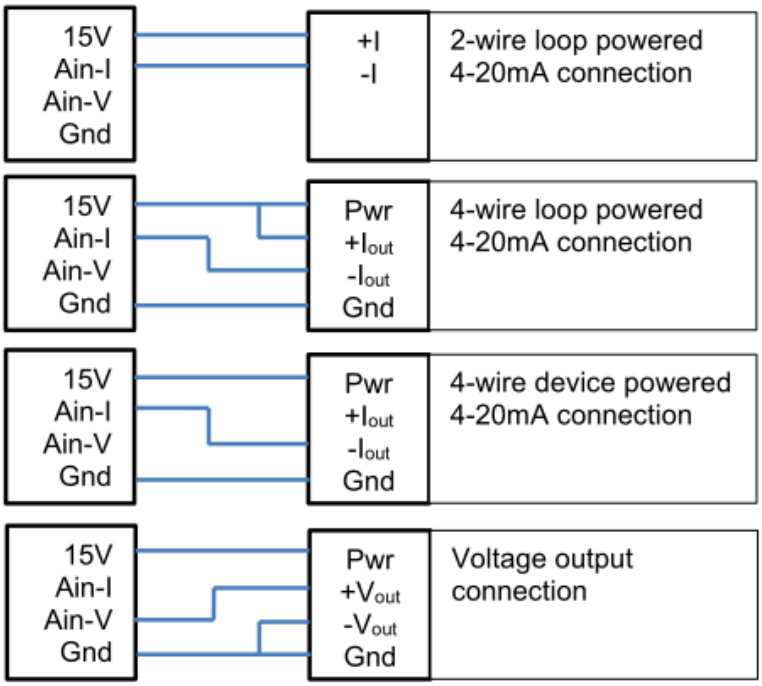


Figure 24. Analog Wiring Diagram Examples

Recommended Cable Specification

For each analogue input, it is recommended to use a cable with the following characteristics:

2x0.5mm2

Radox 125

NOTICE
Please refer to section 11.2, “Recommended Cable”, for the recommended cable and the respective supplier.

© 2022 Siemens Energy

4.4 Analog Outputs

The SITRAM® H2Guard has been equipped with two (2) analog inputs and three (3) analog outputs.

> **WARNING**
>
> Turn off the power supply of the SITRAM® H2Guard before performing any activities on the Analog Inputs/Outputs connectors.

J3 Pin Connection

Three analog outputs are provided on J3 (see Table 6). By default, the Hydrogen measurement is available on Aout1, while the signals injected on Ain1 and Ain2, are repeated on Aout1 and Aout2. Please refer to section 7.1.1, "Reading the Analog Outputs" for more information about the configuration of the Analog Outputs.

J3, Analog Outputs

Pin	Signal	Available Measurement
1	Aout1+	Hydrogen
2	Aout1-	
3	Aout2+	Repeater Ain1
4	Aout2-	
5	Aout3+	Repeater Ain2
6	Aout3-	

Table 6. J3 Pin Connection.

Recommended Cable Specification

For each analogue output, it is recommended to use a cable with the following characteristics:

2x0.5mm2

Radox 125

> **NOTICE**
>
> Please refer to section 11.2, "Recommended Cable", for the recommended cable and the respective supplier.

© 2022 Siemens Energy

4.5 Relay Contacts

Four separate relay circuits are provided on J2 (see Figure 19). The relays are electromechanical devices that energize a coil to switch contacts. The normally closed (NC) and normally open (NO) designation is the state without power and the coil is not energized.

> ⚠ WARNING
>
> Please be aware that there is possibility that the relay wires coming to SITRAM® H2Guard from a SCADA System or other monitoring data logger can be on voltage. Before any wiring makes sure that there is no voltage on wires.

Relay Contact´s Specification

The contact relays are fulfilling the following specifications:

Contact Type:	SPDT
Control Regime:	monostable, 1 Coil
Rated Coil Voltage:	12 VDC
Response Voltage (max.):	30 VDC
Response Voltage (min.):	8.4 VDC
Coil Resistance (+/- 10%)	360 Ω
Switching Current (max.), Contact Rating (resistive):	16 A, 250VAC / 24VDC
Switching Voltage (max):	440 VAC / 300VDC
Max. Switching Power:	4000 VA / 384W
Response Power:	ca. 140 mW

Table 7. Relay Contact Specifications.

© 2022 Siemens Energy

J2 Pin Connection

Each contact is rated for 16A, 250VAC / 24VDC. Default configuration has Relay 1 set for alert (yellow LED), Relay 2 set for alarm (red LED), Relay 3 set for fault (red LED), and Relay 4 is disabled.

Table 8. J2 Pin Connection.

Pin	Relay	State	Triggered by
1	Relay 1	NC	Alert (Yellow LED)
2		Com	
3		NO	
4	Relay 2	NC	Alarm (Red LED)
5		Com	
6		NO	
7	Relay 3	NC	Fault (Red LED)
8		Com	
9		NO	
10	Relay 4	NC	Disabled
11		Com	
12		NO	

As displayed on Table 8, different conditions could trigger the Relay Contacts, which are settable. Check the sections 5.5, "Configure internal FAULT status" and 6.1.2, "ALERT and ALARM Triggering Conditions" for more information about the triggering conditions.

Recommended Cable Specification

For each relay output is, it is recommended to use a cable with the following characteristics:

2 x 1.5mm2

NOTICE

Please refer to section 11.2, "Recommended Cable", for the recommended cable and the respective supplier.

© 2022 Siemens Energy

4.6 Power Supply Connection

AC Power Input

AC power input is through J1 (see Figure 19) and will accept 110-230VAC, 50-60Hz power. Two ground pins are provided so that chassis ground can be connected to AC ground. Chassis ground is provided through a separate wire to internal ground lug. Note that signal grounds are isolated from chassis ground.

J1, AC Power

Pin	Signal	Notes
1	Line	110-230VAC, 50-60Hz
2	Neutral	110-230VAC, 50-60Hz
3	Ground	Connect to earth ground
4	Ground	

Table 9. J2 Pin Connection.

Chassis Ground

In most applications the H2Guard metal housing will be connected to earth ground through the mechanical fittings at the device tube. An internal ground wire between the ground lug and display lid is required and must not be removed.

Still an optional ground wire to connect the chassis to the AC power plug is included. The use of this ground wire depending on system grounding and should be used if the device probe is not connected to earth ground through the transformer enclosure. This ground is not intended to carry large ground currents on a regular basis.

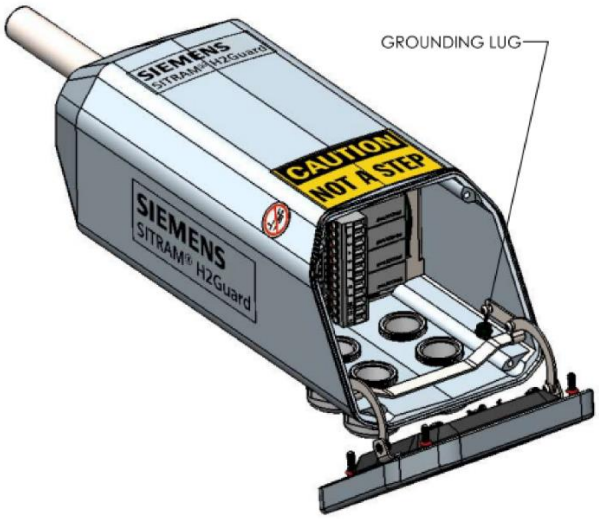


Figure 25. Grounding Lug connection

Recommended Cable Specification

For the connection of the power supply, it is recommended to use a cable with the following characteristics:

2 x 1.5mm2

© 2022 Siemens Energy

NOTICE

Please refer to section 11.2, “Recommended Cable”, for the recommended cable and the respective supplier.

© 2022 Siemens Energy

5. Setting the Device up

Startup

After connecting the cable and turning on the power supply, the device executes a warm-up sequence lasting several minutes. The following operations are done during the warm-up sequence:

Send the power-on-reset message to the serial port

Turn on the Yellow LED

Perform system self-test

Restore configuration settings from non-volatile memory

Start the sampling system to measure hydrogen and oil temperature. Approximate readings will be reported by the device within 15 minutes.

After completing the warm-up sequence the device will send a header line followed by lines of measurement data to the serial port.

Display behavior

From power on reset until the first hydrogen measurement is valid, the display will show “waiting for first measurement”. Typically, it takes 15 minutes from power on reset until the first hydrogen measurement is displayed.

⚠ WARNING
If the display output or serial display indicates an error, turn off power to the H2Guard. Double check the electrical connections and power supply voltage before turning on power again. If the error condition persists, contact Siemens Energy customer service for assistance.

The built-in display will switch between a system information display and hydrogen (ppmH2) display every 5 seconds.

For more information about the display Settings, please refer to section 5.6,” Configure Frontal Display”.

LED´s on Display

The three LEDs below the display will light according to the following table:

© 2022 Siemens Energy

Red	Yellow	Green	Meaning
Off	Off	Off	No Power
Off	On	Off	Not Ready
Off	Off	On	Ready, hydrogen valid
Off	On	On	Relay 1 set, Hydrogen > alert condition
On	On	On	Relay 2 set, Hydrogen > alarm condition
On	On	Off	Relay 3 set, Fault detected during power up
On	Off	Off	Relay 3 set, Fault condition

Table 10. LED´s Meaning Description.

For more information about the relay triggering conditions, refer to sections 5.5, ”Configure internal FAULT status” and 6.1.2, “ALERT and ALARM Triggering Conditions”.

© 2022 Siemens Energy

General Setup Procedure

The general steps to setup the device are the followings:

1. Connect to the Device using the USB Port and stablish a connection using a terminal Emulator, according to the Section 5.1.1, “Foxterm Terminal Emulator”.
2. Get familiar with the CLI and the different common situations that can occur during the communication according to the Section 5.1.2, “Getting access to CLI”.
3. Depending on the communication interface that is required for the customer, please set up the respective communication settings according to Section 5.2,”Configure Communication Settings”.
4. In case, the customer requires the Modbus Communication Protocol, please refer to the section 5.2.3,”Modbus Protocol Settings” for more information.
5. Configure the common device settings like the current time settings (see 5.3.1,”Time Settings”) and User and Device settings (see 5.3.2,”User and Device Information”).
6. Set up the required Data Streaming and Log Settings according to 5.3.3,”Data Stream View Settings” and 5.3.4,”Data Log Settings”.
7. Define the respective settings for the Analogue Inputs as described in Section 5.4,”Configure Analog Inputs”.
8. Configure the FAULT Conditions to trigger the Relay #3, according to the Section 5.5,”Configure internal FAULT status”.

© 2022 Siemens Energy

5.1 Establishing communication to the Device

By default,the configuration routes the Command Line Interface (CLI) to the Mini-USB Port. A good practice when connection to the SITRAM® H2Guard, is to use the USB port for configuration and the other interfaces (RS232, RS485, Ethernet) for remote access.

5.1.1 Foxterm Terminal Emulator

In order to configure the SITRAM® H2Guard, it is required to run a Terminal Emulator on a PC, to get access to the Command Line Interface (CLI). For the current document, the used terminal emulator can be downloaded from www.foxterm.net.

Physical Connection for Communication

By default, the CLI can be accessed through the mini-USB port. Refer to Section 4.2.1,"Mini-USB Port" for more information about the USB port. It is important that the respective USB driver has been already installed, otherwise the communication cannot be stablished.

Other serial Ports (RS232/RS485) can support the CLI, but those ports need to be configured accordingly. Through the Ethernet port, the CLI can be accessed as well, always that the Firmware version is higher than 1:52.

Settings on the Client Side

Based on the used communication port i.e. serial or ethernet, different communication settings need to be considered on the Clients side, which are displayed in Figure 26. For diagnostic purposes it is best practice to log all data from the serial port to a text file.

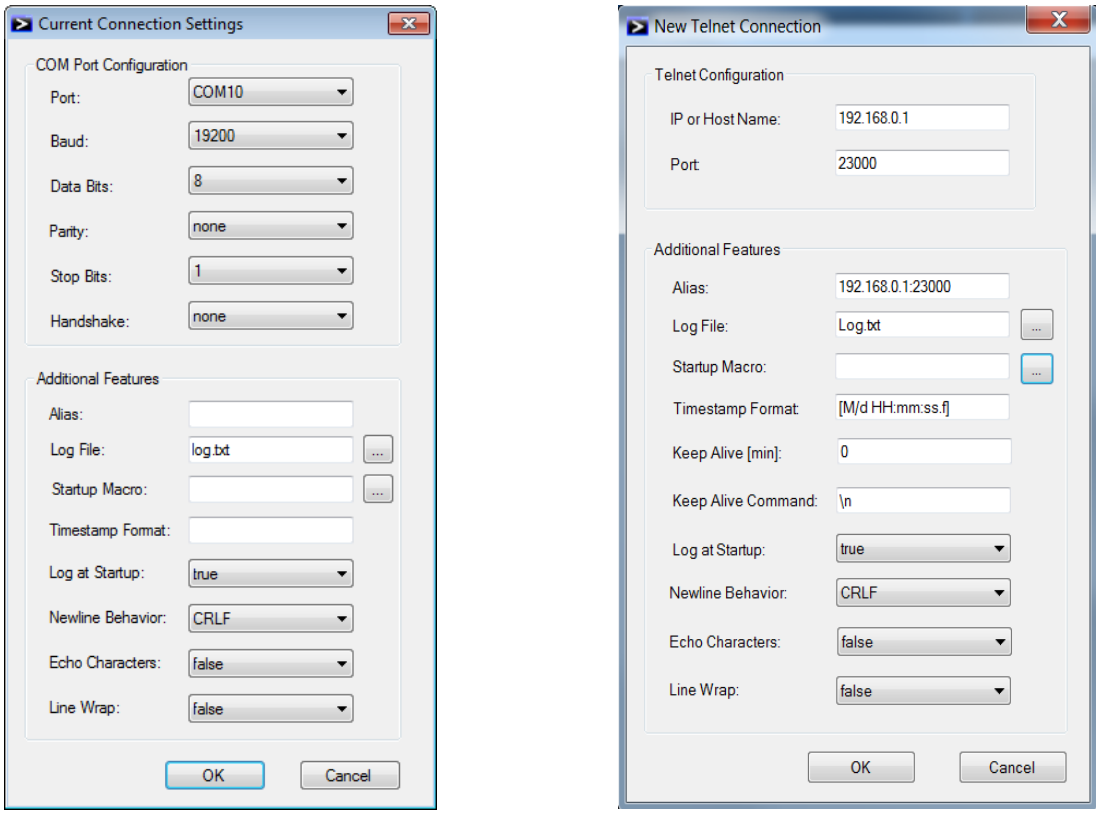


Figure 26. Settings for a Serial Communication (left side) and TCP Communication (right side)

To enable the log at start, follow the next steps:

© 2022 Siemens Energy

1. Select a folder where the “Log File” is going to be store.
2. Ensure that the “Log at Startup” feature has been selected as “True”.

5.1.2 Getting access to CLI

Once the communication is stablished, a prompt window will request a user password.

User Access Levels

The Command Line Interface uses passwords to limit user access to some commands. The password is entered at the H2Guard: prompt and remains in effect until changed. The following table shows the access level and password used to enable commands of that level and lower.

Level	Password	Description
0	=0	Clear Password
1	=h2	User Commands
2	=scan	Advanced User Commands
3	=oem	OEM User Commands

Table 11. User Passwords

The OEM User level has access to all commands, whereas the default level has access to a limited command set. For more information about the allow commands for each user / level refer to Section 11.4,“Overview User Commands”.

Power on Reset Message

A power-on-reset message like the following will be sent on the CLI after power is applied.

```
*** Power on Reset ***

    Load Configuration
    Running firmware 1:51, previous 1:50.
    Initialize Application
    Restore Saved Data

    Start Display Link
    Start Data Log
    backup dlog to SDcard
    Starting Main Application
      Sample Task
      Data Task
      Network Task
      ModBus Task
    SensorB=B11.02RB.10603TN1X,

    FW=1:51:A,  DBFW=1.20
```

Figure 27. Message on the CLI after a Power-on-reset

© 2022 Siemens Energy

Current Device Configuration (CD Command)

In order to get the current Device configuration, please enter **CD** in the prompt. An example of the output can be seen lines below (see Figure 28).

© 2022 Siemens Energy

```
H2Guard: CD

cdis      System Information:
cdis        Model Number: 4800-EE01
cdis        Serial Number: E000000
cdis        Product Revision: 1
cdis        Firmware Revision: 1:50:A
cdis        Display Board FW Revision: 1.20
cdis        Configuration Table Instance #42
cdis        Sensor Board Serial Number: 15L5000-000
cdis        Interface Board Serial Number: 15L5001-000
cdis        Power Board Serial Number: 15L5002-000
cdis        Connector Board Serial Number: 15L5003-000
cdis        Display Board Serial Number: 15L5004-000
cdis        OEM String: "H2Guard"
cdis        Channel A is undefined
cdis        Channel B is valid
cdis.B        Sensor Serial Number:  B11.02RB.10603TN1X

cdpc      System Product Configuration:
cdpc        Product Type is Transformer Monitor, Siemens, Version 1
cddl      OLED Display brightness is 63
cddl      Page3 Display is %RH, Ain2

cdu       User information is:
cdu         Owner: not used
cdu         Site: not used
cdu         Location: not used

cdsc      Analog Input Configuration:
cdsc        Analog Input 1 Configuration:
cdsc.E1       Input Range:
cdsc.E1         Low Input (mA) = 0.00
cdsc.E1         High Input (mA) = 20.00
cdsc        Analog Input 2 Configuration:
cdsc.E2       Input Range:
cdsc.E2         Low Input (mA) = 0.00
cdsc.E2         High Input (mA) = 20.00

cdds      Lab Mode is disabled

cddad     Last DGA Calibration Date = invalid
cddfo     Available Oil Types:
cddfo       OilType[1] is Mineral
cddfo       OilType[2] is Silicone
cddfo       OilType[3] is Natural Ester
cddfo       OilType[4] is invalid
cddfo     Mineral oil type is selected

cddha     Analog Output Configuration:
cddha       Aout1 is enabled
cddha.A1      Hydrogen Signal Range:
cddha.A1        Low Range (ppm) = 0
```


© 2022 Siemens Energy

```
cddha.A1         High Range (ppm) = 5000
cddha.A1       Output Range:
cddha.A1          Low Output (mA) = 4.00
cddha.A1         High Output (mA) = 20.00
cddha.A1       Not Ready (mA) = 3.00
cddha.A1       Fault (mA) = 2.00
cddha        Aout2 is enabled
cddha.A2       Ain1 Repeater
cddha.A2       Output Range:
cddha.A2          Low Output (mA) = 0.00
cddha.A2         High Output (mA) = 20.00
cddha.A2       Not Ready is disabled
cddha.A2       Fault Output is disabled
cddha        Aout3 is enabled
cddha.A3       Ain2 Repeater
cddha.A3       Output Range:
cddha.A3          Low Output (mA) = 0.00
cddha.A3         High Output (mA) = 20.00
cddha.A3       Not Ready is disabled
cddha.A3       Fault Output is disabled

cddhr     Relay Configuration:
cddhr        Relay 1 is enabled
cddhr.R1       Hydrogen Level:
cddhr.R1         Trigger (ppmH2) = 100
cddhr.R1         Hysteresis (ppmH2) = 20
cddhr.R1         Delay (sec) = 60
cddhr.R1       ROC Mode: Daily
cddhr.R1         Trigger (ppmH2/day) = 30.00
cddhr.R1         Hysteresis (ppmH2/day) = 6.00
cddhr.R1         Delay (sec) = 60
cddhr.R1       Ain1:
cddhr.R1         Trigger (mA) = 6.40
cddhr.R1         Hysteresis (mA) = 1.30
cddhr.R1         Delay (sec) = 60
cddhr        Relay 2 is enabled
cddhr.R2       Hydrogen Level:
cddhr.R2         Trigger (ppmH2) = 200
cddhr.R2         Hysteresis (ppmH2) = 40
cddhr.R2         Delay (sec) = 60
cddhr.R2       ROC Mode: Daily
cddhr.R2         Trigger (ppmH2/day) = 75.00
cddhr.R2         Hysteresis (ppmH2/day) = 15.00
cddhr.R2         Delay (sec) = 60
cddhr.R2       Ain1:
cddhr.R2         Trigger (mA) = 8.40
cddhr.R2         Hysteresis (mA) = 1.76
cddhr.R2         Delay (sec) = 60
cddhr        Relay 3 is enabled
cddhr.R3       Unit Status Triggers:
cddhr.R3         PCB temp too high: status trigger is not latched
cddhr.R3         Hres value out of range: trigger is not latched
cddhr.R3         Required data not valid: trigger is not latched
```


© 2022 Siemens Energy

```
cddhr.R3        Heater Error: trigger is not latched
cddhr       Relay 4 is  disabled

cdcp      CLI Communication Port is USB
cdcp      CLI-Tcp:
cdcp        Port Number: 23000
cdcp        Password: h2guard

cdcd      Display Configuration:
cdcd        Date and Time is enabled
cdcd        Record Number is disabled
cdcd        Time Stamp is disabled
cdcd        Power On Hours is enabled
cdcd        Display PCB Temp is enabled
cdcd        Display Ain1 Current is enabled
cdcd        Display Ain1 Voltage is disabled
cdcd        Display Ain2 Current is enabled
cdcd        Display Ain2 Voltage is disabled
cdcd        Display H2 Final is enabled
cdcd        Display ROC/day is enabled
cdcd        Display ROC/week is enabled
cdcd        Display ROC/month is enabled
cdcd        Display extra Messages is enabled

cdlg      Datalog Configuration:
cdlg        Data Logging is enabled
cdlg        Total record size including header (N) = 126
cdlg        Log Rate (min) = 60.0
cdlg        Data Logging Summary is disabled
cdlg        Data Logging Decimate is disabled
cdlg        Date and Time is enabled
cdlg        Record Number is disabled
cdlg        TimeStamp is disabled
cdlg        Power On Hours is disabled
cdlg        PCB Temp is enabled
cdlg        Ain1 Current is enabled
cdlg        Ain1 Voltage is disabled
cdlg        Ain2 Current is enabled
cdlg        Ain2 Voltage is disabled
cdlg        Oil Temp is enabled
cdlg        H2 Final is enabled
cdlg        ROC/day is enabled
cdlg        ROC/week is disabled
cdlg        ROC/month is disabled

cdpm      Modbus Protocol is TCP
cdpm        IP Address:  192.168.0.1
cdpm        Port Number: 502
cdpm        Device ID:   2

cdn       Ethernet Configuration:
cdn         Host Name:              unique for each unit
cdn         IP Address:             192.168.0.1
```


© 2022 Siemens Energy

```
cdn         DHCP is disabled
cdn         Net Mask:               255.255.255.0
cdn         Default Gateway:        0.0.0.0
cdn         Primary DNS Server:     0.0.0.0
cdn         Secondary DNS Server:   0.0.0.0
cdn         MAC Address:            unique for each unit
```

Figure 28. CD Command Response – Getting Current Device Settings

Help Command (? Command)

The question mark is used to get help about the available commands and more information about a specific command. Some example to get more information are:

A question mark by itself will report the entire list of commands available for the active user level

A single letter followed by a question mark will display the commands that begin with that letter

Appending a command with question mark will display information about that command.

The list of commands displayed depends on the user level. To get more information about the available commands and the user levels, please refer to Section11.4,"Overview User Commands".

NOTICE

Due to limited resources in the embedded microcontroller this help system cannot replace the product manual. It will help a trained technician remember which command to use.

Reset to Factory Settings (IUC Command)

In case is required, the user is entitled to restore the Device to its factory settings by writing in the CLI window the command **IUC.**

```
H2Guard: IUC
>>> This will reset the user configuration to factory defaults, Proceed
(Y/N)? y  (N will abort wihout change)

*** Power on Reset ***
```

Figure 29. IUC Command Response

NOTICE

After applying the **IUC** command, all the configured settings will be lost.

Reset Device under Hanging

The H2Guard CLI is not likely to hang or become non-responsive however an apparent hang condition may exist if the user disconnects the communication port in the middle of a command. In this case the

© 2022 Siemens Energy

next time a user connects to the communication port several days, weeks, or months later the CLI may still be waiting for user input to finish a command and not behave as expected.

If this happens please follow the next steps:

1. Press the **ESC** key twice
2. Press **ENTER** key
3. Press then the '**N'**, '**1**', and **ENTER** keys to get a response.
4. If the unit does not respond use the character string **@$@** to invoke a soft reset which will recover from an apparent hang condition.

NOTICE
Best practice is to issue the **=0** command to clear the password before disconnecting the communication port.

© 2022 Siemens Energy

5.2 Configure Communication Settings

5.2.1 Serial Communication

Selecting the Communication Port (CECP Command)

The **CECP** command allows the user to select which communication port the CLI is active on. CLI over ethernet may be enabled or disabled.

```
H2Guard: CECP

cdcp      CLI Communication Port is USB
cdcp      CLI-Tcp:
cdcp        Port Number: 23000
cdcp        Password:
cecp      Anything to Change (Y/N)? y (N will exit without change)
cecp      Select CLI Communication Port(usb):
cecp        1 - RS232
cecp        2 - RS485
cecp        3 - USB
cecp      select: 3(select 1 to 3 or hit return for no change)
cecp      CLI-Tcp:
cecp        0 - disable
cecp        1 - enable
cecp      select: 1 (must select 0 or 1)
cecp      Change Port Number(23000): (enter port number or hit return
for no change)
cdcp      Password: (enter password string or leave empty for no
password)
cdcp      CLI-Tcp:
cdcp        Port Number: 23000
cdcp        Password:

Saving ...
H2Guard:
```

Figure 30. CECP Command Response

NOTICE
Note that the CLI can only be active on one port. Multiple port is not supported.

5.2.2 TCP Interface Communication

The CLI over ethernet connection is a socket connection. The default port number is 23000 and password is “h2guard”. The IP address of the unit is displayed using the **DN** command.

Current Network Settings (DN Command)

The **DN** command reports the current network settings.

© 2022 Siemens Energy

```
H2Guard: DN
Network Settings:
  DHCP is enabled
  Host Name:              h37313300400034
  IP Address:             192.168.102.104
  Net Mask:               255.255.255.0
  Default Gateway:        192.168.0.254
  Primary DNS Server:     194.25.2.129
  Secondary DNS Server:   194.25.2.130
  MAC Address:            02-33-31-34-00-40
```

Figure 31. DN Command Response

Modify Network Configuration (CEN Command)

The **CEN** command allows the user to modify the network configuration. Editing these values will cause a system reset to activate the new setting. These settings may need to be modified if DHCP is not used at the installation site.

```
H2Guard: CEN
cdn       SysComm Ethernet Configuration:
cdn         Host Name:              h37313300270032
cdn         IP Address:             192.168.102.104
cdn         DHCP is enabled
cdn         Net Mask:               255.255.255.0
cdn         Default Gateway:        192.168.102.1
cdn         Primary DNS Server:     192.168.102.10
cdn         Secondary DNS Server:   192.168.102.1
cdn         MAC Address:            02-33-31-32-00-27
cen       SysComm Ethernet Configuration:
cen       Anything to Change (Y/N)? y    (N will exit without change)
cen       Change MAC address? (Y/N)? n   (Y will ask for changes)
cen       Change Hostname? (Y/N)? n      (Y will ask for changes)
cen       DHCP:
cen         0 - disable
cen         1 - enable
cen       select: 0                      (1 will save changes and exit)
cen       Change Static IP address(192.168.102.104)? (Y/N)? n     (Y to
change)
cen       Change Default Gateway(192.168.102.1  )? (Y/N)? n       (Y to
change)
cen       Change Net Mask(255.255.255.0  )? (Y/N)? n              (Y to
change)
cen       Change Primary DNS Server(192.168.102.10 )? (Y/N)? n    (Y to
change)
cen       Change Secondary DNS Server(192.168.102.1  )? (Y/N)? n  (Y to
change)
Saving ...

*** Power on Reset ***
```

Figure 32. CEN Command Response

5.2.3 Modbus Protocol Settings

The maximum response time for the device is 10000 milliseconds.

© 2022 Siemens Energy

NOTICE
The master's timeout should be set to 10000 milliseconds or greater.

Change Modbus Device ID (DI Command)

The **DI** command allows the user to modify the Modbus device ID. After saving, the device will reset to activate the new device ID.

```
H2Guard: DI
Device ID is 1, Change (Y/N)? y
  Change ID to: 2
Saving ...

*** Power on Reset ***
```

Figure 33. DI Command Response

Configure Modbus Communication Type (CEPM Command)

The **CEPM** command allows the user to select which communication port the Modbus is active on. Editing these values will cause a system reset to activate the new setting. The user can select which communications port is used for Modbus over TCP, RS485, or RS232.

```
H2Guard: CEPM
cdpm      Modbus Protocol is TCP
cdpm        IP Address:  192.168.102.104
cdpm        Port Number: 502
cdpm        Device ID:   2
cepm      Anything to Change (Y/N)? y
cepm      Select Port:
cepm        1 - None
cepm        2 - TCP
cepm        3 - RS485, 19200
cepm        4 - RS232
cepm        5 - RS485, 9600
cepm      select: 3
cepm      Device ID(2): 1     (enter new value or press return for no
change)
Saving ...

*** Power on Reset ***
```

Figure 34. CEPM Command Response

Default Modbus TCP Parameters

The default port number is 502. Still, if the port number needs to be changed, the **CEPM** Command can be used for this purpose.

© 2022 Siemens Energy

When the Ethernet port is selected the device will use DHCP to establish an IP address. The IP address of the device is going to be the one that is setup on the Network Settings (see Section 5.2.2, "TCP Interface Communication").

The default Host Name and MAC Address will be unique, based on the unique microcontroller ID number for each assembly. Note that the device can only connect to one Master at a time.

Default Modbus RTU Parameters

The following communication settings are used when Modbus is enabled on the RS485 or RS232 port.

Baud Rate:	**9600, 19200 (default)**
Data bits:	8
Stop bits:	1
Parity:	None
Flow Control:	None

Table 12. Default Modbus RTU Settings

The RS485 baud rate can also be selected to be 9600 or 19200, by typing the **`CEPM`** command and following the respective guidelines given in the CLI.

© 2022 Siemens Energy

5.3 Configure Device Settings

5.3.1 Time Settings

Display current Date and Time (RT Command)

The **RT** command allows the user to display the current date and time.

```
H2Guard: RT
03/25/16 17:40:06.488
```

Figure 35. RT Command Response

Change Date and Time (RS Command)

By typing the **RS** command, the user is allowed to change the date and time. Note that a 24-hour clock format is used; AM/PM is not supported.

```
H2Guard: RS
Time is 03/25/15 17:39:51.070 Change (Y/N)? y
  Year: 2016
  Month: 3
  Day: 25
  Hour: 17
  Minute: 40
  Second: 0
Change time to 03/25/16 17:40:00.000
Save to RTC (Y/N)? y
```

Figure 36. RS Command Response

NOTICE
The Internal clock of the H2Guard might drift over time.

5.3.2 User and Device Information

Modify User Information (UI Command)

By entering the command **UI**, the user can see and set customer specific information about the H2Guard. If the user desires to change the values, each field can be written with up to 20 characters.

© 2022 Siemens Energy

```
H2Guard: UI
cdu       User information is:
cdu         Owner: not used
cdu         Site: not used
cdu         Location: not used
ceu       Change? (Y/N)? y
ceu       Owner string is disabled, Change (Y/N)? y
ceu       Enter Owner string: Name of owner
ceu       Site string is disabled, Change (Y/N)? y
ceu       Enter Site string: Name of facility
ceu       Location string is disabled, Change (Y/N)? y
ceu       Enter Location string: H2Guard location
Saving ...
```

Figure 37. UI Command Response

5.3.3 Data Stream View Settings

Modify Streaming Data (DD Command)

This command allows the user to view and modify what is shown on the CLI data stream. For more information about the definition of the parameters available in the data stream refer to section 7.2.1,"Resume Streaming Data (G Command)".

```
H2Guard: DD
Editing Custom CLI Configuration:
      1 - Restore Default
      2 - Custom
    enter selection: 2 (1 will restore the default display setting and
exit)
    selected: Custom display
cdcd      Display Configuration:
cdcd        Date and Time is enabled
cdcd        Record Number is disabled
cdcd        Time Stamp is disabled
cdcd        Power On Hours is enabled
cdcd        Display PCB Temp is enabled
cdcd        Display Ain1 Current is enabled
cdcd        Display Ain1 Voltage is disabled
cdcd        Display Ain2 Current is enabled
cdcd        Display Ain2 Voltage is disabled
cdcd        Display H2 Final is enabled
cdcd        Display ROC/day is enabled
cdcd        Display ROC/week is enabled
cdcd        Display ROC/month is enabled
cdcd        Display extra Messages is enabled
 Change (Y/N)? n (Y will prompt to enable/disable each item listed
above)
Saving ...
```

Figure 38. DD Command Response

© 2022 Siemens Energy

5.3.4 Data Log Settings

Change Data Log Configuration (DG Command)

The **DG** command allows the user to modify the data log configuration.

```
H2Guard: DG
Editing Custom Datalog Configuration:
      1 - Restore Default
      2 - Custom
    enter selection: 2
    selected: Custom datalog
cdlg      Datalog Configuration:
cdlg        Data Logging is enabled
cdlg        Total record size including header (N) = 130
cdlg        Log Rate (min) = 15.0
cdlg        Data Logging Summary is disabled
cdlg        Data Logging Decimate is disabled
cdlg        Date and Time is enabled
cdlg        Record Number is disabled
cdlg        TimeStamp is disabled
cdlg        Power On Hours is disabled
cdlg        PCB Temp is enabled
cdlg        Ain1 Current is enabled
cdlg        Ain1 Voltage is disabled
cdlg        Ain2 Current is enabled
cdlg        Ain2 Voltage is disabled
cdlg        Oil Temp is enabled
cdlg        H2 Final is enabled
cdlg        ROC/day is disabled
cdlg        ROC/week is disabled
cdlg        ROC/month is disabled
 Change (Y/N)? n (Y will prompt to enable/disable each item listed
above)
                (.. it will also allow change the log rate)
Saving ...
Erase data log (Y/N)? n (Y will erase the data log)
```

Figure 39. DG Command Response

Delete Data Log (LC Command)

By typing **LC** in the CLI, the user clears (erase) the H2Guard data log.

```
H2Guard: LC
Erase data log (Y/N)? y  (N will abort without erasing)
  erased
```

Figure 40. LC Command Response

NOTICE
Before deleting the data log, please be sure that you have created a backup of the respective data log.

© 2022 Siemens Energy

5.4 Configure Analog Inputs

The SITRAM® H2Guard allow the connection of two (2) analog inputs that can be outputted as two (2) different analog outputs. The Hydrogen measured value by the H2Guard will be outputted as an Analog Output as well. Still the device allows the configuration of the inputs depending on project requirements, or different external sensor types.

Changing Analog Input Settings (AI Command)

The **AI** command allows the user to change the Analog Input configuration. The default values are shown for reference in the Figure 41. As displayed, the program allows the user for changes related to:

Enable/disable an input. Unused inputs can be still left enabled, without affecting the device functionality.

Select input type “1” for current or “2” for voltage.

Specify range of input signal (0-5V or 0-20mA) depending on the input type selected previously.

NOTICE
The Input signal range would depend on the specification of the external device that is going to be connected. Check the specification of the external sensor given by its manufacturer.

© 2022 Siemens Energy

```
H2Guard: AI
cdsc        Analog Input 1 Configuration:
cdsc.E1       Input Range:
cdsc.E1         Low Input (mA) = 0.00
cdsc.E1         High Input (mA) = 20.00
cdsc        Analog Input 2 Configuration:
cdsc.E2       Input Range:
cdsc.E2         Low Input (mA) = 0.00
cdsc.E2         High Input (mA) = 20.00
cesc.E       Change (Y/N)? y (n will exit without change)
cesc.E      Analog Input Configuration:
cesc.E      Ain1 is enabled, Change (Y/N)? n (Y will toggle setting)
cdsc.E1       Input Range:
cdsc.E1         Low Input (mA) = 0.00
cdsc.E1         High Input (mA) = 20.00
cesc.E1      Change (Y/N)? y
cesc.E1     Select Input Type:
cesc.E1       1 - current
cesc.E1       2 - voltage
cesc.E1     enter selection: 1
cesc.E1     selected: current
cesc.E1     use Input range is enabled, Change (Y/N)? n  (Y will toggle
setting)
cesc.E1       lowInput (mA) : 4
cesc.E1       highInput (mA) : 20
cesc.E      Ain2 is enabled, Change (Y/N)? n  (Y will toggle setting)
cdsc.E2       Input Range:
cdsc.E2         Low Input (mA) = 0.00
cdsc.E2         High Input (mA) = 20.00
cesc.E2      Change (Y/N)? y
cesc.E2     Select Input Type:
cesc.E2       1 - current
cesc.E2       2 - voltage
cesc.E2     enter selection: 1
cesc.E2     selected: current
cesc.E2     use Input range is enabled, Change (Y/N)? n  (Y will toggle
setting)
cesc.E2       lowInput (mA) : 4
cesc.E2       highInput (mA) : 20
Saving ...
```

Figure 41. AI Command Response

© 2022 Siemens Energy

5.5 Configure internal FAULT status

As described in section 4.5, "Relay Contacts" the SITRAM® H2Guard incorporates four (4) relay contacts that could be triggered based on specific threshold levels or Rate of Change (ROD) values defined for the Hydrogen measurement.

In addition to the Hydrogen alarm condition, the SITRAM® H2Guard allows the configuration of different fault conditions (see Table 13) to recognize any failure on the device itself. In case, any of those conditions is fulfilled the Relay #3 will be triggered.

NOTICE

If one of the conditions has been already triggered and later another alarm condition is fulfilled, the Relay #3 would not change its status.

FAULT Conditions for Relay #3

The Relay #3 would be triggered always that at least one of the following conditions (see Table 13) is fulfilled:

Condition	Status	Trigger Value	Hysteresis	Delay
Hydrogen Levels	disabled	NA	NA	NA
Hydrogen ROC (Daily)	disabled	NA	NA	NA
Oil Temperature	disabled	NA	NA	NA
PCB temp too high	disabled	NA	NA	NA
Ain1 Input	disabled	NA	NA	NA
Ain2 Input	disabled	NA	NA	NA
PCB temp too high	Enabled	NA	NA	NA
Hres value out of range	Enabled	NA	NA	NA
Required data not valid	Enabled	NA	NA	NA
Heater Error	Enabled	NA	NA	NA

Table 13. Relay 3 – Triggering Conditions

As displayed in Table 13, by default the FAULT State would be triggered always that at least one of the four conditions is triggered. Those conditions can be configured only as discrete indicators (Enabled / Disabled), therefore the user does not need to configure a trigger, hysteresis or delay value.

Changing Relay Output Settings (RC Command)

By typing the command **RC** the user may change the relay configuration. The program prompts the user for changes to:

Enable/disable a relay (unused relays can be left enabled);

© 2022 Siemens Energy

Select signal sources to trigger the relay, multiple sources are all together.

Select trigger level for each source, sets the threshold to set a trigger.

Select hysteresis for each trigger that is subtracted from the trigger level and is the threshold used to clear a trigger.

Select a delay time, the signal must be above the trigger level this amount of time before setting the relay.

Select which Fault conditions are used to trigger a relay

The default triggering values are shown below in Figure 42.

© 2022 Siemens Energy

```
H2Guard: RC
cddhr     Relay Configuration:
cddhr       Relay 1 is enabled
cddhr.R1      Hydrogen Level:
cddhr.R1        Trigger (ppmH2) = 100
cddhr.R1        Hysteresis (ppmH2) = 20
cddhr.R1        Delay (sec) = 60
cddhr.R1      ROC Mode: Daily
cddhr.R1        Trigger (ppmH2/day) = 30.00
cddhr.R1        Hysteresis (ppmH2/day) = 6.00
cddhr.R1        Delay (sec) = 60
cddhr.R1      Ain1:
cddhr.R1        Trigger (mA) = 6.40
cddhr.R1        Hysteresis (mA) = 1.30
cddhr.R1        Delay (sec) = 60
cddhr       Relay 2 is enabled
cddhr.R2      Hydrogen Level:
cddhr.R2        Trigger (ppmH2) = 200
cddhr.R2        Hysteresis (ppmH2) = 40
cddhr.R2        Delay (sec) = 60
cddhr.R2      ROC Mode: Daily
cddhr.R2        Trigger (ppmH2/day) = 75.00
cddhr.R2        Hysteresis (ppmH2/day) = 15.00
cddhr.R2        Delay (sec) = 60
cddhr.R2      Ain1:
cddhr.R2        Trigger (mA) = 8.40
cddhr.R2        Hysteresis (mA) = 1.76
cddhr.R2        Delay (sec) = 60
cddhr       Relay 3 is enabled
cddhr.R3      Unit Status Triggers:
cddhr.R3        PCB temp too high: status trigger is not latched
cddhr.R3        Hres value out of range: trigger is not latched
cddhr.R3        Required data not valid: trigger is not latched
cddhr.R3        Heater Error: trigger is not latched
cddhr       Relay 4 is  disabled
cedhr     Edit Relay Configuration:
cedhr     Anything to Change (Y/N)? y (n will exit without change)
cedhr.R1    Relay 1 is enabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R1      Hydrogen Level is enabled, Change (Y/N)? n (Y will toggle
setting)
cddhr.R1        Trigger (ppmH2) = 100
cddhr.R1        Hysteresis (ppmH2) = 20
cddhr.R1        Delay (sec) = 60
cedhr.R1       Change (Y/N)? n (Y will ask for changes)
cedhr.R1      ROC is enabled, Change (Y/N)? n (Y will toggle setting)
cddhr.R1      ROC Mode: Daily
cddhr.R1        Trigger (ppmH2/day) = 30.00
cddhr.R1        Hysteresis (ppmH2/day) = 6.00
cddhr.R1        Delay (sec) = 60
cedhr.R1       Change (Y/N)? n (Y will ask for changes)
cedhr.R1      Oil Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R1      PCB Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
```


© 2022 Siemens Energy

```
cedhr.R1      Ain1 is enabled, Change (Y/N)? n (Y will toggle setting)
cddhr.R1        Trigger (mA) = 6.40
cddhr.R1        Hysteresis (mA) = 1.30
cddhr.R1        Delay (sec) = 60
cedhr.R1       Change (Y/N)? n (Y will ask for changes)
cedhr.R1      Ain2 is disabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R1      Unit Status Triggers are disabled, Change (Y/N)? n (Y will
toggle setting)
cedhr.R2    Relay 2 is enabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R2      Hydrogen Level is enabled, Change (Y/N)? n (Y will toggle
setting)
cddhr.R2        Trigger (ppmH2) = 200
cddhr.R2        Hysteresis (ppmH2) = 40
cddhr.R2        Delay (sec) = 60
cedhr.R2       Change (Y/N)? n (Y will ask for changes)
cedhr.R2      ROC is enabled, Change (Y/N)? n (Y will toggle setting)
cddhr.R2      ROC Mode: Daily
cddhr.R2        Trigger (ppmH2/day) = 75.00
cddhr.R2        Hysteresis (ppmH2/day) = 15.00
cddhr.R2        Delay (sec) = 60
cedhr.R2       Change (Y/N)? n (Y will ask for changes)
cedhr.R2      Oil Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R2      PCB Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R2      Ain1 is enabled, Change (Y/N)? n (Y will toggle setting)
cddhr.R2        Trigger (mA) = 8.40
cddhr.R2        Hysteresis (mA) = 1.76
cddhr.R2        Delay (sec) = 60
cedhr.R2       Change (Y/N)? n (Y will ask for changes)
cedhr.R2      Ain2 is disabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R2      Unit Status Triggers are disabled, Change (Y/N)? n (Y will
toggle setting)
cedhr.R3    Relay 3 is enabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R3      Hydrogen Level is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R3      ROC is disabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R3      Oil Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R3      PCB Temp is disabled, Change (Y/N)? n (Y will toggle
setting)
cedhr.R3      Ain1 is disabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R3      Ain2 is disabled, Change (Y/N)? n (Y will toggle setting)
cedhr.R3      Unit Status Triggers are enabled, Change (Y/N)? n (Y will
toggle setting)
cddhr.R3        PCB temp too high: status trigger is not latched
cddhr.R3        Hres value out of range: trigger is not latched
cddhr.R3        Required data not valid: trigger is not latched
cddhr.R3        Heater Error: trigger is not latched
cedhr.R3       Change (Y/N)? n (Y will ask for changes)
cedhr.R4    Relay 4 is disabled, Change (Y/N)? n (Y will toggle setting)
Saving ...
```

Figure 42. RC Command Response

© 2022 Siemens Energy

5.6 Configure Frontal Display

Modify display Brightness (CEDL Command)

The **CEDL** command allows the user to modify the display brightness. The default brightness is 63 and can range from 0 to 127. A numerically higher value increases brightness, a lower value decreases brightness, zero does not turn off the display.

```
H2Guard: CEDL

cddl      OLED Display brightness is 63
cddl      Page3 Display is %RH, Ain2
cedl      Anything to Change (Y/N)? y (N will exit without change)
cedl       Enter OLED Display brightness(63) [0-127]: (enter a value
or hit return for no change)
cedl      Display Page3:
cedl        0 - disable
cedl        1 - enable
cedl      select: 1 (must select 0 or 1)
cedl      Display Page3 Source:
cedl        0 - none
cedl        1 - %RH, Ain2
cedl      select: 1 (must make a selection)
cddl      OLED Display brightness is 63
cddl      Page3 Display is %RH, Ain2

Saving ...
```

Figure 43. CEDL Command Response

Shows Moisture(%RH) on Display

A third display page may be enabled or disabled to show the content of moisture (%RH) in the display. As shown in Figure 43, using the **CEDL** command, the user can set the third display.

© 2022 Siemens Energy

6. Hydrogen Measurement Configuration

General Procedure

Once the common device settings are finished, follow the next steps to configure the respective gas parameters:

1. Depending on the Oil Type, select the specific one following the steps described in Section 6.1.1, “Defining Oil Type”.
2. Define the respective conditions that would trigger the ‘ALERT’ and ‘ALARM’ settings for the Hydrogen Measurement. Refer to Section 6.1.2, “ALERT and ALARM Triggering Conditions”.
3. On new Installations, submit the settings according to 6.2, “Submitting the Settings”.
4. If a DGA Test is going to be carried out, the Hydrogen Measurement can be corrected to match the DGA Test results. Refer to section 6.3, “Hydrogen Calibration based on DGA Results”, for more information.

© 2022 Siemens Energy

6.1 Hydrogen Settings

6.1.1 Defining Oil Type

Available Oil Types (PT Command)

The **PT** command prints the oil type configuration. Depending on security level some information is hidden (refer to Section 5.1.2, "Getting access to CLI" for more information). Figure 44 examples custom oil type created by an advanced user. An OEM user will see the other oil types after they have been configured with the **OT** command.

```
H2Guard: PT
cddfo     Available Oil Types:
cddfo       OilType[1] is Mineral
cddfo         Mineral.m (gasH2/oilH2/C) = 0.000134
cddfo         Mineral.b (gasH2/oilH2) = 0.043948
cddfo       OilType[2] is Silicone
cddfo         Silicone.m (gasH2/oilH2/C) = 0.000336
cddfo         Silicone.b (gasH2/oilH2) = 0.069400
cddfo       OilType[3] is Natural Ester
cddfo         Natural Ester.m (gasH2/oilH2/C) = 0.000309
cddfo         Natural Ester.b (gasH2/oilH2) = 0.031600
cddfo       OilType[4] is invalid
cddfo     Mineral oil type is selected
```

Figure 44. PT Command Response

Change Oil Type (OT Command)

The **OT** command modifies the calculation of hydrogen dissolved in oil based on an oil temperature dependent solubility coefficient. Up to four (4) different values can be set: three by the OEM and one by the end user.

The end user will only see the name field assigned by the OEM. The OEM password is required to enter values for Oil Type 1, 2, and 3. The Figure 45 shows an advanced user entering a custom oil type and selecting it for use.

```
H2Guard: OT
cddfo     Available Oil Types:
cddfo       OilType[1] is Mineral
cddfo         Mineral.m (gasH2/oilH2/C) = 0.000134
cddfo         Mineral.b (gasH2/oilH2) = 0.043948
cddfo       OilType[2] is Silicone
cddfo         Silicone.m (gasH2/oilH2/C) = 0.000336
cddfo         Silicone.b (gasH2/oilH2) = 0.069400
cddfo       OilType[3] is Natural Ester
cddfo         Natural Ester.m (gasH2/oilH2/C) = 0.000309
cddfo         Natural Ester.b (gasH2/oilH2) = 0.031600
cddfo       OilType[4] is invalid
cddfo     Mineral oil type is selected
cedfo     Anything to change (Y/N)? n
```

Figure 45. OT Command Response

© 2022 Siemens Energy

NOTICE

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

Restore Default Oil Type Configuration (IT Command)

The **IT** command restores the factory default oil type configuration. It will erase all oil types and select the default type.

```
H2Guard: IT
Do you want to restore the default Oil Type configuration (Y/N)? y (n
will exit without change)
```

Figure 46. IT Command Response

6.1.2 ALERT and ALARM Triggering Conditions

By default the SITRAM® H2Guard would trigger two (2) relays (see 4.5, "Relay Contacts" for more information about the connection of the relays), always that at least one of the conditions described in Table 14 and Table 15 is fulfilled.

ALERT Conditions on Relay #1

The Relay 1 would be triggered always that at least one of the following conditions (see Table 14) is fulfilled:

Condition	Status	Trigger Value	Hysteresis	Delay
Hydrogen Levels	Enabled	100 ppm	20 ppm	60 sec
Hydrogen ROC (Daily)	Enabled	30 ppm/day	6 ppm / day	60 sec
Oil Temperature	Disabled	NA	NA	NA
PCB temp too high	Disabled	NA	NA	NA
Ain1 Input	Enabled	6.40 mA	1.30 mA	60 sec
Ain2 Input	Disabled	NA	NA	NA
PCB temp too high	Disabled	NA	NA	NA
Hres value out of range	Disabled	NA	NA	NA
Required data not valid	Disabled	NA	NA	NA
Heater Error	Disabled	NA	NA	NA

Table 14: Relay 1 – Triggering Conditions

© 2022 Siemens Energy

ALARM Conditions on Relay #2

The Relay #2 would be triggered always that at least one of the following conditions (see Table 15) is fulfilled:

Condition	Status	Trigger Value	Hysteresis	Delay
Hydrogen Levels	Enabled	200 ppm	40 ppm	60 sec
Hydrogen ROC (Daily)	Enabled	75 ppm/day	15 ppm / day	60 sec
Oil Temperature	Disabled	NA	NA	NA
PCB temp too high	Disabled	NA	NA	NA
Ain1 Input	Enabled	8.40 mA	1.76 mA	60 sec
Ain2 Input	Disabled	NA	NA	NA
PCB temp too high	Disabled	NA	NA	NA
Hres value out of range	Disabled	NA	NA	NA
Required data not valid	Disabled	NA	NA	NA
Heater Error	Disabled	NA	NA	NA

Table 15: Relay 2 – Triggering Conditions

Changing ALERT and ALARM Settings (RC Command)

By typing the command **RC** the user may change the relay configuration. The default triggering values are shown in Figure 42. Once the required settings have been applied, record the new triggering conditions in the respective commissioning protocol.

© 2022 Siemens Energy

6.2 Submitting the Settings

On new Installations (IS Command)

The **IS** command is recommended when the H2Guard is first installed on a transformer. This command doesn't modify the user configuration settings for relays, analog I/O, etc.

```
H2Guard: IS
>>> This will erase learned data and reset the sensor to factory
defaults; Proceed (Y/N)? y  (N will abort without change)

*** Power on Reset ***
```

Figure 47. IS Command Response

NOTICE
The **IS** command will erase learned/stored data and remove any DGA correction. The device will take about 24 hours to make internal adjustments and report hydrogen accurately.

On old Installations

Given the case the device has been previously installed, but it had to be removed and reinstalled again, there is no need for submitting the settings again. All user configuration settings for relays, analog /I/O are not going to be changed.

© 2022 Siemens Energy

6.3 Hydrogen Calibration based on DGA Results

In case a laboratory DGA test has been performed, it is possible to correct the Hydrogen measurement delivered by the SITRAM® H2Guard to reflect the DGA Test results.

Store the actual H2 measurement (DA Command)

When the oil sample is taken, it is important to store the current measured Hydrogen value by typing the **DA** command. As displayed in Figure 48, the Oil Temperature will be stored as well.

```
H2Guard: DA
Current H2 value is 34 ppm
   Temperature is 23.69C
```

Figure 48. DA Command Response

NOTICE

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

Adjust Hydrogen measurement (DB Command)

Once the DGA results are available, the new Hydrogen value can be inserted into the SITRAM® H2Guard. By issuing the **DB** command, the user will be allowed to enter the new Hydrogen value (see Figure 49). The new Hydrogen values generated by the SITRAM® H2Guard will be corrected considering the stored value when the **DA** command was issued.

```
H2Guard: DB
Enter actual hydrogen in ppm: 40
Set hydrogen to 40 ppm (Y/N)? y (N will ask for the correct value)
```

Figure 49. DB Command Response

NOTICE

The new hydrogen measurement may be different than the laboratory DGA Results due to changes in the real Hydrogen content since the oil sample was taken.

Delete Hydrogen measurement (DC Command)

This command allows the user to clear the DGA adjustment set by a **DB** command.

```
H2scan: DC
```

Figure 50. DC Command Response

NOTICE

Before issuing a **DA** command again, wait at least 24 hours.

© 2022 Siemens Energy

7. Getting Data from the Device

On new installations, the device will take up to 24 hours to reach equilibrium and report an accurate hydrogen reading.

During normal operation, the device will periodically measure oil temperature (approximately once/hour) to provide temperature compensated dissolved gas readings. The unit also will periodically go through an internal calibration check (called reference cycle). These are automatic activities and no user interaction is required.

In order to get the measured valued, the SITRAM® H2Guard offers different type of interfaces depending on the project requirements:

Using Analog / Relay Outputs

Using the CLI Interface

Using the Modbus Protocol (either RTU or TCP/IP)

For more information about the different use cases and their combinations, please refer to 1.2,"Application Scopes".

© 2022 Siemens Energy

7.1 Using Analog / Relay outputs

The most basic integration type of the SITRAM® H2Guard with other systems can be done using only the Analog / Relay outputs as displayed in Figure 1.

The upper system (SCADA or Gateway) needs to convert the analog values delivered by the SITRAM® H2Guard. Likewise, the discrete Signals available as relay outputs need to be powered and acquired by the same system.

7.1.1 Reading the Analog Outputs

By default, the three (3) analog outputs are Configured as displayed in the Table 16.

Pin	Signal	Available Measurement	Measurement Range	Analog Range	Not Ready Value	Fault Value
1	Aout1+	Hydrogen	0 – 5000 ppm	4 – 20 mA	3 mA	2 mA
2	Aout1-					
3	Aout2+	Repeater Ain1	NA	0 – 20 mA	Disabled	Disabled
4	Aout2-					
5	Aout3+	Repeater Ain2	NA	0 – 20 mA	Disabled	Disabled
6	Aout3-s					

Table 16. Default Analog Output Ranges.

The Analog Outputs 2 and 3 are repeaters of the configured Analog Inputs.

NOTICE

The analog outputs 2 and 3 range should be configured depending on the described range given by the manufacturer of the external sensor. Likewise, depending on the project requirements, the “Not Ready Value” and “Fault Value” may be configured.

Change Analog Outputs Settings (AO Command)

The **AO** command allows the user to change the three (3) Analog Output configuration. The default values are shown in the Figure 51. The program prompts the user for changes to:

Enable/disable an output. Unused outputs can be still left enabled, without affecting the device functionality.

Select output type “1” for current signals or “2” for voltage.

Specify range of output signal (0-5V or 0-20mA) depending on the input type selected previously.

7.1.2 Reading the Relay Outputs

The four (4) relay outputs indicates (as discrete signals) if the device itself is working is properly or if the Hydrogen measurement has reached the defined thresholds. Similar to the available LED´s in the display (see Table 10), the Relay outputs would indicate mainly three states:

Relay 1 – ALERT Condition: The hydrogen measurement has reached a specific level.

© 2022 Siemens Energy

Relay 2 – ALARM Condition: The hydrogen content has been increasing, reaching a higher level.

Relay 3 – FAULT Condition: The device itself is not working properly.

The triggering conditions for ALERT and ALARM are described in 6.1.2, “ALERT and ALARM Triggering Conditions”. For the FAULT conditions, refer to the section 5.5, “Configure internal FAULT status”.

© 2022 Siemens Energy

```
H2Guard: AO
cddha     Analog Output Configuration:
cddha       Aout1 is enabled
cddha.A1      Hydrogen Signal Range:
cddha.A1         Low Range (ppm) = 0
cddha.A1        High Range (ppm) = 5000
cddha.A1      Output Range:
cddha.A1         Low Output (mA) = 4.00
cddha.A1        High Output (mA) = 20.00
cddha.A1      Not Ready (mA) = 3.00
cddha.A1      Fault (mA) = 2.00
cddha       Aout2 is enabled
cddha.A2      Ain1 Repeater
cddha.A2      Output Range:
cddha.A2         Low Output (mA) = 0.00
cddha.A2        High Output (mA) = 20.00
cddha.A2      Not Ready is disabled
cddha.A2      Fault Output is disabled
cddha       Aout3 is enabled
cddha.A3      Ain2 Repeater
cddha.A3      Output Range:
cddha.A3         Low Output (mA) = 0.00
cddha.A3        High Output (mA) = 20.00
cddha.A3      Not Ready is disabled
cddha.A3      Fault Output is disabled
cedha      Change (Y/N)? y (n will exit without change)
cedha       Aout1 is enabled, Change (Y/N)? n (Y will toggle setting)
cddha.A1      Hydrogen Signal Range:
cddha.A1         Low Range (ppm) = 0
cddha.A1        High Range (ppm) = 5000
cddha.A1      Output Range:
cddha.A1         Low Output (mA) = 4.00
cddha.A1        High Output (mA) = 20.00
cddha.A1      Not Ready (mA) = 3.00
cddha.A1      Fault (mA) = 2.00
cedha        Change (Y/N)? y
cddha.A1      Hydrogen Signal Range:
cddha.A1         Low Range (ppm) = 0
cddha.A1        High Range (ppm) = 5000
cedha.A1       Change (Y/N)? y
cddha.A1        Signal Source is Hydrogen
cedha.A1        Select Signal Source:
cedha.A1          1 - Hydrogen
cedha.A1          2 - Oil Temp
cedha.A1          3 - Ain1
cedha.A1          4 - Ain2
cedha.A1        enter selection: 1
cedha.A1        selected: Hydrogen
cedha.A1        lowRange (ppmH2): 0
cedha.A1        highRange (ppmH2): 5000
cddha.A1      Output Type is Current
cedha.A1       Change (Y/N)? y
cedha.A1        Select Output Type:
```


© 2022 Siemens Energy

```
cedha.A1          1 - current
cedha.A1          2 - voltage
cedha.A1        enter selection: 1
cedha.A1        selected: current
cddha.A1      Output Range:
cddha.A1         Low Output (mA) = 4.00
cddha.A1        High Output (mA) = 20.00
cedha.A1       Change (Y/N)? y
cedha.A1        lowOutput (mA): 4
cedha.A1        highOutput (mA): 20
cedha.A1      Not Ready Output is enabled, Change (Y/N)? n (Y will toggle
setting)
cddha.A1      Not Ready (mA) = 3.00
cedha.A1       Change (Y/N)? y
cedha.A1        notReady (mA): 3
cedha.A1      Fault Output is enabled, Change (Y/N)? n (Y will toggle
setting)
cddha.A1      Fault (mA) = 2.00
cedha.A1       Change (Y/N)? y
cedha.A1        fault (mA): 2
cedha       Aout2 is enabled, Change (Y/N)? n (Y will toggle setting)
cddha.A2      Ain1 Repeater
cddha.A2      Output Range:
cddha.A2         Low Output (mA) = 0.00
cddha.A2        High Output (mA) = 20.00
cddha.A2      Not Ready is disabled
cddha.A2      Fault Output is disabled
cedha        Change (Y/N)? y
cddha.A2      Ain1 Repeater
cedha.A2       Change (Y/N)? y
cddha.A2        Signal Source is AIN1
cedha.A2        Select Signal Source:
cedha.A2          1 - Hydrogen
cedha.A2          2 - Oil Temp
cedha.A2          3 - Ain1
cedha.A2          4 - Ain2
cedha.A2        enter selection: 3
cedha.A2        selected: Ain1
cddha.A2      Output Type is Current
cedha.A2       Change (Y/N)? y
cedha.A2        Select Output Type:
cedha.A2          1 - current
cedha.A2          2 - voltage
cedha.A2        enter selection: 1
cedha.A2        selected: current
cddha.A2      Output Range:
cddha.A2         Low Output (mA) = 0.00
cddha.A2        High Output (mA) = 20.00
cedha.A2       Change (Y/N)? y
cedha.A2        lowOutput (mA): 0
cedha.A2        highOutput (mA): 20
cedha.A2      Not Ready Output is disabled, Change (Y/N)? n (Y will
toggle setting)
cedha.A2      Fault Output is disabled, Change (Y/N)? n (Y will toggle
setting)
```


© 2022 Siemens Energy

```
cedha       Aout3 is enabled, Change (Y/N)? n (Y will toggle setting)
cddha.A3      Ain2 Repeater
cddha.A3      Output Range:
cddha.A3         Low Output (mA) = 0.00
cddha.A3        High Output (mA) = 20.00
cddha.A3      Not Ready is disabled
cddha.A3      Fault Output is disabled
cedha        Change (Y/N)? n (Y will ask for changes)
Saving ...
```

Figure 51. AO Command Response

7.1.3 Testing the Integration (MTIO Command)

The **MTIO** command automatically cycles through a fixed sequence of output values for testing SCADA wiring. Each step lasts 5 seconds and the cycle repeats forever until ESC is pressed.

```
H2Guard: MTIO
=== Begin I/O Test, Press ESC to Exit ===
; Ain1(mA), Ain1(V), Ain2(mA), Ain2(V),  R1, R2, R3, R4, Aout1, Aout2, Aout3
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  0,  0,  0,    10,     5,     5,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  0,  0,    10,    10,     5,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  1,  0,    10,    10,    10,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  1,  1,    15,    10,    10,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  0,  1,  1,  1,    15,    15,    10,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  0,  0,  1,  1,    15,    15,    15,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  0,  0,  0,  1,    20,    15,    15,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  0,  0,  0,  0,    20,    20,    15,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  0,  0,  0,    20,    20,    20,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  0,  0,     5,    20,    20,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  1,  0,     5,     5,    20,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  1,  1,  1,  1,     5,     5,     5,
    0.00  ,  0.00  ,  0.00  ,  0.00  ,  0,  1,  1,  1,    10,     5,     5,
```

Figure 52. MTIO Command Response

© 2022 Siemens Energy

7.2 Using the CLI

The CLI interface can be accessed either using one of the serial interfaces (see Figure 2) or using the Ethernet interface (see Figure 3). In either case, the device needs to be configured according to the instructions given in section 5.2,"Configure Communication Settings".

7.2.1 Resume Streaming Data (G Command)

By issuing the **G** command, the CLI will display information every second until the ESC key is pressed. As displayed in Figure 53, the First two lines of header information are sent, then a line of measurement data using a CSV (comma separated value) format.

```
H2Guard: G
; SensorB=B11.02RB.10603TN1X, FW=1:51:A, DBFW=1.20,
DF=94F8CA00:F0000001::::82080000:00000000:, FieldMode,
; Owner=, Site=, Location=
;dateTime,PWrOnHrs,ppmH2,ppmH2/day,ppmH2/week,
ppmH2/month,tdcOil,tdcPcb,tdcTresB,htrStateB,ain1mA,ain2mA,Messages,
```

Figure 53. G Command Response

The meaning of each single parameter is described lines below.

User Information

Owner name of the customer.

Site name of the substation where the device has been installed.

Location City, Country where the device has been installed.

Current & Operation Time

dateTime is the date and time for the line of data; using "mm/dd/yy hh:mm:ss.sss" format.

PwrOnHrs is the accumulation of time the device has been powered on, expressed in an integer number of hours.

Hydrogen Parameters

ppmH2 is the dissolved gas hydrogen measurement in ppm (comparable to DGA results).

ppmH2/day is the hydrogen rate of change over the last day (24 hours).

ppmH2/week is the hydrogen rate of change over the last week (7 days).

ppmH2/month is the hydrogen rate of change over the last month (28 days).

Internal Device Parameters

tdcOil is the oil temperature near the device in degrees Celsius.

tdcPcb is the internal PCB temperature in degrees Celsius of the main electrical board.

tdcTresB is the hydrogen device temperature in degrees Celsius.

htrStateB indicates the state of the device heater; no value means the heater is "on" and the die at the expected operating temperature, other values include (see Table 17):

© 2022 Siemens Energy

State	Description
htr_off	Indicates the heater is turned off to measure oil temperature
ramp_up	Indicates the heater is increasing temperature
ramp_down	Indicates the heater is decreasing temperature
ramp_off	Indicates the heater is being turned off
Warmup	Indicates the heater is stabilizing to temperature

Table 17. Heater Status.

Analog Inputs Values

ain1mA reports the input current measured at Ain1 in mA.

ain2mA reports the input current measured at Ain2 in mA.

Relay Status

Messages indicates the state of the hydrogen measurement system including error messages. A list of messages is displayed in Table 18:

Message	Description
err_0x00000	See Table 21, for more information
R1	Indicates Relay 1 is active
R2	Indicates Relay 2 is active
R3	Indicates Relay 3 is active
R4	Indicates Relay 4 is active

Table 18. Default Analog Output Ranges.

7.2.2 Display Data Log (LD Command)

This command is used to display the H2Guard data log from internal memory; use FLD when an SD card is installed. First the data log is scanned to collect summary information then the user can display it using default values or select a custom display. An estimated display time (time to display) is shown along with statistics from the data log. To reduce display time the user can select a custom format and restrict the data displayed. During the display or prompt, press ESC to exit.

© 2022 Siemens Energy

```
H2Guard: LD
scan file ...
Data Log Capabilities (internal):
  Sample record size (bytes): 118
  Recording rate: 60.00 records per hour
  Memory capacity: 8880 records
  Estimated history: 0.02 years.
  Memory used: 2750 of 8880 records, 30.97%.
  Time to full: 0.15 months
Data Captured:
  Total Records: samples = 2750, events = 10
  First record: 0, 12/15/16 20:25:31.960
  Last record: 2762, 12/19/16 16:43:51.839
Data Summary (H2, H2(roc/day), OilTemp):
  ppmH2 (min, max, avg): 20, 35, 27
  ppmH2PerDay (min, max, avg): -3, 8, 1
  tdcOil (min, max, avg): 23.15, 26.01, 25.11
External memory is enabled, use 'FLD' command.
Estimated display time [h:m:s] 00:01:17
  ----------------------
  Use default display (Y/N)? n  (Y use custome format)
  Estimated display time [h:m:s] 00:01:17
  Select Option:
    1 - Print now
    2 - Samples only
    3 - Events only
    4 - Decimate records
    5 - Last number of records
    6 - Range of records
    Press ESC to abort
  Selected:1
```

Figure 54. LD Command Response

© 2022 Siemens Energy

7.3 Using the Modbus Protocol

The SITRAM® H2Guard supports the Modbus protocol either by the serial physical layer RS-485 per EIA/TIA-485 or by Ethernet TCP/IP.

The Modbus communication protocol is based on a master/slave architecture. The protocol implemented in the SITRAM® H2Guard is Modbus RTU for the serial interface and Modbus TCP for the ethernet interface. Because the Modbus protocol is a single-master protocol, is the master which controls the entire data and monitors any possible timeouts (no reply from addressed device). For more information about the Modbus messages please refer to 11.5, “Modbus Protocol”.

The information available through the Modbus Registers is the one that has been configured through the CLI interface. While most of the Modbus registers can be written (access = W), it is recommended to carry out the initial configuration by means of the CLI interface. For more information about writing the available Modbus registers please refer to section 11.5.2,”Writing Modbus Registers”.

NOTICE
Reading registers containing 32 or 64 bit integers – the Modbus task is lower priority than other data collection and computational tasks – therefore, in order to prevent preemption and possible inconsistent reads, 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 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.

7.3.1 Device and Measurement Status Registers

In the Table 19, a list of registers (only readable) describes the condition of the SITRAM® H2Guard.

© 2022 Siemens Energy

Status/Error Information					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
111	Status	Refer to relevant section	16 bit binary flags	See Table 20	R
112	Error Status	Refer to relevant section High word	32 bit binary flags	See Table 21	R
113		Low word			
114	Relay 1 Event	Refer to relevant section	16 bit binary flags	See Table 22	R
115	Relay 2 Event	Refer to relevant section	16 bit binary flags	See Table 22	R
116	Relay 3 Event	Refer to relevant section	16 bit binary flags	See Table 22	R
117	Relay 4 Event	Refer to relevant section	16 bit binary flags	See Table 22	R
118-120	Reserved for future use				

Table 19: Status/Error Information Registers

The Bit map for the interpretation of the register values are described in the following sections.

Status: Register 111

Status information is maintained in Modbus Register 111. The bit map for this status word is described in Table 20:

© 2022 Siemens Energy

Bit #	Description
15	Unit Ready, hydrogen readings are valid
14	New measurement data available, auto-clear after register read
12	Error, indicates an unrecoverable error occurred, read Registers 112-113 for more information
13	Reserved
11	Relay 4 (User) status:1 if active , read Register 117 for more information
10	Relay 3 (Fault) status: 1 if active, read Register 116 for more information
9	Relay 2 (Alarm) status: 1 if active, read Register 115 for more information
8	Relay 1 (Alert) status: 1 if active, read Register 114 for more information
7	Reserved
6	Reserved
5-3	Sensor A state Information: 000 – Sensor A not used 001 – Hydrogen measurement cycle 010 – Oil temperature measurement cycle 011 – Auto calibration cycle 100 – Oil temperature too high
2-0	Sensor B state Information: 000 – Sensor B not used 001 – Hydrogen measurement cycle 010 – Oil temperature measurement cycle 011 – Auto calibration cycle 100 – Oil temperature too high

Table 20: Unit Status

Error Status: Register 112 -113

When the error flag (bit 12) of the Unit Status register 111 is set, this 32 bit register has more information about what is causing the error. The bit map is shown in the Table 21; unlisted bits are reserved.

© 2022 Siemens Energy

Bit #	Hex Value	Description
31	0x8000 0000	Sensor A – Heater fault
30	0x4000 0000	Sensor A – Temperature Sensor Fault
29	0x2000 0000	Sensor A – Hydrogen Sensor 1 Fault
28	0x1000 0000	Sensor A – Hydrogen Sensor 2 Fault
19	0x0008 0000	Sensor B – Heater fault
18	0x0004 0000	Sensor B – Temperature Sensor Fault
17	0x0002 0000	Sensor B – Hydrogen Sensor 1 Fault
16	0x0001 0000	Sensor B – Hydrogen Sensor 2 Fault
2	0x0000 0004	PCB Temperature greater than 105C
1	0x0000 0002	Required data not available
0	0x0000 0001	Configuration data not valid

Table 21: Error Status

Relay Event: Register 114-117

Each single register (from 114 to 117) reflects the actual state of the Relay Outputs (see section 7.1.2, "Reading the Relay Outputs"). Nevertheless, the Modbus registers offer detailed information about the condition triggering the relay output.

When a relay flag (bits 8, 9, 10, or 11) of the Unit Status register 111 is set, the corresponding relay event register shows more information about what caused the relay to trip. The bit map is shown in Table 22, unlisted bits are reserved.

Bit #	Description
15	Unit Status event
14	Hydrogen event
13	Rate of Change event
10	Ain1 event
9	Ain2 event
8	Oil Temperature event
7	PCB Temperature event

Table 22: Relay Event

7.3.2 Hydrogen Measurement Parameters

In order to read the measured data from the SITRAM® H2Guard, the available Modbus Registers are listed in Table 23.

© 2022 Siemens Energy

Measurements					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
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	Oil 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 H2 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 H2 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 H2 per Month +20,000,000 offset	High word	32 bit binary number	-20,000,000 to +20,000,000	R
18		Low word			
19	Ain1, mA	x100 scale; Ain1=(V/100) mA	16 bit binary number	0 to 2000	R
20	Ain2, mA	x100 scale; Ain2=(V/100) mA	16 bit binary number	0 to 2000	R
21-30	Reserved for future use				

Table 23: Measurement Registers

H2 Calibration Registers

In case the Calibration process has been carried out (see section 6.3, "Hydrogen Calibration based on DGA Results"), please use the registers listed in Table 24 to read the respective information:

© 2022 Siemens Energy

Calibration Information					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
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				

Table 24: Calibration Information Registers

7.3.3 User Information Registers

In the Table 25, the registers for the user Information are displayed.

User Information					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
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	Sub-Station ID		ASCII String		R/W
221-230	Transformer ID		ASCII String		R/W
231-255	Reserved for future use				

Table 25: User Information Registers

7.3.4 Device and Time Information Registers

In the Table 25 and Table 27 the registers for the device and time Information are displayed.

© 2022 Siemens Energy

Register	Parameter	Function	Data Type	Data Range	Access
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	Interface Board Serial Number		ASCII String		R
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				

Table 26: Device Information Registers

Time Status					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
175	Month / Year	Date & Time; read register 175 first; order high-byte / low-byte; add 2000 to year	Two Bytes		R
176	Hour / Day		Two Bytes		R
177	Second / Minute		Two Bytes		R
178	Millisecond		16 bit binary number		R
179-200	Reserved for future use				

Table 27: Time Status Registers

© 2022 Siemens Energy

8. Firmware Updates

Siemens Energy provides products and solutions with industrial security functions that support the secure operation of plants, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens Energy' products and solutions undergo continuous development. Siemens Energy recommends strongly that you regularly check for product updates.

The SITRAM® H2Guard has been designed to be updated with simple steps and without modifying any of the configuration files or stored historical data. To stay informed about product updates as they occur, sing up for a product-specific newsletter. For more information, visit:

https://new.siemens.com/global/en/products/energy/services/transmission-distribution-smart-grid/product-support/hv-product-services.html

Required Setup and Files

SITRAM® H2Guard firmware is field upgradable from the command line interface. The following procedure requires:

Windows Computer with a serial communication adapter (USB) or cable connection. Please assure that the USB driver is already installed. For more information refer to section 4.2.1, “Mini-USB Port”.

NOTICE
In case of board firmware higher than version 1:51, the firmware update can be performed using CLI over Ethernet.

Terminal emulator such as Foxterm running on the computer. For more information refer to section 5.1.1, “Foxterm Terminal Emulator”

The firmware upgrade files provided by Siemens Energy.

Unzip the firmware upgrade files to a directory on the PC. The directory will contain six files. The following three files are required for the Firmware Update of the SITRAM® H2Guard.

g4SbR1_51A.hex – sensor firmware hex file

hduG4.exe – sensor downloader utility

snsr1_51A.bat – sensor batch file

NOTICE
The end part of the file name will indicate the version of the Firmware. For example, “1_51A” indicates that the version firmware is the 1:51A.

The other three files are optional, and they are required to upgrade the firmware running on the display:

g4dbu30.exe – optional display downloader utility

© 2022 Siemens Energy

g4DbR120.hex – optional display firmware hex file

ddl_120.bat– optional display batch file

NOTICE
It is recommended to update first the device firmware and then the display firmware.

© 2022 Siemens Energy

8.1 Using CLI over USB serial

8.1.1 H2Guard Firmware Update Procedure

Please follow the next steps to update the Firmware running on the SITRAM® H2Guard:

1. Establish serial communication with H2Guard over the command line interface. Make note of which COM port number is used.
2. Make sure you log data from beginning of the working on SITRAM® H2Guard setting using FoxTerm. Ensure that the FoxTerm settings "Log Files" is enabled. See section 5.1.1,"Foxterm Terminal Emulator" for more information.
3. Check if configuration setting match installation requirements. See command line interface section.
4. Ensure that the commands described in Figure 55 are logged, for documentation purposes. The saved log file data will be requested in case of any support required.

```
=OEM
CD
LD
CLS
```

Figure 55. Logging Data Command

5. At the `H2Guard:` prompt enter the **=scan** command, then close the terminal emulator program or disable the connection. Makes sure you close sessions in Foxterm.
6. Go to folder Hex then folder sensor. Edit the **snsr1_51A.bat** file to use the COM port number that the H2Guard is connected to. The sensor batch file contains the commands displayed in Figure 56.

```
hduG4 g4SbR1_51A.hex com6
pause
```

Figure 56. Bat File Setup

7. Change the COM port (i.e. "com6") according to the real port Number and save the file.
8. Execute the **snsr1_51A.bat** file to send new firmware to the H2Guard which will automatically reboot to complete the firmware upgrade process. This operation takes about 10-15 minutes. An example of the execution can be seen in Figure 57.
9. Re-establish serial communication with H2Guard over the command line interface and confirm the new firmware revision is active using the **CD** command or press the space bar to see the streaming data header.
10. If desired, for documentation purposes, type the commands described in Figure 55, to log the data stored in the device after the firmware update.

© 2022 Siemens Energy

```
C:\> snsr1_55A.bat
hduG4.exe g4SbR1_55A.hex com6
H2scan Downloader32 Version 2.1
type 4
type 4
type 4
type 4
type 4
type 4
type 4
type 4
type 4
--EOF--
boot cnt= 0, cs ffff
main cnt= 8f260, cs 5aa7
=scan
H2Guard: cl
Download Command:
Enter main crc:5aa7
Proceed (Y/N)? y
erase upper 1MB Flashhh......
Ready.... send Hex File... >
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
................................
......
8110000
8120000
8130000
8140000
8150000
8160000
8170000
```


© 2022 Siemens Energy

```
8180000
8190000
--EOF--
Main CRC passed!
Download complete:
C:\> pause
Press any key to continue . . .
```

Figure 57. Execution of the Bat File for the H2Guard Firmware update

© 2022 Siemens Energy

8.1.2 Display Board Firmware Update Procedure

Please follow the next steps to update the Firmware running on the Display:

11. Go to folder Hex then folder Display.
12. Edit the **disp120.bat** file to use the COM port number that the H2Guard is connected to. The display batch file contains the following commands (see Figure 58). Change the COM port accordingly and save the file.

```
g4dbu30.exe g4DbR120.hex com6
pause
```

Figure 58. Execution of the Bat File for the Display Firmware Update

13. Re-establish serial communication with H2Guard over the command line interface.
14. At the `H2Guard:` prompt enter the **=scan** command to stay at the H2Guard: prompt
15. Close the terminal emulator program or disable the connection. Makes sure you close sessions in Foxterm.
16. Execute the **disp120.bat** file to send new firmware to the H2Guard which will automatically reboot to complete the firmware upgrade process. This operation takes about 3 minutes.

```
C:\> disp120.bat
C:\> g4dbu g4DbR120.hex com6
Display Board Downloader Version 3.0
Reset the display board. power-off...power-on...enter display
start download(11 blocks):
....
....
....
....
....
....
....
....
....
....
....
148 bytes left
cd
back to ascii
CRC OK 0x6d5@
DsplBd:
C:\> pause
Press any key to continue . . .
```

Figure 59. Response after executing the bat file for the display upgrade

© 2022 Siemens Energy

17. Make picture of the cmd.exe windows opened and save the picture. Later for any supports would be requested.
18. Re-establish serial communication with H2Guard over the command line interface and confirm the new firmware revision for the display is active using the **CD** command or press the space bar to see the streaming data header.
19. If desired, for documentation purposes, type the commands described in Figure 55, to log the data stored in the device after the firmware update.

© 2022 Siemens Energy

9. Certifications

The SITRAM® H2Guard has been thoroughly tested to guarantee its conformance with recognized standards and has received approval from recognized regulatory agencies.

CE Label Location

On the bottom of the housing there is the type label with specific information as Manufacturer, Product name, order code, product version and serial number.

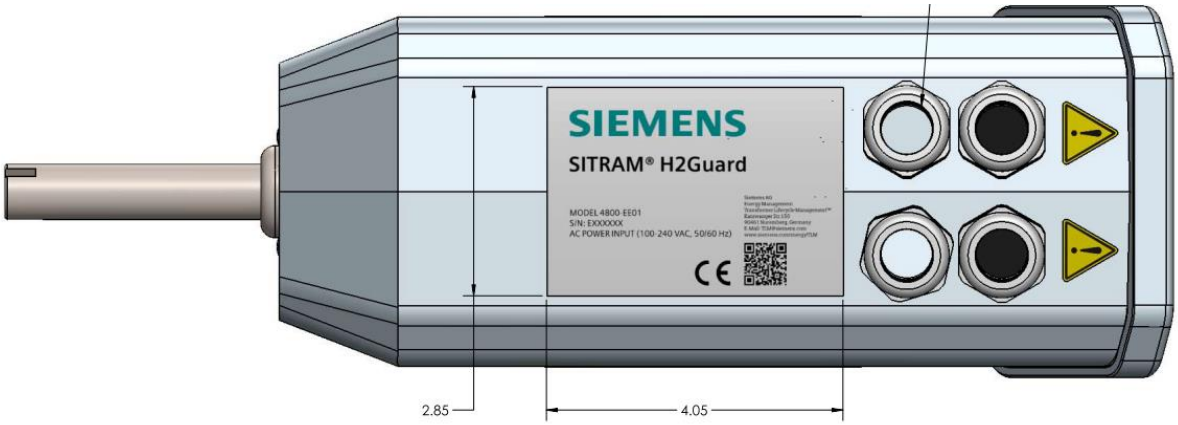


Figure 60. CE Label Location

© 2022 Siemens Energy

9.1 Approvals

The SITRAM® H2Guard Device has been thoroughly tested to guarantee its conformance with recognized standards and has received approval from recognized regulatory agencies.

9.1.1 European Union (EU)

This device is declared by Siemens Energy to comply with essential requirements and other relevant provisions of the following harmonized EU directives:

Reference Number	Date of issue	
IEC 61000-6-5	2015-08	Immunity for equipment used in power station and substation environment
EN55022	2010	Limits and methods of measurement for radio disturbance characteristics from information technology equipment
IEC 61010-1	2010	Safety requirements for electrical equipment for measurement, control and laboratory use. No Breakdowns, passed Dielectric Test. Pollution degree 2, overvoltage category II, working voltage of 600V assumed (reference document “Gen4 Isolation Analysis - Rev 0.02”). Table C.4 of EN 60255-27 used.
EN 50581	2012	Technical documentation for assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 60255-27	2013	Measuring relays and protection equipment - part 27: product safety requirements. Clause 10.6.3, Clearances and creepage distances; Clause 10.6.4.3 AC or DC dielectric Voltage

Symbol	Meaning
CE	CE- Label

9.1.2 FCC

This device has been tested and found to comply with the limits of the requirement specifications as outlined in FCC Part 15, Subpart B Class A, ANSI C63.4 (2009). These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This device generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case users will be required to correct the interference at their own expense.

© 2022 Siemens Energy

9.2 EMC and Environmental Type Tests

9.2.1 Electromagnetic Type Tests

IEC 61850-3 Type Tests

Test	Description
BS EN 61000-4-2	Immunity: electrostatic discharge - ESD
BS EN 61000-4-3	Immunity: radio frequency electromagnetic field.
BS EN 61000-4-4	Electrical fast transients/bursts – EFT/B. No test is needed for cables shorter than 3 m.
BS EN 61000-4-5	Surges. No test is needed for cables shorter than 10 m.
BS EN 61000-4-6	Conducted disturbances induced by radio frequency fields.
BS EN 61000-4-11	Voltage dips, short interruptions
BS EN 61000-4-8	Power frequency magnetic field immunity test

IEEE C37.90.1 Type Tests

Test	Description
IEEE C37.90.1:2012	Oscillatory SWC Test
IEEE C37.90.1:2012	Fast Transient SWC Test

© 2022 Siemens Energy

9.2.2 Environmental Type Tests

Test	Description
EN 60068	IP6X Dust Ingress
EN 60068	IPX7 — Liquid Ingress
DIN EN 60068-2-6	Sinusoidal Vibration Scan
DIN EN 60068-2-2	Dry Heat
DIN EN 60068-2-64	Random Vibration
DIN EN 60068-2-27	Shock
DIN EN 60068-2-11	Salt Mist
DIN EN 60068-2-11	C5-M Equivalent Powder Coating Specification
	Additional Test - Vibrational Dwell at 50 & 60 Hz
	Additional Test - Temperature Cycling

© 2022 Siemens Energy

9.3 Maintenance

The SITRAM® H2Guard has no parts that are intended to be maintained by the end user. In case of failure or malfunction contact the manufacturer as stated in the Preface of this document (Support).

© 2022 Siemens Energy

10.Troubleshooting

This section described the potential problems and its solutions.

© 2022 Siemens Energy

10.1 Device Measurements

The following describes common problems related to the device measurements:

Problem	Solution
The analogue outputs are delivering 0mA.	Check the analog outputs settings. If the analog outputs are set to be between 0-20mA, the external could still be faulty. Set a different output range. For example, from 4 to 20mA. If the analogue output is still 0mA, the external sensor is faulty.
Relay Output #3 is triggered	Recovery from a fault includes: Power cycle the device and determine if the fault condition repeats within one hour. If the fault repeats within an hour then remove the device from the installation and test again for one hour. If the fault repeats the device is defective and needs repair or replacement. If the fault doesn't repeat during the stand-alone test, then problem is likely caused by the installation and mechanical/electrical connections. If the fault doesn't repeat, then leave the unit operating. If the device fails again for the same fault additional analysis/support is required

Table 28. Device Measurements Problems.

© 2022 Siemens Energy

10.2 Time Synchronization

The following describes common problems related to Time Synchronization:

Problem	Solution
The Time Stamp of the measurements are always located in the past.	The internal clock needs to be updated. Please refer to 5.3.1,"Time Settings" for more information.

Table 29. Time Synchronization Issues.

© 2022 Siemens Energy

11.Appendix

This section describes additional information required for the installation or the operation of the device.

© 2022 Siemens Energy

11.1 Assembly Types

Despite the standard stainless probe, the SITRAM® H2Guard requires a mechanical interface to the Transformer. Depending on the conditions and requirements of the customer installation, different type of Flanges can be supplied.

NOTICE
The following information give an overview of the different mechanical interfaces that may be supplied. For more detailed technical details please contact the Siemens Energy Customer Support center.

11.1.1 DN80 Flange Arrangement - Recommended

The recommended mechanical interface can be seen in Figure 61. The flange would offer an ¾" interface for the connection of the SITRAM® H2Guard. In parallel (see blue interface in Figure 61), a connection is available for an additional Oil Moisture sensor.

For more information about the recommended external Oil moisture sensor refer to 11.3,"External Moisture Sensor".

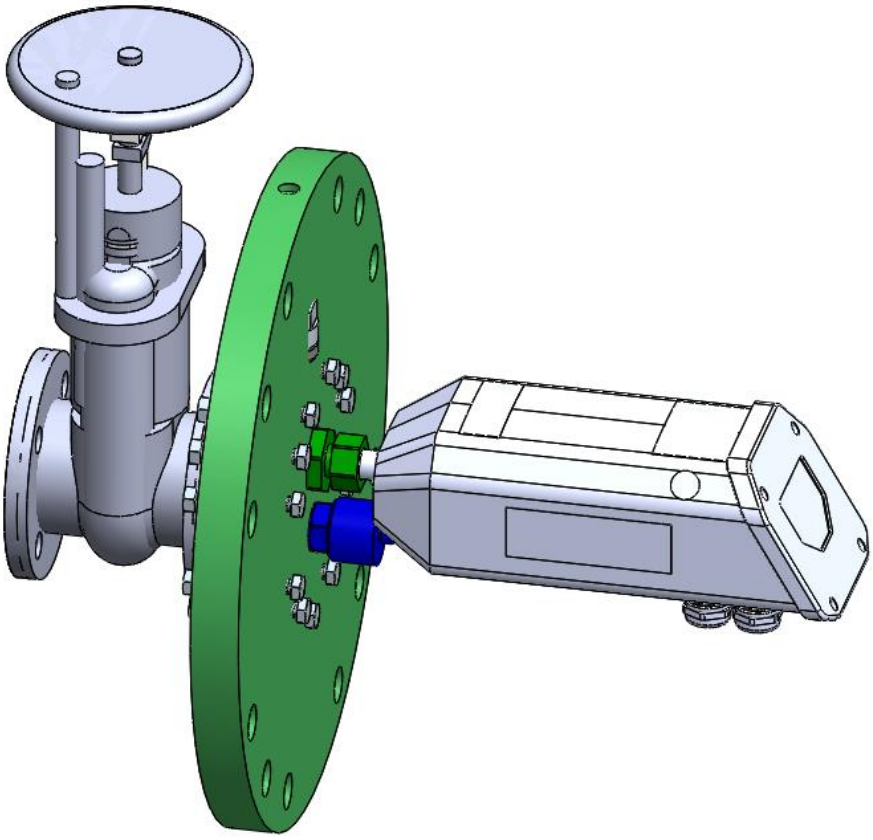


Figure 61. H2Guard Flange Arrangement (green) with external Moisture Sensor (highlighted in Blue).

© 2022 Siemens Energy

11.1.2 ½" NTP Type with isolation valve

In the Figure 62, the ½" NTP Type flange with isolation vale can be seen. On the right side of the Isolation valve, a ¾" interface is available for the connection of the SITRAM® H2Guard.Likewise, and based on customer requirements, an additional interface can be added to the flange in order to mount an external moisture sensor.

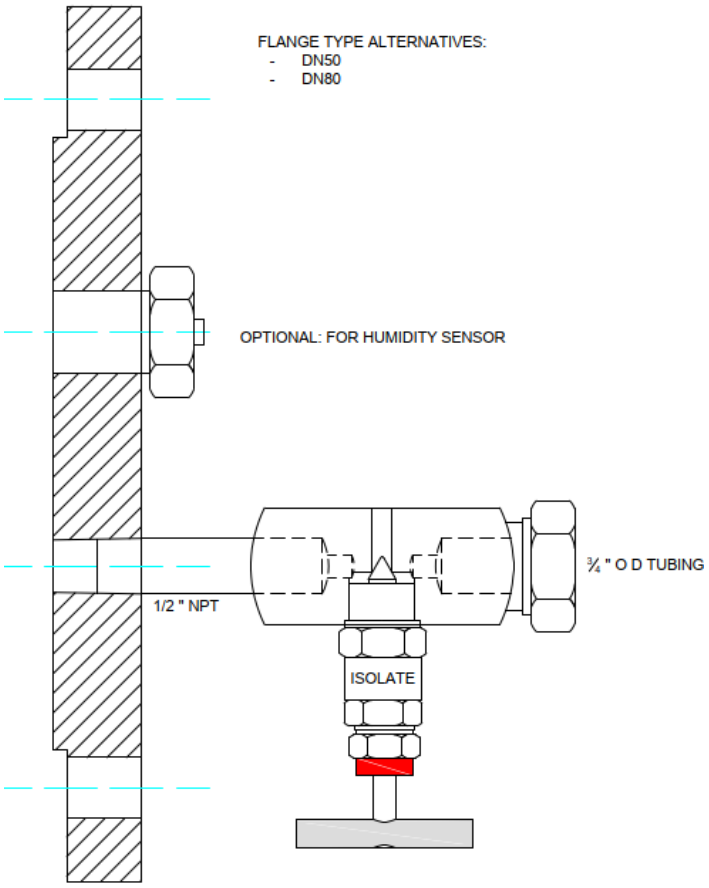


Figure 62. ½" NTP Flange with isolation valve.

WARNING - TBW
Installation with the air vent facing upwards is recommended, so as to have a better result during the bleeding procedure.

11.1.3 T-Shaped Fitting Arrangements

Bleed Valve

In the Figure 63 and Figure 64, different exemplary arrangements with some non-standard fitting equipment from 3rd party suppliers (e.g. "*Swagelok*") can be found, which can serve for special applications or different setups on-site. For saving time the already composed arrangements can be requested from Siemens Energy directly.

© 2022 Siemens Energy

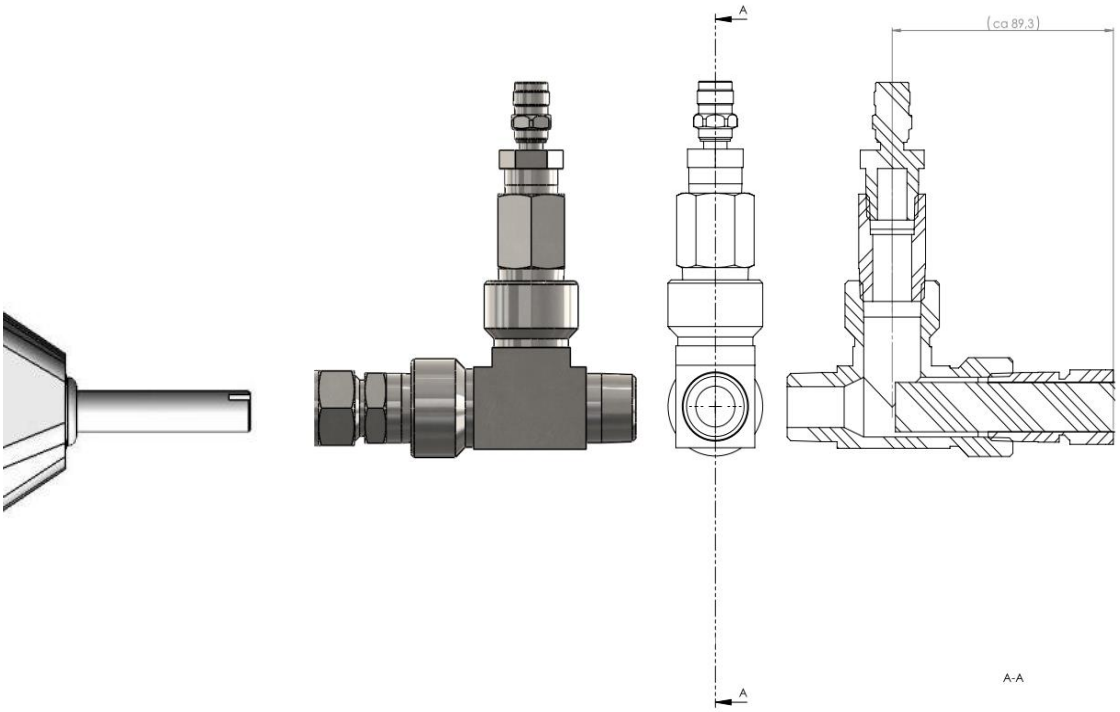


Figure 63. Tube Adapter Street Tee

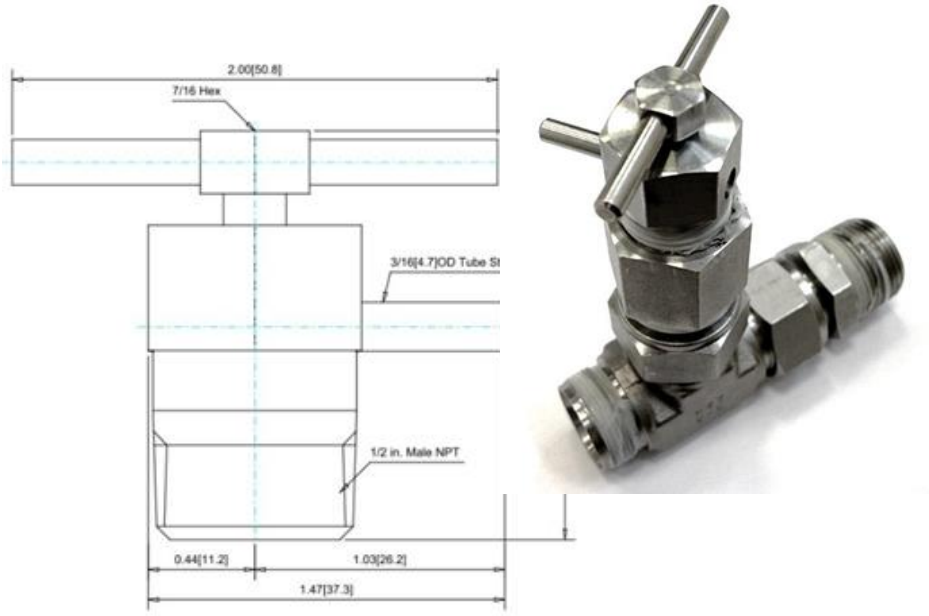


Figure 64. Special Bleed Valve

NOTICE
With the option of special bleed valves, it is possible to establish an access point for classical oil sampling for the laboratory analysis at the same location as the SITRAM® H2Guard installation interface.

© 2022 Siemens Energy

11.2 Recommended Cable

Based on field experience the following cable is suitable for the wiring of the device interfaces.


CAUTION

The technical specification of the recommended cables applies for most of the typical Device installations. It is highly recommended that the technical specifications are reviewed to ensure that they are fulfilling project specific constraints i.e. Ambient Temperature.

Wiring of the Systems Power Supply, Relay Outputs and Analogue Outputs

Control Cable ÖLFLEX ROBUST 210 12 G 1.5 mm2 Black – Supplied by “LappKabel”

Wiring of the Analogue Inputs

Control Cable ÖLFLEX ROBUST 210 4 G 1.5 mm2 Black – Supplied by “LappKabel”

© 2022 Siemens Energy

11.3 External Moisture Sensor

Water is generally not wanted in hydraulic liquids and lubricants. High concentrations of water can seriously affect operation or even cause damage to the Transformer. Different external sensors are available in the market, which can be connected to the SITRAM® H2Guard, by means of the analog inputs available in the device.

NOTICE

Before ordering the external sensor, it is necessary to confirm that the respective mechanical interface to the transformer is available. Refer to 11.1, "Assembly Types" for more information.

NOTICE

Before ordering the external sensor, it is necessary to confirm that the sensor provides the desired moisture reading in the correct manner:

SITRAM® H2Guard expects moisture reading as

- current or voltage input
- moisture as relative moisture (%RH / aw)
- scaling from 0 to 100%.

Thus, the SITRAM® H2Guard device can transfer to SCADA/Other systems, not only the hydrogen concentration measurement, but the oil temperature and relative humidity acquired by the external sensor, via communication protocols or analog outputs.

Furthermore, depending on the settings and configuration of the SITRAM® H2Guard, the user can set alarms on the acquired analog values. For more information refer to 5.4,"Configure Analog Inputs".

11.3.1 Typical External Moisture Sensor

A typical moisture sensor would measure the oil temperature and the relative humidity, giving a more comprehensive condition of the oil in the transformer. In order to be connected directly to SITRAM® H2Guard the moisture sensor needs analogue outputs for the readings.

A typical signal mapping of a suitable moisture sensor would be:

Output	Measured value	Output Signal
Output 1	-20 ... 120 °C (oil temperature)	4...20 mA linear
Output 2	0...100 % rel. humidity	4...20 mA linear

Table 30. Typical moisture sensor mapping

© 2022 Siemens Energy

NOTICE

The display of the SITRAM® H2Guard would only show the correct moisture value in case the scaling of the sensor is 0...100% relative humidity (linear) or 0...1 aw (linear).

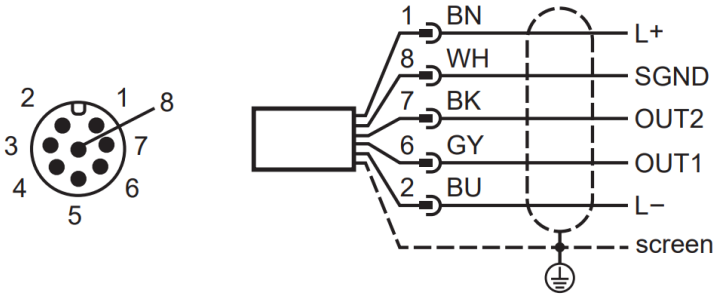
Please make sure that in case of using a moisture sensor with different scaling to deactivate the second window on H2Guard display to avoid misleading readings. For more information refer to 5.6, " Configure Frontal Display". The visualization of the Moisture value is going to be available for firmware versions >1:51.

The temperature value can have any scale, as therefore only the voltage / current reading is processed by the SITRAM® H2Guard.

Connection to the SITRAM® H2Guard

A typical moisture sensors would be passive and therefore requiring external power supply. A suitable moisture sensor would accept 15V DC as supply and consume not more than 0.99W.

Typically a moisture sensor would provide power supply and signaling in a single connector as a 8-pole M12 connector. Following find an exemplary moisture sensor pin-out:



NOTICE

Please note the wiring of the sensor and the sockets (see appropriate accessory data sheet) as core colors and pin assignments are not standardized.

© 2022 Siemens Energy

Following find a valid connection schema of a typical moisture sensor to SITRAM® H2Guard:

Moisture Sensor Connector				J4, Analog Inputs of SITRAM® H2Guard		
Pin	Signal	Note		Pin	Signal	Notes
*	n.c.			1	A in 1 – V	Voltage input
*	OUT 1	Oil Temp		2	Ain 1 – I	Current input
*	L +	15 VDC supply		3	15 V	Output supply voltage
*	L -	Supply GND		4	Ground	Isolated ground
*	n.c.			5	Ain 2 – V	Voltage input
*	OUT 2	Relative Moisture		6	Ain 2 – I	Current input
*	n.c.			7	15V	Output supply voltage
*	SGND	Signal Ground		8	Ground	Isolated ground

Table 31. exemplary connection scheme

* for the pin-out refer to the manual of the moisture sensor. Not connected Pins (n.c.) shall not be wired

NOTICE
Please keep in mind that Analog input 2 of the H2Guard is related to the moisture value. Please make sure that in case of having no moisture sensor, deactivate the second window on H2Guard display. For more information refer to 5.6, " Configure Frontal Display". The visualization of the Moisture value is going to be available for firmware versions >1:51.

11.3.2 LDH100 - External Moisture Sensor

The LDH100 is a suitable device and proven to work with SITRAM® H2Guard. It measures the oil temperature and the relative humidity. The LDH100 sensor has two analogue outputs that can be directly connected to the SITRAM® H2Guard.

The LDH100 can be ordered directly from Siemens Energy with the Material No. 40N70 01 001-01. For more detailed technical information of the Sensor refer to the respective external sensor manufacturer page.

© 2022 Siemens Energy

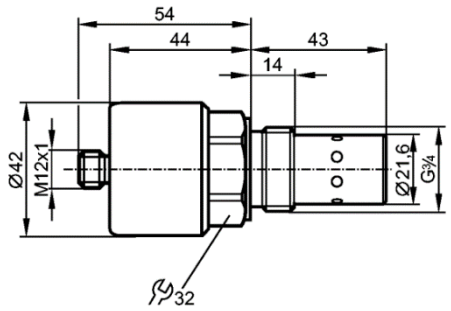


Figure 65. LDH100 Dimensions – All the units are displayed as [mm]

For connection of the sensor refer to the manual of the sensor and the guidelines given in this manual.

NOTICE
The sensor supplier might change any physical and non-physical property of the sensor without notice. Always refer to the documentation of the individual sensor.

© 2022 Siemens Energy

11.4 Overview User Commands

User Commands *(Used from H2Guard: prompt)*		
Command	**Level**	**Description**
?	**0**	Help command
AI	**2**	**A**nalog **I**nput configuration; view current settings, follow prompts to change.
AO	**2**	**A**nalog **O**utput configuration; view current settings, follow prompts to change.
CD	**0**	**C**onfiguration **D**isplay; print a summary of all user information and configuration settings.
CECP	**2**	**C**onfiguration **E**dit **C**LI **P**ort; view current settings, follow prompts to change.
CEDL	**2**	**C**onfiguration **E**dit **D**isp**L**ay; view current settings, follow prompts to change.
CEN	**2**	**C**onfiguration **E**dit **N**etwork; follow prompt to modify Ethernet settings.
CEPM	**2**	**C**onfiguration **E**dit **P**ort **M**odbus, follow prompt to modify which port is used for the Modbus interface.
CL	**2**	**C**ode **L**oad; send new operating firmware to the sensor board.
CLS	**2**	**C**ode **L**oad **S**tatus; show status information about the code load.
DA	**0**	**D**GA Offset Step **A**; saves current measurement data for future DGA adjustment.
DB	**0**	**D**GA Offset Step **B**; enter DGA results and calculates offset that is applied to future measurements.
DC	**0**	**D**GA **C**lear; clear the current DGA adjustment.
DD	**2**	**D**isplay **D**ata configuration; view current settings, follow prompts to change streaming data sent to CLI port.
DG	**2**	**D**isplay lo**G** data configuration; view current settings, follow prompts to change the data log recording rate.
DI	**2**	**D**evice **I**D; view current settings, follow prompts to change device ID used for Modbus.
DN	**2**	**D**isplay **N**etwork; display current network settings.
FDEL	**2**	**F**lash **DEL**ete; delete a file on the SD card.
FDIR	**2**	**F**lash **DIR**ectory; display a directory of files on the SD card.
FDSP	**2**	**F**lash **DiSP**lay file; display a text file on the SD card.
FLD	**2**	**F**lash Data **L**og **D**isplay; follow prompts to show content of the data log from the SD card memory.
FLDR	**2**	**F**lash Data **L**og **R**eset; reset the SD card binary data log file to match the internal data log memory.
FLTX	**2**	**F**lash Data **L**og to **TeXt**; convert a binary data log file to text format on the SD card.

© 2022 Siemens Energy

FREN	**2**	**F**lash **REN**ame; rename a file on the SD card.
FRMT	**2**	**F**lash Fo**RM**a**T**; format the SD card.
FOUT	**2**	**F**lash **OUT**; close all files in preparation to remove the SD card.
G	**0**	**G**o; start streaming data on the command line interface. Press ESC to exit.
IS	**2**	**I**n**S**tall; clear learned data and prepare sensor for installation.
IT	**3**	**I**nitialize Oil **T**ype; clear oil type values and use factory default.
IUC	**2**	**I**nitialize **U**ser **C**onfiguration; follow prompt to restore factory default configuration.
LC	**0**	Data **L**og **C**lear; follow prompt to clear the data log.
LD	**0**	Data **L**og **D**isplay; follow prompts to show content of the data log from internal memory.
LM	**2**	**L**ab **M**ode; select between lab and field mode.
MTIO	**2**	**M**ode **T**est **I/O**; continuous loop reading analog inputs and cycling through various analog output and relay values.
OT	**2**	Configure **O**il **T**ype; view the oil type configuration, follow prompts to change.
PT	**2**	**P**rint Oil **T**ype; display the oil type configuration.
RC	**2**	**R**elay **C**onfiguration; view relay configuration, follow prompts to change.
RS	**0**	**R**eal-time clock **S**etup; follow prompts to set correct date and time.
RT	**0**	**R**eal-**T**ime clock; prints the current date and time.
UI	**2**	**U**ser **I**nformation; view current settings, follow prompts to change.

© 2022 Siemens Energy

11.5 Modbus Protocol

11.5.1 Protocol Description

The following tables comprise the list of Modbus packets, values, registers, and register definitions. The maximum response time for the sensor is 10000 milliseconds. Therefore, the master's timeout should be set to 10000 milliseconds or greater.

Modbus Read Packets

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 32: Modbus Read Request 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.			

Table 33: Modbus Read Response Packet

© 2022 Siemens Energy

Modbus Write 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 34: Modbus Write Request 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

Table 35: Modbus Write Response Packet

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:

20. 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.
21. 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.
22. 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. In order to prevent

© 2022 Siemens Energy

this condition, the master timeout must be set longer than the maximum response time of the slave (10000 milliseconds).

23. 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 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.

Byte	Modbus Parameter	Range	Meaning
1	Slave Address	1 – 247	
2	Function Code	0x83 or 0x86	Read or Write
3	Exception Code	See Table 37	
4	CRC High	0x00 – 0xFF	
5	CRC Low	0x00 – 0xFF	

Table 36: Exception Response Packet

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.

Table 37: Exception Response Codes

© 2022 Siemens Energy

11.5.2 Writing Modbus Registers

Calibration Functions					
Register	**Parameter**	**Function**	**Data Type**	**Data Range**	**Access**
121	DA command		None	See relevant section	W
122	DB command	Write reg 126-129 first	None	See relevant section	W
123-124	Reserved for future use				
125	DC command	clear DGA cal	None	See relevant section	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				

Table 38: Calibration Registers

© 2022 Siemens Energy

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		

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

© 2022 Siemens Energy

Siemens Energy Global GmbH & Co. KG
Grid Technologies Service
Humboldtstr. 64
90459 Nuremberg, Germany

Customer Support Center
Telefon:+49 911 6505 6505
E-Mail: support@siemens-energy.com

For more information, please visit our website:
https://www.siemens-energy.com/gt-service

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract

Siemens Energy is a trademark licensed by Siemens AG.