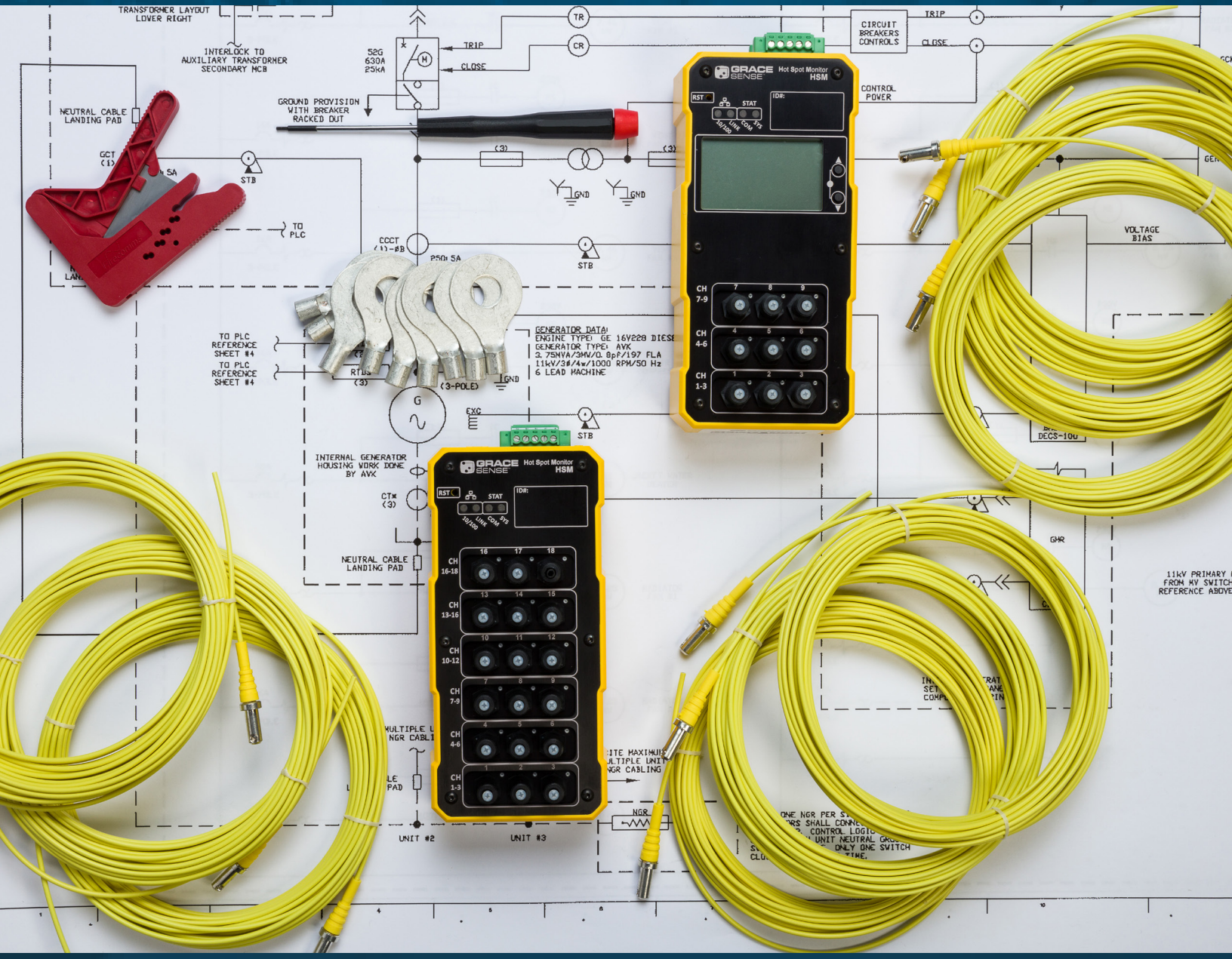
GRACE SENSE™



HOT SPOT MONITOR (HSM)
INSTALLATION GUIDE

INSTRUCTION BULLETIN NO. **HSM-IG-EN**

Contact Information:

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Davenport, IA 52807

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Signal Words

As stated in ANSI Z535.4-2007, the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are **"Danger"**, **"Warning"**, and **"Caution"**. These words are defined as:

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, is used to address practices not related to personal injury.

NOTICE

NOTICE is used to address practices not related to personal injury.

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70E®, is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition to the above qualifications, one must also be:

1. Trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

2. Trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

3. Trained in rendering first aid if necessary.

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Ch 1 General Information

⚠ WARNING

The equipment described in this document may contain high voltages and currents which can cause death or serious injury.

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Grace Engineered Products, Inc. immediately at 1.800.280.9517.

⚠ WARNING

Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

NOTICE

The information in this instruction bulletin is not intended to explain all details or variations of the Grace equipment, nor to provide for every possible contingency or hazard to be met in connection with installation, testing, operation, and maintenance of the equipment. For additional information and instructions for particular problems, which are not presented sufficiently for the user's purposes, contact Grace Engineered Products at 1.800.280-9517.

NOTICE

Grace Engineered Products reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

A. Scope

The information in this instruction bulletin describes the following Fiber-Optic temperature monitoring system

- GraceSense™ Hot Spot Monitor (HSM)

B. Purpose

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the fiber-optic temperature monitoring system described in *Ch 1 General Information, A. Scope.*

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the Hot Spot Monitor
3. Information for ordering renewal parts
4. Illustrations, photographs, and description of the Hot Spot Monitor

The illustrations contained in this document may not represent the exact construction details of each Hot Spot Monitor installation. The illustrations in this document are provided as general information to aid in showing component locations only.

All illustrations and photos are shown using de-energized equipment.

⚠ WARNING

Be sure to follow the appropriate safety precaution while handling any of the equipment. Failure to do so may result in serious injury or death.

C. Approvals and Certifications

1) **Safety Information**

Hot Spot Monitor is designed and tested to comply with IEC 61010.

2) **FCC Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

3) **EMC Directive**

The Hot Spot Monitor has been designed and tested to meet the European Electromagnetic Compatibility Directive (EMC Directive, 204/108/EC). The Declaration of Conformity for the Hot Spot Monitor lists the specific standards to which the system was tested.

Immunity of the Hot Spot Monitor was tested for use in Power Station and Substation Environments according to IEC61000-6-5:2001.

D. Instruction Bulletins Available Electronically

NOTICE

Changes to the instruction bulletin may be implemented at any time and without notice. Go to gracesense.com to ensure use of the current instruction bulletin for the GraceSense™ equipment.

To contact Grace Engineered Products, Inc., call 1.800.280.9517, or email sales@grace-eng.com.

Ch 2 Safety

A. Safe Work Condition

The information in Section A is quoted from NFPA 70E 2012 - Article 120, 120.1 Establishing an Electrically Safe Work Condition.

120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.

3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.

4. Apply lockout/tagout devices in accordance with a documented and established policy.

5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are de-energized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

   Informational Note: *See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.*

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

B. Safety Guidelines

Study this instruction bulletin and all other associated documentation before installing the Hot Spot Monitor.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to Hot Spot Monitor.

C. General

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the monitoring system shall be allowed to work on this equipment.

It is mandatory that this instruction bulletin, any supplements, and service advisories be studied, understood, and followed.

2. Maintenance programs must be consistent with both customer experience and manufacturer's recommendations, including service advisories and instruction bulletin(s).

3. Service conditions and equipment applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; actual continuous current; thermal cycling; number of operations; interrupting duty; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

D. Specific

1. **DO NOT WORK ON ENERGIZED EQUIPMENT.** If work must be performed on a circuit breaker, remove it from service and remove it from the metal-clad switchgear.

2. **DO NOT WORK ON EQUIPMENT WITH THE CONTROL CIRCUIT ENERGIZED.**

3. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND SECURELY GROUNDED FOR SAFETY OF PERSONNEL PERFORMING MAINTENANCE OPERATIONS ON THE EQUIPMENT.**

4. Interlocks are provided to ensure the proper operating sequences of the equipment and for the safety of the user. If for any reason an interlock does not function as described, do not make any adjustments, modification, or deform the parts. **DO NOT FORCE THE PARTS INTO POSITION. CONTACT GRACE ENGINEERED PRODUCTS FOR INSTRUCTIONS.**

E. Safety Labels

The equipment described in this document has DANGER, WARNING, CAUTION, and instruction labels attached to various locations. All equipment DANGER, WARNING, CAUTION, and instruction labels shall be observed when the circuit breaker is handled, operated, or maintained.

NOTICE

Warning and Caution labels are located in various places in and on the switchgear and on the circuit breaker's removable element. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.

Ch 3 Equipment Description

A. General

The GraceSense™ Hot Spot Monitor is intended for use in environments with high voltages and currents, where standard measurement methods such as RTDs, thermocouples, and IR scans are not suitable. Point-source temperatures are measured optically using a polymer optical fiber as a conduit for the optical signals which are used for relaying the temperature data. The materials exposed to energized components are made of inherently insolating materials and pose no risk to the equipment. Each Hot Spot Monitor provides temperature information for either nine or eighteen locations, which can then be extracted in real-time via MODBUS RS-485, MODBUS TCP/IP, or Ethernet I/P. In addition, temperature values can be logged internally and retrieved via standard CAT5 Ethernet cable.

Figure 1: HSM Modules

B. Sensing System Overview

The GraceSense™ Hot Spot Monitor consists of three major components:

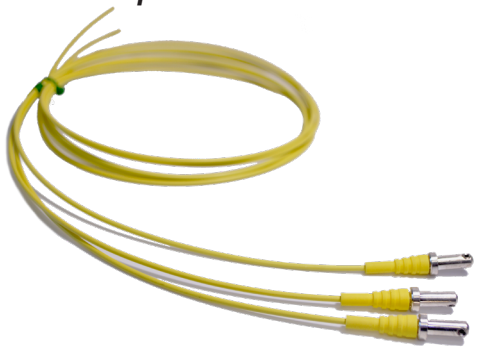
1. The HSM provides the internal control signals, interface telemetry and light generation/detection that are needed to interrogate the location or Potential Failure Points (PFP). Each Module can measure either nine or eighteen discrete points when Fiber-Optic Probes are attached.

Table A: Module Configurations

G-HSM-9SM		G-HSM-18M	
Channels: 9	LCD: Yes	Channels: 18	LCD: No
			

2. The Fiber-Optic Probe provides the optically encoded temperature information from the Potential Failure Points (PFP) to the module. Composed of a polymer-based optical fiber and sensing tip with locking feature, the probe is designed to withstand voltages commonly found in low and medium voltage applications.

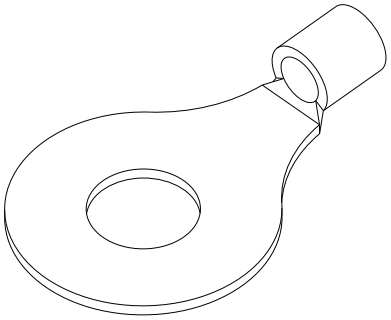
Figure 2: Fiber-Optic Probe



3. The Probe Mounting Fixture has several

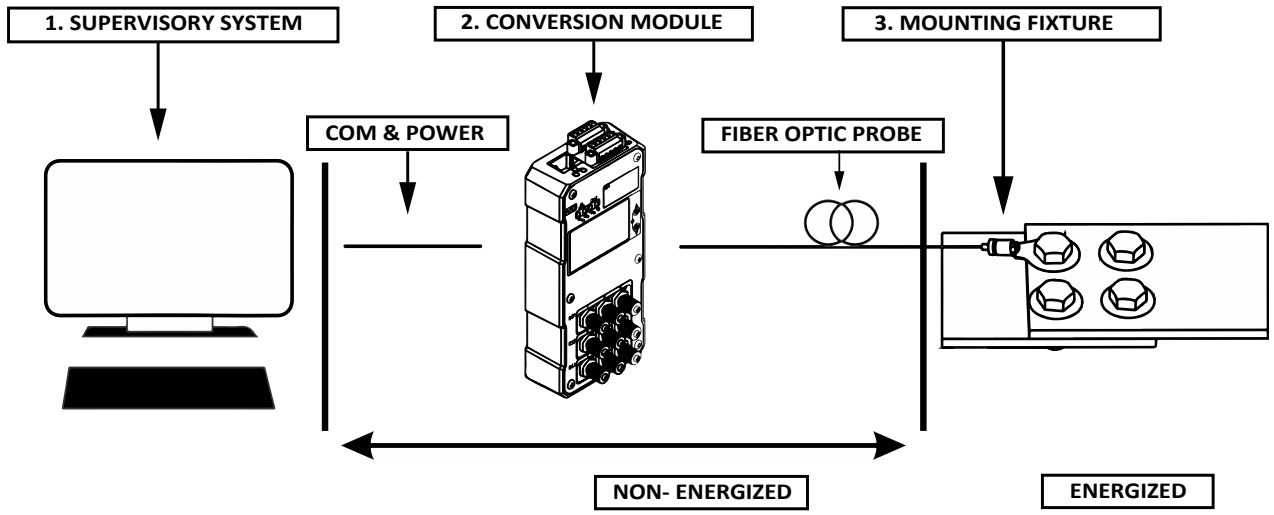
different mounting fixtures available, all of which provide the physical contact between the Probe and the Location of Interest. It is important that the fixture be connected securely, in order to provide robust thermal contact and accurate measurements.

Figure 3: Ring-Style Mounting Fixture



4. Once installed, the three primary components look schematically like shown in *Figure 4.*

Figure 4: HSM System Overview



C. Specifications

1. System Specifications

a. Model Name:
G-HSM-9SM, G-HSM-9M, G-HSM-18M
(3 models)

b. Number of Sensor/ Channels:
9 (G-HSM-9SM & G-HSM-9M) or
18 (G-HSM-18M)

c. Resolution: 1˚C (1˚F)

d. Accuracy: ±2˚C (±3˚F)

e. Measurement Range: -40°C to +160°C (-40°F to +320°F) (probe dependent, see below)

f. Calibration: Not Required. Calibrated @ Factory.

g. Data Refresh Time: ~3sec

h. Communication Protocols:
MODBUS RTU, MODBUS TCP/IP, ETHERNET I/P, HTTP

i. Onboard Data Storage: 16MB (350,000 logs)

j. LCD Interface (G-HSM-9SM only): 2 Buttons, LCD

2. HSM Module Specifications

a. Dimensions: 155mmx75mmx50mm (6”x 3”x 2”)

b. Power Requirements:
Voltage: 12-24 VDC (0.12A@24VDC)
Power: 3 Watts (*Max)

c. Operating Environment Conditions:
Temp. Range (G-HSM-9SM / G-HSM-18M):
-40°C to +70°C (-40°F to +158°F)
Temp. Range (HSM-9SM): -20°C to +70°C (-4°F to +158°F)
Humidity: 0-95% Non-Condensing
Altitude: 0-2000m (0-6500ft)
Pollution Degree: 1

d. Enclosure Material: Aluminum 6061 and Molded ABS/ PC

e. Mounting: 35mm DIN rail

f. Power / Data Connections: 2x 5 position pluggable terminal block w flange, 3.81mm pitch Phoenix Contact, PN: 1827732

g. Output Relay Specifications: Normally Open, 2A/250VDC/VAC TE Connectivity, PN: IM01GR

h. Real Time Clock and Calendar: RTCC, 21 days backup, no daylight saving.

3. **Standard Probe Specifications** (G-HSM-FB3-L007, G-HSM-FB3-L010, G-HSM-FB3-L015)
   a. Material: Nylon
   b. Minimum Bend Radius:12 mm (½")
   c. Probe length: 7,10,15m (21,30,45ft)
   d. Operating Temp Range: -40°C to +120°C (-40°F to +248°F)
   e. High Voltage Characteristics: 38 kV, over 8" gap

4. **High Temperature Probe Specifications** (G-HSM-FB-HT)
   a. Material: Fluoropolymer
   b. Minimum Bend Radius: 12 mm (½")
   c. Probe length: detachable probe 0.25m(10"), max. Fiber extension 10m
   d. Operating Temp Range: -40°C to +160°C (-40°F to +320°F)
   e. High Voltage Characteristics: 38 kV, over 8" gap

5. **Probe Mounting Fixture Specifications**
   a. Material: Tin-Plated Copper
   b. Manufacturer: Tyco/ Amp
   c. Approvals: UL/CSA
   d. Part Numbers:
      i. ¼" Hardware (Tyco/Amp PN 33465)
      ii. ⅜" Hardware (Tyco/Amp PN 36807)
      iii. ½" Hardware (Tyco/Amp PN 36808)

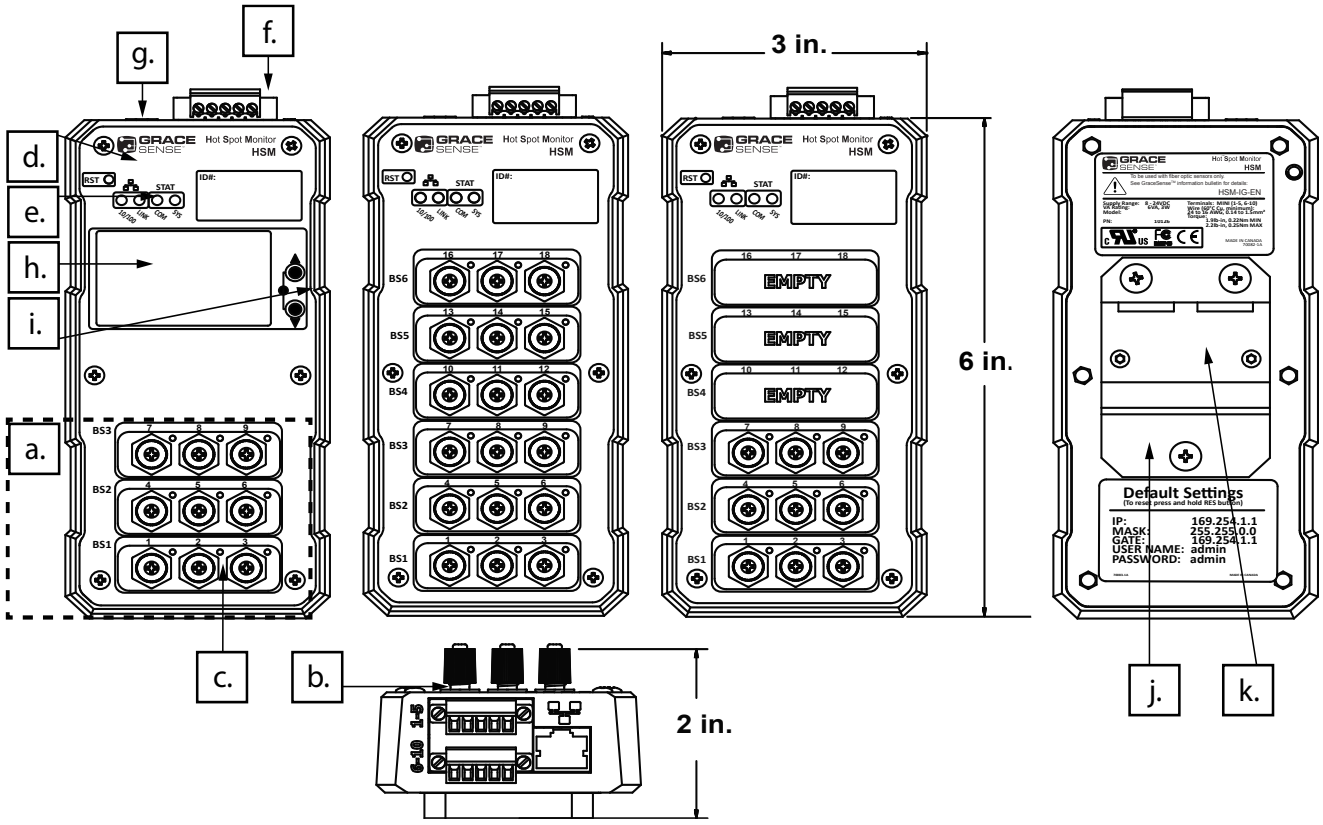
D. Hardware Description

1. Physical Interface

The HSM has the following physical features:

a. Optical Fiber Connection Ports (9 or 18)
b. Fiber Retention Nut
c. Status LEDs
d. Reset Button
e. HSM Indicator LEDs
f. Input Power Connection , RS-485 Serial Port
g. Ethernet Port
h. LCD Interface
i. Interface Buttons
j. DIN Rail Mounting Clip
k. DIN Rail Grounding Contact Plate

Figure 5: HSM Module Overall Views



2. There are four HSM Indicator LEDs visible from the front of the HSM HSM Module. The meaning of the Indicator LEDs is shown in *Table B HSM Indicator LED's.*

Figure 6: Indicator LED's

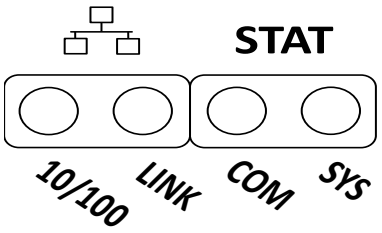


Table B HSM Indicator LED's			
	Indicator LED	**Color**	**Meaning**
Network	10/100	Orange	100 Mbit Mode
		Off	10 Mbit Mode
	LINK	Flashing Green	Ethernet Traffic
		Green	Connection Established
		Off	No Connection Established
Status	COM	Flashing Green	MODBUS / EIP Communication
		Flashing Red	MCS Communication Error
	SYS	Flashing Green	Normal Operation
		Red	Write to Flash
		Flashing Orange	Bootload Mode
		Flashing Red	In Flash Erase Mode/Alarm

3. Each channel has a small indicator LED. The LED is used for indicating the status of the sensor channel. It is of particular use during installation to verify that the fiber has been installed correctly.

Figure 7: HSM Status LED's

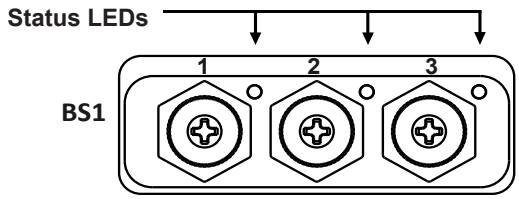
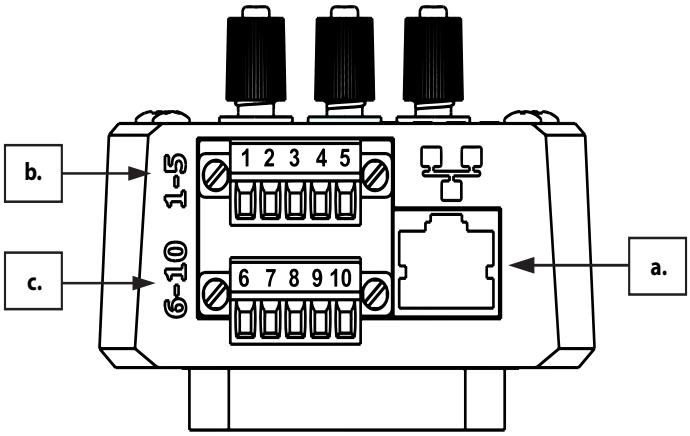


Table C HSM Status LED	
LED Color	**Channel Status**
Red	Fail / Not Ready
Green	Good

4. The HSM modules have 3 interface ports with various applications
   a. Ethernet Port: MODBUS TCP/IP, ETHERNET I/P, Web Interface
   b. Terminals 1-5: RS485, 2 wire, MODBUS, Interface to RS485 Network or to MODBUS Current Sensor (MCS)
   c. Terminals 6-10: Input Power, Relay Output

Figure 8: Interface Ports



Ch 4 Installation

The installation of the GraceSense™ Hot Spot Monitor (HSM) is comprised of several steps. The HSM Module and Fiber-Optic Probe can be installed independently of each other, and hence the order of certain aspects of the installation are at the user's discretion. Many of the images will show installation on medium voltage switchgear, as this provides a typical installation. However, the principles of installation can be carried over to many other applications where temperature monitoring is needed. Other examples include: wiring splices, circuit breakers, motor control centers, bus duct, dry-type transformers and so on.

A. Select a Location

HSM can measure temperatures on any equipment within its operational range. The start of the process is to identify Potential Failure Points (PFP). The tip of the fiber will eventually be placed at this location and secured via the fixture.

Some recommended principles to follow when selecting the Potential Failure Points (PFP) include:

1. The Potential Failure Points (PFP) should ideally be as close to a potential source of failure as possible. For example, if a splice or bolted connection is present and critical, consider mounting the fiber sensing tip right at, or adjacent to, the connection point.

2. The probe can measure temperatures in locations that are not visible, therefore consider locations where infrared monitoring will not be effective. In many situations, important connections are hidden behind ducting and sheet metal. Main Bus compartments are an ideal example as they cannot be viewed in operation.

3. There must be a method for affixing one of the various fixture options to the Potential Failure Points (PFP). Each fixture type has specific requirements for proper attachment.

4. There must be a continuous path going from the Potential Failure Points (PFP) to the mounting location for the Module which can be followed by the fiber. This will be termed the "Fiber Path".

There are additional aspects that need to be considered before proceeding with installation:

1. The Potential Failure Points (PFP) and mounting location for the HSM Module must not be farther apart than the length of the fiber. In practice, they must be even closer as the fiber will frequently not take a direct path, following surface features instead.

2. Provide continuous low-voltage (12-24 VDC) power to the HSM Module. In addition, if RS-485 or Ethernet ports are used for real-time communication, the associated communication wires must be capable of being routed to the HSM Module.

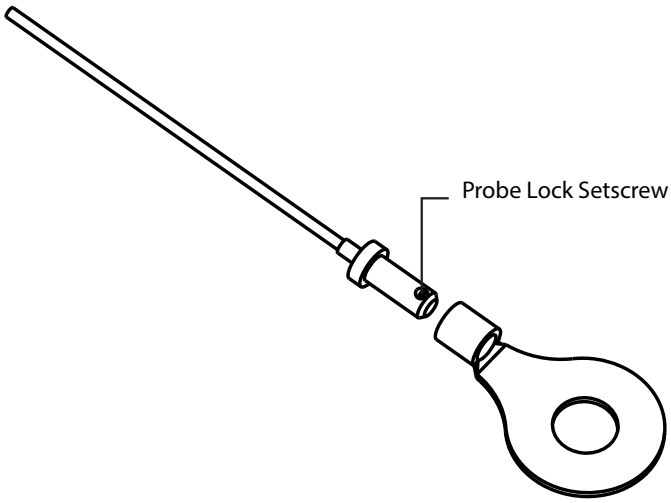
3. Temperature at the Potential Failure Points (PFP) must not exceed the maximum rated temperature of the fiber for an extended period.

4. No point on the fiber path (in contact with the fiber) shall exceed 100˚C (212˚F). This excludes the Potential Failure Points (PFP) where the fiber is attached to the mounting fixture.

B. Secure Probe to Potential Failure Points (PFP)

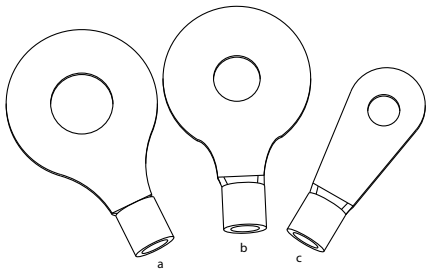
The most common Probe Mounting Fixture for use with the HSM system is based on industry standard ring-style cable termination lugs. These lugs have proven to be reliable, easy to install, and virtually maintenance free. In addition, if installed at locations with existing hardware, no modifications to hardware lengths or specifications are needed. The fiber probe has a special feature, called the Probe-Lock which secures the Probe to the lug without crimping, allowing lugs to be installed first, then the attachment of the probe.

Figure 9: Fiber-Optic Probe with Probe Lock



1. Select the proper lug of the application based on the existing hardware (if present) or planned hardware. Any #6 AWG Tyco/Amp Solistrand™ ring-style lug should be compatible, however not all have been tested. If purchased in kit form, 0.5" lugs have been included. Three lugs sizes are available (sold seperately) and are specified in *Figure 10*. When selecting the lug for a given location, ensure that the lug with the tightest fit around the hardware is selected – this aids in proper thermal conduction and will result in more accurate readings.

Figure 10: Tyco/Amp Ring Style Lugs



a. ½" Hardware (Tyco/Amp PN 36808)
b. ⅜" Hard ware (Tyco/Amp PN 36807)
c. ¼" Hardware (Tyco/Amp PN 33465)

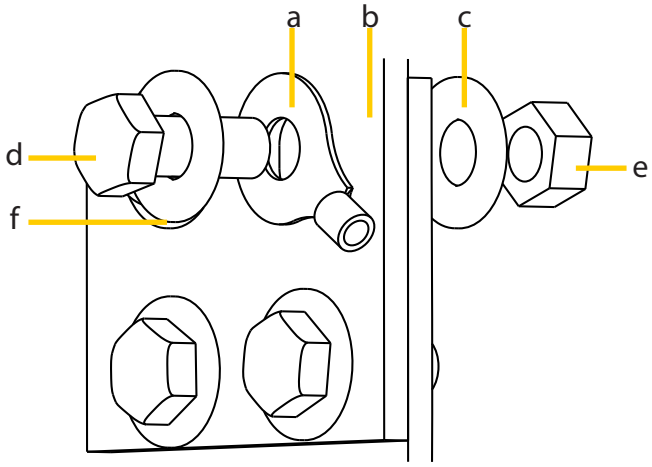
2. To make probe installation easier, consideration must first be given to the rotational orientation of the lug before it is mounted. When the probe is eventually installed, the fiber will need to have a relatively unobstructed path to be inserted into the lug. For example, in some situations protective boots are placed over bolted connections, posing an inconvenience when routing the fiber. Align the fixture to allow the fiber to be threaded through existing seams in the dielectric boot. The lug must also be placed such that the Probe-Lock is accessible to an Allen Key for tightening.

3. Mount the lug so that it is directly contacting the surface to be measured. Washers should NOT be placed between the lug and the surface to be measured; instead they should be placed on the other side of the lug, as shown in *Figure 11*. *Figure 12* shows the proper installation when Belleville washers are used. Absolutely no greases and/or pastes should be used between the lug and the surface it is contacting. Ensure the orientation of the lug is such that the probe and fiber run parallel to the bus.

NOTICE

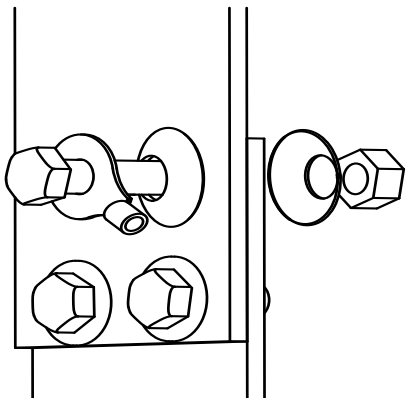
Once the fixture has been put in place, follow the manufacturer's recommended torque setting for the original hardware.

Figure 11: Installation Sequence of Lug with Standard Washers



a. Lug
b. Measurement Surface
c. Washer
d. Bolt
e. Nut
f. Washer

Figure 12: Installation Sequence of Lug with Belleville Washers

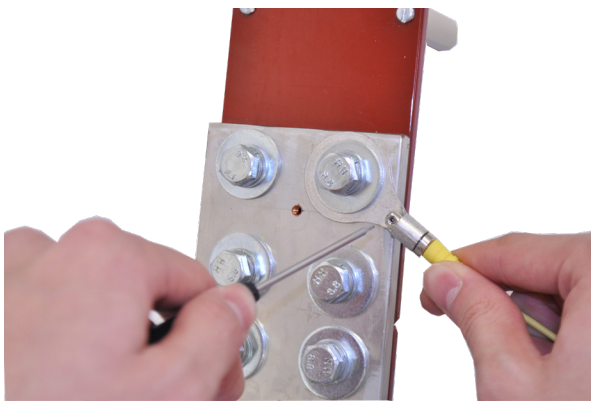


4. Once the lug is mounted, the Probe can be installed. This is simply done by inserting the probe tip into the end of the lug. Ensure that the head of the probe-lock set screw is visible and easily accessible to allow it to be secured.

Figure 13: Mounting Lug

5. With the probe installed, fasten the head of the Allen setscrew. This is performed with a 1.5 mm Allen Key. The setscrew is designed to bite in the lug and is retained by military grade friction patch to ensure immunity to vibration. The set screw should be torqued to approximately 5 inch-lbs.

Figure 14: Secure Probe by Tightening Allen Key



6. Validate that the probe is properly secured into the lug by giving a gentle tug. At this point the joint can be carefully dressed, if required, while ensuring the probe is not abused.

Figure 15: Correctly Installed Probe and Lug

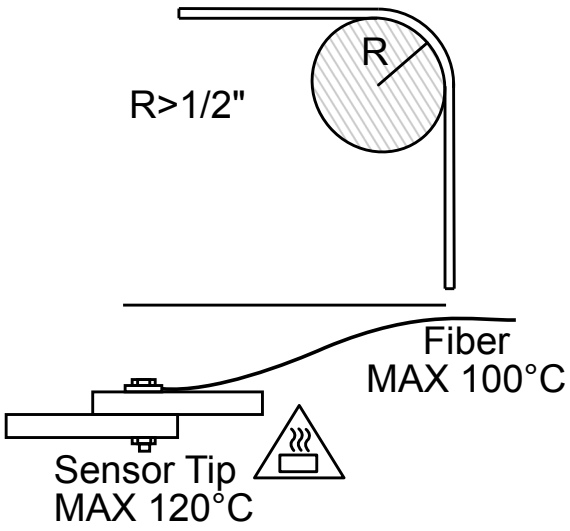
C. Route Fiber-Optic Probe

Proper routing of the probe is important to facilitate proper installation of the HSM. The optical fiber has some general guidelines that must be followed during installation:

1. Ensure that bend radii are greater than 1.3 cm (½”). Bends smaller than this will cause a loss in optical signal.

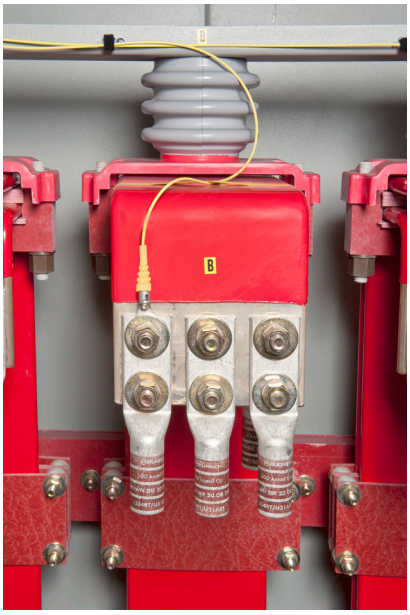
2. Keep exposed sections of the fiber away from excessive temperatures. The tip has been designed to allow for temperatures up to 120˚C (248˚F) and the fiber for temperatures up to 100˚C (212˚F). Temperatures in excess of these could cause premature failure of the fiber.

Figure 16: Fiber Limitations



3. Securing the fiber along its routing path is best done with non-conductive tie-wraps at even intervals every 1-2 m (3-6 ft) depending on the types of features that must be navigated. Use electrical tape as a temporary attachment to assist in installation as indicated in *Figure 17*. When securing tie-wraps, ensure that fiber is not pinched excessively as this can degrade the optical signal. Cables can be bundled together and routed for ease of installation whenever possible. Ensure to clip all extra length from tie-wraps once they have been secured.

Figure 17: Electrical Tape Installation



⚠ WARNING

Do not fasten or attach ANY mounting hardware (tie-wraps, etc.) to at least a 30 cm (12") length of fiber between the portion of the Probe at high voltage and its first non-energized point of contact. This section of suspended fiber provides increased dielectric strength to the probe and therefore must be left unsecured and ungrounded. It is good practice to maintain more than 30 cm (12") of suspended fiber, but not required.

Figure 18: Tie-Wrap Being Secured Over Fiber

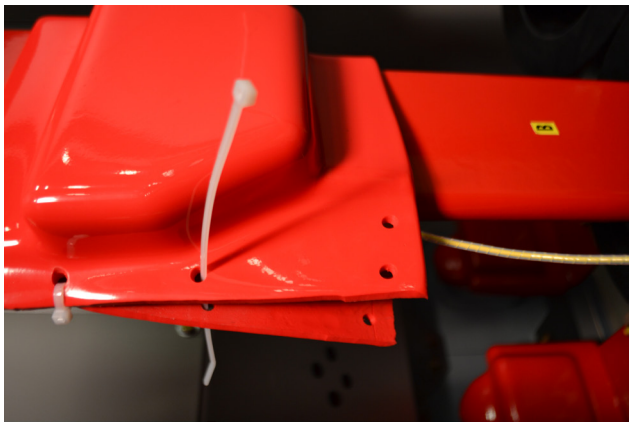


Figure 19: Completed Fiber Installation

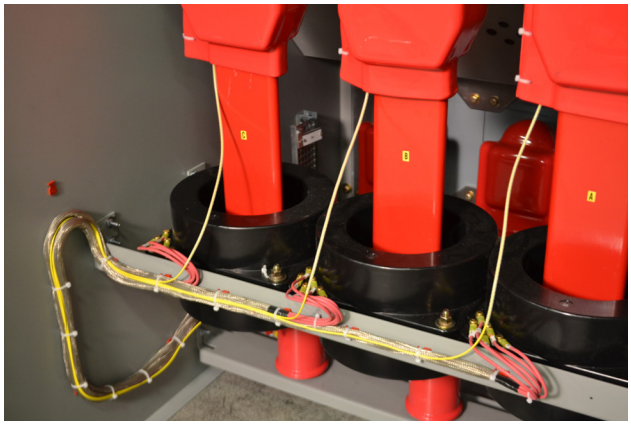
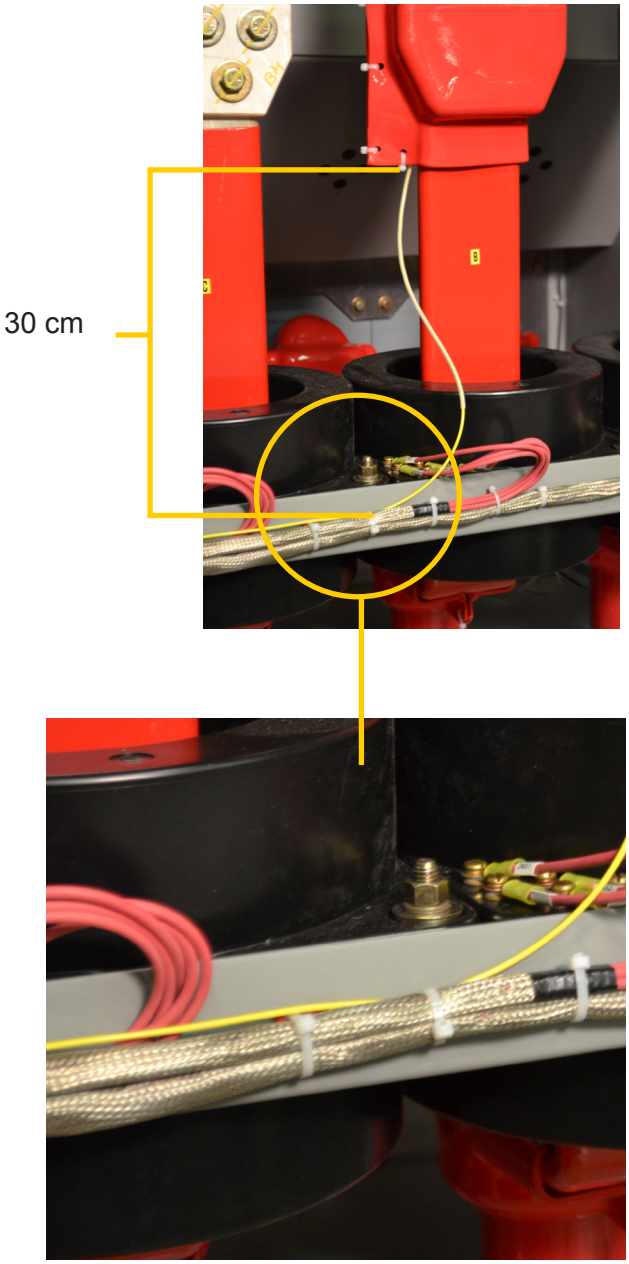


Figure 20: Safe Dielectric Routing Practices



Note: Ensure that at least 30 cm (12") of fiber is suspended prior to fastening.

4. Do not straddle phases with the fiber. The fiber must go from the Potential Failure Points (PFP) to any non-energized contact point and then to the HSM Module.

5. Mark each end of the fiber with a means to identify each fiber when finalizing the installation. If this is not done, it can be very challenging to correlate installation location with the fiber. Black marker and tape are acceptable, as are approved wire markers (preferred). Ensure to make all markings a safe distance from the energized end, typically this is 60-100 cm (2-3 ft).

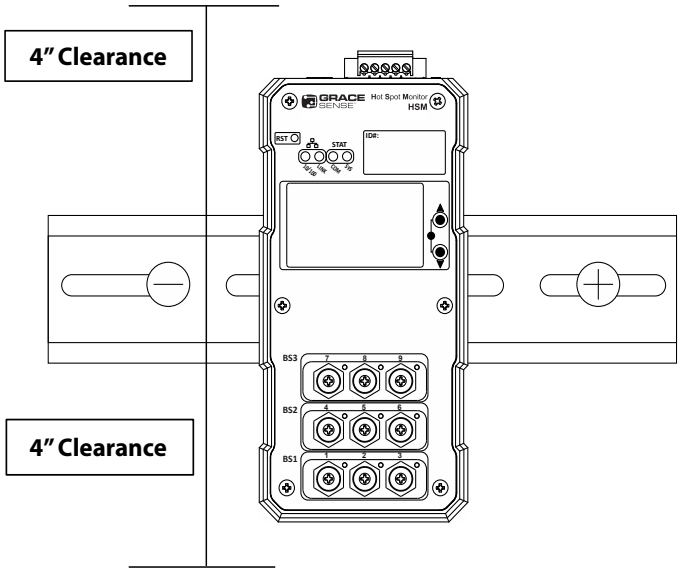
D. Mount HSM Module

The HSM Module provides the power, telemetry, and user interface to the sensors. Once installed, the HSM Module can be configured to provide a wide range of features through the Ethernet and serial ports. In addition to proximity to the Potential Failure Points (PFP), thought should also be given to ensuring that there is access to the HSM Module following installation. This is needed for initial configuration and retrieval of onboard logged data.

1) Mount DIN Rail

Attach a segment of 35 mm DIN rail to a location where the HSM Module will be secured. When selecting a location for installation, ensure that the ambient temperature will be below 70˚C (158˚F). Approximately 13cm (5”) of DIN rail is needed for mounting the module. If other peripherals, such as DC power supplies or MODBUS gateways are also installed, consider increasing the length of DIN Rail to accommodate the extra items. Other items to consider include leaving adequate room for the fibers and wire connections to the module. Approximately 100 mm (4in) should be left both above and below the center of the DIN rail.

Figure 21: DIN Rail Clearances



2) Attaching HSM Module to the DIN Rail
While tilting the top of the module away from the DIN rail, hook the bottom onto the DIN rail. Push the module up and towards the DIN rail until it clips on. In order to remove the unit, first push up and then tilt the top away from the DIN rail.

Figure 22: Installing HSM s Module onto DIN Rail

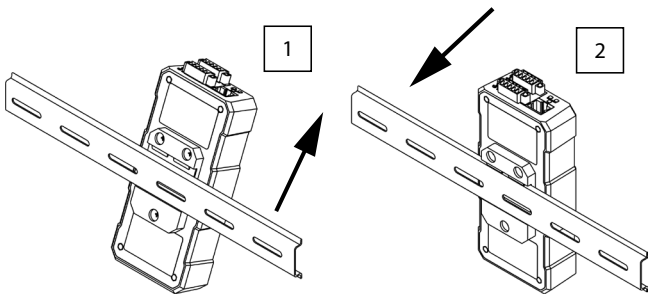
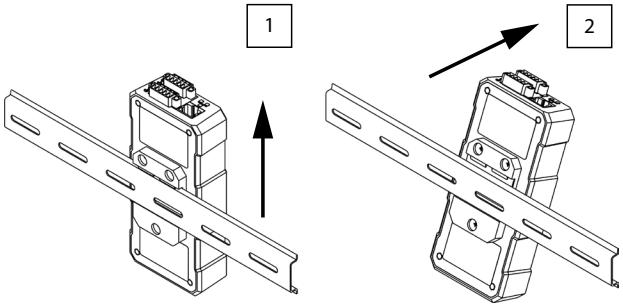


Figure 23: Removing HSM Module from DIN Rail

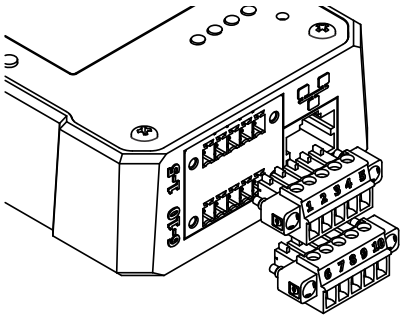


E. Connect Network and Power Wiring

1) **Power Requirements**
The HSM Module requires a 12-24VDC voltage source to operate. Any industrial DC power source that provides power within the range specified can be used. When selecting a DC power supply, ensure that it is capable of providing enough power for all of the units that it will be supplying. Each unit requires 3 Watts of power under maximum load conditions, and considerably less during normal operations. Ensure to add capacity if the power supply will be used for supplying peripherals such as MODBUS gateways.

2) **Remove Terminal Connector**
Begin by removing the Terminal Connector from HSM Module. This is easily done by hand or by prying a screwdriver between it and its mating connector. Make sure to loosen connector flange securing screws.

Figure 24: Terminal Connectors of HSM Module



⚠ CAUTION

Ensure the power is turned OFF to prevent damage to the equipment prior to connecting the power of circuitry.

3) **Connect DC Power Wiring**
With the Terminal Connector labeled "6-10" removed, connect the wires as indicated in *Table D*. Secure the wires into place by using a standard slot screwdriver. For short local connection (<3 m/10 ft) inside the low voltage compartment use unshielded duplex wire such as Belden 8442. For longer runs use twisted shielded cable such as Belden #3105 or similar.

Table D Terminals 6-10

Terminal Number	Name	Function	Wire Gauge	Wire Type
6	V-	Input Voltage Negative	22	Unshielded (<3 m/ 10 ft) Shielded (<3 m/ 10 ft)
7	V+	Input Voltage Positive		
8	PE	Chassis Grounding		
9	COM	Relay: Common Terminal		
10	NO	Relay: Normally Open Terminal		

4) **Connect Communication Wiring** (Two Wire RS-485 MODBUS)
The only serial protocol that is recognized by the HSM Module is 2 wire RS-485 MODBUS. The device acts as a client on the network. The wiring table below refers to *Figure 24* and details that terminals 3, 4, and 5 are reserved for the RS-485 port. Twisted shielded cable shall be used such as Belden #3105.

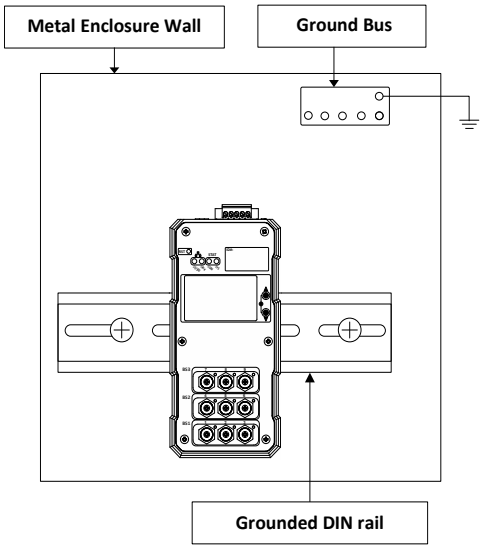
Table E Terminals 1-5

Terminal Number	Name	Function	Wire Gauge	Wire Type
1	V-	Input Voltage Negative	22	Unshielded (<3m) Shielded (>3m)
2	V+	Input Voltage Positive		
3	Rx-	Inverting, 2-wire, RS-485		
4	Tx+	Non-Inverting, 2 wire, RS-485		Shielded twisted pair
5	Shd	Shielding of communication pair		

5) **Grounding**
Grounding of the unit can be achieved via DIN rail contact or via grounding terminal.

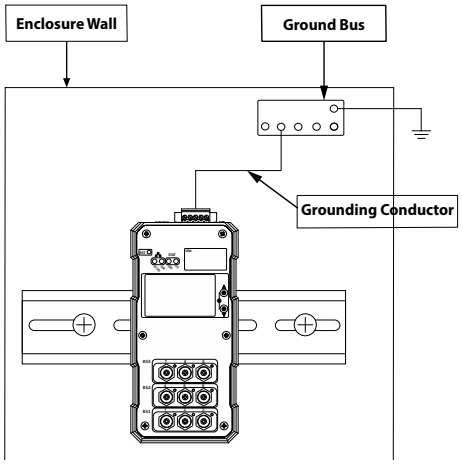
a. **Grounding via DIN rail**
The HSM unit is intended to be mounted to a grounded DIN rail. For this purpose unit is equipped with a grounding plate located on the DIN mounting clip. This plate provides contact between the HSM chassis and the DIN rail. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. Secure the DIN rail to the mounting surface approximately every 200 mm (8").

Figure 25: Typical Grounding via Grounded Din Rail



b. Grounding via dedicated PE terminal and grounding conductor. The HSM unit is equipped with a dedicated PE terminal (Terminal 8). This terminal is internally connected to grounding DIN clip contact plate. Use this contact to ground the unit if grounded DIN rail is not available.

Figure 26: Typical Grounding via PE Terminal



6) **Connect Communication Wiring**
(MODBUS TCP/IP and ETHERNET I/P) Shielded twisted-pair 10/100 Base-T cables (CAT5) with RJ45 connectors are supported. Connect cable to the Ethernet port on the device should either MODBUS TCP/IP or ETHERNET I/P protocols be selected for real-time communication with the device.

7) **Relay Output**
The device is configured with a relay that is normally open during typical operation. The relay contacts close when ANY of the Alarm registers have been triggered. See *Ch 5 Usage, D. Special Registers, 2) Alarm & Warning Registers* for operation of the Alarms. The relay contacts are found on Terminals 9 and 10 of the “6-10” Terminal Block.

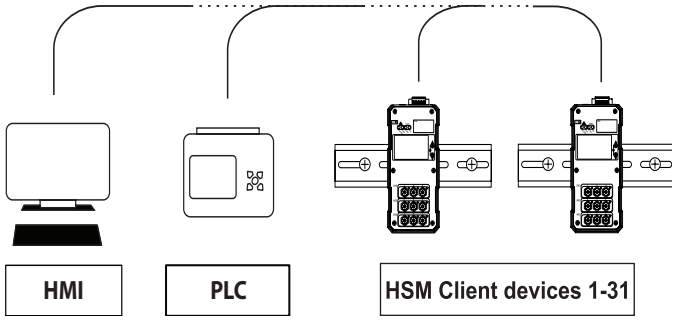
Table F Output Relay Status

Relay	Status
On (Closed)	Any one channel temperature has exceeded alarm threshold
Off (Open)	All temperatures below individual thresholds

8) **Network Topologies**
The following sections only pertain to the networking and real-time data collection of temperature data from the HSM. This section is intended for those planning to connect the HSM Module to a SCADA network.

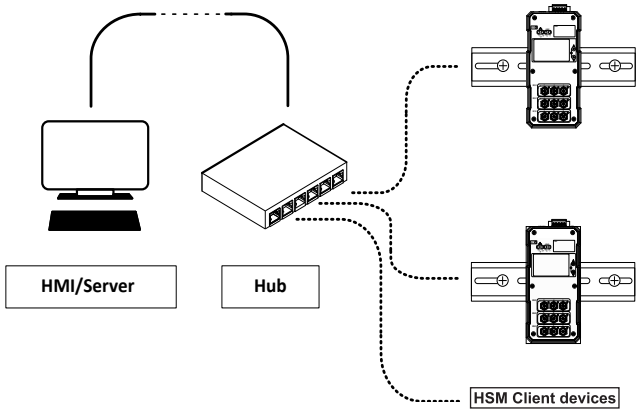
a. RS-485 MODBUS RTU Network Topology. This topology is usually referred to as a “ring topology” in that each unit is connected sequentially along a databus. The flexibility of the system allows for one databus to communicate with up to 31 units. If more than 31 units are required, an additional databus must be added.

Figure 27: Typical Serial Topology for MODBUS RTU



b. MODBUS TCP/IP and ETHERNET I/P Network Topologies. When using either of the Ethernet based communication protocols (Ethernet I/P or MODBUS TCP/IP), the topology is considered a “star”. Each unit is typically wired directly to the server through a network switch as shown in Figure 27.

Figure 28: Star Topology



9) **Fiber Connection / Termination at HSM Module**

a. **Determine Trim Location**
Once the fibers have been secured along their length, they can be prepared for final installation. Determine where the fibers must be trimmed to remove the excess fiber and still reach the HSM Modules. Once a section of fiber has been cut, it can only be cut shorter, therefore be careful to ensure that enough length has been allocated to reach the HSM Module. It is best to leave at least 25-50 mm (1-2") of extra fiber as a precautionary measure.

b. **Trim the Fiber**
Slide the fiber through any of the holes on the provided guillotine trimmer shown in Figure 29. Once inserted into the location to be cut, push down briskly on the trimmer to complete the cut as shown in Figure 30. Each location on the trimmer should only be used maximum 10 times, so keep track of the locations that have already been used.

Figure 29: Fiber Trimmer

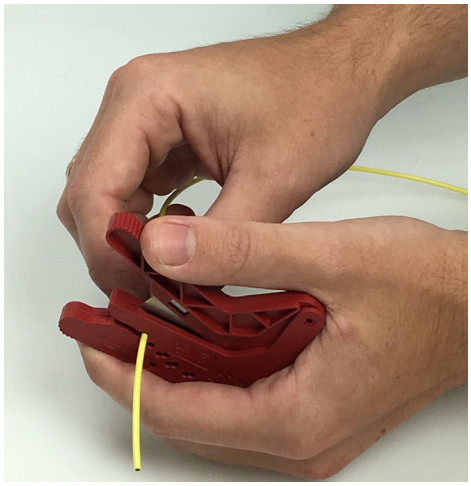
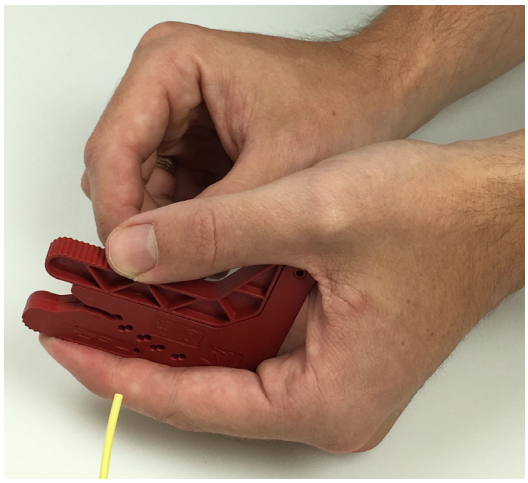


Figure 30: Fiber Trimmed



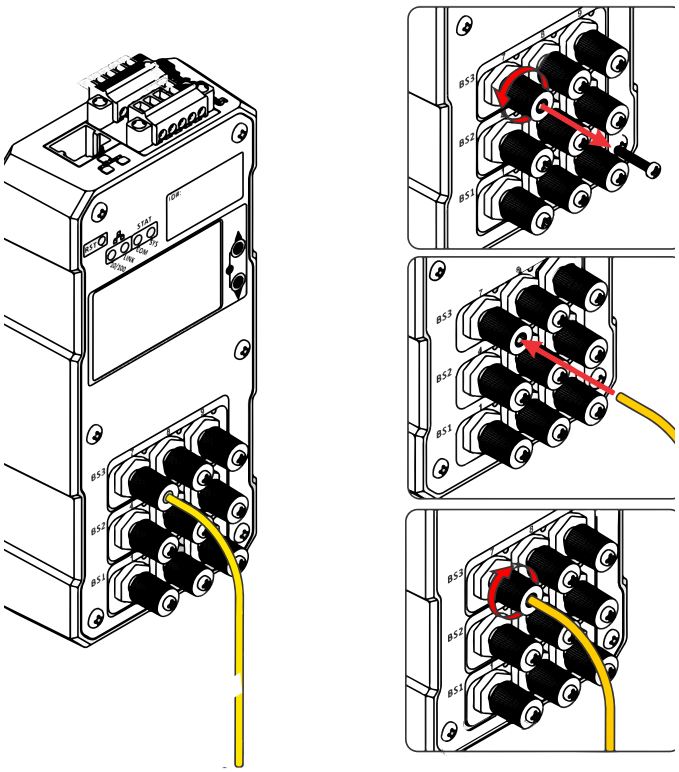
NOTICE

Once the fiber is cut, it is imperative to ensure that the cut end is kept clean and free from debris. If the end becomes contaminated, trim off several millimeters.

c. **Connect the Fiber to the Module**
Ensure that the cut surface of the fiber is clean. Fully disengage the fiber retention nuts on each sensor. This is done by turning them counter-clockwise several turns. They are designed to stay in place once disengaged; if they are inadvertently removed they can be replaced by simply pushing them back on.

Insert the fibers into the proper optical connector. If the fibers have not been marked to identify installation location already, see the procedure in the troubleshooting section for a method of identifying fibers that are not labeled. Insert the fibers individually into the optical connectors until they come to a hard stop. The stop will be very noticeable and does not require excessive force. Secure the Fiber Retention Nut with moderate force by screwing it in clockwise as shown in Figure 31. Do not over tighten the nut, as it is plastic and can be broken if too much force is applied.

Figure 31: Fiber Installation



d. Ensure that Optical Signal is adequate once all the fibers are installed and connected, they must be checked to ensure that the optical signal is strong enough for proper operation of the device.
   i. Apply power to the device and wait several minutes for all probes to stabilize.
   ii. For each probe, look at the color of the HSM Status LED and follow the actions recommended in *Table G: HSM Status LED Colors*.

Table G HSM Status LED Colors

Status LED Color	Status	Action
Green	OK	No Action
Red	Fail	Trim several mm off of fiber end, re-insert

   iii. Complete the procedure by checking the fiber power for the remaining probes. Read the fiber power screen (only G-HSM-9SM) or read fiber power registers (G-HSM-9M and G-HSM-18M). Fiber power shall be 7,8,9 or 10 (strongest signal)
   iv. If any of the probes continue to fail, see *Ch 6 Troubleshooting* for remedial actions.

Ch 5 Usage

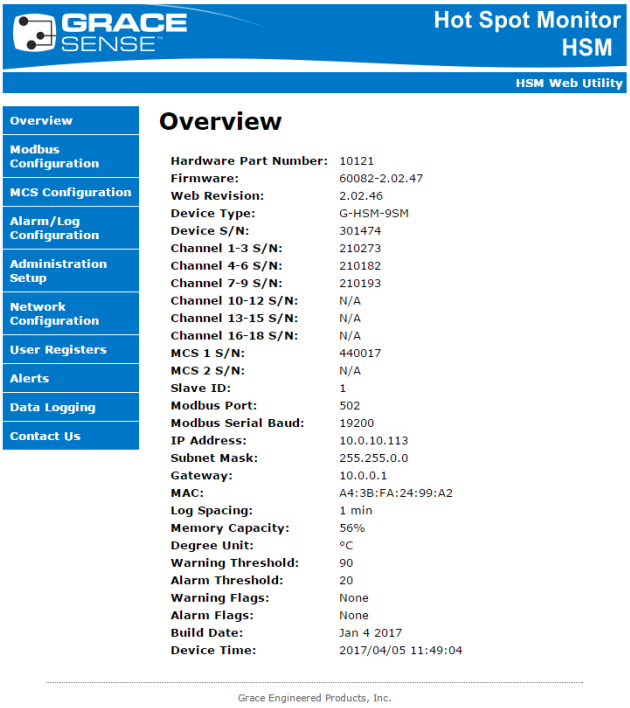
A. User Interface Overview

1) **Web Interface**

Once connected to the HSM via the web interface, a host of information and configuration options are presented. The following section provides a general overview of the pages displayed. More detailed analysis and specifics on establishing the connection is provided in the remaining sections of this chapter.

The general format of the web interface is that of a Navigation Bar in the left portion of the page and data fields on the right, as shown in *Figure 32*. Clicking on any one of the cells in the Navigation Bar will update the page and display the corresponding content.

Figure 32: Web Interface Navigation



2) **LCD Interface** (G-HSM-9SM Only)

The HSM-9SM is equipped with a simple LCD and set of buttons which allows for basic data display and configuration.

Figure 33: LCD Interface Navigation

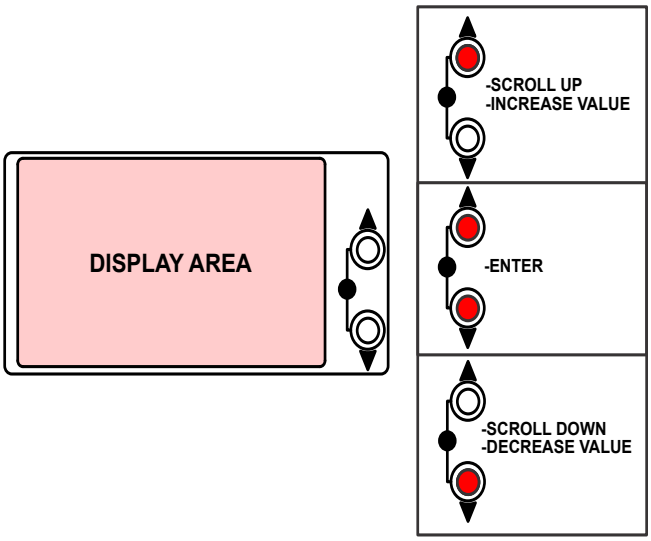
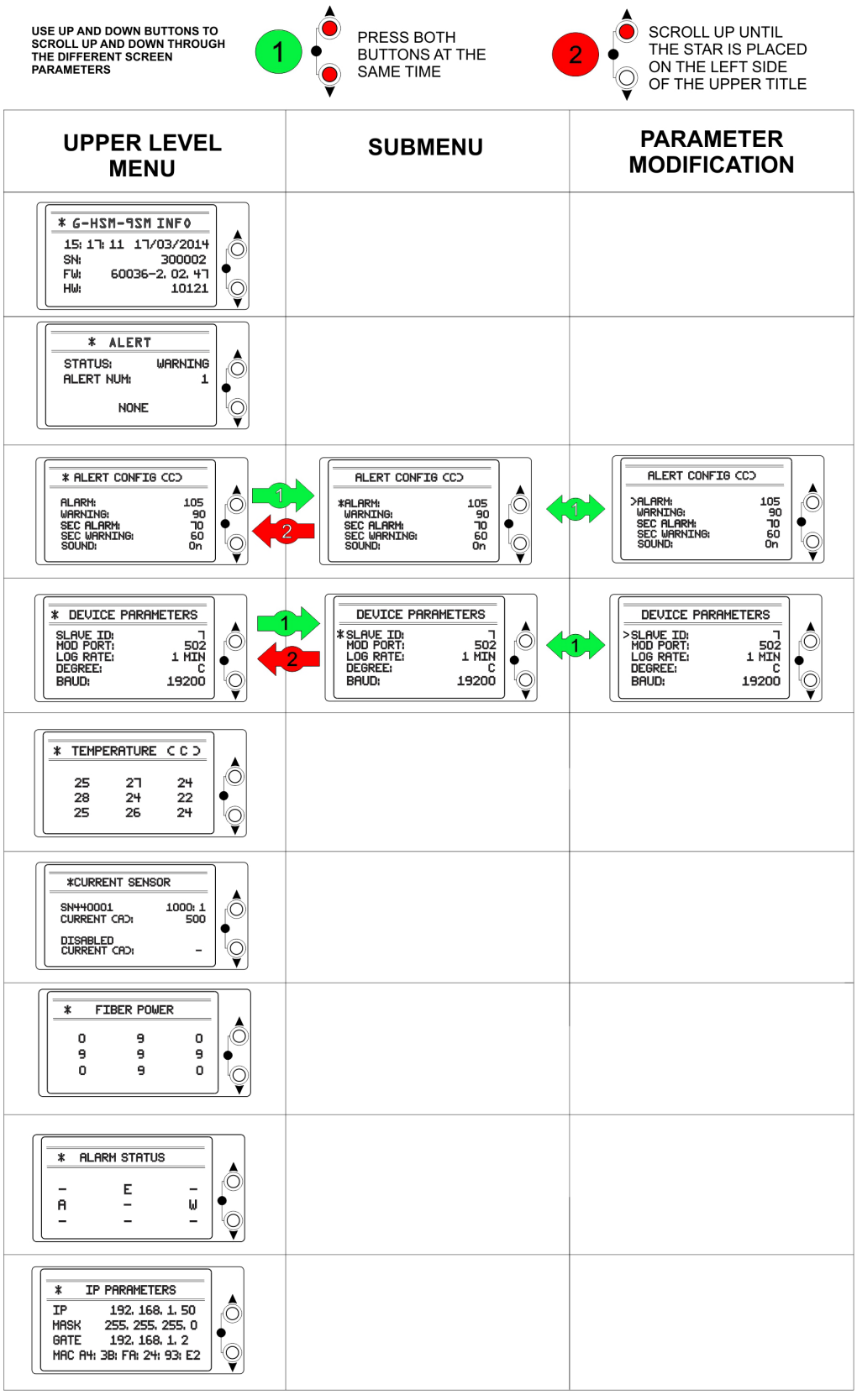


Figure 34: LCD Menu and Navigation


USE UP AND DOWN BUTTONS TO SCROLL UP AND DOWN THROUGH THE DIFFERENT SCREEN PARAMETERS
1
PRESS BOTH BUTTONS AT THE SAME TIME
2
SCROLL UP UNTIL THE STAR IS PLACED ON THE LEFT SIDE OF THE UPPER TITLE
UPPER LEVEL MENU
SUBMENU
PARAMETER MODIFICATION
* G-HSM-9SM INFO
15: 17: 11 17/03/2014
SN: 300002
FW: 60036-2. 02. 47
HW: 10121
* ALERT
STATUS: WARNING
ALERT NUM: 1
NONE
* ALERT CONFIG CC)
ALARM: 105
WARNING: 90
SEC ALARM: 70
SEC WARNING: 60
SOUND: On
ALERT CONFIG CC)
*ALARM: 105
WARNING: 90
SEC ALARM: 70
SEC WARNING: 60
SOUND: On
ALERT CONFIG CC)
>ALARM: 105
WARNING: 90
SEC ALARM: 70
SEC WARNING: 60
SOUND: On
* DEVICE PARAMETERS
SLAVE ID: 7
MOD PORT: 502
LOG RATE: 1 MIN
DEGREE: C
BAUD: 19200
DEVICE PARAMETERS
*SLAVE ID: 7
MOD PORT: 502
LOG RATE: 1 MIN
DEGREE: C
BAUD: 19200
DEVICE PARAMETERS
>SLAVE ID: 7
MOD PORT: 502
LOG RATE: 1 MIN
DEGREE: C
BAUD: 19200
* TEMPERATURE C C)
25 27 24
28 24 22
25 26 24
*CURRENT SENSOR
SN440001 1000: 1
CURRENT CA): 500
DISABLED
CURRENT CA): -
* FIBER POWER
0 9 0
9 9 9
0 9 0
* ALARM STATUS
- E -
A - W
- - -
* IP PARAMETERS
IP 192. 168. 1. 50
MASK 255. 255. 255. 0
GATE 192. 168. 1. 2
MAC A4: 3B: FA: 24: 93: E2

B. Configuration

1) **Web Interface**

Connecting to the Device

i. Connect a CAT5 Ethernet cable directly between the Ethernet ports on the computer and HSM to be configured.

ii. Ensure the power is connected to the device and link is established.

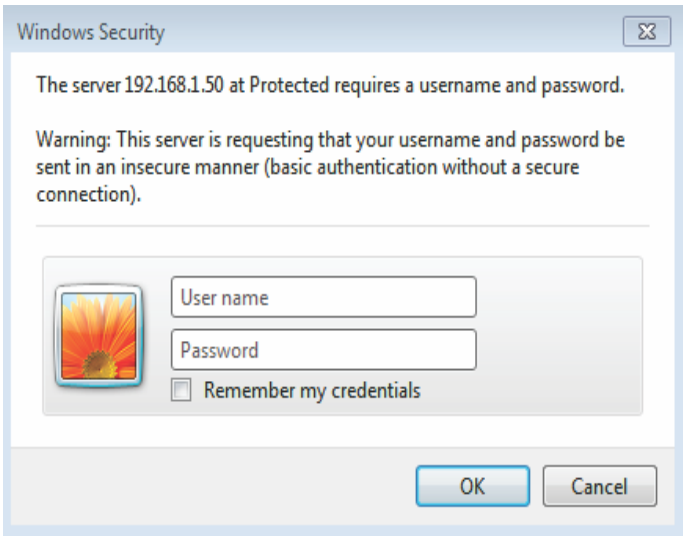
iii. Type in the IP address in the browser (default: 192.168.1.50). A field has been provided on the back sticker in case it has been changed.

iv. From the home page you can navigate through the rest of the site by clicking on the cells of the Navigation Bar on the left.

Configuration Pages

i. Credential Validation
The changing of some parameters will require a username and password. The default values are:
Username: admin
Password: admin

Figure 35: Credential Validation Screen



ii. Network Configuration
Any changes to the network configuration settings will automatically reboot the system.

Figure 36: Network Configuration Web Page

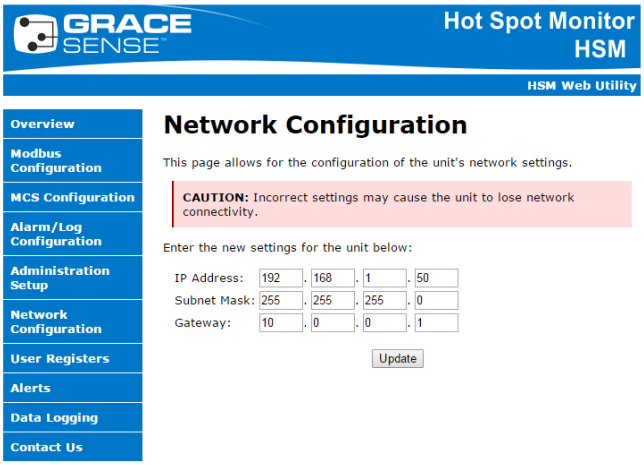


Table H Network Configuration Web Page Settings

Parameter	Default Value	Range/Options
IP Address	192.168.1.50	XXX.XXX.XXX.XXX (XXX is 0-255)
Gateway	192.168.1.2	XXX.XXX.XXX.XXX (XXX is 0-255)
Subnet Mask	255.255.255.0	XXX.XXX.XXX.XXX (XXX is 0-255)

iii. MODBUS Parameters
The MODBUS parameters page displays all the parameters that can be changed.

Figure 37: MODBUS Configuration Web page

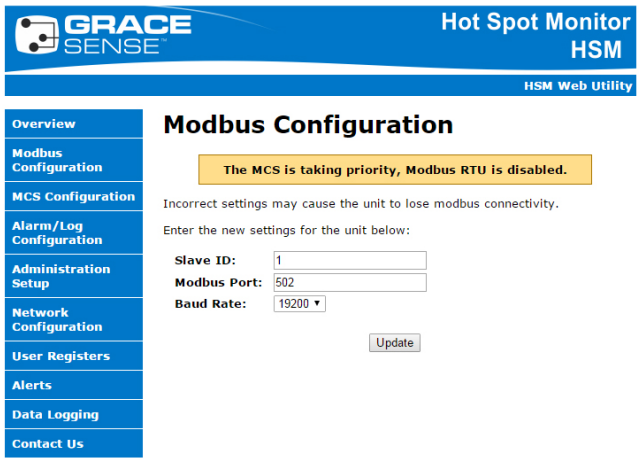


Table I MODBUS Configuration Web Page Settings

Parameter	Default Value	Range/Options
Client ID	1	1-31
MODBUS PORT	502	0-9999
Baud Rate	19200	9600, 19200, 38400 Baud

iv. **Alarm/Log Configuration**

The Device Configuration Page provides some basic interface options and the setting of Warnings and Alarms. See *Ch 5 Usage, D. Special Registers, 2) Alarm & Warning Registers* for full description on the operation of the Warnings and Alarms.

The unit has two independent sets of alarm and warning levels (Primary & Secondary) and allows for assignment of either level to individual channels. Relay enabled option allows for choice of alarm on individual channels to denote relay activation or not.

When updating the Warnings/ Thresholds, the “Update” button must be pressed to enter the changes into the memory of the device.

Figure 38: Device Configuration Web page

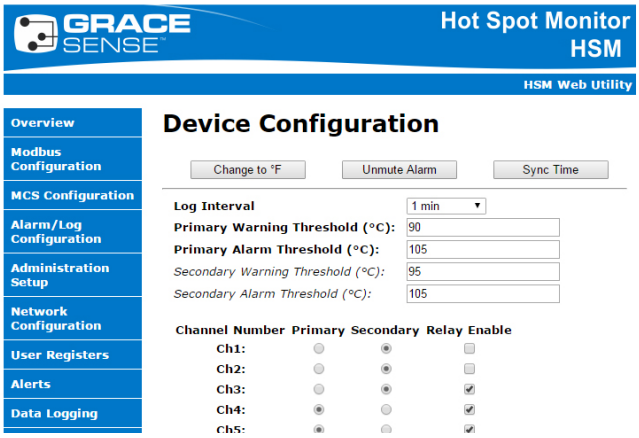


Table J Device Configuration Web Page Settings

Parameter	Default Value	Range/Options
Measurement Units**	°C	°C/ °F
Audible Alarm	On	Mute/Unmute
Log Time	60 min	1 min - 6 hours
Primary Warning Threshold	90 °C (194°F)	0-120°C (248° F)
Primary Alarm Threshold	105 °C (221°F)	0-120°C (248° F)
Secondary Warning Threshold	90 °C (194°F)	0-120°C (248° F)
Secondary Alarm Threshold	105 °C (221°F)	0-120°C (248° F)
Relay Enable Button	Enabled	Enable/Disable
Channel 1-18 Alarm Section	Primary	Primary/Secondary

***Note:** **Measurement units only affect way data is presented on the web pages and LCD screen (if present).*

v. **Administration Setup**

The Administration Setup is used for changing the Administration rights. The username and password must be known prior to changing any values.

Figure 39: Administration Setup Web Page

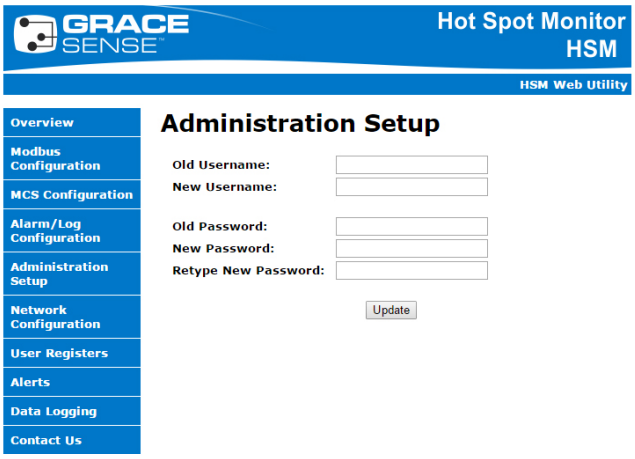


Table K Administration Setup Web Page		
Parameter	**Default Value**	**Range/Options**
Username	admin	16 characters
Password	admin	16 characters

2) **LCD Screen** (HSM-9SM Only)

a. **Configuration Screens**

The LCD Screen provides an alternate method for configuration. The system for navigation and entering data is universal and described in *Figure 33*.

Figure 40: Device Parameters LCD Screen

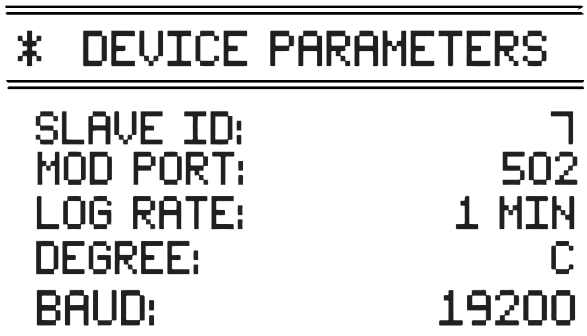


Table L Device Parameters HMI Screen Settings		
Parameter	**Default Value**	**Range/Options**
Client ID	1	1-31
MODBUS Port	502	0-9999
Log Rate	60 min	1 min – 6 hours
Degree	°C	°C or °F
Baud	19200	9600, 19200,38400

C. Real-Time Data Acquisition

Although the HSM device provides onboard logging, the most significant utility is derived when the data is collected in real-time. There are several protocols available for extracting the data, each of which will be covered briefly.

1) **MODBUS RTU** (RS-485 2 Wire)

In order to make a MODBUS RTU connection, use *Ch 4 Installation, E. Connect Network and Power Wiring, 4) Connect Communication Wiring (Two Wire RS-785 MODBUS)* as a guide for the physical connection of the device. It is assumed the user has a basic working knowledge of the MODBUS parameters, therefore, only the salient details of the implementation on the HSM are provided. A detailed MODBUS register listing is provided in *Appendix A*.

Table M MODBUS RTU Parameters		
Parameter	**Default Value**	**Range/Options**
Baud Rate	19200 Baud	9600, 19200, 38400 Baud
Data Bits	8	N/A
Parity	None	N/A
Stop Bits	1	N/A
Max # of Registers per Query	N/A	32
Max Polling Rate	3 Seconds	N/A

2) **MODBUS TCP / IP**

In order to make a MODBUS TCP/IP connection, use *Ch. 4 Installation, E. Connect Network and Power Wiring, 6) Connect Communication Wiring (Modbus TCP/IP & Ethernet IP)* as a guide for the physical connection of the device. It is assumed the user has a basic working knowledge of the MODBUS TCP parameters, therefore, only the salient details of the implementation on the HSM are provided. A detailed MODBUS register listing is provided in Appendix A.

Table N MODBUS TCP/IP Parameters		
Parameter	**Default Value**	**Range/Options**
IP Address	192.168.1.50	XXX.XXX.XXX.XXX (XXX is 0-255)
Port	502	1-9999

3) **Basic MODBUS Queries**

The information in *Table O* is intended to provide several basic examples of queries that can be issued to the HSM Modules. The examples are far from exhaustive.

Table O Basic MODBUS Queries			
Type	**Read Client ID 1, Ch 1**	**Read Client ID 1, Ch 1 Temperature °F**	**Read Client ID 1, Ch 1 Registers**
Client ID	1	1	1
MODBUS Function	04 (Read Input Registers)	04 (Read Input Registers)	04 (Read Input Registers)
Quantity	1	1	18
Start Address	97	115	79
Absolute Address	30098	30116	30080-30097

4) **Basic Ethernet I/P Queries**

The module can communicate using the CIP through Ethernet I/P. This requires an Ethernet connection to the host device. An EDS is provided to assist with the setup. Ensure that desired IP address information is accessible. *Refer to Appendix A for details.*

Table P Basic Ethernet I/P Queries			
Type	**Read Ch 1 Temperature °C**	**Read Client ID 1, Ch 1 Temperature °F**	**Read FW revision**
Connection	User Info	User Info	Device Info (101)
Array Offset	18	36 - 53	3

D. Special Registers

There are several special register types that warrant particular attention when polling the HSM:

1) **Status Registers Interpretation**

The Status Registers provide a generic set of status codes for each channel independently. These codes can identify one of several problems that may need to be rectified. In general, the Status Registers

provide more detailed description when problems arise. The status registers can be accessed via MODBUS (*See Appendix A*) or through the LCD screen (G-HSM-9SM only).

Table Q Status Register Error Codes for HSM Channels

Status Register Value	Description
0	No Errors
1	Optical Probe not detected (broken or not connected)
2	Optical signal too weak
4	Temperature out of range
8	HSM module is still initializing

2) **Alarm & Warning Registers**
Each temperature channel on the HSM Module is equipped with a pair of registers that are used to indicate that the temperature has exceeded a predefined threshold. In some cases, users may prefer to just monitor these registers and take action if they become active. The lower threshold, called the Warning Register, is typically set 10-15°C below the Alarm Register. The location of the Warning / Alarm registers can be found in *Appendix A.*

a. **Operation**
Each bit for the alarms is found in a 16 bit Input Register that is packed from Least Significant Bit (for Sensor Channel 1) to Most Significant Bit (For Sensor Channel 16). G-HSM-18M have additional registers for the last 2 channels. If no Warnings or Alarms are set on any of the channels, all the associated registers will read as “0”. *See Appendix A* for details.
Example: *Reading Input Register 30055*

Table R Example Warning Flag

Input Register Address (Name)	Integer	Hex	Binary
30055 (W Flag L)	64	0x 0000	0b 0000 0000 0100 0000

In the case above, the bit that is set refers to the Warning Register for Sensor 7. A similar register for the Alarm flags is also available. Therefore, in the example above, Sensor 7 has exceeded the warning threshold.

b. **Alarm Types and Default Values**
The unit has two independent sets of alarm and warning levels (Primary and Secondary) and allows for assignment of either level to individual channels.

Table S Recommended Alarm and Warning Actions

Register	Default Temperature	Recommended Action
Primary Warning Register	90°C (194°F)	Visually inspect and service location associated with a warning location at next scheduled maintenance
Primary Alarm Register	105°C (221°F)	Service Location Associated with Alarm

c. **Alarms and Warnings with the LCD** (G-HSM-9SM Only)
The warning and alarm set point registers can be viewed and changed with the optional LCD screen, the details for which can be seen in *Figure 33*. In addition, the current status of the alarms

can be viewed on the Alarm Status LCD Screen as shown in *Figure 41*.

Figure 41: Alarm Status LCD Screen

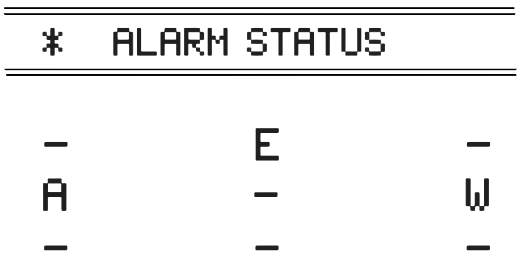


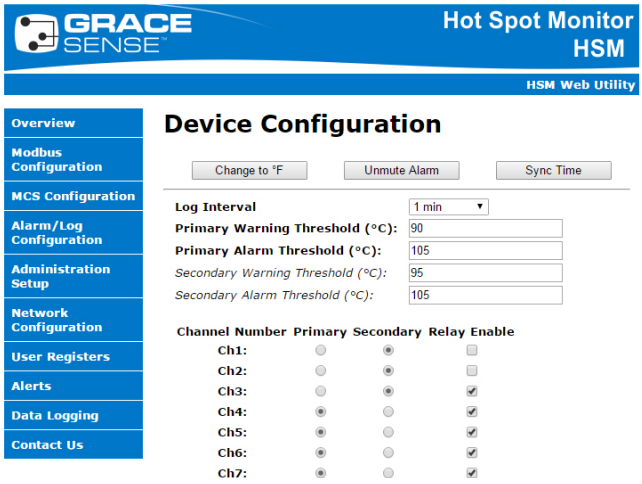
Table T Alarm Status LCD Screen Values	
Value	**Condition**
-	Channel OK
A	Alarm flag for channel is set
W	Warning flag for channel is set
E	Status Code is non-zero (problem with channel)

d. **Relay Output**

The HSM Module is equipped with a Normally Open dry-contact type relay on terminals 9 and 10. This feature is available for each individual temperature channel. The relay is intended to be used by the operator for wiring to an annunciator or any similar device similar should action be desired upon the occurrence of an Alarm.

Table U Relay Conditions	
Contact State	**Condition**
Open	All "relay enable" selected sensors readings are below the respective Alarm Setpoint
Closed	Any one of "relay enable" sensors is above Alarm Setpoint

Figure 42: Device Configuration



E. HSM Alerts

The HSM is equipped with a data processing feature intended to simplify operators decision making. The HSM interprets raw data and alerts user via single register. The HSM will collect, interpret, and archive the data and alerts user only when action needs to be taken.

1) **Status Register**

Each temperature channel on the HSM Module is equipped with a pair of registers that are used to indicate that the temperature has exceeded a predefined threshold.

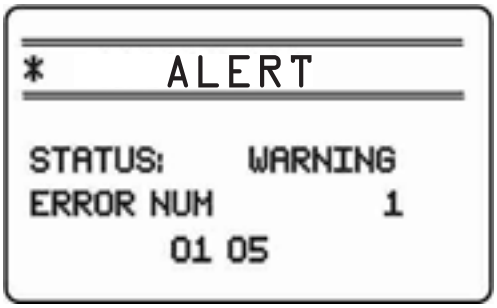
Table V Error Code Table	
Status Register Value	**Description**
0	OK - No action needed system OK
1	WARNING – schedule maintenance of the equipment – no immediate action needed
2	ALERT – dangerous situation, shut down the equipment

2) **HSM Error Code Register**
There is maximum of 10 error codes kept up to date. All error codes are logged internally.

Table W Status Register	
Error Code Register Value	**Description**
01 XX	Over temperature
02 XX	Alarm - Over temperature
03 XX	HSM error - self diagnostics
	XX is qualifier and indicates the channel number (1-18) in HEX format, 1=CH 1,… F=CH 15, 10=CH16, 11=CH17 and 12=CH18

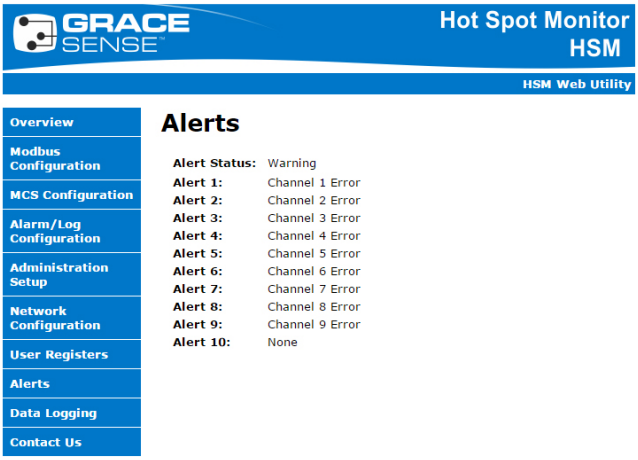
3) **LCD screen** (G-HSM-9SM only)
Below is the main HSM LCD screen.

Figure 43: LCD Screen



4) **Web interface**
Figure 44 shows the main web interface page screen.

Figure 44: HSM Web Interface



F. Data Log

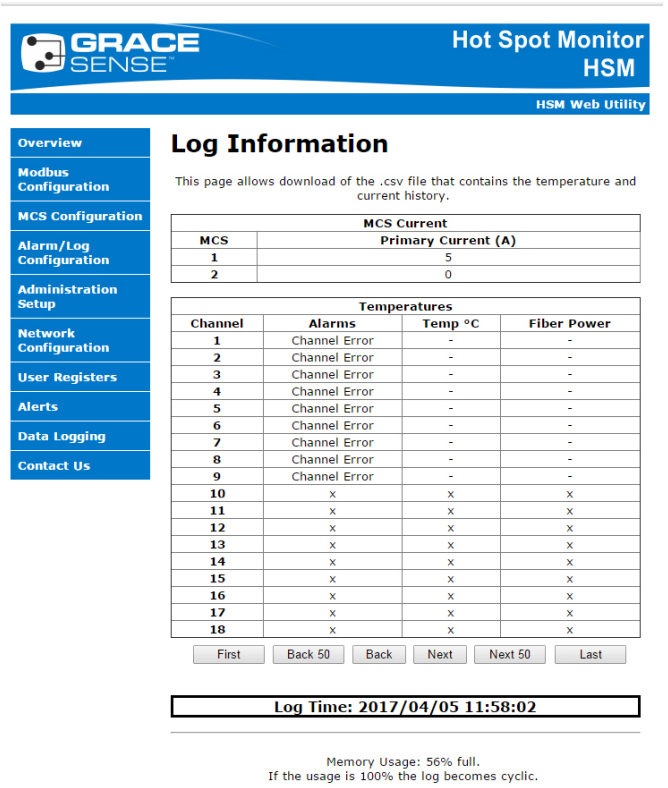
The Data Log allows the user to visualize and download temperature logs for data analysis and trend recognition.

1) **Log Rate and Timespan**
There is a fixed amount of memory available on the device for storage of the Data Log. The data collection interval can be set between 1 minute and 6 hours. Increasing the frequency of the data collection affects the timespan for which data can be collected. *Table X Onboard Data Acquisition Timespans* provides approximate estimates for the how long data can be logged.

Table X Onboard Data Acquisition Timespans	
Log Rate Interval	**Memory Timespan**
1 min	8 months
5 min	3 years
15 min	9 years
30 min	18 years
1 hour	36 years
2 hours	72 years
6 hours	216 years

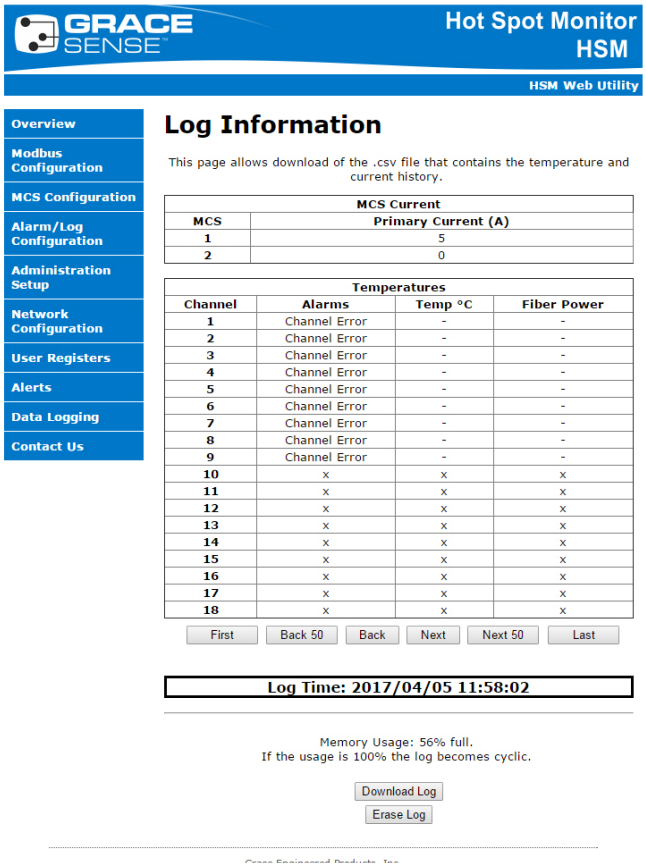
2) **Downloading Log File from Webpage**
   a. On the DATA LOGGING tab, click the DOWNLOAD LOG button to download the stored data. This will download all the data since the last reset. In the case the data log has exceeded the available memory, the oldest data is progressively deleted and replaced with new data; FIFO method.
   b. The file will download with a name similar to: G-HSM-9SM_30003_2017-03-26-14-08 (MODEL_SN_DATE&TIME).
   c. Depending on the amount of data contained in the log file, it can take up to 20 minutes to download should the memory be full.
   d. In the case of error messages, click “Stop” and recheck IP Address. Attempt to download again.
   e. The log can be erased by clicking ERASE LOG on the same web screen.

Figure 45: Log Information



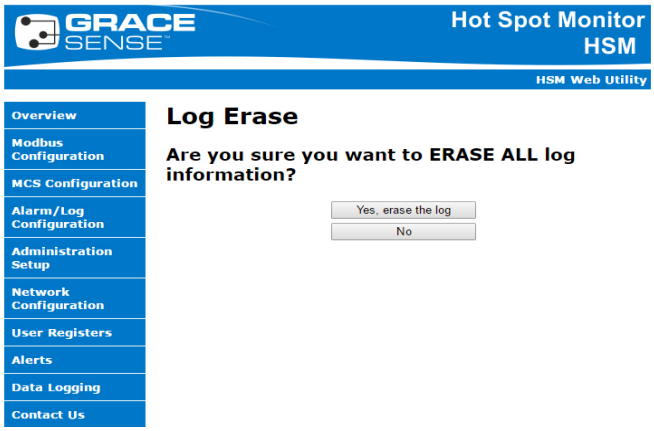
3) **Displaying Log Information Through Web-Interface**
   a. Apply power to the device and connect an Ethernet Cable between the computer and the HSM. Initiate communication between the two.
   b. Navigate to the Log Information page.

Figure 46: Logging Information Webpage



c. The initial log that will be displayed shows the log information that occurred at the most recent alarm event.
d. Use the “Back 50”, “Back”, “Next” and “Next 100” buttons to navigate through the log.
e. If the Log Time says “No information” then the log is finished or no logging has taken place.
f. The ERASE LOG button will erase the log, only use this if necessary.
g. Confirm the erase by depressing “Yes, erase the log” button

Figure 47: Confirming Log Erase

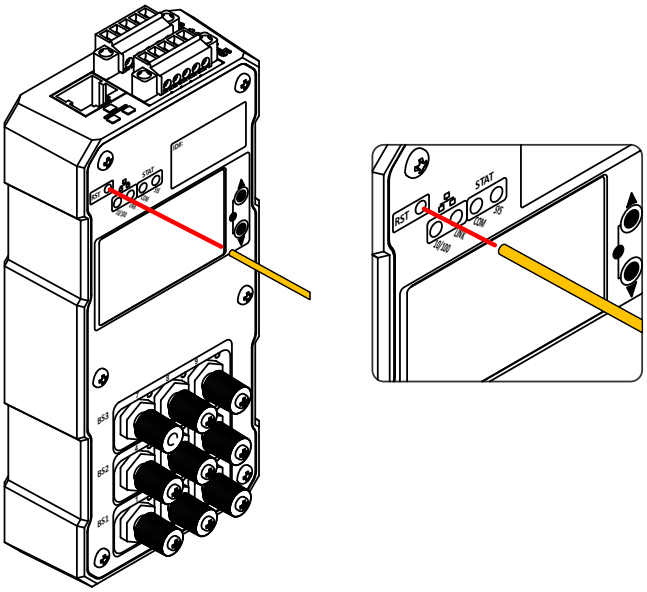


G. Factory Reset

Under some circumstances it may be desirable to return the HSM Module back to the factory configuration. In situations where the administrator password or IP address are lost are compromised, perform the reset procedure as outlined.

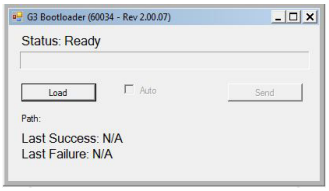
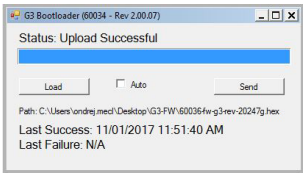
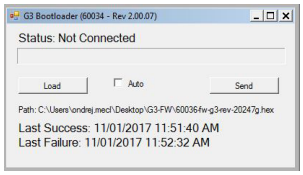
1. Remove power from the module.
2. Using a piece of the polymer fiber, insert it into the hole labeled “RST” and depress the concealed button while applying power to the device. Keep the button depressed until both the “SYS” and “COM” LEDs stay green (about 5 seconds). The hole for the “RST” button has been designed to allow an end from one of the probes to be inserted.
3. Release the button and device will restart with its default values.

Figure 48: Inserting Fiber into RST Button



H. Firmware Upload Procedure for HSM

Table Z Firmware Upload Procedure for HSM

Procedure	
Start Boot-Loader Software 60034	
HSM Device with 10121 Board	
Procedure for Boot-Loading	*a. Connect the Ethernet Cable* *b. Remove power from the device.* *c. Depress the "RST" button and apply power* *d. Release the button in less than 5 seconds.* ***NOTE**: Release the button before 5 seconds elapses, otherwise the unit will reset the Factory Defaults* *e. Wait until the "SYS" LED starts flashing orange (about 5 seconds).* *f. Connect Ethernet cable between the device and computer.* *g. Start the boot-loader application.* *h. Press the "Send" button to select, and load the firmware (.HEX file) in the boot-loader application, wait until the upload is successful.* *i. The status label in the boot-loader application should say "Upload Successful" after it is finished.* *j. If boot-loading is unsuccessful ensure there is no other communication and retry from step b.*
Successful FW Updating - Status should show Upload Successful	
Not Successful - Try Uploading again without any network traffic	

Ch 6 Troubleshooting

A. Troubleshooting the Fiber-Optic Probes

1. Problem: Sensor / Potential Failure Points (PFP) mapping. The user is unsure about which sensors are mapped to which locations. This can happen if several wire tags fall off during the installation of the fibers.
   a. Identify the unknown fibers at their respective Potential Failure Points (PFPs).
   b. Apply an indirect heat source to the vicinity of the Potential Failure Points (PFPs). Heat guns are recommended for the task but should never be directly applied to the fiber or the sensing tip. Heat the adjacent area.
   c. Return to the HSM Module and identify which unknown sensor has shown an increase in temperature due to the application of heat.
   d. Alternatively, apply a heat source sequentially to each fixture and look for a change in measured temperature.
   e. Repeat the process above until all fibers have been properly identified and marked.

2. Problem: HSM Indicator LEDs remain red (optical signal too low)
   a. Determine if the problem is related to the Fiber-Optic Probe or the Optical Connection Port by moving the probe in question to another port that has already been determined to work. If the Probe functions in the test port, then the original Optical Connection Port is likely the problem.
   b. Optical Port Related Problems. Attempt to blow any contaminants off the surface of the LED inside the port with clean compressed air. DO NOT USE UNFILTERED, NON-INSTRUMENTATION TYPE COMPRESSED AIR. Re-insert fiber into connector and allow 30 seconds to stabilize. Proceed next step if HSM Indicator LED remains red.
   c. Probe Related Problems
      ii. Trim ~3 mm (⅛") from the end of the fiber. Re-insert fiber into connector and allow 30 seconds to stabilize. Proceed next step if HSM Indicator LED remains red.
      iii. Replace the Probe.

B. Troubleshooting the Onboard Web-page

1. Problem: Web page does not display (HTTP error 404)
   a. Restart the unit.
   b. Ensure the device is powered and working (the SYS LED flashing green and the LINK and 10/100 LEDs are on).
   c. Ensure the Ethernet cable from the device is connected to the computer.
   d. Ensure the correct IP address is entered in the address bar
   e. If problem persists, perform Hardware Reset.
2. Problem: The website isn't loading properly
   a. Restart the unit.
3. Problem: Memory capacity is 100%
   Explanation: Once the memory is full it will start writing over the beginning.
   a. Download the Log file using the application HSM and save it.
   b. Erase the log, this will set the memory back to 0%, follow the instructions in "data Log section".

APPENDIX A - MODBUS and EIP Memory Map

MODBUS and EIP Memory Map

Range: 30005 to 30016

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
General Parameters	PCB Serial No. LSB	R	Input	LSW of Serial Number	N/A	0-65535	N/A	30005	4	0	N/A	x	x	x	Device Instance 101 (size: 24 bytes)
	PCB Serial No. MSB			MSW of Serial Number	N/A			30006	5	1					
	HW P/N			HW Part Number	10121			30007	6	2					
	FW Rev			FW Revision	N/A			30008	7	3					
System Time	Day	R	Input	Device Days from RTC	N/A	1-31	N/A	30009	8	4	N/A	x	x	x	
	Month			Device Months from RTC		1-12		30010	9	5					
	Year			Device Years from RTC		2000-2009		30011	10	6					
	Hour			Device Hours from RTC		0-23		30012	11	7					
	Min			Device Minutes from RTC		0-59		30013	12	8					
	Sec			Device Seconds from RTC		0-59		30014	13	9					
Board Parameters	Mem Capacity	R	Input	Amount of Log Storage Memory	N/A	0-100	%	30015	14	10	N/A	x	x	x	
	BMO			Board Map 0 for determining the type of HSM configuration		0x0000-0x003F	N/A	30016	15	11					

Range: 30022 to 30026

Category	*Register Name*	*Read/ Write*	*Register Type*	*Description*	*Default*	*Range, Format*	*UOM*	*Register #*	*Modbus Offset #*	*EIP Offset *2*	*Interpretations*	*G-HSM-9M*	*G-HSM-9SM*	*G-HSM-18K*	*EIP Instances*
Comm Parameters	Instance	R	Input	EIP User Assembly Instance	102	0-65535	N/A	30022	21	N/A	N/A	x	x	x	N/A
	MB Port			MODBUS Port	502	1-9999	N/A	30023	22			x	x	x	
	MB Baud L			MODBUS Baud Rate Low Word	19200	9.6K / 19.2K / 38.4K	Baud	30024	23			x	x	x	
	MB Baud H			MODBUS Baud Rate High Word	0	9.6K / 19.2K / 38.4K	Baud	30025	24			x	x	x	
	MB Client ID			MODBUS Client ID	1	1-31	N/A	30026	25			x			

Range: 30027 to 30028

Category	*Register Name*	*Read/ Write*	*Register Type*	*Description*	*Default*	*Range, Format*	*UOM*	*Register #*	*Modbus Offset #*	*EIP Offset *2*	*Interpretations*	*G-HSM-9M*	*G-HSM-9SM*	*G-HSM-18K*	*EIP Instances*
	Log Time	R	Input	Log Interval (minutes)	5	0-1440	Minutes	30027	26	N/A	N/A	x	x	x	N/A
	Timer			Tick Timer (100 ms)	N/A	0-65535	Seconds	30028	27			x	x	x	

Range: 30029 to 30037

Category	*Register Name*	*Read/ Write*	*Register Type*	*Description*	*Default*	*Range, Format*	*UOM*	*Register #*	*Modbus Offset #*	*EIP Offset *2*	*Interpretations*	*G-HSM-9M*	*G-HSM-9SM*	*G-HSM-18K*	*EIP Instances*
Ethernet Parameters	IP H	R	Input	High Word of the IP Address	169.254	0x0000-0xFFFF	N/A	30029	28	N/A	The values must be parsed, each register contains the MSB and LSB of the address. For example if IP H is 0xA9FE the IP address would start with A9->169 and FE->254.	x	x	x	N/A
	IP L			Low Word of the IP Address	001.001			30030	29						
	Mask H			High Word of the Subnet Mask	255.255			30031	30						
	Mask L			Low Word of the Subnet Mask	000.000			30032	31						
	Gate H			High Word of the Gateway	169.254			30033	32						
	Gate L			Low Word of the Gateway	001.001			30034	33						
	MAC 1			First 2 Bytes of the MAC Address	0x3B A4			30035	34		The MAC address should be parsed starting with the MSB of MAC 1 to the LSB of MAC 3. For example using defaults would be 3B:A4:24:Fx:xx:xx				
	MAC 2			Second 2 Bytes of the MAC Address	0x24 Fx			30036	35						
	MAC 3			Third 2 Bytes of the MAC Address	N/A			30037	36						

MODBUS and EIP Memory Map (cont.)

Range: 30038 to 30039

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
HMI Settings	Degree CF	R	Input	Degree C or F Flag (1=C, 2=F)	1	1-2	N/A	30038	37	N/A	(1=C, 2=F)	N/A	N/A	x	N/A
	Sound Mute			Beep and Alarm Mute Flag (0=Sound, 1=Muted)	0	0-1		30039	38		(0=Sound, 1=Muted)			x	

Range: 30040 to 30067

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
Temperature Alarm Registers	Alert Lvl	R	Input	Alert Level for Operator	0	0-2	N/A	30040	39	0	(0=OK, 1=Warning, 2=Alarm)	x	x	x	Alarm Instance 104 (size: 56 bytes)
	Alert Code 1			HSM Alert Code Slot 1	0	0x0000-0x0312		30041	40	1	Example Alarm 0x0310 First byte of the word: (0x03) indicates type of error 0x00...no error 0x01...temperature warning 0x02...temperature alarm...Priority highest 0x03...sensor module error...priority lowest Second byte of the word: (0x10) indicates the channel 0x10...channel 16				
	Alert Code 2			HSM Alert Code Slot 2	0			30042	41	2					
	Alert Code 3			HSM Alert Code Slot 3	0			30043	42	3					
	Alert Code 4			HSM Alert Code Slot 4	0			30044	43	4					
	Alert Code 5			HSM Alert Code Slot 5	0			30045	44	5					
	Alert Code 6			HSM Alert Code Slot 6	0			30046	45	6					
	Alert Code 7			HSM Alert Code Slot 7	0			30047	46	7					
	Alert Code 8			HSM Alert Code Slot 8	0			30048	47	8					
	Alert Code 9			HSM Alert Code Slot 9	0			30049	48	9					
	Alert Code 10			HSM Alert Code Slot 10	0			30050	49	10					
	primaryWarningSetpointC			The Primary Warning Temperature Threshold in C	90	-50 - 200	°C	30051	50	11	N/A				
	primaryAlarmSetpointC			The Primary Alarm Temperature Threshold in C	105	-50 - 200	°C	30052	51	12					
	primaryWarningSetpointF			The Primary Warning Temperature Threshold in F	194	-58 - 392	°F	30053	52	13					
	primaryAlarmSetpointF			The Primary Alarm Temperature Threshold in F	221	-58 - 392	°F	30054	53	14					
	warningFlagHi			High Word of Warning Flags (Ch 17 & Ch 18)	N/A	0x0000-0x0003	N/A	30055	54	15	Bitwise representation the channel warning and alarm status: Example: register 30057=0x1492=0001 0100 1001 0010: D1(Ch 2=1), D4(Ch 5=1), D7(Ch 8=1), D10(Ch 11=1), D12(Ch 13=1) temperature alarm on Ch 2,5,8,11,13				
	warningFlagLo			Low Word of Warning Flags (Ch 1 to Ch 16)	N/A	0x0000-0xFFFF		30056	55	16					
	alarmFlagHi			High Word of Alarm Flags (Ch 17 & Ch 18)	N/A	0x0000-0x0003		30057	56	17					
	alarmFlagLo			Low Word of Alarm Flags (Ch 1 to Ch 16)	N/A	0x0000-0xFFFF		30058	57	18					
	relayEnableFlagHi			Indicates if the channel will control relay on channel alarm or not (Ch 17 AND Ch 18)	N/A	0x0000-0x0003		30059	58	19	N/A				
	relayEnableFlagLo			Indicates if the channel will control relay on channel alarm or not (Ch 1 TO Ch 16)	N/A	0x0000-0xFFFF		30060	59	20					
	secondarySetpointSelectFlagHi			Indicates if the channel uses the primary or secondary setpoint (Ch 17 AND Ch 18)	N/A	0x0000-0x0003		30061	60	21					
	secondarySetpointSelectFlagLo			Indicates if the channel uses the primary or secondary setpoint (Ch 1 TO Ch 16)	N/A	0x0000-0xFFFF		30062	61	22					
	secondaryWarningSetpointC			The Secondary Warning Temperature Threshold in C	90	-50 - 200	°C	30063	62	23					
	secondaryAlarmSetpointC			The Secondary Alarm Temperature Threshold in C	105	-50 - 200	°C	30064	63	24					
	secondaryWarningSetpointF			The Secondary Warning Temperature Threshold in F	194	-58 - 392	°F	30065	64	25					
	secondaryAlarmSetpointF			The Secondary Alarm Temperature Threshold in F	221	-58 - 392	°F	30066	65	26					
	relayStatus			The current status of the Relay	N/A	0-1	On/Off	30067	66	27					

MODBUS and EIP Memory Map (cont.)

Range: 30068 to 30079

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
Serial Numbers of Sensor Modules	L S/N BS 1	R	Input	Low Word of Serial Number for BS1	N/A	0-65535	N/A	30068	67	N/A	N/A	x	x	x	N/A
	H S/N BS 1			High Word of Serial Number for BS1				30069	68			x	x	x	
	L S/N BS 2			Low Word of Serial Number for BS2				30070	69				x	x	
	H S/N BS 2			High Word of Serial Number for BS2				30071	70			x	x	x	
	L S/N BS 3			Low Word of Serial Number for BS3				30072	71			x	x	x	
	H S/N BS 3			High Word of Serial Number for BS3				30073	72			x	x	x	
	L S/N BS 4			Low Word of Serial Number for BS4				30074	73			x	N/A	N/A	
	H S/N BS 4			High Word of Serial Number for BS4				30075	74			x			
	L S/N BS 5			Low Word of Serial Number for BS5				30076	75			x			
	H S/N BS 5			High Word of Serial Number for BS5				30077	76			x			
	L S/N BS 6			Low Word of Serial Number for BS6				30078	77			x			
	H S/N BS 6			High Word of Serial Number for BS6				30079	78			x			

Range: 30080 to 30097

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
System Status Registers	Status 1	R	Input	Status of Ch 1	N/A	0x0000 - 0x000F, 7FFF	N/A	30080	79	N/A	0 - The channel is good 1 - Optical Probe Not Detected 2 - Optical Signal Too Weak 4 - Temperature Out of Range 8 - HSMt Module is Still Initializing 0x7FFF - HSM Module Error	x	x	x	N/A
	Status 2			Status of Ch 2				30081	80				x	x	
	Status 3			Status of Ch 3				30082	81				x	x	
	Status 4			Status of Ch 4				30083	82				x	x	
	Status 5			Status of Ch 5				30084	83				x	x	
	Status 6			Status of Ch 6				30085	84				x	x	
	Status 7			Status of Ch 7				30086	85				x	x	
	Status 8			Status of Ch 8				30087	86				x	x	
	Status 9			Status of Ch 9				30088	87				x	x	
	Status 10			Status of Ch 10				30089	88				N/A	N/A	
	Status 11			Status of Ch 11				30090	89						
	Status 12			Status of Ch 12				30091	90						
	Status 13			Status of Ch 13				30092	91						
	Status 14			Status of Ch 14				30093	92						
	Status 15			Status of Ch 15				30094	93						
	Status 16			Status of Ch 16				30095	94						
	Status 17			Status of Ch 17				30096	95						
	Status 18			Status of Ch 18				30097	96						

MODBUS and EIP Memory Map (cont.)

Range: 30098 to 30115

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
Temperature in C	Temp C 1	R	Input	Temperature in C of Ch 1	N/A	-50 - 200, -999, 0x7FFF	°C	30098	97	0	(-)999 - Temperature Invalid 0x7FFF - HSM Module Error	x	x	x	TempC Instance 102 (size: 36 bytes)
	Temp C 2			Temperature in C of Ch 2				30099	98	1			x	x	
	Temp C 3			Temperature in C of Ch 3				30100	99	2			x	x	
	Temp C 4			Temperature in C of Ch 4				30101	100	3			x	x	
	Temp C 5			Temperature in C of Ch 5				30102	101	4			x	x	
	Temp C 6			Temperature in C of Ch 6				30103	102	5			x	x	
	Temp C 7			Temperature in C of Ch 7				30104	103	6			x	x	
	Temp C 8			Temperature in C of Ch 8				30105	104	7			x	x	
	Temp C 9			Temperature in C of Ch 9				30106	105	8			x	x	
	Temp C 10			Temperature in C of Ch 10				30107	106	9			N/A	N/A	
	Temp C 11			Temperature in C of Ch 11				30108	107	10					
	Temp C 12			Temperature in C of Ch 12				30109	108	11					
	Temp C 13			Temperature in C of Ch 13				30110	109	12					
	Temp C 14			Temperature in C of Ch 14				30111	110	13					
	Temp C 15			Temperature in C of Ch 15				30112	111	14					
	Temp C 16			Temperature in C of Ch 16				30113	112	15					
	Temp C 17			Temperature in C of Ch 17				30114	113	16					
	Temp C 18			Temperature in C of Ch 18				30115	114	17					

Range: 30116 to 30133

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
Temperature in F	Temp F 1	R	Input	Temperature in F of Ch 1	N/A	-58 - 392, -999, 0x7FFF	°F	30116	115	0	0x7FFF - HSM Module Error	x	x	x	TempC Instance 103 (size: 36 bytes)
	Temp F 2			Temperature in F of Ch 2				30117	116	1			x	x	
	Temp F 3			Temperature in F of Ch 3				30118	117	2			x	x	
	Temp F 4			Temperature in F of Ch 4				30119	118	3			x	x	
	Temp F 5			Temperature in F of Ch 5				30120	119	4			x	x	
	Temp F 6			Temperature in F of Ch 6				30121	120	5			x	x	
	Temp F 7			Temperature in F of Ch 7				30122	121	6			x	x	
	Temp F 8			Temperature in F of Ch 8				30123	122	7			x	x	
	Temp F 9			Temperature in F of Ch 9				30124	123	8			x	x	
	Temp F 10			Temperature in F of Ch 10				30125	124	9			N/A	N/A	
	Temp F 11			Temperature in F of Ch 11				30126	125	10					
	Temp F 12			Temperature in F of Ch 12				30127	126	11					
	Temp F 13			Temperature in F of Ch 13				30128	127	12					
	Temp F 14			Temperature in F of Ch 14				30129	128	13					
	Temp F 15			Temperature in F of Ch 15				30130	129	14					
	Temp F 16			Temperature in F of Ch 16				30131	130	15					
	Temp F 17			Temperature in F of Ch 17				30132	131	16					
	Temp F 18			Temperature in F of Ch 18				30133	132	17					

MODBUS and EIP Memory Map (cont.)

Range: 30134 to 30151

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
Fiber Power	Fib Power 1	R	Input	Fiber Power of Ch 1	N/A	0 - 10, 0x7FFF	N/A	30134	133	N/A	0x7FFF - HSM Module Error	x	x	x	N/A
	Fib Power 2			Fiber Power of Ch 2				30135	134				x	x	
	Fib Power 3			Fiber Power of Ch 3				30136	135				x	x	
	Fib Power 4			Fiber Power of Ch 4				30137	136				x	x	
	Fib Power 5			Fiber Power of Ch 5				30138	137				x	x	
	Fib Power 6			Fiber Power of Ch 6				30139	138				x	x	
	Fib Power 7			Fiber Power of Ch 7				30140	139				x	x	
	Fib Power 8			Fiber Power of Ch 8				30141	140				x	x	
	Fib Power 9			Fiber Power of Ch 9				30142	141				x	x	
	Fib Power 10			Fiber Power of Ch 10				30143	142				x	x	
	Fib Power 11			Fiber Power of Ch 11				30144	143				N/A	N/A	
	Fib Power 12			Fiber Power of Ch 12				30145	144						
	Fib Power 13			Fiber Power of Ch 13				30146	145						
	Fib Power 14			Fiber Power of Ch 14				30147	146						
	Fib Power 15			Fiber Power of Ch 15				30148	147						
	Fib Power 16			Fiber Power of Ch 16				30149	148						
	Fib Power 17			Fiber Power of Ch 17				30150	149						
	Fib Power 18			Fiber Power of Ch 18				30151	150						

Range: 30339 to 30340

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
MODBUS Current Sensor Enables	mcsEnable1	R	Input	MCS 1 is Enabled and Trying to Read	0	0, 1	N/A	30339	338	N/A	N/A	N/A	N/A	N/A	N/A
	mcsEnable2			MCS 2 is Enables and Trying to Read	0	0, 1		30340	339						

MODBUS and EIP Memory Map (cont.)

Range: 30341 to 30363

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
MODBUS Current Sensor MCS1	IR_SN_LO_1	R	Input	Lower 16 Bits of the Serial Number	N/A	0-65535	N/A	30341	340	0	N/A	x	x	x	MCS 1 Instance 105 (size: 64 bytes)
	IR_SN_HI_1			Upper 16 Bits of the Serial Number	N/A	0-65535	N/A	30342	341	1					
	IR_FW_REV_1			Firmware Revision	N/A	0-65535	N/A	30343	342	2					
	IR_TURN_RATIO_HI_1			High Side (primary) Turn Ratio (ex. the 1 in 1:500)	1	0-65535	N/A	30344	343	3					
	IR_TURN_RATIO_LO_1			Low Side (secondary) Turn Ratio (ex. the 500 in 1:500)	500	0-65535	N/A	30345	344	4					
	IR_DC_OFFSET_1			User Adjustable Zero Offset	1	-32767 - 32767	N/A	30346	345	5					
	IR_MANU_DAY_1			Day of the Month When Calibrated (manufactured)	N/A	1-31	N/A	30347	346	6					
	IR_MANU_MONTH_1			The Month When Calibrated (manufactured)	N/A	1-12	N/A	30348	347	7					
	IR_MANU_YEAR_1			The Year When Calibrated (manufactured)	N/A	2000-2999	N/A	30349	348	8					
	IR_MA_DC_LO_1			Lower 16 Bits of the DC Current in Milliamps	N/A	-32767 - 32767	mA	30350	349	9					
	IR_MA_DC_HI_1			Upper 16 Bits of the DC Current in Milliamps	N/A	-32767 - 32767	mA	30351	350	10					
	IR_MA_RMS_1			AC RMS Current in mA	N/A	0-65535	mA	30352	351	11					
	IR_A_PRIMARY_RMS_1			Primary Side (after the turns ratio) of the AC RMS Current in A	N/A	0-65535	A	30353	352	12					
	IR_AVG_MA_RMS_1			Averaged AC RMS Current mA	N/A	0-65535	mA	30354	353	13					
	IR_AVG_A_PRIMARY_RMS_1			Averaged Primary Side (after the turns raio) of the AC RMS Current in A	N/A	0-65535	A	30355	354	14					
	IR_MAX_PEAK_LO_1			Lower 16 Bits of the Peak-to-Peak Current	N/A	-32767 - 32767	N/A	30356	355	15					
	IR_MAX_PEAK_HI_1			Upper 16 Bits Peak-to-Peak Current	N/A	-32767 - 32767	N/A	30357	356	16					
	IR_CREST_1			Cresting Factor of the RMS Reading as %	N/A	0-65535	%	30358	357	17					
	IR_FREQUENCY_1			Frequency of the Current (Triggers from +- 100ADC Signal)	N/A	0-65535	N/A	30359	358	18					
	IR_TICK_1			MCSs Tick to See if it is Still Running	N/A	0-65535	N/A	30360	359	19					
	IR_TEMP_1			The Approxiamte Temperature of the MCS Board	N/A	-40 - 105	ºC	30361	360	20					
	IR_MS_MA_LO_1			Lower 16 Bits of the Instantaneous Squared Mean Current in mA	N/A	0-65535	mA^2	30362	361	21					
	IR_MS_MA_HI_1			Upper 16 Bits of the Instantaneous Squared Mean Current in mA	N/A	0-65535	mA^2	30363	362	22					

MODBUS and EIP Memory Map (cont.)

Range: 30373 to 30395

Category	Register Name	Read/ Write	Register Type	Description	Default	Range, Format	UOM	Register #	Modbus Offset #	EIP Offset *2	Interpretations	G-HSM-9M	G-HSM-9SM	G-HSM-18K	EIP Instances
MODBUS Current Sensor MCS2	IR_SN_LO_2	R	Input	Lower 16 Bits of the Serial Number	N/A	0-65535	N/A	30373	372	0	N/A	x	x	x	MCS 2 Instatance 106 (size: 64 bytes)
	IR_SN_HI_2			Upper 16 Bits of the Serial Number	N/A	0-65535	N/A	30374	373	1					
	IR_FW_REV_2			Firmware Revision	N/A	0-65535	N/A	30375	374	2					
	IR_TURN_RATIO_HI_2			Hi Side (primary) Turn Ratio (ex. the 1 in 1:500)	1	0-65535	N/A	30376	375	3					
	IR_TURN_RATIO_LO_2			Low Side (secondary) Turn Ratio (ex. the 500 in 1:500)	500	0-65535	N/A	30377	376	4					
	IR_DC_OFFSET_2			User Adjustable Zero Offset	1	-32767 - 32767	N/A	30378	377	5					
	IR_MANU_DAY_2			Day of the Month When Calibrated (manufactured)	N/A	1-31	N/A	30379	378	6					
	IR_MANU_MONTH_2			The Month When Calibrated (manufactured)	N/A	1-12	N/A	30380	379	7					
	IR_MANU_YEAR_2			The Year When Calibrated (manufactured)	N/A	2000-2999	N/A	30381	380	8					
	IR_MA_DC_LO_2			Lower 16 Bits of the DC Current in Milliamps	N/A	-32767 - 32767	mA	30382	381	9					
	IR_MA_DC_HI_2			Upper 16 Bits of the DC Current in Milliamps	N/A	-32767 - 32767	mA	30383	382	10					
	IR_MA_RMS_2			AC RMS Current in mA	N/A	0-65535	mA	30384	383	11					
	IR_A_PRIMARY_RMS_2			Primary Side (after the turns ratio) of the AC RMS Current in A	N/A	0-65535	A	30385	384	12					
	IR_AVG_MA_RMS_2			Averaged AC RMS Current mA	N/A	0-65535	mA	30386	385	13					
	IR_AVG_A_PRIMARY_RMS_2			Averaged Primary Side (after the turns raio) of the AC RMS Current in A	N/A	0-65535	A	30387	386	14					
	IR_MAX_PEAK_LO_2			Lower 16 Bits of the Peak-to-Peak Current	N/A	-32767 - 32767	N/A	30388	387	15					
	IR_MAX_PEAK_HI_2			Upper 16 Bits Peak-to-Peak Current	N/A	-32767 - 32767	N/A	30389	388	16					
	IR_CREST_2			Cresting Factor of the RMS Reading as %	N/A	0-65535	%	30390	389	17					
	IR_FREQUENCY_2			Frequency of the Current (Triggers from +- 100ADC Signal)	N/A	0-65535	N/A	30391	390	18					
	IR_TICK_2			MCSs Tick to See if it is Still Running	N/A	0-65535	N/A	30392	391	19					
	IR_TEMP_2			The Approxiamte Temperature of the MCS Board	N/A	-40 - 105	ºC	30393	392	20					
	IR_MS_MA_LO_2			Lower 16 Bits of the Instantaneous Squared Mean Current in mA	N/A	0-65535	mA^2	30394	393	21					
	IR_MS_MA_HI_2			Upper 16 Bits of the Instantaneous Squared Mean Current in mA	N/A	0-65535	mA^2	30395	394	22					

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